[Draft: 2/16/2012]

IANAS Energy Program: Energy Efficiency

Improving energy efficiency is widely recognized as important for a broad range of cost reduction, environmental, security and social reasons. What often fails to be recognized is the complex interface of research, development and implementation that needs to be addressed to secure these potential energy savings. The IANAS Energy Program is seeking to navigate this challenging terrain. The goal is to prepare a plan and help initiate actions that will improve efficiency in the Americas, efficiencies throughout the chain from energy sources to and including final energy uses.

Energy efficiency is a high priority in the InterAcademy Council's report, *Lighting the way; Toward a sustainable energy future*, which inspired the creation of the IANAS Energy Program. This chapter highlights the energy efficiency recommendations of the IAC's report, discusses the significance of the recommendations to the Americas, identifies the importance of improved data on energy use and the energy efficiency opportunities in providing energy supplies and in the buildings, industry and transportation end-use sectors. The focus of the chapter is on the role that advanced science, technology and engineering can play in improving energy efficiency.

Lighting the way; Toward a sustainable energy future.

> *Governments should aggressively pursue cost-effective opportunities to improve energy efficiency and reduce energy intensity throughout their economies.*
>
> *Lighting the way...* (p. 52)

The IAC report gives a priority to energy efficiency, addressing it first following an initial chapter which provides an overview of the sustainable energy challenge.[1] The 38 page section on "Energy demand and efficiency" provides a valuable guide to the IANAS energy efficiency priority. The report describes the potential for energy savings, the contrast between the potential and current energy practices, the barriers to achieving the potential savings and the saving opportunities in the end-use sectors.

The report uses the buildings sector to highlight this unrealized potential. "It is already technically possible and cost-effective, for example, to construct buildings that meet or exceed modern standards for illumination, temperature control, and air quality using one-half the energy of conventional buildings."[2] Additional research and development have gone farther to demonstrate zero net energy buildings that combine energy efficiency and on-site renewable energy. Similar striking reductions in energy use have been demonstrated in the industrial and transportation sectors.

Despite this potential, energy saving measures are not adopted as rapidly as would be expected based on cost-effectiveness alone.[3] Institutional, behavioral, and other barriers intervene. Large energy-intensive industries are wary of the high cost of outages if they adopt new unfamiliar technologies. Smaller, less energy-intensive industries lack the

[1] IAC (InterAcademy Council). *Lighting the way; Toward a sustainable energy future.* pp. 19-56. Amsterdam, 2007.
[2] Ibid., p. 21.
[3] Ibid., pp. 28-30.

potential of analyzing their energy use and potential for savings. Energy subsidies shrink the incentive to save energy. Landlords have little incentive for efficiency when tenants pay their own energy bills. Power companies have little incentive to promote efficiency when their incomes are based on total sales. Other obstacles include limited trained professional and technical personnel, lack of access to capital, and the difficulty of integrating complex energy supply and demand systems.

Two of the IAC report's nine conclusions apply to the IANAS energy efficiency priority:

> Conclusion 2: Concerted efforts must be made to improve energy efficiency and reduce the carbon intensity of the world economy.
>
> Conclusion 8: The development of cost-effective storage technologies, new energy carriers, and improved transmission infrastructure could substantially reduce costs and expand the contributions from a variety of energy supply options.

The report acknowledges the limitations of its global approach. "A comprehensive treatment of these trade-offs and linkages, together with a detailed analysis of how much end-use efficiency improvements could be achieved in different parts of the world within specified cost and time parameters, is beyond the scope of this study."[4]

The report also acknowledges that most of the information the IAC group found came from Europe, Japan and the United states and that the discussion may reflect an industrialized country basis. However, it rightly felt the findings would be broadly relevant, saying: "Around the world, people turn out to want much the same things—from refrigerators and air conditioners to televisions and cars."[5]

Developing countries also can benefit from a "leapfrog" to more efficient technologies. The benefits and cost-effectiveness of advanced technologies are greater when starting from the ground up rather than from the retrofitting of existing buildings, equipment and infrastructure.

The IANAS Energy Program has the opportunity to show how the global perspective of the IAC report can be applied to the energy efficiency trade-off and linkages of the Americas. In many ways, the Americas offer an ideal pioneer for finding "a sustainable energy future." The region includes developed and a diverse range of developing economies; countries with abundant traditional fossil fuels and those with none; countries with a wide and generous mix of renewable energy resources, mega urban centers and indigenous corners of the Amazon and a varied geography stretching from tropical islands to the North and South Poles.

Energy Workshops, Dec. 6-7, 2010, and June 9-10, 2011, in Bogota, Colombia

The IANAS Energy Program workshops took up the challenge of converting the global perspective in *Lighting the way...* into the priorities and actions by the science academies and organizations in the Americas. The agendas included reports and updates from the participating countries, presentations from outside experts, and breakout groups on the

[4] Ibid., p. 20.
[5] Ibid.

program's priorities. The breakout groups reported their recommendations in final plenary sessions for discussion on how to move the program forward.

The energy efficiency recommendations from the first workshop focused on expanded research and information and education programs.[6] It called on IANAS to seek increased funding for research on the advanced energy efficiency options with the highest priority in the Americas. The options should be competed broadly based on their technical, economic and environmental impacts. To ensure widespread benefits, the research should be carried out by regional collaborating networks.

The workshop also called for a broad education program to show the social, economic and environmental benefits from a transforming "green," sustainable energy lifestyle. The goal should be improvements at all levels—primary, high school, technical, and university education. The program should be designed and carried out by multidisciplinary working groups including energy scientists, experts in pedagogy and communications and social scientists. The internet and media would be used to deliver this knowledge with courses on line and through the social networks.

The second workshop built on and expanded these recommendations. It called for improved data on how energy is used in the IANAS countries so the largest saving opportunities can be targeted. It offered a proposed list of these opportunities:

- Buildings: Energy efficiency standards for residential and commercial buildings; structural components—envelope: new noise and heat insulation standards; efficient lighting, appliance & HVAC (heating, ventilation and air conditioning) equipment; use of passive and active renewable energy; and Green Buildings-LEED (Leadership in Energy and Environmental Design) standards
- Transportation: Electric and hybrid vehicles; mass transit systems; land-use planning
- Industry (manufacturing and service): Co-generation, industrial symbiosis and recycling, cleaner production technologies, and electrical energy transmission (smart grids) and end-use efficiency.

The workshop called for pulling this information together and exchanged through an intranet discussion beginning in 2012 through the upgrade in the IANAS website, a scheduled virtual meeting in the spring and a proposed group meeting in the fall. To increase the awareness of the IANAS program, the breakout group asked participants to start gathering a list of key actors (academic, political, professional, Chambers of Commerce, etc.) who can be recruited as allies and supporters of these initiatives.

Energy Efficiency: Current Activities and Future Plans

This publication is a vehicle for moving this effort forward. A central question for us is: What can IANAS add to what already is being done in this important and crowded field? The strength of IANAS is the scientific, technical and engineering knowledge and perspective that it brings together through its participating academies and organizations. In

[6] The participants in the breakout groups were Mario Mariscotti, Argentina; Anthony Clayton, Caribbean Academy of Sciences; Jose Lozano and German Poveda, Colombia; Manuel Peña, Dominican Republic; Melio Saenz, Ecuador; Gustvo A. Pérez Munguia, Honduras; and John Millhone, USA. [I'm going by memory. If I left anyone out or added anyone in, please let me know and I'll make the change. Thanks. Millhone.]

this chapter we're looking at what these resources could do to advance the energy efficiency of the Americas.

