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The role of energy planning in new hydropower investments

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INTRODUCTION

A sustainable economic development program requires an energy system capable of meeting demand efficiently, while minimizing environmental impact. Countries that follow this path must integrate their energy systems with social and environmental concerns. The challenge is to combine development and sustainability, keeping in mind that social and economic development are associated with higher levels of energy consumption and increasing demand for natural resources. The challenge is even greater for developing countries, where economic development potentially increases energy intensity, as they move from low energy consumption patterns to higher levels of per capita energy demand.

To mitigate development-related environmental impacts, expansion of energy supply should prioritize renewable sources. Hydroelectricity, for instance, because of its technological maturity and competitive costs, already plays an important role in electricity generation in many countries. However, building new hydro-power plants is quite different from expanding thermoelectric supply, since the latter can be more market driven, while the former requires central planning, usually implemented by public institutions. In a scenario where there is little government investment in the energy sector, private investment tends to opt for thermo-power projects, which require less capital and shorter investment amortization periods. Thermal power projects also involve lower risks and align better with entrepreneurs' capital opportunity costs.

Considering the importance of hydroelectricity to sustainable development, this study maps the main obstacles to increasing the hydropower share of electricity generation that exist even in countries with huge remaining potential. The paper thus starts with two sections setting out key ideas on energy, environment and sustainable development, and addressing the role of renewable energy in this context. The third section describes features specific to hydropower projects, namely their environmental, political and economic aspects. The fourth section examines the cases of Peru and Honduras, where expansion of hydroelectricity is hampered by deregulated power sectors and a lack of central planning. These examples underline the idea that promoting sustained economic development requires government planning and coordination of the energy sector. Finally, the last section concludes.

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1. ENERGY, ENVIRONMENT AND ECONOMIC DEVELOPMENT: THE IMPORTANCE OF SUSTAINABILITY

GOLDEMBERG & LUCON (2007) regard the biosphere as subject to a continuous process of change from natural causes over which mankind has no control. Large-scale natural change occurs slowly, though, enabling life on Earth to adapt to new conditions. Nonetheless, since the start of the Industrial Revolution in the mid-18th century, man-made environmental impacts and modifications have appeared gradually as population increases and socioeconomic development have caused the pace of natural resource extraction and waste discharge into the environment to accelerate exponentially.

Of all human activities, energy production and consumption have been the origin of most adverse environmental impacts over the past 250 years, particularly because socioeconomic development has been based on fossil fuel combustion . There is thus a need to mitigate energy sector impacts on the environment, because they tend to reduce quality of life, increase natural resource extraction, unbalance ecosystems and the biosphere, and ultimately bring into question the very future of human life on Earth.

Now, since the mid-18th century, the energy sector's intense use of natural resources and the related environmental impacts have served essentially to meet the energy demands of what today are termed the developed countries, in the process enabling only one third of the world's population to attain a reasonable quality of life. Accordingly, there is considerable potential energy demand from the developing countries, because the 21st century has inherited standards of economic development that entail high levels of energy resource consumption.

GOLDEMBERG et al. (1988) emphasize that it is crucial to eradicate poverty. They argue that this eradication demands that developing countries boost their agricultural productivity and food distribution, implement appropriate sewerage and water distribution networks, permit access to basic education and health services, besides affording basic amenities and developing their industrial and service sectors. All these activities require significant energy consumption. Based on these parameters, there is a clear, unequivocal relationship between socioeconomic development and rising levels of energy consumption.

According to JOHANSSON & GOLDEMBERG (2002), access to efficient, modern forms of energy is one important indicator of a population's conditions of life. They assert that approximately 2 billion people still have no access to electric power nor to modern fuels, such as liquefied petroleum gas. These populations use firewood and agricultural and animal waste to cook and produce heat in processes that are energy-inefficient and sometimes harmful to health. It is thus evident that improving the conditions of life of this population contingent depends on access to efficient, modern forms of energy. Table 1 shows comparative world estimates of per capita energy and electricity consumption in 2008.

