Integrated Research and Action for Development (IRADe) — 20 Years

MacArthur Foundation

Discussion Paper

Odisha

Enabling State Level Climate Mitigation Actions in the Power Sector

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Abbreviations

ACS	Average Cost of Supply
AES Corp	Applied Energy Services Corporation
APPC	Average Pooled Purchase Cost
AT&C	Aggregate Technical & Commercial
BEE	Bureau of Energy Efficiency
BPL	Below Poverty Line
BSES	Bombay Suburban Electric Supply
CAGR	Compound Annual Growth Rate
CEA	Central Electricity Authority
CESU	Central Electricity Supply Utility of Orissa
COD	Commercial Operation Date
CPPs	Captive Power Plants
DDUGJY	Deendayal Upadhyaya Gram Jyoti Yojana
DISCOMs	Distribution Companies
DSM	Demand Side Management
ECBC	Energy Conservation Building Code
EESL	Energy Efficiency Services Limited
EHT	Extra High Voltage
EEZ	Exclusive Economic Zones
GDP	Gross Domestic Product
GEDCOL	Green Energy Development Corporation of Odisha Limited
GoI	Government of India
GRIDCO	Grid Corporation of Odisha
GSDP	Gross State Domestic Product
GTD	Generation, Transmission, and Distribution
HT	High Tension
LT	Low Tension
MNRE	Ministry of New and Renewable Energy
MoP	Ministry of Power
M&V	Monitoring & Verification
NDC	Nationally Determined Contributions
NESCO	Northern Electricity Supply Company of Orissa Ltd.
NIWE	National Institute of Wind Energy
OERC	Orissa Electricity Regulatory Commission
OREDA	Odisha Renewable Energy Development Agency
OSEB	Orissa State Electricity Board
OPTCL	Odisha Power Transmission Corporation Limited
PAT	Perform Achieve Trade
PFC	Power Finance Corporation
PPA	Power Purchase Agreements

RE	Renewable Energy
REC	Renewable Energy Certificates
RoW	Right of Way
RPO	Renewable Purchase Obligation
SAIDI	System Average Interruption Duration Index
SAIFI	System Average Interruption Frequency Index
SAPCC	State-Level Action Plan for Climate Change
SOUTHCO	Southern Electricity Supply Company of Orissa Ltd.
Talcher TPS	Talcher Thermal Power Station
Talcher STPS	Talcher Super Thermal Power Station
UJALA	Unnat Jyoti by Affordable LEDs for All
UNFCCC	United Nations Framework Convention on Climate Change
WESCO	Western Electricity Supply Company of Orissa Ltd.

Preface

I am delighted to present the Discussion Paper on "Enabling State-level Climate Mitigation actions in the power sector of Odisha", carried out under the MacArthur Foundation-supported project titled "Enabling State Level Actions for India's NDC". For India to achieve its holistic NDC commitment target to UNFCCC, specific actions must be identified and implemented at the state level.

Each state has its own unique dynamics in the power sector, especially in the generation and distribution value chain. Odisha is a state having growing energy demand due to its mining, industries, per capita income growth, etc. It is categorized as a medium-income state with low to moderate renewable energy potential. The state, hence, represents the developing states in the country and we believe, the learnings from the state can be implemented in other states of similar profile.

Odisha has a dominant thermal energy mix followed by hydropower and renewable energy-based projects in the state. The state has a substantial quantum of captive generating stations (mostly thermal) catering to its heavy industrial consumers. The carbon footprint of the generation sector in Odisha is significant, contributing to its more than the national average per capita CO_2(e) emission. On the distribution end, Odisha has seen significant reforms lately, with the second attempt at privatization completed. Expectations are high, and much is expected from the private player (Tata Power) to bring its distribution reform experience into the state and alleviate the ailing value chain.

This discussion paper highlights IRADe's primary objective of promoting a wider consensus through research and analysis on effective policies among stakeholders and policy-makers. It integrates well with our previous studies across South Asia on identifying policy and market-based interventions for low carbon development. The output of this study is based on extensive primary and secondary research carried out through various stakeholder engagements and endeavors to provide a focal point to the efforts of policymakers in the state and center alike.

We are grateful to the MacArthur Foundation for supporting this study and I convey my gratitude to power sector officials in Odisha in helping with requisite details in successfully carrying out this study. I also convey my best wishes to the readers.

Professor Jyoti Parikh
Executive Director, IRADe

Acknowledgements

This research study has benefited from the help and guidance of various individuals in Odisha and New Delhi.

We thank state power sector officials from GRIDCO; Office of State Designated Agency, Govt. of Odisha; Odisha Electricity Regulatory Commission (OERC); Green Energy Development Corp of Odisha Ltd. (GEDCOL); DISCOM Monitoring Unit; Odisha Renewable Energy Development Agency (OREDA) and State Load Dispatch Centre, Bhubaneswar. Their critical comments and presenting an expert's perspective on the power sector situation in Odisha and ground-level realities helped enrich this study.

We thank Mr. Nikunj Bihari Dhal, Principal Secretary, Dept. of Energy, Govt. of Odisha; Mr. Santosh Das, Engineer in chief (Elec)-cum- Principal-Chief-Electrical-Inspector, Govt. of Odisha; Mr. B.B. Mehta, Chief Load Dispatcher, Odisha; Rajiv Agrawal, Secretary, Indian Captive Power Producers Association; Dr. Chandra Kiran B Krishnamurthy, Assistant Professor, Department of Forest Economics, Swedish Univ. of Agricultural Sciences, UMEA, Sweden and Dr. Subhransu Ranjan Samantaray, Associate Professor, IIT Bhubaneswar for their valuable inputs.

We also thank Mr. Pankaj Batra, Project Director IRADe- SARI/EI, and Mr. V K Agrawal, Technical Director, SARI/EI, IRADe, for their constant support and valuable feedback on the content of this study. We are grateful to Dr. Jasleen Bhatti, former Consultant, IRADe and Ms. Jyoti Sharma, Research Analyst, Mohit Kumar Gupta, Project Analyst, IRADe for their contributions in proofreading and editing this document. We also extend our thanks to Dr. Jasleen Bhatti efforts in organizing webinar and workshop concerning this study.

Finally, we would like to extend our sincere thanks to the MacArthur Foundation and Ms. Moutushi Sengupta, Director, India Office, MacArthur Foundation, for supporting this study.

EXECUTIVE SUMMARY

The power sector is the largest source of emissions in India. The electricity generation for public use accounted for almost half of the total energy sector emissions in India (shown in Figure 1). and reducing the carbon footprint of the sector is essential. Electricity being part of the concurrent list in the Seventh Schedule to the Constitution of India (Article 246), is under power to be considered by both the state and the union government. Each state faces unique challenges in its transformation of the power sector. Thus, state-level actions are required to transform the sector and contribute to the Nationally Determined Contributions (NDC) Goals.

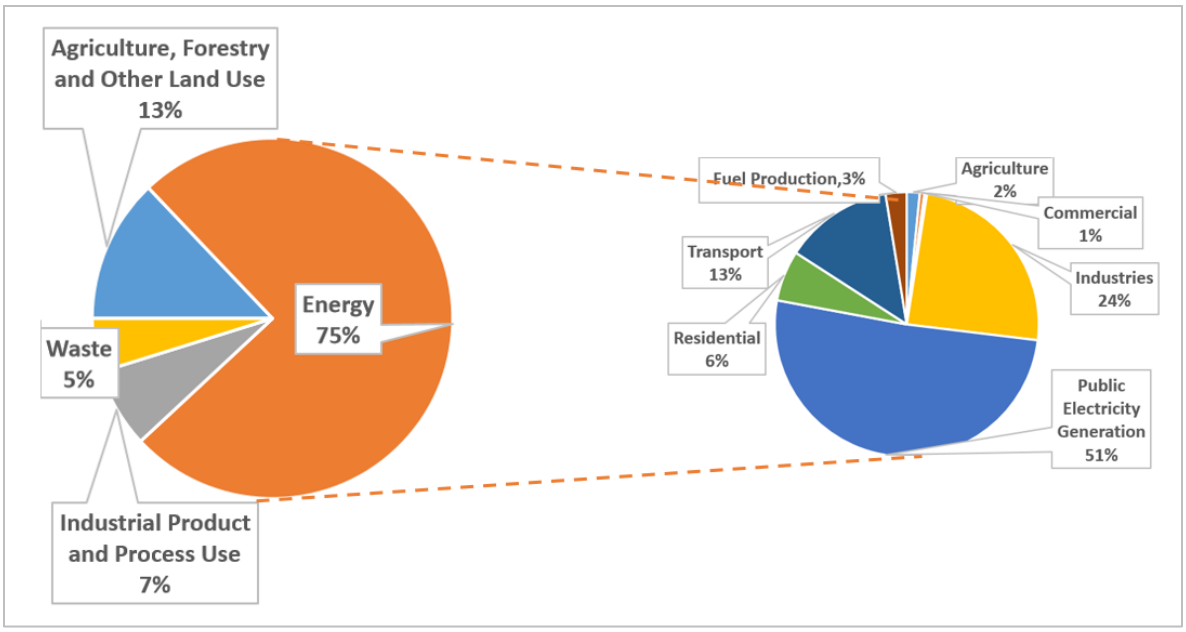


Figure 1: CO2 Emission in India in 2015- Sector wise
(Source: GHG platform Phase 3)

Odisha is one of the fastest-growing states in India. The state is highly industrialized with its vast mineral reserves constituting 28% iron ore, 24% coal, 59% bauxite and 98% chromite of India's total deposits[1]. The CO2 emissions due to various activities in the state in 2015 account for a total of 178 Million tonnes[2] (7% of the total country emission) out of which contribution due to electricity generation (excluding required for captive use) is approximately 34%. The non-fossil fuel capacity share in Odisha's power sector is 30 % at present with major share of Hydro capacity and no installation of nuclear capacity. The coal based generation capacity contributes around 70 % of the total installed capacity meant for public use. Due to high share of coal in power generation mix and presence of huge industries (including captive power plants) in Odisha together contributes around 80

[1] Department of Steel and Mines, Government of Odisha.
[2] GHG Platform Phase 3

percent in state GHG emissions.

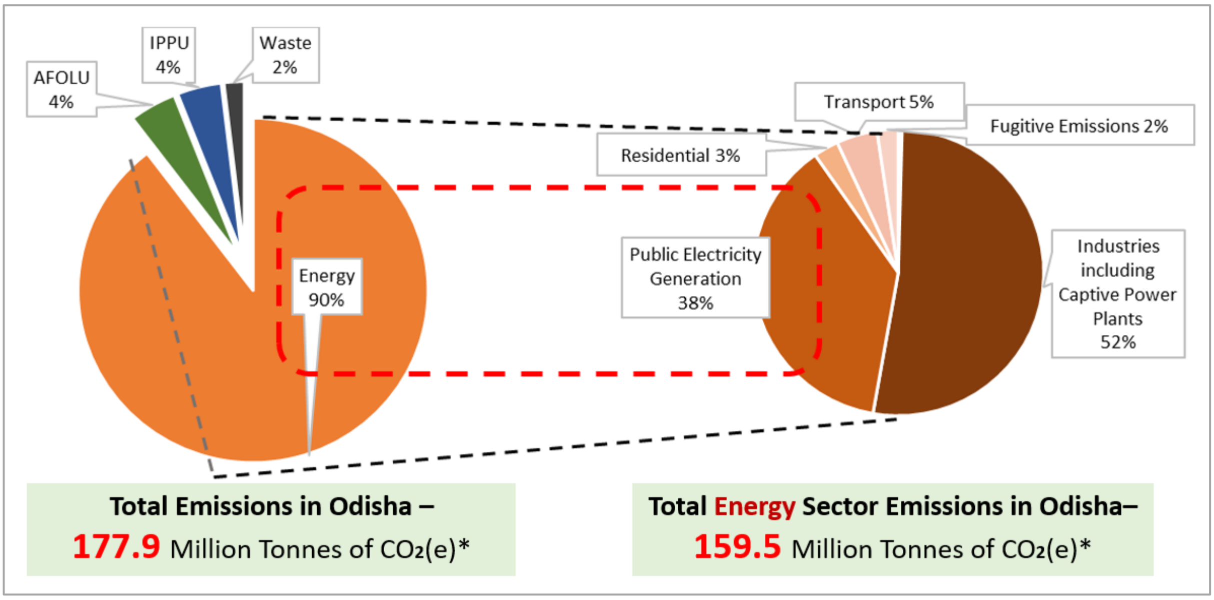


Figure 2: Sectoral GHG emissions of Odisha in 2015 (Source: GHG Platform India)

Odisha has a per capita emission of 4.22 tons which is significantly higher than the national average of 2 tons. Furthermore, emission per GSDP in the state stands at 65.7 gCO2(e)/INR.

The state has a total installed capacity (utilities) of 8.87 GW as of 31/10/2019 (CEA, 2019). The state has an additional capacity of around 11 GW in the form of Captive Power Plants (CPPs) owned by large industries (EIC Odisha). Hence, power sector generation in Odisha is dominated by Captive Power Plants.

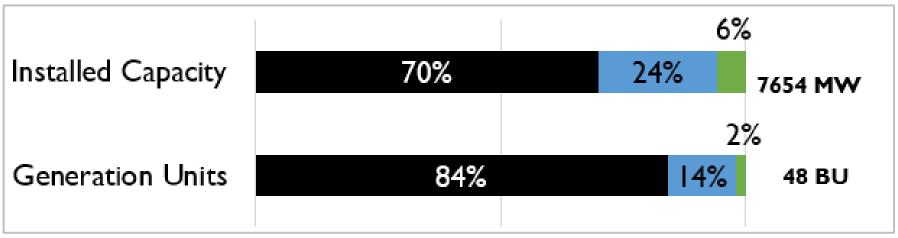


Figure 3: Odisha Energy Mix (FY 2018-19)

The current installed capacity of RE in Odisha (utilities only) is around 520 MW as on 30/09/2019 (CEA, 2019). The capacity is mostly based on solar, biomass, and small hydro capacities. Odisha has a reasonable potential for other RE sources. As per OREDA, the total Gross RE potential in the state is around 53,820 MW, of which around 11,820 MW is the feasible potential (OREDA).

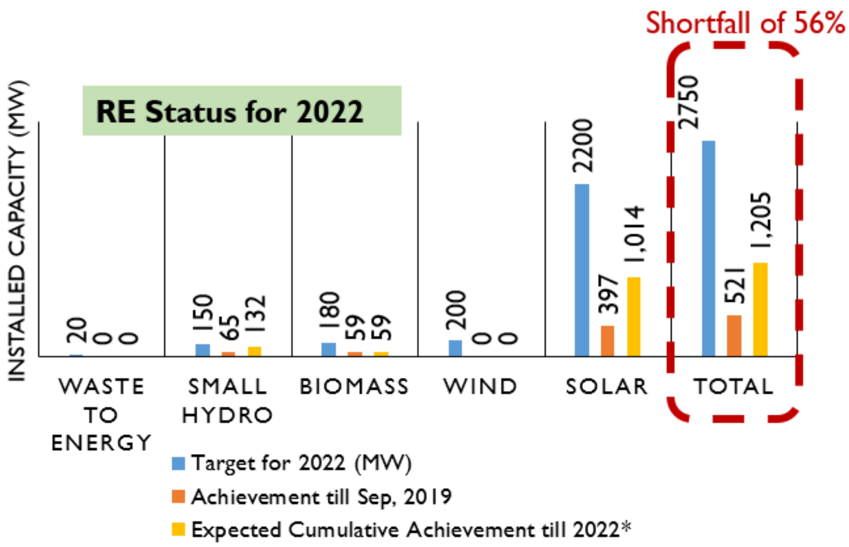


Figure 4: Odisha RE status

As it could be depicted from figure 4 above, Odisha is falling short of its own target by 56% and need to take significant strides in coming years to achieve the same. In RPO terms, state is well behind the targets identified by the state commission. In this regard, IRADe analysed the scope of various scenarios of achieving NDC targets though interventions identified in generation sector.

Table 1: Scenarios and assumptions for the Odisha power sector in 2030

Scenario	Assumptions
A (Baseline scenario)	• RE capacity in the state based on projected RE capacity in GRIDCO Tariff Order 2019-20 by 2022 and no further growth of RE thereof.
B	• Older thermal power station, i.e., Talcher TPS, IB Valley TPS, and Talcher STPS retire by 2030. • The new super-critical power plant is set up in the premises of Talcher TPS • Additional power requirement is sufficient from solar capacity addition in the state.
C	• Capacity addition of Odisha's share of 275 GW RE added by 2030. • Talcher TPS and IB Valley TPS 1 are retired by 2030. • The new super-critical power plant is set up in the premises of Talcher TPS.
D	• Capacity addition of Odisha's share of 275 GW RE added by 2030. • Talcher TPS and IB Valley TPS 1 and Talcher STPS are retired by 2030.

	• The new super-critical power plant is set up in the premises of Talcher TPS.
E	• Capacity addition of Odisha's share of 450 GW RE added by 2030. • Talcher TPS is retired by 2030.
F	• Capacity addition of Odisha's share of 450 GW RE added by 2030. • Talcher TPS and IB Valley TPS 1 is retired by 2030
G	• Capacity addition of Odisha's share of 450 GW RE added by 2030. • Talcher TPS and IB Valley TPS 1 and Talcher STPS are retired by 2030. • The new super-critical power plant is set up in the premises of Talcher TPS.

Figure 5 shows the total and specific emission in the Odisha power sector in 2030. The trend reveals that both the two interventions considered here, i.e., increasing RE capacity and retirement of older TPS, are effective in decreasing the emissions. Retirement of TPSs decreases the emissions through replacement by other plants within the state boundary and central sector plants located outside the state boundary (whose emissions are not considered as state's emissions).

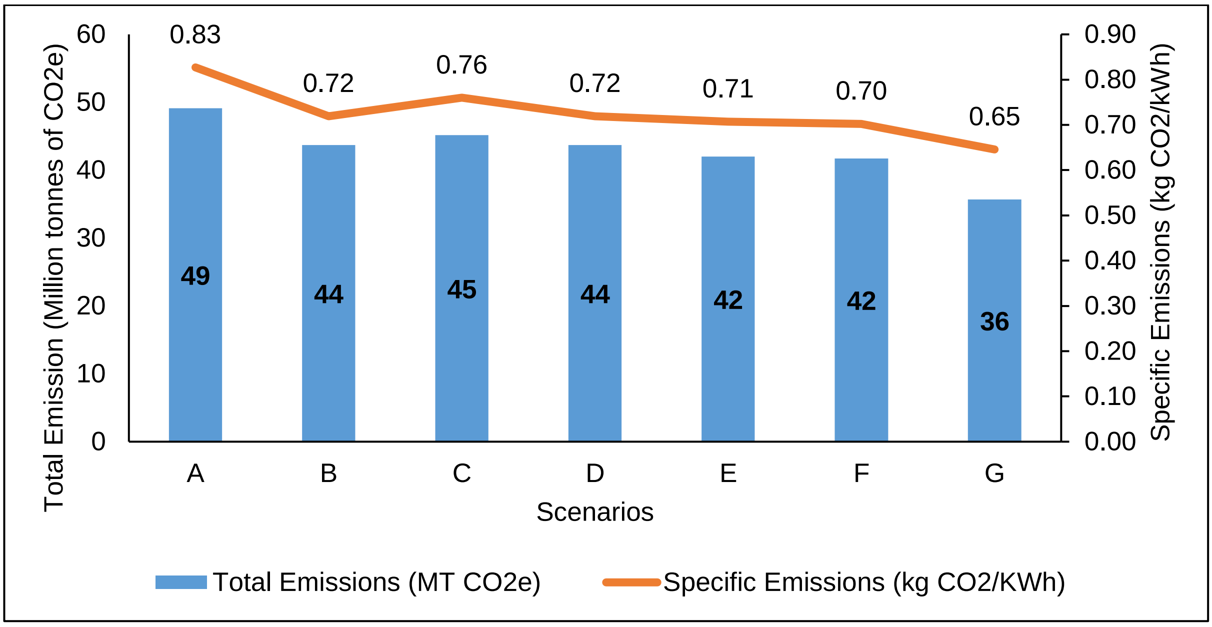


Figure 5: Total and Specific Emissions of Odisha Power Sector (Utilities) in 2030 in various scenarios

The incremental cost of decarbonization in each scenario will be due to the higher variable cost of inter-state generating stations, higher fixed cost of new TPS, and comparatively higher cost of solar energy in Odisha. Figure 6 depicts the incremental cost of different scenarios against emission reduction in Odisha in 2030.

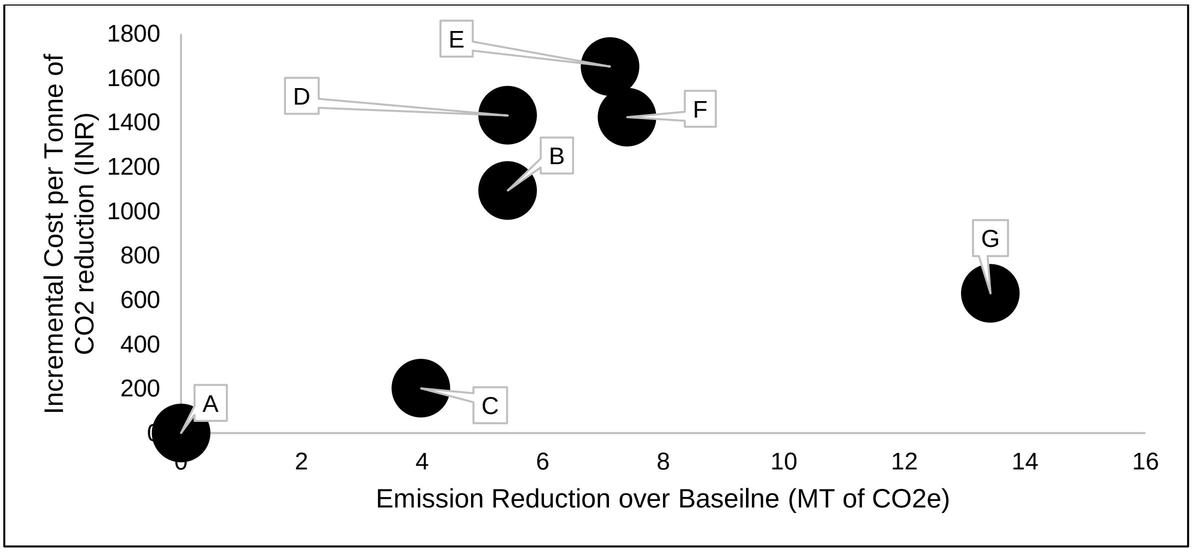


Figure 6: Incremental cost of different scenarios against emission reduction in Odisha in 2030

Captive Power Plants (CPPs) which serve the mining and other industries in the state were found to be more polluting than utility based TPPs, mainly because of the size and vintage of capacities. CPPs allowed industries to produce cheap (and reliable) electricity for themselves and1.1 K even supported the state grid during the time of deficiencies but leaves significant carbon footprint. IRADe analysed 63% of the CPPs in the state and based on the data available and careful assumptions, it was found that the Average emission factor of CPPs was 1.1 KgCO2/kWhr (Odisha grid had an emission factor 0.84 kgCo2/kWhr in FY 2018-19).

A spreadsheet-based model was created based on the Odisha grid's key parameters in 2018-19. The model assessed the power sector emissions (including CPPs) in 2018-19 in different scenarios considering the demand of Odisha Grid in 2018-19 and the demand from CPPs in the same year.

