

# Re-powering of old wind turbines in India Business Model & Incentive scheme

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# Presentation Outline

- Background for Repowering Study
- Repowering Potential Assessment
- Stakeholder Consultation for identifying Key Challenges
- Proposed Business Model and Incentive computation
- Proposed Implementation Framework for Repowering projects
- Way forward

# Background for Re-powering Study

## Objectives : Repowering Study by IGEF

- **Indo-German Energy Forum (IGEF) - Support Office** has initiated study to evolve framework to promote the concept of Re-powering of wind turbines.
- In this context, the IGEF Support Office has engaged **M/s Idam Infrastructure Advisory Pvt Ltd (Idam Infra)** to carry out the study and engage with key stakeholders in the wind industry.
- The study is supported by MNRE and NIWE.

### Objectives

- To understand Repowering market developments: Global & Indian
- To analyse major factors influencing decisions of repowering investments
- To evaluate financing requirements for repowering project(s)
- To evolve policy and regulatory measures needed to pursue repowering in India
- To estimate total market potential and assess business opportunity for repowering in India

# Overview of Repowering Study

- Key components of the Study

## Market study for repowering

- Consultation with select Stakeholder Groups to assess key influencing factors (Go/No-Go) & repowering potential
- Summarizing key learning from international experiences

## Evaluation of business model

- Evaluation of challenges for repowering project considering two sample project references in Gujarat & Tamil Nadu
- Evaluation of business models and devising project structure to address challenges.

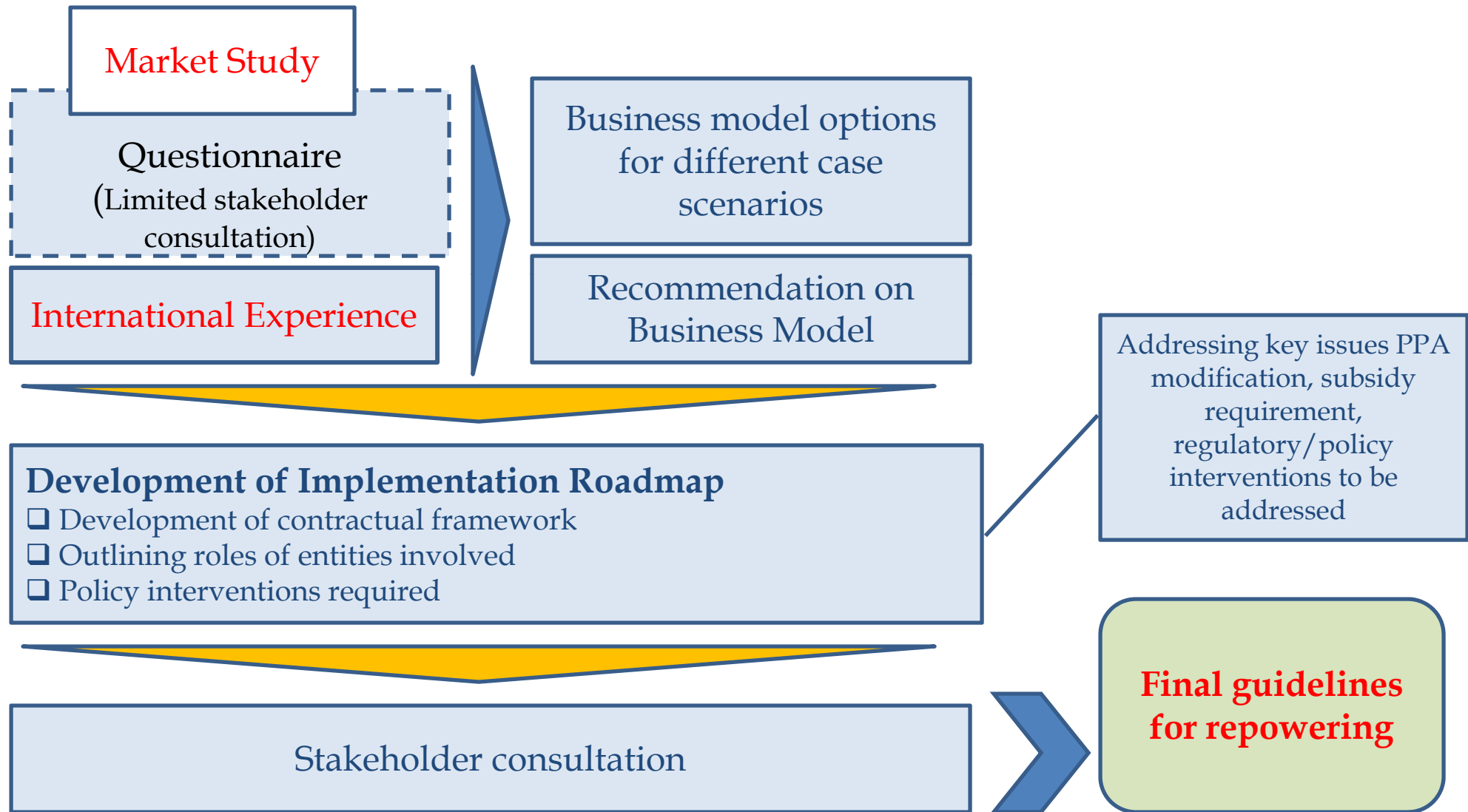
## Implementation Roadmap

- Outlining roles for various entities
- Addressing issues in contractual framework
- Highlighting required policy & regulatory interventions

## Draft Guidelines for Repowering

- Stakeholder Consultation Workshop
- Development of draft guidelines for repowering programme

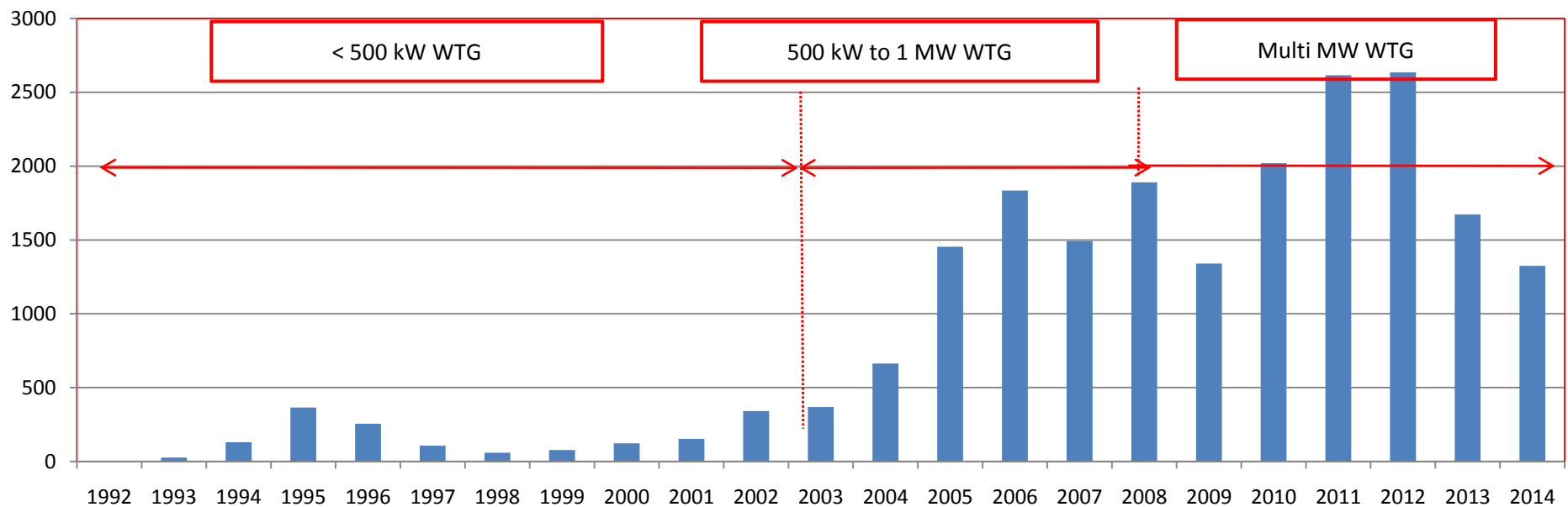
# Approach for Repowering Study



# Introduction to Repowering and Potential Assessment

# Wind power development in India

- India has **fifth** largest wind energy installations in the world, with installed capacity of **23,444 MW** (as on Mar 2015).

