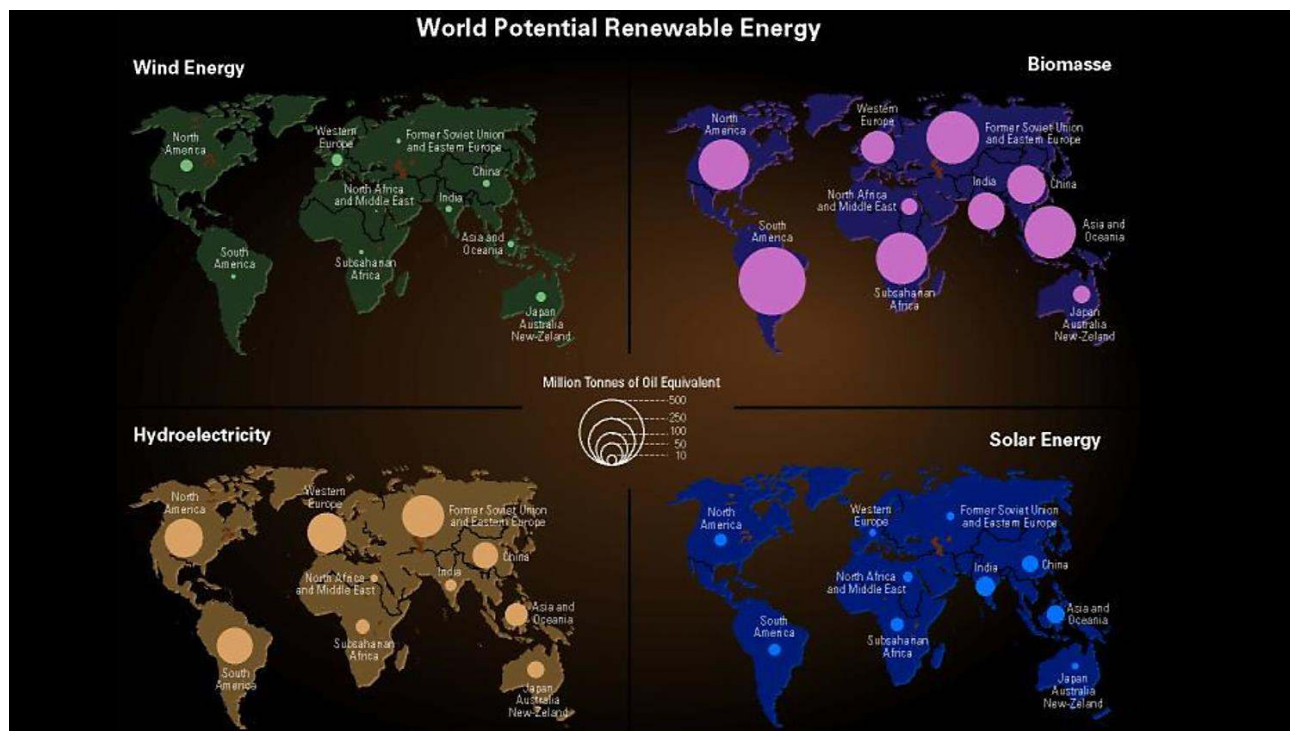


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<https://www.youtube.com/watch?v=u-H7Eqmc9rQ&t=41s>

