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RE-Energising Karnataka:

An Assessment of Renewable Energy Policies, Challenges and Opportunities

Prepared by

CSTEP

CENTER FOR STUDY OF SCIENCE, TECHNOLOGY & POLICY

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List of Abbreviations

AD	Accelerated Depreciation
APPC	Average Power Purchase Cost
BERI	Biomass Energy for Rural India
BOO	Build, Own and Operate
BESCOM	Bangalore Electricity Supply Company
CAGR	Compound Annual Growth Rate
CEA	Central Electricity Authority
CGS	Central Generating Station
CSTEP	Center for Study of Science, Technology and Policy
CSP	Concentrated Solar Power
CSS	Cross Subsidy Surcharge
DC	District Commissioner
DDG	Decentralised Distribution Generation
DESI	Decentralised Energy Systems India Limited
DISCOM	Distribution Company
DPR	Detailed Project Report
EAI	Energy Alternatives India
EPS	Electric Power Survey
ESCOM	Electricity Supply Company
FY	Financial Year
GBI	Generation Based Incentive
GERC	Gujarat Electricity Regulatory Commission
GEDA	Gujarat Energy Development Agency
GoK	Government of Karnataka
HT	High Tension
IEC	Integrated Energy Centres

InWEA	Indian Wind Energy Association
IPP	Independent Power Producer
IREDA	Indian Renewable Energy Development Agency Limited
KERC	Karnataka Electricity Regulatory Commission
KIADB	Karnataka Industrial and Development Board
KPCL	Karnataka Power Corporation Limited
KPTCL	Karnataka Power Transmission Corporation Limited
KREDL	Karnataka Renewable Energy Development Limited
LT	Low Tension
MERC	Maharashtra Electricity Regulatory Commission
MEDA	Maharashtra Energy Development Agency
MGIRED	Mahatma Gandhi Institute of Rural Energy and Development
MNRE	Ministry of New and Renewable Energy
MoP	Ministry of Power
MSME	Micro, Small and Medium Enterprises
MSW	Municipal Solid Waste
NAPCC	National Action Plan for Climate Change
NSSO	National Sample Survey Organisation
O&M	Operation and Maintenance
ORF	Observer Research Foundation
PLF	Plant Load Factor
PPA	Power Purchase Agreement
PV	Photovoltaic
PwC	PricewaterhouseCoopers
RE	Renewable Energy
REC	Renewable Energy Certificate
RET	Renewable Energy Technology

RGGVY	Rajiv Gandhi Grameen Vidyutikaran Yojana
RPO	Renewable Purchase Obligation
RRB	Rural Regional Bank
RREDL	Rajasthan Renewable Energy Development Limited
RVEP	Remote Village Electrification Programme
SECI	Solar Energy Corporation of India
SERC	State Electricity Regulatory Commission
SEZ	Special Economic Zone
TANGEDCO	Tamil Nadu Generation and Distribution Corporation
T&D	Transmission and Distribution
TEDA	Tamil Nadu Energy Development Agency
TERI	The Energy Resources Institute
TNERC	Tamil Nadu Electricity Regulatory Commission
UNDP	United Nations Development Programme
UNEP	United Nations Energy Programme
VAT	Value Added Tax

Executive Summary

Karnataka has about 30,000 MW of estimated Renewable Energy (RE) potential, making it one of the top five RE-rich states in the country. As per official estimates from Karnataka Renewable Energy Development Ltd. (KREDL), this is mainly from wind (13,983MW), solar (10,000 MW), biomass (2,500 MW) and small-hydro (3,000MW) resources. Several studies also indicate that the potential for wind and solar might be higher, depending on land availability. Despite having a comprehensive state RE policy, Karnataka has lagged behind other RE-rich states such as Tamil Nadu, Maharashtra and Gujarat in terms of RE capacity addition over the past few years. While progress in biomass-based cogeneration has been high, all other RE resources have seen slow growth.

The biggest challenge in the state has been project implementation, i.e., progressing from allocation to actual commissioning. Although 60% (18,014 MW) of the state's total RE potential has been 'allocated' by KREDL, only about 15% (4,612 MW) has been commissioned. This has resulted in several high wind resource sites being held up. Also, majority of the commissioned biomass plants are non-operational due to unviable tariffs and difficulty in establishing sustainable supply chains, resulting in stranded investments. It is imperative to address these challenges, in order to make Karnataka a frontrunner in the RE sector and realise benefits such as reduced electricity deficit (currently 14%), reduced dependence on short-term power purchases of state utilities (currently 19%) and meeting Renewable Purchase Obligation (RPO) mandates in the solar sector.

Even though Karnataka's village electrification achievement is 99.95%, an estimated 9.6 lakh rural households continue to rely on kerosene for lighting. Most electrified rural households face 6-8 hours of power cuts each day. Industries are affected by constant scheduled and unscheduled power outages. Businesses are required to opt for captive power generation or cut down their production. This has resulted in 10% of the state's diesel consumption being used towards non-transport purposes, in diesel generators and agricultural pump sets. RE offers an opportunity to reduce diesel and kerosene consumption (1800 crores for kerosene in FY14). It is ideal to minimise the subsidy to agricultural consumers that is predicted to grow at an unsustainable rate of 13-14% in the state (7,200 crores in FY14) as well as help meet the industrial/commercial sector's energy needs. Small-scale biomass and solar plants are well-suited to serve un-electrified rural households and agricultural pump set loads, while captive solar plants can be an ideal option to meet both electricity and heating/cooling needs of commercial/industrial consumers.

In this context, the main objective of this study is to critically examine the state's RE policy to find gaps and implementation challenges specific to Karnataka. The primary audience of this study are the state legislators and policymakers. The methodology involved detailed stakeholder consultation with RE developers, the state nodal agency, the state electricity regulator and other government agencies involved in rural electrification through questionnaires and interviews in order to identify specific measures to address existing barriers to the growth of RE in the state. The study identified challenges and provided recommendations for three main sectors: utility-scale projects, rural RE technologies and alternate technologies with a low land footprint. As this study found land availability to be the key barrier in the deployment of utility-scale ground-mounted projects, technologies with lower land requirements such as waste to energy, small-scale biomass, solar PV pumps and solar PV rooftop need to be given priority focus in the state. The following section provides a summary of the main recommendations.

Utility-scale Projects

Establish Single Window Clearance

Getting permits and clearances for projects is a big hurdle faced by project developers in the state. Additionally, there is no clarity on what clearances are required and no investor grievance redress mechanism exists within KREDL.

A Single Window Clearance committee should have a mechanism to redress investor grievances about delays with clearances. These grievances can be addressed through increased co-ordination and follow-up between district authorities and KREDL. An official, standardised list of permitting and bidding requirements for RE projects should be created by KREDL.

Revive Biomass Industry

Karnataka has over 100 MW of biomass power capacity installed, however, almost 80 MW of biomass projects in the state are non-operational due to inflexible and uneconomical tariffs. Additionally, due to the focus on large-scale rice husk biomass plants, supply chains are difficult to establish as rice husk is increasingly being used in other industries, which makes its availability and cost uncertain.

The biomass sector can be rejuvenated by conducting a detailed district-wise biomass resource survey which identifies opportunities for increasing biomass capacity addition from other agro-residues and forest waste. KERC should establish a two-part tariff which takes variable fuel costs into consideration. The state needs to formulate a small-scale biomass policy which includes leasing small holdings of revenue wasteland for the growth of captive plantations required for feedstock in small-scale biomass projects.

Strengthen Grid Infrastructure

Clearances required by investors to lay electrical infrastructure from RE project sites to the grid are hard to obtain. Investors fear that future addition of RE in Karnataka could lead to local-grid saturation in RE rich districts and grid congestion between power production sites and load centres.

KREDL and Karnataka Power Transmission Corporation Limited (KPTCL) should take active short-term measures to address these issues, by engaging with district level authorities to facilitate required permits. For the purpose of enabling better grid integration, all solar and wind plants should be mandated to install data communication technology which provides real-time RE data to load despatch centres. KPTCL should make a long-term transmission plan in RE-rich districts as well as strengthen the intra-state grid between RE zones and urban load centres to avoid grid congestion. Limited RE-park development by the state provided with necessary grid evacuation infrastructure can also be undertaken, especially for solar projects to meet RPO targets.

Ease Land Acquisition

Land acquisition has been a challenge for the state over the past decade despite this being pointed out as one of the main barriers for RE growth in Karnataka by the Government of India. At present, state revenue lands are unavailable for deployment of RE projects in Karnataka, leaving land acquisition to investors. Wind projects, which have earlier been allotted revenue lands, are held up without investments on it and reallocation procedures are unclear. Steps towards reallocating this land are being made, however more efforts need to be made to ensure that this is expedited in a transparent manner.

The state needs to tackle these challenges in the short-term, by engaging with state and district level authorities to facilitate land acquisition in a time-bound manner and reallocating delayed wind projects to serious players. In the long-term, the state should employ the deemed land conversion procedure for acquiring private lands for all RE projects and make comprehensive provisions in the new Karnataka RE policy, which ensure that technologies with low land footprint such as small-scale biomass, solar rooftop and solar PV pumps are deployed successfully. The Central Ministry of Environment and Forest should co-ordinate with the state Forest Department to formulate clear and transparent guidelines that will be applicable for use of marginal and scrub forest lands for RE development.

Establish Attractive Open Access Regulations

The restrictive and ambiguous open access charges make RE power producers cautious to invest in Karnataka. Recently, the Karnataka Electricity Regulatory Commission (KERC) has provided clarity on the open access charges applicable for solar energy projects; the same needs to be done for power production from other RE sources such as wind and biomass. Hence, KERC should encourage open access sales by easing cumbersome procedures, providing a roadmap for progressive reduction in Cross Subsidy Surcharge (CSS) and a clear time-frame for which regulatory charges are applicable for all RE projects. This will make Karnataka a more investor-friendly destination for RE power producers.

Low Land Footprint Technologies

Formulate Supportive Policies

Land acquisition has been identified as the biggest challenge to the deployment of RE in the state, however there appears to be limited state-level action towards promoting the growth of technologies which have a small land footprint (notable exception is rooftop solar which has been addressed in the Solar Policy 2014-2021).

In the upcoming RE policy, which will take effect from 2015, the state should move towards providing low land footprint technologies which are suitable for the Karnataka context with adequate support. These measures include creating a policy for waste to energy projects. The state should mandate regular data collection of waste by local municipal authorities. Waste segregation should be ensured by imposing an additional garbage collection cess for investing in waste segregation machinery.

In order to ensure that the rooftop solar policy translates to reality, innovative schemes within ESCOMs such as rebates on electricity bills instead of consumers having to collect their due payment should be introduced.

Constitute State-level RE Funds

Although Karnataka has a comprehensive policy and attractive rooftop tariffs, companies have been reluctant to install rooftop plants in the state due to fears that ESCOMs might not have sufficient payment capacity.

A state-level RE fund should be constituted and utilities should draw up a comprehensive set of projects that can utilise this fund, which can include grid-connected solar rooftop plants, waste to energy, and solar irrigation pumps. This shall ensure that rooftop investors have a risk guarantee from the state regarding tariff payments. One source of finance for the fund can be by requisitioning the next Finance Commission to provide incentives to states that have shown considerable progress in RE

targets. As the previous scheme had complicated qualification procedures and no states benefited from the scheme, the state government should request that a new plan be established which shall provide incentives to states that successfully meet their RPO obligations under national mandates.

Rural Electricity Supply

Create a Roadmap for Rural Electrification

There are un-electrified rural populations in Karnataka which are not eligible for the incentives provided by the Central RGGVY and RVEP schemes. A target-driven state-level action plan for such villages should be made in order to ensure universal electrification in the state.

Improved Financial Support

To satisfy Karnataka's mission of universal high quality electricity supply, the state must provide more financial support to rural electricity projects. Lack of access to low-cost finance is a big challenge for off-grid rural RE projects. In order to promote small-scale projects Regional Rural Banks (RRB) should be provided with financial support from the state RE fund to lend money to these projects at low interest rates. Revenue subsidy models should replace conventional capital subsidy-driven models to ensure that plants are kept operational. A risk mitigation mechanism for off-grid power projects in the eventuality of grid extension by declaring buy-back rates can mitigate the threat of obsolescence. State-level Value Added Tax (VAT) charges can be waived off for off-grid project components.

Develop O&M Skill and Capacity

The dearth of technically trained personnel to operate and maintain small-scale rural RE projects poses a great threat in keeping these technologies sustainable.

The state should work with organisations experienced in rural RE technologies such as the Mahatma Gandhi Institute of Rural Energy and Development (MGIRED) to come up with a curriculum for training operators. These training courses should be included in state industrial training and rural development institutes. KREDL should link up with local government and non-government organisations to form a viable operational plan for existing/new capital subsidy driven off-grid rural projects.

Introduction

Background and Motivation for the Study

Renewable Energy (RE) has been assuming increasing significance with the growing concern for climate change and necessity to ensure India's energy security. RE development in India started in the early 1990s through the creation of a separate Ministry of New and Renewable Energy (MNRE). Further, the Electricity Act (2003) provided a legal framework for state electricity regulators to support the uptake of Renewable Energy Technologies (RETs). This has played a big role in the rapid growth of RETs for electricity generation in the last decade — from 1,658 MW in 2003 to 31,700 MW in March 2014 (MNRE, 2014). Currently, renewable sources contribute to about 13% (CEA, 2014; MNRE, 2014) of India's total installed electricity generation capacity and to about 6% of total electricity produced (Planning Commission, 2013). The Prime Minister's National Action Plan for Climate Change (NAPCC) targets 15% of the country's electricity demand to be met from RE by 2020. This requires a quantum jump in RE generation across the country and a significant contribution from RE resource-rich states. Karnataka is one such RE resource-rich state with an officially estimated renewable potential of about 30,000 MW. The high RE potential of Karnataka is primarily due to a high wind power potential (KREDL, 2014).

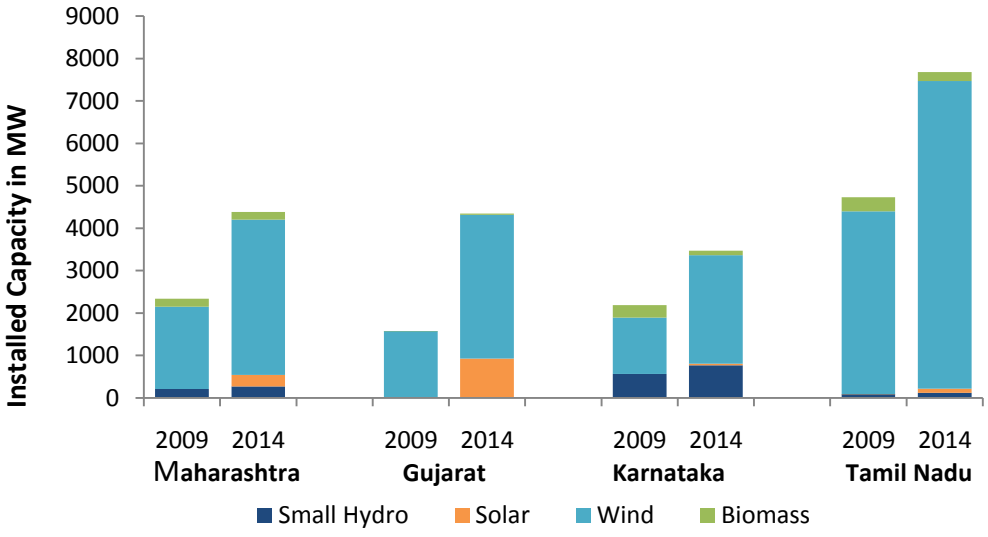

Figure 1: Inter-state comparison of RE achievement (Central Statistics Office, 2010; Central Statistics Office, 2014; KREDL, 2014; MEDA, 2014; TEDA, 2014; C-WET, 2014; MNRE, 2014)

As can be seen in Figure 1, Karnataka was a frontrunner in installed capacity of RE in 2009, but has lagged behind other states in implementation in the past five years.

While Karnataka has registered good progress in small-hydro and biomass as compared to other states, its wind power capacity growth has stagnated (PwC, 2012). The state has also significantly fallen short of its own solar capacity addition targets envisaged in the state Solar Policy 2011-16. Several biomass plants are found to be non-operational (TERI, 2013) due to low tariffs and uncertain rice husk supply chains resulting in stranded investment. Small-hydro capacity has been maxed out as most of the hydro potential is in ecologically sensitive areas such as the Western Ghats, which cannot

be exploited due to environmental concerns (Dandekar, 2013). As a state with one of the highest RE potentials in the country, the slow growth of RE in Karnataka merits a closer study. This is the principal motivation of the present study. In the aforementioned context, this report provides a critical analysis of Karnataka's RE policy, identifies gaps in policy, recognises barriers for effective implementation and concludes with a few broad policy recommendations for overcoming these challenges.

