

# Design and Performance of Policy Instruments to Promote the Development of Renewable Energy: Emerging Experience in Selected Developing Countries

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**The World Bank, Washington, DC**



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Mining Sector Board

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## ACRONYMS AND ABBREVIATIONS

ANEEL	Brazilian Electricity Regulatory Agency <i>Agência Nacional de Energia Elétrica</i>
AAG	Average annual growth
BNDES	Brazilian Development Bank <i>O Banco Nacional de Desenvolvimento</i>
BRIC	The countries of Brazil, Russia, India, and China, all of which are deemed to be at a similar stage of newly advanced economic development
CDM	Clean Development Mechanism
Disco	Distribution company
EU ETS	EU Emissions Trading System
FEC	Firm Energy Certificate
FIT	Feed-in tariff
FITP	Feed-in tariff policy
GBI	Generation-based incentive
Genco	Generation company
IPP	Independent power producer
NAPCC	National Action Plan on Climate Change (India)
NFFO	Non-Fossil Fuel Obligation (UK)
OECD	Organisation for Economic Co-operation and Development
ONS	National Power System Operator (Brazil) <i>Operador Nacional do Sistema Elétrico</i>
PPA	Power Purchase Agreement
PROINFA	Programme of Incentives for Alternative Electricity Sources (Brazil) <i>Programa de Incentivo a Fontes Alternativas de Energia Elétrica</i>
PURPA	Public Utility Policies Regulatory Act (United States)
RD&D	Research, Development and Demonstration
RE	Renewable energy
REC	Renewable Energy Certificate
RPO	Renewable purchase obligation
RPS	Renewable Portfolio Standard
SHP	Small hydropower
SPPDF	Special Purpose Debt Facility
SPPA	Standardized Power Purchase Agreement
T&D	Transmission and distribution
TGC	Tradable Green Certificate
Transco	Transmission company

## UNITS OF MEASURE

GWh	Gigawatt-hour
MW	Megawatt

## FOREWORD

In the early 1990s, developing countries started to introduce different incentives to promote renewable energy investments, especially feed-in tariff policies. Today, more than 30 developing countries have introduced different types of price- or quantity-setting instruments to increase the share of renewable energy in their energy mix.

There is an increasing interest among World Bank client countries to learn more about the experience with the design and performance of these policy instruments, especially lessons learned and the degree to which they are succeeding in creating sustainable renewable energy markets in developing countries.

In response to these client needs, and given the wealth of experience that has emerged over the last few years, the Energy Anchor has started to analyze the effects and performance of renewable energy policies. To this end, this paper discusses the lessons on policy design, implementation, and performance emerging from the experience in six developing countries that introduced renewable energy policy tools before 2005.

We hope that this paper serves to disseminate knowledge about some of the important issues and options confronting the implementation and adoption of renewable energy policies. It is also our hope that the analysis set out in this paper proves useful to World Bank Group staff, as well as the authorities and stakeholders of our client countries.

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## 1. SCOPE AND COVERAGE OF THE STUDY

This paper summarizes the results of a recent review of the emerging experience with the design and implementation of policy instruments to promote the development of renewable energy (RE) in a sample of six representative developing countries and transition economies (“developing countries”) (World Bank 2010).

The review focused mainly on price- and quantity-setting policies, but it also covered fiscal and financial incentives, as well as relevant market facilitation measures. The lessons learned were taken from the rapidly growing literature and reports that analyze and discuss RE policy instruments in the context of different types of power market structures.

The analysis considered all types of grid-connected RE options except large hydropower: wind (on-shore and off-shore), solar (photovoltaic and concentrated solar power), small hydropower (SHP) (with capacities below 30 MW), biomass, bioelectricity (cogeneration), landfill gas, and geothermal.<sup>1</sup> The six countries selected for the review included Brazil, India, Indonesia, Nicaragua, Sri Lanka, and Turkey.

## 2. SUMMARY OF KEY FINDINGS

In the sample countries analyzed, different types of policy instruments and incentives have been introduced either sequentially or in parallel. The diversity of these policy packages and their effect on RE scale-up and market sustainability is the subject of the analysis presented in this paper. The review suggests the following general lessons of experience.

***A tailor-made approach is necessary:*** Choice of policy instruments, policy design, and complexity of the policy package (or regulatory regime) should be tailored to the actual conditions of the system in the type of market, supply or demand volume, and nature and level of risks, as well as institutional and administrative capacity.

***Policy sequencing is critical for policy effectiveness:*** Policy sequencing, the existence of basic legal and regulatory preconditions, as well as institutional and administrative efficiency, are crucial to the effectiveness of RE policy. For example, legal and regulatory frameworks for grid connection and integration, resource and land use and/or the allocation of permits and rights must be in place before RE policy is introduced, and the process for granting permits should not create bottlenecks.

***Policies that successfully lead to the scale-up of renewable energy may not necessarily be efficient:*** Even if the policy mix succeeds in triggering investments that achieve RE capacity targets, its overall economic efficiency (cost per unit of benefits) may be poor.

***Policy interaction and compatibility need to be considered:*** The coexistence of policy instruments has the potential to result in complex interactions and unintended effects. Thus, policy makers need to assess the compatibility among policy and regulatory mechanisms or incentives—that is, their combined impact may result in inefficient outcomes. It is also vital that individual policies are coordinated with the wider set of conditions that impact the energy market in a specific setting.

***Policy and regulatory design is a dynamic process:*** Developing countries have tested different types of

<sup>1</sup> The focus is on RE technologies that are not yet fully competitive and that, when compared to conventional sources, exhibit an incremental cost (that is, in the context of systems where externality pricing has not been introduced).

instruments to support RE development (policy shifts) and many are now using both price and quantity setting instruments to support different segments of the RE market. In the sample countries, feed-in tariff policies (FITPs) have required successive adjustments (the challenge has been attracting private investment while at the same time minimizing inframarginal rents). However, policy adjustments should be controlled through mechanisms—perhaps embedded in the policy design per se—that allow stakeholders to manage the risks in order to maintain a certain level of regulatory certainty (for example, programmed reviews, thresholds on adjustments, and adjustments that affect only new projects).

*RE policy performance (effectiveness/efficiency) depends on a number of key factors:* Even policies with a sound design do not result in effective and efficient development of RE if other critical aspects are not considered in parallel, including the existence of a sustainable incremental cost recovery mechanism (paid through sustainable subsidy sources or a surcharge on consumer tariffs) and the existence of transmission infrastructure capable for RE integration, as well as clear rules on transmission access and connection.

### 3. BACKGROUND

This section discusses the emerging trends and general experience with the use of various policy tools to support RE deployment in the developed and developing world. A general classification of main policy instruments and incentives is provided in Appendix 1 of this paper.

#### ***The Growing Importance of RE Development***

RE plays an important role in contributing to the transition toward low-carbon development growth (to reduce greenhouse gas emissions), in enhancing technology diversification and hedging against fuel price volatility (to increase supply adequacy), in strengthening economic growth (to promote industrial development and employment generation), and in facilitating access to electricity (to promote rural development and reduce poverty).

The global trends indicate a growing commitment to RE development from developed and developing countries in both the introduction of specific policy levers and investment flows. Although RE technologies still represent a tiny share of the world's generation capacity mix (about 7 percent, excluding large hydropower), their share in total new capacity additions, considering all technologies, is gradually increasing (from 10 percent in 2004 to 36 percent in 2009). In 2009, investment in RE (excluding large hydropower) was comparable to that in fossil fuel-based generation capacity, at around US\$100 billion each (UNEP, SEFI, and Bloomberg New Energy Finance 2010).

In particular, the growth of RE capacity in developing countries has been remarkable, and associated services and equipment manufacturing industries have already started to boom. For instance, Brazil, China, and India today are among the top 10 countries in the world in the volume of new financing attracted for investments in sustainable energy (with a combined US\$44.2 billion in 2009, representing 37 percent of global financial investment in clean energy) (UNEP, SEFI, and Bloomberg New Energy Finance 2010).

In 2009 the RE industry in these three countries created almost 1 million jobs, and China alone became one of the largest suppliers of solar photovoltaics, batteries for electric vehicles, wind turbines, and solar hot water collectors (REN21 2010).

Upper and lower middle-income countries are also quickly progressing in the development of their RE markets. For instance, developing countries in Asia and Oceania, the Middle East and Africa, and South America (excluding Brazil, China, and India) received almost US\$11 billion of new financial investment for both RE and energy efficiency in 2009 (9 percent of the global total) (UNEP, SEFI, and Bloomberg New Energy Finance 2010).

Today, more than 50 percent of the existing RE capacity in the world is operating in developing nations. In addition, about half the countries that have issued some type of RE promotion policy are now in the developing world (REN21 2010).

### **Use of RE Policy Tools to Support RE in Developed and Developing Countries**

Developed and developing countries have accumulated a long history with the implementation of different types of policy tools to support RE development.

The RE market is to a large extent a policy-driven market. Developed countries have been designing and implementing diverse types of price- and quota-based mechanisms to promote RE development from the late 1970s. For instance, the United States implemented its first FITP in 1978 (Public Utility Policies Regulatory Act, PURPA) and a quota mechanism known as Renewable Portfolio Standard (RPS) from 1983 so that today 31 of 50 states have these obligations in place; in 1990 Germany was the first European country to introduce a feed-in tariff (FIT), and since then many European countries have experimented with either price- or quota-based mechanisms (REN21 2010).<sup>2</sup> The United Kingdom, in particular, introduced competitive tenders to fulfill specific RE quotas during the 1990s (the Non-Fossil Fuel Obligation, NFFO), but the scheme was later substituted for a type of RPS mechanism with tradable certificates (known as Renewables Obligation Certificates, from 1998) (Butler and Neuhoff 2004).

Developing countries also have a long history of designing and implementing specific regulatory

instruments to promote RE. The first four countries to introduce some type of preferential tariff or FIT were India (from 1993), Sri Lanka (from 1997), and Brazil and Indonesia (from 2002) (REN21 2010). Quota mechanisms, however, have been less popular in the developing world. For instance, a rigorous RPS—in which a quota or target is specified, a proportional obligation is imposed on utilities or retail companies, and the price is competitively determined by the market—has only been introduced as such by a few countries, including Chile (from 2008), Poland (from 2005), and Romania (from 2004).<sup>3</sup>

Although the use of competitive schemes or auctions to deploy RE in the developing world is less common, some countries have or are now testing their effectiveness (for example, Argentina, Brazil, China, Peru, Thailand, and Uruguay).<sup>4</sup> Today, FITPs are being implemented in about 49 countries around the world and are often cited as the most effective policy for attracting private investment in RE. Yet, many developed and developing countries still use quota-based mechanisms, including RPSs and auctions (for example, Brazil, Chile, China, France, Poland, Sweden, the United Kingdom, and the United States).

A range of other supplementary measures is in use that directly stimulates investments in RE, including fiscal and financial incentives, and voluntary measures. These have been adopted in parallel to price- and quantity-setting instruments in both developed and developing countries.

A significant and growing category of policies that indirectly promote the development of RE are known as cap-and-trade programs. The cap-and-trade mechanism sets a ceiling on the emissions of covered entities, issues allowances or emission certificates, and promotes their trading to generate a market price for emissions. Emissions pricing can also be implemented through a tax policy (for example, a carbon tax). Cap-and-trade schemes are being implemented in many developed countries. In the United States the Regional Greenhouse Gas Initiative operates across many states, and in the European Union the Emissions

<sup>2</sup> It is important to note that although the PURPA's tariff was based on avoided cost, the Act did not exclude the possibility of setting tariffs through competitive schemes.

<sup>3</sup> In general, RPS policies use tradable and/or nontradable renewable energy certificates (RECs) to create a market of environmental attributes. The use of RECs has emerged as a market-based tool to facilitate compliance with the purchase obligations (quotas) mandated under the RPS.

<sup>4</sup> Even though auctions do not represent a renewable energy policy per se, they are used as mechanisms to promote the development of RE on a competitive basis.

Trading System (EU ETS) is active now in 30 European nations.

A few developed countries have also been applying carbon taxes since the beginning of the 1990s (the Netherlands and Scandinavian countries), and others have only recently started to apply them (Canadian Province of British Columbia). As of today, no developing country has formally implemented a greenhouse gas cap-and-trade scheme or a carbon tax.

### **Experience with the Use of RE Policy Mechanisms in Developed Countries**

There is a large body of literature analyzing the experience of developed countries with the use of different types of policy and regulatory instruments to promote RE development.

The literature concentrates mainly on the experience in Europe and the United States. In particular, a long and ongoing debate throughout the literature has focused on what policies are more effective and efficient in driving the sustainable least-cost development of RE markets. The debate has centered on the relative advantages and disadvantages between price- and quota-based mechanisms, focused mostly on FITs (German and Spanish models), RPSs (United Kingdom, Renewables Obligation Model; United States, Texan RPS model), and auctions (United Kingdom, Non-Fossil Fuel Obligation model or NFFO).

In most recent analyses, a general consensus has emerged that FITs are more effective at lowering investors' risks than RPS or quota instruments (that is, when considering price, volume, and balancing risks). However, some studies indicate that quota mechanisms (an RPS-REC scheme) can be relatively less expensive than price-based mechanisms, considering that FITPs typically offer high subsidy rates (to mature technologies in the case of technology neutral FITs, and to less mature, expensive technologies in the case of technology specific FITs), while RPS-REC systems encourage competition among technologies (and therefore promote the most mature technologies).<sup>5</sup>

In general, developed countries have made successive adjustments to their RE policies and associated regulatory instruments in response to unexpected feedback effects (for example, effects on electricity or gas prices), difficulties in their implementation, and/or poor performance. Indeed, legal and regulatory frameworks for RE are constantly evolving.

Also, some developed countries have made important policy shifts (that is, from price- to quantity-setting or vice versa). For instance, the United States made a major policy shift from an early FITP (PURPA, introduced in the late 1970s) to a quota mechanism with tradable RECs (RPS-REC scheme), which became widely used in many states. Likewise, Italy went from an FITP (established in 1992) to an RPS policy (from 1999). However, Italy has recently reintroduced an FIT for small scale PV installations (from 2007) and for RE projects with capacities below 1 MW (from 2008). Similarly, many states in the United States are starting to consider or experiment with FITs again, especially to support small scale RE (for example, California from 2006).<sup>6</sup>

In particular, the United Kingdom abandoned its auction mechanism to promote the deployment of mature RE technologies (NFFO) and moved to a quota system, known as Renewables Obligation, in which the government specifies the proportion of RE that must be supplied by distribution utilities as in the U.S. RPS mechanism (that is, the obligation can be fulfilled through either the utility's own RE generation, the purchase of tradable certificates, or a fixed penalty). In 2010, the United Kingdom also introduced an FITP for RE projects with capacities lower than 5 MW.

The analysis of the recent literature thus shows that developed countries have not only made policy shifts to test the performance of different policy tools, but also that FITs are being offered in combination with either auctions or RPS-REC schemes to support less mature RE technologies or small-scale RE projects.

In terms of policy performance, the IEA and OECD (2008) found that high levels of policy effectiveness are linked to three factors coexisting at the same time: (a) a country's level of policy ambition (for example,

<sup>5</sup> FITP can however deliver the same results as an RPS/REC or tradable green certificate (TGC) schemes when offering uniform rates across all types of RE technologies (thereby eliminating special provisions for solar or other expensive technologies) (Fischer and Preonas 2010).

<sup>6</sup> FIT policies are being experimented with in the United States, though at a smaller scale and less comprehensively than in a number of European countries. To date, several utilities in California, Florida, Oregon, Vermont, Washington, and Wisconsin have implemented different variations of FIT policies (Couture and Cory, 2009).

level of targets), (b) the presence of a well designed incentive scheme, and (c) the capacity of the system for overcoming noneconomic barriers that may prevent the proper functioning of the market (such as administrative hurdles and obstacles to grid access).

### Policy Choice and Trends in Developing Countries

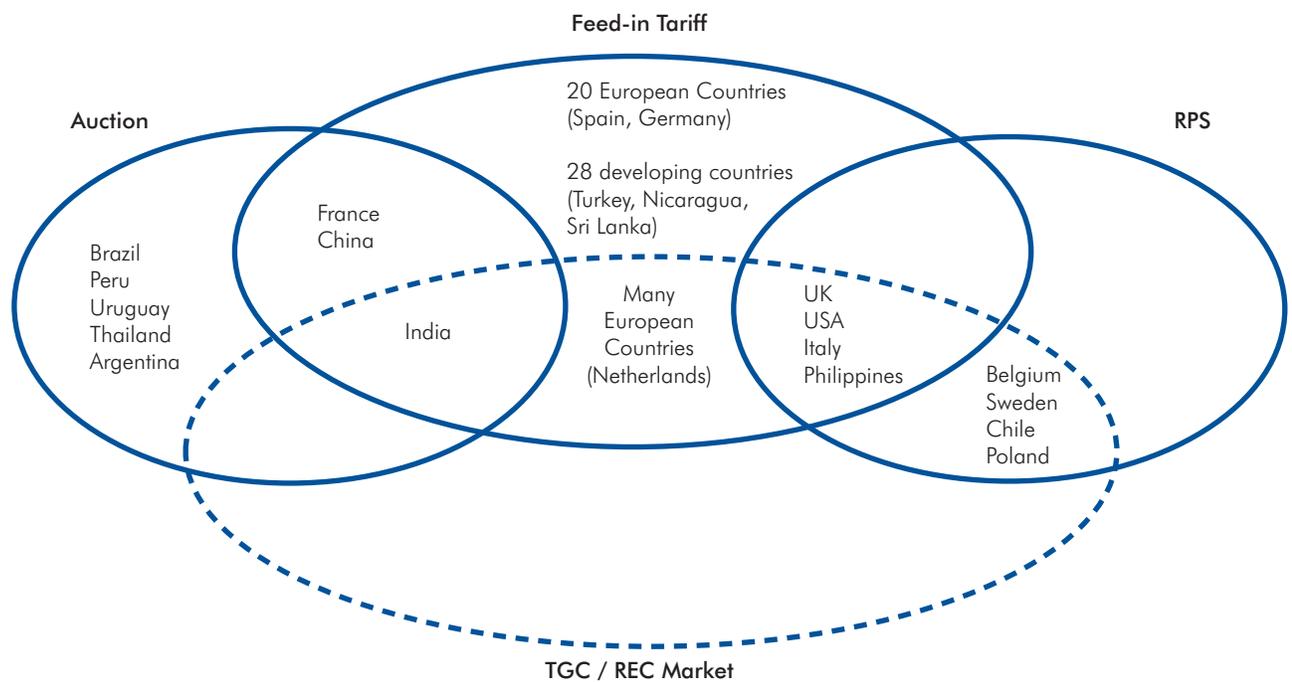
As of today, about 31 developing countries have introduced some type of price- or quantity-setting instrument to increase the share of RE in the electricity generation capacity mix. Of these, at least 26 have opted for an FITP, and only a few have introduced an RPS or use auctions to deploy RE (for example, Brazil, Chile, China, Poland, and Romania) (REN21 2010).

