Formal Report 332/08

Maximizing the Productive Uses of Electricity to Increase the Impact of Rural Electrification Programs

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ESMAP

Energy Sector Management Assistance Program

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Energy Sector Management Assistance Program (Esmap)

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The Energy Sector Management Assistance Program (ESMAP) is a global technical assistance partnership administered by the World Bank and sponsored by bi-lateral official donors, since 1983. ESMAP's mission is to promote the role of energy in poverty reduction and economic growth in an environmentally responsible manner. Its work applies to low-income, emerging, and transition economies and contributes to the achievement of internationally agreed development goals. ESMAP interventions are knowledge products including free technical assistance, specific studies, advisory services, pilot projects, knowledge generation and dissemination, trainings, workshops and seminars, conferences and roundtables, and publications.

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Maximizing the Productive Uses of Electricity to Increase the Impact of Rural Electrification Programs

An Operational Methodology

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and Laurent Durix

Energy Sector Management Assistance Program

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Contents

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Abbreviations and Acronyms

AfDB	African Development Bank
AFDS	Social Development Fund
ASER	Senegalese Rural Electrification Agency
CFA Franc	African Financial Community Franc, 1 Euro = 656 FCFA
CIMES/RP	Senegalese Multi-Sector Committee that aims at reducing poverty by implementing synergies between the energy sector and other sectors.
DSRP	French for Poverty Reduction Strategy Paper (PRSP)
ERIL	Locally Initiated Rural Electrification Project
FER	Rural Electrification Fund
GEF	Global Environment Facility
GoS	Government of Senegal
GVEP	Global Village Energy Partnership
IDA	International Development Agency (part of the World Bank Group)
IFIP	Private Financing Institutions
IRR	Internal Rate of Return
MEC	Multisector Energy Investment Projects (also called PREM in French)
OBA	Output Based Aid
PADMIR	Support Program to Decentralization in Rural Areas
PAOA	Program Providing Support to Agro-industry
PAPASUD	Program Providing Fisheries in the South
PAPEL	Program Providing Support to Stockbreeding
PDMAS	Program Providing Support to Agriculture Markets and Agro-industry
PERACOD	Program Promoting Rural Electrification and Use of Domestic Fuels
PNIR	Rural Infrastructure National Program
PPER	Priority Rural Electrification Programs
PPP	Public-private Partnership
PRAESC	Program Providing Revival of Economic Activities in Casamanse
PREMS	French for Multisector Energy Investment Projects (see MEC)
PSAOP	Program Providing Support to Service Providers in Agriculture
PTIP	Triennial Public Investment Program
RE	Rural Electrification
REGEFOR	Well Drilling Reform Program
SAED	Program Providing Activities Development in the Senegal River Delta

Executive Summary

Rural electrification programs are generally motivated by the effective and lasting impacts that they are expected to generate in the field. While there may be some natural trickle down effect from the massive investments required to reach high rates of rural electrification, spontaneous positive effects on social and economic development are generally limited by a number of local bottlenecks. Two of the most important deterrents to the productive uses of electricity are the lack of technical knowledge and skills of potential users and the financial means to acquire the relevant equipment.

Waiting for electrification projects to generate spontaneous positive effects in rural areas appears to be a very passive attitude. This is especially undesirable when the budgetary resources of governments are seriously constrained, and when the multilateral and bilateral donor community requires serious investments in the social sectors to meet Millennium Developments Goals.

This paper argues that to be successful, rural electrification programs should target direct impact on livelihoods and revenue generation beyond the provision of connections and kilowatt-hours by implementing electricity projects that affect livelihoods and generate new revenues.

The necessity and the modalities of this cooperation with other sectors are discussed and two approaches—the *systematic approach* and the *pragmatic approach*—to foster such cooperation are described in this paper. Both approaches target the same end result and provide complementary steps toward this result.

The *systematic approach* analyzes the technologies used in the production processes of goods and services in a specified rural area. It identifies the bottlenecks, sees whether the use of electricity can contribute to diminishing or removing the limiting factors, evaluates the costs and gains, and provides guidelines to induce the proposed change in the processes. It is *systematic* in the sense that it entails a thorough review of all productive or social activities taking place in a designated area and requires substantial interaction with the anchor sectors in which these activities take place. The systematic approach proposes to follow five key steps:

1. Identification of the productive activities taking place in a project area and the supporting sectors
2. Careful analysis of the production processes involved, identification of possible improvements and limitations
3. Review of the contribution of electricity to these expected improvements and what equipment is required
4. Analysis of the technical and economic feasibility and the social viability of the electrically based solution proposed
5. Targeted promotion campaign to potential users about the gains from the use of electricity for a new production process, involving electricity services distributors, relevant equipment providers, microfinance institutions and any other relevant stakeholders, such as local governments, cooperatives, or NGOs

The *pragmatic approach* follows an opportunistic tactic, taking advantage of preexisting opportunities resulting from the ongoing or planned implementation of another project or program in a given area. It is implemented when conditions are ripe for a quick-win project that would provide rapid revenue-enhancing gains, thanks to access to electricity. It is *pragmatic* in that the focus is on existing projects or programs in other sectors, for which most of the identification and preparation work has been completed. The magnitude of the gain, while important, matters less than the feasibility and rapidity of the implementation of the Multisector Energy Investment Projects (MECs) that will provide the expected gains. The proposed method for their implementation follows three steps:

1. Identify the sectors that have activities taking place in the area of the electricity project, and evaluation of the impact electricity can have on the sector's outputs.
2. Design and cost out electric equipment proposed, both before and after the meter.
3. Secure formal agreement among stakeholders on the MEC, respective duties, and modalities of cooperation. Establish contractual documents and coordination of teams for implementation.

Both the systematic and pragmatic approaches are being tested and implemented in Senegal, where they were initially developed and implemented within the Electricity Services in Rural Areas Project (ESRAP) co-financed by the World Bank. The case of Senegal provides a real-world and practical reference, demonstrating that the approaches are complementary and are generic enough to be applied in many varied rural electrification programs, and the methods described are flexible enough to be adapted to each country's or program's specific situations.

In Senegal, the overarching context in rural electrification included establishing rural concessions to be attributed to the private sector following a bidding process, and the creation of a new entity, the Senegalese Rural Electrification Agency, which assisted and oversaw the process. The implementation of the approach was adapted to the local setting, while introducing the concept of cross-sector collaboration and the practice of including a livelihood component in the country's rural electrification program.

Introduction: The Need for a New Approach to Rural Electrification to Ensure a Positive Impact on Communities

Waiting for Spontaneous Positive Effects of Electrification Projects to Trickle-Down in Rural Areas Is Not a Satisfactory Option

It is commonly agreed that access to modern or improved energy services is one of the necessary conditions to move societies up from a subsistence economy, but it is now also understood that it alone is far from sufficient to move people out of poverty. When the energy source in question is electricity, evaluating the effective benefits of access is complex, especially in rural areas. The end results depend highly on the type and structure of the program that provides the platform for delivery.

Among key factors are the techniques used and the breadth of access to electricity of the different players (rich and poor households, small business, etc.) in each electrified village. In fact, while electrification has long been sold to stakeholders as a central piece of the development of rural areas conventional supply driven approaches often have limited the positive impacts to the use of a few light bulbs and radios by a few households—often the wealthiest—while draining the resources of the states or utilities to build extensive networks.

To accelerate access coverage, large amounts of effort went into decreasing the costs of rural electrification projects through technical design, institutional innovation, and adequate financing options.[1] In parallel, some work has also been undertaken to better estimate the effective economic benefits derived from electricity uses, including the evaluation of those usually considered intangible, such as improved health or security.[2]

Although the efforts mobilized to decrease the costs of electrification and to increase the valuation of the end-user benefits are commendable, the conventional approach to rural electrification is no longer sufficient. Solely extending the networks (or installing minigrids and individual systems), connecting customers to the meter (reaching either some or all customers, using customer payments, subsidies or other financing means), and considering the job done and retreating to a pure activity of exploitation (principally billing and maintenance) is inadequate to ensure a positive impact on the recipients. The central

[1] See, for example the review of such efforts in 10 countries: "*Transformative power: Meeting the Challenge of Rural Electrification,*" ESMAP 2006.

[2] For more on this, see Barnes, Domdom, "*Rural Electrification and Development in the Philippines: Measuring the Social and Economic Benefits,*" ESMAP 2002.

weakness of such an approach is that it does not address the basis of customer consumption once the connection is enabled. It also does not address the question of who will benefit from electrification, the optimal conditions for these benefits to materialize, the time frame for effectiveness, and the projected true benefits.

One factor that contributes to such deficiencies in rural electrification programs is that once the policy decision of expanding access to the rural area is made, often at the highest levels of government, it becomes an end goal in itself rather than a mean toward a larger rural development goal. This is partly because a physical electricity connection is a very measurable item, whereas the effect of the connection is less palpable from a target-oriented standpoint. It is easier for a policy maker or a development organization to claim that the contribution helped raise the connection rate in a given location and to cite some generic benefits attached, such as cheaper lighting for easier reading and increased productivity, than to target and quantify the effective development impacts.

This even leads in some cases to misleading situations where the whole population of a village is counted as having access to electricity, with the implied assumption that all can enjoy all the benefits of electricity, while in fact only a few customers are connected and little to none of the connections are used for revenue generation. All too often, only the wealthiest gain access to grid electricity, a connection that may sometimes only replace earlier access through personal generators.

Waiting for spontaneous positive effects on social and economic development to stem from the *proximity* of electricity appears to be a very passive attitude in contrast to the efforts to build such infrastructure. This is especially regrettable where the budgetary resources of governments are seriously constrained, and where the multilateral and bi-lateral donor community requires serious investments in the social sectors to meet Millennium Developments Goals.[3] So, while there may be some natural trickle-down effect from the massive investments required to reach a high rate of rural electrification, proactive action is needed to ensure that funding rural electrification is effectively funding *rural development* and not just the expansion of the electricity sector.

Proposing an Alternative by Focusing on Productive Uses of Electricity: Scope and Structure of the Paper

This paper argues that the most efficient way to deliver effective and lasting impacts when designing a rural electrification (RE) scheme is to ensure that such programs provide a direct impact on livelihoods and revenue generation, in addition to the more conventional impacts on standards of living. Increasing revenue generation can be accomplished by improving productivity of an existing production process and by creating new lines of activities that will generate employment and local demand.

Targeting positive impacts on revenue generation—beyond good faith statements that such thing will happen spontaneously—requires that the specific activities to develop productive uses be included as a full component of the RE project. However, to do so, one needs a quantity of information and knowledge of rural economy and social dynamics that are not often available to the energy specialists driving such projects. Therefore, it is necessary to initiate a specific activity to reach across sectors and collect the relevant information. Such activity would analyze the existing state of the production process in rural areas and inform the RE project proponents of proactive actions that can maximize the economic and social development impacts of their projects.

This paper proposes a methodology to identify and analyze the needs of target sectors that would maximize the income-generation impact of access to electricity. The paper will not address the improvement of social services—

[3] See www.un.org/millenniumgoals

where a similar approach could nonetheless be used with comparable end results. The approach was originally designed and first implemented in Senegal, so the lessons learnt from this country will be used as an illustration throughout the document. By sharing lessons learned, we wish to demonstrate that such an approach and its related methodology can be used in many other countries to increase impacts of rural electrification programs.

The paper is structured around two complementary approaches: a systematic approach and an opportunistic approach called the *pragmatic approach*. We will alternate a conceptual description of the methodology and a case-specific illustration using the Senegal experience. For easier reading, the Senegalese-specific sections are included in shaded boxes in order to better distinguish them from the more conceptual parts of the text.

More specifically, the paper is composed of three chapters:

Chapter 1 describes the background that led to the design of the proposed approaches and introduces the key concepts. It explains why and how the notion of cross-sector collaboration was raised and became a central activity. It introduces the general rural electrification context within which the Senegal example is being developed. It introduces the concepts and key outputs of the systematic and pragmatic approaches that are then developed further in the two following chapters.

Chapter 2 describes the systematic approach: the identification and promotion of productive uses of electricity. It describes the methods developed to identify and assess the expected gain of access to electricity in key sectors for a given area. It identifies the conditions and the type of intervention required to induce potential users to adopt electricity in their production process. For each step, the Senegal case is used to provide a field-tested illustration.

Chapter 3 describes the pragmatic approach and the instruments designed to implement it. It describes how the Multisector Energy Component (MEC[4]) is structured to quickly boost the impact of access to electricity to end users. It explains how such MECs are identified, appraised, and built, in the context of the collaborative work done with all beneficiary sectors. Again in this case, the generic method is illustrated with actual examples from the Senegal project.

[4] The MEC concept was initially created in Senegal and named PREMs in French for "Programmes Energétiques Multisectoriels." See annex 4 for more details in French.

1 Maximizing the Developmental Impacts of Rural Electrification Programs: Two Approaches Building on Cross-Sector Cooperation

The two approaches, systematic and pragmatic, that will be introduced later in this chapter and developed further in Chapters 2 and 3, were initiated by taking advantage of the confluence of three dynamics: The goal of overcoming the sector silo thinking that tends to bog down the energy sector; an ongoing restructuring of the Senegal rural energy subsector; and the existence of a team open to new ideas both within the Senegalese government and within the World Bank. Knowing the specific dynamics that led to the design of the systematic and pragmatic approaches helps explain how some of the choices were made, and can also show how such an approach may be replicated in different circumstances.

The chapter begins by describing the move to cross-sector collaboration, then describes the reforms taking place in the Senegal rural electrification subsector, and then introduces the two approaches that are developed and discussed in subsequent chapters.

An Increased Awareness of the Necessity of Working Across Sectors

Although it may be relevant for specialists focusing on the physical implementation of the rural electrification drive to see connections as an end result, those in charge of the design of the programs ought to keep a broader perspective on the question. For the power sector, this implies reverting to the original function of provider of services to electricity users.

Such users will be in other sectors such as agriculture, health education, small enterprises, and industries. Some of these sectors may be considered a national priority, while the electricity sector itself may not be. Not being considered a priority sector, but rather a sector providing services to the priority sectors, does not mean that activities and investments in the power sector should cease or even decrease. But it modifies the driving force behind rural electrification by forcing its practitioners to look into the impacts of their work, rather than only at the number or the quality of the physical connections they provide.

An Initiating Event that Provided High Level Buy-in: the Energy-Poverty Workshops

The realization of the value of cross-sector collaboration was at the core of the discussions between delegation members to the "Energy for Poverty Reduction"[5] workshops. These multisector regional workshops, held in Africa between 2002 and 2004, brought together representatives from 20 countries with the joint support of the World Bank and UNDP on behalf of the Global Village Energy Partnership.

Senegal was the host of the second of these workshops, which was attended by delegations of seven West African Francophone countries. Each of these country delegations was composed of ten members. It included two or three specialists from the energy sector and the other seven representing sectors that use energy in order to deliver their own services, such as education or health for the social sectors and agriculture or small enterprises for the productive sectors.

These sector specialists (agronomists, doctors, teachers, small private business owners, as well as civil servants) took great care to inform energy specialists of the end use of their respective sectors' energy needs and mulled over the best ways to meet such energy needs in a manner that would enhance their own end products. The delegates to the workshop collectively became mindful of how proper access and use of energy services can contribute to the availability and efficient delivery of quality outputs in social and productive sectors.

For example, the health impact of modern energies may not be easy to isolate, but fitting to the precise energy needs of health specialists' daily activities, rather than simply fitting dispensaries with a standard electric connection, will enable them to deliver better care thus improving the final health impact. In such a case, while the claim that delivery of health services has improved cannot be directly linked to the energy sector as sole source of improvement, the energy sector can nonetheless play a central, if indirect, role in enabling such improvement.

