Energy

Outline

1 Introduction

1.1 Overview

The objective of this chapter is to help governments diagnose and define energy policies and programs when preparing their comprehensive poverty reduction strategy. The energy linkages to poverty reduction have become clearer as a more comprehensive understanding of poverty has emerged that argues for an approach to poverty reduction that directly addresses the needs of poor people in three priority areas: opportunity (income and capabilities), empowerment and security. The role of the sector in supporting economic growth has been reaffirmed but a broader concept of its role in development has now emerged that embraces cross-sectoral interventions that combine delivery of a range of infrastructure (inter alia energy services) and social services.

Following a brief review of some facts about energy and the poor, Section 2 reviews the demand of households and business for energy. Section 3 presents an energy poverty framework i.e. a framework for analyzing the role of the energy sector and the role of energy services on poverty reduction. Five energy development goals are suggested to focus energy poverty diagnosis and policy formulation. The impact on poverty reduction of progress in achieving the five energy development goals is discussed and indicators are defined to establish baselines and monitor progress. Section 4 outlines policies and programs that may be adopted to achieve these energy development goals. Annex 1 provides a suggested structure for presenting the role of the energy sector and energy services to stakeholders that participate in the Poverty Reduction Strategy Paper formulation process.

1.2 Energy[1] and the poor: some key facts

- The reduction of human drudgery requires the substitution of human 'animate energy' with more convenient forms of inanimate energy that power 'machines' of all kinds. It is likely that all attempts to reduce poverty (including interventions in health, education, transport, market reform, agriculture, small and micro enterprise development) will be more effective if they have access to modern energy than if they do not.

- No one wants energy for itself, they want it for what it can do. In this sense energy is a "derived demand". Typically, energy end-uses include, cooking, lighting, heating and cooling, static and mobile shaft power (machines and vehicles) and services such as communications and entertainment (telephone, radios etc).

- Improved supply of energy requires "complementary infrastructure inputs" to convert the energy into useful energy services. Complementary inputs include energy equipment (e.g. light fixtures, fans, water pumps, machines) and other infrastructure (e.g. roads, water, communications technology, etc.). Often the cost of the end-use technology can greatly exceed the cost of obtaining the energy it uses.

[1] "Energy" includes oil products, natural gas, electricity and biomass when it is used in an efficient and sustainable way.

- The impact of improved energy services on poverty outcomes e.g. their impact on improvements on the health, education and income of poor people is greater when the energy service is made available with other infrastructure services such as transport, communications and water services. Each infrastructure service complementes the others. This experience has encouraged interventions that combine delivery of a range of infrastructure (including energy services) and social services.

- It used to be believed that increasing access to improved energy services (usually rural electrification) caused poverty reduction on its own – it does, but only rarely.

- The poor spend a significant part of their income on the little energy that they do obtain. Once they obtain enough energy (often relying in part on self-collected traditional fuels) for their subsistence cooking and heating needs they pay cash for improved energy services; particularly for the convenience of electric lighting and radios and for productive use. The "discovery" of significant cash payments by poor people for improved energy services suggests that sustainable businesses can develop to their needs.

- There is often no clear distinction between production and consumption activities in poor households i.e. poor households often engage in economic activity. It may well be that lighting allows people to undertake productive work for longer hours, and that "cooking" might including the processing of food for sale. Income to pay for modern energy services may be associated with investment in sustainable (profitable) and productive energy end use activities – through the following "virtuous circle" - improved energy services when combined with productive use leads to increased productivity, increased productivity leads to increased income, and increased income results in the ability to pay for increased energy services.

- Economic growth is strongly associated with increased use of modern energy services.[2] The degree of interdependence between economic activity and energy use is neither static nor uniform across regions. Energy intensity (the ratio of energy demand to GDP) often depends on a country's stage of development.[3]

- It may be argued that the most important energy end uses in terms of directly contributing to reduction in income poverty are those that enhance the major production activities in a country, either by increasing productivity, extending the range of outputs or improving output quality.[4]

- All people (including poor people) prefer modern commercial energy sources such as kerosene, LPG, natural gas, electricity i.e. these are their *fuels of choice*. However, traditional fuels, such as firewood, dung, and manual labor, are often their only option i.e. these are their *fuels of necessity*. Oil products such as kerosene and LPG are the most clean and affordable alternative to traditional fuels for many poor people for whom electricity supply is either unavailable or unaffordable.

[2] **Chapter 7, Pro-Poor Growth** of the PRSP Sourcebook discusses the quality of growth and the degree to which the poor share in the fruits of growth.
[3] For further discussion see World Energy Assessment, UNDP, 2000 **http://www.undp.org/seed/eap/activities/wea/**
[4] The most financially sustainable de-centralized energy supply options are likely to be those which provide power to productive enterprises.

- Women and children are usually the major users and suppliers of energy resources among the poor. They often have to spend much time and physical effort collecting traditional fuels. Smoke inhalation, when traditional fuels are burned inefficiently, causes them further injury.

- The poverty impact of improvements in energy services is largely determined by the choice of end-use to which the energy is put, and by implication, by who chooses what the energy will be used for (and how it is obtained). If energy services are allocated to tasks that are traditionally considered in the woman's domain, (in many societies this will include agro-processing, textiles, pottery, soap making etc), or to new activities not yet dominated by men, the positive impact on women's lives can be considerable.

- Participatory processes that give voice to the poor in prioritizing needed interventions have to take account of the enabling role of energy services in providing the preferences that the poor identify.

- Public resources (from taxes or donor grants) cannot meet the energy needs of more than a small fraction of the poor. Energy-sector reforms designed to attract private capital are essential in order to provide the finance for improved energy services. However the costs of adjustment can be high and can fall disproportionately on the poor; therefore safety nets will probably be required, if severe hardship is to be avoided.

- Even though the supply of energy services to poor people is unlikely to be the most profitable area for private investment, profits may still be earned if the reform program incorporates incentives to expand access and improve service delivery. Subsidies may continue to be necessary post-reform but they will have to be applied with great care so that they make markets rather than destroy them.

- Additional notes on features of energy supply are provided in endnotes to this chapter.[i]

2 Demand for Energy

As pointed out above, no one wants energy for itself, they want it for what it can do. The demand for energy derives from the needs of households and business. These needs are explored below.

2.1 Energy and household welfare

Households require energy first to satisfy basic consumption needs, and then, as their income increases, to obtain welfare-enhancing amenities and energy for production.

Basic consumption needs. All households require a minimum amount of energy to meet basic subsistence needs. They must:

- Cook food to meet their nutritional needs. For poor households, this energy is often in the form of firewood, straw, dung, or other biomass.
- Illuminate their homes. Poor households often obtain this energy service from oil lamps, candles, and dry-cell batteries.
- Heat their homes in cold climates.

Welfare-enhancing amenities. Once households satisfy these basic needs, additional demand for energy is driven by amenities and services that enhance welfare. For example:

- Commercial cooking fuels that reduce the time spent gathering and preparing traditional biomass fuels, as well as the indoor smoke from using traditional fuels.
- Improved electric lighting at the household and community level to enhance educational attainment, perform tasks more easily, and reduce security risks.
- Appliances such as fans to make homes more comfortable, and refrigerators to preserve food.
- Potable water supply and sewerage systems that depend on energy for pumping, system monitoring, and treatment.
- Access to information, entertainment, and communication—household radios and TVs, network receiving and switching stations, and distance learning centers.
- Access to health care and maternity clinics, which need energy for lighting, diagnostic equipment, and vaccine preservation.
- Transportation services to obtain access to other inputs and travel to jobs and schools.

All of these services and amenities that improve welfare and the quality of life require modern commercial energy. The services complement each other; the availability of one service reinforces and increases the benefits of another. For example, when women no longer have to gather fuelwood, their health can be expected to benefit from the reduction in physical labor, and they can convert the time saved into more productive activities that lead to increased income or increased educational benefits. Energy that provides lighting and potable water can in turn help achieve lower rates of illness and improved literacy that reinforces health outcomes such as lower fertility rates.[5]

It should be emphasized, however, that none of these outcomes follows automatically from a new source of energy being made available in a community. Indeed, failure can happen at the very first hurdle, when poor people cannot access or afford the energy services that supposedly have been made available. This highlights, among other things, the need for community participation in infrastructure selection, discussed later in this chapter.

Women and Energy.[6] Women are unequally affected by inadequate supply of modern energy services. A number of factors account for this:

- lack of energy services affects the supply of other essential services such as health and education. See **Education and Health chapters** of the PRSP Sourcebook for discussion of why women are disproportionately affected by the lack of education and health services.

- lack of energy services affect the supply of other infrastructure services such as transport and water. Again, women are disproportionately affected since it is they, for example, who more than men, collect potable water from distant sources with risks for their health and safety (see below). See **Transport and Water chapters** of the PRSP Sourcebook for further discussion of why women are disproportionately affected by the lack of transport and water services.

[5] An analysis (Hoque) of the link between electrification and fertility in Bangladesh shows that the fertility rate among girls between the ages of 10 and 19 is 0.67 in electrified households and 1.17 in nonelectrified households.

[6] See also Energia (International Network on Women and Sustainable Energy) **http://www.energia.org/** and *Gender Perspectives on Energy for CSD-9***,** Draft position paper including recommendations proposed by the ENERGIA Support Group and the CSD NGO Women's Caucus

- lack of energy services in agriculture results in women having to labor at crop tending, harvesting and processing

- since women do most of the cooking in poor households, they, and children in their care, are the most exposed to indoor air pollution. They, along with their children, are more likely than men to suffer the health ill effects of this pollution. Women do most of the gathering of biomass fuels, often having to walk long distances from and to their homes, and as a result suffer a variety of physical injuries when walking with heavy loads of biomass. In addition the terrains where they collect biomass are often hazardous posing risks to their physical safety. **See Section 3.6** (See also the **Gender** Chapter of the PRSP Sourcebook.)

- The time that women spend collecting biomass fuels and water, tending fires or laboring in farm activities – time that is due in great part to the lack of modern energy services - is lost to other activities such as leisure, education and productive activities.

- Many of the potential income activities of women in the informal sector depend for their productivity on modern energy services. See Section 2.2. Household Production and the Rural Non-farm Sector.

When energy-poverty is disaggregated in terms of gender important findings emerge which should be taken into account in program design since it will often be the case that women will be affected differently by the changes in work patterns, health and education benefits, leisure, household expenditures, etc. brought about by an investment or policy that connects the household to a modern energy supply.

Box 1 Women and Energy

One of the main problems for the women of [marginalized urban shantytowns of] Tacna, Peru, was the absence of electricity in their homes, for several reasons: they wanted to make the most of the evening to speed up their textile work; they needed to feel secure in their homes; they needed to facilitate the task of caring for their children; they needed to make the night less dark; they needed to light the streets that they and their families used.

Yturregui, 1998

Current energy production and use entails occupational hazards for women. The estimated 10,000 women fuelwood carriers in Addis Ababa, who supply one third of the wood fuel consumed in the city, suffer frequent falls, bone fractures, eye problems, rheumatism, anemia and miscarriages, from carrying loads often weighing 40-50 kg—nearly as much as their own body weights.

Haile, 1991

Most energy projects do not have the potential to completely change the gender balance and the inequalities of centuries, which are often deeply ingrained in cultures. However, they certainly could set the following near-term objectives:

- Ensuring that the heavy work burdens of women are lightened by modernization of the household fuel supply systems, the kitchen and agriculture;

- Identifying ways in which women can become more independently involved in the cash economy;

- Ensure that women are represented in local dialogue, extension work and resource management .

NEDA Policy Document: The Sustainable Energy Economy, November 1999

2.2 Energy and economic growth

Factories, farms, shops, trading, transportation, and construction are the engines of economic growth. The incomes of the poor generally rise with overall economic growth (**see Pro-Growth Poor Chapter of the PRSP Sourcebook**). Demand for energy rises roughly in step with economic growth[7]. All businesses, formal or informal, large or small, rural or urban, use energy in their offices, in manufacturing establishments, and for transport.

The formal sector. Energy is used by productive enterprises in innumerable ways. Energy is needed to:

- Transform raw materials into final products such as plastics, cement, glass, paper, metals and food products.
- Produce and refine of metals.
- Operate machinery on farms and in agro–processing and forestry operations.
- Drive the motors found in all manufacturing, from textiles and garments to canning, bottling, and printing.
- Operate essential business infrastructure—communications, lighting, and office equipment.

