Asian and Pacific Centre for Transfer of Technology

DESK STUDY REPORT

"Policies to Promote Renewable Energy Technologies (RETs) in the Asia-Pacific Region"

July 2012

Disclaimer

This report was prepared by Mr. G.M. Pillai, Founder Director General, World Institute of Sustainable Energy (WISE), Pune, India under a consultancy assignment from the Asian and Pacific Centre for Transfer of Technology (APCTT) of the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP). The views expressed in this report are those of the author and do not necessarily reflect the views of the Secretariat of the United Nations Economic and Social Commission for Asia and the Pacific. The report is currently being updated and revised. The information presented in this report has not been formally edited. The description and classification of countries and territories used, and the arrangements of the material, do not imply the expression of any opinion whatsoever on the part of the Secretariat concerning the legal status of any country, territory, city or area, of its authorities, concerning the delineation of its frontiers or boundaries, or regarding its economic system or degree of development. Designations such as „developed", „industrialized" and „developing" are intended for convenience and do not necessarily express a judgment about the stage reached by a particular country or area in the development process. Mention of firm names, commercial products and/or technologies does not imply the endorsement of the United Nations Economic and Social Commission for Asia and the Pacific. This report is prepared mostly by desk study through collecting reports and published information/data from related government and non-governmental institutions including electronic publication.

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Abbreviations

AU	:	Administrative Unit
CBSL	:	Central Bank of Sri Lanka
CEB	:	Ceylon Electricity Board
CEI	:	Clean Energy Initiative
CERC	:	Central Electricity Regulatory Commission
CRE	:	Centre for Renewable Energy
CRESP	:	China Renewable Energy Scale Up Program
CSP	:	Concentrating Solar Power
DDG	:	Decentralized Distributed Generation
DISCOM	:	Distribution Company
ECS	:	Electricity Consumer Society
EECA	:	Energy Efficiency and Conservation Authority
ESCO	:	Energy Service Company
ESD	:	Energy Services Delivery
ERC	:	Electricity Regulatory Commission
FIT	:	Feed-in-tariff
FITP	:	Feed-in-Tariff Policy
GEF	:	Global Environmental Facility
GoSL	:	Government of Sri Lanka
HPS	:	Husk Power Systems
ICS	:	Improved cookstoves
IDA	:	International Development Association
IMIDAP	:	Integrated Micro Hydro Development and Application Program
IREDA	:	Indian Renewable Energy Development Agency
IWM	:	Improved Water Mill
JNNSM	:	Jawaharlal Nehru National Solar Mission
KEMCO	:	Korean Energy Management Corporation
KEPCO	:	Korea Electric Power Corporation
LRET	:	Large-Scale Renewable Energy Target
MHP	:	Micro Hydro Project
MNRE	:	Ministry of New and Renewable Energy
NAPCC	:	National Action Plan on Climate Change
NDRC	:	National Development and Reforms Commission
NEPC	:	National Energy Policy Council
NGO	:	Non Government Organization
NRE	:	New and Renewable Energy
O&M	:	Operation and Maintenance
PCI	:	Participating Credit Institutions
PPA	:	Power Purchase Agreements
PPG	:	Project Preparation Grant
PV	:	Photovoltaic
RE	:	Renewable Energy
REC	:	Renewable Energy Certificates
REDP(Australia)	:	Renewable Energy Demonstration Program
REDP(China)	:	Renewable Energy Development Project
REDP(Nepal)	:	Rural Energy Development Program
RERED	:	Renewable Energy for Rural Economic Development
RESS	:	Renewable Energy Sector Support
RET	:	Renewable Energy Technology
RGGVY	:	Rajiv Gandhi Grameen Vidyutikaran Yojana
RPO	:	Renewable Portfolio Obligations
RPS	:	Renewable Portfolio Standards

SERC	:	State Electricity Regulatory Commission
SGP	:	Small Grants Program
SHP	:	Small Hydro Power
SHS	:	Solar Home System
SHT	:	Small Hydro Technology
SME	:	Small and Medium Enterprises
SMP	:	System Marginal Price
SPPA	:	Standardized Power Purchase Agreement
SPV	:	Solar Photovoltaic
SRES	:	Small-Scale Renewable Energy Scheme
STC	:	Small-Scale Technology Certificate
SWH	:	Solar Water Heater
VHP	:	Village Hydro Projects

Currencies

AUD	:	Australian Dollar
Baht	:	Thai Baht
Rs.	:	Indian Rupee
IDR	:	Indonesian Rupiah
KRW	:	South Korean Won
LKR	:	Sri Lankan Rupee
NPR	:	Nepalese Rupee
NZD	:	New Zealand Dollar
RMB	:	Chinese Renminbi
USD	:	US Dollar
Yen(￥)	:	Japanese Yen

Chapter 1

Renewable Energy Development 2012 Global and Asia-Pacific Scenarios

1.1 Global Growth of Renewable Energy

Renewable Energy has been growing at rapid rates in the recent past. This growth has mainly been triggered by concerns of climate change, projected depletion of fossil fuels and consequent need for energy security. Another major reason is the need for energy access to millions of people-mostly in developing countries-who have been deprived of this vital economic input. According to latest estimates, renewable energy supplied an estimated 16.7% of energy consumption in 2010. Out of this, 8.2% came from modern renewables comprising wind power, solar energy, geothermal energy, hydropower, biomass- based power generation and biofuels. The balance 8.5% of global energy was supplied by traditional biomass.[2] (Fig 1.1)

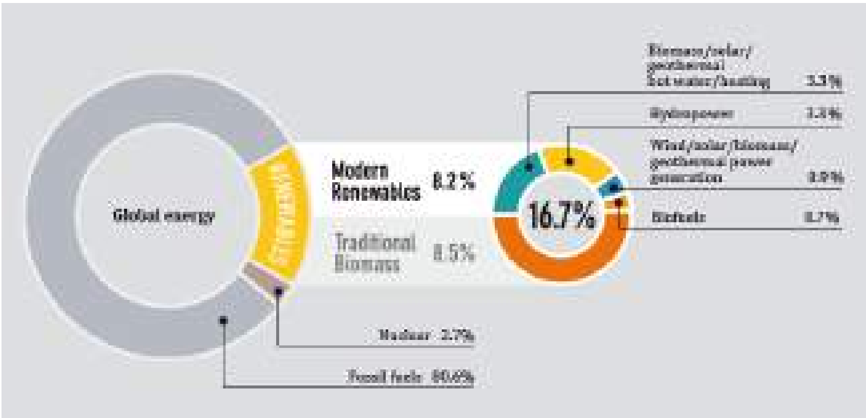

Fig 1.1: Renewable Energy Share of Global Final Energy Consumption, 2010

(Source–Renewables 2012, REN 21)

In 2011, renewables contributed 20.3% of global electricity consumption, with hydropower accounting for 15.3% and other renewables 5% (Fig 1.2). By the end of 2011, total global power generating capacity was 5360 GW. Out of this, total renewable power capacity worldwide exceeded 1,360 GW in 2011, which is an increase of 8% from 2010. If only non-hydro renewables are considered, the installed capacity in 2011 grew to 390 GW, a 24% increase over 2010. Wind power accounted for 40% and solar accounted for 30% of new renewable capacity, followed by hydropower at nearly 25%.

Out of the estimated 208 GW of new electricity capacity installed globally in 2011, almost half of came from renewables. The share of renewables in global generating capacity more than doubled during the period 2004 to 2011.

The top seven countries in non-hydropower renewable power capacity were China, United States, Germany, Spain, Italy, India and Japan-in that order. However, on a per-capita basis, Germany had the highest non-hydropower capacity followed by Spain, Italy, the United States, Japan, China and India.

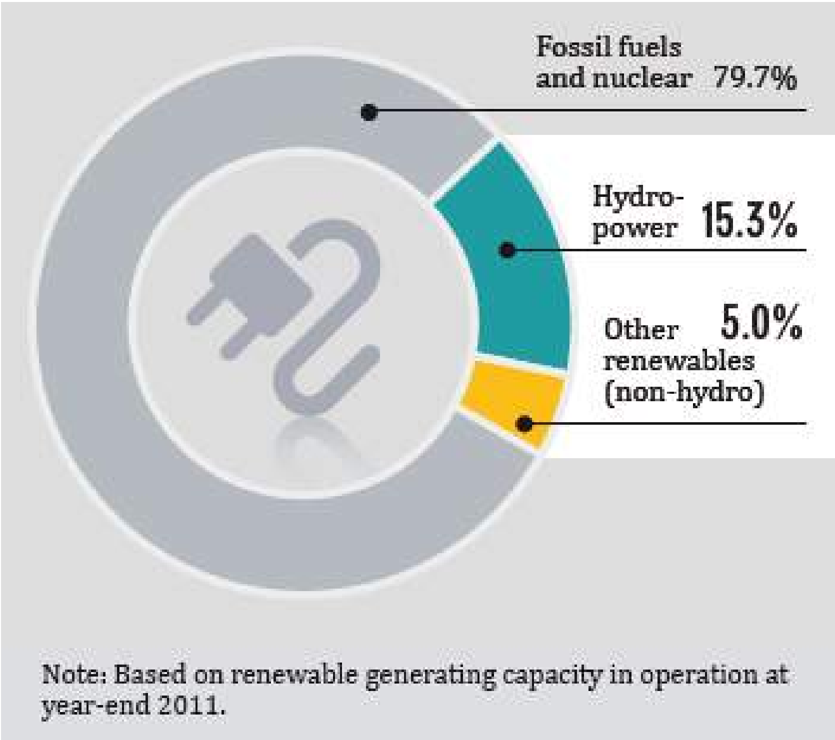

Fig 1.2: Estimated Renewable Energy Share of Global Electricity Production, 2011

(Source: Renewables 2012, REN 21)

In terms of capacity additions, the leading technologies among non-hydro renewables are wind and solar power. The fastest growing technology is solar PV which registered an average annual growth rate of 58% between 2006-2011. During the same period, concentrated solar thermal power (CSP) registered the second largest growth at 37%, though from a smaller base. Wind power grew at an average annual rate of 26% (See Fig 1.3 below). A significant feature of the market expansion is the shift towards developing countries. While China and India played an increasingly significant role, new players emerged around the world, in Asia, Latin America, Middle East and North African region.

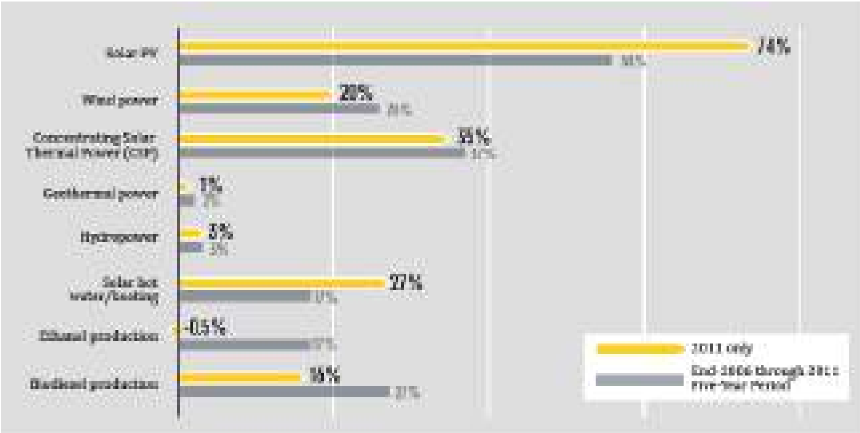

Fig.1.3 Average Annual Growth Rates of Renewable Energy Capacity and Biofuels Production, 2006-2011

(Source: Renewables 2012, REN 21)

In tune with the gradual shifting of the market to developing countries, there were positive improvements in providing energy access to rural people in these countries using modern renewable energy technologies (RET). According to the International Energy Agency (IEA), there was marked improvement in the number of rural people without access to electricity. In 2010, there were 1.5 billion such people, which came down to 1.3 billion in 2011. The IEA also reports a similar reduction in people using traditional cook stoves or open fires for cooking.

1.2 Renewable Energy in the Asia-Pacific

Among the Asia-Pacific countries, at least two Asian countries viz China and India are among the top five in terms of renewable power installation worldwide. China's success story is phenomenal and major developments happened after the enactment of the Renewable Energy law in 2006. India has also a long history of renewables' development dating back to two decades and has an exclusive ministry at the federal level-Ministry of New and Renewable Energy (MNRE) for development of the sector. Other Asia-Pacific countries like Japan, Philippines, Bangladesh, Australia, Indonesia, Thailand etc., are also in the process of putting together effective policy frameworks for renewable energy development. A recent report on the Asian Energy Outlook says "the developments in the Philippines and Bangladesh are pointers to the growing perception of the potential benefits of renewable energy across Asia. Both countries suffer frequent energy blackouts, are experiencing rapid growth in energy demand and import a substantial amount of their energy needs. In this context, renewable energy offers a way of meeting the burgeoning growth in energy requirements, while at the same time bolstering energy security."

The Asia-Pacific region has an interesting mosaic of developed countries like Australia, New Zealand, Japan, South Korea, fast developing countries like China, India, Malaysia, Thailand, Philippines, and less developed countries like Bangladesh, Nepal and Sri Lanka. So the resource base, socio-economic patterns and structures, and consequently energy generation profiles also differ widely. An analysis of some of the leading countries (See Table 1.1) shows that while many have set percentage targets and time-frames for their achievement, some still have only ad-hoc development plans. The stage of development and effectiveness also differs widely, with many countries having realized the need for comprehensive policies only in the recent past. There is tremendous scope for exchange of knowledge and learning within the Asia-Pacific region.

China and India from the region have been part of the top five global RET investment destinations in the past. In fact, about 87% of the investments in 2011 were in United States, China, India, Brazil and Europe. Out of the 13% investment that happened outside these regions, Asia-Oceania (outside China and India) got investment of USD 19.5 billion. Asia-Oceania was the only region to show growth during 2011, at 5%. However, China with USD 52 billion (up 17% from 2010), and India with USD 12 billion (up 62% from 2010) topped the investment charts in the region in 2011.

The RE technology with the largest installed capacity in the Asia-Pacific is again wind power. Many countries in the region have huge unexplored potential of this resource. Certainly China and India have the largest potentials, considering their large land area. But even smaller countries like Philippines and Sri Lanka have huge potential, quite disproportionate to their land mark or local absorption capacity. That creates a new opportunity for inter-country transfer of wind power through creation of regional grids.

However, technology pedigree is not strong in developed countries of the region like Australia, Japan, South Korea, etc. China is fast catching up with R&D and technology adaptation, whereas most countries still depend on technology imports from Europe or United States. The manufacturing base of RETs is also growing in the region, in proportion to market growth. Again, the developed countries in the region have long-established manufacturing capabilities, whereas other countries are trying to catch up.[1]

Table 1.1: Targets and Share of Renewables (Selected Asia-Pacific Countries)[2]

Country and Targets*	Sector	Break up of Renewable Energy Targets	Achievement in terms of Electricity Production (Total RE)‡
Australia 20% by 2020			8.7%
Bangladesh	Solar	500 MW by 2015	–
	Rural off-grid solar	2.5 million units by 2015	
5% by 2015 10% by 2020	Biomass	2 MW biomass electricity plant by 2014	
	Biogas	4 MW biogas electricity plant by 2014	
	Biodigesters	150,000 installed by 2016	
China† 15% by 2020	Wind	100 GW on-grid by 2015; 5 GW offshore by 2015 and 30 GW offshore by 2020	16.2%
	Solar	15 GW by 2015 (1 GW CSP)	
	Hydro	284 GW by 2015	
	Biofuels	5 million tonnes of ethanol fuel used between 2011 and 2015	
India	Renewables in general	3.5 GW new renewables 2011-12	9.9%
15% by 2020	Wind	9,000 MW by 2012	
	Solar	20 GW grid-connected solar by 2022; 2,000 MW off-grid by 2020; 20 million solar lighting systems by 2022; 14 GWth (20 million m^2) solar thermal collector area by 2022.	
Indonesia 25% by 2025††	Wind, solar, hydro	1.4% share (combined) by 2025	13.2%
	Wind	0.1 GW by 2025	
	Solar PV	156.76 MW by 2025	
	Hydro	2 GW, including 0.43 GW micro hydro, by 2025	
	Geothermal	6.3% share in primary energy and 12.6 GW electricity by 2025	
	Biofuel	10.2% share in primary energy by 2025	
Japan 10% by 2020†††	Wind	5 GW by 2020	3.5%
	Solar PV	28 GW by 2020	
	Hydro	49 GW by 2020	
	Geothermal	0.53 GW by 2020	
	Biomass	3.3 GW by 2020	
Malaysia 10% No Target date	Electricity	2,065 MW (excluding large hydro), 11.2 TWh, or 10% of national supply; 6% capacity and 5% generation by 2015; 11% capacity and 9% generation by 2020; 14% capacity and 11% generation by 2030; 36% capacity and 15% generation by 2050.	–

Policies to Promote RET in the Asia-Pacific Region

Country & Targets*	Sector	Break up of Renewable Energy Targets	Achievement (Total RE)‡
Nepal No Targets	Wind	1 MW by 2013	-
	Solar	3 MW by 2013	
	Micro hydro	15 MW by 2013	
New Zealand 90% by 2025	-	-	73%
Philippines 40% by 2020	Renewables in general	Triple 2010 renewable power capacity by 2030	26.3%
	Wind	2,378 MW by 2030	
	Solar	285 MW by 2030	
	Hydro	8,724.1 MW by 2030	
	Geothermal	3,461 MW by 2030	
	Biomass	315.7 MW by 2030	
	Ocean	70.5 MW by 2030	
South Korea††† 6.1% by 2020	Renewables in general	13,016 GWh (2.9%) by 2015; 21,977 GWh (4.7%) by 2020; 39,517 GWh (7.7%) by 2030.	1.9%
	Solar thermal	2,046 GWh by 2030	
	Solar PV	1,971 GWh by 2030	
	Wind	16,619 GWh by 2030	
	Small hydro	1,926 GWh by 2030	
	Forest biomass	2,628 GWh by 2030	
	Biogas	161 GWh by 2030	
	Geothermal	2,803 GWh by 2030	
	Ocean	6,159 GWh by 2030	
	Large hydro	3,860 GWh by 2030	
Sri Lanka 20% by 2020	Biofuels	20% supply by 2020	-
	Non-traditional renewables	10% of power generation by 2015	
Thailand 14% by 2022	Wind	1,200 MW by 2022	5.6%
	Solar	2,000 MW by 2022	
	Hydro	1,608 MW by 2022	
	Biomass	3,630 MW by 2022	
	Biogas	600 MW by 2022	
	MSW	160 MW by 2022	
	New energy	3 MW by 2022	

(Source: Renewables 2012: Global Status Report REN 21)

* Targets are specified in terms of electricity production for all countries except China, Indonesia, Japan and South Korea.
†China's country targets specified in first column above are set in terms of Final Energy.
††Indonesia's targets are in terms of utilization of renewable energy.
†††Japan and South Korea's targets are set in terms of Primary Energy.
‡Shares of renewables in electricity production as on 2010 for all countries except China. For China the share of renewables in electricity production is as on 2009.

