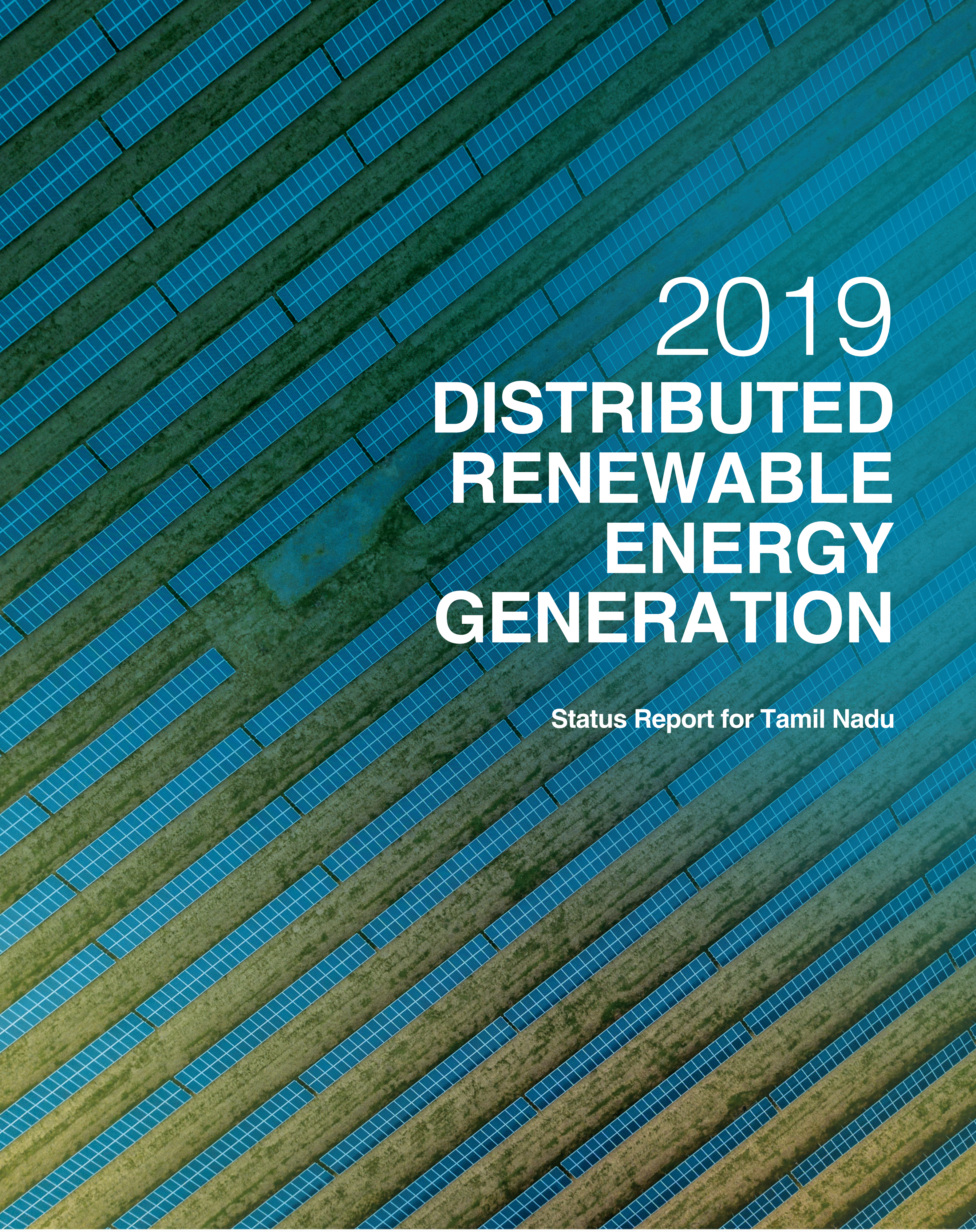

2019 DISTRIBUTED RENEWABLE ENERGY GENERATION

Status Report for Tamil Nadu

AurovilleConsulting

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Status Report for Tamil Nadu

December 2020
Sustainable Energy Transformation Series

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FOREWORD

The global imperative for transitioning to a sustainable energy future accompanied by increasing cost competitiveness of renewables and new technology innovations is leading us to a transformation of the electricity sector. Distributed Renewable Energy Generation (DREG) and energy storage are among the key drivers of this change.

MAKING PROGRESS

Any renewable energy (RE) generated from technology such as solar, bio-energy, wind, and hydro under 10 MW and interconnected at a voltage level less than 33 kV is considered to be DREG (CEA 2013). Currently, DREG is not a specific generation segment explicitly recognized by the Government of India schemes and programs. Though the Government of India has launched a series of initiatives that directly or indirectly promote the acceleration of DREG. Some of these initiatives are adopted by the state Government of Tamil Nadu (Energy Department of Tamil Nadu 2020a), (2020b) including the following:

- Phase II Grid Connected Rooftop Solar Power Plants (GCRTS)
- KUSUM scheme (solar for agriculture)
- Energy from Urban, Industrial, and Agricultural waste/ Residues for biomass and bagasse

DRIVING THE CHANGE

With the emergence of new grid technologies and the low cost of renewables, the future of the electricity grid will be radically different from the past. Especially the distribution network is expected to undergo a fundamental transformation from a one-way delivery service to a two-way flexible service. A stronger presence of DREG and energy storage presents the potential to reduce the cost of supply, improve energy resilience and reliability, and contribute to the de-carbonization of our electricity grid.

HOW TO GO FASTER?

