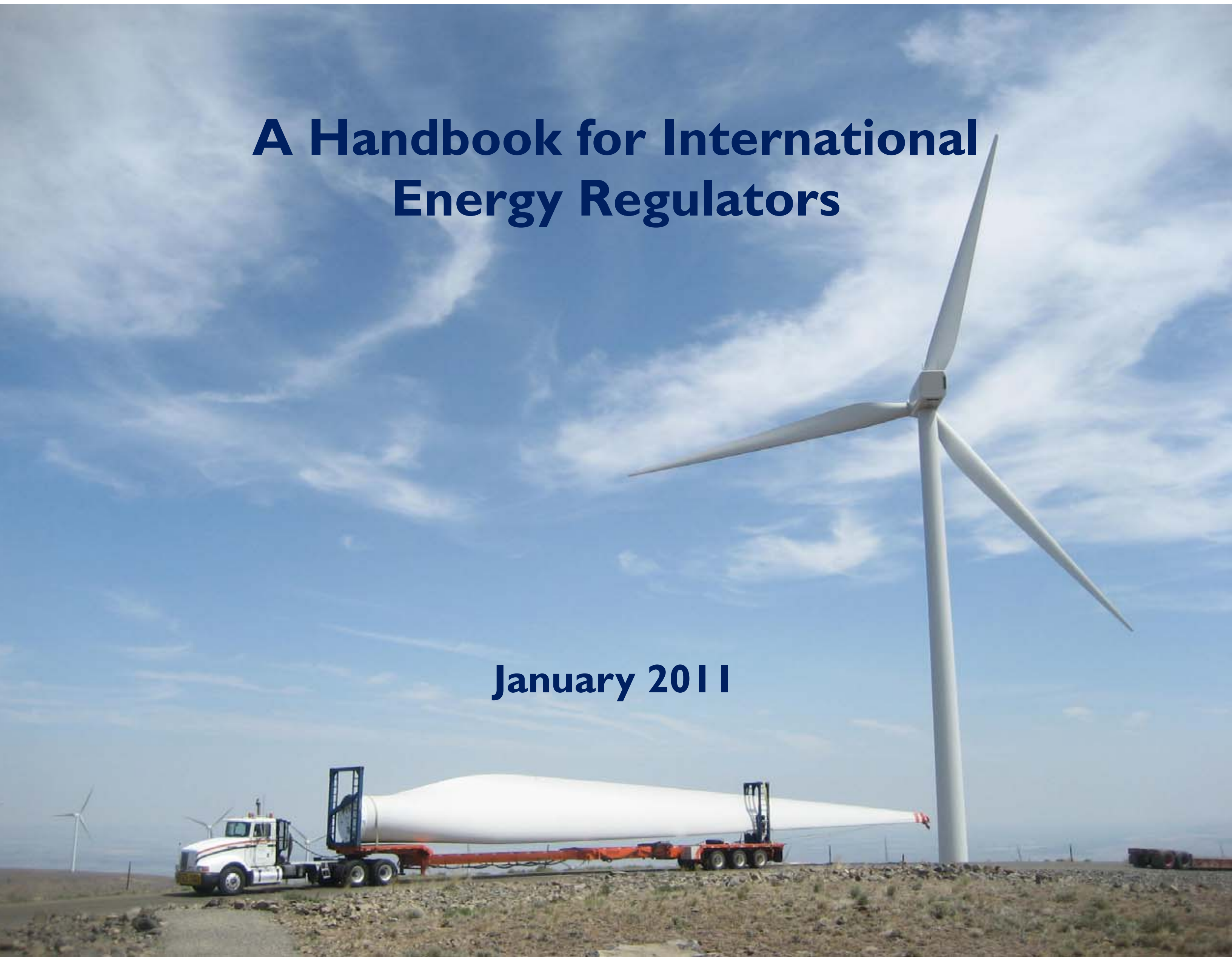
ENCOURAGING RENEWABLE ENERGY DEVELOPMENT:



A Handbook for International Energy Regulators

January 2011

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Table of Contents

Acknowledgments i

Acronyms iv

Executive Summary 1

Introduction 10

PART I: Common Issues in Renewable Energy Promotion 12

CHAPTER 1: Definitions and Rationale for Renewable Energy 12

CHAPTER 2: Understanding the Challenges to RE Expansion: Technology and Economics 19

NAMIBIA: Optimizing Domestic Resource Potential 25

CHAPTER 3: Overview of Considerations for Investors 31

CHAPTER 4: Policy and Regulatory Mechanisms in Support of Renewable Energy 35

THE PHILIPPINES: The Regulator Adopts the Country's First Feed-In Tariff Rules 47

CHAPTER 5: International Agreements, Regional Partnerships and National Plans 53

CHAPTER 6: The Regulatory Environment 60

EGYPT: Building the Foundation for Renewable Energy Investment 71

PART II: Specific Types of Renewable Energy and Case Studies 78

CHAPTER 7: Hydropower 78

ARMENIA: Regulatory Support for Small Hydropower Development 82

CHAPTER 8: Wind Power 87

JORDAN: Recent Steps to Bring Renewable Energy to Market 90

CHAPTER 9: SOLAR ENERGY 95

CHAPTER 10: BIOMASS 98

CHAPTER 11: GEOTHERMAL ENERGY 102

EL SALVADOR: GEOTHERMAL DEVELOPMENT 105

CHAPTER 12: DISTRIBUTED GENERATION 112

GUATEMALA: DISTRIBUTED GENERATION 118

CONCLUDING COMMENTS 127

BIBLIOGRAPHY 129

Acronyms

ACERCA – Asociación Coordinadora de Entidades Reguladoras de Energía Eléctrica de América Central

ACP – Alternative Compliance Payment

AFUR – African Forum for Utility Regulators

ARIAE – Asociación Iberoamericana de Entidades Reguladoras de Energía – Latin America and Spain

BOOT – build, own, operate and transfer

CAFTA – Central American Free Trade Agreement

CDM – Clean Development Mechanism

CIDA – Canadian International Development Agency

CNEE – Comisión Nacional de Energía Eléctrica

CSP – concentrating solar power

DANIDA – Danish International Development Agency

DFID – United Kingdom's Department for International Development

DG – distributed generation

DNA – Designated National Authority

DOE – Department of Energy

DRG – Distributed Renewable Generation

EAPIRF – East Asia and Pacific Infrastructure Regulatory Forum

ECB – Electricity Control Board

ECG – Electricity Cooperation of Ghana

EE – energy efficiency

EEHC – Egyptian Electricity Holding Company

EgyptEra – Egyptian Electrical Utility and Consumer Protection Regulatory Agency

ENTSO-E – European organization of transmission system operators

ERC – Electricity Regulatory Commission

ERRA – Energy Regulators Regional Association – Central, Eastern Europe and Eurasia

ESMAP – Energy Sector Management Assistance Program

EU – European Union

FIT-All – Feed-in Tariffs Allowance

FITs – feed-in tariffs

GDP – gross domestic product

GEDAP – Ghana Energy Development and Access Project

GEF – Global Environment Facility

GHG – greenhouse gas

GO – Guarantees of Origin

GPOBA – Global Partnership on Output-Based Aid

GPRS – Growth and Poverty Reduction Strategy

GREENfund – Ghana Renewable Energy Fund

INDE – National Electrification Institute (Guatemala)

IPPs – Independent Power Producers

JEA – Jordan Electricity Authority

lcoe – levelized cost of electricity

MEMR – Ministry of Energy and Mineral Resources (Jordan)

MME – Ministry of Mines and Energy

NAMAs – Nationally Appropriate Mitigation Actions

NAP – National Action Plan

NAREA – New and Renewable Energy Authority (Egypt)

NARUC – National Association of Regulatory Utility Commissioners

NED – Northern Electrification Department (Ghana)

NEPCO – National Electric Power Company (Jordan)

NGCP – National Grid Corporation of the Philippines

NGOs – non-governmental organizations

NPC – National Power Corporation

NREB – National Renewable Energy Board (Philippines)

NTGDR – Norma Técnica para la Conexión, Operación, Control y Comercialización de la Generación Distribuida Renovable

PEMC – Philippine Electricity Market Corporation

PPAs – power purchase agreements

PSALM – Power Sector Asset and Liabilities Management Corporation (Philippines)

PSRC – Armenian Public Services Regulatory Commission

PURPA – Public Utility Regulatory Policies Act of 1978

PV – Photovoltaic

RAO UES – Russia's Rossijskaja Avtonomnaja Energo Sistema

RE – renewable energy

RE Act – Renewable Energy Act of 2008 (Philippines)

RED – Directive on Renewable Energy

REEEI – Renewable Energy and Energy Efficiency Institute

REEEP – Renewable Energy and Energy Efficiency Partnership

REEEP-SA – South Africa's Renewable Energy and Energy Efficiency Partnership Regional Secretariat

RERA – Regional Electricity Regulators Association of Southern Africa

RESPRO – Renewable Energy Services Project

RETs – renewable energy technologies

RFP – Request for proposals

ROCs – Renewables Obligation Certificates

SAFIR – South Asia Forum for Infrastructure Regulation

SHPP – small hydropower plants

SIGET – Superintendencia General de Electricidad y Telecomunicaciones

TAPCO – Takoradi Power Company (Ghana)

Tcf – trillion cubic feet

TICO – Takoradi International Company

Transco – National Transmission Company (Philippines)

TSO – transmission system operator

TWh – terawatt-hour

UK – United Kingdom

UNDP – United Nations Development Programme

UNFCCC – United Nations Framework Convention on Climate Change

US – United States

USAID – United States Agency for International Development

VAT – Value Added Tax

VRA – Volta River Authority (Ghana)

WESM – Wholesale Electricity Spot Market

Wp – Peak Watts

EXECUTIVE SUMMARY

Regulators and policymakers in the energy sector face new and exciting challenges presented by renewable energy (RE). While not new to the energy mix, renewable energy's importance as part of the overall national and international energy supply is a relatively new phenomenon. Countries, their governments, regulators and populations are only just adjusting to this recent change in the energy world. This Handbook seeks to help international regulators as they navigate through it.

RE is gaining ground because it offers the possibility to address energy needs in a sustainable manner. Governments, the public, and local and international organizations are increasingly recognizing the individual, social and environmental harm that conventional energy sources cause as a result of greenhouse gas emissions. Renewable energy offers the promise of continued energy supply without comparable harm.

A Focus on Regulation

This Handbook places RE in the regulatory context – something that is rarely done. Most often, the focus is on technologies, usually new and advanced ones that offer promise but still require realization, and/or on the economic viability of renewable energy. Identifying what the regulator can do to advance RE efforts can be itself a challenging task. Partly, this is because the RE field is changing rapidly and the break-even point for RE cost is often a moving target and difficult to predict accurately. It is also because RE has associated political and social issues relating to jobs, affordability and access/availability for vulnerable customers and rural populations not present in the conventional energy field. Understanding how to integrate conventional and renewable regulatory approaches is not straightforward.

Certainly renewable energy offers the promise of supplying existing and expanding demand in a clean and sustainable manner, but it can do so only if it is reliably supplied at affordable rates. Quality of supply and price regulation are threshold issues that drive the success of RE. These are also key issues with respect to any energy source; indeed, they are at the center of what regulation is about. But the issues presented by regulation of RE also differ from issues presented by traditional energy regulation (where the mix is mostly from fossil fuels) in numerous ways, some political, operational and technical, such as the following:

- Technologies are relatively new, at least in terms of bringing commercial success, requiring experimentation, research and development, and resulting in lack of certainty and higher cost for many types of RE

- Most RE comes from variable resources, requiring that operational and technical issues are addressed to ensure continuity of supply and grid security

- Offering the promise of reduced pollutants, RE is highly valued by governments seeking to address harms resulting from emissions (including biodiversity, human health, air quality), meaning that it increasingly has become a priority of governments and many stakeholders for reasons that are unrelated to energy per se

- The value of use of RE resources comes from a longer-term perspective that considers external costs not typically included in traditional and market-driven generation cost-benefit analyses

- Harnessing domestic natural resources, RE offers an economic boost in a new industry, making it attractive for financial reasons that are distinct from the actual cost of the product, such as local job creation and development of local technological industries and expertise

- Additional domestic production means enhanced security of supply to countries that have previously depended on imports, implicating geopolitical concerns

In sum, any look at the regulation of RE must focus not only on traditional regulatory issues such as price and quality regulation, but also at the larger context in which RE is being developed and promoted.

To this aim, the Handbook addresses:

- The policy, strategy and legislative tools used to promote RE, which regulators need in order to understand and implement and/or design

- Support schemes or incentives that support RE, what they are and the advantages and disadvantages of each

- Physical and structural advantages and limitations to renewable energy development, including the availability of infrastructure and natural resources in a particular country

Best Practices Combined with Regulatory Experience

This Handbook is based on a review of best practices and consultation with energy regulators around the world. It focuses on countries for which RE development on a large scale is a relatively new priority, and applies best practices to the context of growth and expansion, taking lessons from countries (mostly in Western Europe and North America) where renewable energy frameworks have undergone years of reform. While the Handbook cannot offer a detailed description as to how each regulatory decision regarding RE is made, it seeks to give an understanding of what those decisions are, the context in which they are chosen and implemented, and the various manifestations and consequences of the choices made.

The Handbook also offers case studies of renewable energy projects that implicated regulatory and policy issues, and case studies of regulatory framework development in countries that have prioritized RE investment and implementation. Different types of RE raise different regulatory issues; this Handbook identifies and describes these differences while noting the common principles that underlie regulatory development in the RE field.

This is a Handbook for regulators by regulators. Directed by the National Association of Regulatory Utility Commissioners (NARUC) and supported by the United States Agency for International Development (USAID), it includes contributions from regulators in Africa, Central America, Eurasia, Asia and the Middle East. Prepared to assist energy regulators in implementing renewable energy policies and facilitating the successful development of renewable energy projects, it draws upon NARUC's relationships with AFUR (African Forum for Utility Regulators), RERA (Regional Electricity Regulators Association of Southern Africa), ACERCA (Regional Association of Central American Energy Regulators), EAPIRF (East Asia and Pacific Infrastructure Regulatory Forum), SAFIR (South Asia Forum for Infrastructure Regulation), ARIAE (Asociación Iberoamericana de Entidades Reguladoras de Energía – Latin America and Spain), and ERRA (Energy Regulators Regional Association – Central, Eastern Europe and Eurasia, with recent additional members from the Middle East), among others. Follow-up work on implementation is a core expectation of this project, with ongoing consultation and information exchange.

The Priority of Sustainability

Sustainable energy means use of resources in a manner that provides ongoing energy to meet the needs of the current population, without compromising conditions for future generations. To achieve this balance, energy must be replenished, environmental harms must be minimized, and costs must be affordable. RE is energy derived from relatively replenishable resources, including solar, wind, hydropower, wave and tidal, biomass and geothermal. Because the political and regulatory focus is on sustainability and not on these resources per se, the way they are harnessed requires thoughtful analysis to ensure that an RE investment is in fact meeting the sustainability objective. This determination is normally not a responsibility of the regulator, but the regulator does require an understanding of why and how this matters in order to address the changing investment landscape, as well as to implement governmental choices in a way that promotes this overarching sustainability objective.

Renewable energy offers numerous benefits in the short-, medium- and long-term: security of supply, sustainable local industry and job growth and environmental sustainability, notwithstanding some drawbacks including potentially higher energy prices and the threat to incumbent industries that produce conventional energy derived from fossil fuels. Existing fossil fuel based energy systems can have many negative effects on health and the environment as a consequence of emissions from greenhouse gases, including carbon dioxide, that are released from the burning of fossil fuels. The world's population continues to grow at a rapid pace, bringing marked increases in world energy demand, despite improvements in energy efficiency and clean energy technologies such as carbon capture and sequestration.

Regulators across the world are being increasingly drawn into aspects of RE development, and they need to know how to address the added pressure that comes with this responsibility. RE means more than just new or varied energy sources; it also means a path forward that offers the potential to improve the quality of our lives and the lives of our children.

Variation in Models of Authority

Unprecedented growth brings growing pains, and one question raised by the increasing importance of RE is its impact on the role of the energy regulator. Models for how to transpose renewable energy strategy into legislation or regulation vary across jurisdictions, and fall on a continuum between significant regulatory authority for adoption and implementation, to minimal or no authority for the same. Variation in incentives to promote RE is matched by the variation in choices by nations and states as to the type of renewable energy to promote, and the regulatory template in which those choices are made.

In some countries, governments handle all regulatory issues and no independent regulatory body exists in the energy sector at all; in these cases, governments may address all energy issues together or address RE and conventional energy separately. The same can be true when independent energy regulators do exist – some regulators have authority in the RE field; others do not. Frequently, the entity in charge of regulation (whether independent or a government department/Ministry) has some but limited authority in the RE sector, making regulatory structure and accompanying authority for renewable energy generally fall somewhere along the continuum of:

No formal authority, though expertise and knowledge of the sector mean that the regulator can prove invaluable as an advisor and facilitator

Limited formal authority, with partial ability to implement government policies and some areas of responsibility, e.g., issuing licenses or implementing tariff levels

Strong formal authority to implement government policies in support of renewable energy, including passing tariff methodologies and determining the duration of any mandatory purchase agreements

Despite this variation of the scope of regulatory authority, some principles are common with respect to regulation of RE:

- Coordination is essential. The interface between governmental and regulatory bodies is always important in the energy context, but particularly acute when the focus is RE. Environmental agencies, non-governmental organizations (NGOs) and environmental standards (relating to, for instance, air pollution, water use and zoning); international agreements and commitments; tendering and procurement agencies and rules; loan guarantee and financial regulations; and national policies and strategies all impact the implementing framework for RE. Knowing what other agencies are doing and understanding the priorities set by governments in international forums are just a few essential coordination issues. The regulator will need to know the implication of such priorities, rules and activities on efforts to bring RE to market. Given how quickly the RE landscape is changing, this is not an easy task.

- There is an acute need to select and commit to one coherent support scheme. Many different incentive structures are used to promote RE around the world. These include: feed-in tariffs (FITs); quota and certificates; grants; tax and fiscal incentives; and tendering. They differ in significant ways and it is up to each country to decide what model best fits its situation and the goals it has identified in pursuing the promotion of RE. The difficulty is that the decision must be coherent and designed for the individual circumstances. Regulations must be developed in support of the scheme selected, requiring cohesion of decision-making. Lack of certainty as to the applicable scheme or the failure to make a choice and commit to that choice will impair the success of RE. For growth to take place, selection and certainty are required.

- Any framework selected must have built-in provisions to allow for flexibility in the event of significant market changes or unintended consequences of incentive schemes. To ensure effectiveness for the long term and that the best interests of the implementing country are met, some possibility for change is required, as evidenced by experiences in Spain and France (early leaders in feed-in tariff schemes). At the same time, any such change should be circumscribed within defined parameters that include mechanisms to measure progress toward RE goals, to allow for maximum predictability and minimal investment risk.

- The price of RE is important. If it costs too much and fossil fuel based energy costs less, RE development will stall. Consideration of the price and how this price is integrated into the overall energy mix is an important part of the regulatory equation.

- The return on investment matters. Investors need to know that they will receive a reasonable return on the resources that they devote to an RE project, including their capital. It will not be possible to attract new investment without a tariff regime that offers reliable return over a time period sufficient to cover the investment.

- The energy field contains many interest groups and the push-pull of these interests may affect regulation of RE. For example, traditional economic pricing that fails to account for external costs (such as costs to clean up air pollution and address environmental degradation) may compromise RE development; economic pricing of conventional energy and RE may need some rethinking and are interlinked.

- Rural and vulnerable populations can benefit from RE, particularly in the form of distributed generation, mini grids and small production sites, though affordability and access remain the touchstones for these groups.
- Guiding regulatory principles of transparency, clarity and predictability apply to RE no less than to other energy sources.

From Stepping Stones to Project Implementation

The countries targeted by this Handbook (and indeed the majority outside of Western Europe and North America) are at the early stages of developing their regulatory frameworks for RE. Because the concrete, practical experiences of one country may offer important lessons for another, this Handbook offers case studies each with different examples and in varied stages of RE development. A geothermal binary cycle plant in El Salvador and a distributed generation small hydropower plant in Guatemala are already operational. In Armenia and Jordan, respective hydropower and wind projects have made strides but are not yet online and face challenges ahead. In the Philippines, a feed-in tariff framework has been adopted. In Namibia, a renewable energy program is being implemented, offering the groundwork required for future successful project implementation. In Egypt, the regulator has made adjustments to regulatory framework and worked with other government agencies to encourage use of RE potential. Each case study offers valuable evidence of the strength of RE development, the challenges such development faces, and the need for strong regulatory support to advance RE in a positive – and sustainable – manner. Below is a sample of some of the case studies profiled:

Armenia

This case study profiles efforts to bring a small hydropower investment project to Armenia. The project, led by a Netherlands-based project developer, has proceeded through siting identification, completion of due diligence in 2009, and the securing of partial funding, with the project developer seeking additional funding sources. Efforts to attract additional funding have found support in the country's energy regulatory framework. Amendments to the energy law in 2001, a new energy strategy that promotes RE adopted in 2004, and enactment of a feed-in tariff in 2009 have created a climate for RE investment. With one of the longest standing regulators in the region, Armenia benefits from relative stability and predictability in its regulatory structure, including a record of tariff setting and tariff decision-making, and openness to the public. Because of this record, the project developer has been able to identify and discuss with the regulator various issues that concern potential investors, including a mismatch between expected market opening and actual market opening, and the content of the rules to implement that opening. The project developers have met with the regulator to explain that investors require long term certainty in their contracts. The regulator has been responsive in providing explanations and written letters setting forth the process and the general expectation that the existing structure will be renewed without complication.

El Salvador

In 2007, a public-private company (with domestic and foreign investment) began operation of a 9.2 MW geothermal binary plant in El Salvador. The project was realized after Superintendencia General de Electricidad y Telecomunicaciones (SIGET), the regulator, granted a concession for the field on which the plant is located. Since that time, the regulator has supervised construction and expansion, including construction of five production wells and four injection wells, and four operational units. The project benefited from reforms in the sector, particularly from 2003-2009, directed at improving the wholesale market to enable new entrants. In particular, SIGET has approved new cost-based transmission system operation and wholesale market regulations. The foreign investors have also have been able to capitalize on the Clean Development Mechanism (CDM) opportunities offered by the Kyoto Protocol, having registered a sister geothermal project under the CDM in 2006.

Egypt

The regulator, EgyptEra, has played a vital role over the last several years in readying the framework and sector for broad integration of renewable energy, even before passage of renewable energy primary legislation, which is making its way, slowly, to adoption. The regulator's leadership in ensuring that capacity is built within its staff and in the sector generally, and its focus on the secondary regulations that will be required for successful implication are worthy of careful review, offering valuable lessons for how to effect change in the face of political or parliamentary delays.

Guatemala

The case study on Guatemala profiles the legislative and regulatory reforms that helped bring distributed generation to Guatemala. The Kaplan Chapina project covers small hydropower using distributed generation rather than the central grid to reach rural communities. The project became operational thanks to Guatemala's relatively recently adopted regulatory policies, designed to facilitate development of renewable power plants and distributed generation. These policies enabled the power plant to connect directly to the distribution network, improved quality of electricity services, and offered tax credits to companies that invest in renewable energy projects for a 15-year period.

Jordan

The Jordan case study reviews a wind project that was tendered and awarded to Greek investors in 2009. More recently, however, the director of the renewables department of the Ministry of Energy and Mineral Resources has indicated that the government is reconsidering the project. The reasons given for reconsideration are noise levels and problems over land regulations, but the project faced obstacles when negotiations between the government and the Greek-Jordanian consortium awarded the contract broke down in 2009 over the amount of the tariff. Jordan's experience with this project and its attempts to encourage the growth of domestic renewable energy and wind in particular provide valuable lessons as to the framework needed for wind power development and potential obstacles along the way.

Namibia

The case study of Namibia looks at the 2005 Namibia Renewable Energy Programme (NAMREP) and efforts to select and implement support incentives, with considerable analysis of the impact of feed-in tariffs. The NAMREP was designed to increase affordability and access to RE services and accelerate market development for renewable energy by reducing institutional, information, human capacity, financial, technical, awareness and other market barriers. The main focus of NAMREP was on solar photovoltaic technology for lighting and water pumping, solar thermal for water heating and to a limited extent, efficient domestic use of biomass. This program has benefited from the power of the regulator over evaluating and monitoring performance of its licensees, and jurisdiction extending beyond conventional electricity.

The Philippines

The case study of the Philippines details the path to regulatory reform in the RE sector, leading to the adoption of a comprehensive renewable energy law in 2008 and a feed-in tariff flowing from that law. The law includes mandatory purchasing of power from renewable energy; preferential feed-in tariffs, and a "green energy option" that allows consumers to choose renewable sources and various incentives. Under the law, the government (the Department of Energy) promulgates rules regarding the mandatory purchase of renewable energy, awards RE service contracts, formulates the National RE Plan, and registers RE participants. Pursuant to its mandate under the 2008 RE law, a primary responsibility for the regulator is establishing feed-in tariffs for wind, solar, ocean, run-of-river hydropower and biomass resources. The regulator posted its draft rules for comment in March 2010. Accompanying the draft rules is a detailed conceptual framework describing the economic principles applied in establishing cost-effective RE tariffs.

While these experiences are varied and the particular challenges faced differ from project to project, some themes and lessons can be drawn. First and foremost, RE development must be tackled from a broad base. Because the technology is new and the cost-benefit analysis untraditional, a multi-faceted approach by a country is needed to reduce investor risk and increase the attractiveness of RE investments. The regulator's role in this effort includes contributing its knowledge when the government is making policy decisions, and implementing those decisions in a transparent and predictable way that minimizes transaction costs.

Recommendations

Our future and RE expansion are linked. As the RE sector continues to experience rapid growth and change, regulators need to have the tools to facilitate advancements that can be successfully integrated with the existing market, energy needs, operational integrity and affordability. The following recommendations are priorities to realize this objective:

- Identify any international commitments in which the government has entered, and review the targets, priorities and strategies that may be part of such commitments. Review energy policies or national programs for the same. This process will assist regulators in understanding what steps governments are likely to take in support of the different paths for RE development, and also to understand any constraints.

- Review legal and administrative processes in other sectors that may impact RE advancements, including environmental siting and permitting restrictions, environmental standards, and investment and procurement rules.

- Work closely with other regulators from other countries, particularly those in the region and who work in similar resource, economic and supply conditions, to build knowledge, ideas and strategies to effect change.

- Develop, implement and provide expert advice on incentive schemes for RE (with the scope dependent on legal authority), with a view to sector-wide conditions and needs, and not in isolation.

- Establish mechanisms, formal or informal, for coordinating activity with other governmental bodies with responsibilities in the field, and promote methods for "one-stop shopping" by interested RE investors. Ensure operational transparency, predictability and clarity of regulatory processes. The temptation to provide support for one project is significant when targets are international and national priorities. Sector stability requires transparent and non-discriminatory policies that offer oversight and monitoring, informed by economic and social priorities along with sector and economic analysis, but not favoring individual projects in an unpredictable or subjective manner.

The important work of regulators in the RE sphere requires dedicated attention and support; the Handbook is one step toward ongoing international collaboration between regulators to effect renewable energy development. The Executive Summary and Handbook are available on NARUC's website, www.naruc.org.

INTRODUCTION

This Handbook has been prepared for use by USAID and NARUC to assist energy regulators in implementing renewable energy policies and facilitating the successful development of renewable energy projects. "Regulator" here refers broadly to the administrative or official body that regulates the energy sector; it may be an independent entity, consistent with best practices, or an arm of a ministerial body. The objective of this Handbook is to outline the different considerations surrounding regulation of renewable energy development and production, with a focus on:

- Policy, including individual government energy strategies and implementation plans, as well as legislation
- Support schemes or incentives to support renewable energy, such as feed-in tariffs
- Physical and structural advantages and limitations to renewable energy development, looking in particular at availability of infrastructure and natural resources

Part I, consisting of Chapters 1-6, discusses issues common to the promotion of all types of renewable energy, including the definition and types of RE, common challenges in development and promotion, common methods of promoting RE, and the role regulators play in this promotion.

Part II, Chapters 7-11, focuses on specific types of renewable energy (hydro, wind, solar, biomass, geothermal and distributed generation), and includes project case studies. Intended for regulators everywhere, the emphasis is on countries beyond the borders of North America and the European Union, with a look at lessons that can be learned from all parts of the world.

Historically, regulatory instruments have been the basic mechanism for enacting environmental policy throughout the industrialized world. Environmental quality has been seen as a public good that the State must secure by preventing private agents from damaging it. Direct regulation involves the imposition of standards (or even bans) regarding emissions and discharges, and/or product or process characteristics, enforced through licensing and monitoring. Legislation is usually the foundation for this form of control, and compliance is generally mandatory with sanctions for failing to meet requirements. In the RE field, regulators may also serve to encourage non-mandatory steps to promote RE by using their unique knowledge and understanding of the energy sector.

Regulators come from environments with differing economic, political, geographic, infrastructure and resource conditions that affect how renewable energy growth is addressed. They also come from different regulatory environments. NARUC's relationships with regulatory agencies extend from North America to Europe, Central and South America, Africa and Asia. The combination of breadth of geographic distribution and the rapid pace at which the renewable energy field is growing and changing means that best practice and general principles may be defined, but details of implementation lie with individual countries and their regulators to determine the optimal fit for the environment.

In some jurisdictions, regulators have clear authority to set tariffs and issue licenses for renewable energy; others do not. Indeed, in many jurisdictions, some issues having to do with renewable energy are addressed by bodies other than the energy regulator. Increasingly, however, regulators are being asked to take on some regulatory tasks related to renewable energy, or are finding that they need information regarding regulatory practices in the areas of renewable energy because investors or other stakeholders come to them for guidance, even when authority is not clearly given to them by law. Because renewable energy promotion is a relatively new priority for many countries around the world, and certainly for countries outside the United States (US) and the European Union (EU), the relationship between the energy regulator and the various steps, including support schemes, incentives and national targets, that countries take to promote renewable energy, is itself evolving. For these reasons:

- Regulators may be directly charged with supporting new RE initiatives, or this duty may belong to other agencies. Given the regulatory mandate for oversight of the energy sector, irrespective of whether regulators have direct authority, they need to understand the complexities presented by the RE and energy efficiency (EE) efforts in their jurisdictions and beyond.
- Regardless of whether a regulatory body is expressly charged with implementation of RE programs, effective energy regulation today requires an understanding of RE-specific issues and how they impact on traditional regulatory tasks, including licensing and tariff calculations.
- Successful deployment of renewable energy sources involves expertise across multiple disciplines and, therefore, inter-agency and regional coordination and cooperation.

In recognition of the widely disparate conditions under which national regulators operate, the structure of this Handbook is designed to be a flexible, interactive document that addresses regulators' needs as their authorities and responsibilities develop.

PART I: COMMON ISSUES IN RENEWABLE ENERGY PROMOTION

"Energy is a basic human need. Without energy, everything would come to a standstill. A necessary factor in fostering human development and economic growth is a secure, affordable, reliable, clean, and sustainable energy supply. Today we face monumental challenges: global warming, the waning of natural resources, explosions in population growth, increasing energy demand, rising energy prices, and unequal distribution of energy sources. All of these factors contribute to the urgent need to transform the energy sector – which primarily relies on fossil fuels – to one that uses renewable energies and energy efficient measures.

Renewable energy is one of the key solutions to the current challenges facing the world's energy future. Many countries already foster the production and use of renewable energy through different approaches on a political and economic level because they recognize the many benefits renewable energy provides. The current use of renewable energy, however, is still limited in spite of its vast potential. The obstacles are manifold and include: lengthy permitting procedures, import tariffs and technical barriers, insecure financing of renewable energy projects, and insufficient awareness of the opportunities for renewable energy."

– International Renewable Energy Agency (IRENA), Mission Statement[1]

CHAPTER 1: DEFINITIONS AND RATIONALE FOR RENEWABLE ENERGY

Renewable energy (RE) refers to energy generated from natural resources at sustainable levels and may come from non-fossil energy sources (solar, wind, hydropower, wave and tidal power, biomass and geothermal).[2] With the exception of geothermal, all the resources understood as renewable energy in this document are powered by the sun and the moon and are replenishable for the life of the sun and the moon. Solar energy is derived from the sun; wind energy from air movements that result from low and high atmospheric pressure of hot and cold temperatures produced by the sun; hydropower derives from water movement, also caused by wind and temperature shifts; wave power comes from wind and temperature shifts over water; tidal power derives from the gravitational pull and wind; and biomass from organic matter that grows as a result of interacting factors of sun, wind and water. Geothermal energy is the result of the embodied energy of the Earth's interior and with current technology is believed to be relatively inexhaustible overall (though specific sites may be utilized to capacity). The ability to replenish means that the use is largely sustainable over the short and medium term; the goal is for long-term sustainability but it is understood that use may have some long term impacts that are not fully understood at present.

The interest in renewable energy resources is derived from their sustainability.

Sustainability has two interrelated aspects:

- To use the resources with minimal negative impact on the environment
- To develop resources in an appropriate and cost-effective manner that is able to carry on for the long term

The application of sustainability is individual to the surroundings. Due to relative economic cost, resources that are appropriate for use in one country may not be appropriate for another. For instance, a country with limited economic development may have different priorities to one that has an economy that is rapidly emerging on an international scale. Sustainability means the projects should endure and provide economic benefit over time.

Fossil-based energy sources, using oil, natural gas and coal, are generally not deemed sustainable because they typically are depleted at a relatively quick rate, and any replacement by natural processes is slow. In addition, fossil fuels contain high percentages of carbon and other greenhouse gases so that their burning produces carbon dioxide, a greenhouse gas that contributes to climate change, and other dangerous emissions. So too, nuclear energy, although it does not generate harmful emissions at the rate of fossil fuels, is not deemed to constitute renewable energy because the uranium used in the energy producing process is ultimately not replenished, making the use unsustainable in the medium and long term.

Certainly, the definition of renewable energy is sometimes itself contentious, with concerns regarding long-terms sustainability or emission levels/CO_2 neutrality over a life cycle. These issues are discussed later in the Handbook (such as for instance with regard to the use of biomass), though the Handbook offers the general caution that technologies and ways to assess environmental impacts are constantly evolving in the RE field, so that full life-cycle impacts are not fully known at present. Care and caution for the environment should be guiding principles as RE projects are explored, encouraged and brought to market.

For this Handbook, we concentrate on renewable energy sources that produce electricity.

Types of Renewable Energy

Solar energy is energy from the sun used to generate electricity and to heat water. Broadly speaking, solar energy is converted into three types of energy: solar thermal, solar photovoltaic and concentrated solar. Solar thermal energy refers to solar energy converted to heat; generally aimed at household populations, it can take the form of solar space, water and pool heating and solar thermal cooling. Concentrated solar power is a type of solar thermal energy used to generate electricity. Most often aimed at large-scale energy production, concentrated solar power technologies use lenses or mirrors to reflect and concentrate sunlight onto receivers (a small beam); the concentrated heat is then converted to thermal energy, which in turn produces electricity via a steam turbine or heat engine driving a generator. Photovoltaic (PV) solar power is electricity generated from the use of photovoltaic cells. PV modules can offer electricity in areas where it is not cost effective to use the conventional grid, or where electricity grids are rudimentary.

Wind power is generated from wind turbines. The turbines must be positioned in strategic locations so as to maximize wind potential; low or intermittent output is a challenge, as are objections to noise and visual effects. Large wind farms may be connected to the electricity power transmission network; smaller turbines are connected through the distribution grid.

Hydroelectric power (also referred to as "hydropower") is energy derived from the flow of water (from the hydrological climate cycle, powered by the sun), which is used to turn turbines that produce electricity. Hydroelectric plants range in capacity from a few hundred watts to more than 10,000 megawatts. The most important characteristics are the effective head of the water (the height through which the water falls); the capacity (power output); the type of turbine used; and the location and type of dam or reservoir. Most commonly, electricity is generated by use of *dams* or *run-of-river*. Run-of-river plants are common to small hydropower and are often seen as the most sustainable form of hydropower. Large scale hydropower projects, which have increased over the last couple of decades despite high up-front construction costs, have the advantage of high capacity and storage potential through accompanying reservoirs, but also raise some environmental concerns, including displacement of persons, change to biodiversity and geological damage. Hydropower is affected by droughts, though reservoirs can be used strategically to secure supply over dry periods.

Related types of renewable energy from water, tidal and wave energy are newer and not yet widely deployed but offer significant potential. Tidal energy is the result of the interaction of the gravitational pull of the moon and the sun on estuaries, rivers and seas. Though used for some time (small tidal mills on rivers were used in England and France in the Middle Ages) and a medium-sized (200+ megawatt) tidal power project is now running in France, harnessing of tidal power on a large scale remains limited, mostly because technologies are not fully developed and tested on the same scale as other RE technologies, such as wind and hydropower. Tidal power offers promise in terms of reliability and efficiency, though concern over the impact on sea and coastal life remains. Wave energy generates power from ocean surface waves and is at the beginning stages of commercial development, having begun in the 1970s.