1.3 The Background of this study

This report was prepared by G M Pillai, Founder Director General, World Institute of Sustainable Energy (WISE), Pune, India as a consultant to the project being implemented by the Asian and Pacific Centre for Transfer of Technology (APCTT) of Economic and Social Commission for Asia and the Pacific (ESCAP) "to establish an institutional cooperation mechanism for strengthening capacity of member countries to promote the utilization of renewable energy resources to meet their energy needs and foster sustainable development." As per the Terms of Reference of the work, the report is expected to review the policies (supported by case studies) adopted in ten leading countries of the Asia-Pacific region to promote both grid-connected and off-grid renewable energy technologies (especially with reference to decentralized standalone hybrid systems for rural and remote areas). After discussions with and approval of APCTT, ten countries from the region as listed below were selected for the study.

1	Australia	6	Nepal
2	China	7	South Korea
3	India	8	Sri Lanka
4	Indonesia	9	New Zealand
5	Japan	10	Thailand

Of the chosen set of countries, developed countries like Australia and New Zealand have enough physical and financial resources to fulfill their energy requirements. However, in these countries climate mitigation has been a major motivation behind promoting renewable energy. Other developed countries like Japan and South Korea depend heavily on crude oil and other energy resources. For them energy security has been the prime mover for a shift towards renewables. Countries like China, India, Indonesia and Thailand also share the common problem of importing conventional energy resources to meet ever-increasing energy demand. They need alternative energy sources to address the problem of energy security and climate change. Besides, countries like India, China, Indonesia, Sri Lanka and Nepal have huge rural populations without access to electricity for whom decentralized generation using renewable energy technologies which are modular in nature often tend to be more viable options, with potential for fast scaling up.

Keeping in mind these varied needs, the selected countries have adopted diverse policies to promote grid-connected and off-grid stand-alone technologies. Accordingly, the emphasis in this study is on such policies, and their impacts on development and deployment of RETs. Few case studies have also been provided to demonstrate the effectiveness of adopting the policies and their applications. Overall, we have focused on modern non-hydro renewable energy. Biofuels and sustainable transport policies have not been addressed in this study.

Some major best practices from these countries, throwing light on how these policies can be adopted by the least developed nations in the region, with a special reference to landlocked countries have also been discussed in the last chapter.

References:

1. Platts Global Energy Company; Asian Energy Outlook,2012,
2. Renewable Energy Policy Network for 21st Century; Renewables 2012, Global Status Report.

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Chapter 2

Policies to Promote Renewable Energy

Successful implementation of well conceived policies appropriate to the situation prevailing in respective countries has contributed to the accelerated global growth of renewable energy in the past decade or so. Policy design and deployment has to take into account the socio-economic and cultural circumstances, competing interests, resources available in a particular country etc. Further, the effectiveness of any set of government policies depends on how well they are designed and whether they are enforced suitably.

The major objective for designing appropriate policies to promote renewable energy technologies is to remove the barriers that RETs face during their development and deployment. The policies commonly used for promotion of RETs can be classified into three major groups (Fig. 2.1).

- National Targets
- Mandated Market Policies
- Fiscal and Financial Incentives

The first two categories are normally used for facilitating the development of grid-connected RETs, whereas the third comprises incentives that support grid connected and off-grid RETs.

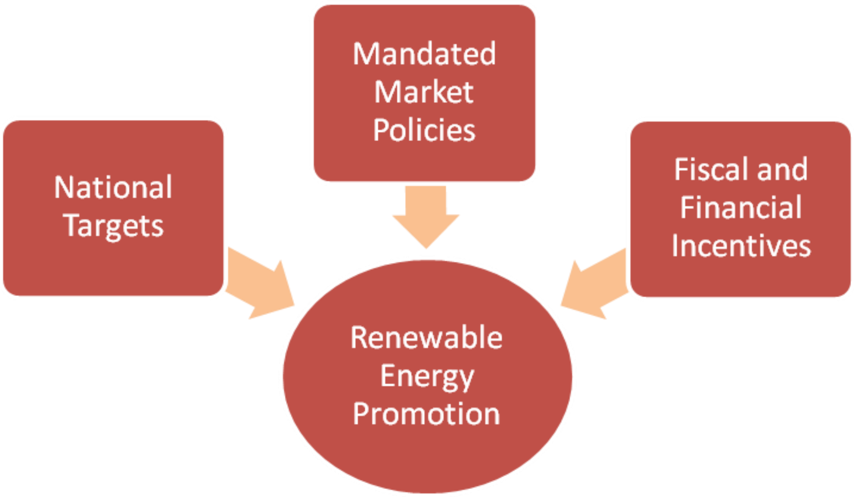

Fig. 2.1 Policy Measures Adopted for RE Promotion

The present study reviews major policies adopted by ten Asia-Pacific countries for promotion of renewable energy technologies, both grid and off-grid. In doing so, an attempt has been made to gradually build up a structure which would shed light on policy implementation, lessons learned and successful results attained by these countries.

2.1 National Targets

Almost all the selected countries have set dynamic targets for RET deployment, both long term (over a number of years) as well as short term (generally for each) dynamic targets for RET deployment. However, targets vary across countries depending on the needs and feasibility of achieving them.

The major driving forces behind setting targets have been the concerns related to reducing carbon dioxide (CO_2) emissions over a designated period, achieving energy security and providing access to energy in all (Fig. 2.2).

New Zealand has set an aggressive long-term target of generating 90% electricity from renewable sources by 2025.[24] ***Australia*** followed a Mandatory Renewable Energy Target policy through the last decade. However, recently, the Government of Australia divided the target scheme into two categories, viz. Large Scale Renewable Energy Target (LRET) and Small Scale Renewable Energy Scheme (SRES). The LRET stipulates that the country should reach a yearly generation target of 41,000 GWh by 2021.[10] ***South Korea*** has modified phase-wise targets for the share of renewables in its primary energy supply. The country is aiming to achieve a renewable share of 4.3% of primary energy by 2015, 6.1% by 2020, and 11% by 2030. [35]

Sometimes, targets are used to galvanize policies for encouraging generation from new and renewable sources, keeping in mind the importance of access to energy by all.

According to many analysts, ***China***, in an attempt to promote renewable energy for addressing its supply side constraints, had mandated 10% and 15% renewable energy targets for 2010 and 2020, through its national target system.[35] A fair performance in terms of its previous targets prompted China to raise its technology- specific targets from 90 GW to 200 GW by 2020) for grid-connected wind power, from 250 GW to 300 GW for hydro and from 9 GW to 10 GW for solar photovoltaic, to be met by 2015. [35]

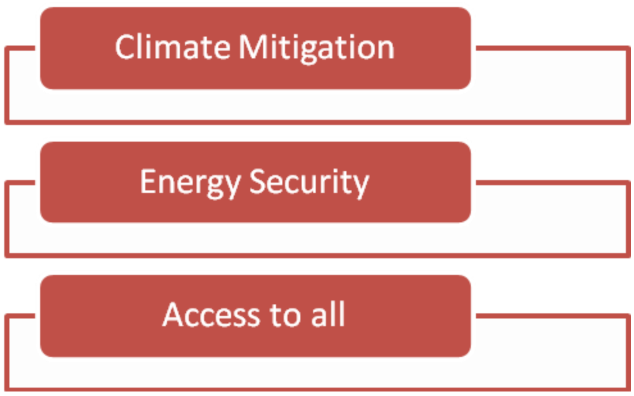

Fig. 2.2 Motivations behind Dynamic RE Target Setting

The National Action Plan on Climate Change (NAPCC) announced by the Prime Minister's Council on Climate Change in ***India*** has specified RE injection target of 5% in to the national grid in FY 2009/10, to be increased by 1% per annum, so as to reach 15% by end of 2020. The Jawaharlal Nehru National Solar Mission (JNNSM), one of the eight missions under NAPCC, has set a target of 20,000 MW grid-connected and 2,000 MW off-grid solar power generation capacity by 2022. The JNNSM explicitly recognized the importance of solar-based off-grid renewable energy supply to remote areas where grid penetration is a costly and improbable option.[17]

Indonesia aims to produce 25% of primary energy by 2025 while ***Thailand*** has set a target of 20% of primary energy by 2022 from renewable energy sources.[35] 'The Development Framework of the Government of ***Sri Lanka'*** mandates a share of minimum 10% for electricity coming from New and Renewable Energy (NRE) Sources by 2016 and 20% by 2020.

Long-term RE targets show a country's long-term commitment towards its energy generation portfolio with long-term policies, measures and indicative roadmaps. Whereas, short-term year-wise targets act as precise guidelines for annual achievements, to meet the long-term targets. Most of the countries selected under the present study, aim for an average annual increase of 0.2%-1.5% in the RE share.[35] For example, ***India*** targeted an additional 3,400 MW of grid-connected capacity and 130 MW of off-grid capacity during the financial year 2011/12.[35] According to ***Australia's*** Large Scale Renewable Energy Target (LRET), the country proposes to increase its yearly RE targets from 16,338 GWh in 2012 to 41,000 GWh by 2020/21.[10] ***Nepal*** follows a practice of setting yearly targets based on funds committed by donors.

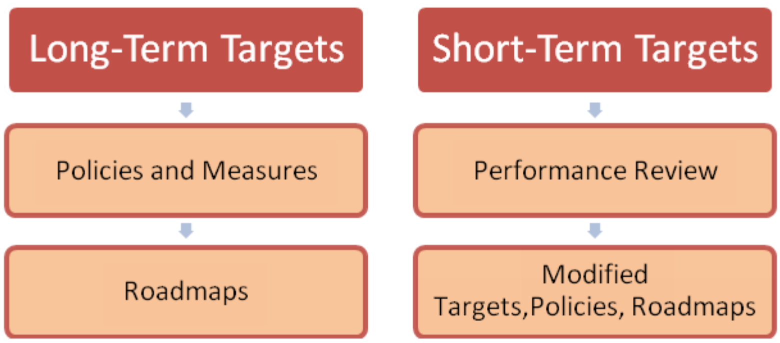

Fig. 2.3 Importance of Setting Long-Term and Short-Term RE Targets

Long-term renewable energy targets help to initiate policies and measures and update roadmaps for promotion of RE. While verifying the performance towards long-term goals, short-term or year-wise achievements are a good indicator. For example, China surpassed the targeted annual wind power capacity additions between 2005 and 2010 and subsequently increased its target for the 12th National Plan (2011-15).

The main reason for non-performance in a few countries appears to be the incompatibility between targets and time lags provided for materialization of fresh initiatives. Further, several interactive policies coupled with administrative/implementation bottlenecks may contribute to the slow evolution of renewable energy development. Nonetheless, falling short of short-term targets in no way reduces the role of long-term targets and policies to adopt suitable measures for promotion of renewable energy.

Box 1: Japan: not so developed in developing targets?

Japan, which imports more than 80% of its energy needs, found nuclear power as a major source of energy supply following the abrupt oil price hike during the 1970s. Only 3.5% of its electricity production in 2010 came from renewable energy sources.[35] More startling is the fact that although it had increased the share of renewables in electricity from 0.4% in 2008 to 2.2% in 2009 and 3.5% in 2010, its target for the remained unchanged at 1.63% by 2014.[36] Thus, the country, which otherwise counts in the group of developed nations, did little to revise targets for encouraging the deployment of renewables until the first half of 2011. However, after the Fukushima disaster, Japan has come up with renewed interest in increasing renewables in the country's energy portfolio, with a target of 10% of primary energy coming from renewables by 2020.[35]

2.2 Mandated Market Policies

One of the prime barriers hindering the development of renewable energy is its high cost of generation and hence the possibility of lower returns from investments. Adoption of policies that produce consistent and reliable markets leading to steady and significant reductions in the cost of renewable energy generation remains the most successful practice around the globe to remove cost-related barriers. Experience from developed countries suggests that diminishing cost-related barriers ensures a relatively easy entry for new enterprise, especially small and medium enterprises (SME), which in turn enhances investment opportunities in renewable energy technologies. This is done through incentives that reduce market risks of investment in the new RE technologies related to price or quantity. Widely used mandated market policies are as follows.

- **Price setting**, through which a guaranteed return is assured to the energy generators by means of a fixed price over a given period of time (generally called Feed-in Tariff or FITs).
- **Quantity setting**, where all electricity providers must ensure a minimum share of electricity generated from renewable energy sources (generally called Renewable Portfolio Standard or RPS). In some countries such standards are also called Renewable Purchase Obligation or RPO). This system is often implemented in conjunction with tradable renewable energy certificates.
- **Competitive bidding or concessions**, where pre-determined quantities of renewable energy generation are purchased based on open competitive bidding.

Fig. 2.4 Mandated Market Policies most widely used

2.2.1 Price-Setting Policy

Under price setting policy, electricity generated through renewable energy is offered a favourable price over conventional energy for a considerably long period. Study of the ten selected Asia Pacific countries indicates that price setting policies are the most popular and have evolved over years to bring in necessary modifications that best suit respective countries. Amongst the price setting policies, the most commonly followed and in line with global best practices, is the feed-in tariff (FIT) policy. Net metering is another option under the price setting policy, but can be viewed as a feed-in tariff in limited form.

2.2.1.1 Feed-in Tariff

A feed-in tariff, also known as advanced renewable tariff, or preferential tariff, is a policy mechanism designed to encourage the adoption of renewable energy sources. Typically, it includes three key provisions.

- Purchase prices that are methodologically based on the actual cost of renewable energy generation
- Guaranteed grid access
- Long-term Power Purchase Agreements (PPAs) for the electricity produced

Under a feed-in tariff, an obligation is imposed on regional or national electric grid utilities to buy renewable electricity at a price determined by energy regulators. Thus investors enjoy a guaranteed return on investment over a given period of time with a lower risk.

Almost all the ten countries have experimented with feed-in tariffs and, over time, this mechanism has been upgraded to suit the country's environment. The exceptions are ***New Zealand,*** which fosters the philosophy of competitive electricity markets and ***Nepal,*** which so far has relied on the use of government intervention through fiscal and financial incentives for promoting renewable energy technologies, especially in the off-grid mode.

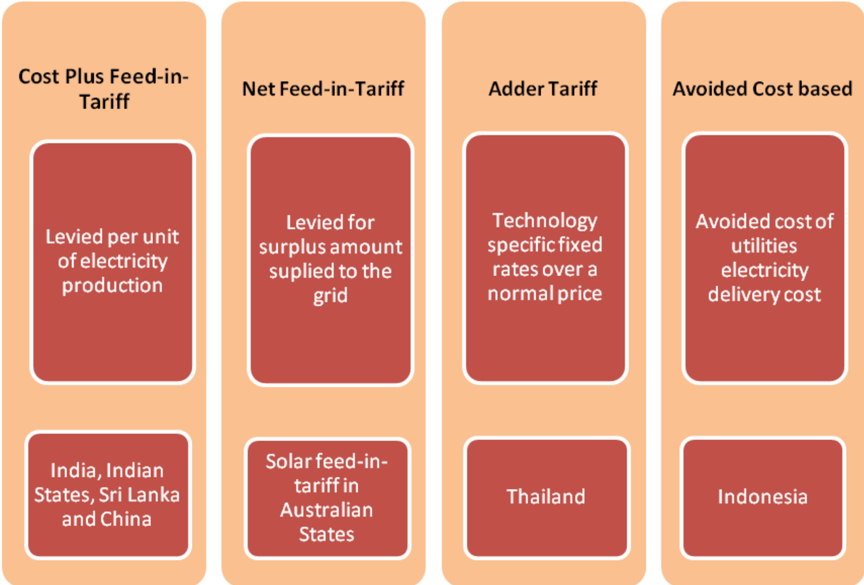

Fig. 2.5 Few Variations in Feed-in Tariff Practices

Feed-in tariffs vary from technology-neutral flat tariffs to technology-specific stepped tariffs. In some countries the tariff is awarded at the state level instead of the national level. For example, ***Australia*** offers feed-in tariffs at the state level, mostly for small solar energy systems in the form of gross feed-in tariff and net feed-in tariff. While gross tariff is given for per unit production of electricity, net tariff is given only for units produced and exported to the gird in excess of the generator's own requirements. However, at present, there are only net feed-in tariff schemes prevailing in ***Australia***.

India offers feed-in tariff at both the central and state levels, with the state electricity regulatory commissions (SERCs) regulating prices for renewable projects commissioned in their respective states, and the Central Electricity Regulatory Commission (CERC) regulating the tariff of RE power projects owned by central government undertakings and RE power plants having a composite scheme of selling power to more than one state. Both SERCs and CERC in ***India*** rely on the cost-plus methodology while awarding generation tariff to RETs.

Box 2: Cost- Plus Methodology followed in India

The Central Electricity Regulatory Commission (CERC) and the State Electricity Regulatory Commissions (SERCs) in India follow the Cost–plus methodology for awarding feed-in tariff for renewable energy technologies in India. The CERC-specified FIT shall be applicable to RE projects owned or controlled by the Central Government or in case where the generating company enters into or otherwise has a composite scheme for generation and sale of electricity in more than one state. Whereas the SERC determined FIT will be applicable to the RE projects commissioned in the respective states.

The exercise for tariff setting in the cost-plus approach is adjusted for performance standards set by regulators, where the rate of return on the capital investments is regulated and a cap is imposed on clear profit earned by the generator. This methodology of tariff computation takes into account the recovery of fixed cost components such as interest on debt, operation and maintenance costs and also assures a fixed return on an investor's equity. This makes it necessary for the regulator to validate project specific data pertaining to cost with the historical data/past trends and other supporting information.

While adopting the cost–plus methodology in the case of renewable power projects due to the presence of a large number of tiny and widely distributed generating stations with diverse ownership, the regulators in India instead of awarding project specific tariffs, prefers the 'generic tariff approach' and specify generic tariffs for each technology. In the generic tariff approach based on cost-plus methodology, the regulator usually fixes the benchmark operating and financial parameters for each of the renewable energy technology separately. Benchmark pricing typically adopts a representative station for determination of tariffs. The benchmark costs could result in the projects that are above the cost benchmark being unattractive. Therefore the regulator needs to be cautious while deciding the benchmark parameters for a particular RE technology. Along with the benchmark technology-specific performance parameters and financial parameters, the regulators also specify general parameters such as tariff period, control period, and tariff structure.

