Department of Industrial and Management Engineering

Indian Institute of Technology Kanpur

9th Capacity Building Programme for Officers of Electricity Regulatory Commissions

21 - 22 Nov. 2015, IIT Kanpur
24 - 26 Nov. 2015, Singapore

Venue: IIT Kanpur & Singapore

To be organised by IIT Kanpur

Supported by

Forum of Regulators

Draft Agenda

9th Capacity Building Programme for Officers of Electricity Regulatory Commissions

21-22 Nov. 2015, IIT Kanpur
24-26 Nov. 2015, Singapore

Day 1 – Saturday, 21st November, 2015	
0830 Hrs. – 0900 Hrs.	Registration
0900 Hrs. – 0930 Hrs.	Inaugural Function:
0930 Hrs. – 1000 Hrs.	High Tea
1000 Hrs. – 1130 Hrs.	Economics of Regulation for the Power Sector Anoop Singh, IIT Kanpur
1130 Hrs. – 1300 Hrs.	Renewable Energy Generation Tariff Determination in Practice, Mr. Rakesh Shah, Sun Edison
1300 Hrs. – 1400 Hrs.	Lunch Break
1400 Hrs. – 1530 Hrs.	Retail Competition in Electricity - Issues and Strategy, Mr. Sambitosh Mohapatra, PWC
1530 Hrs. – 1600 Hrs.	Tea / Coffee Break
1600 Hrs. – 1730 Hrs.	Market for Renewable Energy Certificates, Concepts, Status and Challanges, Mr. Akhilesh Awasthi, IEX
Day 2 – Sunday, 22nd November, 2015	
0830 Hrs. – 1000 Hrs.	Short-term Power Procurement and Open Access Mr. Rajeev Malhotra, Executive Director, PTC India Ltd.
1000 Hrs. – 1015 Hrs.	Tea / Coffee Break
1015 Hrs. – 1145 Hrs.	Solar Rooftop - Policy, Regulation and Experience across Indian States, Dr. A. K. Tripathi, MNRE
1145 Hrs – 1315 Hrs	Developing a Regional Power Market in South Asia Anoop Singh, IIT Kanpur or Electricity Brainstorm Session I, Anoop Singh, IIT Kanpur
1315 Hrs. – 1400 Hrs.	Lunch Break
1400 Hrs. – 1530 Hrs.	Developments in the Coal Sector - Implications for the Power Sector, Mr. A K Bhalla, Jt. Secretary, Ministry of Coal
1530 Hrs. – 1545 Hrs.	Tea / Coffee Break
1545 Hrs	Departure for Lucknow Airport
Day 3 – Monday, 23rd November, 2015	
2315 Hrs. – 0720 Hrs.	Travel to Singapore
Day 4 – Tuesday, 24th November, 2015	
0900 Hrs. – 1030 Hrs.	Regulation of Power Sector in Singapore - Development and Current Practices, EMA

1030 Hrs. – 1100 Hrs.	Tea / Coffee Break
1100 Hrs. – 1230 Hrs.	Implementation of Retail Competition in Singapore , KPMG
1230 Hrs. – 1400 Hrs.	Lunch Break
1400 Hrs. – 1530 Hrs.	Forecasting of Wind and Solar Power, Dr. Dipti Srinivasan, NUS
1530 Hrs. – 1600 Hrs.	Tea / Coffee Break
1600 Hrs. – 1730 Hrs.	Power Sector Regulation / Electricity Market Evolution In Singapore/ASEAN, Dr. Chang Youngho - School of Humanities and Social Science, NTU
Day 5 – Wednesday, 25th November, 2015	
0900 Hrs. – 1030 Hrs.	Performance Standards and Monitoring in Electric Utilities, Singapore Power
1030 Hrs. – 1100 Hrs.	Tea / Coffee Break
1100 Hrs. – 1230 Hrs.	Electricity Contracts and Power Market Operation in Singapore, Mr. Seong Wah Toh, EMC
1230 Hrs. – 1330 Hrs.	Lunch Break
1330 Hrs. – 1500 Hrs.	Implementing Smart Grid Project in Singapore, Dr. Ashwin M Khambadkone, National University of Singapore/EPGC
1500 Hrs. – 1530 Hrs.	Tea / Coffee Break
1530 Hrs. – 1700 Hrs.	Electricity Brainstorm Session II, Anoop Singh, IIT Kanpur
1700 Hrs. – 1730 Hrs.	Valedictory Function
Day 6 – Thursday, 26th November, 2015	
0900 Hrs. – 1030 Hrs.	Site Visit
1030 Hrs. – 1100 Hrs.	Tea / Coffee Break
1100 Hrs. – 1230 Hrs.	Site Visit
1230 Hrs. – 1400 Hrs.	Lunch Break
1400 Hrs. – 1530 Hrs.	Site Visit
1530 Hrs. – 1600 Hrs.	Tea / Coffee Break
1600 Hrs. – 1730 Hrs.	Site Visit

"9th Capacity Building Programme for Officers of Electricity Regulatory Commissions"
21-22 Nov. 2015 at IIT Kanpur
24-26 Nov. 2015 at Singapore

Theory and Economics of Power Sector Regulation

Anoop Singh
Associate Professor
Dept of Industrial and Management Engg.
IIT Kanpur

In Search for a Theory of Regulation

Why is there regulation?

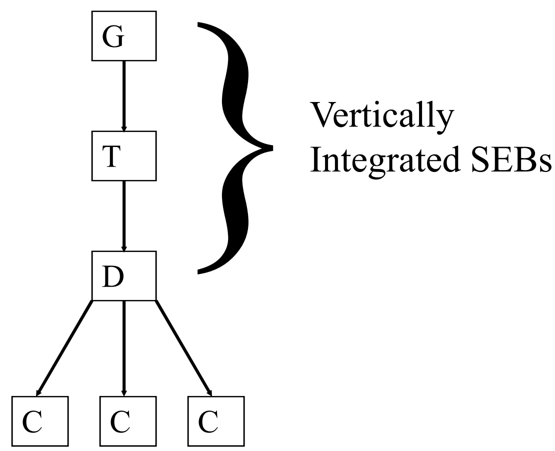
- To address market failure
  - Monopoly/ natural monopoly
- Role of interest groups
- Role of political pressure

‘Theories’ of Regulation

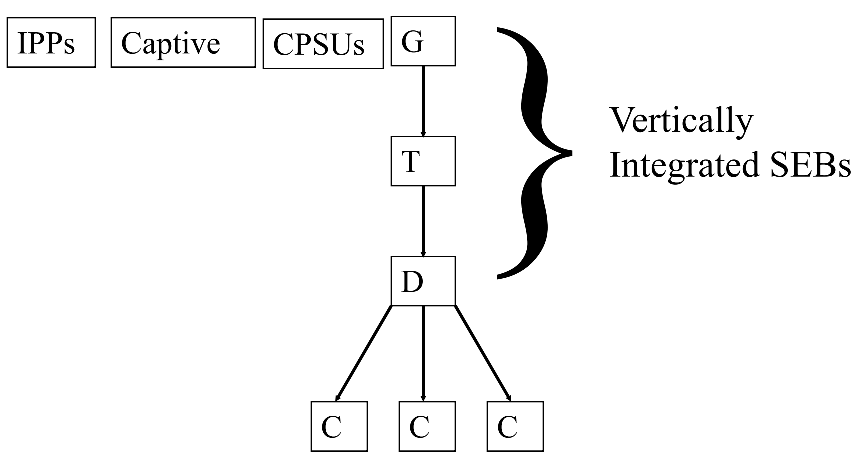
- Public Interest Theory → Normative Analysis as a Positive Theory
- Capture Theory
- Economic Theory of Regulation
  - Stigler/Petlzman Model
  - Becker Model

Emerging Market Structure

Vertically Integrated SEBs



Vertically Integrated SEBs



Segments of the Electricity Markets

Main segments of the power sector are,

- Generation — Genco
- Transmission
- Bulk Supply

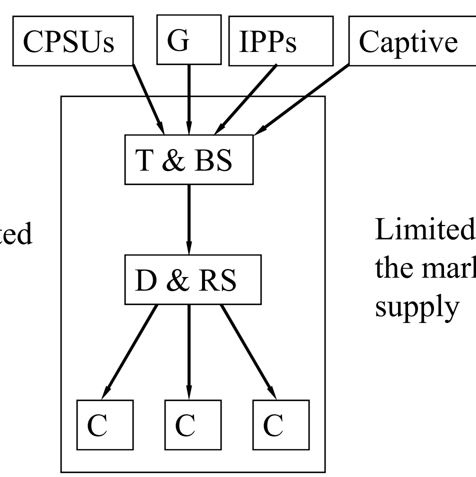
T & BS — Transco

- Distribution
- Retail Supply

D & RS — Discos

- Trading

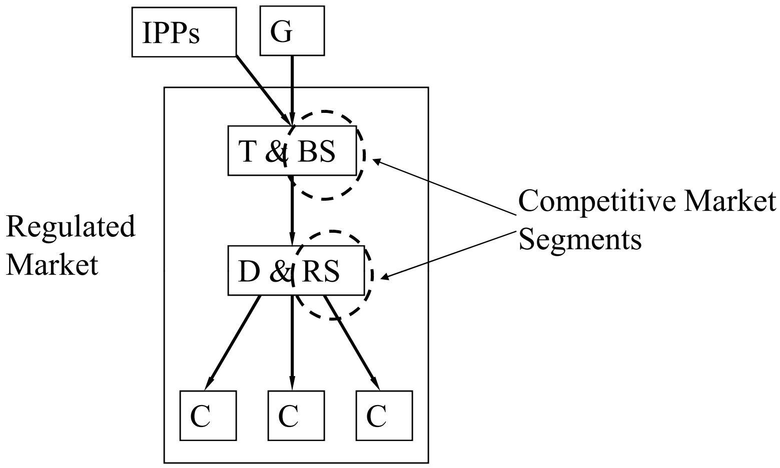
Restructured Power Sector – Pre Electricity Act 2003



Regulated Market

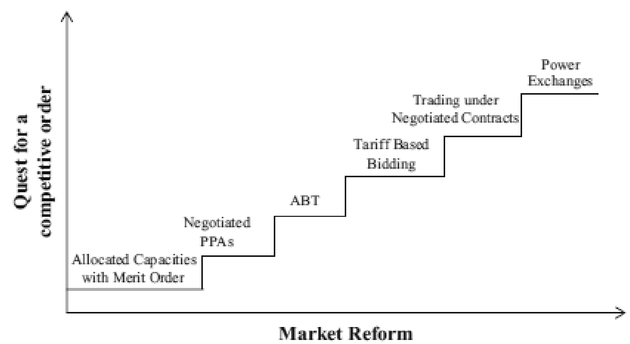
Limited competition for the market of bulk supply

Restructured Power Sector – Emerging Scenario (Post Electricity Act 2003)



Post Electricity Act 2003

Evolving competition in the bulk power market



New Frontier for Competition

- Emergence of Retail Competition - Electricity Amendment Bill 2014
- Separation of Carriage and Content
- Can Competition for Bulk Power be replicated at retail level?

Describing a Power Market (Contd.)

Scope of Competition

- Negotiated
- Regulated
- Competitive Tendering
- Power Exchanges

Scope of Participation

- Generators (including captive) and Discoms
- Traders and PXs
- Limited Customer Access
- Full Retail Competition

Negotiated Contracts in Power Markets

- Negotiated PPAs directly between generator and distribution utilities (subject to regulatory approval)
- Short-term contracts brokered by registered traders (generally not subject to regulatory approval for price but for over all procurement limit for ST power procurement)

Typical Characteristics of Infrastructure/Power Sector

- Technical characteristics
- Economic characteristics
- Socio-economic and organizational characteristics

Technical characteristics

- Input into production
- Technical indivisibity (lumpiness of investment)
- Immobile
- Long life
- Assets not widely traded
- Exclusion could be technically difficult

Economic characteristics

- Reduction of transaction costs
- Sub-additive cost function i.e. there are conditions for natural monopoly
- High sunk costs
- Network externalities
- Little rivalry in consumption

Socio-economic and organizational characteristics

- Necessity of centralized planning and coordination
- Traditionally publicly owned but increasing private-public cooperation
- Sometimes considered citizen right (State should assure a minimum supply)

Infrastructure/Electricity Provision & Need for Economic Regulation

- In in historic times, Kings built bridges, canals etc.!
- In modern times, ownership and operation of infrastructure is undertaken by the governments. While Policy/Regulation, Ownership and Operation was embedded with government, role of regulation was often ignored.

Need for Economic Regulation

- Inadequate and poor quality of services, and poor financial performance under public ownership.
- Private ownership and operation brings in a concern of private monopoly for government as well as consumers .

Economics of Regulation

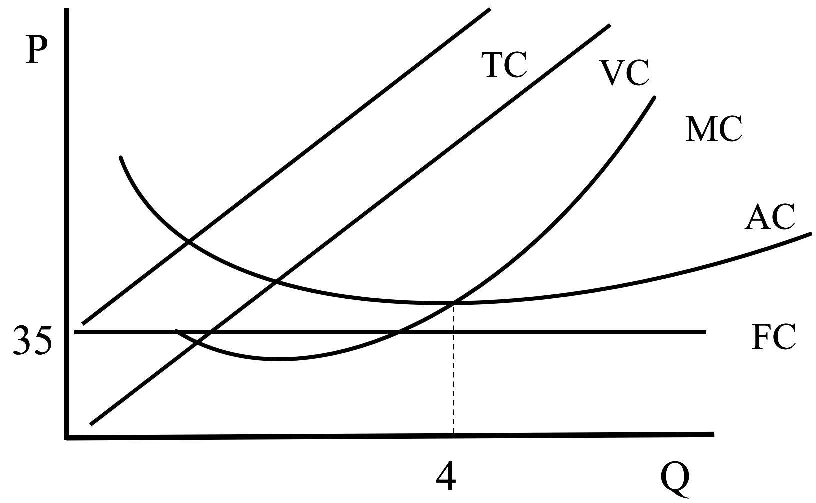
- Perfect Competition - Pricing
- Monopoly - Pricing
- Consumer & Producer Surplus
- Market Failures
- Economic Regulation
- Pricing for Natural Monopoly

Concepts of Perfect Competition and Monopoly

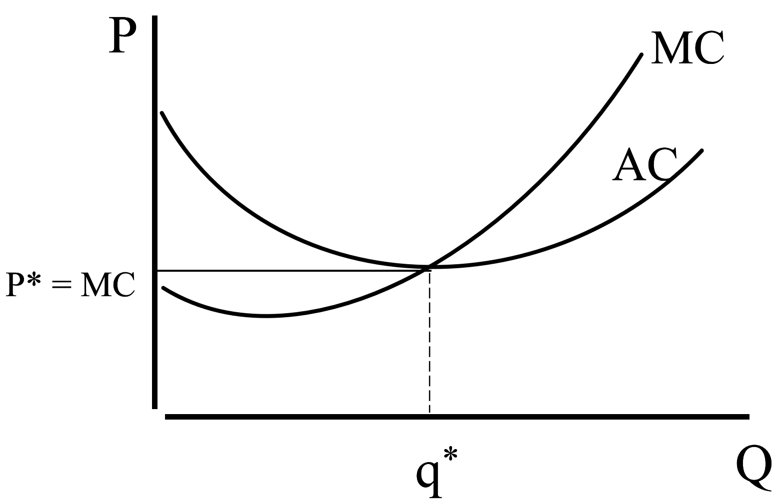
Perfect Competition - Characteristics

- Large number of buyers and sellers, each acting independently
- No buyer or seller is so large to influence the market
- Homogeneous product
- No barriers to entry or exit
- No artificial restraint on prices
- Perfect information
- Profit maximizing firms
- Perfect mobility of factors of production

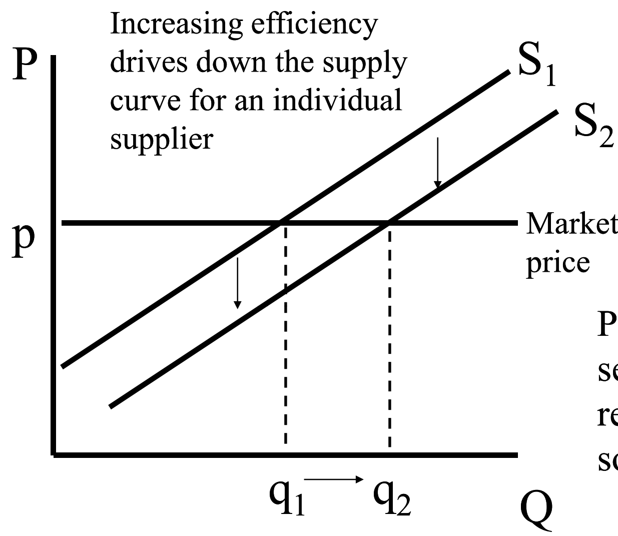
Cost Concepts



Pricing – Perfect Competition Outcome for firm



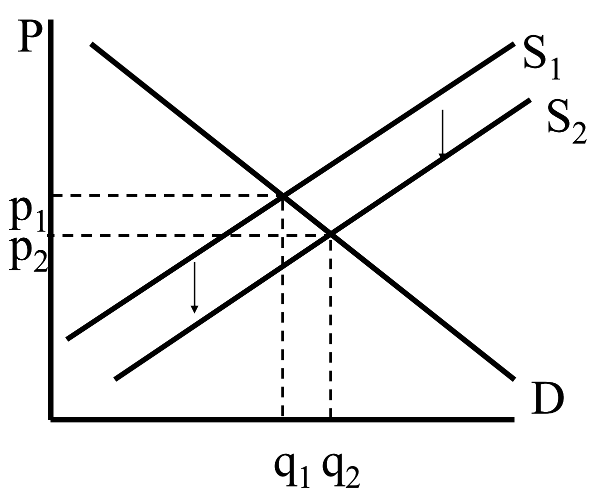
Why companies care about costs



Competitive markets give good incentives for efficiency and innovation

Producer is able to sell more; total revenue increases, so does total profit

Benefits of competition

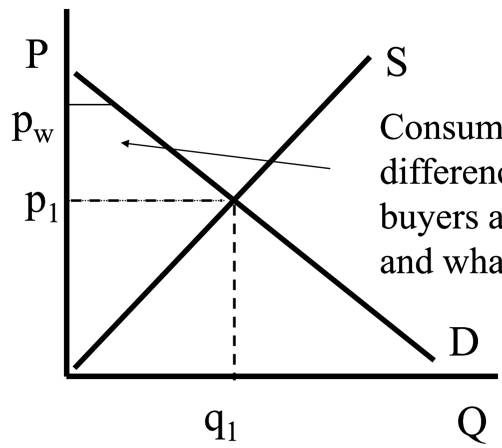


As companies compete with each other, costs are driven down

Consumer benefits:

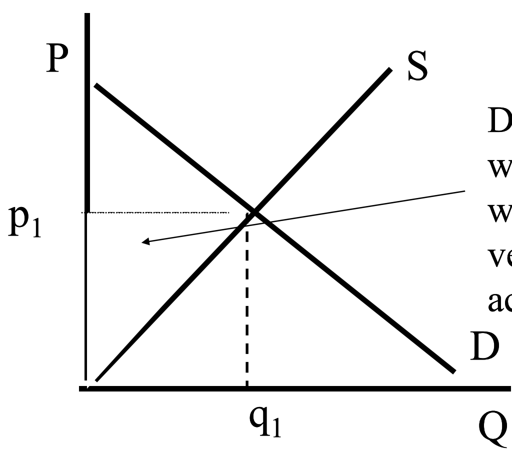
Prices are cut to p_2 and demand rises to q_2 as a result of competition

Consumer surplus



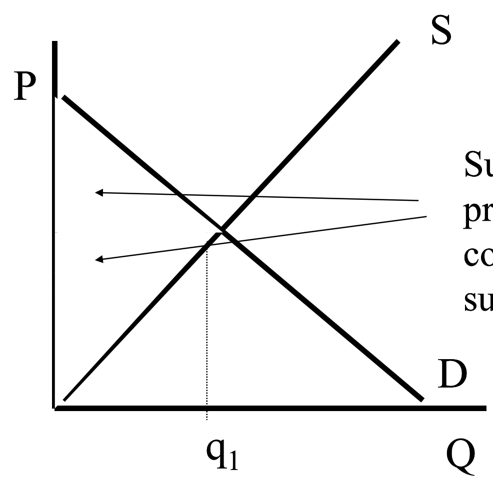
Consumer surplus: the difference between what buyers are willing to pay and what they have to pay

Producer surplus



Difference between what producers are willing to sell at versus what they actually get

Total surplus

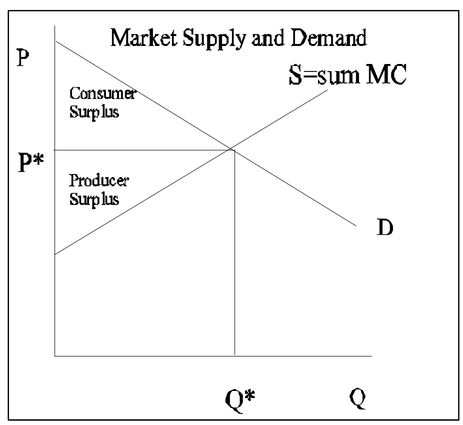


Perfect Competition

- Social Welfare

- <u>Efficiency in Production</u> - incentive to produce at lowest possible cost

- <u>Efficiency in Allocation</u> - right amount of good is produced since MC to produce equals marginal willingness to pay equals price



Concepts of Monopoly

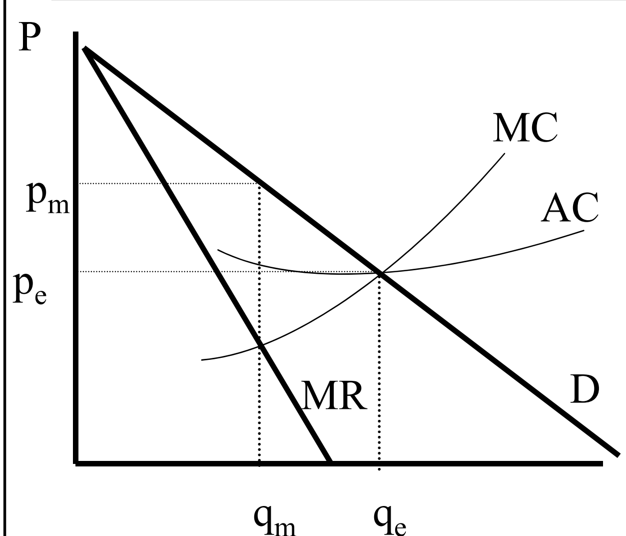
Monopoly

- Single producer (supplier) of products
- Price set by the Monopolist
- Faces no competition because of barriers to entry:
  - high entry costs (investment)
  - legal protection
  - patents, copyrights
  - natural monopoly

Monopoly behaviour

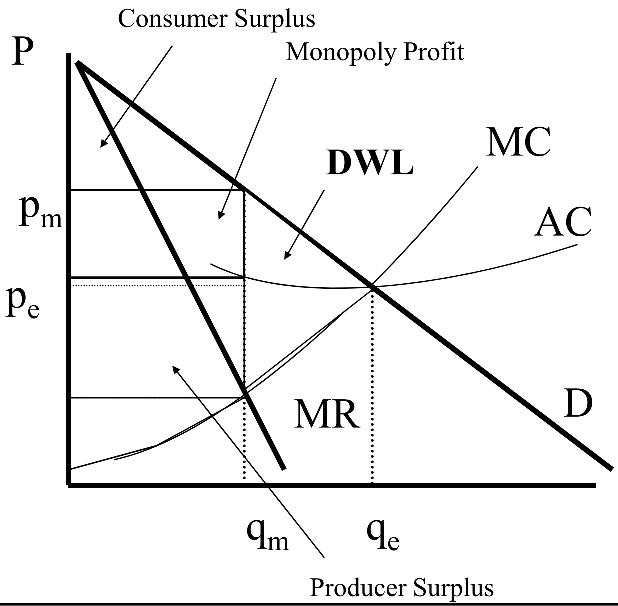
- Goal: maximize profits
- Rational choice: sell less quantity at a higher price (than perfect competition) to maximise profits
- Total surplus (consumer plus producer surplus) is lower than in competitive market case. Dead weight loss.
- X-inefficiency - firm doesn't work hard to cut costs.

Monopoly: Price Setting



Monopolist sets quantity where profits are greatest, output at which MR=MC

Monopoly: How society looses



Monopolist captures part of consumer surplus.

Consumer surplus lower compared to competitive market case.

"deadweight loss"; social loss as compared to perfect competition

Market Failures

Sometimes markets can fail to operate in beneficial way. Market failures can be so severe as to merit regulation. There are three main classes of market failure:

- Market Power
- Externality
- Information asymmetry

Market Failures (contd.)

- Market Power – Ineffective competition; actual or potential; Monopoly, cartel, monopsony; (special case - Natural Monopoly)
- Externality - behaviour of one firm affects others for reasons other than prices (when firms or people impose costs or benefits on others outside the marketplace)
- Information asymmetry – consumers do not have enough information about the goods that they buy

Natural Monopoly

- Industry cost is minimised by having only firm in the industry.
- Average costs are declining.
- Natural monopolies are likely to exist when there is large fixed-cost component to cost. (fixed costs are large as compared to marginal cost).

Natural Monopoly (contd.)

- In case of natural monopoly – allocative and productive efficiency can not exist together.
- Productive efficiency requires that only one firm produces all output (cost minimised).
- Such firm will fix prices above cost to maximise profits – allocative efficiency is violated.
- For allocative efficiency – a number of firms need to compete to bring prices down to marginal cost (P = MC).

Externality

- Actions of agent A effect the welfare of B.

Negative externality

e.g. environmental pollution, fishing

Positive externality

e.g. beekeeper & farmer

Information Asymmetry

- Infn may not only be imperfect but also asymmetric
- Eg. "Market for lemons"

Why Regulation?

- Regulation – restrictions on decision of economic agents (Firms, consumers)

- Rationale for Regulation
  - Market Power - Natural Monopoly
  - Externality
  - Information asymmetry

Market Failure

Types of Regulation

- Antitrust Policy (licensing / certifications) - seeks to protect consumers from anticompetitive behavior through the judicial system (MRTP / Competition Act)
- Direct Regulation or Economic Regulation - controls pricing and/or output due to the belief that the industry is inherently Monopolistic (Power, Telecom etc.). Market power is the main focus of utility regulation.

Types of Regulation (contd.)

- Social Regulation - controls undesirable consequences of firm behavior to obtain various social goods such as clean air and water, safe products and workplaces.
  (Pollution Control Acts, Safety Regulations etc.);
- Technical - licensing requirements, drug regulations, quality certifications like BIS etc., safety in nuclear plants, water flow in hydro plants

Economic Regulation - What can be regulated ?

- Price
- Quantity
- Entry & Exit
- Quality
- Investment
- Access to Resources

Economic Regulation - What can be regulated ? (Contd.)

- Price - power, telecom (partly)
- Quantity - spectrum#, banks branches
- Entry & Exit - telecom, power, banking, insurance
- Quality - telecom, power etc.
- Investment – capacity expansion during license raj
- Access to Resources – mining rights for power (coal), Iron & Steel etc

How to ease Monopolistic Pressure (including regulated natural monopolies)?

- Allow / facilitate entry of more market players
- 'Control/influence' prices / quantity supplied
- Create incentives so that Monopolists emulates a competitive behaviour.

Thank You

www.iitk.ac.in/ime/anoops

anoops@iitk.ac.in

Further Readings

- "Power Sector Reform in India: Current Issues and Prospects", Energy Policy, Elsevier, Volume 34, Issue 16, November 2006.
- "Towards a Competitive Market for Electricity and Consumer Choice in Indian Power Sector", Energy Policy Vol. 38 4196-4208, 2010. (Elsevier)
- "Analysing Efficiency of Electric Distribution Utilities in India: a Data Envelopment Analysis" (with Dilip Kumar Pandey), IAEE International Conference, Stockholm 19-23 June, 2011.
- "Modelling Economic Efficiency of Renewable Energy Policies: A Multi-State Model For India", Accepted for World Renewable Energy Congress, 17-19 Oct. 2011, Bali, Indonesia. (with Sundeep Chowdary).
- "Economics, Regulation and Implementation Strategy for Renewable Energy Certificates in India" in India Infrastructure Report 2010, Oxford Univ. Press.
- "A Market for Renewable Energy Credits in the Indian Power Sector", Renewable and Sustainable Energy Review journal, Elsevier, 2009.
- "Economics of Iran-Pakistan-India Natural Gas Pipeline: Implications for Energy Security in India", Economic and Political Weekly, Vol. XLIII, No. 7 2008.

Courses, Workshops and Conferences

- Short Term Course "Challenges and Implementation Issues post Electricity Act 2003: Regulatory, Policy & Technical Solutions", 10-14 April, 2004
- International Conference on "Power Market Development in India: Reflections from International Experience", 19-21 April, 2005
- National Workshop on "Project Financing for Energy and Infrastructure Sector", April 19-22, 2007
- 2nd National Workshop on "Project Financing for Energy and Infrastructure Sector", April 24-27, 2008
- Capacity Building Programme for Officers of Electricity Regulatory Commissions, 30th June - 5th July, 2008

Courses, Workshops and Conferences (contd.)

- 2nd Capacity Building Programme for Officers of Electricity Regulatory Commissions, 3-8 August, 2009
- 3rd Capacity Building Programme for Officers of Electricity Regulatory Commissions, 23-28 August, 2010
- Energy Conclave 2010, 8-15 Jan. 2010
- 4th Capacity Building Programme for Officers of Electricity Regulatory Commissions, 18-23 July, 2011
- 5th Capacity Building Programme for Officers of Electricity Regulatory Commissions, 18-23 Oct., 2012
- 6th Capacity Building Programme for Officers of Electricity Regulatory Commissions, 9-15 Feb., 2014
- 7th & 8th Capacity Building Programme for Officers of Electricity Regulatory Commissions, Jan./Feb., 2015
- IITK-IEX Training Program on Power Procurement Strategy and Power Exchanges, 20-22 April, 2015

Important Judgments of Appellate Tribunal on some current issues and Tariff related Issues

11/27/2015

V J Talwar
Former Technical Member APTEL
Former Chairman UERC

Layout of the presentation

- Some Current Issues
- General Issues related to tariff
  - Necessity of issuance of tariff order timely
  - Importance of Regulations
- Issues related to ARR
- Issues related to rationalization of tariff

Current Issues

Whether the Commission has power to modify tariff contained in a subsisting PPA.

Appeal No. 61 of 2007

Appellant: **Him Urja Pvt Limited**

Versus

Respondent: **Uttarakhand Electricity Regulatory Commission**

Bench: **Ms. Manju Goel, Judicial Member**

Mr. H L Bajaj, Technical Member

Dated: 30.10.2010

Issue: The validity of the PPA was the basic question in this appeal.

Held: If the PPA is valid, the price of power determined by the PPA cannot be undone by a tariff order of the Commission.

POWER TRADING CORPORATION INDIA LTD.
VS
CENTRAL ELECTRICITY REGULATORY COMMISSION

BENCH: K. G. Balakrishnan, C.J.I.,
S. H. Kapadia ,
R. V. Raveendran,
B. Sudershan Reddy and
P. Sathasivam , JJ.

DATE: 15.3.2010

Whether capping of trading margins could be done by the CERC by making a Regulation in that regard under Section 178 of the 2003 Act?

- Further, it is important to bear in mind that making of a regulation under Section 178 became necessary because a regulation made under Section 178 has the effect of interfering and overriding the existing contractual relationship between the regulated entities. A regulation under Section 178 is in the nature of a subordinate Legislation. **Such subordinate Legislation can even override the existing contracts including Power Purchase Agreements which have got to be aligned with the regulations under Section 178** and which could not have been done across the board by an Order of the Central Commission under Section 79(1)(j).

Appeal No. 35 of 2011

Appellant: **Konark Power Projects Ltd**

Versus

Respondent: **Karnataka Electricity Regulatory Commission**

Bench: **Mr. Karpaga Vinayagam, Chairman**

Mr. V J Talwar, Technical Member

Dated: 10.02.2012

Issue: Whether the Commission has the power to modify the tariff contained in a subsisting PPA.

Concerned Regulation of KERC

- **9. Determination of Tariff for electricity from Renewable sources of energy**:- (1) The Commission may determine at any time the tariff for purchase of electricity from Renewable sources of energy by Distribution Licensees either suo motu or on an application either by generator or by Distribution Licensee;

  Provided that the tariff approved by the Commission including the PPAs deemed to have been approved under sub-Section (2) of Section 27 of the Karnataka Electricity Reforms Act, 1999, prior to the coming into force of these regulations shall continue to apply for such period as mentioned in those PPAs.

Commission's Findings

- "Under Section 86 of the Electricity Act, 2003 read with sections 62 & 64, the Commission has the power to determine the tariff of the generating companies including NCE projects who supply electricity to the Distribution Licensees. In exercise of its powers under these provisions, the Commission has passed two orders, one during 2005 and another on 11.12.2009, and has also approved the PPAs. Once this Commission has powers to fix and approve the tariff, in our considered view, the same includes the power to modify the same in case there are circumstances warranting such modification."

Commission's Findings

- "We have gone through the material placed before us and the reasons urged in support of the revision by the petitioner. **The main reason pleaded by the petitioner in support of its prayer for increase in tariff is that the rate of fuel has gone up abnormally and the tariff paid under the PPA is too low affecting the very viability of the plant.** The petitioner in support of its contention has produced certain invoices of purchase of biomass. In our view, mere production of some invoices will not be enough to justify the increase in rates. The petitioner has not produced details of its actual costs supported by material evidence to substantiate the effect of the present tariff on the viability of the unit. Therefore, we hold that the petitioner has not made out a case for revision of the tariff contained in the PPA. Accordingly this petition is liable to be rejected and hence dismissed."

APTEL's Observations and Ruling

- The guidelines in Section 61 of the Act would indicate that the Commission has to maintain a balance of interests so that the generators also may not suffer unnecessarily. It is not disputed that unit of the Appellant was shut down due to its becoming unviable at the existing tariff.
- The State as well as the Country has been facing power shortage and this fact has been accepted by the Government of Karnataka in its GO mentioned above. Under such circumstances it should be our endeavour to produce energy to the extent possible.
- It would not be desirable to keep any generating unit out of service for want of 'just' tariff more so when 70% of investment is funded by Public Sector Banks or Financial Institutions as loan. In the context of prevailing power scenario in the country, it is well said that "No power is expensive power". In other words power at any cost is acceptable as the Cost of unserved energy (loss due load shedding) could be very high.
- The State Commission as indicated in the impugned order has power to modify the tariff for concluded PPA in larger public interest.
- The guiding principles laid down in Section 61 of the 2003 Act would indicate that the Commission has to maintain a balance so that the generators also may not suffer unnecessarily. In the context of prevailing power situation in the country, it would not be desirable to keep any generating unit out of service for want of 'just' tariff

Appeal No. 132 of 2012

Appellant: **M/s. Junagadh Power Projects Private Limited,**

Versus

Respondent: **Gujarat Electricity Regulatory Commission**

Bench: **Mr. Karpaga Vinayagam, Chairman**

Mr. V J Talwar, Technical Member

Mr Rakesh Nath, Technical Member

Dated: 02.12.2013

Issue: Whether the Commission has the power to modify the tariff contained in a subsisting PPA.

APTEL's Ruling

- The State Commission has the powers to reconsider the price of biomass fuel and revise the tariff of the biomass based power plants in the State in view of the circumstances of the case as the biomass plants in the State are partially closed and are operating at suboptimal Plant Load Factor due to substantial increase in the price of biomass fuel.

Appeal No. 198 of 2014

Appellant: **GUJARAT URJA VIKAS NIGAM LIMITED,**

Versus

Respondent: **Gujarat Electricity Regulatory Commission**

Bench: **Mrs. Rajana P Desai, Chairman**

Mr. T. Munikrishnaiah,, Technical Member

Dated: 28.09.2015

Issue: Whether the Commission has the power to modify the tariff contained in a subsisting PPA.

APTEL's Ruling

- We find no fetters in law on the power of the Appropriate Commission to undertake such exercise. We have already referred to the provisions of the Electricity Act which permit the Appropriate Commission to amend the tariff order. These statutory provisions have a purpose. They are meant to give certain amount of flexibility to the Appropriate Commissions. They have been empowered to amend or revoke the tariff because exigencies of a situation may demand such an exercise.
- In the circumstances, we hold that there is no bar on the Appropriate Commission preventing it from entertaining a petition for modification of tariff after execution of a PPA. In other words, the Appropriate Commission has the power to reopen a PPA and modify the tariff by an order. We, therefore, find no substance in these appeals. The Appeals are dismissed. Needless to say that hearing of the petitions shall now proceed and the petitions shall be disposed of on merits in accordance with law.

Whether fossil fuel fired co-generation plants are obliged to procure certain percentage of power from renewable sources

&

Whether the distribution licensees can be fastened with the obligation to procure power from such co-generation plants

Appeal No. 57 of 2009

Appellant: **Century Rayon**

Versus

Respondent: **Maharashtra Electricity Regulatory Commission**

Bench: **Mr. Justice M. Karpaga Vinayagam, Chairperson**

Mr. H.L. Bajaj, Technical Member

Dated: **26th April 2010**

Issue: Whether a Co-generator generating power from coal can be fastened with RPO by the Commission.

APTEL's Observations

(I) The plain reading of Section 86(1)(e) does not show that the expression 'co-generation' means cogeneration from renewable sources alone. The meaning of the term 'co- generation' has to be understood as defined in definition Section 2 (12) of the Act.

(II) **As per Section 86(1)(e), there are two categories of `generators namely (1) co-generators (2) Generators of electricity through renewable sources of energy. It is clear from this Section that both these categories must be promoted by the State Commission by directing the distribution licensees to purchase electricity from both of these categories.**

(III) The fastening of the obligation on the co-generator to procure electricity from renewable energy procures would defeat the object of Section 86 (1)(e).

APTEL's Observations

(IV) The clear meaning of the words contained in Section 86(1)(e) is that both are different and both are required to be promoted and as such the fastening of liability on one in preference to the other is totally contrary to the legislative interest.

(V) Under the scheme of the Act, both renewable source of energy and cogeneration power plant, are equally entitled to be promoted by State Commission through the suitable methods and suitable directions, **in view of the fact that cogeneration plants, who provide many number of benefits to environment as well as to the public at large, are to be entitled to be treated at par with the other renewable energy sources.**

(VI) The intention of the legislature is to clearly promote cogeneration in this industry generally irrespective of the nature of the fuel used for such cogeneration and not cogeneration or generation from renewable energy sources alone.

Appeal No. 53 of 2012

Appellant: **Lloyd Metal**

Versus

Respondent: **Maharashtra Electricity Regulatory Commission**

Bench: **Mr. Justice M. Karpaga Vinayagam, Chairperson**

Mr. Rakesh Nath, Technical Member

Mr. V. J. Talwar, Technical Member

Dated: 2nd December 2013

Issue: Whether the Distribution Licensees could be fastened with the obligation to purchase a percentage of its consumption from co-generation irrespective of the fuel used under Section 86(1)(e) of the Act 2003."

APTEL's Observations

Summary of our findings:

Upon conjoint reading of the provisions of the Electricity Act, the National Electricity Policy, Tariff Policy and the intent of the legislature while passing the Electricity Act as reflected in the Report of the Standing Committee on Energy presented to Lok Sabha on 19.12.2002, **we have come to the conclusion that a distribution company cannot be fastened with the obligation to purchase a percentage of its consumption from fossil fuel based co-generation under Section 86(1)(e) of the Electricity Act, 2003. Such purchase obligation 86(1)(e) can be fastened only from electricity generated from renewable sources of energy**.

However, the State Commission can promote fossil fuel based co-generation by other measures such as facilitating sale of surplus electricity available at such co-generation plants in the interest of promoting energy efficiency and grid security, etc.

CPP Obligated Entity?

SC Civil Appeal No. 4417 of 2015

Appellant: **Hindustan Zinc**

Versus

Respondent: **Rajasthan Electricity Regulatory Commission**

Bench: **Mr. Justice V. Gopala Gowda and**

Mr. Justice R. Banumathi, JJ.

Dated: **13th May 2015**

Issue: whether the impugned Regulations imposing RE Obligation upon Captive Power Plants framed by the RERC in exercise of power Under Section 86(1)(e) of the Act of 2003, which provides for promotion, co-generation of electricity from renewal source of energy are *ultra vires* the provisions of the Act or repugnant to Article 14 and 19(1)(g) of the Constitution.

Supreme Court's Ruling

50. Article 51A(g) of the Constitution of India cast a fundamental duty on the citizen to protect and improve the natural environment. Considering the global warming, mandate of Articles 21 and 51A(g) of the Constitution, provisions for the Act of 2003, the National Electricity Policy of 2005 and the Tariff Policy of 2006 are in the larger public interest, Regulations have been framed by RERC imposing obligation upon captive power plants and open access consumers to purchase electricity from renewable sources. **The RE obligation imposed upon captive power plants and open access consumers through impugned Regulations cannot in any manner be said to be restrictive or violative of the fundamental rights conferred on the Appellants under Articles 14 and 19(1)(g) of the Constitution of India.**

Gujarat HC Civil Appeal No. 171 of 2011 and Batch

- 14 CPPs approached the Gujarat High Court against the GERC Regulations Fastening CPPs in the State with RPO. The plea taken by the Appellants was similar to the plea taken by Appellants in Hindustan Zinc Case supra.
- Single Bench of Gujarat High Court in its judgment dated 12.3.2015 upheld the GERC Regulations on the similar ground as taken by Hon'ble Supreme Court in Hindustan Zinc Case.
- The matter was taken in Appeal before Division Bench of the High Court
- The Division Bench in its judgment dated 5.5.2015 confirmed the order of single member bench and upheld the GERC Regulations.

Who Should be the Chairperson of a Commission

Civil Appeal No. 4126 of 2013

- Appellants: **T.N. Generation and Distbn. Corpn. Ltd.**

  Vs.

  Respondent: **PPN Power Gen. Co. Pvt. Ltd.**

- **Bench:** S.S. Nijjar and A.K. Sikri, JJ.
- Decided On: 04.04.2014
- Issue: Whether it is mandatory to have a judge as Chairperson of the Commission

Court's Observations

- Section 113 of the Act mandates that the Chairman of APTEL shall be a person who is or has been a Judge of the Supreme Court or the Chief Justice of a High Court. A person can be appointed as the Member of the Appellate Tribunal who is or has been or is qualified to be a Judge of a High Court. This would clearly show that the legislature was aware that the functions performed by the State Commission as well as the Appellate Tribunal are judicial in nature. Necessary provision has been made in Section 113 to ensure that the APTEL has the trapping of a court.
- **This essential feature has not been made mandatory under Section 84 although provision has been made in Section 84(2) for appointment of any person as the Chairperson from amongst persons who is or has been a Judge of a High Court. In our opinion, it would be advisable for the State Government to exercise the enabling power under Section 84(2) to make appointment of a person who is or has been a Judge of a High Court as Chairperson of the State Commission.**

Writ Petition (PIL) No. 172 of 2014 in Gujarat High Court

- Appellants: UTILITY USERS' WELFARE ASSOCIATION

  Versus

  STATE OF GUJARAT & 12

- **Bench:** Jayant Patel, Acting CJ and N V Anjaria, J.
- Decided On: 08.10.2015
- Issue: Whether it is mandatory to have a judge as Chairperson of the Commission

Gujarat High Court's Ruling

1) **The word used "may" in Section 84(2) shall be** interpreted to mean "as far as possible" and unless impossible for the appointment of any person as Chairperson from amongst the persons, who are or have been Judge of the High Court.

2) **When it is impossible to resort to Sub-section**(2) of Section 84 as per the interpretation made in the present judgement, the Government may fall back upon Section 84(1) for appointment of chairperson, but such action of appointment, if made on the basis of misconceived or non-availability of doctrine of necessity, the said action would be vulnerable and subject to challenge under Article 226 of the Constitution.

3) **Even in case of impossibility to make** appointment under Section 84(2), if the State decides to exercise power under Section 84(1) of the Act, then the person to be considered for appointment as Chairperson must possess the minimum experience of work for 5 years in the cadre of District Judge or minimum experience of practice in District Court or High Court for 10 years as an advocate.

Whether CAG can Audit the Accounts Of a Private DISCOM

Writ Petition No. 895 of 2011 in Delhi High Court

Petitiners: UNITED RWAS JOINT ACTION (URJA)

Versus

Respondents: UNION OF INDIA AND ORS

Bench: The Chief Justice and Rajiv Sahai Endlaw (J)

Date: 30.10.2015

Issues: (I) Whether under Section 20(1) of the Comptroller and Auditor Generals' (Duties, Powers and Conditions of Service) Act, 1971 (CAG Act) the Comptroller and Auditor General of India (CAG) can be requested to undertake the audit of the accounts of the Distribution Companies (DISCOMs),

(II) Whether the said decision to request such audit is to be of the Administrator, acting on his own, or on the aid and advice of the Council of the Ministers of GNCTD.

(III) Whether the direction so given to the CAG in the present case has been taken in accordance with the procedure prescribed under Section 20 of the CAG Act and if not, to what effect.

(IV) Whether the audit so directed can be since the date of inception of DISCOMs i.e. 1st July, 2002 and if not, for what period.

(V) If it were to be held that the CAG can conduct audit of DISCOMs but the direction impugned in these proceedings is bad for the reason of having been issued without compliance with the proper procedure, whether a mandate ought to be issued to the GNCTD or to the CAG to conduct the audit of the DISCOMs

Delhi High Court's Rulings

- Issue 1: President or Governor or Administrator in UTs can direct CAG to Audit accounts of any company under Article 149 of the Constitution.
- Issue 2: Administrator of UT has to act on aid and advice of the government.
- Issue 3: Procedure prescribed by the Section 20(1) of the CAG Act has not been followed by the Delhi Government. DISCOMS must have been heard after decision had been taken to get their accounts audited by CAG in consultation with CAG and the Terms and Conditions for CAG Audit had been framed. In other words the DISCOMs must have been heard after finalizing the Terms and Conditions of CAG Audit. In this case opportunity was given to DISCOMS before entry conference with CAG and finalization of Terms and Conditions of Audit. **The Government's order on CAG Audit reversed on this ground.**
- Issue 5: The purpose of ordering CAG Audit was to reduce the tariff. Tariff fixation is exclusive domain of DERC. No useful purpose could have been served for the audit as the Government can not direct the DERC in any matter related to tariff. Govenrment has no role in fixation of tariff.

Tariff Related Issues

OP1 of 2011

- Date of Judgment; 11.11. 2011
- Bench: Karpaga Vinayagam, Chairperson
  Rakesh Nath, Technical member
  V J Talwar, Technical member
- Issue: Non-performance of SERC in issuance of timely tariff orders.

OP1 of 2011

- Suo-Motu action on the letter received from Ministry of Power.
- Complaint that most of the State Commissions constituted all over India have failed to comply with statutory requirements by not making periodical tariff revisions resulting in the poor financial health of the State distribution utilities and requesting this Tribunal to take appropriate action and to issue necessary directions to the State Commissions under section 121 of the Electricity Act,2003 (the Act) to ensure that all the State Commissions perform their statutory functions without any default.

DIRECTIONS

- Every State Commission has to ensure that Annual Performance Review, true-up of past expenses and Annual Revenue Requirement and tariff determination is conducted year to year basis as per the time schedule specified in the Regulations.
- It should be the endeavour of every State Commission to see that the tariff for the financial year is decided before 1st April of the tariff year.
- In the event of a delay in filing of the ARR truing-up and Annual Performance Review, beyond 31st December, the State Commission must initiate suo-moto proceedings for tariff determination in accordance with Section 64 of the Act read with clause 8.1 (7) of the Tariff Policy.

Directions

- In determination of ARR/tariff, the revenue gaps ought not to be left and Regulatory Asset should not be created as a matter of routine except where it is justifiable, in accordance with the Tariff Policy and the Regulations. The recovery of the Regulatory Asset should be time bound and within a period not exceeding three years at the most and preferably within Control Period. Carrying cost of the Regulatory Asset shall be allowed to the utilities to avoid problem of cash flow.
- Truing up shall be carried out regularly and preferably every year.
- Every State Commission must have in place a mechanism for adjustment of Fuel and Power Purchase cost in terms of Section 62 (4) of the Act. … Any State Commission which does not already have such formula/mechanism in place must within 6 months of the date of this order must put in place such formula and ensure its implementation latest by 1.4.2013.

Appeal No. 131 of 2011

- Appellant : Haryana Power Generation Company
- Respondent: Haryana Commission
- Date of judgment: Feburary 2012
- Bench : Karpaga Vinayagam, Chairperson
  V J Talwar, Technical Member

- Issue: Whether provisions of CERC Regulations are binding on State Commissions?

Contentions of the Appellant

- The Appellant, Haryana Generation Company has stated that the Haryana Commission has not followed the guidelines laid down by the Central Electricity Regulatory Commission and principles laid down by the Tariff Policy issued by the Government of India in accordance with Section 3 of the 2003 Act.

- Referring to Section 61 of the Act, the Appellant contended that the State Commissions, while fixing tariff, are required to be guided by the principle laid down by the Central Commission and the National Electricity Policy and Tariff Policy.

- The State Commission has neither followed the principles and methodology specified by the Central Commission nor followed the provisions of Tariff Policy and National Electricity Policy.

Observations of APTEL

- Bare reading of section 61 would elucidate that the State Commissions have been mandated to frame Regulations for fixing tariff under Section 62 of the Act and while doing so i.e. while framing such regulations, State Commissions are required to be guided by the principles laid down in by the Central Commission, National Electricity Policy, Tariff Policy etc.
- It also provide that while framing the regulations the State Commissions shall ensure that generation, transmission and distribution are conducted on commercial principles; factors which would encourage competition and safe guard consumer's interest.
- Once the State Commission has framed and notified the requisite Regulations after meeting the requirement of prior publication under Section 181(3), it is bound by such Regulations while fixing Tariff under Section 62 of the Act and the Central Commission's Regulations have no relevance in such cases.
- However, the State Commission may follow the Central Commission's Regulations on certain aspects which had not been addressed in the State Commission's own Regulations.

Appeal No. 266 of 2006

- Appellant: North Delhi Power Limited
- Respondent: Delhi Commission
- Date of Judgment : 23.5.2007
- Bench: H L Bajaj, Technical Member
  Manju Goel, Judicial Member

- Issue: Truing Up Exercise

Observations of APETL

- Before parting with the judgment we are constrained to remark that the Commission has not properly understood the concept of truing up.
- While considering the tariff petition of the utility the Commission has to reasonably anticipate the revenue required by a particular utility and such assessment should be based on practical considerations.
- It cannot take arbitrary figures of increase over the previous period's expenditure by an arbitrarily chosen percentage of 4% or 20% and leave the actual adjustments to be done in the truing up exercise.

Observations of APTEL

- The truing up exercise is mentioned to fill the gap between the actual expenses at the end of the year and anticipated expenses in the beginning of the year.
- When the utility gives its own statement of anticipated expenditure, the Commission has to accept the same except where the Commission has reasons to differ with the statement of the utility and records reasons thereof or where the Commission is able to suggest some method of reducing the anticipated expenditure.
- This process of restricting the claim of the utility by not allowing the reasonably anticipated expenditure and offering to do the needful in the truing up exercise is not prudence.

Observations of APTEL

- In any case, the method adopted by the Commission has not helped either the consumer or the utilities. It can only be expected that the Commission will properly understand its role in assessing the revenue requirement of the utility and in determination of the tariff in accordance with the policy directions and the relevant law in force.

Appeal No. 36 of 2008

- Appellant: BSES Rajdhani Power Limited
- Respondent: Delhi Commission
- Date of Judgment : 6.10.2009
- Bench: H L Bajaj, Technical Member
  Manju Goel, Judicial Member
- Issue: Load Projections made by the licensee vis-à-vis projections made by the Commissions

Observations of APTEL

- The projection of sale in the area of the licensee depends on the peculiar situation which obtains in the area of the licensee. We are unable to approve the methodology adopted by the Commission which projects the sale of all the DISCOMs together and divides the projection amongst the areas of the different licensees depending upon the proportion of their business. The actual figures for 2007-08 have been submitted to the Tribunal. The actual figures do not tally with the estimation of either the Commission or that of the appellant. Neither of the two estimations is too far from the actuals.

- We do feel that the Commission should determine the sale projection based on the data of a particular area of each distribution agency rather than taking into account the data of the entire city. While doing so the Commission should pay due regard to the projections made by the licensee who is responsible for supplying electricity to the consumers in its area and also has to face the consequences of failure in discharging his responsibility.

ISSUES RELATED TO RETAIL TARIFF

- Components of Retail Tariff
  - Power Purchase Costs
  - Return on Equity
  - Interests on Loan
  - Depreciation
  - Operation and Maintenance Expenditure
  - Interest on Working Capital
  - Income Tax.
- Rationalization of Retail Tariff

ON DEPRECIATION

Appeal no. 265 of 2006

- Appellant: North Delhi Power Limited
- Respondent: Delhi Commission
- Date of Judgment: 23rd May 2007
- Bench: H L Bajaj, Technical Member
  Manju Goel, Judicial Member

- Issue: Whether Depreciation is permissible on APDRP Grant?

Observation and Ratio

- "It may further be said here that there is no rationale for declining to allow depreciation for assets acquired out of the APDRP grant because depreciation is a source of funding required for **replacement of assets**. **Therefore, unless the Commission is able to say that APDRP grant will be available every year and there is no need to create funds for replacement of such assets, it cannot say that no depreciation on such asset may be given."**

- **Ratio: Depreciation is permissible on grant.**

Appeal no. 27 of 2007

- Appellant: Haryana Vidyut Prasaran Nigam Ltd
- Respondent: Haryana Commission
- Date of Judgment: 4.10.2007
- Bench: Anil Dev Singh, Chairperson
  A A Khan, Technical Member
- Issue: Depreciation is meant for ?

Observations and Ratio

- **Issue:- Whether depreciation is meant for replacement of asset after useful life?**
- We are persuaded to hold that in view of the fact that generation does not require any license, value of BBMB/IP stations assets appear in the Balance Sheet of HVPNL and **that replacement will be required after useful life of assets,** the depreciation on BBMB/IP station assets deserves to be allowed as claimed by the appellant. Hence this point is answered in favour of the appellant.

- Ratio: Depreciation is meant for replacement of assets after its useful life

Appeal no. 134 of 2010

- Appellant: Power Grid Corporation of India
- Respondent: Central Commission
- Date of Judgment: 5.4.2011
- Bench: Karpaga Vinayagam, Chairperson
  V J Talwar, Technical Member
- Issue: Whether Depreciation is permissible on Grants?

Usage of Depreciation explained

- In tariff exercise expenditure for meeting the interest payment liability of the utility on the loan raised is allowed.
- Similarly Return on Equity (RoE) for providing Equity for creating an asset is also allowed.

However, no allowance is made for repayment of principle amount of loan.

Depreciation is thus linked to principle repayment liability of the utility. Since the life span of asset created is higher than term of loan raised to create the asset, the depreciation allowed on straight line method would be less than principle loan repayment liability of the utility.

Usage of Depreciation explained

- So as to allow the utility to have sufficient funds to repay its interest and principle repayment liability, the concept of Advance Against Depreciation (AAD) had been introduced by various Electricity Regulatory Commissions in the country. Under this concept in addition to allowable depreciation, the distribution licensee is allowed to claim an advance against depreciation (AAD).
- Thus in practice, depreciation is utilized to meet loan repayment liability of the utility arisen out of creation of an asset.
- When such an asset is required to be replaced after expiry of its useful life, fresh financial arrangements are made.
- In the light of above discussions it is clear that as per definition, depreciation is replacement cost of an asset but in practice it is utilized for repayment of loan.

Treatment of Depreciation

- Accounting Standard 12 of Institute of Charted Accountants of India permits two methods of presentation of grants in accounts.
  - 1st method – Amount of grant is deducted from GFA and depreciation is allowed on net amount
  - 2nd method – Depreciation is allowed on grant and the amount of depreciation on grant is considered as non-tariff income and deducted from ARR of licensee.
- **Impact of both the methods is same i.e. Tariff Neutral**
- Ratio: In Power Sector depreciation is not used for replacement of assets. It is used for repayment of Loan. Accordingly depreciation on grants is not permissible.

Appeal no. 102 of 2011

- Appellant: Haryana Vidhyut Prasaran Nigam
- Respondent: Haryana Commission
- Date of Judgment: 18.4.2012
- Bench: P S Datta, Judicial member
  V J Talwar, Technical Member
- Issue: Whether Depreciation is meant for replacement of asset?

Observations

- The Appellant in this case had claimed depreciation on BBMB and IP assets for replacement after serving useful life.
- It would be pertinent to mention that if the depreciation is used for asset replacement than the Appellant must surrender the amount it has received as depreciation against IP station as this asset has been shut down permanently.
- **We are not passing any direction to recover the said amount as we are aware that in Indian Power Sector the depreciation is normally utilised for meeting the loan liabilities and not for replacement of asset.**

Appeal no. 61of 2012

- Appellant: BSES Rajdhani Power Limited
- Respondent: Delhi Commission
- Date of Judgment: 28.11.2014
- Bench: Karpaga Vinayagam, Chairperson
  Rakesh Nath, Technical Member
- Issue: Whether Depreciation is permissible on consumer's contribution?

Ratio

- Issue: Whether depreciation on consumer contribution is permissible?
- Equating Consumer Contribution with grant, the Tribunal has held that the **Depreciation on Consumer Contribution is not permissible.**

INTEREST ON LOAN/ NOTIONAL LOAN

Appeal no. 40 of 2011

- Appellant: DVC
- Respondent: Central Commission
- Date of Judgment: 1.5.2012
- Bench: P S Datta, Judicial member
  V J Talwar, Technical Member
- Issue: Whether Equity infused in excess of 30% during construction period is to be treated as 'Notional Loan' and IDC is permissible on this?

Appellant's claim

- The cumulative capital cost should be divided in the debt equity ratio of 70:30, the excess equity deployed should be treated as a loan. All such equity amount even during construction period has to be treated as notional loan.
- Accordingly Notional IDC should be duly allowed.
- The Central Commission has, however, allowed only the actual IDC and has disallowed IDC on notional loan.

Observations

- Bare perusal of the Regulation 20 of CERC Tariff Regulations would reveal that debt – equity ratio of 70:30 is to be considered as on date of commercial operation and for the purpose of determination of tariff. It does not provide that the debt - equity ratio of 70:30 would be considered during construction of the project or after its commercial operation.

- Factually, debt component of the capital cost has to be repaid as per term of the loan and equity component of capital would remain constant during the life of the project.

- Therefore, debt – equity ratio would vary from time to time and after repayment of loan only equity would remain. Similarly, Capital would be injected during construction of the project depending upon the requirement and availability of funds either from loan or from equity and debt – equity ratio would vary.

Observations and ratio

- In the present case debt – equity ratio had been varying from quarter to quarter throughout the construction period.
- In the beginning equity component was 100% and during some months it was as low as 10%.
- If the contention of the Appellant is accepted then interest on 'normative' loan would be payable when equity is more than 30% but when loan is more than 70%, interest on actual loan would have to be provided.
- This would result in unjust increase in the capital cost of the project. As brought out above, the Appellant's claim of 'notional interest' on 'notional loan' during construction period is in fact a claim on return on equity during construction which is not permissible.

Appeal no. 160 of 2013 and Batch

- Appellant: Reliance Infrastructure Limited
- Respondent: Maharashtra Commission
- Date of Judgment: 8.4.2015
- Bench: Rakesh Nath, Technical member
  Surendra Kumar, Judicial Member
- Issue: Rate of Interest on Actual Loan taken and also rate of interest on outstanding normative loan?

Facts

- Appellant Rinfra is involved in the Business of Generation, Transmission and Distribution in the city of Mumbai. It is also carrying out other business not regulated by MERC.
- Rinfra submitted ARR separate petitions for generation, transmission and distribution.
- Rinfra-G has not taken any loan and had some outstanding 'Normative Loans'
- Rinfra-T has taken actual loans having terms ranging 5-7 years for the new projects in transmission.
- Rinfra-D has taken loans to replace certain 'Normative Loans'.

