Climate Impacts on Energy Systems | *Key issues for adaptation in the energy sector*

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JOINT TASK OF ESMAP AND

GLOBAL EXPERT TEAM ON CLIMATE CHANGE ADAPTATION

NOVEMBER 16, 2010

"CLIMATE CHANGE IS OCCURRING, IS CAUSED LARGELY BY HUMAN ACTIVITIES, AND POSES SIGNIFICANT RISKS FOR A BROAD RANGE OF HUMAN AND NATURAL SYSTEMS."

WHITE HOUSE TASK FORCE ON AMERICA'S CLIMATE CHOICES, OCTOBER, 2010

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Key messages

- Energy services and resources will be increasingly affected by climate change—changing trends, increasing variability, greater extremes, and large inter-annual variations in climate parameters in some regions
- Adaptation is not an optional add-on but an essential reckoning on par with other business risks.
- Integrated risk-based planning processes will be critical to address these impacts and harmonize actions within and across sectors.
- Awareness, knowledge, and capacity impede mainstreaming of climate adaptation into the energy sector.

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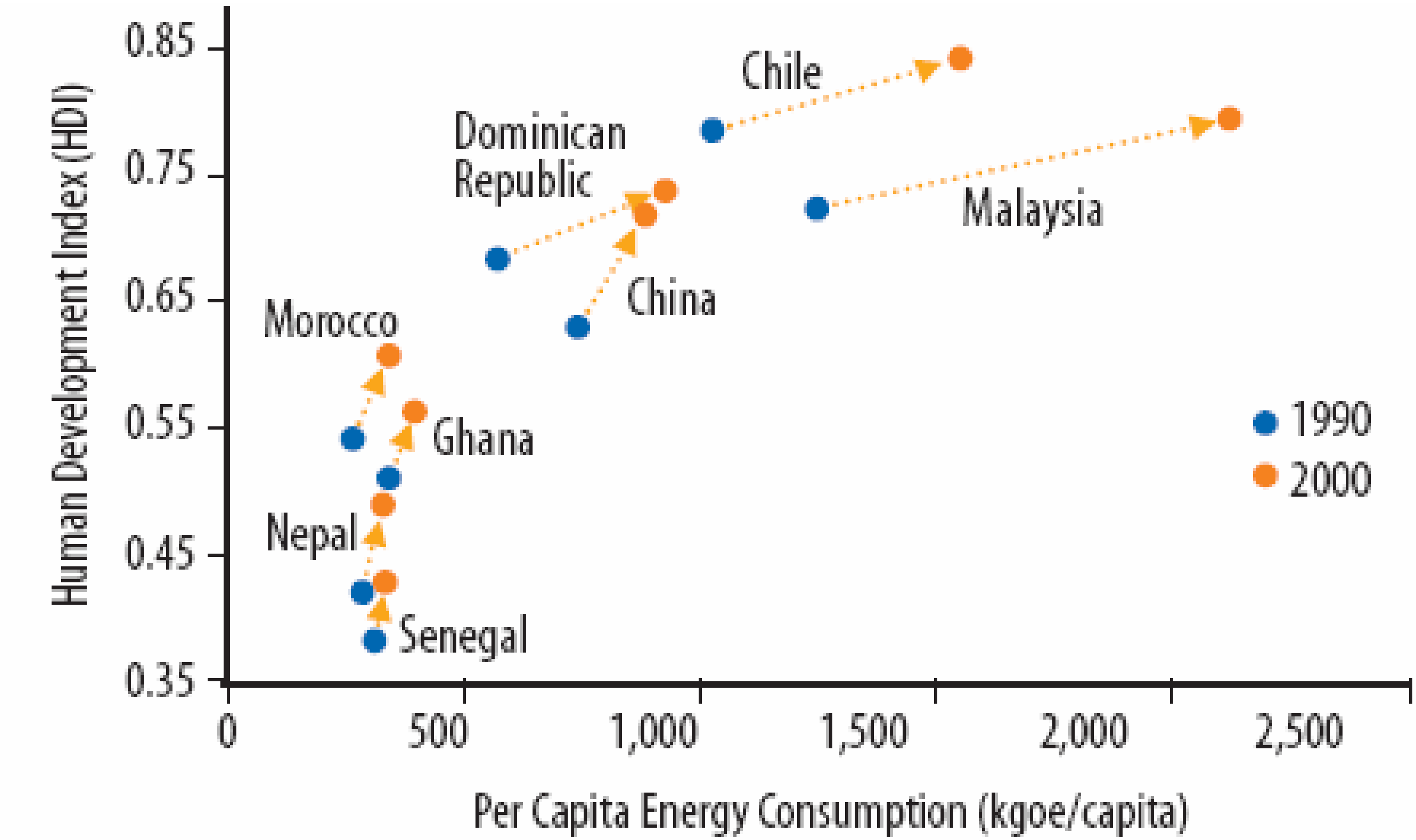
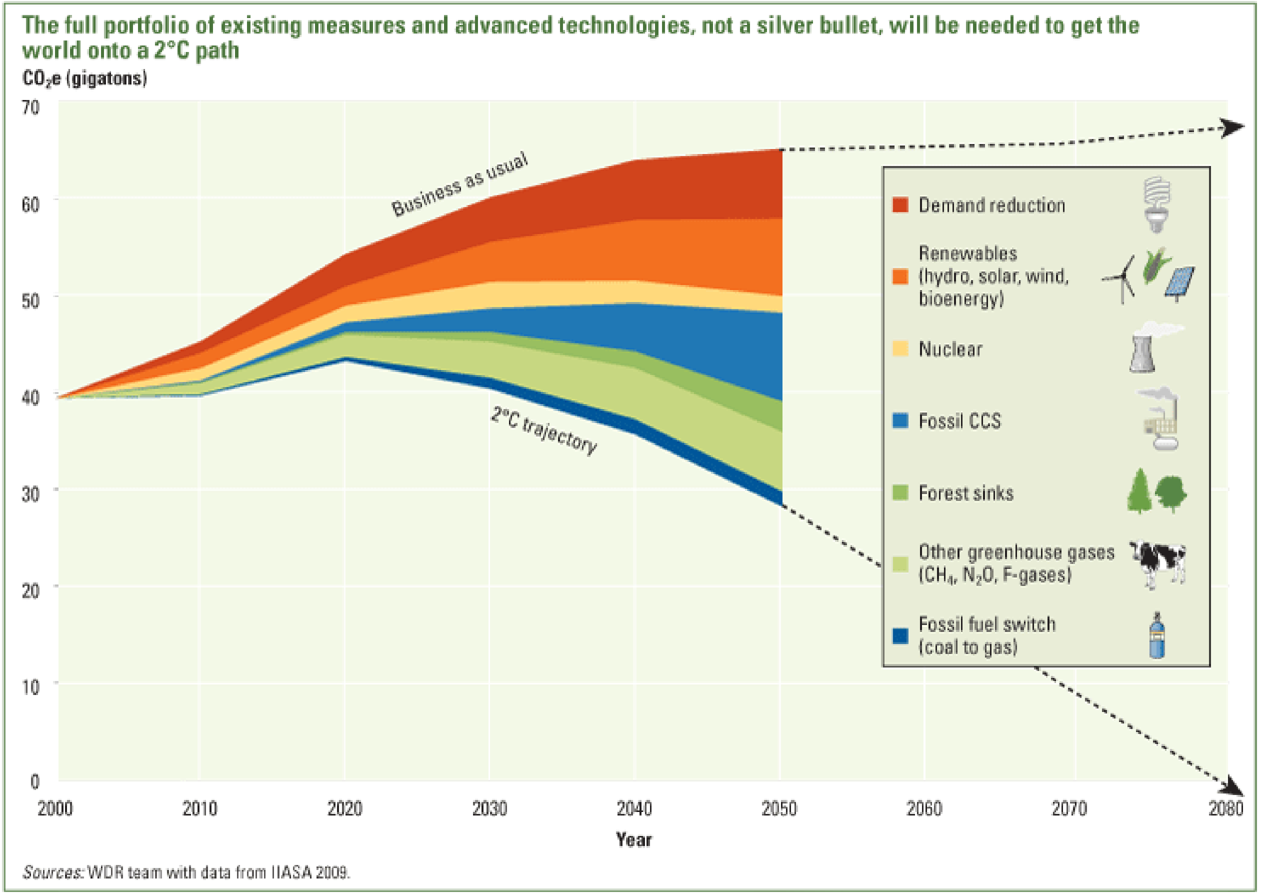
Energy… Rising Demand is tied to improvements in quality of life



Source: World Bank, Energy Poverty Issues, Moscow-Washington DC, February 2, 2006

… At the same time energy sector is a key actor in efforts for reigning-in global GHG emissions



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…also, many consequences of global warming are of relevance to the energy sector, and some are irreversible.