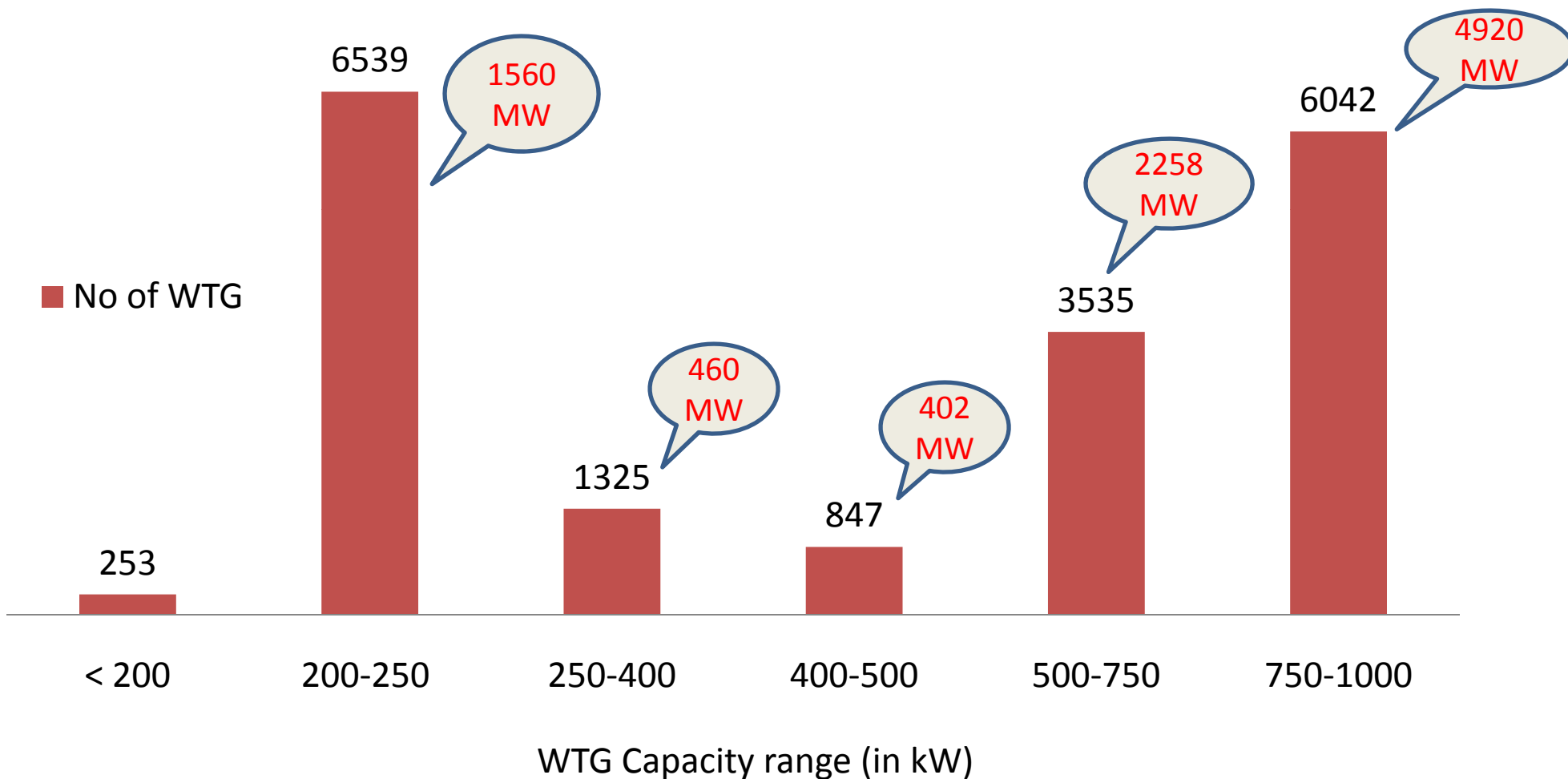


- Around ~ 10% of installed capacity comprise WTGs with Unit Size less than 500kW.
- Most of these projects are located at sites with WPD > 250 W/m<sup>2</sup> at 50 m.



# Classification of installed WTGs (< 1 MW) by turbine capacity size

There are ~18,500 WTGs with installed capacity of <1 MW.



# 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 number of turbines can be reduced while enhancing the natural landscape. The construction height can be raised;
- Higher efficiency, lower costs:
  - modern turbines make better use of available wind energy. The cost of production is significantly lowered;
- 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;

# Repowering Potential Assessment -1/3

- Results for Re-powering potential assessment

- WTGs with operational life of 15 years (commissioned prior to 2000).
- Unit size of each WTG (< 500 KW).
- Quantified figures for potential of major wind rich states are given in the subsequent slides*

- Research methodology - database/sources

- Potential assessment analysis done for all India basis
- Potential assessment of few states/sites in TN & GJ
- Analysis of the wind directory 2014 as published by CECL.
- Scenario analysis for projects commissioned prior to 2000 and WTG capacity size

# Repowering Potential Assessment - 2/3

State wise Break-up of All India installed WTGs (COD prior to 31-Mar-2000) (source : India Wind Power Directory 2014), (all fig in kW)

Name of state	Capacity of individual WTGs in kW					Total capacity (kW)
	<u>&lt;=500 kW</u>	<u>501 to 1000 kW</u>	<u>1001 to 1500 kW</u>	<u>1501 to 2000 kW</u>	<u>&gt;2000 kW</u>	
Andhra Pradesh	84,390	-	-	-	-	84,390
Gujarat	143,745	1,600	-	-	-	145,345
Karnataka	24,525	-	-	-	-	24,525
Kerala	-	-	-	-	-	-
Maharashtra	63,715	2,250	-	-	-	65,965
Madhya Pradesh	21,100	-	-	-	-	21,100
Rajasthan	2,900	-	-	-	-	2,900
Tamil Nadu	717,050	37,900	-	-	-	754,950
	<b>1,057,425</b>	<b>41,750</b>	-	-	-	<b>1,099,175</b>

- Est. Repowering Potential for WTGs with size (<=500 KW & COD prior 2000), is 1057 MW.
- **Tamil Nadu** (717 MW) and **Gujarat** (144 MW) lead the repowering business opportunity.

