CHAPTER 1

The energy-poverty challenge

Census 2011 throws light on the darkness that exists across India today. Over 77 million households depend on kerosene for lighting; 1 million use wood and as much as 1.2 million households in India still remain completely in the dark. Interestingly, according to the Census, as many as 1 million households – the size of a small European country – use solar energy for lighting needs. The growth of solar is taking place in states where the electricity grid has not reached or even if the grid has reached, power has not. By 2011, West Bengal had over 0.24 million households using solar for lighting; Uttar Pradesh had another 0.16 million. This shows the opportunity and the challenge. The fact is that ministry of power of the government of India has been engaged with rural electrification since 1988; since 2005, the programme has the stated objective of meeting energy needs using renewable sources and decentralized solutions. But this has not taken off. On the other hand, the ministry of new and renewable energy (MNRE) also has a decade old programme to provide off-grid solutions. In 2010, it had an enhanced target under the prime minister's Climate Action Programme of 2000 MW of off-grid applications and 20 million solar lanterns by 2022. Therefore, India has an unmet need; it has the intent, programme and funds. The case for decentralized solar is clear and urgent.

The house of Saroj Kumar, a daily wager of Jagdeeshpur village in Vaishali district of Bihar is lit up by electricity generated through an off-grid 75-Watt (W) solar home lighting system. The grid has not reached this village yet. Kumar bought the panel in 2011 and the total cost of the system, including the battery, came to around Rs 7,000 which was about two and a half times his monthly income. Before he acquired this set, he used to pay Rs 100 per month to a private supplier, who used a diesel generator to supply electricity to households in the village. This allowed him to power a 10 W compact fluorescent lamp (CFL) for four hours a day and to charge his mobile phone.[1] He was, perhaps paying one of the highest power tariffs in the country, a whopping Rs 83 per unit. However, he had to bear this cost since he had no access to the grid or state-supplied electricity. But today he is a happy man with his own solar lighting set. This inaccessibility to the grid is probably one of the most important reasons for a thriving solar applications market in Bihar. Even the villages which are connected to the grid hardly get any power. A Greenpeace survey of electrified villages in Bihar found that at least 60 per cent respondents received less than an hour of power supply in a day forcing them to look for alternatives like solar home lighting systems.[2] Exhibition Road, a retail market for solar lighting systems in Patna is touted to be the biggest off-grid solar retail market in the world, reportedly making profits of Rs 500 crore annually.[3] Solar panels are today replacing diesel generator sets as a source of energy in this power-starved state with very

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Solar lights are the alternative to a dark future in India's villages: Panels atop a house in Baunth village in Uttarakhand's Tehri district

little grid supply and the demand is purely market driven.

In remote rural areas off-grid systems are more feasible than extending the grid. In such areas electricity consumption is low and it is difficult to recoup the costs of transmission from these consumers. The capital costs are also high for grid extension.[4] In comparison, off-grid renewable energy-based systems generate electricity at the point of consumption. They are also capable of reduction in greenhouse gases by reducing kerosene consumption. Bihar is the second largest user of kerosene – about 15.6 million households – as a source of lighting in India.[5]

Deba is one of the 50 villages located in the Barnawapara Wildlife Sanctuary in Mahasamund district, Chhattisgarh that have no access to electricity owing to their remoteness and the terrain. But all the houses in Deba are lit up thanks to a 4-kilowatt (kW) solar power plant and a micro-grid which connects it to all households. The plant generates 28 units of electricity each day, enough to light all houses and lanes of Deba with CFLs for seven hours a day, without fail: from 4 to 6 am and 6 to 11 pm. Earlier, the villagers had to depend on kerosene, which they said provided very poor light.[6] The Chhattisgarh Renewable Energy Development Agency (CREDA) installed the first micro-grid in 2004 and by May 2012, 1,439 remote villages in the state had been electrified through micro-grids, with a total capacity of 3,500 kW lighting up 58,000 families in remote villages. Some of this work has been done under the centrally-sponsored Remote Village Electrification Programme (RVEP).[7] Research has proven the feasibility of such decentralised systems for villages located away from the grid.[8]

Solar home lighting systems have proved to be a boon for un-electrified remote villages of Uttarakhand. Avani, a non-governmental organisation based in Tripuradevi, Pithoragarh district of Uttarakhand has not only provided solar home lighting systems to around 2,500 families in more than 254 villages in the Kumaon region of Uttarakhand, but also trained village youth to install, repair and maintain such systems.[9] Social

enterprises such as Avani have played a big role in popularising solar-energy based products in several parts of the country and in remote villages with no access to electricity.

