

4

New and renewable sources of energy

Introduction

From times immemorial, non-conventional energy sources have been used for various applications such as for drying farm produce using solar energy and pumping out water using windmills. The general interest in non-conventional energy sources in India received an impetus following the oil shock of the 1970s, backed by political commitment on the government's part. Today, India boasts perhaps the only Ministry of Non Conventional Energy Sources in the world. The Ministry manages one of the world's largest renewable energy programmes covering the whole spectrum of renewable energy technologies for a variety of grid and off-grid applications. The country has the largest decentralized solar energy programme, the second largest biogas and improved cookstoves programme, and the fifth largest wind power programme in the world. A substantial manufacturing base has been created in a variety of new and renewable sources of energy (NRSE), placing India not only in a position to export technology but also to offer technical expertise to other countries. These sources have begun to emerge as an attractive option sometimes the only one, to provide light and power to areas too remote for grid electrification. Promotion of renewable energy sources is an integral component of the country's strategy for sustainable development.

NRSE are central to Agenda 21. This chapter examines the convergence between initiatives taken in India and the objectives set out in Agenda 21 towards the promotion of NRSE. The chapter begins with a brief overview of the sector in India highlighting the organizational structure of the sector. This is followed by a discussion of the various strategies proposed in Agenda 21, (and including the report of the IX session of the CSD) to promote the growth of NRSE. The next section evaluates policies, programmes and other initiatives taken by the government to highlight achievements and concerns in the sector, vis-a vis the goals set out in Agenda 21. Finally, directions and strategies are proposed that will go towards realizing the goals set out at the Earth Summit.

Overview of the sector in India

Organizational structure

Interest in RETs started from the early years of Independence. The first step towards a dedicated organizational framework was taken in 1981 when the Commission for Additional Sources of Energy (CASE) was set up in the Department of Science and Technology. A year later, an independent Department of Non-conventional Energy Sources (DNES) was created in the Ministry of Energy, to focus attention on this sector. This indicated that the stage of commercialization of NRSE devices had been reached, requiring a range of conducive policy measures. To facilitate commercialization and market development, the Indian Renewable Energy Development Agency Limited (IREDA) was established in 1987. The IREDA functions as the promotional and financing arm of the Ministry and has been able to tie up funds from domestic and international institutions for lending to end-users, manufacturers, financial intermediaries and entrepreneurs, predominantly in the private sector. In 1992, the DNES was elevated into a separate Ministry of Non-conventional Energy Sources (MNES), reflecting the political commitment towards the promotion of NRSE. The Ministry is broadly organized into six groups dealing with rural energy, solar energy, power from renewables, energy from urban and industrial wastes, new technologies and administration and coordination.

The Ministry is implementing several programmes in these areas and has at the same time sought to promote the participation of the private sector through an encouraging policy environment. Programmes for dissemination of renewable energy technologies (RETs), are implemented through state nodal agencies (SNAs) and NGOs. The MNES has nine regional offices in different state capitals, besides a network of autonomous research organizations, NGOs, R&D and financial institutions and private entrepreneurs. These regional offices monitor, supervise and create awareness, liaise with state agencies, NGOs and project promoters, and provide feedback from the field. The programmes of the Ministry have a strong R&D component. A number of research institutions are assigned specific R&D projects not only to develop new technologies but also to improve the cost-effectiveness of existing systems. Besides farming out R&D projects, the Ministry has also set up three specialized institutions, the Solar Energy Centre (SEC), Centre for Wind Energy Technology (C-WET) and the Sardar Swaran Singh National Institute of Renewable Energy (SSSNIRE) to provide a range of services for testing upgradation and standardization of devices and their components. The Ministry is also actively involved in

generating awareness and building capacity in the development and use of NRSE.

A women's cell was been set up in 1997 to review progress and schemes with a view to ensuring, that empowerment of women is fostered through the Ministry's programmes. Promotion of international co-operation remains high on the Ministry's priorities.

The MNES with increasing involvement of the private sector and NGOs has been successful in creating one of the most broad-based renewable energy programmes in the world today.