# Renewable Energy

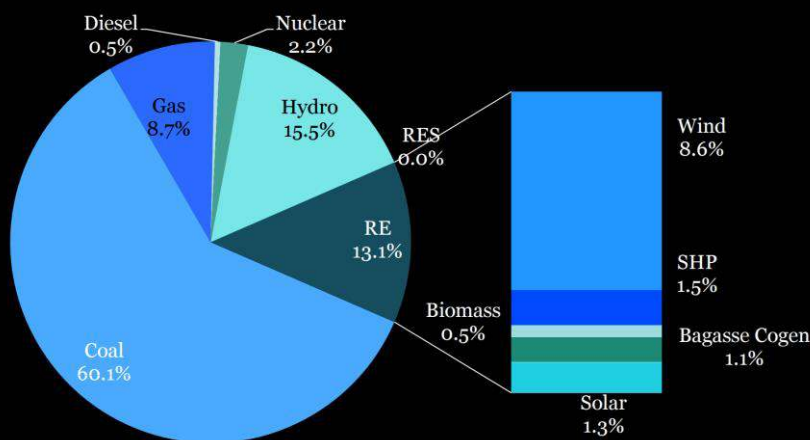
## Indian Scenario

11<sup>th</sup> Largest Economy & 4<sup>th</sup> Largest in Purchasing Power Potential Ahead



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## Power Scenario in India (Installed – 263.66 GW & Renewable Energy – 34.35 GW)



## Ministry of Non-Conventional Energy Sources (MNES)

- Ministry has launched one of world's largest and most ambitious programs on renewable energy
- 3,700 MW are powered by renewable energy sources
- Rural Electrification by 2012 for 1 lakh villages

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## Energy Sources - India

- 57% by Coal - Mainly Central & NE India
- 1/3<sup>rd</sup> from renewable energy – mainly hydropower
- Next to HEP is Natural Gas

## HEP

- Energy from water
- Major Rainfall Areas: Arunachal Pradesh, Assam, Nagaland, Manipur and Mizoram & west coast between Mumbai (Bombay) and Mahe
- Small HEP: Upto 25 MW – Identified Potential Sites 4096
- Renovation and modernization
- Development and up-gradation of water mills
- Industry based research and development

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## Largest Hydroelectricity Producer Countries

- China: 652.846 TWh
- Canada: 369.539 TWh
- Brazil: 363.304 TWh
- USA: 250.916 TWh
- Russia: 167.271 TWh

## Countries with Highest Electricity generation from HEP

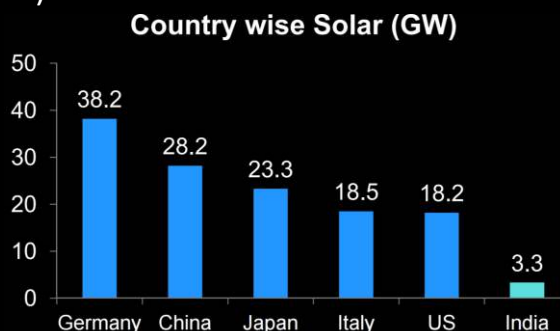
- China: 1,066.1 TW·h/year
- Brazil: 411.2 TW·h/year
- Canada: 376.7 TW·h/year
- USA: 251.2 TW·h/year

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## Solar Energy

- B/w Tropic of Cancer & Equator, average annual temperature that ranges from 25°C – 27.5 °C
- Photovoltaic Cells – Low Energy Factor, No Moving Parts
- Mirrors or parabolic dishes – concentrate lights
- Installed capacity: 3744 MW (as of 2015)
- Capacity: Gujarat > Rajasthan > MP



## Installed Solar Power Capacity Countries

- Germany: 35.736 GW
- China: 18.528 GW
- Italy: 17.861 GW
- Japan: 13.947 GW
- USA: 12.035 GW