Commission's Regulations related to interest on loans

- The rate of interest shall be the weighted average rate of interest calculated on the basis of the actual loan portfolio at the beginning of each year applicable to the Generating Company or the Transmission Licensee or the Distribution Licensee:
- Provided that if there is no actual loan for a particular year but normative loan is still outstanding, the last available weighted average rate of interest shall be considered.
- Provided further that if the Generating Company or the Transmission Licensee or the Distribution Licensee, as the case may be does not have actual loan, then the weighted average rate of interest of the Generating Company or the Transmission Licensee or the Distribution Licensee as a whole shall be considered

Commission's observations

- For Generation business the MERC observed that since there is no actual loan taken by the petitioner, it shall be allowed weighted average of rate of interest for loans taken by the Company for regulated as well as unregulated businesses as per 2nd proviso to regulation 33.5. Accordingly allowed 8% instead of 11% demanded by the appellant as the last available weighted average rate of interest as per first proviso to Regulation 33.5.

- In its order for Transmission the MERC observed that the Appellant has taken short term loans for 6-7 years bearing high rate of interest. The Appellant should have taken long term loans at lower rate of interests.

- In its order for distribution the MERC observed that the Appellant has swapped 'Normative Loans' for Actual Loans at higher rate of interest. Refinancing of Loans would make sense only if fresh loans are taken at lower rate of interest. MERC allowed rate of interest lower than actual rate.

Appellate Tribunal's findings

- i) The interest rate on the normative loan as on 01.04.2011 has to be reconsidered in view of the judgment of this Tribunal in Appeal nos. 138 and 139 of 2012 at the prevailing market rate.
- ii) There is no provision for replacement of outstanding normative loan by actual loan. However, there is no bar in replacing the outstanding normative loan as on 01.04.2011 by actual loan provided the actual loan has been taken for the assets which have been taken into service prior to 01.04.2011 and the Appellant is able to establish that no prejudice has been caused to the consumers by arranging loans at better terms then the prevailing market rates.
- iii) The perception that the State Commission is having that the loan of tenure of 5 to 6 years is short term loan and the interest on a loan for tenure of 10 years or more than 10 years will be lower than the interest rate for 5-7 years tenure is not correct as the Bank may charge higher spread on longer term loans. The Bank would perceive a loan of 10 or more than 10 years as having higher risk than loan of 5 to 6 years. Sometimes when the interest rates are showing declining trend it may be advisable to take shorter term loan. The interest rate on the actual loans taken by the Appellant for the new capital works should be decided taking in account the data on market rates of loan and actual loans availed as furnished by the Appellant after analysis.

RETURN ON EQUITY

Appeal no. 21 of 2010

- Appellant: Haryana Vidhyut Prasaran Nigam
- Respondent: Central Commission
- Date of Judgment: 11.11.2011
- Bench: Karpaga Vinayagam, Chairperson
  V J Talwar, Technical Member
- Issue: The only grievance of the Appellant was against the method of recovery of the charges by PGCIL. According to the Appellant the recovery of charges are computed on yearly basis but recovered on monthly basis. This methodology adopted by the PGCIL would result in over recovery by PGCIL?

Crux of Contentions of the Parties

- The PGCIL's case was based on the fact that the issue in hand is generic and has been adopted throughout the country for tariff determination. In all tariffs, the fixed charges are computed on annual basis but recovered monthly without considering the frequency of interest payment.
- The Appellant categorically stated that issue is not generic but specific to ULD&C scheme.

Whether the issue was generic or specific?

- In generic transmission tariff, Equity and Loan are not recoverable through transmission charges.
- The equity invested in the asset is not recovered and remain invested throughout the life of asset and is not paid through tariff.
- Similarly, repayment of principle of loan amount is not a part of tariff.
- In the present case the PGCIL proposed to recover equity as well as loan capital in 15 years through annual charges.
- Thus, there is a material difference in generic transmission charges and annual charges for ULDC Scheme. Therefore, these two are to be treated differently.

Observations

- The equity is not recovered in generic transmission tariff.
- Accordingly, it would not matter as to whether Return on Equity is paid on annual basis or monthly basis.
- It would also not matter as to whether equity is levelised or not. As long as equity remains same, the Return on Equity would also remain same under all the circumstances.
- However, in the present case before us, the equity is also recovered in equal monthly instalments. As such Return on Equity would also diminish with the reduction in balance equity.
- Since, in this case equity is also recoverable in equal monthly instalments; the methodology adopted by the Central Commission would result in higher recovery of equity as well.

OPERATION AND MAINTENANCE CHARGES

Appeal no. 61 of 2012

- Appellant: BSES Rajdhani Nigam Limited
- Respondent: Delhi Commission
- Date of Judgment: 28.11.2014
- Bench: Karpaga Vinayagam, Chairperson
  Rakesh Nath, Technical Member
- Issue: Whether higher expenditure incurred for one or some of the components in O&M charges is permissible under normative regime?

Observations and Ratio

- There are many sub-components under the head A&G expenses. Audit fee is one of such sub-component. Under normative regime, break up of each component is not considered and the expenses as a whole are approved by the Commission based on applicable Regulations.
- Under normative setup, the licensee may loose on one of the component and gain on other components. If there is gain i.e. actual expense is less than the approved expense, the licensee pockets the gain. Similarly lose, if any, is to be borne by the licensee.
- Under normative regime, the licensee cannot be permitted to claim additional expenditure it is likely to suffer on account of increased expenditure on one component and any gain on reduction in expenditure on other components is kept by the licensee.

INCOME TAX

- **In Reliance Infrastructure Ltd Vs MERC in Appeal No.111 of 2008 (2009 ELR(APTEL 560) dated 28.5.2009 it was held that** for income tax on incentives is to be given to it as a pass through.
- **In Torrent Power Ltd Vs GERC in Appeal No.68 of 2009 23.3.2010 the tribunal** laid down the principle of grossing up of Income tax. Grossing up of the income tax would ensure that after paying the tax, the admissible post tax return is assured to the Appellant. In this way the Appellant would neither benefit nor loose on account of tax payable which is a pass through in the tariff.
- **In Gujarat Electricity Regulatory State Commission Vs Torrent Power Limited in Review Petition No.09 of 2010 in Appeal No. 68 of 2009 dated 5.01.2011** this Tribunal has observed that the Utility should neither benefit nor loose on account of tax payable which is a pass through in the tariff. Thus, there is no question of the company making profit on account of income tax.

Appeal No.251 of 2006 – Reliance Energy Ltd Vs MERC

- The consumers in the licensee's area must be kept in a water tight compartment from the risks of other business of the licensee and the Income Tax payable thereon.
- Under no circumstance, consumers of the licensee should be made to bear the Income Tax accrued in other businesses of the licensee.
- **Income Tax assessment has to be made on stand alone basis for the licensed business so that consumers are fully insulated and protected from the Income Tax payable from other businesses.**

- **In TPC Vs MERC in Appeal No.174 of 2009 Dated 14.02.2011 and in Appeal No.173 of 2009 Dated 15.02.2011** the Tribunal held that Profit Before Tax should be basis for assessment of income tax during truing up and restated the principles of Grossing up and income tax on incentives to be pass through.

- In Appeals No. 104, 105 & 106 of 2012, the Tribunal has carried out detailed analysis of all the above judgments and rendered its view on Income Tax at page numbers 22 to 45.

ISSUES RELATED TO RATIONALIZATION OF TARIFF

Appeal no. 75 of 2011

- Appellant: Sothern Railways
- Respondent: Tamil Nadu Commission
- Date of Judgment: 23.5.2012
- Bench: Karpaga Vinayagam, Chairperson
  V J Talwar, Technical Member

- Issue: Whether Railways being public utility is entitled fro preferential tariff.

Issues framed by APTEL

- Whether the State Commission has violated the provisions of Article 287 of the Constitution of India?
- Whether directive issued by Ministry of Power, Government of India in 1991 are binding on the State Commissions constituted under Electricity Act 2003?
- Whether the Appellant is entitled for concessional tariff by virtue of it being a public utility?
- Whether the provisions of the Distribution Code and the Supply Code relating to voltage wise classification of consumers is binding in tariff determination by the State Commission?
- Whether the special category created by the State Commission for the Appellant is sufficient to offset the investments made by the Appellant in taking the supply at EHT level or further rebate in energy charges would also be necessary?

Article 287 discussed

- Article 287 bars any State Government to impose tax on the consumption of electricity by the Railways. The Tariff determined by the State Commission is in accordance with Electricity Act 2003 which is a Central Act passed by the Parliament.
- The last portion of the Article 287 provides that where the retail tariff includes any tax imposed by the State Government, the tariff for the Railways would be lesser by an amount equal to such tax.
- The Impugned Order determining the tariff for all categories of consumers did not have any component of any tax imposed by the State Government.
- The Article 287 does not deal with tariff much less with the plea of the Appellant that it provides for lower tariff for Railways as compared to other HT consumers.

Whether being a public utility railways is entitled for concessional tariff

- With the advent of economic reforms said to have been initiated by the Government in the early nineties the concept of what should be the attitude of the public utilities in its service to the society has definitely undergone a change and the appellant cannot any longer say that since it serves the people without any profit motive it requires special treatment from the respondents nos. 2 and 3 because to say so is to forget that the respondent no. 2 & 3 are equally Government companies and they are right when they say that they are also equally public utilities and they cannot be asked to run on non- commercial principles, for to do so is to wind up their concerns. It is for the appellant to lay down its own policy.

On Drawal of power on own network at EHT

- The plea of the Appellant is that it is drawing power at 110 kV from the Electricity Board's grid by laying 110 kV line and 110/25 kV substation at its own cost and therefore, it is entitled for lesser demand charges.
- This is untenable for the reason that under Section 46 of the 2003 Act, the licensee is entitled to recover expenditure incurred in providing the electric line and electric plant for giving supply to any consumer under section 43 of the Act.
- The Electricity Board is charging the cost of service line even from a domestic LT consumer. Other 135 EHT consumers taking supply at 110 kV or above also provide the cost of these facilities. The Appellant Railways was required to pay such charges even in case it preferred to take supply at 33 kV or 11 kV. In such a case the Appellant Railways was also required to provide 33/25 kV or 11/25 kV substation as the traction is at 25 kV.

On Drawal of power on own network at EHT

- So there is nothing exceptional for the Appellant Railways in providing the cost of 110 kV lines and 110/25 kV Substation at their own cost.
- Drawal of power at 110 kV or above for consumers with heavy power demand is technical requirement. Theoretically, any load can be met even at 400 volts. However, that would require large number of circuits depending upon the power requirement. Managing large number of parallel circuits would be techno-economically unviable and unpractical. Accordingly, the State Commission has fixed the voltage levels for drawal of power. Undoubtedly, drawal of power at EHT level would result in lesser distribution losses, the same would be true for other EHT consumers also.

Appeal no. 110 of 2009

- Appellant: Association of Hospitals
- Respondent: Maharashtra Commission
- Date of Judgment: 20.10.2011
- Bench: Karpaga Vinayagam, Chairperson
  Rakesh Nath, Technical Member

- Issue: Whether motive of earning profit comes within the preview of 'Purpose for which supply is required' in Section 62(3) of the Act.

OBSERVATIONS

- The State Commission in the present case wrongly placed all the consumers including the Appellants who were neither domestic nor industrial nor falling under any of the categories under the Commercial Category.
- The purpose for which the supply is required by the Appellants can not be equated at par with other consumers in the Commercial Category.
- The Appellants are seeking separate categorisation on the basis of purpose for which the supply is required by the Appellants i.e. rendering essential services.

Observations

- The real meaning of expression ' "purpose for which the supply is required" as used in Section 62 (3) of the Act does not merely relate to the nature of the activity carried out by a consumer but has to be necessarily determined from the objects sought to be achieved through such activity.

- The Railways and Delhi Metro Rail Corporation have been differentiated as separate category as they are providing essential services. The same would apply to the Appellants as well.

- The application of mind should be on identifying the categories of the consumers who should be subjected to bear the excess tariff recoverable based on a valid reason and justification.

Observations and ratio

- The re-categorisation of Charitable Hospitals and Charitable Organizations and grouping them with the consumers of the category such as Shopping Malls, Multiplexes, Cinema Theatres, Hotels and other like commercial entities is patently wrong.
- By the impugned order, the State Commission classified the members of the Appellants into ‘Commercial’ category following a mechanical approach.
- This has been done only because the Appellants cannot fall under either in the industrial or agricultural or residential category and therefore, the Appellant would automatically fall in the Commercial Category.
- This is not a proper approach. In case the State commission felt that the Appellants are not falling under any particular existing category, then the State Commission ought to have applied its mind and provided for a new category and given them a competitive tariff having regard to the purpose for which the electricity is used by them.

Appeal no. 39 of 2012

- Appellant: Rajasthan Engineering College Association
- Respondent: Rajasthan Commission
- Date of Judgment: 28.8.2012
- Bench: P. S. Datta, Judicial member
  V J Talwar, Technical Member

- Issue: Whether motive of earning profit comes within the preview of 'Purpose for which supply is required' in Section 62(3) of the Act.

Facts and question before the Aptel

- The Commission has fixed higher tariff for private owned educational institutions than for the Government owned educational institutions. The question was -
- Whether the State Commission can ignore the phrase '*purpose for which the supply is required*' appearing in Section 62 (3) of the Electricity Act, 2003 while classifying consumers in various categories and classifying the educational institutions in different categories merely because of the difference in ownership.

Section 62(3) explained

- The mandate of Section 62 (3) is that no **undue** preference should be shown to any consumer. If no preference is to be shown to any consumer of electricity, it would mean that all consumers are to be supplied electricity at uniform tariff reflecting the cost of supply. This is clear from the first part of Section 62 (3) which uses the expression ***"shall not………..show undue preference to any consumer***".
- This would mean that due preference can be given. What is prohibited is a preference of undue nature.
- There should, however, be a rationale or reason for giving due preference. For example, a life line consumer below poverty level can be given preference in the tariff based on his non-affordability. Similarly, agricultural consumers can be given preference because of the important nature of activities being carried out by them.

Categorization of consumers explained

- Thus, retail tariff for the Consumers can be differentiated, *inter alia*, on the basis of purpose for which supply is required. There can be numerous purposes for which supply is taken. Some of these are:
  - Residential, Paying Guest Accommodation, Guest House, Hotels, Motels, Gaushala, Piyao, Dharmshala, Night Shelter Cheshire homes, etc.
  - Shops, Shopping Malls, Clubs, restaurants etc.
  - Agriculture, cultivation, horticulture, floriculture, mushroom production, etc.,
  - Public water works, Lift Irrigation, Public lighting,
  - Industry, Glass industry, Liquid Air, Steel Industry, Induction Furnace, Rolling mill, Pharma Industry, Plywood Industry,
  - Transportation, Inter-city and intra-city bus service, Railway, Metro, Airport, Aerodromes, Ship yards etc.

Categorization of consumers explained

- It would not be practical for the ERCs to fix tariff for each of the groups of consumers as listed above. Therefore, the State Commissions all over the country have created various categories clubbing some the groups where supply is taken for similar purposes and created sub-categories within the main categories on other parameters enunciated in Section 62(3). Thus, State Commissions have created following main categories:
  - Domestic
  - Agriculture
  - Industry
  - Public Lighting
  - Public Water Works
  - Railways.
- In addition to above, State Commissions have also created another category viz., Non-domestic which is residual category. Any consumer which could not fall within main categories is categorised as non-domestic category.

Categorization of consumers explained

- Commission have created sub-categories within the main categories to fix differential tariff based on Voltage (LT/HT Industrial tariff), Total Consumption (Slab wise tariff in domestic category), Time of day, (Introduction of ToD tariff for select categories), Load factor (Load factor based Incentive/disincentive), geographical location (lesser tariff for hilly areas) etc.
- Section 62(3) permits the State Commissions to differentiate between the tariff of various consumers. The expression “may differentiate” as found in Section 62(3) clearly indicates that there shall be a judicial discretion to be exercised with reasons. It is well settled that any discretion vested in the statutory authorities is a judicial discretion. It should be exercised supported by the reasons.
- In other words, the categorization of the consumers should be based upon the proper criteria legally valid. It cannot be arbitrary.

Purpose of supply explained

- It could be argued that while residential premises are charged at domestic tariff, the Hotels are being charged at Commercial tariff. Both, the residential premises and the hotels, are used for purpose of residence and, therefore, cannot be charged at different tariff because purpose for the supply is same. The argument would appear to be attractive at first rush of blood, but on examination it would be clear the purpose for supply in both the cases is different.

- The 'Motive' of the categories is different. Whereas Hotels are run on commercial principles with the motive to earn profit and people live in residences for protection from vagaries of nature and also for protection of life and property. **Thus 'purpose of supply' has been differentiated on the ground of motive of earning profit.**

- The fundamental ground for fixing different tariffs for 'domestic' category and 'commercial' category is motive of profit earning. In this context it is to be noted that even charitable 'Dharamshalas' are charged at Domestic tariff in some states. The objective of Dharmshalas and Hotels is same i.e. to provide temporary accommodation to tourists/ pilgrims but motive is different; so is the tariff. Thus the 'Motive of earning profit' is also one of the accepted and recognised criterions for differentiating the retail tariff.

Appellant's submissions

- The term 'purpose' includes many factors. However, the differentiation done by the Commission has to be tested on the anvil of 'undue preference' as per first part of Section 62(3).
- The Appellant has submitted that the Commission has given undue preference to the Government run institutes by keeping them in the mixed-load category and re-categorised the Appellant and shifted it to non-domestic category.
- According to the Appellant ownership cannot be the criteria to differentiate the tariff under section 62(3) of the Act. Both the government run institutes and institutes run by members of the Appellant society imparts education and therefore the purpose for supply is same. Article 14 of the Constitution prohibits Equals to be treated unequally.

Observations and reasons

- The contention of the Appellant that Government run educational institutes and institutes run by private parties are equal is misconceived and is liable to be rejected:
- Government run institutes are controlled by the education departments and run on budgetary support. On the other hand private institutions are run by the Companies incorporated under Companies Act 1956 and operate on the commercial principles. The survival of Government run institutes very often depends upon the budgetary provision and not upon private resources which are available to the institutes in the private sector.

DIFFERENTIATING GOVERNMENT INSTITUTIONS FROM PRIVATE INSTITUTIONS.

- Right to education is a fundamental right under Article 21 read with Articles 39, 41, 45 and 46 of the Constitution of India and the State is under obligation to provide education facilities at affordable cost to all citizens of the country. Private institutes are not under any such obligation and they are running the education institutes purely as commercial activity.
- Article 45 of the Constitution mandates the State to provide free compulsory education to all the children till they attain the age of 14 years. In furtherance to this Directive Principle enshrined in the Constitution, a Municipal School providing free education along with free mid-day meal to weaker sections of society cannot be put in the same bracket along with Public School with Air-conditioned class rooms and Air-conditioned bus for transportation for children of elite group of society. They are different classes in themselves and have to be treated differently. Where Article 14 of the Constitution prohibits equals to be treated unequally, it also prohibits un-equals to be treated equally.

Ratio

- The same is true for hospitals. Right to health is a fundamental right under Article 21 of the Constitution and Government has constitutional obligation to provide the health facilities to all citizens of India. Therefore, Hospital run by the State giving almost free treatment to all the sections of society cannot be treated at par with a private hospital which charges hefty fees even for seeing a general physician.
- Hon'ble Supreme Court in Hindustan Paper Corpn. Ltd. vs. Govt. of Kerala, (1986) 3 SCC 398 has also held that government undertakings and companies form a class by themselves.
- Ratio: Profit earning motive is the purpose for supply under Section 62(3)

Appeal No. 323 of 2013

- Appellant: Shasun Research Centre
- Respondent: Tamil Nadu Commission
- Date of Judgment: 28.8.2012
- Bench: Karpaga Vinayagam, Chairperson
  Rakesh Nath, Technical Member

- Issue: Whether motive of earning profit comes within the preview of 'Purpose for which supply is required' in Section 62(3) of the Act.

Observations and Ratio

- Section 62(3) of the Act provides that the Appropriate Commission may differentiate the consumers on the basis of several factors including the purpose for which the supply is required.

- The benefit accrued out of the Government run Research Units will be driven to public welfare and the profit earning is a secondary one, whereas in private owned Research Units, the profit earning is the prime object and public cause is relegated to next level.

- Therefore, the two can be classified as separate categories for the purpose of tariff. Such classification is based on an intelligible criteria and such classification has nexus to the purpose sought to be achieved.

- The Government run Units are not profit oriented and purely service oriented. Thus, there is a clear distinction between the Research Units recognized by the Government and the Research Units which are Government owned and Government affiliated.

CROSS SUBSIDY SURCHARGE

11/27/2015

Statutory Provisions

- Section 38, 39 and 40 of the Act permits open access to consumer in transmission on payment of a surcharge to be used to meet current level of cross subsidy.
- Section 42 of the Act empowers Commission to permit open access to consumers on payment of a surcharge to be used to meet current level of cross subsidy.
- Tariff Policy has suggested certain formula to determine the cross subsidy surcharge.

Appeal no. 169 of 2006

- Appellant: RVK Energy Limited
- Respondent: Andhra PradeshCommission
- Date of Judgment: 5.7.2007
- Bench: Anil Dev Singh, Chairperson
  A A Khan, Technical Member
  H L Bajaj, Technical Member

- Issue: Whether the State Commissions can deviate from the formula given in the Tariff Policy.

Observations and directions

- We direct the APERC to compute the cross subsidy surcharge, which consumers are required to pay for use of open access in accordance with the Surcharge Formula given in para 8.5 of the Tariff Policy, for the year 2006-07 and for subsequent years.
- In future all the Regulatory Commissions while fixing wheeling charges, cross subsidy surcharge and additional surcharge, if any, shall have regard to the spirit of the Act as manifested by its Preamble. The charges shall be reasonable as would result in promoting competition. They shall be worked out in the light of the above observations made by us. This direction shall also apply to the APERC for computing the cross subsidy surcharge for the year 2005-06 as well.
- This Judgment of the APTEL has been stayed by the Hon'ble Supreme Court.

Appeal no. 119 of 2009

- Appellant: Chhatisgarh State Power Distribution Co.
- Respondent: Chhatisgarh Commission
- Date of Judgment: 9.2.2010
- Bench: Karpaga Vinayagam, Chairperson
  H L Bajaj, Technical Member

- Issue: Nature of the Cross Subsidy Surcharge?

Ratio

- Under the Act and the Regulations framed under the said Act a consumer is entitled to receive the supply of electricity from the source other than the licensee thereby making **a proviso to compensate the licensee therefore, show that there are provisions for the payment of cross subsidy surcharge and by that process, it safeguards the interest of the distribution licensee in whose area the consumer is located.**

Appeal no. 200 of 2011

- Appellant: Maruti Suzuki India Limited
- Respondent: Haryana Commission
- Date of Judgment: 4.10.2012
- Bench: P S Datta, Judicial Member
  V J Talwar, Technical Member

- Issue: Whether the State Commissions can deviate from the formula given in the Tariff Policy.

Facts

- Haryana Commission framed Tariff Regulations 2008 having provision for computation of cross subsidy surcharge based on Average Cost of Supply instead of top 5% marginal cost as suggested by Tariff Policy.
- HERC computed CSS according to its own Regulations i.e. based on ACoS.
- Maruti Motors Challenged the order based on RVK judgment and Tariff Policy.

Observations and decision

- In RVK AP Commission had issued order. In this Case HERC has made Regulations, Regulations framed by the ERC cannot be challenged before APTEL.
- APTEL in two its judgments has held that **the term ‘shall be guided’ used in Section 61, 86 and 108 of the Act cannot be termed as mandatory and any direction hampering the statutory functions of the Commission cannot be considered as binding upon the Commission.**
- **Therefore, provisions of Tariff Policy suggesting computation of CSS is not binding.**

Appeal no. 103 of 2012

- Appellant: Maruti Suzuki India Limited
- Respondent: Haryana Commission
- Date of Judgment: 24.3.2015
- Bench: Ranjana P Desai, Chairperson
  Surendra Kumar, Judicial Member
  Rakesh Nath, Technical Member

- Issue: Whether the term "shall be guided" used in Sections 61, 79 & 86 means appropriate Commission has to mandatorily follow Tariff Policy & National Policy ignoring Regulations framed by it.

Appellant's Contentions

- Formula prescribed by the Tariff Policy for calculating CSS is binding of the Commission.
- Full Bench Judgment in RVK case is binding on the Commission.
- Commission cannot determine CSS without calculating voltage wise cost of supply.

Appellate Tribunal's Findings

- While referring to the Constitutional Bench in PTC judgment the Tribunal in para 42 of its judgment has observed that
- The Act has distanced the Government from all forms of regulations, namely, licensing, tariff regulation, specifying Grid Code, facilitating competition through open access.
- This distance cannot be bridged by this Tribunal by holding that the National Electricity Policy or the Tariff Policy is binding on the Regulatory Commission. They can be only guiding factors.
- If the Regulatory Commissions have to be independent and transparent bodies, they are expected to frame Regulations under Sections 178 & 181 independently. They can take guidance from National Electricity Policy or the Tariff Policy but are not bound by them.

APPELLATE TRIBUNAL'S FINDINGS

- 43. P.T.C. India Ltd. leads us to conclude that Regulations framed under Sections 178 and 181 of the said Act have a primacy. Being subordinate legislation they rank above orders issued by the Regulatory Commissions in discharge of their functions under Section 61 read with Sections 62, 79 and 86.
- **They will have to be followed unless struck down by a Court in judicial review proceedings.**
- Regulations made under Sections 178 and 181 have to be consistent with the said Act.
- **Tariff Policy and National Electricity Policy are mentioned in Sections 61, 79 & 86 merely as guiding factors. They do not control or limit the jurisdiction of the Appropriate Commission.**

Appellate Tribunal's Findings

- 45. It is clear from the above observations of the Supreme Court {in Transmission Corporation of AP} that the policy framed by the State cannot hamper the functions of the Regulatory Commission.
- It is implicit in the above observations that the National Electricity Policy or the Tariff Policy are to only serve as guiding factors.
- If there are Regulations in the field framed by the Appropriate Commission, the Appropriate Commission will have to follow them. Supremacy of Regulatory Commissions in this regard is acknowledged by the Supreme Court.

Appellate Tribunal's Findings

- 46. In our opinion, reliance placed by the Appellant on the Full Bench decision of this Tribunal in R.V.K. Energy is totally misplaced. In that case two orders of the State Commission were under challenge. …. In our opinion, this judgment is not applicable to the present case because in that case no Regulations were framed by the State Commission prescribing methodology to determine the cross-subsidy surcharge. After the judgment of the Constitution Bench in P.T.C. India Ltd. to which we have made reference in great detail, this issue should not detain us any longer.

Appeal no. 132 of 2011

- Appellant: Tata Power Company Limited
- Respondent: Maharashtra Commission
- Date of Judgment: 21.12.2012
- Bench: Karpaga Vinayagam
  V J Talwar, Technical Member

- Issue: Whether consumers opted supply from one licensee (TPC) using the system of other licensee (Rinfra) in the same area of supply (Mumbai) are liable to pay CSS.

Findings

- Acting upon the judgment of Hon'ble Supreme Court in Civil Appeal No. 2898 of 2006 dated 8.7.2008, the Appellant TPC had filed petition before the State Commission under MERC (Open Access in Distribution) Regulations and consequently, the State Commission permitted changing over of Consumer from RInfra to TPC to get supply by using the network of RInfra. Having availed of the same, the Appellant TPC cannot now be permitted to contend that the observations of the Hon'ble Supreme Court relating to surcharge were 'fleeting' observations and not the findings.

FINDINGS

- The only method to use the network of the Distribution Licensee namely RInfra, by the another Distribution Licensee namely TPC, is only through open access under Section 42 of the Act.
- Section 42(3) envisages the existence of parallel distribution licensee and it is equally applicable in this case where a consumer connected to the network of one distribution licensee i.e. RInfra, takes power from other distribution licensee i.e. TPC in the same area of supply.

Findings

- The State Commission is required to look after not only the interest of the consumers but also the interest of licensees. Therefore, the State Commission, while deciding that the change over consumers are liable to pay cross subsidy surcharge to RInfra for using their network has in fact taken into consideration the interest of the consumers as well as the interest of the licensees. Therefore, findings and directions given in the impugned order by the State Commission which would promote healthy competition are perfectly justified.
- Ratio: CSS is payable by the Consumer who are connected to the wires of one licensee and opts for taking supply from other licensee in the same area os supply.

Appeal no. 140 of 2011

- Appellant: Reliance Infra Limited
- Respondent: Maharashtra Commission
- Date of Judgment: 14.11.2013
- Bench: Karpaga Vinayagam
  V J Talwar, Technical Member

- Issue: Whether consumers getting supply from one licensee opted supply from other licensee (TPC) using other licensee's system in the same area of supply (Mumbai) are liable to pay CSS.

Findings

- No doubt, the Cross Subsidy Surcharge is a compensatory charge. When a subsidizing consumer takes supply from any other source by seeking Open Access, the amount of cross subsidy it was paying to the licensee would also be lost. This would put burden on remaining consumers particularly the subsidized consumers. In order to mitigate the loss of cross subsidy, the legislature has introduced the concept of Cross Subsidy Surcharge.
- The rational provided in the findings that but for the Open Access the consumers would have taken the quantum of power from the licensee and in the result, the consumer would have paid tariff applicable for such supply which would include an element of cross subsidy of certain other categories of consumers would not be applicable to situation having more than one licensee.

FINDINGS

- One of the objects of the 2003 Act is to promote competition. The above doctrine, if applied to areas having more than one distribution licensee, would defeat the purpose of the competition. Presently, most parts of the country are served by one distribution licensee only. Sixth proviso to Section 14 of the Act provide for multiple distribution licensee in the same area of supply through own distribution network. Therefore, second distribution licensee in any area will have to lay down its own network and all the consumers, who would opt to take supply from new licensee, will have to pay Cross Subsidy Surcharge of the existing licensee. This would make competition in distribution impossibility.

Appeal no. 178 of 2011

- Appellant: Reliance Infra Limited
- Respondent: Maharashtra Commission
- Date of Judgment: 2.12.2013
- Bench: Karpaga Vinayagam
  V J Talwar, Technical Member

- Issue: Whether the MERC has determined the CSS correctly by adopting the figures of tariff and cost of supply for different periods.

Findings

- The CSS can only be determined with the figures for the current year as per the law (2nd proviso to Section 42 of the 2003 Act). Anything done outside this requirement is patently illegal.
- Hon'ble Supreme Court in its judgment dated 30.9.2013 in Selvi J Jayalalitha Vs Government of Karnataka 2013(12) SCALE 234 has held that when a statue provides that a thing is to be done in a particular way, it has to be done in that way only and no other way.
- In view of the clear provision of 2nd proviso to Section 42, there cannot be any other view on this issue.

Findings

- The contention of the State Commission that Tariff Policy provide that the CSS should not be so enormous to suffocate the Competition is misplaced.
- The Act mandated the State Commission to determine the CSS to meet the requirement of current level of cross subsidy. We have to keep in mind that the CSS is paid by the subsidizing consumers only. This Tribunal in catena of cases has held that CSS is compensatory in nature. It is meant for to compensate the loss suffered by the remaining subsidized low-end consumers.
- Thus, in the scenario of mass change-over of consumers, the CSS has also to be such that exodus of subsidizing consumers does not load the remaining low-end consumers heavily.

Findings

- The State Commission had used actual revenue recovered from various category of consumers during FY 2010-11 and divided it with actual sale to those category during the same period. This approach is completely wrong and dehores any logic. While passing the tariff order for FY 2011- 12 the Commission must have the figures for expected revenue from every category and sale to such category. The Commission should have used these figures approved in the tariff order to arrive at Average Billing Rate or effective Tariff during the relevant year

11/27/2015

THANK YOU

Developments in the Coal Sector - Bidding and its Implications for the Power Sector

9th Capacity Building Programme for Officers of Electricity Regulatory Commissions

November 21, 2015

IIT Kanpur

Agenda

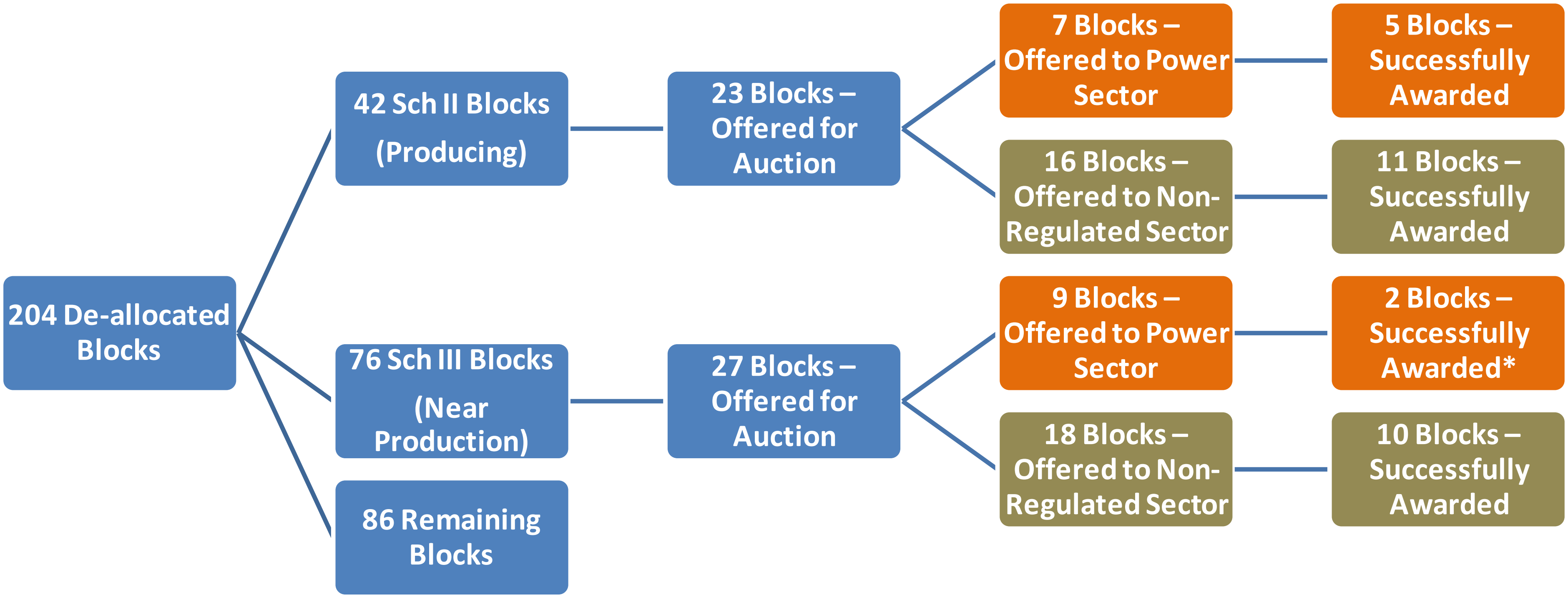
- ***Coal Mine Auction Process - Power Sector***
- ***Impact of Coal Mines Auction on Power Sector***
- ***Conclusion***

Coal Mine Auction Process - Power Sector

Auction of Coal Blocks - Background

May 2012	• Comptroller and Auditor General of India released a report on the coal block allocations
Sept 2014	• Supreme Court of India cancelled the allocation of 204 coal blocks
Oct 2014	• Government promulgated the Coal Mines (Special Provisions) Ordinance, 2014 for allocation of de-allocated coal blocks
Dec 2014	• Government issued the Coal Mines (Special Provisions) Rules, 2014 • Start of the auction process for Schedule II coal blocks – Round 1
Jan 2015	• Start of the auction process for Schedule III coal blocks – Round 2
Mar 2015	• Enactment of the Coal Mines (Special Provisions) Act, 2015
Jun 2015	• Start of the Round 3 of auction process

Classification of Coal Blocks



Matter sub-judice w.r.t. 2 blocks

Overview of the Auction Process

- Government of India (GoI) appointed the **Nominated Authority** to take all the necessary actions for allocation of cancelled coal mines
- Permissible Specified End Uses
  - Production of iron & steel, cement and generation of power for captive use i.e. Non-Regulated Sector
  - Generation of Power i.e. Regulated Sector

  Each mine is earmarked for a Specified End Use by the Central Government
- Methods of Bidding
  - Ascending Forward Auction (for non-regulated sectors) where revenue will be maximized for State Govt
  - Descending Reverse Auction (for regulated sector) where power tariff will be minimized as the rate quoted by Successful Bidder will determine its Variable Charge
- The 2-stage auction process comprises
  - Technical Bid (compliance with the Eligibility Conditions)
  - Financial Bid comprising
    - Initial Price Offer and
    - Final Price Offer
- Initial Price Offer to be submitted along with the Technical Bid

Auction Process for Power Sector - Eligible Bidders

- Eligible Companies
  - A Company engaged in the specified end use including
    - a company having a coal linkage or
    - having made an application for a coal linkage
  - A Joint Venture (JV) Company formed by two or more companies each having a common specified end use
- If a Bidder is a JV Company, then each JV Partner should
  - hold at least 20% of voting rights and economic interest in the JV Company
  - independently meet the qualifying requirements regarding specified end use and specified expenditure of the total project cost
  - Coal requirements of Specified End Use Plant (EUP) belonging to each of the JV Partners shall be considered collectively

Technical Bid | Eligibility Conditions

- Any eligible company can participate in auctions provided it meets all the Eligibility Conditions
  - In case the Bidder is a Prior Allottee,
    - it has paid the applicable Additional Levy within prescribed time period;
    - it has not been convicted for an offence relating to coal mine allocation and sentenced with imprisonment for more than three years
- Extractable reserves of a specific coal mine should not exceed 150% of 30-year coal requirement of a Specified EUP **less** the coal requirement of such EUP met from any other coal mine allocated to the Bidder thro' auction or allotment by the Nominated Authority

Technical Bid | Eligibility Conditions ...2

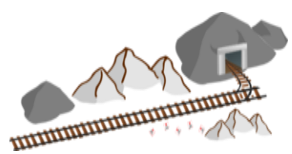
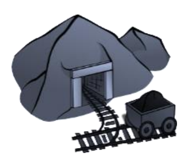
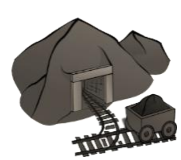
EUP Configuration	Annual Coal Requirement @85% Plant Load Factor or Capacity Utilisation	30-year Coal Requirement	Eligible to Bid for Coal Mine with Reserves @150% of 30-year requirement
 Single 660 MW Unit	2.7 MTPA	81 MT	Up to 121 MT
 3X330 MW	4 MTPA	120 MT	Up to 180 MT
 2X330 + 2X660 MW	8.1 MTPA	242 MT	Up to 363 MT

Bidders have flexibility in configuring the EUP(s)

Technical Bid | Eligibility Conditions ...3

EUP

Annual Coal Requirement	30-year Coal Requirement	Eligible to bid for Coal Mine with Reserves of
5 MTPA @85% Plant Load Factor	**150 MT**	**225 MT** @150% of 30-year requirement

Auction Sequence/ Round	Coal Mine & Capacity	Auction Status	Residual Unmet Requirement
1	 Mine 'X' 120 MT	Highest/Lowest ✓	105 MT
2	 Mine 'Y' 80 MT	Highest/Lowest ✓	25 MT
3	 Mine 'Z' 50 MT	Not Eligible ✗	25 MT

Technical Bid | Eligibility Conditions ...4

- Total Project Cost & Expenditure
  - Bidder should have incurred an expenditure of
    - at least 80% of the Total Project Cost of a unit or phase of the specified EUP(s) for Schedule II Coal Mines
    - at least 60% of the Total Project Cost of a unit or phase of the specified EUP(s) for Schedule III Coal Mines
  - If EUP is being commissioned in units or phases and one or more units or phases are eligible under above provision, then
    - at least 40% expenditure of the cost should already have been incurred on such other units or phases for Schedule II Coal Mines
    - at least 30% expenditure of the cost should already have been incurred on such other units or phases for Schedule III Coal Mines

Selection of Successful Bidder

- At the time of Technical Bid, Bidders registered with MSTC to submit
  - Prescribed Bid Security as per Tender Document of respective coal mine
  - Technical Bid (relevant eligibility certificates/documents)
  - Initial Price Offer (IPO)
- IPO is a price offer in Rs./tonne of coal below the Ceiling Price
- Technical Evaluation Committee will evaluate Technical Bids
- Technically Qualified Bidders (TQB) will be shortlisted
- IPOs of only TQBs will be opened and ranked on the basis of the ascending price offers
- Only top 50% ranked TQBs (by the IPOs) i.e. Qualified Bidders (QB) will be permitted to participate in e-auctions
- Applicable Ceiling Price for the e-auction will be the lowest IPO offered by a QB

Selection of Successful Bidder …2

- Assume 16 Bidders for a specific mine X
- Bidders registered with MSTC - A, B, C ………… O, P
- All Bidders submitted documents for Technical Bid and Initial Price Offer (IPO) on MSTC e-auction platform
- IPOs of all Bidders reside in fully encrypted form on MSTC platform

- Technical Evaluation Committee will evaluate the Technical Bids of 16 Bidders
- Assume 3 Bidders (C, H, I) did not qualify technically
- So, the Technically Qualified Bidders are 13
- IPOs of 13 Technically Qualified Bidders will be opened
- IPOs of 3 technically unqualified bidders (C, H, I) will still remain in fully encrypted form on MSTC platform

- IPOs of 13 Technically Qualified Bidders will be arranged in ascending order
- Assume IPOs of 8 Technically Qualified Bidders in top 50% by ranking (say 3 bids are tied at 4th rank)
- All these 8 Qualified Bidders will be allowed to participate in the e-auction

Selection of Successful Bidder ...3

Qualified Bidder

- For the e-auctions, the applicable Ceiling Price will be the prices discovered i.e. lowest IPO received from the Technically Qualified Bidders
- Say top 50% ranking bids are Rs. 182, Rs. 188, Rs. 197, Rs. 221, Rs. 250, Rs. 285 and Rs. 305 for mines reserved for regulated sector, the Ceiling Price for auctions will be Rs. 182

Preferred Bidder

- 8 Qualified Bidders will participate in the auction and submit Final Price Offers (FPOs) on MSTC e-auction platform
- Qualified Bidder who submits the lowest FPO will be declared as Preferred Bidder (say 'O')

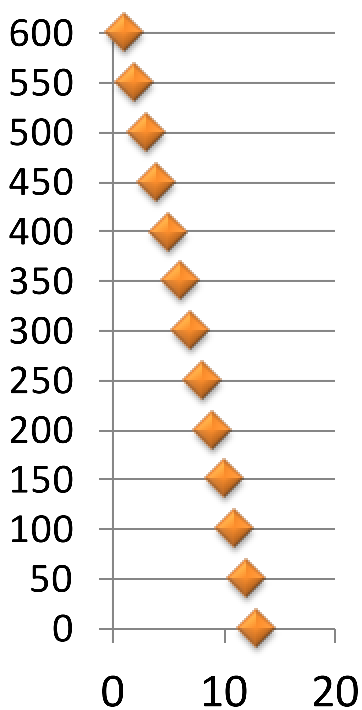
Successful Bidder

- The Nominated Authority will recommend the name of Preferred Bidder 'O' to Central Government
- When GoI directs the Nominated Authority to issue Vesting Order, the Preferred Bidder 'O' will become the Successful Bidder
- On making prescribed payments within stipulated time period, the Successful Bidder will receive the Vesting Order from the Nominated Authority

Selection of Successful Bidder ...4

- The QB who offers the lowest Final Offer Price (FPO), as applicable in e-auction will be declared as a Preferred Bidder
  - On receiving IPO as Zero (0) in technical bid stage or once FPO hits Zero (0) on e-auction platform, Ascending Forward Auction will commence
  - Additional Premium payable to respective states will be selection criteria and QB who quotes highest will be chosen as PB

Descending Reverse Auction for FPO (Rs./tonne)



Ceiling Price after Technical Bids

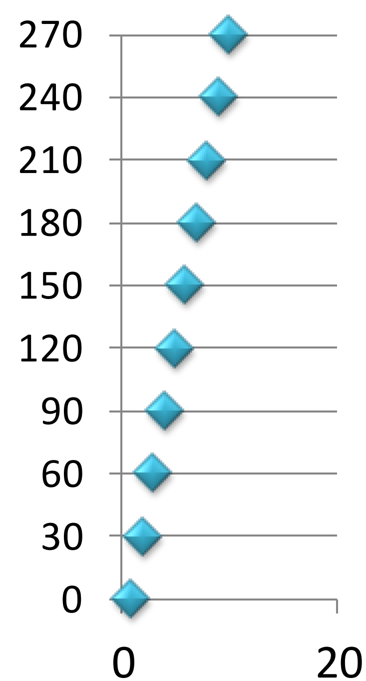
Say, the Initial Price Offers were:

Rs. 852
Rs. 776
Rs. 747
Rs. 695
Rs. 600

Ceiling Price in Tender Document
R. 870

IPO/FPO does not include Rs. 100/ tonne Payable

Ascending Forward Auction for Additional Premium (Rs./tonne)



If price discovered during Technical Bid stage (IPOs) or during e-auctions, FPO reaches INR 0 (Rs.Zero), then Forward Auction for Additional Premium will commence and Bidder willing to pay highest Additional Premium to respective state governments will be chosen.

Additional Premium shall not be reckoned for the purpose of Power Tariff.

Selection of Successful Bidder ...5

- The Nominated Authority will recommend the name of the Preferred Bidder (PB) to the Central Government
- When GoI directs the Nominated Authority to issue Vesting Order, the Preferred Bidder will become the Successful Bidder
- Successful Bidder shall execute a Coal Mine Development and Production Agreement (CMDPA) with the Nominated Authority
- Subsequently, Vesting Order will be issued to the Successful Bidder by the Nominated Authority

One Time Payments by Successful Bidder

- Fixed Amount will be payable prior to the Vesting Order
  - for the value of land and mine infrastructure
  - cost of preparation of Geological Report borne by the Prior Allottee
  - cost of obtaining all statutory licenses, permits, permissions, approvals, clearances or consents relevant to the mining operations, borne by the Prior Allottee
  - the Transaction Expense
- The Successful Bidder shall pay the Upfront Amount (amount mentioned in Tender Document) in 3 instalments as follows
  - 50% of the Upfront Amount prior to issuance of the Vesting Order
  - 25% of the Upfront Amount
    - Sch II Coal Mines – within 6 months from the date of issuance of Vesting Order
    - Sch III Coal Mines – on or prior to expiry of 15 Business Days from the date of execution of Mining Lease
  - Remaining 25% of the Upfront Amount
    - Sch II Coal Mines – within 12 months from the date of issuance of Vesting Order
    - Sch III Coal Mines – on or prior to expiry of 15 Business Days from the date of grant of mine opening permission

Periodic Payments

- The Successful Bidder shall
  - make monthly payments for the coal extracted at Rs. 100/tonne plus Additional Premium, if any
  - payment to be made within 20 calendar days of expiry of each month
- Statutory royalty payable on coal will continue to be governed as per extant rules
- If the Successful Bidder undertakes sale of power up to 15% of generation capacity of EUP on merchant basis, then Rs. 100/tonne shall stand revised to such new price (mentioned in Tender Document of each mine) for the quantum of coal utilised for generation of such power sold on merchant basis.

Periodic Payments ...2

EUP – 3X660 MW

Say, Coal Requirement of the EUP is 8.1 MT @85% Plant Load Factor

PPA	Coal Utilisation	Price/ Tonne	Energy Charges for Tariff	Applicable Annual Escalation
Medium Term/ Long Term	85-100% of mined coal (i.e. 6.9-8.1 MT)	Rs.100	(FPO+Rs.100)/tonne + Royalties + Taxes + other permissible components of energy charge	As notified by Ministry of Power under Standard Bidding Document for Case 1
Merchant Sale	0-15% of mined coal	Say Rs.270	As per market	Wholesale Price Index (all commodities)

- **EUP will be permitted to utilise only 15% of the linked generation capacity of EUP or 15% of approved mining plan whichever is lower**
- Accordingly, say the above EUP manages to win only a single coal mine with 80 MT reserves and Peak Rated Capacity of 3 MT/annum
  - EUP can utilise up to 0.45 MT of coal towards merchant power (i.e. 15% of 3 MT)
  - It can utilise coal of 2.55 MT towards long or medium term PPAs or sell surplus (/all) coal to CIL at CIL Notified Price or Final Price Offer whichever is lower
  - Power tariff of existing long or medium term PPAs may get revised downward (↓) by Appropriate Commission as "Change in Law".

Periodic Payments ...3

- Payments shall be subject to a yearly escalation
  - Final Price Offer, Additional Premium and Fixed Price of Rs. 100/tonne
    - Escalation formula prescribed in new Standard Bidding Document for Case 1 bidding by Ministry of Power for escalation of fuel cost from captive mines
  - For new price relating to power being sold on merchant basis, Wholesale Price Index (all commodities) will be applicable
- Excess coal extracted beyond entitlement of the Bidder shall be supplied to CIL at the aggregate of Final Price Offer based on which the Successful Bidder has been selected and the Fixed Rate, as escalated or the then prevailing CIL Notified Price, whichever is lower
- Energy charges for tariff shall be aggregate of
  - the Final Price Offer
  - Rs. 100/tonne
  - Statutory levies and other permissible components of energy charge

Bid Security

- The Bidder shall furnish a Bid Security to the Nominated Authority (in the form of a Bank Guarantee) as a part of its Bid, for an amount mentioned in that particular Tender Document
- Bid Security shall have a validity period of not less than 240 days from the Bid Due Date, inclusive of a claim period of 60 days, and may be extended as may be mutually agreed
- Bid Security of unsuccessful Bidders will be returned by the Nominated Authority, without any interest
  - on issuance of Vesting Order or
  - when the tender process is cancelled by the Nominated Authority
- Bid Security of Successful Bidder will be returned, without any interest, on signing of CMDPA and furnishing Performance Security
- The Nominated Authority shall be entitled to forfeit and appropriate the Bid Security as Damages as specified in the Tender Document

Performance Security

- Within specified time, the Successful Bidder shall provide an irrevocable and unconditional Performance Bank Guarantee for the performance of its obligations
- The amount of Performance Security shall be aggregate of
  - 1 year royalty based on Peak Rated Capacity (as per Mining Plan) payable to respective State Government for a particular coal mine
  - Annual peak rated capacity of the Coal Mine (as per the approved Mine Plan) multiplied by the Final Price Offer based on which the Successful Bidder has been selected
    - In case of any upward revision in Mine Plan, the amount of Performance Security shall be revised accordingly
- Performance Security shall remain valid for such duration as specified in the CMDPA
- The Performance Security may be appropriated by the Nominated Authority in the manner specified in CMDPA

Change in Control and Composition of Bidder

- A change in the composition of the Bidder, where Bidder is a JV Company is not permitted without the approval of GoI.
  - If one of the JV Partner becomes ineligible or ceases to be a JV Partner,
    - the JV Company may supply coal to the remaining JV Partners subject to the condition that each such remaining JV Partners shall not be entitled to receive coal in excess of the eligibility conditions
    - coal extracted in excess of the limit specified above shall be supplied to CIL at the CIL Notified Price
- Change in Control prior to determination of Successful Bidder
  - No change in control shall be permitted without prior approval of Nominated Authority
  - Approval for change in Control shall be granted only in case such change in control does not make the Bidder ineligible in accordance with the Bid Criteria

Change in Control and Composition of Bidder

- Change in Control of Successful Bidder or transfer of the EUP along with the rights in relation to the Coal Mine shall be permissible with prior intimation to the Nominated Authority and the Central Government if
  - such change in Control does not result in the Successful Bidder becoming non compliant with any of the Eligibility Conditions or the transferee is also compliant with the Eligibility Conditions, as applicable
  - such change in Control or transfer does not require any prior consent, approval, no-objection certificate or the like under any Applicable Law
  - If such change in control and transfer requires prior consent, approval etc., then such approval shall be granted if
    - the transferee or the Successful Bidder subsequent to change of Control, as the case may be, also meets all the Eligibility Conditions, as applicable, or
    - the Successful Bidder continues to meet all the Eligibility Conditions, as applicable.

Utilisation of Coal

- Successful Bidder shall not be permitted to use the coal extracted from a coal mine for any purposes other than utilisation in EUP.
- Any middlings or washery rejects generated from a coal mine may be sold by the Successful Bidder only with the prior approval of the Coal Controller's Organisation.
- Utilisation of coal for any other EUP of the Successful Bidder shall also be permitted in accordance with Rule 20 of the notified Rules.

Rule 20: Utilisation of coal for any other plant of the successful allocatee

- *(1) A successful bidder or allottee proposing to utilise the coal mined from a particular Schedule I coal mine for any of the other plants of such successful bidder or allottee or its subsidiary company for common specified end use in accordance with the provisions of subsection (2) of section 20 of the Act, shall provide prior intimation to the Central Government in writing.*
- *(2) The intimation referred in sub-rule (1) shall be provided at least thirty business days prior to the intended date of such utilisation.*
- *(3) The Central Government may seek further information regarding such utilisation as it may deem fit and may impose such terms and conditions as may be found necessary.*

Utilisation of Coal ...2

- Successful Bidder shall also be permitted to enter into arrangements for optimal utilisation of the Coal Mine in accordance with Rule 19 of the notified Rules.

  Rule 19: Arrangements for optimal utilisation of coal mines

  - *(1) A successful bidder or allottee or a coal linkage holder proposing to enter into any agreements or arrangements referred to in sub-section (1) section 20 of the Act shall make an application to the Central Government in writing.*
  - *(2) The application referred to in sub-rule (1) shall include the complete particulars of the following, namely:- (a) parties to the proposed agreements or arrangements; (b) the proposed agreements or arrangements; and (c) the manner in which such agreements or arrangements would achieve optimal utilisation of coal mines and cost efficiencies.*
  - *(3) The Central Government may seek such further information regarding the proposed agreement or arrangements as it may deem fit.*
  - *(4) The Central Government may after such investigation as may, in its opinion be necessary, by an order in writing, grant its approval or reject the proposed agreement or arrangements, in whole or in part.*
  - *(5) Upon execution of such agreements or arrangements, a certified copy of the same shall be deposited with the Central Government within fifteen business days of such execution.*

Challenges Experienced during the Process

- Transaction was first of its kind with no precedents to refer to
- Stringent timelines were stipulated for the process pursuant to the order issued by Supreme Court
- Ensuring coherence between the tasks done by different agencies
- Ensuring maximum information dissemination (within a limited time) to the Bidders so that value can be enhanced
- Conduct a fair and transparent process in the stipulated timeframe
- Keeping pace with a dynamic process wherein decisions were taken based on external factors
- High stakes and immense scrutiny from media and other stakeholders

Impact of Coal Mines Auction on Power Sector

Sources of Fuel Supply

- Pursuant to cancellation of Coal Mines, only 4 options (or a combination of these) of sourcing fuel are available
  - Linkage coal from CIL
  - Imported coal
  - E-auction coal
  - Coal from captive coal mines allocated through auction
- However, CIL is offering very few coal linkages and in future these linkages are proposed to be auctioned
- Quantity currently available in e-auctions is very small
- Import are costly and are subject to uncertainties related to sourcing and logistics chain
- ***Coal from captive coal mine shall ensure long term fuel security***

Coal Mine Auction – Power Sector

Coal Mine	Sch	GCV Range	Annual Prod (MT)	Successful Bidder	Closing Bid (Rs./ T)*
Amelia North	II	4900-5200	2.80	Jaiprakash Power Ventures Ltd	712
Sarisatolli	II	4000-4300	3.50	CESC Ltd	470
Talabira-I	II	3400-3700	3.00	GMR Chhattisgarh Energy Ltd	478
Tokisud North	II	4600-4900	2.32	Essar Power M.P. Ltd	1110
Trans Damodar	II	5500-5800	1.00	Durgapur Projects Ltd	940
Jitpur	III	3700-4000	2.50	Adani Power Ltd	302
Ganeshpur	III	4000-4300	4.00	GMR Chhattisgarh Energy Ltd	704
Mandakini**	III	4300-4600	7.50	Mandakini Exploration & Mining Ltd	650
Utkal-C**	III	3700-4000	3.37	Monnet Power Company Ltd	770

**Fixed Rate of Rs.100/tonne and Additional Premium; **Matter sub-judice*

- Aggressive bidding was witnessed in the auction of coal mines for power sector
  - Applicable Ceiling Price was **zero** for many mines
  - Negative bidding with Additional Premium ranging from Rs. **202**/tonne to Rs. **1010**/tonne for all mines

Possible Factors Leading to Aggressive Bidding

- Fuel Security
- Value of capital invested in the end-use plant and the potential loss due to lack of fuel
- Considerations on alternate fuel cost say imported coal, e-auction, coal linkage along with reliable fuel supply
- Reduced development risk since mines are either operating or near production
- Probable bid strategy: Bridging under recovery in fuel cost through
  - sale of 15% of the linked generation capacity on merchant basis
  - *quoting higher fixed capacity charge in the future Case-I bid PPAs*

Power Sector - Possibilities

- Power sector has two distinct type of Bidders
  - Bidders without existing PPAs
  - Bidders with existing PPAs

Coal Mine	EUP Capacity (MW) (A)	Linked Capacity (MW) (B)	Quantum of LT/MT PPAs required for capacity linked to coal block (MW) (C=85% of B)	Capacity with LT/ MT PPAs in the EUP (MW) (D)	% Capacity with LT/ MT PPA (D/A)
Amelia North	1320	568	483	495	38%
Sarisatolli	1225	710	604	1225	100%*
Talabira-I	1370	609	518	480	35%
Tokisud North	1200	471	400	420	35%
Trans Damodar	641	203	173	641	100%*
Jitpur	4620	507	431	3424	74%
Ganeshpur	1370	812	690	480	35%
Mandakini	2250	1522	1294	860	38%
Utkal-C	1050	684	581	704	67%

** Distribution Licensees*

Source: ICRA Research

Power Sector – Possibilities ..2

- Cost dynamics is different for both categories
- Successful Bidders having existing PPAs
  - The PPAs will be revised by the respective Regulatory Commissions (ERC) and pass –through of Variable Cost, wherever applicable will be for Final Price Offer quoted
  - Only downward revision in power tariff is permissible
- Successful Bidders without existing PPAs
  - They can participate in future tariff based competitive biddings
  - **However, ERCs may cap the Fixed Charge in future biddings**

Successful Bidders – Without Existing PPAs

- Can participate in future tariff based competitive biddings
  - ***However, limited Case-I bids in the last couple of years is a key concern***
- In order to ensure that the benefits of coal mines auction are passed on to the consumers, Ministry of Power vide its notification dated April 16, 2015 amended the guidelines for future procurement of power under DBFOO (Case-I) Bidding
- Bidders will be asked to quote energy charge and fixed charge separately as on Bid Due Date
- For subsequent years appropriate escalations shall be permitted as per the provisions of PPA or Tender Document
  - Fixed Rate (Rs. 100/tonne), Final Price Offer & Additional Premium to be escalated annually on the basis of pre-specified escalation formula that is prescribed in the new Standard Bidding Document for DBFOO as formulated by Ministry of Power for escalation of fuel cost from captive mines i.e. 30 per cent of the variation in WPI

Successful Bidders – Without Existing PPAs ..2

- As part of **energy charge** under medium/ long term PPAs, Successful Bidders will be able to recover only

Coal Cost

- Fixed Rate of Rs. 100/tonne
- Actual ROM quote by Successful Bidder (Rs./ tonne)

Transportation, Washing, Crushing Charge

- Procurer to specify benchmark rates in advance
- Benchmark rates shall not be higher than rates of CIL, Railway freight rates, any other benchmark specified by ERCs
- Lower of the benchmark rate or quoted rate to be considered

Royalty, Taxes and Duty

- As per prevalent laws

Negative Bidding means that the Successful Bidder would not be able to recover Additional Premium and Mining Cost as energy charge

Successful Bidders – Without Existing PPAs ..3

- Proposed **<u>capping of Fixed Charge</u> (FC)**
  - Power procurer shall determine, in consultation, with the Appropriate Commission, an upper ceiling in terms of per unit Fixed Charge.