Biomass is matter from plants or living organisms that can be converted to electricity (and heat). There are five general categories: wood (including forest residue); agricultural residues (waste from harvesting and processing); food waste (from drink and food manufacturing); industrial waste (from industrial processes); and energy crops (sugar cane and maize, for example, and these are largely used for liquid fuels). While advantageous in terms of common availability and use of waste or other natural residue, transport costs can be considerable and carbon dioxide emissions can be high per unit of energy when compared to most technologies, raising considerable debate regarding the sustainability of biomass for electricity. Material that has an alternative market, such as good quality timber for furniture or housing, is likely to prove uneconomic for energy, though use of waste products is appealing from a sustainability point of view as long as concerns regarding CO_2 neutrality are taken into account. Co-firing biomass with coal is sometimes used to increase efficiency and lower costs, though co-firing raises combustion-related concerns such as fly ash.

Geothermal energy is extracted from heat stored in the earth, most commonly by drilling holes into the earth's crust, pumping in cold water and using the resulting steam to run an electric generator. It is normally clean, relatively cheap to produce (once survey and extraction are complete) and most importantly is not variable, so available on a predictable basis. Worldwide, geothermal capacity has grown at a healthy rate since the 1970s, with accompanying improvements in drilling, exploration and conversion technologies, though implementation is still limited and considerably more work is needed before geothermal becomes economic on a wide scale.

THE REASONS FOR PROMOTING RENEWABLE ENERGY

Renewable energy offers numerous benefits in the short, medium and long term. Existing fossil fuel-based energy systems can have many negative effects on health and the environment, as a consequence of emissions from greenhouses gases, including carbon dioxide, that are released from the burning of fossil fuels. World population growth will bring increases in world energy demand, notwithstanding improvements in EE and clean energy technologies. Renewable energy offers the promise of supplying existing and expanding demand in a clean and sustainable manner.[3]

To make sense of regulation in the renewable energy context, it is important to understand the underpinnings of RE promotion and the regulatory concerns that are implicated as part of the promotional efforts.

Security of Supply

This century has seen not only rising demand, but also rising energy prices. Globally, while prices have risen, they have also fluctuated, bringing unpredictability. At the same time, relying on imports brings the risk that the supply source will decrease, and any such decrease will be out of the control of the importing country. As worldwide demand rises, concerns have increased that fuel supply is peaking or has peaked, and despite some discoveries of new supply sources such as oil in Brazil, it is apparent that reliance on foreign supply places governments at increasing risk of securing domestic supply, from a cost and resource perspective. Geopolitics also plays a role in security of energy supplies, with current energy systems placing an over-reliance on supplies (gas and oil in particular) from Russia, Iran, Turkmenistan, Nigeria, Venezuela and other areas with generous energy supplies but instability of national governments and international policies. As a consequence, and combined with increases in demand, the last decade has seen energy security play a larger role in policy formation and implementation than before.

For countries with limited indigenous conventional energy supplies (e.g., natural gas, coal and crude oil), sustainable development and energy security are closely linked. The goals of meeting rapidly growing energy demands, minimizing reliance on other nations, and reducing environmental effects have spurred the formation of new international energy initiatives and have promoted the research, development and investment in cleaner technological energy consumption and production practices. The development of indigenous RE sources could stabilize real and perceived national energy insecurities while bringing additional sustainability to ways in which energy needs are met.

Sustainable Economic Growth

Renewable energy can offer sustainable economic growth, particularly on a national level, by harnessing local resources and creating new industries, expertise and jobs. Renewable energy development offers opportunities for new business formation and new technologies, particularly for smaller, start-up businesses. Large businesses will benefit too as they often buy up or invest in new technologies as part of long term business plans, and as the economy overall grows, will reap benefits from increased domestic wealth, as recently highlighted by the UN Secretary General:

"Growth need not suffer and, in fact, may accelerate. Research by the University of California at Berkeley indicates that the United States could create 300,000 jobs if 20% of electricity needs were met by renewables. A leading Munich consulting firm predicts that more people will be employed in Germany's enviro-technology industry than in the auto industry by the end of the next decade. The U.N. Environment Program estimates that global investment in zero-greenhouse energy will reach $1.9 trillion by 2020 – seed money for a wholesale reconfiguration of global industry."

– By Ban Ki-moon, Secretary General, United Nations[4]

Environmental Sustainability

In its optimal meaning, a sustainable energy source is one that is not used up over time, does not emit pollutants that cause damage to the environment, and can be harnessed in a manner that does not displace (or cause harm to) ecosystems or populations. Increasingly, this is the benchmark for international best practice in the area of RE development, though implementation is challenging.

As fossil fuel supplies diminish and environmental costs from greenhouse gas emissions rise, environmental sustainability is a key concern of experts. This is particularly true in emerging and developed economies where energy use is high and getting higher, though concerns about potential cost increases wrought by RE pervade efforts to bring them to market. In rural, less developed economies, the question is how to secure economic growth at a reasonable price while reaping minimal environmental costs. Here, short term and long term interests can come into some conflict, as short term development may be facilitated by use of energy technologies that are not sustainable. This conflict is at the core of much international focus on needed assistance to developing countries (discussed further in Chapter 2).

Health Care

Greenhouse gas emissions from fossil fuels contribute to poor air quality, a problem that particularly plagues urban centers in both industrialized and emerging markets where energy use is increasing rapidly and environmental controls are less institutionalized. Lower emissions often means less air pollution and better ambient air quality, and hence better health for the local and regional populace. In addition, RE frequently also means rural electrification through distributed generation. Rural electrification means access to better communication, health care, economic development, and quality of life. This can include providing alternative electricity and heat sources for rural populations, such as offering new sources for women who previously depended on open fires to cook, which has been found to damage overall health.

Energy Access for Vulnerable, Minority, Rural and Disadvantaged Populations

Energy development and access to electricity for rural and disadvantaged populations impact important social issues such as poverty, social equity, women's health and opportunities, economic development and urbanization. For many women and minority populations, lack of access to electricity in particular means less opportunity to work and greater efforts to meet basic life necessities. Women tend to have more responsibility for household tasks than men, and therefore can benefit disproportionately from access to energy. A majority of less economically advantaged groups benefit from greater domestic energy production, which brings jobs and opportunities, though some concerns regarding potential social costs such as displacement or land capture must be managed effectively to ensure that maximum potential benefit is realized.

Distributed generation (DG) generates electricity from many small energy sources rather than centralized large production sites connected to a transmission grid, and can play a key energy supply role in areas with unreliable or no electricity. Instead of developing or expanding a central generation grid, a more effective solution for populations with unreliable or no electricity may be DG. Distributed generation can provide electricity where it is needed, thereby directly helping the people that can benefit the most from the electricity.

Peacebuilding

Resource depletion and environmental degradation can mean considerable hardship for many persons around the world. For populations in areas particularly vulnerable to the effects of climate change (arid parts of Africa and island communities, to name a few), the additional pressures can bring dangerous consequences, including conflict. The United Nations is giving increased attention to the relationship between energy/environmental resource needs and the potential for peace or violence:

"The ability of the environment and resource base to support livelihoods, urban populations and economic recovery is a determining factor for lasting peace. A failure to respond to the environmental and natural resource needs of the population as well as to provide basic services in water, waste and energy can complicate the task of fostering peace and stability."

– The United Nations Environment Programme, 2009 Paper: From Conflict to Peacebuilding, the Role of Natural Resources and the Environment[5]

The development of renewable energy production offers the promise of resource security, which in turn has the potential to prevent conflicts, as well as to bring together different population groups with a common goal of harnessing resources for the good of a large group rather than the individual. Financing and operation of energy systems, even small ones, necessitate cooperation and group coordination.

Maximizing the Value of Indigenous Natural Resources

Each country has its own "mix" of energy resources, conventional (fossil fuel based) and renewable. Some are rich in biomass fuel; others in hydro; others in solar or wind. It is essential that domestic policy supports cost effective development of resources, which usually means resources most plentiful and accessible in that particular country. So, while wind technology may be promising for some countries, other countries that are less geographically advantaged for wind should look to other RE technologies.

There is a natural tendency, in developing rules for what resources "qualify" for incentives, to favor resources that are indigenous. In similar fashion, countries rich in fossil fuels may be reluctant to follow policies that discourage the use of fossil fuels or that encourage the use of other resources. This means that incentives may vary among countries, based on the type of domestic resources and/or the resources a country wants to promote.

Responding to the Public Interest

Public awareness of environmental risks presented by conventional energy use and consequent greenhouse gas emissions is increasing, particularly in developed economies where strong information awareness campaigns have found considerable success. Creative companies are using the public interest in sustainability – and the public interest in being recognized as an individual or business committed to sustainability – to bring in clients, even when the energy costs more. Sustainability is itself becoming a business, albeit an expensive one targeted at higher paying consumers, and advertising campaigns are taking notice with increasing efforts to emphasize social responsibility. While such corporate and public attention is most evident in developed economies, it is also taking hold in many emerging economies and in some developing nations, where increasingly grants and other investment moneys include sustainability objectives alongside overwhelming priorities of access to cheap power.

The contribution of donor funds and the voluntary choices that people make to choose sustainability over non-sustainable energy sources mean that the economic dynamic is affected by public interest. This inevitably plays a leading role in the decisions to support additional production of renewable energy.

CHAPTER 2: UNDERSTANDING THE CHALLENGES TO RE EXPANSION: TECHNOLOGY AND ECONOMICS

In light of the various benefits offered by RE, why is RE not the only form of energy used in the world today? The answers are several; the next chapter discusses the policy, regulatory and market challenges. This chapter looks at the technological and economic challenges.

- Technology development in the RE field is rapid but often still nascent, with large strides made over the last decade and anticipated in the next
- The rapidly changing technological environment results in high private, business and social costs
- Implementation of new technologies can encounter unanticipated hurdles, limiting predictability and inhibiting some investment
- Higher costs associated with RE present particular challenges for countries with struggling economies and high poverty indexes

Addressing the various challenges to bring RE to market in a comprehensive manner requires consideration of how these challenges differ across economies and regions, and how they are affected by short and long term objectives.

Making the Economics Work

Making the economics work is critical to the successful integration of renewable energy in a country's mix of resources. For multiple reasons, despite marked improvements and a steady march toward equalization, most renewable resources cannot yet compete with more traditional fossil fuels. This is particularly true in markets where subsidies for big incumbent energy industries remain and externalities, such as environmental costs, are not monetized. As previously stated, changes are rapidly underway but the reality is that most markets do offer some subsidies to large energy industries powered by fossil fuels and most markets do not (yet) incorporate the many environmental costs into the direct price of energy for the end-user.

Governmental intervention and regulatory implementation serve to address economic imbalances in a manner consistent with market and energy security needs. Well executed, government policy and regulation can assure that RE grows at a careful pace, with appropriate economic, operational and supply checks in place to protect the energy market and economic growth. A sound approach will consider the costs, benefits and trade-offs of using an incremental strategy for the integration of RE.

There are three basic reasons why renewable energy generally has a hard time competing in the market place:

- RE projects tend to have high initial capital costs, making RE unattractive in the short term
- The market place is often saturated with incumbents that benefit from direct and indirect subsidies, and so is not an "open" market per se
- The societal costs or externalities that make renewables attractive compared to conventional resources are difficult to quantify and not attempted in most business analyses. When these costs are accounted for (e.g., long term reduction in costs associated with damage from emissions), RE projects can prove attractive when compared to conventional resources

Current practice in measuring energy costs uses the levelized cost of electricity, known as "lcoe." Lcoe is the constant price at which electricity must be sold for a facility to break even over its lifetime, assuming that it operates at full capacity. Usually this measure does not include the levelized social cost of electricity, and so cannot provide an accurate comparison.[6] The elimination of subsidies for competing conventional fossil fuels and penalties, in the form of fines for carbon dioxide levels, are ways to levelize the playing field between RE and conventional resources. This can have an impact on the cost of operation of utilities, consequently increasing compliance costs. The addition of such costs can have a variety of consequences, including objections or resistance from utilities, cut-backs in other areas that can have deleterious effects on the quality of energy supply if not checked, and reduced investment interest.

Utilities need either incentives or laws to make them look to the long term and take into account societal costs in order to consider renewable energy a more attractive option from an economic perspective.[7] This requires a fundamental change in the standard way that costs and benefits are measured. The traditional approach to environmental protection is the imposition of standards, with penalties for noncompliance. In the RE context, the requirements imposed can include purchase obligations, such as requiring a utility to have a certain percentage of its portfolio mix come from RE, and/or fines/tariff adjustments for carbon emissions.

Straightforward purchase obligations (known as Portfolio Standards in the US,[8] Renewables Obligation Certificates (ROCs) in the United Kingdom (UK), and the Mandatory Renewable Energy Target in Australia) require electric utilities to use renewable resources to meet a specified target percentage of their supply. These targets are sometimes voluntary or act as guidelines, but increasingly they are mandatory with financial sanctions for those who fail to meet them. If the utility is unable to meet the obligation, then there is an accompanying fee that the utility must pay (in Europe, these are in the form of fines or tariff penalties; in the US, this is normally called the Alternative Compliance Payment or ACP). In many jurisdictions, the cost of RE obligations, regardless of whether the form is the cost of procuring renewable energy credits or the ACP, is directly passed on to energy customers. If passed on, costs have no impact on a utility's bottom line, though they may impact energy use and industry competitiveness.

When RE policy and regulation is undergoing change, as is the case in most countries around the world, mandatory obligations are sometimes imposed without accompanying frameworks developed to support incorporation in rate increases, and utilities may find themselves asked to carry the costs. This question of allocating the cost burden can be overlooked in new or changing frameworks. Costs passed on to energy customers can have positive impacts, such as incentivizing energy efficiency, but have unintended consequences too. Additional cost may prove difficult for customers, particularly in developing or transitional economies, and costs borne by companies may compromise quality unless care is taken, in the form of monitoring and regulation.

However the costs are ultimately allocated by regulation, the accompanying question is how to address a situation of noncompliance. In some jurisdictions, regulators have authority to levy fines; in others, this power lies with the Ministry or a court, leaving the regulator to look to alternative methods to address noncompliance. One approach for the regulator is to reflect penalties in rate decisions; as regulators challenge and develop their tariff methodologies, incentive regulation offers a useful tool for regulators to realize their regulatory objectives. In the absence of such a tool, regulators can use less direct methods through providing notice, advice and coordination with other agencies or governmental bodies. Regulatory expertise can be invaluable for persuading and guiding other agencies to act on noncompliance or abuse.

Network Costs

Resources like wind are often found far from population centers, so network and interconnection costs must also be considered. Indeed, renewable energy can often seem more economically attractive to non-utilities for industrial cogeneration, solar photovoltaics for homeowners or small businesses, and other use of resources located near the consumer.

Network costs must be considered in RE economics. Additional costs are associated with the trucking, piping and ongoing transportation costs associated with distant energy sources. The costs of meters and other equipment used to make net metering and smart grids possible sometimes go uncalculated as part of the overall energy cost but should be understood as part of the bigger economic picture.

Environmental Costs of Fossil Fuels v. Renewable Energy

Not all renewable energy is completely benign from an environmental perspective; hydropower, for example, can have a significant adverse impact on riverine ecosystems.

The costs of use of fossil fuels, particularly on the environment (sometimes referred to as external costs or externalities) are typically, absent regulation, not reflected in the competitive market.[9] Tax breaks and incentives for fossil fuels exacerbate this problem of creating price signals that do not reflect all actual costs and benefits, particularly in the long term.

Due to the benefits of economies of scale, in theory the larger the generation plant, the lower the cost of service. Often the cost overruns of large plant construction and the impact of economic and market changes during the time needed to build these large projects can make them uneconomic in practice, as reflected in the US experience with nuclear plant construction in the 1970's. Also, given how rates are often set, with a return on rate base, the larger the plant, the greater the return for the investor, which captive customers must pay. This, among other things, can lead to rate shock when a large investment is introduced into the rate base. While it is difficult to set a monetary value in a "smaller is better" approach that avoids these potential costs, risks and volatility, such advantages should be considered in any pragmatic cost-benefit analysis of RE, which as a general rule tends to include smaller, more targeted projects. In addition, where the technology is available and can be put into place (requiring some up-front investment often not available in developing economies), net metering (using smart meters) enables customers to use their own self-produced generation to offset their consumption over a billing period by allowing their electric meters to account for usage when they generate electricity in excess of demand. This offset means that customers receive retail prices for the excess electricity they generate.

Conversely, renewable energy reduces emissions and contributes to sustainability and energy security,[10] but these advantages are not ordinarily reflected in the price of electricity on the market. Other benefits from renewable energy development that may not be reflected in the open market include the incremental nature of some types of resources, such as distributed generation, which can allow more efficient targeting and avoid the need for "lumpy" investment.

All the costs and benefits of potential choices should be considered. The point being made in this Handbook is that considering costs and benefits requires a more comprehensive consideration of impacts and consequences in the medium and long term than often has occurred in the past when issues of sustainability were not at the forefront of the analysis. This is largely the purview of policy-makers. While in many jurisdictions the existing regulatory structure may exclude consideration of these costs, regulators can use their considerable expertise to advise policy-makers and play a role in expanding the way costs are recognized. Some costs will be unanticipated, and though the benefits are believed to outweigh the negatives, understanding the effects is vital. A 2009 study on wind power in Spain by the Universidad Rey Juan Carlos concluded that each installed MW of wind power, spurred by governmental subsidy, destroyed 4.27 jobs, by raising energy costs and driving away electricity-intensive businesses.[11] The Government of Spain has disagreed with this conclusion;[12] the debate itself has its own value because it has meant a relatively open and public assessment of broad social and economic priorities. To maximize economic efficiencies, each country's renewable plan must be specific to the resources available to it and be sensitive to the particular issues presented in that country in order realistically to identify all costs and benefits of all available choices (compare apples to apples) when identifying appropriate investments and incentives.

Variability Impacts the RE Analysis

While electricity as a general matter presents economic issues based on the inability to store it as a commodity, the intermittent nature of many types of RE resources presents particular network integration availability and reliability challenges which, in turn, affect costs.

Variable energy resources include the older, more conventional renewable sources which operators have significant experience in dispatching, such as hydropower, as well as newer renewable sources that tend to be intermittent (but can be predicted with enough information), such as wind, solar and wave/tidal. In other words, most renewable energy is variable, as a direct consequence of the natural cycles of such sources:

Wind power in Hungary is thought by many to be too extensive, with the Hungarian system (which in turn affects the European market) highly dependent on a variable energy source; approximately 110 wind power generators with a total capacity of approximately 200 MW are online. To keep expansion in check, Hungary's 2007 Electricity Act revamped the support scheme so that new wind power parks can only be established within the framework of a public tender, through a public bidding process. Previously, investors were able to enter the market without centralized scrutiny on the effect that the new RE source would have on system integrity overall; due to the advantageous feed-in tariff mechanisms and mandatory purchase obligations set on electricity traders and power plants directly selling to end-users and importing end-users, wind farms proliferated in Hungary prior to the 2007 amendment.

Attention is now being directed at addressing ongoing transmission system operator (TSO) concerns over grid connection and grid security, as well as general concerns regarding the need to make consistent the various policies, regulations and other incentive structures.

- ***Solar:*** seasonal variations, regulator diurnal variations, short term fluctuations due to clouds, weather
- ***Wind:*** seasonal, diurnal and short term fluctuations
- ***Hydropower:*** seasonal rain and snowmelt cycles
- ***(Some) Biomass:*** seasonal harvest cycles (and growth rates)
- ***Wave/tidal:*** while tidal energy is predictable, wave energy is tied to wind variability
- ***Geothermal:*** is subject to cooling from injection wells

The variable nature of renewable energy resources means two things:

- There must be a diverse mix of types of generation resources – excessive dependence on one type of resource presents intolerable risk
- With the exception of geothermal, the value of the power generated from these resources can be viewed as inferior to options such as fossil fuels because variability lowers the capacity factor of the plant, reducing lcoe calculations in the absence of inclusion of external costs (wind and solar capacity factors are typically below 30%, while coal, nuclear and geothermal can be above 90%)

The current limits of electricity storage technology can lead to added costs for backup power, as well as the need for careful planning and forecasting to integrate RE resources into a country's energy portfolio. The latter point was brought to the forefront in Denmark in 2005, when a hurricane that lasted only six hours resulted in the loss of 2,000 MW of wind power and 83% of total wind generation. Similarly, in February 2008 in Texas, a low frequency event over a 3½ hour period resulted in the unanticipated loss of 1,600 MW of wind power. In both cases, inadequate weather forecasting led to serious consequences. Though the systems could withstand generation loss and have for the duration of conventional energy, the unpredictability coupled with the immediacy of the variation wrought by variable energy such as wind power, can have major, adverse impacts on systems. In short, the growth in variable energy resources magnifies the impact of small weather forecasting errors.

The economic costs of these disruptions are enormous, not only in the energy supply context but the broader business environment, which cannot function properly in the absence of electricity. Use of many different renewable energy sources forces system operators to add to their reserves, though at present the most economic and viable way of doing this requires the use of fossil fuel facilities, undercutting much of the carbon reduction benefits of renewable energy along with adding to the overall financial cost. Conversely, the greater the ability to transmit power across a broader region, the more the diversity of resources within that region can reduce these costs.

The RE Technology Revolution is Not Over

There is a known history that the use of fossil fuel and nuclear resources allows investors to make at least some economic predictions. But just because a technology exists does not make it economically viable. The technology of renewable energy use, in contrast, changes every day. Generally speaking, over the long term as RE technologies develop and become more familiar, the cost of renewable energy is likely to go down. Likely is not certain however, and investors like predictability. Absent intervention, the market is unlikely to reflect and value the declining cost of RE on its own and certainly not in a reliable manner. As a consequence, there is a strong need for a regulatory check that reflects these changes fairly but does not undermine investors in doing so.

In sum, dialogue as to the costs and benefits of choosing RE options over alternatives involves various legal, cultural and social issues, and development priorities will differ from country to country. The economics of RE choices is an integral part of this dialogue, and governments must intervene to ensure that all costs, including societal costs and externalities, are included in the cost-benefit analysis, applying a longer-term perspective while assuaging concerns of investor risk. Such intervention, in turn, will affect the economics of RE. Financial incentives to develop and use renewable technologies can spur demand, which, in the long term, can lead eventually to research and development that lowers the price of those technologies. In the shorter term, however, such demand can raise the price of the currently available technologies.

NAMIBIA: OPTIMIZING DOMESTIC RESOURCE POTENTIAL

2010

CHAPTER 2: Understanding the Challenges to RE Expansion: Technology and Economics

NAMIBIA: OPTIMIZING DOMESTIC RESOURCE POTENTIAL

The Republic of Namibia is in Southern Africa and borders the Atlantic Ocean, South Africa, Angola, Zambia and Botswana. Its population density is low, with an estimated population of just over 2 million in a geographic area of 318,180 square miles. At present, energy production is estimated at 2.69 TWh, with net imports of 10.01 TWh and electricity consumption of 3.22 TWh.[13] About 60% of the population resides in the north of Namibia where electrification rates are very low; and a strong majority of the country's rural population (roughly 80%) relies on wood fuel. The existing grid network currently supplies only about 30-40% of the rural population and about 98% of the urban population, with 2% lacking access as a result of mushrooming informal peri-urban settlements stemming from rural-to-urban migration. Because of the vastness of the country and low population density, it is extremely difficult to extend the grid to un-electrified areas. Recently, the country has looked to renewable energy initiatives as ways to improve electrification for its population, while addressing increasing concerns about security of supply and sustainability. This profile examines efforts by Namibia to promote domestic renewable energy, in particular via its 2005 Renewable Energy Programme and subsequent implementation, demonstrating how a country can change its energy landscape by establishing a clear foundation for RE in its national policies.

Energy Sector Background

The key players in the electricity distribution and supply business are NamPower (the state-owned power utility responsible for generation and transmission of electricity), the Regional Electricity Distributors (state-owned legal entities tasked with the supply and distribution of electricity in a dedicated region) and local authorities. The electricity supply mix is made up of a combination of domestic hydropower and thermal energy combined with imports from the Southern Africa Power Pool member countries, Zambia, Zimbabwe, Mozambique and South Africa. For the period 2000–2009, the contribution of energy imports to the national energy requirements averaged 49.8% annually, varying from 36% in 2000 to 60% in 2009. For the same period, domestic generation averaged 50.2% and varied from 64% in 2000 to 40% in 2009.

Over time, static growth in domestic generation has caused the volume of imports to increase to meet demand. This has made Namibia increasingly dependent on power supplies from beyond its borders and control.[14] Energy delivered into the system in 2009 dropped to 3,692 GWh compared to 3,719 GWh in 2008 partly due to demand-side-management measures and impacts of the economic downturn in the mining sector, particularly the drastic drop in demand and commodity prices of diamonds. In the short term, Namibia is focusing on demand side management programs and construction of the new Caprivi Link, creating a new electricity wheeling corridor to mitigate against transmission capacity constraints or the Namibia-Republic of South Africa interconnector. For the longer term, it is looking to build its domestic portfolio with RE.

Moving toward an RE Framework

As early as 1998, Namibia recognized the value of renewable energy as part of its energy portfolio. The White Paper on Energy Policy (1998) sets out specific national energy policy goals for the electricity supply industry as promoting or enhancing:

- Effective governance
- Security of supply
- Social benefits, including upward mobility for poorer populations
- Investment and growth
- Economic competitiveness and efficiency
- Sustainability

Although the promotion of renewable energy technologies is not mentioned as a special target of energy policies, the White Paper identifies renewable energy technologies as contributing to meeting several targets like energy security and sustainability. The White Paper identifies the "Programme on the Promotion of the Use of Renewable Energy Sources" as responsible for directing Namibia's available resources for maximum social and economic benefit, taking into account long-term environmental concerns while giving priority attention to the country's development needs."[15]

Building upon these objectives, in 2005, the Government of the Republic of Namibia initiated a Renewable Energy Programme with support from the Global Environment Facility (GEF). The Namibia Renewable Energy Programme was designed to increase affordability and access to RE services and accelerate market development for renewable energy technologies by reducing existing barriers, including human capacity, financial, technical, awareness and other market limitations. Namibia has abundant RE resources, in particular with respect to wind, solar and biomass, but pricing remains a challenge. At present, tariffs are not cost reflective, though measures are being taken to make electricity tariffs for NamPower cost reflective by the 2012–2013 financial year. Time-of-use tariffs were also introduced in 2009 to complement other demand response measures. Still, higher costs of RE raise challenges for bringing this technology to market given existing struggles to reach cost reflective tariff levels. At the same time, this cost pressure is counterbalanced by Namibia's desire to optimize existing RE resources and ensure security of supply. Building on domestic resource potential and security of supply objectives, the Programme's main focus at the beginning was on solar photovoltaic technology for lighting and water pumping, solar thermal for water heating and to a limited extent, efficient domestic use of biomass. Since then, as discussed below, renewable energy projects in wind and solar have taken hold.

The Ministry of Mines and Energy (MME) enforces compliance with legal requirements on energy legislation and regulations and conducts research on new and renewable sources of energy. MME also issues petroleum licenses, sets petroleum prices, administers the National

Energy Fund, regulates the oil industry, oversees rural electrification and administers the Solar Electrification Revolving Fund. The Electricity Control Board (ECB) regulates the electricity sector (generation, transmission, distribution, supply, import and export), pursuant to powers given to it by the Electricity Act promulgated in 2000 and amended in 2007 (following the enactment of the Namibia Renewable Energy Programme). Since its inception in 2000, the ECB has concentrated on licensing, setting and implementing tariff methodologies, designing and enforcing quality of supply and service standards, and assisting the Government with the restructuring of the Namibian electricity supply industry, currently operating under a single buyer model. Plans are underway to transform the national power utility NamPower into a modified single buyer to make the market more competitive. Over time, the ECB has devoted increasing attention to evaluating and monitoring licensee performance.[16] The ECB is also on the verge of being transformed from an electricity regulator into an energy regulator.

As part of the regulator's growth, it has assumed responsibilities in the RE sector, having already issued three licenses for wind power development. Still, ongoing work is required to lessen fragmentation of the regulatory framework and modernize it to encourage investment in RE, among other issues. To date, financing has stemmed essentially from either grants or consumers that generate electricity for their own localized consumption. The regulator is currently engaged as part of a stakeholder group in a consultation process to determine the RE incentive structures best suited to Namibia. Renewable energy usage for off-grid electrification still remains a regulatory challenge, and as part of its consultation process the ECB is looking at ways to develop an RE procurement support mechanism that incorporates RE in mainstream electricity supply as well as provides electricity to off-grid customers in rural areas who are not likely to be connected within the next 20 years or so in light of infrastructure limitations.

Investigating RE Options

Since the 1998 White Paper, Namibia has steadily continued to make progress in creating market, regulatory, and other frameworks to support RE. Namibia's regulator and other stakeholders are currently looking at support mechanisms that will drive forward investment in renewable energy, with the understanding that optimum utilization of renewable energy technologies requires a combination of appropriate polices and a favorable investment environment. The study underway is supported by the Renewable Energy and Energy Efficiency Partnership (a non-profit body established alongside the 2002 World Summit on Sustainable Development in Johannesburg) and run by the Renewable Energy and Energy Efficiency Institute (REEEI). REEEI is an arm of the Namibian Ministry of Mines and Energy created in collaboration with the Polytechnic Institute of Namibia 2006 to serve as a national information resource centre for renewable energy and sustainable energy use and management.[17] The study is looking at various procurement mechanisms such as tendering, quotas, net metering and a feed-in tariff structure. The study has issued recommendations, currently under review by stakeholders, including:

- Tendering for solar and large wind based generation systems (those greater than 500 kW in installed capacity)

- Feed-in tariff for small wind, small hydro (less than 5 MW) and biomass including landfill gas, (less than 500 kW)
- Net-metering for photovoltaics
- Other support measures such as soft loans, grants and tax breaks to support the above instruments and continue the promotion of rural and off-grid electrification, through development and implementation of the off-grid master plan

The study also identifies the next steps that need to be taken in order to facilitate successful development. The way forward includes:

- Regulations that govern procurements for renewable energy technologies must be adopted in a clear, transparent manner; MME would lead this effort, with support of the stakeholders including the regulator
- The regulator must prepare itself, through capacity building and development of supporting procedures and rules, to implement the regulations upon adoption
- The renewable energy technologies must have access to the grid, with interconnection of the renewable energy technologies provided for in the transmission and distribution codes, as well as the metering codes (and monitored by the regulator)
- The distributors, local authorities and NamPower must buy renewable energy on a priority basis at a predetermined fixed tariff for a given period of time (pursuant to regulations set forth by the MME and elaborated by the regulator)

The study adopts a realistic approach, readying the Government and stakeholders that it might take some time (possibly greater than five years) for cost reflectivity and grid parity to be reached for some technologies. It encourages the Government to devise financing mechanisms for the procurement of renewable energy technologies in a sustainable manner in the long term, rather than ongoing reliance on a cost pass-through tariff. Finally, it proposes that the existing national Energy Fund be transformed to cover renewable energy technologies. This addition would require the adoption of a regulation to allow RE projects to benefit from the Fund, and would serve to cushion the off-taker and the consumer from direct tariff hikes while at the same time spurring the growth of the RE industry.

The development and implementation of support mechanisms for renewable energy technologies remain works in progress, with considerable steps taken toward a clear direction thanks to the REEEP/Polytechnic study. The regulator is now embarking on the next stage of the process, reviewing the findings of the study and making technical recommendations to policymakers considering the procurement options. The MME has ultimate responsibility as policy-maker, supported by technical recommendations from the regulator.

These developments have the potential to galvanize renewable energy projects that are now at the initial stages and looking to take off in the near term, as well as bringing new projects to market. The proposed Baines hydro power station on the Kunene River, for instance, is at the feasibility study stage. Namibia also has a hydro energy resource development master plan based on studies performed on its major rivers. Funding for the feasibility studies and construction of the proposed 400 MW $7 billion Baines hydro power plant is an equally shared responsibility between the governments of Angola and Namibia. Also at present, in line with the Namibia National Renewable Energy Programme, efforts are currently under way to implement the pilot project on gasification of wood to be derived from 26 million hectares of invader bush.

The biggest change following the Namibia Renewable Energy Programme's enactment is in solar power, the main focus of the Programme. Solar energy generation has increased from 685 MWh in 2004 to 14,941 MWh in 2008. In addition, MME has introduced a revolving fund to support families and individuals not connected to the electricity grid that want to invest in solar home systems. Solar energy is increasingly used for off-grid electrification, with the first two villages having been totally energized by solar power (with Indian Government grant/donor assistance) at Spitzkoppe and Shianshuli in the Caprivi Region.[18] As part of Government efforts to roll out use of solar water heaters, a 2007 Cabinet Directive marked the beginning of the enforcement of theresolution requiring all public buildings to meet their water heating needs through solar thermal technology. The solar hot water project is part of a larger demand side management project with six project options, on which the regulator contributed as part of a working committee dedicated to enhancing energy efficiency.

As solar power continues to develop, initiatives for wind power are also taking hold. Though the overall outcome of early wind energy study reports then was that the exploitation of wind energy was not commercially viable, developments that took place between 2005 and 2010 indicate that the likelihood of having 40-45 MW wind resource capacity integrated into the grid is considerably high. The Polytechnic of Namibia and NamPower are currently working to promote integration of wind resources and the regulator has issued three licenses already for wind development.

With these efforts in place and the study consultation well underway, the momentum to develop Namibia's renewable energy technologies is being advanced in order to meet the country's energy needs and sustainability objectives.

CHAPTER 3: OVERVIEW OF CONSIDERATIONS FOR INVESTORS

Though the end goal of RE development and expansion is the same for national governments, the public and investors, the direct concerns of each group differ somewhat. In short, the most significant concern for investors is whether they will make sufficient profit justifying the investment in the first place. To address this, investors need to have money to invest, a return that makes the investment worthwhile, and a ready market.

General Principles

Direct impacts of the financial downturn leading up to 2011 have included a reduction in the availability of capital for new projects, including renewable energy projects; a reduction in demand for electricity, especially in the commercial and industrial sectors; and a decline in fossil fuel prices. Where capital is scarce, capital costs are necessarily higher, and the degree of certainty of future revenue streams will become more important to investors who are cautious and selective in the capital they access.

All else being equal, the level of regulatory "guarantees" that may be required to attract new renewable energy production investment will be higher, in effect increasing the costs, and the risks, borne by customers. At the same time, despite immediate concern regarding the high prices of electricity from renewable energy sources, in fact the operational costs for most renewable energy is low and the installed cost, though at present still higher than conventional energy, has been decreasing. This means that renewable energy can be seen as more economically viable when viewed in the long term than when it is viewed in the short or medium term.

This makes clear, predictable regulatory frameworks vitally important to securing investment. An investor that does not have faith in the long-term reliability of the regulatory structure that supports the sector and the investment will focus on short term costs. Investors, including investors in renewable energy projects, often require a high degree of regulatory predictability and stability.[19]

Project finance has historically proven to be a significant challenge for RE developers. RE technologies are new and evolving, and financiers unfamiliar or uncomfortable with the risks presented by RE sources have been reluctant to lend on terms that make a project viable. The lack of readily available capital has been a significant barrier to the deployment of what would otherwise be feasible RE projects on a commercial scale. The lack of access to capital markets, coupled with the reality that RE projects have a higher upfront cost than traditional fossil-fired generation, mean that government incentives are generally required to make RE more financially attractive. Typically, RE projects are financed through a combination of the following:

- *Private investment (usually an equity position, venture capital)*
- *Bank financing, usually syndicated to spread risk*
- *Government-sponsored incentives, such as loan guarantees, tax credits, grants, and other incentives*

Equity investors seek out international financial institutions to provide additional financing for energy projects in emerging markets, and such international financial institutions are often asked (and sometimes do) provide up to 70% of the financing (either equity, mezzanine or debt financing). Those financial institutions unsurprisingly seek certainty in the repayment of their investments. This means that any pricing structure designed to promote renewable energy will need to incorporate the requirements of not only the equity investors but also the international financial institutions that offer support.

Part of the decision to invest has to do with the overall risk in the country where the investment is being considered. The equity investors and the international financial institutions will compare the legal and regulatory environment in each country and assign a risk level for investing into each country. Country risk is an overall assessment of the uncertainty of payment due to the variability of the factors that can influence the uncertainty. Perceived investment risks can have more of an impact on the effectiveness of RE policies than do potential profits and costs, so that for national governments seeking to attract RE investors to the country, the question of risk must be directly addressed through various policies, actions and procedures directed at making the investment environment safe and reliable.