The correlation between energy use and economic growth is further evidenced by the counterfactual when its shortage constrains economic growth. In Uganda, India, Indonesia, and other countries, irregular and poor-quality electricity supply has required enterprises to invest in on-site generation. While this solves their immediate power crisis, it significantly reduces the resources that firms could have used for more productive investment.. There is an additional economic cost, since the supplying utilities lose not only the revenues of industrial firms but also the anchor loads that make it possible to extend service to households.

Farm sector. Energy, by enabling mechanization of irrigation and crop and animal husbandry can lead to increases in farm income through improved productivity. (Energy was one of the key inputs to India's "green revolution"). It can pump water from ground water sources or storage reservoirs to increase the number of crop annual yields. Inanimate energy powers mechanization that can increase efficiency and the timeliness of planting, harvesting, post harvest processing, and transport. The costs and reliability of the necessary energy inputs can be improved by market reform, increased competition in retail systems, and by technological improvements.

Transport sector. Reliable transport services are only possible if there is a reliable supply of transport fuels**.** See **Transport Chapter** of the PRSP Sourcebook.

Household Production and the Rural non-farm sector. Formal employment and on-farm incomes will not be an option for many poor people. There is often no clear distinction between production and consumption activities in poor households. This means that their only way of increasing their well-being is through "self employment" in micro or informal

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[7] Gately and Streifel (1997) found that over an extended period of time, economic growth and commercial energy use maintained a near one-to-one relationship in the 37 developing countries they examined from 1971 to 1993. See also World Energy Assessment, UNDP, 2000 **http://www.undp.org/seed/eap/activities/wea/**

enterprise. Improved energy services can make these activities compete more effectively, produce a wider range of products at a higher quality and increase profitability (and therefore sustainability) through increasing the productivity of the resources involved (labor, capital, raw materials).

Energy services for example enable:

- More convenient or controlled heat for food preparation and food preservation
- Improved lighting to extend the working day
- Use of mechanized equipment to prepare food for sale and for fabrication of tools for small scale manufacture
- Use of sewing machines
- Use of communications technology and transport fuels that help integrate these cottage industries with regional and national markets

Small businesses in rural areas can be a significant source of employment and rural incomes. The presence of vegetable and fruit processing and canning, light manufacturing, furniture and wood products, garments, leather, and dairying (see Box 2) are all strongly correlated with reliable energy supply, particularly electrification[8]. Even when the economics of supply do not favor grid extension that provides unlimited, reliable electricity supply, limited energy supply can spawn and sustain small businesses. The energy may be provided by small diesel engines or by renewable sources such as small hydro, or biomass such as bagasse. A trading center can be sustained and developed when such energy supply is available.

Box 2 A dairy success story

Today in India, there are 75 thousand dairy cooperatives across the country with 10 million members, most of whom are landless, marginal, or small farmers with one or two cows or buffaloes. Besides creating employment in dairy plants, marketing, transport, and distribution, these co-ops are the loci of village transformation and have helped to provide farmers with their only regular cash flow. The bulk of the demand for milk is among the poor in urban areas. To make milk affordable to the poor, it is packed in small polythene sachets.

Energy is essential to the industry; without it the industry could not function: energy as ***steam*** to pasteurize raw milk and produce milk products; as ***electricity*** to package and maintain a cold chain from the dairy plant to the point of sale; and as ***transport fuels*** to reach the urban markets.

Some rural artisan or cottage industries, pursued by individuals or households as independent producers, are done so without the benefit of energy. Such activity can include mat making, rice husking, fish processing, coir products, wood carving, leather goods, brewing, and weaving. However, even in these cases, a small amount of energy that provides evening light, extending the working day, or enables partial mechanization can enable increased output and improved productivity.

Rural electrification that allows some traditional activities to be mechanized leads to process and productivity improvements, causing employment in the traditional activities to decline (the mechanization of paddy husking in Bangladesh is one such case that has been documented). This type of transition is inherent in rural development, and it is likely that

[8]A household survey in Ecuador found that rural businesses accounted for 40 percent of rural incomes, employing 40 percent of the men and 50 percent of economically active women, and that the establishment of these businesses was strongly correlated with electrification. (Lanjouw and Lanjouw 1995).

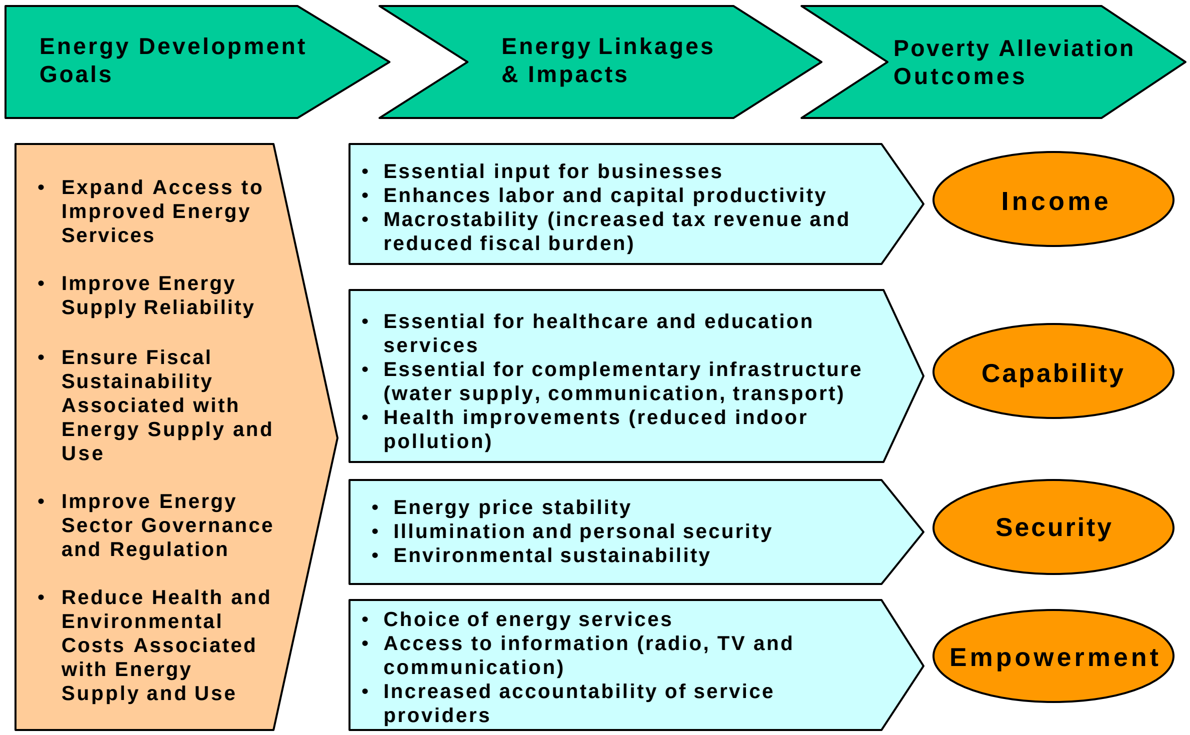
the commercial mill, even as it displaces employment in traditional husking, stimulates employment in other rural nonfarm activities.

Finally, the energy industry itself is a significant source of jobs e.g. those engaged in woodfuel and charcoal production and marketing and petroleum product retailing.

3 Energy Development Goals & Indicators

In this section a energy development goals are proposed for analyzing the role of the energy sector and the role of energy services on poverty reduction. The framework proposes a set of comprehensive energy goals whose achievement will contribute to poverty reduction.

Figure 1 The energy poverty framework



3.1 Defining energy development goals

As governments begin to prepare their poverty reduction strategies they will want to establish energy development goals that will guide the selection of policies and programs to achieve specific targets.

Five energy development goals have been proposed to focus the poverty diagnosis and strategy development effort.

- Expand access to improved energy services
- Improve energy supply reliability
- Ensure fiscal sustainability associated with energy supply and use
- Improve energy sector governance and regulation
- Reduce health and environmental costs associated with energy supply and use.

The suggested development goals are interlinked and reinforce each other—that is, improved governance promotes expanded access and fiscal sustainability promotes reliability and access. Given these synergies, all these goals are important and have been selected for their comprehensive coverage of energy-poverty impacts. Use of the indicators suggested will help determine if a country is performing well or poorly against each of the goals and enable it to prioritize public policies to address those goals on which it is performing poorly. Subordinate goals may be appropriate in particular circumstances.

It should be pointed out that these goals cannot quantify the outputs (cooking, lighting, heating, mechanization, etc.) that households and businesses seek from energy services. In that sense these goals are intermediate goals. However the goals suggested are more appropriate from the perspective of policy making and strategy development. Progress in achieving these goals will permit households and businesses to make efficient choices that would increase welfare and growth.

This rest of this section explains why each of the proposed energy development goals is important in reducing poverty. It also defines indicators that may be used to:

- Diagnose the current situation and establish the relevance of the goals;
- Identify appropriate policy and program interventions to achieve the goals; and,
- Track progress during policy and program implementation.

The indicators proposed may be derived from information readily available or can be obtained relatively easily through simple surveys. While they may sometimes lack the precision needed for detailed project-level monitoring, they serve as reasonable proxies to help policymakers determine the extent of the problem and establish priorities.

It is important to emphasize, however, that information on energy availability and consumption disaggregated by income group, for example, by decile, should be collected to refine baselines for policy development and program monitoring. While household-level energy consumption information of such detail may be unavailable now, future surveys should aim to obtain these statistics.

3.2 Expand access to improved energy services

Access to modern energy can be thought of as a household's ability to obtain an energy service should it decide to do so. ***Access*** is a function of ***availability*** and ***affordability***. Availability means being within economic connection and supply range of the energy network or supplier. Affordability refers to the ability of poor households to pay the upfront connection cost (or first cost) and the energy usage costs. A high upfront cost may discourage poor households from making a switch to a modern energy form.[9]

Availability and affordability are interrelated. For example, a government decision to administratively maintain energy prices below costs with a view of making it more affordable to the poorest households may actually reduce its availability, as the provider may find it unprofitable to extend coverage to areas where the poor actually reside.

The goal of expanding access to modern energy would be met when all low-income households have a modern cooking fuel (kerosene, LPG or electricity) to meet their

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[9] This is because poorer people have higher household "discount rates", and place lower values on benefits that arise in the future. Described differently, a poor person cannot look very far into the future but must satisfy immediate consumption needs. This means that they cannot divert resources from immediate consumption of food and other essentials in order to accumulate enough cash to cover the up-front costs necessary for switching to a modern fuel or improved conversion technology.

needs.[10] The "energy ladder," shown in Figure 2, is a useful way to understand the interactions between poverty and modern energy consumption. As households ascend the energy ladder, increasing their consumption of modern energy, their welfare is enhanced and income-earning potential expanded. The poorest households, which occupy the lowest rung of the energy ladder, generally have little or no access to modern energy services and must use traditional biomass fuels, such as firewood and dung.

The poor place a high value on modern energy services, and to the extent that it is available and affordable, are willing to pay the full cost. There are several reasons for this.

- The convenience, the time saved, and health benefits, along with the higher efficiency[11] make the switch worthwhile.

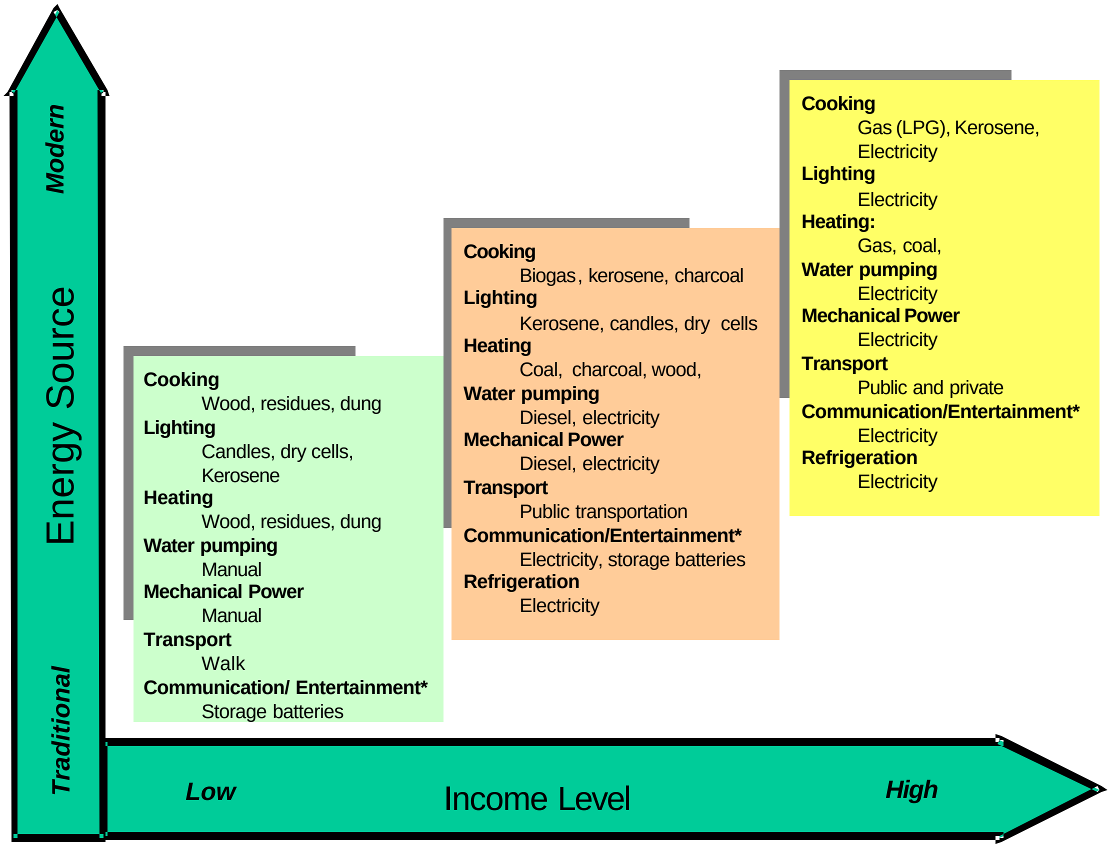
- Livelihoods can be secured when the energy services are used for productive energy end use activities such as small nonfarm businesses, irrigation pumping, mechanized milling and threshing.

