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RE-Energising Odisha:

An Assessment of Renewable Energy Policies, Challenges and Opportunities

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Report Prepared by

Ashden India
Renewable Energy Collective

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Climate Parliament is an international cross-party network of legislators, dedicated to preventing climate change and promoting renewable energy. The organisation provides support to parliamentarians in taking political, legislative, policy, and budgetary initiatives to promote solar, wind, small hydro, biomass, geothermal, and other forms of renewable energy. Climate Parliament has been supporting legislators in their work on renewable energy for over five years, and has established a network of legislators from across Asia, Africa and Europe.

The Ashden India Renewable Energy Collective (AIREC) is a network of India-based winners of the prestigious Ashden Awards. AIREC members are collectively committed to fostering sustainable energy access. AIREC constitutes a pan-India, technology-agnostic network sensitive to the energy and development needs of poor communities. While individually AIREC members are all active in developing and disseminating sustainable energy solutions, at a collective level, AIREC endeavours to develop a favourable ecosystem for large-scale deployment of decentralised renewable energy options in ways that spur economic growth and social development, while protecting the local and global environment. Over the last four years, AIREC has strengthened its activities in policy analysis and advocacy and is currently working on several issues including (a) direct engagement with various ministries to provide inputs for mainstreaming decentralised renewable energy, (b) a series of briefing papers on demystifying and elaborating on issues around decentralised renewable energy, (c) renewable energy applications for rural livelihoods, (d) developing a decision support tool for mainstreaming user priorities in clean cooking energy systems, (e) renewable energy policy frameworks at the state and local levels.

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The AIREC team is led by S P Gonchaudhuri a pioneer of decentralised renewable energy in India. Former Managing Director, West Bengal Green Energy Development Corporation and Renewable Energy Advisor to the Government of West Bengal, he pioneered solar-powered electricity generation that helped nearly a million people in the Sundarbans area of West Bengal to get first-time access to electricity. He continues to be actively engaged with various initiatives of MNRE and advises the North Eastern states and Lakshadweep in their renewable energy programmes.

TABLE OF CONTENTS

Executive Summary

Odisha's three-way energy challenge

Accounting for around 4% of India's land area and population, Odisha is blessed with bountiful forests, minerals, and other natural resources. Yet, Odisha's annual per capita income is about 30% lower than the national average, and nearly a third of its population live in poverty.

The state is also faced with major energy challenges:

- Peak power deficits at the state level
- Poor reliability of grid electricity with outages reported for over 50% of the time
- Around 4000 un-electrified villages
- Over 52 lakh un-electrified (64%) rural households
- Over 98% rural households with no access to clean cooking energy

Odisha's three-pronged energy challenge may be summarised as:

- Bridging the electricity deficit at a macro level
- Providing electricity access to all
- Providing clean cooking energy to all

Thus far, the electricity challenge in the state has been addressed only through the addition of power capacity, largely in the form of coal-based thermal plants. Cooking energy provision has been confined to programmes involving biogas plants and improved cook-stoves.

Why renewable energy, especially decentralised renewable energy, is relevant for Odisha

Odisha produces 20% of India's domestic coal and over 65% of the state's power generation capacity is coal-based. In its plan for expansion of electricity availability, Odisha understandably continues to focus on coal.

Why then is there a need for Odisha to change course and consider a switch to renewable energy? The reasons are manifold.

The environmental and social impacts associated with coal mining heighten uncertainties around coal linkages for power generation. Coal-based power generation is also associated with fly ash, carbon, and other emissions, so there is an impetus to look for alternatives. An important alternative to coal is offered by renewable energy. Odisha is blessed with significant renewable energy (RE) potential, largely in the form of solar energy, but also in the form of wind and biomass. Estimates by OREDA (Odisha Renewable Energy Agency), the State Nodal Agency for RE, point to a realistic renewable energy potential of 11,000 MW and a gross potential of 53,000 MW. This indicates the possibility of a 100-fold expansion of renewable energy in the state given the existing small renewable energy-based installed capacity of under 100 MW.

In order to meet the Renewable Purchase Obligations (RPO) stipulated for the state, it is estimated that a nine-fold expansion in renewables-based electricity is required, failing which the state would have to purchase Renewable Energy Certificates (RECs). This in turn could raise electricity prices, so there is a policy compulsion to scale up renewable energy.

Odisha is frequently faced with natural disasters that can damage infrastructure. In the 2013 cyclone, the loss to the power sector alone was estimated at around Rs. 900 crore due to massive damage to power transmission and distribution equipment, including electrical lines, substations, grid stations, and electric poles). The recent cyclone Hudhud too reportedly battered power infrastructure in five districts of Koraput, Malkangiri, Rayagada, Nabarangpur and Gajapati. The neighbouring state of Andhra Pradesh which bore the brunt of cyclone Hudhud, reported power transmission infrastructure damages of over Rs. 1200 crore. Such large-scale damages could be averted in the case of decentralised systems. This is a point in favour of decentralised renewable energy (DRE). Another important push for DRE in the state comes from the scattered rural population of Odisha. Because

settlements tend to be dispersed, extensive grid networks are required.

It has been observed that for a number of reasons, including an inadequate transmission and distribution network, large grid-connected projects (based on renewables or fossil fuels) are typically not suited to scattered, remote un-electrified settlements. Here renewable energy-based micro grids can be an appropriate solution.

Current renewable energy policy and regulatory landscape

The Ministry of New and Renewable Energy (MNRE) is the nodal ministry of the Government of India for all matters related to renewable energy. The Ministry works in close collaboration with state-level renewable energy development agencies (state nodal agencies [SNAs]). While a range of agencies, policies and regulations provide an impetus for RE development at the national level, several of these schemes and endeavours are also percolated to the state-level in Odisha. The Policy guidelines for power generation from renewable energy (2005), Odisha's solar policy drafted in 2013, tariff orders of the Odisha Electricity Regulatory Commission (to ensure preferential feed-in tariffs for RE), the adoption of the RPO-REC mechanism are all examples of measures that seek to provide a fillip to RE in the state.

A number of organisations are involved in various aspects of and relating to renewable energy development in the state. These include OREDA, the primary state nodal agency for promoting renewable energy, the recently created GEDCOL mandated to develop and implement large grid-connected renewable energy projects, OERC the state's independent regulatory authority and the DISCOMs (power distribution companies). In the government, the responsibility for the overall management of power policies falls under the Ministry of Energy, whereas activities of OREDA are part of the Ministry of Science and Technology.

There have been several central government renewable energy programmes that have been implemented in Odisha. A total of 13 MW of solar power generation has been installed in the state, with another 30 MW under implementation.[3] A biomass power generation unit of 30 MW capacity has been operational in Dhenkanal since 2011, with another 10 MW under implementation in Sambalpur. There are no wind power installations in the state.

There are also several state initiatives for provision of lighting, clean cooking energy, and electricity. Clearly, tremendous efforts are already underway in the sector in Odisha, but a big and systematic push is needed for renewable energy to grow rapidly.

Need of the hour: comprehensive renewable energy policy and planning in the state

Despite the existence of numerous policies and schemes in the state, renewable energy has not taken off, necessitating a major shift in approach if the aim is to deploy renewable energy on a large scale to eradicate energy poverty from the state. A three-pronged plan is suggested:

- Adopt a holistic view of energy planning based on the following principles:
  - Electrification must happen at the household level as well as the village level, bearing in mind that 64% of the state's rural households remain un-electrified.
  - In terms of electrification, meeting merely lighting needs (and in some cases mobile charging) can only be an interim solution. Over the longer term, households are bound to aspire for higher levels of energy and this must be factored into energy plans.
  - Electricity is only one aspect of energy. Energy needs for thermal applications, particularly cooking, are extremely important.

- Households need energy, but critical energy requirements also arise in schools, hospitals, community centres, water treatment plants, and for water pumping. Important rural livelihood sectors such as dairy, horticulture, agriculture, poultry, and bamboo not only have energy needs but also present a potential to generate energy (Table 1).

- Strengthen the renewable energy ecosystem in the state in the following ways
  - Recast and strengthen the state's machinery for RE in the state
  - Develop a strong state-led programme for RE which will spur the development of RE supply chains and also create a demand for RE technologies and services
  - Continue to provide incentives to RE investors
- Integrate renewable energy and energy access with local development efforts
  - Generate jobs around RE while simultaneously creating a pool of skilled manpower
  - Create demand for decentralised RE technologies that can meet critical energy needs in development sectors like health, education, water supply and sanitation and also in livelihoods sectors like agriculture, horticulture, dairy, fisheries.

This kind of a holistic linked approach will have to be reflected in a comprehensive renewable energy plan for the state. The plan should integrates renewable energy with the state's larger energy and development needs and needs to be cognizant of its renewable energy resource potential. Several specific actions that are required for "RE-energising" Odisha that are outlined below must be an integral part of this plan.

The Way Forward: critical specific actions for energising Odisha with renewable energy

I. Strengthen renewable energy institutional framework

AIREC suggests some modification, recasting, and strengthening of Odisha's state machinery for renewable energy as follows.

Recasting OREDA under the Department of Energy and strengthening its role

OREDA functions as the SNA for renewable energy in Odisha; however, it is currently under the Department of Science and Technology. The linkage of OREDA with the MNRE at the central level needs to be clearly established. Within the state, OREDA must be recast to be under the Department of Energy and the possibility of OREDA becoming a Section 25 (not-for-profit) company should be explored. The corporatisation of OREDA will likely improve transparency and spur a sense of urgency in the delivery and sustainability of operations. It is now well recognised that the SNAs, if suitably empowered and equipped with requisite knowledge and skills, can play a critical role in the development of renewable energy in a state as long as they operate in a transparent and investor-friendly mode. Following are some of the key recommended functions and features of a strong SNA and they must be factored into a structured programme to strengthen OREDA:

- Establish linkages and collaborate with central and state energy agencies.
- Act as the focal point for gathering and providing information on renewable resource availability to encourage investors and to also help them to plan projects based on realistic assessments of resource availability.
- Prepare ready reckoners for potential renewable energy investors, including renewable energy resource information and relevant socio-economic background.

- Act as the technical advisory for renewable energy integration in rural development in various government programmes.
- Establish linkages with state agencies in departments that are potential users of renewable energy technologies and applications; e.g., with horticulture department for renewable energy-powered cold storage, fisheries for solar fish dryers.
- Coordinate monitoring and verification of renewable energy devices and projects, and ensure that required corrective action is taken.
- Facilitate the establishment of skills development for the renewable energy sector.

Recasting GEDCOL as a business-oriented technology agnostic nodal point for large-scale renewable energy

GEDCOL was incorporated as a public limited company in 2013 to explore the state's renewable energy resources. That GEDCOL is a subsidiary of OHPC raises some questions about its being a technology and resource-agnostic entity. The lack of any stake of OREDA in GEDCOL is also a point of contention. An example that may be looked at here is the West Bengal Green Energy Development Corporation, which is a joint venture company of the West Bengal Power Development Corporation Limited (WBPDCL), the the West Bengal State Electricity Distribution Company Limited (WBSEDCL), and West Bengal Renewable Energy Development Agency (WBREDA).

Establishing Renewable Energy Directorate

To mainstream renewable energy, the state must consider setting up a Renewable Energy Directorate within the Department of Energy, headed by a Secretary-level officer who would oversee the functioning of OREDA as well as GEDCOL in a coordinated fashion.

II. Separate and distinct emphasis on clean cooking/thermal energy

It is distressing that despite being an early starter in the biogas programme, Odisha is grappling with a cooking energy crisis that does not get the attention it deserves. Odisha, with its long history of working with biogas plants and improved cook-stoves, is well placed to develop a strong and effective programme for providing clean cooking energy.

The cooking energy programme needs to be broad-based, with the goal of meeting thermal energy needs. AIREC suggests that a template or planning methodology be developed by OREDA for a cooking/thermal energy plan at the block or district level, taking into account the following:

- The energy resources available as well as the cooking habits and aspirations of the local people.
- Local women, youth, and self-help groups should be involved in the construction and maintenance of stoves and in organising processed biomass feedstock so that the programme generates livelihoods and community involvement.
- Through local banks and micro finance institutions, financing of improved cooking energy solutions must be in line with the income streams and payment capacities of the communities.
- The clean cooking energy programme must cover not only rural and urban households but also tribal hostels, mid-day meal kitchens, schools, temples and other places of worship, hotels, tea stalls, sweet makers, etc.
- Other thermal applications like vegetable, spice and fish drying, brick kilns, and puffed rice making should be integrated into the programme.
- A range of locally available resources such as bamboo waste, rice husks, and animal and poultry litter may be considered for palletisation after suitable tests for efficiency and emissions.

- Clean cooking energy may be provided through a host of renewable energy options such as solar and biomass, but also through LPG and piped natural gas where these are the most practical solutions.

III. Integrate renewable energy programme with rural development and livelihoods

There are about 4,000 villages in the state that cannot be connected to the grid and will have to be powered by decentralised energy. These villages represent an energy challenge, but they also present an opportunity to demonstrate renewables-based electricity generation in a small-scale decentralised mode. A pilot project announced in August 2014, attempts to electrify some of these villages/hamlets using individual household-scale solar systems. While this pilot project may be able to light up some households, what it appears to miss out on is opportunities for integrating renewable energy with ongoing rural development activities.

Integrating energy access and renewable energy with existing schemes and programmes

It is suggested that energy access through DRE be integrated into the portfolios of local development agencies such as District Rural Development Agencies, Block Development Offices, and Village Panchayats. Solar pumps, RE-based spice and fish dryers, solar aerators for fish ponds, RE-powered milk chillers and cold rooms for vegetables are examples of technologies which can be readily integrated into existing decentralised development plans and also into plans of other departments and agencies. OREDA will play the role of a technical advisory providing renewable energy-specific input in developing and designing these initiatives.

Integration of renewable energy with rural development and rural livelihoods enhance local quality of life, improve income, and facilitate waste management. It will also create awareness about the potential for renewable energy and create a demand for these technologies. Such demand creation is critical for creating a pro-renewable energy ecosystem in the state.

Access to energy, especially renewable energy, must be an integral part of state development programmes and also for initiatives for backward districts such as the Biju KBK Plan, Western Odisha Development Council, and Backward Regions Grant Fund.

Skills development initiatives to prepare for renewable energy sector growth

Renewable energy projects are typically employment-intensive and create 'green jobs.' But these opportunities can be tapped by local people only if they are adequately equipped with the requisite skills. For the renewable energy sector, the recommended mode of development of skilled manpower is through intensive vocational and tailor-made courses (as also recommended by the International Labour Organisation). AIREC suggests that OREDA initiate and spearhead the following activities in this regard:

- Integrate renewable energy into existing vocational and education programmes.
- Reach out to local youth with skills provision activities and make training for DRE available at the district level.
- Retrain local tradespeople.

Lack of trained manpower is impeding renewable energy deployment in many states. Preparing a skilled workforce will incentivise renewable energy investors into the state and it will generate jobs for its youth.

IV. Generate investor interest in renewable energy

Investor and entrepreneurial interest is very low in Odisha's renewable energy sector. There are hardly any renewable energy sector players in Odisha. For instance, while there are no Odisha-based JNNSM (solar) channel partners, states like Maharashtra, Karnataka, and Gujarat have over 10 each, and there are seven partners based out of West Bengal. In a recent call for bids for rooftop solar (Phase IV), states like

Rajasthan, Gujarat, and Tamil Nadu were oversubscribed, while several states, including Odisha, did not receive any bids.

Informal discussions with renewable energy sector investors and entrepreneurs reveal that multiple clearances and lack of incentives plague the sector. Important ways in which investor interest can be spurred include the following:

- Strengthen the SNAs in the state.
- Provide single-window clearances for renewable energy projects without compromising on local social and environmental concerns.
- Establish policy incentives that establish a strong renewable energy manufacturing base and supply chain.
- Create demand for renewable energy within large state programmes in critical areas like health, education, water and sanitation, water pumping, cold storage, and horticulture processing.
- Institute remunerative tariff norms for decentralised electricity generation from renewables.
- Identify a strong network of grassroots organisations and reputed NGOs for grassroots project implementation in line with community needs.
- Create a pool of skilled manpower to conceptualise, design, implement, operate, maintain, and provide last-mile service delivery for renewable energy projects.

Policy incentives play a key role in attracting investors to a state. One incentive that has been promulgated in India is the state-specific REC that is tied in with the RPO. Regulations around the monitoring and verification of RPOs, penalties for noncompliance of RPOs, and REC regulations must all be reviewed to ensure this framework functions as an effective incentive for RECs.

The involvement of the state's Odisha Grameen Bank in financing renewable energy devices and projects will be an important step. Financing schemes must be tailored to suit the payment capacities, income streams, and project viability.

V. "Special status' for Odisha in renewable energy deployment

In terms of the energy including renewable energy landscape, Odisha has numerous special features:

- Some parts of the state are extremely energy poor.
- The state has an unfavourable market ecosystem and will need some special support to rise to the level of other states that already have buoyant renewable energy markets and supply chains.
- Odisha's renewable energy potential is an important advantage, but in the case of wind and solar, the availability is diffused.
- Accounting for one-fifth of the country's domestic coal production, Odisha is one of the largest contributors to the National Clean Energy Fund (NCEF).

Consequently, the following may be considered to factor in a 'special status' for Odisha:

- Renewable energy project bids on a regional basis or on the basis of grouping/categorisation should factor in several criteria, such as need for the project and renewable energy resource availability. For example, equal opportunity to states with diffused renewable energy resources will require them to be treated as a separate category.
- Various MNRE schemes may be customised to include special or additional incentives for Odisha.
- Though the NCEF is currently allocated on a project basis, projects in Odisha may be accorded priority on the basis of the factors outlined above. This would need some tweaking

of the framework for NCEF disbursement, which is now under review.