Workshop participants found that the demand for energy services is not necessarily expressed as such by other sectors specialists. It is often articulated as a request for outputs that are derived from the use of energy services. This generates a difficulty because energy specialists often know how to offer proper technical answers to energy-related issues, but if the question expressing the need is structured differently, the risk for miscommunication is considerable.

For example, issues such as "we have a problem with delivering babies at night" in the health sector or "we can only make one milking a day because of heat" in the dairy cattle industry are not necessarily expressed in an energy-centered manner. But such energy-centered questioning in the first case could be, "What are the reliable, cost-effective, and most readily available energy technologies for lighting our operating room, as well as the outside of the building for safety of personnel and patients, as well as heating water in minutes?" In the second case, it could be, "How can we provide cooling (and possibly basic transformation) of milk between daily collections with sufficient reliability that increasing the yield of cows milk will not backfire?"

Note that in examples provided, while electricity could technically answer all needs, it may not necessarily be the most adequate means to answer all three issues put forward in this example (lighting, heating, and refrigerating). Heating may be faster and more reliably provided by gas, for example.

[5] See ESMAP *"Proceedings of multi-sector workshops"*, East Africa 2002, West Africa 2003, Central Africa 2003. See also annex 3 for more details.

A Mind Shift, Reaching out to Other Sectors to Help Generate Their Outputs

In the case of rural electrification, reaching across sectors enables energy specialists working on project design to start viewing the whole derived demand for electricity. The *derived demand model*[6] shows that electricity is never in demand for itself, but for the outputs derived from the use of electric appliances such as lighting, cooling, and pumping. These energy-derived outputs are used, in turn, by other sectors as an input in their productive processes to generate their own final outputs such as medical care, classes taught, and product transformed.

Figure 1.1 provides a few examples of energy-derived outputs, the electric appliances that produce them, and how other sectors can use them in the production process of their own final outputs. A large part of the description in the coming chapters focuses on the shaded area in Figure 1, which lies after the production and distribution of electricity but before the delivery of other sectors' outputs. Since such work on electric appliances and their derived outputs is generally out of either sector's focus, it tends to be neglected.

The electricity sector is in a unique position, because once it has produced and distributed its electricity, it has formally produced its final output, but this output becomes useful only when consumed by an appliance and produces the derived output. This is why the energy-derived outputs usually remain in the area of knowledge of the energy specialists who are familiar with electric appliances and their requirements in electricity, both in terms of quantity and quality. Considering the energy-derived outputs helps both the energy specialists, who know which appliance can produce them, and the sector practitioners, who know which of these energy-derived outputs are needed as an input for their production process. In this way, they share a common ground of knowledge that enables mutual understanding and optimizes interactions.

From Political Will to Implementation: The Multisector Committee in Senegal

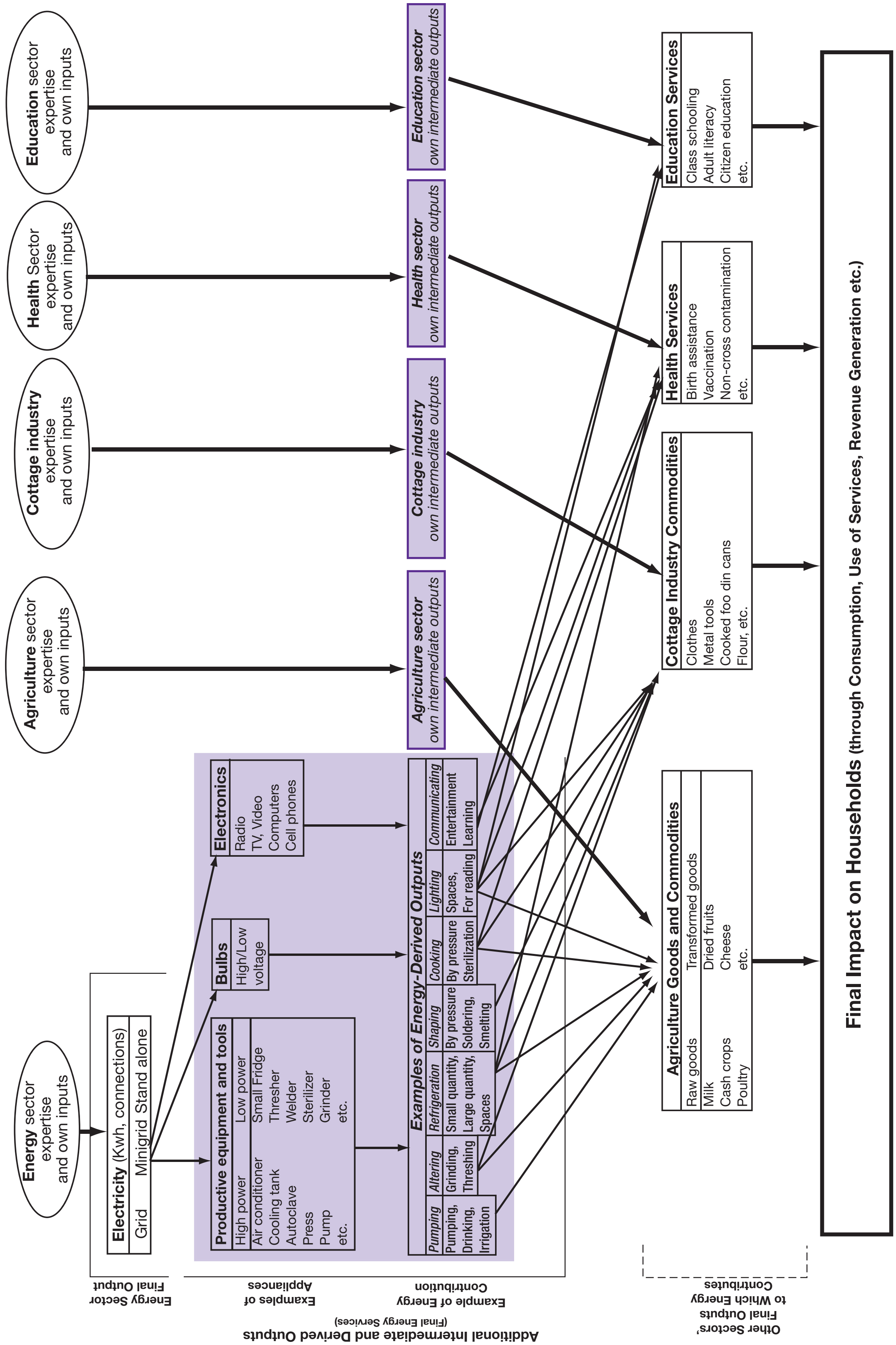
The approach of bridging gaps between sectors was embraced by the Senegalese delegation at the West African regional energy-poverty workshop. Its delegates agreed to keep working together after the closing of the event. In 2003, their unique commitment to the concept of cross-sector collaboration led the Senegalese to establish a multisector committee to identify synergies between the energy sector and other sectors. This committee, called by the French acronym CIMES/RP was an informal working group until was it rendered "official" in 2005 by ministerial decree.

The committee was instrumental in determining how to move from the concept of cross-sector collaboration to effective implementation on the field. It looked into maximizing the productive and social uses of electricity to increase the positive impact of electrification programs in rural areas. At the national level, the committee is composed of representatives from the key ministries involved in rural areas (energy, industry, economic planning, education, finances, health, agriculture, and fisheries), as well as from associations of rural councils, business bureaus, the national utility, the rural electrification agency (ASER), and several NGOs.

Formally attached to the ministry of energy, the committee holds sessions monthly or quarterly depending on the workload and creates subcommittees when needed to address a specific region or a specific group of sectors. The multisector committee can also meet at the regional level, with a similar structure to tackle a region-specific issue. It also convenes with subject specialists and meets donors or financiers to support its work whenever necessary.

[6] See Barnes, Domdom, "Rural Electrification and Development in the Philippines: Measuring the Social and Economic Benefits," ESMAP 2002.

Figure 1.1 Examples of Energy-Derived Outputs and Contribution to Other Sectors' Outputs



The multisector committee provided a strong support to the definition and the practical implementation of the systematic and the pragmatic approaches. It directed consultants in their identification of sector needs and in the detection of possible cross-sector cooperation; it opened doors to identify and provide access to the relevant specialists within each sector and contributed to problem solving whenever possible. Given their duties and affiliations to their respective employers, the committee members were not expected to do the core of the project identification work; such responsibility fell on the consultants.

Such a multisector committee would have been effective in the context of the former vertically integrated structure of the power sector, but the reform undertaken by the Senegalese authorities created an unprecedented window of opportunity to test innovative ways to apply a cross-sector approach to rural electrification.

The Context of the Reform of Rural Electrification in Senegal

National Background to the Senegalese RE Program

Poverty Reduction in Senegal

Starting with the devaluation of the CFA franc in 1994, Senegal undertook a successful series of economic adjustments that led to a period of historically high growth rate. However, despite this good performance, Senegal still has a significant portion of its reform agenda to meet. The economic growth after the devaluation had only a small impact on poverty especially in rural areas. Income inequality is high. Social indicators—primary education, infant and maternal mortality, access to clean water—still lag behind income indicators. The lack of key infrastructure—water, electricity, and transport—handicaps development and poverty reduction. Public policies, notably in the areas of taxation and investment, do not provide sufficient incentives and handicap growth by slowing down private-sector development.

As a result, close to 60 percent of the national Senegalese population is considered to be below the absolute poverty level,[7] and this number can go up to 90 percent in some rural areas. In the electricity sector, it is estimated that less than 4 percent of the villages in Senegal are electrified, and that less than 30 percent of the population of the electrified villages effectively have access to electricity.

A new push toward poverty reduction was started in 2002 with the creation of the Senegal Poverty Reduction Strategy Paper (PRSP, or DSRP in French). The pillars of Senegal's PRSP are: (i) wealth creation; (ii) capacity building and social services; (iii) assistance to vulnerable groups; and (iv) implementation of the PRSP strategy and monitoring of its outcomes.

Earlier Attempts from the Energy Sector to Contribute to Poverty Reduction

In its early efforts to reduce poverty and redress imbalances in development, the government of Senegal (GoS), with the assistance of various donors, undertook numerous initiatives aimed at bridging the rural/urban energy divide through the development of decentralized and renewable energy systems.

Several pilot projects, using both renewable (primarily solar) and conventional energies (grid extension, small diesel generators) and testing different technical and institutional arrangements were implemented. Most of these pilot projects had positive results. They confirmed the demand and interest of rural populations for consumption of energy services, as well as the interest of local and foreign private entrepreneurs to design business models for delivery. Finally, it proved the technical and commercial feasibility of the new technologies tested at the pilot level.

However, these pilot operations could not be replicated at the larger scale of the whole of

[7] In 2001, the last year when the poverty levels were effectively measured for the PRSP, 57 percent of the population nationwide was below the absolute poverty threshold at which an adult cannot meet the minimum nutrition levels of 2,400 calories per day.

Senegal; were not fully taken up by the private sector; and were not able to prove their long-term sustainability. Some reasons were the lack of a coherent RE strategy and the appropriate institutional and legal set-up, as well as the limited availability of public financing and a low level of donor interest.

Strict sector compartmentalization has prevented the development of a supportive environment that would nurture the development of the productive and social use of electricity. In fact, projects and programs implemented by other sectors have suffered from the lack of appropriate and timely delivery of energy services. As a result, the previous rural electrification operations only had a very limited impact on rural poverty and have appeared largely disconnected from PRSP's objectives.

The New Senegalese Rural Electrification Strategy

Learning from past experience in Senegal as well as in other countries, GoS has developed and adopted a new RE strategy that relies on two strategic partnerships: a private-public partnership (PPP) and a multisector partnership.

The PPP acknowledges that to scale-up rural electrification in an efficient manner requires the participation of the private sector, which can increase the implementation capacity and bring innovative ideas, new skills, and additional financing. The multisector partnership aims at maximizing impacts on rural development and poverty reduction.

Key Policy Decisions that Support the RE Program

To foster private-public partnerships, the government of Senegal adopted a series of overarching policy decisions, including the establishment of rural electrification *concessions* allowing small-scale electrification projects and the application of *technological neutrality* in rural concessions.

To be conducive to a truly successful public-private partnership, the GoS established an ad-hoc institutional, legal, and regulatory framework. It removed the monopoly from the national utility, SENELEC, for providing electricity to rural areas, transferring this responsibility to private sector investors and operators. This created a favorable environment for a variety of private players to play an effective role in rural electrification, and thus increased the implementation capacity. To overcome the barrier of high up-front connection fees and installation costs, and to ensure consistency with rural households ability to pay, the GoS also allowed the creation of a new tariff schedule for electricity (monthly lump sum payment) that incorporated prefinancing of connection costs, internal installation, and efficient lamps.

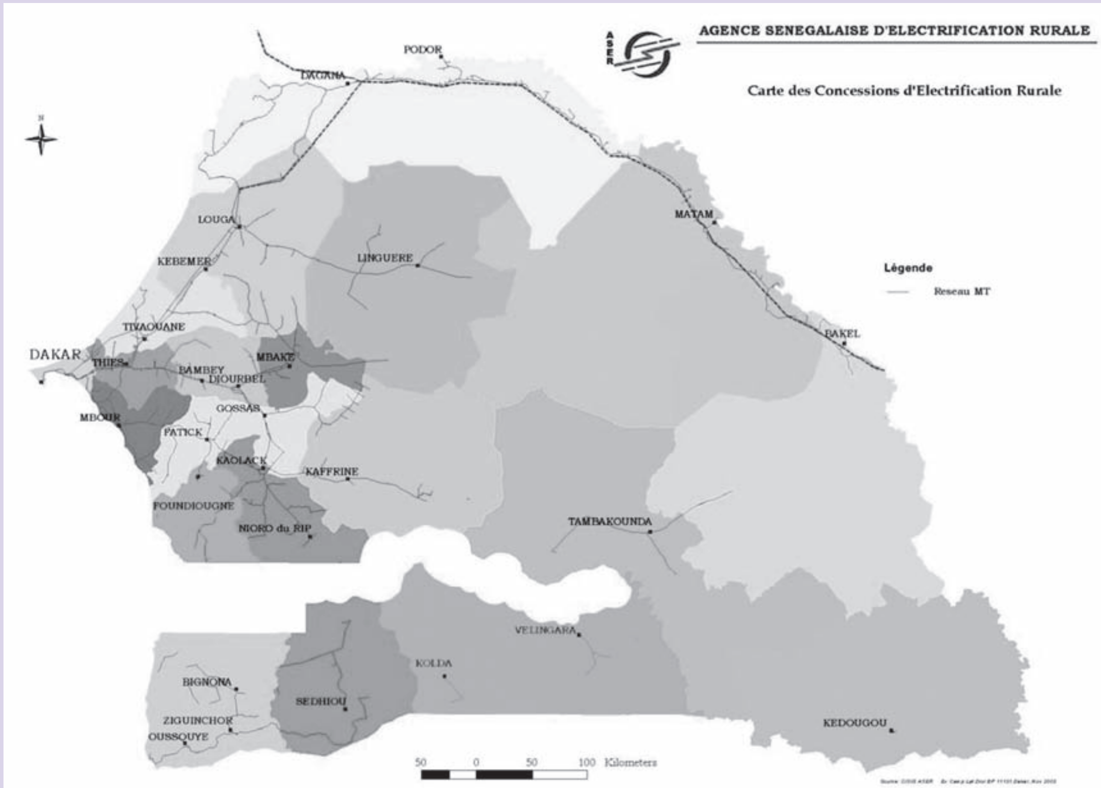
The government chose to resort to rural electrification *concessions* as the main vehicle to implement Senegal's rural electrification program. For the purpose of implementing the RE program, the GoS divided the country into 18 geographical areas, the concessions[8] (see Figure 1.2 below). These concessions were designed to be compact and large enough to be viable and attract large private sector players. Each concession has a minimum potential of 30,000 connections, defined as the estimated number of nonelectrified rural households. The GoS plans to contract these concessions to the private sector under a competitive and transparent international bidding process with selection criteria maximizing the number of beneficiaries.