- Their ability to pay for increased energy service improves with the rise in incomes that they achieve from increase consumption of energy .

Figure 2 The energy ladder

[10] The term modern energy services or improved energy services refers to energy sources/fuels which are not traditional (e.g. wood, crop residues and dung) and are exchanged for money. Modern fuels are generally more convenient and can be converted more efficiently. Modern cooking fuels (liquid, gas or solid smokeless fuels) are less polluting, leading to a cleaner and healthier home environment. Modern biomass fuels that are both convenient and can be efficiently converted to useful energy include biogas, ethanol, densified briquettes and charcoal).

[11] Efficiency refers to the amount of useful energy output e.g. heat for cooking, lumens (brightness) of lighting, that is obtained from a unit of energy input. Modern fuels are easier to control and therefore are more efficient to use. This increase efficiency may actually result in a lower cash outlay for the same output achieved from more traditional sources.



***Entertainment: Radio, TV**

To assess the availability and affordability of modern fuels to low-income households, several indicators are proposed in Table 3.1.

Consumers themselves, should be the ones making the choice of which energy source and energy application best meets their needs. A menu of energy options should be available to them[12].

Table 3.1 Access indicator

Indicator	Analysis/Diagnosis
Availability	
Electricity Availability Number of customers in a district[13] (derived from utility sales statistics) as a percentage of total households (derived from available census estimates). Number of districts in country with electricity availability.	• If this ratio is below a given threshold, say 10%, it may be inferred that most of the poor households in the district do not have proximity to the network. • A low ratio would indicate that most of the poor in the country lack electricity access. would be to increase the

[12] A problem with some aid programs provided by donors is that spoil the market for alternative energy supply options. This can occur if aid subsidizes a particular energy supply technology thereby making it very difficult for other technologies to compete. This again happens where subsidies are tied to a particular supplier (sometimes suppliers in the donor country), thereby making it difficult for other suppliers to develop sustainable local markets.
[13] The term *district* is used here to refer to the smallest administrative zone in the country where census and economic statistics are collected. The choice will depend on prevailing administrative zoning—prefecture, county, commune, municipality, ward, etc. may be used as appropriate.

	coverage at a financially sustainable rate (see Section 4.6)
1.2 **Kerosene and LPG Availability** • Lowest level at which formal or informal distributor is known to operate, by administrative district. • Consumption ratio: Consumption per capita, by administrative district, derived from distributor sales statistics 1.3 **Availability of Modern Biomass Fuels** • Time of households in collecting biomass fuels for cooking.	If formal or informal distributors are not known to operate in a given region, or if the consumption ratio is below a threshold, for example, 6 liters/capita/month for kerosene, and 5 kg/capita/month for LPG, it would indicate low or no availability in that region, particularly for the poor. Survey data will help to determine a suitable target of hours /day spent by poor households in collecting biomass fuels.
Affordability	
2.1 **Connection Cost** Connection, (i.e. first) cost of obtaining access to modern energy. - Cost of home connection for electricity - Cost of kerosene stove - Deposit for, or purchase of, smallest available LPG bottle and stove.	If this ratio is high, >25% of monthly income, it may be necessary to take measures to make these costs easier to bear (see Section 4.3). However, it would first be necessary to determine that supply is efficient by benchmarking these costs against international norms. If supply costs are not efficient, measures to improve efficiency will be required (see Sections 4.5 and 4.6).
2.2 **Usage Dimension** Electricity and Kerosene/LPG Affordability Ratio: Cost of using modern fuels, such as electricity, LPG, and kerosene, to meet subsistence energy needs as a percentage of the average household income of the poorest, preferably by income decile. Approximations for subsistence energy needs: 1) cost of meeting typical bill for low income household; 2) unit price for small residential consumers multiplied by a subsistence threshold, for example, 20-30 kWhrs/month for electricity; 6 liters per month of kerosene.	If this ratio is high, 10-15% in aggregate, there may be a case for subsidizing the use of modern fuels for the poorest households (see Section 4.2). Supply efficiency will need to be assessed to ensure the problem is demand-side affordability and not supply-side inefficiency.

3.3 Improve energy supply reliability

Reliability may be defined as the stable supply of energy services at a quality and quantity that do not impose excessive additional costs on consumers. Reliable energy supply is essential for making sustained improvements in household welfare and as an input to businesses. The needed reliability standards vary with use. Businesses typically need higher standards of reliability than households. For example, even a short supply interruption may create unacceptably high monetary costs and losses for businesses, such as production downtime, material waste, and lost retail sales, but not impact households beyond its inconvenience.

For poor households with access to modern energy, but who are not yet users, chronic supply unreliability may act as a disincentive to make investments required to transition from a traditional energy source. For example unreliable supply will discourage poor households from purchasing a kerosene stove or paying for an electricity connection.

For households relying on modern energy forms, unreliable supplies might force them to obtain alternative supplies at higher prices—for example, forcing them to purchase more expensive supplies in the informal parallel markets.[14] Such price volatility affects the poorer consumers who are least able to pay these higher prices and must forego consumption.

For businesses, poor supply reliability directly results in: 1) increased production costs for goods and services, acting as a disincentive to investment and 2) an erosion in the comparative advantage in other factors of production such as labor and primary materials. While these costs are seemingly borne by owners of capital, presumably the more well-off, they do affect the poor, who suffer most from the reduced employment opportunities that would otherwise accrue from growth.

A combination of the following indicators (Table 3.2) may be used to determine the extent of the reliability problem in the country.

Table 3.2 Reliability indicators

Indicators	Analysis/Diagnosis
1. Production time lost for business and firms due to failure in energy supply. This ratio may be defined as a percentage of total working days or hours. This information may be obtained through informal surveys of large and small businesses.	1. If the production time lost is extremely high, above 10%, it may be inferred that energy supply reliability is poor. An acceptable ratio would be under 2%.
3. Reserve margin : Ratio of the difference between installed capacity and peak demand divided by installed capacity.	3. A low reserve margin, below 15%, would indicate the high likelihood of supply disruptions and poor- quality supply. A reserve margin of 20-25% would be more suitable.[15]

3.4 Ensure fiscal sustainability associated with energy supply and use (See **Public Spending** chapter)

Fiscal instability and growing deficits contribute to higher inflation throughout an economy, often reducing the purchasing power of the poor and increasing their vulnerability. Achieving fiscal stability depends on many variables outside the energy sector. However, the energy sector is unique in the scope of its influence on the public budget through its 1) contribution to revenue through taxes and royalties[16]; 2) claim on the budget to finance subsidies, debt service, and current spending; and 3) share of government borrowing and contingent fiscal risk. How these factors are addressed in the context of an overall energy

[14] A black-market in petroleum fuels often results when fuels are subsidized leading to their diversion to other markets and/or the government being unable to provide quantities demanded at the subsidized price.

[15] The reserve margin indicator needs to be used carefully and should take into account the generation supply mix in the country. Higher levels of hydroelectric power would typically require higher reserve margins.

[16] Fore example exploiting and managing natural resources such as oil, gas and hydropower can be a significant revenue source for government (and increasing for regions where the resource exploitation takes place), offering opportunities for poverty reduction. In some countries, the success of government poverty reduction strategies will be dominated by the success of policies that they employ to develop and manage their oil, gas and hydropower resources – particularly in those countries that have potentially significant: oil exports; gas exports; and hydroelectricity exports.

sector reform and fiscal reform program can have a large impact on macroeconomic stability.

As discussed below, the energy sector makes a positive contribution to fiscal sustainability and macrostability when:

Direct taxes on energy enterprises and indirect taxes on energy commodities provide a net revenue contribution. Petroleum products are a good source of indirect tax revenues, contributing a noticeable share of revenue. High taxes are often imposed on energy products, as their consumption tends to be inelastic—that is, less susceptible to demand changes as a consequence of price changes. Although petroleum taxes are a good "revenue handle," taxes on commodities such as kerosene, used predominantly by lower-income groups, can be regressive.[17] A balance must be achieved between the revenue objective and the equity of the petroleum product taxation. Subsidies, when deemed necessary, should be well-targeted to achieve their objective and avoid excessive fiscal costs (see **Section 4.2**). Differential tax rates on complementary fuels should also be avoided, as they distort consumer choice.

Taxes on fuels used by the poor should be kept at a minimum level consistent with the average indirect tax rate on goods and services. Any attempt to use high excise taxes on petroleum products with a view to maximize revenue may hit the poor particularly hard. Although petroleum product taxes are easy to collect and a good source of revenue, it is important that these taxes not have a regressive impact. Policies must recognize that distortions may lead to low-tax fuels being diverted to other uses (such as kerosene into diesel)..

Large scale energy enterprises, with their relatively stable consumer base, can be a good source of predictable direct tax revenues. This revenue base is often undermined when governments indirectly subsidize energy services by preventing these enterprises from recovering their costs. In turn, these enterprises are not liable for income taxes, depriving the exchequer of revenue. Over the long term, this practice affects the poor disproportionately, as these utilities are unable to extend services.

Royalties and rents from resource exploitation and production of oil, gas, and hydroelectricity can be a significant source of central or local government revenues in countries with such resource endowments. Fiscal policies for resource exploitation need to consider multiple objectives, such as optimizing the economic value of the resource through extraction rates, environmental externalities, risk-reward profiles of private investors, and the local preferences of those who are directly affected by the resource exploitation.

Sector investment needs are not met through government borrowing and direct budgetary support (as pointed out earlier there may be a need to provide budgetary support to subsidize the connection costs including that of energy use appliances provided that the subsidies are well targeted to the poor). Energy enterprises often require large investments in production and supply infrastructure to meet the demand of the economy, as well as those of poor consumers, because there are large economies of scale in parts of the energy supply systems . Publicly owned enterprises sometimes have these large investment needs financed through public borrowing or direct budget transfers from fiscal

[17] A regressive tax is defined as one whose burden fall disproportionately on the poor. For example, taxing fuels such as kerosene consumed by the poor is regressive if the non-poor do not use kerosene.

revenues. There are limits to how much public financing can be used for energy infrastructure without contributing to higher inflation and rising market interest rates. Also, direct budgetary support for the energy sector can squeeze resources available for social investments. In lieu of these forms of public support, 1) targeted connection and consumer subsidies can be employed and 2) privatization pursued and transitional public financial support restrained—requiring these enterprises to finance their investments on the strength of their own balance sheets.

Government revenue and policy guarantees that are contingent public liabilities and increase fiscal risk are no longer necessary. Governments may at times guarantee, implicitly or explicitly, the revenue requirements of privately owned energy projects. These guarantees are often provided because the private investors are unable or unwilling to bear the underlying credit risk. While these guarantees are often needed to obtain private investment, the fiscal risk of this practice can be extremely high in the absence of fundamental sector reform and may contribute to fiscal shocks.

- Table 3.3 defines typical / key indicators to assess the fiscal impact of energy and assist in developing and monitoring strategies for achieving fiscal sustainability.