Legislators and parliamentarians as energy access and renewable energy champions

Renewable energy in Odisha needs champions. While a revitalised OREDA and GEDCOL led by the proposed Secretary (Renewable Energy) would steer renewable energy activities in the state, these efforts would get a tremendous fillip if legislators and parliamentarians got involved in some of the state-led efforts. The MLA Local Area Development (LAD) fund would be a useful starting point. A review of some of the examples of projects under the LAD fund suggests several possibilities for demonstrating renewable energy applications for development including the following:

- Tribal hostels powered by renewable energy systems for thermal and electricity needs
- Passenger rest sheds with lighting powered by rooftop solar
- School toilets with running water and lights powered by renewable energy
- Renewable energy-integrated community centres as a meeting place, as well as for facilities such as pay-per-use machines linked with livelihoods (e.g., sewing machines, spinning machines, bamboo polishing)
- Electrification of specific hamlets using renewable energy-based micro grids
- School roofing to include solar rooftop
- Renewable energy-powered drinking water kiosks

As the LAD funds are to be managed through the DRDA, the success of such renewable energy-integrated community projects will help with scaling up efforts throughout the district and eventually across the state. MLAs and MPs should also play an important role in highlighting energy access problems in Odisha as well as for implementation of the action points suggested for highlighting the creation of a pro-renewable energy ecosystem. Points that may be pursued include the following:

- OREDA to move under the Ministry of Energy
- Creation of a separate Renewable Energy Directorate in the Ministry of Energy to be headed by a Secretary
- Integration of renewable energy into programmes and policies of relevant departments and agencies such as health, education, water and sanitation, poultry, agriculture, horticulture, and irrigation
- Integration of DRE into district development programmes
- Setting up facilities and programmes for skills development for renewable energy sector
- Development of a state clean cooking energy programme or mission
- Working with MNRE, CERC, and Odisha SERC to
  - Strengthen the REC framework at the national and state levels
  - Develop tariff regulations for decentralised electricity generation
- Working with the Ministry of Power, the MNRE, as well as the Central and State Finance Commission to accord ‘special status’ to Odisha
- Working with MNRE to ensure regional bidding for renewable energy projects and to explore the possibility of ‘special status’ for Odisha in incentives for renewable energy as well as in allocation from NCEF
- Involving Odisha Gramya Bank in renewable energy sector lending for entrepreneurs and end users

Chapter 1: Background and approach for the study

The Indian energy challenge and renewable energy impetus

The per capita electricity consumption in India is less than 1000 (kWh), which is just 30 percent of the global per capita average. The impetus to provide improved and eventually universal energy access, reduce dependence on both energy imports and fossil fuels, are the key drivers for India to turn to renewable energy options.

India's renewable energy endeavours are led largely by the Ministry of New and Renewable Energy at the central level. The Ministry works in close collaboration with state level renewable energy development agencies (also referred to as the State Nodal Agencies or SNAs).

Purpose of the study

The purpose of this study is to analyse the renewable energy landscape of the state of Odisha. Faced with numerous development challenges, Odisha witnesses persistent gaps in energy availability at the state-level. At the ground level, in villages and towns, un-electrified households, frequent power outages and kitchens filled with smoke from traditional cook-stoves – are all indicators of "energy poverty". Energy is a basic input for development. So for Odisha to climb up the socio-economic development ladder, access to reliable and affordable energy is imperative. Large coal-fired plants are being planned to meet the state's electricity deficits. But coal-based power generation poses several challenges in terms of organising coal feedstock, managing environmental issues relating to coal mining, managing the carbon content of coal, managing fly ash generation etc. Thus, endowed with many renewable energy resources, the development of renewable energy in Odisha is both an opportunity and a necessity.

This study seeks to examine the energy-development context in Odisha to chalk out the state's major energy challenges. In doing so, the study also examines the ongoing renewable energy initiatives, focusing on the existing institutional, policy and regulatory frameworks. Drawing on the experience of the state and other states in deploying renewable energy, the study presents alternative and renewed approaches to renewable energy development with a focus on energy poverty eradication in the state. The study also pinpoints specific action points towards this goal.

Approach and methodology

The study findings are based on extensive review of a number of reports published by a range of state and central government agencies including OREDA (Odisha Renewable Energy Agency), MNRE (Ministry of New and Renewable Energy) and CEA (Central Electricity Authority). These reports cover various topics relating to renewable energy and energy access as well as rural electrification and rural development. The study team is led by members of AIREC (Ashden India Renewable Energy Collective) who have extensive on-the-ground experience in rural energy access and renewable energy. The AIREC team was led by Dr S P Gon Chaudhuri, chairperson of AIREC, also a well-known name in decentralised renewable energy. The study benefited from policy reviews by Rekha Krishnan of AIREC. The AIREC team was ably aided by Ashok Das of SunMoksha and Bhagawati Prasad Pattnaik of NIST (National Institute of Science and Technology) who provided local insights and the critical local linkages to gather relevant perspectives.

The study draws on a range of information and reports available online and / or specially requested from various organisations including Census data, RGGVY data, OREDA and OERC information. SunMoksha has also shared some of its internal reports that contain extensive field information. A number of stakeholders were formally and informally consulted including personnel from OREDA, OERC (Odisha Electricity Regulatory Commission), GEDCOL (Green Energy Development

Corporation of Odisha Limited), Sambandh and SunMoksha.

Data gathering was a challenge given that consolidated information was rarely available from a single organisation, report or website and in several cases required several personal visits. Assumptions for many of the government data and estimates were not available and this posed some challenges.

Structure of the report

This report commences with an introduction to the energy and development context in Chapter 2 followed by a tracking of governmental and non-government renewable energy initiatives in the state in Chapter 3. The following chapter focuses on the renewable energy potential in the state and highlights the scope for expansion of decentralised renewable energy. What are the challenges in energy planning in Odisha and how can the state facilitate scaling up of renewable energy in Odisha: this is the core question addressed in Chapter 5 to outline broad approaches that the state should adopt. Detailing out this approach, Chapter 6 pinpoints recommendations for the state and its parliamentarians to expand the adoption of renewable energy for provision of sustainable energy access in the state.

Geographical and physiological features

In order to examine the renewable energy landscape of Odisha, it is important to place it in the larger geographic, demographic and socio-economic context of the state. Odisha has a land area of 155,707 sq. km (4.74 per cent of India's landmass) and a population of 36.8 million people (3.47% of India's population). Administratively the state is divided into 30 districts with 58 sub-divisions and 316 Tehsils. The extensive ranges of hilly forests, several lofty peaks, plateau lands, a long stretch of coastline, an extensive riverine system, brackish waters, coastal mangroves, and coastal plains together have endowed the state with a wide range of ecological habitats for a diverse and broad spectrum of flora and fauna. Odisha has a rich forest cover over 37% of the state's geographical area. The per capita recorded area of forest cover in the state is high at 0.14 ha as compared to the national per capita average of 0.06 ha. The forest cover in Odisha is unevenly distributed with Kandhamal, Malkangiri and Gajapati districts being the most densely forested while the coastal districts have the least forests (Figure 2.1).

On the basis of physical features and agro-climatic conditions, it is possible to divide Odisha into four zones:(i) Northern Plateau; (ii) Central Table Land (iii) Eastern Ghats and (iv) Coastal Plains. Odisha receives about 1500 mm (60 inches) of rainfall normally, with a variability of 25–30 per cent. About 77 per cent of the rainfall comes from the southwest monsoon (June to September). However, the south-western districts of Kalahandi, Bolangir, and Koraput fall in the rain shadow zone of the southwest monsoon and hence receive highly erratic rainfall (Figure 2.1).

ODISHA (ORISSA) MAP

Figure 2.1: Poltical map of Odisha

Socio-economic features: high incidence of poverty and inequality

Odisha's annual per capita income in the range of Rs. 24000 is amongst the lowest in the country and is about 30% lower than the national per capita income (Figure2.2). The economic plight of the State is also reflected in the monthly per capita expenditure (MPCE); rural Odisha had the lowest spending among the states. With an MPCE of Rs. 1,003, almost 57% of the expenditure of rural households is on food. The MPCE for urban areas of the State is also low at about Rs. 1,941 with 45% spent on food consumption. High proportion of expenditure on food indicates low availability of income for spending on basic non-food items, and is an important indicator of poverty.

While the all India poverty head-count ratio was 21.9 per cent, Odisha's poverty head count ratio is at 32.6 percent. Along with, Madhya Pradesh, Assam, Uttar Pradesh and Bihar, Odisha has the highest poverty incidence in the country. Odisha along with Madhya Pradesh has the highest percentage of rural poor in the country. The rural poverty head count ratio for the State stands at 35.7 % while the urban poverty head count ratio is 17.3 %.

Unemployment is high in rural pockets of the State at 22 per 1,000.The Odisha economy has been steadily growing, but the state's growth rate has swung between 4.5 to 12.5 per cent per year in the last seven years.

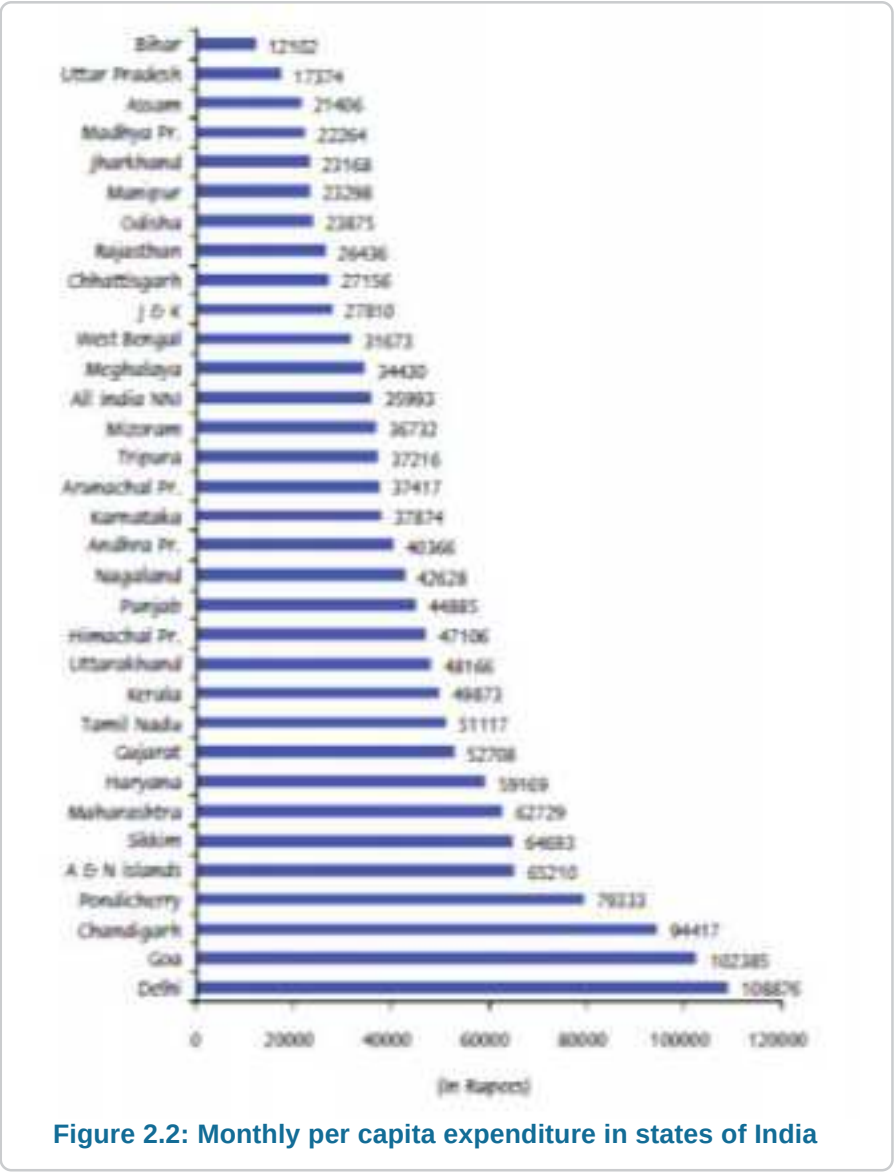


Figure 2.2: Monthly per capita expenditure in states of India

About 23 per cent of Odisha's population comprises the indigenous tribal population, mostly concentrated in the north-western and south-western districts of the state with traditional means of livelihood. The tribal population have a heavy dependence on forests for their livelihood. The north-western districts (Sundargarh, Keonjhar, and Mayurbhanj) account for 35.3 per cent of Odisha's tribal population and the south-western districts (Koraput, Kalahandi, Malkangiri, Nawrangpur, Nuapada, Rayagada, Kandhamal, Boudh, Balangir and Saharanpur) account for another 39.1 per cent. The forces of modernization have largely bypassed them and marginalized them in economic terms, threatening their livelihood security. The population belonging to Scheduled Caste constitute a little more than 16 per cent of the state's population. Unlike the tribal population, they are mostly concentrated in the coastal districts, namely Balasore, Bhadrak, Cuttack, Jajpur, Jagatsinghpur, Kendrapara, Khurda, Ganjam, Nayagarh and Puri.

Regional disparities have plagued Odisha for several decades. The undivided districts of Koraput, Bolangir and Kalahandi (popularly known as the KBK region) and several other pockets of southern and western Odisha are socio-economically depressed. Persistently high poverty in these belts is aggravated by frequent calamities including floods and drought. Several government programmes including Biju KBK Plan, Backward Region Grant Fund, Western Odisha Development Council, Gopabandhu Gramin Yojana, Central-assisted Tribal Sub Plan seek to address regional disparities albeit with limited success thus far

Basic demographic and socio-economic information about Odisha is listed in Table 1.1 below, which includes important data on access to energy in the state, examined in detail later in this Chapter..

Table 2.1: Basic information on Odisha

Parameter	National	Odisha
Basic indicators – geographic and demographic		
Population (in millions)	1210	41.94
Population Rank (28 States)		11
Population density (persons per sq km)	382	269
Number of districts	672	30
Number of inhabited villages	593,731	47,529
Geographical area (sqkms)	3,287,590	155,707
Socio-economic indicators		
Income per capita in 2010-11	60972	34361
Human Development Index (HDI)	0.467	0.362
Rank in India (of 23 recorded States)		22
Poverty (% below poverty line)	21.92	32.59
Poverty rank (of 28 States)		23
Rural Unemployment rate (Nos. Per 1000 population)	16	30
% rural population below the poverty line	26%	36%
Share of agriculture in state economy		18%
% of villages electrified	94.4%	81.9%
% of rural households using electricity for lighting		58%
% of rural households using modern fuels (LPG/PNG/solar) for cooking	12%	2%

Table 2.2: Odisha Installed Capacity As On February 28, 2014[i] (MW)

	Thermal (coal)	Hydro	Renewable	Total
State	420	2062	64	2546
Private	3100	0	36	3136
Central	1585	105	0	1690
Total	5105	2167	100	7372
	70%	29%	1%	100%

Electricity supply in Odisha: dominated by coal; plagued with inefficiencies and ironies

The state of Odisha depends primarily on thermal and hydro power generation to meet its power requirements. Coal-based power generation dominates electricity supply in the state. Renewables account for just 1% of installed capacity.

High transmission and distribution losses can nullify the benefits of capacity additions

Odisha has a wide power distribution (as indicated in Figure 2.3). However, the state is ridden with high AT&C (aggregate technical and commercial) losses at around 40% losses compared with all-India average of 26%. This is largely due to lack of renovation efforts, theft and lax collection efforts. It is useful to point out here that estimates indicate that a 1% reduction in T&D loss has the potential to save nearly Rs. 700 to 800 crores in India.

It is estimated that 600-900 MW of power can be saved by just addressing T&D. Further, promoting energy–efficiency and demand side management in the user industries can bring about a saving of about 500 MW. In other words, if T&D losses and energy inefficiencies in other areas are not addressed, additional capacity to the tune of 1400 MW will have to be built.

Since 2013, a major grid extension project "Odisha Distribution System Strengthening Project" is underway, as part of the plan to provide uninterrupted and quality power to the people of the state (Box 2.1)

Box 2.1: Efforts to lower distribution losses

In light of the large AT&C (average technical and commercial) losses, the State plans to set up Special Energy Courts and Energy Police Stations in various parts of the State to deal with cases relating to electricity theft. Further, a State Nodal Vigilance Cell headed by a retired Senior Police Officer in the rank of Superintendent of Police with four such retired officers at four Regional Cell Offices has been established across the State to prevent theft of power. These steps are part of the state government's project to strengthen the power network in the state.

The state government would construct 500 new 33/11 KV sub-stations with a CAPEX of Rs. 2600 crore. The project would cover all the 30 districts with priority focus on rural and semi-urban areas. This grid extension initiative is also important given that Odisha is faced with a large number of un-electrified villages

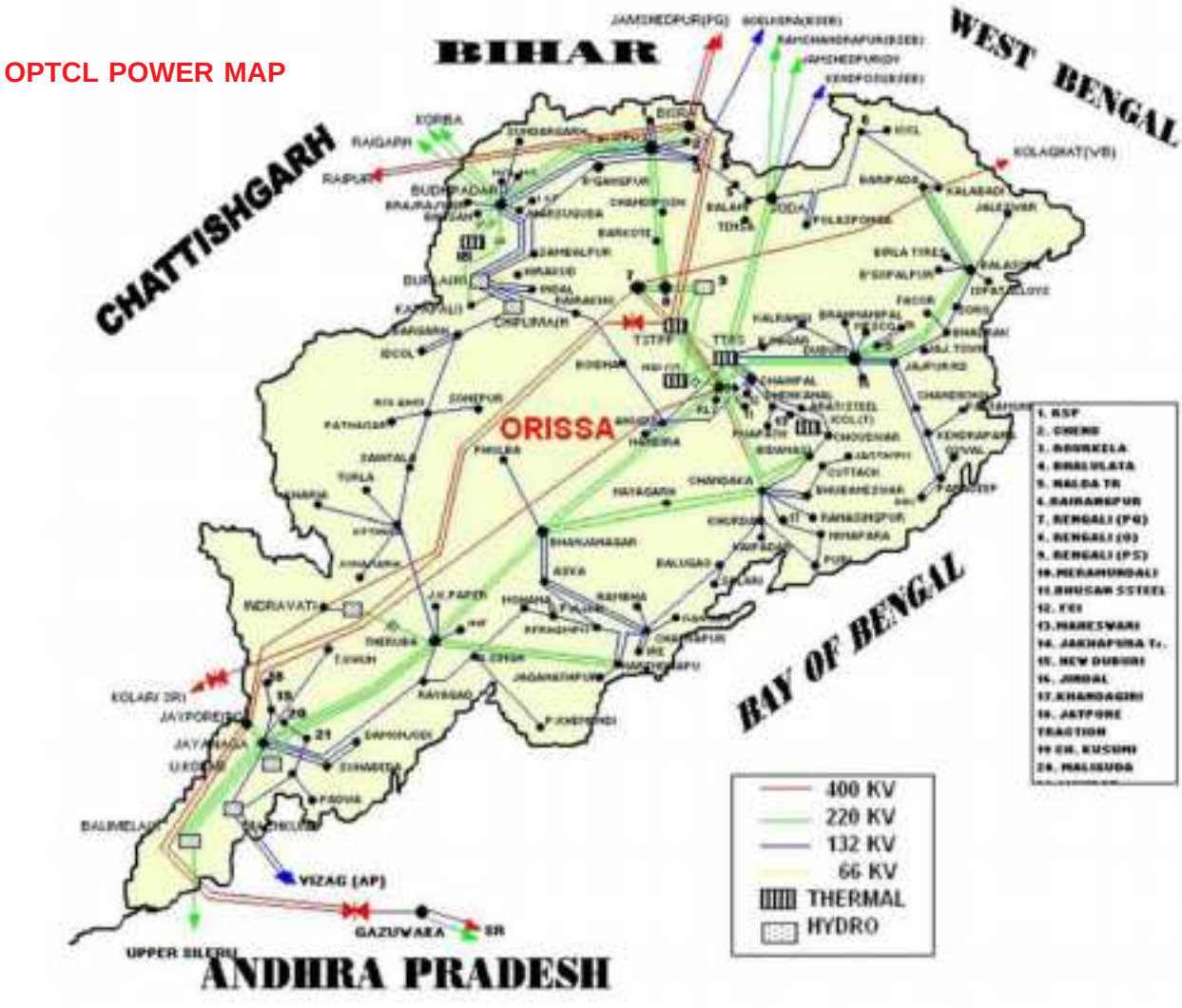
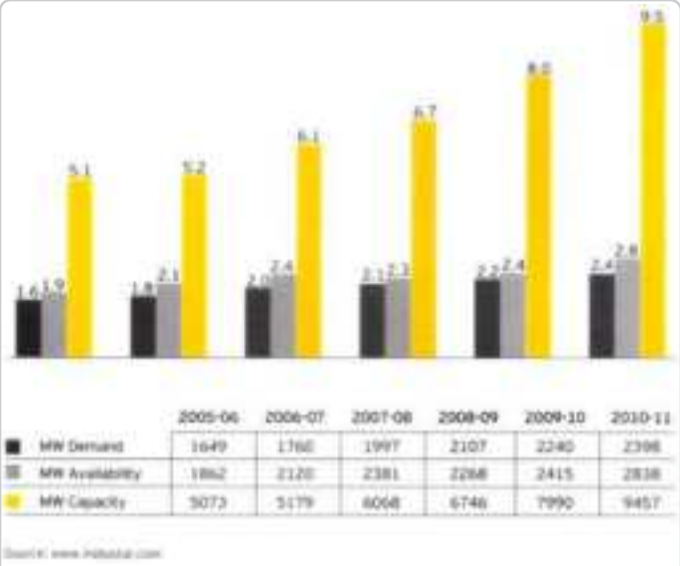


Figure 2.3: Power distribution map of Odisha

Large unutilised electricity capacity[ii]

In the past several years, Odisha has reported both surplus and deficit of electricity. In the past two decades, it has been reported that Odisha has a surplus of electricity and in fact earned more than Rs. 5300 crores by supplying power to neighbouring states.