Developing countries—especially emergent economies—have also made important policy shifts, and many are now also using both price- and quota-based instruments in parallel to support different

segments of the RE market. For instance, Brazil moved from an FITP (known as PROINFA and introduced in 2002) to the use of auctions (from 2007). Conversely, China moved from the use of auctions (on-shore wind) to an FITP in 2005 (which ultimately applied only to biomass-based generation). Most recently (May 2010), however, China launched an auction to deploy off-shore wind-based capacity. The Philippines is also trying to implement a regime that includes both an RPS-REC system (with a target for mature technologies) and an FITP for less mature technologies (such as solar or tidal). In addition to its FITP and REC market, which support all types of RE technologies, at the end of 2010 India also began to launch auctions to deploy solar capacity.

Figure 1 shows the policy instrument of choice of various developed and developing countries today and Table 1 illustrates the increasing adoption of RE policy mechanisms by some of these countries as well as policy shifts.

**Figure 1: Use of RE Policy Instruments**



Note: Almost all countries apply some type of fiscal or financial incentive in parallel to price or quota based mechanisms.

**Table 1: RE Policy Instruments: Adoption and Policy Shifts**

Year	FITP	RPS/REC	Auction
1970s	<b>USA (PURPA) (1978)</b>		
1980s		<b>USA (first in Iowa)</b>	
1990s	Germany (1990) <b>Italy (1992)</b> Many European Countries India* (1993), Sri Lanka (1997)	<b>Italy (1999)</b>	<b>UK (NFFO) (1990)</b>
2000–05	Brazil, Indonesia (2002) Nicaragua (2004) Turkey, Ecuador, China (2005)	<b>UK (RO) (2002)</b> Belgium, Austria, Japan, Sweden, Canada, Poland	<b>China (2003)</b>
2006–10	<b>USA** (from 2006)</b> Argentina (2006) <b>Philippines</b> , Kenya, South Africa (2008) + 11 developing countries <b>Italy (2007–2008)</b> <b>UK (2010)</b>	Chile Romania, <b>Philippines (2008)</b>	Brazil (2007) Peru (2008), Uruguay, Thailand <b>China (2010)</b> <b>India (2010)</b>
Today	About 42 Countries	13–15 Countries	22 Countries

Source: REN 21 (2010), Barroso and Maurer (2010).

In bold: Countries that have shifted from one mechanism to another or that are using them in parallel.

\* Indian states introduced FITPs gradually in the period 1993 to 2008.

\*\* Different USA states have started to introduce FITPs from 2006.

#### 4. EMERGING EXPERIENCE IN SELECTED DEVELOPING COUNTRIES

This section establishes the rationale for the need to investigate further the experience with the design and performance of price and quantity-setting instruments in the developing world and describes the characteristics of the sample of countries subject to the review.

##### Objectives of the Review and Characterization of the Sample

A growing body of analytical work is now reporting on the experience of developing countries with the design and implementation of different types of RE policies and regulations, especially on a country-by-country basis. However, the general experience and the degree to which these policies are succeeding in creating sustainable domestic markets in the context of different power sector structures has been less analyzed.

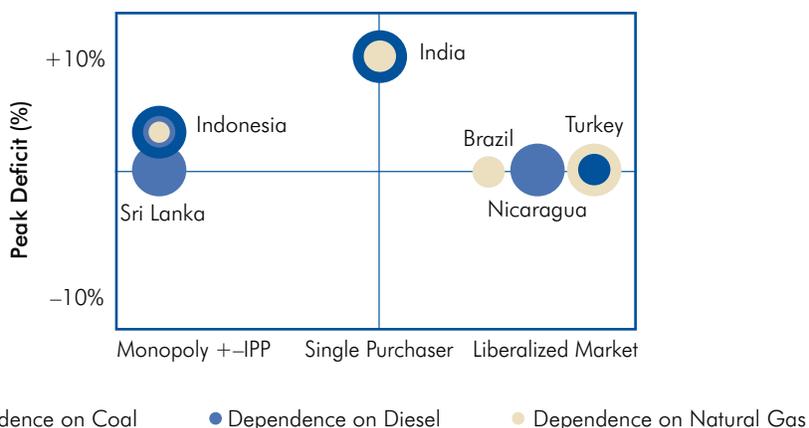
Thus, the review was set at identifying the main lessons learned, as well as best practice associated with the design, implementation, and performance of RE policy tools through the experience in six developing countries. The work was limited to a desk review;

thus, the conclusions must be eventually confirmed through other more formal quantitative assessments (for example, statistical analyses or appropriate modeling to more accurately assess causality between policies and their impacts). The sample was chosen among the 12 developing countries that introduced specific instruments of regulation to promote RE before 2005 (as indicated by REN21 2010).

The selection of countries covers a broad spectrum of economic and power sector sizes, as well as the degree of market liberalization, while at the same time exhibiting the common energy security problems characteristic of electricity supply industries across the developing world: fuel dependence and/or reduced or negative reserve margins (that is, peak deficits).

In the sample countries, RE policy—or its adjustments—has been streamlined primarily through legal frameworks associated with the reform and the liberalization of their power sectors (Brazil, India, Turkey) or through legal provisions specifically addressing security of supply concerns (Indonesia, Nicaragua, Sri Lanka, and Turkey), or both. Figure 2 maps the sample in terms of the peak deficit that is exhibited today and the current power supply structure (that is, degree of market liberalization).<sup>7</sup>

**Figure 2: Mapping the Sample**



**Note:** Almost all countries apply some type of fiscal or financial incentive in parallel to price or quota based mechanisms.

<sup>7</sup> From a vertically integrated monopoly (with or without IPP participation), to a single buyer (that is, as a national Genco, Transco, or Disco, or a combined national Genco-Transco or Transco-Disco and IPPs), to a structure with many Discos, Gencos, and a Transco as a single buyer (with third party access), to a power market of Gencos, Discos, large users, Transco, and an independent system operator. In Brazil, the model established after the enactment of Law 10.848 (2004) relies on a combination of competition and strong government planning with centralized procurement (auctions). In this sense, the Brazilian model can be considered a hybrid model, where the public and private sector coexist (and compete) in a contracts market, but where state-owned enterprises still dominate the market and the government still exercises considerable control.

In the sample of countries chosen for the review, all countries except for Brazil and Nicaragua are committed to official targets for RE capacity additions in the system.<sup>8</sup> Also, all countries in the sample offer some sort of price-based incentive (for example, FITs, preferential tariff in standardized or small power purchase agreements, reduction in transmission and distribution (T&D) charges, generation based incentives or premiums), but none of them has committed to a formal RPS. In particular, India has recently introduced the use of RECs, but this market is not set to function in combination with an RPS, as in the developed countries that have introduced them (United Kingdom, United States); rather, it will operate in combination with state FITPs and other supplementary incentives. The competitive route to RE procurement is being used at present in Brazil and India (through auctions), and in Indonesia, Sri Lanka and, Turkey through conventional bidding processes.<sup>9</sup> Auctions in India however have only been recently launched to deploy solar based generation (from December 2010). Finally, all countries in the sample offer some sort of fiscal or financial incentive. Table 2 shows the composition of the policy package applied today in the sample countries (a more detailed list of incentives is given in Appendix 2).

In the sample, the countries with the lower gross national income and smaller power sector in terms of installed generating capacity (Indonesia, Nicaragua, and Sri Lanka) are the countries with the less diverse policy package. Emergent economies (BRIC countries) and/or upper middle-income countries exhibit a rich variety of mechanisms for increasing the use of RE.

### **Emerging Experience with Designing and Implementing Price-Setting Policies**

Price-setting policies reduce cost and pricing-related barriers by establishing favorable price regimes for RE relative to other sources of power generation (World Bank 2008). This section focuses on FITPs, given their importance and effectiveness in driving investments and scaling up RE.

The design of FITPs typically involves three key incentives: (a) a preferential tariff, (b) guaranteed purchase of the electricity produced for a specified period, and (c) guaranteed access to the grid. In general, FITPs impose a purchase obligation on national or regional utilities (renewables purchase obligation, RPO) and, in some countries, the obligation to purchase or share the revenues associated with tradable environmental attributes (such as certified emission reductions). FITPs may also offer additional incentives to entities purchasing RE supply, such as reduced cross-subsidy surcharges or reduced wheeling charges.

Experience with the design and implementation of FITPs in the sample countries can be summarized as follows. First, except for Indonesia, all countries in the sample have experimented with FITPs, and in all cases the tariffs per se have evolved from simple to more sophisticated formulations (the experience with the Brazilian FITP is described in Box 1).<sup>10</sup>

Also, all these countries have made successive adjustments to their FITs, either to increase their performance (effectiveness and efficiency) or to adapt to new system or market conditions (in order to maintain the incentive for investments in RE).

In the former case, FITs have evolved from technology-neutral flat tariffs (based on either leveled or avoided costs) to technology-specific stepped tariffs (designed to lower inframarginal rents and the overall cost of FIT subsidies) and/or to tariffs with degression factors (designed to account for technology improvement, innovation, and learning). These adjustments are aligned to what has been identified by leading sources as best practice with FIT design in Europe and other developed countries (that is, tariffs differentiated by technology, size, resource intensity, and degree of technological maturity improve the overall economic efficiency of the policy).<sup>11</sup>

In systems that exhibit a high vulnerability to oil price fluctuations or fuel oil dependence, the FIT structure has been adjusted to maintain the incentive for investments

<sup>8</sup> In the past, however, Brazil did commit to a formal target on RE through its official program to stimulate RE development (PROINFA); this program has been cancelled.

<sup>9</sup> Although competitive biddings and auctions do not represent RE policy instruments per se, they can be used as mechanisms to convey RE policy. For this reason, they are generally classified as incentives under “mandated market policies” (see World Bank 2008).

<sup>10</sup> In Indonesia and Sri Lanka, a “preferential” tariff has been channeled through SPPAs. This arrangement has also included a guaranteed purchase for a multiyear period and a guaranteed access to the grid. In both countries, the “preferential tariff” was originally designed as a function of avoided costs of power generation (in 2008 Sri Lanka moved to a technology specific FIT, also provided through SPPAs); however in the case of Indonesia the tariff was set at a level below avoided costs. The arrangement was quite successful in Sri Lanka, but largely unsuccessful in Indonesia, as explained later in this paper.

<sup>11</sup> See Couture and others 2010; Mercados—Energy Markets International 2009; and Klein and others 2008.

**Table 2: Policy Mix in Selected Countries as of the Last Reform, 2010**

Policy Instrument	IN	BR	TK	INDO	NI	SRL
<b>Targets</b>						
Formal/Official NCRE Targets	●		●	●		●
<b>Price Based Instruments</b>						
Feed-in Policies and Premiums	●		●		●	
SPPA (fixed term and preferential price or FIT)				●		●
Reduced T&D Costs	●	●				
Net Metering/Banking	●		●			●
Carbon Market/CDM Transactions	●	●		●	●	●
<b>Quantity Based Instruments and Procurement Mechanisms</b>						
Renewable Portfolio Standard (RPS)						
Competitive Bidding/Auction		●	●	●		●
<b>Investment Cost Reduction/Financial Incentives</b>						
Accelerated Depreciation	●			●		
Green Funds (e.g.; soft loans, grants)	●	●	●			●
Capital Subsidy/Equity Participation	●					
<b>Fiscal Incentives</b>						
Tax Exemptions	●	●	●	●	●	●
<b>Grid Connection and Dispatch</b>						
Prioritized Dispatch	●	●	●	●	●	●
<b>Other Measures</b>						
Green Power/Retail Tariff	●					
R&D Funds/Subsidies	●	●	●			
Single Window Clearance Systems	●					
Exempted/Reduced Licensing Fees	●		●			
IN = India, SRL = Sri Lanka, BR = Brazil, INDO = Indonesia, NI = Nicaragua, CHI = China, TK = Turkey Note (1): Reduced transmission charges may include discounts on wheeling prices or connection costs.						

in RE (for example, FITs pegged to international oil prices, or shifts from avoided-cost tariffs to technology-specific, levelized cost-based FITs when the avoided cost of power generation is expected to fall as a result of planned substitutions from expensive to cheaper fossil fuels in the generation mix).

In general, all sample countries applying FITPs have successively increased the level of FITs and adjusted the periods of support. However, in some specific cases, frequent FIT design adjustments, especially those that are applied in response to unexpected shocks (fuel price

fluctuations or spikes) or system instabilities (volatile spot prices) have lowered policy predictability, increased risks, and rendered the FITPs ineffectual.

The analysis of successive policy adjustments and their effectiveness for the countries under consideration suggests that cost-based FITs (that is, not linked to market fluctuations in fuel and electricity prices) are more effective at promoting RE market development than those linked to wholesale or fuel prices. Table 3 below shows the type of tariffs used to promote RE in the sample countries.

### Box 1: Feed-in Tariff Policy in Brazil

PROINFA was the first step toward developing RE on a larger scale in Brazil. However, the initial design of the program imposed rules and specific constraints that created bottlenecks and affected the overall economic efficiency of RE deployment.

The first issue was the allocation of the targeted amount of 3,300 MW in equal shares of 1,100 MW to wind, SHP, and biomass projects, despite their different costs (that is, the mechanism did not promote the least-cost expansion of RE capacity in the system).

Project selection—within the technology specific quotas—was also not based on a least-cost approach. Projects were selected based on the dates that relevant environmental permits were issued (that is, the older the permit, the closer the project was in the merit order for contracting). This process ended up creating a “black market” for environmental licenses. In fact, the issue of permitting and licensing in Brazil became a bottleneck to the introduction of new capacity in general, creating serious economic distortions, high transaction costs, and even court cases.

In addition, the minimum *national business participation rate* (that is, equipment and services of national origin) of 60 percent required by PROINFA became a bottleneck to wind generation development, given that Brazil had only one local wind manufacturer at the time. As a result, not all technologies could reach their quotas, and eventually some volumes of capacity had to be transferred from one technology to the other in order to achieve the total target of 3,300 MW.

The deadlines for the initiation of commercial operation of different plants were also postponed several times, and the lack of market confidence in the continuity of PROINFA was considered a “stop and go” situation.

In addition, there is no evidence that PROINFA was effective in its management of CDM revenues. Under PROINFA, Eletrobras was responsible for managing carbon revenues to reduce program costs (and hence the “uplift” on consumer tariffs). However, there is no information on whether projects were registered under the CDM or on the use of carbon revenues to lower program costs and reduce consumer tariffs.

In general, PROINFA was criticized for failing to provide economic signals for efficiency and technological improvement.

Source: Barroso 2010.

Second, all countries applying FITPs offer guaranteed, nondiscriminatory access to the grid and impose a purchase obligation on utilities, retail providers, and large consumers. This is also aligned with international best practice. However, the actual compliance with purchase obligations has been generally poor for two reasons. On one hand, many Discos (especially those operating in India, Nicaragua, and Turkey) exhibit weak or unsustainable financial balances, and the purchase obligation has become an additional burden, especially in cases where the FIT subsidy is not passed on to consumer tariffs (or when the transfer is incomplete or subject to government approvals) (this point is illustrated in Table 4 for the case of India). On the other hand, the actual design of purchase obligations has—in some cases—lacked penalty mechanisms and realistic escalation schedules or has imposed ambitious targets not aligned with lag times required for the construction of new plants. In particular, different states across India are working toward strengthening the design of RPOs.

Third, an important factor in determining the success of FITPs is the existence of a formal incremental cost recovery mechanism. This mechanism must be viable, transparent, explicit, and sustainable in the long term. The lack of a viable and sustainable funding source is indeed a limiting factor to compliance with RPOs and ultimate RE deployment.

In systems where FIT subsidies are not passed through to consumer tariffs, FITPs need to be tied to a realistic strategy that outlines the short- and long-term options for the financing of incremental costs (for example, if the funding source is the state budget, tranches to cover FIT policies must be formally approved at the beginning of the fiscal cycle). In India, for instance, fiscal transfers to cover FIT subsidies have been incomplete, and utilities have been expected to partially cover the subsidy with their own revenues.

In Sri Lanka, invoices from the Ceylon Electricity Board to cover the incremental costs associated with the existing five small hydropower (SHP) facilities (which have been commissioned under the new FIT system) are accumulating at the Sustainable Energy Authority, which has been unable to pay them (Meier 2010).

Thus, without a sustainable mechanism for covering incremental costs, the mobilization of financing for new

**Table 3: FIT Design in Sample Countries as of the Last Reform (2010)**

Country	Purchase Obligation	Fixed Price			
		Stepped Tariff	Tariff Degression	Flat Tariff	Premium Price
<b>Sample Countries</b>					
Turkey	X			X <sup>1</sup>	
Nicaragua	X			X <sup>2</sup>	
India	X	X (wind, solar, SHP)	X (wind)		X <sup>7</sup>
Indonesia	X			X <sup>3</sup>	
Sri Lanka	X	X <sup>4</sup>		X <sup>4</sup>	
<b>Some European Countries</b>					
Denmark	X <sup>5</sup>	X			X (wind)
France	X	X	X (wind)		
Germany	X	X	X (wind)		
Italy	X	X	X (PV)		
Spain	X <sup>6</sup>	X			X

Source: Data on European countries comes from Klein and others 2008, data on the six sample countries come from a variety of sources (see main report, World Bank 2010).