Table 3.3 Fiscal sustainability indicators

Indicator	Analysis/Diagnosis
1. **Net indirect tax revenue on energy commodities as percentage of total revenue.** Revenue from indirect taxes on commercial energy commodities—petroleum products and electricity—net of consumer subsidies from the budget.	1. A net indirect tax contribution in excess of 5-10% of total revenues should be expected. If the ratio were negative, it would indicate a fiscal crisis.
2. **Income taxes paid by energy enterprises and utilities.** Total income taxes paid by energy utilities and enterprises. As these enterprises are easily identified, these numbers may be obtained from the income tax authorities.	2. If all or most energy enterprises were not paying income taxes over a two- to three-year timeframe, it would indicate that they are either making a loss or have special tax preferences. Both of these situations are undesirable for long-term fiscal sustainability.
3. **Public financing of energy-sector investments**: Identify public support for energy –sector investments by category:	3.1 Public support in any of the four categories would indicate a situation that should be changed to minimize fiscal risk and fiscal burden. The "**Public Spending" chapter of**

Indicator	Analysis/Diagnosis
3.1 Direct budget transfers 3.2 Government domestic borrowing. 3.3 International borrowing (commercial and official development assistance) 3.4 Government guarantees for commercial risk. 3.5 Government guarantees for political risk.	**the PRSP Sourcebook** provides guidance on analyzing sector allocation in the budget and should be consulted. 3.2 Concessional credit for the energy sector should be minimized. 3.3 Multilateral and bilateral debt provides substantial resources that are cheaper than alternative sovereign commercial borrowing. The effect of this borrowing on Government liabilities needs to be analyzed. 3.4. Since the Government cannot control commercial risk, it should phase out these liabilities. 3.5. Political risk guarantees may be appropriate in some countries.

3.5 Improve energy sector governance and regulation

Market-based mechanisms, formal oversight institutions, and processes that lead to efficient investment, production, and energy service delivery are indicators of good sector governance and regulation. Good governance and regulation are key determinants of whether the poor in particular, and the economy in general, receive adequate service at an acceptable price. Poor governance undermines the performance of existing sector enterprises and reduces the attractiveness for potential new entrants, affecting the poor in the following ways:

- A badly performing sector may lack the financial ability to expand and deliver service to poor households.
- Inefficient enterprises have high-cost operations that price the services beyond the reach of the poor.
- The regulations and policies that engender bad performance also protect inefficient enterprises from competition on prices and service quality that new entrants could provide.

Deteriorating performance may be due to three sets of factors. First are adverse movements in exogenous factors, such as world oil prices, access to foreign loans, high domestic interest rates, and inflation. Second are inappropriate national policies on energy pricing and investment. Third are specific enterprise governance related factors, including conflicting objectives, lack of management accountability, and autonomy. The second and third factors would indicate the need to focus on sector governance and regulatory changes.

There are many ways to address governance and regulation problems—the key elements in general comprise:

- Establishing a credible regulatory framework that is able to authorize investment and prices which are consistent with access and service quality goals;
- Initiating structural changes that subject monopolies and centralized operations to increased competition and decentralized management; and

- Increasing the business orientation of the enterprises through improved corporate governance or privatization, where feasible.

The above points suggest that there are many facets to good governance, and hence a one dimensional metric is generally inappropriate. In table 3.4 a series of five questions are suggested to assess the quality of governance. These questions have simple "yes" or "no" answers. Each "no" answer would indicate an area of existing or potential governance problems – and therefore an area for reform. The greater the number of "no" answers, the greater the potential for severe governance problems.

Table 3.4 Assessing energy sector governance

Indicator	Analysis
1. Are sector entities established as commercialized corporations whose managers are subject to commercial discipline?	Creation as an independent legal corporation is often a first step in the reform process. Subjecting the entity to commercial disciplines makes it more likely that costs can be reduced and efficiency improved.
2. Do prices for energy services cover costs and have large cross-subsidies between consumer classes and between regions been eliminated?	When prices cover costs (on average) and cross-subsidies between and within consumer categories are minimized, it is more likely that access and quality goals will be met.
3. Are new entrants permitted and/or encouraged in the delivering energy services to consumers – to both those who already have service and those who are in underserved areas?	The presence and encouragement of multiple service providers has two potential outcomes: (a) there are pressures for cost efficiency; (b) energy services are more likely to reach the poor.
4. Does the energy supply chain comprise separate functionally specialized corporations that are separately owned? For example: multiple oil product distributors and multiple generation and electricity distribution firms?	An integrated energy supply chain as opposed to an unbundled structure comprised of multiple functionally specialized firms, tends to result in higher cost energy supply and to be less responsive to consumer needs.
5. Is there a separate regulatory body that is able to authorize investments and price adjustments without political interference?	Access and service quality goals are more likely to be met if such a regulatory framework is in place.

3.6 Reduce the health and environmental costs associated with energy supply and use (See **Environment** chapter of PRSP Sourcebook)

An overwhelming majority of the poor in developing countries depend on biomass for their energy needs. Their health is damaged from burning biomass—wood, charcoal, dung, and straw—owing to high levels of exposure to the combustion byproducts, particularly particulates and carbon monoxide. These pollutants directly affect the health, life expectancy, and quality of life of anyone who is exposed to them at moderate or high levels. Breathing air containing suspended fine particles is a major cause of chronic and acute respiratory infections, which are among the greatest causes of death and ill health of the poor. [18] Indeed, across all developing countries, health damage from air pollution is of comparable magnitude to that from inadequate water supply and sanitation. The effects are particularly significant in Asia and Sub-Saharan Africa (see Table 3.5).

[18] WHO World Health Report 1999 estimates that acute lower respiratory infections ranked fourth in their share of the burden of disease in Sub-Saharan Africa in 1998, responsible for 7 percent of the total, with AIDS at 17 percent, malaria at 10.6 percent, diarrheal diseases at 7.5 percent, and perinatal conditions at 6.2 percent.

Table 3.5 Percentage of total burden of disease in DALYs

	Sub Saharan Africa	Asia and Pacific	Middle East North Africa	Latin America and Caribbean	Eastern Europe	Developed Countries	All Developing Countries
Indoor air pollution	5.5	5	1.7	0.5	0	0	4
Urban air pollution	1	2	3	3	3	1	2
Diseases related to inadequate water supply and sanitation, for comparison	10	8	8	5.5	1.5	1	7

Note: DALYs: Disability Adjusted Life Years, which combine years lost to premature death and healthy life lost to illness or disability.
Sources: Murray and Lopez 1996, Smith 1993, 1998, 1999, World Development Indicators 1999, World Bank staff.

Traditional biomass can have a variety of negative health impacts (Table 3.6), especially when it is burned indoors without either a proper stove to help control the generation of smoke, or a chimney to draw the smoke outside. Women and children are particularly exposed to the effects of indoor air pollution, as it is they who tend to cooking fires. The use of biomass, then, may also promote higher medical care spending and diminish the ability of people living in poverty to work productively. These effects are reinforced to the extent that users of biomass are less likely to boil the water they drink, for reasons of cost or custom. Insofar as the use of biomass in urban areas promotes deforestation, reliance on biomass may also tend to increase its future cost, further diminishing the living standards of people living in poverty. The World Health Organization(1997) estimates that 2.8 million people die each year as a result of indoor air pollution. In India, a study of 1992-93 data indicates that the risk of mortality increases with the use of solid or biomass cooking fuel by 30-35 percent in rural households and 15-20 percent in urban households [19].[20]

[19] The Burden of Disease from Indoor Air Pollution in Developing Countries: Comparison of Estimates by Kirk R. Smith and Sumi Mehta, Environmental Health Sciences, University of California Berkeley, CA 94720-7360, Prepared for the USAID/WHO Global Technical Consultation on The Health Impacts of Indoor Air Pollution and Household Energy in Developing Countries May 3-4, 2000 Washington, DC. See also Smith KR, Corvalan C, and Kjellstrom T. "How Much Global Ill-Health is Attributable to Environmental Factors," Epidemiology, in press, 1999.
[20] Hughes and Dunleavy, 2000 (Draft)

Table 3.6. Health effects of biomass fuel use in cooking

Processes	**Potential Health Hazards**
Production	
- Processing/preparing dung cakes	Fecal/oral/enteric infections, skin infections
- Charcoal production	CO/smoke poisoning, burns/trauma, cataract
Collection	
- Gathering/carrying fuelwood	Reduced infant and child care, bites from venomous reptiles/insects, allergic reactions, fungus infections, severe fatigue, muscular pain, /back pain, arthritis
Combustion	
- Effects of smoke	Conjunctivitis, upper respiratory irritation and inflammation,
- Effects of toxic gases (CO)	Acute poisoning
- Effects of chronic smoke inhalation	Chronic obstructive pulmonary disease (COPD), chronic bronchitis, adverse reproductive outcomes, cancer (lung)
- Effects of heat	Burns, cataract
- Ergonomic effects of crouching over stove	Arthritis
- Effects of location of stove (on floor)	Burns in infants and toddlers

Source: Goldemberg and Johansson, 1995

In cities, the burning of solid and liquid fuels causes smoke, particulate emissions, smog, and acidic precipitation. The sources arise from transport, power and heat generation, and industrial and commercial uses. Among the worst pollutants in terms of their detrimental health impact are fine particulates and lead.

Interventions to reduce air pollution can be extremely cost-effective in their benefits to public health. Many of the interventions also have a private benefit for which people are willing to pay. They can therefore sometimes be justified on economic criteria alone. The cost-effectiveness is highly variable, however, particularly for interventions aimed at reducing urban air pollution.

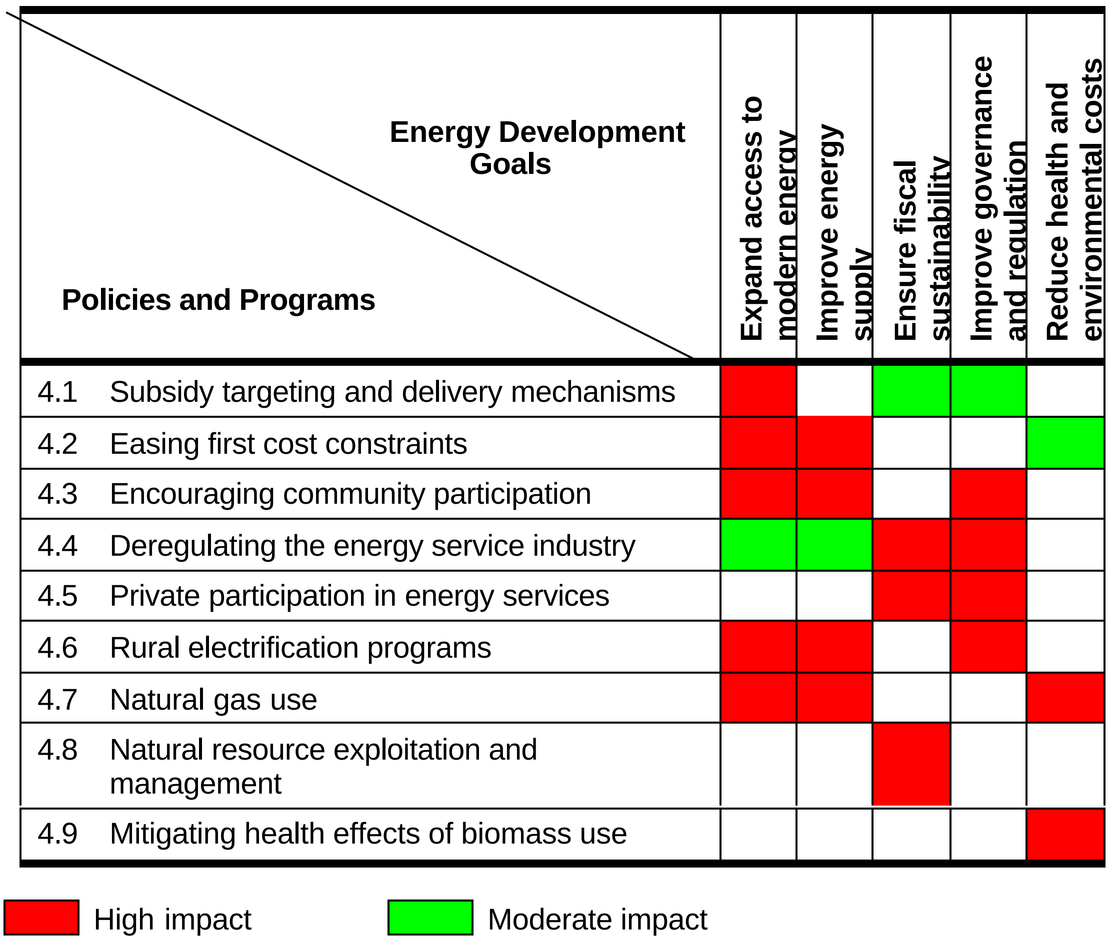
Natural resource development (hydropower, oil and gas) can have large environmental and social impacts. Safeguards must be established for these and compliance monitored. [21]

4 Policy and program interventions

This section provides guidance in assessing and designing specific policy and program interventions to advance energy development goals. Figure 3 maps the potential impact of a menu of feasible policy and program interventions against the development goals.

