Chapter 8. Assessing the Energy Contributions to Sustainability

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Introduction

"Ecodevelopment", which first came into use in the 1970s, is intended to reconcile economic and ecological approaches to growth. International conferences started to gather constituencies dedicated to the environment and to the economy as in Stockholm in 1972. There was strong reaction to the word "ecodevelopment"; translation of this new concept into action was interpreted as saying that nature may be as important as money.

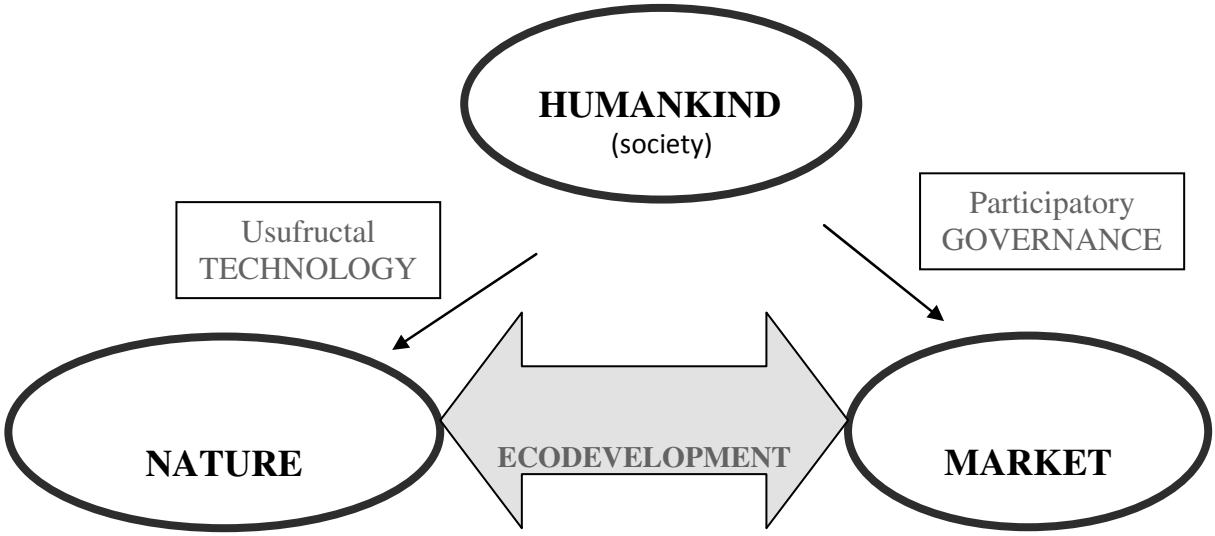
It took almost two decades, *i.e.* until the World Commission on Environment and Development (WCED) issued the Brundtland Report, to translate the concepts embodied in "ecodevelopment" into the acceptable term "sustainable development" which added society to the pillars of environment and the economy (WCED, 1987). This concept had just been coined, when the awareness of an unprecedented threat to our planet arose: global warming.

Five elements of ecodevelopment

With the challenge of climate change, the tenets of science and technology came into the fray to better study the relationships between nature and mankind and try to stop the enhancement of the greenhouse effect. This task led to the creation of the Intergovernmental Panel on Climate Change (IPCC). With the 3rd and 4th IPCC Reports, it became obvious that attempts to mitigate climate change would not be sufficient to stop the trend (IPCC, 2007). The most recent step has been to add efforts to adapt to the problem.

For this adaptation, the mobilisation of the population at large is needed. Ecodevelopment requires now a fifth component: participatory governance, *i.e.* an improved, more balanced relationship between society and the economy. It is these five elements (or pillars and relationships) that should be the basis for sustainability assessments. Ecodevelopment results from the harmonious relationships between nature and humankind served by a fair market, usufructal technologies and participatory governance (Figure 8.1).

Figure 8.1. Actors and Relationships for Ecodevelopment



Source: HELIO International

Energy sustainability assessments

HELIO International started working on ecodevelopment assessments in 1996, focusing on energy policies since they are the main climate change driver and are conspicuously absent in both the Brundtland Report and the Agenda 21. In 1997, at Rio+5, a first global report was issued based on regional observations by local analysts. Through a series of methodological workshops, a roadmap and process were then designed and structured around a handful of central indicators of national energy policy. Country reports were written by national experts in a number of countries, issued on CDROMs and on the website for use by policy- and decision-makers, as well as media, NGOs and researchers.