This process can be accelerated by:

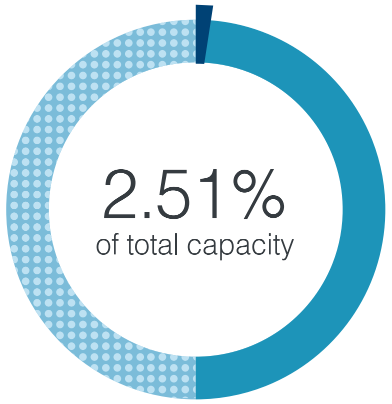
- Demonstrating the technical, commercial, and environmental benefits of DREG
- Setting dedicated capacity or generation targets for DREG and measuring progress
- Create enabling regulations, policies, and markets

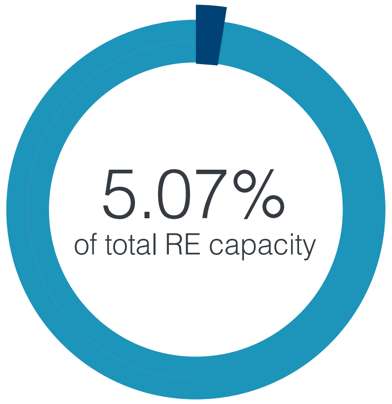
KEY FINDINGS

Moderate capacity share

800 MW

With a cumulative installed capacity of 800 MW as of December 2019, DREG accounts for 2.51 % of the total installed generation capacity and a 5.07 % share of the total RE capacity in the state.

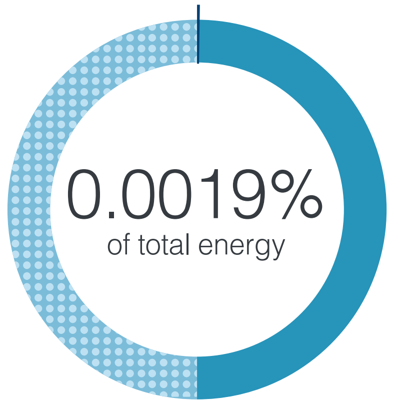


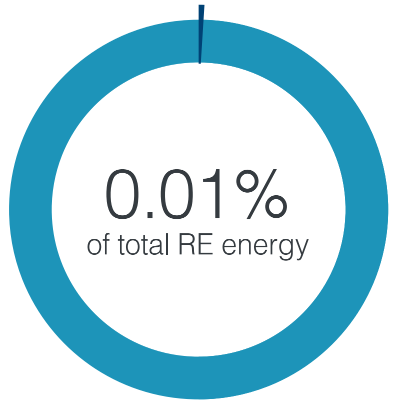


Negligible energy share

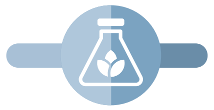
2.07 MW

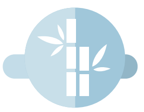
DREG contributes an estimated 2.07 MU or 0.0019% to the total energy share as of December 2019 in the state of Tamil Nadu. The DREG share on total RE generation stood at 0.01%.





Capacity		Generation
611 MW	Solar	0.91 MU
168 MW	Biomass	1.06 MU
20 MW	Bagasse	0.09 MU





Solar is dominating

76%

Distributed solar energy leads with 76% of the total installed capacity of DREG technologies whereas in energy terms, biomass energy leads with 1.06 MU.

Concentration in the west

>36%

36% of all distributed solar energy is located in 3 western districts. Other DREG technologies, such as biomass and bagasse are more evenly distributed across Tamil Nadu.

Source: MNRE (2020c), CEA (2019) & Energy Department (2020a)

1 PROGRESS & AMBITIONS

There is a lack of understanding, recognition, and awareness about the benefits of DREG, which translates into an absence of targets, strategic capacity addition planning, and an enabling regulatory and policy environment.

Introduction

As of January 2020, RE constituted 50% of the total installed power capacity in the state of Tamil Nadu (Energy Department of Tamil Nadu 2020a). By 2022, Tamil Nadu targets an installed RE capacity of 21,508 MW (NITI Aayog 2015). Achieving this target would result in the reduction in further thermal capacity additions, reduce energy-related carbon emissions, and contribute to meeting India's COP21 climate commitments (UNFCCC 2015). Also, the State has set a target to electrify 100% of its household and increase substantially the share of renewable energy by the year 2030 (Energy Department of Tamil Nadu 2020a).

There are many challenges to be addressed in the path towards reducing emissions. The Government of India has ambitious electrification plans and is aiming to provide electricity to all the households by 2022 (NITI Aayog 2015) (NITI Aayog 2017) (Power for All - Government of India 2016). Currently, 2.4% of the Indian households remain to be electrified. Providing uninterrupted, adequate, and quality power for the already grid-connected consumers is another challenge faced. The average Indian household receives electricity for 20.6 hours a day (CEEW 2020).This will require substantial investments in transmission and distribution infrastructure and generation capacity addition in the near future. Especially considering that the capacity of electricity consumption is expected to grow over the next years to come.

Defining DREG

DREG can be defined with the following parameters (CEA 2013):

- Interconnection at a voltage level below 33 kV.
- Integration into the existing distribution infrastructure
- Consumption of the energy generated primarily within the local distribution network (i.e., close to the point of consumption).

As data for interconnection voltages for power generators is not available, DREG in this context has been defined as a single generation unit or multiple units with an aggregated capacity of up to 10 MW, interconnected at 22kV voltage level and below (TANGEDCO 2014).

Absence of DREG targets

"Except for consumer category solar energy (behind-the-meter), Tamil Nadu has not set any DREG specific targets".

The consumer category solar energy target is 3,600 MW to be achieved by the year 2023 (TEDA 2019). As of September 2020, 247 MW of consumer category solar or 6.87% of the target has been met (MNRE 2020b).