- Increasing surface and lower troposphere temperatures
- Increasing intensity of weather extremes
- Rising sea levels
- Loss of permafrost
- Loss of glacier cover in mountain areas
- Changing precipitation patterns – more intense rainfall, longer periods of drought
- Changes in river streamflows.
- Decreasing mean mid-latitude wind speeds

THEREFORE, ENERGY SERVICES WILL BE INCREASINGLY AFFECTED BY THE CONSEQUENCES OF CLIMATE CHANGE

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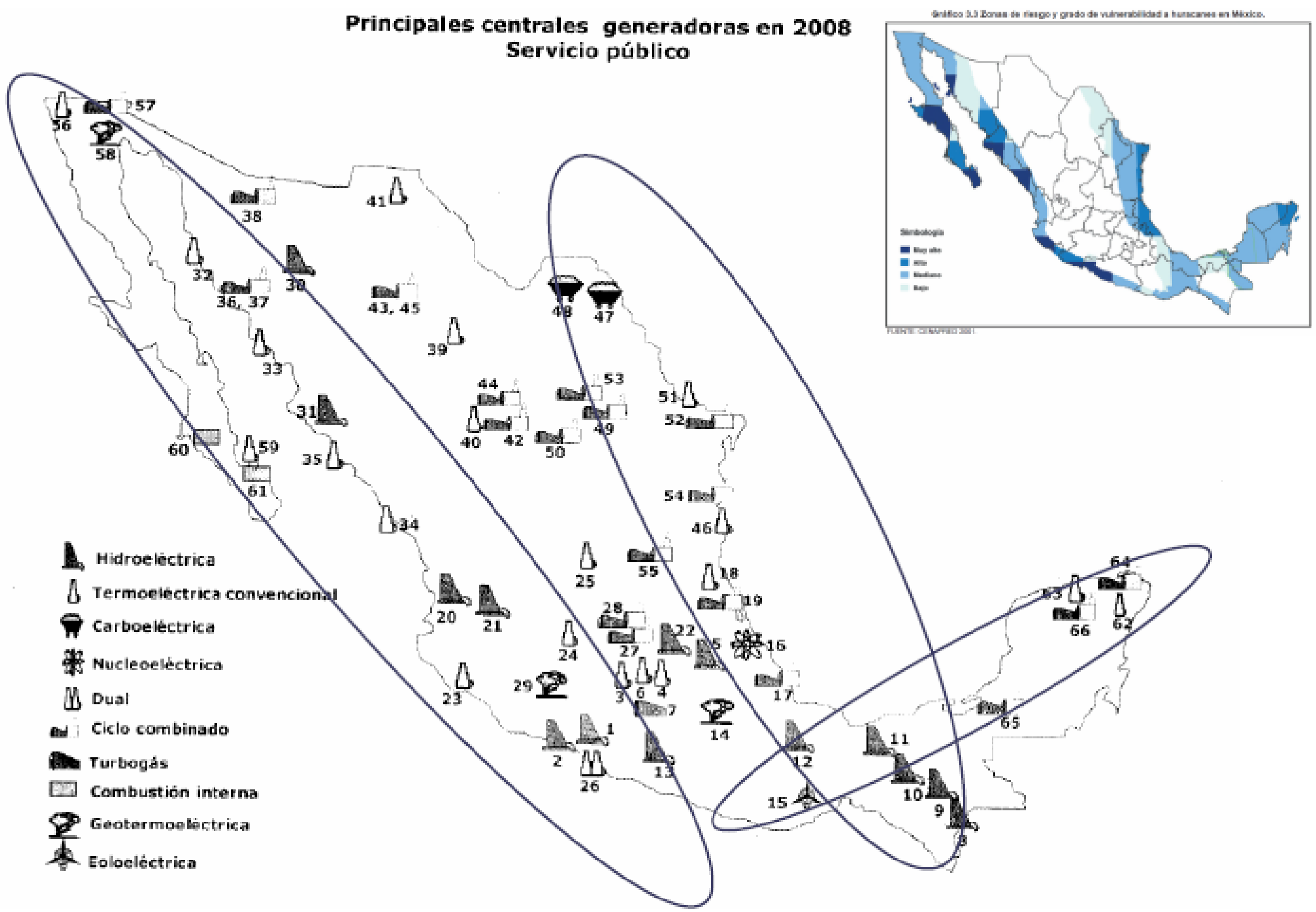
For example, Hydropower may be affected by changing precipitation & loss of water regulation in mountainous regions

Source: http://spectrum.ieee.org/energy/renewables/future-of-hydropower

Changes in extreme weather events will affect energy infrastructure vulnerability

Relative location of power plants vs. hurricane/typhoon zoning areas in Mexico



Extreme Ice and Snow Loads on Pylons Near Münster, Germany, in Autumn 2005

Source: Picture by Benno Rothstein, Professor in Resource Economics, University of Applied Forest Sciences, Rottenburg/Germany.

