



A GREEN ENERGY STRATEGY FOR INDIA



AGENDA

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- Business Case
- India's Power Sector
- Energy Generation
- Major Energy Source(Coal)
- Energy Consumption
- Energy Deficit
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- Factors Driving Consumption
- Does Energy Really Affect GDP?
- Does Population Affect Energy?
- Heading Towards Fully Electric India-Electrification Rate
- Consumption Per Capita
- Forecasted India (2014 - 2040)
- Renewable Energy Sources
- Why Renewable Energy for India?
- India - Renewable Energy (2014 - 2017)
- Potential Sites with Renewable Resources
- Cost Analysis of Energy Resources
- From Inaction to Action
- Energy and National Security
- Acknowledgment

OVERVIEW

“Energy is like blood in the veins. It is as vital as that to the economic growth”.

- India is at the forefront of global energy scenario today, being one of the leading power consuming and generating nations.
- India is 3rd largest Consumer of energy after USA and China with 6% of world's energy consumption but per capita consumption is lowest indicating huge demand surge is imminent.
- Economic growth, rising population, low per capita energy consumption and rapid urbanization are likely to spurt the energy demand further.
- Renewable energy will also play a huge part in India's economic growth, if India wants to meet its growing demand.
- To cope up with people's dissatisfaction in the election time, **PM Modi** had promised to electrify the villages and rural regions . They have hired us to look at the energy gaps and ascertain whether renewables can be a sustainable resource and if it could fill the energy deficit.
- States are given more preference with GDP higher than average relationship between energy consumption and GDP .

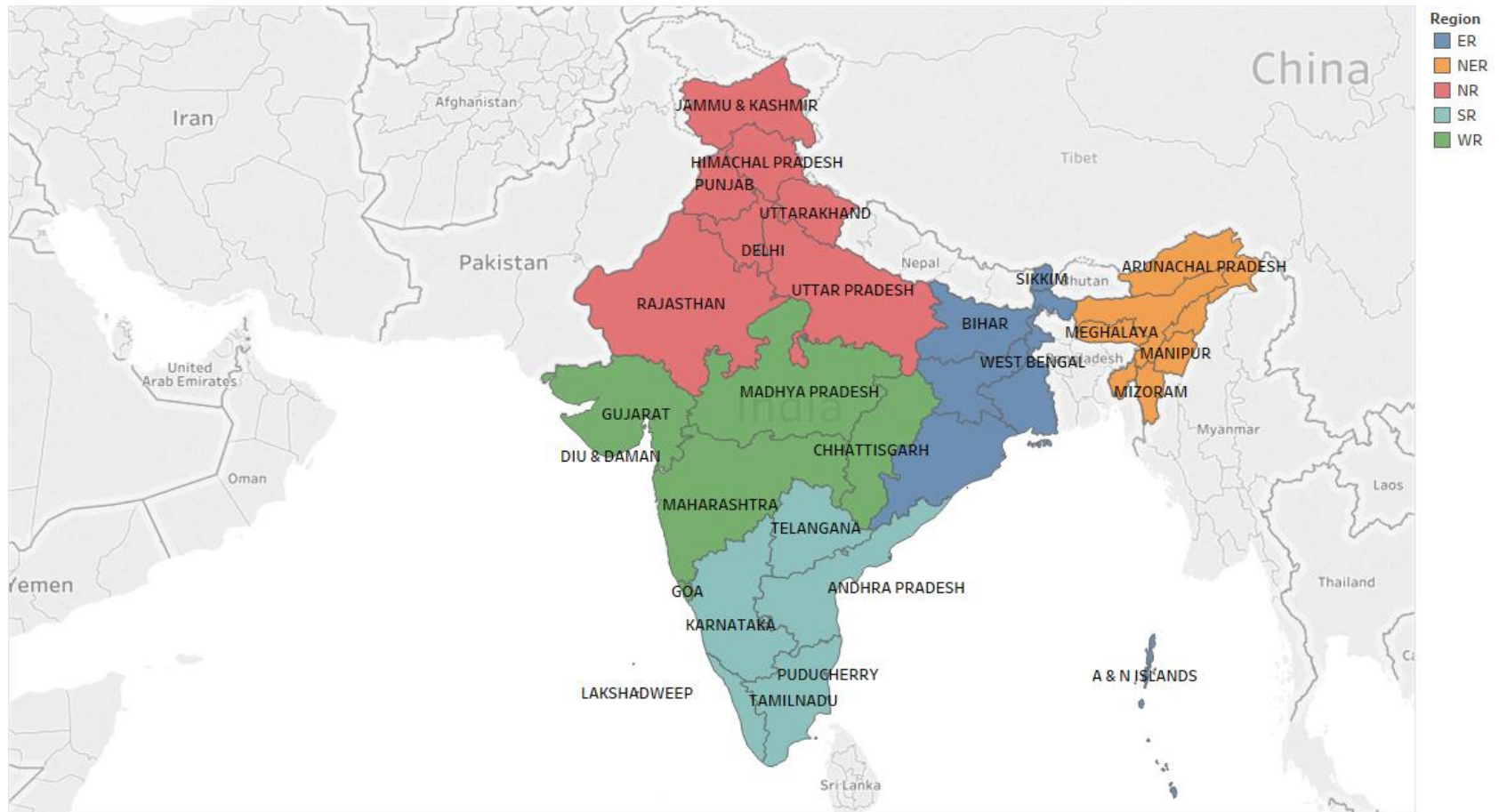
BUSINESS CASE

The main **OBJECTIVES** of this presentation:

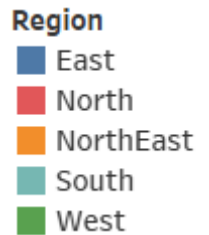
- To apprise key stakeholders of the present electricity scenario.
- Reduce dependency on imports of energy sources like coal and oil.
 - The usage of Coal & Oil triggers higher imports.
 - Imports are vulnerable to global supply disruptions and price volatility due to global events.
- To enlighten on electricity deficiency problem and leading role of the alternative energy sources , namely renewables for future survival.
- Propose options on sustainable development in the field of power sector which is critical for Indian Economy.
- To highlight the urgent need of reforms in power sector, not just in power generation but also transmission, distribution and the pricing of electricity.