In 1999, to contribute to the implementation and viability of the Kyoto Protocol mechanisms, a set of indicators were developed to insure that these mechanisms would be designed to be conducive to sustainable development. This work gave rise to the CDM SD-Matrix and to the South-South-North organisation (SSN) and work, as well as to further methodological tools, including monitoring protocols and the Gold Standard.

Recently, studies have been conducted on how to assess the vulnerability to climate change and to reinforce the resilience of energy systems, mostly in African countries which are the most threatened by such changes (Helio, 2007). Tools are being developed to measure the impacts of renewable energy penetration with a particular attention to rural electrification and with the co-operation of several Mediterranean institutes.

Sustainable Energy Watch (SEW)

There is a world-wide network of observers and regional co-ordinators (Sustainable Energy Watch) who monitor and regularly report on sustainable energy developments using a series of specific indicators (SEW, 2008). A group of international energy experts

serve as advisors and have developed the methodology for the set of selected indicators. They also regularly review the approach to ensure that the monitoring accurately reflects changes underway.

These indicators are in line with the actual *credo* of the wise-use energy community (users and producers alike), that energy efficiency improvements, renewable energy and changes in consumption, behaviour and management patterns are necessary to restore long-term sustainability. They deal with the five aspects of sustainability: environmental, social, economic, technical and civic, but remain very close to everyday preoccupations so as to be able to enlist the good will of policy- and decision-makers to which this work is primarily addressed.

Energy analysts in every part of the world have started using this approach which is both quantitative and qualitative to evaluate the contribution of energy to sustainable development. Findings are reported to civil society and interested parties, who will be in a position to arrive at energy decisions which are more conducive to ecodevelopment. It is the Sustainable Energy Watch approach to assessing the pertinence and the long-term sustainability of energy systems that this paper will now outline.

Assessment methodology and process

In a given geographical area each, observer-reporter (OR) audits the current energy situation, *i.e.* reports using statistics and facts, and compares them to those of previous years for the same area and evaluates progress towards ecodevelopment. The observer-reporter analyses a situation which is rooted in the past and is constantly evolving. The OR is not mandated to advocate a specific course of action, but to outline possible alternatives which, in his/her view are likely to improve overall welfare.

The number of quantitative energy sustainability indicators retained has been limited to ten for the sake of manageability (two for each of the five components of sustainability: environmental, social, economic, civic and technological). These indicators have been selected as they provide an overall snapshot that is reasonably coherent and representative. The indicators are simple and refer to everyday realities. Some are easy to assess from information collected in official documents, others have to be computed by the observer-reporters using their expert knowledge of the country they live in.

It would be wrong, however, to expect that ten indicators can completely explain the full situation. A good and meaningful sketch is what is hoped for. The choice of these benchmarks, furthermore, is not value-neutral. They have been selected to simplify monitoring, but nevertheless assess progress made by energy policies in order to lead to an increased welfare for the population and to a more sustainable development for all. Better indicators may come to light as a result of future experience and the representation will, it is hoped, reflect this process of self improvement over time.

Each geographical area is described by a few general statistics which are used to introduce a qualitative discussion of the particular conditions of the area and its contribution to social progress by comparison with those studied in the previous years:

1) *geographical traits:* percentage of arable land, main resources, presence of desertification, etc.;
2) *demographic characteristics,* reflected by total population, its distribution, evolution and state of health, reference to the Human Development Index;