As of November 2011, there were about 10,000 remote villages in India that were completely un-electrified.[10] Located far away in areas where the power grid may never reach, these villages depend on either kerosene or biomass for their basic lighting needs. The 2011 Census of India has some telling figures: about 77.5 million households still depend on kerosene for their basic lighting needs. Another million use other oil or wood while 1.2 million households have no access to any form of lighting sources.[11]

The 2011 Census: a case for solar

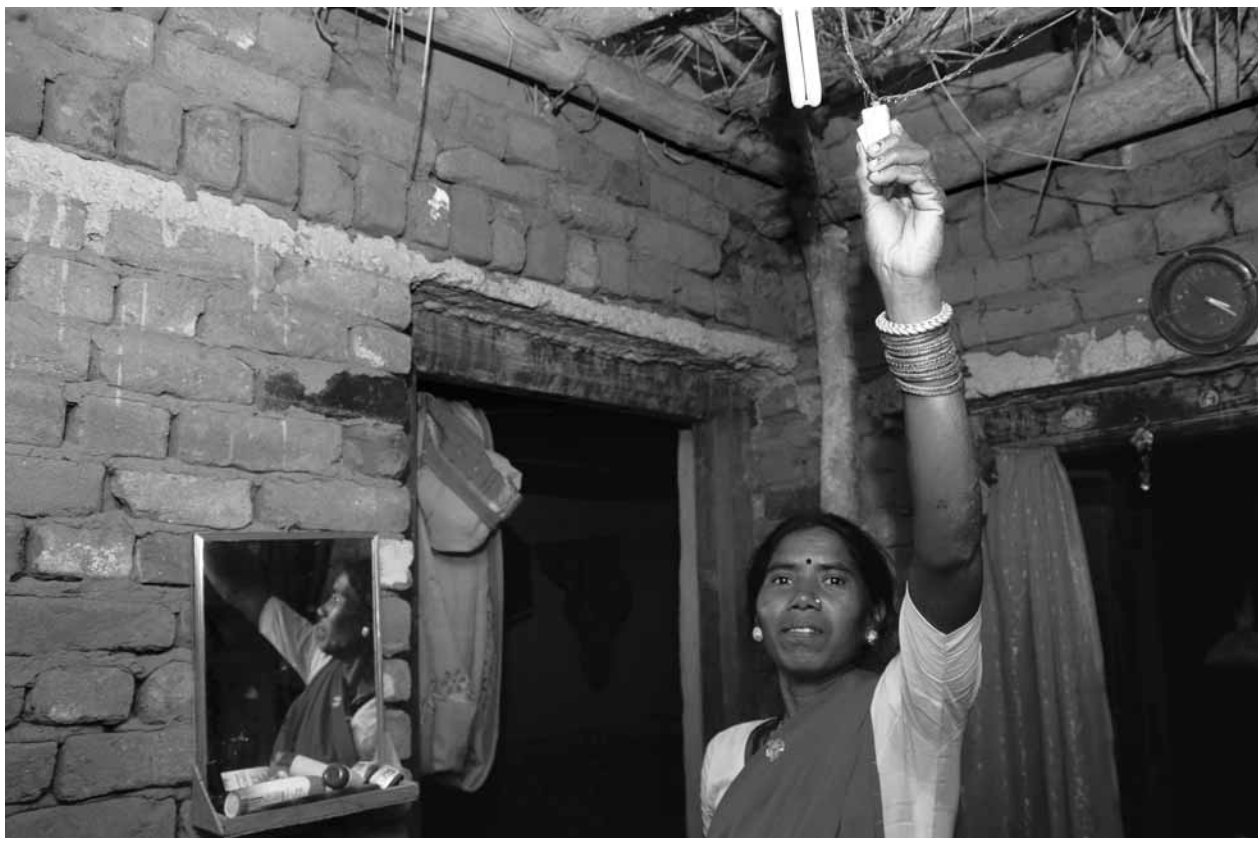
The Census of 2011 has thrown up data which have a bearing on planning for solar. It records that there were 246,692,667 residential households in the country. Out of these, 67.3 per cent (165,897,294) had access to grid power, 31.4 per cent (77,545,034) used kerosene and only 0.4 per cent (1,086,893) used solar lighting systems for lighting. Overall, 0.5 per cent (1,164,584) had no access to any energy sources for lighting.[12]