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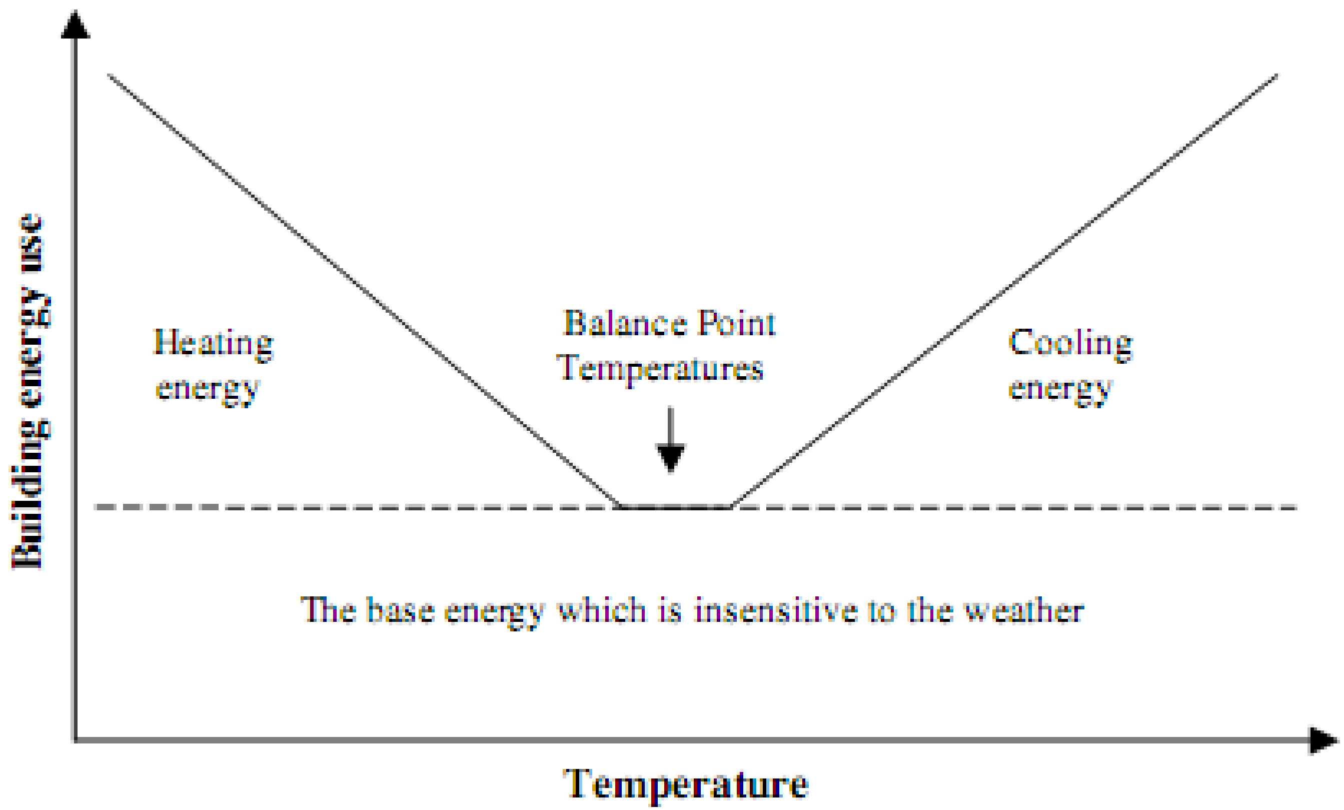
Impacts on demand: … with rising temperatures, heating loads will decrease but cooling demand will rise

✓Inter-annual variability and cold periods will remain
✓Seasonal demand profiles will shift for buildings, infrastructure, agriculture
✓Temperature tolerance of infrastructure will be tested



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Other wide-ranging impacts

ENERGY IMPACT	CLIMATE CHANGE
RE resources	Changes in runoff, wind, crop response, ocean climate
Energy supply	Hydro – water availability and seasonality Wind – variable wind regime Bio-fuels – reduced transformation efficiency Solar – reduced solar cell efficiency Thermal - Generation efficiency and cooling water availability Oil & Gas – extreme events
Transport/ T&D	Extreme event frequency, sea level rise
Design, O&M	Siting – sea level rise, extreme events Downtime/ trade – extreme events
Demand	Temperature rise, inter-annual variations
Cross sector	Water resource management/ competition & siting