Notes:

- <sup>1</sup> The previous scheme (fixed FiT with upper and lower limits, in which RE generators could opt for the wholesale electricity price) was substituted for a flat fixed FiT (amendments to Renewable Energy law of December 2010). RE producers can also sell their energy in the “free market”.
- <sup>2</sup> Tariff level is a function of marginal costs and varies with oil prices
- <sup>3</sup> Tariff in SPPAs is fixed as 80–85 % of avoided cost of power generation (not a FIT in strict sense).
- <sup>4</sup> IPPs can choose between a flat and a three tier stepped tariff, stepped tariff applies to all RE eligible technologies.
- <sup>5</sup> Except for wind onshore.
- <sup>6</sup> Only in combination with fixed (stepped) tariff.
- <sup>7</sup> The Generation Based Incentives (GBI) recently introduced for solar and wind are a premium in practice.

RE investments is implausible, even in the presence of attractive FITs. The implementation of a transparent mechanism to share the incremental costs associated with RE policies (including grid integration and balancing costs) has been identified as best practice across the developed world. This has been achieved in Brazil, but remains a challenge for most of the countries in the review.

In particular, the FITPs of Brazil, India, and Sri Lanka have included rules that determine the allocation of carbon revenues to explicitly reduce the impact of FIT

subsidies on consumers or tax payers. This measure was not completely successful under PROINFA in Brazil (as described in Box 1), but it has proven successful in other countries (as long as the additionality criterion is met in the presence of an FITP).<sup>12</sup>

Fourth, developing countries have learned that some requirements or preconditions embedded in the design of FITPs have the potential to constraint the actual use of the incentive and development of RE. For example, the design of PROINFA established the requirement of a *minimum business participation rate* (that is, 60 percent

<sup>12</sup> A CDM project activity is considered additional if anthropogenic emissions of greenhouse gases by sources are reduced below those that would have occurred in the absence of the registered CDM project activity. Probing additionality in the presence of FITPs is therefore more challenging. For instance, in December 2009 the CDM Executive Board rejected 10 wind projects located in China for failing to prove that projects could not achieve financial closure even in the presence of existing FITPs (PCF 2010). In this case, the concern was focused on the FIT design (that is, determination of actual level of payments). The additionality criterion is also more difficult to justify when RE projects participate in REC markets.

**Table 4: Compliance with RPO in India, 2009**

State	Targets (introduced from 2006)	Achievement 2009	Extent to which the target has been achieved (%)
RPO Andhra Pradesh	5% (1% from wind)	4.52% (target on wind not met)	90
RPO Gujarat	2	2.10	105
RPO Haryana	3	0.01	~ 0
RPO Karnataka	7 to 10	9.47	95–135
RPO Kerala	5	1.22	24
RPO Madhya Pradesh	10	0.11	1
RPO Maharashtra	5	3.17	63
RPO Rajasthan	6.5–6.75	7.49	111–115
RPO Punjab	1	1.8	180
RPO Tamil Nadu	10	NA	NA
RPO Uttarakhand	5	1.32	26
RPO Chhattisgarh	10	3.77	38
RPO Himachal Pradesh	20	—	—

Source: World Bank 2009, ESMAP 2010, States' Regulation on RPO (Maharashtra, Andhra Pradesh, Haryana).

of services and equipment associated with RE projects had to be produced or manufactured locally), which seriously constrained the development of wind-based capacity. In contrast, Turkey recently approved the use of premiums over the actual FIT to promote the use of equipment manufactured locally (proposal approved on December 2010).

Other typical constraints affecting the performance of FITPs—and ultimately RE deployment—are related to bottlenecks in the administrative process for granting the required licenses and permits. This has been especially notable in Brazil and India, although both countries have made major efforts to improve the efficiency of administrative procedures.

Finally, one important lesson learned concerning the effectiveness of FITPs is that policy sequencing is crucial and that some key preconditions have to be met before incentives to promote RE are introduced. The existence of specific legal and regulatory provisions addressing the issues of land use, resource use, and allocation

of rights is also necessary to avoid bottlenecks in RE development.

### **Emerging Experience with Designing and Implementing Quantity-Setting Policies**

Quota-based or quantity-setting mechanisms (also known as market share policies) mandate the introduction of a certain percentage or absolute quantity of RE capacity or generation at unspecified prices (World Bank 2008). This section focuses on the experience with the use of different procurement mechanisms in the sample countries, especially with the use of auctions in Brazil. None of the sample countries has implemented a formal RPS.<sup>13</sup>

### **Formal RE Targets**

Except for Brazil and Nicaragua, all other countries subject to the review are committed to formal targets on RE (see Table 5). The extent to which these targets are attainable is discussed below.

<sup>13</sup> With the recent introduction of auctions to deploy solar-based capacity, India now has the elements typical of an RPS (only for the case of solar initiatives): (a) targets and purchase obligations, (b) a REC market with solar-specific RECs, and (c) use of a competitive mechanism to determine the price. Yet, the purchase obligations are mandated under the FITP framework.

**Table 5: Formal and Indicative Targets in Sample Countries**

	Issued	Size of Target/Share	Deadline
<b>Official Targets</b>			
India	2008	1% annual increase, about 20% share (NAPCC)	2020
	2009	54 GW, approx 12.7% share (13 <sup>th</sup> Plan)	2022
	2010	1 GW, solar capacity (National Solar Mission)	2013
Turkey	2009	30%	2023
Indonesia	2006	10%	2025
	2008	4 GW geothermal capacity	2015
	2008	9.5 GW geothermal capacity	2020
Sri Lanka	2006	10%	2015
European Union	2007	20%	2020
<b>Indicative Expansion Plans</b>			
Brazil	2010	Add 10.7 GW, approx 19% share	2019
Nicaragua	2007	37% share	2014

Note: all targets exclude large hydroelectric capacity.

**Procurement Mechanisms**

As mentioned before, the competitive route to RE procurement is only being used at present in Brazil and India (through auctions) and in Indonesia and Sri Lanka through conventional bidding processes. However, none of the countries in the sample has committed to a formal RPS. In fact, the only developing country that had introduced a formal RPS before 2005 was Poland. In 2008, both Chile and Romania implemented a type of RPS mechanism.

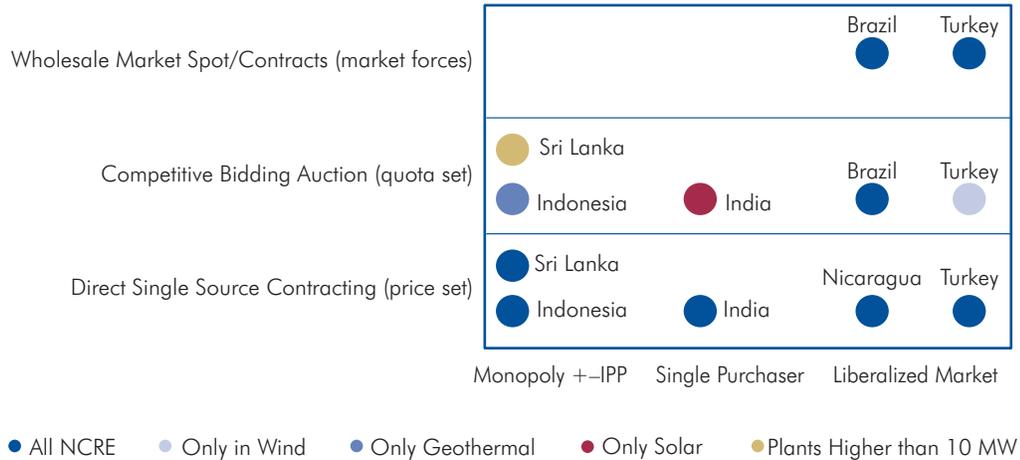
The procurement of RE in the sample countries varies from direct contracting (cost-plus, fixed-fee contracts) to competitive mechanisms (such as biddings, auctions, and transactions in the wholesale market).

In India, Indonesia, Nicaragua, Sri Lanka, and Turkey, the bulk of RE capacity has been procured through cost-plus, fixed-fee contracts. In particular, Indonesia and Sri Lanka have used Standardized Power Purchase Agreements (SPPAs) to procure small-scale RE. In fact, the use of SPPAs in Sri Lanka has been notoriously successful for rapidly increasing SHP capacity. This has not been the case in Indonesia, however. Figure 3 illustrates the options for RE procurement in sample countries.

Turkey has recently allowed the use of competitive bidding to procure wind-based generation when there are multiple available projects in the same region. The country also allows RE developers to sell in the wholesale energy market. Also India has recently introduced auctions to procure solar installations.

The procurement of RE in Brazil is carried out through auctions, but developers are also allowed to sell directly through bilateral contracts in the free unregulated market. In both, Brazil and Turkey selling in the wholesale market (especially through bilateral contracts) has been a real possibility to RE developers. In the case of Turkey, the spot market prices were well above the FIT in place until the formal approval of new technology-specific FITs in December 2010, and in Brazil, other incentives in place have leverage the feasibility of bilateral contracts between small-scale RE developers (less than 30 MW) and large consumers (that is, discounts on T&D tariffs). Both Indonesia and Sri Lanka now allow the use of competitive biddings for small-scale RE and geothermal initiatives, respectively.

**Figure 3: Options for RE Procurement in Sample Countries**



**Experience with Auctions in Brazil**

Brazil has launched two types of auctions to deploy RE: technology-specific auctions and reserve energy auctions.<sup>14</sup>

Technology- or project-specific auctions are carried out within the framework of the regular auctions to deploy new capacity and supply the regulated market. This type of auction has been used to support specific energy policy decisions or the introduction of special projects (such as large hydroelectric plants). In this case, contracts have to be covered with Firm Energy Certificates (FECs) to ensure that new generation is added to maintain minimum adequacy and reliability levels at the system level.<sup>15</sup> Reserve energy auctions, by contrast, are carried out to directly increase the system’s reserve margin. In this case, contracts do not have to be covered by FECs, and the auctioned quantity is independent of the demand forecasts issued by Discos.

The experience with the use of auctions to deploy RE capacity in Brazil can be summarized as follows. First, the procurement of RE through auctions has been so far more successful with reserve energy auctions than with technology specific auctions. In 2007 the Government

of Brazil launched the first technology-specific auction to supply the regulated market where only RE could participate, although participation in the auction was unexpectedly low. This lack of interest has been attributed to the following factors: (a) RE developers have obtained higher prices in the free market because of the attractiveness of the T&D discount (which is offered only to RE of less than 30 MW); (b) it is often more difficult for RE to comply with the FEC coverage obligation, since intermittent generation faces a higher risk of penalization; and (c) the upper limit for the remuneration level in the auction was set at a rate lower than the FITs previously offered by PROINFA (de la Torre, Fajnzylber, and Nash 2008; IEA and OECD 2008; Barroso 2010).

Indeed, one of the main challenges of auction mechanisms is to attract sufficient bidders and ensure that competition is established (for example, it is important to mitigate the barriers to entry for new players and lower information asymmetries as much as possible).

As of today, three “reserve energy” auctions for RE have been launched (August 2008, December 2009, and August 2010), awarding an aggregated capacity of about 6.2 GW in SHP, sugarcane bagasse cogeneration, and wind-based generation for delivery

<sup>14</sup> The experience with auctions to deploy solar based capacity in India is too recent, and thus it is not analyzed in this review.

<sup>15</sup> FECs (denominated in GWh/year) are issued by the Ministry of Mines and Energy (MME). The methodology for their calculation is fairly complex. In practice, FECs reflect the sustainable energy production of each generator when interconnected to the grid. For instance, to sign a contract of 100 “average MW,” a generator or trader must also acquire an equivalent amount of FECs (in GWh/year). The FEC of a plant is also the “maximum amount of energy that it can sell through contracts.” Any shortfall is penalized at a price that mirrors the cost of new energy.

dates between 2008 and 2015, with contract terms ranging from 15 to 30 years.

Second, the auctioning of RE in Brazil has resulted so far in low prices (in the lower bound, but not outside the range of international FITs), raising concerns as to the extent to which auction winners will be able to construct and profit from the plants (see Table 6).

Although the auction system in Brazil includes a number of prerequisites and mitigation measures<sup>16</sup> to avoid speculative behavior among participants and lower the risk of construction delays or no construction of facilities at all (deployment risk), the actual enforcement and payment of project completion guarantees is an issue of concern (for example, potential lengthy court cases that may then discourage other investors).

In general, to ensure that auction winners will deliver the awarded projects it is important to pre-qualify bidders to discourage speculators or financially insolvent companies from participating and to include ad hoc mitigation measures and requirements (for example, projects with granted environmental licenses and relevant permits, bids that include audited

historical records of hydrology or wind velocities as well as grid access studies that demonstrates the feasibility of the connection point). In addition, the proper design of project completion guarantees and penalties to avoid construction delays and underperformance are crucial for ensuring deployment and operational efficiency.

In particular, the low prices that resulted from the reserve energy auctions to deploy wind-based generation carried out in December 2009 and August 2010 have raised the fear of no-implementation of projects because of financial insolvency.<sup>17</sup>

The 2009 auction for wind-based generation did not result in a clear correlation between capacity factors and prices, confirming to some extent the influence of strategic behavior in bidding results (that is, win the bid, then adjust) (see Figure 4). However, this behavior may also be associated with the lack of a good record of historical data on wind velocities.

When comparing Brazil's auction prices for on-shore wind with other countries, it can be observed that the bid rounds have delivered prices in the lower bound,

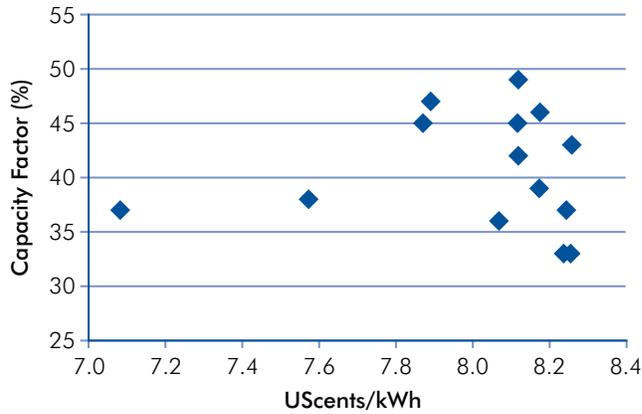
**Table 6: Final Bid in Brazil Auctions and FITs for On-Shore Wind**  
Data 2009–2010 (USD cents/kWh)

Country	Tariff Level	Remuneration Period
India FiT (CERC levelized tariff 2010–2011)	7.4–11.05	
India (Maharashtra)	9.92 with annual escalations	6
India (Gujarat)	7.76, 25 years	25
Sri Lanka	20.5, 20 years	20
Turkey (proposed FiT)	11.1, 10 years	10
Nicaragua (Amayo plant)	8.6, 20 years	20
Germany	9.2, 20 years	20
France	8.2, 15 years	15
Brazil Auction December 2009	8, 20 years	20
Brazil Auction August 2010	7.5, 20 years	20

<sup>16</sup> These include the requirement of granted environmental licenses prior to participation in auctions, deposit of bid bonds (equal to 1 percent of a reference investment, deposited before the auction and returned after the contract is signed), and project completion guarantees (10 percent of a reference investment value deposited after the contract is signed and released as the project completes construction), as well as the existence of grid access studies showing that a connection point is feasible and available. In addition, investors can be severely penalized for not delivering the project. In the case of wind power, new wind turbines must be used (machines could not have been used before for prototype testing) and a historical record of wind speed and direction for a period of at least 12 months issued by a third party is required.

<sup>17</sup> On average, offered capacity factors reached 45 percent, and in a few cases even more than 50 percent.

**Figure 4: Capacity Factor vs. Winning Auctioned Prices for On-Shore Wind (Auction 2009)**



but not outside the international range (as shown in Table 6). Yet the costs of debt and capital, as well as the types and level of risks exhibited in a country like Brazil, are different to those exhibited in developed countries.

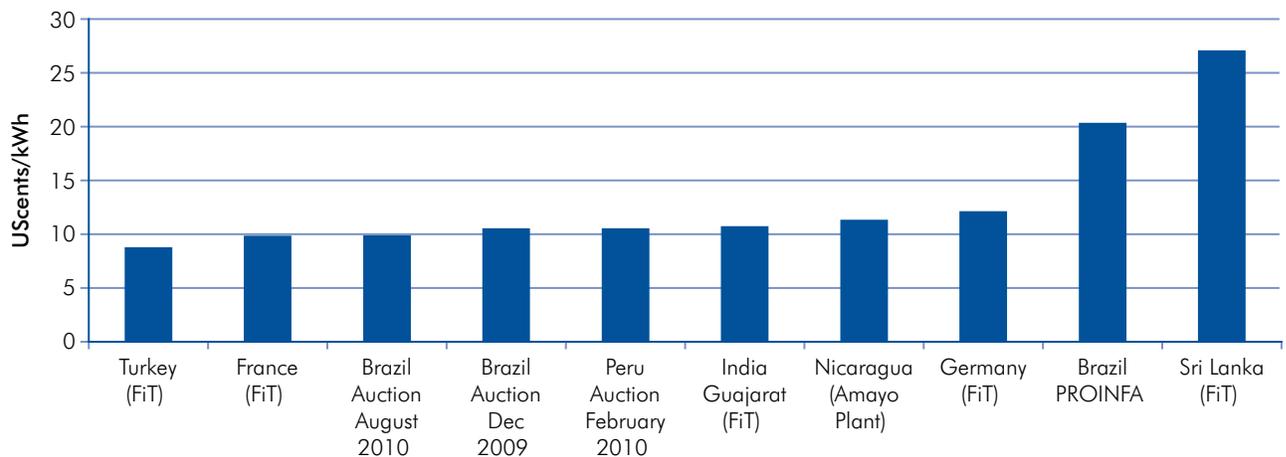
A comparison of the remuneration levels using common assumptions for a 30 MW wind-based plant again shows that the auctions in Brazil delivered prices within the range of other countries (France, Germany, Nicaragua, and Turkey), although well below FITs provided in India and Sri Lanka (see Figure 5).