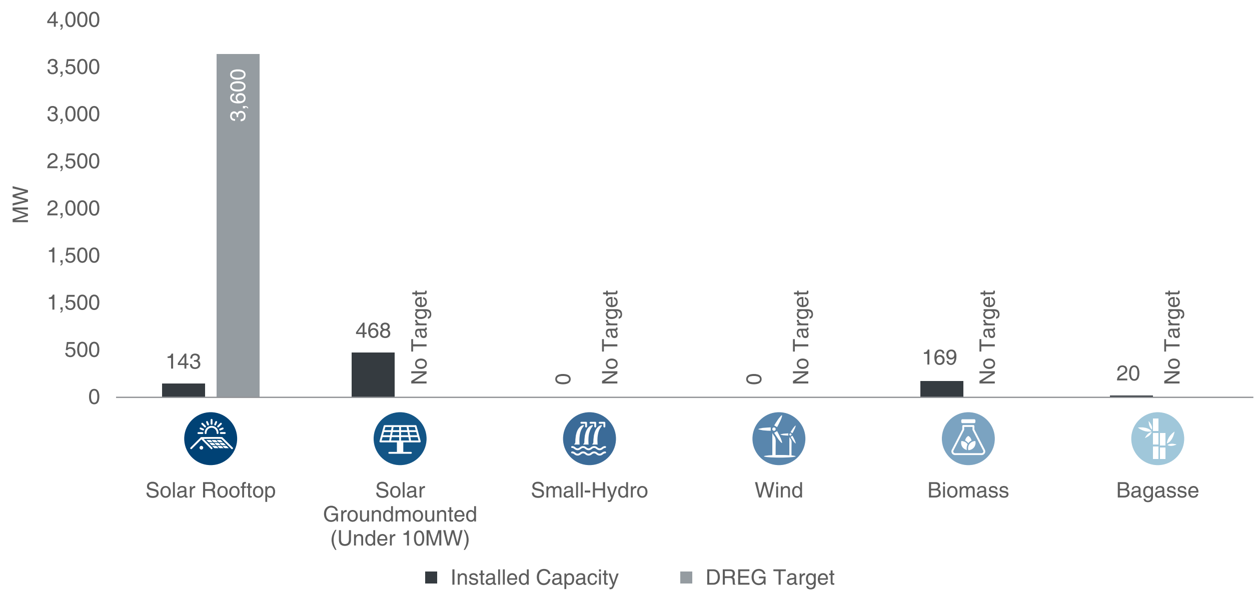
Capacity Share

As of December 2019, 51% of the states' total installed capacity is conventional in nature (Energy Department 2020a). DREG accounts for a capacity share of 2.51% only of the total capacity. Distributed solar energy has been growing in the state steadily since 2012. With 800 MW of installed capacity, distributed solar energy leads DREG. In 2019 the share of distributed solar on the total solar energy capacity in Tamil Nadu was 16%. Distributed biomass energy constituted 63% of the total capacity of biomass energy, while that of distributed bagasse energy stood at a mere 3% of the total installed bagasse energy capacity.

Energy Share

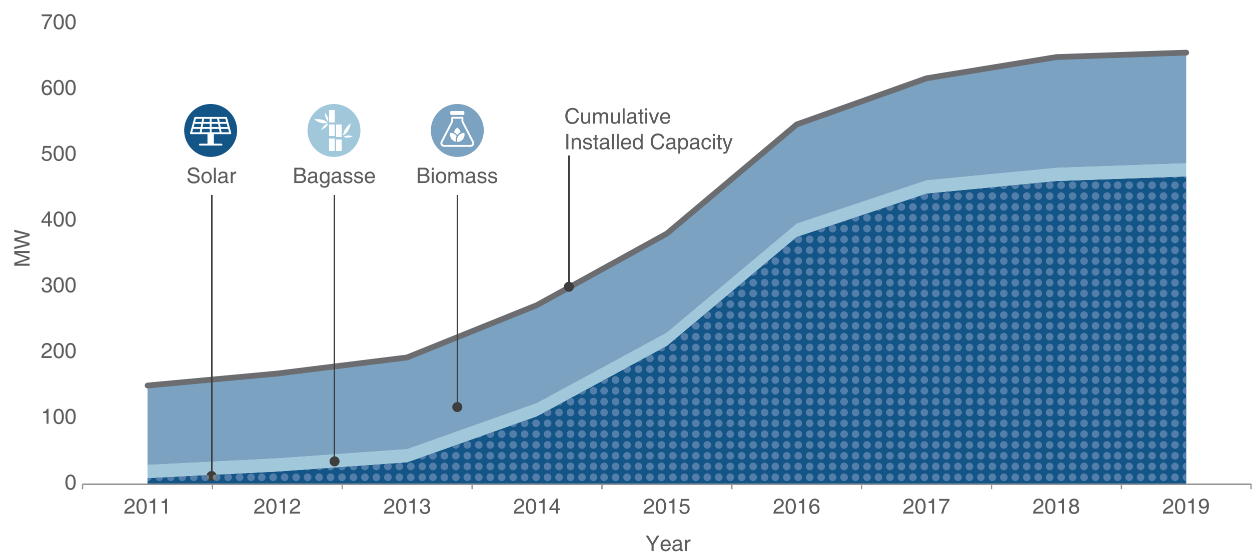
DREG constitutes a minuscule share of RE generation in Tamil Nadu. Distributed biomass and solar energy together formed 95% of the total energy share of DREG. In which, biomass energy accounted for 1.06 MU while solar energy accounted for 0.91 MU of total DREG generation.