Renewable sources of energy and Agenda 21

Agenda 21 is founded on the principle that integration of environmental and developmental concerns and greater attention to them will lead to the fulfilment of basic needs, and improved living standards for all, better protected and managed ecosystems and a safer, more prosperous future. To promote the growth of NRSE several strategies — to be jointly undertaken by governments, local institutions, NGOs, the private sector and the international community — were proposed in Agenda 21 and reiterated at the IX session of the CSD. These strategies include the following.

- Identify NRSE suited to the particular circumstances in individual developing countries, develop and implement policies and address existing constraints to increasing their growth. Develop and implement measures to make renewable technologies more affordable.
- Create conditions for the participation of the private sector in the development of NRSE.
- Promote and strengthen research, development, demonstration and institutional capacities.
- Encourage education and awareness raising programmes at the local national, sub-regional and regional levels and strengthen information networks, compilation and dissemination systems concerning NRSE.
- Strengthen financial support to developing countries for the promotion of renewable energy as well as transfer of advanced NRSE technologies and practices. Coordinate energy plans regionally and sub-regionally, where applicable and study the feasibility of efficient distribution of environmentally-sound energy from NRSE.

The following section reviews how policies and other initiatives in the country have sought to address Agenda 21 concerns, in most cases even prior to 1992.

Review and analysis of policies and programmes

Since the emergence of a formal institutional set-up for the promotion of NRSE in the early 1980s, there have been concerted efforts towards identifying NRSE suitable for the country, intensifying R&D efforts to make RETs more user-responsive and affordable, setting up demonstration and pilot projects to establish the usefulness and commercial viability of RETs and improving support infrastructure for the financing and maintenance of applications based on these technologies. A large number of national programmes have evolved covering the entire spectrum of NRSE to meet a variety of energy requirements. In what follows, the major programmes and policies for the promotion of NRSE are discussed and analyzed to assess achievements and concerns vis-a-vis the objectives set out in Agenda 21.

Achievements

National programmes and policies

Agenda 21 emphasizes the need for a set of national programmes and policies to promote the use of NRSE. The growth of renewable energy in India has been possible due to a conscious and proactive government commitment towards its promotion that existed even prior to the adoption of Agenda 21.

The organizational structure for NRSE was significantly strengthened in the 1990s. At the apex level, the Department of Non-Conventional Energy Sources was upgraded to the level of a Ministry. At the same time, new institutions were created to cater to the new and growing challenges faced in expanding the role of this sector. These organizational changes have been simultaneously matched with a widening and deepening of programmes aimed at specific technologies.

The major programmes supported by the government include the following.

1. Rural energy

- National Programme on Biogas Development
- National Programme on Improved Cookstoves
- Integrated Rural Energy Programme
- Rural Energy Entrepreneurship and Institutional Development
- Women and Renewable Energy Development

2. Solar energy

- Solar thermal energy Programme
 - Solar water heating
 - Solar cooking
 - Solar air heating

- Solar buildings
- Solar Photovoltaic Programme

The programme envisages direct conversion of sunlight into electricity for such decentralized applications as fixed and portable lighting units, water pumping, small power plants, power for telecommunications, railway signalling, offshore oil platforms, and TV transmission. Noteworthy progress has been made in the following areas.

- Solar lanterns
- Solar home lighting systems
- Solar street lighting systems
- SPV power plants
- SPV water pumping units

3. Power from renewables

The following technologies are making substantial contributions to the share of renewable sources, which makes up about 3% of the total grid capacity.

- Wind
- Small hydro
- Biomass (including bagasse-based cogeneration)
- Solar

4. Energy from urban and industrial wastes

5. New technologies

Since its inception, the MNES has been promoting RD&D to tap the potential of other forms of energy namely:

- Chemical (fuel cells)
- Hydrogen energy
- Alternative fuel for surface transport (electric/battery-operated)
- Geothermal energy
- Ocean energy (tidal power, wave power and ocean thermal energy)

The details of these programmes and their achievements are discussed in Annexure 4.1. A snapshot picture of achievement under these programmes since 1992 is shown in Table 4.1.