In recent years, however, peak deficits have re-emerged. Analysts claim that this is largely the result of bulk of the state's installed capacity remaining unutilised across the state. The figure below highlights this very clearly. The generation was less than 30% of the installed capacity of over 9.5GW (Figure 2.4).



	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11
MW Demand	1649	1760	1997	2107	2240	2398
MW Availability	1862	2120	2381	2268	2415	2838
MW Capacity	5073	5179	6068	6746	7990	9457

Figure 2.4: Large gaps between installed capacity, availability and demand (MW)

Limited analysis of the causes for the low utilisation of capacity indicates that problem with availability of feed-stock (coal) is an important impediment in the state. It is also pointed out that "mismanagement, hooking and lack of proper infrastructure development" constrain utilisation of capacity. It may be noted that Odisha accounts for nearly a quarter of domestic coal reserves. The PLF of coal-based plants in the state are said to hover around 40% though high PLFs of over 80% have also been observed. Only 0.04% of the hydro energy generated in the state is of the run-of-the-river type, while the balance is based on reservoirs.

Continued focus on coal-based capacity additions

It is strange that despite such under-utilisation of existing capacity, new capacity additions are being planned. It may, however, be noted that there are also plans to retire some of the very old thermal plants. New capacity additions proposed are coal-based albeit on the newer super-critical technology. Coal linkages are also reportedly tied up through linkages with mines as also relevant rail corridors.

To meet the growing needs and bridge the deficit, Government of Odisha is taking steps to generate more power, according to the Odisha Climate Change Action Plan[iii] (OCCAP). In the next 5 years, additional 4,000 MW will be added. In addition, NTPC will install power plants of 7720 MW capacity total under the national grid. The state government is planning to add 3120 MW. In the coming decade, it is anticipated that the installed capacity will have rapid additions of thermal (coal)-based power. This will cause substantive stress on the local environment and on human health via emissions of particulates and nitrogen oxides, excessive consumption of water and generation of fly ash. The negatives associated with coal mining and coal-based power generation must be kept in mind for future energy plans.

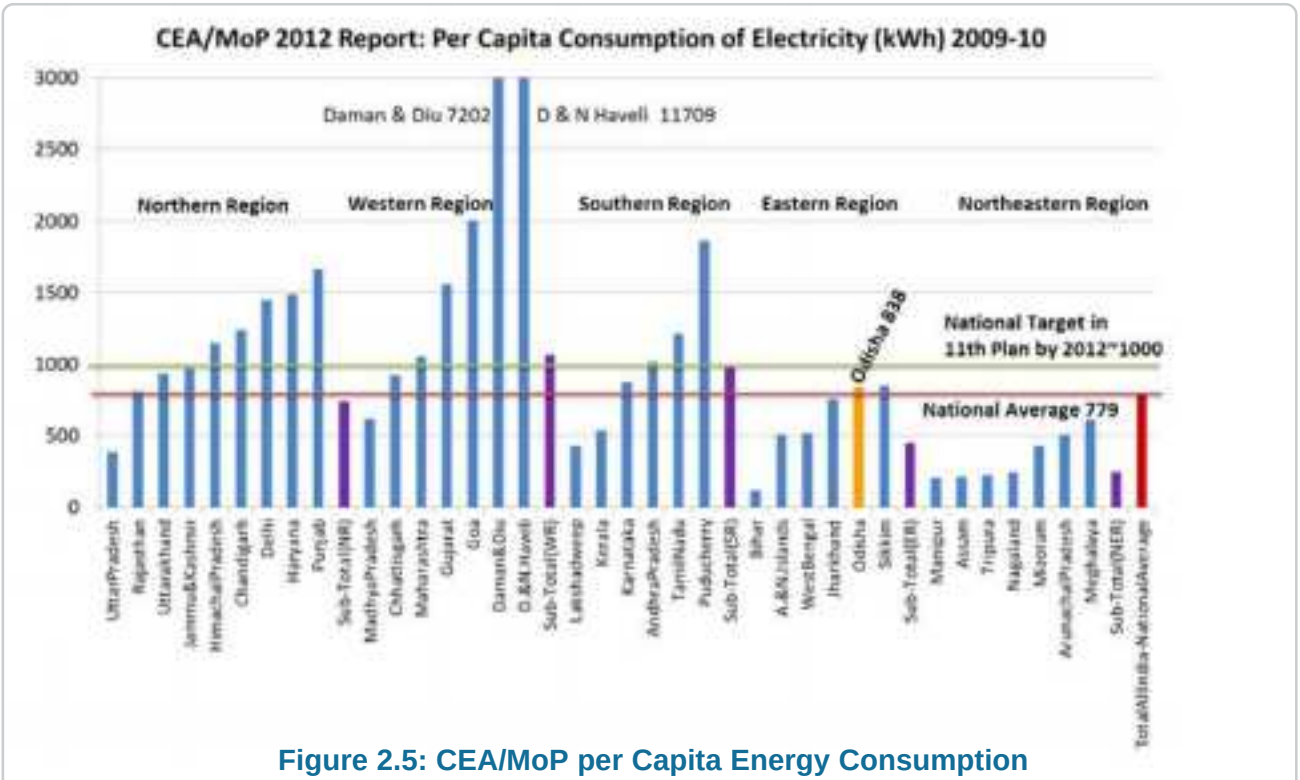


Figure 2.5: CEA/MoP per Capita Energy Consumption

Issues relating to electricity demand

Low level of per capita electricity consumption

According to CEA (2012)[iv], the per capita electricity consumption of Odisha in 2010 was 838kWh, slightly above the national average of 779kWh. As shown in Figure 2.5, the eastern and north-eastern regions of India have lower per capita consumption, compared to northern, western and southern regions. However, the average per capita annual consumption level in Odisha (and in the country as a whole) is still below the 11th plan target of 1000kWh[v]. Notably, even the figure of 1000 kWh is just one-third of the global average per capita consumption. This not only indicates the poor state of energy access in the state, but also the potential for growth in energy consumption as economic activity picks up.

Rural electrification challenge: large number of un-electrified households, unreliable grid electricity

According to recent estimates[vi],82% of villages are electrified in Odisha leaving 18% of the state's villages un-electrified, most of these in remote tribal areas of the state. An estimated 52 lakh households including 10.8 lakh BPL households are yet to be electrified. It may be pointed that in terms of % households un-electrified, Odisha ranks fifth. Only four states – Assam, Uttar Pradesh, Bihar and Jharkhand have higher figures of un-electrified households as percentage of total households (Figure 2.6).

The large discrepancy between percentage of un-electrified villages (18%) and percentage of un-electrified households (64%) is primarily because (a) the definition of RGGVY grid-connectivity (see below) and (b) the deficit in electricity generation to meet the demand, where invariably, the rural areas get last priority in the scheduling of electricity distribution.

As per the new definition of RGGVY in 2007, a village would be declared as electrified, if:

- Basic infrastructure such as Distribution Transformer and Distribution lines are provided in the inhabited locality as well as the Dalit Basti hamlet where it exists,
- Electricity is provided to public places like Schools, Panchayat Office, Health Centres, Dispensaries, Community Centres etc., and
- The number of households electrified is at least 10% of the total households in the village.

According to the 2011 Census, only 43% of Odisha's households use electricity for lighting[vii]- 36% in the rural areas and 84% in urban areas respectively. It is estimated that 18 out of 30 of districts have less than 40% households with access to electricity for lighting in the rural areas, with the figure going down to 10% in some districts.

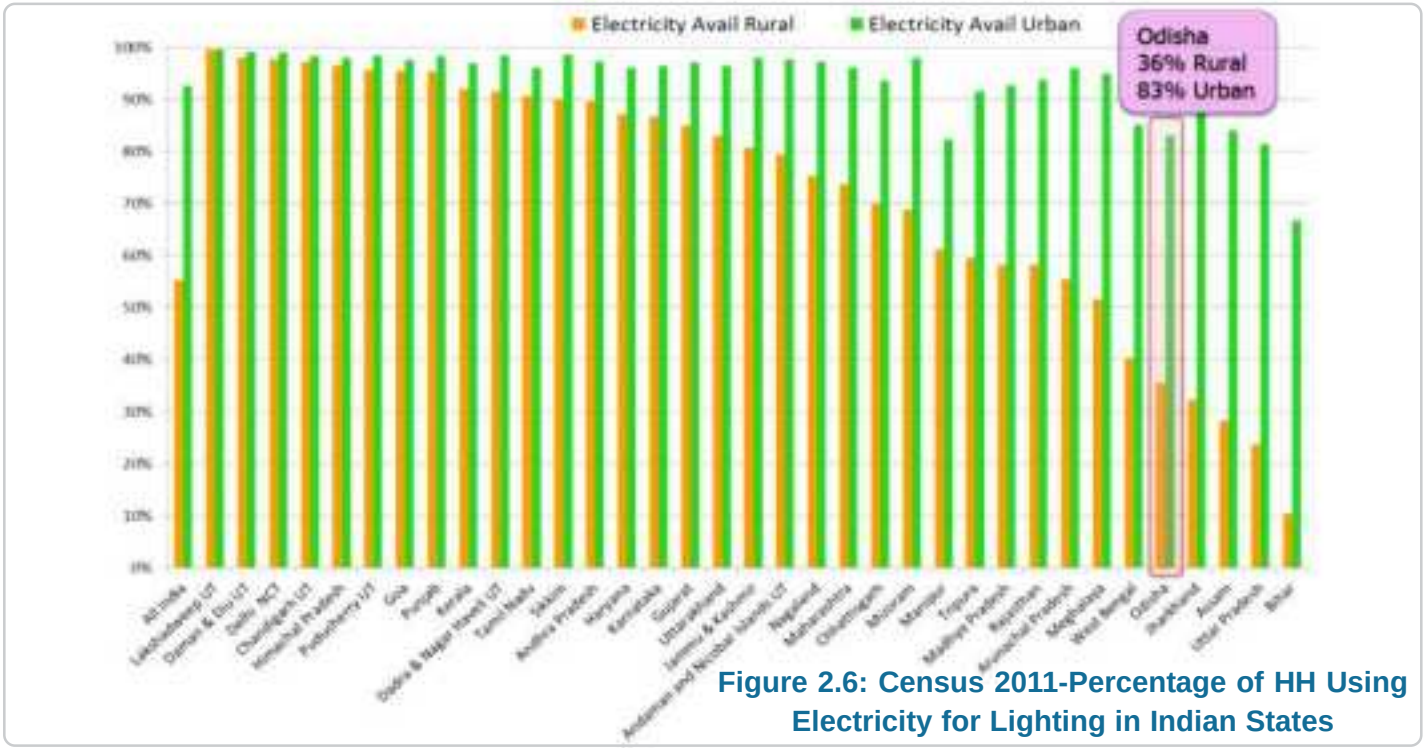


Figure 2.6: Census 2011-Percentage of HH Using Electricity for Lighting in Indian States

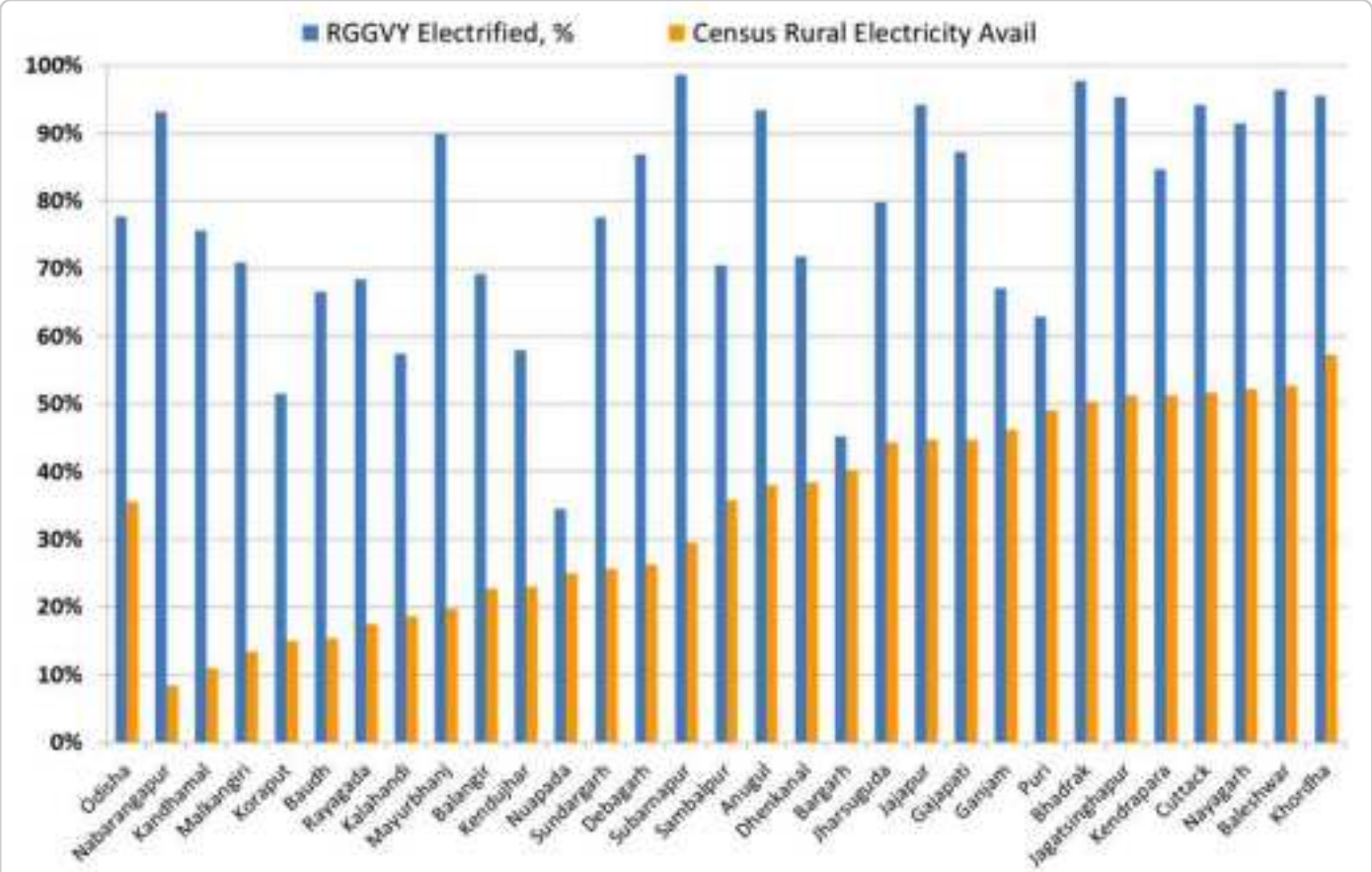


Figure 2.7: Odisha Comparison: RGGVY Villages Electrified vs. HH Electricity for Lighting

Table 2.3: Sources of Lighting in households of Odisha (Census 2011)

District	Total Households	Electricity	Kerosene	Solar energy	Electrified		Un-electrified	
					No.	%	No.	%
Bargarh	3,39,364	1,36,817	1,98,851	826	1,37,643	41	2,01,721	59
Jharsuguda	83,664	37,112	45,082	200	37,312	45	46,352	55
Sambalpur	1,78,958	63,967	1,12,587	366	64,353	36	1,14,605	64
Debagarh	70,511	18,487	50,555	240	18,727	27	51,784	73
Sundargarh	3,10,762	79,585	2,23,841	2,197	81,782	26	2,28,980	74
Kendujhar	3,49,736	80,461	2,63,466	1,937	82,416	24	2,67,318	76
Mayurbhanj	5,44,764	1,07,023	4,31,910	1,526	1,08,549	20	4,36,215	80
Baleshwar	4,73,512	2,49,429	2,16,443	1,804	2,51,233	53	2,22,279	47
Bhadrak	2,74,191	1,38,080	1,32,319	842	1,38,922	51	1,35,269	49
Kendrapara	3,11,465	1,59,811	1,47,154	1,379	1,61,190	52	1,50,275	48
Jagatsinghapur	2,37,411	1,21,609	1,12,323	1,045	1,22,654	52	1,14,757	48
Cuttack	4,25,082	2,19,784	1,98,234	922	2,20,706	52	2,04,376	48
Jajapur	3,78,135	1,69,035	2,01,905	994	1,70,029	45	2,08,106	55
Dhenkanal	2,53,118	97,381	1,51,455	434	97,815	39	1,55,303	61
Anugul	2,49,585	94,796	1,49,057	902	95,698	38	1,53,887	62
Nayagarh	2,13,265	1,11,131	97,230	936	1,12,067	53	1,01,198	47
Khordha	2,47,940	1,41,984	1,00,200	512	1,42,496	57	1,05,444	43
Puri	3,17,002	1,55,294	1,56,415	803	1,56,097	49	1,60,905	51
Ganjam	6,02,216	2,78,201	3,12,092	1,444	2,79,645	46	3,22,571	54
Gajapati	1,12,872	50,484	60,598	468	50,952	45	61,920	55
Kandhamal	1,55,335	17,001	1,36,255	743	17,744	11	1,37,591	89
Baudh	1,03,239	15,832	86,173	273	16,105	16	87,134	84
Subarnapur	1,40,714	41,563	97,025	297	41,860	30	98,854	70
Balangir	3,87,345	87,948	2,92,681	1,504	89,452	23	2,97,893	77
Nuapada	1,51,921	37,851	1,11,626	1,116	38,967	26	1,12,954	74
Kalahandi	3,77,001	70,132	2,99,920	3,344	73,476	19	3,03,525	81
Rayagada	1,91,615	33,587	1,55,198	847	34,434	18	1,57,181	82
Nabarangapur	2,53,461	21,511	2,28,728	1,541	23,052	9	2,30,409	91
Koraput	2,83,522	42,352	2,37,188	1,467	43,819	15	2,39,703	85
Malkangiri	1,26,306	16,964	1,07,316	961	17,925	14	1,08,381	86
Total	**81,44,012**	**28,95,252**	**51,13,827**	**31,870**	**29,27,122**	**36**	**52,16,890**	**64**

In most electrified villages, power supply is erratic and limited to 4-8 hours a day and that too at very low voltages that merely light up the bulbs. Due to this erratic low-quality power supply, consumers opt not to get electricity connection, as it does not make economic sense for them. They prefer to depend on kerosene lighting which they consider more reliable! In Nabarangpur and Mayurbhanj districts where electrification is above 90%, households using electricity are only 8% and 18% respectively.