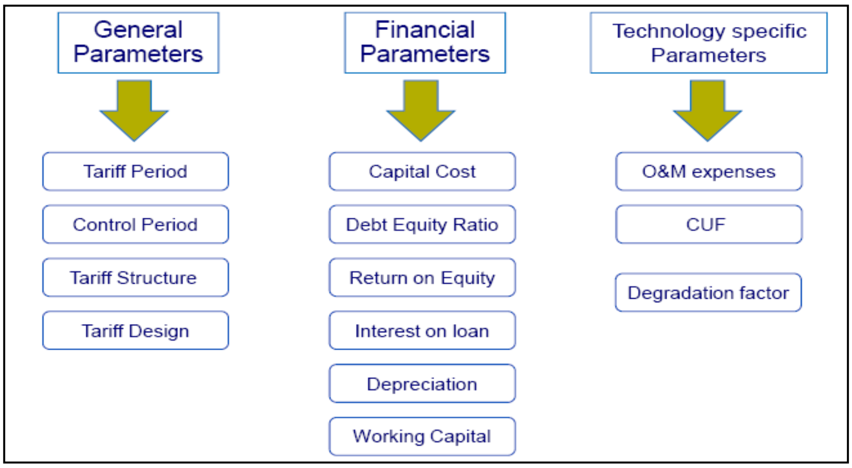

Fig. 2.6: Generic RE tariff determination based on cost-plus methodology

South Korea, a high income country, had been following the policy of technology-specific feed-in tariffs since 2002 with solar PV getting the highest tariff. The 'Electricity Business Law' of the country placed an obligation on the Korea Electric Power Corporation (KEPCO), ***South Korea's*** electricity utility, to purchase electricity generated from renewable sources through feed-in tariffs. The FIT is offered in two ways: a fixed tariff (for most of the sources apart from PV and fuel cells) which appears to be below the average system marginal price (SMP), or a variable tariff - often set at 0.45 US cents to 1.8 US cents/kWh (KRW 5–20/kWh)[1]above the system marginal price (SMP). The FIT compensates for the differences between the electricity generation costs of RE and SMP. Funding for these preferential tariffs comes from the general state budget (electric industry foundation fund) and the burden of additional cost is not passed on to Korean consumers.[5]

Thailand implemented a feed-in tariff scheme that provides a technology-specific adder (a premium) rates over the normal price approximately, 6.56 US Cents to 8.2 US Cents (2.0-2.5 baht/kWh). Tariffs were specified for seven years from the date of commercial operation of the project except for solar and wind projects, where the tariff was locked in for a period of 10 years from the commercial operation date. ***Thailand***, like South Korea, provided highest tariffs for solar PV. However, the Thai National Energy Policy Council (NEPC) passed a resolution on July 28, 2010, that lowered the 10-year feed-in tariff adder from 26.24 cents to 21.32 cents per kWh (8 baht/kWh to 6.5 baht/kWh) for all solar projects.[28,29,38]

China began introducing feed-in tariffs for wind and solar photovoltaic power from 2009 and 2011 respectively. Since July 2009, ***China*** introduced zone-based feed-in tariffs for wind power in its four regions. The region with the richest wind resources, located mainly in ***China's*** north and west, has a tariff of US cents 7.8 per kWh (RMB 0.51); the region with modest resources, mainly in the east and along the southern coastline, has a tariff of US cents 8.3 per kWh (RMB 0.54) and US cents 8.9 per kWh (RMB 0.58) per kWh; and the region with relatively low wind resources, in the middle of the country, has a tariff of US cents 9.4 (RMB 0.61). For solar photovoltaic power also, ***China's*** energy regulator, the National Development and Reform Commission (NDRC), announced its first nationwide feed-in tariff in July 2011.[34]

In ***Indonesia*** and ***Sri Lanka***, a "preferential" tariff has been channelled through SPPAs. This arrangement has also included guaranteed purchase for a multiyear period and 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.[39]

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[1] Average exchange rate (USD/local currency of the relevant country) for the year 2011 has been considered for currency conversions through out the text.

The importance of feed-in tariffs in promoting renewable energy has been acknowledged worldwide. The countries covered in this study are no exception. A prominent example may be that of ***South Korea.*** In the three years up to mid-2008, solar photovoltaic had seen an exceptional growth rate with a total of 99 MWh of capacity being installed. Much of this growth was aided by a generous feed-in tariff. But a reduction in tariff in the range of 8% to 30% (depending on installation size) instituted in October 2008 had a significant negative impact with only 10 MWh of capacity being added between October 2008 and March 2009.[49]

2.2.1.2 Constraints of FITs

While bringing cheer to developers and generators, carelessly crafted FITs could burden customers of electricity inefficiently. A major concern of this policy appears to be the obligation of the utilities to use FITs to purchase power. Poor financial conditions of the Distribution Companies (DISCOMs) in many developing countries, coupled with absence of a viable mechanism to recover the extra cost incurred due to procurement of power at FIT, are major constraints.

To overcome these barriers, incremental cost recovery mechanisms need to be put in place. Countries that rely on state financing or their utilities for meeting the incremental cost for renewable energy purchase are required to consider this problem. In ***Sri Lanka***, invoices from the Ceylon Electricity Board (CEB) to cover the incremental costs associated with the existing five small hydropower (SHP) facilities (which have been commissioned under the new FIT system) were accumulating at the Sustainable Energy Authority, which had been unable to pay them. In ***India*** also, state subsidies to cover excess burden created by FITs have been insufficient, and utilities end up meeting the extra cost from their own revenues.[39] ***Indonesia*** is another example where the government has not allowed the incremental cost to be passed on to the end consumers and subsidized the PLN (electricity utility) instead by increasing subsidy amounts over the years. Now with pressures mounting on the PLN to reduce its subsidies, the policy is actually acting as an incentive for the utility to shift towards the low-cost coal-based generation.[7]

The implementation of a transparent mechanism to share the incremental costs associated with the FIT policy under way in ***Japan***.[25] Effective from 1 July 2012, the costs of electricity generated from solar PV and wind resources shall be transferred to electricity customers all over the country in the form of a nationwide equal surcharge (surcharge/kWh), which will be decided every year by the government, based on the results of the previous fiscal year.

In ***Sri Lanka*** and in some states in ***India***, electricity regulators have stipulated that part of the carbon revenues (like carbon credits received under the CDM mechanism) should be passed on to the DISCOMS to reduce the impact of FITs.

2.2.1.3 Net Metering

Net Metering is another form of FIT, that allows households or businesses to install small renewable systems and supply excess power produced to the grid. A successful experiment of this kind has been done in ***Japan*** since November 2009, which is more commonly known as the buyback program. Electricity is bought back for a period of 10 years at a fixed price, which is subject to variation depending on the fiscal year of installation. The price of buyback is varied across categories: residential users receive higher price than non-residential users and expenses are borne by the end-customers as surcharge. Although the initial price gap between the two categories was 100%, it was reduced in subsequent years. A successful implementation of net metering is restricted to the availability of support measures such as financial incentives. Japan came up with subsidies for systems to be installed by households and businesses.[25]

Given below (Fig. 2.7) is a diagrammatic representation of the buyback program for Solar Photovoltaic.

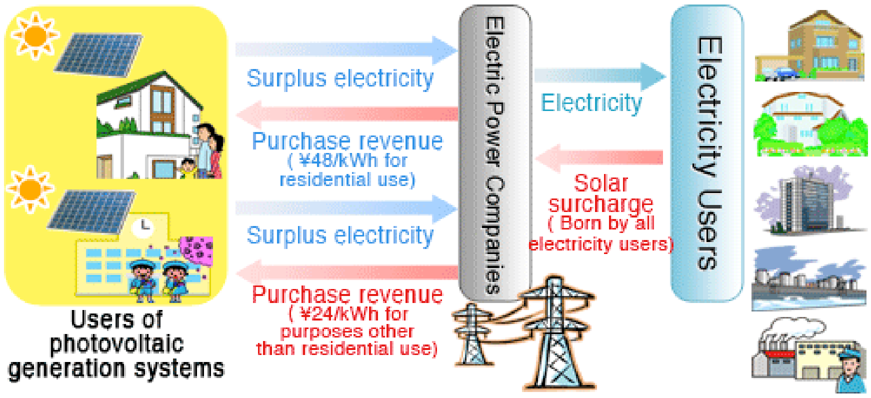


Fig. 2.7 Implementation Mechanism of Solar Energy Buyback Policy in Japan

*(Source:*METI, Japan)

Note: At the average annual 2011 exchange rate (USD/Yen) the purchase revenue for the residential use (¥48/kWh) was US Cents 60.48 and purchase revenue for purposes other than the residential use (¥24/kWh) was US Cents 30.24.[25,26]

2.2.2 Quantity Setting Policy and Tradable Energy Certificates

Quantity setting policies create obligations to purchase a quota for a part of electric utilities or retailers. Generally the government/regulator of a country mandates a fixed amount or percentage of electricity generation that should come from renewable energy sources within a target period. The share of generation from renewable sources gradually increases over time with a specific target and an end date. An example of quantity setting policy is the Renewable Portfolio Standard (RPS), which gained popularity among major Asia-Pacific nations in the past decade or so. In some countries it is known as Renewable Purchase Obligation (RPO). For the sake of uniformity we will use the term RPS terminology here.

2.2.2.1 Renewable Portfolio Standards (RPS)

Renewable Portfolio Standards is an instrument that legally stipulates a minimum share of generation coming from renewable energy. Entities liable for fulfilling the RPS norms are required to demonstrate that they have met their targeted minimum share through the ownership or purchase of renewable energy (that can be used to meet targets) within a specified time period, failing which a penalty fee needs to be paid. In most countries, liable entities can purchase green certificates like Renewable Energy Certificates or REC, issued by suppliers or generators through the market.

Fewer countries have adopted RPS as a promotional policy compared to those that have adopted feed-in tariffs. Japan has been reliant mostly on its RPS Act enacted in 2002 for the development of renewables in the country. ***South Korea*** shifted to an RPS system from feed-in tariffs early in 2012. Among others, ***China, India, Indonesia,*** and ***Sri Lanka*** have fixed quotas for renewable energy in the total electricity to be purchased by the utilities. Some countries like India currently follow a mixed policy of FITs, RPS and RECs prevalent concurrently, by complementing and supplementing one another.

Like the feed-in tariff policy, the renewable portfolio standard has varied across countries at the level of implementation. ***Japan*** follows an RPS scheme accompanied with tradable certificates, which obliges each of ***Japan's*** utilities to buy a certain absolute amount from renewables each year until 2014. According to the RPS law in ***Japan***, the country has fixed an obligation of 16 billion KWh of electricity to be generated from renewables by 2014. [20]

In ***India,*** under the Electricity Act, 2003, the State Electricity Regulatory Commissions are empowered to fix RPS targets for the respective states. Considering the national target of 15% RE electricity by 2020, as envisaged in the NAPCCC, In order to overcome the mismatch in RE potential across the states and to enable inter-state transfer of green power, the Central Electricity Regulatory Commission has introduced Renewable Energy Certificate scheme since 2010.

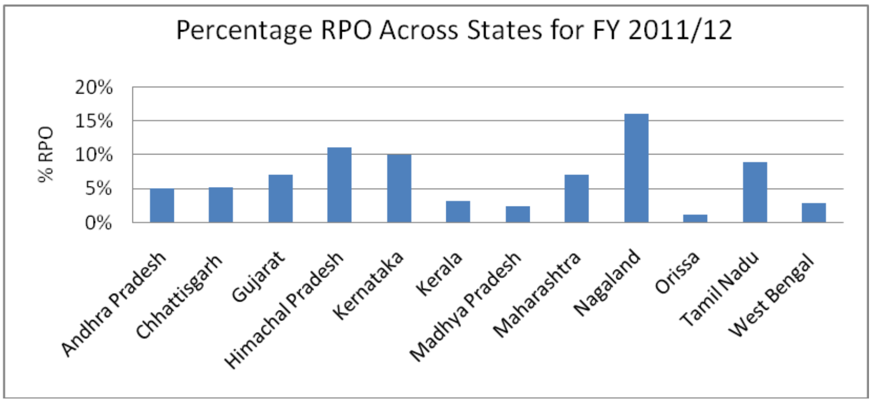


Fig. 2.8: Renewable Purchase obligations in Indian states

RECs are generation-based 'certificates' awarded (electronically, in demat form) to those who generate electricity from renewable sources such as wind, biomass, hydro and solar. A renewable power generator who opts for the REC market mechanism will then receive only an Average Pool Price from the electricity utility who buys the power, which will be much lower than the preferential feed-in tariff. The balance revenue will have to be generated by sale of the environmental attribute of the green electricity in the market through RECs.

These certificates are tradable on power exchanges and are bought by 'obligated entities', who are either specified consumers or electricity distribution companies. These obligated entities may have to purchase a certain quantum of either green power or RECs. Inter-state trading of these certificates is allowed, so that obligated entities in RE resource-deficit states can meet their obligations by procuring RECs from resource rich or surplus states without physically buying electricity. Fig. 2.9 gives the diagrammatic representation of REC operational framework in India.[8]

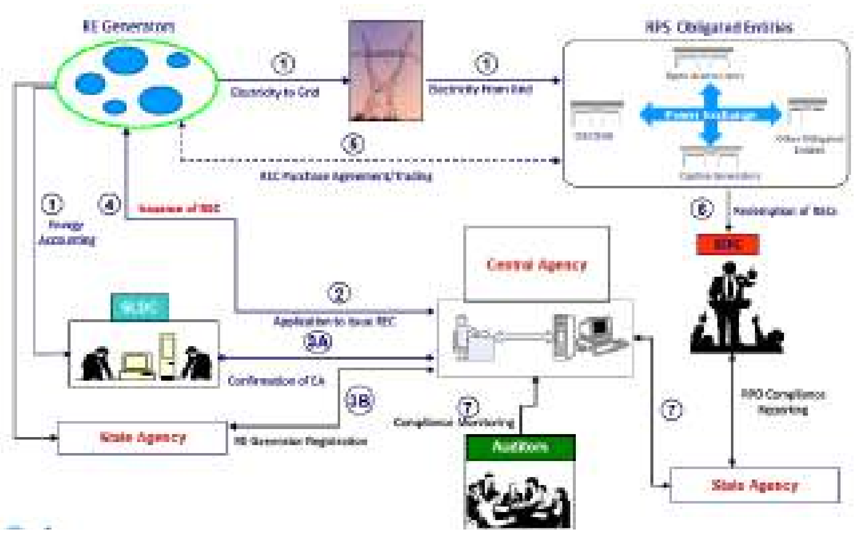


Fig. 2.9: REC operational framework in India

One major way in which ***Japan*** differs from India in implementing its RPS policy is that Japan allows the utilities to carry forward the excess renewables purchased to the next year. This banking mechanism has its disadvantages as can be seen from Box 4.[11]

In both ***India*** and ***Japan***, generators are allowed to create Renewable Energy Credits (certificates) that can be sold through the open market to the utilities or retailers while selling electricity to different markets or supplying to the grid.

Box 3: Renewable Energy Certificates (RECs)

Renewable Energy Credits (RECs) are a market-based instrument to promote and facilitate renewable energy markets and help in meeting Renewable Purchase Obligation (RPO) or /Renewable Purchase Standards (RPS). Tradable RECs have been extensively used as a successful market-based policy instrument to promote renewables and ensure compliance with quota obligations in countries like Australia, Japan, United States (Texas, Arizona, Wisconsin, and Nevada), the Netherlands, Denmark and the United Kingdom. RECs are simply a monetary quantification of the non-energy and societal benefits accrued from certain amount of renewable energy power production, usually one megawatt-hour (MWh). RECs in many cases are created and defined by statue as part of the quota obligations in countries such as USA, Japan and Australia or as part of the similar quota schemes in countries such as the UK. Such certificates are usually meant to make the renewable electricity market stable and predictable by maximizing the benefits of renewable generation while reducing costs. Tradable REC system eases compliance demonstration and tracking, improves liquidity in the market, provides additional flexibility to suppliers, and lowers the overall cost of quota policy compliance. However, RECs are not to be perceived as a support system.

In ***India*** the REC mechanism was introduced to facilitate compliance with RPO and address the mismatch between availability of RE resources and the requirement of obligated entity to meet the RPO resulting due from the uneven spread of RE potential across the Indian states. The obligated entities in India are allowed to meet their RPO by procuring green power at SERC-declared FIT or by sourcing equivalent RECs from the power exchanges at market-determined prices within the upper and lower ceiling prices specified by the CERC. The RE generators have two options for sale of electricity. The RE generator can sell the green power in a bundled form at FIT determined by the SERCs or can opt to sell the electricity and the REC component in un bundled form separately. In the latter case, the RE generator has to sell the electricity at average pooled cost of the utility whereas the REC can be sold on a power exchange.

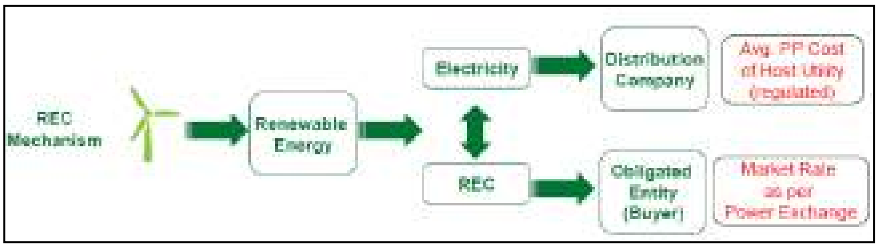
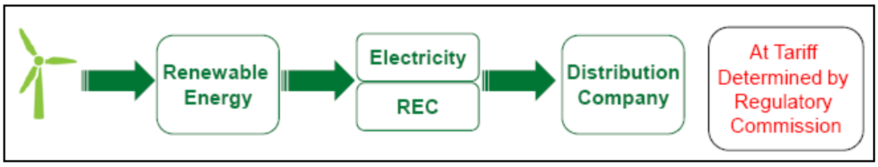


Fig. 2.10: Options for sale of green power in India



The regulatory framework for renewable energy in ***South Korea*** shifted from feed-in tariff based mandates to RPS, effective January 2012.[21] Thirteen of the largest public and private utilities have obligations to purchase or to generate renewable energy as a share of their total

Box 4: Japan's Policy of Banking: A probable deterrent to RE deployment?