- **Capping of Fixed Charge may inhibit the ability of the Successful Bidder (who is yet to tie-up capacity) to quote a higher FC so as to recover the under-recovery in energy charge**
- Bidders may be reluctant to proceed with the operations of coal mine on account of the uncertainty of coal cost recovery
- *For example,* ***Monnet Power Company Ltd*** *proposed to surrender the* ***Utkal-C*** *coal mine on account of the capping of FC. Matter is sub-judice.*
- *Further,* ***Mandakini Exploration and Mining Ltd****, who was declared as the Successful Bidder of* ***Mandakini*** *coal mine, approached court regarding this issue. Matter is sub-judice.*

- **If FC is capped then it may benefit Bidders having fully depreciated plants (FC in the range of about Rs 0.50 – 0.70 per unit)**
- Even if FC is capped in future bids, it can stay competitive if FC is to be capped at a higher value
- Bidders can benefit from allowed merchant sale (up to 15% of linked generation capacity)
- However, without PPA Bidders are mandatorily required to sell balance 85% coal to CIL

Successful Bidders – With Existing PPAs

- In order to ensure that the benefits of coal mines auction are passed on to the consumers, the following Clauses were stipulated in the Methodology published by Ministry of Coal (dated December 26, 2014)
  - For generation capacity having cost plus PPAs

"For the purpose of determining the fuel cost, the Appropriate Commission will allow bid price of coal along with subsequent escalation as provided in the coal block bid document as being equivalent to ROM cost of coal together with other allowable expenses and levies, provided that it shall not lead to higher energy charge throughout the tenure of the PPA than that which would have been obtained as per the terms and conditions of the existing PPA."

Successful Bidders – With Existing PPAs ..2

– For generation capacity contracted through Case-I bidding

"The Appropriate Commission shall review the quoted energy charge keeping in view the fact that the actual bid price of coal along with subsequent escalation as provided in the coal block bid document as being equivalent to ROM cost of coal along with statutory levies and other permissible components of energy charge, provided that such revision shall not lead to higher energy charge throughout the tenure of the PPA than that which would have been obtained as per the terms and conditions of the existing PPA. For this purpose the allocation of coal block under the new provisions shall be treated as "Change in Law" to enable the appropriate commission to revise the tariff downwards in accordance with the provisions of the PPA."

Successful Bidders – With Existing PPAs ..3

- Accordingly, it was stipulated in Clause 3.10.2 of the Tender Document,

"However the aggregate of (i) the Final Price Offer pursuant to which the Successful Bidder has received the Vesting Order; and (ii) the aforementioned Fixed Rate, will be the input for computation of energy charge for the purposes of determination of tariff for electricity.

It is clarified that in the event that an ascending forward auction is conducted in accordance with Clause 3.3.2 (c)(iv), only the aforementioned Fixed Rate of INR 100/Tonne, will be the input for computation of energy charge for the purposes of determination of tariff for electricity and the Additional Premium shall not be reckoned for the purposes of determination of tariff for electricity."

Successful Bidders – With Existing PPAs ..4

- MoP has issued a direction to CERC (dated April 16, 2015) for downward revision of tariff under already concluded PPAs where coal is being sourced from auctioned coal mines
  - CERC to review energy charge components: ROM cost, transportation cost, washery charge, crushing charge, royalty/ duties, levies etc; other charges
  - Basis of determination of these components shall be same as described for future Case-I bidding power procurement
  - Tariff revision shall not lead to higher energy charges and total tariff throughout the tenor of PPA than that which would have been obtained as per existing terms and conditions of the PPA

Successful Bidders – With Existing PPAs ..5

- Scenarios under existing Case-I bidding PPAs: Bidders have quoted
  - Fixed Charge and Variable Charge for first year; escalable annually
  - Fixed Charge and Variable Charge for each year
  - Non-escalable fixed and variable charge for each year and escalable fixed and variable charge
- However, the bidders did not quote individual components of the energy charge i.e. ROM cost, transportation, crushing, washing charges etc. were not quoted separately
- ***Hence, methodology of revision of energy charge under existing PPAs remains unclear***

Successful Bidders – With Existing PPAs ..6

- Scenario 1: PPA revised with Final Price Offer
  - Unit Size of 1000 MW assumed
  - Coal of GCV 4500 kcal/kg assumed
  - Additional premium assumed to be Rs 500/T
  - Coal cost for variable cost Rs 0 /T
  - Extraction cost of Rs 500/T & other cost of Rs 500/T
  - Out of above costs Rs 500/T will passed through in the tariff
  - Bidder will incur Additional Premium of Rs 500/T and extraction cost of Rs 500/T which shall not be passed through
  - This will effectively result in forgoing Rs 0.60 per unit in power tariff
  - Reduction in Variable Charge can be partly compensated by foregoing ROE

How to treat "Capital Costs"

- Upfront Payment includes payments for land and mine infrastructure.
- It also includes costs of obtaining clearances and GR
- Further expenditure on land and equipment may be necessary, especially in case of Schedule III mines
- For new PPAs, Bidder may be able to include these as capital costs
- For existing PPAs, the situation is not clear
- Also, it is not clear whether the ERCs will take this cost into account while "capping" the capital costs
- Clarity is also required as to how JVs will be treated

Potential Positives

- A number of Bidders had fully depreciated plants with very low fixed cost (in the range of about Rs 0.50 per unit to 1.00 per unit)
  - Such Bidders are better placed to absorb additional coal cost
- A number of Bidders are also into distribution of power dependent solely on existing plants for supplying electricity in their area.
  - In absence of alternate long term sources of coal, such bidders are dependent on own coal mines for supply of coal.
- Bidders without existing PPAs and dependent on imported coal have alternate source of coal at competitive rate
  - These bidders can also benefit from merchant sale of electricity.
- Some Bidders have got the mine so as to bundle it with their existing power plants
  - Allowed coal entitlement is 150% of coal requirement of the plants. It will enable Bidders to set up expansion plants in future.

Impact of Coal Mines Auction on Power Sector

Conclusion

- Reverse bidding methodology was followed with the objective of minimizing tariff
- Negative bidding for all the coal blocks; may be attributed to importance of fuel supply security to the bidders
- Significant under-recovery on account of non-recovery of Additional Premium and Mining Cost as energy charge;
  - Merchant realizations may help bridge some of the under-recovery
  - Efficient mining and cost control are key to viable commercial operations
- Further clarity on methodology for revision of tariff under existing PPAs is awaited
- Clarity on treatment of expenditure incurred in the nature of capital costs is also awaited
- State distribution utilities to benefit from Negative Price Bids in the coal mine auction
  - Power variable cost is estimated to reduce by around Rs. 97000 crore (over 30 year period)

Conclusion 2

- In a developing economy like India, under the present environment, any natural resource allocation to private parties will invite close scrutiny
- Whether we like it or not, auction process is here to stay
- Problem is not with the process but irrational strategy of the bidders
- It is expected that as the market matures, so will be the participants
- In the interim, steep penalties as deterrent is the only solution

Thank You

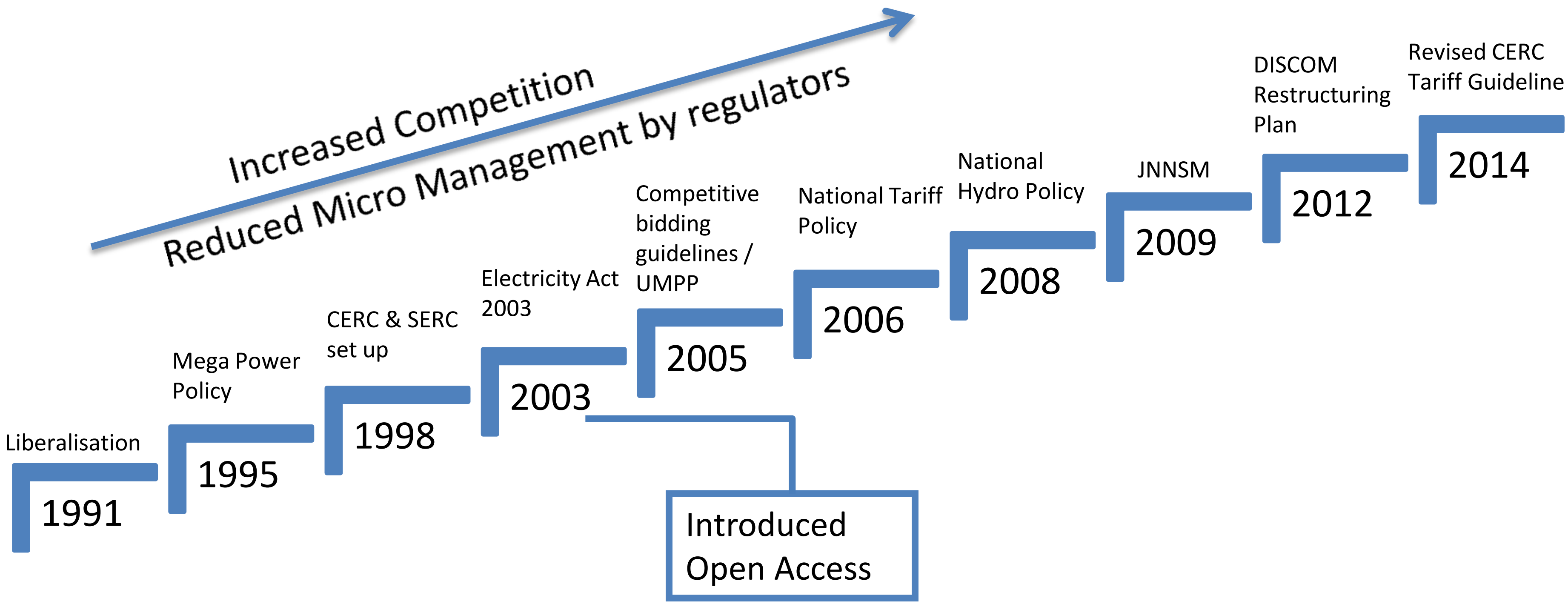
Competitive Bidding in Power Sector: Experience and Development

Rajat Misra, SVP (Infra)

SBI Capital Markets Limited

India’s Premier Investment Bank

Evolution in Indian Power Sector



Pre Liberalization (Pre-1991)

- Monopolized by Centre and State Utilities
- Minimal Participation by Private Sector

Post Liberalization (Post-1991)

- Private Participation in Generation, Transmission and Distribution
- 100% FDI allowed
- National Tariff Policy announced

Background

- Sec - 63 of the Electricity Act states that –

  "Notwithstanding anything contained in section 62, the Appropriate Commission shall adopt the tariff if such tariff has been determined through transparent process of bidding in accordance with the guidelines issued by the Central Government"

- The Competitive Bidding Guidelines (CBG) have been framed under the above provisions of Section 63 of EA 2003

- On January 19, 2005, Ministry of Power (MoP) issued CBG for medium term (1-7 years) and long term (>7 years) procurement of power

- Post January 2011, it is mandatory for generating companies including Central PSUs & State PSUs to follow competitive bidding route for sale of power

Objectives

- Encourage competition amongst developers and procure reliable power at minimum price
- Facilitate transparency and fairness in procurement processes -
  - Transparency ensured by Guidelines & Standard Bid Documents for tariff based bidding
- Enhance standardization and reduce ambiguity and time for materialization of projects -
  - Standardization of Bid documents, Bid submission and evaluation process
  - Provide flexibility to suppliers on internal operations while ensuring certainty on availability of power and tariffs for buyers line for bidding process, tariff structure etc.
  - Tariff to be quoted upfront for life of plant and regulator to adopt tariff arrived through transparent bidding process as specified by Guidelines
  - Developer has flexibility to choose optimum unit configuration
  - Incentive to developer to adopt innovative financial modeling and tax planning methods to ensure competitive tariff & return on investment

National Tariff Policy 2006

- Objective - Addition of 100,000 MW during 10th and 11th Plan Periods to provide per capita availability of over 1000 KWh per annum
- Balance needs to be maintained between the interests of consumers and investors in the determination of the rate of return
- The Central Commission determines the rate of return on equity parameters for generation & transmission projects keeping in view the assessment of overall risk and the prevalent cost of capital which shall be followed by the SERCs also
- Suitable performance norms of operations together with incentives & dis-incentives with appropriate arrangement for sharing gains with consumers
- MYT framework is to be adopted for any tariffs to be determined from April 1, 2006
- Uncontrollable costs should be recovered speedily to ensure that future consumers are not burdened with past costs
- Power procurement should be through a transparent competitive bidding mechanism

It became essential to provide thrust to private participation (along with Lenders for providing required funding) for a healthy growth of the sector.
As per CRISIL, the share of the private sector in installed capacity has increased to 30% in 2014-15 from 11% in 2009-10.

Generation

Competitive Bidding - Scope

Period of Procurement

- Long Term → For 7 or more years
- Medium Term → From 1 upto 7 years

Procurement Applicable For

Base Load

Seasonal Power

Peak Load

Competitive Bidding - Scope

Bidding Mechanisms

- Procurement by more than one distribution licensee through a combined bid process permitted through authorized representative
- In case distribution licensees are located in more than one State, CERC shall be the Appropriate Commission

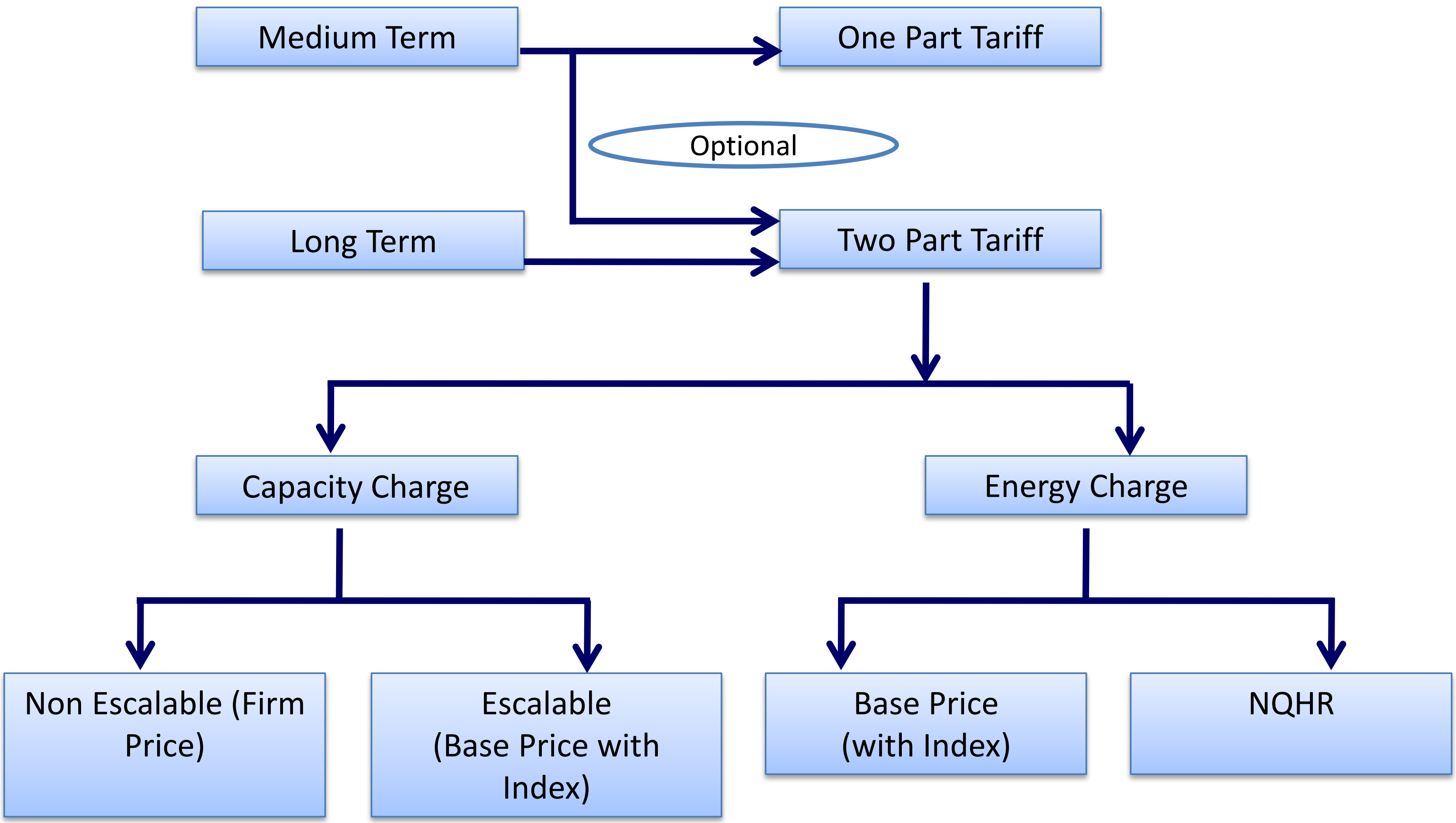
Case 1

- Location/ technology/ fuel – not specified
- Bidder responsible for clearances/ approvals etc.
- More relevant for States with limited fuel sources
- Higher risk for developer
- Lower risk for state

Case 2

- Land/ Fuel provided by Procurer
- More applicable for States where fuel sources are available or having coastal areas
- Higher risk for State
- Lower risk for developer

Tariff Structure

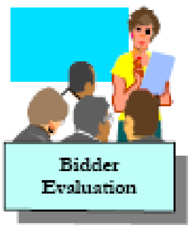


Bidding Process

- Two stage process for Long term procurement:
  - Request for Qualification (RFQ)
  - Request for Proposal (RFP)
- For Medium term the procurer has an option to adopt a single stage tender process combining the RFP & RFQ process
- The bidding shall be necessarily by way of International Competitive Bidding (ICB)

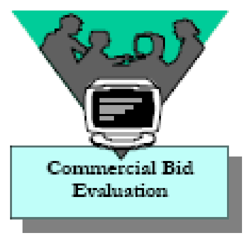
Bidding Process

Preparation of bid documents and technical analysis done by procurer



RFQ invited and qualified bidders selected

Creates a common platform and removes conditionality. Doubt clearance and feedback



Technical and financial bids evaluated

LOI issued
PPA signed

UMPP – Mundra (Case 2)

- Mundra Ultra Mega Power Project is a 4,150 MW coal based thermal power plant developed by Coastal Gujarat Power Limited (CGPL)
- The project was awarded by Ministry of Power following a two stage ICB process
- The Project attracted considerable interest from various established developers in the infrastructure sector, of national and international repute –
  - 36 EoIs were received
  - Based on the RfQ, 12 bidders met the qualification criteria
  - Final Bids were submitted by six bidders
  - Tata Power was declared as the short listed bidder amongst six bids
- For UMPP Bids for Mundra, Tata Power and Reliance had different bid strategies
  - TPL bid numbers were broken into escalable and non-escalable components - Reflects clear direction of owning mine and ships (or equivalent long term contracts) while retaining limited risk
  - Reliance had bid all numbers as escalable - Reflects strategy of procurement on spot basis for coal and transport; No upsides possible unless captive mines/long term contract on different terms

UMPP – Mundra (Case 2)

Comparison of Original Bid parameters & Current Parameters for Mundra UMPP

CERC- Parameter	Value for Original Bid	Revised Values
Annual Escalation for Capacity Charge	5.37%	5.21%
Annual Escalation for Variable Charge	3.46%	14.02%
Annual Escalation for Fuel Transportation	9.08%	15.99%
Annual Escalation for Fuel Handling	5.37%	5.21%
Discount Rate	10.60%	10.74%
Variability of Exchange Rate	1.07%	0.64%
Levelized Tariff	**2.26449**	**4.75490**

If we consider the price of imported coal at $101 /tonne (for international coal of similar GCV):

- Escalable and non-escalable in the same ratio as the original bid: Rs 3.74/kWh
- All escalable component: Rs. 4.36/kWh

UMPP – Mundra (Case 2)

- Tata Power had quoted a levelised tariff of Rs2.26/kWh for the supply of 3800MW to various state DISCOMs
- The project was envisaged to be operated on imported coal for which the company also purchased a 30% stake in an Indonesian mining company
- However, due to unanticipated change in the Indonesian law in September, 2011, the increase in the cost of coal was far greater than assumed at the time of bidding which threatened the project viability
- Company had requested relief by way of tariff revision is premised on 3 independent foundations -
    - Change in law (Art 13 of PPA)
    - Force majeure (Art 12 of PPA)
    - Power of commission to regulate tariff under sec 79(1)(b) of the Electricity Act

UMPP – Mundra (Case 2)

- Consequently, CERC has devised a formula for calculating the gross compensatory tariff, which will be linked to the Indonesian coal reference index for the relevant calorific value

  {(GCV adjusted Indonesian coal reference index) x (Normative quantity of coal imported)/Unit supplied under the PPA during the time period} – (quoted non-escalable fuel cost + (escalable fuel cost × CERC escalation index))

- The fuel under-recovery has been quantified by the CERC at Rs 3.3 bn or 29 paise/kWh for FY13
- For FY14, tariff arrears to be recovered from DISCOMs, have to be calculated within 2 months from the end of financial year
- From FY15 onwards provisional gross compensatory tariff will be calculated using the Indonesian coal reference index at the beginning of each financial year
- The company shall then submit quarterly statements of actual costs within 30 days and reconcile the costs at the end of each quarter

Developer had to assume responsibility for long-term fuel cost, foreign exchange rate, macro economic conditions and change in law (for country where imported coal mine located) – Viability of Project affected in long term

DB Power Limited (Case 1)

- DBPL has set up a coal based subcritical Thermal Power Plant (TPP) of capacity 1200 MW (in two phases of 600 MW) at Chhattisgarh.
- The Company has tied up 78% of the capacity of the project through long term PPAs with CSP Trade Co. for 30 MW (Gross), TANGEDCO for 220 MW (Gross) and Rajasthan State Discoms (through PTC India Ltd.) for 434 MW (Gross).
- Rajasthan Rajya Vidyut Prasaran Nigam Limited (RVPN) issued Request for Proposal (RFP) on May 28, 2012 for long term procurement of 1000 MW power (± 10%) under Case–1 bidding procedure through tariff based competitive bidding process
- The Rajasthan government terminated power purchase obligations for all but two of the nine PPAs signed by it in 2013 (allotted under Case 1 bidding mechanism). Rajasthan Electricity Regulatory Commission has ordered to reduce the PPA quantum from DBPL to 250 MW (from 410 MW signed in PPA) .

Developer are tackling with lack of assured buyers for electricity under power purchase agreements (PPAs). Adding to this, even the limited number of PPAs signed in recent years could also be cancelled.

Recent Case 1 & 2 bids

Bidding :
Developers’ Perspective

Bidding Considerations

All technical and commercial assumptions to be questioned

- Determine the Hurdle Rate for IRR
  - Criteria shifts to IRR from RoE
  - Hurdle Rate usually determined by Cost of Equity and risk profile
  - Typical IRR for cost-plus is 11-12%
- Extremely important to have pre-bid tie-ups in place
  - Commitment on major costs and escalation
  - Time period for which commitments would hold
- EPC:
  - Costs
  - Performance guarantee on heat rate, auxiliary consumption, degradation etc.
  - Construction schedule
  - Currency, payment terms
  - Availability of ECA financing

Bidding Considerations

- O&M:
  - Recurring Capex requirement
  - O&M arrangement – Price, escalation, warranties and experience
- Domestic coal as fuel:
  - Mine development expense
  - Calorific value estimates
  - Cost of ash disposal and transportation
  - Operations cost
  - Mix of Indexed and non-indexed costs
- Imported Coal as Fuel:
  - Mine development expense
  - Calorific value estimates
  - Cost of transportation
  - Operations cost
  - Mix of Indexed and non-indexed costs

Bidding Considerations

- Financial Assumptions
  - Financing Mix and sources to be decided - Large projects like UMPP have to source mix of RTL and external financing
  - Limited availability of ECB for sector and such tenures
  - ECA are a viable option but are time consuming
  - Equator Principles to be followed for ECB/ECA funding

Developers’ & Lenders’ Concerns

Concerns

- **Enforceability**- Competitive Bidding being an optional route for procurement of power by a distribution company. The same can be seen from the case of Maithon Power -
  - Maithon Power (generator) & NDPL (distribution licensee) signed a negotiated PPA
  - BSES Rajdhani & BSES Yamuna filed an objection petition contending the approval of the said PPA
  - DERC however granted approval to the PPA as the Electricity Act provides alternative routes (Sec 62 & 63) to distribution licensee for procuring power
  - DERC's order was challenged in the ATE by the appellants and there too the PPA was upheld
  - The order of ATE was challenged in the Supreme Court
- **Power Cutting** - The DISCOMs are not penalised for not supplying power to the consumers. The DISCOMs are not inviting bids for power procurement and are cutting power for consumers.

Capacity utilization in the power sector is in an uninviting situation. Therefore, a lot of capacity is stranded and stressed

Concerns

➢ **Fuel Security –** Fuel security is to be ensured in terms of supply, quality and price.

- PLFs have declined due to low fuel availability as growth in fuel supply have lagged capacity additions

As per Energy Statistics 2015, Compound Annual Growth Rate of Installed Thermal Generating Capacity of Electricity in Utilities and Non-Utilities in India was 9.46% from 2005-06 to 2013-14. Whereas, the coal production in India was about 407.04 MTs during 2005-06, which increased to 565.77 MTs during 2013-14 with a CAGR of 3.73%.

- Further, CIL to enter into FSA for fuel supply for projects with PPAs only. The terms and conditions of PPA and FSA should be synchronised so as to support development of projects

- The cost of fuel should be passed through based on actual cost and “as

The Cabinet Committee on Economic Affairs (CCEA) on April 22, 2013, had approved cost-plus mechanism for FSA signed between Coal India Limited and power projects commissioned post 2009. Thus, CIL will supply 65% of annual contracted quantity through domestic sources while the balance 15% will be imported and sold on a cost-plus basis. Subsequently on June 21, 2013, the CCEA approved that the higher cost of imported coal would be allowed as a pass through to the end consumers.

Concerns

- **Evacuation Arrangement –** Evacuation arrangement has been a roadblock in supply from installed capacity.
- **Open Access** – A level-playing field for competition is not provided due to non implementation of full scale open access
- **Macro Economic factors** - Unforeseen and material adverse changes in macro economic factors such as inflation, currency depreciation, interest rate etc. adversely affect the project economics. These risks should be adequately addressed during the bidding stage.
- **Change in Law** – Change in Law for India and country from where fuel is being supplied is to be covered. Otherwise quoted tariffs would become non cost-reflective
- **Separation of Carriage and Content –** Clarity on the role of existing and future PPAs after implementation of carriage and content
- **Health of Discoms and Payment Security –** The developers and lenders have concerns about the health of DISCOM and consequently the surety of the payments.
- **Role of Short Term Market** – A clear role of Short term market has to be developed with increased participation from buyers and sellers.

Concerns

- **Regulatory lead time adversely impacting other stakeholders**
  - Most private power generators (~39,038 MW, Rs ~1,57,730 Cr) have petitioned in CERC and SERCs for compensatory tariffs due to adverse reasons beyond the control of the developers.
  - As many as 17 projects have approached the Regulatory authorities for Compensatory tariff petition
  - Time taken for release of order on the recent petitions of Tata Power and Adani Power regarding compensatory tariff = ~20 months – orders have been challenged
- **Retrospective nature of regulations** for e.g. the Supreme Court ruling on the methodology followed for captive coal block allocations adversely effect the investments made by players in both coal block and linked projects

Due to the above concerns no new capacity is coming up. Private investment and financing of power projects especially thermal projects is not forthcoming as the projects would not be able to generate adequate cash flows to cover operating costs and service debt.

New Standard Bidding Documents

- In 2013, the Ministry of Power has notified revised standard bid documents on DBFOT (September 20, 2013) and DBFOO (November 08, 2013) model after extensive inter-Ministerial consultations.
- For the purposes of UMPPs sourcing coal from allocated domestic captive coal blocks, new Guidelines (under discussion) shall replace the earlier Guidelines notified in September 2013.
- Evolution of Tariff determination can be represented as below –

Standard Power Purchase Agreement (UMPP)

- The Power Ministry in August 2015, has released draft standard bidding documents and guidelines for UMPPs based on allocated Domestic Coal Blocks.

Parameter	Guideline

Standard Power Purchase Agreement (UMPP)

Parameter	Guideline

Risks and Concerns in PPA (UMPP)

Risk / Concern	Description
Land Acquisition	The process has been split up between the procurers and the successful bidder – Seller. Procurers will decide on quantity of land required and its site, but will procure critical (to be decided by them) land up to provisions of Section 23 of LARR and lease it to Op SPV prior to signing of PPA/ transfer of Op SPV. Seller will have to complete the balance procurement activities, if any, for Land-1 (e.g. actual payment of compensation & possession), as also procure Land-2 within the identified site/ land size likely through direct negotiations with the land holders to implement the project. • Such an arrangement will lead to higher land cost, implementation delays and impact bankability of the PPA/ viability of such projects.
Site Selection	Procurers will decide on the site. Such large single site projects if set up as inland projects will have added challenges like inland transport logistics, transportation & handling cost, transportation leakages, water availability for operations, water arrangement etc. • It is suggested that such projects may be taken up as coastal projects with proximity to port having capacity to handle the required quantity of imported coal; coal could be transported through conveyor system.

Risks and Concerns in PPA (UMPP)

Risk / Concern	Description
Blending	Procurers may, at their discretion, at any time and as many times during the Operations Period, require the Seller to blend up to 30% domestic coal with Imported Coal. Prior to issuance of notice to blend, Procurers should finalise source of domestic coal and corresponding revision of Variable Charge with Seller and obtain approval of the Commission. • The proposed process could result in different coal source/ specifications every time switch over is sought; bidding process does not visualise any domestic coal specifications for the bidders
Change in Law	The plant is to largely use imported coal; change in law in country of origin of coal in not included in the 'Change of Law' meaning clause. • While it is expected that the escalation rate notified by the Commission will be broad based to address coal cost changes in major coal exporting geographies, the risk is that it may not fully address/ neutralise steep changes in individual country from which coal is being imported, which may impact project viability significantly.

Risks and Concerns in PPA (UMPP)

Risk / Concern	Description
Defaults and their consequences	Lenders' have been given the right to substitute, time provided for which can be extended by agreement between lenders & Procurers. In case substitution fails, Procurers can acquire the plant at miniscule cost which also will be paid as received from the Central/ State government or terminate the PPA, in which case land will no longer remain available to the Seller/lenders –the equipment etc. will have to be moved/ disposed off. • Time lines may be extended, with a reference to the Regulator and not Procurers, who are interested parties. • In case Procurers decide not to acquire the plant but terminate the PPA, land should be allowed to be retained by the project company, if considered necessary, after reference to the regulator. The rationale is that the lenders/ Seller will require time to shift/ dispose off the movable assets and the residual heavy civil structures etc. will not render the land usable for any other purpose or return to the original land owners. • In case the Procurers acquire the plant, Termination Payment should cover debt outstanding of the lenders. • Lenders should also be allowed the option to change management to restore viability.

Risks and Concerns in PPA (UMPP)

Risk / Concern	Description
Power Evacuation	Power evacuation is the obligation of the Procurers. Transmission System should become available 6 months prior to Scheduled COD Further deferment is allowed on day for day basis for period up to 2 years. LDs for delay include damages paid by Transmission Licensee as per TSA and sharing of IDC with Seller. Post consultation period etc., Seller can issue Termination notice for PPA and Termination Payment shall be paid by the Procurers to the Lenders, as and when the Procurers receive the cost of Power Station Land from Central/ State Government (amount is also limited to amount received from Government. • TSAs typically provide for very little LDs for delay. As most of the loans would have been disbursed, interest burden would almost be at peak – even 50% IDC will be a big additional burden on the Seller. • Termination should not be an option – while additional time may be permitted, tariff should be adjusted to restore Sellers' original financial position as per lenders' financial model by reference to the regulator

Risks and Concerns in PPA (UMPP)

Risk / Concern	Description
Debt Due	Debt Due shall mean the aggregate of the following, expressed in Indian Rupees, outstanding on the relevant date: (a) the principal amount under the Financing Agreements excluding the principal amount that had fallen due for repayment 2 (two) years prior to the issuance of the Termination Notice by the Procurers and (b) Interest on Debt. • Debt due to the lenders should be the amount actually outstanding on the Termination Notice date plus any interest/ incidentals till settlement takes place.

Model Power Supply Agreement (DBFOO)

- The Power Ministry in September 2013, released the Model Power Supply Agreement (MPSA) for projects based on Design, Build, Finance, Own, and Operate (DBFOO) model
- The MPSA framework addresses the complexities of the Public Private Partnerships (PPP), while attempting to balance interests / risks of all stakeholders

Parameter	Guideline
Fixed Charge	The Utility shall pay the supplier a Fixed Charge, determined through competitive bidding, for availability of the Power Station. The Fixed Charge determined for each accounting year shall be revised annually to reflect 30% of the variation in a composite index comprising WPI and CPI. An annual reduction of 2% in Fixed Charge has been stipulated to pass the benefit of the depreciated asset to the consumers
Fuel Charge	The framework contained in the MPSA provides alternative formulations for determination of fuel costs depending on the source and pricing of fuel supplies Pass through in fuel costs including the cost of freight and inland transportation. The foreign exchange risk would be borne by distribution utility

Model Power Supply Agreement (DBFOO)

Parameter	Guideline
Station Heat Rate	Efficiency attained by power producers shall be computed through Station Heat Rate (SHR), which needs to meet prescribed specifications in order to safeguard interests of the Utility. Achieving greater SHR shall be incentivized in the form of an enhanced fixed charge
Increase / Decrease in Fixed Charges with Heat Rate (during Testing)	For every 1% decrease in Heat Rate during Testing, Fixed Charge increases by 1.5% • If source of fuel is within 100km, Fixed Charge will only increase by 1% • If source of Fuel is imported or open market, Fixed Charge will increase by 2.5% For every 1% increase in Heat Rate during Testing, Fixed Charge decreases by 2% • If source of fuel is within 100km, Fixed Charge will only decrease by 1.5% • If source of Fuel is imported or open market, Fixed Charge will decrease by 3%

Model Power Supply Agreement (DBFOO)

Parameter	Guideline
Fuel Supply Agreement	Power producers shall enter into a Fuel Supply Agreement (FSA) in order to ensure generation of a pre-determined quantum of electricity, backed by sufficient supply of fuel. Prior to achievement of the financial closure, supplier will have to execute FSA for the project
Additional Fuel Supply	In the event of inadequate fuel supply under a Fuel Supply Agreement (FSA), the supplier shall make best efforts to identify additional sources of fuel supply to meet such fuel shortage. The supplier shall notify the Utility of the landed cost of such additional fuel and shall demonstrate that it will be procured at the best prices available. If the proposed landed cost is acceptable to the Utility and the Appropriate Commission, the supplier shall procure such additional fuel for the agreed price and quantity
Minimum Fuel Stock	Power producers need to stock sufficient fuel to generate sufficient supply for a period of 7 days. In case of fuel shortage only 70% of the fixed charge shall be payable by the utility
Change in Law	Any change in law or taxes occurring in jurisdiction where captive mines are located shall be deemed as Change in law for developer and its associate.

Model Power Supply Agreement (DBFOO)

Parameter	Guideline
Concessional Fuel	Fuel attained by the supplier through preferential treatment or captive allocation or sale by a Government instrumentality will be categorized as concessional fuel. The supplier shall have to pay the utility a revenue share equal to the higher of - • fixed charge, and • 30% of gross sale revenue arising from such a sale
Availability of Power Station	Normative plant availability factor (PAF), a metrics used for complete fixed cost recovery, should be maintained at 90%
Committed Capacity	A definite proportion of the installed capacity shall be utilized for production and sale of electricity to utilities with which the supplier has entered into an agreement with. In case of this capacity not being utilized owing to fuel shortage, the supplier can purchase fuel from the open market and sell the electricity to third parties
Open Capacity	The supplier can utilize 20% of the installed capacity to generate electricity and supply it to any third party buyer at unregulated prices on mutually agreed terms. This provision will facilitate the development of a power market that will aid power production and enhance competition in the supply of electricity

Model Power Supply Agreement (DBFOO)

Parameter	Guideline (Domestic Linkage)
Cost of Fuel	Base Price Lower of: • Indicative price of Fuel which shall be computed from the Fuel Charge, as specified in the Bid; and • 101% of the price payable by the Supplier to CIL Variation permitted • In proportion to the revision in CIL price as compared to the rate specified hereinabove
Additional FSA	Base Price Lower of: • Current price of similar Fuel sold by CIL through e-auction or any substitute thereof; and • Actual cost of procurement
Cost of transportation of fuel	Lower of: • 110% of freight payable to Indian Railways • Actual cost of transportation • Escalation: Revised in proportion to revision in rail freight price as on Bid Date
Cost of Washing	Lower of: • Average cost of washing incurred by CIL for similar washing • Actual cost of washing • Escalation: Revised in proportion to revision in average CIL cost as on Bid Date

Model Power Supply Agreement (DBFOO)

Parameter	Guideline (Domestic Captive Mine)
Cost of Fuel	Base Price Lower of: • Indicative price of Fuel computed from the Fuel Charge as specified in the Bid • 95% of the price of similar Fuel (unwashed) as charged by CIL for supply from mines in the region on the day immediately preceding the Bid Date • Price of Fuel as determined by the Appropriate Commission with reference to the Bid Date Variation permitted • Escalated at a compounded annual rate of 2%; and • Revised annually to reflect 60% of the variation in WPI occurring between Bid Date and current tariff year
Cost of transportation of fuel	Lower of: • 110% of freight payable to Indian Railways • Actual cost of transportation • Escalation: Revised in proportion to revision in rail freight price as on Bid Date

Model Power Supply Agreement (DBFOO)

Parameter	Guideline (Imported Coal)

Cost of Fuel	Free on Board (FOB), shall be computed as the lower of:
	• Average of coal indices comprising
	  • API4 (South Africa),
	  • Coalfax (Australia), and
	  • Global Coal (Australia),
	  • or any substitute thereof, or any index that the Parties may mutually agree upon, and
	• the actual cost
	Indices referred to shall be reckoned on the date on which the Fuel is loaded at the port of origin

Cost of transportation of fuel	Lower of: • As per Bid, in US cents • 20% of the price of Fuel, as specified in the Bid plus 110% of the freight payable to the Indian Railways shall be added for inland transportation • Actual cost incurred by Supplier Escalation: Revision in Freight Index computed as 40% and 60% of: • Baltic Dry Index • Singapore 380 cSt Bunker Fuel Price Index

Model Power Supply Agreement (DBFOO)

<table>
<tr><th>Parameter</th><th>Guideline (Captive Mines abroad)</th></tr>
<tr><td>Cost of Fuel</td><td>Base Price Lower of
the indicative US cents FOB price of the Fuel at the normative GCV applicable to the Index, as specified in the Bid; and
80%/ 85% / 90% of the variation for a period of 6 (six) calendar months immediately preceding the Bid Date
SBI TT rate at the beginning of each quarter to be used to convert base price into INR
Variation permitted
Escalation at a compounded annual rate of 4%, from Bid year</td></tr>
<tr><td>Cost of transportation of fuel</td><td>Lower of:
As per Bid, in US cents, and
20% of the price of Fuel, as specified in the Bid plus 110% of the freight payable to the Indian Railways shall be added for inland transportation
Actual cost incurred by Supplier
Escalation: Revision in Freight Index computed as 40% and 60% of:
Baltic Dry Index
Singapore 380 cSt Bunker Fuel Price Index</td></tr>
</table>

Risks and Concerns in MPSA (DBFOO)

Risk / Concern	Description
Financial Closure	Financial closure is to be completed in 180 days followed by penalties thereafter FC requires 9 to 12 months depending on nature of project and kind of lenders involved
Fuel supply	Concessionaire gets deemed availability to the extent of 70% for non availability of fuel Supplies from CIL / Imported fuel at Market prices In case of supplies from captive mines, if the reserves are lower than estimated than the treatment for the same is not addressed in the bid The supplier should be covered for these risk or back to back coverage of the risk from the Fuel supplier
Fuel Cost	The proposed mechanism doesn't ensure effective pass through of fuel price risk The cost of fuel should be passed through based on actual cost and "as received" GCV

Risks and Concerns in MPSA (DBFOO)

Risk / Concern	Description
Assignability of FSA	For successful financing of Project on non-recourse basis, Lenders would insist on assignment of Project Agreements including FSA for concessional Fuel
Fuel Stock	Shortfall in Minimum Fuel Stock would lead to reduction in Deemed Availability of Project and consequently it would lead to reduction in payment of Fixed Charge by Utility to Supplier Minimum Fuel Stock could be delinked from Deemed Availability
Substitution of Utility	In the event of substitution of Utility, arrangements would be made on “best endeavour basis” and credit enhancements shall be provided by the substituted entity to bridge the gap Utility is the key counterparty to performance of MPSA. Further, Lenders would prefer that MPSA and its ancillary documents are in full force and effect at all times

Risks and Concerns in MPSA (DBFOO)

Risk / Concern	Description
Escrow Account	Revenues equal to 50% of Annual Capacity Charge should be routed through Default Escrow Account Default Escrow Account provides second level of payment security (LC being the first). As long as the Utility is not in default, it could freely use the receivables flowing through this account. However, in the event of default, this account should be able to service entire debt service obligation of the Utility
Termination Provisions	The termination provisions for utility and supplier is un-equitable

Levelized Tariff – Cost Plus vs Competitive Bidding

- CERC had undertaken a detailed exercise to compare the tariffs being discovered through competitive bidding and cost plus tariffs. This analysis compares non UMPP bids with same plants under CERC norms under cost-plus mechanism for domestic coal

- Major assumptions used for this analysis are -

  - Capital cost is imputed cost by CERC based on unit size, technology, site, etc.
  - Interest rates taken at 7.05% p.a.
  - In spite of the fact that some assumptions like interest rate etc. are out of market for IPPs and highly volatile
  - CERC also mentions that these are conservative cost estimates; no allowance has been made for additional capitalization over the Life of the Plant.
  - Similarly coal transportation costs are also on conservative side: for example for less than 500 km, distance assumed is 100 km

Levelized Tariff – Cost Plus vs Competitive Bidding

Project	Size (MW)	State	Developer	COD Date: 1* Unit	Levelized Tariff (Rs/kWh) as per Competitive Bidding	Calculated levelized Tariff under MOU Route (Rs/kWh)	Diff.
Talwandi Sabo	3X660	Punjab, Case-2	Sterlite	Aug-12	2.8643	3.0703	0.206
Rajpura	2X660	Punjab, Case-2	L&T	Jan-14	2.89	3.4822	0.5922
Kamalanga	3X350	Haryana, Case-1	PTC/GMR	Oct. 2011	2.54 (Bus bar)#	2.6237 (Bus bar)@	0.0837
Babandh	4X660	Haryana, Case-1	LANCO	Jul-12	2.075, (Bus bar)#	2.5695@	0.4945
Jhajjar	2X660	Haryana, Case-2	CLP Power	Nov-Dec, 2012	2.996	3.3027	0.3067
Mandva	2X660	Maharashtra, Case-1	LANCO Mahanadi	Oct. 2012*	2.7	3.0062	0.3062
Tiroda Ph-I	2X660	Maharashtra, Case-1	Adani Maharashtra	Aug. 2012	2.642	2.9703	0.3283

Levelized Tariff – Cost Plus vs Competitive Bidding

Project	Size (MW)	State	Developer	COD Date: 1* Unit	Levelized Tariff (Rs/kWh) as per Competitive Bidding	Calculated levelized Tariff under MOU Route (Rs/kWh)	Diff.
Chitrangi Ph-I	3X660	MP, Case-1	Reliance	June, 2012	2.45	2.5652	0.1152
Mahan	2X600	MP, Case-1	Essar	May, 2011*	2.45	2.3119	-0.1381
Nandgaonpeth	2X660	Maharashtra, Case-1	India Bulls	Mar. 2014	3.26	3.2958	0.0358
Tiroda Ph. 2	2X660	Maharashtra, Case-1	Adani Maharashtra	Sept. 2014	3.28	2.8752	-0.4048
Mahanadi	3X600	Gujarat	KSK Energy	Mar. 2015	2.345	2.5137**	0.1687
Prayagraj	3X660	UP, Case-2	JP Associates	Jul-14	3.02	3.4673	0.4473
Sangam	2X660	UP, Case-2	JP Associates	Jan, 2014	2.97	3.3045	0.3345

** lack of clarity regarding actual COD date, assumed as obtained from CEA data.*

@ No escalation in transportation cost of coal

 # Arrived at after subtracting Rs. 0.28/kWh of transmission charges

*** Excludes transmission cost to Gujarat periphery*

Levelized Tariff – Cost Plus vs Competitive Bidding

- The study has concluded that the computed prices under cost plus methodology are higher than the levelized tariffs discovered under competitive bidding in respect of 12 out of 14 projects
- It is pertinent to note that the levelized price, whether under cost plus methodology or under competitive bidding process, is not the price that consumer ultimately ends up paying. The actual price that the consumer pays depends on the actual escalations rates of coal cost, coal transportation costs, and O&M costs, etc.
- In the case of competitive bidding process, the actual price paid is also dependent on how the bid is structured in terms of escalable and non-escalable components
- Further, Bidder is under competitive pressure to quote large part of his tariff as non-escalable, which in turn reduces the amount by which tariffs can go up in future even though the actual cost escalations can be of very high order
- The risk is shared between consumer and the supplier under competitive bidding, whereas under the cost plus methodology, the risk is almost completely borne by the consumers and all escalations are generally required to be a pass through

Levelized Tariff – Cost Plus vs Competitive Bidding

- The positive spread between bid out tariff and cost plus tariff could partly be explained on account of following:

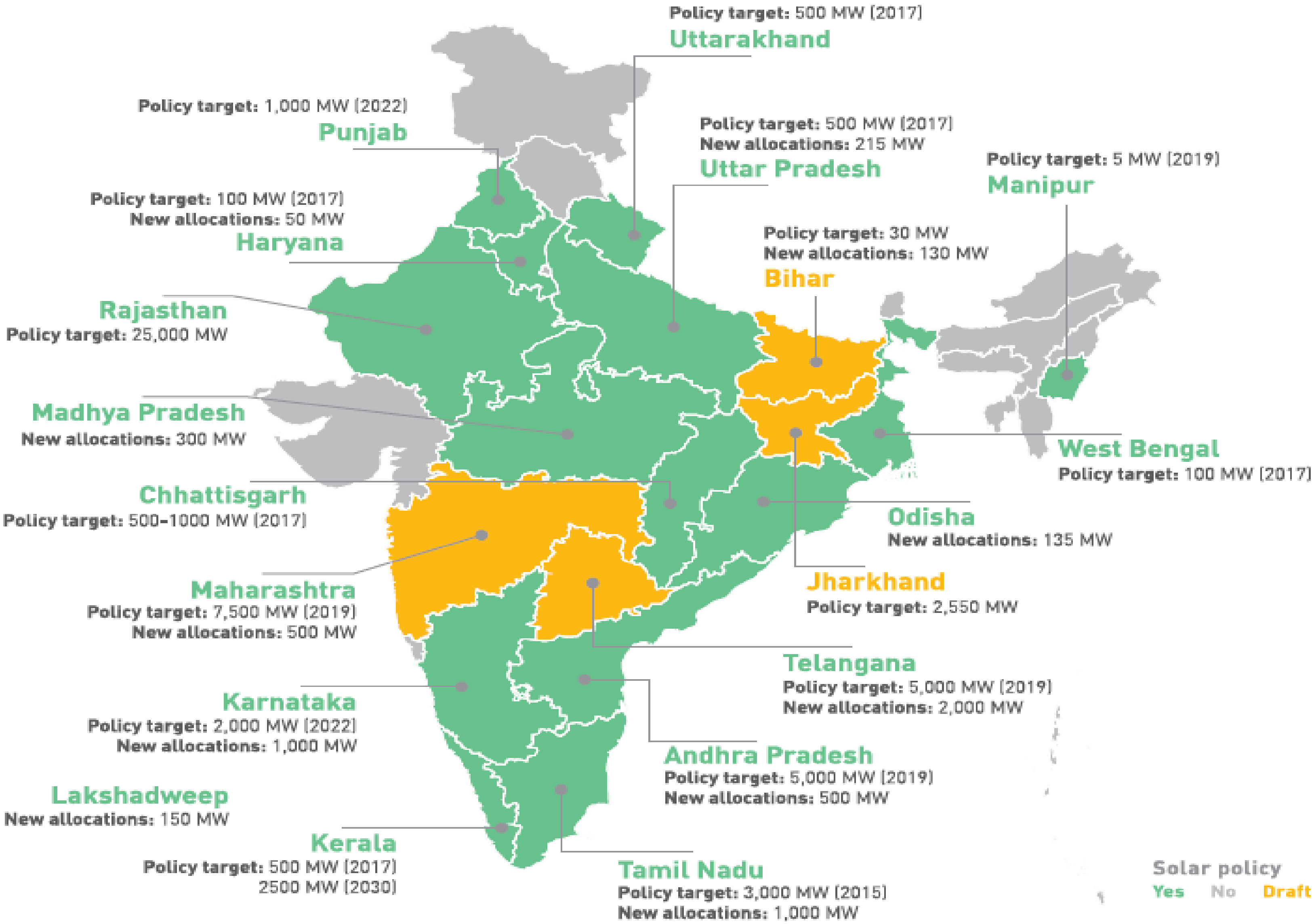
  - Take or Pay risk associated with discoms could have led to higher fixed charges for bid out projects vs. regulated tariff projects. UDAY scheme and consequent improvement in discom finances is expected to reduce Take or Pay risk and fixed charges are expected to reduce

  - To protect Roe on account of coal availability risk, Developers may have structured the bids so as to have higher fixed charges for bid out projects vs. regulated tariff projects

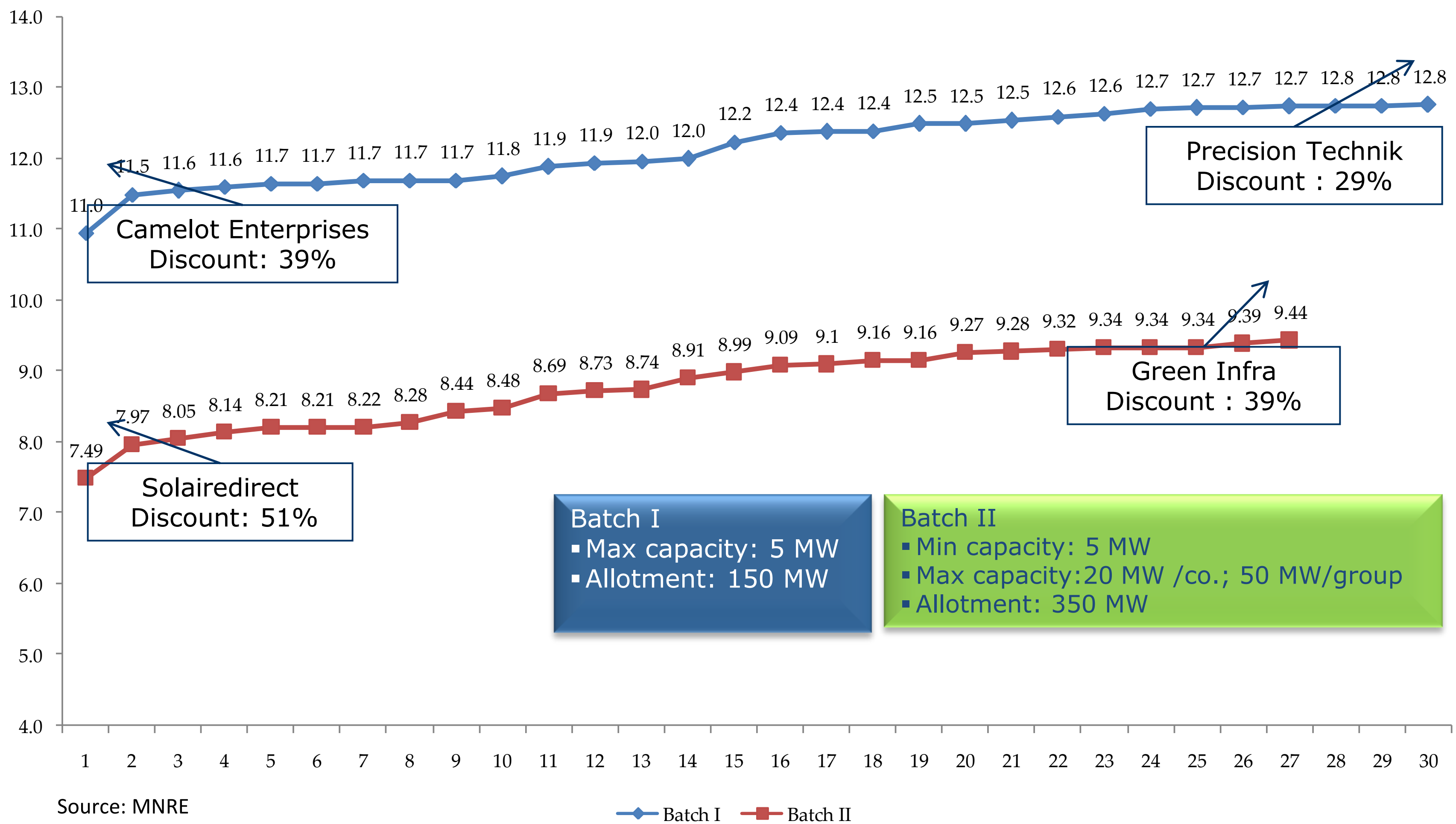
  - The cost and uncertainty associated with 20% open power capacity (that is not eligible for domestic coal) and transmission/ open access charge for open capacity (approx. 50 paise per unit) is loaded on the fixed tariff. In case of regulated projects, complete power capacity is tied up and tariff is quoted at project bus bar and hence, these add-on costs are not factored in

Renewables

State Government Initiatives



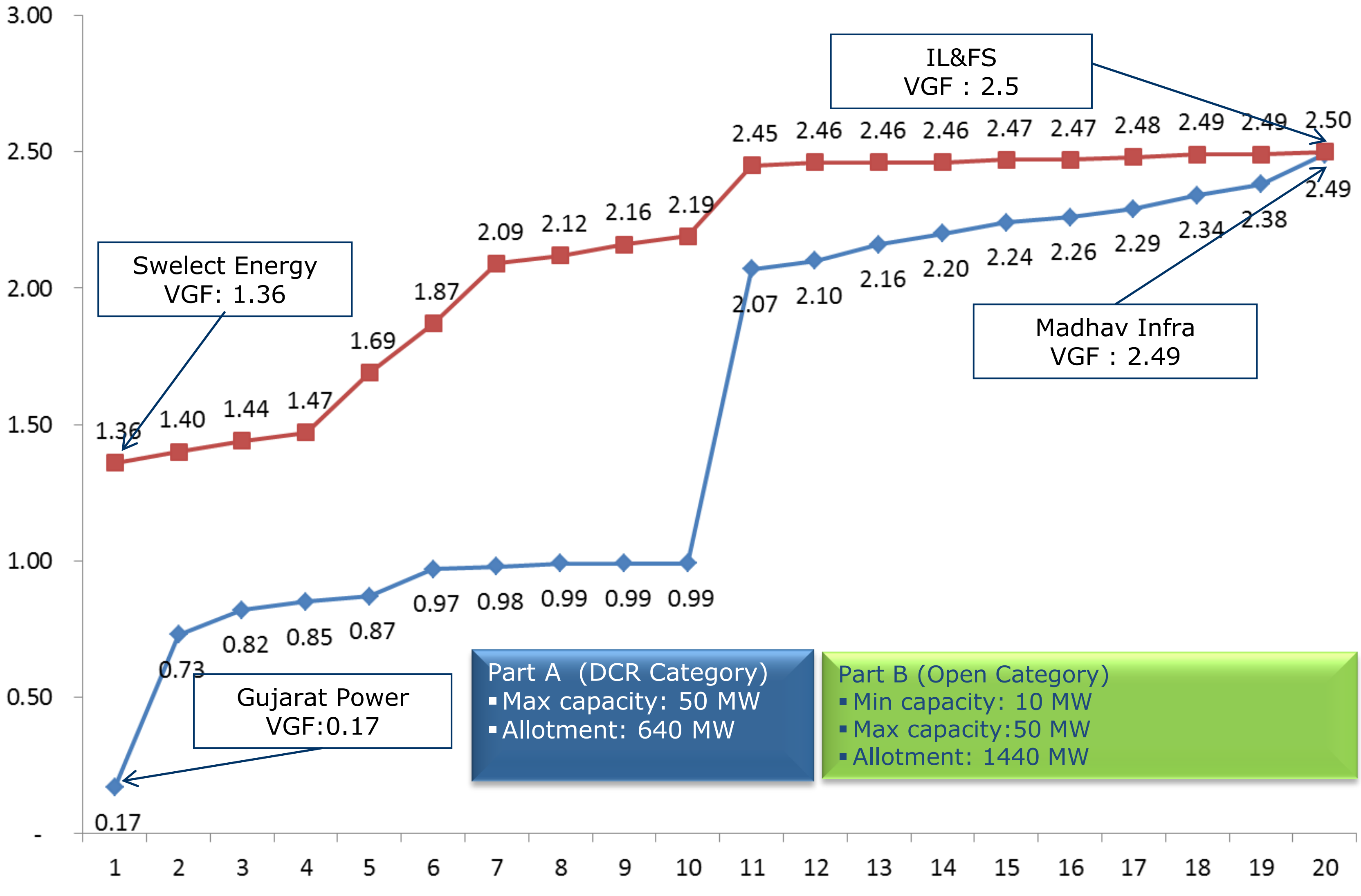
JNNSM - Trends in Solar PV Tariff Bids Phase I



Source: MNRE

Fall in module prices have pushed down solar tariffs

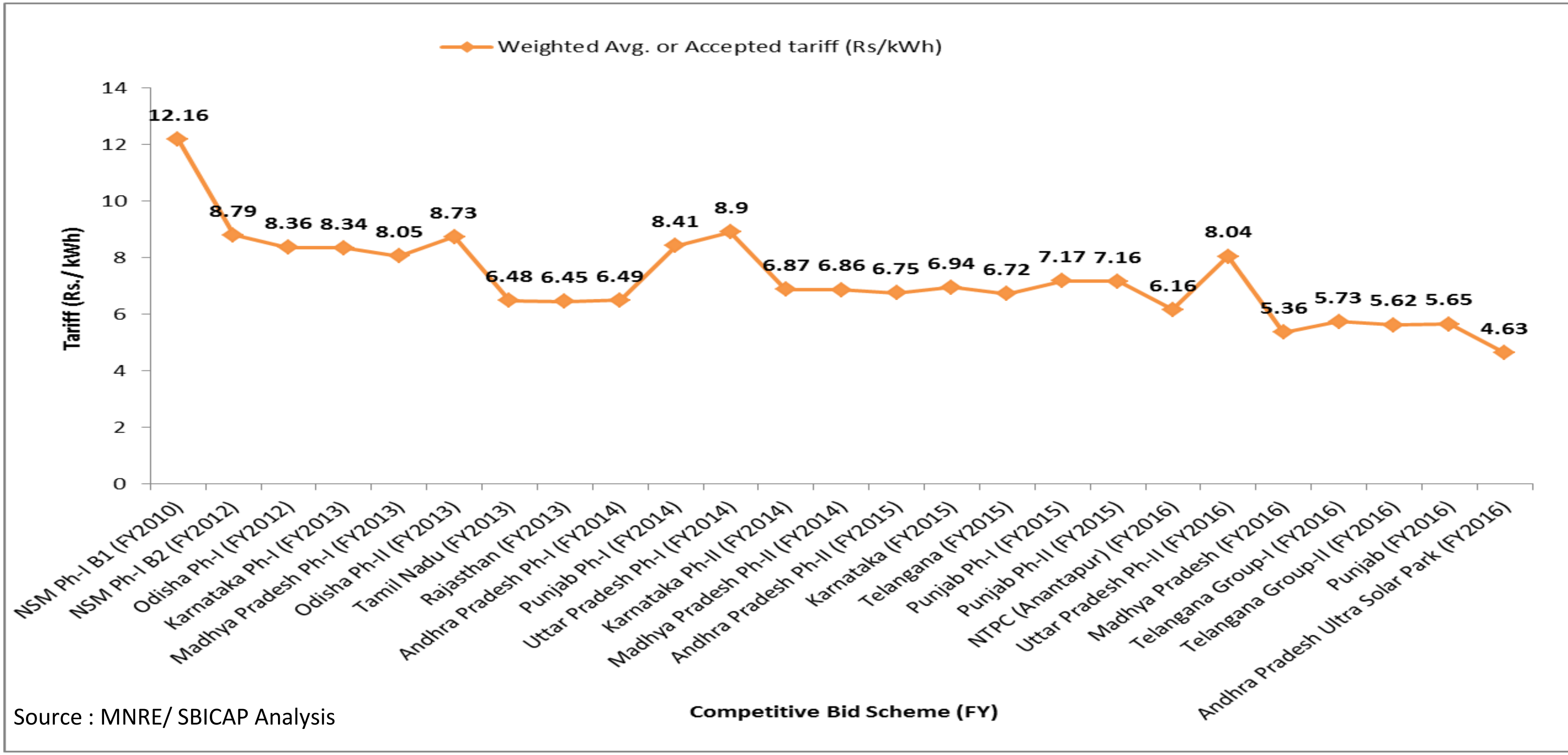
JNNSM - Trends in Solar PV Tariff Bids Phase I



Source: MNRE

Top & Bottom 10 VGF Bids observed during JNNSM Phase II Batch I

Recent Trends in Solar Power Tariff



Source : MNRE/ SBICAP Analysis

Tariffs have declined by more than 60% over last 5 years; Higher tariffs discovered in few states could partly be attributed to state specific policies and local factors like cost of land acquisition, solar radiation, available infra for project implementation etc.