When viewed from our multi-country perspective, the challenge is to expand our vision to encompass both the global experience and the requirements for success nationally and in our local communities.

The first step is to define the scope of energy efficiency we're using in our program. The second step is to summarize the available data—and its limitations—needed to prioritize energy-saving policies and investments. These initial steps then lead to the more extensive review of the across-the-board mix of advanced technologies and public policies that will improve energy efficiency, reduce greenhouse gas (GHG) emissions and improve the quality and reliability of energy services.

In this chapter, we are relying heavily on information from the program's participants and on international and regional energy information sources. See Box A for these sources and their contact information.

Defining the scope of energy efficiency

The IANAS Energy Program seeks to improve energy efficiency from energy sources to final end uses. The underlined text makes a distinction between the IANAS approach and the approach of many energy efficiency policy papers which focus only on the potential savings in the end-use sectors.

A broader approach is used by the International Energy Agency and the U.S. Energy Information and the U.S. Energy Information Administration—the two major international energy data resources. *Lighting the way...* used this approach when it describes the building sector as using 38 percent of all primary energy, the industrial sector 37 percent, and the transportation sector 22 percent.[7] These number don't count traditional biofuels.

Energy efficiency has been described as simply changing a lightbulb. And it can be. But it's also a large and complicated systems problem. A more efficient turbine can increase the output from a hydropower plant; a new power line can take the additional electricity to an unserved community; where school age students use CFLs lamps to study their lessons at night. .

IANAS is seeking to contribute to the understanding of the efficiency potential along this supply and end-use chain. To optimize many of the saving opportunities require multi-country, regional cooperation. The identification of these opportunities requires improvements and sharing of the energy use data on this energy chain, which receives an expanded discussion below.

Essential Role of Energy Statistics

As energy gets more attention for security, economic, social and climate change reasons, the calls are growing for major improvements in the statistics on energy use. Energy efficiency

[7] op cit., pp. 30, 38, 43.

is increasingly recognized as having a central role in meeting future energy demands. Success depends on an optimal mix of actions at the municipal, state, national or multi-national level. The prioritization of the options requires accurate, timely and continuous data on energy use. International energy information programs have focused on energy supply in the past, but there are some signs this is starting to change. See the IEA initiative in 2011 below. In the IANAS countries, the pooling and expanding of energy use data at the national and local level is necessary to identify attractive multi-country projects.

In analyzing these energy data, it's useful to view them as three connected blocks.

The first block tracks the primary energy from a country where it is produced—Production—to the country(ies) countries where it is used—the receiving country's Total Primary Energy Supply, or simply its primary energy. The difference is simply a country's production modified by its exports and imports. A comparison of the blocks show the energy "haves" and the "have nots"—important information for trade, policy, security and source diversity issues. From an energy-efficiency perspective, the data shows the opportunities for increased efficiency in multi-country transmission lines and pipelines, such as the Central American Electric Interconnection System (SIEPAC), discussed below. For all countries, the primary energy supply is the resource available to meet all its energy needs. It's the unit used in performance metrics, such as a country's energy intensity per GPU. It's the starting point for designing a country's energy efficiency program.

The second block traces the primary energy in a country to the amount of energy that reaches the end use sectors—buildings, industry and transportation. The dominant subtraction in this source-site bloc is the energy used to generate, transmit and distribute electricity to end-use customers. The dominant use of electricity is in buildings. This is what bumps buildings into the lead as the primary energy consumer. Smaller uses in this bloc carry petroleum products and natural gas to their customers.

The third block is divided further into the energy consumption in each of the three end-use sectors. The greatest opportunities for energy savings usually are in these end users. To capture those savings, it's not enough just to know what a sector uses. In the building sector, you need to know the consumption of the residential buildings and the commercial buildings and the amount used for heating, cooling, lighting, plug loads, etc. In industry, you need to know the industrial process loads, the mix of energy-intensity industries, the electric motor loads, the share of small- and medium-sized (SME) enterprises, etc. In transportation, you need to know the use of passenger cars, mass transit, shipping-railroad-highway interface, and the effects of land-use density, etc.

The need for this breakdown of energy use data is getting some increased recognition. The IEA focuses on energy efficiency in its *IEA Scoreboard 2011; Implementing energy efficiency policy; Progress and challenges in IEA member countries.* The report describes the recent progress and challenges of the IEA member countries in implementing energy efficiency policies. The report offers 25 policy recommendations for both member and non-member countries. (See Box B)

The final topic in the report's Executive Summary is "The vital role of energy statistics." It emphasizes:

> In order to make a valid assessment of the energy efficiency situation and carry out reliable monitoring of the progress/failure of the implementation of policy and measures, energy analysts and policy makers need timely access to accurate, detailed data. IEA member countries—and more generally all countries that make energy efficiency an important component of energy policy—must continue and further strengthen their efforts in collecting data and building indicators.[8]

The vital need for improved data in Latin America and the Caribbean was also recognized in a policy discussion paper prepared jointly by the Inter-American Development Bank and the World Bank for a meeting of the LAC finance ministers July 3, 2009, in Viña del Mar, Chile.

The priority areas of action pointed to "a lack of up to data, specific information available to identify specific locations where renewable energy and energy efficiency can be harnessed in LAC." More specifically, it noted: "For energy efficiency, identifying high priority areas, industries, and sectors will also help policymakers and investors to determine where big savings can be achieved quickly, thereby providing an example for the success of energy efficiency measures and reducing perceived risk."[9] The paper proposed eight areas for action in the Americas. (See Box C)

More recently, the importance of improved statistics was recognized by the "Roundtable on Energy Efficiency Metrics & National Energy Efficiency assessment in Developing Countries" held on June 3-4, 2010, in Washington DC. The Roundtable was co-hosted by the Energy Sector Management Assistance Program (ESMAP) and the Energy Unit of the World Bank. The participants represented leading international policy and financial institutions. The Roundtable reviewed the status of energy efficiency [EE] indicators and recommended: "Going forward, increased coordination among international partners will be important, especially in terms of promoting broadly consistent EE indicators, methodologies and data collection guidelines."[10]

The Washington meeting addressed energy efficiency metrics also referred to as energy efficiency indicators. These are the pragmatic yardsticks used to measure energy-savings. For example, the data might show commercial buildings offer major potential savings and that a large share of these savings would be in efficient lighting. An energy efficiency indicator for lighting is lumens per watt—the amount of light produced by a watt of electricity. Replacing wasteful incandescent lights with efficient CFLs or LEDs are major improvements, but they're not the whole answer. There are also lighting controls and light placement, turning off lights when they're not in use, optimizing air conditioning to adjust to the reduced thermal load. In the same way, improving the mpg of passenger vehicles is an energy efficiency indicator in transportation, but the savings lose momentum in chronically stalled traffic. In the industrial sector, electric motors—the largest consumer of electricity—are measured by the percent of electricity converted into mechanical energy, but in practice the full benefits of potential savings also depend on the use of adjustable-speed drives where

---

[8] Ibid. IEA Scoreboard, p. 9

[9] [Get reference information from the IDB website.]

