China

提高公共机构能源效率

Improving Energy Efficiency in Public Institutions

世界银行集团

ESMAP
Energy Sector Management Assistance Program

中国
提高公共机构能源效率

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1818 H Street NW
Washington DC 20433
电话 : (202) 473-1000
网址 : www.worldbank.org
电子邮件 : feedback@worldbank.org

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致　谢

本报告是世界银行政府建筑节能（P123066）技术援助项目的研究成果，特别感谢能源领域管理援助项目 (ESMAP) 的经费和技术支持。能源领域管理援助计划是由世界银行管理的一项全球性知识技术援助信托基金计划，旨在帮助中低收入国家提升知识水平，完善制度建设，以便为减贫和经济增长提供有助于环境可持续发展的能源方案。该项目由咨询集团管理和出资，该集团由双边捐助方和多边机构组成，代表国家和组织包括澳大利亚、奥地利、丹麦、法国、芬兰、德国、冰岛、立陶宛、荷兰、挪威、瑞典、英国和世界银行集团。

本报告由世界银行工作组共同编写完成，该工作组由世界银行的 Gailius J. Draugelis（首席能源专家，中国和蒙古能源部主任）和 Alberto U. Ang Co（高级能源专家）牵头、Anke S. Meyer (首席顾问和第一作者), Robert P. Taylor (高级能源顾问)，刘才丰（建筑节能专家）以及 Tao Xue (研究分析员) 等组成。工作组也得到了沈龙海以及其他一些中国专家，以及国际节能环保协会、节能服务公司以及 William Nesmith (NASEO) 等机构的支持。Cristina Hernandez 和 Kun Cao 负责行政管理和客户支持。

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最后，世界银行项目成员对中国国务院机关事务管理局公共机构节能管理司在研究过程中给予的战略性指导和支持深表谢意。

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缩略语表

ACEEE	美国能效经济委员会
ACUPCC	美国大学和学院校长气候承诺
ADEME	环境及能源管控署
AEE	能源工程师协会
ARRA	美国复苏和投资法令
APPA	高等教育建筑管理人员协会
ASHRAE	美国供暖、制冷与空调工程协会
BPIE	欧洲建筑绩效研究院
Btu	英制热工单位
CC	工程建设项目调试
CDD	制冷度日数
CEM	认证的能源管理师
CEN	欧盟标准化组织
CENELEC	欧盟电子标准化委员会
CFR	联邦立法标准
CMVP	认证的测量与验证人员
CO2	二氧化碳
D&F	测定与裁决
DCAM	资产评估管理处
DGS	总务部
DOD	国防部
DOE	能源部
DPA	人力管理部
DRC	发展改革委
EISA	能源自主和安全法令
EMCA	中国节能协会节能服务专业委员会（即大家熟知的能源管理公司协会）

EO	行政令
EPA	环保署
EPAct	能源政策法令
EPC	合同能源管理
ESCOs	节能服务公司
ESD	能源服务指令
ESPC	节能绩效合同
EU	欧盟
EVO	效率评估组织
FAR	联邦采购法规
FB	财政局
FEMP	联邦能源管理计划
FY	财年
FYP	五年计划
GAO	美国政府问责局
GDP	国民生产总值
GHG	温室气体
GOA	机关事务管理局
GSA	总务局
GWh	兆亿瓦时
HDD	采暖度日数
HVAC	采暖、通风和空调
IDIQ	无限交付和无限数量
IEA	国际能源署
IFC	国际金融公司
IGA	投资级的能源审计
IPMVP	国际绩效测量与验证协议
K-12	幼儿园到高中的12年级
KfW	德国开发银行
KLIMP	气候投资项目（瑞典）
kWh	千瓦时
LCC	全寿命周期成本
LEED	能源和环境设计示范
M&V	测量与验证
MIIT	工业和信息化部
MOE	教育部
MOF	财政部
MOH	卫生部
MOHURD	住房和城乡建设部
MUSH	市政、大学、中小学和医院
NDAA	国防授权法令

NDRC	国家发展改革委
NECPA	国家节能政策法令
NEEAP	国家节能行动计划
NPV	净现值
O&M	运行与维护
OMB	管理和预算局
PAs	初审
PDCA	策划-实施-检查-改进
QEM	合格的能源管理师
RfP	邀标建议书
RMB	中国人民币元
SEK	瑞典克朗
Super ESPCs	超级节能绩效合同
tce	吨标煤
tCO2	吨二氧化碳
UESC	公用事业能源服务合同
US$	美国美元
USGBC	美国绿色建筑委员会

执行摘要

1. 中国公共机构节能工作尽管起步相对较晚，但在今后几年将是持续取得节能成就的关键时期。在中国，公共机构是指全部或部分使用财政性资金的国家机关、事业单位和团体组织。

2. 尽管相对于社会经济其它领域，公共机构的能源消耗总量相对较小，但它仍是一个需要重点关注的节能领域，这是因为：（1）通过政府的示范表率作用，可以有效地影响和鼓励其它私营单位和个人采取节能行动；（2）世界各国都认识到公共机构建筑物节能项目能产生多重效益，能有效地影响公共机构建筑物内人员的行为和生活方式的选择；（3）节能可以有效地减少浪费，促进公共资源的高效利用，从而能节省资金并可将其用于其它用途。

3. 相对于工业等商业领域而言，公共机构节能要困难得多。人们面对制度管理、积极性和融资等方面的困难时很容易畏缩不前。本报告研究团队将公共机构节能存在的这些问题定义为“三个缺乏”，表 1 详细阐述了这些障碍因素，并给出了一些可能的解决措施。

表 1：公共机构在改善节能方面的“三个缺乏”，以及解决方案

问题	解决方案
缺乏激励机制并存在一定的风险	• 设置节能目标 / 指标 • 实施奖惩制度 • 开展公共机构节能绩效监督考核工作，并向社会公开考核结果 • 允许公共机构节能留成
缺乏清晰的责任和义务，且无专业技能	• 安排合格人员，如要求聘用认可的能源管理师 • 开展能耗数据统计、能源计量和能耗对标工作；监督节能进展情况； • 开展人员培训，提供节能工具和节能信息
缺乏可靠的节能融资渠道	• 提供节能专项资金 • 推广合同能源管理，调整和完善现有的节能投资会计和预算管理制度

4. 尽管公共机构节能存在诸多挑战，但中国公共机构节能工作，尤其是在过去四年中在组织机构建设和节能目标管理等方面，已取得了巨大进展。虽然能耗绝对总量仍处于增长状态，但公共机构建筑物的能源消耗强度（人均能耗或单位建筑面积能耗）却在下降。国外公共机构节能工作已开展了数十年，在如何应对这些挑战方面积累了一些经验，中国在深入推进公共机构节能工作的进程中，可予以借鉴参考。世行研究团队在对中国公共机构节能进展情况和国际经验对比分析基础上，提出了一些政策建议。

5. 研究团队认为中国公共机构节能未来一段时间面临的挑战主要包括以下四方面：（1）组织机构建设工作的进一步健全和完善，（2）公共机构能耗数据统计和能源审计分析工作的深入开展，（3）如何建立和实施节能奖励制度，充分调动公共机构节能积极性，（4）如何拓宽公共机构节能融资渠道，特别是促进合同能源管理的发展。中国政府已经开始着手应对前两个问题，当前重点应确保实施工作落到实处。关于节能奖惩制度和拓宽融资渠道的后两个问题，也已经纳入了中国政府的工作范畴。在处理这两个问题时，尤其需要有一定的创新性的方法和举措。学习借鉴国际经验，有助于中国公共机构节能工作的开展和推进，这也是本报告的重点关注内容。

健全管理制度框架，加强能耗数据统计和能源诊断工作

6. “十一五”（2006-2010 年）中期，中国启动了公共机构节能制度框架体系建设工作，包括颁布了一些重要的法律法规、明确了机构的职责、组织实施了一系列试点示范项目，但仍需进一步加强组织机构建设工作。尽管公共机构能耗统计数据尚未对外公开，但中国已制定出台了公共机构能耗统计报告制度。公共机构涉及到不同的行政管辖范围，不同系统有不同的政府主管部门（例如，不同行政级别都分别有政府机关建筑物主管部门、教育主管部门、医疗卫生系统主管部门）。因此，管理制度框架的建设和完善，将是中国公共机构节能的一项长期工作。

7. 要确保公共机构节能组织管理制度框架有效的建立和实施还有大量的工作，其中许多工作应是“十二五”的工作重点。鉴于中国地域辽阔，各项工作任务都应采取轻重结合、循序渐进的原则：

- **指派能源管理师。**已经要求各级公共机构指派能源管理师，负责用能情况的监管和能源的科学规范管理工作。要在所有的公共机构全部配置合格的能源管理师是一项非常巨大的任务，比较明智的方法是采取分步实施的策略。首先应重点加强大型政府机关及其重要建筑设施能源管理师的配置工作，在一些条件相对成熟的地区或行政管辖范围，全面系统地开展公共机构能源管理师岗位设置、培训和认证试点，编制全国性的能源管理指南和手册，帮助能源管理师提高技能。国际上，广义的“资源可持续管理师”已逐步取代了能源管理师，可在大学等相关公共机构，探讨引入“资源可持续管理师”的可能性。

- **培训。**应大规模组织实施有针对性的培训活动，提供培训教材和培训教师，加强政府监管，促进各级公共机构的管理以及相关人员的能力建设。

- **计量。**全国公共机构能源计量器具的配备，是一项非常艰巨的任务。较好的做法是先选择一些地区，针对一些特定的机构类型，启动能源计量改造工作。对于那些节能潜力较大且制定了节能行动实施计划的单位，为了投资目的需要计量，此时应优先开展计量改造工作。从中期而言，供热计量非常重要。公共机构虽然可以自愿带头开展供热计量和供热系统改造试点，发挥示范表率作用，但也应与市政府主导的供热收费制度改革步调保持一致。

- **能源审计。**急需大力开展公共机构能源使用情况的评估诊断工作。能源评估的目的不能仅是为了响应政府政策的号召，而更主要的是应通过评估识别出实际有价值的节能投资和管理改进项目，并确保项目的后续落实。

- **对标。**能耗对标（同类型公共机构能源消耗量指标的对比）的全面深入开展，需要积累能耗相关数据，以便各级公共机构与同行业之间对比分析自己所处的能耗水平。可采用与精神或物质奖励挂钩的对比排名对标奖励制度，但这需要深入研究对标方法，确保对标工作的公平公正性。

提高节能积极性

8. 公共机构节能面临的最大挑战可能在于如何采取激励措施充分调动各类公共机构的节能积极性。这也是世界各国所面临的难题。公共机构管理人员和职工为什么要重视节能工作？商业企业节能动机在于能获得经济收益，而公共机构节能尽管可以节省财政经费，但这通常对公共机构管理人员和职工自身没有实质好处。相反的是，如果节省了财政经费，有可能造成会缩减以后的财政预算经费，这将是大家所不喜欢的坏事。

9. 事实上，公共机构节能成效显著的所有国家，都制定了与时间挂钩的节能目标，以便引起各方关注并组织开展节能工作。中国针对各级公共机构以及各个行政管辖范围也制定了一系列节能目标，实践证明这对于获得管理层的重视以及将节能工作落到实处非常有用。由于节能目标的制定及监督

管理，能有效地推进节能工作，因此应进一步加强和完善节能目标管理制度。但如果仅依靠节能目标还远远不够。此外，要为各个具体的公共机构设定与自身用能设施节能潜力相匹配的节能目标是非常困难的。这需要采取其它的辅助措施，切实调动用能设施能源管理人员和职工的节能积极性，针对单位自身特点组织实施开拓性的节能工作，促进行为的改变，带来节能的实质变革。为此，项目研究团队认为：为取得较好的节能效果，中国应在节能目标管理基础上，进一步采取其它节能激励管理措施。

10. 形象激励是许多国家普遍采用的一项措施。多数公共机构由于机构的性质是非常在意自身形象的。例如，可以针对某一类或多类具体的公共机构（如大学或中小学）实施“节能示范单位”表彰活动。更激进的做法是针对某类公共机构对其节能绩效的好坏实施计分牌制度。如果可能，向社会公布计分结果将会取得非常显著的效果。

11. 部分国家提高公共机构能源管理人员和职工节能积极性的另一个重要措施，是允许节省的能源成本费用可以保留用作其它用途，这是能源管理人员和职工非常欢迎的一种方式。应制定政策法规允许各级公共机构至少可以保留部分节省的能源费用，并可支配使用这笔费用。如果职工知道该项措施并明白自身利益与节能效果挂钩，那么他们就会具有较高的节能积极性。相似的，北美和部分欧洲国家公共机构合同能源管理项目也规定公共机构除了节约能源外，还可直接保留部分节能收益。事实上，公共机构作为合同能源管理项目业主，一些节能收益是以设备或设施的改造形式、而不是以现金的形式体现的，这也是大多数公共机构能源管理人员和职工所喜欢的方式。如窗户的更换或提高集中空调的舒适性本身在投资效益上并不高，但所提供的舒适性或便利性却是大家所欢迎的，实践证明这能极大地提高公共机构实施合同能源管理项目的积极性。

大力推广合同能源管理

12. 和其它国家一样，在财政预算拨款制度（包括专项资金）以外探索其它的公共机构节能融资渠道，对中国来说也是非常重要的。包括滚动贷款资金和租赁等许多融资方式都应予以考虑，尤其要指出的是：政府财政预算经费应重点加强对以下三方面的支持：（1）试点示范项目；（2）对那些降低某些节能设备初始投资或对那些融资比较困难的公共机构，如农村中小学，应实施针对性的补贴措施；（3）对各种重点需要的“软”投资项目，如能源统计报告制度的建立、计量器具的安装、能源管理师的培训、能源审计、各个公共机构量身定做节能方案的制定、节能效果的监督管理等。这对于深化公共机构节能工作意义重大，但如果没有专项资金或专门的政府财政预算经费支持，难以开展这些工作。

13. 除了一些传统的节能融资方式外，比较明智的做法是将合同能源管理作为中国公共机构的一项重要融资替代模式。北美和欧洲公共机构合同能源管理业务开展比较成功。实际上美国合同能源管理的最大客户群是联邦、州和地方政府机关、大学、中小学和医院，占全部合同能源管理业务总量的 80% 以上。合同能源管理这种商业模式对公共机构非常具有吸引力，这是因为合同能源管理不仅在常规的政府预算拨款基础上提供了融资渠道，同时技术和项目管理都由专业机构负责，而且节能服务公司还承担了所有的节能绩效风险，仅在实现节能预期效果后才被偿还投资。但要在公共机构有效地组织实施合同能源管理项目也并不容易，有大量的工作需要做。在充分考虑国际经验和中国现实情况下，研究团队建议：

- **明确合同能源管理的财务核算问题。**2010 年国务院合同能源管理的相关通知中明确指出：公共机构可以从（能源）运行成本预算栏中支付合同能源管理费用，但需要对该原则条款的实际应用进一步细化和完善。不同行政管辖范围的公共机构节能主管部门应对合同能源管理经费的具体支付问题做出具体的管理规定，并需要在实际工作中，结合具体实施情况对合同的处理以及费用的支付等问题做出及时地调整和补充。同时也应有具体的政策文件规定允许公共机构在合同能源管理项目中保留部分节能收益，以及如何使用所保留的节能资金。

- **指定具体的政府部门负责提供技术援助。**2010 年国务院合同能源管理的相关通知中明确指出：公共机构可以从（能源）运行成本预算栏中支付合同能源管理费用，但需要对该原则条款的实际应用进一步细化和完善。不同行政管辖范围的公共机构节能主管部门应对合同能源管理经费的具体支付问题做出具体的管理规定，并需要在实际工作中，结合具体实施情况对合同的处理以及费用的支付等问题做出及时地调整和补充。同时也应有具体的政策文件规定允许公共机构在合同能源管理项目中保留部分节能收益，以及如何使用所保留的节能资金。

- **选用有能力的节能服务公司。**目前列入中央政府合同能源管理财政奖励清单中的节能服务公司有 2000 多家，这对公共机构来说要选用合适的节能服务公司非常困难。相关部门正在考虑建立国家独立的或自我管理的节能服务公司认可制度，这有助于公共机构今后在其领域范围内选择合适的节能服务公司。同时，各级政府部门可在其职权范围内出台满足基本资格条件和业务经验标准的节能服务公司推荐名单，这有助于公共机构在选择节能服务公司时确保他们具备相关的资格要求，同时也有助于帮助筛选节能服务公司。

- **利用政府采购制度采购合同能源管理服务。**大多数国家实际工作中都发现公共机构在正式采购合同能源管理服务时面临较大的挑战，这是因为项目合同包含服务、设备以及融资等因素，涉及的时间周期很长，如果要有效采购这类合同，需要对标准的政府采购程序进行大量的研讨和修改。合同阶段是另一个需要考虑的问题。竞争可以降低成本，因此一些国家已经设法通过保证在可控的交易成本前提下，实现竞争利益之间的平衡。研究团队建议中国公共机构节能主管部门，重点应研究在中国现有政府采购制度体系下，如何有效地采购合同能源管理服务。

- **打捆项目。**单个合同能源管理项目交易成本可能会比较高，大多数情形下只有把许多项目打捆形成一个包含多栋建筑物的大项目时，招投标才具有竞争性。中国政府主管部门可以参照德国、奥地利、捷克、瑞典、美国以及其他一些国家的具体做法。

- **组织实施综合性项目。**目前，中国的大多数节能服务公司，都倾向于运作那种投资回收期相对较短、操作相对简单、技术单一的合同能源管理项目。但在国外，节能服务产业市场已发展到节能服务公司根据业主的需要组织实施综合性的合同能源管理项目。将投资回收期长短不同的各种节能技术改造项目打包到一个合同中，这通常会涉及到建筑设施的一些重大升级改造，这是公共机构项目业主所希望的事情。中国大多数节能服务公司需要较长的时间，才会具备从事长期合同项目的必备技术能力和资金实力，但这应是今后支持的重要方向。

- **节能量的测量与验证。**实际产生的节能量是费用支付的条件，合同能源管理项目要求节能服务公司和客户之间就项目的节约效果达成协议。理想的节能量测量与验证方案应是简单实用且费用较低，但同时又能确保客户的满意认可。研究团队建议中国节能量监管单位和节能服务公司应向美国和欧洲学习公共机构建筑物合同能源管理项目节能量测量与验证的经验。

后续行动和优先措施

14. ″十二五″公共机构节能目标的实现，需要中央、省级和地方各级政府的共同努力，应进一步健全和完善″十一五″期间所建立的各项制度措施，制定发布相关的政策法规文件，确保各项工作的顺利开展。组织制定并发行各种节能技术指南、手册、模板，以及其它类型的指导材料，帮助公共机构节能主管部门、各级公共机构人员了解掌握如何才能满足和实现各项政策制度中所提出的具体节能要求。

15. 此外，应按中央和地方政府机关建筑物、大学、中小学和医院等不同性质的单位，分别组织实施上文（第 5 段）提到的各项具体措施。部分措施适用于所有公共机构，而部分措施仅适用于特定的行政管辖范围。具体如表 2 所示。

表 2：按行政管辖范围建议的节能优先措施

行政管辖范围	负责单位	具体措施
所有	所有应承担节能义务的公共机构	1. 针对如下四类单位的决策人员、主管领导和专职人员开展节能培训和能力建设工作：政府官员和所在单位领导，能源管理部门，第三方技术和服务机构，以及租户 / 用户 / 产权单位。 2. 配置合格的能源管理人员（包括职责、资格条件和培训）。同时也应评估是否可把能源管理师扩展为广义的可持续管理师（负责能源 / 水、资源循环和其它“绿色”管理）范畴。 3. 组织开展机构形象相关的奖励制度。 4. 健全能耗统计和计量制度，实施能源审计，策划符合机构实际情形的节能项目，按不同行政管辖范围组织开展能耗对标工作，对节能效果进行持续评估，开展节能信息传播和意识提高等活动。 5. 在一些主要的行政管辖范围组织实施重大节能示范项目。 6. 大力加强省际间以及国际间的信息传播和交流。
中央政府机关	国务院机关事务管理局	1. 加强与能源费用支出上限挂钩的能源消耗定额制度研究和制定，并组织实施试点； 2. 在一些重点建筑物组织开展能源计量、包括能源分项计量试点； 3. 持续改进和完善能耗数据在线统计、报告和分析制度； 4. 传播涵盖能源管理和节能技术的最佳实践案例； 5. 为用能单位实施合同能源管理项目提供项目实施全过程的技术援助服务。项目全过程包括能源审计、节能服务公司的选择、政府和商业融资服务、政府资金的申请、节能量测量与验证等。
省级和地方政府机关	省级和地方相应的机关事务主管部门	1. 按“十二五”节能目标制定节能规划 2. 加强与能源费用支出上限挂钩的能源消耗定额制度研究和制定，并组织实施试点； 3. 组织实施简单的能源审计，制定适合公共机构自身特点的节能行动方案，编制完成节能改造项目建议书； 4. 北方地区组织实施供热计量和基于实际消耗的采暖收费工作; 5. 通过政府采购制度组织开展合同能源管理试点； 6. 指定合同能源管理技术服务单位，为各级公共机构提供技术支持。
大学	教育部，省教育厅，大学代表	1. 在教育部的支持下，联合感兴趣的大学、以大学节能自愿承诺为加入条件，组建“大学节能联盟”（或“绿色大学联盟”） 2. 组织开展综合性的能源计量，包括分项计量试点工作； 3. 进行节能奖励试点。如可能的话，可包括节能设备奖励，即对取得显著节能效果的单位，可奖励高性能的节能设备，而节能设备的资金可从节省的能源费用中支付。 4. 倡导组织开展单位内部的节能竞赛和表彰活动。

行政管辖范围	负责单位	具体措施
中小学	省级和地方教育主管部门（接受教育部业务指导），中小学所在地区代表	1. 在中小学校舍翻新改造中考虑节能和可再生能源的应用，特别是有采暖需求的北方地区和农村地区。 2. 如果可能，组织实施合同能源管理节能改造示范项目， 3. 将节能活动和节能教育纳入学校课程中。
医院	卫生部，省卫生厅，医院协会及相关代表	1. 开展先进的能源计量试点活动，为医院建筑物能源审计提供全面系统的能源基础数据； 2. 选择部分医院精心组织实施带有监督性质的能源审计试点，包括一些特殊的和复杂的要求，组织实施具体的节能改造试点项目并评估试点效果。编制节能实践案例并通过合适途径传播实施经验。 3. 参照大学的建议，组建“医院节能联盟”（或绿色医院联盟） 4. 汇编合同能源管理实践案例，包含医院节能技术方案和实施综合性节能改造经验教训的具体案例。

第一章：简介：提高中国公共机构能源效率

关于本报告

1.1. 本报告的主要目的是为中国政府提供相关资料和分析结果，以便政府决策人员能更好地制定和实施相关政策措施，有效地推进中国公共机构节能工作。本报告也适用于那些为政策制定和项目设计提供技术支持的机构，让其了解中国公共机构节能所面临的挑战和机遇。

1.2. **范围。**本报告的主要目的是为中国政府提供相关资料和分析结果，以便政府决策人员能更好地制定和实施相关政策措施，有效地推进中国公共机构节能工作。本报告也适用于那些为政策制定和项目设计提供技术支持的机构，让其了解中国公共机构节能所面临的挑战和机遇。

1.3. **内容框架。**第一章的后续内容，给出了中国公共机构的定义，阐述了公共机构提高能源效率的原因，介绍了世界各国公共机构节能所面临的一些重大问题。第二章概述了中国公共机构节能工作的组织框架、公共机构节能已采取的措施以及取得的成果。第三章论述了中国公共机构节能下一步发展所面临的问题以及解决方案。在评估论述国际经验对中国的潜在参考作用以及美国和欧洲公共机构节能工作的总体框架后，对中国所制定的公共机构节能中期规划进行了简要介绍。后续章节内容重点阐述了中国公共机构节能持续推进所面临的具体困难和潜在的解决措施。第四章重点阐述了融资问题，介绍了在缺乏常规或专项财政预算资金的情形下，如何通过项目节省的能源成本费用支持节能改造工作。该章还讨论了私营节能服务公司在开发、投资以及组织实施公共机构建筑节能项目时所承担的角色。第五章汇总了公共机构节能的政策措施和优先工作，同时给出了今后公共机构节能措施建议。

公共机构范围

1.4. 中国公共机构是指全部或部分使用财政性资金的国家机关、事业单位和团体组织，如表 1.1 所示。中国公共机构的定义基本上和其他国家的定义大体一致 [1]。关键之处在于政府预算资金的使用对节能积极性以及项目组织实施机制有特别的影响，而节能又需要采用特殊的政策干预措施，这就是为什么大多数国家将这些单位当作公共机构进行整体考虑的原因。

提高公共机构能源效率的重要性

1.5. 政府建筑设施通常是用能设备和能源服务的重要采购方，同时也是一个国家数量最多的单一类型的能源用户。但与社会经济其它领域相比，公共机构在采暖、空调、热水、照明、插拔式负荷等方面的能源消耗总量并不是很大，就能耗总量本身来说并不值得过分关注。由于公共机构建筑能耗数据统计基础薄弱，大多数国家都普遍缺乏公共机构能耗数据，大致估计公共机构建筑能耗会占一个国家社会总能耗的 2-6%[2]。

1.6. 中央和地方政府之所以积极介入政府产权所有并管理运营的建筑物节能工作，存在着一些重要原因，包括形象因素的考虑，具体原因包括：

1. 本报告讨论的内容不包括军队建筑和监狱。许多国家，例如美国，军队建筑和监狱是能源消耗大户，同时也是公共机构节能工作的重点。

2. 法国公共机构建筑物能耗占全社会终端能耗的 1.7%（参见 Pouffary et al. 和 ADEME 2009）；公共建筑包括集体建筑（地方政府）和（中央）政府机关建筑。德国，估计公共机构能耗占社会终端总能耗的 2.3%。美国公共建筑能耗大约是总能耗的 4%（根据美国联邦能源管理计划（FEMP）的大体估计 Building Energy Data Book 以及 3.5 部分）。

表1.1： 公共机构的主要用能设施和活动

公共机构	涉及领域	本报告是否涵盖	
		是	否
建筑物 / 设施	新建建筑		X
	既有建筑	X	
	• 中央、省及地方政府机关建筑物	X	
	• 研究机构及政府附属单位	X	
	• 大学	X	
	• 幼儿园和中小学	X	
	• 医院和卫生设施	X	
	• 博物馆、体育设施等	X	
	• 监狱		X
	• 军队设施		X
	• 政府职工住宅		X
货物和服务的政府采购			X
公务车辆			X
公共照明			X
公共事业			X

来源：作者

- **示范表率。**政府不仅负责环保和可持续政策制定，而且也通过这些政策影响各级单位和个人。如果政府自身不发挥示范表率作用，社会各界也会缺乏遵守相关政策的动力和积极性。

- **多重效果。**公共机构对其周围相关人员有重要的教育和宣传推广作用。如果提高了教师、学生、父母、护士、医生、病人及其家属的节能意识，那么他们就能在其日常工作环境中学习到节能知识并能进行实际运用。世界各国的经验充分证明：公共机构建筑节能项目能影响这些用户的个人行为（并不仅仅是下一代），因为他们已从周围的节能改造项目中享受到了实实在在的好处。这又会造成他们在其家庭或办公室能源使用时，选择合适的生活方式。

- **提高公共资源的利用效率。**私营单位和居民个人缴纳的税金是公共资金的来源。公共资金始终会显不足，如果以毫不在意的能源消耗模式浪费公共资金，就会导致社会各界对公共财政资金使用浪费的严厉批评谴责。实际上，减少能源浪费，可以反过来提供资金用于重要设备的改造，和 / 或将富裕的财政资金用于其它急需的用途。

- **市场培育与转型。**公共机构最终可利用自身的市场力量帮助推广和实施一些节能新机制和措施，大范围地推动全社会节能，形成一个强劲的、可持续的、消费者导向的节能市场。政府的购买力和看得见的积极主动示范表率作用，是一种强势的、非法律约束的节能措施，将有效地刺激节能产品和服务市场需求。通过建立一个可靠的节能产品[3]和服务市场，政府鼓励国内产品和技术供应商以有竞争力的价格引入节能产品，同时为包括节能服务公司、能源咨询、融资业务员、合同方、设备供应商等在内的节能服务产业相关方创造更多的市场机会。

3. 参见 McGropy 等，2002. 作者引用了美国“能源之星认证项目”作为范例。1993 年发布的政策指令是能源之星认证业务拓展的重要基础。该指令要求美国联邦政府机构必须采购通过能源之星认证的节能计算机和办公设备。尽管联邦政府的采购量只占全国市场销售量的 2-3%，但该政策直接有效地调动了生产企业参与能源之星认证的积极性，“能效之星认证”的办公设备很快占到美国市场的 90% 或更高比例。

1.7. 正如下面所指出的那样，由于财政预算体制的问题造成缺乏节能积极性，公共机构节能工作长期以来重视程度不够。因此，公共机构开展节能，有相当大的潜在机会去迅速取得节能效果。通常，采用一些低成本或无成本节能措施，如办公室或学校做到人走灯灭、休息间和其他一些不常用的房间安装感应控制器，节能潜力和节省的能源费用一般可为 10-15%。在保证盈利的前提下，大多数节能改造投资项目的节能潜力在 20-40%。

提高公共机构能效水平的特殊问题

1.8. 人们常常会问既然公共机构节能是有利可图的，但为什么没人进行节能投资呢？公共机构节能投资面临的障碍也与其他经济领域的内在问题一样：对节能潜力和效益缺乏了解、缺乏专业人员、缺乏激励机制、较高的交易成本、以及缺乏融资渠道等。

1.9. 公共机构对能源高效合理利用，有其自身的一些特殊问题，因此如果没有针对性的解决措施，公共机构节能工作将会进展十分缓慢。下述的一些重大问题，“三个缺乏的问题”，将是公共机构能源利用效率较低的主要原因：

- ***缺乏激励措施。*** 在国家现有的财政预算制度中，公共机构节省的能源成本归属于经营成本预算栏，这对公共机构节能是毫无激励作用。对于实施节能措施的公共机构，无法从预算栏中节省的费用中得到任何好处。问题反而是，节能减少了水电和其它能源开支，有可能相应地减少今后财政预算经费。同时，由于可能会出现运行风险，大家也不会有积极性对建筑能源系统作任何改变。

- ***缺乏技术能力。*** 通常职责分工中并没有明确要求各公共机构监控并有效降低能源费用成本。因此，只要这种制度体系仍然存在，节能积极性仍会严重缺乏。同时，公共机构作为能源消费终端用户，在没有外部帮助的情况下，通常都会缺乏技术手段和能力去监控和提高能源利用效率。总体上，公共机构能源计量、能源利用状况的监控、以及能源数据的统计工作非常薄弱。

- ***缺乏资金。*** 如果没有节能专项经费，常规的政府财政预算拨款很少会用于节能项目。正规的建筑改造财政预算经费很少，而且也会优先用于其它一些急需领域或项目。

1.10. 中国公共机构节能现状、存在的问题都与其它国家有许多重大相似之处。特别是公共机构财政预算制度对公共机构节能积极性和节能改造项目融资渠道影响方面，包括合同能源管理项目的障碍问题，都具有高度相似性。此外，对于中国目前所面临的人才队伍建设、技术服务能力的提高、能源消耗的监管、成本效益最佳节能措施和项目的识别等问题，许多国家也分别进行了各种尝试。

1.11. 中国在加强公共机构能源管理、提高能源效率方面的工作尚处于起步阶段。许多北美和欧洲国家公共机构节能工作已开展了 20 多年，积累了大量的成功和失败案例以及相应的经验教训。因此，本报告在讨论问题和提出政策建议时，也直接借鉴参考了一些国际经验教训。

1.12. 尽管中国公共机构节能工作可以借鉴国际经验，但任何经验教训和解决措施必须结合自身独特的制度框架予以应用。下一章将介绍公共机构的制度框架结构、以及中国近年来公共机构节能的一些措施。

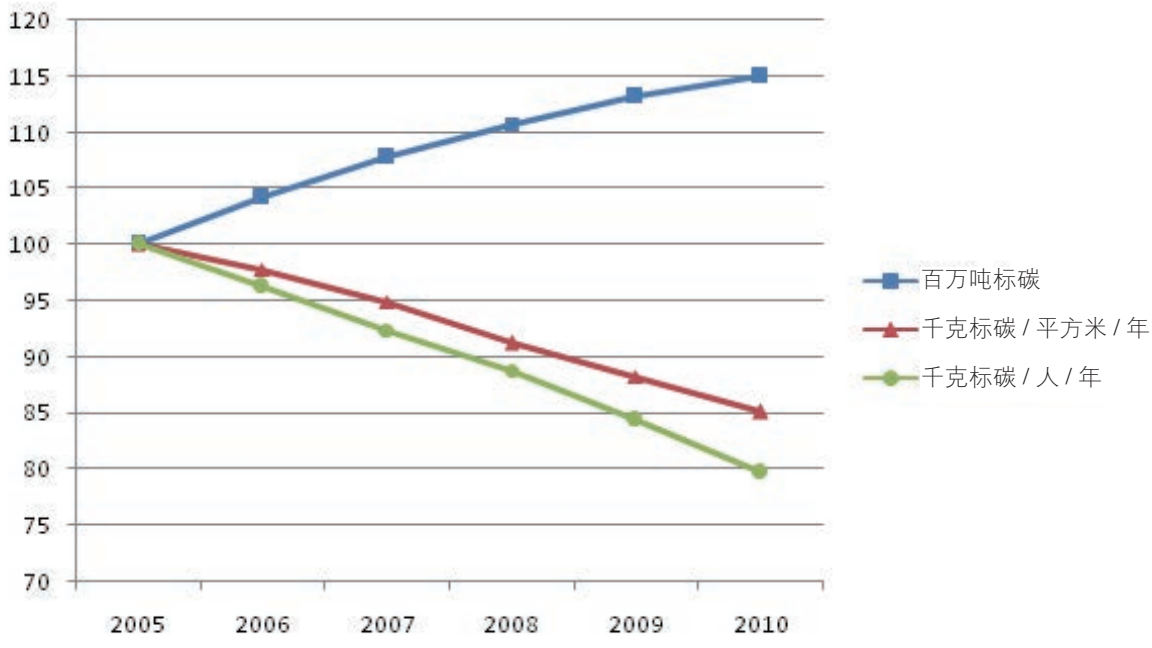
第二章：公共机构节能进展情况

2.1. 过去 10 年，中国公共机构节能最重要的成果可能是建立了全面的公共机构节能法律法规和政策制度，并建立了从事公共机构节能工作的组织机构框架。本章在对公共机构能耗情况总体介绍基础上，将会介绍中国公共机构的组织制度框架以及近年来公共机构节能的相关政策措施。最后一节重点介绍了中国“十一五”期间公共机构节能的主要措施和取得的成就。这为后续章节深入讨论加强中国公共机构节能工作所面临的挑战和机遇提供了背景资料。

中国公共机构能源消耗现状

2.2. 2010 年中国公共机构终端能耗总量为 1.92 亿吨标煤，约占全国能源消耗总量的 6.2%，其中包括公共机构建筑能耗和公务车辆油耗。尽管增长速度较慢，但公共机构能耗水平仍在逐步缓慢增长（参见图 2.1）。在 2006 至 2010 年间，公共机构能耗增长了大约 15%[4]。尽管过去 5 年公共机构建筑物的总栋数和建筑面积增加，但单位建筑面积能耗仍在逐步下降，人均能耗下降幅度更大。

图 2.1：中国公共机构终端能耗进展（2005=100）

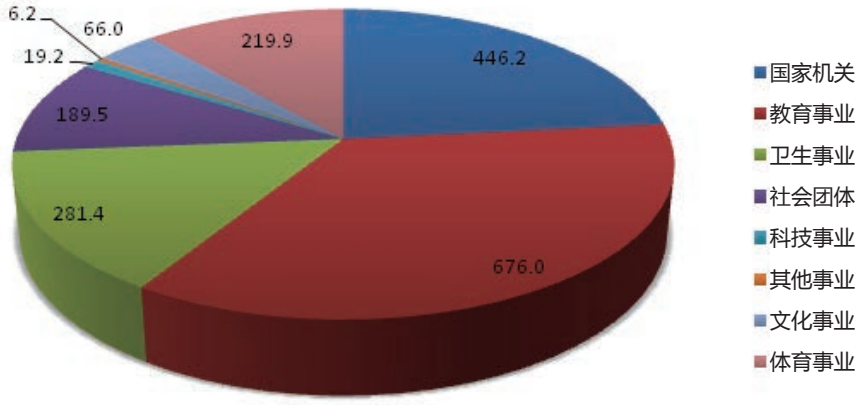


来源：公共机构节能“十二五”规划

2.3. 公共机构建筑能耗随单位性质变化较大，单位建筑面积能耗或人均能耗也有较大差别。中国全国大约有 200 万家公共机构（参见图 2.2），其中包括许多农村地区的公共机构，而这些公共机构建筑规模非常小。全国各地都有政府办公建筑、中小学和公共医疗设施。其中包括：中央各部委、省级地方政府的大型政府办公建筑或研究机构建筑物；医院大约有 20,500 家，包括一些非常大的医院；大学有 2700 多家，其中大多数都有大型的校区；中小学有 360,000 家，社区或乡镇医疗机构或诊所有 250,000 多家（不包括 600,000 家乡村医疗站）。

4. 公共机构节能“十二五”规划，中国机关后勤，2011 年 9 月， pp. 7-12

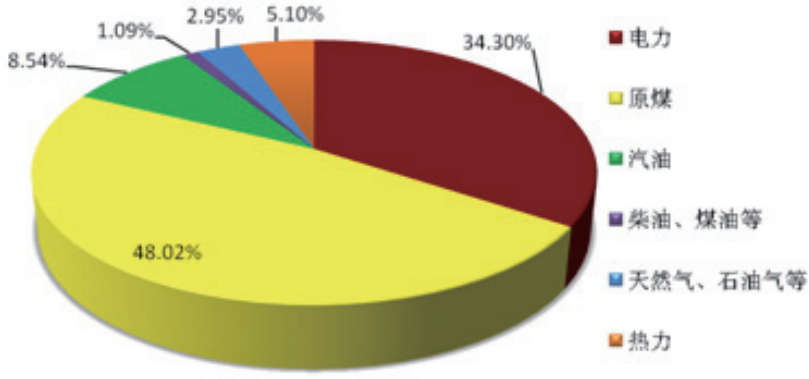
图 2.2： 2010年中国不同类型公共机构数量（单位：千）



来源：公共机构节能“十二五”规划

2.4. 能源需求类型。公共机构能源需求形式主要是采暖空调[5]、照明和插拔式负荷[6]，但也有一些特殊的专用负荷，特别是在医院和一些大学有这种情况。采暖是北方地区的一项重要且量大面广的能源需求类型，采暖一般采用集中供热、或单独的燃煤或燃气锅炉作为供应热源，采用热水集中供热系统。严寒地区的小型办公建筑、农村医疗设施以及农村地区的大量中小学需要合适的采暖方式为公共建筑用户提供足够的热量，采暖是北方严寒地区最大的能源问题。因此，中国北方严寒地区能源使用的最大问题是公共建筑热力供应是否能足够高效。采暖用煤和外购热力占公共机构能耗的 50% 以上（参见图 2.3）。在中国南部、东部和中部，特别是城市地区，夏季炎热并要求通风，电制冷是这些地区公共机构建筑物最主要的能源消耗形式。但在中小学和一些小型建筑物，空调仍是一项奢侈品，除一些特殊场所外，还非常少见。例如，在四川省的中北部，即使是在规模较大的大学教室也很少有空调。总体来说，这些地区能源需求主要集中在照明、计算机以及水泵等用电设备上，能源用量需求相对较小。但在中国北方的广大地区，由于大型建筑物需要采暖和制冷（北京就是典型的例子），能源需求就相对较高。

图2.3： 2010年中国公共机构能源结构比例



来源：公共机构节能“十二五”规划

5. 由于中国跨越〝严寒地区〞、〝寒冷地区〞、〝夏热冬冷地区〞、〝夏热冬暖地区〞以及〝温暖地区〞等五个气候区，中国不同地区对房间调节，即采暖、制冷和通风，以及建筑能耗的需求是不同的。

6. 插拔式负荷是指电力输出端设备能源消耗总量，如办公设备以及各种用电设备。

2.5. 建筑***使用方式***是照明、采暖空调和通风能源需求总量的重要影响因素。公共机构使用方式差别也较大：许多医院的大部分区域需要每天 24 小时使用；但一些政府办公建筑，可能仅在办公时间开放，一周只使用五天；大学学生宿舍一天 24 小时中的居住使用情况也是不断变化的，但也仅是在学校开学期间；教室也仅在上课时候才使用。学校建筑设施大部分都仅在白天和上课的时候使用。正确有效地利用建筑物使用方式加强能源管理，是节能工作的一项重要内容，是节能改造项目中取得明显节能效果的重要因素。

2.6. **能耗统计。**目前中国已开展了公共机构能耗统计工作，但尚未向社会公布详细的统计数据结果，政府正在努力进一步健全和完善能耗统计制度。尽管各个公共机构都向地方节能主管部门填报了能耗数据，但据有关人员介绍能耗统计数据的质量和一致性还有待进一步提高。

中国公共机构节能组织架构

2.7. 应在中国公共机构的组织制度框架和财政预算程序范畴内，制定和实施公共机构节能的政策措施和具体活动。

中国政府组织结构

2.8. 如图 2.4 所示，中国政府是垂直管理的组织结构，包括中央、省级[7]、县级和乡级等不同层级的政府部门。国务院，是最高国家权力机关的执行机关，国务院实行总理负责制。国务院下属有中央各部委，各中央政府部门的部长和独立的部门以及各省级政府都直接向国务院汇报。国务院下属有 27 个中央部委，直接向国务院汇报，这其中包括对公共机构节能工作尤其重要的一些政府部门，如国家发展改革委（NRDC）、住房城乡建设部（MOHURD）、财政部（MOF）、教育部（MOE）以及卫生部（MOH）[8]。截至 2011 年初，除中央各部委外，有 38 个其他中央政府部门向国务院汇报，统计局、税务局、中国科学研究院以及国家电力监管委员会等。国务院机关事务管理局也是 38 个直接汇报单位之一[9]。国务院机关事务管理局负责中央国家机关行政办公用房建设、土地使用、权属登记、使用调配、办公用房管理、运营和改造，同时还负责中央国家机关政府办公建筑的节能以及全国公共机构节能工作。

2.9. 类似于国家层次的总理管理体制，各省的省长负责管理省级的政府机构。省长向国务院直接汇报，省长与各部委的部长行政级别一样。在中国，省一级基本上都照搬中央政府的组织框架体系。各种委员会、省级政府部门以及其它政府机构，如省级发展改革委员会（DRC）、省级财政厅（FBs）或省级机关事务管理局，都直接向省长办公室汇报。此外，各省下属的地级市市长也直接向省长汇报。各地级市的政府部门设置也类似于省政府部门组织框架体系，类似地全国下属的 4000 多个县级政府部门也采用类似的部门设置。

2.10. 省级、地市级以及县级政府部门均向其所在行政区域内的同级政府负责人进行汇报。但是，他们也同时与上级和下级单位在同一业务领域或“工作系统”（如图 2.4 中点线所描述）中保持工作关系。例如，省级财政厅不仅和财政部有密切的工作关系，同时也和地市级以及县级财政局保持紧密的工作关系。在同一工作业务系统内，下级单位接受上级部门的工作指导和业务安排。根据具体工作的不同需要，对于不同工作业务系统，上级业务主管部门的影响力和范围也是不同的。例如，统计局工作业务系统采用垂直管理的方式，独立于地方政府，而不是像其他部门那样的管理方式。例

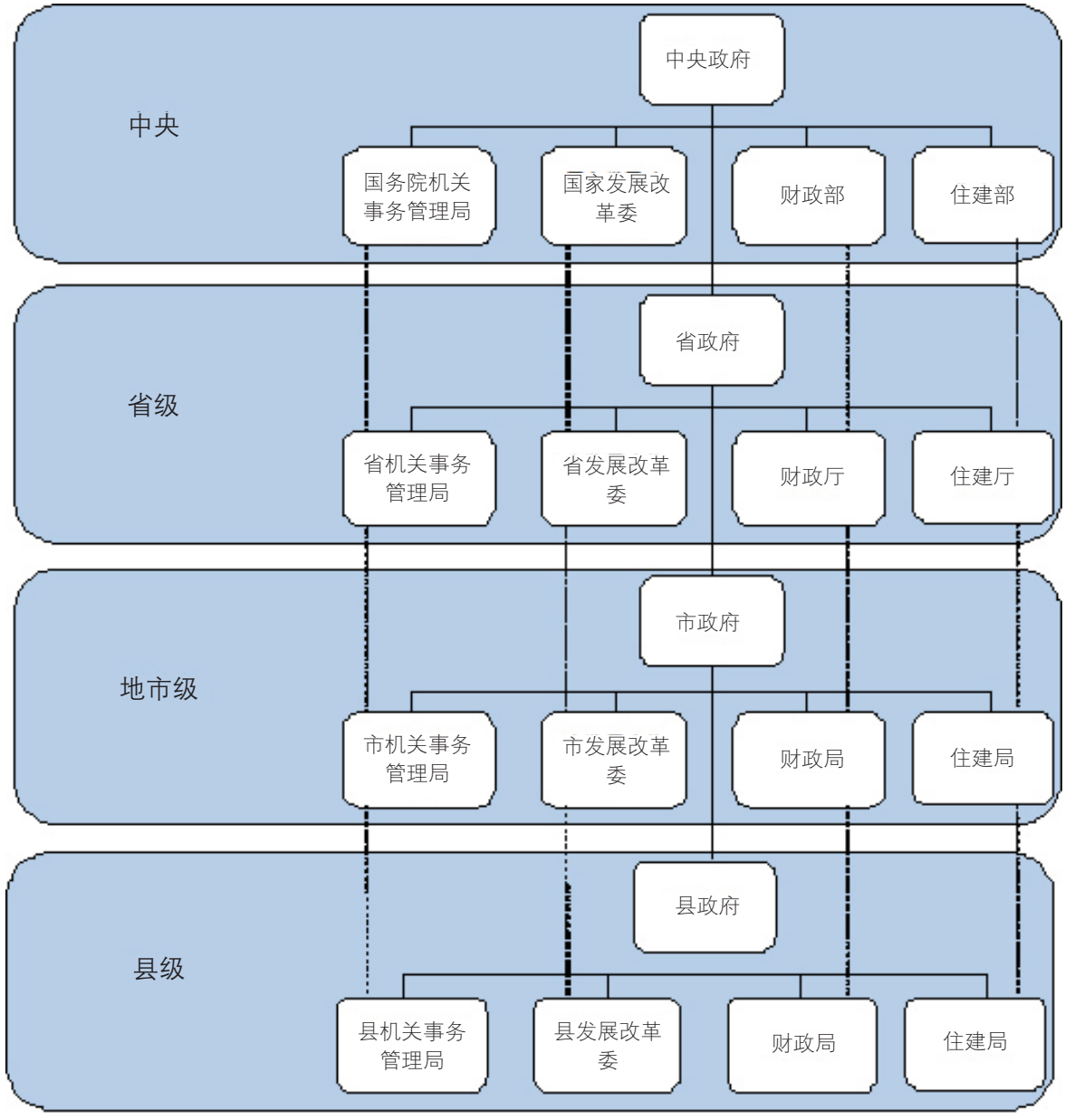
7. 不包括香港、澳门和台湾地区，省级管理的包括 22 个省、4 个直辖市（北京、上海、天津和重庆）以及 5 个省级自治区（内蒙古、广西、西藏以及新疆）。为简化起见，本报告中一般涉及的“省级”讨论都包括这些地区。

8. 为方便介绍起见，仅提到向国务院汇报的各个中央政府部门中的四个。

9. 国务院机关事务管理局不是像描述其它三个单位那样属于部委，但它向国务院进行独立直接汇报；各省各地政府机关事务的管理工作的机构组织安排各地有所不同，并不是所有的省和地方政府都有独立的机关事务管理部门；参见 2.32 部分。

如住房和城乡建设部与地方建设委员会（CC）就不是垂直管理的方式，住房和城乡建设部的职责是制定国家政策、对地方建设委员会进行指导和技术支持，在实际业务中地方政府有较大的决定权。

图 2.4：中国各级政府组织框架



注：为便于阐述，各级政府仅选择介绍了部分政府部门。实线代表直接汇报关系，点线代表在相同业务流程中其它运行关系。

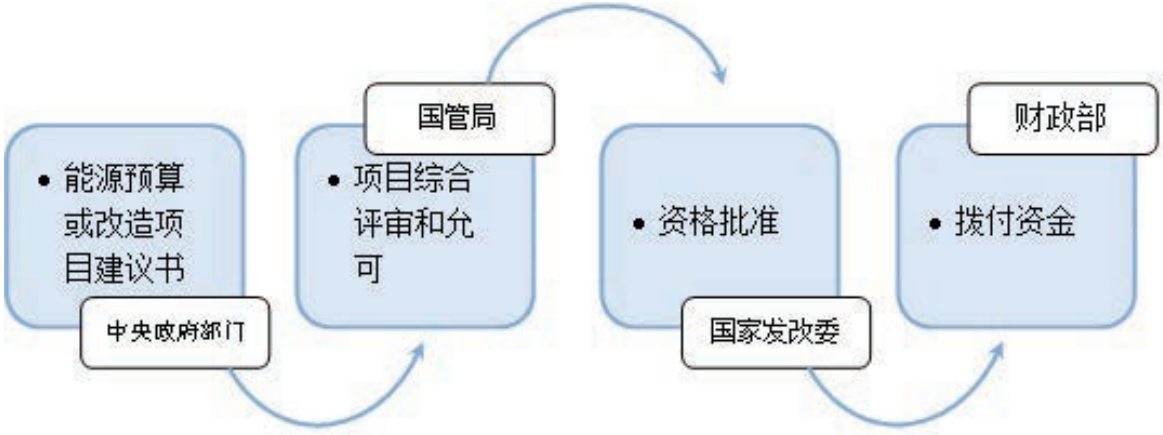
资料来源：作者

政府财政预算程序概述

2.11. 中国政府财政预算基本程序与大多数其他国家原则上都相差不多。财政部和地方财政厅负责财政预算管理。尽管也有范围更广的多年指导计划，但依靠国家财政支持的各级单位财政预算拨款都是以财政年度为基础进行经费预算（采用中国的日历年）。财政部从其财政收入中向中央政府部门拨款并向省级政府转移支付，中央政府部门每年的财政预算是向中央政府部门进行拨款的依据。省级财政厅从其财政收入中向省级政府部门拨款并向地市级政府转移支付，省级政府部门每年的财政预算是向省级政府部门进行拨款的依据。各部委都有自己的财务部门负责监管获得的财政预算拨款经费的具体管理，与他们财务监管的各个单位打交道。例如，省一级的大学从省级教育厅的财务部门获得国家财政预算拨款经费，而省级教育厅反过来又从省级财政厅获得所有的财政预算拨款。

2.12. **节能专项资金。**财政部或省级 / 地方财政部门可能掌握有可用于公共机构节能项目的节能专项资金。如果中央国家机关的某栋建筑需要用节能专项资金进行节能改造项目，该单位的后勤部门向相关的部委提交申请，然后该部委向国管局提交评审。国管局根据评审结果将好项目向国家发展改革委申报审批。国家发展改革委审批通过后，财政部会在下一财政年度拨付资金。具体设备采购时，需要从公布的中央国家机关政府采购供货商名单中选择设备供货商。图 2.5 给出了中央政府项目审批基本流程。各省实际情形大体也一样，只要用省级单位替换掉对应的中央政府部门即可。

图 2.5：节能改造项目资金基本审批流程



资料来源：作者

2.13. 中国公共机构定义为至少依靠部分政府财政预算资金拨款的单位。各级公共机构在获得年度财政预算拨款时，都会走政府财政预算流程。但是，各级公共机构财政预算资金占其年度经费总额中的比例是不同的。政府机关各项开支基本上都是靠财政预算拨款。中小学，特别是相对贫困地区的学校，基本上主要都依靠政府财政预算拨款，但可能也会从学费或其它渠道获得部分经费来源。大学除了财政预算拨款外，经费来源会有各种不同途径。医院在经费上是最独立的，收入主要是患者费用外加政府资金。如后面所介绍的那样，各公共机构经费来源渠道的不同，对节能积极性和融资方案都会有较大影响。

2.14. **中央政府办公建筑。**尽管国管局直接负责监管各类中央国家机关建筑物，但主要的建筑类型还是政府办公建筑物和职工住宅。国管局负责中央国家机关及其附属中心、研究机构以及其他相关机构建筑物的日常管理，管理职责包括但不限于总资产管理和土地使用管理、建设项目和改造项目的监管、指导相关资产管理单位相关政策制定、实施和监督考核、以及指导中央国家机关职工住宅建设和资产管理等。国管局也负责中央国家机关的节能工作（见表 2.1）。

表 2.1：公共机构建筑物所有权和职责

公共机构	数量 / 百万 m^2	所有权	I 投资	运行管理预算	运行管理的主管单位
中央政府建筑物	未公布	中央政府	财政部	财政部	国务院机关事务管理局
省级政府建筑物	未公布	省级政府	省级财政厅	省级财政厅	省级机关事务管理局
地方政府建筑物	未公布	地方政府	地方财政局	地方财政局	地方政府
大学	2700 / 590	教育部 / 省教育厅	- 中央 / 省级政府 - 自有资金（学费）	- 中央 / 省级政府 - 自有资金（学费）	教育部、其它政府部门
中小学	366,300 / 1388	教育部	地方政府	地方政府	地方政府
医院	20,500 家医院 240,000 家卫生中心 650,000 乡村医疗站	卫生部	- 卫生部 / 财政部（最终投资） - 自有资金（用于改造）	自有资金（患者收费）	医院

资料来源：作者

2.15. **省级和地方政府办公建筑。**各省级、地市级和县级政府办公建筑也由政府机关事务管理局或政府同级的类似部门进行独立管理。尽管在业务上机关事务管理部门会接受上级单位的政策和工作指导，但他们是向本地区的政府负责人直接汇报。尽管在职责上类似于国管局对中央国家机关建筑物的管理，但有些地方在具体的组织结构上有所不同。例如，一些地区国管局的类似职责是由一个更大的政府部门承担，但在一些地区，国管局类似的相关职责被剥离安排到不同的政府部门，例如党政系统就分属于不同的单位。

2.16. **大学。**中国大多数大学，特别是那些规模庞大、综合水平较高的学校，都是公立大学。中国全国有 2700 所大学，在校生超过 3000 万人，建筑物建筑面积超过 5.9 亿平方米，相当于全国城市建筑总面积的 2.7%。大学归口管理单位为教育部及其地方教育管理部门，各大学也通过教育主管部门获取政府预算经费拨款。大多数著名的大学都归教育部（这即是中央政府部门）直接管理，部分大学归省教委管理（这即是省级政府部门）。少数由于历史原因同时归中央和地方教育主管部门管理。据估计，平均而言，大学政府财政预算经费收入低于其总费用（主要靠学费和其他收入来平衡开支）的一半，各所大学的具体比例也是不同的。

2.17. **中小学。**中国绝大多数中小学都是公立学校。截至 2009 年末，中国全国大约有 280,200 所中小学，其中不到 5500 所为私立学校。共有 56,300 所初中，29,800 所高中 [10]。截至 2009 年底，全国中小学建筑面积总量为 13.88 亿平方米，是大学建筑物建筑总面积的 2.4 倍。中小学归口管理单位为所在地区的政府教育主管部门，并从教育主管部门获得资金。地方教育主管部门负责管理学校投资、

10. 国家教育发展统计公报，2009。

改造以及运营成本的财政预算。和许多其他国家一样，不同地区地方财政资金在中小学总费用的比例是不同的，而且各地用于中小学的财政经费总额也是有差别的。

2.18. **医院。**中国目前有 20,500 家综合医院，但有部分医院附属于一些大学或广义的研究所，大多数独立运营管理。除了这些综合医院外，还有大约 30,000 家社区医疗服务中心、38,000 家镇级卫生中心、174,000 家诊所以及大约 650,000 家农村医疗站。这些都归卫生部及地方卫生部门管理。一些大医院归卫生部直接管理，但大多数都归省级政府卫生主管部门管理。中国的医院分为三级。一级医院为地方医院，主要为周围的社区服务；二级医院是地区医院，为多个当地社区（如城市）服务，三级医院不仅仅服务于一个特定的地区。由于大多数医院都希望患者医疗费用（包括医疗保险或患者直接支付的医药费）以及收入来源能覆盖医院经营成本，因此平均而言，政府预算经费仅占医院总支出的 10% 左右。

2.19. **其他单位。**尽管能耗总量较小，但除国防和安全部门外，还有许多其他类型的使用财政预算资金的公共机构。例如，体育设施、博物馆或展览馆等文化设施、科学技术中心等，这些单位归其他部委及其地方下属部门管理，如文化部或科学技术部等。

公共机构节能节能主管部门的权限范围

2.20. 国家发展改革委、财政部、住房与城乡建设部、国管局以及对应的地方政府部门都对公共机构节能按职权范围各司其职。各行政管辖范围节能主管部门直接承担本系统有关完成节能目标、组织实施节能工作以及节能监督等职责。主要的政府机关及其相应的职责范围如下：

- 国管局：推进、指导、协调、监督全国公共机构节能工作，具体监督管理中央国家机关本级节能工作
- 省级机关事务管理局：省级政府机关
- 市 / 县级机关事务管理局：市 / 县级政府机关
- 教育部：中央政府直管的大学
- 省教育厅：省级政府直管的大学和中小学
- 市 / 县级教育局：当地政府直管的中小学
- 卫生部：中央政府直管的医院
- 省 / 市 / 县级卫生部门：省级和地方政府直管的医院和医疗诊所。

体育、文化、科技等系统的管辖权限也类似。

中国公共机构节能政策现状

2.21. 与那些公共机构节能工作已有数十年的国家相比，中国公共机构节能工作总体而言开展时间还相对较短。但在这较短的时间内，中国已经制定了大量的公共机构节能政策措施，公共机构节能工作取得了显著地成效。

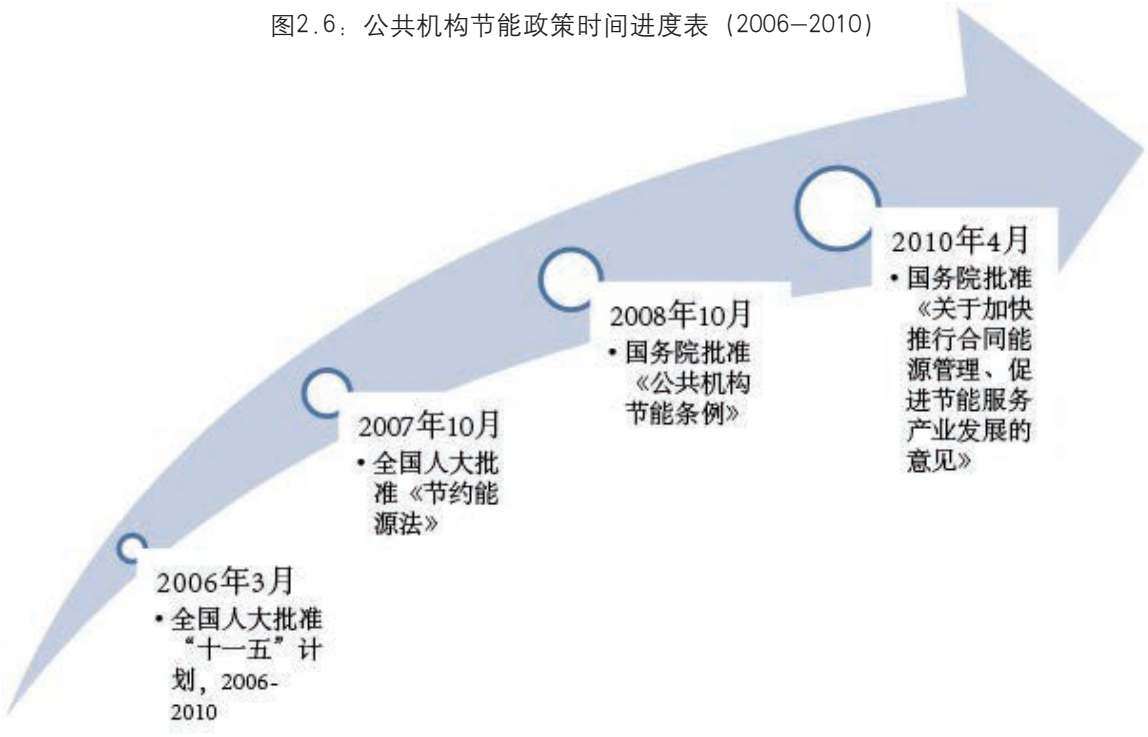
近年来的主要政策

2.22. 在刚进入二十一世纪新元年，中国政府高层领导就开始高度关注公共机构能源和水资源使用中的效率问题。2002 年，相关单位对公共机构实际能耗状况以及管理现状进行了两次随机调查。调查初步结论为后续工作的开展奠定了良好基础。

2.23. 2004 至 2005 年，党中央发布了系列文件要求采用切实措施提高公共机构的能源效率，特别包括倡导制定政府办公建筑物能耗和水耗定额以及相应的财政预算支出标准、建立体现节能要求的新设备和车辆政府采购新制度、以及在政府办公建筑改造中关注节能问题等。高层领导也指出政府在提高自身建筑物能源和水资源利用效率方面树立示范表率作用的重要性，同时也指出在教育机构开展节能工作对于树立示范表率的教育意义。

2.24. 2006 年中国启动了第十一个五年计划，节能是“十一五”计划的重要内容，并且比上一个五年计划要激进得多，提出了具体的节能目标，首次关注了公共机构的节能问题。图 2.6 给出了先后制定的一些公共机构节能政策时间进度表。2006 年 2 月，一些中央政府部门发布了一系列通知要求开展公共机构资源节约工作，并要求公共机构节能目标设定为人均能耗和单位建筑面积能耗降低 20% 以上，同时也包括采取措施节电节水各 20%。公共机构节能列入 2006-2010 五年计划的“十大重点节能工程”之一，后续章节将会对一些具体措施进一步讨论。出台了新的政策措施，制定了节能产品清单和淘汰落后产品目录，并要求在今后政府采购中强制采购列入节能产品清单中的产品，禁止采购列入淘汰落后产品目录中的产品 [11]。

图2.6：公共机构节能政策时间进度表（2006–2010）



资料来源：作者

2.25. 2007 年中国全国人民代表大会通过的《节约能源法》修正案，新增加了公共机构节能的章节内容。修正的节能法明确规定公共机构有加强能源管理、提高能源利用效率的责任和义务，同时节能法中的相关条款为公共机构节能各项法律法规和政策措施的制定提供了法律依据，后面将进一步介绍。

2.26. 2008 年 8 月，国务院颁布了一项重要的法令，即《公共机构节能条例》规定了各级公共机构提高能源效率的职责和具体要求。正如前面所提到的，公共机构是指全部或部分使用政府财政预算资金的单位。公共机构节能的后续许多工作都是围绕《公共机构节能条例》的贯彻落实以及相应的能力建设等工作开展的。

11. 近年来，大力促进政府采购节能产品和公务用车的节油是中国公共机构节能的重点之一。由于本报告的重点是讨论公共机构既有建筑物提高能源效率问题，所以不包含采购和公务用车的内容。但是，可从有关中文资料中获得有关这方面的更多详细信息。在 ESMAP 报告中包含有节能采购的内容，参见 Public Procurement of Energy Efficient Products—China Case Study, 尚未出版的 ESMAP 咨询报告，刘才丰，2011 年 11 月。

2.27. 2010 年国务院办公厅转发了《关于加快推行合同能源管理、促进节能服务产业发展的意见》。除了相关条款明确将重点支持合同能源管理的发展外，还特别指出：各级政府机构（或其他非公司性质的公共团体）采用合同能源管理方式实施节能改造，按照合同支付给节能服务公司的支出视同能源费用进行列支。该政策的出台，解决了公共机构组织实施合同能源管理项目的最大财务障碍问题，是合同能源管理业务的重大性突破（参见 4.12 部分）。

2.28. 省级和地方政府也根据实际情况制定了配套政策和地方法规。截止到 2011 年底，至少 20 个省政府制定了地方公共机构节能管理条例。

专栏 2.1：2008年8月国务院颁布的《公共机构节能条例》内容概述（国务院令531号）

《公共机构节能条例》颁布于 2008 年 8 月 1 日，生效日期为 2008 年 10 月 1 日。制定该条例的目的在于加强公共机构的能源管理、推行技术上可行、经济上合理的节能措施，降低公共机构的能源消耗、减少能源浪费。

节能规划。各级负责公共机构建筑设施管理工作的机构，根据本级人民政府节能中长期专项规划，应当制定本级公共机构节能规划。公共机构节能规划应当包括用能现状和问题、节能目标和指标、节能重点环节、实施主体和职责、保障措施等方面的内容。各个公共机构应当制定具体的年度节能目标和实施方案，有针对性地采取节能管理或者节能改造措施，保证节能目标的完成。公共机构应当将年度节能目标和实施方案报本级人民政府管理机关事务工作的机构备案。

节能管理。公共机构应当实行能源消费计量制度，区分用能种类、用能系统实行分项计量。公共机构应当指定专人负责能源消费统计，如实记录能源消费计量原始数据，建立统计台账。公共机构应当于每年 3 月 31 日前，向本级人民政府管理机关事务工作的机构报送上一年度能源消费状况报告。根据不同行业、不同系统公共机构能源消耗综合水平和特点，制定能源消耗定额，财政部门根据能源消耗定额制定能源消耗支出标准。超过能源消耗定额使用能源的，应当向本级人民政府管理机关事务工作的机构作出说明。公共机构应当采购列入节能产品、设备政府采购名录中的产品、设备，不得采购国家明令淘汰的用能产品、设备。公共机构新建建筑和既有建筑维修改造应当严格执行国家有关建筑节能设计、施工、调试、竣工验收等方面的规定和标准。固定资产投资项目审批或者核准时应进行节能评估和审查

公共机构应当按照规定进行能源审计。公共机构应对本单位用能系统、设备的运行及使用能源情况进行技术和经济性评价，根据审计结果采取提高能源利用效率的措施。具体办法由国务院管理节能工作的部门会同国务院有关部门制定。能源审计的内容包括：（1）查阅建筑物竣工验收资料和用能系统、设备台账资料，检查节能设计标准的执行情况；（2）核对电、气、煤、油、市政热力等能源消耗计量记录和财务账单，评估分类与分项的总能耗、人均能耗和单位建筑面积能耗；（3）检查用能系统、设备的运行状况，审查节能管理制度执行情况；（4）检查前一次能源审计合理使用能源建议的落实情况；（5）查找存在节能潜力的用能环节或者部位，提出合理使用能源的建议；（6）审查年度节能计划、能源消耗定额执行情况，核实公共机构超过能源消耗定额使用能源的说明；（7）审查能源计量器具的运行情况，检查能耗统计数据的真实性、准确性。

节能措施。公共机构应当建立、健全本单位节能运行管理制度和用能系统操作规程，推行低成本、无成本节能措施。公共机构应当设置能源管理岗位，实行能源管理岗位责任制。重点用能系统、设备的操作岗位应当配备专业技术人员。公共机构可以采用合同能源管理方式。公共机构选择物业服务企业，应当考虑其节能管理能力。公共机构与物业服务企业订立物业服务合同，应当载明节能管理的目标和要求。公共机构实施节能改造，应当进行能源审计和投资收益分析，明确节能指标，并在节能改造后采用计量方式对节能指标进行考核和综合评价。同时也规定了一

些具体的节能技术措施，包括加强用电设备的管理、严格执行国家有关空调室内温度控制的规定、充分利用自然光和自然通风、电梯系统实行智能化控制、使用高效节能照明灯具，优化照明系统设计，改进电路控制方式，推广应用智能调控装置、严格控制建筑物外部泛光照明以及外部装饰用照明等。公共机构应当对网络机房、食堂、开水间、锅炉房等部位的用能情况实行重点监测，采取有效措施降低能耗。公共机构应按照规定用途使用公务用车，积极推进公务用车服务社会化。

监督和保障。负有监管职责的部门应加强监督检查工作。监督检查的内容包括：（1）年度节能目标和实施方案的制定、落实情况；（2）能源消费计量、监测和统计情况；（3）能源消耗定额执行情况；（4）节能管理规章制度建立情况；（5）能源管理岗位设置以及能源管理岗位责任制落实情况；（6）用能系统、设备节能运行情况；（7）开展能源审计情况；（8）公务用车配备、使用情况。

“十一五”公共机构节能措施

2.29. 为了发挥公共机构节能的示范表率作用，随着国家对节能工作的高度重视，“十一五”公共机构节能工作重点主要建立健全公共机构节能政策制度体系、组织实施一批重大节能示范工程项目。为了有效推动公共机构节能工作，需要在如下方面开展大量的工作：（1）形成各方参与的节能组织网络体系并明确各方具体职责；（2）建立能耗统计和基准数据体系，为便于科学合理地规划和制定各项节能管理政策法规，需要加强能耗计量基础工作和人员队伍建设；（3）建立健全有效地节能机制，策划、提供融资并组织实施更多的节能项目。表 2.2 概述了节能进展情况以及相关的工作。

表 2.2：“十一五”公共机构节能的主要政策措施

节能领域	主要政策措施
法律框架体系的建立	1. 节约能源法的修改 (2007) 2. 公共机构节能条例 (2008) 3. 公共建筑节能设计标准 * 4. 党政办公建筑节能设计标准 *
管理体制的建立	1. 节能目标的分解与考核 2. 国家节能管理机构的职责分工、落实与协调管理 3. 全国公共机构节能管理网络体系的建立 4. 实施强制与优先相结合的政府节能采购制度 * 5. 建立健全公共机构能耗统计制度 6. 建设公共机构能耗计量与在线监测平台 7. 能源审计 8. 公共机构能耗定额的制定、实施、监督管理和考核 9. 新建建筑节能设计评审和全过程监管 * 10. 建筑节地节水管理 11. 公务用车节油管理 * 12. 信息传播和宣传培训

节能领域	主要政策措施
组织实施节能改造项目	1. 设立节能项目专项资金，制定《国家机关办公建筑和大型公共建筑节能专项资金管理暂行办法》 2. 推广合同能源管理新机制 3. 开展节能改造试点 （1） 照明改造 （2） 采暖制冷系统节能诊断与改造 （3） 综合电效改造 （4） 食堂燃气灶具节能改造 （5） 大型机房节能运行维护管理与改造

* 本报告不讨论这些问题及相应的解决措施。
资料来源：作者

2.30. 如下所述，“十一五”期间公共机构节能在三个方面取得巨大成就。当然，部分政策措施仍需要在“十二五”期间进一步深化和继续实施，这在第三章中会进一步讨论。尽管“十一五”公共机构节能的最大成就可能是及时制定并组织实施了一批政策措施、建立了公共机构节能组织管理体系以及探索实施了节能新机制，但也取得了定量的节能效果。尽管目前政府仅仅公布了公共机构节能效果评估的一些结论性数据，但结果表明人均能耗下降了 20.27%，实现了“十一五”设定的节能目标；单位建筑面积能耗仅下降了 15%，未实现预定的 20% 下降目标。如图 2.1 所示。

公共机构节能工作的组织协调

2.31. 公共机构节能涉及到多个不同的且相互独立的部门参与，需要加强这些部门之间的组织协调，这是一项具有一定难度的工作。尽管 2008 年国务院颁布的《公共机构节能条例》明确了公共机构节能的主要政策措施，而这些措施的组织实施需要许多独立的政府部门来共同承担，这并不是像国务院对各个部委的那种上下级领导关系。尽管中国公共机构节能工作已经取得了明显的成效，但这并不是一项简单容易的工作。

2.32. 为进一步加强公共机构节能工作，2008 年国管局组建了公共机构节能管理办公室，配备了专职人员负责监督管理中央国家机关的节能、并负责总体推进全国的公共机构节能工作。2010 年，公共机构节能管理办公室升级为公共机构节能管理司。新成立的公共机构节能管理司承担全国公共机构节能推进、指导、协调、监督的具体工作；监督管理中央本级公共机构节能工作；承办指导教育、科技、文化、卫生等主管部门开展本级系统内公共机构节能的有关工作；会同有关方面开展公共机构节能宣传、教育和培训等工作；以及监督考核全国公共机构节能的总体进展情况。

2.33. 实际工作中，国管局需要协调许多同级的中央政府部门。中央政府层面上，节能工作需要加强与国家发展改革委（负责全国总的节能政策和项目）、财政部（负责管理相关的节能专项资金）和住房和城乡建设部（指导全国总的建筑节能工作）等单位之间的协调沟通。同时，国管局还需要与行政上没有直接隶属关系的其他负责本系统公共机构节能管理的部委或单位，如负责大学和中小学节能工作的教育部、负责医院节能的卫生部，进行协调沟通。

2.34. 国管局与省级和地方公共机构节能主管部门之间也仅是一种业务指导关系而不是直接的上下级领导关系。如 2.9 部分所叙述的那样，省级机关事务管理部门归省政府管理，当地的各级政府机关也只分别向当地的政府部门负责人进行汇报。同时，国管局的传统职能仅是管理中央国家机关的资产，地方政府机关的资产归地方所管理，不像其他部门形成的工作关系那样，国管局与各地的机关事务管理部门之间关系相对松散，业务联系并不十分紧密。因此，随着国管局承担指导全国公共机构节能工作的新职责，需要重新建立全国的组织网络体系。

2.35. 在过去五年中，全国公共机构节能网络体系的建设取得了显著成效。截至 2011 年，26 个省建立了专门的公共机构节能管理处或科 [12]。由于需要指导其他省级或地方教育、医疗或其他系统的公共机构节能工作，这些新成立的公共机构节能管理处或科的工作范围也有所不同。此外，国管局还牵头组建了 5 个公共机构节能工作片区协作组，每个协作组由 5-8 个省组成，由各成员单位轮流担任组长单位。协作组根据工作需要不定期组织召开工作会议（经验交流会）或采取其他有效方式，及时研究公共机构节能减排重大问题和事项。

2.36. 在国务院组织实施的全国节能目标考核工作中，国务院机关事务管理局协调国家发展改革委将公共机构节能列入 2008 年省级政府〝十一五〞节能目标责任制评价考核体系。2009 年、2011 年国务院机关事务管理局会同国家有关部门的相关人员组成检查组，分赴全国各地对各省区市节能年度目标与投入情况以及贯彻实施 2008 年颁布的《公共机构节能条例》工作情况进行了专项检查。内容主要包括：公共机构节能管理体制建设、宣传培训、规划制定、能耗统计、制度建设、节能管理、措施落实、监督检查、资金落实等 9 个方面。检查以省级公共机构节能管理部门为重点，并每省选取 2 至 3 个地市、县级公共机构进行抽查。黑龙江等部分省市也制定了针对其行政区域内下级公共机构节能监督检查程序。监督考核工作是一种掌握全国公共机构节能进展情况、发现基层问题以及鼓励表彰先进的有效工作机制。

2.37. **大学和中小学。**中国教育部采取切实措施提高大学和中小学的能源效率，并将提高节能意识作为学生教育的重要内容。2006 年教育部针对各省教委和部直属高等学校发布了《教育部关于建设节约型学校的通知》，号召通过完善资源节约规划、加强资源管理、使用新技术以及采取其它措施等建设〝资源节约型学校〞，核心是节能、节水、以及其它资源综合利用。鼓励在校内外工作学习生活中实践应用资源节约技术知识。随后 2007 年发布的通知也强调了组织开展各种资源节约教育活动的重要性，同时也强调应将各项措施应用到〝资源节约型学校〞的建设中 [13]。

2.38. 2010 年 6 月北京召开会议正式宣布成立了全国高校节能联盟。大约 100 家大学参与作为联盟发起成员。全国高校节能联盟，是由中国高等教育学会设施管理分会及各大高校共同发起的高校节能平台，致力于推动节约型校园、绿色大学的建设，提升广大青年学生的环保意识，调动节能环保积极性。联盟启动了〝十百千万工程〞，即每个参与高校在本校建设十项节能工程，在全国建立百所节能示范高校，在全国组织千个绿色节能环保为主题的学生社团，在全国培养万名节能管理人员，系统推进高校节能工作的开展。

2.39. 尽管中小学的节能工作都由各地自行组织实施，但 2009 年 8 月启动了全国性的〝20 行动中小学节能教育试点项目〞。该项目将在北京、上海、成都和保定四地 100 多所中小学将在课堂内外开展系列以节能为主题的教育活动，将陆续组织教师培训、教材辅导、定期指导等活动，以帮助当地的中小学建立以节能减排为侧重点的环境教育体系，从多方位培养中小学生的节能减排意识和行动能力。具体内容包括在语文、数学、外语等现有基础教育课堂中，有机融入能源和气候变化等知识，在课堂内外开展以节能减排为主题的综合实践活动，组织学生在家庭和社区开展节能宣传行动等。从 2007 年至 2008 年，已有超过 60 余所学校参与了世界自然基金会（WWF）组织的〝20 行动〞京沪中小学节能教育竞赛 [14]。

2.40. **医院。**从二十世纪九十年代后期开始，在卫生部的推动下，中国医院协会资产管理专业委员会在促进中国医院节能工作发挥着越来越重要的作用。几乎所有的医院都是协会会员。资产管理专业委员会是医院主管部门和相关专家群体交流节能信息和经验的重要平台。资产管理专业委员会的网站在业内非常具有影响力，资产管理专业委员会组织召开了许多专业会议。2008 年，受卫生部委托，

12. 北京、广东、贵州以及新疆等地没成立单独的公共机构节能管理的部门，而是由当地的发展改革委负责公共机构节能工作。

13. 教育部，2006 年 1 月，《教育部关于建设节约型学校的通知》；教育部，2006 年 9 月，《关于开展节能减排学校行动的通知》。

14. 更多信息参见〝20 行动中小学节能教育试点项目〞官方网站 (http://www.20to20.org/)

资产管理专业委员会对不同类别、不同气候区的 50 所医院进行了能耗调查。在此基础上，资产管理专业委员会制定了医院节能减排规划，包括开展相似类型医院能耗对标的开拓性工作。

建立能耗计量统计报告制度

2.41. 提高能源管理水平、组织实施节能项目，需要了解公共机构能源使用状况。能源消耗统计必须确保数据收集和分析的可靠性。准确的统计也要求前期应对能源使用情况进行计量。在组织实施具体节能项目时，也需要对建筑物能源使用状况进行某种现场诊断评估（能源审计）。

2.42. 中国公共机构节能工作开始于本世纪之初，当时尚未对公共机构能耗统计数据的计量与收集工作进行统一，因此当时公共机构能耗统计质量是比较差的。按照正常的财务管理制度，公共机构的电力、燃气和热力等费用支出发票都会长期保管，但数据的可靠性却较差。有时发票保管要求不严，由于不规范的计量造成能源支出并不能反映实际的能源使用情况；采暖方面采暖费用是按照采暖建筑面积而不是实际的用热量进行收取。具体的能源系统或下属单位建筑设施（单栋建筑或建筑区）普遍缺乏分项计量。几乎从未开展过能源审计工作。

2.43. 准确的能源统计和终端数据对提高能源管理水平、实现 2008 年国务院颁布的《公共机构节能条例》节能目标、确定节能重点领域等具有非常重要的意义和作用。中国政府充分认识到了这一点，“十一五”期间，为解决能源计量的问题，中国政府采取了许多措施。毫无疑问尽管还需要在这一方面下大力气开展有关工作（见第三章），但在能源计量方面的投资是及其明智的，它是长期节能工作的基础。具体措施包括明确公共机构能耗统计基础数据收集、报告和监管的具体职责、制定标准规范化的能源统计方法和模板、进一步明确计量要求、开展人员培训、开展在线实时终端能耗报告与监测平台试点建设、中央和省级公共机构组织实施各种能源审计工作等。

2.44. **能源统计报告。**自 2006 年开始，国管局逐步建立和完善了中央国家机关建筑能耗统计报告制度，并逐步扩展到全国，组织开展了 2005 – 2008 年全国公共机构能耗统计工作，绝大部分省区市完成了统计上报。2009 年初，国管局向各省级政府机关事务管理部门印发了《关于开展全国公共机构能源资源消耗统计工作的通知》，要求各地区按照《节约能源法》和 2008 年国务院颁布的《公共机构节能条例》的要求实施定期的能耗统计报告制度。切实加强组织领导，明确专人负责，并规定每年 4 月 30 日前报送上一年度公共机构能源资源消耗统计情况。2010 年 1 月，经国家统计局审批，国管局正式印发施行了《公共机构能源资源消耗统计制度》[15]，提供了能耗统计报告的统一模板（试用至 2011 年年中）、明确了向国管局每隔一定时期统计报告的具体要求，公共机构能源资源消耗统计全面纳入了国家统计制度体系，这也为以后能耗统计工作奠定了良好基础。随后，国管局组织开展了大量培训工作，包括 2 次针对中央国家机关的培训以及四次针对省级和地方公共机构的培训，到 2011 年初共计培训了 1300 多人。

2.45. 部分省市也大力开展了能耗统计报告制度的建设工作。例如，江苏省在该省“公共机构节能管理办法”颁布实施后，制定出台了能源消耗统计报告、计量和审计的具体实施要求和指南，包括明确了具体联络责任人。

2.46. 尽管已初步建立了能耗统计报告的基本框架，但还需大力加强对各级公共机构上报数据的统计质量和一致性的控制管理，这将是一项漫长的工作，需要长期的经费支持、明确的指导以及较强的组织能力。

2.47. **计量。**尽管未对公共机构能耗计量状况进行调查统计，但公共机构缺乏能源计量系统和 / 或计量器具的使用不当现象是普遍存在的。“十一五”颁布的系列政策措施多次反复强调了按照相关标

15.2010 年 1 月 1 日，经国家统计局审批，国管局正式印发施行了《公共机构能源资源消耗统计制度》。

准安装和正确使用计量器具的重要性，但仍有大量工作要做。此外，对于那些相对复杂的大型机构，如大学校区或大型医院区，如果要准确了解各个建筑物的能源使用情况，需要安装分项计量仪表，尤其需要对电力、燃气和集中供热系统进行分项计量。

2.48. 在过去的几年中，部分省市在其所在区域的一些主要政府办公建筑已安装了实时在线能耗报告系统。2007 年，财政部批准同意提供财政资金用于北京、天津和深圳地区能耗在线监测平台试点。北京对 54 家公共机构全部安装了用电分类计量系统和采暖用热计量系统，实现了连续监测。该系统为以后节能工作提供了多种类型的分析结果，包括为不同类型用户建立和监控单位能耗基准。广西自治区也利用自有资金为 30 家政府办公建筑或其他公共机构建筑物安装了动态能耗监控系统。

2.49. **审计。**2008 年国务院颁布的《公共机构节能条例》强调了公共机构能源审计的重要性，并规定了能源审计应包括的基本内容（见专栏 2.1）。全国已开展了大范围的能源审计工作。中央国家机关也对 13 家规模相对较大的政府部门进行了能源审计试点，包括全系统测试、诊断分析并为节能改造提出了低成本无成本的措施建议。许多省市也组织开展了公共机构能源审计工作。山西省机关事务管理局 2010 年完成了 150 家公共机构能源审计工作。随着能源计量和能耗统计制度的不断完善，应在未来几年大力开展能源审计。

实施机制的建立与推广

2.50. ″十一五″期间各级公共机构成功组织开展了各种节能改造项目，其中部分项目经费是政府预算资金拨款，特别是政府新设立的节能专项资金。部分项目是与节能服务公司组织实施的合同能源管理项目，没有政府的节能专项拨款经费（参见 2.57-2.58 部分的介绍）。随着政府对合同能源管理的大力推动，预计合同能源管理项目实施机制将在未来数年获得快速发展。下面将对″十一五″的主要成果进行总结介绍，后面两章将进一步详细讨论。

2.51. **利用政府预算资金拨款或自有资金组织实施项目。**当使用公共资金实施节能项目时，原则上公共机构可用政府财政预算资金或自有资金。正如 2.13 部分所讨论的，不同类型的公共机构，用于潜在的节能项目投资的资金来源渠道区别很大。例如，医院的资金来源就很多，而大多数中小学和政府机关实际上几乎没有任何渠道。

2.52. 可通过建筑改造拨款的方式获得年度政府拨款预算经费用于公共机构节能改造项目。通常要想在长期的政府预算经费栏中获得节能经费，需要实施项目的公共机构及其上级主管部门的审议批准。但是，由于经费总量有限，有许多其它的长期优先领域，公共机构节能改造项目并一定能获得支持。因此，″十一五″期间，通过利用中央政府层面的财政部以及省级和地方财政厅（局）管理实施的节能专项资金，已组织实施了一些具体的公共机构节能融资项目。节能专项资金是以年度方式一次性拨款，它包含在相关政府每年的总预算中。″十一五″期间，财政部为中央国家机关节能改造项目安排了 5 亿元资金推进节能改造工作。2006 年至 2009 年，各省及地方政府也至少单独安排了额外的 2.15 亿元用于公共机构节能改造工作。

2.53. 通常公共机构所在的设施管理部门负责提出使用政府节能专项资金的项目建议[16]。设施管理部门具体负责公共机构建筑物的管理、改造、保养以及日常运行管理。一旦公共机构所在单位的领导同意了项目建议，项目建议还将通过正常审批程序（参见 2.12 部分）获得批准，从项目提交申请到最终得到经费可能要一年多的时间。

2.54. 启动实施一项节能改造项目（不管是政府财政支持的项目还是合同能源管理项目），所涉及到资产管理部门、公共机构内部主管领导以及相关的上级主管部门等单位的职责和作用是不同的，但

16. 有时严格的翻译为″后勤管理部门″。

他们都是特别重要的。资产管理部门最了解他们所管理的建筑物的日常运营情况，并在今后运营过程中承担主要的具体实施和运营管理责任。但这些单位不可能从节省的能源成本费用中得到直接收益、也很少是所在公共机构的主营业务而得到管理层的重视。在大学和医院，成功组织实施节能项目需要所在单位领导的积极介入和浓厚的热情，这样领导就能将财务等相关部门动员起来一块行动。中小学的校长可能愿意开展节能工作，但重大资产管理、项目融资以及成本节约问题都涉及到当地教育委员会的不同单位，因此需要这些单位共同行动确保项目成功实施。对于政府机关办公建筑物，建筑物资产管理部门和相关政府机关事务管理单位之间的关系对节能项目的成功至关重要。