Projects in countries with higher risk, by definition, will require higher returns. If the higher returns are not reflective of the higher risks, the investors will not invest in the country. The risk that agreements reached between government-owned entities and an investor will be renegotiated due to political pressures or disappointed expectations create levels of financial risk that will increase the cost of securing new resources or discourage investors entirely. Investors and international financial institutions use various strategies to mitigate these risks, including requiring long term power purchase agreements (PPAs) to ensure predictable income streams. The laws designed to make development more economically attractive include:

- Property and sales tax incentives
- Production and investment tax credits
- Grant or rebate programs for RE developers and owners
- Loan guarantee programs
- Renewable energy interconnection standards
- Government mandated long-term off-take agreements or feed-in/preferential tariffs
- Efficient and effective dispute resolution systems, either in the form of general rule of law (transparent and speedy courts and appeal processes are the ideal way of satisfying this requirement but are not always realistic) or in the form of specific rules that address individual investments and ensure speedy resolution of any claims

Regulators should expect to see innovative business structures in RE source financings. In part, this is necessary to spread risk and bring in investors who can take advantage of tax and other government credits and subsidies. Due to the higher upfront cost of RE as compared to traditional carbon-fired generation, lenders and investors want greater certainty that the project will generate a stable and predictable revenue stream than market forces will supply.

Therefore, financiers typically require RE developers to enter into long-term off-take arrangements and, if applicable to technologies such as biomass and biogas, financiers will also require secure feedstock supply agreements. Although the counterparties may not need to be investment grade, they must nonetheless be creditworthy and preferably backstopped by a letter of credit, parent guarantee or similar security.

Integration of renewable energy sources into existing energy systems requires adapting the existing system and creating a supporting framework to minimize voltage fluctuations while accommodating intermittent renewable energy production. A policy that looks to reduce barriers to RE grid connection should address the following:

- System reliability
- Uniform technical standards for interconnecting distributed generation to the grid
- Testing and certification procedures for equipment that interconnects with the grid
- Rules eliminating or reducing barriers for entities to install and interconnect systems
- Monitoring equipment for utilities to assess the value or impact of power anywhere on the grid at any given moment
- Regulatory tariffs
- Utility incentives in order to eliminate the disincentive to allow distributed generation (distributed generation results in reduced energy sales)
- Interconnection rules, including related conditions and procedures
- Any deference or priorities for certain types of technologies

Electricity grid connections can be complex legal and technical undertakings, involving a variety of agreements required for planning, building, and operating power lines. Especially for larger systems, RE development often requires grid upgrades. Frequently, the process of obtaining the upgrades at a level sufficient to support new RE production faces several challenges that must be set forth in policy and law, and implemented through regulation.

Although grid interconnection can provide the developer with a broad market of potential off-take counterparties, the same cannot be said for feedstock supplies. A biomass or biogas generator can only generate if it has sufficient feedstock. Desirable feedstock supply characteristics include: local availability, diversity of sources, reliable supply and delivery chains, and consistent quality (e.g., moisture and energy content). The availability of feedstock supply as the project scales up or expands, third-party competition for feedstock from similar generators or completely different industries (e.g., forest products industry), and the cost of energy involved in growing or transporting the feedstock must also be considered.

In Albania, as privatization of the distribution company proceeded, it became clear that, notwithstanding a high degree of technical skill, experience, and demonstrated independence of the regulator, the investor required additional assurances concerning regulatory treatment in several key tariff areas. Following the identification of the winning bidder, the government, regulator and bidder worked together to draft a "regulatory statement" that would establish, for the initial years following privatization, the manner in which tariffs would be applied. The regulatory statement included the weighted average cost of capital to be applied to the regulated asset base, the trajectory for the reduction of losses in the system and improvements in the rate of collections, and a mechanism to defer certain costs found to be legitimate but that could not be included immediately in rates due to practical and political limitations on rate increases in any one year.

In order for project developers to be financially motivated to install renewable energy, they must have access to markets to sell energy and trade environmental attributes. This means that regulators must provide non-discriminatory access to transmission and distribution systems through a transparent interconnection process. In some jurisdictions, incentives for renewable energy go further: they require priority access for renewable energy projects. Such assurance should include public, transparent and accessible laws, supported by a national policy and a transparent, effective regulatory body.

From an investor point of view, however, time is of the essence. The time that is required to demonstrate and ensure the effectiveness of a policy and regulatory framework sufficient to address these various investor needs is often not practical. The policy and regulatory framework development must sometimes occur simultaneously with the investment. In such cases the regulator may be called upon to secure investor confidence through interim steps. Such steps can be directed at a particular investment, and may involve decisions, official statements or the approval of specific contracts and dispute resolution provisions.

In conclusion, factors affecting investor interest include:

- The balance between the need for RE sources and the price impact on the customer
- A clear risk understanding and policies structured to address and allocate risk
- A predictable tariff structure
- Secure and sufficient transmission infrastructure
- Interconnection requirements
- Access to market and customers

CHAPTER 4: POLICY AND REGULATORY MECHANISMS IN SUPPORT OF RENEWABLE ENERGY

Overview

How a country prioritizes the benefits and costs of renewable energy vis-à-vis its own resources will determine the direction and implementation of its policy and legislation in this area. Governmental intervention typically includes incentives for producers and investors, as well as obligations (with contingent penalties). In the RE field too, some non-mandatory policy steps are being taken to encourage RE.

Policy and regulatory steps to encourage RE are multiple and varied, including:

- Incentives for investors/entities installing RE
  - Tariff-based incentives that result in favorable tariff rates, ensuring that investors are guaranteed income that covers costs and additional return on capital sufficient to motivate investment; these are often in the form of feed-in tariffs
  - Quota systems, green credits/certificates
  - Tendering, by which investors compete for a project through a competitive bidding system initiated by a government department or agency.
  - Power purchase agreements
  - Direct investment support, including loan guarantees and tax incentives
- Incentives for RE development
  - Direct research and development grants and use of targeted funds
  - Assistance in resource mapping
- Encouraging the voluntary sector
  - Making green look good

In summary, there are a host of possible mechanisms. These are not mutually exclusive, nor are they clear-cut. Not all economists are likely to agree on what works best either in the abstract or in any specific context. The variation in incentives is matched by the variation in choices by nations and states as to the type of RE renewable energy to promote. By early 2009, at least 64 countries had policies to promote generation from RE resources, including 45 countries and 18 states/provinces/territories with feed-in tariffs (many of these recently updated), and 49 countries/states/provinces have imposed renewable portfolio standards/obligations that require electricity supply companies requiring them to generate specified percentages of their power mix through RE.

There are many reasons for the choices made. Most have to do with resource availability, though others may have to do with employment efforts (promoting the use of solar panels in Greece not only maximizes one of Greece's most plentiful natural resources – the sun – but also has provided jobs and strengthened local industry) or regional needs (as is the case in Central Asia and the Middle East, where water use agreements with neighbors may restrict use of water as hydroelectricity, despite the existence of the water resource).

Looking at the specific country or region and deciding on the best approach or combination of approaches is partly an economic exercise, and partly a political and social analysis. Individual examples from elsewhere provide useful information for countries developing RE strategies, which is why this Handbook offers case studies and country profiles. Despite some generally applicable principles, best practice and lessons from other countries, it must be emphasized again that each country's approach will flourish only if the approach is based on the unique characteristics of the geographic area and economic and political environment.

Tariff-Based Incentives

Tariff-based incentives for renewable energy production often include preferential and, more often, feed-in tariffs (also known as Advanced Renewable Tariffs or Renewable Energy Payments) for qualifying facilities. As noted, feed-in tariffs, i.e., a fixed rate that is paid to RE producers for each unit of electricity sent to the grid, remain a common and popular choice.

- ***Feed-in tariffs*** refer to the obligation of utilities to buy energy at fixed purchase prices (the purchase price is normally different depending on the type of renewable energy) for a fixed term. The feed-in tariff purchase prices are usually based on the cost of renewable energy generation paired with considerations as to social cost, investor requirements and political will. With a feed-in tariff, any customer or entity is normally eligible to sell energy under the terms of the tariff. This type of feed-in tariff is the most common form of tariff-based incentive used around the world (see case study on the Philippines).

- ***Preferential tariff systems*** incorporate the concept of feed-in tariffs, but also include tariffs that are not fixed per se but set by application of a tariff methodology that assigns a favorable rate of return or other preferential multiplier for renewable energy producers. In such cases, though less common, the price may not be specified, but the structure or methodology for arriving at a price is.

Tariff-based incentives are often paired with mandatory purchase obligations (or off-take arrangements) so that investors can recoup and profit from the (often) higher costs associated with renewable energy investment and production. Tariff-based incentives can be set in primary legislation or in supporting regulation (often referred to as "secondary legislation" outside of North America), or even individual decisions by regulators. Feed-in tariffs in particular are often set forth in primary energy legislation.

Some economists argue that feed-in tariffs are the most effective regulatory support mechanism to encourage RE.[20] Examples of success are plenty. Germany, for instance, has the highest market penetration of solar power in the world and the largest single market for solar, with 40% of the world's total photovoltaics sales in 2007, although it has fewer hours of sunlight than many other countries. This result is largely due to its aggressive feed-in tariffs for solar power, along with other incentives for solar power use and aggressive funding of research. Germany offers an interesting study. Germany revised its feed-in tariffs in 2000 with its Renewable Energy Sources Act and differentiates rates depending on technology type, size and site, with rates designed to decline over time; yet some economists argue that the aggressive German feed-in tariff approach is not cost-effective and are highly critical of the Act.[21] The level of payments provided under the legislature has fallen substantially since the program was revised in 2000, with another proposed cut of 15+% for solar PV in 2010. Despite some revisions to the tariff structure and some opposition to the feed-in tariff approach by some experts overall, feed-in tariffs continue to be used to promote RE across developed and developing economies. Ontario just launched a feed-in tariff program, and some economists are arguing in favor of feed-in tariffs in the United States.[22] Feed-in tariffs are also being introduced in countries in Africa and Asia.

Incentives that are tariff-based (however executed) present a regulatory dilemma. A central principle of electricity regulation is that energy prices should reflect economic cost. Regulators must ensure that tariffs are set in order to allow regulated companies to recover costs of operation and earn a return sufficient to attract capital investment. Following this theory, where a company or operator has mandatory purchase requirements to buy and resell power produced by particular (e.g., renewable) resources, the regulator should ensure that the costs relating to that purchase are included in the tariff rate. Tariff-based incentives for renewable energy may increase the costs of electricity production, raising some important issues that, depending on the statutory authority of the energy regulator, regulators may need to address:

- Over what timeframe should regulators analyze the impacts of the tariff-based incentive? Over the short-term in order to appropriately consider the impacts on customers; over the term of the contract in order to equally consider the benefits and the costs, including the future expectations of environmental compliance costs and the value of hedging energy costs; or over the long-term in order to capture the lost-opportunity that the current development of RE creates in the future?

- Does the increase in end-use electricity price required to accommodate a particular level of renewable power impose too great a burden on customers (either vulnerable customers or commercial firms)?

- How should the "extra" costs of such production be spread over the various customer classes and services? Should such costs be spread evenly across all services, on the theory that all customers benefit in the long run from such development? Should the costs be spread based on "inverse elasticity" pricing, to minimize the impact of such costs on economic development? Should the costs be allocated to customers based on kWh (on the theory that renewable power is designed principally to displace energy) and/or on kW (on the theory that, for at least some renewable sources, capacity costs will be high, and this approach would impose higher costs on customers who required proportionally greater capacity)?

Regulators should, to the extent possible, establish prices for particular services as close to the economic cost (measured most commonly using marginal cost) as possible. Because the sum of the economic (marginal) cost for each service will likely differ from (and often be lower than) the total costs that the company is entitled to recover through its tariff rates, the regulator (or the tariff setting entity if not a regulator) must make a determination of how much to depart from the economic cost for each service and each customer group in order to achieve the requisite level of revenues. There is no universally accepted "right" approach to any of these issues; the resolution requires careful judgment by the regulator and must be tailored to local, national and regional circumstances and include political authority. In general, however, the regulator should strive to minimize, to the greatest extent possible, the degree to which the introduction of additional renewable resources, or the increase in EE in electricity use, distorts these basic pricing principles.

Even when tariff rates are set at levels based on the economic costs of providing each service, a regulator will be faced with decisions concerning how certain costs – for example costs of social service obligations and general overhead costs – are allocated among customer groups. Both renewable energy programs and energy efficiency programs create costs that are not clearly associated with any service or customer group as an economic matter, and allocating these costs requires the regulator (or the policy maker) to balance a number of conflicting considerations, including:

- Affordability, especially for vulnerable customer groups
- Impact on industrial and commercial activity (i.e., will an increase in tariff rates discourage economic expansion?)
- Perceived fairness (i.e., if the premium is being paid to achieve a broad social goal (such as increased employment or an environmental goal), should the cost be spread evenly among all customers)

> *Feed-in tariffs were adopted at the national level in at least five countries for the first time in 2008/early 2009, including Kenya, the Philippines, Poland, South Africa, and Ukraine.*
>
> *In Ukraine, the 2008 Green Tariff Law empowers the regulator to set a "green" tariff, which is about twice the tariff of thermal power generators, and will be guaranteed (with corresponding purchase obligations) for a period of 10 years. The rate will be reviewed each year based on the previous year's prices (approximately $100-120/MWh in 2010 based on 2009 tariffs of thermal generators).*

The feed-in structure creates security for investors by allowing a guaranteed payment for electricity from renewable sources that are fed into the grid. The guarantee comes from a fixed price set by the Government for each defined type of renewable energy over a long period of time, giving investors the stable and predictable policy and legal frameworks they desire. The tariff may or may not be supplemented with subsidies from the state, though the bulk of the costs are generally borne, ultimately, by electricity consumers in the form of higher electricity rates. Many different adaptations are possible. The level of the rates in a feed-in tariff can be based on: the avoided cost of the utility that has the purchase obligation; investor costs; or on the need to motivate investors (and not with any direct correlation to true cost or price). As a matter of terminology, a feed-in tariff's rate/value is the price per kWh received by an independent producer of renewable energy, i.e., including the amount above or additional to market prices, but not including tax rebates or other production subsidies paid by the government.

The most important components of feed-in tariffs (the details of which vary across jurisdictions to meet country-specific needs) are:

- A fixed price set in law, regulation or decision (or, in the more advanced markets, a premium tariff structure which is the market price with a fixed additive).
- The fixed price level differentiated across technologies (e.g., hydropower commands a different price than solar).
- In the more developed feed-in tariff frameworks, stepped tariff designs (e.g., differentiation within same technology based on site, plant size or conditions that affect the yield). International best practice is to stagger new feed-in tariffs so that they decrease annually in an effort to motivate entities to install renewable energy technologies in the current year – rather than waiting until the price of RE systems decreases – while accounting for developments in technology.
- Process and period for tariff revision, limiting the amount of time that a feed-in tariff applies. This gives adequate comfort to investors but also ensures that incentives are in effect only as needed, and offers a process for reconsideration if expected market integration is not yet reached and/or incentives remain necessary.
- Long duration. Most variants and best practice hold that the price should be guaranteed for a specific period of time reflecting the cost of investment, usually around 20 years.
- Purchase obligations, requiring that a utility or a transmission company, distributor or supplier purchase the RE-generated power at a rate determined by public authorities. In most cases, regulatory measures are applied to impose an obligation on electricity utilities to pay the (independent) power producer a price as specified by the government

One of the most important lessons learned from the feed-in tariff experience (and more broadly preferential tariffs for renewable energy) is that sufficient flexibility must be added to the model to ensure prices adapt to market needs and changes, while still offering the security that investors needs. A good regulator is one that strives to get this balance right.

Quota systems, green credits/certificates

A quota system is one where the government sets the percentage or an amount of energy, usually annually, that comes from renewable sources and then allows the market place to determine the cost. The idea is that a certain amount of energy from RE is mandated, but how this is done and at what cost is left to the market to decide. The underlying theory is that competition in this market place will drive down the costs of supplying renewable electricity and thus minimize the costs to the consumer of meeting renewable energy targets. Given the focus on market action, quota systems fit the more developed economies better than transitional or developing economies where energy markets, to the extent they exist, are less mature.

Generally the quota is set in law or regulation that places an obligation on market actors (usually the company that serves a supply function) to purchase a certain amount of its energy supply from renewable energy producers. The mechanism is in place in different forms in just over half of US states as well as the United Kingdom (UK), Italy and Belgium amongst other European countries. In the US, this type of system is known as "Renewable Portfolio Standards" and in the UK, "Renewable Obligations." In the US, quota mechanisms applied at the state level are often assisted by the intermittent application of a federally mandated production tax credit. (Cap and trade systems (also known as emissions trading), whereby a cap is placed on emissions of pollutants and a market-based trading approach is used to limit emissions, are addressed separately as part of the discussion in the next chapter on international agreements and cooperation.)

Under the quota system, companies failing to meet the obligation must pay a penalty, generally established per unit of electricity short of the obligatory amount. For instance, in the US, if compliance is too expensive (e.g., the cost to buy renewable energy is too expensive), suppliers can instead opt to pay the alternative compliance payment. The ACP is usually determined in legislation, and is the maximum obligation price that a supplier should pay. As such, an ACP functions as a kind of price cap.

The quota system is usually matched by an electricity certificate system of some form. This system involves the issuance to a qualifying RE producer of a certificate for each MWh of electricity produced. In turn, certificates provide a vehicle for measuring whether the quota has been met, and for trading to meet the quota or to trade when RE rises above quota requirements. The certification system is used in seven of the 27 EU Member States, including the UK, Belgium, Romania, Sweden and Italy. Nordpool, the single financial energy market for Norway, Sweden, Finland and Denmark, introduced spot trading of Electricity Certificates in March 2004. Electricity Certificate trade in 2008 only took place bilaterally, directly between producers, directly between producer and power supplier, or through brokers. Any electricity user or supplier that has surplus Electricity Certificates may sell them or save them for the needs of future years. The Certificates are valid until the end of the system in 2030. This means that it is profitable to save Certificates if one expects certificate prices to increase in later periods (taking discount rates into account).

The energy regulator, the government or the system operator is usually empowered by law to qualify/register an RE producer, so that it enters the certificate system and can begin to sell certificates. If the regulator does not have the power to qualify the producer, it often has the power to issue supporting regulations or monitor compliance.

The number of certificates that needs to be purchased is a pre-determined percentage of the supplier's total electricity that needs to come from RE. There are a variety of factors that determine the frequency at which certificates are issued. In some jurisdictions, the system operator issues the certificates based on the plant's production (after the plant is deemed an eligible facility by the regulator or government). In most cases, suppliers can bank certificates and use them to meet their obligations for subsequent years, though some consideration has been given as to how this affects market incentives and whether such banking contributes to the overall goal of expanding the base of renewable energy projects. This helps to foster early compliance and may help with transition period costs. Advantages of the quota-certificate system include:

- The development of least-cost resources, generally resulting in lower costs for customers because demand is for the cheapest resources
- No (or limited) direct governmental subsidization
- The development of a market-based mechanism (though such market mechanisms are still developing)

Such a system also means that cheaper technologies are incentivized over others that could be a better fit with natural resources or a higher long-term priority for development. The problem is that often green certificate schemes result in support for low cost technologies only. Experience in Europe (Sweden for instance) has shown that the immaturity of the green trading market has meant a low increase in RE supply where quotas were chosen over feed-in tariffs. In Europe, quota systems are not fully formed, so much is unknown regarding how they operate in practice and the effects over time with respect to market distortion. Certainly the fact that these efforts are relatively recent means that a degree of market distortion and higher cost is inevitable as different structures are tried, tested and adapted. In the US, quota systems have been in place for over ten years, though most trading is through bilateral agreements. There are firms that aggregate customers (in order to create more market efficiencies) and jointly sell their energy certificates to suppliers. The market is multi-jurisdictional (crossing state boundaries) and relatively efficient.

Tendering

Tendering procedures can be used to select beneficiaries for investment support or production support (such as feed-in tariffs), or for other limited rights, such as sites on public property for wind energy. Potential investors or producers compete through a competitive bidding system. Generally in such a system, a target amount of generating capacity is set forth, often specifying use of a particular type of RE. The criteria for the evaluation of the bids are set before each bidding round. The government decides on the desired level of electricity from each of the renewable sources, their growth rate over time, and the level of long-term price security offered to producers over time. The bidding is accompanied by an obligation on the part of electricity providers to purchase a certain amount of electricity from renewable sources at a premium price.

The tendering process may include use of concessions from the government. Such instances require clear processes for applications, approval of proposed projects and monitoring performance. The regulator will, at minimum, have some oversight responsibility; in some jurisdictions the regulator may participate in drafting or advising on terms and processes for tendering and monitoring compliance post-award.

Tendering is an appealing option from a process point of view. It is tangible, limited and can be directed by a small group of people to achieve a concrete objective. It has found disfavor in many countries, however, because it incentivizes bidders to make low cost offers that are unrealistic or to cut corners, leaving questions concerning long-term effectiveness and safety. In the EU, several countries used the system to jump start renewable energy development, though its success has been questioned, and among the EU Member States only France used tendering as its core incentive structure. From a regulatory perspective, when tendering is used, it is important to develop transparent rules to minimize corruption and level the playing field. Any tendering system requires transparent rules to minimize corruption and ensure the adequacy of information that is disseminated to bidders.

Power Purchase Agreements

Guaranteed long-term PPAs at fixed prices also assist in financing new technologies. PPAs usually are used as part of a feed-in tariff structure, but can attach to other incentive designs as well. The Pelamis wave project in Portugal included a guaranteed purchase price for its electricity for 15 years, supported by a specific feed-in tariff of approximately €0.23/kWh.[23] Long-term PPAs outside of a feed-in tariff are also possible (with the same financing security), but are agreements between parties rather than rates set by regulators, legislative bodies, or other governmental entity (though in many jurisdictions the regulatory entity would approve such contracts and issue standard model agreements for consideration of the parties). The PPA must be with a creditworthy counterparty (investment grade rating preferred).

The US experience with government mandated long term power purchase agreements has been mixed. In the late 1970's, while the US was in the throes of an energy crisis, vertically integrated utilities were perceived by some industry stakeholders as overbuilding large fossil-fired generation. In response, the Public Utility Regulatory Policies Act of 1978 (PURPA) was enacted to require local utilities to enter into off-take PPAs with small "Qualifying Facility" generators. The term of many of those contracts was a minimum of 15-20 years, and the prices were tied to the utility's long-term "avoided costs" (i.e., the projected costs of fossil fuel generation). The predictions made in the early 1980's as to what a utility's avoided costs would be in the 1990's and beyond turned out to be grossly overstated. As a result, PURPA contract prices that were five to six times the then-existing market wholesale price were not uncommon. As a result, consumers overpaid for generation.

Lenders who are financing RE projects frequently require the developer to obtain long-term power purchase agreements to demonstrate that the project has a predictable income stream to cover its debt obligations. Due to the relative expense of RE development as compared to traditional fossil-fired generation, the wholesale energy markets may not provide sufficient value in order to satisfy the lender. Governments have responded to this barrier to RE development by acting (or directing others to act) as a counterparty by entering into long-term PPAs with the RE developer. In the US, this is typically accomplished by imposing obligations upon electric utilities to serve as the counterparty. Although utilities can certainly be the off-take counterparties that are generally needed to spur investment, regulators must be careful how the prices in the contract are determined. Regulators also need to carefully evaluate long-term PPAs so that they are ultimately backed by customers for the term required.

A few points to keep in mind include:

- Procurements should be offered in stages, so that while PPAs are useful to provide security, the purchase and sale process should be staggered to allow for market changes and not to tie up the market in one or even a few large deals. As RE technologies mature, they will become more efficient and less costly. Utilities should stage their Request for Proposal (RFP) process to take advantage of these future efficiencies.

- Similar to staged procurements, competitive processes such as auctions can be used to ensure that efficiencies are wrung from project developers.

- The RFP process must be transparent and fair to all stakeholders. This will allow competition to flourish and give customers greater access to choice. As part of this transparency, the tendering framework should incorporate considerations for how to open competition to smaller, less established entities/project developers.

In addition, innovative deal structures that include long-term PPAs, but structure them as, for instance, contracts for differences, may allow the developer to satisfy its lender's need to finance against a predictable income stream, allowing customers to benefit when wholesale markets exceed the strike price.

Direct investment support, including loan guarantees and tax incentives

Complementary mechanisms such as investment subsidies and fiscal measures tend to be part of an overall strategy towards RE, set forth in local, regional, and/or federal policy. For the most part, these mechanisms should be seen as additions to pricing support schemes, and not a substitute for them. For instance, a feed-in tariff scheme usually includes various investment subsidies, such as tax breaks or tax waivers, licensing fee waivers or reductions and even direct state subsidies for certain building activities. In many developing countries, financing (in the form of debt/loans) may not be available due to the perception of risk by the lender (due to political, investment, or technology environments in nascent renewable energy initiatives). Investment subsidies and guarantees can help to overcome the barrier of high initial investment costs by stimulating investments in RE technologies with longer horizons for investment returns. Such subsidies are often in the range of 20-50% of eligible investment costs, or can take the form of low interest loans, long-term loans, loan guarantees and partial risk guarantees and grants. In some circumstances these subsidies may reach higher levels.

Tax incentives, such as tax credits (for investment and/or production), property and/or income tax alleviation or reduction and sales tax exemptions, are also part of the investment support mix, and are common in the US, EU, Japan and India, among other nations. Some EU Member States support renewable electricity by means of the fiscal system, e.g., favorable depreciation schemes, rebates on general energy taxes or special emission taxes, lower Value Added Tax (VAT) rates or tax exemption for green funds. Investment subsidies and fiscal measures in the EU, like all support schemes, must be in line with the Community Guidelines for State Aid for Environmental Protection[24] (which govern use of various support schemes for renewable energy in the EU). The Guidelines explains that state aid for renewable energy should result in an overall increase in renewable energy sources and not in shifts from one Member State with less favorable renewable energy incentives to another with more favorable state aid.

Since the 1980s in the US, production tax credits have been intermittently used to promote wind farm development, while investment tax credits have been intermittently used to promote both solar installations and small RE installations in general. In addition, the US has employed an accelerated depreciation mechanism in order to further incent renewable energy development. In 2010, the United States increased the focus on cash grants and investment tax credits available for wind, solar and geothermal investments with the American Recovery and Reinvestment Act of 2009, as well as $545 million of grants for wind farms awarded in September 2009. Many states also provide incentives, such as exemption from property tax, green credits, credits for equipment produced in the state, state tax exemptions and production tax credits, as well as the implementation of Portfolio Standards with purchase requirements.[25] The availability of production and investment tax credits in the US has allowed the evolution of a tax equity market, which attracted investors with sufficient tax appetite to take advantage of the tax credits that some project developers were otherwise unable to use due to their lack of taxable income. Thus, a variety of business structures have evolved to allow tax investors to essentially monetize the tax credit for the developer by purchasing the right to claim the credit at a discounted rate. This relationship is often referred to as "Third-party Ownership." In the Third-party Ownership structure, the entity with the RE project on their property does not own the project. Instead, a different entity owns the project and either leases the project to the property owner or sells the output of the project to the property owner (who normally uses the output of the facility on-site).

Incentives for RE Development

One tool to promote RE development that is used increasingly around the world is the use of a national fund. Such funds are created to support sustainable energy in particular, and most often are created by law and may be directed at support of certain technologies (e.g., increase in biogas production). These funds may also extend more broadly to different categories of initiatives, such as energy efficiency for old and new buildings, the development of distributed RE generation, or even all RE production that falls under a national legal designation for eligibility in applicable legislation. Funds are designed to be used for long-term loans, direct assistance to projects aimed at low income or vulnerable populations, and support research and development of new technologies. Resources for these funds can come from the state budget, donor contributions, targeted percentages of national lottery returns, or charges imposed within rates or on particular taxpayers or power generators, suppliers or users. Funds are useful government tools because, although the boundaries of use are set in law or regulation, flexibility can be built in to ensure that fund resources adapt to changing market needs consistent with national objectives. Such funds must be governed by rules that promote transparency, to guard against improper use of funds or awards that are not subject to clear transparent and non-discriminatory procedures.

Because renewable resources vary considerably from one geographic location to another, within a country as well as across regions, RE development requires a good understanding of optimal siting. This, in turn, requires knowledge of the specific resource characteristics – availability, variability and size/magnitude – across particular locations. Without this information, the ability of a government to set national policy that correctly targets production of RE from specific indigenous resources is limited and informed analysis is not possible. Resource mapping is an investment that governments need to make, often using specialized firms to do the job, to create the basic foundation for a renewable energy program.

Encouraging the Voluntary Sector: Making Green Look Good

The relationship between economics and social values is becoming a force in worldwide efforts to promote renewable energy. This is particularly true in North America and Europe, where the economic viability of renewable energy is enhanced by the social commitment to environmental sustainability. Since not all environmental costs are internalized in cost effectiveness analyses, some projects are necessarily looked at through a broader lens than a cost-benefit ratio for the public good. As such, some environmental practices are promoted as a social directive, rather than as a strict economic decision.

Some companies are looking to unique incentives to drive people to buy renewable energy. In the US, Dominion Green Power used a creative approach to get customers to sign up to buy its power under the renewable energy certificates system. Potential customers were asked to purchase renewable energy certificates equal to 100% of their monthly electric use (at an anticipated increase of about $15) or at a fixed additional cost, which would be around $2. The solicitation explained the benefit in terms of value to the planet "choosing 100% option avoids carbon emissions equivalent to removing 1.5 cars from the road, with an additional personal incentive of a free chocolate bar!"

Some creative companies are using the public interest in sustainability – and the public interest in being recognized as an individual or business committed to sustainability – to attract clients, even when the renewable energy costs more. The fact of being renewable is itself becoming a business, and advertising campaigns are increasing efforts to bring in business by emphasizing social responsibility. Social responsibility has become a factor, along with other, more traditional incentives, in the quest for clientele. The United Kingdom, which for a number of years focused on credits (ROCs), introduced a "clean energy cash back" feed-in tariff scheme for homeowners in 2010. To encourage homeowners to think in the longer term regarding the payback for their solar installations, British Gas and other industry partners are also testing a "pay as you save" mechanism with the Energy Saving Trust, in which residential consumers are fronted the investment cost of their solar installations, and pay it back through monthly savings on their bill. In Egypt the regulator will be a key player in the effort to make green more valuable. Under pending legislation EgyptEra, the Egyptian regulator, would be able to issue ‘green certificates’ that businesses can use to advertise their products and services both nationally and internationally (see case study on Egypt for more information).

For countries that are transitional or developing, the higher cost of renewable energy presents greater challenges, but the social aspects should not be overlooked.

THE PHILIPPINES: THE REGULATOR ADOPTS THE COUNTRY'S FIRST FEED-IN TARIFF RULES

2010

CHAPTER 4: Policy and Regulatory Mechanisms in Support of Renewable Energy

THE PHILIPPINES: THE REGULATOR ADOPTS THE COUNTRY'S FIRST FEED-IN TARIFF RULES

In July 2008, the Philippines enacted an ambitious new renewable energy law[26] and in 2010 the country's regulator, the Energy Regulatory Commission (ERC), adopted the country's first Feed-In Tariff Rules. The new law on renewable energy identified clear tasks for the Energy Regulatory Commission, including the promulgation of Tariff Rules. This country profile looks in depth at the 2010 Feed-in Tariff Rules to offer guidance as to how committed, strong regulatory contribution can result in a comprehensive renewable energy legislative framework, with incentivized tariffs that drive forward RE investment.

The Republic of the Philippines, an archipelago of over 7,000 islands in the Pacific Ocean with a population of 94 million, imports approximately 45% of its energy needs.[27] Installed capacity as of December 2008 totaled 15,681 MW. Fossil fueled power plants, primarily located in the Luzon island grid, are the dominant generation source. Renewable energy sources such as hydro, geothermal, wind and solar contributed 21.0%, 18.0% (the second largest share in the world), 12.5% and 0.2% shares, respectively. Over the last few years, the Philippines has made increasing domestic renewable energy a priority. An 8 MW wind plant, the Northwind Power Phase II located in Bangui, Ilocos Norte, became operational in September 2008, and the 2.5 MW Sevilla Mini-Hydro located in Bohol was commissioned in November 2008.

The Philippine electric power sector can be divided into two categories: the main grids on the islands of Luzon, Visayas and Mindanao, and other localized grids on the other islands. In the main grids, supply comes from the government-owned National Power Corporation (NPC) and various independent power producers (IPPs). The remaining areas are served by numerous small power plants with a combined installed capacity of approximately 250 MW. Transmission in the main grids is performed by National Grid Corporation, the investor-owned utility that holds the concession, to provide this service, while the NPC serves the other areas through its Missionary Electrification Program. There are well over a hundred distribution companies, some investor-owned.[28]

The Electric Power Industry Reform Act of 2001[29] was designed to modernize the sector and create a competitive market. The 2001 Act created the ERC and provided for the disaggregation and eventual privatization of the NPC, with the transmission component spun off under the law to the National Transmission Company (Transco).[30] The law also created a Wholesale Electricity Spot Market (WESM), to be overseen by the Philippine Electricity Market Corporation (PEMC) for the transition period, after which the PEMC functions would be transferred to an independent market operator (yet to be become operational).[31] After the Implementing Rules and Regulations were approved in February 2002, the ERC unbundled the tariffs of NPC and the distribution utilities and promulgated the grid and distribution codes in December 2001. Rules governing WESM were issued in June 2002 and the market began commercial operation in 2006, setting the stage for increased investment and competition from all forms of energy sources.

Retail prices remain high for various reasons, including drought, high-cost IPPs and reliance on imported oil. The highly concentrated WESM market may also be a factor.[32] One benefit is that implemented feed-in tariffs (FITs) do not have to compete with subsidized tariffs and existing tariff levels are not so low as to make FITs unviable.[33]

The RE Regulatory Framework

Governmental bodies involved in oversight of the regulatory sector – with impact on the renewable energy framework – include:

- The Department of Energy (DOE) – created in 1992 under Republic Act No. 7638, responsible for preparing, coordinating and supervising all activities of the Government relating to energy exploration, development, use and conservation
- The ERC, created in 2001, to regulate sector participants
- The National Electrification Agency, primarily responsible for rural electrification[34]
- The National Renewable Energy Board (NREB), created by the 2008 Renewables Law consisting of a 15-person advisory board of government and private sector representatives
- The Board of Investments, under the Department of Trade and Industry, with the power to offer tax breaks and incentives to encourage investment in the sector

In 2008, the Philippines enacted a comprehensive and ambitious renewable law, Republic Act No. 9513, also known as the Renewable Energy Act of 2008 (hereafter, the RE Act).[35] The RE Act includes mandatory purchasing of power from renewables, a renewable energy certificate market as a subset of WESM, preferential feed-in tariffs, a "green energy option" that allows consumers to choose renewable sources and various other incentives. With respect to the different market actors responsible for renewable energy development, the RE Act provides that:

- The DOE promulgates rules regarding the mandatory purchase of renewable energy, awards RE service contracts, formulates the National RE Plan, and registers RE participants.[36]
- The ERC sets rates, including feed-in tariffs for wind, solar, ocean, run-of-the river hydropower and biomass resources, as well as the pricing methodology for net metering.

- The NREB sets the minimum percentage of renewable power for the renewable portfolio standards; assists the ERC in crafting and setting the FIT system regulations as well as in the setting the tariffs; and consults with the DOE on how to establish the green energy option and on the use of a Renewable Energy Trust Fund. The NGCP is responsible for the settlement and payment of the FITs for the Eligible RE Plants, and for this purpose, consolidates the information on physical sales of all Eligible RE Plants and the RE generation for the whole country, including off-grids, and shares this information with relevant stakeholders.

The Feed-In Tariff Rules

The FIT Rules came into effect after a lengthy public consultation and comment process. The regulator posted its draft Rules for comment on its website in March 2010 and offered an open comment process. The ERC approved the Rules in July.[37]

The FIT Rules provide for:

- Guidelines as to how to establish FITs through a renewable energy charge to be collected from all consumers through the Feed-In Tariffs Allowance, or "FIT-All," a uniform charge to be imposed on all electricity consumers based on their kWh consumption. The proceeds of the FIT-All go to a fund which National Grid Corporation of the Philippines (NGCP) will manage. This fund will provide payments to the renewable energy developers based on the FITs applicable to them and their actual energy deliveries into the system. The ERC is responsible for setting the FIT-All upon petition by NGCP.

- A 15-year duration. Renewable energy developers are entitled to receive the FITs corresponding to the year it starts commercial operation for a period of 15 years. The ERC is reviewing requests from potential investors to extend this duration to 20 years.

