# WIND ENERGY IN INDIA – IPP's PERSPECTIVE

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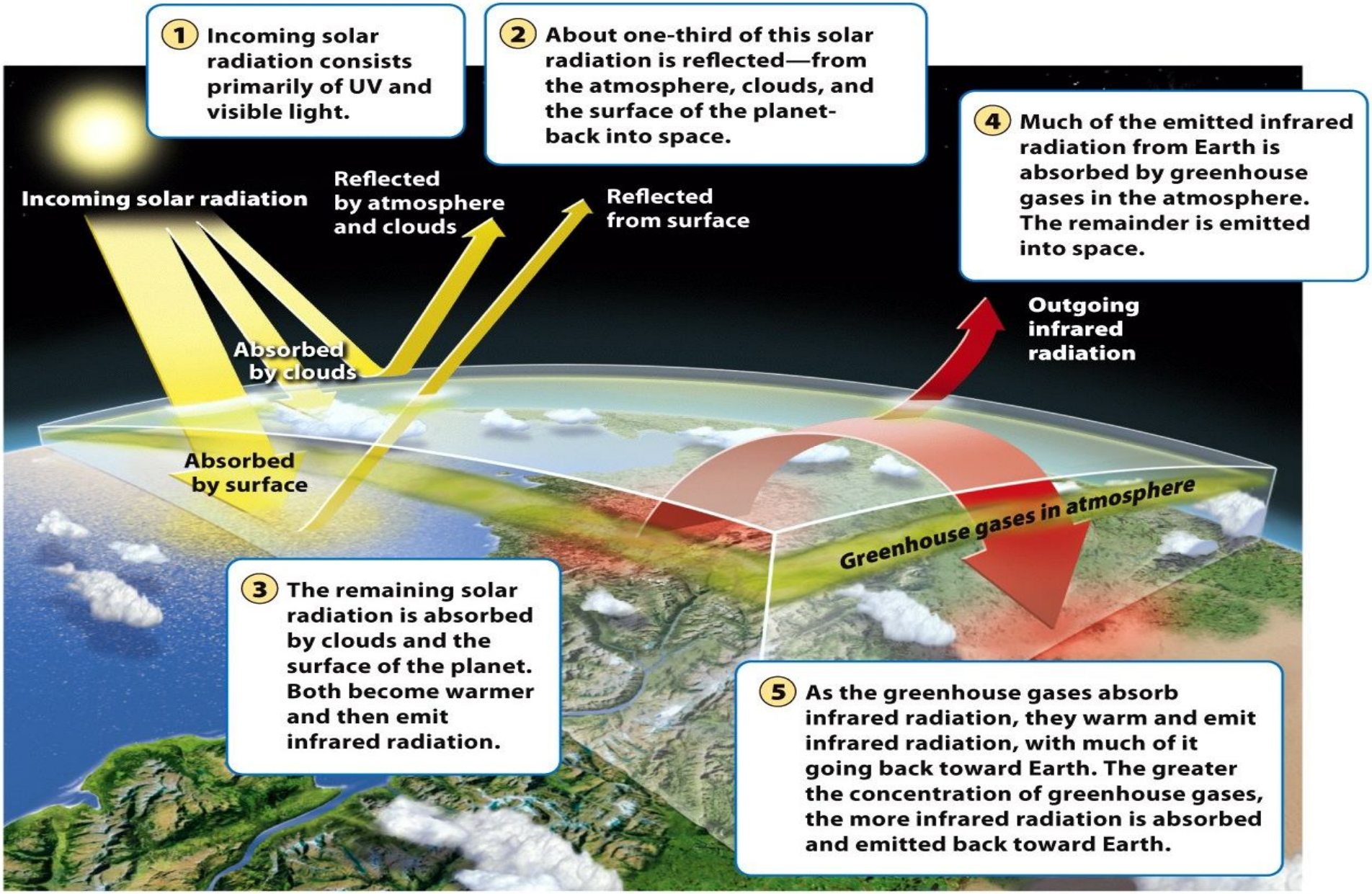
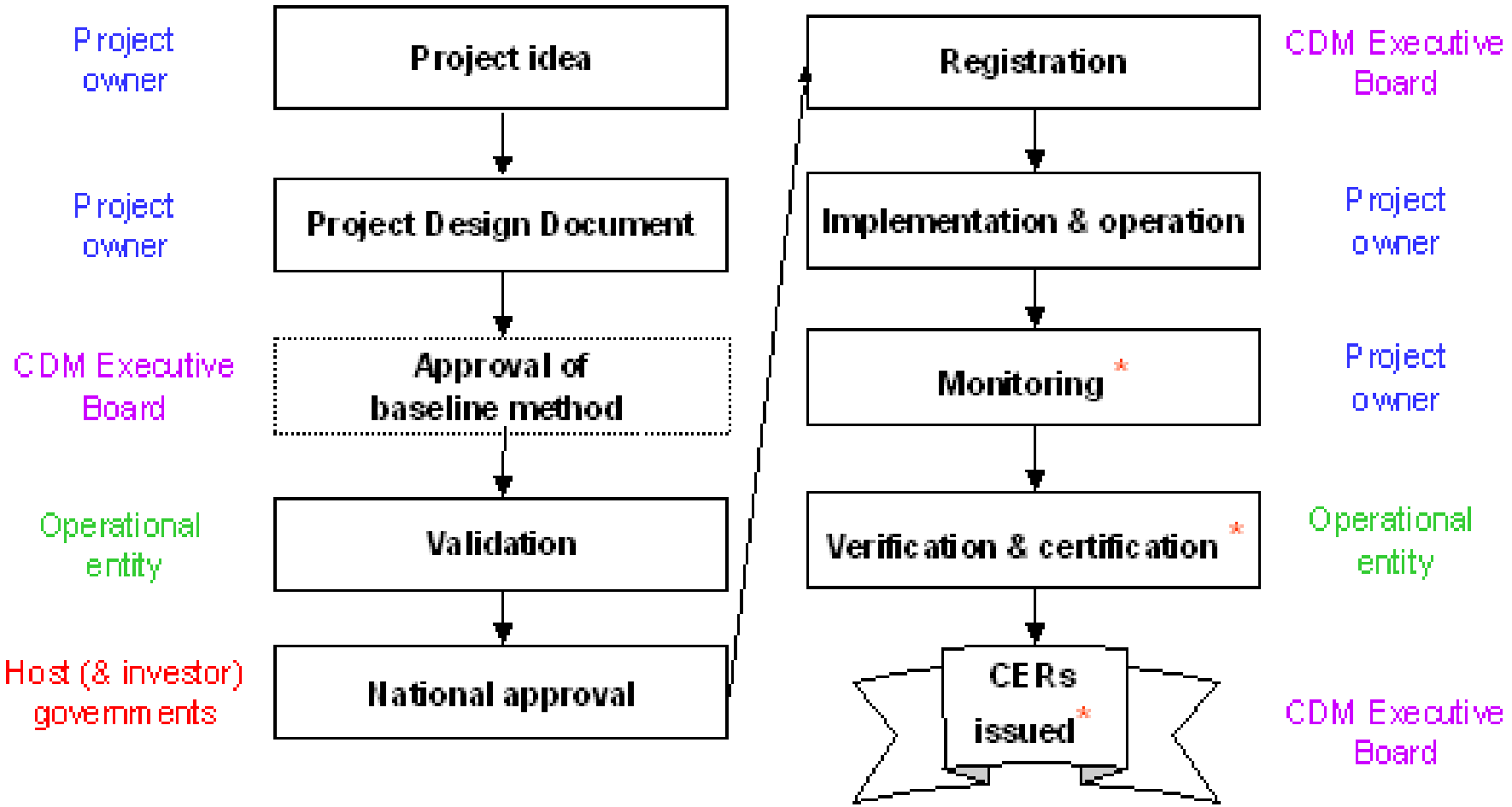
# The Greenhouse Effect