Table 4.1 Renewable energy technologies: estimated potential and achievements

Technology	Potential	Cumulative installation up	
		March 1993	December 2001
Family-size biogas	12	1.76	3.27
Improved cookstoves	120	14.50	33.8
Solar			
Solar thermal			
Solar hot water systems	140	0.25	0.60
Solar cookers (million)		0.29	0.48*
Solar photovoltaics	20		82.0 MWp**
Biomass			
Biomass gasifier (MW)	17000 MW		
Biomass power/Co-		-	42.8
Biomass power/Co-	19,500	-	358.00
Windfarms (MW)	45000	53.00	1507.00
Small hydro (MW)	15000	93.00***	1423.00
Waste to energy (MW)	1700	-	17.10

* As in April 2000

** Of this, 29 MWp SPV Products have been exported

*** The MNES was handling projects up to 3 MW capacity initially, but recently projects up to 25 MW capacity have been transferred to its charge from the Ministry of Power.

Source. MNES (2002)

While initially technologies were promoted through design and development support, and through establishment of large-scale demonstration projects, the government has placed much greater emphasis on developing market linkages and promoting commercialization since the 1990's by involving the private sector and providing fiscal and tax incentives, rather than public investment. The main elements of the government policy include:

- Budgetary support such as for financial assistance or demonstration projects
- Institutional finance through IREDA and other financial institutions for commercially viable projects;
- Promoting private investment through fiscal incentives, soft loans, capital subsidies, facilities for wheeling and banking of power for the grid and remunerative returns for power provided to the grid. These incentives differ across technologies, applications and regions
- Institutional capacity building for a range of services ranging from research to marketing
- Education and information dissemination

These incentives have led to a phenomenal growth of the private sector and have sought to make NRSE more affordable to the final consumer.

Private sector

The role of the private sector, as an agent of technological innovation and financial resources, has been stressed in Agenda 21. As discussed above, the MNES has catalyzed the creation of a policy regime conducive to private investment in development, manufacture, ownership and operation of NRSE projects. Another favourable feature has been the interest evinced by financial institutions to provide the required funds for such projects. As a result, a number of known domestic and international names are manufacturing and marketing NRSE systems on their own and with foreign collaboration. While the manufacture of solar cells, photovoltaic modules, wind and hydel turbines etc. is by and large in the large sector, there is a significant presence of units in the small and medium sectors, particularly catering to the requirements of rural energy devices such as biogas plants, biomass briquettes, solar cookers, etc. The country also exports several NRSE devices, such as gasifiers and wind turbine equipment to developing and developed countries. There has also been a growth of private foreign investment in the country, especially in the areas of solar photovoltaics, cogeneration, wind energy, waste-to-energy projects and battery-operated vehicles, encouraged by the liberalized policies of the government. Foreign investors are permitted to enter into a joint venture not only for the manufacture of renewable energy devices but also for setting up power generation projects based on RETs. For the entire non-conventional energy sector, 100% foreign direct investment is allowed under the automatic route without the prior approval of the government. The growth of the private sector is reflected in the fact that over 95% of the installed wind capacity is in the private sector.

Institutional finance

The IREDA is the promotional and financing arm of the Ministry and has emerged as one of the main instruments for promoting developing and financing technologies and projects related to NRSE. It has been able to tie up funds from leading multilateral agencies such as the UN organizations, the Asian Development Bank and the European Commission, bilateral organizations and domestic financial institutions for lending to end-users, manufacturers, financial intermediaries and entrepreneurs, predominantly in the private sector. Cumulative loan disbursements by IREDA have risen from

around Rs 16 million in its first year (87-88) to Rs 25478 million in December 2001, while cumulative sanctions touched Rs 50447 million (Table 4.2). In addition, major national financial institutions such as the IDBI, ICICI, IFCI, and PFC have also been financing wind power projects.