If we take a closer look at the scenario, 92.7 per cent (73,089,256) of urban households had access to grid power, only 6.5 per cent (5,109,731) used kerosene and few used solar systems, which is about 0.2 per cent (170,690) of the urban households. About 0.3 per cent (229,436) used wood and other oils. Those without access to electricity stood at 0.3 per cent, or 266,824 households.[13]

In the case of rural households, access to grid power stood at 55.3 per cent (92,808,038). There was a substantial usage of kerosene – 43.2 per cent (72,435,303). Just about 0.5 per cent (916,203) households used solar home lighting systems and 0.5 per cent (897,760) had no access to energy. About 0.4 per cent (769,426) used wood and other oils[14] (see Tables 1.1 and 1.2: *Number of households using various sources of lighting, 2001 and 2011*).

Five states – Uttar Pradesh, Bihar, Odisha, Madhya Pradesh and Assam – constitute 63.2 per cent of the total households without any access to grid power in the country. In these electricity-

The large potential for off-grid solar applications has activated the interests of social businesses, financial institutions and NGOs



SURYA SEN / CSE

Table 1.1: Number of households using various sources of lighting, 2001

Item No.	Source of lighting (2001)	Absolute number			Percentage		
		Total	Rural	Urban	Total	Rural	Urban
a	Total households	191,963,935	138,271,559	53,692,376	100	100	100
b	Electricity	107,209,054	60,180,685	47,028,369	55.8	43.5	87.6
c	Kerosene	83,127,739	76,896,701	6,231,038	43.3	55.6	11.6
d	Solar energy	522,561	394,425	128,136	0.3	0.3	0.2
e	Other oil	184,424	146,165	38,259	0.1	0.1	0.1
f	Any other	305,308	227,210	78,098	0.2	0.2	0.1
g	No lighting	614,849	426,373	188,476	0.3	0.3	0.4

Source: Census of India, 2001

Table 1.2: Number of households using various sources of lighting, 2011

Item No.	Source of lighting (2011)	Absolute number			Percentage		
		Total	Rural	Urban	Total	Rural	Urban
a	Total households	246,692,667	167,826,730	78,865,937	100.0	100.0	100.0
b	Electricity	165,897,294	92,808,038	73,089,256	67.2	55.3	92.7
c	Kerosene	77,545,034	72,435,303	5,109,731	31.4	43.2	6.5
d	Solar	1,086,893	916,203	170,690	0.4	0.5	0.2
e	Other oil	505,571	407,919	97,652	0.2	0.2	0.1
f	Any other	493,291	361,507	131,784	0.2	0.2	0.2
g	No lighting	1,164,584	897,760	266,824	0.5	0.5	0.3

Source: Census of India, 2011

starved states, solar has started to slowly replace kerosene as a lighting source: Uttar Pradesh and Bihar are the largest users of solar lighting systems. Maharashtra ranks at the top of the list of states with households that have no access to lighting. Gujarat, the state with highest grid-connected solar power in India, has the second largest number of households without access to any forms of lighting (see Box: *Five states: the energy sources*).

If one compares data from the 2001 and 2011 Census, in 2011, 1,086,893 households used solar lighting systems: nearly twice the number of households – 522,561 – as identified by Census 2001.[15] This increase cannot be attributed only to government programmes. Social businesses, financial institutions and non-governmental organisations have also been instrumental in the deployment of off-grid solar home lighting systems to energy-deprived poor. The large potential for off-grid solar applications attracted these sectors. Certain successful business models have been exhibited by these sectors in this field, although these models have been unable to scale up to the national level.