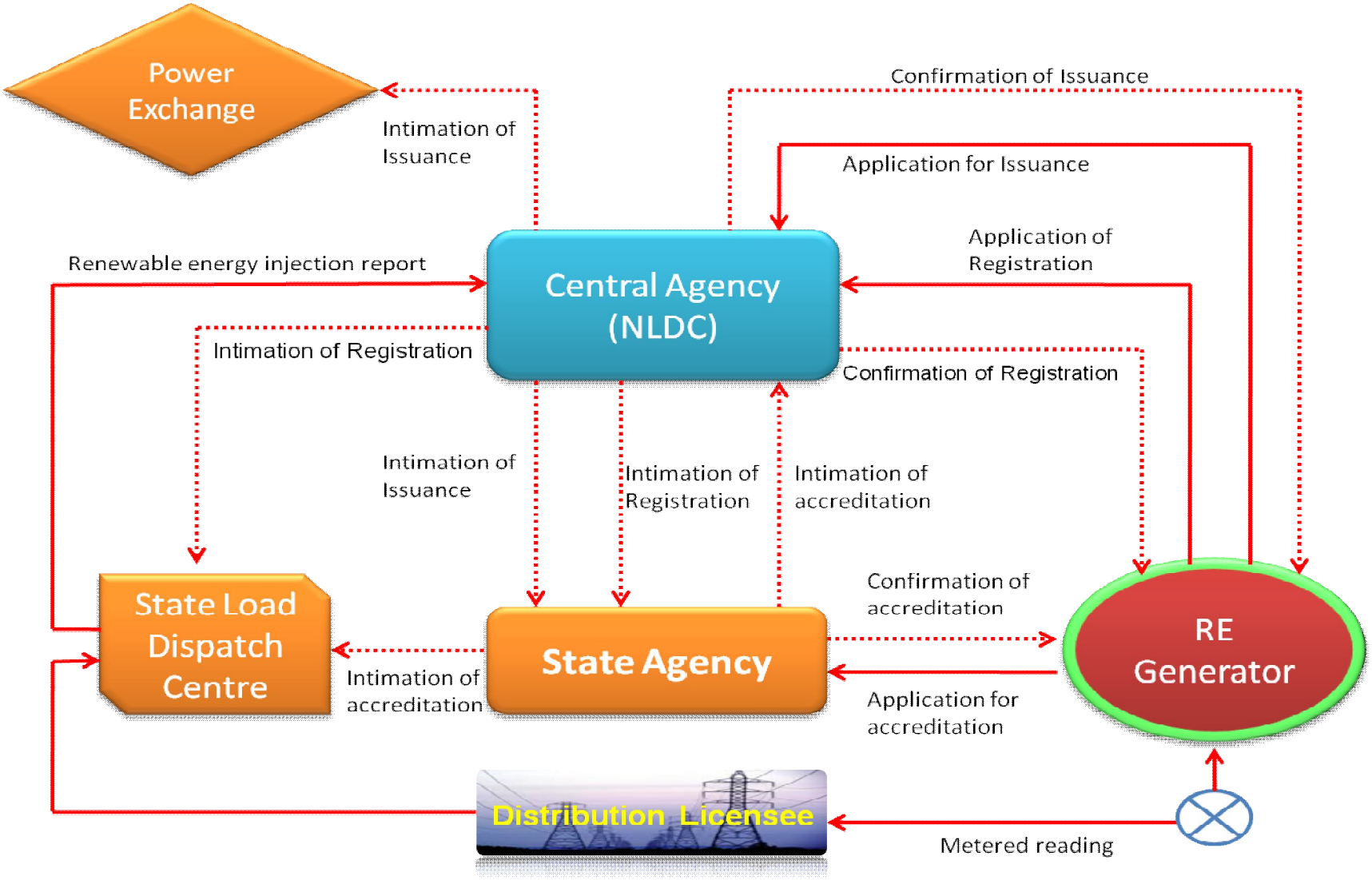
United Nations
Framework Convention on
Climate Change

# CDM Process




**The process flow chart illustrates the typical CDM project cycle, leading to the generation of Certified Emission Reduction units (CER = 1 t CO2e reduced /avoided)**

# REC Schematic model



# Renewable Energy Certificate (REC) Mechanism

❑India launched the REC mechanism in January 2010 to encourage Renewable Energy generation in the country. Similar mechanisms have been operating in the developed markets such as Australia, Europe etc.

❑REC mechanism considers the electricity generated from renewable sources as composed of 2 benefits –Power generated and Environmental attribute with the 'renewability' of this power. Second part known as REC is traded in the energy markets of India.

❑REC treats the environmental benefit of renewable power separately and values it as a tradable commodity as against the fixed feed-in or preferential tariff.