Table 1: World per capita Energy and Electricity Consumption (2008)

	Per-capita Energy Consumption (TEP)	Per-capita Electricity Consumption (kWh)
World	1.83	2782
OECD	4.56	8486
Latin America	1.24	1956
Africa	0.67	571

Source: IEA (2010).

Developing countries need to develop socioeconomically in order to improve their conditions of life and reduce the number of people living in extreme poverty. That need, however, will have to be achieved within environmental limits at the same time meeting repressed demand so as not to cause adverse externalities for future generations.

Those prior conditions give the basis for constructing the concept of sustainable development, i.e., which meets present social demands without prejudicing the quality of life of future generations.

As signaled by BÜRGENMEIER (2005), the endeavor to promote sustainable development should be pursued as described in the Brundtland Report (1987), i.e., by exploiting resources, directing investment and adopting techniques and institutional arrangements that make it possible to meet humankind's present needs and those of future generations.

Making sustainable development feasible depends, among other things, on the adoption of sustainable solutions for the energy system, taking into account its interface with the social and environmental spheres. The next section examines strategic policies that make for sustainability in the energy sector.

2. RENEWABLES AND THEIR ROLE IN ENERGY SECTOR SUSTAINABILITY

Before analyzing and discussing energy strategies, it is as well to discuss overall development strategy as such. On the assumption that there is an unequivocal relationship between socioeconomic development and higher levels of energy consumption, a balance has to be sought in this dynamic relationship, which entails selecting priority sectors of the economy through which achieve economic growth and improve conditions of life for society.

According to PINTO et al. (2007), energy consumption is determined by the interplay of the level of economic activity, the sectorial composition of the economy, and the energy intensity of the economy. In that light, energy consumption changes as a function of variations in one or more of these three vectors. Energy demand projections based on econometric relations between energy consumption and income level ignores variations on those structural effects, like economy and technology-related changes that entail variations in energy intensity. The former type of analysis is valid for short-term projections, but becomes less reliable as the analytical time horizon is extended, because the hypothesis that structure and intensity effects have significant impact on variation in energy demand becomes far more plausible in longer timeframes.

The relationship between economic development and energy demand is thus not static over time and one of the factors that can alter this relationship is precisely economic structure. In this regard, before any discussion inherent to the energy sector, it is well to consider that an industrial policy focused on sectors that are less intensive in energy consumption, but which produce goods with more added value, can reduce the magnitude of the challenge facing the energy sector.

A country's development process tends to go through an initial industrialization phase with strong investments in heavy industry[2]. Then it is possible for development of industries with greater added value to occur, culminating in a process of relative de-industrialization where the service sector gains in importance. This, by and large, has been the development path followed by what are referred to today as the developed countries. In energy terms, this trajectory means increasing energy intensity in the initial stages of development until the point where energy intensity stabilizes and, from then on, begins to decline as greater added-value sectors come to account for an increasing share of the economy, population stabilizes, higher levels of *per capita* income boost residential electricity consumption, and so on.

What is proposed is that developing countries do not need to replicate the development path of the developed countries. It is possible to adopt development strategies focused on sectors that offer greater added value and

[2] See GOLDEMBERG & LUCON (2007).

are less energy-intensive. This kind of strategy approach is referred to in the literature as “leapfrogging”, by which it is possible to raise per capita income with less increase in energy intensity.

However, while leapfrogging strategies are a sound economic development approach in some countries, this path cannot be applied to developing countries as a whole, because it rests on a new international organization of work. This is explained as follows: priority for greater value-added sectors does not eliminate the demand for more energy-intensive primary goods, which would have to be met by a set of countries to which the basic industries would ultimately be transferred. It is largely this transfer and the resulting new international organization of work that has enabled developed countries to reduce, to some extent, the energy intensity of their economies.