Table 2: Different scenarios and corresponding assumptions

Scenario	Assumptions
Current power sector emissions (No captive shift)	This is the baseline scenario considering the emissions of Odisha grid and analyzed CPPs.
Captive shift - super-thermal	Shifting of analyzed CPPs to current Odisha grid, and sufficing the remaining electricity demand from a new Super-thermal Power plant.
Captive shift - super-thermal, retirement of TTPS and IB Valley -1	Shifting of analyzed CPPs to current Odisha grid, and sufficing the remaining electricity demand from a new Super-thermal Power plant, Retirement of old thermal power stations whose emission factors are higher than or comparable to emission factor of the analyzed CPPs.
Captive shift - 50% super-thermal, 50% solar	Shifting of analyzed CPPs to current Odisha grid, and sufficing half of the remaining electricity demand from a new

Scenario	Assumptions
	Super-thermal Power plant and another half from solar energy.
Retirement of Talcher TPS, IB Valley 1 – captive shift – 50% thermal, 50% solar	Shifting of analyzed CPPs to current Odisha grid, Retirement of old thermal power stations whose emission factors are higher than or comparable to emission factor of the analyzed CPPs, and sufficing half of the remaining electricity demand from a new Super-thermal Power plant and another half from solar energy.
Captive shift – solar	Shifting of analyzed CPPs to current Odisha grid, and sufficing the remaining electricity demand from solar energy.

The results of emissions in different scenarios are given in Figure 7.

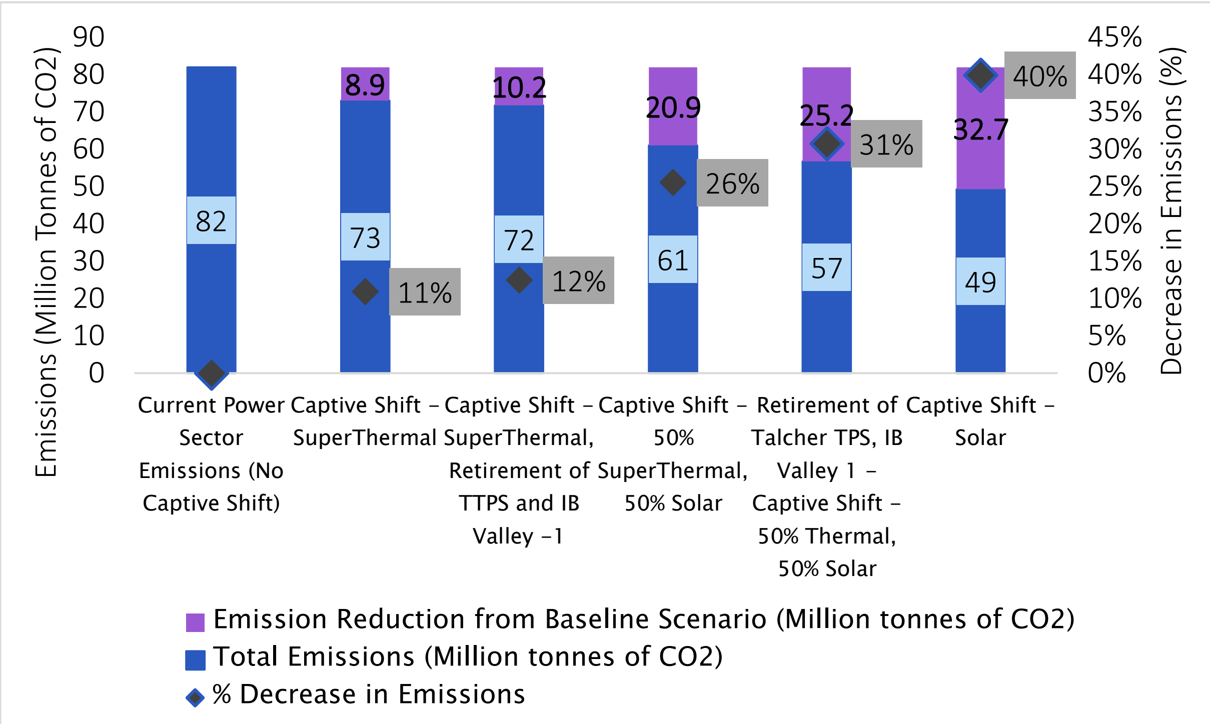


Figure 7: Emission reductions from captive shift in various scenarios in 2018-19 (IRADe Analysis)

Figure 7 shows that a progressive decrease in emissions is seen as we move from the current power sector scenario in Odisha to captive shift – solar scenario. However, it must be said that although the captive shift – solar scenario leads to the highest reduction in emissions, such a scenario is hypothetical and currently not feasible without battery support or other storage technologies.

An additional analysis on the tariff front for EHT and HT consumers showed that the captive consumers do not have any economic benefit to shift to grid electricity as they end up paying more because of the tariffs of the DISCOM. The above analysis shows that a clear emission reduction potential exists in shifting CPP capacities to the grid. However, losses that firms would incur on making such a move are also staggering. Therefore, policy incentives are required that discourage new CPPs of smaller capacities from being installed and encourage old CPPs to shift to the grid. The distribution system in Odisha is overseen by Four DISCOMs- CESU, WESCO, NESCO and SOUTHCO each of which has recently been taken over by Tata Power through a competitively bidding process. The AT & C loss levels of DISCOMs are shown in Figure 8 below.

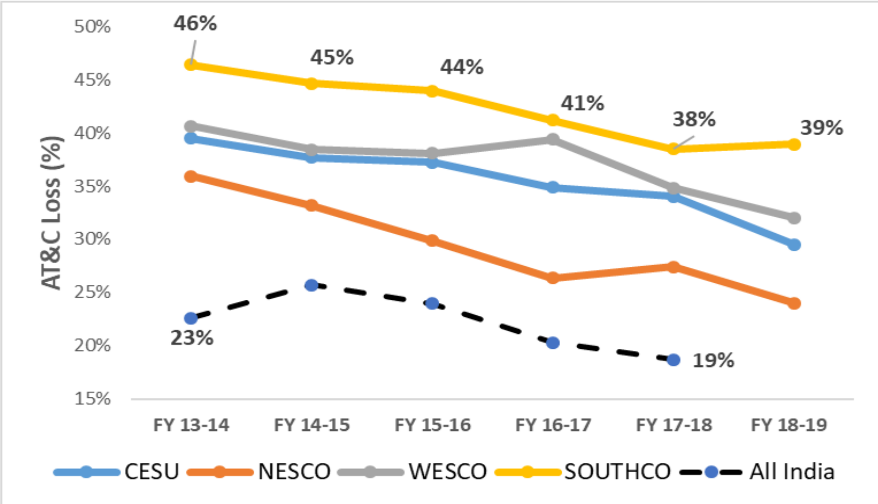


Figure 8: AT & C loss levels of DISCOMs

Major contributors to the high loss levels of DISCOMs are its LT Consumers. Odisha also loses a significant chunk of its revenue in agricultural consumers. The below table shows the LT loss levels in the state.

Table 3: LT loss levels for Odisha DISCOMs in FY 2017-18

LT Division DISCOM	Energy input (MU)	Energy sold (MU)	T&D loss	Billing efficiency	Collection efficiency	AT&C loss
CESU	5668	3580	37%	63%	94%	41%
NESCO	2733	1795	34%	66%	95%	38%
WESCO	3864	2476	36%	64%	71%	55%
SOUTHCO	2623	1726	34%	66%	87%	42%
Odisha Total	14888	9577	36%	64%	87%	

IRADe estimates that reducing the technical loss levels to 10% in FY 17-18 would have helped in emission abatement of 0.6 Million Tonnes of CO2(e). IRADe further estimates show that in FY 2029-30, due to DISCOMs requirement of power, emissions as shown in figure 9 below would be emitted.

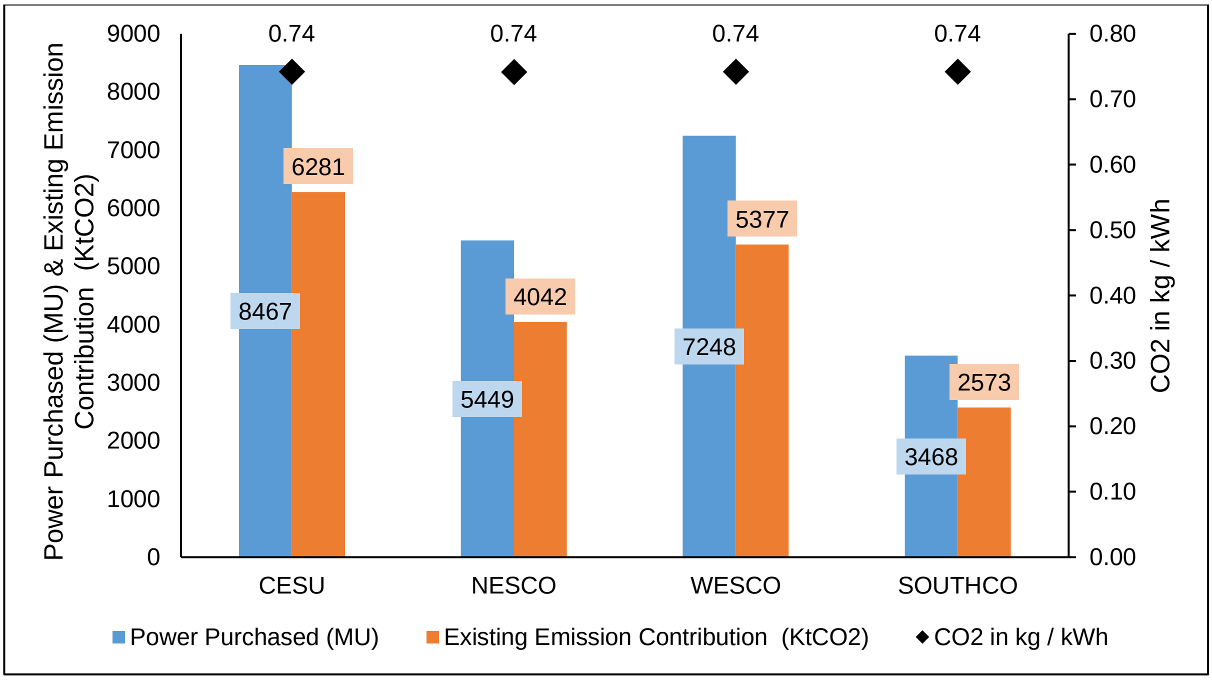


Figure 9: Estimation of Power Purchase and existing emissions contribution in distribution utilities by 2029-30

Key recommendations for Enabling Odisha Climate Mitigation Actions in the Power Sector:

Demand Side Interventions
Improve RPO Compliance by all obligated entities
Remove the categorization of RPO targets
Prescribe long term RPO trajectory so that DISCOMs enter into future PPAs considering RPO
Mandate on CPPs to reduce emissions
Discouraging New CPPs
Make Shift to Grid Cost Effective and attractive for CPPs
Restoration of RPO trajectory for CPPs
Coal Cost Rationalization
Explore avenues to shut CPPs
Design Institutional framework to promote competition among electricity distribution divisions to reduce losses
Expand Solar Potential of Odisha through canal top solar and floating solar plants
Emphasis on improving Reliability and Consumer Service

Chapter 1.

Study Objective and Justification

As per its commitment to the United Nations Framework Convention on Climate Change (UNFCCC), India has committed to reduce its emission intensity of gross domestic product (GDP) by 33 percent to 35 percent over the 2005 level and achieve 40% of non-fossil fuel based electricity generation installed capacity by 2030. While the commitment has been at the national level, the state-level actions are required to achieve the goals on the ground.

The power sector is the largest source of emissions in India, and reducing the carbon footprint of the sector is essential. Electricity being part of the concurrent list in the Seventh Schedule to the Constitution of India (Article 246), is under power to be considered by both the state and the union government. Each state faces unique challenges in its transformation of the power sector. Thus, state-level actions are required to transform the sector and contribute to the Nationally Determined Contributions (NDC) Goals.

Some states in India are larger than many countries in terms of area, population as well as economy. Hence, technical interventions and modeling at the national level may not be aptly applicable for state level issues. Therefore, it is imperative to undertake state level analysis. Often, modelling or techno-economic analytic approaches do not address institutional constraints that involve modern and historic institutions, power plants and utilities. It is thus important to introduce reforms at that level given the role state, nation and the global community can play. This study, thus broadly, aims to address the following questions.

1. How does a coal dependent state in India begin to decarbonize with least damage to its economy?
2. To what extent this needs to be done through state level initiatives?
3. What national and international support can help the transition?

Chapter 2
Odisha State Profile

Odisha is one of the fastest-growing states in India. It is the 11th most populous state with close to 5% of the total area of India under its jurisdiction. Its GSDP is larger than many countries and is comparable to Finland[3] when considered on the basis of purchasing power parity. The state is highly industrialized with its vast mineral reserves constituting 28% iron ore, 24% coal, 59% bauxite and 98% chromite of India's total deposits[4]. It is second among coal producing states with its production of 144.3 Million Tonnes[5] in FY 2018-19 accounting for a fifth of all India production. It is also the largest aluminum producing state having 68 percent[6] of all India's aluminum production capacity and also contributes to a sizeable production of iron and steel to the country. The CO_2 emissions due to various activities in the state in 2015 account for a total of 178 Million Tonnes[7] (7% of the total country emission) out of which contribution due to electricity generation (excluding required for captive use) is approximately 34%.

Odisha requires a robust power system to back its industries and to further growth. The non-fossil fuel capacity share in Odisha's power sector is 30 percent at present with major share of Hydro capacity and no installation of nuclear capacity. The coal based generation capacity contributes around 70 percent of the total installed capacity meant for public use. Due to high share of coal in power generation mix and presence of huge industries (including captive power plants) in Odisha together contributes around 80 percent in state GHG emissions. Therefore, Odisha has a per capita emission of 4.22 tons[8] which is significantly higher than the national average of 2 tons. Furthermore, emission per GSDP in the state stands at 65.7 gCO2(e)/INR which is higher than the national emission intensity of 23.3 gCO2(e)/INR (details provided in further sections).

Odisha was the first state in the country to introduce power sector reforms, which led to the unbundling of the generation, transmission, and distribution (GTD) activities of the erstwhile Orissa State Electricity Board (OSEB). The reforms also heralded a transparent regulatory regime in the sector with the establishment of the Orissa Electricity Regulatory Commission (OERC). The state was the first to do so not only in India but among all the

[3] Source: http://statisticstimes.com/economy/comparing-indian-states-and-countries-by-gdp.php (Accessed on 30 July 2021)
[4] Department of Steel and Mines, Government of Odisha.
[5] Source: Provisional Coal Statistics 2019
[6] As per Indian Minerals Yearbook 2019 (Part- II: Metals and Alloys), Indian Bureau of Mines, Ministry of Mines.
[7] Source: GHG Platform Phase 3
[8] Source: IRADe Calculations

developing countries of Asia. However, the state suffers from some unique problems of its own. This study identified three major areas with a high scope of mitigation: 1. Decarbonizing generation from utilities, 2. Decarbonizing generation from captive power plants and 3. Decreasing Aggregate Technical & Commercial (AT&C) losses of utilities.

2.1 Generation of Electricity

The state has a total installed capacity (utilities) of 8.87 GW as of 31/10/2019 (CEA, 2019). The state has an additional capacity of around 11 GW in the form of Captive Power Plants (CPPs) owned by large industries (EIC Odisha). Hence, power sector generation in Odisha is dominated by Captive Power Plants. Figure 1 depicts the sector-wise installed capacity of Odisha (utilities only) in 2019. The introduction of the reforms in the power sector during early 2000, paved the way for substantial participation of the private sector in the power generation sector. Captive power plants were historically introduced when the state power grid was not capable to provide quality uninterrupted power necessary for production of aluminum, iron & steel and similar energy intensive industries. Further, the proliferation of captive power plants was also incentivized by allowing sale of excess power to grid.

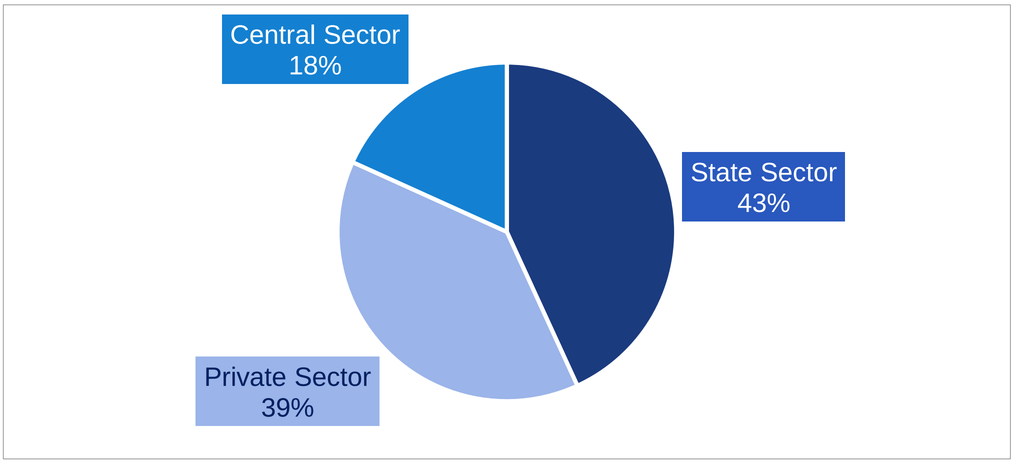
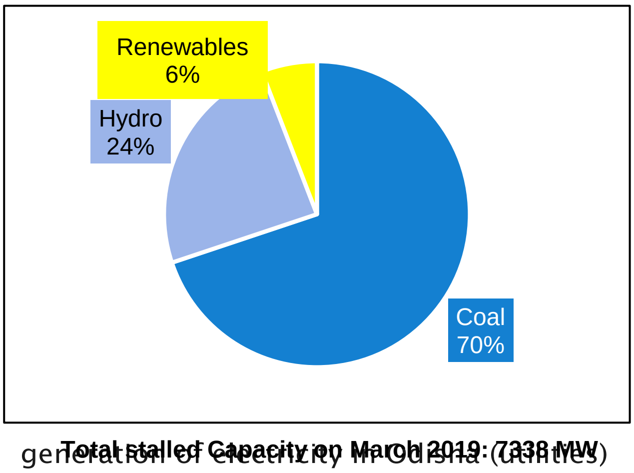


Figure 1: Sector-wise installed capacity of Odisha (utilities only)
Source: CEA (As of September 2019)

As mentioned earlier, the state is rich in coal resources and coal dominates the power generation mix in the state with a share of 70 percent followed by large hydel contributing around 24 percent. Electricity production from coal accounted for 84 percent of the total electricity generated in the state. Figure 2 illustrates the source-wise installed capacity and generation of power (utilities only) in the state in FY 2018-19. The share of renewables in the state installed capacity is only 6 percent which much lower than the national average of 22 percent. In terms of achieving the NDC Goal 4 target of 40% non-fossil fuel installed capacity at national level, the contribution of non-fossil generation capacity in the state stands at 30%. The total electricity generation by public generation utilities was 48 BUs in 2018-19 while that from captives accounted for approximately 58 BU (EIC Odisha).



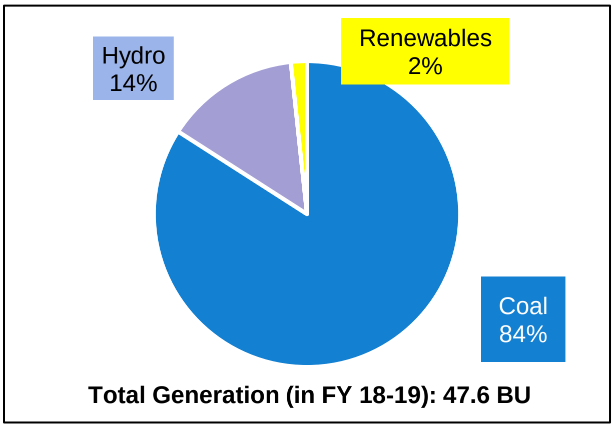


Figure 2: Source-wise installed capacity and generation of electricity in Odisha (utilities) in FY 2018-19 (**Source**: CEA)

2.2 Transmission of Electricity

An effective and economical transmission system is a prime requirement for the smooth flow of electricity from generating stations to load centers. The Odisha Power Transmission Corporation Limited (OPTCL) is the body entrusted with ensuring the same for transmission lines in the state of Odisha. As of 01.04.2018, Odisha has 140 grid sub-stations of different voltage classes and extra high voltage (EHT) transmission lines of 13,442 ckt. km out of which 1133 ckt kms (8 percent) are of 400 KV lines, 5923 ckt kms (44 percent) are of 220 KV lines, and 6386 ckt kms (48 percent) are of 132 KV lines (OPTCL, 2019).

The OPTCL recorded transmission losses of 3.34 percent in its transmission system for the FY 2017-18, which has decreased progressively in the past few years. The transmission system availability factor for the year 2017-18 was 99.98 percent, which is among the best in the country (OPTCL, 2019).

2.3 Distribution of Electricity

The distribution business in Odisha is overseen by four Distribution Companies (DISCOMs): Western Electricity Supply Company of Orissa Ltd. (WESCO), Northern Electricity Supply Company of Orissa Ltd. (NESCO), Southern Electricity Supply Company of Orissa Ltd. (SOUTHCO) and Central Electricity Supply Utility of Orissa (CESU).

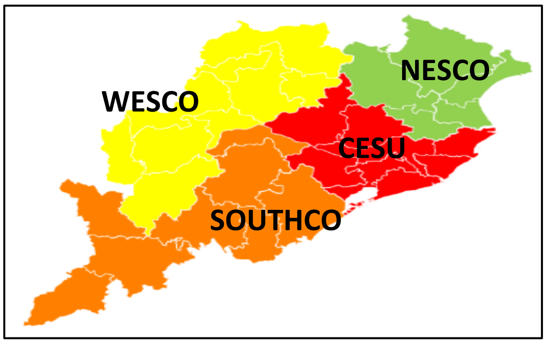


Figure 3: Distribution companies and their control areas in Odisha

After an unsuccessful attempt to privatize the DISCOMs at the turn of the century (Please refer to **Appendix-B** for reasons attributed to failure for first round of privatization of Odisha DISCOMs), DISCOMs have again been privatized recently. As on 1 April 2021, the license of distribution in the CESU, WESCO, NESCO and SOUTHCO area has all been awarded to Tata Power and the DISCOMs are rechristened as Tata Power Central Odisha Distribution Limited (TPCODL), Tata Power Western Odisha Distribution Limited (TPWODL), Tata Power Northern Odisha Distribution Limited (TPNODL) and Tata Power Northern Odisha Distribution Limited (TPNODL) respectively.