A review of data shows that low levels of electricity access coincide with high level of poverty, unemployment and larger area under forests. While poverty affects affordability, forested lands and remote locations hinder grid extension.

Cooking energy challenge: persistent dependence on traditional fuels

Nearly 90% of rural households in Odisha use firewood, crop residue and dung cake for cooking. Traditional cook-stoves consume excessive amounts of biomass and cause health-threatening levels of indoor air pollution. It is estimated indoor air pollution causes more than 480,000 premature deaths in India each year. Soot from cook-stoves is also considered to be an aggravator of climate change.

According to the 2011 census data, firewood is a major cooking fuel in Odisha. In rural areas, over 70% of households use firewood. In urban areas too, over 35% urban households use firewood for cooking. Crop residue and cowdung cake are the next largest cooking fuels in rural households at 12% and 11% respectively. While, LPG is the main fuel source for 46% of urban households, only 10% of rural households in Odisha use LPG as cooking fuel (Figure 2.8).

That nine out of ten households in rural Odisha continue to use traditional cooking fuels is an indication of a lack of serious effort in addressing the cooking energy access issue. This is true not just of Odisha but many other states in the country, However, in the case of Odisha, it is ironical that the state was once a pioneer in biogas plants. Receding forests and the emergence of a formal market for fuelwood (which in turn raises fuelwood prices) could spell doom for the poorest households that traditionally depended on wood gathered from forest fringe areas.

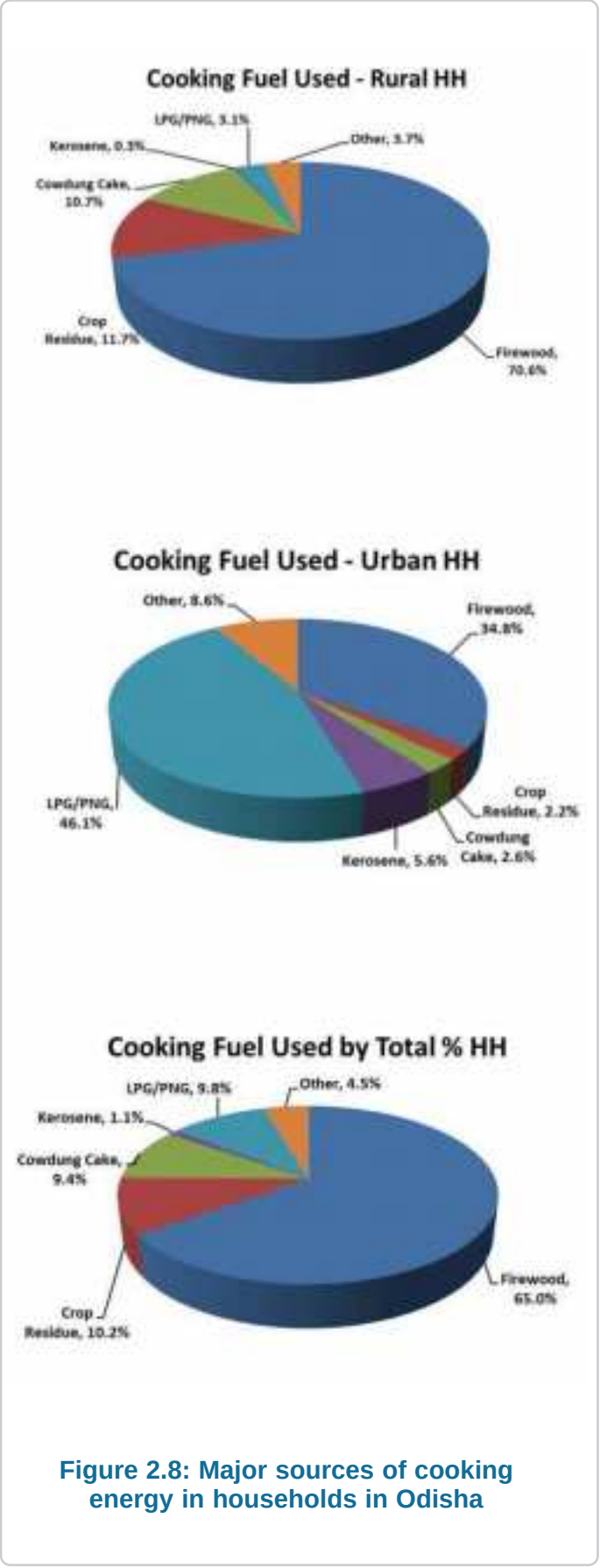


Figure 2.8: Major sources of cooking energy in households in Odisha

Limited domestic fossil fuel resources, high dependence on fossil fuel imports and the need to limit carbon emissions have driven the search for alternative energy sources. The Government of India recognizes that aggressive development of its renewable energy resources is critical to ensure that it is able to meet both its economic and environmental objectives. Renewable energy development is promoted through a range of policies and actions since 2003 with the Ministry of New and Renewable Energy (MNRE) as the focal point. By contrast, energy access has been recognised as a major development concern and a range of programmes for provision of electricity and cooking energy have been in existence for several decades. These include rural electrification programmes largely through grid extension (merged into the RGGVY Rajiv Gandhi Grameen Vidyutikaran Yojana in 2005) subsidies on LPG and programmes for improved cook-stoves and biogas plants. Thus the energy access efforts have been driven by various disconnected schemes of the Ministry of New and Renewable Energy, and the Ministry of Power and to a lesser extent, Ministry of Petroleum and Natural Gas.

The national level policy and institutional framework for renewable energy

MNRE is the nodal Ministry of the Government of India for all matters related to new and renewable energy. MNRE has evolved through several steps from the Commission of Additional Sources of Energy that was established in 1991. The Ministry works in close collaboration with state level renewable energy development agencies (State Nodal Agencies - SNA's). The Ministry has been instrumental in setting up and supporting a wide range of institutions to develop and promote renewable energy technologies and applications in India. These include public financial institutions such as the Indian Renewable Agency Development Agency (IREDA) and research institutes such as the National Institute of Solar Energy (NISE), Centre for Wind Energy Technology (C-WET), Alternate Hydro Energy Centre (AHEC), Sardar Swaran Singh National Institute of Renewable Energy (SSS NIRE), and the more recent addition - the Solar Energy Corporation of India (SECI).

MNRE reports that India has over 30 GW of installed renewable electricity generation capacity, which is approximately 15% of India's total installed grid electricity generation capacity. However, generation of electricity from renewable energy sources is estimated at just over 5% of total grid electricity generation.

A wide range of Government of India (GoI) policies and schemes have sought to support the expansion of renewable energy, as follows:

- Electricity Act 2003: Mandates that each State Electricity Regulatory Commission (SERC) must establish minimum renewable power purchases; allows for the Central Electricity Regulatory Commission (CERC) to set a preferential tariff for electricity generated from renewable energy technologies; and provides open access of the electricity transmission and distribution system to licensed renewable power generators.
- National Electricity Policy 2005: Allows SERCs to establish preferential tariffs for electricity generated from renewable sources.
- National Tariff Policy 2006: Mandates that each SERC must specify a renewable purchase obligation (RPO) with distribution companies in a time-bound manner with purchases to be made through a competitive bidding process.
- Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY) 2005: Supports extension of electricity to all rural and below poverty line (BPL) households through a 90% subsidy on capital equipment costs for renewable and non-renewable energy systems.
- Eleventh Plan 2007–2012: Established a target that 10% of power generating capacity should be based on renewable sources by 2012 (a goal

that has already been reached); it also supported the phasing out of investment-related subsidies in favour of performance-oriented incentives.

In June 2008, India's first National Action Plan on Climate Change (NAPCC) was released. It outlined existing and future policies and programs addressing climate mitigation and adaptation. The plan identified eight core "National Missions" running through 2017.

The Jawaharlal Nehru National Solar Mission (JNNSM) is part of the NAPCC. JNNSM has a target for the deployment of 20,000 MW of solar power, 20 million m^2 of solar thermal collector area and 20 million solar lighting systems by 2022. The objective of JNNSM is to create a policy and regulatory environment that provides a predictable and effective incentive structure that enables rapid and large-scale capital investment in solar energy applications and encourages strong technical innovation and the lowering of costs. The Mission adopted a 3-phased approach, spanning the remaining period of the 11th Plan and first year of the 12th Plan (up to 2012-13) as Phase 1, the remaining 4 years of the 12th Plan (2013-17) as Phase 2 and the 13th Plan (2017-22) as Phase 3. At the end of each plan, and mid-term during the 12th and 13th Plans, there will be an evaluation of progress and a review of capacity and targets for subsequent phases – to be based on emerging cost and technology trends, both domestic and global.

The National Clean Energy Fund was created in 2011 as a funding mechanism for research and development in the field of clean energy technologies. The fund is created through a levy on coal. Though the fund is large (expected to grow to Rs. 100 billion) the guidelines for utilisation of this Fund have been found to be very broad-based with the result that the Fund is now being used for routine energy projects including those in the new and renewable energy sector. The recent Budget that doubled the cess on coal will dramatically increase inflows into this Fund.

Renewable energy institutions in Odisha

The framework for renewable energy and energy access in Odisha largely mirrors that at the national level with a range of agencies and schemes. A number of agencies deal with various aspects of renewable energy in Odisha. These include:

- OREDA (Odisha Renewable Energy Development Authority): As the primary nodal agency for promoting renewable energy in the state, OREDA has several active programs in the decentralized RE sector. Till recently, it was also overlooking the grid-connected RE programs.
- GEDCOL (Green Energy Development Corporation of Odisha Ltd): Formed as a 100% subsidiary of Odisha Hydro Power Corporation (OHPC), GEDCOL's mandate is to develop and implement large grid-connected RE projects.
- Odisha Electricity Regulatory Commission (OERC): Another key agency impacting the implementation of RE in the state is the OERC, an independent regulatory authority that Issues and enforces licenses, determines tariff and charges, formulates policy and incentives for electricity in the state, monitors financial viability of operators, sets service standards and monitors compliance.
- DISCOMs (distribution companies): Playing significant roles in RE deployment by providing the last mile connectivity and infrastructure to transmit and deliver power to the end consumers, Odisha has four DISCOMS – Western Electricity Supply Company of Odisha Limited (WESCO), North Eastern electricity Supply Company of Odisha Ltd. (NESCO), Central Electricity Supply Utility of Odisha (CESU), and Southern Electricity Supply Company of Odisha Ltd (SOUTHCO). These DISCOMs were originally part of the mother organization, GRIDCO (Figure 3.1).
- GRIDCO: After spinning off the DISCOMS as separate companies, GRIDCO undertakes bulk purchase and bulk sale of power to the four

DISCOMS inside the State and trading of surplus power to promote exchange of power with neighbouring states.

Figure 3.1: Distribution companies across districts

In the government, the responsibility of overall management of power policies falls under the Energy Ministry, whereas, activities of OREDA are part of Science and Technology Ministry. The Ministry of Environment and Forest looks after the activities related to climate change and thus impacts renewable energy through mandates and policies. Thus, there are multiple agencies and ministry that drive the deployment of renewable energy in the state, and sometimes, create confusion amongst the stakeholders.

Renewable energy policies in Odisha

Odisha has a few renewable energy policies and initiatives of its own in addition to those of the Central Government.

Policy guidelines for Power generation from RE

The Policy Guidelines for Power Generation from Non-conventional Energy Sources was, in 2005, was one of the early policy initiatives by the state to steer RE deployment. The guidelines covered solar PV, biomass energy, wind, geothermal, hydro (mini/micro/small), ocean / wave with the dual objective of environmental protection and large scale employment generation while also enhancing generation of grid-quality power from RE and attracting private investment into the sector. The guidelines laid down detailed procedures for a power producer with specifics on grid integration, metering, wheeling, power banking and sale of power. A number of incentives were also offered including Electricity Duty exemption, easy allotment of land and relief from transmission charges for a period of five years post-commissioning.

Consultations with local stakeholders indicate that these guidelines have been unable to incentivise investors. In fact, it is reported that a revised version has currently been drafted by OREDA and is being reviewed by GEDCOL. The linkage of this document with the proposed renewable energy policy for the state (as indicated by the World Bank) is unclear.

Odisha Solar Policy drafted

Odisha drafted a solar policy[viii] in the year 2013, under the guidance of OREDA and GEDCOL. The scope of this draft policy for harnessing solar power in Odisha is wide and extensive. It touches upon all areas of solar implementation – electricity generation and trade mechanisms, funding mechanisms, off-grid & roof-top decentralized power generation. On the thermal applications, not only addresses domestic and industrial water and air heating, but also solar pumping, solar refrigeration, and other innovations such as sterling engine. OREDA has been identified as the agency for Single Window Clearance of the Off-grid projects and GEDCOL for Grid-connected projects. This policy is an important step in the mainstreaming of renewable energy in Odisha.

The policy has been set up with the main objective "to promote the use of solar energy in the state to support development and address the problem of energy security."It attempts to achieve multiple additional goals, as outlined in the policy document:

1. Long term energy security of the state, as well as reduction in carbon emissions

2. Long term sustainable solution for meeting energy needs and reducing dependence on fossil fuels
3. Conducive environment for solar manufacturing capabilities through fiscal incentives
4. Generating direct and indirect employment opportunities
5. Creation of skilled and semi-skilled manpower through promotion training facilities
6. Creating an R&D hub for innovation in application of solar power technologies and solar based hybrid co-generation technologies
7. Creation of a performance testing facility at OREDA for different types of solar PV and Solar thermal systems and components

Scope of harnessing solar power in Odisha:

The policy's scope for harnessing solar power in Odisha is wide and extensive. It touches upon all areas of solar implementation – electricity generation and trade mechanisms, funding mechanisms, off-grid & roof-top decentralized power generation, and several solar thermal applications. The policy covers the following major areas:

1. Generation and supply of power to State Grid through PPA
2. Generation and sale of power through open access.
3. Setting up solar power project under REC mechanism
4. On grid/off-grid Roof top solar power plants.
5. Solar Water Heating for domestic use and industrial processes
6. Solar air heating for industrial processes
7. Solar cooking
8. Solar pumping
9. Solar refrigeration
10. Triple effect and tri-generation
11. Other innovative solar energy applications like sterling engine application etc.

Creation of Odisha Renewable Energy Infrastructure Development Fund:

It is also proposed to create a separate Odisha Renewable Energy Infrastructure Development Fund for accelerated development of solar/renewable energy in the state. The resources mobilized by collection of development charges will be credited to the said fund. The State Government will evolve other suitable mechanism for generating financial resources for further strengthening of this fund. This fund will be utilized for creation of infrastructure such as transmission network, roads etc. for accelerated development of renewable energy as per the guidelines issued by State Government in this regard.

Preferential tariffs for RE

The tariff orders of the Odisha Electricity Regulatory Commission[ix] provide additional incentives for renewable energy based electricity generation. These orders seek to provide preferential feed-in-tariffs to RE to enable innovative and lucrative pricing for RE. Tariff is fixed on basis of technologies and allows for recovery of return on Equity, interest, depreciation as well as operation and maintenance expenses.

Table 3.1: Renewable Purchase Obligation for Odisha State

FY	Minimum quantum of purchase in percentage (in terms of energy consumption in state in KWH)				
	Consumption (Grid + Captive)	Solar	Non-Solar	Cogeneration	Total
2009-10		-	0.80	3.45	4.25
2010-11		-	1.00	3.50	4.50
2011-12	44000	0.10	1.20	3.70	5.00
2012-13	51000	0.15	1.40	3.95	5.50
2013-14	58000	0.20	1.60	4.20	6.00
2014-15	64000	0.25	1.80	4.45	6.50
2015-16	70000	0.30	2.00	4.70	7.00

Renewable Energy Certificate and Renewable Purchase Obligation as implemented in Odisha

Additionally, in 2010, OERC issued a regulation[1] fixing the Renewable Purchase Obligation (RPO) in the State of Odisha as shown in Table 3.1. Every obligated entity should purchase 5% of its total annual consumption of energy from co-generation and renewable energy sources under the RPO regulations from 2011-12 onwards. The obligation will increase 0.5% every year till 2015-16 or earlier as reviewed by the OERC.