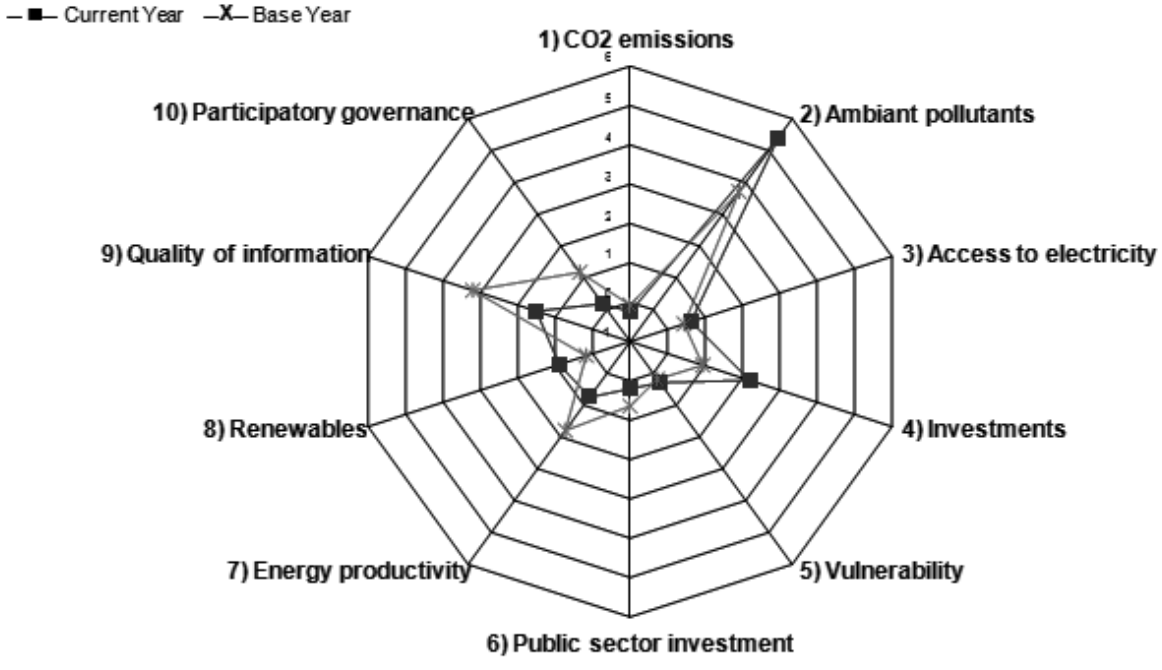
3) *economic development,* measured by GDP and GDP per capita, at current prices and at Purchasing Power Parity, alongside the Index of Sustainable Economic Welfare (Daly and Cobb, 1994). This allows a discussion of income distribution, of its bias and of progress in alleviating poverty.

Ten indicators of sustainability

Ever since the Brundtland Report (1987), a lot of work has been devoted to the definition of sustainable development and to the choice of appropriate indicators. More often than not these indicators, however, remain environment indicators and do not incorporate the full flavor of ecodevelopment. A limited set of statistics are needed based on two of the most representative or typical figures on each aspect of sustainability: environmental, social, economic, civic and technological.

Rather than making up a composite index, a visual representation of the ten indicators can give a good idea of the overall progress of a country towards improved sustainability (Figure 8.2). The level of sustainability reached since 1990 is shown by the length of ten vectors reaching towards the center of a circle. The periphery of the circle will therefore be point 0 (1990 reference) and the center be 1.

Figure 8.2. Ten Indicators of Energy Sustainability



A scale of evaluation has been provided for each indicator. An achievable optimum level of sustainability will be reached when all vectors have reached the center. Progress in each of the five components of sustainability will be materialised thanks to a line joining the top part reached by the two vectors specific to this form of sustainability. This

line will thus delineate an area, similar to the part of a wing, representing the specific form of sustainability reached in the region considered. The graph thus achieved can be likened to a dynamic helix, illustrating the capacity of each nation to move towards improved sustainability.

A baseline set of indicators has been created from which to infer progression towards or regression from energy-related sustainability. By concentrating on feasible, policy-relevant, energy-related indicators at the intersection of economic, social, technological and environmental sustainability, this tool can deliver a usable set of goals and measurements to citizens and decision-makers alike. However, important as the indicators are, they are only carefully chosen statistics and merely give one part of the story. The most interesting contribution comes from the qualitative personal assessment given by the observer-reporters in each country.