2.4 Consumption of Electricity

Energy Consumption (utilities only) has been rising progressively over the years in Odisha. The per capita consumption of electricity has increased from 1146 units/person in 2011-12 to 1622 units/person in 2016-17 (Rajya Sabha Starred Question). The domestic sector grew with a CAGR of 6.2 percent between 2014-15 and 2018-19 as against the total consumption in state with a CAGR of 9 percent during the same period (Government of Odisha, 2020). As seen in 13 below, the captive consumption for industrial use increased drastically from 24 BU to 51 BU in only four years

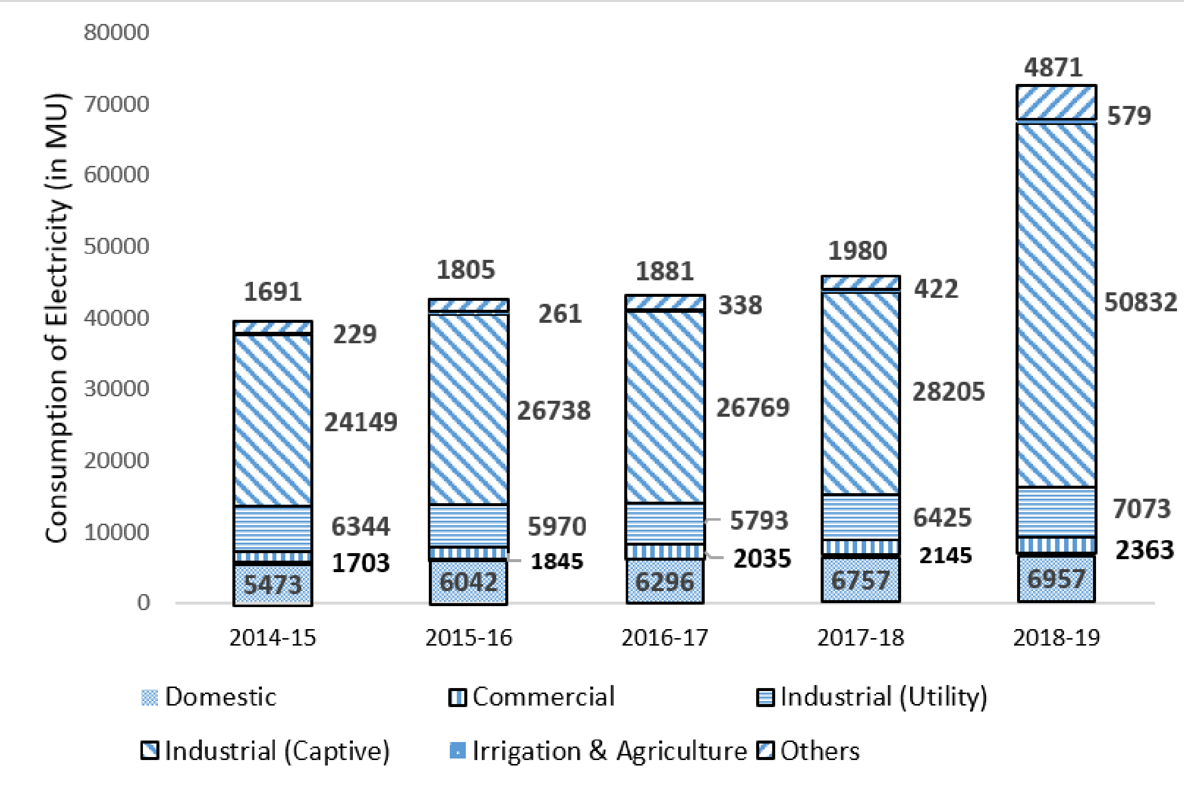


Figure 2: Electricity consumption in different sectors in Odisha
Source: Odisha Economic Survey 2019-20/ CEA General Review

Table 1 shows the sale of electricity in Odisha in FY 2017-18, segregated for EHT, high tension (HT), and low tension (LT) consumer-wise for each DISCOM. As established from **Table 1**, the CESU is the largest DISCOM in terms of the volume of electricity sold. In FY 2017-18, the sale of power in the CESU area was 5781.64 MU, which is projected to grow to 7291.51 MU by the end of FY 2019-20. The CESU serves areas which are more populated than any other DISCOM, and the same is reflected in terms of the 60 percent contribution of its total sales from the LT consumer category.

Table 1: Electricity sale in Odisha for FY 2017-18

DISCOM	% of state area served	Sale to EHT Consumers (MU)	Sale to HT Consumers (MU)	Sale to LT Consumers (MU)	Total
CESU	19%	1003	1329	3449	5782
NESCO	18%	1998	442	1795	4235
WESCO	32%	1219	1682	2476	5378
SOUTHCO	31%	399	248	1687	2334

ODISHA	100%	4620	3701	9407	17729

Source: OERC Tariff Order for DISCOMs 2018-19

2.5 Energy Sector Policies

As per the constitution of India, both the Centre and the States have jurisdiction over the electricity sector. By and large, large generation projects are with centre and the state; transmission and distribution are with state as far as management is concerned. However, through certain schemes, the centre guides the energy and development related policies through states via various enabling measures, which may be funds or capacity building for the purposes such as promotion of energy efficiency through LED bulbs or electricity for all villages and then households etc.

2.5.1 Central Government Policies

Various policies and schemes have been launched by the Government of India (GoI) to strengthen the power sector in the country and make it more sustainable. A comparative table of national-level policies in the Indian power sector having an impact on NDC Goal 3 has been provided in **Table 2.**

Table 2: Major central policies for the power sector in India

S. No.	Policy/Schemes	Description	Nodal Agency
1	175 GW Renewable Energy by 2022	To increase the total capacity of RE to 175 GW by 2022.	Ministry of New and Renewable Energy (MNRE)
2	Unnat Jyoti by Affordable LEDs for All (UJALA)	Promote replacing of ordinary bulbs with energy-efficient LED bulbs.	Energy Efficiency Services Limited (EESL) and DISCOMs of participating state
3	Perform Achieve Trade (PAT)	Reduction in Specific Energy Consumption (SEC) of energy-intensive industries.	Bureau of Energy Efficiency (BEE)
4	Clean Coal Technology (Super-critical Power Plants)	No new sub-critical power plant addition after 2017.	Central Electricity Authority (CEA)
5	Renovation and Modernization of Thermal power plants	Increasing energy efficiency of old power plants.	CEA

S. No.	Policy/Schemes	Description	Nodal Agency
6	Integrated Power Development Scheme	AT&C loss reduction and strengthening of distribution networks in urban areas.	Power Finance Corporation (PFC) Limited
7	Deendayal Upadhyaya Gram Jyoti Yojana (DDUGJY)	Rural electrification, strengthening of sub-transmission and distribution system in rural areas, and separation of agricultural and non-agricultural feeders.	Rural Electrification Corporation
8	National Smart Grid Mission	Accelerate smart grid deployment in India.	Ministry of Power
9	Ujjwal DISCOM Assurance Yojana (UDAY)	Operational and financial turnaround of state-owned DISCOMs through revival package, linked to operational and financial improvements of the DISCOM.	Ministry of Power
10	Bachat Lamp Yojana	Promote replacing incandescent bulbs with efficient CFLs.	BEE
11	Street Light National Program	Replacement of conventional street lights with LEDs.	EESL
12	Smart Meter National Program	Replacement of conventional meters with advanced metering infrastructure (smart grids).	EESL
13	Municipal Energy Efficient Program	Retrofitting inefficient municipality pump sets.	EESL
14	Renovation & Modernization, Uprating and Life Extension (RMU&LE) of hydropower plants	Increasing energy efficiency of old hydel power projects.	CEA
15	National Wind-Solar Hybrid Policy	Promotion of large grid-connected wind-solar PV hybrid systems for effective utilization of land and transmission infrastructure.	MNRE
16	National Offshore Wind Energy Policy	Explore and promote the deployment of offshore wind farms in the Exclusive Economic Zones (EEZ) of the country.	National Institute of Wind Energy (NIWE)
17	Rajiv Gandhi Grameen Vidyutikaran Yojana		Ministry of Power

2.5.2 State Government Policies

The evolution of reforms in the Odisha power sector started in the mid-1990s, following the enactment of the Orissa Electricity Reforms Act, 1995. The reforms resulted in the unbundling of the generation, transmission, and distribution sectors. This was followed by the establishment of the OERC for transparent regulation. The act also paved the way for private participation in the generation and distribution sector of the state.

Table 3: Major state-level policies for the power sector in Odisha

S. No.	Policy/Schemes/Regulations	Description	Nodal agency	Useful links (Accessed on September 20 2019)
1	Odisha Renewable Energy Policy 2016	To increase the total capacity of RE to 2.75 GW by 2022 Solar: 2200 MW Wind: 200 MW Small Hydro: 150 MW Biomass: 180 MW WTE: 20 MW.	Green Energy Development Corporation of Odisha Limited (GEDCOL) and Odisha Renewable Energy Development Agency (OREDA)	https://energy.odisha.gov.in/PDF/2178.pdf
2	OERC (Procurement of Energy from Renewable Sources and its Compliance) Regulations, 2015	11 percent of total RPO target (5.5 percent each from solar and non-solar) by 2019-20.	OREDA	http://www.orierc.org/Gazette percent 201301-2015.pdf
3	Biju Gram Jyoti Yojana	To electrify villages or habitations having less than 100 population.	District Collector's Office	http://energy.odisha.gov.in/Schemes/BGJY.pdf
4	Biju Saharanchala Vidyutikaran Yojana	Providing access to electricity to the people living in un-electrified areas of urban local bodies.	District Collector's Office	https://energy.odisha.gov.in/Schemes/Biju_Saharanchala_VidyutikaranYojana.pdf
5	OERC (Mini-Grid Renewable Energy Generation and	Facilitate the development and management of RE generation and supply	OREDA	http://www.orierc.org/GAZETTE

S. No.	Policy/Schemes/Regulations	Description	Nodal agency	Useful links (Accessed on September 20 2019)
	Supply) Regulations, 2019	through mini-grid projects.		percent 201409.pdf

For decarbonization of the power sector and increasing the share of renewables in the energy mix, the state notified the Odisha Renewable Energy Policy 2016. The policy sets out targets for 2022 and issues guidelines for the production of power from RE in the state. The policy also notifies the nodal agency for the development of different types of RE sources. The GEDCOL is notified to be the nodal agency for large scale on-grid solar projects (capacity 1 MW or above), the Engineer in Chief (EIC) - (Electricity) is notified to be the nodal agency for small hydroelectric power projects and the OREDA is the nodal agency for all other RE projects including small scale solar projects (capacity less than 1 MW).

2.6 Emissions Levels

Odisha is rich in natural resources and is highly industrialized. Odisha contributed 7 percent {178 million tonnes of CO2 (e)} of the total emissions in the country {2498 million tonnes of CO_2 (e)} in 2015 (Source: GHG Platform). In Odisha, power generation for public use contributes approximately 38 percent of the state energy sector emissions (**see Figure 3**). Industry sector emissions, which include the Captive Power generation in the state has 52 percent share in the state's energy emissions bucket. Odisha has a per capita emission of 4.22 tons which is significantly higher than the national average of 2 tons. Furthermore, emission per GSDP in the state stands at 65.7 gCO2(e)/INR which is substantially high than the national emission intensity of 23.3 gCO2(e)/INR (Source: IRADe Analysis & GHG Platform).

Industries and public electricity generation were the highest emitting sectors in 2015. As can be seen in **Figure 3**, public electricity generation alone accounted for 35 percent of total emissions in the state in 2015. Odisha's public electricity generation sector accounted for 6 percent of emissions of the national public electricity generation sector in 2015 (GHG Platform India, 2019).

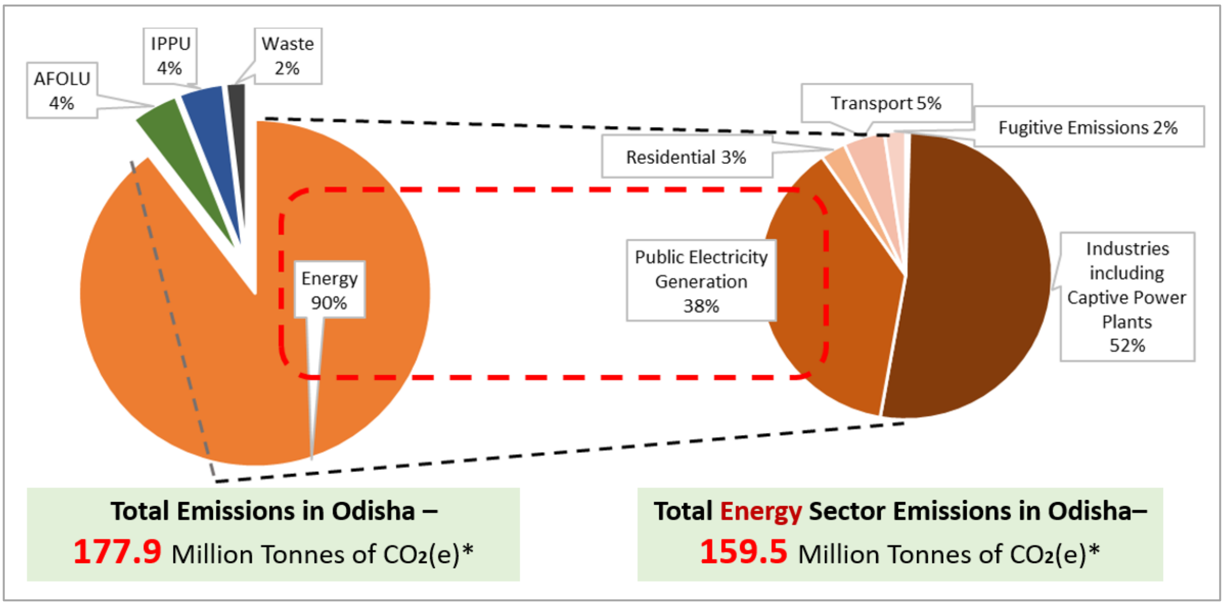


Figure 3: Sectoral GHG emissions of Odisha in 2015 (Source: GHG Platform India)

AFOLU– Agriculture, Forestry & Other Land Uses; IPPU – Industrial Product & Process Use

*CO_2 equivalence data is considered on the basis of global warming potential of gases as per IPCC AR5 synthesis report

Note: Agriculture, Fisheries & Commercial sector emission contributions in the energy domain are very limited

2.7 Odisha State Climate Change Action Plan – Power Sector Snapshots

In addition to state energy policies, each state has to develop its climate action plan. The state of Odisha was the first state in India to come up with a State-Level Action Plan for Climate Change (SAPCC) and included climate mitigation in its development planning. The first SAPCC was prepared for the term 2010-2015 and it focused more on improving the traditional system, via promoting clean coal technologies, decreasing T&D losses and promoting Demand Side Management (DSM), etc. Additionally, a key priority of the first SAPCC was institutional development, which included capacity building of the Energy Department, conducting various studies, and framing an integrated RE Policy. The state has been successful in achieving most of the tasks identified in the first SAPCC. However, tackling climate change requires continuous action and so the second phase of the Odisha State Climate Change Action Plan was prepared for 2016 – 2020.

The second SAPCC has a widened purview that includes focus areas from the first SAPCC as well as some new ones to fill the gap. The key priority areas outlined for the power sector in the second SAPCC are as follows:

Generation of power through clean coal approaches such as promoting super-critical power plants with an aim to achieve following objectives

- Target to reduce coal consumption from 1 MT to 0.88 MT per MWh
- Increase in plant efficiency from 37 percent to 42 percent
- Encourage more gas-based Combined Cycle Power Plants where CO_2 emission is 0.46 per MWh and

Institutional development of the energy department which shall include, but not limited to, following objectives

- Capacity building of Energy Conservation Cell, Orissa Electricity Regulation Commission (OERC), Orissa Renewable Energy Development Agency (OREDA), creation of separate cell for small & medium hydel plants
- Formulation of Integrated Super Critical IPP Policy

Reduction of T&D losses and distribution system improvement

Improvement in energy efficiency through the Energy Conservation Building Code (ECBC), PAT, etc.

Fly Ash Utilization.

Promotion of small and medium hydel plants.

Promotion of biomass and wind generation.

Maximizing solar energy generation potential.

Promotion of biogas and manure management.

Promotion of grid-connected wind power.

No official update on the same. Individual status update not possible due to data insufficiency

Chapter 3
Generation Profile in Odisha

Coal, followed by hydro resources, dominates the generation profile in Odisha as described above. Two major options for decarbonization of the power sector exist on the generation end: increasing the efficiency of the current system, and substituting with cleaner power generation sources such as RE. The following section will examine the current status, hurdles faced, and opportunities of transformation in different segments of the Odisha power generation system.

3.1 Thermal Power Stations

Predominant thermal power plants account for 70 percent of the total installed capacity available in Odisha (utilities). The state being home to significant coal reserves, most of the thermal plants are pit-head and thus provide cheap electricity. The efficiency of thermal power plants must be ensured from both economic and environmental points of view. If coal is expected to play a major role in the power sector of Odisha in the future as well, decarbonization options must be explored.

Figure 4 gives the plant-wise specific emissions of thermal power plants in Odisha. The per-unit emissions are dependent on various plant characteristics such as load factor, technology, and vintage, and operational maintenance.

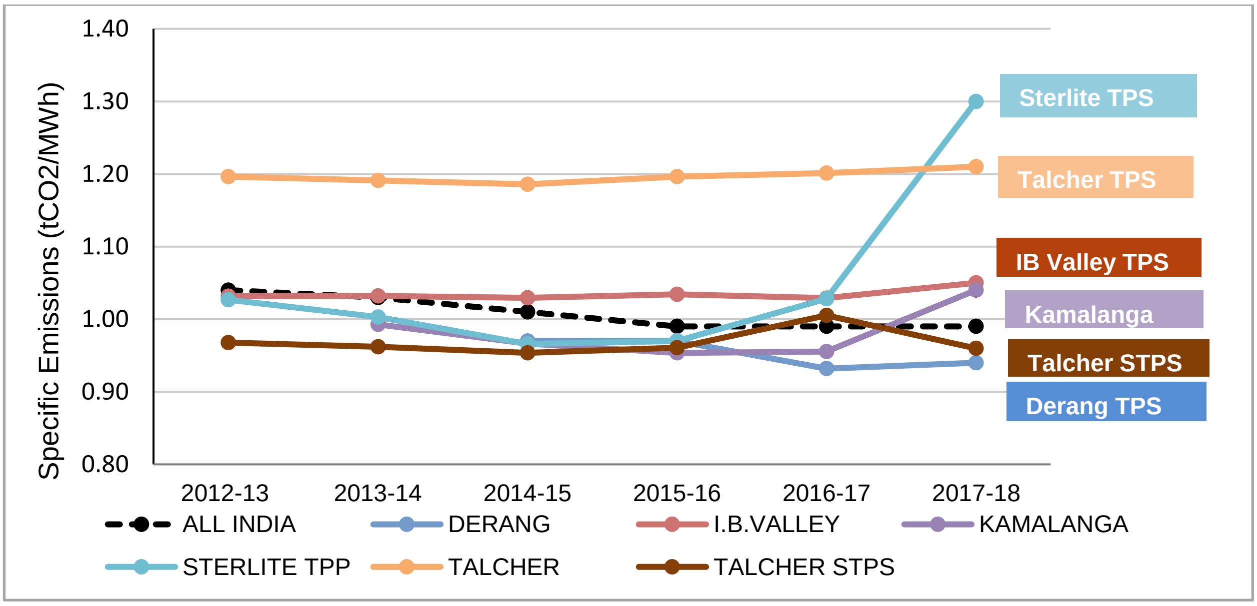


Figure 4: Plant-wise specific emissions of thermal power plants in Odisha
Source: CEA

As can be seen in **Figure 4**, specific emissions of Talcher Thermal Power Station (Talcher TPS) and IB Valley TPS are consistently high. A look on the PLF of thermal power stations of the state as shown in **Figure 5** reveal that Talcher TPS and IB Valley TPS are the plants with load factors on a higher side. It was observed during the analysis that these plants are very old. Talcher TPS is more than 50 years old and IB Valley TPS is around 25 years old. However, as per the National Electricity Plan (NEP) and as indicated by a state official, these plants are to be tentatively retired by 2022. The NEP also states that Talcher Super Thermal Power Station (Talcher STPS) can be retired by 2027.

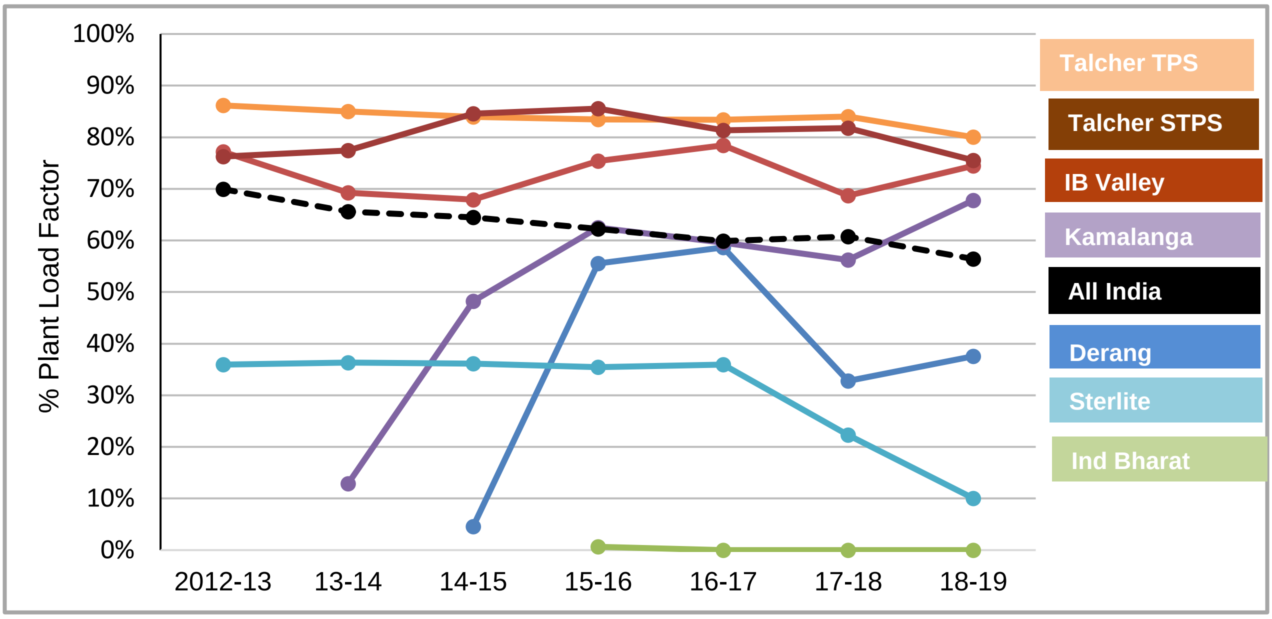


Figure 5: Plant load factor of thermal power plants in Odisha
Source: CEA

New thermal capacities amounting to 3170 MW are in the pipeline for the state. Of these, two super-critical units of IB Valley TPS (660 MW each) have already achieved COD (Commercial Operation Date) as in December 2019 (CEA, 2020).

Thermal capacities of more than 3500 MW in the state have been declared uncertain and stressed. These plants are privately-owned, and construction has stopped in these plants (CEA, 2020).

3.2 Renewables in Odisha Energy Mix

The first solar power plant in Odisha was launched in 2003 in district Bolangir with a capacity of 1 MW. The state has since been gradually increasing its capacity of renewables. **Figure 6** shows the growth of renewable capacity and generation in the state.