Tariffs have declined from ~Rs. 7 per unit in FY 15 to ~Rs. 5 .50 per unit in FY 16 mainly on account of decrease in capital & financing costs and availability of long tenor loans.

Concerns – Solar Power PPA

- Solar Power PPA - Take or Pay stipulation is a major concern
  - Model PPA for the states like Rajasthan, Tamil Nadu, UP, Telangana, Andhra Pradesh etc. doesn’t have a take or pay clause in an event of default condition where the discom fails to pay to power producer. Same is the case for projects under JNSSM
  - PPPA’s for these states specify that the solar power developer has the option of selling the power to third parties in case of event of default by the procurer (“Discom”). Further, non-payment by procurer for a period exceeding 90 days has been defined as one of the event of default by the procurer
  - States like MP and Gujarat, provisions like Discom’s reimbursing the difference in rate between third party and PPA rate (for MP) or advance payment to tune of 3 years of tariff (for Gujarat) are available for addressing the concern
- Aggressive bids and existing PPAs – With the continuous drop in the quoted tariff, the actual viability of the projects seem uncertain. Further, due to these very low tariff the future of the legacy PPAs is at peril.

Concerns – Solar Power PPA

- Renewable power policies are not uniform across the country -
  - In certain states, PPA is executed close to COD/after project execution thus casting uncertainty over off-take resulting in discomfort to lenders
  - PPA tenors vary across the states (e.g.. 13-year tenor for wind power projects does not allow comfortable tenor for debt financing and does not leave adequate tail to accommodate any unforeseen project related challenges
  - Power banking facility benefit is not present in all states
- Frequent policy changes are causing uncertainty and affecting investment in the sector (viz. accelerated depreciation, GBI, VGF etc.)
- Resource estimation of renewable source is a challenge (solar radiation, wind, hydrology etc.) especially site specific data
- Power evacuation is a challenge as most of the renewable projects are located in remote & inaccessible locations far from evacuation infrastructure & load centres
- RPO related issues - RPO targets vary across states. In addition, enforcement of RPO targets have been lax and penalties are not being imposed for non-compliance

Transmission

Transmission Bids - Interstate

Date	SPV	BPC	Line / S/s Type	SS	Km	L1	Levelised Tariff p.a. (Rs. Cr.)
Jul-15	Maheshwaran Transmission Company Limited	REC	400KV D/C	2	254	Sterlite Tech	55.00
Jul-15	Sipat Transmission Compnay Limited	PFC	765KV D/C	1	196	Adani Power	79.00
Jul-15	Chhattisgarh Part A Transmission Limited	PFC	765KV D/C	1	273	Adani Power	132.40
Jul-15	Chhattisgarh Part B Raipur-Rajnandgaon – Warora Tranmission Limited	PFC	765KV D/C	7	297	Adani Power	178.00
Apr-15	Powergrid (Gadarwara [A] Transmission Limited)	REC	765KV D/C	2	460	PGCIL	290.15
Apr-15	Powergrid (Gadarwara [B] Transmission Limited)	REC	765KV D/C	2	460	PGCIL	256.73
Feb-15	Powergrid (Vindhyachal-Jabalpur Transmission Limited)	REC	765KV (D/C, Hexa Zebra ACSR)	0	350	PGCIL	210.99

Transmission Bids - Interstate

Date	SPV	BPC	Line / S/s Type	SS	Km	L1	Levelised Tariff p.a. (Rs. Cr.)
May-14	Instalaciones Inabensa SA (DGEN Transmission Company Limited)	PFC	400 KV (D/C, Twin moose ACSR)	2	135	Instalaciones Inabensa SA	58.40
Jan-14	NRSS XXXI-B (Kurusksheta - Malerkotla, Malerkotla-Amritsar)	REC	400 KV (D/C, Twin moose ACSR)	0	305	Essel InfraProjects	88.7
Oct-13	ERSS Scheme VI (Darbhanga Motihari)	PFC	400 KV (D/C Quad)	2	102	Essel InfraProjects	117.4
Aug-13	RAPP 7 & 8	PFC	400 KV (D/C, Twin moose ACSR)	0	200	Sterlite Tech	36.5
Sep-13	Transmission System for Patran 400 KV s/s	PFC	400 KV	1	-	Technoelectric & Engg	27.4
Sep-13	ERSS VII (Purulia & Kharagpur Transmission)	PFC	400 KV D/C	0	273	Sterlite Tech	58.9

Transmission Bids - Interstate

Date	SPV	BPC	Line / S/s Type	SS	Km	L1	Levelised Tariff p.a. (Rs. Cr.)
Aug-13	Kudgi Transmission	REC	400 (Quad D/C)	0	497	L&T	179.6
Apr- 13	Sathpura- Astha 400 kv transmission line	REC	400 KV	0	240	KPTL	
Apr-12	Nagapattinam- Madhugiri Transmission Co. Ltd	PFC	765 (D/C , S/C)	1	250	PGCIL	98.7
Mar-12	Vemagiri Transmission System	REC	765 (D/C)	1	250	PGCIL	119.7
Feb-11	Bhopal Dhule Transmission Co.	PFC	765(975 km) & 400 (30 km) ACSR/AAAC	2	1,005	Sterlite Tech	199.5
Jan-11	Raichur Sholapur Transmission Co	REC	765 (S/C)	0	210	Patel+ Simplex+BS	29.4
Jan-11	Jabalpur Transmission Co.	PFC	765 (AAAC/ACSR)	0	635	Sterlite Tech	142.1

Transmission Bids - Intrastate

Date	SPV	Agency	Line / S/s Type	State	SS	Km	L1	Levelised Tariff p.a. (Rs. Cr.)
May '13	Jhajjar KT Transo	KPTL + Techno	400 KV	Haryana	2	100	KPTL	42
Feb' 13	Satpura – Astha	KPTL	400 KV	MP	0	240	KPTL	38
Apr '09	Western Region System Strengthening Scheme II	PGCIL	400 KV	UP	0	1031	Reliance Power	170

Point of Connection regime

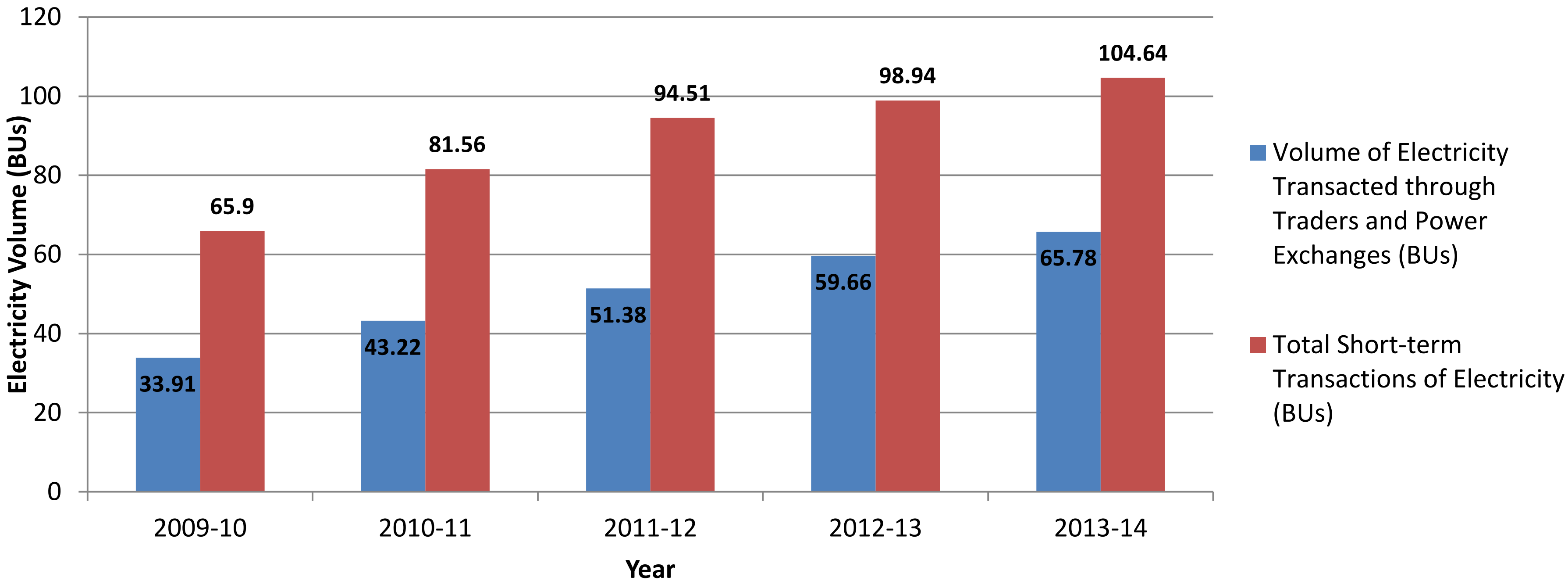
- **Features**
  - Central Transmission Unit (CTU / PGCIL) acts as a Counterparty for billing, collection and disbursement of Transmission Charges.
  - In case of payment default, CTU to enforce recovery of payment through Letter of Credit on behalf of all the TSPs.
  - Partial payment or nonpayment of transmission charges in a month by any LTTC will result in pro-rata reduction in the payouts to all the TSPs.
- **Benefits**
  - For developers, the problem of dealing with multiple LTTC's for multiple projects would be eliminated
  - Conducive to attracting private sector investment
  - Risk of payment by DICs is borne by all ISTS Licensees on pro-rata basis
  - Eliminates the risk of developer not getting tariff due to delay in COD of generator
  - CTU empowered to undertake Regulation of Power Supply in event of default, thus recovering the defaulted amount.

Concerns

- **Relative Under-investment in power transmission**
  - Power generation capacities grew at higher rate as against capacities in transmission
- **Long bidding process**
  - Even with SBD, it takes 12-18 months of planning before the bid in a total 60 month from concept to commissioning for transmission projects.
- **Inappropriate Risk allocation and uncertain clearances**
  - Uncertain and lengthy clearances and regulatory processes beyond control of developers are not provided fast redressal mechanism
  - Private players wait and bear uncertainty for the authorization for 12-24 months as against PSUs which receive deemed authorization – giving clear edge in terms of time available as well as certainty

Short Term Market

Short Term Transactions - Volumes



- 2009 was 1st year for procurement of power by industrial sector consumers through power exchanges (IEX only)
- 94% increase in volume of power transacted through traders & exchanges from 2009 to 2014
- In 2014, short-term power transacted through traders & exchanges was 63 per cent of the total short term transactions

Short Term Transactions - Prices

Price of Short-Term Transactions of Electricity (Rs/Kwh)							
	Bilateral Through Traders				Power Exchange		UI Price in All India Grid
Period	RTC	Peak	Off-Peak	Wt. Avg.	IEX	PXIL	
Apr-14	4.21	3.56	3.51	4.19	3.42	3.05	2.62
May-14	4.5	3.32	3.46	4.41	3.26	3.15	2.09
Jun-14	3.93	3.12	3.54	3.91	3.71	3.63	2.97
Jul-14	4.06	4.37	3.53	4.03	3.5	3.53	2.87
Aug-14	4.15	4.82	3.98	4.15	4.33	3.68	3.14
Sep-14	4.31	4.33	3.87	4.28	4.14	3.48	2.54
Oct-14	4.61	4.77	4.15	4.56	4.33	3.45	2.22
Nov-14	4.66	5.06	3.48	4.58	2.97	2.67	1.54
Dec-14	4.37	4.32	3.45	4.33	3.2	2.85	1.84
Jan-15	4.43	4.15	3.53	4.39	2.95	2.67	1.77
Feb-15	4.38	4.57	3.6	4.33	2.87	2.7	1.62
Mar-15	4.57	4.08	3.34	4.49	2.78	2.65	1.87
Apr-15	4.29	3.05	3.64	4.20	2.68	2.57	1.81
May-15	4.07	4.13	3.55	4.00	2.49	2.37	1.96
Jun-15	3.98	3.91	3.54	3.90	2.71	2.76	1.62
Jul-15	4.07	3.60	3.57	3.99	2.47	2.70	1.86
Aug-15	4.25	3.52	3.52	4.18	2.80	2.59	2.14

Way Forward

- Indian Power Sector has come a long way in terms of liberalization
- Electricity Act 2003 combined with NEP, NTP have promoted competition / better tariff for end customer
- Regulators have to play the primary role in order to promote confidence in the sector. Apart from addressing the before-mentioned concerns, the regulators may also support by following measures -
  - A holistic approach is to be taken for development of sector wherein all the related issues including Fuel, off-take arrangement, transmission are addressed. It is essential that generation (de-licensed business) is not affected by licensing nature of other associated sector like coal, transmission etc.
  - A central registry / information sharing mechanism needs to be developed wherein developers can be provided with all the information and progress of the project.
  - Need for a robust and time-bound mechanism for disposal of petitions.
  - Further, a framework for granting interim relief to be put in place for cases where the Commission deems that bonafide grievance of the petitioner exists.

Thank You

Questions?

Annexures

Case 1 Bids

State	Quantum (in MW)	Bid Date	Developer	L1/L2- Levellized tariff (Rs. p.u.)
Rajasthan	1200	Nov 2009	Adani Power Ltd	3.24
	100	Nov 2009	GMR Kamalanga	3.81
	150	Jan 2010	Monet Power (PTC)	3.76
Karnataka	430	Jan 2010	Thermal Power Tech (PTC)	3.77
Gujarat	1000	Jan 2010	Essar Energy	2.80
Bihar	450	Mar 2010	Essar Energy	3.05
	400	Feb 2011	RKM Power Gen	4.59
	100	Feb 2011	Vandana Vidyut Power	4.68
Uttar Pradesh				
	300	Feb 2011	PTC- Athena	3.32
	2456	Feb 2011	Reliance Power	3.70
	580	Feb 2011	PTC-Hinduja	3.45
Andhra Pradesh	620	Feb 2011	PTC-East Coast Energy	3.48

Case 1 Bids

State	Quantum (in MW)	Bid Date	Developer	L1/L2- Levellized tariff (Rs. p.u.)
Uttar Pradesh	240	Feb 2011	Essar Power	4.09
	200	Feb 2011	Visa Power	4.19
	300	Sep 2012	NSL (Orissa)	4.48
	390	Sep 2012	PTC TRN (ACB Ltd)	4.89
Rajasthan	195	Sep 2012	PTC- MCCPL	4.517
	311	Sep 2012	PTC -DB Power	4.811
Tamil Nadu	200	Mar 2013	DB Power	4.91
	400	Mar 2013	Jindal Power Ltd	4.95
Kerala	200	Nov 2014	Jindal Power	3.6
	115	Nov 2014	Jhabua Power	4.15
	115	Nov 2014	Balco	4.29
	200	Nov 2014	Jindal India - Thermal	4.39
	150	Nov 2014	Jindal Power	4.29

Case 1 Bids

State	Quantum (in MW)	Bid Date	Developer	L1/L2- Levellized tariff (Rs. p.u.)
Andhra Pradesh	488	June 2015	East Coast Energy Ltd	4.27
	500	June 2015	NCC Power Projects	4.35
	540	June 2015	Korba West Avantha	4.49
	374	June 2015	MB Power Ltd	4.69
	400	June 2015	Jindal India Thermal Ltd	4.83
	500	June 2015	Essar Power Ltd	4.83
Tata Power Discom (Delhi)	200	Sept 2015	Jindal India	3.99
	120	Sept 2015	Balco-Chattisgarh	4.071
	374.15	Sept 2015	M B Power	4.23
	100	Sept 2015	Lanco Anpara	4.24
	400	Sept 2015	Ratan India	4.479

Approx. 6500 MW has been awarded under Case 1 bids whereas about 63000 MW thermal capacity has been added between FY13 to FY16 (till September)

Case 2 Bids

Captive Coal Based				
Project	Capacity (MW)	Bid Date	Winning Bid (Rs / Kwh)	Successful Bidder
Tilaiya (Jharkhand)	3960	Jan 2009	1.77	Reliance
Bhaiyathan (Chatts.)	1320	March 2008	0.81	Indiabulls
Sasan (MP)	3960	Dec 2006	1.19	Reliance

Imported Coal Based				
Project	Capacity (MW)	Bid Date	Winning Bid (Rs / Kwh)	Successful Bidder
Krishnapatnam (AP)	3960	Nov 2007	2.33	Reliance
Mundra (Gujarat)	4000	Dec 2006	2.26	Tata Power

Case 2 Bids

Linkage Based					
Project	Capacity (MW)	Bid Date	Winning Bid (Rs / Kwh)	Landed Coal Cost (Bid)	Successful Bidder
Rajpura (Punjab)	1320	Nov 2009	2.89	Rs 1,724/ton	L&T
Bara (UP)	1980	Nov 2008	3.02	Rs 1,351/ton	Jaypee
Karchana (UP)	1320	Sep 2008	2.97	Rs 1,305/ton	Jaypee
Jhajjar (Haryana)	1320	July 2008	2.996	-	CLP
Talwandi Sabo (Punjab)	1980	July 2008	2.864	Rs 2,018/ton	Sterlite
Anpara C (UP)	1200	June 2006	1.91	-	Lanco

The last case 2 bid was in November 2009. Since then no new project has come up.

State Government Initiatives

Rajasthan Solar Energy Policy, 2014	
Valid up to	Next notification
Nodal Agency	Rajasthan Renewable Energy Corporation Limited
Capacity Target & Period	Aim to develop 25000 MW solar capacity to achieve its energy requirement • Competitive Bidding: 550 MW • Rooftop & small solar: 50 MW • Sale to Discom: 600 MW by 2017 • Captive use: unlimited
Land Allotment	RREC will recommend allotment of Government land to the concerned District Collector on deposit of a refundable security deposit Setting up solar power projects on private Khatedar land will be permitted without requirement of land conversion
Other Incentives	Industrial grant, water availability, single window clearance, special provisions for mega solar power projects of 500 MW or more capacity, grant of open access
Solar park	Capacity of 500 MW or more The state will promote development of solar park by investing up to 50% equity in the joint venture company formed for this purpose

State Government Initiatives

Andhra Pradesh Solar Power Policy, 2015	
Valid up to	5 years or till new policy is issued
Nodal Agency	New and Renewable Energy Development Corporation of AP Limited
Capacity Target & Period	Aim to add minimum 5000 MW solar capacity in the state in the next 5 years • Sale to Discom: 2000 MW capacity phased over 5 years • Solar Park: 2500 MW over the next 5 years • Third party sale/captive use/rooftop solar: Unlimited
Incentives	• Deemed PPP status for plants set up for sale of power to Discoms • Deemed non-agricultural status for land for the power project • Exemption of T&D charges for wheeling of power for captive/3rd party sale within the state for 10 years from COD • Intra-state open access for whole tenure or project (max 25 years) • Exemption from electricity duty for captive consumption, discom & 3rd party sale • Exemption from cross subsidy surcharge for 5 years from COD for 3rd party sale

State Government Initiatives

Andhra Pradesh Solar Power Policy, 2015	
Land	To be acquired by the developer
Power Evacuation	Developer to bear cost of construction of evacuation facilities from project up to interconnection point
Solar park	• To be developed in clusters of 500-1000 Ha • Various zones viz. Solar Power Producers, Manufacturing Zones, R&D & Training Centres • State will help building up the initial infrastructure like power evacuation, water requirements, internal roads

State Government Initiatives

Karnataka Solar Policy 2014-2021	
Valid up to	2021
Nodal Agency	Karnataka Renewable Energy Development Limited
Capacity Target & Period	Aim to add minimum 2000 MW solar capacity in the state by 2021 Utility scale grid connected projects: 1600 MW by 2021 with project size as under • Land owning farmers – 1 to 3 MW (aggregate 300 MW) • Competitive bidding – min 3 MW for Solar PV, min 10 MW for Solar Thermal • REC mechanism & IPP - min 1 MW for Solar PV, min 10 MW for Solar Thermal • Captive/group captive – no size limit • Grid connected rooftop projects: 400 MW by 2018 Third party sale/captive use/rooftop solar: Unlimited
Land	To be acquired by the developer

State Government Initiatives

Karnataka Solar Policy 2014-2021	
Power Evacuation	Developer to bear cost of construction of evacuation facilities from project up to interconnection point
Incentives	Tax concessions in respect of Entry tax, stamp duty and registration charges as per Karnataka Industrial Policy
Solar park	Will promote Plug and Play integrated solar parks Will promote small solar parks with area not less than 100 acres Supports deployment of grid connected projects on canal corridor by water resource department on pilot basis

State Government Initiatives

Telangana Solar Power Policy 2015	
Valid up to	5 years
Nodal Agency	Energy Department, Govt. of Telangana
Capacity Target & Period	Grid connected solar power plants for sale to state discoms and 3rd party sale within state • Captive/group captive plants • Solar Rooftop Projects • Off grid applications • Solar Parks
Land	To be acquired by the developer, max 5 acres/MW
Implementation Period	Within time limit specified in the PPA or 2 years from date of application, whichever is earlier
Power Evacuation	Developer to bear cost of construction of evacuation facilities from project up to interconnection point

State Government Initiatives

Telangana Solar Power Policy 2015	
Incentives	Incentives under the policy will be available for 10 years from COD. For availing these benefits, power generated from the solar projects has to be consumed within the state • Single window clearance • Deemed conversion to non-agricultural land status • Exemption from transmission & wheeling charges for captive use within state • Exemption from cross subsidy surcharge for 5 years and from electricity duty • All solar power projects will be awarded "must run" status • 100% refund of VAT/SGST for all inputs for a period of 5 years • 100% refund of stamp duty on land

State Government Initiatives

Tamil Nadu Solar Energy Policy 2012	
Valid up to	2015
Nodal Agency	Tamil Nadu Energy Development Agency
Capacity Target & Period	Aim to add 3000 MW solar capacity in the state by 2015 • Utility scale projects: 1500 MW (1000 MW through Solar Purchase Obligations, 500 MW through GBI) • Through REC mechanism: 1150 MW
Land	To be acquired by the developer
Power Evacuation	Developer to bear cost of construction of evacuation facilities from project up to interconnection point
GBI for Rooftop Solar	For all solar ad solar-wind hybrid rooftops installed before March 31, 2014 (target capacity 50 MW) • Rs.2 per unit for first two years • Re.1 per unit for next two years • Re.0.5 per unit for next two years
Other Incentives	Exemption from payment of electricity tax for captive use/sale to utility for 5 years

State Government Initiatives

Tamil Nadu Solar Energy Policy 2012	
Solar park	Utility scale solar parks of capacity 250 MW/600 MW/650 MW with project sizes 1-5 MW, 5-10 MW and >10 MW respectively

State Government Initiatives

Uttar Pradesh Solar Power Policy 2013	
Valid up to	2017
Nodal Agency	Uttar Pradesh New and Renewable Energy Development Agency
Capacity Target & Period	Aim to add 500 MW solar capacity in the state by 2017 • Minimum project size – 5 MW • Projects through competitive bidding – 200 MW (UPPCL to sign PPA for 10 years)
Land	To be acquired by the developer
Implementation Period	Solar PV – 13 months from execution of PPA Solar Thermal – 28 months from execution of PPA
Power Evacuation	Developer to bear cost of construction of evacuation facilities from project up to interconnection point
State Support	State government to provide budgetary support to the Nodal Agency for paying the distribution utility difference in competitive bid tariff of conventional energy and solar energy. This subsidy will not be available to projects for 3rd party sales

State Government Initiatives

Uttar Pradesh Solar Power Policy 2013	
Other Incentives	All the incentives provided under the Uttar Pradesh State Industrial Policy,2012 will be applicable Expenditure on the construction of transmission line and substation will be borne by the State Government on all the projects in the Bundelkhand region Single window clearance
Solar farms	Special incentives on case to case basis for solar farms with total investment of more than Rs.500 cr.

State Government Initiatives

Madhya Pradesh – Policy for Implementation of Solar based projects, 2012	
Valid up to	Till next notification
Nodal Agency	Madhya Pradesh Urja Vikas Nigam Ltd
Capacity Target & Period	Sale to Discoms: As per RfS Captive/3rd Party sale outside state: Unlimited, with project size as follows: • Solar PV: Min 0.025 MW, Max 100 MW • Solar Thermal: Min 1 MW, Max 100 MW Under REC mechanism: Unlimited
Land	To be acquired by the developer
Implementation Period	Solar PV – 17 months from Approval to set up the project Solar Thermal – 24 months from Approval to set up the project
Power Evacuation	Developer to bear cost of construction of evacuation facilities from project up to interconnection point
Incentives	Exemption from payment of electricity duty and cess for 10 years from COD Will be eligible for benefits under MP Industrial Promotion Policy Exemption from VAT and entry tax for all solar power plant equipment

State Government Initiatives

Haryana Solar Power Policy 2014	
Valid up to	2017
Nodal Agency	Haryana Renewable Energy Development Agency
Capacity Target & Period	Aim to add 1300 MW solar capacity in the state by 2022 to meet RPO obligations • Through reverse bidding: 100 MW by 2017 (25 yr. PPA with discoms) • Others: no limit not specified
Land	To be acquired by the developer
Implementation Period	12 months from signing of PPA
Power Evacuation	Developer to bear cost of construction of evacuation facilities from project up to interconnection point
Min. Equity Requirement	For solar power projects developed by private companies, controlling shareholding of 26% is to be maintained for 3 years from COD
Other Incentives	Exemption from land use charges, external development charges etc. Benefits under the Industrial Policy of the state will be available

State Government Initiatives

Chhattisgarh State Solar Energy Policy 2012	
Valid up to	2017
Nodal Agency	Chhattisgarh Renewable Energy Development Agency
Capacity Target & Period	Aim to add 500 – 1000 MW solar capacity in the state by 2017
Land	To be acquired by the developer
Implementation Period	24 months from date of allotment
Power Evacuation	Developer to bear cost of construction of evacuation facilities from project up to interconnection point
Other Incentives	• Exemption from payment of Electricity Duty on auxiliary consumption and captive consumption within state • Exemption from VAT for all solar power plant equipment • Benefits under the State Industrial Policy such as interest subsidy, capital investment subsidy, exemption from stamp duty, exemption/concession in land premium, project report subsidy and technical patent subsidy

State Government Initiatives

Chhattisgarh State Solar Energy Policy 2012	
Other Incentives	• Cross subsidy surcharge shall not be applicable for open access obtained for 3rd party sale within state • Single window clearance
Solar park	State will promote implementation of solar park either on its own through PPP model on cost sharing basis

Short-term Power Procurement and Open Access

Akhilesh Awasthy
Director (Market Operations)

9th Capacity Building Programme for Officers of Electricity Regulatory Commissions
22nd Nov 2015, IIT Kanpur

Short Term Market?

- Liberalisation of power sector resulted in investment and efficiency, while at the same time called for competitive and flexible market systems
- Markets for Short term OTC, Exchange based Spot contracts in Day Ahead and Intraday, Real-time balancing markets including Demand Response, Ancillary service markets, and Financial derivative products for risk management like Futures, Options, CfDs, etc. have come into being in many countries with varying level of penetration

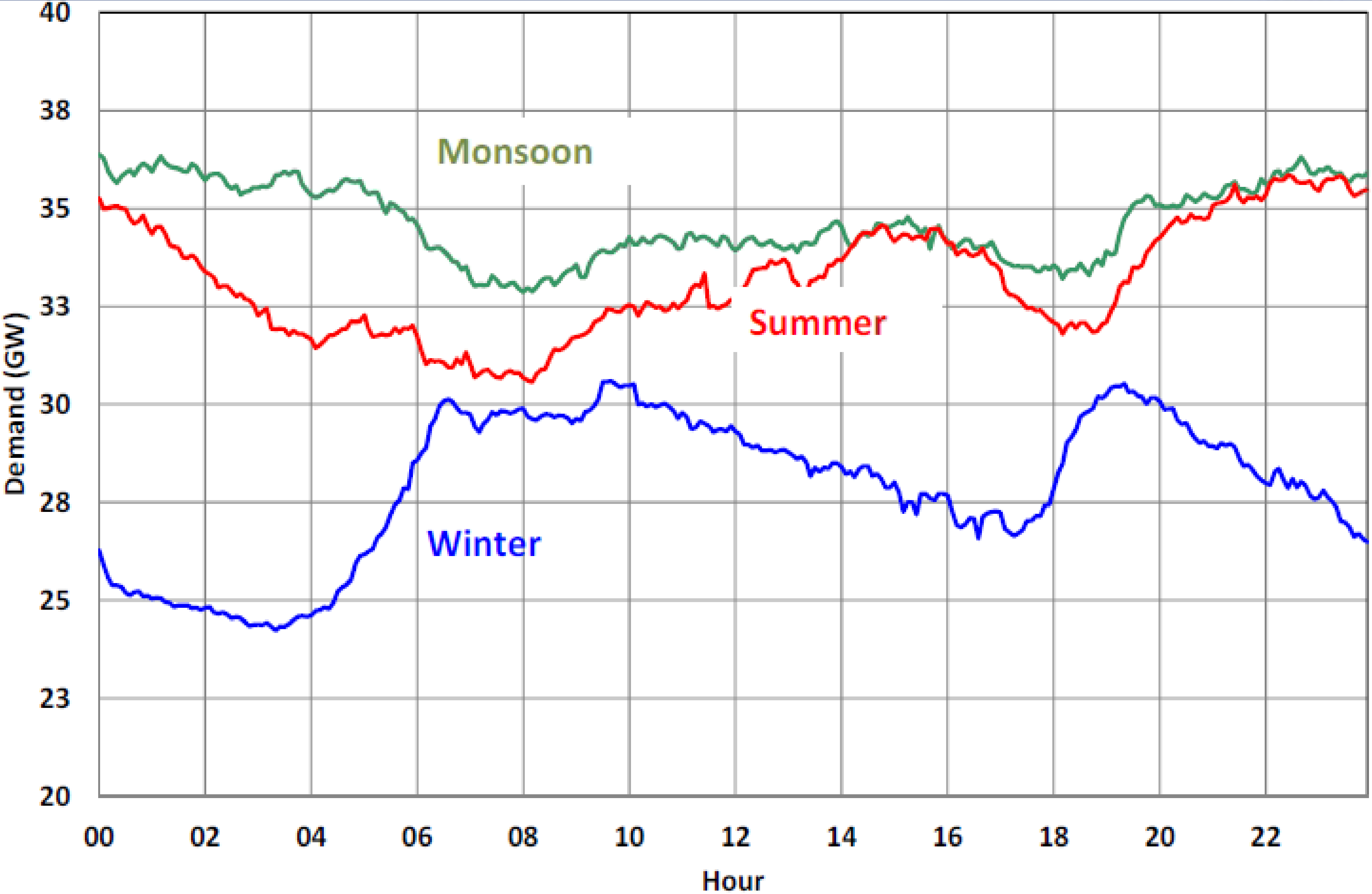
What determines the short term market share and associated market products?

- Generation mix?
- Level of privatization?
- Fuel linkage agreements?
- Financial institutions?
- Political or Governance structures?

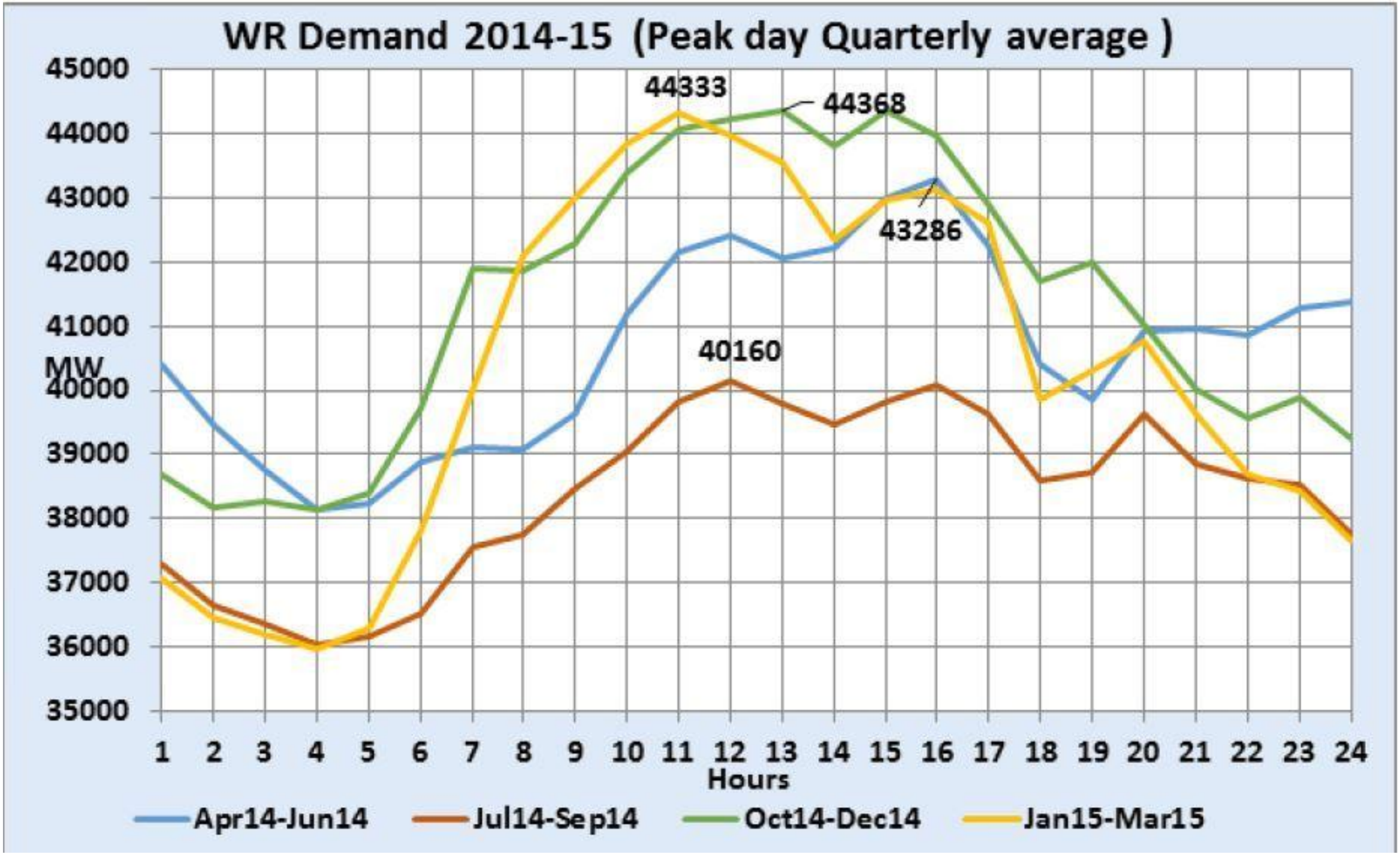
What should be power procurement policy

- Judicious mix of both long and short term procurement should be deployed based of forecasted demand and price forecasts
- Supply side and Demand side uncertainties should be quantified for the long term, accordingly uncertainties better manageable with short term should be identified
- Growing renewable penetration increases uncertainties for long term/base load procurement
- Spot market's liquidity and volatility play an important role in deciding procurement strategy

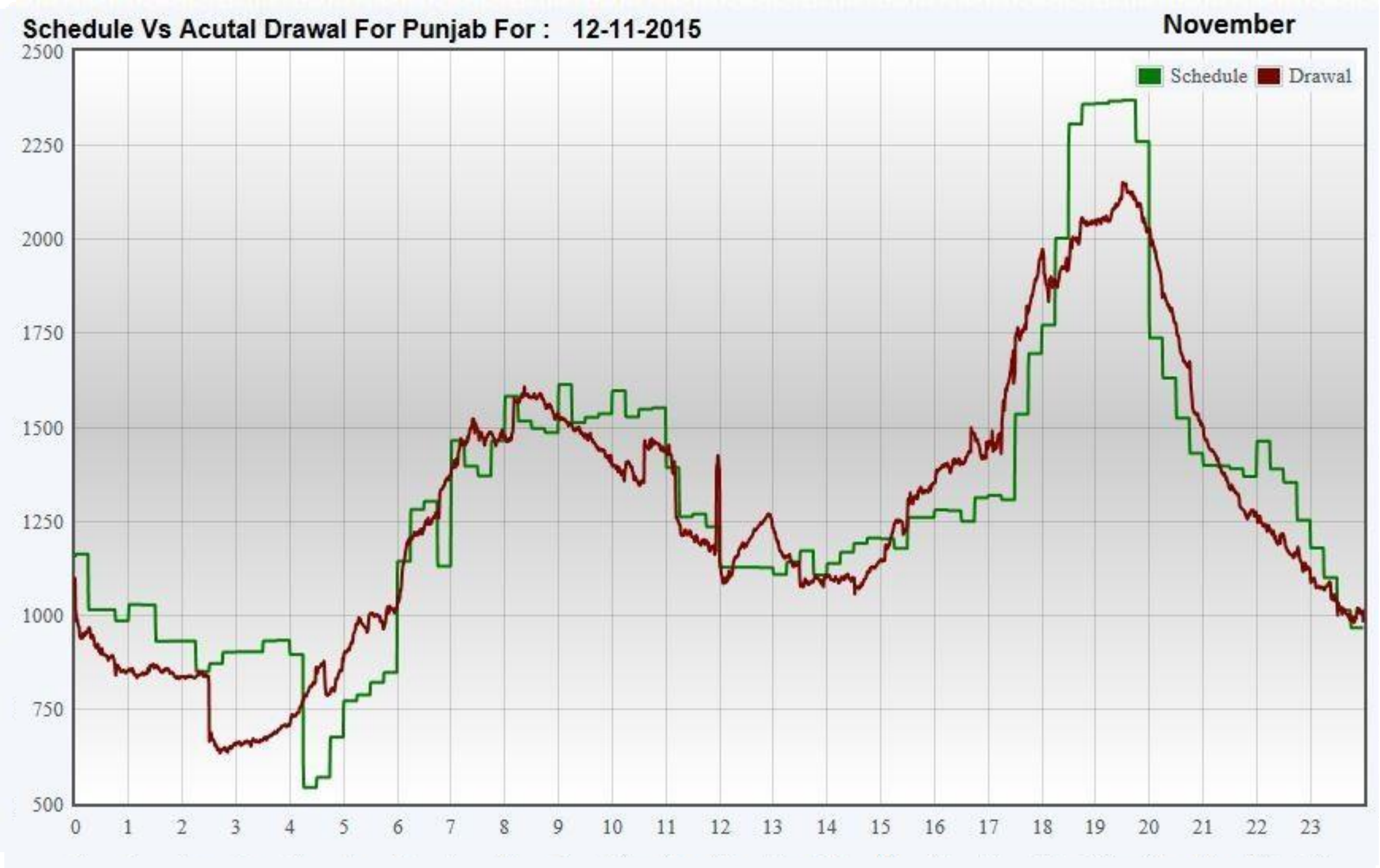
NR Typical Demand Curve



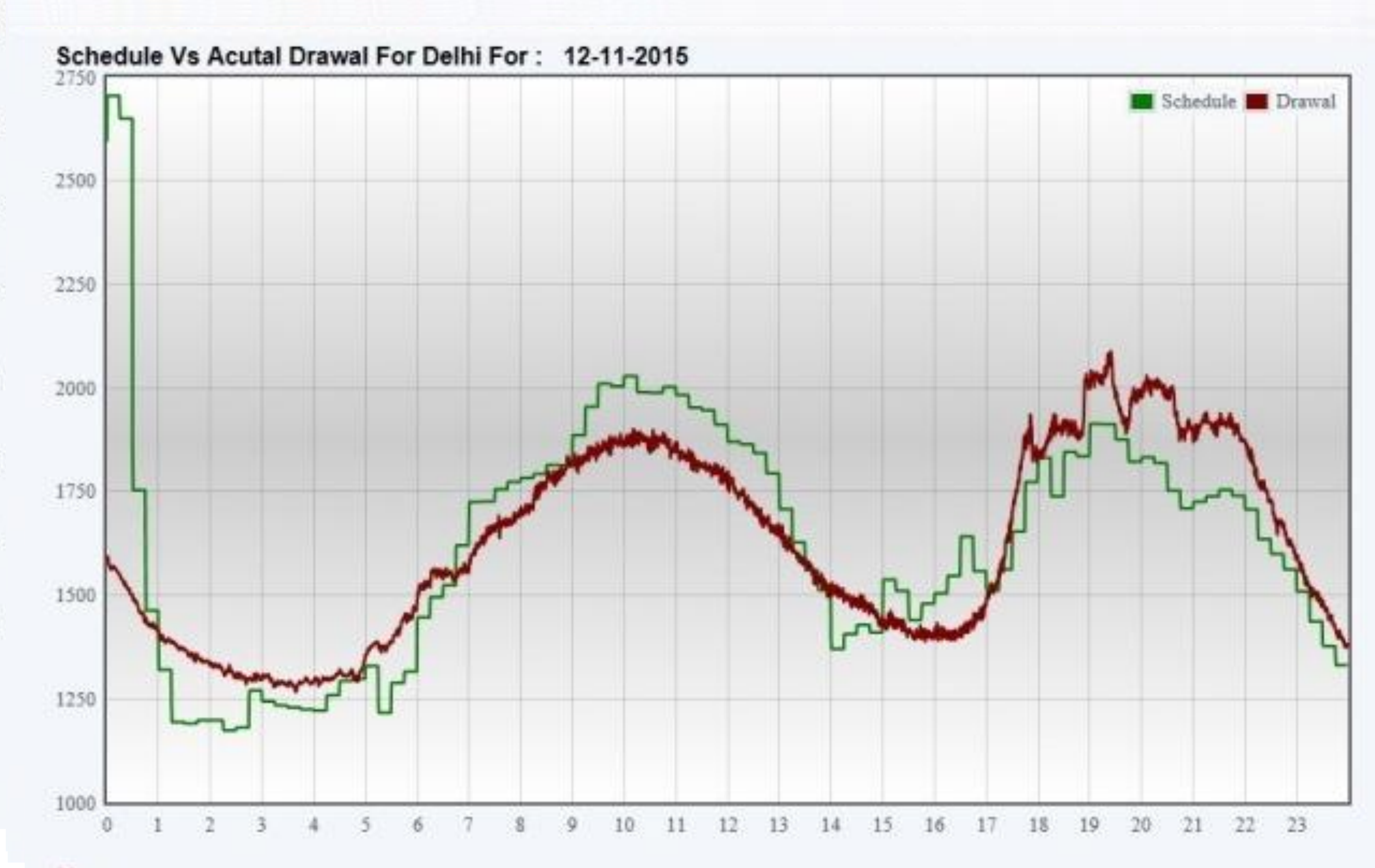
WR Demand Curve



Punjab - Large agricultural load

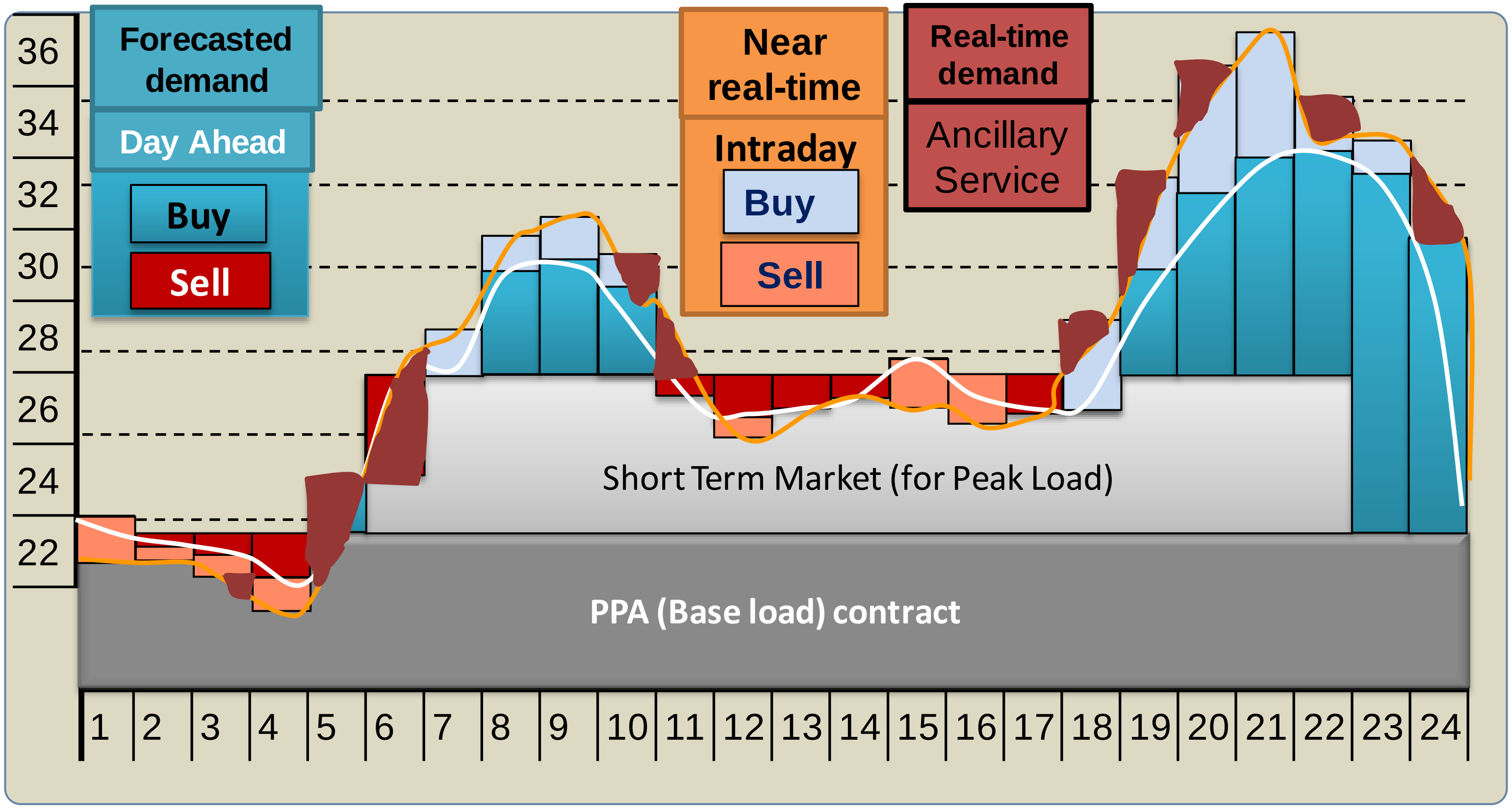


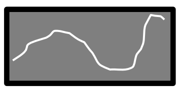
Delhi- Residential & Commercial Load

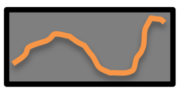


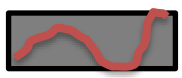
Rajasthan- Mixed load

Efficiently matching the Demand Curve




Forecasted Demand Curve of the Discom

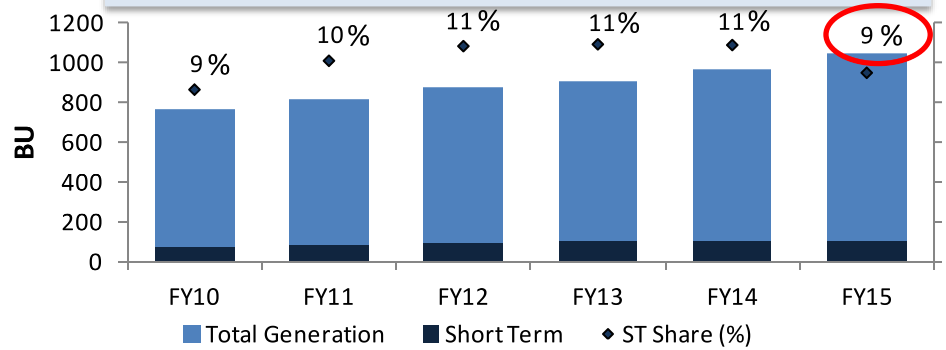

Actual Demand


Real time variations

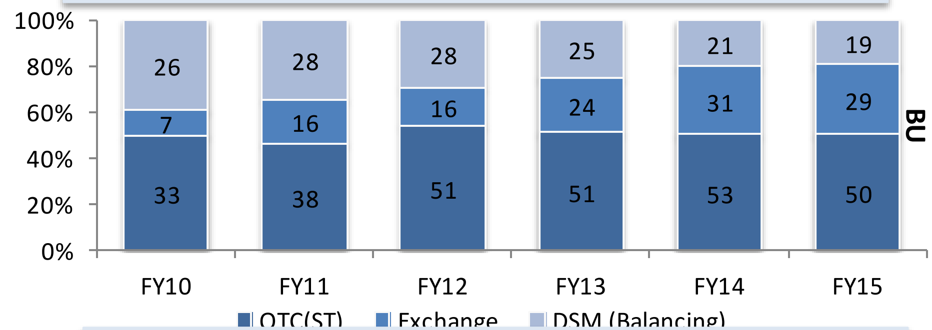
Indian Power Market Overview

Segment	Duration	Product	Share
Long Term	Upto 25 Years	OTC PPAs	91%
Medium Term	3 months – 3 years	OTC Bilateral	<1%
Short Term	Intraday - 3 months	OTC Bilateral	4%
		+ EXCHANGE Weekly Daily Day Ahead Intraday	3%
Balancing Market	Real Time	DSM Frequency linked	2%

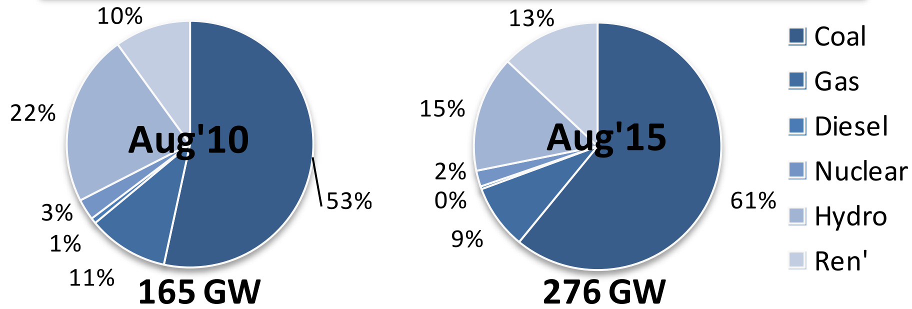
Short Term Market Remained Stable, Long term prioritised



Exchange Transactions Registered Growth in Short Term Mkt.



Installed Capacity tilted towards Coal & Renewables



Regulatory intervention

- To frame regulations/guidelines for power procurement under long term, medium term and short term with flexibility to access cheaper power
- Encouraging procurement through competitive bidding/exchanges to meet requirements, so as to enhance transparency
- Regular monitoring of market prices and associated procurement practices of Discoms, so as to meet demand at least cost

Consequences of not having correct mix

- Payment of fixed charges to costly generators even though no energy is scheduled (Sunk investment), with no option to relinquish before the end of PPA
- Greater exposure to short term markets and associated volatility, in excess of volatile demand – unless price hedging products are judiciously used
- Technology and Fuel Risk generally on the beneficiary – therefore longer duration PPA commits for longer duration

Govt. policies increasing thrust on LTA: Fuel supply only to long term PPAs

- **Coal from e-auction mines to be used only** for supply of power under long term contracts.
- Coal Allocation and supply only for Capacity tied up under long term PPAs
- **Domestic gas allocation** is also being done to generators having long term PPA.
- Recent initiative to **allocate LNG** at subsidised price is also applicable only for the generating stations having long term PPA.
- During 2014-15, **e-auction coal quantity was reduced** to ensure higher coal supply to generating stations having long term PPA.
- Need to appreciate importance of short term market

Exchange SPOT market share

Country	PX	Volume Share
USA	PJM	100%
UK	N2EX *& APX	55% 2015
Australia	AEMO	100%
New Zealand	NZX	100%
Singapore	SEMO	100%
Germany	EPEX Spot	60% 2014
France	EPEX Spot	13% 2014
Norway	Nordpool Spot	100% 2013
Sweden	Nordpool Spot	100% 2013

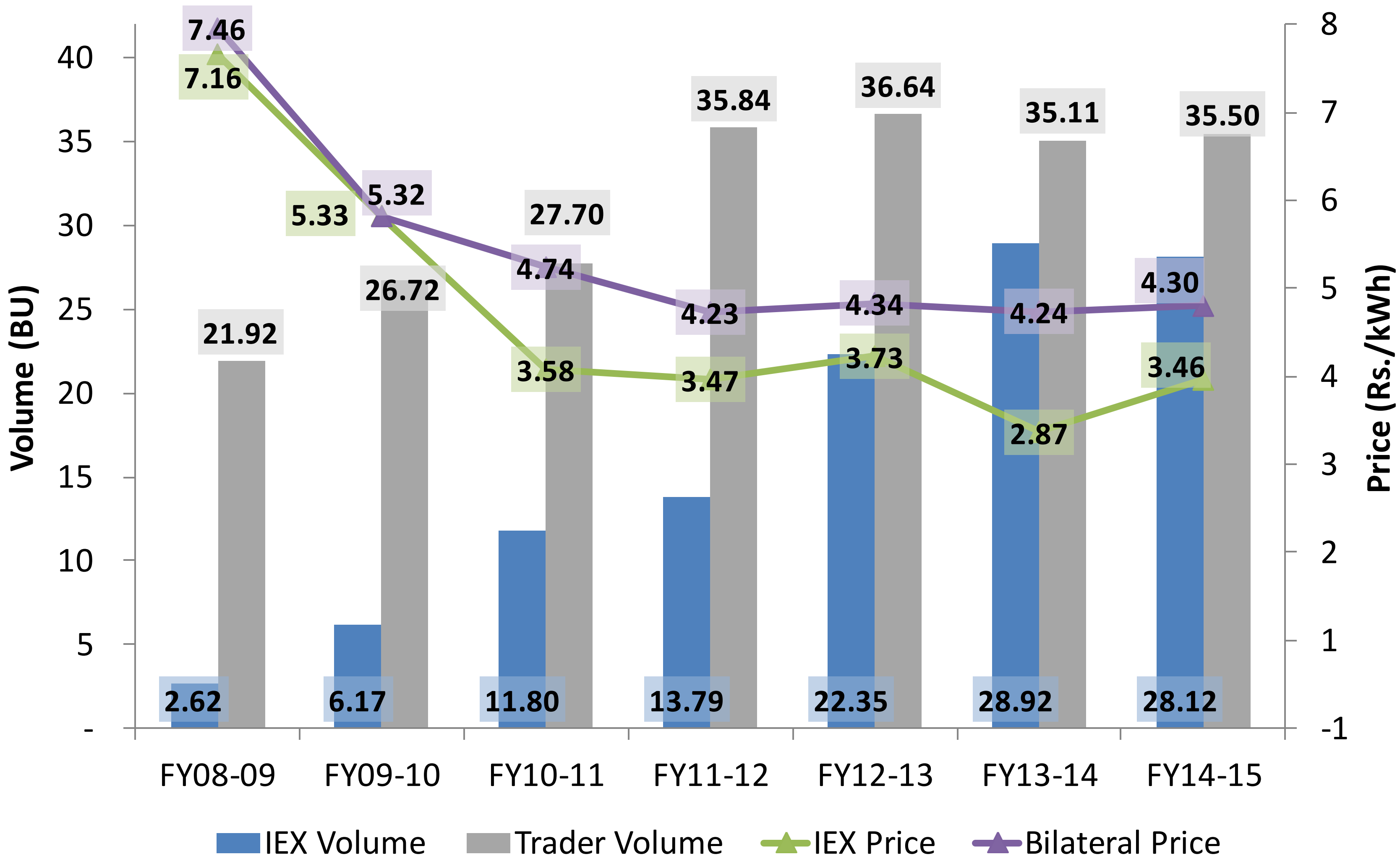
Power Purchase Cost Reduction

for States

Replacement of High Variable Cost power by DISCOMs

- Spot market of Power Exchanges can be used to optimise power procurement cost
- **Under long term PPA two component**
  - **Capacity charges (commitment charges):** paid irrespective of whether discom purchase power from these plants or not
  - **Energy charges :** Paid corresponding to the number of units of power purchased from that particular plant
- **Discoms can replace costlier long term power by procurement from Exchanges(DAM),**
  - When energy charge of power plant is greater than DAM rates
  - During night hours prices in DAM are very low and savings can be enhanced
- **Discoms can continue paying fixed charge under Long Term PPAs and substitute where energy charge is higher than DAM prices**

ST Price and Volume: Bilateral & DAM (IEX)



Power Portfolio of Delhi

Power Plant	Allocated Capacity (MW)	Annual Volume (MU)	Fixed Cost (Rs./kWh)	Variable Cost (Rs./kWh)
IGPCL Gas Turbine	267	1,207	1.29	5.05
Pragati-I	236	1,613	0.81	4.45
Badarpur TPS	532	2,892	1.21	4.29
APCL, Jhajjhar	267	1,162	2.66	4.25
Auraiya Gas	74	277	1.38	3.89
Farakka	23	132	1.09	3.83
Dadri Gas	93	407	1.17	3.81
NCPP-Dadri	630	3,478	1.15	3.65
Rajghat	131	569	2.41	3.50
Anta Gas	45	208	1.28	3.39
Dadri Extension	735	5,126	1.84	3.36
Pragati-III, Bawana	919	2,344	2.66	3.32
Kahalgaon Stage-I	52	301	1.19	2.92
Mejia Unit-6	71	610	1.84	2.80
Kahalgaon Stage-II	160	896	1.53	2.75
Unchahar-I	25	166	1.07	2.52
Unchahar-III	30	198	1.63	2.50
Unchahar-II	48	327	1.10	2.49
Chandrapur (Ext.-7 and 8)	329	1,728	2.41	1.97

Power Portfolio of Delhi

Power Plant	Allocated Capacity (MW)	Annual Volume (MU)	Fixed Cost (Rs./kWh)	Variable Cost (Rs./kWh)
Maithon Power Limited	300	2,215	1.41	1.92
Rihand-II	128	861	1.12	1.62
Rihand-I	101	695	0.95	1.61
Rihand-III	126	880	0.89	1.55
Singrauli	152	1,081	0.61	1.15
Sasan UMPP	107	1,084	0.04	0.99
Thermal	**5,580**	**30,455**		
Nuclear	**750**	**2,914**		
Hydro	**121**	**609**		
Renewable	**11**	**64**		
Total	**6,462**	**34,042**		

Cost Optimisation Potential in Delhi(Annual): Plant-wise

S. No	Power Plant	Allocated Capacity (MW)	Variable Cost (Rs./kWh)	Annual Savings (Rs. Cr)
1	Badarpur TPS	532	4.29	181
2	NCPP-Dadri	630	3.65	163
3	Pragati-I	236	4.45	161
4	IGPCL Gas Turbine	267	5.05	142
5	Dadri Extension	735	3.36	87
6	Pragati-III, Bawana	919	3.32	39
	Total	**3,319**		**772**

Source:

- *Annual Variable Cost of Power Stations (FY 2014-15) from ARR*
- *Source for Volume:*
  - *Volume of CGS taken from NRPC*
  - *Volume of SGS taken from SLDC*

Cost Optimisation Potential in Delhi Annual: Month-wise

S.no	Month	Total Energy (MU)	IEX Price (Rs/kWh)	Energy Replaced (MU)	Annual Savings (Rs. Cr)
1	Apr-14	1,068	3.44	824	**38**
2	May-14	1,357	3.16	1,324	**74**
3	Jun-14	1,589	3.56	1,006	**39**
4	Jul-14	1,588	3.35	1,076	**68**
5	Aug-14	1,425	4.19	277	**5**
6	Sep-14	1,292	4.06	279	**9**
7	Oct-14	1,266	3.66	413	**25**
8	Nov-14	1,153	2.63	1,153	**112**
9	Dec-14	1,035	2.97	1,035	**69**
10	Jan-15	1,201	2.70	1,201	**120**
11	Feb-15	917	2.60	917	**96**
12	Mar-15	947	2.44	947	**117**
	Total	**14,839**		**10,453**	**772**

Note: Power Stations with variable cost above Rs.3/kWh & 6 high saving potential power plants are considered

Potential of replacing about 31% of 34 BU and achieving cost saving of about Rs. 772 Crores through IEX

Way Forward

- Power procurement from IEX is at more competitive prices than bilateral transactions
- Power purchase cost of Delhi can be reduced by about Rs. 750 cr/year by substituting power from costlier generating stations with IEX
- Even when prices at IEX are high, cost savings can be achieved during night hours when prices are invariably low

Cost reduction of Long term Power Purchase – Rajasthan

Cost Optimisation Potential in Rajasthan Annual: Plant-wise

S. No	Power Plant	Allocated Capacity (MW)	Variable Cost (Rs./kWh)	Annual Savings (Rs. Cr)
1	Jhajjar	18	4.21	13
2	Auraiya GF	46	3.89	8
3	Dadri GF	59	3.83	11
4	Suratgarh STPS I TO VI	1500	3.58	284
5	Dadri-2	50	3.36	5
6	Kota I TO VII	1240	3.27	126
7	Farakka	11	3.22	1
8	Anta GF	61	3.10	4
9	Dholpur	330	3.02	6
	Total	**3,406**	**-**	**460**

Source:

**Annual Variable Cost of Power Stations (FY 2014-15) from ARR*

***Power Stations with variable cost above Rs. 3/unit are considered*

****Source for Volume:*

1. *Volume of CGS taken from NRPC*
2. *Volume of SGS taken from ARR*

Cost Optimisation Potential in Rajasthan Annual: Month-wise

S.no	Month	Total Energy (MU)	IEX Price (Rs/kWh)	Energy Replaced (MU)	Annual Savings (Rs. Cr)
1	Apr-14	1,692	3.44	43	1.9
2	May-14	1,704	3.16	901	19.5
3	Jun-14	1,737	3.56	78	2.5
4	Jul-14	1,724	3.35	64	3.6
5	Aug-14	1,798	4.19	0	0.0
6	Sep-14	1,680	4.06	5	0.0
7	Oct-14	1,689	3.66	43	1.1
8	Nov-14	1,701	2.63	1,701	96.0
9	Dec-14	1,711	2.97	1,605	39.0
10	Jan-15	1,690	2.70	1,690	82.6
11	Feb-15	1,623	2.60	1,623	95.4
12	Mar-15	1,684	2.36	1,684	118.0
	Total	**20,431**		**9,435**	**460**

Note: Power Stations with variable cost above Rs.3/kWh

Potential of replacing about 15% of 66 BU and achieving cost saving of about Rs. 460 Crores through IEX

Open Access

Implementation & issues

Why Open Access?