Since the enforcement of the RPS scheme in 2003, almost all power companies have exceeded their targets and such accumulated excess had been carried over to the next year (known as the practice of 'banking'), which has limited the development of the renewable energy market. According to the 'Report on Implementation of the RPS Act in FY 2010' by the Ministry of Economic Trade and Industry (METI), all the regulated electric utilities except one used more renewable-energy-sourced electricity than the mandatory amount. Besides, 23 electric utilities and 12 power producers banked the excess amount, amounting to 4,173,690,000 kWh (4,097,196,000 kWh by electricity utilities as 76,494,000 kWh by power producers) of renewable energy-sourced electricity for FY 2011. Because of low targets and facilities of banking, Japan has been unsuccessful in achieving cost reductions by economies of scale, which in turn slowed down the development of renewables.[11,25]

electricity, starting at 2% in 2012and gradually increasing to 10% by 2022. The RE generator is eligible to get fixed tariff for power generated from renewables at the system marginal price, plus revenue from RECs. A positive feature of the South Korean frame is that the REC mechanism has a 20 year life span, helping to create long-term investor certainty.[22]

In ***Australia*** there is no formal RPS scheme but electricity retailers have legal obligations to buy generation certificates. These certificates are created by power stations, and the liable entities (electricity retailers) purchase and surrender certain amounts of these certificates through the REC registry. Nevertheless, while Large-Scale Generation Certificates are issued on additional MWh of power generated by the power stations above their baseline, Small-Scale Technology Certificates are created for installations such as solar water heaters, heat pumps, solar panel systems, small-scale wind systems or small-scale hydro systems, according to MWh of electricity they produce or displace. The number of LGCs to be purchased each year is set by the Renewable Power Percentage (RPP). The number of STCs to be purchased each year is set by the Small-scale Technology Percentage (STP). Both the RPP and STP are set by 31 March for a given year. A diagrammatic presentation of currently operational Large- Scale and Small-Scale Generation Certificate circulation mechanism is shown in Fig. 2.11.[10]

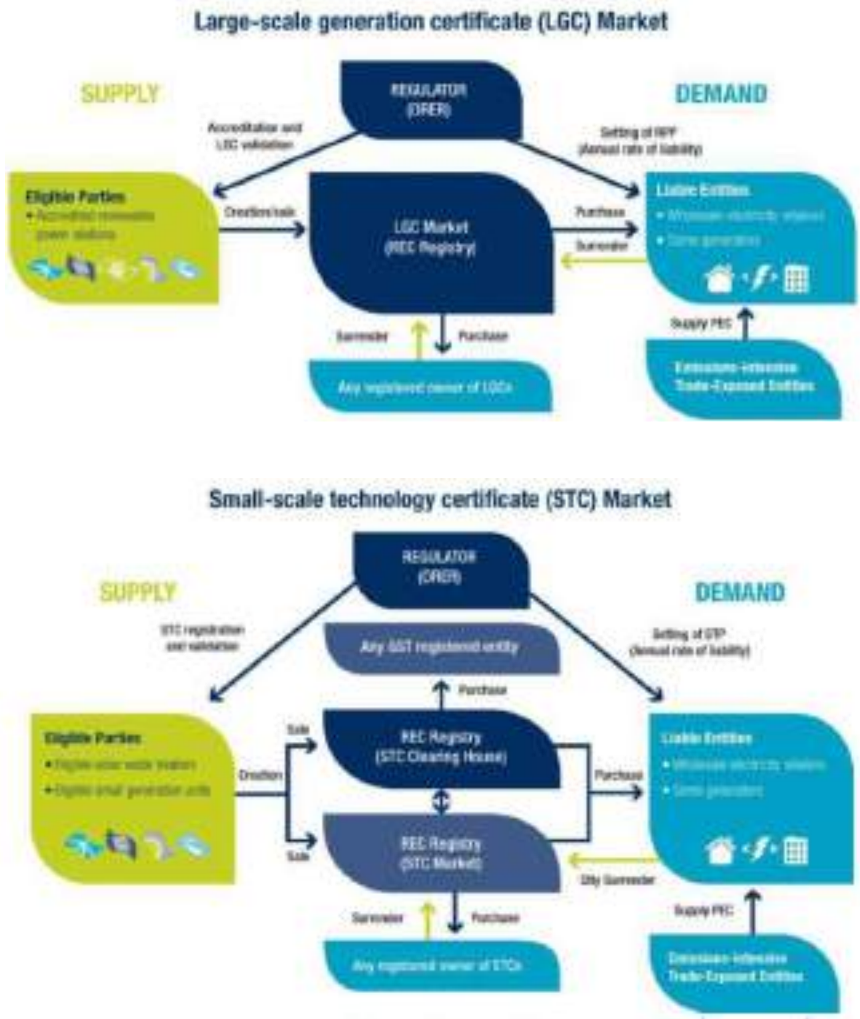


Fig. 2.11 Structural Framework of Australia's Tradable Certificate Market

2.2.2.2 Merits and Demerits of Quantity Setting

Quantity-setting policies to promote renewable energy are relatively new in most of the Asia-Pacific countries. The main objective of this policy is to provide investors with a market that secures a minimum off-take from total renewable energy production over a period of time in a country. Moreover, RPS (RPO) policy, coupled with the certificate scheme, generates a market for tradable environmental attributes, which in turn incentivizes investors. Thus, a more efficient electricity market, besides assisting utilities in meeting their renewable purchase obligations, creates opportunities for better revenue earnings for the developers so long as the supply does not exceed demand.

One major problem associated with the RPS system has been the recovery of incremental costs by the utilities. Although highly diversified renewable energy technologies are available for meeting targets, which, in turn are supposed to reduce the overall cost burden of retailers by dint of certificate purchases, lack of appropriate cost recovery mechanisms adversely affects the book values of utilities. More often, especially in countries like ***India***, the adverse effect of mandatory purchase outweighs the favourable effects accrued through the certificate market. Another, important fact is related to the compliance with the targets by the liable entities. Although enforcement is poor in many countries, once penalty mechanisms are fully enforced, utilities will have an additional financial burden.

Many of the countries covered in this study have very little information relating to their experience on implementation of RPS. However, ***Japan*** has been following a well-coordinated RPS system for a decade now. Despite this, ***Japan*** has observed a very slow momentum in the RE sector mostly due to the slow rate of upgrading of annual targets along with the policy of banking. Although ***Australia*** had no RPS, its certificate market motivated investments, with the small renewable energy sector creating more than 1.3 million certificates between 2001 and 2010.

Box 5: Principles for development of effective RPS framework

International best practices suggest following broad principles for designing effective RPS framework.

- RPS framework should support expeditious harnessing of renewable energy sources and encourage increased level of generation from such environmentally benign RE sources.
- RPS framework should be cost effective and should not have a significant impact on retail tariff.
- RPS framework should be enforceable, so that renewable energy targets can be achieved.
- RPS framework should not differentiate amongst any obligated entity and should be non-discriminatory.
- RPS framework should avoid specifying the RE technology for the purchase obligation to enable healthy competition between different RE technologies. Segmented purchase obligation is recommended only in the case of new and emerging RE technologies having substantial potential for future development.
- RPS framework should provide market stability and transparency, thereby increasing investment into the renewable energy sector.
- RPS framework should be compatible with the existing Central and State Government laws and regulations already in force for the development of renewable energy sources.

2.2.3 Competitive Bidding

Another less frequently used policy mechanism in the region is the competitive bidding process, according to which open competitive solicitations are made by different developers to produce a target amount of generating capacity or share of electricity. Project developers submit bids for contracts and, if successful, they can begin to develop their projects. Whereas FITs sometimes tend to over-reward investors, competitive processes also face the risk of unsustainable price bids, submitted only to corner capacities. Broadly speaking, the international experience of procurement of renewable power through competitive bidding has not been encouraging. Internationally competitive bidding was tried by the U.K. for renewable-energy-resource obligations during the 1990s under its “Non-Fossil-Fuel Obligation” (NFFO) policy. The NFFO process was criticized as encouraging competing projects to bid below cost in order to capture contracts, with the result that successful bidders were unable to meet the terms of the bid or ended up insolvent. This criticism proved valid in practice; contracts awarded to low-bidders did not always translate into projects on the ground. The UK abandoned the NFFO approach after the fourth round of bidding in 1997. Similarly Denmark’s 2009 offshore wind tender attracted just one participant. So recent international experience is littered with sub-optimal outcomes from wind power auctions, whereas the recent (2011) world bank report titled ‘Design and performance of policy instruments to promote the development of renewable energy: emerging experience in selected developing countries' shows that feed-in tariffs are being implemented in about 49 countries around the world and FITs are often cited as the most effective policy for attracting private investment in RE.

In some countries competitive bidding has been used to implement concession programs, and is called concessional bidding. A good example of **concessional bidding** procedure is the one followed by ***China*** between 2003 and 2006 to develop its wind power market. The process was held in several phases and in each phase, the government asked for bids from project developers to develop a wind power project site of 100 MW. Winning bidders were granted approval to develop the selected project site, a PPA for the first 30,000 hours of the project operation, guaranteed grid interconnection, financial support for grid extension and access to roads, and preferential tax and loan conditions by the central government. Concessional tendering in ***China*** was meant to spur market development, reduce year-long high wind electricity tariffs and thereby, find a suitable benchmark price for wind power.

Instead of revealing the true cost of wind power, the bidding process generated very low initial bidding prices, which made many projects economically non-viable. Also, rules of the tendering process had various stringent conditions at the beginning. For example, the proposed projects were required to use turbines over 600 kW in capacity with over 50% local content. Difficulties in obtaining finance by the selected developers was another issue. Despite efforts from the Chinese government to correct the previous shortfalls, the process offered little incentive to producers. In 2004, concessional tariff for Huitengxile wind farm in Inner Mongolia (Western) remained as low as US cents 5.9/kWh (0.382 RMB/kWh).[16] Although over the years, rules were modified to adjust to the market, prices continued to remain at a lower level and subsequently, the number of applications went down. Consequently, the low prices from the bidding procedure affected other wind projects in the country, which received a government approved tariff based on no clear benchmark.[40]

In ***India,*** in the first phase of JNNSM, a 'reverse bidding' process was adopted for selecting companies to install solar PV and CSP power plants.[18] The CERC declared 38.15 US cents/kWh (Rs. 17.91 per kWh) for solar PV and 32.61 US cents/kWh (Rs. 15.31/kWh) for CSP as ceiling tariff and the bidders were asked to offer discounts over the ceiling tariff. The discovered tariff for solar PV varied from 27.20 US cents (Rs. 12.77/kWh) to 15.95 US cents (Rs. 7.49/kWh) during two phases of the bidding process. Whereas the discovered tariff for CSP varied from 22.34 US cents/kWh (Rs. 10.49/kWh) to 5.99 US cents/kWh (Rs. 12.20/kWh), at an average bid price of 24.81 US cents/kWh (Rs. 11.65/kWh). The minimum tariff discovered for solar PV was as low as 15.95 US cents/kWh (Rs. 7.49/kWh) which is 51.33% below the CERC ceiling solar tariff.

2.3 Fiscal and Financial Incentives

So far we have discussed policies that are conducive to the promotion of grid-connected technologies. However, huge subsidies to conventional fossil-fuel based technologies create market distortions that impede the growth of renewable energy technologies. Market policies alone are not sufficient to overcome barriers in a sustainable manner. To complement the market policies, introduction of financial and fiscal incentives are necessary. All ten countries selected in this study have chosen such policies in some form or the other to help in lowering the barriers to promoting renewable energy technologies.

Most significant among these barriers is the high initial project cost of RE technologies as compared to their conventional counterparts, especially in the context of some developing countries where most of the investments in RETs come from small and medium enterprises. Moreover, countries where promoting off-grid technologies is an imperative should heed the need to mobilize resources to attract investments in them, as entrepreneurs most often lack incentives to invest in such technologies.

Financial and fiscal incentives are provided to reduce cost of investment in renewable energy technologies. While financial incentives can come from the government as well as non-government entities, fiscal incentives are channelized through the governments. These incentives can be categorized into four major groups, namely grants, subsidies, tax incentives, loans and loan guarantees (Fig 2.10). This section attempts to study how these four types of incentives have been instrumental in renewable energy promotion from the perspective of the chosen countries in the set. An additional policy instrument, namely 'Clean Energy Funds' is discussed.

The issues related to large scale RE based power generation and small scale distributed RE based generation need different perspectives. Distributed generation being more complex and with mass scale implications for kW size projects, will need a separate treatment. 'Micro-generation' strategies, 'net metering' and feed-in tariff mechanism for distributed energy generation are required to promote this important sector. Introduction of grid-connectivity for RE based micro-generation can also unleash huge RET potential.

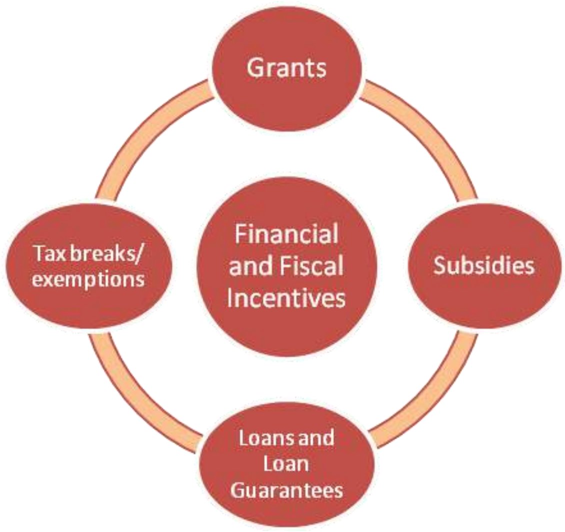


Fig. 2.12: Financial and Fiscal Incentives for Promoting Grid-Connected and Off-Grid Renewable Energy Technologies

2.3.1 Subsidies

Most popular of the financial incentives are subsidies allotted and disbursed to the projects in the region. While capital subsidies dominate, production subsidies are also in practice. Capital subsidies are offered mainly in countries like ***China, India and Nepal***. However, developed countries like ***Japan and South Korea*** also provide subsidies, even for grid-connected technologies.

China, through its **Golden Sun Program** started in 2009 provided capital subsidies for solar PV installation. Off-grid (stand-alone) installations received 70% subsidies while grid-connected installations received 50% subsidies with a limit on overall quantity of systems installed in a given province.[6,34] In early 2009, China launched a subsidy program for **rural use of household RET-based electrical appliances**, including solar water heaters (SWH). Under the program, consumers are supposed to be subsidized directly for 17% of the cost of the units. To encourage the collection and processing of a wide variety of wastes for more efficient energy use, a subsidy of USD 20.11– 23.205 (RMB130-150) is provided for **every ton of biomass pellets made from agricultural or forestry residues**. Also, in August 2008, a regulation was issued stating that the manufacturer of the first batch of locally made megawatt-level wind turbines (50 units) could apply for an award of USD 92.82 (RMB 600) per kW. Certification will ensure that the units qualify for the award conditions and criteria. For **biomass power, a feed-in tariff** is provided for all projects. In 2008, production subsidy of approximately US cents 3.87 (RMB 0.25) per kWh for a 15 year period was increased to US Cents 5.41 (RMB 0.35) per kWh. [34]

India, through its **Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY),** supports extension of electricity to all rural and below the poverty line households through a 90% subsidy of capital equipment costs for renewable and non-renewable energy systems. Solar water heaters, watermills and micro hydro projects up to 100 kW also received subsidies. Watermill subsidies range between USD 745.5 (Rs. 35,000) and USD 2,343 (Rs. 110,000). Micro hydro subsidies range from USD 852 (Rs. 40,000) to USD 2130 (Rs. 100,000). [47]

Japan provided an installation subsidy per kW on solar PV installations equal to an amount of USD 8,820 (¥700,000/Kw) or lower to meet quality guarantees and other requirements for residential users, half of the introduction cost for local governments etc. and a third of introduction cost for private operators since 2009.[26]

Table 2.1 A Few Important Subsidy Programs

Nature of Subsidy	Scheme	Country
Capital Subsidy	Rural End User Subsidy	China
	Rajiv Gandhi Grameen Vidyutikaran Yojana	India
Installation Subsidy	The General Deployment Subsidy	South Korea
	100,000 solar-roof installations program	South Korea
	Golden Sun Program	China
Generation-Based Subsidies	Biomass pellets made from agricultural or forestry residues	China
Compensatory Subsidies	Incremental cost subsidy caused by feed-in-tariff from government budget	South Korea
	Biomass Power feed-in-tariff	China

South Korea, on the other hand, used the public budget to subsidize the incremental cost accrued by the utilities for purchase of electricity from renewable energy sources at a feed-in tariff higher than the system marginal price.

The **'One Million Green Homes'** program in ***South Korea*** provided subsidies for the installation of a range of renewable energy systems in residential homes. Subsidies are provided to cover up to 50% of the capital costs for roof-top solar PV, small-scale solar thermal and geothermal, and small-scale hydroelectricity and wind. The objective of the program was for one million South Korean homes to be using one of these renewable energy sources by 2020. In 2009, the One Million Green Homes program subsumed the '100,000 solar-roof installations program' and expanded the coverage of subsidies to other renewable systems. As a result, the large majority of renewable generation supported by the program until the end of 2009 relates to roof-top solar, which consumed around 90 % of the total subsidies paid out under the program. Another subsidy scheme in the country is the 'General Deployment Subsidy' scheme, for established renewable technologies including solar and wind. The subsidy supports up to 70% of the costs of installing a renewable energy system. [5,21]

Nepal gives subsidy for many technologies keeping in mind its structural inabilities to reach the rural households. Two of these technologies are micro hydro projects (MHP) and solar home systems (SHS). According to its subsidy policy of 2009, the Government of Nepal announced some modifications in subsidies provided to the micro hydro power projects, which is now given per household served by a project with a total cap per kW of generation. Subsidies are also provided to households installing SHS of 10–18 Wp and more than 18 Wp.[2]

2.3.2 Grants

Grants as a potential measure for promoting renewable energy technologies is another financial incentive which is used globally. Grants can come from multilateral, bilateral or national sources. While multilateral agencies have been sanctioning grants with an emphasis on developing countries like ***China, Indonesia, Sri Lanka and Nepal***, national grants are used by the developed countries like ***Australia and New Zealand***.