Scope and Approach

This report presents results of a three-month study commissioned by Climate Parliament – an international network of legislators working to promote RE to combat climate change. The primary audience of this report is state-level policymakers in the electricity domain. The main objective is to identify drivers of RE for the state and galvanise government action towards increased deployment of those RETs that are most appropriate for Karnataka's development goals. The approach involved extensive consultation with state RE stakeholders, viz. government agencies involved in the RE sector, investors of various RETs and the regulatory commission to identify barriers and challenges specific to Karnataka. The study followed the below steps to achieve its stated objectives:

1) Review the state's current electricity scenario and identify state-level drivers for renewables
2) Map the state's institutional and policy framework for RE implementation
3) Consult with stakeholders to identify policy gaps and implementation challenges specific to the state
4) Provide suggestions for overcoming challenges and present results at a stakeholder consultation workshop
5) Generate a policy brief for further action by state policymakers

Current Electricity Scenario

Karnataka has an installed capacity of 14,270 MW (CEA, 2014a), out of which 4,612 MW (KREDL, 2014) is from renewable sources as shown in Figure 2. It should be noted that not all installed renewable capacity projects are under long-term Power Purchase Agreements (PPA) with state utilities.

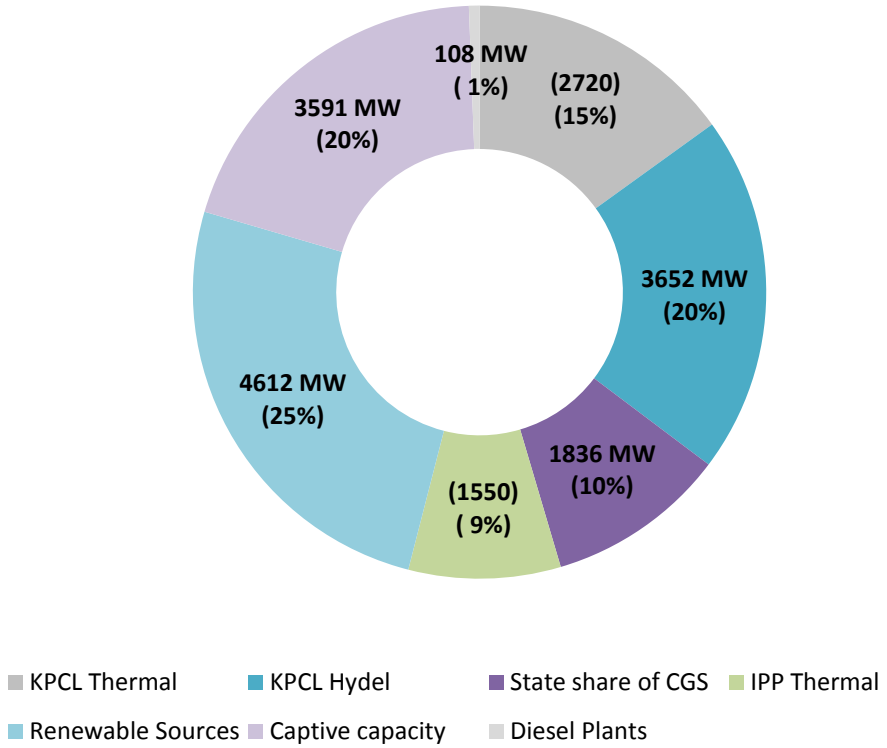

Figure 2: Installed capacity (as of June 2014) in MW (KREDL, 2014; CSTEP, 2013; GoK, 2013)

Consumers of electricity in the state fall under categories of domestic, commercial, agricultural and industrial (low tension (LT) and high tension (HT)) users. It is interesting to note that in Karnataka, agriculture is one of the primary consumer categories, with over 38-40%[1] of the share, unlike other RE-rich states (Gujarat, Maharashtra and Tamil Nadu) where the contribution is between 18-19%[2]. On the other hand, the industrial sector (LT and HT) is comparatively low as compared to other states with 33% of the share, while in other states, this sector dominates with a share ranging between 43-59% (CSTEP, 2013). Tariffs for different consumers are shown in Figure 3.

[1] This is an accounting estimate, in the absence of 100% metering and/or may change subject to actual measurement.

[2]This does not include generation from captive plants which comprises of steam (954 MW), diesel (884 MW) and gas (338 MW) captive plants in industries having demand of 1 MW and above (CEA, 2012)

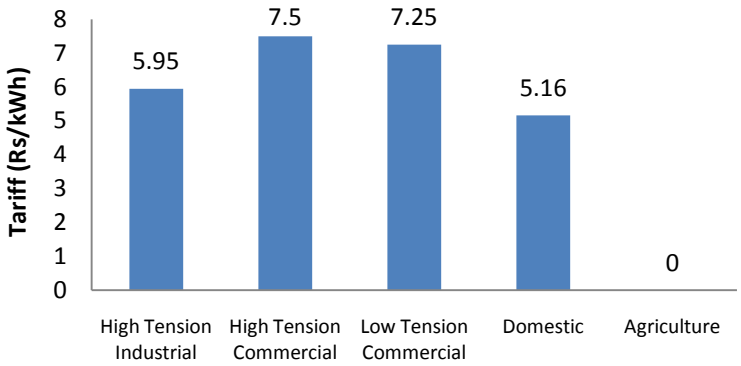

Figure 3: Indicative electricity charges for different consumer categories (BESCOM, 2014)[3]

Electricity demand in the state has grown at 10.44% Compound Annual Growth Rate (CAGR) from FY08 to FY13, whereas, for the same time period, supply has increased at a mere 7.82% (Figure 4). This indicates that capacity addition has not been able to match the increasing demand of electricity. Peak demand in the state has grown from 6,583 MW in FY08 to 10,124 MW in FY13 with a CAGR growth rate of 9% during the period and the state's peak deficit was 13.5% in FY13 (CSTEP, 2013).

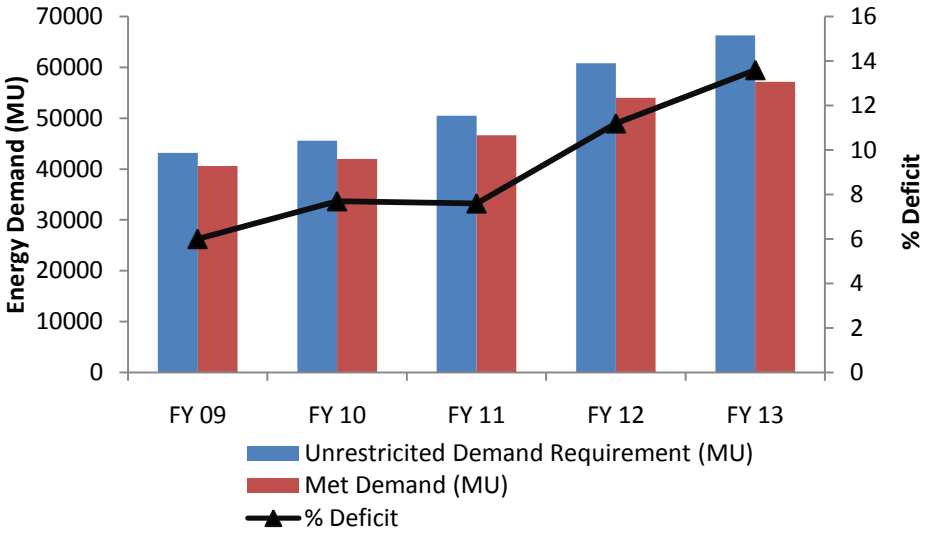

Figure 4: Electrical energy demand vs. supplied in MU from FY08 to FY13 (CSTEP, 2013)

According to the 18th Electric Power Survey (EPS) (CEA, 2014b), approximately 18,400 MW will be required to meet the electricity demand of Karnataka by 2021-22 (Table 1). However, demand may be higher than the EPS-calculated values if the state electricity demand grows at the same rate as witnessed between FY08 and FY13 when the CAGR was 10.44% (CSTEP, 2013).

[3] Averages of different electricity tariff slabs for each consumer category were accessed at http://bescom.org/wpcontent/uploads/2011/11/TO-BESCOM-2014.205-244.pdf.
In case the GoK does not release agriculture subsidies in advance in the manner specified by the Commission in KERC (Manner of Payment of subsidy) Regulations, 2008, 203 paisa/unit shall be demanded and collected from these consumers.

Table 1: Forecast of state utility electricity requirement (CEA, 2014b)

Karnataka	2011-12	2016-17	2021-22
In MUs	53523	78637	108012
In MW	8545	13010	18403

Apart from augmenting state-owned generation capacity, the state has been importing power from central power-generating stations (CGS) of neighbouring states, and also buying short-term power to tide over power shortages. When it is highly difficult to bridge the demand-supply gap, load shedding is imposed. The state regulator has approved a supply pattern in the state as follows:

- 6 hours of 3-phase supply to agricultural pump sets (fully subsidised by state)
- 24 hours of supply in Bangalore and 22 hours in other urban areas
- Single phase supply to rural areas for at least 11 hours at night (CSTEP, 2013)

The supply pattern mentioned above is not always practised, and in reality consumers are affected by constant scheduled and unscheduled power outages. Businesses which are already suffering due to economic slowdown are further required to opt for captive power generation or cut down their production. This unreliable supply of electricity has also made domestic and commercial customers turn to inverters and diesel generators to serve as a reliable back-up. However, this forces them to bear high costs as well as emit harmful carbon emissions (PwC, 2013).

In order to tackle problems of electricity deficiency (Figure 4), expensive short-term purchases (Figure 5) and power outages, the state government needs to make a long-term strategy to ensure reliable power supply.

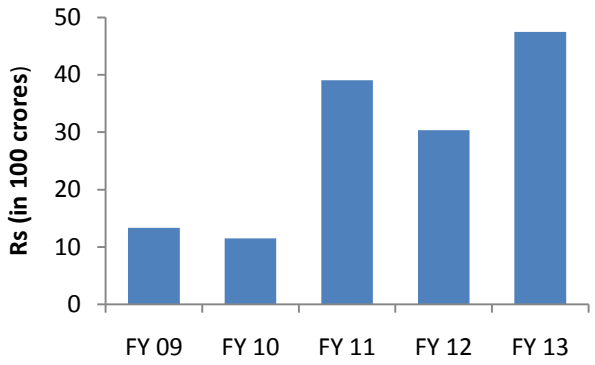

Figure 5: Annual costs of short-term power purchases from FY09 to FY13 (CSTEP, 2013)

This is required to support both the economic growth of the state and a better standard of living. RE has an important role to play in this long-term strategy as Karnataka has no fossil fuel reserves, and has to import fossil fuels for its power generation (PwC, 2013). Since Karnataka has a significant share of its electricity generation (20%) from large hydro plants, as shown in Figure 2, it has a good lever to absorb intermittency arising from renewable sources like wind and solar. In light of the current electricity situation in Karnataka, the section below takes a look at key drivers for implementation of RE in the state.

Drivers for Renewable Energy

RE development at the sub-national-level in India has been driven mainly by top-down targets set by the Centre and enforced through state-level Renewable Purchase Obligation (RPO) commitments. However being a state with abundant potential, Karnataka's RE policy should not be limited to meeting RPO targets alone. In light of this, the section below identifies other drivers for RE in the state in addition to its RPO mandate.

State's Electricity Deficit

The electricity deficit in the state is around 13.9% (CSTEP, 2013). The state has been procuring power through short-term contracts in order to tide over these deficits. The deficit without such short-term purchase is actually 30.58% (CSTEP, 13). As seen in Figure 6, the state's short-term power purchases have grown rapidly in the last few years, from 1964 MU in FY09 to 11047 MU in FY13 (CSTEP, 2013). Even though average cost of power for these purchases has come down from about 6.8 Rs/kWh in FY09 to 4.3 Rs/kWh in FY13, this is still almost twice the Average Power Purchase Cost (APPC) of utilities (CSTEP, 2013) and the availability of this power is highly dependent on transmission corridors. The total cost of power purchases increased by 4 times in FY13 (4750 crores) compared to in FY09 (1335 crores). Therefore, it is important to look at more long-term and secure sources of electricity and decrease the dependence on short-term purchases. More dispatchable sources of RE like biomass power can also provide reliable capacity during peak times.

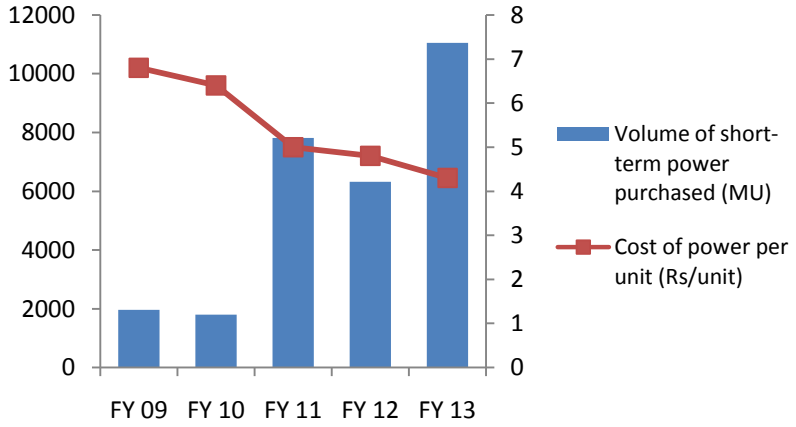

Figure 6: Short-term power purchases and average per unit rate of purchase from FY09 to FY13 (CSTEP, 2013)

Electricity Poverty in Rural Areas

Access to quality electricity services continues to be a major issue in the state, similar to rest of the country. Electricity access is not only essential at the household level, but is also very important basic infrastructure in hospitals, schools and industries. Supported by several years of central and state schemes, electrification in Karnataka has increased between 2001 and 2011. Majority (99.95%) of villages in Karnataka (Table 2) are electrified considering the definition of "village electrification" provided by the national rural electrification program, Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY). A village is deemed electrified if public places like schools, Panchayat offices, health centres, dispensaries and community centres and 10% of all households are electrified. This does not

guarantee that all households in a village are connected to the grid, even if the village itself is. Electrification achievement in the state was similar at 99.90% in 2009.

Table 2: Village electrification in Karnataka (CEA, 2014c)

Total Inhabited Villages as per 2011 census	Villages Electrified as on 31-03-2014		Un-electrified Villages as on 31-03-2014
	Number	Percentage	
27481	27468[4]	99.95	13

Even with a high electrification achievement, the 2011 Census mentions that 8.6% (11 lakh) households (Figure 7) in Karnataka are still dependent on kerosene to meet their lighting needs, implying that several households have no access to electricity even in officially "electrified villages" (Krishnaswamy, 2010).

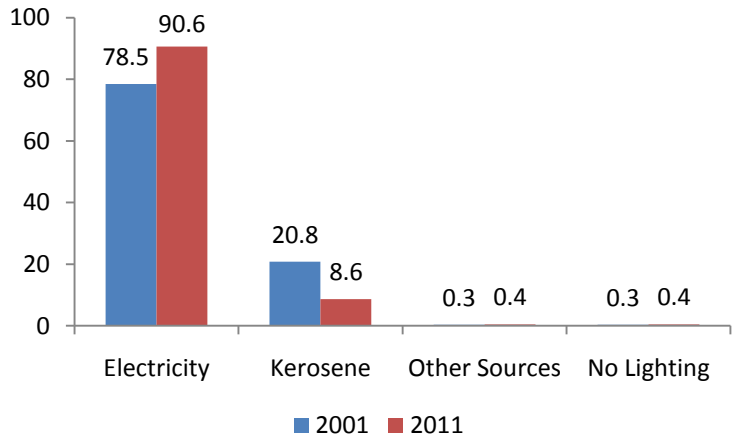

Figure 7 : Source of lighting for households in Karnataka (%) (Census of India, 2011)

Additionally, there is a wide gap in rural and urban access to electricity (Figure 8), with 96.4% of urban households having electricity as a source of lighting opposed to 86.7% in rural areas. Kerosene is still used in about 12% (9.6 lakh) rural households to meet their lighting demand as compared to approximately 3% in case of urban households. Kerosene usage emits toxic fumes that can lead to eye and respiratory ailments implying high associated health costs.