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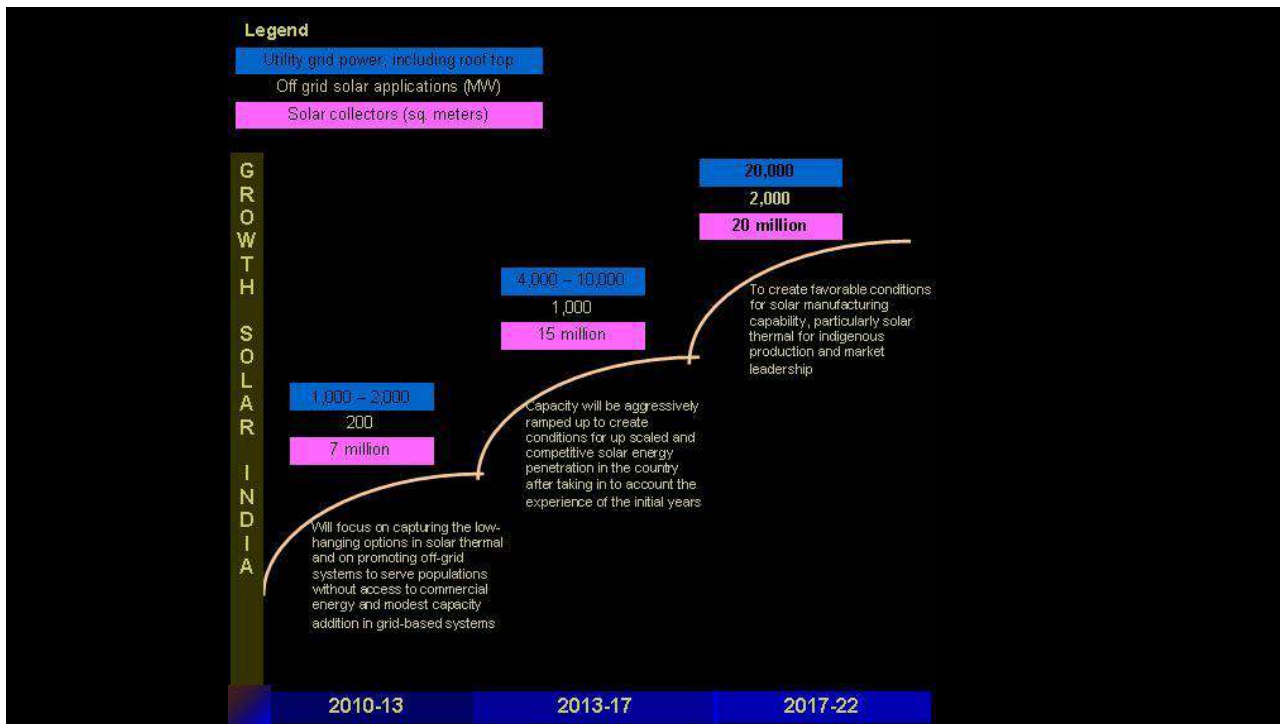
## Jawaharlal Nehru National Solar Mission

- Launched on 2010
- Target to deploy 20,000 MW of grid connected solar power by 2022
- Ecological Sustainable Growth
- To achieve 15 million sq. meters solar thermal collector area by 2017 & 20 million by 2022.
- To deploy 20 million solar lighting systems for rural areas by 2022

## Applications

- Concentrated Solar Power
  - Uses only Direct Normal Radiation fraction of solar radiation & solar heat for steam generation and finally electricity production.
  - Started by JNNSM
- Solar Water Heaters
- Domestic Use

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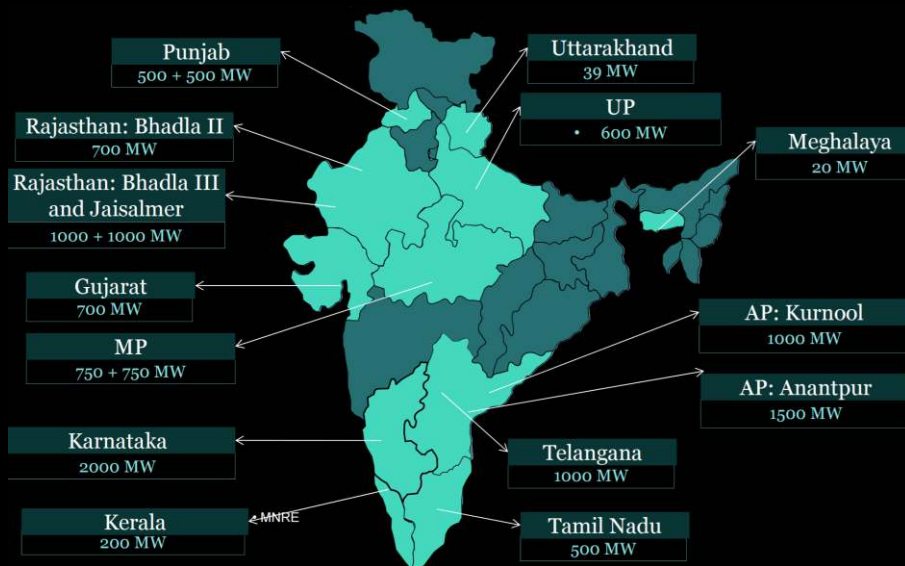