The Federal government of ***Australia*** launched a **Solar Flagship Program** in December 2009, as part of its approximately USD 4.65 billion (AUD 4.5 billion) Clean Energy Initiative (CEI) and allocated approximately USD 1.55 billion (AUD 1.5 billion) towards it. The primary objective of the program is to provide the foundation for large-scale, grid-connected solar power to play a significant role in Australia's electricity supply and to operate within a competitive electricity market with the aim of up to 1,000 MW of solar power generation.[48]

Australia also announced the **Renewable Energy Demonstration Program** (REDP), under which approximately USD 242.76 million (AUD 235 million) was granted to successful applicants. The programme included following four projects.[49]

- MNGI Pty Ltd - approximately USD 64.83 million (AUD 62.762 million) grant for a 30 MW Paralana Geothermal Energy Project
- Geodynamics Limited - approximately USD 92.97 million (AUD 90.000 million) grant for the Geodynamics Cooper Basin of 25 MW Geothermal Demonstration
- Victorian Wave Partners Pty Ltd – approximately USD 68.66 million (AUD 66.465 million) grant for the first commercial scale ocean energy project
- The Hydro-Electric Corporation (Hydro Tasmania) - approximately USD 15.78 million (AUD 15.280 million) grant for the King Island Renewable Energy Integration Project

In order to remove capital cost barriers for the uptake of renewable energy in ***New Zealand,*** many financial assistance programs have been administered by the central government. For example, **project grants** are provided to business houses by the government in order to help businesses in finding investments, either for using energy-efficient devices or adopting renewable energy technologies. These grants are disbursed after Energy Efficiency and Conservation Authority's (EECA) assessment of economics of the project and barriers to implementation. Subject to a third party monitoring and evaluation, 40% of the project cost is awarded to the concerned business house as a grant with remaining 60% coming from the developer themselves Besides, a **Feasibility Study Grant** is allocated to businesses that are considering a specific energy efficiency or renewable energy project. Qualified applicants for these grants are given an amount equal to 40% of the feasibility study costs, with a maximum of USD 15,832 (NZD 20,000). In an attempt to reduce greenhouse gas (GHG) emissions, the EECA offers grants to households and businesses for adopting solar water heating and heat pump water heating technologies. The efficient water heating program is designed to get the greatest value for money, by giving the highest grants to those solar water heating systems and heat pump water heaters that save the most energy. It provides grants to eligible systems of USD 395.8 (NZD 500) or USD 791.6 (NZD 1000), depending on the energy savings offered by the system. However, the efficient water heating program is supposed to end by mid 2012.[15]

The **Global Environmental Facility (GEF)** provides grants for promoting renewable energy technologies. ***China*** received grants of approximately USD 40.22 million (RMB 260.006 million between 2006 and 2011) from GEF for the ***China*** Renewable Energy Scale-Up Program (CRESP) between 2006 and 2011, which aimed at removing barriers to the introduction of cost- effective renewables and increase their market penetration, enough to make a sizable cut in GHG emissions. [41]

Table 2.2: Countries Benefited by GEF Grants

Country	Scheme
China	Renewable Energy Scale-Up Program (CRESP)
Sri Lanka	Renewable Energy for Rural Economic Development Project (RERED)
Indonesia	Integrated Micro hydro Development and Application Program (IMIDAP)
Nepal	'Light for All' movement

Sri Lanka received about USD 8 million (SRL Rupee 110.518) grants from the GEF under the Renewable Energy for Rural Economic Development Project (RERED) between 2002 and 2011.[44] The main objective of the project was to improve the quality of life and bring about economic development by improving access to electricity via improved commercial availability and the use of renewable energy technologies.

Indonesia was another beneficiary of GEF grants for renewable energy development in the rural sectors. Integrated Micro hydro Development and Application Program (IMIDAP), which was supposed to be implemented between 2007 and 2010 received a grant amount of USD 3,012,300 (IDR 26,362 million)[42]

Centre for Renewable Energy (CRE) in ***Nepal***, used the Global Environment Facility Small Grants Program (GEF SGP) of the United Nations Development Program (UNDP) to launch the 'Light for All' movement in 2005 for providing cheaper solar electricity to poor communities in rural areas. The main objective of the project was to replace kerosene wick lamps and resin lamp with 'solar tukis'.[9]

2.3.3 Tax Incentives

Imposing taxes may accentuate the adverse effects of cost related barriers to promoting renewable energy technologies. On the contrary, reducing taxes partially or completely can contribute to bringing down the cost of renewable technologies. Although developed countries like ***Australia, New Zealand and Japan*** have not introduced tax incentives, other countries have relied on tax incentives as a promotional measure for renewable energy development.

Tax incentives can come in various forms ranging from exemptions from taxes on imported equipment, manufacturing, accelerated depreciation on capital cost of power plant or tax holidays on generation incomes. A list of major tax incentive policies is shown in Table 2.3.

Table 2.3: Fiscal Incentives Offered for Promotion of RETs

Type of Fiscal Incentives	Countries
Import Duty/Excise Duty concession	India, Indonesia, South Korea, Sri Lanka, Thailand
VAT concession	China, Indonesia, Srilanka, Nepal
Tax credit/Accelerated Depreciation	India, Indonesia, South Korea
Production Tax concession	Thailand
Tax Holiday on Generation Income	India

The ***South Korean*** government allows a deduction of about 20% of total investment in installation of RE systems from the income tax or corporate income tax for RE systems which have been completely commercialized.[21]

During the 1990s ***India*** used investment subsidies for wind energy which promoted large investments. However, this policy generated concerns about maintenance and long-term performance of the wind power projects resulting in lower than expected capacity utilization factors for early wind farms in ***India***. Further, the country's accelerated depreciation policy allowed 100% depreciation, which was later reduced to 80% in the first year of operation, helping spur one of the largest wind power industries among developing countries. This policy was discontinued from FY 2012–13. However, the policy led to large investments without ensuring proper long-term operating performance and maintenance, resulting in low capacity utilization factors. In addition to this, wind investors can avail a 10 year tax holiday on generation income, concessional import/excise duties on equipment etc.

China's national policies included a reduction of 6% VAT collection from small hydropower projects, a 50 % tax reduction for wind power projects, and a tax reduction or exemption for imported renewable energy equipment.[34]

Among other countries, ***Indonesia's*** Ministry of Finance in 2010 had declared a list of tax incentives entailing Income Tax facilities, such as: reduction from investment; accelerated depreciation; lower tax for dividend; and compensation of losses. Besides, other incentives like tax exemption for Import machineries and equipment, exemption of Value Added Tax, Import duty exemption etc were allowed for promotion of RE.[13]

Thailand offered import duty exemptions on manufacturing of renewable energy equipment including solar PV.[28,29,38]

2.3.4 Loans and Loan Guarantees

Loans serve the purpose of financing renewable energy applications. Long-term loans are generally available for renewable energy projects in countries with long technological experiences and mature capital markets. However, the context of developing countries is somewhat different. Most often projects in these countries suffer from unavailability of commercial loans due to lack of trust in these nascent technologies and the level of risk perceived by the lenders. However, loan guarantees may ease the situation. Sometimes governments in developing countries resort to public financing options to provide soft loans and interest subsidies. ***India, Thailand, and China*** have been following such mechanisms for disbursing funds to renewable energy projects.

In ***India*** provisions of low interest loans are available for SWH, and small hydro technologies (SHT). ***China*** provided government-discounted loans for infrastructure capacity building projects. ***Thailand*** implemented a revolving fund (RF) mechanism through which loans were granted at a very low interest rate. The revolving fund's main objective is to stimulate and leverage commercial investment for EE improvement. There are 11 participating banks in the RF mechanism that were made familiar with EE, RE lending market and opportunities. Fig. 2.13 depicts the working of the RF.[28,29,38]

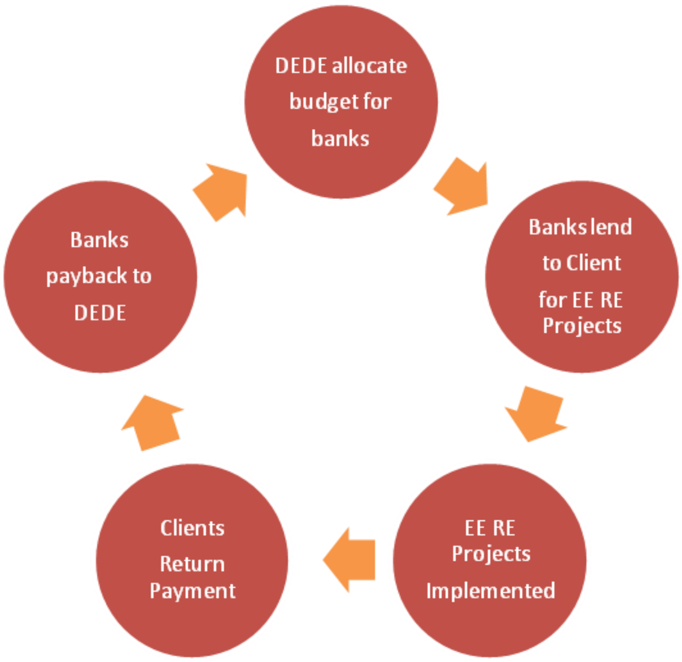


Fig. 2.13: Revolving Fund Mechanism of Thailand

In Thailand, through this process, an amount up to USD 1.25 million (approximately. Thai Baht 38.10 million) is disbursed to facilities' owners, Energy Service Companies (ESCO) and project developers for a maximum period of 7 years, at a negotiable interest rate of not more than 4%. The major achievements of the RF mechanism include reduction of oil imports, EE investments, and environmental benefits.

Multilateral agencies provide loan facilities for renewable energy promotion with a special focus on rural sectors. One such example is ***Sri Lanka***'s RERED, which received credit lines from the International Development Association (IDA).

Sometimes loans are managed by government organizations. One prominent example of this is the Indian Renewable Energy Development Agency (IREDA), which was formed in 1987 to provide assistance in obtaining international multilateral agency loans and in helping private power investors obtain commercial loans.[47]

Box 6: Indian Renewable Energy Development Agency (IREDA)

The Ministry of New and Renewable Energy (MNRE) has created a number of dedicated institutions to facilitate development of renewable energy in India. On the institutional side, the MNRE has been playing a key role in catalyzing all aspects of renewable energy development, from resource mapping to R&D investment and promotional projects. On the financing side, the India Renewable Energy Development Agency (IREDA) has a long track record of providing financial support to renewable energy projects. IREDA was established in 1987 as an independent specialized Public Sector Undertaking under the Ministry of New and Renewable Energy (MNRE), Government of India with the objective of promoting and developing new and renewable sources of energy . Since then IREDA is commonly known as financial arm of MNRE. It has completed 25 years of its existence and has played a key role in the development of renewable energy in India.

The cumulative sanctions and disbursements of IREDA to RE sector as on 31 December, 2011 were of the order of USD 3.6696 billion (Rs. 172.28 billion) and USD 1.9204 billion (Rs. 90.16 billion) respectively. From time to time the Government of India contributed equity to IREDA and IREDA has raised resources from international agencies like Kreditanstalt fur Wiederaufbau (KfW), Agence Francaise Developpement (AFD) & Japan international Cooperation Agency (JICA).

Table Sector-wise Break-up of Sanctions and Disbursements (amount in billion)

Sector	Cumulative Loan Sanction as on 31st Dec.2011	Cumulative Disbursement as on 31st Dec.2011
Wind Power	USD 1.56 (Rs. 73.64)	USD 0.95(Rs. 44.73)
Hydro Power	USD 0.90 (Rs. 42.44)	USD 0.37 (Rs.17.72)
Cogeneration and Biomass Power	USD 0.71 (Rs. 33.47)	USD 0.41 (Rs. 19.40)
Waste to Energy	USD 0.01 (Rs. 0.79)	USD 0.01 (Rs. 0.55)
Energy Efficiency and Conservation	USD 0.18 (Rs. 8.46)	USD0.0 4 (Rs. 1.99)
Solar Energy	USD 0.25 (Rs. 12.08)	USD 0.10 (Rs.4.98)
Biomass Briquetting	USD0.0041 (Rs. 0.19)	USD 0.002 (Rs. 0.09)
Biomass Gasification	USD 0.002 (Rs. 0.12)	USD 0.001 (Rs.0.05)
Bio-methanation from Industrial Effluents	USD0.01(Rs. 0.72)	USD 0.01 (Rs.0.57)
Miscellaneous	USD 0.706308 (Rs. 33.16)	USD 0.069012 (Rs. 3.24)

The Summary of the policy instruments practiced in the selected countries is given in table 2.4

Table 2.4 Country Classifications and Policy Status

Income Status	Country Name	National Targets	Market Based Policy			Financial and Fiscal Incentives		Competitive Bidding
			Price Based Incentives/ Feed-in Tariff	Quantity Restrictions /RPS	Tradable Energy Certificates	Subsidies/ Grants/Loans	Tax exemptions/ credit	
High Income Countries	Australia	√	O	ɸ	√	√	ɸ	ɸ
	Japan	√	√	√	√	√	ɸ	ɸ
	New Zealand	√	ɸ	ɸ	ɸ	√	ɸ	ɸ
	South Korea[2]	√	ɸ	√	√	√	√	ɸ
High-Middle Income Countries	China	√	√	√	ɸ	√	√	√
	Thailand	√	√	ɸ	ɸ	√	√	ɸ
Low-Middle Income Countries	India	√	O	O	√	√	√	√
	Indonesia	√	√	√	ɸ	√	√	√
	Sri Lanka	√	√	√	ɸ	√	√	ɸ
Low Income Country	Nepal	√	ɸ	ɸ	ɸ	√	√	√

√: National Level
O: State Level
Φ: Non-existent/non-operational

2.3.5 Clean Energy Fund

Governments all over the world are becoming sensitive to the externalities of fossil fuel based energy generation and are veering towards developmental models that have the least impact on the global environment and society. Some state Governments/State Electricity Regulators in India have started adopting a few global best practices, some of which are listed below

- Setting target for achieving a certain percentage of electricity production through renewable energy sources (Renewable Purchase Obligation or Renewable Portfolio Standards)
- Preferential tariffs for renewable energy
- Levying green cess on the electricity produced/consumed from conventional sources and creation of Clean Energy Funds

[2] South Korea replaced the feed-in tariff policy by RPS beginning 2012

The first two measures above pertain to the jurisdiction of electricity regulatory commissions, whereas the third creation of a Clean Energy Fund by levying green cess, comes within the powers of the government. In India the Central Government as well as few state governments have created such type of funds for promotion of clean technologies and renewables.[45]

2.3.5.1 National Clean Energy Fund in India

There was a recent decision (Union Budget 2010-11) to levy a cess of USD 1.065 (Rs. 50) per metric tonne on all coal, lignite and peat produced in India, as also on imports from abroad. The revenues from which will go towards the creation of a National Clean Energy Fund (NCEF). On 24 June 2010, the Union Finance Ministry issued formal orders for levy of the cess as a duty of excise w.e.f. 1 July 2010. The NCEF is proposed to be utilized for the development and deployment of clean energy technologies in India. A detailed analysis by WISE shows that all India coal availability will have to increase at a CAGR of 9% over the 12th and 13th five year plans in order to cope with the rising demand from the power and industry sectors and therefore, a corpus of USD 14.38 billion (Rs. 675.31 billion) will accumulate in the NCEF up to 2022. It is imperative that a substantial portion of the NCEF should be made available for development of renewables.[45]

Recently, a capital subsidy scheme by the National Bank for Agriculture and Rural Development (NABARD) through Regional Rural Banks and other Commercial Banks for installation of 120,000 solar lighting systems and small capacity PV Systems received proceeds of USD 9.9684 million (Rs. 468 million) from the National Clean Energy Fund. This Scheme will be applicable for the Solar lighting systems and other small-capacity PV Systems for systems having module capacity from 10 Wp to 210 Wp. Proposals for funding for strengthening the power evacuation lines for evacuating wind power in the states of Tamil Nadu and Rajasthan were submitted for necessary funding from NCEF.

2.3.5.2 State Clean Energy Fund

In ***India*** such initiative was taken by the state government of Maharashtra, way back in 2004. The state has taken the initiative to promote renewable energy by creating a 'Clean Energy Fund' by levying green cess on sale of electricity to industrial and commercial establishments in the state. The levy of Green Cess in Maharashtra, which was originally 4 paisa for every unit of power consumed by commercial and industrial consumers, was subsequently increased to 8 paisa. Current annual generation from this levy is about USD 42.6 million (Rs. 2000 million). The Clean Energy Fund is controlled by the State Government of Maharashtra and utilized for R&D as well as promotion of non-conventional electricity generation from Bagasse, Small hydro, Wind, Solar, Solid waste and Tidal power as well as electricity conservation measures as CFLs.

The proceeds from the fund can be used to create a revolving fund to promote investment in Renewable Energy Projects. This fund can be utilized for providing credit guarantees for loans and leveraging debt for RE projects. Creation of such type of fund will be important for mitigation of Climate Change through accelerated development of Clean and Green Energy.[45]

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Chapter 3

Stand-alone Systems for Rural Electrification

Rural electrification receives a significant place in government policies around the globe. However, the most important question remains as to which RE technology is to be adopted for rapid expansion of rural electrification. This depends on local energy needs, available resources, and methods of acceptance of different target groups. The choice and selection of RE technologies for off-grid applications would also depend on the location of the villages with respect to the conventional grid.

Over the years, different technologies have come up with solutions for energy problems in the rural areas in developing countries. Among those, RETs occupy an important place, especially in the remote and inaccessible villages in the less developed countries. However, promotion of such technologies has not been smooth without adequate support of suitable policies. In the present chapter an attempt has been made to cover the prominent policies used for promoting stand-alone renewable energy technologies used for rural electrification in the selected group of countries.

Among the chosen Asia-Pacific countries, use of stand-alone systems as means of addressing the energy requirements of the rural sector, especially with regards to remote villages, bears great significance. Solar Home Systems (SHS), Small Wind Systems (SWS),and Solar Water Heating (SWH) Systems are few examples of frequently used applications for this purpose. The major objective of using stand-alone systems is to provide fuel independent electricity in a cost effective decentralized manner to millions of people in the villages in developing countries.

Like other technologies, stand-alone systems face barriers and policy intervention are needed to lower such barriers. The barriers are mostly legal and financial. To overcome such barriers, measures such as government policies for inclusive rural electrification and financial and fiscal incentives to promote such applications for rural electrification are essential.

3.1 Policies for an Inclusive Rural Electrification Promotion

Existence of a policy framework to clarify the roles and criteria for grid expansion, mini grids and stand-alone systems serves to expand stand-alone systems in rural areas. Especially in remote villages situated far from urban or regional grids, stand-alone systems would be more economically viable than grid-expansion. However, lack of information and sometimes wrong information about areas unlikely to be served by electricity grids within a few years raises false expectations among consumers, who may believe that grid service will arrive in the future. This creates a disincentive to market stand-alone systems as consumers are reluctant to purchase what is perceived to be only a short-term solution. Instead, explicit government policies can help in disseminating information among consumers about the prospects of different energy sources in a region and may spur the development of stand-alone systems through appropriate provisions under regulations and policies.