Table 4. 2 Cumulative sectorwise loan sanctions by IREDA till December 31, 2001

Sectors	Rs
Biomass briquetting	194.7
Biomass cogeneration	8736.1
Biomass gasification	104.2
Biomethanation from	724.7
Biomass power generation	4430.0
Energy efficiency &	1693.7
Solar thermal	753.7
Solar photovoltaic	5497.6
Small hydro	10276.7
Waste to energy	449.2
Wind energy	17562.5
Miscellaneous	23.5
Total	50446.6

Source. MNES (2002)

Research and development

Promotional policies and programmes of the government are backed by a strong research and development base aimed at reducing costs and enhancing efficiency. This includes upgradation of existing NRSE and the development, demonstration and commercialization of new and emerging technologies. The Ministry engages leading research organizations in the country to undertake R&D projects. In addition, three specialized technical institutes — SDC, C-WET and the SSSNIRE have been set up. These provide a range of services for testing and standardization of devices, upgradation of production technology, improving operational efficiency of systems and organizing programmes for skill upgradation and human resource development. In recent years, the Ministry has provided a market-oriented thrust to R&D efforts and has evolved a policy of supporting R&D with the involvement of the industry. The Ministry proposes to take up goal-oriented, industry driven R&D activities with large-scale private sector participation in order to expedite the commercialization of NRSE. The Ministry has also established an R&D Advisory Committee consisting of eminent scholars drawn from industry, academia, national laboratories and so on. The Committee considers specific proposals for research

and also recommends research priorities and strategies. Individual research efforts are promoted through scholarships for advanced education at leading institutes in the country. The MNES also facilitates the acquisition of patents in the area of renewable technology.

Information dissemination and publicity

The Ministry's programme of dissemination of information and generation of public awareness plays an important role in popularizing the use of NRSE systems in the country. Under the programme, mass awareness is created of the multiple benefits, design features, product availability etc. of renewable energy products and devices. Target groups in all sections of the society are influenced through electronic (radio and television) and print media, postal stationary, outdoor media including static and mobile exhibitions and folk arts, song and drama. A recent initiative by the government is the concept of energy parks usually organized in educational institutions, consumer fora and large public places to demonstrate the benefits of renewable energy systems and devices amongst students and teachers, rural and urban people.

Information on technological development and the promotional efforts of the government is also widely disseminated to attract investors. Much of this information has also been made available on the Internet. A Renewable Energy Network has been set up to facilitate electronic flow of information between the Ministry and the SNAs, state governments, R&D and technology institutions, consultants, NGOs etc. The MNES also organizes regular seminars and symposia to bring together stakeholders perception on the aspects of NRSE development.

International cooperation

India realizes the vital need for international cooperation and interaction with other countries and international agencies at bilateral and multilateral levels for sharing experience and technical expertise. The country has strengthened international cooperation by:

- Mobilizing financial resources from multilateral and bilateral agencies
- Facilitating foreign direct investment and acquisition of state-of-the-art technologies.
- Promoting export of renewable energy products and technologies.
- Offering technical assistance to other countries and assisting in human resource development. India has provided technical assistance and consultancy services to many countries such as Cuba, Morocco, Tunisia,

Philippines, Sri Lanka, Bangladesh, Bhutan, Mali, Nepal, Myanmar, Senegal, Namibia and Uganda.

The country has actively sought to strengthen South-South cooperation. A recent initiative to promote cooperation in the region is the BIMST-EC (Bhutan, India, Myanmar, Sri Lanka and Thailand Economic Cooperation).

Concerns

Despite the impressive growth of the renewables sector, there are concerns and barriers to further growth. Some of the major ones are:

- High initial costs
- Low product responsiveness to user needs
- Weak markets and market-support infrastructure including networks of suppliers, dealers, credit facilitators, maintenance and spares supply organizations etc.
- Weak linkage between R&D on the one hand and market requirements for product development, deployment and technological upgradation on the other
- Absence of attractive and consistent policies in certain states with respect to grid-based renewable energy, inadequate evacuation networks in some resource-rich regions and the current power tariff structure that subsidizes the use of conventional fuels
- Lack of confidence amongst developers and final users in the merits of NRSE due to biased perceptions

NRSE already occupy an important role in the energy sector of the country especially in rural areas. Their future growth would depend on how effectively such concerns are addressed.

Strategies for promoting new and renewable sources of energy

Agenda 21 recognizes the great potential in renewable sources of energy in meeting the energy needs of people in a socially and environmentally sound manner. It calls for concerted efforts by governments, local institutions, NGOs, the private sector and the international community towards the promotion of NRSE. The Government of India was taking a conscious and keen interest in harnessing the country's abundant potential of NRSE in partnership with stakeholders, long before the conceptualization of Agenda 21. Significant

growth has taken place in the 1990's because of policy initiatives by the Ministry of Non-conventional Energy Sources.