The effectiveness of the auction system to procure RE in Brazil will only be discovered with time; their potential to deliver least-cost RE capacity has already been proven. A comparison between the costs of PROINFA and the costs of RE delivered through auctions is provided in Table 7, showing that auctions are delivering a more economically efficient output than the previous FITP (PROINFA).

Third, the auctions for wind-based capacity additions in Brazil have rapidly attracted the participation of new equipment suppliers to the market. In addition to Wobben Wind Power, which has been present in the market for many years (a subsidiary of German company Enercon), IMPSA (Argentinean), Suzlon (Indian), Vestas (Danish), Siemens (German), and GE (United States) are now operating—or in the process of starting operations—in the country. Many private developers have also emerged to participate in auctions (for example, in the auction launched in December 2009, 14 companies were awarded a portion of the auctioned quota).

Fourth, environmental licensing issues are still creating a bottleneck to the development of RE projects in Brazil. For instance, many projects have been severely delayed, large cost overruns have been incurred, and some have even given up altogether, because of environmental impediments. Although there is an established sequence of environmental licenses to be obtained at each step of the project, with each license being more detailed than the preceding one, requirements sometimes change significantly from one license to

**Figure 5: Remuneration Level Efficiency On-Shore Wind**



Note: Annualized NPV of remuneration levels, under similar assumptions, not adjusted to inflation.

**Table 7: Efficiency Comparison: PROINFA and Auctions**

	PROINFA			Technology-specific auction ("reserve energy" auction) 2009		
	MW	GWh/year	USD/MWh	MW	GWh/year	USD/MWh
Wind	1423	3740	154	1800	6596	80
Small Hydro	1191	6260	96	—	—	
Bioelectricity <sup>1</sup>	779	2661	77	2379	4800	84
<b>Impact on costs</b>						
Total capacity (MW) <sup>2</sup>	3,393			4,179		
Total energy (GWh/year)	12,661			11,397		
Average cost (USD/MWh)	109			80		
Total cost (million USD/year) <sup>3</sup>	1,381			911		
Net impact on tariffs (USD/MWh) <sup>4</sup>	3.8			1.6		

Source: Barroso 2010.

Notes:

<sup>1</sup> Values of April 2010, prices include taxes.

<sup>2</sup> Installed capacity includes self-consumption. In the auction case, energy values correspond to the excess energy sold to the grid at the auction. More excess energy from the new plants is available to be sold to the free market of at future auctions.

<sup>3</sup> Gross cost, i.e., total (fixed) cost paid by the consumers.

<sup>4</sup> For the auction case, it is the net cost, i.e., includes estimates of yearly spot revenues collected by consumers.

<sup>5</sup> Exchange rate: 1.85 USD/BRL.

the next, and licenses are frequently challenged by public attorneys on various grounds, resulting in unpredictability and long-drawn-out lawsuits.

Finally, several other issues have generated strong debate among market participants and different stakeholders. One area of concern is the role of the public sector as both auctioneer and power purchaser, which creates a conflict of interest. For instance, there has been frequent interference of the government in technical functions, such as dispatch, the selection of projects for capacity expansion, and even in the decisions on what public enterprises can participate in auctions. Also, the type of technology and contract volume can be discretionary (that is, the government has the prerogative to call an auction to contract a given volume of energy even if it is not contemplated in the demand forecasts prepared by Discos).

In fact, debate among auction participants has been strong concerning some of the technical parameters included in the auction scheme (which may favor specific projects or technologies and, indirectly, specific companies). In addition, private participants have expressed concern with regards to the different

perception of risks of public and private enterprises and its effect on competition (such as different hurdle rates or costs of capital).

### **Policy Interactions and Instrument Compatibility**

A growing body of literature suggests that the compatibility among coexisting policy or regulatory instruments and fiscal or financial incentives is critical to the success of RE policy. In particular, many studies have focused on the interaction among different RE policy instruments, concluding that (a) some instruments are more effective when combined with other supporting schemes and (b) the effect of policy overlapping may produce counterintuitive effects that create substantial excess costs.

In developed countries, the focus has been on the effects of investment tax credits on operational efficiency (in the absence of technology standards) and the interactions between RE policies and emissions trading systems, especially in European countries. Other studies have analyzed the effect of RE deployment on electricity and gas prices, especially in the context of liberalized

markets.<sup>18</sup> In the review, a few examples that illustrate the issue of policy interactions and compatibility were identified. Two of these examples are briefly described below.

### Investment Tax Credits and Feed-in Tariff Policies

In 1994–95 India introduced accelerated depreciation to trigger investments in wind-based generation through adjustments to the Income Tax Act. The original incentive allowed 100 percent depreciation within the first year on a written down value basis. In 2002 the incentive was reduced to 80 percent depreciation, also within the first year. To some extent, however, the incentive attracted diversified profit-making companies with high tax liabilities—as opposed to wind developers—seeking to use accelerated depreciation as a tax shield against profits on the entire company balance sheet. At the same time, these companies had a marked preference for the use of turnkey project packages sold by equipment vendors.

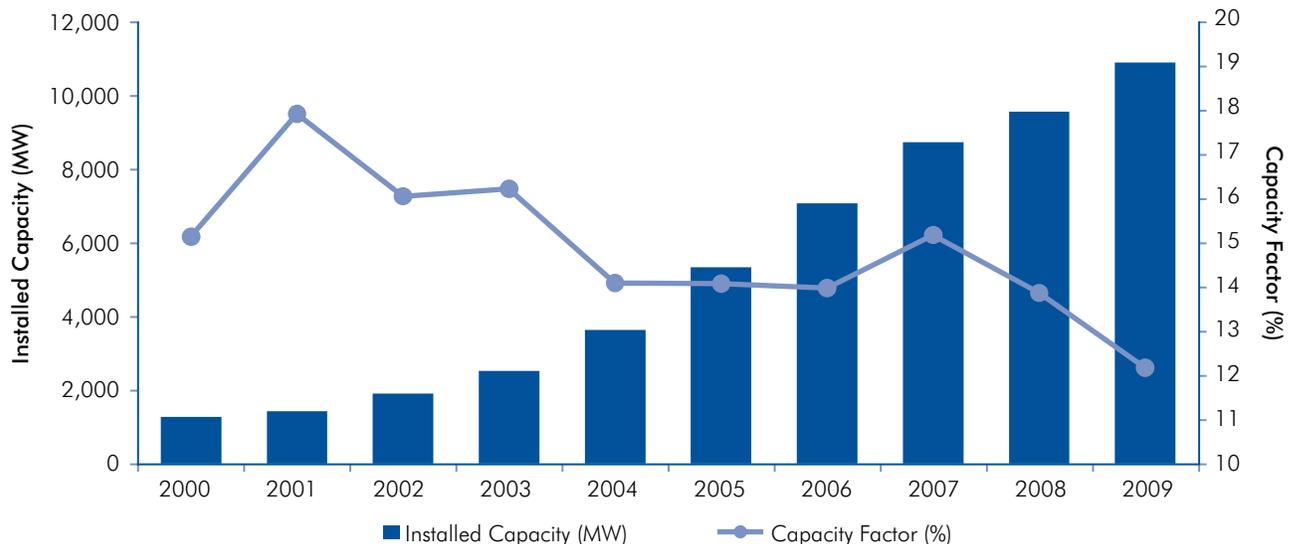
Investors have profited from the use of accelerated depreciation in addition to the FIT. The combination

of these two instruments has resulted in unintended effects, both in the operational efficiency of wind installations and the costs of equipment. First, contrary to world market trends, technology improvements and economies of scale have not reduced the costs of the wind generation industry. In fact, the average costs of equipment increased from about US\$880,000 to US\$1.3 million per MW between 2003 and 2008 (ESMAP 2010; World Bank 2009). Second, wind-based installations in India have exhibited very low operational efficiencies (as shown in Figure 6).<sup>19</sup> Third, the lack of harmonization among FITPs across different States has driven investments to the regions where these policies are more attractive, and not necessarily to the locations with the highest wind or resource potential.

This suggests that the types of instruments chosen to support RE and the policy mix per se have an effect not only on deployment but also on operational efficiency.<sup>20</sup>

In response, the Government of India has introduced generation-based incentives, which are designed to shift the incentive from installations to production and

**Figure 6: Evolution of Wind Capacity and Aggregated CF, India**



Source: EIA 2009; Ministry of Power India 2010.

<sup>18</sup> The literature on “policy interactions” is rapidly evolving. See, for instance, Jensen and Skytte 2002; De Jonghe and others 2009; Blyth and others 2009; Fischer and Preonas 2010.

<sup>19</sup> The lowering of this aggregated factor may also be attributed to dispatch dynamics and grid limitations. Thus, further investigation is necessary to differentiate between the impacts of policy and grid and dispatch constraints.

<sup>20</sup> In the literature a few authors have emphasized that FITPs can have a negative effect on cost reductions, as they induce generators to choose high cost-sites and provide fewer incentives for cost cuts (Soderholm and Klaassen 2007).

facilitate the entry of independent power producers (IPPs). These incentives have been offered since 2008 for solar- and wind-based capacity additions in an attempt to improve their technical and operational efficiency. In addition, the Government has also recently introduced a REC market, mainly as an equalization mechanism to improve the overall economic efficiency of RE deployment. However, as of today the accelerated depreciation incentive has not been phased out, and it is being offered in parallel with generation-based incentives (in this case, a premium over the FIT).

The dynamic resulting from this type of policy mix has also been exhibited in other countries (for example, investment tax credits for RE in California and for biofuels across the United States have also resulted in unintended effects) (Sawin 2004; de la Torre, Fajnzylber, and Nash 2008).

### Firm Capacity Incentives and Obligations

Many power markets have developed financial instruments or incentives to stimulate investment in new capacity and maintain an adequate reserve margin. These incentives, generally termed “reliability payments” or “firm capacity charges” have been offered either as price premiums to technologies capable of delivering “firm energy”, or auctioned as incentives to achieve prespecified levels of adequacy and reliability.

In general, capacity payments compensate investors for higher capital costs arising from regulatory risk and the failure of market design to accommodate for long-term contracts with domestic consumer franchises to allow hedging of investment decisions. Thus, these mechanisms compensate for market failures, rather than removing them (Neuhoff and Twomey in Grubb, Tooraj, and Pollit 2008). In hydropower-based systems, capacity payments are provided to help mitigate price spikes and encourage investments in flexible and backup plants (that is, peaking generation receives capacity payments to anticipate and receive a certain level of scarcity rents over time).

The issue of firm capacity also arises when an important volume of RE is expected to be deployed. As intermittent generation is added in a system, additional reserve capacity is necessary to maintain minimum levels of supply adequacy (for example, Germany, Portugal, and Spain require about 250–300 MW of additional reserve for every 1 GW of wind capacity added to the system

(Bakovic 2010)). The “stand-by” plants can only recover their investments if the spot price allows price spikes or if a capacity payment is offered.

In some systems, the need for “firm energy” is addressed through an obligation. As discussed before, in Brazil all energy loads (regulated and unregulated consumers) are required to cover 100 percent of their energy needs with contracts; at the same time, all contracts have to be covered by FECs. The FEC coverage requirement ensures that new generation is added on time to cover the growing future load. Nicaragua, by contrast, offers capacity payments (a price premium) to generators capable of supplying firm energy, but has imposed an obligation on all generators (including RE) to provide a capacity reserve equal to 5 percent of installed capacity.

In general, however, firm energy incentives and obligations have not been designed to acknowledge the capacity of intermittent RE to also provide “firm energy services” (for example, RE can be dispatched in base-load when hydropower reservoirs are low or in between biomass harvesting seasons). In fact, RE is generally excluded from the incentives (payments or premiums), but not from the obligations (as in Nicaragua).

As they are designed, firm capacity instruments tend to reward or simply favor conventional technologies, but directly or indirectly undermine the financial viability and competitiveness of intermittent sources of power supply, given their specific characteristics and the greater uncertainty associated with their annual output delivery. The existence of firm capacity obligations also has the potential to affect the effectiveness of regulatory instruments or measures to promote RE development. In Brazil for instance, RE developers have not participated in the so-called technology-specific auctions specifically aimed at deploying RE in part because of the FEC obligation. The use of “reserve energy auctions” to deploy RE, by contrast, has attracted more participation, mostly because in this type of auction, FECs are not required. However, the use of reserve energy auctions to deploy RE is limited. In a system where the price of RE is discovered through auctions, the FEC obligation may prove a limiting factor to the scale-up of RE.

Thus, the existence of firm capacity payments and obligations may have two effects: (a) reduce the capacity of RE to compete on an equal footing with thermal generation in some markets; and (b) undermine

their financial viability as firm capacity and reserve obligations impose a greater financial burden on RE, given their operational characteristics.

The introduction of FITs in systems that also offer firm capacity instruments need to consider this aspect because it may change the way RE is priced. How

“stand-by” plants and RE are priced to appropriately pay for the value of “firm energy services” needs to be explored on a case-by-case basis (or at least until externality pricing is introduced). Already in Colombia, an innovative mechanism is being explored by the regulator to allow intermittent RE to compete in “firm energy” auctions (see Vergara and others 2010).

## 5. POLICY PERFORMANCE

The performance of renewable energy policy depends on a number of factors, including macroeconomic conditions, institutional structure and capacity, governance (regulatory quality, rule of law, control of corruption, political stability, and government effectiveness), fuels and electricity market dynamics, and infrastructure capacity (for example, capacity of the grid to evacuate intermittent generation).

Thus, the review of the design and performance of RE policy cannot be decoupled from the analysis of the prevailing system and market conditions. Indeed, the successive reforms of key regulatory incentives respond

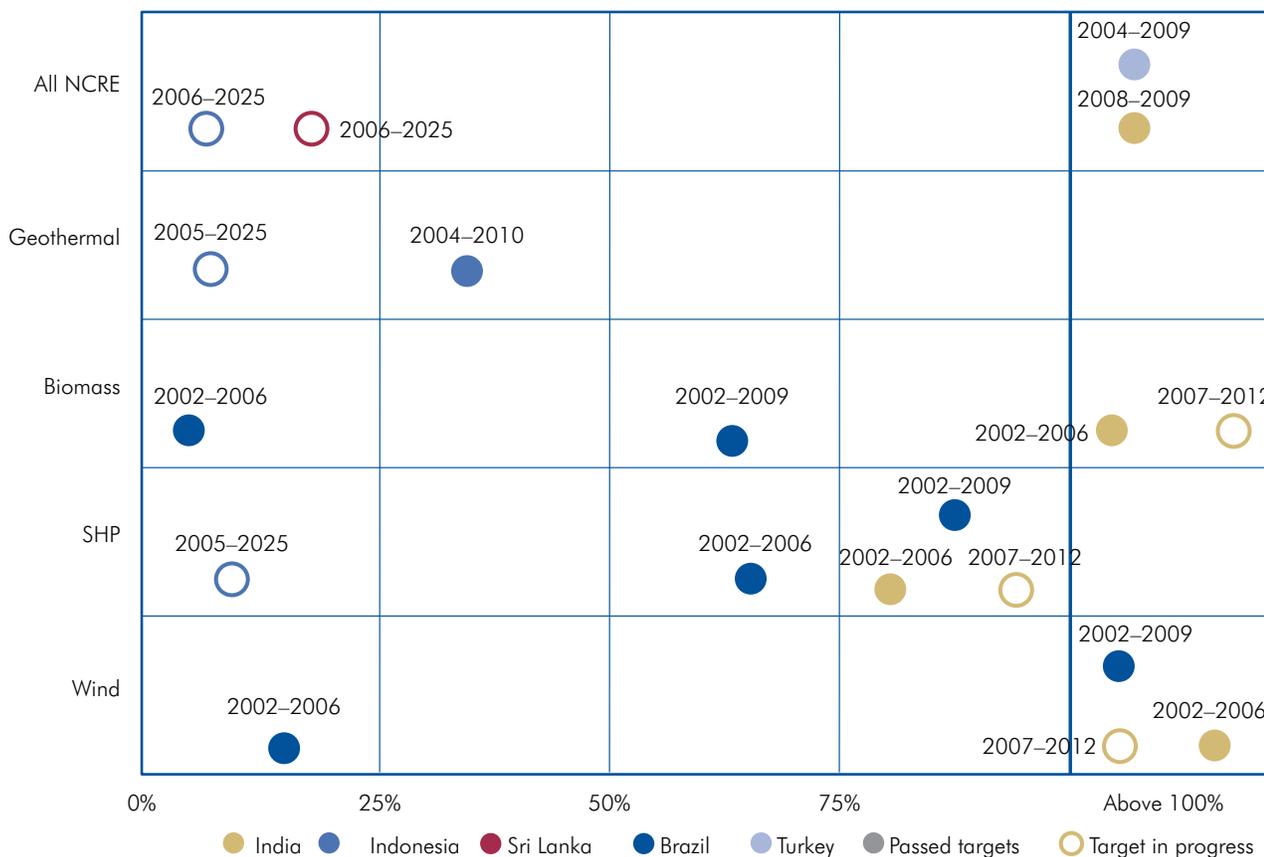
to feedback effects between design and implementation experience in the context of a dynamic system (that is, a dynamic legal, institutional, economic, financial, and technical system).

This section briefly discusses the effectiveness of policy packages in the sample countries in terms of market growth.<sup>21</sup> In this exercise, it is implicitly assumed that policy design and implementation have a direct link with the intended outcome (that is, RE market growth).<sup>22</sup>

### Attainment of Targets

Except for Nicaragua, all countries in the sample have committed to targets on RE. Figure 7 depicts the degree

**Figure 7: Degree to which Official Targets on RE have been Attained**



<sup>21</sup> Trends in RE market growth are compared to the growth required for attaining official targets in the case of sample countries that have officially established them.