❑ 1 REC = 1 MWhr of Electricity generated from Renewable Energy Source and injected or deemed to be injected ( in case of self consumption by eligible captive power producer) into the grid.

❑**Market Clearing Price:** (as on 16-4-2016 trading Session)

| | |
|---|---|
| Solar | Rs.3500 |
| Non Solar | Rs.1500 |

# REC TRADING RESULTS

**Analysis of Trading (As on May 2016):**

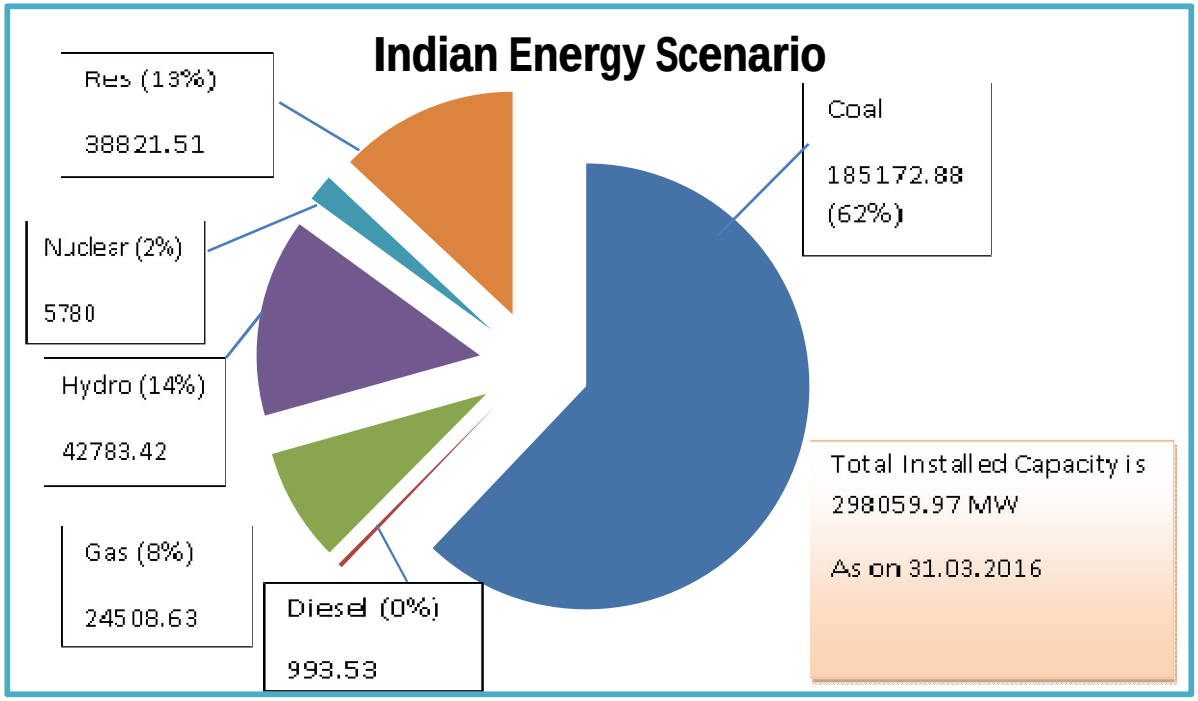
- **Non Solar –** Clearing ratio in exchange stood at **1.15%** and **1.38%** in IEX and PXIL respectively for Non Solar REC's. A total of **161,858** RECs were traded as compared to **290,457** RECs traded in April.

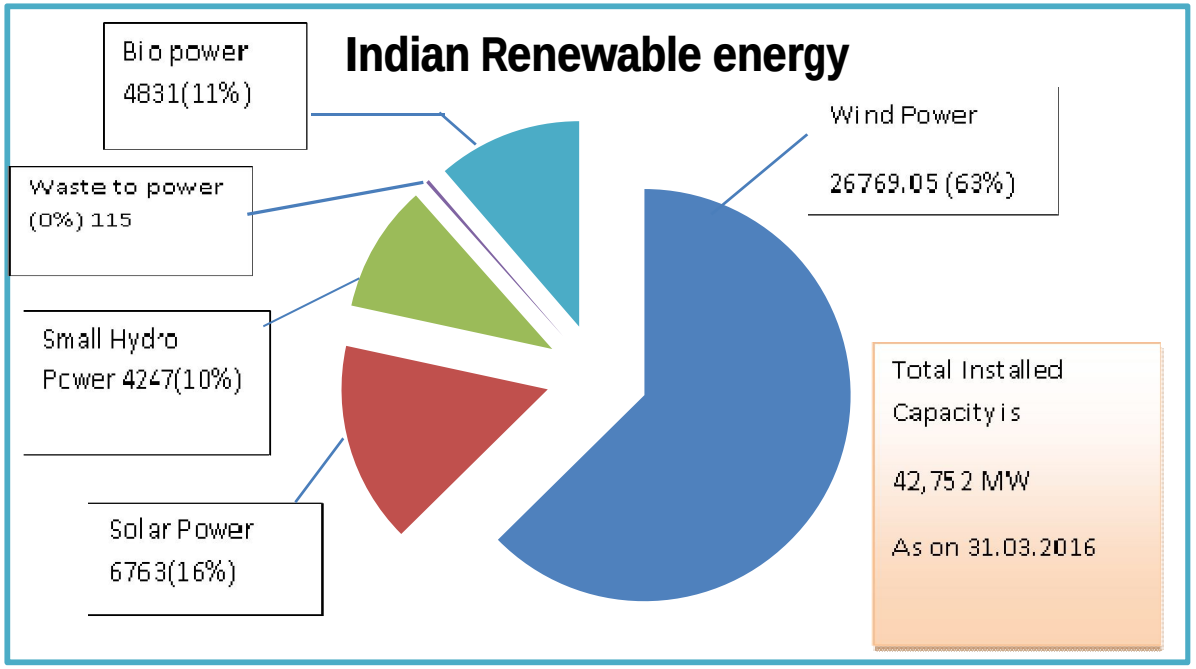
- **Solar –** Clearing ratio stood good at **0.61%** and **0.41%** in IEX and PXIL respectively, with total clearing volume falling marginally as compared to last month.