INDIA'S POWER SECTOR- REGION WISE

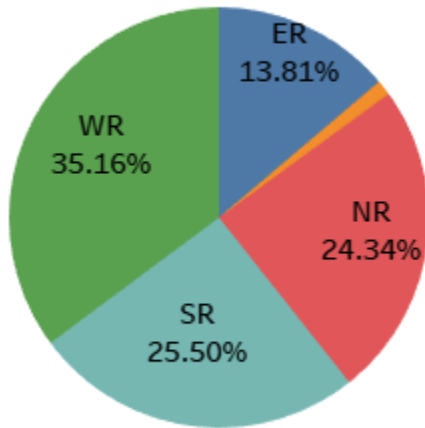
A QUICK GLANCE



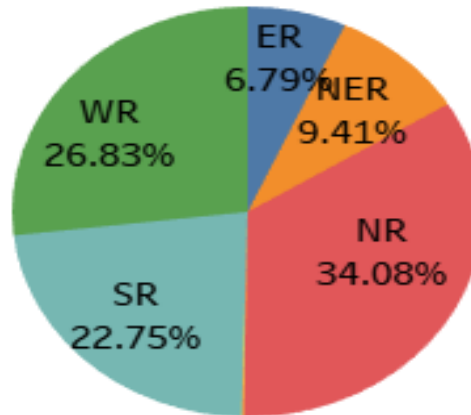
ENERGY GENERATION (2016)



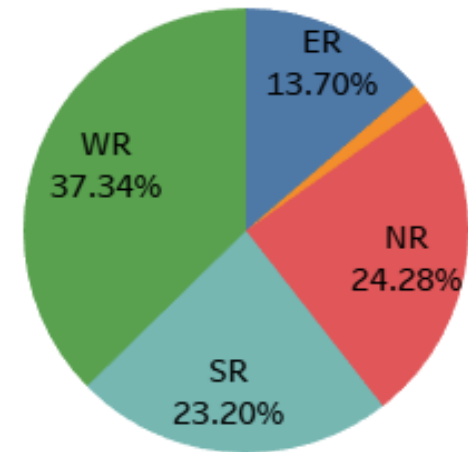
Installed Capacity



Potential Capacity



Energy Across Regions



Installed Capacity:

- Total : 298509 MW
- Highest :Western Region : 35%
- Lowest : North-Eastern : 2%

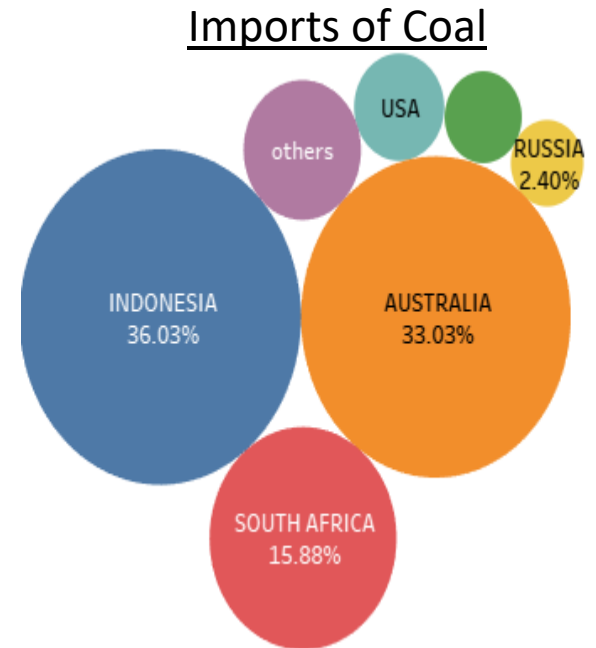
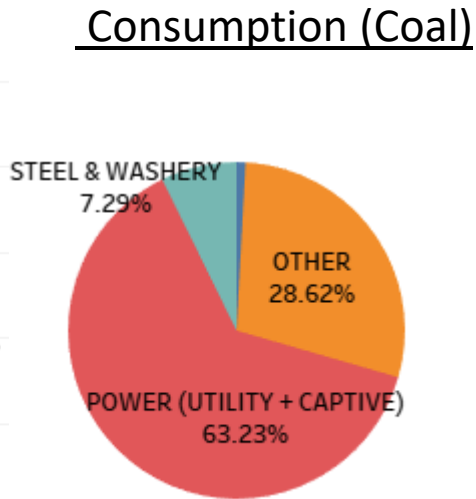
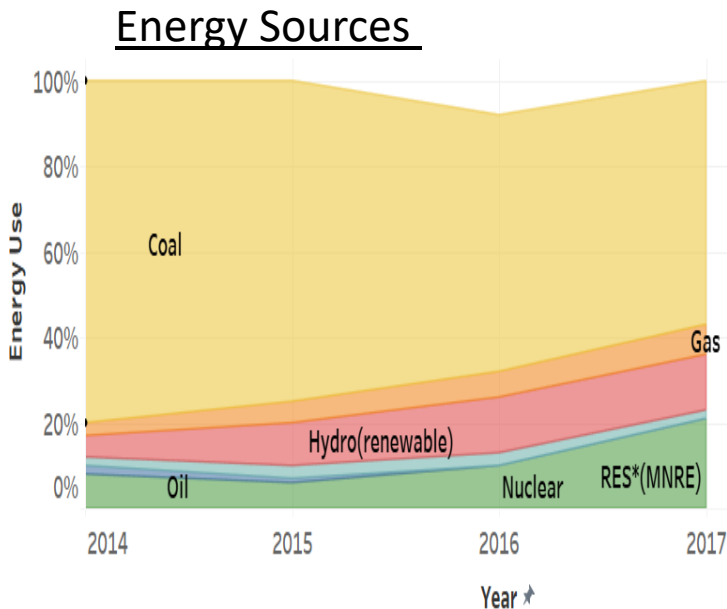
Potential Capacity:

- Total : 1266998 MW
- Highest :Northern Region : 34%
- Lowest :Eastern Region : 6%.

Electricity distribution

- Total : 267,403.42 MW
- Highest : Western Region :37%
- Lowest : North-East : 1.5%

MAJOR ENERGY SOURCE (COAL)



Presently
maximum
amount of
electricity is
generated from
coal.

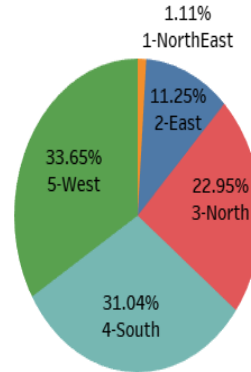
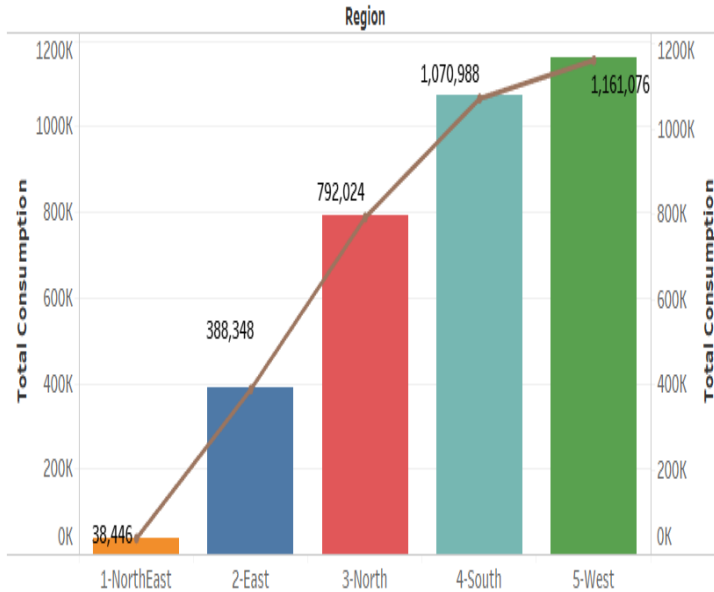


maximum
amount of coal
is used in power
sector.