<sup>22</sup> Clearly, it is necessary to control for a number of factors to more accurately assess causality between policies and their intended outcomes or empirical performance. In the absence of a formal impact evaluation or appropriate modeling of the system, attribution cannot be rigorously assessed. However, the simple analysis of market growth as a first step in the discussion of RE policy performance is thought to be appropriate in the context of a case-study approach.

to which passed targets have been attained, as well as the degree to which new targets are being met.

In particular, India has a very good record in achieving targets, especially those offered in the 9<sup>th</sup> (1997–2001), 10<sup>th</sup> (2002–06), and 11<sup>th</sup> (2007–12) five-year plans. Also, the target introduced in the Indian National Action Plan on Climate Change for increasing the share of RE by 1 percent annually was met in its first year (2008–09). Brazil, by contrast, did not meet the PROINFA target offered in 2002 (an additional 1,100 MW for each RE technology type, including wind, biomass, and SHP, by 2006); however, the country managed to reach the target for wind in 2009 and has progressed substantially with biomass and SHP.

At the other end of the spectrum, Indonesia could not attain the target on geothermal capacity offered in its Geothermal Road Map of 2004 (2,700 MW by 2010) and targets offered in its National Energy Management Blueprint of 2005 have also not progressed substantially.

The new targets offered by Sri Lanka and Turkey are fairly recent. Thus, it is too soon to report progress.

However, in 2004 the Government of Turkey set up a Special Purpose Debt Facility to promote RE development with the support of a World Bank loan. Under this initiative, the targets on RE were in fact surpassed by 2009.

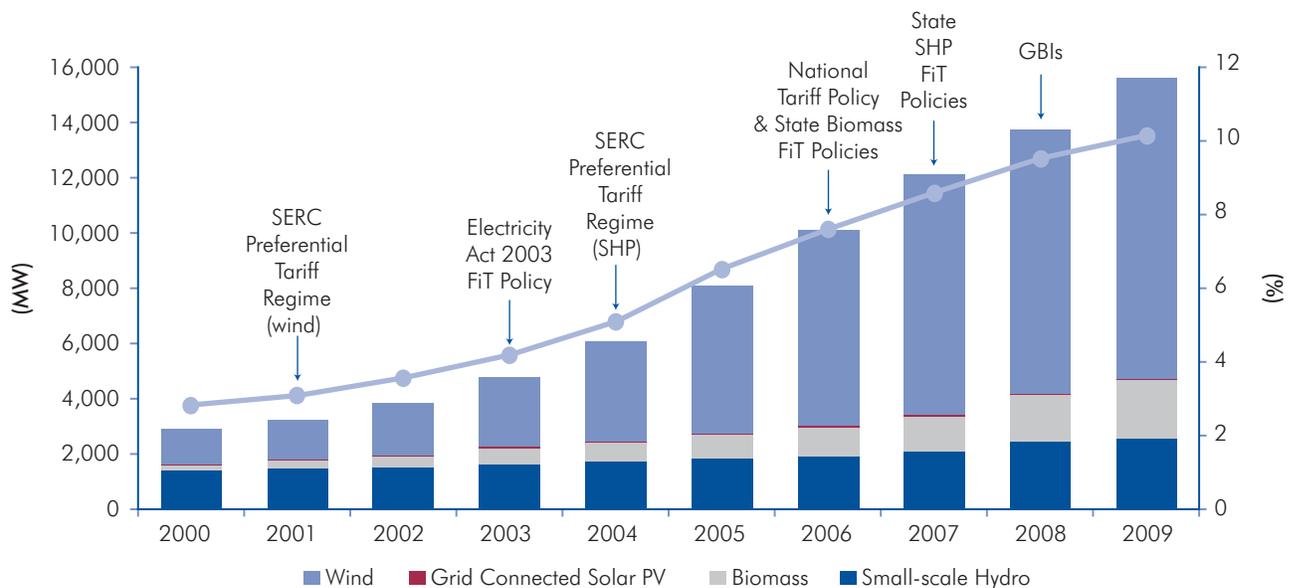
### Effectiveness of Policy Package in Sample Countries

This section briefly discusses the effectiveness of policy packages in the sample countries in terms of market growth.

#### Brazil and India

Of the sample countries under review, Brazil and India have exhibited sustained RE market growth that started soon after the introduction of an FITP (as depicted in Figures 8 and 9).<sup>23</sup> India started introducing incentives to promote the development of RE as early as 1993 when the newly created Ministry of New and Renewable Energy (MNRE, previously Department of Non-Conventional Energy Sources) issued tariff guidelines that offered a national preferential rate to all types of RE. Today, the Government of India offers a complex combination of

**Figure 8: Evolution of RE Capacity and Share in Power System, India**

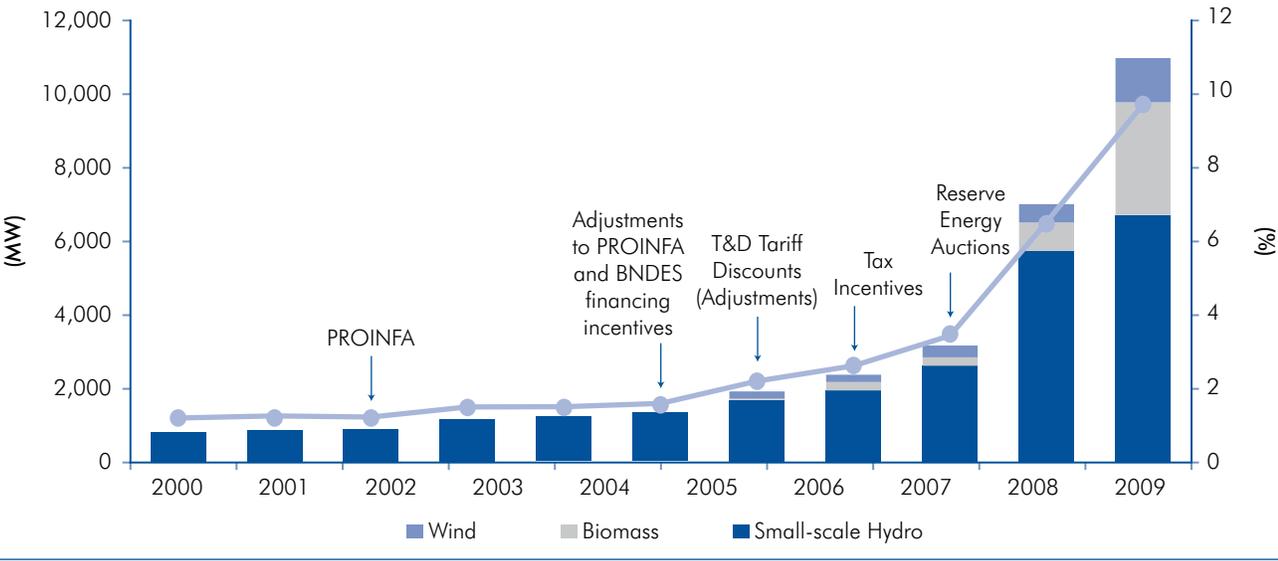


Sources: EIA 2009; Ministry of Power India 2010.

Note: India introduced a REC market and the use of auctions from 2010.

<sup>23</sup> The adjustments to PROINFA in Brazil included changes in the financing conditions offered by the BNDES to PROINFA projects.

**Figure 9: Evolution of RE Capacity and Share in Power System, Brazil**



Source: EPE 2009.  
 Note: Data for the years 2009 and 2010 are “expected deployments” (actual data still not officially released).

policy incentives that includes FITPs, fiscal and financial incentives, generation-based incentives, and competitive mechanisms (for example, auctions to deploy solar-based capacity and a market of solar and nonsolar RECs from 2010) (see matrix in Appendix 2).

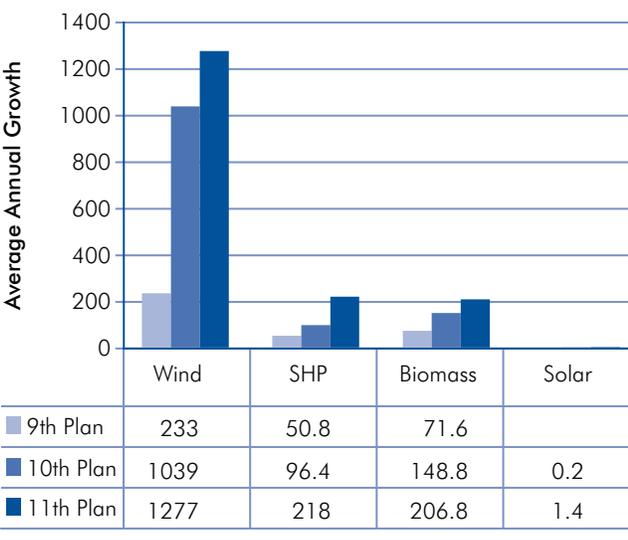
Brazil introduced an FITP (PROINFA) in 2002 for a relatively short period and moved to the use of auctions from 2007. The policy package to support RE deployment in Brazil is less diverse and includes only discounts on T&D, fiscal and financial incentives, and the use of auctions to support the introduction of a predefined quota of RE (as shown in Appendix 2).

Many factors have contributed to the sustained RE market growth in both Brazil and India: (a) strong government commitment (most notably in India); (b) the creation of institutions exclusively focused on RE development at the central and state levels (India); (c) the existence of a growing domestic equipment manufacturing industry (in India, but also emerging in Brazil); (d) a sustained effort toward attracting private sector participation (Brazil, India); and (e) the existence of either a tight reserve margin or a large supply demand gap, which has signaled the need for new capacity investments, among others (Brazil, India).

In India, the use of FITPs in combination with fiscal and financial incentives has effectively promoted the

deployment of different types of RE capacity, especially on-shore wind (as seen in Figure 10 below). Yet, this sustained market growth has not been accompanied by acceptable levels of operational efficiency—especially in wind-based generation—partly because of unintended

**Figure 10: Effectiveness as Average Annual Growth, India**



Source: Planning Commission 2001a,b; Ministry of New and Renewable Energy 2006.  
 Note: Periods of the 9<sup>th</sup>, 10<sup>th</sup>, and 11<sup>th</sup> Plans are 1997–2001, 2002–06, and 2007–12, respectively.

or perverse incentives driven by the policy mix per se, as explained before.

In 2010 the Government of India introduced specific policy mechanisms to address this issue (generation-based incentives, REC market), but their capacity to improve the overall operational and economic efficiency of the RE market is yet to be seen. Thus, the case of India suggests that the design of policy mechanisms and the composition of the policy mix can have a positive effect on market growth, but a negative effect on efficiency and the overall costs of RE deployment.

By contrast, the case of Brazil suggests that an emphasis on policy efficiency through the use of competitive auction mechanisms (in terms of low policy costs and least-cost expansion), may not necessarily lead to a sustained RE deployment. In this case, the proper design of project completion guarantees, as well as penalties to avoid construction delays and underperformance, are crucial for ensuring deployment and operational efficiency. The reserve energy auctions launched in 2008, 2009, and 2010 have already awarded a total of 6,199 MW of new least-cost RE capacity to be deployed before 2012. The effectiveness of the auction mechanism in terms of actual market growth is yet to be seen, although the construction of some of the first scheduled new RE plants is already delayed (ANEEL 2011).

Since the first successful auction for RE in Brazil was carried out recently (August 2008), the deployment of RE before that date can only be partially attributed to the combination of other existing incentives, including the FITP (PROINFA), the reduced T&D tariff, tax incentives, and the preferential financing conditions offered by BNDES. Even though the PROINFA target was not reached by 2006 as originally established, adjustments to policy design and the introduction of new incentives allowed Brazil to reach the quota of 3,300 MW before the end of 2010.<sup>24</sup> Investments in small-scale RE to supply the free or nonregulated market (lower than 30 MW) have also increased, mainly because of a discount—generally on the order of 50 percent—on T&D charges offered by the government to support RE development.

## Turkey and Sri Lanka

Although on a more modest scale than in Brazil and India, RE capacity has also gradually increased over the last decade in Turkey and Sri Lanka.

In Turkey, the sustained growth of on-shore wind capacity additions are largely attributed to the introduction of an FITP in 2005 (see Figure 11). The policy package for the promotion of RE-based capacity in Turkey includes an FITP that offers technology-specific fixed FITs, green funds (which offer preferential loans under a Special Purpose Debt Facility), and reduced or exempted licensing and land use fees, as well as funds to support RD&D activities.<sup>25</sup> Turkey has also established an official target on RE—30 percent by 2023.

Many other contributing factors may explain the initial takeoff of RE in Turkey: (a) the financing leverage achieved under the Special Purpose Debt Facility, which triggered 620 MW of new privately owned additions in RE capacity, especially in SHP (that is, equity-to-debt ratio on the order of 2.6); (b) the demonstration and replication effect resulting from this facility, which induced the emergence of new financing programs for RE in local commercial banks and the additional deployment of new SHP capacity; (c) the existence of a strong regulatory agency; (d) the consistent effort toward the establishment of a dynamic wholesale market and cost-reflective tariffs; and (e) the tight balance in supply and demand in the system, which provides a strong signal for the need of new investments.

However, to reach the committed targets and significantly scale up RE, Turkey will need to revise the effectiveness of the policy mix. For instance, it may be necessary to adjust the FIT levels—which are perhaps too low to attract private sector investments—and to ensure that the utilities or retail companies subject to the purchase obligation are able to guarantee the purchase.<sup>26</sup>

In Sri Lanka, the sustained market growth of SHP can be attributed to the introduction of SPPAs from 1998, which offered a 15-year purchase guarantee and an attractive tariff (based on avoided costs of power generation), as well as to the provision of fiscal and financial incentives

<sup>24</sup> For instance, the financing conditions offered by BNDES under PROINFA were adjusted after 2006, allowing higher debt-to-equity ratios, longer amortization periods, and lower interest rates. Also, from 2007, new tax incentives were introduced to promote RE development.

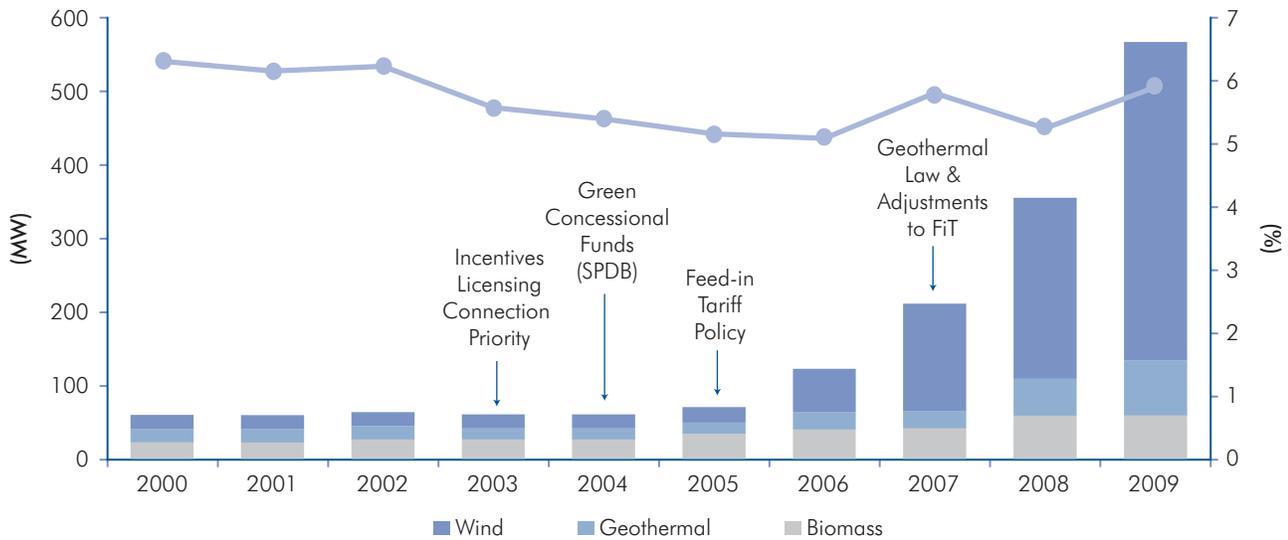
<sup>25</sup> Other actions aimed at facilitating the introduction of RE include the release of a wind energy grid code.

<sup>26</sup> One issue of concern in Turkey is that RE generators must approach retail companies in addition to Discos, given the low purchase obligations imposed on Discos (on the order of 4 percent). However, unlike Discos, most retail companies have no sizeable assets in their balance sheet to guarantee the purchase.

(see Figure 12). In 2008, the Government of Sri Lanka modified the scheme to the use of 20-year SPPAs based on technology-specific FITs (with the choice of stepped or flat FITs for on-shore wind, SHP, and solid biomass). In particular, the Government of Sri Lanka has recently

committed to ambitious RE targets that will require the ramp-up of previous market growth trends. However, the new FIT levels are high—when compared to the international range—and given the legal limitations to pass incremental costs on to consumer tariffs, the fiscal

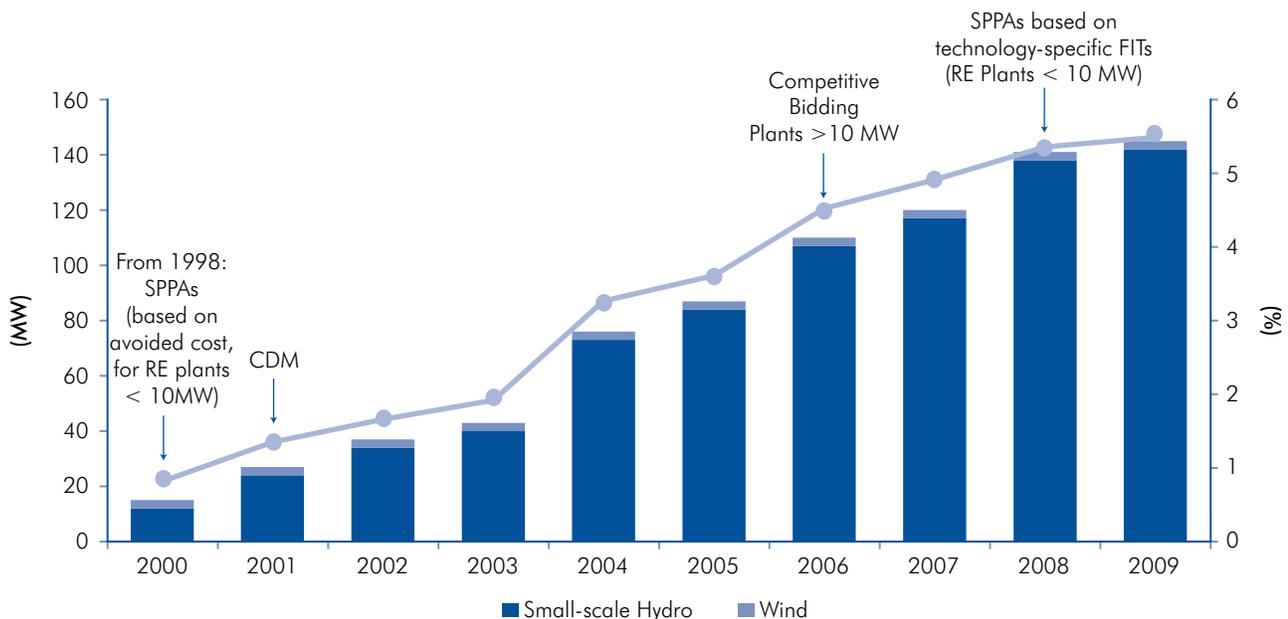
**Figure 11: Evolution of RE Capacity and Share in Power System, Turkey**



Source: TEIAS 2009; Global Wind Energy Council 2009.