The relevance of NRSE as decentralized sources of energy for the poor has received special attention in the country. The Approach Paper to the Tenth Plan (2002-07) explicitly recognizes the role of NRSE in meeting the energy needs of people in remote areas, using local resources and cutting out expensive delivery mechanisms associated with conventional energy sources. The GOI has recently announced a scheme for using NRSE in energizing villages that have no access to electricity. It is necessary that such villages be identified and energy options — NRSE as well as conventional sources — evaluated so that cost effective options are selected and scarce resources available for NRSE are judiciously used.

The high relative cost of RETs remains the single largest problem. This needs to be tackled from both the demand and supply ends. On the one hand, R&D and market development will help in bringing down costs as technologies mature and gain acceptance; this phenomenon needs to be accelerated. Rural co-operative banks, micro-credit schemes and ESCOs (energy service companies) will play an important role in strengthening market support infrastructure and building confidence in NRSE. On the other hand, NRSE would need to be provided a level playing-ground either by bringing down subsidies on conventional energy or by giving preferential treatment to NRSE. The new electricity regulatory structure that is slowly spreading throughout the country can be used to further the growth of renewables. In giving preferential treatment, incentives should be linked with performance so that there are built-in incentives for improving efficiency and bringing down costs.

The GOI has proposed to come out with a new policy statement on NRSE. It is expected that the above challenges and concerns will be effectively addressed in this new initiative. In addressing these concerns, the state governments, regulators and other stakeholders will have to be taken along so that efforts at the national level are effectively implemented.

Finally, the international community will need to play its role by providing greater financial and technical support to complement domestic efforts and to make up for the limited resources available to developing countries often subject to competing and more pressing claims. The responsibility of the international community comes into focus in the light of grave inequities in energy consumption patterns worldwide that have also affected the global environment adversely. Only an international partnership can help ensure that

the energy needs of all are met in an economically efficient, socially equitable and environmentally accountable manner.

References

Agenda 21, United Nations
<http://www.un.org/esa/sustdev>

Committee on Power. 1980
Report of the Committee on Power
 New Delhi: Ministry of Energy. 205 pp.

Fuel Policy Committee. 1974
Report of the Fuel Policy Committee
 New Delhi: Planning Commission. 139 pp.

IREDA. 2001
Annual Report 2000/2001
 Indian Renewable Energy Development Agency Limited, Government of India. 72 pp.

Mathur A and Shah C. 1998
Renewable Energy Sources - Key Issues for commercialisation, Energy for Growth and Sustainability
 Kalpakkam: INAE pp. 131-152

MNES. 2001
Annual Report 2000-2001
 New Delhi: Ministry of Non-Conventional Energy Sources. 110 pp.

MNES. 2001
Renewable Energy in India - Business Opportunities
 New Delhi: Ministry of Non-conventional Energy Sources. 163 pp.

MNES. 2002
Annual Report 2001-2002
 New Delhi: Ministry of Non-conventional Energy Sources. 140 pp.

Planning Commission. 1979
Report of the Working Group on Energy Policy
 New Delhi: Planning Commission. 121pp.

Planning Commission. 2001
Approach Paper to the Tenth Five-Year Plan (2002-07)
 New Delhi: Planning Commission. 49 pp.

TERI. August 2000
Renewable energy sector in the country: Draft status paper
 New Delhi: Tata Energy Research Institute
 (Report number 2000RT41)

TERI. 2001
TEDDY 2000/2001 (TERI Energy Data, Director, and Yearbook)
 New Delhi: Tata Energy Research Institute. 452 pp.

Seventh Five Year Plan: 1985-1990

Vol. 2: pp. 50-70, 125-166

New Delhi: Planning Commission. 421 pp.

Eighth Five Year Plan: 1992-1997

Vol. 2: pp 197-202

New Delhi: Planning Commission. 480 pp.

Ninth Five Year Plan: 1997-2002

Vol. 2: Thematic Issues and Sectoral Programmes

New Delhi: Planning Commission. 1059 pp.