2.55. ″十一五″期间，财政部节能专项资金″支持的公共机构节能项目，包括 200 多万平方米中央国家机关政府办公建筑的节能改造以及公务员居住的 525,000 平方米政府住宅建筑节能改造。节能改造的设备包括锅炉、建筑中央空调系统、燃气灶具、电开水器以及照明系统。国务院机事务管理局 2009 年组织国家发展改革委、工信部等 20 个中央政府部门开展空调采暖系统节能改造。在财政部等 10 个部门安装智能开关 2000 多只，节电率 36%；在 32 个部门安装食堂清洗设备，节水率 50% 以上。

2.56. 2009 年国家发改委、财政部、国管局以及其他相关单位共同组织实施的中央国家机关节能灯补贴项目，是″十一五″组织实施的众多成功节能项目中的一个典型例子。截至 2010 年 5 月，中央国家机关共推广照明产品 326 万只，超额完成 2010 年年度 200 万只推广任务，年可节电 1.1 亿千瓦时，相当于年节约 3.7 万吨标准煤，减排 9.5 万吨二氧化碳。截止到 2011 年底，中央国家机关节能灯推广总量达到了 480 万只。国管局在组织实施节能灯补贴项目时采取多项措施，包括严格规范工作流程、严格把好资金审核关、全力抓好监督检查以及广泛开展宣传引导与技术服务工作等。

2.57. **实施合同能源管理项目。**在公共机构采用合同能源管理方式实施节能改造项目，如果采用中国广泛使用的效益分享（或服务外包）模式，并不需要或很少需要公共机构自身或政府财政资金的支持。节能投资项目从节省的能源费用中回收投资成本。第三方的节能服务公司与负责建筑管理的公共机构共同组织实施节能投资项目、签署能源绩效合同。目前，节能服务公司多是通过直接谈判或通过简单、相对快速地采购程序参与公共机构节能。对于中国广泛采用的效益分享型合同能源管理项目，节能服务公司负责项目投资（资金通常从其它地方拆借）、监管设备采购和工程建设、与业主共同完成运行调试，并且担保节能量。节能服务公司将会根据合同条款的约定分享估算的或实际取得的节能收益，实际分享金额由实际项目投资与合理的利润两部分组成。目前中国合同能源管理项目的合同期通常为 2 至 5 年，节能服务公司分享节能效益的 80% 左右，项目业主获得其余的节能效益（参见 2.59 部分）。

2.58. 目前，中国的节能服务产业非常活跃。中国合同能源管理业务起源于 1996 年开展的三个试点的节能服务公司，到 2010 年中国节能服务产业的投资规模超过 42 亿美元，使中国成为与美国并驾齐驱的全球节能服务产业领头的两个国家。2010 年中国节能协会节能服务产业委员会（业内也广泛称作中国能源管理公司协会，或 EMCA）的 428 个会员单位，具备成功组织实施合同能源管理项目的经验。中国合同能源管理一般分为三种类型，即效益分享型、节能量担保型或服务外包型（见第四章对合同能源管理的详细讨论）。尽管在许多方面，各种合同能源管理类型的特征与北美或其他国家相似，但在中国也有一些特殊之处。大多数情况下，节能服务公司通常负责具体的项目设计、负责项目的组织实施，并担保节能量。但融资方式、合同以及资产所有权等方面内容会有差别 [17]。

2.59. 2007 年至 2009 年，节能服务产业委员会的 400 多个会员单位中实施的合同能源管理项目大约有 61% 为效益分享型，这与其他国家许多类似的合同项目有所差别。对于中国大多数分享型合同能源管理项目，只要节能量监测证明设备正常运行中达到了约定的节能效果，节能服务公司就按合同约定的比例分享估计的最小节能收益作为投资回报。对于额外的节能收益通常都归于业主。只要项

17. 有关中国节能服务公司的更多信息，参见 Sun et al. 2011, ″中国节能服务产业 2010：通过市场每天节省更多能源″（报告未公开发表，2011 年 5 月，从节能服务产业专业委员会获得）。

目实施过程中达到的原始预期的基本节能效果，项目合同方就能获得预期的投资回报。在合同期间，根据实际的节能量测量结果的变化，可能会发生在支付周期内每次所支付的费用可能有所不同，但这种情况是比较少见的。因此，中国开展的大量效益分享型合同能源管理项目，本质上类似于美国联邦政府实施的节能服务公司提供融资的节能量担保型项目，唯一的区别是节能服务公司在整个合同期间都从节省的能源费用分享部分收益比例。

2.60. 2007 年至 2009 年，节能服务产业委员会会员单位组织实施的合同能源管理项目，约有 36% 为节能量担保型项目。在该模式下，业主自己负责融资，节能服务公司财务担保项目的节能效果。居于效益分享型和节能量担保型两种模式，是服务外包型。服务外包型模式现在越来越普遍，在该种模式下，通过设备的运营管理实现节能效果，具体而言节能服务公司对业主建筑物内的一些主要用能系统进行节能融资、管理和运营、或者在一段较长时期内管理。

2.61. 2007 年至 2009 年，工业领域的合同能源管理项目目前是中国节能服务产业的主要业务领域，占合同能源管理项目总数的一半、占节能服务产业委员会会员单位合同能源管理项目投资总额的四分之三。尽管单个项目的投资规模相对较小，但建筑领域的合同能源管理项目越来越多，占项目总数的 49%。但目前建筑领域的合同能源管理项目还处于商业运营探索中。部分大学和医院已成功开展了一些合同能源管理项目，但政府办公建筑的合同能源管理项目还十分少见。在这点上，与美国节能服务产业的情形完全不同，美国政府办公建筑和中小学的合同能源管理是节能服务产业的主力，商业建筑或工业领域的合同能源管理项目相对很少。

2.62. 随着政府支持力度的不断加强、日益强劲地市场增长动力以及 2010 年 4 月国务院颁布的节能服务产业扶持政策中关于在政府预算核算制度中增加合同能源管理项目支付栏目等，为公共机构建筑物合同能源管理市场的发展奠定了强有力的基础。但公共机构合同能源管理业务的发展还需克服许多障碍因素。经历 2011 年初期的激情后，许多中国节能服务公司正面临市场快速开拓的困难。在对中国公共机构节能面临的主要挑战和应对措施讨论基础上（第三章），第四章进一步讨论了中国合同能源管理发展的一些案例和推进建议。

第三章：大力推进并深化公共机构节能工作

3.1. 正如前面章节内容所述，中国近年来的努力已为公共机构节能打下了坚实的基础，接下来应是进一步做大做深公共机构节能工作。本章在对现有问题进行评述基础上，提出了如何加大工作广度和深度的措施建议。第一章提出的三个缺乏：缺乏激励措施、缺乏技术能力以及缺乏资金，是公共机构节能面临的主要障碍因素。为确保公共机构节能工作能持续健康开展，在对中国现有中期节能计划讨论基础上，本章介绍了美国和欧洲实践证明应对这些障碍因素行之有效的经验教训，并给出了克服这些障碍因素的应对措施。

中期规划：中国“十二五”规划中的公共机构节能措施

3.2. 中国新制定的〝十二五〞规划中提出了国民经济生产总值（GDP）能耗进一步降低16%的节能目标，这是在〝十一五〞已经实现的19.1%降低目标基础上提出来的。进一步加强公共机构节能工作是实现该目标的具体措施之一。为此，特别提出了公共机构人均能耗下降15%的目标、单位建筑面积能耗下降12%的目标。

3.3. 为实现上述节能目标，政府需要在2015年建立健全相对完善的公共机构节能组织机构和管理体系，包括制度体系、效果测量与监督体系、技术支持体系、公众信息交流和培训体系、市场化的服务体系（即合同能源管理）等。〝十二五〞期间工作的重心应是继续贯彻落实2008年国务院颁布的《公共机构节能条例》以及深化〝十一五〞期间的一些具体工作（如表2.2所示）。主要工作任务包括：

- **健全组织管理体系、加强机构之间的协调配合。**包括加强与中央政府节能相关主管部门、教育与卫生等具体行政管辖范围内部等单位之间的协调，在条件成熟的行业领域建立节能管理和监督制度体系；

- **完善政策体系、建立有利于长期有效运行的节能制度和管理机制。**包括研究建立能源审计制度以及加强公共机构能源使用状况的经济和技术评估。制定涵盖数据类型和计算方法等内容的能耗统计标准，完善公共机构能耗统计制度。在综合考虑不同单位类型的能源使用水平和具体用能特点基础上，制定公共机构能耗定额和能源费用财政支付标准。

- **加强能源计量和统计，夯实节能基础，指导科学决策。**包括四个重要方面：（1）建立按能源用户、单位类别和用能系统分类的公共机构能耗计量标准体系；（2）规范能源计量器具和计量方法，开展试点示范，按能源用户、单位类别和用能系统分类进行能源计量，重点加强新建建筑和条件成熟的既有建筑的热计量工作；（3）完善公共机构能耗统计数据的收集、传输和处理，包括统计数据的核查、专业统计监管和检查；（4）加强统计人员的培训。

- **通过奖惩制度加强公共机构节能目标完成情况的监管。**为各级公共机构设定节能目标，加强节能目标完成情况的监督管理，建立节能目标责任考核制度。建立节能表彰和惩罚制度。

- **建立节能技术支撑体系，加快新技术的应用示范和普及。**包括制定节能技术推广目录。

- **加强宣传推广、教育培训和能力建设工作。**包括能源管理等内容在内的不同形式的节能信息传播和人员培训。

- **探索建立多渠道的融资机制，提高节能投资水平。**发挥政府财政资金四两拨千斤的作用，中央、省及地方各级常规财政预算中安排资金用于支持节能运行和部分节能改造工作。利用地方节能资金作为配套经费。更重要的是通过合同能源管理的方式充分利用社会资金。应考虑通过财政补贴、允许公共机构节能留成等方式，促进合同能源管理的推广应用。

- **加强国际交流和国际合作。**组织国际交流和培训活动，拓展与国际机构和双边金融机构之间的合作，开展不同国家和地区之间的节能合作项目，研究学习国际先进的节能政策措施、公共机构节能技术、成熟的管理经验和模式。

- **组织实施节能示范项目。**应加大如下领域的节能投资力度：（1）节能型公共机构建设示范项目，（2）优秀的能源计量和分项计量体系建设示范项目（包括用能系统单独计量和各重要用能单位的分项计量），（3）采暖计量和基于实际消耗的采暖收费示范项目，（4）重大节能改造示范项目。公共机构节能的重点领域是建筑物及其用能系统节能、车辆节油、新能源和可再生能源的应用以及节水。表 3.1 概述了这些领域计划开展的重点节能工程，2011 年至 2015 年期间的节能目标和推广应用指标。

表 3.1：“十二五”公共机构重点节能工程和目标

	2011-2015 节能目标（百万吨标煤）	2015 推广应用指标
节能型公共机构示范创建工程中的建筑围护结构和用能系统的节能改造	1.2	2000 家示范单位，建筑面积 2000 万 m^2
绿色照明 • 节能灯 • LED（以及其它高效照明灯）	0.6	• 100% • 10% (25 00 万只)
绿色数据中心	0.4	1000 个公共机构
零待机能耗计划	0.64	N/A
节能燃气灶具	0.36	80%
建筑供热计量和节能 • 管网改造和按用热量计价收费 • 建筑围护结构节能改造 • 供热锅炉改造	1.3	• 1 亿 m^2 • 3000 万 m^2 • 15,000 吨蒸汽
新能源和可再生能源应用（太阳能利用和地热源热泵）	0.2	2%
节水设备	N/A	80%
采购节能与新能源公务用车	N/A	50%
垃圾分类	N/A	80%
废旧灯管和废旧电子产品回收处理	N/A	80%
重点节能工程的总节能目标	4.7	

注：N/A= 不适用
来源：“公共机构节能十二五规划”，中国机关后勤，2011 年 9 月，7–12 页

国际经验

3.4. 尽管中国的国情和政府结构与欧美国家不同，但也具有许多相似性，这为研究学习这些国家在公共机构节能工作的启动、持续开展以及逐步深入等方面的经验奠定了基础[18]。公共机构节能项目奖励和融资渠道的财政预算制度是欧美与中国公共机构节能工作的最大相似之处。此外，许多国家和中国一样，在公共机构节能工作推进过程中也面临统计数据的符合性、能源计量、能源审计、对标、建筑标识以及替代融资机制的推广（特别是第四章介绍的合同能源管理）等问题。欧美国家公共机构节能工作已开展了30余年，积累了许多成功和失败的案例，这有助于帮助中国制定合适的政策措施，以便最好地实现中期节能目标。

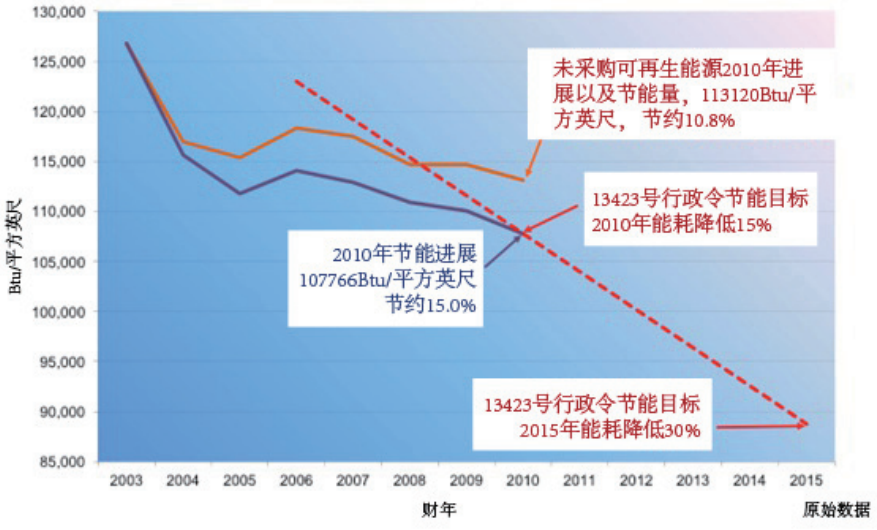
美国公共机构节能目标概述

3.5. 联邦政府是美国最大的单一能源消耗大户。联邦政府负责管理大约500,000栋建筑物，建筑面积约合2.8亿平方米。每年联邦政府建设费用约300亿美元。能源费用每年高达70亿美元[19]。联邦政府占美国公共机构（包括公立大学、中小学、医疗机构以及政府机关）能耗总量的20%左右。由于公立学校的数量较大，州及地方公共机构能耗占所有公共机构能耗总量的80%左右。

3.6. 目前，美国没有制定针对全社会的能源强度总体下降目标，也没有制定公共机构节能的总体性全国目标。但是，联邦政府、许多州及城市都单独设立了本行政管辖范围内的公共建筑节能目标，其中许多节能目标政策已组织实施了很多年。

3.7. 在联邦层面，从1988年《国家节能政策法令（NECPA）》修正案颁布开始，已颁布了国家能源法和许多行政令要求开展联邦政府机构节能工作。《国家节能政策法令》规定了联邦政府节能目标：1995年财政年度联邦政府在1985年基础上节能10%。自此之后，节能目标越来越严格、越来越具体全面，包括强制使用可再生能源、节水、提高车辆油耗的效率、以及其它可持续性等相关方面的内容。目前的节能目标是在2007年的13423号行政令中提出、并在当年的《能源独立和安全法令（EISA）》中明确，具体目标是每年降低建筑能耗3%、到2015年在2003年基础上总的节能目标为30%。图3.1

图 3.1：联邦政府建筑物节能进展与节能目标对比（2003—2015）



Btu= 英制热单位，RE= 可再生能源，EISA= 能源独立和安全法令，EO= 行政令， GSF= 每平方英尺
来源： Tremper 2011.

18. 一个很有趣的现象是在如下关系方面各国都具有相似性和区别：美国的联邦和州政府节能项目、欧盟与各成员国和地方政府节能项目、中国中央政府和省级政府的节能项目。

19. 参见 FEMP，Sustainable Buildings and Campuses。

对比了联邦政府建筑物 2003 年至 2015 年间每年的节能目标和实际节能效果。由于节能量是以〝二次能源〞计算的，原始数据表明 2010 年中期目标没实现。但是，如果将可再生能源的使用考虑在内，同时按〝一次能源〞[20] 计算节能效果，那么就实现了中期节能 15% 的目标。

3.8. 图 3.1 对联邦政府建筑物 2003 年至 2015 年间每年的节能目标和实际节能效果进行了对比。由于节能量是以〝二次能源〞计算的，原始数据表明 2010 年中期节能目标没实现。但是，如果节能效果考虑了〝一次能源〞的计算问题和可再生能源的利用，那么就实现了中期节能 15% 的目标。

3.9. 13514 号行政令（2009）是规定可持续能源目标的最新行政令，要求联邦政府部门加强能源计量、管理并降低温室气体排放（GHG），实现各单位自行制定的节能目标。例如，总务局（GSA）设定的节能目标是 2008 年至 2010 年降低温室气体排放 28.6%，环保署（EPA）的目标是 25%、国务院是 20%。这些机构的温室气体减排目标是通过降低建筑物和交通的能源消耗强度、提高可再生能源的使用等措施实现的。以前颁布的相关法律以及 13514 号行政令共同构成了联邦政府机构节能框架体系，涵盖了联邦政府实现节能目标的战略规划、责任制以及增强节能透明度等内容。这也包括组织实施具体的节能措施，如指派能源管理师、能源计量、能源审计以及建筑能耗对标（本章的相关章节将讨论实施的问题及实施效果）。第三章附录中专栏 A.3.1 给出了联邦政府节能政策和项目的详细信息，后面的章节会进一步讨论实施的问题以及具体的实施效果情况。

3.10. 用于公共机构节能的财政预算拨款专项经费额度是非常有限的，联邦政府要开展节能工作实现节能目标决不能依赖这点资金。事实上，联邦政府在使用其它保留的预算资金的同时，也特别鼓励使用替代融资方式解决资金问题，包括节能绩效合同（ESPCs）和公用事业能源服务合约（UESCs）、或者是许多州根据州政府法律法规组织实施的、并由能源公用事业单位提供的节能专项奖励和投资成本补贴资金，详细参见 3.81-3.89 部分和第四章。在过去 20 年，联邦政府建筑物节能投资总额超过 60 亿美元，包括财政预算资金和替代融资资金，联邦政府建筑能耗降低约 30%。1998 年到 2011 年 5 月，仅超级能效服务合同的节能投资规模就高达 24 亿美元，每年节能量为 6.37 亿吨标煤，节省的能源成本费用总额为 66 亿美元，联邦政府净节省的资金为 2.2 亿美元（见专栏 4.1）。

3.11. 除了联邦政府设定了节能目标外，几乎所有州 [21]、一些城市和地方政府也单独设立了政府部门强制性的温室气体减排目标和 / 或能耗降低目标。部分目标是非常激进的。第三章附录中的表 A.3.1 给出了一些例子。许多州都组织开展了综合性的公共建筑节能项目，尤其要指出的是，要求新建和改建建筑必须满足能源和环境设计示范（LEED）[22] 标准、或者是其它的绿色建筑标准、或者是要求高于现有的州建筑节能标准。一些州和城市，例如加州的旧金山、奥尔良、华盛顿地区的西雅图、马赛诸州的剑桥、华盛顿以及其他一些城市，还要求政府机关成为节能和 / 或气候行动的带头人。更重要的是，条件相对成熟的一些州和地方政府，还组织实施了一些创新性的节能工作，这可成为其它地方政府借鉴参考的最佳实践案例 [23]。

欧盟节能目标概述

3.12. 从二十世纪九十年代末期，欧盟总体的法律法规和相关政策都要求欧盟各成员国既要制定一般性的能源政策，也要制定专门的节能政策措施。欧盟 20-20-20 行动计划构建了欧盟能源政策总体框架：

20. 有关一次能源和二次能源的具体计算方法，参见 DOE/FEMP 2004：计算指南的 502（e）节：对于一次能源使用降低而二次能源增加的投资效益比较显著地项目，节能目标加分方法（2004 年 10 月 1 日修订）。

21. 美国节能经济委员会（ACEEE）在其报告中指出：在 2010 年开展的州节能计分牌（ACEEE 2010）评比中，除了 5 个州以外的其它州都有〝率先垂范的政策〞。州节能计分牌评比制度是由美国节能经济委员会这一非盈利性质的研究机构组织实施并每年发布。〝率先垂范的政策〞是确定各州排名的一项重要考核指标。

22.LEED (http://www.usgbc.org/LEED) 是一个绿色建筑认证体系，由美国绿色建筑委员会（USGBC）开发和管理。LEED 推行全建筑的方式，对九个方面的性能进行评估：可持续建筑选址、节水、节能、材料的选择、室内空气质量、位置和链接、意识教育和培训、设计创新以及区域优先性。

23. 参见 ACEEE 2010（脚注 22）以及环保署报告，Energy Efficiency in Local Government Facilities and Operations.

2007 年，欧盟正式承诺无论经济发展速度多快，到 2020 年温室气体和主要能源使用量的绝对值分别降低 20%、可再生能源占能源结构的比例提高到 20%。欧盟委员会最近估计，欧盟到目前为止只实现了总能耗降低目标的一半。为此，2011 年初，欧盟委员会颁布了新的节能计划，力争完成原定的节能目标。其中包括几项与公共机构关系紧密的节能建议。节能计划指出：公共机构产权所有或占用的建筑物面积占欧盟总建筑保有量的 12% 左右，应当在全社会树立示范表率作用。每年建筑节能改造速度应该加倍，至少达到建筑保有量的 3%，这样确保公共机构建筑能效水平普遍达到占全社会建筑保有量 10% 的最佳节能建筑的水平。欧盟委员会同时还建议公共采购中全面引入节能标准。欧盟委员会也鼓励节能服务公司在私人建筑和公共建筑节能改造中发挥重要作用，并且今后将逐步立法促进节能服务公司在建筑节能改造中的发展 [24]。

3.13. 欧盟议会和国会颁布的一些欧盟指令也支持 20-20-20 行动计划。与公共机构节能相关的是有关能源终端使用效率和能源服务的 "能源服务指令（ESD）" [25]2006/32/EC。其中的六大核心内容为：

- 每隔三年制定国家节能行动计划（NEEAPs）；
- 九年内国家指令性节能目标为绝对值的 9%；
- 重视公共机构，尤其是市场导向的重要作用；
- 强制要求政府在燃气和电力领域运营管理时承担公共服务的节能义务；
- 支持创造条件培育和加快节能服务公司（ESCOs）的发展；
- 要求进行能源计量和收费。

3.14. 欧盟成员国应设立本国具体的节能目标，在所提及的六个领域采取具体措施落实其国家节能行动计划（NEEAPs），以期实现本国的节能目标。欧盟各成员即将对最初的 2007 年国家节能行动计划（NEEAPs）进行评估，并在 2011 年制定后续的国家节能行动计划（NEEAPs）。专栏 3.1 给出了德国公共机构节能的主要政策目标和具体措施。

专栏 3.1：德国公共机构建筑节能

德国公共机构建筑物约有 200,000 栋，其中仅约有 2% 属于联邦政府所有。部分属州政府所有，绝大多数还是属于地方政府所有。但是，地方政府的建筑规模非常小、能耗总量也很低。每年公共机构全部建筑物能源费用为 35 亿多欧元，而联邦政府建筑物能源费用支出占总费用的 16%，地方政府建筑占 64%[26]。

德国 2007 年制定的国家行动计划承诺在 2001 年至 2005 年基准上，9 年内能源消耗总量降低 9%。联邦政府再次确认联邦建筑二氧化碳排放量降低 30% 的承诺，这是在 2005 年国家气候保护项目中已经确定的减排目标。为实现该目标，一方面重点依靠合同能源管理进行节能融资，另一方面计划在 2008 年至 2012 年政府每年提供 1.2 亿欧元的财政预算投资资金用于节能。州及市政建筑的节能改造将继续从德国开发银行 Kreditanstalt für Wiederaufbau (KfW) 申请低息贷款。据估算，加强公共建筑能源管理和用能设备的密切监控可以识别低成本的节能措施，并能带来 10% 的节能效果 [27]。新建联邦建筑的能源性能比德国建筑能源标准要高 20%。

2011 年的国家节能行动计划将体现 2010 年国家“能源概念”。总体性目标是 2020 年温室气体绝对量降低 40%、2050 年降低 80%（与 1990 年相比）。实现该目标的措施是提高可再生能源

24. 参见欧盟官方刊物：2006 年 4 月 5 日的欧盟参众议院 2006/32/EC 指令。

25. 参见欧盟官方杂志，Directive 2006/32/EC of the European Parliament and of the Council of 5 April 2006.。

26.Dena/Prognos (2007). Marktstudie: Contracting-Potenzial in öffentlichen Liegenschaften; compare http://www.kompetenzzentrum-contracting.de/fileadmin/uploads_redaktion/PDF/Download_Vortraege/2010_Magdeburg/Magdeburg02_dena_Buehner_Einfuehrung.pdf

27. 德国，2007，国家节能行动计划。

比例分别达到 18% 和 60%，一次能源消耗分别降低 20% 和 50%。希望 2050 年建筑基本实现碳中和 [28]。

为实现上述国家节能减排目标，联邦政府承诺 2020 年在 1990 年基础上建筑物二氧化碳排放量降低 50%，其中包括在 1990 年的能耗基准上，2005 年和 2010 年二氧化碳排放量分别降低 20% 和 30% 的目标。针对这些目标提出的措施包括：提高既有和新建建筑的能源效率、增加可再生能源的使用、实施节能采购以及其它一些措施。联邦政府节能工作效果显著：截至 2007 年，联邦政府建筑物温室气体排放量在 1990 年基础上已降低了 42%[29]。

联邦房地产署（Bundesanstalt fuer Immobilienaufgaben）拥有所有联邦政府建筑物的产权并负责管理运营。联邦房地产署与建设部共同制定了联邦政府建筑节能改造长期战略和时间进度表。初步估计实现 2020 年节能减排目标投资需求额度为 2 亿欧元。两家单位共同负责向上级汇报能耗和温室气体排放进展情况，这包括每家联邦机构，也可能是按资产分拆的机构的具体情况（见注脚 28）。

德国大多数州，但不是全部，已经根据国家计划和目标制定了自己的气候保护计划。各州都强调需要“示范表率”，并且通过对州政府产权所有的建筑节能改造实现二氧化碳减排目标。合同能源管理是首选的融资机制。许多州建立了州资产署，负责产权归州政府的建筑和租赁建筑的管理和运营。这些州资产署对州政府建筑进行能源管理并定期报告能源消耗情况 [30]。越来越多的地方政府都采用类似的气候保护战略和理念，其中大多数地方政府都是各种欧洲节能和气候联盟的成员。第三章附录中专栏 A3.2 介绍了 Baden—Wuerttemberg 和柏林两个州的节能项目情况。

公共机构节能的三个主要障碍因素

3.15. 公共机构节能工作存在三个重大难题，即缺乏积极性、需要加强人力队伍和数据 / 诊断体系的建设、需要额外的融资机制。正如和其他国家一样，中国公共机构节能的持续发展也需要找到这些问题的解决方案。

提高建筑管理人员和住户的节能积极性

3.16. 正如第一章所介绍的，中国公共机构节能工作的深化需要克服三个障碍因素，第一个障碍因素是资产管理人员和建筑物内的住户缺乏采取节能行动的积极性。除非有一些具体的措施，否则公共机构建筑物资产管理人员和住户一般没有理由去关注用了多少能源。建筑物资产管理部门主要是关注建筑物的运营是否满足服务质量的要求。其它（财务）部门负责处理能源账单，通常是从固定的财政预算拨款经费中扣除。建筑物内的住户一般也只关注舒适度和便利性是否满意。只要能源费用是由国家财政预算支付，对使用建筑物的公共机构来说，如果节省了能源费用，建筑物资产管理人员和住户没有任何直接收益。公共机构节能缺乏积极性，这是个严重的传统性问题，在全世界都是非常普遍的（也参见 1.9 部分）。

28. 请注意这些可再生能源份额目标以及能耗降低目标已经在 2011 年初作出的关于到 2022 年淘汰核能的决策中进行了修改，并提出了公共机构节能的补充措施，即通过合同能源管理以及新设立国家节能资金等形式加强节能融资，具体参见德国 Energy Plan (˝Energiekonzept) 和第二版 NEEAP 2011, http://www.bmwi.de/English/Redaktion/Pdf/zweiter-nationaler-energieeffizienz-aktionsplan-der-brd,property=pdf,bereich=bmwi,sprache=en,rwb=true.pdf.

29. 参见德国报告 Transposing the concept of sustainability into administrative actions (˝Nachhaltigkeit konkret im Verwaltungshandeln umsetzen˝)—联邦政府可持续性措施项目。

30. 例子参见德国 Schleswig-Holstein 州有关州资产报告 Energiebericht 2010 für die landesgenutzten Liegenschaften in Schleswig-Holstein ；在该案例中降低了采暖能耗，但电力消耗增加，结果在过去 10 年间二氧化碳排放量仅降低很少。相应的，能源成本增加超过 75% (Gebaeudemanagement Schleswig-Holstein (GMSH) 2010)。

3.17. 有几种措施可以解决积极性的问题。正如在中国和其它许多国家那样，最重要的是在公共机构建立明确的节能目标。通过公示节能成绩、以及将节能绩效与单位的形象挂钩等方式，可以有效地提高实现节能目标的积极性。此外，允许节省的能源成本费用用于支持用于设施升级改造和提高服务质量等其它优先领域，也能提高节能积极性。本节的后续内容将讨论这些措施。

节能目标制度的使用

3.18. **节能目标制的好处。**中国已经在过去的几年中建立了利用节能目标、职责和责任的制度框架进行能源管理和节约能源。节能目标、职责和责任制度毫无疑问有利于促使公共机构重视能源管理、强化节能责任、促使公共机构迅速采取节能行动。在其他国家实施的节能目标责任制，也有助于激发公共机构的节能热情。但这些国家的节能目标监督考核不力。中国已经通过对各级公共机构年度节能目标完成进展情况考核和撰写节能成果报告的方式，将节能目标与责任制有机结合。

3.19. 但是，还需进一步加强和深化节能目标管理制度，确保节能目标制度尽可能客观公正和科学系统，而且更重要的是促进基层各级公共机构的节能工作，尽可能针对各个地域行政管辖范围内的不同行政管辖范围的公共机构制定一些重要的节能绩效指标（如单位面积或人均能耗目标）。节能目标管理制度中的工作重点之一是应进一步加强各类建筑物的一些基础数据和能耗数据系统采集工作，包括建立节能目标的能耗基准。由于各级公共机构涉及到的建筑物的数量巨大、种类繁多，这需要花费相当多的时间和精力。应明确界定数据的种类和收集方法，确保数据的可比性和准确性（参见 3.61-3.63）。应进一步建立健全核查监督管理制度，保证数据质量。针对不同类型的建筑物开展能效对标工作，能促进建立一种让人感觉公平有效的能耗目标管理制度（参见 3.77-3.83）。

3.20. **定额制度。**中国修订的《节约能源法》以及 2008 年国务院颁布的《公共机构节能条例》都要求建立公共机构能耗定额制度，并将能耗定额与公共机构申请政府的能源预算开支挂钩。俄罗斯也建立了类似的能耗定额和财政预算挂钩制度。俄罗斯规定公共机构每年的节能目标是降低 3%，同时不管是否节约了能源，能源消耗财政预算都相应地降低 3%。为此，即使降低了舒适性或缩减了其它费用支出，各个公共机构也不得不节约能源 [31]。很明显该项工作将面临统计和技术方面的挑战。由于不同类型的公共机构所处的环境不同，不仅仅是气候的不同，而且在能源负荷方面也会不同，这就要求定额的制定需要公平合理且有足够的严厉性。为此，在对标准和能耗对标情况进行全面分析基础上，需要收集整理大量有关公共机构能源系统的消费模式以及影响消费模式的主要因素，然后才能制定能耗定额。如一些中国专家所建议的那样，*可能最好首先在一些条件相对成熟的地区对能耗定额与能源费用支出挂钩的财政预算拨款制度进行试点。例如，可先在统计报告体系完善、已对不同类型的建筑设施开展了大量的能源审计工作、以及已建立或即将公共机构在线实时能耗监控系统等条件具备的地区进行试点。*

3.21. **节能目标责任制和能耗定额的不足。**节能目标和能耗定额的建立和监督管理，对调动节能积极性是有积极作用的，特别是对那些与政府关系密切的科研机构。但也需要认识到作为政策工具的不足之处。首先，作为有用的激励工具，节能目标（或定额）必须分解到微观层次，以便尽可能直接地影响到各个公共机构的节能行为 [32]。但是，为公平客观起见，分解工作需要克服许多技术难题。其次，节能目标、特别是能耗定额，作为一项政策手段，有利于甄别和消除能源浪费极端严重的情形，这直接给公共机构增加了压力，要求改变浪费现象。但对于鼓励大家超越平均水平是没用的。制定节能目标和能耗定额时，具体指标水平应符合大多数公共机构的实际情况。因此，从定义上看，不可能促进公共机构超越平均水平。这样，该制度就可能导致倡导平庸的情形。第三，当政府能源预算对于公共机构很重要时，节能目标和能耗定额才能发挥最大效果；如果公共机构主要依靠自有资

31. Jas Singh，个人交流，2012 年 2 月。

32. 利沃夫的乌克兰城市的节能监管目标管理制度是一个较好的参考范例，参见利沃夫案例研究：http://www.esmap.org/esmap/node/1246.

金来源（如医院和一些大学）时，效果就不会太好。第四，资产管理人员可能不了解所负责的建筑物为什么运行效果不好，也不知道怎么采取应对措施，结果导致迟迟不能进行节能投资改造。

形象激励

3.22. 公共机构是为人民服务的。正如像一些中国领导人所强调的，作为政策法规的制定者，政府机关应率先带头节能发挥示范表率作用。大多数普通群众每天要经常和大学、中小学、当地的医疗机构以及某些政府机关等公共机构打交道。公共机构建筑物在资源可持续性管理方面的工作是直观可见的，成功的资源可持续性管理能给广大群众留下深刻印象。反过来，随处可见的浪费也会给群众留下较差的印象。因此，公共机构的部门领导和建筑物管理人员都会高度关注机构在公众心目中的形象。

3.23. 许多国家都充分利用公共机构的部门领导及管理人员重视单位公众形象的心态，组织实施了一些节能项目，调动各级公共机构主动节能或“绿色发展”的积极性。各级公共机构如果能充分认识能耗问题，并将自己作为节能和绿色发展的推动者，采取积极主动态度开展节能工作，就会避免公众谴责其浪费能源。但这要求要公布的公共机构节能或其他环境性能信息，应具有较高的权威性、且无任何偏见。

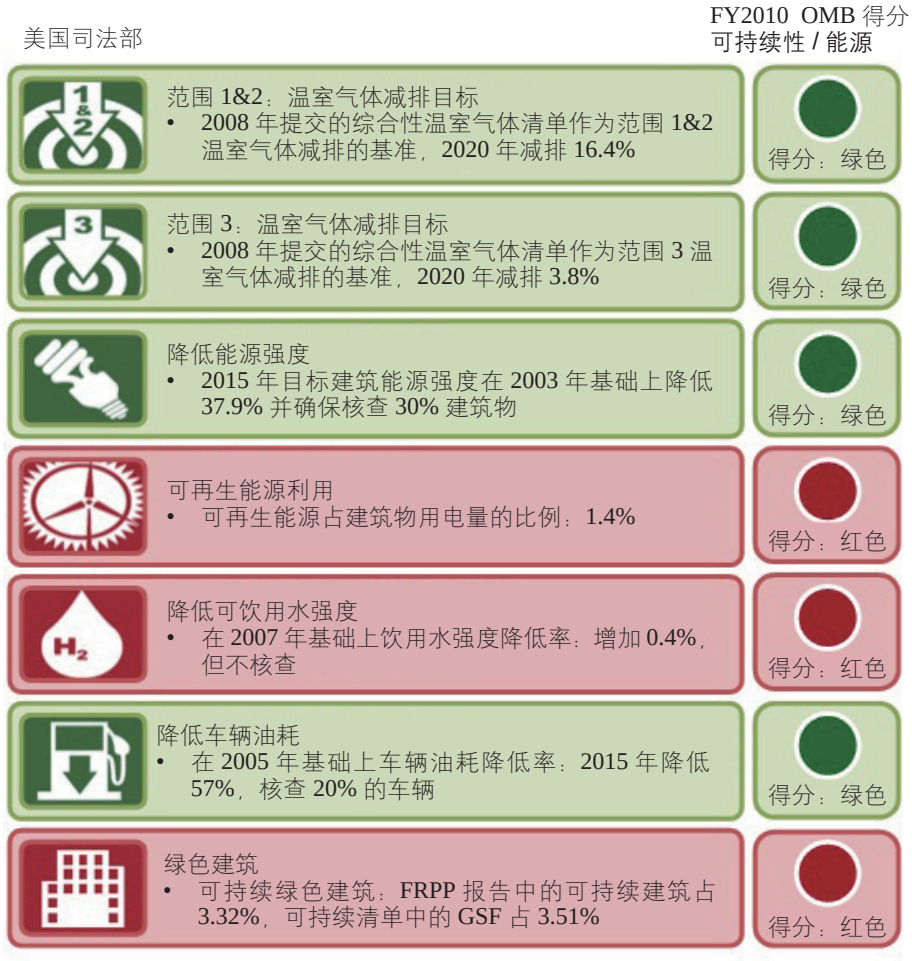
3.24. 如果当地居民关注气候变化、环境和其它可持续性问题时，利用单位形象调动节能积极性的做法就会特别有效。例如，一所大学的学生、教职员工的意见是非常重要的，大多数情形下能促进大学行政管理层参与包括节能在内的各种活动，如创建气候中和型校园[33]。教职员工和学生能产生大量的节能想法，并且这些想法通常都是富有激情且具有一定的创造性。美国和欧洲的一些大学研究发现，学校在清洁能源和环境问题上的形象已成为学生选择报考大学的一个考虑因素，这也给学校管理层提供了一个信号。世界各地的许多地方政府网络和联盟研究指出，地方政府也迫切向公众传递重视可持续性和气候变化的积极态度。第三章附录中的表 A.3.2 列出了一些包括具体领域的团体网络。

3.25. 通常通过表彰先进典型的方式来帮助公共机构树立形象、调动节能积极性。表彰引入了竞争机制，这就鼓励大家取得节能成就，也希望提高大家对所在单位节能工作的热情，同时鼓励其他人也采取节能行动。美国环保署的“能源之星”表彰就是一个很好的范例。例如获得“能源之星”表彰的几个地区，就很自豪地帮助宾夕法尼亚州的牛顿地区 Council Rock 学校组织实施节能项目。通过加强能源管理、重新调试刚竣工不久的建筑物、在采购新产品时尽可能采购“能源之星”认证的产品等措施，该所学校在 2005 年至 2011 年期间，能源消耗总量已成功削减 40% 以上，降低能源成本 530 万美元[34]。

33. 例如，占美国高等教育学生人数 1/3 的 700 所大学都是美国大学和学院校长气候承诺（ACUPCC）的成员。ACUPCC Reporting System - Reporting Institutions 给出了温室气体清单、气候行动计划、有关各个学校的节能项目以及其它相关信息、以及对比统计数据。也可参见表 A.3.2 中有关 ACUPCC 信息。

34. 参见美国环保署， Energy Efficiency Programs in K-12 Schools.

图 3.2：美国联邦政府记分牌



资料来源：节选自美国司法部 FY2010 OMB Scorecard on Sustainability/Energy

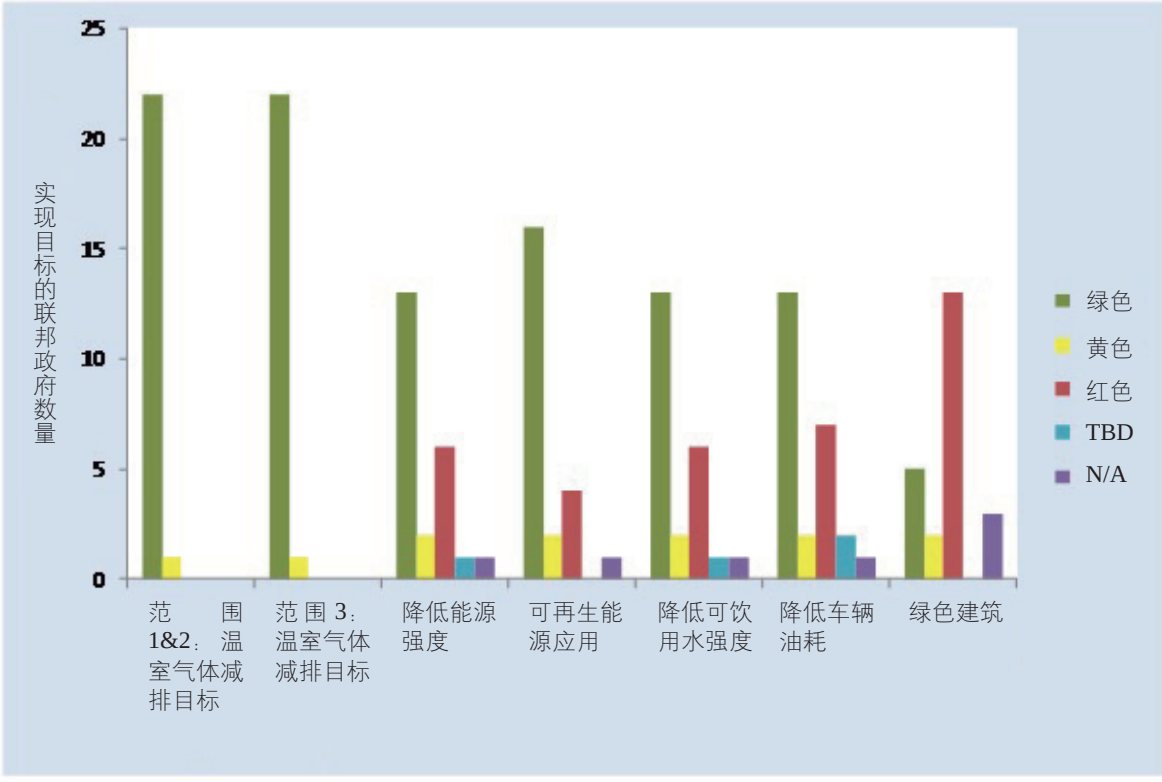
3.26. 另一个通过形象调动节能积极性的更有效做法是对某一类别的所有公共机构进行节能（和环境）效果的评比并公布评比结果。美国联邦政府的计分牌就是个很好的例子，它对联邦政府完成政府规定的节能和环境可持续性目标的具体情况进行评比[35]。据说计分牌制度逆转了长期盛行的"对行动的恐惧要远大于不行动的恐惧"的想法（Vallina 2007）。每年，各个联邦政府部门要向管理和预算局（OMB）就本单位可持续性和节能目标实施情况进行两次报告，计分牌的结果体现了具体的实施效果。在联邦政府内部使用几年后，2011 年白宫网站正式公布了计分牌的评比结果[36]。

3.27. 作为一个例子，图 3.2 给出了美国司法部最终评比结果的计分牌。一个规模较大的联邦政府部门计分牌的结果由于比预期要差，因此该部门就向公众详细解释原因并提出了今后进一步改进提高的行动计划。事实上，除了温室气体排放目标外，如图 3.3 所示那样，全部取得优秀的情形是非常少的。

35. 私营部门也用能源计分牌。例如，AT&T，美国电信公司，开发了一个能源计分牌，用于其下属的 500 栋能耗最高的建筑物能源绩效的追踪和对标。计分牌也用于各栋建筑物目标的设定。每季度，能源团队对能源绩效进行评估，给各个建筑管理人员的工作情况给出一个成绩，按照项目数、节约量、电力消耗以及培训等变量参数进行评估打分。2010 年，相对于 2009 年，2010 年的成绩评估得分提高了 58%（参见 AT&T's 项目，Managing energy, improving efficiency）。

36. 参见 http://www.whitehouse.gov/administration/eop/ceq/sustainability/omb-scorecards。

图3.3：美国联邦政府计分牌结果比较



注：绿色、黄色和红色分别代表具体的计分目标：绿色表示实现目标，黄色（中间）和红色分别表示还需改进和该单位未纳入今后目标考核中。三种颜色的定义参见 http://www.justice.gov/jmd/ep/docs/omb-scorecard.pdf ，TBD= 待定， N/A = 不适用。
资料来源：节选自 Schmutter 2011，节能联盟新闻简报， Federal Sustainability Scorecards：An Overview of a Program ‘Leading by Example’.

3.28. **研究建议。**中国有关政府主管部门在今后的节能工作中可以考虑以下三方面的措施：

- *节能先进表彰活动。*在某一类型或多种类型的公共机构中高调开展“节能示范单位”表彰活动，在起到宣传作用的同时，也能激励节能。一种方案是针对大学举办全国性的节能表彰竞选评比活动，可能最终只评选 10 所大学作为节能带头单位。有效组织实施评比表彰活动，需要提前制定好评价标准，要满足评价标准的要求是有一定难度的，但评价标准应是公平科学的。在正式启动表彰活动以及最终正式公布表彰结果时，可通过安排国家领导人出席表彰活动等方式，最大限度地提高表彰活动的公众知名度。评比活动必须科学客观。也可在政府机关或中小学开展类似的评比竞选表彰活动。评比中应让机关工作人员、学生和 / 或当地社区居民共同参与。

- *大学和医院的“节能联盟”（或“绿色联盟”）。*可在教育部的支持下，组建大学节能联盟；在卫生部的支持下，组建医院节能联盟。医院或大学都可自由加入联盟，但申请加入联盟的单位应承诺并积极主动组织实施一些具体节能和可持续或绿色行动。反之，联盟成员应将大学或医院当做节能或绿色行动履行者，并可作为在政府支持下与同行开展节能经验交流的良好平台。

- *节能计分制度试点。*可参照美国管理预算局针对试点的某类公共机构那样，组织实施试点，对外公布节能计分牌评比结果。例如，可针对某一地区或某一系统的政府机关办公建筑物进行试点。当然，需要提前充分通知提醒相关的政府机关。

公共机构能源成本节约奖励

3.29. 降低能耗能有效地降低能源费用。商业领域节约成本以及节能措施能增加经济收益是节能项目的最大卖点。由于公共机构并不需要追求利润，因此大多数公共机构对抓住节约成本的机会并不积极。而且如果节省了政府财政预算资金的唯一后果是减少今后能源经营成本预算资金，节能的好处被其他人所享受到，那么公共机构更没有节能积极性。当政府预算仅占公共机构总预算的一部分时（如大学和医院），能源成本节约奖励就会重要的多，因为这可节省自有资金，而节省的资金可被公共机构自己再次使用。但是，如果能源成本相对较小时，能源成本节约调动的节能积极性也仍不会太高。2008 年中国医药协会资产管理专业委员会对 50 家医院的调查结果表明，能源成本平均仅占医院总运行成本的 2-5% 左右，这对医院来说是微不足道的，也很难引起医院管理层的重视。

3.30. 虽然能源成本节约奖励有些传统上的缺陷，但也并不是说不能在公共机构推行能源成本节约奖励制度。关键问题是所制定的具体政策或采取的措施应有利于节能工作。下面给出一些范例。

专栏 3.2：中小学通过效益分享和培训手段实现节能

地区范围的节能效益分享行动。奥尔贡州的 Gresham—Barlow 地区中小学由于各种节能成就获得了多次财政资金奖励，包括某一时间段内实现了节能目标和学校建立了资源委员会。在北加州的 Wake 县，学校每年能保留 10% 的节能收益，该地区 100 所学校每年保留的节能收益共计 600,000 美元。Wake 县节能效果主要是依靠学生和教职员工的节能行动和培训教育取得。宾夕法尼亚州的费城中小学采取了用能收费制度，有效地节省了能源成本。这些节省的能源成本费用又用作节能改造资金，从而取得更大的节能效果 [37]。

美国节能联盟绿色学校项目。凡签约参与绿色学校项目的学校，节省的能源成本费用至少 50% 返还给学校。2009 年至 2010 年，加州的 Lake Elsinore 同意将节省资金的 70% 返还给学校，2010 年至 2011 年返还比例是 80%。学校可将节省的资金用于自认为任何适合于教学或教学以外的活动。2009 年至 2010 年，Lake Elsinore 和 Wildomar 返回给学校的经费高于 216,000 美元，这是节省的能源总成本 308,000 美元的 70%。凡加入项目活动的学校每年将获得 1,000 美元用于创建和管理一个绿色团队。项目主办方提供节能课程培训，每个学校都配备数据监测模型精确测量节能效果。中小学节能采用的措施包括主要电子设备自动关机、拔掉未使用的家用电器设备插头、设置采暖温度、通风和空调系统以及照明系统的节能改造等 [38]。

3.31. ***节能效益留成。***针对具体的公共机构实施能源成本节约奖励措施的一个基本要求，是允许公共机构能自主支配至少一部分节省的能源成本，而不是把节省的能源成本全部上交给其他政府部门。美国节能效益留成的具体规定是分别由州政府（如华盛顿州和特拉华州 [39]）、一些中小学社区教育管理部门以及联邦政府等制定的 [40]。专栏 3.1 中的例子展示了财政预算资金留成政策在中小学产生节能热情的重要性。

3.32. 中国部分省政府也认识到节能留成奖励机制的重要性，已经着手开始制定公共机构节能效益留成政策，允许公共机构实施节能项目时能保留部分收益。2010 年 11 月北京市颁布的《北京市合同能

37. 参见能源之星，Facility Type: K–12 Schools。

38. 参见节能联盟的绿色学校项目，Green California Schools Summit Advances Energy Efficiency. http://ase.org/efficiencynews/southern-california-green-schools-save-nearly-1-million-energy-costs。

39. 参见 Bond Buyer, Energy Efficiency Deal Powers Up.

40. 明确允许联邦政府机构进行能源成本节约留成，但在 2005 年 EPACT 法令中规定上限不超过 50%。2007 年 EISA 法令进一步加大了节能留成力度，允许政府机构 100% 保留节省的能源和水成本，并用这些资金开展其它的能源项目，包括员工奖励项目。如果采用合同能源管理，奖励资金额度就可能会很少，因此美国联邦政府机构实施的能源绩效合同允许节能服务公司在合同期结束前可以分享全部的节能收益。但是，由于担保的节能量通常都是很保守的，公共机构分享超过合同担保量部分的节能收益，根据法律规定公共机构可以保留这部分收益。

源管理项目财政奖励资金管理暂行办法》，明文规定允许公共机构从合同能源管理项目中保留一部分节省的能源成本费用，并按照总体计划使用该项资金。这点是非常重要的，因为在合同期间所有分享型的合同能源管理项目都能以现金方式返还给项目业主一部分节省的能源成本费用。同时该文件还规定：在项目合同期满后，单位的能源节约收益，在 3 年内全部留存单位，在部门预算中统筹使用。中国大多数合同能源管理项目合同期都小于国外的项目，这对于开发合同期相对较长的合同能源管理项目具有非常重要的意义和作用 [41]。

3.33. 如果公共机构允许通过节能行动留存政府财政预算拨款的能源节约收益，那么随之而来的问题是应允许公共机构如何使用这些资金？应按什么预算栏进行财政拨款？如果公共机构对该笔资金有较大的自由支配权，能按照自身的工作重点和为大多数员工谋福利的原则，使用留存的能源节约收益，显然这样最能调动公共机构的节能积极性。***中国的政府主管部门可能希望进行各种方案试点，包括地方试点直接允许将能源节约收益用于花钱不大但大家都能享受到的设施改造升级或相关的文化娱乐活动。留成的资金可以使用多年，这可充分调动办公室工作人员或学生和教职员工的节能积极性。双边合作单位或其他的捐款方也可能对支持这些节能活动感兴趣。***最终，政府既节约了资金，又提高了能效水平。按此思路，一个想法是可在某个省或地市的某个中学组织实施“节能用于购买新计算机”的项目，学校组织节能竞赛，允许学校将节省的大部分但并不是全部能源成本费用（和可能包括水和其它公用事业费用）用于为学生购买新的计算机。

3.34. 尽管节能留成非常重要，但要制定并实施节能留成相关的政府财政经费管理政策措施却不是一件简单的事情。政策的制定需要政府财政预算管理部门的同意，而具体实施又涉及到许多具体的细节问题。***对那些愿意大力推动公共机构节能的各级省及地市级地方政府，应根据 2008 年国务院 531 号文的精神，根据本地实际制定节能留成的相关政策文件。根据试点实施情况，应编制具体的实施指南。中央政府也可针对中央国家机关制定具体的政策措施，并提供具体的支持和指导。***

3.35. **政府预算经费缩减时的能源成本节约收益奖励。**美国和相当多的其他国家，随着金融危机和住宅市场危机的泛滥，地方政府的税收收入大幅下降，不得不大幅缩减当地的公共开支。消除资源使用过程中的浪费，而不是削减这方面的开支，会有利于稀缺资源的优化使用。因此，尽力寻找能源（和水）成本节约机会，确保地方政府不会砍掉节能投资项目或减少主要节能人员的配置数量。此外，能源成本的节约也可用于支持其他单位的节能工作，但这可能与成本节约收益奖励稍有不同，并且这种情形也不是太多。

通过节能项目升级改造设施、提高服务质量

3.36. 公共机构出于了节能目标管理、形象激励和节约成本奖励外，调动公共机构节能积极性的另一措施是获得升级用能设施或者提高服务质量的机会。公共机构常常没有足够的资金用于必要的改造投资，特别是简单设施的改造以及破旧设备的更换方面的资金远远不足。这种情况不仅中国存在（见第二章的不同领域部门），美国和欧洲也存在 [42]。中小学的经费投入主要大幅度地依靠各种各样的地方资金，严重缺乏资本投资资金，尤其是在美国，迫切需要利用各种融资工具筹集资金，为中小学破旧的设备和建筑基础设施更换提供资金。

3.37. 对于大多数公共机构来说，事实上设备改造是最大的节能动力。通过实施节能项目完成用能设施升级改造的例子很多。设施升级改造包括升级改造建筑制冷和通风系统、安装高质量的室内温度自动控制装置（保证室内温度恒定在舒适水平，当房间内无人时能调节室内温度）、更换安装性能优良的建筑外窗、提高照明质量、提供高质量的供暖服务、安装新的厨房炊具和制冷设备等。

41. 北京市财政局和发展改革委联合发布了“北京市合同能源管理项目财政资金奖励暂行办法”，2010 年 11 月 30 日。

42. 欧盟成员国要求包括地区和地方政府在内的各级政府从二十世纪九十年代开始遵守严格的财政记录。许多政府发现他们不能利用其自己的预算资金资助公共建筑的翻修，同时还要求他们降低运行费用。在此情形下，能源服务合同，包括能源绩效合同、能源供应合同或服务外包，看起来是同时实现降低财政预算经费并改造建筑物双重目标的最好工具。一些国家的能源署，重点是奥地利和德国，开始各州和各地公共机构推行合同能源管理项目。参见专栏 4.4 中德国柏林的例子。

3.38. 当采用合同能源管理融资方式时，节能服务公司提供融资资金、组织实施项目、从节省的能源成本费用中获取投资回报，公共机构在没有使用任何财政资金的情况下安装了新设备、提高了建筑物的多方面性能。全世界的节能服务公司都反映，只要业主是绝对依靠使用财政预算资金的单位，实施合同能源管理的动力和积极性，主要是因为业主通过设备升级改造，提高了舒适度、便利性、可靠性、服务质量、以及现代化的感觉等。美国是全世界公共机构合同能源管理投资最多的国家，由于公共机构实施合同能源管理的最大兴趣在于设备升级带来的各种好处，因此几乎节约的所有能源成本费用都补偿给了节能服务公司。公共机构更喜欢获得更多的设备和完成更多的改造升级，而不是获得能源节约收益现金[43]。

3.39. 中国政府已经组织开展了全国范围的公共机构节能改造工作。选择中小学和其它一些具有社会公共服务性质的建筑物进行节能改造，不仅是为了满足建筑物功能需求（升级提高建筑物的使用功能），同时也是为了节能示范表率的需要。公共机构建筑物住户感受到了实际的舒适性和便利性，特别是在成功项目被广泛宣传时，住户会推动所在的单位和地方政府领导组织实施更多的节能投资项目。

专栏3.3：塞尔维亚和亚美尼亚学校和医院供暖改造和节能项目

塞尔维亚和亚美尼亚的大多数公共建筑由于使用不洁净的燃料以及设备破旧，供热效果非常差。大多数中小学这种情况特别突出，学校只有部分建筑供暖或供暖温度非常低，甚至在最寒冷的季节不得不放假。

世界银行为这两个国家的政府提供了贷款，用于这两个国家的几个城市的一些学校和医院供热改造和改善建筑条件。同时，世界银行还为市政府改造项目提供赠款。这两个国家实施的节能改造项目都非常成功。用户由于享受到的多重好处，如提高了舒适度、增加了教学成果以及改善了室内环境等而感到非常满意。

塞尔维亚。仅进行了一些小规模的建筑改造，如安装新的建筑外窗、恒温阀、温度自动控制器以及节能灯等，就取得了巨大的节能效果。2005 年至 2010 年，18 所学校和 10 家医院的能耗总量平均下降了 40%。一些学校由于建筑供热改造减少了燃料消耗，这些学校就有可能利用节省的能源成本支持供热系统的改善[44]。项目的第一期，建筑业主，即市政府，从节省的能源成本中获益。项目第二期，将实施效益分享型方案，这样建筑物用户，即学校和医院，就可获得能源节约收益。特别是在学校，节能改造的溢出效应非常明显。通过在上课期间开设节能课程、采用一些节能教学方式、组织实施全校的节能活动、时时刻刻目睹到的性能更好、舒适性更好的设施设备等；不仅学生、而且教师和家长等认识到节能生活模式所带来的好处，并在自己家庭中身体力行进行节能。

亚美尼亚。项目实施前，117 所中小学都是用木材炉子、煤油或昂贵的电力进行采暖。项目为他们安装了燃气锅炉。项目实施后，房间舒适性大幅提高，以前使用电采暖的学校供暖成本也降低了。选择学校的一个原则是，平均每个学生的投资成本小于 120 美元。11 所学校还采用一些其它的节能措施（如窗户、外墙和屋顶的保温处理、外窗的更换）。这些学校的节能效果为 10% 至 40%。如果按改造前的实际能源价格计算，平均能源成本节约率为 23%；由于项目期间能源价格上涨较快，按当前的能源价格计算，节约率为 50%[45]。

43. 美国联邦政府机构组织实施的超级节能绩效合同，使投资规模达到最大化——不仅合同期最长可达 25 年、投资回收期在 5 至 15 年（Hopper et al 2005），而且公共机构业主单位只象征性地收取 1 美元的收益，而将担保的节能收益全部支付给节能服务公司，并能严格地遵守执行合同条款。相比于其它州或地方公共机构，美国中小学的合同能源管理项目已倾向于签署合同期长、且包括多种节能措施（涵盖非能源的措施）的项目合同（Hopper et al 2005）。突尼斯尼亚州，合同能源管理的核心法律条款允许少量的非能源措施（最高可达总项目投资额的 15%，并不是仅对学校）可以加入能源绩效合同中，以便加快整栋建筑物的现代化进程（Bharvirkar et al 2008）。

44. 参见世界银行，Serbian Schools and Hospitals Are Warmer and More Energy Efficient.

45. 参见世界银行，Education Rescued From the Cold and video on Armenia Urban Heating Project.

3.40. 专栏 3.3 介绍了塞尔维亚和亚美尼亚的世界银行项目。项目主要是对地方医院和学校通过供热系统和照明节能改造，改善了建筑功能环境、以及提高了教育质量。这些项目中未采用合同能源管理。但是，研究团队建议*中国也应该开展类似的项目，特别是针对中国北方地区的中小学供热系统节能改造，或者采用合同能源管理的方式组织实施捆绑项目，利用节约的能源成本费用资金支持更多的节能措施。合同能源管理的节能资金不能只用于学校供热系统的改造，还应支持提高供热能力的的更大范围的改造。如果合同能源管理项目策划的好并且采暖是按能耗（不是按采暖面积）付费的话，节省的能源费用应能偿还节能投资费用。（也可参见 **3.84** 部分）*

加强人才队伍建设、建立信息和诊断制度

3.41. 缺乏专业知识和可靠的数据是公共机构节能深入开展的第二个重大障碍因素。要克服这一障碍，应高度重视人才队伍建设和节能诊断工作，以便提供节能技术支持和数据资料。中国政府已将这些工作列入十二五公共机构节能的重要内容。本节的后续内容将讨论提高专业技能和可靠数据的五项具体措施：（1）指派负责实现规定的各项节能要求的能源管理师，（2）加强能源计量和能耗数据统计收集工作；（3）有针对性地组织开展能源审计工作，制定适合公共机构自身特点的节能方案；（4）能耗对标和标识；（5）节能量的测量与验证。

3.42. 组织开展上述工作，就会收集大量有关公共机构建筑物及其能耗现状的大量重要信息，确保能在公共机构中制定合理的行动计划。那些专门任命的并且接受过培训的能源管理师，能判定自己所在建筑物的运行状况的好坏，并确定提高建筑物性能的基本措施。相应地，他们也清楚哪些地方应改造、哪些地方需要进行监管。在更大层面上，比如那些负责实现节能目标的地方政府或某一系统，就可根据能源审计和对标结果，利用掌握的一些数据和相关工具，确定节能工作的优先次序。

3.43. 人才队伍建设以及相关制度的建立工作量巨大。考虑到中国地域广阔、实际情形变化多样，各方面的工作都需要投入巨大的精力，需要长期持续开展各项工作。在继续现有工作的同时，还应列出一些节能工作的优先领域。中国实践总结有效操作方式是：在中央的指导和关注下，先在地方进行试点，然后根据所取得的成功经验制定出台政策措施并进行大面积推广。下面重点讨论这些问题，结合相关的国际经验，针对重点工作内容提出相关的政策建议。

公共机构能源管理人员

3.44. 中国《节约能源法》以及 2008 年国务院颁布的《公共机构节能条例》都要求公共机构应指派能源管理人员，负责公共机构能源管理和节能工作。公共机构典型的能源管理活动至少应按策划—实施—检查—改进的方法实施以下步骤 [46]：

- ***策划。*** 获得最高管理层的承诺并指派负责任的能源管理人员；建立公共机构能源方针以及涉及以下内容的能源管理改进的优先领域：（1）能源因素，（2）能源基准，（3）能源绩效指标，（4）法律和其它相关要求，（5）目标、指标和能源管理方案。

- ***实施。*** 组织实施能源管理改进项目（如安装、改造或建筑系统升级），组建支持能源管理改进的管理体系，如：（1）能力、培训和意识项目；（2）文件要求和控制；（3）信息沟通；（4）能源服务和产品采购程序。

- ***检查。*** 能源管理绩效以及能源目标和指标完成情况的监督、测量与评估；实际和潜在不一致性的处理、纠正或预防措施。

46. 这和如下标准内容是一致的：（1）中国能源管理标准（国家标准 GB/T 23331-2009，管理体系的能源要求，国家质检总局发布，2009 年 3 月 11 日）；（2）脚注 47 介绍的美国环保局指南；（3）2009 年欧洲能源管理标准 EN 16001，已被欧盟各成员国采用（例如德国，参见 DIN EN 16001: Energy Management Systems in Practice）

- ***改进。***评审能源管理工作进展，评审能源方针、目标和指标实施情况；追踪能源管理过程、分析节能工作实施效果；采取纠正和预防措施保证能源管理的持续有效，运用经验教训，扩大能源管理范围，增加能源管理人员。

3.45. 并不要求公共机构的能源管理人员自己能独立完成所有这些工作，最重要的是他们有职责、能力和资源确保正确组织实施和完成这些工作。例如，所有公共机构的能源管理人员应有足够的知识去组织管理所需要开展的各项工作，对外包给能源审计公司等专业团队所承担工作进行评估并交流意见。一些国家要求能源管理人员应圆满通过某些培训考试和 / 或获得证实满足基本技能要求的相关证书。

3.46. **什么样的公共机构应配备能源管理人员？**根据机构规模大小和人员数量多少的不同，各国对公共机构能源管理人员的配置要求也不同。日本和印度，超过一定规模的公共机构应安排专职的能源管理人员。根据《能源政策法令》，美国要求联邦政府从 2005 年开始应对所有能源消耗量大的建筑物指派能源管理人员，这样每年联邦政府的 75% 总能耗都由专业的能源管理人员进行管理。截至 2009 年，4000 多个指定的联邦政府建筑物的 99% 都指派了一个能源管理人员 [47]。德国地方政府建议城市居民在 5 万至 10 万之间的城市，应设立 2-5 个办公人员组成的市政能源管理办公室，而大城市的办公室要根据公共建筑的多少相应确定规模大小。柏林要求每个城市区都必须有一个能源管理人员，但截至 2009 年 12 个区中只有 9 个城市安排了能源管理人员 [48]。

3.47. 对那些仅有几栋建筑物的小规模公共机构，一些国家只要求指派兼职的能源管理人员，可能同时配备一个全职的、负责多个不同公共机构的能源管理专家，或者是配备一个同时负责能源管理和其它基础设施管理工作的专家，例如同时管理水、废弃物或其它“环境可持续性”等问题。如在中国大家所理解的那样，允许有其它职责的员工以兼职身份从事能源管理工作，会导致所安排的员工会有其它的全职工作，能源管理的身份只是名义上的，他们缺乏能力、也不会全身心地投入到所需要从事的能源管理工作中。因此，即使安排的能源管理人员并不是全职的，但划清职责、具备基本的能力是非常重要的。

3.48. **职责范围。**在过去的几年中，各个政府主管部门及公共机构已开始将能源管理和节能扩展为更广义的“绿色管理”，包括节水、可再生能源的使用、废弃物管理 / 减量化等。组建“可持续性管理”部门已越来越普遍，能源管理和其它相关资源的管理等工作都由一个部门来承担。在这种比节能工作范围要大的部门内，仍然需要配备具体的专业能源管理人员。这种情况在大学里比较常见（见脚注 30）。美国联邦政府也开始要求政府机关进行可持续性规划。但是，由于可能会产生机构间的冲突，仍需要考虑管理协调的问题。例如，美国联邦能源管理项目（FEMP）负责能源管理，但另一个部门负责可持续性管理。

3.49. **能源管理人员认证。**政府会面临一些具体问题，其中之一是如何确认能源管理人员的能力是否足够以及是否满足任职资格要求。能源管理人员是否应该考试获得特定的资格证书；如果要考试，谁来负责组织考试？参加考试是否有持续培训的要求？是政府还是专业机构进行管理？或是否有圆满完成某种培训的完整档案记录？不同的政府会采取不同的路径。日本建立了非常有名的合格能源管理师认证（QEM）制度和 / 或认证能源管理师（CEM）。只有通过全国性考试后，才能获得认证能源管理师的认证证书；而合格能源管理师只需完成某种培训后就被承认。印度能源效率局（国家管理署负责节能工作）每年组织实施能源管理师和能源审计师认证的全国性考试 [49]。美国能源工程协会和其它单位共同负责能源管理师的认证工作。从二十世纪八十年代开始，美国能源工程协会为

47. 参见 FEMP, Covered Facility Footprint and Energy Manager Assignment (Federal-wide).

48. 参见柏林 Energy Plan 2020 (“Energiekonzept 2020”).

49. 参见 Energy Manager Training.

10,000 多名能源管理师颁布了证书。美国联邦政府以及绝大多数州能源办公室、主要的公用事业单位、公司以及节能服务公司都承认能源工程协会的证书 [50]。中国目前的工业能源管理师培训制度的做法也有点类似，培训后会颁发证书证明参加了培训或者是完成了任职资格的课程学习。这种做法也适用于公共机构的能源管理师。研究团队并不建议在公共机构采用其它形式的专业培训制度，否则会增加能源管理师审批制度的复杂性，为能源管理师制度的建立造成不必要的麻烦。

3.50. 组织实施培训。公共机构承担能源管理师职责的工作人员，在大多数情况下都需要接受能源管理各方面的培训，包括技术方面的内容，如能源测量、用能分析、预防性维护、系统优化和运行机会（O&M）、改造项目的策划和组织实施等，同时也需要掌握项目财务评估分析基本内容。培训可由专业协会、大学或其他团体提供。公共机构领域常常要求员工接受继续教育，以便掌握行业的最新知识。定期组织召开一定级别的公共机构能源管理师（如一个省的市政府建筑物能源管理师，或中央国家机关能源管理师）会议或大型研讨会，组建能源管理师联盟，创造机会交流技术问题和各种解决方案等。例如，德国黑森州政府已经持续组织召开了 20 多年能源管理师培训会议，编制了涵盖公共机构各个子系统的能源管理指南，指导能源管理人员理解职责和相关要求。美国环保署和德国城市协会（Staedtetag）分别编写了针对地方政府的能源管理指南 [51]。

3.51. 如果今后中国考虑在公共机构推行实施能源管理师制度，最好是采取循序渐进的方式。正如不同的中国专家和主管部门所考虑的那样，***循序渐进的方式应包含以下内容：***

- 首先应在规模较大的公共机构及其重要的建筑物配置能源管理师；尽管大多数公共机构和建筑物最终都需要有能源管理师，但第一步首先应该是规模较大的公共机构和重点建筑物。

- 试点建立综合的公共机构能源管理师制度体系，在条件相对成熟的地区（如中央国家机关或一个或多个省）组织实施能源管理师的培训和认证。这可能会包括一套完整的政策和措施：（1）颁布政策明确规定不同的公共机构应配置什么级别的能源管理师；（2）明确规定相关的能力要求；（3）详细规定能源管理师认证以及考试、证书的发放等实施层面的细节内容；（4）组织实施多年的培训项目，包括课程设置、教材内容开发以及培训实施计划，（5）组织实施培训；

- 编制全国性的能源管理指南和手册，内容应包括不同类型公共机构（如政府机关办公建筑、大学、中小学和医疗机构）科学进行能源管理过程中的工作范围、节能途径以及相应方法等 [52]。

- 评估探讨在一些重点公共机构配置专门的部门和人员的可能性，负责广义的可持续性管理，可能最好先从大学开始。

3.52. 国际赠款组织可能感兴趣并愿意在学习国际经验、协助策划、组织管理和实施、以及能源管理初期培训等方面提供资金援助。

加强能源计量和能耗数据收集工作

3.53. 建筑物的基本信息以及能耗数据是科学合理进行公共机构能源管理的重要前提。基础数据主要有以下几方面的用途：

- 制定节能目标以及考核节能目标完成情况；
- 对建筑物以及公共机构的相关性能进行评估和比较；

50. 参见 AEE, Certification 和 Comprehensive 5-Day Training Program for Energy Managers.

51. 参见能源之星，Guidelines for Energy Management Overview 以及德国城市协会 Information on municipal energy management ("Hinweise zum kommunalen Energiemanagement").

52. 附录 B 中的表 B.2 给出了各个不同领域针对能源管理师的具体信息工具和网络资源。表 B.3 给出了重点用能设备节能运行手册的例子。

- 在节能改造内容和项目两个层次上识别具体的节能措施和节能项目，并确定优先次序；
- 监督考核节能进展。

3.54. 中国在过去数年里为公共机构能耗数据的收集以及统计报告制度的建立打下了良好的工作基础，发布了建立专人进行能耗数据收集的相关政策文件，编制了能耗数据统计指南和方法，并对统计人员组织实施了培训，以及加大了能源计量和数据收集系统的投资建设。从长远来看，节能主管部门和专家还应进一步加强能耗数据收集体系的建设工作：（1）改进能耗数据统计质量、扩大针对节能诊断评估的能源审计范围；（2）针对不同建筑类型，构建具有实时统计报告功能的综合数据收集和分析系统；（3）建立能耗对标体系，对比分析不同建筑物的能耗水平；（4）利用能耗数据进一步加强节能目标责任制、建立能耗定额制度，并将科学合理的节能考核监督工作制度化。这需要多年的锲而不舍地努力，并在各方面都应采取循序渐进的方法。建立健全不同类型公共机构数据收集和分析整理系统，也要求根据政府的角色定位以及实际情况灵活处理。

3.55. 当务之急是基础数据的收集。建筑物的基础数据主要包括建筑规模、居住情况、建筑保温隔热性能（如建筑外窗、外墙保温）、主要的耗能设备以及实际能耗情况。功率、供热和燃料消耗量的计量是评估建筑能耗的最正确方式，但安装必要的硬件设施并将其与软件和收费系统整合，将是一件比较困难的事情。如果建筑物缺乏计量，就需要根据设备数量、能源需求以及使用时间等参数，估算各种水电以及其它燃料的消耗[53]。同时还应考虑气象参数，因此气候变化对能源消耗量影响较大，年度能耗数据的波动在很大程度上取决于采暖或制冷天数等气候变化情况。要单独区分开气候的影响，能耗数据可取用一段时期，如三年或更长时间的平均结果，目前已经有了许多地方的气候数据修正参数[54]。最好是在各地完成基础数据的收集。为确保数据的可比性和可靠性，始终都应确保各个系统的各级公共机构都应采用统一的方法学和标准化的数据采集程序。应坚持加强集中统一的指导管理，针对各地人员组织开展培训，讲解如何正确地收集统计数据。对于规模较小、功能简单的建筑物，可考虑采用简化的方法学。应将各个单位收集的基础数据汇总到省和国家层面。应对基础数据进行初步的检查，避免明显的数据错误。

3.56. 公共机构节能由于长期未受到足够重视，同时公共机构建筑分布又十分广泛，针对中国不同类型的公共机构进行科学合理的能源计量，具有极大的挑战性。可将这些挑战归为如下三类：（1）加强基本燃料和电力消耗的基础计量、采购记录以及估算方法的建立；（2）加强中国北方地区集中采暖系统的标准热水散热器的供热计量和控制；（3）重点耗能系统 / 或单位分部门的分项计量。

3.57. **基础计量和能耗记录。**中国政府主管部门和专家都重点指出了近年来在加强公共机构基础能耗计量以及能源采购记录方面所做出的大量工作。需要根据相关标准和校准要求，检查和安装一些最基本的主要计量器具。同时还需要分析和修正计量数据和采购记录数据。燃煤供应、分配和使用的统计也需要协调统一。对于那些共用计量仪表和 / 或采购记录系统的各个公共机构，可能需要分解计量数据和采购记录以反映每个单位实际基准能源消耗情况。

3.58. 采暖计量和系统控制。中国北方地区公共建筑物供热消耗的计量和控制，涉及到复杂且牵涉面很广的中国供热计价和收费制度改革以及相应的重大技术改造问题[55]。除了少数的试点项目以及北京等少数城市的尝试外[56]，采用区域供热系统的集中供热是按照采暖面积（如居住面积每平方米）、而

53.USAID 出版物，˝Powering Health, Energy Management in Your Facility˝，是一本针对大多数离网发电的农村环境的医疗卫生设施能源管理指南，（参见 Powering Health - Energy Management in Your Health Facility）。

54. 气候标准化建立了能源使用与气候数据之间的关联关系，通常是采用统计数据的方法如回归分析法进行分析，允许在较长一段时间内对自身建筑能耗进行对比，这就解决了逐年气候差异的问题；例如，可参加能源之星，Portfolio Manager Methodology for Accounting for Weather。另一个例子是加拿大自然资源部的 Benchmarking Guide for School Facility Managers，该工具采用过去 30 年的平均采暖度日数（HDD）对某一具体年份的数据进行规范处理，气候数据是从加拿大环境部获得，方法学是由 Agence de l'efficacité énergétique 和 Quebec's Ministère de l'Éducation 提供。也可采用类似的程序使用制冷度日数（CDD）对制冷能耗的气象数据进行规范。

55. 要了解中国供暖制度改革的问题以及建筑节能的重要性，参见 Taylor et al. 2001，China: Opportunities to Improve Energy Efficiency in Buildings.

56. 2012/13 采暖季，北京地区的所有公共机构将完成所有公共建筑的供热计量改造，并强制实施按热收费制度。

不是按实际消耗的热量进行收费的。相应地，由于与供热采购无关，建筑供暖能耗基本上都没有计量，也无从知道实际的建筑采暖能耗。同时，传统的供暖系统是采用的前苏联技术，不允许用户对室内供暖负荷进行调节，甚至当整栋建筑如果没有专门配置热力站进行供热调节或者是建筑物有独立的供暖系统时，则整栋建筑物也不能进行供暖调节。在此情形下，人们根本没有采暖节能的积极性。即使公共机构采取各种供暖节能措施也绝不会降低供暖能耗，因为公共机构自身不能根据削减的供暖需求调节供暖负荷。

3.59. 中国目前正在进行供暖制度改革。供暖改革涉及到以下内容：（1）供暖分配调节改造，包括将固定流量改为变流量系统，以便能根据实际需求调节建筑物供热量；（2）新建建筑采用水平双管供热系统，而不是垂直式的单管供热系统，允许建筑物内部的采暖散热器的调节控制；（3）对旧的建筑物供暖系统进行改造，至少允许对建筑物内采暖进行部分调节控制；（4）对整栋建筑物安装热计量表，需要时也可在建筑物内部安装热计量表；（5）对采暖计价体制进行改革，包括按实际供暖收费等内容；（6）将供热收费制度调整为新的热计量和计价制度。

3.60. 公共机构仅是众多采暖用户的其中一类，因此公共机构的供热改革应与市政府建立的采暖政策以及供热改革进展速度保持一致。如果公共机构的建筑物是当地区域供暖系统的一部分，可利用公共机构供暖系统的改造升级和供热制度的改革，促进当地的整体供热改革工作。*但是，公共机构应采取切实措施，在节约自身采暖能耗的同时，也推进整体的供暖制度改革。首先，政府部门本着“树立典型”的思想，应将自己的建筑物拿出来作为用户端供暖升级改造和收费改革的率先试点，促进城市热力公司作出相应调整。其次，对于那些建筑年代相对较短、已经采用了现代的内循环采暖系统和控制调节阀的建筑物，可以要求配置局部的子热力站，允许对整栋建筑物或楼梯间供暖系统安装自己的热计量。第三，可在上述公共机构的建筑物内推广建筑物热力子站和温控阀等采暖节能技术，这会是比较典型的优秀管理节能案例。第四，如果公共机构有自己的锅炉和供热系统，应对供热系统进行技术改造，包括采用按需求进行热分配、采用先进的调节控制、以及供热系统综合节能措施（旧建筑供热系统配置所能允许的最大限度的节能措施）。其中第四项工作如果不是按采暖面积进行热计量收费，那最好采用服务外包类型的合同能源管理方式推进。*

专栏 3.4：美国大学校园的分项计量

美国“能源之星”项目和高等教育建筑办公人员协会（APPA）最近对大学校园分项计量调查结果表明：69% 的受调查大学对学生宿舍进行一种或多种能源计量、48% 对所有非实验室的教室建筑进行一种或多种能源计量（这两种建筑占这些大学建筑面积的绝大比例）。分项计量，特别是电力的计量，已越来越多。分项计量的主要目的是为了减少能源成本、用能收费以及建立责任制等。例如，密西根州立大学给每栋建筑都安装了能源计量仪表。一个专门的网站负责公布每栋建筑的月度能耗、与以往月份 / 年份的能源消耗对比分析结果、相应的能源成本、最近的节能投资以及每栋建筑节省的能源成本[57]。

3.61. **分项计量。**一些大的政府办公区或大学校园等大型公共机构，如果只知道整个单位的能耗状况，是很难评估节能优先领域或者是很难调动用户精细管理能源的积极性。应对不同的用能系统（重点是空调或照明系统、数据中心等）和 / 或一些重要的子单位安装电力、燃气和 / 或采暖分项计量仪表，这样就能制定更加具体的能源管理计划并能监控能源消耗状况。实际上，如果没有提前安装一些类型的分项计量仪表，几乎是不可能对这些建筑物进行有效的能源审计，或者也是不可能设计出有意义的能源鼓励方案。

57. 参见能源之星，Sub-Metering Energy Use in Colleges and Universities: Incentives and Challenges 以及密歇根大学，能源管理电厂运行部，Building Information.

3.62. 除非建筑规模非常小，安装分项计量仪表基本上都是任何成功能源管理改善项目的重要组成部分。专栏 3.4 给出了美国大学系统的一个例子。目前中国公共机构分项计量还比较少。为此就需要按照工作的优先次序，首先应针对最大的能源用户以及准备制定后续行动方案的建筑物进行分项计量，以便以最短的时间获得最大的收益。

3.63. **计量工作的几点建议。**最重要的是保持目前的工作热情尽快完成所有主要建筑物的能源基础计量工作，但同时也应注意到公共机构能源计量的需求程度是非常巨大的。为此，研究团队提出如下两点建议：

- ***在各地选择某类行政管辖范围进行试点。****在各地选择一类公共机构组织实施能源计量项目，积累经验，为重要行业领域能源管理和节能项目的策划提供坚实的实践基础。。例如，可具体针对一个省的省政府和市政府机关办公建筑物、一定数量的感兴趣的大学或医院、或者是某一个地区的许多中小学开展计量改造工作。项目活动应制定有时间限制且相对全面的计划，应在计划中包括满足所有能源计量基本要求的内容。同时项目活动还应包括各种计量试点内容的选择，包括分项计量、热计量以及智能计量（有能源价差存在的情形时）。应提供类似于美国的那种具体的技术指导。美国能源部（DOE）为美国联邦政府建筑进行电力计量[58]。相关的财政部门应为计量仪表的采购和安装提供资金支持。*

- ***针对节能潜力大且有具体节能方案的公共机构。****组织实施基础的能源计量等节能项目时，建议拟开展的能源计量单位应是那些既有大量节能潜力、又有组织实施具体节能项目的实际方案的单位。由于能源计量的需求太大，最好将计量的重点放在鼓励提高能源管理或节能投资的项目上，而不仅仅是收集能耗数据。*

开展能源审计，因地制宜制订节能规划

3.64. 能源审计是指通常由第三方专家提供的、针对具体建筑能耗进行的数据分析和 / 或诊断评估，包含一些现场检测。能源审计有可能仅是很简单的一天活动，包括对容易获取的数据进行评估以及快速“走访”建筑物的观察；也可能是相对复杂、需要耗时几个月的活动，包括各种能源系统以及各个建筑物设施的复杂测量和有针对性的分析评估。

3.65. **能源审计目标。**由于能源审计的类型有多种、能源审计的目的也不同，要确保成功组织实施能源审计项目，关键是要清楚能源审计的目的、相关方的预期要求、尤其是要求的后续行动。能源审计的目的常见有如下几种：

- *为改进内部能源管理体系组织实施的诊断评估。*当能源审计的目的是帮助单位制定改善内部管理方案时，此时能源审计的重点是考虑对现有内部程序的详细了解。审核员特别应与大量的机构工作人员进行密切沟通交流。预期的后续行动包括对内部程序和管理方法改进的制度化。

- *为上级主管单位以及机构自身提供数据资料而进行的能源审计。*简单的能源审计可用于确认或提高公共机构的数据统计报告，以便提供有关建筑特征、能耗类型和一些可能的节能项目思路，既可用于上级主管部门制定政策和策划项目时用作基本资料，也可用于公共机构自身对相关资料的需求。预期的后续行动既可能只是简单的信息收集和分析，也可能是将这些数据资料用于今后能耗定额制度制定过程中的能耗对标，或者是建筑物能效性能标识或最低能耗认证。由于目的不同，对公共机构来说能源审计的意义也就不同，因此在能源审计过程中，摸清审计的目的是至关重要的。

58. 参见 FEMP, Guidance for Electric Metering in Federal Buildings.

- *诊断评估，识别今后的项目，包括节能改造投资需求以及投资项目的组织实施。*依据目的不同，与项目相关的诊断评估的细致程度差别也非常大。简单的走访式审计对于为今后分析筛选潜在的项目类型非常有用。综合全面的投资级能源审计（IGAs）通常是为了一些重大项目而进行的，特别是如果包含有多种措施和技术，而且这些特别是会成为合同条款时，就会进行全面的能源审计。如果审计的目的是为了识别今后的项目、获得可靠的财务分析结果、为实际的组织实施活动提供依据、安排下一步工作任务、识别合适的财务资源等，并将认真执行相关后续行动时，就要求高度重视能源审计过程。选取的能源审计公司也意味着就是今后项目组织实施的合同方，因此在项目前期就需要考虑这一点[59]。

3.66. **将能源审计和后续行动结合起来。**成功的能源审计意味着达到了审计目的，而失败的能源审计则意味着未达到审计目的。如果能源审计的一个重要目的是帮助公共机构改进能源管理，那么公共机构是否会实际采用完善的能源管理体系呢？如果能源审计的目的是为主管部门提供更多的信息资源，那么这些信息资源是否有用且可靠呢？如果能源审计的目的是为了识别有投资价值的改造项目，那么公共机构是否实际进行了节能改造投资？大多数国家都广泛存在着能源审计完后并不能充分采取相关行动措施的问题。提高后续措施的执行力，最好的方式是清楚能源审计的目的和预期结果，然后确保能源审计是实现这些目标的大项目中的一部分内容，而不是仅是单单为了形成一份审计报告。

3.67. 许多国家都要求公共机构能源审计要识别出成本效益最佳的节能项目。捷克、法国[60]、印度、泰国、美国以及其他相关国家都有这方面的要求。这种强制性的要求有些是针对所有的公共机构（捷克、法国、美国俄亥俄州[61]），有些仅针对大型的建筑物（如印度和泰国制定的公共机构、美国的联邦政府[62]）。除非已有满意的财务安排并且授权组织实施成本效益最佳的节能措施，否则这种强制性的能源审计质量是比较糟糕的，并不能准确地为今后的投资提供依据。捷克的能源审计工作就是一个典型的例子[63]。

3.68. 目前，中国已开展的大多数能源审计工作的最大问题是对节能投资项目的识别分析重视程度不够。多数情况下能源审计报告只是对能耗情况进行工程分析，仅在最后一页给出该单位可采用的潜在节能措施清单。通过能源审计仅进行基本的能源消耗状况的分析，与准备具有实践价值的能源管理改进和投资项目二者之间是有较大差别的。多数情形下，所准备的现场具体的节能方案不是十分清楚，还不足以为随即所采取的节能行动提供足够的基础信息，最好是在进行能源审计时就应为制定这种具体的节能方案做准备。如果在能源审计时做不到这一点，就应重新做一次“投资前期”的研究。为改进能源审计的效果和作用，研究团队建议：今后公共机构能源审计应包括一些有关制定具体可操作的节能行动方案的具体要求，同时还应包含对所建议的节能改造项目资金和投资回收期的分析。应对政府财政经费支持的能源审计项目提出这些要求。

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59. 如果计划实施合同能源管理项目，需要进行第一阶段的一个简单的能源审计，为感兴趣的节能服务公司提供基本的项目信息，也为节能服务公司准备标书设定基本参数。一旦合同签署，经常需开展投资级的能源审计工作，为最终确定落实合同能源管理、记录能耗基准以及具体的项目设计提供精准的细节资料。能源审计的费用应计入合同中。参见第四章以及 Singh et al. 2010，Public Procurement of Energy Efficiency Services - Lessons from International Experience, p. 78.