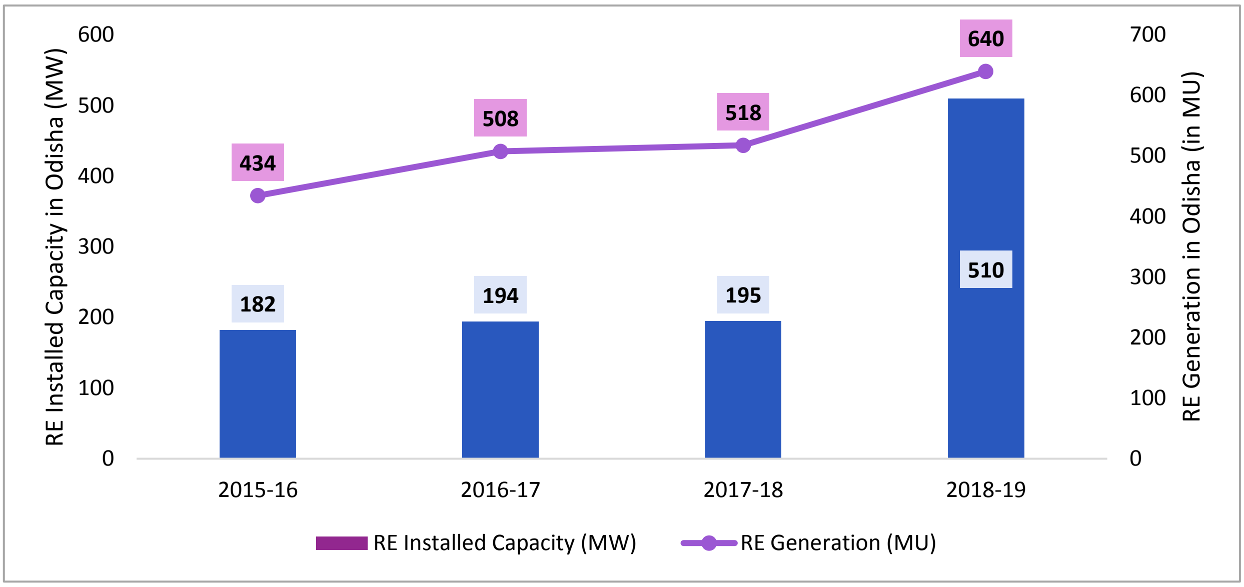


Figure 6: RE installed capacity and generation in Odisha
Source: CEA Monthly Reports

The current installed capacity of RE in Odisha (utilities only) is around 520 MW as on 30/09/2019 (CEA, 2019). The capacity is mostly based on solar, biomass, and small hydro capacities. As of now, no wind capacities are installed in the state. Interaction with established wind energy developers revealed that some patches in the state, mostly in the southern areas bordering Andhra Pradesh, have the potential of wind energy at 120 m hub height generation. However, frequent cyclones are one of the reasons that have deterred developers till now from harnessing the potential for electricity generation.

Odisha has a reasonable potential for other RE sources. As per OREDA, the total Gross RE potential in the state is around 53,820 MW, of which around 11,820 MW is the feasible potential (OREDA, n.d.). Figure 10 shows the technology-wise breakup of RE feasible potential in the state. Odisha has currently realized only 4 percent of its RE potential. Some RE stakeholders are of the view that the actual potential of solar and wind energy is lesser than the estimated value. According to an OREDA official, the potential has been estimated based on the assumption of land availability of 2 percent; but the actual land availability is far lesser because of substantial forest and agriculture land in the state.

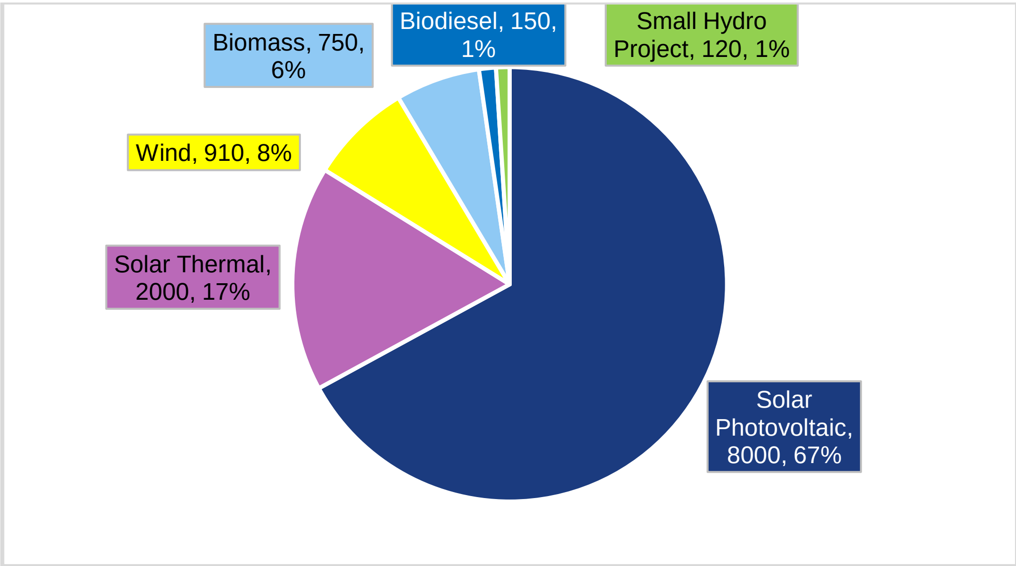


Figure 7: Technology-wise breakup of RE feasible potential (in MW) in Odisha (Source: OREDA)

Off-grid solar and mini-grids

Mini grids were conceptualized to provide uninterrupted power supply to remote villages that were otherwise un-electrified. The power supply through the mini-grids was costlier, but they provided quality power supply to the people. The electricity access lightened the lives of these villagers. Soon, it introduced the people to new livelihood avenues that uplifted them. "Mini grids enabled community-centric growth in these villages," said a state official.

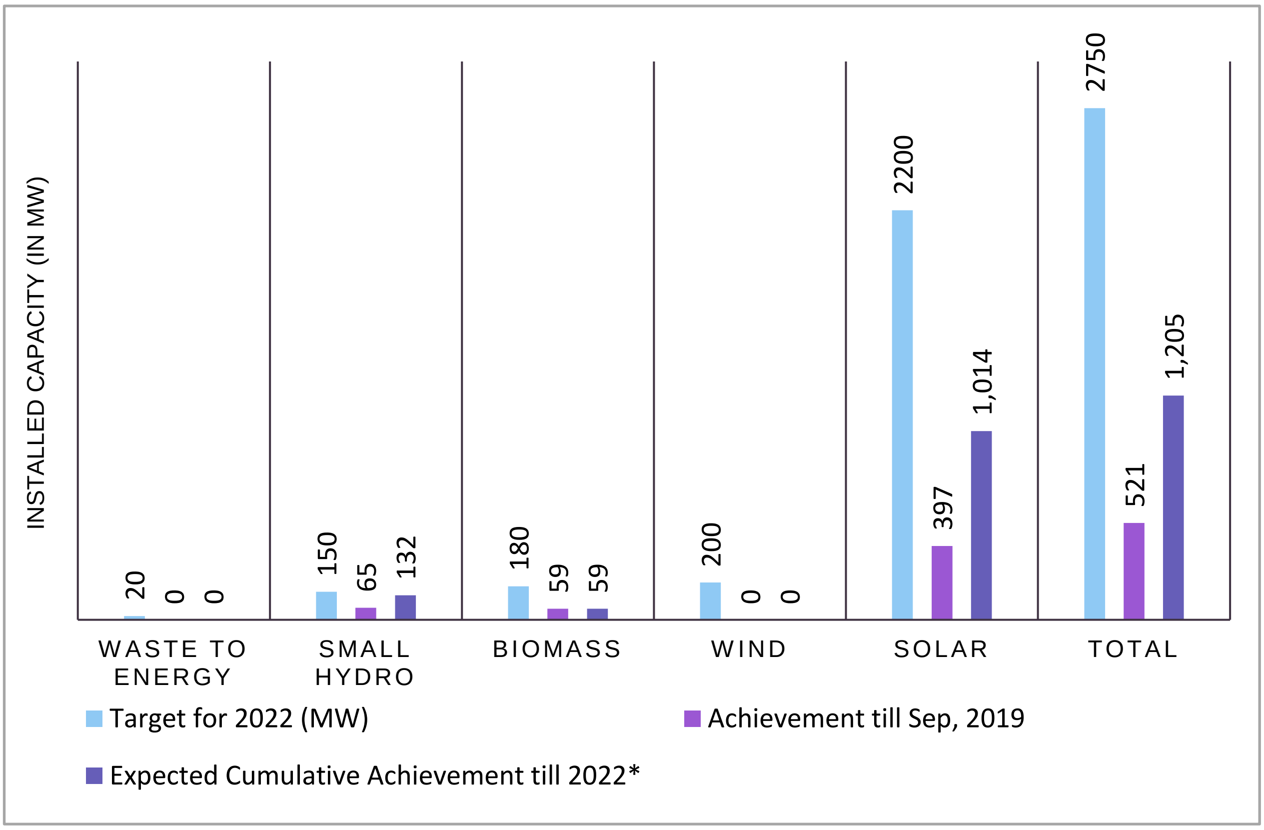
The advent of grid electricity happened all over the state, including the ones with the mini-grids. Grid electricity was heartily welcomed by the villagers as it was much cheaper compared to the mini-grids, which collapsed since then due to lack of maintenance and unawareness. Grid electricity, however, arrived with power cuts and unreliable supply.

This story is not of one but many villages in India. Today, ideas are being explored to better accumulate distributed generation. Initiatives are being taken by Smart Power India, Tata Power etc. to extend solar micro grids in rural areas to eradicate energy poverty.

3.2.1 Promoting Renewable Generation – Installed Capacity Targets (Odisha Renewable Energy Policy, 2016 and MNRE State-wise Target for 175 GW RE)

As per the Odisha Renewable Energy Policy, 2016, the target of total RE installed capacity in the state by 2022 is 2.75 GW. **Figure 8** depicts the technology-wise target, achievement until Sep 2019, and the expected achievement of installed RE capacity in Odisha until 2022. As of now, only 19 percent of that target has been achieved. While no progress has been made in the wind energy sector and the waste to energy sector, solar capacity has been able to meet only 18 percent of its target. As per the state's plan, the RE capacity of more than 600 MW will come online by 2022 (GRIDCO, 2019). Even with this addition, the state's cumulative achievement would only be 44 percent of its target set for 2022. The MNRE has proposed a target of 2.37 GW for the state by 2022, all in the form of solar capacity. Other central government targets such as 275 GW by 2027 and 450 GW by 2030 do not accompany the state-wise distribution with them.

Figure 8: Technology-wise target, achievement until September 2019 and expected achievement until



2022 of installed RE capacity in Odisha

(**Source**: Odisha RE Policy 2016, GRIDCO Tariff Orders and IRADe Analysis)

3.2.2 Promoting Renewable Generation – Renewable Purchase Obligation

The Renewable Purchase Obligation (RPO) mechanism was first envisaged under Section 86 (1) (e) of the Electricity Act 2003. The RPO is imposed on the obligated entities[9] to ensure that a fixed portion of energy, as specified by the State Electricity Regulatory Commission, be procured from an RE generating station. Separate obligations are prescribed for the procurement of solar and non-solar power.

The state started initially with exceeding solar RPO compliance; however, it has not been able to keep up with the rising targets. The shortfall has been observed for the non-solar RPO targets (Government of Odisha, 2019). **Figure 11** gives the RPO target and achievements of the state over the past years. shortfall is even higher if the state's RPO target increases through 2022 (as is shown in the Present Growth Scenario of Total RPO Target)

[9]- Entities who are obliged to have a portion of their electricity consumption generated from RE based generators-Distribution Companies, Consumers consuming electricity from its conventional Captive Generating plant of 5 MW and above capacity, consumers procuring electricity from conventional generation through open access and third-party sale

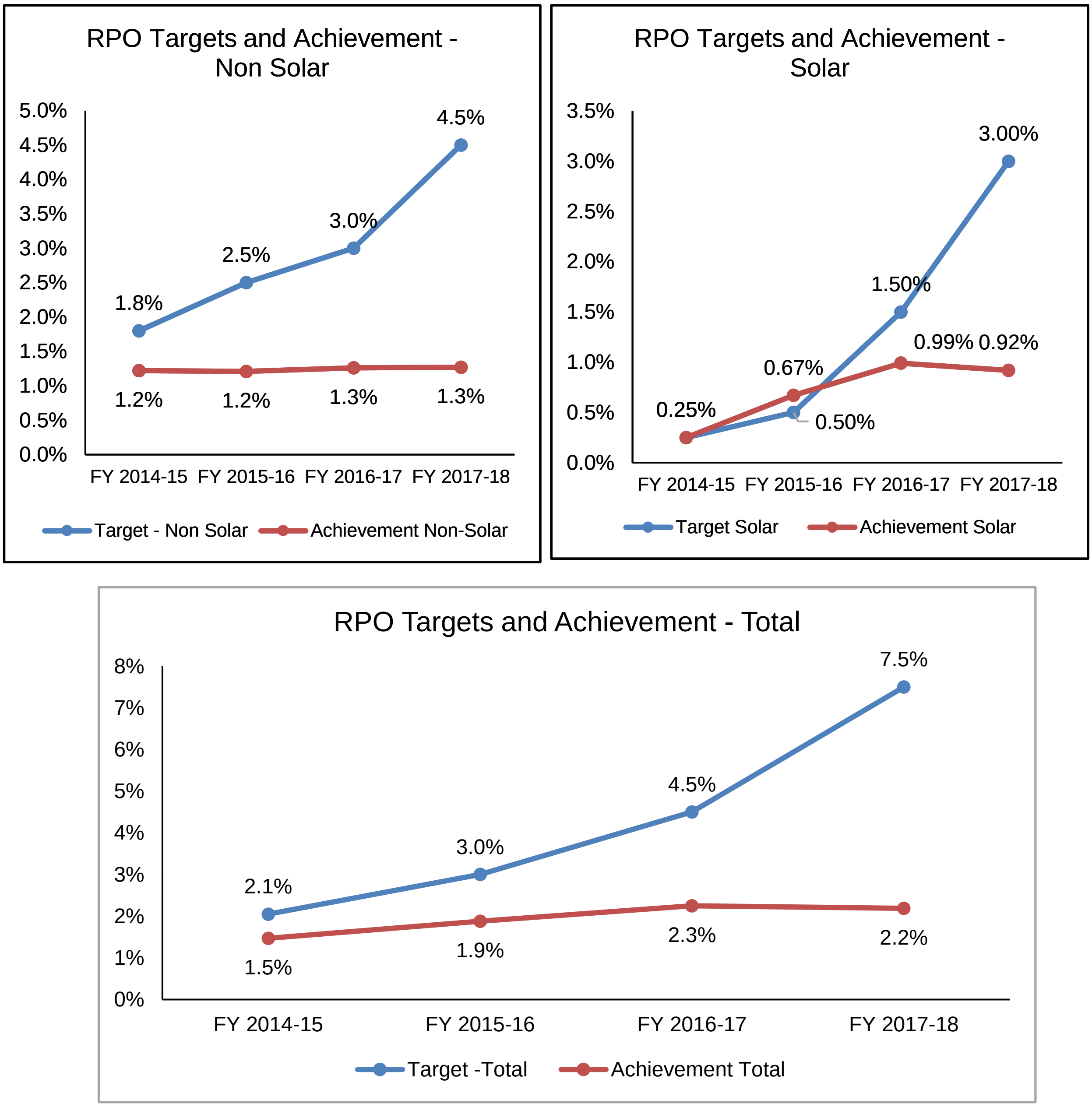


Figure 9: RPO targets and achievements in Odisha

Source: Department of Energy Activities Report 2018-19

Figure 10 highlights that even when the planned capacity of RE comes online, it does not fulfill the 11

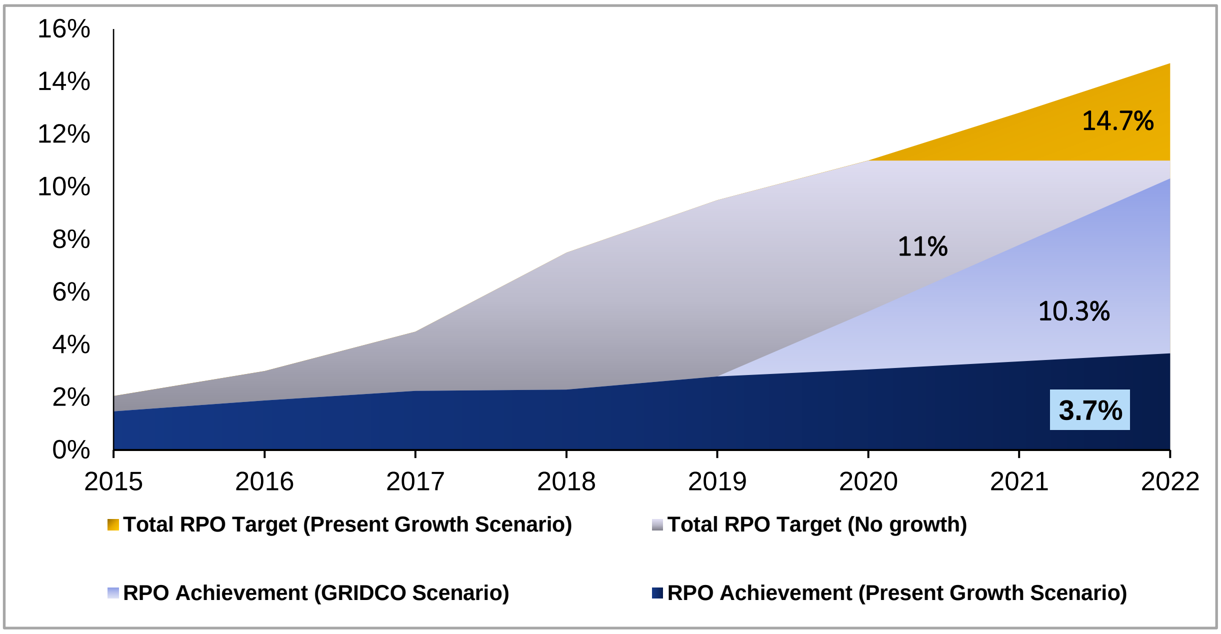


Figure 10:

Trajectory of RPO targets and achievements in various scenarios in Odisha **Source**: GRIDCO and IRADe Analysis

3.2.3 Major Hurdles in RE Growth in Odisha

The Odisha state officials believe that land acquisition is the major problem for RE development in the state. The state's RE rich sites are primarily in the forest areas or agricultural land, making it difficult for the state to go for large scale solar. In addition to this, Right of Way (RoW) issues also hinder the progress of RE in the state.

Some officials were of the view that the large-scale hydro available in the state should also be considered as RE. Large hydro would contribute towards state RE targets since the scope of doing so through other sources is limited. It was indicated that the state is trying to achieve its solar RPO targets through solar-based agricultural pumps.

Another reason for the state's shortfall in compliance to the RE targets could be the opportunity cost of RE. The state has existing Power Purchase Agreements (PPA), under which a fixed quantum of power must be purchased from conventional power sources, failing which they the capacity charges for the purchase quantum agreed upon will still have to be paid. Thus, if the difference between the demand and PPA commitments from conventional power plants is less than the RPO obligations, the opportunity cost of purchasing more renewables is the price of renewables plus the capacity charges of the PPA that is not honored.

Biomass Power – A low hanging fruit waiting to be plucked?

Odisha is primarily dependent on agriculture and has a high potential for biomass energy. However, the sector has not taken off as expected. PPAs with eight developers of biomass projects with a combined capacity of 98 MW were signed by GRIDCO in 2010. However, only one such plant, named Shalivahana Green Energy Project, was commissioned in 2011.

Despite interest from private developers, the sector has not picked up. Due to technical constraints, bio-power is yet to achieve low tariffs as compared to solar or wind energy technology. Private developers feel that raw material prices are very erratic and shoot up, especially after the initial time of the project, making it financially unviable. The developers are of the view that the government should ensure long term supply of biomass at reasonable prices. One such developer believes that a government entity may become an aggregator or sponsor cooperatives to become aggregators and ensure regular supply at reasonable prices to the developers.

Developers also feel that data availability regarding biomass waste is also an issue. One such developer is of the view that a district-wise database may be maintained by the state to aid the developers.

Since the DISCOMs in Odisha are not strong enough financially (explained in detail in later sections), it is difficult for them to balance both.

3.3 Achieving NDC Goals

Going ahead, Odisha has to decarbonize its power sector to contribute to NDC Goals 3 and 4. Based on the electricity demand for Odisha, as calculated in the 19th Electric Power Survey (EPS) Report in 2030, various scenarios were considered to assess the emissions from the sector in 2030. Assumptions associated with the scenarios are listed in Table 4.

Table 4: Scenarios and assumptions for the Odisha power sector in 2030

Scenario	Assumptions

A (Baseline scenario)	• RE capacity in the state based on projected RE capacity in GRIDCO Tariff Order 2019-20 by 2022 and no further growth of RE thereof.
B	• Older thermal power station, i.e., Talcher TPS, IB Valley TPS, and Talcher STPS retire by 2030. • The new super-critical power plant is set up in the premises of Talcher TPS • Additional power requirement is sufficient from solar capacity addition in the state.
C	• Capacity addition of Odisha's share of 275 GW RE added by 2030. • Talcher TPS and IB Valley TPS 1 are retired by 2030. • The new super-critical power plant is set up in the premises of Talcher TPS.
D	• Capacity addition of Odisha's share of 275 GW RE added by 2030. • Talcher TPS and IB Valley TPS 1 and Talcher STPS are retired by 2030. • The new super-critical power plant is set up in the premises of Talcher TPS.
E	• Capacity addition of Odisha's share of 450 GW RE added by 2030. • Talcher TPS is retired by 2030.
F	• Capacity addition of Odisha's share of 450 GW RE added by 2030. • Talcher TPS and IB Valley TPS 1 is retired by 2030
G	• Capacity addition of Odisha's share of 450 GW RE added by 2030. • Talcher TPS and IB Valley TPS 1 and Talcher STPS are retired by 2030. • The new super-critical power plant is set up in the premises of Talcher TPS.

The analysis shows a progressive decrease in the emissions from the baseline scenario in the power sector of the state. **Figure 11** shows the total and specific emission in the Odisha power sector in 2030. The trend reveals that both the two interventions considered here, i.e., increasing RE capacity and retirement of older TPS, are effective in decreasing the emissions. Retirement of TPSs decreases the emissions through replacement by other plants within the state boundary and central sector plants located outside the state boundary (whose emissions are not considered as state's emissions). The analysis sees a lesser increase in emissions involving TTPS expansion due to an increase in power exported to other states through the plant. **Figure 14** shows the power exported outside the state boundary.