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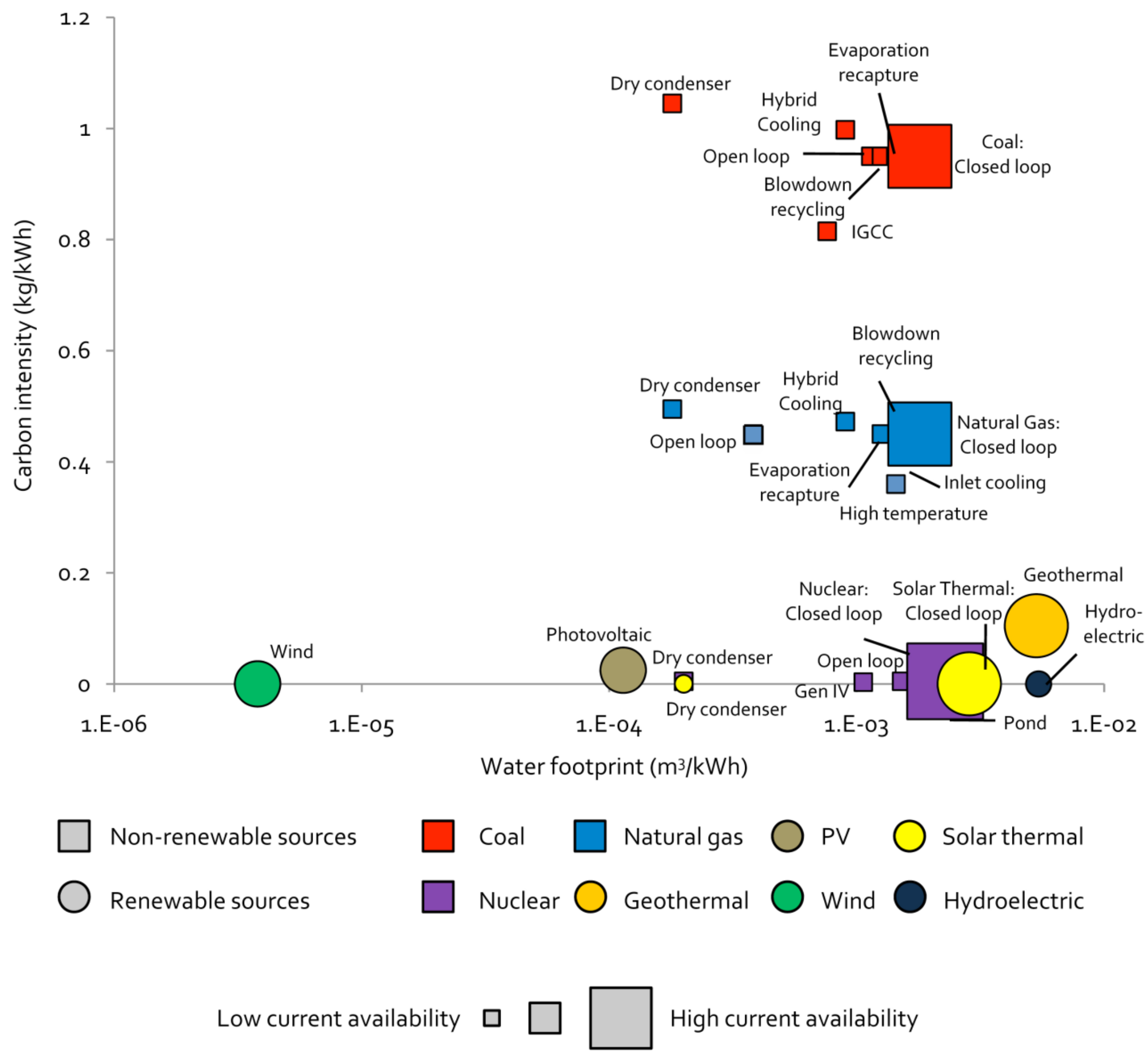
Energy choices: not just carbon intensity but also water use



Source:
Lux Research, June 2009, Global Energy: Unshackling Carbon from Water

ADAPTATION IS NOT AN OPTIONAL ADD ON BUT A REQUIREMENT FOR CURRENT OPERATIONS AND FUTURE DEVELOPMENT

"GUARANTEE THE DELIVERY AND INCREASE THE RESILIENCE OF ENERGY SYSTEMS WHILE ADJUSTING TO LOWER CARBON FOOTPRINT REQUIREMENTS"

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Adaptation can be costly (US$ billions/year)

Comparison of adaptation cost estimates by the United Nations Framework Convention on Climate Change and the Economics of Adaptation to Climate Change

Sector	United Nations Framework Convention on Climate Change (2007)	Economics of Adaptation to Climate Change study: National Centre for Atmospheric Research (NCAR), wettest scenario	Economics of Adaptation to Climate Change study: Commonwealth Scientific and Industrial Research Climate (CSIRO), driest scenario
Infrastructure	2–41	29.5	13.5
Coastal zones	5	30.1	29.6
Water supply and flood protection	9	13.7	19.2
Agriculture,[a] forestry, fisheries	7	7.6	7.3
Human health	5	2	1.6
Extreme weather events	—	6.7	6.5
Total	28–67	89.6	77.7

Source: UNFCCC (2007) and Economics of Adaptation to Climate Change study team.