[4] Provisional numbers from CEA, 2014c

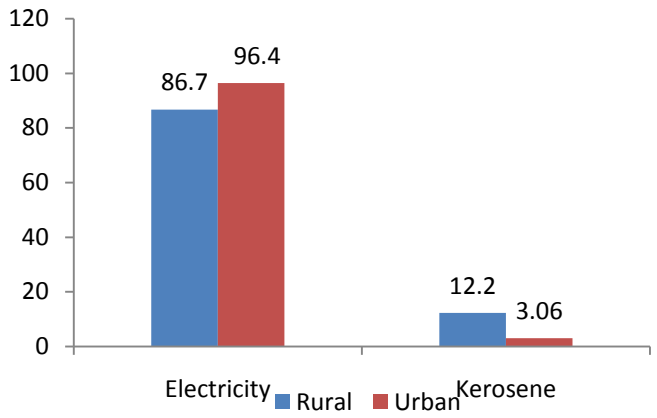

Figure 8: Source of lighting for rural and urban households in Karnataka (%) (Census of India, 2011)

There are two main issues with electricity access in rural areas. Electrified villages have erratic and unreliable supply. Secondly, there are still a number of remote hamlets comprising less than 100 households, which are un-electrified and do not fall under the RGGVY scheme.

The cost of delivering power from the grid, which includes generation, transmission, and distribution of electricity from a centralised coal thermal power plant, varies across the country. For plain areas, it ranges between 0.15-20.47Rs/kWh, however these prices rise significantly to 0.31-228Rs/kWh in hilly terrains. Prices vary according to the distance from central grid (5-25km) and the peak load capacity of the grid (25-100kW). For instance a village with about 20 households that has a peak load of 5 kW which is 5 km from the grid will cost about 26 Rs/kWh, which increases to 95 Rs/kWh if the village is 10 km away from the central grid and becomes prohibitively high at 228 Rs/kWh for a village 25 km away from the central grid (Nouni, Mullick, & Kandpal, 2008; Aggarwal, et al., 2014).

Karnataka is home to the ecologically sensitive Western Ghats as well as other areas where the remote location of hamlets in hilly terrains makes it technically and economically unfeasible to extend the grid. As can be seen from Table 3, small-scale RETs can become economically attractive as compared to grid extension to provide electricity to these rural areas across the state. The modular nature of bioenergy and solar can be used effectively for small-scale off-grid deployment. Bioenergy is an ideal option for rural areas because of the abundant availability of raw materials such as farm and animal waste. Solar PV can be customised to serve an individual household or a community. These technologies and their hybrids can be appropriately adopted for improving rural access to electricity services in the state.

It should be noted that RE can be deployed for many decentralised uses other than power generation such as cooking, drying, milling, heating and cooling purposes. However, the focus of this report is primarily to investigate the gaps and opportunities regarding the deployment of RE for electrification.

Table 3: Comparison of technology options for electrification of rural Karnataka (Aggarwal, et al., 2014; Prayas Energy Group, 2012; KERC, 2014; Tetratech, 2013)

Characteristics	Grid Extension[5]	Micro grid
Reliability / Power Quality	Unreliable power, with 16-18 hours of power a day in rural Karnataka. Abundant power cuts in rural areas	Reliable "on demand" power
Cost of supply	Ranges between 0.31-228Rs/kWh. Villages with smaller number of households and longer distances from central grid can go above 200Rs/kWh	(In Rs/kWh) Solar micro-grid : 20-30 Biomass micro grid: 6-10 Micro Hydro: 3.5-8 Wind: 4-80

Opportunity to Replace Fossil Fuels and Reduce Subsidies

Poor access to electricity in rural areas and power deficit in other areas have a direct bearing on consumption of subsidised fuels as rural lighting services and commercial/industrial productive services rely on kerosene and diesel respectively as backup sources. Consumers are increasingly using diesel as an alternative to overcome this electricity shortage at costs between 16-40 Rs/kWh, depending on the application (EAI, 2014). Agricultural water pumping is an energy intensive activity and is carried out either using electricity from the grid (which is subsidised) or diesel-run irrigation pump sets.

Non-transport use of diesel in generator sets, agricultural pump sets and mobile towers accounts for about 10% of diesel consumption in the state (Petroleum Planning and Analysis Cell, 2013), which leads to large carbon and particulate emissions. Kerosene receives a subsidy of 33 Rs/litre (India Today, 2014). Karnataka receives a quota of 540,000 kilolitres of kerosene annually (The New Indian Express, 2014) which amounted to 1,800 crores of subsidies in FY14.

Agriculture consumers receive 6 hours of free electricity supply in the state and the remaining is met with the help of diesel driven pump sets. As Karnataka provides free and un-metered electricity for irrigation purposes, farmers have no incentive to use electricity judiciously and often use inefficient pumps. In 2014, 25 lakh irrigation pump sets in Karnataka accounted for 38-40% of the state's power consumption (The Economic Times, 2014). Electricity for agriculture requires a substantial subsidy of 7,200 crores (The Hindu, 2014) from the state government's policy to supply free power. By promoting the use of solar PV pumps, the utilities can realise savings by reduced subsidised electricity, which can improve the financial condition of the state utility as well as reduce the electricity deficit situation in the state.

Costs of generation from biomass plants (3.5-6.5 Rs/kWh) (TERI, 2013) are much lower than diesel and can be a reliable source of electricity, however these plants only become viable in areas where there is an abundance of agricultural or forestry residue available. Therefore, supply chain issues might constrain the establishment of biomass plants.

[5]Includes cost of generating, transmitting, and distributing electricity from a coal thermal power plant to the required location through the central grid

Solar plants are intermittent, and companies might require a storage mechanism to ensure continuous supply of electricity if the plants are not grid-connected. The cost for a rooftop solar PV system with battery storage has been calculated at about 8.24 Rs/kWh for a 5 kWp plant (CSTEP, 2014) and without a battery these costs are lower. Captive solar power plants can avail several benefits like 30% capital subsidy and Accelerated Depreciation (AD) from the Centre. According to the Karnataka Solar Policy 2014-21, grid-connected captive solar plants can be set up for private consumption. There is no minimum or maximum project capacity requirement to commission the project. Project investors are eligible to avail Renewable Energy Certificates (REC) in compliance with KERC regulations (GoK, 2014). Captive solar plants are becoming economically attractive and offer an opportunity to replace diesel-based captive use.

Requirement to Meet RPO Mandate

The NAPCC targets 15% of electricity procurement in the country to be from RETs by 2020. RPOs have been mandated by the Electricity Act (2003) as a mechanism to ensure demand for RE. To comply with this, each State Electricity Regulatory Commission (SERC) has set an RPO target for distribution companies and other obligated entities in the state. These targets vary across states (between 0.5 to 10% of total electrical energy demand) and are meant to incrementally increase over time. The National Tariff Policy of 2011 has also announced specific targets for solar RPO – starting from 0.25% in FY12-13 and going up to 3% in FY21-22. In view of these central mandates, KERC has directed state Electricity Supply Companies (ESCOM) to procure 0.25% electricity from solar sources out of the total electricity procured; this is expected to increase to 3% by FY20-21 in line with national targets.

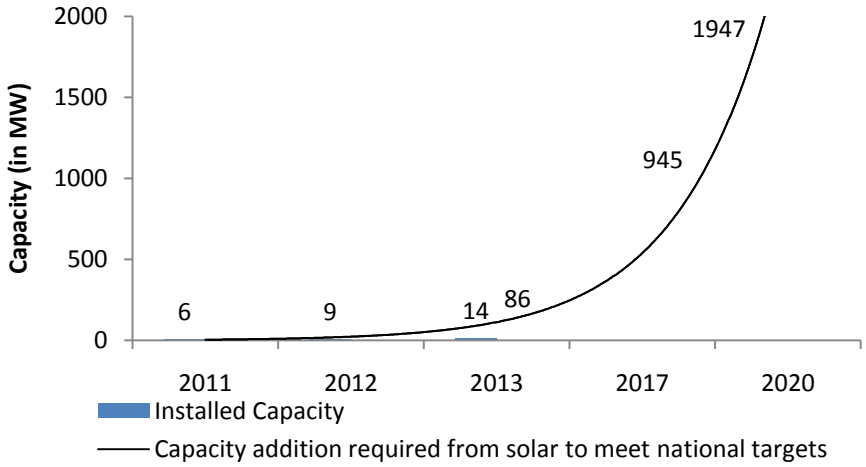

Figure 9: Capacity addition required from solar to meet national targets

Until recently, the Solar Policy 2011-16 for the state of Karnataka targeted a capacity addition of 200 MW by 2016 which was insufficient to comply with the national tariff policy targets. However, the state introduced a new Solar Policy 2014-21 that has updated its targets till 2021 with an envisaged capacity addition of 2000 MW (400 MW rooftop and 1600 MW utility-scale) (GoK, 2014). The new solar policy targets match with the targets required to meet the national mandate (Figure 9). However, it can be seen that Karnataka has lagged behind in satisfying its solar purchase obligation and has not met its policy targets, as implementation has been poor. As of August 2014, Karnataka has installed 51 MW of solar (KREDL, 2014), therefore, the capacity needs to increase by 40 times to satisfy the 2020 RPO mandate. This requires the state to make an exponential progress in solar capacity addition.

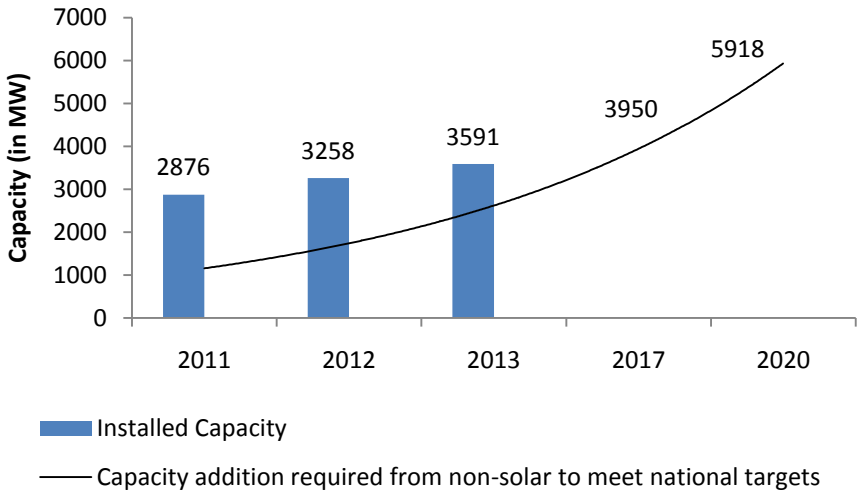

Figure 10: Capacity addition required from non-solar to meet national targets

It can be seen in Figure 10 that Karnataka has been successful in meeting its non-solar RPO mandate. If the current allocation of wind projects alone is implemented, it is sufficient to meet Karnataka's non-solar RPO in the future as well. However, despite project allocation, commissioning of capacity has been extremely slow for wind projects in the state.

The calculation method for Figure 9 and Figure 10 can be accessed from Table A.1 and A.2 in Appendix A. It should be noted that the in this study, we have considered that the total NAPCC target of 15% shall be met partially by solar-specific target of 3% and a non-solar RPO of 12% in Karnataka.

Socio- economic Impact

RE can play a major role in solving the sustainability problems associated with conventional fuels as these sources are non-exhaustible and relatively clean. Along with improving electricity access, RETs also have socio-economic value such as creation of employment opportunities and increasing incomes in the rural economy. There are other benefits such as reduction of indoor air pollution and overall improvement in the quality of air. Specifically in rural areas, renewable solutions can contribute significantly in the expansion of health, education, telecommunications and infrastructure facilities, ensuring regional self-reliance and poverty alleviation by generating employment opportunities and earnings if reliable electricity is made possible. This will in turn reduce energy imports and will also help in overall cost saving in supply of power to rural areas

CASE STUDY: SOCIO-ECONOMIC IMPACTS OF ELECTRIFICATION

An emphasis on the electrification of villages is a must, as this can lead to significant benefits such as local self-sustenance, income generation and increased access to health and education infrastructure. A report made by Tetratech (2013) on behalf of the Rural Electrification Corporation Limited for 5 districts in Karnataka on the evaluation of the RGGVY scheme showed the perceived benefits of village electrification as per a field survey (Figure 11). It shows that while villagers felt that education, security and the standard of life has considerably improved, the perceived impact on health and employment is a bit lower. This can be explained by the fact that the electricity was not very reliable and the grid was not able to handle higher loads. Unpredictable outages do not give villages faith in investing in any business opportunities.

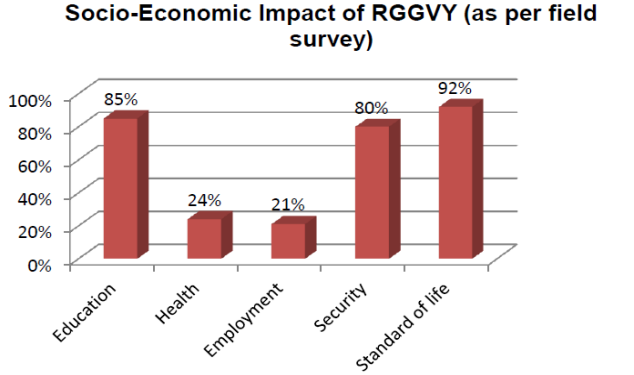

Figure 11: Socio-economic impact of RGGVY (Tetratech, 2013)

Renewable Energy Landscape

Although Karnataka has a good policy on paper and extensive RE resource, the state has lagged behind other RE-rich states in implementation and is far from effectively exploiting its potential. This section takes a look at the status of RE in the state as well as what policies and institutions govern the RE sector.

CASE STUDY: INDIA's FIRST 3MW SOLAR PLANT IN KARNATAKA

Karnataka was a pioneer and frontrunner in the field of RE. In 2009, Karnataka Power Corporation Limited (KPCL) installed the country's first 3 MWp capacity grid-connected solar plant in the Kolar district of Karnataka (shown in Figure 12). This project was set up as a demonstration plant in the tail-end to improve the rural power supply in three districts. The plant annually sells about 3.3 million kWh of electricity to the grid.

Figure 12: 3 Solar PV plant in Kolar district of Karnataka

Institutional Framework

Key institutions responsible for RE implementation in the state are:

Institutions	Role
The Ministry of New and Renewable Energy (MNRE)	It is the central nodal agency and its main aim is to develop and deploy new and renewable energy for supplementing the requirements of the country. MNRE is responsible for timely approval/ disposal of RE projects proposals that are received from the state nodal agency for release of financial support (Central Financial Assistance).
Ministry of Power (MoP)	MoP is in charge of evolving a general policy in the field of energy, energy conservation and efficiency. MoP is responsible for the Central Electricity Authority (CEA), and Central Electricity Regulatory Commission. Rural electrification programmes such as RGGVY are also under the mandate of MoP and executed through its agency Rural Electrification Corporation Limited.

Department of Energy, Government of Karnataka	Department of Energy is responsible for co-ordination between all segments of the electricity supply chain: generation, transmission and distribution in the state. KPCL, KPTCL and the five ESCOMs in the state are also under the administrative control of Department of Energy. It formulates power sector plans and the RE policy for the state.
Karnataka Power Transmission Corporation Limited (KPTCL)	KPTCL is the state transmission utility. They are responsible for supervising permits that RE investors require for establishing electrical infrastructure.
Karnataka Power Corporation Limited (KPCL)	It is a state owned power generating company, which operates thermal and hydro plants. KPCL has also been involved in promoting RE in the state by setting up solar and wind plants.
Energy Supply Companies (ESCOMs)	Distribution of power is entrusted to these regional distribution companies. There are 5 ESCOMs in Karnataka – BESCOM (Bangalore Electricity Supply Company), MESCOM (Mangalore Electricity Supply Company), HESCOM (Hubli Electricity Supply Company), GESCOM (Gulbarga Electricity Supply Company) and CESCO (Chamundeshwari Electricity Supply Corporation Ltd.). ESCOMs are in charge of rural electrification and manage the RGGVY scheme. BESCOM is responsible for the implementation of the solar rooftop scheme.
Karnataka Electricity Regulatory Committee (KERC)	KERC is the state regulator for the power sector. It determines feed-in-tariffs for power procurement from RE plants by ESCOMs and regulates the operation of intra-state transmission (State Load Dispatch Centre). KERC also sets year-wise RPO targets for obligated entities in Karnataka.
Karnataka Renewable Energy Development Limited (KREDL)	KREDL is a state nodal agency for new and renewable energy which works under the purview of Energy Department, Government of Karnataka. It initiates necessary actions required for the promotion of RE. It acts as a facilitator between industry, finance, government, and technical experts to evaluate challenges and opportunities arising from law and policy in the RE sector.
Mahatma Gandhi Institute of Rural Energy Development (MGIRED)	MGIRED is a regional Institute for Integrated Rural Energy Planning, established by the Department of Rural Development and Panchayati Raj, Government of Karnataka (GoK) with the assistance of MNRE, to cater to the training needs of southern states in the field of rural RE.