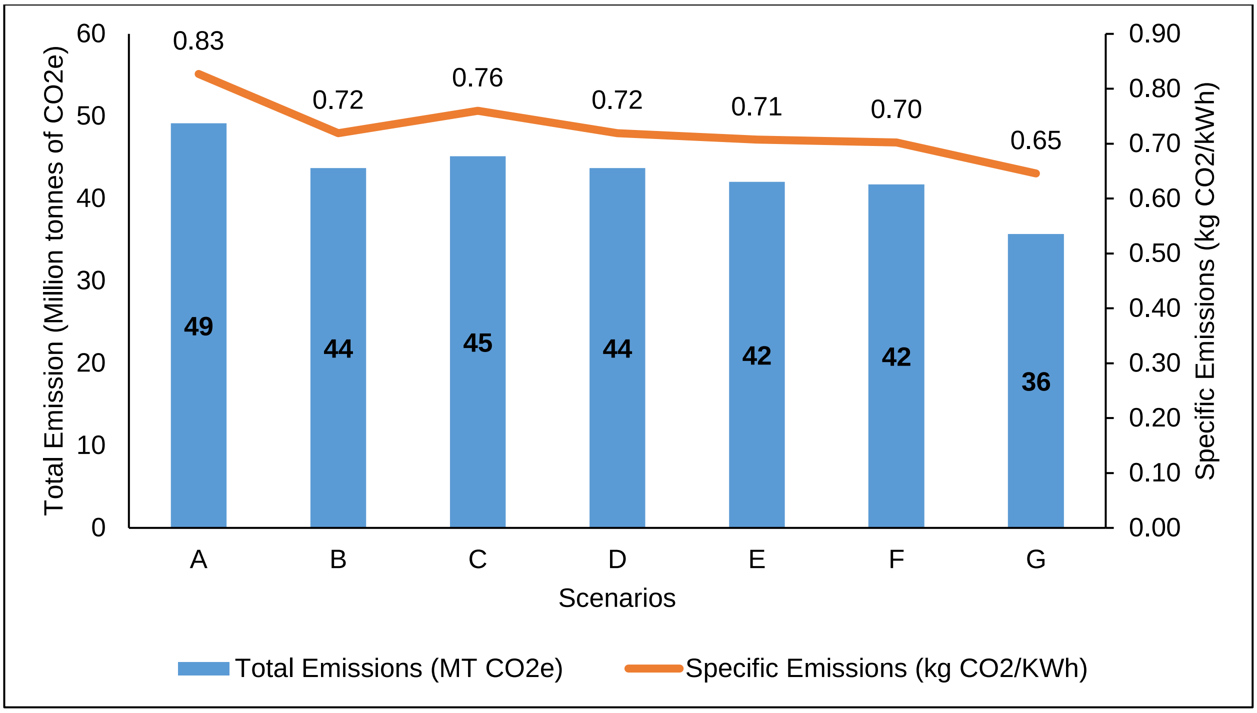


Figure 11: Total and Specific Emissions of Odisha Power Sector (Utilities) in 2030 in various scenarios

Source: IRADe analysis

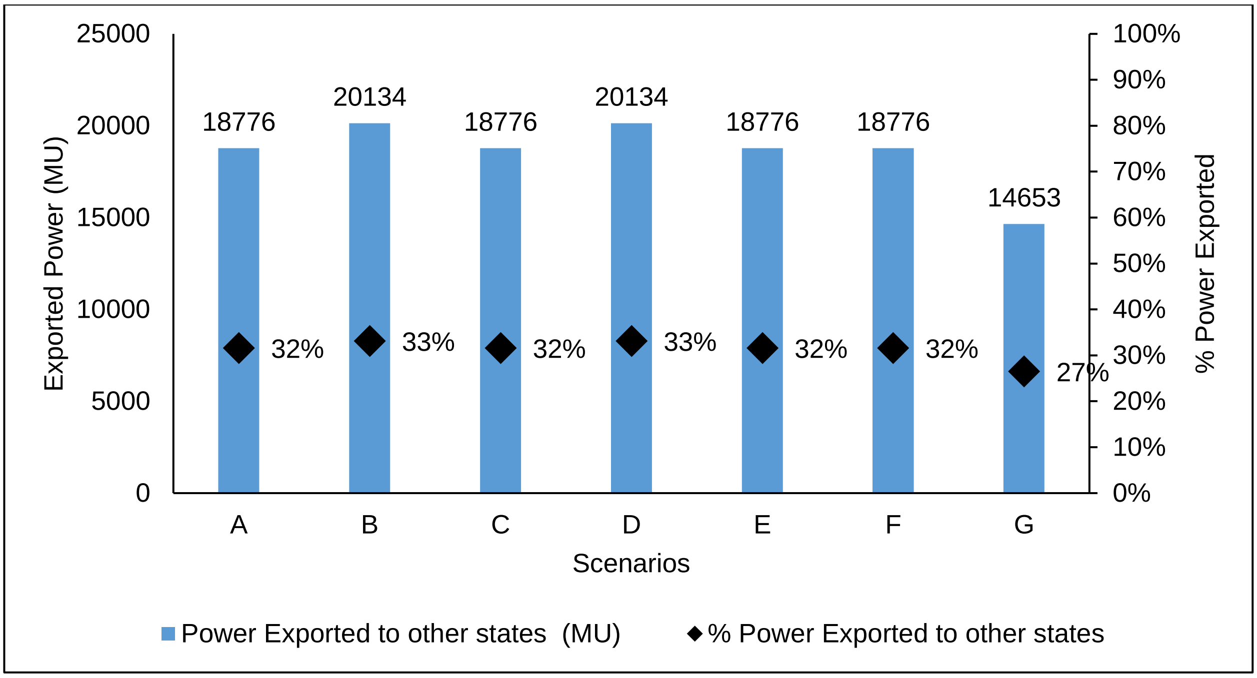


Figure 12: Power exported to other states by power plants in Odisha in 2030 in various scenarios

Source: IRADe Analysis

The incremental cost of decarbonization in each scenario will be due to the higher variable cost of inter-state generating stations, higher fixed cost of new TPS, and comparatively higher cost of solar energy in Odisha. **Figure 15** shows the incremental cost of different scenarios against emission reduction in Odisha in 2030. The 450 GW scenario with retirement as per NEP comes (SCENARIO "G") out to be a cost-effective scenario.

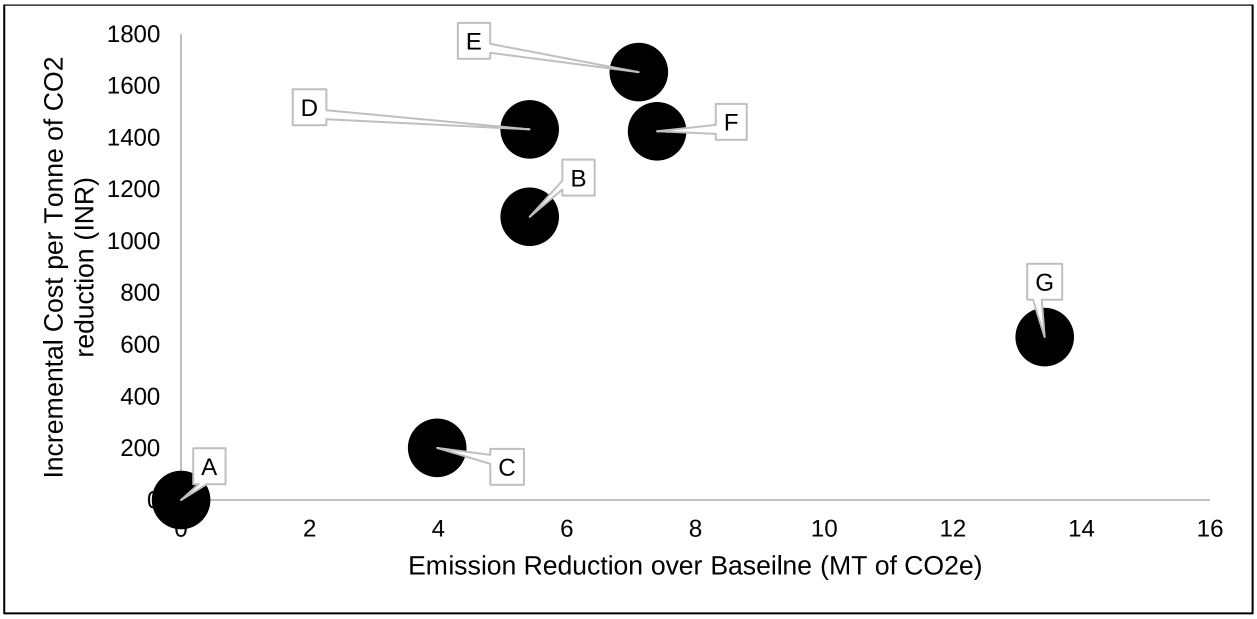


Figure 13: Incremental cost of different scenarios against emission reduction in Odisha in 2030

Source: IRADe Analysis

It would require at least the 250 GW scenario to achieve that goal. **Figure 14** shows the installed capacity of non-fossil fuel-based resources in the state (utilities only) by 2030.

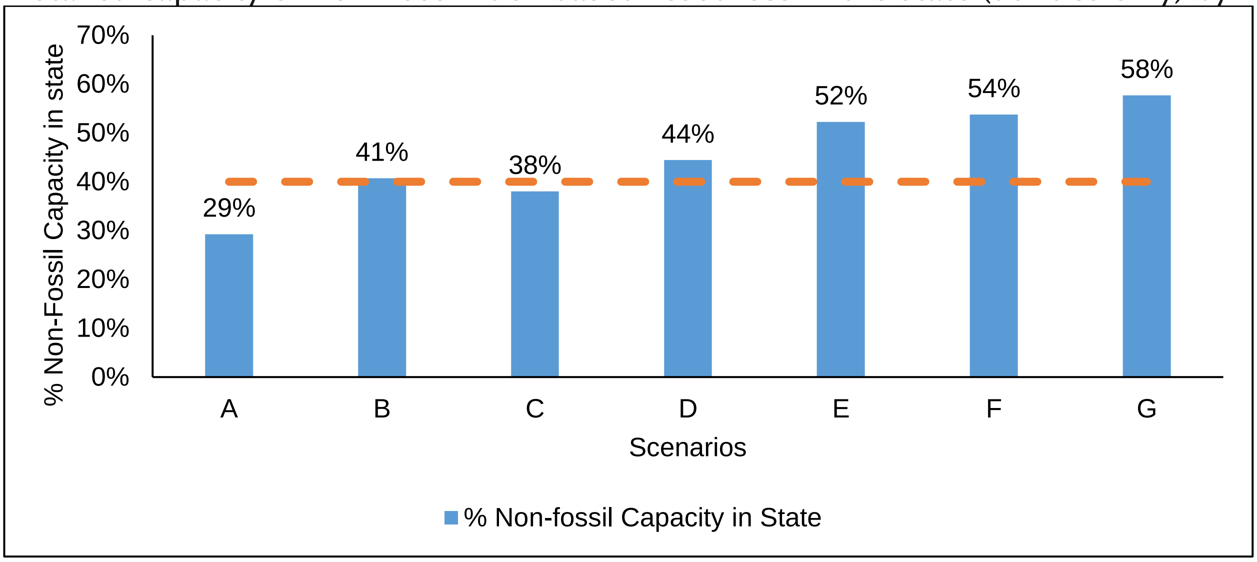


Figure 14: Percentage of non-fossil fuel-based installed capacity in Odisha (utilities) in 2030 in various scenarios

Source: IRADe Analysis

3.4 Captive Power Plants

The state of Odisha being rich in minerals, is home to various industries. Besides, the state is also rich in coal resources. Large industries in the state are supported by CPPs for their energy requirements. The CPPs are characterized by small units that are sufficient to fuel the electricity needs of the industry. However, these plants are inherently less efficient than the large-sized grid-based power plants. CPPs flourished in Odisha in the mid-2000s, they allowed industries to produce cheap (and reliable) electricity for themselves and even supported the state grid during the time of deficiencies. However, now that Odisha has surplus capacity, we assessed the potential of emission reduction in shifting the CPPs to the grid. The capacity expansion and economic aspects of such a move were also calculated.

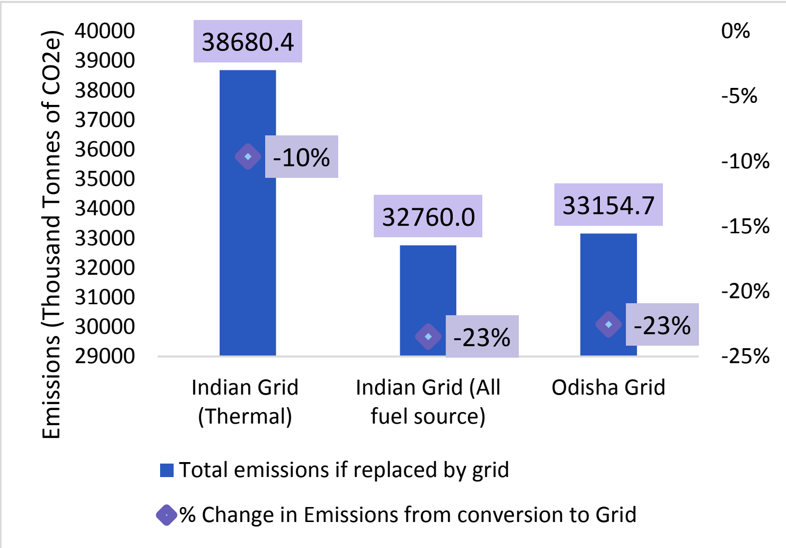
The total installed capacity of CPPs (11 GW) in Odisha is higher than the capacity installed for public electricity generation (9 GW). As shown in **Table 5** below, this study analysed 63 percent of the total installed CPPs in the state. CPPs are based on various technologies. Large industries may have Waste Heat Recovery plants and cogeneration plants that are more efficient than regular coal-based power plants. However, for this analysis, firms with only coal-based units were chosen. Data on firm-wise installed capacity of CPPs and the generation of electricity by them in 2018-19 was collected (EIC Odisha). Actual emissions from CPPs are not publicly available; so, emission Factors from the Central Electricity Authority (CEA) were chosen - based on the unit size of the CPPs - to calculate the emissions in 2018-19. The resultant emission factor for CPPs in Odisha was subsequently calculated. A general profile of the analyzed CPPs is given in **Table 5**Error! Reference source not found..

Table 5: General profile of CPPs in Odisha

Parameter	Analysed	Total
Capacity of CPPs analyzed (MW)	7126	11391
Total generation from CPPs in 2018-19 (MU)	39470	58408
Average PLF of CPPs in 2018-19	63 percent	59 percent
Total emissions from CPPs in 2018-19 (thousand tonnes of CO2)	42807	-
Average emission factor of CPPs (thousand tonnes of CO2/MU or kg CO2/KWh)	1.1	-

Source: IRADe Analysis/ CEA

The average emission factor of analyzed CPPs was found to be higher than that of grid thermal (coal) power plants by virtue of their size. Thus, it was concluded that a potential of emission reduction exists from shifting the CPPs into the grid. Comparison from the Indian grid (thermal), Indian grid (all sources), and Odisha grid in 2018-19 yielded the emission reduction potential from converting CPPs to the grid. Results, as shown in **Figure 17**, indicate that emissions from analyzed CPPs can be reduced by up to a quarter by conversion to the grid.



Emission Factor in 2018-19 (kg CO2/KWh)	
Indian grid (thermal)	0.98
Indian grid (All fuel sources)	0.83
Odisha grid	0.84

Source: CEA and IRADe Analysis

Figure 15: Emission reduction potential in converting CPPs to Grid

A spreadsheet-based model was created based on the Odisha grid's key parameters in 2018-19. The model assessed the power sector emissions (including CPPs) in 2018-19 in different scenarios considering the demand of Odisha Grid in 2018-19 and the demand from CPPs in the same year.

Details of the scenarios and assumptions associated with them are given in **Table 6.**

Table 6: Scenario and assumption for CPP shift to the grid in 2018-19

Scenario	Assumptions
Current power sector emissions (No captive shift)	This is the baseline scenario considering the emissions of Odisha grid and analyzed CPPs.
Captive shift - super-thermal	Shifting of analyzed CPPs to current Odisha grid, and sufficing the remaining electricity demand from a new Super-thermal Power plant.
Captive shift - super-thermal, retirement of TTPS and IB Valley -1	Shifting of analyzed CPPs to current Odisha grid, and sufficing the remaining electricity demand from a new Super-thermal Power plant, Retirement of old thermal power stations whose emission factors are higher than or comparable to emission factor of the analyzed CPPs.
Captive shift - 50% super-thermal, 50% solar	Shifting of analyzed CPPs to current Odisha grid, and sufficing half of the remaining electricity demand from a new

Scenario	Assumptions
	Super-thermal Power plant and another half from solar energy.
Retirement of Talcher TPS, IB Valley 1 – captive shift – 50% thermal, 50% solar	Shifting of analyzed CPPs to current Odisha grid, Retirement of old thermal power stations whose emission factors are higher than or comparable to emission factor of the analyzed CPPs, and sufficing half of the remaining electricity demand from a new Super-thermal Power plant and another half from solar energy.
Captive shift – solar	Shifting of analyzed CPPs to current Odisha grid, and sufficing the remaining electricity demand from solar energy.

Source: IRADe Analysis

For the scenarios involving shifting of CPPs to the grid, the demand for electricity from CPPs was first met through the existing grid capacity in the model. The leftover demand was then used to assess the additional installed capacity required.

The results of emissions in different scenarios are given in **Figure 18**. The figure displays that a progressive decrease in emissions is seen as we move from the current power sector scenario in Odisha to captive shift – solar scenario. However, it must be said that although the captive shift – solar scenario leads to the highest reduction in emissions, such a scenario is hypothetical and currently not feasible without battery support or other storage technologies.

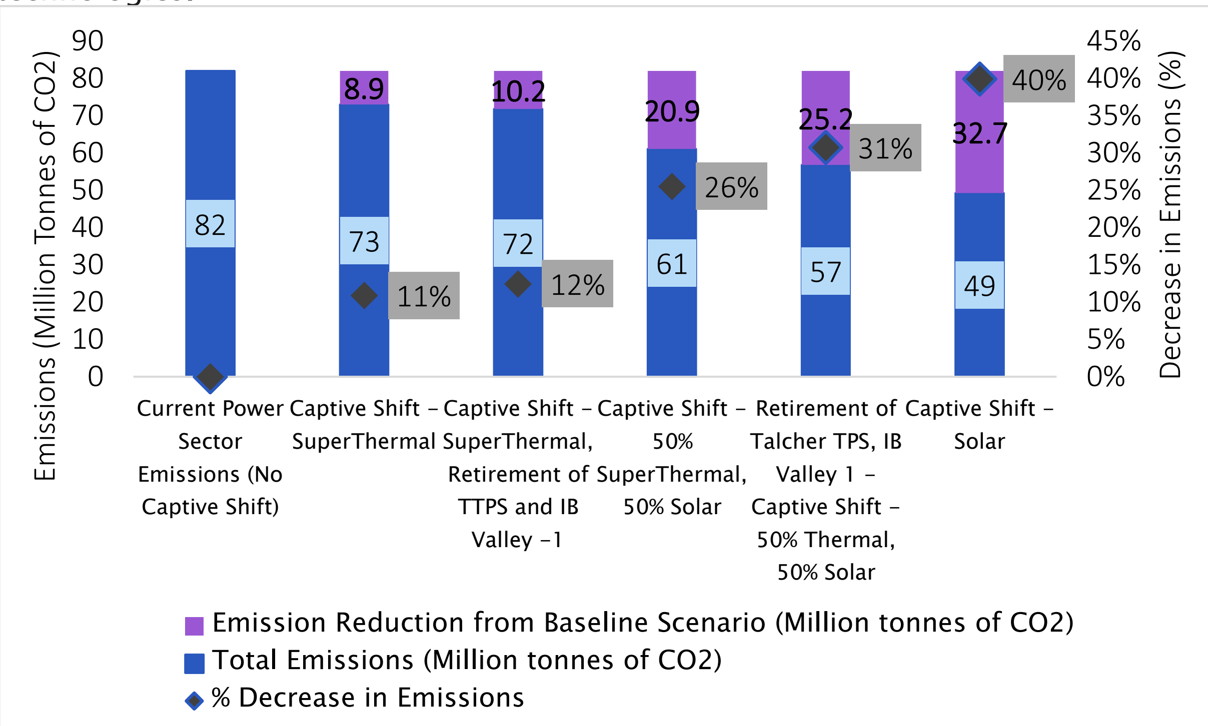


Figure 16:

Emission reductions from captive shift in various scenarios in 2018-19

Source: IRADe Analysis

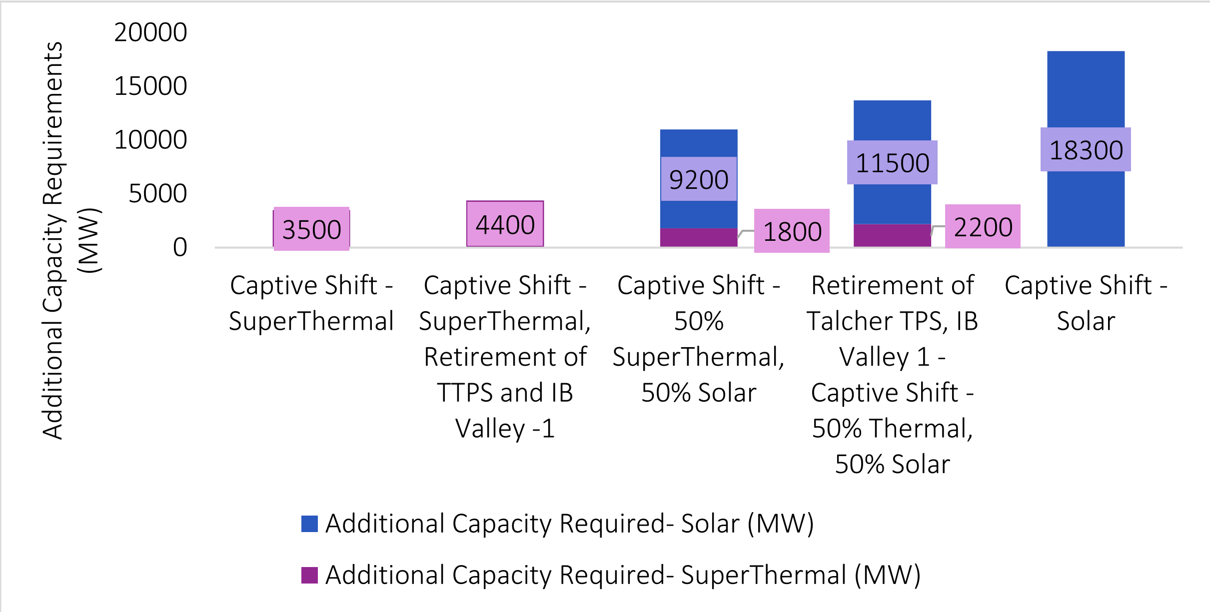


Figure 17: Source-wise installed capacity required in various scenarios in 2018-19
Source: IRADe Analysis

Figure 19 depicts the source-wise additional capacity required in each scenario in 2018-19.

Even with their inherent inefficiency, CPPs have thrived in India and Odisha due to their cost advantage and the demand for reliable electricity. To assess the extent of this cost advantage, tariffs for two 200 MW CPPs were calculated based on the methodology used by CERC (Terms and Conditions of Tariff), and landed cost of coal in 2018-19. The first CPP was assumed to be ten years old in 2018-19 and was termed 'old' CPP, and the other CPP was assumed to be commissioned in 2018-19 and was termed as 'new' CPP.

The tariffs of these CPPs were compared to the average per unit charge (HT) and the average per unit charge (EHT) in Odisha in 2018-19. The annual cost difference between the power from CPPs and power from the Odisha grid gave us the annual losses that a CPP would incur by shifting to grid power. The tariffs of the old CPP and new CPP were then compared to the average cost of supply of electricity in Odisha in 2018-19, and the annual cost difference between the two was calculated. The tariffs used are given in Table 7. The annual cost difference between power from CPPs and power from the grid is given in **Table 8.**

Table 7: Tariffs used in 2018-19 in INR/ kWh

Plant established ten years ago (old **CPP**) *	4.004
Plant established in 18-19 (new **CPP**) *	**4.75**
Average per unit charge (HT)#	5.77
Average per unit charge (EHT)#	**5.8**

Average cost of supply (ACS)#	4.89

Source: * IRADe Analysis, # GRIDCO Tariff Order

Table 8: Difference in total annual cost if electricity purchased from the grid instead of own CPP in FY 2018-19 (Annual Electricity Cost from CPP vs Annual Electricity Cost from Grid)

Annual cost comparison (2018-19)	INR Crore
Old CPP vs. HT	-195.6
Old CPP vs. EHT	-197.9
New CPP vs. HT	-113.0
New CPP vs. EHT	-115.2
Old CPP vs. ACS	-98.2
New CPP vs. ACS	-15.5

Note: Negative symbol denotes that there is a loss by shifting to grid if existing tariffs for HT/EHT are considered

The analysis shows that industries currently have little incentive to dismantle their existing CPPs and move to the grid. The cost difference is significant, even for new CPPs. This shows that large industries still have an economic advantage in setting up a new CPP rather than obtaining power from the grid.