# Repowering Potential Assessment - 3/3

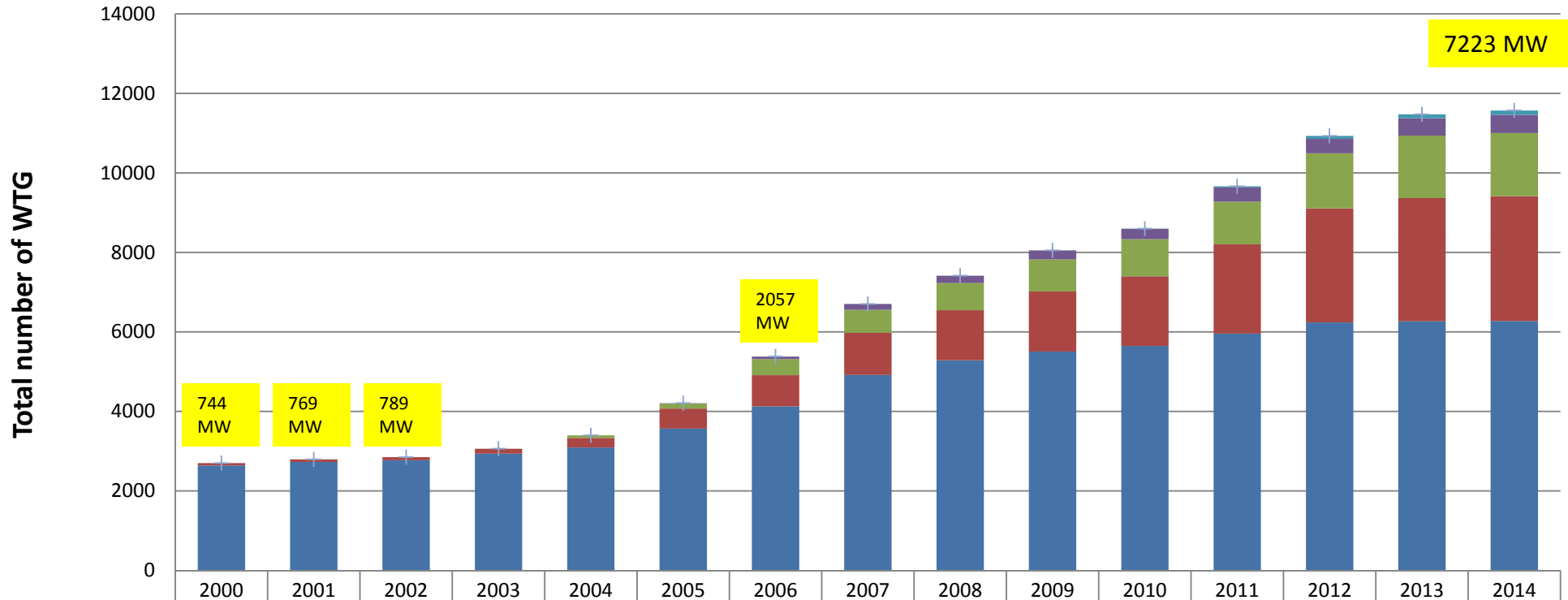
State wise Break-up of All India installed WTGs (COD prior to 31-Mar-2006) (source : India Wind Power Directory 2014), (all fig in kW)

Name of state	Capacity of individual WTGs in kW					Total capacity (kW)
	<=500 kW	501 to 1000 kW	1001 to 1500 kW	1501 to 2000 kW	>2000 kW	
Andhra Pradesh	86,240	30,400			-	116,640
Gujarat	157,845	77,150			-	234,995
Karnataka	41,445	350,150			-	391,595
Kerala	225	-			-	225
Maharashtra	241,795	204,350			-	446,145
Madhya Pradesh	21,550	4,500			-	26,050
Rajasthan	47,825	163,350			-	211,175
Tamil Nadu	1,330,235	705,700			-	2,035,935
	<b>1,927,160</b>	<b>1,535,600</b>	-	-	-	<b>3,462,760</b>

- Est. Repowering Potential for WTGs with size (<=1000 KW & COD prior 2006), is 3463 MW.
- Key States - **Tamil Nadu** (2035 MW), **Maharashtra** (446 MW) and **Karnataka** (391 MW).

# Tamil Nadu : WTG capacity-wise Annual installations

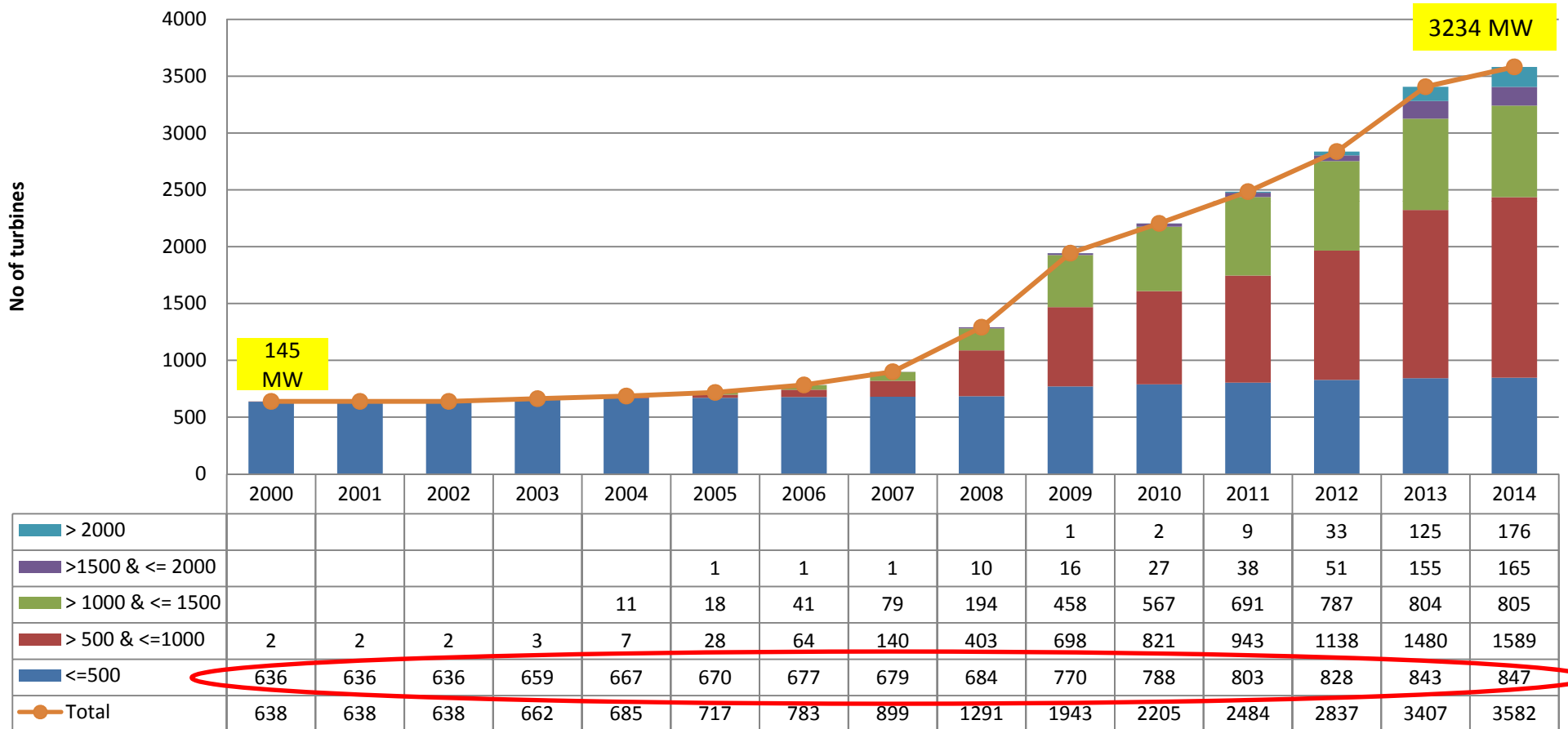
Total number of WTG installed since 2000



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
> 2000								1	1	1	3	28	76	97	108
>1500 & <= 2000						10	63	146	185	226	260	359	363	439	457
> 1000 & <= 1500				3	64	124	404	574	682	807	936	1075	1383	1571	1588
> 500 & <=1000	60	65	78	121	243	505	786	1062	1258	1509	1750	2242	2872	3099	3140
<=500	2640	2728	2771	2938	3091	3568	4127	4919	5288	5507	5648	5959	6237	6267	6276
+ Total no of turbines	2700	2793	2849	3062	3398	4207	5380	6702	7414	8050	8597	9663	10931	11473	11569