[10] ESMAP website: http://www.esmap.org/esmap/note/199 The Communications Note provides a good summary of the Roundtable, which includes Background, Status of EE Indicators Development and Applications, Main Findings and Conclusions, and Recommendations and Next Steps.
[Comments: In the next version of this chapter, I'll include more information on the status of the Next Steps called for in the Communications Note. The recommendations include increased funding to strengthen the energy efficiency indicators and data collection guidelines. Millhone].

appropriate, the optimizing of the complete industrial system, and reliable maintenance and repairs.

There's a symbiotic relationship between the statistics that identify the promising areas for energy efficiency and the pragmatic energy efficiency indicators used in delivering energy-saving programs. Energy policy makers must continue to monitor and improve these indicators to ensure that they're taking them where they want to go.

As the IANAS program goes forward, we intend to work with these efforts to improve the statistics on energy efficiency and to use the results to focus and strengthen the energy efficiency programs in the Americas. We will do this under five subtopics: 1) Cross-cutting activities, 2) supply efficiency from sources to end uses, and in the three end uses: 3) buildings, 4) industry, and 5) transportation.[11]

Cross-cutting activities

As energy prices, energy security, and climate change have gained increased attention, major international political and financial organizations are giving a higher priority to energy issues. Energy efficiency is high on their agendas. Their activities are supporting cross-cutting energy savings from all sources to all uses.[12]

These organizations include the InterAmerican Development Bank (IDB), the World Bank through its Energy Unit and its administration of the Energy Sector Management Assistance Program (ESMAP), the International Partnership for Energy Efficiency Cooperation (IPEEC), the Energy and Climate Partnership of the Americas (ECPA), and the Clean Energy Ministerial (CEM). These organizations often co-fund projects along with other government and financial partners. See Box A for snapshots of these organizations.

The showcase for this new collaboration was the Energy Efficiency and Access Forum held Sept. 28-29, 2010, in Mexico City. The forum touted energy efficiency as Latin America's new growth engine as its economy rose to a 5-6 percent expansion in a quick recovery from the global financial crisis. The forum was sponsored by the Secretariat of Mexico, IDB, World Bank Group and World Economic Forum and provided a platform for ECPA and IPEEC.

The forum identified three pillars of action for energy efficiency that together and even separately, could significantly reduce the growth in energy demand without inhibiting robust GDP growth. Examples of the pillars were:

- Demand-side EE: switching to higher-efficient lighting (CFLs, LEDs), promoting a change to more efficient appliances, installing high-performance electric motors and pumps in industry, enacting more pro-energy efficiency building codes, expanding

[11] [Comment: I believe this data section is important, but I'm afraid that the data from a focus group meeting might show that many participants have fallen asleep. In the next version, I may summarize this section and pull much of this information into a separate box or appendix. - Millhone]

[12] The initiatives of these international political and financial organizations also cover the other Energy Program priorities, including energy for unserved populations, renewable energy, bioenergy, capacity building and education and information. Information on the activities in these other priority areas are covered by the chapters on those topics.

industrial heat recovery; and adjusting tariff structures to smooth consumption across peak and non-peak periods.

- Supply-side EE: rehabilitating and refurbishing generation plants; expanding the use of co-generation and IGCC [integrated gasification combined cycle]; installing efficient and low-loss transformers and high-voltage transmission lines; rehabilitating substations; optimizing power systems and promoting smart grids; district heating/cooling systems; increasing the efficiency of oil and gas extraction processes and equipment; improving refinery efficiency; and reducing gas flaring.
- Energy conservation: turning off lights and equipment when not in use; taking shorter showers; using mass transit rather than individual cars; adjusting thermostats to lower heating and air conditioning consumption.[13]

The report on the meeting provides an excellent overview of energy efficiency measures, barriers, financing, capacity building, climate change benefits, and energy for unserved populations. The report's annexes provide information on the energy efficiency activities and contacts in the LAC countries.

These organizations are continuing their support for cross-cutting programs, as described below.

InterAmerican Development Bank The IDB website shows its perspective in the first sentence on its dropdown page on Energy Efficiency. "Of all the untapped sources of clean energy in Latin America and the Caribbean, energy efficiency may offer the greatest impact at the lowest costs." The IDB's support is through special funds for different types of energy efficiency investments and through the direct funding of country projects.

The recently as Jan. 13, 2012, the IDB approved a $30 million green fund for Latin America and the Caribbean. The bank expects to attract investors, reaching an eventual $150 million. The fund will invest in energy efficiency and smart grids, energy service companies and renewables.[14]

This followed the IDB's creation in 2010 of a Microcarbon Development Fund, funded at $50 million, aimed at promoting sustainability among low-income families and projects at the local level. The program is designed for projects ranging from retrofitting buildings, to efficient appliance, solar water heaters, light-emitting diode (LED) lights and forest rejuvenating forests. The announcement anticipated no more than 10 projects between $2 million and $8 million each. Colombia and Mexico were the first targeted countries; followed by Brazil, Ecuador and Central America among other regional groupings.[15] [Comment: Any information on the status of these projects from these countries would add useful content to this text. – Millhone.]

The IDB also has provided country-level funding for crosscutting projects. Examples: Jamaica received a $153 million loan for efficiency, quality and sustainability of potable water services in Kingston and the surrounding area. Mexico received $2.5 million from the IDB and Korea to support a joint contest to fund applied R&D on sustainable energy projects. Uruguay received support totaling $1.8 billion in sovereign-guaranteed loans for the period

[13] http://foroeea.energia.gob.mx/ , p. 47
[14] www.iadb.org/en/news/news-releases/2012-01-13/9807.html (Downloaded 1/17/2012)
[15] www.ecoseed.org/politics/funding-a-incentives/article/35-funding-incentives/8287-latin-america (Downloaded 11/23/2011)

2010-2015 covering energy, transport, water and sanitation, innovation and education. Peru received a programmatic policy-based loan of $25 million to develop a sustainable energy matrix.

World Bank Group. The World Bank Group is an immense resource on energy efficiency ranging from information resources, to support for capacity building, to major funding for multi-government and government projects. While its responsibilities are global, the World Bank also directs its efforts toward the activities most relevant to different regions, including the LAC. The bank also administers ESMAP, a global, multi-donor technical assistance trust fund with many activities in the Americas.

The World Bank and ESMAP support cross-cutting programs, which are summarized here, as well as supply and end-use sectors, which are described in the following sections. .

The World Bank Group's energy efficiency portfolio has more than doubled from 2007 to 2011, increasing from $753 million to $1,551 million; related support for transmission and distribution improvements grew from $458 million to $1,397 million; and support for renewable energy from $840 million to $2,977 million.

The World Bank and ESMAP have published a basic guidebook, *Financing Energy Efficiency; Lessons from Brazil, China, India, and Beyond,* which shows how to capture the enormous potential savings in existing industries and buildings.[16] The World Bank and ESMAP co-sponsored the roundtable on energy efficiency indicators mentioned earlier.

The World Bank website is a source of information on projects it has supported in the LAC countries. Some examples: Brazil's Eletrobras Distribution Rehabilitation Project ($495 million), Mexico's Lighting and Appliance Efficiency Project ($350 million), Argentina capacity building program ($15 million), and Uruguay's innovative Energy Efficiency project ($7 million) where children encourage their parents to refrain from wasting energy.

ESMAP has five technology assistance programs on: Energy Access, Clean Energy, Energy Efficient Cities Initiative, Energy Assessments and Strategic Programs, and Results-Based Outputs for Energy Sector Development. The Case Studies Database has reports on the LAC projects. www.esmap.org/esmap/EECCaseStudies The case studies include building, transportation, industry (solid waste and water/waste water) and urban planning projects.