- Annual Adjustments for cost of local inflation and foreign exchange rates. The ERC reviews and adjusts the FITs annually for the entire period of its applicability to allow pass-through of local inflation and foreign exchange rate variations, employing "a simple benchmarking indexation formula to apply to all technologies based on the applicable percentage sharing between local and foreign capital . . ." The ERC will publish these adjusted FITs annually and use them in the calculation of the FIT-All for the current year.

- Technology-specific tariffs. Further differentiation based on peak or off-peak generation, or on plant size may be instituted by the ERC, subject to additional analysis by the ERC. Such differentiation would be linked to installation targets, which the NREB shall set for each technology.

- Degression rates. The ERC may subject FITs to a degression rate to account for the maturing of renewable energy technology over time. With respect to degression, the FIT rules provide: "To encourage the RE producers to invest at the initial stage and hasten deployment of RE, the FITs to be established by ERC shall be subject to a degression rate which it shall determine based on NREB's recommendation. The Eligible RE Plants shall be entitled to such degressed FITs corresponding to the year when they started commercial operation. The ERC may approve a different degression rate for different technologies."

- FITs for self-generation. FITs shall be established for each generation plant exporting net excess electricity to the distribution or transmission network.

- Reasonable Flexibility. While fixed, the ERC may review and re-adjust the FITs if/when: (1) the installation target per technology as defined by NREB is achieved; (2) the installation target per technology is not achieved within the period targeted; (3) there are significant changes to the costs or more accurate cost data become available that will allow NREB to calculate the FITs based on the methodology included in the annex; or (4) "other analogous circumstances that justify review and re-adjustment of the FITs." However, the new FITs approved by the ERC may apply only to new RE projects. Eligible RE plants in commercial operation at the time of approval of the new FITs remain entitled to their existing FITs (although section 9.1 of the FIT Rules contains a general good cause exemption permitting changes to existing FITs when to do so "is found to be in the public interest and is not contrary to law or any other related rules and regulations").

Furthermore, the Rules state that the cost of the FIT will be passed on to transmission and distribution customers as a uniform kWH rate to be listed separately on customer bills. NGCP is responsible for collecting FIT-All proceeds to ensure payment to RE producers. A portion of the proceeds will be dedicated to a Working Capital Allowance for this purpose. In cases of delay of payment or non-payment, ERC has the authority to impose penalties, including a surcharge of up to 20% as well as monthly accumulated interest. NGCP may disconnect any customer defaulting on payment for a period of over two billing periods.

The FIT may be reviewed on an annual basis based on petition from NGCP but the Rules allow for revision of the tariff should funds in the Working Capital Allowance fall under 50% of the projected FIT-All proceeds. According to the Rules, the FIT will be set based on "forecasted[38] annual required revenue of the Eligible RE Plants; the previous year's over or under recoveries; NGCP's administration costs; the forecasted annual electricity sales; and such other relevant factors to ensure that no stakeholder is allocated with additional risks in the implementation of the FITs."

The FITs that NREB calculates and submits to the ERC for approval must conform to the Rules, except that the initial tariff may be based on "a reference cost study for each technology based on a real candidate project or a hypothetical one depending on the available information. The project to be chosen shall be representative of the average conditions of the renewable energy plant operating in compliance or at par with applicable international technical standards and practices for such technologies, and the pricing study shall consider also all non-price incentives in R.A. No. 9513." The FIT Rules provide that "the NREB shall propose the FITs taking into account the expected MW capacity for each technology that it shall set as installation targets and the number of years when this target shall be achieved. The FITs shall cover the costs of the plant, including the costs of other services that the plant may provide, as well as the costs of connecting the plant to the transmission or distribution network, calculated over the expected lives of the plant, and provide for market-based weighted average cost of capital (WAC e) in determining return on invested capital."

In summary, ERC has established a strong foundation for the FIT-All by creating a clear regulatory framework supporting the mechanism and providing a detailed blueprint of the analysis to maximize benefits and minimize cost. These guidelines allow flexibility in the implementation of the FIT while at the same time setting up a predictable regulatory environment that encourages investment in renewables.

CHAPTER 5: INTERNATIONAL AGREEMENTS, REGIONAL PARTNERSHIPS AND NATIONAL PLANS

Issues like climate change are by definition global problems, spurring international responses and national policies including promotion of renewable energy as a non-greenhouse gas (GHG) emitting energy resource. Given the very nature of climate change plans and their constant evolution, the role of the regulator in these efforts is often as a monitor, determining if there are negotiations or working committees at the government, presidential or parliamentary level regarding possible adoption of such plans. Ideally, the regulator would be fully informed of such efforts and could work toward advising and perfecting the plan so that any strategies adopted offer realistic approaches that are well integrated with existing sector needs. In practice, efforts to promote renewable energy in the context of climate change are moving quickly due to the increased political attention. This means that coordination is weak in many instances; under these conditions, the regulator's role can be proactive and self-determinative. The regulator must be knowledgeable about its country's commitments, and act as a resource to the policymakers in developing the country's renewable energy strategy.

International Agreements and Commitments

Perhaps the best known international agreement to support sustainable energy initiatives is the Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC), an international treaty that establishes legally binding country commitments for the reduction of greenhouse gases (the most well known is carbon dioxide). In addition, numerous regional agreements promote sustainability generally and renewable energy development in particular. It is critical that the regulator understand the national commitments that have been made by its government, as these may inform sector decisions.

The regulator needs to know whether its government has signed the Protocol – or other parallel international or regional agreements – to know the direction and priority of reforms, the pool of money that may be made available and, specific to Kyoto, the activities being undertaking under the CDM that may affect the portfolio of renewable energy sources in the country. In practice, non-Annex I countries have no GHG emission restrictions, but by ratifying Kyoto they demonstrate a national commitment to prevent climate change, have some emissions reporting obligations, receive some financial support and have financial incentives of different types, including for developing projects that qualify under Kyoto for credits for the Annex I countries.

The Kyoto Protocol entered into force in February 2005, and expires in 2012, with negotiations ongoing to determine the appropriate next iteration. As of early 2009, the Kyoto Protocol had been ratified by 183 governments. The basic premise of Kyoto is that industrialized countries (referred to as Annex I countries) reduce, on average, their GHG emissions by 5.2% from 1990 levels, with a somewhat differing target for certain countries. Perhaps the most controversial parts of the Kyoto Protocol were the unchanged emissions target for Russia and an allowance for Australia to increase its emissions.[39] The December 2009 conference in Copenhagen (the 15th Convention of the UNFCCC) did not result in mandatory obligations that would follow Kyoto. Nonetheless, initiatives to promote renewable energy and energy efficiency continue to expand internationally.

For Annex I countries, several approaches can be used to reach the Kyoto target reductions, from decreased production, increased RE use and energy efficiency domestically, as well as what are commonly known as flexible mechanisms such as emissions trading (a cap and trade system similar to the European Trading System), the clean development mechanism (investment by industrialized countries (Annex I countries) in developing countries (non-Annex I[40] parties to Kyoto)) and joint implementation projects (investment by one industrialized country in emission reduction projects in another industrialized country). These flexible mechanisms allow signatories to meet emissions reductions obligations through support or financing of emissions reductions in other countries rather than domestically.

For many of the regulators from regional regulatory associations such as AFUR, RERA, ACERCA, EAPIRF, SAFIR, ARIAE and ERRA, which predominantly represent non-Annex I countries, the clean development mechanism (CDM) is of some interest, though it comes with administrative and institutional requirements that can prove daunting. Under the CDM, project-based GHG reductions can be used as Certified Emission Reductions that are sold to industrialized countries for use as credits against their own Kyoto emission control commitments. The CDM incorporates a cumbersome verification and certification process, which can be time consuming and difficult to navigate. Integration with existing national credit systems is ongoing but offers potential. A CDM Executive Board must approve the project and the host country must set up a Designated National Authority (DNA) to be responsible for directing its CDM processes.[41] Brazil, Indonesia, China and India are all non-Annex I parties that have established a DNA responsible for directing their respective CDM processes, with an eye to hosting CDM projects; China currently leads in numbers of CDM registrations. A list of countries with DNAs can be found at http://cdm.unfccc.int/DNA/index.html.

The biggest debates regarding extending Kyoto – voiced loudly in Copenhagen – surround obligations that should be placed on emerging markets such as China and India. Neither is considered an industrialized country under Kyoto but both produce significant amounts of GHG and their emissions are rising incrementally by the day. As economic distribution across the globe changes, the question of which countries should pay to counteract climate change is a hot one. The debates turn on responsibility. To what extent should emerging markets pay a price for development? Where does collective responsibility start and individual (national, industry, regional) responsibility begin? In the same vein, to what extent should measures to bring energy to communities with limited or no energy supply be subject to limitations directed at reducing greenhouse gas emissions? Who has a right to develop, at what cost, and how is this cost allocated? These same debates underscore national efforts to assign responsibilities in the field of renewable energy. What body should finance the measures? What incentives exist, beyond the altruistic, to ensure that reasonable measures are adopted and supply (at high quality and reliability) secured. These questions plague regulatory and policy decision-making around the world. As a consequence, processes have been set up to encourage voluntary action that takes place in a cohesive manner.

Copenhagen encouraged participating developing countries (of which there were just over 150) to submit Nationally Appropriate Mitigation Actions, known as "NAMAs," which are reports from the government of each country detailing voluntary measures the country will undertake to reduce greenhouse gas emissions. These measures include the development and implementation of renewable energy policies, laws and projects. The reports go directly to the UN, and are meant to be a leading document with respect to national commitment to address climate change. As of early 2010, 25 countries had submitted such plans.

The NAMA approach has been adopted on a smaller scale by regional institutions, such as the EU. The analogy in the EU is the National Action Plan (NAP). To ensure that Member States achieve their renewable energy targets, the new EU Directive on renewable energy (*Directive 2009/28/EC of the European Parliament and of the Council on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC*) requires EU Member States to adopt, by June 2010, NAPs that describe the measures that they will adopt to encourage the production and consumption of renewable energies. Among other things, NAPs must specify the national specific targets for the use of renewable energies in each of the areas of electricity, heating and cooling and transport, as well as measures on:

> *Ethiopia recently issued a NAMA plan, which includes a heavy emphasis on the promotion of wind (by 2013, more than 760 MW of planned wind power capacity from seven different projects), geothermal (by 2018, more than 450 MW of geothermal capacity), and biomass projects (with a focus on biodiesel and bioethanol).*

- Facilitating the licensing of the production and distribution of renewable energies
- Technical specifications for renewable energy equipment
- Certification schemes for installers of renewable energy technologies
- Guarantees of renewable origin for electricity
- Facilitation of access to and operation of electricity grids
- Promotion of renewable energies in building codes
- National support schemes
- Specific measures for the promotion of energy from biomass, and
- Joint projects for the production of renewable energies with other Member States or third countries[42]

One task for regulators is to determine whether their government has submitted a NAMA, or if in the EU, a NAP, or their equivalents in other areas of the world. If such a plan is submitted or in process, the regulator should be cognizant of integrating renewable energy regulatory incentives with the priorities and objectives set forth in the applicable plan.

Harmonization with Neighbors and Trading Partners

Often, electricity systems and markets operate most efficiently when they cover a broad area, though efficiencies of operation and supply can be realized when equipment and structure are carefully tailored to each other. For instance, micro grids used by some industries and universities can be more reliable than much larger grids and in fact, the institutions that create microgrids do so because they need more reliable power than the distribution system can offer. But when looking at supply for the population, economies of scale often make large grids a favored choice.

The practical limits on the size of electricity systems are not fully understood, but based on experience in the US it appears that systems as large as 150,000 MW of peak load can operate reliably and efficiently. In order for larger systems to develop effectively, however, the participating jurisdictions must harmonize the rules according to which transactions are accomplished in addition to harmonizing the physical electric systems themselves. With regard to expanding renewable electricity generation, the additional strength that comes from a regional approach may prove constructive to renewable energy growth. A regional system can help minimize the impacts of intermittency, though certainly the cost of building large systems are high and optimal regional application would come from expansion and enhancement of a network already in place, assuming this can be achieved in a cost effective manner. Where cost effectiveness cannot be realized, even after a calculation of long term benefits, RE can serve as a hedge against having to build or expand transmission and distribution infrastructure. Distributed generation, in combination with demand response, storage technologies, balancing technologies (everything from natural gas plants – large or small – to flywheels), and quick-start technologies like small hydropower can all combine to create a reliable system that is cheaper than building and expanding infrastructure.

The new NAMA initiative of the UN is taking hold in Africa, and to maximize its effect, a regional approach is being applied: at the end of 2009, the World Future Council and the Alliance for Rural Electrification helped African nations set up the African Renewable Energy Alliance to spur broader electrification and fight climate change. Among its members are the Union of African Utilities, which represents 54 private and public electricity producers and distributors in 43 countries as well as industry members and policy-makers. The Alliance founding declaration states, "Now is the time to set the course towards a massive uptake of renewable energy for all people in urban and rural Africa."

Where economically sound, a renewable energy framework that is regional offers benefit to many countries at the same time. The key is to develop the plans in the context of resources, politics, and economics of the country of production, and neighboring jurisdictions. Certainly, variations may create difficulties in the liquidity of the market for renewable attributes, meaning the ability of the renewable electricity producers to market the value of their production beyond the value of the energy itself. Harmonization need not take the form of identical standards and timetables for renewable power development. It would not, for example, be a disadvantage to a producer in one country if the countries into which it sold its attributes each had different "portfolio" requirements (i.e., the percentage of power that had to be produced using renewable resources), or had differing schedules for achieving particular renewable percentage levels. A different definition of what constitutes renewable energy could be problematic, however, as could significantly different rules regarding licensing, trade and import arrangements.

The first step in harmonization is establishing regional organizations from which plans and actions emerge that facilitate renewable energy growth in each participating country. Such organizations are vital not only as venues for information exchange and education, but also for the development of agreements on the regional and national level. For the regulator, participation in such regional initiatives is crucial. Often, utilities and governments attend, without adequate representation from regulatory bodies. In these cases, the regulator should seek out government representatives, the regional bodies and also donors to secure participation. For those that are able to attend, the opportunity to share information could be used to maximum effect. The regional platform can be invaluable to move individual countries towards commitment, such as greenhouse gas emission targets and regionally agreed-upon definitions for what qualifies as a renewable resource in each country. These moves also facilitate entry by investors into the market. In particular, they help attract capital to areas that are physically and environmentally well suited to the development of a particular resource, rather than encouraging development based on relatively more favorable rules. Achieving regional harmonization, and minimizing local attempts to "capture" resources by offering more attractive regulatory or financial packages, will require inter-jurisdictional arrangements to ensure that benefits and burdens are distributed across the region in a fair and transparent manner. The objective of consistency is important because any local differences in treatment will inevitably lead to at least some degree of inefficiency – in other words, customers in the region will pay more for the same level of overall benefit.

Investors, particularly those that are multi-national or supported through international financial institutions or donor agencies, are encouraged by environments that allow for a broad customer base (in the country of operation and in other countries that are part of the region through trade). In the end, most investors will be driven by the need to realize the value of their investment in the market – and thus reduce the level of required subsidy. For example, a regional agreement that a producer in any jurisdiction could sell its production, without further licensing obligations, into other jurisdictions, would reduce the transaction costs of participating in the regional market and encourage development. There are always issues of national/regulatory and governmental autonomy, and these must be carefully addressed in any regional process to ensure sufficient respect for national jurisdiction is offered. This means consultation, the development of framework agreements with minimal micromanaging of execution, reporting processes that do not intervene in national affairs beyond agreed-upon terms, and a staggered process that allows for planning and negotiation, with an understanding that voluntary commitments may need to proceed or be substituted for mandatory commitments if broad national buy-in cannot be achieved.

South Africa's Renewable Energy and Energy Efficiency Partnership Regional Secretariat (REEEP-SA) is tasked with ensuring that steps taken in South Africa to remove barriers to RE development and use as part of regional trade, are coordinated and mutually supporting. REEEP-SA is building up a growing network of Southern African NGOs, experts and companies in the sustainable energy network, with a focus on activities such as: facilitating financing through workshops and networking; supporting the development and dissemination of innovative financing mechanisms through REEEP-funded projects and events; collecting and collating information on important Southern African case studies as a basis for networking, information exchange and political capacity-building; contributing to the activities of REEEP-International; and providing an access point to the REEEP network in Southern Africa.

The EU offers a good example of how a regional framework can be developed to promote renewable energy development, while respecting the autonomy of the individual nations that make up part of the EU. In recognition of a need to increase the requirements and make commitments mandatory (and after significant consultation and negotiation periods), in June

2009 the EU adopted the Renewable Energy Directive[43] (RED) and a companion Directive, the Fuel Quality Directive 2009. The deadline for the EU Member States (of which there are now 27) to implement the RED is 5 December 2010, with Member States required to submit National Action Plans to the European Commission by the end of June 2010, detailing how they intend to meet their obligations. Each Member State will have to submit a report on progress towards its targets by 31 December 2011 and every two years following that, with the sixth report submitted by 31 December 2021. The overall target is 20% renewable energy by 2020. With respect to individual Member State obligations, the RED sets forth mandatory differentiated targets for each EU Member State, taking into account national potentials based on GDP per capita, global energy consumption and resources.

The RED also creates a voluntary trading mechanism, allowing Member States to transfer their Guarantees of Origins to other countries as long as they have already reached their national targets (trade is prohibited if countries have not reached their targets). The main objective of this mechanism is to enhance market stability and help lagging Member States achieve their RE targets. Importantly, the RED also requires electricity transmission operators to provide RE producers equal access to the electricity grid. The Directive urges that: rules concerning the costs of such connection be transparent and non-discriminatory; priority access be given to renewable energy under certain circumstances; administrative burdens be removed from producers (i.e., a one-stop shopping system for approving construction permits); and transparency be improved, with the objective of catalyzing investment. The EU also gives particular attention to the issue of overlapping and cumbersome administrative measures that may impede successful implementation of sustainability goals. The RED includes several provisions designed to address the need for non-discriminatory procedures, transparent rules, proportionate measures and the like. The RED recognizes the need for attention to the intersection of national, regional and local administrative procedures. Spatial planning is specifically mentioned, highlighting that, wherever possible, requirements should be expressed using European-wide standards to ensure compatibility and ease.

The "Baku Initiative" was launched at the Energy Ministerial Conference held in Baku in 2004 with the participation of the European Commission and Azerbaijan, Armenia, Bulgaria, Georgia, Iran (observer), Kazakhstan, the Kyrgyz Republic, Moldova, Russian Federation (observer), Romania, Tajikistan, Turkey, Ukraine and Uzbekistan. The Baku Initiative seeks to create a functioning integrated energy market, specifically through legal reform, extending and modernizing existing infrastructure; and integration of efficient and sustainable energy systems. In 2006, a road map for achieving these goals was developed, and efforts are ongoing.

In strategically important regions, such as the Black Sea region, regional initiatives have the potential to facilitate economic growth and improve security of supply across many countries if infrastructure is sufficiently developed over time. Regional efforts can have the accompanying benefit of spurring forward needed infrastructure development that is consistent and integrated. For regulators the core benefits of a regional approach are:

- Capacity building, in particular assisting the regulator in setting up transparent and open rule- and decision-making processes and legislative frameworks that minimize regulatory risk and encourage investment, while building the technical skills of the regulatory staff.

- Harmonization of frameworks so that trading can be realized (i.e., cross border tariffs are eliminated or equalized, auctioning rules are agreed upon in advance, operations are coordinated)

- Working relationships with sister agencies and government policy makers to educate regulators on the challenges to regulated utilities resulting from particular renewable energy policies and to help authorities better understand and implement the desired policy objectives

CHAPTER 6: THE REGULATORY ENVIRONMENT

Regulators are uniquely positioned to help their countries realize the opportunities brought by renewable energy. They have an unparalleled understanding of (and access to) the energy market, which in turn provides an understanding of the impact of renewable energy development in relation to energy pricing, market needs, and operation and infrastructure potential and limitations.

The authority of a regulator – indeed, the presence of an independent entity known as an energy regulator – differs across jurisdictions. In the energy sector, best practices show that an independent regulator with authority in key areas such as tariff-setting, license issuance and monitoring is vital to the development of a liberalized energy sector conducive to investment. Renewable energy falls within the energy sphere but is treated differently for several interrelated reasons. This Chapter reviews best regulatory practices, places the emerging field of renewable energy within the context of regulation and regulatory responsibilities, and looks at the various models around the world for regulation of renewable energy. The regulator should become familiar with and make use of the communications tools that will help ensure that the regulator's constituencies – including in particular the public – understand the reasons for, and the benefits and risks of, the decisions undertaken by the regulator in furtherance of these objectives.

Renewable energy is an extraordinary growth industry. It is constantly changing. The frameworks themselves are fluid, with governments still assessing the optimal support structures and portfolio needs and opportunities. So too, the special incentives directed at renewable energy differ from treatment of conventional energy. As a consequence, the two general types of energy – renewable and conventional – are sometimes segregated, with incentives adopted and implemented by bodies other than the energy regulator, despite clear overlap. Because this area is fluid, it is expected that regulators with limited authority in renewable energy increasingly will find themselves called upon to regulate – in an advisory or decision-making capacity – the production, sale, distribution or transmission of renewable energy. As noted in the Executive Summary, regulatory structure and accompanying authority for renewable energy generally fall somewhere along the continuum of no formal authority to partial authority to strong formal implementing authority over RE policies.

> *Morocco's commitment to renewable energy development is being realized in dual paths: the first, a slow but steady effort to build a legal framework with licensing, quality of supply and tariff rules, and the second, an accelerated path to build large solar projects that will go into operation by 2020. To do this, the Moroccan government has established MASEN, an agency dedicated to seeing through 2000 MW solar projects (five different projects are envisioned, with the first plant to be commissioned by 2014). MASEN is leading the projects, inviting expressions of interest and responding to these, with a governmental mandate to oversee the entire procurement, construction and operational development process from start to finish.*

Models for how to transpose renewable energy strategy into legislation or regulation vary across jurisdictions, and fall on a continuum between significant regulatory authority for adoption and implementation, and minimal to no authority for the same.

Model: Strong Regulatory Authority

In some countries, the government will adopt primary legislation that is broad and gives only general direction to other administrative bodies, such as the energy regulator ("Government" here means parliament, ministry or executive, depending on applicable government structure). Under this model, the law brings greater definition to energy strategy, structuring the strategy to assign responsibility to different entities, but leaves the details of implementation to those entities. For instance, an energy strategy could give national targets for renewable energy, prioritize certain types of renewable energy based on resources and other economic priorities, place limits on the time and scope of any incentives offered, and assign responsibility for implementing those incentives to an energy regulator, which is then given the power to make decisions and issue supporting regulations in concert with existing policy.

Oman's energy regulatory authority stands out in the region for leading RE initiatives, driving the sector toward competition, and rejecting the need for FITs. When the regulator assumed responsibility, there was no clear framework for renewable energy projects and limited due diligence, so the authority designed and led programs in each; it is now spearheading efforts to realize the recommendations of due diligence and the rules set forth in the new regulatory framework, advocating competitive tendering for large renewable energy projects, purchase obligations and consumer protection safeguards. Pilot projects are underway, with a large solar project targeted for 2011, all under the leadership of the regulatory authority.

Model: Limited Regulatory Authority

More often, the regulator is given some but not full authority, either because decisions from the regulator must be approved by another authority, or entities other than the regulator have some decision-making power that also impacts regulatory implementation of renewable energy frameworks in support of RE projects. In these instances, it is vital that the framework clearly set forth which entity is responsible for each aspect of implementation, and how all the various pieces of regulation fit together. Because this is a relatively new and expanding area, clarity as to roles and responsibilities is often lacking, hindering not only project implementation but also initiation.

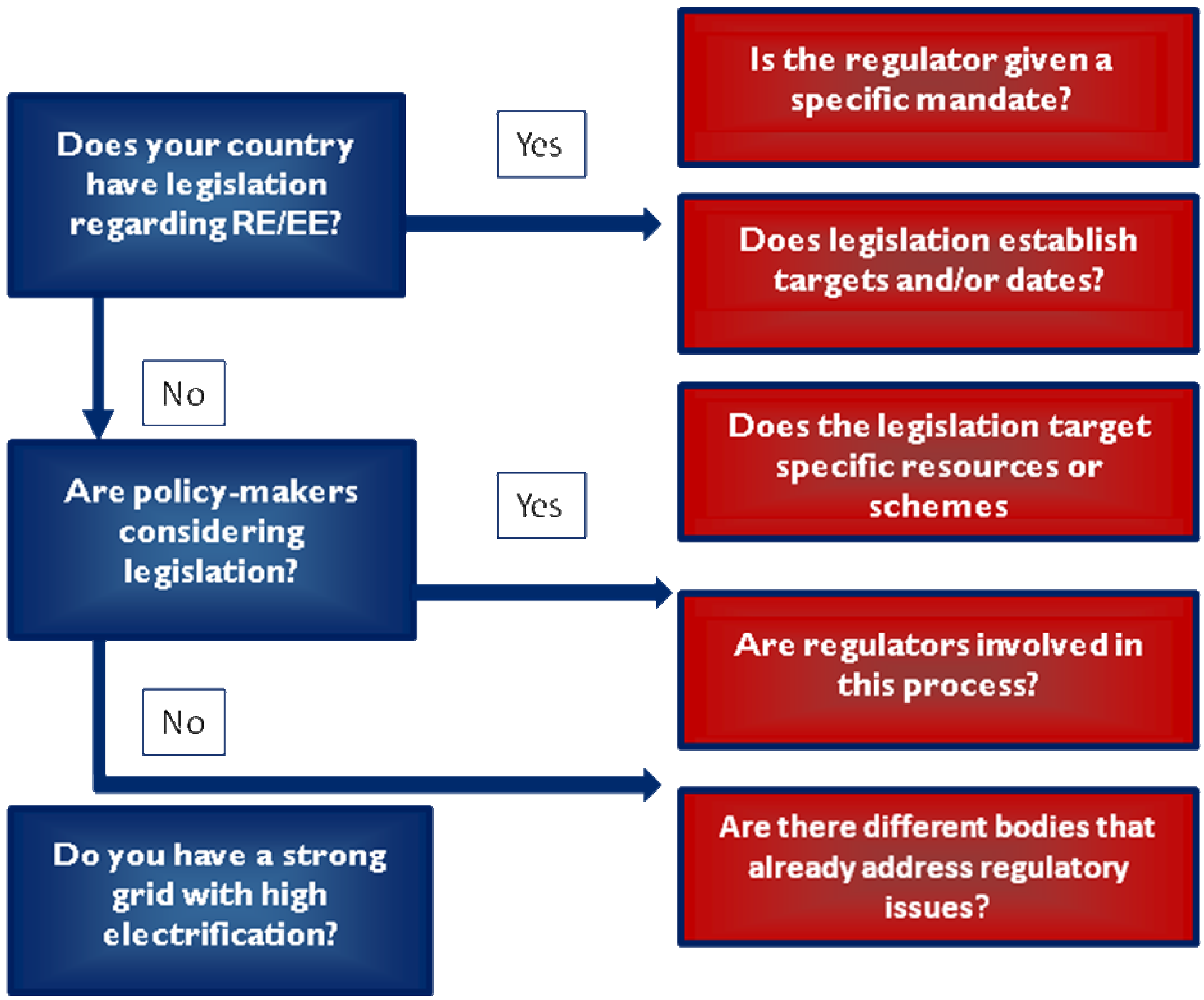
Model: No Formal Authority for the Regulator

Under another model, the primary legislation adopted by the government also provides detail as to the nature and level of the incentives. It may, for instance, define the amount of a feed-in tariff for a particular type of energy. This is a common approach in Europe (in Germany, for instance, where wind energy in particular has grown at unparalleled rates, the primary legislation sets the amount of the feed-in tariff and the energy regulatory body monitors the market, including the renewable market, but does not fix the tariff).

In Botswana, there is no energy regulatory body, and energy policies are developed and implemented by the Ministry of Minerals, Energy and Water Affairs, which monitors and approves the tariffs of the monopoly utility Botswana Power Corporation. The Ministry's Department of Energy has developed a plan to increase renewable energy consumption to 1% of total national energy consumption by 2016 ("Vision 2016"), and to integrate grid and non-grid technologies for rural electrification. A biomass energy strategy is also under development.

The flow chart below identifies some of the questions that regulators may want to ask when considering the different levels of responsibilities that may attach to the energy regulatory role.

Quick Reference Guide/Self-Evaluation Chart



Regulatory Considerations Persist Irrespective of the Model

Whatever the model applied, regulatory issues will be implicated. Typically, the role of the regulator in renewable energy promotion can include:

- Licensing – to create streamlined rules or exemptions for small renewable energy producers and distributed generation, while ensuring that the process is non-discriminatory and transparent
- Grid codes – to ensure open access to the network, and facilitate interconnection, and address variability issues

- Pricing – to encourage the use of renewable energy sources through various pricing responsibilities, including the establishment of feed-in tariffs and development of network expansion to facilitate renewable energy use, e.g. the United States Federal Energy Regulatory Commission has approved regulatory approaches developed by the California Public Utilities Commission for management of cost recovery for transmission development to facilitate connection of remote renewable electricity generation

- Net metering – to enact regulations to encourage consumer production of renewable energy

- Power purchase agreements – to draft template or model PPAs for renewable energy resources

- Green certificates – in jurisdictions where the regulator has authority to do so and a market that can support this kind of structure, to partner with a system operator to establish a trading platform that allows participants in the energy markets to buy and sell the environmental attributes of RE (done in the United States in certain jurisdictions)

Guiding Principles in the Regulatory Contribution

In order to carry out regulatory mandates or use regulatory expertise to contribute to the policy decisions that form these aspects of renewable energy development, the policy, legal and regulatory framework in a country must be based on clarity, predictability and transparency.

Clarity. The laws, policies and regulations must be written in a manner that can be understood by customers and potential investors. The combination of laws, policies and regulations that make up the energy policy must also be coherent and accessible.

Predictability. Customers in general, and commercial and industrial customers especially, value cost predictability. Businesses must plan months and years into the future, and the predictability of prices for inputs such as electricity can contribute to the success of such planning. The increase of renewable electricity in the generation mix will itself likely have the effect of increasing the predictability of future rates, because for most renewable resources, fixed costs predominate over variable costs, so the cost of electricity produced by such resources can be more easily predicted in advance. Predictability and lack of volatility must, of course, be balanced against the risk that costs for other generation may fall relative to the prices paid for renewable generation, in effect "locking in" higher prices and creating pressure to abrogate or amend power purchase agreements with high priced resources.

Transparency. The development and implementation of any policy, including policies designed to encourage renewable generation and increase energy efficiency, must be fully transparent. This is especially important where the time horizon over which benefits will be achieved is long and associated price increases immediate: customers who will bear the burden of the near term costs will have an interest in ensuring that policies are being implemented as efficiently as possible. For this reason, all the steps in the process concerning these programs should be open and well defined, and should minimize opportunities for favoritism or other forms of corruption. The selection of the criteria for renewable targets, for example, should be as objective as possible, and clearly linked to overall policy objectives. In addition, the selection of particular resources should be accomplished through an open and transparent mechanism, such as an auction conducted according to sound procurement rules. Individually negotiated franchise or power purchase agreements should be avoided, as these provide an opportunity to mask corrupt behavior and are unlikely to produce the most cost effective means of achieving the targets. In some cases, these will be essential to bring renewable energy to the market; if so, then agreements must be made public and the terms must be transparent.

Assurance must come from a law that is public, transparent and accessible, such that investors and stakeholders in the country alike can easily read and understand the rules on access and the requirements to facilitate such rules in a non-discriminatory manner. Such laws should be supported by at a minimum a national policy, a regulatory body that provides effective oversight of grid access, and rules that define the procedures for requesting and granting access as well as resolving any disputes that may arise from access denials, delays or unreasonable fees that may impede effective operation. The sound development of third party access is a central tenant of this framework. Where investment is required to facilitate grid access (a particular problem of renewable energy producers due to the outlying locations of many wind farms or biomass plants), interconnection rules serve to identify responsibility for payment of investment in new transmission lines, thus reducing potential for disputes between investors in RE sources and existing network owners and utilities. In sum, regulators should:

- Consider coordinating oversight with all relevant regulatory bodies
- Develop grid access policies to ensure that renewable energy developers have access to markets and customers
- Review, and if needed revise, grid management policies to accommodate intermittency and unique RE dispatch scenarios

Factors Influencing the Content of the Regulatory Contribution

Finally, the regulatory role is defined and circumscribed by a variety of contextual issues, of which the key ones include:

Market opening/competition. Market liberalization is being achieved to varying degrees throughout the world. The principal elements of liberalization, which are often but not always combined, include opening electricity production to merchant providers; developing wholesale competitive electricity markets, which in turn may be based on a variety of models ranging from "real time" and "day ahead" markets to more limited administrative approaches; permitting or requiring customers to purchase their energy and capacity (though generally not their distribution or transmission) services on the open market; and the creation of local or regional transmission organizations that are separate from generation or distribution interests. Increases in renewable electricity production, as well as efforts to increase energy efficiency can be accomplished under any degree of market liberalization, from vertically integrated government-owned electricity systems to completely disaggregated competitive markets. The regulatory tools that are most effective in achieving these policies, however, must be tailored carefully to the particular structure in place. Further, the tools must be employed in a way that can accommodate changes in the degree of liberalization without distorting either the programs involved or the efforts to liberalize.

Economic viability. As noted in Chapter 3, the benefits of renewable energy are likely to extend beyond short term lower cost, or at least beyond reductions in the kinds of costs with which electricity regulators are most familiar. There is little dispute that new renewable production should be encouraged in order to reduce carbon emissions, and to moderate climate change. Accurately measuring the impact of such new generation, both in terms of its physical impact on the environment and the long term cost savings associated with that impact, is likely to be extraordinarily difficult if not impossible tasks. On the other hand, the cost of adding renewable resources beyond those that would be supported by the market in the short term will have immediate and in some cases significant rate impacts on customers. Put another way, regulators may be confronted with balancing the value of benefits that may be difficult to quantify and that may not be realized for years or decades, against the burden of costs that are certain and immediate. It is important to consider the reactions and incentives of the network companies and whether steps can be taken within the tariff framework to allow the network owner to share the cost of the higher tariffs with other sector actors, such as generators, customers and distributors. Some regimes have this (such as Denmark), others do not.

Samso, Denmark is an island powered entirely by renewable energy. It achieved this through an innovative cost-sharing approach that allowed its 4,000 or so residents (energy customers) to own shares in the wind turbines. At present, about 10% of residents own shares in the turbines, and receive a check annually based on output and price of electricity.

The impact of variability on the system. The energy sector is looking and in many cases finding solutions for the operational, regulatory and economic impacts of the variability that accompanies renewable energy. Forecasting has been steadily improving over the last few years, offering greater detail over a variety of time horizons (week, day, hour). Because forecasts increase in accuracy closer to dispatch time (in other words, it is far easier and accurate to predict the wind level in 5 minutes than in 5 hours), strategies such as intra-hour scheduling are being applied, with some success. In addition, variable energy requires consistent interconnection standards that specify response to system faults and set frequency and voltage requirements as well as communications and external control requirements. It is difficult for wind turbines to comply with rules prepared for traditional generation. Although the newest turbines can comply with strict requirements, these rules require assessment of appropriateness for new technologies. Increasing amounts of wind may

In Europe, there is a wide variation in grid codes from country to country. The European organization of transmission system operators, ENTSO-E, is working hard at harmonizing grid codes. It is doing so while recognizing that different requirements may be appropriate for countries or regions with different levels of variable energy. At the same time, Europe, which has an increasing amount of wind generation (expecting 200 GW of wind by 2020), is studying and making recommendations as to how this increase will affect its market; a March 31, 2010 European Wind Study sets forth numerous recommendations for better integration of this resource.

have implications for grid stability due to changes in voltage and frequency, and strict or overly costly interconnection standards may discriminate against variable resources. Solutions include new market designs, and these in turn include more frequent reliability assessments, modification of penalties for variable resources for failure to deliver, and modification of other requirements for capacity markets. All of this means that the regulator has numerous important considerations to weigh as renewable energy comes to market.

In general, effects of variable energy resources are mitigated when spread out over larger geographic areas and markets. This suggests a need for harmonization of balancing markets, and additional transmission infrastructure to eliminate congestion and facilitate inter-area load flows. Here too, the regulator can prove invaluable in helping to manage or even lead the management of such moves toward harmonization and grid development.

Communication between regulators and policy makers. Due to changes in the renewable energy sphere – in terms of policy and regulatory framework but also in terms of generation mix and development – it is especially important for policy makers to provide the regulator with as much specificity and clarity as possible with respect to market design (including present status in relation to future plans), the level of renewable production that is to be achieved, and guidance as to any implementation priorities. The question of how to balance long term environmental goals against near term price impacts is not one that can be "solved" using the metrics available to regulators concerned with the economic regulation of electricity. The question is fundamentally a political one and an important role for the regulator is to help inform the "political" debate so that those making the policy decision are aware, to the extent possible, of the economic implications of any course they may choose to take.