# Renewable Energy– Solution to Tackle Climate Change

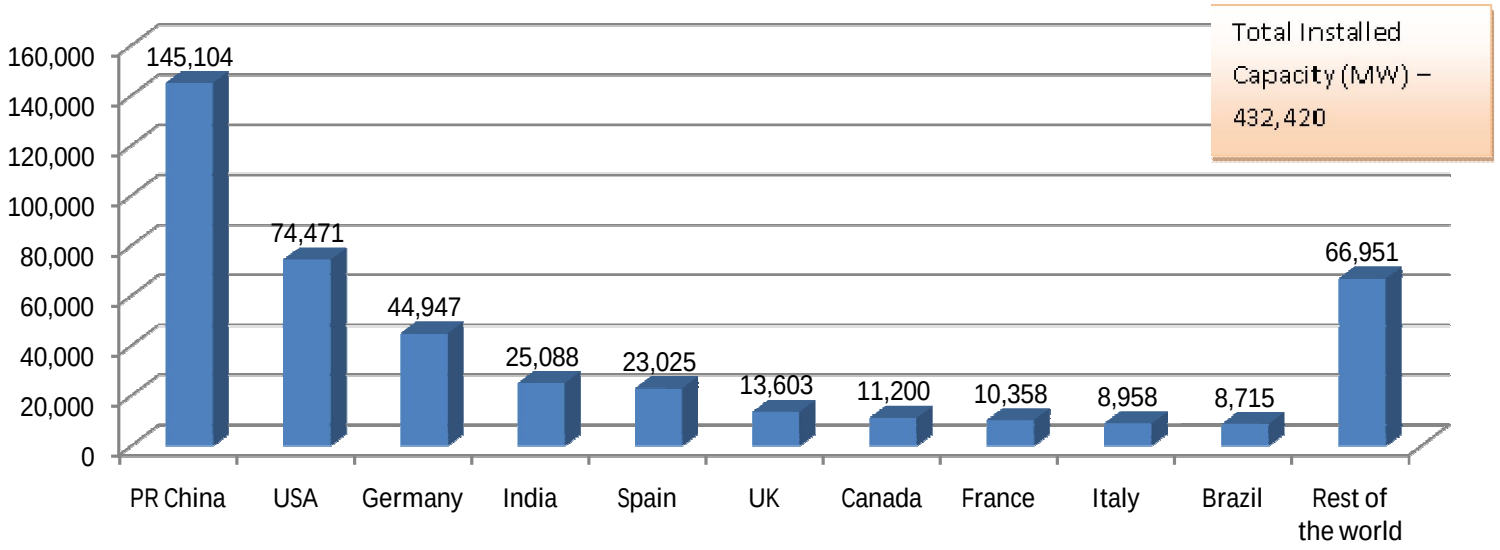
- A target of 175 GW is set for 2022 of which 100 GW would be solar, 60 GW wind, 10 GW Biomass and 5 GW small hydro power.

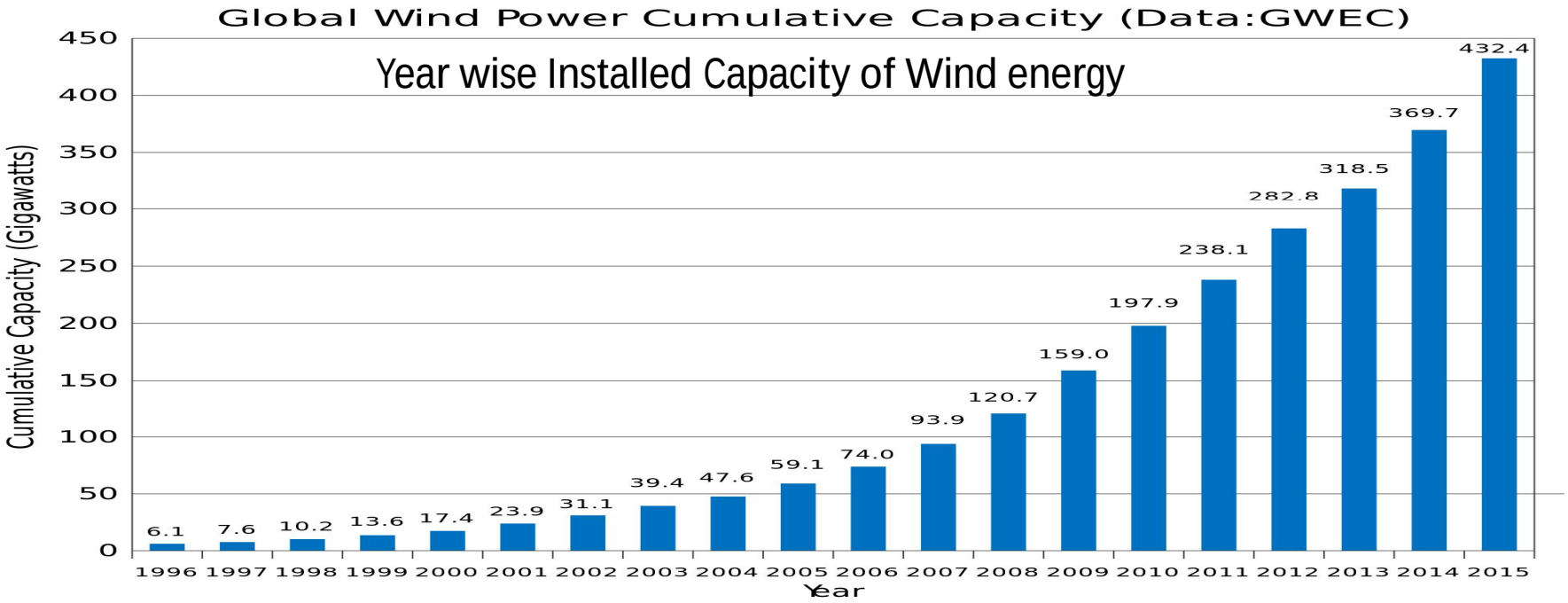
- Encouraging environment
  - Central government
    - Capital/Interest subsidy
    - Accelerated Depreciation (80% in first year)
    - Income Tax Holiday
    - Concessional custom duty/duty free import
    - Generation Based Incentive
    - Feed-in-Tariff
  - State Government
    - Concessional land allotment
    - Single window clearance
    - Sales tax exemption/reduction
    - Transport duty reduction
    - Exemption/reduction in electricity duty