Energy and Climate Partnership of the Americas The growing recognition in the Western Hemisphere of the importance of sustainable energy led to the creation in 2009 of the Energy and Climate Partnership of the Americas (ECPA). At the Summit of the Americas, U.S. President Barack Obama invited countries to participate in the partnership, a flexible program with government and private sector participation in initiatives on energy efficiency, renewable energy, energy poverty reduction, infrastructure, cleaner and more efficient use of fossil fuels, sustainable forests, land use, and adaptation to climate change. Participating international organizations include the World Bank, IDB, Organization of American States (OAS}, the Latin American Energy Organization (OLADE), and others.

[16] The guidebook can be downloaded from the World Bank website at: http://www.worldbank.org/research/2008/01/9014995/financing-energy-efficiency-lessons-brazil-china-india-and-beyond

The initiatives include cross-cutting, energy supply, and end-use initiatives. See Box D for the ECPA Fact Sheets and Box E for a list of the more than 20 initiatives. Information on the goals, overviews on the activities, participants and financing are available on the ECPA website http://www.ecpamericas.org.

The cross-cutting activities, described above, are many and wide-ranging. Even so, there are many additional cross-cutting multi-country and country activities. The IANAS Energy Program is continuing to expand its understanding of these multiple activities to identify those that would benefit most from participation by IANAS. We see two areas where our capabilities would be useful. We are looking for activities where advanced science, technology and engineering can make a significant contribution. And we are looking for initiatives where our Americas perspective can be used to encourage additional countries to participate in these programs. .

Energy Efficiency from Sources to End Uses

The energy supply chain stretches from the conversion of natural resources to a useable form of energy and its delivery to the building, industry or transportation end use sectors. At the front end, it begins with the efficiency of the coal and uranium mines, oil and natural gas wells, and hydropower and other renewable sources. The supply chain then extends to electricity generation plants and the transmission and distribution lines to electricity end users and to the refineries and pipelines, tankers and tank trucks that carry petroleum products and natural gas to their end users.

This largest opportunities for energy efficiency in the delivery of primary energy sources to end user customers is in the generation, transmission and distribution of electricity.

Energy efficiency in the generation of electricity. Significant improvements are being made in the efficiency of power generation both from conventional sources, such as coal, petroleum and natural gas and from renewable resources, such as solar, wind, biomass, hydro and geothermal sources. These advances affect the performance, cost and reliability of different sources. Since natural energy sources are oblivious to political boundaries, the optimal mix of fossil and renewable sources depends on an international perspective.

While they have gained less attention, significant improvements are being made in the generation of electric power from traditional fuel sources as well as from renewable resources. For example, new gas combined cycle power plants have efficiencies approaching 60 percent, compared with an upper efficiency of around 40 percent for traditional steam plants.

The optimal supply side systems are influenced by a mix of interactive options. A distributed system composed of large and small power plants may have lower aggregate generation efficiency than large centralized plants, but this might be offset by lower transmission costs. Cogeneration plants that provide both electricity and heat are a good choice in locations with both electricity and thermal demands and may add to the benefits of distributed power. The increased use of solar and wind power with intermittent supplies needs to be considered. The increased use of energy storage, such as pumped hydro and advanced batteries, and of “smart grids” with demand-control features are supply choices that may offset intermittency and lower peak demands.

As the Americas rely on increasing contributions from renewable energy, the integration of renewable sources into load management, grid management and energy transportation will be increasing important. This challenge and the opportunities for the growing use of renewable sources are addressed by the International Council for Science Regional Office for Latin America and the Caribbean (ICSU-LAC) in its *Sustainable Energy in Latin America and the Caribbean; Potential for the Future.*[17]

These supply side choices are increasingly important in different regions of the Americas as countries and power companies give growing attention to the cost and environmental and security benefits of multi-country electrical grid connections, which are considered below.

Energy efficiency in the transmission and distribution of electricity.

The energy efficiency indicator for power transmission and distribution systems is the share of electricity lost along the way. Reducing these losses in the Americas should be a high priority, according to World Bank energy expert Philippe Benoit, who addressed this loss at the September 2010 Mexico City energy forum cited above.

"Electricity loss through inefficient distribution is a major problem in the region," Benoit said. "Latin America's registered losses in electricity distribution in 2005 equaled the total combined energy consumption of Argentina, Chile and Colombia. Currently, the average losses hover around 16 percent of the region's total output. If losses could be reduced in a 20-year period, energy savings could eliminate the need to generate up to 6 percent of the additional electricity needs for those years."

Reducing distribution losses are closely related to integrating power systems, introducing "smart grids" and modernizing the Americas' power grid, including the interconnection of national power grids. .

The ambitious Central American Electric Interconnection System (SIEPAC for its Spanish acronym) is constructing a transmission line connecting Guatemala, Honduras, El Salvador, Nicaragua, Costa Rica and Panama. The project begun in 2006 is nearing completion. The integration of the national power systems should increase efficiency, lower costs and increase energy security across the region. To achieve these economic and energy benefits, policy issues relating to regulation, operations, and integration with the national power systems are being addressed. All the IANAS priorities—energy efficiency, renewables, bioenergy, unserved populations, capacity building, information and education—are important in these decisions.[18]

The Caribbean islands are also getting increased attention as a region that would benefit from a regional electricity supply system. The Caribbean countries and territories are plagued by high and volatile fuel prices, limited diversity of sources, and little coordination of energy efficiency and renewable energy projects.

---

[17] *Sustainable Energy in Latin America and the Caribbean: Potential for the Future,* pp. 87-88. The report can be downloaded at: http://www.icsu.org/icsu-latin-america Click on Publications, then on Reports and Reviews, and then on Sustainable Energy for English and Spanish versions of the report.

[18] [Comment: I see this as significant for a number of sustainable energy issues, but also know that there other participants in the Energy Program are far more familiar with SIEPAC and Caribbean projects than I am. I'll appreciate your corrections and insights. – Millhone]

This is the subject of a recent World Bank study, *Caribbean regional electricity supply options; toward greater security, renewable and resilience.*[19] The report found that most of the energy studies in the Caribbean have considered individual countries in isolation. The interconnection of electricity systems is getting increased attention globally. The Caribbean has lagged behind other regions. The short distance between the islands and small markets promise benefits from interconnections. The World Bank study notes that "Increasing interconnection in the Caribbean could pave the way for greater energy security, a larger use of renewables and enhanced climate resilience."[13]

The modernization of electricity grids is also taking place at the country level. Some examples: In Ecuador, the IDB is supporting a rural electrification program under that country's Urban and Rural Electrification Program of Ecuador (FERUM) in 2011 and 2012. In the Dominican Republic, the IDB has approved a $200 million project designed to make the electricity sector more efficient and reliable.[20] [Additional projects could be cited here.-Millhone.]

While the electric power system offers the largest opportunities for primary energy savings, significant savings can also be made in the supplying of traditional coal, petroleum products and natural gas to consumers. The efficiency advances for renewable and bioenergy sources also play into the primary energy decisions and are discussed in those chapters. Once these energy sources reach end users, they enter a wide, expanding world of additional energy saving potentials, which are described below.