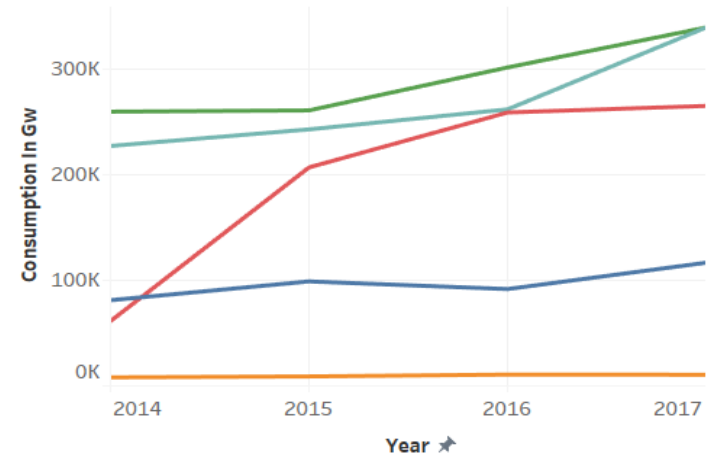


India is heavily
importing coal
making it
dependent on
many countries

ENERGY CONSUMPTION TREND (2014-2017)



Total Consumption -(2014-2017)



Energy Consumption (Region):

- Total : 946,600 GW
- Highest :Western Region : 34%
- Lowest : North-Eastern : 1.2%

Energy Consumption (Period) :

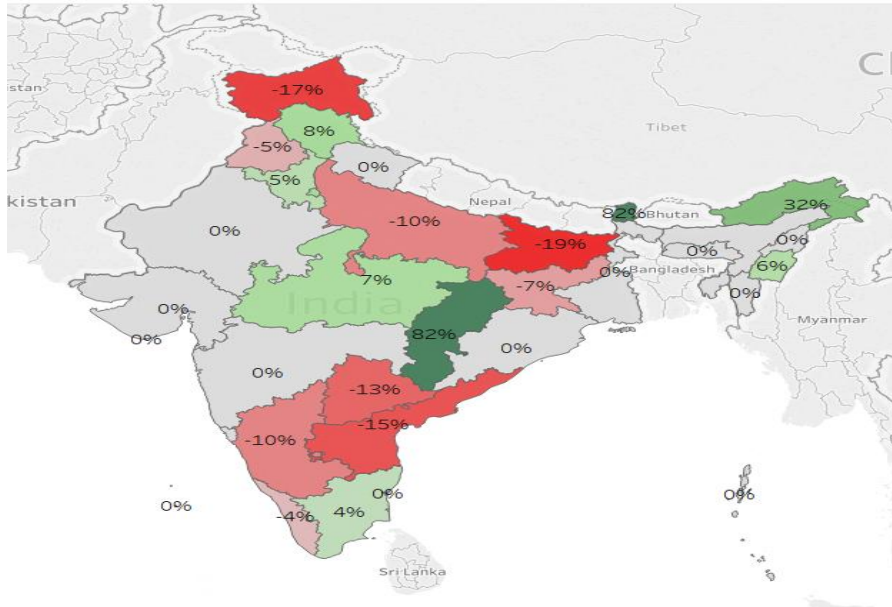
The Energy Consumption is increasing over period (2014-2017)

Reasons:

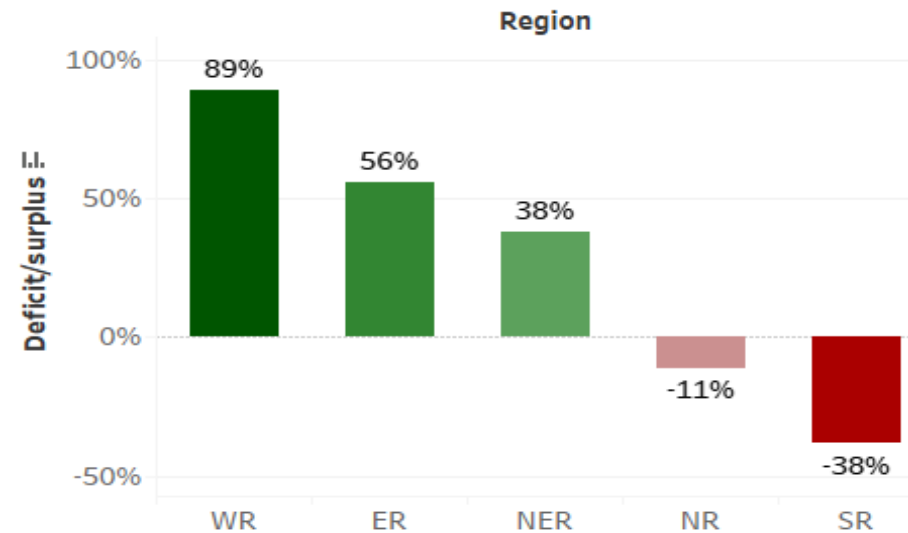
Industrialization
Population
Urbanization

ENERGY DEFICIT (2016)

State Wise



Region Wise



States with Surplus

- Chhattisgarh
- Madhya Pradesh
- Tamil Nadu
- Himachal Pradesh
- Sikkim.

States with deficiency

- Andhra Pradesh
- Andhra Pradesh
- Karnataka
- Bihar
- Jammu & Kashmir
- Jharkhand