Indian Energy Scenario
Res (13%)
38821.51
Coal
185172.88
(62%)
Nuclear (2%)
5780
Hydro (14%)
42783.42
Gas (8%)
24508.63
Diesel (0%)
993.53
Total Installed Capacity is
298059.97 MW
As on 31.03.2016


Indian Renewable energy
Bio power
4831(11%)
Wind Power
26769.05 (63%)
Waste to power
(0%) 115
Small Hydro
Power 4247(10%)
Solar Power
6763(16%)
Total Installed
Capacity is
42,752 MW
As on 31.03.2016

As on Dec 2015



# Wind energy (Target - 60 GW by 2022)

## Key players in the Wind Power Project Development

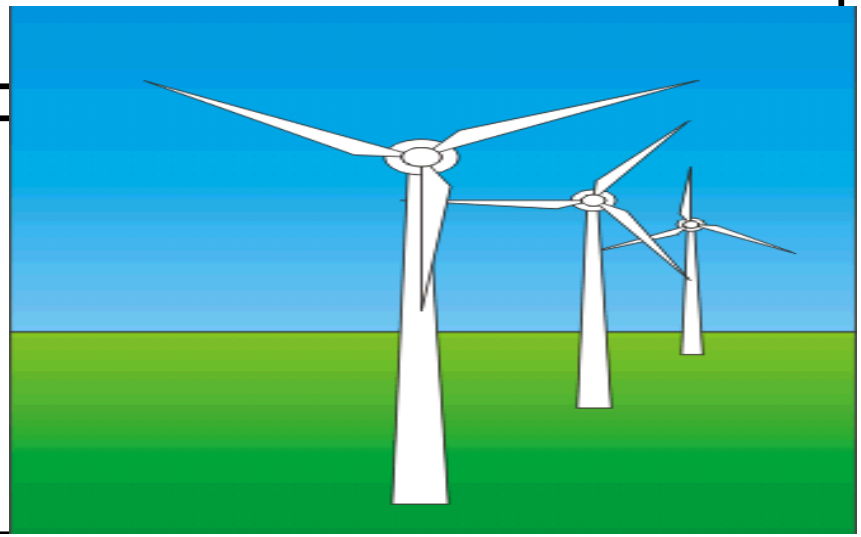
- Wind turbine manufacturers (including EPC).
- Developers (buy or lease land, finance the installation, O&M after the warranty period).
- Private consultants and contractors (provide specialized skills or knowledge, meteorologist, technical comparisons of products, due diligence).
- Electric utilities(SEBs).
- Land owners.
- Equipments service providers, Spare parts Suppliers

## Challenges

- Transmission challenges – evacuation infrastructure is inadequate.
- Lack of collaborative research between academic institutions government and private industries
- Harnessing low velocity wind regimes
- Wind power forecasting
- Storage techniques
- Offshore wind farm development
- Repowering old wind farms
- Specific skill set from Human Resource Development for the sector

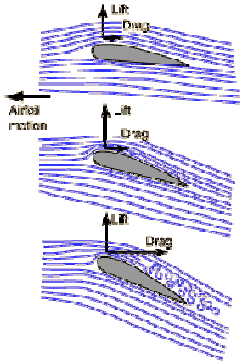
## Wind Turbine Manufacturers in India

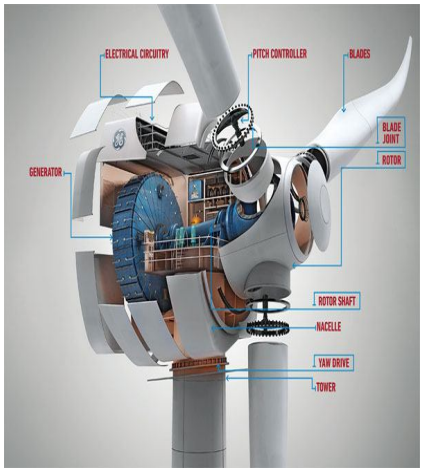
- Chiranjjeevi Wind Energy Limited, Gamesa Wind Turbines Private Limited,
- GE India Industrial Private Limited, Inox Wind Limited,
- Kenersys India Private Limited, Leitwind Shriram Manufacturing Limited
- Pioneer Wincon Private Limited
- Regen Powertech Private Limited, RRB Energy Limited, Suzlon Energy Limited
- Siva Windturbine India Private Limited, Southern Wind Farm Limited



# Wind Technology

- Types
  - Fixed speed wind turbine
  - Variable speed wind turbine
  - Gearless wind turbine
  - Horizontal / vertical wind turbine
  - Onshore / Offshore
- Upgradation
  - Increased Hub Height (26m to 120m)
  - Increased Rotor Diameter (16m to 126m)
  - Variable Speed
  - Gearless Design
  - Better Aerodynamic Blade design
  - Larger Onshore Capacity ( 55 kW to 2500 kW)
  - Offshore ( 3500 to 6000 kW)
  - Indigenous Components
  - Controller
  - SCADA & Online monitoring
- Engineering & Design
- Construction
- Operation & Maintenance