As regards energy systems, JOHANSSON & GOLDEMBERG (2002) explain that the necessary physical resources and technological capability for the energy sector to take a path compatible with promoting sustainable development do exist. However, incentive policies must be enacted if these alternative paths are to be taken more widely. They state that policies designed to increase energy efficiency and use of energy from renewable sources are fundamental strategies for achieving a sustainable energy system.

Promotion of energy efficiency is the only available tool capable of meeting the three – conflicting – strategic goals of sound energy policy:

i. Secure supply;
ii. Competitive costs; and
iii. Environmental sustainability.

It should be stressed that even in developing countries there is room to promote energy efficiency through technical solutions that enable demand for energy services to be met using smaller amounts of inputs. JOHANSSON & GOLDEMBERG (2002) also underline the care that must be taken with average consumption values in developing countries, because the degree of inequality in these countries is such that, even when average values are low, there is an elite whose energy consumption is at the same level as in developed countries, thus leaving ample room for the introduction of energy efficiency policies.

However, although energy efficiency policies should be enacted in developing countries, the repressed demand in these countries is of such an order that substantial investment will inevitably be necessary to expand energy supply. The issue raised here is which sources should be prioritized with a view to that expansion occurring on a sustainable basis. For that purpose, it is necessary to format policies to foster increased participation by renewable energy sources, which today account for only 12% of world energy supply.

In the electricity sector, there are some alternative renewable energy sources (hydroelectricity, bioelectricity, wind power, solar power) to be used in expanding the electric power matrix. The major obstacle to most of these sources continues to be their higher cost in comparison to conventional sources. Accordingly, policies are necessary for financing the development of these sources. Among the renewable sources for electric power generation, hydroelectricity stands out for its technological maturity and competitive costs. In addition, there is vast hydroelectric potential to be developed, particularly in developing countries. Nonetheless, in many cases the expansion of electricity supply in such countries is not prioritizing the exploitation of hydroelectric potential. The authors are of the opinion that, among the main reasons are the very particular economics of major hydroelectric projects and the need for greater participation by central State planning, as discussed in the following sections of this article.

3. HYDROELECTRICITY

Use of hydroelectricity offers substantial advantages in terms of the energy system's quality and its alignment with sustainable development:

i. Contributes to improving the terms of the energy balance of trade and attenuates exposure to international oil product prices;
ii. Is the energy source with the lowest average cost;
iii. Represents one of the cleanest sources in terms of greenhouse gas emissions; and
iv. Because it demands major capital investment and large-scale generation of direct and indirect employment, it is responsible for more substantial multiplier effects in the economy than other energy sources.

In addition, in terms of electric system operation, availability of hydropower permits technologies with less operational flexibility to be used more efficiently, contributing still further to reducing fossil fuel combustion.

Choosing the most appropriate energy mix involves variables such as: environmental conditions and availability of energy resources, economic environment, technical capacity-building, the degree of development of the electromechanical industries, competitiveness of available energy sources, and so on.

Countries are strongly differentiated by the share of hydroelectricity in their energy systems, given differences in river systems and hydroelectric potential. Allocation of investment to hydroelectric projects is also influenced by environmental concerns, the institutional regulatory environment and public interests surrounding the energy sector. In addition, issues of investment maturity and financing also bear – differently among countries – on the decisions of private and state investors in this energy source.

As regards the environment, it can be said that 30 years ago it was common for the construction of dams and reservoirs to displace large contingents of population. At present, there is strong local opposition to large-scale projects, representing delays in the construction of dams. These impacts caused by big dams are extremely important, but improper environmental evaluations and a lack of sensitivity towards populations affected by major projects are signs of shortsighted energy planning and regulation. These errors have occurred along with the expansion of fossil fuel-fired thermoelectric plants, which raise energy costs and environmental impact via greenhouse gas emissions. As mentioned earlier, the energy system plays a strategic role in a country's economic development, and significant changes in the cost of energy have knock-on effects on various sectors of the economy.