In the decade of 2001-2012, 58.8 million households have gained access to lighting through electricity. Under the Rajiv Gandhi Vidyutikaran Yojana (RGGVY), a total of Rs 25,913 crore has been spent until 2011. Although the entire 58.8 million households need not have gained electrification through the extension of the grid

FIVE STATES: THE ENERGY SOURCES

The energy profile of states provides a clear direction on the need for focus – states that remain un-reached by power and electricity provide the opportunity for the future

Access to the grid

- Uttar Pradesh, among all states in India, has the largest number of households [32,924,266] to begin with. The state also has the largest number of households [20,808,136] without access to grid power. This is about 8.5 per cent of the total number of households [246,692,667] in the entire country. Only 36.8 per cent of the households in UP [12,116,130] have access to electricity.
- Bihar has slightly more than half the number of households in UP [18,940,629]. However, it is close to UP in terms of those that lack access to grid power [15,834,366]. This is about 83.6 per cent of the total number of households in the state.
- UP and Bihar are followed by Odisha [5,506,819], Madhya Pradesh [4,924,339] and Assam [4,005,029] in terms of the number of households in each state without access to grid power. These five states together constitute 36.8 per cent of all the households in the country. However, 63.2 per cent of the households that lack access to grid power also lie in these five states.

Kerosene usage

- 97.9 per cent of households in UP that lack access to grid power [20,808,136] use kerosene [20,380,121] for their lighting purposes. This observation is similar in the other states as well – Bihar (98.6 per cent), Odisha (97 per cent), Madhya Pradesh (97.6 per cent) and Assam (98.3 per cent).
- In southern India, at least a million households in each state including Tamil Nadu, Karnataka and Andhra Pradesh still depend on kerosene as their basic source of lighting.
- 95.9 per cent of all the households in the country without access to grid power [77,545,034] depend on kerosene as their source of light. This comes to 31.4 per cent of all the households in the country [246,692,667].

Lighting through solar

- In 2011, West Bengal was the highest user of solar lighting systems [240,807 households] for its basic lighting needs. This is 2.6 per cent of all the households without access to grid power in West Bengal. However, 95.6 per cent of the state's households without access to grid power still depend on kerosene for their lighting needs.
- Uttar Pradesh is the second largest user of solar energy [164,621 households] as a source for lighting needs, which accounts for only 0.8 per cent of the households without access to grid power. This is followed by Bihar where 0.7 per cent of the households without access to grid power [113,644] depend on solar lighting systems. Again, in each of these two states, at least 98 per cent of the households without access to grid power depend on kerosene for their lighting needs.

No access to electricity

- The Census also reveals figures on households that have no access to lighting whatsoever, be it kerosene, solar or any other oils. Maharashtra has the highest number of households [214,475] that have absolutely no access to any sources of lighting.
- Gujarat has the second highest number of households [121,817] in this category followed by Odisha [106,271], Rajasthan [100,650] and West Bengal [100,336].

[Also see Annexure 2A: Distribution of lighting in households across Indian states, 2011]

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About 1.2 million households have no access to any lighting. The decadal increase of un-electrified households stands at 618,614. They present an immense challenge as well as potential for the solar power sector

under RGGVY, it would be safe to assume that a majority were electrified under this Central government scheme. Out of this, 16.47 million connections are for BPL (below poverty line) households covered under the RGGVY.[16]

In the same period, the Union ministry of new and renewable energy (MNRE) spent Rs 634.19 crore under RVEP to provide basic lighting facilities using SPV applications. Around 8,500 villages and 1,400 hamlets received solar power during this period.[17] These efforts to increase access to energy for remote households have helped in decreasing the usage of kerosene. At least 5.6 million (5,582,705) households have withdrawn their usage of kerosene for lighting purposes over the decade. Besides, 5.3 million households have also withdrawn their usage of kerosene for cooking purposes over the decade.[18]