Note: The graph excludes SHP to illustrate capacity additions of other types of RE. SHP accounted for 2,000 MW at the end of 2009 (including a net addition of 335 MW during the period 2002–09). The line representing the share of RE in the system includes SHP.

**Figure 12: Evolution of RE Capacity and Share in Power System, Sri Lanka**



Source: Central Bank of Sri Lanka 2010.

sustainability of the scheme may prove a limiting factor to RE deployment.<sup>27</sup>

### Indonesia and Nicaragua

By contrast, Indonesia has not been able to develop its RE market consistently or sustainably (as shown in Figure 13). In this country, SPPAs were offered from 1993, but it was not until after 2002 that they actually started to attract investments. This has been largely attributed to contextual factors (such as the effect of the Asian financial crisis and governance issues, among others).

In practice, the use of SPPAs based on tariffs levels below avoided costs of power generation has been largely unsuccessful. Also, although competitive biddings (with a tariff ceiling) have been recently allowed for geothermal capacity, the existing concessions have been so far negotiated directly.

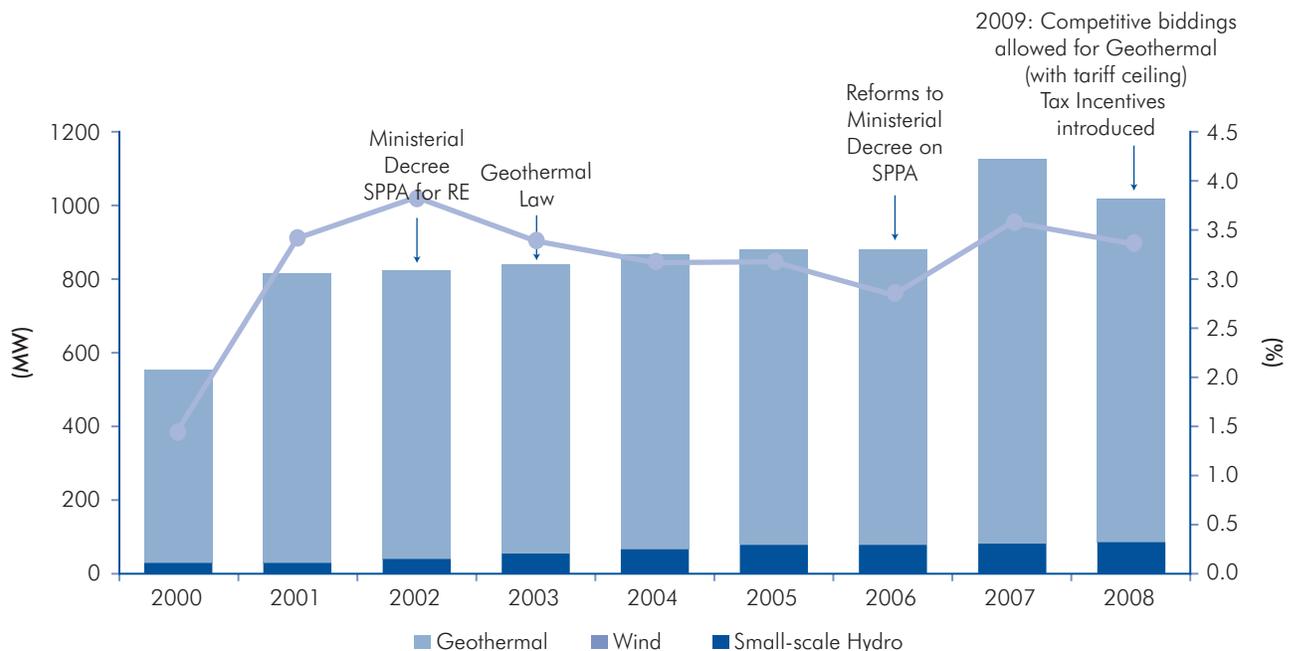
Three issues affect the scale-up of RE in Indonesia: (a) high levels of regulatory uncertainty in the power

sector; (b) lowering avoided costs of power generation, especially in the islands that have switched from oil- to coal-based generation (and thus the existing policy is becoming even more ineffective); and (c) lack of clarity as to how the government will cover incremental costs (there is a high off-take risk).

In Nicaragua, the FITP has also been largely ineffective. Yet, the system is fairly small in terms of installed capacity (about 974 MW as of 2009) and thus, RE capacity additions represent a high share of total system's capacity.

Nicaragua introduced its first FITP in 2002 through Presidential Decree 279 to stimulate the addition of SHP and wind-based generation. However, the policy had no effect on either SHP or wind-based capacity additions. With the enactment of the Renewable Energy Promotion Law in 2005, the Government of Nicaragua then introduced a second FIT scheme (successively adjusted in 2007 and 2009). However, the scheme did not lead to new investments in RE either (except perhaps for a 1 MW SHP facility added in 2007) (see Figure 14).<sup>28</sup>

**Figure 13: Evolution of RE Capacity and Share in Power System, Indonesia**

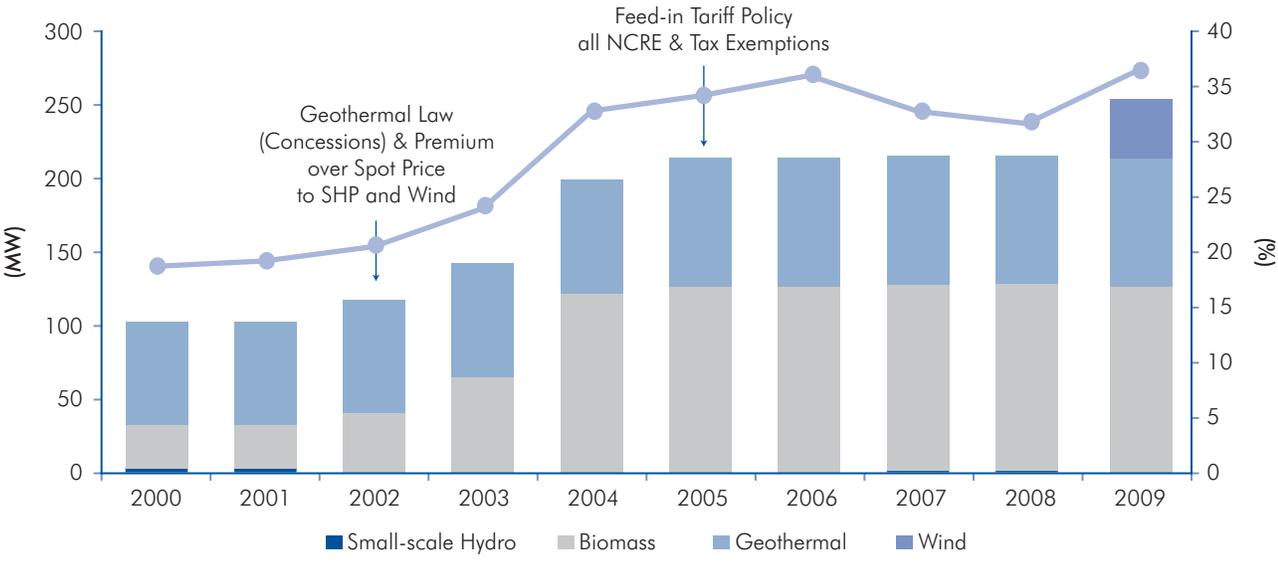


Source: Ministry of Energy and Mineral Resources Indonesia 2008.

<sup>27</sup> Today, the invoices from the Ceylon Electricity Board (CEB, the largest vertically integrated utility in the country) to cover the incremental cost of RE capacity introduced under the new FITP are accumulating at the Sustainable Energy Authority (SEA), which has no ability to pay. Incremental costs are estimated to reach US\$116 million by 2015 (Meier 2010).

<sup>28</sup> Neither was the introduction of a 40 MW wind-based generating plant in 2009 triggered by the FITP; rather, it was the result of a direct single-source contracting in which the negotiated price was set above the FIT established in the regulation.

**Figure 14: Evolution of RE Capacity and Share in Power System, Nicaragua**



Source: CEPAL 2009.

The lack of investments in RE despite the existence of an FITP—and other fiscal incentives—in Nicaragua has been attributed to a number of factors: (a) a generalized legal and regulatory uncertainty; (b) the lack of a critical water rights law; (c) the existence of legislation that converted geothermal resource-rich areas into national parks; and (d) lack of clarity in the design of the FITP of 2002 (the pricing formula was not clearly defined in the regulation) (Mostert 2007, 2009).

In the sample countries, as indicated before, RE policy—or its adjustments—has been streamlined primarily through legal frameworks associated with the reform and the liberalization of their power sectors (Brazil, India, Turkey) or through legal provisions specifically addressing security of supply concerns (Indonesia, Nicaragua, Sri Lanka, and Turkey), or both.

**Alignment of Exhibited Trends in RE Deployment to Future Committed Targets**

Figure 15 depicts the evolution of average annual growth (AAG, MW/year) for RE in the four sample countries that have a formal target on RE today. In the case of India, the country has experienced sustained growth through the 9<sup>th</sup> (1997–2001), 10<sup>th</sup> (2002–06),

and 11<sup>th</sup> (2007–12) five-year plans. However, to reach its target on RE (54 GW by 2022), India will have to almost double its present AAG.<sup>29</sup> This is even more acute in Indonesia, Sri Lanka, and Turkey, which will have to ramp up their efforts considerably if they are to attain the targets they are committed to (increasing their AAGs by 3-, 7-, and 12-fold, respectively).

**Economic Efficiency of RE Policy in Sample Countries**

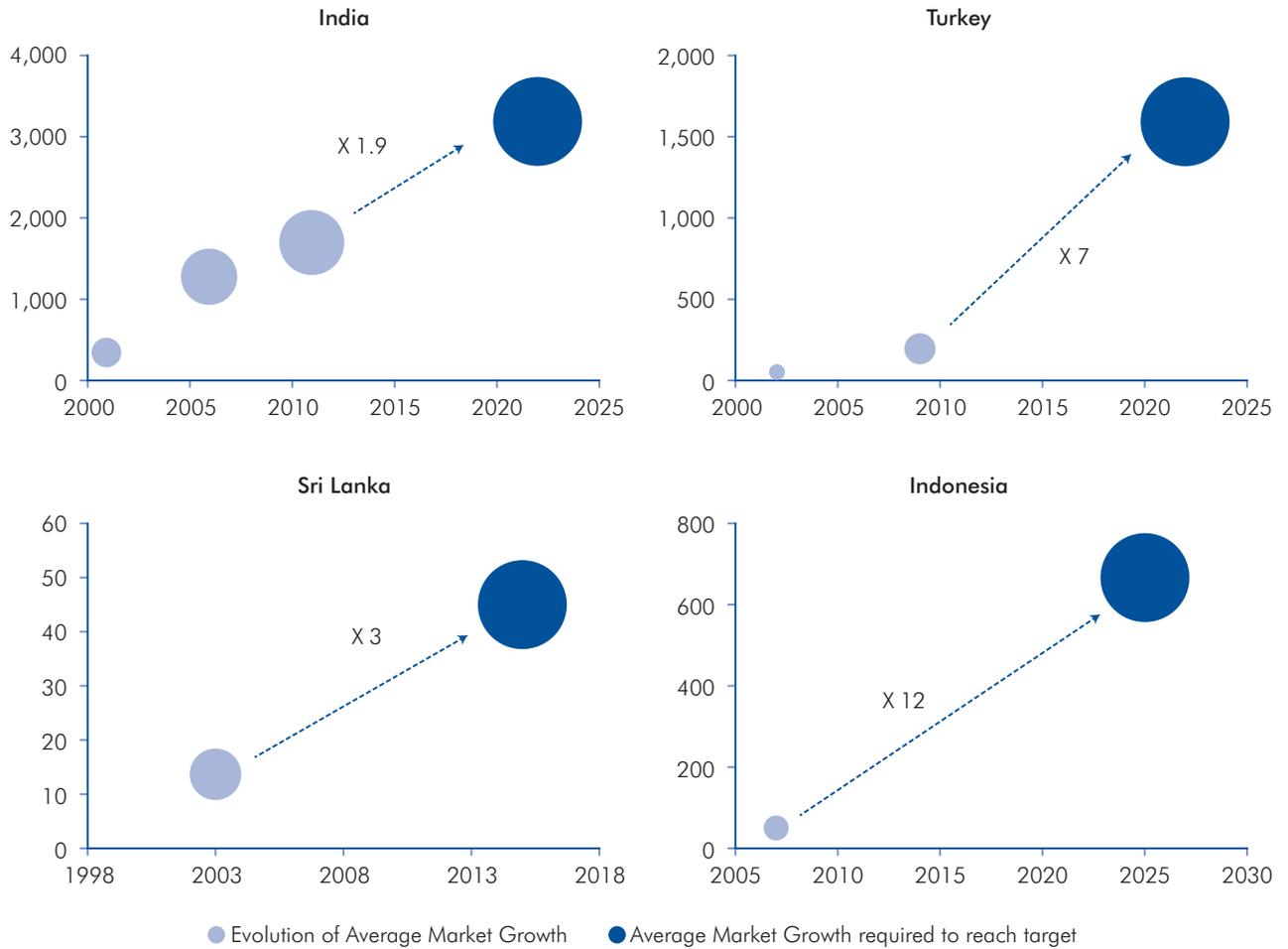
This section provides a general discussion of the costs and impacts of RE policy, the implications of policy design on efficiency, and the sustainability of cost recovery mechanisms.

**Costs and Impacts of RE Policy**

There is a general lack of analytical work that would provide estimates on the subsidy volume required to reach the targets committed on RE across developing countries, and/or on the impact of RE supporting policies on consumer tariffs or fiscal accounts. An indication of the subsidy volume required to cover the incremental costs associated with RE additions in relation to targets has been found for India and Sri Lanka (as shown in Table 8).

<sup>29</sup> The extent to which India will be able to maintain this sustained growth will be challenged by the existence of sites with good resource potential (in the case of wind) and the actual installation of solar-based projects.

**Figure 15: Evolution of AAG vis-à-vis AAG Required for Reaching Targets for All RE**



Note: Average annual growth (AAG) is in MW per year.

**Table 8: Subsidy Required for Meeting RE Targets, India and Sri Lanka**

Country	Expansion Scenarios	Target		Subsidy Required (incremental cost)	
		Volume	Year	Total	Per Year
India	Scenario 1: Diversified Mix (all types of NCRE)	45 GW	2020	USD 68 Billion	USD 6.8 Billion
	Scenario 2: Only Wind and SHP (least cost)	45 GW	2020	USD 12 Billion	USD 1.2 Billion
Sri Lanka	Diversified Mix (SHP, Wind, Biomass)	366 MW	2015	USD 116 Million	USD 23.2 Million
		851 MW	2025	USD 258 Million	USD 17.2 Million

Sources: ESMAP 2010, Meier 2010.

In the case of Sri Lanka, the FIT subsidy could have an important impact on consumer tariffs if the incremental costs were passed through to electricity tariffs, as shown in Figure 16.

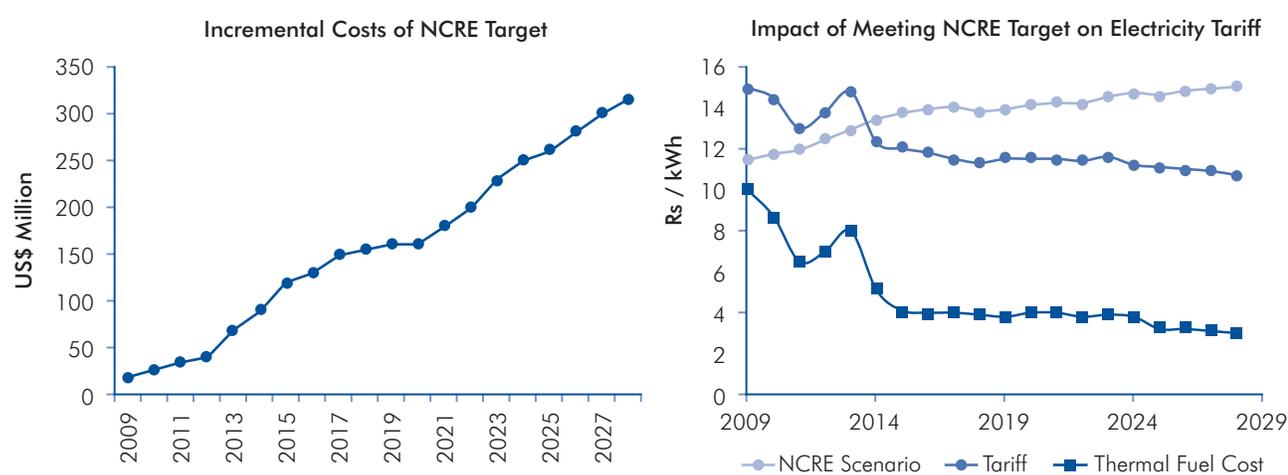
In Brazil, as shown earlier in Table 7, the total annual cost originating from RE generation triggered by both PROINFA and auctions is estimated at US\$1.38 billion per year and US\$911 million per year, respectively. The impact on consumer tariffs today, however, is

negligible, given the size of the market (that is, 1.35 percent from PROINFA and 0.6 percent from auctioned RE capacity).