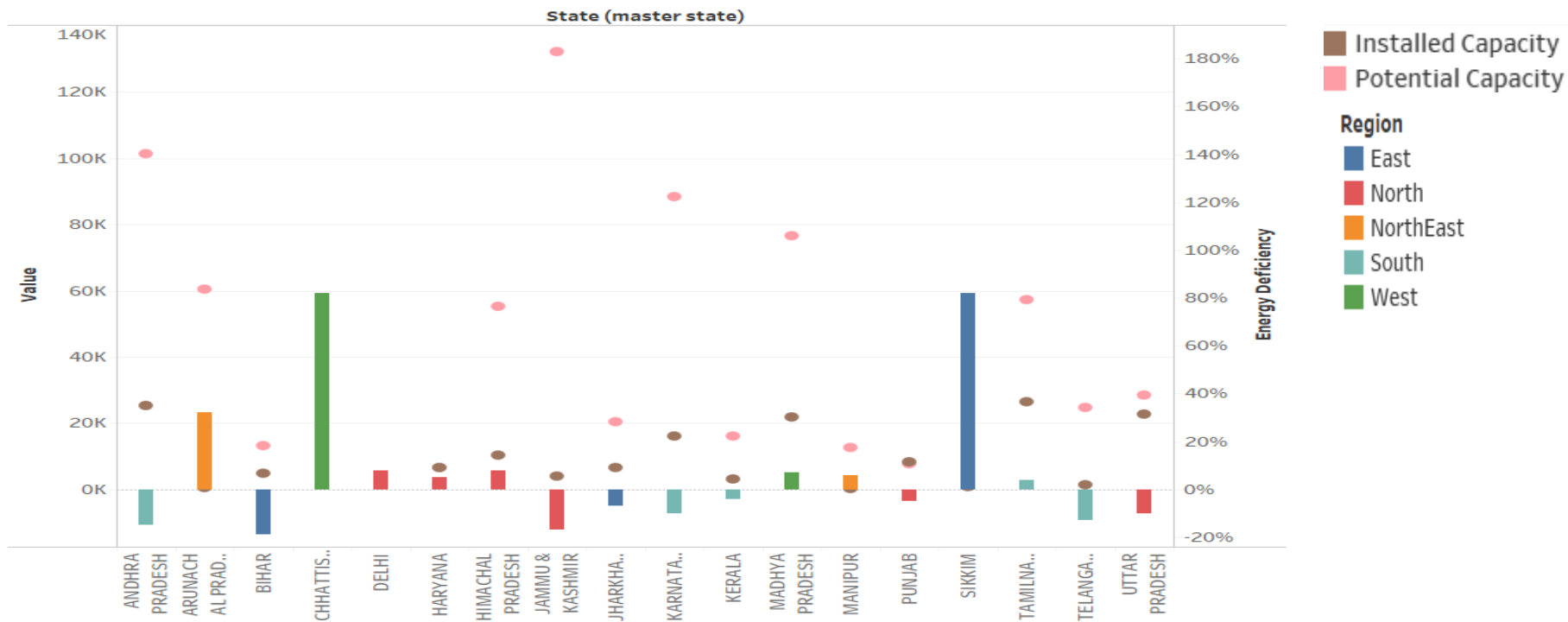
• Regions with Surplus

- Western Region
- North Eastern
- Eastern region

• Regions with deficiency

- Southern Region
- Northern Regions

- All other remaining states are self sufficient



States with deficit

- Andhra Pradesh
- Bihar
- Jammu & Kashmir
- Karnataka
- Kerala
- Telangana
- Uttar Pradesh

– Reason:

- Not exploiting their potential to generate energy to the fullest

• States fully exploiting potential Capacity:

- Delhi
- Chhattisgarh
- Sikkim
- Punjab

Andhra Pradesh ,Himachal, Jammu & Kashmir, Karnataka , Madhya Pradesh have too much potential to make them energy surplus states

ENERGY SCENARIO – HEALTH CHECK

- India ranks 81 position in overall energy self-sufficiency at 66% in 2017
- India's electricity sector is dominated by fossil fuels, and in particular coal, which in 2016 produced about three fourths of all electricity.
- Due to dependency on non renewable energy it is making India dependent on other countries for imports and increasing environmental hazards.
- According to world's bank report :
 - **Population:**
 - In India nearly 85% of the country's population having access to electricity
 - Challenges still remain to provide electricity to the rest of the 15% of the 1.25 billion population
 - **GDP :**

A sustained 8% GDP growth of India requires an annual increase of:

 - Commercial energy supply from 3.7% to 6.1%
 - Total primary energy supply from 2.2% to 5.1%
- Target is to fully electrify India by 2025 as promised by government

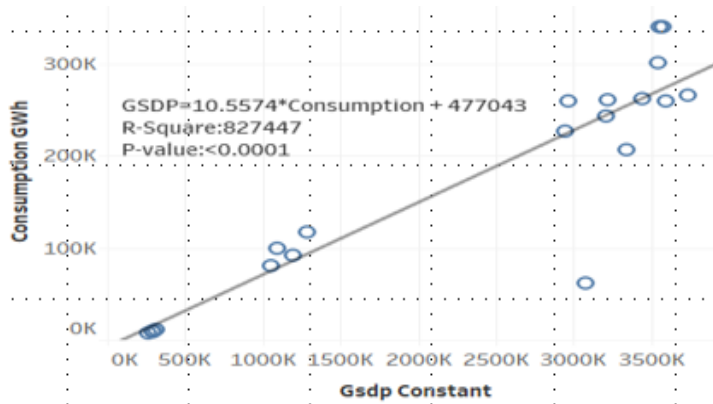
FACTORS DRIVING CONSUMPTION

- Demand has the following key drivers:
 - Industrialization
 - Population
 - Urbanization
 - Agriculture
 - Average Household consumption
 - Electrification of rural areas
 - Weather
- These factors can be measured with:
 - **Increase in GDP** : Economic growth measured by per capita GDP is an important factor in energy consumption. Mainly economic growth shows the effect on energy demand.
 - **Population Growth** : with continuous improvement in the public revenue and living standards, energy consumption will increase with the steady growth of population
 - **Electronification Rate**: Indicates the % of population or households with electricity. Higher the rate symbolizes the higher economic growth.
 - **Consumption Per Capita**: Indicates the average consumption by a person belong to a particular nation calculated from the known total consumption of that nation and the total population. Higher the consumption per capita shows surplus of energy

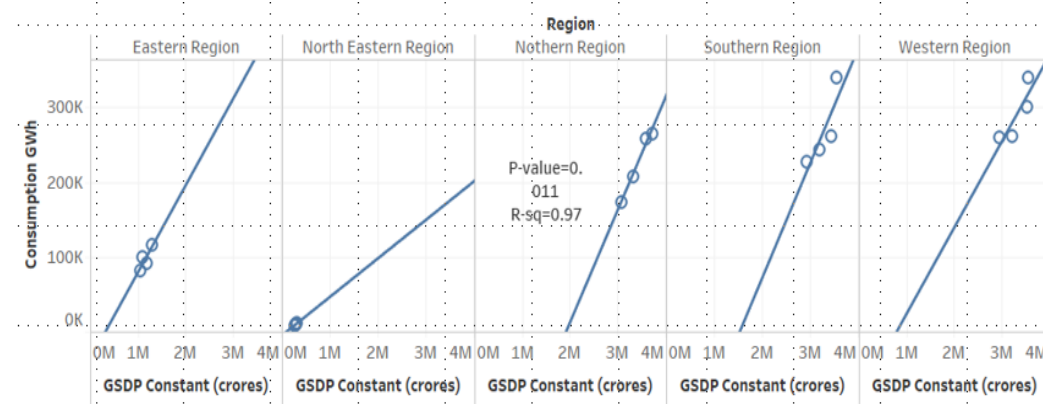
DOES ENERGY REALLY AFFECTS GDP?

“Energy is the power to make us do things”

GSDP V/s Consumption



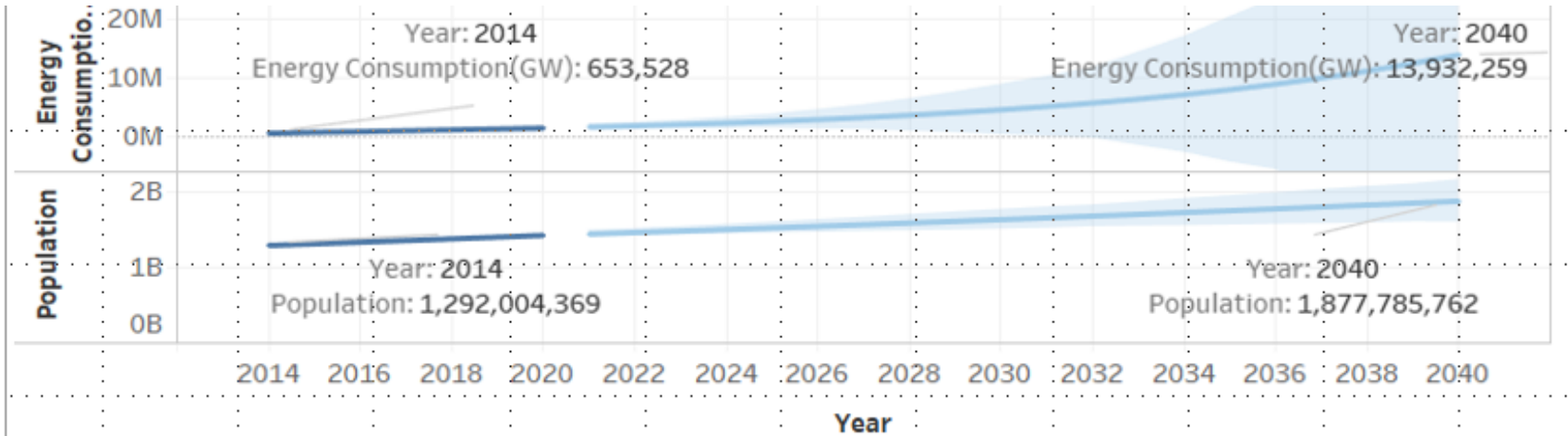
GSDP V/s Consumption (Region)