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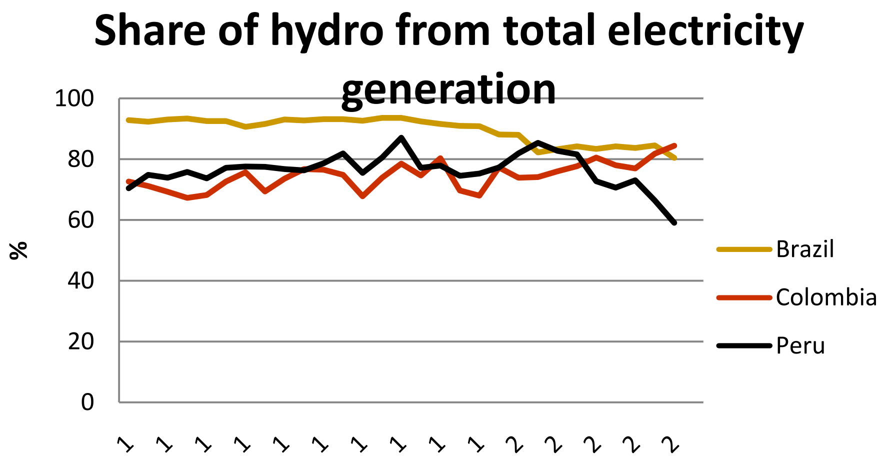
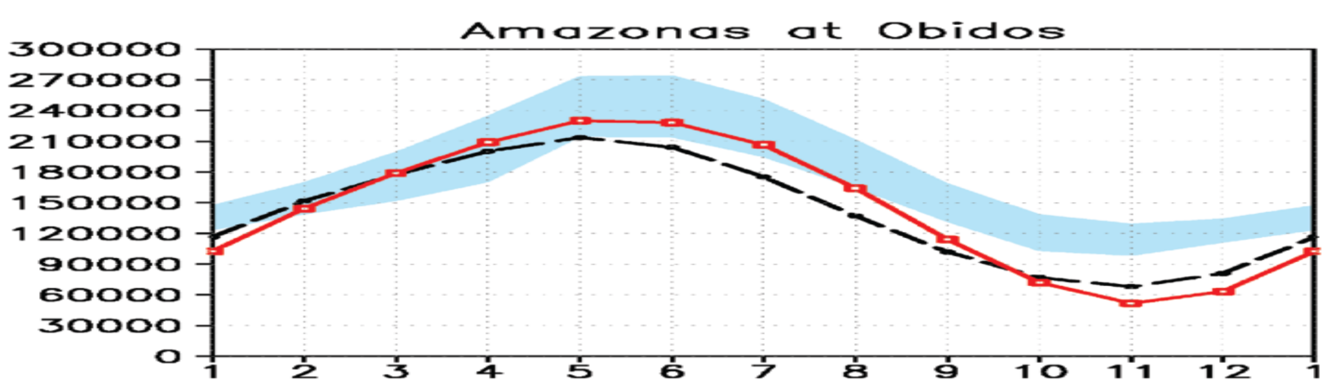
Adaptation can be costly

For example, power systems largely relying on hydropower may require diversification to other more expensive options, including some with higher carbon footprints…



Simulate current and future stream-flows of Amazonas River



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Options to adjust to future conditions and/or reduce risks

- Technological responses
  - Physical protection (e.g. targeted retrofitting to address increase in climate impacts)
  - Better design: apply adapted design practices or standards (e.g. pipelines in discontinuous permafrost zones)
  - New technologies (Better grids to handle diversification of power sources; example: coupling of hydro-wind in power generation)
- Behavioral responses
  - New zoning decisions (reconsider location for coastal infrastructure)
  - Revised contingency, risk management plans (e.g. better forecasting, revised hazops)
  - New O&M protocols (e.g. adapt to new river flow patterns in hydropower)

Options to strengthen climate resilience

- Structural responses
  - Adopt a policy framework that allows for internalization of adaptation concerns in energy systems (economic and fiscal incentives for improved climate-resilience)
  - Develop tools for risk-reduction and sharing of risks

Adaptation opportunities

- New financial instruments (e.g. weather derivatives, insurance)
- Diversification of portfolios
- Energy/ water saving and demand side management
- Decentralized energy structures
- Urban policy & land use planning