### Economic Efficiency in Policy Design

Although the scope of this review did not include an assessment of the economic efficiency associated with the policy mix of sample countries, a few observations on efficiency were made during the course of the review.

**Figure 16: Estimated Cost and Impact of Meeting RE Target, Sri Lanka**



Source: Meier, 2010

**Table 9: Incremental Cost Recovery Mechanisms**

Incremental Cost Recovery	IN	BR	TK	INDO	NI	SRL
<b>Pass-Through to Consumer Tariff</b>						
Equal Burden Sharing		●	●			
Differentiated Burden Sharing		●			●	
<b>Fiscal Transfer &amp; Other</b>						
Fiscal Transfer (national/central or state level)	●			●		●
Utility Revenue	●					
CDM Revenues	●					●
Grants						

IN = India, SRL = Sri Lanka, BR = Brazil, INDO = Indonesia, NI = Nicaragua, CHI = China, TK = Turkey

First, FITs designed to minimize producers' inframarginal rents and the overall costs of FIT subsidies are only being used in India and Sri Lanka (that is, technology-specific stepped FITs and/or FITs with degression rates).<sup>30</sup> In Sri Lanka, however, as shown earlier in Figure 5, the initial value of FITs for on-shore wind has been set at very high levels (the remuneration level is one of the highest in the world).

In India on the other hand, despite the efforts in designing and introducing FITs that encourage economic efficiency, other factors seem to have significantly affected the overall economic efficiency of FITPs and RE development (especially in wind): (a) the lack of consistency across state FITPs seem to have driven investments to the states with the most attractive policies, as opposed to the areas with the best resource potential (thus, the expansion has not necessarily been least-cost); and (b) the provision of accelerated depreciation, together with the FIT, has induced the installation of wind-based plants with low operational efficiencies (as discussed previously). Thus, the actual design features of the FITPs are not sufficient to ensure an economically efficient expansion of RE generating capacity.

Second, Brazil, India, Indonesia, Sri Lanka, and Turkey use competitive mechanisms to procure RE development (as shown in Figure 3). In this case, competition is expected to induce the least-cost installation of RE (that is, for one or all types of RE, depending on the policy and procurement rules).

In particular, the auction mechanism used in Brazil to add RE capacity has already delivered an efficient

outcome (projects have been awarded based on lowest price, and the prices delivered are in the lower bound when compared to international levels), although its effectiveness in project completion rate is yet to be seen (in general, there is a high deployment risk associated with auctions in RE).

### Sustainability of Incremental Cost Recovery Mechanisms

Brazil, Nicaragua, and Turkey allow the pass-through of incremental costs associated with RE generation to consumer tariffs, while India, Indonesia, and Sri Lanka transfer fiscal resources to utilities to cover these costs (see Table 9). In the case of India, other contributing sources are carbon revenues (CDM proceedings should be shared between the developers and the consumers for the case of solar initiatives) and utility revenues (which indeed are expected to partially cover the costs of FITPs). In Brazil, depending on the type of auction, incremental costs are passed through to either regulated users (technology specific auctions) or both regulated and nonregulated consumers (reserve energy auctions) as a fixed charge or uplift.

In Sri Lanka, the 2006 Energy Strategy proposed the establishment of a fund to be supported through "an energy cess, grants received from donors, well wishers and CDM revenues." As of today, however, the fund has not been established.

In practice, the success or failure of RE policy is largely dependent on the sustainability of proposed mechanisms for the recovery of incremental costs.

<sup>30</sup> In 2009, a new FITP that included technology-specific FITs with two-step degression rates, was proposed in Turkey. However, the proposal was rejected and instead the government approved technology-specific flat tariffs with characteristically low levels in December 2010 (as shown in Figure 5 before).

## 6. POLICY TRENDS AND MARKET STRUCTURE

The section briefly discusses the links and compatibility between market structure and types of policy instruments, procurement methods, and policy performance.

### **Market Structure and Types of Policy Instruments**

The review did not find any relevant association between the type of market structure and the type of RE policy instruments being applied in the sample countries.

However, there seems to be a distinction between large and medium-size countries (that is, gross national income and size of power sector) in the diversity of instruments included in the policy package. For instance, Brazil, India, and Turkey are using a more diverse set of mechanisms to advance RE than Indonesia, Nicaragua, and Sri Lanka (as shown in Appendix 2). Also, BRIC countries Brazil and India are applying the most complex types of instruments (complex FIT design, REC market, and auctions).

### **Market Structure and Types of Procurement Methods**

Surprisingly, no links can be identified between the type of market structure and the degree of competition in the RE market. In Nicaragua and Turkey (markets in transition to full liberalization), as well as in India (single purchaser), the bulk of RE supply has been contracted through direct single-source procurement. In Nicaragua, however, although FITPs have been designed as a function of wholesale electricity price, they have been largely ineffective, considering the size of the market and its vulnerability to oil price shocks.

In Turkey, RE developers are allowed to sell directly in the wholesale market, but there is a high price risk associated with this possibility in the long term, and investors have not responded to the incentive (the amendments of December 2010 to the Renewable Energy Law in Turkey introduced technology-specific, cost-based FITs).

Brazil (wholesale market with strong government control), by contrast, is now using auctions to attract investment in RE and has successfully promoted competition among developers, since auctions have attracted numerous companies and resulted in very low prices. Most recently (December 2010), India introduced auctions to deploy solar based capacity.

Both Indonesia and Sri Lanka (monopolies that allow IPP participation) are now promoting competitive solicitations to attract RE (for geothermal capacity and plants higher than 10 MW, respectively).

### **Market Structure and Policy Performance**

The review did not find any relevant association between the type of market structure and the performance of the policy mix in the sample countries.

The policy pathway to support RE seems to have been more effective in the higher-income countries (Brazil, India, and Turkey). This is also associated with other factors, such as investment climate, economic and political stability, and governance issues.

As discussed before, low RE market growth was exhibited in both Indonesia and Nicaragua for reasons related to policy or contract design in combination with other external or contextual factors (such as regional financial crises, governance issues, or regulatory uncertainty).

With regard to economic efficiency, the two countries that have explicitly tried to attract least-cost RE generation are Brazil (through auctions) and Turkey (with a low FIT set at about wholesale market levels—subsequently substituted for technology-specific flat FITs with higher levels, but still in the lower bound when compared to those offered in the sample countries).<sup>31</sup>

Both the Indian policy package and Brazil’s PROINFA are believed to have delivered RE generation at very high costs, either because of a high FIT (Brazil, as shown in Figure 5 and Table 7) or because of a low operational efficiency (India, as shown in Figure 6).<sup>32</sup> In particular, the levels of the FITP issued in Sri Lanka in

<sup>31</sup> Turkey recently (as of the end of 2010) introduced a new FIT regime, based on technology-specific fixed FITs whose level is in fact higher than the previous fixed technology-neutral FIT (that is, to increase the producer rent and hence the policy effectiveness). In the new amendments, however, RE firms are still allowed to participate in the free unregulated market.

<sup>32</sup> Of course, RE capacity additions provide additional services related to enhanced security of supply, which need to be estimated and compared to a business-as-usual scenario to formally assess economic efficiency.

2007 are among the highest in the world for on-shore wind and SHP allowing producers a higher rent given the level of other risks exhibited in the country.

### **Use of RE Policy Instruments in Different Market and System Structures**

The review suggests that FITPs can be very effective in attracting private investment for RE development in the context of markets in transition where the institutional structure and legal and regulatory frameworks are evolving, and where players are still learning and gaining experience on competition practice and rules. In this case, the FIT provides the degree of price certainty necessary to counterbalance the other set of risks (such as regulatory uncertainty or off-take risk). For instance, countries with no record of sound regulation face greater lending constraints, and the FITP plays a critical role in increasing the debt-to-equity ratio.<sup>33</sup>

However, FITP—which directly addresses price risks—can be unsuccessful when the other set of risks is too high or when unusual external factors hit the sector or the economy (such as regional financial crises; fuel price shocks that affect the financial health of the industry; and a track record of frequent or unpredictable regulatory changes, governance issues, such as corruption, and of course grid constraints).

The literature suggests that an RPS or quota system can only be implemented effectively where the electricity market is more mature: institutions are experienced, legal and regulatory frameworks and the process for amending them are strong and predictable, competition practices and rules have been established, and players are both experienced and financially strong (such as in countries with large sophisticated utilities). In other words, quota mechanisms are more appropriate for systems where price uncertainty can be accommodated, given the low level of other types of risks. As discussed in this review, none of the sample countries has implemented an RPS.

The use of auctions can also be more successful in systems where the markets are mature and relatively stable, where the rules are not evolving, and where there are a sufficient number of players and scope for market growth to achieve competition. For instance,

developed power markets with a large number of buyers and sellers in sound financial standing are generally more conducive to competition; but even in systems where competition is modest and markets are small, countries can benefit from the use of competitive auction mechanisms (Maurer and Barroso 2010). However, effective auctions require a sophisticated level of regulatory and administrative capacity as well as a robust rule of law (for example, existence of independent regulators with the oversight capacity, enforcement of contracts).

Nevertheless, auctions can be seen as a very good mechanism for FIT-level determination (for example, they help lower information asymmetries between the government and RE suppliers right from the beginning). Indeed, auctions for long-term contracts may result in the same Power Purchase Agreement (PPA) and risk allocation as that provided in FITPs.

In smaller vertically integrated power sectors, where private sector participation in RE development is more difficult to attract and where there are no balancing markets, State-owned utilities have played an anchoring role in smoothing out some of the risks through take-on contracts (for example, price volatility and intermittency risks are better addressed). This model has been successful in some countries only when the PPAs are sustainable and the off-take risks are low.

The evidence in developed countries shows that the type, complexity, and sequencing of RE policy are crucial for creating sustainable RE markets. For instance, introducing simple technology neutral FITs—although expensive—help pave the way for attracting investors and lowering uncertainties in an initial stage or before a quota mechanism is introduced. The importance of policy sequencing is also reflected in the need to introduce legal and regulatory frameworks for resource and land use, before RE policy is introduced.

The review of the experience of sample developing countries shows that the design of policy instruments aimed at creating sustainable RE markets is a dynamic process, which requires frequent adjustments and the introduction of complementary mechanisms to leverage the overall effectiveness of the policy mix. Clearly, along the way, regulators need to establish a solid track

<sup>33</sup> The effectiveness of the FITP can be enhanced if combined with partial risk guarantees or other types of financial mechanism.

record of decisions that consider and involve the various stakeholders participating in the market.

Appendix 3 of this paper provides a relative comparison of most important price and quantity setting instruments.

## 7. KEY FINDINGS

### ***Emerging Experience with Feed-in Tariff Policies***

In the sample analyzed, all countries have implemented some type of FITP. The experience with the use of FITPs can be summarized as follows.

FITPs can effectively promote the sustained deployment of RE capacity, especially when other key policy and regulatory instruments are also in place, including (a) clear rules on transmission connection and RE integration, (b) a sustainable incremental cost recovery mechanism, and (c) fiscal and financial incentives.<sup>34</sup> FITPs have been particularly effective in India and Turkey, but largely ineffective in Indonesia and Nicaragua. In all cases, the design of FITPs has required successive adjustments, either to improve policy performance (that is, lower inframarginal rents) or to adapt to new system or market conditions (for example, oil price fluctuations, decarbonization of generation mix, and market liberalization). However, policy adjustments should be controlled—perhaps through a mechanism embedded in the policy design per se—that allows stakeholders to manage the risks in order to maintain a certain level of regulatory certainty (for example, programmed reviews, thresholds on adjustments, and adjustments that affect only new projects).

Also in the countries analyzed—except for the case of Indonesia—feed-in tariffs (FITs) have evolved from simple to more sophisticated formulations (for example, as information asymmetries between policy makers and RE producers diminish). However, compliance with the renewable purchase obligations (RPOs) imposed by FITPs has been poor in systems where off-takers exhibit weak or unsustainable financial balances or where schemes have lacked penalty mechanisms or realistic escalation schedules (that is, an RPO becomes an additional burden, especially in systems where incremental costs or the subsidy per se is not passed through to consumer tariffs or where the fiscal transfer is incomplete or unsustainable).

Indeed, the effectiveness of FITPs seems to be strongly linked to the existence of fiscal and financial

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<sup>34</sup> Of course, RE policy effectiveness is also subject to the capacity of the grid to absorb renewables.

incentives. This is particularly important for developing countries where uncertainties are higher and risks are more diverse. In particular, FITPs have been less effective when the FIT design is structured as a function of wholesale electricity markets or pegged to oil prices, given that this type of preferential tariff does not provide the minimum level of certainty on revenue flows required to attract private investment. Nevertheless, the lack of policy effectiveness is also linked to other factors, including overall investment climate in the country and sector risks (off-take risks, regulatory uncertainty, governance issues), as well as other external factors (such as global or regional financial crises).

Despite the relative success of FITPs in some of the sample countries analyzed, the analysis suggests that effective FITPs have not necessarily led to efficient outcomes (that is, in overall costs and operational efficiency). Poor economic efficiency may be attributed to one or more of the following three factors: (a) use of a complex policy package that provides multiple sources of incentives (expensive policy package); (b) a driving policy mechanism that allows high producer rents (that is, poor FIT design); and (c) policy interactions that introduce unintended economic distortions (such as the use of FITPs in combination with accelerated depreciation or tax breaks in the absence of technology standards). Of course, grid access (connection) and the capacity of the system to absorb RE (integration) are critical to the delivery of green electrons.<sup>35</sup>

Expensive FITPs can have a direct impact on the poor when incremental costs are passed through to consumer tariffs, especially when there is no differentiated burden sharing.<sup>36</sup> The potential impact of FITP on poorest consumers needs to be considered and properly assessed by policy makers when designing FITPs. In this review, information on the impact of FITPs on consumer tariffs was only found for the case of Sri Lanka.

Ultimately, an FITP can only be successful if—in combination with other policy levers—it leads to the deployment of RE capacity, as well as to the sustainable and efficient delivery of green electrons.

### **Emerging Experience with Competitive Schemes**

None of the sample countries analyzed has experience with the implementation of Renewable Portfolio Standards (RPSs) or with the use of Renewable Energy Certificates (RECs). The use of RPSs has actually been less common in the developing world—with only Poland, Romania, and most recently Chile implementing this scheme.

The review, however, provides an analysis of this type of regime because India recently introduced a REC market (mainly as an equalization mechanism to improve the overall economic efficiency of RE deployment). With time, the use of RECs may become more common, especially in systems where many Discos or retail companies operate and where the potential for RE scale-up is high and distributed across a large geographic area. The review was, therefore, more focused on the experience with auctions for RE in Brazil and on the use of competitive mechanisms in other sample countries.

The experience with auctions to deploy RE in Brazil can be summarized as follows: (a) auctions have been a useful tool for ensuring the economic efficiency of RE deployment, although the resulting low prices have raised concerns as to the extent to which bid winners will be able to construct and profit from the plants (this has been the experience with RE auctions in other countries in the past, for example, the United Kingdom and China); and (b) it is possible that these low prices may be the result of speculative behavior from bidders (low correlation between capacity factors and offered prices), although low prices may also be associated with the lack of a good record of historical data on resource potential (for example, wind velocities).

The auction design and process is complex, and requires a sophisticated level of regulatory and administrative capacity. For instance, the auctions in Brazil have included a number of prerequisites to avoid speculative behavior and lower the risk of construction delays or no construction of facilities at all, but the actual

<sup>35</sup> This has been an issue of concern in the cases analyzed when the grid evacuation infrastructure is weak or when the regulations on connection and dispatch are not clear.

<sup>36</sup> These incremental costs may include not only the cost associated with the production of RE, but also the cost associated with FITPs that promote the use of local equipment manufacturing.

enforcement of project completion guarantees remains an issue of concern (for example, potential court cases, which may then discourage future private investment).

The effectiveness of auctions can be affected by other external or sector issues (such as environmental licensing as a bottleneck to the development of projects, or the multiple roles of the public sector as a planner, dispatcher, auctioneer, and power purchaser introducing potential conflicts of interest). Nevertheless, auctions can also be seen as a very good mechanism for FIT level determination (helps lower information asymmetries between policy makers and RE producers, right from the beginning).

As with FITPs, the provision of fiscal and financial incentives—as well as the existence of clear rules on transmission connection and RE integration—is crucial to the effectiveness of quota-based mechanisms. In Brazil for instance, the Brazilian Development Bank (BNDES) provides very cheap financing with long amortization periods to RE-based projects, and the regulator has designed innovative mechanisms on grid connection based on a cooperative planning approach.

In sum, auctions can deliver a very efficient outcome but their effectiveness depends on a number of other important preconditions.

As of November 2010, except for India and Nicaragua, all other countries encourage the use of competitive schemes (biddings, auctions) to procure a specific segment of the RE market (Indonesia, Sri Lanka, and Turkey), but the use of competitive schemes has been allowed only recently in these countries. Both India and Nicaragua use only direct contracting or cost-plus fixed FIT contracts for all types and scales of RE.

Concerning RE targets, except for the case of India, the analysis suggests a significant disconnection between committed quotas and historical trends, especially in Indonesia, Sri Lanka, and Turkey (these countries would have to ramp up their RE deployment rate 3-, 7-, and 12-fold, respectively, in order to reach committed targets).

### **Emerging Trends on the Use of Price and Quota-Based Mechanisms**

There is a large body of literature analyzing the experience with the use of different types of policy and

regulatory instruments to promote RE development. The leading reports concentrate mainly on the experience in Europe and the United States. In particular, a long and ongoing debate throughout the literature focuses on what policies are more effective and efficient in driving the sustainable least-cost development of RE markets.