60. 2009 年 7 月颁布的 “Grenelle 1” 法律要求所有的公共建筑在 2010 年底前进行一次能源审计，并根据能源审计建议在 2012 年底前启动节能改造工作。希望到 2020 年 9.2 亿平方米公共建筑中的 2.5 亿平方米完成节能改造。除了财政预算资源外（240 亿欧元主要用于州和公共机构拥有的 1.2 平方米建筑物的改造），推荐各公共机构，特别是地方政府机构应采用合同能源管理模式。目标是到 2020 年公共建筑能耗降低 40%。参见生态建筑国际俱乐部，“Grenelle de l’environnement”颁布后的法国气候变化政策，Policy and measures in the building sector 以及 Energy audits: state-of-the-art study.

61. 美国俄亥俄州 2007 年颁布的行政令（2007-02S）要求所有的州政府机构、董事会和委员会在 2007 年 6 月前对所有州拥有或租赁的建筑物进行能源审计，在审计后第二年建筑能耗降低 5%、在随后的 4 个财年内降低 15%(Office of the Governor News Release 2007)。

62. 自 2009 年开始，要求美国联邦政府每年对其 25% 的 “占用的建筑物”（这些建筑物能耗占联邦政府机构总能耗的 75%）进行能源和用水评估。截至 2010 年 12 月，约 50% 的建筑物已完成了评估，占建筑总面积的 38%、建筑总能耗的 34%。资料来源：http://www1.eere.energy.gov/femp/regulations/facility_ctsreports.html.

63. 捷克 2000 年颁布的《能源管理法令》要求对公共机构领域的大多数建筑物都进行能源审计，并在 2006 年底前完成。同时还规定了组织实施能源审计提出的低成本节能措施的义务。但是，能源审计以及组织实施这些节能措施的资金是非常有限的，导致公共机构与一些报价较低、审计质量较差、审计结果无多大用处的审计师签署合同。参见欧盟能源和环境地区联邦管理署，Framework Conditions for Energy Performance Contracting 以及国际能源署（IEA），Energy Efficiency Policies and Measures, Czech-Republic.

3.69. 能源审计的优先次序。一般而言，能源审计最先应关注哪些年代久远并且近年来没有进行改造的大型建筑物，这类建筑物的能源成本费用高，并且 / 或者设备已经达到其使用寿命周期[64]。对于那些仅有一些基本设备的小型建筑物，能源审计最好由建筑管理人员按照能源审计模板自己完成审计工作，给出建筑物的基本信息、设备清单和能源费用概况。特别是在公共机构节能的初期，能源管理部门、公用事业单位或类似的相关单位通常都能为能源审计提供支持或者帮助完成简单的能源审计工作，一般都是免费的、即使收取费用也是很少的。例如德国的许多地方或地区能源署，通过使用非常简单的检查表收集整理建筑物的基础数据以及能耗数据，从而帮助当地的政府准备合同能源管理项目的招标工作[65]。中国在刚开始这样做是有难度的，因为建筑物是集中供暖并没有热计量。采暖能耗的估算是非常复杂困难的。

3.70. **制定审计师的资格要求。**从室内技术人员到能源部门、大学、公用事业单位、工程公司以及专业的能源审计公司都能从事能源审计工作。能源审计的目的不同，对专业水平的要求也不同。制定国家或地方的能源审计指南有助于确保审计结果的一致性和最低质量水平，但这些指南最好应重点包括以下内容：针对特定审计项目的具体目标以及在大项目框架中最能满足这些目标的具体审计内容和程序。对能源审计公司进行认证是非常有用的，这可确保能源审计公司满足最低的资格要求并具备必要的审计经验。但在制定能源审计公司的认证标准和认证程序时，应确保公司获得认证后在证书有效期内能始终保持足够的专业能力。同时也要指出的是很少有国家对能源审计师进行认证。美国从事民用建筑能源审计工作的审计师要求获得几个行业协会的认证证书，但对其它建筑物的能源审计师没有认证要求。印度能源审计师主要从事工业领域的审计工作，需要参加全国性考试获得认证证书。

不同建筑物的能耗对标和标识

3.71. 能耗对标是指对实施能源计量的建筑物当前能源绩效在能源基准基础上的计算比较[66]，或者是对实施能源计量的建筑物当前能源绩效与类似类型建筑物的能源绩效进行比较的过程。能耗对标既可用于同行业所有单位内部或相互之间一段时间内的能源绩效比较，也可用于记录能源管理最好的建筑物[67]。能耗监管和能耗对标的区别在于：能耗对标的建筑物局部或整体的能源管理过程与同类或同行的最好者之间进行对比，以便制定改善能源管理的某个环节或整栋建筑物能耗的行动方案。能耗对标通常以单位能耗进行表示，如单位建筑面积能耗、人均能耗等。

3.72. 能耗对标既可仅作为一种信息工具进行使用，也可当作制定节能目标、建立能耗定额制度或激励措施的基础。在后一种情况下，大范围的实施必须保证相互之间具有可比性。这不仅要求应采用统一的定义和方法收集基本的建筑参数和能耗数据，确保数据的可比性和可靠性；同时建筑物的类型也应按照类似的运行模式和能源使用形式进行界定和归类。应对收集到的数据进行气候修正，确保在一定时间跨度内和不同气候区的能耗数据具有可比性，而不会造成彼此差别太大。其次，应为不同建筑类别制定合适的性能指标，如单位建筑面积的能耗（对大多数建筑物而言，建筑面积平方米的定义是一致的），人均能耗，或单位病床能耗（医院）。这样，公共机构建筑物就可根据相应的能耗数据按这些指标参数进行评比。

64. 这些是美国联邦政府建筑物推荐的重要标准，参见 FEMP,Energy Savings Assessment Training Manual.

65. 参见德国 Guide to Energy Performance Contracting in public buildings (˝Leitfaden für Energiespar-Contracting in öffentlichen Liegenschaften˝)。

66. 基准是指初期计量的能耗，是能耗数据比较的参考点。例如，美国能源之星建筑管理人工具将 12 个月的建筑能耗计量数据作为能源基准。

67. 参见 FEMP, Building Energy Use Benchmarking Guidance.

专栏 3.5：将信息对标作为公共建筑节能的一种工具手段

根据2007年颁布的《能源自主与安全法令》，美国联邦实施能源计量的建筑物要求进行能耗对标。美国能源部选定获得能源之星认证的能源管理人员从事对标工作。对标工作具有如下特点[68]：

- 将建筑物能源绩效与从能源部商业建筑能耗调查（CBECS）数据建立的统计代表模型进行比较；
- 能对几种商业建筑类型进行能源绩效评级，这几种商业建筑占美国商业建筑面积总量的60%以上；
- 主要用于对标目的，能储存能耗数据；
- 是基于网络申请且有安全访问保障。建筑物管理人员利用授权方式进行访问，可选择是否与其它用户分享建筑数据；
- 可用于所有的商业建筑和公共机构建筑，能追踪一段时间内的能耗，也能追踪水耗、能源费用、水费以及碳排放量；
- 使用简单，所需要的数据信息量很小且容易获取，易于理解；
- 数据输入既可针对单体建筑采用手工输入，大批量数据也可采用表格模板，或者是自动对标，或者是直接由公用事业单位或对标服务提供方直接上传数据。

建筑物管理人员对建筑物或设施的能耗与全国类似建筑进行比较，并按1到100的分数进行评级，这就是大家所熟知的能源之星绩效评级。评级分数是根据标准气候条件下建筑物各个计量仪表获得的十二个月能耗数据与十二个月能耗基准数据进行对比得出的。还可对建筑物的特殊运营情况进行调整修正，如运营时间、居住情况等。当输入所需要的建筑物各种数据后，就迅速得到以百分数表示的评级分数。75分及以上的建筑物能获得“能源之星”认证证书。

2004年美国明尼苏达州实施了B3能源对标项目（(https://mn.b3benchmarking.com)）。B3能耗对标项目涵盖的建筑物范围包括公共建筑在内：州、市、县级公共建筑以及公立中小学。B3对标项目收集既有公共建筑的设计参数、运营情况以及能源绩效数据，这样州及地方政府主管部门就可以对那些最需要并且成本效益最好的节能改进的地方进行指导，同时也能指导节能投资回报最大的地方。设计和运营资料主要用来创建特定区域的工程基准模型。B3对标涵盖明尼苏达州5,100多栋公共建筑的建筑模型和能耗数据资料。

数据通过网站进行收集，公共建筑的相关人员输入包括建筑特征参数和水电费等数据。建筑用户可看到建筑物的对标结果。B3采用了一种特殊的对标方法：基于空间模拟的参数模型以及明尼苏达州现有能源标准中的规范性要求。将建筑物和独特的对标系统进行比较，就可确定节能机会。然后对建筑物的所有节能机会进行比较分析，建筑用户就可以得到依照节能潜力最大、成本效益最好的节能改进措施的优先次序列表。这种系统比较方法有助于建筑物管理人员有足够理由申请并获得资金，从而完成能源审计过程中的深层次分析，最终实现节能目的。

2009年，对网站对标工具中涉及到的有关标准化气候条件下的运营建筑能源管理内容进行了功能升级，用户可将建筑物能耗与上一年度进行对比，从而评估技术和运营改进潜力。B3对标工具在两个重要方面弥补了能源之星分析工具的不足：增加了能源绩效工程模型，扩大了气候和空间类型方面的细节内容（ACEEE 2010）。

68. 参见能源之星，Portfolio Manager Overview.

3.73. **信息对标。**当把信息对标当做一种信息工具时，信息对标的目标群体既可是公共机构自身也可是普通大众。信息对标的主要目的是帮助用户将本单位的用能设施与那些类似的但不知名的同行进行对比。用户可选择是否与其他用户进行数据分享。能源之星能源管理人员对标工具就是一个信息对标的范例（参见专栏 3.5）。美国“能源之星”系统中，排在前 25% 的节能建筑可以向公众展示排名并且可以使用能源之星标志。要求实施计量的美国联邦政府建筑物应参与对标工作。明尼苏达州对标项目中，公共建筑的对标工作可帮助用户识别节能措施，并根据成本效益性能评估不同建筑物应用这些节能措施的潜力。

3.74. 通常在刚开始打算备进行建筑物节能改造时组织开展能耗对标工作。一旦确定要进行能耗对标，就需要进行初步的能源审计，确认建筑物的能效水平是否低于平均水平，找出能效水平较低的原因，识别出具体的节能措施。例如，德国政府为了实施合同能源管理项目，选定了一批建筑物进行能耗对标（参见 4.46 部分）。在对标工作中通过对比分析建筑物能耗，可以了解到建筑物的节能潜力。但是，建筑物能源绩效的测量不能仅当做一次性的工作。应持续测量建筑物的能源绩效，定期进行自我对标，从而比较分析节能情况。

3.75. **鼓励性对标。**对标也可用于形象激励或节能目标 / 能耗定额制度工作（见 3.29—3.35 部分）的基础。如果公开公布某栋建筑物单位能耗与类似的建筑物进行能耗对标结果，如各种公开的建筑标识系统一样，这对公共机构形成了形象激励，促进他们进一步做好节能工作。对好的节能效果建筑物进行公开标识能增加机构的公众形象，而向公众披露差的评级结果就会对机构的形象带来负面影响，促使机构加强节能工作提高评级得分。例如，丹麦的公共建筑根据对标结果进行评级，无论评级结果好坏都在网站上向公众公布（见 3.78 部分）。部分美国州或市政府要求包括公共建筑在内的商业建筑进行能耗对标，并披露对标结果。纽约要求对标的公共建筑每隔 10 年应重新进行调试以及能源审计。市政府拥有产权的建筑物要求组织实施投资回收期小于 7 年的各种推荐节能措施 [69]。

3.76. 正如美国能源之星那样，有时仅关注那些大众所认可的、做的好的节能建筑物。德国开展的“节能型医院”认证是此类表彰性质的对标制度另一个范例。德国“节能型医院”评比的一个重要标准是单位能耗水平要低于对比医院的石英级的对标值（参见专栏 4.4）。

3.77. 如果将能耗对标用于建立强制性的节能目标、能耗定额或对节能工作不力的进行批评教育，就需要完善对标制度并进行很好的测试验证，避免对那些有合理理由的高能耗用户进行惩罚。对标结果较差的建筑物也应给出时间提高能效水平。

3.78. 中国住房城乡建设部已经制定了***全国性的建筑能耗分级和标识制度*** [70]，并在部分省市进行了试点。但是，该建筑标识制度并没给出推荐的节能改进建议，也没有要求在建筑物或网络上向公众披露建筑物标识结果。住房城乡建设部的商业建筑监管项目或者上海（长平）开展的商业建筑节能改造项目为公共机构节能工作提供了一些基础数据和经验。可以借鉴和参考的内容包括：***相同的能耗标识流程、建筑分级、性能指标以及其它的一些内容***。

3.79. **欧洲建筑物能源性能认证。**欧盟成员国所有的大型建筑物，包括所有的公共建筑，要求至少每隔 10 年开展一次能源性能认证，以满足“2002 年建筑物能源性能指令”。认证报告包括一系列的推荐性的改进建议。最初，大型的公共建筑仅简单要求向公众展示一个表示已开展认证过程的标志。但发现这没什么用处，现在要求建筑能源性能认证时应有一名专家进行现场检查。德国联邦政府建筑物能源性能认证工作很到位，包括复杂的且费用昂贵的能源需求情况的模拟。丹麦和葡萄牙，要

69. 参见 Burr et al. 2010, The Future of Building Energy Rating and Disclosure Mandates: What Europe Can Learn From the United States。如需了解重新调试的定义和更多信息，请参见附录 B 中的表 B3。

70. 参见 Cao 2011, Building Energy-Efficiency Evaluation & Labeling Technologies in China，对该问题以及大范围的推广计划进行了讨论。

求公共建筑业主应对能源审计所推荐的各种回收期分别小于 5 年和 8 年的节能措施进行投资 [71]。丹麦公共建筑还必须参加在线的对标系统，并定期在线登记其能耗数据，这有利于节能设备供应商和能源服务提供方及时获取信息，捕捉市场商机。

3.80. 人们发现建筑能源性能认证存在诸多问题 [72]，认证工作形势变得很严峻且没有任何意义。认证初期，由于缺乏合格的专家，许多国家的认证工作都拖后了好多年。最初几年非民用建筑的认证证书寥寥无几。由于认证的要求、培训程度以及评审员的资格等因素的不同，不同国家之间认证质量以及最终的认证价值作用都是不同的。由于缺乏标准的方法，即使是在同一个国家，过去认证结果是不能直接进行比较的。后来认证所用的信息资源以及质量都发生了重大变化，经历了从简单地输入水电费数据和使用缺省值到采用详细的建筑检测的严格评审制度的发展阶段。许多国家质量控制是远远不够的或者是根本不存在的，认证的准确性并不能随机地进行核证。仅在少数国家建立集中的数据库或认证注册系统，造成难以进行正确的监督、评估、质量控制和实施，也造成认证数据对后续的分析和政策制定没有任何用处。

3.81. 2010 年 5 月，欧盟议会和国会批准了修正后的“建筑能源性能指令”。修改后的指令有助于解决过去所经历的许多问题，也应能改善认证质量和可信度。例如，欧盟成员国要求建立控制体系对能源性能认证的准确性进行检查。同时，欧盟标准化委员会（CEN）（或者 Comité Européen de Normalisation）公布了建筑物能源性能计算和评级定义的标准（EN 15603）[73]。

公共机构节能投资融资

3.82. 当节能奖励措施逐步到位、配备有专业的建筑能源管理人员、掌握了建筑物能耗和节能潜力的一些重要数据资料后，公共机构就可开始节能项目设计、开发和实施等工作。要顺利地组织实施节能改造项目，还需要克服公共机构能源管理的第三和第四个障碍隐私，即缺乏节能改造资金的问题。启动项目，必须要安排好资金的问题。公共机构的融资渠道要远少于商业建筑。政府机关、中小学以及许多其他类型的公共机构会严重受限于自身的融资能力，传统上这些单位除了依靠政府预算资金外没有任何其他的选择。但是，也可开发其它的一些融资渠道。

3.83. 所有国家在组织实施公共机构节能项目时，政府预算资金拨款永远都不会是足够多到足以支持节能投资的资金水平。许多国家公共机构还严重受限于从市场为节能项目借款的能力不足问题。为此，一些国家为公共机构节能项目开发了各种替代融资机制。如下面进一步讨论的那样，最常见的替代融资机制包括：（1）节能服务公司提供大部分项目融资经费的合同能源管理；（2）地方能源供应公用事业单位提供的资金奖励（见 3.87 — 3.88 部分）；（3）滚动贷款专项资金；（4）发售专门的债券、租赁或者是法律所允许的其它融资机制。大多数情况下，按几年的时间平均计算，替代融资机制提供资金总量要远多于政府财政预算拨款资金量。

3.84. 和其它国家一样，中国公共机构仅仅是那些具有较好的投资效益并能立即组织实施的节能项目数量就会是非常巨大，相应地所需投资资金规模也是海量的，不能把所有希望都放在政府财政预算拨款上。应积极建立替代融资机制以弥补财政资金的不足问题。本章的后续章节将会简要讨论政府财政预算经费的使用、欧美国家的替代融资以及可能用到的滚动资金。第四章将讨论什么是最具希望的替代融资机制，即合同能源管理。

71. 包含在这些回收期范围内的节能措施取决于能源价格水平，但通常包括：暖通空调的优化与控制、通风废热回收、锅炉和管道保温、节水以及照明节能；为比较起见，可参看 Coolen 2009，http://www.fedarene.org/documents/projects/EESI/Country_report/Country_Report_Belgium.pdf

72. 例如参见欧洲建筑性能研究院（BPIE）2010，Energy Performance Certificates across Europe，以及 RAND 公司 2009，Improving the Energy Performance of Buildings.

73. 参见 CENSE, Information paper on Energy performance of buildings – Overall energy use and definition of energy ratings – Calculated energy rating EN 15603 (Overall energy use)。(Zirngibl 2009)。

3.85. **利用政府财政预算拨款和专项资金。**中国在国家、省级甚至部分地方管理的节能专项资金的持续拨款，对于公共机构节能工作来说是非常重要的。节能专项资金在传统的且非常受限制的改造预算拨款资金基础上提供了重要的资金支持。为有效地建立和运营多年的节能项目，保持对公共机构节能拨款资金的持续稳定是非常重要的。尽管需要根据各地具体情形（如项目类别或当地政府的资金来源）做出相应的资金安排，但公共机构节能资金应重点加强对以下领域的支持：

(a) ***加强对不同类型公共机构内部的各种示范项目，特别是引入节能新举措和节能技术的示范项目的资金支持。***表 3.1 给出了〝十二五〞期间重点示范工程项目的主要领域。

(b) 组织实施有针对性的补贴项目。一些针对具体领域的补贴项目，如长期以来一直开展的节能灯补贴（参见 2.25 部分），有助于***缩短一些节能技术的投资回收期***。利用这类的节能补贴项目，公共机构可将年度预算中的常规支出预算经费和补贴提供的增量成本资金用于购买那些能在寿命周期内节省大量能源的节能设备。此外，农村中小学等这类公共机构的资金来源渠道非常有限，难以解决初始投资资金需求，应为其节能投资提供补贴，这可以改善采暖等基本条件，同时还节约能源。

(c) 为各种软成本提供财政经费支持。软成本主要包括以下活动的费用：能源管理师的培训、统计报告制度的建立、计量器具的安装、能源审计、现场具体节能方案的制定、监督考核等。没有专门的财政预算资金支持，对大多数完全依靠政府财政预算资金的公共机构来说，难以正确地承担这些基础工作，而这些工作又是节能成功的重中之重。尽管过去已对上述大多数活动提供了一定的财政经费支持，但今后尤其应重点关注且予以支持的是现场具体节能方案的制定，最好把完整的能源审计工作也纳入财政经费支持范围。

3.86. **美国替代融资概述。**由于政府财政预算拨款资金总是不足以支持现有各项节能工作，美国创建了各种融资模式。各种融资机制大量应用于联邦政府，但尤其是在各州和各地，对各种融资模式进行大量创新。各州和各地政府创新这些融资模式的动力在于，除了少数个别之外，地方法律要求政府要平衡财政预算。此外，各州的地方法规也允许采用各种形式的融资安排，如设置专项收入经费的资本金、针对某些具体的资本支出的借贷补贴（所产生的债务由经费收入来承担）。根据各州的具体情况以及一些因素的考虑，如借贷机构的批准范围、贷款安全法规、交易成本、税收以及公共平衡表的处理等，各地的融资安排也有所不同。

3.87. 美国联邦的融资方式主要局限于三类：直接财政预算拨款、合同能源管理（美国也称作能源绩效合同）以及公用事业合同能源管理。后两者通常称作***替代融资***。联邦政府的合同能源管理项目要求节能服务公司提供主要的融资资金。政府对这种节能融资机制很感兴趣，但在这种模式下由于节能服务公司的融资成本要比联邦政府机构高，大约高 3% 左右 [74]，而受到了一些批评。

3.88. 公用事业合同能源管理的使用主要取决于地方能源供应公用事业单位提供的服务。建立在与公用事业单位的现有关系上，公用事业合同能源管理允许联邦政府机构可以直接签署综合性的能源服务合同。地方公用事业单位安排资金（换句话说，使用拨款资金）用于节能项目的资本投入。公用事业单位的资金投入，在合同期内从节能措施所产生的能源成本节省中收回 [75]。

3.89. 联邦政府机构（或其他公共机构）的节能和可再生能源项目也从***公用事业奖励和补贴项目***，即所谓的公共效益项目中，获得资金并被尽可能地打包到融资方案中，因为这可降低项目整体成本。美国大多数州，公共事业立法部门要求公用事业单位（特别是电力部门）和 / 或公共效益管理局加强

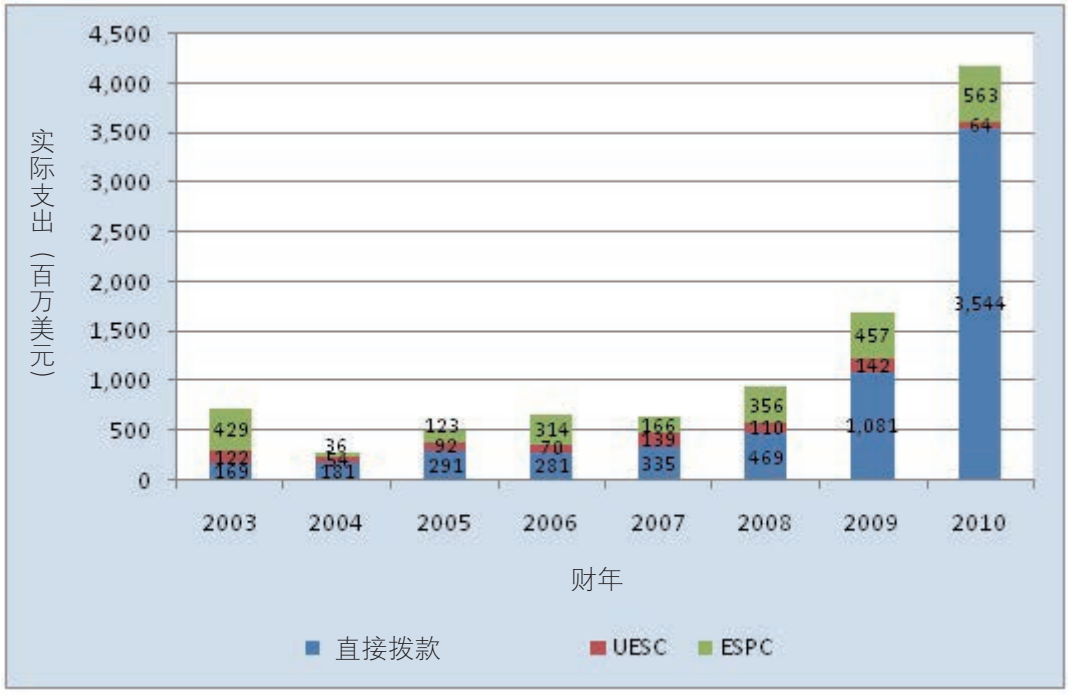
74. 参见 Coleman 2010, ESPC in the U.S. Government: What´s worked and what hasn´t。专栏 4.1 详细介绍了合同能源管理的相关内容。

75. 超级能效合同项目并不需要对节能量进行担保、测量或验证。但建议应至少将最低性能的担保纳入合同中；参见 FEMP, Quick Guide: Utility Energy Services Contracting.

节能投资、在所服务的用户之间开展节能项目、并向立法主管部门展示节能效果。立法部门允许从他们所制定的能源价格中弥补公用事业单位节能服务方面的一些损失[76]。节能奖励和补贴的例子包括：节能设备补贴、非标准设备或整栋建筑物的用户奖励、低成本或无成本的能源审计、调试和重复调试等[77]（参见附录中的表 A3.4）。

3.90. 图 3.4 比较了 2003 年至 2010 年期间美国联邦政府部门节能和可再生能源项目方面的政府财政预算直接拨款和替代融资资金规模。“正常”年份替代融资的资金规模和财政预算直接拨款规模大体相当。近年来，由于美国（以及许多欧洲国家）政府经济刺激政策投资，增加了公共建筑方面的政府节能专项资金量。但估计这只是临时性的。

图3.4：美国联邦政府机构在节能和可再生能源项目上的投资



资料来源：节选自 Tremper 2011，http://www.greengov2011.org/presentations/GreenFacilities/GreenGov-2011-GreenFacilities-S6-ChristopherTremper.pdf.

3.91. 美国各州和各地政府以及中小学都有大量的可操作的节能项目融资手段。他们可以发行债券、开展融资租赁、接受联邦政府赠款、从公用事业单位获取补贴或其它奖励、或者与节能服务公司签署合同。美国州政府、地方政府以及中小学都能发行债券，特别是在州政府这一级上，这为节能融资提供了一种重要的资金来源。根据情况不同，公共机构用公共资金和各种公共收入机制偿还债券。投资者投资在政府或公共机构债券上的利息收入通常都是免税的，这就会降低融资成本。融资租赁是地方上普遍使用的另一种融资手段[78]。由于支付给租赁方的利息是免收联邦收入税的，因此租赁业务是非常具有吸引力的。如果地方公共机构保证能获得比节能服务公司更廉价的融资资金（这是很常见的），即使采用了合同能源管理模式，公共机构会倾向于利用节能服务公司的服务和节能效果担保进行租赁融资，而不是从节能服务公司进行融资。

76. 公共效益项目：美国各州开展的节能项目，由各公用事业单位、各州公共机构或第三方负责管理，资金来源主要是通过对公用事业费用上支取一定费用，即大家熟知的“公用事业效益收费（SBC）”的方式筹集，具体可参见 http://www.epa.gov/statelocalclimate/documents/pdf/guide_action_chap4_s2.pdf，该文总结美国各州的公用事业效益项目，同时还可参见各州公用事业项目数据库 http://www.aceee.org/sector/state-policy/utility-policies

77.Stuart 2011 概述了联邦政府能源项目奖励资金最新进展及发展趋势。

78. 由于新的会计制度要求将所有的租赁交易在财务平衡表中列支为资产和债务（在目前的租赁业务中并无此要求），这样今后融资工具的成本会越来越高，应用面也会越来越有限。该会计要求消除了租赁销售中的利润“不入账”的做法，这将会妨碍开发商、公司以及非盈利机构的节能投资。（Feldman 2011）。

3.92. 政府建筑是美国合同能源管理产业的重要客户（加拿大和大多数欧洲国家也一样）。仅在2008 年，美国联邦和其它公共机构节能服务市场的合同能源管理收费估计为 34 亿美元，几乎占整个合同能源管理行业总收入的 84%。1990 年至 2003 年，美国联邦、州和地方政府、大学、中小学以及医院等单位的合同能源管理项目的节能投资总额为 150 至 190 亿美元。联邦政府大约占其中的 30 亿美元，包括节能服务公司实施合同能源管理项目、组织实施的公用事业能效合同项目、以及作为政府直接预算拨款项目的承包方等 [79]。

3.93. 美国公共机构领域合同能源管理项目投资规模相对较大的州主要有马赛诸州、宾夕法尼亚州（这两个州投资规模迄今已超 4 亿美元）、科罗拉州、马里兰州、弗吉尼亚州以及德克萨斯州（2 亿多美元）。按人均投资规模看，爱德华州、夏威夷州、尤太华州以及堪萨斯州等在合同能源管理推广方面非常成功。堪萨斯州已实施的合同能源管理项目已达到州政府产权所有或使用的建筑物建筑面积的 75% 左右 [80]。总之，即使是各州都在积极推动合同能源管理工作，但整体来说合同能源管理市场占有率也还是很低的（20% 或者更低）。美国一些大一点的州，特别是加州、纽约和德克萨斯州，尽管实施了大量的合同能源管理项目，但其它的一些节能融资项目，如公用事业节能项目、直接拨款项目、能源债券和贷款项目等，还是要比合同能源管理项目多的多 [81]。

3.94. 欧洲替代融资概述。欧盟各国公共建筑节能项目主要有以下四种融资渠道：直接财政预算拨款、专项赠款、贷款（包括滚动贷款资金）以及合同能源管理。尽管直接的财政预算拨款规模始终在变化，由于 2007 年金融危机后所采取的专门的经济刺激措施，近年来财政预算拨款资金也在不断增加。作为气候缓解项目的一部分，为地方政府机关、教育系统和卫生系统组织实施了节能补贴项目和滚动资金项目。专栏 3.6 给出了这些项目的一些例子。

3.95. 合同能源管理在欧洲并没有美国那么流行，但公共机构领域的合同能源管理项目却在逐年增长。和美国一样，在几乎所有的欧盟国家，公共机构也是合同能源管理行业的最大业务领域。合同能源管理项目融资是欧盟融资的一个重要措施，欧盟各国公共机构建筑物签署的合同能源管理项目几乎都要求节能服务公司提供大部分项目资金。从二十世纪九十年代开始，欧盟条约对各级政府规定了严格的财政纪律要求，削减了各级政府的融资方式。要求大多数城市削减运营成本，也不能从自己的预算经费中用于公共建筑物的修缮，因此，欧盟各国开始与节能服务公司签署合同对公共建筑进行改造。

3.96. 许多欧洲国家对一些有自己收入来源的公共机构（如最底层的政府部门、或教育和卫生系统的公共机构）提供投资补贴。例如，在瑞典，国家层面的气候投资项目（KLIMP）在 2003 年至 2008 年间为市政府和其它一些地方政府部门提供了赠款支持，赠款金额最高可达各单位降低温室气体排放长期投资项目投资总量的 30%。2003 年至 2008 年期间，气候投资项目总共资助了大约 1.64 亿欧元，带动了 7.28 亿欧元的投资。在其资助的项目经费中，10% 是用于建筑领域。实施合同能源管理的项目还非常少。建筑领域的项目占气候投资项目资助资金总额非常小的一个原因是：瑞典的供热已经非常高效节能了、并采用的是诸如生物质锅炉一类的低碳技术。每年温室气体减排量估计大约为 110 万吨碳当量（tCO2），相当于瑞典气候减排目标的三分之一左右，即在 1990 年基础上 2008 年至 2012 年温室气体排放量降低 4%[82]。

79.Satchwell et al. 2010, A Survey of the U.S. ESCO Industry: Market Growth and Development from 2008 to 2011.

80. 能耗数据主要靠自我申报的方式，一些开展有较大合同能源管理项目的州可能会漏掉部分数据。参见能源服务联合会，Energy Performance Contracting.

81. 参见 Bharvirkar et al. 2008, Performance Contracting and Energy Efficiency in the State Government Market。

82. 参见 Lindgren and Nilsson 2009, Transforming the ″efficiency gap″ into a viable business opportunity: lessons learned from the ESCO experience in Sweden，以及瑞典环保署 Climate Investment Programmes (Klimp)。

专栏 3.6：公共机构建筑物节能融资项目

专门的贷款项目。德国开发银行 kfW 有几个针对建筑节能投资的长期／低息贷款项目；其中之一是市政建筑节能改造项目；改造结果要求建筑能耗等于或低于针对新建建筑的现有建筑能源标准的 15%。在第一种情况下，最大贷款金额是每平方米 350 欧元。第二种情形是每平方米 600 欧元。一位认可的专家负责对按照投资计划组织实施的节能改造项目进行认证。贷款也支持另外几种规范性的节能措施[83]。

滚动贷款资金。英国英格兰和威尔士的 Salix 滚动贷款资金在 2005 年至 2008 年期间共向 166 个公共机构提供 4000 多万英镑（5900 万欧元）的无息贷款。一般每个项目贷款额度 约为 250,000 英镑（370,000 欧元），借贷方提供配套资金共同作为保证资金，用于投资回收期最长不超过 5 年、碳成本不大于每吨二氧化碳 100 英镑（159 欧元）的节能项目。节省的能源费用返还给资金，直到原始的项目投资收回为止。在项目投资收回后，业主可自由的保留节能的能源费用并用于前端的服务开支。只要有实施足够多的项目，资金自身就能循环运转，通常也不要求返还原始的投资。此外，在高等教育系统也建立了一个类似的资金，从 2008 年到 2011 年资金总规模为 3000 万英镑（4400 万欧元）[84]。（注：2006 年 12 月 31 日汇率）

3.97. **滚动贷款资金。**中国公共机构合同能源管理尚未开始，下一章将对此进行详细讨论。发行债券和公用事业单位融资方案对目前的中国来说没有太大的兴趣；各省和各地政府目前还不允许发行债券，大的能源供应公用事业单位的节能目标还没有怎么开展。但如果资金的融资、运营和使用都在同级政府部门之间，并且基本上资金采用内部安排的方式，那么建立滚动贷款资金或有可能[85]。

3.98. 研究团队的建议。研究团队建议各级公共机构节能主管部门，特别是省级主管部门（如管理省级大学和中小学的省级卫生厅、管理当地医院的省级卫生厅），应开展对其所管辖范围的公共机构设立滚动贷款资金的可行性。政府的财政预算资金加上其它的资金来源可共同构成滚动贷款资金的资本金。公共机构从节能项目节省的能源成本费用中偿还贷款、这同时又为新的贷款提供资金。政府预算资金可以充分发挥杠杆作用，从而在更多的项目中取得更大的收益，而不仅仅是当作赠款或补贴提供给各级公共机构。这种资金安排方式在许多国家都运转良好。国外的经验教训以及相关的建议包括：

- *原始资本金的来源。*滚动贷款资金的原始资本金可采用直接的财政拨款、临时的拨款资金，如来自于奖励资金[86]、一些特殊的资金如碳基金、或者是一些其它的资金来源，如债券发行、或者从世界银行等国际机构或双边资助机构获得的融资。

- *发挥其它资金的杠杆作用。*使用滚动贷款资金的借贷方或许应要求提供主要比例的项目投资资金作为配套资金。在整个项目中，如果资金管理方是个商业金融机构，在将滚动贷款资金用于节能项目时，此时的资金来源可能是由来自于非政府预算资金与政府的公共预算资金两个方面。

- *贷款期限。*许多情况下借贷方，特别是公共机构，借贷利息通常都低于市场利率（例子可参见专栏 3.6 中的德国 KfW 项目）。但是，当市场发展起来时，由于利息率低于市场，很容易产生

83. 参见 KfW, Energy Efficient Rehabilitation - Municipalities (*"Energieeffizient Sanieren - Kommunen"*)。

84. 参见英国环境、食物和农村事务部 UK Energy Efficiency Action Plan 2007 以及英国国会环境审查委员会，Written evidence submitted by Salix Finance。教育领域的滚动资金参见法国的 Salix 资金或英格兰的高等教育资金委员会 /The Higher Education Funding Council for England，Salix/HEFCE Revolving Green Fund - Update 和 Evaluation of the Revolving Green Fund: a report to HEFCE。

85. 德国的一些公共机构有处理内部资金建立滚动资金的成功经验。由于外部的合同能源管理成本相对较高，市政管理局管辖范围内的单位建立了滚动资金。例如，斯图加特城市，环境部承担了部分内部的节能服务公司的作用，向城市管辖范围内的其它单位以及市政拥有的公共建筑提供能源服务，参见 http://www.reneuer.com/upload/STUT_EN_M.PDF。

86. 美国联邦政府推动组建了滚动资金项目，资金来源于用作州能源项目的美国复苏与再投资法令 ARRA 资金；例如尤太华州建立了针对学校的资金项目；参见美国能源部节能和可再生能源、气候性 & 政府间项目：Revolving Loan Funds and the State Energy Program.

排挤商业融资的风险，这就需要在滚动项目设计时进行细致分析研究。通常都要求借贷方在节能投资项目中必须提供一定比例的自有资金，在一些特殊情况下才不会有这种要求。可能要求借贷方提供担保或者抵押物。许多节能投资项目周期很长，这允许组织实施那种投资回收期较长的节能改造项目。随着时间的推移，投资回收期短的项目越来越少，合同期长的项目将越来越多。但长期贷款合同又会降低滚动资金的回款能力并造成时间一长投资放量过大的问题。

- *贷款资格。*节能项目必须满足一系列的标准要求（如投资回收期标准）、最低的回款率、以及最起码的节能成本效益等。这能保证实现滚动贷款原定目标，如促进节能或温室气体减排目标的实现。在滚动贷款资金项目运营初期，资金的使用要灵活一些，为了有效地将资金流动起来，实际放贷大都采用“先申请先放贷”的原则。

- *资金的滚动。*大多数滚动贷款资金项目都要求借贷方用节省的能源费用现金流偿还贷款。但有些贷款资金项目，如英国的 Salix 资金（专栏 3.6），允许公共机构自己实现资金的滚动，即利用节省的能源费用现金流去资助公共机构自身内部的更多节能项目。

- *资金的管理。*在滚动资金项目设计之初就应严格包含运营成本，这样就不会将滚动资金的资本金用尽。滚动贷款资金项目实际运营时专业知识尤显重要，特别是信用评审、项目评审、有效的资金流动、以及积极有效的贷款监管等。金融机构作为政府的代理方介入进行资金的运作是一个选择方案。

- *配套的技术援助。*要保证滚动资金项目的成功，应安排专门的资金支持一些配套活动，如通过对贷款资金项目的营销推广，建立固定的项目申报通道、工作团队的建立、合同方的认证与培训、项目评估、以及节能量的测量与验证等。专栏 3.7 中介绍的德克萨斯州的 LoanStar 项目就包括上述技术援助活动。有时会为这些活动提供经费补助，但有时也要求业主支付部分服务费用，如节能量的测量与验证。

专栏 3.7：德克萨斯LoanSTAR项目—质量控制良好的滚动贷款项目范例

美国德克萨斯州从 1988 年就开始运营了一个针对公共机构建筑物节能改造的 LoanSTAR 滚动贷款资金项目，并取得了非常成功。根据联邦政府原油价格政策，政府从罚金收入中，提取了 9860 万美元的财政预算资金，用作滚动贷款项目的原始资金，截止 2007 年，LoanSTAR 贷款资金项目共向公共机构提供了 191 笔贷款、贷款资金总额为 2.4 亿美元、节省的能源成本总计达 2.12 亿美元。贷款最长期限不超过 10 年（项目初期贷款期限很短）、利息率为 3%。自 2001 年以来，开始为合同能源管理项目和节水项目提供贷款。州能源局负责管理贷款资金项目。

LoanSTAR 贷款项目对各阶段的质量控制，保证了它成为美国各州和联邦记录上最成功的节能项目。质量控制措施包括：

- 编制了 LoanSTAR 贷款项目能源评估技术报告指南；
- 对地方能源工程咨询公司能源审计技术以及 LoanSTAR 贷款指南等内容进行培训；
- 制定了对各个 LoanSTAR 项目计量和监控协议，以便追踪改造前后能耗状况（仅在 LoanSTAR 贷款项目的头五年，所有的项目要求进行能源计量并对节能量验证进行监督管理）
- 制定改造项目节能效果分析评估的方法学。

LoanSTAR 贷款项目在以下方面非常有名：能源审计指南、培训、计量和监管、与公共机构后续共同合作确保节能改造进展顺利、提供建筑调试技术帮助改善运营管理并提高能效水平。通过这些措施，LoanSTAR 贷款项目实际测量和验证的节能量超过了能源审计预估的节能量。

资料来源：州节能办公室， LoanSTAR 滚动贷款项目。

监督和监管体系：过程评估

3.99. **建立并实施监管体系。**中国正在建立一个更全面和有意义的监管体系，用以监督“十二五”期间公共机构能耗状况以及政府节能目标完成情况。监管工作的一些重要指标应按不同机构类别、不同能源种类（电力、热力）、能源成本、建筑面积、如居住率等相似数据、温室气体排放量、投资资金等参数对能耗指标进行分解，在其它国家也对这些指标进行监管。建议中国的专家应与国外同行就监管体系建设过程中的看法和意见进行交流。

3.100. 中国对政府办公建筑节能目标完成情况的监管体系的建设进展非常迅速。但同时也需要将监管工作有效地扩展到非政府机关的公共机构领域（大学、中小学、医疗卫生机构等）。但监管最困难的问题是计量系统的改造以及能耗数据的准确性（见 3.56—3.60 部分）。热计量的准确数据体系的建立尤其需要许多年的努力。

3.101. **进展评估。**中国目前已建立的监管体系为评估节能进展情况奠定了良好的工作基础。除了对各个政府机关和各地完成节能目标进展情况进行评估外，研究团队还强烈建议采用系统的方法客观评估项目的节能量，并对组织实施这些节能项目的工程进行评估。正确评估项目，对于宣传成功案例并对其进行复制推广、以及客观了解不太成功的案例并作出相应的调整等方面，都具有非常重要的意义和作用。项目评估要求对项目有良好的监管、节能量的验证（见 4.56—4.63 部分）、以及对投资、尤其是公共财政投资的成本效益的有效评估等。其他国家的一些项目，为确保对公布的节能量进行公正评估，要求采用第三方验证数据，例如专栏 3.8 介绍的佛蒙特州节能公用事业项目年度评估。有一些开展上述评估的现成资源，例如根据美国《国家能源效率行动计划》制定的《节能示范项目影响评估指南》。不管项目是否实现了节能目标，在项目评估中需要确定的突出问题是项目成本和收益（节能量、节省的能源成本、排放减排量、提供就业机会、健康性以及系统可靠性等）、以及项目的成本效益性。如果项目没有成本效益性，评估应给出项目不足之处以及可能的改进方面的原因。德国联邦政府机构建筑物合同能源管理项目在 5 年期的试点项目结束后开展的评估是一个较好的例子。尽管 19 个项目的平均节能效果为 29% 并且项目回收期都在 5 年内，但需要指出的是通过项目主管部门，德国能源署（DENA）开展的大量宣传和支持活动才得以动员这 19 家单位参与。评估也建议应在联邦政府部门及相关公共机构内部建立胜任节能工作的中心并加强这些机构的节能工作，例如通过奖励、鼓励建立内部节能目标、建立排放交易制度等。

专栏3.8：监管制度培育公共机构节能积极性的意义和作用

1999 年，佛蒙特能源投资公司（VEIC），作为一家私人公司，中标负责为佛蒙特州提供节能服务。佛蒙特州(人口约 62.6 万)计划将该州的所有节能项目组合成一个项目,创建了名为“节能佛蒙特”的节能公用事业项目（EEU），这是美国创建的第一个节能服务组织协调项目。VEIC 利用节能佛蒙特从电价中征收的电价加价收费（公用效益收费）资金组织实施节能项目。VEIC 与节能佛蒙特签订协议，约定按照最低的节能绩效标准和可测量的绩效指标支付费用。合同中有一个重要经费保留条款：仅当达到规定的节能效果时才支付 VEIC 的费用。该合同对明确界定彼此的责任和义务，包括独立严谨的评估制度的建立和保持等内容。

州公用事业主管部门每年安排独立的节能量测量和验证专家负责核实节能效果。年度节能量的核查是一项非常严谨的技术性工作，目的是识别节能效果计算、假设和方法学中的错误问题。由

87. 例如，能源之星项目要求建筑节能量应在建筑物获得能源之星认证之前，由认证的专业工程师进行验证，参见能源之星，2010 Licensed Professional’s Guide to the Energy Star Label for Commercial Buildings.

88. 参见美国环保局指南，Model Energy Efficiency Program Impact Evaluation Guide.

89. 参见德国报告，Evaluation of the project "Contracting for Government properties" on the basis of benchmarks and monitoring of selected measures (*"Bewertung des Projektes "Contracting für Bundesliegenschaften" auf der Grundlage von Benchmarks und Monitoring ausgewählter Maßnahmen"*)

于存在大量的小项目，因此按照项目规模（KW 和 KWh）和项目类型（如改造项目）进行抽样统计。

因此，VEIC 必须建立一套良好的数据系统，确保数据的可信、可靠和共享。数据系统负责保持一些数据资料的记录，如所采取的节能措施、节能计算的假设、与客户之间的沟通、项目合作伙伴的信息资料等。数据系统不仅可以证明已开展的节能活动，同时是节能目标改进、节能方案策划、用能系统的评估等工作的重要依据，形成了一个良性的循环。

据节能佛蒙特介绍，节能改造投资成本可降低到每度电 4.1 美分，而电力供应的平均成本却为每度电 14.4 美分。

资料来源：佛蒙特投资公司的演讲，北京，2011 年 11 月

第四章：合同能源管理—用节约的能源成本资助公共机构节能项目

4.1. 合同能源管理（EPC）[90] 是推进中国公共机构节能工作的一种有效机制。通过合同能源管理，公共机构可利用项目节省的能源费用支付节能改造项目。本章将讨论中国公共机构开展合同能源管理的好处，介绍合同能源管理的两种常见的开展途径，讨论公共机构通过制度引入和启动合同能源管理的相关内容。本章的最后一节将讨论如何克服合同能源管理的一些障碍因素，及扩大合同能源管理应用规模的潜在措施。

公共机构合同能源管理的好处

4.2. 在第二章的最后，我们对中国节能服务产业状况进行了简要介绍，中国节能服务产业业务目前主要集中于工业领域，但也在建筑领域取得了一定进展。目前中国各省市已经有了一些关注建筑市场领域且实力较强的节能服务公司，这些公司的业务增长迅猛并且具有较强的技术实力。近年来，节能服务公司已在公共机构，特别是大学和医院，开展了一些成功的合同能源管理项目。

4.3. 在最初的中国公共机构合同能源管理项目中，主要采用两种常见的合同能源管理模式，包括：

（1）中国自己定义的“效益分享模式”（与美国所谓的节能分享模式并不一样，美国的这种模式已不太受欢迎）。在此模式下，节能服务公司提供主要的节能投资资金，担保节能效果，并通过大比例分享节省的能源成本而收回投资 [91]；

（2）能源服务外包模式。在此模式下，节能服务公司负责公共建筑的能源系统的运营（特别是中国北方地区的采暖系统），签署重点关注节能以及能源系统升级改造的建筑维护合同。

4.4. 最初的这些项目表现了合同能源管理的基本优势，包括：

- 通过利用节能服务公司的替代融资资金，有能力独立开展节能改造项目；
- 通过引入有技术实力的合作方（节能服务公司）而带来项目管理经验、组织实施技能、以及技术知识，并完成节能改造，这可产生更多技术上先进、见效快的节能项目机会；
- 将公共机构业主的技术风险和经济风险转移给了节能服务公司，特别是项目不能实现预期节能效果以及设备不能高效运行的风险。

4.5. 合同能源管理的这些优势还不足以激发公共机构大规模采用合同能源管理。节能服务公司进入公共机构节能市场还受限于公共机构的以下一些制度上的问题：

- 最初公共机构财务核算制度还不能解决合同能源管理项目中节能服务公司的费用支付问题。尚未明确应从哪项预算栏目中支付费用。由于财政预算是按 12 个月的周期制定的，对于横跨几年的合同，费用的支付授权批准也是个问题。
- 尽管制定了新的节能目标要求，但公共机构业主方主动与第三方开展合同能源管理项目的积极性还严重不足；

90. 美国一般将合同能源管理称为节能绩效合同（ESPC）。

91. 美国公共机构早期的合同能源管理项目都是节能服务公司和业主之间的节能效益分享类型，其中节能服务公司负责投资。二十世纪八十年代由于产生的大量节能量法律纠纷而基本上不再采用这种模式。参见 See Taylor et al. 2008.

- 由于公共机构相对较高的项目开发成本，很难在公共机构实现规模经济。

4.6. 在新的五年计划启动之初，各级政府节能主管部门对公共机构引入合同能源管理项目表示了浓厚兴趣。合同能源管理兴趣的培养是多年努力的结果，2010 年国务院关于鼓励合同能源管理的通知（见第二章）以及随后的一些具体政策措施，为克服合同能源管理推广应用方面的上述障碍提供了全新强劲的催化剂。但是，这些政策措施的贯彻落实还需要各省各地的努力，一些配套措施也需要补充完善。

4.7. 其他国家公共机构合同能源管理项目的启动阶段也存在类似的问题。虽然各国公共机构具体工作方式不同，但由于在合同能源管理问题上的相似性，各国促进公共机构合同能源管理项目推广应用所采用的政策措施、以及管理和支持手段对中国来说是具有指导意义的。

撬开公共机构合同能源管理业务的大门

4.8. 合同能源管理是一项全新的业务模式。中国合同能源管理业务客户主要是公司性质的业主。要在公共机构中组织开展合同能源管理业务，需要对严格的财务核算和预算制度做些调整并对如下问题找到解决方案：

- 现有法律法规是否允许采用能源成本节约（如合同能源管理）以及从现有的预算支出中支付合同成本的方式进行政府财政投资项目的融资？
- 如何在公共机构财政预算制度中对支付给合同方的费用进行记账处理？
- 如何处理在今后财政年度发生的合同支付问题？
- 如果合同能源管理作为第三方的方式对节能投资项目进行融资，这是否与政府债务相关限制要求相抵触？
- 在什么条件下上级主管部门可以允许地方公共机构对产权所有的建筑物组织实施合同能源管理项目？
- 公共机构组织实施合同能源管理需要如何进行鼓励以及需要提供什么帮助？

4.9. 如果不能圆满地回答这些问题，那么合同能源管理在最初的示范之后不可能得到大范围推广应用 [92]。

4.10. 了解一些国家公共机构合同能源管理方面的经验教训，这不仅对示范项目有用，对这种交付机制在节能项目投资中的大规模应用也是非常有用的。美国、加拿大 [93] 以及德国是最典型的例子。美国和加拿大联邦政府是公共机构合同能源管理的倡导者，并对联邦政府建筑物合同能源管理颁布了相关的法律法规以及实施规则。美国州政府也紧跟其后采取了类似的活动。美国州政府的经验尤其具有指导意义，49 个州颁布了覆盖地方政府的合同能源管理政策法规，并广泛提供各种技术支持并产生了很好的效果 [94]。其它一些国家，如德国和奥地利，合同能源管理更多地先是从底层推广采用。一些超前的州和省率先进行了合同能源管理试点，然后最终对财政预算和核算制度做了调整，确保公共机构建筑物能合同能源管理业务的开展。

92. 参见 Taylor et al., Financing Energy Efficiency - Lessons from Brazil, China, India, and Beyondand Singh et al. 2010, Public Procurement of Energy Efficiency Services - Lessons from International Experience.

93. 加拿大自然资源部的联邦建筑行动项目从 1991 年来共推动开展了 86 个改造项目，吸引了 3.2 亿美元的私人投资，每年节约的能源成本超过 4300 万美元。关于加拿大合同能源管理过程的更多信息，请参阅 Singh et al. 2010，案例 2。

94. 参见美国橡树岭国家实验室，Status of ESPC Enabling Legislation in the United States.

滚动支付和财务会计的问题

4.11. 几乎所有国家的财政预算都是按年度根据上一财年的开支进行财政拨款，结余的资金不能转移到下一财政年度。此外，资本预算和运营成本预算也有严格的区分。这种财政制度对所有节能投资都是致命的。当试图将今后几年节省的能源成本用于资助节能投资项目时，就会发现资本预算和运营成本预算关系非常紧密。

4.12. ***公共机构合同能源管理项目中节能服务公司费用支付的会计处理。*** 2010 年 4 月国务院颁布的有关合同能源管理的政策规定包括：明确规定公共机构能在财政预算中从能源成本预算栏中支付合同能源管理费用，这项政策规定为解决中国合同能源管理基本的会计问题奠定了良好基础。但是，***各级财政部门***（特别是省级财政部门）***还应制定具体的政策措施，为如何支付的问题提供具体指导***。公共机构节能对北京市总体节能工作的推进具有特别重要的意义和作用，为此北京市政府对合同能源管理项目从节省的能源成本中进行支付的问题制定颁布了地方政策文件[95]。一旦各地的政策法规文件颁布实施后，***接下来就是通过制度的方式处理几种合同，以进一步明确如何实施合同能源管理项目***。

4.13. 其他国家也针对这些问题颁布了类似的政策法规文件。许多美国州政府规定水电费预算栏目可用作合同能源管理项目的开支。德国，节能服务公司的费用支付被当作建筑维护费用进行预算。

4.14. ***多年的合同能源管理项目***。随着中国地方政府主管部门开始制定颁布合同能源管理支付方面的政策法规，就有必要促进推广多年的合同能源管理项目。一些国家已经要求对法律法规进行明确调整，允许公共机构开展多年的合同能源管理项目。例子之一是韩国[96]（引用自 Singh et al. 2010， 67 页）。对于德国联邦政府实施的大型合同能源管理项目，联邦财政预算中必须包括超过目前财政年度的财务承诺授权书（具体内容参见 Singh et al. 2010， 178 页）。美国 1992 年的立法授权允许联邦政府机构开展多年期的节能量担保型的合同能源管理项目（具体参见专栏 4.1）。

4.15. ***合同能源管理模式下第三方投资融资是否与债务限制的问题冲突？*** 一些国家由于对下级的政府有严格的规定不允许发生债务，因此明确规定无论是否是合同能源管理项目，都应被计入政府债务。通常但也不绝对是，产生净节约量的合同能源管理项目（即项目合同期节约的费用总额高于按合同支付给节能服务公司的总费用）不应计作债务。这是许多德国和美国地方州政府的实际情形。

专栏4.1：美国联邦政府合同能源管理项目

美国能源部（DOE）管理的联邦能源管理计划（FEMP），负责协调管理联邦政府机构的节能、可再生能源、节水和温室气体管理等方面的工作。联邦能源管理计划（FEMP）支持联邦政府机构识别、获得并实施替代融资资金（见 3.85—3.89 部分），用于资助节能和节水项目。

根据美国各州和各地中小学自二十世纪七十年代开始实施合同能源管理项目的经验，二十世纪八十年代中期，联邦政府机构开始实施合同能源管理项目（参见 Taylor et al. 2008）。这需要开发合同模板、采购程序模板、以及监督与验证要求模板，以便顺利地纳入政府合同和采购体系。此外，还需要针对联邦政府部门及其官员制定奖励措施鼓励采用新的业务模式，同时也需要开展宣传培训工作。

1992 年正式立法授权允许实施合同能源管理项目。美国能源部在 1995 年制定了具体的政策法规。2007 年的《国家能源政策法令》继续赋予了联邦政府实施合同能源管理项目的权利。

95. "在项目合同期内，市财政批复单位部门预算时，公用经费按照能源消耗下降后的经费下达；合同约定支付节能服务公司的能源节约分享收益，在单位项目支出预算中予以安排，同部门预算一并批复；合同约定留存单位的能源节约分享收益，在单位部门预算中统筹使用。" 公用经费包括水电费、后勤管理费、会议费、商务差旅、办公设施等；北京市合同能源管理项目财政奖励资金管理暂行办法，第 26 条（2010 年 11 月 30 日）。

96. 引用自 Singh et al. 2010, p. 67.

1978 年纳入法律体系的《国家节能政策法令》，首次赋予联邦政府与私营的节能服务公司实施分享型节能合同的权力。1992 年的《能源政策法令》扩大了联邦政府合同能源管理的权力范围，具体包括如下方面的内容：

- 授权允许联邦政府组织实施节能量担保型的合同能源管理项目；
- 要求节能服务公司担保节能量；
- 允许作为《反超支法令》[97] 的特例，规定如果每年节省的能源成本超过支付费用时，联邦政府在组织实施合同能源管理时仅在合同第一年允许使用现有资金支付节能服务公司的费用。
- 要求进行节能量测量与验证；
- 规定合同最长期不超过 25 年，包括建设期在内。

美国能源部最新的规定：联邦法规（CFR）436 号 B 部分的条款 10 明确规定了合同能源管理使用中的相关问题，包括：

- 建立节能服务公司资格管理制度；
- 制定选择节能服务公司的具体采购程序和标准；
- 允许非招标提案；
- 推荐性标准条款；
- 界定支付条件：支付给合同商的费用只能从联邦政府机构的能源或相关的运行和维护开支经费中支取；
- 明确了每年节能量测量与验证的要求；
- 当 10 CFR 436 与联邦采购法规（FAR）发生冲突时，10 CFR 436 优先

Skaggs 管理局（公众法 105—277，即 1998 年的“综合拨款法案”）允许转移给能源部的资金无需批准和理由，可用于节能方面的技术援助服务，如项目沟通以及具体的项目设计管理。2005 年通过的《国防部授权法令》对联邦合同能源管理项目的节能，包括节水措施进行了重新定义。2007 年《能源自主与安全法令》扩展了联邦合同能源管理的权利。

联邦能源管理计划（FEMP）通过引导采购过程并调整公布批准的节能服务公司名单等措施，促进节能服务公司的发展和合同能源管理项目的推广应用。从 1998 年开始，联邦能源管理计划（FEMP）启动了超级能效合同，目的是帮助联邦政府机构实施综合性的节能项目。在竞争评比的基础上，联邦能源管理计划（FEMP）选择了有限数量的节能服务公司（目前仅 16 家）有资格承担超级能效合同项目。合同为无限交付和无限数量（IDIQ）合同，每个合同上限不超过 50 亿美元。根据节能服务公司在 IDIQ 中规定的条款为联邦政府机构提供服务的能力，从而将合同授予给节能服务公司。超级能效合同概念允许联邦政府机构跨越采购程序、跳过耗时的充分竞争过程、直接和预先资格审查合格的节能服务公司打交道，设计和实施节能项目。项目要求必须从能源费用或水费中、或者是能源相关的运营管理经费中节省经费。在上限 50 亿美元的合同框架下，一个联邦政府机构可以和节能服务公司实施多个项目。

在 2007 年前，根据项目程序，预资格审查合格的节能服务公司根据对建筑物的初步能源审计结果提出项目建议。在收到公共机构授予合同的意向通知后，节能服务公司开展投资级的能源审计（IGA），识别节能措施、安排融资资金、向联邦政府机构担保一定量的年度节约量、以及组织实施双方认可的节能措施。联邦政府机构通过将担保的部分节省的能源成本，通常是 100% 的

97. 除非在相关的拨款预算中有足够的资金覆盖所有费用，否则政府官员不会支付或者也不会承诺美国在今后对这些货物或服务进行支付。详细内容参见：美国问责局（GAO），Antideficiency Act Background.

节能收益减去象征性的 1 美元，支付给节能服务公司。超级能效服务合同允许联邦政府机构在一定范围内按任务次序对投资级的能源审计（IDIQ）条款进行修订。联邦能源管理计划（FEMP）在超级能效合同实施过程内向联邦政府机构提供负责全程指导服务的项目协调员；在初步的项目建议阶段，协调员的服务是免费的。

近年来，对节能绩效合同的程序进行了两次修改。2007 年，《国防授权法令》试图增加联邦政府机构合同（超过 500 万美元的任务／交付定购）的竞争性，包括价格的竞争。此外，超过 1000 万美元的任务定购是不允许的。对于节能绩效合同来说，这意味着联邦政府机构启动项目时不得不通知 16 家预审查合格的节能服务公司；节能服务公司随后在能源评估基础上，提交标书。联邦政府机构根据节能服务公司的过去业绩、标书的准确性以及价格因素等进行评标。但是，甚至在基于节能投资级的审计结果产生不同的节能措施时，项目中标方也不能对项目投标建议书内容作出修改。结果导致节能服务公司非常不愿意参与投标、联邦政府机构很少能收到综合性的节能改造建议。在这点上，大多数联邦政府机构都喜欢利用超级能效合同方式单一外包节能改造项目（参见 Singh et al. 2010 和美国能源部网站 ESPC Contracting and Negotiations — A Short Course）。2011 年《国防授权法令》再次对节能绩效合同程序进行了修改，程序变得要简单得多，有点类似于 2007 年以前的程序。但联邦政府机构还仍需自己根据资格要求和相关讨论选择至少 2 家节能服务公司、并通知节能服务公司准备初步的投标建议书。这样，节能绩效合同项目程序又重新启动了。

表B4.1.1：节能服务公司的选择（2010之后）

节能服务公司启动的项目	联邦政府机构启动的项目
• 节能服务公司向联邦政府机构表达递交项目建议书的意向 – 如果项目预估项目金额小于 500 万美元，联邦政府机构可以选择节能服务公司作为唯一的合同投标方 – 对金额超过 500 万美元的项目，联邦政府机构必须通知其它超级节能服务公司参与投标，并明确投标要求，如理想的节能效果、包括的建筑物等。 • 其它的节能服务公司然后提交大约 20 页的初步评审报告； • 联邦政府机构依据公平原则，根据最佳价值方法选定一家节能服务公司； • 选择后的任务报告；如果项目金额超过 1000 万美元，允许反对项目。	• 联邦政府机构将招标要求和选择标准通知全部 16 家节能服务公司； – 招标要求：如包括的建筑物、理想的节能效果等； –选择标准: 如价格(必须项)、技术途径、以往的业绩； – 联邦政府机构可对感兴趣的节能服务公司进行现场走访。 • 一家或多家节能服务公司递交初步的评审报告； • 联邦政府机构依据公平原则，根据最佳价值方法选定一家节能服务公司； • 选择后的任务报告；如果项目金额超过 1000 万美元，允许反对项目。

节能绩效合同实施过程中的技术支持。联邦能源管理计划（FEMP）向所有的联邦政府机构提供技术帮助、指导文件编制、研讨会、合同安排以及项目协调服务等，具体包括：

- 联邦能源管理计划（FEMP）联邦融资专家的一般性管理（1 位专家负责 4 个区域）；
- 为每个项目提供从初始通知到项目建设／调试以及第一年节能量测量与验证等环节全程服务的项目协调员；
- 由来自于国家实验室的核心团队对节能服务公司提交的初步审计报告以及最终的项目建议书进行评审；
- 提供合同模板、标准化的条款和协议。

融资。节能服务公司负责对节能绩效合同项目提供融资。需要收到至少 3 份竞争性的融资报价。《能源自主和安全法令（2007）》规定了将政府预算拨款和私人资金组合用于美国能源部项目的可能性，但不适用于国防部项目。相应地，联邦政府机构开始对项目提供配套资金，最高不超过总成本的 25%。

测量与验证。联邦节能绩效合同项目主管部门要求合同方应负责节能量测量与验证活动，并提交文件证明满足了担保的节能量。联邦能源管理计划《节能量测量与验证指南 3.0》（2008 年）是将《国际性能测量与验证协议（IPMVP）》在联邦项目上的具体应用（见 4.56—4.57 部分），包含了对节能绩效项目的节能设备、节水、改善运行维护管理、可再生能源、以及热电联产项目实施过程中产生的节能量进行量化的程序和指南。美国能源部超级能效合同项目包括对节能服务公司的合约要求，即节能服务公司应在联邦政府机构节能项目的策划与节能量测量与验证等过程中应遵守该指南。根据 166 个超级能效合同项目成本计划的估算，超级能效合同项目平均每年节能量测量与验证的成本费用为每年项目节省的能源成本费用的 3.3%（参见 FEMP，M&V Guidelines：Measurement and Verification for Federal Energy Projects Version 3.0，p. 5—2）。

实施效果。在 1998 年至 2011 年 5 月间，超级能效合同理念已应用到 49 个州的 25 个政府机构的节能投资项目，项目投资总额为 24 亿美元，而总的合同价格为 64 亿美元（除了投资外，还包括节能服务公司费用、融资成本以及节能量测量与验证费用）。节省的能源成本总费用为 66 亿美元、净节约资金总额为 2.2 亿美元；每年节能量约为 18 兆亿英制热单位（Btu）（或 6.37 亿吨标煤）

资料来源：美国能源部可再生能源和节能， 联邦能源管理计划，Energy Savings Performance Contracts.

动员公共机构开展合同能源管理项目

4.16. 一旦制定颁布了允许合同能源管理项目有效实施的相关政策法规，就需要花大力气动员并帮助公共机构尝试并成功运用这种节能新机制。当其他国家刚启动合同能源管理业务时，大多数公共机构并不愿意进行尝试。许多公共机构抱着观望的态度想知道是否能获得政府的资金直接资助节能改造项目。许多政府机构也并不了解如何处理合同能源管理项目、惧怕与节能服务公司打交道。中国也存在类似的情形。和其他国家一样，需要积极主动地提高公共机构尝试这种节能新机制的积极性，特别是在初期，应尽可能使合同能源管理业务变得容易操作。尽管这可能会要求政府在初期要做许多工作，但从长远来看这是非常重要的，并能产生巨大收益。正如第三章所讨论那样，政府直接财政预算拨款用于公共机构节能项目的资金是远远不够的，通过合同能源管理等替代融资方式，是实现节能目标的必要环节。合同能源管理项目还能提供较强的技术解决方案。特别是像美国所展示的那样，政府采取措施有效推行合同能源管理业务，是对长期性的公共机构节能工作进行平衡和强化的重要基础。

4.17. 为了推动那些不愿意开展合同能源管理项目的联邦政府机构组织实施合同能源管理项目，美国采用了认可和强制相结合的政策手段。这些政策手段是通过以下工作来实现的：对财政预算和会计规则进行实际调整、修改采购和合同管理规定、为联邦政府机构项目的策划与实施提供部分技术帮助（参见 4.19—4.21 部分）。强烈鼓励联邦政府机构使用替代融资开展节能项目，或者是通过合同能源管理项目或者是公用事业单位进行替代融资（参见 3.85-3.89 部分）。大多数州政府颁布了一些强硬的指令，例如[98]：

- 宾夕法尼亚州州长向政府机构强调合同能源管理是节能技术改造项目的首选融资方案；

98. 参见 Bharvirkar et al. 2008, Performance Contracting and Energy Efficiency in the State Government Market。

- 华盛顿州合同能源管理授权法规要求所有州政府机构实施成本效益好的节能改造项目。同时要求各州政府部门应进行能源审计并实施节能项目，并要求将合同能源管理项目作为优先方式，用于开展能源审计工作和组织实施节能项目。

- 堪萨斯州长命令所有资金规模超过 10 万美元的州政府建筑建设项目必须进行分析评估，确定是否可应用合同能源管理方式降低对州财政预算资金或资本开支的需求。

- 马赛诸州的州长颁布的 2007 年行政令要求应在不要求大量的州政府预算资金支持的前提下，提出州政府建筑物节能项目融资建议；州资产评估管理处（马赛诸州州建筑物合同能源管理的牵头单位）应在建筑面积超过 10 万平方英尺的所有适用的州建筑物寻求实施合同能源管理项目的机会。

- 科罗拉多州州长批准了使用合同能源管理促进能源需求的降低。要求各州政府机构的行政负责人以及负责州属建筑物的管理部门开展以下工作：（1）调查研究合同能源管理的可行性，并向负责制定合同能源管理项目实施规则和程序的州建筑局人事管理部提交最终的可行性研究报告；（2）向所有已被确定为开展合同能源管理项目具有技术可行且经济合理的建筑物发布合同能源管理项目建议邀请书；（3）按州建筑局人事管理部的合同能源管理项目程序和要求组织实施项目。

4.18. **研究团队建议**：鉴于中国公共机构合同能源管理市场尚处于初期发展阶段，研究团队认为如果强制规定公共机构必须采用合同能源管理是不合适的，并且可能适得其反。但各级政府对合同能源管理的持续支持是非常重要的。当前阶段动员公共机构实施合同能源管理项目的关键是明确公共机构通过实施合同能源管理项目能取得的直接收益。这可通过两方面的具体措施来实现：一是制定政策措施，明确规定实施合同能源管理项目的公共机构可以留存部分节省的能源成本并将这些资金用于单位内部的一些经费用途，这可类似参考 2011 年 11 月北京市的政策文件；二是有意地推动组织实施一批合同能源管理项目，包括公共机构普遍存在且有较大节能潜力的设备改造或其它设施的升级改造项目。北美和欧洲开展的这类项目，对提高公共机构的积极性非常有帮助（参见 3.37,3.38 部分）。如果能在一定范围内成功组织实施几个合同能源管理项目，就可作为案例大范围地向其它公共机构传播推广，帮助激发其它公共机构实施合同能源管理项目的兴趣。

为公共机构合同能源管理提供帮助

4.19. 政府要在公共机构成功实施合同能源管理项目的另一项重要内容，是向各级公共机构提供主动积极且手把手的帮助，指导并协助解决合同能源管理项目策划和组织实施过程中的方方面面内容，特别是在初期更显重要。合同能源管理是一个全新的概念，公共机构尤其陌生，有许多财政预算和采购方面的问题单纯依靠法律法规不一定能解决，此时找到这些问题的解决办法就非常重要了。此外，节能服务公司的筛选过程、签订完善的合同、以及节能量测量与验证方法的界定和监管等问题，对大多数初次接触这个行业的公共机构来说都是非常困难的。许多国家联邦、州和 / 或地方政府在公共机构领域组织实施合同能源管理的一个成功之处是在政府部门安排专人或者是指定专业机构为各级公共机构提供技术支持服务。同时还与研究实验室或大学的专家签署合同，帮助协调推进合同能源管理项目。例如，美国宾夕法尼亚州的总务局（DGS），是州公共机构合同能源管理推广实施的牵头部门，聘用了专业人员负责运作管理合同能源管理项目的相关工作。该专业人员主要负责具体的管理事务，宾夕法尼亚州立大学的建筑工程研究院的工程专家以及其他单位的顾问，负责具体的技术支持工作。美国联邦能源管理计划，要求联邦政府部门在超级节能绩效合同项目的开发和实施过程中应邀请联邦能源管理计划的项目协调员提供支持（参见专栏 4.1）。德国柏林州以及其它州和以及市政能源署以及其它相关机构积极介入项目打捆实施过程（参见专栏 4.1）以及其它的合同能源管理项目。

4.20. ***研究团队建议。建议对大力推进公共机构合同能源管理工作感兴趣的中国政府相关部门，应指定一个具体的单位向本系统范围内的公共机构提供实施合同能源管理项目的不同形式的帮助。***在省级范围内指定上述支持机构对各省合同能源管理工作是非常重要的，但在中央及地市级指定该种技术支持机构，也会获益良多。指定单位从事合同能源管理相关业务的目标是促进相关公共机构采用合同能源管理项目，为感兴趣的公共机构提供各种服务，帮助解决实际工作中遇到的各种问题。参照其它国家的经验，建议指定的单位应能提供“一站式”服务。该单位应有专人全职负责服务工作，很有可能需要与外部单位的不同领域专家签署合同，帮助处理遇到的各种具体问题。需要指定单位从事的主要工作包括：

- 加强各级政府部门官员的培训教育，激发其对公共机构节能工作的热情和需求。培训内容包括：实现节能的途径、合同能源管理的作用、开展合同能源管理项目的具体活动、使用合同能源管理的成功案例等。各国经验表明：需要采取系统和渐进的方式，动员并确保各个重要的公共机构合同能源管理项目的工作进展顺利。例如，美国政府问责局（GAO，代表美国国会负责监管财务控制问题），刚开始并不了解合同能源管理，特别是合同能源管理的经济问题（项目成本的计算，而不是收益的计算），结果在开始一段时间一直反对合同能源管理的大范围推广应用[99]。

- 监督管理公共机构合同能源管理项目宣传册以及其它详细参考教材的编制工作，对一定系统范围内的各级公共机构的各种人员组织开展培训工作；

- 管理和维护一个信息数据库，或者与其它数据库建立链接。数据库内容包括：一定范围内公共机构能耗数据的统计、各个公共机构指派的节能目标、项目的组织实施、开展的合同能源管理项目及其节能效果。应对这些数据进行分析整理，帮助在实施新的合同能源管理项目时提出优先领域的建议以及人员培训的优先次序等；

- 向公共机构提供筛选节能服务公司的指南，包括 4.30 部分建议的理想状况下的节能服务公司资格要求等内容；

- 提供公共机构合同能源管理项目合同模板，指导如何操作合同能源管理项目。最好仅把合同模板当作指导性材料提供给公共机构，那么各个公共机构就可根据自身的具体需求和特殊的项目要求做出相应调整。也最好为试点项目和新的方案途径保留一定的灵活性。

- 监管针对公共机构合同能源管理项目的节能量测量与验证方法学的开发（参见 4.59 – 4.61 部分）以及应用案例的编写；

- 提供手把手的技术帮助，从项目筹备的各个阶段到项目的批准和费用支付，特别是在合同能源管理业务刚启动时，提供全面指导；

- 监管公共机构合同能源管理项目成功案例的编制工作，并进行广泛地传播。

4.21. 随着时间的推移，该种合同能源管理支持单位的工作范围和复杂程度也会逐步扩大。更多的工作包括：合同能源管理项目采购方法学的开发、标准和模板文件的开发、为项目融资方提供指导并建立联系等。美国马赛诸州[100]的资产评估管理处（DCAM）目前已开展相当复杂的合同能源管理支持工作，包括提供技术服务（包括工程研究和建筑物评估）、管理和实施合同能源管理项目的采购和签约、开展第三方调试、提供现场工程技术、监管建设、制定节能量基准的测量与验证标准以及基准标准、

99.Donahue & Associates 2006。A Review of Maryland′s Energy Performance Contracting Program, prepared for Maryland Energy Administration; http://energy.maryland.gov/incentives/allprograms/epc/epc_report.pdf.

100. 参见 Bharvirkar et al. 2008, Performance Contracting and Energy Efficiency in the State Government Market.

监督合同能源管理项目节能量测量与验证的报告编写等内容。节能服务公司向资产评估管理处和政府机构业主按季度递交节能量测量与验证报告。资产评估管理处制定了各个州政府机构广泛使用的标准化的采购和合同文件。制定了州合格融资供应商的名单，各个州公共机构可从这些名单中选择免税的租赁融资投标方。项目融资中应将公用事业单位奖励、赠款以及偶尔的债券等组合在一起。

4.22. 在初始阶段，通常由政府提供上述支持和技术援助的相关资金。但一旦某个国家或地区合同能源管理项目业务运转良好时，通常都希望公共机构作为项目业主能帮助支付各种支持服务的费用。例如，美国马里兰州针对合同能源管理项目在项目建成后的项目监督和节能量测量与验证报告评审方面的支持服务环节收取费用。美国宾夕法尼亚州计划收取合同能源管理项目的项目管理费用，用于支付提供技术支持的专家顾问成本，而在过去这笔费用是在合同能源管理项目前八年由州财政预算经费支付[101]。德国柏林能源署为州和市政公共机构提供项目管理支持服务。从项目策划到签署合同之间政府机构发生的费用由政府提供一个固定的补贴，但在项目投资阶段的技术支持服务，政府机构支付支持服务费用总额的 50%[102]。

公共机构加大应用合同能源管理的主要问题

4.23. 前面章节所讨论的各种打开公共机构合同能源管理大门的各项措施，已在许多国家得到了广泛应用。但到目前为止，除了少数几个例外，大多数国家都避免将合同能源管理作为公共机构节能的主流商业模式。造成这种困难的因素有几方面，其中最重要且与中国最相关的是：

- 许多国家节能服务产业总体较弱，仅有有限数量的节能服务公司有足够的技术能力为公共机构提供所需的各种服务。加强节能服务公司的质量管理，或许在初期组建公立的节能服务公司培育节能服务产业，帮助潜在的业主识别有能力的节能服务公司，是增加合同能源管理业务供应的有效方式。

- 公共机构政府采购大多数情况下是个复杂且耗时的事情。合同能源管理这种全新且高度复杂的商业模式，会进一步增加采购的复杂性。现在已有一些简化采购流程的方法，例如提前进行节能服务公司资格审查，但这又会减少竞争，而竞争又是提高节能项目公共机构自身收益的重要手段。

- 一个倾向是大家“捡软柿子捏”，即在规模较大的建筑物选择实施那些投资回报率高的简单的节能项目。尽管这降低了交易成本（或者项目开发和监管成本），但在规模较小的建筑物留下了许多项目，或者在同一建筑物中留下了投资回收期较长的项目。促进几个建筑物打捆成为一个大的合同能源管理项目，或者是在一栋建筑物内组织实施综合程度高的节能项目，是将项目进行集成的两种方式，可保证将较大范围的项目纳入节能工作总体考虑中。

4.24. 后续章节将会讨论解决这些问题的可能措施，以及如何提高节能服务公司质量、加强和规范采购程序、项目打包、组织开展综合性高的节能改造项目以及节能量测量与验证等内容。

节能服务公司的质量

4.25. 理想状况是节能服务公司提供各种服务，将各种不同货物、工程和服务打包形成一个交钥匙工程合同，并承担所有的项目风险。节能服务公司负责对项目计划进行识别和评估；并对项目进行设计、安装、调试和管理；负责提供资金或帮助安排融资；开展节能量测量与验证；对业主相关人员进行培训；负责合同期内系统的维护；并担保节省的能源成本费用能覆盖项目的总成本。由于节能服务公司业

101. 参见 Bharvirkar et al. 2008, Performance Contracting and Energy Efficiency in the State Government Market.

102. 与柏林能源署 U. Schlopsnies 的个人交流，2011 年 4 月

务能力范围变化大，从仅能提供技术咨询服务而收取咨询费用的咨询顾问公司到能提供上述所有服务内容的综合性节能服务公司，所以实际上节能服务公司所能提供的服务是大有所不同的，可能是仅能提供上述服务内容的一种、多种或者全部服务[103]。

4.26. 节能服务公司所擅长的节能技术以及节能措施区别也是很大的。中国的大多数节能服务公司都自己拥有某种技术，如能源控制技术或锅炉更换技术，专注于仅开展这种类型技术和设备的合同能源管理项目。不仅在中国，在一定程度上其他国家也是这样，很少有节能服务公司能对建筑物进行系统综合的节能评估并考虑采用很多种节能措施。

4.27. 由于大多数节能服务公司都是技术出身[104]，他们的管理能力、业务和法律技能常常不足。合同能源管理是一项复杂的业务，要求节能服务公司要让业主、融资机构、分包方、能源审计人员、税务人员以及其他相关人员感到满意，大多数节能服务公司并不擅长这些工作。

4.28. 因此，并不是每家自称为节能服务公司的单位都能从事合同能源管理业务工作并能让业主感到满意。事实上在合同能源管理市场的初期以及增长阶段，一些最开始的节能服务公司可能业务已经开展很好，同时有许多新的节能服务公司涌入合同能源管理市场，就可能出现许多结果让人失望的合同项目。特别是从 2010 年初开始，中国有许多新公司注册为节能服务公司，但到目前为止，大多数合同能源管理实际业务经验都非常欠缺。尽管在中国合同能源管理市场也有一些实力较强、业务稳定且有项目经验的公司，但对业主来说是很难判断选择合格的节能服务公司。为确保合同能源管理业务的持续健康发展，需要采取一些方式帮助公共机构项目业主筛选能胜任且可靠的潜在节能服务公司。但是，从这种新理念和新途径应用方面来说，应避免人为设置合同能源管理业务障碍，扼杀产业的成长、破坏产业的创造性。

4.29. 其它国家在发展节能服务产业的过程中，也存在不了解节能服务公司能力和质量的类似问题。可采用如下一些方式帮助项目业主识别有***实际项目经验且满足资格条件要求的节能服务公司***：

- ***节能服务公司的资格认可***。有几个国家[105]，对节能服务公司实行资格认可制度，帮助提高项目业主和商业银行等其他相关方对节能服务公司的信任。节能服务公司要通过核心能力和业务实践（美国）两方面的考试，或者是对其实施节能项目的成功经验、技术团队以及合同能源管理项目投资的财务实力等方面的内容进行考核（印度）。既可是一个独立的行业专家委员会（美国）、也可以是信用评级机构（印度）组织实施认可工作。美国目前仅有 20 多家节能服务公司完全通过了国家节能服务协会的认可。国家节能服务协会公布的认可名单，和美国联邦能源管理计划（FEMP）授权有资格从事超级能效合同项目的节能服务公司名单有较大的重叠。印度，节能服务产业尚处于发展初期，2009 年对 37 家公司申请了评级，其中 25 家节能服务公司评级结果为“好”。

- ***节能服务公司资格预审***。美国联邦能源部以及许多州能源局或类似的政府机构都公布了通过初审或前期批准的节能服务公司名单。名单通常是根据节能服务公司从事合同能源管理项目的实际经验竞争采购招标获得。这样公共机构就只能在有限的节能服务公司中进行挑选。一方面这帮助了公共机构，但另一方面又可能会减少了竞争性、限制了新组建的节能服务公司的发展。

103. Singh et al. 2010, Public Procurement of Energy Efficiency Services - Lessons from International Experience.

104. 最近中国的一些节能服务公司也具有金融背景。

105. 美国参见国家能源服务公司协会，NAESCO Accreditation Programs；印度参见印度政府电力部能源效率局，Accredited Energy Service Companies (ESCOs) 以及 Delio 2009, Accreditation to Increase the Credibility of Energy Service Companies in India。新加坡也有节能服务公司认可体系，但是是针对不同级别的能源审计服务进行认可；参见新加坡国立大学设计和环境学院能源可持续系，Energy Services Companies (ESCOs) Accreditation Scheme。菲律宾能源部认可节能服务公司有四家，参见 Energy Service Companies (ESCOs) Accreditation.
节能服务公司认可方案。菲律宾能源部认可了四家节能服务公司，参见 Energy Service Companies (ESCOs) Accreditation。

- 国家协会或贸易组织对节能服务公司的“半认证”性质的资格管理工作。协会或者贸易组织一般对会员都有明确且可靠的质量和能力方面的要求，只要协会自身有较高的知名度，那么这种“自律”体系为合同能源管理市场参与方提供了会员公司的一种资格参考依据。许多节能服务产业协会对其会员组织开展培训和能力建设工作，部分扮演着行业“看门狗/优良业务管理部门”的角色。根据公司业务记录优良程度以及能力大小等标准的判断，会员之间（如理事会员单位、副理事会员单位等）也可能有不同的等级关系。

- ***节能服务公司资格名单***。美国能源部还管理一份由能源部资格评审委员会，根据资格条件和客户反馈而筛选得出的节能服务公司名单。名单上约有 90 家节能服务公司，名单在网站上公布[106]。如果联邦政府机构并不想将节能项目纳入能源部超级能效合同的项目中，那么就可从公布的节能服务公司资格名单中选择进行常规的政府采购（参见 4.40 部分）。

- ***制定节能服务公司标准和／或节能服务公司服务标准。***2010 年，欧洲标准机构（CEN）以及欧盟电子标准委员会（CENELEC）（或者“Comité Européen de Normalisation Électrotechnique”）共同制定了节能服务标准，目前该标准已纳入各个欧盟国家的国家标准体系中[107]。专栏 4.2 概述了标准的基本要求。就可根据标准对节能服务公司进行认证。节能服务公司服务标准化的最重要内容之一是节能量测量与验证（M&V）。一些工业组织，如 IPMVP（参见 4.56—4.61 部分），已经单独开发了节能量测量与验证标准。美国经验表明：提高客户和银行对节能服务公司所有活动的信任是至关重要。

专栏4.2：节能服务 – 标准 EN 15900：要求

EN 15900 规定了节能服务的基本要求。其中，最重要的内容包括：

- 被指派开展节能服务、实现节能效果；
- 基于收集到的能耗相关数据；
- 应包括能源审计 + 节能行动 + 节能量测量与验证等环节；
- 对活动和后续行动程序的框架内容进行文件描述；
- 在一定期限内根据约定的方式对节能效果进行测量与验证。按约定的间隔周期提交节能量测量与验证报告；
- 界定基准和修正参数；
- 说明是否要提供节能效果的合同担保以及担保的节能量大小；
- 合同能源管理业务介入各方的职责。

资料来源：Dijkstra 2011，Standardization energymanagement and de standard for energy efficiency services.

- ***节能服务公司项目的质量认证。***相比全国性的节能服务公司标准和节能服务公司项目标准来说，质量认证的内容要少的多，而且所需费用也要低的多。例如，奥地利的 Thermoprofit 质量认证项目，设置了一系列要求节能服务公司及其项目满足的标准。只要地区能源署以及一个独立的委员会每隔一段时间定期证明满足 Thermoprofit 相关标准，Thermoprofit 的受认证方就可使用 Thermoprofit 认证标志[108]。

106. 美国联邦能源管理计划根据 EPAct 1992 和 10 CFR 436 等法规要求建立了节能服务公司合格名单（能源部合格名单）。加拿大的自然资源部能源效率局建立了能源管理服务提供方的名录，给出了满足资格条件、且能为 ecoENERGY 改造奖励项目从事项目前期能源审计的人员名单，Commercial and Institutional Organizations.

107. 参见 EN 15900:2010，节能服务的定义和要求。例如，Piantoni 2011, The Energy audit, energy efficiency services and energy efficiency benchmarking.

108. 参见能源城市，Thermoprofit: Marketing Performance Contracting.