This has led to a reduction in the allotment of kerosene under the public distribution system by 16.87 per cent from an allotment of 10,490,199 tonnes for the year 2000-01 to 8,719,546 tonnes for the year 2010-11.[19] This is, in effect, a reduction of 1,770,653 tonnes which amounts to a huge 2.254 billion litres of kerosene saved, a tonne of kerosene being equivalent to 1,273 litres. According to a World Bank report, a litre of kerosene emits 2.45 kg of carbon dioxide into the atmosphere.[20] Therefore, keeping in mind just kerosene consumption, India has reduced its carbon emissions by 5.5 million tonnes by 2011 (as compared to 2001 figures).

Despite this, about 1.2 million households still live in darkness as they have no access to any form of lighting. This is twice the number of households as compared to the Census count in 2001: 0.61 million.

The total number of residential households during the decade (2001-2011) increased by about 54.7 million in India, from 191,963,935 in 2001 to 246,692,667 in 2011. Going by the fact that 58.8 million households had gained electrification in the same decade, the rate of electrification of households in India is greater than the rate at which new households are being built. This fast pace can be attributed to the goal that was set to electrify all households by 2012 by the Union ministry of power (MoP) through the Rural

Electrification Policy (2006). However, India is still way short from achieving this goal. The number of un-electrified households has doubled during this period – from 614,849 in 2001 to 1,233,463 in 2011. The question is if the solar 'off-grid' model for rural electrification can be adopted in these un-reached villages.

Lighting up rural India: a status check

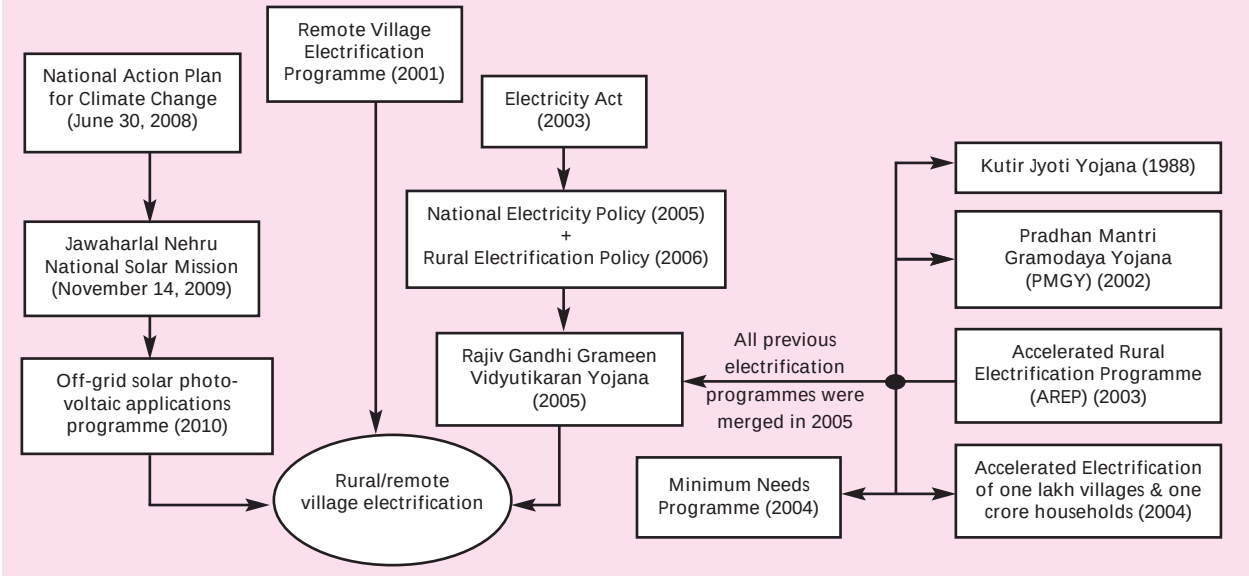
The Kutir Jyoti scheme launched in 1988 by the Union ministry of power (MoP) was one of the earliest programmes that initiated the task for rural electrification in India (see Figure 1.1: *Evolution of electrification programmes for rural areas*). It had a basic objective – to extend single-point light connections to the rural poor living below the poverty line, with special quotas for scheduled castes and tribes. However, the scheme attracted some criticism. On one hand, the increasing transmission and distribution losses as the grid was being extended to serve rural areas came in for criticism.[21] There were also reports of widespread misuse of the programme. A 2003 World Bank report suggests that the scheme "would be more effective and efficient in providing the poor with grid access if there were better identification of the targeted population and beneficiaries served."[22] In May 2004, this scheme was incorporated within a new programme under the MoP – the 'Accelerated electrification of one lakh villages and one crore households programme'.[23]