Of the total RPO, 0.1% in 2011-12 is required to be procured from solar power generation (Solar Purchase Obligation, or SPO) and it will increase at a rate of 0.05% every year till 2015-16, or earlier as reviewed by the OERC. The RPO obligation includes purchases from all the renewable energy sources already being made by the obligated entity, if any.

According to OREDA[x], the total requirement of renewable power to meet the OERC RPO requirement by 2016, the state would need a total of 802 MW of renewable power generation, with 173 MW solar, 330 MW wind, 182 MW small hydro, and 117 MW biomass power.

State-wise reviews of regulation[xi] with regard to RPO show the following for Odisha:

- The regulation shall be applicable to any other person consuming electricity generated from conventional captive generating captive plant having capacity of 5 MW and above for his own uses
- Renewable energy sources includes small hydro, wind, solar including its integration with combined cycle, biomass, biofuel cogeneration, urban or municipal waste and other such sources recognised by MNRE
- Such obligation to purchase renewable energy shall be inclusive of the purchases, if any, from renewable energy sources already being made by concerned obligated entity.
- Odisha has a separate RPO for co-generation based plants also

Renewable energy programmes in Odisha

There have been several renewable energy initiatives in Odisha, most of them extension of central government initiatives. A total of 13MW of solar power generation has been installed in the state, with another 30MW under implementation[3]. A biomass power generation unit of 30MW capacity is operational in Dhenkanal since 2011, with another 10MW under implementation in Sambalpur[3]. There are no wind power installations in the state. The details are here below.

Solar Programs

Odisha state receives an average solar insolation of ~5.5kW/m^2/hr yielding a PLF of 19% for solar power generation. According to OREDA[xii], so far 13 MW solar power projects have been commissioned under the RPSSGP (Rooftop PV and Small Solar Power Generation Programme) of MNRE and the New Grid Connected project of NVVN (NTPC Vidyut Vyapar Nigam Limited). Two more projects for 5 MW and 25 MW has been allotted through tariff-based bidding, and are under installation by M/s Alex Solar and M/s ACME Tele Power respectively in Bolangir District. Since 2013, the grid-connected solar power projects have been transferred to the recently constituted Green Energy Development Corporation Limited (GEDCOL) under the Energy Department.

According to 2011 Census data, the penetration of solar into the households is shown in Figure 3.2. Less than 0.4% of the rural households and less than 0.15% urban households in the state have solar lighting. The penetration is higher in the districts with sparsely populated remote habitats compared to densely populated mainland districts. This is primarily attributed to the RVE program undertaken by OREDA to install solar home lighting systems[6].

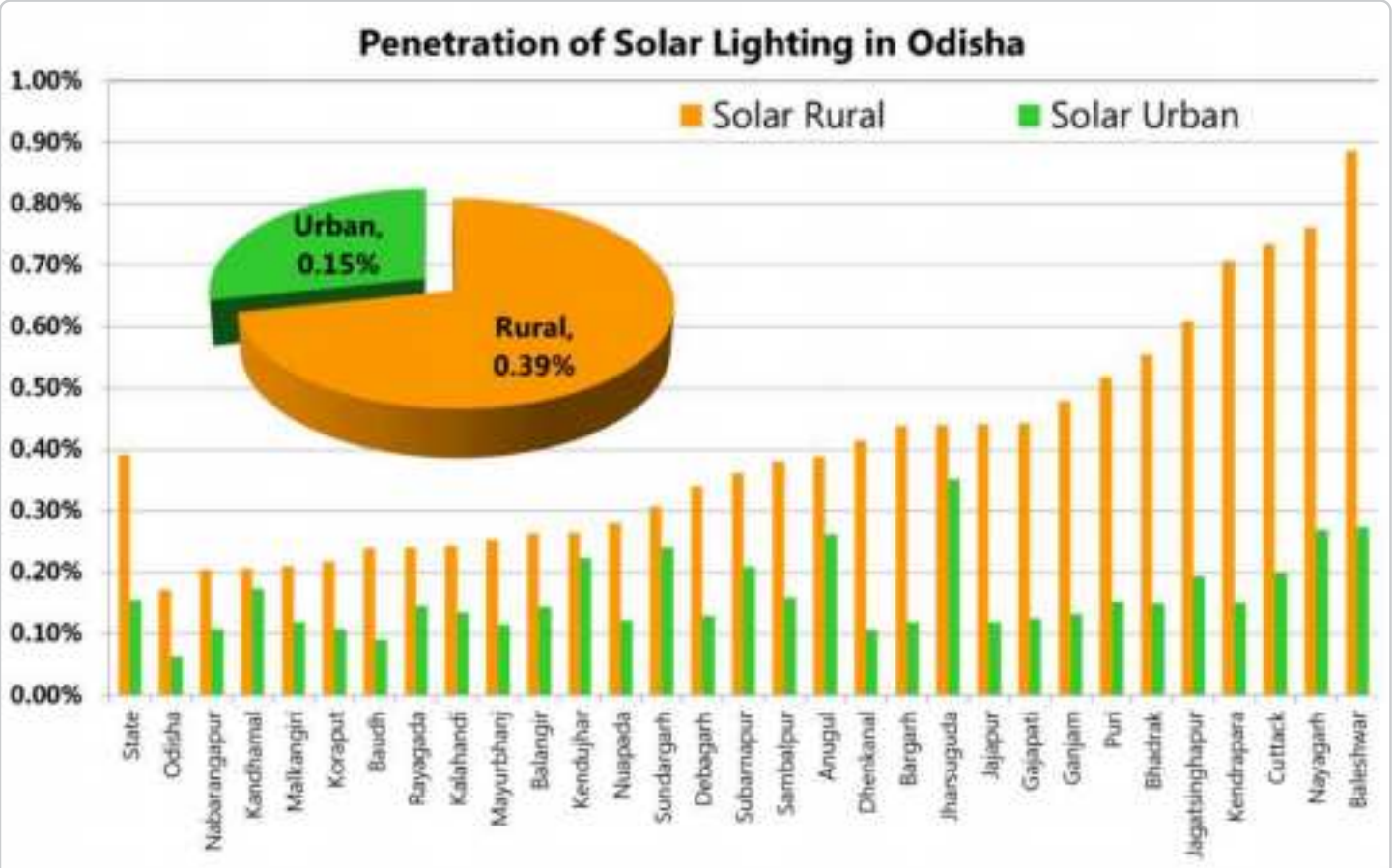


Figure 3.2: Census 2011 – Penetration of solar lighting in Odisha districts

Wind Programs

While Odisha can generate 910MW of wind power from a gross wind potential of 1700MW, there are no wind power generation units installed in the state. Since 2012, CWET has deployed nine Wind Resource Assessment (WRA) masts at several locations in the state to get real wind speed estimates.

Biomass Programs

Of the estimated potential of 300MW, the state only has a 20MW power plant commissioned in 2011, with another 10MW currently in the implementation phase. OREDA has signed agreements for 11 projects worth 138MW[3]. However, six of these have been cancelled due to inability of the developers to execute the projects. It has been proposed to cancel all the projects and move to tariff-based bidding for new biomass projects.

Micro-Hydro Programs

No study on the potential of pico/micro and mini hydro potential was found. Two private pico-hydro projects of 10kW each has been implemented by an NGO Agragamee in Rayagada district.

Table 3.2 Details of on -grid RE Projects in Odisha

S/N	Source	Installed capacity	Under installation
1	Solar PV	25.5 MW	30 MW
2	Biomass	50.4 MW	10 MW
3	Small Hydro	64.0 MW	-
	TOTAL	139.9	40 MW

Table 3.3 Details of off -grid and stand-alone RE Projects in Odisha

S/N	Source	Installed capacity
1	Solar PV (lanterns, home lights, street lights, power plants, pumps etc.)	4.0 MW
2	Biomass (small gasifiers and Direct combustion based power plants in rice mills)	2.75 MW

Remote Village Electrification programme: progress by OREDA

The distributed renewable energy comprises of both lighting and cooking, both implemented by Odisha Renewable Energy Development Agency (OREDA), which has been active in deploying DRE since its inception in 1984. Its primary focus has been access to energy in remote areas. Under the Remote Village Electrification program, OREDA has undertaken the survey of villages, and prepared Detailed Project Reports (DPRs), helped constitute Village Energy Committees, and installation solar Lighting systems in households, streets and for community uses. Over the past six years, the program has achieved the provision of lighting in 1522 villages as of 2012, as shown in Table 3.4. The program has benefited a total of 56567 households in 18 districts as listed in Table 3.6.

Table 3.4: OREDA's Remote Village Electrification program progress

FY	No. of villages sanctioned	No. of villages dropped due to grid connectivity and other reasons	No. of villages completed
2006-07	197	5	192
2007-08	0	0	0
2008-09	91	4	87
2009-10	371	52	319
2010-11	761	29	709
2011-12	296	3	215
Total	1725	93	1522

As a result of this program, several benefits have been achieved such as light for children to study at night, extended working hours, evening meetings and social interactions, protection against entry of wild animals in to villages, and reduction of indoor air pollution due to less use of kerosene. Financially, each household saves about Rs. 500 to Rs. 600 per year against expenses on kerosene (See also Box 3.1[xiii]).

Other village electrification and lighting programmes in Odisha

Apart from the RGGVY and the RVE programmes, the State Government of Odisha has its own schemes to reach out to un-electrified villages and households. The Biju Gram Jyoti Programme launched in 2007 seeks to

Box 3.1: Benefits of renewable energy for lighting tie in closely with kerosene savings and the resultant subsidy savings

Here below are observations based on field surveys in very poor areas of rural Odisha (where average household income was found to be as low as Rs. 625 per month largely from farming supplemented with leaf plate making). The villages are un-electrified and located at an average of five km from the nearest market, the only location to purchase kerosene. In these villages, it was found that kerosene is the primary source of light after sunset and an average household consumes approximately eight to twelve litres of kerosene per month. Government subsidized kerosene is sold at Rs. 10 per litre, but the subsidised quantity is limited to five litres per month per household, and villagers can only purchase one litre per day. Villagers supplement subsidised kerosene with purchases from the black market at an average rate of Rs. 15-30 per litre. It was found that an average household spends nearly Rs. 100 per month on kerosene purchases. A round-trip to the market requires a minimum of two valuable daylight hours.

Kerosene as a lighting source creates many health and safety hazards. Village homes do not have efficient ventilation and indoor combustion causes routine respiratory problems. In addition, children, stray dogs, or even wind can knock over kerosene lamps, posing a fire hazard. Additionally, it has been seen that nearly 100,000 households in the state that cannot even afford to buy kerosene or other oils and sometimes live in darkness or burn tyres, lubricants or bundles of leaves, exposing themselves to even more dangerous levels of smoke and pollution.

Table 3.5: OREDA's Remote Village Electrification – Households covered

District	Households Covered					
	2006-07	2008-09	2009-10	2010-11	2011-12	Total
Gajapati	860	22	0	3238	0	4120
Keonjhar	1333	132	1428	0	4430	7323
Sundergarh	2516	0	3489	0	2213	8218
Kalahandi	2861	95	2834	0	1934	7724
Nayagarh	0	776	0	796	0	1572
Balasore	0	130	0	0	0	130
Angul	0	200	193	999	0	1392
Kandhamal	0	9	0	3886	0	3895
Nuapada	0	20	0	0	0	20
Malakangiri	0	128	0	0	0	128
Rayagada	0	80	1765	10760	0	12605
Mayurbhanj	0	228	2635	498	0	3361
Bolangir	0	0	56	0	0	56
Nawarangpur	0	0	78	0	0	78
Deogarh	0	0	0	492	0	492
Sambalpur	0	0	0	685	0	685
Koraput	0	0	0	0	3406	3406
Ganjam	0	0	0	0	1362	1362
TOTAL	7570	1820	12478	21354	13345	56567

provide access to electricity to all the habitations having population of less than 100. Such villages are not covered under the RGGVY. The programme includes village / habitation electrification, BPL connections (KutirJyoti) and lighting points. Additionally, the Biju Saharanchala Vidyutikaran Yojana seeks to provide electricity access to people living in un-electrified areas of urban local bodies. Only about 1000 habitations have been covered under this programme so far.

Another major initiative is undertaken for the MoP's DDG (Decentralized Distributed Generation) program for electrification of large number villages/hamlets through biomass and solar PV based micro-grids.

The Tikiye Aluo (A little Light) project is also going through the approval process to provideLED-based solar lanterns and study lamps to 56 lakh households using kerosene for lighting their homes. The scheme is operated by the Science and Technology department through OREDA. The scheme envisages to localise the assembling of the solar lighting systems by involving Women Self-Help Groups (WSHGs), which, besides providing additional income to members, will instil confidence among the beneficiaries for carrying out repair at the local level through Odisha Rural Livelihoods Mission. Odisha Rural Development and Marketing Society (ORMAS) in consultation with OREDA works on the detailed project report for this.

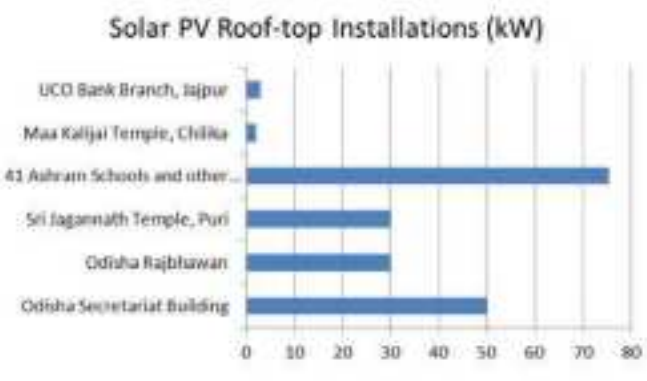


Figure 3.3: Roof-top Solar PV Installations by OREDA

OREDA programmes for off-grid RE devices including cooking energy solutions

For cooking energy, OREDA has undertaken programs for both biogas and clean cook-stoves. In this on-going program, OREDA has constructed 2.33 lakhs of domestic biogas plants till FY 12-137 under the National Biogas and Manure Management Program of MNRE. OREDA is targeting another 6500 biogas plants under this program for FY 13-14. While it implemented several improved smokeless cook-stoves, the program has halted after transfer of this program to the State Sector. OREDA proposes to revive the program as it has huge potential to save woody biomass, reduce indoor air pollution and drudgery to women.

Since 2012, the state has also embarked on rooftop solar installation on government buildings and heritage sites by OREDA3. Figure 3.3 shows the completed roof-top projects at these sites. In addition, 173kW has been installed in 52 villages under various programs. OREDA has another 30 roof-top projects under implementation for a total of 80kW. It is also distributing 10 thousand solar lanterns to weaver families in the state. Several new projects are in the pipeline, amounting to a few hundred kilowatts.

Under new projects, OREDA is taking up a massive solar PV water pump project, on behalf of RWSS (Rural Water Supply and Sanitation) under the National Rural Drinking Water Project, for supply of piped drinking water in3400 villages in 18 districts of the state. Table 3.6 summarises some of the achievements of OREDA till the end of last year.

Table 3.6 Achievement of OREDA up to 2012-13

Domestic biogas plants:	2, 25,725 nos.
Improved cook stoves for rural households:	21, 02,950 nos.
Solar lanterns:	9603 nos.
Solar Home lighting systems:	60,754 nos.
Solar street Lighting systems:	10,986 nos.
Solar PV Power plants:	91 nos.
Solar pumps:	56 nos.
Solar cooker:	3524 nos.
Solar stills:	192.5 LPD
Solar Water Heating Systems:	1, 70,800 LPD
Water pumping windmills:	232 nos.
Biomass gasifiers:	25 nos.

Source OREDA website accessed in July 2014[xiv]

Private and NGO efforts in renewable energy in Odisha: case studies offer important learnings

Though renewable energy initiatives in Odisha have largely been state-driven, private sector operators and NGOs have shown interest in the renewable energy sector. In Odisha, however, non-state actors in the renewable energy space are limited. Nevertheless, several social sector organisations have set up renewable energy projects (mainly small-scale decentralised projects) and these offer useful lessons for the state's renewable energy plans in the future.

Case Study 1 – Kandhal Test Project in Cuttack District – Gasifier for Lighting (OREDA)

Kandhal is a remote village about 125 Kms from District Headquarter of Cuttack. It has 143 households, that are dominated by ST. Most of the families belong to BPL. The village is surrounded by Forest. The project to light up the villagers was completed in June, 2009. It was implemented by Odisha Project & Marketing Development Centre (OPMDC), Cuttack, and was monitored and coordinated by the Odisha Renewable Energy Development Agency (OREDA).

Two 10kW Gasifiers were installed to meet the daily requirement of lighting for 150 families, community hall, primary school, street lighting and other entertainment activities. Each household was provided with two light points and one power point for domestic lighting and entertainment. One oil expeller of 100 kg/hr capacity was installed for extraction of oil from Karanj and other edible oil-seeds. With the introduction of electricity in the village, the quality of life of the villagers improved drastically and villagers were happy as they have installed televisions in their houses for entertainment and their children are able to study at night in a proper light. The fear of wild animals has reduced, as 15 street lights have been installed in the village, which provide adequate illumination during night. This has brought a sea change in their outlook towards development of their village. The villagers have decided to use the power generated for many other applications, such as, flour mill, chafe/fodder cutter machines and water pumps.

20 Nos. of biogas plants have also been installed in the village for meeting out their cooking & lighting requirements. The lighting from biogas plants is facilitating women to work at night in making Dona Patta from Sal / Teak leaves. The role of women in biogas plants involves feeding of cow dung and also slurry treatment for use in agricultural fields. The Village Energy Committee has undertaken plantation of Karanj & fuel wood in 10.5 hectare land, which would provide biomass for running the gasifiers and oil seeds for running the oil expeller.

Case Study 2 – Salepada Power Plant (OREDA)

Salepada is a small hamlet in Sunabeda GP of Komna block. Situated in the midst of the scenic Sunabeda plateau it is a picturesque hamlet surrounded by forest and natural habitat. A total number of 40 households are located in the village, which houses a total population of 206 inhabitants of Chuktia-Bhunjia tribe. The geographical location of this village makes it impossible to be connected by the grid. Decentralized renewable energy is the only solution.

A solar SPV plant has a restricted capacity of 2 kW was installed with a micro-grid under the UNDP-DESI Development Programme for demonstration of power generation through renewables. The electricity generated provides supply for 5 hours to 85 households with 9W CFL each and 12 hours for 8 streetlights of 11W each. Each home received 9 watt CFL for illumination purpose. Additionally, for the community, electricity for TV was also provided. The tariff for the villagers was fixed at Rs. 30 per month. Funds collected from the monthly tariff were used for upkeep of the system as and when needed.