4.30. 自 2010 年 10 月以来，财政部和国家发展改革委共公布了四批节能服务公司名单，列入名单的公司开展的合同能源管理项目可申请国家合同能源管理项目财政奖励资金 [109]。截止到 2012 年初，包括四批在内总共有 2000 多家节能服务公司。公布的名单包括公司的位置、联系方式以及从事的技术领域。进入名单的节能服务公司，需要提供满足一些基本要求的证明。但是，大多数公司都是刚刚组建，所提交的能力和业务记录证明并不是很清楚可靠。这是一个很好的开始，公布名单的主要目的在于表明这些公司满足政府所支持的某一类业务的条件，而并不是向业主提供选择最优节能服务公司的权威性推荐。

4.31. **研究团队建议**：上面讨论的各种如何帮助业主识别优秀的节能服务公司的许多方案，中国目前已经对这些方案展开了讨论和争论。***对于公共机构合同能源管理市场，现阶段最好是一个或多个节能主管单位在其职责范围内***（如国家层面的国管局负责中央政府机关建筑、教育部负责中央政府管理的大学、省机关事务管理部门负责省级政府机关建筑等）***分别进行试点，颁布临时的节能服务公司资格要求，以便所有的节能服务公司在所在区域的公共机构中开展合同能源管理项目都必须满足这些资格要求。当节能服务公司提出申请后，应逐个审查节能服务公司资格要求满足情况。应严格节能服务公司的资格要求，确保应有足够的业务记录、财务状况、人员配备以及实际经验。应定期公布节能服务公司的资格要求，以便节能服务公司根据实际获得的经验方便进行调整申请。应对本管辖范围内的所有申请、资格审批以及项目结果等内容保持良好的档案记录。随着时间的推移，试点工作能为今后组织实施更复杂的持续认可制度、资格预审制度或标准制度提供基础，其中会涉及到第三方机构参与节能服务公司的筛选或认可工作。***

4.32. 帮助没有经验的业主成功组织实施合同能源管理项目的一个替代工具是***提供合同模板、标准化的重要合同条款和其它模板文件***。几乎在合同能源管理业务能成功进入公共机构节能市场的所有国家，都开发了这种合同模板和文件模板。中国国家发展改革委颁布了效益分享型合同能源管理项目的合同模板基本格式。如果进一步提供合同能源管理项目、特别是公共机构的合同能源管理项目选择方面的具体细节和指南，将是非常有用的。例如，德国有几套针对联邦政府和非联邦政府公共机构的合同模板文件以及相关的指南 [110]。实际上捷克合同能源管理项目不太普遍的主要原因是缺乏政府的支持，包括上述文件的开发 [111]。

4.33. **公共节能服务公司。**在节能服务产业刚刚起步或者是尚处于弱小阶段、或者是缺乏获得商业融资渠道的几个国家，都把合同能源管理看作是一个重要的业务模式，引入了公共节能服务公司。重要目标之一是帮助培育当地节能服务公司的发展。比利时、乌克兰和克罗地亚，公共所有且经营管理的节能服务公司的资本金主要来自于政府投资，它们进入公共机构合同能源管理市场，然后分包给更小的私人节能服务公司或者承包商。公共节能服务公司一般负责融资，从为业主担保的节能量中收回投资。一般根据服务内容向分包方支付费用。专栏 4.3 介绍了 Fedesco 公司，这是比利时负责联邦政府建筑领域的一家公共节能服务公司。从该案例中获得的一项重要经验教训是，最好是公共机构有多种方式选择完成节能任务。Fedesco 公司主要开展合同能源管理项目，但也促进并资助针对联邦政府建筑物的所谓的横向节能措施（简单的节能措施，如照明、控制等），并按照服务项目进行收费。

4.34. 在地方政府的支持下，中国公共节能服务公司的概念，可能在初期发展公共机构合同能源管理业务以及帮助地方节能服务公司的发展方面是有用的。公共节能服务公司应是一个商业实体，可采用各种形式的公司治理结构 [112]。

109. 有关符合奖励政策的所有领域合同能源管理项目详情，参见 Sun et al (2011)。

110.ingh et al. 2010, Public Procurement of Energy Efficiency Services - Lessons from International Experience（德国案例研究）。

111. 参见 Sochor and Valentová 2009, Framework Conditions for Energy Performance Contracting.

112. 参见世界银行 2012 年报告：亚美尼亚—节能项目，华盛顿，http://documents.worldbank.org/curated/en/2012/03/15931877/armenia-energy-efficiency-project.

专栏 4.3：公共节能服务公司–当节能服务产业比较弱时促进合同能源管理业务的措施：例如比利时Fedesco公司

在世纪之交，比利时节能服务产业的市场发展很慢，有部分国际公司进入了比利时合同能源管理市场，但多数都是进行前期业务市场“探路”[113]。为打开联邦政府建筑物节能服务市场，联邦政府组建了公共节能服务公司，Fedesco 公司。这是一家有限责任公司，所有权归联邦政府和投资公司共同所有，属于政府所有的金融控股公司。最开始注册资本金为来自于 Kyoto 资金的 150 万欧元，2007 年提升到 650 万欧元。提供国家担保的 1000 万欧元的融资（债务）能力。

Fedesco 公司的愿景是对联邦政府公共建筑节能和可再生能源项目进行研究、实施并进行融资服务。主要投资三类项目：标准项目、横向节能措施以及合同能源管理。目标是在 2005 年至 2016 年间降低联邦政府建筑物温室气体排放 22%，估计所需的投资总额为 1.52 亿欧元。联邦政府所有或使用的建筑物有 1650 栋，建筑面积为 800 万平方米，每年的能源费用和水费共计超过 1 亿欧元。能源消耗主要集中在一些最大的建筑物（20% 建筑物 =80% 能耗），这些建筑物每年总用电量为 20 亿千瓦时，产生的二氧化碳排放量 60 多万吨。

2007 年 1 月开始，Fedesco 公司被指定为唯一一家单位负责为联邦政府建筑物提供第三方融资服务。Fedesco 公司与联邦建筑管理署合作，代表建筑住户管理交钥匙的能源服务项目，并在 2008 年开展了合同能源管理项目。Fedesco 公司支持组建的节能服务公司协会（BELESCO）在 2008 年正式开始运作，主要职责是指导节能服务产业、向公共和私人用户进行信息传播和培训、建立合同能源管理项目数据库、进行节能服务公司认可、开发公共机构合同模板和招标程序的模板。Fedesco 公司采用柏林能源署和其它合作伙伴在执行 EURCONTRACT 项目过程中开发的合同能源管理项目合同。招标程序和合同都具体适用于比利时公共招标法。这为 BELESCO 开发公共机构通用合同模板提供了基础。

合同能源管理业务推广实施的最大障碍是公共和私人建筑物以及工业领域，都对合同能源管理概念以及如何应用缺乏了解以及必要的知识。BELESCO 将重点加强意识和知识技能的教育培训工作。另一个障碍是现存的大量（长期）建筑维护合同，包括越来越多的技术设备性能的保证。很难采用合同能源管理的方式对这些设备进行更换。拥有建筑物的公共机构，宁愿采用自有资金或者使用传统的信贷资金，进行节能改造，单独地组织实施各种技术措施。Fedesco 公司大约投资计划的一半都不是合同能源管理项目，而是所谓的横向节能措施（如锅炉或冷却片的更换、建筑控制、保温、外窗贴膜等）。尽管也采用第三方的投资，但不要求提供全套能源服务或合同能源管理业务。

比利时节能服务产业得到了联邦政府的强力支持。联邦政府通过 Fedesco 公司向各节能服务公司授权允许对其下属的 1800 栋建筑物选择签署大的公共机构服务合同。将联邦政府作为客户进行信用评级，使项目融资变的容易，节能服务行业也获得了发展。Fedesco 公司拥有排他性权利，负责采用第三方融资模式组织实施联邦政府公共建筑的合同能源管理项目，并负责在比利时和弗兰德斯牵头推广合同能源管理项目。

招标过程。公共节能服务公司与公共机构业主签署合同不需进行公开招标，但要求在外包时遵守公共招标法。合同能源管理项目大多采用 1 步或 2 步的公开谈判招标程序（多个标准）或者是竞争谈判招标程序（新）。

根据有关经验，合同能源管理招标是非常复杂的，这需要：(1) 适用于公共机构的标准招标文件（由信息中心和 BELESCO 负责编写）；（2）陪伴客户的技术顾问和市场协调员；（3）正确合理的节能量测量与验证方法（采用了 IPMVP）。私人的节能服务公司也需要开展大量的市场培训工作

资料来源：Vanstraelen 2008，Overview Belgian ESCO Market.

113. 所谓的“探路合同”是指包含了运行管理、但却没明确承诺进行节能投资的合同。根据该合同，在维持条件不变的前提下，承包商应以较低的成本对既有系统进行优化运行，同时又必须提供合约双方约定的建筑物舒适度（如温度、湿度）。承包商可通过投资节能设备或采购廉价的燃料等方式降低成本、提高利润。Paolo Bertoldi, Benigna Boza-Kiss, Silvia Rezessy (2007). Latest Development of Energy ServiceCompanies across Europe - A European ESCO Update. European Commission, Joint Research Centre, Institute for Environment and Sustainability; http://www.energy.eu/publications/LBNA22927ENC_002.pdf.

节能服务公司采购：规模、交易效率和竞争收益的平衡

4.35. 节能服务公司系统根据不同阶段以及在一定时间范围内分别提供服务、设备和融资等节能服务相关工作。中国的典型情况是第三方的节能服务公司和项目业主单位共同开发节能投资项目，包括调查或能源审计以及具体的项目设计、并签署能源性能服务合同。中国普遍采用的是分享型合同能源管理模式，节能服务公司提供项目投资资金（有时资金也可能是从其它渠道借贷而来）、监管设备采购和工程建设、和项目业主共同完成项目调试、还可能负责运行维护管理以及对项目进行监督和评估。从最初的项目概念到合同执行可能需要好几个月，中国大多数建筑物合同能源管理项目的合同期限一般至少为 3-5 年。

4.36. 项目研究团队了解到中国公共机构合同能源管理的示范项目刚开始，而且刚完成节能服务公司的评审工作。节能服务公司是按照合同谈判或者是采用相对简单的招标程序进行选择。随着市场的发展，越来越多的公司愿意且有能力承担要求的合同能源管理项目并且此时的项目也会越来越复杂，此时合同能源管理项目采购过程中就面临更多的问题需要解决。同时，如果建立了透明公正的合同能源管理项目采购方法、降低了建筑物住户抱怨的风险，越来越多的公共机构能源管理人员会愿意采用合同能源管理模式。其他国家在建立满足公共机构政策法规要求且在不增加太多交易成本和时间的前提下有效提供成本效益好的质量保证的采购方法时，发现是一项比较困难的工作。下面将介绍实际获得的一些经验教训。

4.37. 大多数国家公共机构为保证获得优惠的采购条件以及避免腐败，都必须遵守严格的货物和服务采购规定。合同能源管理合同采购也不能例外。美国和欧盟公共机构合同能源管理项目的采购是一个漫长且复杂的过程，节能服务公司和公共机构业主双方的成本都会很高。表 4.2 给出了北美或欧洲在充分竞争基础上签署合同通常包括的典型步骤（1-7）。美国联邦政府合同能源管理项目从项目概念开发到合同签署需要花费 1-2 年，这是非常普遍的；而州 / 地方政府机构、大学、中小学和医院一般需要花费 6-9 个月。所花费时间的不同的原因在于联邦政府机构项目规模相对较大、合同签署审批环节也要多、而且合同要求也要多 [114]。

表4.1：合同能源管理项目的组织实施步骤及负责单位

合同能源管理项目过程步骤	负责单位
1. 最初的数据收集 / 分析 / 项目目标和要求的节能措施的确定	• 有能源署或类似单位支持的项目业主
2. 表达兴趣；确定节能服务公司短名单	• 有能源署或类似单位支持的项目业主，可采用提供的文件模板
3. 提交项目建议书（RfP）	• 有能源署或类似单位支持的项目业主，可采用提供的文件模板
4. 包括走访式审计在内的投标准备；项目设计所需要的节能措施和成本效益分析，估算节能量	• 投标单位 • 有能源署或类似单位支持的项目业主
5. 招标评审	• 有能源署或类似单位支持的项目业主
6. 和前几名投标单位的谈判	• 有能源署或类似单位支持的项目业主
7. 确定融资渠道	• 项目业主和 / 或节能服务公司，取决于项目招标文件要求
8. 签署合同	• 项目业主和节能服务公司

114. 参见 Hopper et al. 2005, Public and Institutional Markets for ESCO Services: Comparing Programs, Practices and Performance.

合同能源管理项目过程步骤	负责单位
9. 根据需要进行投资级的能源审计，进行具体的项目设计、确定基准和最终的节能量（节省的能源费用）	• 节能服务公司
10. 节能偏差的处理 / 合同豁免	• 项目业主和节能服务公司
11. 组织实施节能投资，包括货物和工程采购	• 节能服务公司（除非合同中具体指明，否则并不要求遵守公共采购规定）
12. 项目调试	• 节能服务公司，项目业主负责监理和能源署或类似机构负责监管
13. 运行维护	• 项目业主或节能服务公司，取决于合同
14. 节能量测量与验证	• 节能服务公司或独立的第三方，取决于合同

资料来源：作者

4.38. 每个国家公共机构合同能源管理项目的实施，首先需要解决的问题就是合同能源管理项目采购的问题。采购主要有三个问题：（1）合同中用能设施能源审计的时间阶段和内容；（2）节能服务公司之间的竞争，（3）后面将讨论到的不同项目之间的评标方法。如果希望能更彻底地解决整个项目环节的采购问题，包括从项目开发到项目的组织实施的合同方选择以及节能量的监督验证等各环节，推荐参考 2010 年 Singh 等人发表的有关世界银行 /ESMAP 文章以及相关的世行研究机构开发的电子学习工具 [115]。

4.39. ***时间阶段。***应在什么时间节点上签署合同？全面的能源审计（即投资级的能源审计—IGA）是在合同签署前还是签署后进行？合同的含义是什么？公开的合同招标文件通常要求有采购项目具体细节。这只能根据审计结果才能制定采购的具体细节内容。合同能源管理是靠合同方找出建筑物最佳节能方案，而这种采购程序就否定了合同能源管理的这种属性。在大多数国家，巴西尤其典型，由于招标文件要求规定节能措施的具体细节内容，结果成了合同能源管理推广实施难以克服的障碍。比较适合合同能源管理招标的是功能性的描述说明，包括项目技术、财务、组织方式、法律和经济性要求以及节能措施组织实施的框架条件等。提交项目建议书而进入短名单的节能服务公司通常允许进行走访式审计工作，并根据走访审计结果提出项目建议。为节约招标准备成本、增加参与竞争的节能服务公司的数量，此时通常不进行投资级的能源审计。如果项目相对较简单，仅包含几个简单的投资事项，公共机构和中标的节能服务公司签署合同能源管理项目合同后，节能服务公司可不进行投资级的能源审计工作而直接组织走采购环节。如果项目相对复杂（参见 4.51 部分），例如是一家大型的联邦政府机构或医院，中标的节能服务公司需要进行投资级的能源审计，并根据审计结果进行项目设计和细节说明，估算最终的投资规模和节能量。投资级的能源审计费用是项目成本的一部分，在项目实施后在项目收益中补偿给节能服务公司。如果具体的项目设计内容大体和原始的项目建议要求书中规定的内容一致，那么就可进行节能服务公司采购。投资级的能源审计过程中的详细调查结果可能与最初的项目建议书会有巨大偏差。此时，就需要进行谈判。如果偏差超出预先设定的担保节能量限制或者是其它的一些重要合同参数 [116]，公共机构项目业主甚至可以撤销合同，而不需向节能服务公司支付投资级的能源审计费用。如果这种两阶段过程经常导致无法签署合同，节能服务公司的投资级能源审计成本费用就不会得到补偿，这些风险会造成节能服务公司提高项目报价，增加项目总成本。为避免节能服务公司在投资级能源审计结束后大幅增加项目成本，项目建议邀请书中规定节能服务公司应在最初的项目建议书中承诺设备的单位价格和人力投入时间 [117]。

115. 参见能源领域管理援助项目：New e-Learning Course: Improving Public Sector Energy Efficiency.

116. 美国联邦能源管理计划以前的超级能效合同项目的规定的限值是 20%，现状公共机构可以自行指定（参见 Singh et al 2010, p. 114）。

117. 详细讨论参见 Singh et al 2010， p. 47 和 100/101.

4.40. 在最初的进入门槛上进行竞争而不是在每个项目上进行竞争。这种情形下，表 4.2 中前七步就可减少成更少的步骤了。减少竞争性的好处是明显地降低了交易成本，因为下属的各个公共机构不必每个项目都进行竞争性采购招标。这也避免了竞争招标中节能服务公司需要进行多次审计。两方面会影响成本。如果要求节能服务公司公开书面报价，节能服务公司可能就愿意从上级政府机构那里获得更加优惠的合同条款。但是许多专家认为单个公共机构组织的竞争性招标采购，由于有多个节能服务公司参与投标，这会降低项目成本。有许多在最初的进入门槛上进行竞争而不是在每个项目上进行竞争的措施例子。包括：

- 节能服务公司的资格预审，这是最常用的方法。牵头的部门通过竞争方式根据各公司的以往业务经验以及所提供的服务内容描述，选择一定数量的节能服务公司，比如说 8-16 家。这种方式缩小了潜在的服务提供方的专业领域范围，保证了节能服务公司的业务质量并规定了最低服务基准 [118]。公共机构然后就能从这些资格预审合格的节能服务公司中进行选择，而不必进行竞争性招标采购，（例如美国联邦能源管理计划实施的超级能效项目，参见专栏 4.1）；或者是从其中选择几家进行小范围的竞争招标采购 [119]。

- 另一种方案是某个部委或类似部门组织实施节能服务公司的招标，中标的节能服务公司可以在任何下属的公共机构开展合同能源管理项目而无需额外的公共采购。有趣的例子是匈牙利组织实施的名为〝孩子眼中的照明（Szemunk Fenye）〞项目，该项目涵盖 700 所中小学的 300,000 名学生，所有学校的采暖和照明系统的更新改造（后面的其它城市建筑物也合适）资金全部来自于中央政府预算，项目由市政府管理。教育部组织了集中招投标，对所有合同条款内容都集中统一进行谈判，包括采暖和照明系统的单位价格 [120]。

4.41. 上述措施方案的缺点在于：（1）限制了许多新组建或刚开始业务的节能服务公司的商业机会，他们只能成为大型节能服务公司的分包方；（2）由于项目缺乏竞争性，有项目成本增加的风险；（3）在组织实施一系列大项目或对许多小项目一次打包成大项目时，要寻找有足够资源和人力的节能服务公司有潜在的难度。

4.42. 由于各个投标单位投标书中提供的服务、设备和融资等内容都可能不同，这就造成合同能源管理项目**评标**变得很复杂。但是，透明进行评标，可以减少投诉。评标通常不能采用最低报价法。制定评标标准时，应考虑不同节能服务公司的标书通常包含有不同的投资规模和类型，包括不同的服务内容并且因此带来不同的收益。此时，评标不能采用最低报价法，而应采用寿命周期成本法（LCC）[121]，评标对比分析中应包括收益。多数专家认为能找到最好投标方的方法是计算拟将开展的项目净现值 [122]。净现值是项目节约量的折现净值的总和。

118. 例如，参见华盛顿州对今后从事超级能效合同项目的 14 家节能服务公司的资格要求的介绍：http://www.ga.wa.gov/EAS/epc/SOQ/Cover.pdf，资格要求的例子参见 http://www.ga.wa.gov/EAS/epc/RFQ-Sample.doc

119. 例子参见伦敦发展署的 RE:FIT 项目发布的节能新闻： 2.7 million energy makeover for London′s public buildings.

120. 中标联合体由一家节能服务公司、一家商业银行以及三家设备供应商组成。国际金融公司（IFC）向银行提供了 50% 的风险分享基金，这反过来为节能服务公司提供了贷款（2.5 亿美元）。联合体向各个城市推销项目、与各个城市签署服务 / 租赁合同、为照明和采暖节能提供融资并组织实施、担保节约量、从城市获取一笔固定费用用于支付项目服务工作。在该种模式下，由于节能服务公司作为总的服务集成方，这降低了各城市以及金融机构的交易成本。教育部负责管理运行一个资料信息技术系统，各地的公共机构可以申请加入该系统，但需要提前进行资格审查。教育部还负责项目节能效果和影响的监督评估。参见 IFC, OTP Local Institution Energy Conservation Program. 取得经验教训有：（1）加强在服务供应商采购和管理环节与终端用户的紧密接触，比单纯由中央政府的采购做法要成功得多；例如地区政府根据学校实际运算进行的采购；（2）美国经验特别表明：相比于选择单个的节能服务公司，公布节能服务公司短名单更有利于项目业主、增加业主对项目的控制（业主有一定的选择自由度，这只从社会学角度较好，但在节能服务公司之间有一定的竞争性对于成本的控制是非常重要的）；（3）节能服务公司实施项目的能力以及要求业务覆盖全国是另一个重要的因素，这在仅有 1000 万人口的匈牙利能做到；但在较大的国家就需要几家节能服务公司。资料来源：与 IFC 的 Martin Dasek 个人交流。

121.LCC 综合考虑投资的资金成本以及资产全寿命期内的运行维护成本。作为许多国家公共机构可持续性承诺的一部分，LCC 正逐步成为公共采购制度中设备和服务采购评估的一项标准。例如，美国各级政府、欧盟成员国、英国等，参见 Meyer 和 Johnson 2008，Energy Efficiency in the Public Sector—A Summary of International Experience with Public Buildings and Its Relevance for Brazil.

122.NPV 是指一段时间内，以当前货币价格计算，估计的成本和收益流；计算中将设备按合适的寿命期进行折旧计算、考虑通货膨胀因素、还需要其它一些参数，如初投资、能源节约量、合同期、设备的寿命期等（Singh et al 2010, p. 99）。

4.43. 如果项目不采用竞争性招标方式，项目业主最好是在项目协调员或采购单位的帮助下，先对所有合同条款深入评审，包括价格以及节能服务公司增加部分的验证，然后才和选定的节能服务公司进行详细具体地合同谈判。美国建议对如下合同条款进行核查[123]：

- 业主（开展项目的公共机构）应充分了解各种节能措施；
- 项目业主应验证报价是否公平合理，可采用 RSMeans®（http://rsmeans.ReedConstructionData.com/）建设成本数据或类似的数据资源比较成本；
- 应从设备供应商处验证价格增加比例；
- 工程和设计的时间以及费用是否合理？
- 在不影响质量或效果的前提下是否有可能降低成本？
- 设备安装进度是否合理？
- 项目管理时间和成本是否合理？

项目打捆

4.44. 公共机构合同能源管理项目很难实现足够的规模效益。合同能源管理项目的交易成本相对较高，略微扩大一点项目规模，就会增加交易成本。因此建议节能服务公司仅介入那些有一定建筑或资产规模或者是基准能耗或能源成本相对较大的项目。所建议的单栋建筑合同能源管理项目最小规模范围各地都不同，从加拿大联邦政府[124]建筑物规定的年度能源费用不低于 10 万美元到德国市政府规定的 20 万欧元不等。中国由于能源价格相对较低、而且项目开发成本也可能较低，因此项目最低规模的要求也会相应较低。但是，对中国大多数单体建筑来说，合同能源管理并不会是一个好的方案，特别是那些既无采暖又无空调能耗的建筑尤其如此。

4.45. 但是，如果将许多项目打捆成大项目然后与节能服务公司签署合同，就能对小型建筑物组织实施节能项目。当技术措施基本一样时，项目打捆就有意义了。这就有可能缩减能源审计费用，例如仅对一栋有代表性的建筑物进行能源审计，或者是对设备进行大宗采购。最好是将同一管理或所有权的建筑物进行打包，这在管理以及财务处理上就容易得多（参见表 4.4）。相应地，将建筑物打包成一个合同能源管理项目有助于降低如下成本实现规模效益：（1）项目开发（招标和能源审计）成本；（2）通过大宗采购的方式组织实施项目；（3）合同管理。打捆方式也能推动将投资回收期长但有价值的项目与快速收回投资的项目进行组合，生成一个有吸引力的混合型项目。有时项目打捆也有助于小型的节能服务公司作为项目分包方，在大型节能服务公司的总体管理下成长获取业务经验。

4.46. 欧洲一些国家项目打捆的做法很普遍。德国，尤其是柏林，就是一个典型例子（参见专栏 4.4），但奥地利、捷克、瑞典和其它一些国家也存在[125]。例如在法国[126]的一些地区或者美国（如巴尔的摩 / 马里兰州[127]）的一些学校区域，许多不同国家将中小学的节能项目打捆成大的合同能源管理项目。这些项目大都在项目协调员的支持下组织实施，并受益于标准化的合同模板和其它相关文件。

123. 见 FEMP, Negotiating and Entering into an Energy Savings Performance Contract.

124. 见能源效率局，The Federal Buildings Initiative: An Executive Overview. 但也在考虑能源足迹较小的建筑物。例如，分布在美国科罗拉多州、爱达荷州、蒙泰纳州、内华达州、俄勒冈州以及怀俄明州等地的国土管理局的小型建筑，每年电费仅 1000 多美元，但被打捆成了一个超级能效合同项目。遇到的问题是节能服务公司在许多遥远地方开展能源审计时如何能有效地降低管理费用和工程费用。最初，这些地方按照“工程性质的”或者“指定性质的”方式进行归类。前者需要进行投资级的能源审计，后者仅对照明和暖通空调控制系统进行快速评估。由于发现后者太粗浅，后来要求对照明和暖通空调控制系统进行详细调查。节能措施包括：照明及附属控制装置、暖通空调控制系统、暖通空调数字控制器系统的升级、新的锅炉、地源热泵、以及安装高级的计量仪表（见 EPAct 2005）。参见 FEMP, Bureau of Land Management: A Successful ESPC Across Six States.

125. 见 http://www.european-energy-service-initiative.net/

126. 见 Leroy 2010, Good practice examples High schools in Alsace Region.

127. 巴尔的摩城市公立学校项目是根据学校的水电费来选择学校的。在四个合同能源管理项目中共包括 160 所学校，项目成本（包括预防性维护）总额为 1.06 亿美元、能源成本担保节约量为 480 万美元。参见马里兰州能源管理局 ,Energy Program for Baltimore City Public Schools.

专栏 4.4：将单个节能项目打捆成合同能源管理项目—例如柏林节能伙伴项目

柏林州背景介绍：

- 二十世纪九十年代初期的情形：政府财政预算吃紧；缺乏经费来源；相关能源费用较高（大约 2.55 亿欧元）；节能潜力平均大约 30%；
- 柏林上院、卫生部以及环境和消费者保护部的决策：所有消费领域 2010 年二氧化碳减排目标在 1990 年基础上降低 25%；调整后的 2020 气候保护概念：2020 年二氧化碳减排目标为在 1990 年基础上降低 40%。

柏林公共建筑合同能源管理—1996 年以来取得的成绩：

- 将 500 多家单位（超过 1300 栋建筑物）打包成 25 个合同能源管理项目；每个打包项目包括 20 栋建筑物；
- 私人的节能服务公司投资规模为 5160 万欧元；
- 担保的能源成本节约量为 1170 万欧元（26%）；
- 柏林州政府年度分享的能源成本节约量：270 万欧元；
- 总的二氧化碳减排量（1996–2010）:50 万吨
- 平均合同期：12 年

最佳实践案例—Steglitz– Zehlendorf 地区（第 19 个打捆项目）

- 打捆项目：区政府所有的 69 栋建筑物（中小学、幼儿园、体育场馆）
- 基准：每年 184 万欧元
- 担保的节约量：每年 29.4 % = 541,679 欧元；
- 投资：约 280 万欧元；
- 二氧化碳减排量：每年 3,973 吨；
- 合同周期：14 年；
- 节能措施：11 栋建筑物安装新锅炉，将燃煤供热锅炉改为燃气锅炉，安装建筑自动化设备；更换照明灯具；可再生能源技术投资 10 万欧元，如太阳能集热系统。

建筑物打捆原则：

- 1 个合同目标（所有的单位都打包在该合同中）；
- 1 个能源成本基准（单个单位的能源成本总额）；
- 1 个客户（在协调方面有用）；
- 1 个合同；
- 1 个合同方；
- 1 个担保的能源成本节约量；
- 1 个节约量分享参与方（各单位内部进行分配）。

适合打捆为合同能源管理项目／参与项目的单位条件（在将单位纳入打捆项目之前的单位审查）：

- 最小项目规模：基准期的能源成本费用大于 25 万欧元；
- 建筑物应在合同期内连续使用（即至少 10 年）
- 过去数年的能耗用量相对固定；
- 如果建筑物内涉及到不同单位且建筑物并不归自己所有的，那么应有自己能源计量；

- 具备管理集中供热设备的能力。

节能服务公司的业绩经验

- 规模较大的国家级节能服务公司或者是规模较大的全国性公司的专业部门；
- 是承担 25 个打捆项目中的 14 个节能服务公司（部分是合资公司）之一；
- 总计有组织实施节能措施和运行维护管理的 100 个分包方（地区性的中小企业）；
- 有合同实施过程中改善质量的经验；
- 在过去能解决所遇到的所有问题，而未产生项目安全的问题。

经验教训

- 应有足够的时间对所需的节能措施进行调整；
- 加强与客户和合同方之间的沟通交流；
- 当基准条件（如建筑用途）发生变更时，应与客户和合同方之间进行沟通讨论；
- 在整个合同期，有可能实施其它的节能措施；
- 实际节能量大都在担保范围之内或者是更高；
- 当合同范围扩大或在重新招投标后，节能量甚至可能会增加；
- 标准化的程序和合同对项目组织实施的及时性、有效性和可靠性方面非常重要；
- 增强竞争和透明度有利于降低成本。

驱动力

- 节能主管相关单位政府决策人员的推动；
- 愿意进行私有化；
- 项目协调员（柏林能源署）对项目开发和实施的支持。

资料来源：Gei ler 2010, Energy services Hotspot Berlin as a national and international role model; Schlopsnies 2011, Berlin Energy Saving Partnership 15 years — from model to project success ("15 Jahre Berliner nergiesparpartnerschaften vom Modellprojekt zum Erfolgsmodell"), Singh et al. 2010, Public Procurement of Energy Efficiency Services — Lessons from International Experience.

4.48. 建筑领域的合同能源管理项目一般都是由单一的节能技术项目开始。北美或欧洲，最初实施的都是照明节能改造、锅炉更换、暖通空调以及建筑控制方面的项目。例如，美国在二十世纪九十年代，公共机构领域的合同能源管理项目 20% 都只是照明节能改造项目 [128]。

4.49. 目前中国建筑领域的合同能源管理业务还处于初期发展阶段。项目都局限于仅仅关注具体且直观的用能系统，项目投资回收期相对较短，特别是照明节能改造项目，大多采用规定的节能量模式，很轻松地就实现节能效果 [129]。也很容易在众多的类似客户中推广复制项目。其它国家的经验表明：建筑物用能系统，如照明和暖通空调的技术节能潜力范围在 10-30%。如果项目合同期间能源成本节约的 20% 或者更多返还给项目业主，由于财务回报率较高，中国节能服务公司也能在三年或更短的时间内收回全部投资和利润。这种项目是最容易下手的项目，有较高的投资回报率并且投资回收期很短。

4.50. 仅对那些简单好做、投资回收期短、回报率高的项目进行投资，这不利于组织实施那些节能量大、投资回收期长、长期收益相对较差的项目，随着项目经验的积累，北美和欧洲的大多数公共机构业主开始关注这一问题。因此，目前已越来越多地将那些投资回收期短的节能措施与投资回收期

128. 见 Hopper et al. 2005, Public and Institutional Markets for ESCO Services: Comparing Programs, Practices and Performance.

129. 具体定义参见脚注 140。

较长的节能项目平衡捆绑，形成仍能满足整体盈利预期和合同期的综合性项目[130]。

4.51. 与中国不同的是，美国和欧洲过去 10 至 15 年内的大多数公共机构合同能源管理项目的合同期都在 10 至 25 年，项目投资规模数百万美元或欧元，节能效果都在 20-40%。这些项目涉及了大范围的节能措施（例如，专栏 4.5 介绍的德国医院项目采用了 120 项单独的节能措施），覆盖了众多耗能设备以及建筑围护结构的节能措施，如建筑外窗更换和保温。最近，可再生能源的应用也纳入了合同能源管理范围，特别是美国公共机构经常为所要求的一些投资回收期长的节能措施，如建筑外窗的更换等提供配套经费，否则节能服务公司开展合同能源管理项目时不愿意将这些投资回收期长的措施纳入合同范围。

4.52. 采用合同能源管理方式组织实施综合性的节能项目时，需要满足以下条件：

- **合格的节能服务公司应具备为复杂的长期项目提供设计、融资以及各种相关服务的能力。**现有市场中的节能服务公司应有能力从事：（1）涵盖各种节能措施的综合项目设计和实施工作；（2）有强大的融资能力（从股票市场或债务等方式融资）[131]；（3）能提供运行维护服务或者对现有建筑管理人员进行培训和监管；（4）组织实施复杂的节能措施并进行效果验证（参见 4.59-4.61 部分）。大多数国家，具备上述条件的公司数量是有限的。美国实质上仅有 10-15 家公司能通过资格预审列入节能服务公司名单，并在联邦政府或州政府机构建筑组织实施项目。德国的柏林州，通常有 2-6 家节能服务公司参与打捆项目的招投标；在 1996 年至 2010 年期间，14 家节能服务公司组织实施的节能打捆项目有 25 个（参见专栏 4.4）。

- **修订的法律法规以及建立的组织框架应有利于长期合同能源管理项目的实施。**如果法规或管理规定制定过程中规定了最长的合同能源管理项目合同期，那么所规定的最大合同期应大于节能措施所预期的经济寿命（或正常投资回收期），这对公共机构项目业主来说是相当重要的。例如在美国，为了对综合性的节能项目或者涉及中央暖通空调设备的更换改造，合同期就需要超过 15 年[132]。还应考虑的一些其它因素包括：长期合同是否能够执行、节能服务公司和项目业主是否能够正确降低较长时期项目的风险等。

- **能耗较高和用能相对稳定的建筑物。**应把综合性合同能源管理项目的工作重心放在那些一年到头 24 小时使用、能耗和能源成本费用都较高的建筑物，如医院等，而不是把工作重点放在能源使用和能耗都有限的小型建筑物，如中小学等[133]。专栏 4.5 给出了德国医院（Bremerhaven）作为一个相当典型的合同能源管理项目例子。

4.53. ***研究团队建议：中国组织实施综合性节能项目应是今后支持的重要方向。但大多数节能服务公司需要花较长的时间，才能培养具备集成项目的必备技术能力以及从事长期合同项目的财务实力。***

130. 更一般的是，建筑和气候变化专家指出：现有建筑如果要实现 UNFCCC 谈判中目标，需要在 2050 年节约 80%。例如，参见国际能源署全球能源展望，(http://www.worldenergyoutlook.org)。

131. 美国 MUSH 建筑领域的合同能源管理项目，通常是公共机构资金筹集筹集，原因是融资成本比死人的节能服务公司要低；见第三章。

132. 见 Bharvirkar et al. 2008, Performance Contracting and Energy Efficiency in the State Government Market.

133. 中小学通常是综合性相对较高的合同能源管理项目开展的主要目标，通过合同能源管理项目能升级基础设施并对建筑维护进行改造。例如，法国的 Alsace 地区，对校园面积总规模为 19 万平方米的 14 所学校实施了合同能源管理项目，投资总规模为 300 万欧元。采取的节能措施包括：木材锅炉、热泵、新的锅炉、集中供暖管网连接、保温、建筑外窗和光伏发电。该地区为可再生能源发电提供补贴。见 Leroy 2010, Good practice examples High schools in Alsace Region.

专栏 4.5：德国医院（Klinikum Bremerhaven Reinkenheide）综合性合同能源管理项目的例子

一家综合性的、私营非盈利的医院（gGmbH），100% 归 Bremerhaven 城市所有，710 张床位，每年总的能源成本费用为 8000 万欧元，其中 80% 的费用都是私人费用。

合同能源管理项目流程（总共 8 个月时间）

- 数据收集和分析：在不莱梅能源署的支持下由医院技术人员自己完成，每个月医院交 2 笔费用：电费和集中供暖费用，无分项计量；确定了最小的能源成本节约率（25%）以及所要求的节能措施；
- 在不莱梅能源署支持下，面向欧洲范围进行招标采购；
- 竞投兴趣表达书：13 份
- 短名单：11 家公司，走访式能源审计（一至几天）；
- 招标：4 家公司竞标；评标标准：节能量、总投资；
- 和 2 家投标单位进行首轮谈判；
- 和 1 家投标单位进行第二轮谈判；
- 和节能服务公司签约。

合同期	12 年（2008–2019）
投资额（合同方）	520 万欧元
所要求的节能措施投资额（医院）	26.5 万欧元（在合同期内总支出）
2004 年能源成本（基准）	206.5 万欧元（净现值）
担保的能源成本节约量	25.6% = 52 万欧元（多余的节约量按 60:40（业主：节能服务公司）比例分享）
实际节约量	能源成本节约率 35–40%；节约 40% 能源，其中 65% 的蒸汽、42% 的采暖能耗、14% 的电力
二氧化碳减排	2635 吨 / 年（实际 2950 吨 / 年 =30%）

节能技术措施和管理软措施（共计 120 项）

- 节能
  - 暖通空调：安装新的空调 / 通风系统（带需求侧控制）、新型的制冷吸收螺纹制冷片、变频装置、电力负荷管理系统；
  - 新建建筑自动系统，包括峰谷负荷管理，能进行自动数据采集和月度能耗分析；
  - 采暖系统优化（需求端控制）、安装新的热回收系统；
  - 节能灯具；
  - 节水措施（低流量水龙头）；
  - 对医院人员进行用户动员培训；
- 医院要求的节能措施（总投资额：200 万欧元，其中合同方提供 2/3 的资金）
  - 安装新的低压电力输配系统；
  - 安装新的杀菌系统；
  - 安装新的集中制冷生产设备；
  - 为主要的厨房安装新的洗碗机；
  - 分离医用和技术用的空气压缩设备，包括新安装医用空气压缩设备。

医院的技术人员负责运行维护，对新设备的使用由节能服务公司提供培训。

测量与验证：承包商负责节能量的测量与验证，并远程获取所有的数据。医院有外部控制器。基准期的能源成本根据建筑物的使用情况和实际度日数进行修正；假定能源成本年增长额为 4%（实际能耗是增长的，因此能源成本节约量是相对较高）。医院负责向节能服务公司通报建筑物用途及耗能设备重大变更情况。

资料来源：Breuer 2008，Energy Performance Contracting in Hospital Bremerhaven Reinkenheide ("Energiespar—Contracting im Klinikum Bremerhaven Reinkenheide “)，personal communication Juergen Breuer，Klinikum Bremerhaven Reinkenheide，April 2011 (http://www.klinikum—bremerhaven.de/)

节能量的测量与验证（M&V）

4.54. 节能从定义上来看，是指不用能或少用能，节能效果是不能直接测量获得的。对一个典型的节能改造项目而言，节能量是通过对一个用能设施，或者是用能设施内的某一个系统，在采取节能措施前（基准）后（改造后）的能源消耗对比基础上获得的。如果用能设施的条件发生改变，节能量的测量和验证（M&V）也必须反映这些变化。

4.55. 随着中国节能服务产业的持续发展，尚待开发的巨大的公共机构合同能源管理市场也即将面临节能量测量与验证的问题，而节能量测量与验证在证明并展示合同能源管理项目所取得节能绩效收益方面是至关重要的。合同能源管理项目的基本思路是利用担保的节能量去弥补节能融资、安装、运营维护等相关成本。而合同能源管理项目同时也只有在节能服务公司与项目业主之间共同努力、保持良好的合作关系以及建立互信的基础上才能顺利实施。节能服务公司和项目业主双方之间发生利益冲突的情况并不少见，特别是当建筑物材料发生变化或者基准能源消耗发生了调整[134]时，更容易发生利益冲突。

4.56. 对公共机构节能项目节能量进行准确测量与验证，可以有如下好处：

- 有利于**政府**对如下内容进行评估：（1）公共机构能源效率和节能项目的成本效益和影响；（2）项目对国家总体节能和二氧化碳减排承诺的贡献率；（3）制定进一步提高和推进公共机构节能的相关政策工具。
- 有利于**公共机构**（或公共建筑业主）及时获得并准确反馈政府财政支持的节能项目的性能、改善或调整建筑物的运行管理以便最大限度的节能、为其它目的或财政预算要求提供合适的能源成本节约量。
- 有利于**节能服务公司**采用双方认可且权威的方法证明合同能源管理项目的节能效果，并将其作为按绩效进行的费用支付或分享效益，因此可帮助进一步推动合同能源管理业务的透明性、权威性以及可见性。
- 如果有**金融机构**介入，那么有助于金融机构提高对节能项目的信心、加强贷款项目的资金安全。

4.57. ***国际节能量测量与验证协议和指南。***国际上，有三个广泛采用的节能量测量与验证的框架，可将其用于中国公共机构节能项目节能量的测量与验证工作中[135]：

134. 材料改变可定义为建筑物内的任何结构或运行变化，这可能造成能耗的重大增加或减少，超过了合同能源管理项目的范围。修正是指对已知的或者双方同意的建筑物变化，这不属于能源改造项目的一部分，也不是由于改造项目造成的，如运行时间或工作计划的改变、建筑活动的改变、建筑规模或配置的改变等。

135. 最近，向国际标准化组织提交了一项标准提案，提案名称为〝改造项目、工业企业以及区域项目节能量确定的一般性技术规定〞。该提案对口的技术委员会（ISO TC 257）的秘书处是中国的标准化委员会。

- IPMVP 第 I 卷：确定节能量和节水量的概念与方法 [136]；
- 节能量测量与验证指南：联邦能源项目测量与验证 3.0 版（美国联邦能源管理计划）[137]；
- 美国供暖、制冷和空调工程师协会（ASHRAE）指南 14：节能量和能源需求节约量的测量 [138]。

4.58. ASHRAE 指南 14、IPMVP 第 I 卷以及联邦能源管理计划的测量与验证指南，都是为量化节能项目节能效果提供指南和指导的补充性文件。但是，这三个协议之间也有区别，例如，IPMVP 为节能量测量与验证制定了一般性框架和术语，而 ASHRAE 指南重点关注具体的技术层面。IPMVP 是一个概念性的框架内容，用途广泛；而 ASHRAE 指南提供了利用框架执行测量与验证计划的细节。

4.59. ***基本的测量与验证概念和方案。*** 三种国际性的节能量测量与验证指南都建议了四种类型的测量与验证选项方案。其中只有 ASHRAE 指南没有 A 类型的方案。每个节能量测量与验证选项根据现场具体参数以及公共机构建筑管理的实际需求和预期的不同，各有其优点和缺点。表 4.2 给出了 M&V 的四种方案。

表4.2：M&V的四个选项说明

M&V 选项	说明
选项（A） 单独改造 （测量主要参数）	对采取节能措施的用能系统的部分能耗数据进行现场测量，在剔除用能设施其余能耗的基础上确定最终节能量。测量可是短期也可是连续性的。可规定仅测量部分而不是全部参数 [139]。
选项（B） 单独改造 （测量全部参数）	对采取节能措施的用能系统的全部能耗数据进行现场测量，在剔除用能设施其余能耗的基础上确定最终节能量。改造结束后整个过程进行短期或连续性测量。
选项（C） 整个用能设施	对整个用能设施的能耗情况进行测量后确定节能量。改造结束后整个过程进行短期或连续性测量。通过对采取节能措施前后的能源费用账单评价分析获得节能量。
选项（D） 校准模拟	通对用能设施的部分或全部系统的能耗状况模拟确定节能量。模拟程序应是经过实践验证证明足以反映用能设施的实际能源绩效水平。

资料来源：作者，依据三种协议

4.60. 一般而言，节能量测量与验证选项的选择取决于许多参数，如项目成本、预期节约量、合同期、效益分享比例、以及不确定性因素或者风险等。节能量测量与验证的费用预算为年度能源成本节约量的 2% 至 14%（单凭经验的做法是测量与验证成本不应超过年度能源成本节约量的 10%）[140]。选项 A 和选项 B 的费用一般小于选项 C 和选项 D。在美国组织实施的 128 个联邦超级能效项目中，选项 A 是迄今为止应用最广的测量与验证方法（80%）、紧随其后的是选项 B（13%）、选项 C（2%）以及选项 D（5%）[141]。

4.61. 四种测量与验证选项适用于计划任何类型的节能改造项目，但是表 4.4 凭经验给出了各种应用途径中最合适的测量与验证方法。

136. 见 IPMVP 公共图书馆文件 , Concepts and Options for Determining Energy and Water Savings - Volume I.

137. 见 FEMP, M&V Guidelines: Measurement and Verification for Federal Energy Projects Version 3.0.

138. 参见 ASHRAE 出版物：ASHRAE Guideline 14-2002 Measurement of Energy and Demand Savings.

139. 规定是一种合约机制，合约双方的约定值，该值与实际测试结果无关。能耗、能源费用、运行时间、运行方式等参数可在合约中规定。双方可接受的规定格式包括工程分析、基于测试的模型、厂商数据、标准表格以及企业日志。不能接受的格式包括无档案记录的假设、专有算法、口头协议、参数猜测、基于有问题的数据的模型等。

140. 参见 Jump and Stetz 2000, Initial Application of the FEMP Measurement & Verification Guidelines in Super ESPC Delivery Orders.

141.Shonder et al. 2010, Reported Energy and Cost Savings from the DOE ESPC Program.

表4.3：M&V选项的经验选择

M&V 选项	典型应用
• 单独改造	✓适用于简单的设备改造项目，这种项目的节能量小于建筑物相关水电仪表或分项计量仪表读取的总能耗的 20%； ✓单项措施的节能值只是理想值，可忽略交叉影响，或者可对影响进行估算而不必进行长期测量； ✓影响能耗的独立变量不太复杂、监测难度不是过大或者过分昂贵； ✓有记录子系统能耗的分项计量仪表。
• 整个用能设施	✓设备更换和控制项目非常复杂； ✓预期节能量比有关水电仪表或分项计量表记录的能耗数据要大很多（大 10% 到 20%）； ✓单项措施的节能值无法获得； ✓需要考虑交叉影响的问题； ✓影响能耗的独立变量不太复杂、监测难度不是过大或者过分昂贵；
• 校准模拟	✓涉及到新建建设项目； ✓能获得单项措施的节能量理想值。

资料来源：作者，依据 FEMP，M&V Guidelines：Measurement and Verification for Federal Energy Projects Version 3.0.

4.62. ***中国的节能量测量与验证。***中国目前由于缺乏能耗计量和分项计量，特别是采暖计量（参见 3.57 部分），限制了测量与验证选项的选择。中国过去的许多合同能源管理项目，约定或者双方认可节能量是最普遍的测量与验证方法[142]，这是迄今为止确定节能量所花费用最少的方法。约定是一种降低项目成本的有效方式，但过度使用或滥用约定方法会增加节能量的不确定性。前面提到的三个国际协议中的任何一个中推荐的测量与验证选项都不包含单纯的约定方式。随着中国合同能源管理机制的日益成熟，市场参与各方，特别是公共机构及其主管机构，会越来越要求或需要根据水电费测量或者确定节能量的一些先进的测量与验证方法。

4.63. ***谁应开展测量与验证？***理想情形是，测量与验证是节能服务公司和公共机构（或建筑业主）之间应共同开展的工作。节能服务公司最适合组织实施测量与验证工作，因为在实施任何合同能源管理项目之前，节能服务公司一般都要对建筑物进行能源审计，确定能耗基准，分析节能措施的经济性，计算潜在的节能量。在此过程中，节能服务公司获得了建筑物运行的第一手资料。节能服务公司同时还有能力将测量与验证活动打包进所提供的能源总服务工作中。建筑物业主通过提供相关的能源或水电费数据、调查建筑设施或设备、采用正确的次序和条件维护和运行合同能源管理涵盖的设备或系统等，全方位支持节能服务公司开展测量与验证工作。节能服务公司和建筑业主都应跟踪记录所有重要的能耗基准数据，弄清楚能耗增长或降低的原因并对能耗基准进行相应的调整。如果公共机构有一个技术团队帮助界定或评估测量与验证结果，此时就不需要第三方的监督或节能量顾问[143]，因为第三方的监督或节能量顾问只是额外的增加了项目成本。如果对节能量测量与验证结果意见不统一，合同能源管理就应包含争端解决的过程。

4.64. **研究建议：**研究团队建议应节能量测量与验证方法应简单实用，费用较低，但也应确保满足用户对节能量测量与验证的需求。中国节能主管部门和节能服务公司的专家应学习借鉴其它各国的经验。

142. 美国节能联盟和国际效率评估组织（EVO）建立了节能量测量与验证人员认证（CMVP）项目，有两方面的目的：一是对能源行业节能量测量与验证高速发展领域的最合格的专业人员进行认可表彰；而是提高节能量测量与验证领域的总体专业水平（http://www.aeecenter.org/）。北美的多数节能服务公司的团队中都有 CMVP 人员，这样也加强节能服务公司向其合同能源管理项目以及第三方提供节能量测量与验证服务的能力。

143. 参见 Sun et al. 2011。

第五章：各行政管辖范围节能措施及优先工作建议

5.1. 本章总结了研究团队提出的加强中国“十二五”时期公共机构节能的政策建议。在对政策制定、工作指导和政府支持等相关活动讨论基础上，按不同行政管辖范围的方式提出了节能行动措施建议，各行政管辖范围都有具体负责的主管部门，并具体负责一个具体的公共机构子领域。2.20 部分介绍了主要的公共机构节能主管部门及其具体的管辖范围。从表 5.1 也可推断了解它们的职责内容。

政策制定、工作指导和政府支持的重点内容

5.2. 中央、省和各地政府的核心任务是建立健全公共机构节能推进的工作体系，重点包括节能目标的设定和监督考核、能耗的测量、能耗数据统计报告以及公共机构节能机构和管理体系的其它相关内容（参见 3.4 部分）。应进一步加强相关政策和法律法规的研究制定工作，确保公共机构节能，特别是各地节能工作的正确推进。尽管“十一五”期间已经建立了基本的制度框架体系，但与其它领域的节能主管部门相比较，国管局节能工作启动相对较晚，工作体系尚不健全。大力提高国家、省及地方各级能源管理人员的节能专业技能工作，是节能成功的重要保证。

5.3. 随着节能政策法规的不断制定和完善，应大力加强技术指南、节能手册、模板以及其它形式指导材料的制定和发放工作，指导节能主管部门和公共机构能源管理人员的日常工作，确保节能政策法规的各项要求落到实处。各种指导性文件是编写各种培训材料、组织开展各项培训工作的基础（参见 5.7 部分）。当务之急首先应加强以下领域的技术指南、节能手册、模板等相关材料制定工作：

- 能源管理——公共机构不同行业领域科学进行能源管理的工作范围、工作途径和工作方法；
- 能源审核员和能源审计——确保能源审核结果满足符合性要求和最低质量要求的能源审核指南，尤其应关注针对具体审核项目特定目标的能源审计；
- 用能设施和能源消耗基础数据收集——应针对全国不同性质的公共机构制定统一的指南，确保采用统一的统计方法和标准化的数据采集协议，实现能耗统计数据的可比性和可靠性；
- 能耗测量——公共机构用能设施的用电量和采暖计量的具体技术指南，包括分项计量和智能或逐时计量；
- 对标——根据现有商业建筑监测或节能改造项目的试点情况，明确能耗对标的统一程序、建筑分类、性能指标以及其它相关参数；
- 建筑能源管理——空调、锅炉和采暖系统等重点用能系统的运行和维护管理；
- 节能改造项目和节能工程影响评估——针对节能改造项目和节能工程，系统客观地开展节能效果和投资收益评估，为今后改进和强化相关工作提供参考；
- 合同能源管理——制定合同能源管理指南，包括节能服务公司的选择、合同能源管理项目合同模板、节能量的监测和验证方法等。

5.4. 制定公共机构节能留成政策，特别是合同能源管理项目中允许至少保留部分节省的能源费用，是当前合同能源管理市场机制培育推广急需制定的一项具体政策措施。2010 年国务院有关合同能源管理的政策文件特别明确了这一点（参见 2.27 和 4.12 部分），但尚需制定出台贯彻落实该规定的具体政策措施。相关中央政府节能主管部门牵头制定合同能源管理实施指南，有助于合同能源管理的推广应用。省级政府部门，特别是省财政厅，应制定具体的政策措施帮助感兴趣的公共机构组织实施合同能源管理项目。

5.5. 公共机构节能工作的开展急需政府财政预算经费的支持。中央和省级政府已经建立了节能专项资金。应在节能专项资金中安排部分资金用于公共机构节能工作（参见 3.84 部分），尤其是应重点支持以下三方面的工作：（1）节能示范项目（参见表 3.1）；（2）对部分节能设备或农村中小学等融资困难的公共机构实施针对性的节能补贴政策，降低初始投资费用；（3）一些比较重要的“软”投入工作，包括统计报告制度的建立、计量仪表的安装、能源管理师的培训、能源审计、各个公共机构节能方案的量身定制、以及节能效果的监管等。这三方面对公共机构节能工作的深入开展非常重要，但如果没有专门的经费支持或者专门的财政预算经费，人们很少会开展这些工作。此外，应在省及地方不同行政管辖范围层级上考虑建立用于节能投资的滚动资金（参见 3.96 部分）。

按部门和行政管辖范围建议的节能优先措施

5.6. 应按各个具体的行政管辖范围，如中央政府机关建筑物、地方政府机关建筑物、大学、中小学和医院等，组织开展一些具体的节能工作。尽管有些节能措施适用于所有的公共机构，但有些节能措施仅适合于一些特定的行政管辖范围。表 5.1 汇总了第三章和第四章建议的一些主要节能措施。表中第一部分介绍了所有公共机构都应采用的节能措施，在其后部分介绍了不同行政管辖范围应采取的其它节能措施。第三章和第四章详细介绍了各项节能措施的具体内容。

表 5.1：按行政管辖范围建议的节能优先措施

行政管辖范围	负责单位	具体措施
所有	所有应承担节能义务的公共机构	1. 针对如下四类单位的决策人员、主管领导和专职人员开展节能培训和能力建设工作：政府官员和所在单位领导，能源管理部门，第三方技术和服务机构，以及租户 / 用户 / 产权单位。 2. 配置合格的能源管理人员（包括职责、资格条件和培训）。同时也应评估是否可把能源管理师扩展为广义的可持续管理师（负责能源 / 水、资源循环和其它“绿色”管理）范畴。 3. 组织开展机构形象相关的奖励制度。 4. 健全能耗统计和计量制度，实施能源审计，策划符合机构实际情形的节能项目，按不同行政管辖范围组织开展能耗对标工作，对节能效果进行持续评估，开展节能信息传播和意识提高等活动。 5. 在一些主要的行政管辖范围组织实施重大节能示范项目。 6. 大力加强省际间以及国际间的信息传播和交流。
中央政府机关	国务院机关事务管理局	6. 加强与能源费用支出上限挂钩的能源消耗定额制度研究和制定，并组织实施试点； 7. 在一些重点建筑物组织开展能源计量、包括能源分项计量试点； 8. 持续改进和完善能耗数据在线统计、报告和分析制度； 9. 传播涵盖能源管理和节能技术的最佳实践案例； 10. 为用能单位实施合同能源管理项目提供项目实施全过程的技术援助服务。项目全过程包括能源审计、节能服务公司的选择、政府和商业融资服务、政府资金的申请、节能量测量与验证等。

行政管辖范围	负责单位	具体措施
省级和地方政府机关	省级和地方相应的机关事务主管部门	1. 按“十二五”节能目标制定节能规划 2. 加强与能源费用支出上限挂钩的能源消耗定额制度研究和制定，并组织实施试点； 3. 组织实施简单的能源审计，制定适合公共机构自身特点的节能行动方案，编制完成节能改造项目建议书； 4. 北方地区组织实施供热计量和基于实际消耗的采暖收费工作； 5. 通过政府采购制度组织开展合同能源管理试点； 6. 指定合同能源管理技术服务单位，为各级公共机构提供技术支持
大学	教育部，省教育厅，大学代表	1. 在教育部的支持下，联合感兴趣的大学、以大学节能自愿承诺为加入条件，组建“大学节能联盟”（或“绿色大学联盟”） 2. 组织开展综合性的能源计量，包括分项计量试点工作； 3. 进行节能奖励试点。如可能的话，可包括节能设备奖励，即对取得显著节能效果的单位，可奖励高性能的节能设备，而节能设备的资金可从节省的能源费用中支付。 4. 倡导组织开展单位内部的节能竞赛和表彰活动。
中小学	省级和地方教育主管部门（接受教育部业务指导），中小学所在地区代表	1. 在中小学校舍翻新改造中考虑节能和可再生能源的应用，特别是有采暖需求的北方地区和农村地区。 2. 如果可能，组织实施合同能源管理节能改造示范项目， 3. 将节能活动和节能教育纳入学校课程中。
医院	卫生部，省卫生厅，医院协会及相关代表	1. 开展先进的能源计量试点活动，为医院建筑物能源审计提供全面系统的能源基础数据； 2. 选择部分医院精心组织实施带有监督性质的能源审计试点，包括一些特殊的和复杂的要求，组织实施具体的节能改造试点项目并评估试点效果。编制节能实践案例并通过合适途径传播实施经验。 3. 参照大学的建议，组建“医院节能联盟”（或绿色医院联盟） 4. 汇编合同能源管理实践案例，包含医院节能技术方案和实施综合性节能改造经验教训的具体案例。

所有行政管辖范围都应采取的节能措施

5.7. **组织开展培训和能力建设工作。**应大力加强中央，尤其是省和地方各个行政管辖范围能源管理人员的节能培训工作。此外，世界各国经验表明：各个单位的领导和决策人员应充分认识到节能的重要性，并了解组织实施节能改造项目的具体步骤。各级公共机构能源管理人员的培训应包括技术、财务、政策、流程以及项目组织实施等方面的内容。应重点加强以下四类单位或人员的培训工作：（1）政府官员和公共机构领导，（2）用能设施管理部门，（3）第三方技术和服务机构，（4）凡列入节能意识和培训教育范畴的住户、用户和业主。

5.8. **配置合格的用能设施能源管理师。**指派专人负责识别节能因素并组织实施能源管理工作，即指派能源管理师，是所有公共机构重点用能单位加强能源管理的一项重点工作。由于公共机构数量众多、

人员能源管理技能的培训需要花费较多精力，因此建议应采取逐步推进的策略。对于那些用能设施相对较多、能源消耗量相对较大的公共机构，应首先要求配备能源管理师。应建立能源管理培训制度和资格认可制度，通过认可或要求持续接受教育等方式确保满足资格要求（参见 3.48-3.49 部分）。对于部分公共机构或部门，尤其是规模相对较小的单位，能源管理人员应同时兼任节水、资源循环利用以及其它“绿色”措施等可持续管理工作（参见 3.47 部分）。

5.9. **组织开展基于形象的激励工作。**正如本文所介绍的，公共机构一般都缺乏节能积极性。负责各个公共机构节能管理的主管部门应建立基于形象的激励制度。例如，针对一个或多个不同类型的公共机构组织实施“节能示范单位”表彰工作，可同时为那些节能工作作出突出贡献的单位提供小额的金钱奖励。可针对某类公共机构的节能（和环境）绩效进行分级评估。可把这种分级评估当做公共机构节能监管的重要手段之一。如果公布评估考核结果，更能有效地推动节能管理工作（参见 3.25-3.26 部分）。

5.10. **健全和完善能源统计和计量制度，开展能源审计、编制各级公共机构节能改造方案，策划不同行政管辖范围的能耗对标工作，对项目节能效果进行持续评估，加强节能信息传播，提高节能意识。**各级公共机构应制定一定时间阶段内的节能改造项目以及实现具体节能目标的工作方案，针对如下内容组织开展节能工作：能源统计、能耗计量、用能设施具体节能方案的制定、对标、试点示范以及项目实施效果评估。

- ***能源计量。***应按各个单位逐步推进的方式，策划和组织实施能耗数据的收集分析以及基础计量工作。应采取针对性更强的方式组织实施采暖计量和分项计量工作（相对于下面介绍的其它领域而言）。

- ***能源审计和具体节能方案的编制。***能源审计的目的应是为了今后节能行动的需要，它是后续节能项目开展的基础。为此，各级公共机构在能源审计完成后，应编制具体可操作的节能行动方案，节能方案应包含具体的节能改造项目和可采用的能源管理改进措施。由于工作任务巨大，应采取循序渐进的方式按轻重缓急稳步推进。

- ***能耗对标。***根据能耗统计、能源计量数据以及能源审计报告，公共机构即可按照不同领域的主要建筑类型组织开展能耗对标工作。能耗对标有利于筛选节能改造投资项目。如果能耗对标工作组织较好，可以很容易地建立强制性的节能目标和能耗定额管理制度。

- ***节能效果评估与信息传播。***应系统客观地组织开展公共机构节能实施效果评估工作，加强公共机构试点示范项目成功案例的传播（参见 5.11 部分）。

5.11. **按不同行政管辖范围组织实施重点示范项目。**公共机构节能“十二五”规划要求不同行政管辖范围的公共机构在国管局指导下组织开展各种试点示范项目（参见表 3.1）。应优先安排那些愿意进行采暖计量和建筑围护结构改造并按热收费管理的公共机构组织开展试点示范项目。

5.12. **加强省际间和国际节能信息传播和交流活动。**开展节能工程和项目、以及相关问题的交流沟通，有利于政府官员和专家学者学习和了解各种成功经验。加强省际间的信息交流，积极参与国际活动，加强国际交流与合作。政府官员可重点加强节能目标的制定和监管、能耗对标、形象奖励、节能专项资金的使用、合同能源管理的推广等相关问题的交流沟通。第三方单位和用能单位代表（如医院、中小学和大学代表），重点应加强能源管理、计量和分项计量、能源审计、以及节能投资等相关内容的沟通交流。此外，应通过主办公共机构能耗对标、滚动资金、合同能源管理、节能项目打捆、医院综合节能改造项目等专题研讨会，推进经验交流沟通工作。

中央国家机关建筑节能措施（国管局）

5.13. 国管局除了承担全国公共机构节能工作的协调和指导职责外（参见 5.2 和 5.3 部分），还应在中央国家机关组织开展一些节能措施，具体的节能领域包括：

1. 帮助指导所有的中央国家机关制定和实施节能方案和节能目标。国管局应牵头组织开展此项工作，批准各个单位的节能方案和节能目标，加强监督管理，并提供必要的技术支持。

2. 对条件成熟的用能设施开展与能源消费预算支出上限挂钩的能耗定额试点工作（参见 3.19 部分）。

3. 针对一些重点用能设施开展能源计量试点。针对条件相对成熟的公共机构，如能源使用方式不同的单位或建筑物，实施能源分项计量，以便各栋建筑物或各个单位都分别进行电力和采暖单独计量。在能源计量试点正式实施之前，应征得各个单位同意将能源计量数据用于以下目的：节能分析和评估、能源审计、具体节能改造项目方案的制定、能源管理绩效的持续监管等。

4. 继续支持能耗在线数据收集和统计报告制度的进一步健全完善和扩展，加强对重点用能设施能源使用情况的监管，分析确定具体的节能措施。

5. 加强各种最佳节能实践案例的收集和传播。具体的节能实践案例包括：优秀的能源管理和监督案例，以及二联供或三联供系统、照明节能改造、采暖自动控制、制冷通风、建筑自动化系统等各种节能技术成功案例。

6. 为那些对合同能源管理感兴趣的公共机构提供技术帮助。应开展节能技术援助工作，为各单位合同能源管理项目的组织实施提供帮助，包括：项目的准备、节能服务公司的选择和签约、监督管理、合同支付、节能效果的监管等（也请参见 5.14 部分第（6）项中的省级类似公共机构的工作任务清单）

省级/地方政府机关建筑物（省级/地方机关事务主管部门）

5.14. 在省级和地方机关事务主管部门的指导下，应采取以下措施加强省级和地方政府机关建筑物的节能工作：

1. 根据“十二五”公共机构节能的总体目标，制定“十二五”后续几年具体的节能方案；

2. 在条件成熟地区，组织开展与能源费用支出上限挂钩的能耗定额试点；

3. 组织实施简单的能源审计，制定各个单位的具体节能行动方案（参见 3.67 部分），编制节能改造项目建议书。应针对重点用能设施开展这些工作；

4. 尽可能在所有北方地区，组织开展采暖计量和按热收费工作，为相关城市供热改革树立榜样；

5. 开展合同能源管理试点，确保利用政府采购制度全部实现项目的准备、与节能服务公司合同的签订、节能投资、节能效果的监测、合同支付等相关内容，从而探索途径促进今后合同能源管理项目的大规模推广。

6. 对那些对合同能源管理感兴趣的省或较大地级市公共机构节能主管部门而言，应组建并实际运行合同能源管理技术援助机构，为本级政府管辖范围内的公共机构提供服务。应正式组建这类技术援助机构，并应授权开展以下工作（参见 4.20 部分）：

- 加强本级相关政府部门有关官员的培训教育，激发对公共机构节能的积极性和需求，促使采取合同能源管理等在内的各项节能措施；
- 监督管理公共机构合同能源管理项目宣传册以及其它详细参考教材的编制工作，组织开展公共机构能源管理人员的培训；
- 运行和维护公共机构信息数据库，该数据库应包括能耗统计、合同能源管理项目实施以及节能效果等相关内容。加强数据库相关数据的分析整理，有助于确定合同能源管理项目重点、评估项目进展情况以及人员培训等。
- 为公共机构遴选节能服务公司提供指导；
- 编制公共机构借鉴参考的合同能源管理项目合同模板，包括合同模板的使用指南；
- 监督指导适合公共机构用能设施合同能源管理项目节能量测量与验证方法的制定，以及应用案例的编写；
- 从项目准备、到项目融资、项目批准和资金支付等各个阶段，为项目提供手把手的帮助；
- 负责监管编制公共机构合同能源管理项目成功实践案例，并广泛传播。

大学（教育部，省教育厅，大学代表）

5.15. 在大学代表的支持下，教育部和省教育厅监管指导的各所大学应优先组织开展以下工作：

1. 在教育部的支持下，可考虑由感兴趣的大学联合组建“大学节能联盟”或者是“绿色大学联盟”。郑重承诺采取节能和资源可持续性措施并实现相应的节能目标，是各所大学加入联盟的一项条件。联盟成员作为节能和可持续行动者，享有获得国家公开宣传和认可的权利，并可优先享有政府项目支持的权利，以及享有与同行经验交流和学习的机会。

2. 在感兴趣的大学组织开展包括分项计量在内的综合性能源计量试点项目。应对单栋建筑物和各个部门的电力和采暖能耗进行分项计量，从而为明晰各个下属管理单位的节能义务、评估节能进展提供基础，也为优秀节能项目方案的制定提供必要的数据。当各个大学明确承诺开展实实在在的后续节能改造项目时，才能在这些大学组织实施能源计量试点项目。

3. 进行节能表彰和奖励，如可能可采用美国“能源之星”的类似方式。对于那些节能效果显著的大学，可获得部分资金奖励。学生的积极参与具有非常重要的意义和作用，应将节能和其它可持续性的相关内容纳入大学课程教育中。

4. 组办大学内部竞赛和奖励活动，如宿舍或院系之间的竞赛，动员教师和学生广泛参与。对于那些零成本或低成本节能效果突出的部门，可通过采用节省的能源费用支付更换设备的方式予以奖励。

中小学（教育部指导下的省和地方教育主管部门，中小学所在街道社区代表）

5.16. 在教育部的指导下和中小学所在街道社区代表的支持下，省和地方教育主管部门监管下的各所中小学应优先开展以下节能工作：

1. 涉及采暖和建筑节能改造的北方地区，尤其是农村地区的中小学，应将节能措施纳入学校的翻新改造项目中。可在中小学翻新改造项目建议方案审查过程中，增加对节能和可再生能源使用情况的评估内容，促进中小学节能改造。尽管部分费用仍需政府资金的支持，但节省的燃料费用可承担绝大部分的节能改造成本，从而可以极大地改善采暖质量。可采用合同能源

管理的市场机制模式，如可能可将不同建筑物进行项目打包（参见下面的内容）。

2. 为建筑情况类似且需开展类似节能改造的中小学，提供节能改造项目设计模板，降低实施成本。可对同一街道社区范围内的几所典型学校组织开展能源审计，获得各种用能设施节能改造项目方案（如采暖系统的自动控制、门窗更换、照明节能改造）。这样可将大批量的中小学节能改造项目，按照所参与学校的节能改造内容，如可能采用合同能源管理的方式进行打捆实施。

3. 将节能活动和节能教育全面纳入学校课程教育，能起到较好地促进作用。可参照上面所介绍的大学做法，可对街道社区内的学校，组织实施零成本或低成本节能改造竞赛表彰活动。尽管节能改造项目投资回报相对较低、交易成本较高，但也应将那些节能改造项目能取得显著溢出效应的中小学一并考虑在内。在儿童节（或许其它重要活动）中将节能教育和其它教学方法相结合，向教师和学生介绍学校所采取的节能措施、眼见为实的节能效果以及舒适性更高的学校建筑等，提高学生、教师和家长对节能型生活方式的认识。

医院（卫生部、省卫生厅、医院代表和协会）

5.17. 在医院协会和医院代表支持下，卫生部和省卫生厅监管指导下的各家医院应优先开展以下节能工作：

1. 选择部分医院组织实施能源计量试点，为后续全面的能源审计和节能效果评估提供必要的数据；

2. 选择部分医院组织开展能源审计，包括对一些情况相当复杂的用能设施进行深层次的能源审计，然后启动和组织实施具体的节能改造和能源管理工作。在组织完成一些复杂用能设施的高质量节能诊断工作后，应从方法学和技术途径的角度为其它医院提供实施指南，传播交流能源审计结果。

3. 可参照上述大学建议，考虑在卫生部支持下组建“医院节能联盟”或者是“绿色医院联盟”。该联盟不仅负责开展节能经验交流，促进医院领导、管理人员、职工和用户对节能问题的关注，还应是能源服务商和设备供应商的一个市场信息渠道，有助于提供最优秀的节能医疗设备和医院能源管理最佳实践。

4. 编制和传播合同能源管理最佳实践案例。实践案例的内容既包括节能技术措施的信息（如热电联产方案、采暖需求侧控制、制冷通风系统、建筑自动化系统），也应包括合同能源管理项目合同实施过程的内容、以及综合节能改造项目实施经验（参见专栏 4.5）。

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附录B：第三章的补充资料

专栏B.1：美国联邦政府建筑物可持续能源使用的综合框架

美国联邦政府每年货物和服务费用支出 3000 亿美元，其中的 170 亿美元为能源费用。联邦政府总能耗为 1600 兆亿 Btu（一次能源），相当于 5760 万吨标煤；二次能源 1100 兆亿 Btu（3960 吨标煤）中的 33% 是由“目标”建筑物消耗的。联邦政府机构所占用建筑物有 50 多万栋，建筑面积约 30 亿平方英尺（2800 万平方米），其中约 3700 万平方英尺的建筑物是租赁的 [144]。

最新的能源法令和行政令主要有：3423 号行政令、2007 年的《能源自主和独立法令（EISA）》、2009 年的 13514 号行政令。这些法令和行政令构成了涵盖联邦政府建筑物可持续能源使用规划、实施以及性能改进等内容的综合性框架体系。仅为实施联邦政府建筑节能项目拨付了很少的财政预算经费，但更多的经费是希望联邦政府机构使用直接的财政拨款、奖励资金、补贴资金、节能效益留成、采用超级能效合同（ESPCs）或者是公用事业能源服务合同（UESCs）方式的替代融资等。

目标：

- **降低建筑能耗：**所有的联邦政府机构每年降低 3%、到 2015 年末总降低 30%（相对于 2003 年）；各联邦政府机构自己的具体温室气体减排目标（2008 年—2020 年）（此外，还包括提高可再生能源的使用、节水和车辆能源改进等目标）；
- **新建建筑：**到 2030 年建筑物在现有标准基础上节能 30%、并实现净能耗建筑要求；
- **可再生能源：**2010 年—2012 年可再生能源使用占电力用量的比例提高到不低于 5% 的水平，2013 年不低于 7.5%，2013 年后每年新增电力的至少一半应采用可再生能源，联邦政府机构建筑物使用可再生能源应确保具有可行性。
- **计量：**所有的建筑物都进行能源计量，2012 年完成所有电力计量、2016 年完成天然气和蒸汽计量。

要求：

- 从 2010 年末开始，总务局租赁的建筑物必须是获得能源之星顶级 [145] 的建筑物。联邦政府机构应直接和房东就所在建筑物的成本效益性能好的节能改造问题进行沟通谈判；
- 每个联邦政府机构应指定一位能源管理师负责实施法定的节能要求、降低每栋建筑物的能源消耗；
- 找出占机构建筑总能耗至少 75% 的那些建筑物（称作“占用建筑物”）；
- 每隔 4 年对各个占用建筑物进行综合性的能源和用水审计，并报告所有的节能、节水的潜力以及具体措施；
- 组织实施那些被识别为寿命周期内成本效益最好的节能措施；
- 将占用建筑物的能耗、节能评估、开展的项目以及后续行动等内容输入基于网站的信息跟踪系统（参见下面的介绍）；
- 将每栋开展能源计量的建筑物能耗数据输入对标系统，如能源之星建筑物管理员系统。

责任：

- 每个联邦政府应指定一个高级的管理官员担任可持续高级官员，负责机构的可持续管理；
- 计分牌：每年应向管理预算局（OMB）两次汇报机构的实施状况概要，并以计分牌的形式对外公布（参见图 3.2）

144. “目标”建筑：满足能耗降低要求的建筑；与第 3.7 段对比。

145. 与专栏 3.5 对比。

2007 财年联邦政府建筑的节能成绩：

- “目标”建筑总能耗为 353 兆亿 Btu，比 1985 年降低 29%（二次能源）；
- 2007 财年“目标”建筑的能源成本费用为 58 亿美元；
- 自 2003 年，节能投资总额为 28 亿美元，约一半是直接财政拨款，10 亿美元来自超级能效合同，大约 5 亿美元来自公用事业能源服务合同（参见图 3.x）；
- 自 1985 年，节能改造投资总额为 63 亿美元，估计能源成本节约量为 50—80 亿美元，其中 10—20 亿美元来自于超级能效合同；
  计量：11 个联邦政府机构的所有建筑物都至少采用标准的电力计量仪表对电力使用情况进行了计量。2007 年环保署和住房和城市发展部 100% 完成了自己所有建筑物的高级计量工作。

资料来源：FEMP，参见：http://www1.eere.energy.gov/femp/regulations/requirements_by_reg.html；FEMP 2010 http://www1.eere.energy.gov/femp/pdfs/annrep07.pdf；以及 http://www.naesco.org/events/meetings/federal/2007/presentations/Cynthia_Vallina.pdf)

表B.1：美国州*和地方**政府节能目标的范例

州 / 地方政府	目标单位	节能目标	Source
科罗拉多州	州政府机构	能耗在 2005/06 基础上降低 20%	（州）行政令 D0011-07, 2007 年 4 月 16
佛罗里达州	州政府机构	（1）2012 年温室气体排放在 2007 年基础上降低 10%、2017 年降低 25%、2025 年降低 40%；（2）提高州建筑物的能源效率。	州行政令 07-126, 2007 年 7 月 13 日正式施行
夏威夷	州政府机构	要求在 2010 年底前州政府机构应对所有既有公共建筑（大于 5000 平方英尺或年度电力用量超过 8,000KWh）进行节能评估。应采用能源之星建筑管理员软件进行能耗对标，找出提高能源效率的机会。每隔 5 年应对建筑物重新进行调试。 结果：2009 年所有州政府机构电力消耗比 2008 年降低 5.8%、比 2005 基准年降低 2.5%。2009 年降低的能耗估计节约的能源成本费用为 1000 万美元（资料来源：ACEEE 2010）	州议院议案 1464，2009 年 6 月实施
马赛诸州	行政办公室管辖下的州政府建筑	2012 年州所有以及州租赁建筑物总能耗在 2004 年基础上降低 20%、2020 年降低 35%。2012 年州政府温室气体排放量在 2002 年基础上降低 25%、2020 年降低 40%、2050 年降低 80%。政府机构应采用具体的节能措施（如在间断使用的房间内使用编程温控器、感应器或者定时设备）	州行政令 484（率先垂范：洁净能源和节能建筑），2007 年 4 月 18 日实施
纽约	州政府机构，包括负责人由州长任命的所有公共效益公司和公共主管局	2010 年州政府机构所拥有、租赁或运行的建筑物能耗应在 1990 年基础上降低 35%。	州行政令 111，2001 年 6 月 10 日实施

州 / 地方政府	目标单位	节能目标	Source
威斯康辛州	州设施、办公建筑、办公区和校区	节能目标由州管理部制定，2008 年单位平方英尺总能耗在 2005 年基础上降低 10%、2010 年降低 20%。	州行政令 145，2006 年 4 月 11 日实施
德克萨斯	州和地方政府机构	中小学、一些高等教育学院、行政分支州政府机构等都设定了节能目标。从 2007 年 9 月开始，每 6 个州财政年度年度电耗降低 5%。	议院议案 3693，2007 年 6 月 15 日签署
印地安那州，韦恩堡	地方政府	2010 年在 2003 年基础上地方政府建筑物每平方英尺能耗降低 10%、2015 年降低 35%。	行政令 2007**

注：

*绿色建筑和公共建筑节能要求，http://www.ncsl.org/default.aspx?tabid=12987，给出了截至2011年5月38个州的名单，这些州对财政支持的建筑建设项目，包括学生宿舍建设项目有节能相关的法规政策要求。

**环保署发布了《地方政府机构建筑物节能和运行指南》，详细介绍了各地节能政策设计和实施过程中出现的许多范例和案例， http://www.epa.gov/statelocalclimate/documents/pdf/ee_municipal_operations.pdf

专栏B.2：德国面向全州的公共机构节能目标范例

Baden-Wuerttemberg。2020 年全州二氧化碳排放量在 1990 年基础上降低 30%、2050 年降低 80%。2020 年目前是与德国国家总体 40% 减排目标是一致的。

2008 年州拥有产权的建筑物能耗超过 2000GWh，相应的排放量比 1990 年降低 25%。90% 以上的建筑都是 1995 年以前的建筑。通过资助节能改造和使用可再生能源等工作，力争 2020 年二氧化碳排放量在 1990 年基础上降低 35%、2030 年降低 43%。替代融资，特别是合同能源管理模式，有望发挥较大的作用。人员的信息培训是另一项重要措施。该州也支持城市和中小学勾画气候概念，包括职责安排、制定有时间约束的行动计划。

柏林。《能源概念 2020》提出了 2020 年二氧化碳总的排放量在 1990 年基础上降低 40%、2050 年降低 85%。希望 2020 年公共机构能耗降低 20%、二氧化碳排放量降低 37%，主要的措施是提高可再生能源的应用以及推广应用分散热电联供技术。尽管联邦、州以及地区拥有产权的建筑物的相关数据还不完善（平方米、能耗和建筑物状况），但近期工作目标是利用公众可以访问的电子数据银行完成这些相关数据的收集。这是改善一个城市能源管理的工作基础。中期目标是将要求公共建筑业主查验建筑物实施合同能源管理项目的可行性，并将建筑围护结构的节能改造（参见专栏 4.x）纳入现有的合同能源管理管理项目（ESPplus）。

资料来源：Baden-Wuerttemberg Klimaschutzkonzept 2020PLUS，http://www.um.baden-wuerttemberg.de/servlet/is/76162/Klimaschutzkonzept_2020PLUS.pdf?command=downloadContent&filename=Klimaschutzkonzept_2020PLUS.pdf；Berlin Energiekonzept 2020，http://www.berlin.de/imperia/md/content/sen-wirtschaft/energie/energiekonzept.pdf?start&ts=1302593601&file=energiekonzept.pdf

表B.2：市政、大学、中小学和医院系统的信息工具和网络资源

对于建筑领域总体来说，**能源之星**，作为美国环保署（EPA）和美国能源部（DOE）共同管理推广的认证项目，提供了各种信息资源，包括能源管理战略、能耗对标和能源绩效评级体系、以及对顶尖性能优秀的建筑物的表彰[146]等。在专业的建筑网页上有包括政府机关、高等教育、中小学和医院等各个领域的一般性以及详细的信息资源。（https://www.energystar.gov/index.cfm?c=business.bus_index)

政府建筑节能改造的 IT 工具包（EnERGO）

按照 IEA 附录 46 的框架结构开发了政府建筑物节能改造决策流程的电子工具包。该工具包总结了美国、加拿大、芬兰、丹麦、德国等不同国家的经验教训和最佳实践案例，同时还涵盖了有咨询、评估和信息等功能的十种不同的工具：

1. 对特定公共建筑的能耗评估，评估参照对象为全国平均能耗水平的建筑物（从 20 种不同类型的建筑物中选定的建筑物）
2. 对既有建筑的建筑基本信息详细采集的电子协议；
3. 对建筑技术体系进行修正比较的检查表；
4. 包括对附属设施在内的能源审计协议；
5. 70 多个示范建筑改造实践案例；
6. 各种改造措施的说明和统计分析，包括对建筑围护结构、供暖、通风和制冷系统，照明、家用设备，以及与运行维护相关的能源因素等内容的改造；
7. 基于德国 DIN V 18599 标准的计算软件，软件的目的是评估建筑物的实际用能状况以及各种可能的节能改造措施；
8. 供公私伙伴（PPPs）合同能源管理项目中实施用的项目指南：节能改造的资金都由私人资金提供，投资成本从节省的能源费用中收回；
9. 对公私伙伴（PPPs）项目或合同能源管理项目进行投资分析的电子表格；
10. 公私伙伴（PPPs）项目或合同能源管理项目案例。

资料下载：http://www.annex46.de/tool_e.html

146. ″美国环保署开展了各种形式的外部认可表彰工作。得分在石英级的单栋建筑有资格获得能源之星认证（www.energystar. gov/index.cfm?c=business.bus_bldgs）。与能源之星合作的机构以及能耗降低 10% 的单位可认可为 ″能源之星示范″（www.energystar.gov/index.cfm?c=leaders.bus_leaders）。根据整个机构的业绩情况，能源之星合作伙伴还可申请成为 ″能源之星年度合作伙伴″（www.energystar.gov/index.cfm?c=pt_ awards.pt_es_awards）″ 。

医院

《医疗卫生能源手册》

这是 2001 年 11 月到 2003 年 12 月期间执行的医疗卫生能源项目的一项成果。

项目由美国医院协会下属的美国医疗卫生工程协会（ASHE）组织实施，内容参见：

http://www.ashe.org/e2c/resources.html

该手册介绍了美国医疗卫生市场规模和能源相关的一些基本特征，给出了可在不同医疗卫生机构建筑物之间进行比较分析的能耗对标数据。手册编写的目的是对适用于提高医院能源效率的具体实践措施、方法和技术进行评估分析，帮助建筑管理人员更好地了解低能耗和高能耗各种医疗卫生建筑物的主要用能特征。能源管理人员还可从中学到一些看起来没有或者很少有区别的节能实践措施。

e2c 网站按气候分区、优秀医院的年度表彰等内容给出了具体案例。

给出了一个美国大型医院集团的例子，介绍了在医院加强能源管理、指派能源管理师、加强与员工之间的成功交流等工作的好处。具体内容参见：

http://www.energystar.gov/index.cfm?c=healthcare.bus_healthcare_providence_health

大学 / 学院

高等教育建筑管理人员协会（APPA）给出了能力建设相关的信息、培训和研究等相关内容，包括能源、建筑设施以及环境表率等四个核心领域。同时还开展了资格认可和认证项目，参见 http://www.appa.org/FourCore/index.cfm。

美国大学和学院校长气候承诺（ACUPCC）与克林顿气候行动（CCI）共同合作大范围推进大学校园的节能工作。ACUPCC 将充分利用克林顿气候行动（CCI）建筑节能改造项目（EEBRP）的资源成果，包括正面奖励的节能大师计划、项目支持、利用 CCI 建立的建筑节能行业领导者人脉资源等。CCI 建立的建筑节能人脉资源包括金融公司、项目承包商、建筑节能技术的用户和提供方等。ACUPCC 和 CCI 为那些对学习和实施合同能源管理项目感兴趣网站注册人员，开发了最佳实践工具包。内容参见：

http://www.presidentsclimatecommitment.org/resources/eebrp

中小学

国家能源教育开发项目：http://www.need.org/，提供了供教师和学生使用的各种资料。

办公建筑

建筑业主和管理员协会（BOMA）：给出了有关培训、信息和表彰等相关内容，与总务局可持续网站建立了链接：http://www.boma.org/EverGreen/Pages/default.aspx. 2010 年， BOMA 获得了美国能源之星的表彰，详细内容如下：

国际建筑业主和管理人员协会（BOMA），一个重要的商业房地产协会，有 16,500 位会员，在北美集中拥有或管理 90 多亿平方英尺的办公建筑，占北美市场的 80% 以上。这是 BOMA 第二次获得能源之星可持续优秀认证表彰。主要成就包括：

- 开展了 BOMA 360 绩效项目，该项目对建筑运行维护管理最佳实践（包括参与能源之星认证和利用环保署建筑管理人软件工具对标）的商业建筑进行认可表彰。2009 年，37 栋建筑物获得表彰。

- 推进它的 7 分挑战项目实现 2012 年节能 30%。2009 年，120 家单位、超过 30 亿平方英尺的办公建筑参与了挑战项目，比 2008 年增加了 10 亿平方英尺。
- 优化并提供了利用环保署建筑管理人工具提高能源效率战略的 6 模块课程，共计培训了 14,000 工业人员。
- 鼓励协会会员采用 BOMA 大师软件进行建筑物能源绩效对标并分享结果。超过 1000 栋会员建筑分享了对标结果，总计 2.7 亿平方英尺建筑物能源绩效得分超过 78 分。
- 在会员中推广使用绿色租赁指南和合同能源管理模板

国际建筑管理协会（IFMA）给出了与可持续建筑专业人员相关的信息、培训和认证等内容，参见：http://www.ifma.org/sustainability/

州和地方政府

能源服务联合会（http://www.energyservicescoalition.org/），是一个非盈利的全国性机构，由通过合同能源管理模式在各州和各地提高能源效率以及对建筑物进行节能改造的各种单位组成的专家网络。它提供大量的信息资料，特别是针对州和地方政府官员和专家的信息资料，最重要的是有大量的最佳实践案例以及培训和模板文件。

ICLEI—可持续地方政府（http://www.iclei.org/index.php?id=about），是一个由致力于可持续发展的 1200 多个地方政府成员组成的国际协会。协会成员来自于 70 个不同的国家，代表了 5.69 亿多人。沈阳是目前为止唯一的中国成员。ICLEI 提供网络、培训和信息资源，包括城市清洁能源工具包：http://www.icleiusa.org/action-center/tools/municipal-clean-energy-toolkit/energy-efficiency

能源城市：是一个由致力于创新未来能源的政府主管部门组成的欧洲协会。该协会创立于 1990 年，代表了 30 个国家的 1000 个城镇，工作主要是加强经验交流、知识转移以及共同组织实施项目：

http://www.energy-cities.eu/spip.php?page=index_en

市长保证书：是欧盟成员国地方和地区政府主管部门发起的一项活动，承诺通过节能和可再生能源行动到 2020 年超越欧盟能源和气候目标、削减二氧化碳排量至少 20%。共有 2665 位市长签署了保证书，代表了约 1.3 亿居民。保证书的内容包括制定基准排放清单、递交一份概述拟开展的主要行动措施的可持续能源行动计划。签署保证书后，可获得宣传推广、技术以及管理方面的帮助，工具和方法学：

http://www.eumayors.eu/about/covenant-of-mayors_en.html

气候联盟：17 个欧洲国家的 1600 多个城市、市政和地区都是气候联盟的成员，其中大多数都是本地雨林人口的欧洲城市，这是一个地方政府主管部门组成的网络，致力于包含全球气候。会员城市和市政将力图利用自有资源降低温室气体排放，承诺每五年二氧化碳排放量降低 10%、到 2030 年人均排放量降低一半（以 1990 年为基准）。气候联盟还负责管理运作市长保证书的保证书支持中心，促进地方当局加入保证书，开发方法学工具。

http://www.climatealliance.org/

表B.3：重点用能设备运营指南的案例

- 办公室电力管理—纽约能源明智办公室项目 http://www.nyserda.org/programs/offices/default.asp
- 暖通空调节能小贴士及其它：
  http://www.boma.org/Resources/TheGREEN/EnergyResources/Pages/HVACConservationTips.aspx
- 重新节能调试。重新调试是一个系统性验证过程，验证内容包括：建筑物系统能否按照设计目的相互匹配运行、是否满足建筑业主和住户的运行需求、负责运行维护管理的人员是否有足够的专业技能等。重新调试的目标是提高系统的性能、改善运行维护、提高能源效率、住户舒适性以及室内环境质量。重新调试需要重点关注节能的问题。NYSERDA 的 FlexTec 项目要求重新调试的建筑物和设备系统应至少稳定运行使用 1 年。重新调试并不涉及重要的暖通空调系统或其它建筑部件的更换，而是关注正确控制措施的验证和识别、运行的次序、运行和维护计划以及其它建筑或系统优化措施。被确定为节能调试的项目必须对找到的每项缺陷填写一份 NYSERDA RCx 缺陷工作表（附录 B-4）。每份 NYSERDA RCx 缺陷工作表应有项目总结的相应栏目内容。
- http://www.nyserda.org/programs/flextechprojects.asp - Retro
- 提高现有锅炉 / 采暖系统的性能，例如： http://www.aceee.org/consumer/heating - improve;

欧盟（EPBD）**锅炉和空调检查制度**。第 8 条和第 9 条强制要求建立供暖热水锅炉的检查制度。允许欧盟成员国自行规定 20KW 至 100KW 锅炉的检查周期。对于容量大于 100KW 的锅炉，要求必须每隔 1 年进行一次检查（燃气锅炉是每隔 4 年）。指令也同时批准允许对容量大于 20KW、服役超过 15 年的锅炉供暖系统进行一次性检查。指令提出了放弃检查方案的替代选择，即可选择开展公众教育和意识提高工作，为建筑业主提供关于正确和定期进行锅炉维护的重要性建议以及确保合适的锅炉容量的好处。不同成员国选择了不同的方式。例如，芬兰调查发现每套锅炉系统预期节约量每年仅为 7 欧元、而预期的检查成本为 50 欧元至 100 欧元，此时芬兰选择开展了全国性的锅炉更换宣传活动。荷兰研究发现定期检查能产生节能效果 5% 至 35%。有些国家选择对容量大于 100KW 的锅炉进行检查，而对汇报率低的小容量锅炉开展宣传教育工作。第 9 条也同时强制要求对大于 12KW 的空调系统进行检查。检查的目的是验证空调系统的运行效率、同时核查系统容量是否与空调房间面积相匹配。（参见 Ries et al 2009，基于 Antinucci 2008 的资料，http://www.epbd-ca.org/Medias/Pdf/CA_Annex_2_Inspections.pdf）

附录C：德国医院概况及医院节能项目

德国节能型医院认证项目

德国有 2000 多家医院，共计 500,000 张病床。约 35% 的医院为公立医院、38% 为非盈利医院（教会等）、27% 为私营医院。医院的数量在逐步减少（1999 年至 2009 年减少了 7.5%），部分是因为破产了。（资料来源：Bundesamt 统计）

医院有两套融资体系，投资是由相关的州政府提供资金（仅指包括在州医院计划中的那些医院）、而运营经费是由健康保险提供资金（每个患者一个固定数额，按患者诊断数计算）。用于投资的公共资金严重短缺（投资缺口估计为 126 亿欧元；资料来源：Krankenhaus2010 年评估报告）、医院更多的是依靠信贷融资。

德国医院总体运营成本约为 700 亿欧元，其中 60% 为人员成本、能源和用水成本约为 5 亿欧元。单单是能源成本平均占医院总经营成本的 2-3%，如果不考虑人员成本则能源成本占总经营成本的 8-9%。（资料来源：Leittretter, S. (ed) 2004，Energieeffizientes Krankenhaus – für Klimaschutz und Kostensenkung. www.boeckler.de/pdf/p_edition_hbs_154.pdf）

德国医院的节能潜力巨大：估计每年能节省能源成本 6000 万欧元、减排二氧化碳 600 万吨。
(资料来源 : http://www.energiesparendes-krankenhaus.de/).