Besides the cost issue, an integrated conception of the energy matrix rests on the understanding that continuous development of hydroelectric potential corresponds to a reduction in the greenhouse gas emissions caused by thermoelectric plants. As an example of how controversial the issue is, in the late 1980s the Austrian government held a plebiscite to consult its citizens on building a hydroelectric facility on the Danube River. Knowing that the alternative would be to build thermoelectric plants, 70% of the population voted for the hydroelectric plant. Even with these issues in view, many countries where coal accounts for a large part of the electric power matrix have under-exploited hydroelectric potential.

The economic rationale inherent to a major hydroelectric project also influences large in investment decision-making. Large hydroelectric projects are favored by gains of scale, which reduce the cost per kW installed. Table 2 shows cost estimates that illustrate the competitiveness of hydroelectricity against other energy sources and the estimated investment cost for a large-scale project. Even with gains of scale, the necessary volume of funding is very large, estimated at R$ 12.5 billion for a 5-GW hydroelectric plant.

Table 2: Cost estimates (2009)

Energy	Investment	Load	Minimum

Source	(Million R$/MW)	factor	power cost (R$/MWh)
Hydro – Large	**2.5**	**70%**	**95**
Thermal – Biomass	**2.5**	**66%**	**100**
Hydro – Medium	**3.5**	**50%**	**135**
Thermal – Coal	**3.5**	**90%**	**140**
Hydro – Small	**4.0**	**55%**	**140**
CCGT	**2.0**	**90%**	**147**
Wind Power	**5.0**	**36%**	**200**
Thermal – Diesel	**2.5**	**90%**	**>350**

Source: SANTOS (2009).

Construction timeframes are rather long and require that investors have the financial capacity to make major capital outlays without receiving operating revenues during the construction period. This long lag between initial investment and cash inflows, added to the large volumes of capital and the long investment maturities involved[3], may discourage private investors who do not necessarily evaluate the opportunity costs of capital in the same ways as governments.

As a result, government institutions around the world usually feature as the key players in the implementation of large-scale hydroelectric projects, following the example of what occurs in other infrastructure sectors where return on investment is subject to very long timescales. As signaled by STERNBERG (2009, p. 8), "hydropower is among this group of monumental investments that the private sector likes to build and use, but not invest in". To assure such investments is part of the State's larger strategy for ensuring social well-fare and safeguarding national interests.

The issues raised here explain the slow pace at which hydro potential is harnessed in most regions of the world (as shown in Table 3), which has been aggravated by the neoliberal reforms begun in the 1980s and 90s that led to a reduction in State participation in the electric power sector, especially in directly inducing investments and planning.

[3] Hydroelectric projects plan to a 30 to 50-year time horizon, which is the time necessary to ensure project viability. In practice, these assets can last 100 years or more (STERNBERG, 2009).

Table 3: Hydropower installed, percent change, potential (1950-2000)

	1950 installed (MW)	2000 installed (MW)	% change 1950, 2000	% hydro 2000	Potential, 2000 (MW)	% built 2000
Africa	485	22,122	4461	22	158,400	14
Asia	7584	190,953	2418	19	1,606,000	12
Europe	27,355	241,317	782	23	1,450,000	17
North America	53,569	178,957	234	18	1,290,900	14
Oceania	944	13,281	1307	24	120,000	11
South America	2164	109,370	4954	67	866,900	13
World	92,105	756,000	721	22.4	5,492,000	14

Source: STERNBERG (2008, p. 10).

Hydroelectricity is extremely important to the sustainability of the energy system. As suggested by STERNBERG (2008, 2009), this resource must be seen not as a definitive energy solution, but as an "energy bridge" capable of paving the way to a "decarbonizing" energy transition.