- Both Consumption and GDP shows an increasing trend from 2014 to 2017.
- The GDP growth rate from 2014 to 2017 is stable and is around 10% per year and the Growth rate of Consumption is not linear.
- Over a period of 2014-2017 , the growth of in Northern region is evidently following linear relation ship between the GDP and the energy consumption than compared to other regions.
- The Western region and the North Eastern region has more positive correlation between Energy consumption and GDP
- Economic well-being is directly coupled with increase in energy use and population growth, as it generates more goods and services.

DOES POPULATION AFFECTS ENERGY?

Forecast-Energy & Population(2014-2040)



Forecast Period: 2022-2040

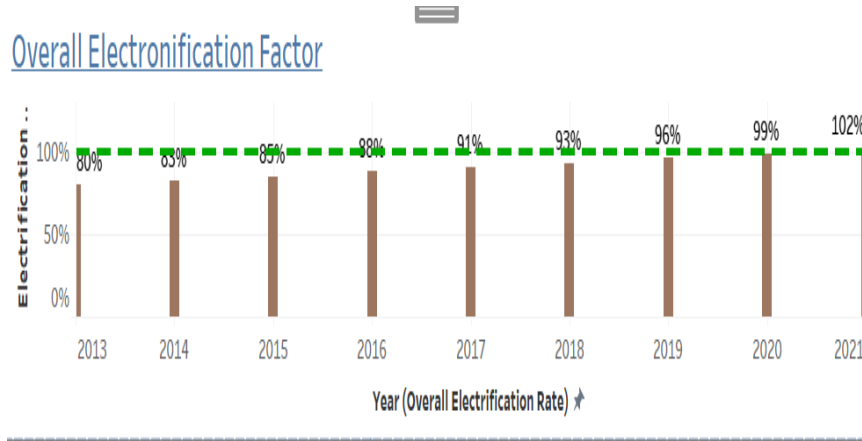
For every 1% increase in population, the energy consumption is estimated to increase with 12% (keeping external factors constant) . <https://drive.google.com/file/d/1Ky5a63IxYCLnuybK6cSrPeh3QDdY23hm/view?usp=sharing>

REGION WISE

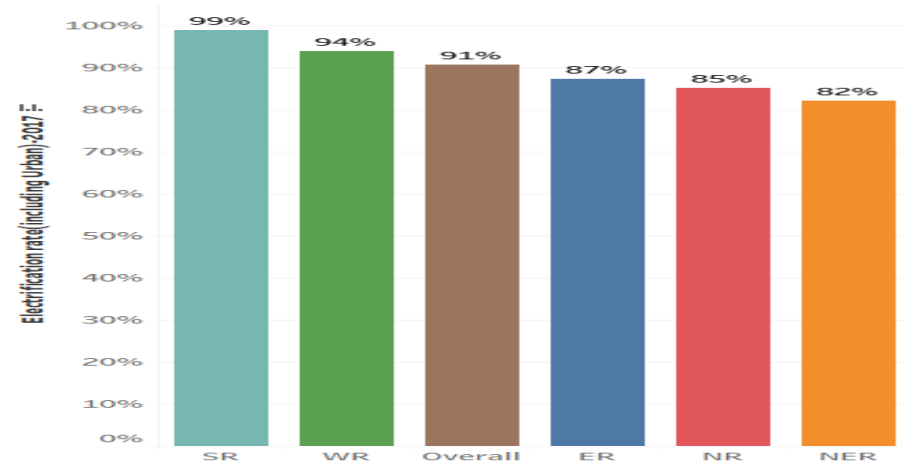
- I. East Region : 8% increase in consumption rate for unit increase in Population.
- II. North East Region : 11% increase in consumption rate for unit increase in Population.
- III. North Region : 7% increase in consumption rate for unit increase in Population.
- IV. South Region : 6% increase in consumption rate for unit increase in Population.
- V. West Region : 8% increase in consumption rate for unit increase in Population.

HEADING TOWARDS FULLY ELECTRIC INDIA

Overall



Region-wise



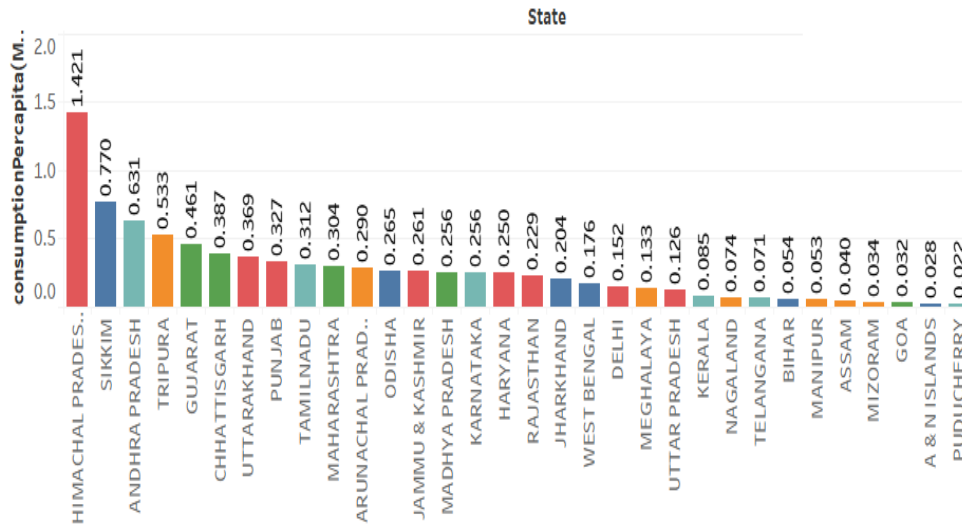
Electrification Rate

- <https://drive.google.com/open?id=1Ky5a63IxyCLnuybK6cSrPeh3QDdY23hm> explains the methodology followed for computation.