Policy Framework

Karnataka Renewable Energy Policy (2009-2014)

This was introduced by the Government of Karnataka (GoK) in 2009 to promote the growth of RE in the state. It is a comprehensive policy which seeks to enhance the contribution of renewables to the overall energy mix, create a favourable investment environment, implement energy efficiency measures and achieve commercial viability for RE projects. Targets for various renewable sources from the policy are as shown in Table 4.

The salient features of the policy include:

- Creation of a Green Energy Fund which will be used for promotion of RE generation in the state through land acquisition.
- Establishment of a Single Window Clearance mechanism to handle all statutory clearances. This will be done by strengthening co-ordination between various state departments. It details time limitations, evacuation arrangements, fiscal policies and necessary regulatory issues required to be followed to commission RE projects.
- Description of tariffs mechanisms for different RE projects.
- Separate incentives and plans to promote growth of RE projects based on the renewable resource.
- Detailed strategies and programmes for energy conservation and efficiency to be implemented in the state.

Table 4: Proposed capacity addition targets between FY11-14 for procurement by ESCOMs (GoK, 2009)

RE Source	Year-wise proposed capacity addition (MW)					Capacity addition by FY14 (MW)	
	FY10	FY11	FY12	FY13	FY14	Target	Cumulative
Cogeneration in Sugar Industry	56	56	56	56	57	281	816
Biomass/Bio-gas	60	60	60	60	60	300	381
Wind	630	680	530	530	599	2969	4337
Waste to Energy	10	10	10	10	10	50	50
Mini and Small-hydro	100	100	150	150	100	600	1016

Karnataka Solar Policy (2014-21)

In suite with Gujarat and Rajasthan, Karnataka came up with a Solar Policy (2011-16) dedicated solely for growth of solar energy in the state. However as targets were low, and implementation has been poor, the state has recently introduced a new Solar Policy (2014-2021) with more aggressive targets to ensure it can meet 3% the state's electricity consumption with solar energy by 2021. The year-wise targets to achieve the same are shown in Table 5.

Table 5: Proposed targets solar capacity addition between FY14-21 (GoK, 2014)

% of solar on total consumption of energy	Year-wise proposed targets						
	FY15	FY16	FY17	FY18	FY19	FY20	FY21
	1.5	1.75	2.0	2.25	2.5	2.75	3.0

The policy states that there is a potential to harness about 10 GW of solar energy in the state, and aims at exploiting 2 GW of this resource by 2021. This will be done through a combination of utility-scale grid-connected projects and rooftop PV projects (off-grid and grid-connected). Year-wise targets are shown below in Table 6.

Table 6: Proposed solar capacity addition targets between FY14- FY21 (GoK, 2014)

Segment	Year-wise proposed capacity addition (MW)							Capacity addition by FY21 (MW)	
	FY15	FY16	FY17	FY18	FY19	FY20	FY21	Target	Cumulative
Utility-scale projects	350	150	150	150	200	200	200	1400	1600
Rooftop solar PV (grid-connected and off-grid)	100	100	100	100	-	-	-	400	400

The policy focuses on 3 segments — utility-scale projects, rooftop projects and off-grid and Decentralised Distributed Generation (DDG). Salient features of the policies for these 3 categories are as mentioned below.

Segment	Salient features
Utility-scale grid-connected PV and Concentrated Solar Power (CSP) projects	Projects • To promote distributed generation by land owning farmers • Selected based on competitive bidding process • Under RECs • Under Captive/Group Captive generation • Under Independent Power Producer • Under Bundled Power
Grid-connected solar rooftop projects and metering	• Promote rooftop technology in the public, domestic, industrial and commercial sector • Net metering system to be implemented. Surplus shall be injected into the grid, and ESCOMs will pay a tariff to power producers • ESCOMs will develop standards and guidelines for equipment. They will administer the scheme

Solar Off-grid and DDG	• Options like street lighting and rooftop PV with battery storage shall be encouraged for rural and urban purposes • Focus will be on solar power for irrigation pumps

Karnataka Semiconductor Policy (2010)

Semiconductors are an important component of solar PV technology. In order to encourage semiconductor industry growth, the Karnataka government formulated a policy to assist indigenous production of semiconductor parts. Highlights of this scheme include:

- Providing land to manufacturers which are located close to ports and airports
- Developing solar farms on Joint Venture and Public Private Partnership mode in districts like Bijapur, Gulbarga, Raichur and Bellary in association with KPCL and KREDL
- Providing financial incentives for micro, small and medium enterprises (MSME)
- Exempting stamp duty for MSMEs, large and mega projects
- Exempting entry tax on various parts essential for the manufacturers
- Exempting electrical duty and tax for 3 years and providing low interest loans for MSMEs at 5% (PwC, 2012)

Surya Raitha Scheme (2014)

A scheme launched to encourage famers to install solar panels for running their irrigation pumps. 2,400 pumps sets are expected to be deployed with the help of the central subsidy. The salient features of this scheme include:

- Farmers can opt for 90% subsidies on the solar systems
- Unsubsidised systems can sell excess electricity to the grid at 9.56 Rs/kWh; subsidised sets at 7.20 Rs/kWh (The Hindu, 2014)

Potential, Targets and Achievement

Karnataka is abundantly endowed with resources required for solar, wind, biomass and small-hydro RETs. In order to utilise this potential, the state has specified targets for RETs by 2014 in the Karnataka RE Policy 2009-14 and separately for solar technologies in the Karnataka Solar Policy 2011-16. It should be noted that the new Solar Policy 2014-21 is effective from 2014 onwards, hence we have used the Solar policy 2011-16 targets to evaluate the solar achievements of the state till date. It can be observed from Figure 13 that Karnataka has, in most cases, except for biomass and waste to energy technologies, allocated projects in line with targets specified in the state's RE policies.

KREDL is responsible for allocation of RE projects in the state. This means that project developers are given a letter of intent by KREDL that covers timelines for project completion. Projects are currently allocated through several procedures like tariff-based bidding for grid-connected solar or regulated feed-in tariffs for others like wind, small-hydro and biomass projects. Earlier, wind investors were allotted land by KREDL, however currently all RE project investors are required to obtain land by themselves.

In this context, the next section presents the findings of the stakeholder consultation process for identifying challenges with grid-connected RE in the state. The list of stakeholders consulted and the questions posed to them can be found in Appendix B.

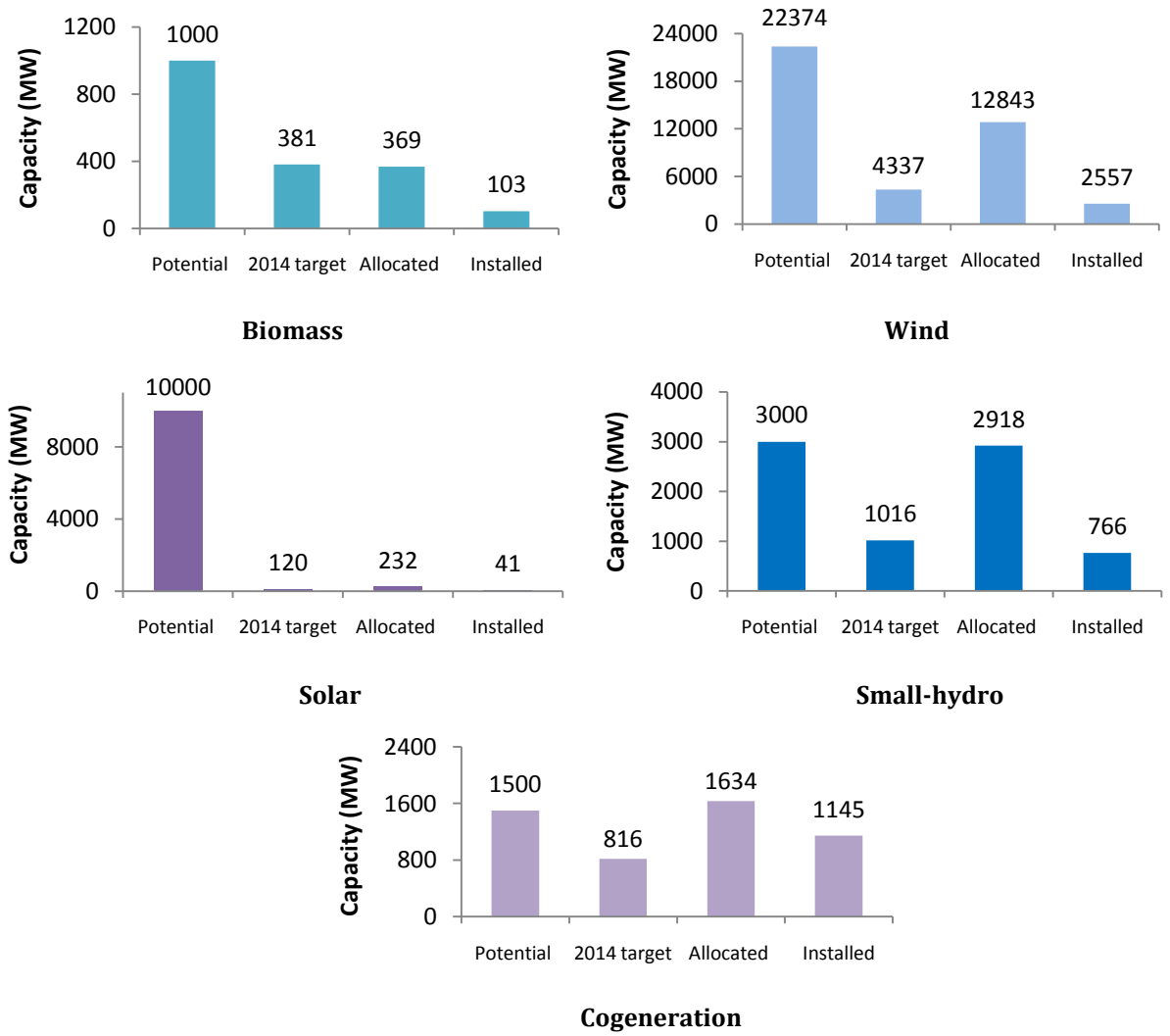

Figure 13: RE status in Karnataka as of June 2014 (KREDL, 2014)

Utility-scale Projects: The Way Ahead

Establish Single Window Clearance

"Although there is single window clearance on paper, in reality the system doesn't work... There is no co-ordination between different state agencies, such as the DCs and KREDL."

Senior Manager-Business Development, Solar Company

Ease of execution of RE projects in Karnataka is perceived to be very poor by investors. Stakeholder response indicated that the single window clearance system in Karnataka was not effective. Investors are unclear on what steps to take after project allocation as KREDL does not have a comprehensive list of documents and procedure required for the commissioning and bidding of different RE projects. The determination of tariffs for solar energy projects through a reverse bid tender in 2013 was faced with a few companies being dissatisfied with processes leading to litigation and about 30 MW of solar capacity not being commissioned. Furthermore, it appears that there is no mechanism with which investors can approach KREDL to redress their grievances.

In the previous RE policy, KREDL was envisaged to play a bigger role in project commissioning i.e. to monitor clearances and permits to ensure that these were given within 90 days from the date of project allotment. However, investors state that this has not happened in practice, and according to the latest Solar Policy (2014-21), the role of KREDL is primarily limited to inviting tenders for project allocation and issuing facilitating letters to other authorities that are involved in the project commissioning process. Once a project is allocated, it becomes the responsibility of ESCOMs to supervise the project timelines and collect fines in case these timelines are not met.

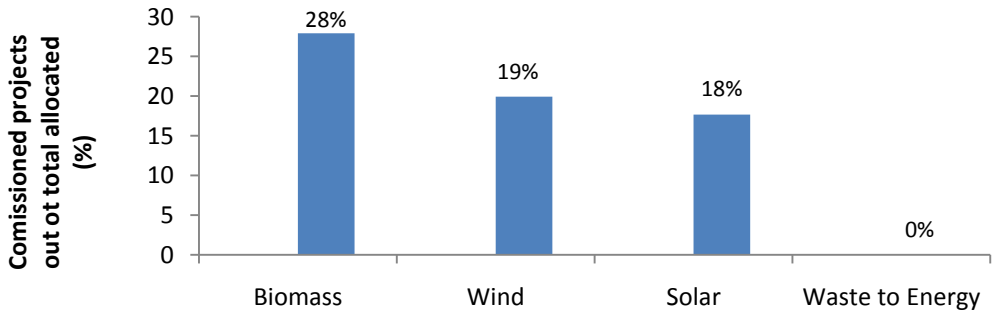

Figure 14: Commissioned projects out of total allocated in Karnataka as of June 2014 (KREDL, 2014)

Restricting the role of KREDL to mere project allocation is one of the reasons that there appears to be a lack of co-ordination between different state agencies — each department continues to follow their separate procedures for permitting and documentation. In Karnataka, this is a considerable problem, where majority of allocated projects are unable to reach commissioning (as can be seen in Figure 14). The RE Policy 2009-14 makes certain provisions to facilitate the smooth commissioning of RE projects. However the industry feels that state agencies view the policies only as a guideline.

Policy Provisions	Ground Reality	Outcome
Formation of State-level Committee to provide single window clearance	This Committee has not been formed	Investors need to get clearances from respective departments
Review of required clearances from various departments	No clarity in what permits and clearances are required	Delay in commissioning, as procedures are not clear
Strengthen inter departmental co-ordination	KREDL not empowered to make follow up with other departments. No co-ordination between different agencies	State/District agencies do not respond to clearance requests in a timely manner
KREDL to obtain all statutory clearances within 6 month period	KREDL is not involved in clearance processes	Investors take more than a year to get required clearances
KREDL to pass on concessions and incentives allowed by MNRE to the project investor	Investors claim that subsidy disbursal is very slow	Investors have not received the financial incentives offered by the centre , and have no clarity in how to avail the same

RECOMMENDATIONS

- **Instead of only playing a role in project allocation, KREDL should be empowered with more manpower to play a more active role to take projects to commissioning**
- **Formation of Single Window Clearance Committee with representation from district level entities of RE-rich districts so that KREDL can facilitate co-ordination with district officials**
- **Single Window Clearance committee should have a grievance mechanism, where investors can file complaints if permits and clearances are not dealt with in a timely manner for KREDL allocated projects**
- **KREDL should create an official, standardised list of all permits and clearances required for the commissioning and bidding of RE projects**

Revive Biomass Industry

"There is high potential for biomass projects in the state... Low tariffs make the plants uneconomical."

Associate Professor, Centre for Sustainable Technologies, Indian Institute of Science

The biggest challenge faced by biomass plants in the state is the uneconomical and inflexible tariffs. Biomass plants provide dispatchable power compared to other sources of RE and hence adds high value in the power portfolio of the state. Although the state RE policy mentions that it will create an enabling tariff atmosphere for biomass projects, Karnataka has a low tariff compared to other RE-rich states as shown in Figure 15. According to the latest KERC report, the price will increase from 3.66-4.13 Rs/kWh incrementally for ten years starting from 2009, implying that the current tariff is 3.81 Rs/kWh. In order to be economically viable, the tariffs proposed by biomass combustion power producers have been between 4.4-5.50 Rs/kWh. The average cost of generation of power through biomass combustion has been estimated at about 5 Rs/kWh (KERC, 2009; TERI, 2013). Similarly, although the actual generation cost is 6.5 Rs/kWh, the current buyback tariff is only 2.25 Rs/kWh for gasifier plants. (TERI, 2013).

After the first 10-year period of the PPA, power producers and ESCOMs signed PPAs based on mutually agreeable terms. Most of these extensions happened around 2010-2011 and the tariffs negotiated with ESCOMS are currently between 3.58-5.13 Rs/kWh. A number of power producers did not extend PPAs when the tariffs offered by ESCOMs were not economically viable to run the biomass plants (TERI, 2013). Although ESCOMs were willing to pay 5.30 Rs/kWh in the summer months to meet peak demand requirement, in 2012-13 regulators disallowed this practice and mandated ESCOMs to pay tariffs decided in the PPAs (TERI, 2013).