- Choice, Competitive retail
- Competition would force improvement in efficiencies of Discom’s
- Reduced Subsidy burden on State
- Economizing Power Procurement for Industries – They face international competition, cant load them with cross subsidy for long
- Promoting investments in Generation out side long term PPAs (merchant capacities)
- Higher Liquidity would make power prices more competitive

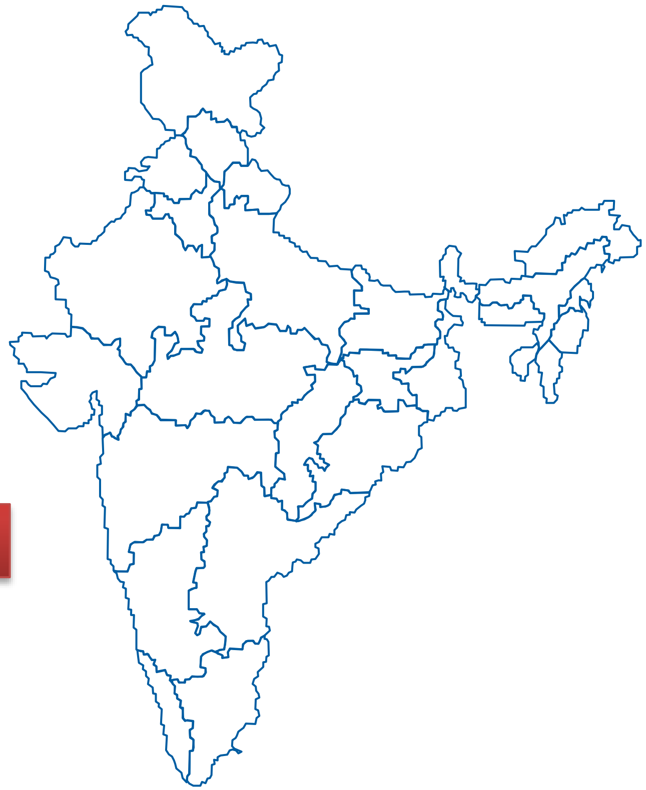
Open Access Status across Indian States

Northern Region

States	Generator	Consumer
Haryana	✓	✓
Punjab	✓	✓
Rajasthan	✓	✓
HP	✓	✓
J&K	✓	✗
Uttaranchal	✓	✓
Delhi	✓	✓
UP	✗	✗

Western Region

States	Generator	Consumer
M.P	✓	✓
DNH & DD	✗	✓
Gujarat	✓	✓
Chhattisgarh	✓	✓
Maharashtra	✓	✓



✓ **Allowed** ✗ **Not Allowed**

East & North Eastern Region

States	Generator	Consumer
Assam	✓	✓
Bihar	✗	✗
Manipur/Mizo	✓	✓
Tripura/Sikkim	✓	✓
Jharkhand	✗	✗
A.P.	✓	✓
Meghalaya	✓	✓
Orissa	✓	✓
West Bengal	✓	✗

Southern Region

States	Generator	Consumer
A.P	✓	✓
Karnataka	✓	✓
Tamil Nadu	✗	✓
Kerala	✗	✓

Barriers to Open Access

Prohibitive Open Access Charges

- High Cross subsidy surcharge
- High wheeling charges
- Additional surcharge

Legislative Impediments

- Gross misuse of certain statutes in the EA 2003
- **Section 11** (Govt. directs to Generator): T.N, Karnataka
- **Section 37** (Govt. can direct to RLDC/SLDC): Haryana
- **Section 108** (Govt can direct to State Commission)

Operational Hurdles

- Unwilling SLDC/ needed capacity building
- Procedural Bottlenecks
- Physical infrastructural constraints

States blocking Open Access (OA)

- Most of the major states have allowed Open Access to comply with the Act and Policies but the regulations framed there under are restrictive

Various tools used to block Open Access:

- **High Open Access Charges:** States like **Punjab, Madhya Pradesh, Andhra Pradesh, Tamil Nadu, West Bengal, Odishsa** have increased applicable charges
- **Regulatory Restrictions imposed:**
  - **Maharashtra** No buy through Day-Ahead Market
  - **Rajasthan** issued draft regulation to block Open Access through DAM
- **Non issuance of NoC: Gujarat** cancelled NoC from March 2014 citing constraints in the upstream transmission network in South and central Gujarat.

State specific OA issues

Madhya Pradesh

- Cross Subsidy Surcharge increased by Rs. 1.65/kWh

Himachal Pradesh

- Increase in wheeling charges by Rs. 0.03/kWh.
- Cross Subsidy Surcharge for Peak hours is high at Rs 2.70/kWh.

Uttarakhand

- Transmission & wheeling charges will be charged at Rs 4000/MW/Day basis. Earlier it was charged on per Unit basis. Disincentive for procurement on non RTC basis.

Daman & Diu

- Cross subsidy increased by Rs 0.82/kWh
- Increase in Wheeling charges by Rs 0.09/kWh

Dadar N Nagar Haveli

- Cross Subsidy increased by Rs. 0.51/kWh

Andhra Pradesh

- Cross Subsidy fixed at Rs. 2.39/kWh
- Wheeling charges increased by Rs. 0.07/kWh for 11 KV.

Open Access Charges Losses and Charges in select States at 33 kV level

State	CTU Charges (Rs/kWh)	CTU Loss (%)	STU (Rs/kWh)	STU Loss (%)	Wheeling (Rs/kWh)	Wheeling Loss (%)	CSS (Rs/kWh)	Additional Surcharge (Rs/kWh)
Rajasthan	0.17	0.02	0.29	0.04	0.11	0.04	0.13	
Haryana	0.17	0.02	0.36	0.02	0.85	0.00	0.93	0.50
U.P.	0.15	0.03	0.19	0.04	0.34	0.04	0.47	
Punjab	0.13	0.02	0.19	0.03	1.08	0.02	0.89	
Gujarat	0.13	0.02	0.12	0.05	0.14	0.10	0.59	**0.98**
Telangana	0.17	0.02	0.11	0.03	0.02-0.08	0.04-0.06	**1.54**	
Andhra P	0.17	0.02	0.11	0.03	0.02	0.03-0.05	**2.39**	
Madhya P	0.15	0.02	0.07	0.03	0.23	0.06	**1.67**	
West Bengal	0.13	0.01	0.08	0.03	0.82	0.04	**2.20**	
Delhi	0.13	0.02	0.26	0.01	0.61-0.72	0.01	0.46-0.64	
Tamil Nadu	0.17	0.02	0.12	0.02	0.19	-	-	-

Gujarat

- 18th Mar 14: GETCO cancelled OA for over 163 consumers in South and Central Gujarat indicating constraints in upstream network
- Industries filed petition in GERC and in April 2015: GERC directed SLDC to grant NoC.
- SLDC not adhering to the GERC Order.
- Appeal filed in High Court by GETCO/Discoms
- SLP in Supreme Court by industries to expedite & SC directed Gujarat High Court to dispose of the matter within 30 days.
- Purchase by industries in last 1 year has increased from 5 MU per day to about 8 MUs per day.

Other Petitions filed against high OA charges

- **Haryana**
  - State Govt decision of invoking section 37 of Electricity Act, 2003 and restriction of STOA.
  - Petition filed in High Court of Punjab & Haryana
  - On 31.07.2015 the High Court passed a final order ruling in favor of the industries. **Restriction under Sec 37 Withdrawn**
  - **Open Access volume has now restored to earlier levels**

- **Andhra Pradesh**
  - Increase of CSS to Rs 2.39 per unit for FY 16, making Open Access unviable
  - Review Petition filed to APERC
  - **Also challenged in APTEL, since it is against the Policy issued by the Central Government**

Other Petitions filed against high OA charges

- **Madhya Pradesh:**
  - Increase in CSS from 2 paise per unit to Rs 1.67/unit in for FY 16.
  - **Review petition filed through Consumers in MPERC**
  - **Also Appeal filed in APTEL**

- **Rajasthan**
  - **Discoms filed petition for** increase in CSS, Additional Surcharge and other applicable charges to Commission
  - **RERC issued draft regulations for comments in which provision of not allowing Open Access on DAM is included.**

Issues in other States

- **Delhi**
  - Discoms not favoring open access and blocking on pretext of metering, feeder separation etc
  - **First Consumer from Delhi is registered at IEX and will start trading by December 15 as during Aug to Nov additional surcharge of Rs 3/unit is levied.**
- **Uttar Pradesh**
  - Infrastructure Constraints
  - State government not willing for open access to industries

Issues in Other States

- **West Bengal:**
  - High CSS of Rs 2.20 per unit makes OA unviable
- **Bihar**
  - Infrastructure constraints
- **Jharkhand**
  - Regulations in place but JSERC, JSEB against OA.
  - The distribution system is poor
  - High wheeling loss

Derivatives

- *'Derivative is a financial instrument or security whose pay-off depends on another financial instrument or security or commodity. Derivatives neither create nor destroy wealth, they provide means to transfer risk'*
- May or may not involve physical delivery of commodity
- Types of derivatives prevalent in electricity markets:
  - **Futures**: Promise to exchange a product for cash by a set delivery date at a pre determined price /spot electricity prices(marking to market)
  - **Options**: Right to either buy or sell something at a set price, within a set period of time (call/ Put @ exercise price)
  - **Contract for Differences**: Parties agree a Strike Price and amount of commodity. It's a combination of Call & Put option with the same exercise price. Prevalent in Pool model wholesale electricity markets.

Electricity Derivatives?

- ‘*Introduction of derivatives has decreased the volatility of the underlying stock; Evidence from Indian Market* ’ Derivative trading and spot market volatility, Dr. Dhanya Alex, Dr. Verghese, IJIED, 2015
- “*There is still tremendous distrust of certain products such as financial options, or more generally derivatives*” Raghuram Rajan in Report of the Committee on Financial Sector Reforms 2009
- Electricity markets are highly volatile, owing to unique physical commodity features of production, transmission and distribution.
- Uncontrolled exposure to market price risks in restructured market will have devastating impact on market participants.
- For example, fall in Exchange(IEX) DAM prices to an average of Rs 2.8/kWh in 2015 has resulted in many Discoms question existing higher cost long term PPAs, but unavailability of price hedging instruments left them exposed
- Day Ahead Market in India has attained wide acceptability in the past 7 years, with an average volume of over 85 MUs/ day. Transparent price discovery is now considered as reference for many bilateral trades. Penetration of renewables likely to aggravate volatility. As such, introduction of derivative market will help in controlling volatility and also aids volumes.
- Do we already have some form of Electricity Derivatives? May be!

Spot Market	+	Derivative Market
Allocative Function		Financing Function

Thank You for your attention

www.iexindia.com

Best Power Exchange in India
– Enertia Awards '14, '13 &'12
– India Power Award 2014
– Power Business View 2014

Inc India Innovative 100 Award for 'Innovation in Product and Technology'

Best Performing Power Exchange –
Power Line Awards '13 & '12

India Power Awards '15 & '09

Renewable Energy Generation Tariff Determination in Practice

Capacity Building Programme for Officers of Electricity Regulatory Commissions
IIT Kanpur
22/11/2015

Rakesh Shah
Director- Regulatory Affairs
SunEdison Energy India Limited

Legal and Policy Framework for promotion of RE

Legal Framework

- Federal Structure
- Electricity is a concurrent subject.
- Principal Central legislation:
  - Electricity Act, 2003
    - Basic policy and regulatory framework
- Regulatory Framework
  - Central level
    - Central Electricity Regulatory Commission (CERC) (inter-State issues)
  - Province level
    - State Electricity Regulatory Commission (SERCs) (intra-State issues)
  - Forum of Regulators - for harmonization

The Electricity Act, 2003 : Enabling provisions

- Section 86(1)(e): Specify Renewable Purchase Obligation (RPO) from renewable energy sources
- Section 61(h): Tariff regulations to be guided by promotion of renewable energy sources
- Section 3: National Electricity Policy, Tariff Policy and Plan
- Section 4: National Policy permitting stand alone systems including renewable sources of energy for rural areas

The Electricity Act, 2003: Sec. 86(1) (e)

- The State Commission shall discharge the following functions, namely:

  "promote cogeneration and generation of electricity from renewable sources of energy by providing suitable measures for connectivity with the grid and sale of electricity to any person, and also specify, for purchase of electricity from such sources, a percentage of the total consumption of electricity in the area of a distribution licensee;"

The Electricity Act, 2003: Sec.61(h)

- The Appropriate Commission shall, subject to the provisions of this Act, specify the terms and conditions for the determination of tariff, and in doing so, shall be guided by the following, namely:-

(h) the promotion of co-generation and generation of electricity from renewable sources of energy;

National Electricity Policy:
(12th February, 05)

- Urgent need of promotion renewable sources of energy
- Efforts need to be made to reduce the capital cost of such projects
- Cost of energy can be reduced by promoting competition
- Adequate promotional measures would have to be taken for development of technologies and sustained growth of these sources
- SERCs to provide suitable measures for connectivity with grid and fix percentage of purchase from Renewable sources
- Progressively the such share of electricity need to be increased

Tariff Policy:
(6th January 2006)

- Appropriate Commission
  - shall fix RPO
  - shall fix tariff
  - Initially fix preferential tariffs
- In future Discoms to procure RE through competitive bidding within suppliers offering same type of RE
- In long-term, RETs need to compete with all other sources in terms of full costs
- CERC to provide guidelines for pricing non-firm power if RE procurement is not through competitive bidding

National Action Plan on Climate Change (NAPCC), 2008

- National level target for RE Purchase
  - 5% of total grid purchase in 2010, to be increased by 1% each year for 10 years: 15% by 2020
- SERCs may set higher target
- Appropriate authorities may issue certificates that procure RE in excess of the national standard
  - Such certificates may be tradable, to enable utilities falling short to meet their RPO
  - RE generation capacity needed: From 18000 to 45500 MW by FY2015

Jawaharlal Nehru National Solar Mission (JNNSM) 2010

- One of the eight Missions under NAPCC, launched by the Government of India in January 2010.
- The objective of the JNNSM is to establish India as a global leader in solar energy.
- Mission aims to achieve grid tariff parity by 2022 through
  - Large scale utilization, rapid diffusion and deployment at a scale which leads to cost reduction
  - R&D, Pilot Projects and Technology Demonstration
  - Local manufacturing and support infrastructure
  - 0.25% SPO by 2012-13 and 3% SPO by 2022

Tariff Policy Amendment : 2011

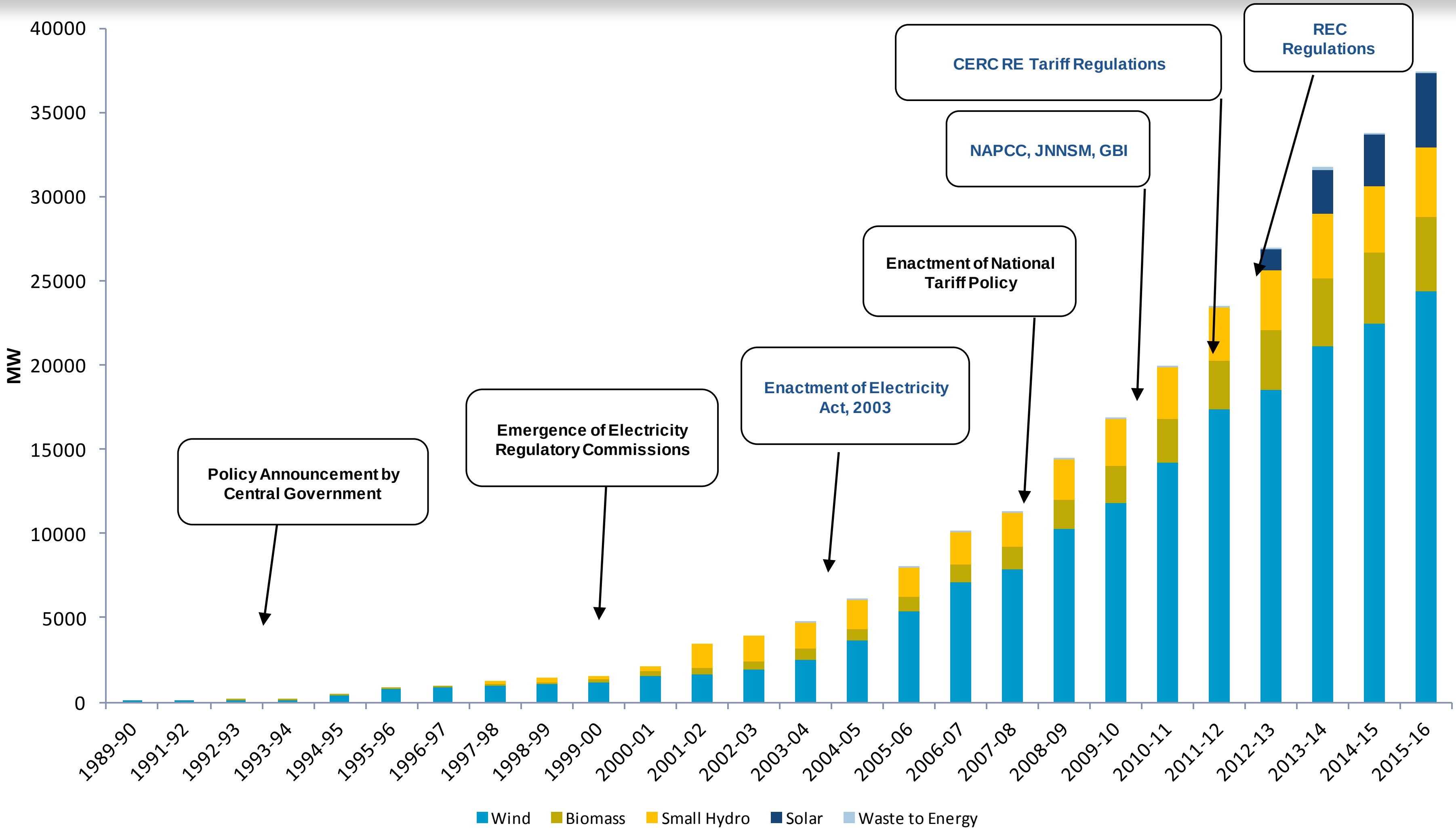
Para 6.4 (1) of the Tariff Policy amended on dated 20/1/2011

- SERC shall fix a minimum percentage of the total consumption of electricity in the area of a distribution licensee
- Such purchase should takes place more or less in the same proportion in different States
- SERCs shall also reserve a minimum percentage for purchase of solar energy
  - **Up to 0.25% by the end of 2012-2013**
  - **Further up to 3% by 2022**
- Renewable Energy Certificate (REC) would need to be evolved with separate **solar specific REC**

Regulatory Intervention

- Renewable Purchase Obligation (RPO)
- Preferential Tariff
- Facilitative Framework for Grid Connectivity
- Market Development (Tradable Renewable Energy Certificates)

Renewable Energy Development



RPO & RE Tariffs : Played important role in RE Capacity addition

Achievement of Renewable Energy in India (as on 30.09.2015)

Sector	Cumulative Achievements in MW
Wind Power	24376.26
Solar Power	4344.91
Small Hydro Power	4146.90
Bio-Power (Biomass & Gasification and Bagasse Cogeneration)	4418.55
Waste to Power	0127.08
Total	37413.70

Sl. No.		Wind	SHP	Biomass	Bagass	W to E	Solar	Total
1	Andhra	14497	978	578	300	123	38440	54916
2	Arunachal P	236	1341	8			8650	10236
3	Assam	112	239	212		8	13760	14330
4	Bihar	144	223	619	300	73	11200	12559
5	Chhatisgarh	314	1107	236		24	18270	19951
6	Goa		7	26			880	912
7	Gujarat	35071	202	1221	350	112	35770	72726
8	Haryana	93	110	1333	350	24	4560	6470
9	Himachal P	64	2398	142		2	33840	36446
10	Jammu & K	5685	1431	43			111050	118208
11	Jharkhand	91	209	90		10	18180	18580
12	Karnataka	13593	4141	1131	450		24700	44015
13	Kerala	837	704	1044		36	6110	8732
14	Madhya	2931	820	1364		78	61660	66853
15	Maharashtra	5961	794	1887	1250	287	64320	74500
16	Manipur	56	109	13		2	10630	10811
17	Meghalaya	82	230	11		2	5860	6185
18	Mizoram		169	1		2	9090	9261
19	Nagaland	16	197	10			7290	7513
20	Orissa	1384	295	246		22	25780	27728
21	Punjab		441	3172	300	45	2810	6768
22	Rajasthan	5050	57	1039		62	142310	148518
23	Sikkim	98	267	2			4940	5307
24	Tamil Nadu	14152	660	1070	450	151	17670	34152
25	Telangana						20410	20410
26	Tripura		47	3		2	2080	2131
27	Uttar Pradesh	1260	461	1617	1250	176	22830	27593
28	Uttarakhand	534	1708	24		5	16800	19071
29	West Bengal	22	396	396		148	6260	7222
30	Andaman & N	365	8				0	373
34	Delhi					131	2050	2181
36	Puducherry	120				3	0	123
37	Others					1022	790	1812
	Total	102772	19749	17536	5000	2554	748990	896602

Renewable Energy Tariff Design

Renewable Energy Policies

- Feed-In Tariff (FiT)
- Competitive Bidding
- Renewable Energy Certificates
- Net Metering

FITs are the most widely used policy mechanism globally

Feed-In-Tariff Definition

Feed-in Tariff (FIT):

A renewable energy policy that offers a guarantee of payment to renewable energy developers for the electricity they produce.

Access to the grid

- Must be able to connect
- Guarantee in interconnection
- Connection must be simple, timely, and at reasonable cost

Priority Purchase

- Renewable energy must be first priority
    - Must run status
- Producer must be assured that the electricity they produce is purchased
- Only exception is “system emergencies”

Contract Length

- Tariff levels are usually guaranteed for a longer period
  - 20 years or more
  - Longer contracts = lower initial tariff
  - Shorter contracts = higher initial tariffs
- Standardized Contract (Model PPA)

In this way FiT provides long-term certainty about receiving financial support, which is considered to lower investment risks

Specific tariff design

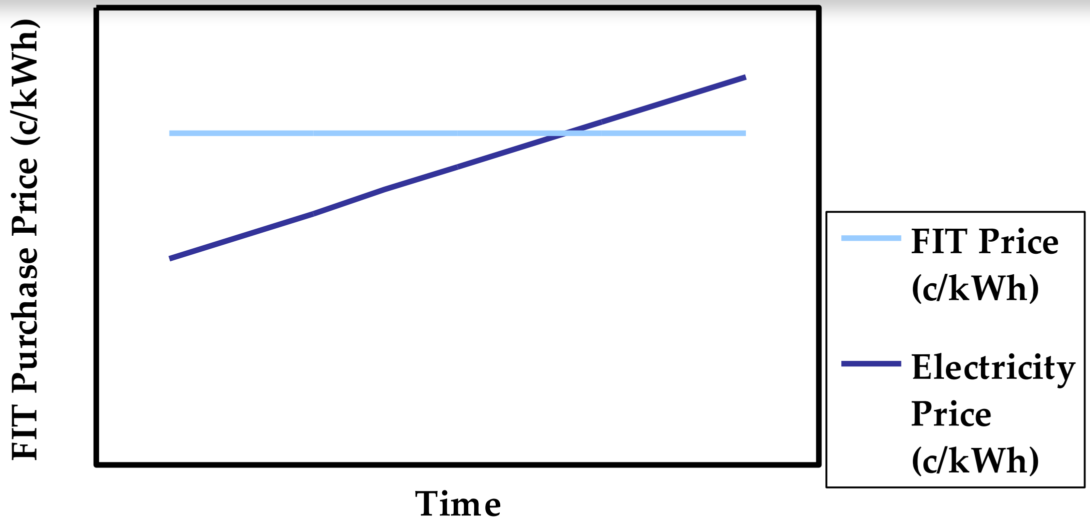
- Differentiated by technology
  - wind, solar, biomass, hydro, etc.
- Differentiated by project size
  - higher prices for small projects
  - lower prices for large projects
- Differentiated by resources qualities
- Differentiated by application
  - higher prices for rooftop solar , BIPV
- Differentiated by project location

Ancillary design elements

- Pre determined tariff degression
- Responsive tariff degression
- Annual inflation adjustment
- Front-end loading (i.e., higher tariffs initially, lower tariffs later on)
- Time of delivery (coincidence with demand to encourage peak shaving)

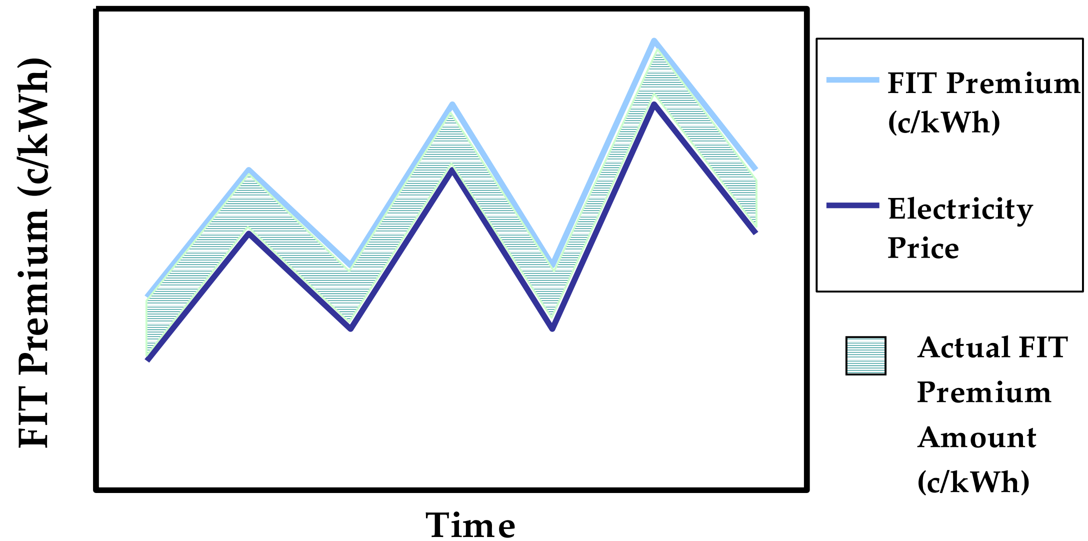
Fundamental FIT Payment Choice

(1) Fixed Price FIT Payment



Fixed Price FITs most common

(2) Premium FIT Payment (above market price)



Front loading payment stream

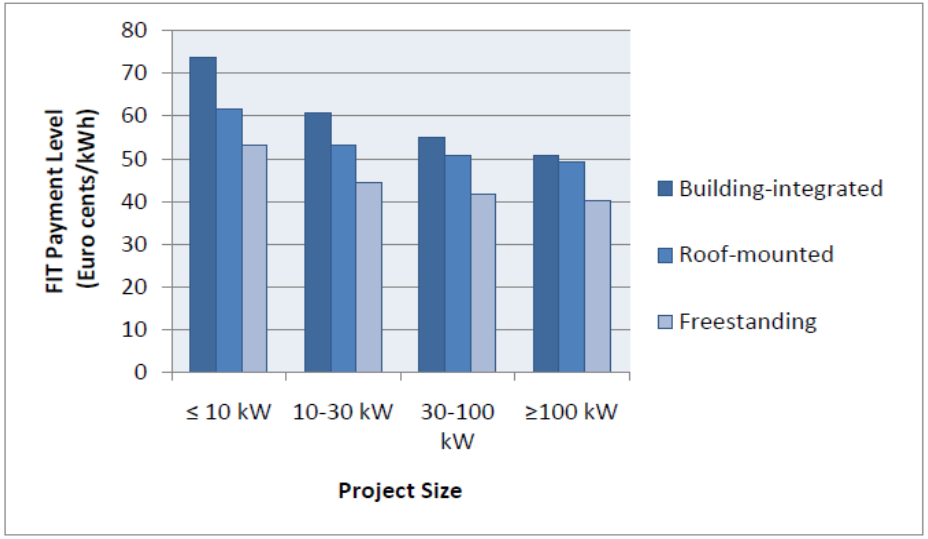
- Instead of having a constant tariff level for the complete support duration, it can be considered to increase tariffs for the first years of a project while decreasing tariffs in the last years.
- Without increasing the total sum of financial support, this can help to reduce financing cost.

Differentiation by Project Size

(i.e., kW or MW Capacity)

- Lowest payment level is typically offered to the largest plants
  - Reflecting the gains that result from economies of scale
- Differentiating FiT payments by project size is another means of offering FiT payments that reflect actual project costs

E.g.: France, Germany, Switzerland, and Italy provide the highest tariff amounts for the smallest PV installations



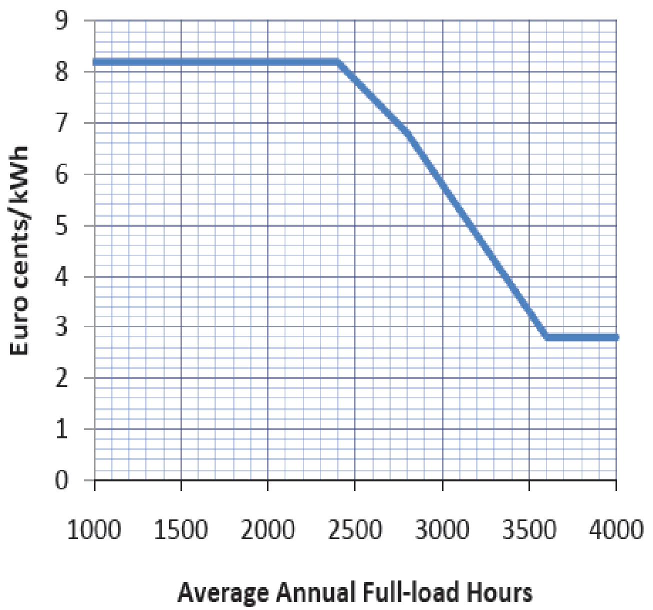
Source: SFOE 2010

Switzerland's solar PV payment

Differentiation by Resource Quality

- Different payments to projects in areas with a different cost of production
  - to encourage development in a wider variety of areas, which can bring a number of benefits both to the grid and to society
  - to match the payment levels as closely as possible to RE generation costs
  - For e.g. areas with a high-quality wind resource will produce more electricity from the same capital investment, all else being equal, leading to a lower levelized cost (FIT)

Denmark, France, Germany, Portugal, and Switzerland have implemented resource adjusted payment levels



On Shore wind farm FIT Payment Level (10 to 15 Years)
Source: France 2006, NREL 2010

Differentiation by Project Location

- Varied payments to projects mounted in different physical locations (without regard to resource quality)
  - To encourage project development in particular applications,
  - To encourage multi-functionality (e.g. solar PV),
  - Target particular owner types such as homeowners,
  - To meet a number of other policy goals

System Location	Payment Level (€ cents/kWh)
BIPV on recently constructed[42] residential buildings, schools, & health facilities	58
BIPV (on other recently constructed buildings)	50
Simplified BIPV	42
Freestanding PV (>250 kW)[43]	31.4
Source: France 2010a	

France FIT Payment Differentiation by Location for PV Systems (2010)

Predetermined Tariff Degression

- Used to keep tariffs in line with evolving cost realities through decreases in the payment level, at either specific points in time, or as capacity targets are reached
- Fixed annual percentage declines, or According to a “responsive” formula that allows the rate of degression to respond to the rate of market growth
  - Degression rates will be greater for rapidly evolving RE technologies such as PV
  - Degression creates greater investor security by removing the uncertainty associated with annual program revisions and adjustments

Tariff Degression for Landfill Gas Facilities in Germany (Germany RES Act 2008)

Project Size	Payment levels (€ cents/kWh) Based on an annual degression of 1.5% In-Service Year					
	2009	2010	2011	2012	2013	2014
0-500 kW	9.00	8.87	8.73	8.60	8.47	8.34
500 kW-5 MW	6.16	6.07	5.98	5.89	5.80	5.71

FIT: Responsive Degression

- Degression is adjusted according to the rate of market growth (Germany RES Act 2008)
- In Germany's case, if the annual installed PV capacity in a given year exceeds a certain amount, the percentage rate of annual degression is increased by 1%; if it falls short of a certain annual installed capacity, the degression rate is decreased by 1%

German Responsive Degression Rates

Year	Market Condition (this year)	Next year's annual degression rate
2009:	< 1,000 MW installed	Declines 1% (e.g. 8% to 7%)
	Between 1,000-1,500 MW installed	No change
	1,500+ MW installed	Increases 1% (e.g. 8% to 9%)
2010	< 1,100 MW installed	Declines 1% (e.g. 8% to 7%)
	Between 1,100-1,700 MW installed	No change
	1,700+ MW installed	Increases 1% (e.g. 8% to 9%)
2011	< 1,200 MW installed	Declines 1% (e.g. 8% to 7%)
	Between 1,200-1,900 MW installed	No change
	1,900+ MW installed	Increases 1% (e.g. 8% to 9%)

Source: Adapted from Jacobs and Pfeiffer 2009; see also Germany 2008 and 2010

Inflation Protection

- Feed-In Tariffs are index linked to the Retail Prices Index (RPI), which means the tariff is subject to inflation
    - Protects invested capital
- Higher protection = lower initial tariffs
- Prices adjusted periodically
    - For new projects
    - Inside existing contracts

Greater protection offered on the value of project revenues, adjusting FITs for inflation can reduce the perceived risk of the policy for investors

Periodic Review

- Determines if targets being met
- Allows price adjustment
  - If profits are too high
  - If targets are not being met
- Allows addition of new technologies
- Every 2-5 years

Fiscal and other support incentives

- Direct production incentives/Generation Based Incentive
- Investment subsidies
- Low-interest loans
- Loan guarantees
- Flexible/accelerated depreciation schemes
- Investment or production tax exemptions

Advantages of FIT Policies

- Offer a secure and stable market for investors
- Stimulate significant and quantifiable growth of local industry and job creation
- Only cost money if projects actually operate (i.e. Fits are performance-based)
- Provide lower transaction costs
- Can secure the fixed-price benefits of RE generation for the utility's customers by acting as a hedge against volatility

Advantages of FIT Policies

- Settle uncertainties related to grid access and interconnection
- Enhance market access for investors and participants
- Predictable revenues : Enable traditional financing
- Encourage technologies at different stages of maturity, including emerging technologies
- Customize the policy to support various market conditions, including regulated and competitive markets

Other benefits are that FIT policies

- Have a measurable impact on RE generation and capacity
- Tailor the policies using a range of design elements that will achieve a wide range of policy goals
- Are compatible with RPS mandates
- Can help utilities meet their RPS mandates
- Can provide a purchase price to renewable energy generators that is not linked to avoided costs
- Demonstrate a flexible project-specific design that allows for adjustments to ensure high levels of cost efficiency and effectiveness

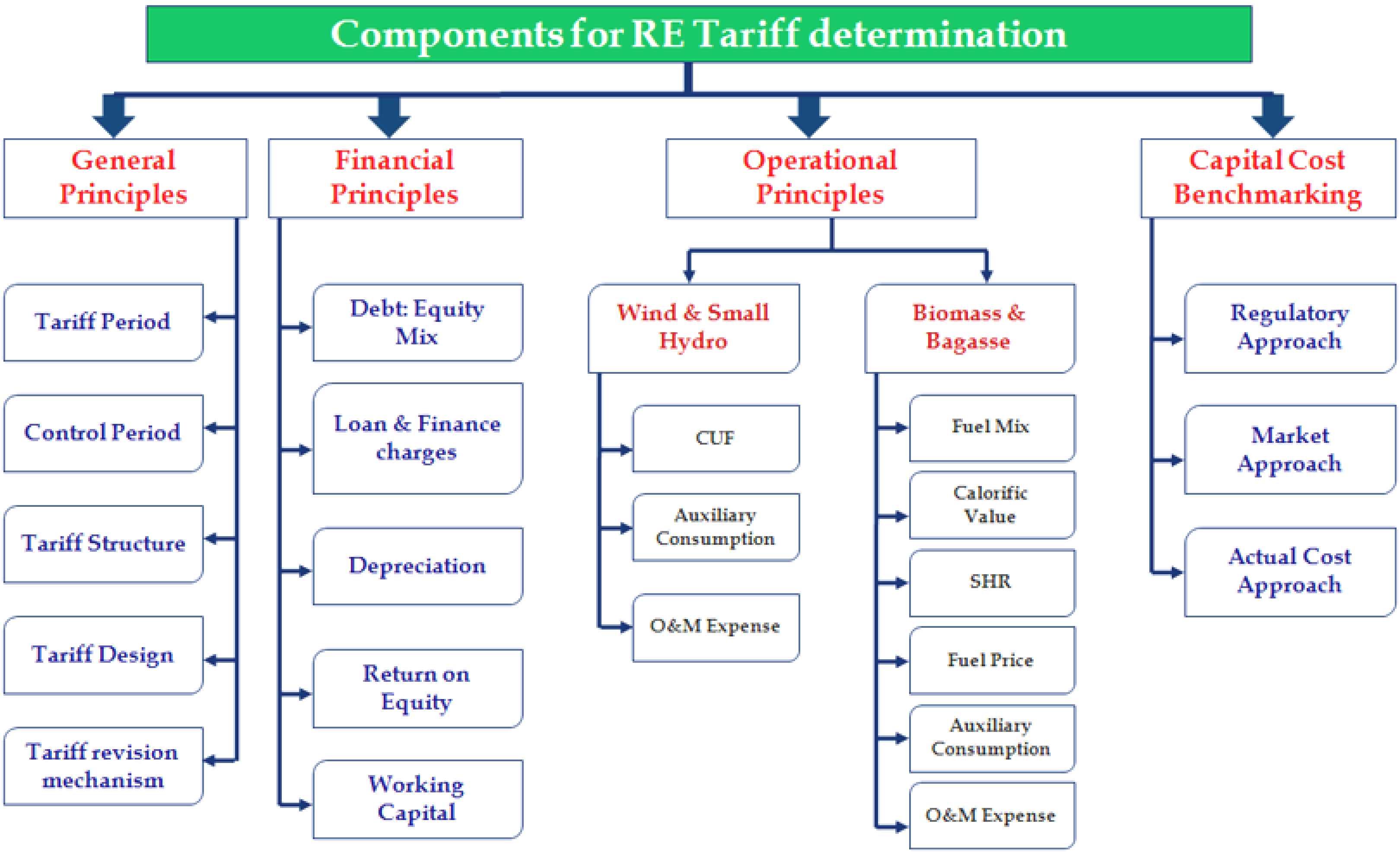
Disadvantages of FIT Policies

- FITs can lead to near-term upward pressure on electricity prices, particularly if they lead to rapid growth in emerging (i.e., higher-cost) RE technologies
- FITs may distort wholesale electricity market prices
- FITs do not directly address the high up-front costs of RE technologies – instead, they are generally designed to offer stable revenue streams over a period of 15-25 years, which enables the high up-front costs to be amortized over time

Disadvantages of FIT Policies

- FITs do not encourage direct price competition between project developers
- It may be difficult to control overall policy costs under FIT policies, because it is difficult to predict the rate of market uptake without intermediate caps or capacity-based degression
- It can be challenging to incorporate FITs within existing policy frameworks and regulatory environments
- FITs are not “market-oriented,” primarily because FITs often involve must-take provisions for the electricity generated, and the payment levels offered are frequently independent from market price signals

Components of cost plus RE Tariff Determination



CERC RE Tariff Regulations, 2012

Levellised tariff

- Generic tariff on levellised basis for the Tariff Period
- RE technologies having fuel usage :
  - Single part tariff with two components: Fixed and variable
  - Tariff shall be determined on levellised basis for fixed cost component
  - While the fuel cost component shall be specified on year of operation basis
- For the purpose of levellised tariff computation, the discount factor equivalent to Post Tax weighted average cost of capital
- Levellisation to be carried out for the 'useful life'

A balanced approach vis a vis concerns of front loaded tariff, back loaded tariff etc.

Generic v/s Project specific tariff

- Provision for project specific tariff on case to case basis, for new RE technologies like:
  - Municipal Solid Waste to Energy Projects
  - Hybrid Solar Thermal Power plants
  - Hybrid options (i.e. renewable–renewable or renewable–conventional sources)
  - Any other new renewable energy technologies as approved by MNRE

The financial norms specified for determination of Generic Tariff except for capital cost, would be ceiling norms while determining the project specific tariff

Tariff Period

- ❑Wind, Biomass, Bagasse based cogeneration projects:13 years

  - **Regulatory support during the 13 year tariff period will provide certainty to the project developer to meet its debt service obligations**
  - **After this period, the competitive procurement of RE will ensure that power is procured at most reasonable rate, and benefit passed on the consumer**

- ❑Small hydro projects below 5 MW: 35 years
- ❑Solar PV and Solar thermal power projects: 25 years
- ❑Biomass Gasifier and Biogas based power projects: 20 years

  - **Longer duration of tariff support in view of smaller size/nascent technologies**

Capital Cost Benchmarking

- Various approaches are evaluated for development of benchmark capital cost for different RE technologies
  - **Regulatory Approach:** Norms as approved by various SERCs are most simple and easy to follow
  - **Market Based Approach:** Project awarded through competitive tender process carried out by public and private entities
  - **Actual Project Cost Approach: Information furnished by developers as a part of project appraisal requirements to various financial institutions/banks to avail** loan or to UNFCCC for registering the project to avail CDM benefits
  - **International Project Cost based Approach**

Subsequently suitable indexation mechanism devised to consider the year on year variation for the underlying capital cost parameters

Financial Principles

- **Debt : Equity Ratio** considered at 70 : 30. For project specific tariff,
  - In case of equity funding in excess of 30%, to be treated as normative loan.
  - In case of equity funding lower than 30%, actual equity to be considered.
- **Return on Equity**
  - Value base at 30% of capital cost or actual equity (whichever is lower).
  - Pre-tax ROE: 19% p.a. for first 10 years and 24% p.a. from 11th year onwards.
- **Loan Terms**
  - Tenure of loan considered as 12 years.
  - Interest rate : SBI Base rate + 300 basis points
- **Depreciation**
  - 'Differential depreciation' approach over loan period & 'Straight Line' method over the remaining useful life.
  - Allowed upto 90% of capital cost considering salvage value as 10%.
  - On SLM basis at 5.83 % p.a. for first 12 years and remaining depreciation to be spread over balance useful life of asset.

Financial Principles

Useful Life

- Wind Energy : 25 years
- Biomass power / cogeneration : 20 years
- Small hydro power : 35 years
- Solar PV and Solar thermal : 25 years

Sharing of CDM benefits

- Share of developer to be 100% for 1st year after COD.
- Share of beneficiary to be 10% in second year to be increased progressively at 10% per year till it reaches 50%.
- Thereafter, sharing shall be on equal proportion basis.

Financial Principles

Working Capital

Technology	O&M expense	Receivables	Maintenance spares	Fuel cost
Wind/ Small Hydro/ Solar	1 Month	2 Month	15% of O&M expense	
Biomass/ Non-fossil Fuel Co-generation	1 Month	2 Month	15% of O&M expense	4 months of fuel stock at normative PLF

- Interest rate equivalent to average SBI Base rate plus 350 basis points

TECHNOLOGY SPECIFIC PARAMETERS

Wind Energy

Eligibility Criteria :

- New Wind energy projects

Capital Cost:

- Rs 575 Lakh/MW for first year of Control Period (FY 2012-13)
- Linked to indexation mechanism over Control Period

O&M expense:

- Rs 9 Lakh/MW for first year of Control Period (FY 2012-13 with escalation at 5.72% / annum

Capacity Utilization Factor :

Annual Mean Wind Power Density (W/m^2)	CUF
Up to 200	20%
201-250	22%
251300	25%
301-400	30%
> 400	32%

Small Hydro Projects

S. No.	Particular	Unit	Description
1.	**Capital cost**		
	Himanchal Pradesh and Uttarakhand (Below 5 MW)	Rs Lakh/ MW	770
	Himanchal Pradesh and Uttarakhand (5 MW to 25 MW)	Rs Lakh/ MW	700
	Other States (Below 5 MW)	Rs Lakh/ MW	600
	Other States (5 MW to 25 MW)	Rs Lakh/ MW	550
2.	**Capacity Utilisation Factor (CUF)**		
	Himanchal Pradesh and Uttarakhand	%	45%
	Other States	%	30%
3.	**O&M cost**		
	Himanchal Pradesh and Uttarakhand (Below 5 MW)	Rs Lakh/ MW	25
	Himanchal Pradesh and Uttarakhand (5 MW to 25 MW)	Rs Lakh/ MW	18
	Other States (Below 5 MW)	Rs Lakh/ MW	20
	Other States (5 MW to 25 MW)	Rs Lakh/ MW	14
4.	Auxiliary Consumption	%	1%

Biomass Power Projects

Eligibility Criteria:

- Biomass power projects based on Rankine cycle technology and using biomass fuel sources, provided use of fossil fuel is restricted only to 15% of total fuel consumption on annual basis.

S. No.	Particular	Unit	Description
1	Capital Cost	Rs Lakh/MW	450
2	Plant Load Factor		
	1^{st} yr during stabilization	%	60%
	remaining period of the 1^{st} yr	%	70%
	Next year onward	%	80%
3	Auxiliary Consumption	%	10
4	Station Heat Rate	kCal/kWh	4000
5	O&M Expenses	Rs Lakh/MW	24

CERC RE Tariff (Third Amendment) Regulations, 2015, 10/7/2015

38. Station Heat Rate

- *The Station Heat Rate for biomass power projects using fossil fuel up to 15% of calorific value on annual basis shall be as under:*
- *a. 4126 kcal/kWh for project using travelling grate boilers*
- *b. 4063 kcal/kWh for project using AFBC boilers*

43. Calorific Value

For Biomass based projects using fossil fuel up to 15% of calorific contribution, the Calorific Value of fuel used for the purpose of determination of tariff shall be 3174 kcal/kg

Non- Fossil Fuel Based Co-generation

S. No.	Particular	Unit	Description
1.	Capital Cost	Rs Lakh/MW	420
2.	Auxiliary Consumption	%	8.5
3.	Station Heat Rate	kCal/kWh	3600
4.	O&M Expenses	Rs Lakh/MW	15
5.	Plant Load Factor	Operating days	PLF
	Uttar Pradesh and Andhra Pradesh	180 days	45%
	Tamil Nadu and Maharashtra	240 days	60%
	Other States	210 days	53%
6..	GCV	kCal/kg	2250

Solar PV & Solar Thermal

S. No.	Particular	Unit	Solar PV	Solar Thermal
1.	Technology Aspect		crystalline silicon or thin film etc.	Concentrated solar power (CSP) technologies viz. line focusing or point focusing
2.	Capital cost	Rs Lakh/ MW	691	1200
3.	CUF	%	19%	23%
4.	O&M cost	Rs Lakh/ MW	9.0	13
5.	Auxiliary Consumption	%	NA	10%

MSW and RDF based on Rankine cycle technology power projects : 7th Oct. 2015

- Useful Life- 20 years
- Capital Cost Norm for FY 2015-16:
  - Rs1500 lakh/MW: for municipal solid waste based
  - Rs900 lakh/MW: for refuse derived fuel based
  - Provided that the Capital Cost norms for the remaining years of the control period, for municipal solid waste and refuse derived fuel based power projects shall be reviewed on annual basis.
- Plant Load Factor: MSW / RDF
  - During Stabilisation: 65% / 65%
  - During the remaining period of the first year (after stabilization): 65% / 65%
  - From 2nd Year onwards: 75% / 80%
  - The stabilisation period shall not be more than 6 months from the date of commissioning of the project
- Auxiliary Consumption: 15%

MSW and RDF based on Rankine cycle technology power projects : 7th Oct. 2015

- Station Heat Rate: 4200 kcal/kWh for power projects which use municipal solid waste and refuse derived fuel
- Normative O&M expenses (FY 2015-16):
  - 6% of normative capital cost
  - Annual escalation @ 5.72% per annum.
- Calorific Value: 2500 kcal/kg for refuse derived fuel
- Fuel Cost:
  - Refuse derived fuel price during FY 2015-16 shall be Rs 1,800 per MT.
  - Normative escalation factor of 5% per annum
- No fuel cost considered for determination of tariff for the power projects using municipal solid waste
- Tariff 2015-16 : MSW: Rs./kWh 7.04, RDF: Rs.7.90 /kwh

RE Tariff Order 2015-16
SO4 of 2015 (suo-moto)

Wind

	Annual Mean WPD (W/m2) at 50 mtr HH	CUF	2009-10 ` /kWh	2010-11 ` /kWh	2011-12 ` /kWh
Zone-1	200-250	20%	5.63	5.07	5.33
Zone-2	250-300	23%	4.90	4.41	4.63
Zone-3	300-400	27%	4.70	3.75	3.95
Zone-4	> 400	30%	3.75	3.38	3.55
	WPD at 80 mtr		2012-13 ` /kWh	2014-15 ` /kWh	2015-16 ` /kWh
Zone-1	Upto 200	20%	5.96	6.34	6.58
Zone-2	200-250	22%	5.42	5.76	5.98
Zone-3	250-300	25%	4.77	5.07	5.27
Zone-4	300-400	29%	3.97	4.23	4.39
Zone-5	> 400	32%	3.73	3.96	4.11

Solar PV & Solar Thermal tariff

	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16
Solar PV							
Module Cost USD/Wp	3.40	2.20	1.75	0.85	0.60	0.59	0.52
Capital Cost Rs. Crore/MW	17.00	16.90	14.42	10.00	8.00	6.91	6.06.
Tariff Rs./kWh	18.44	17.91	15.39	10.39	8.75	7.72	7.04
Solar Thermal							
Capital Cost Rs. Crore/MW	13.00	15.30	15.00	13.00	12.00	12.00	12.00
Tariff Rs./kWh	13.45	15.31	15.04	12.46	11.90	11.88	12.05

Small Hydro Power

	09-10	10-11	11-12	12-13	13-14	14-15
HP, Uttarakhand and NE States (Below 5MW) ` /kWh	3.90	3.59	3.78	4.14	4.38	4.45
HP, Uttarakhand and NE States (5MW to 25 MW) ` /kWh	3.35	3.06	3.22	3.54	3.75	3.80
Other States (Below 5 MW) ` /kWh	4.62	4.26	4.49	4.88	5.16	5.25
Other States (5MW to 25 MW) ` /kWh	4.00	3.65	3.84	4.16	4.40	4.46

Competitive Bidding for Tariff Discovery

Solar PV Tariffs discovered in Bidding

Previous bid results					
	Year	Capacity on Offer (MW)	Highest Bid (Rs./KWh)	Lowest (Rs./KWh)	Weighted Avg. Price (Rs./KWh)
NSM Batch 1	Dec'10	150	12.76	10.95	12.16
NSM Batch2	Dec'11	350	9.39	7.49	8.79
Orissa Phase 1	Mar'12	25	8.98	7.0	8.36
Orissa Phase 2	Dec'12	25	9.50	7.28	8.73
Karnataka	Apr'12	60	8.5	7.94	8.34
Madhya Pradesh	Jun'12	125	12.45	7.9	8.05
Tamil Nadu	Mar'13	150	14.5	5.97	6.48*
Rajasthan	Mar'13	75	8.25	6.45	6.45 (L1)
Andhra Pradesh	Apr'13	226	15.99	6.49	6.49 (L1)
Punjab Phase 1	June'13	270	8.75	7.2	8.41
Uttar Pradesh Phase 1	Aug'13	130	9.33	8.01	8.9
Karnataka Phase 2	Aug'13	130	8.05	5.5	6.87
Madhya Pradesh Phase 2	Jan'14	100	6.97	6.47	6.86
Andhra Pradesh Phase 2	Oct'14	500	5.99**(7.03 Levelized)	5.25** (6.17 Level.)	5.75** (6.75 Level.)
Karnataka	Nov'14	500	7.12	6.71	6.94
Telangana	Nov'14	500	6.9	6.46	6.72
Punjab (Capacity 5-24 MW)	Feb'15	100	7.45	6.88	7.17
Punjab (Capacity 25-100 MW)	Feb'15	100	7.56	6.88	7.16
NTPC Anantapur	May'15	250	-	-	6.16*** (L1)
Uttar Pradesh Phase 2	June'15	215	8.6	7.02	8.04
Madhya Pradesh	June'15	300	5.641	5.051	5.36
Telangana Group 1****	August'15	500	5.8727	5.4991	5.73
Telangana Group 2****	August'15	1500	5.8877	5.1729	5.62
Punjab	Sept'15	500	5.98	5.09	5.65

*5% escalation for 10 years

** 3% escalation for 10 years. Separate L1 for 9 districts

*** EPC Bids with Domestic content requirement. Capital subsidy of Rs. 1 Cr/MW

****Results for the lowest bid for 500 and 1500 MW respectively. The sub-station wise final list to be declared soon

With such a low tariff Discoms will replace future their power requirement with solar and hedge power purchase cost

Telangana and Andhra Pradesh's bid size of 1000 MW each, convey that with reduction in cost of generation of solar PV legislative support in the form of RPO/SPO would not be required

All time low tariff discovered in November 15 :

Andhra Pradesh : 500 MW: Rs. 4.63/kWh

FIT Related Concerns

Challenges

- Significant variation in approach and principles for FIT determination across states in
  - Variation in technical and operational norms
  - Control period and Tariff period
  - Capital Cost indexation not followed by many states.
  - Differences in financial parameters and treatment for time value for money

- Policy makers and many State Commissions are debating continuation of Preferential RE Tariff route as against adoption of Tariff based Competitive bidding route.
- Uncertainty on such critical policy/regulatory matters related to mode of procurement be detrimental to growth.
- Should FiT co-exist with REC

Possible Solutions

- National Tariff Policy / FOR could draw up transition roadmap for the regulatory regime for each RE technology.
- FiT for Wind and Solar could be thought of for large MW additions

Thank You

Solar Tariff

Policy	Total Capacity (	Year	Lowest Tariff	Highest tariff
NSM Batch 1	150	2011	10.96	12.76
NSM Batch 2	350	2012	7.49	9.44
Karnataka 1	80	2012	7.94	8.5
Odisha	25	2012	7.28	L1 matching
Madhya Pradesh 1	200	2012	7.95	8.05
Tamil Nadu	1000	2013	6.48 +esc.	L1 matching
Rajasthan	100	2013	6.45	L1 matching
Punjab	200	2013	7.67	8.74
Karnataka 2	135	2013	5.51	8.05
Karnataka 3	50	2014	6.66	7.74
Chhatisgarh	100	2014	6.44	7.9
Madhya Pradesh 2	100	2014	6.47	6.97

FIT Related Concerns

Challenges

- Significant variation in approach and principles for FIT determination across states in
  - Variation in technical and operational norms
  - Control period and Tariff period
  - Capital Cost indexation not followed by many states.
  - Differences in financial parameters and treatment for time value for money

- Policy makers and many State Commissions are debating continuation of Preferential RE Tariff route as against adoption of Tariff based Competitive bidding route.
- Uncertainty on such critical policy/regulatory matters related to mode of procurement be detrimental to growth.
- Should FiT co-exist with REC

Possible Solutions

- National Tariff Policy / FOR could draw up transition roadmap for the regulatory regime for each RE technology.
- FiT for Wind and Solar could be thought of for large MW additions

TECHNOLOGY SPECIFIC NORMS: WIND ENERGY

Wind - Capital Cost

Wind

Capital Cost

CUF

O & M Cost

RE Tariff Regulations-2009

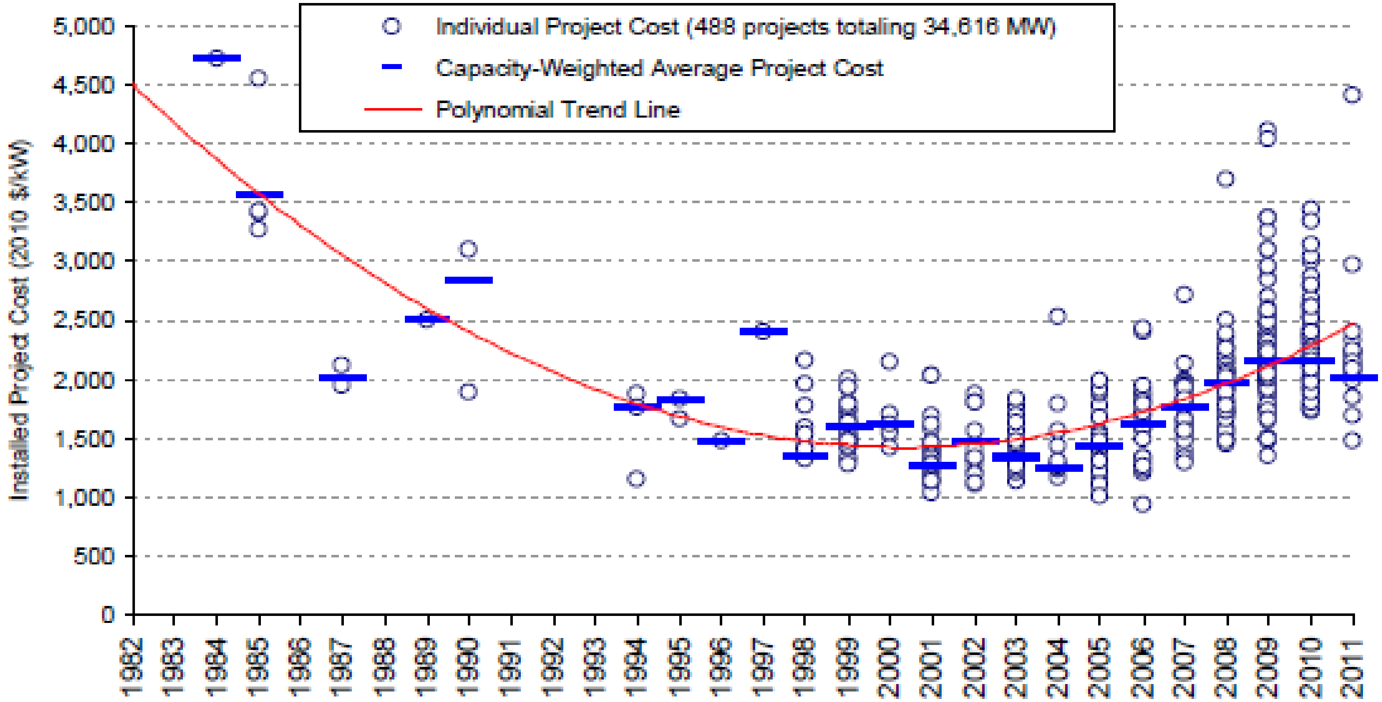
Year	Date of Regulations/Order	Capital cost ` Lacs/MW
2009-10	17.09.2009	515.00
2010-11	26.02.2010	467.13
2011-12	09.11.2010	492.52

Wind - Capital Cost

Wind

- Capital Cost
- CUF
- O & M Cost

International Trend: Installed Project Cost - USA



Note: 2011 data represent preliminary cost estimates for a sample of 17 projects totaling 1.1 GW that have either already been or will be built in 2011, and for which reliable cost estimates were available.