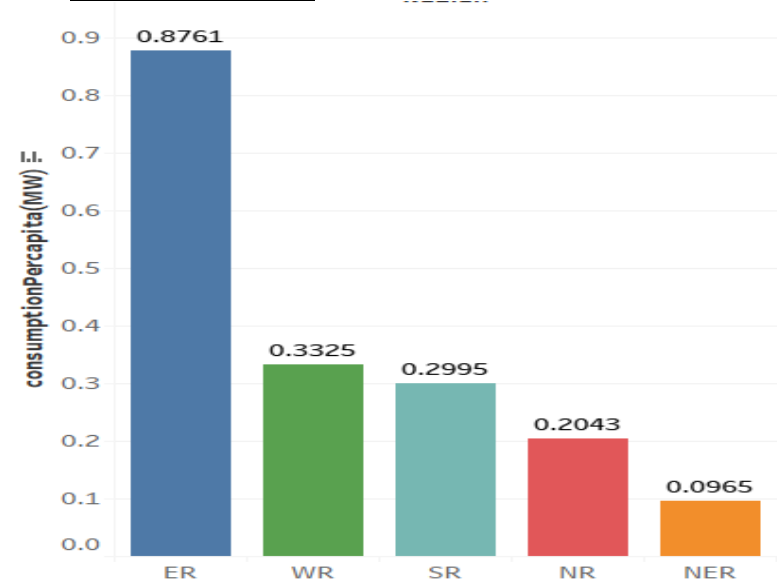
Year (East Electrification..)	Electrification Rate (East)	Electrification Rate(North-Eas..)	Electrification Rate (North)	Electrification Rate (South)	Electrification Rate (West)	Electrification Rate (Overall)
2013	77%	73%	75%	88%	83%	80%
2014	80%	75%	78%	90%	86%	83%
2015	82%	77%	80%	93%	88%	85%
2016	85%	80%	83%	96%	91%	88%
2017	87%	82%	85%	99%	94%	91%
2018	90%	85%	88%	102%	97%	93%
2019	93%	87%	90%		100%	96%
2020	95%	90%	93%		103%	99%
2021	98%	93%	96%			102%
2022	101%	95%	99%			

CONSUMPTION PER CAPITA

State-Wise



Region-Wise



CONSUMPTION PER CAPITA

State Wise

- Highest : Himachal Pradesh :1.42Mw
- Lowest : Chandigarh : 0.005Mw

Region Wise

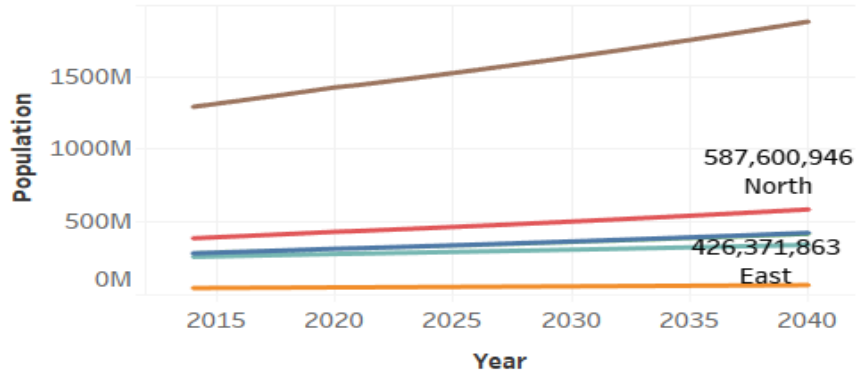
- Highest : Eastern Region :0.867Mw
- Lowest : North east : 0.0965Mw

*BASED ON THE ELECTRONIFICATION FACTOR CONSUMPTION PER CAPITA IS CALCULATED

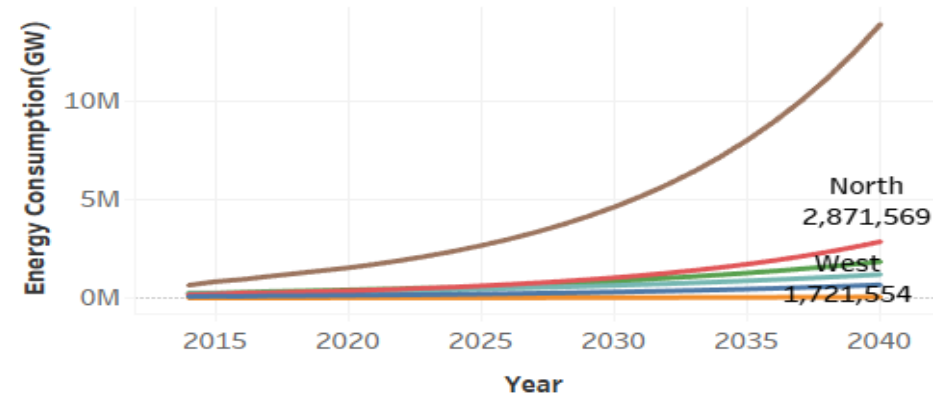
- Consumption Per Capita = Consumption/(population * Electronification factor)
- By using Electronification factor , we can include the people who are actually having access to the electricity

FORECASTED INDIA (2014-2040)