Target vs. Installed Capacity of DREG as of 2019[1]



Source: MNRE (2020c), CEA (2019) & Energy Department (2020a)

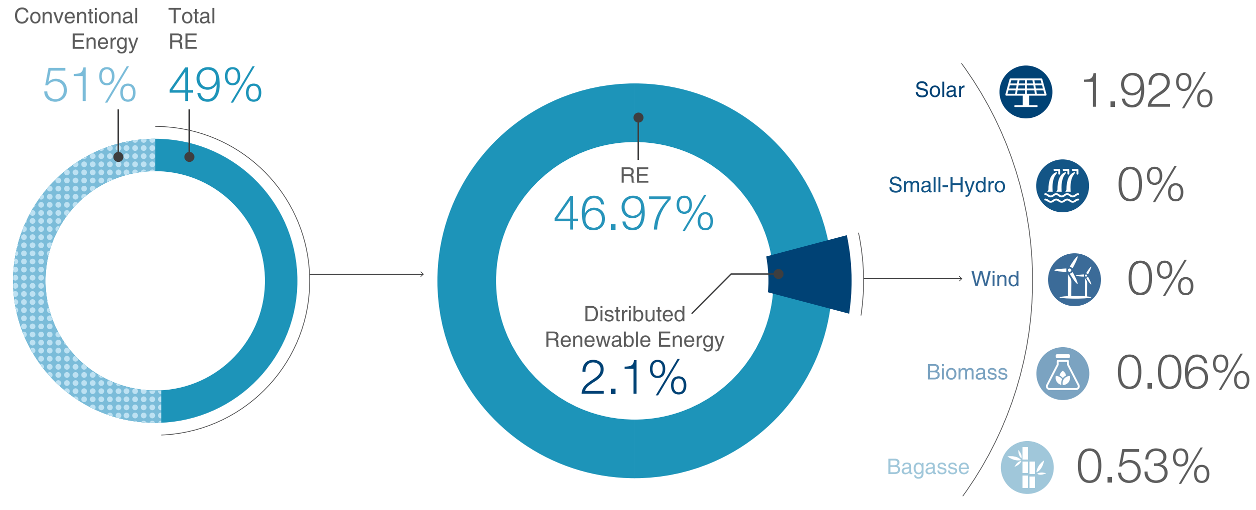
DREG Installed Capacity Growth 2011 - 2019[2]



Source: MNRE (2020c), CEA (2019)

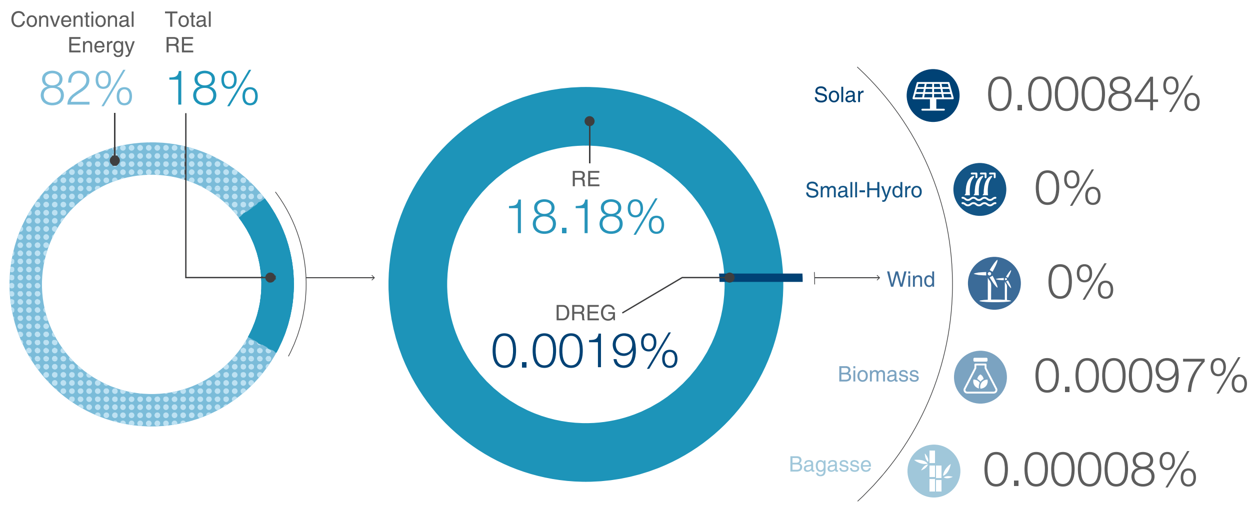
[1] The target of 3,600 MW of rooftop solar is set for the year 2023.
[2] The cumulative solar capacity in this figure includes only the ground mounted solar. Rooftop solar is not included in this.

Share of DREG in State's Total Installed Capacity in 2019



Source: MNRE (2020c) & CEA (2019)