Energy Efficiency in the Buildings Sector

The building sector offers energy savings as simple as changing a lightbulb to as complex as building a new office building. The use of primary energy in buildings, particularly in the form of electricity, nudges out the industry sector at the global level—38% to 37%, but the role of buildings is even greater. The industry sector data is not confined to industrial processes, but also includes corporate buildings, which benefit from the spill-over of efficiencies designed for the building sector. Improved efficiency in lighting for buildings also has spill-over benefits for industry and transportation (street lighting). Because of the long lifetimes of buildings, compared with industrial plants and cars, it's also important to lock in advanced energy efficiency features in new buildings for the decades that will follow..

The IANAS workshop recommendations are in areas being pursued in many projects throughout the Americas. The challenge is: How can the region's scientific academies and organizations contribute to these programs? The likely opportunities include energy efficient new building codes, the retrofit of existing buildings, energy-efficient standards and labels for appliances and equipment, and energy-efficient lighting. The program is reviewing this ongoing work to identify areas where IANAS should focus its efforts.

Energy Efficient Building Codes. A good overview of residential and commercial building codes and how they can be developed and implemented effectively is available from the World Bank, *Mainstreaming Building Energy Efficiency Codes in Developing Countries; Global Experiences and Lessons from Early Adopters."*[21] The paper covers the energy use in

[19] http://go.worldbank.org/HHXUYOUH60
[20] http://www.iadb.org/en/news/news,2359.html
[21] The World Bank, World Bank Working Paper No. 204. 2010.

buildings, savings opportunities, market and other barriers, the role of incentives and the challenges of implementing building codes in developing countries.

The working paper integrates the requirements of an effective code—practical format, continuous updates, actual enforcement, and overcoming market barriers—and includes five case studies that shed light on how these requirements have been addressed in real time. Two of the case studies are in the Americas—Mexico and the state of California—which provide special relevance for the IANAS project. The other case studies are China, Egypt and India.

While some countries in the Americas have initiated strong energy efficiency codes for residential and commercial buildings a great deal more needs to be done. The passage of legislation is an important first step, but experience shows the implementation and enforcement of codes is often even a greater challenge. Regular updates are critical to strengthen codes by incorporating advanced energy-saving technologies. In many parts of the Americas, a multi-country collaborative effort to overcome these barriers will be more effective than separate national efforts.

Parallel capacity-building programs will be critical to the success, as well as participation by engineering, education and building societies. Internationally active organizations include the American Society of Heating, Refrigerating and Air-conditioning Engineers (ASHRAE) www.ashrae.org and the International Code Council www.iccsafe.org . Both offer online training programs. The ICC has some activity in the LAC. It recently signed an agreement with the Honduras Institute of Architects to develop a national building code for Honduras based in the 2006 International Building Code Spanish edition.

Enforceable building codes do more than save energy; they also save lives. Richard P. Weiland, ICC Chief Executive Officer, made this point after the 7.1 magnitude earthquake Haiti, where more than 300,000 lives were lost. By comparison, the 1989 *Loma Prieta* earthquake, which registered a similar 7.1 severity and with an epicenter just south of densely populated San Francisco, caused 63 deaths. In 2010, a Chilean earthquake that registered 8.8—five times more powerful than Haiti's—fewer than a thousand lives were lost. Both California and Chile use and enforce building codes.

Energy codes can be complimented by the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) programs that recognize new buildings that exceed the code requirements. The participants in the Low-Carbon Communities in the Caribbean (LCCC) workshop March 1-2, 2011, at the National Renewable Energy Laboratory (NREL) in Golden, Colorado, had an opportunity to tour the Research Support Facility on the NREL campus, which won a LEED Platinum certificate and is among the most energy-efficient office buildings in the world.

Energy Efficiency in Existing Buildings. Existing buildings designed and constructed when energy prices were low and before energy efficiency and climate change became global priorities provide major opportunities for cost-effective investments. Energy codes, described above, usually require energy-saving features in major building renovations. Programs that address this area include building commissioning, the use of energy service companies (ESCOs), government retrofit of its own buildings, and the targeted retrofit of the housing of low-income families.

Building commissioning is the broadest approach to the retrofit of commercial buildings. Buildings age. Building envelopes and equipment deteriorate. Building uses change. Higher performing building components become available. In commissioning, specialized engineers and architects perform audits of building and identify and prioritize the higher performance and cost-saving improvements.

Commissioning is a useful tool throughout the life of a building. New buildings are commissioned to ensure all the equipment is working as intended and that the building operators are properly trained—particularly important when advanced equipment is installed. The commissioning of existing buildings typically identify cost-effective saving opportunities of 20 percent or higher.

Commissioning and ESCO programs can be linked to provide financing for cost-effective building retrofits. The ESCO provides funding for the retrofits and is repaid from the resulting energy savings. After the ESCO is repaid, the building owner continues to enjoy the energy savings and improved performance of the building.

The commissioning-ESCO approach is often attractive to national, regional and local governments for their own buildings. They gain energy and long-term saving benefits without difficult up-front budget outlays. They set an example by reducing energy use and GHG emissions. The approach can also be attractive to businesses that provide energy-saving products, to chain stores, and to power companies in jurisdictions that award them for energy-saving programs. In an example, the IDB is funding an Energy Efficiency Loan Program to Jamaica to provide efficient equipment to public sector buildings. http://www.iadb.org/en/project,1303.html?id=JA-L1025

The retrofit of the housing for low-income families can provide multiple benefits. The direct benefits are the energy savings and the creation of healthier home environments. In some countries, the retrofits can be part of a package of action that reduces and ends subsidized energy prices. Subsidies undercut energy and Climate Change programs. A frequent argument against cost-based energy prices is the hardship they would bring on poor families. The answer is to target assistance to those who need it most and to reduce the societal cost by support for energy-efficient housing.

Energy Standards and Labels for Appliances and Equipment. Energy standards and labels for appliances and equipment was a priority topic at the Energy Efficiency and Access Forum in Mexico City. The reasons for the priority were expressed by Richard Jones, Deputy Executive Director, International Energy Agency.

He cited the benefits:

- They are very cost effective,
- They require change in the behavior of a manageable number of manufacturers rather than all consumers,
- They treat all manufacturers, distributors and retailers equally, and
- They provide large measurable energy savings that are comparatively easy to quantify and verify.

Standards and labels offer strong prospects for cooperation in the Americas. Countries can coordinate the provisions of their programs, create a large common market that encourages

manufacturers to scale up production of efficient products, adopt similar financial incentives, and work together to monitor, verify and enforce the enlarged program.

The global role of standards and labels is growing. "Over 75 countries have energy standards and labeling," said Christine Egan, Executive Director, Collaborative Labeling and Appliance Standards Program (CLASP), another speaker at the forum. "This growing trend is taking over Latin America and the Caribbean as energy efficiency is going mainstream in the region." And, she added, "...there are ample opportunities for regional cooperation among national programs."[22]

The IANAS Energy Program is assessing how it can assist this trend. Encouraging broader country participation is one area. The harmonizing of some standards to reflect the LAC markets is another. Compliance requires laboratory test facilities and the sharing of facilities among the IANAS countries could be productive. The region's researchers are among those finding efficiency improvements in appliances and equipment, leading to stronger standards and labels. Capacity building and education and information programs play an important role in increasing the impact of standards and labels making it important for collaboration in this and other IANAS programs.