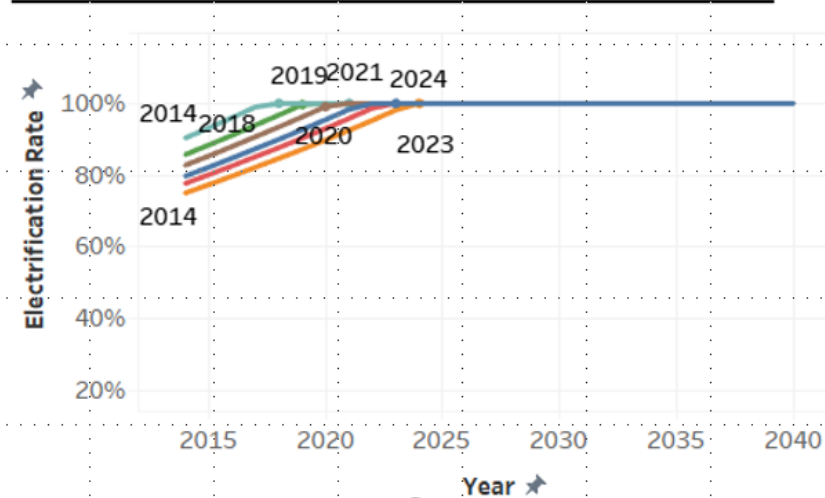
Forecasted Population



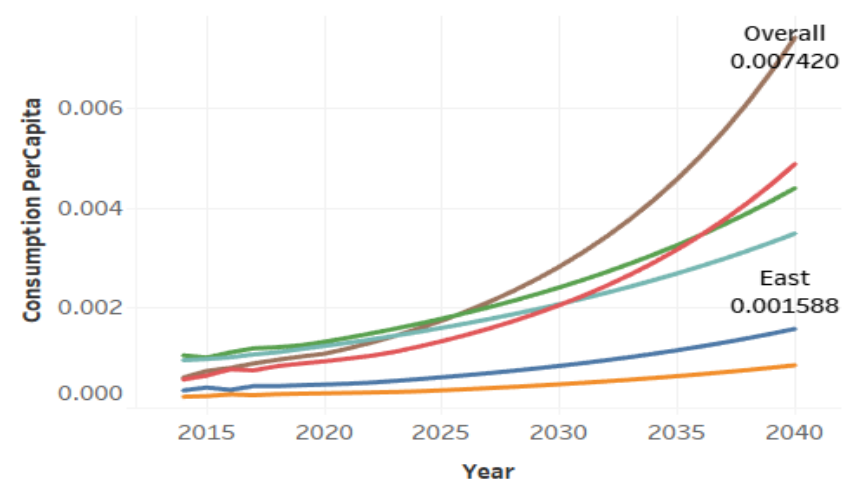
Forecasted Consumption



Forecasted Electrification Rate



Forecasted Consumption Per Capita





PROPOSED SOLUTIONS

RENEWABLE ENERGY SOURCES



Wind



Solar



Hydro



Biomass & Waste



Geothermal



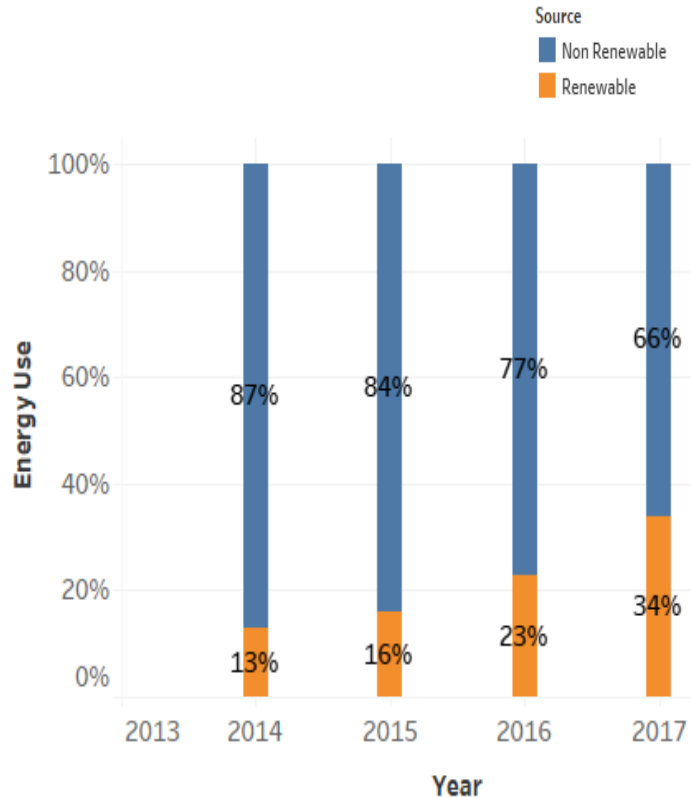
Tidal

WHY RENEWABLE ENERGY FOR INDIA?

- India has a large potential for energy generation by utilization of renewable energy sources due to its geographical location
- Rising Prices for Oil & Gases
- Ecological Hazards - Unlike conventional thermal power generation from coal, they do not cause pollution and generate clean power
- Ample Resources and Sites availability
- Abundant sunshine
- Avoids the high cost involved in transmission
- Avoids recurring fuel cost
- Boosts the urban and rural economy

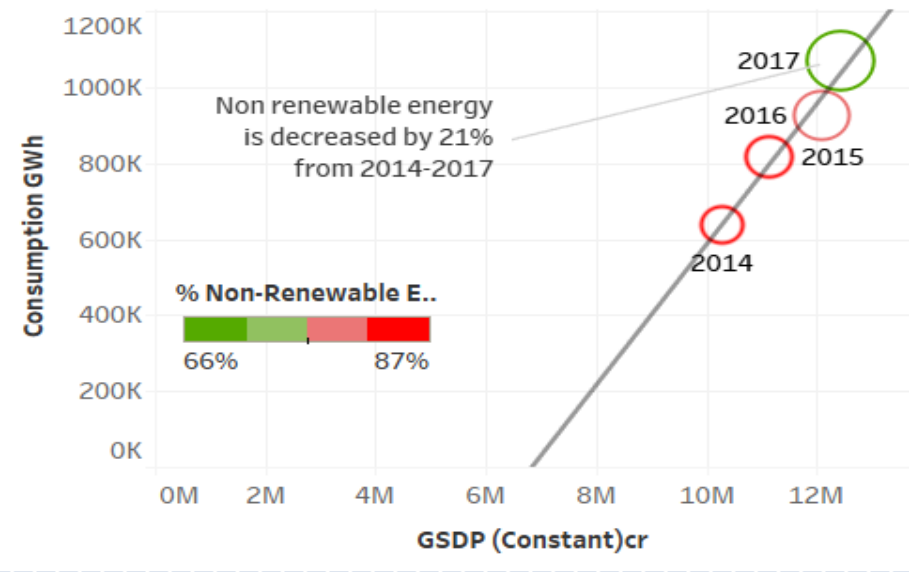
INDIA - RENEWABLE ENERGY (2014-2017)

Non-Renewable to Renewable Energy Progression Map



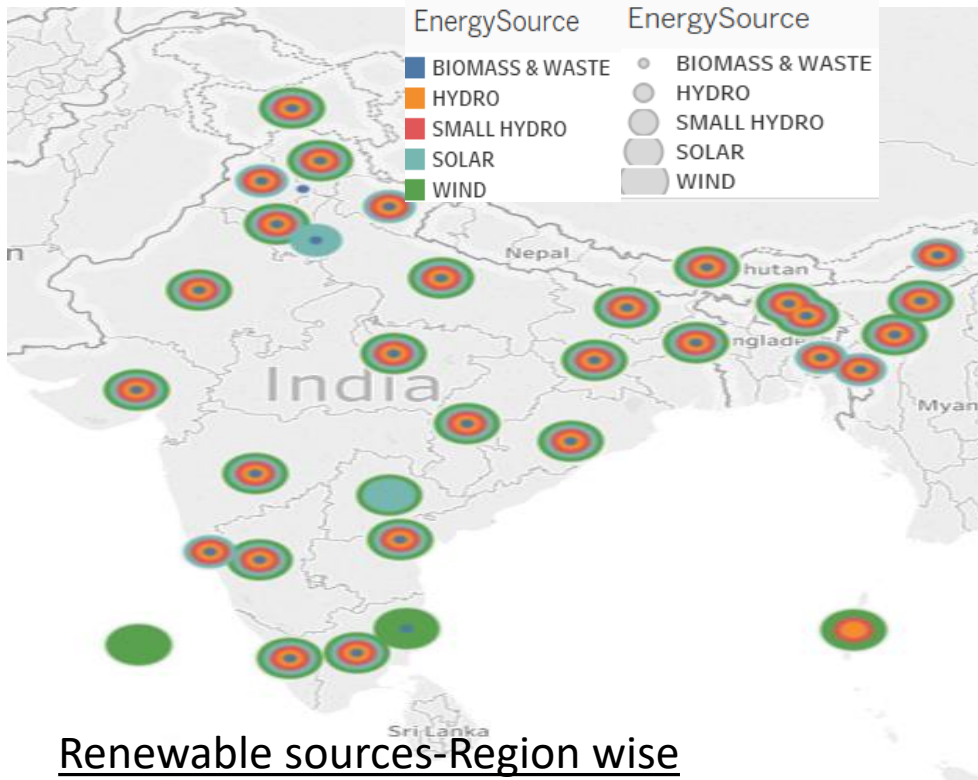
- Decrease in non-renewable energy consumption by 21%

GDP v/s Green Energy Technology



- We can see the impact of moving towards renewable energy resources on GDP i.e. with increasing use of renewable energy GDP is also showing progression.