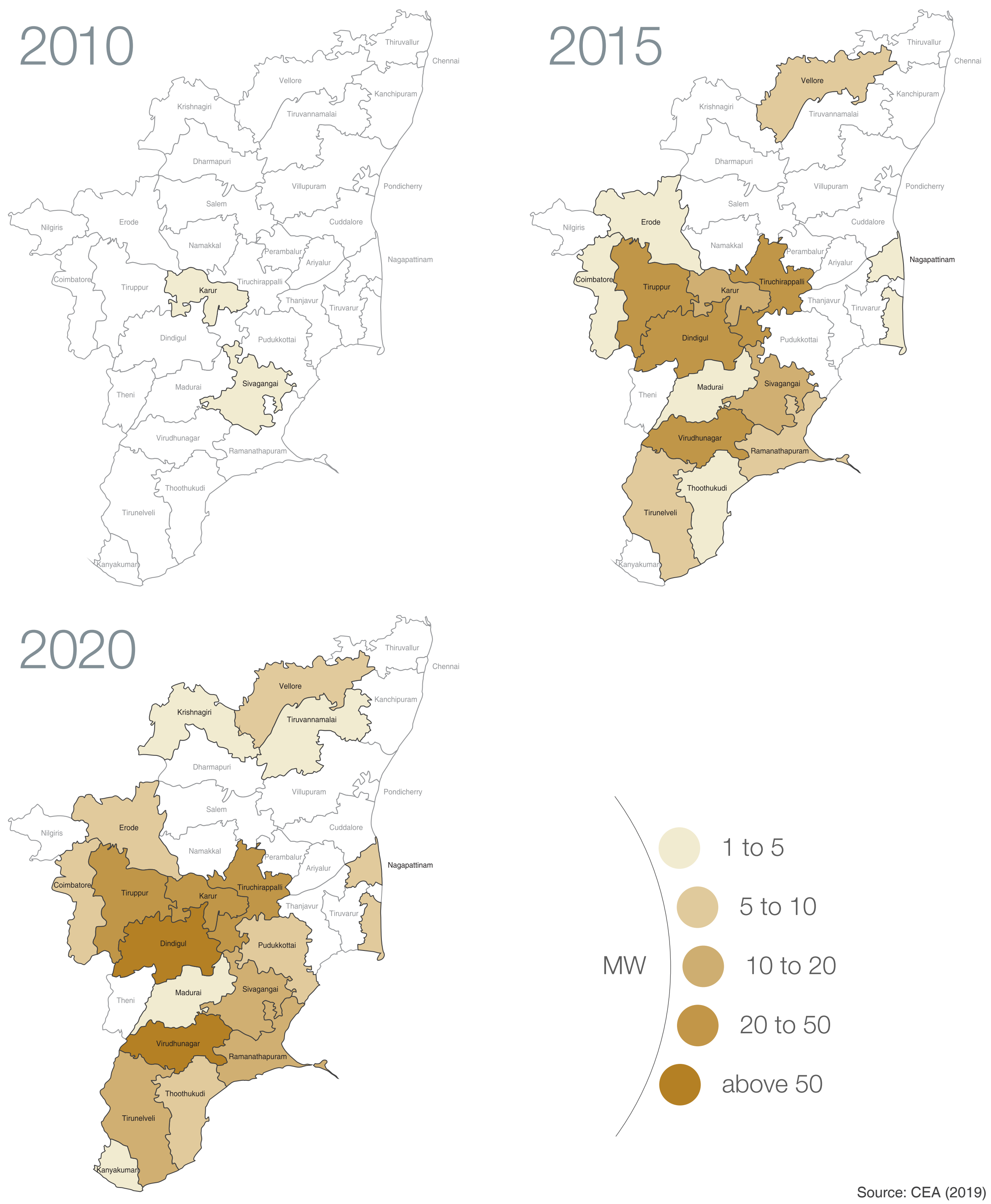
Share of DREG in State's Total Energy in 2019



Source: Energy Department of Tamil Nadu (2020a), MNRE (2020c) & CEA (2019)

Geographical Distribution of DREG[3]