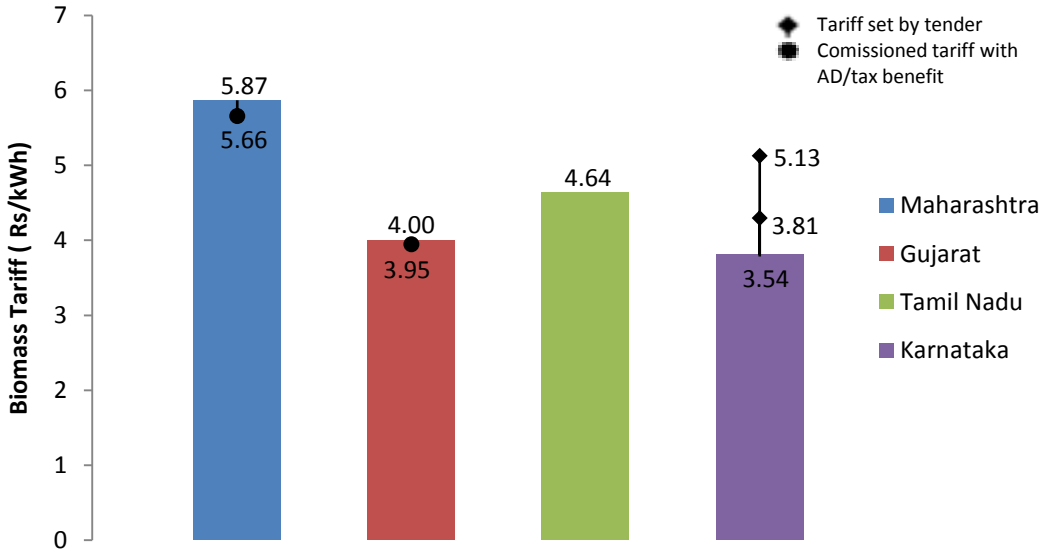

Figure 15: Comparison of biomass tariffs of select states (KERC, 2009; Mahadiscom, 2013; GERC, 2010; TERI, 2013)

Another aspect of the tariff is that it does not take into account fluctuations in fuel price (mainly rice husk). Due to the seasonal nature of cultivation, often agro-waste prices fluctuate, which is not captured in the tariff. Many SERCs, including Tamil Nadu, Gujarat, Rajasthan, Andhra Pradesh and Maharashtra have taken an approach to biomass projects with a separate fixed cost component that is fixed for 20 years with escalation, and a variable cost which depends on the fluctuation of fuel cost

(TERI 2013). An in depth comparison between tariffs for RE-rich states in India has been shown in Tables C.1 to C.3 in Appendix C.

"Large scale biomass plants are failing...fuel linkages are becoming difficult and systems use more fossil fuel."

Associate Professor, Centre for Sustainable Technologies, Indian Institute of Science

Majority of biomass plants in the state are combustion units between the ranges of 6-8 MW, with one plant sized at 20 MW. Using woody biomass as a fuel for such plants becomes impossible as land requirements for a captive plantation would be very large. Therefore, most plants are reliant on rice husk as the primary fuel source. The increasing demand of rice husk from other industries has led to a rise in cost of rice husk and a shortage of husks for use as fuel in biomass plants, resulting in low Plant Load Factor (PLF) for currently operational plants. It is hard for new players to enter the market as forming linkages for consistent supply of biomass is continuously becoming more difficult. This is the primary reason, why allotted biomass plants have not been successful in the state (TERI, 2013).

As large-scale power plants are bound to suffer the scarcity of feedstock, it is advantageous to promote the use of small-scale (less than 2 MW) plants in Karnataka. This is also an appropriate scale for decentralised operation and can be linked to schemes such as pumping or providing light to health centres and schools deriving benefits of community-centred employment, income generation and self-sustenance.

Figure D.1 in Appendix D, shows the locations of existing biomass plants in Karnataka as of 2013. Many high resource potential districts with a biomass surplus lack biomass power plants. These districts can be the focus for commissioning small-scale biomass plants. Previously a few small-scale systems of 100-250 kW were installed in the state under the BERI project implemented jointly by the GoK and UNDP. However, none of these plants were sustained due to uneconomical grid tariffs, shortage of feedstock and operation and maintenance issues (UNDP, 2011). These small-scale biomass plants can be used for captive power plants by MSMEs and for rural community electrification.

RECOMMENDATIONS

- **Undertake a detailed district-wise biomass resource survey as a starting point to developing a plan to increase biomass capacity addition**
- **KERC should revise biomass tariffs to a two-part tariff, taking into consideration variable and fixed costs**
- **Create a small-scale biomass (power plants up to 2MW) policy provision which includes leasing small holdings of revenue wasteland for the growth of captive plantations required for feedstock in small-scale biomass projects**

Strengthen Grid Infrastructure

"We are lucky to get a good site with adequate grid access, but most other investors are struggling as the existing grid is weak and unable to deal with the evacuation required."

Senior Manager-Business Development, Solar Company

In Karnataka, districts such as Chitradurga, Davanagere and Gadag are rich in both solar and wind capacity (as shown in Figure D.3 and D.4 of Appendix D). Future wind and solar investors fear electricity off-take constraints in these regions as local capacity might be saturated by existing wind projects. KPTCL is in charge of transmission and power planning in the state and their annual report for 2013-14 shows a focus on work in RE-rich districts (KPTCL, 2014). Projects in progress and those being planned are shown in Figure 16 and 17 respectively. Chitradurga, which was stated as the most problematic district for evacuation is planned to have 8 augmentations, and 2 substations.

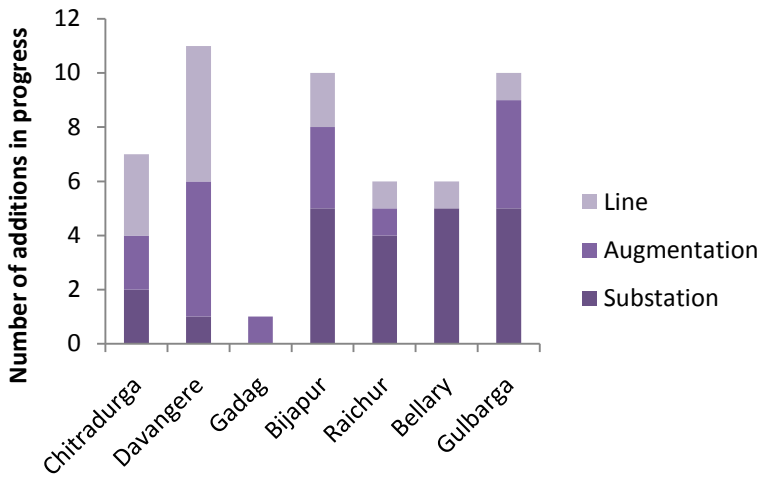

Figure 16: In progress additions as per the KPTCL Capital Expenditure report for 2013-14

Concerns of developers are justified to some extent as grid infrastructure projects take 4-5 years to commission, whereas solar and wind projects take only 2-3 years (PwC, 2012). Therefore, due to the longer lead time for transmission infrastructure, projects might face grid evacuation challenges in the short-term.

"Presently, there is no problem with grid infrastructure in Karnataka... By the time wind projects are commissioned, KPTCL would have added required evacuation infrastructure."

Official, Wind Department, Karnataka Renewable Energy Development Limited

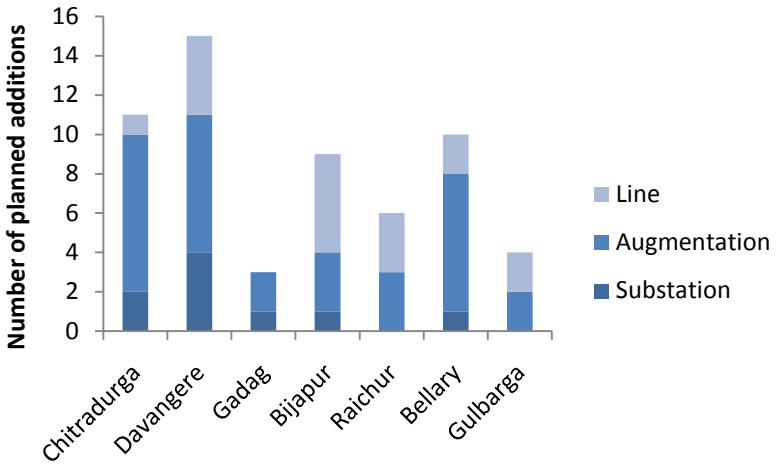

Figure 17: Planned additions as per the KPTCL Capital Expenditure report for 2013-14

As per state policy, investors are expected to install their own electrical infrastructure from project sites to the substation (GoK, 2009). Most of the potential sites are in remote areas and often require lengthy evacuation lines to be built. This also requires a number of clearances from district authorities as well as KPTCL to lay the lines and obtain evacuation approval. Getting these approvals is a cumbersome process resulting in delays. If the existing grid network faces any challenges, such as a pole or tower malfunctions, the project is at stake as power off-take is interrupted. Although it is the mandate of the district authority to fix such problems, often wind power producers are asked to handle these issues themselves. The wind industry also stated intra and interstate network congestion as a major barrier to transmit wind energy from Northern Karnataka generation sites that are RE-rich to load centre in Bangalore. Karnataka Renewable Policy 2009-14 makes several recommendations with respect to grid infrastructure (GoK, 2009), which if implemented would perhaps ease present concerns.

Policy Provisions	Ground Reality	Outcome
Augment evacuation infrastructure for RE zones	KPTCL does have a number of projects planned or in progress in the areas with RE projects	Industry is concerned whether the infrastructure will be commissioned on time. They foresee problems in grid evacuation
Establishment of committee to examine grid related issue for RE projects	No separate department within KPTCL to handle RE projects	Significant time to get required approvals
RE project investors have to bear the cost of transmission lines from project site to substation	Lengthy transmission lines often requiring several clearances need to be built by RE industry	Disinterested to invest in state, as other states such as Gujarat offer required infrastructure to investors
Investor is required to commission project within 3 years including grid synchronisation	No co-operation from district level personnel and KPTCL approvals take a long time	Investors face great challenges regarding erection of electrical infrastructure, leading to commissioning delays

RECOMMENDATIONS

- **KPTCL should make a long-term transmission plan with a focus on RE-rich zones to avoid evacuation issues**
- **Improve and strengthen intra-state grid infrastructure between RE rich zones to load centres to reduce network congestion**
- **KREDL and KPTCL must engage with district level entities, to facilitate permits and clearances required for laying down electrical infrastructure by RE developers**
- **In regions which are RE-rich, the government can set up RE land banks with required evacuation infrastructure, to the extent of meeting state RPO requirements**
- **For the purpose of enabling better grid integration all solar and wind plants should be mandated to install data communication technologies which provide real-time RE data to load despatch centres**

Ease Land Acquisition

"Fortunately, Karnataka is blessed with good wind potential.... But the acquisition of private lands for setting up any project in Karnataka has to undergo the most tedious process."

Indian Wind Power Association, Karnataka Chapter

A key reason for slow growth of RE in Karnataka can be attributed to difficulty in land acquisition. After KREDL allocates a project it becomes the investors' responsibility to acquire land. This includes lengthy processes that take up to a year, to get the required permits and clearances. As private players cannot acquire agricultural land, the farmer needs to convert the land from agricultural to non-agricultural status with permission from the district authorities. Investors across technologies repeatedly state that district agencies are not sufficiently engaged in this process and therefore they have no incentive to prioritise these clearances.

Historically, most wind projects in Karnataka have been installed on hillocks, however as most of these lands are barren and uncultivated, they have been changed to forest and deemed lands. Hence, these lands are now under the Forest department, and permits which used to take a year, now take about 4-5 years. This does not deter the industry from investing in the state, as Karnataka is endowed with good wind potential even in plain lands; however the tedious procedure for private land acquisition is a major challenge contributing to the slow growth of the state's wind industry.

The wind industry has requested the government for an exemption from conversion of land for setting up wind farms. The industry is of the view that this process currently causes huge project delays. As of now, a move has been made by the government to change land acquisition procedures only for the solar industry.

The state has allocated wind projects of 12 GW capacity, but only 2.2 GW has been commissioned, with 6.6 GW yet to be commissioned and the rest of 3.5 GW of land held up due to rejection, cancellation or surrendering of projects (PwC, 2013). Land allocated to projects that have not seen investments for several years have not been reallocated to serious players due to unclear reallocation procedures. Although steps are being taken towards easing land acquisition, there is still a lack of transparency and progress is slow.

"No revenue lands are available... the wastelands available are scattered, uneven and situated far away from required grid infrastructure."

Official, Solar Department, Karnataka Renewable Energy Development Limited

Karnataka's RE Policy 2009-14 made ambitious provisions for land acquisition (GoK, 2009), which if implemented can ease the present issues being faced by the industry.

Policy Provisions	Ground Reality	Outcome
Green Energy Fund to acquire land	No fund constituted, no activity towards land acquisition by government	Land is a big barrier in implementation of projects, especially for new players. Difficult to get financial closure
Establish Special Economic Zones for RE technology manufacturers	No land has been allotted for this purpose	Disinterest to invest in state
Identification of land by District Commissioners to deploy RE projects	District level authorities have not been engaged in this process	Tedious process for agricultural land acquisition at district level
Identification and allotment of waste and industrial lands in windy locations	Difficult for investors to acquire their own land. Government wasteland is not available	Commissioning delays, disinterest to invest in state
Identification of government wastelands for setting up of biomass projects	Investors have to purchase their own land	Delay in land acquisition is a barrier in commissioning

"Land acquisition is the major hurdle in Karnataka's solar development and the core issue behind the slow progress in the state as compared to Gujarat and Rajasthan."

Senior Engineer, Solar Company

Solar industries appear to get hit hardest by this issue as they are expected to pay a heavy fine if they are unable to get financial closure within 9 months of project allocation by KREDL via the bidding route. Banks are willing to finance if investors have tied-up land for the project. However, time taken for acquiring land often takes longer than 9 months, and banks are unwilling to give investors financial closure within this time period. This is the biggest risk for new players entering the market.

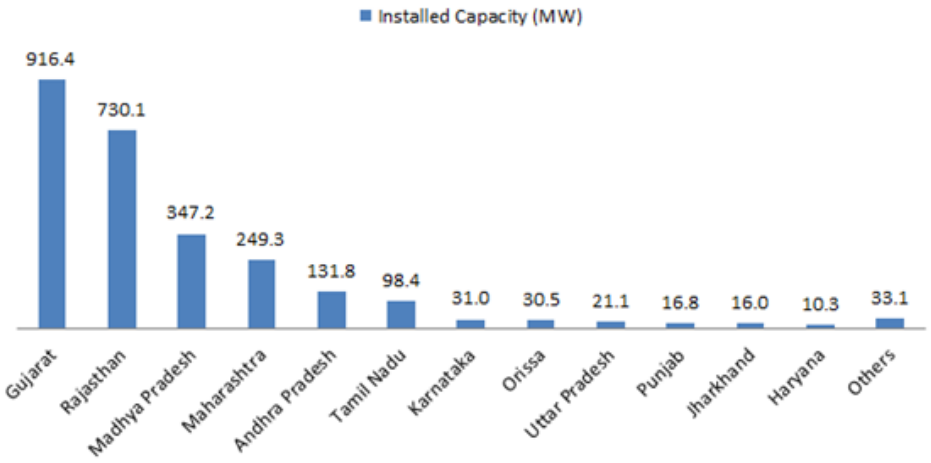

Figure 18: Installed solar capacity by state as on March 31st 2014 (Manoharan, 2014)

As seen in Figure 18, Rajasthan and Gujarat currently have the highest installed capacity of solar energy in the country. The industry unanimously agree that they are most interested in investing in these states as they provide land banks and required infrastructure required to set up solar plants. Therefore, ease of implementation of projects is very high, as investors don't have to liaise with multiple departments to get permits and clearances. This is also a potential reason for Karnataka not receiving many bids in the National Solar Mission allocation while competing with states such as Gujarat and Rajasthan.

Amongst the other RE-rich states, the land issue appears to be specific to Karnataka. Most other RE-rich states follow the deemed land conversion process where land is automatically deemed non-agricultural if the district authority does not issue any order regarding the request (orders include approval and full/part rejection) within a period of 1-3 months depending on the state. The recent Solar Policy 2014-2021 makes a provision to ease land acquisition problems for solar by encouraging farmers to lease/develop their barren land for solar plants and by following the deemed conversion process. The success of this approach is yet to be proven (GoK, 2014).