The results also show that industries make losses even if the cost of power supply to industries is reduced to the average cost of supply in Odisha in 2018-19. Overall, around 30 percent reduction in tariffs is needed for such a shift to take place.

The analysis shows that a clear emission reduction potential exists in shifting CPP capacities to the grid. However, losses that firms would incur on making such a move are also staggering. Therefore, policy incentives are required that discourage new CPPs of smaller capacities from being installed and encourage old CPPs to shift to the grid.

Chapter 4
Transmission and Distribution in Odisha

4.1 Aggregate Technical and Commercial Losses

Due to its topography, extreme climate vulnerabilities - which are not limited to cyclones and hot temperatures- as well as consumer mix, Odisha's distribution sector deals with a variety of issues while catering to its consumers. The state has invariably high AT&C losses as compared to the national average, with around a third of its energy purchased lost due to system inefficiencies.

Odisha is one of those states in the country which needs substantial improvement in terms of reduction of AT&C losses. The state, as discussed, has four distribution licensees: CESU, NESCO, WESCO, and SOUTHCO, catering to a population of more than 4.6 crore scattered over an area of 1.55 lakh sq.km. **Table 9** shows the AT&C losses in Odisha for the last five years, and the graph shows the trajectory.

Table 9: AT&C loss trajectory for DISCOMs in Odisha

DISCOMs	FY 13-14	FY 14-15	FY 15-16	FY 16-17	FY 17-18	FY 18-19
CESU	40%	38%	37%	35%	34%	30%
NESCO	36%	33%	30%	26%	27%	24%
WESCO	41%	38%	38%	39%	35%	32%
SOUTHCO	46%	45%	44%	41%	38%	39%
All Odisha	37%	38%	37%	35%		

Source: OERC Tariff Orders

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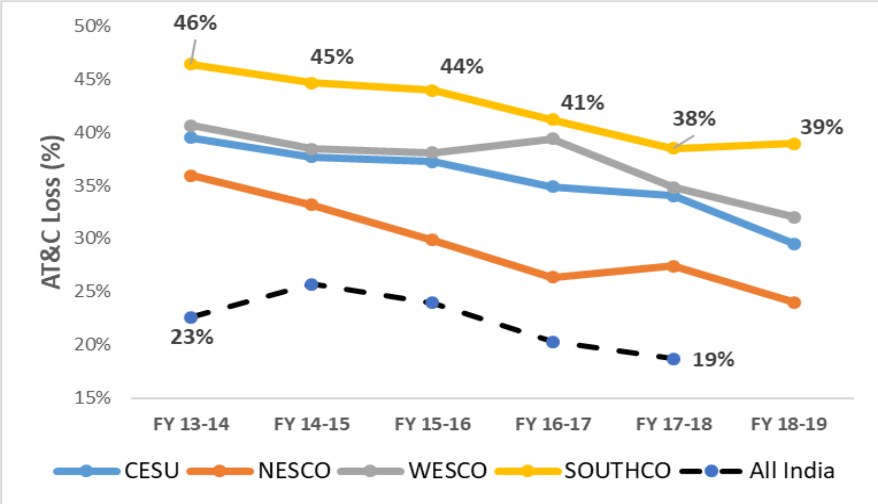

Figure 18: Aggregate technical and commercial losses –Odisha DISCOMs
Source: OERC Tariff Order for DISCOMs

It can be seen from the above graph that SOUTHCO has the highest losses among all the four DISCOMs losing close to 40 paise per rupee of electricity purchased by the DISCOM. While the losses have come down for all the DISCOMs, the rate of loss reduction has failed to meet the targets identified by the state. **Table 10** compares the target identified by the state in its Power for All document with the actual status.

Table 10: Target and achievement of performance by Odisha DISCOMs

DISCOMs	AT&C Loss		Collection Efficiency	
	Target (FY 2017-18)	Actual (FY 2017-18)	Target (FY 2017-18)	Actual (FY 2017-18)
NESCO	24%	26%	99%	93%
WESCO	26%	39%	99%	88%
SOUTHCO	29%	38%	99%	91%
CESU	24%	34%	99%	97%

Source: PFA and OERC Tariff Order for DISCOMs

As shown in **Table 10** above, apart from NESCO, no other DISCOM has made significant improvements in the loss levels. The collection efficiency of WESCO is less than 90 percent, and a significant improvement is needed. In terms of household electrification, 100 percent electrification, as mandated under the Saubhagya Scheme, has been achieved. While this is a remarkable achievement, it might have contributed to technical losses of the DISCOMs in the short term as the loss levels of LT divisions are higher for all DISCOMs as compared to HT/EHT divisions. Also, the cost of serving a household is not realized by the tariff alone, and there is a substantial difference in the Average Cost of Supply (ACS) to the Average Revenue Realized. **Table 11** below shows the ACS for the state and compares it with the tariff of the three categories of consumers, viz. LT, HT, and EHT, and also showcases the cross-subsidy applicable for each category of consumers.

Table 11: ACS and cross-subsidization per unit of each consumer category

Year	Voltage level	ACS (INR /kWh)	Average tariff (INR/kWh)	Cross subsidy (INR /kWh)
FY 15-16	EHT	4.89	5.72	0.83
	HT		5.76	0.87
	LT		3.97	-0.92
FY 16-17	EHT	4.80	5.72	0.92
	HT		5.76	0.95
	LT		3.93	-0.87
FY 17-18	EHT	4.88	5.80	0.92
	HT		5.82	0.93
	LT		3.99	-0.89
FY 18-19	EHT	4.89	5.77	0.87
	HT		5.79	0.90
	LT		3.99	-0.91
FY 19-20	EHT	5.00	5.77	0.78
	HT		5.79	0.80
	LT		4.06	-0.94

Source: DISCOM Tariff Order dated 29.03.2019

Table 12 given below shows the household electrification by Odisha DISCOMs between October 10,2017 (Prime Minister Narendra Modi launched the Saubhagya Scheme in September 2017) and March 31, 2019.

Table 12: Household electrification in Odisha under SAUBHAGYA

DISCOM	Total households	Households (HH) electrified between October 10, 2017, and March 31, 2019	Percentage of HH electrified between October 10, 2017, and March 31, 2019
NESCO	22,55,344	5,11,787	23%

WESCO	21,95,918	7,68,766	35%
SOUTHCO	21,92,813	5,87,769	27%
CESU	30,27,778	5,84,122	19%

Source: SAUBHAGYA Dashboard – accessed on 01.03.2020

As shown in the **Table 12**, the state DISCOMs have made significant progress in household electrification after the SAUBHAGYA scheme and the targets mentioned in the Power for All document stand achieved. The AT&C loss levels of the state are primarily due to the low billing efficiency of the LT consumers.

Table 13: LT division performance for FY 2017-18

LT Division DISCOM	Energy input (MU)	Energy sold (MU)	T&D loss	Billing efficiency	Collection efficiency	AT&C loss
CESU	5668	3580	37%	63%	94%	41%
NESCO	2733	1795	34%	66%	95%	38%
WESCO	3864	2476	36%	64%	71%	55%
SOUTHCO	2623	1726	34%	66%	87%	42%
Odisha Total	14888	9577	36%	64%	87%	

Source: OERC ARR for DISCOMs dated 29.03.2019

Table 13 shows that a substantial portion of the energy is lost as it never shows up on the bill of a consumer.

Figure 19 below shows the billing efficiency and loss levels across various LT divisions were segregated on the basis of each DISCOM's control area. The billing efficiency of LT divisions across all the four DISCOMs is quite low. Further, almost 30 percent of the billed amount is not collected from WESCO consumers, which aggravates the loss of the LT division in the DISCOM to 55 percent. This means that more than half of the energy supplied to LT consumers in the WESCO control area is not realized and hence the troubled condition of distribution in Odisha.

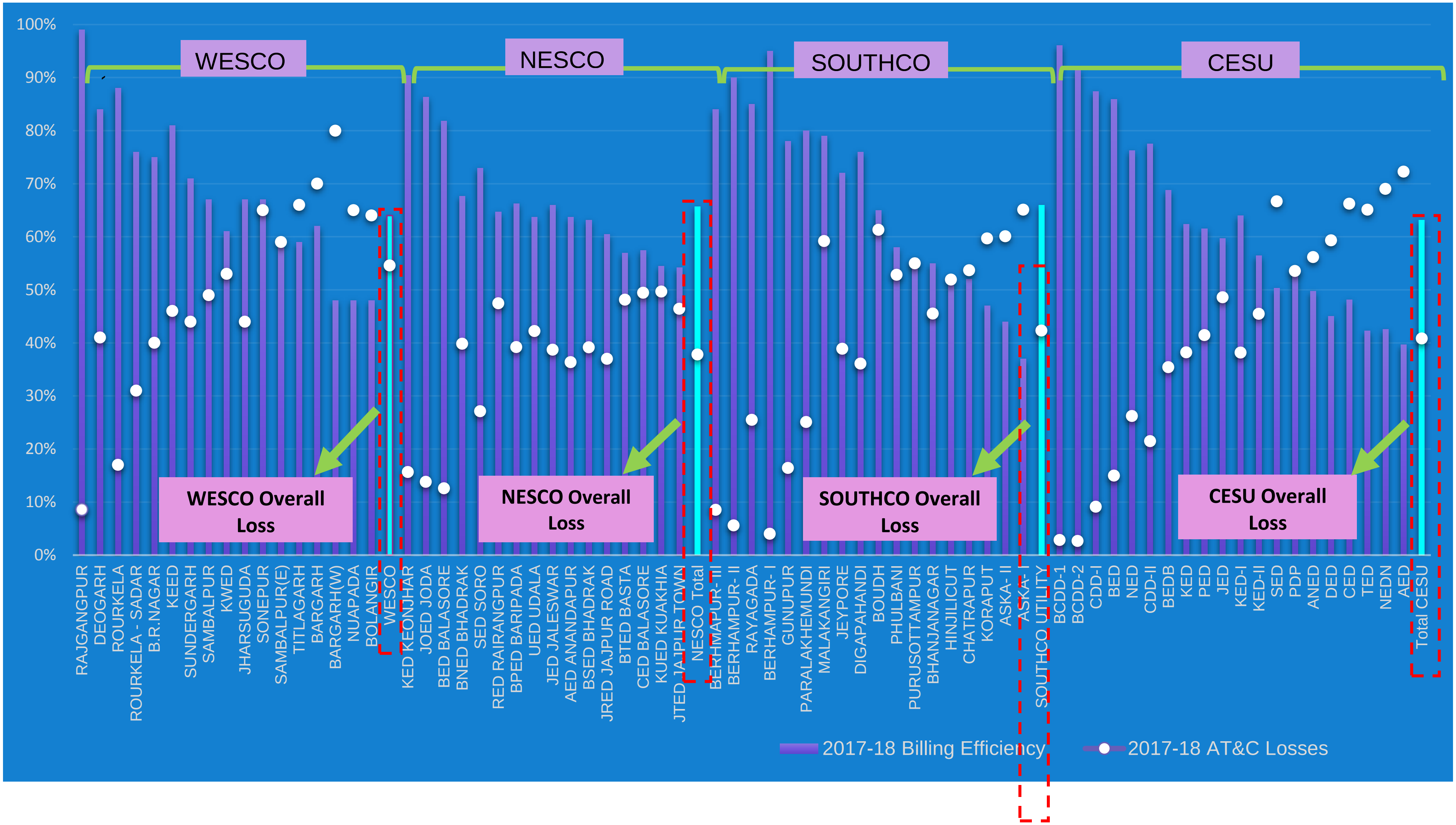

Figure 19: Odisha DISCOMS - AT&C loss and billing efficiency of various LT divisions

4.2 DISCOM's Performance for Agricultural Consumers

As discussed earlier, a substantial portion of the state population is dependent on agriculture and allied activities. It is imperative for the state DISCOM as a public unit enterprise to ensure a minimum quantum of electricity supply to its agro-consumers and do so with minimum leakage of electricity from its system. As of March 2019,[10], the state had a registered count of 104,106 agricultural consumers accounting for a total load of 440 MW. Of the total agricultural consumers, around 42 percent are either supplied unmetered electricity or through defective meters. Hence, accountability for agricultural consumers is quite low, which raises pilferage threats. The revenue realization ratio for the Odisha DISCOMs is only 46 percent for agricultural consumers, which means that close to 55 percent of the total energy supplied for agricultural consumption is lost. For FY 2018-19, this led to a cumulative revenue loss of INR 68.6 crore in Odisha. The Figure 23 graph captures the individual DISCOM's performance level and its share in Odisha's agricultural sector on various parameters.

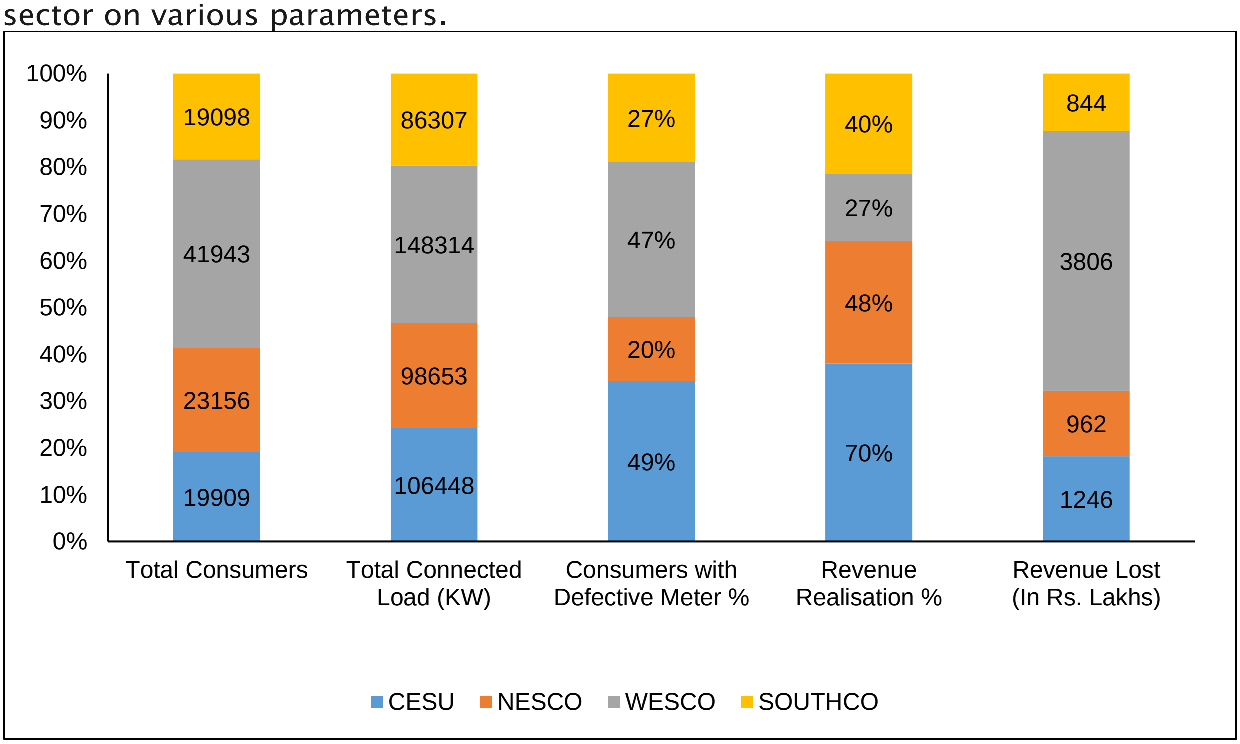

Figure 20: DISCOM's agricultural consumer performance for FY 2018-19
Source: ARR of DISCOMs

[10]Source: ARRs filed by DISCOMs for FY 2019-20 and FY 2020-21

4.2.1 Fixed Cost Obligations of DISCOMs

One of the major analysis outputs that were confirmed during the discussions with the stakeholders was that Odisha currently has overcapacity commitment in terms of energy requirement. The CEA's Load Generation Balance Report (LGBR) confirms that the state completely met its 29,692 MU of energy requirement, i.e., it had zero energy requirement shortfalls in 2019-20. The state was also able to meet its peak load requirement of 5292 MW in 2019-20.

It was also highlighted during one of the discussions that the fixed cost obligations of the state due to this overcapacity may be a limiting factor in fresh commitment of PPA by the state utility, GRIDCO. This also means that new generators, including RE generators, may find it difficult to have their generations scheduled in the state.

4.2.2 Private Sector Participation in the operation of DISCOM

In a recent development, w.e.f. 1 June 2020, the control area of CESU, serving a population of 1.36 crore with customer base of 26 lakh and a distribution area of 29,354 sq. km., has been handed over to TP Central Odisha Distribution Limited (TPCODL) - a joint venture between Tata Power and the Government of Odisha with the majority stake being held by Tata Power Company (51 percent). The distribution franchisees (FEDCO and ENZEN), which were earlier executing various functions including collection and other value chain related activities, in CESU area have been discontinued. Further, Tata power company (TPC) has also won the bid to manage the other three DISCOMS in the state namely NESCO, WESCO and SOUTHCO and has acquired 51% stake in all the three organization rechristening their names and starting operations as TP Northern Odisha Distribution Limited (TPNODL) {w.e.f. 1 April 2021}, TP Western Odisha Distribution Limited (TPWODL) {w.e.f. 1 January 2021} and TP Southern Odisha Distribution Limited (TPSODL) {w.e.f. 1 January 2021} respectively.

Odisha has had mixed results in terms of handing over the distribution licenses to private companies ever since it became the first state in Asia to do so. In light of success of various other private licensees in other parts of the country, Odisha has high hopes from incoming private player (Tata power company) to turn around the ailing value chain of the electricity distribution business in Odisha.

4.3 Emission Contribution by DISCOM activities

4.3.1 Current Scenario

In FY 2017-18, the share of power procured by GRIDCO from the non-fossil-based power generation activities amounted to around 27 percent of the total power procured. Hence, around 73 percent of the total power quantum of 24632 MU procured by DISCOMs from GRIDCO were generated from fossil fuel-based generation activities. Thus 18.3 million tonnes[11] of CO2(e) were emitted[12] in the FY 2017-18 alone for catering to the DISCOM needs of power requirement.

Table 14: Indirect emissions due to power procurement by Odisha DISCOMs in FY 17-18

DISCOM	Total sale (MU)	Power purchased from GRIDCO (MU)	Total emissions contribution (ktCO2)
CESU	5782	8467	6281
NESCO	4235	5449	4042
WESCO	5378	7248	5377
SOUTHCO	2334	3468	2573
ODISHA (At DISCOM periphery)	**17729**	**24632**	**18274**

If the OPTCL's transmission loss level, 3.34 percent[13], and Auxiliary Power Consumption, 9 percent[14], in thermal power plants are considered, the total emissions due to DISCOM's requirement rise to 20.54 million tonnes of CO2(e). Further, out of the total power procured, as mentioned above, only 16406 MU are realized by the DISCOMs due to various AT&C losses, including collection efficiency and billing efficiency losses. If only the collection efficiency woes are considered, in FY 2017-18 alone, a potential revenue supposed to be generated from around 1322 MU of billed energy could not be realized. Thus, an approximate revenue loss of INR 555 Crores[15] happened in a single year. If loss levels of all the DISCOMs were

[11] Odisha thermal power plant average emission - 1.01 tCO2/MWhr (Calculated from CEA emission database)

[12] Not considering the power lost in transmission of power from generators to GRIDCO periphery

[13] As per OPTCL Tariff Order dated 29.03.2019

[14] Assumed as per Research Report "Minimization of Auxiliary Power Consumption in Coal Fired TPS" by Narayana, Bhatt, IIT KGP, NPSC 2004

[15] Almost all of collection efficiency loss occurred for LT consumers; so the average revenue billed per unit for LT consumer is considered for the calculation (Data from ARR of individual DISCOMs considered and collated).

only 20 percent in FY 17-18, a total of INR719 crore in revenue would have been saved.

Table 15: Positive economic impact through AT&C loss reduction (sample year-2017-18)

DISCOM	Total sale (MU)	Actual energy procured	Energy required for a loss level of only 20%	Power procurement cost (INR per unit)	Revenue saved loss level of only 20% (In Cr)
CESU	5782	8467	7227	2.96	367
NESCO	4235	5449	5294	3.36	52
WESCO	5378	7248	6722	3.34	176
SOUTHCO	2334	3468	2918	2.25	124
ODISHA	**17729**	**24632**	**22161**		**719**

4.3.2 Estimated Emissions in FY 2029-30

As per the 19th EPS survey report published by the CEA, the total energy requirement in Odisha would be 40634 MU. IRADe's analysis shows that in a scenario where 275 GW RE is achieved at the national level, the retirement of existing units of the TTPS, Talcher STPS's Unit 1 and IB and Valley 1 TPS is affected. Augmented by the TTPS expansion, the total non-fossil share in the energy mix for the state would be expected to be around 33 percent. To meet its energy needs, Odisha DISCOMs would have a substantial amount supplied by fossil fuel-based power plants, which would lead to an estimated emission of 31 million tonnes of CO2 (e)[16]. The figure below shows the energy requirements of the state DISCOMs along with the emission estimates.

[16] Including State Tx Utility loss and Thermal Power Plant's Auxiliary Power Consumption

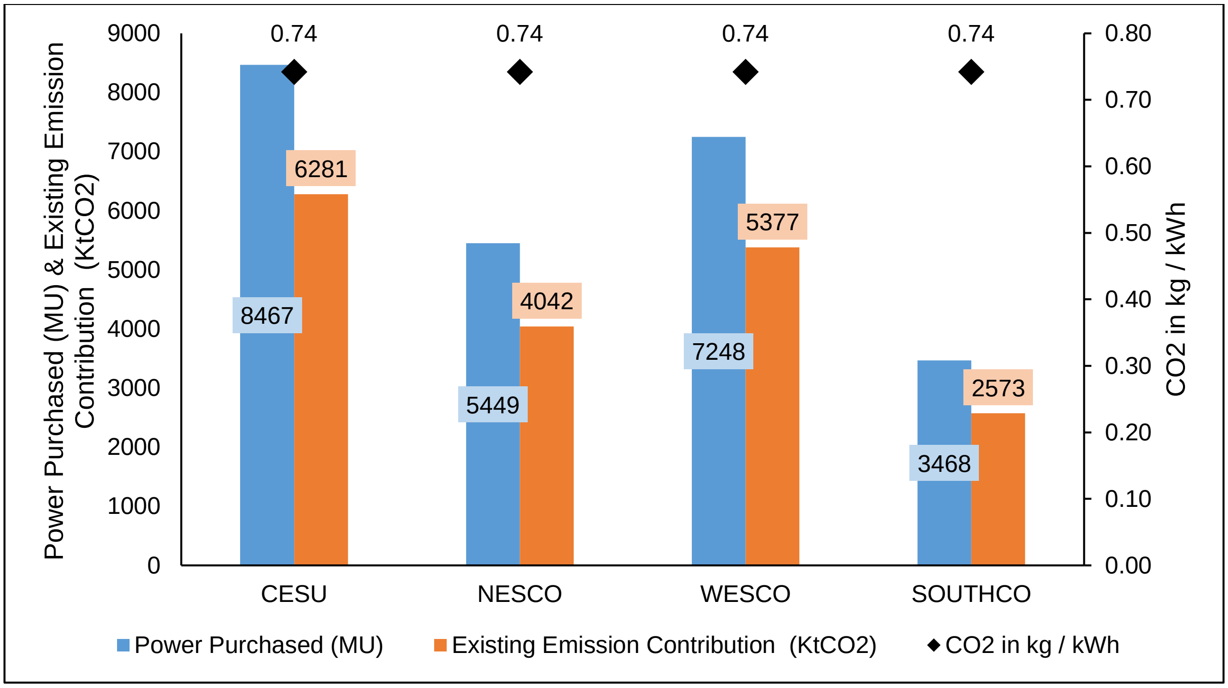

Figure 21: Emission estimated due to energy requirement by DISCOMs in FY 2029-30
Source: 19th EPS and IRADe Analysis

4.4 Energy Audit at DT and Feeder Level

It is vital to investigate and identify the exact loss-making pockets in the distribution value chain to improve any system. Improvements ought to be made on a large scale in the operational practices through energy audits at DT and feeder levels. Despite being highlighted multiple times by OERC, to date, sufficient measures have not been taken to undertake this major accounting exercise to arrive at the actual loss calculation at important node points in the distribution system. As per OERC T.O. dated 29.03.2019, as in September 2018, energy audits of 294 feeders out of 474 - 33 KV feeders, 1841 feeders out of 2780 - 11KV feeders and 52445 DTRs out of 220395 feeders have been completed by the DISCOMs in Odisha. To ensure accountability and zero-in on loss-making points, there is a need to do a lot more energy audits, especially at the DTR level. Table 17 below captures the performance of DISCOMs in terms of energy accounting as of September 2018.