Source: Berkeley Lab (some data points suppressed to protect confidentiality)

U.S. Department of Energy's report on "2010 Wind Technologies Market Report": June - 2011 prepared by the Lawrence Berkeley National Laboratory (LBNL)

- 1 GW of capacity that either have been or will be built in 2011 suggests that average installed costs may decline in 2011

Wind - Capital Cost

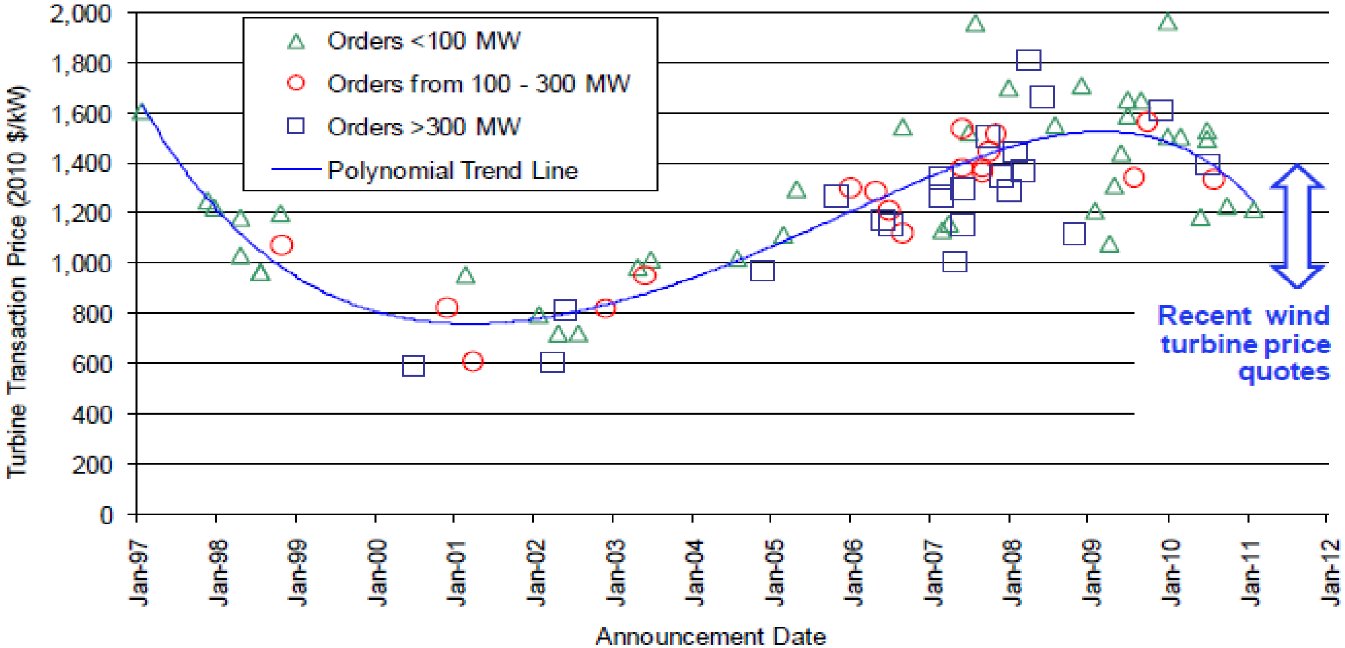
Wind

Capital Cost

CUF

O & M Cost

International Trend: Turbine Cost - USA



Source: Berkeley Lab

U.S. Department of Energy's report on "2010 Wind Technologies Market Report": June - 2011 prepared by the Lawrence Berkeley National Laboratory (LBNL)

- **In US total Project costs which were bottomed out in 2001-04; rose by $850/kW on average through 2009; held steady in 2010 at around $2,160/kW and appear to be dropping in 2011 at around $2000/kW**

Wind - Capital Cost

Wind

Capital Cost

CUF

O & M Cost

Capital Cost considered by other SERCs

Name of the Commission	Date of Order/Regulation	Capital cost ` Lacs/MW
CERC (2009-10)	17.09.2009	515.00
KERC	11.12.2009	470.00 (inc. evacuation cost)
CERC (2010-11)	26.02.2010	467.13
MPERC	14.05.2010	500.00 (inc. evacuation cost)
OERC (FY 10-11 to12-13)	14.09.2010	467.13 (As per CERC)
CERC (2011-12)	09.11.2010	492.52
MERC (2010-11)	29.04.2011	489.53 (As per CERC)

Wind - Capital Cost

Wind

Capital Cost

CUF

O & M Cost

Capital Cost:

Source	No. of Projects	MW	Weighted Average Capital Cost ` Cr./ MW
IREDA (FY 10-11)	10	570	5.90
IREDA (FY 11-12)	4	220	5.90
UNFCCC (FY 09-10)	14	137	5.23
UNFCCC (FY 10-11)	5	84	5.47
Tender (FY 10-11)	5	34	6.00
Total	38	1045	

Wind - Capital Cost

Wind

Capital Cost

CUF

O & M Cost

2.1 MW-S88		
Component Breakup	% cost	Net Cost
SUPPLY OF WTG WITHOUT TT	58%	33265546
SUPPLY OF BLADE	9%	5284916
SUPPLY OF TT	12%	6761086
SUPPLY OF TRANSFORMER	1%	751232
ERECTION	2%	974985
COMMISSIONING	0%	108272
MEDA CHARGES	1%	315517
MEDA Application Fees	0%	5259
ZP Road charges	0%	210345
CIVIL WORKS	5%	2925897
ELEC LINE & SUPPLY	4%	2299406
LAND	3%	1442365
EVACUATION	5%	3155174
	100%	57,500,000

Wind: Capacity Utilisation Factor

Wind

Capital Cost

CUF

O & M Cost

RE Tariff Regulations-2009

Annual Mean Wind Power Density (W/m2) at 50 mtr hub height	CUF
200-250	20%
250-300	23%
300-400	27%
> 400	30%

- **MNRE Circular dated 1.08.2011: No restriction will exist for WPD criteria as far the development of wind power project is concerned**

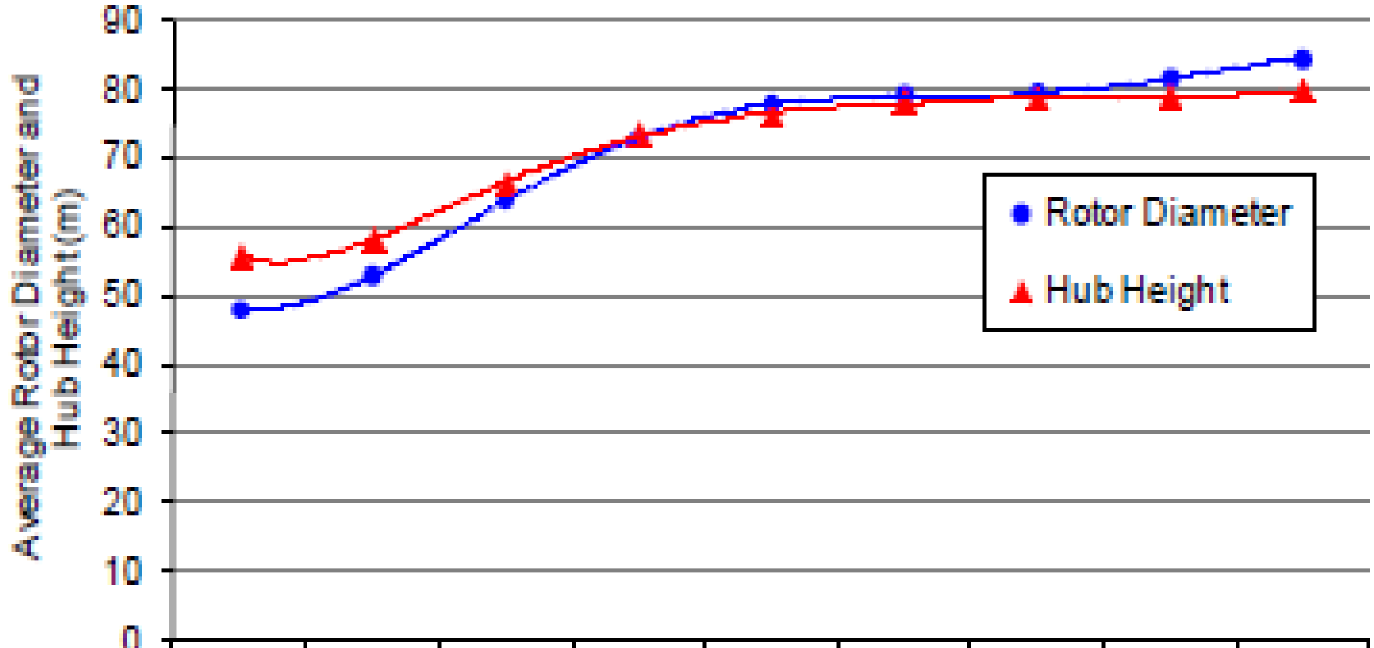
Wind

Capital Cost

CUF

O & M Cost

Historical Increase in Hub Height & Rotor Diameter: USA



COD:	1998-99	2000-01	2002-03	2004-05	2006	2007	2008	2009	2010
Turbines:	1,418	1,982	1,686	1,942	1,515	3,190	5,004	5,733	2,855
Capacity:	1,014 MW	1,756 MW	2,080 MW	2,779 MW	2,440 MW	5,249 MW	8,348 MW	9,993 MW	5,113 MW

Wind Energy Installation: FY 10-11

Wind

Capital Cost

CUF

O & M Cost

Developer / State	MAH	KAR	TN	RAJ	MP	GUJ	AP	Total	%	Hub Height
Suzlon	107.2	93.95	191.55	333.5	42.6	183.1		951.9	**40.48**	65 75 78 80
Enercon	31.2	116	112	103.2		78.4	63.2	504	**21.43**	50 56 57 65
Vestas		39.6	115.5			20.4		175.5	**7.46**	70 78 80
Maruti Windfarm	21.15							21.15	**0.90**	
RS Windfarm	41.25							41.25	**1.75**	
TS Windfarm	25							25	**1.06**	
Sriram EPC	1		25			2.5		28.5	**1.21**	41
Vestas RRB			99					99	**4.21**	65
Gamesa			213.35			14.45		227.8	**9.69**	
Regen		4.5	96			7.5		108	**4.59**	75 85
SWPL					6	0.45		6.45	**0.27**	45
GWL			31.93			3		34.93	**1.49**	
Pioneer Wind	2.25		28			2		32.25	**1.37**	50
WinWind			29					29	**1.23**	70
Cwel			14.03					14.03	**0.60**	
INOX			2					2	**0.09**	80
Kenersys	10		2					12	**0.51**	80
Shiva Wind			1.5					1.5	**0.06**	50
TTG			0.25					0.25	**0.01**	
LeitWind			36.3					36.3	**1.54**	65
IWPL						1		1	**0.04**	
TOTAL	**239.05**	**254.05**	**997.41**	**436.7**	**48.6**	**312.8**	**63.2**	**2351.81**	**100**	
%	**10.16**	**10.80**	**42.41**	**18.57**	**2.07**	**13.30**	**2.69**	**100.00**	**84.46**	

LBNL : Reassessing Wind Potential Estimates for India:

Wind

Capital Cost

CUF

O & M Cost

Wind Power Class	50 m		80 m			100 m			120 m		
	WPD	WS	CF	WPD	WS	CF	WPD	WS	CF	WPD	WS
1	0-200	0-5.6	-	0 - 200	0-5.6	-	0-200	0-5.6	-	0-200	0-5.6
1a	*NA*	*NA*	*20%*	*200 -251.3*	*5.6 -6.0*	*20.0%*	*200-220*	*5.6-5.7*	*20.0%*	*200-237.9*	*5.6-5.9*
1b	*NA*	*NA*	*NA*	*NA*	*NA*	*21.6%*	*220-276.5*	*5.7-6.2*	*23.3%*	*237.9-299*	*5.9-6.3*
2	200 -300	5.6-6.4	25%	251.3 - 375.1	6.0 -6.9	27.0%	276.5-412.7	6.2-7.1	29.0%	299-446.3	6.3-7.3
3	300 -400	6.4-7.0	32%	375.1 - 490.8	6.9-7.5	34.0%	412.7-540	7.1-7.7	35.5%	446.3-583.9	7.3-7.9
4	400 -500	7.0 - 7.5	36%	490.8 - 603.6	7.5-8.0	37.5%	540-664.2	7.7-8.3	39.0%	583.9-718.2	7.9-8.5
5	500 -600	7.5-8.0	39%	603.6 - 732.6	8.0 -8.6	40.5%	664.2-806.1	8.3-8.8	42.0%	718.2-871.6	8.5-9.1
6	600 -800	8.0 - 8.8	42%	732.6 - 975.1	8.6-9.4	43.5%	806.1-1,072.9	8.8-9.7	45.0%	871.6-1,160.1	9.1-10

Source : LBNL

Forecasting of Renewable Power Generations

By

Dr. S.N. Singh, Professor
Department of Electrical Engineering
Indian Institute of Technology
Kanpur-208016, INDIA.
Email: snsingh@iitk.ac.in

Present and Future Power System

Present Power System
- Heavily Relying on Fossil Fuels
- Generation follows load
- Limited ICT use

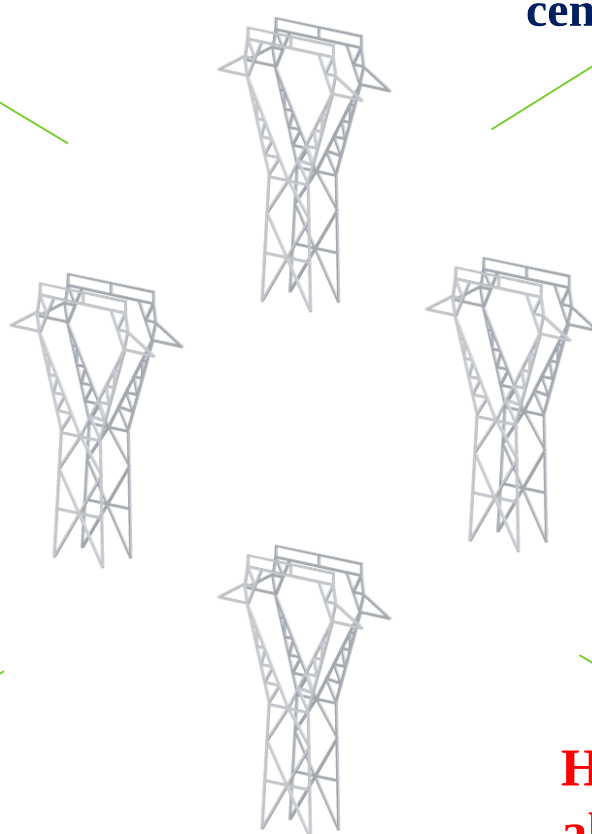
Future Power System
- More use of RES, clean coal, nuclear power
- Load follows Generation
- More ICT & Smart meter use
- More competition

SMART GRID

Future Grid – Smart(er) Grid

Wide area monitoring and control systems

Coordinated, full energy management and full integration of DG with large central power generation



Extensive small, distributed generation close to end user

Secure, reliable and green power supply

Customer driven value added services

Harmonized legal framework allowing cross border power trading

Smart Grid Advantages

Operational Efficiency

Reduced Onsite Premise Presence / Field Work Required
Shorter Outage Durations
Optimized Transformer Operation
Standards & Construction
Improved Network Operations
Reduce Integration & IT maintenance cost
Condition-based Asset Maintenance / Inspections

Energy Efficiency

Reduced Energy Losses

Active/Passive Demand-side Management

Smart Grid

Customer Satisfaction

Enable Customer Self-Service / Reduce Call Center Inquiries

Improved Revenue Collection

Environmental Impact

Reduced Greenhouse Gas Emissions

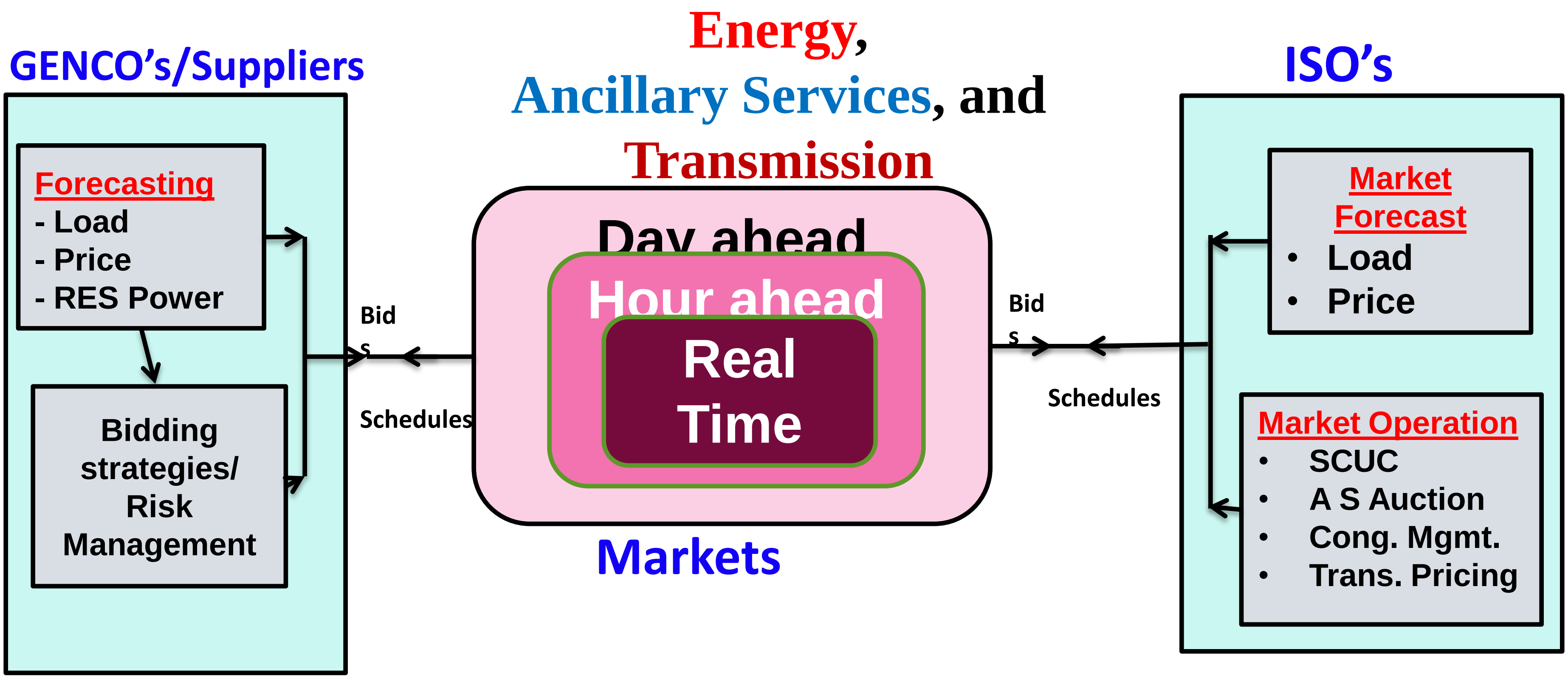
Delayed Generation & Transmission Capital Investments

Challenges in Smart Grid Implementation

- Increase in system Operational Complexity
- More business oriented attitude
- Large Data Handling
- Information Security
- Cost-effecting implementation (including ICT)
- Requirement of Accurate Forecasting approaches
- Utilization of Demand Response
- Redesigning of electricity market structure
- Fast analysis tools
- Integration of renewable energy sources
- Power Quality and Many more…

Role of Forecasting in Electric Power System

Electricity Market Operation



Necessity in Market Operation

1. Load Forecasting
2. Price Forecasting
3. Operating Reserve Margin Forecasting
4. Wind/Solar Forecasting

Planning and Operational problems due to uncertainity in Renewable energy

Planning Problems:

Due to uncertainty, unlike conventional generators, RES(wind, solar) power generation cannot be included into ELD and UC problems.

Operational:

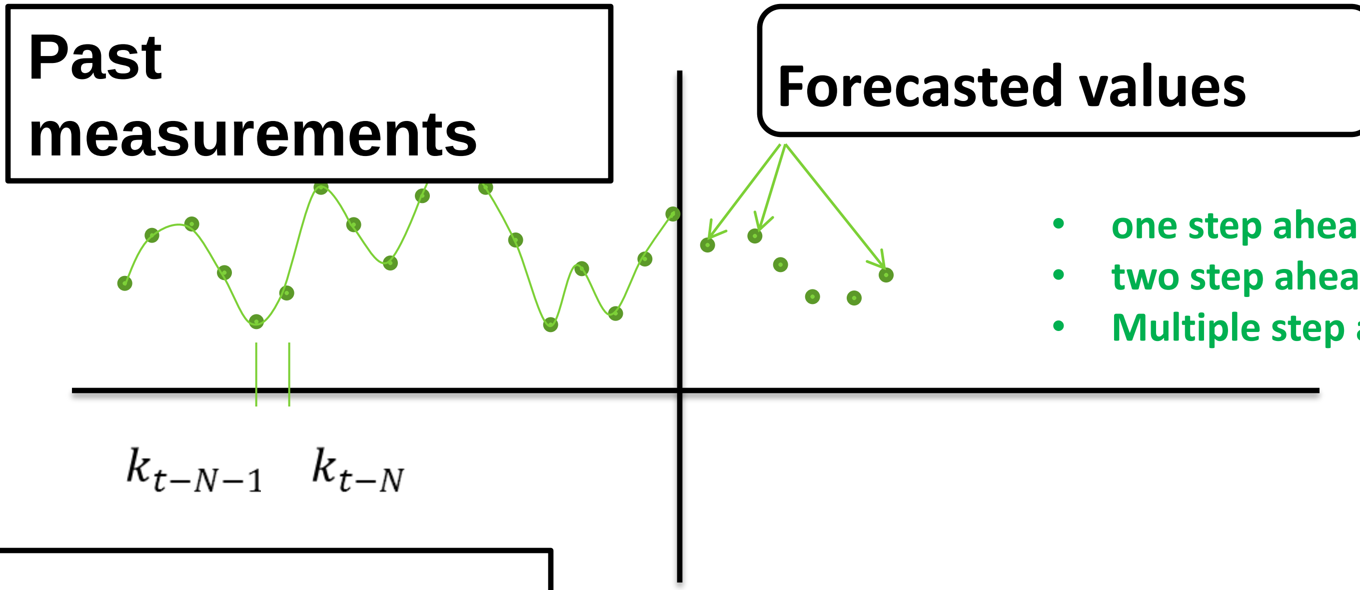
Frequency control, Voltage control, Power Quality, Ancillary services provision.

RES power producer point of view:

Bidding in day ahead, adjustment and settling Electricity Markets to maximize profits/minimize their imbalance costs.

Basic Definition of Forecasting

Forecasting is a problem of determining the future values of a time series from current and past values.



- one step ahead
- two step ahead
- Multiple step ahead

Time sampling can be in sec, min, hours, days, months and years

- Short term forecast
- Medium term forecast
- Long term forecast

Factors Influencing the Forecast variable

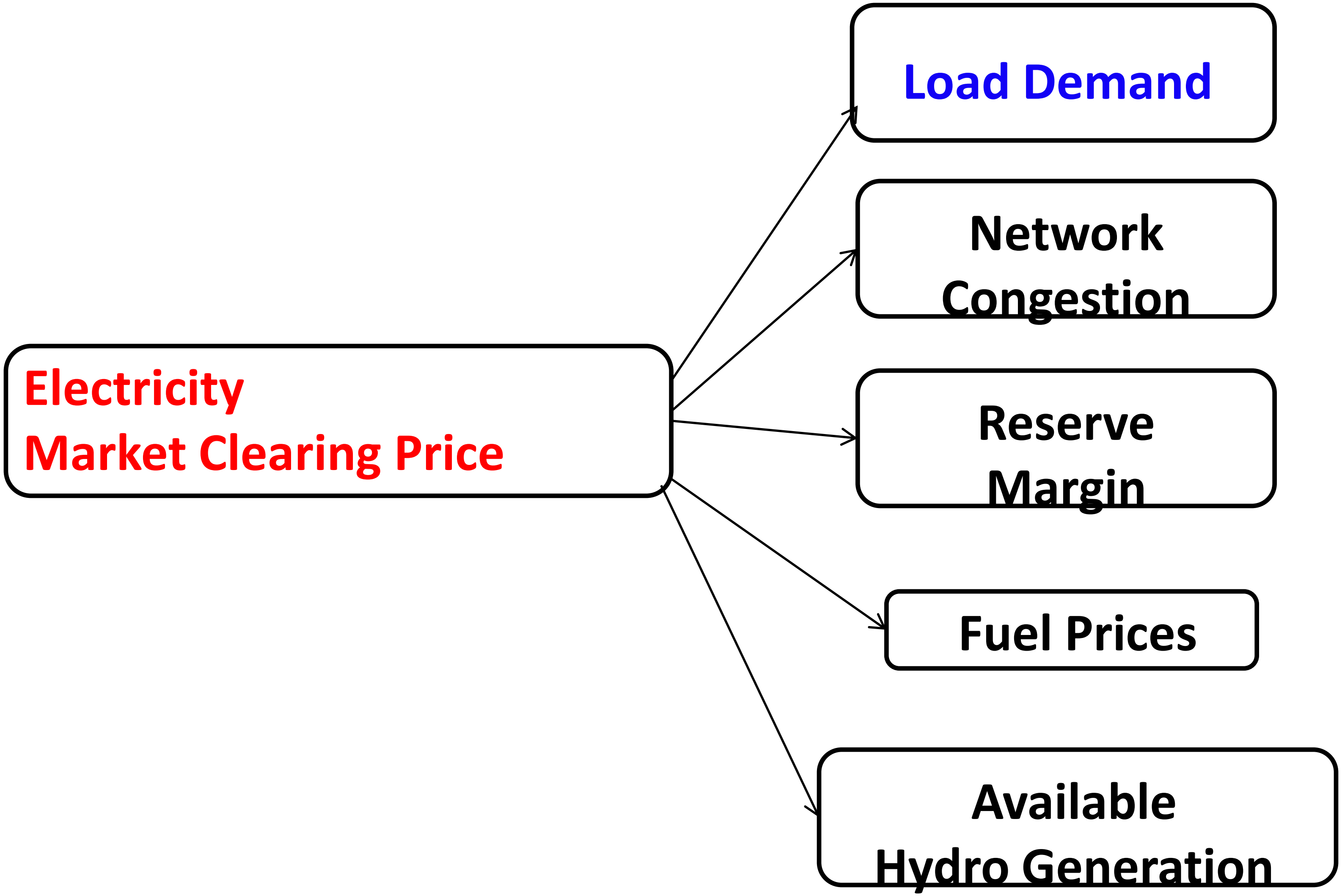
Load Demand

Time Factor
- Hour in a day
- Day of the Week
- Holiday

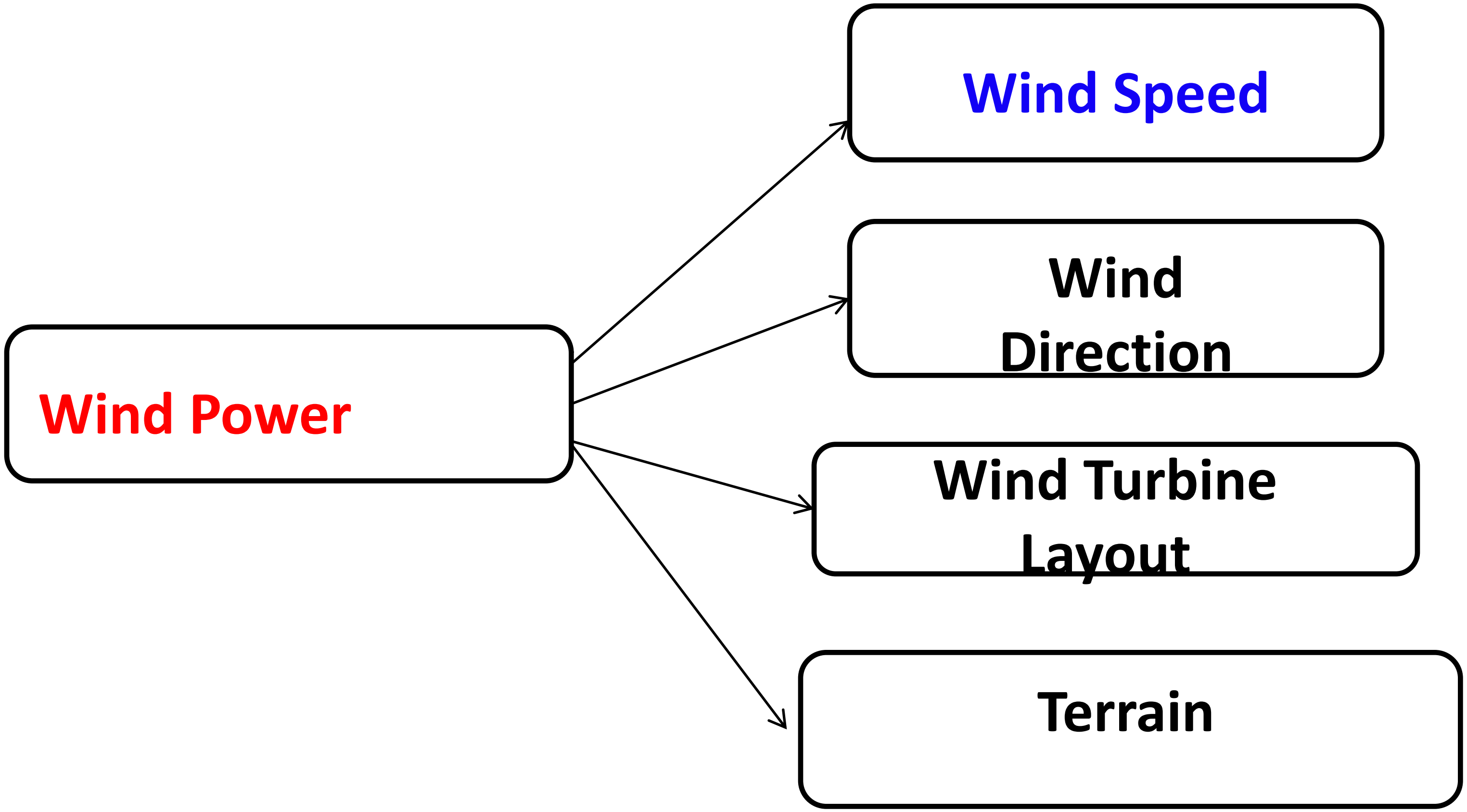
Type of Customer
- Domestic loads
- Commercial loads
- Industrial loads

Weather Parameters
- Temperature
- Humidity
- Sky cover
- Sun shine
- Wind Speed

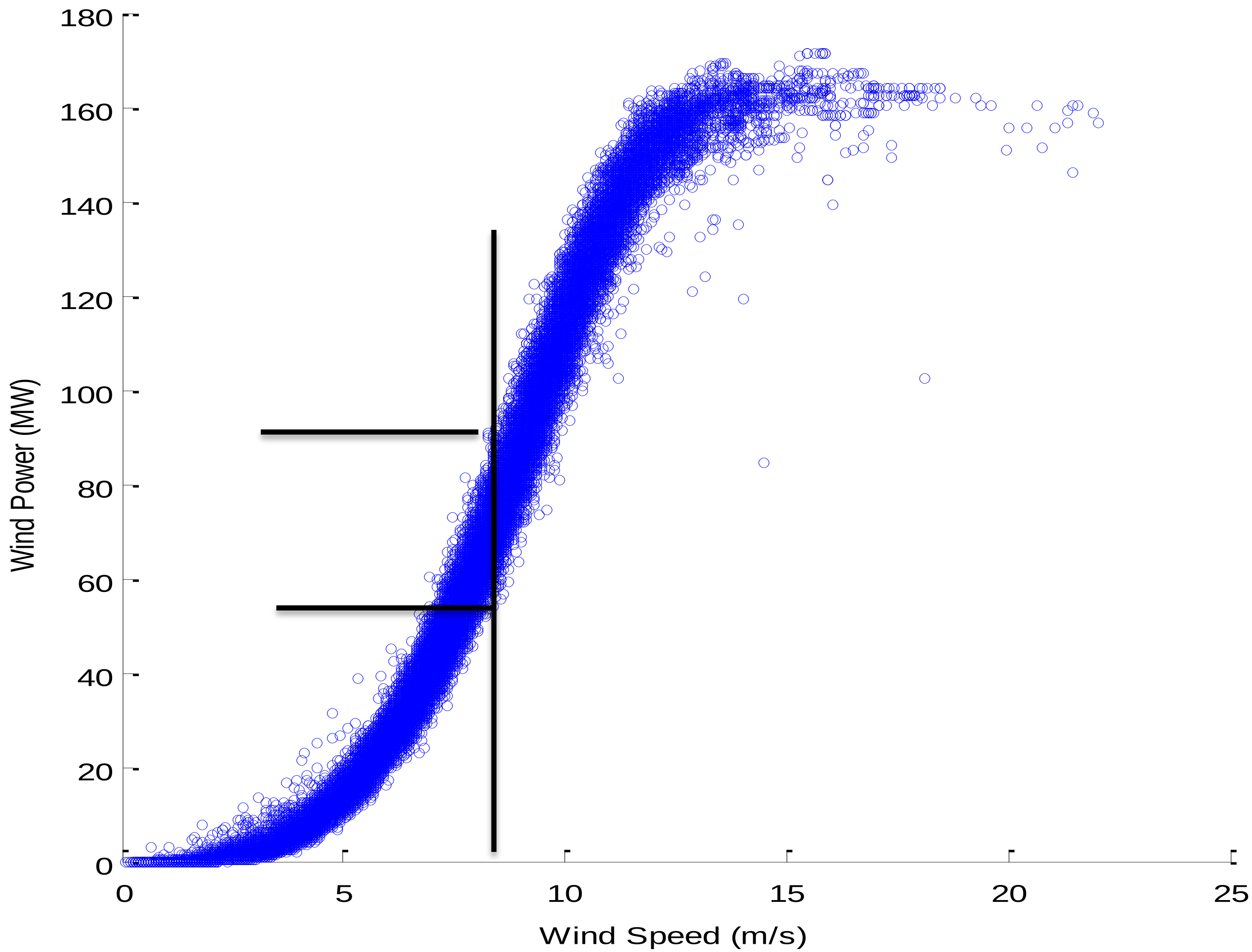
Factors Influencing Electricity Market Price



Factors Influencing Wind Power Generation



Wind Speed vs. Wind Power scatter plot



Forecasting Approaches

Linear Regression Models : (AR, ARMA, ARIMA, GARCH, etc.)

The forecast value is linearly dependent on the past historical values of the time series

- **Time Series Modeling – Maximum Likelyhood Estimation, Least Square Estimation Methods are used for Parameter Estimation.**
- **State Space Modeling- Kalman Filtering Techniques used**

Limitations of Linear Regression Models

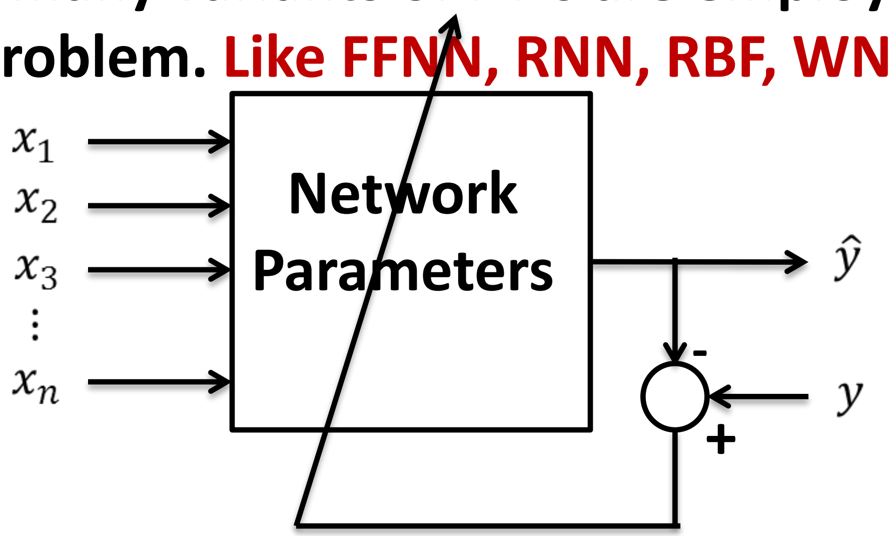
1. **As they are linear models, they cannot capture the non-linear relation between the independent and dependent variable.**
2. **The forecasting error increases rapidly with the increase in look-ahead time.**
3. **The model parameters have to be updated very frequently.**

Forecasting Approaches .....contd

Non-Linear Regression models:

$$X_t = F(X_{t-1}, X_{t-2}, X_{t-3}, \cdots, u_t, u_{t-1}, u_{t-2}, \cdots) + \varepsilon_t$$

Artificial Neural Networks (ANN) are well established in function approximation, many variants of NNs are employed in the field of forecasting problem. Like FFNN, RNN, RBF, WNN.



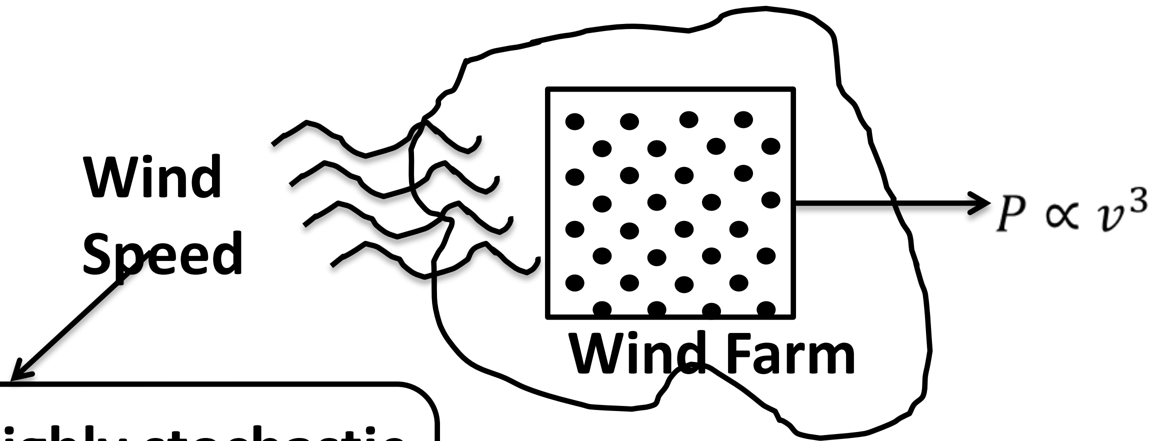
Back-Propagation Algorithm, Evolutionary based Optimization methods like GA, PSO are also applied for network training.
Input variables are selected using ACF and PACF.

Other Methods..

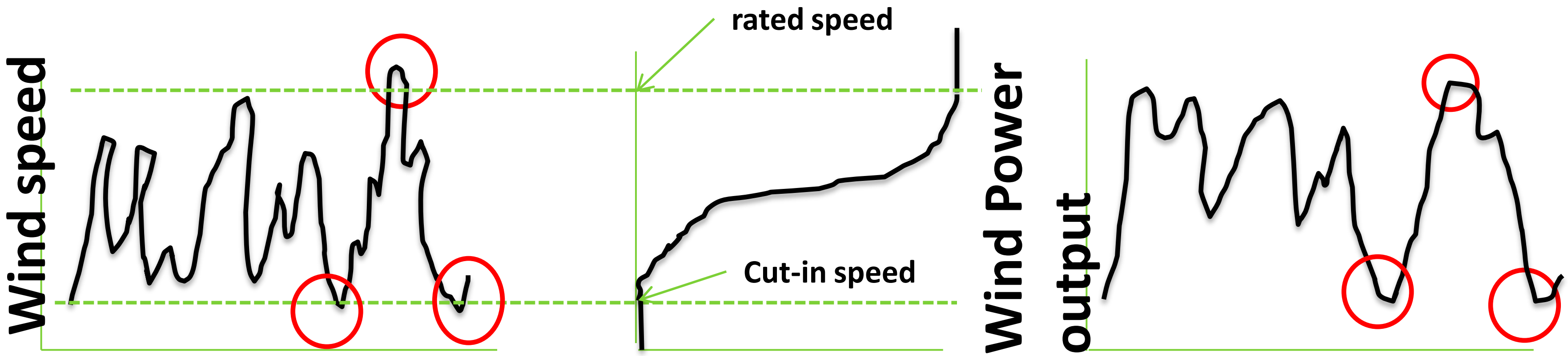
- **Fuzzy Logic**
- **Adaptive Neuro-Fuzzy Inference System (ANFIS)**
- **Data Mining techniques like clustering and Support Vector Machines (SVM) based classification and Regression models.**
- **Wavelet pre-filtering based ANN and Fuzzy models.**

Wind Power Forecasting

Wind Power Forecast



highly stochastic
random
non-stationary.



Manufacturer curve

Wind Power Forecasting: Approaches

1) Physical Models

- **The idea is to transform the wind speed forecasts, of NWP model, on a coarse numerical grid to the onsite conditions at the location of the wind form.**
- **Detailed physical description of lower atmosphere by considering factors like :surface roughness and its changes, scaling of the local wind speed within wind forms, wind form layouts and turbine power curves.**
- **The first physical wind power prediction model, *Prediktor*, developed at National Laboratory, Risø, Denmark, is based on the local refinement of wind speed prediction of the NWP system HIRLAM.**

Examples of Physical Model [1]

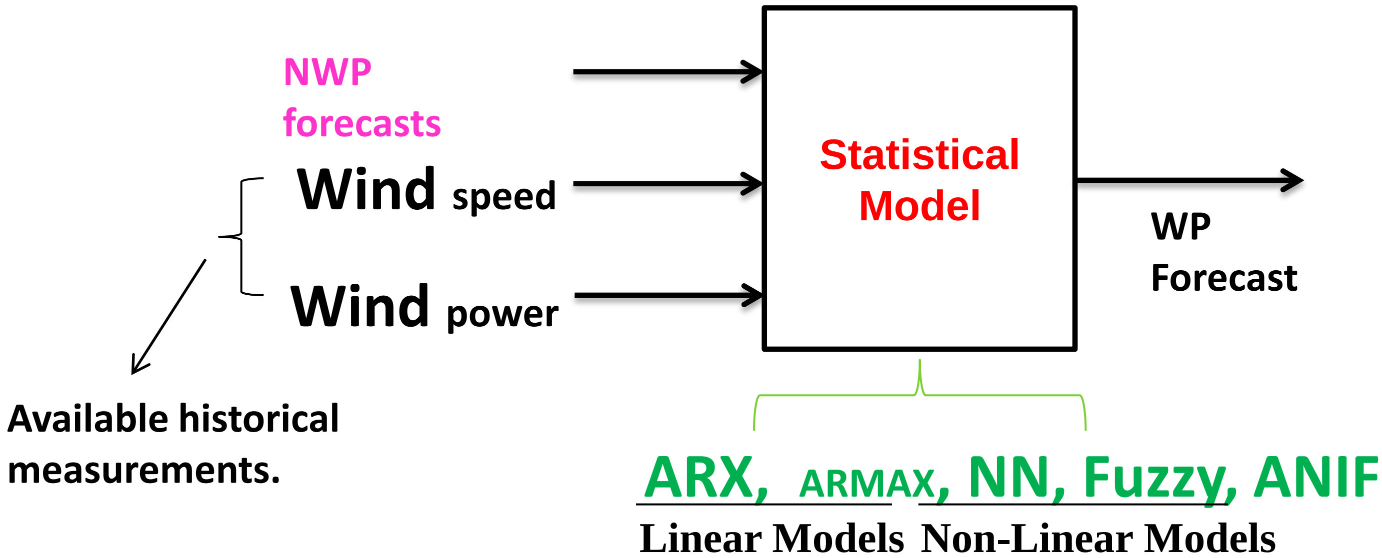
PREDICTION MODEL	DEVELOPER	OPERATIONAL STATUS	OPERATIONAL SINCE
Prediktor	National Laboratory, Risø, Denmark.	Spain, Denmark, Ireland, Germany, (US)	1993
Previento	University of Oldenburg, Germany. (Later with) Energy & Meteo system	US & European countries.	- 2004
LocalPred	CENER	La Muela, Soria, Alaiz	2001
HIRPOM (HIRlam POwer prediction Model)	University College Cork, Ireland & Danish Meteorological Institute	Denmark	2001

- They are complex mathematical models.
- More time for execution
- They are site-dependent and not Plug and Play models

[1] G. Giebel, L. Landberg, G. Kariniotakis, and R. Brownsword, "State-of-the-art on methods and software tools for short-term prediction of wind energy production," in *Proc. Eur. Wind Energy Conf. and Exhibition (EWEC)*, Madrid, Spain, 2003.

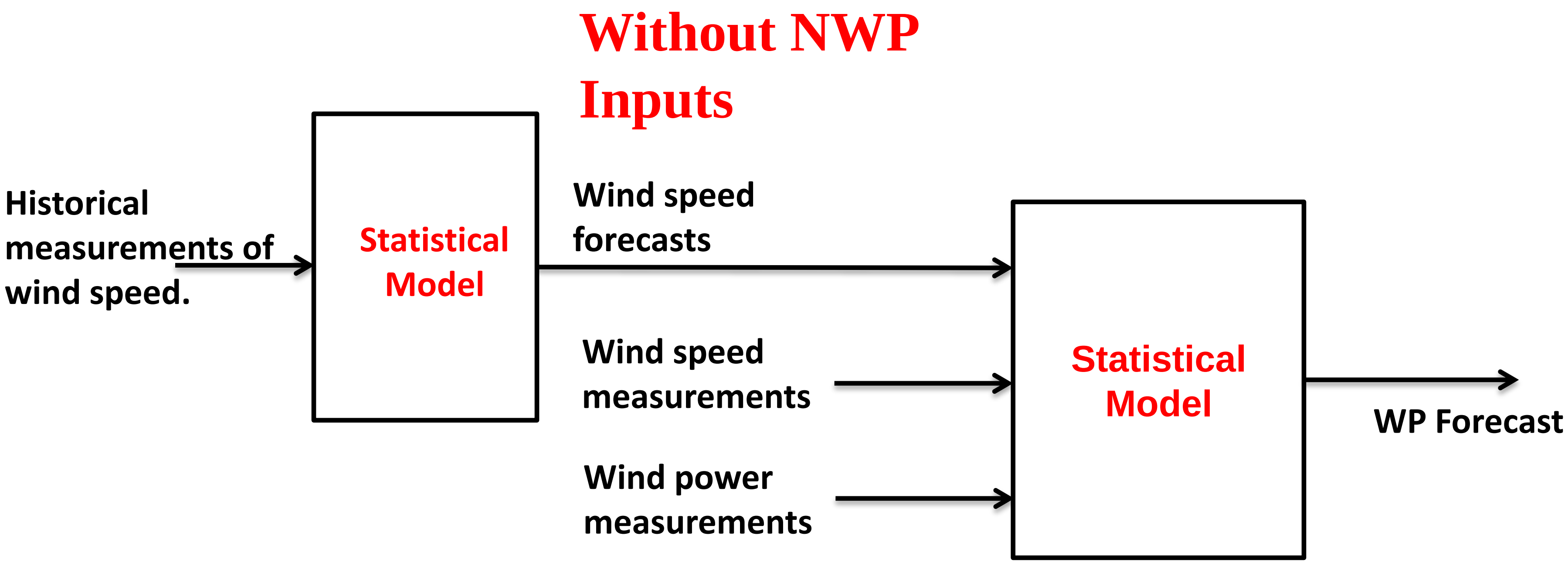
Wind Power Forecasting: Approaches Contd

2) Statistical Models
- i) with NWP inputs
- ii) without NWP inputs



- **Statistical systems require no mathematical modeling**
- **Have very high accuracy in very short term forecasting**
- **They are not site dependent**

Two stage approach for Wind Power Forecast



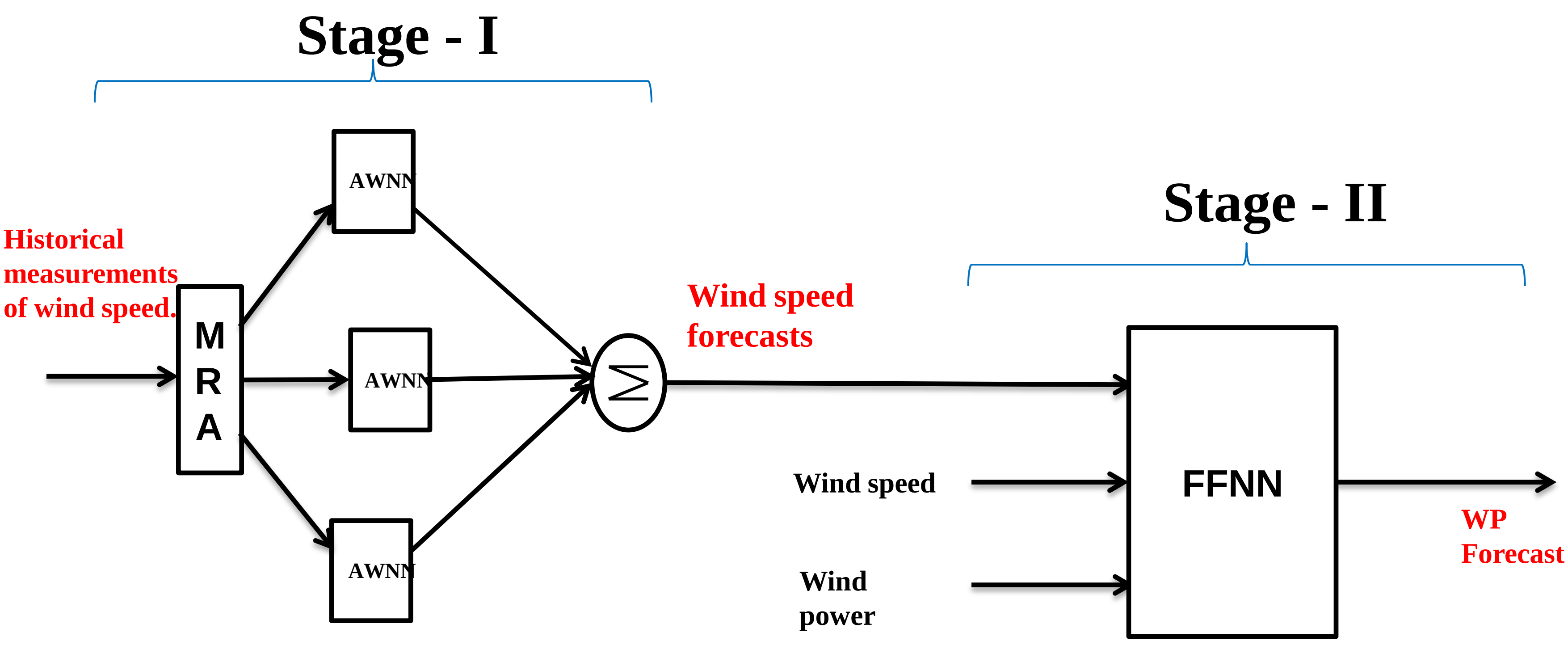
- Statistical models with NWP inputs are capable of forecasting up to 72 h and models taking purely measured values of wind speed and power can forecast up to 24 h.

Examples of Statistical Models [1]

PREDICTION MODEL	DEVELOPER	OPERATIONAL STATUS	OPERATIONAL SINCE
WPPT (Time Series)	IMM (Informatics and Mathematical Modelling); University of Copenhagen	Denmark (E & W)	1994
AWPPS (Fuzzy-ANN)	Armines/Ecole des Mines de Paris	Ireland, Crete, Madeira	2002
AWPT (ANN based)	ISET (Institut für Solare Energieversorgungstechnik)	Germany	
SIPREÓLICO (Time Serie & ANN Models)	University Carlos III, Madrid Red Eléctrica de España	Spain	2002

A Two-stage approach for Wind Power Forecast

- **The model uses only historical measurements of wind speed (locally and/or near by sites) and wind power output values.**



Benchmark Models

Forecasting up to 30 h ahead is carried and compared with benchmark models (persistence and new-reference models).

Persistence Model:

Also called as naive predictor, the most common benchmark model, which states that future wind production remains the same as the last measured value of the power;

$$\hat{P}(t+k|t) = P(t).$$

Drawback: forecast error increases rapidly with the increase in look-ahead time

New Reference Model: $\hat{P}(t+k|t) = a_k P(t) + (1-a_k)\bar{P}(t)$

The constant a_k is defined as the correlation coefficient between $P(t)$ and $P(t+k)$.