Tracking attributes/certificates. Regardless of the regulatory structure adopted to achieve more renewable electricity production, some reliable and transparent mechanism is needed to confirm the quantity and environmental characteristics of that production. When renewable attributes can be traded separately from the energy produced by a facility, as is increasingly the case where efforts to increase renewable production are underway, tracking and verifying the amount and character of renewable production becomes especially important. Renewable energy attributes can take a variety of forms, such as renewable energy certificates as part of the Renewable Portfolio standards in the US, or "guarantees of origin" in the EU.

A clearly designed system for tracking attributes allows load-serving entities to develop specific products for retail consumers with a high degree of certainty that their product claims can be verified. For owners of generation, a certificate approach provides a means to precisely measure the quantity of particular attributes of each generation unit. For state agencies seeking effective ways to implement policies and regulations, a certificate approach and central database provide a means to monitor, verify and document compliance. The EU and the United States have taken the lead internationally in creating systems to track attributes across State/country borders.

In the EU, rules on tracking attributes apply pursuant to the new Directive on Renewable Energy (RED). Guarantees of Origin (GO) are to be used to demonstrate the amount of renewable energy in a supplier's fuel mix. The GO can be traded between suppliers across countries, but only affect suppliers' fuel mixes. The goal of the GO under the RED is to verify the origin of electricity and heat produced from renewable generation facilities where those facilities have a capacity of at least 5 MW. The GO must be accurate, reliable and fraud resistant. GOs must include information regarding:

- Intended use – i.e., for electricity, heating or cooling
- Source
- Start and end date of production
- Capacity of the installation
- Any benefits from support and the type of support scheme
- Commissioning date
- Date and country of issue
- A unique identification number

The tracking of environmental attributes (certificates) present particular challenges for regulators. Regulators must exercise caution when exploring a model that contemplates regulator partnership with the system operator to establish the trading platform. The market characteristics to support a trading platform must be in place in order for the certificate program to function properly. Both the electronic and physical infrastructure are required in order to facilitate certificate trading, and both conditions are not normally met in most parts of the world. Where the regulator's authority is less extensive, the regulator can assist the operator and other stakeholders to create a system most beneficial to the country. Should the regulator attempt a variation of a trading platform, it should address:

- Complex permitting arrangements, requiring simplified and standardized regulations
- Inadequate legal infrastructure, including but not limited to the absence of special procedures in support of smaller-scale (10 to 50 MW) RE projects allowing them to bypass the normal review process
- Insufficient grid capacity as a major technical challenge, including high voltage transmission lines, low voltage distribution lines, and transformer substations
- Responsibility in some jurisdictions for network owners to pay the higher prices set by feed-in tariffs, thus disincentivizing them to support access and connection for RE, unless the full regulatory framework provides them with sufficient compensation to pay preferential feed-in tariffs

Infrastructure/grid development. Successful grid development in support of renewable energy projects may require coordination with a number of governmental bodies and compliance with relevant legislation. For grid expansion planning, governments need to establish a forecast for the development of RE projects, including the expected availability or the potential share of each RE technology regarding energy production in the different regions of the country on a yearly basis until 2020. Moreover, key technical and operating differences among the specific RE systems are also significant, e.g., wind power is variable in availability and capacity, hydropower capacity is lower in dryer summer months, solar electric systems require that the sun shines.

Care must be taken so that grid interconnection ordinances are harmonized with other national and local laws. In the same vein, limits on purchase obligations or new development must be consistent with grid capabilities or at least in line with funding allocations for grid development.

In order to facilitate the review of interconnection applications, regulators should:

- Train government and private sector specialists in the following areas: electricity transmission engineering and power flow modeling; finance; utility management; law; marketing; regulation; negotiation and arbitration; information systems and database development; planning and policy development; data collection; and environmental analysis

- Evaluate technical issues including parameters of power loads and flows in transmission systems; the status of regulatory, financial, and legal systems; energy sector forecasts and planning; demographic and social data; resource, hydrologic and environmental data; and data on the costs and performance of RE source energy and environmental technologies

In sum,

- There are a variety of templates available for the role of the regulator in policymaking and decision-making in the RE arena

- Whatever template is chosen, the regulator will have some input

- In exercising its authority, the regulator should keep in mind the guiding principles of clarity, predictability and transparency

- The substantive content of the regulator's contribution will be influenced by a variety of factors, including the governing market framework used, economic considerations and procedural processes

- Elements needing particular regulatory oversight in the RE context include certificate tracking and grid interconnection

Inter-Regulatory Coordination

In order to develop a fluid market in renewable energy that crosses borders (state or national), the definition of what is considered "renewable" is important. If there is a size limitation on hydro facilities in one country, producers above that size will be unable to sell their renewable attributes into that country, and with a smaller market available to them, will (all other things being equal) require a greater subsidy. This is a problem in particular for hydropower; there is little agreement whether large hydropower should qualify for certificates given the environmental costs of such projects. As regulators advise on renewable energy policies, and implement those policies, they should develop a clear understanding of the areas where regional interests are common, where they diverge, and the policy implications of these differences. Part of doing so means coordination with neighboring regulators as well as a keen understanding of international best practices.

There are always multiple bodies involved in renewable energy, including an energy regulator, the ministry, environmental agencies and more recently government bodies set up with the specific mandate to address climate change. Part of the challenge for any country, region and entity seeking to regulate energy and renewable energy integration in particular is to coordinate with other agencies that may have related responsibilities that affect how renewable energy is developed and applied. The "one stop shopping" structure is gaining ground in some jurisdictions, most notably in Europe, where the complexities of multi-agency regimes are acknowledged and solutions in the form of streamlined information or response points are appealing. On a regional basis, regional regulatory boards, or regional forums for operators or others engaged in parallel tasks related to renewable energy promotion, serve to coordinate activities and guard against a lack of organization. This issue of coordination, however, is one of the biggest obstacles in the renewable energy sphere.

Special Issues for Transitional and Developing Countries

Countries with fewer economic resources face particular hurdles in promoting renewable energy. Demand for energy is growing rapidly in many of these countries. They do not have the economic resources to pay high initial capital costs, and are in even less position to reflect societal costs in the market to encourage use of renewable energy through governmental subsidies. Asking developing countries to look beyond short-term economics is an even greater challenge than with their more developed counterparts. Yet there are multiple factors that make the promotion of renewable energy resources particularly attractive in these countries:

Small steps mean more. Often it is these countries in which the use of renewable energy resources has the greatest potential benefit, given the impacts of the current options to renewable energy – such as deforestation from the harvesting of wood. Often small and incremental steps, such as distributed generation, can have substantial effects, spurring economic development in general, and greatly improving quality of life.

RE can mean exploitation of local resources. Renewable power often relies on resources found domestically – waste, sun, wind, water – and for that reason can offer more viable and economically sound choices, particularly when transportation and costs are considered.[44]

RE can be the more attractive option in remote and rural areas. Transporting electricity generated by conventional fossil fuel plants can be an expensive proposition in rural and remote areas, producing renewable energy with local resources can avoid those costs.

RE technologies can be put to multiple uses. Renewable energy technologies, e.g. solar, can assist in alleviating poverty by providing energy for cooking, space heating, and lighting.[45]

The argument in favor of making RE choices may hold particular advantages in developing and transitional countries. Before reviewing specific types of RE and case studies of projects undertaken in hydropower, wind and geothermal, as well as an example of a successful distributed generation project, this Handbook examines the efforts of Egypt to create the supporting frameworks to advance RE offers an example of the stepping stones to RE development (see Egypt case study).

EGYPT: BUILDING THE FOUNDATION FOR RENEWABLE

2010

CHAPTER 6: The Regulatory Environment

EGYPT: BUILDING THE FOUNDATION FOR RENEWABLE ENERGY INVESTMENT

With a population of over 78 million (99% of which has access to electricity), Egypt is the 16th most populous country in the world. It has depleting oil reserves,[46] more plentiful natural gas resources,[47] and impressive wind and solar potential. Egypt is also strategically located as a transportation hub and has electricity interconnections with Jordan, Syria, Iraq, Turkey and Libya.

Electricity demand is increasing at about 7% annually and is expected to continue to grow at this rate for the foreseeable future. Egypt's peak electricity demand reached 21,330 MW for the fiscal year 2008/2009 (fiscal year June-July).[48] Under Egypt's five-year plan (2007/2008–2011/2012), Egypt intends to add 7,750 MW of power generation capacity to meet the expected average annual demand growth rate of 6.38%. For the five-year plan (2012/2013–2016/2017) an additional 11,100 MW will be needed to meet the expected average annual demand growth rate. Thus Egypt is looking to a portfolio of resources to increase supply, including rapid addition of thermal plants, most of which are combined cycle gas.[49] In January 2010, the Egyptian government announced that it was considering constructing five IPPs, with a total capacity of 3,500 MW. Recently built combined cycle plants include Cairo North (1,500 MW), Nubaria (1,500 MW), Talka (750 MW) and El-Kureimart (750 MW).

At the same time, Egypt has some of the highest greenhouse gas emissions in the world. The Arab Forum for Environment and Development states that rising sea waters risk shaving 6% off Egypt's gross domestic product, while UN studies indicate that possible flooding of 4,500 square kilometres of agricultural land in the Nile Delta would cost $35 billion. To address the dual issues of demand and emissions, Egypt is taking impressive steps to develop its considerable renewable energy potential.

The regulatory system was designed in 1998, while the Egyptian Electrical Utility and Consumer Protection Regulatory Agency (EgyptEra) became operational in 2001. Movement appears ongoing towards both regulatory strengthening and price rationalization, which are needed to make Egypt's renewable resources more cost competitive and therefore attractive to private investors in the long term. In the RE field, EgyptEra has prepared itself over the last few years to ensure sound regulatory frameworks and its capacity to address an influx of new renewable energy projects.

This profile reviews how Egypt is moving towards this goal by examining (1) Egypt's resource potential; (2) the application of and adjustments made to the regulatory framework to encourage use of RE potential; (3) the incentives used as interim steps until the RE market is developed; and (4) the crucial role of the regulator in helping to bring these goals to fruition.

Existing RE generation and potential penetration in Egypt's energy mix

Egypt's wind and solar energy potential has been mapped and appears substantial. Two-thirds of the country's geographic area has a solar energy intensity of more than 6.4 kWh/m2/day. In some areas of the country, such as the Red Sea coast, the wind speed approaches at least 10 m/sec.[50] The country has set a target of reaching 20% of its energy mix from renewables by 2020 (primarily hydro and wind) and 50% by 2050.

In order to understand the work of EgyptEra to ready itself for RE penetration, it is important to review the background of the Egyptian energy market and the various RE strategies and initiatives now in place. In brief, the Egyptian Electricity Holding Company (EEHC) continues to own over 90% of Egypt's generating capacity and transmission and distribution also remain a monopoly under the EEHC umbrella (which includes six generating companies, nine distribution companies and one transmission company). Generation facilities have been built using the build, own, operate and transfer (BOOT)/IPP model. Egypt has a long history of using the BOOT model; in fact, the Suez Canal was financed using this approach. Sidi Kiri, a 683 MW natural gas power station, was the country's first IPP. Using a 20-year PPA BOOT approach, the project was awarded to InterGen in 1998 and commercial operation began in 2002. Additional facilities were built at Port Said and the Gulf of Suez using similar models.[51] In 1996, a law was enacted allowing foreign entities to own power stations, but (flowing from nationalizing of electricity assets in 1962) most remain under the publicly-owned EEHC.

With respect to renewable resources, approximately 11.2% of Egypt's power comes from hydropower facilities, the first of which was built in 1960. This facility, the Aswan Dam, was constructed to control the Nile water discharge for irrigation. In 1967, the 2.1 GW High Dam hydropower plant was commissioned, followed by the commissioning of the Aswan 2 power plant in 1985, the commissioning of the Isna hydro power plant in 1993 and that of Naga-Hamadi in 2008. Power generation from gasification of sewage sludge in waste water treatment plants is already being used (for example, the El-Gabal El-Asfer 23 MW plant), with a potential generation of 1,000 MW from agricultural waste.

Less than 1% of Egypt's current energy mix comes from wind, despite an abundance of wind resources, particularly in the Suez Gulf area: Western Egypt (west bank of the Nile), Kharga region, Eastern Egypt (east bank of the Nile) and the Gulf of Aquaba area.[52] As of 2008/2009, Egypt's New and Renewable Energy Authority (NREA), the authority affiliated with the Ministry of Energy that manages Egypt's clean energy portfolio, has installed 425 MW of wind power, including a wind farm at Zafarana. Zafarana has been operational since 2004 and has a capacity of 360 MW, where wind averages 9 meters/second. Egypt has registered Zafarana as a CDM project. Though wind penetration is small at present, Egypt's experience with wind projects goes back 20 years, with a plant of installed capacity of 405 MW. Various studies indicate that electricity generated from wind resources represents the best opportunity for Egypt's RE to reach competitive prices with electricity generated from oil and gas. Similarly, solar penetration is negligible (though undergoing radical advances), though Egypt receives some of the highest solar radiation in the world (up to 3,000 kWh per square meters per year) and 96% of the country is desert, making it a prime location for use of this resource. More than 20 years ago, Egypt issued a ministerial decree requiring all houses in new communities to utilize solar water heating systems. About 500,000 square meters of such units were installed, modest relative to Egypt's neighbors (for example, Jordan installed 6 million square meters and Israel installed 3 million square meters). Solar heating for hotels was required beginning in the 1980's, but implementation was retarded by the large demands of four and five star hotels, dust covering the solar panels (reducing their efficiency), and hard water causing calcification in the piping. In addition to maintenance difficulties, the high initial investment needed for these projects has proved a difficulty in bringing additional solar to market. Commercial operation of the first solar thermal power plant at Kureimat should begin soon.[53]

Egypt faces considerable challenges in bringing wind and solar energy to market and is tackling many of these issues through advances to its regulatory framework, which is supported by various market actors, including the regulator. These challenges include:

- At present, Egypt has some of the lowest retail prices for electricity (from fossil fuels) in the world, making the challenge to make renewable energy cost-competitive all the greater.
- One challenge with the current system lies in the fact that oil and gas are subsidized upstream, with the transmission company, which buys from generators and then redistributes power to distribution companies, buying electricity at a low rate. Given that fossil fuels, absent recognition of societal costs and externalities, remain less expensive than renewable alternatives, these oil and gas subsidies exacerbate the distortions in the market, making renewables uncompetitive.
- The Ministry of Finance also provides social subsidies, distorting market signals to end users and discouraging conservation.
- Renewable energy projects also tend to have intensive capital costs (often requiring technology and parts not produced in Egypt). Solar, which uses some of the most expensive kinds of technology, is particularly vulnerable to the price differential.
- Most renewable energy sources have low power intensity, presenting problems for the power system, which is currently structured with centralized plants, and requires the use of distributed generation.
- With regard in particular to harnessing wind resources, many high wind speed resources are concentrated in discrete and/or state-owned land areas, requiring attention to land use regulations.

The importance of Egypt's RE focused regulatory framework and its RE prepared regulator

The regulator plays an active role in realizing Egypt's RE potential and many steps have been taken in the last five years to integrate RE as a more significant part of Egypt's energy mix. Among the most important of these are the Renewable Energy Strategy, the draft Electricity law, the Renewable Energy Fund and efforts to bring a feed-in tariff into force for smaller RE projects. In all these efforts, the regulator has contributed its expertise and sector know-how to drive forward reform and prepare itself for RE integration.

The Renewable Energy Strategy of 2008 marked a vital step in this effort, setting a target of reaching 20% of total electrical energy mix from RE including hydropower by 2020. Taking into account current hydropower capacity (and projections for that hydropower), it is expected that 12% of contribution from renewable energy sources other than hydropower will need to be added by 2020 (i.e., equivalent to installed capacity of 7,200 MW). The Strategy identifies concrete steps, including large pilot implementation of solar projects and electrification of rural areas, development of mini and micro hydropower plants with capacity of less than 100 MW, assessing potential for geothermal, and developing 1,000 MW of biomass from agricultural and municipal waste. The Strategy also promotes the local manufacturing of RE equipment, including incentives for activities supporting localization of RE technologies. As part of its efforts to implement the Strategy, EgyptEra coordinates with Egypt's Industrial Modernization Center (IMC), which is responsible for direct contact with manufacturers.

Initially under review in 2007, a proposed new Electricity Law is now "under ratification" and includes important market reforms, such as the establishment of an independent operator, shifting from the single buyer to a bilateral market, third party access, and priority dispatch for power generation from renewable energy sources. The proposed Law, while not final, is expected to pass largely in its current form. Considerable work has already been done by the regulator and others to ensure the draft Law's framework is supported upon adoption. In sum, there are four avenues by which RE is now incentivized in Egypt; these are reviewed below.

- ***Plants built through competitive bidding:*** Under this approach, the grid operator will issue tenders requesting power supply from RE sources, directed at large size installations (such as a 250 MW wind farm). These tenders will be designed to: control the increase in RE capacity such that it matches the capacity of the transmission system and the capacity of the market to absorb the new RE; increase local manufacturing; increase private investment; drive down cost; and provide the investors with guarantees through long term PPAs. The goal is to reach 2,500 MW in capacity through long terms PPAs, in blocks of 250 MW, targeting large international developers with strong financial status and high capacity for technology transfer. Evaluation criteria will include additional points for a high share of locally manufactured components. EgyptEra's role with respect to the competitive bidding process is to review power purchase agreements, issue licenses, help the investment review process, and auditing.

- ***Feed-in tariffs for smaller RE projects:*** Feed-in tariffs will be introduced for smaller capacities (less than 50 MW installations), again with a goal of reaching 2,500 MW capacity, and will work in parallel with the competitive bidding process. The tariffs are to be set for 15 years, and development of the tariff design and PPA contract is underway. As with the competitive bidding process, EgyptEra's role is to review power purchase agreements, issue licenses, help the investment review process, and audit projects.

- ***The Solar initiative.*** Recognizing the natural resource potential, the Egyptian government has identified the growth of solar energy as a priority. Solar energy can benefit from the recently adopted European directive (2009/28/EC), which enables European countries to build renewable plants in a third country, providing that electricity will be physically exported to Europe. There are currently two regional solar initiatives that Egypt will be able to participate in, the Mediterranean Solar Plan and Desertec, though both are inhibited by existing transmission capacity limitations. To accelerate the establishment of solar power implementation and mitigate the lack in transmission capacity in the short and medium terms, Egypt may need to consider alternative methods. One such option would be to export the natural gas quantity equivalent to the electricity generated from RE sources, while using the actual generated electricity from RE domestically. Under the solar initiative, a registered and internationally recognized logo will be issued by the regulator which accredits solar energy consumers, offering holders better financing terms, export advantages and potential tax credits. Interested consumers will voluntarily commit themselves to consume up to 5% of their electricity from solar energy. A Solar Energy Trader, or "SET," will be established to consolidate the committed inquiries and contract suppliers through long term PPAs to satisfy these demands. SET will be owned and operated by a financial institution(s); committed consumers can have shares in SET, while suppliers cannot. Transactions will be conducted according to a feed-in tariff which will be a pass through cost to consumers. EgyptEra is expected to play a prominent role:

    - Issuing the solar energy logo/certification
    - Developing a committed consumer register
    - Setting up mechanisms to guarantee consumer payments through electricity supply contracts and transactions between SET and distribution or transmission networks operators
    - Licensing SET and monitoring its operation to ensure transparency, free competition and nondiscrimination
    - Issuing the solar feed-in tariff, approving the PPAs and ensuring their transparency
    - Licensing the solar energy producers; issuing certificates of origin
    - Ensuring third party access and priority of dispatching
    - Ensuring exemption from transmission or distribution fees as well as energy banking as a requirement for Public Social Obligation (PSO) of network operators
    - Dispute resolution

- Hosting a steering committee of representatives of the stakeholders; the committee would promote the initiative among different business communities and refine the initiative as well as follow up the progress of the initiative

- ***Projects led by the New and Renewable Energy Authority (NREA).*** Established in 1986, NREA is both a national agency for developing and planning the technology transfer and a developer that must seek and receive a license from the regulator in order to operate its new facilities. Construction is being completed on an integrated solar combined cycle power plant with 9,150 total MW, 30 MW solar) at Kureimat, with $327.5 million financing capacity from the World Bank using the Global Environmental facility to offset the cost differential between solar and thermal resources, and support from the Japanese Bank of International Cooperation and the National Bank of Egypt. In February 2010, NREA signed an agreement with Masdar to build a 200 MW wind farm on the east.[54]

The draft Electricity Law also envisions a Renewable Energy Fund, derived from the state public budget, endowments, donations, grants and investments, which will provide support to purchase electricity from plants using renewable energy. The Fund would cover: full or partial deficit between the RE cost and market prices; exchange rate risk; guarantee of transmission company payments; financial support to pilot projects; and research and development of renewable energy technologies locally. The Fund would be financed by the state budget, some amount of the subsidies that currently go to existing energy industry, donations and ultimately investment of Fund money.

These policy and regulatory advances are matched by conditions that make Egypt particularly likely to fulfill its RE objectives: a track record of bringing large investment, relatively large and stable economy for the region, transport corridor location and potential; and its place as a leader in the region, making it able to spearhead regional initiatives, such as a Mediterranean super grid that would facilitate export of RE.

PART II: SPECIFIC TYPES OF RENEWABLE ENERGY AND CASE STUDIES

CHAPTER 7: HYDROPOWER

Snapshot of key regulatory issues:

- *Oldest technology; has entrenched regulatory baggage that may limit development*
- *Incentives for dispatchability where ponding/storage is available*
- *Fish migration challenges*
- *Maintaining appropriate incentives for older projects*
- *Not a new technology, so it doesn't get much attention from policy makers (i.e., usually limited tax credits and FITs)*

For many developing countries and transitional economies, renewable energy development means hydropower development. Hydropower produces about a sixth of the world's annual electrical output and over 90% of the electricity from renewable energy sources. It is the most used renewable energy resource, and the source with which investors and governments have the most knowledge and therefore comfort.

Hydropower releases limited amounts of carbon dioxide or chemicals harmful to health; emissions are negligible except in the case of dams when land that has been submerged decomposes and releases greenhouse gases. Hydropower uses a (mostly) renewable source, water, and it long has been a favorite electricity source for many countries with large water flows. Increasing concerns in parts of the world regarding water shortages, however, present challenges so hydropower must be viewed – like most renewable energy, dependent on natural resources – as highly geographic and site specific. There is some (still to be developed) evidence that methane is released as a result of some large hydropower dams, and also evidence of other negative environmental impacts of large hydropower, such as hydroelectric effects including diverting water flow and supply, dam failure resulting in flooding and effects on downstream land and populations, and displacement of populations from their homes. Small hydropower plants have fewer of these adverse impacts; displacement and collapse/damage from dams are a lesser problem, though efficiency and output are greater with most large projects.

Sustainability concerns. Questions persist as to the sustainability of hydropower, and some environmentalists make distinctions between large and small hydropower on this basis.

Accordingly, some renewable laws will define all hydropower as RE, while other countries' RE laws may limit the definition to small hydropower facilities. There are also arguments that only new hydropower projects with new technology and approaches that specifically address sustainability issues are renewable. Though there is no formal internationally recognized definition of what constitutes large verses small hydropower, generally speaking a large hydropower facility can be in the range of 50-500 MW, while small hydropower is often defined as plants with a capacity of 10 MW or less (some countries set the maximum lower, as in the UK (at 5 MW) and others higher, as in the US (at 30 MW). Some jurisdictions make several graded distinctions, such as "pico" for hydropower that is less than 5 kW, "micro" for hydropower that is between 5 and 100 kW, "mini" for hydropower that is between 100 kW and 1 MW, at which stage the hydropower may be defined as "small," with thresholds for medium and large placed anywhere from 10 MW to 30 MW.

This definition is not as important as is the impact level that the resource will have on the environment and other social issues. In the EU for instance, the new Directive on renewable energy includes the caution that any project that will have detrimental impact on the environment should be avoided and not considered a renewable energy source, including but not limited to hydropower plants with large dams requiring forests and grasslands to be flooded. Environmental impacts must be carefully watched for damage that would thwart the value of renewable energy incentive policies. The following are considerations for hydropower development:

- Dam: impeded fish passage, reduction of wetlands; reduced habitat for wildlife (biodiversity); flooding of property including farmland; river bank erosion before intake and after discharge; release of water for downstream use, sanitation purposes, aesthetics (during initial lake creation and thereafter); use of lake by the public; liability in case of accidents; and public safety, including emergency evacuation plans in case of dam rupture

- Existing pipes (for potable water, irrigation, post sewage treatment plant): environmental (protection of drinking water pipes from contamination); water rights (water flow can vary in pipes, so rights often are for minimum flow), interruption of utility services for construction and maintenance

- Intake structure and penstock on river or water canal: fish passage; land rights (rights on both sides of the river to lay the penstock); water rights (release of water for downstream use and sanitation purposes), and land aesthetics

Input variability, but storage potential. Variations in input and demand mean that the ability to reserve and store energy is critical. Hydropower holds advantages over other forms of energy – conventional and renewable – for its storage abilities via use of reservoirs and pumped storage. Certainly most hydropower will suffer if there is a serious drought, though how much the drought affects immediate supply has to do with the type of facility, its engineering and storage capacity. An installation with a high (and reasonably sized) reservoir usually can maintain output over a dry period, whereas a reservoir or collection of water behind a run-of-river plant may not be able to operate during dry periods as easily. This means that most small hydropower plants offer less reliability in terms of supply, though some networks of small hydropower plants in different sites may be exposed to slightly different rainfall patterns. Part of the regulatory task is to understand the reserve potential of hydropower, to assess how this reserve will affect the energy market overall, and to incorporate this consideration as part of the ultimate rate-making.

The need for long transmission lines can be one of the biggest encumbrances on power plant development. The transmission system in most countries has grown around initial need; existing lines may not be in geographic locations conducive to additional power plant development, due to siting, geographic and resource limitations. Building new lines is costly and usually a time consuming process, and therefore not an attractive option for investors. Large hydropower plants tend to require long transmission lines because few can be positioned near city centers. Hence, a key regulatory question is the availability of the grid for different projects, and the transmission need those projects present at the outset and in the future, and how to cover costs for electrification expansion. The last point is a particularly hot-button issue. In southern African countries, for instance, capital costs associated with grid connection often are subsidized by the government. Local authorities or municipalities may pay for part of the ongoing operational expenses, which are then recovered through cross-subsidization arrangements between other services or users. This inconsistency can prove problematic if evidenced in neighboring jurisdictions; it is critical therefore that trading partners assess compatibility.

Angola's energy policies are indirectly addressed by the National Reconstruction Program, which is designed to rebuild the country's infrastructure following the war. The Program promotes energy sector development through building and restoring power facilities, given that investment is impossible without an adequate grid. Less than 20% of Angola's population has access to electric power, and blackouts occur frequently. Renewable energy efforts are centered on development of Angola's hydroelectric power resources, which offer approximately 65,000 GWh/year in firm potential. Angola and Namibia are working toward joint hydropower development that would benefit both countries and use communal water resources. Important goals include the creation of a single national electricity transmission system that will connect all regions into one integrated grid, as cross-border trade will require supporting infrastructure. Against this backdrop, two main regional networks have considerable influence in the energy sector: the Southern African Power Pool and RERA. Both of these entities provide specific guidance and direction on financial, regulatory, strategic and infrastructural matters for the development of the sectors in Angola and other Southern African Development Community countries.

High up-front costs. Large hydropower plants are notoriously expensive to build, in part because construction can take decades. Because of these high capital costs, investors are particularly concerned about tariff structures, and will seek out arrangements that guarantee a certain income over a fairly lengthy period of time. Small hydropower costs tend to be site specific, given the variations in size and environmental conditions, but up-front costs are still high as a fair amount of experience and technology are required at the outset. The key advantage of hydropower, however, is that fuel costs are nil (at least as traditionally defined) because the water is the fuel. This means that fuel price volatility and fossil fuel geo-politics do not factor in the cost analysis (though considerations as to water rights and access may be implicated).

Water rights and usage. Conventional hydropower uses large quantities of water. In the US, for instance, coal, gas and nuclear plants use 136 billion gallons of fresh water daily to generate electricity – approximately 3% of all water consumed; energy consumes 27% of all non-agricultural water in the US, with carbon emission requirements anticipated to increase demand by 1-2 billion gallons/day.[55] Trade-offs among irrigation, water sanitation and electricity exist, with different interests to consider, sometimes on a local municipal basis, sometimes nationally, and for many regions, interstate. The term "watergy" has been coined[56] to describe the relationship between water and energy and to emphasize the need to look at these together in order to bring efficiencies to the use of both. While often used most to look at water distribution and supply efficiencies in the context of municipal sanitation and drinking as well as supply for electricity, the underlying concept of identifying synergies and needs that result from the integrated relationship of water and energy is critical to the sustainability of hydropower, and should be integrated into the regulatory analysis.

In Central Asia, Uzbekistan, the Kyrgyz Republic and Tajikistan are all heavily reliant on hydropower, and water rights and usage are cross-border issues with economic and social implications. Part of the electricity growth equation therefore has to be an assessment of water rights, needs and exploitation. A new interstate agreement is needed to address irrigation-hydropower trade-offs, water storage payment requirements (covering seasonal supply shifts) and water management policies.

Run-of-river. In a run-of-river plant, many environmental concerns are alleviated or diminished as dams and reservoirs are avoided and the systems are usually small enough to design protection of sanitation and fish and alleviate other environmental concerns. One of the challenges in transitional economies and developing countries that need power now is to find a way to build quickly but contain the environmental costs and ensure that the potential environmental protections can be built into a system. The difficulty is that such systems are usually small and can serve a limited number of persons; in addition they are also water and weather dependent. Run-of the river plants, which are smaller and pose less of a hindrance (in terms of land use, space and appearance) may be near high population centers, alleviating the need for long transmission lines. Generally, hydropower systems that are connected to micro grids are run of the river. Such systems tend to support villages or large farms in rural communities.

ARMENIA: REGULATORY SUPPORT FOR SMALL HYDROPOWER DEVELOPMENT

2010

CHAPTER 7: Hydropower

ARMENIA: REGULATORY SUPPORT FOR SMALL HYDROPOWER DEVELOPMENT

Armenia has one of the older energy regulators in the region, the Armenian Public Services Regulatory Commission (PSRC). Established in 1997, the PSRC has regulatory oversight of the Armenian energy sector, which includes considerable domestically generated hydropower.[57] Renewable energy in the form of hydropower accounts for 30% of the overall electricity generation in Armenia and 100% of the renewable energy generation. Armenia's Ministry of Energy has indicated that hydropower could provide a majority of the country's energy requirements by 2020. Indeed, the number of operating small hydropower plants in Armenia has increased by a factor of four in the last four years. As of 1 October 2010, 95 SHPP's are in operation, totaling 124 MW and generation 387 GWh yearly. Under construction are another 66, which collectively would total 138 MW and generate 517 GWh yearly (of these, many remain un- or under financed, with completion dates unclear). The Government of Armenia, supported by the PSRC, has worked diligently over the last few years to encourage RE production. This case study looks at how the regulatory framework and the regulator have served to further efforts by the Government to incentivize new RE production, and particularly hydropower production, in Armenia.

The regulatory framework background. The Energy Law (first adopted in 1996 and amended various times over the years) requires that electricity generation, transmission, and distribution companies receive separate licenses, which are issued by the energy regulator. It also requires legal unbundling between transmission and other activities.

Established in 1997, the PSRC is an autonomous regulatory agency, meaning that government entities cannot overrule or alter its decisions. PSRC is responsible for setting tariff methodology and tariff levels; issuing licenses and authorizations (including for the construction and operation of new capacity); establishing and controlling service quality standards; examining consumer complaints; and approving *ex ante* investment plans in the sector under its responsibility. PSRC, in collaboration with the Ministry of Energy, defines basic market rules. It is also able to impose fines for infractions, and may issue orders, suspend or revoke licenses. Regulatory decisions may be appealed to the Administrative Court. No time limit has been set for appealing to the courts, and decisions remain in effect while the appeal is pending. Currently, the PSRC has 107 staff members.

Consistent with the legislative framework (the Energy Law and the related "Procedure of Establishing and Reviewing of Tariffs in the Sector of Energy," June 2007), the PSRC Commission has established the procedure for approving and reviewing tariffs, as well as a list of necessary documents that a licensee must submit. The following categories of tariffs are currently in force in the electricity sector: generation (single price nationwide, which includes a capacity component with monthly payment), transmission, distribution, retail supply (two rates: day and night), and export. In principle, tariffs cover all current and capital costs, and include a fair profit. No subsidies or grants are provided to private or state companies to cover possible financial gaps. Tariffs may be reviewed either on the initiative of a licensee or the Commission.

Once it has begun a tariff review process, the PSRC has a 90-day window to issue its decision. The procedure for approving and reviewing tariffs is the same for all types of licenses.

The regulatory role in renewable energy promotion and implementation. The Armenian government's strategy for the energy sector depends on and encourages private sector participation in the development of the renewable energy sector in general and more specifically in the small hydropower plant industry. On 9 November 2004, the Law "On Energy Saving and Renewable Energy" was passed. Though most secondary legislation to support this Law and most substantial implementation mechanisms are still lacking, some steps have been taken to encourage RE and give the regulator a clear role to achieve this objective.

Licensing offers a good example of how the regulator is integral to the RE development process. To carry out any licensed activity in the energy sector, applicants must submit to the PSRC a business plan that includes an environmental impact assessment and a detailed description of the technical solutions required to meet the environmental impact limits set by law. As a consequence of an amendment passed April 2001, the Energy Law assigns dispatching priority to all electricity produced from small hydropower plants and other renewable energy sources for the 15 years following plant commissioning. As a condition of its own license, the privatized distribution system operator must pay all small hydropower producers before it can book its own revenue, and payments to hydropower plants have been paid fully and on time for the past 10 years. The hydropower plants are paid directly by the privatized distribution operator via a special account administered through an independent Settlement Center and not through any government controlled agency or middleman. The operator is obliged to enter into a 15-year guaranteed power purchase agreement and to take 100% of all (renewable) production during that time period.

The regulator has also worked to bring a feed-in tariff system into place that drives forward hydropower investment, particularly for small plants. These tariffs, like all energy tariffs in Armenia, are set by the PSRC. A feed-in tariff system is now in place and tariff levels have been adjusted a couple of times to reflect market needs. Most recently, on 1 November 2010 the PSRC adopted a new tariff system effective January 2011:[58]

- Small hydropower plants (constructed on natural water flows) = 19.28 dram/kWh (5.33 cents USD/kWh)
- Small hydropower plants (constructed on irrigation systems) = 12.853 dram/kWh (3.55 cents USD/kWh)
- Small hydropower plants (constructed on drinkable water aquaducts) = 8.57 dram/kWh (2.38 cents USD/kWh)
- Wind power plants = 33.756 dram/kWh (9.32 cents USD/kWh)
- Power plants that use biomass as a primary energy = 36.928 dram/kWh (10.2 cents USD/kWh)

In short, though not as favorable as in some countries, renewable energy tariffs in Armenia are of a level sufficient to encourage investment, with tariffs for electricity sold from small hydropower (on natural water systems) comparable to that in the EU and US. The tariffs for small hydropower plants are reviewed annually, prior to the 1st of December each year, and new tariffs are put into place by the following January. The tariffs include an escalation clause linked to inflation and the US/Armenian currency exchange rate. The estimated increase in tariffs projected for 2011 is about 5%.

Regulatory efforts to address challenges to RE investment. The energy regulatory regime, including all licensing and permitting requirements, are well known and transparent; the energy regulator is well established; and the renewable energy mandatory purchase requirements are executed reliably and in a manner that minimizes risk. The regulator operates in a transparent manner, and is accessible and responsive. In addition, power purchase agreements of 15 years are in place and there is a record of enforcement. Notwithstanding the existence of this framework minimizing regulatory risk, however, investment projects have encountered stumbling blocks that have delayed realization of full funding and therefore stalled the project. These obstacles are primarily to do with the rigidity of the regulatory framework, which properly exists to guard against corruption and manipulation, but does not offer long term security for investors.

Recent efforts by a Dutch investor have hit some stumbling blocks around long-term contract and tariff security, though the regulator has made efforts to assist the investment. In 2008, a Netherlands project developer initiated due diligence of Hydroenergia Limited Liability Company, a registered company of Armenia, with a view to investing in existing small hydropower facilities operating and in various stages of licensing and construction (Yerevan Lake Hydropower Plant and Kotayk Lake Irrigation Canal Hydropower Plant; some background data on the project is offered in the notes of this country profile[59]). Due diligence is now complete, partial funding secured and the project developer is seeking additional funding sources. Outstanding legal, financial and technical risks have been identified and costs projected, all within the anticipated range. There is significant investor interest, though some concerns have been expressed and the full amount of required funding is not yet secured. In particular, the intended offer to invest in this small hydropower was for a facility that has been operating for 10 years, and has an operating license and power purchase agreement due to expire in five years. Investors expressed concern that only five years remained on the agreement, thus not providing the amount of security they were hoping for. The 15-year license and power purchase agreement was limited to that time period because, when granted, it was anticipated that there would be a free and open market for electricity sales at the end of that period. As with all countries in the region and indeed the vast majority of countries outside of the EU, a free and open market for electricity has not been realized, though remarkable steps are being made in that direction in Armenia.