A good example may be encouraging private sector participation to create a competitive supply side of electricity sources which in turn act as a catalyst in promoting stand-alone renewable energy sources. The Electricity Act of 2003 of ***India*** has de-licensed generation and distribution of electricity for the purpose of rural electrification.

A provincial council and the Ministry for Plantation Infrastructure in ***Sri Lanka*** recognized the need for stand-alone systems in areas where full grid electrification was not financially viable. Consequently, they included SHS in their development plans and linked their respective initiatives with the program.

Case Study: Energy Self-Sufficient Villages in Indonesia: A government initiative to incorporate renewable energy in the mainframe of the country's energy portfolio

The Energy Self-Sufficient Village (Desa Mandiri Energi) Program of Indonesia was launched in 2007. The objective of the program was to improve village-level energy security by reducing dependency of the rural community on fossil fuels, specifically kerosene. The program aimed to utilize locally available resources in the villages that have the potential to be self-sufficient in energy. Locally available resources were divided into two broad categories: bio-energy such as biofuels, and the other was non-bio-energy renewable sources micro hydro, solar energy, and biogas.

Rural self-sufficiency in energy was a strategy to accelerate the development of infertile regions in the country. Several villages were selected for which the government provided bio-energy crops such as japonica curcas, sugar-cane, oil palm, and cassava. As the program specifically emphasized biofuels, the Ministry of Agriculture was assigned a major role by the President. The Ministry of Agriculture was supposed to take the lead in studying potential areas and disseminate applied technology packages for each of the above-mentioned crops. However, other ministries were included in the program to perform their respective roles. These ministries are the Ministry of Energy and Natural Resources, the Ministry of Manpower and Transmigration, the Ministry of Home Affairs, the State Ministry of Less Developed Regions, the State Ministry of State Enterprises, and the Ministry of Fisheries and Marine Affairs.

Between 2007 and 2009, 2,000 villages were selected to be part of the program, and rural communities were encouraged to provide sufficient energy for their respective villages so that they were able to open new job opportunities, to reduce poverty, and to create other productive activities by means of increased access to electricity. [13,14,15]

3.2 Fiscal and Financial Incentives

High initial costs of stand-alone systems like SHS act as a deterrent to the expansion of such technologies. In the developing countries, low income households lack resources to afford high-cost systems. To overcome such cost-related barriers, financial and fiscal incentives are necessary. These incentives come in the form of subsidies, tax reductions or exemptions and/or grants.

Most noteworthy among these incentives is the use of subsidies and we can find a few such schemes in the less developed countries. ***Nepal*** for example, promised to provide subsidies to households installing solar home systems in remote villages through its Subsidy Policy for Renewable (Rural) Energy 2009. The same policy announced 75% subsidy on the cost of solar pump up to the capacity of 1,500 Wp, but not exceeding USD 13,500 (NPR 1,000,000).[1]

The RGGVY in ***India,*** although emphasizing grid-connected electricity supply, supports stand-alone systems powered by renewable sources, namely Decentralized Distributed Generation (DDG) systems, for the areas where grid connection is either not feasible or not cost-effective.

Jawaharlal Nehru National Solar Mission in ***India*** explicitly recognized the importance of solar-based off-grid renewable energy supply to remote areas where grid penetration is a costly and improbable choice. An ambitious target of 2,000 MW by 2022 was specified for off-grid solar power projects under JNNSM.[11] The total project cost of such off-grid solar systems will be funded through a mix of debt and incentives where the promoters' equity contribution would be at least 20%. The Government of ***India*** would provide balance financial support through a combination of 30% subsidy and/or 5% interest-bearing loans for meeting the remaining cost (50%). For Solar PV applications the benchmark cost for 2011/12 has been set at USD 5.751 (Rs. 270) per Wp (with battery) and USD 4.047 (Rs. 190) per Wp (without battery). In the case of the special category states, viz. Sikkim, Himachal Pradesh and Uttarakhand, capital subsidy to the extent of 90% of the benchmark cost would be available. In addition, same benefit is extended for setting up stand-alone rural solar power plants/packs (both PV and thermal) in remote and difficult areas such as Lakshadweep, Andaman and Nicobar Islands, and districts on India's international borders.

In addition to the above, to meet unmet community demand for electricity or in unelectrified rural areas, stand-alone rural SPV power plants with battery storage in a micro grid mode/local distribution network would be provided USD 3.195 (Rs.150)/Wp of capital subsidy and soft loan at 5%. Similarly, India also provides special assistance to water mills and micro hydro projects (MHP) up to 100 KW to be set up for stand-alone application. A capital subsidy of USD 745.5 (Rs. 35,000) per water mill and USD 2,343 (Rs. 110,000) per water mill is provided depending upon mechanical or electrical output. In the case of micro hydro projects set up for stand-alone application, similar subsidies are available which range from USD 852 (Rs. 40,000) to USD 2130 (Rs. 100,000) per KW depending on the location of the MHP.[12]

Grants are also used for creating incentives for stand-alone systems. The best examples are from ***China*** and ***Sri Lanka***. ***China's*** Renewable Energy Development Project (REDP) offered grant assistance to qualified participating PV companies to establish and sell high-quality PV systems to rural customers.[9]

Box 7 : REDP in China: Stand-Alone PV Systems

The REDP offered grant assistance to qualified participating PV companies to establish and sell high-quality PV systems on commercial basis to rural customers scattered throughout the provinces of Tibet, Qinghai, Xinjiang, Gansu, Sichuan, and Inner Mongolia. Establishing low-cost but responsive sales and service operations is particularly difficult to achieve in these sparsely populated and rugged north western provinces where population densities are less than 40 people per square kilometer.

The direct grant of US$1.50 (approximately, RMB 9.7) per Wp of PV system capacity was provided to support the development of sales and service operations. Any PV system that had met quality standards and had been sold by a qualified participating company was eligible to receive the grant after sales were confirmed. In addition to providing US$15 million (approximately RMB 96.96 million) in direct grants for PV sales, the REDP provided another US$10.5 million (approximately RMB 67.87 million) in grants for management, capacity building, technology improvement, and piloting financing schemes related to stand-alone PV applications.

By mid-2003, the number of participating PV companies had grown from 17 to 25. Between December 2001 and April 2003, PV sales eligible to receive GEF grant support were about 60,000 with aggregate sales of about 1.2 MWp. Sales were averaging about 4,000 units per month. The majority of the sales were undertaken by about eight companies. Average unit size was 19 Wp, although unit sizes might range from 10 Wp to 500 Wp. PV system retail prices ranged from US$6 (approximately, RMB 38.784) to US$10 (approximately, RMB 64.64) per Wp, depending on the type and number of end-use appliances provided.

Sales were usually made through company-owned sales outlets and independent dealers. By 2007 all members of the leading group of 18 SHS companies were engaged to some extent in contracting, with contracting sales accounting for almost half of the sales on average.[9]

On the other hand, Sri Lanka, through the Energy Services Delivery (ESD) and Renewable Energy for Rural Economic Development (RERED) program, channelized GEF grants for the promotion of SHS and Village Hydro Projects (VHP) in the rural areas of the country.[10]

Case Study: Off-grid community-based Village Hydro Projects (VHP) in Sri Lanka [10]

Community based Village Hydro Projects (VHP) were promoted through the Energy Services Delivery (ESD) project (1997–2002) and Renewable Energy for Rural Economic Development (RERED) project (2002–2011) in Sri Lanka. VHP is typically a small, run-of-the-river micro hydropower system. About 40 households, each receiving approximately 250 W of power (sufficient to light a home with compact fluorescent lamps and operate a television set or a radio) can be served at a time by a typical 10 kW capacity VHP. Additional benefits accrue through productive use of electricity by small businesses, particularly in daytime, when household demand for electricity is low.

Village hydro projects are implemented and owned by electricity consumer societies (ECS) consisting of community members. ECS are responsible for calculating and collecting flat monthly subscription fees (instead of tariff) from ECS members. These fees are used mainly for loan repayment including interest payment and expenditure incurred on operation and maintenance. Along with that, a small amount of fund is kept aside for emergencies. ECSs are also responsible for ensuring that there is no overloading of the system and that only the agreed amount of electricity is used by the members. The committees hold the right to disconnect the defaulters and to provide new connections.

Each VHP construction was financed through a combination of loan and grant supports from the ESD and the RERED projects. The International Development Association (IDA) of the World Bank extended credit to the Central Bank of Sri Lanka (CBSL), which disbursed credit funds to the investors through the participating credit institutions (PCIs). The GEF grant, used for project support and technical assistance activities, was directly disbursed by the CBSL to the respective beneficiaries. Each successfully completed VHP received a co-financing GEF grant of USD 600 (LKR 66,310.8) per KWe of installed capacity.

Loans to construct VHPs were also received from non-PCI financial institutions. The electricity consumer societies were entrusted to negotiate their loans with lenders and agree on terms including interest rates, loan amount, loan period, grace period and security. Loan size depended on the subproject cost and the repayment capacity of the ECS members. Apart from these, equity from households and other sources (e.g. provincial councils, various governing bodies under their decentralized budget, state agencies and NGOs) were used for financing.

Technical assistance for all tasks related to establishing VHPs including design, construction and operation and maintenance (O&M) is extended by the project preparation consultants (PPCs) to the ECS. The consultants also mediate between ECS and other relevant stakeholders such as provincial councils, lending institutions and the project administrative units (Project

Under the ESD, a PPC used to receive USD 9,000 (LKR 994,662) as a project preparation grant (PPG) upon successful design verification. Later, when it became clear that this amount exceeded the subproject (community-based VHPs are referred to as subprojects) development cost, and that upfront payment led some PPCs to abandon the subproject. Consequently, the PPG was reduced to USD 6,000 (LKR 663,108) with the introduction of a three staged payment system (40% payment upon successful design verification, 30% payment upon successful installation verification, and the final 30% payment six months after installation verification). Such staged PPG payments sought to ensure quality VHP design, implementation and follow-up of the performance. Along with the staged PPG, a new payment of USD 2,000 (LKR 221,036) was introduced to set up income-generating activities. However, in July 2008, the PPG was increased to USD 8,000 (LKR 884,144) under the RERED. This was done after taking into account the additional costs involved in developing sites deeper into the interior and the rising transport, transaction and labour costs. Also the incentive for setting up economic activities in villages using the electricity generated was reduced to USD 1,000 (LKR 110,518).

The effect of VHP on RET applications and uses can be traced by means of the number of households benefited by the VHP installations in rural Sri Lanka. According the RERED administrative unit, the number of beneficiary households increased by 7,952 while total installed capacity of VHPs increased by 2,120 kw between 1998 and 2011.

The impact of VHPs on rural livelihood of Sri Lanka is reflected in several indicators like saving on kerosene and other energy sources, generation of employment, productive use of electricity, gender equality and children's education.

According to impact studies as reported in a UNDP study, VHP installation has resulted in the average monthly reduction of household consumption of kerosene from 6.0 litres to 1.8 litres. The same report sates that an additional income of USD 244.30–USD 325.74 (LKR 27,000–36,000) per month is generated in a community as 90–120 person days of employment is created (based on the assumption that 3 to 4 workers work 30 days a month) after construction of each project.

Use of electricity in the VHP villages was meant to increase production efficiency, improve workplace cleanliness and product hygiene (i.e. less dirt and soot), introduce new products and increase revenue by keeping businesses open for longer hours. Electricity also enabled the opening up of information technology education and made communication facilities such as television accessible to rural communities in Sri Lanka, which in turn have a positive impact on children's education and attitudes.

Despite all the benefits of VHP projects, there are concerns associated with the anticipation of the expansion of grid to remote villages.

The electrification rate in Sri Lanka has increased from 42% in 1996 to 85% in 2009. Further the plan of the Government of Sri Lanka (GoSL) to expand national grid to at least 95% of the population by 2015 indicates that only the remotest parts in the country will remain unelectrified. Anticipating access to the national grid, many villages are losing interest in off-grid technologies like VHPs. Besides, people in many VHP villages are shifting to grid- connected electricity once the grid reaches their village.

At this juncture, several negative developments can be anticipated. With fewer members to share the costs and the physical effort required to maintain a VHP, maintenance could become a challenge for members who wish to stay on. More alarmingly, some communities might abandon the VHP in anticipation of getting connected to the grid, and then fail to obtain grid connection for years. Furthermore, with the gradual reduction in market size, some PPCs and equipment suppliers could move out of the VHP sub-sector, leaving some ECSs without maintenance and repair support.

Anticipating such outcomes, a cadre of local technicians is being trained in VHP maintenance. In addition, the introduction of net metering for RE power makes it possible for existing VHPs to supply electricity to the national grid.

Reduction in import duties stimulates markets for stand-alone systems in the developing countries where most of the equipment is imported from developed countries. ***China, India and Indonesia*** have followed the practice of import duty reductions to develop the markets. Sometimes, the government directly procures the systems on behalf of the customers and then distributes the systems among the targeted groups. ***Indonesian*** government decided to purchase Solar Home Systems from private companies through a bidding process and then provide the systems to the households for free to overcome the barrier of the high upfront capital cost.[4]

Another significant policy may be to encourage local manufacturers to produce stand-alone systems. ***China*** may be cited as an example where many nationwide public tenders were initiated during the last decade to select system integrators to design, procure and install systems like small wind turbines, PV, and SHS locally. In most cases these projects were part of bi-lateral and/or multi-lateral technical co-operation.

Case study: Husk Power Systems, Bihar (India)

The company, Husk Power Systems, provides electricity for six to seven hours each evening to about 100,000 people across 125 villages, using only rice husk.[2] The power plants that have achieved this impressive task are modest in appearance. A typical Husk Power Systems (HPS) compound is only 5000–6000 square foot of rented land with a small biomass gasifier on it, one storey tall and slim enough that two men could encircle it with their arms. There are large piles of biscuit coloured rice husk for feeding the machine, and smaller piles of black rice husk char, which is the small amount of solid waste the gasification process generates in addition to the gas. Next to the gasifier are four filters for cleaning tar and dust from the gas, and a generator in which the gas is used to fuel an internal combustion engine and generate electricity. From the compound run the HPS wires that carry electricity to houses: a local distribution grid. Grids reach a maximum distance of two to three kilometres, because, beyond that the voltage begins to drop. To further increase efficiency, the company also insists that customers may use only CFL bulbs. HPS focuses its attention primarily on villages that are off-grid, but will set up anywhere there is rice husk and a demand for electricity. As of September 2010, 35 power plants were in operation; 4 of 52 kW and the rest of 32 kW installed capacity. Once the 25 plants currently under installation are complete, HPS will have a total installed capacity of about 2 MW. HPS pays under one rupee per kilogram for rice husk, and by loading 50 kilograms per hour into one of their 32 kW power plants, can produce enough power to sustain a load of 700 typical rural households at the same time. The model seems unstoppable this year, Bihar will produce 1.8 billion kilograms of rice husk. Part of the beauty of the model is that it's built on a resource that costs not that much. When HPS first began buying rice husk for their pilot plant, local millers noticed the commodity had become valuable and started hoarding it, driving prices up accordingly. By setting up their own rice mill, dehusking villagers' rice for, HPS put the other rice mills out of business. The company signed a contract with the mill, guaranteeing that they would sell rice husk to HPS at an affordable price for the next six to eight years, and then shut down the free mill to direct the business back to the other mills.

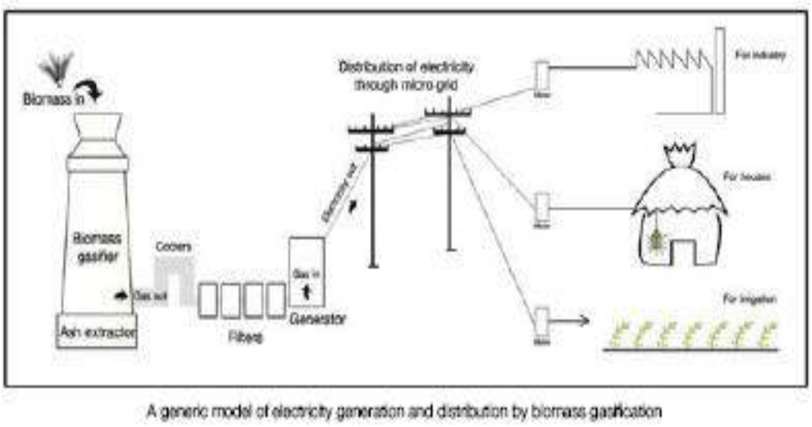

Fig. 3.1: A Generic Model of Electricity Generation and Distribution by Biomass Gasification

Box 8: Husk Power Systems, Bihar (India)	
Type of Technology	Biomass Gasification
Source of Energy	Rice Husk. Fifty kg of rice husk an hour can run a 32 kW plant. This year Bihar will produce 1.8 billon kg of rice husk; which could produce about 2.2 GW of power.
Supply Chain	Husk purchased from local mills at less than 2.13 US cents/kg (Rs.1/kg), without seasonal varition. One month's stock of husk is stockpiled during the monsoon to ensure that dry feed is available.
Plant Details	Thirty five in operation, and twenty five under instalation. Most plants are 32 kW installed capacity; four are 52 kW. Once all 60 plants are completed, total installed capacity will be about 2 MW.
Funding	Initial investments were from promotional funds. Since, then HPS has received funding from the Shell foundation, International Finance Corporation and other financial bodies. The company also receives USD 319.50 (Rs. 15,000) per kW of the system as capital subsidy from the MNRE.
Investment	Total installation costs are less than USD 1.605 (Rs. 50/watt), including distribution. Running costs are USD 426 to USD 468.6 (Rs. 20,000-22,000), including salaries, husk cost and maintanence cost.
Return Time	About 2-3 months to become operationally profitable, and 2-3 years for capital expenditure to be returned, depending on wheher subsidies are received.
End Users	Eleven to twelve thousand connections have been taken across over 125 villages, of which 80%-90% are domestic users. In all more than 100,000 people benefit from HPS electricity.
Type of Technology	Biomass Gasification

Billing a Payment	Domestic users pay USD 1.704 to USD 2.13 (Rs. 80–100) per month for a 30 W connection (two 15 watt CFLS).Electricity is available for six to seven hours in the evening in most of the plants. Payment is monthly, collected in advance by a local HPS employee
Employment Created	Each Plant employs around four people

Features to Notice

- Reliable energy services are linked to local economic development.
- The financial viability of the systems comes from their local emphasis.
- Business plugs into a local supply chain-in this case, rice dehusking, without polluting the local environment.