In addition to the 18 primary concessions, the PPER program includes several multisector energy components (MECs[9]) to enhance the linkages between electrification and small

[8] The concessions are also called "Programmes Prioritaires d'Électrification Rurale." PPER.

[9] The concept was initially created in French for Senegal as Programmes Energétiques Multisectoriels (PREMs).

Figure 1.2 Map of Rural Electrification Concessions



business productivity and improved social service delivery. These MECs will be discussed in detail in Chapter 3.

Since it is expected to take more than 10 years to award the 18 concessions to private operators, some communities facing socially sensitive situations may require access to electricity without waiting their turn, as designated by the overall electrification plan. To address such situations, small-scale concessions (called ERILs[10] in French) can be awarded with a waiver from the larger concessions when too long of a waiting period may not be socially acceptable. Such small projects will be developed by capable local communities and stakeholders (local governments, consumer or emigrant associations, village groups and other community-based associations, and private entities). To be eligible for a waiver, ERIL projects have to be locally initiated, geographically limited (usually to a small area or a village), and not part of an area targeted for rural electrification in the short term.

Finally, against usual practices, *technology neutrality* will be enforced for rural concessions. This means that, to the extent that they respect the minimum service requirements set in the tender documents, bidders for the concessions will be free to choose the technology—either grid extension, mini-grids or off-grid individual solutions—used to achieve the quantitative objectives set in the contract documentation. To reinforce incentives for optimal mix of technologies, a GEF grant will be used by the

[10] ERIL is the French acronym for "Electrification Rurale d' Initiative Locale."

GoS to level the playing field for renewable technology. It will finance technical assistance and capacity building activities, and enable the internalization of positive global environmental externalities through the use of some targeted investment subsidies.

The ASER, the FER, and the Private Sector: Key Players that Support the Drive for Rural Electrification

The GoS has created a single, national, and autonomous entity, the *Agence Sénégalaise de l'Electrification Rurale, or ASER*, to implement the rural electrification program. The agency was created in 1998 through the Electricity Reform Law, and its principal mission is to promote rural electrification by providing the requisite technical and financial assistance pursuant to the energy policy formulated by the minister of energy. ASER now has 25 staff members, and its capacity is being reinforced as part of the World Bank funded project.

More precisely, the missions of the ASER are:

- Developing services relative to the RE; providing project evaluation, technical financial, and jurisdictional packaging support; review of innovative technologies and of technical services to RE material and equipment
- Providing information to all partners on the options and available alternatives relative to RE projects
- Providing supervision on behalf of the Ministry of Energy for the rollout of rural electrification concessions
- Designing the concessions, supervising, and undertaking all steps for their attribution and providing required assistance to the concessionaire selected
- Managing the financing of rural electrification by setting financing policy and mobilizing the support for funding partners
- Monitoring and evaluating the implementation of rural electrification and checking the quality of equipment, controlling the safety of operations, and arbitrating conflicts among stakeholders

A *Rural Electrification Fund (FER)* also was created and funded from resources provided by the national budget and as well as international donor organizations. Mobilization of these resources is subject to specific and strict procedures. Within FER, special accounts were opened by ASER allowing a separation of funds allocated to investment in concessions from funds allocated to other supporting activities, an easier tracking of sources and disbursements of funds (national budget, donors, etc.) and to meet some donors' specific requirements. Over time, it is envisioned that the financing instruments may comprise direct subsidies; refinancing; guarantees backed up by the FER or other instruments; interest-relief accounts; and specific funding facilities for ERIL's set-up costs. However, in the initial project phase, only the subsidy account and the funds for ERILs will be activated by ASER.

Finally, the private sector is expected to play a central role in the implementation of the program, and great care was given to ensure this. Throughout the project preparation phase, special emphasis was placed on maintaining close contacts with private-sector stakeholders to assess their perception of the project and their understanding and acceptance of its institutional, legal and regulatory framework. Several workshops were held in Dakar in 2003, 2004, 2005, and 2006 that registered attendance far beyond expectations. More than 200 representatives from over 60 firms, including 14 international firms, attended these workshops.

Mechanisms for the Award of Concessions and the Support to Electrification

The award of concessions to private operators is done internationally and competitively. The selection criteria maximize the number of beneficiaries, or connections, for a given amount of subsidy. The concession agreement gives the concessionaire the right to generate, distribute, and sell electricity throughout the concession area for a period of 25 years. This right is exclusive when the chosen technology is grid extension—because grid is a natural monopoly—but is not when the concessionaire chooses individual photovoltaic (PV) systems or other technologies.

The bidding process is designed to be results oriented. The concessionaire is chosen using a two-stage international competitive bidding (ICB) process with prequalification. The firm that offers to provide the maximum number of connections within the first three years, for a preset subsidy amount, is awarded the concession. Such criteria maximize private funds committed for a given subsidy and motivate the bidders to increase their contribution and serve more clients. It also encourages bidders to seek a lower unit cost as a way of increasing the number of clients served with a given amount of public resources available.

In addition to the core investment subsidy allocated to the concession area, an additional subsidy, which targets exclusively renewable energy solutions and is financed under a grant received from the Global Environment Facility (GEF), is also made available to level the playing field for renewables. The selection criteria remain the maximum number of connections independently of whether or not bidders claim the GEF subsidy. To overcome the barrier of high up-front connection costs, and to leverage private financial resources and ensure the quality of connections, the concession program uses *output-based aid* (OBA) type of capital subsidies. Under OBA subsidies, a significant part of the subsidy is disbursed only after the connections (including internal installations) are made and verified. A full ex-post OBA disbursement was not deemed feasible, since it would entail a high up-front capital financing requirement on concessionaires. In addition, it was determined that private bidders would not be willing to take such a financing risk without a higher amount of subsidy. Hence, it was decided to disburse the OBA subsidy in tranches following predetermined milestones reached by the service provider. However, to ensure that effective connections happen, the final 40 percent of the subsidy is being paid only after the connections are made and verified by ASER.

The business plan model developed during the concession design phase has demonstrated that the monthly user payments will cover the operation and maintenance costs, delivery costs, and replacement costs of systems, as well as at least 20 percent of initial investment cost, assuming a 20 percent rate of return. Therefore, the concession agreement requires the concessionaire to contribute at least 20 percent of the total investment costs. This financial commitment of the concessionaire will ensure service delivery throughout the concession term, since consumers' monthly payments remain the source of return on investment for the concessionaire.

Progress in the Implementation of the RE Concessions

The bidding process for the first concession in Dagana-Podor Saint Louis, Senegal, was launched in early June 2006 by ASER under Phase I of an IDA-GEF project. The private sector welcomed the OBA subsidy tender, and eight firms formally applied for prequalification, either on their own or in consortium with other firms. These results were particularly encouraging, since these firms represent the full range of private participants being targeted by the PPER program: local private sector (EQUIP+ and CSI-Matforce), private sector from the region (ONE from Morocco), as well as international firms (Electricite de France (EDF) and Total Energie Dévelopement from France, and the National Rural Electrification Cooperatives Association (NRECA) from the United States).

Out of the four applications received for prequalification, two were prequalified—ONE from Morocco and a consortium of EDF, Total and CSI-Matforce. Final bids were received in August 2006 and the evaluation process was completed in November 2006.

The winning bid led to a dramatic increase in the number of connections compared to what was initially expected based on consultant simulation. The winning bid, by ONE from Morocco, proposed to more than double the minimum 8,500 connections set in the tender documents with a target of 21,800 connections. To achieve such a figure, the winner brought US$9.6 million of private financing (equity and commercial loans), which is far higher than the 20 percent expected. Average cost per connection was estimated at US$725 and the average estimated subsidy per connection requested was around US$286, representing 40 percent of total cost, far less than originally expected.

Around one-fourth of all connections will be achieved through individual PV systems, lowering the incremental GEF subsidy to only US$1.03 /Watt peak or "Wp" (US$400,000 GEF subsidy for 389,000 Wp). These results demonstrate that the combination of international competitive bidding with OBA can leverage significant amount of private resources and potentially deliver far better results than a traditional non-OBA-based rural electrification approach.

The PPER program plans to launch at least three new concessions every year. The prequalification process for the next wave of concessions was launched at the end of 2006, with two concessions being funded under Phase 1 of the IDA/GEF project and one under an African Development Bank (AfDB) loan. AfDB and KfW, the German Cooperation Agency, have committed 14 million euros and 8 million euros, respectively, to finance two additional PPER concessions each.

Two Approaches Contained within the Rural Electrification Strategy and Targeting to Increase the Impact on Rural Communities

Although innovative in many respects, the Senegalese rural electrification strategy did not specifically address the issues of limited impact on income generation and of lack of cross-sector cooperation. Therefore, there was a risk that its final impact on rural communities would end up being limited. To avoid such outcome, the work was expanded to generate a demand for social and productive uses of electricity in addition to basic household uses that generally develop following such rural electrification project.

This meant identifying, assessing, and promoting social uses of electricity—primarily within the health and education sectors—to ensure collective gain as well as to promote productive uses of electricity for income generation that support gains at individual level. The productive uses of electricity—defined here as uses of electricity that support any activity that will generate revenue to the user—are the center of this document. The uses of electricity that are here defined as productive can vary widely and are subject to interpretation. For example, lighting will be considered nonproductive if it is used in a household to go about daily life at night, but will be productive if used by a small grocer to attract customers after dark or if the same household uses it to sew clothes to be sold at a market.

Each time, depending on the dominant economic activities found in regions affected by the rural electrification project, a different group of sectors will be targeted in order to identify the most promising activities for livelihood improvement and social development. It could be small businesses in one region, craft in another, and support to agriculture and food transformation in a third.

The Systematic Approach: Identification and Promotion of Productive Uses of Electricity

The systematic approach analyzes in a specified rural area, the technologies used in the current production chains. It identifies the bottlenecks and sees whether the use of electricity can contribute to diminishing or removing the limiting factors.

It is *systematic* in the sense that it entails a thorough review of all productive or social activities taking place in a designated area and requires substantial interaction with the anchor sectors to ensure a good understanding of their specificities.

Although the methods are quite generic, the results will depend on each area studied. The implications for prioritization will also be tailored to the specificity of each area. The study will yield a list of activities that can gain from access to electricity. It uses the estimation of the magnitude of the gains—which vary according to each activity in each region—to prioritize the level of effort to be put in promoting the use of electricity for each type of activity identified.

The Pragmatic Approach: Collaboration with Other Sectors' Key Programs via the Multi-Sector Energy Investment Projects (MEC)

The pragmatic approach is opportunistic in the sense that it aims at taking advantage of preexisting opportunities in a given sector or in a specific rural area. It is implemented when conditions are ripe for a quick win project or an activity that would rapidly obtain large sectoral gains from access to electricity.

It is *pragmatic* in that it focuses on existing projects or programs in other sectors where most of the identification and preparation work has already been undertaken. In this case, the magnitude of the gain, while important, matters less than the feasibility and rapidity of the implementation of the identified projects.

Although quite different in design, scope, and targets, the systematic and pragmatic approaches are complementary. The former provides the frame of reference for potential users of electricity for productive purposes; it convinces them of the role and value of investing in electricity-using equipment or appliances to improve their productive process. The latter provides an early case study with tangible real-world results within a quick time frame. The two approaches were developed in Senegal, which will be used as case study in this report, but they are applicable to almost any rural electrification project.

2 Identification and Promotion of Productive Uses of Electricity: A Systematic Approach

As was briefly presented in Chapter 1, the systematic approach serves to develop an accurate picture of existing productive activities in order to direct energy investments in a manner that will serve the goal of rural development. To this end, a multi-step approach is described in this chapter. It is first explained in a generic fashion and then illustrated by using the case of the Senegal experience.

This chapter will focus on electricity. Other sources of energy might provide as good or better outputs depending on the type of activity considered and in such case, this will be acknowledged and a swap to electricity will not be advocated. All types of sources of electricity are considered, whether it is provided by a central grid, a mini-grid, or self-generated such as generators, solar, hydro, or wind. The source of the electricity matters less than how it is used and how adequate it is to meet the end users needs.

More specifically, the focus will be on productive uses of electricity, setting aside household uses as well as social uses for which a nonproductive label may not be fully accurate but is widely accepted. The focus is on productive activities primarily for their revenue generation aspect, which is highly needed in rural areas in order to move beyond a subsistence economy. However, a similar approach could be undertaken in the case of social use of electricity, looking into means to increase their impact.

A Generic Overview of the Systematic Approach to Promote Productive Uses of Electricity

Using the collaborative links established with sector practitioners (see Cross-sector Collaboration in Chapter 1) a series of data gathering and fact checking activities are undertaken both at central level and in the field. This is done using sector specialists networks, ministries and official agencies, local government as well as NGOs resources. This data gathering enables the decision makers to understand the socioeconomic context within which the decision to bring access to electricity is made and how it may contribute to increased economic activities and incomes in a given area. It is recommended that a dedicated consultant be hired to undertake or coordinate such activities, because as one ventures into the periphery of stakeholder knowledge, the risk of losing focus can be high.

The systematic approach to the identification and promotion of productive uses of electricity is to be implemented in five key steps:

(i) Identify the productive activities and the sectors in which they currently take place in the project area.
(ii) Carefully analyze the production processes involved within the region of interest. Identification of the existing limitations

and areas of possible improvement of these processes.

(iii) Analyze the role electricity can play and what equipment is required.

(iv) Analyze the technical feasibility and economic and social viability of the electrically based solution proposed.

(v) Implement a promotion campaign to communicate the gains that can be obtained. Based on the results of the earlier analysis, the campaign should target specific energy users and promote a specific use of electricity that can provide them with clear benefits.

The first two steps usually lay outside of the usual sphere of knowledge of most energy specialists, but they are nonetheless central to a good identification and analysis of the following steps, which are more energy-centered.

Step 1: Identify the Type of Productive Activities Taking Place in Each Sector and Subsector of the Targeted Rural Areas

Having identified the region where an energy-related project is to be implemented, the rural areas are scanned to identify major sectors and subsectors. The mining sector, energy generation facilities, and large industries should be set aside, since they are usually either self-sufficient or large enough to be provided for by dedicated projects.

In rural areas, *the regions* are characterized by the specific agricultural systems that adapt to local conditions, and by the related cottage industries or artisan networks supporting productive activities. It is likely that most of the other sector activities will revolve around these various agricultural systems, which emphasizes the importance of establishing a good collaboration with agricultural specialists.

Examples of *productive sectors* found in rural areas start with agriculture, which, depending on the area, may include subsectors such as cash crops, food crops, fresh market crops, tree crops, fishing, timber, and livestock farming. Linked to these are cottage industries and home-based activities in the small industry and services sectors and their subsectors. These could include agriculture products transformation such as bakeries, drink and juices making, dairy products, meat and fish transformation, tannery, and woodwork. Support to production activities such as production and repairs of equipment, building, fertilizers and pesticides, and services to households and small businesses, for example, transport, markets and grocers, clothing, and restaurateurs could also be included.