Energy-Efficient Lighting Lighting is one of the products covered by Standards and Labels, but it has received so much attention as an energy-saving topic that it's discussed separately. Lighting is the ultimate leapfrog technology. For generations, lighting meant incandescent lightbulbs, a technology from 100 years ago. An incandescent lasts an average of 1,000 hours. Compact fluorescent lightbulbs (CFLs) and light-emitting diodes (LEDs) are making light-year advances. CFLs use 70 percent less energy than incandescents and last at least six times longer. LEDs are solid-state light sources captured by on-going R&D into new products that continue to enter the market with even higher energy efficiencies and longer lifetimes.

The Sustainable Lighting Program in Mexico is demonstrating the huge savings from changing light bulbs. The program replaces incandescent light bulbs with compact fluorescent lamps (CFLs) through 1,100 exchange centers in 56 metropolitan areas across the country. The process is simple. Each family can replace four incandescent bulbs. They simply bring in four incandescents, a paid electrical bill and proof of residence. The goal is to reach more than 11 million families in 2012. The initiative expects to reduce energy consumption by the equivalent of 7.44 million barrels of oil and reduce the greenhouse gas (GHG) emissions to the equivalent of 36% of the annual emissions of vehicles in Mexico City. The program is implemented by the Mexican Electric Power Savings Trust Fund (FIDE) and funded by the World Bank.[23]

Energy Efficiency in the Industry Sector

The opportunities for energy efficiency in the industrial sector are large. Industry consumes 37 percent of the primary energy globally and its share is rapidly increasing in developing countries. The choice of energy efficiency technologies is important to both society and industry decision-makers. Energy savings translate into long-term cost savings and competitiveness. The right choices depend on an understanding of advanced science,

[22] Transparency note: I'm a member of the CLASP Board of Directors. – Millhone

[23] http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/LACEXT/MEXICOEXTN/O,,print:Y... (Jan. 23, 2012)

technology and engineering. The science academies and organizations can play a key role by providing the information needed for informed choices.

The strategy of the IANAS Program is to bridge the gap between the top-down sources of information on industrial energy efficiency and the wide application of these advances in the Americas. The closing of this gap is particularly important in countries less active internationally. Allies in this effort are state and local governments, university groups and trade associations working together in ground-up efforts to broaden and strengthen their industrial base.

The top-down activities are represented by the International Partnership for Energy Efficiency Cooperation (IPEEC), Clean Energy Ministerial (CEM), recent action by the International Organization of Standardization (ISO), and Institute for Industrial Productivity (IPI), among other new programs.

The birth of IPEEC reflects this merging of developed and developing perspectives. The partnership grew out of the recognition by the Group of Eight (G8) industrialized countries of the growing independence between the developed and developing countries at its 2007 summit in Heiligendamm, Germany. This led to the creation of IPEEC which has rapidly a major source of energy efficiency information and programs, focusing on industrial energy efficiency, but also extending to other energy uses, as found on its website http://ipeec.org/ IPEEC reaches out to developing countries, private companies and non-government organizations to participate in its programs.

The international goals of sustainable energy and confronting Climate Change inspired the Clean Energy Ministerial. U.S. Secretary of Energy Steven Chu, a co-chair of the IAC panel that drafted *Lighting the way...*, initiated CEM at the UNFCCC conference in Copenhagen in December 2009. The first meeting was held on July 20, 2010, in Washington, DC. The forum promotes policies and programs that advance clean energy technologies. The ministerial has launched 11 initiatives, including the Global Superior Energy Performance Partnership (GSEP), which has working groups on industry and related topics: certification, power, steel, cool roofs, combined heat and power, and cement.
http://www.cleanenergyministerial.org

Established international leaders have joined the cause. In June, 2011, The International Organization of Standardization (ISO)—the leader in the coordination of international standards since it was formed in 1947—issued ISO 50001, *Energy management systems—Requirements with guidance for use*. The new standard sets forth an improved Plan-Do-Check-Act approach that supports a continual, comprehensive energy management system.
http://industrial-energy.lbl.gov

The non-profit organization, Institute for Industrial Productivity, established by the ClimateWorks Foundation in 2010, is a growing source of information on energy efficiency in energy-intensive industries, including cement, iron and steel, chemicals, petroleum refining and pulp and paper. An excellent example is: *Best Practices in Energy Efficiency Industrial Technologies Motor Systems.* Electric motors consume 40 percent of global electricity demand, double the second largest consumer of electricity, lighting. Motors also consume about 70 percent of the electricity consumed in the industrial sector as well as significant shares in the building sector. The IIT Best Practices guide was prepared by the University of Coimbra, Portugal. info@iipnetwork.org .

Some members of IANAS are active in these international efforts. Brazil, Canada, Mexico and the United States are active in IPEEC and the CEM. The IPEEC's program includes regional energy efficiency workshops as part of its Worldwide Energy Efficiency Action through Capacity Building and Training (WEACT). The September 2010 workshop in Mexico City, referenced above, also served as IPEEC's inaugural regional workshop. Brazil and the United States co-chair the ISO Project Committee 242, *Energy management*, which developed the new ISO 50001 standard.[24]

While these activities are gaining momentum internationally, at the in-country level there are an increasing number of industrial energy efficiency projects in the Americas. Some examples:

In Chile, a government program supported by the IDB is training energy efficiency service providers and carrying out plot projects in the food, wine, metals, chemicals and retail industries. The Chilean Government's Production Development Corporation (CORFO) provides investments up to US$1 million for energy efficiency investments by industrial and commercial companies.

In Uruguay, a project is being launched to improve the energy efficiency of dairy farming. With support through the IDB's Multilateral Investment Fund (MIF), the US$6 million project will benefit as many as 500 small- and medium-sized dairy producers.

The bank's MIF is partnering with the Nordic Development Fund to launch a pilot microfinance program to foster the development of clean technology markets for micro, small and medium-sized enterprises in the LAC region. The $7 million program announced in October, 2011, will provide training to microfinance institutions in the region. Information about these and many other projects can be found on the IDB website along with contact information. http://www.iadb.org/en/news

In Argentina, the World Bank has funded a multiyear US$15 million Global Energy Facility grant. The project extends from development of the Argentina Energy Efficiency Fund to utility-based energy efficiency programs to capacity building. Information on this and other projects are available on the World Bank website:
http://web.worldbank.org/WEBSITE/EXTERNAL/COUNTRIES/LACEXT

This summary of industrial energy efficiency activities at the international and national levels in the Americas is just a start in covering these programs. Even so, the literature frequently describes this important work is still in its infancy with much more needing to be done. The countries of the Americas are in different places in this movement. Some are leading the global changes. Others are advancing their programs rapidly. And still others are barely getting started. The role of the IANAS Energy Program is still being determined, but some things are clear. Advanced science, technology and engineering will play important roles in the future industry of the Americas. The information resources on these changes are rapidly expanding.

[24] Aimee McKane, a Lawrence Berkeley National Laboratory researcher, played a central role in developing the standard. McKane also co-authored with Lynn Price and Stephane de la Rue du Can a text for progress in this area: *Policies for Promoting Industrial Energy Efficiency in Developing Countries and Transition Economies.* http://industrial-energy.lbl.gov/node/395/print

Energy Efficiency in the Transportation Sector

Globally, the transportation sector accounts for 22 percent of primary energy use and 27 percent of global carbon emissions. In the major industrialized countries, nearly all (96 percent) of transportation energy comes from petroleum fuels.

In the Americas, particularly Latin America and the Caribbean, the transportation sector has noteworthy differences from the rest of the world in energy sources, geography and stage of development. These differences pose a unique mix of opportunities and challenges.