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INTEGRATED LONG-TERM (RISK BASED) PLANNING WILL BE CRITICAL

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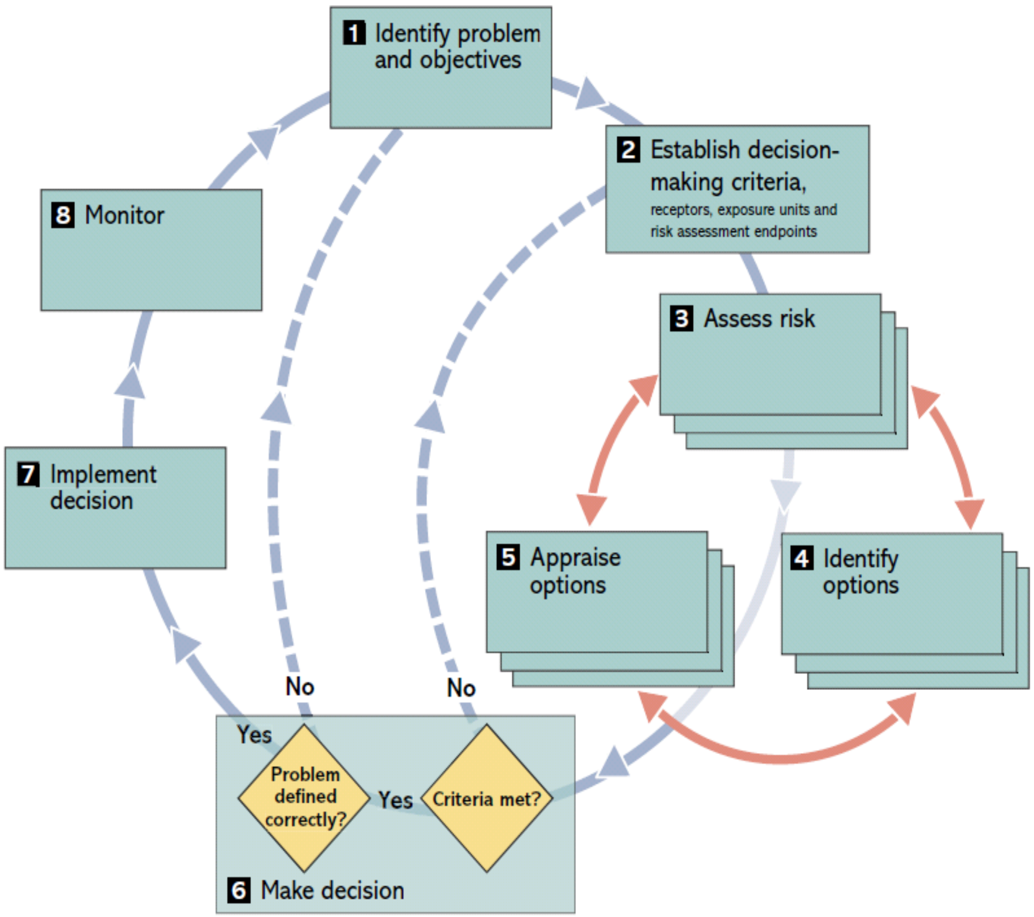
Climate Risk Management



Source: Willows and Connell (2003)

"Responding to climate involves an iterative risk management process that includes both mitigation and adaptation, taking account of actual and avoided climate change damages, co-benefits, sustainability, equity and attitudes to risk" (IPCC 2007)

Integrated planning is highly important

- Integrate plans
  - Within the sector (climate may affect energy chain at multiple links)
  - Between sectors (e.g., climate will affect water/ energy/ agriculture)
  - Across stakeholders (e.g., national/ local, public/ private etc)
  - Mitigation and adaptation (e.g., RE)

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POOR AWARENESS, LIMITED KNOWLEDGE AND CAPACITY LACKING REPRESENT BARRIERS TO ADAPTATION