In the same year, the Planning Commission also introduced the Minimum Needs Programme as part of the Fifth Five Year Plan. It was designed to establish a network of basic services and facilities of social consumption with rural electrification being one of the key elements.[24] Two other programmes under the MoP were also operational around this time. The Accelerated Rural Electrification Programme (2003) provided assistance for electrification via conventional and non-conventional sources of energy. The Pradhan Mantri Gramodaya Yojana (2002) had six components which included rural electrification.[25]

Thus, at this point in time, the MoP was primarily focussed on extending the grid connection to households. It had not really opened up to decentralised solutions for electrification. In fact, the definition of 'electrification' then current with the ministry had a very general contour: "A village will be deemed to be electrified if the electricity is used in the inhabited locality, within the revenue boundary of the village for any purpose whatsoever".[26]

In April 2004, the MoP brought forth a more specific definition of 'electrification' which laid emphasis on providing electrification infra-structure to a certain percentage of the households and all the public places in the village.

Figure 1.1: Evolution of electrification programmes for rural areas



Source: Centre for Science and Environment (CSE), 2011

ELECTRIFICATION ACCORDING TO POWER MINISTRY: UNDERMINING SOLAR SYSTEMS

A village would be classified as electrified based on a certificate issued by the *gram panchayat* certifying that:

(a) Basic infrastructure such as distribution transformers and distribution lines are provided in the inhabited locality as well as one dalit basti/hamlet where it exists,

(b) Electricity is provided in public places like schools, panchayat office, health centres, dispensaries, community centres, etc and

(c) The number of households electrified are at least 10 per cent of the total number of households in the village.[1]

The MNRE does not provide basic infrastructure like transformers for distribution and power lines because they are not needed for applications like solar home lighting systems and street lanterns. This makes these villages still 'un-electrified' as per the power ministry's definition even after providing solar home lighting systems. The MNRE's programme has been considered a temporary measure until the grid reaches the village in the as yet indefinite future. By providing home lighting systems, every household would receive at least 3-5 hours of lighting every day. However those villages that are connected to grid power receive poor quality of electricity. These villages sometimes receive electricity only once in three days and at other times very intermittently. Still, villages receiving power from the grid, would be considered 'electrified' as against the villages that were provided longer hours of lighting through solar home lighting systems. The new definition, has undermined the usage of stand-alone renewable energy systems.

However, the definition mainly laid emphasis on conventional sources for generating electricity, as solar home lights and street lights did not come up with basic transmission and distribution infrastructure (see Box: *Electrification according to ministry of power: undermining solar systems*). In 2005, the National Electricity Policy and in 2006, the Rural Electrification Policy, direct outcomes of the Electricity Act of 2003 (see Box: *Electricity Act, 2003: the legal and policy framework for renewables*), laid emphasis on this new definition and also addressed the need for renewable energy sources for off-grid and decentralised projects.

In 2005, all the previous schemes under the MoP aimed at rural electrification were merged to form the Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY), a flagship programme. The RGGVY initiated the use of stand-alone renewable energy systems as an option for provision of electricity to poor households to which grid extension was not possible. Under this programme, there is also an option to set up community power plants (independent of the grid) as part of a decentralised distributed generation (DDG) scheme. The scheme allows for the use of mini-grids powered by conventional and non-conventional energy sources or a combination of

ELECTRICITY ACT, 2003: THE LEGAL AND POLICY FRAMEWORK FOR RENEWABLES

The first steps towards a framework for creating policies aimed at rural electrification which incorporate the use of renewable energy systems can be found in Sections 4 and 5 of the Electricity Act, 2003.