医院特别适合采用合同能源管理模式，这是因为医院的能耗高、有通过降低能源成本减少总体经营成本的积极性、也不用担心总预算受到削减的问题。而且，合同能源管理有助于对年代相对较长的医院基础设施进行投资改造、否则是很难获得其它资金资助的（参见专栏 4.5 的 Bremerhaven 经验）。一般来说，医院的合同能源管理措施综合程度相对较高的，包括暖通空调、照明、能源管理体系等。

表C.1：德国医院的能耗对标（VDI 3807）

病床数和护理类型		采暖		电力	
	样本数量	平均（或中位数）值	最差 25% 的平均值	平均（或中位数）值	最差 25% 的平均值
	数量	kWh/ 平方米			
0-250，最基础的护理	102	24	14	4.4	2.7
251-450，常规护理	76	20	14	5.5	3.8
451-650，集中护理	46	26	17	6.4	4.0
651-1000，最全面的护理	27	26	19	6.5	3.0
> 1000	31	37	22	14	4.0

资料来源：Klimaschutz— und Energieagentur Baden—Württemberg GmbHhttp://www.kea—bw.de/fileadmin/user_upload/pdf/kem—leitfaden/Energiekennwerte.pdf

Breuer 先生是 Bremerhaven 医院的技术主任（参见专栏 4.5），对医院能耗对标持严重的怀疑态度，因为医院问题的多样性，例如：涉及到各种服务的外包、不同的能源类型、或者是不同的建筑类型（如紧凑型建筑、要求通风而比伸展型建筑物能耗要高的多的高层建筑）。

自 2001 年来，共有 30 家医院获得了节能型医院认证。（http://www.energiesparendes-krankenhaus.de/）

认证证书有效期为 5 年，要求满足以下 4 项标准：

五年内二氧化碳排放量降低至少 25%；
持续降低能源消耗，能耗低于对比医院的能耗对标平均值；
长期持续优化能耗，能耗低于对比医院的能耗对标石英值；
加强建筑物的能源管理。

30 家认证医院的三分之一采用合同能源管理模式实现节能目标，这些项目的节能投资主要都是合同能源管理承包商提供。除此之外的其它项目，节能投资资金来自于自有资金 / 公共资金，其中部分是针对生物质锅炉、太阳能集热或太阳能发电设备等具体节能措施的赠款资金。

通常要满足这些标准要求，需要采取各种节能措施。其中的典型节能措施包括：分散式冷热电三联供、太阳能光伏、暖通空调系统的改造、热水系统、空气压缩机、供热和蒸汽输配系统、变速泵、包括节能外窗的建筑保温隔热、日照太阳光和节能灯、包括建筑自动系统的能源管理系统等。节能软措施包括管理维护人员的培训、用户动员等。

节能效果：

- 每年节约电力超过 32,000 MWh、采暖 110,000 MWh，相当于德国每年 20,000 人的电力消耗量和 910,000 平方米的采暖能耗；
- 每年减排二氧化碳 55,000 吨；
- 节约医院能源成本：
  - o 每年 100,000 欧元 – 210 万欧元；
  - o 每年共计 700 万欧元。

资料来源：Dickhoff/BUND 2010，http://www.energiesparendes-krankenhaus.de/index.php?id=143，http://www.energiesparendes-krankenhaus.de/unterlagen/Vortrag%201_Annegret%20Dickhoff%20BUND.pdf

China:
Improving Energy Efficiency in Public Institutions

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1818 H Street NW
Washington DC 20433
Telephone: (202) 473-1000
Internet: www.worldbank.org
E-mail: feedback@worldbank.org

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Abbreviations

Currency Unit (as of August 1, 2011)

Currency Unit	=	Renminbi Yuan (RMB)
RMB6.407	=	US$1.0000
RMB1.000	=	US$0.1549
RMB9.220	=	€ 1.0000
RMB1.000	=	€ 0.1075

ACEEE	American Council for an Energy-Efficient Economy
ACUPCC	American Colleges and Universities Presidents' Climate Commitment
ADEME	Agence de l'Environnement et de la Maîtrise de l'Energie
AEE	Association of Energy Engineers
ARRA	American Recovery and Reinvestment Act
APPA	Association of Higher Education Facilities Officers
ASHRAE	American Society of Heating, Refrigerating and Air-conditioning Engineers
BPIE	The Buildings Performance Institute Europe
Btu	British thermal unit
CC	Construction Commission
CDD	Cooling Degree Days
CEM	Certified Energy Manager
CEN	European Committee for Standardization
CENELEC	European Committee for Electrotechnical Standardization
CFR	Code of Federal Regulations
CMVP	Certified Measurement and Verification Professional
CO_2	Carbon Dioxide
D&F	Determination and Finding
DCAM	Division of Capital Asset Management
DGS	Department of General Services
DOD	Department of Defense
DOE	Department of Energy
DPA	Department of Personnel & Administration

DRC	Development and Reform Commission
EE	Energy Efficiency
EISA	Energy Independence and Security Act
EMCA	ESCO Committee of the China Energy Conservation Association (also known as Energy Management Company Association)
EO	Executive Order
EPA	Environmental Protection Agency
EPAct	Energy Policy Act
EPC	Energy Performance Contracting
ESCO	Energy Service Company
ESD	Energy Services Directive
ESPC	Energy Savings Performance Contract
EU	European Union
EVO	Efficiency Valuation Organization
FAR	Federal Acquisition Regulations
FB	Finance Bureau
FEMP	Federal Energy Management Program
FY	Fiscal Year
FYP	Five-Year Plan
GAO	United States Government Accountability Office
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GOA	General Offices Administration
GSA	General Services Administration
GWh	Gigawatt Hour
HDD	Heating Degree Days
HVAC	Heating, Ventilation and Air Conditioning
IDIQ	Indefinite-Delivery, Indefinite-Quantity
IEA	International Energy Agency
IFC	International Finance Corporation
IGA	Investment Grade Audit
IPMVP	International Performance Measurement and Verification Protocol

K-12	Kindergarten through 12th Grade
KfW	Kreditanstalt für Wiederaufbau (Germany)
KLIMP	Climate Investment Programme (Sweden)
kWh	Kilowatt Hour
LCC	Life-Cycle Costing
LEED	Leadership in Energy and Environmental Design
M&V	Measurement and Verification
MOE	Ministry of Education
MOF	Ministry of Finance
MOH	Ministry of Health
MOHURD	Ministry of Housing and Urban-Rural Development
MUSH	Municipalities, Universities, Schools and Hospitals
NDAA	National Defense Authorization Act
NDRC	National Development and Reform Commission
NECPA	National Energy Conservation Policy Act
NEEAP	National Energy Efficiency Action Plan
NPV	Net Present Value
O&M	Operation and Maintenance
OMB	Office of Management and Budget
PAs	Preliminary Assessments
PDCA	Plan-Do-Check-Act
QEM	Qualified Energy Managers
RfP	Request for Proposal
RMB	Chinese Renminbi Yuan
SAR	Special Administrative Region
SEK	Swedish krona
Super ESPC	Super Energy Savings Performance Contract
tce	Tons of coal equivalent
tCO_2	Tons of Carbon Dioxide
UESC	Utility Energy Services Contracts
US$	United States Dollar
USGBC	U.S. Green Building Council

Executive Summary

1. The next several years are critical for achieving lasting results in China's relatively new energy efficiency program for public institutions. Public institutions in China are defined as those government agencies, public service units, and organizations that either fully or partially receive government budget funds.

2. Even though the public sector is a fairly small consumer of energy compared to other sectors of the economy, for several reasons it is an important sector to focus on with efforts to achieve energy efficiency: (i) The government can and should lead by example to affect and inspire all private sector entities and citizens to pursue similar actions; (ii) energy conservation projects in public buildings worldwide have been known to have a multiplier effect and influence the behavior and life-style choices of public building users; and (iii) energy savings avoid waste and lead to a better use of public resources, thus freeing up budgets for other purposes.

3. Achievement of energy efficiency results in the public institutional sector is particularly daunting, with unique organizational, incentive, and financial challenges compared to more commercialized sectors such as industry. These issues have been termed "The Three No's" by the study team. They are explained in more detail in Table 1, together with possible solutions to these issues.

Table 1: The Three No's: Issues in the Public Sector for Improving Energy Efficiency and Solutions

Issue	Solutions
Incentives are missing and risks are present	• Set target/goals/quotas • Provide rewards and issue penalties • Rate energy saving performance of public agencies and make it public • Allow public agencies to retain a share of their energy cost savings
Responsibilities, accountability, and staff technical competence are lacking	• Assign staff, e.g., require accredited energy managers • Collect energy consumption, metering, and benchmarking data; monitor progress • Train staff and provide tools and information
Financing is insufficient and unreliable	• Provide special earmarked funds • Develop Energy Performance Contracting (EPC) and complete accounting and budgeting procedures authorizing payment for energy savings investments

4. Despite these challenges, China has made impressive progress in its program so far, especially during the last four years and especially related to institutional organization and target setting. Absolute energy use is still increasing, but energy intensity in public buildings (the use of energy per employee or per square meter) is declining. To make further progress, China also can benefit

from the experience of other countries, some of which have decades of experience working to overcome the special challenges of energy conservation in public institutions. This note summarizes the main recommendations from a World Bank review of both China's recent efforts and relevant international experience, presented in this World Bank report.

5. In the study team's opinion, key challenges for China's public institution energy conservation program for the medium-term might best be summarized to include the following four: (i) Completing program institutional infrastructure, (ii) making further inroads in the huge task of completing energy use data collection and diagnostic analysis in China's many public entities, (iii) further improving incentives and generating greater enthusiasm among public entities for action, and (iv) expanding financing options for public entities, especially using energy performance contracting (EPC). Plans already exist to address the first two challenges and emphasis should be placed on quality of implementation. Efforts dealing with the third and fourth challenges---improving incentives and expanding use of energy performance contracting—also are parts of China's current agenda. Meeting these two challenges in particular will require creativity and development of new approaches. Consultation of international experience in these two areas may be particularly helpful, and this receives special focus in this report.

Completing Program Frameworks and Making Further Inroads in Data Collection and Diagnostic Work

6. China has made rapid progress since the middle of the Eleventh Five-Year Plan (FYP) period (2006-10) in developing a specific framework for promoting energy conservation in public institutions, issuing key regulations, assigning institutional responsibilities, and launching a series of pilot programs and demonstration efforts. Although the statistics are not publicly available, China also has put in place new requirements for energy use reporting by public entities. However, much work remains to be done to complete the organizational framework. Different jurisdictions are involved, all managed by different government units (for example by units for managing government facilities, units managing educational facilities, and units managing medical facilities, all at different government levels). Successful establishment of effective frameworks will serve China well far into the future.

7. Many subtasks need to be implemented to ensure the institutional framework can operate effectively. Many of these are central elements in the work program for the current 12th FYP period. Because of China's size, each represents a major, multi-year, step-by-step undertaking:

- *Putting energy managers in place*. Public institutions are now required to assign energy managers to look after energy use trends and promote energy efficiency. Placement of competent energy managers in all sizable public entities is a massive task, requiring a step-by-step approach. Focus might best be placed on establishing qualified energy managers in large agencies and their most important facilities first. It would be useful to first pilot comprehensive and integrated energy manager placement, training, and certification programs in several relatively advanced jurisdictions. National-level guidance and manuals need to be developed to help energy managers. It also would be useful to review possibilities for

introducing broader "resource sustainability management" units and staff in some entities, perhaps beginning with universities.

- *Training.* Large-scale and targeted training programs, with materials and trainers, are required for government supervisory, entity management, and service provider staff at all levels.

- *Metering.* Massive efforts are still required to complete the installation of appropriate energy use metering equipment in public entities across the country. Within this program, it may be useful to launch special, relatively comprehensive meter improvement projects for selected subsectors in selected localities. Entities with both substantial savings potential and concrete plans for energy savings implementation, which will use the metering investment straight away, should be targeted first. Heat metering is critical over the medium term. Although public institutions can usefully be among the first to volunteer for heat metering and heat system control pilots, to lead by example, they must follow the pace of broader heat pricing and billing reforms set by municipal governments.

- *Energy auditing*. Huge needs also exist to complete facility energy use assessments. However, these assessments should not be undertaken just to meet a regulation requirement. Strong focus must be on identifying practical and meaningful investment and management improvement projects in these assessments and ensuring follow up.

- *Benchmarking*. Further development of benchmarking systems (energy use indices to compare energy use across similar facilities) is needed where data is available, to help inform users of how they compare with their peers. Incentivizing benchmark systems also can be usefully developed where comparative rankings have reputational or financial consequences, but greater methodological rigor is required to ensure that these are fair.

Improving Incentives

8. Probably the biggest challenge in promoting energy conservation in public institutions is providing incentives for the various public entities to enthusiastically pursue energy savings. This is true worldwide. Why should public facility managers and staff care about saving energy? In commercial companies, energy savings can increase profits. In public institutions, energy savings result in budget savings, which often bring no real benefit to facility managers or staff themselves. Indeed, visible budget savings may be perceived as a bad thing if they result in budget reductions in following years.

9. Virtually all countries with success in public institutional energy savings develop specific time-bound energy savings targets as frameworks for rallying attention and organizing specific programs. China also is developing a series of energy savings targets for public institutions, at different levels and, increasingly, for specific subsectors. This has certainly proved very useful for attracting management attention and providing concrete frameworks for organizing programs. The targets and their supervision help to improve incentives, and should definitely be further developed and strengthened. But by themselves they are not enough. It is very difficult, if not impossible, to allocate targets for specific entities that truly match their facility-specific energy

efficiency potential. Perhaps even more important, additional measures are needed to truly instill enthusiasm among facility operators and staff to pursue the types of creative site-specific programs and behavioral changes that often make a real difference in energy efficiency work. The study team therefore believes that China needs to pursue additional incentives measures, over and above the target systems, to achieve the best results.

10. One option employed by many countries is to increase the use of reputational incentives. Many public institutions, by their nature, are very conscious of their image. For example, a highly visible "model energy efficiency unit" award program can be offered for one or more specific categories of public institutions (such as universities or secondary schools). A more aggressive option that can also be considered is the issuance of scorecards for subsets of public institutions, which rate both good and bad performers. Where possible, such systems are especially effective if the scorecards are made public.

11. A key option used in other countries to increase facility management and staff interest in energy savings is to allow some of the saved energy cost budget funds to be used for purposes particularly welcomed by facility management and staff. Regulations can be put in place to allow entities to use at least a portion of saved energy budgets for purposes they determine. If staff are informed, and a benefit popular with staff is targeted to be financed with the savings, great enthusiasm can be generated. In a similar fashion, energy performance contracting projects with public entities in North America and parts of Europe typically include tangible benefits for entities beyond energy savings alone. In effect, the client entity's share of energy savings benefits is often provided to the client in the form of equipment or facility improvements desired by facility managers and staff, rather than in cash. Examples might be window replacement or space conditioning comfort upgrades that might not be highly cost effective on their own, but which are popular for the comfort or convenience provided. Practitioners have found that this greatly increases public entity interest in pursuing energy performance contracting.

Expanding Energy Performance Contracting

12. Developing financing options for public energy conservation projects additional to budget allocation systems (including special funds) is essential for China, as it is for other countries. A variety of options are worth exploring, including development of special revolving loan funds and leasing projects. It is important to emphasize that three areas in particular need government budget support: (i) financing for demonstration projects; (ii) targeted subsidies to reduce the upfront costs of certain energy-efficient equipment or to support entities that generally have difficulty raising funds, such as rural schools; and (iii) budget allocation to cover the costs of various critically needed "soft" investments, including setting up statistical reporting systems, installing meters, training energy managers, energy auditing and preparation of site-specific energy savings plans, and monitoring and supervision. These areas are very important to advance energy efficiency in the public sector, but won't happen without special funding or special budget allocations.

13. In addition to more traditional financing options, China is wise to have placed strong emphasis on energy performance contracting as a key alternative financing method for public entities. In

North America and Europe, energy performance contracting has worked well in the public sector. Indeed, in the United States, where energy performance contracting was first developed on a large scale, over 80% of the total energy performance contracting business volume is with the federal, state, and local governments, universities, schools and hospitals. The business model is attractive to public institutions because it provides a financing means outside of regular budget appropriations, technical and project management is handled by a specialized contractor, and the ESCO contractor assumes all performance risks and is paid only if the project performs as promised. But efficient development of energy performance contracting for public institutions is not easy and will require much effort. Suggestions by the study team, considering international experience and China's current circumstances, include:

- *Clarifying energy performance contracting accounting issues.* Although opinions issued by the State Council in 2010 make it clear that public institutions may disburse energy performance contracts using energy cost budget lines, work needs to be completed to apply this principle. Authorities for different jurisdictions need to issue specific regulations on how disbursements should be made. Contract processing and disbursement systems then need to be tested in practice, after which additional clarification may be required. It is important regulations also specify if client entities can retain a share of energy budget savings achieved through energy performance contracting projects, and how such funds can be used.

- *Assigning government units to provide technical assistance.* Experience elsewhere has shown that governments need to organize active, hands-on assistance to public entities in all aspects of development and implementation of energy performance contracting. The study team recommends that Chinese government jurisdictions interested in aggressively promoting use of the new mechanism in public institutions, assign and staff a specific unit to help public entities in that jurisdiction with education, training, assessment of priorities for project work, guidance on ESCO selection, preparation of model contracts, contract procurement, project monitoring and verification, and other tasks.

- *Identifying competent ESCOs.* Over 2000 ESCOs are currently registered with the national government and it is difficult for public entities to determine which are the most qualified and competent. National independent or self-governing ESCO accreditation systems are being considered, but in the meantime, governments at different jurisdictions can prepare lists of recommended basic qualifications and experience criteria for entities to check, and perhaps also help screen company profiles to make sure that companies meet these criteria.

- *Aligning energy performance contract procurement with government procurement rules.* Most countries have found formal procurement of energy performance contracts by public entities to be a special challenge. Because the contracts combine services, equipment, and financing elements for a long period of time, much discussion and modification of standard government procedures is often required to procure such contracts efficiently. Contract phasing is another issue that needs consideration. Other countries have struggled to balance an interest in competition, which can reduce costs, with an interest in keeping transaction costs under control. The study team recommends Chinese authorities begin to specifically study how

energy performance contract procurement may best be developed within China's current public entity procurement systems.

- *Bundling small projects into larger packages.* Transaction costs for individual energy performance contracts tend to be high. In many cases it makes sense to bundle projects together into larger, multi-building contracts that are tendered competitively. Chinese authorities can usefully consult a variety of models, such as those practiced in Germany, Austria, the Czech Republic, Sweden, and the United States, among others.

- *Developing comprehensive projects.* Most ESCOs in China today focus on relatively simple single-technology projects that yield savings and repayment in a short time. Overseas, however, markets have evolved such that ESCOs carry out more comprehensive energy performance contracting projects, based on the demand of clients. Quick and long-term payback projects with a variety of technologies are combined into long-term contracts, often including major facility upgrades of key interest to public entity clients. While it will take time for many ESCOs in China to develop the capacity to deliver such projects, the study team considers the development of projects with comprehensive measures a useful direction to support for the future.

- *Monitoring and verification.* Energy performance contracts require an agreement between ESCOs and clients on the energy savings achieved from a project, as this is a condition of payment. The art of good measurement and verification protocols is to keep them simple, practical, and not too costly, while still providing satisfactory comfort to clients that projects have performed. The study team recommends that Chinese supervising entities and ESCOs consult the extensive experience of confirming energy savings in public building contracts in the United States and Europe.

Next Steps and Priority Actions

14. To successfully deliver the public sector energy savings targets of the 12th FYP, the basic working system for promoting public institution energy efficiency established during the 11th FYP period needs to be completed as outlined above by the government—at central, provincial, and local levels. Many policy and regulation documents remain to be issued to allow work to be organized properly, especially at local levels. A large effort will also be needed to prepare and disseminate detailed technical guidelines, manuals, templates, and other types of instruction materials to show supervising agency and public entity staff how to meet the detailed requirements specified in the policies and regulations.

15. In addition, many concrete actions in the four areas mentioned above (para. 5) need to be organized within specific jurisdictions, particularly central government and local government buildings, universities, schools, and hospitals. Some actions may be taken by all jurisdictions, some are specific to individual jurisdictions. These are specified in Table 2.

Table 2: Recommended Priority Actions by Jurisdiction

Jurisdictions	Responsible agencies	Actions
All	All agencies with direct implementation responsibilities	1. Providing training and capacity building programs for decision makers, leaders, and specialized staff of four audiences: government officials and entity leaders, facility management units, third party technical and service entities, and occupants/users/ owners. 2. Placing competent facility energy managers (including arranging for appointments, qualifications, and training). This includes reviewing the possible application of broader sustainability managers (to address energy/water, recycling, and other "green" measures) vs. the use of specific energy managers. 3. Implementing reputation-based incentive programs. 4. Improving statistics and metering, completing energy audits and site-specific energy savings project preparation, preparing benchmarks within jurisdictions, and implementing continuous evaluation of results, dissemination, and awareness raising. 5. Implementing key demonstration projects in the main jurisdictions. 6. Expanding information dissemination and exchange through cross-provincial and international exchanges.
Central government facilities	GOA	1. Piloting entity consumption quotas tied to energy cost expenditure ceilings. 2. Organizing state-of-the-art metering pilot programs in key facilities, including for sub-metering. 3. Supporting continuing improvement of online data collection, reporting, and analysis. 4. Disseminating successful case studies, including of management and supervision examples and energy efficiency (EE) technologies. 5. Assisting energy using entities to undertake EPC projects across the project development cycle (auditing, selecting ESCOs, applying for government and commercial financing/support, disbursement of government funds, M&V).

Jurisdictions	Responsible agencies	Actions
Provincial and local government facilities	Provincial and local GOA or equivalent	1. Completing energy savings plans in line with 12th FYP targets. 2. Piloting energy use quotas tied to energy cost expenditure ceilings. 3. Implementing simple energy audits and site-specific energy savings action plans, complete with project proposals. 4. Implementing heat metering and consumption-based billing programs in northern regions. 5. Piloting energy performance contracts through the government system. 6. Creating and operating EPC technical assistance units for all public institutions.
Universities	MOE, provincial education departments, university representatives	1. Developing a ″University Energy Efficiency Network″ (or Green University Network) of interested universities, with MOE support, and university energy savings commitments as a condition of participation. 2. Implementing comprehensive metering pilot projects, including sub-metering. 3. Piloting award/bonus programs, including, possibly, incentives programs where units receive improved equipment paid through energy cost savings of successful energy efficiency projects. 4. Sponsoring internal competitions and incentives programs.
Schools	Provincial and local education departments (with guidance from MOE), school district representatives	1. Integrating energy efficiency and renewable energy opportunities into school renovation projects, especially in northern regions where heating is required and in rural areas. 2. Template project implementation, possibly with EPC. 3. Incorporating energy efficiency activities and education into a wide range of educational curricula.
Hospitals	MOH, provincial health departments, hospital associations and representatives	1. Implementing state-of-the-art metering pilots to generate data at the level of sophistication needed for hospital building energy audits. 2. Implementing carefully monitored pilot energy audits in several hospitals, covering their special and complex needs, followed by the development of site-specific pilot projects and monitoring of results; Generating case studies and finding effective channels to disseminate experiences. 3. Creating a “Hospital Energy Efficiency Network” (or Green Hospital Network) similar to that recommended for universities. 4. Generating case studies of EPC, with concrete examples of technical options for hospital energy efficiency and lessons learned for implementing comprehensive EE retrofit projects.

Chapter 1: Introduction to Improving Energy Efficiency in China's Public Institutions

About this Report

1.1. The main objective of this report is to provide information and analysis to the Chinese government to enable a better informed policy-development process towards a platform of policies and programs that can enable and more aggressively promote energy efficiency in China's public facilities. The report will also inform those organizations that support the development of policies and programs about challenges and opportunities for energy efficiency in public institutions in China.

1.2. **Scope.** The report focuses on policies and initiatives to improve the energy efficiency of existing public buildings that belong to central, provincial, and municipal government agencies. This includes office buildings, schools, universities, and hospitals. The report thus focuses on policies for building renovation and does not cover policies and measures to support energy efficiency initiatives for new buildings, equipment procurement, or public vehicles.[1] Because energy efficiency efforts are often combined with renewable energy initiatives or measures to conserve water and other natural resources (thus supporting a broader sustainability agenda), where appropriate this report presents water conservation and other measures as part of energy conservation activities.

1.3. **Roadmap.** The remainder of this chapter, Chapter 1, defines "public institutions" in China, describes the reasons for improving energy efficiency in public facilities, and presents the key issues all countries face when improving energy efficiency in public institutions. Chapter 2 presents an overview of the organizational structures that provide the context for public institutional energy efficiency initiatives, as well as China's recent efforts and progress in this area. Chapter 3 reviews the main challenges and options for China's future efforts on public institutional energy efficiency. The chapter discusses China's current medium-term goals and presents international experience from the United States and Europe. The second part of the chapter discusses specific barriers and possible solutions for sustained progress in energy conservation in China's public institutions. Chapter 4 focuses on financing and describes how public institutions can pay for energy conservation projects without regular or special budget funding, but by using the project's energy cost savings. The chapter presents the possible role of private energy service companies (ESCOs) to develop, finance, and implement energy conservation projects in public buildings. Finally, Chapter 5 summarizes priorities for policy and program development, as well as recommended next steps.

1.Energy-efficient purchasing is covered in an ESMAP report; see Public Procurement of Energy Efficient Products—China Case Study, consultant report to ESMAP by Liu Caifeng, November 2011.

2.This report does not cover military facilities and prisons. In many countries, however, such as in the United States, both types of facilities are major energy users and important targets of public sector energy conservation initiatives.

What is Included Under Public Institutions?

1.4. Public institutions in China are defined as those government agencies, public service units, and organizations that either fully or partially receive government budget funds. Table 1.1 presents an overview. This definition of public institutions conforms to international definitions. [2]Most importantly, a key characteristic of all public facilities is their use of government budget funds, which directly impacts their response to program or policy incentives and project implementation mechanisms. As a result, special types of policy interventions are needed for public institutions.

Table 1.1: Energy-using Facilities and Activities in the Public Sector

Public Sector	Subsector	Covered in this Report	
		Yes	No
Buildings/facilities	New buildings		X
	Existing buildings	X	
	• Central, provincial, local government facilities	X	
	• Institutes and government-affiliated agencies	X	
	• Universities	X	
	• Kindergartens and schools	X	
	• Hospitals and health facilities	X	
	• Museums, sports facilities, etc.	X	
	• Prisons	X	
	• Military facilities	X	
	• Public housing	X	
Public purchasing of goods and services			X
Vehicle fleets			X
Public lighting			X
Public utilities			X

Source: Authors.

Why is Improving Energy Efficiency in Public Facilities Important?

1.5. Government facilities are often major purchasers of energy services and energy-using equipment; they typically are the largest energy user in a country. However, the total amount of energy public buildings consume—for heating, air-conditioning, hot water preparation, lighting, and plug loads—is not particularly large compared to the rest of the economy and by itself would not merit a lot of special attention. Although few countries have reliable data, public buildings are estimated to account for only about 2-6% of a country's total energy consumption. [3]

1.6. There are, however, good reasons for central and local governments to engage in energy conservation in the buildings they own and operate. Four key reasons are:

- *Leading by example.* Government laws and regulations for the environment and sustainable development affect all entities and citizens. To be credible and inspire others, the government must set and follow its own regulations.

- *Multiplier effect.* Public institutions have an important educational role. Energy saving projects in public facilities give their users (such as teachers, students, and hospital staff or patients) an opportunity to learn about and practice energy conservation in their everyday environment. Energy conservation projects in public buildings worldwide have been known to influence the behavior and life-style choices of the building users.

- *Better use of public resources.* Tax payments, by citizens and the private sector, are the largest source of public funds. Careless energy consumption is a waste of public money. Energy savings can be used for capital improvement projects or free up budgets for other purposes.

- *Market creation and transformation.* The public sector can use its market power to help develop mechanisms and institutions for energy conservation in society at large, creating a strong, sustained, buyer-led shift in the market toward energy efficiency. The government's buying power and active, visible leadership can provide a powerful non-regulatory means to stimulate demand for energy-efficient products and services. By establishing a reliable market, the government can encourage domestic suppliers to introduce more energy-efficient products at competitive prices[4] and also create more opportunities for the energy efficiency services industry, including ESCOs, energy consultants, financing businesses, contractors, and equipment vendors.

1.7. Energy conservation has long been neglected in the public sector because of the difficulties of the public budget environment for promoting energy conservation. As a result, the potential for

3. In France, public sector buildings consume about 1.7% of total final energy (see Pouffary and Dupont 2009 and ADEME 2011). In this case, public buildings include communal buildings (local government) and central government buildings. In Germany, estimates indicate that public sector buildings account for about 2.3% of total final energy use. In the United States, the energy consumption of public buildings is around 4% of total energy consumption (rough estimate based on information from the U.S. Federal Energy Management Program (FEMP) Building Energy Data Book and para. 3.5).

4.See McGrory et al. 2002. The authors cite the example of the U.S. Energy Star label—based on "a 1993 policy directive that U.S. federal agencies were to purchase only energy-efficient computers and office equipment that qualified for the Energy Star label; this had an immediate positive effect on manufacturer participation in the labeling program; even though federal sales amounted to only 2-3% of the total market, Energy Star office equipment quickly achieved penetration rates of 90% or more for the entire U.S. market."

quick gains is often large. In this situation it is common for low- or no-cost interventions (such as ensuring that lights are off after office or school hours or installing motion sensors in restrooms and other intermittently used rooms) to achieve 10-15% savings in energy consumption and costs. With larger, but still profitable investments, savings of 20-40% can be achieved.

The Special Challenges of Promoting Energy Conservation in Public Institutions

1.8. Energy efficiency investments in public institutions are impeded by the same barriers that have slowed down energy conservation in other sectors of the economy: lack of information on energy efficiency potential and benefits, lack of trained personnel, lack of incentives, high transaction costs, and scarcity of financing.

1.9. In addition to those barriers, however, the public sector poses special challenges for efficient energy use. Without specific intervention this sector will continue to be slow in improving its energy intensity. The following "three no's" are considered to be the main reasons for energy inefficiency in the public sector:

- *No incentives.* Public entities have little incentive to save energy costs when energy costs are a line item in their operating cost budgets provided by the government. Savings in this budget line item typically would not benefit the public entity implementing the energy savings measure. If utility payments and other energy expenditures were reduced due to energy efficiency improvements, the budget would likely be cut accordingly in the future. Furthermore, there may be disincentives to change a facility's energy systems as this may involve operational risks. This lack of incentives is exacerbated by bureaucratic hurdles—budgeting, accounting and procurement rules—that further impede investments in energy efficiency.

- *No technical competence or institutional responsibility.* Public institutions typically don't have a staff or office responsible for monitoring and potentially reducing energy costs. As a result, there is little interest in efficiency as long as systems continue to work. Without outside help, entities often lack the technical means and competence to monitor and improve energy use. Also, the metering of energy consumption and monitoring of energy use and statistics typically are poor, if they exist at all.

- *No funding.* Without specific programs, regular government budget allocations are rarely spent on energy efficiency projects. Normal facility renovation budgets are small and used for other pressing needs.

1.10. The situation China faces in promoting energy savings in public institutions shows a striking similarity to those in other countries. Examples are the impact of the public sector budgeting system on incentives for improving energy management and on project financing channels, as well as the barriers faced in developing energy performance contracting (EPC) (see also Chapter 4). In addition, many countries also struggle to improve their human and technical infrastructure to

monitor energy use and identify the most cost-effective energy-saving measures and projects—a situation that is recognizable in China.

1.11. China's intensive efforts to improve energy management and energy efficiency in public institutions are relatively new. Many North American and European countries have been operating active programs in this area for more than two decades, with successes and failures and the lessons that come from both. Accordingly, lessons learned from international experience are drawn on in the discussions and recommendations on these issues.

1.12. While China can build on international experience, any lessons and solutions must be integrated into its own unique institutional setting. The next chapter will introduce that institutional framework of public organizations and describe China's recent efforts related to public institution energy conservation.

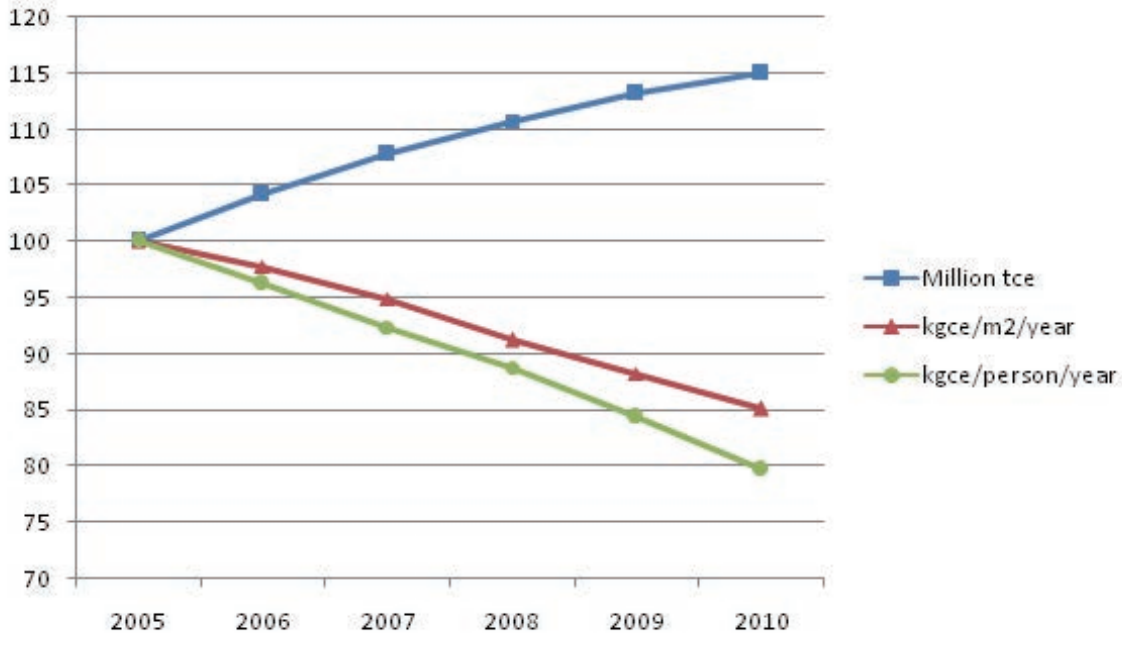
Chapter 2: Recent Progress in Promoting Energy Efficiency in Public Institutions

2.1. Probably China's two greatest achievements over the last ten years for promoting energy efficiency in public institutions have been the creation of a comprehensive policy and regulatory framework and the establishment of institutional systems to undertake the energy efficiency work. This chapter, after a brief overview of energy use in China's public institutions, will describe China's public sector institutional framework and present recent policies related to energy conservation in public institutions. A final section highlights efforts and successes from the implementation of China's 11th Five-Year Plan (FYP). These recent successes and the institutional context will provide the background for the next chapters' discussion on key challenges and opportunities for future expansion of energy savings in public institutions in China.

Energy Use in China's Public Institutions

2.2. In 2010, China's public institutions consumed a total of about 192 million tons of coal equivalent (tce) in final energy, which represented 6.2% of the national total. This figure includes energy consumption for buildings and transportation purposes. Energy consumption in the sector has increased steadily in recent years, although the rate of increase has been slowing (see Figure 2.1). Public institution energy consumption rose about 15% during 2006-2010.[5] Even though the number of buildings and the total floor area in public buildings has gone up over the last five years,

Figure 2.1: Development of Final and Relative Energy Consumption by Public Entities in China (2005=100)



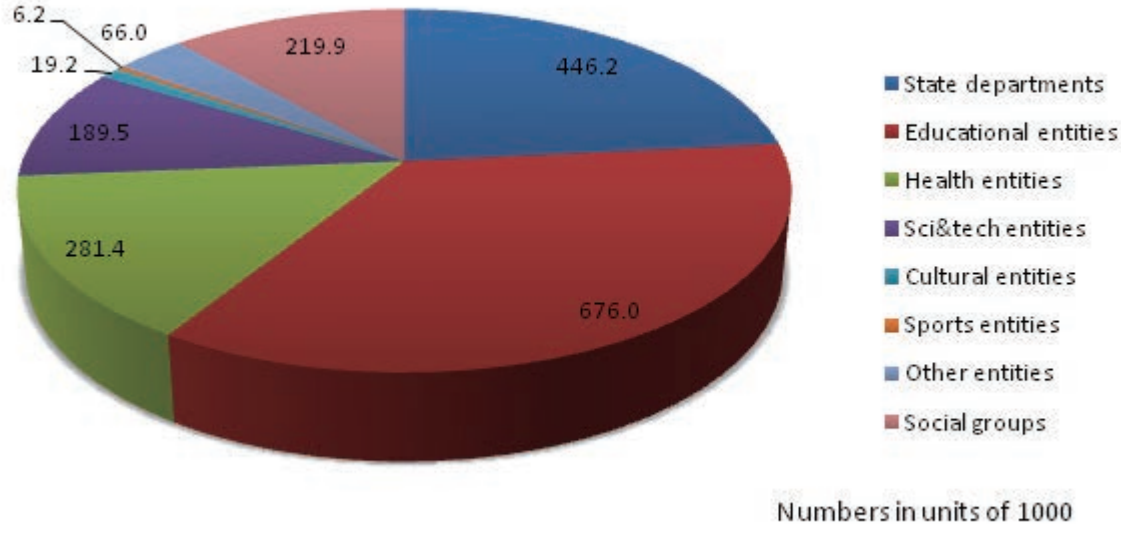
Source: The Twelfth Five-Year Plan for Energy Conservation in Public Institutions.

5."The Twelfth Five-Year Plan for Energy Conservation in Public Institutions," as published in "Zhongguo Jiguan Houchin" (China Public Agency Facility Management magazine), Sept. 2011, pp 7-12.

the energy consumption per square meter has steadily decreased. Energy consumption per occupant decreased even faster.

2.3. Energy use in public institutional buildings is characterized by its dispersion among many entities and by substantial variations in energy use per unit of floor area or per occupant. There are almost 2 million public institutional entities in China (see Figure 2.2), although many involve small buildings in rural areas. Included in the sector are large government office and research institute compounds (from both central government ministries and provincial governments), about 20,500 hospitals (including some very large ones), and more than 2,700 universities (often involving large campus compounds). The sector also includes more than 360,000 primary and secondary schools, over 250,000 community or township health centers and clinics, and more than 600,000 village health stations.

Figure 2.2: Number of Public Entities in China by Sector, 2010 (in thousands)



Source: The Twelfth Five-Year Plan for Energy Conservation in Public Institutions.

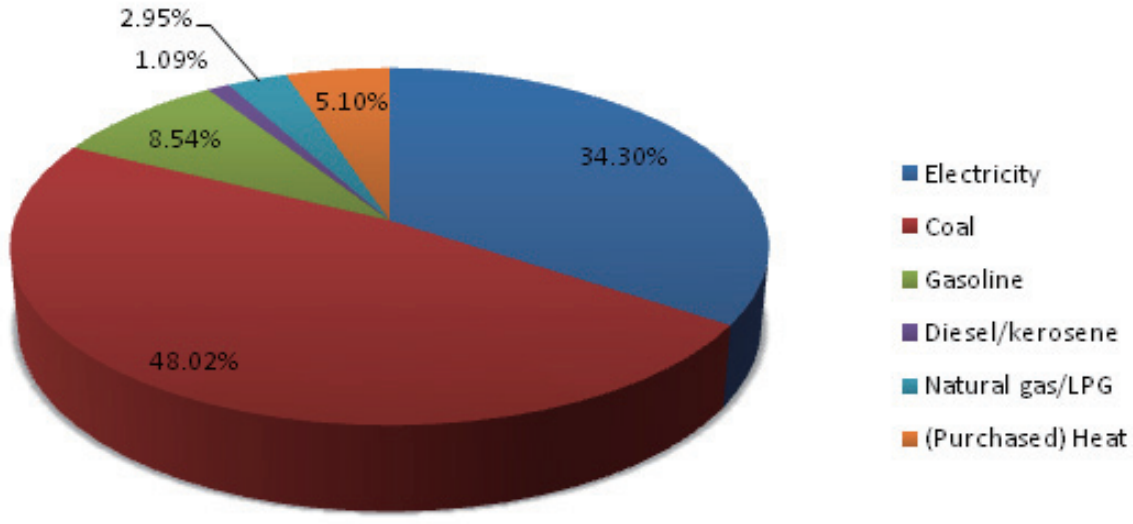
2.4. **Types of energy demand.** The main types of energy demand in the public building sector are energy for space conditioning,[6] lighting, and plug loads.[7] Special additional loads, such as hot water heating, exist as well, particularly in hospitals and at some universities. Energy demands for space heating are particularly critical and large in northern areas, with heating typically relying on central hot water radiator systems supplied from district heating systems, or on individual coal or gas-fired boilers. Smaller office buildings, rural health facilities, and large numbers of primary and secondary schools in the countryside are often underheated in the winter. The efficient supply of sufficient heat for public building occupants is therefore easily the biggest energy use issue for these entities in the colder, northern areas of China. Coal and purchased heat account for more than 50% of the energy consumed in the public sector (see Figure 2.3). In most large and medium-

6. Demand for space conditioning (heating, cooling and ventilation), and with it building energy consumption, varies a lot across China as the country encompasses five climate zones: “extremely cold,” “cold,” “hot summer and cold winter,” “hot summer and warm winter,” and “warm.”

7.Plug loads refer to the amount of energy consumed by devices from an electrical outlet, such as office equipment and miscellaneous electrical equipment.

sized buildings in the southern, eastern, and central parts of China, especially in urban areas, electricity-based space cooling represents perhaps the biggest energy use, as summers are hot and ventilation requirements key. However, in many schools and smaller buildings, space conditioning is still considered a luxury and generally not common unless there are special circumstances. In north-central Sichuan Province, for example, even large university compounds have little space conditioning, and the total energy demand—stemming mainly from lighting, computer equipment, and some water pumping—is therefore quite small. In other areas, however, such as in Beijing, both space heating and cooling may be used in larger buildings.

Figure 2.3: Percentage of Energy Consumption by Public Entities in China by Fuel, 2010



Source: The Twelfth Five-Year Plan for Energy Conservation in Public Institutions.

2.5. An important determinant of energy consumption is the occupancy pattern of buildings, which varies widely among public entities. For example, large sections of many hospitals are occupied 24 hours per day, while some government office facilities are only open during office hours five days per week. University facilities have a 24-hour occupation in dormitories, but only during the school year; classroom space is only used during class time. Other school facilities may only be used during the day and when class is in session. Dealing efficiently with occupation patterns is therefore a key energy management issue and an important factor in determining the real energy savings benefits from energy conservation projects.

2.6. **Energy use statistics.** Macro-level statistics on public institutional energy use are now collected, but detailed statistics are not available to the public. Efforts are underway to improve the system for collecting statistics. While officials at various levels have access to a variety of statistical reports, the quality and consistency of the reports is said to be very uneven.

Overview of the Institutional Framework for Public Organizations in China

2.7. Policies and specific activities for energy conservation in public institutions in China will need to work in the specific context of China's institutional framework and budgeting process for public entities.

Introduction to the Organization of the Chinese Government

2.8. China's government is organized along a vertical hierarchy with four main levels: the central government, provincial governments,[8] prefectural governments, and county governments (see Figure 2.4). The State Council, China's highest executive body chaired by the premier, presides at the top of the government organization, with all central government ministries, independent departments, and all provincial-level governments reporting directly to the State Council. Of the 27 central government ministries and commissions reporting to the State Council, several are especially important for public institutional energy conservation work. These include the National Development and Reform Commission (NDRC), the Ministry of Housing and Urban-Rural Development (MOHURD), the Ministry of Finance (MOF), the Ministry of Education (MOE), and the Ministry of Health (MOH).[9] As of early 2011, an additional 38 central organizations outside of the framework of ministries and commissions also reported to the State Council. These include the National Bureau of Statistics, the State Administration of Taxation, the Chinese Academy of Sciences, and the State Electricity Regulatory Commission. Among these 38 organizations is also the General Offices Administration (GOA) of the State Council.[10] GOA is charged with oversight for central government office building development, land use, registration, occupation, management, operation, and renovation. It also plays a key role in energy conservation work, both for central government office buildings under its purview, and for China more generally.

2.9. Mirroring the responsibility of the premier at the national level, provincial governors lead governments at the provincial levels. They report directly to the State Council (occupying the same rank as ministers). The basic set-up of China's central government is then repeated at the provincial level. Various commissions, provincial departments, and other agencies report to the governor's office, such as provincial Development and Reform Commissions (DRCs), provincial finance bureaus (FBs), and provincial GOAs. In addition, prefecture directors also report directly to the governor. The prefecture government, under the leadership of these prefecture directors, then follows a setup similar to the provincial government system, as do the more than 4,000 county governments below them.

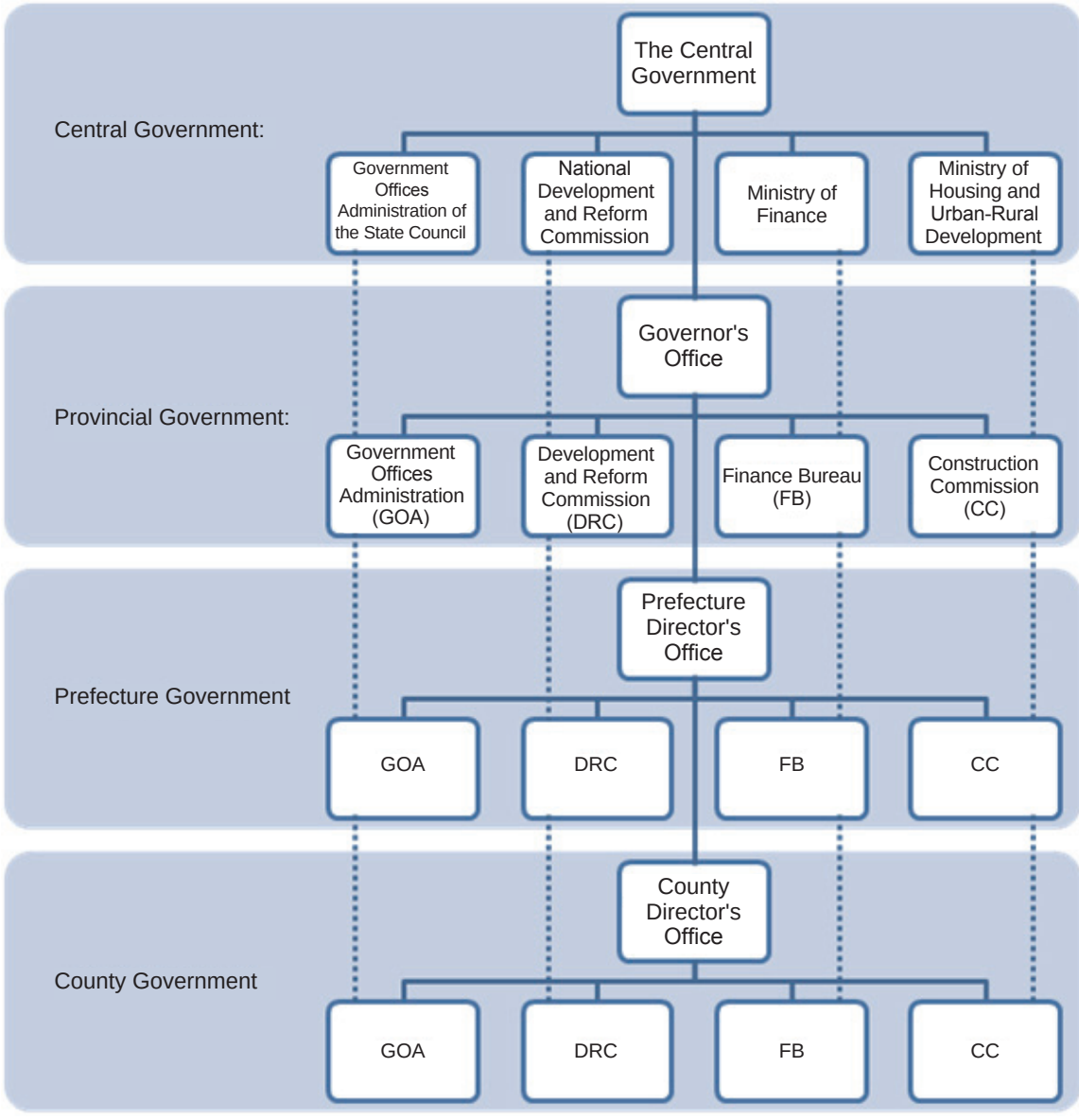
2.10. Provincial, prefecture, and county departments report to the government leaders at their own level, but also maintain working relationships with higher- and lower-level departments within their

8. Excluding Hong Kong SAR, Macao SAR, and Taiwan, provincial-rank administrative entities include 22 provinces, 4 provincial-level municipalities (Beijing, Shanghai, Tianjin, and Chongqing), and 5 provincial-level autonomous regions (Inner Mongolia, Guangxi, Tibet, Ningxia, and Xinjiang). For simplicity, general discussions of "provincial level" in this report include all of these entities.

9. For illustrative purposes, Figure 2.4 only shows four of China's many central agencies reporting to the State Council.

10. The GOA of the State Council is not a ministry like the other three entities that are shown, but it does report independently and directly to the State Council. The organizational arrangements for completing government office administration tasks at provincial and local government levels vary—not all provincial and local governments have independent GOAs; see para.2.35.

Figure 2.4: China's Multilevel Government Structure



Note: For illustrative purposes, only a selection of agencies is shown for each level of government. Solid lines depict direct reporting relationships; dotted lines depict additional operational linkages within the same professional streams ("xitong" or work systems).

Source: Authors.

professional stream or "work system" (depicted by the dotted lines in Figure 2.4). For example, provincial FBs work closely with both MOF and prefecture and county FBs. Lower-level units receive guidance and professional instructions from higher level units in the same work system. The cohesiveness and extent of higher-level operational authority vary among work systems, depending on the needs of the work. For example, the work system of the Bureau of Statistics is more vertically driven and autonomous from local governments than for example the system including MOHURD and local Construction Commissions (CCs). MOHURD promulgates national policies and provides guidance and technical support, but allows local governments a strong direction in operational matters.

Overview of the Government Budgeting Process

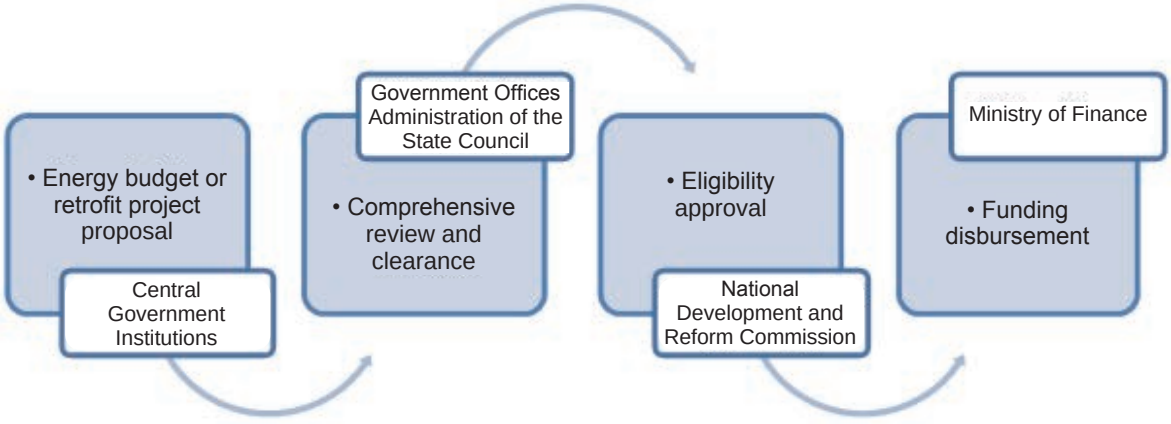
2.11. The principles behind China's basic government budget processes are similar to those of most other governments. MOF and local government FBs are in charge of the overall system. While there are broader, multi-year guidance plans, budget allocations to units receiving state budget support are made on an annual basis for the fiscal year (which in China follows the calendar year). At the central level, MOF has oversight of the central government's allocation of its revenue to the annual budgets of central government departments and for transfers to provincial governments. On the provincial level, provincial FBs allocate their provincial government revenue to the annual budgets of the provincial government departments and for transfers to prefecture governments. This pattern continues with the local levels of government. The various ministries and departments have their own financial units, which oversee the details of the budget allocations they receive and also work with the various entities they supervise. For example, a provincial-level university will receive its state budget allocations from the finance unit of the provincial-level education department, which in turn receives its overall budget allocation from the provincial FB.

2.12. **Special energy conservation funds.** MOF and most provincial and local FBs have special energy conservation funds that can be used by government facilities to implement energy conservation projects. If a central government facility wants to use these funds for an energy conservation project, the facility management department submits an application to the relevant ministerial department, which in turn submits the application to GOA for review. If the review is positive and the project's merits have been demonstrated, GOA submits the project to NDRC for approval. Once approved by NDRC, funds will be disbursed the following fiscal year by MOF. In the case of equipment purchases, suppliers must be selected from an approved list of suppliers for government procurement by central government institutions. This basic approval process for central government energy conservation projects is illustrated in Figure 2.5. The approval process at the provincial level is almost the same, with provincial entities replacing the central government ones.

2.13. The government budgeting process affects all public institutions in China, but the extent to which different public institutions rely on government budgets varies dramatically. Government offices typically rely on government budget allocations for all their expenditures. Primary and secondary schools also usually rely heavily on government budget allocations—especially in poorer areas—but may also have some funds from tuition and other sources. Universities typically have a mix of funding resources in addition to budget allocations. Hospitals are among the most independent in funding, with substantial revenue from user fees in addition to government funds. This variation has a big impact on the entities' energy conservation incentives and financing options.

2.14. **Central government offices.** Although GOA has direct oversight over a broader range of central government facilities, office buildings and staff residential compounds comprise a large portion of its responsibility. GOA oversees the management of buildings of the central government and associated centers, institutes, and related institutions. This responsibility includes, but is not limited to, overall real estate and land use management; oversight of construction and renovation projects; establishment, implementation and supervision of policies guiding property management

Figure 2.5: Basic Approval Process for Funding Energy Conservation Retrofit Projects



Source: Authors.

units and contractors; and guidance of construction and property management of residential blocks for central government staff. GOA also is responsible for energy conservation work in central government facilities (see Table 2.1).

2.15. **Provincial and local government offices.** Government offices at provincial, prefectural, and county levels are each managed by GOAs or similar organizations at their respective levels of government. Although they may receive policy and program guidance from higher level GOA units, they report to the government leaders at their own level. Specific arrangements vary, but responsibilities similar to those of the central-level GOA for central government facilities are shared among one or more entities. For example, in some areas GOA-type functions are undertaken by one broad government unit, while in others these functions are split between different agencies, such as between government and Communist Party entities.

Table 2.1: Ownership of and Responsibilities for Buildings of Different Public Institutions

Public institution	Number of separate entities /surface area (million m^2)	Building ownership	Investment	Operation and maintenance budget	O&M management
Central government buildings	Unpublished	Central government	MOF	MOF	State Council GOA
Provincial government buildings	Unpublished	Provincial government	Provincial FB	Provincial FB	Provincial GOA
Local government buildings	Unpublished	Local government	Local FB	Local FB	Local government

Public institution	Number of separate entities /surface area (million m^2)	Building ownership	Investment	Operation and maintenance budget	O&M management
Universities	2700 / 590	MOE / Provincial education department	- Central / provincial government - Own funds (tuition)	- Central / provincial government - Own funds (tuition)	MOE, other government entities
Schools	366,300 / 1388	MOE	Local government	Local government	Local government
Hospitals	20,500 hospitals 240,000 other health centers 650,000 village health stations	MOH	- MOH / MOF (for initial investment) - Own revenue (for renovation)	Own revenue (user fees)	Hospital

Source: Authors.

2.16. **Universities.** The great majority of Chinese universities, especially the largest and best, are public universities. China's more than 2,700 universities educate over 30 million students and occupy buildings with a total construction floor area of about 590 million square meters, equivalent to some 2.7% of the country's total urban building area. Universities fall under the oversight of MOE and its local government affiliates, through whom universities also receive their government budget allocations. Many of the more famous universities report directly to MOE (and hence to the central government), but many others also report to provincial education commissions (and hence to provincial governments). A few report to both for historical reasons. While it is estimated that universities on average rely on government budget allocations for less than half of their expenditures (relying on tuition and other revenue sources for the rest), this ratio varies among universities.

2.17. **Primary and secondary schools.** The vast majority of China's primary and secondary schools is also public. At the end of 2009, some 280,200 primary schools were in operation, of which less than 5,500 were private. Middle schools numbered 56,300, while high schools totaled almost 29,800.[11] Total construction floor area of the primary and secondary schools amounted to 1,388 million square meters at the end of 2009, which is 2.4 times larger than the total floor area of higher education facilities. Primary and secondary schools report to and receive the bulk of their funding from local government education departments, which closely manage school investment, renovation, and operating cost budgets. As in many other countries, heavy reliance on local funding results in great differences between regions in the amount of resources available to schools.

11.Statistical Communiqué on National Educational Development, 2009.

2.18. **Hospitals.** Although quite a few of China's 20,500 hospitals are associated with universities or other broader institutions, most are managed independently. In addition to hospitals, almost 30,000 community health service centers, 38,000 township health centers, 174,000 clinics, and almost 650,000 village health stations are operated in the country. These institutions fall within the purview of MOH and its local government affiliates. Major hospitals may report directly to MOH, but many report to provincial government health departments. Hospitals are ranked into three classes. Class I hospitals are local hospitals, serving the surrounding local community, Class II hospitals are regional hospitals, serving several local communities (such as a city), and Class III hospitals serve beyond a particular region. With many hospitals expected to basically cover their own costs from user fees (including either insurance or patients' out-of-pocket payments) and other revenue sources, public funding of hospital expenditures is estimated to only account for about 10% of total expenditures on average.

2.19. **Other.** Although their total energy consumption is small compared to that of the large public institutions, many other types of institutions (outside of the defense and security establishments) rely on budget allocations to operate buildings. Examples include sports facilities, cultural facilities such as museums or exhibition halls, and science and technology centers. These are overseen by other ministries and their affiliates, such as the Ministries of Culture or Science and Technology.

Main Jurisdictions of Government Agencies for Energy Savings in Public Institutions

2.20. NDRC, MOF, MOHURD and GOA, as well as their local equivalents all have responsibilities developing policies and guidance on energy savings in public institutions. Direct responsibilities for meeting specific energy conservation goals, implementing programs, and supervising results fall to the agencies that have overall supervisory responsibility for a specific subsector. The main responsible agencies and their direct jurisdictions are as follows:

- GOA: Guides and monitors the energy savings of public institutions nationally, and monitors and manages energy savings of central government facilities.
- Provincial GOAs or equivalents: Provincial government facilities
- Prefecture/county GOAs or equivalents: Prefecture/county government facilities
- Ministry of Education: Universities reporting to the central government
- Provincial departments of education: Universities and schools reporting to provincial governments
- Prefecture/county departments of education: Schools reporting to local governments
- Ministry of Health: Hospitals reporting to the central government
- Provincial/prefecture/county departments of health: Hospitals and clinics reporting to provincial and local governments.

Other facilities such as sports facilities, cultural centers, and science and technology centers follow similar patterns.

Overview of China's Recent Policy Development for Energy Conservation in Public Institutions

2.21. China's comprehensive effort to improve energy efficiency in public institutions is relatively new, compared to some other countries that have had programs in place for several decades. However, China's effort is remarkable in that formal policy backing is strong and much progress has been made in a relatively short period of time.

A Timeline of Recent Key Policies

2.22. Soon after the beginning of the new century, leaders in China's government began to pay special attention to the issues of energy and water use efficiency in public institutions. In 2002, two surveys (using random samples) were used to collect information on energy use in public buildings, as well as on associated management issues. The survey results provided a basic and practical understanding of the situation, which was a foundation for future work.

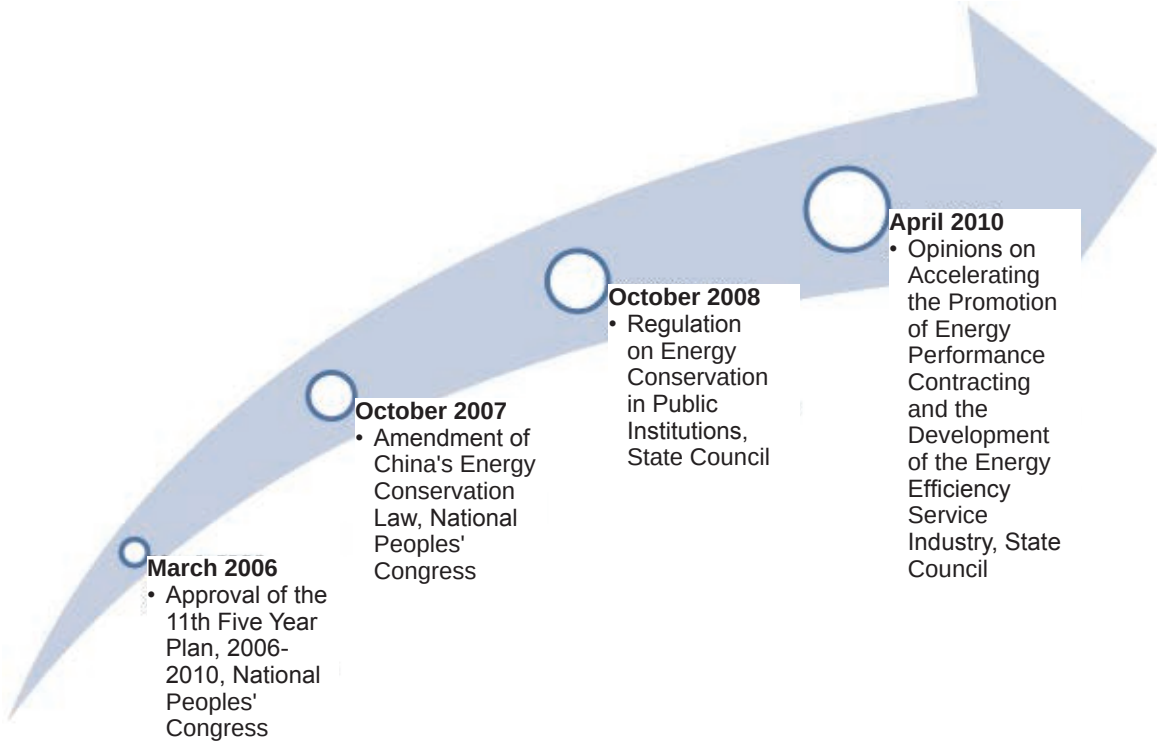
2.23. In 2004 and 2005, a series of central government and Party documents were issued, calling for new and serious efforts to improve energy efficiency in the public sector. This in particular included proposals for the establishment of energy and water use quotas and related budget expenditure standards for government offices, the establishment of a new system to include energy efficiency criteria as a key element in the government's procurement of new equipment and vehicles, and attention to energy efficiency issues when renovating government office buildings. Senior leaders also pointed out how important it was for the government to set a good example in using energy and water efficiently in its facilities, and the educational importance of leadership in promoting energy efficiency in educational institutions.

2.24. In 2006, China launched its 11th FYP (2006-10), and the plan's energy efficiency program—far more aggressive than that of previous plans—for the first time included a focus and specific efforts to improve energy efficiency in public institutions. Figure 2.6 shows a timeline of successive key public sector energy efficiency policies. In February 2006, several government ministries issued a circular calling for improvements in resource savings in government institutions, setting a target to reduce both energy use per occupant and energy use per unit of building area by at least 20%. The circular also specifically mentioned an electricity and water savings target of 20% for each. Energy conservation in public institutions became one of the "Ten Key Energy Conservation Projects" for the 11th FYP, encompassing many of the initiatives discussed in subsequent sections of this chapter. New regulations also established lists of energy efficient and energy wasteful equipment, mandating use of the former and banning use of the latter in future government procurement.[12]

2.25. In 2007, China's National People's Congress passed a major amendment to the Energy Conservation Law, which included new sections on energy efficiency in public institutions. In the

12. China's recent efforts to promote both the purchase of energy efficient equipment in government procurement transactions and energy conservation in public vehicle use are major topics. Because this report focuses on energy efficiency improvements of public institutional buildings these topics are not covered here. However, more information is available from public Chinese sources. Energy-efficient purchasing is covered in an ESMAP report; see Public Procurement of Energy Efficient Products—China Case Study, unpublished consultant report to ESMAP by Liu Caifeng, November 2011.

Figure 2.6: Timeline of Key Public Sector Energy Efficiency Policies (2006-2010)



Source: Authors.

amended Law, public institutions are assigned definite obligations to improve energy management and the efficiency of their energy use. Specific provisions in the Law also set a strong legal basis for a suite of new regulations and policies that were subsequently issued, further discussed below.

2.26. In August 2008 the State Council issued the "Regulation on Energy Conservation by Public Institutions," a key regulation describing the responsibilities and requirements of all public institutions for improving energy efficiency (see Box 2.1). Much of the subsequent work on public institution energy conservation has involved developing and organizing the more detailed programs and building the necessary capacity to implement this regulation.

2.27. In 2010 the State Council endorsed and issued "Opinions on Accelerating the Promotion of Energy Performance Contracting and the Development of the Energy Efficiency Service Industry." Among its many provisions supporting further expansion of the EPC business, this regulation specifically states that where government entities at any level (as well as other non-corporatized public organizations) utilize EPC to implement energy conservation renovations, payments to the ESCOs according to the contracts can be listed in accounts as energy costs. This provision opens the door for elimination of one of the biggest barriers to EPC by public institutions (see para. 4.12).

2.28. Provincial and local governments have also issued complementary policy documents and regulations. By the end of 2011, at least 20 broad overview regulations for public institution energy conservation had been issued by provincial governments.

Box 2.1: Summary of the State Council's August 2008 Regulation on Energy Conservation in Public Institutions (State Council Order 531)

Issued on August 1st and effective October 1st, 2008, the Regulation on Energy Conservation in Public Institutions aims to strengthen energy management in public institutions and foster their use of feasible and economically rational measures to reduce energy consumption and waste.

Energy conservation plans. Organizations responsible for overseeing management of public institutional facilities are required to prepare energy conservation plans for the institutional facilities under their purview. The plans should be in line with the overall medium and long-term energy efficiency plans at their respective government level. The plans should include a review of current energy use, issues, goals and targets, key steps for improving energy efficiency, and implementation assignments and duties. Individual entities should set specific annual energy conservation targets and develop implementation plans, specifying concrete measures and reporting on results.

Energy conservation management. Entities should implement energy use measurement systems, with sub-metering for different fuel types and energy use systems. Entities should appoint specialized persons to be responsible for energy consumption statistics, including the recording of original energy use measurements and establishing statistical accounts. Every year by the end of March, entities should report the previous year's energy use situation. Energy use quotas should be set, considering the overall energy consumption levels and special characteristics of different subsectors and systems. Finance departments should establish energy use expenditure standards based on these quotas. Above-quota energy use should be explained to the organization responsible for overseeing those particular public institutional facilities. Entities should procure new equipment from established energy efficient equipment lists, and not procure from established lists of banned wasteful equipment. Relevant design, construction and commissioning codes and standards should be strictly followed and supervised for new public building construction and building renovation projects. Project proposals must include energy efficiency assessments which must be approved.

Energy auditing. Energy audits should be completed according to regulations. They should include technical and economic assessments and recommend specific energy conservation measures. Detailed methodologies should be set by relevant departments. The energy audits should include: (i) review of energy efficiency design standards used at the time of commissioning and as listed in equipment documentation; (ii) assessment of energy use of different systems and fuels, using measurement recording and financial receipts, and calculation of unit consumption per occupant and per unit floor area; (iii) inspection of the operational situation of energy use systems and equipment, and the systems being used for their management; (iv) review of follow-up on recommendations for rational energy use in previous audits; (v) assessment of energy savings potential for different segments or departments, and recommendations on rational energy use; (vi) inspection of annual energy conservation plans and the implementation of energy use quota, as well as a verification of reasons for any above-quota energy use; and (vii) inspection of the operating situation for energy metering equipment and a review of the validity and correctness of energy use statistical reporting.

Energy conservation measures. Public institutions should establish energy system management protocols and in line with those protocols adopt low and no-cost energy efficiency improvements. Institutions should also establish energy management positions accountable for implementing state energy policies and hire specialized technical personnel to operate key energy using systems and equipment. EPC can be used. In selecting property management companies, institutions should consider the company's energy conservation management capacity. Targets and requirements for energy conservation management

should be specified in the service contracts. Energy conservation renovation projects should be based on audits and a cost-benefit analysis, using clear energy savings indicators, which then should be monitored and verified upon project completion. Some of the technical measures called for include improved management of electrical equipment; adjustment of temperature controls according to regulations; use of natural light and natural ventilation; use of smart-control elevators; adoption of high energy efficiency lamps and optimized lighting system design; electrical circuit control; smart electricity control; and minimizing wasteful external lighting. Energy use in computer network facilities and canteens and for hot water heaters and boilers, among others, should be tested and evaluated to identify energy conservation measures. The use of public vehicles should follow regulations.

Monitoring and guaranteeing results. Units responsible for supervising energy conservation management should increase their efforts. Supervision should include an evaluation of the following components: (i) the establishment and implementation of annual energy conservation targets and their implementation plans; (ii) energy use measurement, testing and statistics; (iii) execution of energy use quotas; (iv) establishment of internal energy management regulations; (v) establishment of energy management positions and implementation of related responsibility systems; (vi) operating conditions for energy use systems and equipment; (vii) implementation of energy audits; and (viii) public vehicle outfitting and use.

Key Efforts Launched during the 11th Five-Year Plan Period

2.29. Building on the broad policies that had been issued in previous years and with active support from Government leadership, work during the 11th FYP period focused on putting the systems in place to implement the new polices and begin the flow of concrete project implementation. This involved work in three key areas to (i) organize the many groups involved in energy conservation in public institutions and clarify their responsibilities for implementation; (ii) develop statistics and baseline data (which required major improvements in metering and human capacity) to identify priority areas and implement the new energy efficiency management regulations, and (iii) set up and improve effective mechanisms to develop, finance, and implement more energy efficiency projects. Table 2.2 provides an overview of the key measures and programs undertaken during the 11th FYP period.

2.30. Substantial progress was made in all three areas during the 11th FYP period (as summarized below), although of course much work remains on most of the agenda items, with efforts continuing under the 12th FYP (see Chapter 3). Although probably the most important results of the 11th FYP effort were putting key policies in place, developing institutional systems to manage public institutional energy efficiency, and developing project implementation mechanisms, quantitative energy savings results were also achieved. Only a summary of overall energy savings by public institutions during the 11th FYP period has been made public, but results show that energy use per occupant fell by 20.27%, meeting the target set in the FYP. The 20% reduction target for energy use per building area was missed, however, with only a 15% decline reported; see Figure 2.1.

Table 2.2: Key Agenda Items Developed during the 11th FYP for Energy Conservation in Public Institutions

Category	Key measures and programs
Establishment of legal and regulatory framework	1. Revised Energy Conservation Law (2007) 2. Public Institution Energy Conservation Regulations (2008) 3. Public Building Energy Conservation Design Standards* 4. Party and Government Office Building Design Standards*
Establishment of management mechanisms	1. Disaggregation and evaluation of energy conservation targets 2. Demarcation of work responsibilities, management of implementation arrangements, and coordination among state energy conservation management organizations 3. Establishment of a national management network for pursuing energy conservation in public institutions 4. Further highlighting and enforcement of the government's energy conservation procurement system* 5. Completion of statistical systems for energy use in public institutions 6. Public institution energy use measurement and online reporting platforms 7. Energy auditing 8. Development, implementation, and monitoring and evaluation of entity energy use quotas 9. Appraisal and complete process monitoring and supervision of the energy efficiency of the design for new buildings* 10. Management for conservation of water and land in buildings* 11. Management to conserve gasoline in public vehicles* 12. Information dissemination and training
Pursuing energy conservation renovation projects	1. Establishment of special funds for energy conservation projects and protocols for disbursement and monitoring 2. Promotion of EPC mechanisms 3. Sample project themes: a. Renovation of lighting systems b. Completion of diagnostics and energy conservation renovation of heating and cooling systems c. Comprehensive electric power efficiency renovations d. Energy conservation renovations in canteen gas use e. Improved operational management and upgrading of large data centers to save energy

** Issues and options concerning these agenda items are not covered in this report.*
Source: Authors.

Organizing Groups and Agencies involved in Energy Efficiency in Public Institutions

2.31. A particular challenge in China for promoting actions to improve energy efficiency in public institution buildings is coordinating and organizing the many different and separate groups involved. While the 2008 State Council Regulation is clear about what basic efforts need to be undertaken, these efforts must be implemented by a particularly large number of separate agencies, which are not as a group under any single direct higher command other than the State Council. China has made good progress in organizing the new public institution energy conservation effort, but it is not a simple task.

2.32. To clarify responsibilities for energy efficiency in public institutions, GOA in 2008 established a Public Institution Energy Conservation Management Office, with specialized staff and an objective to both oversee the implementation of energy efficiency measures in central government facilities and to more generally help promote the public institution energy conservation work. In 2010, the office was further upgraded to become the new Public Institution Energy Conservation Management Department. The new department is in charge of managing all of GOA's work to promote energy efficiency in central government facilities, but also has been asked to promote, coordinate, and supervise the overall national public institution energy conservation effort. The department also guides the energy conservation work of other government ministries (such as MOE and MOH), undertakes broad promotional and training activities, and monitors and evaluates the overall national progress on public institution energy conservation work.

2.33. In its work, GOA must coordinate with many central government agencies on the same level. On energy efficiency issues, coordination at the central government level especially includes NDRC (which oversees the country's overall energy efficiency policy and program), MOF (which manages relevant special energy conservation funds), and MOHURD (which guides the country's overall building energy efficiency work). GOA must also coordinate with other ministries and agencies in charge of public institutional entities for which GOA does not have a direct mandate, such as with MOE on energy conservation in universities and schools, and with MOH on energy conservation in hospitals.

2.34. GOA's relationship with provincial and local government entities on public institution energy conservation issues is one of guidance rather than direct authority. As described in para. 2.9, provincial government entities report to the provincial governor, and local government units report to their local government leaders. Moreover, with its function focused on managing central government facilities and with local government facilities managed by local offices, GOA does not traditionally have the same strong ties with local entities as many other work systems. With GOA's new role of guiding national public institution energy conservation, efforts were needed to develop a national network system.

2.35. In the last few years, developing this national network has made good progress. By the end of 2011, 26 provinces had established special government divisions or sections for public institution

energy efficiency. [13]The coverage of these new units varies in the extent that they also help guide other provincial or local entities in energy conservation work in education, health, or other sectors. GOA also has worked with the provinces to develop five regional coordination groups, each involving 5-8 provinces, with group chairmanship rotating between the provinces. It also has sponsored an innovative exchange program among practitioners to discuss policy developments and implementation issues and exchange new ideas.

2.36. In 2008 GOA and NDRC worked together to include the evaluation and results of the public institution energy conservation work as an important part of the national annual energy conservation target evaluation. In 2009 and 2011, authorities and experts from GOA and other relevant state departments inspected implementation progress in all provinces for the 2008 State Council Regulations. The review covered the local establishment of public institution energy conservation management systems, information dissemination and training efforts, development of energy conservation plans, the use of energy use statistics, implementation of specific measures, monitoring and evaluations efforts, and the arrangement of financing, among others. In addition to provincial-level inspections, for each province also two to three local governments were randomly selected for evaluation. Several provinces, for example Heilongjiang, have also instituted detailed monitoring and inspection procedures for lower levels of government in their provinces. This encourages improved performance and, on the national level, enables a better understanding of progress and problems on the ground.

2.37. **Universities and schools.** China's MOE has promoted efforts to both improve the energy efficiency of universities and schools and also increase awareness of the importance of energy conservation as part of student education. Circulars, issued in 2006, to provincial education committees and higher learning institutions reporting directly to the ministry, called for the development of "resource saving schools." This should be accomplished through improved planning, resource management, use of new technology, and other measures, including an emphasis on saving water and other resources in addition to saving energy. Use of technical expertise both inside and outside of schools has been encouraged. A subsequent circular in 2007 also emphasized the importance of developing and implementing a variety of activities on resource savings education, and the need to combine this with the development of the resource-savings schools.[14]

2.38. In June 2010, China's launched its new National High Education Energy Conservation Alliance at a national meeting in Beijing. Almost one hundred universities participated as founding members. The platform was developed by these leading universities together with the Facility Management Department Sub-association of China's Higher Education Association. It aims to promote more resource-saving college campuses, encourage the development of green universities, and increase environmental awareness and enthusiasm among university students. The Alliance has initiated a "10-100-1000-10,000 Program," which seeks to promote 10 types of energy conservation projects among its university members; develop 100 model energy conservation universities

13. Separate public institution energy efficiency government divisions had not been formed in Beijing, Guangdong, Guizhou, Qinghai, and Xinjiang, where DRC divisions are responsible for energy efficiency for public institutions.

14. Ministry of Education (MOE), January 2006, "Notification on Development of Resource-saving School;" MOE, September 2007, "Notification on Launching Energy Conservation and Emissions Reduction School Activities."

nationwide; foster the development of 1,000 student organizations that have energy conservation and environmental protection as their main focus; and train 10,000 energy conservation management personnel who can systematically promote energy conservation work in universities.

2.39. While most energy conservation activities in primary and secondary schools are organized locally, one national program was launched in August 2009. The pilot program, "20 Ways to 20% Savings," aims to help over 100 local schools in Beijing, Shanghai, Chengdu, and Baoding integrate environmental education into their overall curriculum and school activities. The program publishes manuals, provides teacher training, coaches on the preparation of training materials, and periodically provides advice. The schools can cover environmental topics as part of Chinese language, mathematics, and foreign language classes, as well as through a wide variety of activities. In a precursor to the program, the World Wildlife Foundation helped organize energy conservation education competitions among over 60 schools in Beijing and Shanghai.[15]

2.40. Hospitals. The Property Management Professional Committee of China's Hospital Association, which was established in the late 1990s, has been playing an increasingly active role in promoting energy conservation in China's hospitals. It has done so with the encouragement of MOH. Virtually all hospitals in China are members of the association, and its committee provides a key forum for hospital authorities and related experts to exchange information and experiences in promoting energy efficiency. The committee maintains a well-populated website and organizes many specialized meetings. In 2008, it conducted an energy use survey, commissioned by MOH, of 50 hospitals of different classifications and in different climate zones. The committee is further developing energy conservation and emission reduction plans, including a challenging effort to develop benchmarks of energy use for hospitals that have similar characteristics.

Developing Energy Use Measurement and Systems for Statistical Reporting and Analysis

2.41. To implement initiatives for improved energy management and energy savings, it is important to know how the energy is used. Energy use statistics must be reliably collected and analyzed. Preparation of accurate statistics also requires measurement of use. In addition, for specific projects an energy audit—an on-site diagnostic review of facility energy use—is needed.

2.42. When China, just after the turn of the century, launched its public institution energy conservation drive, no uniform system for preparing and collecting public institutional energy use data existed. The quality of statistics that were prepared was poor. While invoices and payment records existed for electricity, gas, and heat—as part of regular financial management systems—the data was not always reliable. Record keeping was sometimes lax, and payments would not always reflect actual energy use. This could be a result of substandard metering or, in the case of heat consumption, of the fact that payments are based on the amount of heated floor area and not actual heat use. Sub-metering of specific energy systems or sub-facilities (individual buildings or building compounds) generally is lacking and few energy audits had been attempted.

15.See http://wwfcn.panda.org/en/what_we_do/climate___energy/lclc/20_ways_to_20_/.

2.43. Under the 11th FYP, China's government launched major efforts to address this lack of reliable information, as it needed accurate statistics and end-use information to improve energy management and energy efficiency as set forth in the 2008 State Council Regulation and identify priority projects. This has involved assigning clear responsibilities for collecting and reporting (as well as supervising the collection process) of public institution energy use statistics; defining standardized methodologies and templates; further specifying metering requirements; training personnel; piloting new, on-line and real-time end-use reporting and monitoring; and launching various energy auditing efforts at central and provincial levels. While certainly more needs to be done (see Chapter 3), this investment has laid the foundation for long-term progress.

2.44. **Statistical reporting.** GOA has led a major effort to improve the system for collecting and reporting energy use statistics for central government facilities beginning in 2006. Most provinces participated in an initiative to develop an energy use statistical report for public institutions covering 2005-2008. In early 2009, GOA issued a circular to all provincial-level government office administration units emphasizing the need for regular statistical reporting to comply with the Energy Conservation Law and 2008 State Council Regulation. In January 2010, GOA formally issued the requirements and templates for reporting all public institution energy use, with the approval of the National Statistical Bureau.[16] Public institution energy use statistics became part of the national statistical system, with uniform templates (for trial use until mid 2011) and clear requirements to report statistics to GOA at specified intervals. To ensure correct implementation, GOA has also organized and delivered training, including two sessions for central government entities and four for provincial and local level entities. Over 1,300 participants had attended the trainings by early 2011.

2.45. Several provinces also have made special efforts to formalize their statistical reporting systems. For example, after formally issuing its "Management Method for Energy Savings in Public Institutions," Jiangsu Province also released its own detailed implementation requirements and guidelines for energy use statistical reporting, measurement, and auditing, along with a list of specific contact persons for queries.

2.46. While a good general framework has now been put in place, much work remains to be done to ensure statistical quality and consistency in the many reports coming from local entities and jurisdictions. This is a long process, requiring steady support, definitive guidance, and strong organization.

2.47. **Metering.** Statistics on the status of energy use metering for public institutions is not available, but it is understood that substandard metering systems and their incorrect operation are a common problem. Regulations issued during the 11th FYP period have increasingly emphasized the necessity of installing and using metering equipment according to the standards, but much more work needs to be done. In addition, relatively complex facilities, such as university campuses and large hospital compounds, need to install sub-metering, especially for electricity but also for gas and central heating, if a decent understanding is to be gained about who uses energy for what.

16."The Public Institution Energy Resource Consumption Statistical System" was established by the Government Office Administration of the State Council with approval of the National Statistical Bureau, effective January 1, 2010.