POTENTIAL SITES WITH RENEWABLE RESOURCES



Hydro

Highest :Arunachal Pradesh

Small hydro

Highest :Karnataka

Solar

Highest :Rajasthan

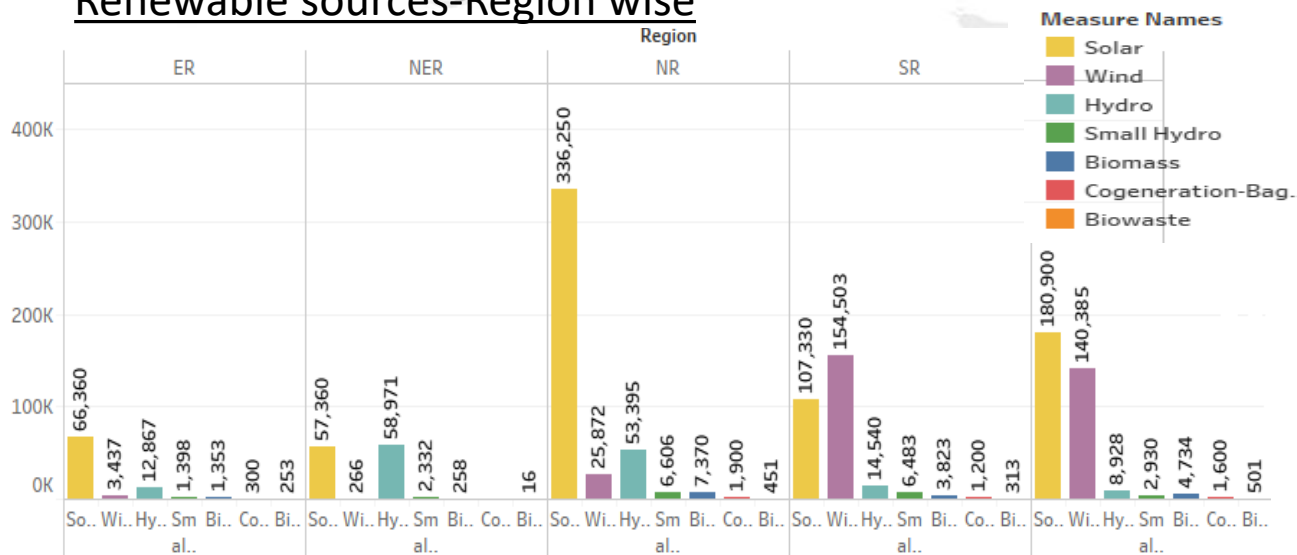
Wind

Highest :Gujarat

Biomass

Highest: Punjab

Renewable sources-Region wise



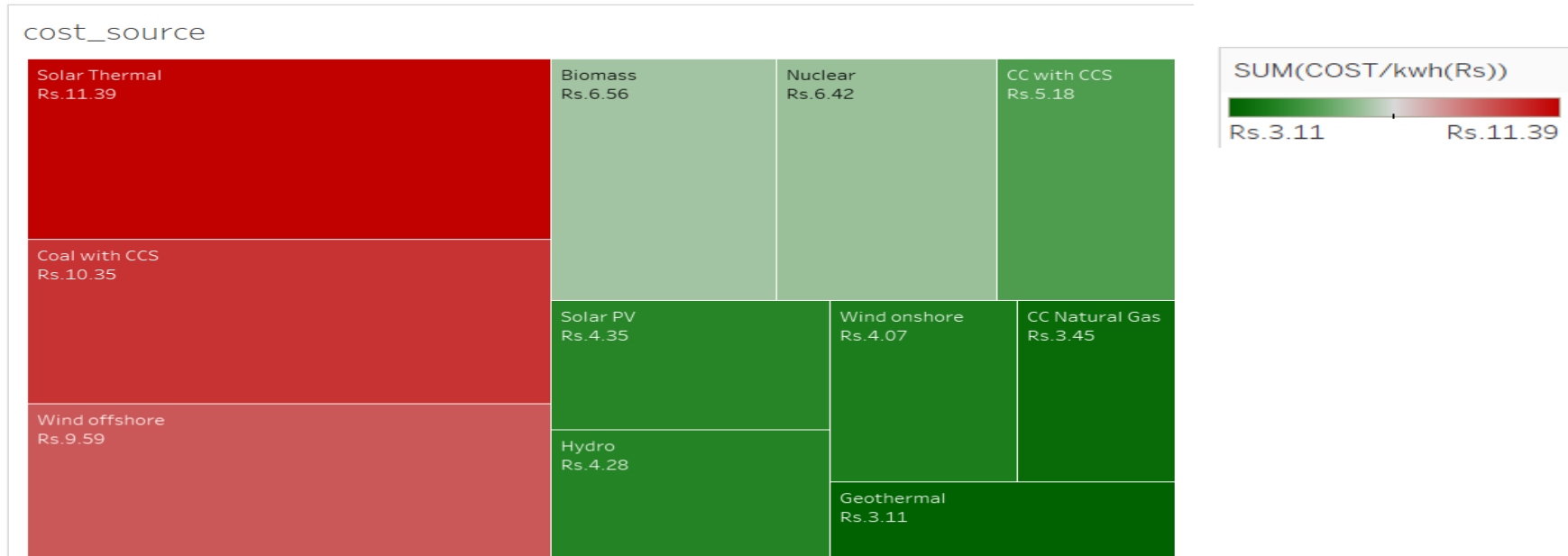
Highly used Renewable source:

- Solar
- Wind
- Hydro

Highest generating region :

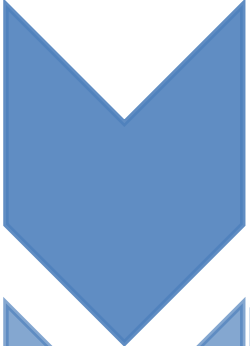
- Northern region is having majority of generation from renewable sources.


COST ANALYSIS OF ENERGY RESOURCES

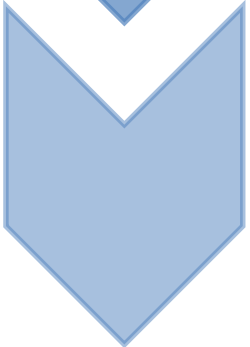


- Cost taken is in terms of levelized cost. It represents actual cost to society without government incentives.
- However, the price of coal-based electricity can nearly double due to government imposed cost on CO2 emissions.
- Photovoltaic systems are still more expensive than fossil-based ones, although PV cost keeps falling every year.

FROM INACTION TO ACTION

- 
- Minimise the import of Oil & Gases
 - Minimise the effect of global market crisis and price volatility
 - Decrease cost of production and maximise the growth

- 
- Need to reduce energy-related CO₂ emissions to limit climate change (Decarbonisation)
 - Lower transmission and distribution costs
 - Minimise the Reserves

- 
- Nullify the energy deficit by improving the production from renewable energy sources
 - Promoting of energy efficiency methods by using renewable sources.
 - The identification and analysis of key metrics across large industries and suggest the best way to check with renewable energy-related policies.

ENERGY AND NATIONAL SECURITY

- **Energy security** is the association between **national security** and the availability of natural resources for energy consumption.
- Threats to energy security include the political instability, the manipulation of energy supplies, attacks on supply infrastructure, natural disasters, terrorism, and reliance on foreign countries for oil.
- New threats to energy security have emerged in the form of the increased world competition for energy resources due to the increased pace of industrialization in countries such as India
- The modern world relies on a vast energy supply to fuel everything from transportation to communication, to security and health delivery systems.
- It is time to define "a global energy policy model, which not only aims at ensuring an efficient environmental protection but also at ensuring security of energy supply"