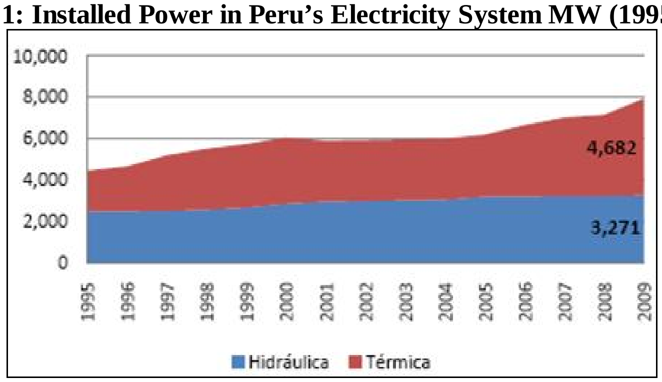
4. CASE STUDY: PERU AND HONDURAS

The previous section analyzed the economic, political, environmental and social issues relating to under-utilization of hydroelectric potential in many countries. In Latin America, from the 1990s onwards, electric sector deregulation played down the importance of sectorial planning and attributed responsibility for expanding energy supply to market forces, leading to a drastic reduction in investments in hydroelectric projects.

In this regard, note that many Latin American countries expanded their respective electric power generation installations on the basis of thermoelectric facilities, even when holding substantial hydroelectric potential suitable for exploitation. To exemplify these arguments, this section examines the electricity mix of Peru and Honduras. These countries were chosen basically because they are investing massively in thermoelectric plants to the detriment of harnessing their respective hydro potentials.

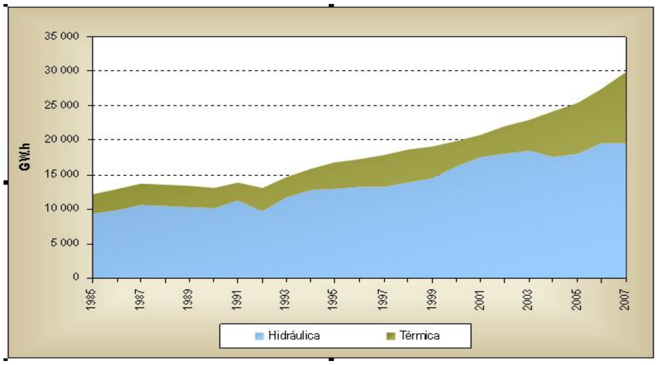
According to OLADE (2009), Peru has hydroelectric potential of 62,000 MW, of which it uses only 3,242 MW. Electricity supply could thus clearly be based on that sustainable source. However, recent analysis of the evolution of Peru's electric power matrix indicates increasing thermopower generation associated with the coming on line of gas from the Camisea reserve. In 2009, thermopower plants totaled installed capacity of 4,682 MW and, although generation continued to be mainly hydro-based, thermoelectric plants now account for 45% of power generation in Peru. Graphs 1 and 2 illustrate these assertions.

Graph 1: Installed Power in Peru's Electricity System MW (1995-2009)



Source: MINEM (2010).

Graph 2: Electricity Consumption in Peru GWh (1995-2007)



Source: MINEM (2009).

The predominance of thermoelectric projects in the expansion of power supply in Peru contrasts with the considerable remaining hydroelectricity potential in the country. This apparent paradox can be understood by briefly examining deregulation of the Peruvian electricity sector in the 1990s.

As in many countries (Brazil among them), neoliberal-based reform of the Peruvian electricity sector was intended to promote competition in the generation and commercialization segments, and that competition was to be made workable by guaranteed access to the transmission and distribution segments of the chain, which were characterized as natural monopolies. In that regard, the main purpose of the reform was to promote sector efficiency by stimulating competition, while at the same time attracting the capital necessary for the sector to expand.

However, the logic of private enterprise prevailed and priority was given to investments in thermoelectric projects to the detriment of expanding hydroelectric capacity. That choice rested on the fact that thermopower projects demand smaller capital investments and offer shorter maturities, as explained in the previous section, as well on funding and institutional framework concerns.

This larger share by thermal plants tends to increase the marginal cost of operating the electric system. These higher operating costs are not reflected in higher tariffs, however, because natural gas prices are heavily subsidized. Added to this is the fact that exploration of the Camisea reserves is reducing the need to import oil products, which are subject to price volatility and cause impacts on the balance of payments. The question that arises is: Why not reduce dependence on oil by making greater use of renewable energy sources?