2.48. Over the last several years, a number of localities have introduced new real-time, on-line energy use reporting systems for the main government office buildings in their area. In 2007, MOF approved government financing for implementation of pilot systems in Beijing, Tianjin, and Shenzhen. The Beijing system covers 54 major entities, for which energy use can be monitored continually. Data from the system is also used for many types of analysis to determine priorities for future action, for example by establishing and monitoring unit energy consumption benchmarks for different types of consumers. Guangxi Autonomous Region, using its own funds, also developed a dynamic energy use monitoring system for 30 government office and other public buildings.

2.49. Auditing. The 2008 State Council Regulation emphasizes the importance of auditing energy use in public institutions and it set out the minimum scope that should be covered (see Box 2.1). Progress has been made with a range of auditing efforts nationwide. At the central government level, demonstration audits were undertaken for 13 relatively large ministries, including full system testing and diagnostic analysis and recommendations for no-cost, low-cost measures, as well as substantial renovation projects. Many provinces also have organized energy audits for their facilities. The government office administration of Shanxi Province, for example, organized the completion of 150 energy audits of public institutional facilities in the province in 2010. As with metering and quality statistical reporting, however, energy auditing work must be ramped up in the coming years.

Developing and Scaling-up Project Implementation Mechanisms

2.50. During the 11th FYP period, a variety of energy efficiency renovation projects were successfully completed in public institutions at different levels. Some projects were implemented through government budget allocations, using new energy efficiency special funds earmarked by the government. A few other projects were financed without special government budget allocations and used energy performance contracts with ESCOs (see paras. 2.57-2.62 for an introduction). With new promotion policies in place, the use of energy performance contracting (EPC) is expected to grow in coming years. Highlights of the 11th FYP are presented below, with further details provided in Chapters 3 and 4.

2.51. **Projects implemented with government budget allocations or own resources.** When using public funds for energy efficiency projects, public institutions can in principle use either government budget funds or their own funds. As discussed in para. 2.13, the ability to access own funds for possible investment in energy efficiency projects varies dramatically among the different types of public institutions, with hospitals having the most access and most primary and secondary schools, along with virtually all government facilities, having almost none.

2.52. One way to finance energy efficiency projects through annual government allocated budgets is by using funds allocated for facility renovations. Generally, the use of these longstanding line items needs to be discussed and agreed upon between the entity hosting the project and its supervising government agency. However, these funds are quite limited and many other longstanding priorities exist. Because of this, special public institution energy conservation financing programs were operated during the 11th FYP period, using the energy conservation special

funds established by MOF at the central government level and by the FBs at the provincial and local levels. The energy conservation special funds are allocated each year in lump sum amounts as part of the overall annual budget developed by the relevant government. Over the entire duration of the 11th FYP period, MOF arranged RMB 500 million for energy conservation renovation efforts in central government public institutions. Provincial and local governments provided at least an additional RMB 215 million during 2006-2009 alone.

2.53. Project proposals to use the special government funds are usually developed by the facility management units[17] of the host public institution. These units are in charge of overall facility management, renovation, upkeep, and especially daily operation. Once approved by the leadership of the host entity, the project proposal must be approved through the regular channels (see para. 2.12). The time between project proposal submission and receipt of funds usually is more than one year.

2.54. When initiating projects (either for government financing or EPC), the roles of the various property management units, entity leaderships, and relevant supervising government entities are all very different, but important. Property management units best understand the daily operation of their facilities and must be responsible for detailed project implementation and the ongoing maintenance of implemented measures. The property management units, however, are not likely to directly gain from the energy cost savings and they rarely receive a lot of management attention. Strong involvement and interest of the entity's leadership is essential for successful project implementation, in part because the leadership can pull together relevant departments, such as the finance department. The important role of entity leadership has been particularly demonstrated at universities and hospitals. In the case of primary and secondary schools, the various units within local education departments responsible for major property management, project financing, and cost savings will all need to work closely together. School principals may be enthusiastic about energy savings possibilities, but the responsible authorities will need to be involved to make projects happen. The same is true for government office facilities, where collaboration between building property management units and the relevant GOAs is key.

2.55. The public institutional energy efficiency projects that were implemented during the 11th FYP period with support from MOF's energy conservation special fund included renovations of more than two million square meters of central government office building space and about 525,000 square meters of government-owned residential area used by government staff. Upgraded equipment included boilers, building space conditioning systems, gas stoves, electric hot water heaters, and lighting systems. In 2009, GOA oversaw renovation project investments for heating and air conditioning systems in about 20 agencies, including NDRC and the Ministry of Industry and Information Technology. Over 2,000 smart energy control systems were installed in about 10 major agencies, including MOF, with electricity savings estimated to be around 36%. Thirty-two agencies installed improved dish washing equipment in their canteens, each reducing water use by more than 50%.

17.Sometimes more strictly translated as "logistical management units."

2.56. Among the many successful projects undertaken during the 11th FYP, one is an energy-efficient lamp subsidy program for central government organizations. The program was launched in 2009 by NDRC, MOF, GOA, and other agencies. By May 2010, some 3.3 million energy efficient lighting products had been disseminated, already surpassing the goal of 2 million for the year. Estimated annual energy savings were about 110 Gigawatt hours (GWh). By the end of 2011, the number of energy efficient lighting products that had been disseminated had risen to 4.8 million. To support the program's implementation, GOA had established strict procedures for application, clear disbursement mechanisms with proper fiduciary control, monitoring and supervision procedures, and good program outreach and technical assistance.

2.57. **Projects implemented through EPC.** When using EPC to implement public institution energy conservation projects—using either the common shared-savings or the outsourcing models as practiced in China—the public institution or government entity has little or no financial outlay. The investments are paid for from the energy cost savings achieved. A third-party ESCO works with the host entity to develop an energy conservation investment project and signs an energy performance contract. Current common practice is for ESCOs to be engaged through direct negotiation or through simple, relatively quick, procurement procedures. Under the shared savings type of contract commonly used in China, the ESCO will pay for the project investment (sometimes using funds it borrows elsewhere), oversee equipment purchases and project construction, complete commissioning of the project together with the client, and guarantee the energy savings. The ESCO is then paid amounts to cover the investment plus reasonable profits from a portion of the estimated or actual energy savings achieved by the project, based on the provisions in the energy performance contract. Contract durations in China are typically 2-5 years, with the ESCO often receiving 80% or somewhat less of the energy cost savings, and the host receiving the balance. So far, however, relatively few EPC projects have been implemented in public institutions in general, or in government offices specifically (see para. 2.61).

2.58. Today, China's ESCO industry is very vibrant. EPC in China has developed from the initial operations in 1996 of three pilot ESCOs to a domestic industry with investments exceeding US$ 4.2 billion in 2010, making China and the United States the two global leaders in the EPC business. Energy performance contracts in China are generally classified into three types: shared savings, guaranteed savings, and outsourcing contracts (see Chapter 4 for a comprehensive discussion of EPC). Although generally similar to energy performance contracts in North America and other countries, Chinese contracts do have some unique characteristics. Under all three contract types, ESCOs typically undertake the detailed project design, manage most project implementation aspects, and guarantee energy savings performance. Financing, contract details, and asset ownership however vary by contract type.[18]

2.59. Most of the energy performance contracts, about 61%, that were implemented during 2007-09 by the more than 400 members of the ESCO Committee of the China Energy Conservation Association (also known as China's Energy Management Company Association, or EMCA) were "shared savings" contracts. China's shared savings contracts are different from contracts with

18.For more information on China's ESCOs, see Sun et al. 2011, "China's ESCO Industry 2010: Saving more Energy Everyday through the Market" (unpublished report, May 2011, available from EMCA).

similar names that are used in other countries; most shared savings contracts in China base the payments to the ESCOs on an agreed percentage of an agreed estimated minimum energy savings scenario, as long as project savings monitoring arrangements verify that at least the agreed level of energy savings has materialized with normal asset operation. Any additional savings are usually 'given' to the clients. As long as the project delivers the basic results that originally had been expected, these contracts typically result in a predictable payment stream. Although cases exist in which payment streams vary every payment period, as they are based on ongoing measurements of actual savings during the contract period, these cases are a minority. Hence, most Chinese shared savings contracts are actually more similar in principle to the "ESCO-financed guaranteed energy savings contracts" typically used for federal government energy performance contracts in the U.S., except that Chinese ESCOs usually share some portion of energy cost savings with their clients throughout contract periods.

2.60. About 36% of energy performance contracts implemented by EMCA members during 2007-09 were "guaranteed savings" contracts. Under these contracts clients provide the bulk of the financing themselves, while ESCOs offer some form of financially significant guarantee of the energy savings performance. The remaining few contracts during the same period were "outsourcing" contracts. With outsourcing contracts, which are growing in popularity, ESCOs finance, manage, and operate (or assume long-term management contracts) key energy-using assets within the client's facilities in exchange for compensation that in some way is related to the energy savings resulting from the operation of the asset.

2.61. Industrial sector EPC currently dominates the ESCO industry in China. It accounts for half of all projects and three-quarters of the total investment of EMCA member ESCOs during 2007-2009. Although the investment levels per project are lower, energy performance contracted building projects are common and thriving, accounting for 49% of project totals. However, the bulk of building energy performance contract projects is with commercial establishments. Some energy performance contracts have been successfully implemented with universities and hospitals, but projects involving government facilities are rare. This is dramatically different from the ESCO industry in the United States, where EPC with public institutions, especially government facilities and schools, has long dominated the ESCO industry, and where EPC with commercial building entities or industries is relatively rare.

2.62. With the strong support of the government, strong market growth momentum, and the new provisions in the April 2010 ESCO policy statement of the State Council, a good basis exists for development of the public institutional facility EPC market. However, EPC in the public sector must overcome a variety of hurdles. After strong initial enthusiasm in 2011, many Chinese ESCOs are frustrated in their efforts to rapidly develop this market. After a discussion of key challenges and options for public institution energy savings in China (in Chapter 3), examples and suggestions for further developing EPC in China are presented in Chapter 4.

Chapter 3: Broadening and Deepening Energy Efficiency Programs in Public Institutions to Expand Energy-Saving Results

3.1. China's recent efforts, described in the previous chapter, have enabled and created a solid base for energy efficiency programs in China's public institutions. The next step will be to broaden and deepen the current energy efficiency programs. This chapter reviews the issues and options to do so. After a brief overview of China's current plans for the medium term, the chapter presents relevant experiences from the United States and Europe that have proven useful in addressing the three key barriers—the "three no's"—described in Chapter 1: no incentives, no technical competence and no funding. The chapter presents options to overcome these barriers so that sustained progress in energy conservation in public institutions can be achieved.

Plans for the Mid-term: Energy Conservation Efforts in Public Institutions under China's 12th Five-Year Plan

3.2. China's new 12th FYP includes a key target to further reduce China's energy consumption per unit of gross domestic product (GDP) by 16%. This follows the 19.1% reduction already achieved during the 11th FYP period. One of the specific measures to achieve this goal is the further promotion of energy efficiency in public institutions. Specifically, public institutions' energy consumption per person should be reduced by 15% and the unit energy consumption for building floor area by 12%.

3.3. To meet these targets, the government would like to put a relatively complete public institution energy conservation organization and management system in place by 2015. This system should include a regulatory system, a measurement and supervision system, a technical support system, a public information and training system, and a marketized service system (that is, EPC). The focus of the 12th FYP is to continue with concrete measures to implement the vision laid out in the 2008 State Council Regulation and the agenda initiated during the 11th FYP period (compare Table 2.2). Key goals include the following:

- *Completing the organization of the management system and strengthening coordination of organizations.* This includes increased coordination between central government agencies and within specific subsectors such as education and health, establishing energy conservation management and supervision systems based on the special conditions of the sectors.

- *Completing the policy system and establishing institutional and management mechanisms that can be effective over the long term.* This includes research into setting up an energy auditing system and strengthening economic and technical assessments of public institution energy use situations. To complete the statistical system for public institution energy consumption, norms are to be established for the types of and calculation methods for energy use statistics. Public institution energy consumption quotas and expenditure disbursement standards will be introduced, considering the energy use levels and special characteristics of different subsectors.

- *Strengthening measurement and statistics to solidify the foundation for work and provide a better basis for decision making.* This includes four important areas: (i) Establishment of a system of standards for measuring public institution energy consumption by user, type, and use system; (ii) normalization of measurement equipment and management, and development of pilots, demonstration, and promotional efforts for measurements for different users, energy types and energy use systems, with a special emphasis of installing heat measurement equipment in entities with appropriate conditions and in new buildings; (iii) improvements in the collection, transfer, and processing stages for public institution energy consumption statistical data, including statistical data checking and specialized supervision and inspection of statistics; and (iv) development and training of statistical staff.

- *Strengthening the supervision system and monitoring of entity target achievement, with incentives and penalties*. The energy conservation responsibility system will be further developed with the gradual assignment of targets and supervision of compliance at different levels. A system of awards and penalties will be established.

- *Establishing a technology support system and speeding up new technology demonstrations and popularization.* This includes a catalogue of technologies to promote.

- *Deepening the development of promotion, education and training, and promoting capacity building.* This will consist of a series of information dissemination and training programs on various topics, including energy management.

- *Developing mechanisms for multiple channels of financing to increase the level of investment.* The catalytic role of government funds is emphasized and the need to include funds for energy efficiency (EE) operating expenses and some EE renovation work in regular government budgets, at the central, provincial and local levels. This could be supplemented with regional energy conservation funds, and, importantly, with increased levels of private sector funds, especially through EPC. To encourage the use of EPC, subsidies and the ability to retain some savings by entities implementing EPC projects will be considered.

- *Strengthening international exchange and promoting international cooperation.* To study advanced energy conservation policy, technology, mature management experiences, and models that are relevant to public institution energy conservation, international exchanges and training will be organized and developed with international organizations, international financial institutions, and the energy conservation cooperation programs of different countries and regions.

- *Implementing energy efficiency demonstration projects.* The following areas are targeted for the realization of energy conservation investments: (i) model public entity energy conservation programs, (ii) demonstrations of good energy use metering and sub-metering

19. It is interesting to note both similarities and differences in the relationships between the federal and state government programs in the United States, between the European Union (EU) and individual country and local programs in Europe, and between the central and provincial government programs in China.

systems (including both separate energy-use system metering and separate key sub-entity metering), (iii) demonstrations of effective metering and use of consumption-based billing systems for heat, and (iv) demonstrations of key energy efficiency renovation projects. Public buildings and their energy use systems will continue to be a key focal area for activities, as will be vehicle fleets, use of new and renewable energy, and water conservation. Table 3.1 presents an overview of planned projects in these areas, showing 2011-15 targets for energy savings and penetration.

Table 3.1: 12th FYP Key Public Institution Projects and Targets

	2011-2015 Energy savings target (mtce)	2015 Penetration target
Model energy saving public institutions energy efficiency renovation of building envelope and key energy-using systems	1.2	2000 units with 20 million m^2
Green lighting • High efficiency fluorescent lamps • LED (and other advanced lighting)	0.6	• 100% • 10% (25 million units)
Green data centers	0.4	1000 entities
Office equipment energy use planning	0.64	N/A
Energy efficient gas stoves	0.36	80%
Building heat metering and energy conservation • Measured heat supply and consumption-based billing • Building envelope structural energy conservation renovation • Heat boiler renovation	1.3	• 100 million m^2 • 30 million m^2 • 15,000 tons of steam
New and renewable energy (solar energy use and ground-source heat pumps)	0.2	2%
Efficient water devices	N/A	80%
High-efficiency or new energy vehicles of newly procured vehicles	N/A	50%
Garbage separation	N/A	80%
Recycled/properly managed disposal of old lamps and electrical equipment	N/A	80%
Total targeted energy savings from key projects	4.7	

Note: N/A=Not applicable

Source: "The Twelfth Five-Year Plan for Energy Conservation in Public Institutions," as published in "Zhongguo Jiguan Houchin" (China Public Agency Facility Management magazine), Sept. 2011, pp 7-12.

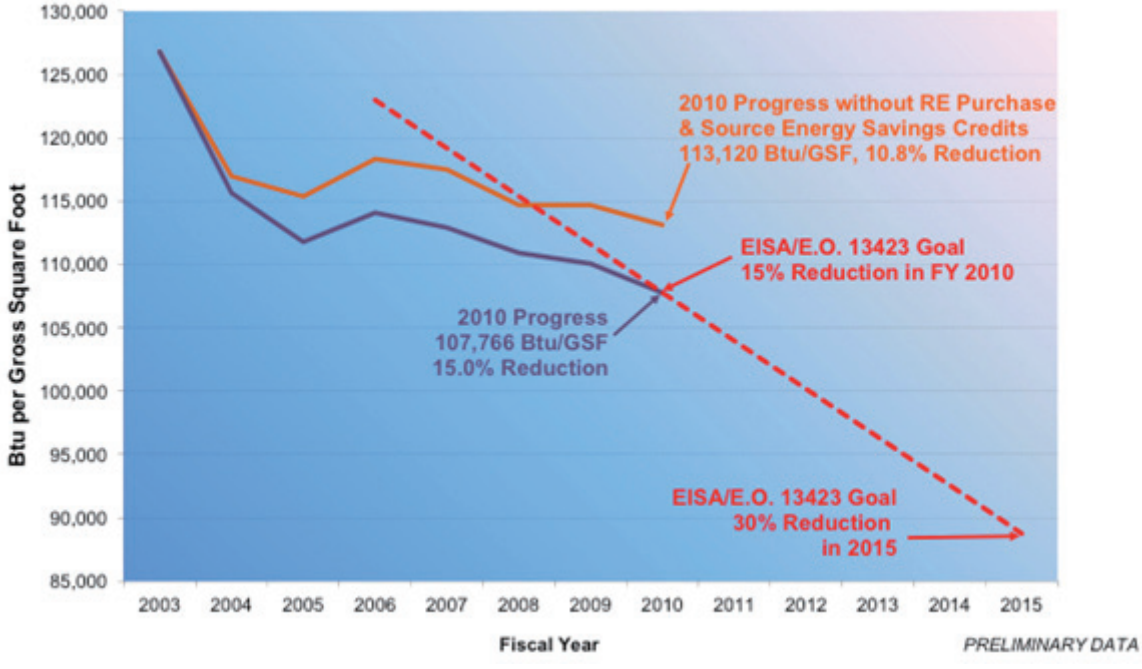
Relevant International Experience

3.4. While China's situation and government structure differ from those in Europe and the United States, many similarities exist, making it relevant to study these regions' experiences with initiating, sustaining, and growing energy savings projects in public institutions.[19] One key similarity is the impact of the public sector's budgeting system on both incentives and financing channels for energy savings projects. In addition, many countries have also had to address the same issues of statistical conformity, metering, energy auditing, benchmarking, building labeling and development of alternative financing mechanisms (in particular EPC, discussed in Chapter 4) that China currently faces. Because programs in Europe and the United States have been developed over the last 30 years, many good examples of successes—and failures—exist, which can help China make informed decisions about the best ways to accomplish its medium term goals.

Public Institution Energy Efficiency Targets in the United States

3.5. The U.S. Federal Government is the largest single energy consumer in the United States. It oversees approximately 500,000 buildings with a total of about 280 million square meters. Federal construction spending is approximately US$30 billion per year. Energy costs alone equal about US$7 billion annually.[20] Still, federal government energy use, which covers public universities, schools, and medical and government facilities, accounts for only about 20% of total public facility

Figure 3.1: U.S. Federal Government Progress toward Facility Energy Efficiency Goals (2003 – 2015)



Btu=British Thermal Unit, RE=renewable energy, EISA=Energy Independence and Security Act, EO=Executive Order, GSF=Gross Square Foot

Source: Tremper 2011.

20.See FEMP, Sustainable Buildings and Campuses.

energy use in the country. Public entities at the state and local level account for the remaining 80%, with public schools as one of the largest consumers of energy.

3.6. The United States currently does not have a target for an overall reduction in energy intensity of the national economy or an overall national target for energy savings in public buildings. However, the federal government and many states and municipalities have set their own targets for energy savings in their public buildings. Many of these targeting programs have fairly long histories.

3.7. At the federal level, national energy laws and executive orders have established requirements for energy savings, starting with the 1988 Amendment to the National Energy Conservation Policy Act (NECPA), which set a goal to achieve energy savings of 10% by fiscal year (FY) 1995, compared to a FY 1985 baseline. Since then, targets have become stricter, more detailed, and more comprehensive, encompassing mandates for renewable energy deployment, water conservation, greater efficiencies in vehicle fleet energy consumption, and other sustainability aspects. The current goal, established in 2007 in Executive Order (EO) 13423 and codified in the Energy Independence and Security Act (EISA) in the same year, is to reduce building energy use by 3% annually and 30% in total by the end of 2015, relative to 2003.

3.8. Figure 3.1 contrasts the annual targets and actual energy use in federal government buildings between 2003 and 2015. Preliminary data suggest that the interim goal for 2010 was missed in terms of the energy savings measured "at site." If, however, energy saving credits from reduced energy use "at source"[21] and from renewable energy purchases are considered, the interim goal of 15% savings was achieved.

3.9. The latest Executive Order to set sustainable energy goals is the 2009 EO 13514, requiring federal agencies to measure, manage, and reduce greenhouse gas (GHG) emissions toward specific agency-defined targets. For example, the General Services Administration (GSA) had a target to reduce GHG emissions by 28.6% during 2008-2010, the Environmental Protection Agency (EPA) 25%, and the Department of State 20%, to be achieved through reduction of the intensity of energy use in buildings and transport and an increase in renewable energy use. Together with previous laws and executive orders, EO 13514 establishes a framework for strategic planning, accountability, and transparency in implementing those goals. This includes targets for the implementation of certain measures, such as the designation of energy managers, metering, auditing, and benchmarking of facilities. Box B.1 in Appendix B provides more information on energy efficiency policies and programs in the federal government; subsequent sections in this chapter discuss implementation issues and results.

3.10. To implement the program and meet federal targets, federal agencies cannot rely on the very limited budgets specifically appropriated for this program. Instead, federal agencies use other

21. For details on the calculation of energy consumption at site and on a source basis, cp. DOE/FEMP 2004; see FEMP 2004, Section 502(e) Guidance: Providing Credit Toward Energy Efficiency Goals for Cost-Effective Projects—Where Source Energy Use Declines But Site Energy Use Increases (Amended October 1, 2004).

22. The American Council for an Energy-Efficient Economy (ACEEE) notes in its report, The 2010 State Energy Efficiency Scorecard (ACEEE 2010), that all but five states have "Lead by Example Policies." Such policies are one component in determining a state's ranking in ACEEE's state energy efficiency score card, published each year by this non-profit energy research organization.

retained budget funds as well as alternative financing sources such as Energy Savings Performance Contracts (ESPCs) and Utility Energy Services Contracts (UESCs), or special incentives and investment cost rebates offered by energy utilities in many states following state government regulation; for details see paras. 3.81-3.89 and Chapter 4. Using both budget financing and alternative financing sources, investments in energy efficiency measures in federal buildings are more than US$6 billion over 20 years. As a result, energy consumption in federal buildings has been reduced by about 30%. Between 1998 and May 2011, the Super ESPC concept alone has resulted in US$2.4 billion of project investment and annual energy savings of about 637 million tce, generating a total energy cost savings of US$6.6 billion and net savings for the federal agencies of US$220 million (see Box 4.1).

3.11. In addition to federal government targets, almost all states[22] and many cities and local governments have independently established their own mandatory targets for state agencies to reduce GHG emissions and energy consumption. Some of the targets are quite aggressive (see also Table B.1 in Appendix B). Many states have fairly comprehensive programs for public buildings, which might specify, among other things, that new and refurbished buildings must comply with Leadership in Energy and Environmental Design (LEED)[23] or other green building standards, or surpass existing state building energy codes. Several states and cities have acquired a reputation for being leaders on energy efficiency or climate-related issues. Key examples are the states of California and the city of San Francisco, the state of Oregon, the state of Washington and the city of Seattle, the state of Massachusetts and the city of Cambridge, and the capital city, Washington, D.C., among others. Their innovative programs can serve as best practice examples for other governments.[24]

Public Institution Energy Efficiency Targets in the European Union

3.12. Since the late 1990s, the development of energy policies in general and energy efficiency policies in particular in member states of the European Union (EU) has been driven by overall EU policies and regulations. An overarching energy policy was established by the EU 20-20-20 Plan: In 2007, the EU committed to reduce absolute GHG emissions and primary energy use totals by 20% each, and to increase the renewable energy share in the energy mix to 20%, all by 2020, irrespective of how fast the economy would grow. Recent EU Commission estimates, however, have shown that the EU has been on course to only achieve about half of the targeted reduction in total energy consumption. Accordingly, the Commission published a new Energy Efficiency Plan in early 2011, designed to close the energy savings gap. It includes several proposals relevant for public institutions. The plan states that public institutions should set a good example for others, as they own or occupy about 12% of the entire EU building stock by area. The building renovation rate should be doubled to at least 3% of the stock per year, bringing public building energy efficiency up to the level of the best 10% of the overall building stock. The EU Commission also is proposing for energy efficiency standards to be incorporated more fully into public procurement. The Commission

23. LEED (http://www.usgbc.org/LEED) is a green building certification system, developed and administered by the U.S. Green Building Council (USGBC). LEED promotes a whole-building approach and rates performance in nine areas: sustainable site development, water savings, energy efficiency, materials selection, indoor environmental quality, location and linkages, awareness and education, innovation in design, and regional priority.

24. See ACEEE 2010 (footnote 22) and EPA report, Energy Efficiency in Local Government Facilities and Operations.

calls for ESCOs to play a more important role in building energy efficiency in both the private and public sectors. There will be legislative proposals to increase their role.[25]

3.13. Several EU Directives of the European Parliament and of the European Council have been enacted in support of the 20-20-20 Plan. Relevant for public sector energy efficiency initiatives is the Energy Services Directive (ESD)[26] 2006/32/EC on energy end-use efficiency and energy services. It has six key elements:

- Preparation of national energy efficiency action plans (NEEAPs) every three years
- National indicative energy saving targets of 9% in absolute terms over a period of nine years
- Emphasis on the importance of the public sector, particularly as a market driver
- Agreement that governments can impose public service obligations regarding energy efficiency on those operating in the gas and electricity sectors
- Support for creating conditions to develop and promote a market for energy services (ESCOs)
- Requirements on metering and billing of energy consumption.

3.14. Member States of the EU need to establish their national energy saving targets and adopt their NEEAPs with specific measures in each of the six areas mentioned to reach their individual energy saving targets. Member states had to prepare follow-up NEEAPs in 2011, including evaluations of the results of their initial 2007 NEEAPs. Major policy targets and measures for energy efficiency improvements in public facilities in Germany are briefly described in Box 3.1.

Box 3.1: Energy Efficiency in Germany's Public Facilities

Of the approximately 200,000 public properties in Germany, only slightly more than 2% are owned by the federal government. The overwhelming majority (94%) of public properties is used by local governments, the remainder by state governments. Because local government buildings are small and consume less energy, federal government buildings account for 16% of the more than €3.5 billion spent on energy in public buildings annually. Local government buildings account for 64%.[27]

Germany's 2007 National Energy Efficiency Action Plan (NEEAP) commits to a 9% reduction in total energy use over 9 years compared to a 2001-05 baseline. The federal German government re-affirmed its commitment to reduce carbon dioxide emissions in its facilities by 30%, as it had specified earlier in its 2005 national climate protection program. This reduction would be achieved by increased emphasis on EPC and through a government-budgeted investment program of €120 million annually between 2008 and 2012. Energy efficiency retrofitting of state and municipal public buildings will continue to be supported by low-interest loans from the German Development Bank, the Kreditanstalt für Wiederaufbau (KfW). Energy management and close monitoring of energy-using equipment in public buildings is expected

25.See press release on The Commission's new Energy Efficiency Directive: http://europa.eu/rapid/pressReleasesAction.do?reference=MEMO/11/440&format=HTML&aged=0&language=en&guiLanguage=en

26.See Official Journal of the European Union, Directive 2006/32/EC of the European Parliament and of the Council of 5 April 2006.

27.Marktstudie: Contracting-Potenzial in öffentlichen Liegenschaften (Dena/Prognos, 2007).

to identify low-cost energy efficiency measures, resulting in 10% energy savings.[28] The energy performance of new federal buildings should be 20% above what is required by the German building energy code.

Germany's new 2011 NEEAP reflects the 2010 national "Energy Concept," with the overarching target of an absolute cut of GHG emissions by 40% by 2020 and 80% by 2050 (compared to 1990). This would be achieved by increasing the share of renewable energy, to 18% by 2020 and to 60% by 2050 and by decreasing primary energy consumption by 20% (by 2020) and 50% (by 2050), compared to 2008. The building stock is expected to be almost carbon-neutral by 2050.[29]

In line with these national targets, the federal government committed to reducing carbon dioxide emissions in its own buildings with 50% by 2020, compared to the 1990 baseline. This follows earlier targets of 20% and 30% emission reductions for 2005 and 2010, respectively, against the same baseline. The proposed measures to achieve the new goal include improved energy efficiency of old and new buildings, increased use of renewable energy, and energy efficient procurement. Progress in the federal government's program has been strong: by 2007 GHG emissions in federal government facilities had been cut by 42% compared to 1990.[30]

The Federal Real Estate Agency (Bundesanstalt für Immobilienaufgaben) is currently in the process of assuming ownership and management of all federal government buildings. Together with the Ministry of Construction, it is developing a long-term strategy and timetable for the energy efficient retrofit of federal buildings. A preliminary estimate of the investment necessary to reach the 2020 target is €200 million. Both agencies will report annually about the retrofit achievements, regarding both energy consumption and carbon dioxide emissions, for every federal ministry and agency, possibly also disaggregated by property (see footnote 29).

Most of the German states—if not all—have developed climate protection programs designed to fit in with the national program and targets. They emphasize the need to "lead by example" and decrease carbon dioxide emissions, mostly through energy efficiency retrofitting of state-owned buildings. EPC is a preferred delivery and financing mechanism. Many states have created state property agencies that are responsible for the management and operation of buildings owned and leased by the state. Most of these agencies have introduced energy management in state facilities and produce energy reports on a regular basis.[31] Similar climate protection strategies and concepts are pursued by an increasing number of local governments, many of which are members of various European energy efficiency and climate networks. Box B.2 in Appendix B provides details of the programs in the states of Baden-Württemberg and Berlin.

28. German 2007 National Energy Efficiency Action Plan (BMWI, 2007).

29. Note that these targets for renewable energy share and decrease in energy consumption are being revised in the light of the 2011 decision to complete the phase-out of nuclear energy by 2022. Additional energy efficiency measures in the public sector will include improved funding of energy efficiency activities through EPC and a new national Energy Efficiency Fund; see German Energy Plan ("Energiekonzept") and the Second NEEAP 2011, http://www.bmwi.de/English/Redaktion/Pdf/zweiter-nationaler-energieeffizienz-aktionsplan-der-brd,property=pdf,bereich=bmwi,sprache=en,rwb=true.pdf.

30. See German report on Translating the concept of sustainability into administrative actions ("Nachhaltigkeit konkret im Verwaltungshandeln umsetzen")—a program of sustainability measures of the federal government.

31. See for example the German report, Energiebericht 2010 für die landesgenutzten Liegenschaften in Schleswig-Holstein for state properties in the state of Schleswig-Holstein. Results are typical for most public properties in Germany, showing a reduction of energy consumption for heating, but an increase in electricity consumption, resulting in a small decrease of CO_2 emissions during the past 10 years. In parallel, energy costs have increased more than 75%. (Gebaeudemanagement Schleswig-Holstein (GMSH) 2010).

Three Major Barriers to Promoting Energy Efficiency in Public Institutions

3.15. Three major barriers make implementation of energy conservation measures especially difficult in the public sector—lack of incentives, need for improved human infrastructure and information/diagnostic systems and need for additional financing mechanisms. Finding and implementing solutions to these issues is necessary to achieve sustained progress in energy conservation in China's public institutions, just as in other countries.

Improving Energy Saving Incentives for Building Managers and Occupants

3.16. As described in Chapter 1, expanding energy conservation in public institutions in China will require overcoming three key barriers, the first of which is the lack of incentives for property managers and building occupants to take energy saving actions. Unless specific measures are adopted, these actors generally have no reason to care about the amount of energy that is used. Property management units are primarily concerned with operating a facility according to service quality requirements. Energy bills are paid by other departments (usually the finance department), often with budget allocations determined by higher levels within the organization. The occupants themselves generally also have few incentives and are only concerned with having satisfactory comfort and convenience. If energy costs are saved, this provides no direct benefit to the property managers, the occupants, or even—if energy costs are paid for from state budgets—the entities using the buildings. This severe problem of a lack of incentives for improving public institutional energy efficiency is true worldwide.

3.17. To overcome this barrier, several options exist. Establishing clear public targets—as is being done in China and many other countries—is essential. Incentives to achieve those targets can be improved by publicizing energy saving results and thus linking energy saving performance to an institution's reputation. In addition, allowing the energy cost savings to be used to finance improvements in other priority areas, such as facility upgrades and improved services, will provide further incentives. The sections below will discuss these various options.

Use of Targeting Systems

3.18. **Benefits of targeting systems.** Over the last several years, China has put in place the framework for a system to manage and save energy that relies on using targets, assigning responsibilities, and making entities accountable. This system of "targeting, responsibility, and accountability" is essential for drawing the attention of public entities to their energy management responsibilities and for putting energy efficiency squarely on the agenda. Other countries have also relied on targeting systems to galvanize energy efficiency efforts, but many have been weak on monitoring and evaluation. China has started to combine its targeting system with systems for responsibility and accountability by annually evaluating progress and preparing report cards of achievements against targets at various levels.

3.19. However, more needs to be done to strengthen and deepen China's system, to make the process as objective and systematic as possible, and—in particular—increase efforts at lower levels and in all types of public institutions. It would be useful for key performance indicators (such as energy use targets per square meter or per building occupant) to be defined for the various subsectors in the different geographic jurisdictions. A key part of this effort will also have to be further improvement in the systematic gathering of the necessary and detailed data of the diverse facilities and their energy use, including the development of baselines against which targets can be established. Given the large number and diversity of facilities at the various government levels, this effort will take considerable time and energy. Efforts must include defining how and which data will be collected to ensure the data is comparable and reliable (see also 3.53-3.55). Supervision efforts with checking systems must also be further developed to enhance data quality. The development of benchmarking for different types of buildings will be helpful in creating an energy use targeting system that is perceived as fair and useful (see 3.70 -3.76).

3.20. **Quota systems.** China's amended Energy Conservation Law and the 2008 State Council Regulations call for the eventual establishment of energy use quotas for public institutions, which would directly link to the government-provided energy expenditure budgets for those institutions. This systematic and direct link between energy use quotas and budget allocation shows similarities with an approach in Russia, where the government has a goal to reduce public energy use by 3% annually and reduces the budgets by that amount regardless of whether energy is saved or not. To survive, agencies need to save energy, even though in practice they often might just reduce comfort or other expenses.[32] The statistical and technical challenges are obvious: the quotas need to be fair and attainable, but also sufficiently rigorous and appropriate for a variety of public entities that all face different circumstances in terms of climate and common energy loads. To set fair but rigorous quota, excellent data is needed on consumption patterns of the energy systems at the various locations and the key factors influencing those patterns. This must be followed by a sophisticated analysis of norms and benchmarks before any quotas are established. As suggested by some Chinese experts, perhaps it would be best to first pilot several quota-expenditure allocation systems in relatively advanced areas. For example, pilots might first be developed in entities with statistical reporting systems that are or can be sound, where a good amount of detailed energy auditing work in different types of facilities has been or can be undertaken, and—ideally—where online, real-time and detailed energy use monitoring systems for the targeted public institutions are already in place or well on their way.

3.21. **Limitations of targeting and energy use quotas.** The use of targets and energy use quotas certainly provides an incentive for energy savings, especially in institutions close to the government. This is especially true if achievement of the target is part of the leadership's performance evaluation. As a policy tool, however, their use has several limitations. First, to be a valuable incentives tool, targets (or quotas) have to be disaggregated to micro levels to influence the behavior of the actual entities as directly as possible.[33] This disaggregation involves overcoming many technical difficulties in order to be fair and objective. Second, basic targeting and especially

32. Jas Singh, personal communication, February 2012.

33. The monitoring and targeting system employed by the Ukrainian city of Lviv is a good case in point; see the case study on Lviv's experience at http://www.esmap.org/esmap/node/1246.

the use of quotas can be quite valuable for identifying and eliminating cases of extreme energy waste (putting pressure on the most wasteful entities—the outliers—to change), but they are not as useful for generating better-than-average performance. Targets and quotas need to be set at levels that are realistic for most entities. By definition, that means they are unlikely to challenge entities that can achieve more than the average. In this way, the systems may result in incentivizing mediocrity. Third, targeting and quotas tend to be most effective when government energy budgets are important, and less so when entities primarily rely on their own resources, such as is the case for hospitals and some universities. Fourth, property managers may not understand why their building underperforms and may not know how to respond. This may lead to slower than expected physical investments.

Reputational Incentives

3.22. Public institutions serve the people. As often emphasized by China's leaders, government institutions should be the first to abide by the government's own rules and lead by example. In addition, many people interact with public institutions, for example, by using universities, schools, local medical facilities, and certain government offices. Visible, successful initiatives to increase sustainable use of resources in these facilities can leave a strong and positive impression on the local community. Similarly, examples of obvious waste can leave a poor impression. For these reasons, leaders and managers in public entities will often be quite concerned about the reputation of their institutions.

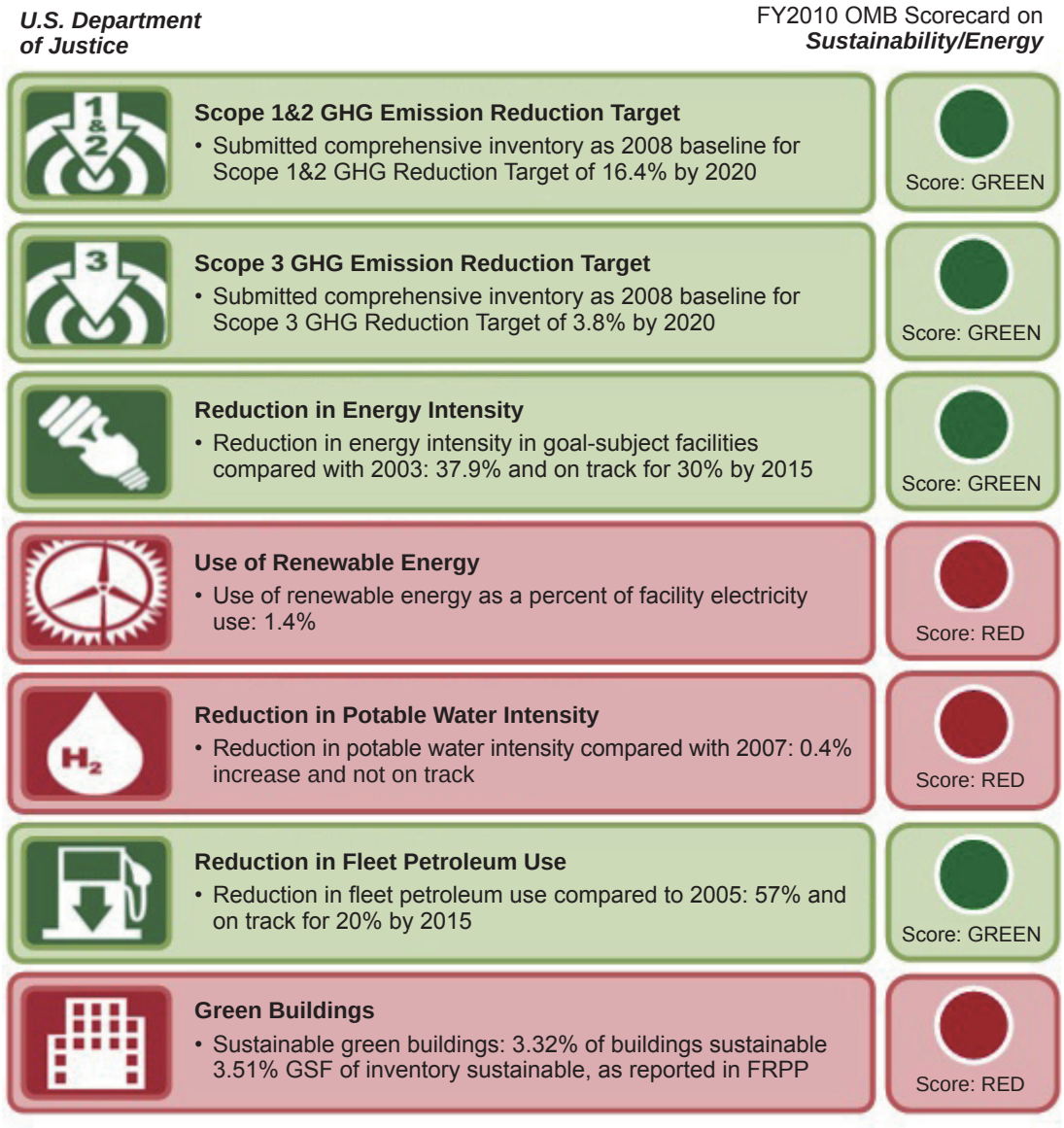
3.23. Many countries have instituted programs to harness this natural interest of leaders and managers in public entities for positive, public recognition, and use it to create additional incentives for pursuing energy efficiency or "green development." By acknowledging their current energy consumption and being pro-active, these public institutions position themselves as promoters of energy efficiency and green development and thus can avoid public criticism for being wasteful. However, this requires that credible, unbiased information on energy efficiency or other types of environmental performance is made public.

3.24. Reputational incentives work especially well in environments where local communities care about climate change and other environmental or sustainability issues. In universities, for example, the opinions of students, faculty, and trustees are important and in many cases have propelled university administrations to participate in activities related to energy efficiency, such as creating climate-neutral campuses.[34] Faculty and students can also provide a tremendous pool of enthusiasm and productive ideas. Some universities in the United States and Europe are now even reporting that their reputation related to clean energy and the environment has become a factor in the students' choice for a university as it is one signal of the attitude of the school administration. Local governments too can be eager to show their responsiveness, as is shown by the many networks and alliances of local governments worldwide that are focused on sustainability and climate change. Table B.2 in Appendix B lists some of the many networks, including some sector-specific ones.

34. For example, almost 700 universities with about a third of the U.S. higher education student population are members of the American Colleges and Universities Presidents' Climate Commitment (ACUPCC). GHG inventories, climate action plans, energy saving projects, and other information on individual universities and comparative statistics can be found at ACUPCC Reporting System - Reporting Institutions. See also the information on ACUPCC in Appendix B, Table B.2.

3.25. One frequently used way to strengthen reputational incentives is by recognizing success through awards. Awards introduce an element of competition and enable those who have made progress to show it, hopefully generating enthusiasm for increased efforts in their own facilities and inspiring others to create their own programs. The Energy Star awards of the U.S. EPA are a good example. Receiving public recognition from Energy Star, for example, helped the Council Rock School District in Newtown, Pennsylvania, bolster its energy conservation program. The school district managed to curtail its energy consumption between 2005 and 2011 by more than 40% and its energy costs by US$5.3 million. It did this using an energy management program, re-commissioning newer buildings, and requiring Energy Star labeled products, when possible, for new purchases.[35]

Figure 3.2: Example of U.S. Federal Government Scorecard



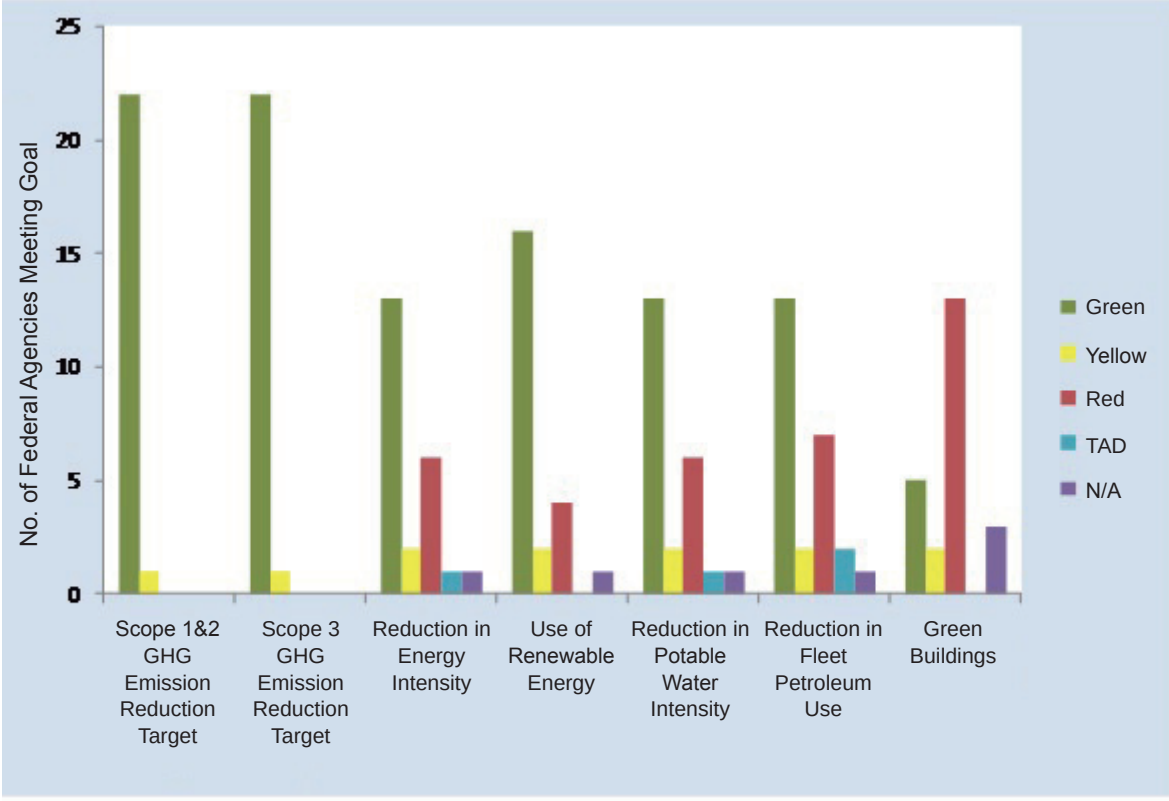
Source: Adapted from U.S. Department of Justice FY2010 OMB Scorecard on Sustainability/Energy.

35.See, EPA, Energy Efficiency Programs in K-12 Schools.

3.26. Another way to develop perhaps even stronger reputation incentives is to rate the energy savings (and environmental) performance of all entities within a specific category and publish the results. A good example is the U.S. Federal Government Scorecard, which rates the performance of federal agencies in achieving the energy efficiency and environmental sustainability targets set by the government.[36] It is said that the scorecards reversed the long-held attitude "where fear of action was greater than fear of inaction" (Vallina 2007). The scorecards represent summaries of the implementation status for the sustainability and energy goals that each agency must report twice a year to the Office of Management and Budget (OMB). After several years of internal use, scorecards were first released publicly on the White House's website in 2011.[37]

3.27. An example of a scorecard for the U.S. Department of Justice, which received mixed scores, is provided in Figure 3.2. Another large agency, after getting several ratings that were less than satisfactory, felt compelled to publish a detailed explanation of why its ratings were less than

Figure 3.3: Comparison of U.S. Federal Agencies' Scorecards, FY 2010



Note: The definition of the Green, Yellow, and Red Standards depends on the specific target that is scored; green indicates the target was met, while the yellow (intermediate) and red indicate that improvements are still needed and that the agency is not on track to meet future targets. See http://www.justice.gov/jmd/ep/docs/omb-scorecard.pdf for exact definitions. TBD=To be determined; N/A = Not available.

Source: Adapted from Schmutter 2011, Alliance to Save Energy e-Efficiency News, Federal Sustainability Scorecards: An Overview of a Program 'Leading by Example'.

36.Energy scorecards are also used in the private sector. AT&T, a U.S. telecommunications company, for example, developed an Energy Scorecard to track and benchmark the energy performance at each of its 500 largest energy-consuming facilities. This information is used to set goals for each facility. Quarterly, the AT&T Energy Team reviews performance and gives each real estate manager a score for her or his efforts, determined by variables such as projects, savings, electricity usage, and training. In 2010, scores improved by 58% compared to 2009 (see AT&T's program Managing energy, improving efficiency).

37.See http://www.whitehouse.gov/administration/eop/ceq/sustainability/omb-scorecards.

perfect, along with planned actions to improve them. Other than the results for the GHG emission reduction targets, less than perfect scores are in fact the norm rather than the exception, as shown in Figure 3.3.

3.28. **Study recommendations.** In China, authorities might consider the following three types of initiatives to take advantage of public institutions' interest in positive public attention:

- *Energy efficiency award program.* Implementation of a highly visible "model energy efficiency unit" award program for one or more specific categories of public institutions could create publicity and incentives for energy conservation. One option would be a nationwide, competitive energy efficiency award program for universities, in which perhaps 10 universities would be recognized as energy efficiency leaders. A monetary award, even if small, could provide additional incentive. Evaluation criteria would need to be established well in advance and be both rigorous and fair; the evaluation must also be scientific and objective. The launch and award announcements would also have to be highly publicized and perhaps could be introduced by a well known national leader. Similar programs might be considered for competitions among government agencies or schools. The latter could be designed to involve staff and students, as well as local communities.

- *"Energy Efficiency Networks" (or "Green Networks") for universities and hospitals.* An energy efficiency network for universities could be organized with support from the Ministry of Education, while a network for hospitals could be organized with support from the Ministry of Health. Membership could be open to any hospital or university, but an interested entity would need to implement and commit to specific—and quite aggressive—energy savings and other sustainability/green actions and results before being admitted. In return, membership would recognize the university or hospital as a leading energy-efficiency/green actor, which could be a priority position for certain types of government support and provide an excellent opportunity to exchange experiences with similar institutions trying to increase energy efficiency.

- *Pilot program of energy efficiency scorecards.* A program to publish scorecards similar to those of the U.S. OMB could also create incentives and transparency. The pilot could cover subsets of public institutions—for example office buildings of government agencies within one jurisdiction. The agencies would need to receive a timely warning about the planned pilot program to prepare for the public release of their energy saving results.

Cost-Savings Incentives in Public Institutions

3.29. Reduced energy consumption can lead to significant cost savings. In commercial entities, this potential for cost savings and increased profitability from economically attractive energy conservation measures is a critical selling point for energy conservation projects. Most public entities, however, have far less incentive to react to cost-saving opportunities because they are not driven by the motive to increase profits. Furthermore, if energy savings lead to a reduced need for government budgeted funds, there is no incentive to pursue these cost savings if they only result in

future cuts in energy operating cost budgets and the savings are realized by others. If government budgets account for only a share of the total budget of a public institution, such as at universities and hospitals, cost savings incentives may become more significant as savings may result in savings of own funds, which can be redeployed by the entity itself. Whether in commercial buildings or public institution buildings, if an entity's energy costs are relatively low, interest in energy conservation to achieve cost savings may still be scant. According to a 2008 survey by the Property Management Professional Committee of the China Hospital Association among 50 hospitals, energy costs averaged some 2-5% of total hospital costs. While not a trivial amount, it will not easily attract management attention.

3.30. Despite these traditional weaknesses in using cost-savings incentives with public institutions, appropriate incentives can be developed. Specific policies and initiatives, however, will be needed to develop and implement them.

Box 3.2: Energy Savings in Schools through Shared Benefits and Education Programs

District-wide shared-savings initiatives. Schools in the Gresham-Barlow district of Oregon in the United States accumulate financial rewards based on a variety of metrics, such as savings achieved during particular periods of the year or whether or not the school has created a resource committee. In Wake County, North Carolina, schools get to keep 10 percent of the annual savings achieved, which has been a primary factor in rounding up over US$600,000 per year in energy savings at the district's 100 campuses. Much of Wake County's savings are due to student and faculty activity as well as training. The school district of Philadelphia, Pennsylvania, discovered that a similar program brought in unexpected savings from demand-charge reductions. Those unanticipated funds were channeled into capital retrofits to capture even more savings.[38]

Alliance to Save Energy Green Schools Program. School districts that sign on to the Green Schools Program pledge to give at least 50 percent of the savings back to individual school sites. The Lake Elsinore school district in California in the United States agreed to give 70 percent back to its schools in 2009-2010, and 80 percent in 2010-2011. The savings can be spent in whichever way schools see fit to support curricular or extra-curricular activities. As a result, more than US$216,000 (70 percent of US$308,000 in savings) went back to the schools throughout the district in 2009-2010. Enrolled schools are given a US$1,000 stipend per year to create and manage a Green Team at each site. An energy conservation curriculum is provided and districts are equipped with data monitoring models to accurately measure their savings. Measures to conserve energy at schools have included auto-shutdown of all major electronics, unplugging appliances not in use, retrofitting lights, and applying set points for heating, ventilation and air conditioning (HVAC) systems.[39]

38. See Energy Star, Facility Type: K–12 Schools.

39. See Alliance to Save Energy's Green School Program, Green California Schools Summit Advances Energy Efficiency. http://ase.org/efficiencynews/southern-california-green-schools-save-nearly-1-million-energy-costs.

3.31. **Cost-savings retention.** A fundamental requirement of cost-savings incentives in public entities is to allow the individual entity to use at least a portion of the cost-savings, without passing all of the savings on to other government departments. In the United States, some state governments (for example Washington and Delaware),[40] many school districts, and the federal government have made such provisions.[41] Box 3.2 provides examples of budget retention policies generating enthusiasm for energy savings in schools.

3.32. Aware of the potential value of using incentives, some provincial governments in China have begun to devise policies concerning retention of government budget energy cost savings by entities implementing energy conservation projects. In its "Interim Measures for Management Funds for Fiscal Awards to Energy Performance Contracted Projects" of November 2010, for example, the Beijing municipal government included specific provisions allowing public institutions to retain their portion of energy cost savings delivered from energy performance contract projects and use these funds according to an overall plan. This is important as virtually all shared savings energy performance contracts provide some cost-savings cash flow to host entities throughout the contract period. The Beijing Municipality regulation also states that entities may retain all of the annual energy cost savings achieved from energy performance contracts for three years after ESCOs have been fully paid and contracts concluded. This is significant because most energy performance contracts in China are much shorter than those abroad.[42]

3.33. If entities are allowed to retain some of the savings generated from energy conservation initiatives, the question arises how they would be allowed to use these funds. What line items could they be allocated to? Obviously the entities will have the most enthusiasm for pursuing energy cost savings if they have maximum flexibility and can use the cost savings funds for their own priorities and programs popular with staff. Chinese authorities may wish to pilot various programs, including local pilot programs, which explicitly allow use of saved funds for relatively minor but popular facility upgrades or cultural and recreational expenses. Such programs could run for a few years and may create great enthusiasm among office workers or students and faculty. Bilateral agencies or other donors might be interested in supporting these activities. In the end, the government both saves money and increases energy efficiency. Along these lines, one idea may be for a province or prefecture to pilot an "Energy Savings for New Computers" program in selected secondary schools, allowing the schools to use most if not all of the energy cost savings (and perhaps water and other utility cost savings) they achieve to purchase new computers for the students.

3.34. Retaining energy cost savings is important, but issuing and implementing the necessary government financial management policies to allow it, is not a simple matter. Policy development will require key officials involved in government budget management to agree, and implementation

40. See The Bond Buyer, Energy Efficiency Deal Powers Up.

41. Energy cost savings retention for federal agencies was explicitly allowed but limited to 50% in the 2005 EPAct legislation. The 2007 EISA legislation then went further, allowing agencies to retain 100% of energy and water cost savings and use them for additional energy projects, including staff incentive programs. If EPC is used, however, the incentives value of these provisions is less than it might appear, as U.S. energy performance contracts with federal entities allow ESCOs to share all of the savings until contract completion. Still, since the energy performance contract guaranteed savings are usually conservative, entities do receive cost savings above those guaranteed in contracts, and are allowed by law to retain those savings.

42. "Interim Measures for Management Funds for Fiscal Awards to Energy Performance Contracts in Beijing Municipality," issued by the FB and DRC of Beijing Municipality, November 30, 2010.

will involve working through a variety of detailed issues. Provincial and municipal governments interested in aggressively promoting public institution energy savings should prepare and promulgate necessary regulations allowing retention of energy cost budget savings under properly defined circumstances, as allowed in the State Council's 2008 Order 531. Following pilot implementation efforts, it also would be useful to issue detailed implementation guidance. The central government also could support the effort by issuing regulations covering central government facilities and by providing specific support and guidance for local efforts.

3.35. Cost-saving incentives in budget-cutting environments. Following the financial and housing market crises, local governments in the United States and quite a few other countries have seen tax revenues fall sharply and have had to make major cuts in all types of local public expenditures. Rather than cutting expenses across the board, eliminating the wasteful use of resources would contribute to the optimal use of scarce resources. Thus, taking a hard look at energy (and water) cost savings possibilities would enable local governments to avoid cutting popular programs or key staff. Again, although in a somewhat different and perhaps less obvious way, reductions in energy costs can thus be used to support other entity priorities.

Gaining Facility Upgrades and Improved Service Quality through Energy Conservation Projects

3.36. In addition to setting targets and establishing reputational and cost-savings incentives, a fourth incentive for public institutions to engage in energy conservation projects is the opportunity to upgrade their facilities or otherwise improve service quality. Public agencies are often less than fully funded, especially when it comes to investments to renovate rundown facilities or replace worn-out equipment. This is the case in China (see Chapter 2 for the different subsectors), but also in the United States and in Europe.[43] Schools in particular have been suffering from capital investment shortfalls, since they depend on widely divergent local funding, and have been eager—especially in the United States—to use a variety of financial instruments to finance replacement of old utility and building infrastructure.

3.37. For many public entities, upgrading opportunities are actually their strongest incentive to proceed with energy savings programs. A few of the many examples of how an energy savings program can be used to upgrade a facility include upgrading building cooling and ventilation systems, installation of quality automatic room temperature controls that enable temperatures to be consistently maintained at comfort levels (and room temperature conditioning to be curtailed when rooms are unoccupied), installation of improved windows, improvements in lighting quality, provision of quality heat service, and the installation of new canteen cooking and refrigeration equipment.

43. In member states of the European Union, governments, including at the regional and local level, were required to abide by strict fiscal discipline starting in the 1990s. Many governments found that they were unable to finance the rehabilitation of public facilities from their own budgets and, moreover, that they needed to reduce operational costs. In this situation, energy service contracting, including energy performance and energy supply contracting or outsourcing, seemed the perfect instruments to achieve both budget cuts and facility retrofits. Energy agencies in several countries, foremost Austria and Germany, started to promote them to public agencies at the state and local level. See the example of Berlin (Germany) in Box 4.4.

3.38. When EPC is used, with ESCOs providing financing and services while being compensated from the energy cost savings, the public entity will in effect be receiving new equipment and various building improvements without any budget expenditures. ESCOs worldwide report that in cases where clients heavily rely on government budgets, a key driving force in the interest of such clients in pursuing EPC is their ability to receive upgrades that add to comfort, convenience, reliability and good service, and a sense of modernity. In the United States, where EPC investments with public entities are the highest in the world, this interest of public entities in multi-benefit upgrades is a key reason for contracts to be structured with virtually all of the cost savings used to compensate the ESCOs. The public entities generally prefer contracts that provide for more equipment and upgrades rather than the cost savings in cash.[44]

3.39. Governments have invested in energy efficiency upgrades to promote a broad, nation-wide energy efficiency agenda. Schools and other social services facilities are chosen not only for their societal benefits (upgrading the functionality of the building used by people in need) but also for their demonstration value. Occupants and building users who see real comfort and convenience benefits may push agency and local government leaders to implement more energy efficiency investments, especially if successful projects are widely publicized. They may also become motivated to act outside the facility, for example at home, and share experiences widely.

3.40. Box 3.3 introduces recent World Bank projects in Serbia and Armenia in which major renovation projects were implemented in local hospitals and schools to improve the functional environment and educational performance through better heat supply and lighting. Energy performance contracts were not used in these cases. Nevertheless, the study team recommends exploring *similar approaches in China, especially utilizing bundled projects to implement improved heating systems in schools in northern China, perhaps through energy performance contracts. Funds from energy savings alone are not likely to cover the brunt of investment projects to improve heating services in schools, and broader renovation funds will likely be required to make these projects happen. However, energy savings can cover an important part of the costs if well-designed energy performance contracts are used and if heating is paid for according to energy consumption (rather than a flat square meter rate). (See also para. 3.84).*

Box 3.3: Improved Heating and Energy Efficiency in Schools and Hospitals in Serbia and Armenia

Many public buildings in Serbia and Armenia suffer from insufficient heating provided by dirty fuels, a situation exacerbated by the run-down condition of many facilities. In schools especially this situation was so bad that in some cases only part of the building could be heated, or buildings could only be heated to a very low temperature. Some schools had to be closed during the coldest winter months.

44. Super ESPC projects in the U.S. federal sector are structured to maximize the amount of investment—not only are contract terms up to 25 years and investment payback times between 5 and 15 years (Hopper et al. 2005), but client agencies also receive only US$1 of benefits, leaving the remainder of guaranteed savings to repay ESCOs, while still managing to abide by the contract term restriction. Energy performance contracts in U.S. schools tend to have longer contract terms and include more measures (including non-energy measures) than in other state or local public agencies (Hopper et al. 2005). In Pennsylvania, the authorizing EPC legislation allows limited non-energy measures (up to 15% of the total project value; not just for schools) to be added to energy performance contracts to expedite overall facility modernization (Bharvirkar et al. 2008).

To improve the heating and building conditions in schools and hospitals, the World Bank extended loans to governments in both countries. In both cases, municipalities received the improvements as a grant. Both projects were highly successful and users are very satisfied with the multiple benefits they have received, such as improved comfort, better education outcomes, and an improved indoor environment.

Serbia. In Serbia, a series of small building interventions—such as the installation of new windows, thermostatic valves, automatic temperature control equipment, and efficient lighting—have led to huge energy savings. Between 2005 and 2010, the consumption of energy was reduced by 40 percent on average in 18 schools and 10 hospitals. In some schools it was possible to finance the upgrade of the heating system with the cost savings from lower fuel consumption due to the thermal renovation of the building.[45] In the first phase of the project, the owners of the buildings—the municipalities—benefited from the reduced energy costs. In the second phase, a benefit-sharing scheme will be implemented to allow the building users (the schools and hospitals) to participate in the savings. In the schools in particular, there was a significant spill-over effect from the energy saving retrofit measures. The combination of introducing lessons and other pedagogical approaches during the school day and special events about the measures taken at the school and the visible benefits of a better functioning and more comfortable facility, raised awareness of the benefits of energy efficient lifestyles not only among students but also among teachers and parents who are starting to implement energy saving measures in their homes.

Armenia. In Armenia, 117 schools that were previously heated with wood stoves, kerosene, or expensive electricity were equipped with new gas-fired boilers. As a result, comfort improved significantly and heating costs came down for some schools that had previously used electricity. Schools had been selected such that investment costs would be below US$120 per student. In 11 schools, additional energy efficiency measures were installed (such as insulation of windows, walls, and roofs, and the replacement of windows by walls). In those schools energy savings ranged from 10 to 40%. Average energy cost savings are 23% if taking into account the actual energy price before renovation, and 50% based on the current energy price, which increased substantially.[46]

Building Human Infrastructure and Information and Diagnostic Systems

3.41. To overcome the second major barrier to the expansion of energy conservation in public institutions—a lack of technical competence and reliable data—China will need to focus on building the necessary human infrastructure as well as diagnostic systems that can provide the technical support and data for energy conservation projects. This is already a core part of China's energy conservation plan for public institutions for the next five years. The following sections will focus on five specific actions to increase technical competence and the availability of reliable data: (i) assigning energy managers to assume responsibility for meeting energy efficiency requirements, (ii) strengthening metering and energy use data collection, (iii) developing and implementing targeted auditing programs and preparing site-specific energy savings plans, (iv) benchmarking and labeling of energy use, and (v) monitoring and verifying results.

3.42. Carrying out these efforts will generate essential knowledge about the status of public buildings and their energy consumption and abilities to develop action programs within entities.

45.See The World Bank, Serbian Schools and Hospitals Are Warmer and More Energy Efficient.

46.See The World Bank, Education Rescued from the Cold.

Assigned and trained energy managers will be able to determine how well their own building is performing and what basic measures could be taken to improve performance. Alternatively they would know where to get support and to supervise it. On a broader level—for example, in local governments or subsectors—those responsible for achieving the energy conservation targets would possess the information and tools to decide about priority projects based on audits and benchmarking.

3.43. Implementing this vision, however, is a truly massive task. Given China's size and diversity, each of these areas requires great effort, which must be sustained over quite a few years. Initiatives and work programs will need to be staggered, with some efforts given priorities over others. As in so many areas in China, an effective procedure is likely to be piloting at local levels with some central guidance and keen observation, and then building up successful results with strong policy support. The subsections below highlight various issues, present international experience and offer some suggestions for priority activities.

Assigning Energy Managers

3.44. China's Energy Conservation Law and the 2008 State Council Regulation emphasize the need for public entities to assign energy managerial personnel to oversee energy management and energy savings activities at the entity's facilities. Following the Plan-Do-Check-Act (PDCA) method,[47] energy management in a typical public institutional entity would involve at least the following steps:

- Plan. Planning for energy management involves securing top management commitment and appointing a responsible energy manager. In addition, the public institution needs to establish its energy vision and priorities for improvement, addressing their (i) energy profile; (ii) energy baseline; (iii) energy performance indicators; (iv) legal and other requirements; and (v) objectives, targets, and action plans.

- Do. Following the planning, energy improvement programs (such as installing, retrofitting, or upgrading building systems) can be implemented. This must be combined with the set-up of a management system to support the improvement programs. This management system could include (i) competence, training, and awareness programs; (ii) documentation requirements and control; (iii) communication systems; and (iv) procurement procedures for energy services and products (as applicable).

- Check. Implementation must be combined with monitoring, measuring, and evaluating the performance of energy management, determining the extent to which energy objectives and targets are met. This includes dealing with actual and potential nonconformities and taking corrective or preventive actions.

47. The PDCA method is in line with the (i) Chinese Energy Management Standard (National Standard GB/T 23331-2009, "Management System for Energy-Requirements," issued by the General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China, March 11, 2009); (ii) the EPA guideline cited in footnote 52; and the (iii) European Energy Management Standard EN 16001 of 2009, which has been adopted in every member state of the EU (for example in Germany, see DIN EN 16001: Energy Management Systems in Practice).

- Act. Progress and success of energy policy, objectives, and targets must be reviewed. This includes (i) tracking progress and analyzing how well the energy-saving efforts have worked, (ii) taking corrective and preventive actions to ensure the continuing suitability, adequacy, and effectiveness of the energy management program, (iii) applying lessons learned, and (iv) expanding both the scope of the energy management program and the involvement of energy managerial personnel.

3.45. Entity energy managers do not necessarily need to be able to do all of these tasks themselves. The key is for them to have the responsibility, competence, and resources to ensure that this process is properly carried out and completed. Energy managers can rely on specialized experts, such as energy auditing companies, but must have enough technical knowledge to oversee their work. Many countries require energy managers to pass specific training courses or demonstrate competence through certification.

3.46. **Which facilities should have energy managers?** In most countries the required number of energy managers per agency depends on the size of the agency and the number of facilities involved. In both Japan and India, facilities above a certain size must employ full-time energy management professionals. In the United States, federal agencies are required, since the 2005 Energy Policy Act, to assign energy managers for all larger energy-using facilities in a way that at least 75% of the agency's total annual energy use is managed by professional energy managers. By 2009, 99% of more than 4,000 designated federal government facilities had in fact assigned an energy manager.[48] In Germany, the recommendation is for local governments of smaller municipalities with 50,000-100,000 inhabitants to have a municipal energy management office with 2-5 staff members, and for larger municipalities to increase staff depending on the number of public buildings in the municipality. In Berlin, each city district is obligated to have an energy manager, but by 2009 only 7 of the 12 districts had complied.[49]

3.47. For smaller entities involving only a few facilities, most countries aim to have part-time energy managers or perhaps one full-time energy management professional covering a number of different entities. Another option is for this professional to combine energy management with other infrastructure or sustainability-related management tasks, such as water and waste management. However, as is well understood in China and elsewhere in the world, allowing staff with other responsibilities or full-time jobs to assume energy manager tasks part time, can result in the appointment of staff that are energy managers in name only, or that have no real competence or dedication to the work. Clear obligations and demonstrated basic competence remain important, even if assignments are not full-time.

3.48. **Scope of responsibility.** During the past few years, various governments and entities have begun to merge concerns about energy management and energy conservation with broader "green management" work, including water conservation, on-site renewable energy use, waste management, and waste minimization. This has led to the establishment of an increasing number of "sustainability management" units, which cover energy management together with other topics.

48.See FEMP, Covered Facility Footprint and Energy Manager Assignment (Federal-wide).

49.See Berlin Energy Plan 2020 ("Energiekonzept 2020").

In larger entities, specific professional energy managers may still be in place, but they would then operate within such a broader unit. Sustainability units are especially popular in universities (see footnote 34 on ACUPCC). The federal government in the United States also has started to require agencies to engage in sustainability planning. However, administrative issues need to be considered, as institutional conflicts can emerge. In the United States, for example, FEMP remains responsible for energy management, but a different "office" within the Department of Energy is responsible for sustainability management.

3.49. **Competence of energy managers.** Among the many issues governments face is the issue how to best confirm that staff carrying out energy manager functions are competent and meet required qualifications. Should this be carried out through accreditation, and if yes which organization should be in charge? Or should continuous education requirements with examinations be established; should they be administered by the government or by a professional organization? Could documentation of having satisfactorily completed specific training be sufficient proof of qualification? Various governments have taken different approaches. Japan has established a well-known system to certify Qualified Energy Managers (QEM) and Certified Energy Managers (CEM). QEMs are certified after passing a national exam, while CEMs are recognized after completing specific training. In India, the Bureau of Energy Efficiency (the national agency tasked to lead energy efficiency efforts) conducts annual national-level examinations for both energy manager and energy auditor certification.[50] In the United States, certification of energy managers is provided by the Association of Energy Engineers (AEE), as well as other institutions. Since the 1980s, AEE has certified more than 10,000 energy managers. AEE certification is recognized by the relevant federal U.S. agencies as well as by numerous state energy offices, major utilities, corporations, and ESCOs.[51] *A very similar approach is currently being taken in China to train energy managers for industry and provide them with documented evidence that they have passed suitable training or qualification courses. This route also seems appropriate for public sector energy managers.* The study team does not recommend a new type of formal professional-stream distinction since this would introduce an unnecessary barrier to entry and complexities of approval systems.

3.50. **Training.** Staff assuming energy manager responsibilities will, in almost all cases, need to receive training on various aspects of energy management. Training should cover technical aspects—such as energy measurement, use analysis, preventative maintenance, opportunities in system operation and maintenance (O&M), renovation project development, and implementation—but also the basics of financial evaluation of projects. Training can be provided by professional associations, universities, or other groups. In the public sector, staff is often required to undergo continuing education to keep up with new developments. It may also be helpful to organize regular meetings or workshops for energy managers of agencies at certain levels (such as municipal government facility energy managers in a province, or central government agency energy managers) to create networks and provide opportunities to exchange experiences on technical issues. In Germany, for example, the state government of Hessen has been organizing such workshops for more than 20 years. In addition, guidelines on energy management within a specific subsector can

50.See Energy Manager Training.

51.See AEE, Certification and Comprehensive 5-Day Training Program for Energy Managers.

be helpful to provide a common understanding of the tasks and requirements involved. In the United States, for example, energy management guidelines targeting local governments are produced by the U.S. EPA; in Germany they are developed by the Association of Cities ("Staedtetag").[52]

3.51. Study team recommendations. As China continues to put energy managers in place in public institutions, a step-by-step approach is likely to be necessary. As various Chinese experts and authorities are already considering, *elements of such a step-by-step approach could include the following:*

- *Placement of energy managers in large agencies and their key facilities. While eventually most agencies and facilities will need energy managers, the first focus should be on the larger agencies and key facilities.*
- *Piloting the development of integrated public institution energy manager and training and certification programs within several relatively advanced jurisdictions. Pilot programs could be developed for a selection of central government facilities or in one or more provinces. Programs could include the full set of policies and programs needed to make the efforts effective, including (i) issuance of clear policies describing which institutions must retain what levels of energy managers; (ii) issuance of clear policies on what specific competencies are required; (iii) issuance of policies for certification of energy managers, along with implementation arrangements for testing, issuing certificates, and so forth; (iv) development of multi-year training programs, including curriculum, course content, and training delivery plans; and (v) training delivery.*
- *Development of national-level guidance and manuals on the work scope, approaches, and methods for pursuing energy management in the various subsectors of public institutions. Guidance could for example cover government office buildings, universities, schools, and medical facilities.*[53]
- *Review of possibilities for introducing broader sustainability management units and staff in key entities. This effort might perhaps begin with universities.*

3.52. International donor groups will likely be able to help introduce experience from abroad and help plan, organize, and initially deliver part of such efforts.

Strengthening Metering and Energy-use Data Collection

3.53. Information on buildings and their energy consumption is essential for proper building energy management. Information is used for several purposes:

- Development and reporting on energy saving targets
- Assessment and comparison of the relative performance of buildings and agencies, among others

52. See Energy Star, Guidelines for Energy Management Overview and German Association of Cities Information on municipal energy management ("Hinweise zum kommunalen Energiemanagement").

53. Table B.2 in Appendix B contains a list of specific information tools and networking resources for energy managers in the various subsectors. Table B.3 gives examples of manuals for the energy-efficient operation of key energy-using equipment.

- Identification and prioritization of energy saving measures and projects, at both the project and the program level
- Monitoring of progress.

3.54. Over the last several years, China has made substantial progress in laying the foundations for energy-use data collection and statistical reporting in public institutions. It has issued regulations to assign responsibilities and establish basic data collection requirements. It has also provided some guidance on methods and staff training and made initial investments in metering and data collection systems. The vision of authorities and experts for the future is to continue to build the data collection system to (i) improve the quality of statistics, (ii) develop selected, integrated data collection and analysis systems for various building groups, using real time reporting, (iii) develop energy-use benchmarking systems so that energy use in different buildings can be compared, and (iv) utilize this information to improve the targeting system. Achieving this vision will require a concerted effort over quite a few years. Implementation of improved data collection and analysis systems in the different subsectors of public institutions also requires somewhat different approaches as the role of the government and the conditions on the ground vary.

3.55. The first step forward will be the improved collection of basic data. For buildings, this includes information about building size and occupancy, state of the building (for example about the type of windows and wall insulation), and details about major energy consuming equipment, as well as actual energy use. Metering of power, heat, and fuel consumption is the most correct way of assessing energy consumption in a building, but installing the necessary hardware and combining it with the software and billing system is a challenge. If a building is not metered, information on the consumption of various utilities and other fuels must be estimated based on the type of equipment, its energy demand, and hours of use.[54] Weather data should also be considered. Climate plays a major role in energy consumption and variations in annual data, for example the number of heating and cooling days, depend for a large part on weather changes. To separate the influence of climate, energy consumption data can be averaged over a period of about three years or, as a more advanced method, corrected with climate data that are now available for many individual locations.[55] This basic data collection is best done at the local level. *To ensure that data are comparable and reliable, continued efforts are needed to ensure that a unified methodology and standardized data compilation protocol is used across all the subsectors at all different levels. Central guidance needs to be adhered to and training for local officials and enumerators on how to correctly follow the guidelines needs to be further expanded.* For small and simple buildings a simplified methodology might be useful to consider. All local data is then aggregated as necessary at the provincial and national levels. Basic checks must be employed to ensure the data are free of obvious mistakes.

54. The USAID publication “Powering Health, Energy Management in Your Facility” provides a guide to energy management in health care facilities in rural settings that are frequently supplied by off-grid power (see Powering Health - Energy Management in Your Health Facility).

55. Weather normalization correlates the relationship between usage and weather data—typically through statistical methods such as regression analysis—and allows for a comparison of a building’s energy use relative to itself over time, accounting for year-to-year differences in weather. For an example, see Energy Star, Portfolio Manager Methodology for Accounting for Weather. Another example is the Natural Resources Canada’s Benchmarking Guide for School Facility Managers, which uses the average heating degree days (HDD) for the past 30 years to normalize heating energy consumption for a specific year, using the weather data obtained from Environment Canada and the methodology provided by the Agence de l'efficacité énergétique and Quebec's Ministère de l'Éducation. A similar procedure can be used to weather-normalize cooling energy consumption using cooling degree days (CDD).

3.56. Given the lack of serious attention until recently and considering how widely dispersed facilities are, proper metering of energy use in China's various public institutional subsectors presents tremendous challenges. Perhaps these challenges can be addressed through actions in three areas: (i) strengthening basic metering and purchase recording, as well as improving methodologies to estimate basic fuel and electricity consumption, (ii) dealing with the major heat metering and control issues in the standard hot-water radiator central heating systems of northern China, and (iii) implementing sub-metering of key energy-use systems and sub-entities.

3.57. **Basic metering and energy use recording.** Chinese authorities and experts have recently put a strong emphasis on improving basic metering and recording of the main energy purchases of entities, and with good reason. Basic, main meter installations need to be checked and improved to ensure they are properly in place, up to standard, and calibrated. Metering data and purchase records need to be analyzed and reconciled. Coal supply, distribution, and use statistics need to be reconciled, and checked by authorities. Metering and purchase recording may need to be realigned to properly report the baseline energy use of different public entities, which in the past may have been sharing meters or recording systems.

3.58. **Heat metering and system control.** Measurement and control of public building heat use in northern China involve the complex and broader issues of China's heat pricing and billing system reform and associated required major technical renovations.[56] Except for a few pilot projects and special efforts in a few cities such as Beijing,[57] central heating relying on local district heating systems is billed according to the floor area of heat supplied (for example per square meter of living area) rather than according to heat consumption. Accordingly, building heat consumption is rarely metered and actual building-level heat use is therefore unknown. Furthermore, the traditional heat supply systems based on Soviet-era technology do not allow for adjustment of heat levels by consumers, including even at the building level, unless heat substations have been specifically configured to allow for such control or buildings have separate heating systems. In this situation, therefore, there are few incentives to undertake heat savings measures. Even if an entity undertakes such measures, they will not result in heat savings at the source because the heat supplier cannot adjust its heat supply level to match reduced demand.

3.59. China is in the midst of major heat supply system reforms to address these problems. These reforms involve (i) renovation of heat distribution system configurations, including changes from fixed flow to variable flow systems, which would allow adjustments in heat supply to buildings based on actual demand; (ii) increased use of dual, horizontal internal heat piping systems (as opposed to the single, vertical heat piping systems) in new buildings, with thermostats or other end-use control devices which allow for heat radiator control within buildings; (iii) renovation of old-system heat piping systems within buildings to allow for at least some control of heat use within buildings; (iv) installation of heat meters at building levels, and, where needed, within buildings; (v) reform of heat pricing systems to include charges for actual heat used; and (vi) revamping of heat billing to accommodate the new metering and pricing systems.

56. For an introduction to heat system reform issues and their importance for building energy efficiency in China, see Taylor et al. 2001, China: Opportunities to Improve Energy Efficiency in Buildings.

57. In Beijing, completion of heat metering of all public buildings and use of consumption-based billing in all public institutions will become mandatory starting with the 2012/13 heating season.

3.60. Public institutions are just one set of heat consumers among many others and have no other option than to operate within the systems established by the municipalities. This makes them dependent on the rate of progress of the heat system reform by these municipal governments. If the public institution's buildings are part of the local district heating system, overall upgrading and reform of that system will dictate much of what the institution can do to generate heat savings. *Nevertheless, public institutions can take several actions to both increase their own heat savings and support progress of the overall heat system reform. First, municipal governments, in the spirit of "setting an example," should offer their own facilities as among the first for piloting upgrades and billing reforms on the customer end (including passing the payment responsibility for the bill to residential consumers), and help spur municipal heat supply companies to accommodate accordingly. Second, in the case of relatively new buildings with modern-era internal heat systems and control potential, public institutions can push for a local configuration that would allow them to have their own meter, preferably at the building or staircase level. Third, in such buildings, public entities could promote advanced heat saving technologies like building-level substations and thermostatic radiator valves. This will provide excellent show-cases of potential good management and savings schemes. Fourth, if the public facilities operate their own local heat production and supply system, they should upgrade and reform their own system to include demand-based heat dispatch, modern controls, and other heat savings measures (to the extent allowed by the internal heat pipe configurations of older buildings). Using the outsourcing-option of EPC may be a good way to implement this fourth type of measure but only if it does not "lock in" a heating tariff based on floor area.*

3.61. **Sub-metering.** If at large facilities, such as large provincial government compounds or university campuses, only the energy consumption for the entire complex is known, it is very difficult to assess priorities for energy savings or get users excited for improved energy management. Electricity, gas, and heating sub-meters need to be installed for different key energy systems (such as the main air conditioning and lighting systems or key data centers) and for important subgroups, so that more specific energy management plans can be developed and monitored. In fact, without the advance installation of some types of sub-meters in these large facilities, it is almost impossible to have a reliable energy audit or develop meaningful energy savings incentives programs.

3.62. Installation of sub-meters is part of most successful energy management programs, unless facilities are quite small. Box 3.4 provides an example from the university subsector in the United States. In China's public institutions, however, few sub-meters exist and it will be important to prioritize efforts. To yield the greatest benefits, sub-metering should focus first on the largest energy consumers and on facilities where follow-up action is definitely planned.

Box 3.4: Energy Sub-metering at University Campuses in the United States

A recent survey on sub-metering on university campuses undertaken by the Energy Star Program and the Association of Higher Education Facilities Officers (APPA) showed that 69% of participating universities meter all dormitories and 48% meter all non-laboratory classroom facilities (both types of facilities account for the majority of floor space in these universities) for one or several types of energy uses. The trend towards increased sub-metering, especially for electricity, is driven by cost reduction efforts, charge-back practices, and efforts to establish accountability. For example, the University of Michigan has installed meters for every single building. A dedicated website provides information on the monthly consumption of each building, how that compares with previous months and years, and how much the associated energy costs are. The site also reports on recent energy savings investments and cost savings at each building.[58]

3.63. **Suggestions for the development of metering programs.** While it is essential to maintain the current drive to achieve basic energy metering in all main facilities as soon as possible, the extent of the need for energy metering in the public institutional sector is so great that it may best be tackled in staggered approaches. The study team has two suggestions:

- ***Focus on selected subsectors in specific localities.*** *Developing programs to improve energy metering for selected subsectors in selected localities will build the necessary experience while starting to provide an improved basis for energy management and design of energy efficiency programs in key subsectors. Examples could include provincial and municipal government office buildings in a province, a selected number of interested universities or hospitals, or a number of school districts in a given area. Programs could include a time-bound, relatively comprehensive plan, including meeting all basic energy metering requirements, but also selection of key pilots for sub-metering, heat metering, and perhaps smart metering (where relevant energy tariffs exist). Specific technical guidance should be provided, perhaps similar to what the U.S. Department of Energy (DOE) provides for electricity metering in U.S. federal government buildings.*[59] *The relevant FBs should allocate funds to support meter purchase and installation.*

- ***Target entities with high savings potential and concrete plans.*** *For the implementation of all but the basic metering programs, it is suggested to target entities that have both a substantial savings potential as well as concrete plans to implement specific energy savings programs. Considering the great need for advanced metering in many locations, it may be best to focus on cases where meters can be expected to lead to incentives programs for management improvement or energy savings investment, rather than just used for information purposes alone.*

58. See Energy Star, Sub-Metering Energy Use in Colleges and Universities: Incentives and Challenges and University of Michigan, Plant Operations Division, Energy Management, Building Information.

59. See FEMP, Guidance for Electric Metering in Federal Buildings.

Energy Audits and Preparation of Site-Specific Energy-savings Plans

3.64. Energy audits are informational or diagnostic reviews of energy use in specific facilities. They involve some kind of on-site inspection, usually by third-party experts, which can either be a simple one-day activity combined with a review of readily available data and a quick "walk through" of facilities, or a complex, multi-month activity involving sophisticated measurement and diagnostic analysis of all energy systems and facility sub-groups.

3.65. **Energy audit objectives.** Because energy audits can be pursued for different reasons, successful energy auditing programs are clear about the audit's objectives and manage expectations of the involved parties. Also, most importantly, successful audits specify required follow-up action. Three common types of energy audits are:

- *Diagnostic reviews for developing improved internal energy management systems.* To help entities develop improved internal management methods, a detailed understanding of existing internal procedures is key. Auditors will need to work closely with many of the staff at the public entity. Expected follow-up to this kind of energy audit would include the institutionalization of improved internal procedures and management methods.

- *Audits to provide information to supervising units as well as to the entities themselves.* Simple audits can be used to confirm or augment statistical reports from the public entities on building characteristics and energy use patterns. This could also confirm the feasibility of possible project ideas. The audit results could also be used by the supervising units and the host public entity as basic information for policy and program development. The audit could involve just information collection and analysis, but expected follow-up may also encompass use of the information to establish benchmarks for future quota systems, facility energy efficiency performance labeling, or minimum certification. As these different objectives may have different implications for the entities involved, and thus for the auditing process, clarity at the outset would be useful.

- *Diagnostic reviews to identify future projects, including renovation investments, and promote implementation of those investments.* The level of detail in project-related diagnostic reviews varies dramatically depending upon the objective. Simple walk-through audits may be helpful for screening potential project types for future analysis. Full investment grade audits (IGAs) are often required for major projects, especially if multiple measures and technologies are included. Typically these IGA reports become key contractual documents. In all cases, however, if the objective of the audit is to identify future projects, the audit must cover a credible financial analysis, identification of practical implementation issues, assignment of next-step implementation responsibilities, and identification of eligible financing sources, to ensure serious follow-up. The selection of auditing companies also may have implications for the future procurement of contractors for project implementation, which needs to be considered upfront.[60]

60. If EPC projects are planned, a first-stage relatively simple audit is used to provide basic information to interested ESCOs and to set basic parameters for ESCOs to prepare proposals. Once a contract is awarded, an IGA is then often completed "to finalize the precise details of the energy performance contract, document the baseline and develop the detailed project design." The cost of this audit is rolled into the contract. See also Chapter 4 of this report and Singh et al. 2010, Public Procurement of Energy Efficiency Services - Lessons from International Experience, p. 78.

3.66. **Linking energy auditing with results.** Inadequate follow-up to energy audits is a common problem in most countries. If one of the key reasons for undertaking an audit was to help the entity improve its energy management, was an improved energy management system in fact adopted by the entity? If the audit was undertaken to provide supervising entities with more information, was the provided information useful and credible? If the main purpose of the audit was to identify attractive renovation investments for implementation, is the entity now actively investing in new projects? A successful audit means that the broader objectives of the audit are met, not just that the actual diagnostic review or walk-through happened. The best approach for increasing audit follow up is to be clear about objectives and expectations in advance, and then to ensure that audits are part of a broader program to realize those objectives, rather than an isolated exercise focused solely on producing a report.