Table 16: Energy accounting for feeders and DTs by DISCOMs (as of September 2018)

Metering	CESU	NESCO	WESCO	SOUTHCO	ODISHA

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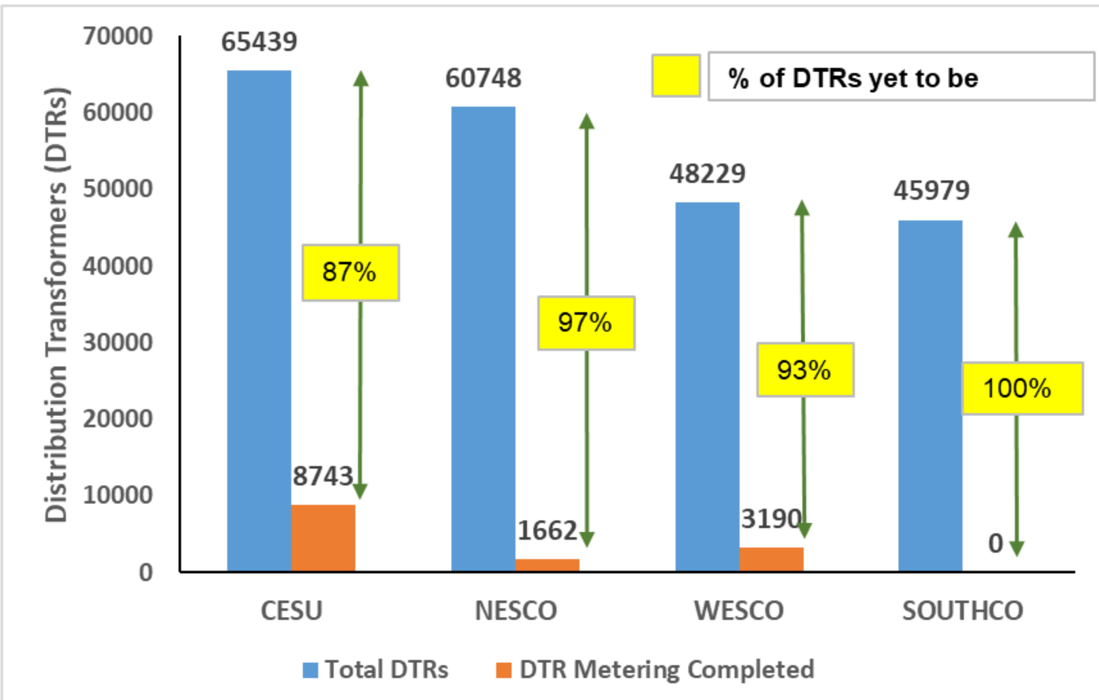
No. of 33 KV feeders/metering completed	171/171	80/80	124/112	90/70	474/433
No. of 11 KV feeders/ metering completed	850/744	619/619	663/614	648/227	2780/2204
No. of 33/11 KV transformers/ metering completed	596/232	377/120	425/40	375/ …….	1773/392
No. of distribution transformers (11/0.4 and 33/0.4 KV)/ metering completed	65439/8743	60748/1662	48229/3190	45979/0	220395/ 13595

Source: OERC Tariff Order for DISCOMs dated 29.03.2019

Figure 22: **Distribution transformers' metering status (As of Sep 2018)**



Source: OERC Tariff Order for DISCOMs

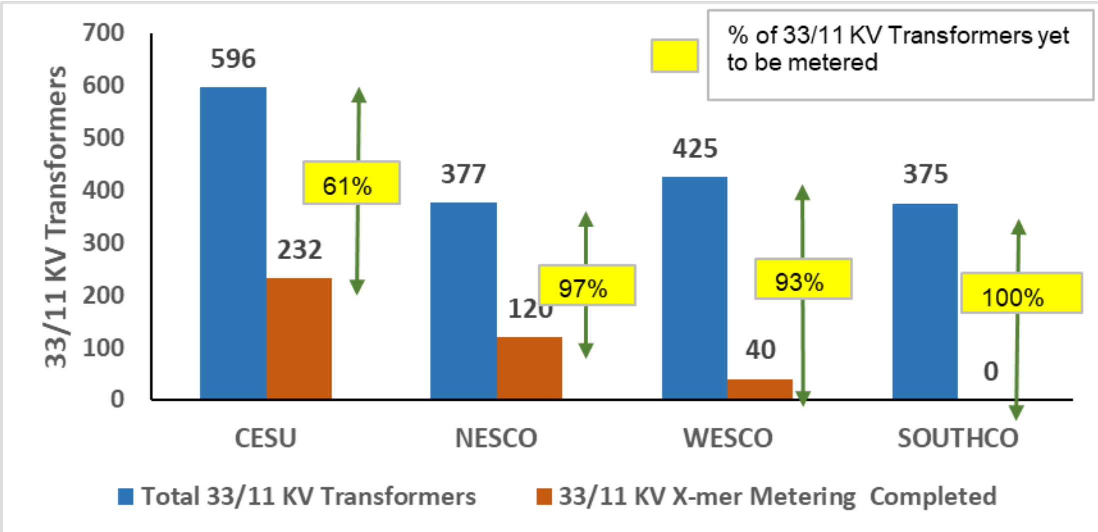


Figure 23: 33/11 kV Transformers' metering status (as of Sep. 2018)
Source: OERC Tariff Order for DISCOMs

As seen from **Figure 24** and **Figure 25**, a substantial quantum of LT transformers is yet to be metered, and hence, the identification of precise loss-making units is still an issue in the state. The auditing of all feeders and transformers cannot be completed, and therefore, improvement of these units remains a challenge for the distribution loss identification and alleviation divisions of the DISCOMs. **Table 17** lists the status of energy audit exercise in terms of the various voltage levels of the distribution system.

Table 17: Status of energy audit of the LT system

Voltage level	Total feeders/ transformers	Energy audit completed	Percentage of energy audit
33 KV	474	294	62%
11 KV	2780	1841	66%
0.440/0.230 KV	220395	52445	24%

Source: DISCOM ARRs

4.4.1 Technical Loss Conundrum

As discussed earlier in the chapter, Odisha is among the highest AT&C loss makers in the whole country with a substantial portion of the energy supplied not realized. While the improvement of commercial aspects, viz. billing and collection efficiency will do a lot for improving the finances of the state DISCOM, it is the technical efficiency which will help in the actual abatement of greenhouse gas (GHG) emissions.

Reducing the technical loss levels to 10% in FY 17-18 would have helped in emission abatement of 0.6 Million Tonnes of CO_2(e)

As per one of the CESU filings in January 2016, the technical losses in DISCOM area were 20 percent which was a sizeable portion of the AT&C loss (38 percent) for that particular year (FY 14-15). If a similar loss level ratio is considered for FY 17-18 when the AT&C loss for CESU was 34 percent, the technical loss turns out to be 18 percent. Thus, if the technical loss in FY 17-18 for CESU was only 10 percent, emissions abatement of 0.6 Million Tonnes of CO2(e) could have been achieved.

Thus, substantial scope remains in terms of emission abatement through technical loss reduction.

4.5 Interventions taken and Challenges faced by the DISCOMs to reduce AT&C losses

SOUTHCO has around 19.20 lakh consumers with around 7.60 lakh are below poverty line (BPL) consumers who are billed @ INR 85.00 per month who are located in inaccessible areas of Malakangiri, Koraput, Nawrangpur, Jeypore, Phulbani, and Boudh. So, the cost to serve them is higher than the existing consumers in urban pockets. Due to the sizeable topographical area with the BPL category of consumers, the AT&C loss is higher than other utilities. Also, the technical loss in the SOUTHCO area is around 8 percent due to the vast network area spreading from hills to plains. SOUTHCO has also submitted that vigilance on the disconnection squad has increased at the section level to improve the collection and deployment of additional outsourced personnel through agencies to improve the disconnection activity. WESCO has not achieved 100 percent energy audit due to a shortage of funds that is beyond its control.

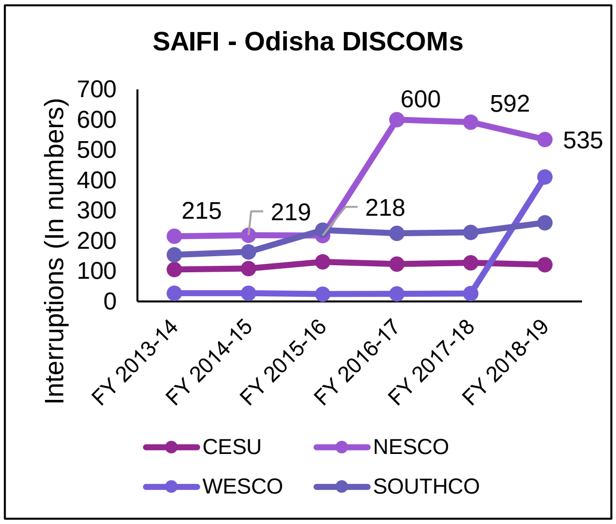
NESCO has submitted that it is duty-bound to reducing the transmission and distribution (T&D) losses over the years and the ground reality is that the infusion of subsidized consumers by way of rural electrification is mainly responsible for containing the T&D losses. For metering challenges facing the DISCOM, NESCO has submitted a solution to overcome the difficulty in installing meters for consumers in the irrigation category. To overcome the problem of inaccessibility which increases the cost of supply, the licensee has proposed LT billing for these particular consumers in areas where there is no meter or the meter is defective to cover up the losses.
The CESU has deployed Distribution Franchisees (DFs), which have been engaged for five years, as a measure for reducing the AT&C loss further so that the BST cost is recovered from the franchised divisions. The CESU has submitted that all the 171 33KV feeders have been metered, and in the case of 11KV feeder meters, 744 out of 850 have been metered. CESU generates an energy audit report every quarter, and action is being taken to complete 100 percent metering in the case of 11KV Feeders. About sticking to the perform, achieve and trade (PAT) scheme, all divisions have been instructed to achieve the distribution loss target fixed by the Bureau of Energy Efficiency (BEE).
WESCO is in the process of covering more distribution transformers into its audit fold through the installation of a metering unit, which will be helpful for further reduction of loss.

4.6 Reliability of Power Supply in Odisha

While the state has achieved 100 percent household electrification, power cuts are not uncommon in different parts of the state. Interactions with stakeholders from the state reveal that there is a challenge is supplying round-the-clock power to various parts of the state despite the claims that Odisha has sufficient power to meet the state's demand. Odisha has an irregular supply of power, as shown by the graphs below, of System Average Interruption Frequency Index (SAIFI) and System Average Interruption Duration Index (SAIDI).

(SAIFI) - Total number of interruptions each lasting more than five minutes faced by 1 KW connected load.

(SAIDI) – Total duration of interruption in minutes for each 1 KW connected load



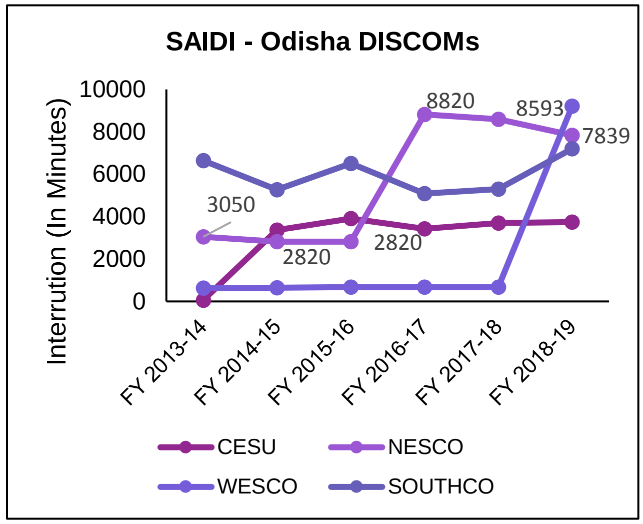


Figure 24: SAIFI-SAIDI analysis in DISCOMs
Source: SOP document in OERC

Although the CEA data of the Load Generation Balance Report shows that the state has met its peak demand requirement and energy requirement for FY 2018-19, the reliability loss remains a concern at the ground level.

Chapter 5. Recommendations and the Way Forward

As discussed in the previous sections, Odisha is an upcoming state with its energy needs expected to only go northwards. There are few stringent challenges to this growth being less carbon intensive in the wake of climate action targets. On generation side, the state's installed capacity of captive power plants is more than the capacity installed for utility perspective. Captive capacities generally of smaller size has higher specific emission levels compared to utility power plants. Additional, substantial quantum of electricity produced for public use in the state is lost/unaccounted for due to its high distribution loss levels. It is felt that there is a lack of competition among DISCOMs to be better in its operations. Furthermore, obligation to purchase RE power on obligated entities isn't on par with national standards.

Below mentioned recommendations can be explored to have a power sector growth that is less carbon intensive.

5.1 Demand Side Interventions

Demand Side Management (DSM) interventions can help in controlling customer behavior and flattening the demand curve. It not only bodes well for the system's health but helps in financial savings for the DISCOMs as the need for the inherently costly peak load power can be reduced.

DSM also leads to emission abatement as such interventions help in reducing the power requirement as a result of which systems become more efficient and power losses are reduced. There have been plans at the utilities level to employ a DSM mechanism through financial incentives to control consumer behavior of load usage and raising awareness wherever required to help in easier adoption.

Bringing in a DSM mechanism may affect the DISCOM's finances not only because it will entail an investment on the utilities' part but will also amplify the already available surplus power for dispatch. However, the power surplus is temporary and when economic growth picks up, it shall disappear. Thus, the additional power available to be scheduled may put an extra financial burden on the DISCOM which will have to pay the mandatory fixed cost in the short run. This may also limit their capacity to increase RE in the existing energy mix. Thus, while it may prove to be a double-edged sword initially, in the long term, it will not only help in emission abatement but also improve the DISCOMs' financial health.

5.2 Increase Penetration of Renewable Generation - Improve RPO Compliance

Even the relatively low RPO targets are not fulfilled by the DISCOMs in the state. This is because of the separate targets for solar and wind power specified. Also, the legacy of existing PPAs increases the opportunity cost of purchasing renewable power. Some stakeholders in Odisha argue that it should have a lower RPO as it has lower renewable potential. However, since no transmission charges are levied on renewable power and renewable certificates can be purchased on the exchange, this argument is not valid. We suggest two measures to address this:

a. Remove the categorization of RPO targets

RPO targets in India have been categorized into two categories – solar and non-solar. Initially, the cost of solar energy was higher than wind energy (the most common non-solar RE technology). Thus, separate targets were proposed so that investments could be encouraged in both RE technologies. However, now that the costs of the two technologies are comparable, it makes little sense for categorization of the targets.

In states such as Odisha, which have more potential in solar technology as compared to wind, it creates an added burden. Stakeholders in Odisha also felt that the categorization of RPO should be removed.

b. Prescribe long term RPO trajectory so that DISCOMs enter into future PPAs considering RPO.

A significant number of DISCOMs across the country are already showing inhibition in signing long term contracts in an ever-evolving electricity market. With a Round the Clock (RTC) market already operational in generation that overpowers demand in the contemporary scenario, long term contracts that force a DISCOM to set aside a specific quantum of money every year for fixed cost charges are fast becoming a less preferred choice. Furthermore, if a market-based mechanism is to be developed in conjugation with an organically developing RE portfolio, ultimately leading to a less carbon intensive electricity system, it is important to do away with out-of-market policies and instruments which distort the transparent mode of identifying the right price of electricity and hinders the trading of electricity as a true commodity.

Additionally, it is also important for the regulator to prescribe long term RPO trajectory such that DISCOMs/obligated entities have sufficient time to plan for RE procurement.

5.3 CPPs Should Also Reduce Their Emissions

Odisha has many industries with captive power plants (CPPs). The installed capacity of thermal CPPs is twice that of DISCOMs. These came up because of the poor development and coverage of power supply and chronic shortages leading to unreliable supply. Many CPPs are old and have higher specific coal consumption and higher rate of CO2 emissions. Emissions from CPPs can be reduced by retiring old plants, shifting to grid supply and or having the same level of RPO obligations on CPPs.

a). Discouraging New CPPs

Unlike China, India has not discouraged CPPs despite excess power available. The first step forward in this direction could be to discourage the installation of new CPPs. Supply from grid can be based on larger and more efficient power plants. Also, a transition has to be made to shift CPPs to the grid gradually so that CPPs may retire older and inefficient plants. The pre-requisites for such a transition include increasing capacity of grid accordingly, and assuring reliable power to the industries. Industries require stable power for their production to continue smoothly. Thus, the grid has to be ready as and when such a transition takes place. Industry stakeholders such as CPP Association are of the opinion that a push for CPPs in the grid would require a "compensation mechanism" where DISCOMs/grid would have to pay them for the losses incurred due to unreliable power supply. A compensation mechanism, however, does not seem to be a workable solution due to the complexity of the issue. Without such assurance, trust in the quality power has to be built up. This will take time.

b). Make Attractive Shift to Grid Cost Effective for CPPs

Tariff rationalization (cost reflective tariffs) is critical to make this shift happen. The average per unit charge to HT and EHT customers in Odisha was 18 percent higher than the Average Cost of Supply (ACS) in 2018-19. The analysis shows that around a 30 percent reduction in tariff is required for the cost to become equal to a typically old (10-year-old) CPP, and 18 percent reduction for a new CPP. This shows that Odisha needs to charge firms at the actual cost of supply to industries as losses for supply to industries are lower than the ACS.

c). Restoration of RPO trajectory for CPPs

The installed capacity of thermal CPPs in Odisha is almost double the thermal capacity of the grid (SLDC Odisha). Decarbonization of the CPPs is thus as important as the state grid. Unlike the DISCOMs, the Ministry of Power (MoP), in April 2018, clarified that RPO for CPPs may be capped at the RPO level applicable in the year in which the CPP was commissioned. For CPPs installed before 2016, the RPO levels of the year 2015-16 apply. CPPs argue that they have difficulties in fulfilling RPOs due to various technical and non-technical reasons such as the variability of RE, steam pressure requirements, uniform demand (as compared to DISCOMs), and DISCOMs not signing new RE PPAs at Average Pooled Purchase Cost (APPC), hindering new plants from coming up in Renewable Energy Certificates (REC) mode.

The OERC adopted the MoP regulation in December 2019 and pegged the RPOs for the CPPs. Majority of the CPPs in Odisha were installed before 2015-16. For Odisha, the RPO level in 2015-16 was 3 percent. Capped RPOs do not provide enough impetus on CPPs to decarbonize their operations and invest in RE. For Odisha, this means a reduced overall action towards increasing RE. RPO imposes an additional cost on consumers which should be borne by the industries along with the CPPs.. Thus, we recommend that RPO trajectory for CPPs should be restored at the same level as that for DISCOMs and same must be notified till 2030.

d). Coal Cost Rationalization

Industry stakeholders such as CPP association highlighted that they already pay up to 20 percent higher price for coal than other regulated sectors such as power for the same grade of coal. Coal price distortions have negatively impacted their profitability and other decarbonization measures may put additional pressure on them. Thus, we suggest that uniform coal prices should be promoted for all sectors as it will level the playing field. Additionally, this can be done at the same time as when the RPO obligation is made for DISCOMs and CPPs. This will also compensate the industries to have an RPO trajectory aligned with the DISCOMs.

e). Explore avenues to shut CPPs

A difficult but efficient decision of having less carbon intensive power sector in Odisha is to close down CPPs, especially ones which have high specific emissions. With the addition of installed capacities in coming years, the capability of grid to supply to industries currently having separate CPPs is expected to improve. This opportunity needs to be leveraged to close down CPPs with an amicable involvement of its owners.

A one-time compensation may be extended to them which can be calculated based on the remaining value of the plant plus the difference in tariff over the remaining life of the plant.

5.4 Institutional framework for promoting competition among electricity distribution divisions to reduce losses

While technical and commercial interventions to improve the condition of Odisha DISCOMs would go a long way in alleviating current financial condition, few innovative methods to inspire inclusion of performance enhancement at institutional level can work wonders for the state.

As discussed earlier in the study, each of the four DISCOMs has very high loss-making divisions as well as divisions where losses are comparatively moderate. Incentives have been very few and penalties have been almost non-existent for the divisions to improve their performance.

If competition among the divisions of a DISCOM can be introduced with proper incentives/penalties available for best performers/laggards, then better results can be expected from DISCOM as a whole which could be a win-win situation for all. Responsibility alignment of this kind may make divisional as well as sub-divisional officers accountable for their area's performance. This can be done with identification of **critical efficiency parameters** for the performance of the division and then aligning strong monitoring & verification (M&V) system to it. A simple flow diagram is shown below.