## 13 States: Solar Policy supporting grid MNRE connected rooftop systems

- Andhra Pradesh
- Chhattisgarh
- Gujarat
- Haryana
- Karnataka
- Kerala
- Manipur
- Punjab
- Rajasthan
- Uttar Pradesh
- Tamil Kerala
- Manipur
- Punjab
- Rajasthan
- Uttar Pradesh
- Tamil Nadu
- Uttarakhand
- West Bengal

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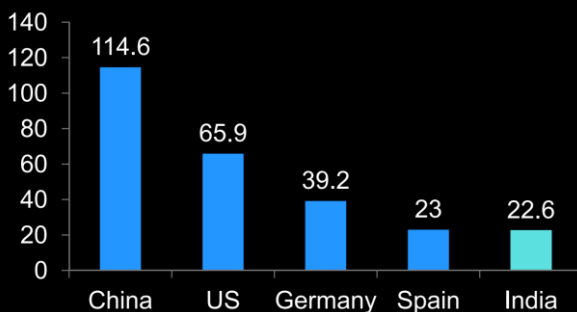
## 17 Solar Parks Approved – 12,759 MW



## Wind Energy

- India next to Germany – Fastest growing market
- Wind Power Potential – AP > Gujarat > Karnataka > Kerala
- Current Installed capacity of 22645 MW
- Installed Capacity – Tamil Nadu > Maharashtra > Guajrat > Rajasthan

Country wise Wind (GW)





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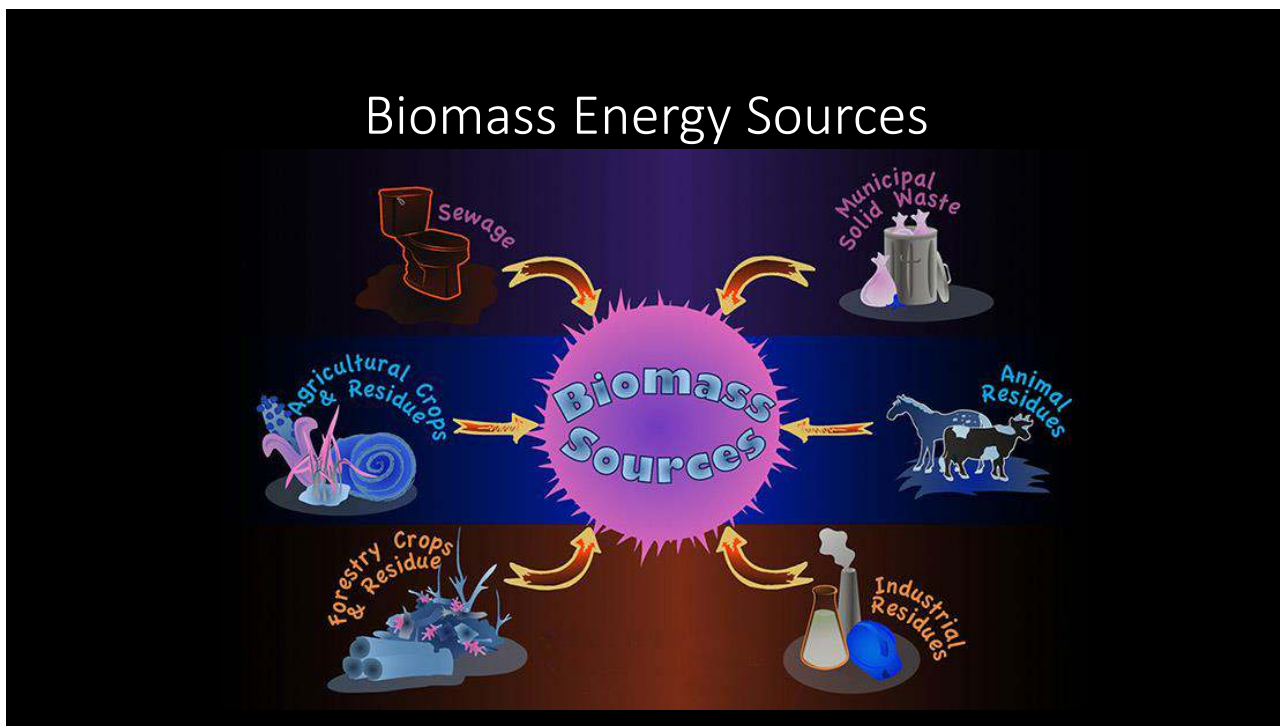
## Largest Wind Power Producing Countries