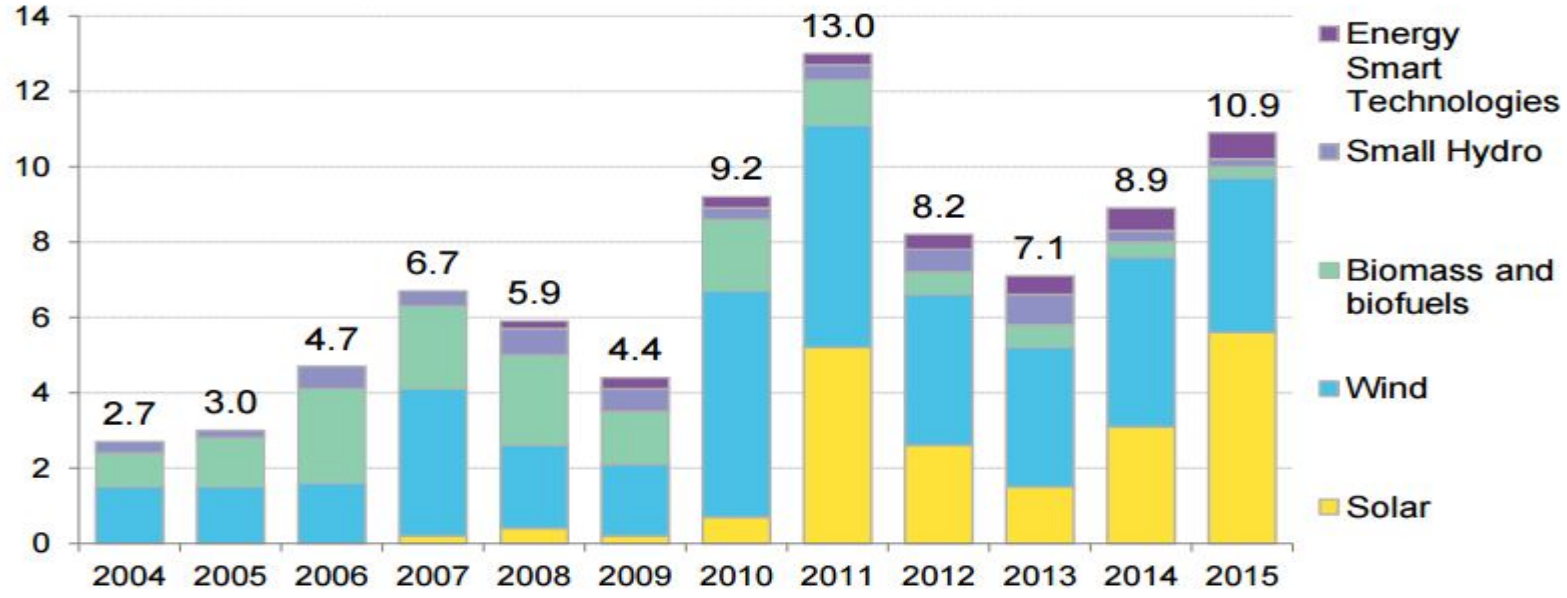


# Investment and Financing Scenario

Investment and Financing Scenario

- 100% FDI allowed
- Financing available through diverse mix of debt and equity options; asset financing
- Also through financing institutions like IREDA, PFC, REC etc.,
- Advent of IPPs helps establish Standalone project financing as an avenue
- Domestic banks considering non-recourse financing with longer repayment schedule.

**Figure 1: Total renewable energy investments in India ($bn)**




*Source: Bloomberg New Energy Finance*

# Wind Energy Policies in India

- Generation-Based Incentive
- State Wise FIT(Feed-in tariff) for Wind Power
- Renewable Energy Certificate Scheme (REC)
- National Clean Energy Fund (NCEF)- Collecting Carbon tax from polluting industries to help RE sector (Collateral policy)

# Offshore Wind Power

- Offshore wind power refers to the construction of wind farms in bodies of water to generate electricity from Offshore wind farms are the results of revolutionary technology that has encouraged man to set up wind energy harvesting farms on the water surface. Apart from oceans, lakes also act as sites for the installation of wind parks. An advantage of offshore wind farm is that it makes use of powerful winds blowing over the water surface. Moreover, it is easy to transport huge parts of a wind turbine to the offshore sites using big ships and vessels. Some of the other advantages of these farms include mitigation of noise due to distance from land and higher capacity factors.

# National offshore Wind Energy Policy

The Ministry of New & Renewable Energy (MNRE) has been authorized as the Nodal Ministry for use of offshore areas within the Exclusive Economic Zone (EEZ) of the country and the National Institute of Wind Energy (NIWE) has been authorized as the Nodal Agency for development of offshore wind energy in the country and to carry out allocation of offshore wind energy blocks, coordination and allied functions with related ministries and agencies. The approval paves way for offshore wind energy development including, setting up of offshore wind power projects and research and development activities, in waters, in or adjacent to the country, up to the seaward distance of 200 Nautical Miles (EEZ of the country) from the base line.

**Key aspects of the Policy**

1. *International Competitive Bidding*: National Institute for Wind Energy (NIWE) will allocate the blocks to the project developers through an open international competitive bidding process. It has been clarified in the Policy that on grounds of national security, NIWE shall reserve the right to refuse participation of entities without providing any specific details. The selection of project developers through competitive bidding process requires a basis of selection generally ranging from the tariff, total cost of project, sharing of production benefits or revenue, rate of lease on land etc.
2. *Facilitator of Clearances and Intermediate Off-taker*
3. *Costs*
4. *Environmental Aspects*
5. *Security*

# Essential Elements of Development of Offshore Wind Energy

- ✓ Preliminary Resource Assessment and preliminary oceanographic & bathymetric studies for demarcation of blocks.
- ✓ Environment Impact Assessment (EIA) study of proposed Offshore Wind Farms regarding aquatic life, fishing etc., studies relating to navigation, undersea mining and related exploration/exploitation activities and other users of the sea.
- ✓ Detailed studies & surveys - These studies will determine the construction costs for special foundations, special ships for both operation and maintenance requirements.
- ✓ Sea Bed Lease Arrangement.
- ✓ Statutory Clearances and NOCs.
- ✓ Grid Connectivity and Evacuation of Power (both offshore and onshore)
- ✓ Technology
- ✓ Incentives
- ✓ Security of offshore installations and confidentiality of the data collected during studies and surveys.
- ✓ Financing and Insurance.

# Advantages & Disadvantage of Offshore Windmills

**Advantages:**

- Wind a rapid growing, inexhaustible, free environmental friendly and cost effective energy source to power the turbine - in turn producing cost effective electricity.
- No injuries to birds
- The intensity of the wind speed is steadier and heavier in the deeper waters, hence producing high output per revolution.
- Longer windmill life approx 23- 30 years.
- The wind blows faster and more uniformly at sea than on land. A faster, steadier wind means less wear on the turbine components and more electricity generated per turbine.

**Disadvantages:**

- Cost – This is the biggest disadvantage of off shore wind power over onshore wind energy.
- Offshore installation is generally more expensive than onshore, depending on the location. Offshore towers are a fair bit taller than onshore towers once the submerged height is included, making the foundation more expensive to build.
- Offshore saltwater environments also raise maintenance costs by corroding the towers, but fresh-water locations such as the Great Lakes do not. Repairs and maintenance are usually more costly than on onshore turbines, motivating operators to reduce the number of wind turbines for a given total power by installing the largest available units.
- Construction complexity

# Repowering of Wind Turbines

The replacement of old and inefficient turbines by the new and more efficient ones in an attempt to increase not only the installed capacity but also the power generation can be referred to as the classical definition of repowering. There are several methods in which this replacement can happen, but generally the increase in installed capacities for most repowered projects around the world is typically below 25%, although the net power generation can go up by more than 300% given the higher hub heights and the higher turbine efficiencies.