[21] See for example the World Bank's **Environmental Assessment & Safeguard Policies. http://www.worldbank.org/environment/op_policies.htm**

Figure 3 Impact mapping of policies and programs against development goals



4.1 Subsidy targeting and delivery mechanisms

Final consumer prices influence consumer behavior at all stages of the energy transition. Energy prices are used as instruments of government energy policy to meet particular social objectives—specifically, through price subsidies to poor households. While some form of subsidy to assist lower-income households in meeting minimum subsistence needs is often useful, these subsidy programs should be designed in a way that minimizes pricing distortions.

Subsidies are almost universal in the energy sector at all stages of economic development and transition. It should be borne in mind that the costs of adjustment in moving to a reformed private sector operated energy sector with economic regulation can be very high, and that much of this burden will fall on poor people[22] – poverty sensitive adjustment will require a safety net. While extremely useful, perhaps indispensable in addressing the needs of the poor, poorly designed subsidy mechanisms often do not benefit the groups for

[22] High cost of adjustment to the poor is documented in "Bolivia: Introducing Competition into the Electricity Supply Industry in Developing Countries: Lessons from Bolivia, ESMAP Report 233/00, August 2000,

whom they are intended. It is also important to ensure that subsidies make markets rather than destroy them.

A few principles to be considered in establishing energy pricing policy are noted below.

- As much as possible, energy prices should reflect the full costs of supply. If subsidies are needed, they should be high enough to ensure that service providers have a financial incentive to meet the demand of subsidized consumers. Without a financial incentive to meet their demand, these consumers may not receive the desired level of service. When a cross-subsidy mechanism is used between categories of users, it will also create a disincentive to serve those who do not pay full costs. Furthermore, cross-subsidies rest on monopolistic supply arrangements and therefore preclude innovation and competition in service provision, which may actually benefit the poor through better access (see Section 3.1).

- Although energy pricing mechanisms should, in principle, seek to internalize the costs of pollution that result from energy use, these environmental taxes should not make the energy the poor rely on unaffordable. For example, a tax on commercially available charcoal, coal briquettes, or kerosene may be largely borne by the poor.

- Subsidies should be designed in such a way as to re-enforce the commercial orientation to reduce costs and improve service. In most cases this will mean focusing on reducing the cost of the initial investment, thereby increasing the numbers of people who have access to the energy service, rather than continuously subsidizing the recurrent cost of operation[23].

Subsidies may be used to 1) assist poor households in obtaining or affording a minimum level of service—a consumer, or consumption, subsidy, such as a low charge for very low levels of household electricity consumption or 2) wholly or partially, cover the cost of connecting the poor—a capital subsidy or first-cost subsidy. In this context the financial resources needed for the subsidy may be provided 1) directly from outside the industry, typically from an earmarked revenue source or general public expenditure or 2) cross-subsidies when one group of consumers is charged a price below costs and the shortfall is financed from other consumers. This section discusses ways to improve consumer subsidy targeting and delivery; ways to provide connection subsidies are reviewed in the next section. Six subsidy evaluation criteria and six possible subsidy mechanisms are discussed below, and a summary is provided in Table 4.1. Countries should perform a similar evaluation to determine the appropriate subsidy mechanism in their context.

[23] Lifeline tariffs may well be an exception to this, but may be justified where the subsidy is essentially paid by a "cross subsidy" from richer consumers, so preserving the notion that the energy supplier covers its operating costs.

Subsidy Evaluation Criteria[24]

- ***Coverage:*** The extent to which the poor are being reached. Obviously, if the poor are not using the subsidized service, coverage is inadequate.
- ***Targeting:*** The share of the subsidy that goes to the poor. If a large share of the subsidized product is actually consumed by the middle class and the rich, targeting is inadequate.
- ***Predictability:*** The extent to which the poor can count on the subsidy each month.
- ***Distortion:*** The extent of pricing distortions and unintended side effects. Subsidies may exacerbate supply bottlenecks and create disincentives for private businesses to deliver energy services to poor consumers. For example: 1) subsidizing kerosene may prevent switching to nonsubsidized LPG, or supplies being diverted to other markets uses such as transportation; 2) subsidizing electricity for agricultural users in India has led to illegal use for other nonagricultural use, such as small industries. The objective is to minimize distortion.
- ***Cost Effectiveness:*** Direct or indirect cost of the subsidy with the objective of minimizing cost. High costs of providing the subsidy may prove a direct burden on the budget. Although a cross-subsidy may minimize cost, it would increase the distortions and create disincentives to supply.
- ***Administrative cost:*** Simplicity and ease of administration—avoiding the potential for graft and corruption, and rent-seeking behavior.

Subsidy Mechanisms

- **General price subsidies**. Keeping electricity utility prices and the prices of kerosene, diesel & LPG below costs for *all* residential consumers is a widely used subsidy mechanism. The coverage of this subsidy can be high for a network service, for example, electricity), however, and it is not well targeted. Across-the-board subsidies can place a heavy burden on the budget. Predictability of the benefit received through across-the-board utility price subsidies is fairly high for the poor who have the service. However, these subsidies create a distorted price regime, resulting in wasteful consumption practices among households. It is nevertheless simple to administer.

- **Lifeline Subsidies**. These subsidies to electricity are restricted to an initial block of consumption, perhaps equivalent to a basic need level. The coverage of this mechanism is equal to the share of connected households among the poor. Since consumption grows with income, the targeting improves as the size of the initial block decreases. Depending on the size and the source of the price subsidy, lifeline tariffs can place a significant burden on the budget, on the finances of the utility, or on other consumers. There are several design innovations—two-block lifeline, floating blocks—that should be investigated to improve targeting and predictability, as well as to minimize the financing burden.

- **Merit-Based Price Discounts**. These may be provided based on some normative measure of poverty—for example, reduced prices to those living in slums and public housing. These subsidies are difficult to target well and can be very distorting. A cap placed on the volume of discounted consumption, like a lifeline subsidy, can minimize

[24] Much of this section draws on the draft report *Maintaining Utility Services for the Poor – Policies and Practices in Central and Eastern Europe and the Former Soviet Union*, by Laszlo Lovei et al.

the impact of price distortion, particularly if the cap is set below the typical consumption level. However, establishing these normative poverty measures and administering them can be quite expensive.

- **Burden Limit**. Here the total payment for service is limited based on an income test or similar measure of energy spending as a share of household income. This mechanism has low coverage of the poor and is not well-targeted. The low targeting ratio of burden limit is due to a weak correlation between per capita household income and the share of energy spending within the household income. The burden limit mechanism is probably the most distortionary of utility subsidy mechanisms. The distortionary effect, however, is confined to those households that receive support, while the distortions created by an across-the-board subsidy affect every consumer. Placing a cap on per capita or total household consumption of utility services that counts toward the burden limit, or using consumption norms to fix the level of utility expenditures for the purpose of subsidy, can significantly reduce the distortionary effect. Burden limits can be quite costly for the budget, particularly if the limit is set low.

- **Noncollection** refers to non-enforcement of disconnection for unpaid bills, allowing illegal connections to continue. This occurs when governments pressure utilities not to disconnect households that do not pay their bills. Coverage of this mechanism is low. There are significant pricing distortions associated with this scheme, since the effective price of the utility service is below the cost for many consumers even if the notional price is set properly, resulting in inefficient consumption.

- **Cash transfers and general cash benefits targeting poor households.** The coverage of this subsidy is the only one discussed here that is not subject to the constraint of the share of the poor connected to services and products. This mechanism is the least distortionary because households can spend the cash support as they wish. While it can involve significant fiscal cost, there is no direct financial burden for utilities or other consumers.

Table 4.1 Evaluation of subsidy mechanisms

	General Price Subsidies	**Life-line Tariffs**	**Merit-based Price Discounts**	**Burden Limit**	**Cash Transfers**	**Noncollection**
Coverage of the poor	3	3	1	1	3	2
Targeting the poor	1	1	2	2	2	2
Predictability to the poor	3	3	3	2	2	1
Pricing distortions minimized	1	2	2	2	4	1
Administrative ease	3	3	1	1	1	4

Scoring: 4 – Excellent; 3 – Good; 2 – Marginal; 1 – Poor

4.2 Easing first cost constraints

Two fundamental elements of energy pricing influence a poor household's decision to obtain and use a particular energy service. The first is the upfront connection and equipment cost of using the energy service, for example, the cost of grid connection and home wiring; kerosene/LPG stove; and service deposit. The second is the per-unit price of using the service, that is, the electricity price per kilowatt-hour, cost of kerosene per liter.

High first costs significantly constrain the ability of the poor to shift to modern energy services. For example, the cost of connecting to the electricity grid can range from the equivalent of 20 dollars to over a thousand dollars, depending on proximity to the existing network. Even at the lower end of the range, this cost can be prohibitive to low-income households. The investment in a kerosene/LPG stove may cost the equivalent of a few month's wages for the poorest households, while the cost of installing a solar home system may cost over 200 dollars—once again a large multiple of the monthly income of the poorest. Methods are needed to ease these first-cost barriers; two options are discussed below.

It is also important to note in this context that all modern renewable energy technologies have higher initial capital costs and lower recurrent (fuel) costs relative to fossil fuel based technologies. This is particularly so for photovoltaic electricity, hydro-power, and wind energy. The poorer a person, the less likely it is that they can afford new forms of renewable energy (technically because the opportunity cost of capital increases with lower incomes). Poorer people often pay more per unit of energy used simply because they cannot cover the initial capital costs of the less expensive supply options.[25].

Lowering system costs through more 'appropriate design standards

Design standards—capacity, size, and robustness—are sometimes higher than needed to provide the poor with a basic level of service. For electricity access, many electricity distribution systems require household connections to be sized for 3 to 7 kilowatts of service when a rural poor household might instead prefer from between 0.2 to 0.5 kilowatts of service. This overdesign requires heavier wires, larger transformers, and more sophisticated controls, all of which are more expensive. The entire system design can be "lightened" to provide service at less cost. Although many of these low-cost designs may imply increased maintenance costs and lower reliability, and are therefore resisted by utility service providers, there are ways to transfer some of the maintenance tasks to consumers.

Inappropriateness in design and sizing is also present in off-the-shelf household systems. For example: 1) availability of 50 peak-watt, or larger, PV panels when the average poor household can afford and requires only a 12-25 peak-watt system; 2) availability of 15 liter or larger-size LPG cylinders when the poor could better afford smaller bottled quantities.

Providing consumer credit and connection subsidies

[25] Similarly, where generating utilities have very severe limits on capital expenditures, their opportunity cost of capital at the margin rises to very high levels. They will then commonly opt for technologies with a lower initial capital cost, for example diesel generators, over an apparently preferable renewable option such as hydro. Where utilities have very severe limits on capital (or where the private sector requires a high return on its investment), the 'opportunity cost' of capital at the margin rises to very high levels, explaining perhaps why they then opt for diesel generators rather than hydro with its higher initial capital cost. There has been a marked reduction of investment in medium and large scale hydro as utilities have been corporatized or privatized.

The indivisibility or 'lumpiness' of many energy systems means that the "initial or first cost" for improved energy services may often be a multiple of a poor household's monthly income, there is a need to find a way to break these payments into smaller installments and spread them over a reasonable timeframe. Many options are available for providing this form of credit for modern energy access.

- **Utility Credit**: Electric companies could allow customers to pay connection costs over several monthly payments on their electricity bills. By charging interest to the consumer, the utility can make a profit on this activity, provided they are able to cut off the consumer for nonpayment. This provides the utilities with an effective form of collateral. A public electric company in Bolivia doubled its customers in several villages after offering to finance connection charges over a five-year period.

- **Microfinance**: Providing consumer credit through microfinance institutions (MFIs) may sometimes be a feasible way of easing first-cost barriers. These institutions offer standardized small loans to individual households or groups, often targeting women within the poorest households. Unlike traditional financial institutions, they can be more flexible with collateral policies. Some MFIs have indeed been successful in offering credit to communities for rural electrification (see Box 4). An additional benefit of the approach is that it is consumer-led, which makes it more likely that an affordable solution will be identified. A drawback of the approach is that most microfinance institutions have found it difficult to refinance themselves through commercial sources, and remain dependent on the extension of donor and government loans.