State	Land acquisition status
Karnataka	• Government revenue lands are exhausted • Agricultural land cannot be bought by private players without conversion to non-agricultural land • Land needs to be converted from agricultural to non-agricultural land by the farmer with consent from the district officials • Karnataka Industrial and Development Board (KIADB) can acquire land for RE projects, but have stopped this practice • Solar policy 2014-21: Includes provision to encourage land-owning farmers to set up utility-scale solar plants (1-3 MWp) • Solar policy 2014-21: GoK is considering amending the land act to install a deemed conversion provision
Tamil Nadu	• Private players can purchase agricultural land up to 16 standard hectares (55-60 acres) without any conversion process
Gujarat	• Deemed conversion of land. If permissions have not been given within a certain period, the land is automatically considered non-agricultural
Maharashtra	• Deemed conversion of land. If the application is not acknowledged within 90 days, the land is automatically considered non-agricultural

RECOMMENDATIONS

- **Implement the deemed conversion process for all RE projects**
- **Enforce stricter monitoring regulations for projects which have been allotted lands, but not commissioned on time. Re-allocate this land to serious players**
- **Since land has such a huge opportunity cost, the state should provide thrust to RETs like biomass and decentralised solar in addition to ground-mounted RETs**
- **The central Ministry of Environment and Forests and state Forest Department should co-ordinate in order to issue guidelines for the transparent and timely approval of scrub forest lands**

Establish Attractive Open Access Regulations

"It is very difficult to do open access and third party sales in Karnataka."

Technical Director, Solar Company

Open access charges are paid by power generating companies to use existing infrastructure of state transmission and distribution utilities to sell to buyers, other than ESCOMs (Indian Power Sector, 2013). Concessional open access charges can incentivise investment in the RE sector by creating demand from commercial and industrial consumers. It is noteworthy that Tamil Nadu offers lower

wind tariffs compared to other Indian states, however the state has witnessed significant capacity addition aided by concessional open access charges. The Karnataka RE Policy 2009-14, provides for concessional wheeling and banking charges for RE projects. However, there is a lack of clarity on whether the concession will continue for the term of wheeling and banking agreement or will change with KERC orders. Such policy uncertainties are affecting the wind industry. The concessional wheeling and banking charges for the wind industry is valid up to June 2014, but there is no visibility beyond that.

Secondly, the cross-subsidy charges (CSS) are high in Karnataka in comparison to other states. The procedure for open access approval is claimed to be complicated and uncertain. As investors get competitive prices in the open market there is interest to sell in the open access route. They prefer states that make this process simpler. An in depth comparison between open access charges for RE-rich states in India has been shown in Tables D.1-D.3 in Appendix D. Hence, although the concessional charges are an attractive feature for RET investments, as the open access approval mechanism is cumbersome and uncertain, investors find the open access mode for projects risky for RETs in Karnataka.

RECOMMENDATIONS

- **Cumbersome procedures currently required for open access sales should be eased for all RE projects**
- **Encourage open access sales for wind projects by providing adequate incentives**
- **When concessional open access charges are applicable for RE projects, there should be clarity on the time-frame of their applicability. This has been done for solar projects and should be announced for all RE projects**

Need of the Hour: Low Land Footprint Technologies

The previous section highlighted the major challenges faced by large-scale solar, wind and biomass plants. Keeping these issues in mind, this section discusses RET options which could mitigate the main challenge of land availability faced by large-scale ground-mounted technologies in Karnataka.

Rooftop Solar

"We are very keen to be active in the Karnataka rooftop space...However a good net metering system and guarantee of payments by ESCOMS would increase investor trust."

Associate Manager-Business Development, Solar Company

It appears that the primary reason for slow commissioning of large scale utility RE projects in the state is difficulty in land acquisition. This makes Karnataka, an ideal state to encourage the growth of rooftop PV solar plants. Although there have been previous policy provisions and programmes to encourage rooftop PV systems, none of them have taken off. The lack of interest from investors was due to unclear commissioning and metering mechanisms. Additionally, the only incentive appeared to be a capital subsidy of 30% from the centre, with no guaranteed revenue stream.

The new solar policy has given importance to grid-connected solar rooftop installations. It has proposed to achieve minimum 400 MW of generation from solar rooftop projects by 2018.

ADVANTAGES

- **There are no land requirements, resulting in shorter commissioning periods. The biggest barrier for successful implementation of RE technologies is avoided**
- **Reduction in transmission and distribution losses. In Karnataka, these losses are about 20%**
- **Diesel consumption offset by replacing back-up diesel systems in commercial and residential complexes**
- **Avoided cost of development of new transmission infrastructure**
- **Creation of value from underutilised/unused roofs**

Recently the government has announced an attractive tariff with the net metering scheme for rooftop PV grid-connected systems in Bangalore, as seen in Table 7, and ESCOMs are in the process of empanelling net meter and rooftop solar suppliers. Solar Energy Corporation of India (SECI) has

received an enthusiastic response in Karnataka, with about 4.8 MW being bid and 2 MW being given out for commissioning (RESOLVE , 2013).

Although the state policy and tariffs are very attractive, investors are still sceptical about the net metering system and the ability of the ESCOMs to pay for the high cost of rooftop PV. Provision of payment guarantees from the state can provide confidence for further development of rooftop projects as it is a priority area for RE growth in Karnataka.

Table 7: Comparison of solar tariffs in Karnataka (KERC, 2013)

Type of solar plant	Approved tariff in Rs/kWh
Solar PV	8.40
Solar Thermal	10.92
Rooftop and Small Solar PV	9.56
Rooftop and Small Solar PV with 30% central capital subsidy	7.20

These payment guarantees can be acquired by the creation of a state-level RE fund, which can generate finances through different routes. One of these routes could be by the state requisitioning the Finance Commission to offer incentives for states that meet their RPO targets. Currently, the 13th Finance Commission offers grants to states based on their renewable capacity additions between 2010 and 2014; however the frame work for qualifying for the incentive was very complicated. Hence, instead of a capacity-linked incentive, measures like achievement of RPO targets over the past few years should be considered in the next Finance Commission to incentivise states to deploy RE beyond their RPO mandates. This will provide incentives to states such as Karnataka, which has constantly met its non-solar RPO mandates. Another option for securing funds could be the collection of a public benefit surcharge from consumers.

RECOMMENDATIONS

- **A state-level RE Fund should be constituted. Utilities must come out with a comprehensive set of programmes that can access this fund. This can include state driven programmes in energy efficiency, low land footprint and rural RETs**
- **Karnataka should request the next Finance Commission to provide grants to states based on their achievements in meeting RPO targets. These funds can be used in the state RE Fund**
- **State must provide risk guarantee possibly from the fund to procure electricity from solar rooftop plants**
- **Rebates can be offered on consumer electricity bills, instead of consumers having to go to DISCOMs to receive their due payments**

Waste to Energy

"Incineration of waste should be curbed...in order to push systematic waste disposal and usage for generating energy...this is beneficial for the environment"

Founder-Director, Waste Management Company

In Karnataka, rapid urbanisation and changing lifestyles have led to generation of huge amounts of waste in urban areas. Handling of Municipal Solid Waste (MSW) has been a major organisational, financial and environmental challenge with state entities claiming that they do not have enough landfills to dispose this waste. Common methods of disposing waste involve open disposal, incineration and dumping in landfills. All three methods are unsustainable and have long-term environmental hazards on local communities. In spite of having a waste to energy electricity generating potential of 135 MW and having allotted 15.5 MW as shown in Figure 19 (GoK, 2009), there are currently no operational waste to energy plants in the state. The major reason is the unavailability of an integrated policy for waste to energy projects.

ADVANTAGES

- **Free up land that would have otherwise been used for landfills. Furthermore landfills cause harmful effects on people who live in surrounding areas**
- **Reduce net quantity of waste. This will help ease the waste management crisis**
- **Fuel for electricity generation is consistent and cheaply available. It is not an intermittent source**

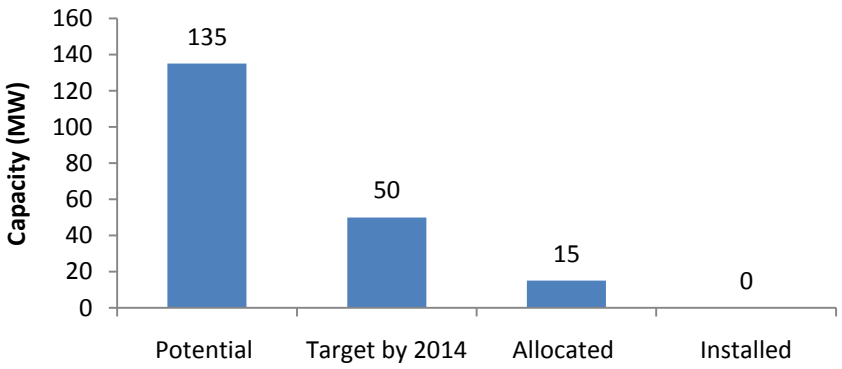

Figure 19: Waste to energy status in Karnataka as of June 2014 (KREDL, 2014)

RECOMMENDATIONS

- **Provide state-level support for waste to energy demonstration-projects**
- **Municipal authorities and Energy department should co-ordinate and form a comprehensive waste to energy policy for cities in Karnataka**
- **State RE fund can be used by utilities to guarantee tariffs to pilot projects that can generate data for regulator-fixed tariffs**
- **There needs to be regular data collection by local municipality authorities. Data for waste disposal is not available after 2009**
- **Waste segregation should be ensured either by introducing a cess on garbage collection that can be used to invest in garbage segregation machinery**

Rural Electricity Supply: Increase Role of RE Technologies

Although, Karnataka has one of the highest electrification rates in the country (99.95%), there are still over 9.6 lakh rural households which don't use electricity as their primary source of lighting (Census of India, 2011). One of the major reasons for lack of universal electricity access arises from the stress on centralised grids, which can often be uneconomical or technically unfeasible to implement.

Create a Roadmap for Rural Electrification

"KREDL is often focused on larger-scale renewable energy programs and has not actively promoted sustainable models for small-scale technologies. The concentration is on wind and solar megawatt scale plants."

Principal Analyst, Off-grid Policy Foundation

Organisations in Karnataka who are actively involved in promoting rural electricity projects feel that the government has given no priority to this area. The state's renewable policies have comprehensive plans for large-scale grid-connected plants but only make a few vague statements regarding off-grid solar projects which are as follows:

- Off-grid solutions such as Street Lighting Systems and Home Lighting Systems shall be promoted via involvement of gram panchayats and local bodies for various applications such as schools, milk pasteurisation plants and cottage industries
- Isolated standalone systems will be encouraged. Solar PV systems, below 2 kWp will be battery backed up systems. Systems up to 200 kWp will be considered for rural applications
- Irrigation pumps will be encouraged by involving the Departments of Agriculture, Minor Irrigation and Social Welfare

There are no state-level guidelines or methodologies to ensure RETs are used for better electricity delivery in under-served areas. The state follows a rural electrification policy under the MoP's RGGVY to implement their projects. ESCOMs are the implementing agencies under RGGVY, and their mandate under this scheme is to ensure that all villages have access to electricity. As Karnataka is 99.95% electrified according to national guidelines (a village is considered electrified if public buildings and 10% of households are electrified), ESCOMs have technically satisfied their role in providing village electrification in the state. However, there are several hamlets[6] without electricity connections, even in officially electrified villages. This is the main challenge for the state to increase access to electrification. Further, electricity supply to rural Karnataka is not reliable and is highly uncertain due to a number of scheduled and unscheduled power cuts every day in most rural areas. This is a major hindrance for investments in income-generation activities.

"MNRE provides subsidies on off-grid technologies...but there are significant delays in the release of these subsidies."

Official, Karnataka Renewable Energy Development Limited

[6]According to the National Sample Survey Organisation (NSSO), any village with a population more than 2500 will be divided into hamlets to form approximately numerically equal geographically contiguous cluster of households.

The DDG scheme under the RGGVY makes a provision for implementing decentralised projects in areas where grid extension is not possible and where the population receives grid electricity for less than 6 hours a day. As electrified villages in Karnataka get an average of 16-18 hours of electricity these villages cannot avail the DDG scheme (Tetratech, 2013). However, continuous and reliable supply of electricity is imperative to improve socio-economic conditions of the rural population and promote local small enterprises/livelihoods.

There are currently no RGGVY-DDG scheme projects operational in Karnataka as the tenders called for them did not generate any interest. Rural Electrification Corporation Ltd claims this is because areas in Karnataka for which Detailed Project Reports (DPR) have been submitted do not have ideal implementation conditions (hilly areas or clusters which are far apart). Therefore, costs for technology as well as labour charges do not fall within benchmarks costs set out by RGGVY guidelines, causing commissioning of projects to become uneconomical and unfeasible. Additionally according to an evaluation report for RGGVY by TetraTech (2013), utilities don't feel that they are best placed for implementing DDG schemes due to their limited manpower and resources. In order to ensure that under-served villages are provided with electricity, it becomes necessary for Karnataka to look at options other than the central RGGVY schemes and form state-level rural electrification plans.

Hamlets with not more than 100 people do not fall under the RGGVY scheme, and are being taken care of by KREDL under MNRE's Remote Village Electrification Programme (RVEP). The objective of RVEP is to provide financial assistance for the electrification of remote census populations through renewable sources. KREDL states that the main reason for its reluctance to play a bigger role in rural electrification is due to very long delays in getting subsidies from MNRE.

In short, there is a severe lack of coordinated planning for the provision of rural electricity services. There is too much focus on capital subsidy-driven off-grid projects with very little thought to ensure continued operation and maintenance. Current policy is inadequate to ensure that all rural households have electricity access, let alone guarantee reliable electricity supply.

In order to manage these challenges, organisations working in this sector believe that encouraging private sector investments and entrepreneurship seems to be the best way to promote decentralised generation. Community-owned projects often face barriers of consensus and have difficulty in accessing finance from banks. Further, investors are uncertain about their returns in the event of grid extension. Hence, in order to promote growth of rural decentralised plants, the state needs to have a risk mitigation policy so that investors are able to recover their investment costs. This could be provided through buy-back tariffs at regulator-determined rates.

CASE STUDY: ADOPTION OF RE IN RURAL KARNATAKA

The study conducted on adoption of solar home lighting systems in Karnataka, highlights gaps that exist in the current electricity supply of the state. It shows how the rural population is compelled to look for alternate sources of reliable energy supply. There is a great need for the state to promote growth of decentralised electricity generation and distribution (Harish, Iychettira, Raghavan, & Kandlikar, 2013).

"*We found that a large proportion of households in our sample were connected to the grid but chose to install solar lighting because they consider the power supply from the grid to be unreliable...Given the constraints in resources, the power supply scenario in rural areas is unlikely to improve in the near future.*"

Government programmes must focus on revenue subsidies to provide electricity to un-electrified hamlets. This will require comprehensive planning and implementation from the state Energy department and the Rural Development and Panchayati Raj department.

RECOMMENDATIONS

Formulate a state-level action plan which has a target-driven approach for un-electrified rural populations which do not fall under the RGGVY scheme

Improved Financial Support

"Good financing mechanisms such as low interest rate loans and generation based incentives should be implemented. Banks should be open to financing solar technologies and this should be a priority area, because it is hard to access finances."

Senior Technical Manager, Off-grid solar Company

Access to suitable financing has a significant impact on the ability of communities and entrepreneurs to invest in RETs. Entrepreneurs have a key role to play in the installation of small-scale rural electricity systems. Therefore, it is imperative that the state takes steps to lower existing financial barriers.

Currently, accessing finances for RETs is difficult; loans are available from Rural Regional Banks (RRB) and Indian Renewable Energy Development Agency (IREDA) at about 12-14% interest rate, which is higher than other rural loans (7-12%) (IREDA, 2014; NABARD, 2014). Soft-loans with rates of 4-5% are only available at RRBs if they have access to capital from a larger entity to promote RE systems. Such programmes were earlier implemented nationally by IREDA for solar heating systems and only for Karnataka and Maharashtra by United Nations Energy Programme (UNEP). The UNEP programme was very successful in Karnataka and provided a boost for financing from banks for small-scale rural RE. At present, no such programmes are in effect. Hence, there is no guaranteed access of low-rate

loans from any financing agencies, which makes it difficult to increase the dissemination of RETs. The state government should have a scheme which makes small-scale rural RE electricity project loans low-cost and easier to access.