- China: 114,364 MW
- USA: 65,628 MW
- Germany: 39,963 MW
- Spain: 22,538 MW
- India: 22,562 MW
- UK: 12,597 MW

## Biomass Energy

- Top Nations: Brazil, USA (Low Cost & Indigenous Supply)
- Includes solid biomass, biogas, liquid biofuels and municipal waste
- Most successful forms of biomass are sugarcane bagasse (agriculture), pulp and paper residues (forestry) and manure (livestock residues)
- Methods: Combustion, Gasification, Fermentation & Anaerobic digestion
- Potential Biomass Production: AP > Bihar > Gujarat > Karnataka

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## Tidal Power

- Tidal energy can be harnessed in two ways: tidal stream generators & barrage generation
- South Korea, China, United Kingdom
- Sihwa Lake Tidal Power Plant in 2011: 254 MW capacity is the largest tidal power installation in the world

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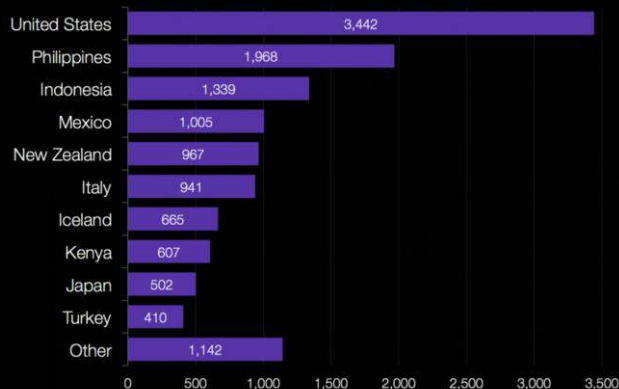
## Wave Power

- Top Nations: South Korea, Australia
- South Korea tops due to its exposed peninsula
- It is sporadic

## Geothermal Energy

- Till Now only 6.5% geothermal energy is tapped
- Countries generating more than 15% electricity from geothermal sources: El Salvador, Kenya, Philippines, Iceland & Costa Rica.

Top 10 Countries – installed capacity



Source: ThinkGeoEnergy Research, GEA, IGA (2015)

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## Targets 2022

- Generate 175 GW by 2022 - 18.9% of entire power consumption
- 100 GW from solar power – 40 GW from rooftop solar panels
- 60 GW from wind
- 10 GW from biomass
- 5 GW from small hydro power
- India – to Achieve 147 GW by 2020
- \$160 billion needed in next 7 years (until 2022) at an average of \$23 billion per year
- Goal is four times of India's annual defense spending & over 10 times India's annual spending on health and education.

## Indian Renewable Energy Development Agency

- Income tax breaks
- Accelerated depreciation
- Custom duty/duty free import concessions
- Capital/Interest subsidy
- Incentives for Detailed Project Reports (DPR) and feasibility reports
- 100% income tax exemption for any continuous block of power for 10 years in the first 15 years of operations
- Accelerated 100% depreciation on specified renewable energy-based devices
- Accelerated depreciation of 80 percent in the first year of operations
- Interest rate subsidies to promote commercialization of new technology