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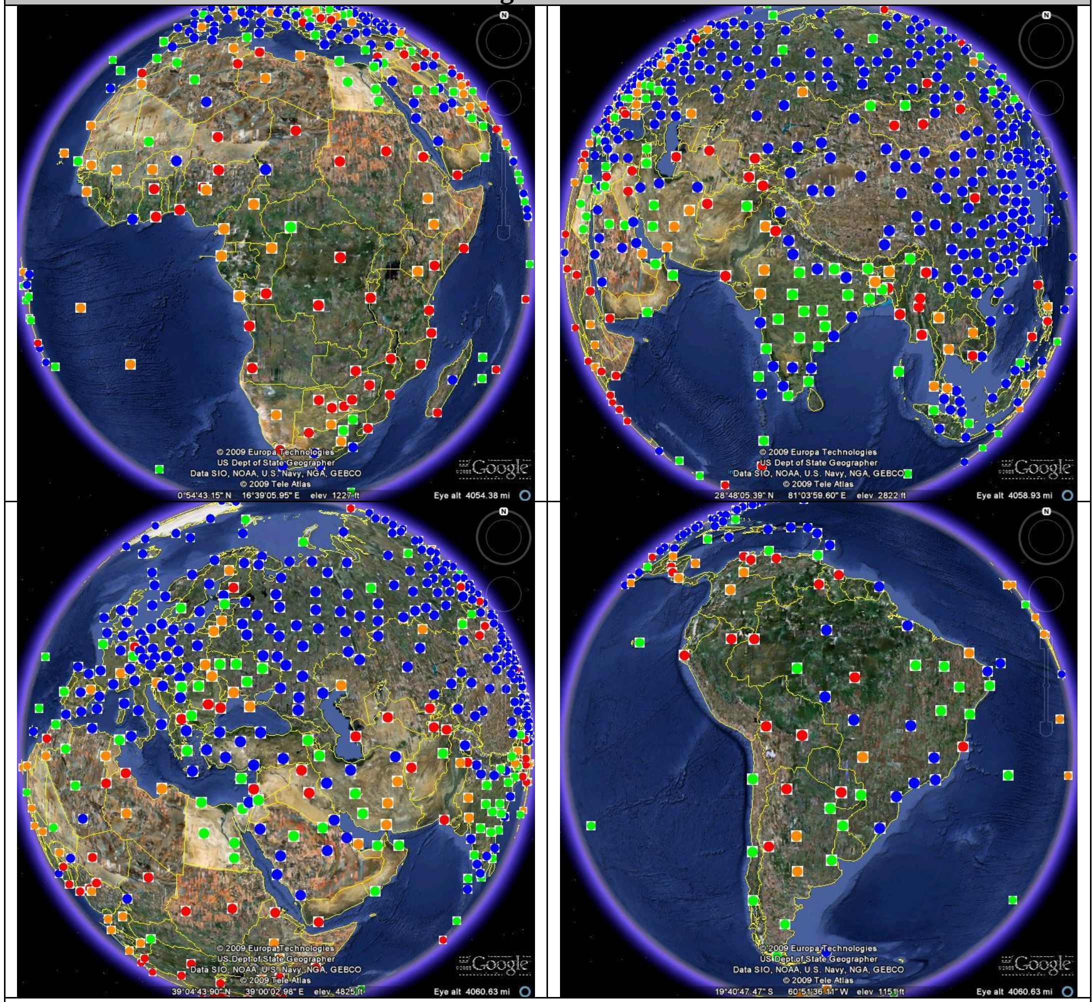
Weather & Climate Services

Gaps in Capacity

- Need to document current climate trends
- Many services below WMO standards, need immediate upgrade
- Historic records frequently lacking or inaccessible, need to document current trends
- Lack local skills and capacity for climate modeling
- Lack of tailored information and dialogue (cross sector)

WMO Monitoring of TEMP October 2008



BLUE: stations for which more than 90 percent of the reports were received
GREEN: stations for which 45 to 90 percent of the reports were received
ORANGE: stations for which less than 45 percent of the reports were received
RED: silent stations

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More information and data needed

- Nature and timing of climate change impacts
- How climate parameters affect energy systems
- Emerging adaptation practices
- Practical tools and approaches for addressing climate trends and climate risk management
- Research (e.g. technologies, modeling etc)

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NEAR-TERM ACTIONS

Road map for immediate action

- Awareness and knowledge exchange
  - Support better awareness on the issue with public, private decision makers
  - Support access to state of the art data on the consequences of climate destabilization
- Impact needs assessment
  - Assess the consequences of climate change, estimate impacts
- Project screening tools and guidance
  - Support the development of guidance, information and screening tools for internalization of climate change issues in normal energy sector practices
- Adaptation standards
  - Examples: standards for robust coastal infrastructure
  - Revised zoning standards
  - Construction standards in traditional permafrost areas

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Road map for immediate action cont.

- Needs for retrofitting of existing infrastructure
  - Assess need for changes in location, structural changes, changes in O&M requirements
- Planning timeframes and use of historical data for future investments
  - Review and implement changes in use of historical data as a basis for future investments (for example, introduce weights to reflect recent climate trends
  - Adjust shelf-life of investments in use of resource endowments affected by climate change
- Pilot adaptation measures to address novel, anticipated threats
  - Invest in pilot measures to illustrate costs and benefits of alternative adaptation strategies
  - Support assessments on how to integrate results in large scale operations

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Road map for immediate action cont.

- Policy instruments
  - Assess use of policy instruments to support internalization of adaptation issues in operations
  - Assess need for incentives to adjust planning and operations to longer-term time-frames
- Capacity building
  - Support increases in skills with regulators, energy policy-makers, operators, “bring policy-makers up to speed”

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The tall brick wall

- “There is a tall wall between our scientists and our Decision Makers. Scientists do their research and lob their information over the wall, hoping that somebody on the other side will catch it in receptive hands and act on it. However, what is on the other side of the wall is a big pile of papers and information that the Decision Makers pay no attention to.”
  - Jonathan Foley, 2010

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Thank You!

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