Meanwhile, analysis of Honduras's electricity sector indicates that there the option to invest in thermopower plants to the detriment of hydro projects can be taken independently of electricity sector deregulation and can occur in vertically integrated monopolies where there is no effective planning, and system expansion is left to the responsibility of private players.

In Honduras the electricity sector is characterized by a strong State presence in planning, operation and asset ownership. The State nature of this system rests on the vertically-integrated monopoly model. Note that the liberal reform prepared in the mid-1990s was ultimately not entirely implemented. Accordingly, the electricity sector continued to be coordinated and operated by the Honduran State electricity enterprise. However, regarding generation facilities, private investments grew greatly, to majority proportions, leaving the State enterprise with the responsibility of purchasing, i.e., contracting thermal-sourced electric power from foreign private firms.

Until the mid-1990s, electric power supply in Honduras was essentially hydroelectric, and the generating plants were State-owned. Since then, the mechanism for expanding power supply came to be based on investments by private players that generally have been electing thermal plants projects. Table 4 shows the increasing share of thermoelectricity in Honduran generating capacity.

Table 4: Generating Capacity in Honduras MW (1967-2009)

Años	Tipo de Central							Variación	
	Plantas Estatales			Plantas Privadas				Variación	
	Hidráulica	MDMV	T. Gas	Hidráulica	MDMV	T. Gas	BIOMASA	Total	Anual %
1967	31.0	15.7	----	----	----	----	----	46.79	-0.2
1968	31.6	27.4	----	----	----	----	----	59.05	26.2
1969	31.6	27.7	----	----	----	----	----	59.25	0.3
1970	30.2	30.7	15.0	----	----	----	----	75.89	28.1
1971	70.2	31.3	15.0	----	----	----	----	116.50	53.5
1972	70.2	31.9	28.6	----	----	----	----	130.68	12.2
1973	68.6	21.1	28.6	----	----	----	----	118.30	-9.5
1974	68.6	50.4	28.6	----	----	----	----	147.64	24.8
1975	68.6	48.9	28.6	----	----	----	----	146.12	-1.0
1976	68.7	48.9	28.6	----	----	----	----	146.14	0.0
1977	68.7	51.3	28.6	----	----	----	----	148.55	1.7
1978	108.7	51.8	28.6	----	----	----	----	189.02	27.2
1979	108.8	52.8	28.6	----	----	----	----	190.12	0.6
1980	108.8	84.1	28.6	----	----	----	----	221.47	16.5
1981	108.8	85.6	28.6	----	----	----	----	222.97	0.7
1982	131.3	83.7	28.6	----	----	----	----	243.57	9.2
1983	131.3	83.3	28.6	----	----	----	----	243.14	-0.2
1984	131.3	113.8	28.6	----	----	----	----	273.69	12.6
1985	424.3	103.3	28.6	----	----	----	----	556.20	103.2
1986	424.4	103.3	28.6	----	----	----	----	556.30	0.0
1987	432.4	103.3	28.6	----	----	----	----	564.30	1.4
1988	432.4	103.8	28.6	----	----	----	----	564.80	0.1
1989	432.4	104.8	28.6	----	----	----	----	565.80	0.2
1990	432.4	99.8	15.0	----	----	----	----	547.20	-3.3
1991	432.4	89.4	15.0	----	----	----	----	536.80	-1.9
1992	431.0	88.4	15.0	----	----	----	----	534.40	-0.4
1993	433.5	88.6	15.0	----	----	----	----	537.10	0.5
1994	432.7	92.9	18.0	0.8	20.5	----	----	564.90	5.2
1995	432.7	93.2	76.5	0.8	107.7	39.5	----	750.40	32.8
1996	432.7	92.8	76.5	0.8	84.5	39.5	----	726.80	-3.1
1997	432.7	92.8	76.5	0.8	84.5	39.5	1.5	728.32	0.0
1998	432.7	93.6	63.0	0.8	130.7	39.5	1.5	761.77	4.6
1999	432.7	94.0	63.0	0.8	288.2	39.5	1.5	919.71	20.8
2000	434.4	92.8	63.0	0.8	288.2	39.5	1.5	920.20	0.05
2001	434.4	93.2	63.0	0.8	290.7	39.5	1.5	923.10	0.32
2002	464.4	92.7	33.0	1.3	395.7	39.5	17.0	1,043.62	13.24
2003	464.4	92.7	33.0	2.5	395.7	39.5	17.0	1,044.85	0.12
2004	464.4	91.6	33.0	10.5	609.9	39.5	30.0	1,279.91	22.40
2005	464.4	91.6	33.0	14.7	823.8	39.5	59.8	1,526.80	19.38
2006	464.4	91.6	33.0	38.5	821.2	39.5	59.8	1,548.01	1.39
2007	464.4	91.6	33.0	55.3	816.8	39.5	67.8	1,568.32	1.31
2008	464.4	91.6	33.0	57.5	824.8	39.5	81.8	1,592.58	1.55
2009	464.4	91.6	33.0	57.5	828.4	39.5	91.4	1,605.79	0.83