All of these sectors and subsectors productive processes are intertwined, making it difficult to identify each activity's contribution to the whole and how energy can fit as an enhancing tool. Furthermore, the range of knowledge of the sector specialist may only span a few of the activities in consideration, and this may complicate the global review. One way to address the complexity is to use the "Sector-System Matrix,"[11] with examples shown in Table 2.1 and Table 2.2.

The *Sector-System Matrix* shows the different commodities produced within each subsector. The rows list the different tasks required to produce and transform these commodities into finished products. Using a simplified format, the matrix can provide an overview of the subsectors present in a region studied and of the commodities produced in this region. A more complex format of the matrix, would list carefully for each commodity each step of activity required of its production and the key players involved.

It is useful to note that at that stage, identifying and understanding the activities for which electricity does not yet bring a contribution is as important as for the ones where it does. This is because that situation may change, and understanding the full linkages can help avoid electric investments that may seem useful but in fact would not improve the overall production

[11] Adapted from "*A Strategic Approach to Agricultural Research Program Planning in Sub-Sahara Africa,*" Boughton et al., MSU International Development, working paper 49, 1995.

Table 2.1 The Sector-System Matrix

COMMODITIES, TASKS and PLAYERS	SECTOR X, in REGION A					
	Subsector			Subsector		
	Commodity 1	Commodity 2	Commodity 3	Commodity 4	Commodity 5	Etc …
Task 1						
Task 2						
. . .						
Task *n*						

process. It may be, for example, that a specific step of the process to produce a commodity could see its productivity greatly improved by using electricity but that investing in electricity would not make sense because the step immediately before suffers from a non–electricity-related bottleneck.

Although systematic, the approach does not necessarily need to be exhaustive. There is a trade-off to be considered between the transaction cost of analyzing one additional commodity or subsector and the benefit expected from the information generated in terms of economic development. Priority should be given initially to existing or potential activities that are already acknowledged to be of major importance for the region. The simplified version of the matrix maps out the activities undertaken in each region and can help spot gaps (lack of one type of activity in a region that could create a bottleneck) and identify cross-dependency (between corn subsector and livestock production, for example).

In addition to the agriculture system matrix, other system matrixes could be developed to cover the service industry and the cottage industry, as well as nonproductive sectors, such as health, education, and administrative services, if relevant to the goals of the project.

At the end of this initial step, the productive activities and their key outputs should be known, and by extension, a list of the central stakeholders to involve in the discussion should emerge. Such a list might be quite extensive; including sector specialists, local administrators, practitioners' representatives, equipment producers, retails and grocers, and cottage industries. Working with rural development experts during this initial mapping exercise might help the energy specialist keep focus.

Step 2: Analyze the Production Process for Each Commodity and Identify the Areas of Improvement

Once all the productive activities taking place in a targeted project region have been identified and mapped out by sectors and subsectors, the following step is to analyze in detail each tasks of the production process in the subsectors that are active in the region. Depending on the similarity of productive tasks required, the analysis can be done for groups of commodities by subsectors (the threshing activity is common to most cereal plants for example) or commodity by commodity (watering needs differ among cash crops for example). Table 2.2 gives a theoretical illustration of a possible output in the form of a developed Sector-System Matrix for Agriculture in an imaginary *Region A*.

The matrix is developed both at the central and regional level in cooperation with sector specialists. It provides the list of individuals and entities involved in the tasks to produce the commodities. Sector specialists will be able to point out shortcomings or bottlenecks in the productive activity, as well as the initial explanation of it. Comparing the best-case matrix (with well functioning subsectors and a full set of tasks implemented) with the field matrix (the reality as seen in the field) can pinpoint areas of improvement on which the study could concentrate.

For example, the illustration in Table 2.2 shows that the dairy and the river fisheries only cater to local markets and do not provide transformation, transport, and storage. Looking into it, by field investigation and interrogation of the key players might provide different reasons explaining this. The situation could be due to lack of transportation infrastructure due to remoteness, coupled with a lack of market for the transformed commodities, and thus no transformations effort is deemed necessary. Another possibility may be that a transportation network may exist (as for the peanut commodity) but not be used because no transformation of the raw commodity occurs, thus diminishing the relevance of the commodity to the outer markets. This may be because the untransformed commodity itself is not transportable.

In the first case—no existing transport infrastructure—the fix may be well beyond the reach of the energy sector and investing energy resources may be wasted. In the second case—of the existing but unused transport infrastructure—while the energy sector may not be the primary responder to the problem, it may contribute to the solution. For example, energy may help provide refrigeration or icing to provide conservation and enable transport of fish to higher-valued markets, or it could provide heating to kill bacteria in collected milk, refrigeration for preservation, and further processing into cheese or another product.

The analysis of the production process is also an occasion to review the cross-dependencies of the various commodities in the area of study. For example, would the local cottage industry be able to provide sufficient nets and boats for the fishermen if the demand for fish increased following downstream processing and opening to export to other markets? Investment in electricity may help boost productivity but may be of little use if upstream tasks or commodities remain constrained. The review of the production process might also help identify new opportunities to exploit complementarities or similarities between commodities' production processes.

Step 3: Assess When Electricity Can Contribute to Potential Gains; Identifying the Required Equipment

Having identified and investigated the areas of possible improvement, the nature of the bottlenecks or inefficiencies should be examined. Although some areas of improvement may lay beyond the reach of the energy sector, in many cases access to electricity may bring increased value, added competitiveness, improved quality, improved productivity, or even the creation of a new activity altogether. Thus, using the areas of improvement identified in collaboration with sector specialists, a closer look will be given to the ones where electricity can provide improvement. During this step, energy specialists should take back leadership of the process, which had been left to the other sector specialists during the two previous steps. It is the energy specialists' technical knowledge that will be required in identifying the level of expected gains, the type of electricity desirable, and the list of possible equipment needed. Equipment refers both to the electricity generation or distribution equipment before the meter and the productive equipment using electricity after the meter.

In many developing countries, for instance, the harvesting and the initial processing (primarily threshing) can take up to 40 percent of the total time required for the commodity production. Often, these tasks need to be done in a short time frame, during which the commodity is ripe. The lack of human resources creates a bottleneck that can reduce the total output and increase losses dramatically. Although the capacity of electricity to contribute to the harvesting is limited, its involvement in the primary processing can free-up valuable human

Table 2.2 Illustration of Sector-System Matrix, for Agriculture in Region A

COMMODITIES, (in lines) TASKS, (in columns) and PLAYERS, (in cells)	AGRICULTURE SECTOR, REGION A									
	Cash Crop Subsector			Livestock Subsector			Fishery Subsector			Other Subsector
	Cotton	**Peanuts**	**Etc.**	**Dairy**	**Meat**	**Etc.**	**River Fish**	**Shellfish**	**Etc.**	**Etc.**
Investment (seeds, material, heads)		Farmers blacksmiths, grocers, cooperatives					Nets, boats making, cottage industries, fishermen			
Preparation (tillage, tools, fertilizer)		Farmers, cooperatives								
Inputs (seeds, feed)		Grocers, farmers		Feed providers, farmers						
Caretaking (water, material, pesticides)		Farmers, utility, local government		Farmer, veterinary, aid groups						
Harvest (crop, fish, milk)		Farmers, cooperatives		Farmer, health authorities, equipment providers			Fishermen, health enforcement			
Initial processing (threshing, icing, etc.)		Farmers, coop, family, small cottage industry		Only minimal processing: Family, small cottage industry			No further processing: Sold live, dried or salted			
Transport and storage		Trans-portation, cooperatives								
Transformation (milling, cooking, drying)		Small cottage industry, coop								
Resale (Grosser, markets retail)				Direct in markets			Direct in markets			
Intermediary consumption (use by another sector to produce its own goods)		Cottage industries								

Notes: The text in the shaded cell provides the list of key players or stakeholders that will have an influence in how the task is performed and could provide clues on shortcomings or bottlenecks in the productive activity.

resources and thus increase the overall quantity of commodity harvestable. Hence, the gain brought by electricity would be the sum of the gain in time and quality of the processing, as well as the gain in additional harvesting rendered possible by the reallocation of manpower to harvesting from processing.

A new matrix called "Electricity Contribution to the Commodity Value Chain"[12] may be produced and used to organize the outputs of this step. Table 2.3 provides an example, referring to the possible contribution of electricity to the peanut, dairy, and fish during the transformation task previously identified as missing or incomplete in Table 2.2 for the theoretical Region A. This is given as a nonexhaustive illustration, as other steps and commodities could also benefit from use of electricity in Table 2.2. Table 2.3 provides the link between the commodities transformed and the intermediary or final products. It outlines the type of generic equipment required for this transformation, as well as the required type of electricity source (that will later need to be matched with available sources) and the potential providers of equipment available in the region of study. It also provides a preliminary listing of the type of support that will be necessary to encourage the acquisition, the correct use, and maintenance of the equipment by potential users as well as a listing of expected beneficiaries and possible providers of such support.

Before the meter, the type of equipment and source of electricity should be evaluated both from availability and economic standpoints as well as from the standpoint of the type of need in power and reliability. Although renewable energies may provide practical answers in many cases and seem logical due to the remoteness of many project sites, they may not provide sufficient power to be used with many productive tools and equipment. Solar, hydro, wind, biomass, minigrids, and central grid electrify provide different levels of power, quality, and cost-effectiveness that add up to different electricity services for different tools and equipments.

Thus, it is important to establish the link between the expected gains identified and the behind-meter type of equipment or tools necessary, and then match them with the type of electricity source required. A variety of equipment and tools will be identified, some able to be produced locally, some needing to be imported from urban centers or from abroad. Some production processes may need to be reorganized to make the best use of the new equipment; some others may benefit from cost savings or increased speed with minimal disturbances, such as in the case of switching a thresher from diesel to electric.

Step 4: Establish the Economic Viability of a New Production Process and of the Conditions for Its Implementation

Following the completion of the earlier step, one should have gained a good overview of the contribution of electricity to some parts of the production process. The current step will build the case for an adaptation of the production process, primarily by identifying the economic and financial gains expected from a switch to electricity. This step is also an occasion to examine the competitiveness of electricity versus other production process and eliminate projects where a feasible alternative brings cheaper, easier, or better results. Great care should also be taken when the electricity option is considered superior for social or environmental reasons but is not directly financially viable. In other words, the aim is to advocate the benefits of electricity, but not at all costs.

This step should entail thorough field work to collect production costs, labor costs, intermediary input costs, market resale prices of the commodity, and the processed product level, as well as market absorption capacity both at the region level or the nearby urban areas. There are many thorough guides on the subject of creating business plans, so this will not be detailed much further here. However, a preliminary level of information should be created to encourage

[12] Adapted from "A study to increase productive uses of electricity for in rural areas", EXA Development, Senegal, April 2005

Table 2.3 Example of Electricity Contribution to the Commodity Value Chain: Case of the Task Transformation for Peanut, Fish, and Dairy Commodities

Commodity	Transformed Good	Type of Equipments	Type of Electricity	Equipment Providers	Beneficiaries and Support Providers	Example of Required Support
Peanut	Salted peanuts	Roaster / sacking	Grid, Mini Grid, Diesel set	Local industries, International groups. *Examples:* Temdo, Tanzania Euromat, France Devraj, India	Beneficiaries: - Farmers/ Fishermen - Cooperatives - Women coops - Small cottage industries	- Financial support for equipment purchase. - Training of users - Training and support to develop local producers of equipment. - Business training of users to help with investment capacities. - Support to counter initial negative cash flow
	Peanut paste or butter	Roaster / Grinder	Grid, Mini Grid, Diesel set			
	Peanut oil	Sheller / Masher-squeezer	Grid, Mini Grid, Diesel set			
Fish	Dried fish	Drier	Solar, Grid, Mini Grid, Diesel set.	Local industries, International groups. *Examples:* Marinas, Philippines Jyoti, India Lehman, USA Narang, India Petersime, Brazil	Support providers: - Cooperatives - Equipment providers - Training institutes - Finance providers - Unions - Research centers - Donor programs - Local governments - Utilities	
	Fish flour	Sifter / Shredder / Autoclave	Grid, Mini Grid, Diesel set			
	Frozen fish	Cold storage	Grid, Mini Grid, Diesel set			
Dairy	Dairy products (Homogenized milk, yogurt, cheese, butter)	Sterilizer / Churner / Skimmer / Packager	Grid, Mini Grid, Diesel set	Local industries, International groups. *Examples:* Udyog, India Sismar, Senegal		

practitioners to look further into the option of using electricity for their productive activities.

Table 2.4 provides another theoretical example of calculations and matrixes, using the peanut commodity that could be used to engage stakeholders. It provides calculations of the expected cost reduction when moving from a baseline production process to the use of electricity. In this example, cost reductions have been calculated for the three tasks where a potential gain had been identified in the earlier steps. In most cases, the baseline used to calculate the cost reduction was obtained from field surveys or was calculated in cooperation with the given sector specialist.

The information from Table 2.4 is to be used as a discussion basis with farmer unions, cooperatives, and other stakeholders to discuss the option of investment in electricity and productive equipment using electricity. Depending on the level or receptiveness of the stakeholders, further economic analysis will then be undertaken, including valuation of volume increase and quality improvement that are not included in the current calculations of cost reduction.

The primary focus is placed on these financial and economic assessments because they will indicate the cost recovery capacities of the electricity users, and therefore their capacity to repay the investment, as well as face the variable costs. This, in turn, will determine the certainty of payment for electricity and therefore the level of risk that electricity providers will bear for electricity purchase and investment in distribution network. Some attention should also be paid to the other nonfinancial issues and conditions that will contribute to the effective success of a production process change. Farmers' training and cottage industries on effective equipment choice, use and maintenance are examples. Other issues to keep in mind could be access to adequate financing sources, knowledge of market demand and competition, transportation infrastructures, availability of trained operators, reliability of input providers, existence of support groups, government incentives, and so on.

The work undertaken during this step should provide a helpful tool to rural electricity projects managers in prioritizing the localization of new electricity investments. It may also be helpful to task managers in charge of orienting the electricity-related investments in a fashion that favors productive uses of electricity. Although this may be only one of multiple variables to consider, using productivity increase or level of cost reduction for each task may help pinpoint areas where there are clusters of tasks that could benefit from a new electricity access or identify tasks and commodities that would benefit most from a selective access to electricity.

Step 5: Design and Implement Promotion Campaigns Tailored to Each Type of End Users

Prior to this final step, the economic viability of the change of production process to integrate electricity uses should be established; and sector stakeholders should be convinced of the interest of the approach or at least view favorably trying it in a given area and subsectors. Then a promotional campaign or road show can be contemplated. Depending on the most efficient medium, such a campaign could be tailored to target subsectors, tasks, regions, or a mix of the three. Table 2.5 gives an overview of potential stakeholders that could be engaged in the design and execution of the information campaign.

Not all stakeholders listed here are relevant to all information campaigns and it may be that, to keep a campaign well-focused and relevant to end users, the number of stakeholders involved can be narrowed to these immediately relevant to the subject discussed.