Providing subsidies for Technical Assistance

- It is also important to consider ways in which the costs of a particular energy development can be reduced, and not just be a subsidy to the providers of finance. Providing subsidised assistance for the training of equipment manufacturers, or independent on-site feasibility studies appears to be particularly effective in reducing costs to the user, and in reducing the risks to the investor.

Box 4 Delivering Connection Subsidies - Examples

Guatemala

Genesis Empresarial (GE) was established in 1988 to improve living conditions of low- income communities in Guatemala. GE has an extensive branch network and is currently the largest provider of microcredit in Guatemala. GE offers financial products such as microenterprise loans to individuals and groups, and infrastructure loans to rural communities. It also provides technical assistance and training to borrowers where required.

The infrastructure loans are designed primarily to meet the needs of Guatemala's rural electrification program, whereby rural communities initiate electrification projects and must contribute to the project costs to qualify for public subsidies. All members of the community must contribute equally toward these costs if they are to receive an electricity connection. GE provides loans to groups of poorer households providing them with the needed funds. All group members are jointly liable for all loan repayments, which helps to ensure a high repayment rate - less than 8 percent of loans are nonperforming. The loan amounts are for up to $450 per household and for terms of up to four years, depending on the repayment capacity of the household. GE normally makes a number of group loans in each community, with households grouped by incomes, so all households in a group have the same repayment terms. Local commercial banks are used for handling disbursals and repayments and interest rates are 21 percent to 30 percent.

GE began offering community electrification loans in 1993 and in its first five years, disbursed almost 1,000 group loans with a value of approximately $35 million to 8,700 families in almost 200 communities.

Source: Ruster, 1999

Ensign programme
See also the UNDP/ APDC "Ensign programme" which supplied small amounts of credit to enable small and micro enterprises to gain access to improved energy services.

PROJECT ENSIGN *Financing Energy Services and Income-Generating Opportunities for the Poor* Summary of Concluding Meeting of Project Ensign steering Committee, 7-9 July 1998, Ahmedabad, India.

Chile's rural electrification program.
The program relies on communities to initiate projects. Electricity utilities then compete for subsidies to extend the grid and provide connections to these communities. Grants are allocated to the utility requiring the lowest subsidy. Launched in 1992, the program has helped increase rural electrification from 53 percent to 75 percent in just five years, with an average subsidy requirement of just over $1,000 per connection.

4.3 Encouraging community participation

Most energy supply options benefit from economies of scale (the unit price falls as the size of the conversion technology increases). This means that joint or "community" decisions are often required to ensure that sufficient numbers of consumers are involved from the outset.

Community or locally based approaches in project selection and project management are therefore essential for the success of energy supply options located in the niche between the two extremes of small systems for individual consumers or large network schemes that cover wide areas. Community programs are relevant in the following contexts:

- **Choice of energy service.** Decentralization of decision-making to local communities is essential if they are to signal their energy service needs. Poor communities must usually choose between different supply options. Also, they must choose between different community-based rural infrastructures, such as health and maternity posts, schools, water supply and sanitation, culverts, and energy supply, and decide on the scope, mix, and sequencing of these investments. Empowering local communities to assume the responsibility of making these choices reveals their willingness to pay as well as the quality of services they require (see Box 5)

Box 5 People power: the village of Pura, India

Local people in the village of Pura now administer household electricity and water supplies that are driven by large community biogas digesters. Initial attempts to promote community biogas systems in Pura failed because they were directed at substituting biogas for wood as a cooking fuel. Abundant wood resources in Pura make fuelwood collection relatively easy, and villagers therefore had no incentive to maintain the system. Subsequent discussions with villagers indicated that they were more interested in obtaining clean and reliable water supplies located near their homes. Because grid electricity supply was unreliable, the community decided to establish a system of biogas powered diesel engine driving an electricity generator. Electricity from the generator was supplied through a microgrid to households and also powered a deep tubewell pump that supplied water to a local system. Each household participating in the program received a tap with clean water at the front of their house, thereby eliminating long walks to the local tank and significantly improving health. Each household is charged a fixed rate for the water tap and each electricity connection.

Reddy, et al

- **Community-based management.** Cooperatives and community groups can support the delivery of energy services to the poor. Community management of billing and collection can improve payment discipline. Using local labor to provide maintenance services can increase local employment, encourage local entrepreneurship, and reduce costs. These factors can be extremely important in increasing access and improving affordability of the energy services.

In practice while it is often important to have community ownership of an (energy) asset, it is also important that the management of these assets is performed in a business-like way. This usually means that the day to day operation of community energy services is insulated from political interference, that the rules of operation (including criteria for adding new customers) are transparent and known in advance, that prices cover not only the cost of operation and maintenance, but that a fund is built up to pay for future capital replacement.

Community-based development cannot assume the entire burden of rural energy infrastructure development—for example, a regional petroleum distribution system or a regional electrification program cannot be managed by local communities. However, their participation in planning these regional networks can benefit their design.

4.4 Reform of Energy Markets

No single service provider, public or private, can deliver the entire range of energy services needed to meet the varied needs of rural and urban businesses and high- and low-income households. Public, private, and community-based service providers are needed to effectively meet the needs of the poor. This diversity normally leads to complementary services being delivered and fosters competition to drive down supply costs, both of which benefit the poor.

Often the poor cannot access modern energy forms, not because the demand is lacking, but because of supply-side problems with unresponsive public and private monopolies deny them access. Recent experience in the industrial countries, and increasingly in developing countries, shows that energy supply through networks can be made competitive. Competition creates opportunities for expanding services and cutting costs both on and off networks. Competition takes advantage of emerging technologies that have the potential to economically provide the electricity requirements for isolated small loads. Technology has also profoundly changed the options for managing the transmission of power and gas across grids, increasing consumers' chances of accessing cheaper, more reliable energy.

Reform of energy markets should cover the following goals:

- Opening up electricity generation and distribution to multiple competing providers.

- Opening up petroleum product distribution, and import, to multiple competing providers—with common access to terminals and pipeline networks.

- Allowing small businesses and community groups to provide commercial energy services to rural and poor areas—installation, operation and management of small distribution grids; billing, collection and other consumer service functions; distribution of petroleum products and LPG; manufacture of improved cooking stoves and supply of woodfuel and charcoal.

Typical constraints and barriers to the entry of new service providers include:

- Regulations that either accord exclusive supply rights to a single or a limited number of public or private-sector corporations.
- Price-setting practices that do not consistently cover costs and provide an acceptable risk-adjusted return to investors and operators creating a disincentive to engage in the energy service business.
- Demand profiles and intensity in the unserved and underserved areas that are not attractive for private providers.

Regulation of Energy Markets. Transparent, credible, and consistent regulation of the monopolistic elements of the energy sector and overall service quality is a necessary condition for effective service delivery. International experience with how to implement good regulatory institutions and processes is increasingly well-documented.

General principles that should be considered are:

- **Encouraging nonexclusivity in the licensing of energy service companies.** While competition for consumers of electricity and gas network services in areas already served areas may not be initially feasible, nonexclusivity should be ensured for petroleum fuel and LPG distribution businesses.

- **Allowing competition for the right to serve in unserved regions.** Some form of incentive, for example, capital cost subsidy, or tax incentives, may be required to attract service providers to make the investments to serve rural poor consumers in low-consumer density and demand areas. If these subsidies or incentives are economically justified, it is preferred that they be provided competitively.

- **Regulations on service quality standards to low-income households need to avoid overspecification**, which may only retard service provision (see Section 4.2).

- **Participation of local communities**. Low-income consumers, through community organizations, should be able to participate in monitoring small-scale service providers and retailers at the local level (see Section 4.3).

4.5 Private participation in the energy sector

Restructuring and regulation of energy utilities has to be carefully designed so that the poor benefit and are not disadvantaged as can happen if service is withdrawn because of their inability to pay the unsubsidized prices of the private supplier.

Private participation in ownership and/ or operation of the energy sector entities can have positive short and long-term impacts on the poor:

- Private owners and operators can improve the operating efficiency of the energy production, transport, and supply chain, thereby reducing the cost of providing the service. Effective regulation will be needed to ensure that cost reductions are passed onto consumers.

- Private ownership will require cost-covering tariffs. If tariffs are initially below cost, tariffs will need to rise, to the short-term detriment of all consumers. Of course, in the medium term, such changes generate the funds needed to pay for enhanced investment and maintenance and hence result in improved services for all.

- Private operators have been found to be more responsive than parastatals to service delivery obligations and consumer needs.

- Private operators will have incentives to contain their costs by reducing "non-technical" losses (theft).

- Private operators will typically be able to obtain large-scale injections of capital and use the capital more efficiently, if the regulatory environment is stable[26]. This will allow system expansions to be undertaken and supply shortages avoided.

- Private ownership may sometimes lead to a short-term decrease in employment in the affected industry, but the resulting improvement in service reliability or cost should lead to longer-term increases in job creation that accompany growth.

- The scale and distribution of benefits of privatization will depend on the form of privatization chosen. A variety of mechanisms can be employed to involve the private sector in the energy sector (see Table 4.2). For example in a management contract the private operator may be paid a flat fee to improve enterprise management, but the incentive to increase sales or to improve billing and collection is weaker than with a lease, where the operator can keep the collected revenues and pays a lease fee to the government. A concession with investment obligations, a BOT (Build, Operate and Transfer) scheme or divestiture will make the private operator responsible for deciding upon investments, delivering stronger incentives than a lease to minimize the costs of capital investment, a crucial determinant of the final price of infrastructure services.

[26] When regulatory commitments are honored, sovereign guarantees to suppliers can be avoided and country fiscal risk reduced.

Table 4.2 Privatization options

Option	Asset ownership	Operations & Maintenance	Capital investment	Commercial risk	Typical duration (years)
Service contract	Public	Shared	Public	Public	1-2
Management contract	Public	Private	Public	Public	3-5
Lease	Public	Private	Public	Shared	8-15
Concession	Public	Private	Private	Private	25-30
Build-operate-transfer (BOT)	Shared	Private	Private	Private	20-30
Divestiture	Private	Private	Private	Private	++

Source: Neil Roger, The World Bank

4.6 Electrification Programs

Electrification profoundly affects village life, bringing a strong sense of 'modernity' and connection to the world beyond the village and expectations for a better future.

About 1.6 billion people in developing countries do not consume any electricity. Electrification rates are as low as 5% in some sub-saharan countries and are quite high rates in countries such as Indonesia (80%), the Philippines (78%), China (97%), Sri Lanka (75%) and Tunisia (95%). The evidence from countries which have or continue to implement electrification suggests the following

- Allowing for non-exclusivity in supply is critical. In China, Bangladesh, the USA, and the Philippines it is decentralized suppliers such as rural co-operative societies rather than the national or regional utilities that have been instrumental in bringing electricity supply to rural areas.

- Electrification is not possible in regions within countries where people are so poor that they cannot afford the cost of electricity use even when the first cost barriers are removed[27]. These households will, however, benefit indirectly through access to improved community services, such the health centers, and to publicly accessible radios and televisions. Furthermore they can benefit from the general rise in rural incomes obtained from increased farm and nonfarm employment resulting from the productive use of electricity, .

- More and more evidence suggests that even poor consumers will pay very high unit costs to gain access to electricity. One type of evidence is provided by data on the

[27] In this case, measures that improve the supply and clean use of biomass fuels and oil products assume critical importance. There will be still opportunities for increased electricity services in such areas that fall short of electrification. For example it may be that a rural business such as a trading center or an agricultural produce process center may find it economic to provide some electricity service to the nearby community.

widespread use of 12 volt (car) batteries for lighting, radio and TV where alternative sources of electricity are unavailable [28].

Broadly, there are two delivery mechanisms, grid extension and off-grid supply.

- **Grid Extension Programs:**

When a grid extension program is justified, the following principles merit consideration:
- Ensure the principal focus of the grid extension program is building a consumer base with the potential for increasing demand.
- Set tariffs high enough to avoid the need for ongoing operating subsidies. They should cover, at a minimum, the full cost of generation, transmission, and distribution, plus operating and maintenance costs.
- Limit subsidies to a portion of the distribution system's initial capital investment costs, which can be controlled by the funds available at the time of the investment.
- Low lifeline tariffs are an exception to the above rule, justified on income distribution grounds, but they should cover only a small block of electricity related to a minimum use level.
- All consumption should be metered.
- Utilities should maintain separate financial accounts for rural electrification so that financing, real costs, and monetary implications can be identified and analyzed.