# Gujarat : WTG capacity-wise Annual installations

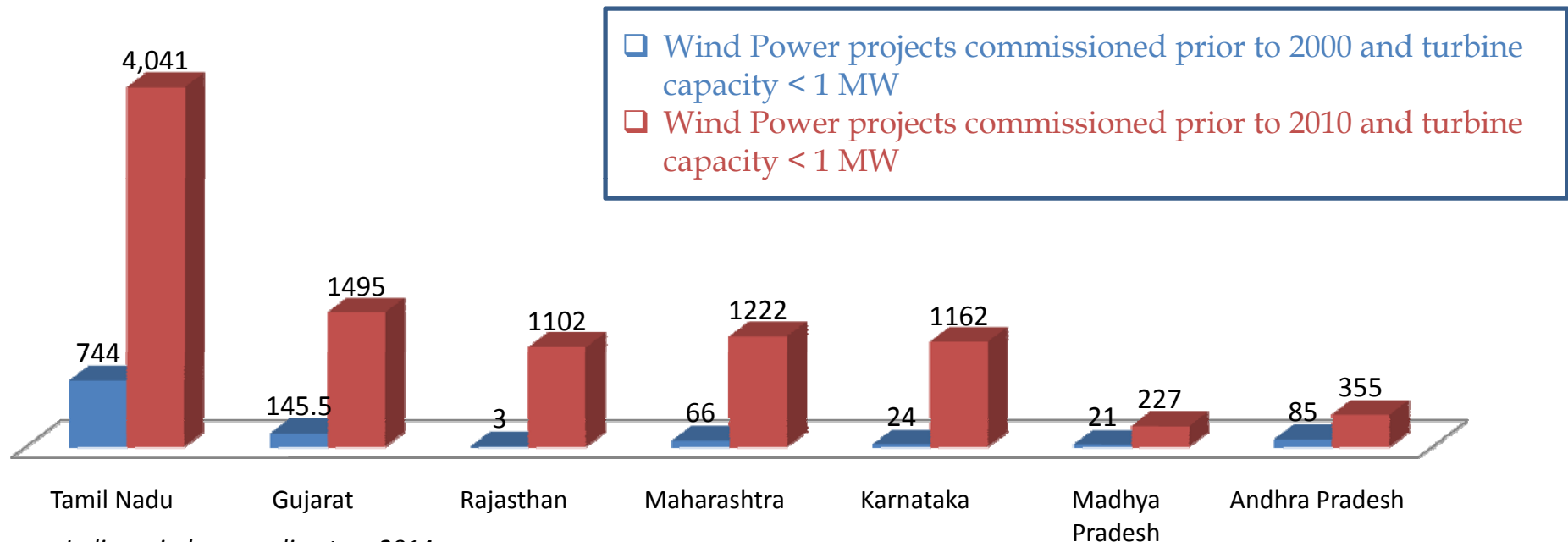
**WTG capacity wise installation since 2000**



# Repowering potential estimate for major wind rich states of India

## Repowering potential in wind rich states

■ Potential Capacity for repowering in this FY (2015) (MW) ■ Potential capacity in next 10 years (2015-2025)(MW)



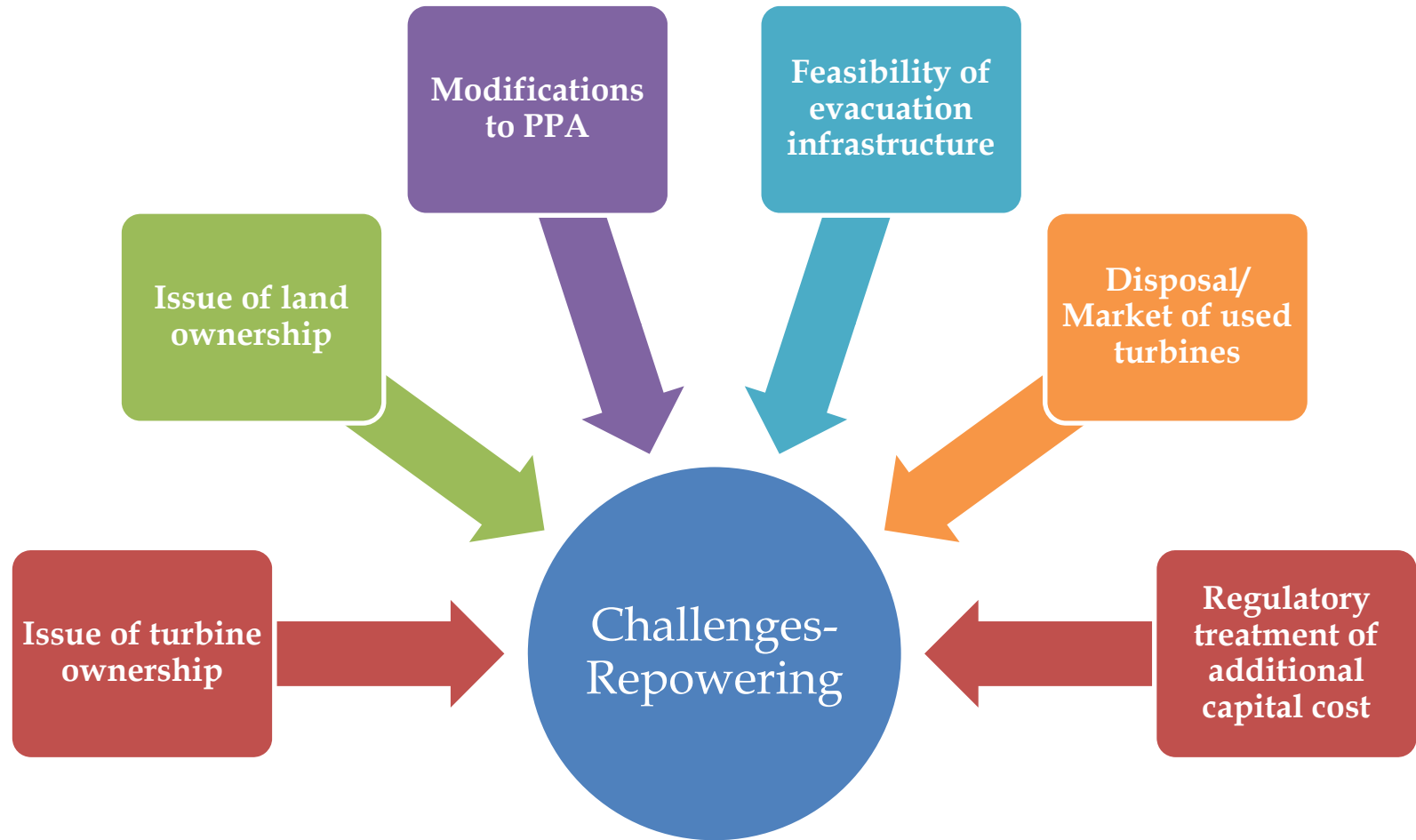
Source: Indian wind power directory 2014

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



**Stakeholder consultation  
for  
identifying key challenges**

# Identifying key challenges in Repowering



Stakeholder consultation provided useful insights into above key considerations.

## Repowering study: Stakeholder consultation

- Initial consultation meetings have been held with agencies such as NIWE, Nodal Agencies in Gujarat & Tamilnadu and IWPA, InWEA, IWTMA.
- **Background research** on the international experience & Indian wind repowering market potential assessment currently underway.
- In order to gather **different perspective(s) of various stakeholders** associated with repowering, **a consultation process through structured interview** has been planned.
- **Questionnaire has been circulated to following stakeholder groups as under:**
  - SNA (5): GEDA, KREDL, MEDA, TEDA, RRECL
  - State utilities (14) : Gujarat, Maharashtra, Karnataka, Rajasthan, Tamil Nadu, Tata Power
  - SERCs (6): GERC, MERC, KERC, MPERC, RERC, TNERC
  - Wind Industry associations : IWPA, InWEA, IWTMA, WIPPA.
  - Wind developers/IPP (15)
  - WTG manufacturers (5)

