

1. INTRODUCTION

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Energy poses a formidable challenge to those working to achieve sustainable development goals. We need to use energy to alleviate poverty, promote economic growth and foster social development. But as we consume more energy, stress is placed on the environment at the local, regional and transboundary levels. As we work together to safeguard the environment without slowing socio-economic development, we look for technological solutions, we look to change unsustainable patterns of consumption and production, and we seek the low-hanging fruit and the win-win solutions that provide the least costly ways of achieving sustainable development goals. Analytical tools, such as the energy indicators described in these case studies, can be helpful in finding the best solutions in a menu of available options, aimed at achieving these goals.

When the international community first made the commitment to sustainable development in 1992, at the Rio Conference on Environment and Development, there was an emphasis on environmental concerns. Though environmental concerns are still important, greater stress is now placed on the development side of the sustainable development equation. This is clearly reflected in the outcome of the World Summit on Sustainable Development (WSSD), held in Johannesburg in 2002.

Also, energy as an issue has received greater attention since the Rio Conference. At the ninth session of the United Nations Commission on Sustainable Development (CSD) held in 2001, key energy issues that contribute to achieving sustainable development goals were agreed upon. Since then, actions at the national level, as well as activities at regional and international levels, have been in line with these decisions. At WSSD the following year, further elaboration was made. The decisions embodied in the Johannesburg Plan of Implementation (JPOI) reflect a concern about entrenched poverty and the urgent need to achieve the Millennium Development Goals (MDGs) on poverty, as well as devote more emphasis to energy efficiency, renewable energy, advanced and cleaner technologies, and an enabling environment marked by a level playing field without market distortions. For the first time, the international community acknowledged that access to modern energy services for all is necessary for the alleviation of poverty. Reference to energy in the context of sustainable development was also made in the recently held United Nations 2005 Summit.¹ Follow-up on energy for sustainable development at the international level took place during the 14th session of the United Nations Commission on Sustainable Development held in 2006 and will continue during the 15th session of the Commission in 2007.

Amid this flurry of activity at the international level, individual countries are still faced with, and often grappling with, difficult decisions and trade-offs with regard to energy as they strive to achieve sustainable development. Current estimates indicate that 1.6 billion people are without access to electricity and that 2.4 billion people have no access to modern fuels. This means that approximately one third of the world's population live in the dark, eat uncooked or semi-cooked food and/or are exposed to hazardous indoor air pollution on a daily basis. Expanding energy access to this group of people is essential for alleviating poverty and, in fact, for achieving all of the MDGs. Improving energy access for the alleviation of poverty also means promoting small- and medium-scaled businesses, industrial development and better transportation networks in a general effort to improve socio-economic well-being. All of this will require greater energy use. To achieve these goals with minimal adverse effects on the environment is a basic goal of sustainable development.

¹ The High-level Plenary Meeting of the 60th session of the General Assembly. United Nations, New York, 14-16 September 2005.

While there are no absolute answers and solutions vary by region, by country and even by locality, a common thread in reaching solutions is being able to ask and answer the right questions. The system of energy indicators and their implementation, discussed in the national case studies that follow, constitute a major step in this direction.²

These energy indicators were formulated in line with sustainable development goals and were designed to complement the indicators on sustainable development developed by the United Nations Commission on Sustainable Development. Work on developing indicators on sustainable development was undertaken in response to a call in Agenda 21 for harmonizing efforts, and the set has been tested, reviewed at the Commission's ninth session, and is currently being updated and modified based on national level feedback received.³ While the indicators on sustainable development include some energy-specific indicators, the need for a more systematic approach for energy was noted by energy experts as this work progressed. There are other credible and viable indicator systems that focus on energy,⁴ but those identified, discussed and applied in these case studies, are notable for their flexibility of use and their specific orientation towards sustainability dimensions, identified as economic, social and environmental. Countries can adapt these indicators to suit national energy characteristics and needs. In other words, the indicators are designed to fit real-life situations, rather than modifying or assuming away information that does not fit the model, as often occurs when applying statistical models and tools.

The effort that culminated in the development and refinement of these indicators was initiated by the International Atomic Energy Agency (IAEA) in cooperation with the International Energy Agency (IEA), the European Environmental Agency (EEA), EUROSTAT and the United Nations Department of Economic and Social Affairs (DESA). The indicators are identified and elaborated in the chapter entitled, Indicators for Sustainable Energy Development written by I.A. Vera, L.M. Langlois and H.H. Rogner. This chapter provides background on the rationale and need for energy indicators, and the ways and means of testing the indicators and encouraging their use. The chapter elaborates on the indicators themselves and illustrates their individual relevance to the economic, social and environmental dimensions of sustainable development; it also identifies their interrelationships and their credibility as a set or system for analyzing energy within the framework of sustainable development. Various activities undertaken by the IAEA as the indicators were developed, refined and tested with other international and regional agencies as well as experts in developing countries, are highlighted. This chapter provides an interesting and very useful introduction to the national case studies that follow.