Customer segment that is largely perceived to be unwilling or unable to pay for electricity is both willing and able if the service is good.

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Chapter 4

Impact of Promotional Policies on Deployment of Renewable Energy

In the previous chapter, we discussed policies and financial and fiscal incentives instituted by governments for market development of grid-connected and off-grid RE technologies. Government policies and financial and fiscal incentives complement each other. For example, South Korean government used the general state budget (electric industry foundation fund) to compensate for the incremental cost incurred by utilities for purchasing power from renewable energy sources at a feed-in tariff higher than the system marginal price. The maximum collective impact is seen when different policy instruments are conceived and weaved together cohesively; often a single individual instrument has shown significant impact. Basically policy measures, policy stability which is linked to political and social stability have also been critical success factors. Under the present study, we have attempted to concentrate on specific policies to delineate their individual and collective impacts.

4.1 Impact of RE promotional policies

4.1.1 Feed-in tariff

The most prominent among the policies for market development followed by most of the selected countries is the feed-in tariff. Under this mechanism, incentives are provided to the generators through preferential tariff to guarantee an assured return for a definitive duration along with access to the grid. In ***South Korea*** during the three-year period prior to October 2008, solar photovoltaic saw an exceptional growth with a total of 99 MWh of installed capacity, aided by a generous feed-in tariff. This FIT was reduced in October 2008, to the extent of 8 % to 30 % (depending on installation size). This reduction had a significant impact, with only 10 MWh of additional capacity installed between October 2008 and March 2009.[11]

In many other countries, however, FITs together with fiscal and financial incentives contributed to the growth of the renewable energy sector. For example, India provided feed-in tariff along with other fiscal incentives like accelerated depreciation (by way of exemption from income tax) and a ten-year tax holiday for income from sale of power to promote wind energy. As a result, cumulative wind power capacity in India increased from 1665 MW in 2002 to more than 17,351.54 MW by June 2012.[10]

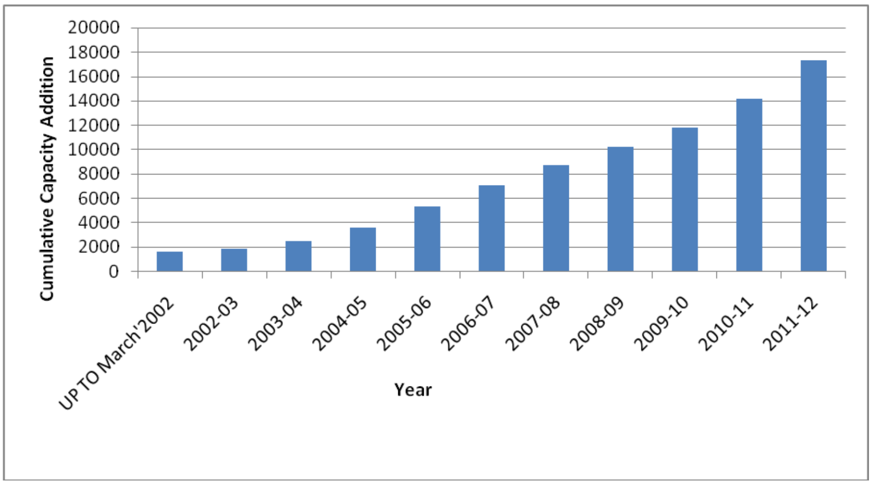


Fig. 4.1: Cumulative Wind Power Capacity Addition in India

Similarly, the growth of small hydro power in ***Sri Lanka*** could be ascribed to the introduction of Standardized Power Purchase Agreements (SPPAs) since 1998, which offered a 15-year purchase guarantee and an attractive tariff (based on avoided costs of power generation), along with provision of fiscal and financial incentives. On the contrary, the use of SPPAs based on tariff designed as a function of avoided costs of power generation has been largely unsuccessful in ***Indonesia***, because the country's decision to switch over from oil to coal based generation resulted in further lowering down of avoided cost of generation . An uncertain regulatory regime coupled with lowering the tariff below avoided costs of power generation, especially in the islands that have switched from oil to coal-based generation, made the Indonesian feed-in tariff unsuccessful.[15]

4.1.2 Quantity Setting Policies

Quantity setting policies generally called as Renewable Portfolio Standards (RPS) are relatively new in the sector in Asia-Pacific and therefore, it is difficult to visualize the impact of this regulatory instrument by country examples. However, RPS has been operational in Japan since 2002, and utilities in the country have been largely able to meet the targets. In FY 2010, total amount of renewable-energy- sourced electricity supplied to electricity utilities from such power generation facilities in Japan was 10,245 GWh (8,873 GWh in FY 2009), which is more than the specified target by 4,173 GWh for year 2010. This includes 1,336 GWh of designated photovoltaic electricity[3] that does not count towards fulfilment of the requirements.[19]

[3] "Designated photovoltaic electricity" refers to the kind of renewable-energy-sourced electricity produced at photovoltaic power generating facilities that the electric utilities are obliged to purchase under the "Excess Electricity Purchasing Scheme for Photovoltaic Power." This electricity may not be applied to the fulfillment of obligations under the RPS Act.

Table 4.1 Contribution of Different RETs in Electricity Generation (in kWh)

Power generation source	Electricity supplied (in kWh)
Wind power	4,143,413,522
Hydroelectricity	989,079,899
Photovoltaic power	16,615,435
Biomass power	3,744,516,697
Geothermal power	10,535,868
Cogeneration	4,853,396
Total	8,909,014,817
Designated photovoltaic power	1,336,893,027
Grand total	10,245,907,844

(*Source:* Report on the implementation of the RPS Act in FY 2010)

Most of the countries have put in place a certificate mechanism (like Renewable Energy Certificates of RECs) to meet Renewable Portfolio Standards. ***Australia***, however, has created a separate certificate scheme for Large Renewable Energy Technologies (LRET) and Small Renewable Energy Technologies (SRES). The impact of breaking the renewable energy targets into LRET and SRES is reflected through the country's astounding performance in solar and wind sector. As at the end of August 2011, cumulative installed capacity of solar power across the country was 1,031 MW which represents more than half a million household systems. This is more than nine times the installed capacity as at the end of 2009 and more than 35 times the total installed capacity in 2008. Moreover, more than 230,000 of these home lighting systems were installed in the first eight months of 2011. [5,6]

4.1.3 Competitive Bidding

The ***Chinese*** government's effort to reduce the price of wind electricity through competitive bidding led to abnormally low tariffs. Many projects awarded through this process remained unaccomplished due to economic viability and consequently the bidding procedure lost its appeal to the investors in China.[16]

In ***India,*** in the first phase of JNNSM, a 'reverse bidding' process was adopted for selecting companies to install solar PV and CSP power plants. The CERC declared 38.15 US cents/kWh (Rs. 17.91 per kWh) for solar PV and 32.61 US cents/kWh (Rs. 15.31/kWh) for CSP as ceiling tariff and the bidders were asked to offer discounts over the ceiling tariff. The discovered tariff for solar PV varied from 27.20 US cents (Rs. 12.77/kWh) to 15.95 US cents (Rs. 7.49/kWh) during two phases of the bidding process. Whereas the discovered tariff for CSP varied from 22.34 US cents/kWh (Rs. 10.49/kWh) to 25.99 US cents/kWh (Rs. 12.20/kWh), at an average bid price of 24.81 US cents/kWh (Rs. 11.65/kWh). The minimum tariff discovered for solar PV was as low as 15.95 US cents/kWh (Rs. 7.49/kWh) which is 51.33% below the CERC ceiling solar tariff. So, from the point of view of price discovery, the reverse bidding process was a success. However many stakeholders initially felt that some of the bidders would have tried to corner project capacities by quoting unviable rates. A clear picture of the success would therefore emerge only after the installations are operational.[7]

Box 9: The Renewable Energy Law of the People's Republic of China

On February 28, 2005 the new Renewable Energy Law of China was adopted by the Standing Committee of the National People's Congress, which was subsequently made effective from 1 January 2006. Since its enactment, the RE law was instrumental in elevating renewables to a strategic position in China. The law provides the framework for legislative initiatives designed to secure the future development of renewable energy. The goals of the law include increasing the domestic energy supply, optimizing the energy structure, ensure energy security, protecting the environment, and realizing sustainable development of the Chinese economy and society. The targets set under the law for achieving a 10 percent renewable energy share in the country's total energy consumption by 2010 and a 15 percent share by 2020 are quite ambitious and shows commitment of government towards RE development in the country.

The law identifies four schemes to guide renewable energy development in China. The cost-sharing scheme requires that the additional cost of renewable energy generation be shared nationwide by the end-users of electricity. The surcharge levied to users under this scheme comes to as little as US cent 0.03 (RMB 0.002) per kWh. The feed-in tariff scheme requires that a fixed amount (differentiated according to each renewable energy technology) be added to the price for all renewable energy generation connected to the grid. Currently, the feed-in tariff is enforced directly for biomass power, whereas for wind and solar PV power a regional feed-in tariff system is applied based on a bidding price that varies by location. The mandatory grid-connection system requires grid companies to purchase all electricity generated from renewable energy, under any condition. Finally, the national target system sets the 10% and 15% renewable energy targets for 2010 and 2020, respectively. Most of the regulations have been formulated within the framework of these four schemes in early 2007.

Subsequent to adoption of the Renewable Energy Law in 2006, China's renewable energy sector boomed, resulting in China taking a leading position globally, particularly in wind power, solar water heating, and small hydropower. By the end of 2008, China's annual renewable energy use totaled 250 million tons of coal equivalent*(tce), excluding traditional biomass energy but including large hydropower. This represented nine percent of total primary energy consumption, two percent more than in 2005. Hydropower use amounted to 180 million tce, and solar, wind, and modern biomass energy use totaled 70 million tce. This has put China well on its way to achieving its strategic objective of 10 percent share of renewable in primary energy use by 2010. According to statistics from the China Electricity Council , by the end of 2008 total electricity generation from renewable sources in China amounted to 586.7 terawatt-hours (TWh), including 563.3 TWh from hydropower (both large and small), 12.8 TWh from wind power, and 9.2 TWh from solar PV, geothermal, and biomass power combined. The share of renewable energy accounted for 17 % of national electricity production in 2008. As per the figure quoted by REN 21 website, by end of 2009 the share of Renewable energy in total electricity was slightly lowered to 16.20%.[12, 20]

4.1.4 Financial and Fiscal Incentives

So far, we have concentrated on the impacts of mandated market policies that are mostly applicable to grid-connected technologies. However, these policies are complemented by financial and fiscal incentives as we have already seen from examples of India, Sri Lanka and South Korea. But in the case of off-grid technologies and stand-alone systems used for remote village electrification, financial incentives are seen to be the most effective. Experience from different countries in the Asia-Pacific region shows that initially subsidies have been successful in promoting off-grid RETs. ***China's*** Township Electrification Program, carried out between 2000 and 2003, focused on utilization of off-grid solar PV systems using solar and small-scale wind energy to electrify more than 1,000 towns in western China. The total subsidy was over USD 309.4 million (RMB 2 billion), and the initiative benefited more than 100,000 people.[12] For many years, Japan also provided subsidies. Grants are used in ***Australia*** to promote various projects. The Renewable Energy Demonstration Program was one that successfully implemented four projects totalling USD 242.755 million (AUD 235 million) during 2009. ***New Zealand*** provided grants for installation of solar water-heating systems. Reduction in import duties is a major fiscal incentive, which motivated the promotion of renewable energy in less developed countries. Subsidies and grants have played a crucial role in providing resources for stand-alone systems in remote villages.

Rural family opts for Solar Water Heating: A case study from New Zealand

Vivien Edge and Ken Ross are a rural Kiwi family with two children. While building their new home in 2006 in a site located at an exposed ridge, they had been considered the option of designing a house that would be totally off-grid. But, the capital costs of building such a house were estimated to be USD 19,790 (NZD 25,000), an amount too high to be financially justifiable when mains power was available at the gate. Nevertheless, according to Ken, the economics of investing in solar water heating made good sense.

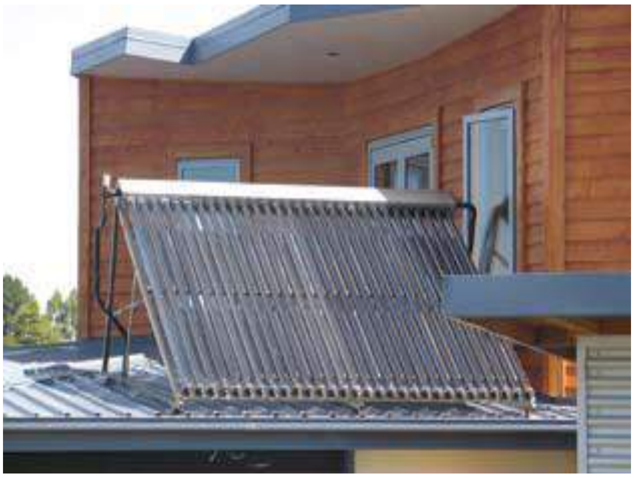
The family engaged an architect to help them design an environmentally sound and energy-efficient home. While designing the house they kept in mind a few factors.

- The building site was on an exposed ridge, with the main view to the north-east, while optimal solar gain opportunities are to the north and north-west. This meant that orienting the house required a compromise between views and solar efficiency.

- The family wanted a good indoor-outdoor flow, plenty of light and space, but also high thermal efficiency. This resulted in large windows and glass doors being designed into the house, all with double glazing to achieve thermal efficiency.

- There was no town water supply available at the site. Therefore, it was prepared to harvest rainwater from roof, store it in 2×25,000 litre tanks, and pump the water into the house. This constraint on water supply meant the family was conscious of the need to use water efficiently, irrespective of the solar water-heating considerations.

- The double storey design, with multiple mono-pitch roofing areas, posed a challenge to finding an ideal site for the solar collectors of the water-heating system. The choice of a site needed to take into account the optimal pitch and angle to the sun, keeping the system close to the main hot water tank, sheltering the system from strong winds, and minimizing its intrusion into the view from upstairs windows.



The roof-top solar collector

While investing in the solar water-heating system, the family wanted to ensure that they were making a sound and long-term investment. After researching through the internet and 'Home and Leisure Show', they decided to chose a SolarPeak AP30 system in conjunction with a specialised 300 litre hot-water tank. Their key reasons for choosing this system were

- the warranties offered with the system
- the reputation of the supplier and their franchised installers
- the fact that the supplier was accredited by the Solar Industries Association, and was also able to offer a government subsidy scheme on solar water-heating installations through the Energy Efficiency and Conservation Authority (EECA).

The economic assessment of the system was straightforward. The cost over and above a standard hot water installation was around USD 3,166.4 (NZD 4,000). At the current and forecast electricity prices, this provides a payback of about five years (the equivalent of putting money in the bank and earning about 20% interest).

The family rely almost entirely on the sun to receive hot-water for eight months of the year (from late August through to mid-May). However, they switch on an electrical boost element in the hot-water tank during the mid-winter months. The electrical boost is on a timer, and will only come on between the hours of 7 pm and 10 pm and that too, only if the temperature of the water in the tank is below 60 °C. The family also occasionally turn on the boost at other times of the year if there are extended periods of bad weather.

The system incorporates its own pump that circulates water between the collector panel on the roof and a heat exchanger in the hot-water tank. The pump runs when the temperature in the solar collector is 10 °C higher than that in the hot-water tank, thus heating the water in the hot-water tank.

The family use hot water for four showers a day, plus whatever is needed for the kitchen sink and hand basins. The family never goes without hot water.[21]

In many rural electrification programs, multilateral agencies collaborate with national governments. For example, the Government of Nepal has executed the Rural Energy Development Program (REDP) jointly with UNDP and the World Bank since 1996 to promote decentralized renewable energy, specially the community-managed micro hydro projects in rural areas. Under the REDP, rural communities have commissioned a total of 185 community-managed micro hydro systems with a total output of 2,477.2 kW benefiting more than 200,000 households. In addition, a total of 4,022 toilet-attached biogas plants, 2,119 solar home systems and 9,795 ICSs including 247 institutional ICSs with kitchen and store facilities in primary schools have also been installed.

Box 10: Improved Water Mill Projects in Nepal

In most of the hilly and mountain areas of Nepal, agricultural product processing such as milling, hulling and shelling is done traditionally using water mills. Realizing its need and effectiveness in socio-economic upliftment, subsidy is being provided by the Government of Nepal to improved water mill program since 2003/04 (NFY 2060/61). This scheme is being executed under the Renewable Energy Sector Support (RESS) program.[1,2]

Objectives

- To improve the living conditions of rural households, especially that of the traditional water millers, women and children.
- To improve the sustainability of the Improved Water Mill (IWM) sector as a whole through institutional and local capability development.

Subsidy for improved water mill is as follows:

1. USD 162 (NPR 12,000) for grinding and USD 364.5 (NPR 27,000) for other end-use activity in all districts except 15 remote, or inaccessible districts
2. USD 27 (NPR 2,000) for grain grinding and USD 47.25 (NPR 3,500) for other end-use activity in 12 remote districts and inaccessible districts
3. USD 40.5 (NPR 3,000) for Grinding and USD 60.75 (NPR 4,500) for other end-use activity in 3 very remote and inaccessible districts

Achievement of IWM Programme (2004 - 2010)

- Installation of 6,349 improved water mills
- Improved livelihood of 330,148 rural households
- Reduced drudgery of more than 330,000 women by reduction of 2 hours work per milling
- Increased income of IWM owners by 25% in case of SS and 100% in case of LS IWM
- More than 850 rural households benefited from installation of 17 IWM electrification systems
- Creation of additional employment for more than 1,000 people in IWM sector
- Well established local service providers network: 16 IWM service centres, 15 GOAs and 17 IWM kit manufacturers

China is another country which has mobilized grants from international organizations. The Chinese Renewable Energy Development Project (REDP) estimates that 400,000 solar home systems were distributed during 2006–2010.[17]

Indonesia, in collaboration with the UNDP, launched an integrated micro hydro development and application program in 2007. The objective of the program was to utilize the country's hydro energy potential specially for rural electrification.

Case Study: Integrated Micro Hydro Development and Application Program (IMIDAP): Indonesia

The Integrated Micro Hydro Development and Application Program (IMIDAP) of Indonesia tried to address the country's rural electrification challenge. The program utilized donor funds from the Global Environment Facility to tap the hydro potential of the country by means of micro hydro projects.