Measure of Errors

If error is given as; $e(t+k|t) = P(t+k) - \hat{P}(t+k|t).$

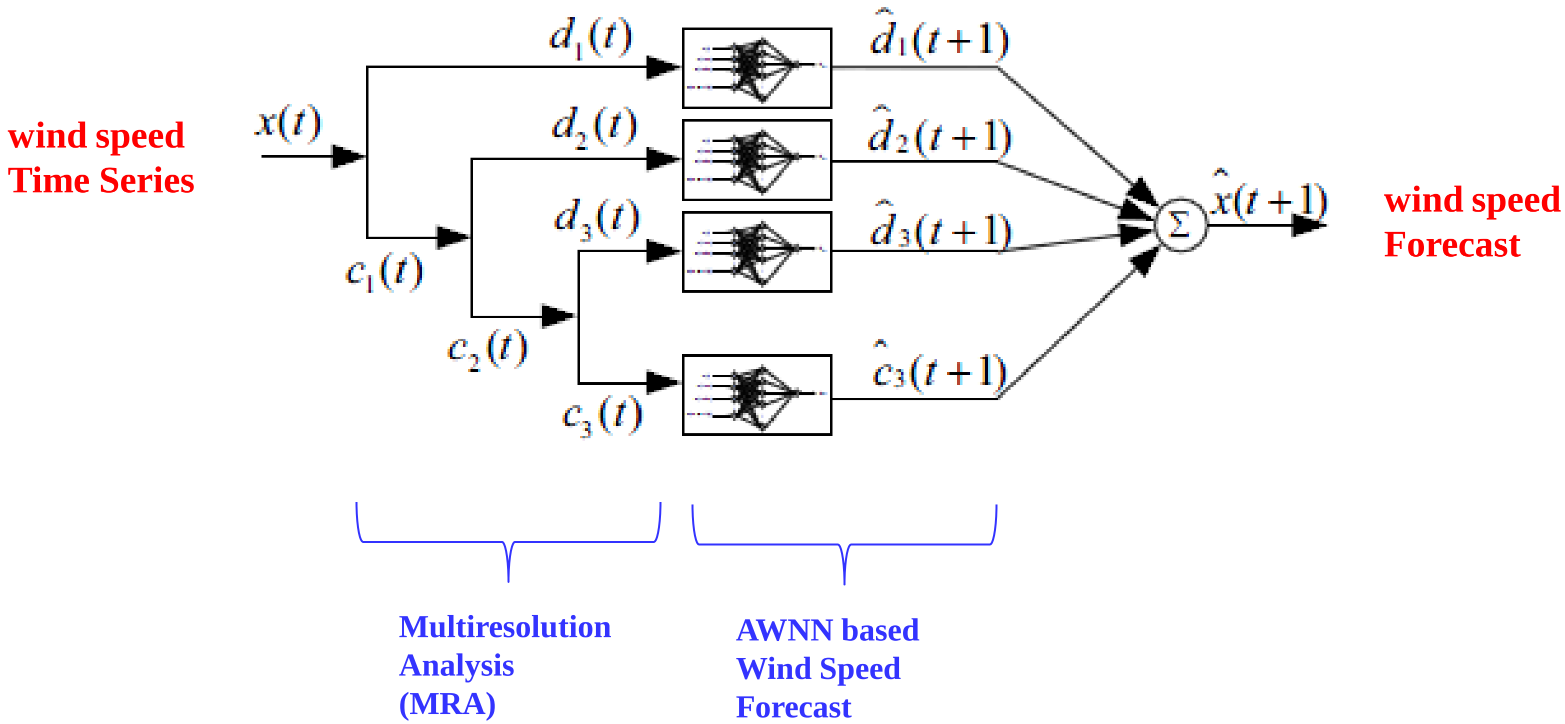
Then, $$BIAS(k) = \bar{e}_k = \frac{1}{N}\sum_{t=1}^{N} e(t+k|t)$$

$$MAE(k) = \frac{1}{N}\sum_{t=1}^{N} |e(t+k|t)|$$

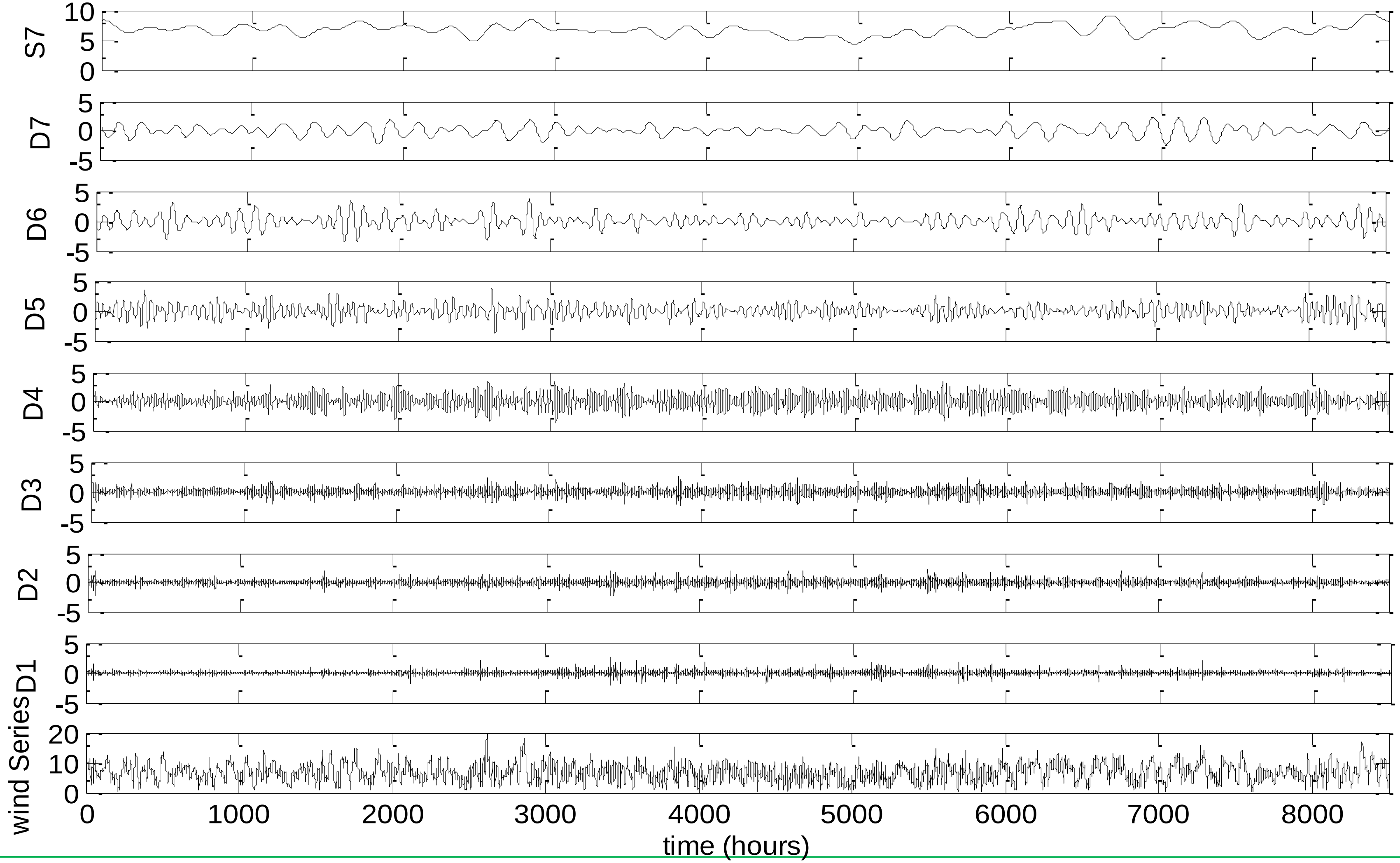
$$RMSE(k) = \left[\frac{1}{N}\sum_{t=1}^{N} e^2(t+k|t)\right]^{1/2}$$

Schematic Block Diagram for Wind Speed Forecasting

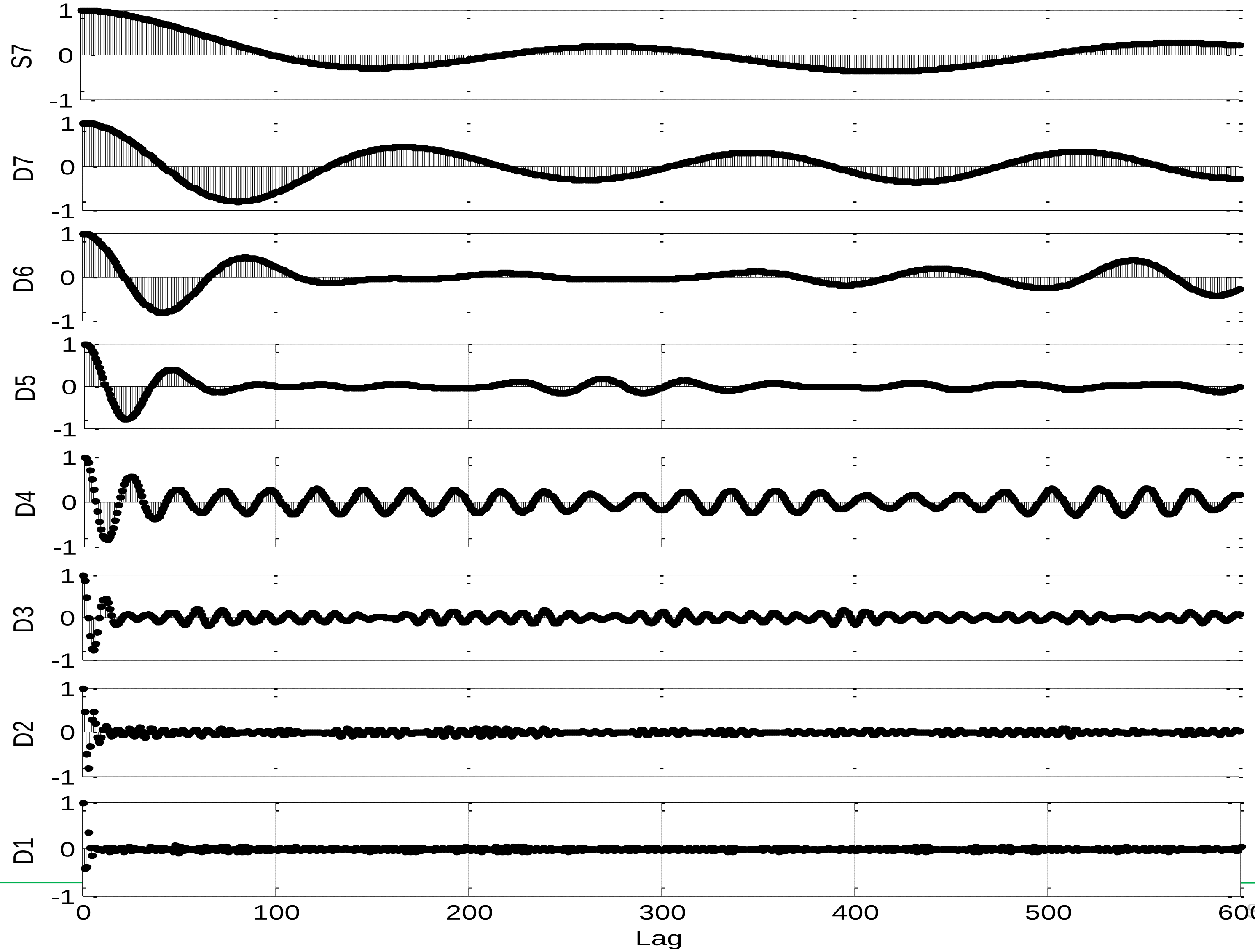
Stage -I



MRA of Wind Time Series using LA-8 Wavelet



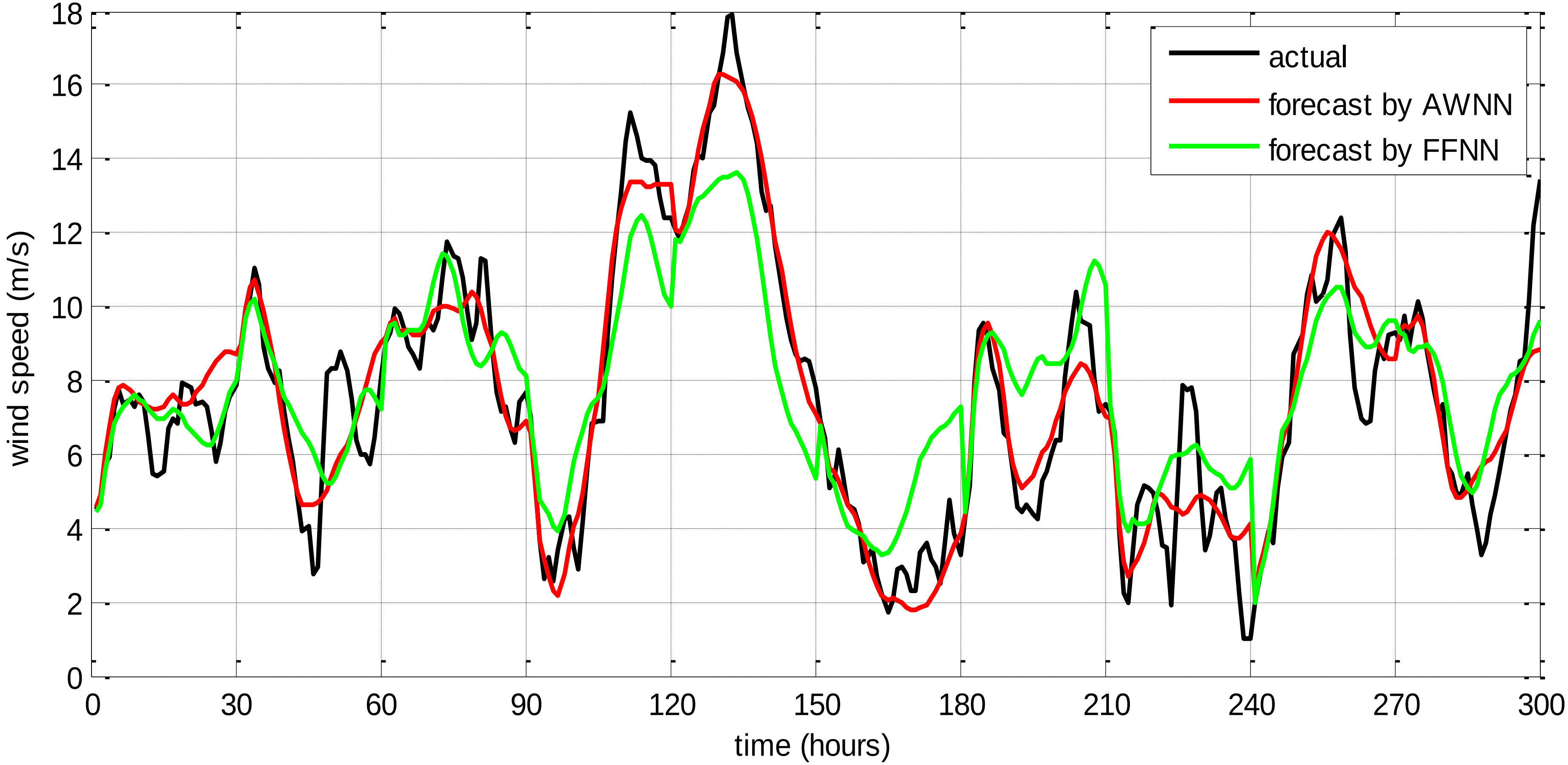
Auto-Correlation Analysis of Decomposed Wind Speed Time Series for Network Input selection



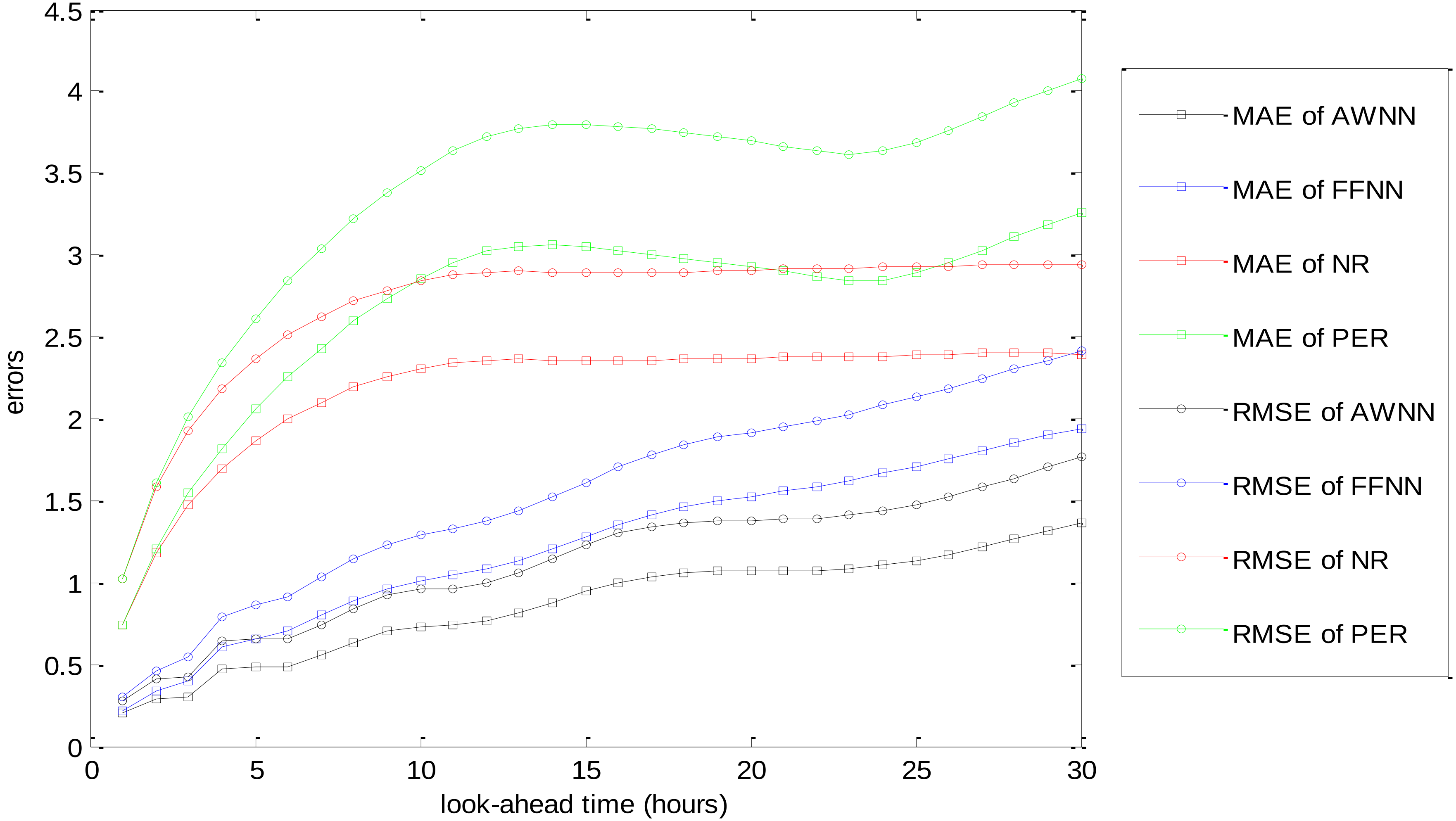
Network Architectures and Input Lag Hours used

Decomposed Signal	Input Lag-hours	Network Architecture	
		AWNN	FFNN
S7	1-14,157-159,285-287	20-2-1	20-3-1
D7	1-12,76-83,167-169	19-2-1	19-3-1
D6	1-10,41-44,84-86	17-2-1	17-3-1
D5	1-6,21-23,44-47	13-2-1	13-3-1
D4	1-3,11-13,23-25,48,72	11-2-1	11-3-1
D3	1,2,5,6,12,60,72	7-2-1	7-3-1
D2	3,6,9,15	4-2-1	4-3-1
D1	1,2,5,22	4-2-1	4-3-1

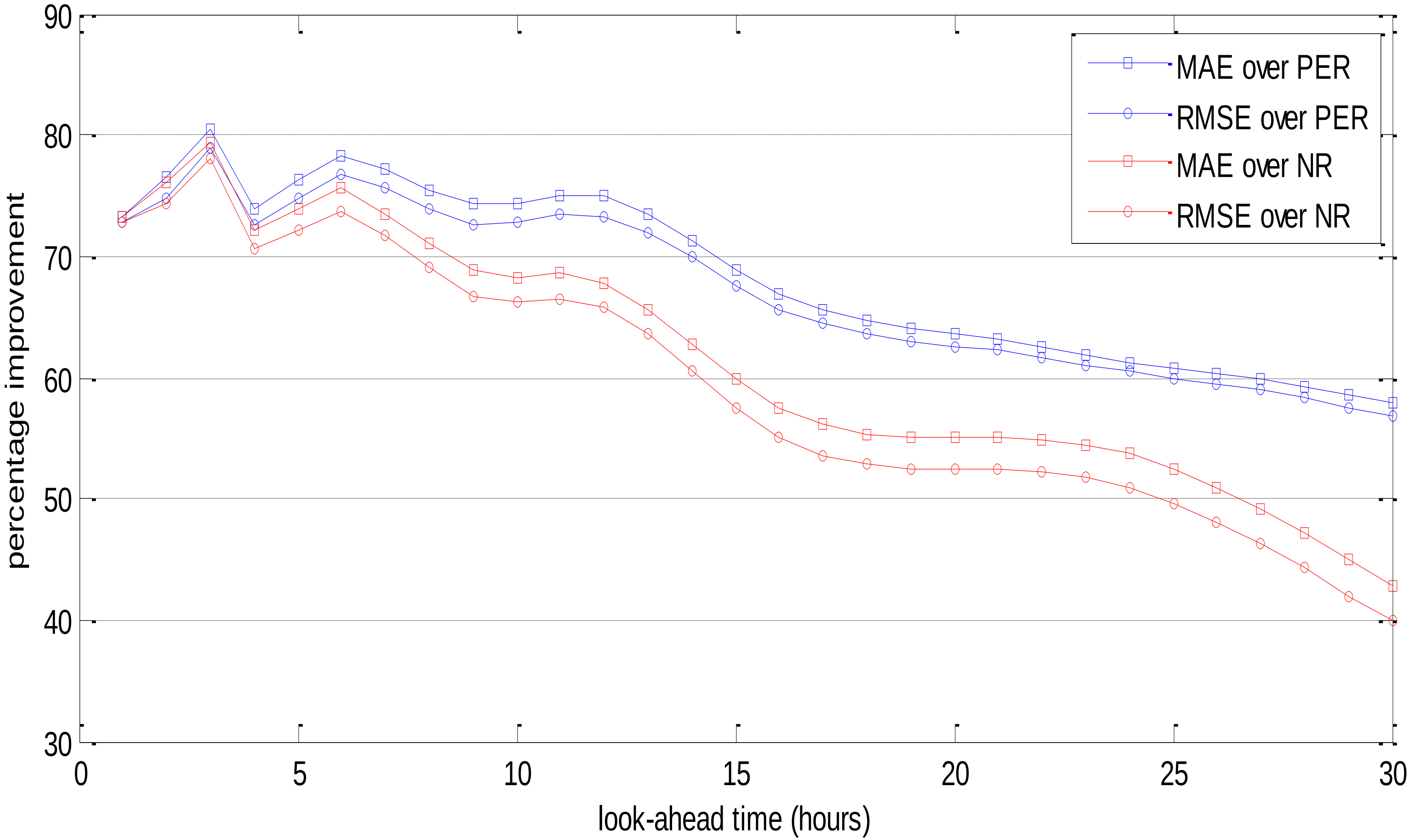
30-hours ahead Wind Speed Forecast



Comparative Performance

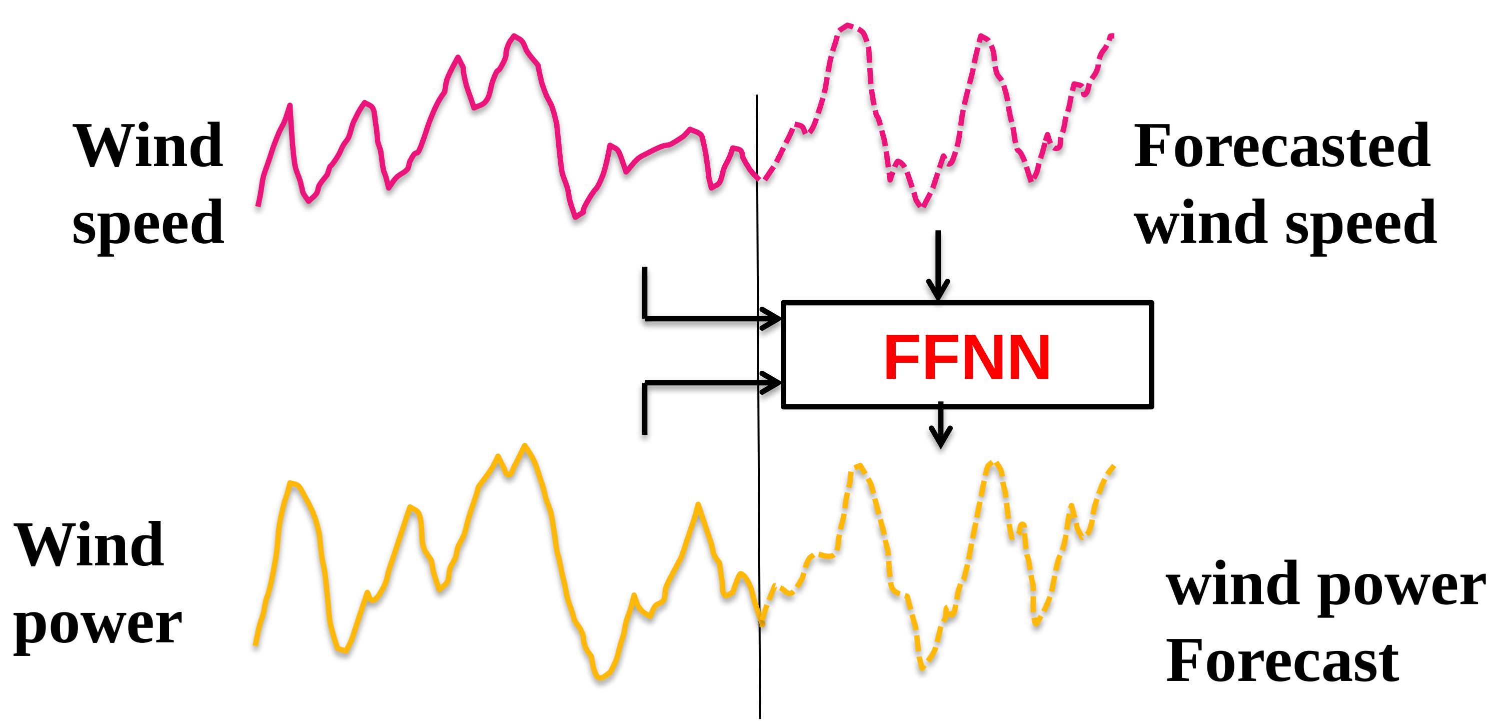


Percentage Improvement



Wind speed to Wind Power Transformation

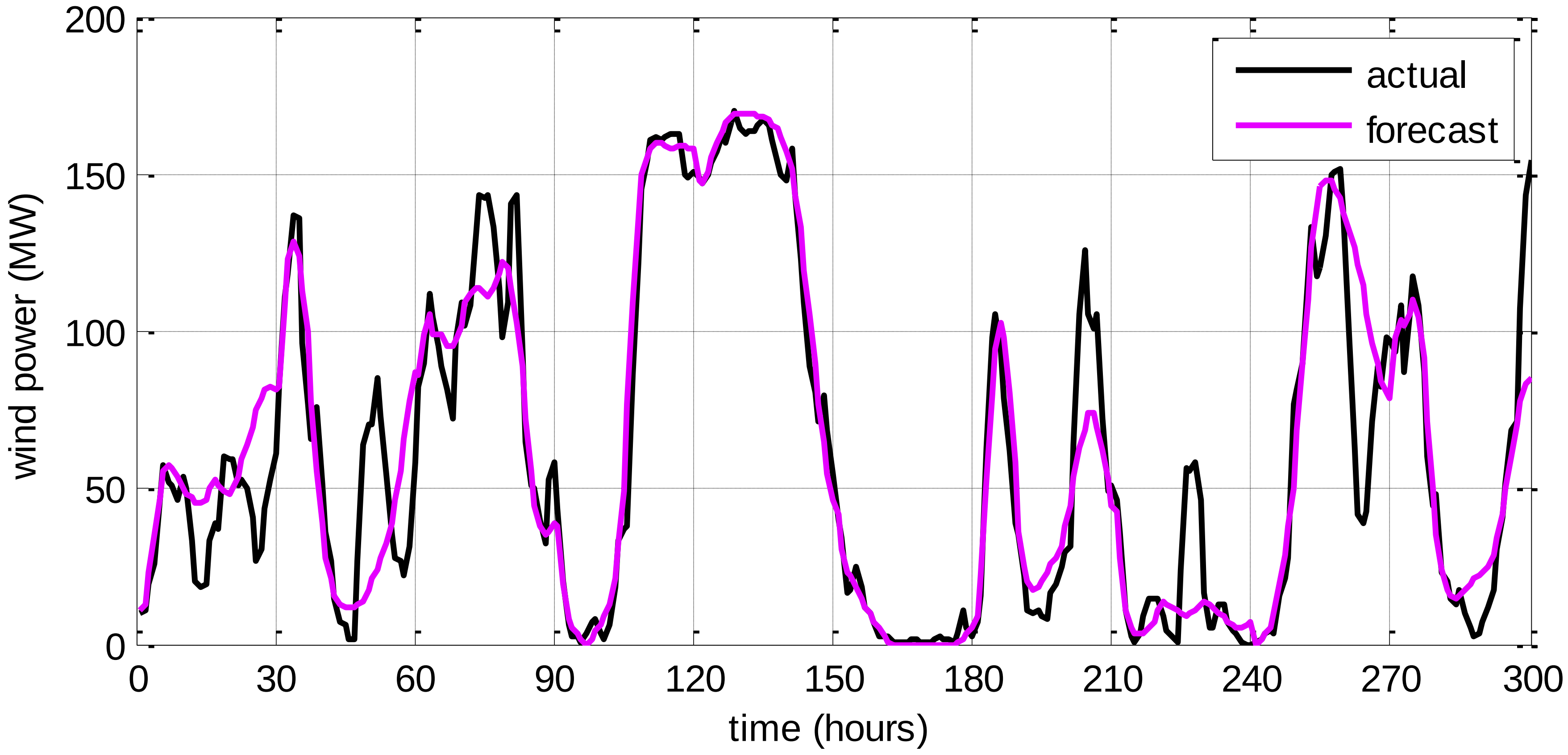
Stage -II



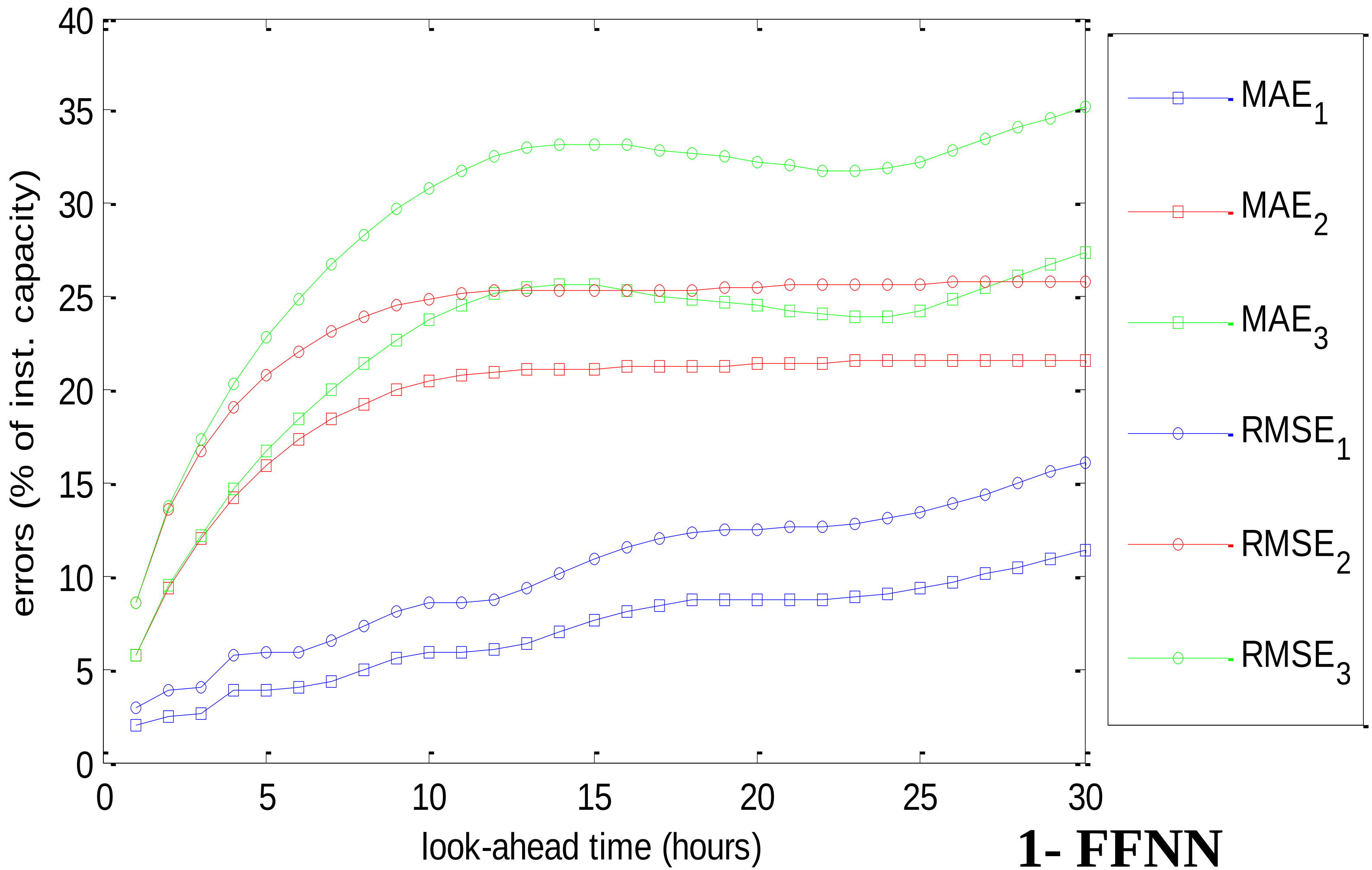
FFNN Inputs:

wind speed {0, 1, 2} lag hours and from wind power series {1, 2, 3, 4, 5, 6} lag hours.

30-hours ahead Wind Power Forecast



Comparative Performance

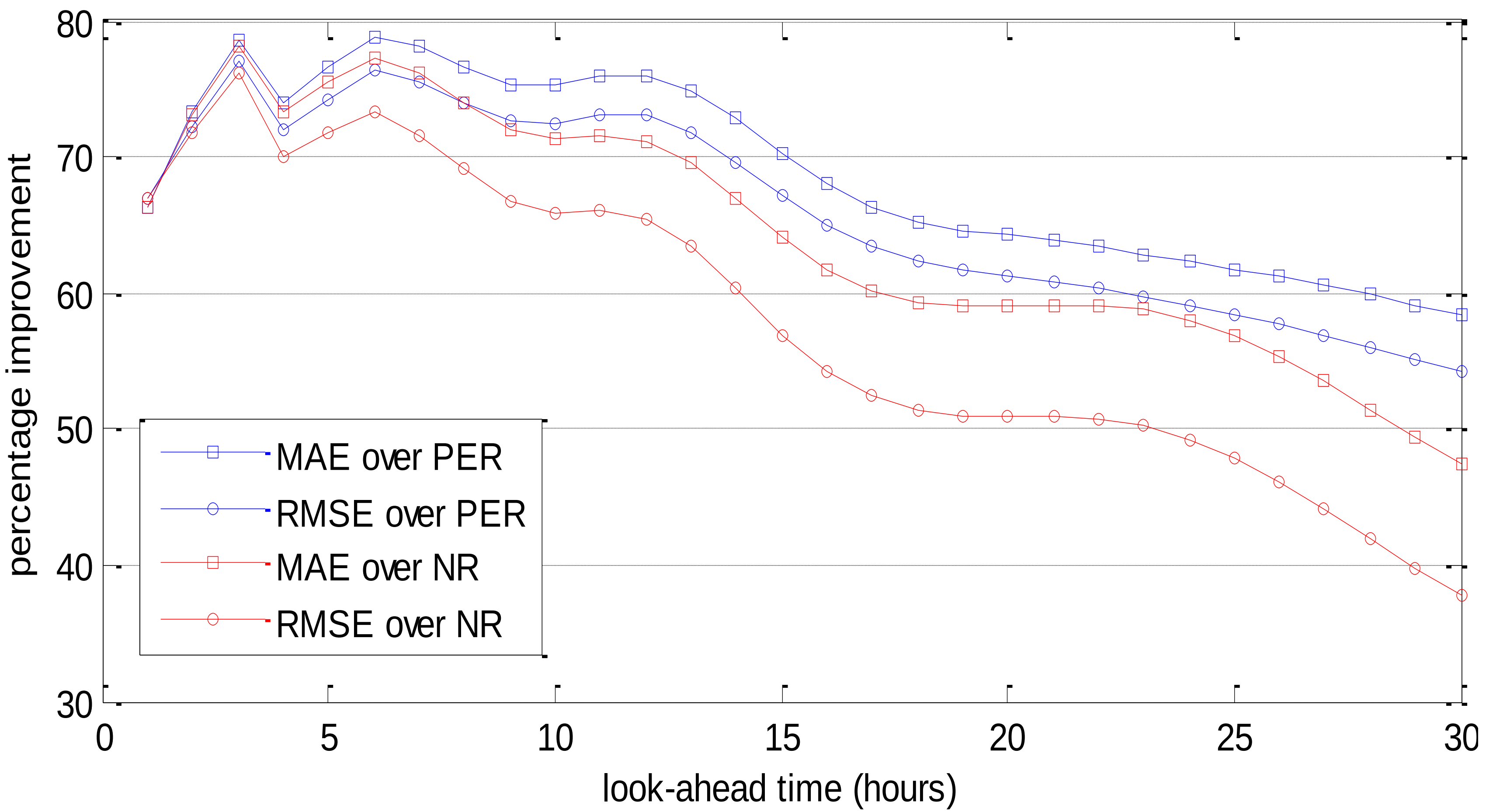


1- FFNN

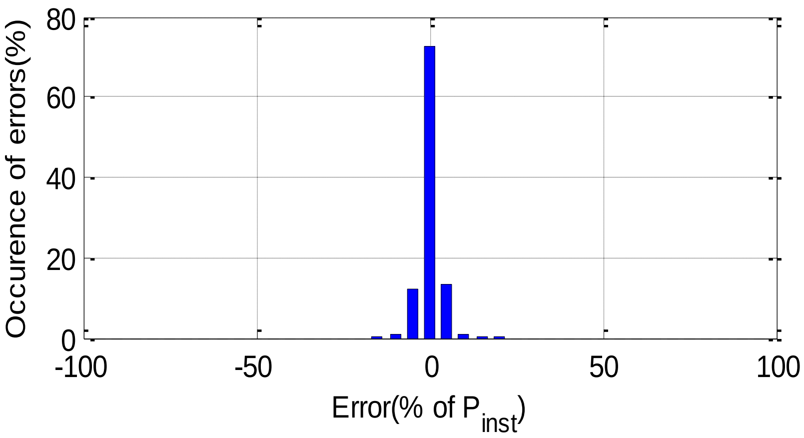
2-New-Reference

3-Persistence

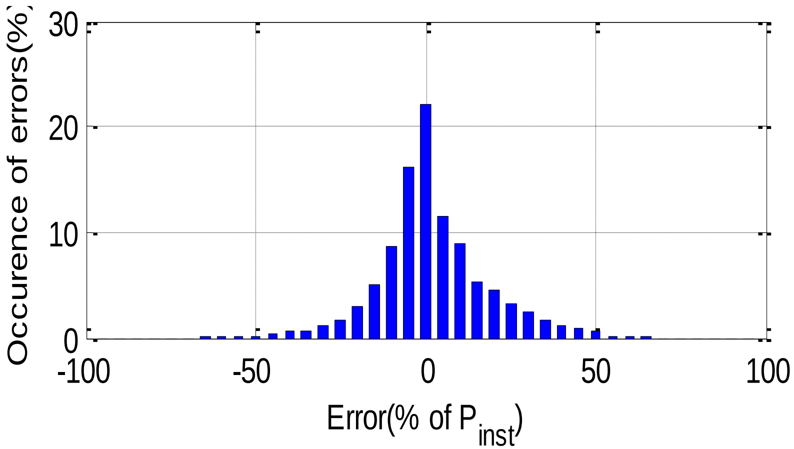
Percentage Improvement



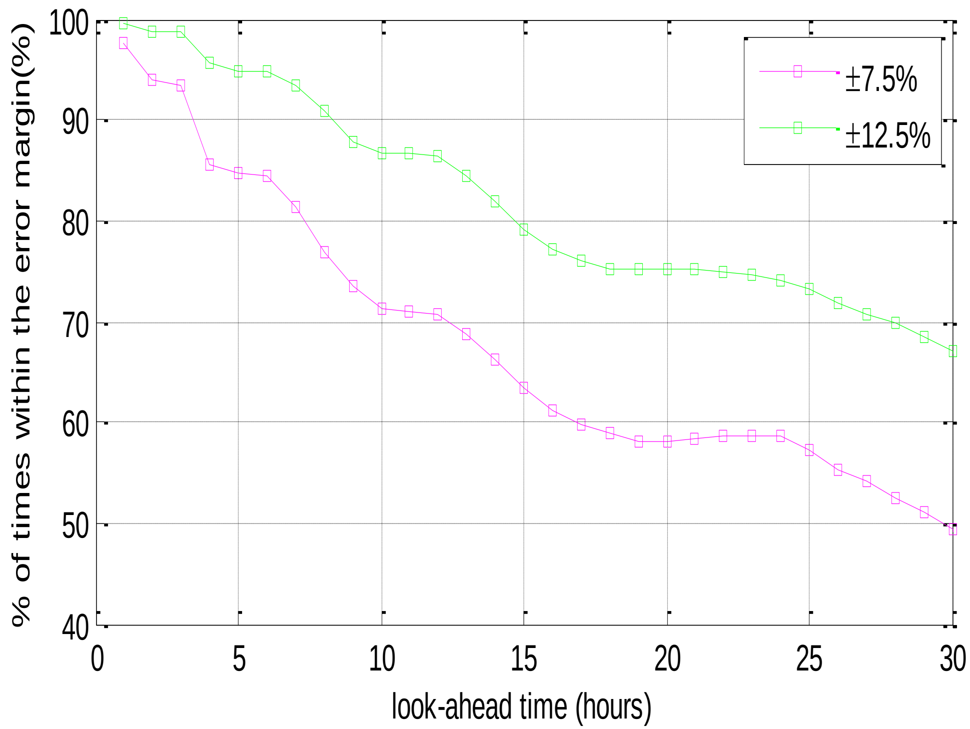
Error Distributions and Forecasting Ability



1-hr ahead forecast error distributions



30th -hr ahead forecast error distributions



Summary

- **Hourly forecast of wind power, up to 30h ahead, is carried out in two stages.**
- **In stage-I, multiresolution analysis of wind speed is carried and the decomposed signals are forecasted using AWNN.**
- **In stage-II, a Feed Forward Neural Network is used for non-linear mapping between the obtained wind speed forecasts and wind power outputs.**
- **The forecasting results when compared, shows that the proposed method has an average improvement of 67% over Persistence and 60% over New-Reference benchmark model.**


THANK YOU



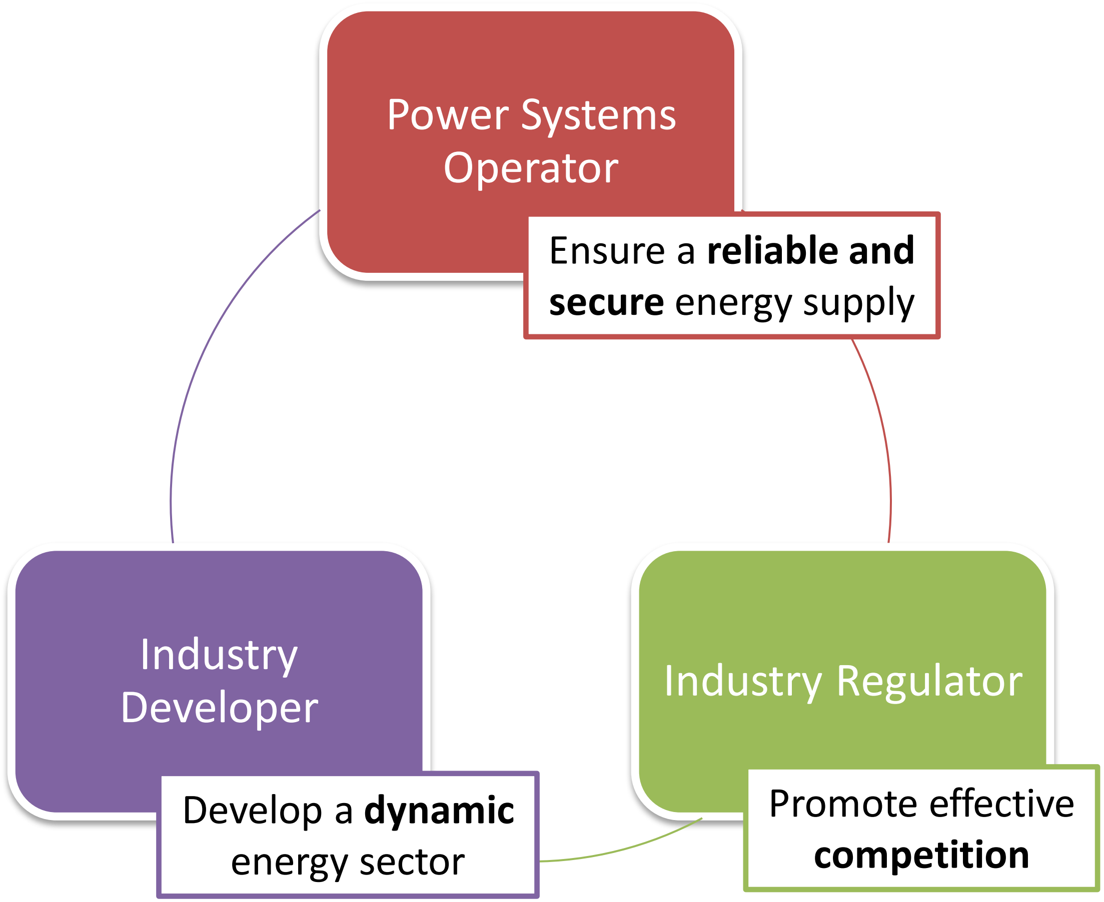
Regulation of Power Sector in Singapore - Development and Current Practices

9th Capacity Building Program for
Officers of Electricity Regulatory Commissions

Presenter: Rachel Su, Deputy Director
(Market Development and Surveillance Department)

24 Nov 2015

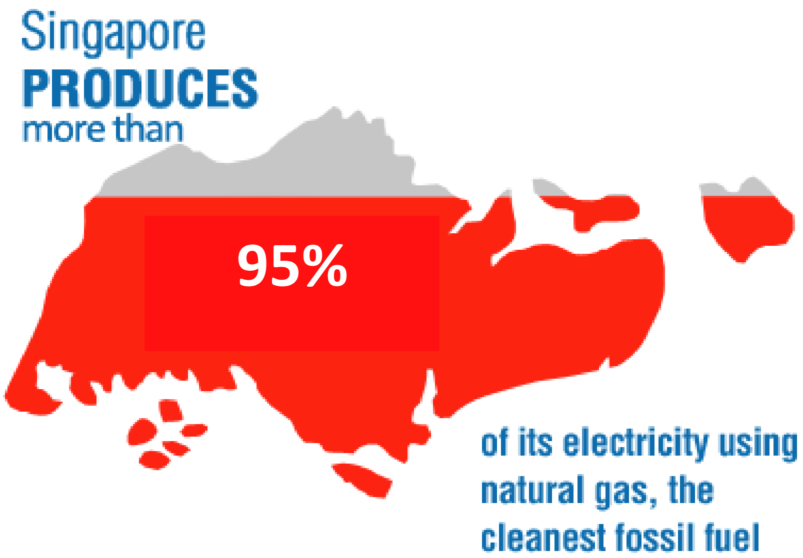
Energy Market Authority (EMA) is the lead agency for energy matters in Singapore



SINGAPORE'S ENERGY LANDSCAPE

Balancing Singapore's energy challenges

Singapore's energy landscape



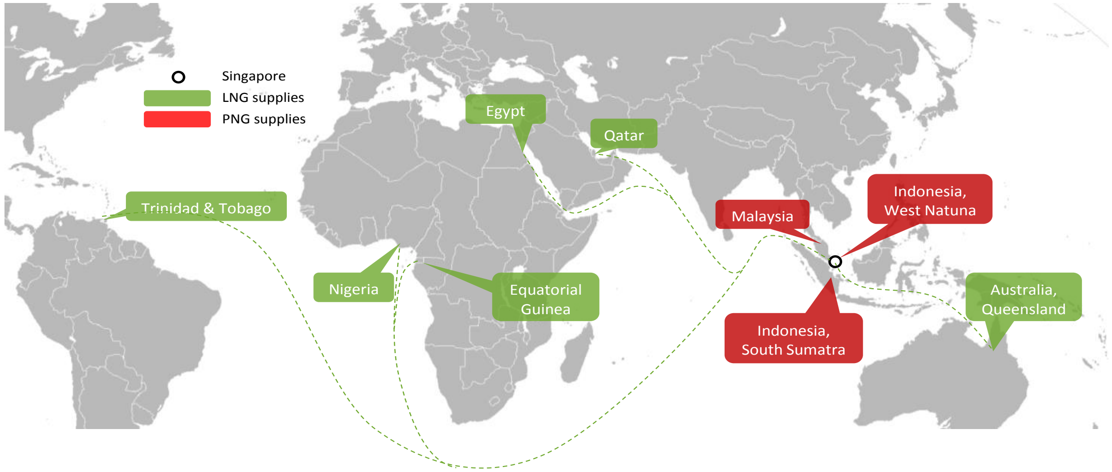
- Natural gas is the **dominant fuel source for power generation in Singapore** and is used in several industry applications.

- Beyond natural gas, Singapore is also exploring **alternative energy options to diversify our energy mix.**

Decision to import LNG to meet our strategic objectives of energy security and price competitiveness

1

Flexibility to **import from multiple sources** and access **competitively priced gas from global markets**



Reference: http://thediplomat.com/2013/09/singapore-emerges-as-lng-trading-hub/

2

Enhances competition in the electricity market

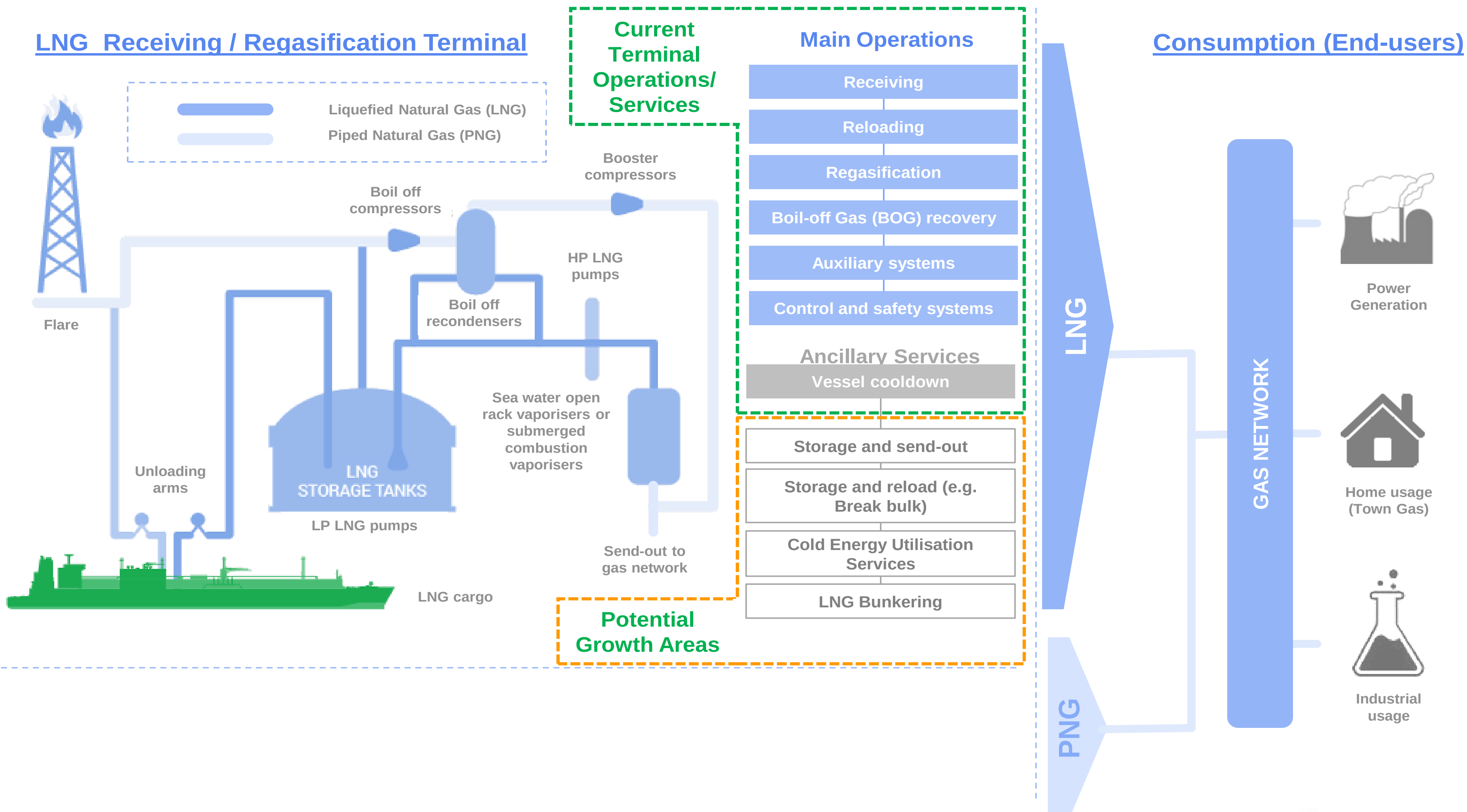
3

Places Singapore in a **favourable position to be the natural gas hub for Asia** and support **growth of LNG ancillary services** in Singapore

4

Environmentally Cleaner Fuel due to its lower carbon intensity compared with other fossil fuels

Singapore's 1st LNG terminal was commissioned in May 2013



Building ahead of demand to widen our strategic options

- **Continued expansion of our existing terminal** to enhance our energy security and allows buyers to access spot cargoes when the price is right.

- **Forward looking terminal design to allow for the development of ancillary services** such as break-bulk, LNG bunkering and cold energy integration.

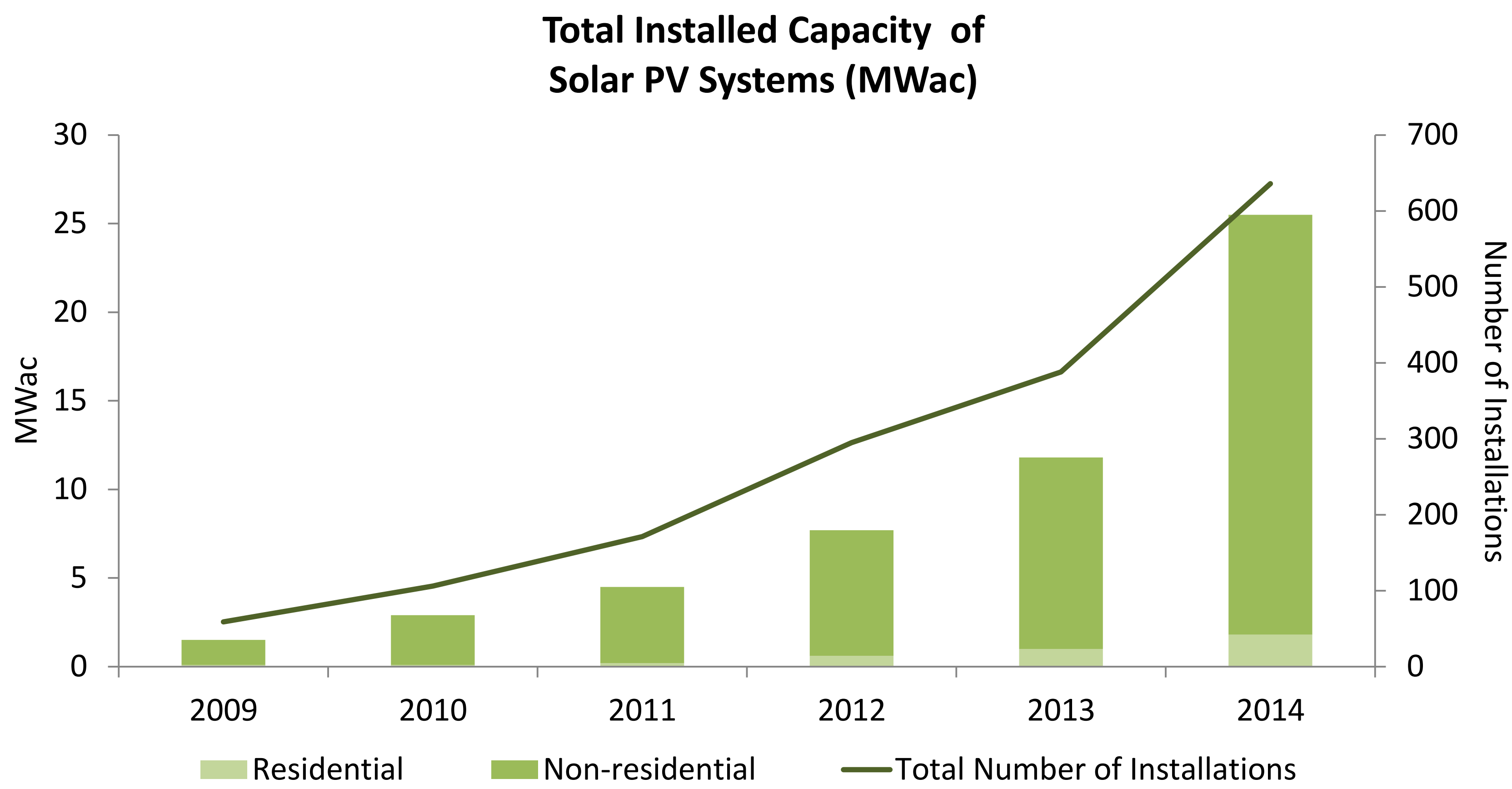
Solar PV offers greatest deployment potential for Singapore

- Due to our physical constraints, Singapore has **limited renewable energy options** –

Renewable Energy	Our Constraints
Hydro	Singapore's terrain is relatively flat
Tidal	Tidal range in Singapore is generally low and our waters are relatively calm
Wind	Singapore has low average wind speeds

- Nonetheless, Singapore is located in the tropical sunbelt with good irradiance. Amongst the renewable energy options, **solar energy offers the greatest deployment potential.**

Steady growth in solar PV deployment in Singapore



Singapore's efforts to maximise solar PV deployment

Solar energy will benefit Singapore when it becomes commercially viable

- Environmental Sustainability
- Energy Security
- Price Competitiveness

Challenges that need to be addressed

- Intermittent in nature and fluctuates due to changes in weather conditions, cloud cover and shadows
- Require back up from conventional power sources to ensure system stability

Singapore's efforts to maximise solar deployment

- Streamline deployment process
- Simplify payment procedures
- Build internal capabilities (e.g. solar forecasting)
- Ensure that the power system is able to manage intermittency

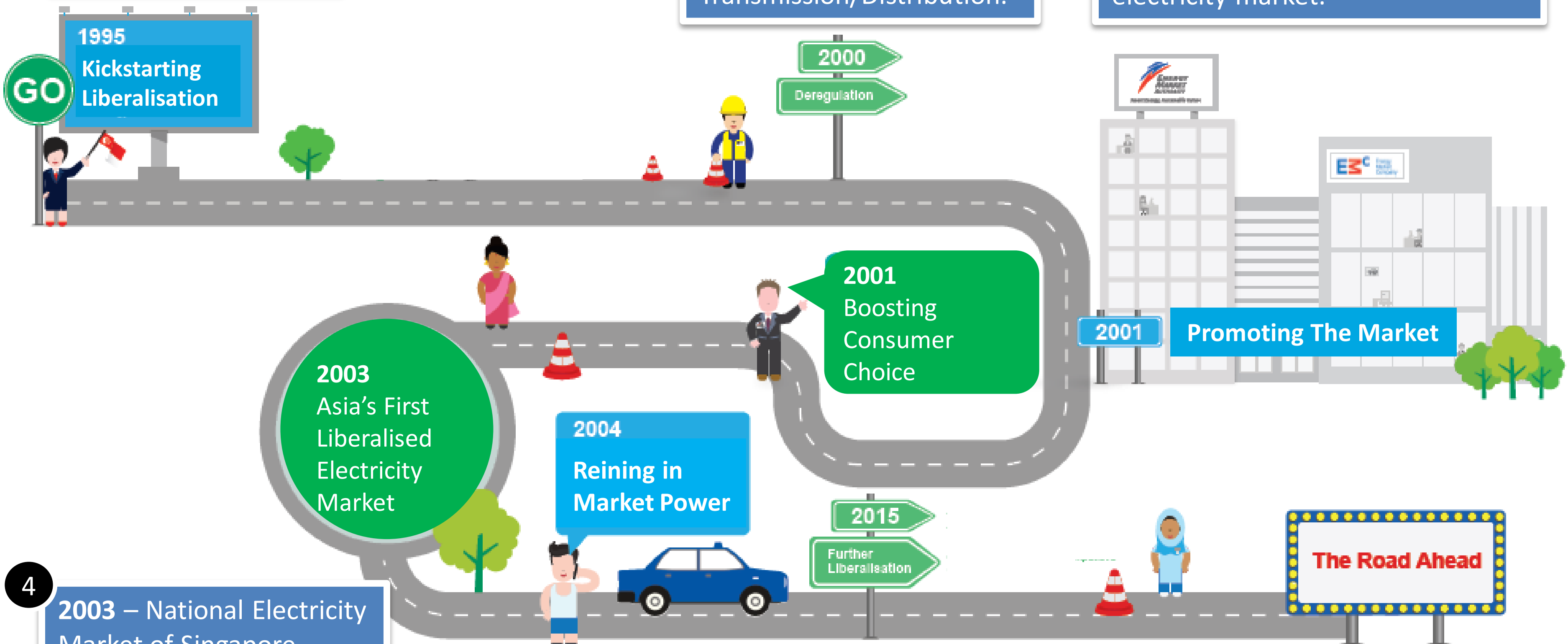
SINGAPORE'S ELECTRICITY MARKET DESIGN AND REGULATORY FRAMEWORK

Singapore's market liberalisation journey

1 **1995** - Electricity and gas undertakings of PUB was corporatised.

2 **2000** - Separated at ownership level competitive functions of Generation/Retail from Transmission/Distribution.

3 **2001** - EMA was set up as an "referee" for the sector. EMC became the operator and administrator of the wholesale electricity market.

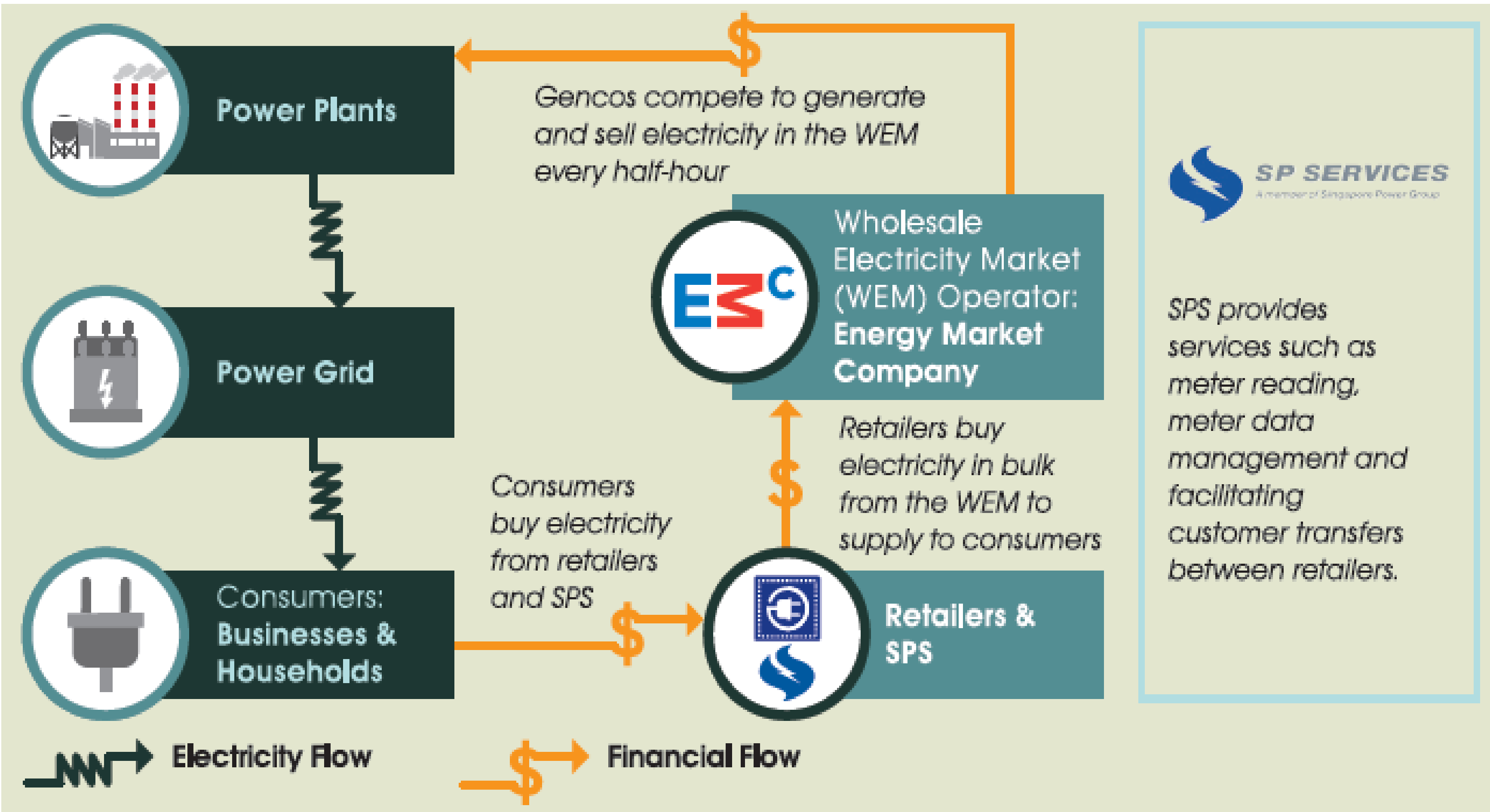


4 **2003** – National Electricity Market of Singapore opened for trading.