The current legislation requires that a new application be made 30 days prior to the expiration of the license (tracking the life of the power purchase agreement). The difficulty is that until the application is made, reviewed by the regulator and approved, there is no mechanism to provide guarantees to investors that the agreement will be renewed, the tariff levels at which it will be renewed, and the length of the renewal. Developers will not invest without the certainty of the renewal; the legal and regulatory framework limited this certainty in the expectation of market reform that has yet to be realized.

The regulator has been responsive in providing explanations and written letters explaining the process and the general expectation that the existing structure will be renewed without complication. The PSRC has made clear efforts to set the tariffs at levels and with incentive mechanisms that balance the risk to investors, the country's RE goals, and the sector and population's energy needs. Because investors require certainty, however, securing the financing has been difficult in the absence of a clear regulatory commitment.

CHAPTER 8: WIND POWER

Snapshot of key regulatory issues:

- *Variability*
- *Noise regulation*
- *Light flicker regulation*
- *Siting challenges (tall, usually highly visible on mountain peaks/ridges)*
- *Offshore challenges (waters with sometimes overlapping regulatory jurisdiction within federal or state governments; competing interests such as fishing and recreation; development of new tower technology needed for deep water applications; and creation of deep water incubation zones)*

Wind offers a pollution-free means of generating electricity. Though used for electricity generation for about two centuries, wind power has become possible on a large scale only since about the 1980s, when technology advanced sufficiently to make large wind turbines cost-effective. As the technology improves, costs for wind power continue to decrease, making it an attractively cost-efficient source of renewable energy, at least with respect to onshore projects. Off-shore wind sites are also feasible and the number of installations are increasing, though they are less common and more costly. The difficulties with wind have to do with intermittency (winds vary in strength and intensity), appearance and noise levels.

Despite the problems of variability that accompany wind (if the wind stops, so do the turbines and electricity production), wind speeds are reasonably predictable. Estimates, when conducted diligently and regularly (one hour ahead is ideal, where feasible), are generally accurate enough to provide sufficient information to allow for reliable forecasting and safe planning as long as less variable energy sources are used to balance the load or provide reserves. The key is to look at wind output along with other electricity output, to weigh the risks of the variability in relation to other electricity sources.

The amount of energy produced from a wind turbine depends on wind speed and the regularity of the energy produced depends on the length of time the wind blows at optimal or other speeds. This means that location is critical, and that wind speed and frequency must be assessed carefully prior to building. Furthermore, regulators, or other relevant government bodies, must complete their due diligence prior to permitting. In addition, steps can be taken to assess the impact of reliability on the grid and to prevent emergencies that may result from reductions of wind power in systems that are heavily reliant on wind power.

Texas, one of the largest states in the southwestern US, produces the most wind power of any US state. During February of 2008, a drop in wind generation that coincided with the onset of colder weather caused the grid operator to declare a system emergency and shed interruptible load. The grid's frequency dropped suddenly when wind production fell from over 1,700 MW before the event, to 300 MW when the emergency was declared. At the time of the emergency, grid demand increased from 31,200 MW to a peak of 35,612 (about half of the total generating capacity in the region). Operators throughout the US are now studying the effects on the grid of the addition of significant RE capacity to better manage system reliability. At the same time, research and development efforts are focusing on storage technologies including flywheels, compressed gas, and advanced battery banks, to name a few, to address the variability challenges presented by wind power.

From an investment perspective, wind is not quite cost competitive with conventional energy, but with constant advances in technology it is approaching competitiveness, even without subsidies. With the subsidies being offered currently in many countries, wind has become a prime investment, and indeed in some countries – particularly in Europe and North America – there are concerns that the wind market is over-saturated. Once construction begins, wind farms are quick to build and the technology is reliable. Wind turbines have to meet safety standards and should be selected to meet weather and other conditions in the area. There are a number of safety standards being developed; the International Organization for Standardization and the Danish DNV (Det Norske Veritas) Wind Turbine Certification program are two organizations that have developed international safety standards intended to minimize the number of errors in design and provide additional confidence to manufacturers, developers, owners, finance, insurance and the authorities.

The environmental impacts of wind power are visual, noise and possibly electromagnetic, with some additional concerns for sea life with respect to offshore wind power. It is important that noise levels do not exceed noise emission level requirements, if requirements exist. If noise level ordinances do not exist, it is vital that municipalities or local government at the intended site are consulted and any noise considerations vetted (the International Energy Agency has developed a noise measurement test that is widely used).[60] Modern turbines are considerably quieter than earlier versions, with the noise level highly dependent on the technology being used. Electromagnetic interference can come from some materials used for wind turbines and may affect television reception in particular, though again this is related to the technology used and can be addressed both in terms of turbine materials and by use of changes to the transmitters used for television. Though not a significant issue, possible interference should be considered and assessed for consequences on the local population. The visual impact of turbines depends on size, design and location, along with the reaction of the local population. From a regulatory perspective, public consultation is vital to ensure acceptance and success. Renewable energy projects that have greater support in the local community face less public opposition, making public consultation a vital and useful aspect of the regulatory role.

Many transmission tariffs in effect today were crafted based on the assumption that there is no supply variability. Thus, penalties, sometimes harsh, may be imposed on generators who fail to deliver capacity that was bid into the market. These imbalance penalties can deter the development of wind power, which is one reason that feed-in tariffs have been used to great success, particularly in Europe.

Germany – one of the first countries to promote wind, now has about 20,000 wind turbines with 25 GW of installed capacity, making it the world's second largest user of wind power.

Often cited as a leader in the renewable energy area because of the large growth of renewable energy, most of which is wind power, Germany adopted a feed-in tariff system early on (1991), when other countries were only beginning to consider the impact of renewable priorities on the existing energy tariff regime and corresponding end user cost. Eurostat reports, "Germany is not particularly privileged with renewable sources. However, the development of new renewable sources is among the most advanced in Europe, due in part to the favorable framework for renewable energy via the feed-in tariff law of 1990 and the renewable energy act of 2000, which was amended in 2004. The German feed-in tariff system has led to one of the highest global rates of deployment of existing potential in the case of wind power." Germany utilized something of a trial and error approach, with some missteps that were remedied over time with revisions to the legislation.

The current German feed-in tariff structure has some important characteristics:

- *The Law sets the price of renewable energy, with the quantity determined by the market*
- *A long term fixed price of 20 years (per site, the date of expiration is 20 years after the date of installation)*
- *A staggered tariff regime for new technologies, with the later installations receiving lower tariffs (annual decreases in long term fixed rates) to reflect expected progress and to create efficiency and cost incentives*
- *The rate of decrease is based on the empirically derived progress ratios for different technologies and based on the site, yield/generation costs of each particular plant, with periodic review to assess the price in light of technological and market developments*

Under this structure, the price of the tariff is designed to mirror the cost resource curve of the technology, leading to a reduction of profit for the producer and lower costs for the consumer. For example, tariffs have been adjusted to increase market competitiveness, in particular for small-scale biomass plants. Sites with below average wind yield receive a favorable tariff for longer than do sites above an identified reference value, thus promoting less advantageous sites, i.e., localizing support where it is most needed. In short, production costs are key to the tariff setting structure for renewable energy, but the price is determined at a political level and inserted into the primary law in order to provide a secure and predictable investment climate for producers. Price is determined by the government, but suggested by a committee made up of electricity suppliers, renewable energy researchers and scientists, and government and academics. Germany also has set some boundaries through provisions on:

- *Monitoring progress achieved every two years, with the possibility of proposing adjustments to remuneration levels*
- *Remuneration of wind sites based on the differing quality of plants, to avoid undue compensation and also to create incentives for installing sites at less economically competitive areas; and*
- *Limits on guaranteed remuneration for PV power, consistent with EU guidance in this area*

The German structure is designed to follow a marginal cost curve, and operates on the assumption that efficiency gains will result in the need for less producer profit over time.

In 2004, the German law was amended to include tariffs for offshore wind, with the goal of encouraging investment in that area. Corollary supporting features of the German structure include reinforcement of priority right for connection to the grid and special incentives for the use of innovative technologies, plant/crop-based renewable resources and combined heat and power. The 2004 amendment allocated costs for grid connection to the plant operators, with costs for upgrading borne by the grid operator. Increases in tariffs paid to PV were made to stimulate PV production. The amendment also reassessed pricing and incentives for efficiency and modernization.

JORDAN: Recent Steps to Bring Renewable Energy to Market

2010

CHAPTER 8: Wind Power

JORDAN: RECENT STEPS TO BRING RENEWABLE ENERGY TO MARKET

With a size of 89,200 km^2 sharing borders with Iraq, Syria, Israel and Saudi Arabia, and a population of 6 million, Jordan's economy is growing at an average annual rate of over 7%.[61] At present, Jordan imports 97% of its energy resources (its only potential domestic resources are some natural gas and undeveloped oil shale[62]).[63] Electricity is imported (and some exported) via the Inter-Arab Electricity Network, which includes Jordan, Syria and Egypt. Gas is imported from Egypt through the Arab gas grid. The country has some oil shale though development is nascent, and Jordan remains almost fully dependent on oil imports from its regional neighbors such as Iraq. With political change and the sharp escalation in oil prices in international markets, Jordan has found itself in a difficult position, particularly with electricity demand growing steeply and predicted to continue in the future.[64] In 2007, for example, peak demand was well over 2,000 MW, a double-digit increase over the previous year.[65] In 2009, the peak demand was 2,330 MW.

Jordan is a signatory to the European Energy Charter and currently is in the process of accession to the Energy Charter Treaty.[66] Efforts to ensure universal service commenced with the creation of the Jordan Electricity Authority (JEA) in 1967, and by the early 1990s nearly 100% of Jordan's population was supplied.[67] In September 1996, the JEA was converted to the National Electric Power Company (NEPCO), a public shareholding company wholly-owned by the government, which currently owns and operates the transmission grid. The current sector model is single buyer, with NEPCO the buyer via long-term power purchase agreements, then selling to distributors and large consumers at regulated prices; retail prices from the distributors are also set by tariff.[68] Supply comes largely from steam and combined cycle plants,[69] with privatization efforts ongoing. The 380 MW combined cycle Amman East power plant was Jordan's first independent power producer. The plant was owned and operated by AES Jordan PSC, a company owned by a consortium of AES Oasis Limited and Mitsui and Company Limited, subject to a 25-year power purchase agreement with NEPCO and supplied with natural gas by a pipeline from Egypt.[70] The Central Electricity Generating Company, which produces 70% of the electric power generated in Jordan, was privatized in 2007, with 51% ownership sold to the Enara Company.

Though it has strong solar and wind potential, Jordan currently generates just 1%-2% of its electricity from renewable energy sources.[71] Over the last few years, Jordan has made significant efforts to develop renewable energy resources and build a framework to support investment. Its regulator, the Electricity Regulatory Commission (ERC),[72] established in 2001, has supported these efforts by providing ongoing input to policy initiatives and investment project evaluations. Under Jordanian law, the Ministry of Energy and Mineral Resources (MEMR) sets policy, with the ERC implementing the regulatory framework, including setting tariffs, licenses, issuing codes and protecting consumer interests. This case study looks at the steps taken to incentivize renewable energy production in Jordan, while profiling the supporting role that the regulator has played and continues to play in these initiatives before project implementation takes hold.

RE Initiatives

Jordan's National Energy Strategy calls for 7% of the country's energy mix to come from renewable energy sources by 2015 and 10% by 2020. The Jordanian government created the National Energy Research Center for renewable energy in 1996, which focuses also on energy savings. The government intends to build 600 MW of wind by 2015 and a further 600-1,000 MW by 2020. The 2007 Energy Strategy listed obstacles to renewable energy development as including: (1) the high capital costs of such projects compared to non-renewables; (2) the need for large amounts of land which can be hard to secure; and (3) lack of legislation, including treatment of customs and tax issues.[73] The recommended actions to take included enactment of a renewable energy law and energy fund for renewables,[74] the law was issued in early 2010 and the Renewable Energy and Energy Efficiency Fund is in the process of being established according to the law.

A renewable energy law was enacted at the beginning of 2010 through Royal Decree as temporary legislation, setting Jordan ahead of many of its neighbors in creating a legislative framework specifically for renewable energy. It provides investors in the renewable energy sector with a number of incentives, guaranteed network access, and some tax and customs exemptions. The law also provides favorable treatment to land devoted to renewable energy project development. In particular, it allows private companies with renewable energy projects to bypass the competitive government bidding process and negotiate directly with the Energy Ministry. The law also sets guidelines for net metering.[75] The regulator took part in discussions (through numerous meetings) related to the preparation of the law in the different stages.

The law anticipates execution of power purchase agreements with renewable energy developers on a case-by-case negotiated basis, allowing developers to make offers (as opposed to open tenders) to the MEMR to develop renewable energy projects, with the tariff offered within a reasonable range compared to a standard reference, without further elaboration. NEPCO must purchase all electricity produced by renewable energy power plants and pay the cost of connecting the project to the network.

In early 2010, Jordan established a Renewable Energy and Energy Efficiency Fund (now in the process of being established), with resources available to private sector companies or investors in and outside of Jordan, to support energy-saving and renewable energy initiatives. The Fund is financed by the state budget and international donor agencies, including the World Bank and the Global Environment Fund.

The Government is currently reviewing the regulatory issues related to RE such as the Reference Price mentioned in the law (Article 6), incorporating RE needed regulations in the regulatory documents and also reviewing the technical details for connection to the grid.

These steps have placed Jordan in a strong position to bring renewable energy to market, with negotiations on several renewable energy projects now underway.

Bringing RE Projects to Life

In 2009 negotiations for Jordan's first wind farm (in Al Kamshah) began, with Terna Energy, one of Greece's major owner-operators of wind farms, selected as the preferred bidder for a 30-40 MW facility at Al Kamshah, north of Amman, with output to be purchased by National Electric Power Company. Al Kamshah was only to be the first in a series of wind projects, with still existing plans for an 80-90 MW project in Fujij, near Wadi Musa, and wind turbines at Al Harir, Maan and Wadi Araba, to produce a total of 300-400 MW of power.[76]

Negotiations for Al Kamshah stalled in 2009, with the director of the renewables department of the Ministry of Energy and Mineral Resources indicating publicly that the government is reconsidering the project,[77] though renegotiations have recently resumed. Initial delay was due to concern over noise levels and land regulations, but the project also faced obstacles when negotiations between the government and the Greek-Jordanian consortium over the amount of the tariff.[78] Only one other bidder, Russia's Rossijskaja Avtonomnaja Energo Sistema (RAO UES), had responded to the tender. Via the 2010 law described above, the Government of Jordan is reassessing use of the tendering process verses use of other support schemes; though some tendering schemes may continue for large projects.

Jordan's experience with this project and its attempts to encourage the growth of domestic renewable energy and wind in particular provide important valuable lessons in the framework needed for development and potential obstacles along the way. The regulator has played a supporting role, as a member of the project evaluation committee, and also participated in the various meetings directed at reform in the topics pertinent to its role. With respect to Al Kamshah in particular, a Commissioner from the ERC has served as part of the project evaluation committee and another is currently serving on the project evaluation committee for another large wind farm project. As a member of this Committee, the Commissioner is able to contribute information that is regulatory in nature and therefore not necessarily available to other Committee members. Some examples are:

- Offering details as to the permitting and licensing process, so as to help estimate time
- Making compatible the different project documents and agreements, including avoidance of duplication or conflict between the license and the other documents

Committee participation by the ERC has a collateral benefit for the sector, namely it prepares the regulator for imminent responsibilities, such as the need to license in a timely manner, once the project is approved. This has the potential to improve the overall process and ensure maximum efficiency and minimize delay.

To further efforts to stimulate renewable energy growth in Jordan, the ERC was actively involved in committee evaluation of two projects in 2010. One is the mentioned El Kamshah project; the other is Al Fujij, an 80-90 MW project. A total of 29 interested letters were received, with 16 found qualified and invited in September 2010 to send their proposal by March 2011. The ERC is now working with other committee members to prepare needed documents and analysis for the anticipated submissions of proposals. The ERC is also involved in actively planning for future projects. In particular, it is engaged as part of a committee established to implement a 1 MW PV pilot project in Jordan, intended to pave the way for a larger PV effort in the future.

In parallel, the ERC is currently working with relevant institutions to develop specific regulations in the renewable energy field to ensure streamlined implementation of existing and future projects. At present the ERC is focusing on regulations for:

- Integration of wind farms in the national electric system of Jordan
- Estimating indicative price for various renewable energy products
- Consulting service for strengthening the legal, regulatory and institutional framework for the development of renewable energy resources

This preparatory work is part of the ERC's larger commitment to ensuring investment and successful operation of renewable energy projects to secure a sustainable energy supply for Jordan.

CHAPTER 9: SOLAR ENERGY

Snapshot of key regulatory issues:

- *Variability*
- *Availability to residential market creates new challenges*
- *Siting challenges (e.g., rooftop zoning and strength codes)*
- *Government finance programs coupled with tax repayment structure*
- *Net metering (this applies to others also, but is perhaps most prolific in residential solar applications)*

The potential for generation of electricity from sunlight is enormous, able to provide all the total worldwide energy needed multiple times over[79] – although it currently provides only 0.01% of total energy consumption.[80] Generation can occur through direct powering with photovoltaics or indirectly, through concentrating solar power (CSP), in which heat from the sun is used to boil water, which is then used in power plants. While sometimes used for off-grid energy production, including small solar water heaters, most solar applications are now interconnected to the grid. Grid-connected solar PV continues to be the fastest growing power generation technology.[81]

Market growth. The largest solar power plants, such as the 354 MW Solar Energy Generating Systems in the Mojave Desert in California, are concentrating solar thermal plants. Nonetheless, with recent technological developments, multi-megawatt photovoltaic plants have been built such as: (1) the 60 MW Omedilla plant built in Spain in 2008; (2) the 54 MW solar park in Strasskirchen, Germany; and (3) the 46 MW Moura station in Portugal. Building on its success in developing wind farms, Germany became the largest market for solar installations in 2009, thanks to its attractive feed-in tariff.[82] The PV industry generated $43 billion in global revenues in 2009, with Europe accounting for 5.60 GW, or 77% of world demand. The top three countries for solar use in Europe in 2009 were Germany, Italy and Czech Republic, which collectively accounted for 4.07 GW, with Italy the second largest market in the world. The third largest market in the world in 2009 was the United States, which grew 36% to 485 MW, followed by Japan, growing 109%.[83]

Morocco is developing five solar energy sites that total 2,000 MW to come online between 2015 and 2020. Morocco's NAMA calls for the installation of 440,000 square meters of rooftop solar water heater collectors by 2012 and 1.7 million square meters by 2020. Morocco's NAMA also specified an Energipro Programme that is developing a 1000 MW wind park by 2012 with plans to increase the park to 5,000 MW by 2030.

Spanish demand collapsed in 2009 to just 4% of its prior year level (a total of 180 MW of PV and CSP capacity installed during 2009, compared to 2,710 installed during 2008). The Spanish experience shows the continuing importance of subsidies to sustain growth; while costs have diminished markedly, incentives are still required to make this resource economically viable, both on a plant and household front. In both instances, the issue is creating appropriate incentives to encourage investments that are economic in the long-term when investors typically have expectations for returns in the short-term. Starting in 2004, Spain embarked on an aggressive program to develop solar power and became the largest market in 2008. It then cut subsidies, which, contemporaneous with the general economic downturn, resulted in a sharp decrease in the growth of solar power use.

The situation in Spain, however, should not be mistaken as a problem with PV itself. The market shrank in Spain as a result of the design of the incentive and the subsequent adjustment of the incentive. Germany is also now reducing its incentives, but, as noted above, remains the single largest market for PV in 2009, with the installation of 3,800 MW of capacity installed (compared to 1500 MW installed during 2008).[84] Despite the Spanish experience, reliance on solar power is anticipated to continue to grow. China and India announced in 2009 plans to increase their solar power capacities to 20,000 MW each by 2020.[85]

Regulatory issues. Issues the regulator is likely to confront in the development of solar production include fitting this intermittent power source, like wind, into the national and regional portfolio of energy sources. While advances in battery storage continue, energy production from solar requires the sun. This variability creates dispatch issues that must be addressed. Options include, but are not limited to, stronger and more extensive transmission networks and greater interconnectivity; load management; and/or identification of appropriate back-up systems. In addition, environmental considerations include:

- PV:
    - Pollution during production
    - Large amounts of space are needed during installation
- All solar collectors:
    - Air space and solar access rights; new construction cannot block sunlight to existing solar panels

Net metering. If individual households can install PV systems, net metering and appropriate tariffs must be considered. Most electricity meters can accurately record in both directions, but regulations need to identify how excess production is treated. The US Energy Policy Act of 2005 requires all public electricity utilities to make net metering available on request to its consumers, with net metering service defined as "service to an electric consumer under which electric energy generated by that electric consumer from an eligible on-site generating facility and delivered to the local distribution facilities may be used to offset electric energy provided by the electric utility to the electric consumer during the applicable billing period." In 2002, Thailand was the first developing country to adopt net metering regulations (known as the Very

Small Power Producer Program), providing streamlined interconnection arrangements for small renewable energy generators (under 1 MW in size, increased to 10 MW). In a net metering framework, excess production is when the output of the distributed generation exceeds the usage of the customer (customer's generation is greater than usage), and the customer is a net exporter of electricity for that billing period. If there is excess production, the net metering rules should address how that production is treated. Excess production normally takes the form of a credit. Nonetheless, how the credits are calculated and treated varies widely (complications can arise in dealing with issues such as how to pay and refund value added taxes on electricity).

Siting. Siting issues can arise for both large and small projects. As to large projects, sometimes the sun is found in environmentally sensitive areas, e.g., some environmental groups are opposing the development of large-scale solar projects in undeveloped desert areas in the US west[86] or in tourist areas where other stakeholders have business interests to protect. On the household PV front, steps should be taken to establish a cost-efficient and streamlined mechanism for safe placement and operation.[87] Because large-scale plants often need large, flat areas of sunny land, such property is often, in the United States for example, found on public or tribal land, and thus triggers a host of regulatory issues about the use of such land.[88]

CHAPTER 10: BIOMASS

Snapshot of key regulatory issues:

- *Air quality regulation issues – biomass production (for example, wood burning), results in air emissions during production and carbon accounting challenges*
- *Sustainability of feedstock – from a lifecycle point of view, sustainability needs to be assessed and measured*
- *Regulation of feedstock types (e.g., construction demolition debris, consumer waste)*

Biomass is energy derived from organic material (wastes, energy crops and natural plant life). It is carbon-based, absorbed from the atmosphere as carbon dioxide by plant life, using energy from the sun. Because plants may be then eaten by animals, animal waste can also be biomass material, but primary absorption is performed by plants, and biomass material can include garbage, wood, landfill gases and alcohol fuels produced through the fermentation of plants such as corn and sugar. It is the oldest source of renewable energy – used since the discovery of fire. Despite large technological advances in the last few decades, the most common use of biomass for energy is from firewood and crops. Considerable sustainability issues are associated with the use of biomass. For instance, some cooking stoves and other more rudimentary methods of using biomass for energy can be polluting, and use of crops may, in terms of lifecycle, emit considerable carbon dioxide.

Biomass has advantages and disadvantages compared to other renewable energy sources.

Potential advantages of biomass include:

- Its use can be adjusted to meet demand
- It can produce heat as well as electricity (a benefit if managed so that the heat is used and does not result in heat pollution)
- It does not have the intermittency problems of renewables such as solar and wind
- It can be applied at a variety of different scales

- It can involve more complex supply chains (preparation is required, such as making into pellets), with the potential to create jobs and stimulate rural development; and

- It presents an opportunity for energy costs to be recycled within the regional economy, rather than distributed over an extended fossil-fuel supply chain

For many of these advantages, there are some associated disadvantages. In particular, processes used to convert biomass to energy often produce emissions. A summary of the disadvantages include:

- Low energy density and transportation costs

- Biofuel resources can be dispersed and the logistics of utilization can be difficult

- A supply chain requires multiple inputs, thereby increasing the environmental costs

- Carbon emissions (although zero or positive net CO_2 emissions are undetermined)

- Environmental concerns regarding other emissions[89]

Carbon output. Although the definition of biomass depends on the country, biomass generally includes wood, farm and food production waste, bagasse (fibrous residue from sugar cane or sorghum) and household, commercial and industrial waste. While in theory this means that biomass can be carbon neutral, if fertilizers are used with nitrous oxide to grow the material and fossil fuels used to transport the material, the net may not be completely neutral, and one issue with biomass is identification and measurements of its environmental benefits.

Fossil fuels like coal, oil and gas are excluded from the definition of renewable biomass for timing reasons: they absorbed their carbon dioxide from the atmosphere many millions of years ago. While such fossil fuels offer high energy density, the combustion required to release their energy releases to the atmosphere carbon sequestered millions of years ago and thus contributes to climate change. Supporters of biomass argue that biomass can be managed on a sustainable basis so it is harvested as part of a constantly replenished crop that maintains a closed carbon cycle with no net increase in atmospheric carbon dioxide levels.[90] Others are concerned that the emissions are not neutral when the full lifecycle is examined. Fundamentally, there is much support for both positions, and the question of sustainability of biomass as an energy source turns on specific conditions of use.

Usage. Energy from biomass can be released directly in the form of heat, used to generate electricity, or converted to other usable forms of energy like methane, the main ingredient of natural gas, or transportation fuels like ethanol and biodiesel, the last of which can be produced from food waste products such as vegetable oils and animal fats. Biomass for energy is produced by the following methods: combustion system (boiler that produces steam); landfill gas (anaerobic decomposition of waste); gasification; and biogas from industrial waste streams.

The largest source of energy from wood is "black liquor," a waste product from processes of the pulp, paper and paperboard industry. Issues regarding subsidies for the use of such material can thus prompt arguments regarding fair trade for paper products.[91] As of 2008, biomass contributed to a little less than 10% of all renewable energy production in the United States, or about 1.2% of the US electricity supply – more than 15 times the contribution of wind and solar power combined.[92] The US Department of Energy estimates that energy crops and crop residues alone could supply as much as 14% of the country's power needs.[93] Currently, the 140 MW New Hope Power Partnership in Florida is the largest biomass power plant in North America, using sugar cane fiber (bagasse) and recycled urban wood as fuel. As of 2005, the EU countries met 4% of their energy needs through biomass with the potential for much more, and the 2005 EU Biomass Action Plan[94] identified various activities for boosting the bioenergy market, including actions to encourage Member States to establish national biomass action plans.[95] As of 2009, biomass production provides about 1.5 billion toe per year worldwide. In developing countries over 30% – in some cases up to 50%-80% – of a country's domestic generation can come from this source.[96] Finland has the highest utilization percentage of developed countries, with 23% of its production from biomass, and national programs in Brazil, China, India and Malaysia among others plan to significantly increase reliance on this resource.[97]

Localized value. The economics of biomass often depend on the availability of nearby material, given the transport costs of such bulky fuel. Biomass contains less energy per pound than fossil fuels. This means that raw biomass typically cannot be cost-effectively shipped more than about 50 miles before it is converted into fuel or energy. It also means that biomass energy systems are likely to be smaller than their fossil fuel counterparts, because it is hard to gather and process more than this quantity of fuel in one place.[98]

Sustainability. One basic issue with the use of biomass is ensuring that it truly is an environmentally sound, renewable energy source. Biomass is often used by less affluent populations, where wood and charcoal are readily accessible and cheap. The difficulty is that the way they are being used can present problems for the broader objective of sustainability.[99] Use of wood and charcoal fuels can be a politically sensitive subject which policies and regulations must consider.[100] Biomass fuels can be seen as antiquated, stigmatized or contributing to deforestation and indoor pollution. Furthermore, biomass often does not receive priority in government planning for energy management and poverty alleviation, in spite of the current dependence upon this resource by impoverished people.[101] Policy and regulation must be developed with an understanding and appreciation of existing conditions, including social impacts and the pattern and practice of resource use. Biomass use cuts across many different sectors (electricity, forestry, agriculture, rural development, health, and so on).[102] As an example, the electricity regulator addresses production and pricing, the environmental agency determines whether or not an impact assessment is needed, and the

Ghana presents one illustration of the many factors that must be addressed in developing biomass energy production. The jatropha plant, which requires little water and can grow on low-quality land, has been a focus of biodiesel production. Since a national initiative was introduced in Ghana in 2006, approximately 20 private companies (mostly foreign owned) have started large-scale projects, and as of 2009, 19% of all agricultural land has been planted with jatropha or earmarked for future production. But there are no specific bioenergy policies or regulatory frameworks to monitor these companies' actions, and food security could arise as subsistence farmers are displaced to create large plantations.

land use body addresses permitting. One key to an effective biomass use policy is identifying the proper lifecycle assessment, so that regulators can use this assessment to level the playing field in furtherance of an economically efficient and environmentally sound approach.[103]

The German-sponsored "BEST (Bioenergy Strategy)" program for Africa notes the issues facing use of this resource in Africa as follows:

- ***Perception:*** Policy-makers are often preoccupied with electricity and liquid fuels. Biomass energy is associated with low income populations and low revenue making businesses, with accompanying concerns over environmental degradation, and as such is given low political priority

- ***Financial:*** Biomass fuels tend to be relatively cheap per unit of energy, and production and supply is generally managed piecemeal and is decentralized. Together with long gestation periods and small profit margins, this usually makes investment in biomass energy unattractive to large capital project investors and financiers

- ***Legal:*** In many countries, biomass fuels may only be harvested and transported under license, and these licenses are often not issued. Large sections of the industry thus operate outside the law, making it difficult to engage effectively with those in the supply chain. Boilers require certification and should be designed for compliance with codes, though certification and checks can prove challenging in some areas where biomass is particularly localized

- ***Information:*** Facts and figures concerning the central role of biomass energy are often inaccurate or undocumented. The home-grown nature of biomass and the complexity (and sometimes illegality) of production and marketing networks makes supply and demand much more difficult to measure than with respect to fossil fuels or electricity. Institutions responsible for biomass energy data gathering often lack financial and human resources and have a marginal role

- ***Technological:*** The *de facto* illegality of some biomass fuels, the informal nature of production and consumption, and a general lack of access to information mean that uptake of modern systems of production and consumption (e.g., charcoal kilns) tends to be low

- ***Institutional:*** The low status accorded to biomass energy is often reflected in a shortage of well qualified personnel to support the sector. There tend to be few experts in the area of biomass energy, and they are typically sidelined in under-funded institutions with limited potential to influence others

CHAPTER 11: GEOTHERMAL ENERGY

Snapshot of key regulatory issues:

- *Defining ownership – the legislation needs to specify how ownership is treated. For instance, do geothermal facilities fall under rules similar to minerals or petroleum; and whether geothermal jurisdiction stays under state ownership, with rights granted through concession to use the resource, explore a given area and produce the energy?*
- *Agency coordination - Interaction between multiple authorities requires coordination, including how regulatory differences should apply for shallow or deep geothermal resources*
- *Environmental oversight - Groundwater and other environmental impacts must be considered with streamlined processes in place for less invasive shallow resources (though shallow resources present less environmental harm, they can present some; thus, individual conditions should be monitored to guard against specific environmental harms or pollutants)*
- *Planning - Monitoring and reporting of operations, particularly deep exploration sites, is necessary for national forecasting*
- *Investment encouragement - Incentives must be carefully structured to fit with the specific nature of geothermal, including consideration of the cost and risk at the exploration stage and environmental or tax credits*

Leading environmentalist Al Gore has said, "Geothermal energy is potentially the largest – and presently the most misunderstood – source of energy in the US and the world today."[104]

The term "geothermal," refers to the heat below the surface of the earth. Boreholes are drilled in order to access the heat source, where water or steam is pumped up and used to drive electric generators. Once used and cooled, the water is generally pumped back to the heat source. Because not all geothermal resources have water resources and some have only limited resources requiring water to be infused later, there are two wells, one injection well and one steam/hot water well. The geothermal resource is accessed with steam/hot water (or even another liquid), but geothermal doesn't inherently mean that there is steam/hot water present.

Typically resources with temperatures greater than 150 degrees Celsius are used for electricity generation, with lower temperature/shallower resources applied to direct uses such as space heating.[105] Direct geothermal energy (ground source heat pumps) is now used in at least 76 countries. Global geothermal power capacity surpassed 10 GW in 2008, led by the United States. Geothermal power facilities currently generate 25% of Iceland's total power production as well as comprise a significant portion of the power production in multiple other countries.[106]

Potential pollutants if not managed properly. While geothermal power is considered a renewable resource given the earth's abundant heat and the reinjection of the water, there are environmental concerns regarding its use. Subsurface steam or hot water usually contains gases such as carbon dioxide (CO_2), hydrogen sulphide (H_2S), ammonia (NH_3), methane (CH_4), and trace amounts of other gases, as well as dissolved chemicals, such as sodium chloride (NaCl), boron (B), arsenic (As) and mercury (Hg), whose concentrations usually increase with temperature and which are sources of pollution if discharged. Waste water from geothermal plants also has a higher temperature than the surface surroundings and thus constitutes a potential thermal pollutant. Such waste water should be treated, re-injected into the reservoir, or both. Air pollution can also become an issue when generating electricity in conventional power-plants, with hydrogen sulphide a main pollutant. Extraction of large quantities of fluids from geothermal reservoirs without reinjection can also cause subsidence, i.e. a gradual and irreversible sinking of the land surface.[107]

Regulatory issues. Regulatory issues surrounding geothermal use relate to its particular qualities – like a mineral, it is found below ground and can require large upfront costs not just for feasibility studies and exploration but plant construction. Thus at the extraction stage, mining regulations often apply, while after extraction, energy regulation is triggered. Finally, use of geothermal resources involves new and evolving technology, requiring expertise in application and review, which is also critical to understand to protect against potential pollutants. In some countries, for example, geothermal resources are dealt with in a law on mining (most often separate from the energy law and sometimes uncoordinated with it). The production of geothermal fluids from the subsurface is regulated by water protection legislation. This can be read as meaning that responsibilities are assigned to different ministries with limited cooperation and additional regulatory expense to the investor. Any royalties imposed for the use of the resource should also make a distinction between water and energy.

Investment barriers. Given the nature of the resource, often governments lack clear policies in this area and legal frameworks may overlap, retarding investor interest. In sum, reforms at the policy and legislative level must consider the full cycle of investment, including how developers can access the resource, particularly in the case of geothermal when the resource itself is in the ground at locations not within the discretion of the investor. Clear rules about ownership, how concessions are awarded and how risks are deployed and mitigated

Indonesia provides an example of both the potential for and regulatory obstacles to geothermal development. In Indonesia, the Government has instituted considerable legal and regulatory reforms in the geothermal power sector, with a view to capitalize on Indonesia's recognized wealth of geothermal resources. Despite the legislative reforms that create some incentives for investment, a number of barriers to geothermal development exist, including persistent conflicts over land use and related fragmentation and confusion as to licensing and permitting requirements. Most geothermal sites in Indonesia are in protected forests, national parks and other forests classified by the Ministry of Forests, land controlled by regional governments or privately owned land. Forested land is protected due to concerns about deforestation and climate change, and some sites under local government control in particular are of religious significance. There is no right to eminent domain and burdensome procedures (national, local and private) are in place for release and compensation of land, along with licensing and permitting.

are key to promoting investment in this area.[108] Efforts to streamline and create a one-stop shopping approach have taken place in South Australia,[109] and Peru recently announced that it is undertaking a reform of its geothermal regulations to facilitate development. A more graphic example of the problems with an unclear geothermal regulatory framework can be found in Turkey, where the involvement of three different regulatory bodies has resulted in confusion and litigation.[110] An overview of applicable Romanian laws include the mining law, concession law, environmental protection law, renewable energy law, water law, energy efficiency law and thermal energy law.[111] Encouragement of geothermal development is facilitated through clear "one-stop shopping" rules and investor incentives and risk mitigation such as defined feed-in tariffs (used primarily in Europe), geological risk coverage, insurance and other incentives such as tax credits. The typically small size of geothermal energy projects, the substantial up-front investment, the credit risk barrier and the newness of the technologies used means that developing countries must use a host of tools to promote investment in this area. As such, the regulators' role includes not only assuring safety, technological and environmental compliance, but also action as a facilitator to guide investors through the thicket of potential applicable legislation and regulation.