# Main challenges for repowering and suggestions for framework..1/2

Issue	Key Challenges by Respondents	Suggestions
Ownership	<ul style="list-style-type: none"> <li>Ownership of windfarm with multiple wind turbine owners in given wind farm is an issue.</li> <li><b>All parties/WTG owners may not be willing</b> to opt for repowering.</li> </ul>	<ul style="list-style-type: none"> <li>A suitable business model has to be evolved where interest of all parties are taken care of.</li> <li><b>Formation of SPV with equity participation</b> from concerned parties with sharing of revenue in proportion to equity interest could be a solution.</li> </ul>
Evacuation	<ul style="list-style-type: none"> <li><b>Most of the old wind projects are connected to 11 KV line (particularly in TN)</b>, which poses as the major hurdle for any repowering initiative.</li> </ul>	<ul style="list-style-type: none"> <li><b>The evacuation infrastructure has to be upgraded</b> to 66 KV.</li> <li>In some cases, up-gradation of the pooling s/s may be required as well.</li> </ul>
Land	<ul style="list-style-type: none"> <li>Multiple ownership of land for given a wind farm poses another challenge for repowering project.</li> <li><b>Optimal micro-siting for repowered site require</b> unhindered access &amp; planning flexibility to land site.</li> </ul>	<ul style="list-style-type: none"> <li><b>Lease of land or right to use land on footprint basis in favor of SPV</b> could be explored to address requirement in case of multiple land owners.</li> </ul>

## Main challenges for repowering and suggestions for framework..2/2

Issue	Key Challenges by Respondents	Suggestions
Offtake arrangement	<ul style="list-style-type: none"> <li>• <b>Retaining earlier offtake arrangements</b> (sale to DISCOM or captive) and identifying off-takers for excess generation</li> </ul>	<ul style="list-style-type: none"> <li>• There exist multiple options for offtake. Viz. a) Sale to Discom. b) Captive model. C) Sale to any 3rd Party by open access route and combination to be allowed.</li> <li>• <b>Existing off-take to be protected at least for residual life period.</b></li> </ul>
Tariff & incentives	<ul style="list-style-type: none"> <li>• Existing tariff is too low as the PPAs are over 20 years <b>with perpetual nature with no termination clause.</b></li> <li>• Tariff is unviable for repowering projects.</li> </ul>	<ul style="list-style-type: none"> <li>• FIT for wind shall prevail. But to continue the tariff of old PPA, <b>a certain incentive over and above the FIT</b> would be required for the developer.</li> <li>• In case of <b>captives, attractive wheeling and banking provision</b> needs to be brought in.</li> </ul>
Utility	<ul style="list-style-type: none"> <li>• Utility is in a secured PPA with developer at a much lower cost.</li> <li>• <b>It would not allow prior termination of PPAs to enable repowering.</b></li> </ul>	<ul style="list-style-type: none"> <li>• <b>Utility off-take as per old PPA rates to continue for balance tenure of existing PPA.</b></li> <li>• New PPA shall cover the new FIT for additional generation through repowering.</li> </ul>

# Repowering : Implications on captive generators- Issue

- Post repowering, when the actual capacity as well as the aggregate energy yield would increase by around 2 to 3 times the present quantum; the consumer may not be able to consume 51% of the aggregate energy generated in such a plant.
- **As a result the consumer may lose the captive status**, which could result in levy of additional cross subsidy surcharge on the entire consumption of the consumer.
- In the present legal framework, such captive generators would not take up repowering due to the minimum consumption criteria.
- Further, it may be noted that early development of wind sector has led to multiple WTG owners at a Windfarm site. **Repowering project could include multiple wind projects, captive or otherwise.** All the project owners may or may not participate as Wind Repowering Project.
- **Repowering could reduce number of turbines, but it may not be possible to evolve an arrangement with exact replacement.**
- Further, it is possible that Repowering Project is undertaken by one dominant investor and existing captive project owners may become minority stakeholders.
- As a result, the repowering project may or may not be able to meet criteria of 26% ownership in such repowered project.

## Repowering : Implications on captive generators- Proposed Solution

- The criteria for captive consumers as defined in The Electricity Rules, 2005 can be relaxed by way of notification under Section 176 (z) of the Electricity Act 2003.
- It is proposed to allow the existing captive users of wind power project to continue to consume energy quantum equal to their captive consumption prior to repowering as elaborated below irrespective of whether plant meets the definition set out in the said rule:

The condition of 51% consumption and 26% ownership shall not be applicable in case of existing captive users of the repowered power projects, so long as annual captive consumption of such captive users from the repowered projects remains at least equal to average annual captive consumption for last three years prior to commissioning for repowered wind power project.

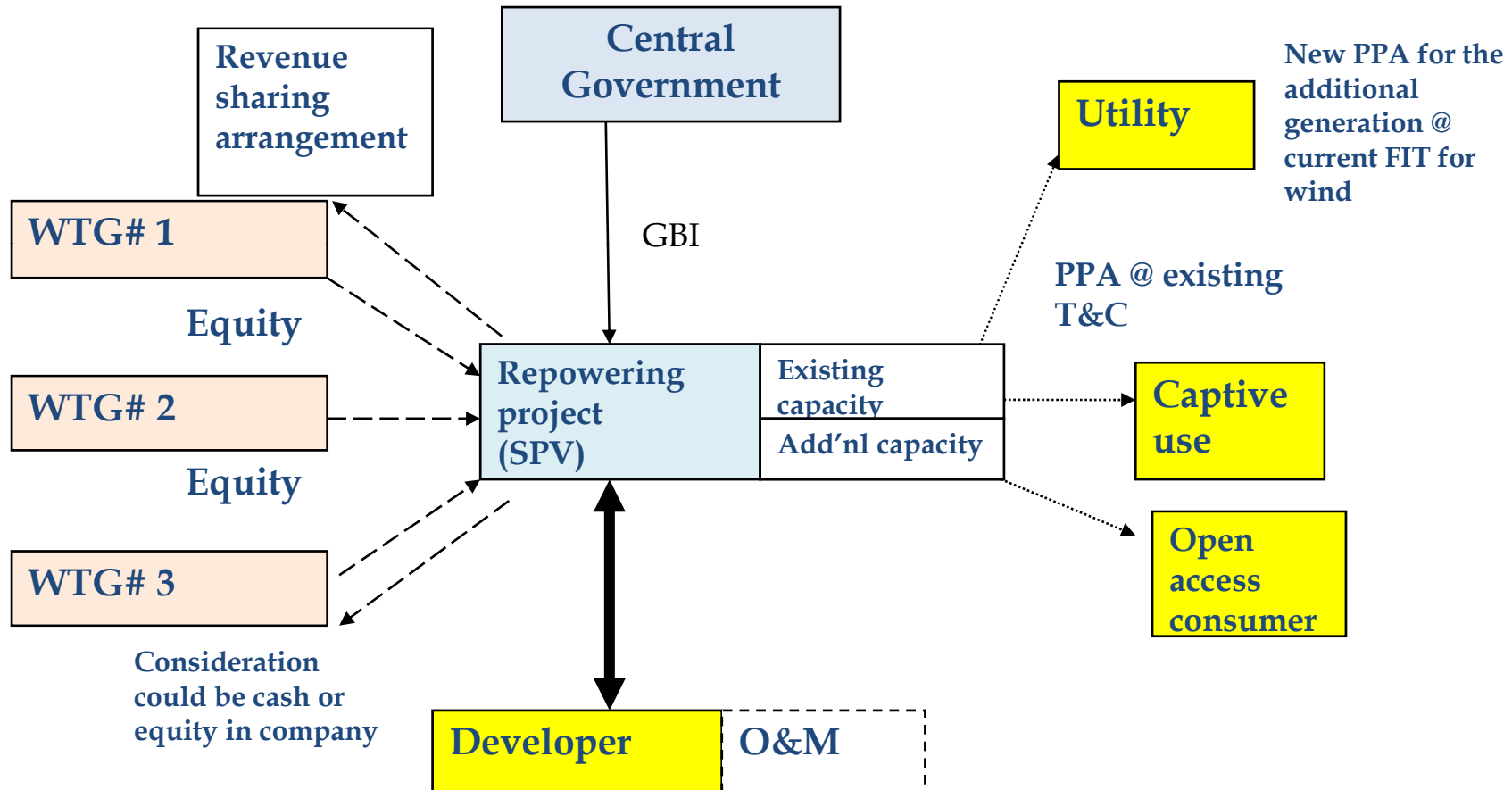
# Proposed Business Model and Incentive Computation



## Desired features of proposed business model

- As fragmented ownership of wind farm is an issue, a SPV can be formed with equity contribution from each interested party, with agreement to share revenue in proportion to equity contribution.
- SPV would procure the existing assets, both turbines and required land use rights.
- Interest of the utility in terms of existing PPA (at least for balance tenure of PPA) has to be protected.
- Consumers would benefit from proposed repowered scheme in terms of enhanced renewable generation from given wind farm site.
- The model has to be supported by the Government in terms of incentives to make it financially viable for developer.