Selection of indicators of sustainability

Several criteria have guided the selection of the ten indicators of sustainability. Each indicator must:

1) be clearly definable, simple to understand, and easily communicated to citizens and decision-makers alike;
2) be relevant to actual or anticipated policies;
3) reflect an important aspect of the social, economic, environmental, or technological elements of the energy system;
4) measure something of obvious value to observers and decision-makers; and
5) have durability and long-term relevance.

In addition, the underlying metric – the actual measurement or statistic used – must be generally available for most, if not all, countries. This combines measurability, data availability, and achievability; in other words, data collection and vector calculation must be do-able. If calculation is required to derive an indicator, it must be simple to do. The indicator set as a whole should be indicative of a country's and the world's progress towards energy-related sustainability. And improvement in an indicator's measurement is indicative of genuine progress toward an energy system that sustains and improves human health and happiness.

The aim of this indicator set is to be applicable to the current energy situation in a given country and to highlight what is pertinent and achievable. The environmental indicators cover CO_2 emissions per capita (global pollution) and ambient energy-related emissions (local pollution). The social indicators cover guaranteed access to electricity and investments in clean energy. The economic indicators cover energy resilience and burden of public energy investments. The technological indicators cover energy intensity and renewable energy deployment. The civic indicators cover quality of information and participatory governance. These are outlined in more detail below.

Indicators for environmental sustainability

Indicator 1: Per Capita Energy Sector Carbon Dioxide Emissions

Global environmental impact is measured by carbon dioxide (CO_2) emissions per capita. Each nation's per capita emissions will be compared to the 1990 global average. The long term objective is a convergence towards a reduction of seventy percent of global emissions.

Indicator 2: Most Significant Energy-Related Local Pollutant(s)

Selecting the indicator for the most significant local environmental pressure is done by local observer-reporters. It is necessary to choose a pollutant that strongly impacts local human or environmental health, *i.e.* impacting human respiratory, reproductive, and immune systems, negatively effecting forestry, lakes and rivers, agriculture, domestic animals, fisheries, or infrastructure etc. Such pollution sources are frequently related to industry, mining, fuel refineries, manufacturing, or electric power plants. Non-point pollution sources such as vehicles often pose the greatest hazard to health and are often difficult to mitigate. If information is available their emission rates could be used. The objective is a nine-tenth reduction of the selected pollutant(s).

Indicators for social sustainability

Indicator 3: Households with Access to Electricity / Percentage of Household Income Spent on Energy

Access to electricity is considered a social good; it helps spread literacy and education, it contributes to improved health through the refrigeration of medicines, and to increased communication and awareness. While western standards of electric consumption need not be adopted, access to some level of affordable power is appropriate.

Indicator 4: Investment in Clean Energy (a proxy for employment)

Several studies show that investment in clean energy – renewable energy and energy efficiency – creates more jobs and generates faster growth than comparable investment in conventional energy. For this social indicator new employment in clean energy projects could be measured, *e.g.* employment in cleaning up conventional energy projects through the installation of pollution control equipment or the reclamation of mined areas or wetlands restoration etc. However, comprehensive data on employment gains are not available in most countries. There is therefore a substitute indicator for which data are generally available: investment in renewable energy and energy efficiency.

Indicators for economic sustainability

Indicator 5: Energy Resilience / Energy Trade Benefits

Many countries are highly dependent on imported fuels for transportation, heating, cooling and lighting of buildings and electric power generation. The threat of supply interruption is real, primarily for unforeseeable political reasons but also due to pipeline accidents, system vulnerabilities, embargoes, terrorism, and civil strife. The more universal threat is price fluctuations that can destabilize both importing and exporting nations. The development of improved extraction technologies and new discoveries of reserves have led to increased fossil fuel supplies that have out-paced consumption. Indeed, contrary to price forecasts, energy prices have declined strongly in real terms since the mid-1970s. The latest international problems brought about by disruption of supplies, *e.g.* war in the Middle East, hurricanes, however have recently raised the price of fuels significantly.

Separate metrics have to be selected for import-dependent and export-dependent countries. In order to provide an incentive for net energy importers without discouraging imports of renewable energy, imports of non-renewable energy are measured as a fraction of non-renewable energy consumption. Importing countries can improve sustainability by reducing either imports or consumption of non-renewables or increasing imports or consumption of renewable energy.