3.67. Many countries require energy audits in public facilities to identify cost-effective energy efficiency projects. This is for example the case in the Czech Republic, France,[61] India, Thailand, and the United States. In some cases this mandatory requirement pertains to all public facilities (Czech Republic, France, and the state of Ohio in the United States[62]), while in other cases it pertains only to larger buildings (for example in India and Thailand, and federal government facilities in the United States[63]). Unless satisfactory financing arrangements and mandates to implement cost-effective measures are in place, however, these mandatory audits are often of low quality and do not properly result in follow-up investments. The program in the Czech Republic provides an example.[64]

3.68. Insufficient attention to the identification of good investment projects is a serious problem in many audits completed recently in China. Too often, audit reports provide only an engineering analysis of energy consumption and a general list, on the final pages, of potential measures for entities to consider. A major gap then exists between the completed basic energy use analysis and the preparation of actionable management improvements and investment projects for the site that was audited. Too often, the preparation of site-specific energy savings plans is vague and insufficiently detailed to provide a basis for immediate action. It would be most efficient to include the preparation of this kind of specific energy savings plan in the overall auditing process.

61. The “Grenelle 1” law of July 2009 requires that all public buildings undergo an energy audit before the end of 2010 and on the basis of the audit recommendations start their energy efficiency retrofits work before the end of 2012. It is expected that 250 million square meters of the total of about 920 million square meters of public buildings will be renovated by 2020. EPC is a recommended tool to be used by public entities, especially by local governments, in addition to budgetary resources (€24 billion mainly for the retrofit of 120 million square meters of buildings owned by the state and public bodies). The goal is to reduce energy consumption of public buildings by 40% by 2020. See Eco-Building International Club, Climate change policy in France after the “Grenelle de l’environnement,” Policy and measures in the building sector and Energy audits: state-of-the-art study.

62. In the United States, in the state of Ohio, a 2007 Executive Order (2007-02S) required all state agencies, boards and commissions to conduct energy audits for all state-owned and state-leased facilities by June 2007 and to reduce energy use in their facilities by 5% during the next year, and 15% during the next four fiscal years (Office of the Governor News Release 2007).

63. Since 2009, U.S. federal agencies are required to evaluate the energy and water use of 25% of their “covered” buildings (those accounting for 75% of an agency’s energy use) every year. As of December 2010, almost 50% of the number of facilities had been evaluated, accounting for 38% of the gross area and 34% of the total energy use. Source: http://www1.eere.energy.gov/femp/regulations/facility_ctsreports.html.

64. In the Czech Republic, the Energy Management Act of 2000 required the preparation of an energy audit for most buildings in the public sector, to be completed by end 2006, and the obligation to implement low-cost audit recommendations. However, funding for the audits and the implementation of the recommended measures was quite limited. This resulted in agencies contracting low-cost auditors who often delivered low-quality and fairly useless audits; see European Federation of Agencies and Regions for Energy and Environment, Framework Conditions for Energy Performance Contracting and International Energy Agency (IEA), Energy Efficiency Policies and Measures, Czech-Republic.

However, if that is not possible, a second "pre-investment" study should be undertaken. To improve achievement of energy savings results from audits the study team recommends that new energy audits for public institutional buildings should include specific requirements for the preparation of detailed, actionable energy savings plans, complete with an analysis of financial requirements and paybacks for recommended projects. This should be a specific requirement for audits supported with public budget allocations.

3.69. **Auditing priorities.** In general, energy audits should initially be limited to larger facilities that are older and have not been renovated recently, or facilities that have high energy costs or equipment that has reached its useful lifetime.[65] In smaller facilities with fairly basic equipment, it may be best for facility managers to complete audit templates themselves and provide basic facility descriptions, equipment inventories, and energy bill summaries. Especially in the beginning of public sector energy efficiency programs, energy agencies and utilities (or similar entities) are often available to provide support or to complete simple audits for free or minimal charges. In Germany, for example, many local or regional energy agencies assist local governments in the preparation of calls for proposals for EPC projects by assembling basic data on the buildings and their energy consumption using fairly simple checklists.[66] In China, however, this approach may initially be difficult in buildings that are supplied by district heating and not metered. Estimation of heat consumption would involve more complicated calculations. This, however, is not a limitation in other parts of China.

3.70. **Setting auditor qualifications.** Energy audits can be undertaken by a wide range of organizations, ranging from in-house technicians to energy agencies, universities, utilities, engineering companies, and specialized energy auditing companies. The purpose of the audit should determine the level of required expertise. National or local guidelines can help ensure conformity and minimum quality, but such guidelines might best include strong emphasis on the specific objectives of specific auditing programs and cater auditing content and procedures to best meet those objectives in the broader program framework. It may be useful to consider certification of auditing companies to ensure that they have minimum qualifications and experience. However, certification criteria and procedures for those companies need to ensure that companies after certification retain the human expertise at the time of certification. It should also be noted that few countries require formal certification for energy auditors. In the United States, auditors working in the residential building sector need to be certified by one of several industry associations, but there is no certification requirement for other building energy auditors. In India, energy auditors work mostly in the industrial sector and need to obtain certification through a national exam.

Benchmarking and Labeling of Energy Use in Different Buildings

3.71. For buildings, benchmarking, generally, is the process of establishing and comparing a metered building's current energy performance with its energy baseline,[67] or comparing a

65. These are the essential criteria recommended for the U.S. federal government buildings; see FEMP, Energy Savings Assessment Training Manual.

66. See the German Guide to Energy Performance Contracting in Public Buildings ("Leitfaden für Energiespar-Contracting in ofentlichen Liegenschaften').

67. The baseline is an initial period of metered energy consumption used as a point of reference for comparison purposes. For example, the Energy Star Portfolio Manager tool uses a 12-month period of metered building energy consumption as the energy baseline.

metered building's energy performance with the energy performance of similar types of buildings. Benchmarking can be used to compare performance over time, within and between peer groups, or to document top performers.[68] The difference between a monitoring system and a benchmarking system is that the latter relates energy management processes within a building or the entire building to top performers in their class or group for the purpose of generating plans to improve a certain process or entire building's energy use. Benchmarks are typically expressed in unit energy consumption, for example energy per unit floor area or energy per occupant.

3.72. Benchmarking has a strong information function and can be used as a basis for targeting, establishing quotas, or establishing incentives for improvements. Especially in the latter case, care is required to ensure fair comparability. Not only must the basic building and energy use data be collected using the same definitions and methodology to ensure that data are comparable and reliable, when using the data, building types must be defined and grouped according to similar operational and energy use patterns. Climate correction should be applied to the data to make energy use comparable over time and across climate zones that are not too different from each other. Next, appropriate performance scales should be developed for building groups, such as a range of energy use per square meter (for most buildings, where m^2 is uniformly determined), per occupant, or per bed (for hospitals). Buildings can then be rated on this scale according to their relative energy use.

3.73. **Informative benchmarking.** When benchmarking is used as an information tool, the audience can be the facility itself or even the public. A key goal of this type of benchmarking system is for users to be able to compare themselves with other, similar, but unnamed, facilities. Users can elect to share their data with other users or decide not to. An example is the Energy Star Portfolio Manager benchmarking tool (see also Box 3.5). In the Energy Star system the top 25% of buildings in terms of energy efficiency can choose to make their ranking public and display an Energy Star plaque. Metered federal government facilities are required to participate in this benchmarking program. In the Minnesota program, the benchmarking tool for public buildings also helps users to identify energy savings measures and assess the potential application and cost-effectiveness of these measures in different buildings.

Box 3.5: Informational Benchmarking as a Tool for Energy Efficiency Improvements in Public Buildings

Following the 2007 Energy Independence and Security Act (EISA), metered U.S. federal buildings are required to be benchmarked. DOE selected Energy Star Portfolio Manager, which has the following characteristics:[69]

- Ability to compare the energy performance of a building to a statistically representative model created with data from DOE's Commercial Building Energy Consumption Survey (CBECS)
- Ability to provide an energy performance rating for several commercial building types that represent over 60 percent of the U.S. commercial floor space
- Designed for benchmarking and capable of storing energy consumption data

68.See FEMP, Building Energy Use Benchmarking Guidance.

69.See Energy Star, Portfolio Manager Overview.

- Developed as a Web-based application with secure access. A Portfolio Manager user controls data access and chooses whether or not to share building data with other users
- Ability to be used by all commercial and institutional buildings to track energy consumption over time, and also track water consumption, energy costs, water costs, and carbon emissions
- Designed to be simple to use and easily understood, requiring only minimal, easy-to-acquire information
- Opportunities for data entry using manual entry (either for a single building or for large sets of data using a spreadsheet template) or automated benchmarking (with data directly uploaded by the utility or by the benchmarking service providers).

Portfolio Manager rates the energy consumed by a building or facility on a scale of 1 to 100, relative to similar buildings nationwide. Known as the Energy Star Energy Performance Rating, this score is based on comparing twelve months of weather-normalized energy data for each meter in the facility to a twelve-month energy baseline. It also adjusts for the unique operating characteristics of the building, such as operating hours and occupancy. Once all the required data is entered, the score indicates a percentile rank of the facility. A score of 75 or higher qualifies the building to earn the Energy Star Building Label.

In 2004, the state of Minnesota in the United States launched the B3 Energy Benchmarking program (https://mn.b3benchmarking.com). The program includes buildings in all public building sectors: state, cities, counties, and public school districts. The B3 Benchmarking program collects information on the design, operation, and energy performance of existing public buildings so that the state and its political subdivisions can direct energy conservation improvements where they are most needed and most cost-effective, and where the return on investment for a capital expenditure is greatest. Information on design and operations is used to create engineering baseline models for the specific space uses in their locations. B3 Benchmarking contains building models and consumption information for more than 5,100 public buildings in the state.

The data collection process of the benchmarking program relies on a Web-based tool through which building representatives of public buildings enter data, including building characteristics and utility bills. The users can see how their buildings compare to individualized benchmarks. B3 advances a unique approach to determining the benchmarks, using a parametric model based on space-type simulations combined with the prescriptive requirements in the current Minnesota energy code. By comparing a building to its unique benchmark, the opportunity for energy savings can be determined. By then comparing opportunities across buildings, the user can come up with a prioritized list of buildings that offer the highest potential for cost-effective improvements in energy consumption. This systematic method of comparison will help managers justify and secure the funds necessary to complete further analysis through energy audits and, ultimately, energy conservation upgrades.

In 2009, an upgraded Website tool provided functionality for on-going—weather normalized—operational building energy management where users can compare their buildings' energy consumption to a previous year of their choice to evaluate technology and operational improvements. B3 Benchmarking supplements an Energy Star analysis in two important ways: by providing an engineered model of performance, and by providing greater climate and space type specificity (ACEEE 2010).

3.74. Benchmarking is frequently used for the initial targeting of buildings for energy efficiency improvements. Once identified, the building will have to undergo a preliminary audit to confirm that the building is indeed a below-average performer, determine the reasons for under-performance, and identify specific energy saving measures. In German municipalities, for example, buildings are pre-selected for participation in a pool for EPC based on comparison with the benchmark. Comparing a building's energy consumption to an appropriate benchmark will provide an indicator about the level of potential energy savings. Measuring the energy performance of a building, however, is not a one-time exercise. The process is continuous, requiring periodic updating of the benchmark itself and subsequent comparisons to it.

3.75. **Incentivizing benchmarking.** Benchmarking can also be used as a basis for reputational incentives or targeting/quota system incentives (see paras. 3.21–3.27). If the unit energy consumption of specific facilities is publicly compared to benchmarks for similar facilities, as in various publicized building labeling systems (see paras. 3.78-3.80 for the systems in EU countries), this can provide reputational incentives for entities to improve performance. Publicly labeled good performance provides reputational benefits, while public disclosure of poor ratings provides reputational costs, unless the ratings are improved. For example, Danish public buildings are rated according to a benchmarking system, with both good and bad results provided on a publicly accessible website (see para. 3.78). Several U.S. states and municipal governments require benchmarking of commercial buildings, including public buildings, and disclosure of the benchmark values. New York City requires that benchmarked public buildings undergo retro-commissioning every 10 years, as well as an energy audit. Buildings owned or leased by the city are required to implement any recommendations that have a payback time of seven years or less.[70]

3.76. In some cases, such as in the Energy Star system in the United States, the focus is only on publicly recognizing good performers. Another example of such rewarding benchmarking systems is the award of "energy-saving hospital" certificates in Germany, for which a key criterion is achievement of unit energy consumption levels below the lower quartile benchmark value of comparable hospitals (see Appendix C).

3.77. If benchmarking is used for establishing mandatory energy savings targets, for setting energy use quotas, or for punishing bad performers, the tool should be fairly refined and well tested, to avoid penalizing energy use that is justifiably higher. Buildings with bad benchmarking values should also be given time to improve performance.

3.78. In China, MOHURD has already developed a national building energy rating and labeling system [71]and is piloting the effort in a number of provinces and municipalities. At this point, however, this building labeling system does not include recommended energy efficiency improvements and public disclosure (in the building or on the internet) is not required. MOHURD's commercial building monitoring programs or Shanghai (Chanping) municipalities' ongoing effort to target commercial buildings for energy efficiency retrofits may provide data and experience to kick

70. See Burr et al. 2010, The Future of Building Energy Rating and Disclosure Mandates: What Europe Can Learn From the United States. For a definition and more information of retro-commissioning, see Table B3 in Appendix B.

71. See Cao 2011, Building Energy-Efficiency Evaluation & Labeling Technologies in China for an update and discussion of issues and plans for broader dissemination.

start efforts in public institution buildings with similar functions. This could include the definition of common processes, building classifications, performance indicators, and other metrics.

3.79. Building energy performance certification in EU Member States. In the member countries of the EU, all larger buildings, including all public buildings, are required to undergo an energy performance certification at least every ten years in fulfillment of the 2002 Energy Performance of Buildings Directive. The certification report includes a list of recommended improvements. Initially, larger public buildings were simply required to publicly display a label showing they had undergone such a certification process. However, this did not prove very useful and now onsite inspection by an expert is required for energy performance certification. In Germany, energy performance certifications for federal government buildings are taken very seriously and involve complex and costly simulations of energy demand. In Denmark and Portugal, public building owners are required to implement all recommended energy efficiency measures with a payback time of less than five and eight years, respectively.[72] Danish public buildings also need to participate in an online benchmarking system and regularly register their energy use online. This allows energy-efficient equipment suppliers and providers of energy services to acquire information on market opportunities.

3.80. The EU requirement for certification of building performance has encountered many implementation problems[73] and in its early years great variation existed in the rigor and meaningfulness of the program. Early implementation suffered from a lack of qualified experts and in a number of countries certification began several years late. Also, few certificates were issued for non-residential buildings. The quality of the exercise, and therefore its ultimate value, also varied among countries due to differences in requirements, training, and the qualifications of the entity providing the assessment. Labels were not directly comparable, even within one country, due to a lack of standard methodologies. Moreover, the sources and quality of the information used for the certifications also varied substantially, from using default values or simple utility data, to the use of intensive assessment systems combined with detailed building inspections. Quality control was insufficient or did not exist in many countries and the accuracy of certificates was not randomly verified. Central databases or registration of certifications were established only in a few countries, making it difficult to undertake proper monitoring, evaluation, quality control and enforcement, and rendering the certification data useless for follow-up analysis and policy development.

3.81. In May 2010, a recasting of the Energy Performance of Buildings Directive was adopted by the European Parliament and the Council of the EU. The revision is expected to help solve many of the issues experienced in the first few years of the program and should improve the quality and credibility of the system. For example, member states will have to set up control systems to check the accuracy of performance certification. In the meantime, the European Committee for Standardization (CEN) (or "Comité Européen de Normalisation") published a standard for the calculation of the energy performance of buildings and the definition of ratings (EN 15603).[74]

72. Measures falling within these payback ranges depend on the level of energy prices, but typically include optimization and control of HVAC, ventilation heat recovery, insulation of boiler and piping, water saving and sometimes lighting measures; compare, for example, Coolen 2009,http://www.fedarene.org/documents/projects/EESI/Country_report/Country_Report_Belgium.pdf.

73. See, for example, The Buildings Performance Institute Europe (BPIE) 2010, Energy Performance Certificates across Europe, and The RAND Corporation 2009, Improving the Energy Performance of Buildings.

74. See CENSE, Information paper on energy performance of buildings – Overall energy use and definition of energy ratings – Calculated energy rating EN 15603 (Overall energy use). (Zirngibl 2009).

Financing Public Institution Energy Efficiency Investments

3.82. With proper incentives, dedicated and qualified technical staff, and reliable information about energy use and potential projects, public entities can proceed with project design and development. For the actual implementation of projects, however, the third and final key barrier to expanding energy management in public facilities—"no financing"—must be overcome and financing must be arranged. For public institutions, financing sources are more limited than for commercial entities. Government departments, schools, and many other types of public institutions are tightly constrained in their ability to raise funds. Traditionally these entities have had little choice but to rely on government budget resources. However, additional options can and should be developed.

3.83. In all countries implementing major public institution energy conservation programs, government budget appropriations alone are never large enough to support the level of energy conservation investment that must be undertaken. In many countries, public institutions also face severe restrictions on their ability to borrow on the market for such projects. As a result, countries have taken advantage of various alternative financing mechanisms for public institution energy conservation projects. These include (i) the use of energy performance contracts (under which ESCOs provide the bulk of project financing); (ii) use of incentives provided by local energy supply utilities; (iii) use of special revolving loan funds; and (iv) issuance of special bonds, use of leasing arrangements, or use of other mechanisms (where regulations allow). In most cases, averaged over the years, the amount of funding provided by such alternative financing mechanisms substantially exceeds amounts funded through government budget allocations.

3.84. Similar to other countries, China cannot expect to rely primarily on government budget allocations to fund the huge amount of public institution energy savings investment that is cost effective and needs to be undertaken. Alternative financing mechanisms must be aggressively developed to complement budget allocations. The next sections will briefly discuss the use of government budget appropriations, alternative financing in the United States and Europe, and the potential use of revolving funds. Chapter 4 will discuss what may be the most promising alternative financing mechanism for China: energy performance contracting (EPC).

3.85. **Use of government budget appropriations and special funds.** Continued allocations from China's energy conservation special funds, which are in place at the national level, many provinces, and even some sub-provincial government levels, are critical for the public institution energy conservation effort. These funds provide important financing that co-finance traditional, very constrained renovation budget allocations. It is very important to maintain stability in funding allocations for public institutions to match the multi-year nature of many capital expenditure plans and subsequent implementation contracts. While specific financing arrangements need to be tailored to local circumstances (such as types of projects or the financial performance of the local government), strong support from the public special energy efficiency funds is especially useful in the following cases:

- *Financing of a wide variety of demonstration projects within all of the public institutional subsectors, especially for introduction of new approaches and technologies.* An overview of the main areas targeted for demonstration projects during the 12th FYP is provided in Table 3.1.

- *Provision of targeted subsidies.* In some useful cases, such as the energy efficient lamp subsidies discussed earlier (see para. 2.55), targeted subsidies can help reduce the payback period of certain energy efficiency technologies. Using such subsidies, public entities may be able to combine regular expense provisions in their annual budgets with the incremental cost subsidy to buy equipment that saves large amounts of energy over its lifetime. Another key area is providing subsidies for energy savings investments in entities that are typically very constrained in financing options for upfront costs, such as rural schools. Subsidies for projects in such cases can improve basic conditions, including heating, in addition to saving energy.

- *Budget support for various soft costs.* This includes costs for training energy managers, setting up statistical reporting systems, installing meters, energy auditing and preparation of site-specific energy savings plans, and monitoring and supervision. Without specific budget support, it is difficult for most government-budget-dependent entities and their energy managers to undertake these activities properly, even though they are critical for program success. While most of these areas have received some level of budget support in the past, one particular area that deserves more consideration is public funding for the costs of preparing site-specific energy savings plans. This could be better included in funding for overall energy auditing work.

3.86. **Overview of alternative financing in the United States.** In the United States, where government budget allocations have always been insufficient for the large investments that are needed to comply with energy saving targets, a variety of financing models has emerged. Alternative financing mechanisms are used at the federal level, but also especially at state and local levels, where there has been much innovation. One driving force for most state and local governments is that, with only a few exceptions, these governments are usually required by local law to balance their operating budgets. In addition, local laws allow a variety of financial arrangements, such as setting up capital funds with earmarked revenue streams and allowance for borrowings (the debt service of which is clearly covered by the revenue) for specifically defined capital expenditure purposes. The arrangements generally depend on state regulations and considerations such as publicly approved borrowing authorizations, loan security regulations, transaction costs, tax implications, and public balance sheet treatment.

3.87. At the U.S. federal level, financing choices for energy efficiency investments are limited to three sources: direct budget appropriations, energy performance contracts—in the United States referred to as energy savings performance contracts (ESPCs)—and utility energy services contracts (UESCs). The last two are often referred to as alternative financing. Federal government ESPCs require ESCOs to arrange the bulk of the financing. This initially made this energy efficiency

delivery mechanism attractive to lawmakers, but the model also has received some criticism because the financing costs for ESCOs tend to be higher than for federal government agencies, by a premium of about 3%.[75]

3.88. Use of Utility Energy Services Contracts (UESCs) varies depending upon the services offered by local energy supply utilities. Building on the already existing relationship with the utility, UESCs allow federal government agencies to contract directly for comprehensive energy services. The local utility arranges financing (alternatively, appropriations can be used) to cover the capital costs of the energy conservation project, which are repaid over the contract term from cost savings[76] generated by the energy efficiency measures.

3.89. Energy efficiency and renewable energy projects in federal (and other public) agencies also benefit from utility incentives and rebates from so-called public benefit programs that are bundled into the financing arrangements as much as possible, since this tends to lower overall costs. In most U.S. states, public utility regulatory agencies have directed utilities (especially electricity utilities) or public benefit administrators to invest in energy efficiency, develop energy savings programs among their customers, and demonstrate these savings to the regulatory agencies. The regulatory agencies allow the utilities to be compensated for these services, usually from the energy prices set by these agencies.[77] Examples of incentives and rebates include: rebates for energy efficiency equipment, "custom" incentives for non-standard equipment or whole building approaches, no or low-cost energy audits, and re- and retro-commissioning (see Table B.3 in Appendix B).[78]

3.90. Figure 3.4 compares the amount of direct appropriations and alternative financing of energy efficiency and renewable energy projects in the federal sector in the U.S. during 2003-2010. In "normal" years, alternative financing amounts are about equal to budget appropriation amounts. In recent years, as a result of government stimulus funding in the United States (and many European countries), special government funding of energy efficiency programs in public buildings has increased. This increase, however, is expected to be only temporary.

3.91. Compared to the federal government, state and local governments and school districts in the United States have a larger number of financial instruments for energy efficiency projects at their disposal. They can issue bonds, enter into financial leases, receive grants from the federal government, use rebates and other incentives from utilities, or enter into contracts with ESCOs. Bonds issued by the state and local governments or school districts can provide an important source of energy efficiency financing, especially at the state level. Public entities repay bonds with public funds, using a variety of public revenue mechanisms depending on the case. The interest paid on government or public entity bonds is typically tax-exempt for investors, leading to lower financing

75. See Coleman 2010, http://www.esmap.org/esmap/sites/esmap.org/files/World%20Bank%20talk%20on%20US%20Gov't%20ESPC%20experience.pdf. More details on financing ESPCs can be found in Box 4.1.

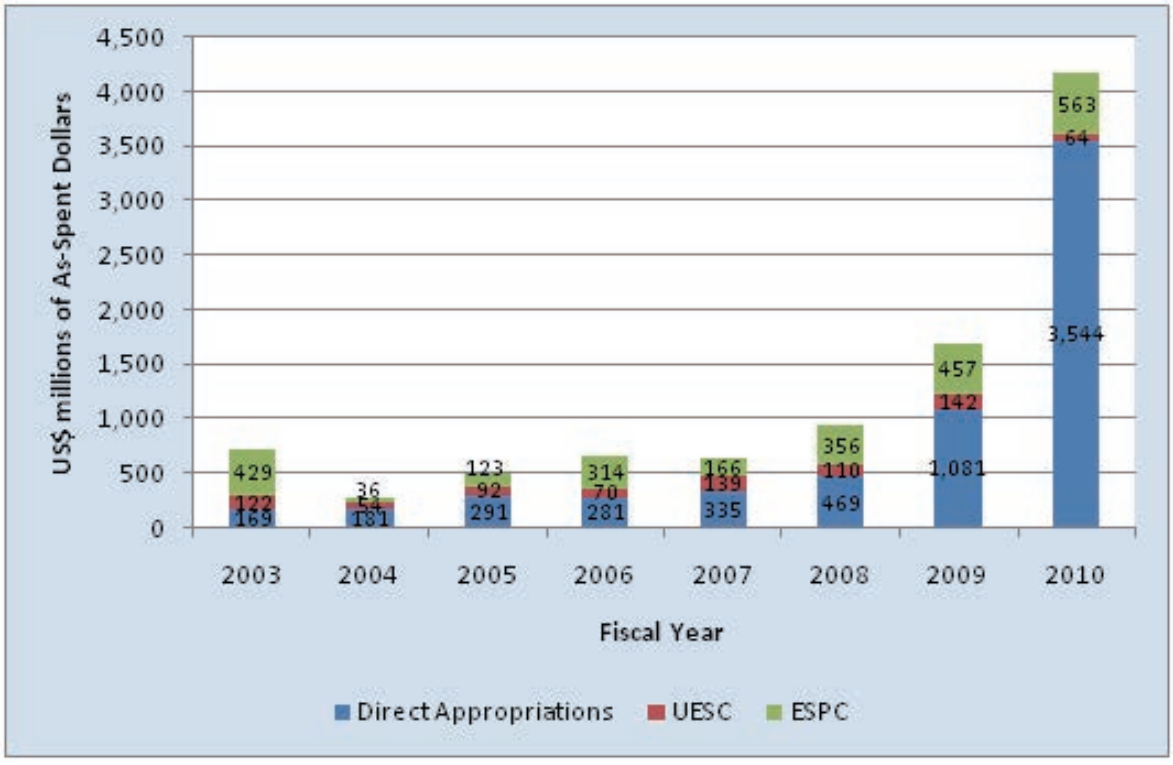
76. In UESCs, energy savings do not have to be guaranteed or measured and verified; it is, however recommended that at least a minimal performance assurance plan is part of the contract; see FEMP, Quick Guide: Utility Energy Services Contracting.

77. Public benefit programs: U.S. States fund energy efficiency programs operated by utilities, state agencies, or third parties primarily through a charge on ratepayer utility bills known as a "Systems Benefits Charge (SBC)," see for example an overview of these programs and funds in U.S. states at http://www.epa.gov/statelocalclimate/documents/pdf/guide_action_chap4_s2.pdf and a database on state utility programs at http://www.aceee.org/sector/state-policy/utility-policies.

78. Stuart 2011 gives an overview of the current status of the Energy Project Incentive Funds Updates and Trends and their use in the federal government sector.

costs. Financial leasing is another financing instrument that is quite popular at the local level.[79] Financing terms can be attractive because the interest paid to the lessor is exempt from federal income tax. If local public entities can secure cheaper financing than they can through ESCOs, which is often the case, public agencies will tend to provide project financing even if energy performance contracts are used, taking advantage of ESCOs' services and result guarantees, but not their financing.

Figure 3.4: Investments in Energy Efficiency and Renewable Energy Projects in the U.S. Federal Sector using Direct Appropriations, UESC, and ESPC



Source: Adapted from Tremper 2011.

3.92. In the United States (similar to the situation in Canada and most European countries), government buildings are the dominant customers for the ESCO industry. In 2008 alone, U.S. federal and other public institution markets contributed an estimated US$3.4 billion to ESCO revenues, almost 84% of overall ESCO industry revenues. Between 1990 and 2003 a total of US$15–19 billion of energy efficiency investments was done on the basis of ESCO activities in the federal, state and local government, university, school, and hospital sectors. The federal sector accounts for about US$3 billion of this, with ESCOs working under ESPCs, implementing UESCs, and being contractors of projects funded by direct appropriations.[80]

79. In the future, this financing tool will probably become more expensive and therefore more limited in its application, since a change in accounting rules would require listing of all lease transactions as assets and liabilities on balance sheets (this is not currently required for operating leases). This requirement could deter energy-efficiency investments for developers, companies, and non-profits by eliminating the "off-the-books" benefits of sale leasebacks (Feldman 2011).

80. Satchwell et al. 2010, A Survey of the U.S. ESCO Industry: Market Growth and Development from 2008 to 2011.

3.93. Examples of U.S. states that have seen fairly large EPC investments in the public institution sector include Massachusetts, Pennsylvania (both more than US$400 million so far), Colorado, Maryland, Virginia, and Texas (each more than US$200 million). In terms of investments per capita, Idaho, Hawaii, Utah, and Kansas have been quite successful in the use of EPC as well. Kansas has energy performance contracts in place for about 75% of the floor area of state-owned or state-occupied buildings.[81] In general, however, overall EPC market penetration is still relatively low (20% or less), even in states actively promoting it. While some of the larger U.S. states—California, New York and Texas in particular—have seen substantial EPC activities, their other energy efficiency activities (funded by utility energy efficiency programs, direct appropriations, energy bonds, and loan programs) are much larger.[82]

3.94. **Overview of alternative financing in Europe.** In European countries, public building energy efficiency projects are funded from four major sources: direct budget appropriations, special grants, loan programs (including revolving loan funds), and EPC. Direct budget appropriation levels have varied, but budget allocation availability has improved recently due to special stimulus measures following the 2007 financial collapse. Subsidized loan programs and revolving funds have been made available to local governments, the education sector, and the health sector as part of climate change mitigation programs. Box 3.6 provides examples of each of those programs.

3.95. EPC is not as widespread in Europe as it is in the United States, but the public sector market for ESCOs has been growing gradually. Similar to the situation in the United States, public institutions are also the largest customer sector for ESCOs in almost all European countries. ESCO project financing is a key attraction in Europe and EPC projects in public facilities of EU member countries almost always require that ESCOs provide the bulk of the financing. Since the 1990s, EU treaties require strict fiscal discipline at all levels of government, which limits their financing options. Many cities were required to reduce operational costs and—unable to fund the rehabilitation of public facilities from their own budgets—began entering into contracts with ESCOs for facility retrofits.

3.96. Many European countries also provide investment subsidies for public entities that have some revenue of their own (such as for lower levels of government or education and health sector entities). In Sweden, for example, the national level Climate Investment Programme (KLIMP) has supported municipalities and other local actors between 2003 and 2008 with grants of up to 30% of the investment for long-term projects that reduce GHG emissions. Between 2003 and 2008, the program catalyzed an investment volume of about €728 million with its funding of approximately €164 million, of which 10% was spent in the buildings sector. Quite a few of the projects were implemented using EPC. One possible reason for the fairly low share of building sector projects in this program is that heat supply in Sweden is already fairly efficient and provided by low-carbon technologies such as biomass boilers. GHG emission reductions are estimated at 1.1 million tons of carbon dioxide (tCO_2) equivalents per year, corresponding to about a third of the Swedish climate

81. The data rely on self-reporting and thus some states with a large EPC program may be omitted. See Energy Services Coalition, Energy Performance Contracting.

82. See Bharvirkar et al. 2008, Performance Contracting and Energy Efficiency in the State Government Market.

Box 3.6: Special Financing Programs for Energy Efficiency Improvements in Public Buildings

Special loan programs. The German Development Bank (KfW) has several long-term/low-interest loan programs for building energy efficiency investments. One of those programs is for the energy-efficient retrofit of municipal buildings. In these projects, the renovation has to result in an energy consumption either equal to or 15% below the prevailing building energy code requirements for new buildings. In the first case, the maximum loan amount is €350/m^2, in the second €600/m^2. An accredited expert has to certify that implementation was according to plan. Alternatively, several prescriptive, individual measures can be implemented and financed with a low-interest loan.[84]

Revolving loan funds. The Salix Revolving Fund for England and Wales has provided interest-free loans of more than £40 (€59) million to 166 public sector bodies from 2005 to 2008. Typically, funding of around £250,000 (€370,000) was made available, matched by each borrower, and fed into a ring-fenced fund to be spent on proven energy saving projects with maximum five-year payback periods and carbon costs of £100(€150)/tCO_2. The energy savings are returned to the fund until the original project investment is repaid. After that, clients are free to keep the savings to spend on front-line services. The fund itself can stay in place, and as long as sufficient compliant projects continue to come forward, the fund will not normally ask for the original investment to be returned. A similar fund was established for the higher education sector, amounting to £30 (€44) million from 2008 to 2011.[85] (Note: Exchange rate of December 31, 2006.)

objective, which is reducing the level of GHG emissions by four percent over the period 2008-2012 compared to the 1990 level.[83]

3.97. Revolving loan funds. While EPC has much potential for use in the public institutional sector in China (see Chapter 4), the use of revolving loan funds also presents an interesting opportunity for funding public sector energy savings programs in China. Two other financial options, bond issuance and utility financed schemes, right now are not of great interest in China, as provincial and local governments are currently not allowed to issue bonds and major energy supply utility energy conservation programs are not yet in the mainstream. Development of revolving loan funds may be a possibility, however, especially if fund financing, fund operation, and fund use are all within the same level of government and are basically internal arrangements.[86]

3.98. *Study team recommendation. The study team recommends that agencies responsible for different public institutional jurisdictions, especially at provincial levels (for example, provincial education departments for provincial universities or schools, and provincial health departments for local hospitals), review the feasibility of setting up revolving loan funds for use of public*

83. See Lindgren and Nilsson 2009, Transforming the "efficiency gap" into a viable business opportunity: lessons learned from the ESCO experience in Sweden; and Swedish Environmental Protection Agency, Climate Investment Programmes (Klimp).

84. See KfW, Energy Efficient Rehabilitation - Municipalities ("Energieeffizient Sanieren - Kommunen").

85. See the United Kingdom Department for Environment, Food and Rural Affairs, UK Energy Efficiency Action Plan 2007 and United Kingdom Parliament, Environmental Audit Committee, Written evidence submitted by Salix Finance. For the education sector revolving fund see Salix Finance/The Higher Education Funding Council for England, Salix/HEFCE Revolving Green Fund - Update and Evaluation of the Revolving Green Fund: a report to HEFCE.

86. In Germany, several public agencies have had good experience with "intracting". Units within the municipal administration set up a revolving fund to finance energy and water-saving measures of other departments, enabling the implementation of smaller projects for which external contracting (EPC) would be too expensive. In the city of Stuttgart, for example, the Environment Department has taken on some roles of an internal ESCO and offers energy services to other units of the municipal administration (host departments) and municipally-owned public utilities; see http://www.reneuer.com/upload/STUT_EN_M.PDF.

entities within their jurisdictions. Revolving loan funds could be capitalized with government budget resources blended with other financing sources. Public entities could pay back loans from the energy cost savings of projects, providing funds for new loans. This can greatly leverage government budget resources, allowing those resources to achieve benefits in many more projects than if provided as grants or subsidies. This type of arrangement has worked well in a number of countries. Some lessons learned and suggestions from experience elsewhere suggest that the set-up of revolving loan funds should include the following considerations:

- *Initial capital sources.* Revolving loan funds can be set up with direct budget appropriations, but also with temporary appropriations (for example from stimulus funds),[87] from special sources such as carbon credits, or even using other sources such as bond issuance or financing from international organizations (such as the World Bank or bilateral donors).

- *Leveraging of other funds.* Borrowers with some access to capital may be required to provide a substantial investment share. Funds from other non-public sources also are sometimes blended with public funds in the overall program, for example, if the administrator of the fund is a commercial financial institution that contributes its own funds to the program.

- *Terms.* In many cases, borrowers, especially from the public sector, are charged positive interest rates that are lower than market rates (for an example, see the program of the German Development Bank in Box 3.6). However, below-market interest rates risk crowding out commercial financing when there is market pick up, thus requiring very careful analysis before engaging in such a scheme. Borrowers usually must provide some share of the investment financing from their own sources. This can be waived in special cases. Borrowers may be required to provide insurance or collateral. Many programs have fairly long terms, which allow implementation of measures with longer paybacks. Loan tenures tend to increase with time since fewer and fewer short payback measures may be available over time. Long loan tenures, however, limit the ability of revolving of the funds and before long can lead to oversubscription.

- *Eligibility.* Projects usually must meet a series of criteria (for example payback criteria), minimum rates of return, and minimum energy savings cost-effectiveness. This helps to ensure that the original goal of the revolving fund is achieved, such as contribution to energy savings or GHG emission reduction targets. At the beginning of operations, however, some funds have been especially flexible, operating largely on a first-come-first-serve basis—at least at the outset—to effectively launch the flow of funds.

- *Revolving of funds.* Most funds require borrowers to pay back loans to the fund using the energy cost savings cash flow. However, some funds, such as the Salix fund in the United Kingdom (Box 3.6), allow entities to revolve the funds themselves, using the energy cost savings cash flow to fund more projects in their own facilities.

87. In the United States, the federal government promoted the set-up of revolving funds from American Recovery and Reinvestment Act (ARRA) funds destined for the State Energy Program; for example, Utah has a fund for schools; see U.S. DOE, Energy Efficiency & Renewable Energy, Weatherization & Intergovernmental Program, Revolving Loan Funds and the State Energy Program.

- *Fund administration.* The fund should be designed to strictly contain operating costs so that fund capital is not depleted. Professional expertise is important, however, especially for credit review, project review, efficient funds flow, and good active loan monitoring. Engagement of a financial institution to operate the fund as an agent of the government is an option.

- *Complementary technical assistance.* For the revolving loan fund to be successful, special funds should be available for complementary activities such as marketing and outreach to create a solid project pipeline, workforce development, contractor certification and training, evaluation, and M&V. The Texas LoanStar Program described in Box 3.7 has extensively implemented such activities. Sometimes these activities are subsidized program costs, but sometimes clients may be required to pay for some of these services, for example, energy savings M&V.

Box 3.7: The Texas LoanSTAR Program—A Revolving Fund with Extensive Quality Control

The state of Texas in the United States has operated a very successful public buildings energy efficiency revolving loan fund since 1988, called the LoanSTAR Program. Using US$98.6 million of original funding from government funds received as penalties paid under federal government oil pricing policies, the LoanSTAR Program by 2007 had funded 191 loans to public entities totaling over US$240 million, resulting in energy cost savings of US$212 million. Loans are made with a 3% interest rate over a maximum of 10 years (this term was initially shorter). Since 2001, projects carried out under EPC and with water conservation measures can also be funded. The program is overseen by the State Energy Office.

The quality control on all phases of LoanSTAR has made it one of the most successful and best-documented building energy efficiency programs, state or federal, in the United States. Quality control measures include:

- Development of LoanSTAR technical energy assessment report guidelines
- Training of local energy engineering consulting firms on audit techniques and the LoanSTAR guidelines
- Development of protocols to have each LoanSTAR project metered and monitored to track pre- and post-retrofit energy consumption (only during the first five years of the program all major projects had to be metered and monitored for savings verification)
- Development of methodologies for analyzing energy savings from retrofits.

The LoanSTAR Program has been known for its audit guidelines, training, metering and monitoring, follow-up with agencies to ensure the retrofits were working properly, and building commissioning assistance for improved operation and efficiency. As a result of these efforts, the actual measured and verified LoanSTAR energy savings have exceeded energy audit estimates of energy savings.

Source: State Energy Conservation Office, LoanSTAR Revolving Loan Program.

Monitoring and Supervision Systems: Evaluation of Progress

3.99. **Establishing and maintaining a monitoring system.** China has already started to develop more comprehensive and meaningful systems to monitor energy use trends and comply with the government energy conservation targets for public institutions under the 12th FYP. Many of the key

indicators that would be important for the monitoring effort—energy use broken down by subsector and type of energy (power, heat), energy costs, floor area, and similar data such as occupancy, GHG emissions, and investments—are currently monitored in other countries as well. It may be useful for Chinese experts to exchange views and ideas about the development of monitoring systems in China with practioners abroad.

3.100. The development of China's system to monitor target compliance in government buildings is proceeding quickly, but additional efforts are needed to also implement effective monitoring systems for the non-government public institutional subsectors (such as universities, schools, and medical facilities). The most difficult challenge will be improving the metering systems and accuracy of the energy use data (see paras. 3.54-3.59). Having access to accurate data on heat consumption in particular will require years of effort.

3.101. **Evaluating progress.** The monitoring systems that are being put in place in China help provide a foundation for evaluating progress over time. In addition to evaluating the progress of various agencies and jurisdications in meeting energy conservation targets, however, the study team highly recommends the development of systematic efforts to objectively evaluate energy savings projects and, from those, evaluate the programs that support the projects. It is important to evaluate projects properly to be able to both highlight successful cases and foster their replication, and to objectively understand less successful cases and make adjustments accordingly. Evaluation requires good project monitoring and verification of savings (see paras. 4.57-4.62), and good evaluation of the cost-effectiveness of investments, especially public investments. Some programs in other countries require third-party verification of data to ensure an unbiased assessment of energy saving claims.[88] One example is the annual evaluation of Vermont's Energy Efficiency Utility, described in Box 3.8. Resources for conducting such evaluations are available, for example, the Model Energy Efficiency Program Impact Evaluation Guide developed under the U.S. National Action Plan for Energy Efficiency.[89] Typical issues to be determined are the benefits (energy savings, cost savings, emission reductions, but also job creation, health benefits, and system reliability) and costs of a program and its cost-effectiveness, and whether it has in fact met its goals. If it hasn't, the evaluation should indicate the reasons for the shortfall and possible changes to the program. An example is the evaluation of the German EPC program in federal government buildings after the completion of its five-year pilot phase.[90] Even though overall results of the individual 19 projects were quite positive with average energy savings of 29% and payback periods of five years, it was pointed out that participation in the program depended too much on the marketing and support activities of the project facilitator, the German energy agency DENA. Recommendations were to develop central competence centers and strenghten the own initiative of federal departments and agencies, for example by providing incentives, encouraging establishment of internal energy saving goals, and establishing emissions trading.

88. The Energy Star program, for example, requires that energy savings in buildings are verified by a certified professional engineer before a building can qualify for an Energy Star label; see Energy Star, 2010 Licensed Professional's Guide to the Energy Star Label for Commercial Buildings.

89. See U.S. EPA, Model Energy Efficiency Program Impact Evaluation Guide.

90. See German report, Evaluation of the project "Contracting for Government properties" on the basis of benchmarks and monitoring of selected measures ("Bewertung des Projektes "Contracting für Bundesliegenschaften" auf der Grundlage von Benchmarks und Monitoring ausgewählter Maßnahmen")

Box 3.8: The Value of Monitoring and Supervision Systems in Nurturing Cost-Effective Government Incentives for Energy Efficiency

In 1999, the Vermont Energy Investment Corporation (VEIC), a private company, won a competitively bid contract to supply energy efficiency services to the state of Vermont. Vermont (population about 626,000) wanted to combine all its energy efficiency programs into one single program for the state. It created "Efficiency Vermont," an Energy Efficiency Utility (EEU), which was the first-of-its-kind to coordinate delivery mechanism for energy efficiency services in the United States. VEIC implements energy savings projects financed from electricity ratepayer resources (public benefits charge) that are eventually collected by Efficiency Vermont through power utility bills. VEIC signed a contract with Efficiency Vermont and is paid based on minimum energy savings performance requirements and measurable performance indicators. There is a significant financial hold-back to assure VEIC's performance and VEIC is paid only if performance is satisfactory. The contract includes clear roles and responsibilities, including the build-up and maintenance of a rigorous and independent evaluation system.

The State utility regulator sends independent measurement and verification specialists to Efficiency Vermont each year to verify savings. The annual verification of savings is very technical and rigorous, intended to identify errors in calculations, assumptions, and methodologies. Due to many small projects, statistical methods are used to sample project groups in terms of size (KW and kWh) and type of project (such as retrofit).

The incentive for the VEIC, therefore, is to have a sound information system, which is essential for credibility, reliability, and data sharing. The system maintains record of items such as implemented measures, savings assumptions, customer communications, and references to project partners. These data systems not only prove what the energy efficiency utility has done, but also support improved targeting, planning, and evaluation of the utility's own systems. It becomes a virtuous cycle.

Efficiency Vermont has reported that average costs of efficiency improvements amounted to about 4.1 cents/kWh while the average cost of electricity supply is 14.4 cents.

Source: Vermont Energy Investment Company Presentation, Beijing, November 2011.

Chapter 4: Energy Performance Contracting—Using Energy Cost Savings to Finance Energy Efficiency Projects in Public Institutions

4.1. Energy Performance Contracting (EPC)[91] will be a useful mechanism for China to expand energy saving programs in public institutions. Using EPC, public institutions can pay for energy efficiency projects by using the energy cost savings generated by the project. This chapter describes the benefits of EPC in the public sector in China—introducing the two popular approaches to EPC—and describes what is needed to allow and enable the use of EPC in China's public institutions. The last section addresses the key challenges—and possible solutions-for scaling up the use of EPC in public institutions in China.

Benefits of Energy Performance Contracting in the Public Sector

4.2. Chapter 2 first presented an overview of the Chinese ESCO industry. The industry is already strong in the industrial sector and making progress in the building sector. There are quite a few strong ESCOs in different parts of China now focusing entirely on the buildings market, with impressive business growth and technical competence. In recent years, ESCOs have been able to develop a few successful cases of EPC projects with public institutions, in particular with university and hospital clients.

4.3. Two popular Chinese EPC models being used in those initial projects for public institutional buildings include:

- *The Chinese-defined shared savings model,* in which ESCOs provide the bulk of the project financing and are repaid by receiving a large share of the project energy cost savings, which they guarantee. (Note that this model is not the same as the so called "shared savings model" in the United States, which has fallen out of favor.[92])

- *Energy facility outsourcing contracts*, whereby ESCOs assume responsibility for the operation of complex energy utility systems (especially heating systems in northern China), under building maintenance contracts with a special focus on energy efficiency and involving an upgrade of the utility system.

4.4. These initial projects have shown the basic advantages of EPC, including:

- Ability to proceed with projects independently of special government project financing by providing access to alternative financing from the ESCO

91.In the United States EPC is known as Energy Savings Performance Contracting (ESPC).

92The early EPC projects with U.S. public sector entities were based upon sharing the energy cost savings between the ESCO and the customer, with the ESCO undertaking the borrowing. This concept was largely abandoned in the 1980s due to excessive litigation over claimed savings. See Taylor et al. 2008.

- Opportunities for more rapid and technically advanced project development by introducing a technically competent actor (the ESCO) who brings project management and implementation skills, as well as technical knowledge and innovation to the project

- Transfer of the technical and economic risks from the public sector client to the ESCO, in particular the risk that the project will not result in the estimated savings and that the equipment will not perform at high efficiency levels.

4.5. These advantages, however, are not enough by themselves to trigger a substantial uptake of EPC projects in the public sector. The efforts of ESCOs to develop further into this market have been stymied by several systemic particularities of the public sector:

- Public entity accounting initially is not prepared to deal with the disbursements of payments to ESCOs on energy performance contracts. For example, there has been a lack of clarity on which budget line to charge, and it can be problematic to authorize multi-year contract payments when fiscal budgets only cover a 12-month period.

- Incentives for public entity representatives to actively pursue EPC with third parties remain weak despite new targets for energy efficiency improvements.

- It is difficult to achieve sufficient economies of scale to make the high project development costs in the public sector worthwhile.

4.6. Interest for opening up the government system to engage in EPC projects has been building for several years and today, at the onset of the 12th FYP period, interest is especially high among energy conservation authorities at all levels of government. The April 2010 State Council decree on further encouraging EPC (see Chapter 2) and subsequent more detailed policies have provided a new, strong catalyst to overcome some of the barriers mentioned above. However, the decree and policies will need to be implemented at the provincial and local levels and supplemented with additional measures.

4.7. The difficulties China experiences in this start-up phase of its public sector EPC programs are similar to those other countries have experienced. Even though the specific workings of government institutions vary among countries, enough similarities exist to make it instructive for Chinese experts to review the policies and administrative and support measures that other governments have implemented to boost the uptake of EPC in their public sectors.

Opening Doors for EPC in Public Institutions

4.8. EPC is a relatively new business model and so far in China has been developed and used primarily with corporate clients. To use EPC in the public sector—beyond a few initial demonstration projects—accounting and budgeting rules will need to be adjusted and the following questions will need to be addressed:

- Do regulations allow for the financing of public investments through energy cost savings (that is, EPC) and thus allow for the payment of contract costs from the budget for current expenditures?
- How should agency budgets account for payments to contractors?
- How should contract payments that occur in future fiscal years be handled?
- If investments are financed by a third party under EPC, will this count against any debt limit that may be imposed on the government?
- Under which conditions will EPC in locally-owned facilities be allowed by supervising authorities at higher levels?
- What encouragement and help do public agencies need to engage in EPC?

4.9. If these questions cannot be satisfactorily answered, then EPC is unlikely to be deployable beyond initial demonstration projects.[93]

4.10. In addressing these questions, it will be useful to look at the experience of several countries that have been able to turn EPC into a mainstream delivery mechanism for energy efficiency investments in the public sector. In the United States and Canada,[94] for example, the federal governments were the initiators of EPC in the public sector and have enacted legislation and implementation rules to enable the use of EPC in federal government facilities. State governments in the United States later followed the federal initiative and their experience is particularly instructive: 49 states have enacted EPC legislation, which generally also covers local governments, with support arrangements and results varying substantially.[95] In other countries, such as Germany and Austria, EPC developed more from the bottom up. Some leading states and provinces experimented with EPC and eventually adopted budgetary and accounting rules that enabled public facilities to enter into energy performance contracts. The following sections will present examples of these and other countries' actions to allow, enable, and encourage EPC in public institutions by solving disbursement and accounting issues, providing the right incentives, and supporting the agencies using EPC.

Resolving Disbursement and Accounting Issues

4.11. In virtually all countries, fiscal budgets are usually appropriated on an annual basis based on the spending of previous years, and a surplus cannot be transferred to the next fiscal year. In addition, there is a strict division between the capital budget and the operating cost budget. These kinds of budgeting rules are a deterrent for all investments in energy efficiency, but particularly

93. See Taylor et al. 2008, Financing Energy Efficiency - Lessons from Brazil, China, India, and Beyond and Singh et al. 2010, Public Procurement of Energy Efficiency Services - Lessons from International Experience.

94. In Canada, the Federal Buildings Initiative of Natural Resources Canada has facilitated 86 retrofit projects since 1991, attracting US$320 million in private sector investments and generating over US$43 million in annual energy cost savings. For information on the EPC process in Canada, see also Singh et al. 2010, case study 2.

95. See Oak Ridge National Laboratory, Status of ESPC Enabling Legislation in the United States.

problematic for financing energy efficiency investments from savings that occur over several years in the future, such as is the case in EPC. Three specific issues that will need to be addressed are: (i) public entity accounting of EPC payments, (ii) multi-year contracting, and (iii) the contribution of EPC to government debts.

4.12. Public entity accounting of payments to ESCOs on energy performance contracts. The State Council's April 2010 policy statement on EPC explicitly states that public institutions can make payments under energy performance contracts from energy cost provisions in their fiscal budgets. While this high-level policy statement provides the foundation for solving the basic problems around EPC accounting in China, *detailed regulations will need to be issued by financial departments in the various jurisdictions* (especially on the provincial government level) *to provide specific guidance on how disbursements should be made*. Beijing Municipality, where public institutions are responsible for a particularly large part of the municipality's energy consumption, has issued such a regulation to specify how EPC disbursement can be made from energy cost savings.[96] Once local regulations are issued, *the next step is to process several contracts through the system, which will further clarify the road that EPC can follow.*

4.13. Other countries have issued regulations with a similar intent. Many U.S. state governments, for example, have specified that utility expense budget lines can be used to pay for energy performance contracts. In Germany, payments to ESCOs are budgeted as building maintenance expenditures.

4.14. **Multi-year contracting.** As China's local authorities begin to issue regulations on disbursement of energy performance contracts, it is important to ensure these regulations also facilitate multi-year contracting. Some countries, such as Korea,[97] have needed to make explicit legislative or regulatory changes to allow public entities to enter into multi-year energy performance contracts. In Germany, for big energy performance contracts at the federal level, an authorization for financial commitments beyond the current fiscal year must be included in the federal budget (for details see Singh et al. 2010, p. 178). In the United States, federal agencies were authorized by 1992 legislation to enter into multi-year guaranteed savings contracts (see Box 4.1).

4.15. **Contribution to government debts?** One question that will need to be addressed is whether the investments under EPC, which are financed by a third party, count against statutory debt limits. Strict rules against indebtedness of sub-national governments have forced some countries to clarify whether or not energy performance contracts are counted as government debt. Frequently, but not always, the answer is that projects that generate net savings (that is, the value of the savings over the contract period is higher than the total of contract payments to the ESCO) do not count as debts for purposes of meeting statutory debt limits. This has been the decision in many states in Germany and the United States.

96."The Beijing Municipality regulations stipulate that"during the contract period, the municipal finance authority should allocate the budget item 'common expense,' based on the reduced energy consumption; the part of the energy savings paid to the ESCO, as agreed in the contract, should be prepared under the entity's expenditure budget and be submitted together with the departmental budget for approval; the energy savings left to the hosting institution should be managed by the entity for coordinated use." Common expenses include utility expenses, expenses for logistics, conferences, business trips, office facilities and so on; Item 26 of the Interim Measures for Management Funds for Fiscal Awards to Energy Performance Contracts in Beijing Municipality (November 30, 2010).

97.Cited in Singh et al. 2010, p. 67.

Box 4.1: Energy Performance Contracting in the U.S. Federal Sector—FEMP

The U.S. Federal Energy Management Program (FEMP), operated by the U.S. Department of Energy (DOE), is responsible for coordinating the activities of federal agencies in the areas of energy efficiency, renewable energy, water efficiency, and greenhouse gas management. FEMP supports federal agencies in identifying, obtaining, and implementing alternative financing (see para. 3.85-3.89) to fund energy and water efficiency projects.

EPC in the federal government started in the mid-1980s, building on the experiences with EPC in state and local schools since the 1970s (see Taylor et al. 2008). Model contracts, model procurement procedures, and model monitoring and verification requirements were needed to develop a smooth path through contracting and procurement systems. In addition, incentives for organizations and officials to participate in the new way of doing business, as well as training programs, had to be put into place.

Several legislative acts and federal DOE regulations are at the base of the federal government's ability to use EPC. These are the National Energy Conservation Policy Act (NEPCA), Energy Policy Act (EPAct), the DOE Final Rule 10 CFR 436 Subpart B, the National Defense Authorization Act (NDAA), and the Energy Independence and Security Act (EISA). Legislation authorizing ESPCs was enacted in 1992 through EPAct, and DOE promulgated regulations for their use in 1995. ESPC authority was made permanent in 2007 through EISA.

NEPCA and EPAct: The NECPA, signed into law in 1978, first gave federal agencies the authority to enter into shared-energy savings contracts with private-sector ESCOs. It was superceded by the EPAct of 1992, which included the following provisions:

- Authorized federal agencies to execute guaranteed-savings ESPCs
- Required ESCOs to guarantee savings
- Allowed an exception to the Antideficiency Act,[98] specifying that a Federal agency can enter into an ESPC with funds for repayment on hand for only the first year of the contract, provided energy cost savings exceed payments every year
- Required M&V of savings
- Set the maximum contract term at 25 years, including the construction period.

DOE Final Rule: The 1995 DOE Final Rule 10 Code of Federal Regulations (CFR) 436 Subpart B promulgated clarifying regulations for the use of ESPCs. It:

- Established a list of qualified ESCOs
- Specified procurement procedures and criteria for selecting ESCOs
- Allowed unsolicited proposals
- Recommended standard terms and conditions
- Defined conditions of payment: Payments made to the contractor could only come from funds made available to an agency for energy and related operations and maintenance expenses
- Addressed annual M&V requirements
- Prioritized 10 CFR 436 over Federal Acquisition Regulations procurement requirements if the two conflict.

98. Under the Antideficiency Act, government officials may not make payments or commit the United States to make payments at some future time for goods or services unless there is enough money available in the relevant appropriation to cover the cost in full. For details see, U.S. Government Accountability Office (GAO), Antideficiency Act Background.

The **National Defense Authorization Act (NDAA)** for FY 2005 revised the definition of energy savings in federal ESPCs to include water conservation measures. The national EISA of 2007 extended the federal ESPC authority indefinitely.

FEMP promotes the use of ESCOs and EPC by facilitating the navigation of procurement processes and maintaining lists of approved ESCOs. Starting in 1998, FEMP also developed **Super Energy Savings Performance Contracts (Super ESPCs)** for use by federal agencies to implement comprehensive energy saving projects. Through a competitive process, FEMP selects a limited number of ESCOs (currently 16) to be eligible for Super ESPCs. The contracts—indefinite-delivery, indefinite-quantity (IDIQ) contracts, with a maximum ceiling of US$5 billion each—are awarded to the ESCOs, based on their ability to serve federal agencies under terms and conditions outlined in the IDIQ. The Super ESPCs concept allows federal agencies to bypass procurement procedures, skip time-consuming full competition, and deal directly with a pre-selected ESCO to design and implement energy efficiency projects. Projects must save money from energy or water bills, or energy-related operation and maintenance.

The procedures for ESPCs have been subject to change. Until 2007, a pre-selected ESCO could initiate a proposal based on a preliminary audit of a facility. After receiving from the agency a notice of intent to award the contract, the ESCO conducted an Investment Grade Audit (IGA), identified measures, arranged financing, guaranteed a level of annual cost savings to the agency, and implemented the agreed measures. The agency paid for the measures through a portion of the guaranteed savings, usually 100% minus US$1. ESPCs allow the agency to revise, within scope, IDIQ terms in task orders.

In 2007 and again in 2011 the procedures for ESPCs changed. The 2007 NDAA tried to introduce more competition, including price competition, into the contracting process for federal agencies involving task/delivery orders above US$5 million. In addition, task orders above US$10 million became protestable. For the ESPCs this meant that the government had to initiate a project and sent notices to each of the 16 pre-selected ESCOs; the ESCOs then had to conduct preliminary assessments and make their bids, which were evaluated according to past performance, adequacy of the proposal, and price factors. However, the winner would not be able to change the proposal, even if the IGA resulted in different measures. As a result, ESCOs were very reluctant to participate, and federal agencies received very few comprehensive proposals. Instead, many agencies preferred to carry out projects by sole-sourcing them under the Utility Energy Services Contracts (UESCs) (see Singh et al. 2010 and DOE webinar ESPC Contracting and Negotiations - A Short Course). The 2011 NDAA changed ESPC procedures again, making the process more similar to the pre-2007 requirements. While the government still needs to issue notices, it has to select, based on qualifications and discussions, at least two ESCOs to prepare preliminary proposals. The change in procedures has again encouraged the use of ESPC in federal government agencies. Currently, the process to initiate an ESPC can be initiated by either the ESCO contractor or the government agency. An overview is presented in the table below.

Table B4.1.1: ESCO Selection Options (post 2010)

Contractor-initiated method	Government-initiated option
• The ESCO alerts the agency of its desire to submit a proposal: – If the project's estimated value is below US$5M, an agency can proceed with the ESCO as sole source – If the project value is above US$5M, the agency must notify other Super ESCOs and identify requirements, such as desired EE measures or buildings to include • Other ESCOs can then also submit Preliminary Assessments (about 20 pages) • The agency, using "fair consideration," issues a statement selecting one ESCO based on best value • The agency organizes a post-selection de-briefing; protests are allowed if the project value exceeds US$10M.	• The agency sends notice to all 16 ESCOs with requirements and selection criteria: – Requirements: e.g., buildings, EE measures to include – Selection criteria: e.g., price (required), technical approach, past performance – Agency may host site visits for interested ESCOs • One or more ESCOs submit a preliminary assessment • The agency, using "fair consideration," issues a statement selecting one ESCO based on best value • Agency organizes a post-selection de-briefing; protests are allowed if the project value exceeds US$10M.

Support of the ESPC process. FEMP actively supports the ESPC process by providing technical assistance, guidance documents, workshops, contracting arrangements, and project facilitation services to federal agencies. This for example includes:

- General supervision by FEMP Federal Financing Specialists (1 specialist for each of 4 U.S. regions)
- Availability of project facilitators to accompany each project from initial notice through construction/commissioning and the first year of M&V
- Review of the preliminary assessments and the final proposals by a core team from the national laboratories
- Provision of model contracts and standardized terms and conditions.

Financing. ESCOs are responsible for financing projects under ESPCs. They generally secure third party financing, rather than using their own funds. Since 2004, ESCOs are required to receive at least three competitive offers of financing. The host agency reviews the written offers and discusses the recommendation with the ESCO. The offer with the lowest interest rate does not need to be the final choice as other considerations can have an important impact such as cancellation charges, and others. To protect the financier's interest, the contractor may be required to assign to its lenders some or all of its rights to payments from the public client under the ESPC. EISA (2007) introduced the possibility of combining appropriations with private sector funds for DOE, but not for the Department of Defense (DOD). Accordingly, federal agencies are starting to co-finance projects, contributing up to 25% of total costs.

Measurement and verification. The federal ESPC authority requires the contractor to undertake M&V activities and provide documentation to demonstrate that the guarantee has been met. The DOE Super ESPCs specifically require ESCOs to comply with the FEMP M&V Guide 3.0 (2008), which is a specific application of the International Performance Measurement and Verification Protocol (IPMVP) for federal projects (see paras. 4.57-

4.58). It contains procedures and guidelines for quantifying the savings resulting from energy efficiency equipment, water conservation, improved O&M, renewable energy, and cogeneration projects implemented through ESPCs. For Super ESPC projects, the average annual M&V costs are 3.3% of annual project cost savings, based on cost schedules from 166 Super ESPC projects (see FEMP, M&V Guidelines: Measurement and Verification for Federal Energy Projects Version 3.0, p. 5-2).

Results. Between 1998 and May 2011, the Super ESPC concept has resulted in US$2.4 billion of project investment by 25 agencies in 49 states, with a total contract price of US$6.4 billion (in addition to investments, this includes ESCO fees, financing cost, and M&V); energy cost savings of US$6.6 billion and net savings of US$220 million; and annual energy savings of almost 18 trillion British thermal unit (Btu) (or 637 million tce).

Source: U.S. DOE Renewable Energy & Energy Efficiency, FEMP, Energy Savings Performance Contracts.

Motivating Public Agencies to Engage in Energy Performance Contracting

4.16. International experience shows that even when regulations are in place to allow for the effective implementation of energy performance contracts, public entities will not automatically start using them and may be reluctant to try the new mechanism. When the EPC business was just starting in other countries, most public entities were reluctant to try it. Many preferred to wait to see if they could obtain government funds to directly finance their projects, and others did not understand how to proceed with EPC projects and were wary of the ESCOs involved. In China, a similar situation exists. As in other countries, an active effort is required to increase incentives for public entities to try out the mechanism, and to make it as easy as possible for them, especially in the early stages. While this may initially require a major government effort, it is important and can yield big benefits over the longer term. As discussed in Chapter 3, direct government funding for public institutional energy efficiency projects is greatly insufficient and alternatives, such as financing through energy performance contracts, are necessary to realize meaningful energy savings. EPC projects also can provide technically strong solutions. As shown in particular in the United States, government efforts to effectively launch the EPC business can lay the foundation for a balanced and strong public institutional energy efficiency program for the long term.

4.17. To accelerate the use of EPC among reluctant agencies, federal and state governments in the United States have made great use of both endorsements and mandates. Such policies were preceded by actual changes in the budgeting and accounting rules, as well as the procurement and contracting rules, and supported by technical assistance to the agencies for development and implementation (see paras. 4.19-4.21). Today, federal government agencies are strongly encouraged to use alternative financing for energy efficiency projects, provided either through ESCOs or utilities (see paras. 3.86-3.88). Many state governments have issued even stronger directives, for example.[99]

- The governor of Pennsylvania emphasized to agencies that EPC was the option of first resort for capital improvement projects.

99.See Bharvirkar et al. 2008, Performance Contracting and Energy Efficiency in the State Government Market.

- The EPC authorizing legislation in Washington State directs all state agencies to implement cost-effective energy conservation improvements. It requires that each state agency undertake an energy audit and implement energy projects using EPC as the preferred method for completing audits and implementing projects.

- The governor of Kansas ordered that any state building construction project with a value of more than US$100,000 be analyzed to determine if it can use an energy performance contract to reduce the need for state budget or capital expenditures.

- The governor of Massachusetts' executive order 2007-484 directs that recommendations be submitted by the "lead by example" program's lead agencies how to finance energy projects in state facilities without requiring significant infusion of state funding. The order further directs that the Division of Capital Asset Management (the lead agency for EPC in state facilities in Massachusetts) should seek to implement EPC projects at all applicable state facilities with a floor area greater than 100,000 square feet.

- The governor of Colorado endorsed the use of EPC to facilitate energy demand reduction. Executive Directors of all state agencies and departments responsible for state-owned facilities were required to (i) investigate the feasibility for an energy performance contract and submit a final feasibility study to the Department of Personnel & Administration's (DPA) Office of the State Architect, which sets EPC project implementation rules and procedures; (ii) issue a request for proposal (RfP) for an energy performance contract for all buildings for which is determined that an energy performance contract is feasible, viable, and economically sound; and (iii) follow energy performance contract procedures and requirements as set by the DPA.

4.18. **Study recommendations.** Given the early stages of EPC market development in public institutions in China, mandating the use of EPC in public institutions appears to the study team as premature and possibly counterproductive. Steady government support at all levels, however, is important. To motivate public entities at the current stage, it is essential to reinforce the benefits they can directly receive by engaging in EPC. This can be done in two concrete ways. First, regulations can be issued to clarify that public entities hosting EPC projects can retain their share of energy savings they achieve and use those funds for their own purposes. (The November 2010 Beijing Municipality regulation provides an example (see para. 3.31)). Second, a conscious effort can be made to facilitate implementation of EPC projects involving equipment or other facility upgrades that would both be popular with host public entities and save energy. Projects like this were key to raising public entity interest in North America and Europe (see paras. 3.37-3.38). If several such projects can be successfully implemented in a given jurisdiction, the results can be broadly shared among other public entities, helping to spark their interest as well.

Providing Assistance to Public Entities to Engage in Energy Performance Contracting

4.19. In addition to budgeting and accounting rules supportive of EPC and endorsements to use EPC, another critical aspect of a successful launching of EPC in the public sector is the

availability of government-provided, active, hands-on assistance to the public entities in all aspects of development and implementation of EPC projects, especially in the early stages. EPC is a new concept and especially in the public sector it is necessary to find solutions to budgeting and procurement problems that are not always resolved only through laws and regulations. In addition, the processes of selecting ESCOs, ensuring sound contracting, and defining and supervising energy savings monitoring and verification, is likely to be difficult for many who are new to the business. Governments of many countries, states, and municipalities that have succeeded in launching strong public sector EPC programs often had specific staff available in the government energy office (or a similar institution) to provide the needed support. Some also contracted experts from research laboratories and universities to help facilitate projects. For example, in the state of Pennsylvania in the United States, the Department of General Services (DGS), as lead agency for promoting EPC in public institutions in the state, has hired dedicated staff to run the EPC program. This staff assumes primary responsibility for administrative matters, with additional technical support provided by consultants and engineers from the Facilities Engineering Institute at Pennsylvania State University. In U.S. FEMP, federal agencies are required to engage project facilitators who support them in the development and implementation of Super ESPC projects (see Box 4.1). In Germany, in Berlin and other states and municipalities, state and municipal energy agencies and other organizations are actively involved in the project bundling process (see Box 4.4) and other EPC contracting issues.

4.20. **Study team recommendations.** The study team recommends that Chinese government jurisdictions interested in aggressively promoting the use of EPC in public institutions assign a specific government unit to be responsible for providing all support to public entities in that jurisdiction for the implementation of EPC projects. The assignment of such institutional responsibility may be especially important at provincial levels, but serious efforts to promote EPC in central government facilities or at prefecture level also could benefit from this approach. The objective of the designated unit's EPC development effort should be to promote the adoption of EPC projects in all relevant public entities, and to provide a full range of services to interested public entities to help them overcome any problems. Based on experience elsewhere, it is advisable to set up one unit that can provide a "one-stop" service. The unit should have staff specifically dedicated to this work, but would most likely also need to contract specific experts from outside institutions to help with the various details. Specific key tasks for which such units can provide valuable support include:

- Educating and creating awareness among government agency officials at all levels on the needs for public institutional energy efficiency improvements, ways to achieve those improvements, the potential role of EPC, and specific actions required to use EPC to establish energy efficiency improvements. The unit could also highlight examples of successful applications of EPC. Experience elsewhere shows that only a systematic and steady effort can engage all key entities required to make EPC work effectively. This includes focused education or training for higher-level decision makers, including comptrollers and other fiscal agency personnel,[100] who might otherwise be likely to object to an unfamiliar project implementation and financing mechanism such as EPC.

100.See Donahue & Associates 2006. A Review of Maryland's Energy Performance Contracting Program, prepared for Maryland Energy Administration; http://energy.maryland.gov/incentives/allprograms/epc/epc_report.pdf.

- Developing information brochures and detailed reference materials on EPC as a project implementation method in the public sector, as well as organizing training for a wide range of public entity staff in the given jurisdiction.

- Maintaining an information database—or linkages to other databases—on public institution energy consumption statistics within the given jurisdiction, on targets assigned to different entities, implemented projects, and the energy saving results of EPC projects. Analysis of this data can help determine priority areas for new EPC projects and staff training.

- Providing guidance to public entities on ESCO selection, including, if desired, completion of ESCO Qualification Requirements, as suggested in para. 4.31.

- Preparing model EPC contracts and contract templates for public entities to consider, and providing guidance on how to use them. These model contracts are best used as guidance only, allowing the contracts to be adapted to the particular needs of each agency and project, thereby leaving flexibility for experimentation and new approaches.

- Providing hands-on assistance to guide projects through the various stages of preparation, approval, and disbursement, especially when the EPC business is just beginning.

- Preparing guidance on monitoring and verification methods applicable to public facility EPC (see paras. 4.59-4.61).

- Guiding agencies and ESPC contractors through various government incentive programs is also an important role that can be played.

- Preparing and disseminating case study examples of successful EPC projects in the public sector.

4.21. Over time, the work scope and sophistication of such EPC support units may develop further. Additional activities could include the development of EPC procurement methodologies, standards, and model documents, as well as project guidance and establishing connections to help project financiers. The U.S. State of Massachusetts now operates a quite sophisticated EPC support operation in its Division of Capital Asset Management (DCAM).[101] The division provides technical services (including engineering studies and facility assessments), performs and manages EPC procurement and contracting, conducts third party commissioning, provides onsite engineering, oversees construction, establishes baseline M&V and baseline standards, and monitors M&V reporting on EPC projects. As part of the M&V reporting, the ESCOs submit reports to DCAM and the host state agency on a quarterly basis. DCAM also provides standardized procurement and contracting documents that are used by state agencies, as well as a state master list of qualified financing vendors from which public agencies can choose bidders for tax-exempt lease financing. Utility incentives, grants, and sometimes bonds are also combined into project financing.

101.See Bharvirkar et al. 2008, Performance Contracting and Energy Efficiency in the State Government Market.

4.22. Financing of technical assistance and other supporting efforts is usually, in the initial stages, provided by the government. However, once an EPC program is fairly well established in a country or region, public entity clients are often expected to help pay for the costs of support services. For example, in the United States in the state of Maryland, energy performance contracts are assessed a fee to cover the costs of post-construction project monitoring and the review of savings M&V reports. In the state of Pennsylvania, plans are being made to charge a program administration fee to EPC projects to cover the program costs of consultant support, which for the first eight years of the program were paid from the state budget.[102] In the German capital Berlin, the Berlin Energy Agency provides project management support for state and municipal public agencies. For the costs that agencies incur up to the point of entering into a contract, the state government gives a fixed subsidy; for support during the investment phase, it contributes 50% of the cost.[103]

Key Issues for Scaling Up the Use of EPC in the Public Sector

4.23. Once the legislation, guidance, and support for EPC are in place, the next step will be scaling up the use of EPC in the public sector. While the measures described in the previous section have been introduced in many countries, only few have succeeded in mainstreaming EPC as a business model to achieve substantial energy savings in the public sector. Several factors contribute to this difficulty; among the most important—and most relevant for China—are the following:

- *Quality of ESCOs.* Many countries do not have a strong ESCO industry and only a limited number of ESCOs skilled enough to provide the wide range of services required by the public sector. Strengthening the quality of ESCOs, perhaps nurturing the industry by initially setting up a public ESCO, and helping potential clients to identify competent ESCOs, are means to strengthen the supply side of the EPC business. However, approaches that crowd out competition should be avoided to attract more companies to the public institution EPC market.

- *Complexity of public sector procurement.* Public sector procurement is quite complex and time consuming, and introducing EPC—a new and fairly complicated business model—creates even more potential complications. There are methods to streamline the process, for example, by prequalifying several bidders, but this could reduce competition, which is an important mechanism by itself to contain costs of energy conservation projects.

- *Preference for "simple," high-return projects.* The tendency exists to "cherry pick" simple energy conservation projects with very high returns in fairly large facilities. While this minimizes transaction (or project development and supervision) costs, it leaves out many projects in smaller facilities or projects with longer payback periods in the same facilities. Pooling or bundling several facilities in one EPC project or developing comprehensive energy conservation projects in one facility are ways to aggregate projects and enable the inclusion of a broader range of projects into energy conservation programs.

102.See Bharvirkar et al. 2008, Performance Contracting and Energy Efficiency in the State Government Market.

103.Personal communication with U. Schlopsnies, Berlin Energy Agency, April 2011.

4.24. The following sections discuss and present possible solutions to address these key issues and enhance the quality of ESCOs, strengthen and streamline procurement, bundle projects, move towards more comprehensive projects, and measure and verify energy savings.

Quality of ESCOs

4.25. Ideally, ESCOs provide a wide range of services, combining many different goods, works, and services together in one turnkey contract, while assuming various associated risks. As part of their many tasks, for example, ESCOs need to identify and evaluate project opportunities; design, install, commission, and manage projects; provide or help arrange for financing; guarantee savings; measure and verify savings; train client staff; provide ongoing maintenance services; and guarantee that savings will cover all project costs. In the real world, however, not all ESCOs will be able to provide this full range of services. ESCOs come in a wide range—from technical consultants with fixed fees to full-service ESCO with payments based on performance—and may provide only one or a few or all of the above services.[104]

4.26. ESCOs also vary in the range of technologies and energy conservation measures they implement. Many ESCOs in China have proprietary technology, such as energy controls or high-efficiency boilers, and concentrate on implementing energy performance contracts with just this type of equipment. In China, and to some extent also in other countries, few ESCOs are able to evaluate a facility comprehensively, considering a wide range of measures.

4.27. Because many ESCOs come from a technical background,[105] their management capacities and business and legal skills are also often deficient. This makes different ESCOs poorly equipped for the complexities of EPC, which requires the ESCO to be able to satisfy not only clients, but also financiers, subcontractors, auditors, tax collectors, and others.

4.28. Thus, not every company that calls itself “ESCO” may be able to carry out an energy performance service to the satisfaction of its client. In fact, during both the early development and growth phases of an EPC market—when some of the initial ESCOs are doing well and many new companies are entering the market—some EPC projects can and will have disappointing results. In recent years, and especially since early 2010, many companies have registered as ESCOs in China (see para. 4.30), but so far many have a limited track record. While quite a few strong, stable, and experienced companies are active in the Chinese market, it is difficult for clients to judge who is most competent. For the EPC business to truly take off, potential clients will need some support in screening ESCOs for competence and reliability. At the same time, however, it is very important to not create any barriers for companies to enter the EPC business, which would stifle growth and destroy the creativity of the industry in terms of its ability to develop new ideas and approaches.

4.29. Other countries have had similar issues with unclear ESCO competence and quality in the development of their ESCO industry. Possible solutions to support potential clients in the identification of experienced, qualified ESCOs include the following:

104.Singh et al. 2010, Public Procurement of Energy Efficiency Services - Lessons from International Experience.

105.Recently in China some ESCOs also come from a financial background.

- *Accreditation of ESCOs.* In several countries,[106] ESCOs can undergo an accreditation process to improve their credibility and increase confidence among potential clients and other parties, such as commercial banks. In the United States, ESCOs go through an examination of their core competencies and business practices. In India, the examination involves an assessment of their success in implementing energy efficiency projects, their technical manpower, and their financial strength to invest in such projects. Accreditation may be undertaken by an independent committee of industry experts, as is the practice in the United States, or by credit rating agencies, as is done in India. In the United States, the national ESCO association awards the accreditation in three categories, with a total of just over 20 companies now fully accredited. There is a significant overlap between this list and the list of "Super-ESCOs" prequalified as eligible to carry out ESPCs under FEMP. In India, where the ESCO industry is still in its initial growth phase, thirty-seven companies sought a rating in 2009 and twenty-five companies received a ranking of "good." When implementing accreditation, two key issues that must be addressed are (i) the risk that accreditation becomes perfunctory if enforcement is weak and (ii) the problem that accredited companies release qualified experts after accreditation.

- *Prequalification of ESCOs.* In the United States, the federal Department of Energy (DOE) and many state energy offices or similar agencies maintain lists of pre-qualified or pre-approved ESCOs. These lists are usually the result of a competitive procurement, based on ESCOs' experience with EPC projects. This pre-approval of ESCOs, however, restricts the public clients' choice to a limited number of ESCOs. While this is useful for the public entities because it gives them some assurance of the quality and experience of the pre-approved ESCOs and allows them to not have to undergo a regular public procurement process, it also limits competition and runs the risk of restricting the growth of new ESCOs (see para. 4.40).

- *Quasi-certification of ESCOs by national associations or trade groups.* Associations and trade groups can also help indicate the quality of member companies. As long as the association has clear and credible quality and competence requirements for membership and itself has a strong reputation, such "self-regulated" systems can provide indications to market players on the track record of member companies. Many ESCO associations provide their members with training and capacity building and some act as a "watchdog/better business bureau." It also is possible to have different tiers of membership (for example, principal member, associate member, and so forth) based on how companies comply with clearly defined track-record and competency criteria.

- *List of qualified ESCOs.* In the United States, DOE also maintains a list of ESCOs that have been screened by a DOE Qualification Review Board based on qualifications and client feedback. About 90 ESCOs are on this list, which is published on the Internet.[107] A public

106. In the United States, see National Association of Energy Service Companies, NAESCO Accreditation Programs; in India, see Government of India, Ministry of Power, Bureau of Energy Efficiency, Accredited Energy Service Companies (ESCOs) and Delio 2009, Accreditation to Increase the Credibility of Energy Service Companies in India. Singapore also has an accreditation scheme for ESCOs, but it is for energy auditing services at different levels; see Singapore Government, ESCO Accreditation Scheme. In the Philippines, four ESCOs have been accredited by the Philippine DOE; see Energy Service Companies (ESCOs) Accreditation.

107. In the United States, FEMP established the Qualified List of Energy Service Companies (DOE Qualified List) in accordance with the EPAct 1992 and 10 CFR 436. In Canada, the Natural Resources Canada's Office of Energy Efficiency maintains a directory of energy management service providers and provides a summary list of the acceptable qualifications for individuals who can perform a pre-project energy audit for its program, ecoENERGY Retrofit Incentive for Commercial and Institutional Organizations.

agency that does not want to undertake an energy savings project under the master DOE ESPC contract with any of the "Super-ESCOs" (see Box 4.1) can carry out regular public procurement with companies from the list of qualified ESCOs.

- *Standards for ESCOs and ESCO services.* The European standardization bodies, the European Committee for Standardization (CEN) and the European Committee for Electrotechnical Standardization (CENELEC) (or "Comité Européen de Normalisation Électrotechnique"), jointly developed a standard for energy efficiency services in 2010, which now will be incorporated into the system of national norms in every country in the European Union.[108] Box 4.2 outlines the basic requirements. ESCOs can be certified based on this standard. One of the most important services under EPC with public institutions, especially government buildings, to standardize is measurement and verification (M&V). This is also important for government incentive programs. M&V standardization has been done separately by several industry organizations, for example, through the International Performance Measurement and Verification Protocol (IPMVP) (see paras. 4.57-4.61). In the United States this standardization of M&V has been crucial for increasing the trust of customers and banks in ESCO activities.

- *Quality labels for ESCO projects.* The use of quality labels for projects may be less comprehensive, but probably also less expensive to implement than a national ESCO or ESCO project standard. Such labeling programs can raise awareness of successful EPC transactions. An example of a project quality label is the Austrian Thermoprofit quality label, which sets a series of standards to be met by ESCOs and their projects. The Thermoprofit label may be used only by Thermoprofit partners who, at regular intervals, are assessed by the regional energy agency and an independent commission to confirm they are observing Thermoprofit standards.[109]

Box 4.2: Energy Efficiency Services - Standard EN 15900: Requirements

EN 15900 establishes requirements for Energy Efficiency Services. Key requirements are that the services need to:

- Be designed to achieve energy efficiency improvements
- Use collected data related to energy consumption
- Include an energy audit, actions, and M&V
- Work from a documented description of a framework for action and a follow up procedure
- Include efforts to measure and verify improvements over a defined period and with agreed methods, which will be reported at agreed intervals
- Use a definition of the baseline and adjustment factors
- Include a statement on whether a contractual guarantee of energy efficiency improvement is provided or not, and on the level of this guaranteed improvement
- Document the responsibilities of all parties involved.

Source: Dijkstra 2011, Standardization energymanagement and de standard for energy efficiency services.

108.See EN 15900:2010, Energy efficiency services - Definitions and requirements, and for example, Piantoni 2011, The Energy audit, energy efficiency services and energy efficiency benchmarking.

109.See Energy Cities, Thermoprofit: Marketing Performance Contracting.

4.30. Since October 2010, MOF and NDRC have issued four batches of lists of ESCO companies that may submit projects for award of subsidy payments for qualified completed EPC investment projects.[110] By early 2012, the combined list—including all four batches —contained over 2000 companies. The list, which includes the location of the companies, contact information, and the general technical areas of their work, is publicly available. To make it onto the list, companies need to demonstrate compliance with a number of basic requirements. However, many of the companies on the list are quite new and not all can demonstrate competence or show a clear track record. Although a good first step, the main purpose of the list, however, is to determine eligibility for certain types of government support and not to provide definitive recommendations on the best choice of companies for clients to engage.

4.31. **Study recommendations.** *Several options for assisting clients to identify good ESCOs to work with are already being discussed in China. For the public institution market, it may be best at the current time for one or more energy efficiency units overseeing specific jurisdictions to pilot the issuance of interim ESCO Qualification Requirements that any ESCO seeking an energy performance contract with any public entity in that jurisdiction must comply with. Examples of such energy efficiency units would be, for example, the national GOA for central government facilities, the MOE for central government supervised universities, and provincial GOAs for provincial government facilities. The compliance of ESCOs with these ESCO Qualification Requirements could be reviewed on a case-by-case basis when ESCOs propose projects. The Qualification Requirements should be stringent enough to ensure that track records, financial standing, staffing, and experience are sufficient. They should be issued on an interim basis so that they can be easily revised based on new experience. Good records should be maintained of all applications, qualification approvals, and project results within the jurisdiction. Over time, such pilot systems may provide the foundation for more sophisticated and sustainable accreditation, pre-qualification, or standard systems, which could involve third parties in ESCO screening or accreditation.*

4.32. **Model documents and standardized contract provisions.** An alternative tool for helping inexperienced clients secure good EPC services is the provision of model documents, including model contracts, and a standardization of key contract provisions. In almost every case of an ESCO business making inroads in the public sector, these kinds of model contracts and documents had been developed. China's NDRC has issued the basic format for a model shared-savings contract, but *it would be useful to develop further details and guidance about available choices, specifically for public institutional energy performance contracts.* In Germany for example, several sets of model contracts exist, for both the federal and the non-federal public sector, as well as sets of guidelines.[111] Indeed, one of the main reasons given why ESCO projects in the Czech Republic have not become more prevalent is the lack of public support, including the development of such documents.[112]

4.33. **Public ESCOs.** Another option to provide ESCO services specifically to the public sector is the introduction of public or publicly owned ESCOs. This has been done in several countries

110.See Sun et al. (2011) for details of this subsidy program for which EPC projects in all sectors are eligible.

111. Singh et al. 2010, Public Procurement of Energy Efficiency Services - Lessons from International Experience (German case study).

112.See Sochor and Valentová 2009, Framework Conditions for Energy Performance Contracting.

where EPC seemed a valuable business model but where the ESCO industry had been nascent, weak, or with limited access to commercial financing. A key objective in introducing public ESCOs is to help foster the growth of local ESCOs. In Belgium, Ukraine and Croatia, publicly-owned and operated companies have been capitalized with funding from the government or international financial institutions (IFIs). They enter into energy performance contracts with public agencies and subcontract with smaller private ESCOs or contractors. The public ESCO would generally provide financing and be paid from the savings it guarantees to the client. Subcontractors would generally be paid on a fee for service basis. Box 4.3 provides details on Fedesco, the Belgian public ESCO in the federal building sector. A valuable lesson from the Fedesco example is that it is preferable for the entity to have several instruments to pursue its mission. Fedesco enters into energy performance contracts, but it also facilitates and finances so-called transversal measures—simple energy saving measures, such as lighting or controls—in the properties of federal agencies on a fee for service basis. It should also be noted that Fedesco carries out many activities to organize the ESCO industry, to provide capacity building, and to help both ESCOs and their potential clients by developing model documents and contracts.

4.34. In China, the concept of a public ESCO supported by local governments may be useful for both developing the EPC business in the public sector and for helping local ESCOs to develop in situations where the local ESCO industry is weak. The public ESCO should be a commercial entity, but could use a variety of corporate structures. Before embarking on creating a new entity, it should be carefully investigated whether there are alternatives. One idea might be to invite well-known ESCOs from other provinces to carry out closely supervised demonstration projects in public facilities, using local companies as subcontractors. Another could be to create a provincial energy efficiency fund that would introduce the concept of EPC to the local energy efficiency industry by letting contractors design and implement projects in public sector buildings and base part of the contractor's payment on the performance of the implemented measures. Such an energy efficiency fund promoting a path toward EPC in the public sector is currently being tested in a World Bank project in Armenia.[113]

Box 4.3: Using a Public ESCO when the ESCO Industry is Weak: Example of the Belgian Fedesco

The market for ESCO services was slow to develop in Belgium around the turn of the century. Some international companies were entering the market, but mostly for "*chauffage*"[114] services. To open up the federal public buildings market for ESCO services, the federal government created a public ESCO, Fedesco. It is a limited liability company, owned by the Federal Participation and Investment Company, a government-owned financial holding. It was started with €1.5 million in capital from the Kyoto Fund, which increased to €6.5 million in 2007. Its financing (debt) capacity of € 100 Million is backed by a state guarantee.

113. See The World Bank 2012. Armenia - Energy Efficiency Project. Washington D.C. http://documents.worldbank.org/curated/en/2012/03/15931877/armenia-energy-efficiency-project.