Installation of solar power plant to provide light has resulted in several benefits. The children are able to study in the evening after sunset. Even adult literacy centres are operating after dark. Streetlights have enabled extra playing hours for the children, social gathering and outdoor activities free from the fear of snakes and wild animals. Livelihood generation activities, such as sewing, handicrafts fabrication, also commenced, when light became available at night. Vocational training for self-employment was initiated.

Case Study 3 – Solar PV for Herbal Medicine Processing, Cuttack (SunMoksha/Sambandh)

Healing Heritage Producers' Company is a Sambandh initiative in Kochila Nuagaon village of Choudwar block, in Cutttack district of Odisha. The company provides livelihood to the community by engaging more than 100 villagers including women in various activities, such as, medicinal plant processing, that includes grading, drying, primary processing (making semi-powder) and packaging.

Even though the company could engage workers for 10-12 hours per day, it could not due to load shedding. Moreover, in rainy seasons the raw materials are dried through an electric dryer but couldn't due to power cuts. It resulted in decomposition of the raw materials and consequently, loss to the company and the people.

The company finally opted for decentralized renewable energy option. SAMBANDH and TERI set up a Solar Multi Utility Unit of 8kW to provide electricity for the operations. With this unit, backed by enough battery storage and powerful inverter, provides power for the operations as required. The solar power is sufficient to run the processing equipment and provide livelihood to the people of Patapola Sahi.

The same solar plant also provides power to a water purifier. Villagers near this 500LPD water purification centre come to collect water from the centre. Prior to this, they depended on the only one tube well half a kilometre away from the village. The tube well did not function well most of the time, and was not able to supply adequate quantity of water, and hence, villagers had to wait up to 2-3 hours to fill up a single pot of water. People resorted to drinking water from nearby pond (natural water storage), which resulted in them falling sick. Establishing the water purifier with support from TERI, has taken care of this issue and people are able to get drinking water from the water purifier.

A visit to the location by SunMoksha, confirmed the utility of the solar power plant for medicinal processing. The entire complex is powered by solar and has improved the productivity of the company. However, the size of the purifier is not sufficient to meet all the water needs of the villagers nearby. An alternative is being worked on.

Case Study 4 – Biomass based micro-grid for lighting, Jamugonda, Nayagarh (SunMoksha/ OREDA)

SunMoksha has developed a novel integrated and holistic solution for rural electrification, namely, NanoPower. To implement this solution in the villages, it has taken up survey of various villages in the state of Odisha, as identified by OREDA. One of these villages is Jamugonda, in Ranpur block of Nayagarh district. The total number of households in the village is 125 with a population of approximately 500 – 235 males and 265 females. The main source of livelihood is NTFP–products made of Sal leaves from the nearby forest – and agriculture.

The village is very remote, and does not have any electricity grid. In 2008, OREDA established a 20kW biomass gasification system for power generation, under the Village Energy Security Programme (VESP), and with financial support from READ Foundation, at a cost of Rs.21.9 Lakhs. The system used wood as fuel to provide electricity from 6pm to 10pm. The system was managed by the village committee, which appointed one person to be operator. They all provided wood for the gasifier, and enjoyed electricity. It worked well for two years. After that, the system was shut down, and has not been restarted till date. The prime reasons for the non-operation and shut down were identified as:

1. Lack of maintenance – the start-up battery was deep discharged, without any alternate power source to charge the battery, and it died. No one was there to replace it. The engine also needed maintenance, but didn't have anyone to do that.
2. Operator issues – from our analysis of the usage pattern, it appears that the operator lackeddiscipline, and didn't take care of the gasifier and the engine properly. Only two trained operators were trained to run the power plant without any backup. These two migrated from the village, leaving no one trained enough to run the power plant.
3. Low availability of woody biomass – supply was curtailed.

So, the key learning from this is that (1) we must have continuous maintenance and technology support for such projects with vested interest from both side; (2) proper and continuous skill training is a must to make sure we plant is in operation; and (3) ensure availability of biomass supply to the power plant with long term contract and additional back-up such as energy plantation.

The gasifier and engine can be overhauled and repaired to bring the plant back to life. Electrical lines are still there which can be used if any source of electricity is provided. At present, the villagers don't have any access to electricity. SunMoksha is working with OREDA on a revival plan for this power plant.

While renewable energy has tremendous potential and offers significant developmental and environmental benefits, it should not be seen as a panacea for Odisha's energy and development challenges. Extensive deployment of renewable energy poses many questions and issues that must be understood and this is the focus of the next Chapter.

Chapter 4: Relevance of renewable energy, especially decentralised renewable energy for Odisha

Odisha produces 20% of India's domestic coal and over 65% of the state's power generation capacity is coal-based. In its plan for expansion of electricity availability, Odisha understandably continues to focus on coal.

Why then is there a need for Odisha to change course and consider a switch to renewable energy?

Environmental and social impacts associated with coal mining heighten uncertainties around coal linkages for power generation. Coal-based power generation is also associated with fly ash, carbon and other emissions, and there is an impetus to look for alternatives. An important alternative to coal is offered by renewable energy. Several other additional factors favour the expansion of renewable energy, especially small-scale decentralised renewable energy.

Renewable energy potential of Odisha

Odisha's renewable energy potential was recognised in as early as 1984 when OREDA (Odisha Renewable Energy Development Agency) was constituted to "popularize the exploitation and use of renewable energy resources in the State". OREDA estimates point to a realistic renewable energy potential of 11,000 MW and a gross potential of 53,000 MW. Odisha thus has a significant renewable energy potential, largely in the form of solar energy, but also in the form of wind and biomass. Installed capacity based on RE is just 97.3 MW, compared to the realistic potential of 11,000 MW. In other words, considering just the estimates of realistic potential, **a 100-fold expansion of electricity generation from renewables is possible** in Odisha! (Table 4.1 based on OREDA estimates)

Table 4.1 Potential of Renewable Energy in Odisha

Renewable Energy Source	Gross Potential (MW)	Feasible Potential (MW)
Solar Photovoltaic	40,000	8000
Solar Thermal	10000	2000
Wind	1700	910
Biomass-paddy husk	300	250
Biomass – paddy straw	600	250
Other Biomass	800	250
Biodiesel	300	150
Small Hydro Project	120	120
Total	**53820**	**11820**

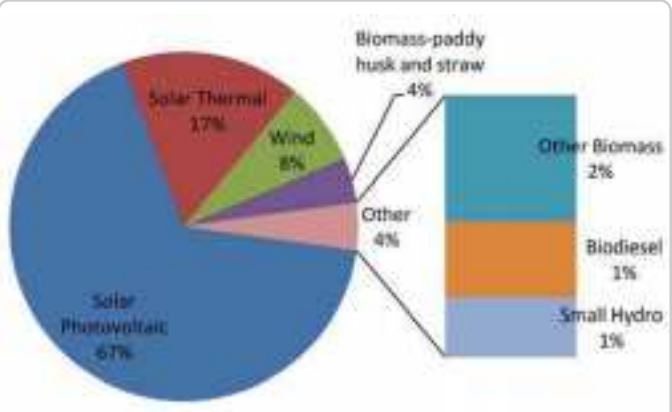


Figure 4.1 Potential of various RE sources in Odisha

Policy push for renewables through RPO / REC

Towards enhancing the contribution of renewable energy to electricity generation, in line with the policy at the national level, the Odisha Electricity Regulatory Commission (OERC) stipulated in 2010 that every obligated entity should purchase 5% of its total annual consumption of energy from co-generation and renewable energy sources under the RPO regulations from 2011-12 onwards[xv].

For Odisha, tenders were floated by GEDCOL for solar rooftop projects in Bhubaneshwar and Cuttack. Setting these up as pilot projects, GEDCOL is seeking regulatory approval for grant of "RPO" status to these projects so that they may be included in the RPO compliance for the state to meet its growing deficit of solar RPO.

According to ORED Odisha needs to ensure a nine-fold expansion in renewables-based electricity to meet its RPO targets, failing which it would have to purchase RECs. This in turn could raise electricity prices. Thus there is a policy compulsion to scale up renewable energy.

Decentralised renewable energy well-suited for Odisha

There are a number of features of small-scale decentralised energy (described in Box 4.1) that make

them particularly suited to the physiographic, socio-economic and demographic context in Odisha.

Odisha is frequently faced with natural disasters that can damage infrastructure. In the recent cyclone in 2013, the loss to the power sector alone was estimated at around Rs. 900 crore due to massive damage to power transmission and distribution equipment, including electric lines, sub-stations, grid stations, electric poles etc.[xvi]). Such large scale damages could be averted in the case of decentralised systems.

Another important push for decentralised renewable energy in the state comes from the scattered rural population of Odisha. Odisha is frequently faced with natural disasters that can damage infrastructure. In the 2013 Phailin cyclone, the loss to the power sector alone was estimated at around Rs. 900 crore due to massive damage to power transmission and distribution equipment, including electrical lines, substations, grid stations, and electric poles).[xvii] The recent cyclone Hudhud too reportedly battered power infrastructure in five districts of Koraput, Malkangiri, Rayagada, Nabarangpur and Gajapati[xviii]. The neighbouring state of Andhra Pradesh which bore the brunt of cyclone Hudhud, reported power transmission infrastructure damages of over Rs. 1200 crore[xix]. Such large-scale damages could be averted in the case of decentralised systems. This is a point in favour of decentralised renewable energy (DRE). Another important push for DRE in the state comes from the scattered rural population of Odisha. Because settlements tend to be dispersed, extensive grid networks are required.

Additionally, in Odisha rural settlements tend to be dispersed calling for extensive grid networks. Decentralised micro grids are particularly well-suited for such settlements.

It has been observed that for a number of reasons including inadequate transmission and distribution network, large grid-connected projects (based on renewables or fossil fuels), are typically not suited to reach out to scattered, remote un-electrified settlements. Here renewable energy based micro grids can be an appropriate solution.

Renewable energy, especially decentralised renewable energy: possibilities for rural development and livelihoods

Renewable energy integration can open up a world of opportunities. While grid-connected large power plants based on renewable energy sources can help meet electricity deficits at the macro level and can at least partially replaced conventional grid-connected plants based on fossil fuels. This helps reduction of the carbon and environmental footprint of electricity generation. As mentioned earlier, renewable energy based electricity generation can go up manifold in Odisha.

In addition to these large power plants, there is an enormous potential for mini grids based on renewables such as solar or biomass that may or may not be connected to the grid. Such mini grids can help electrify hamlets and can also energise small commercial establishments and machines. Access to reliable and affordable electricity can improve income considerably. Apart from providing electricity, it must be noted that decentralised renewable energy technologies can be harnessed not only for electricity generation but also for meeting a range of thermal and mechanical energy gaps in the state.

Solar pumps to replace conventional electric pumps that now depend on unreliable power, can help farmers irrigate their fields when required, thus improving farm productivity and income. Solar lights and solar home lighting systems as well as solar street lights can help remove darkness, thus improving quality of life and in some cases generate income / savings too. Provision of clean cooking energy is also possible through renewable energy sources like biogas. Improved biomass cook-stoves save precious fuel resources through efficient combustion, but importantly, also reduce indoor air pollution.

Box 4.1: What is meant by decentralised renewable energy?

Decentralised renewable energy refers to a range of applications providing electrical, mechanical, and thermal energy services. It includes:

- Stand-alone renewable energy devices such as solar lanterns and home-lighting systems, solar pumps, and solar charging stations;
- Distributed generation of power from renewable energy sources such as biomass (combustion, gasification), solar PV, solar thermal, small hydro, small wind-farms, and waste-to-energy plants, and hybrid systems. These technologies may be totally off-grid or grid-interactive.
- Renewable energy devices for thermal applications such as improved biomass-stoves, biogas plants and biomass gasifiers, solar cookers, solar water heaters, and solar and biomass dryers.

DRE solutions are often misunderstood as solely household-level energy technologies. As a result, the potential of DRE for several commercial/productive and social/community applications is underutilised in India. Water purification, water pumping, cold storage or drying of vegetables, fruits and fish, milk chilling, aeration of ponds, or powering of boats are just some of the energy services that can be powered by solar, biomass, or other renewable energy or hybrid renewable energy systems.

Additionally, use of renewable energy at the decentralised level (e.g solar home lighting systems or RE-powered min grids) reduces dependence on centralised utilities such as electricity or gas grids and LPG distribution networks. Decentralised renewable energy projects and devices typically require less capital investment and is easier to set up through small start-ups, making it possible for young local entrepreneurs to get involved.

Decentralised renewable energy solutions (See Box 4.1) by their intrinsically local and small-scale features, make it possible and necessary to connect with the local communities, planning agencies and supply chains. DRE solutions are typically manpower-intensive (though not necessarily full-time manpower needs) and offer tremendous employment opportunities.

Renewable energy also has other important applications for a range of community services. Solar packs for health workers can include a light and small cold packs for vaccines. Reliable power for schools, hospitals, community centres can be provided through renewable energy sources. Solar-powered lights for toilets (especially for girls) are a boon where the toilets become completely dark on closing the door. RE can also be used to purify water.

Of the livelihoods sectors that are the most significant and critical for rural Odisha i.e. farming, horticulture, dairy, poultry, fisheries, handicrafts such as bamboo, cane and weaving and a range of other cottage / village industries – several suffer from low productivity and income insecurity. Higher and stable productivity is associated with higher energy intensity. As a result, access to reliable energy is an imperative. Energy requirements are typically for electric, mechanical and / or thermal applications.

A recent consultative review on integrating RE into livelihoods in a few states including Odisha point to numerous possibilities including solar-power packs for backyard poultry farms, RE-powered cold rooms for storage of fruits and vegetables, RE-powered dryers for drying spices, herbs, fish.

Thus, Odisha with its significant renewable energy potential and its grave energy poverty situation needs to look to RE resources not just for large-scale grid connected power generation, but also to decentralised energy applications that can bridge energy access gaps while also simultaneously catalysing rural development and livelihoods.

Chapter 5: Renewable energy and energy access policy in Odisha: pragmatic and holistic approaches needed

This Chapter dwells on various dimensions and aggravators of the three-pronged energy challenge that the state is faced with:

- Bridging the electricity deficit at a macro level
- Electrifying all villages and households
- Provision of clean cooking energy to all households

There are several serious lacunae in the current thinking on energy access in the state and addressing these calls for the adoption of new more holistic and pragmatic approaches to energy planning in general and to renewable energy development in particular. In the context of the proposed state-level renewable energy policy, these points are extremely relevant.

Holistic energy planning: beyond the 100% village "electrification" target to 24*7 energy when needed

Figures of electricity plans for Odisha indicate that the state is rapidly approaching a state of surplus. Can Odisha claim to be approaching electricity "surplus" even as millions are plunged in darkness?

After analysis of data, the team concluded that when claims of electricity surplus are made, it must be examined whether the electricity demand figures account for adequate 24/7 electricity for all. While "all" refers to all basic needs of households as well as community and livelihoods energy needs, the definition of "adequate" needs discussion and must be a dynamic concept that varies over location and time[xx].

It is essential to understand the provision of access to energy in a broad and holistic manner. Thus far the focus of rural energisation has been targeted at 100% electrification of villages. It is essential to recognise that lack of access to reliable electricity and other forms of energy is hampering rural economic growth, keeping the villagers trapped in poverty. In order to break the poverty trap, a holistic view of energy access will call for major shifts in thinking and planning (Figure 1):

- While village electrification has been the focus thus far, household electrification must be considered, bearing in mind that 64% of the state's rural households remain un-electrified.
- In terms of electrification, meeting merely lighting (and in some cases mobile charging) needs, can only be an interim solution. Over the longer terms, households are bound to aspire for higher levels of energy and this must be factored into energy plans.
- Electricity is only one aspect of energy. Energy needs for thermal applications, particularly cooking are extremely important and must never be lost sight of.
- Households need energy, but critical energy requirements also arise in schools, hospitals, community centres, water treatment plants and water pumping. Important rural livelihoods sectors such as dairy, horticulture, agriculture, poultry, bamboo etc. not only have energy needs but also present a potential to generate energy (see Table 5.1 below).

The eventual target would be to provide 24/7 access to clean, reliable and affordable energy as per need and demand.

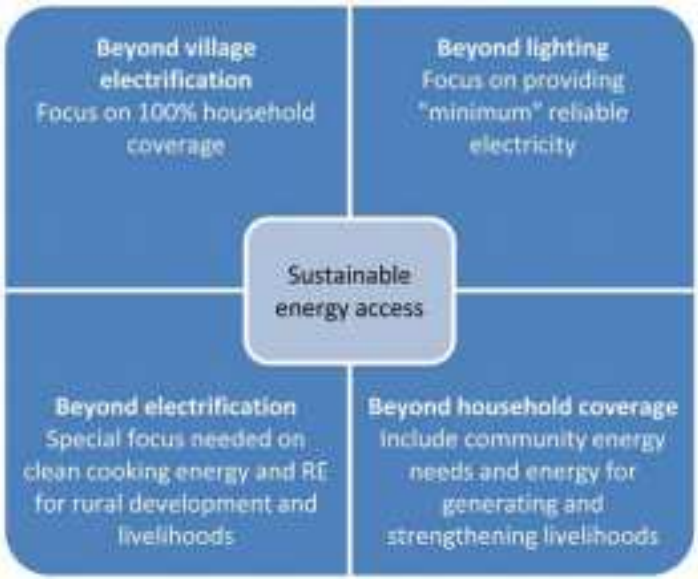


Figure 5.1: Towards holistic energy access planning

Systematic planning for scaling up of renewable energy

While the Government of India is actively pursuing the expansion of renewable energy in India, the states are also being encouraged to develop their own efforts to scale up renewable energy. Many states in India have introduced state-level renewable energy policies with their own schemes and tax incentives for renewable energy. Various states have implemented provisional measures such as concessional open access charges for captive renewable energy projects and waivers on cross-subsidy surcharges. These measures are meant to reduce the burden resulting from the generally lower plant load factors of renewable energy projects. Odisha too offers a number of incentives for renewable energy, largely in line with those offered by MNRE. Incentives and policy push in the form of REC/ RPO, preferential tariffs as well as a range of subsidies have been offered in Odisha. Yet, investor and entrepreneurial interest is very low in Odisha's renewable energy sector. While eventually private investors will have to be roped in, AIREC recommends that scaling up of renewable energy is to be taken up in a systematic and pragmatic manner and proposes initially a state-led intensive RE programme to be anchored around a strong state renewable energy institutional framework (described below). This will help generate interest in RE in the state amongst the consumers, suppliers, entrepreneurs and also financiers. It is recommended that the much neglected area of clean cooking energy be brought to the forefront alongside electricity access. Figure 5.2 below summarises this sort of an integrated approach and specific next steps are discussed below.