# Need & benefits of Repowering

- **More wind power from the same area of land**: –wind power generation is multiplied without the need for utilising additional land;
- **Fewer wind turbines**: –The construction height can be raised and the number of turbines can be reduced while enhancing the natural landscape.
- **Higher efficiency, lower costs**: –modern turbines make better use of available wind energy thereby cost of production is lowered significantly.
- **Better power grid integration**: –modern turbines offer much better grid integration, since they use a connection method similar to conventional power plants and also achieve a higher utilization degree;
- **Better appearance**: –modern turbines rotate at much lower speeds and are thus more visually pleasing than older, faster-rotating turbines;

**Financial Advantages :**

- Reduction of the ratio of land area to per MW of installed capacity
- Increase in the opportunities of the states to achieve Renewable Purchase Obligation (RPO) targets, and thereby the national targets in National Action Plan on Climate Change (NAPCC).
- Increase in the number of issued Renewable Energy Certificates (RECs)

**Technical Advantages :**

- Efficient utilization of premium wind resource rich sites. Increasing the energy yield by several times from current levels
- Higher Plant Load Factors (PLF)

**Social and Environment Advantages :**

- Increase the visual appeal of the farm
- Lowering the incidents of the collision of birds

# Challenges in Repowering

**Technical Issues**

- O& M of old WTGs
- Underutilization of wind resource site
- Electrical grid and substation
- Rating of WT for repowering
- Micro siting
- Options to dispose off
    - Scrap
    - Exporting to other countries
    - Buy back by the WTG manufacturer / intermediaries

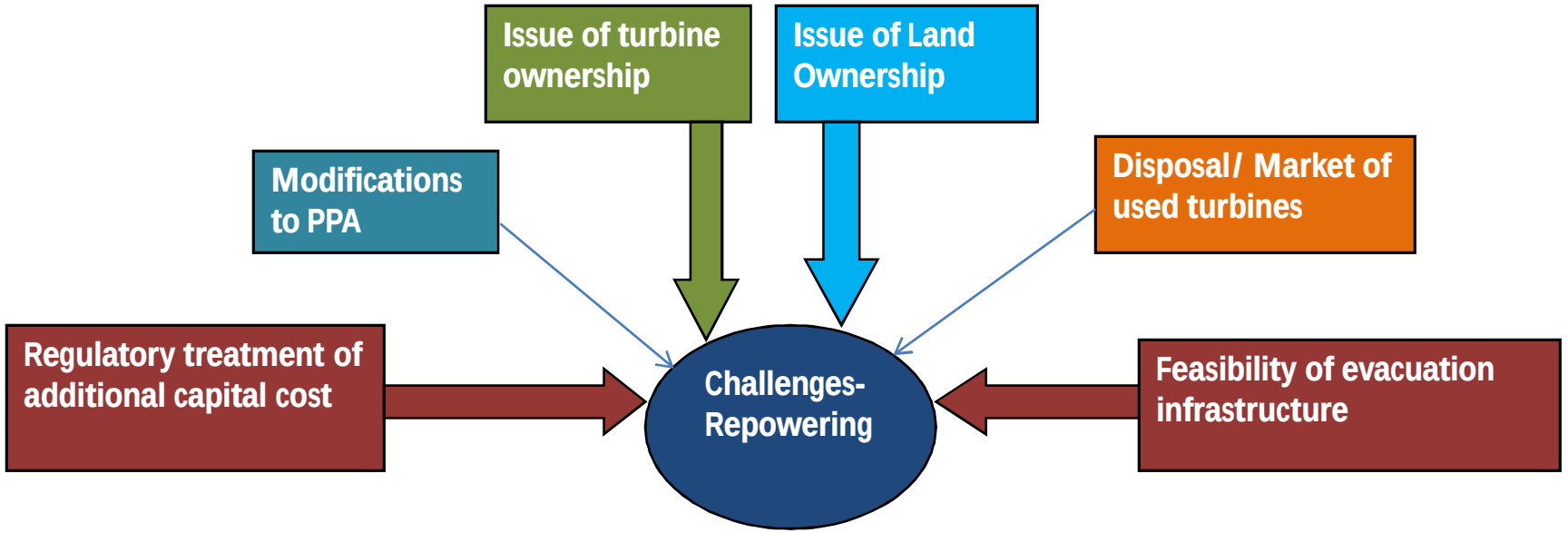
**Financial Issues**

De-erection & Transportation Cost

- Salvage value of old project
- Discounting factor
- Sale to EB v/s Captive Power Projects
- Tariff and incentives for repowering

**Policy and Regulatory Issues**

- PPA Issue
- Mode of sale of electricity
- High open access charges to new captive wind projects


Issue of turbine ownership
Issue of Land Ownership
Modifications to PPA
Disposal/ Market of used turbines
Regulatory treatment of additional capital cost
Challenges- Repowering
Feasibility of evacuation infrastructure

# Repowering - Incentive

**Repowering Incentives**

- Uniform higher Feed-in tariff support in all states where repowering potential is available.
- Generation linked repowering incentive for minimum 5 years.
- Accelerated Depreciation (AD), bonus (additional) tariff for repowered projects for fixed period.
- Incentive to Discoms for accepting power from repowered projects.
- Provision of funds for Infrastructure Development Charges (IDC) by MNRE on the basis of increased capacity.

**Key findings for Incentive requirement**

- Incentive requirement varies from State to State depending upon the prevalent tariff regime.
- The nature of off-take arrangement, viz. Sale of Utility, Captive wheeling or Third party wheeling also greatly influence the need for incentive requirement within a state.
- Continuation of the concessional banking & wheeling arrangements and cross subsidy surcharge plays important role in assessing the incentive requirement and viability of the repowering project.
- For a repowering project, apart from energy yield, cost economics and incentive framework, it is possible to devise multiple project scheme with various offtake arrangements.