El Salvador: Geothermal Development

2010

EL SALVADOR: GEOTHERMAL DEVELOPMENT

El Salvador is the world leader in terms of the percentage of its electricity output from sustainable geothermal resources (24%-26%). The regulator, Superintendencia General de Electricidad y Telecomunicaciones (SIGET), helps to facilitate the success of the geothermal market by ensuring sound regulation and monitoring of the project evaluation process to further the dual objectives of sustainability and energy security. This profile looks at how geothermal competes in the energy market and the steps taken by SIGET to ensure a sustainable and predictable regulatory framework for renewable energy through examination of the illustrative example of the 9.2 MW Binary Cycle Geothermal Plant in Berlin, El Salvador.

The Market for Geothermal Energy

In the mid 90's El Salvador began a process of modernizing the public sector, which facilitated the creation of a competitive model of free access to the various activities of the electricity industry, freeing prices of power generation and setting regulations for transmission and distribution. The country has developed a legal and institutional framework that seeks to promote competition and the necessary conditions to ensure the availability of an efficient energy supply able to meet demand while complying with appropriate technical, social, economic, environmental and financial viability criteria.

In November 2007, El Salvador adopted the Law on Tax Incentives for Renewable Energy Development. This new legal framework includes incentives such as tax exemption for ten years for projects under 10 MW of generating capacity. The exemption applies to expenses necessary for research, exploration and preparation of power generation projects based on renewable energy, and projects of total reinjection of the geothermal resource, for projects over 20 MW. A new System for Renewable Energy Development provides for the creation of a Revolving Fund for the Promotion of Renewable Energy to support loans, guarantees and assistance to finance feasibility studies for new projects.

At present, the legal framework for the El Salvadoran electricity sector is made up of the following legislative and regulatory orders:

- Law creating the regulator was issued by Legislative Decree No. 808 of 12 September 1996
- General Electricity Law, issued by Legislative Decree No. 843 of 10 October 1996
- Electricity Law Regulations, established by Executive Decree No. 70 of 25 July 1997, including amendments thereto
- Electric Power Marketing Activities Regulations, issued on 24 October 2000, which aims to promote competition in energy market

- Amendment to the General Electricity Law, issued by Legislative Decree No. 1216, dated 11 April 2003

- The Legislative Decree No. 405 of 30 August 2007

The Salvadoran Wholesale Electricity Market allows all Market Participants with a direct connection to the transmission system (115,000 volts and over) to participate in energy transactions. These participants may be generators (>5 MW), distributors or end users. Agents with no connection to the transmission network also may participate indirectly in the market, as traders, pursuant to special regulations developed by SIGET.

A look at the energy sector's overall market and structure is important to understand the importance of geothermal energy operation and development in El Salvador. The overall installed electrical power generation capacity reported by the end of 2008 was 1,422.2 MW supplemented by 2% imported power. Peak demand was 924 MW and yearly demand was 5,475 GWh, an increase of 4.06% over the reported value of 5,261.7 GWh in 2007.[112] 2009 data shows El Salvador produced 2,524 GWh from oil and 1,501 GWh from hydro.[113] Geothermal sources provided 1,421 GWh, representing approximately 25.5% of overall generation.[114] Notably, the government has significantly increased investment spending in the electricity sector in recent years. As a result, households with access to electricity nationwide have increased from 70% coverage in 1999 to almost 88% in 2005, and finally to 91% in 2009.[115]

The country's abundant geothermal resources, combined with the scarcity of other domestic energy resources and a population of 6.5 million, make the Central American country a particularly appropriate location to develop geothermal power.[116] Exploration for geothermal energy sources began in the 1950's and 1960's with the assistance of the United Nations. Two geothermal fields currently include operating plants: Ahuachapán and Berlin, with a total installed operating capacity of over 200 MW. Exploration is ongoing in two other fields: San Vicente and Chinameca.[117]

The electricity market in El Salvador was liberalized in 1998, with thermal generation and distribution sold to foreign investors, readying the environment for additional investment in all sectors, including geothermal. CEL, the state-owned energy company, kept the hydropower facilities, and geothermal was spun off and given to what is now LaGeo, a private-public Italian joint venture geothermal power generation company. Transmission was also spun off from CEL. With respect to the electricity generation sector, market participants include: (1) CEL; (2) one US investor that bought three thermal generation plants from CEL in 1999; (3) an Indian-Israeli consortium that recently bought a thermal power plant from a British company; and (4) LaGeo. As a result, geothermal financially competes in an open power market. The number of plants, amount of energy produced, and the share of total energy production for geothermal continue to grow.

The Regulatory Role: the 9.2 MW Binary Cycle Project in Berlin

SIGET is responsible for promoting competition, overseeing compliance with the General Law on Electricity, approving tariffs, granting concessions, resolving sector conflicts and regulating procedures, technical standards and methods. As such, SIGET supervises the development of power generation projects using geothermal resources. The regulator monitors project evaluation in order to ensure use of sustainable resources and is responsible for ensuring that clear and transparent rules are adopted and implemented fairly and that concessions are granted in a non-discriminatory manner and in compliance with the Electricity Law.

When the electricity market reformation began in El Salvador under the Electricity Law of 1996 geothermal assets were spun off of the formerly vertically integrated state-owned monopoly (CEL) to a new company, GESAL formed in 1999. GESAL was later renamed LaGeo, S.A. de C.V. (La Geo). The Italian company, Enel Green Power, originally invested in LaGeo in 2002 and then increased its share from 12.5% to 36.2% in 2008 with CEL owning the remaining portion.

In Berlin, the first exploratory well (TR-1) was drilled in 1968, and operations began in the Berlin field in 1992 with two small (5 MW each) plants, financed with Belgian assistance. The original installations were followed by 56 MW in 1996 and were financed by CEL with support from the Inter-American Development. The Berlin field was further expanded by 44 MW (Berlin III) by LaGeo, a public-private company, in 2007. The 9.2 MW Binary Cycle Project initiated in 2004 builds on these previous studies and infrastructure at the Berlin site.

The Berlin binary plant was engineered under an Engineering, Procurement, Construction Management contract awarded to Enex, an Icelandic firm. It uses convection Organic Rankine Cycle technology, which utilizes an organic, high molecular mass fluid with a boiling point at a lower temperature than the conventional water-steam phase change. The working fluid flows in a closed loop and is circulated and re-used constantly. A binary plant enables 100% re-injection of the geothermal brine, which maintains the sustainability of the reservoir. After a two-year service guarantee period, the facility now operates at a net capacity of 7.8 MW.

Initiating the Project: Application and Approval. As was the case with the Berlin binary plant, the regulator's role in projects begins at the outset. The Electricity Law provides that an operator of geothermal fields wishing to increase the installed capacity must apply for authorization from SIGET. The Berlin binary project represents an expansion of the installed capacity in the concession area of the Berlin Geothermal Field with the addition of Unit IV to the existing units. This expansion required that a permit be obtained from SIGET. The application procedure requires that:

- The investor (concessionary) must conduct a feasibility study with all its components: technical description, location, investment costs, resources to be used, environmental permit, etc.

- The concessionary submits an application, together with a feasibility study of the additional capacity to be installed, detailing all the technical, economic and financial information, as well as the respective environmental permit.

- The regulator evaluates the application and verifies the sustainable use of the resource, issuing a technical opinion regarding the project viability. The extent and nature of the regulator's evaluation depends on the size of the project. In the case of the binary cycle, SIGET´s staff has the capacity to evaluate the project and issue a technical report recommending its approval. If the project requires a higher level of expertise, an international expert (consultant) is hired to advise SIGET during the evaluation of the feasibility study.

- Upon a positive finding in the technical evaluation SIGET authorizes via a resolution, the amendment to the concession contract.

There is no legal time limit for this expansion application process. If the feasibility study is fully complete and the investor has prepared the application in full, the process can take as little as 15 working days for the concession to be extended and renewed. If an expert is needed to evaluate the project to support SIGET, the process can take up to three months due to the hiring process.

If a project is to be constructed outside the established concession area, it must seek approval from SIGET for a license or permit to use the geothermal resource. In this case, the processing time is two to four months for projects with an installed capacity of less than 5 MW, and five months for projects with a capacity greater than 5 MW.[118] This delay, while not an issue in the Berlin binary project, can prove burdensome for investors seeking new concessions and is recognized as a barrier in need of attention.

Monitoring. After an application is approved, SIGET has a leading monitoring role:

- During the construction phase, the concessionaire shall annually report on the information necessary to track the project. SIGET reviews, evaluates and follows up on these reports

- In the operation stage, the concessionaire must report data annually for the operation of the field, expansion and improvement projects, and all information that guarantees the efficient use of the resource. SIGET reviews, evaluates and follows up on these reports

- At project closure, the concession contract establishes that the concessionaire will have a period of twelve months for the removal of their property and restore the environment in accordance with the specifications for the abandonment phase of the project, which is part of the contract concession. SIGET verifies compliance with the contract

Developing Rules of Operation and Market Regulations. Looking first at the underlying regulations in support of geothermal production in El Salvador, the most important rules for operation of the sector include Rules for the Transmission System Operation and Wholesale Market Regulations, both first approved by the regulator in 1999. These regulations set out the conditions for dispatch of all power resources available in El Salvador. Geothermal competes with thermal generators, hydropower and imports with no subsidies and is paid either by contract or at market prices. Historically, LaGeo's price bid into the market has been the lowest so all available geothermal power has been dispatched first. As regards information management, energy management, restricted energy supply and mandatory generation systems, even though market variations are based on cost, these do not affect the operation of Unit IV.

To begin the operation of Unit IV, appropriate arrangements were made for both the incorporation of the unit into the transmission system, operated by the Transactions Unit, S.A. of C.V. which manages the Wholesale Energy Market, and the contract for interconnection to the transmission network with the Transmission Company of El Salvador, S.A. of C.V.

To improve the operating rules of the wholesale market in July 2009 SIGET approved the publication of the Production Cost-Based Transmission System Operation and Wholesale Market Regulations, which come into effect in early 2011. Accordingly, there have been significant changes to the Transmission System Operation and Wholesale Market Regulations, including the information management and energy management system, Restricted Power Bids and Mandatory Generation, and the Transient Transfer Mechanism of energy price to end user rates. The latter establishes the conditions to be met by generators of any type of resource (geothermal, hydroelectric, cogeneration and thermal) in order to allow participation in the dispatch of the Wholesale Market.

Because LaGeo's price has historically been the lowest bid into the market, the improved rules have not directly affected the Berlin binary plant. However, the improved operating rules for the wholesale market do create investor friendly conditions for new renewable power. The new cost-based scheme allows for payment for installed power capacity, thus guaranteeing a return on investment and allowing the investor to sell energy in the spot or opportunity market at a marginal cost.

Oversight of the Concession Process. The regulator is closely engaged in the concession process, with responsibility for granting a permanent concession. In compliance with the provisions in Article 120 of the General Electricity Law for granting concessions to companies resulting from the restructuring of CEL and the ruling No. 14-E-2000 dated 27 March 2000, SIGET granted a permanent concession for the exploitation of the Berlin geothermal resource field to LaGeo, S.A. de CV. The agreement was signed by deed of contract on 28 March 2000. The concession contract establishes the rights and obligations of LaGeo regarding geothermal resource management, establishing a program for implementing the grant in a manner that is sustainable and environmentally, technically and economically sound. The execution program in the concession contract foresaw the increase in generation capacity for the 2002-2004 years. Since 2004, LaGeo has constructed five production wells and four injection wells. In 2006 Unit III, with an installed capacity of 44 MW, was built and in 2007 Unit IV (binary cycle) was constructed with an installed capacity of 9.2 MW.

To develop the Berlin binary project, regulatory filings were made as follows:

- Obtained environmental permits for the "Binary Cycle Assembly for Generating 9.2 MW", in accordance with Articles 19 and 22 of the Environment Law,[119] which was issued by resolution MARN-No-6348-119-2005 dated 15 February 2005 (this process is dependent and interlinked with the permit process with SIGET).

- As part of an expansion to the capacity of a field under concession, a permit application was filed with SIGET, in compliance with Articles 23 of the General Electricity Law and Article 52 of the General Electricity Law Regulation, in order to assess the impact of performing these works in the operation of the geothermal field.

- The Berlin Binary Cycle project was registered under the Kyoto Protocol to the UNFCCC[120] on 30 November 2007, with 235,459 tons of CO_2 to be reduced during the first crediting period (six years), using the methodology ACM0002, ver. 6. The Ministry of Environment and Natural Resources is the entity responsible for approving the Environmental Impact Assessment and Clean Development Mechanism projects. (The third process is independent and the investor must deal with the designated entities. SIGET does not intervene in this process).

Regulatory Coordination with Other Governmental Entities. SIGET's relationship with other entities in El Salvador is one of constant communication and coordination, while respecting the scope of the powers assigned to it by the Act of Creation, by the General Electricity Law and its regulations. In practice, SIGET dedicates considerable communication with the Ministry of Environment, in proceedings related to the concession projects and the consultation process for standards. For the Fiscal Incentives Law, since 2008, SIGET coordinates with the Ministry of Finance on projects seeking certification (not applicable to the Binary Cycle plant, which predates the Fiscal Incentives Law). With the municipal governments, they also carry out consultations of the various operators in the electricity sector, which are addressed in a timely manner.

Through its coordination efforts, adoption of the applicable framework, and its oversight of the application and concession processes, SIGET helps to ensure streamlined and successful implementation of energy projects and to facilitate growth in geothermal energy, a priority of the El Salvadoran Government.

CHAPTER 12: DISTRIBUTED GENERATION

Snapshot of key regulatory issues:

- *Coordination with agencies, NGOs and donor/grant organizations to assess appropriateness of grid expansion and off-grid development. With respect to rural electrification in particular, the coordination typically required is between the energy regulator and a special commission or fund established to promote rural electrification.*

- *Investment incentives – because electrification of poor populations is not generally remunerative in the way that building large conventional energy and renewable energy facilities in higher income city centres are. A primary issue is creating a realistic financial package to achieve the desired policy result. This need also requires coordination among various policy-making and regulatory governmental bodies.*

- *Gradation and evolution – small projects unconnected to the grid implicate different issues than larger generation connected to the national network. Planning the first type of project must take into account how the country's networks are anticipated and desired to grow, so as to avoid waste, duplication and other cost inefficiencies.*

- *Local buy-in – given the nature of the resource, local participation in the process and subsequent operations can be essential to success.*

One of the dilemmas national governments face in setting energy policy, particularly in light of the international move toward cost-reflective rate structures and away from state-subsidized energy supply for all, is how to stimulate clean energy growth while also alleviating energy poverty. Domestic production of clean energy can stimulate economies, bringing increases in business, jobs and continuity of supply. Certainly providing energy can turn locally available resources (water, sun, crops) into economic assets and, in turn, promote education and health by expanding power. Access and affordability, however, do not necessarily go hand in hand with clean energy production. In fact, though poor populations may be hit the hardest by

In Mozambique, where more than 80% of the population is off-grid, the Government in 1998 formed the Mozambique National Rural Energy Fund to develop off-grid energy and electrification. With support from the Mozambique Government and multiple donor groups, the fund has managed installation of PV systems, wind pumps and the development of microhydro projects. Two pilot projects implemented in the south and central region of the country provide electricity to schools, clinics and water pumping systems, which now extend to 300 rural schools and clinics.

climate change and indeed the effects of climate change may hinder efforts to reduce poverty, access and affordability present twin challenges for poorer populations.

Access to the Grid

A starting point for energy poverty alleviation is infrastructure. In some parts of the world, large populations suffer from the basic unavailability of energy because energy infrastructure does not exist where they live. This tends to be a greater concern for rural populations for whom cost can be prohibitive than for urban or peri-urban populations. For the rural populations, questions having to do with cost and affordability are secondary, as access is the first barrier. In some rural areas, as much as four out of five people – a population of over 2 billion – lack electricity[121] and conventional grid-connection service does not reach them. Access to energy by rural populations raises several intersecting issues related to poverty alleviation, social equity, women's rights, economic development and urbanization, while also triggering more generic questions of how to cover the costs of bringing energy to rural areas and still provide an energy source that is affordable to the rural population. Most often this population is far poorer than the urban population; yet the cost to bring energy to the rural populations is most often far higher due to the absence of adequate infrastructure and breadth of area. Given these constraints, in rural areas with dispersed populations, bigger is not necessarily better, at least at the beginning of an electrification effort.

To provide basic access to these populations, governments have two options:

- ***Off-grid electrification:*** This includes micro grids and distributed generation, consisting of a smaller (typically 5 – 10 MW) generation unit or units placed close to load, including small island generators servicing individual houses or industries. A smaller generation facility might be a home-owner with excess power from his solar panel or wind turbine, who may sell electricity back to the grid. Distributed generation may also be part of a smaller grid area, separated from the rest of the grid, due to the cost limitations of extending the network, with the added benefit of protecting those smaller systems if a failure of the larger transmission network were to occur. Micro grid systems can be made up of small industrial generators or several smaller systems such as photovoltaics.

- ***Grid extension:*** Under this approach, capital costs can be considerable, including transmission, distribution, reticulation and revenue management.

Though separate approaches, these options should not be viewed as mutually exclusive. Populations that suffer from energy poverty, in rural, urban or peri-urban areas, would benefit most through use of both centralized and decentralized systems. Fundamentally, if electricity is produced on a small scale level, any electricity surplus can only be sold if connected to the grid. So too, if small scale efforts fail, back-up electricity from the grid should be available lest advances in business and economics are threatened. Small, decentralized production units should be supported through legislation, to ensure some ability to integrate with larger systems that tend to dominate markets. The variability and storage challenges presented by renewable energy manifest more easily on the small scale.

The Economic Challenge

According to a World Bank study of several developing countries, grid extension to rural areas typically range from $8,000-$10,000 per kilometer, not including the cost of materials, which adds an additional $7,000. This high cost, coupled with low capacity utilization of such grids due to small loads, makes grid extension economically unviable to utilities. Because of the high costs of extending electricity coverage to rural areas in particular, renewable energy technologies may be the least-cost solution as part of a micro grid.

Distributed Generation and Micro Grids

Decentralized electricity generation minimizes waste due to the proximity of electric generation plants to consumers (losses are far less than with centralized fossil energy production). It is expected that by 2050 a large proportion of electricity will be produced by decentralized energy sources. Efficient least cost local generation connected to a small local distribution network (microgrids) may meet the population's needs more effectively and promptly than attempting immediately to connect all areas of the country to one national transmission grid.

- From an electrical system perspective, distributed generation can reduce the need for some kinds of infrastructure, for example transmission or "peaking" generation units. From an environmental perspective, using renewable distributed generation can reduce reliance on fossil fueled central station power plants.

- From an economic perspective, local renewable distributed generation may be able to bring economic development and power into remote or underserved areas more quickly and efficiently than central generation and a transmission and distribution system.

Countries with large rural populations often depend on distributed generation projects (which in turn are often renewable energy projects) in order for populations to access energy. Distributed generation projects have proven particularly important for large, highly populated countries with large populations spread out across vast distances, as is the case in China and India, where examples of past or ongoing distributed generation projects include the Chinese Township and Village Electrification Programs,[122] and India's Decentralized Distribution Generation component of its rural energy Program (11th Plan).[123]

While DG options can include non-renewable resources, such as diesel generators, such generators can be expensive to operate. The use of other renewable options with diesel as a back-up may be a more sustainable approach from both an environmental and economic perspective. Technologies such as run-of-river hydro, small hydropower systems, biomass and

In light of the 2010 earthquake in Haiti and its legacy of natural and political disasters, one of the best solutions for Haiti for its energy poverty and insecurity issues may be off-grid electricity, which is less prone to systematic collapse during and after disasters. It is also cheaper than extending the grid, particularly in Haiti where the infrastructure is old and the existing thermal and hydropower generating stations need repair, better management and maintenance.

biogas plants may also be more attractive options for rural energy supply when compared to current alternatives, such as unsustainable use of wood fuel which leads to deforestation.

Distributed generation's advantages can include: (1) reduction in network costs; (2) easier and faster planning, siting and installation; (3) greater reliability if multiple units are involved; (4) greater flexibility if the installation can run on multiple types of fuels; and (5) local fuel independence if a resource such as biogasification is used and the resource is a sustainable fuel (which may be found in rural areas of developing countries). The possibility of cogeneration also means that the recovered heat can be used for hot water, space heating and in industry processes. As DG technologies become more efficient and decrease in costs, this alternative may become even more attractive.

The Challenges of Decentralized Energy

Obstacles presented in developing distributed generation and mini-grids (i.e., decentralized energy systems) include: (1) limited experience with these developing technologies for rural electrification; (2) lack of standardization; (3) variation and interruption in renewable resource availability (e.g., wind); (4) the efforts needed to educate or obtain community buy-in; and (5) the lack of a regulatory framework addressing, among other things, feed-in tariffs, if and when DG projects become grid connected. Grid stability and protection are technical issues, with important implications for the regulator. DG facilities must be monitored for their connection status, real power output, reactive power output and voltage at the point of connection to ensure personnel safety and avoid operating problems. Tensions between the developer, the utility and the regulator can result because monitoring is essential to maintain system integrity but may present costs that developers and utilities are unwilling to bear and rural populations cannot afford. Thus, monitoring arrangements must take cost and practicality into consideration, and focus on units that may have a real impact on system reliability. This requires rules that stagger responsibilities based on kilowatts.[124]

The Government of Ghana has launched an "energy economy" initiative with mandates to increase renewable energy production, with particular attention to electrification of rural communities by 2020. The Government now understands that this goal may not be reached if electricity supply is understood as based on grid extension only. Off-grid solar PV projects have offered an interim solution. Such projects have received funding since 1992 from donor agencies, but there is increasing recognition that such projects are unsustainable in the long term, given their high cost (the lifetime for a PV panel is about 30 years and the cost of replacement has not been set into the tariffs, which is a common problem). Recognizing the limitations, the Government and the regulator are working toward the creation of a level playing field for RE by removing existing fiscal and market barriers, such as custom duty and value added tax. Current regulatory efforts are directed at development of a pricing framework that encourages utility companies to adopt renewable energy as part of their supply mix.

Regulating Clean Energy as a Tool to Counter Energy Poverty

For countries with high rural populations, energy sector reform means establishing a legislative framework directed at growth in agricultural non-urban areas, allowing these issues to be addressed separately from other energy sector issues. A typical approach is the creation of a governmental agency to assist in financing that focuses solely on rural electrification issues.[125] Crucial to the successful integration of DG is the development of a legislative and regulatory framework encouraging private investment. Often these agencies contribute to separate regulatory frameworks, including tariff structures and subsidy schemes, making coordination between whatever institutional body is employed for rural electrification and the national electricity regulator critical.

Liberia passed a National Energy Policy in June of 2009, in an effort to reform its energy sector. The National Energy Policy paid particular attention to the development of rural renewable energy services. Staff, financial and capacity constraints mean that the Liberian Electricity Corporation cannot develop and operate the grid in its current state. The Policy encourages private investment in the sector to fill the needs that cannot be met by government or the utility. The Policy envisions the establishment of several institutional bodies to support these endeavors, including a Rural Energy Fund (to provide low-interest loans, loan guarantees and grants to improve energy access to the poor), the Rural and Renewable Energy Agency, and a new Energy Regulatory Board. In keeping with the needs of the population and the distribution of its citizenry, institutional development efforts are focusing first on the Rural and Renewable Energy Agency, with secondary attention to the establishment of an

The World Bank Energy Sector Management Assistance Program (ESMAP) program has recommended simple and light-handed regulation, with a clear definition of responsibilities, and the ability by the national or regional regulator to delegate regulatory tasks to other entities, such as the rural electrification agency or fund. It suggests that the regulatory framework permit a portfolio of approaches, including: (1) concessions, permits and licenses, depending on context; (2) quality of service standards that are realistic, affordable, easily monitored and enforced; (3) government regulations that permit private sector participation and create a level-playing field for all; and (4) a tariff structure that permits recovery of costs while remaining within the consumers' ability to pay. On this last point, while legislation or policy typically establishes the subsidies, the regulator can effectively undercut them through tariff regulation absent appropriate protections. Also, because community involvement is critical, local populations can sometimes contribute a significant portion of upfront capital investment in labor, material or cash contributions, which must also be taken into account in establishing the appropriate tariff structure.[126]

Innovative Approaches

Though distributed generation and the use of micro grids are touted as an answer for poorer populations in part because they are less expensive than grid expansion, the costs of distributed generation can also be daunting. In India, efforts to bring solar energy to market have stumbled, largely due to high cost. India is trying to sell the most expensive power to the poorest people through distributed generation in rural areas. Carbon markets reward sophisticated companies that build enormous projects, and the surge in voluntary commitments to green energy largely comes from middle to higher income populations in developed areas. The projects that affect the very poor garner less attention, less support (political and financial) and less revenue.

Micro-credit and small loan projects offer hope for successful integration of the dual goals of stimulating economic development in deprived areas and promoting clean energy. Some are offering ways to measure the emission reductions that result from each loan, thereby allowing lenders to calculate the carbon offsets they helped to create, even on a small scale.

Energy In Common is a new venture with the ambitious goal of delivering clean energy to 15 million people in five years, all the while fighting poverty by empowering developing world entrepreneurs through microloans. The projects being funded have a clear sustainability focus – such as solar-powered lighting systems in Ghana – lowering energy reliance and cost for local small-business owners and ordinary citizens. At the same time, lenders are able to see exactly where their money goes, adding transparency to the carbon offsets they receive for lending.

GUATEMALA: DISTRIBUTED GENERATION

2010

CHAPTER 12: Distributed Generation

GUATEMALA: BUILDING OF A REGULATORY FRAMEWORK FOR DISTRIBUTED GENERATION

In the last years, Guatemala's regulatory framework has been modernized in order to promote investment in new renewable energy projects. One of the most important changes to the regulatory framework has been the introduction of the concept of Distributed Renewable Generation (DRG) in the Rules of the General Electricity Law (hereafter, DRG Rules). The regulator, the Comisión Nacional de Energia Eléctrica (CNEE) (formed in 1997 as the Regulatory Authority of the electricity sector in Guatemala) played an active role in the adoption of the DRG Rules and the creation of the technical Norm that followed, the Norma Técnica para la Conexión, Operación, Control y Comercialización de la Generación Distribuida Renovable (Technical Standard for the Connection, Operation and Marketing Distributed Renewable Generation), referred to hereafter as NTGDR.

The DRG Rules were adopted in response to needs identified by electricity market actors for regulation of renewable generation below 5 MW and for improvement of the electrical parameters in the distribution lines that are not in close proximity to distribution stations. The goal was to create a framework that would encourage and promote small renewable energy projects under 5 MW. The electricity sector regulator along with other market actors was part of the early consultation stage, which allowed for comments on the proposed rule and several outreach activities. The NTGDR was approved by the CNEE in compliance with the provisions of the amendments to the Regulations of the General Electricity Law approved by Government Agreement 68-2007.

This supporting Norm that followed in 2008, the NTGDR, enables distributed generation access to the distribution grid, taking into consideration size, geographical location, and distribution companies' actual infrastructure and voltage level. The NTGDR is designed to promote construction of renewable energy power plants that are economical and feasible from a technical and market perspective. To achieve this, the NTGDR creates a framework for investment in small distributed generation (less than 5 MW), requiring that distribution companies allow such power plants to connect to the distribution network at the generator's cost, after approval of a capacity study. The NTGDR also enables distributed generators to participate in public tenders for supply of the distribution companies' electricity demand or to sell their electricity in the Guatemala spot market.

This country profile looks at how the regulator's actions over the last several years have served to shape distributed generation reform and specifically facilitated the creation of a technical norm to promote investment in DRG in Guatemala.

IDENTIFYING NEEDS AND BARRIERS

Guatemala has a population of almost 13 million and the largest economy in Central America, though poverty remains high. Firewood is used as an energy source by 80% of rural families. As of 2009, Guatemala's electricity mix was 46.6% thermal (fuel oil and coal), 36.1% hydro, 3.5% geothermal, 13.3% cogeneration (sugar cane) and 0.5% imports. The Renewable Energy and Energy Efficiency Partnership (REEEP), an international non-profit that advocates for sustainable reform in the energy sector, estimates 5,000 MW of hydro is available. *The Solar and Wind Energy Resource Assessment*, a United Nations Environment Programme, provides ready access to credible renewable energy data to stimulate investment in, and development of, renewable energy technologies, estimates 7,800 MW of wind is possible and geothermal resources of up to 1,000 MW can also be developed.[127] Though the potential for RES development is great, Guatemala currently imports fossil fuels for up to 60% of its electric energy generation needs.

Use of distributed generation to utilize Guatemala's abundant domestic resources provides one solution to this situation. Distributed generation is defined in the new DRG Rules, discussed in more detail below, as:

> *electric generation…produced by generating technologies that use renewable resources and that are connected to distribution installations, with installed capacities of less than 5 megawatts; … technologies with renewable resources are those using solar, wind, water, geothermal, biomass and other determined by the Ministry of Energy and Mines*

How to encourage investment in DRG however was a stumbling block, until the CNEE conducted an analysis, receiving input from market stakeholders as to the various reasons that renewable power plants, mainly the small ones, were not being developed. CNEE identified the following as key reasons, ultimately determining that these could be addressed through a new regulatory framework for DRG:

- The existing framework (before 2006 when DRG efforts began in earnest) failed to offer proper "signals" for the construction of small power plants that use renewable resources or DRG. Some of the reasons were the existence of long term PPA´s, signed under emergency conditions in the 1990´s between distribution companies and private generators with fossil fired power plants (resulting in distribution companies to be over-contracted); the brief duration (two years) of these new PPA´s sent short-term signals for the contracting of electricity, mainly resulting in the construction of (lower cost) oil fired power generation plants. Another reason was that incumbent generators were resistant to bringing in new investments.

- Stakeholders and potential investors reported that the existing framework was difficult to understand and to interpret, with limited guidance as to the current regulation around this important issue to help promote investments specifically in DRG. General public and investor perception was that the current regulation was too complex and did not allow for generators with installed capacities of less than 5 MW to participate in the electricity market; though this was in fact not the case, CNEE found the misunderstanding was prevalent and that it was necessary to change perceptions and facilitate access to information so that regulation became more comprehensible to potential developers of DRG.

Regulatory Action: Taking Steps To Effect Change

CNEE began a concentrated effort of investigating DRG in early 2006, through a program of consultation with state market actors, regulatory and business counterparts in Latin America, and a study visit to California.

Consultation with State Market Actors

Work began at the government level in Guatemala, with outreach and consultation periods seeking input from all state market actors. In 2006, the Ministry of Energy and Mines formed a Committee, where CNEE participated, in order to analyze the Regulation of the General Electricity Law and Regulation of the Wholesale Market Administrator. One of the objectives was finding alternatives to promote the development of new renewable energy investments in Guatemala. CNEE actively participated and proposed that the concept of DRG should be included, not in a lot of detail (as this should be developed in a technical norm), but nevertheless as a definition in the Regulation of the Electricity Law. This was proposed in order to give more support to DRG.

Review of the Rules was conducted during 2006 and the first two months of 2007; amendments were approved by government decision and published on 5 March 2007, entering into force on 6 March of the same year. CNEE had been working on elaboration of NTGDR, which was approved by CNEE and published in the Official Gazette on 16 September 2008 via Resolution 171–2008. Although this Norm was designed and approved by the CNEE, receipt and assessment of ongoing input from agents in the electricity sector and related experts were a constant priority for CNEE. For instance, CNEE conducted two major forums, sent the first draft in writing to Guatemala's leading universities and the Chamber of Commerce, and presented the draft in numerous other forums, such as the School of Engineers of Guatemala and ANACAFE, which is the National Association of Coffee in Guatemala, (whose members (small, medium and large coffee producers) have a 400 MW potential to generate hydro electricity with small generators (less than 5 MW)). Guatemala has a maximum demand of 1,500 MW.

The Norm, ultimately designed to promote investments through clear and comprehensive rules and regulatory mechanisms, received input from current or potential investors with business knowledge. Having in mind that particular interests are involved when outside agents are asked for comments, the regulator is challenged to balance these interests with efficient regulatory principles and a "just and reasonable" approach for the market, a difficult task due to the imperfectness of the market and the imperfectness of regulation.

Study Tour to California and Consultation with Spanish Counterparts

In February of 2006, CNEE representatives visited the State of California in the United States to look at how businesses addressed DRG, visiting Southern California Edison, the Municipal Electric Company of California, the Municipal Electric Company of River Side and the Wind Generating Park in Palm Springs. With respect to DRG in particular, CNEE drew lessons from the use of isolated generation and net metering in River Side. In addition, CNEE learned about practices involving the use of combined cycle generators, energy efficiency measures (including improvement of efficiency in generating plants through the use of methane gas, increasing the efficiency of such plants to achieve up to 68% plant factor (normal for a plant of this type is 40%)), use of existing photovoltaic plants that fed an exclusive grid for air conditioning load for the city, and wind power generation (from Palm Spring Park), which generated about 400 MW of firm power efficiently, with large investments, and connected to an interconnected power system.

In May 2006, staff from CNEE visited the Spanish regulator in Madrid along with the Central Control of Wind Generation. The main focus of the visits to Spain was not distributed generation as such, but a discussion of the impact of wind generation on the operation of the network system and the cost of wind projects, leading to the conclusions that large wind generation impact on the electricity system and the way these projects should be managed would have to be addressed in the future; and that a more detailed technical analysis of DRG was going to be needed. Collectively, these efforts led to the conclusion that Guatemala would benefit from a unique approach that limits the maximum size of DRG to 5 MW, while restricting production to renewable energy and providing corresponding incentives. In many other countries, for example, there is no size limitation or exclusivity for renewable energy. In Guatemala, the abundant RE resources and the needs of rural businesses, such as coffee farms, point to the need for rules that regulate businesses that self-generate and have surplus that will allow sale to the national electricity market.

In developing the Norm, CNEE and counterparts assessed the primary objectives, namely to encourage investment in small renewable power stations, and to connect these small renewable energy projects below 5 MW to distribution networks. Prior to enactment of the Norm, quality of product in some parts of the country was low, so the development of the Norm and its incorporated incentives were also aimed at improvement in product quality. A vital development in the Norm was the incentive to the investor of not paying for the use of distribution networks as long as the energy supplied by their power plant to the distribution grid is against the direction of the prevailing flow of electricity in that part of the system. Development of the Norm relied in part on technical references in IEEE Standard 1547, which offered direction as to the minimum protective equipment for power plants below 5 MW.

SUMMARY OF THE LEGAL REFORMS TO SUPPORT DRG

In 2007, the Guatemalan government published the *Acuerdo Gubernativo 68-2007* which amended the General Electricity Law, and the *Acuerdo Gubernativo 69-2007*, amending the wholesale market rules (reforms to the Rules of the Administrator of the Wholesale Market), with the goal of increasing competition, investment, coverage and improving service and developing distributed generation. This amendment set forth the DRG Rules, which included the definition of DRG as discussed above, and general rules for the connection and regulation of DRG, including Article 16, which gives CNEE authority to approve rules to regulate the connection, operation, control and marketing conditions:

> *"The Distributors are compelled to allow connections to their installations and the performance of the necessary modifications or enlargements in order to allow the operation of the Renewable Distributed Generators, for which they have to determine the capacity of the point of connection and the necessary enlargements of their installations. Before the authorization, the Commission will evaluate the appropriateness of the scope of the modifications and enlargements of the installations of the Distributor, likewise, the respective cost and the benefits from the improvement of the quality of the distribution service and from the reduction of losses. The costs of the enlargements, modifications, transmission line and equipment, necessary to reach the connection point with the distribution network, will be on the account of the Renewable Distributed Generator. The Commission will elaborate general stipulations and standards for the regulation of connection, operation, control and commercialization conditions of the Renewable Distributed Generator, including payments or credits by concept of toll and saving on losses, as pertinent and applicable and in accordance with the Law and this Regulation. In case of operations not under contract, the Distributor will become the purchaser of the electricity generated by the Renewable Distributed Generator, by fulfilling the stipulations of the Law. The remuneration of power will be a ceiling price equal to the Price of Opportunity of the Power in the Wholesale Market; and will be considered the effective reduction of the losses."*

In September 2008, on the basis of its empowerment via the DRG Rules, CNEE's Board of Directors adopted the NTGDR to further the Government's plan to utilize the country's large hydropower potential and lessen its dependence on fossil fuels. In all, the adoption of NTGDR took approximately 14 months and involved an ongoing process of review, consultation and redrafting.