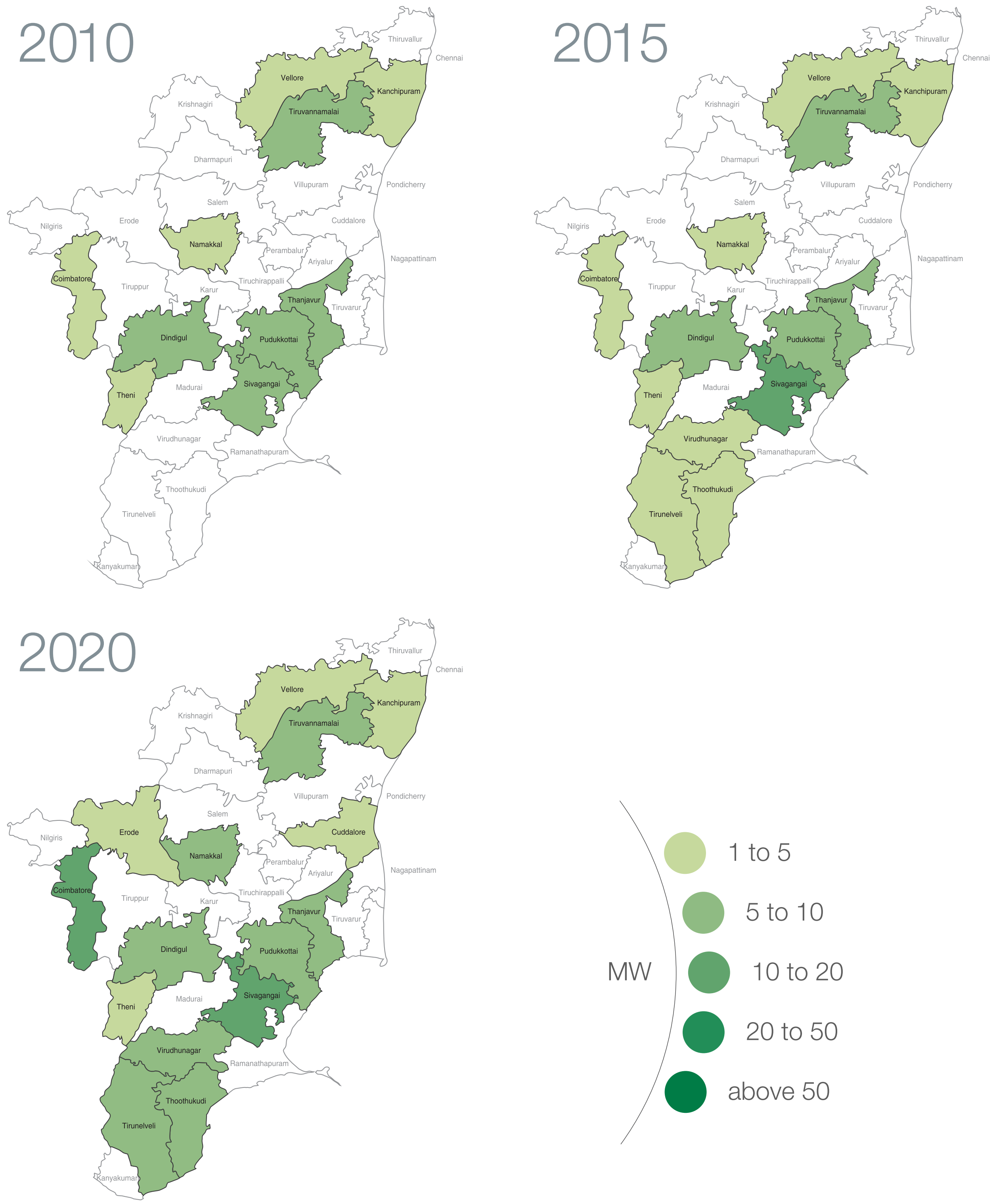
Distributed Solar Energy



Source: CEA (2019)
The installed capacity values are cumulated over the years.

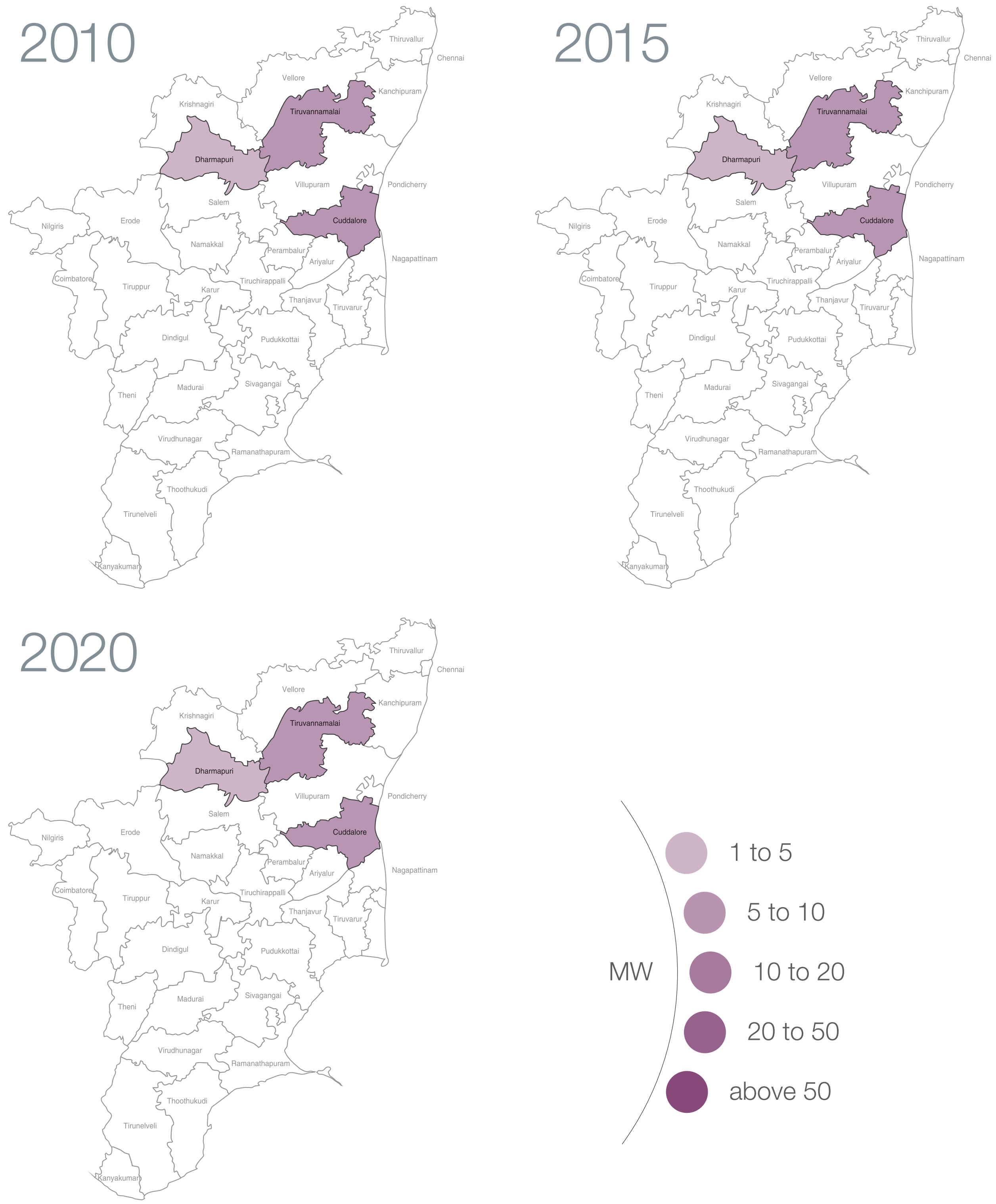
[3] *Rooftop solar is not included in this since the state-wise distribution data is not available*

Distributed Biomass Energy



Source: CEA (2019)