# Proposed SPV-Business Model



## Stakeholders roles & responsibilities..1/3

- **Project Company**
  - Project company can be any **owner from existing wind generators** or any other party who is willing to buy multiple turbines of the wind farm at a mutually agreed value based on standard parameters.
  - The project company would enter into new PPA with the utility and ensure **continuity of quantum at existing rate for balance tenure of PPA.**
  - For additional generation, the project company either has to enter into new PPA with utility or **sale the additional electricity** to open access consumers through bilateral transactions at mutually agreed rate.
- **Other Stakeholders (Interested to take up equity stake in SPV)**
  - **Share holders agreement** to address the role/responsibility of shareholder and its entitlement in view of its equity share contribution into the project company.
  - The terms of subscription would outline conditions related to **existing asset sale/transfer of land use rights** etc.

## Stakeholders roles & responsibilities..2/3

- **Utility**

- Utilities are expected to continue the power procurement of repowered wind farm **at old rate for the earlier quantum for balance useful life/tenure** of PPA.
- Utility should sign new PPA with project developers at approved FIT for additional generation and for existing capacity beyond existing PPA tenure.
- Utility to procure power from the market during the construction phase of the repowering project. A strict time frame of 6 months can be given beyond which, if generation is delayed, utility would be entitled for compensation on actual basis.
- Should **ensure availability of network for evacuation of wind power** post repowering.

- **Government**

- The Government shall issue **Policy with incentive** to promote repowering projects.
- Government can consider providing **Incentive linked to generation** for fixed period (say, 5 to 10 yrs) to the project company.
- Government may involve **state level renewable energy development agency** to monitor generation and disburse the required amount.

## Stakeholders roles & responsibilities..3/3

- **Government ( Continued )**
  - The policy guidelines should provide **attractive wheeling, banking provisions** for repowered captive/group captive projects with suitable regulatory framework.
  - Government may **relax criteria** for wind turbine locations from **5Dx7D to flexible conditions** based on micro-siting studies for better utilization of land.
  - The need for **prioritisation for upgradation of evacuation** infrastructure for repowering sites should be emphasized at all necessary levels for quick action.
  - Relax **eligibility conditions under Captive Rules** to facilitate captive structuring
  - **Publish list of wind rich sites** where repowering projects are essential. (It may not be mandated, but should be encouraged)
  - The offtake of the additional generation due to repowering would be accomplished only if there is a **strong RPO compliance mechanism** in place for all states.

# Principles for determination of Incentive

- Incentive requirement would vary from state to state and depending on type of off take arrangement.
- Incentive is required to address following:
  - Cost of equivalent generation to serve Utility as per existing PPA rate at least for balance PPA tenure
  - Loss of revenue during transition period during repowering
  - Acquisition cost of existing assets, costs associated with SPV formation
  - Decommissioning costs associated with old wind project
- However, in following cases, the cost implications would be minimal.
  - For Captive / Group captive / Single Owner arrangement(s), there may not be requirement to form SPV or acquiring existing asset(s) / land transfer.
  - Net benefit of revenue from sale of scrap and decommissioning costs can be factored.

# Methodology and calculation of incentive

Following steps are undertaken one by one to arrive at the incentive figure:

- I. Compile existing wind tariff and tariff prevalent for WTG projects commissioned prior 2000 for several states.
- II. Compile applicable (past & present) wheeling charge, loss, CSS for several states.
- III. Assessment of energy yield after repowering on realistic basis, estimation of duration for commissioning, interest costs for debt financing etc.
- IV. Based on various assumptions and applicable charges, develop cost of generation and thereby, levelized tariff corresponding to useful life for repowering projects with RoE as per CERC norms
- V. Compare the levelized cost of generation vis-à-vis existing state specific FIT or Net Realisable Revenue in case of wheeled units.
- VI. Evaluate the incentive requirement based on shortfall between levelised COG and state-specific FIT or Per unit revenue for wheeled units.

## Key assumption for Incentive Computation

S No.	State	Wind Tariff for Sale to Utility		Wheeling Model : Captive or Third party wheeling						
		prior to 2000/2003	FY15	prior to 2000/2003			FY15			
				Wheeling charge	Wheeling loss	cross-subsidy surcharge	HT-Industrial tariff (only Energy Charge)	Wheeling charge	Wheeling loss	cross-subsidy surcharge
		Rs/unit	Rs/unit	Rs/unit	%	Rs/unit	Rs/unit	Rs/unit	%	Rs/unit
		(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
1	Gujarat	3.20	4.15	0.00	4.0%	0.00	4.65	0.54	10.0%	0.00
2	Karnataka	3.10	4.50	0.00	5.0%	as applicable	6.15	0.00	7.0%	0.43
3	Maharashtra	2.52	5.70	0.00	7.0%	0.00	7.60	0.40	10.2%	0.23
4	Rajasthan	3.79	5.64		7.0%	0.00	6.50	0.64	8.0%	0.00
5	Tamil Nadu	2.70	3.51	0.00	5.0%	0.00	6.35	0.18	5.0%	1.76

*\*Note : For model computations, it is assumed that Incentive would be available for period of 10 years for entire generation upon Repowering*



## Summary Results for Incentive Computation

Incentive* (Rs/unit)	<u>Case-1</u> Sale to Utility	<u>Case-2</u> Captive Wheeling	<u>Case-3</u> Third Party Wheeling
Gujarat	0.96	1.25	1.25
Karnataka	0.24	0.00	0.00
Maharashtra	0.00	0.00	0.00
Rajasthan	0.14	0.08	0.08
Tamil Nadu	0.92	0.00	0.03