Indicator 6: Burden of Public Energy Investments

This indicator compares government investment in non-renewable energy supply to total GDP as a measure of the burden of energy development on the economy. The primary purpose of this indicator is to measure the level of public funds in the energy supply sector and to provide incentives for investment in cost-effective renewable energy supplies and end-use efficiency. Government enterprises and deals with private entities tend to shift scarce resources into capital-intensive buys. Such investment should either be decreased or shifted to the private sector, or both should occur.

Indicators for technological sustainability

Indicator 7: Energy Intensity (energy consumption/GDP)

This indicator measures each nation's progress towards increasing the level of economic activity per unit of energy consumed. Many nations already track such progress and the World Bank, United Nations, International Energy Agency and the OECD publish periodic comparative reports. However, this simple calculation is complicated by a number of factors. The available data compare economies with widely different geography, economic development, climate and levels of industrialisation. Some sources compare indices of energy efficiency, *e.g.* fuel economy of personal vehicles; others compare specific sectors, *e.g.* industrial energy use per dollar of industrial output; while others aggregate the nation's economy.

Only consumption of commercial energy is typically counted, thus ignoring large quantities of "traditional" fuels such as wood, charcoal, bagasse, and other biomass fuels used in many countries. A consistent definition of what is meant by economic output is

not clear-cut either; the convention of counting GDP output at current exchange rates works better for comparing industrialised countries than developing nations. In the latter cases, purchase power parity (PPP) accounts of GDP are more appropriate.

Indicator 8: Renewable Energy Deployment

Global use of renewable energy is growing faster than the use of fossil fuels and electricity. Globally, wind power capacity is increasing annually. The use of photovoltaic cells – semiconductor devices that turn solar radiation directly into electricity – is expanding nearly as fast as wind power. Fossil fuels and nuclear power – heavily subsidised and politically favored for decades – still generate a large fraction of the world's electricity. Yet the market is changing, as is political and popular support. Renewable costs are falling and are becoming more competitive even without counting the multiple benefits of clean, environmentally superior power. India, Germany, and Denmark are now leading the world in installed wind power capacity.

Indicators for civic sustainability

Indicator 9: Quality of Information

Adequate, reliable and accessible information are the main requirements for civic processes to function effectively. They provide for transparency and good policy. Quality information is dependent on the accuracy, availability and free accessibility to good data. Early dissemination of quality information allowing fairness and equality of participation by independent bodies and energy agents representing both the energy demand and supply sides is also needed. Polls have shown that independent environmental non-governmental organisations (ENGOs) are more trusted that any other organisations to provide reliable information, therefore their engagement with civic bodies or means of action, financial and otherwise, will be used as a proxy for this indicator.

Indicator 10: Participatory Governance

Decision-making processes show the true measure of civic sustainability. If citizens are genuinely involved from the time a policy or project is contemplated, they will develop a sense of ownership and the decision will likely be better and easier to take and implement. Balanced governance also prevents a whole host of problems and confrontations. Participatory governance can be measured by the number of independent bodies and of ENGOs on the boards of energy entities.

Conclusions

Assessment reports based on these indicators are produced periodically and subject to peer review. For some countries they constitute a reward of their efforts towards ecodevelopment, but for others the results are not as positive. For all involved, it is an opportunity to learn where a country stands in terms of energy sustainability and where efforts should be applied to lead to ecodevelopment.

To communicate this knowledge, a graphic representation is used. The graphic representation of data is eloquent, but purely indicative of where efforts have to be made

to improve overall energy sustainability. It is still necessary to ask who has the power to improve the situation. Who makes decisions in the energy sector of the country?

From their own experience, observers in the energy field will all say that the most important way of promoting improvements in energy policies is through an authentic planning and decision-making process involving energy users as early as possible in the planning process.

The work of the Sustainable Energy Watch (SEW) had been replicated in a number of countries. With its simple set of indicators and its monitoring worksheets, it aims to prevent decisions that have often proven detrimental to entire countries. Tools are provided for energy analysts who want to look at the bigger picture and help promote energy policies to be more conducive to ecodevelopment for all.

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