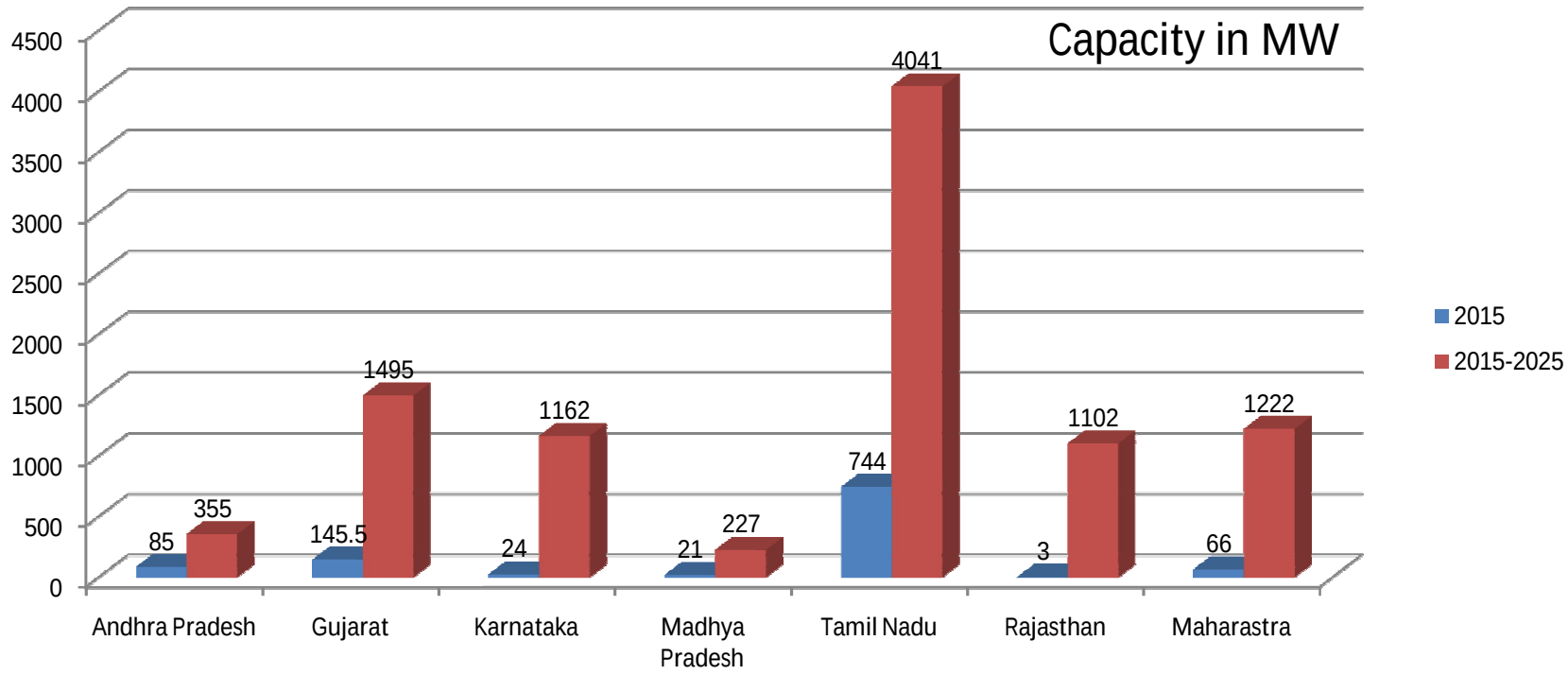
# Repowering Policy

- **Stakeholder Consultation**: It is necessary identify and engage concerned stakeholders such as owners of the wind-farms, OEMs, project developers, financial institutions, regulatory bodies, nodal agencies, land owners, O&M agencies etc. to arrive at a workable business model. One of the major challenges in repowering which is likely to create complications is multiple ownerships. Therefore, engagement of key project proponents is a crucial factor to arrive at a workable business model.
- **Single window clearance:** A single window clearance is recommended as there are many approvals and permissions required from concerned regulatory bodies. A single window would avoid time delay in obtaining various approvals.
- **Revenue Sharing mechanism:** This is a very important factor influencing the decisions as most PPAs signed must be either with SEBs or third parties and respective project proponents. It is assumed that the power procurer may not be interested in discontinuing it before the stipulated time. Therefore, a workable business model is recommended which incorporates possible solutions for such challenges.
- **Financing instruments:** It is found that most of the early wind turbines in Tamil Nadu were captive and repowering project need to be approved to choose alternate option of power sale such as under REC mechanism, third party sate, captive consumption, etc.
- **Public Private Partnership (PPP):** The model needs to be encouraged by government towards development of infrastructure.
- **Must run / Must Take Status:** needs to be encouraged for financial viability.

# Repowering Potential estimate for major wind rich states of India

Wind Power projects commissioned prior to 2000 and turbine capacity < 1 MW

Wind Power projects commissioned prior to 2010 and turbine capacity < 1 MW




- Potential business opportunities for repowering are plenty.
- Long term repowering program with continuity of policy & regulatory regime would be necessary.

# Conclusion

- Wind energy has seen huge potential in the last few years. There is no doubt that more investment will be made in this renewable source of energy in the years to come to fulfill the ever increasing demand for the electricity.
- India's wind energy market is expected to attract investments totalling Rs 1,00,000 crores (US$ 15.7 billion) by 2020, and wind power capacity is estimated to almost double by 2020 from over 23,000 MW in June 2015, with an addition of about 4,000 MW per annum in the next five years.
- The government's immediate goal is to generate two trillion units (kilowatt hours) of energy by 2019. This means doubling the current production capacity to provide 24x7 electricity for residential, industrial, commercial and agriculture use.
- According to the report by the Intergovernmental Panel on Climatic Change (IPCC), by 2050 wind energy will play a major role in electricity generation among renewable energy. Its contribution will be about 80% of the world's energy demand. Wind energy is known for its simplicity and limited space needs.
- In the development of renewable energy, there are many barriers including investment. All these barriers are not solved by only technological, social, political, or economic factors. There must also be a multidimensional approach toward identifying and explaining the fundamentals of these barriers to develop a viable solution.
- IREDA under the guidance of MNRE has drawn long-term policy for the international market to invest in India for the development of wind power energy. It has also designed policy for local investors in the renewable energy development sector.

# THANK YOU