Take, for example, the case of an information campaign for the use of a "jigger-screener" electric machine. In the peanut commodity (see Table 2.4), such a machine was found to reduce costs of 76 percent from a manual baseline by separating residues from the usable pieces while increasing the quantity processed daily and improving the quality of

Table 2.4 Example of Estimated Cost Reduction Obtained from the Use of Electric Equipment

Equipment (Power)	Function	Estimated Fixed Costs (Fictional currency)	Estimated Yearly Variable Costs (Fictional currency, Fc)	Production Capacity	Estimated Value of Cost Reduction (Compared with baseline)	Estimated Gain in Percentage (Compared with baseline)
			Task "Caretaking"			
Electric motor-pump (5 to 30 hp)	Irrigation pumping	30 to 90 Fc (Fc = Fictional currency)	(D = Depreciation, E = Electricity costs M = Maintenance) M=Maintenance) D= 6 to 18 Fc E = 1.2 to 7 Fc M = 3 to 9 Fc	75 to 150 m^3/h Hourly cost of 55 Fc	If from rainfall baseline: Increase of cost 55 Fc/h If from manual baseline: Decrease of cost 21 Fc/h If from diesel baseline: Decrease of costs of 14 Fc	Net cost against rainfall baseline. But, if insufficient rainfall, baseline becomes manual or diesel pumping, thus there is a net cost decrease of 30 and 20 percent, respectively. Nb: With rainfall baseline: increase in yield may also justify investment
			Task "Initial Processing"			
Threshing machine (7 to 9 Kw)	Threshing	56 Fc	D = 11.2 Fc E = 8.55 to 11 Fc M = 5.6 Fc	Additional 6,5 to 10 ton/day from manual baseline	Machine 40 Fc/ton Manual 75 Fc/ton Cost reduction: 35 Fc/ton	Reduction 47 percent From manual to electric engine
Jigger and screener (2 à 3 CV)	Separating shells and residues	45 Fc	D = 9 Fc E = 0.46 to 0.7 Fc M = 4.5 Fc	Additional 20 t/d from manual sifting	Machine 30 Fc/ton Manual 125 Fc/ton Cost reduction: 90 Fc/ton	Reduction 76 percent From manual to electric engine
			Task "Transformation"			
Electric crusher for peanut paste (3 KW)	Crushing and mixing into paste	15 Fc	D = 5 Fc E = 3.65 Fc M = 1.5 Fc	150 Kg/h	Machine 30.5 Fc/h Manual 72.6 Fc/h Cost reduction = 42.1 Fc/h or 280 Fc/ton	Reduction 76 percent From manual to electric engine
Masher-squeezer semi industrial (40 kVA)	Peanut Oil extraction	300 Fc	D = 30 Fc E = 39 Fc M = 30 Fc	1 600 t/d	Machine 0.21 Fc/t Manual 15.5 Fc/t Cost reduction = 15.4 Fc/t	Cost reduction 99.9 percent From manual to semi-industrial electric engine
Automatic measurer-bagger (1 KW)	Conditioning and packaging	30 Fc	D = 10 E = 1.2 M = 3	180 Kg/h	New activity rendered possible following previous transformation activities. No baseline, to compare from, gain to be calculated from classic business plan.	

Table 2.5 List of Stakeholders That Could Be Involved in a Promotion Campaign

Stakeholder	Possible Role in Promoting Adoption of Electricity
Manufacturers, suppliers: • Local distributors of targeted equipment • National manufacturers • Local cottage industries • Maintenance service providers	Demonstration of equipment Possibly technical adaptation to local uses Training of users Develop retail network to facilitate local purchase of the targeted equipment
Energy sector: • Utilities • Energy service providers and their associations • Retail technology vendors	RE targets; DSM; consumer awareness/support Customer education and 'training'; adherence to standards Customer education and training Completing the energy infrastructure to adjust to the local growth of energy demand
Financial institutions: • Private banks • Development banks • Micro-finance and credit unions	Providing customized financing to potential users willing to purchase the targeted equipment Risk analysis Sector awareness Customer education to loans
Sector-specific development entities: • Agriculture and other institutes • Enterprises promotion centers • Donor-funded projects	Providing sector knowledge, field presence, user confidence, networking and outreach capacities, demonstration capacity, vocational training, etc. Training of users
Education sector	Curriculum development • For vocational classrooms • For teacher training • For current practitioners
Policymakers, regulators: • In the electricity sector • In other sectors central to adoption of change of production process	Adoption and enforcement of: Standards and quality review, productive uses adoption targets, support of adequate and available electricity supply, price regulation

the finished product (peanuts free of shells and residues). Assuming that the production of peanuts is done in very specific regions, a series of meetings at the villages in production areas, at markets, and possibly cooperatives would involve manufacturers-suppliers of such machines, electricians, agriculture specialists, and some local financing entity. The agriculture specialist would explain the expected gains for the growers and detail how they measure against estimated investments and exploitation costs. The manufacturers would bring and demonstrate a range of machines suited to the quantity likely to be treated by the different types of users. The electrician would explain the electric requirements and installation methods and would establish the link to existing and forecasted electric availability in the areas visited. And finally, local finance representatives would describe the range of financing options realistically available to cover the investment cost. These last participants would be key to a successful campaign. Most potential beneficiaries would need some access to affordable credit to undertake the necessary investment to seize the demonstrated opportunity to increase their productivity and their income generation.

Although the design of a promotional campaign is not the subject of this work, a few basic principles for such design can be mentioned. Whenever possible, bearing in mind the feasibility factor, the design of the campaign should be participative, engaging both practitioners in the target sectors and the local authorities and populations. This will ensure that the proposed technical response to a need effectively caters to and answers such need and is acceptable from a local and social point of view. It should be integrative, taking into account existing and past initiatives in the targeted sectors or areas to avoid duplication or repetition of past well-intended errors. It should be prospective, bearing in mind the impact of proposed changes of customs in the productive field, on the downstream tasks and the final commodities or transformed goods. And it should be empowering, both at the individual and the local level, avoiding catching end users in a web of dependencies that they cannot master, and favoring local equipment manufacturers and outfitters whenever feasible.

In collaboration with stakeholders, thematic meetings should be held in the regions. They should involve suppliers, providers, and manufacturers of electricity-powered productive equipment to present, demonstrate, and obtain feedback on their materials, equipment, maintenance, capacities, after sale services, and policies. Possibly, energy specialists might have earlier undertaken a review of performance and reliability of such products, within the specific context of the tasks identified, and can share these neutral reviews with end users. Also, centralized resource centers can be established where individuals or cooperatives could find year-round information on the techniques, their availability, and their alternatives. Such centers could provide information in a very intelligible format, centered on the major tasks and commodities that have strong potential for improvement. In collaboration with the anchor sector specialists, thematic meetings on financing should also be held, helping to sort out what support exists for individuals and small nontraditional enterprises to invest. This could be existing public support that could be adapted to encompass electric equipment, donor policies to be adapted, or private-sector lending to be modified to take advantage of new opportunities.

The use of communication media should be adapted to habits, levels of literacy, and business knowledge of end users. It may therefore range from general mass media messages (radio, local TV, newspapers, billboards, leaflets, markets and fairs) to tailored information to target audiences (cooperative meetings, village assemblies, craft and trade unions, peer meetings, etc).

A Practical Application of the Systematic Approach: The Case of the Senegal Project

As explained in Chapter 1, Senegal had put substantial thought into, and invested time in, finding the way to foster cross-sector collaboration in order to obtain an effective increase of productive uses of electricity. Similar steps as the ones described in the generic overview were followed, but some steps were undertaken simultaneously, and this led to the following sequence:

1. Identification of the activity champion and its team
2. Categorization of productive activities
3. Electricity contribution to gains on production process, identification of required equipment, and determination of basic economic viability
4. Program and tools for advocacy of change

Identification of the Activity Champion and Its Team

The work started with identifying the individuals or entities that could champion the implementation of the activity. The activity in Senegal benefited from the favorable conjunction of World Bank task managers interested in cross-sector work, of the preexistence of the multisector committee—the CIMES/RP—and of the keen involvement of the rural electrification agency ASER in the subject. Given its hands-on capacity and its central role, it was decided that ASER would be the leading agency and that it would guide the work of the multisector committee.

The next action was to hire a consultant to undertake most of the legwork, coordination, data collection, analysis, policy recommendation and project identification. Using World Bank Trust Fund's ESMAP as the source of funding, a recruitment process was undertaken following World Bank guidelines. It should be noted that the activity that we describe in this chapter was not an isolated work but was bundled within a set of three major activities to be undertaken by the same consultant: (i) the analysis and promotion of productive uses of electricity, discussed in this chapter; (ii) the identification and development of the MECs, described in next chapter; and (iii) a review of the role of local government in RE projects, which is not included in this paper. It was done this way because of the connection between the three activities, and their results were expected to feed each other in a timely fashion.

After technical and economic evaluation, a local consultant company, the Senegalese Dakar-based EXA Development, was selected and hired. EXA Development provided a fully local team, with a wide variety of sector experts and a very good knowledge of Senegal's rural areas. The core consulting team included a rural electrification expert, a cottage and medium industry expert, and agronomist and machinist specialist, a local collectivities expert and a socio-economist. The secondary team included a health and education specialist, a project management expert, a training specialist, additional energy and electricity experts, and staff specialized in data gathering and analysis. This variety provided a wide range of perspectives, experience, and field knowledge to the consulting team, as well as good access to strategic stakeholders and central administrative contacts. It also ensured definitive ownership of the work being done in Senegal by Senegalese, with very little international involvement. Consequently, a longer-lasting effect was anticipated for the final results of the work, with possible replications in other sectors.

To kick-start the work, several meetings were held between the consultants and the World Bank representatives to discuss methodology and plan of action. It was followed, over a two-year period, by a series of workshops, numerous meetings, and field investigations. Frequent meetings were held also between the interministry committee that has been set up to promote cross-sector activities, the consultant, local stakeholders (central and local authorities, local rural communities and local NGOs among others), the ASER, and the private sector.

Categorization of Productive Activities

The data collection work started with a desk review of the public triennial investment program (PTIP) for the targeted rural areas, covering all sectors both productive (cottage and medium industries, commerce, farming and agriculture, fisheries etc.) and nonproductive (health, education, social and administrative services, etc.). This was coupled with reviews of strategies and current levels of involvement of the key central ministries and administrations, as well as interviews with their staff and project managers. This provided the start-up picture of project planning, as well as the baseline description of current field conditions as viewed by the central level.

The next step was to identify and list the type of technologies currently used in the productive sector. Table 2.6 provides the technology baseline for the cottage industry sector and complements the Sector-System Matrix of the St. Louis-Dagana-Podor regions, given later in Table 2.7. These three regions are grouped together because they constitute the first Rural Electrification Concession to be attributed under the concession program.

Table 2.6 Type of Technologies Currently in Use in the Cottage Industry Sectors in Rural Senegal

Line of Trade, Occupation	Type of Technology Used
Bakery—pastry shop	Traditional wood oven
Wine and palm oil	Rudimentary equipment (cask, barrel, bowls, wood fire)
Small dairy industry	Traditional tools (Bowls, hand wood batter, etc.)
Drink production (juices, liquor)	Rudimentary equipment (marmites, casks, stove, etc.)
Jam producer	Rudimentary equipment (marmites, casks, stove, etc.)
Fish drying and smoking	Wood stoves, sun drying by spreading on floor
Clothing industry	Sewing machine, manual or electric
Tanning, leather	Simple tools only
Cobbler, shoe maker	Small hand tools, sanders
Woodwork, joinery, millwork	Small hand tools, multipurpose machines
Calabash transformation	Small hand tools
Sawmill	Manual or electric saws
Pottery—ceramics	Small hand tools, traditional stoves
Small quarries	Simple tools (hammers, pick ax)
Smelters	Wood mold, simple coal oven
Metallurgy	Spot welders, soldering irons, hand drills, small tools, etc.
Blacksmithing	Anvil, hammer, pliers, etc.
Boiler making, pots pans, brassware	Spot welders, soldering irons, hand drills, small tools, etc.
Tool making for agriculture	Spot welders, soldering irons, hand drills, small tools, etc.
Masonry, stonework	Spatula, clamp, etc.
Salt harvest and treatment	Pick ax, shovel, casks, hand sorting, and sun drying
Soap factory	Rudimentary equipment (cask, barrel, bowls, wood fire)

This review of the level use of technology feeds into the mapping exercise that identifies, for the region of focus, the major tasks undertaken to obtain and transform commodities and goods. The list of these tasks is shown in Table 2.7. The team identified that the major areas of improvement resided in the *transformation tasks* of products or commodities, and decided to concentrate on these tasks during the implementation step.

Electricity Contribution to Gains in Production Process, Identification of Required Equipment and Determination of Basic Economic Viability

Here, for practical reasons, the Senegalese team grouped together steps 3 and 4 described earlier in the generic method. This exercise was primarily intended to identify the areas

Table 2.7 Sector-System Matrix for the St. Louis-Dagana-Podor Region Key Commodities and Tasks Currently Undertaken

		Crop Subsector			Animal Subsector			Cottage Industry Sector			Other
	Commodities, Tasks and Players	**Rice**	**Fruit Grower**	**Sub-sistence Crops**	**Fisheries**	**Poultry**	**Dairy**	**Cobbler, Leather Goods**	**Metallurgy**	**Clothing Industry**	**Market Garden Produce**
	Investment (seeds, material, heads)										
	Preparation (tillage, tools, fertilizer)										
	Inputs (seeds, feed, material)					By hand	By hand		Not locally	Not locally	
	Caretaking (water, material, pesticides)	Diesel pumps		Hand watering							Diesel pumps
	Harvest (crop, fish, milk, fruits)						By hand				
	Initial processing (threshing, icing)	Hand threshing		By hand	Limited			By hand			By hand
Tasks Usually Done by Cottage Industries	Transport and storage										None
	Transformation (milling, cooking drying, milling)	By hand or diesel	Sun drying, hand pressing	Limited, by hand	Limited			By hand	Simplified	By hand	By hand
	Resale (grosser, markets retail)								Local mostly		
	Intermediary consumption										

Note: In shaded box, the type of technology used is mentioned when it is relevant to the future steps to follow.

and sectors that had needs, and then prepare proposals to foster change of production methods and advocate for their improvement. Once the generic step 3 (analysis of gains on production process and required equipment) was completed, the focus moved rapidly to the establishment of Multisector Energy Investment Projects (MECs, explained in details in the Chapter 3) and to the practical implementation of step 4 (economic viability and conditions for implementation), rather than deepening its formal analysis as described earlier in the generic version. The process described in steps 3 and 4 of the generic method was nonetheless followed, and the details of the calculations are provided in the CD-Rom attached in the Annex.

This sequence of work provided the information summarized in Table 2.8, which classifies subsectors and tasks by the level of productivity increase expected to derive from the use of electricity. The initial analysis was done at the regional level and was then followed by thorough work to establish economic viability at the project level.

Table 2.8 provides the review of the level of cost reduction expected from a switch to electricity for specific tasks of the production process in agriculture and in the cottage and medium industries. The general ranking gives a sense of processes that should have a priority for electricity investment. In this case, it points toward the need to focus the intervention at the *transformation* level, which provides the highest levels of potential cost reduction.

Table 2.9 shows that to be complete, the analysis should have required a more thorough

Table 2.8 Estimated Cost Reduction, by Subsectors and Tasks, Brought by the Use of Electricity

Levels of Cost Reduction	Agriculture Sector	Cottage and Medium Industries
High	Dairy and poultry inputs (feed crusher, 69 percent, feed mixer, −73 percent)*	Fruit transformation (extractor, −97 percent)
	Dairy harvest (milking machine, −75 percent)	Fishery transformation (residue grinder, −98 percent)
	Rice transformation (husking, −84 percent, stone sorter, −75 percent)	Dairy processing (sterilizer/cookers +98 percent)
	Fishery initial processing and storage (refrigeration, −98)	
	Subsistence crop initial processing and transformation (huller, −92 percent, miller, −64 percent, granulator, −98 percent)	
Medium	Rice initial processing (threshing, −47 percent)	Leather initial processing and transformation (hydraulic press/sawing machine/splitter/stitcher, −33 percent,)
	Market garden produce caretaking (pumps, −21 percent)	Clothing industry transformation (embroider, −57 percent, Ironing, −42 percent)
Low	Crops and rice caretaking (pumps, −7.5 percent)	

* The use of an electric feed crusher in the Dairy and Poultry Inputs task can help reduce the cost of the feed crushing task by 69 percent.