Electricity from small-scale decentralised systems is expensive. Typically micro-grid tariffs paid by local communities for solar PV range between 20-25 Rs/kWh (with capital cost grants) (Chandran-Wadi, Deorah, & Nair, 2014; Aggarwal, et al., 2014) and for biomass gasifiers is between 4-6 Rs/kWh (ITCOT, 2005; UNDP, 2010). Micro-hydro plants have generating costs between 3-8 Rs/kW and standalone wind systems range from 4-80 Rs/kWh (Prayas Energy Group, 2012).

As mentioned previously, there are no central schemes currently in place that are suitable to provide financial assistance to DDG projects that are set up in grid-connected rural areas of Karnataka. Hence, the state should establish revenue subsidy models to encourage local entrepreneurs. These can includes schemes such as generation based incentives, or an exemption from repaying loans if systems are found to be operated and maintained well.

"Value Added Tax on Renewable Energy Products, which is exempted in states like Maharashtra, Andhra Pradesh and Punjab, is still being imposed in Karnataka. This increases the costs of systems and serves as a financial barrier."

Principal Analyst, Off-grid Policy Foundation

Another financial barrier is the imposition of 5.5% Value Added Tax (VAT) by the Karnataka government on clean energy solutions. A study by SELCO Foundation, a Bangalore based organisation, shows that the abolition of VAT would result in about 15% reduction in the overall cost of a solar home lighting system. According to the analysis, VAT is counter-productive to the subsidy offered by the National Solar Mission. A system costing Rs 10,000 would be eligible to Rs 1944 subsidy, however with VAT; the price would increase by Rs.1486. Therefore, VAT results in the subsidy being less than 25% of what it was originally meant to be. The Solar Policy 2014-21 makes a provision to consider discontinuing VAT for certain technologies but it did not materialise in the budget of 2014-15.

RECOMMENDATIONS

- **VAT should be discontinued for RETs that are used for decentralised rural energy projects**
- **The state should provide financial support through the state RE fund to provide low interest loans to off-grid decentralised electrification projects. This could be through the RRBs**
- **There should be a focus not only on capital-subsidy driven electrification, but also on high quality electricity supply. The state should explore utility franchisee models like build, own and operate (BOO) for distributed micro-generation projects for un-electrified villages that do not fall under the RGGVY scheme. The state RE fund can be used to facilitate these projects**
- **A risk mitigation policy with predetermined financial safeguards should be implemented for entrepreneurs setting up off-grid projects so that it is viable even when grid is extended (such as bulk purchase tariffs)**

Develop O&M Skill and Capacity

"One of the major problems being faced is lack of trained personnel to handle the O&M of equipment once it is installed. Therefore, often the systems fall to disuse...communities should be given advanced support in terms of training programmes."

Senior Technical Manager, Off-grid Solar Company

All experts agreed that while implementation of projects is important, it is also vital to make sure that reliable mechanisms are in place for sustainable operation of plants. Often systems are successfully commissioned and installed in villages, but due to lack of know-how amongst the community, they are not maintained well. When systems need to be repaired, somebody from the implementing organisation needs to be called, and this takes a lot of time. These two problems lead to the community being reluctant to continue using these systems and they fall into disuse.

Central government policies include budgets for state nodal agencies to conduct workshops and training programmes for operation of small-scale and off-grid plants. MGIRED said that they had training courses for students and communities, on various topics such as solar street lighting and biomass based technologies. However, these are sporadic and not effective to ensure adequately trained manpower to repair and maintain RE plants. Hence, the state needs to give communities advanced support in terms of training programmes for handling RE plants along with its implementation.

CASE STUDY: ARARIA GASIFIER PROJECT

The Baharbari Gasifier Project in Araria district of Bihar is an example of a successful and sustainable grassroots level initiative (Figure 20). The project has benefited 250 poor households in Bihar by providing them with electricity. The project is a collaboration of Decentralised Energy Systems India Ltd (DESI) and a local cooperative in the village. A case study by UNDP (2010) credits the success of the plant primarily to the formation of a local partner co-operative and training of village personnel.

"*The success lies in its successful implementation, management and delivery overcoming challenges. DESI Power facilitated the forming of Baharbari Udyogic Vikas Swavalambi Shakari. The other challenge was the lack of trained staff to operate the gasifier. This was overcome by training staff at Indian Institute of Science at Bangalore.*"

Similar projects (GoK with UNDP) in villages of Karnataka under the Biomass Energy for Rural India (BERI) program failed as not much effort was taken in monitoring and maintaining the units. The policy for operation and maintenance of the project was unclear and systems fell to disuse. Scalability of such a project can only happen with support from the government for training personnel to handle technical issues (UNDP, 2010).

Figure 20: Rural gasifier project at Araria district, Bihar (UNDP, 2010)

RECOMMENDATIONS

- **KREDL should work with organisations that have experience in rural RETS and come up with a curriculum for training operators and village-level entrepreneurs. Include these training courses in the state industrial training and rural development institutes**

- **KREDL should link up with local governments and non-government organisations to form a viable operational plan for existing and new capital subsidy driven rural projects**

Rural Technology Models

Presently, Karnataka does not have any government sanctioned DDG projects under the RGGVY scheme (Tetratech, 2013). TetraTech (2013) reports that 88% of respondents from Karnataka villages preferred having DDG schemes in their area as they perceived these sources of electricity as more reliable than the grid. However, as ESCOMs felt that they are not the agency most suited for the job, the role of the entrepreneur and community has been stressed repeatedly in this report. This section takes a look at case studies of some projects, which can be replicated on a large scale by local communities and individuals with adequate support from the state.

Integrated Energy Centres

The purpose of Integrated Energy Centres (IEC) is to ensure that communities in rural/semi-urban and urban areas have a space where they can avail electricity for lighting, battery charging and mobile-phone charging for a certain amount of monthly/daily rent. SELCO has been working for about 20 years to provide solar based solutions for un-electrified communities. Through the SELCO Foundation, they have successfully installed a number of these IEC's in the state. These centres run on solar powered technologies, but they are specially customised to suit the needs of the local community. Centres are usually managed by entrepreneurs, groups and partners from within the community. Income generated by services provided to the community allows centre operators to recover their capital and operation costs. Revenue models currently being followed by SELCO Foundation are shown below in Figure 21.

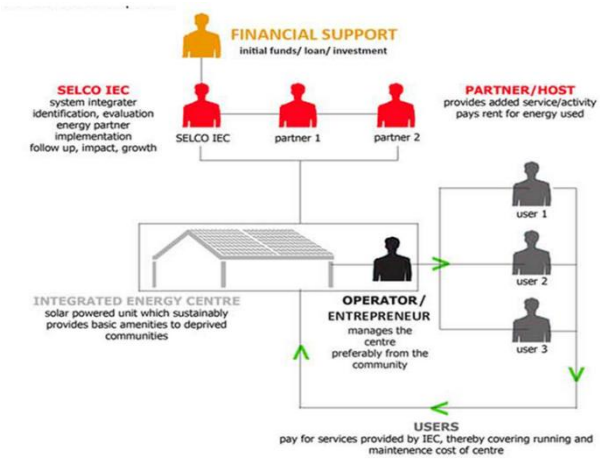

Figure 21: Revenue model for IECs (SELCO Foundation, 2014)

Presently, SELCO Foundation has 18 projects installed or in the pipeline, primarily through local partners, other community organisations and local entrepreneurs. The plants are mainly situated in urban slums, un-electrified urban labour camps, tribal villages and fishermen communities. Often these centres not only serve as electricity centres, but they also have health, education, training and awareness services which the community can avail. Equipment such as fridges, ultrasound machines, computers and projectors can be installed in these centres and used by the community effectively.

Figure 22: IEC at Dharmastala (SELCO Foundation, 2014)

An IEC that has been established in the temple town of Dharmastala, Karnataka is shown in Figure 22. Through these IECs, SELCO has made modern electricity services available to under-served communities that can help them improve their standard of living and address their fundamental energy needs. The next steps to be taken by SELCO India are to come up with more income generating activities in these centres, formalise entrepreneur training and find more effective technological solutions for the centres.

Mini-grids

Mini-grids are a good electrification option for both remote locations that do not have access to electricity as well as areas where the electricity supply is unreliable. This is because these systems have the capacity to provide 'on demand electricity' to communities for 24 hours a day. Observer Research Foundation (ORF), a Mumbai based think tank has been working in the sphere of mini-grids in association with Gram Oorja, a Maharashtrian non-governmental organisation. ORF has documented a 9 kWp mini-grid system set up by Gram Oorja in a hamlet in the Western Ghats which has a population of 200 residents. The community is mainly involved in collecting wild herbs and rain-fed farming. This system gives the community 24 hours electricity supply, and has been running for about 20 months now. Each home can get basic lighting, with 2-3 bulbs and one charging point.

Street lights and lighting for common areas are also taken care of by the mini-grid. Solar PV panels with battery storage are being used for power generation. Tariffs (20 Rs/kWh) have been set such that they can cover all operation and maintenance costs as well as battery replacement once in 4-5 years. Each household pays a fixed charge of Rs. 90 per month for lighting of public areas, and a variable fee depending on their consumption. There have been no defaults in payment for the past 20 months. The mini-grid is shown in Figure 23.

Figure 23: Solar mini-grid at Darewadi, Maharashtra (Gram Oorja, 2013)

Chhattisgarh has been the most active Indian state to install mini-grid systems for rural applications. Contrary to the model used in Gram Oorja, the government fixed a tariff of Rs 5 for all households, no matter what the consumption was. This lead to an overburdening on the system, and the community stopped getting continuous electricity. Therefore, the learning by comparing both models is that states can be great advocates and help projects like mini-grids become a reality. However, by subsidising electricity and not ensuring responsible usage, the system becomes unsustainable (Chandran-Wadi, Deorah, & Nair, 2014).

Mini-grid technology can serve as a sustainable source of electricity for rural populations, if certain long-term planning is made by the government. State governments should not view small-scale RE solution distribution schemes as "stop gap" solutions, which can be removed once the grid reaches remote areas. They should view these solutions as systems that can be integrated into the main framework, and that can help in the spread of renewable energy in rural areas.

Call for Action

Utility-scale Projects

Establish Single Window Clearance

- State department must strengthen KREDL by providing more manpower to change its role from a project allocation to RE implementation agency
- Establish a Single Window Clearance Mechanism for investor grievance redressal
- Implement channels for co-ordination between district level authorities and KREDL to facilitate clearances and permits for approved RE projects
- KREDL should create a standardised official list of all the procedures required to commission and bid for various types of RE projects

Revive Biomass Industry

- Undertake a detailed district-wise biomass resource survey as a starting point to the deployment of small-scale biomass plants in the state
- KERC should revise biomass tariffs to a two-part structure taking into consideration variable fuel costs
- Create a small-scale (less than 2 MW) biomass policy which includes leasing small holdings of revenue wasteland for the growth of captive plantations required for feedstock in small-scale biomass projects

Strengthen Grid Infrastructure

- KPTCL should prepare a long-term transmission plan with a focus on RE-rich districts
- Strengthen intra-grid infrastructure between RE zones and urban load centres to avoid grid congestion
- Establish RE land banks with required grid evacuation infrastructure to the extent of meeting RPO
- Enable better grid integration by mandating all solar and wind power plants to install data monitoring technologies which provide real-time data to load despatch centres

Ease Land Acquisition

- Implement the deemed land conversion process for all RE projects
- Enforce stricter monitoring for projects that are allocated land by the state. Ensure a transparent project allocation process in these projects
- Reallocate land from delayed projects to serious players
- The central Ministry of Environment and Forests and state Forest Department should co-ordinate in order to issue guidelines for the transparent and timely approval of state scrub forest lands

Establish Attractive Open Access Regulations

- Provide clarity on the time-frame for which concessional wheeling and banking charges are applicable. This has been done for solar and should be followed for all RE projects

- Encourage open access sales by reducing cumbersome procedures for all RE projects
- Progressively reduce cross subsidy surcharge (CSS) for all RE projects

Low land Footprint Technologies

Formulate Supportive Policies

- Form a comprehensive waste to energy policy to encourage state-level waste to energy projects
- Mandate regular data collection of waste disposed by municipal authorities
- Ensure waste segregation by introducing a cess on garbage collection that can be used to invest in segregation machinery
- Encourage innovative schemes within ESCOMs such as rebates on electricity bills instead of consumers having to collect their due payment

Constitute State-level RE Fund

- Constitute a state RE fund. Utilities should draw a comprehensive set of projects that can utilise this fund, which can include grid-connected solar rooftop and waste to energy plants
- Karnataka should request the next Finance Commission to provide grants to states based on their achievements in meeting RPO targets. These funds can be used in the state RE fund

Rural Electricity Supply

Create a Roadmap for Rural Electrification

- Implement a state-level action plan which has a target-driven approach for un-electrified rural populations which not fall under the RGGVY scheme

Improved Financial Support

- ESCOMs should adopt revenue subsidy models such as the Build, Own and Operate (BOO) franchisee model for un-electrified villages which do not fall under RGGVY scheme. The finances required can come from the state RE fund
- Provide financial support from state RE fund to rural regional banks (RRB) in order to provide access to low interest loans for small-scale rural projects
- KERC should provide risk mitigation for off-grid power projects for the eventuality of grid extension by declaring bulk purchase or feed-in tariff rates
- VAT should be discontinued for small-scale rural RET projects

Develop O&M Skill and Capacity

- Work with organisations to develop a curriculum for small-scale rural RETs and implement these courses in state industrial training/rural institutes
- KREDL should link up with local government authorities and NGO's to form a viable operational plan for off-grid projects

Conclusion

Karnataka has one of the highest estimated potential for RE in the country with majority of share coming from wind (13,983 MW) followed by solar (10,000 MW) and biomass (1,000 MW). Currently, only 15% (4,612 MW) of this potential has been tapped. There has been very little recognition of opportunities provided by Karnataka's high RE potential beyond that of meeting RPO targets. It is important for the state to acknowledge the role of RETs in reducing its electricity deficit and agricultural subsidies, as well as providing quality electricity services to currently under-served rural areas which will yield social and economic benefits.

The government has allocated 18,014 MW for grid-connected projects amounting to 60% of the state's potential; however, advancing from allocation stage to commissioning has been a big challenge for Karnataka. The reason for slow commissioning of utility-scale grid-connected projects in Karnataka has been delays in land acquisition and ineffective co-ordination mechanisms between state agencies to obtain necessary clearances which have resulted in high perceived risk by investors. KREDL can do much to mitigate these risks by playing a more active role in the commissioning phase of projects.

The solar industry has been most sluggish with only 51 MW till date and the once impressive growth of the wind industry in the state has stagnated as several allocated projects have not progressed. Biomass plants have suffered most, with even installed plants being non-operational because of uneconomical, inflexible tariffs and feedstock supply chain issues. Grid infrastructure availability and cumbersome and unclear policies for open access provision have been challenges for all RETs. Easing grid and open access constraints could see the increased use of RE in the industrial sector.

As land availability could soon be a barrier for large-scale ground-mounted RE projects the state should focus on modular technologies that do not require large tracts of land such as rooftop solar plants, small-scale biomass plants, solar pump sets and waste to energy plants, all of which offer the potential for wider socio-economic benefits for the state. A state-level RE fund should be constituted which can financially support low land footprint technologies. The finances for this fund can be through requesting the Finance Commission for incentives based on RPO achievements or through a public benefit surcharge.

Currently, around 9.6 lakh households in rural Karnataka do not have access to electricity even though 99.5% of villages are electrified. Several households in already electrified villages are not connected and those that do have grid access are plagued with poor quality and availability of supply. Although small-scale RE solutions can help in tackling these problems, the state does not have a policy to make these technologies viable. Disinterest by state ESCOMs to implement DDG schemes under RGGVY and lack of clear policy towards rural electricity access plan has led to the present situation.

The state needs to encourage the growth of small-scale rural electrification projects by making clear, comprehensive guidelines for the market-based implementation of these projects in un-electrified and under-served areas. An effort should be made to move away from capital subsidy models and the state should promote revenue/interest subsidy based electricity models through appropriate financial and policy support.

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Appendix A

Renewable capacity required to meet national RPO targets:

This section calculates the renewable capacity that the state must plan for in order to meet the national RPO targets. NAPCC targets 15% of electricity from renewable sources by 2020 and based on that, stipulates state electricity regulators to set RPOs for all obligated entities[7]. Further, the National Tariff Policy, was amended in January 2011 to prescribe solar-specific RPO, starting from 0.25% in 2012 to progressively increase to 3% by 2022.