Figure 5.2: Action points for creation of a pro-RE ecosystem in Odisha

Pragmatic RE planning

Renewable energy for addressing Odisha's energy needs may take various forms:

- To enhance the overall availability of electricity at the state-level, mega grid-connected(typically MW scale) projects for generation of electricity from renewable energy sources such as solar, wind or biomass
- To meet electricity needs in un-electrified areas as well as in areas where grid electricity is very unreliable, micro grids based on renewable energy sources like solar, biomass, wind, small hydro involving generation (typically between 50 kW to 5MW scale capacity) and distribution to limited connections, traditionally not connected to the grid
- To meet a variety of electrical, thermal and mechanical needs in households, community services and enterprises, renewable energy based devices like solar home lighting systems, solar lanterns, solar water heaters, improved biomass cook-stoves, biogas plants

These categories of renewable energy initiatives are not mutually exclusive and all these types of projects may be pursued hand-in-hand. But some specific aspects of renewable projects must be borne in mind to ensure that these initiatives go beyond providing limited or token energy access to becoming sustainable and long-term energy solutions. A checklist for RE planning is provided in Figure 5.3. The importance of realistic site-specific assessment cannot be over-emphasised. An important point to note about Odisha is that though the state has considerable RE potential, its wind and solar potential are quite diffused at various locations. However, this does not mean that these resources are to be ignored. There are opportunities to develop hybrid systems in such a way that the intermittent nature of some RE

resources can be addressed. For instance, where wind is limited during summer months or on windy days with limited sunshine, a hybrid system of solar PV plus wind turbines will tend to accommodate fluctuations in resource availability. Similarly, if there is a hybrid system consisting of micro hydro plus solar PV, power generation from hydro could be maximised during the rain or monsoon seasons, and power generation from solar PV could be maximised during the summer months. RE systems may also be hybridised by teaming up with existing diesel generators. In such as case, the running cost of diesel can be minimised by restricting use of diesel to those time periods when the RE resource is unavailable.

RE resource-rich areas that have low levels of economic activity. A striking example is the KBK (Kalahandi- Bolangir-Koraput) region, which is characterised by good solar resource availability but also by hilly terrain, dense forests, poor connectivity, scattered population, and poverty-stricken communities that represent low demand and low ability to pay.

While planning for renewable energy projects, scientific assessment of resource availability for energy generation is very crucial. A case in point is that of wind energy. While Odisha has a long coastline, its wind power potential at 910 MW is just a fifth or tenth of states

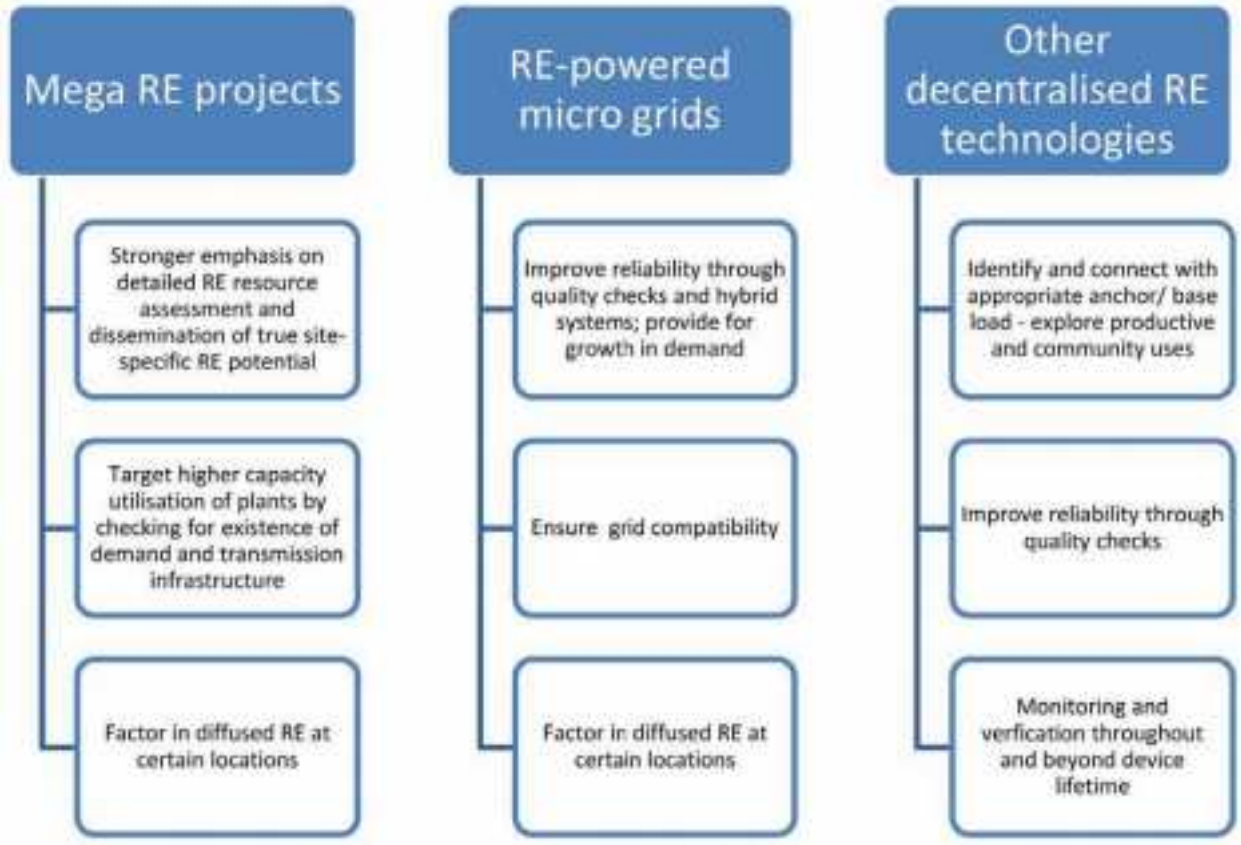


Figure 5.3: Checklist for various types of renewable energy interventions

A serious challenge with both renewable energy-based mini grids as well as mega projects is the adverse geographical features and lack of infrastructure (roads, water, and connectivity) that constrains project development and operations. Evacuation of power post-project commissioning is a challenge given the constrained transmission and distribution networks as also the low levels of local demand for electricity in many

like Gujarat, Andhra Pradesh and Karnataka. It is also important to take into account the prevailing land use pattern to ensure whether it permits the setting up of wind farms. This point and the rapidly changing wind power technology are being taken into account in recent studies by CWET.

Box 5.1: Odisha's Diffused Resource Availability For Solar And Wind – Hybridisation Must Be Explored

An important limitation of some renewable energy technologies (both centralised and decentralised) is their intermittency of supply, with resource availability peaks not necessarily coinciding with energy demand peaks. This is well-known in the case of solar and wind which are subjected to both diurnal and seasonal variations in availability. While biomass-based technologies are not characterised by diurnal variations, there could be seasonal issues with timely feedstock availability of suitable quality.

Odisha's solar and wind energy potential is reasonable but it also has long days of diffused or low resource availability on account of its location and climate. For biomass projects too, long periods of rainfall make feedstock availability a challenge in some locations. For renewable energy to emerge as a reliable source of energy, the Odisha government should push for hybrid RE projects. While such projects are not currently common, there is tremendous potential to hybridise solar or wind projects with biomass systems to power hamlets and pilot projects are under way. [1] As an interim solution, planners may also consider solar and wind systems hybridised with diesel.

Locating solar PV farms on degraded lands and on water bodies is a possibility. For this an assessment and mapping of degraded lands and water bodies is required. Whether the setting up solar panels will cause any adverse effects for communities dependent on the land and water resources must also be studied carefully. Some of these common property resources play important roles for livelihoods activities such as livestock grazing or fishing. Odisha's solar irradiation is also diffused (See Map – Figure 5.4). Mini and pico hydro systems are stated to have good potential in Odisha, but there has not been much progress on this front – in terms of understanding the real potential and then in seeking out potential investors

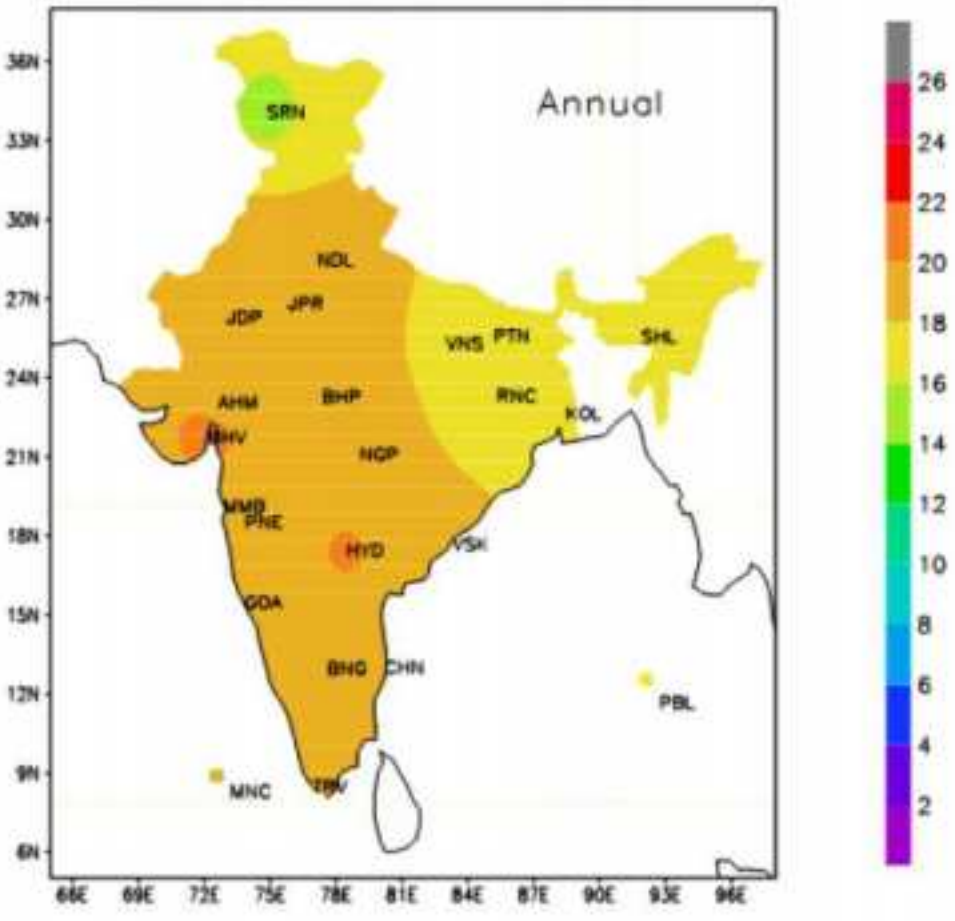


Figure 5.4: Solar irradiation map of India

Table 5.1: RE applications for rural community services and rural livelihoods

Community services/livelihoods sectors	Renewable energy technology/application
Health	Solar-powered ice packs for vaccines, medicines, etc.; renewable energy-powered primary health centres
Education	Renewable energy-powered schools, classrooms, school toilets
Water	Solar pumps for irrigation and drinking water
Sanitation	Solar-powered running water and lights for toilets
Community kitchens in schools for mid-day meals, tribal hostels, tea stalls, sweet shops	Community-sized solar cookers, biogas plants, improved large biomass cookstoves
Poultry	Solar power packs for lighting and ventilation of backyard poultry farms Biogas generation based on poultry litter Briquetting of poultry bedding material for use as fuel
Dairy	Solar power packs for lighting and for small equipment such as for testing Renewable energy-powered milk chillers Biogas generation using cattle dung
Horticulture	Solar pumps Renewable energy-powered cold rooms for storage of fruits and vegetables Renewable energy-powered dryers for spices, ginger, garlic, herbs
Small-scale industries (e.g., khadi, bamboo)	Solar lanterns Solar packs for powering small equipment Energy generation from waste material like cane dust

Dovetailing RE with development

Renewable energy, especially decentralised renewable energy technologies have the potential to meet electric, thermal, mechanical energy needs of not just households but also of a number of community services and livelihoods. An indicative list of such RE technology applications is tabulated below. It is suggested that for the potential of RE to be fully used, these applications and devices must be brought into the mainstream through intensive governmental efforts initially following which effective demand would be created for these RE technology applications to take off on significant scales

Another aspect of integrating RE into local development plans is to tap the tremendous job creation potential of this sector. Mega RE projects in other states such as Rajasthan, Maharashtra and Gujarat have created many jobs than grid-tied conventional plants. As a thumb rule, while manpower requirement for coal based power plants is 3-4 persons/ MW, solar plants require about 7 persons / MW. Fuel-free technologies like wind power and solar PV create more jobs during the manufacturing and construction phases (with limited openings also during the operations phase for jobs such as cleaning the power plant). On the other hand, fuel-based technologies such as biomass-based plants require maximum labour for feedstock production. For instance, a 10 MW biomass power project that can create employment for 100 workers during the 18-month construction phase, 25 full-time workers employed in the operation of the facility, and 35 persons in the collection, processing, and transportation of biomass material[xxi]. Tapping the employment potential of the RE sector will need a planned approach towards development and deployment of skills, as outlined in the next Chapter.

In order to scale up the deployment of renewable energy (including decentralised renewable energy) to eradicate energy poverty in the state and to address critical energy needs in rural Odisha, the following specific actions are suggested. These pertain to changes in the institutional, policy and regulatory framework for RE.

1. Strengthening RE institutional framework

AIREC suggests some modification, recasting and strengthening of Odisha's state machinery for RE as follows (Figure 6.1)

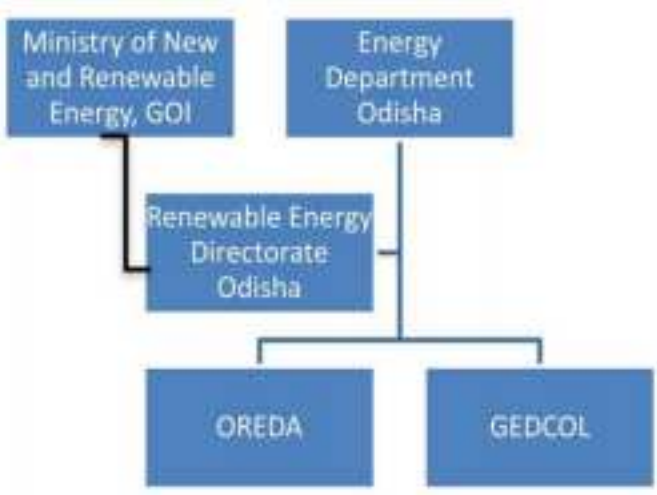


Figure 6.1: Suggested institutional framework for renewable energy in Odisha

Recasting OREDA under Department of Energy and strengthening its role

OREDA functions as the state nodal agency for renewable energy in Odisha. However, it continues to be under the Department of Science and Technology. The linkage of OREDA with the Ministry of New and Renewable Energy at the central level needs to be clearly established. Within the state too, OREDA must be recast to be under the Department of Energy. The possibility of OREDA becoming a Section 25 (not-for-profit) company should be explored. The corporatisation of OREDA will likely improve transparency and spur a sense of urgency in delivery and of sustainability of operations. It is now well recognised that the State Nodal Agencies if suitably empowered and equipped with requisite knowledge and skills, can play a critical role in the development of renewable energy in a state. SNAs – if they operate in a transparent and investor-friendly mode. The following are some of the key recommended functions and features of a strong nodal agency and must be factored into a structured programme to strengthen OREDA:

- close linkage and working with central energy and state energy agencies
- being the focal point for gathering and providing information on renewable resource availability to encourage investors and to also help them to plan projects based on realistic assessments of resource availability,
- preparing ready reckoners for potential RE investors including RE resource information, relevant socio-economic background
- being the technical advisory for RE integration in rural development in various government programmes
- establishing linkages with state agencies in departments that are potential users of RE technologies and applications – e.g. with horticulture department for RE-powered cold storage, fisheries department for solar fish dryers
- co-ordinating monitoring and verification of RE devices and projects and ensuring that required corrective action is taken (Box 6.1)
- Facilitating the establishment of skills development for RE sector.

Box 6.1: Periodic monitoring of energy access interventions and aspirations

Many energy access initiatives (not just in Odisha) disappoint when they fail to meet user expectations of energy services in terms of quantity, quality, reliability and pricing over a long period of time. Odisha's plans to scale up RE to provide sustainable energy access must factor in the learnings from the past as gathered through field surveys. Where grid power is unavailable or unreliable, provision of user-friendly, low maintenance solar home lighting systems is a solution. However, this can only be an interim solution till grid-quality electricity is made available. It is common for solar to be distributed and then forgotten. Batteries run out or parts stop working and the device is trashed away for want of replacement and services. While officials cite problems with maintenance contractors, what this reflects is the need for a clear system of monitoring and of assessing whether people's energy aspirations are being met.

Recasting GEDCOL as a truly business-oriented technology-agnostic nodal point for large-scale RE

GEDCOL (Green Energy Development Corporation of Odisha Ltd. (GEDCOL) has been incorporated as a public limited company in 2013 to explore the state's renewable energy resources. That GEDCOL is a subsidiary of OHPC (Odisha Hydro Power Corporation) and this raises some questions about its being a technology and resource-agnostic entity. The lack of any stake of OREDA in GEDCOL is also a point to be thought through. An example that may be looked at here is the West Bengal Green Energy Development Corporation which is a joint venture company of West Bengal Power Development Corporation Limited (WBPDCL), West Bengal State Electricity Distribution Company Limited (WBSEDCL) and West Bengal Renewable Energy Development Agency (WBREDA).

Establishing Renewable Energy Directorate

In mainstreaming renewable energy, the state must consider the setting up within the department of energy, a Renewable Energy and Energy Access Directorate headed by a Secretary level officer who would oversee the functioning of OREDA as well as GEDCOL in a co-ordinated fashion. A single point co-ordination of all renewable energy activities in the state with the focus also of overseeing energy access initiatives would be served by the Directorate. A Secretary-level position as the head of the Directorate will provide it with adequate authority to oversee all activities as also to establish linkages with other energy sector activities as well as with other departments as required.