Table 2.9 Cases Where Electricity Does Not Reduce Monetary Unit Costs But Increases Productivity: Cases of New Activities Without Original Baseline

	Agriculture Sector	Cottage and Medium Industries
Increased Productivity	Poultry incubator (increases number of eggs incubated and decreases losses)	Clothing industry transformation (sewing, whipping, embroider, ironing). Up to 2400 percent increase in monthly outputs
	Fruit dryer (decreases time, evenness and decreases losses)	Leather transformation (hydraulic press, sawing machine, and splitter). Up to 900 percent increase in monthly outputs
New Activity	Storage and refrigeration of raw products (dairy, fishery, fruits and market gardens)	Conditioning, storage and refrigeration of transformed products (dairy, fishery, fruits and market gardens)
	Bagging/sacking (crops, rice, market garden produce, fruits, fisheries)	Metallurgy transformation (welding, soldering, metal grinding, boring)

examination of the increase of productivity through increased quantities or quality of products obtained by use of electricity, in addition to the analysis based on cost reduction. For example, in the clothing industry, no monetary cost reduction per unit was found to come from the use of electricity in the embroidery of Boubous, but using dressmaking electric equipment provoked a dramatic increase in quantity produced, going on a monthly basis from 4 pieces to close to a 100. Also, through uses of electricity, new activities can be created that did not exist before and therefore cannot be valued from a cost-reduction standpoint. Electricity used for refrigeration or conditioning of transformed dairy products, for example, can help increase their life duration to a point where it becomes valuable to produce them, whereas before, rapid decay would lead to little interest in such products. The key question in the case of new activities then becomes whether they can find a sustainable market at a profitable price. This is one of the limitations of the current work, which focused on removing bottlenecks or hourglass situations where a viable market demand already existed for the commodity that was being produced more efficiently.

Program and Tools for Advocacy of Change

The results of this work were used, in part, to support the work of the MECs described in next chapter, but also as a supporting tool to the ASER (Senegalese Agency for Rural Electrification) for its "Program to Maximize the Impact of Rural Electrification." This program focuses on increasing productivity in productive sectors of rural areas, as well as creating and valorizing new economic activities in these rural areas by use of electricity. The scope of the program was defined in order to avoid duplicating other stakeholders' existing initiatives and to avoid pushing toward unjustified or unsustainable levels of use of electricity. There is, hence, a strong adequacy with the spirit of the approach we just described in this subchapter, which involved substantial work across sectors as well as a specific evaluation of the level of gain expected from the conversion to electricity for a given task in a given subsector. Using the systematic approach decreases the risk of providing blanket statements on universal value of electricity that are likely to mislead potential users.

The ASER used the information generated by this work to feed into its RE impact maximization program and inform and enhance its realm of intervention. The program includes the following goals:

- Refinancing support to the decentralized financing organisms that target grassroots development in rural areas
- Support the availability, marketing and commercialization of relevant and viable electric equipment and materials
- Support the development of targeted rural agro-industrial projects
- Creation of a sector-specific database documenting the benefits that can be generated from the use of electricity in productive activities

The ASER decided to finance or contribute to the following actions and tools to be set up by priority to support these goals:

- Participate in the *financing of reliability tests* for small electric equipment and appliances used beyond the meter that were identified in step 3 to validate their effective hardiness in real-use conditions before making recommendations to sector practitioners.
- Study and analyze structural *hindrance to access* to electrical equipment and appliances by potential rural users.
- Define, create and implement a *revolving fund* to assist existing decentralized financing institutions in providing lines of financing to users for acquisition of material and equipment intended for productive uses.
- Organize regional meetings and fairs to *disseminate lessons learned and inform potential users*, encourage manufacturers to improve their products and after-sale services, and foster local cottage industries' interest in producing electric materials and equipment.
- Create a centralized system, reachable in a decentralized fashion that provides the type of information produced in this study in a comprehensive yet accessible format by region, productive activities, etc.

These advocacy tools and activities are still being rolled-out today by the ASER. Future projects are to expand the line of work beyond productive uses to include new sectors commonly defined as nonproductive yet indispensable to the effective running of a successful local economy. These include an educational structures, health centers, commons (faith gathering premises, markets, and association or co-op premises) and administrative buildings (town halls, local administration etc.). Finally, some resources will be used to encourage the development of local cottage industries catering to the new needs generated by these innovative electricity uses in order both to reduce dependency on foreign equipment and to bring the producers closer to the user, thus increasing the desired economic impact in the targeted regions.

3 Methodology for the Implementation of the Pragmatic Approach: The Multisector Energy Investment Projects (MECs)

As was briefly presented in Chapter 1, the pragmatic approach is designed to both feed from and complement the results and impacts of the systematic approach described in an earlier chapter. The pragmatic approach is to ensure that a series of quick response projects, the Multisector Energy Investment Projects (MECs[13]), will be identified and quickly implemented before the end of the design phase of an overarching rural energy program and the start of its implementation. This chapter will once more focus on productive uses of electricity, setting aside household as well as social uses.

The pragmatic way, while respecting the spirit of cross-sector work and preserving a region-specific angle, ensures that projects are in fact identified, made available for financing, and implemented so as to demonstrate in a concrete fashion the soundness of the approach. It shows stakeholders that the whole exercise is not just a global brainstorming exercise running the risk of producing little real-life outputs at the end. It also provides an occasion to tackle head-on any potential cross-sector coordination problems that could be met in the project life by moving very quickly to the implementation phase. Such an approach is also opportunistic in the sense that it takes advantage of preexisting opportunities in a given sector or in a precise rural area. It is implemented when conditions are ripe for a quick win project or an activity that would rapidly obtain large sector gains, thanks to access to electricity.

Here again, the start point is to capture a picture of the sectors at play in the areas in consideration in order to direct energy-related investments to effectively serve local rural development. Only the overview need not be as complete and as accurate as in the systematic method, and will target a different set of information tools that will allow a faster move to the implementation phase. Yet again, the proposed Multisector Energy Investment Projects (MECs) approach will be described as a multistep method, first in a generic fashion to be later illustrated with the case of the Senegal experience.

[13] The concept was initially created in Senegal and named PREMs in French for “Programmes Energétiques Multisectoriels.”

An Opportunistic and Practical Method to Speed up the Delivery of Positive Impact of RE: The Multisector Energy Investment Projects (MECs)

The Multisector Energy Investment Projects (MECs) can be defined as the energy subcomponent of another sector's project that has a strong need for energy (and more specifically electricity in the case of this paper) to function or provide its outputs. Therefore, a MEC does not exist alone; it is only part of a larger project or a sector's activity to which it provides support. Since it is the other sector, not the energy sector, that provides the de facto anchorage for the MEC, it is referred to as the "anchor sector."

As mentioned earlier, the MEC concept is opportunistic in that it relies on opportunities provided by the existence of sector projects either already in place or will be developed in the near future in the region targeted for electrification. It then proceeds to tack on an electricity component aimed at creating, supporting, or enhancing productive uses in the anchor sector's projects. By providing an interface between the sector project and the electrification activity, it aims at providing quick wins that show tangible benefits to the rural communities.

In most cases, the sector specialists have already done all the preparatory work from their sector's standpoint for the reference project, to which an energy component may be added. They have mobilized the financing and the sector specific expertise, have validated the project design and timelines, and engaged the sector specific support to ensure recipients will be trained and buy-in. However, as seen in the previous chapter, there are many instances where the sector's performance targets are limited or hampered by lack of access to electricity. This is, in large part, because the sector specialists are not well informed on the options, limits, and gains to be associated with electricity. They, therefore, either bypass the issue altogether or tackle it as a last resort and wind up with detrimental technical choices.

This is where the MECs provide their added value by analyzing the need, proposing solutions, and effectively building the energy interface between the power utility and the anchor sector project. Although this may intuitively seem obvious and simple, the complexity of the undertaking soon appears and reveals the need for establishing a method as well as dedicating means, both financial and technical, to support such interface. A MEC team can be set up that, following the principles described in Chapter 1, would be led by a championing entity, and supported by a group of specialized consultants for the technical matters as well as the sector partners from the multisector committee.

The method for the design of MEC projects comprises three steps:

- **(i)** Begin by identifying the sectors that have activities currently taking place or about to take place in the area of the electricity project, and evaluate the impact electricity could have on the sector's outputs;
- **(ii)** Next, design and determine the costs of the electric equipment needed to respond to the needs, both before and after the meter; and
- **(iii)** Finally, secure agreement among the stakeholders on the value of the MEC, decide on respective duties and modalities of cooperation, establish contractual documents and coordinate the teams for implementation.

Step 1: Inventory of Other Sectors' Programs Whose Outputs Could Benefit from Electricity and Joint Evaluation of Sectors' Interest in Creating a MEC

Although this initial step may seem similar to the one described at the start of the systematic approach, there is a major difference in that we do not focus here on existing activities in the field but, rather, on programs or projects from other sectors that support these activities.

These can be existing programs and projects or proposed ones. The identification work is phased, moving in sequences from the central level to more decentralized and customer-user levels, at which the MECs will be designed, sized, and implemented.

The work starts in the central government by requesting that the major public and private planning agencies identify the country's priorities. This data will provide public investment plans, Poverty Reduction Strategies (PRSs are especially found in less developed countries, IDA borrowers) and other national documents that show what sectors currently are, or are expected to be, of top priority in the target areas over the coming years.

Once this preliminary identification has been completed and the country's priorities are well understood and listed, the next action is to confer with the priority sectors identified and ascertain their approach to implementing their own plan to achieve their specific goals. This is done by meeting with the sector ministries, the implementing bodies both at headquarters level and in the regions, and the local administrations. Other players may be included to capture a more complete picture, maybe with a different bias or experience, such as donors and development banks, users unions, and sector NGOs.

One will then notice that even at the highest levels, when sector specialists are asked about how they intend to implement the energy component or deal with energy requirements of their projects, they usually have not given much thought to it and often intend to tackle the problem as it arises. This is no criticism of these practitioners, simply the reflection of the time consumed by the other demands of their work, often more in line with their core competencies and interests. However, the experience shows that when specialists from the energy sector raise the issue ahead of time and show a willingness to contribute in shaping a response to the issue, the reaction is overwhelmingly positive.

Having identified four or five priority sectors and determined through discussion with their practitioners how the sector's targets are being met or planned to be in the near future, the list of supporting projects should be compared to the areas to be covered by upcoming RE projects. The next step is to proceed to the selection of programs and sub-projects for which the idea of cross-sector cooperation makes sense and a MEC could be proposed. To help in decision making, these projects and programs need to be weighed against a number of preestablished criteria.

A list of possible criteria to be used is proposed below but it should be adapted to each specific region targeted:

a. The level of *value added* by the sector program in terms of revenue generation for end users.
b. The *expected impact of* the access to electricity as compared with the baseline without electricity. Here, information can be drawn from work done in the systematic approach or created for the circumstance by general estimations.
c. The *scale and breadth* of intervention of the sector project and the expected replication options. Sector projects that are too dissimilar from the RE project in size or reach, or that are unlikely to provide replication effects, may be less attractive.
d. The *level of investment* and the quantity of equipment required for the electricity component respective to the rest of sector project. Too large and it may require a stand-alone energy project, too little and the incentive to cooperate becomes minimal.
e. The effective *schedule and advancement* of the sector projects, both in terms of financing and implementation. A very advanced project with finalized financing and tight schedule might generate as many problems as one still at the rough-idea stage with no concrete financial backing.
f. The *readiness to collaborate* by sector stakeholders at every level of the project. Although this is a very subjective criterion, it can make a big difference at the implementation stage and for the final success of the cross-sector collaboration.
g. The *level of experience* of the sector project, whether pilot, mainstream, extension of existing or new line of activity. Here, there is

no clear positive or negative situation. A pilot may be more receptive to collaboration but may not be replicated; mainstream projects may have more experience and provide more security but might not want to accommodate necessary changes for integrating electricity for fear of loosing their known dynamics.

h. Additional criteria may be added, depending on local circumstances or on the focus of the overarching RE project. Some could be linked to minorities, sustainable energy, gender, social impacts, and so on.

A summary table, linking these criteria to the various sectors and their eligible programs within reach of the RE project, can be created as shown in Table 3.1.

From Table 3.1, we could conclude that further collaboration with sector C would be profitable. It has two major programs oriented toward revenue generation, with significant expected impact from electricity and good cross-sector receptivity. The main point of concern would be the lack of experience and the associated risks of delays or failure. At the same time, sector A may be put aside with little relevance of its programs for revenue generation and multiple risks of failure, primarily due to lack of cross-sector receptivity. Programs 3 and 5 of sector B could also be of interest. Program

Table 3.1 Possible Selection Criteria to Identify Sectors and Programs That Could Provide Anchor to MECs

	Sector A			Sector B				Sector C		Other Sectors
Criteria, Anchor Sectors and Programs	Program 1	Program 2	Etc.	Program 3	Program 4	Program 5	Program 6	Program 7	Program 8	Etc.
a. Revenue Generation	**	*		****	*	***	*	****	****	
b. Expected Impact of Electricity	*	****		***		****	**	**	****	
c. Similitude of Programs (Area, scale etc.)	*	****		***	*	*	****	****	**	
d. Relative Level of Investment	**	**		**		*	*	****	**	
e. Level of Advancement	****	*		**	****	**		**	***	
f. Cross-sector Receptivity	*	**		**	*	***		****	**	
g. Cumulative Experience	****	*		**	*	***	**	**	*	
h. Other criterion										

Notes: Level of criterion intensity:
No star = criterion not met, * = low intensity, ** = Medium intensity, *** = High intensity and **** = maximum intensity.
Other criteria evaluation tools can be substituted to intensity when it is more relevant.

5 has a risk brought by a different type of organization but it could be compensated by a strong expected impact of electricity and a keen interest in cross-sector collaboration.

Having selected a series of programs (here it would be programs 3, 5, 7, and 8) with which further collaboration may be contemplated, the next step is to engage their respective teams in designing the MECs and demonstrate their effective value added to both the sector program and the RE project.

Step 2: Localization, Design, and Costing of Electrical Components, Including after the Meter

This step is where the potential project becomes specific, aggregating the information from all stakeholders into a real project in the field. The team will identify specific locations in the regions targeted by RE that are likely to benefit from the sector programs. It will develop a proposal synopsis (see the examples in Annexes 6C and 6D) that outlines the reasons for the proposed project, its expected socioeconomic impacts, the type of equipment proposed, the expected costs for the whole anchor sector project, the costs of the MEC itself (both before and after the meter), the expected financing plan (including the expected rate of return), and the expected roles and duties of each party.

The information on the desired localization, as well as the expected benefits, is to be provided by the sector experts who should provide proof of their sector's intent to invest in the designated area. This is because, following the principle that the MEC will only provide the additional amount of funding necessary to include an energy component in a sector project, the validity of the energy investment will rest largely on whether the anchor project actually happens. Once the potential sector project is delineated, with an explanation of the type of contribution or output expected from the energy source, the energy sector specialist checks the technical feasibility on the ground. If deemed feasible, it provides a proposal for what type of electric equipment could be used after the meter to provide the required output and what type of electric investment is needed before the meter to supply electricity to the MEC.