Grid extension is likely to be the least cost option in peri-urban areas and will usually produce the lowest cost electricity supply per unit of capital employed.

- **Off-Grid Electrification:**

Extensions of a centralized grid become unprofitable for electric utilities, the distance from distribution centers is high, when the "density of demand" is low because households are dispersed or when consumption per household is low. In such conditions, other participants may provide off-grid electricity service to the unserved in shorter timeframes than grid extension RE programs. In nearly all developing countries, least-cost analysis will favor off-grid solutions in large parts of the country..

Off-grid electrification is based on distributed generation solutions such as stand-alone photovoltaic systems, battery charging stations, minigrids powered by sun or wind, and isolated systems based on diesel, hydropower, and biomass. Privately led off-grid electrification can be a viable alternative to grid electrification.

The key driver of improved access to off-grid electricity services has been an emphasis on decentralized approaches with local participation.

Box 6: A report *Rural Electrification: a hard look at costs and benefits*[1] of the Operations Evaluation Department of the World Bank made the following points:

- Rural electrification (RE) reduces rural poverty only through a general rise in rural income obtained by productive uses. And--again with the exception of irrigation pumping--these

[28] Recent survey data from Uganda show that in 1996, 94% of households not connected to the grid used dry cell batteries, and were thought to spend about $6 per household per month on them. Although such batteries are very convenient, they are a very expensive way of obtaining electricity. UGANDA: Rural Electrification Strategy Study, Final Report, September 1999, ESMAP, World Bank

productive uses of electricity appear to come about only when other factors are already raising rural and national per capital income.

- One of the most persistent claims for RE is that it can induce industrial growth in otherwise lagging low-income rural economies. The evidence from developing countries does not support this claim; RE has not, by itself, triggered industrial growth or regional development. In certain circumstances, however, it has supported growth led by a dynamic agricultural sector. The study found that where other prerequisites of sustained development were absent, demand for electricity for productive uses did not grow. (An important exception is demand for electricity for water pumping to spread irrigated farming.) Without agricultural growth, the use of electricity in rural areas has remained low, and many of the expected economic benefits of electrification have not been realized. OED's findings support that of the World Bank's 1975 Rural Electrification Policy Paper: investment in RE is economically justified only when the emerging uses of electricity are strong enough to ensure sufficient growth in demand to produce a reasonable economic rate of return on the investment.

- Although RE in Asia may not have been an engine for economic growth, it has provided significant benefits. Many of these benefits have been underestimated, for three reasons:

- Where tariffs are far below economic costs, and demand is constrained by non- price factors, conventional rules of thumb for establishing the demand curve often underestimate the benefits that consumers derive from electricity. The most common error is to assume that the observed consumption level represents a point on the demand curve, when in fact it may be far below the demand curve because consumption is being held down by inadequate supply.

- The economic benefits of electricity may be difficult to measure on the basis of the cost of substitutes. For instance, because electric lighting provides an order of magnitude improvement over lighting from candles and kerosene, electric light is much more than a simple replacement for kerosene.

- Even if a substitute is deemed to exist for electricity (as with the use of diesel pumps in irrigation, for example), microeconomic rate of return calculations may be flawed for two reasons. First, observed consumer behavior and underlying prices are often distorted by taxes, subsidies, and lack of information about access to rural credit. Second, assumptions about RE and its substitutes that may be valid for a small project, taken in isolation, do not necessarily apply to a massive RE program; on that scale, diesel fuel may not be available, and prices and benefits may differ.

- When this happens, RE may be in a unique position to promote a paradigm shift in agricultural production, by making possible irrigation and associated modern technology and practices. This occurred in the Indo-Gangetic plain of the Indian subcontinent and in some areas of China. Project analyses have failed to evaluate the alternatives and to account for the indirect benefits of national and regional food security and the accompanying low and stable food prices that may flow from RE.

- All the evidence to date, including that from Bank-financed RE projects in Asia, shows that RE does not directly reduce poverty by helping the poorest rural people. Most of the direct benefits from rural electricity go to wealthier people. Even when tariffs are low, potential consumers cannot always afford the initial connection and household wiring. Once connected, the amount of electricity consumed, and therefore the benefits obtained, depend on the ability to buy electrical equipment, whether light fixtures, televisions, fans, water pumps, or motor-driven machines. Evidence from Indonesia suggests that the poorest 25-50 percent of the population could not afford electricity, even if connections were to be financed through power company loans. Direct observation tends to support this supposition for most countries with per capita rural incomes of less than $200 a year.

- RE reduces rural poverty only through a general rise in rural income obtained by productive uses. And--again with the exception of irrigation pumping--these productive uses of electricity appear to come about only when other factors are already raising rural and national per capital income, as has been the case, most noticeably, in Malaysia and Thailand.

- Hence the justification for investing in and subsidizing RE programs needs to be based on their ability, after a start up-phase, to elicit a sufficient level of consumption at an economic price. All proposed projects should therefore provide estimates of expected consumption growth.

Although most RE schemes in Asia have generated substantial economic benefits, they have had a dismal cost recovery record, even without taking account of peak load generation costs. While the capital and operating costs of generation, transmission, and distribution are significantly higher for rural communities than they are for urban, rural tariffs have been at best equal to, and in many cases much lower than, urban tariffs. Only 10 to 50 percent of the economic cost is generally recovered. Thus RE has usually been highly subsidized, either indirectly by urban industrial users or directly by government allocations.

4.7 Natural Gas use

For countries with potentially easy and low-cost access to natural gas, its availability and premium qualities may make it a highly desirable alternative to traditional fuels as well as oil in nonpremium uses. Increasing the availability of natural gas[29] (methane) can bring to the poor many of the direct benefits of lower cost and higher environmental quality associated with oil products

For the poorest, the indirect benefits of natural gas development are likely to be substantial. These include the positive impact on economic growth that natural gas availability will bring. In particular, natural gas development and supply will be a powerful impetus for more electricity generation and for industrial and commercial development, including basic industries such as glass and brick manufacture, bakeries, and food service establishments. Also, it may be associated with additional macroeconomic fiscal benefits available from local gas production (see Section 4.8).

Given the nature of the industry, for example, the "natural monopoly" nature of gas pipelines, the need for effective regulation and the difficulty of ensuring competition are greater than for oil products. Issues of regulation and subsidies are discussed in Sections 4.2 and 4.5. Specific natural gas policies that are priorities for governments are:

- Pricing gas in a way that reflects the cost of alternative fuels or the long- term economic costs of gas production and distribution

[29] Butane obtained from natural gas is a source of the cooking fuel LPG.

- Establishing fiscal regimes (see Section 4.8) and credible regulatory frameworks (see Section 4.4 that encourage the private-sector development of gas production and distribution.

- Encouraging technological innovations that reduce the costs of connecting remote communities to gas services. There is growing experience in developing small-scale gas distribution systems that use stranded gas resources or gas from nearby large-scale trunk lines by applying low-cost approaches, such as special plastic pipes and small generators. These developments offer remote communities the chance of accessing a premium fuel directly or through small-scale electricity generation. Governments should be alert to the opportunities for such small-scale gas operations and ensure that fiscal and other regulations, especially electricity monopolies, do not discourage them.

- Integrating natural gas networks into urban planning. In some cases, the poor can benefit from natural gas if gas distribution forms a part of urban planning for new, low-cost housing and urban renewal. Retrofitting houses with gas pipelines and meters, for example, is usually not justified where unit consumption is low. However, incorporating natural gas lines and meter points into low-cost housing at the time of construction greatly reduces the capital cost of supply. These types of policies need to be enforced when appropriate through building codes.

4.8 Oil, Gas & Hydropower natural resource exploitation and management

Exploiting and managing natural resources such as oil, gas and hydropower can be a significant revenue source for government (and increasingly for local governments), offering opportunities for poverty reduction. In some cases, the success of government poverty reduction strategies will be dominated by the success of policies that they employ to develop and manage their oil, gas and hydropower resources – particularly in those countries that have potentially significant oil, gas or hydroelectricity exports that account for a very high share of exports/government tax revenues.

The development of local resources can generate substantial fiscal rents that can be used for public spending in support of poverty reduction. In the case of a few emerging market economies, the scale of these potential rents is extremely large relative to the size of the local economy and they can provide a very significant boost for development. However, even when resource exploitation is successful and profitable, natural resource development requires appropriate macro-economic and social policies if it is to lead to poverty reduction. Some substantial oil exporters, for example, have a greater incidence of poverty after years of oil and gas development than before first oil production. Economic growth led by resource development can create substantial increases in income inequalities, between different economic groups, and between the resource-rich and resource-poor regions of a country.

The impact on poverty alleviation, positive or negative, of the development of oil and gas resources depends primarily on government policy and actions in two key areas:

- At the **national level**, where the management of the development of a country's resources - from the form and pace of development, to the design of fiscal terms and the use of the tax revenues generated – will be crucial in ensuring that the benefits of production of a non-renewable resource are translated into sustainable economic development

- At the **local level** where an appropriate framework and mode of development will need to be established to ensure that local people do not bear excessive costs of disruption and development and not receive any of the benefits.

When it comes to overall **national management** of resource development, key areas for policy development are:

- **Ensuring development is effective**:

  - A strategy for development that plans a program of development/access resources in a way that ensures that the pace of development matches the resource base, and the capacity of the country to absorb and mobilize resources and investment.

  - Private vs. public development – in particular the mix between private investment, public regulation.

  - The role of national oil companies – in particular the need to separate commercial operation from government responsibilities.

  - The process of gaining access to oil and gas resources and the division of risks and rewards between investors and country by using well tested and understood devices such as bidding rounds, and specialist oil and gas taxation methods that attract investors and provide them attractive incentives but which also ensure that the net benefit of resource development is optimized for the country.

  - Environmental and other regulations (including an approach to gas flaring and the use of gas found in exploration).

  - Policies designed to encourage local content and ancillary development that can effectively encourage the development of local industry and services and broaden the impact of development.

- **Using the resources generated by development well**

  Developing a long term plan for spending revenues which could involve :

  - Funds for future generations - recognizing that in some cases there may be a need to preserve directly some of the financial benefits of the development of a depletable resource for future generations.

  - Consumption versus investment – deciding on broad policy allocations of revenues between consumption and investment (physical and human)

  Putting in place shorter term stabilization policies that might involve:

- Dealing with the macro-economic management of the potential problems that can arise from a rapid build up in revenues and spending as a result of resource development ("Dutch Disease")

- Establishing stabilization funds - setting in place automatic mechanisms designed to manage short term fluctuations in fiscal and export revenues from volatile commodity prices.

At the **local level**, the issues are more specific (although local communities will also be impacted by national policy decisions) :

- **Resource rent sharing policies**

  Most countries see natural resources as belonging the country as a whole, although this will depend on local law and customs. But experience generally indicates that local communities closest to development and who may perceive of the resource as theirs, need to be involved in development and share directly in the fiscal or fuel supply benefits in some way.

- **Managing environmental and community issues**

Much resource development takes place in remote areas. As well as offering benefits, in for example the form of jobs and services to remote poor communities, it can also have negative impacts. Good environmental and social practice, is essential to ensure that local communities are not harmed by development. This is particularly true when sensitive environments and isolated indigenous peoples are concerned. There is increased awareness of these issues and an emerging body of experience and best practice in this respect that countries should tap into.[30]

4.9 Mitigating health effects of biomass energy

The burning of biomass as a cooking fuel causes is detrimental to people's health. Interventions to reduce this air pollution can be extremely cost-effective in their benefits to public health and compare favorably with other public health measures such as vaccination. Many of the interventions also have a private benefit for which people are willing to pay. They can therefore sometimes be justified on economic criteria alone.

Policies to expand access to modern energy are in the long run those that will have the most impact on reducing the harmful effects of biomass use.

Policies that directly target biomass use include:

- Policies that promote the use of improved stoves that increase combustion efficiency. Introducing chimneys to expel the smoke from indoors.

- Encouraging sustainable management of biomass fuels such as wood. Management and use of woodfuel resources should be transferred as much as possible to local

[30] **http://www.worldbank.org/html/fpd/energy/oil&gas/BestPractices/index.html**

communities. Transfer of ownership and land title of forest areas to local communities can help to ensure sustainable use of woodfuel resources.

- Processing biomass and coal to make them cleaner—for example, as charcoal and biogas or smokeless coal and coal gas. In general, the environmental pollution from the final use of processed solid fuel is less than from the raw forms. However, the limitation is that new sources of pollution are created during processing, for example, at the kiln, although these would not affect the poor as much as direct combustion of raw biomass or coal.