In sum, general policy features of the NTGDR include:

- Incentives for the following renewable energy sources: biomass, wind, geothermal, hydro and solar
- Limitation on the size of the power plants (distributed generators) to 5 MW or less
- Connection to the distribution power lines at the generator's cost after approving a capacity study, and distribution company maintenance of the power lines
- Distribution line access via a request to the distribution companies with the necessary information to reinforce the power lines if necessary; distributed

generators are able to participate in public tenders to supply the distribution companies' electricity demand or to sell their electricity in the Guatemalan Spot market

Some advantages are:

- This policy was published on September 2008 and since then nine projects have been authorized by CNEE for a total of 10.93 MW; all are hydropower plants.
- The national coffee association in Guatemala estimates that in the areas of coffee plantations a total of 500 MW hydroelectric potential could be exploited in the near future.
- Distribution losses will be reduced and the quality of the service will be improved.
- Distributed generators are exempted from paying transmission fees.

DISTRIBUTED GENERATION PROJECTS IN GUATEMALA: DRIVING REFORMS AND DRIVEN BY REFORMS

The Renewal Energy Incentives Law was enacted in 2003; though some investors came into the market after the adoption of the law, they continued to push for reforms after this time, particularly for rural communities, leading to the development of supporting rules and ultimately to development of the technical Norm. The law's passage encouraged investment, though in the early years, most funding was from international donor agencies seeking to support the legislative changes and initiate the path toward renewable energy investment in rural communities in particular. In 2004, for example, 180 solar PV systems were installed in six rural communities of Guatemala's Northern Quiche region for household, commercial and community use. The program was led by Fundación Solar, in collaboration with the Global Environmental Facility, UNDP, the Ixil Project, USAID, the Sandia National Laboratories of the US Department of Energy, the Guatemalan Ministry of Environment and Resources, the Guatemalan Ministry of Energy and Mines and the local organization, Asociación de Desarrollo Integral de Multiservicios (Association for Integrated Multiservice Development, an organization which promotes economic and social development of former communities of populations in resistance in Sierra de Chamá and Chajul, Quiche).

An important and recent project regarding distributed generation is "Kaplan Chapina," a 2 MW hydropower plant which started construction in 2006. The electricity to be produced by this power plant is expected to reach 3.5 GWh per year, following operation start-up in October 2009. The Kaplan Chapina project took advantage of Guatemala's recently adopted policies, designed to facilitate development of renewable power plants and distributed generation. These policies enabled the power plant to build a transmission line and connect directly to the distribution network. Mr. Arimany, former chairman of Papeles Eleaborados, S.A., the company that constructed the project, identified the NTGDR as one of the two policies that encouraged the construction of this project (the other was a 2003 law published by the Congress of Guatemala that exempts the payment of valued aggregated, income and importing taxes to companies that invest in renewable energy projects for a 15-year-period).

As noted, following adoption of NTGDR, nine hydropower projects have been approved by CNEE; the following table offers a description of each project:

Table 3. Approved Distributed Renewable Generators in 2009 and 2010:[128]

No.	Name	Location	MW
1	Santa Elena	Escuintla, Escuintla	0.70
2	Kaplan Chapina	Pueblo Nuevo Viñas, Santa Rosa	2.00
3	Hidroeléctrica Los Cerros	San José El Rodeo, San Marcos	1.25
4	Hidroeléctrica Cueva María	Cantel, Quetzaltenango	1.50
5	HidroPower	Escuintla, Escuintla	2.16
6	El Prado	Quetzaltenango, Colomba	0.5
7	Jesbon Maravillas	San Marcos, Malacatán	0.72
8	Covadonga	Retalhuleu, Nuevo San Marcos	1.6
9	Finca Las Margaritas	Sn. Francisco Zapotitlán, Suchitepéquez	0.5
TOTAL			**10.93**

Development of distributed generation is expected to have the added benefit of reducing distribution network losses.

Lessons Learned: Granting Competencies To The Regulator in Primary Legislation

The Electricity Law gives CNEE explicit powers to develop Technical Norms related to the electricity sector. According to the regulator, because other parties, each with its own interests, knew that the regulator was clearly acting within its competencies and with an identified goal of having a more efficient generation mix in the future, CNEE's authority in this area was not contested. The Electricity Law empowers the regulator to:

"Issue technical standards for the electricity industry and monitor their compliance in accordance with internationally accepted practices" and "Issue directives and rules as required to safeguard unrestricted access to transmission lines and distribution systems, in accordance with this law and regulations hereunder."

One important lesson learned in Guatemala is that General Laws, in this case the General Electricity Law (approved by Congress), must remain "General," establishing only the foundations or basic principles that will be later developed in more detail through Regulations and Norms. This allows the technical staff to develop the concepts in a more comprehensive way and in a manner consistent with sector expertise and knowledge.

With a new framework for distributed generation in place, Guatemala is looking forward to improving supply and service, particularly for its rural population.

Concluding Comments

Over the next decade energy regulators around the world will be tasked with implementing national carbon reduction policies in the electricity sector via clean energy initiatives. As emphasized in this Handbook, integration of RE into the market and electricity grid can present a number of new challenges and opportunities to regulators.

Regulators will find that their expertise opens unique possibilities for them to engage in RE, through preparation, planning, design, regulation drafting, public consultation, public outreach and ultimately, implementation of regulations designed to encourage RE production. While conditions will differ across countries due to a variety of factors including policy, resources, economics and energy outlook, some overriding principles can help regulators navigate the developing environment of RE:

- Clearly defined goals inform and guide the regulatory framework and lead to the creation of predictable, consistent rules. Mixed goals, unclear goals, or inconsistent goals create uncertainty for investors, jeopardizing efforts to increase RE penetration.

- Transparency of regulations and implementation creates an environment of certainty and predictability that encourages new entrants to the market and guards against discriminatory practices or unfair advantages to certain participants, particularly incumbents that can distort efforts to open the market. Flexibility provides opportunities to improve and adjust. While predictability of framework is important, the regulator and policy-makers benefit from openness to adjustment when needed.

- The choice of incentive scheme or schemes is individual to each country. There is no one right answer to designing feed-in tariffs or other support mechanisms for renewable energy projects.

- Designing and implementing a renewables policy takes a great deal of work, and different organizations will have different and valuable inputs. A cross-section of government and industry can provide valuable direction and regulators can play an essential role in facilitating collaboration.

- The process is continual. Experience in other countries teaches that it is important to have periodic reviews of both the price mechanisms and actual prices for renewables as well as the entire process of tenders, long-term contract terms and conditions, locational and fuel preferences, and portfolio mixes. While governments and regulators should avoid retroactively changing contract terms and conditions, especially price conditions, if at all possible, the renewable business is dynamic, technologies mature quickly, costs of production drop, and customers should receive the benefit of these changes and not get locked in to policies that fail to keep up with a dynamic renewable market place.

- Renewables should be part of a comprehensive plan that also includes energy efficiency, technical loss reduction, and other "smart" technologies to optimize use of energy while minimizing its waste and unnecessarily deployment. The policies for energy efficiency should be meshed with the policies for energy renewables.

- Regulators should also review legal and administrative processes in other sectors that may impact RE advancements, including environmental permitting restrictions, environmental standards, and investment and procurement rules, and understand the economic and sector implications of selected incentive schemes in order to maximize effectiveness and minimize harm.

- Regulators can help prepare by becoming familiar with the landscape of national and international RE initiatives and by collaborating with other regulators, experts and stakeholders within their country and/or region.

National regulators are part of a team committed to RE. It is particularly important for regulators to learn from one another when it comes to RE because often the speed and ambitiousness of national policies tend to leave little time for the RE market to naturally develop and mature. By sharing knowledge, lessons learned and best practices with regional and/or international counterparts, regulators can respond to the international and national policy commitments their governments have made and help the furtherance of RE in their countries.

By reason of expertise and access, regulators are the natural leaders of today and the future of national efforts to encourage RE.

BIBLIOGRAPHY

[1] http://www.irena.org/ourMission/index.aspx?mnu=mis. This statement is from the website of the new International Renewable Energy Agency (IRENA), which was officially established in Bonn on 26 January 2009. To Date 148 states and the European Union signed the Statute of the Agency; amongst them are 48 African, 38 European, 35 Asian, 17 American and 10 Australia/Oceania States. Mandated by these governments worldwide, IRENA will promote the widespread and increased adoption and sustainable use of all forms or renewable energy. Acting as the global voice for renewable energies, IRENA will facilitate access to all relevant renewable energy information, including technical data.

[2] The international focus on climate change has engendered a push to expand the definition of renewable energy to include non-renewable, but non-carbon producing, generation technologies such as nuclear generation. This is mostly because renewable energy and clean energy definitions are often merged, and also because nuclear energy is viewed as having a longer life sustainability than fossil fuels. This Handbook takes the position that because it is fundamentally exhaustable, nuclear energy is not included in any definition of RE considered here. Combustion-based renewable sources such as biomass and biogas are generally assumed not to produce any net carbon emissions, since the natural processes that created the fuel draw carbon out of the environment. In many jurisdictions this rationale has been extended to municipal solid-waste combustion and is considered "renewable" due to the organic component of such waste. Some studies, however, have questioned whether biomass is CO_2 neutral and sustainable; see for instance the study at http://www.mass.gov/?pageID=eoeeaterminal&L=4&L0=Home&L1=Energy,+Utilities+%26+Clean+Technologies&L2=Renewable+Energy&L3=Biomass&sid=Eoeea&b=terminalcontent&f=doer_arra_bscps&csid=Eoeea. Environmental concerns may compel policymakers to exclude traditional renewable energy facilities such as biomass or hydroelectric generation from the definition of renewable energy, unless those facilities comply with air quality or fish passage regulations. Here, consistent with generally accepted international standards, we include these under our definition of RE, but caution that all RE must be produced in a manner consistent with the goal of sustainability and that evidence of the contrary must be taken into consideration whenever issues of subsidies or support schemes to promote RE are implicated.

[3] Renewable energy efforts are not stand-alone, and operate parallel with energy efficiency developments and various efforts to reduce carbon and other greenhouse gas emissions of fossil fuels. Energy efficiency efforts focus on the demand side, diminishing demand itself as well as changing patterns of demand (night/day usage). For fossil fuels, technologies are developing to convert them to hydrogen, capture and sequester the carbon, and use fuel cells from the hydrogen produced and existing oxygen to produce clean energy.

[4] A New Green Economics, The Test for the World in Bali and Beyond**,** *By Ban Ki-moon,* Monday, December 3, 2007**,** *Washington Post.*

[5] The United Nations Environment Programme, 2009 Paper: *From Conflict to Peacebuilding, the Role of Natural Resources and the Environment.*

[6] See World Bank RE Toolkit, citing to a report by Nicholas Stern, 2006, The Economics of Climate Change, The Stern Review, Cambridge University Press, Cambridge, UK.

[7] See World Bank RE Toolkit, at 141, Table 1, comparing fossil fuel and renewable resources, indicating that most renewable is not yet cost comparable absent consideration of externalities.

[8] Over 20 US states require between 15 and 20% of all electricity to be from renewables resources by 2020 to 2030; see http://www.pewclimate.org/what_s_being_done/in_the_states/rps.cfm for additional information.

[9] See World Bank RE Toolkit, at 129, defining externalities as "benefits or costs generated as an unintended by-product of an economic activity that do not accrue to the parties involved in the activity and where no

compensation takes place. Environmental externalities are benefits or costs that manifest themselves through changes in the physical-biological environment."

[10] On the security front, *see* A. Owen, "Environmental externalities, market distortions and the economics of renewable energy technologies" 25 *Energy Journal* 127, 129 (2004), ("To the extent that governments bear the security costs associated with ensuring that uninterrupted supplies of fuels reach the relevant markets, then these fuels are being subsidised and hence there exists an inefficient allocation of resources")

[11] See http://www.juandemariana.org/pdf/090327-employment-public-aid-renewable.pdf

[12] http://switchboard.nrdc.org/blogs/paltman/media/Rodriguez%20letter.pdf

[13] See the International Energy Agency website, http://www.iea.org.

[14] Namibian Electricity Control Board, http://www.ecb.org.na/download.php?fl_id=150

[15]http://www.mme.gov.na/pdf/energy_policy_whitepaper.pdf

[16] Namibian Electricity Control Board, http://www.ecb.org.na/download.php?fl_id=150

[17] Namibian Renewable Energy and Energy Efficiency Institute, http://www.reeei.org.na/aboutus.html

[18] The Renewable Energy and Efficiency Partnership, REEEP, http://www.reeep.org/index.php?id=9353&text=policy&special=viewitem&cid=95

[19] The European Commission's Intelligent Energy division issued a Final Report in February 2007 which assessed the effectiveness of different support schemes used in the EU. *See* www.optres.fhg.de.

[20] In a 2008 working document, for example, EU Commission staff, after studying the various tools used to promote renewables, concluded that a properly set feed-in tariff is "generally the most efficient and effective support schemes for promoting renewable electricity," http://ec.europa.eu/energy/climate_actions/doc/2008_res_working_document_en.pdf

[21] RUHR Economic Papers, http://repec.rwi-essen.de/files/REP_09_156.pdf

[22] See, e.g., the California Public Utilities Commission's calls for such a tariff to encourage solar use. http://www.energy.ca.gov/2008publications/CEC-100-2008-008/CEC-100-2008-008-CMF.pdf .

[23] For the Pelamis Wave project, see http://www.pelamiswave.com/content.php?id=149

[24] COMMUNITY GUIDELINES ON STATE AID FOR ENVIRONMENTAL PROTECTION, European Commission 2008/C 82/01, found at http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:C:2008:082:0001:0033:EN:PDF

[25] For data showing the relationship between tax credits and investment in renewables in the United States see G. Heal, The Economics of Renewable Energy, National Bureau of Economic Research, at 10, Figure 3 (June 2009) http://www.nber.org/papers/w15081.pdf (Heal).

[26] http://www.doe.gov.ph/popup/republic_act.asp

[27] For information on the RE policy of the Philippines, see http://www.doe.gov.ph/EnergyAccReport/2009%201-Page%20Ad_CABfinal.pdf

[28] By far the largest distribution company is MERALCO, which serves the capital, Manila, and the surrounding area. About 25% of the population lives within this service territory. Luzon constitutes the largest island grid, with

11,907 MW of the total installed capacity and a peak demand of 6,674 MW. The Luzon and Visayas grids share power via submarine cable interconnections, while the third largest population center, Mindanao, remains a separate grid.

[29] http://www.doe.gov.ph/Laws%20and%20Issuances/RA%209136.pdf

[30] http://www.transco.ph/; the Transco became a subsidiary of the Power Sector Asset and Liabilities Management Corporation (PSALM), which also acquired the NPC's IPP contracts (see http://www.psalm.gov.ph/index.asp).

[31] http://www.doe.gov.ph/Downloads/Revised.pdf

[32] When WESM started its commercial operations, PSALM and NPC controlled about 55% and 22%, respectively, of the generation capacity registered. To mitigate this dominance and enhance competition, the PSALM IPPs are grouped under a different IPP Administrator, an independent entity appointed by PSALM. When WESM began operations, these IPP Administrators were not yet in place, however, which made PSALM an interim IPP Administrator controlling more than 30% of the installed capacity in the Luzon Grid. Eventually PSALM initially split its IPPs into four trading teams and NPC created a trading team for each plant, with nine trading teams at the start of WESM. As of July 2008, PSALM had merged its trading teams into three and NPC eliminated four teams via privatization.

[33] As long as the IPP Administrators remain controlled by the same entities, an inherent conflict exists between the multiple use of Administrators to lower prices through competition and the objective of management to increasing revenues. Given tight supply, moreover, many plants become crucial suppliers during peak demand, creating opportunities for the exercise of market power. PSALM's dominance of the spot wholesale market became even more pronounced when more generators shifted to bilateral contracts, leaving the PSALM-IPPs with an even greater share of the diminished uncommitted capacity that competes in the spot market.

To alleviate this situation, the next step in reform is to make the IPP Administrators independent. The first RFP for IPP Administrators was held in June 2009 and failed because the bids fell short of the reserve price; a second round of bidding in August 2009 resulted in the appointment of independent IPP administrators to manage the contracted capacities of two coal-fired plants accounting for roughly a third of the IPP contracts for Luzon and Visayas. http://www.econ.upd.edu.ph/dp/index.php/dp/article/view/644/Full%20Paper

[34] Information about the National Electrification Administration can be found at: http://www.nea.gov.ph/

[35] http://www.doe.gov.ph/popup/republic_act.asp

[36] The DOE's Implementing Rules and Regulations for the Law were signed on 25 May 2009. To expedite processing of renewable energy projects, other enabling guidelines were issued by the DOE such as the Department Circulars covering the accreditation of manufacturers, fabricators and suppliers of locally-produced Renewable Energy equipment and components, as well as guidelines governing the award of RE service and operating contracts and registration of RE developers. 87 RE service and operating contracts were executed on 23 October 2009, adding about 555 MW of hydropower, 18.4 biomass and 623 MW of wind. http://www.doe.gov.ph/EnergyAccReport/2009%201-Page%20Ad_CABfinal.pdf

[37] http://www.erc.gov.ph/pdf/Revised%20FIT%20Rules%20for%20POSTING_final.pdf

[38]"The forecasted annual required revenue of the Eligible RE Plants shall be determined considering the following: for deliveries to the transmission network, the forecasted annual generation of the Eligible RE Plants and the applicable FITs for the year. For deliveries to distribution network, the forecasted annual generation of these embedded Eligible RE Plants, the applicable FITs for the year, and the annual average generation charge of all the distribution utilities where the Eligible RE Plants are embedded, consistent with Section 2.8, shall be considered.

The projected WESM generation revenues shall also be considered, if applicable, based on subsequent issuances of the ERC as mentioned in Section 2.9." (See http://www.erc.gov.ph/pdf/Revised%20FIT%20Rules%20for%20POSTING_final.pdf)

[39] See http://unfccc.int/kyoto_protocol/items/2830.php. The Kyoto Protocol was adopted in Kyoto, Japan, on 11 December 1997 and entered into force on 16 February 2005. 184 Parties of the Convention have ratified its Protocol to date. The detailed rules for the implementation of the Protocol were adopted at COP 7 in Marrakesh in 2001, and are called the "Marrakesh Accords."

[40] Id. These are: Afghanistan, Albania, Algeria, Angola, Antigua and Barbuda, Argentina, Armenia, Azerbaijan, Bahamas, Bahrain, Bangladesh, Barbados, Belize, Benin, Bhutan, Bolivia, Bosnia and Herzegovina, Botswana, Brazil, Brunei Darussalam, Burkina Faso, Burundi, Cambodia, Cameroon, Cape Verde, Central African Republic, Chad, Chile, China, Colombia, Comoros, Congo, Cook Islands, Costa Rica, Cuba, Cyprus, Côte d'Ivoire, Democratic People's Republic of Korea, Democratic Republic of the Congo, Djibouti, Dominica, Dominican Republic, Ecuador, Egypt, El Salvador, Equatorial Guinea, Eritrea, Ethiopia, Fiji, The former Yugoslav Republic of Macedonia, Gabon, Gambia, Georgia, Ghana, Grenada, Guatemala, Guinea, Guinea-Bissau, Guyana, Haiti, Honduras, India, Indonesia, Iran (Islamic Republic of), Israel, Jamaica, Jordan, Kazakhstan, Kenya, Kiribati, Kuwait, Kyrgyzstan, Lao People's Democratic Republic, Lebanon, Lesotho, Liberia, Libyan Arab Jamahiriya, Madagascar, Malawi, Malaysia, Maldives, Mali, Malta, Marshall Islands, Mauritania, Mauritius, Mexico, Micronesia (Federated States of), Mongolia, Montenegro, Morocco, Mozambique, Myanmar, Namibia, Nauru, Nepal, Nicaragua, Niger, Nigeria, Niue, Oman, Pakistan, Palau, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Qatar, Republic of Korea, Republic of Moldova, Rwanda, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Samoa, San Marino, Sao Tome and Principe, Saudi Arabia, Senegal, Serbia, Seychelles, Sierra Leone, Singapore, Solomon Islands, South Africa, Sri Lanka, Sudan, Suriname, Swaziland, Syrian Arab Republic, Tajikistan, Thailand, Timor-Leste, Togo, Tonga, Trinidad and Tobago, Tunisia, Turkmenistan, Tuvalu, Uganda, United Arab Emirates, United Republic of Tanzania, Uruguay, Uzbekistan, Vanuatu, Venezuela (Bolivarian Republic of), Viet Nam, Yemen, Zambia, Zimbabwe.

[41] CDM projects must prepare a Project Design Document ("PDD") detailing how the project will achieve real, additional reductions and avoid emissions "leakage." The "additionality" element requires a project to show that emissions reductions would be additional to any reductions occurring in the absence of the CDM project. The "leakage" element requires a project to show that the CDM project will not result in increased emissions occurring outside the project's boundary.

[42] Details of what needs to be included in the NAP are explained in the European Commission Decision, 2009/548/EC, 0f 30 June 2009, establishing a template for National Renewable Energy Action Plans under Directive 2009/28/EC of the European Parliament and of the Council.

[43] Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC (Text with EEA relevance); found at http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32009L0028:EN:NOT

[44] A D Owen, "Renewable Energy: Externality Costs as Market Barriers", Energy Policy, Vol. 34, 2006, pp. 632-642.

[45] See Energy for Development: The Potential Role of Renewable Energy in Meeting the Millennium Development Goals pp. 7-9, available at http://www.worldwatch.org/system/files/ren21-1.pdf

[46] In 2007, Egypt produced 664,000 barrels of oil per day (bbl/d) continuing its fall from a high of 950,000 bbl/d in 1995. http://www.eia.doe.gov/cabs/Egypt/pdf.pdf

[47] Production and consumption of natural gas production more than quadrupled over the period 1995–2007 and continues to rise with a total of 1.9 trillion cubic feet (Tcf) produced and 1.3 Tcf consumed in 2006, making Egypt a net gas exporter. Id.; http://www.iisd.org/pdf/2009/bali_2_cophenhagen_egypt_wind.pdf

[48] http://www.moee.gov.eg/english/e-fr-main.htm. See also http://www.eia.doe.gov/emeu/cabs/Egypt/Electricity.html

[49] Energy Information Administration, http://www.eia.doe.gov/cabs/Egypt/pdf.pdf

[50] PowerPoint presentation, Renewable Energy Strategy for 20/20 and Regulatory Framework, provided by EgyptEra, May 2010.

[51] See http://www.eia.doe.gov/emeu/cabs/Egypt/Electricity.html

[52] http://www.windatlas.dk/Egypt/About.html; http://www.iisd.org/pdf/2009/bali_2_copenhagen_egypt_wind.pdf

[53] http://www.eia.doe.gov/emeu/cabs/Egypt/Electricity.html

[54] Other authorities include the Hydropower Projects Authority, the Rural Electrification Authority, the Atomic Energy Authority, the Nuclear Power Plants Authority and the Nuclear Materials Authority.

[55] M. Hightower, Scandia National Laboratories, February 2009 NARUC meeting, citing USGA, 1998.

[56] See for instance, work undertaken in this area by USAID supported Alliance to Save Energy, http://ase.org/section/program/watergy.

[57] Figures regarding Armenia's share of total primary energy supply can be found at IEA statistics, 2006, http://www.iea.org/stats/.

[58] Taxes are not included; 1 USD=362.09 dram.

[59] Background on the potential project

Table 1: Yerevan Lake Information Summary

	Description
Name of Project:	Yerevan Lake Hydropower Plant
Location of Project:	City of Yerevan, Armenia
Type of Project:	Small hydropower plant using the discharge water from Yerevan Lake
Nameplate Capacity of the Generators:	750 kW
Annual energy production since start of commercial operation:	2003 - 3,339 MWh 2006 – 1,736 MWh 2004 - 2,975 MWh 2007 – 1,706 MWh 2005 - 2,193 MWh 2008 – 3,145 MWh
PSRC approved tariff for 2008	16.11 AMD/kWh (exclusive of VAT)

Table 2: Kotayk Lake Information Summary

	Description
Name of Project:	Kotayk Irrigation Canal Hydropower Plant
Location of Project:	Village of Jraber, in the Kotayk Marz Region, Armenia
Type of Project:	Small hydropower plant connected to an irrigation pipeline
Capacity of the Generators:	Name Plate -[8x315, 1x200] kW Design Capacity – 1800 kW Maximum Operating Capacity – 1350 kW
Annual energy production since start of commercial operation:	2003 – 2,429 MWh 2006 – 2,926 MWh 2004 – 2,489 MWh 2007 – 3.084 MWh 2005 – 2,854 MWh 2008 – 3,006 MWh
PSRC approved tariff for 2008	16.41 AMD/kWh (exclusive of VAT)

[60] See 2010 *IEA Report for the Clean Energy Ministerial* TRANSFORMING GLOBAL MARKETS FOR CLEAN ENERGY PRODUCTS *Energy Efficient Equipment, Vehicles and Solar Photovoltaics,* http://www.iea.org/papers/2010/global_market_transformation.pdf

[61] http://www.heritage.org/Index/Country/Jordan

[62] http://tonto.eia.doe.gov/country/country_energy_data.cfm?fips=JO; http://www.iea.org/stats/gasdata.asp?COUNTRY_CODE=JO; http://pubs.usgs.gov/sir/2005/5294/pdf/sir5294_508.pdf at 18.

[63] http://www.nepco.com.jo/engDetails.aspx?news_id=139

[64] See http://www.usea.org/programs/EUPP/Jordan_Distribution/Article_Jordan_Dist_EEV_May_2009.pdf; http://www.powergenworldwide.com/index/display/articledisplay/259077/articles/middle-east-energy/volume-3/issue-2/features/country-focus-jordan-sector-for-sale.html; http://www.jordantimes.com/?news=21078

[65] See http://www.erc.gov.jo/English/Pages/default.aspx; http://www.nepco.com.jo/english_statisticalDetails.aspx?album_id=5. 2008 peak demand was 2260 MW. http://www.nepco.com.jo/PDF%20Documents/Annual ReportEnglish2008.pdf

[66] http://www.encharter.org/index.php?id=474

[67] See http://www.nepco.com.jo/english_history.html

[68] The distribution sector is made up of three companies all of which are privately owned:

- Jordan Electric Power Company, formed in 1947 as a private power company and 23% owned by the government, which serves Amman and central Jordan, and supplies about 64% of electricity consumers in Jordan;
- Electricity Distribution Company, established in 1997 when JEA was disaggregated and privatized in 2007 (purchased by Kingdom Electricity Company (KEC)), which covers the south and east of Jordan and serves approximately 140,000 customers; and
- Irbid District Electric Company (IDECO), established in 1961 and serving the northern part of the country with 250,000 customers. KEC also purchased 55.4% of IDECO in 2007.

http://www.nepco.com.jo/english_reorganize.html; http://www.usea.org/programs/EUPP/Jordan_Distribution/Article_Jordan_Dist_EEV_May_2009.pdf

[69] http://www.nepco.com.jo/english_statisticalDetails.aspx?album_id=8

[70] See http://www.petra.gov.jo/Artical.aspx?Lng=1&Section=1&Artical=145129; http://www.nepco.com.jo/PDF%20Documents/AnnualReportEnglish2008.pdf

[71] See http://www.usea.org/programs/EUPP/Jordan_Transmission/April_2009_Presentations/Article-for_NEPCO_first_EEV_May_2009.pdf

[72] http://www.erc.gov.jo/English/Pages/default.aspx

[73] http://www.nerc.gov.jo/Download/english%20-energy%20strategy.pdf

[74] *Id.*

[75] See http://www.jordantimes.com/?news=23153

[76] http://www.menafn.com/qn_news_story_s.asp?storyid=1093278395

[77] See http://www.windpowermonthly.com/go/middleEastAfrica/news/993625/Jordans-first-commercial-wind-farm-endangered-noise-issues-regulations/

[78] See http://www.menafn.com/qn_news_story_s.asp?storyid=1093278395

[79] See http://www.iea.org/papers/2005/solarthermal.pdf

[80] http://www.solarbuzz.com/fastfactsindustry.htm

[81] Renewables Global Status Report 2009, http://www.ren21.net/globalstatusreport/g2009.asp

[82] http://www.solarbuzz.com/fastfactsindustry.htm

[83] http://www.solarbuzz.com/Marketbuzz2010-intro.htm

[84] http://seia.org/galleries/default-file/2009%20Solar%20Industry%20Year%20in%20Review.pdf. Berkeley FIRST is one example of a local home financing program for solar installations, financing the cost of solar installations through an annual special tax on the homeowner's property tax bill that is repaid over 20 years.

[85] *Id.*

[86] See, e.g., http://www.dpcinc.org/_bigsolar.shtml

[87] For an example of interconnection standards, see http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=TX10R&state=TX&CurrentPageID=1&RE=1&EE=1

[88] See, for example, the guidance from the US Bureau of Land Management on solar right of ways, http://solareis.anl.gov/documents/docs/BLM_Solar_IM2007_097.pdf

[89] See http://www.scotland.gov.uk/Publications/2006/09/22094104/2

[90] http://www.biomassenergycentre.org.uk/portal/page?_pageid-76,15049&_dad=portal&_schema=PORTAL

[91] See http://www.forestcouncil.org/tims_picks/view.php?id=1946

[92] http://www.eia.doe.gov/cneaf/alternate/page/renew_energy_consump/table4.html; http://www.ucsusa.org/clean_energy/technology_and_impacts/energy_technologies/how-biomass-energy-works.html

[93] *Id.*

[94] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2005:0628:FIN:EN:PDF

[95] http://ec.europa.eu/energy/renewables/bioenergy/national_biomass_action_plans_en.htm

[96] http://www.biomass.kiev.ua/pdf/BAP_EN

[97] *Id.*

[98] http://www.ucsusa.org/clean_energy/technology_and_impacts/energy_technologies/how-biomass-energy-works.html

[99] See http://www.esmap.org/themes/index.asp?id=15

[100] http://www.euei-pdf.org/fileadmin/user_upload/Newsletter_Archive/EUEI_PDF_News_No_04.pdf. Biomass is the main source of energy in sub-Saharan Africa where, in some countries, it accounts for more than 90% of primary energy consumption. http://euei-pdf.org/uploads/media/New_BEST_Guide_12_2009.pdf.

[101] http://euei-pdf.org/uploads/media/New_BEST_Guide_12_2009.pdf

[102] See *Id.*

[103]For an article discussing disputes over proper levels of subsidies in the United Kingdom, for example, see http://www.powergenworldwide.com/index/display/articledisplay.articles.powergenworldwide.renewables.biomass.2010.02.drax-warns_that_uk.QP129867.dcmp=rss.page=1.html.

[104] Al Gore in *Our Choice – A plan to solve the climate crisis* (2009)

[105] *Id.*

[106] See http://www.nea.is/ regarding Iceland. In 2007, approximately 81% of primary energy use in Iceland came from indigenous renewable resources, of which 66% was geothermal. http://www.nea.is/geothermal. As of 2001, electric energy produced from geothermal resources represented 27% of the total electricity generated in the Philippines, 12.4% in Kenya, 11.4% in Costa Rica, and 4.3% in El Salvador. Dickson.

[107] *Id.*

[108] See M. Coviello, "Barriers, nisks and new regulatory schemes for the development of geothermal resources," contained in *Geothermal Energy Resources for Developing Countries* (2002) at 63 (describing failed geothermal promotion in Latin America due to lack of clear regulatory frameworks). One template for such regulations can be found in an EU Discussion Document for the GTR-H project, "Geothermal Regulation Framework," found at http://www.gtrh.eu/downloads/Draft%20framework%20template_Jan09.pdf.

[109]See http://outernode.pir.sa.gov.au/__data/assets/pdf_file/0009/126909/Best_Practice_Activity_Approval_Processes_for_EGS_Projects__Including_Induced_Seismicity.pdf; http://www.legislation.sa.gov.au/LZ/C/A/PETROLEUM%20AND%20GEOTHERMAL%20ENERGY%20ACT%202000.aspx.

[110] See http://www.geothermal-energy.org/304,iga_geothermal_conference_database.html

[111] http://www.geothermal-energy.org/304,iga_geothermal_conference_database.html

[112] *Id*.

[113] http://www.ren21.net/pdf/REN21_Report_RETs_for_MDGs.pdf; http://www.energyblueprint.info/fileadmin/media/documents/national/2009/11_gp_e_r__national_india_lr.pdf; Unidad de Transacciones, Statistical Yearbook 2009, page 2, http://216.184.107.60:8080/c/document_library/get_file?folderId=10266&name=DLFE-2807.pdf.

[114] ELECTRICITY STATISTICS BULLETIN No. 10, 2008, SIGET.

[115] Energy Policy 2007, Electricity Board, Ministry of Economy

[116] All the Central American States, except Belize, are located within the Pacific Rim's volcanic zone with large geothermal potential identified as amounting to over 13,000 MW. As of 2009, ten developing countries rank among the top 15 in geothermal electricity production, with four of them in Central America: Costa Rica, El Salvador, Nicaragua and Guatemala. Three (El Salvador, Costa Rica and Nicaragua) are among the top six with the highest share of geothermal power as a percentage of national electricity output. Geothermal production makes sense in Central America from both an environmental and economic standpoint and is likely to grow. See Garcia-Gutierrez, ICS-UNIDO conference presentation, December 2009, http://www.ics.trieste.it/core-programmes/geothermy/meetings--courses.aspx?itemID=2971.

[117] Feasibility Study for The Optimization and Developments of Ahuachapán, Chipilapa and Cuyanusul Geothermal Systems, LAGEO-ENEL, 15 September 2004.

[118] The developer also is obligated to comply with the specific regulations of the municipality where the project is located, as well as institutions that regulate the cutting of trees, use of neighborhood streets and storage of fuels.

[119] http://www.marn.gob.sv/uploaded/content/category/285351936.pdf

[120] http://cdm.unfccc.int/Projects/DB/DNV-CUK1182851006.68/view

[121] See E. Petrie, H. Willis, M. Takahashi, *Distributed Generation in Developing Countries* (2001), http://www.localpower.org/documents/reporto_agri_DGinDevCountries.pdf) (hereinafter Petrie). Petrie reports that over $30 billion per year is spent on home heating fuels, batteries and candles in rural parts of the world, along with annual investments in 10-15 GW of diesel generation capacity, with distributed generation targeting a large fraction of this rural market. *Id*. at 1 (citation omitted). Petrie describes newly developed DG systems as ranging from 5kW to 5 MW, with a foot print size of between 0.01 and 59 kW / square meters, capital costs ranging from $200 to $6000 / kW, and a capability of producing electricity in the 3-20¢ / kWh range. *Id*. at 3. These technologies include microturbines, fuel cells, wind, solar, reciprocating engines and hydro. *Id*. at 3-6.

[122] See http://www.nrel.gov/docs/fy06osti/39588.pdf. The China Township Electrification Program, followed by the China Village Electrification Program, includes the use of solar, wind and hydropower.

[123] http://www.indiaenergyportal.org/subthemes.php?text=dis_gen&themeid=14; http://www.ruralelec.org/172.0.html#c1213.

[124] Source and For More Information: The NRECA Guide to IEEE 1547, pp. 36-38 (March 2006); http://www.nreca.org/Documents/PublicPolicy/DGApplicationGuide-Final.pdf

[125] Approaches have included separate rural electrification agencies like Mozambique's National Rural Energy Fund; rural electric cooperatives (e.g. Costa Rica); allocation of rural electrification to a department of the national

distribution company (Thailand); or delegation to the regional offices of the utility (Tunisia). *See* Rural Electrification in the developing world: A summary of lessons from successful programs, ESMAP, 2004.

[126] *See Reducing the Cost of Grid Extension for Rural Electrification* (2000b); ESMAP Report 227/00; Energy Sector Management Assistance Program (ESMAP), Washington, DC: World Bank 2000; *8 Best Practice Manual: Promoting Decentralized Electrification Investment*, Joint UNDP/World Bank ESMAP, October 2001; *Promoting Electrification: Regulatory Principles and a Model Law*; Reiche, Kilian, Bernard Tenenbaum, and Clemencia Torres, Joint Publication of ESMAP and the Energy and Mining Sector Board; World Bank: Washington, D.C., Paper No. 18 July 2006.

[127] See http://www.reeep.org/index.php?id=51&content=2659:

> The nation has the capacity to generate all its own energy using renewable and non-renewable sources. Reviewing the data, the Guatemalan Ministry of Energy and Mines has pointed out Guatemala's huge range of untapped resources. Guatemala could generate around 13,800 MW itself using hydro, wind, biogas, biodiesel, bioethanol as well as fast-growing energy crops, sustainable forestry, industrial and agroforestry waste.
>
> Water, sun, wind, biomass and geothermal are abundant enough to produce, supply and export energy to all of Central America. Available water resources and the large, small, private and state owned hydroelectric projects have the capacity to generate some 10,000 MW of energy for nearly 40 million Central Americans, but to date only 7% of this capacity has been used. The Guatemalan sun could generate up to 5 kWh per square kilometre – which would satisfy the region's energy needs for the next five or six years.

[128] *Changes in the Regulatory Framework in Order to Promote Distributed Renewable Generation in Guatemala*, by Carlos Eduardo Colom Bickford, President CNEE, Guatemala´s Electricity Sector Regulator, June 2010

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