Primary sources are one difference. Brazil and its South American neighbors are the international leaders in the use of biofuels to meet their transportation needs. This is the subject of the biofuels chapter.

Another difference is the geography of the LAC region. New highways through historically bypassed indigenous area in the Amazon and elsewhere create new opportunities, but also open up virgin habitats to destructive exploitation. Special attention is required to optimize the mix of shipping, railways and highways. Mega-metropolitan areas demand attention for mass transportation and land use planning and rapidly growing cities provide opportunities for smarter growth.

The review of the transportation sector also calls for a review of transportation subsidies and whether they are undermining cost-based energy efficiency efforts. This question was raised at the discussion of challenges to implementing energy efficiency measures at the IDB and World Bank's Second Meeting of the LAC Finance Ministers in July 3-4 at Viña del Mar, Chile, referenced earlier. The report on the meeting noted: "The Financial Times recently reported that Latin America and the Caribbean has spent around US$50 billion in subsidies for transportation fuel since 2008. This is about five times what the IDB let to the region during 2008 for all sectors." [25] [Comment: In this draft, I haven't looked into where the subsidies are or their impact, but see this as an important issue. Any information on this issue would be welcome. – Millhone]

Because of these differences, the Americas' transportation sector exposes the limitations of some common energy intensity indicators. The common indicator is the mpg of passenger vehicles. Improving the efficiency of the transportation sector in the Americas includes this metric but a higher priority should be given to a more complex mix of social, economic and environmental priorities.

The "leapfrog" strategy, referenced earlier for industry, also applies to the Americas' transportation infrastructure. For the LAC region, this means giving a priority to an enlightened investment in the transportation infrastructure. These opportunities occur at the urban, country, and multi-country areas.

The ESMAP Energy Efficient Cities Studies Database is a valuable source of information on the sustainable activities of the world's cities. http://www.esmap.org/esmap/EECase.Studies

[25] IDB and World Bank. 2009. *Second Meeting of the Finance Ministers of the Americas and the Caribbean; Implementing Renewable Energy and Energy Efficiency measures: Challenges and Opportunities for Latin America and the Caribbean.* p. 42. [See IDB Energy Efficiency #7. http://www.iadb.org/document.cfm?id=35028463 (Feb. 1, 2012)]

The case of Curitiba, Brazil, is highlighted in these case studies as showing that cost is no barrier to ecological and economic urban planning, development and management. Curitiba, with a population 2 million, is the capital of the State of Paraná in the south of Brazil. To avoid urban sprawl, urban growth is linear along high density commercial, and residential axes linked into the city's master plan. An affordable, innovative bus system has a 45 percent ridership that reduces traffic congestion. A car-free central city zone is walkable and inviting. Crime has decreased. Green areas have been expanded in parks that also improve flood prevention.

The database also recognizes other energy efficiency projects in the Americas cites: Energy management in the provision of water services in Campinas, Brazil; bus rapid transit urban transportation in Bogota, Colombia; the upgraded drinking water system, Monclova, Mexico; LED traffic lights in Portland and Los Angeles, USA; and a municipal energy efficiency fund, in Ann Arbor, USA.

The IDB is a source of funding for transportation programs. In Colombia, financing from IDB and Clean Technology Fund totaling $320 million is extending the transit systems improvements in Bogota to four of Colombia's major cities[26] benefiting 800,000 passengers daily. The improved passenger transport systems are expected to save energy and reduce carbon gas emissions by half. In San Salvador, a $45 million IDB loan will provide 5.3 km of preferential bus lanes in the city's center, increasing the number of passengers using mass transit by 40,000 a day. In Haiti, a $55 million grant will upgrade highways and pave streets improving transportation efficiency and also created needed jobs.

In a major program that recognizes the potential of these improvements, the IDB has created a Sustainable Emerging Cities platform to assist the more than 140 fast-growing cities with populations between 100,000 and 2 million people in Latin America and the Caribbean. These cities are growing two to three times faster than the region's megacities. The platform will provide sustainable solutions to transportation, housing, water and energy use and public services.

Projects that improve the transportation infrastructure in and between countries also are investment in large future benefits.

An example in Central America would be the completion of the Pacific Integration Corridor—the highway from Mexico to Panama—the transportation equivalent of the SIEPAC electric power line. IDB President Luis Alberto Moreno urged support for the project at the Summit of Central American leaders December 5, 2011, in Meridan, Yucatan. While the project is touted primarily for its trade, transportation and development benefits, it also would have major energy efficiency and GHG emission reduction benefits. The project is expected to shorten the travel distance between Mexico and Panama by some 200 kilometers, increasing the average speed from 17 km/hour to 60 km/hr and reducing travel time from the present 190 hours to 54 hours.

Major improvement in travel between Brazil and Colombia is also getting attention, stimulated by a new study released by the IDB's Integration Department.[27] Trade between the two countries is booming to $3 billion last year, but still represents less than 1 percent of

[26] The cities are Pasto, Popayán, Armenia and Santa Marta.
[27] IDB. 2011. *Toppling the Wall: Trade and Integration between Brazil and Colombia.*

their total trade. The two countries have a combined population of 230 million, Atlantic coastlines, economies based on abundant natural resources, a 1,950-km border, but no significant connecting transportation infrastructure. Trade depends on maritime transport and freight costs are very high.[28] Leaders in both countries are looking for less costly alternatives.

In these areas and throughout Latin America and the Caribbean, there are opportunities to modernize transportation systems. Transportation connects people and goods and the responses to these opportunities will have far-reaching economic, environmental, social and energy consequences.

Summary

The IAC report, *Lighting the way...,* gives a priority to energy efficiency, which—though often mentioned—rarely receives the breadth of analysis and policy coordination required for successful policies and programs. Energy efficiency is frequently referred to as the fastest, cheapest and most certain way to reduced energy costs and lower GHG emissions. But the next steps—the policies and actions required to realize these savings—too often are missing.

The objective of the IANAS Energy Program is to serve as an instrument that helps mobilize a coordinated effort to bring real energy efficiency changes in the Americas.

Global political, financial and non-governmental organizations have dedicating resources to achieving the needed changes, e.g. the IEA, IPEEC, World Bank Group, IDB, ClimateWorks and others. The Americas represent a diverse mix of developed and developing countries. IANAS is a unique organization that brings together the scientific academies and organizations of this mix of countries. The ingredients for change are here.

The Energy Program uses a sweeping definition for energy efficiency extending from energy sources to and including final end uses. Major, cost-based energy savings are available all along this energy chain from converting natural resources to usable forms of energy, supplying energy to end users, and in the buildings, industry and transportation end-use sectors.

The pervasive reach of energy efficiency measures makes it important to coordinate this effort with related priorities and programs, including the energy for unserved populations, renewable energy and bioenergy priorities of the Energy Program and the Water, Women for Science, Capacity Building and Education and Information Programs of IANAS.

[28] http://www.iadb.org/en/news/webstories/2011-08-03/colombia-brazil-investment-forum,9491.html

Box A

Primary Information Sources

IEA Scoreboard 2011. The International Energy Agency (IEA) is a comprehensive global source of energy information. While it focuses on the topics affecting its members, it does so within a global perspective that encompasses non-IEA countries. The subtitle of last year's IEA's Scoreboard is: *Implementing energy efficiency policy: Progress and challenges in IEA member countries.* The Scoreboard has 25 energy efficiency policy recommendations which have applications in the Americas and globally. See Box B.