Annex 1
Country X

Draft Guidance Note on Energy

The purpose of the PRSP Sourcebook and inter-alia the Energy Chapter is to assist countries in preparing poverty reduction strategies. Following a consultative and participatory process, countries articulate these strategies in a Poverty Reduction Strategy Paper (PRSP). An Energy Note should be prepared for input into the PRSP process.

The Energy Note should:
- Identify the energy sector and energy service linkages to the priority poverty reduction strategies. Table 1 below illustrates this.
- Propose energy sector goals and strategies to achieve them and establish quantifiable indicators to measure progress in achieving the goals. Table 2 below illustrates this.

Table 1. Assessing Energy-Poverty Linkages in the PRSP

Priority Poverty Reduction Objectives and Policies (derived from the PRSP)	Complementarity of Energy to poverty reduction strategies	
	Extent	Linkage and Rationale
1. Poverty Reduction Broad- Strategy		
Growth - Raise annual growth to 6%. - Ensure more equitable income and assets **Notes:** Manufacturing (handicraft) is an important non-farm business for the rural poor in Country X. assets. Agriculture diversification is essential to growth in Country X.	High	Plans to expand manufacturing for exports are partly dependent on reliable energy supply. Modern lighting that extends the working day & partial mechanization can boost output and improve productivity. Energy is needed for mechanical lift irrigation, for operation of mini-dairies and for post harvest processing and marketing of some crops.
Food Security - Reduction of chronic and transitory food security. - Increase agriculture production & the productivity of commercial farming **Notes** Country X's agriculture production system is largely rainfed and subject to periodic droughts which leads to large variability in annual food output.	High	Energy services to ensure a cold chain can improve productivity of dairying and boost consumption of milk products. Plans for increased commercial farming will benefit from inputs like refrigeration and storage.
2. Social Sector Development		
Education - Reduce illiteracy. - Improve teaching and learning in schools.	Low	Modern lighting in the home that is accessible to all household members has strong correlation with improved literacy.
Health	High	Energy services are needed in basic health care (to operate

Priority Poverty Reduction Objectives and Policies (derived from the PRSP)	**Complementarity of Energy to poverty reduction strategies**	
	Extent	**Linkage and Rationale**
- Improve primary health services. - Improve water supply and sanitation services. **Notes** In Country X's drought prone conditions 65% of the population rely on rain-fed water collection		diagnostic equipment, for lighting and for vaccine preservation). Energy is needed for expanded use of water from boreholes.
Gender - Mainstream gender issues in all government policies	Medium	Women disproportionately bear the burden of gathering biomass fuels for cooking, and the health and safety impacts of gathering and using these fuels. The opportunity costs to women are in terms of lost education, leisure and productive activity because of time spent collecting, processing and using these traditional fuels. Similarly inadequate water supply (the result, in part, of inadequate energy supply) results in women having to carry containers of potable water long distances. The lack of farm mechanization results in women having to labor long hours in the fields.
3. Economic Management		
Fiscal Policy - Promote macroeconomic stability and reduce size of government.	High	Borrowing for infrastructure investment by energy utilities in Country X (specifically the electricity utility) is direct incurred by government. Tthe electricity utility is unable to service its debts placing the burden on the government budget. Reforms are needed to minimize the build-up of these public liabilities. Direct taxes on energy enterprises and indirect taxes on energy commodities could provide an excellent tax base. However, taxes on fuels used by the poor should not be regressive.
Expenditure Policy - Reduce total expenditure while reorienting the structure toward social sectors.		Direct budgetary support for the sector can squeeze out resources available for social investment. However well designed mechanisms that subsidize connection costs of energy access or equipment can be pro-poor.
4. Private Sector Development		
Industry sector & Investment promotion - Manufacturing for exports; product diversification; etc. **Competition and Consumer protection** - Increase efficiency and broaden ownership base by privatizing public enterprises.	High	The investment attractiveness of Country X for export manufacturing will be influenced by the reliable supply of energy services. Competition in the energy sector by allowing entry of new, non-utility service providers can meet the energy needs of rural trading centers. Rule based economic regulation of the energy sector leads to increased investment by encouraging business confidence.
6. Natural Resources and Environment		
Encourage co-management of forest and forest resources and foster ownership.	High	Wood is virtually the only cooking fuel in rural areas. Sustainable markets for woodfuel exploitation are implicit in sustainable forest management. Use of charcoal and improved stoves with chimneys for cooking and heating also impacts on the sustainability of woodfuel exploitation.

Table 2. Proposed Energy Sector Goals, Strategies and Indicators

Energy Sector Goals	Monitoring Indicators	Potential Energy Strategies
Expand Access (Aggressively increase the availability and affordability of energy services) **Notes:** 1. Firewood is virtually the only cooking fuel in rural areas(85 % of population). 2. 95% of households do not consume any electricity 3. Analysis of data from the proposed energy survey will help refine the access indicators (e.g. by relating them to the poverty line determined in the Poverty Profile and to women's roles in the supply and use of energy) 4. Population growth rates exceed the present rate at which households are being connected to grid supplied electricity. 5. The electricity tariff structure such that it provides an incentive for the urban non-poor to cook with electricity.	**Availability** **Cookstoves** - Ownership of improved cookstove increases from ___ to ____ of households **Electricity** - Increase in number of low voltage points / transformers from __ to __ (by district) **Kerosene** - Increase in kerosene retail outlets from __ to __ (by district) **Affordability** **Biomass** The cost of an improved cookstove to be made affordable to the poorest households. **Electricity Connection Costs** - Payments by new customers of the cost of a home connection spread over a longer period (i.e. increased from 12 months presently to __ years). <u>Data sources</u> : Utility, regular quick surveys of vendors.	1. Implement an efficient licensing process for private firms to enter into production and distribution of electricity – particularly independent suppliers in areas outside the present grid. 2. Revise excessively onerous equipment standards that raise the cost of service provision. 3. Identify energy use equipment eligible for micro-credit (e.g. improved cook stoves) 4. Make the program of consumer credit that spreads the cost of a home electricity connection more attractive to potential customers. 5. Revise the electricity tariff structure. Introduce a lifeline tariff. 6. Tariffs on imported kerosene (for lighting) to be maintained at reasonable levels – i.e. not taxed regressively. 7. Policies for sustainable forest use.
Improve Reliability Increase the dependability of supply of energy services to benefit firms and household's productive end-uses of energy. Notes - The goal addresses the competitiveness of firms and impacts on rural non-farm incomes.	- Unplanned outages of 66kV transmission line reduced from 1318 to 600 (?) hours/month. - Production time lost in a sample of the largest manufacturing firms reduced from __ to __ hours per month. - Unplanned low-voltage (distribution leve) outages reduced. (specific targets for each district). <u>Data sources</u> : Utility, Regular quick surveys of firms.	1. Competitively bid O&M contracting for utility operations 2. Carry out a feasibility study to identify potential improvement in reliability through power imports or exchanges with neighboring countries. 3. Establish mechanisms to utilize electricity from neighboring countries.

Energy Sector Goals	Monitoring Indicators	Potential Energy Strategies
Achieve Fiscal Sustainability - Reduce claim of the sector on the budget - Reduce fiscal risk due to the sector. - Achieve cost recovery in electricity supply (eliminate energy subsidies to the non-poor.) Note: - The electric utility is currently unable to service debt to Government implying annual net increase in energy sector share of Govt. liabilities.	**Fiscal discipline for Energy Utilities** Set sector targets for reduction in: - Direct budget transfers - Government domestic borrowing. - International borrowing **Private sector participation** - Private ownership of electricity supply and distribution (Yes/No) **Cost of Use** - Non subsistence consumption of electricity (i.e. > 30 kWhr/month) priced to recover full costs. **Collection** - Reduce receivables from __ to __ days. Data sources : Utility, Govt. accounts	1. Revise the electricity tariff structure to ensure cost recovery. 2. Improve collection rate for electricity billing. 3. Define an open/competitive market structure. 4. License new entrants. 5. Implement deregulation & establish separate regulator. 6. Encourage private sector ownership.
Improve Governance Promote market-based mechanisms, formal oversight institutions, and processes that lead to efficient investment, production, and energy service delivery.	- Are tariff orders implemented following a rule based process? (Yes/No) - Are licenses awarded through in a public process of competitive bidding. (Yes/No) - Increase in number of independent suppliers increased from __ to __ (specific targets for each district). Data sources : Public records of regulator. Regular rapid survey of firms. Confidential complaints mechanism.	1. Improve regulatory mechanism 2. Implement an efficient licensing process for private firms to enter into production and distribution of electricity –(with performance conditions & incentives to expand service.)
Ensure Environmental Sustainability Ensure the sustainable supply and use of biomass fuels. Ensure the sustainable development of hydroelectricity.	Increase in ratio of households using improved cook stoves from __ to ___ (specific targets for each district) Data sources: Household survey, Annual rapid survey of charcoal supply.	1. Empower communities to manage forest resources. 2. Promote the leasing of plantation areas for tree planting and management by the private sector. 3. Promote use of improved stoves in micro-credit schemes.

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Endnotes[i]

Energy comes in a variety of forms. In very poor societies the main forms of energy are likely to be animate energy provided by draft animals and human labor. Even the poorest people will also use some inanimate energy such as wood fuel, crop residues and dung ("biomass fuels") mainly for cooking . These energy sources are often referred to as "traditional energy" sources to distinguish them from "modern energy" sources such as electricity, coal, oil and gas. The essential features of modern energy sources are that they are in some senses more convenient (more energy per unit volume, are easier to store or distribute, or are more efficient at doing useful work). Great confusion arises, and poor policy advice given, when the term "energy" is used but what is actually meant is "electricity". The provision of electricity, while important, will only rarely meet all the energy needs of a community. Policies appropriate for electricity are rarely the same as those appropriate for oil, gas and biomass fuels.

Clearly all modern fuels and some traditional fuels are traded (wood fuel is increasingly traded for money, and charcoal is almost always traded) and are therefore known as "**commercial fuels**" to distinguish them from "**non-commercial fuels**". While non commercial fuels are not traded for cash, they are not "free". This is because non-commercial fuels usually require considerable expenditure of time for their collection and processing (and this time can have a high opportunity cost in terms of other things that the collectors – usually women and children – could be doing, including going to school, if they were not collecting fuel). In addition both non-commercial and commercial fuels may incur costs (often called "externalities") on society that are not necessarily reflected in their price (such as environmental damage).

Some forms of energy from "traditional biomass" can be converted into more useful forms and are then known as "**modern biomass fuels**" (for instance biomass can be converted into liquid or gas fuels).

Of particular interest is that some energy sources are said to be "**renewable**" while others, namely the fossil fuels, are not, and are termed "**non-renewable**". However the distinction is not always clear in practice. For instance, wood and other biomass fuels are only renewable if they are replaced by new planting. In many parts of the world this is not the case – here the biomass may be said to be "mined not harvested". Similarly, energy (often electricity) obtained from hydraulic sources (hydro electricity) is renewable, but frequently it is not regarded as such, because of the environmental and human degradation that has been associated with the building of dams and the resulting lakes (this is clearly this is not a necessary effect of all hydro plant – such as run of river schemes). There are people who regard natural gas as being so plentiful (and so relatively clean to use) that it should be considered as "effectively renewable" .

Converting energy from one form to another has a cost (both in terms of conversion processes, such as engines, and in terms of efficiency losses). This means that the cost of "useful energy" can be quite different from the cost of the "primary energy" or fuel. The wide range in the efficiency with which energy is converted means that the cost of "useful energy" can be quite different from the cost of the "primary energy" or fuel. This is why energy specialists increasingly refer to the provision of "energy services" rather than merely the supply of "energy" ("energy supply/fuel" plus "conversion equipment" equals "energy service"). It is also important to remember that even if people have access to an energy supply and, indeed, can afford to pay for it, they still may not be able to afford the cost of the device that makes the energy useful (for instance, a gas stove, a radio, a light bulb, or a motor) .

End use efficiencies.. It is important to note that electricity is far more efficient for lighting than candles and kerosene, and that liquid (kerosene) and gas-fuels (LPG – Propane) are far more efficient for cooking than wood. The nominally high cost fuels such as LPG can be as cheap as fuel wood in their end use application e.g. the cost of LPG as compared to wood fuel per meal cooked. People everywhere have a very strong desire to switch from kerosene to electricity for lighting.

The **costs of converting energy** also means in practice that it is important to match energy sources with particular applications. Some applications clearly need electricity (computers, radios etc), but few people find it economic to use electricity for cooking. Similarly while small amounts of electricity can be provided by "renewable" photovoltaic technology, they cannot (usually) provide the power necessary to run motors.