The case of the fisheries, where storage and initial processing were identified in an earlier chapter as good sources of gains, can provide an illustration. Should a fishery program exist in an area earmarked for rural electrification, it would have identified specific ports due for renovation of docks and fish conditioning in order to improve outputs from fishermen. The fishery sector would have earmarked funds for civil engineering, training, boat and fishing techniques modernization, and would have a project for transformation, but would not have a clear idea of the type of electricity source required, as well as the equipment alternatives. This is where the MEC project would provide support, helping size the equipment to the demand and quantity treated while keeping in mind the real costs. It would help identify option for energy equipment (using cold chambers, sifters, shredders, driers and possibly autoclaves) that would provide the expected outputs (conservation, flour, dried fish) in the most efficient and adapted manner. In such a case, after providing the rationale for the MEC involvement, the synopsis would list the type and cost of transformers needed, the amount of medium or low voltage cabling, the necessity or not for back-up generation depending on the quality of the supply at the given area, and would provide help in identifying the most adequate provider of cold chambers and other equipment.

The MEC could also help in creating a bridge to other sectors likely to provide enhancement of fishery outputs subject to access to electricity. Following an example seen recently in India, a bridge to the telecom sector could be made, providing electricity to power a cell phone tower, as well as charge batteries of fishermen users, thus ensuring that fishermen could check prices offered for their catch in several potential unloading docks. Fishermen could also be informed, should the maximum capacity of the storage and transformation unit be reached in a given dock, thus limiting the losses but redirecting the fishermen to another dock.

At that stage, the degree of advancement in the creation of the MEC and the speed at which each MEC is likely to be implemented should start to be clear. This opens the option of creating several waves or generations of MECs according to their level of preparedness and likelihood of swift implementation:

- The *first generation* will regroup the MECs that are located in the areas of national priority, where the technical-economic work is finalized for the project from the anchor sector standpoint, where an existing source of financing is committed and the anchor sector's practitioners are cooperative.
- The *second generation* will regroup the MECs where some of the conditions just listed are not yet met or need further work to warrant the full commitment from the energy sector.
- And finally, the *MEC pipeline* will regroup promising projects that need further investigation and are unlikely to reach a decision point in the short term, but could provide big gains and impacts if they can be developed. Some of these potential MECs will prove too complex to remain within a pragmatic approach and might need to be dropped or transferred to another type of structure for development. Others will develop favorably and turn into a new generation of MEC. New candidates will also appear as conditions change in the field and will be added to the pipeline.

One additional reason for establishing a MEC, which has not been addressed here, would be the existence of several electricity-sensitive activities within a specific town or village that, while not being viable alone from the standpoint of their respective anchor sector, could become viable by teaming up on the electricity uses. It could be that the combination of several types of uses help reach the level of consumption that renders the investment in electricity distribution lines viable. Or, it could be that such uses are complementary, thus decreasing investment costs by avoiding redundancy. For example, a dairy unit could be teamed up with a leather processing and transformation cottage industry. This would enable an evening milking and overnight cold storage for the dairy, awaiting the morning collection for outside processing—practically doubling the milk output—while enabling day use of electric machinery for the cottage industry. In such a case, it is unlikely that the anchor sector providing support to the dairy farm would cooperate on its own with the one providing support to cottage industries over little-known issues such as electricity access or sizing of electric equipment. The MEC could provide a real added value and make an informed connection between all stakeholders.

The information produced could be summarized in Table 3.2, used for decision making and to follow-up on implementation with the anchor sectors. The sample synthesis shown in Table 3.2 is extracted from real potential MECs using a fictional currency but keeping the respective ratios. It provides an idea of the relative costs of the MECs in the context of the total investment for each project earmarked by the anchor sector.

Step 3: Decision to Collaborate, Definition of Each Sector's Roles and Responsibilities, Establishment of Contractual Documents, and Implementation

In Table 3.2, one can notice that the MEC usually only represents a small portion of the project cost; it ranges from 3 to 10 percent in the sample presented. In a "business as usual" project, the sector would set aside on its own the funds for the costs behind the meter (here amounting to less than 2 percent on average) and would ask the local utility for the electricity connection to the project.

Depending on the responsiveness of the utility, the connection may or may not be established, in large part because the connection request becomes one among many others. The speed and adequacy of the connection will also depend on the incentives at play for the

Table 3.2 Example of Synthesis of First Generation MECs in a Given Area

Type of MEC	Anchor Subsector	Total Project Costs to Anchor Sector (Fictional Currency, Fc)	Costs of the MECS (Fictional Currency)	Electricity Related Costs (Fictional Currency)	Type of Electric Equipments before the Meter	After the Meter Electric Equipment Costs	Type of after the Meter Electric Equipment	Potential Financing Sources for the after the Meter Electric Equipment
MEC1: Electric component for docks and fish processing	Fisheries	19,9 Fc	0.56 Fc	0.33 Fc	Transformers 25/50kva and public lighting	0.23 Fc	Cold chambers; driers sifter, shredder	State, donors, users and unions
MEC2: Electric component for dairy and cattle feed	Dairy, husbandry	99 Fc	4,52 Fc	3 Fc	Low voltage lines AT; transformer and public lighting	1,52 Fc	Cold tank, back-up generators, churner, sterilizer	State, donors, users and unions
MEC3: Transforma-tion of rice	Agro-industry	13,9 Fc	1,62 Fc	1 Fc	Generators (no grid available).	0.62 Fc	Threshing, husking and sorting machines,	State, local communities, emigrant remittance
MEC4: Irrigation system	Hydraulic	73,4 Fc	2,80 Fc	1,59 Fc	Generators; transformers 25/50kva ;	1,21 Fc	Different types of pumps, dripping machines.	State, donors, users and unions

utility, which may concentrate on easier and less costly ones and possibly perceived with lower nonpayment risks. At the same time, if the funding for the equipment costs after the meter connection is not clearly earmarked, the temptation may be high to use it during the course of the construction to offset other unexpected sector-specific costs that would be more palatable to the sector specialist. Either complication would derail the gains expected by the end user from the use of electricity.

This is where the MEC approach changes the dynamics by creating a team dedicated to this subcomponent of the global project that will provide the information to all parties and coordinate their respective involvement. As described in the earlier step, the MEC will estimate the costs, provide a technical design, and validate it with the stakeholders. It will ensure that the corresponding funding is set aside and will coordinate the writing and the agreement on necessary implementation documents. This will go from the technical design, to the issuance of bidding documents for construction and even its supervision, if needed, through the establishment of a convention among participants, clarifying each party's roles and duties.

These actions, while seemingly simple, can be very time consuming and require a strong commitment, as well as good negotiation skills, to navigate the various sectors' bureaucracies and players, their different procedures, targets, and set of funding partners.

Whenever possible, the MEC will try to ensure that sector partners directly fund the area of the MEC the closest to their core activity, letting the MEC play purely the role of interface. In other words, the anchor sector would fund the after-the-meter equipment, and the energy sector would fund all materials necessary to bring electricity to the meter, including the meter. In such a case, the value added of the MEC resides in coordination and possibly in the supervision of the implementation by the contractors on behalf of both sectors.

However, it might happen that either or both sectors may meet with difficulties to fund the part of the MEC close to their core competency. If such a situation should arise, the MEC may work to provide alternative sources of financing, either by bridging the funding from one sector to the other or by getting a new source of funding altogether. Specific repayment schemes would need to be designed, discussed, agreed upon and contractually accepted by all stakeholders. It may be, taking for example the case of the dairy MEC, that the energy sector rather than the agriculture sector would have a better capacity to fund the generators, dairy tanks, and processing material. The corresponding loan repayments from the users (say, a cooperative) would be directed to this sector rather than the agriculture sector. Specific examples are described next in MEC case study in Senegal that helps to further illustrate this situation.

Other issues tackled by the MEC team could include training of users, suppliers or contractors that would operate and maintain the material behind the meter; establishment of repayment schedules, collection methods and, if necessary, nonpayment enforcement; resolution of conflicts; and other miscellaneous issues. Whenever possible, the operation of the behind-the-meter equipment and the electricity distribution or generation material would be contracted to an outside entity. If resorting to the MEC was found necessary or useful for the anchor sector project to include the energy component, it is unlikely that the anchor sector practitioners will have sufficient interest, time available or knowledge to give adequate attention to the operation of the energy component. Having the option of using a specialized outside contractor could help alleviate problems while creating or providing support to a viable productive activity in the target area.

Once they are agreed upon, all these issues and decisions are combined in a contract or a convention signed by all stakeholders. It clarifies each partner's role, duties, and rights, and it closes the door to damaging misunderstandings or last-minute changes in course by any partner. This is also required to ensure sufficient financial stability and to secure financing for the MEC that may be running over a period of 5 to 20 years, depending on the type of equipment at stake.

Finally, a monitoring and dissemination tool should be carefully put in place to track the impact of the MEC in the field. One should look for impacts in terms of change of minds (better inclusion of energy components in new sector projects), in terms of effective viability of the MECs and in terms of contributions to improvement of life in the rural areas, especially with regard to income generation.

How the MECs Were Developed in the Case of Senegal

As mentioned in Chapter 1, both the concept of the MECs and their effective implementation are closely associated with the development of rural electrification in Senegal. Its specific context has been described in that chapter, so we will focus here on how the MECs were pragmatically developed to deliver the desired impact of rural electrification. Again, we will focus on productive uses even though some social MECs were also developed to improve social and communal services through access to electricity.

The approach taken in Senegal follows the general approach described earlier. However, it was tailored to fit the ongoing restructuring of the rural distribution sector and the creation of the concession program described in Chapter 1. This program influences the structure of the MECs, constraining them to fit the boundaries of the concessions while opening new opportunities of sources of financing. The MECs were put together following the same approach as described in the generic case but combined into two steps to fit with the field realities:

(i) Determine national priorities, contact the sectors implementing the priorities, and identify the areas of collaboration, followed by the design and costing of proposed electric equipment necessary to respond to the need, both before and after-the-meter.

(ii) Agreement among stakeholders, and especially the potential concessionaires, on the MECs to be implemented, respective duties and modalities of cooperation, creation of all contractual documents, and ensure coordination of teams for field implementation.

Analysis of the Rural Development Priorities, Identification of Sector Programs, Areas of Cooperation, Technical Design, and Costing

In Senegal, the design of the MECs happened simultaneously with the systematic identification of productive uses of electricity if developed in the rural areas. Therefore, the activity was championed by the same team, led by the ASER, supported by the consultant EXA Development and the CIMES-RP multisector committee.

The team reviewed the key Senegal official national documents, the DSRP (Poverty Reduction Strategy) and PTIP (Triennial Public Investment Program), to identify the key productive sectors (as well as social services which are not referred to in this document) in the national priorities. These priorities are agriculture, rural irrigation, stockbreeding, fishing, and rural cottage industries.

The team then looked into these sectors to identify their key implementation programs. At the national level, some key programs are the PNIR (Rural Infrastructure), the PADMIR (Support to Decentralization in Rural Areas), AFDS (Social Development Fund), REGEFOR (Well Drilling), PAOA and PDMAS (support to Agro-industry), PAPEL (support to stockbreeding), or PSAOP (support to services to agriculture). Other programs target specific areas such as PAPASUD (fisheries in the south), PRAESC (revival of economic activities in Casamanse region), or SAED (activities in the delta of the Senegal River).

The number of programs, with which cooperation would be both feasible and the use of electricity provide value-added, was narrowed by using the method described earlier in the generic approach. Discussions were then held with the program representatives that led to the identification of nearly to 20 MECS, of which 16 were linked to income generation through productive uses of electricity. Nine of these were with programs sufficiently advanced and collaborative to be developed as first generation MECs, while the rest should be considered second generation or MEC pipeline.

Following the pragmatic principle, the activities were delineated to follow the concessions' boundaries and the work focused on MECs located in the first three concessions to be attributed to the private sector as part of the rural electrification restructuring program. The summary table of the MECs initially identified is provided in Table 3.3.

For all MECs identified, the project financing was fully covered by the anchor sectors except for the very first one, the dairy project, which had obtained only 70 percent of its financing at the time of the cross-sector discussions. This project was nonetheless kept in the list of prospective MECs given the high level of added value expected.

However, prior to the MEC discussions, while the overall anchor projects were generally well funded, including all their sector-specific technical components, allocations for their energy components were less well accounted for, if at all. Table 3.3 shows that with 1.5 billion CFA Francs over a total cost of 85.2 billion CFA francs, the MECs' costs represent only a small fraction of the total sector project cost: 1.8 percent on average. This confirms that sectors' tendency of not integrating energy component in the design of their project is most of the time due to lack of knowledge of options and benefits, rather than lack of affordability.

Table 3.3 also shows that on average a little more than two-thirds of the MEC additional costs come from the before-the-meter side, while one-third comes after the meter. Typically, in a usual project this two-thirds would be financed by a utility and the remaining would be at the expense of the project. Since the effectiveness of the total energy component in delivering the output desired by the anchor sector project depends largely on determining the appropriate equipment before and after the meter, as well as in the timely implementation of their set-up and maintenance, the MEC will attempt to ensure that all these aspects are handled. Ideally, the anchor sector should be the lead in bearing all costs relative to their sector-specific equipment and training. When it comes to electric equipment behind the meter and its related training, the preferred financing source remains the anchor sector, followed by the concessionaire and in the last resort, the MEC, which draws and catalyses money from the earlier two, as well as public money such as donors or RE Funds.

Who Does What? Establishing Effective Stakeholder Cooperation within the RE Concessions: Example of MEC Implementation in St. Louis–Dagana–Podor

Following the first round of identification, the dimensioning and the costing of the first generation of potential MECs, the next step was to move from agreement in principle between all stakeholders to effective contractual commitment and joint implementation.

We will illustrate this step using the example of the first rural electrification concession to be established: St. Louis–Dagana–Podor, located in the north of the country near the Mauritanian border (see Figure 1.2). As explained earlier in this document, the MEC concept has been developed in Senegal to accompany the movement toward the creation and the attribution of rural electrification concessions to the private sector through a bidding process. Therefore, cooperation with the MECs was logically included in the conditions and criteria for bidders to obtain a concession. Although the MECs would represent only a small fraction of the set of data and issues to consider for the potential bidder, opening this option to the private sector required an advanced and well documented case corroborating the viability of such MECs.