The applications of the energy indicators in developing countries and countries with economies in transition are highlighted in the national case studies of Brazil, Cuba, Lithuania, Mexico, Russia, Slovakia and Thailand. Experts from these countries participated in the testing of the energy indicators, as part of the IAEA project. Thus, the case studies contained in this publication represent initial applications of the indicators, and are considered first steps in a hopefully more comprehensive and long-term utilization of the tool. Nevertheless, these cases highlight the flexibility and versatility of the indicators. They are used to assess energy situations and trends in countries with markedly different energy resources, dissimilar energy needs and wide variations in their economic systems and stages of development. Each application provides not only an example of the way in which the indicators can be used to support sustainable development measures and policies, but also an identification, and in some cases an analysis, of priorities and goals with regard to energy within the context of the broader sustainable development framework.

Brazil's energy mix is dominated by non-carbon emitting energy sources, notably hydroelectricity, used in the household and industrial sectors, and ethanol (from sugarcane), used in the transport sector. The Brazil case study written by R. Schaeffer, A. Salem Szklo, F. Monteiro Cima and G. Machado identifies a number of energy policy options on both demand and supply sides. On the demand side,

² These indicators were recently updated and renamed as 'energy indicators for sustainable development.' See IAEA *et al.* (2005).

³ For additional information, see United Nations (2001).

⁴ See e.g., Schipper (1997), Howarth *et al.* (1993), Schipper and Haas (1997), and Unander *et al.* (2004).

policy options for energy efficiency and end-use efficiency include reduction of energy intensity in the industrial sector, and transport efficiency; the chapter also discusses the potential impact of a fund to improve energy affordability for the poor. Supply side policy options for Brazil include: small-scale hydroelectric; wind power; solar photovoltaic; ethanol (as automotive fuel); sugarcane bagasse cogeneration; and natural gas-fired combined heat and power (CHP) plants. Moreover, the indicators highlight interlinkages among energy, economic, social and environmental data in a coherent way. The authors use time-series and cross-sectional data to support their analyses and assessments.

The recent history of Cuba, the largest Small Island Developing State, provides a rather unique case. After the dissolution in 1989 of Cuba's traditional trade agreements with the former Soviet Union, the country's favourable terms for importing crude oil and petroleum products ended. The adjustments that Cuba had to make in its energy policies are detailed in the chapter on Cuba written by D. Pérez, I. López and I. Berdellans. The authors use the indicators to evaluate the effectiveness of energy policies, including measures to reduce energy import dependence, increase the share of renewable energy resources in the total supply mix, and improve energy efficiency.

Lithuania provides an interesting illustration of a country faced with limited indigenous energy resources and an ageing nuclear power plant in an increasingly globalized economic environment. The Lithuanian case study by D. Streimikiene describes efforts at applying the ISED methodology to analyze energy trends and to set energy priorities and goals. These applications result in interesting policy recommendations for Lithuania, suggesting how to reduce energy intensity and increase end-use efficiency, as well as guaranteeing energy security and reaching a balance between affordability for the poor and end-use efficiency.

Mexico's evaluation of its energy priorities using the indicators is reported on by J. Medina-Ross, J. Mata-Sandoval and R. Lopez-Perez. In terms of the economy, energy represents an important contribution to Mexico's overall gross domestic product (GDP). The authors use the indicators to assess national energy priorities as articulated in Mexico's national plan of development. The article focuses especially on assessment of energy intensities, emissions levels, energy import dependency and the utilization of renewable sources. The authors also highlight the need for better data and statistical support to undertake a more extensive review.

The economy of the Russian Federation has undergone radical changes during the past decade, and its energy sector holds much promise for significant contributions to GDP. Russia's energy priorities, identified in the national energy strategy, are assessed by G. Aslanyan, S. Molodtsov and V. Iakobthcouk in the Russian chapter. Main energy priorities for Russia include: ensuring a stable supply for domestic needs and export; reducing energy intensity; increasing energy efficiency; reducing adverse environmental impacts associated with energy production and use; and ensuring energy affordability for the poor. The application of the indicators highlight the need for greater attention to environmental impacts and the needs of the poor, as well as necessary measures for the transport sector and for overcoming barriers impeding greater energy efficiency.

The Slovakian case study prepared by J. Balajka illustrates how the ISED system can be used to assess the country's energy system and to identify national energy priority areas. The trends resulting from energy policies implemented before the country's accession to the European Union in 2004 are analysed in detail. The ISED implementation results in interesting policy recommendations for Slovakia, suggesting how to improve energy pricing policies, reduce energy intensity and guarantee energy security.

The Thailand case study by J. Todoc, M. Todoc and T. Lefevre focuses on energy efficiency, affordability and accessibility, and the environmental dimensions of energy use. Data are available to analyze trends in the transport, manufacturing, commercial, household and residential sectors. The authors focus on energy use by the poor, noting that progress has been made in extending the electricity grid and encouraging more efficient cooking stoves. They also focus on the transport sector, which is the fastest growing sector in Thailand in terms of energy consumption.

While the application of the energy indicators, detailed in the national case studies contained in the following chapters, provides a snapshot view of the status of the energy sector in each country, more work is needed, in most countries, for a systematic and complete analysis. The indicators as a set have been modified and updated since these case studies were undertaken. It is hoped not only that these

preliminary tests provide useful information and lessons on each country, but also that they illustrate the usefulness of these indicators in highlighting problems, identifying barriers and pointing national policies and measures in the right direction. The 14th session of the United Nations Commission on Sustainable Development (CSD 14) provided a venue to highlight lessons learned, and we are optimistic that the international and regional work on energy indicators, as well as these national case studies, will provide valuable insights, lessons and a range of options for consideration.

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