In most recent analyses, the general consensus seems to be that FITPs are more effective at lowering investors' risks than RPS or quota instruments (that is, when considering price, volume, and balancing risks). However, some studies indicate that quota mechanisms (such as the RPS-REC scheme) can be relatively less expensive than price-based mechanisms, considering that FITP typically offers high subsidy rates.

The analysis of the recent literature shows that developed countries have not only made policy shifts to test the performance of different policy tools, but also that FITPs are being offered in combination with either auctions or RPS-REC schemes to support less mature RE technologies or small-scale RE projects (hybrid regimes).

Developing countries—especially emergent economies—have also made important policy shifts, and many are now also using both price- and quota-based instruments in parallel to support different segments of the RE market.

Future analysis should depart from the previous debate on the relative effectiveness of price- and quota-based mechanisms (in practice, this depends very much on country specific factors, institutional and administrative capacity and the types and nature of risks) and focus more on the complementarities between different types of price- and quota-based instruments, as well as on the issue of policy interactions and their effects on overall policy efficiency.

### **General Lessons of Experience**

The review suggests the following general lessons of experience.

*A tailor-made approach is necessary:* Choice of policy instruments, policy design, and complexity of the policy package (or regulatory regime) should be tailored to the actual conditions of the system in the type of market, supply or demand volume, and nature and level of risks, as well as institutional and administrative capacity.

**Policy sequencing is critical for policy effectiveness:** Policy sequencing, the existence of basic legal and regulatory preconditions, as well as institutional and administrative efficiency, are crucial to the effectiveness of RE policy. For example, legal and regulatory frameworks for grid connection and integration, resource and land use and/or the allocation of permits and rights must be in place before RE policy is introduced, and the process for granting permits should not create bottlenecks.

**Policies that successfully lead to the scale-up of renewable energy may not necessarily be efficient:** Even if the policy mix succeeds in triggering investments that achieve RE capacity targets, its overall economic efficiency (cost per unit of benefits) may be poor.

**Policy interaction and compatibility need to be considered:** The coexistence of policy instruments has the potential to result in complex interactions and unintended effects. Thus, policy makers need to assess the compatibility among policy and regulatory mechanisms or incentives—that is, their combined impact may result in inefficient outcomes. It is also vital that individual policies are coordinated with the wider set of conditions that impact the energy market in a specific setting.

**Policy and regulatory design is a dynamic process:** Developing countries have tested different types of instruments to support RE development (policy shifts) and many are now using both price and quantity setting instruments to support different segments of the RE market. In the sample countries, feed-in tariff policies (FITPs) have required successive adjustments (the challenge has been attracting private investment while at the same time minimizing inframarginal rents). However, policy adjustments should be controlled through mechanisms—perhaps embedded in the policy design per se—that allow stakeholders to manage the risks in order to maintain a certain level of regulatory certainty (for example, programmed reviews, thresholds on adjustments, and adjustments that affect only new projects).

**RE policy performance (effectiveness/efficiency) depends on a number of key factors:** Even policies

with a sound design do not result in effective and efficient development of RE if other critical aspects are not considered in parallel, including the existence of a sustainable incremental cost recovery mechanism (paid through sustainable subsidy sources or a surcharge on consumer tariffs) and the existence of transmission infrastructure capable for RE integration, as well as clear rules on transmission access and connection.

### **Final Remarks**

Ultimately, a low carbon development growth in the developing world depends on the availability of resources to finance the solutions that exhibit incremental costs.

The volume of financing resources required and the sources are an issue of great concern. While green growth in the developing world is necessary to minimize climate change impacts on a global level, other more pressing developmental priorities compete for the use of budgetary resources, concessional finance and official development assistance.

The pass-through of incremental costs to consumer tariffs is also an issue of concern, given the huge implications on affordability and potential impacts on the poor. Moreover, the use of budgetary resources—or the issuing of debt—to support RE development displace other present and future competing priorities.

For this reason, policies to support RE development should be designed and introduced in combination with strategies that clearly identify sources of finance and establish a sustainable incremental cost recovery mechanism (for example, using concessional financial flows from developed countries to leverage private financing, strengthening the performance of utilities and Discos, or allowing the partial pass-through of incremental costs to consumer tariffs with a differentiated burden sharing that protects the poor).

Without question, policy makers will have to ensure that the design of different policy mechanisms and the policy mix per se deliver RE targets with the lowest possible incremental costs and volume of subsidies.

## APPENDIX 1: TYPES OF RE POLICY MECHANISMS AND INCENTIVES

Classification	Type of Instrument/Incentive
<b>I DIRECT</b>	
Price Based Incentives	Feed-in Policies (FITs or Premiums over Spot Price)
	Other Premiums: Generation Based Incentives (GBIs), Premiums for Use of Domestic Equipment or Services
	Reduced T&D Costs
Quantity Based Incentives or Quota Obligations	Targets on RE penetration
	Renewable Portfolio Standards (RPS) in combination with Renewable Energy Certificate or Credit (REC) markets (also known as Tradable Green Certificates, TGC markets)
	RE Policy (quota) through Competitive Procurement Mechanisms (competitive biddings, auctions)
Fiscal and Financial Incentives	Tax Credits/Incentives and Fiscal Exemptions (such as accelerated depreciation)
	Grants/Capital Subsidies
	Preferential Loans and Loan Guarantees
	Carbon Financing (through CDM)
	R&D grants, loans or subsidies
Voluntary Measures	Green Tariffs
	Investment focused (shareholder/contribution programs)
<b>II INDIRECT</b>	
Pricing of Environmental Externalities	Carbon Tax
	Cap-and-Trade or Emissions Trading Schemes (ETS)
Environmental Standards	Performance Standards: penalize high emitting sources
Voluntary Measures	Voluntary agreements
Source: Adapted from Menanteau, Finon, and Lam 2003; Klein and others 2008; World Bank 2010; Fischer and Preonas 2010.	

## APPENDIX 2: POLICY PACKAGE OF SAMPLE COUNTRIES AS OF LAST REFORM (2009–10)

Instruments Deployed (1990–10)	IN	BR	TK	INDO	NI	SRL
<b>Targets</b>						
RE Targets	●	Indicative	●	●	Indicative	●
Technology Specific Targets	●		●	●		●
<b>Price Based Instruments</b>						
Feed-in Tariff/Premium	●		●		●	●
Premium for Use of Domestic Equipment	●		●			
Generation Based Incentive (GBI)	●					
Reduced Transmission Cost (wheeling price and/or connection cost)	●	●				
Net Metering/Banking	●		●			●
Carbon Market/CDM Transactions	●	●		●	●	●
<b>Quantity Based Instruments and Procurement Mechanisms</b>						
Renewable Portfolio Standard (RPS)						
REC Market	●					
Competitive Bidding/Auction	●	●	●	●		●
<b>Investment Cost Reduction/Financial Incentives</b>						
Accelerated Depreciation	●			●		
Green Funds (e.g.; soft loans, grants)	●	●	●			●
Capital Subsidy/Equity Participation	●					
100% FDI Equipment Manufacturing	●					
<b>Fiscal Incentives</b>						
Value Added Tax Exemption	●			●	●	● (1)
Income Tax Exemption /Reduction		●		●	●	
Property/Turn-Over Tax Exemption					●	
Import Duty/Customs Tax Exemption	●			●	●	●
Excise Duty Exemption	●					
Entry Tax Exemption	●					
Electricity Duty Exemption	●					
Corporate Tax Exemption (10 years)	●					
Municipal Taxes Exemption					●	
Tax on Financial Operations Exemption		●				
Corporate Tax Credit on R&D Expenses			●			
<b>Other</b>						
Prioritized Dispatch	●	●				
Specific Connection Alternative for RE		●				
Grid Code to Facilitate RE Integration	●		●			

Instruments Deployed (1990–10)	IN	BR	TK	INDO	NI	SRL
<b>Voluntary Measures and Other Market facilitation Measured</b>						
Green Power/Retail Tariff	●					
Voluntary Carbon Trading			●			
Reduced or Exempted Water Charges	●					
Biddings for the Use of Resources					●	
R&D Funds/Subsidies	●	●	●			
Single Window Clearance Systems/ Special Processing Environ Licensing	●	●				
Exempted/Reduced Licensing Fees			●			
Exempted/Reduced Land Use Fees	●		●			
IN = India, SRL = Sri Lanka, BR = Brazil, INDO = Indonesia, NI = Nicaragua, CHI = China, TK = Turkey						

## APPENDIX 3: INSTRUMENT COMPARISON

Investment Risks	Effectiveness/Efficiency	Complexity
<b>Feed in Tariff Policy (FITP)</b>		
<ul style="list-style-type: none"> <li>• Low price, volume and balancing risks</li> <li>• In spot market transactions, balancing risk may arise (this risk can be minimized introducing a “per area” mechanism)</li> <li>• Designed to create stable investment environment (although successive FITP design adjustments may decrease investors’ confidence)</li> <li>• Predictable revenue streams</li> <li>• Help increase debt financing</li> </ul>	<ul style="list-style-type: none"> <li>• Effectiveness in terms of market growth is high (subject to compliance with RPO)</li> <li>• Sophisticated FIT design can reduce inframarginal rents</li> <li>• Allows for strategic support of different types of RE</li> <li>• No incentive for cost reductions (entire supply chain)</li> <li>• Overall cost of FITP may be high (depends on FITP design and market conditions)</li> </ul>	<ul style="list-style-type: none"> <li>• In general complexity is low, but depends on type of FIT (trade-offs between simplicity and complexity)</li> <li>• Depending on design complexity, calibration may require a complex administrative process</li> </ul>
<b>RPS-REC</b>		
<ul style="list-style-type: none"> <li>• Moderate to high price risk (value of REC depends on market dynamics)</li> <li>• Moderate to high volume risks (once targets are met, suppliers do not have an incentive to purchase RE generation)</li> <li>• Balancing risk may be high (depends on market rules and support mechanisms)</li> <li>• Less predictable revenue streams require higher IRRs</li> <li>• Participation in bids may entail high transaction costs</li> <li>• More difficult to secure financing</li> </ul>	<ul style="list-style-type: none"> <li>• Effectiveness in terms of market growth depends on actual compliance with quotas (market share)</li> <li>• Market based instrument, fosters competition among RE suppliers (least-cost RE introduced first)</li> <li>• Favors mature technologies</li> </ul>	<ul style="list-style-type: none"> <li>• REC market design and the periodic setting or targets/quotas may be complex</li> <li>• REC market requires high institutional and administrative capacity</li> </ul>
<b>Competitive Procurement (Auctions, Biddings)</b>		
<ul style="list-style-type: none"> <li>• Moderate to high price risk (depends on contract design, market rules)</li> <li>• Stop-and-go nature creates uncertainty</li> <li>• Less predictable revenue streams require higher IRRs</li> <li>• Awarded contracts provide predictable revenue streams</li> <li>• Participation in bids may entail high transaction costs</li> <li>• More difficult to secure financing</li> </ul>	<ul style="list-style-type: none"> <li>• If competition is effectively fostered, delivers low prices (entire supply chain)</li> <li>• Allows for strategic support of different types of RE</li> <li>• High deployment risk (project delays or no implementation at all due to difficulties in financial closure, administrative or licensing barriers, weak rule of law or weak enforcement of contracts or project completion guarantees)</li> </ul>	<ul style="list-style-type: none"> <li>• Design of auction mechanism may be complex (depends on type of market and market conditions)</li> <li>• Requires high institutional and administrative capacity</li> <li>• Requires robust rule of law, enforcement of contracts</li> <li>• Regulatory stability is crucial (stable auction rules)</li> <li>• Requires proper design of project completion guarantees and penalties for delays and underperformance.</li> </ul>

## GLOSSARY

**Accelerated depreciation.** Refers to the accelerated amortization of fixed assets, such as plant and equipment (that is, faster recovery of capital costs and earlier tax advantages). For tax purposes, accelerated depreciation provides a way of deferring corporate income taxes by reducing taxable income in current years, in exchange for increased taxable income in future years. This is a valuable tax incentive that encourages businesses to purchase new assets.

**Additionality criterion.** Applies to projects considered under the Clean Development Mechanism (CDM). A CDM project activity is additional if anthropogenic emissions of greenhouse gases by sources are reduced below those that would have occurred in the absence of the registered CDM project activity. The baseline for a CDM project activity is the scenario that reasonably represents the anthropogenic emissions by sources of greenhouse gases that would occur in the absence of the proposed project activity (UNFCCC, 2008).

**Auction.** A selection process designed to procure (or allocate) goods and services competitively, where the award is made to a prequalified bidder and is based on a financial offer. In the most common type of auction, potential buyers bid for a product and the highest bid price wins. In most cases involving electricity auctions, the sellers, such as generators, are the ones bidding their products, since they are interested in selling power contracts to large consumers or distribution companies, with the bidding process designed in part to select the lowest price. This is the so-called “reverse auction,” where the lowest offer is the winner (Maurer and Barroso, 2010).

**Capacity payment.** A payment that compensate investors for higher capital costs arising from regulatory risk and the failure of market design to accommodate for long-term contracts with domestic consumer franchises to allow hedging of investment decisions (Grubb and others, 2008). In hydropower-based systems, capacity payments are provided to help mitigate price spikes and encourage investments in flexible and backup plants (that is, peaking generation receives capacity payments to anticipate and receives a certain level of scarcity rents over time).

**Feed-in tariff (FIT).** A special tariff paid to renewable energy generators. The payment levels for each kilowatt-

hour can be differentiated by technology type, project size, resource quality, and project location to reflect actual project costs better. FITs are categorized as fixed tariffs or premiums. Fixed FITs are paid to generators as guaranteed remuneration independent from the electricity market price (different types include stepped tariffs, tariffs with degression rates, and flat tariffs). Premiums are paid to renewable energy generators on top of the electricity market price; for this reason, they are considered a market-based support instrument.

**Feed-in tariff policy (FITP).** An energy supply policy focused on supporting the development of renewable energy projects by offering three key provisions: (a) guaranteed access to the grid; (b) stable long-term purchase agreements or an arrangement that ensures a stable revenue stream for a prespecified period (for example, in multiple-buyer power markets, renewable energy suppliers are paid a preferential tariff or premium for a prespecified number of years from the market operator; in this case the market operator imposes a surcharge on consumer tariffs to cover the incremental cost); and (c) payment levels, usually above market price, based on the cost of renewable energy generation (that is, a feed-in tariff). FITPs also typically mandate a renewables purchase obligation (RPO) on utilities or retail companies (for example, in the form of market share or minimum percent of electricity purchase from RE suppliers).

**Firm Energy Certificate (FEC).** In the Brazilian regulation, a FEC is a certificate (denominated in GWh/year) for the maximum amount of energy that a power plant can sell annually through contracts. Any shortfall is penalized at a price mirroring the cost of new energy (Barroso, 2010).

**Clean Development Mechanism (CDM).** A mechanism established by Article 12 of the Kyoto Protocol for project-based emissions reduction activities in developing countries. The CDM allows emissions emission reduction (or emissions removal) projects in developing countries to earn certified emissions reductions (CERs), each equivalent to one tone of carbon dioxide. These CERs can be traded and sold, and used by industrialized countries to meet a part of their emissions reduction targets under the Kyoto Protocol (UNFCCC, 2010).

**Generation-based incentive (GBI).** A premium paid over the FIT or electricity price to shift the incentive

from renewable energy installations (MW) to production (GWh). By rewarding the actual generation, GBIs encourage the higher output efficiency of renewable energy plants.

**Price-setting policies.** Price-setting policies reduce cost and pricing-related barriers by establishing favorable price regimes for renewable energy relative to other sources of power generation. The most common price-based policy is known as FITP (World Bank 2008).

**Quantity-setting policies.** Quota-based or quantity-setting mechanisms (also known as market share policies) mandate the introduction of a certain percentage or absolute quantity of RE capacity or generation at unspecified prices. The government sets a target and lets the market determine the price. The most common quota-based mechanisms for promoting RE deployment are the RPS and auctions (World Bank 2008).

**Renewable Energy Certificate (REC).** Represents renewable and environmental attributes associated with energy production. For instance, a REC—for California RPS purposes—is a certificate of proof, issued through the appropriate accounting system, that one unit of electricity was generated and delivered by an eligible renewable energy source. A REC includes all renewable and environmental attributes associated with the production of electricity from the eligible energy resource, except for emissions reduction credits. RECs can be used not only as a unit of account for compliance purposes, but they can also be traded separately from the energy produced. RECs are also known as Tradable Green Certificates (TGCs).

**REC market.** A platform or legal framework for the trading of RECs. The use of RECs has emerged as a market-based tool to facilitate compliance with

purchase obligations under the RPS mechanism. The obligated entities under the standard (utilities, retail suppliers) can either own generating capacity or buy RECs. Suppliers can also exercise a “buy-out” option by paying a fixed penalty, which theoretically caps the price of credits.

**Renewable Portfolio Standard (RPS).** A quota-based policy that mandates that electricity suppliers source a given proportion or share of their electricity from renewable energy. An RPS can be phased, with incrementally increasing targets, over a number of years. Assuming there is sufficient capacity to meet the requirement, and assuming ideal operation of the market, eligible renewable generating sources will “stack themselves” into a merit order of increasing cost of generation. These sources then compete to supply renewable electricity to meet market demand, which is determined by the policy target or quota. Typically, generators of eligible electricity receive a Renewable Energy Certificate or Credit (REC, also known as Tradable Green Certificates or TGCs), an official record certifying that a specified amount of renewable electricity has been generated (Grubb and others, 2008).

**Renewable purchase obligation (RPO).** An obligation imposed on utilities or retail companies to source a given proportion or share of their electricity from renewable energy. In this case, the RPO is a component of the FITP.

**Standardized Power Purchase Agreement (SPPA).** A legally binding standardized contractual agreement by which an entity, such as single buyer or a distribution company, undertakes to purchase the power generated by an independent or affiliated small-scale renewable energy power producer under specified terms for a multiyear period.

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