Section 4: (National policy on stand-alone systems for rural areas and non-conventional energy systems): The Central government shall, after consultation with the state governments, prepare and notify a national policy, permitting stand-alone systems (including those based on renewable sources of energy and other non-conventional sources of energy) for rural areas.

Section 5: (National policy on electrification and local distribution in rural areas): The Central government shall also formulate a national policy, in consultation with the state governments and the state commissions, for rural electrification and for bulk purchase of power and management of local distribution in rural areas through panchayat institutions, users' associations, co-operative societies, non-governmental organisations or franchisees.[1]

both. Although funds have been sanctioned for these projects by the power ministry, none of them have been commissioned yet (see Box: *Decentralised distributed generation*). This is what needs to be understood.

The MNRE and off-grid solar

On the solar energy front, however, the country has had an active programme in the field of stand-alone SPV applications for more than a decade. From 2001 onwards, the MNRE started installing

DECENTRALISED DISTRIBUTED GENERATION

Under the DDG scheme of the Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY), there is significant potential to deploy off-grid renewable energy systems. Projects have been sanctioned for 220 villages, but none have been commissioned. A Right to Information (RTI) response received in February 2012 from the Rural Electrification Corporation (REC) – the nodal agency for electrification projects under the power ministry – claimed that no funds had been utilised. Therefore, the number of villages electrified under the DDG scheme can be considered nil. On the other hand, as of August 2012, 104,456 villages have been covered under RGGVY for grid extension. Hence, under the power ministry, grid extension to villages remains the prime focus.

Table: Status of decentralised distributed generation programmes

State	Type of project	Sanctioned amount (Rs crore)	Total capacity of projects (kW)	Number of villages/ hamlets proposed to be electrified
Uttarakhand	**Micro-hydel**	**27.05**	**200**	**2**
West Bengal	Hybrid (bio-diesel + SPV)	69.92	600	1
	Hybrid (bio-diesel + SPV)	67.20	500	2
	Biomass briquettes fired boilers TG sets	217.25	1,500	7
	Biomass briquettes fired boilers TG sets	216.58	1,500	8
	Hybrid (biomass gasifier + SPV)	130.83	880	5
	Hybrid (biomass gasifier + SPV)	105.31	705	7
	Hybrid (biomass gasifier + SPV)	52.44	300	2
	Hybrid (biomass gasifier + SPV)	74.39	590	3
	Hybrid (bio-diesel + SPV)	59.48	500	4
Total (West Bengal)		**993.44**	**7,075**	**39**
Chhattisgarh	SPV (9 projects)	29.43	56	9
	SPV (10 projects)	75.83	177	10
Total (Chhattisgarh)		**105.26**	**233**	**19**
Andhra Pradesh	**SPV (57 projects)**	**169.42**	**365**	**57**
Uttar Pradesh	SPV (7 projects)	32.37	79	103
	SPV (14 projects)	373.39	973	
	SPV (41 projects)	235.19	588	
Total (Uttar Pradesh)		**640.96**	**1,640**	**103**
	148 projects	**1,936.15**	**9,513**	**220**

Note: The funds utilised for the projects so far is nil
Source: RTI No. REC/RTI/390/11-12/, received by CSE on February 30, 2012

solar home lighting systems and street lighting systems on a large scale across India through two key policy vehicles which had been in existence for some years – the solar photo-voltaic (demonstration and utilisation) programme and the solar photo-voltaic water pumping programme (see Box: *Solar photo-voltaic programmes*).