Inter-American Development Bank. The IDB is rapidly increasing its funding of energy efficiency projects. It explains on its website: "Of all the untapped sources of clean energy in Latin America and the Caribbean, energy efficiency may offer the greatest impact at the lowest costs." The website is a rich source of information on energy projects, including new funding announcements. http://www.iadb.org/en/topics/energy/energy-efficiency

World Bank. The World Bank is a major source of information on energy efficiency, expanding in recent years with its increased funding and support for capacity building activities. The information is reached at http://www.worldbank.org/energy/ From there, you can select sites including energy strategy consulting, topics, portfolio, regions, publications, projects, toolkits and learning for additional information. The Energy Sector Management Assistance Program (ESMAP) is reachable at www.esmap.org

International Partnership for Energy Efficiency Cooperation. IPEEC is a high level international forum founded in 2009 by the Group of Eight leading industrialized nations (G8) to provide global leadership on energy efficiency. A voluntary forum of developed and developing countries, the member nations account for over 75 percent of energy use and GHG emissions. IPEEC promotes information exchange on best practices for improving energy efficiency. http://www.ipeec.org/

Energy and Climate Partnership of the Americas (ECPA). ECPA is a collaborative program of the U.S. DOE, the OAS, IDB, World Bank, and country partners. ECPA is guided by seven pillars: Energy efficiency, renewable energy, cleaner fossil fuels, infrastructure, energy poverty, sustainable forest and land use and adaptation to climate change. Information on its activities is available at http://www.ecpamericas.org

Box B

IEA 25 Energy Efficiency Policy Recommendations

Cross-sectoral

1. Energy-efficiency investments
2. National energy efficiency strategies and goals
3. Compliance, monitoring and enforcement
4. Energy efficiency indicators
5. Evaluating energy efficiency policy implementation

Buildings

6. Building codes or new buildings
7. Passive energy houses and zero energy buildings
8. Energy efficiency incentives for existing buildings
9 Building certification schemes
10. Energy efficiency improvements in glazed areas

Appliances and equipment

11. MEPs [minimum energy performance standards] and labels
12. Low-power modes, including standby power
13. Televisions and "set-top" boxes
14. Test standards and measurement protocols

Lighting

15. Phase-out of incandescent bulbs
16. Non-residential building lighting

Transport

17. Fuel-efficient tyres
18. Fuel economy, light-duty vehicles
19. Fuel economy, heavy-duty vehicles
20. Eco-driving

Industry

21. Industry indicators
22. MEPS for electric motors
23. Energy management
24. Energy efficiency for SMEs [small and medium-sized enterprises]

Electric utilities

25. Utility end-use energy efficiency schemes

Source: *IEA Scoreboard 2011, Implementing energy efficiency policy: Progress and challenges in IEA member countries.* OECD/IEA 2011. Paris, France. www.iea.org

Box C

Renewable Energy and Energy Efficiency Measures
Key Proposals and Areas for Actions

From Inter-American Bank and World Bank discussion paper
Second Meeting of the Finance Ministers of the Americas and the Caribbean
July 3, 2009
Viña del Mar, Chile

- Prioritize institutional capacity building to address energy efficiency and renewable energy in the context of climate change. (See Capacity Building section.)
- Increase investment in technology, research, development and demonstrations. (See Cross-cutting section.)
- Establish incentives for renewable energy deployment and fuel; switching, according to each countries energy matrix. (See Renewable Energy chapter.)
- Harmonize energy efficiency standards and labeling across the region for products and buildings, to facilitate quick adoption and increase user acceptance and awareness. (See Energy Efficiency section.) ;
- Establish energy efficiency targets across sectors, with a focus on transport and buildings. (See Energy Efficiency section.)
- Maximize opportunities for sustainable biofuels production including export or imports tariffs (i.e. eliminating export tax for biofuels production that meets key sustainability criteria). (See Renewable Energy chapter.)
- Increase education and awareness on climate change, energy efficiency and renewable energy to foster implementation and acceptance. (See Education and Information section.)
- Bundle climate mitigation projects throughout the region to access new financing mechanisms such as the Climate Investment Fund and programmatic Clean Development Mechanisms funding. (See Cross-cutting section.)

Box D

Energy and Climate Partnership of the Americas

At the 2009 Summit of the Americas, U.S. President Barack Obama invited countries in the Americas to join as partners in working for sustainable energy.

The ECPA Fact Sheet shows the following successes:

- Peace Corps renewable energy and climate change volunteers in 11 countries
- U.S. and Brazil with American. Planning Association cooperation to build a network of urban planners in the LAC. .
- DOE support for Chile's Renewable Energy Center and Costa Rica's Energy Efficiency Center
- Support for SIEPAC Central American power infrastructure from the Institute of the Americas in San Diego
- U.S. TDA Clean Energy Exchange program: six clean energy reverse missions.
- USDA sustainable biomass and renewable energy use with Guatemala, Honduras, Ecuador and Uruguay.
- DOE and OAS support for Low Carbon Communities of the Caribbean Program

The ECPA website lists the following commitments:

- Andean glacier monitoring and research center
- Geothermal energy cooperation program with Chile.
- Regional adaptation hub to strengthen the resilience of vulnerable sectors and populations of Central America
- Earth observation and monitoring to help Central America monitor weather, forest fires and ecological changes
- Reducing emissions from deforestation and forest degradation in tropical ecosystems.
- Sustainable Urban Development: energy efficiency housing in low-income urban areas.
- U.S.-Chile Energy Business Council

Source: http://ecpamericas.org/ Click on Energy and Climate Partnership of the Americas Fact Sheet.

Box E

ECPA Initiatives

Initiatives

1. Advanced Renewable Biomass Energy
2, 32. Alianza entre Gulf Power—A Southern company y el Centro de Estudios Estratégicos Latinoamericanos (CEELAT)
3. Central American Energy and Environmental Security Initiative (EESI)
4, 6. Centro de Energia Renovable de Chile
5, 15. Centro de Innovación Energética
7, 34. Closed Looped Cycle Production in Ecuador
8. Colombia Biomass Initiative
9, 30. Comunidades de las Américas con Baja Emisión de Carbono: Centro Costarricense de Capacitación sobre Eficiencia Energética
10, 31. Comunidades de las Américas con Baja Emisión de Carbono: Proyecto Eólico de Dominica
11, 29. Comunidades del Caribe con Baja Emisiónde Carbono (LCCC)
12. Course on Geothermal Exploration and Development
13, 24. ECPA Caribbean Initiative
14, 17. Energy Efficiency Working Group
16. Global Shale Gas Initiative: South America
18. Grupa de Trabajo sobre infraestructura Energética—Interconexión Eléctrica
19, 20. Grupo del Trabajo sobre Petróleo Pesado
21, 28. Illuminando las Américas
25, 38. Iniciativa de planificación urbana
27. Iniciativa sobre Energia Renovable y Cambil Climático del Cuerpo de Paz
35, 37. Programa de Expertos de la ECPA
39, 40. USTDA Clean Energy Exchange Program of the Americas

Information on the goals, overviews, activities, implementing partners for these initiatives are listed at the ECPA website: http://ecpamericas.org/initiatives/default.aspx

Note: On the ECPA website, many of the initiatives are listed separately in Spanish and English. Where this occurs, both numbers of the initiatives are noted.