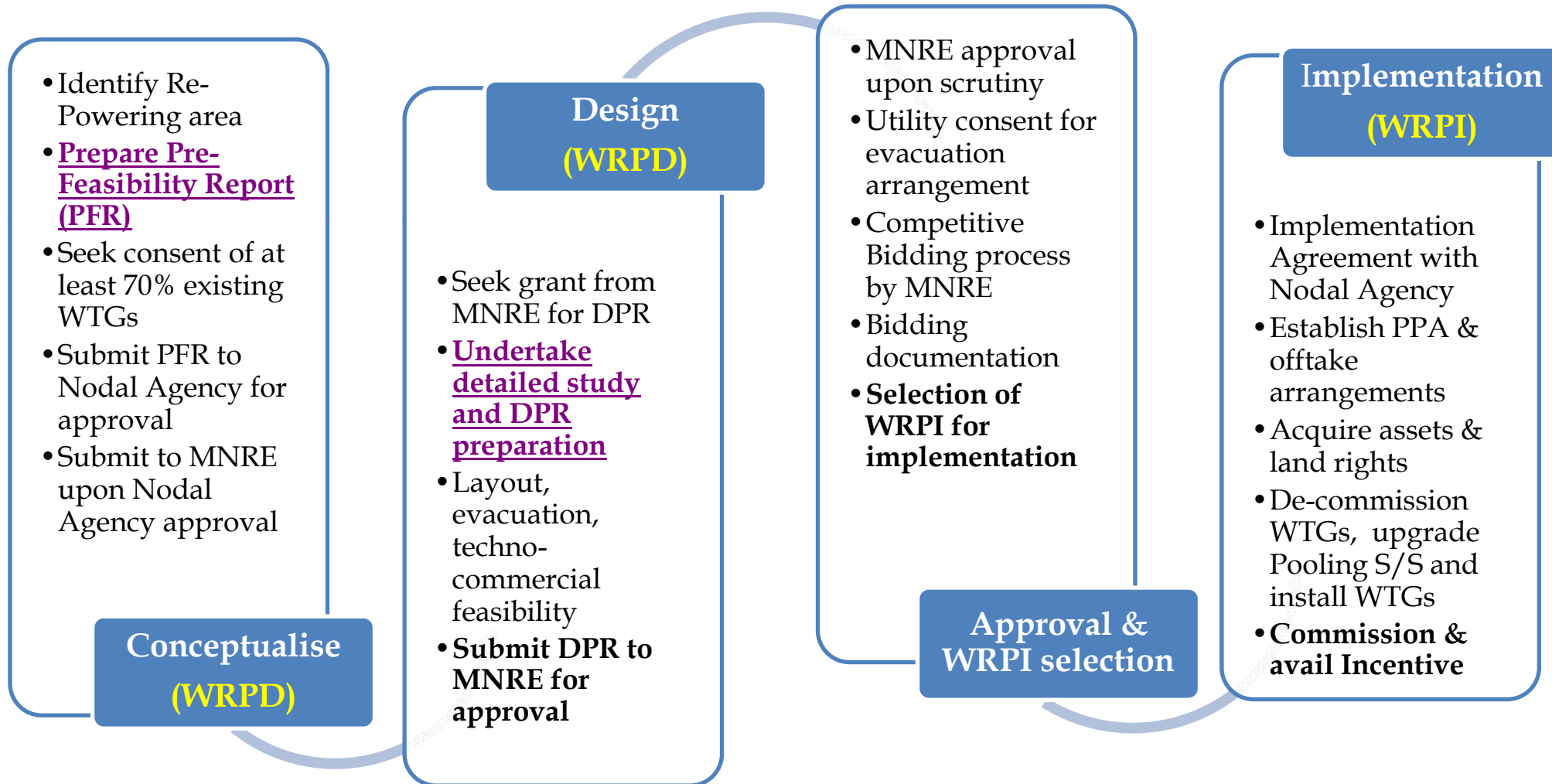
*\*Note : For model computations, it is assumed that Incentive would be available for period of 10 years for entire generation upon Repowering*

## Key findings for Incentive requirement

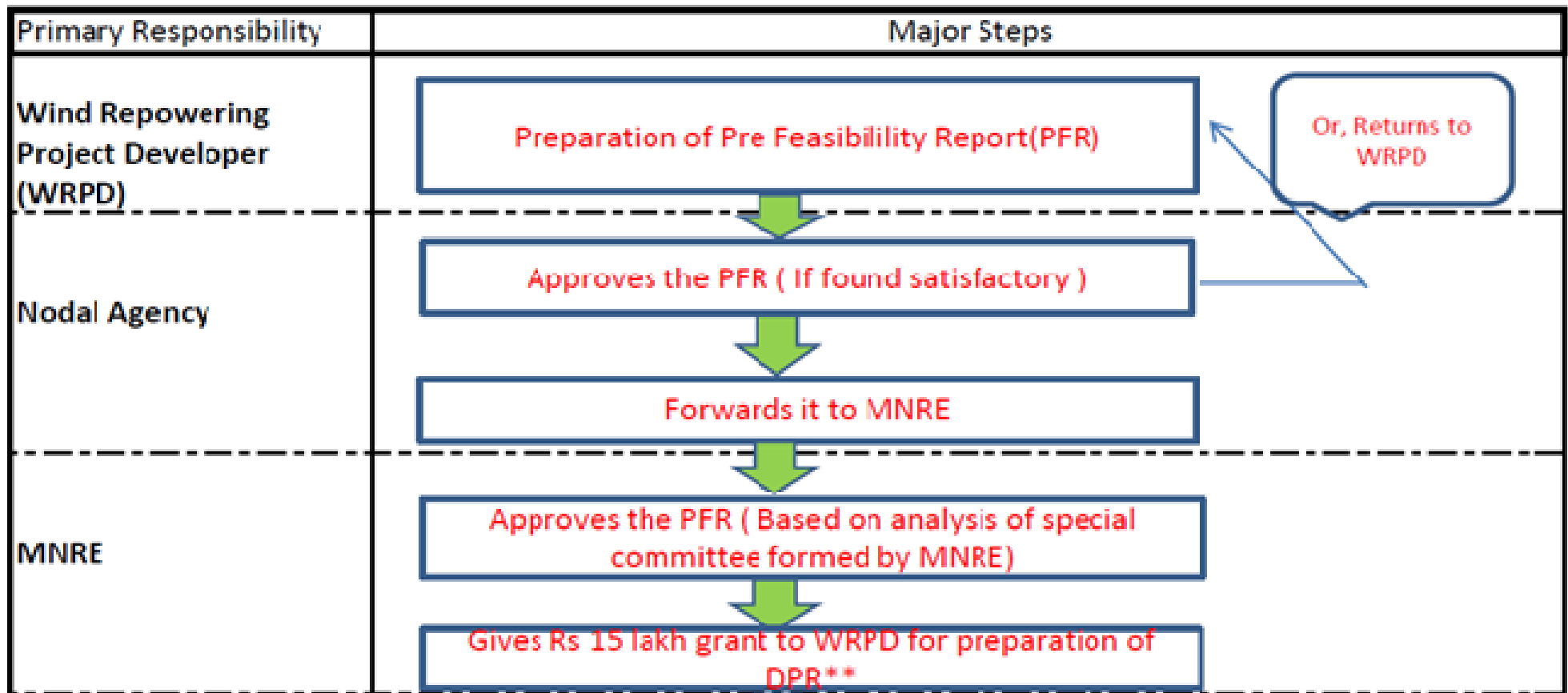
- Incentive requirement **varies from State to State** depending upon the prevalent tariff regime.
- The **nature of off-take arrangement**, viz. Sale of Utility, Captive wheeling or Third party wheeling also greatly influence the need for incentive requirement within a state.
- **Continuation of the 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.**
- **Structuring of the Repowering Project**, would play important role in devising repowering project scheme.

# Proposed Implementation Framework for Repowering Projects

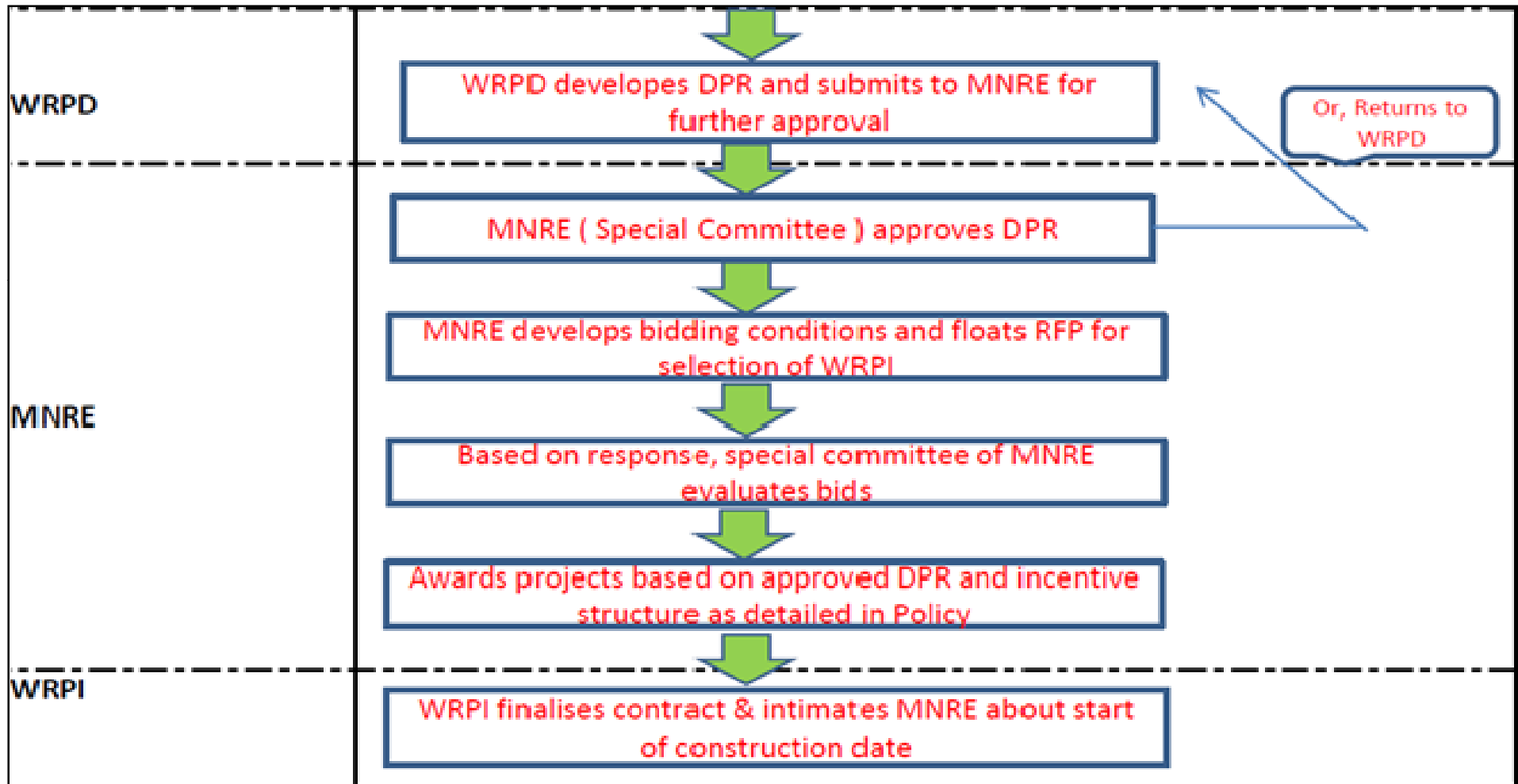
# Proposed Framework for Re-powering Project Implementation