Distributed Bagasse Energy

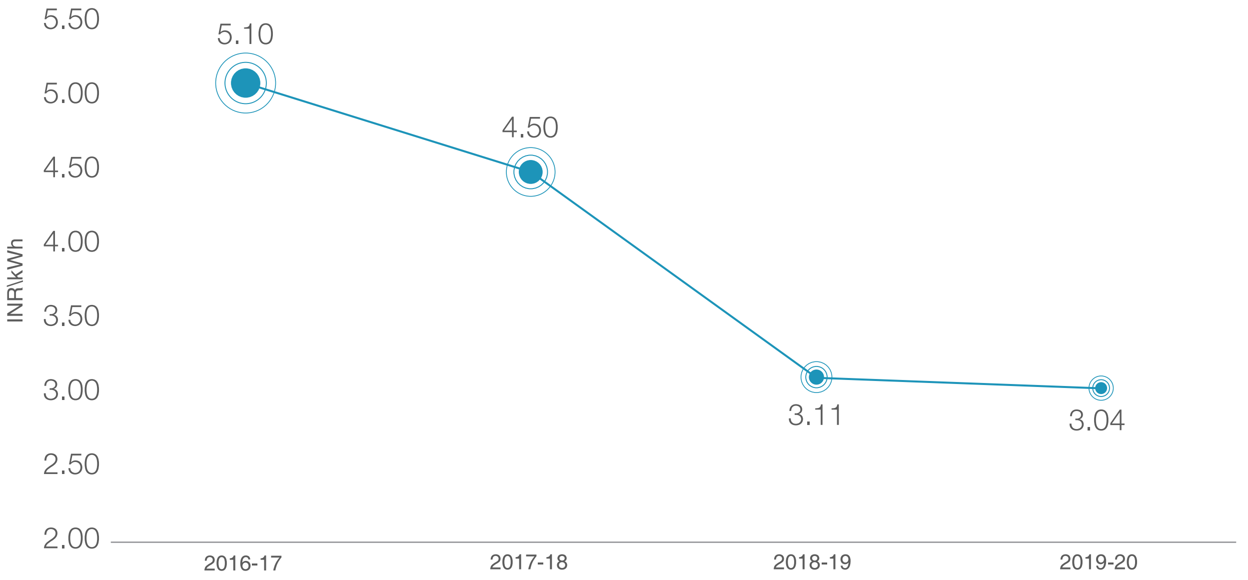


Source: CEA (2019)

2 THE DRIVERS

• Reducing cost of solar energy

The cost of solar energy has been on a declining trend. The feed-in tariff set by Tamil Nadu Electricity Regulatory Commission (TNERC) for capacities above 1 MW has seen a drop from INR 5.10 per kWh in 2016-17 to INR 3.04 per kWh[4] in 2019-20 (Mercom 2019).



Source: (Mercom 2019) [5]

[4] *This value is without accelerated depreciation.*
[5] *The values quoted by Mercom are taken from various tariff orders of TNERC.*

• Capital Subsidies for DREG

Initiatives taken by the Central and State Governments through various programs are contributing to an increased share of DREG capacity. These programs include:

(1) Grid Connected Rooftop Solar Power Plants (GCRTS) under phase II. 40% capital subsidy for systems up to 3 kW and 20% capital subsidy on every kW above 3 kW up to 10 kW is available for domestic consumers. Group housing and residential associations are granted a 20% capital subsidy on an installation of up to 500 kWp at 10 kWp per house. The state's target under GCRTS has been set at 5 MW for the year 2019-20. Energy Department (2020a).

(2) Programme on Energy from Urban, Industrial, Agricultural Wastes/Residues, and Municipal Solid Waste. Central Financial Assistance (CFA) is granted for the installation of biomass gasifiers for both electrical and thermal applications (MNRE 2020a).

(3) KUSUM-C implementation. For the implementation of KUSUM–C in Tamil Nadu, Tamil Nadu Energy Development Agency (TEDA) has been designated as the implementing agency. As part of the scheme, 20,000 pumps with 7.5 HP capacity each will be solarized with an 11 kW grid-connected solar PV system each (Energy Department 2020b). Hence, KUSUM–C in Tamil Nadu is expected to add a total distributed solar energy capacity of 220 MW.

• Solarisation of Government Buildings

For solarisation of government buildings in the State, the TEDA has entered into an agreement with Energy Efficiency Services Limited (EESL) in September 2019 for developing at least 50 MW of rooftop solar PV under the Renewable Energy Service Company (RESCO) model (EESL 2019). As of October 2020, agreements with government departments are in place, and around 300 kW of capacity is under installation. So far, no capacity is operational (Auroville Consulting 2020c).

• Distribution Networks

The existing distribution network of Tamil Nadu faces problems such as space constraints, higher land cost, and Right of Way (RoW) issues (Energy Department 2020a). These problems faced by the distribution networks could be addressed by integrating DREG and energy storage solutions in order to defer or avoid the investment in the expansion of the distribution network PSCC (2008).

• Awareness

There is a growing awareness among the public to use renewable energy in India which holds true to Tamil Nadu as well (Shakti Sustainable Energy Foundation 2019). This may contribute to a higher uptake of rooftop solar energy systems in the state.

3 THE BARRIERS

• Lack of tariff rationalization slowing down DREG

Tariff rates of certain low tension (LT) consumer categories such as domestic consumers, huts, power looms, agriculture, etc. are currently highly subsidised (TANGEDCO 2017). The transition towards DREG, with the primary purpose of self-consumption, for these consumer categories is therefore a financially less attractive or unviable opportunity. This may contribute to slower uptake of DREG in the state.

• Low Feed-in tariff

Competitive bidding resulted in aggressive and low RE tariffs for the utility category RE generation, which encouraged large RE plants rather than DREG (Prayas 2018). The preferential feed-in tariff for utility-scale solar, though higher compared to the tariffs discovered through competitive bidding, does not appear to encourage distributed solar energy sufficiently. If these tariffs were higher, then there is a scope for Distributed Solar to flourish.

The current net feed-in tariff for consumer category solar energy (behind-the-meter) is at INR 2.28 per kWh (TNERC 2019). This low solar net feed-in tariff has contributed to making consumer category solar energy generation a less attractive investment option for many consumer categories in the state (Auroville Consulting 2020). Net feed-in tariffs for other DREG technologies or energy storage are currently not available.