Table 3.3 List of First Generation MECs Identified in the Three Initial Concessions

Concession Name	Type of MEC	Anchor	Total Project Costs to Anchor Sector (Million CFA Francs / k€)	Costs of the MECS (Million CFA/ thousand €)	Electricity Related Costs (Million CFA Francs/k€)	Type of Electric Equipments before the Meter	Behind the Meter Electric Equipment Costs (MCFA/k€)	Type of Electric Equipment behind the Meter	Potential Financing Sources for behind the Meter Electric Equipment
Podor-Dagana St-Louis	Provision of electricity to dairy and cattle feed centers (MILK1/DP)	Dairy	9,900 MFCA / 15,091 k€	554 MFCA / 844 k€	275 MFCA / 419 k€	Transformers, MV lines, lighting, generators	259 MFCA / 232 k€	Cooling tanks; buildings, cold storage, sterilizer, skimmer, churner.	COVAPE, PNIR, ASER
	Electric component to the program for domestic and productive uses of energy, PERACOD (ENE1/DP).	Energy	5,663 MFCA / 8,633 k€	300 MFCA / 457 k€	200 MFCA / 305 k€	Generators LV lines to users	100 MFCA / 152 k€	Small productive instruments	KFW, State, ASER , IFIP
	Electrification of drinking water distribution (HYD1/ DP).	Irrigation	7,375 MFCA / 11,242 k€	280 MFCA / 427 k€	159 MFCA / 242 k€	Electric pumps; generator sets; transformers	121 MFCA / 184 k€	Mills; refrigerator for vaccines; wood carving equipment	National State, BID, ASER, IFIP, REGEFOR
Subtotal			**22,338 MFCA (34,966 k€)**	**1,132 MFCA (1,723 k€)**	**634 MFCA (966 k€)**		**480 MFCA (731 k€)**		
Mbour	Reinforcement and extension of the electric connection of the rural well drilling program REGEFOR. (HYD1/ MB).	Irrigation	5,178 MFCA / 7,893 k€	81 MFCA / 123 k€	51 MFCA / 78 k€	Electric pumps; generator sets; lighting.	30 MFCA / 46 k€	Mills; threshers	REGEFOR, ASER, IFIP
	Electric component for harbor docks and fish treatment areas (PEC1/MB).	Fisheries	1,989 MFCA / 3,032 k€	56 MFCA / 85 k€	33 MFCA / 50 k€	Transformers 25/50kva.	23 MFCA / 35 k€	Cooling rooms, hybrid driers; (sun/ electricity), mills	National State, UE, AFD, ASER, IFIP
Subtotal			**7,167 MFCA (10,925 kĐ)**	**137 MFCA (209 kĐ)**	**84 MFCA (128 kĐ)**		**53 MFCA (81 kĐ)**		

(continued)

Table 3.3 List of First Generation MECs Identified in the Three Initial Concessions (*continued*)

Concession Name	Type of MEC	Anchor	Total Project Costs to Anchor Sector (Million CFA Francs / k€)	Costs of the MECS (Million CFA/ thousand €)	Electricity Related Costs (Million CFA Francs / k€)	Type of Electric Equipments before the Meter	Behind the Meter Electric Equipment Costs (MCFA / k€)	Type of Electric Equipment behind the Meter	Potential Financing Sources for behind the Meter Electric Equipment
Kolda -Velingara	Corn transformation (MAI1/KV).	Agro-industry	1,390 MFCA / 1,112 k€	162 MFCA / 247 k€	100 MFCA / 152 k€	Generator sets; installations et electric engines and accessories	62 MFCA / 95 k€	Mashers, oil extractors, bagging material	National State, ASER, IFIP
	Equip and modernize the communal infrastructures (INF1/KV).	Cottage industry	27,900 MFCA / 42,530 k€	57 MFCA / 87 k€	41 MFCA / 63 k€	Generator sets; transformer 25/50kva; lighting	16 MFCA / 24 k€	Fridge for vaccines; cold room	AFDS, ASER, IFIP
	Equip and modernize the communal infrastructures (INF2/KV).	Cottage industry	25,800 MFCA / 8,633 k€	43 MFCA / 66 k€	30 MFCA / 46 k€	Generator sets; transformer 25/50kva; lighting	13 MFCA / 20 k€	Fridge for vaccines; cold room	PNIR, ASER, IFIP
Subtotal			**55,090 MFCA (83,979 k€)**	**262 MFCA (399 k€)**	**171 MFCA (261 k€)**		**91 MFCA (139 k€)**		
Grand Total			**85,195 MFCA (129,870 k€)**	**1,533 MFCA (2,337 k€)**	**889 MFCA (1,355 k€)**		**624 MFCA (951 k€)**		

In St. Louis–Dagana–Podor, three possible MECs had been identified (see Table 3.3):

- MILK1/DP Provision of electricity to dairy and cattle feed centers
- ENE1/DP Electric component of PERACOD, program to enhance domestic and productive uses of energy
- HYD1/DP Electrification of drinking water supply network

The MEC team started building the case for these MECs by fostering thorough exchanges between all parties involved. Using the preliminary proposals established for each of the three MECs identified, comprehensive exchanges were done between:

- the ASER
- the three sectors' anchor programs (COPAVE for the dairy, PERACOD for the cottage industry productive uses and REGEFOR for irrigation)
- technical advisors (agronomists, local development experts, etc.)
- the users (private individuals, unions, cooperatives)
- the financing institutions (World Bank, KfW, AFD, IFIP for private investment)
- suppliers (both of electric material and of electricity) using equipment, such as EquipPlus, Afriwatt)

It should be mentioned that in this case, the private sector concessionaire was not involved, since the attribution of the concession had not yet happened; but in future MECs in the concessionaire is expected to play a prominent role. These discussions helped clarify and provide agreement among all participants on the conditions that would be required from each to have the MECs move from concept to reality.

Once the respective sources of financing are agreed upon, an agreement is signed by all implementing parties that spells-out the respective responsibilities and supports that each will provide or receive. The implementing party, in this case the concessionaire, is expected to check and confirm the technical choices made by the MEC team within a given time frame. Together with the client and with support from the anchor program, it negotiates the request for subvention to the FER (Rural Electrification Fund) that can cover part of the MEC investment. It then drafts and negotiates its supply contracts with the client, both for the installation of the material and equipment as well as for its maintenance, describing levels of services, payments, and ways to solve disputes.

Following the concessionaire-client contracting, the concessionaire implements the MEC. It issues tenders and purchases the electric material and equipment on both side of the meter, it installs the electricity distribution equipment, delivers, and installs the material after the meter that the sector program will use to produce its products. It also ensures the initial start-up of all electricity related equipment and trains the sector program staff in basic maintenance that they need to provide, while preparing to undertake the heavier maintenance schedule. It is highly recommended to require the concessionaire to undertake the maintenance, including after the meter—which is unusual since utility responsibility usually ends at the meter. Such after-the-meter tasks may be subcontracted if it differs substantially from usual tasks that the concessionaire staff are used to do. This ensures that the life of the equipment after-the-meter is not diminished by lack of maintenance because the project staff on the anchor sector side is not aware of such needs, does not have time for it because of its other sector-related duties or does not have the adequate training to answer them.

During the exploitation phase, the concessionaire provides the billing for the electricity and the services according to the contract and within the framework of the concession agreement with the ASER. It agrees with the sector project served on repayment modalities and collection mechanisms in case of nonpayment or delayed payments. In some cases, it may provide advice to the sector project in case of the generation of excess electricity on how to supply other users. In the long run, the concessionaire ensures the delivery of electricity with quality of service agreed upon in the contract, provides the maintenance, stocks necessary replacement parts and reports periodically to the ASER to give feedback on the operation of the MEC.

The St. Louis–Dagana–Podor Concession was open to bids in June 2006. In the end, the bidding documents included two compulsory MECs, the dairy MEC and a social health MEC not discussed here. In addition, the information on the two other productive uses MECs listed in Table 3.3 was provided to the bidders, who were free to choose to implement them in addition to the two compulsory ones. The initial reaction both on the concept and on the feasibility of the implementation of the MECs among the four bidders for the concession has been very positive and the dairy and health MECs are expected to be implemented shortly after awarding of the concession.

Fostering Stakeholder Cooperation: Example of the Dairy and Cattle Feed MEC in St. Louis–Dagana–Podor

The MEC Goals. The Dairy and Cattle Feed Multisector Energy Investment Project supports the construction and the electricity supply of four dairy collection and transformation centers as well as two cattle-feed processing plants. The project also provides veterinary services. It is intended to increase production (better feed, increased milk collection using cooling for preservation) and increase value locally rather than at the town level (transform and package raw milk into dairy products) by reaching 10,000 farmers and 25 cooperatives.

Agreement on financing. It was agreed that the COPAVE, the sector anchor program, would include in its project and provide the whole financing for the equipment components situated after the meter (cold storage, sterilizer, skimmer, churner), as well as for all the civil construction work, including buildings surrounding the necessary electric equipment. The costs relative to sizing and providing the electric equipment itself (transformers, medium and low voltage lines, back-up generators and consulting services) would be funded by the concessionaire. If we exclude the non-MEC related civil construction work, that bears a high price tag (2 billion CFA francs); the total MEC cost is 554 million FCFA, roughly divided in half before and half after the meter. This unusually high level of cost after the meter is due to the high quality and complexity of the dairy equipment required in the six locations to ensure sufficient reliability to farmers and coops.

Providing financing support: It was also agreed that the concessionaire could benefit from a grant subvention from the FER (Rural Electrification Fund) of up to 85 million FCFA, to cover part of its 275 million FCFA investment costs. This was proposed as part of the global architecture of the RE concession program that guarantees a maximum IRR (internal rate of return) of 20 percent to the concessionaire over a 10-year period. Thus, the concessionaire would have to cover the remaining 190 million FCFA of the cost through capital investment or loans.

Respective responsibilities for the implementation: A tripartite agreement (see CD-Rom in annex) was prepared to be signed between the concessionaire, the client (the cattle farmers' association), and the ASER. It spells out the investments expected from the concessionaire and from the client to ensure that each meets its end of the arrangement. The agreement explains the contract responsibilities for provision of electricity and its payment, as well as the relationship with the ASER and the FER.

Conclusion

Having outlined the philosophy behind the systematic and the pragmatic approaches, demonstrated how they complement each other, and described their practical implementation in Senegal, it is hoped that this paper will convince readers of the usefulness of working across sectors and the validity of including a livelihood component in future rural electrification programs.

In conclusion, the key lessons learned during the design process of these approaches and from field experience include:

- Working across sectors can seem daunting and time consuming, but if initiated early during the preparation phase of the project, no additional delay is introduced. Such activities also can be developed as a continuous process during the long operational phase of rural electrification. And when well defined, interaction with sector specialists can create energy projects better targeted to livelihood improvement, which will enhance the final impact of electricity on rural populations.
- It is strongly recommended that dedicated funding be set aside at the onset of new rural electrification projects to ensure that sufficient time and thought be put into exploring cross-sector synergies with all stakeholders; and to ensure that once a plan has been devised these synergies materialize and deliver in the field.
- Lack of coordination between the energy sector and other sectors and lack of means of others sectors to address energy issues on their own are very common situations in developing countries. As a result, there are numerous low-hanging fruit that can increase the impacts of rural electrification projects as well as the outputs of projects implemented in other sectors. This paper presented how opportunistic *win-win* situations can be developed between the energy sector and the anchor sectors.
- Large pockets or reserves of productivity can be tapped by using electric-powered equipment. A careful analysis of production processes is generally required to reveal these gains and to pinpoint where they may be the most effective. The *systematic approach* presented in this paper provides a practical method to identify, select, and generate these benefits. The importance of access to credit that is affordable, customized, and available in remote areas in order to see such benefits materialize should be noted.
- The issue of market and demand for products and commodities that are impacted by use of electricity is not treated in this work since for the MECs, this aspect is normally addressed by the anchor sectors as part of the normal project analysis. It remains a complex issue that can have direct impact in the field, especially when dramatic increases in production occur such as in the clothing industry. One may consider adding some market analysis to the TOR of the consultant as part of the last phase of the systematic approach.
- By targeting the development of specific social and/or productive benefits, both the systematic and the pragmatic approach monitor the specific impacts of rural electrification projects. The systematic approach can help establish the baseline and

the pragmatic approach, through its direct cross-sector involvement, can facilitate the post-project impact data collection.

- Cross-sector cooperation requires the strong involvement of a local champion—preferably connected to the government—to ensure cooperation from other sector officials, but not necessarily from ministries. An electrification agency can provide such support. Also, a contracting phase should follow the goodwill discussions and initial agreement, to shield all partners from possible setbacks following unexpected changes in priorities.
- Using a consulting team for the fieldwork—preferably local—is usually required to ensure that the specific requirements of such cross-sectoral activities are properly identified and ad hoc solutions are effectively implemented. Without the support of such a paid consultant, the risk is high that no one will be committed to identify bottlenecks and propose pragmatic solutions. However, supervision is required to keep the work focused.
- Effective implementation of either approach should be customized to the local context. For example, the approach was tailored to fit in Senegal's concession program but could very well be adapted to a very different environment.
- There is no requirement to be exhaustive in the systematic approach or perfectionist in the pragmatic approach. Rather, being cognizant of the reality in the field and the constraint of the project timetable, while keeping an open mind to new linkages between electricity and productive activities, may bring the chance to have greater impacts on livelihoods.

Annexes on CD-Rom

All annexes are contained on a CD-Rom inserted on the inside cover page of the paper version of the report.

It contains the electronic version of this report, the World Bank PAD relative to the project described in this paper, original reports in French, and conceptual documents associated to the organization of multi-sector meetings and their follow-up, as well as documentation linked to the implementation of the Multi-Sector Energy Investment Projects (MECs).

In English:

Annex 1: Electronic version of this paper: *"Maximizing the Productive Uses of Electricity to Increase the Impact of Rural Electrification Programs: An Operational Methodology"*

Annex 2: Project Appraisal Document *"Senegal Electricity Services for Rural Areas Project,"* World Bank. This is the World Bank funded project described in the chapter 1 of this paper.

Annex 3: Documents related to the Energy-Poverty Workshops held in Africa in 2002/2004 and mentioned in beginning of Chapter 1.
3A—Sample brochure, agenda and proceedings, Addis Ababa workshop
3B—Sample brochure, agenda and proceedings, Dakar workshop (in French)
3C—Notes proposing methods to follow-up on the regional energy poverty workshops and establish cross-sector consultative groups.
3D—Note on a subsequent workshop in Asia using a similar design.

In French:

Annex 4: 4A—ESMAP Technical Paper 109/07 FR, "*Maximisation des retombées de l'électricité en zones rurales, Application au cas du Sénégal.*" Mai 2007. This technical paper groups, summarizes and provides contextual information to the original consultant reports provided in the annex 3B.
4B1 to B5—Original Consultant Reports (5 volumes).

Annex 5: Details of the calculations to establish the anticipated levels of cost reduction through productive uses of electricity.

Annex 6: Other documents relative to the implementation of the MECs:
6A—Official decree creating the multisector committee, CIMES/RP.
6B—Tripartite convention (ASER/Concessionaire/MEC) for the dairy and cattle feed MEC in Dagana–Podor–St. Louis concession.
6C—Detailed information, convention and sector commitment for the Health MEC.
6D—Detailed information, convention and sector commitment for the Dairy MEC

Annex 7: ASER PowerPoint presentation on the MEC concept

Maximizing the Productive Uses of Electricity to Increase the Impact of Rural Electrificaiton Programs

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1. Is the format of this report easy to read? ☐ Yes ☐ No
2. Is the report a comfortable length to read? ☐ Yes ☐ No
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What impact, if any, does this information have on:

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What are the main lesson(s) you have learned from the information contained in this report?

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Would you like to share any study/research similar to the information in this report?

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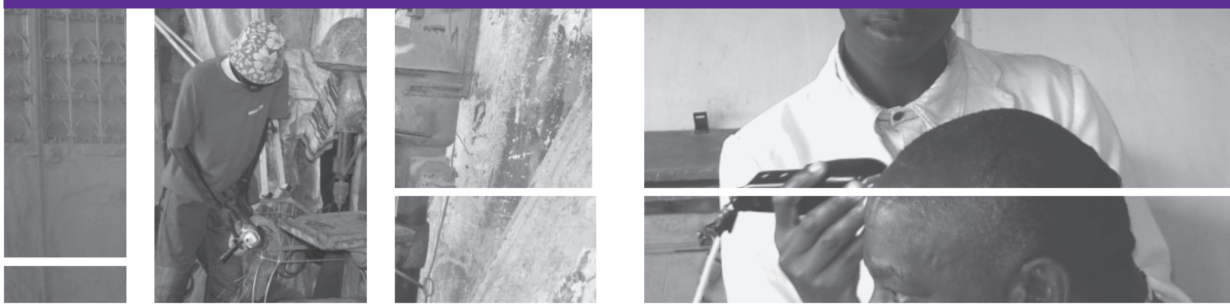

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