# Repowering Project : Implementation Procedure (1/2)



# Repowering Project : Implementation Procedure (2/2)



# Guidelines for Repowering policy

- Preamble & Objectives
- Definitions
- Operative Period
- Eligible Entities and Eligibility Criteria for Repowering Projects
- Procedure for Implementation of Repowering Project
  - Prefeasibility Report (PFR) : key contents
  - Detailed Project Report (DPR) : key contents
- Grant for Preparation of DPR
- Competitive Bidding Process for selection of WRPI
- Roles and Responsibilities of Entities
  - Nodal Agency, WRPD, WRPI
- Repowering Incentive
- Powers to Relax, Amend, Remove Difficulties
- Miscellaneous

# Towards Repowering in India . . .

**Thank You**





# Brief about Pre Feasibility Report

- The **Pre-Feasibility Report** to be prepared by WRPD shall contain following information about the Repowering Project:
  - Definition of Repowering Area
  - Existing wind turbines and turbine owners
  - Pooling substation and interconnection arrangement
  - Existing offtake arrangements
  - Generation from existing wind turbines
  - Wind potential in Repowering Area (incl. WRPD at 80 m hub-height)
  - Initial consent of at least 70% turbine owners to consider repowering
  - Details about land – ownership, location, latitude/longitude
  - Preliminary details about Evacuation Arrangement – Existing and Proposed

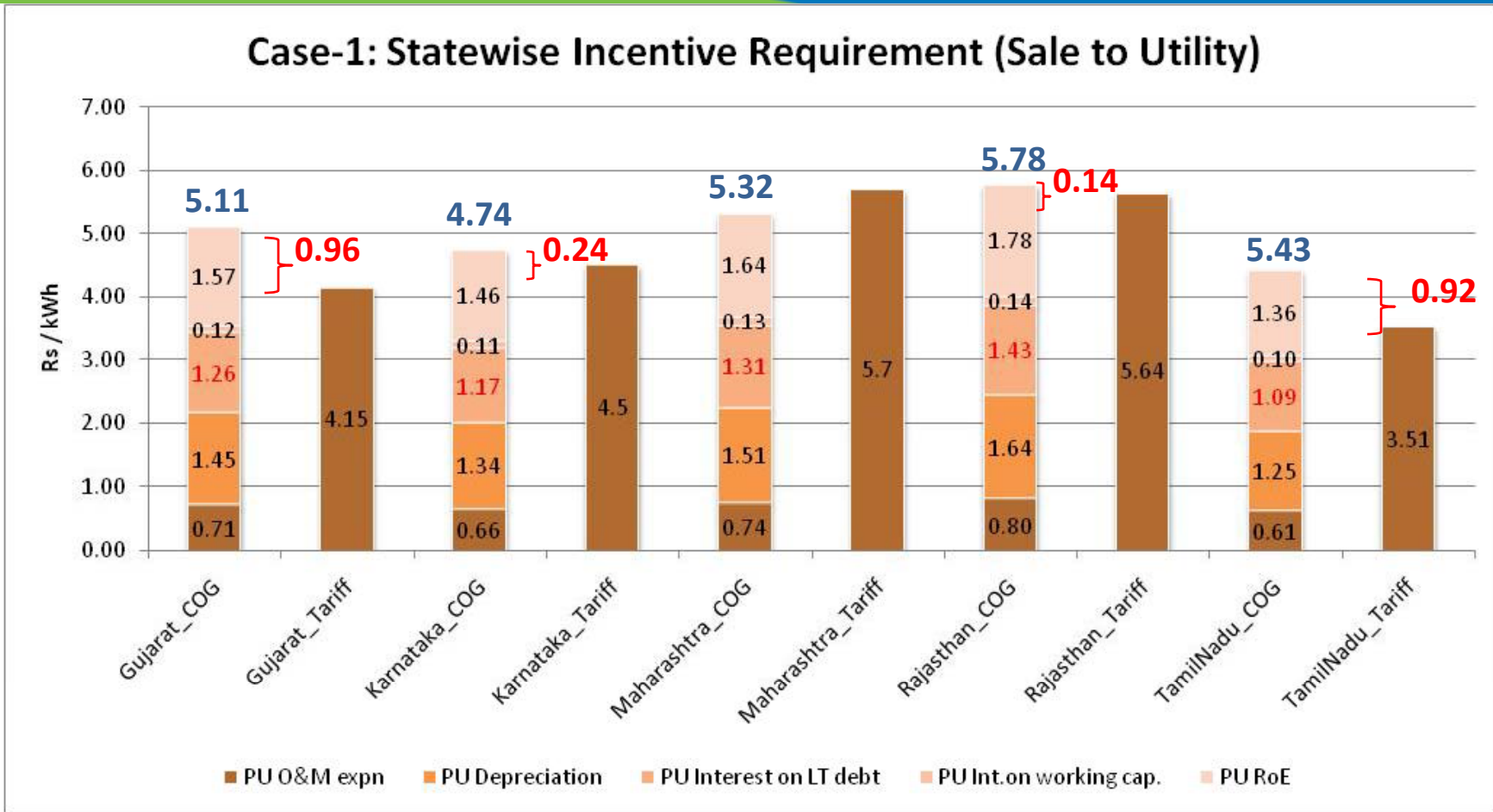


## Brief about DPR

- DPR shall contain following information about the existing turbines.
  - ❑ Coordinates of existing WTG
  - ❑ Capacity of each WTG
  - ❑ Information about land ownership
  - ❑ Electricity generation details for last three years
  - ❑ Interconnection arrangements with Single Line Diagram
  - ❑ Offtake arrangements including PPA details,
  - ❑ Budget Cost Estimate – repowering and de-commissioning
- DPR shall demonstrate the **feasibility of repowering using minimum 3 types of turbines** currently available in India.
- **Land requirement for new turbines and availability of the same.**
- **Power evacuation arrangement** beyond pooling station and estimation of capital expenditure .
- **Consent of WTG owners** in Repowering Area to be part of the Repowering Project and sell existing turbines to WRPI at the price set out in this Policy.



# Case-1: Incentive Computation (Sale to Utility)



# Case-2: Incentive Computation (Sale to Third Party)