The below table calculates solar capacity addition required to meet the national RPO targets. It is assumed that the 3% solar-specific RPO will contribute to the overall 15% NAPPC target i.e. the non solar RPO is targeted at 12%.

The capacity utilisation factor was taken to be 19% (CERC RE Tariff Regulation 2012 - 19% for solar PV).

Table A.1: Required capacity addition from solar (MW) to meet national targets

Year	Electricity Demand[1](MU)	Solar RPO (%)[2]	Solar Electricity required for RPO compliance (MU)	Required capacity addition from solar (MW)
FY13	57,184	0.25	143	86
FY17	78,637	2	1,573	945
FY20	108,012	3	3,240	1,947

[1]For FY17 and FY20, electricity demand forecasts from 18th EPS report has been considered for the calculation

[2] Solar-RPO targets are taken from the Solar Policy (2014-21)

Karnataka's Solar Policy (FY14-FY21) proposes to install 2000 MW of solar capacity by 2021 and plans for 1.5% solar RPO in 2014-15, gradually increasing to 3% by 2020-21, which is well in line with national targets. However, the ESCOMs in the state have not been able to comply with the current solar RPO of 0.25% in FY13 despite a comprehensive solar policy.

Karnataka is one of the few states that is fulfilling the non-solar RPO mandate of 10% through a combination of wind, biomass and small-hydro power. The below table calculates the capacity required from non-solar renewable sources to fulfil the RPO targets in FY17 and FY20. Capacity utilisation factor of 25% was assumed from non-solar renewable capacity.

[7]Obligated entities include State utilities, captive consumers and open access consumers

Table A.2: Required capacity addition from non-solar (MW) to meet national targets

Year	Electricity Demand [1](MU)	Non-Solar RPO (%)[2]	Non-Solar Electricity required for RPO compliance (MU)	Required capacity addition from Non- Solar (MW)
FY13	57,184	10	5,718	2,611
FY17	78,637	11	8,650	3,950
FY20	108,012	12	12,961	5,918

[1] For FY17 and FY20, electricity demand forecasts from 18th EPS report has been considered for the calculation

[2]Non-solar RPO is assumed to be increased in a manner as to meet the stipulated national target.

Appendix B

Following questions were asked to the RE power generators of large-scale grid-connected, low land footprint technology companies as well as off-grid rural electricity service providers to understand the challenges faced by them in Karnataka. The interviews were semi-structured and open-ended.

LIST OF INDUSTRY STAKEHOLDERS

1. Indian Wind Power Association (IWPA), Karnataka Chapter
2. Wind Independent Power Producers Association (WIPPA)
3. SELCO Foundation and EMMVEE Solar
4. 7 solar companies who had bid in the grid-connected utility-scale tenders offered by KREDL in 2012 and 2013. They wished to remain anonymous.
5. 2 solar companies who have bid in Karnataka in the 2014 Solar Energy Corporation of India (SECI) rooftop PV tender.
6. 3 waste to energy companies with plants in Andhra Pradesh and Karnataka.
7. Center for Sustainable Technologies, Indian Institute of Science
8. Mini-grid analysts cKinetics and Observer Research Foundation

Questionnaire to developers

1. What are the challenges faced in setting up power plants in Karnataka?
2. How easy is it to implement projects in the state in comparison to other states in India?
3. What are the specific recommendations to government stakeholders to enable growth in the state?

For case studies related to electricity services in rural areas, we contacted some entrepreneurial firms based out of Karnataka and presented the below questions:

Questionnaire for case studies

1. Where is the plant located?
2. What were the problems faced by the villages before the plant came up?
3. What was the solution offered by the company and the benefits of it?
4. Can the project be scaled-up? Are there plans to set-up a similar plant in another location?
5. Do you receive support from the state government in these projects?
6. What are the recommendations you would like to put across to the legislators for promoting growth of decentralised systems?

State government agencies were also approached, to understand what support is being provided by them. The questions were based on resource and department specific issues.

LIST OF GOVERNMENT STAKEHOLDERS

1. Karnataka Renewable Energy Development Limited (KREDL)
2. Karnataka Electricity Regulatory Commission (KERC)
3. Mahatma Gandhi Institute for Rural Energy Development (MGIRED)
4. Rural Electrification Corporation Ltd, Bangalore Office

Appendix C

Table C.1: Comparison of tariffs and open access charges for biomass projects in different RE-rich states (MNREa, 2013; KERC, 2009; Bridge to India, 2012; GERC, 2014; TNERC, 2012; MERC, 2013; MahaDISCOM, 2013)

State	Wheeling	Banking	Tariff (Rs/kWh)		CSS (Rs/kWh)
Maharashtra		2%	With AD 5.9	Without AD 6.12	Exemption
Gujarat			4.40		
Karnataka	5%	2%	1st Year: 3.66 10th- year: 4.13 with an escalation every year		
Tamil Nadu	5%	N.A.	Ranges between 4.69–4.89		

Table C.2: Comparison of tariffs and open access charges for solar projects in different RE-rich states (PwC, 2013; TNERC, 2013; First Green Consulting Private Limited, 2013; REConnect, 2014; GERC, 2014; KERC 2013)

State	Wheeling	Banking	Tariff (Rs/kWh)		CSS (Rs/kWh)	Incentives and General
Maharashtra	0.04 Rs./kWh	0	With AD: Solar PV: 6.13 Solar rooftop and small solar projects: 6.63	Without AD: Solar PV: 7.15 Solar rooftop and small solar projects: 7.65	0.61	• 15% electricity duty
Gujarat	2%	N.A	With AD Solar PV commissioned between: 2012- 2013: 9.28 2013-2014: 8.63 2014-2015: 8.03 Solar thermal commissioned between: 2012- 2015: 11.55	Without AD Solar PV commissioned between: 2012- 2013: 10.37 2013-2014: 9.64 2014-2015: 8.97 Solar thermal commissioned between: 2012- 2015: 12.91		• Exempted from demand cut to an extent of 50% of installed capacity • Exempted from electricity duty
Karnataka	0	0	Projects entering into PPAs between 2014-2018 Solar PV: 8.40 Solar thermal: 10.92 Solar rooftop: 7.56 (7.20 with 30% subsidy from MNRE)		0	
Tamil Nadu	0.14 Rs/kWh	0	Solar PV :6.28		2.07	• Promotion of rooftop solar projects with GBI benefits and power credits for excess generation • 100% exemption from demand cut • Electricity tax exemption for 5 years

TableC.3: Comparison of tariffs and open access charges for wind projects in different RE rich states (EAI, 2012; GEDA a, 2013; MNREa, 2013; IREDA, 2013; MNREb, 2012; MahaVitran, 2014; GoK, 2009; MNRE, 2014)

State	Wheeling	Banking	Tariff (Rs/kWh)		CSS(Rs/kWh)
Maharashtra	2%	12 months of banking period	With AD Zone 1 : 5.24 Zone 2: 4.62 Zone 3: 3.85 Zone 4 3.61	Without AD Zone 1 : 5.6 Zone 2: 4.93 Zone 3: 4.11 Zone 4: 3.85	
Gujarat	7% of electricity for investors having one turbine & 10% for having more turbines	N.A.	4.15		Exemption
Karnataka	5%	2%	4.20		1.15 Rs/kWh for 3rd party sale
Tamil Nadu	40% of the wheeling charges as applicable to conventional power	5%	3.51		50% as that applicable to conventional power

Appendix D

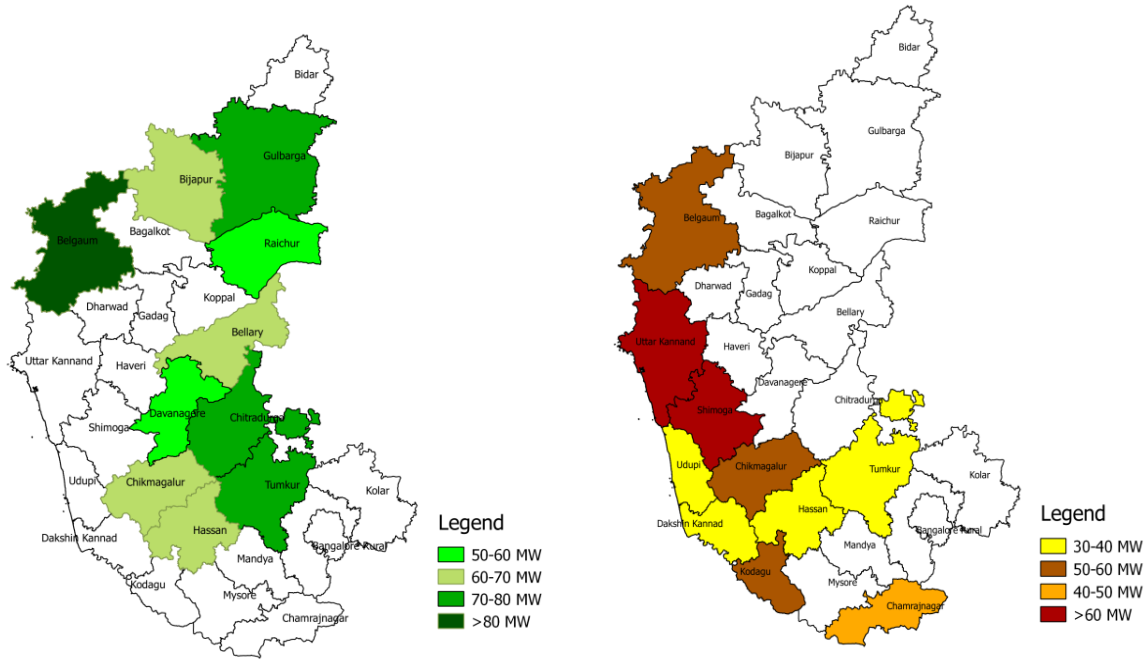

Figure D.1. Districts with highest biomass surplus a) agro-residues b) woody and wastelands (Source: IISc , 2004)

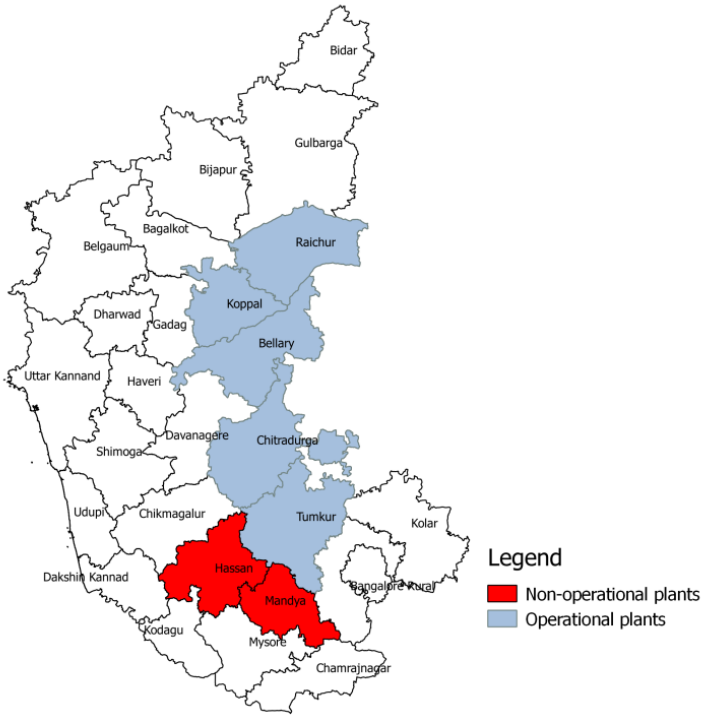

Figure D.2. Districts with installed biomass plants (Source: TERI, 2013)

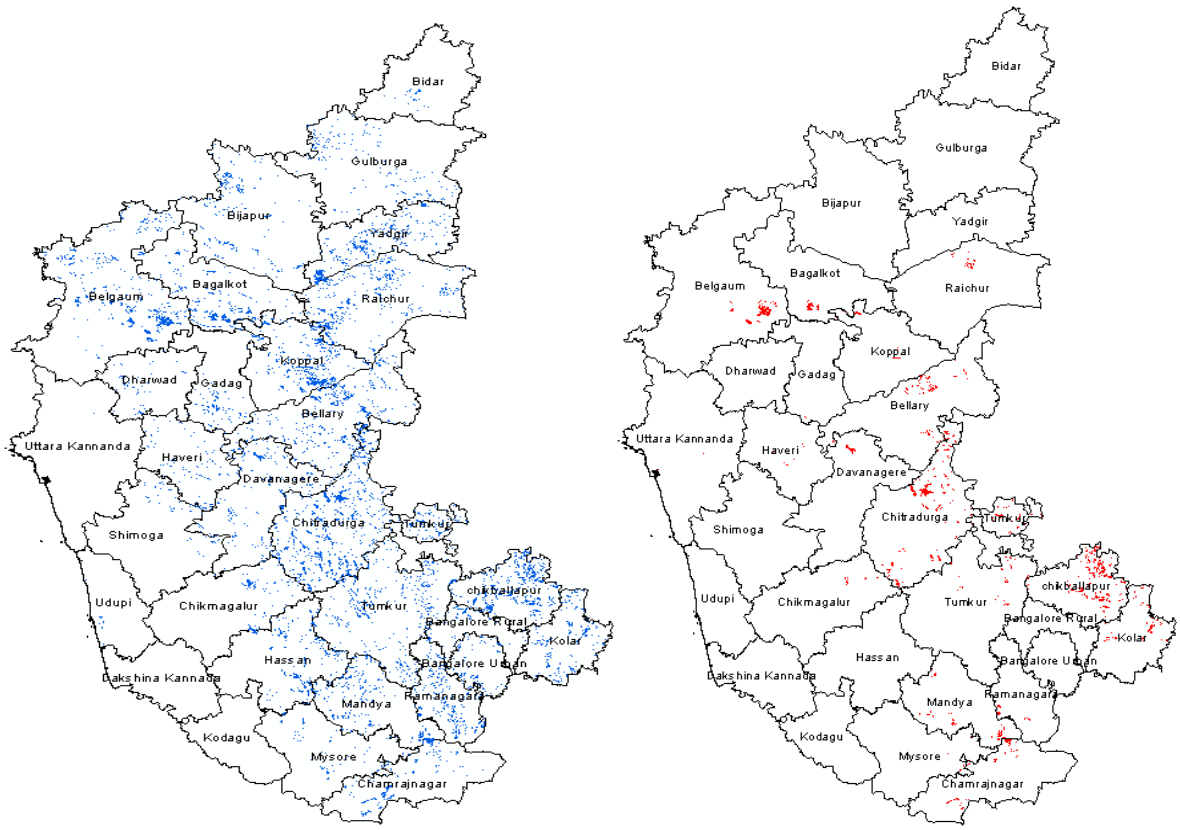

Figure D.3. Districts in Karnataka with wastelands suitable for a) CSP b) PV solar plants (CSTEP, 2013a)

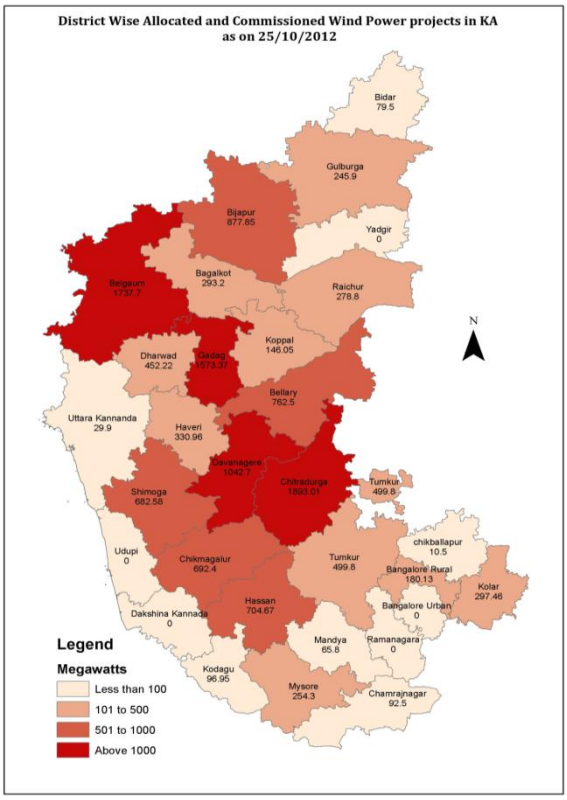

Figure D.4. District-wise allocated and commissioned wind power capacity (MW) as of 2012 (CSTEP, 2013a)

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