En las plantas hidraúlicas y biomasa privada, es capacidad firme según contrato.

* MDMV is heavy fuel oil.
Source: ENEE (2010).

This profile of electric power supply expansion in Honduras is paradoxical in view of its available hydroelectric potential of the order of 2,000 MW. In that respect, it can be seen that, as in Peru, the economic logic of the market has overridden sustainable expansion of electric power supply. Thence the need to resume energy planning, which is fundamental if hydroelectric potential is to be utilized.

CONCLUSIONS

The energy sector is substantially and inseparably connected with the socio-economic and environmental spheres, because development requires rising levels of energy consumption, while at the same time using resources extracted from nature as inputs, thus causing environmental impacts. In that light, in order to promote sustainable development, expansion of energy supply must occur in line with new paradigms where energy efficiency policies and greater participation by renewable energy sources are essential.

Renewable energy sources, it must be stressed, tend to entail higher costs than conventional generation sources. Accordingly, policies to promote such sources may be necessary at first. Policies of this kind are justified by the environmental benefits deriving from such sources and the prospect that, in the medium term, increasing scales of production and technological maturation will make them more competitive as economies of scale are exploited and learning is brought to bear. However, hydroelectricity stands out among renewable energy sources, because it is more competitive and technologically mature than other renewable and non-renewable sources.

One prime objective of properly formulated energy policy is to guarantee secure supply. That supply, however, must be competitive so as not to prejudice the competitiveness of the economy and the ability of the population to bear the costs. In line with that principle, the liberalizing electricity sector reforms of the 1990s were designed to make the sector more efficient by encouraging competition in the energy generation segment.

However, if system expansion is left to market forces, there is no guarantee that such expansion will occur in the manner most beneficial to society, because in such a situation it is the outlook of private interests that prevails. The examples of Peru and Honduras show clearly how the logic of private capital, which was prioritized by the neoliberal reforms of the 1990s, led to investments only in thermal plants, even though those countries had major hydroelectric potential. There are thus signs of incompatibility between the neoliberal reforms and investments in hydroelectric projects.

Market logic permits investors not to prioritize social or environmental variables in their project assessments. Their focus is strictly financial. As a result, sustainable expansion of the electric power matrix demands an energy policy that lays down basic guidelines for sector expansion. In order to implement such a policy, new regulatory and market instruments must exist to make it possible to implement a planned matrix, particularly a return to State planning and encouragement for the formation of public-private partnerships.

As regards investment in hydroelectric projects, investor risk perceptions must be allayed, and that depends on environmental licensing-related risks being transferred to society, attractive funding conditions and energy purchases being guaranteed by establishing long-term contracts.

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