• Lack of recognition

There is a lack of recognition of DREG and its benefits. Only when DREG is recognized as a viable generation option, can a vision and roadmap be set to increase its capacity share.

• Challenges with Interconnection

The existing plant capacity limitations (TNERC 2019) do not permit the interconnection of generators with less than 1 MW for sales of energy (a gross feed-in mechanism). The Interconnection of generators to existing distribution feeders is not permitted either (TNERC 2019), thereby limiting the integration of DREG.

Case Study 1

• Feed in Tariff to Promote Renewable Energy in various Countries

Feed-in Tariffs (FiTs) for distributed renewables in various countries were attractive during the introductory phase, which led to the expansion of the distributed renewable energy capacity. Most Australian states established high FiTs for small PV systems. Under a net FiT scheme, solar generation is first used on-site to offset electricity consumption; any excess energy exported to the grid is compensated at the net FiT rate. Most state FiTs started at a much higher rate than the retail electricity price.

The UK introduced the policy of FiTs in 2010 with an expiration in 2019. By March of 2016, 4.6 GW of distributed generation was installed. The FiT remunerates small-scale renewable and low-carbon generation technologies, including solar PV, wind, hydro of 5 MW or less, and micro-CHP of 2 kW or less. The tariff is linked with the U.K.'s Real Prices Index so that it automatically adjusts with inflation.

Source: NREL (2017)

Case Study 2

• Low Voltage Grid Integration of RE In Germany

The low-voltage distribution system in Germany provides grid access points for households, small businesses, and small farms. In addition, distributed power generation systems are connected to this voltage level as well. These are mainly photovoltaic systems, but can also include small wind turbines and small biomass plants. For rooftop PV systems up to 30 kW, the building connection point is considered the most economical grid access point; for systems larger than 30 kW, the distribution system operator must determine which grid access point is most economical. The grid access point is therefore the point where the connection and expansion of network capacities bring about the lowest possible overall costs. This might be the building connection point, for example, or the nearest local distribution transformer.

Source: (Bayer et al. 2018)

4 WAY FORWARD

• Set DREG targets

Mandates and targets are powerful tools to drive capacity addition and to stimulate enabling regulations and the overall DREG market (Auroville Consulting 2019). Setting DREG specific capacity or energy generation targets has the potential to accelerate DREG deployment in the state.

• Determine capacity specific tariffs

Set capacity and technology-specific feed-in tariffs for all DREGs, including energy storage. These feed-in tariffs should account for the variable capital costs with respect to different generation capacities by technologies.

• Enable sales

Enable the sale of energy for generators of less than 1 MW capacity to the utilities, under the Open Access mechanisms, and at the Power exchange markets.

• Enabling aggregation

Create an enabling market design that allows aggregation of DREG, including energy storage systems, for sale of energy.

• Introduce Time-of-Day tariffs

Introducing the time of the day (ToD) tariffs for generation and consumption to incentivise the integration of DREG and energy storage systems.

• Launch innovative models for solar energy

Introduce innovative implementation models such as community solar energy systems with a virtual net feed-in mechanism. Such a program may in particular target the highly subsidised consumer categories and can result in a reduction of subsidy and cross-subsidy disbursement to the State Government and to TANGEDCO (Auroville Consulting 2020) (Auroville Consulting 2020a).

• Review Interconnection standards

Permit the interconnection of DREG at any voltage level and at existing distribution network nodes to avoid capital expenses for a dedicated power evacuation infrastructure.

Conduct hosting capacity studies to determine the optimal interconnection points of DREG in the distribution network to optimize the locational value of DREG (Auroville Consulting 2020b).

Case Study 3

• Aggregation of Dreg to Enhance Grid Stability In Italy

In a pilot launched by Enel X in Italy in 2019, around 100 solar PV systems with energy storage are integrated with a communication and a remote control system. This aggregation of solar PV and storage with technology would enable participation in demand response programs to bring stability to the grid during the times when energy demand is high.

Source: ENEL (2020), SWECO (2015).

Case Study 4

• Incentives for Storage in Germany and Australia

Germany's storage incentive scheme consists of a low-interest loan of up to EUR 2/W for the PV system, and direct payment for up to 22% of the eligible costs of the system (not to exceed EUR 0.50/W of the PV capacity). The portion of eligible costs to which the grant can be applied will decrease by three percentage points every six months until it reaches 10% in the second half of 2018, at which time the program will expire. This incentive scheme is largely responsible for the residential storage sector's surge to USD 149 million in market size in 2015 (BNEF 2016a). Storage systems can assist German ratepayers in self-consuming the electricity generated by their PV systems, which, even with the partial EEG (erneuerbare energien gesetz – German Renewable Energy Law) surcharge, effectively reduces their retail electricity rate.

Australia does not have a national subsidy program for distributed energy storage, but several subnational programs have emerged. The Australian Capital Territory government plans to finance 36 MW of distributed battery storage in more than 5,000 homes by 2020 (Environment, Planning, and Sustainable Development Directorate 2016). The City of Adelaide offers up to AUD 5,000 per system for 50% of the installed energy storage system costs.

Source: NREL (2017), SWECO (2015)

Case Study

5

• Permitting Sales to Third Parties

The 2012 revision to the EEG introduced a "feed-in premium" (FiP) scheme as an optional alternative to the FiTs (Feed-in Tariffs). Under this scheme, renewable energy generators between a capacity of 500 kW and 10 MW could choose to forgo guaranteed FiT payments and sell their electricity directly into the energy market at a premium to the spot price (i.e., the market-clearing price on the European Power Exchange). This premium was sized to bring total compensation per kilowatt-hour in line with what the system owner would have received under the FiTs, affording generators a comparable level of compensation.

Source: NREL (2017), SWECO (2015)

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