The program was a comprehensive package of capacity development designed to assist the Government of Indonesia to achieve the following objectives

1. Increase the micro hydro business opportunities for local SMEs.
2. Implement a number of community-based micro hydro projects in rural Indonesia.
3. Increase joint project implementation involving private sector and rural communities.

In short, the main activities the project has undertaken included provision of a wide range of capacity building measures, which include technical training as well as business plan development for local micro hydro developers, workshops and private or community-based users. The project, however, did not cover investment and financing for building micro

Availability of loans, interest subsidies and loan guarantees also contributes to the promotion of renewable energy. However, only facilitating disbursement of credits without other complementary policies may not be very successful. One example is that of Thailand, where low-interest loans through revolving fund facilities along with an adder rate (premium rate similar to FITs) contributed enormously to renewable energy growth, which is illustrated in table 4.2.[14]

Table 4.2: Renewable Energy Development in Thailand

Progress on Renewable Energy Development					
Category	Unit	Existing 31 Jan 2010 (1)	Goal 2011 (2)	Expected 2011-12 (3)	% Comparison (1/2)
Natural Energy					
1. Wind	MW	5.13	115	200-300	4.5%
2. Solar					
2.1. Electricity Generation	MW	38.6	55	145	68.4%
2.2. Water Heating	ktoe	0.5	5	5	10%
3. Hydro	MW	67	165	172	40.6%
Bio Energy					
4. Bio Mass					
4.1. Electricity Generation	MW	1,844	2,800	2,400	58.7%
4.2. Process Heating	ktoe	3,071	3,660	3,600	83.9%
5. Bio Gas					
5.1. Electricity Generation	MW	79.6	60	≥100	132.7%
5.2. Process Heating	ktoe	201	470	≥500	42.7%
6. Municipality Solid Waste-MSW					
6.1. Electricity Generation	MW	5.6	78	77.5	7.2%
6.2. Process Heating	ktoe	1.09	15	15	7.3%
Bio Fuel					
7. Ethanol	ML/ day	1.2	3.0	3.00	40.0%
8. Bio Diesel	ML/ day	1.8	3.0	3.00	60.0%
Total Electricity	MW	1,839	3,273	3,500+	56.2%
Total Heat	ktoe	3,274	4,150	4,000+	78.9%

4.2 Success and Failure Factors of RE Promotion Policies

The foregoing discussion shows that most countries have adopted a 'policy package' approach, rather then enunciating stand-alone policies. Since this mechanism works in the interactive mode, success or failure of one individual policy will depend on the effectiveness of other complementary policies. Besides, several political, social and economic factors contribute to the impact of these policies.

In this Chapter an attempt has been made to illustrate several success and failure factors of major policies pertaining to both grid- connected and off-grid technologies. In doing so the focus was on success or failure of individual policy instruments. But as and when the situation demands, emphasis was given to the combined impact of policies.

4.2.1 Success Factors of Feed-In Tariff

- **They provide a higher price to the generators** to stimulate increased supply of renewable energy to the grid. It also ensures a shorter payback period for investments which attracts small and medium enterprises. While removing the barriers of market entry for these small investors, possible market monopoly of large corporates is also avoided.
- FITs can be designed according to the variations in RE technology, market structure and location, which makes the system flexible, thereby making it amiable to price adjustments, when necessary after fixed periods.
- A secured return over years for investors reduces risk to increase creditworthiness of projects.
- A sustainable mechanism of incremental cost recovery either through budgetary financing (Like South Korea) or by pass-through to end users by leveraging equal surcharge (like in Japan) may help the utilities in reducing cost burden and encourage them to buy electricity from renewables even after meeting their obligations.
- A strong regulatory framework to hasten up timely award of tariff.

4.2.2 Failure Factors of Feed-in-Tariff

- Tariffs are not easy to determine at the beginning as it is not always possible to discover true costs. This happened during the wind power tariff determination in China where the government experimented with a two-track tariff system consisting of a government administered price and concessional bidding procedures between 2003 and 2008 to discover the price of wind energy.
- Consistently high prices of electricity generated from renewable energy sources create financial burden on the utilities that they may not be allowed to pass on to the end users and are not compensated by the government. Therefore, a paradoxical situation may appear where the DISCOs may be encouraged to shift towards a cheaper source of energy like coal as is happening in Indonesia.
- Feed -in tariff not adjusted to field performance may cause market inefficiency.

4.2.3 Success Factors of Renewable Portfolio Standards

- Least- cost option for promotion of RE.
- Technology-neutral RPS promotes least-cost RE projects which bring down the early cost of a technology and thereby create a competitive market for different renewable energy technologies. Thus, price of electricity generated from renewable energy sources becomes lower.
- The Government's initiatives in compensating the utilities for the extra cost may make the policy sustainable and more favourable to the utilities. This may be done by means of subsidies or incremental cost transfer to end- users.
- Long term RPS setting creates certainty regarding future market share. This helps in attracting new investment in RE sector.
- Facilitates the creation of Green Certificate Market that helps liable entities to fulfil portfolio obligations without physically purchasing renewables. A green certificate mechanism

encourages generation of electricity and attracts investments. This has been observed in Australia where introduction of LRET and SRES schemes has created a large market for electricity generation.

4.2.4 Failure Factors of Renewable Portfolio Standards

- Lack of flexibility makes it difficult to fine-tune or adjust targets in the short term if required.
- Recovery of incremental costs borne by utilities to meet purchase obligations exerts burden on the utilities. This in turn may promote only few technologies with least cost ignoring the main objective of promoting renewable energy.
- Targets set the upper limit for development of renewable. Japan's electric utilities have historically met their annual targets and banked the purchase made in excess of the target for subsequent years. This results in lower power purchase from renewable energy sources in subsequent years.
- Weak enforcement mechanism with inadequate penal provisions destroys the RPS market.
- High concentration only at locations with high resource efficiency and thereby low cost may create regional imbalance in pricing of energy. As a result locations with high generation may get electricity at a lower price while utilities in other places may need to spend more to buy certificates. This may cause a downward pressure on targets ultimately vitiating the purpose.

4.2.5 Success Factors of Competitive Bidding

- Reduction of prices through market-based pricing, which promotes the minimum cost technology. As a result, this may be the most favourable policy for end consumers and the government.

4.2.6 Failure Factors of Competitive Bidding

- While guaranteed price mechanisms like feed-in tariff could tend to over- reward investors, competitive processes also face the risk of unsustainable price bids, merely to corner capacities. Extremely low price of energy acts against the motivation of investors and sends a bad signal to the industry. The example of China in administering competitive bidding in wind power sector, which failed due to the low price quoted while acquiring contracts and thereafter failed to commission the project. Ultimately China shifted their focus towards feed-in tariff policy.

4.2.7 Success Factors of Subsidies and Grants

- Government's strong willingness to spur renewable energy supported by a consistent mechanism to release funds.
- Proper administration of subsidies to reach the intended targets.
- A healthy mechanism of recovering costs of subsidies over time will be useful to maintain sustainability. For example, In Thailand, the bulk power supplier is not affected financially by the bulk power subsidies provided for financing rural electrification because the supplier

is able to recover the subsidies with higher prices to its urban customers – a system whereby the urban customer cross-subsidies the rural customer.

- Grants provided for demonstration projects through proper mechanism may be successful. Australia is a good example of such grants.

4.2.8 Failure Factors of Subsidies and Grants

- Subsidies provided for a long term without reforms create unnecessary financial burdens on the government and thereby makes the receiving entities vulnerable to financially critical situation.
- A long- term subsidy disbursement mechanism makes recipients inefficient, especially in case of operational subsidies and once done away with, the recipients fail to maintain their operational efficiency.
- Disbursing grants before materialization of projects may undermine the whole purpose of the grant.

4.2.9 Success Factors of Tax Incentives

- A suitably structured tax policy with strict enforcement mechanism can remove problems associated with tax payments and discourage bad practices.
- Tax incentives may reduce prices of RETs to bring them on par with conventional technologies.

4.2.10 Failure Factors of Tax Incentive

- Tax incentives on investments reduce operational efficiency. This happened to the Indian wind farms in the early 90s. After getting the benefits of investment tax credit, the wind farm owners lost interest in maintenance and operation of wind farms, which lowered capacity utilization factors. Therefore a better incentive mechanism may be a production tax credit, which motivates the generators for effective operation of plant to generate more electricity.
- A bad administration system reducing the collection efficiencies may make the incentives to fail.

4.2.11 Success Factors of Loans

- A good mechanism of loan recovery like revolving funds can encourage the bankers to provide more finances to RETs.
- Incorporating microfinance institutions in loan financing supported by government policies is important, especially for stand -alone systems.
- Guarantees from governments may overcome the lack of faith in technologies.
- Soft loans and interest subsidies from governments may encourage institutions to channelize loans in a targeted manner.
- Soft loans can leverage more capacity addition than subsidies.
- Encourages government institutions including banks to come up with targeted loans.

4.2.12 Failure Factors of Loans:

- Too short loan periods may deter the investors.
- A steep interest rate expands the payback period and hence interest subsidies may be needed in high interest regimes.

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Chapter 5

Key Findings and Way Forward for Less Developed Countries

In this chapter, the best practices in the field of RET policies and regulation in the selected group of countries would be derived as the way forward for the less developed countries in the Asia-Pacific region for accelerating the growth of RETs. The key findings of the study would be spelt out in brief in terms of general experience and policy-specific experience.

5.1 General Experience

- A review of policies across the set of selected countries shows a clear distinction between the policy setting approach adopted by the developed, developing and less developed countries depending on the gross national income, size of the power sector, investment climate and economic and socio-political stability. For example, developed countries like Australia and South Korea and developing countries like ***China and India*** are adopting a comparatively more diverse set of policy and regulatory measures for promotion of RE, whereas the less developed countries like Nepal have utilized international grants and funds effectively for promotion of RE in the initial phase.
- It is noticed that a tailor-made approach to designing policy and regulatory instruments has proved successful in some countries. Policies should be designed to suit the actual conditions like resource availability, type of market, stage of market development, supply and demand volume and nature of risks as well as institutional and administrative capabilities of Government/Regulators in the particular country. For example, in order to encourage small-scale RE technologies in **Australia**, the Renewable Energy Target (RET) was split into two parts, Large scale RE target (LRET) and Small scale RE scheme (SRES).[3] The utility/retail supplier of electricity has mandatory targets for both LRET and SRES. Along with the large scale RE technologies, small scale RE technologies are entitled to get a certain number of small-scale technology certificate (STC) based on the amount of electricity the system produces or displaces. The electrical utilities have an obligation to purchase specified quantity of certificates generated from large-scale and small-scale RE technologies over a specified period.

  India, a developing country from the sample, has introduced the REC mechanism to complement the state-wise RPOs. The REC mechanism has been introduced as an equalization mechanism to improve the overall economic efficiency of RE deployment since the RE potential is distributed across a large geographic area in India. Both these tailor-made approaches have helped in accelerating the growth of RE in the respective countries.

- The choice and order of policies are critical to policy effectiveness and to obtaining the desired results. The existence of basic legal and regulatory framework, as well as institutional and administrative efficiency, is 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 policies are introduced. Otherwise, policies may fail to deliver the expected results.[1]

- It may not be true that policies which successfully lead to capacity addition of RE are 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. For example, in ***India*** wind power capacity addition in the initial phase (1990–1994) was due to the attractive tax benefits offered by the federal government and some state governments. This tax benefit was subsequently factored in by the Regulators while awarding the feed-in tariff and later on withdrawn by the government to increase the economic efficiency of wind power projects.
- Collective policy impact and compatibility need to be considered. The coexistence of re-inferring policy instruments has the potential to result in complex interactions and un-intended results. Thus, before selecting the particular policy and regulatory instruments for promotion of RE, policymakers/regulators need to ensure compatibility among policy and regulatory instruments so as to avoid any undesirable results due to their combined impact.
- Policy and regulatory design is a dynamic process. It has been noticed that some of the developed/developing countries from the sample have tried different types of policy and regulatory instruments to support RE development. Important policy shifts have been made, to accelerate the development of RE. For example, ***China****,* after the experience of unsuccessful concessional competitive bidding rounds during 2003–2005, reinstated the FIT policy for procurement of wind- power- based electricity zone-wise FIT.[6] **South *Korea*** has made an important policy shift, i.e. from feed-in tariff to quantity-setting policies, to encourage RE deployment in the country due to the rising concern of recovery of incremental cost associated with RE procurement.[7] In order to realize the ambitious targets of grid-connected solar capacity addition specified under JNNSM the Federal Government in ***India*** has amended the National Tariff Policy and made provision for a mandatory 'Solar specific RPO' at state level. Further, in order to reduce the impact of higher power purchase cost on utilities, the government has initiated a competitive bidding process for procurement of solar power from the projects commissioned under JNNSM in the first phase.[8]
- 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 addressed in parallel. For example absence of a sustainable cost recovery mechanism for utilities, transmission infrastructure capable of RE integration, as well as clear rules on transmission access and connection may hinder the growth of RE irrespective of the existence of sound policies.[1]

5.2 Policy-specific Experience

5.2.1 Experience with Feed-in Tariff policies

In the sample countries analyzed, all countries except Nepal and New Zealand have implemented FIT policies for promotion of RETs. The experience with FITs shows that this instrument has largely succeeded in accelerating the growth of RE. FIT policies can effectively promote sustained deployment of RE capacity, especially when other key policy and regulatory instruments are also in place. FIT policies have been particularly effective in ***India, Sri Lanka, Thailand, and Australia*** but have largely been unsuccessful in ***Indonesia*** due to the fact that the FIT in Indonesia was set below the avoided cost of generation. The other issues that affected the growth of RE in Indonesia include high level of regulatory uncertainty and lowering the avoided cost of generation due to the policy of switching from oil to coal-based generation. This made the FIT even more unattractive to the investors. Lack of clarity about how the government will cover the incremental cost of RE purchase by the utility, also adversely affected RET promotion.

The effectiveness of FIT policies seems to be strongly linked to the existence of fiscal and financial incentives. This is particularly important for developing countries where uncertainties are higher and risks are more diverse. In particular, FIT policies have been less effective when the FIT design is structured as a function of wholesale electricity markets or pegged to oil or coal prices. This type of preferential tariff does not provide the minimum level of certainty on revenue flows required to attract private investment.

A FIT policy which will ensure a reasonable return on investment for sufficiently longer duration will attract investors. For example, in ***India*** the regulators are awarding RE technology specific 'generic tariff' to RE developers. The SERCs across the states usually fix the benchmark operating and financial parameters for RE power projects to be commissioned in the respective states. Benchmark pricing typically adopts a representative RE plant for determination of tariff. The normative performance and financial parameters were set in such a way that the investors get reasonable returns after recovering the underlying costs. The FIT policies have played a pivotal role in accelerating the development of RE in India.[4]

The literature review suggests that FIT policies 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 the sector is not mature enough for a competitive environment.[1] In such case, FIT provides a degree of price certainty necessary to counterbalance the other set of risks (such as regulatory uncertainty or off-take risk).

5.2.2 Experience with quantity-setting policies

The study suggests that an RPS or quota system can only be implemented effectively where the electricity market is more mature and institutions are experienced. Further, the legal and regulatory frameworks and the process for amending them need to be strong and predictable, competition practices and rules should have been established, and players are both experienced and financially strong (such as in countries with large sophisticated utilities). The experience of quota setting policies in the sample countries analyzed in the study substantiates the above facts. For example the *Indian* state RPO framework is lagging in effective enforcement and compliance mechanism due to absence of strict penal provisions and to some extent due to absence of recovery of the incremental cost associated with purchase of RE. With introduction of REC, the issue of recovery of incremental cost has been solved to a large extent. In the case of *Japan,* the policy of allowing the utilities to carry forward the excess renewable energy purchase to the next year (termed as banking) has been emerging as a deterrent to RE deployment since the banking provision effectively reduces the quantum of RE purchase for meeting the subsequent year’s RPO target.[9]

5.2.3 Experience with competitive bidding

The experience of competitive bidding for procurement of RE reveals that competitive bidding could be a useful tool for ensuring the economic efficiency of RE deployment at least in some cases. But very often the rush to block capacities by bidding for low tariffs has resulted in many projects becoming unviable and consequently not being installed. For example, in ***China*** instead of revealing the cost of wind power, the bidding process generated very low bid prices and later the bidder was not able to commission the wind power projects. Consequently, the low prices from the bidding procedure affected other wind projects in the country. It is possible that these low prices may be the result of speculative behaviour by bidders (low correlation between capacity utilization factors and offered prices).[2] The bidding design and process is complex, and requires a sophisticated level of regulatory and administrative capabilities. Well-designed pre-qualification criteria to avoid speculative behaviour of bidder and to lower the risk of construction delays need to be put in place. But the actual enforcement of project completion guarantees remains an issue of concern.

5.2.4 Experience with Financial and Fiscal policies

Most countries around the world offer some form of fiscal incentives in terms of various tax credits/concessions or financial incentives in terms of subsidies, rebates, and production-linked incentives for promotion of renewables. In order to get the desired results, the fiscal and financial policy instruments needs to be set in line with the prevailing government policies, targets and market realities. Similarly, support in this form needs to be gradually reduced as the RE technologies progress towards the stage of commercial viability. But the most important thing that needs to be kept in mind is that such types of support (financial and fiscal) have a direct bearing on government budget. Therefore, particularly in the developing countries and least-developed countries (such as land-locked and island countries), the volume of finance required and its sources are an issue of great concern. While RE deployment in the developing/least-developed countries is necessary to minimize climate change impacts on a global level, other more pressing developmental priorities compete for the use of budgetary resources.

For this reason, in the least developed countries policies to support RE development should be designed and introduced in combination with strategies that clearly identify sources of finance. The strategy adopted for deployment of RE by ***Nepal***, the least developed country from the sample countries, may be cited as a good example. Nepal, under its Rural Energy Development Programme (REDP)[12], has received total donor funding of about USD 30 million (NPR 2,237 million) from World Bank and UNDP during phase I, Phase II and Phase III collectively. The REDP program resulted in installation of 307 micro hydro plants, 3,099 solar home systems, 6,811 toilet attached biogas plants and 14,255 improved cook stoves thereby benefiting more than 0.5 million people living in remote areas. Later on, the government has also started giving capital subsidies for deployment of RE technologies. Other options for raising finance for the least developed countries may be using concessional financial flows from developed countries to leverage private financing and strengthening the performance of utilities and DISCOMS

To sum up, policy makers and regulators will have to ensure that the design of different policy mechanisms and the policy mix should succeed in deploying RE with the lowest possible incremental costs and volume of subsidies.

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