After the 2001 Census, the MNRE initiated the Rural Village Electrification Programme (RVEP), after identifying 18,000 remote un-electrified villages. The programme was to provide basic lighting systems using SPV applications. It was proposed that all the identified villages be provided lighting systems by the end of 2012. But as per data from March 2012, the ministry has managed to complete electrification of only about 9,009 villages.[27]

During the early stages of the RVEP, in a notable project, 39 remote villages in Leh district and 18 villages and 27 hamlets in Kargil district of Ladakh were electrified. The project was sanctioned to the Jammu and Kashmir government and implemented by the Ladakh Autonomous Hill Development Council. A target to provide 10,000 solar home lighting systems and 6,000 solar lanterns to these villages was set. The project cost was estimated at Rs 20 crore of which 90 per cent was subsidised by the MNRE. At least 60 per cent of the households in a village would have to be provided SHS for the village to be considered electrified. The project was completed in 2003.[28] By March 30, 2010 close to 800,000 million street lighting systems and a little over 600,000 million

JOEL KUMAR / CSE

Solar street lighting systems were rolled out by MNRE from 2001

SOLAR PHOTO-VOLTAIC PROGRAMMES

The first solar photo-voltaic (SPV) programme was started in 1976 by the Department of Science, Government of India. This was a research and development programme focused on development of solar cell technology. The 'solar photo-voltaic (demonstration and utilisation) programme' was initiated in 1980. Under this programme, commercial establishment of solar applications was the focus. A range of SPV applications were tested and developed. They included home lighting systems, railway signals powered by solar, small power plants, water pumping sets, etc. During these stages, the Centre subsidised 50 per cent of the capital cost and the beneficiary would pay the rest. Many government organisations and agencies put up SPV plants in their buildings to test the viability of the new technology. This programme was later called the solar photo-voltaic programme and helped in the deployment of various SPV applications across the country.

Water pumps powered by solar energy were one of the first SPV applications to be developed in India. In 1993, the Central government came up with the 'solar photo-voltaic water pumping programme' that provided soft loans for 90 per cent of the cost of the systems after including a 10 per cent capital subsidy.

These programmes were implemented up to 2010, when the Jawaharlal Nehru National Solar Mission superseded them.

Table 1.3: Off-grid applications, March 30, 2010

Type of application	Installed till date
Street lighting system	797,344
Home lighting system	603,307
Solar lanterns	119,634
Power plants (kWp)	2,922
Solar PV pumps (nos)	7,334

Source: March 2010, Union ministry of new and renewable energy, Government of India

home lighting systems had been installed in the country (see Table 1.3 *for March 2010 data*).

The Solar Mission: 2010

In 2008 the National Action Plan for Climate Change (NAPCC) issued by the Prime Minister's Council for Climate Change put forth an agenda to rapidly upscale the use of solar energy technologies in the energy mix of the country. The Jawaharlal Nehru National Solar Mission (JNNSM) was established in 2010 as a direct result of the NAPCC mission statement. It notes: "A National Solar Mission will be launched to significantly increase the share of solar energy in the total energy mix while recognising the need to expand the scope of other renewable and non-fossil options such as nuclear energy, wind energy and biomass. Solar energy, therefore, has great potential as a future energy source. It also has the advantage of permitting a decentralised distribution of energy, thereby empowering people at the grassroots level. Photo-voltaic cells are becoming cheaper with new technology."[29]

The JNNSM superseded all the previous solar schemes (both rural and urban applications) with new targets of 2,000 megawatt (MW) for off-grid

Way to go: why are our solar energy schemes failing to provide energy access to the millions still outside the grid?

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SPV applications and 20 million solar lanterns by 2022. The JNNSM policy document notes: "The immediate aim of the Mission is to focus on setting up an enabling environment for solar technology penetration in the country both at a centralised and decentralised level. The first phase (up to 2013) will focus on capturing the low hanging options in solar thermal, on promoting off-grid systems to serve populations without access to commercial energy and modest capacity addition in grid-based systems".[30]

In the first phase of JNNSM till 2013, a target of 200 MW in terms of aggregate off-grid SPV capacity has been set. According to the MNRE, 40.648 MW of projects have been installed in 2010-11 using off-grid SPV applications as against a target of 40 MW.[31]

As of today, the Central government's flagship schemes to reach electricity to remote locations are the MNRE's RVEP and JNNSM and the power ministry's RGGVY. The question is why these schemes are failing in providing energy access to the millions still outside the grid. The question is how these schemes and funds can be used to bring the lights of solar to these homes. What is working and how can experiences be upscaled to make a difference?