2. Separate and distinct emphasis on clean cooking / thermal energy

It is distressing that despite being an early starter in the biogas programme, Odisha is grappling with a cooking energy crisis that does not get the attention that it needs. Odisha with its long history of working with biogas plants and improved cook-stoves is well-placed to develop a strong and effective programme for provision of clean cooking energy.

It is suggested that the cooking energy programme be broad-based and aimed that provision of meeting thermal energy needs. AIREC suggests that a template or planning methodology be developed by OREDA for a cooking / thermal energy plan at the block or district level, taking in to account the following:

- The programme must take into account the energy resources available as well as cooking habits and aspirations of the local people.
- Local women, youth and / or self-help groups should be involved in the construction and maintenance of stoves and in organising processed biomass feed-stock so that the programme generates livelihoods and community involvement.
- Through local banks and micro finance institutions, financing of improved cooking energy solutions must be ensured to be in line

with the income streams and payment capacities of the communities.

- The clean cooking energy programme must cover not only in rural and urban households but also tribal hostels, mid-day meal kitchens, schools, temples and other places of worship, hotels, tea stalls, sweet makers etc.
- Other thermal applications like vegetable, spice drying, fish drying, brick kilns, puffed rice making etc. should also be integrated into this programme
- A range of locally available resources such as bamboo waste, rice husk, animal and poultry litter may be considered for palletisation after suitable tests for efficiency and emissions.
- Clean cooking energy may be provided through a host of renewable energy options such as solar and biomass, but also through LPG and piped natural gas where these are the most practical solutions

3. Development of RE programme dovetailed with rural development and livelihoods

There are about 4,000 villages in the State, which cannot be connected to the grid and will have to be powered by decentralised energy. These villages represent an energy challenge, but they also present an opportunity to demonstrate renewables-based electricity generation in a small-scale decentralised mode. A pilot project announced in August 2014, attempts to electrify some of these villages / hamlets using individual household scale solar systems (Box 6.2) . While it is heartening to note that in the proposed pilot project renewable energy (solar) is being used to power more than just lights, it would be useful to consider the huge possibilities of deploying solar as well as non-solar RE applications to power needs in a range of energy needs in not just households but also in community services and livelihoods activities.

Integrating energy access and renewable energy in existing schemes and programmes

It is suggested that energy access through decentralised renewable energy be integrated into the portfolios of local development agencies (such as District Rural Development Agency, Block Development Office and Village Panchayat). This is in line with the concept of integrated rural development planning (Box 6.3)

An indicative list of RE technologies that can be readily integrated into existing decentralised development plans and also into plans of other departments and agencies is provided in Table 5.2. OREDA will play the role of a technical advisory providing RE-specific inputs in developing and designing these initiatives. Each health worker may be provided with a solar-powered light and a solar-powered cold pack for vaccines. Reliable power for schools, hospitals, community centres can be provided through renewable energy sources. Planning for toilets for schools should highlight the importance of lighting and running water, both of which may be facilitated through solar energy. RE can also be used to pump and purify water. Renewable energy technologies based on solar or biomass may be employed for activities such as drying of fish, vegetables

Box 6.2 Pilot Project To Power Unelectrified Villages Through Solar Power

The Odisha government has set in motion the task to identify un-electrified villages to be powered through solar power. The work is being taken up as per a pilot scheme to be launched by the Union ministry of new & renewable energy (MNRE). Under this scheme, solar PV (photo voltaic) based home systems would be provided to every household in two villages/hamlets in every Lok Sabha/Rajya Sabha constituency.

Each household will be provided with a 10-200 W peak solar PV system enough to provide power to 3-5 LED lights,1-2 fans, provision of mobile charging and running other small appliances at the discretion of the household. Each system is estimated to cost Rs. 50,000. While MNRE will bear 60 per cent of the cost, state governments are being persuaded to provide 30 per cent subsidy. The balance 10 per cent will be contributed by the beneficiary.

Box 6.3: Thoughts on decentralised renewable energy planning – integrated with decentralised development planning

The idea of integrated energy planning at the district, block or village level is not a new one. Odisha was the first state to have constituted District Planning Committees (DPC) in all districts in 2003 and prepared annual district plans since 2008-09. While the exercise is deemed to be an extensive and participatory one, the planning apparatus is reportedly weak especially in terms of technical support. What is missing in the district planning is a close linkage with renewable energy and this is what AIREC strongly recommends. This is in line with the Rural Electrification Policy 2006 which suggests that the rural electrification plan "may be linked to and integrated with District Development Plans."

AIREC's recommendation is that rural energy plans integrating renewable energy be prepared. These plans need to be dovetailed with district / block development plans on various aspects. The planning for community services and livelihoods activities should factor in deployment of relevant RE technologies. Similarly, manpower planning for RE should be integrated with RE plans as well as with existing livelihoods activities and retraining possibilities as mentioned in the Box above.

The Kerala model follows a multi stage decentralised plan formulation process. The different stages adopted and found successful in this decentralized planning are environment setting, situation analysis, need identification, vision setting, plan formulation, project planning, plan vetting, plan approval and plan implementation. These steps may be followed in Odisha also.

While district / block agencies could be responsible for overseeing implementation and be the nodal agency for funds flow, OREDA would continue to have a pivotal role as a technical advisory agency. OREDA should also act as the state-level nodal agency co-ordinating and guiding important processes like detailed RE resource mapping, developing toolkits for decentralised energy mapping, review of techno-economic feasibility of various RE options. It is suggested that this approach be taken up for some districts / blocks to establish and streamline the process before taking it across the state.

or spices, aeration of fish ponds as well as powering of cold rooms to store fruits and vegetables, fish or milk. Bamboo waste, animal dung and agri-waste can also be used to generate energy.

Integration of renewable energy with rural development and rural livelihoods enhance local quality of life, improve income and facilitate waste management. It will also create awareness about the potential for RE and create a demand for these technologies. Such demand creation is critical for creating a pro-RE ecosystem in the state.

Access to energy, especially renewable energy, must be an integral part of development programmes of the state and also for initiatives for backward districts such as the Biju KBK Plan, Western Odisha Development Council and Backward Regions Grant Fund.

Skills development initiatives to prepare for RE sector growth

RE projects are typically employment-intensive and create "green jobs". But these opportunities can be tapped by local people only if they are adequately equipped with requisite skills. It is estimated that 6-8 jobs out of 10 jobs in the RE sector require some vocational training. AIREC suggests that OREDA should initiate and spearhead the following skills development activities in this regard:

- Integrating RE in existing vocational and education programmes: Currently RE is not a part of the curriculum in Odisha. Practitioners recommend introducing DRE electives and projects in electrical, civil, electronics, chemical, and other streams of engineering as well as including them as part of the curriculum in degree, diploma, and certificate courses. The

integration of RE into engineering curricula through AICTE and/or MHRD in the industrial training institutes (ITIs). Subject areas include electrical, civil, and chemical engineering, agriculture, and architecture. It is also recommended to introduce DRE enterprise development courses and electives through existing programmes in entrepreneur development institutes (EDIs) across districts.

- Reaching out to local youth with skills provision activities: Additionally, training for decentralised RE be made available at the district level. District headquarters or District Rural Development Agencies (DRDAs) could be entrusted with this role. DRE training could also be integrated with Rural Livelihood Missions. The involvement of block development officers and village panchayats would also be useful. This would not only expand the opportunities for DRE training, but also equip local youth to take on roles in DRE projects and programmes. Local youth are good candidates for managing or implementing DRE projects because of their local knowledge and community acceptability.
- Retraining facilities keeping in mind existing skill sets: It is critical to bear in mind that although manpower requirements for DRE are large, they do not always present full-time employment opportunities. For example, the labour demand for installation and maintenance of solar pumps is high, but the need is typically seasonal. Similarly, the maintenance requirements of solar lanterns or SPV off-grid projects are low and do not require large numbers of full-time staff. This raises the issue of employability of a trained workforce. Several experts recognize the value of retraining existing workers rather than providing DRE training to untrained youth. For instance, for solar water heating (and to a lesser extent solar pumping), plumbers may be retrained. Electricians are good candidates to undergo training in installation and maintenance of SPV off-grid projects and lighting systems. Masons, welders and fabricators can be easily trained to build improved cook-stoves and biogas plants.

Lack of trained manpower is impeding RE deployment in many states. Preparation of a skilled workforce will also incentivise RE investors into the state apart from generating jobs for its youth.

4. Generating Investor Interest In RE

Investor and entrepreneurial interest is very low in Odisha's renewable energy sector. There are hardly any renewable energy sector players in Odisha. For instance, while there are no Odisha-based JNNSM (solar) channel partners, states like Maharashtra, Karnataka and Gujarat have over 10 each, and there are seven partners based out of West Bengal. In a recent call for bids for rooftop solar (Phase IV), states like Rajasthan, Gujarat and Tamil Nadu were oversubscribed, while several states including Odisha did not receive any bids.

Informal discussions with RE sector investors and entrepreneurs reveal that clearances and lack of incentives plague the sector. Every RE power project requires the following clearances, several of which are reportedly quite cumbersome:

1. Pollution Control Board
2. MoEF Clearance
3. Forest Clearance
4. Water Permission
5. Airport authority clearance
6. Mining clearance

Additionally, potential RE investors point out there are no special incentives for RE manufacturing and industrial development in the state with the RE sector coming under the purview of IPR (Industrial Policy Resolution) of 2001 and its amendment in 2007.

Important ways in which investor interest can be spurred include the following which are part of the approach suggested here in this report:

- strengthening the nodal agencies in the state as mentioned above,

- single-window clearances for RE projects without compromising on local social and environmental concerns
- policy incentives, thus establishing a strong RE manufacturing base and supply chain
- creating demand for RE within large state programmes in critical areas like health, education, water and sanitation, water pumping, cold storage, horticulture processing (as mentioned above)
- remunerative tariff norms for decentralised electricity generation from renewables
- identifying a strong network of grassroots organisations and reputed NGOs for grass roots project implementation in line with community needs.
- creating a pool of skilled manpower to conceptualise, design, implement, operate, maintain and provide last mile service delivery for RE projects (as mentioned above)

Policy incentives play a key role in attracting investors to a state. One such incentive that has been promulgated in India is the state-specific Renewable Energy Certificate tied in with the Renewable Purchase Obligation. Regulations around monitoring and verification of RPO, penalties for non-compliance of RPO and REC regulations are all required to be relooked at to make the RECs function as effective incentives for RE investors.

The involvement of the state's Odisha Grameen Bank in financing of renewable energy devices and projects will be an important step. Financing schemes must be tailored to suit the payment capacities, income streams and project viability.

5. "Special status" for Odisha in renewable energy deployment

In terms of energy, especially renewable energy, Odisha has numerous special features:

- Some parts of the state are extremely energy poor
- The state has an unfavourable market ecosystem, and will need some special support to come up to spiel with other states that already have buoyant RE markets and supply chains.
- Odisha's RE potential is an important advantage, but in the case of wind and solar the availability is diffused
- Accounting for one-fifth of the country's domestic coal production, Odisha is one of the largest contributors to the National Clean Energy Fund.

Consequently, the following may be considered to factor in a "special status" for Odisha:

- RE project bids on a regional basis or on the basis of grouping / categorisation should factor in various criteria such as need for the project and RE resource availability. Equal opportunity to states with diffused RE resources will require them to be treated as a separate category, for instance.
- Various MNRE schemes may be customised to include special or additional incentives for Odisha
- Though the NCEF is currently allocated on a project basis, projects in Odisha may be accorded priority on the basis of the factors outlined above. This would need some tweaking of the framework for NCEF disbursement which is under review.

In conclusion: Legislators and parliamentarians as energy access and renewable energy champions

Renewable energy in Odisha needs champions. While a revitalised OREDA and GEDCOL led by the proposed Secretary (Renewable Energy) would steer RE activities in the state, these efforts would get a tremendous fillip if legislators and parliamentarians are involved in some of the state-led RE efforts in the state. MLA Local Area Development Fund is a useful starting point.

The following are some other possible Community development projects that may be taken up under the

MLA LAD scheme to showcase the potential of RE in development and livelihoods:

- Tribal hostel powered by RE systems for thermal and electricity needs
- Passenger rest-sheds with lighting powered by rooftop solar
- School toilets with running water and lights powered by RE
- RE-integrated community centres as a meeting place as well as with facilities such as pay-per-use machines linked with livelihoods (e.g. sewing machines, spinning machines, bamboo polishing)
- Electrification of specific hamlets using RE-based micro grid
- School roofing to include solar rooftop
- RE-powered drinking water kiosks

As the LAD Funds are to be managed through the DRDA, the success of such RE-integrated community projects will help scaling up these efforts throughout the district and eventually across the state also. It would be useful to establish through these projects a model wherein funding may be provided through MLA LAD funds and / or OREDA schemes. OREDA could provide the technical advisory and could supervise the project design and implementation and also train a few local youth in implementation and further to maintain and operate the system. This sort of hands-on training will demonstrate how simple systems (particularly solar-PV based) can be readily installed to meet some critical needs such as lighting and water purification. In certain parts of Odisha such as in Koraput where electrification rates are low and supply if available is unreliable and have many cold but sunny days in a year, solar water heating has tremendous potential. A model that is working well in hilly states of northern India involves the setting up of a hot water kiosk where solar water heating facility is available. Locals come and buy water at very reasonable rates for their various uses. In remote electrified locations, legislators can reach out to their electorate with such life-changing projects.

MLAs and MPs should also play an important role in highlighting energy access problems in Odisha as well as for implementation of the action points suggested for highlighting the creation of a pro-RE ecosystem in Odisha. They can also play an important role in mobilising financing for the sector through sensitisation of many public sector undertakings and private enterprises in the state.

Based on the action points detailed above, the following suggestions may be taken up by the legislators for consideration by the state:

- OREDA to move under Ministry of Energy
- Creation of separate Renewable Energy Directorate in the Ministry of Energy to be headed by a Secretary
- Integration of RE into programmes and policies of relevant departments and agencies such as health, education, water and sanitation, poultry, agriculture, horticulture, irrigation
- Integration of decentralised renewable energy into district development programmes
- Setting up facilities and programmes for skills development for RE sector
- Development of a state clean cooking energy programme or mission
- Working with MNRE, CERC and Odisha SERC to
  - strengthen the Renewable Energy Certificate framework at the national
  - develop tariff regulations for decentralised electricity generation
- Working with Ministry of Power, MNRE as well as Central and State Finance Commission to accord “special status” to Odisha
- Working with MNRE to ensure regional bidding for RE projects and to explore possibility of “special status” for Odisha in incentives for RE as well as in allocation from NCEF
- Involving Odisha Gramya Bank in renewable energy sector lending for entrepreneurs and end-users

With parliamentarians and legislators championing the cause of energy access and renewable energy and demonstrating the political will to energise the state with RE, Odisha the land of the sun temple will surely transition from darkness to not just light but to sustainable development for all.

ENDNOTES AND REFERENCES

[i] http://www.cea.nic.in/reports/monthly/executive_rep/feb14.pdf

[ii] This section draws extensively on the EY report on Energizing Odisha, 2013

[iii] Odisha Climate Change Action Plan, 2010-15, http://www.odisha.gov.in/forest_environment/ActionPlan/CCAP%20ORISSA%20FINAL-1.pdf

[iv] Ministry of Power Per Capita Energy Consumption, 2009-10, 18-May, 2012, http://pib.nic.in/newsite/erelease.aspx?relid=84206

[v] Only the western region average is above this target, southern region is just meeting the target. The eastern and north-eastern regions have a long way to go before achieving the average target.

[vi] http://www.cea.nic.in/reports/monthly/dpd_div_rep/village_electrification.pdf

[vii] Census 2011 – Electricity Availability in State of Odisha, Table HH7, http://www.censusindia.gov.in/2011census/hlo/District_Tables/HLO_Distt_Table_Odisha.html

[viii] The entire Odisha Solar Policy (Draft) is available at http://www.orissa.gov.in/sciencetechnology/Odisha_Solar_Policy.pdf

[ix] Details on the tariffs for various renewable energy technologies are available at the OERC website www.orierc.org.

[x] Orissa Electricity Regulatory Commission Notification, No. OERC-Engg-02/2010/, 30th September, 2010; http://www.orierc.org/REC_Regulation_Notification_for_Gazette.pdf

[xi] http://mnre.gov.in/file-manager/UserFiles/Solar%20RPO/analysis-of-SERCs-RPO-regulation-for-captive-users.pdf

[xii] Odisha Renewable Energy Development Agency (OREDA) Program Status Document, March 15, 2014.

[xiii] Source: discussions of the team with locals http://www.beyondsolar.org/downloads/summary.pdf as well as http://www.tathya.in/news/Home/tabid/55/articleType/ArticleView/articleId/2028/Solar-Lanterns-For-Rural-Zones.aspx

[xiv] http://oredaodisha.com/achivements.htm

[xv] The obligation will increase 0.5% every year till 2015-16 or earlier as reviewed by the OERC. Of the total RPO, 0.1% in 2011-12 is required to be procured from solar power generation (Solar Purchase Obligation, or SPO) and it will increase at a rate of 0.05% every year till 2015-16, or earlier as reviewed by the OERC.

[xvi] http://www.firstpost.com/india/cyclone-phailin-power-sector-in-odisha-lost-rs-900-cr-says-odisha-govt-1173581.html

[xvii] http://www.firstpost.com/india/cyclone-phailin-power-sector-in-odisha-lost-rs-900-cr-says-odisha-govt-1173581.html

[xviii] http://www.business-standard.com/article/current-affairs/cyclone-hudhud-batters-power-infra-in-odisha-districts-114101300825_1.html

[xix] http://www.ndtv.com/article/south/cyclone-deaths-rise-to-43-in-andhra-pradesh-chandrababu-naidu-leaves-for-hyderabad-609276?curl=1413781835

[xx] For purposes of simplicity we may take the lifeline (least required) electricity consumption at one unit of electricity per household per day as mentioned in the Electricity Act (2003). This compares favourably with the IEA's minimum annual threshold level of 250 kwh and 500 kwh for urban households respectively.[21]"Adequate" electricity may therefore be taken at about 1000 kwh per household per year for the present moment, though this figure needs to be debated.

[xxi] http://mnre.gov.in/file-manager/UserFiles/faq_biomass.htm

Projects that MLAs could take up on priority in their constituencies:

Community solar PV system for livelihood activities

Biomass gasifier for village electrification

Solar street lights in an unelectrified village

Solar-powered RO (reverse-osmosis) based water purification systems that may be installed in schools, youth hostels, hospitals or in community centres

Solar powered lights in schools, hospitals and tribal hostels

Solar-powered lights and running water in toilets in girls' schools

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