114. The so-called "Chauffage contract" is a contract which includes operation without explicitly committing to carrying out energy efficiency investment. Under a Chauffage contract, the contractor ensures optimal operation of an already existing system and must provide an agreed comfort level (for instance temperature, humidity) at a lower cost for the client if conditions remain unchanged. The contractor can increase its profits by investing in more energy saving equipment or by procuring cheaper fuel, thus reducing the costs;" Paolo Bertoldi, Benigna Boza-Kiss, Silvia Rezessy (2007). Latest Development of Energy Service Companies across Europe - A European ESCO Update. European Commission, Joint Research Centre, Institute for Environment and Sustainability; http://www.energy.eu/publications/LBNA22927ENC_002.pdf.

Fedesco's mission is to study, realize, and pre-finance energy efficiency and renewable energy projects in federal public buildings. It implements investments through three channels: standard projects, transversal measures, and EPC. Its goal is the reduction of GHG emission in the federal buildings sector by 22% between 2005 and 2016. It is estimated that this would require an investment of €152 million. The federal government owns/occupies 1650 buildings with a surface of 8 million square meters and an annual energy and water bill of more than €100 million. The buildings' energy consumption of 2 billion kilowatt hours (kWh) per year results in carbon dioxide (CO_2) emissions of more than 600,000 tons and is heavily concentrated in the biggest buildings, with 20% of buildings accounting for 80% of energy consumption.

Since January 2007, Fedesco has the exclusive right to apply third-party financing to federal buildings. Fedesco manages turnkey energy services projects on behalf of the building occupants and in collaboration with the federal Building Agency. In 2008 it started the development of EPC projects. Fedesco also supported the creation of the ESCO Association, BELESCO, which started its activities in 2008. BELESCO will focus on representing the ESCO industry, disseminating information and providing training to public and private customers, building a database of EPC projects, establishing an accreditation program, and developing a model contract and tendering procedure for the public sector. Fedesco uses an EPC contract based on the one developed by the Berlin Energy Agency but with tendering procedures and contracts specifically adapted to Belgian public tendering law. This contract will be the basis for a common model contract for the public sector that will be developed by BELESCO.

One of the biggest barriers to the development of EPC in Belgium has been the lack of awareness and knowledge about the ESCO concept and how to use it, both in the public and private building and industrial sectors. BELESCO will play an important role in that area. Another barrier is the large amount of existing (long-term) maintenance contracts, including a growing number with total guarantee on technical equipment. It is difficult to replace these contracts by EPC contracts. When public sector agencies own buildings, they may prefer alternative renovation projects using their own funds, managing technical measures individually, or using traditional credit funding. At Fedesco, roughly half of its investment plan will not be based on EPC projects, but on so-called Transversal Measures (such as boiler or chiller replacement, building control, isolation, or window films). Although transversal measures use third-party investing principles by Fedesco, full energy service offerings or EPC contracts would not be required.

The Belgian ESCO industry has strong support from the federal government. Through Fedesco, the federal government grants ESCOs immediate access to large public sector contracts for its 1,800 buildings. The credit rating of the government as a client makes financing projects easy and the industry is set to grow. Not only does Fedesco have the exclusive right to carry out EPC for federal public buildings with third-party financing, it is also taking the lead in promoting EPC-projects. Fedesco benefits from the fact that public ESCOs can sign contracts with public sector clients without the need for public tendering. For outsourcing contracts, however, the public tendering law has to be applied.

Among the many lessons learned is the fact that EPC tendering is perceived as being complex. There is a need for (i) standard tender documents in the public sector (being developed within the Fedesco-affiliated Knowledge Center and BELESCO); (ii) consultants and market facilitators supporting customers; and (iii) proper and good M&V (IPMVP is being adopted).

Source: Vanstraelen 2008, Overview Belgian ESCO Market.

Procurement of ESCOs: Scale and Transaction Efficiency vs. Benefits of Competition

4.35. ESCOs provide a unique mix of services, equipment, and financing, often broken up in different phases and over a period of time. The typical case in China is that a third-party ESCO works with the host entity to develop an energy conservation investment project, including a survey or audit and detailed project design, and—following negotiations with the host entity or a fairly simple bidding procedure—signs an energy performance contract. Under the shared savings type of contract commonly used in China, the ESCO will then pay for the project investment (sometimes using funds it borrows elsewhere), oversee procurement and construction, complete commissioning of the project together with the client, guarantee the energy savings, possibly carry out operations and maintenance, and perform monitoring and evaluation. The phase from initial project idea to contract execution can take many months and contract durations for substantial buildings projects in China typically are at least 3-5 years.

4.36. In recent examples, as reviewed by the study team, of public institutions and ESCOs getting started on an EPC project, the ESCOs had been selected based on negotiations or according to fairly simple bidding procedures. As the market develops, however, and more companies are willing and able to enter into contracts and projects are becoming more complicated, likely more issues will need to be addressed in the procurement of energy performance contracts. In addition, many public entity managers are more likely to consider EPC if established and transparent procurement methods are available, which will reduce the risk of complaints. Experience from other countries indicates it can be difficult to develop procurement methods that conform to public institutional regulations and at the same time efficiently provide cost-effective, quality results, without large transaction costs or delays.

4.37. In most countries, the public sector has to abide by strict rules to procure goods and services competitively to secure better conditions and avoid corruption. Procurement of energy performance contracts is no exception. Procurement of an energy performance contract in the public sector in the United States or Europe is a lengthy and complicated process that involves fairly high costs on both the side of the ESCOs as on the side of the public client. Table 4.1 shows the typical steps (1-7) that commonly need to be taken for a contract to be awarded competitively in North-America or the European Union. In the U.S. federal sector, a time horizon of 1-2 years from project development to contract award is fairly normal, whereas in the state and local government, university, school and hospital sectors 6-9 months is more typical. The difference can be explained in part by the larger size of federal projects, but also is a result of "the number of layers of approval required for awarding a project and the complexity of the contract requirements."[115]

4.38. Procurement issues are often the first issues that need to be resolved in a particular country to make EPC work in the public sector. Three key issues are (i) phasing and extent of facility audits and implications for the contract; (ii) competition among ESCOs; and (iii) evaluation of bids that can be dissimilar; discussed below. A more thorough treatment of the procurement issues of the entire project cycle—from project development and contractor selection through implementation

115. See Hopper et al. 2005, Public and Institutional Markets for ESCO Services: Comparing Programs, Practices and Performance.

and monitoring and verification of results—is provided in the recent World Bank/ESMAP publication by Singh et al. 2010 and the related World Bank Institute e-learning toolkit.[116]

Table 4.1: Steps in Processing and Implementing Energy Performance Contracts

EPC process steps	Responsible party
1. Initial data gathering, analysis, and definition of project goal and required measures	• Host with support from energy agency or similar organization
2. Expression of interest; selection of shortlist	• Host with support from energy agency or similar organization, could be based on model documents
3. Request for Proposal (RfP)	• Host with support from energy agency or similar organization, could be based on model documents
4. Bid preparation, including walk-through audit, resulting in project design with measures and cost-benefit analysis, estimated energy savings	• Bidder • Host with support from energy agency or similar organization
5. Evaluation	• Host with support from energy agency or similar organization
6. Negotiation with top bidders	• Host with support from energy agency or similar organization
7. Identification of financing sources	• Host and/or ESCO, depending on RfP requirements
8. Contract	• Host and ESCO
9. IGA, if required, and detailed project design, determination of baseline, and final energy (cost) savings	• ESCO
10. Dealing with deviations / contract void	• Host and ESCO
11. Implementation of investment measures, including procurement of goods and works	• ESCO (not required to abide by public procurement rules, unless specified in contract)
12. Commissioning	• ESCO, observed by host and possibly supervised by energy agency or similar organization
13. Operations and maintenance	• ESCO or host, based on contract
14. M&V	• ESCO or independent third party, depending on contract

Source: Authors.

4.39. **Phasing.** An important part of successful procurement is the phasing of procurement steps, especially of the facility audit. At what point is the contract awarded? Is a thorough audit (that is, an investment grade audit (IGA)) done before or after a contract is signed; and what are the implications of the timing of the audit for the contract? Bidding documents for public contracts usually require detailed specifications of any item to procure. For existing buildings, this can only

116.See Energy Sector Management Assistance Program, New e-Learning Course: Improving Public Sector Energy Efficiency.

be done on the basis of audits. So the fact that a bidding document already specifies the exact equipment or measures negates the very essence of EPC, which is to rely on the contractor to find the best solution for improving energy efficiency in a facility. In Brazil and several other countries, bidding documents require such a detailed specification of measures that they result in a formidable barrier for the implementation of EPC. The use of functional specifications would be a better fit for EPC, which could include defining a project's technical, financial, organizational, legal, and economic performance requirements and framework conditions for the implementation of the measures. Short-listed companies responding to a request for proposal (RfP) are usually permitted to do a walk-through audit and develop their proposal on this basis. IGAs are usually not done at this point to reduce the costs of bid preparation and increase the number of competing ESCOs. If the project is fairly simple, consisting of only a few investment components, the public client and the winning bidder sign an energy performance contract and the ESCO may go ahead with procurement without an IGA. If the project is more comprehensive (see para. 4.51), for example in large federal agencies or hospitals, the winning ESCO will need to perform an IGA, on which it will base the detailed project design and specifications, final investment amount, and energy savings estimates. The costs of the IGA become part of the project costs for which the ESCO will be remunerated. If the detailed project design basically conforms to the requirements laid out in the original RfP, the ESCO can proceed with procurement. The detailed investigation of the IGA could also result in the need to substantially deviate from the initial proposal. In this case, negotiations may need to commence. If the deviations exceed a pre-specified limit in the guaranteed savings amount or other important contract parameters,[117] the client can typically withdraw from the contract without reimbursing the ESCO for the IGA costs. To avoid that the ESCO inflates project costs after the IGA, the RfP could require that the ESCO in its initial proposal commit to unit prices for items such as equipment (including a mark-up) and man hours ("open book pricing").[118]

4.40. **Competition for initial entry rather than for each project.** If ESCOs only compete for initial entry into a specific market, but not for each project, this immediately reduces the number of steps in the EPC process. The first seven steps described in Table 4.1 can then be collapsed into far fewer. The advantage of limiting competition is obviously the reduction of transaction costs, because the sub-agencies do not each have to carry out a competitive procurement. It also avoids the need for multiple audits by ESCOs in the competition. The impact on project costs, however, could go both ways. ESCOs may be willing to grant better conditions to the parent agency if it requires open book pricing. Many experts, however, state that competitive procurement by a single agent involving several ESCOs generally leads to lower project costs. Two methods to provide for competition for initial entry rather than competition for each project include:

1. *Prequalification of ESCOs.* Pre-qualification is the most common method. Lead agencies competitively select a fairly large number of ESCOs—perhaps 8-16—based on their previous experiences and a broad description of the services to be provided. This narrows the field of possible providers, assures their quality, and sets a minimum benchmark of services that must be delivered.[119] Public agencies can then choose among those

117. Under previous US FEMP ESPCs this limit was set to 20%, now agencies can specify it (see Singh et al. 2010, p. 114).

118.For a more detailed discussion see Singh et al. 2010, p. 47 and 100/101.

prequalified ESCOs without any competitive procurement (for example in the FEMP Super ESPC program based on IDIQ; see Box 4.1), or select several of them for a mini-competition.[120]

2. *Central procurement.* In this second option, a ministry (or similar agency) carries out a tender for an ESCO to access the entire market of its sub-agencies without any additional public procurement. An interesting example is the "Szemunk Fenye"—Light in Children's Eyes—program in Hungary, covering about 700 schools with more than 300,000 students. The modernization of the heating and lighting facilities in all schools (later other municipal facilities became eligible as well), funded from the central government budget and operated by municipalities, was centrally tendered by the Ministry of Education (MOE). All major terms and conditions were centrally negotiated, including unit prices for heating and lighting systems.[121]

4.41. Using competition for initial entry rather than for each project has several disadvantages, including: (i) a constriction of opportunity for many new and emerging ESCOs, who may only be able to participate as sub-contractors to larger ESCOs; (ii) risks of project cost increases due to a lack of competition for projects, and (iii) potential difficulties in finding ESCOs with sufficient resources and manpower to deliver a series of large projects, or large packages of small projects, at the same time.

4.42. **Bid evaluation.** The evaluation of bids for major EPC projects is complex, as the bids are likely to include a mix of services, equipment, and financing that is different from bidder to bidder. Bids therefore cannot be evaluated on the basis of the lowest price alone. Evaluation criteria need to take into account that the bids of different ESCOs will typically consist of different volumes and types of investment, include different services, and also result in different benefits. Life-cycle costing (LCC)[122] needs to be used instead of the lowest price criterion, and benefits have to

119. See for example the sample request for qualification for the Washington State EPC program: http://www.ga.wa.gov/EAS/epc/RFQ-Sample.doc. It is quite similar to the model documents made available by the Energy Services Coalition for use in state programs: http://www.energyservicescoalition.org/resources/model/index.html - Pre-Qualify. An example of an ESCO submittal to the request for pre-Qualification for future ESPC projects in Washington State is at http://www.ga.wa.gov/eas/epc/soq/Noresco/NORESCO Response to State of Washington Prequalification.pdf.

120. See for example the London Development Agency RE:FIT Program in the Energy Efficiency News, £2.7 million energy makeover for London's public buildings.

121. The winning consortium consisted of an ESCO, a commercial bank, and three equipment providers. The International Finance Corporation (IFC) provided a 50% risk sharing facility to the bank, which in turn provides a credit line (US$250 million) to the ESCO. The consortium markets the program to the municipalities, enters into service/lease contracts with each municipality, finances and implements the lighting and heating measure, guarantees savings, and receives a fixed fee from the municipality for its services. The approach reduces transaction costs not only for the municipalities, but also for the financial institution, since the ESCO acts as an aggregator. The MOE operates an information technology system through which municipal institutions can apply to participate in the program, essentially undergoing a pre-qualification. Also, MOE is responsible for monitoring overall efficiency and impact of the program. See IFC, OTP Local Institution Energy Conservation Program. Lessons that have been learned from this experience include: (i) Having an entity closer to the end-users be involved in procuring and managing the service provider might be more successful than procurement by the central government; an example would be procurement done by regional government for schools on its budget; (ii) Experience, especially from the United States shows that having a short-list of ESCOs versus a single-selected ESCO benefits clients and increases their ownership of the project as they can choose an ESCO; meanwhile, the competition among ESCOs is important for cost containment; and (iii) the capacity of the ESCO to deliver as well as its presence throughout the country are critical factors; this eventually worked out in Hungary which has only 10 million inhabitants; in larger countries probably several ESCOs would be needed. Source: Personal communication with Martin Dasek, IFC.

122. LCC takes into account the capital cost of the investment and the operating and maintenance costs over the life of the asset. In many countries, LCC is becoming standard in public procurement rules for evaluating both equipment purchases and services, as part of those countries' sustainability commitments for the public sector. Examples are the U.S. governments at all levels and EU countries, foremost the United Kingdom; see Meyer and Johnson 2008, Energy Efficiency in the Public Sector—A Summary of International Experience with Public Buildings and Its Relevance for Brazil.

be included in the comparison. The method that most experts feel is best able to identify the best proposal is a calculation of proposed project net present value (NPV), which is the sum of the discounted net savings of the project.[123] Most importantly, evaluation criteria need to be transparent to minimize complaints.

4.43. If competitive bidding is not taking place for a project, for example because the ESCOs were already pre-qualified, the host agency should carefully negotiate the contract with the selected ESCO. This negation should follow an in-depth review of all contract clauses, including a verification of prices and mark-ups quoted by the ESCO, preferably with the help of a facilitator or procurement agent. In the United States, it is recommended to check the following contract-related items:[124]

- The entity implementing the project should completely understand the energy saving measures.
- The entity should verify that pricing is fair and reasonable, using RS Means® (http://rsmeans.ReedConstructionData.com/) construction cost data or a similar resource to compare costs.
- To verify equipment prices, quotes should be obtained from suppliers.
- Are the time and costs for engineering and design reasonable?
- Is cost reduction possible without affecting quality or result?
- Is the installation schedule reasonable?
- Are project management time and cost reasonable?

Project Bundling

4.44. Achieving sufficient scale economies for EPC in the public sector is not easy. EPC transaction costs are fairly high, but they increase only slightly with project size. It is therefore recommended to engage ESCOs only for larger projects above a certain building or property size, or a baseline energy consumption or cost. The suggested minimum size for an energy performance contract for a single building ranges from an annual energy bill of at least US$100,000 for Canadian federal buildings[125] to €200,000 in German municipalities. In China such a limit might be lower as energy costs may often be lower but project development costs also will likely be lower. Still, EPC would not be an option for many individual buildings in China, especially in cases where neither space heating or air conditioning energy use are large.

123. The NPV expresses the estimated stream of costs and benefits, over a set period in current dollars, by discounting equipment with different life-times appropriately, adjusting for inflation and factoring in such parameters as initial investment, energy saved, contract duration, and life of equipment (Singh et al. 2010, p. 99).

124. See FEMP, Negotiating and Entering into an Energy Savings Performance Contract.

125. See Office of Energy Efficiency, The Federal Buildings Initiative: An Executive Overview. In addition to buildings with large energy bills, buildings with smaller energy footprints have also been considered. For example, in the states of Colorado, Idaho, Montana, Nevada, Oregon, and Wyoming in the United States, small and dispersed Bureau of Land Management facilities with over US$1,000 in electricity charges each year have been included in a Super ESPC. The challenge was organizing the ESCO's energy audits and minimizing its overhead and engineering costs in many remote locations. Initially, target sites were categorized as either "engineered" or "prescribed." The former received IGAs, the latter only a cursory review of lighting and HVAC controls. When the latter proved too superficial, it was later replaced by a detailed lighting and HVAC control survey. Implemented measures include lighting and associated controls, HVAC controls, digital HVAC control upgrades, new boilers, ground source heat pumps and advanced meter installations (as per EPAct 2005). See FEMP, Bureau of Land Management: A Successful ESPC Across Six States.

4.45. Smaller building energy efficiency projects can still be undertaken if a pool of projects can be bundled together and then contracted out to an ESCO. Project bundling makes the most sense for buildings where technical measures are fairly similar. This may make it possible to cut down on audit costs (for example by auditing only one representative building), or to purchase equipment in bulk. Also, it is preferable to combine buildings that are under common management or ownership, since this makes it easier to handle the administrative process and budget implications (see Box 4.4). Accordingly, bundling of properties into one energy performance contract can help achieve economies of scale by reducing the costs of (i) project development (tendering and auditing), (ii) project implementation through bulk purchasing, and (iii) contract management. Bundling also facilitates blending projects with positive NPV but longer payback periods with quick-return projects, to potentially provide an attractive package. In some cases, project bundling can also help smaller ESCOs to grow and gain experience, working as a subcontractor under the overall management of a large ESCO.

4.46. Project bundling has become popular in some European countries. Germany, with key projects in Berlin, is a prime example (see Box 4.4), but examples also exist in Austria, the Czech Republic, Sweden, and other countries.[126] Various countries have also bundled energy efficiency projects in schools to implement EPC solutions, for example in several regions in France[127] and in many school districts in the United States (such as in Baltimore, Maryland).[128] Most of those projects have been implemented with the support of a facilitator and have benefited from standardized or model contracts and other documents.

Box 4.4: Bundling Individual Energy Efficiency Projects into Energy Performance Contracts—Example of the Berlin Energy Saving Partnership

Background on the State of Berlin. In the early 1990, Berlin experienced a tight budgetary situation with lack of financial resources and high energy related costs of approximately €255 million. Investigations showed an energy saving potential of about 30% on average in public facilities.

The Berlin Senate (State Government) made a decision in 1994 to introduce a target to reduce CO_2 emissions by 25% by 2010, compared to 1990. This was updated in the 2020 Climate Protection Concept, targeting a 40% CO_2 reduction by 2020, compared to the 1990 baseline.

Berlin model of energy saving partnerships. To reduce public sector energy costs, improve public building infrastructure, and contribute to the targeted CO_2 emission reductions, starting in 1996 the concept of EPC was developed with support of the Berlin Energy Agency. The Berlin model of Energy Saving Partnerships pools buildings of different sizes with different levels of energy consumption, construction material, fixtures and fittings into one project that can be tendered to a private ESCO for the design, financing, and implementation of energy-saving measures.

126. See http://www.european-energy-service-initiative.net/.

127. See Leroy 2010, Good practice examples High schools in Alsace Region, and footnote 134.

128. In the Baltimore City Public School System the selection of schools was based on a review of their utility bills. 160 schools were included in four energy performance contracts with a total of US$106 million project cost (including for preventive maintenance) and US$4.8 million guaranteed annual energy cost savings; see Maryland Energy Administration, Energy Program for Baltimore City Public Schools.

EPC for public buildings—Results since 1996:

- 25 pools with more than 500 properties (more than 1,300 buildings); a typical pool includes 20 buildings
- €51.6 million private ESCO-investment
- €11.7 million (26%) guaranteed savings
- Annual participation in energy cost savings by the State of Berlin: €2.7 million
- Total CO_2 reduction (1996-2010): 500,000 tons
- Average term of contract: 12 years.

Best practice example: District Steglitz-Zehlendorf (Pool 19):

- Pool: 69 buildings (schools, kindergarten, sports facilities) owned by the district government
- Baseline energy costs: 1.84 million €/year
- Guaranteed energy cost savings: 29.4 % = 541,679 €/year
- Investment: approx. €2.8 million
- CO_2-reduction: 3,973 t/year
- Duration of contract: 14 years
- Energy Saving Measures: New boilers in 11 buildings, fuel switch from coal/heating oil to gas, building automation, modernization of lighting; € 100,000 for renewable energy technologies, e.g., solar thermal systems.

The following principles guide the bundling/pooling of buildings in practice: A pool should contain only one contractual object, into which all properties are bundled. Only one energy cost baseline should be relevant, consisting of the total energy costs of all individual properties. Only one contract should be concluded between one client and one contractor/ESCO. The ESCO provides one overall guarantee for energy cost savings, and one share of savings that goes to the client and is allocated internally among the participating properties.

Conditions for properties suitable for EPC/participation in pools include the following: The minimum baseline energy cost for each property should be above €250,000. The building should continue to be in use for at least the term of the contract (i.e., at least 10 years). It should have experienced a fairly constant development of energy use during the past few years. For buildings with mixed uses, non-owned objects should have their own metering. The project should be able to address the central heat supply equipment. These conditions are to be checked before incorporating a property into the pool.

Experiences with ESCOs. In general large, national ESCOs or specialized divisions of large national companies are bidding for the EPC projects. So far, 14 ESCOs are responsible for the total of 25 pools (some in joint ventures). A total of 100 subcontractors, consisting of regional small and medium enterprises, are involved in the implementation of measures and O&M. In the past all problem issues were resolved without any need to touch project securities.

Lessons Learned:

- A reliable legal framework is necessary that provides clarity about the legality of EPC
- Sufficient time for adjustment of measures needed
- Intensive communication between client and contractor is essential

- Changes in baseline conditions (for example, use of building) have to be discussed between client and contractor
- Additional efficiency measures are possible during the entire contract phase
- Achieved savings are usually within the scope of guarantee or higher
- Energy savings can be even higher when extending the contract or after re-tendering
- Standardized procedures and contracts, developed by the Berlin Energy Agency, contribute to time- and cost-effectiveness of implementation and reliability
- Competition and transparency leads to lower costs.

Driving forces:

- Decision makers who commit to challenging targets and take on the responsibility to implement measures to achieve them
- Willingness to develop new concepts for public-private partnerships
- Support of project development and implementation by a facilitator, the Berlin Energy Agency.

Sources: Geißler 2010, Energy service–Hotspot Berlin as a national and international role model; Schlopsnies 2008, Berlin Energy Saving Partnership - from model to project success ("Berliner Energiesparpartnerschaften – vom Modellprojekt zum Erfolgsmodell"); Schlopsnies 2012, Die Berliner Energiesparpartnerschaften; Singh et al. 2010, Public Procurement of Energy Efficiency Services - Lessons from International Experience.

4.47. **Study recommendations.** Bundling energy efficiency retrofit projects in different public facilities for implementation using EPC certainly has an important role to play in China. A number of local government agencies have already begun to sign agreements with ESCOs to implement bundled EPC projects in various facilities. The agreements specify integrated packages of energy services, including energy audits, diagnostics, design, implementation, equipment management, and, frequently, the establishment of a monitoring platform. ESCOs are asked to provide the financing. Similar to the international situation, particularly good markets for EPC project bundling in China include provincial and local government facilities and local school districts.

Moving toward Integrated and Comprehensive Energy Efficiency Projects

4.48. The involvement of ESCOs in the building sector often starts with single technology projects. In North America and Europe, projects involving lighting improvements, boiler or HVAC replacements, and building control were initially widespread. For example, in the United States in the 1990s, 20% of all ESCO projects in the public sector were focused on lighting-related measures.[129]

4.49. This international trend also applies to the building EPC business in China. Projects focusing on specific energy systems are fairly straight-forward, have relatively short pay-back times and—especially in the case of projects focused on lighting—can make it easy to determine savings, mostly in the form of stipulated savings.[130] These single-technology projects are also easy

129.See Hopper et al. 2005, Public and Institutional Markets for ESCO Services: Comparing Programs, Practices and Performance.

130.For a definition see footnote 140.

to replicate. Experience in other countries further shows that the technical savings potential of building energy systems, such as lighting and HVAC systems, can range from 10-30%. In China, these high financial paybacks have allowed ESCOs to receive full payment and profits within three years or less, even if 20% or more of the energy cost savings over the contract period is given to the client. Such projects are referred to as "low-hanging fruit," as investments have fairly high returns and short payback times.

4.50. With increasing experience, many public clients in North America and Europe have become concerned that doing only easy, short-term and high-return investments will prevent the realization of longer-term projects that result in larger energy savings but are less profitable over the short term. This has led to an increased use in those markets of short-term payback measures to leverage measures with longer payback times, creating comprehensive projects that still fit within expectations of overall profitability and contract terms.[131]

4.51. Unlike projects in China, most ESCO projects of the last 10-15 years in the public sectors in the United States and Western Europe have had terms of 10-25 years, involving millions of dollars or Euros in investments, and resulting in energy (cost) savings of 20-40%. The projects have included a broad range of energy efficiency measures (for example, 120 separate measures in the German hospital project described in Box 4.5), covering most energy-consuming equipment as well as some building shell measures such as window replacement and insulation. More recently, renewable energy applications are also being incorporated into energy performance contracts, particularly in the United States. Public clients are often providing co-financing for investments for some of the required measures with long payback times (such as window replacement) because ESCOs would otherwise be reluctant to enter into contracts that include them.

4.52. Implementation of comprehensive energy efficiency projects using energy performance contracts requires the following three conditions:

- *Qualified ESCOs able to design, finance, and provide a wide variety of services for complex, long-term projects.* To support long-term complex projects, ESCOs in the market place need to have the capacity to (i) design and implement a project with a wide variety of measures, (ii) raise a large amount of financing (either from equity or debt),[132] (iii) provide operation and maintenance services or train and supervise existing facility staff, and (iv) carry out sophisticated measurement and verification programs (see paras. 4.59-4.61). In most countries, the number of such companies is limited. In the United States, essentially the same 10-15 companies tend to appear on the lists of ESCOs prequalified to enter into contracts at the federal or state level. In the German State of Berlin, 2-6 ESCOs usually participate in bidding for pools of projects and, so far, 14 ESCOs are implementing energy efficiency projects in the 25 pools tendered between 1996 and 2010 (see Box 4.4).

131. More generally, building sector and climate change experts point out that existing buildings need to achieve about 80% savings by 2050 if they are to deliver the GHG reductions consistent with targets negotiated through the UNFCCC; see for example, IEA World Energy Outlook (http://www.worldenergyoutlook.org).

132. In the United States, ESCO projects in the municipal, university, school and hospital sectors usually are financed by the public clients since they can access funds more cheaply than private sector ESCOs; see Chapter 3.

- *Amenable regulations and a legal and institutional framework favorable for implementation of long-term EPC projects.* If a maximum contract term is specified in EPC enabling legislation or administrative rules, this term should be longer than the expected economic lifetime (or the normal payback time) of the energy efficiency technologies required by the public client. In the United States, for example, contract terms in excess of 15 years have been necessary to finance comprehensive energy efficiency projects or projects that involve central HVAC plant replacement.[133] For any long-term contract, however, it will be important to consider whether or not the contract can be enforced and whether risks can be properly mitigated by the ESCO and the client over the duration of the contract.

- *Buildings experiencing high and steady energy consumption.* Buildings that are used during most of the day and the year and have high energy consumption and high energy costs, such as hospitals, are better targets for comprehensive energy efficiency projects than smaller buildings with limited use and energy consumption, such as schools.[134] Box 4.5 provides an example of a fairly typical ESCO project in a German hospital in Bremerhaven. Yet, schools may also have important public awareness and social benefits that can provide a boost to promoting energy efficiency.

4.53. **Study recommendations.** *In China, implementation of comprehensive energy efficiency projects is a useful direction to support for the future. It will take time, however, for many ESCOs to be able to develop the necessary technical capacity for integrated projects and the financial strength to engage in long-term contracts.*

Box 4.5: Example of an Integrated EPC Project in a German Hospital

The German hospital "Klinikum Bremerhaven-Reinkenheide," implemented an integrated EPC project. The hospital is a general hospital, with a status as a private non-profit company (gGmbH). It is 100% owned by the city of Bremerhaven. The hospital has 710 beds and its total annual costs are €80 million, of which 80 percent are personnel costs.

Steps in the EPC process

The EPC process at the hospital, which took 8 months, included seven major steps:

(i) Data gathering and analysis. This first step was carried out by hospital technical staff with support from the Bremen Energy Agency. Energy consumption at the hospital was billed monthly, by the electricity supplier and the supplier of district heating. There was no submetering. The data gathering process also led to a determination of minimal energy cost savings that could be achieved (25%) and measures that would then be required.

(ii) Procurement. A Europe-wide procurement process was started, supported by the Berlin Energy Agency.

(iii) Expressions of interest. Thirteen expressions of interest were received.

133.See Bharvirkar et al. 2008, Performance Contracting and Energy Efficiency in the State Government Market.

134.Schools nevertheless are often the target of fairly comprehensive energy performance projects, enabling an upgrade of their utility infrastructure and renovation of their building shell. For example, in the French region of Alsace, 14 schools with a total size of 190,000 square meters have received investments of a total of €30 million under one energy performance contract. Included are some of the following measures: wood boilers, heat pumps, new boilers, district heating connection, insulation, windows, and photovoltaic electricity. The region subsidizes the renewable electricity generation. See Leroy 2010, Good practice examples High schools in Alsace Region.

(iv) Shortlisting. Eleven companies were included in the shortlist. The short-listed companies were invited to do a walk-through audit, which lasted one to several days.

(v) Presentation of bids. Four companies presented bids. The main evaluation criteria were savings and overall investment.

(vi) Negotiations. A first negotiation was held with two bidders; A second negotiation was held with one bidder.

(vii) Contract signed. A contract was signed with the winning ESCO.

Specific details of the contract were as follows:

Contract term	12 years (2008-2019)
Investment (Contractor)	€5.2 million
Investment for required measures (Hospital)	€0.265 million (payment over term of contract)
Energy costs 2004 (baseline)	€2.065 million (net of VAT)
Guaranteed cost savings	25.6% = €0.52 million with additional savings shared 60:40 between host and ESCO
Actual savings	35-40% energy costs and 40% energy savings, of which 65% steam, 42% heat energy and 14% electricity
CO_2 emission reduction	2,635 tons/year (actual 2,950 tons/year = 30%)

Examples of technical and soft investment measures (total of 120):

- Energy saving measures
  - HVAC: new air conditioning/ventilation system (with demand-based control), innovative cooling absorption and screw chillers, application of frequency converters, electricity load management system
  - New building automation system, including peak load management, with automatic data collection and monthly analysis of consumption
  - Optimization of the heating system (demand-based control), new heat-recovery system
  - Energy-efficient lighting
  - Water saving measures (low-flow faucets)
  - User motivation training for hospital personnel
- Upgrades required by the hospital (total investment: €2 million of which contractor finances 2/3)
  - new low-voltage distribution system
  - new sterilization system
  - new central cooling production unit
  - new dishwashers for main kitchen
  - separation of medical and technical compressed air production, including new medical compressed air unit

O&M is carried out by hospital technical staff, after being trained by the ESCO in the use of new equipment.

M&V. The contractor is in charge of M&V and has remote access to all data. The hospital employs an external controller. The baseline energy costs are corrected with actual facility use and actual degree days; energy cost increases of 4% annually are assumed (actual increases—and therefore cost savings—are higher). The hospital has to provide information to the contractor about any substantial changes in facility use and energy-consuming equipment.

Source: Breuer 2008, Energy Performance Contracting in Hospital Bremerhaven Reinkenheide ("Energiespar-Contracting im Klinikum Bremerhaven Reinkenheide"); personal communication Juergen Breuer, Klinikum Bremerhaven Reinkenheide, April 2011 (http://www.klinikum-bremerhaven.de/).

Measurement and Verification (M&V) of Savings

4.54. Energy savings are, by definition, an absence or reduction of energy use and can therefore not be directly "measured." For a typical energy conservation retrofit project, energy savings are determined by comparing the energy use associated with a facility—or certain systems within a facility—before ("baseline") and after ("post-retrofit") the installation of energy conservation measures. If the conditions in a facility change, the monitoring and verification of savings must account for those changes.

4.55. EPC projects are based on the principle of using guaranteed energy savings to offset the cost of financing, installing, operating, and maintaining the energy efficiency measures. While EPC projects should also be based on joint effort, good relationships, and mutual trust between the ESCO and the facility owner, it is not uncommon for those two parties to have conflicting interests, especially if there are material changes or baseline energy use adjustments in the facility.[135]

4.56. Proper measurement and verification (M&V) of savings for energy conservation projects in public institutions benefits all involved stakeholders:

- *Government.* The government can use M&V results to (i) assess the cost-effectiveness and impacts of energy efficiency and conservation programs in public institutions, (ii) measure the contribution of such programs to the country's overall commitment to reduce energy consumption and CO_2 emissions, and (iii) formulate related policy tools to further improve and promote energy efficiency in public institutions.

- *Public institutions.* Public institutions or public facility owners can use the M&V data to obtain timely and accurate feedback on the performance of their energy conservation projects, improve or adjust the operation of facilities to maximize energy savings, and appropriate energy cost savings for other purposes or budget requirements.

- *ESCOs.* ESCOs can use the M&V process as an acceptable and credible method to prove energy-saving results of EPC projects. M&V results are the basis of the projects' performance-based payments or shared-savings and promote the transparency, credibility, and viability of the EPC business.

135. A material change may be defined as any structural or operational change in the facility, which could significantly increase or decrease the energy consumption beyond the scope of the EPC project. Adjustments refer to known or agreed changes to the facility, which are not part of or caused by the energy retrofit project, for example, changes in hours of operation or work schedules, building activity, and building size or configuration.

- *Financing institutions.* M&V results that confirm the profitability of EPC will increase confidence of financing institutions in the new business model, lower their risk perception, make them more willing to extend loans for such projects, and enhance the security of loans.

4.57. **International protocols and guidance.** Internationally, three well-established M&V frameworks exist to measure and verify energy savings. An adapted version of these frameworks could be used to measure and verify energy savings in Chinese public institutions.[136] The three frameworks are:

- International Performance Measurement and Verification Protocol (IPMVP) Volume I: Concepts and Options for Determining Energy and Water Savings.[137]

- M&V Guidelines: Measurement and Verification for Federal Energy Projects Version 3.0 (U.S. FEMP) [138]

- American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Guideline 14: Measurement of Energy and Demand Savings.[139]

4.58. The three frameworks complement each other in providing guidance and instructions for how to quantify savings results from energy conservation projects. For example, the IPMVP establishes a general framework and terminology for M&V, while the ASHRAE guideline focuses on the technical level and provides detail on implementing M&V.

4.59. **Basic M&V concepts and options.** The three international frameworks each recommend the use of four options for M&V. The only exception is ASHRAE, which does not have an equivalent of option A. Each option has its own advantages and disadvantages based on site-specific factors and the needs and expectations of the facility management of the public institutions. Table 4.2 describes the four M&V options.

4.60. Generally, the selection of an M&V option depends on many factors such as project costs, expected savings, contract term, benefit-sharing arrangement, and uncertainty or risk. M&V budgets can range from 2% to 14% of the annual energy cost savings, though a rule-of-thumb guideline is that M&V costs should not exceed 10% of the annual energy cost savings.[141] Options A and B are generally less costly than options C and D. In a sample of 128 U.S. federal ESPC projects, option A was by far the most widely used M&V method (80%), followed by option B (13%), option C (2%) and Option D (5%).[142]

4.61. The four M&V options can be applied to almost any type of retrofit project; however, the rules of thumb listed in Table 4.3 generally indicate the most appropriate M&V approach for an application.

136.More recently, a proposal was submitted to the International Organization for Standardization (ISO) regarding “General technical rules for determination of energy savings in renovation projects, industrial enterprises and regions.” This proposal is under the technical committee (ISO TC 257), with the Standardization Administration of China serving as the Secretariat.

137.See IPMVP Public Library of Documents, Concepts and Options for Determining Energy and Water Savings - Volume I.

138.See FEMP, M&V Guidelines: Measurement and Verification for Federal Energy Projects Version 3.0.

139.See ASHRAE Publications, ASHRAE Guideline 14-2002 Measurement of Energy and Demand Savings.

Table 4.2: Description of Four M&V Options

M&V option	Description
Option (A) Retrofit isolation (Key parameter measurement)	Savings are determined by partial field measurements of the energy use of the system(s) to which an energy saving measure was applied, separate from the energy use of the rest of the facility. Measurements may be either short-term or continuous. Some but not all parameters may be stipulated.[140]
Option (B) Retrofit isolation (All parameter measurement)	Savings are determined by field measurement of the energy use of the systems to which the ECM was applied, separate from the energy use of the rest of the facility. Short-term or continuous measurements are taken throughout the post-retrofit period.
Option (C) Whole facility	Savings are determined by measuring energy use at the whole facility level. Short-term or continuous measurements are taken throughout the post-retrofit period. Energy savings are assessed at the whole-facility level by analyzing utility bills before and after the implementation of energy saving measures.
Option (D) Calibrated simulation	Savings are determined through simulation of the energy use of components or the whole facility. Simulation routines must be demonstrated to adequately model actual energy performance measured in the facility.

Source: http://eetd.lbl.gov/newsletter/nl10/eetd-nl10-4-ipmvp.html.

Table 4.3: Rules of Thumb for Selection of M&V Options

M&V option	Typical applications and conditions
• Retrofit isolation (A or B)	√ For simple equipment replacement projects with energy savings that are less than 20% of total facility energy use as recorded by the relevant utility meter or sub-meter. √ Energy savings values per individual measure are desired. Interactive effects are to be ignored or are stipulated using estimating methods that do not involve long-term measurements. √ The independent variables that affect energy use are neither complex nor excessively difficult or expensive to monitor. √ Sub-meters that record the energy use of subsystems are already present.
• Whole facility (C)	√ The equipment replacement and controls projects are complex. √ Predicted savings are relatively large (greater than 10% to 20%) as compared to the energy use recorded by the relevant utility meter or sub-meter. √ Energy savings values per individual measure are not desired. √ Interactive effects are to be included. √ Independent variables that affect energy use are not complex and excessively difficult or expensive to monitor.
• Calibrated simulation (D)	√ New construction projects are involved. √ Energy savings values per measure are desired.

Source: Authors, based on FEMP, M&V Guidelines: Measurement and Verification for Federal Energy Projects Version 3.0.

4.62. **Who should carry out M&V?** Ideally, M&V is a joint effort between the ESCO and the public institution (or facility owner). The ESCO usually is well-positioned to carry out the M&V efforts because it already, before the implementation of energy saving measures, has conducted an energy audit of the facility to determine the baseline, economic viability of energy conservation measures, and potential energy savings, which has given the ESCO detailed knowledge of the facility's operations. The ESCO can also bundle the M&V activities into its package of energy services offerings. The facility owner can support the ESCO in all aspects of M&V by providing pertinent energy or utility data, giving access to the facility or equipment, and properly maintaining and operating the equipment or system covered by the energy performance contract. Both the ESCO and facility owner should keep track of all significant baseline adjustments to account for growth or reduction in energy consumption. If the public institution already has a technical team to assist with defining or reviewing M&V results, a third-party monitoring or savings consultant might not be necessary or practical and only increase costs.[143] In case of disagreements on M&V of savings, the EPC should include a process for dispute resolution.

4.63. **M&V in China.** In China, the lack of metering and sub-metering, especially for heat (see para. 3.57), currently restricts the choice of M&V options. In many past EPC projects in China, stipulated or deemed savings have been the most common M&V method.[144] Stipulation, a contractual mechanism in which two parties agree on values regardless of actual measured data, is by far the least expensive method to determine savings. While a useful tool to lower project costs, however, the over-use or misuse of stipulation can increase the uncertainty of savings. Pure stipulation is not a recommended M&V option by any of the three international protocols mentioned previously. As the EPC mechanism matures in China, market players—especially clients in the public sector and their supervising entities—may increasingly demand more advanced M&V methods focusing more on measured savings or determination of savings based on utility bills.

4.64. **Study recommendations.** *The study team recommends keeping M&V protocols simple, practical, and not too costly, while still providing satisfactory assurance to clients that projects have performed successfully. Experts from Chinese supervising entities and ESCOs should consult experience gained elsewhere.*

140. *Stipulation* is a contractual mechanism where two parties agree on values regardless of actual measured data. Energy use, energy costs, run times, and operating schedules are a few items that can be stipulated in a contract. Acceptable forms of stipulation include engineering analysis, measurement-based models, manufacturer's data, standard tables, and enterprise logs. Unacceptable are undocumented assumptions, proprietary algorithms, unsupported handshake agreements, guesses at parameters, and models based on questionable data.

141. See Jump and Stetz 2000, Initial Application of the FEMP Measurement & Verification Guidelines in Super ESPC Delivery Orders.

142. Shonder et al. 2010, Reported Energy and Cost Savings from the DOE ESPC Program.

143. In the United States, the Association of Energy Engineers (AEE), in cooperation with the Efficiency Valuation Organization (EVO), has established the Certified Measurement and Verification Professional (CMVP) program with the dual purpose of recognizing the most qualified professionals in this growing area of the energy industry, and raising the overall professional standards within the M&V field (http://www.aeecenter.org/). Many ESCOs in North America may have CMVPs in their team, enabling the ESCO to meet third-party requirements and strengthen its own capability to offer M&V services as part of its EPC projects.

144. See Sun et al. 2011.

Chapter 5: Next Steps and Priority Actions for Different Jurisdictions

5.1. This chapter summarizes the concrete actions recommended by the study team for strengthening energy efficiency in China's public institutions, for consideration during the implementation of the 12th FYP. Following a section on key efforts on policies, guidance, and government support, recommended actions are grouped by key jurisdiction, each of which is led by a specific responsible agency or type of agency and covers a specific subsector of public institutions. The main responsible agencies and their direct jurisdictions are described in para. 2.20; they can also be inferred from Table 5.1.

Key Efforts on Policies, Guidance, and Government Support

5.2. A central task for the government—at central, provincial and local levels—is to complete the working system for promoting public institution energy efficiency. Important areas include provisions relating to the setting and supervision of energy savings targets, measurement of energy use, statistical reporting, and other elements of a public institution energy conservation organization and management system (see para. 3.4.) Many policy and regulation documents remain to be issued to allow work to be organized properly, especially at local levels. While the basic system was established during the 11th FYP, the role of GOA and its working system in energy conservation is relatively new compared with other agencies involved in promoting energy efficiency. Investments to strengthen the technical expertise of staff in energy conservation offices at the national, provincial, and local levels can allow for greater chances of successful delivery.

5.3. As the policy and regulatory framework is further filled out, a large follow-on effort will also be needed to prepare and disseminate detailed technical guidelines, manuals, templates, and other types of instruction materials to show supervising agency and public entity staff how to meet the detailed requirements specified in the policies and regulations. These guidance documents then provide the foundation for the preparation of training materials and implementation of training activities (see para. 5.7). Some of the most important areas for issuance of technical guidelines, manuals, and templates include:

- Energy management—Work scope, approaches, and methods for properly pursuing energy management in the various subsectors of public institutions.
- Auditors and audits—Guidelines to ensure conformity and minimum quality levels, strongly emphasizing the specific objectives of specific auditing programs.
- Basic data collection on facilities and energy use—Central guidance to ensure that data are comparable and reliable, and that a unified methodology and standardized data compilation protocol is used across all subsectors at all different levels.
- Energy use measurement—Specific technical guidance for electricity and heat metering of public sector facilities, including sub-metering and smart or time-of-day metering.

- Benchmarking—Definition of common processes, building classifications, performance indicators, and other metrics, based on ongoing pilots with commercial building monitoring or energy efficiency retrofit programs.

- Building energy management—Detailed operation and maintenance of key energy–using systems, such as AC systems, boilers, and heating systems.

- Impact evaluation of projects and programs—Systematic and objective evaluation of energy savings and the cost-effectiveness of investment projects and programs to improve and strengthen future work.

- Energy Performance Contracting—Guidance on the selection of ESCOs, model EPC contracts, and monitoring and verification methods for energy savings.

5.4. One specific regulatory area that requires immediate attention to help foster greater use of EPC is related to the issuance of regulations allowing individual public entities to retain at least a portion of energy cost budget savings achieved through energy conservation projects, especially those using EPC. The State Council's 2010 policy statement on EPC specifically allows for this (see para. 2.27 and 4.12), but specific regulations must be issued for this key measure to be achieved. Guidance from relevant central government ministries would be very helpful. Provincial agencies, especially finance bureaus, need to issue specific documents and help interested entities work through implementation.

5.5. Energy savings efforts in public institutions need specific government budget support. Energy conservation special funds have already been established at the central and provincial levels. It would be useful to earmark portions of those funds for public institutions (see para. 3.84). Three areas in particular need budget support: (i) financing for demonstration projects (see Table 3.1); (ii) targeted subsidies to reduce the upfront costs of certain energy-efficient equipment or for entities that commonly have difficulty raising funds such as rural schools; and (iii) budget allocation for a variety of critically needed "soft" costs, including costs for setting up statistical reporting systems, installing meters, training energy managers, energy auditing and preparation of site-specific energy savings plans, and monitoring and supervision. These areas are very important to advance energy efficiency in the public sector, but wouldn't happen without special funding or special budget allocations. In addition, establishment of revolving funds should be considered for energy efficiency investments at provincial and local jurisdiction levels (see para. 3.96).

Recommended Priority Actions by Sectors and Key Jurisdictions

5.6. Many concrete actions need to be organized within specific jurisdictions, for example for central government buildings, local government buildings, universities, schools, and hospitals. While some actions may be taken by all jurisdictions, some are specific to individual jurisdictions. Table 5.1 consolidates the main actions recommended in Chapters 3 and 4. A first section describes actions relevant for all jurisdictions, while subsequent sections describe additional and specific actions for each of the main subsectors. Context and further details are provided in Chapters 3 and 4.

Table 5.1: Recommended Priority Actions by Jurisdiction

Jurisdictions	Responsible agencies	Actions
All	All agencies with direct implementation responsibilities	1. Providing training and capacity building programs for decision makers, leaders, and specialized staff of four audiences: government officials and entity leaders, facility management units, third party technical and service entities, and occupants/users/ owners. 2. Placing competent facility energy managers (including arranging for appointments, qualifications, and training). This includes reviewing the possible application of broader sustainability managers (to address energy/water, recycling, and other "green" measures) vs. the use of specific energy managers. 3. Implementing reputation-based incentive programs 4. Improving statistics and metering, completing energy audits and site-specific energy savings project preparation, preparing benchmarks within jurisdictions, and implementing continuous evaluation of results, dissemination, and awareness raising. 5. Implementing key demonstration projects in the main jurisdictions. 6. Expanding information dissemination and exchange through cross-province and international exchanges.
Central government facilities	GOA	1. Piloting entity consumption quotas tied with energy cost expenditure ceilings 2. Organizing state-of-the-art metering pilot programs in key facilities, including sub-metering 3. Supporting continuing improvement of online data collection, reporting and analysis 4. Disseminating successful case studies, incl. of management and supervision examples, and energy efficiency (EE) technologies. 5. Assisting energy using entities to undertake EPC projects across the project development cycle (auditing, selecting and contracting ESCOs, applying for government and commercial financing/support, disbursement of government funds, M&V).

Jurisdictions	Responsible agencies	Actions
Provincial and local government facilities	Provincial and local GOAs or equivalent	1. Completing energy savings plans in line with 12th FYP targets. 2. Piloting energy use quotas tied to energy cost expenditure ceilings. 3. Implementing simple energy audits and site-specific energy savings action plans, complete with project proposals. 4. Implementing heat metering and consumption-based billing programs in northern regions. 5. Piloting energy performance contracts through the government system. 6. Creating and operating EPC technical assistance units for all public institutions.
Universities	MOE, provincial education departments, university representatives	1. Developing a ″University Energy Efficiency Network″ (or Green University Network) of interested universities, with MOE support, and university energy savings commitments as a condition of participation. 2. Implementing comprehensive metering pilot projects, including sub-metering. 3. Piloting award/bonus programs, including, possibly, incentives programs where units receive improved equipment paid through energy cost savings of successful energy efficiency projects. 4. Sponsoring internal competitions and incentives programs.
Schools	Provincial and local education departments (with guidance from MOE), school district representatives	1. Integrating energy efficiency and renewable energy opportunities into school renovation projects, especially in northern regions where heating is required and in rural areas. 2. Template project implementation, possibly with EPC 3. Incorporating energy efficiency activities and education into a wide range of educational curricula.
Hospitals	MOH, provincial health departments, hospital associations and representatives	1. Implementing state-of-the-art metering pilots to generate data at level of sophistication needed for hospital building energy audits. 2. Implementing carefully monitored pilot energy audits in several hospitals, covering their special and complex needs, followed by the development of site-specific pilot projects and monitoring of results. Generate case studies and find effective channels to disseminate experiences. 3. Creating a “Hospital Energy Efficiency Network” (or Green Hospital Network) similar to that recommended for universities. 4. Generating case studies of EPC, with concrete examples of technical options available for hospital energy efficiency and of lessons learned for implementing comprehensive EE retrofit projects.

Actions for All Key Jurisdictions

5.7. **Providing training and capacity building.** A large training effort will need to be undertaken for staff working in the various jurisdictions at central and especially provincial and local levels. In addition, experience worldwide shows the need for leaders and decision makers to be sensitized to the importance of energy efficiency and the various steps involved in implementing energy conservation projects. Training for responsible staff needs to include technical, financial, regulatory, procedural, and project implementation aspects. Four audiences should be distinguished: (i) government officials and public entity leaders, (ii) facility management departments, (iii) third party technical and service entities, and (iv) occupants, users, and owners, who should be enlisted as part of broad awareness and educational campaigns.

5.8. **Placing competent facility energy managers.** An important action for all major public sector facilities is to appoint staff responsible for identifying key energy waste problems and actions to address those problems; that is, to appoint energy managers. Given the huge number of facilities and the need to train staff in the basic skills of energy management, a staggered implementation is recommended. The needs of large entities with many facilities and substantial energy use should be addressed first. Training programs for energy managers need to be established and decisions made about how to best confirm that staff meet the required qualifications, for example through accreditation or continuous education requirements with examinations (see para. 3.48-3.49). In some agencies or units, especially smaller ones, it may be best for staff to be responsible for other sustainability issues in addition to energy conservation, such as water conservation, recycling, and other "green" measures (see para. 3.47).

5.9. **Implementing reputation-based incentive programs.** There is a strong lack of incentives for energy efficiency in public institutions, which this report has discussed in detail. Agencies responsible for oversight of various public institutions should consider establishing reputation-based incentive programs. An example would be a highly visible "model energy efficiency unit" award program for one or more specific categories of public institutions. This could include small monetary awards for units that particularly distinguish themselves. In some pilot agencies the energy savings (and environmental) performance of all entities within a specific category could be rated. Such ratings could be used as a management tool by supervising agencies. Even more noticeable results can be achieved if results are published (see para. 3.25-3.26).

5.10. **Improving statistics and metering, completing energy audits and site-specific energy savings project preparation, preparing benchmarks within jurisdictions, and implementing continuous evaluation of program results, dissemination, and awareness raising.** Each agency should formulate time-bound programs and plans to achieve their specific targets and implement the required measures for improved statistics, metering of energy use, auditing and preparation of site-specific energy savings plans for facilities, benchmarking, demonstration projects, and evaluation of project results:

- *Metering.* Programs to complete the collection and analysis of facility data and basic metering programs for all larger facilities need to be prepared and implemented in a staggered fashion

by each agency. Heat metering and sub-metering should be implemented in a more targeted way (compare actions for subsectors below).

- *Auditing and site-specific project preparation.* Audits need to be action-oriented, providing a basis for specific project follow-up. Even so, most entities will need to follow auditing efforts with the preparation of detailed, actionable energy savings plans that include initial preparation of specific projects and recommended energy management changes. Given the huge needs, such programs need to be staggered and actions prioritized.

- *Benchmarking.* Based on improved statistics, energy use metering data, and audit results, agencies can start the benchmarking of important building types in their jurisdictions. This would support the selection of priority investment projects and, when more refined, the establishment of mandatory energy savings targets and energy use quotas.

- *Evaluation and dissemination.* Agencies should carry out systematic and objective evaluation and dissemination of the results of the demonstration projects they implement (see para. 5.11).

5.11. **Implementing key demonstration projects in the main jurisdictions.** Plans for energy conservation in public institution during the 12th FYP period call for the implementation of a range of demonstration projects to be carried out by different jurisdictions under GOA oversight (see Table 3.1). Special emphasis should be placed on demonstration projects in public buildings that pro-actively seek out opportunities to demonstrate the benefits of heat metering and consumption-based billing in combination with building envelope retrofits.

5.12. **Expanding information dissemination and exchange through cross-province and international exchanges.** Exchange of information on successful programs and projects as well as on issues to be resolved would be very useful for officials and experts. Exchanges could take place across provinces or through participation in international exchanges. For government staff, possible topics for information exchange could include targets, monitoring, benchmarking, reputation incentives, use of special energy conservation funds, and use of EPC. For third party entities and energy user representatives (for example, representatives of hospitals, schools, and universities), topics of interest could include energy management, metering and sub-metering, auditing, and specific investment studies. In addition, symposia could be used to exchange information on a variety of topics, such as benchmarking, revolving funds and EPC in the public sector, bundling of energy efficiency projects, and comprehensive energy efficiency projects in hospitals.

Actions for Central Government Facilities (GOA)

5.13. In addition to implementing its overall coordination and guidance role (see para. 5.2 and 5.3), GOA will also need to initiate action in several areas related to central government facilities. Action areas include:

1. Assisting and guiding the definition and implementation of energy savings plans and targets in all major central government facilities. GOA needs to organize for this task, agree with the

entities on their savings plans and targets, monitor implementation, and provide necessary technical support.

2. Implementing pilot efforts in facilities where suitable conditions exist to establish energy consumption quotas that are tied to energy cost budget expenditure ceilings (see para. 3.19).

3. Organizing the piloting of state-of-the-art metering programs in a number of key facilities. Where appropriate—for example when different departments or buildings have different energy use patterns—sub-metering should be applied such that each building or department has a separate electricity and heat meter. Before undertaking pilots, specific plans should be agreed with entities on programs to use the data for analysis and evaluation, for use in energy audits, for definition of specific energy saving projects, and for continuous monitoring of energy use performance.

4. Continuing with support for the improvement and expansion of online data collection and reporting systems to monitor and analyze energy use and define energy saving measures in key facilities.

5. Preparing and disseminating case studies with examples of good management and supervision and showing the successful implementation of energy saving technologies such as co- or tri-generation systems, improved lighting systems, automatic controls for heating, cooling and ventilation, and building automation systems.

6. Providing assistance to entities interested in undertaking EPC projects. A special program should be considered, providing support for project preparation, selection and contracting of ESCOs, supervision, disbursement of contracts, and monitoring of energy saving results (see also the task list for similar units at the provincial level in item (6) of para 5.14).

Provincial/Local Government Facilities (Provincial/Local GOAs or Equivalent)

5.14. Additional, priority actions to be implemented in provincial and local government facilities guided by provincial and local GOAs or equivalent agencies include the following:

1. Specifying energy savings plans for the remainder of the 12th FYP period, in line with the overall public building sector targets established in the FYP.

2. Piloting the establishment of energy consumption quotas tied to energy cost expenditure ceilings in situations where suitable conditions exist.

3. Implementing simple energy audits and site-specific energy saving action plans (see para. 3.67), complete with project proposals. These should be launched for key entities.

4. Implementing heat metering and consumption-based billing programs in northern regions where at all possible, setting examples for other consumers and supporting heat reform efforts in the relevant municipalities.

5. Piloting energy performance contracts in a way that project preparation, contracting with ESCOs, implementation of investment, monitoring of energy saving results, and contract disbursement are all realized within the government system, establishing a path for scaling up EPC projects in the future.

6. Creating and operating EPC technical assistance units for all public institutions at the relevant government level, in cases where provincial or large municipal governments are truly interested in developing EPC. The technical assistance units would need to be formally established and might be entrusted with the following types of tasks (see para. 4.20):

    - Educating and sensitizing officials in all relevant agencies at that level to the needs for public institutional energy efficiency improvements and the means to achieve those improvements, including the potential role of EPC.
    - Overseeing the preparation of information brochures and other reference materials on EPC, and organizing training for public entity staff.
    - Maintaining an information database on public institution energy consumption statistics and on implemented EPC projects and their energy saving results. Data analysis would help assess priority areas for EPC projects, help assess progress to date, and assist the training of staff.
    - Guiding public entities on selection of ESCOs.
    - Preparing model EPC contracts for public entities to consider, including guidance on how to use them.
    - Overseeing the preparation of guidance on M&V methods applicable to public facility EPC, as well as case study examples of applications.
    - Providing hands-on assistance for guiding projects through the various stages of preparation, application for financial support, approval, and disbursement.
    - Overseeing the preparation of case study examples of successful EPC projects in the public sector and their broad dissemination.

Universities (Ministry of Education, Provincial Education Departments, University Representatives)

5.15. Additional priority actions to be implemented in universities under the supervision and guidance of the Ministry of Education and provincial education departments and with support from university representatives include the following:

1. Considering establishing an “University Energy Efficiency Network” or possibly a “Green University Network” of interested universities with Ministry of Education support. As a condition of membership, universities would pledge serious commitments to energy savings

and resource sustainability actions and results. Members would gain national publicity and recognition as leading energy-efficiency and sustainability actors, a priority position for certain types of specific government support, and opportunities to exchange experiences with and learn from other similar entities.

2. Implementing comprehensive metering pilot projects, including sub-metering, in interested universities. Electricity and heating sub-metering should be applied to individual buildings and departments to provide a basis for accountability and assessing progress in sub-administrative units, as well as needed data to design good energy conservation projects. Such pilots should only be undertaken if there is a commitment to concrete energy savings project follow-up.

3. Piloting of award and bonus programs, perhaps similar to the well-known EnergyStar programs in the United States. Universities that achieve large energy efficiency gains might receive monetary awards. Student involvement would be very important and curricula should incorporate energy saving and other sustainability topics.

4. Sponsoring internal competitions and incentives programs, for example, between dormitories or departments, aiming specifically to involve faculty and students. Units with the most successful no- or low-cost energy saving results might receive improved equipment paid from energy cost savings.

Schools (Provincial and Local Education Departments, Ministry of Education Guidance, School District Representatives)

5.16. Schools—under the supervision of provincial and local education departments, with MOE guidance, and with support from school district representatives—should focus on the following priority actions:

1. Incorporating energy efficiency measures in school renovation programs in northern regions involving heating or building improvement, especially in rural areas. Such projects could be promoted by introducing a widely applicable appraisal method for school renovation proposals to identify energy efficiency and renewable energy opportunities. Although a portion of the costs will still need to be covered with government funds, big improvements in heating service levels can be achieved with a large portion of costs covered by savings in fuel costs. EPC mechanisms could be applied, perhaps using project bundling arrangements (see below).

2. Designing energy efficiency project design templates to be used in situations where school buildings are fairly similar and need similar energy efficiency retrofits. This can lower implementation costs. Within a school district, several typical schools could be audited and various generic energy saving projects sketched out (for example, automatic control of heating systems, windows replacement, or improved lighting). Projects for a larger number of schools could then be put together, based on templates completed by participating schools, possibly on an EPC basis.

3. Incorporating energy efficiency activities and education into a wide range of educational curricula. This can bring high value added. Awards programs for the best no- and low-cost energy-efficiency innovations and results could be considered within school districts, similar to those described above for universities. In schools in particular there can be significant spill-over effects from school energy efficiency retrofit projects, despite their relatively low payback and high transaction costs, which should be taken into consideration. The combination of introducing lessons and other pedagogical approaches during the school day (perhaps also special events) about measures taken at the school and the visible benefits of a better functioning and more comfortable facility, raise an awareness of the benefits of energy efficient lifestyles not only among students but also among teachers and parents.

Hospitals (Ministry of Health, Provincial Health Departments, Hospital Representatives and Associations)

5.17. In addition, priority actions to be implemented in hospitals under the supervision and guidance of the Ministry of Health and provincial health departments, and with support from hospital associations and representatives, include the following:

1. Implementing state-of-the-art metering pilots in a number of hospitals. This can provide data needed for subsequent sophisticated energy audits and assessment of performance over time.

2. Undertaking energy audits for a number of hospitals, covering their relatively complex facilities in sufficient depth, followed by the development of site-specific energy projects and energy management initiatives. Completion of high-quality diagnostic efforts in several complex facilities, and their dissemination, could provide guidance to many others in methodologies and technical options.

3. Considering the creation of a "Hospital Energy Efficiency Network" or possibly a "Green Hospital Network," similar to that recommended for universities above, with support from the Ministry of Health. In addition to the benefits of experience exchanges and sensitizing leaders, managers, staff and users to energy efficiency issues, such networks streamline information channels that can be helpful for service and equipment providers to channel information about best-in-class, energy efficient health care equipment, and hospital building energy management best practices.

4. Preparing and disseminating case studies of successful EPC projects. Case studies could include information on the technical scenarios supported (including, for example, solutions for cogeneration, demand-based control of heating, cooling and ventilation systems, and building automation systems), as well as contracting aspects, and lessons learned about implementing comprehensive energy efficiency retrofit projects (see also Box 4.5).

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Appendix A: Recommended Top Resources

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Appendix B: Additional Information Related to Chapter 3

Box B.1: A Comprehensive Framework for Sustainable Energy Use in U.S. Federal Government Facilities

The US Federal Government spends $300 billion annually on goods and services, of which $17 billion is for energy for a total of 1.6 quadrillion (quads) Btu (primary energy), equivalent to 57.6 million tce, and 1.1 quads Btu (39.6 million tce) of delivered energy of which 33% is consumed in “goal”[145] buildings. The federal government occupies about three billion square feet (280 million square meters) of space in more than 500,000 buildings, about 370 million square feet of space of which is in leased space.

The most recent energy acts and executive orders—EO 3423 and Energy Independence and Security Act (EISA) of 2007 and EO 13514 of 2009—establish a comprehensive framework for planning, implementing and tracking improvements in performance of sustainable energy use in federal facilities. Only minimal budgets are appropriated specifically for implementation of this program; instead, federal agencies are supposed to use direct appropriations, incentives, rebates, retention of funds and alternative financing, either energy savings performance contracts (ESPCs) or utility energy services contracts (UESCs).

Targets:

- **Reduce buildings energy use** 3% annually and 30% total by end 2015 (relative to 2003) – for all agencies; agency-specific GHG reduction targets (2008-2020) (plus many more on renewable energy use, water efficiency and fleet energy improvements)
- **New buildings** to be 30% more efficient than current code and achieve net-zero-energy building requirement by 2030
- Increase use of **renewable energy** to not less than 5% of electricity use in 2010 – 2012 and not less than 7.5% in 2013 and thereafter, at least half from new sources each year, and implement renewables on agency property for agency use as feasible
- All buildings to be **metered**—for electricity by 2012 and for natural gas and steam by 2016

Requirements:

- GSA to lease space in buildings that are top EnergyStar achievers[146] starting end 2010;
- Federal agencies to directly negotiate cost-effective energy efficiency improvements to their space with the landlord;
- Each Federal agency to designate an **energy manager** responsible for implementing the statutory requirements and reducing energy at each covered facility;
- Identify those facilities (referred to as "covered facilities") that constitute at least 75% of the total facility energy use for the agency;
- For each covered facility perform a comprehensive energy and water **audit** every four years and report total potential energy and water savings and types of measures;
- Implement identified efficiency measures that are life-cycle cost-effective;

145.“Goal” buildings: subject to the energy use reduction requirements specified under federal targets; compare para 3.7.

146.Compare Box 3.5.

- Input covered facilities' energy use, evaluations, projects and follow-up into a web-based tracking system;
- Enter energy use data for each metered building into a **benchmarking** system, such as the ENERGY STAR® Portfolio Manager.

Accountability:

- Each agency to designate a senior management official to serve as Senior Sustainability Officer, accountable for agency compliance and performance;
- Scorecards: Summaries of agency implementation status to be reported twice per year to the Office of Management and Budget (OMB) and published as scorecards (see Figure 3.2)

Results in federal government buildings, FY2007:

- Consumption of 353 trillion Btu in "goal" buildings, 29% less than 1985 (delivered energy)
- Energy costs in "goal" buildings of $5.8 billion in FY2007
- From 2003 to 2006/07 energy efficiency investments of $2.8 billion, roughly half was from direct appropriations, $1 billion from ESPCs and almost $0.5 billion from UESCs (see Figure 3.4)
- From 1985 to 2006/07, $6.3 billion were invested in energy efficiency improvements with estimated savings of $5-8 billion, of which $1-2 billion from ESPCMetering: 11 federal agencies have all of their buildings metered for electricity use with at least standard electricity meters. EPA and HUD (Housing and Urban Development) completed advanced metering in 100 percent of their buildings in 2007.

Sources: FEMP, see: http://www1.eere.energy.gov/femp/regulations/requirements_by_reg.html; FEMP 2010 http://www1.eere.energy.gov/femp/pdfs/annrep07.pdf; and http://www.naesco.org/events/meetings/federal/2007/presentations/Cynthia_Vallina.pdf).

Table B.1: Examples for U.S. State* and Local** Government Energy Efficiency Targets

State/ local government	Targeted entities	Targets	Source
Colorado	State agencies	Reduce energy consumption in 2011/12 by 20% compared to 2005/06	(State) Executive Order D0011-07, April 16, 2007
Florida	State agencies and departments	(i) decrease GHG emissions 10% by 2012, 25% by 2017, and 40% by 2025 (compared to 2007 levels) (ii) increase the energy efficiency of state buildings.	State Executive Order 07-126, enacted 7/13/2007

State/ local government	Targeted entities	Targets	Source
Hawaii	State agencies	State agencies are required to evaluate the energy efficiency of all existing public buildings (>5,000 square feet or use more than 8,000 kWh annually) by end 2010. Opportunities for increased energy efficiency must be identified by setting energy benchmarks for these buildings using ENERGY STAR Portfolio Manager. Buildings have to be retro-commissioned every five years. Results: During FY2009, total state agency electric consumption dropped 5.8% from 2008 and 2.5% from the baseline year of 2005. 2009 reduced consumption is estimated to generate savings of $10 million (Source: ACEEE 2010)	State House Bill 1464, enacted June 2009
Massa-chusetts	State government buildings under control of the executive office	Reduce overall energy consumption at state-owned and state-leased buildings by 20% by FY 2012 and 35% by FY 2020 (FY 2004 baseline). Reduce state government unadjusted GHG emissions 25% by FY 2012, 40% by FY 2020, and 80% by 2050 (FY 2002 baseline). Agencies shall also adopt specific energy efficiency measures (e.g. use of programmable thermostats and the use of motion sensors or timing devices in rooms used only intermittently).	State Executive Order 484 (″Leading by Example: Clean Energy and Efficient Buildings″), enacted 4/18/2007
New York	State agencies, including all public-benefit corporations and public authorities whose heads are appointed by the Governor	Reduce energy consumption by 35% from 1990 levels by 2010 in buildings that are owned/leased/ operated	State Executive Order 111, enacted 6/10/2001
Wisconsin	State facilities, office buildings, complexes and campuses	Department of Administration to set energy efficiency goals that reduce the overall energy use per square foot by 10% by 2008 and 20% by 2010 (FY 2005 baseline, adjusted for weather)	State Executive Order 145, enacted 4/11/2006

State/ local government	Targeted entities	Targets	Source
Texas	State and local government entities	School districts and certain institutions of higher education and executive branch state agencies to establish goals of reducing their annual electricity consumption by 5% for each of six state fiscal years beginning September 1, 2007	House Bill 3693, signed 6/15/2007
Fort Wayne, Indiana	Local Government	Reduce energy consumption per square foot in local government facilities by 10% by 2010 and 35% by 2015 (2003 baseline)	Executive Order 2007**

**The website of the National Conference of State Legislatures Green Building and Energy Efficiency Requirements for Public Buildings, http://www.ncsl.org/default.aspx?tabid=12987, provides a list of the 38 states that have legislation concerning energy efficiency in state-funded building construction, including student housing, as of May 2011.*

***EPA has published a guidebook Energy Efficiency in Local Government Operations with many examples and case studies on various aspects of designing and implementing an energy efficiency policy at the local level; http://www.epa.gov/statelocalclimate/documents/pdf/ee_municipal_operations.pdf.*

Box B.2: Examples of State-wide Targets for Public Buildings in Germany

Baden-Wuerttemberg. Reduce state-wide CO_2 emissions by 30% until 2020 and 80% until 2050 (compared to 1990). The 2020 target is in line with the 40% reduction goal for Germany as a whole (see Box. 3.1).

State-owned buildings use slightly more than 2000 GWh energy in 2008; related CO_2 emissions were 25% lower than in 1990. More than 90% of those buildings were built before 1995. CO_2 emissions are targeted to be reduced by 35% in 2020 and 43% in 2030 (compared to 1990), with the state and the private sector providing financing of energy-efficient retrofits and of renewable energy to achieve those goals. Alternative financing, particularly EPC, is expected to play a large role. Information and training of staff is another measure. The state will also support municipalities and schools in drawing up climate concepts, including assignment of responsibilities and development of time-bound action plans.

Berlin. The Energy Concept 2020 targets a reduction of overall CO_2 emissions by 40% by 2020 and 85% by 2050 (1990 baseline). The public sector is expected to reduce energy consumption by 20% by 2020 and CO_2 emissions by 37%, based on increased use of renewable energy and decentralized cogeneration.

Data of federal, state and district-owned buildings are still incomplete (square meters, energy consumption and facility status), but the short-term goal is to complete these and collect them in a publicly accessible electronic data-bank. This would be the basis for city-wide improved energy management. In the mid-term, it is considered to require public building owners to check whether EPC is feasible and to extend the existing EPC (see Box 4.4) to include building shell measures (ESPplus).

Sources: Baden-Wuerttemberg Klimaschutzkonzept 2020PLUS, http://www.um.baden-wuerttemberg.de/servlet/is/76162/Klimaschutzkonzept_2020PLUS.pdf?command=downloadContent&filename=Klimaschutzkonzept_2020PLUS.pdf; Berlin Energiekonzept 2020, http://www.berlin.de/imperia/md/content/sen-wirtschaft/energie/energiekonzept.pdf?start&ts=1302593601&file=energiekonzept.pdf.

Table B.2: Information Tools and Networking Resources for the Municipal, University, School and Hospital Sectors

For the building sector in general, **Energy Star**, a joint program of the U.S. EPA and the U.S. DOE, provides information resources on energy management strategy, a benchmarking and energy performance rating system and an annual recognition[147] of top performing buildings. A dedicated buildings webpage provides general and specific information for various subsectors, including government, higher education, schools, and hospitals https://www.energystar.gov/index.cfm?c=business.bus_index)

IT-Toolkit on Energy Efficient Retrofit Measures for Government Buildings (EnERGo)

An electronic tool assisting in the decision-making process of energy retrofits of public buildings was developed within the framework of the IEA Annex 46. It is based on the experiences and best practices in the United States, Canada, Finland, Denmark, and Germany and comprises ten different tools for consulting, assessment and information, namely:

1. The assessment of the energy consumption of a specified public building compared to a building with an average national energy requirement (to be selected from almost 20 different types of buildings)
2. An electronic protocol for the detailed collection of building data of an existing building
3. A checklist for the correct operation of technical building systems
4. An energy audit protocol including auxiliary programs
5. More than 70 examples of model building retrofits
6. Descriptions and statistics of various retrofit measures, including building envelope, heating, ventilation and cooling systems, lighting, domestic appliances etc as well as operational and management-related influences
7. A calculation tool based on German standard DIN V 18599 to evaluate the actual condition of buildings and a variety of possible energy retrofit measures
8. A guideline for projects carried out under Public-Private Partnerships (PPPs) EPC: Renovation measures are financed with private funding and investment costs are repaid from the energy savings.
9. A calculation spreadsheet for the financial evaluation of PPP- or EPC-projects
10. Exemplary PPP- or EPC-retrofitting projects

Available for download at: http://www.annex46.de/tool_e.html

147."The EPA provides a variety of opportunities for external recognition. Individual buildings that perform in the top quartile are eligible for the ENERGY STAR label (www.energystar.gov/index.cfm?c=business.bus_bldgs). Organizations that partner with ENERGY STAR and achieve a 10 percent energy reduction across their portfolio can earn recognition as ENERGY STAR Leaders (www.energystar.gov/index.cfm?c=leaders.bus_leaders). In addition, ENERGY STAR Partners may apply to be recognized as an ENERGY STAR Partner of the Year based on their accomplishments across an entire organization (www.energystar.gov/index.cfm?c=pt_awards.pt_es_awards)."

Hospitals

Healthcare Energy Guidebook

Results of the Healthcare Energy Project, November 2001 through December 2003

American Society for Healthcare Engineering (ASHE) of the American Hospital Association, 2004. http://www.ashe.org/e2c/resources.html

The guidebook "profiles the U.S. healthcare market on size and energy-related characteristics and provides energy benchmarking data that can be used to make meaningful comparisons between healthcare facilities. The intent of the guidebook is to provide assessment of practices, methodologies, and technologies being applied for the purpose of improving energy efficiency in hospitals. This guidebook will enable managers to gain a better understanding of the key characteristics of healthcare facilities that have lower energy usage and those that have higher energy usage. Managers can also look at practices that seem to make little or no difference."

The e2c website also provides case studies—organized by climate zone, annual recognition of outstanding hospitals, and so on.

An example of the benefits of introducing energy management, assigning an energy manager, communicating success to staff, and so on, in a large corporate group of hospitals in the US is described in http://www.energystar.gov/index.cfm?c=healthcare.bus_healthcare_providence_health

Universities/Colleges

The Association of Higher Education Facilities Officers (APPA) provides information, training, and research on four core areas of competency, including energy, utilities and environmental stewardship. It also offers credentialing and certification programs; see http://www.appa.org/FourCore/index.cfm

The American Colleges and Universities Presidents' Climate Commitment (ACUPCC) has partnered with the Clinton Climate Initiative (CCI) to exponentially increase the number of large-scale energy saving projects on campuses. ACUPCC signatories are able to take advantage of the benefits of CCI's Energy Efficiency Building Retrofit Program (EEBRP), including pro bono energy efficiency master planning and project support and access to CCI's established relationships with leaders in the building energy efficiency industry, including financial firms, project contractors and implementers and manufacturers of energy efficient building technologies. The ACUPCC and CCI have created a best practices toolkit as a resource for signatories interested in learning about and carrying out EPC. Source: http://www.presidentsclimatecommitment.org/resources/eebrp.

Schools

National Energy Education Development project: http://www.need.org/. It provides resources for teachers and students

Office buildings

Building Owners and Managers Association (BOMA): Provides training, resources, awards; links to the GSA sustainability webpage; http://www.boma.org/EverGreen/Pages/default.aspx. In 2010, BOMA received an Energy Star Award.

Building Owners and Managers Association (BOMA) International, a leading commercial real estate trade association, represents over 16,500 members who collectively own or manage more than 9 billion square feet of office space in North America—representing more than 80 percent of the market. This is the second time BOMA has received ENERGY STAR Sustained Excellence recognition. Key accomplishments include:

- Launching the BOMA 360 Performance Program—a groundbreaking new program to recognize commercial properties that demonstrate best practices in building operations and management, including participation in ENERGY STAR and benchmarking through EPA's Portfolio Manager. In 2009, 37 buildings earned the designation.
- Advancing its 7-Point Challenge to achieve a 30 percent improvement in energy efficiency by 2012. Through 2009, more than 120 organizations representing over 3 billion square feet of office space have endorsed the Challenge, an increase of 1 billion square feet over 2008.
- Streamlining and reoffering its 6-module course on strategies for improving energy efficiency and using EPA's Portfolio Manager—more than 14,000 industry practitioners have been trained to date.
- Encouraging its members to continue to benchmark and share their buildings' energy performance with the BOMA master account. To date, more than 1,000 member buildings have been shared, totaling 270 million square feet and achieving a portfolio-wide average energy performance score of 78.
- Promoting the use of its Green Lease Guide and Energy Performance Contract Model among members.

The International Facility Management Association (IFMA) provides information, training, and certification of sustainability facility professionals; see http://www.ifma.org/sustainability/.

State and Local Governments

Energy Services Coalition (http://www.energyservicescoalition.org/) is a national nonprofit organization composed of a network of experts from a wide range of organizations working together at the state and local level to increase energy efficiency and building upgrades through energy savings performance contracting. It provides a wide range of resources, especially to state and local officials and experts, among others best practice examples, but also training and model documentation.

ICLEI-Local Governments for Sustainability (http://www.iclei.org) is an association of over 1200 local government members, committed to sustainable development. Members come from 70 different countries, representing more than 569 million people. Shenyang is the only member so far from China. ICLEI provides networking, training and information resources, including a municipal clean energy toolkit; http://www.icleiusa.org/action-center/tools/municipal-clean-energy-toolkit/energy-efficiency

Energy Cities is the European Association of local authorities inventing their energy future. It was created in 1990 and represents now more than 1,000 towns and cities in 30 countries. It enables the exchange of experiences, the transfer of know-how and the implementation of joint projects; http://www.energy-cities.eu/spip.php?page=index_en

The **Covenant of Mayors** is a movement involving local and regional authorities in EU member states, committed to go beyond the EU's energy and climate goals and curb their CO_2 emissions by at least 20% by 2020 through energy efficiency and renewable energy actions. It has 2665 signatories, representing almost 130 million inhabitants. Covenant signatories undertake to prepare a baseline emission inventory and submit a sustainable energy action plan outlining the key actions they plan to undertake. They can receive promotional, technical and administrative assistance, tools and methodologies. http://www.eumayors.eu/about/covenant-of-mayors_en.html

More than 1.600 cities, municipalities and districts in 17 European countries are members of the **Climate Alliance** of European Cities with Indigenous Rainforest Peoples, a network of local authorities committed to the protection of the world's climate. Member cities and municipalities aim to reduce greenhouse gas emissions at their source, committing to reduce CO_2 emissions by 10% every five years and to halve per capita emissions by 2030 at the latest (from 1990 baseline). The Climate Alliance also runs the Covenant helpdesk of the Covenant of Mayors, facilitating the process of local authorities to join the Covenant, and develops methodological tools. http://www.climatealliance.org/

Table B.3: Examples of Guidance Materials on Operation of Key Energy-using Equipment

- **Implementing power management in offices** - New York Energy $martSM Offices Project, http://www.nyserda.ny.gov/Publications/NYE$-Program-Reports.aspx.
- **HVAC Conservation** tips and other; http://www.boma.org/Resources/TheGREEN/EnergyResources/Pages/HVACConservationTips.aspx.
- Energy Efficiency **Retro-commissioning**. Retro-commissioning is the systematic process of verifying that all building systems perform interactively according to design intent, that they meet the operational needs of the owners and occupants, and that staff responsible for operation and maintenance are sufficiently trained. The goal of this service is to improve system performance, operation and maintenance, energy efficiency, occupant comfort, and indoor environmental quality of facilities and equipment that have been in use for some time, for example, at least one year in NYSERDA's FlexTech Program. Retro-commissioning does not include replacement of significant HVAC or other building components, but rather focuses on the verification and identification of proper control strategies, sequence of operations, operations and maintenance plans, and other building or system optimization strategies. http://www.nyserda.org.
- Improve performance of **existing boiler/heating system**: e.g., http://www.aceee.org/consumer/heating - improve.
- **Inspection of Boilers and Air Conditioning.** Articles 8 and 9 of the EU's EPBD require establishment of a system to inspect hot-water boilers used for heating. Member States are permitted to set the inspection interval for 20- to 100-kW boilers. For boilers larger than 100 kW, inspection must be done every other year (every four years for gas boilers). The directive also mandates "one-off" inspections of the whole heating system for boilers larger than 20 kW and more than 15 years old. The EPBD provides EU member states the option to forgo an inspection scheme in favor of a public education and awareness effort that offers advice to building owners about the importance of proper and regular maintenance of boilers and the benefits of ensuring proper boiler size. Member states have been split on their choices. Finland, for example, chose a national information campaign for boiler replacement after determining that the expected savings from inspections was only €7 per year for each system, while the expected cost of an inspection was €50 to €100. The Dutch found evidence that periodic inspections resulted in energy savings of 5-35 percent. Another option some countries have chosen is an inspection program for boilers larger than 100 kW and an information campaign for smaller boilers, which have smaller returns on investment. The inspection of air-conditioning systems larger than 12 kW is also mandated by Article 9. The inspection is intended to verify the operating efficiency of a system and to check that it is appropriately sized for the space it is servicing (see Ries et al. 2009, based on information from Antinucci 2008; http://www.epbd-ca.org/Medias/Pdf/CA_Annex_2_Inspections.pdf).

Appendix C: Energy Efficiency Initiatives in the Hospital Sector in Germany

Information about the German program to certify energy saving hospitals

Germany has about 2000 hospitals with a total of about 500,000 beds. Approximately 35% are hospitals in public ownership, 38% in the ownership of non-profit organizations (churches etc) and 27% in private ownership. The number of hospitals is going down (7.5% between 1999 and 2009), in part due to bankruptcies. (Source: Statistisches Bundesamt).

The hospital financing system is a dual system, whereby investments are financed by the relevant State (for those hospitals that are included in the state hospital plan) and operating costs are financed by health insurers (fixed amount per patient, based on diagnosis). Public funding for investments is scarce (the investment bottleneck is estimated at €12.6 billion; Source: Krankenhaus Rating Report 2010), and hospitals are more and more relying on credit financing.

In German hospitals, total annual costs are about €70 billion, 60% of which are personnel costs, and energy and water costs amount to about €0.5 billion. Energy alone has a cost share of 2-3 percent on average, 8-9 percent if personnel costs are excluded. (Source: Leittretter, S. (ed) 2004: Energieeffizientes Krankenhaus – für Klimaschutz und Kostensenkung. www.boeckler.de/pdf/p_edition_hbs_154.pdf).

The energy savings potential in the German hospital sector is substantial: Annual energy cost savings are estimated at €600 million and the annual CO_2 reduction at 6 million tons (Source: http://www.energiesparendes-krankenhaus.de/).

Table C.1: Benchmarking Hospitals in Germany (VDI 3807)

Number of beds and type of care		Heating		Electricity	
	Sample size	Mean (or median) value	Mean value of lowest quartile	Mean (or median) value	Mean value of lowest quartile
	Number	kWh/gross square meter			
0-250, basic care	102	24	14	4.4	2.7
251-450, regular care	76	20	14	5.5	3.8
451-650, central care	46	26	17	6.4	4.0
651-1000, maximum care	27	26	19	6.5	3.0
> 1000	31	37	22	14	4.0

Source: Klimaschutz- und Energieagentur Baden-Württemberg GmbH http://www.kea-bw.de/fileadmin/user_upload/pdf/kem-leitfaden/Energiekennwerte.pdf.

Hospitals are in general good targets for EPC since they have very substantial energy consumption and have incentives to reduce energy costs to reduce overall operating cost without a threat of having their overall budget cut accordingly. Furthermore, EPC contributes to financing older hospital infrastructure which is difficult to finance otherwise (see Bremerhaven experience in Box 4.5). Typically, EPC measures in hospitals are quite comprehensive, covering HVAC, lighting, energy management systems etc.

The technical director of the Bremerhaven Hospital (see Box 4.5) is very sceptical of hospital energy benchmarking, since hospitals are very diverse, e.g. regarding outsourcing of various services and implications for energy consumption, or type of building (for example, compact, high-rise buildings requiring substantially more energy for ventilation than spread-out buildings).

30 hospitals received the certification „Energie-saving Hospital“ since 2001 (http://www.energiesparendes-krankenhaus.de/). Certification is valid for 5 years and requires fulfilling two of the following four criteria:

- CO_2 reduction of at least 25% over five years
- Continuous reduction of energy consumption, and consumption is below average benchmark value of comparable hospitals
- Long-term optimal energy consumption, and consumption is below the lower quartile benchmark value of comparable hospitals
- Facility carries out energy management.

One third of the 30 certified hospitals use EPC to achieve savings; in these cases financing is provided mostly by the contractors. In the other cases, investment financing is from own/public funds, with some grants for specific measures such as investment in biomass boilers, or solar-thermal or solar-electric equipment.

Typically a wide range of measures is installed, necessary to achieve the criteria. Among the typical measures are decentralized CHP units, solar PV, improvements to ventilation and air conditioning systems, steam, hot water, and compressed air production, heat and steam distribution, use of variable speed pumps, thermal insulation including energy efficient windows, daylighting and energy efficient lighting, energy management system incl. building automation system. The soft measures include training of maintenance personnel, user motivation and similar.

Results of the certification program:

- Annual savings of more than 32,000 MWh/a electricity and more than 110,000 MWh/a heat, equivalent to electricity consumed by about 20,000 persons in Germany and heat consumed for 910,000 square meters annually
- More than 55,000 t CO_2 reduction annually

- Cost reduction in hospitals:
    - 100,000 Euro - 2,1 million Euro annually
    - in total €7 million annually

Source: A. Dickhoff (2010). Vorstellung der BUND-Auszeichnung für den Klimaschutz im Krankenhaus. Bund für Umwelt und Naturschutz Deutschland (BUND) e.V. Berlin, 13. Dezember 2010 (see http://www.greenit-bb.de/assets/files/GreenIt_RZ_BM_NEST_13_12_10.pdf).

1818 H Street NW
Washington DC 20433
Telephone: (202) 473-1000
Internet: www.worldbank.org
E-mail: feedback@worldbank.org