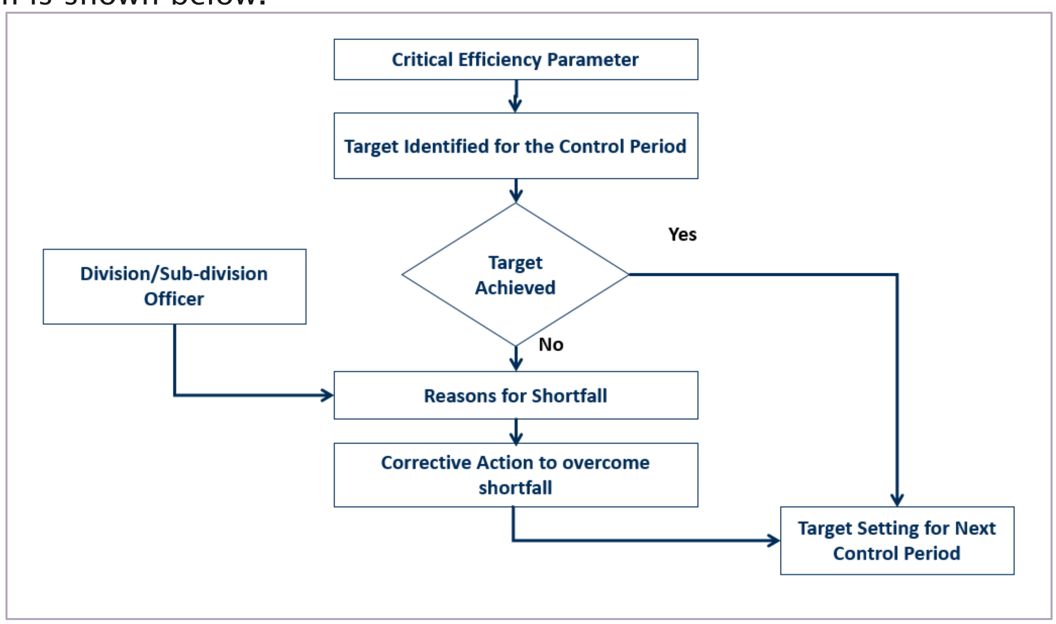


Figure 25: A simple flow diagram for performance evaluation at Division level of DISCOM

Critical Efficiency Parameters (CEP) in the above context may be defined as the parameters that are very vital for monitoring DISCOM'S efficient technical and commercial operation. The optimum level of these parameters is important for the feasibility and sustainability of DISCOM operation without outside intervention / aid.

5.5 Expanding Solar Potential of Odisha through canal top solar and floating solar plants

More than 70 percent of land area in Odisha is covered by forests and is used for agriculture. (Odisha Economic Survey, 2018-19). Land availability is a major issue highlighted by stakeholders in Odisha for RE development. Thus, innovative solutions have to be pushed to support RE in Odisha.

Examples of such innovative solutions are canal-top solar plants and floating solar plants. The first canal top solar PV Power plant in India was of 1 MW, which was built in Gujarat. The plant was built over a 750m stretch of canal. Odisha has a high installed capacity of hydro resources and is home to one of the largest hydro power stations in the world. This presents Odisha a unique opportunity to invest in the same.

Stakeholders say that the cost of the structure, especially in canal top solar plants, could act as a limiting factor. However, since a canal top plant has a higher efficiency and it saves water due to lower evaporation, the higher cost can be justified. Odisha has also recently signed an MOU to develop 500 MW of floating solar capacity in the state. Thus, the limited solar potential should be significantly expanded.

5.6 Emphasis on improving Reliability and Consumer Service

Electricity is an essential commodity and people have to use it for one purpose or other. It's important and vital from DISCOM's perspective to recover the charges for its use. As discussed earlier regarding situation of low reliability of DISCOMS in Odisha and obvious from **Error! Reference source not found.Error! Reference source not found.**, the collection efficiency for all DISCOMs are not satisfactory. Reliability and improved customer service are important variables for increasing collection efficiency. Proper billing with replacement of faulty meters, increased reliability, convenience in payment and good service in case of faults may improve consumer confidence which will ultimately lead to better recovery of revenue at consumer end.

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Appendix A

During the course of the study, the researchers interacted with stakeholders on multiple occasions to understand the ground realities and their perspective on the improvement avenues. These interactions include as part of focus group discussions, interviews, telephonic conversations, etc. through inception workshop, local stakeholder consultations and output disseminating webinar.


Policy Dialogue
on

A. Inception Workshop

Inception workshop was conducted in Bhubaneswar, Odisha on 29 January 2019. The stakeholders were sensitized about the project's objectives along with a brief general profile of power sector in the state. Dignitaries and representatives included Dr. Saurabh Garg, Principal Secretary, Govt. of Odisha; Sri. M.K.Das, Director(Commercial), GRIDCO; Er. K.P. Koner, OREDA; Dr. Subhransu Ranjan Samantaray, IIT Bhubaneswar, etc. Few of the major points highlighted by the state stakeholders are mentioned below.

1. Power doesn't account much in Odisha GDP as power is priced at generation/production end and consumed in other states.
2. Issues in GDP Vs CO_2 emissions for Odisha state needs to sorted out
3. Renewable Energy integration is an important step forward for the state considering its coal dominated energy mix. Integration issues can be resolved through various solutions such as virtual generators, inertia less generators, smart grids, storage technologies development, grid monitoring, and power system studies.
4. Huge potential of using RE technologies exists in the off-grid application in DC mode. RE on-grid and off-grid application needs to be developed in tandem for the state of Odisha.
5. State has procured 125 MW of RE power from outside the state for meeting its obligations.
6. GRIDCO and private developers are developing 275 MW and 175 MW of solar capacity respectively in the state. These capacity are to help the state achieve its 2700 MW targeted capacity by 2022.
7. For solar rooftop implementation, RESCO and BOOT model, both are suitable for Odisha.
8. GRIDCO doesn't purchase power from captive generators due to their high prices.
9. Key points assimilated from open discussion
    a. For promoting RE such as solar rooftops the awareness among the people needs to be increased
    b. Effective compliance of PAT, RPO and RGO schemes is needed
    c. Deregulation of markets is needed to bring change in the sector

d. Data analytics is needed for improving the performance of the sector
e. Awareness among the people for accepting Solar rooftop needs to increase
f. Decreasing RE cost will help in meeting RPO targets in future

Agenda of the Workshop:

15 IRADe Integrated Research and Action for Development

MacArthur Foundation

Agenda
Policy Dialogue on Climate Change & Development
| Odisha Chapter|
29th January, 2019
Swosti Grand, 103, Janpath, Bhubaneshwar

9:45 – 11:00	**Session I – Inaugural**	
9:45 - 10:00	**Welcome Address**	**Prof. Jyoti K Parikh**, Executive Director, IRADe
10:00 – 10:15	**Special Address**	**Dr. Padmaja Mishra** –Vice- Chancellor, Rama Devi University, Bhubaneswar
10:15 -10:30	**Key Note Address**	**Dr. Saurabh Garg**- Principle Secretary- Department of Agriculture, Government of Odisha
10:45- 11:00	**Special Remarks**	**Kirit Parikh,** Chairman IRADe
11:15 – 12:45	**Session II- Mobilising Energy and Power sector to meet NDCs (Nationally Determined Contributions) targets**	
	Session Chair	***Dr. Kirit Parikh*** ***Chairman, IRADe***
	Theme Context (10-15 Minutes)	IRADe presentation on **"Mobilising Energy and Power sector to meet NDC's target"**
	Remarks by Panelists	**Panelists** 1) Dr. Subhransu Ranjan Samantaray- IIT, Bhubaneswar 2) Sri M.K Das- GRIDCO, Bhubaneswar
13:30: 15:00	**Session III- Energy efficient transport systems to reduce emissions**	
	Session Chair	**Mr. C. R Rao** Odisha Motor Vehicle Department
	Theme Context (10-15 min)	IRADe presentation on **"Energy efficient transport system to reduce emission"**
	Remarks by Panelist (7-10 mins. each)	**Panelists** 1) Shri D.K. Upadhyaya- Urban Transport (CRUT), Bhubaneswar. 2) Prof. Mayank Dubey- Xavier Institute of Management, Bhubaneswar 3) Nihar Ranjan Sahoo- State Pollution Control Board, Odisha
15:00 : 16:30	**Session IV- Promoting the use of solar water pump in the agriculture sector**	
	Session Chair	***Prof M.K. Mohanty*** *College of Agricultural Engineering and Technology*
	Theme Context (10-15 Minutes)	IRADe presentation on **"Promoting the use of solar water pump in the agriculture sector"**
	Remarks by Panelists (About 7-10 Minutes Each)	**Panelists** 1) Dr. Srijit Mishra- Nabakrushna Choudhury Centre for Development Studies Bhubaneswar 2) Er. K. P. Koner- OREDA, Bhubaneswar 3) Dr. Gouranga Kar-ICAR-IIWM, Bhubaneswar 4) Mr. Dil Bahadur-Jain Irrigation Private Ltd. 5) Chief Engineer Department of Agriculture, Government of Odisha
16:30 : 16:45	**Closing Remarks**	**Prof. Kirit Parikh,** Chairman, IRADe

B. Stakeholder Consultations

Stakeholder Consultation was done throughout the study with the team visiting the state in January 2020. The interviews were conducted with stakeholders which included people from organizations including, but not limited to, state utilities viz., GRIDCO, GEDCOL, SLDC, OREDA, DISCOM Monitoring Unit; OERC, private RE developers, academia, private DISCOMs, captive generator association, etc. Some of the discussion points highlighted by the stakeholders are presented below.

GRIDCO

1. The AT & C losses in the state are high. This is primarily due to high billing and collection losses and theft in the state. It was also mentioned that the low paying capacity of the consumers due to weak economic background is also a reason for consumers to resort to theft.
2. It was mentioned that Odisha could not be a part of schemes like the Restructured Accelerated Power Development and Reforms Programme (R-APDRP, UDAY and other central government schemes meant only for state DISCOMs because of privatization of its DISCOMs.
3. Distribution license of the CESU area has been awarded to the Tata Power Company in a recent bid and hence losses are expected to decrease as theft is likely to be controlled. Transmission losses in the state are quite low, which needs to be replicated in the distribution system as well.
4. GRIDCO was of the view that Odisha should be reimbursed for the environmental cost of coal and power production.
5. It was also highlighted that the MoEFCC should not force the power plants already complying with environmental norms to install Flue Gas Desulphurisers (FGDs).
6. Captive generation plants should also be monitored for GHG emissions.
7. Hydro is required to be considered as a renewable source of energy and be considered for fulfilling the RPO obligations of the state. There should be a single RPO for solar, non-solar and other forms of RE.
8. It was also informed that 4 percent HPO (Hydro Power Obligations) is already in the pipeline and may become operational in the near future.
9. RPO obligations of the state needs to be based on the state's discretion and their paying capacity. It was mentioned that MoP targets for RPO compliance need not be forced upon the state. OERC was hailed for keeping the RPO targets attainable from the perspective of financial health of DISCOMs.

10. The GRIDCO was also of the view that RE targets of the state need to be based on the actual potential of the state. The state is willing to invest in RE now that prices of RE are lower than thermal power stations. However, they are hindered by the limited potential of the state.
11. The RE projects in Odisha have limited commercial viability; so a subsidy may be given by the central government for RE development in the state.
12. It was mentioned that an RE cost of INR 4.50 is still very high for Odisha. The state has the second-lowest APPC cost in the country.
13. On reliability issues, it was highlighted that the distribution sector needs to be improved. There is no problem on the generation side as the state is currently power surplus.
14. On being asked about the diesel captive power stations in the state, it was said that they must be used during power outages only or an issue of quality power may be present.
15. NESCO, WESCO and SOUTHCO are also expected to be privatized in a year or so. (*As on 1st April 2021, privatization has been completed and given to the TATA Power)*

GEDCOL

1. GEDCOL highlighted that land availability is a major issue in the development of RE in the state. The state primarily has RE rich sites in forest land and agricultural land.
2. It was also highlighted that getting forest clearances is a time-consuming process, thus RE projects sometimes take longer than the allotted time to develop.
3. Getting the Right of Way for RE projects is apparently another major issue faced by the state which delays the process of RE development.

DISCOM Monitoring Unit (WESCO, NESCO & SOUTHCO Utility), Bhubaneshwar

1. It was mentioned that the Odisha government does not provide any tariff subsidy, but it gives CAPEX to the DISCOMs for infrastructure development from time to time. The state government has funded around INR 10,000 crores in the last ten years for the same.

2. On the issue of increasing diesel captive power plants in the state, it was informed that Right of Way may be an issue for the said industries. Forest clearances may be another issue affecting power supply to these industries.
3.
4. It was mentioned that Odisha being a mineral rich state supports a lot of large industries. Thus, 20 percent of consumers in Odisha consume 80 percent of the electricity.
5. A business mechanism between Odisha and Gujarat for balancing power may be technically possible.
6. Increasing renewables in the grid will not be a problem for Odisha as there is ample hydro capacity and the grid is future ready.

OREDA

1. It was informed that land is a major issue in the development of RE in the countryside as Odisha does not have many wastelands or deserts where ground-mounted solar RE systems can be set up.
2. It was mentioned that the state is currently looking to meet its RPO targets through solar agricultural water pumps (through the KUSUM Yojana). The state is looking forward to a potential of around 2.3 GW for solar agricultural pumps.
3. It was also mentioned that Odisha has paid a tariff of INR 18.52/unit of electricity from an 8 MW solar plant to promote RE in the state.
4. The government regularly ensures the quality of panels supplied for its RE programme. The state has got panels for as low as INR 29/Watt due to its proactive approach.
5. Potential for small hydro power plants is also high in the state. However, social costs for hydro plants are also high, thus limiting further development of the resource.
6. Currently, the RE addition in the state will only be able to fulfill the RPO regulations.
7. On the issue of RPO obligations compliance by CPPs, it was informed that CPPs are now in the process of introducing biomass utilization through co-firing in pulverized coal-fired boilers. This will help them achieve their non-solar RPOs.
8. It was highlighted that independent biomass-based plants have not materialized despite its potential in the state, as the technology is expensive and requires support for the tariff.
9. Waste to Energy development has also not materialized for the same reason and a policy push may be needed for them.

10. The potential of wind is not high in Odisha as winds are quite erratic in the state. However, there are a few sites of wind in Odisha which may be developed with technological advancements.
11. RE potential calculations for Odisha has been done based on technological feasibility and 2 percent land availability. However, the same is not true on the ground level as there is an issue of land availability.
12. It was highlighted that off-grid RE can be a good solution for increasing RE penetration in the state.
13. It was suggested that for overall development, the power consumption needs to increase from the lowest level. This would translate to increase in the paying capacity of poor people, thus increasing the GDP.
14. Off-grid solar development is currently household-centric or individual-centric. The OREDA is of the view that development should be community-centric such that livelihoods are developed and actual growth takes place. Improvement in value-chain such as cold storage is thought to be necessary for the upliftment of the poor.
15. It was also informed that mini grids were set up in the state, but with advent of grid-based electricity in the region, the mini-grids system have become irrelevant. With battery storage systems, the cost of electricity comes to around INR 8/unit which is much more expensive than grid electricity.

SDA Odisha

1. The engineer in chief (Elec)-cum- principal-chief-electrical-inspector (EIC) of Odisha stressed on the importance of energy consumption for the development of state
2. The EIC was also critical of the popular belief that increase in energy consumption necessarily entails an increase in emissions.
3. \
4. It was also informed that of the total 64 DCs of PAT in Odisha (from all cycles), 50-60 percent have installed captive generation plants for their power requirements.

SLDC

1. It was informed that generation and load balance is currently not an issue in Odisha, as the quantum of RE is low. Also, Odisha has ample hydro resources which can be used for balancing.

2. Of the total RE installed capacity in the grid, a lot of it is consumed by captive generation plants themselves and not injected into the grid. JK Paper, for instance, utilizes its own biomass RE energy. Also, of the total 20 MW RE installed capacity of Salivahan GE, only 7 MW is injected into the grid.
3. Energy banking takes place in Odisha.
4. Some hydro plants are being converted to PSP mode by the state, so as to make the grid future-ready.
5. Irrigation has the first priority over hydro resources. Thus, an average daily schedule is provided by the irrigation department which the SLDC has to comply with. It was highlighted that since most canals are downstream, the SLDC has to sometimes back down thermal power to comply with the hydro schedule furnished by the irrigation department.
6. On the availability of hydro power, it was mentioned that even during the periods of drought, a capacity of around 600 MW is available from the hydro resources.
7. Currently, Odisha is a power surplus state, but the price of power at Indian Energy Exchange (IEX) is so low that Odisha is not able to sell the excess power.
8. On the issue of old thermal power plants with high per unit emissions, it was informed that Odisha is in the process of phasing out old thermal plants like Talcher TPS and IB Valley – 1. It was also mentioned that phasing out older plants will not affect Odisha as ample thermal capacity is available in the state.
9. On the issue of converting CPPs to the grid, it was mentioned that Odisha is home to large industries with huge installed capacities. Thus, it is difficult to cater to that demand.
10. Balancing of the grid will not be an issue for Odisha in the near future because of the comfortable position provided by hydro resources.
11. It was informed that AT&C losses are high in the Odisha DISCOMs due to billing efficiency issues as well as theft. This should be improved in the state to further decrease the tariff.

C. Research Output disseminating Webinar and Final Stakeholder Discussions

In order to disseminate the outputs of the study and seek final stakeholder comments from various organizations and individuals, webinar was conducted on 2 September 2020. The invitees of the webinar included eminent power sector people including Mr. Nikunj Bihari Dhal, IAS, Principal Secretary, Dept. of Energy, Govt. of Odisha; Mr. Upendra Nath Behera, Chairperson, OERC; Mr. Santosh Das, Engineer-in-Chief cum Principal Chief Electrical Inspector, Odisha and Head, SDA Odisha; Mr. B.B. Mehta, Chief Load Dispatcher, SLDC, Odisha; Mr. Pankaj Batra, Project Director, SARI/EI, Ex-Chairperson, Central Electricity Authority; Mr. V.K. Agrawal, Technical Director, SARI/EI, Former-ED, POSOCO; Shri. Rajiv Agrawal, Secretary, Indian Captive Power Plants Association; and others. Key recommendations from the webinar is mentioned below.

1. Distinction of Solar and Non-Solar RPO may be done away with and only single RPO is prescribed.
2. Captive Consumers, dominated by large scale industries, should be motivated to set up more RE based generation capacities.
3. Single Window Clearance for upcoming RE based generation capacities, especially for Small Hydro Power (SHP), necessary for facilitating inter-departmental coordination
4. Land Bank Database creation for Odisha, already in motion, will help in identifying land at low cost and may also minimize regulatory hurdles
5. State may buy RECs to make up for RPO shortfall.
6. To reduce Technical Losses, Network Strengthening programmes have been planned
7. Demand Side Management mechanisms through incentives, promoting behavioural changes, raising awareness etc. are being planned
8. Special Tariffs for Industries eventually leading to tariff rationalization may be undertaken to help reduce their captive usage and hence GHG abatement.
9. Aggressive Rooftop solar promotion is an important intervention to increase RE capacity in the state with Floating solar is also an option, subject to infrastructure cost entailed.

10. Cross subsidization of Electricity as well as Coal may be eliminated for Captive Industries to help Industries have equal footing with its competitors worldwide.
11. Inclusion of CPPs in policy change henceforth is important as they are major stakeholders.
12. CERC mechanisms viz. Security Constraint Economic Dispatch (SCED) and SANTULAN may be replicated by SERC at state level.
13. Capacity Planning exercise for Odisha with no further thermal capacity addition may help in evolution of transparent electricity market structure in the state.

Agenda of the Webinar:

Integrated Research and Action for Development (IRADe)

Supported by MacArthur Foundation

Agenda

Enabling State Level Strategic Actions for India's NDC

|Odisha Chapter- Power and Agriculture|

Date: 01st September, 2020

11:00 - 11:25 AM	**Session I – Inaugural Session**	
	Welcome Address	***Dr. Jyoti K Parikh*** *Executive Director, Integrated Research and Action for Development (IRADe)*
	Project Introduction	***Shri. Pankaj Batra, Project Director IRADe- SARI/EI*** *Ex-Chairperson (I/c) & Member (Planning), Central Electricity Authority*
	Special Remarks	***Ms. Moutushi Sengupta*** *Director, India Office, MacArthur Foundation*
	Inaugural Address	***Shri. Nikunja Bihari Dhal, IAS*** *Principal Secretary, Department of Energy, Government of Odisha*
	Special Address	***Shri. Upendra Nath Behera, IAS*** *Chairperson, Odisha Electricity Regulatory Commission (OERC)*
	Inaugural Remarks	***Shri. Sourabh Garg, IAS*** *Principal Secretary, Department of Agriculture, Government of Odisha*
	Session Closing Remarks	***Prof. Kirit Parikh*** *Chairman, Integrated Research and Action for Development (IRADe)*
11:25 - 12:30 PM	**Session II- Adapting Energy and Power Sector to meet NDC's Target**	
11:25 -11:45 AM	**A context setting presentation based on Sectoral Discussion Paper for Odisha prepared by IRADe researchers**	
	Session Chair	***Prof. Kirit Parikh*** *Chairman, Integrated Research and Action for Development (IRADe)*
11:45 – 12:30 PM	**Remarks by Panelists**	▪ ***Shri. Santosh Das,*** *Engineer-in-Chief cum Principal Chief Electrical Inspector, Odisha and Head, SDA Odisha* ▪ ***Shri. B.B. Mehta,*** *Chief Load Dispatcher, SLDC, Bhubaneshwar* ▪ ***Shri. Rajiv Agrawal,*** *Secretary, Indian Captive Power Producers Association* ▪ ***Mr. Vinod Agrawal,*** *Technical Director, SARI/EI, IRADe* ▪ ***Dr. Chandra Kiran B Krishnamurthy,*** *Assistant Professor, Department of Forest Economics, Swedish Univ. of Agricultural Sciences, UMEA, Sweden*
12:30 – 13:25 PM	**Session III - Promoting the Use of Solar Water Pump in the Agriculture Sector**	
12:30 - 12:45 PM	**A context setting presentation based on Sectoral Discussion Paper for Odisha prepared by IRADe researchers**	
12:45 – 13:25 PM	**Session Chair**	***Dr. Tushaar Shah*** *Senior Fellow, International Institute of Water Management India*
	Panelist Remarks	▪ ***Mr. M.R. Pattnaik,*** *Executive Engineer OLIC (Odisha Lift Irrigation Corporation)*
13:25 – 13:30 PM	**Closing Address** *& Vote of Thanks*	***Shri. Pankaj Batra, Project Director IRADe- SARI/EI*** *Ex-Chairperson (I/c) & Member (Planning), Central Electricity Authority*

Appendix B

First Distribution Privatization in Odisha and its failure

Odisha was the first state in India to embrace privatization in order to turn its ailing distribution sector from loss making to a sustainable enterprise under "The Orissa Electricity Reforms Act 1995". After handing over of its distribution business to AES Corp. and BSES, there was insignificant improvement in the condition of distribution value chain and after facing various challenges, the license of AES Corp. and BSES were revoked in 2001 and 2015 respectively. Broad reasons, but not limited to, attributed to the failure of privatization[17] are mentioned below;

1. **Estimation** of the initial T&D losses of the system were **severely underestimated** and the **targets for reduction were unrealistic**.
2. The assumption in the **growth in demand for power** in the state **was highly ambitious**, not only in terms of totals but also in the composition. The **demand for industrial power** (EHT) which, subsidizes domestic demand (LT supply), was grossly **under realized** while domestic and commercial demand with high losses grew fast. The **preference for captive generation** on part of **EHT consumers** with rising tariffs was **not anticipated**.
3. The **reform** scheme was **vitiated by** sharp, **up valuation of assets** at the time of transfer to the utilities. This led to a **steep increase in the cost of power**.
4. Unabated **increase in tariffs without** a perceptible **reduction in techno–commercial losses** or improvement in **customer service** led to **growing public discontent** against reform. This situation has worsened because of spiralling increase in costs and the deteriorating health of the utilities. The DISCOMs have been rendered utterly unviable as a result of their inability to reduce T&D losses, control rampant misuse and theft of electricity and contain costs.
5. On the **collection** front, the assumption that **100% of the billings** would be collected from the year 1997/98 onwards was **unrealistic**.
6. Expensive consultancy services were employed

[17] Source: Kanungo Committee Report, TERI Report on Odisha Case Study (https://www.teriin.org/sites/default/files/2018-02/2001ER63%20Case%20study.pdf)

7. The private promoters of the DISCOMs **neither brought superior management** skills **nor did they arrange** financial support even by way of **working capital**.

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