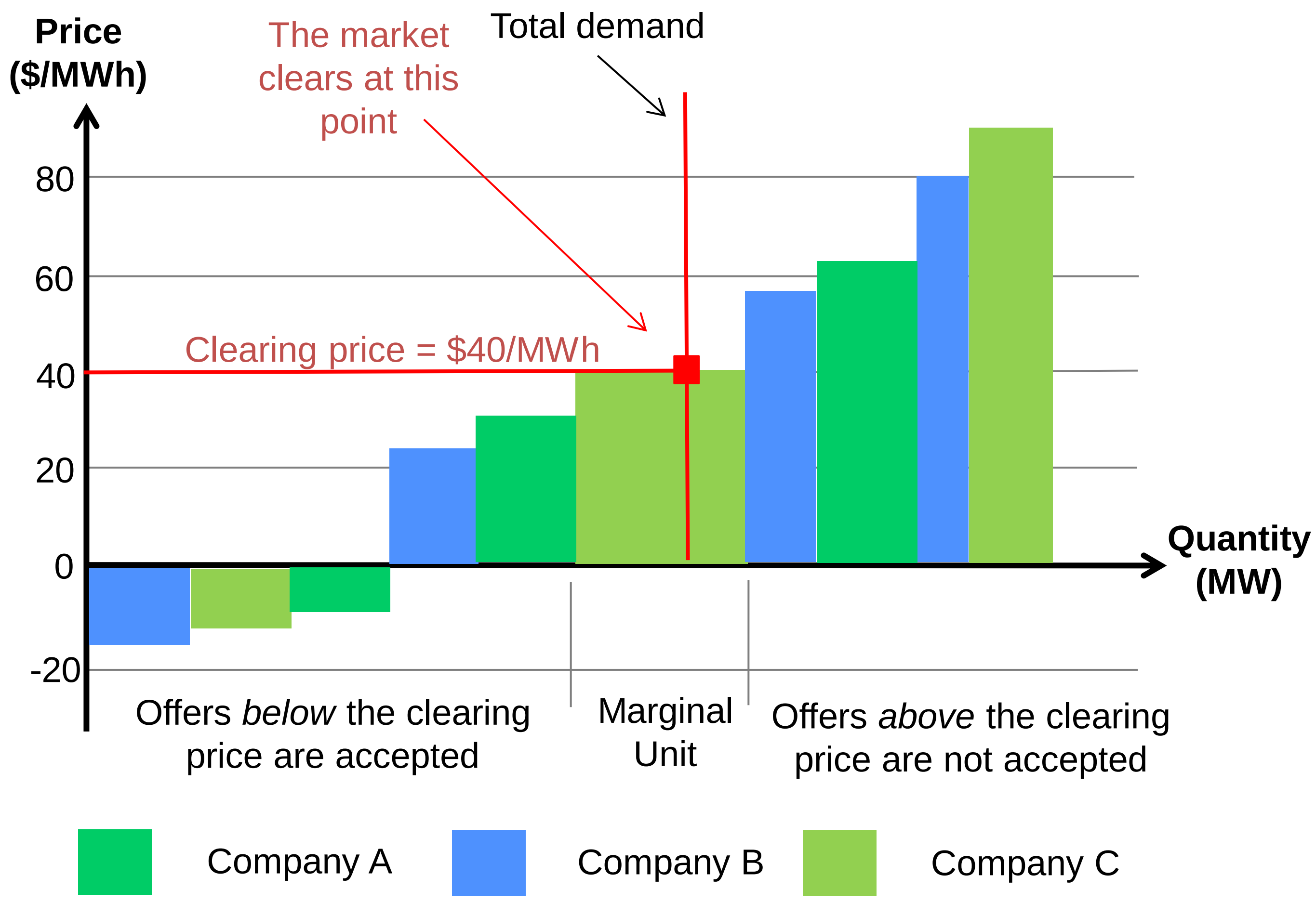
5 **2004** – Vesting Contracts introduced to mitigate the exercise of market power of generation companies.

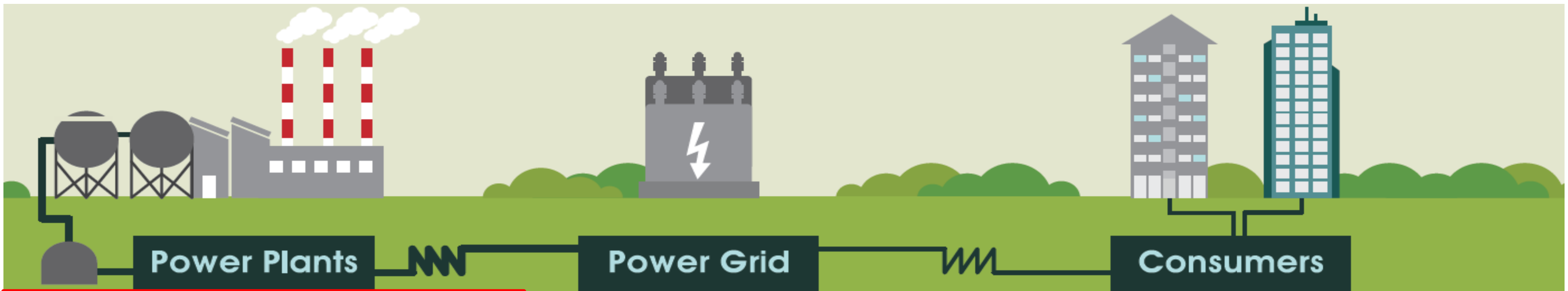
6 Gradual opening up of the retail electricity market since **2001**. Eligible consumers can choose different price packages.

Singapore's electricity market design



Market clearing mechanism



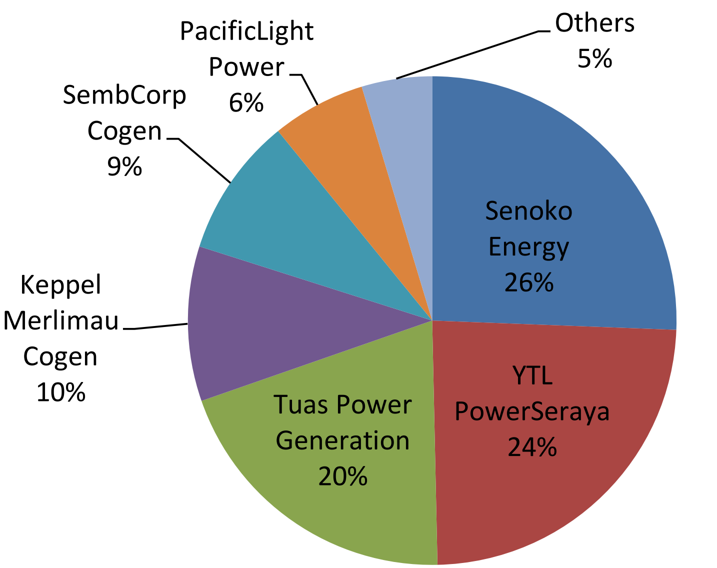


6 major generators & other small generators

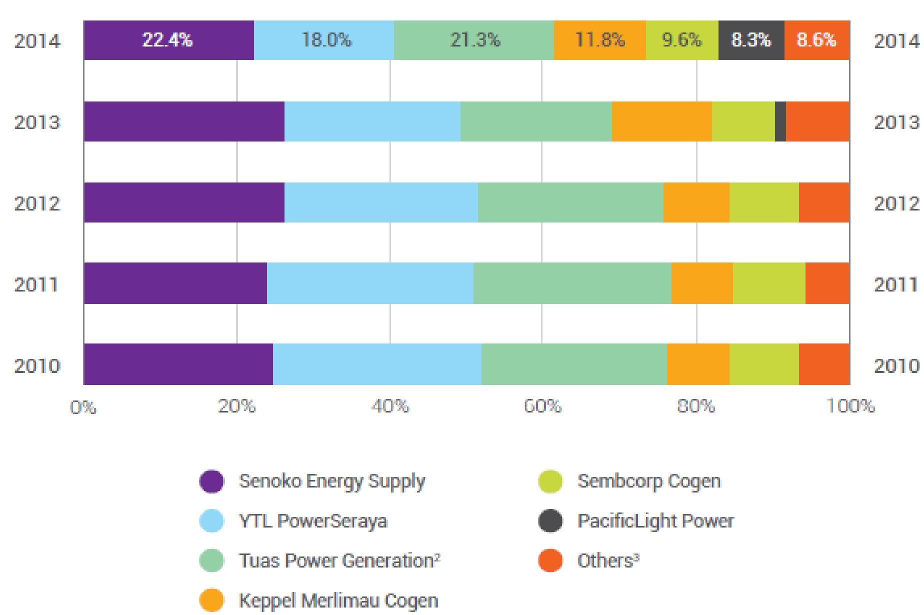
1 grid operator

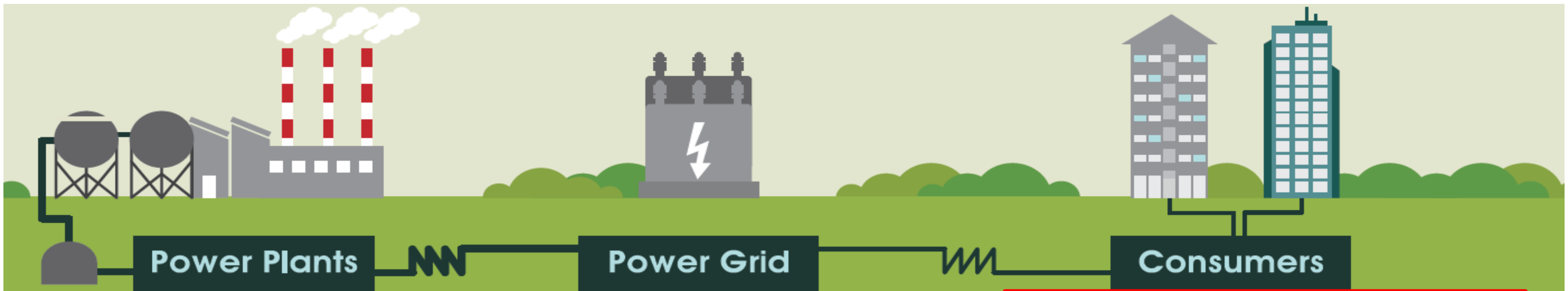
14 electricity retailers & SP Services

Licensed Generation Capacity, Q1 2015



Market Share for Electricity Generation



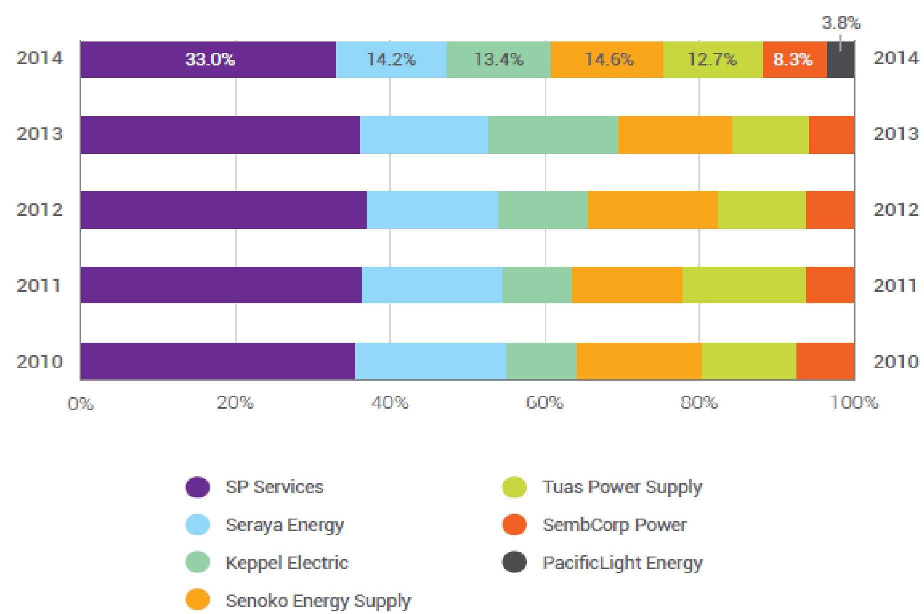


6 major generators & other small generators

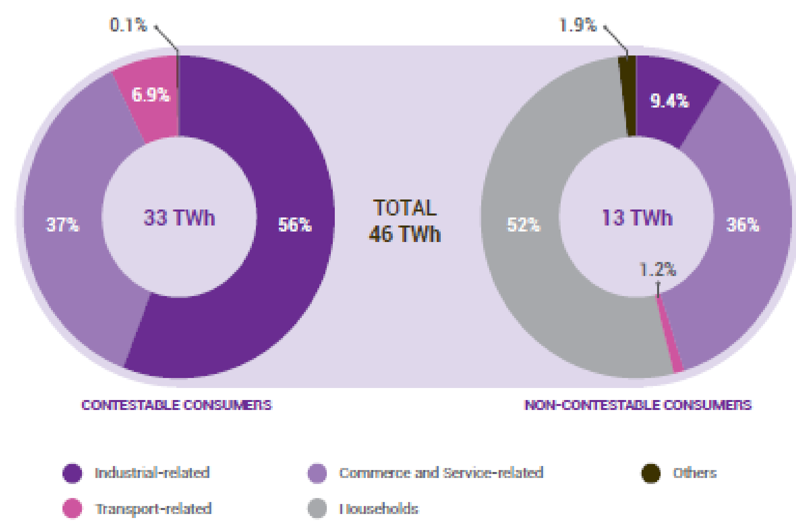
1 grid operator

14 electricity retailers & SP Services

Market Share for Electricity Retail



Electricity Consumption by Contestability & Sector, 2014



Regulatory roles

Competitive Sector

(Power Generation Companies and Electricity Retailers)

- Clear and transparent regulatory regime
- Rely on market signals
- Ensure level playing field
- Low barriers of entry

Monopoly Service Providers

(Grid Operator, Market Support Services and Wholesale Market Operator)

- Regulate revenue of monopolies
- Incentivise efficient behaviour
- Open access

Competitive Sector
Addressing the issue of market power

- In the electricity generation and retail businesses, companies compete with one another at competitive prices for dispatch and customers.

- However, there are three large generation companies who have market power. They could exercise market power and raise electricity price. As such, EMA introduced **Vesting Contracts to mitigate the exercise of market power of these players**.

Monopoly Service Providers

Ensuring outcomes of reliability, affordability & open access

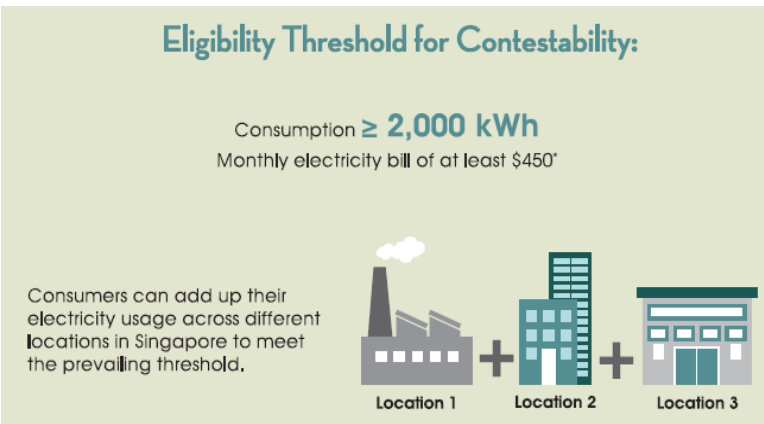
Reliability	Affordability	Open Access
Performance standards	Price Regulation framework	Separate ownership of infrastructure from competitive activities
Annual system-wide emergency exercises	“Efficiency Carryover Mechanism”	

KEY ACHIEVEMENTS

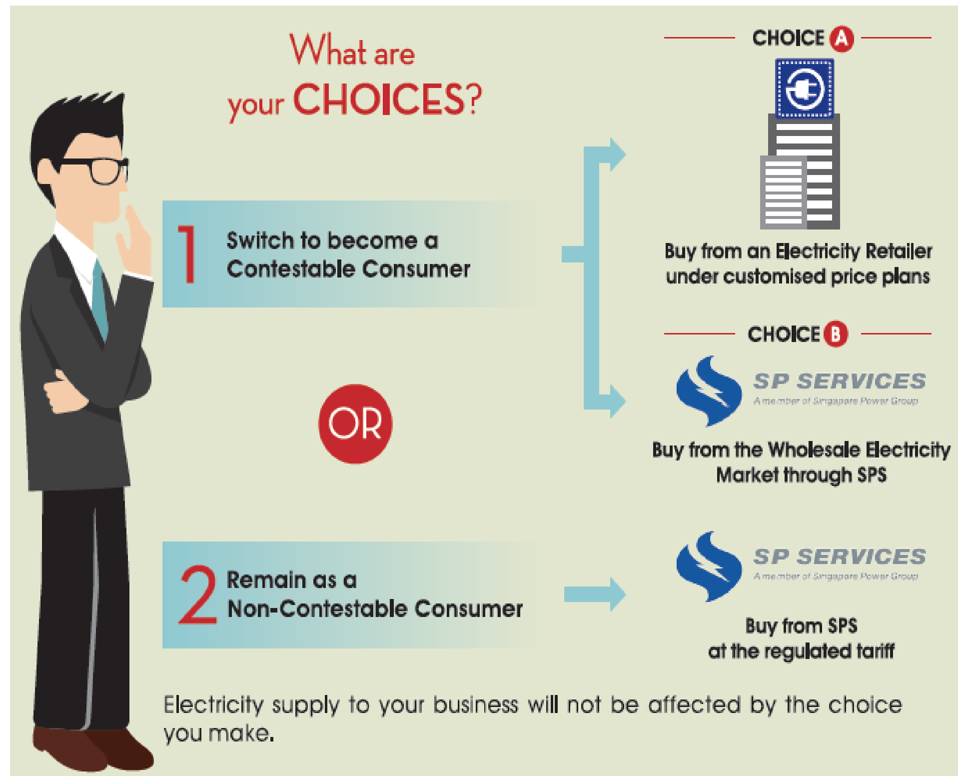
Competition motivated the switch from oil-fired steam plants to more cost efficient gas-fired plants

Consumers benefit from having a greater choice of retailers and pricing plans

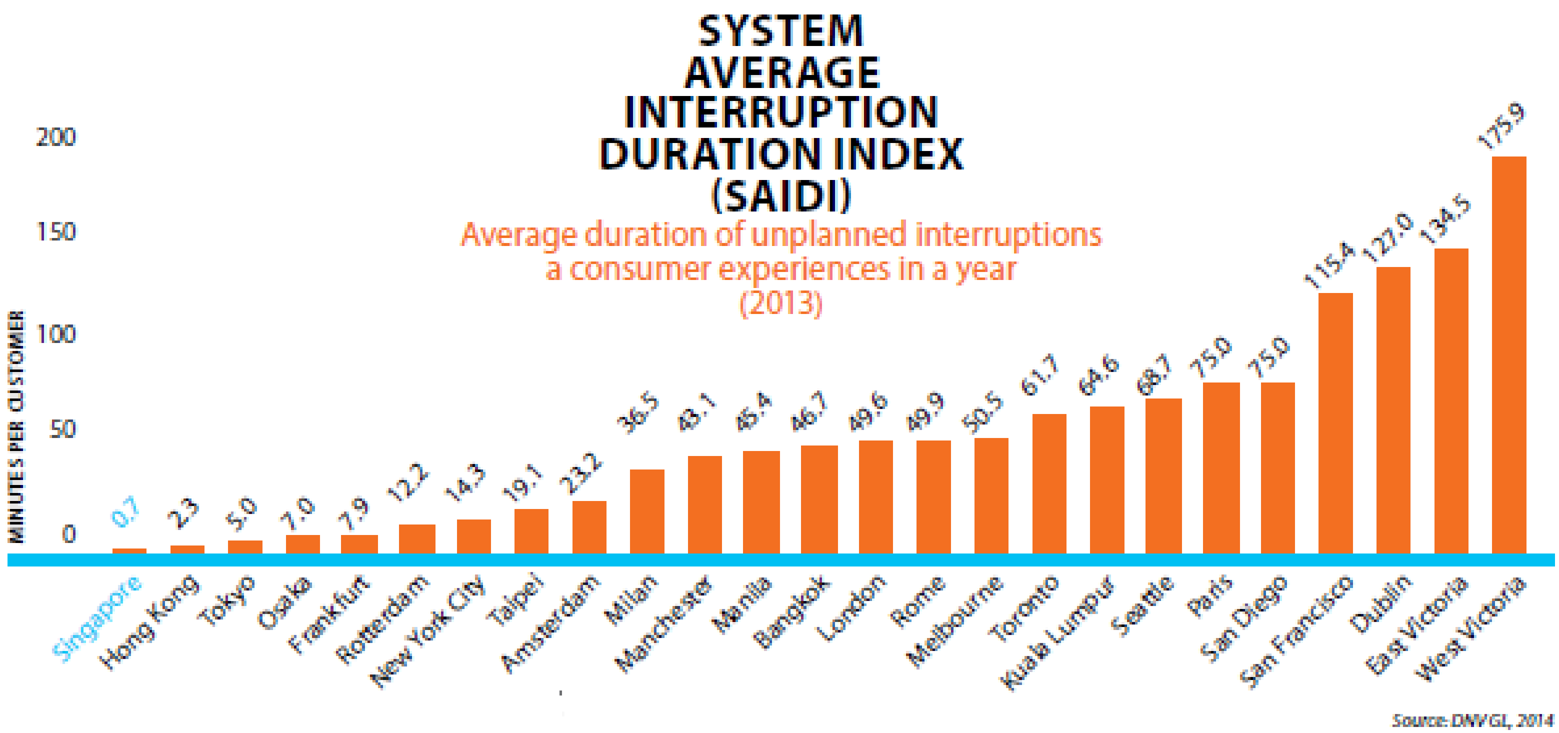
- Today, around **80% of demand have retail choice**, and we are working on how to let the remaining 20% also enjoy the benefits of competition by 2H 2018.



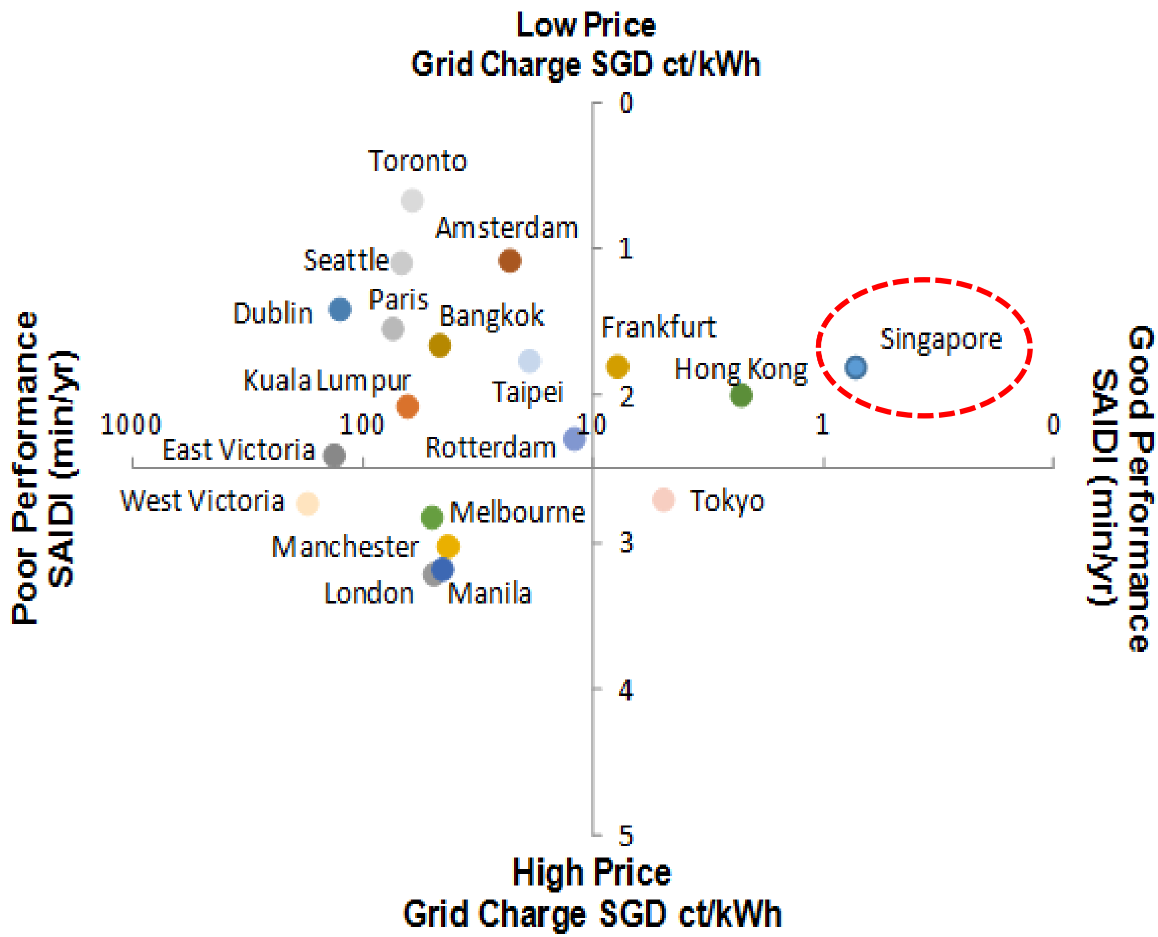
* *Based on Q4 2015's regulated tariff of 20.35 cents/kWh (before GST).*



Singapore's enjoys high system reliability



… at a relatively low cost (grid charge)



FUTURE DEVELOPMENTS

Electricity futures market as a platform for risk management and investment activities

Generators

- Platform to hedge their commercial and operational risks

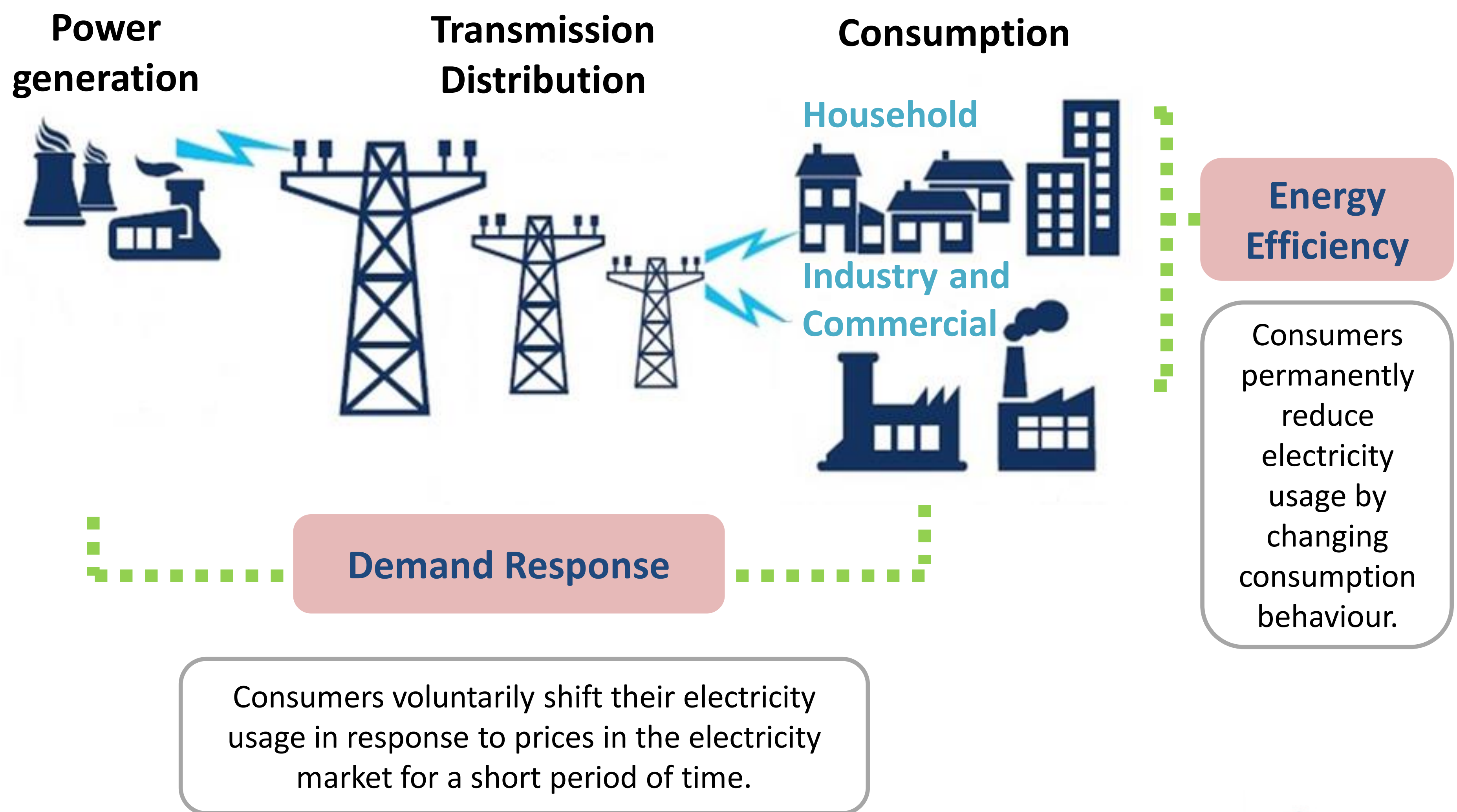
Consumers

- Lock in long term prices
- Utilise futures price to negotiate their electricity retail package

Retailers

- Expand retail volumes
- Option to secure fixed price contracts for their customers

Improving demand side management



Introducing demand response to enhance competition

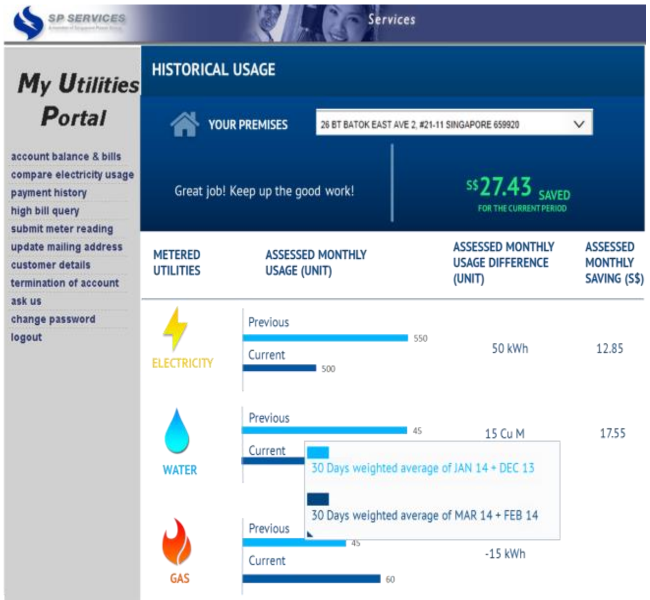
Demand side bidding where consumers can manage electricity usage in response to price signals

Reduce peak wholesale electricity prices

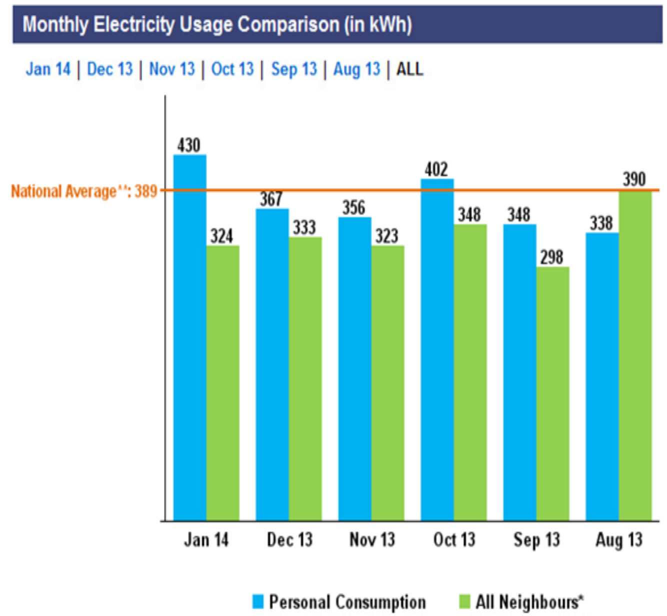
Promote more efficient investment

Provide additional resource to improve system reliability

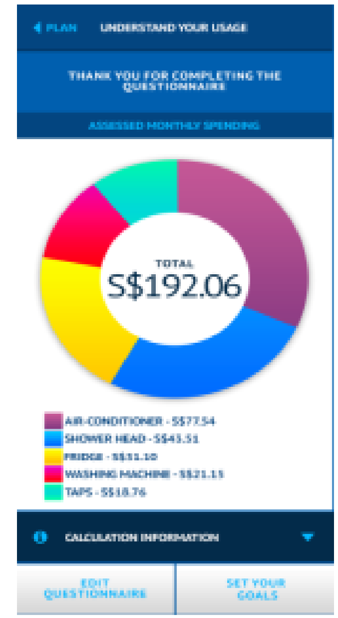
Joint pilot to nudge households to conserve water and electricity



Web portal



Six-month comparison against peers



Home Utility Audit

Project Rain Tree.mp4

Thank You

THE FUTURE OF ENERGY

Singapore

24 November 2015

Presentation to 9th Capacity Building Programme for Officers of Indian Electricity Regulatory Commissions

Ashish Sethia

APAC Lead – Power & Gas

Bloomberg NEW ENERGY FINANCE

BLOOMBERG NEW ENERGY FINANCE IS AN ENERGY MARKET RESEARCH BUSINESS WITHIN BLOOMBERG LP

Bloomberg	Bloomberg NEW ENERGY FINANCE
Since 1981	Since 2004
Over 15,000 employees in 192 locations	200 employees in 15 locations on six continents
Generating 5,000 news stories per day from 150 bureaus	Generating over 700 Insight reports annually
320,000 global clients	2,500 global clients

WE HAVE A GLOBAL ANALYST TEAM WITH STRONG SUPPORT AND PRESENCE IN APAC

Bloomberg
NEW ENERGY FINANCE

10 RESEARCH THEMES

Bloomberg NEW ENERGY FINANCE

1. Utility strategies and new power sector business models
   New retail strategies, distributed generation, unbundling assets
2. Power, renewable energy and carbon market reform
   Capacity markets, auctions, tariff reforms, trading schemes
3. Changing electricity demand patterns
   Prosumers, peak demand shifts, energy efficiency, decoupling electricity and GDP
4. The impact of oil and other commodity prices on the energy system
   Oil–gas price links, oil impact on distributed generation, manufacturing inputs and EVs
5. Region-specific gas supply/demand, and power market implications
   US shale, European pipelines, LNG, and competitiveness of gas in the merit order
6. Technology innovation and (component) cost declines
   Experience curves, process improvements, optimisation
7. The market opportunities for solar PV combined with energy storage
   Integrated distributed generation and storage, new solar+storage business models
8. Integrating renewable generation and maintaining system flexibility
   Intermittency, system balancing, energy storage, demand response
9. The ‘connected home’ and the ‘connected car’
   “Internet of things”, smart homes, energy management systems, EVs
10. Financial innovations for clean energy deployment
    Yieldcos, Green Bonds, securitization, corporate direct investment

Utilities (themes 1–3)
Commodities (themes 4–5)
Technology (themes 6–9)
Finance (theme 10)

WE WORK WITH MANY OF THE WORLD'S LEADING ENERGY ORGANIZATIONS

Bloomberg NEW ENERGY FINANCE

Public Sector & NGOs

Supply Chain &Technology

Finance & Investment

Utilities & Energy

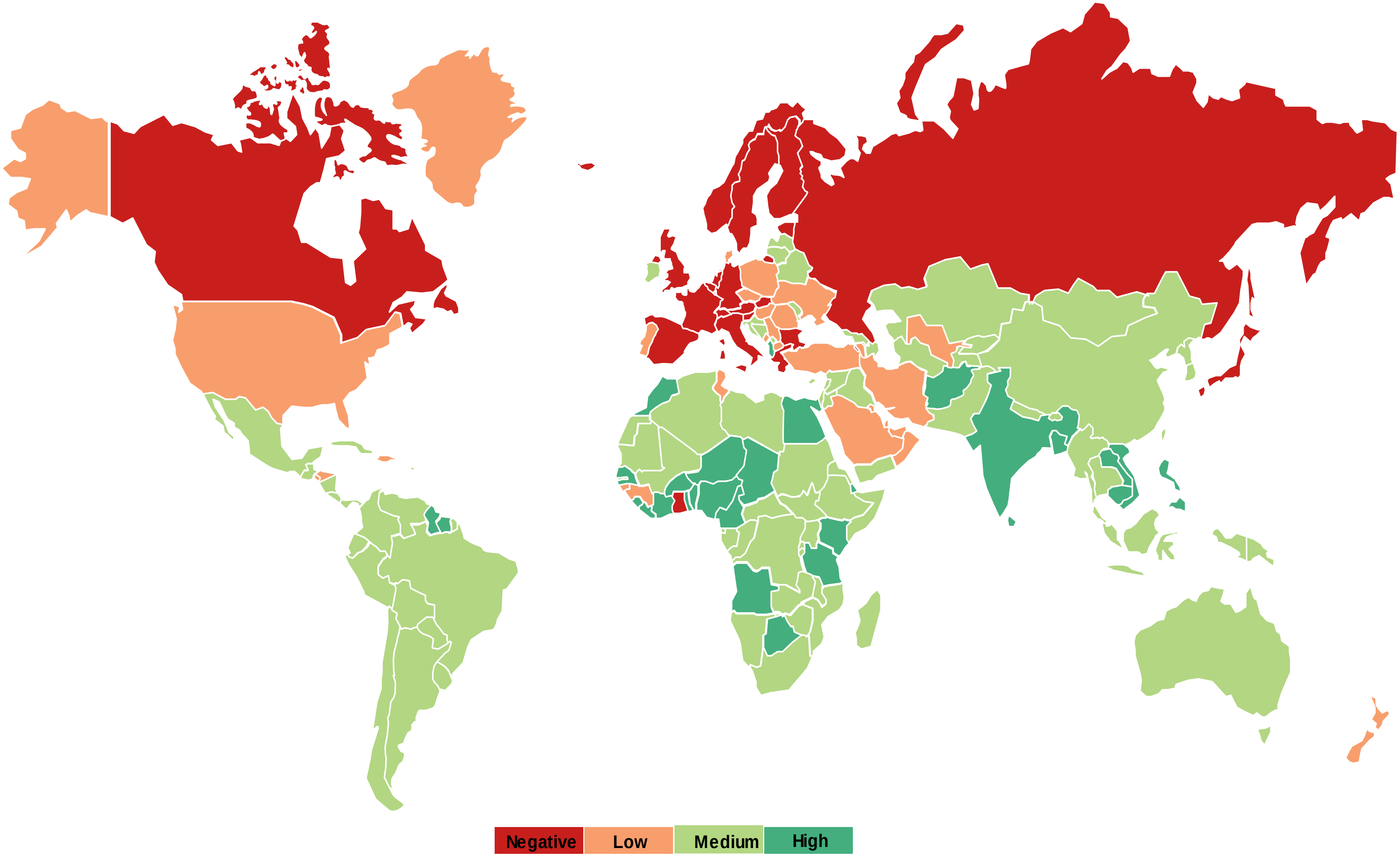
The logos listed do not represent a full client list. They are illustrative of the organizations we have worked with in the past.

NEW NORMAL: GROWING RENEWABLES

Bloomberg
NEW ENERGY FINANCE

GLOBAL POWER DEMAND GROWTH, 2012-40

Bloomberg
NEW ENERGY FINANCE



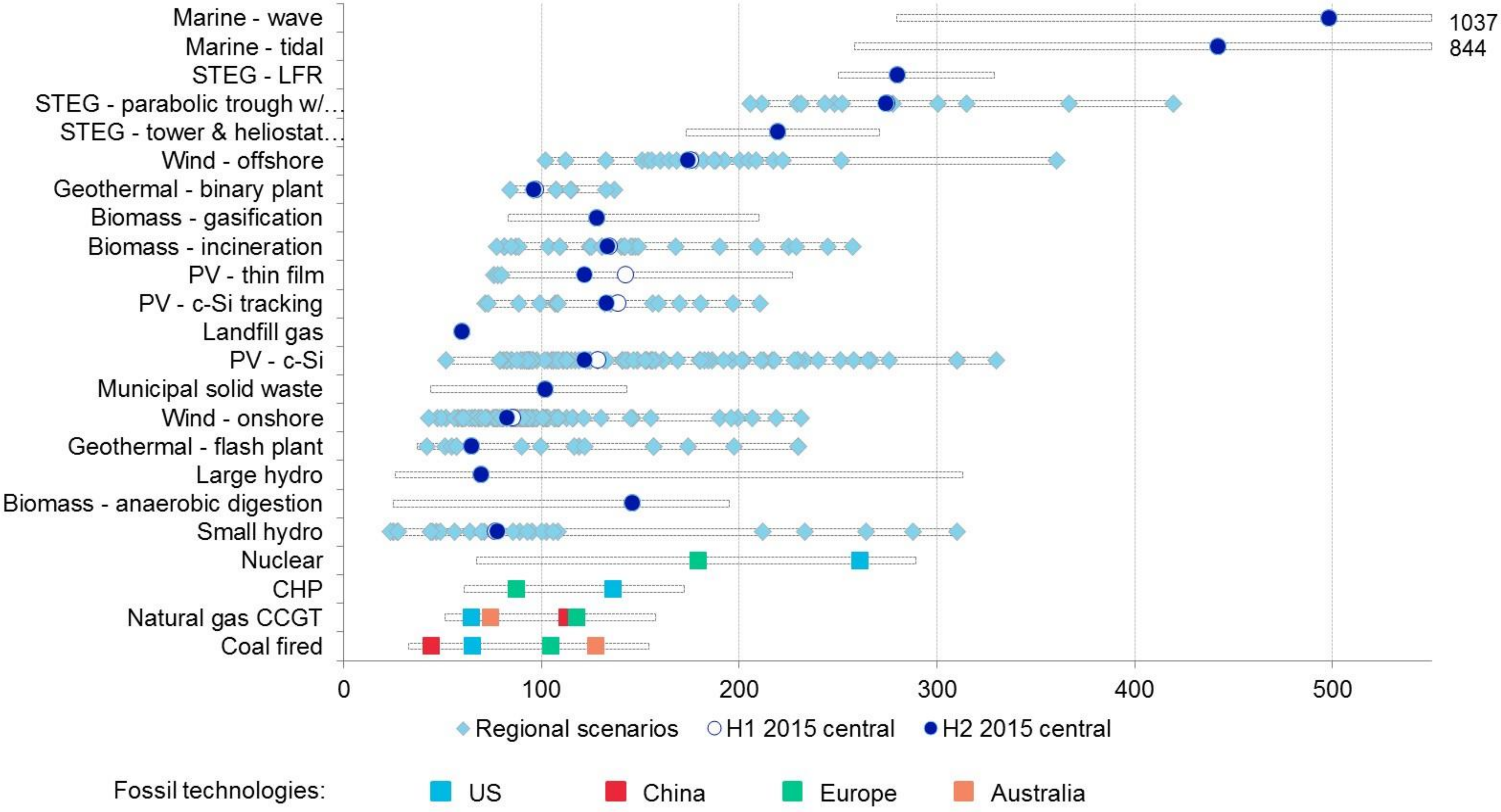
Note: low < 0.5%, Medium 0.5-4%, High >4%

Source: Bloomberg New Energy Finance

H2 2015 LEVELISED COST OF ELECTRICITY

CENTRAL AND REGIONAL SCENARIOS ($/MWH)

Bloomberg NEW ENERGY FINANCE

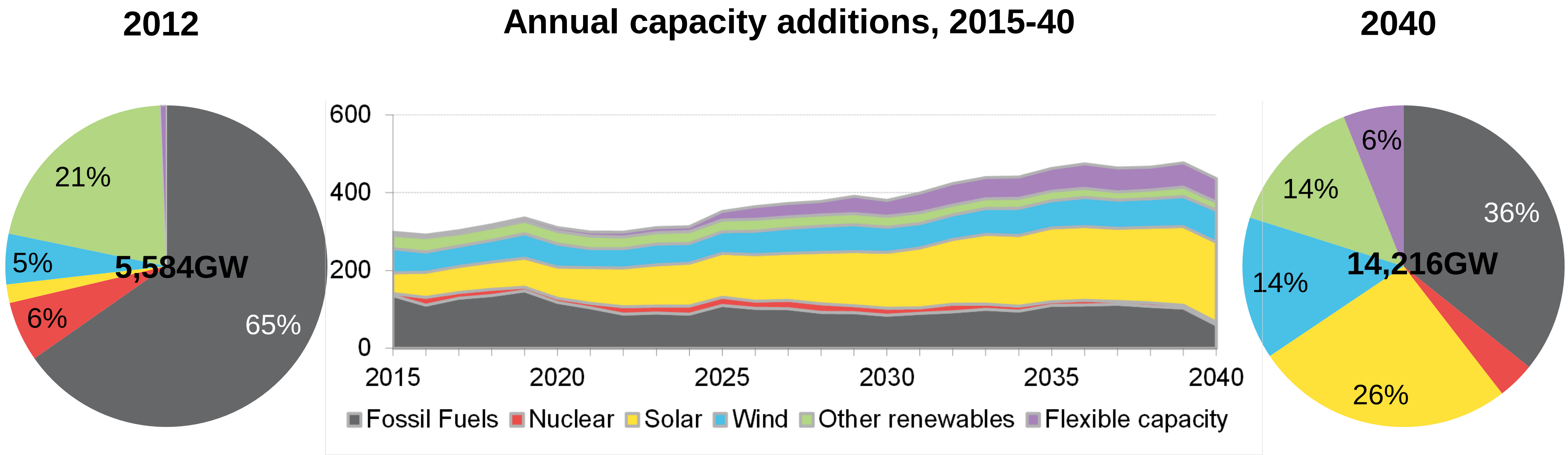


Note: STEG = solar thermal electric generation

Source: Bloomberg New Energy Finance

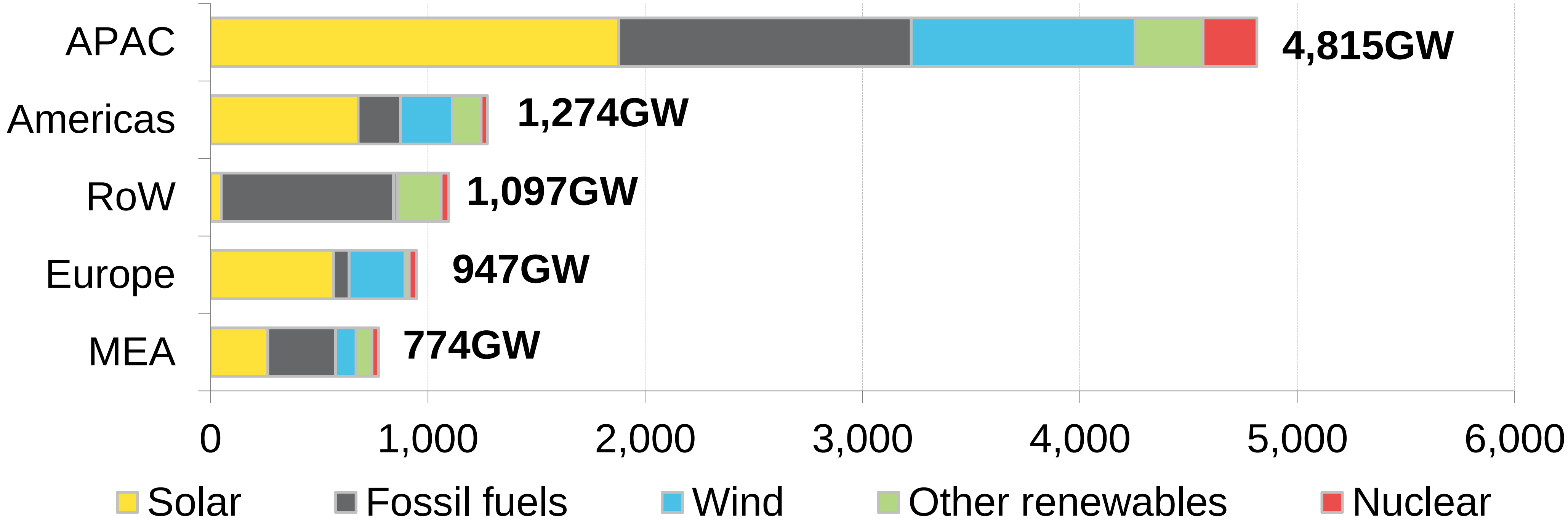
GLOBAL INSTALLED CAPACITY 2012 AND 2040 AND PROJECTED CAPACITY ADDITIONS, BY TECHNOLOGY (GW)

Bloomberg NEW ENERGY FINANCE



Source: Bloomberg New Energy Finance

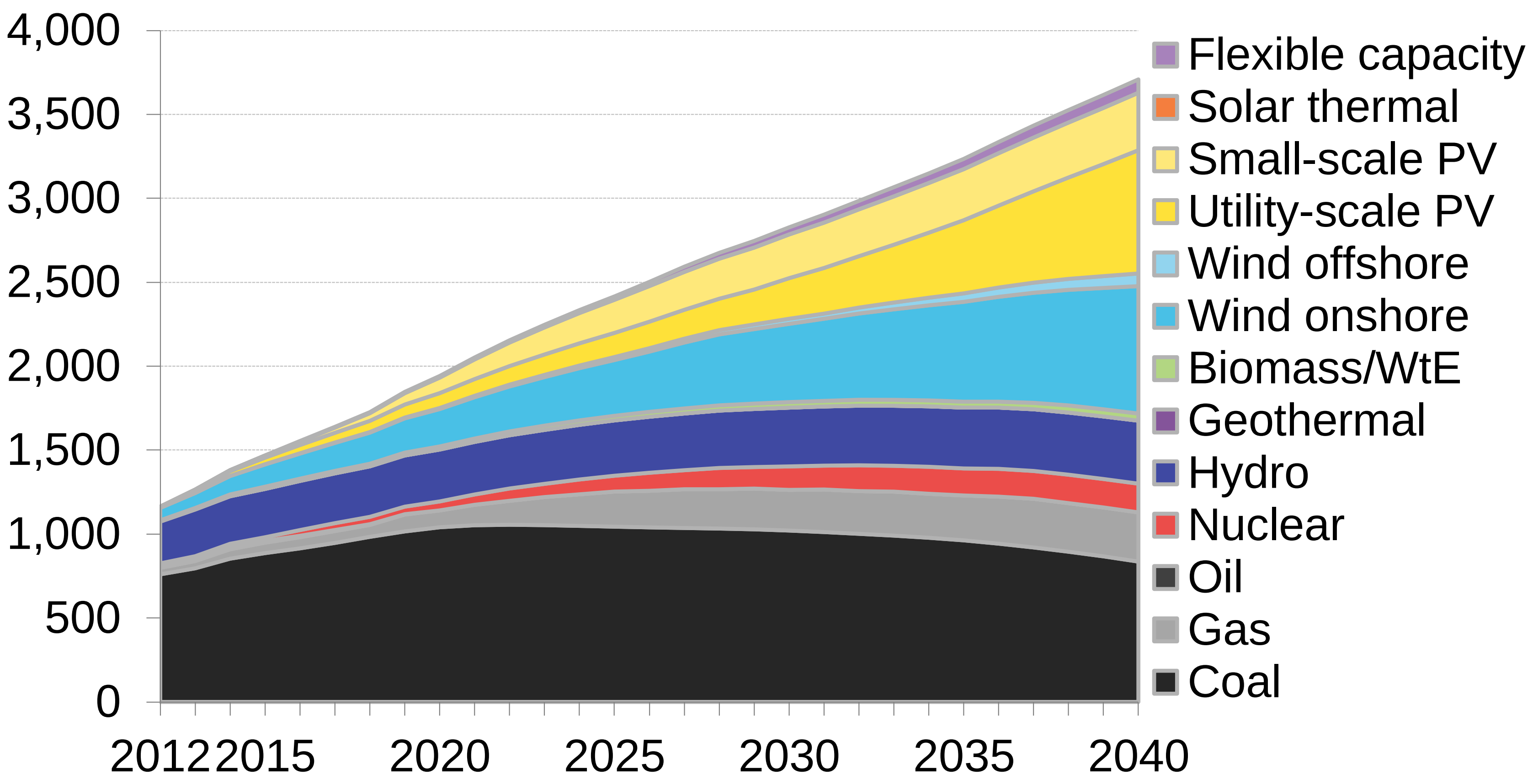
GROSS CAPACITY ADDITIONS BY REGION AND BY TECHNOLOGY, 2015-40 (GW)



Source: Bloomberg New Energy Finance

CHINA CUMULATIVE INSTALLED CAPACITY BY TECHNOLOGY, 2012-40 (GW)

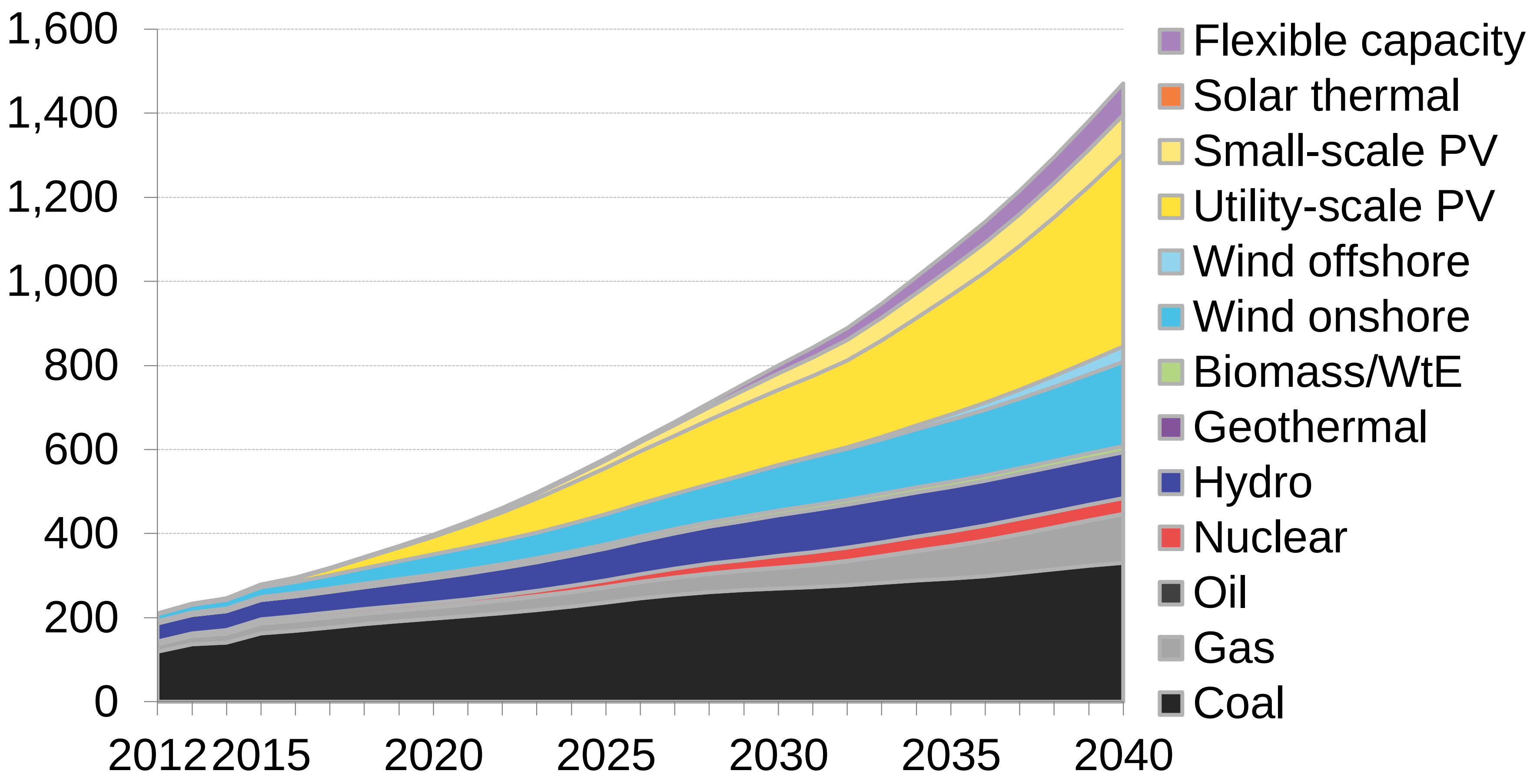
Bloomberg NEW ENERGY FINANCE



Source: Bloomberg New Energy Finance

INDIA CUMULATIVE INSTALLED CAPACITY BY TECHNOLOGY, 2012-40 (GW)

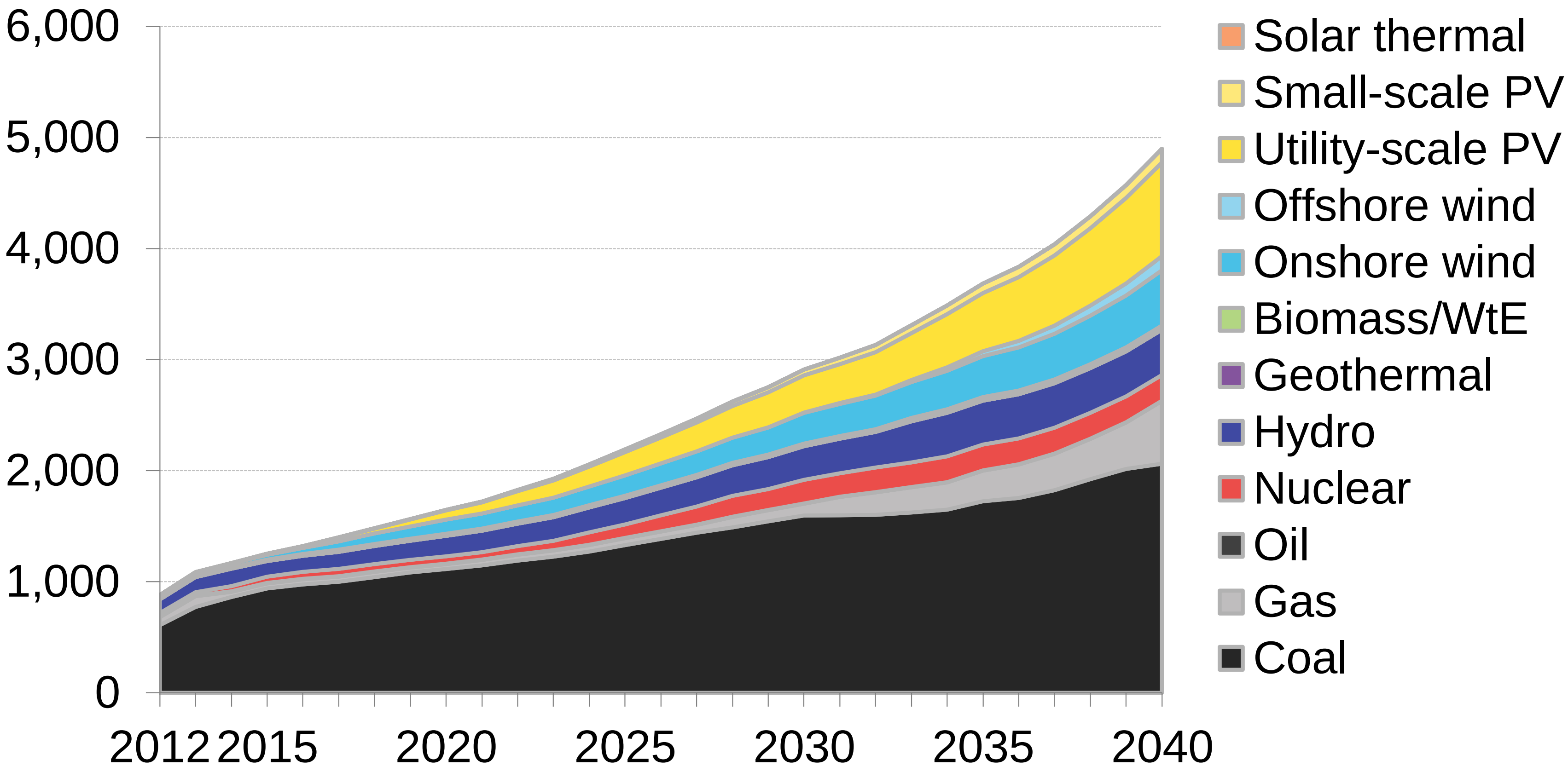
Bloomberg NEW ENERGY FINANCE



Source: Bloomberg New Energy Finance

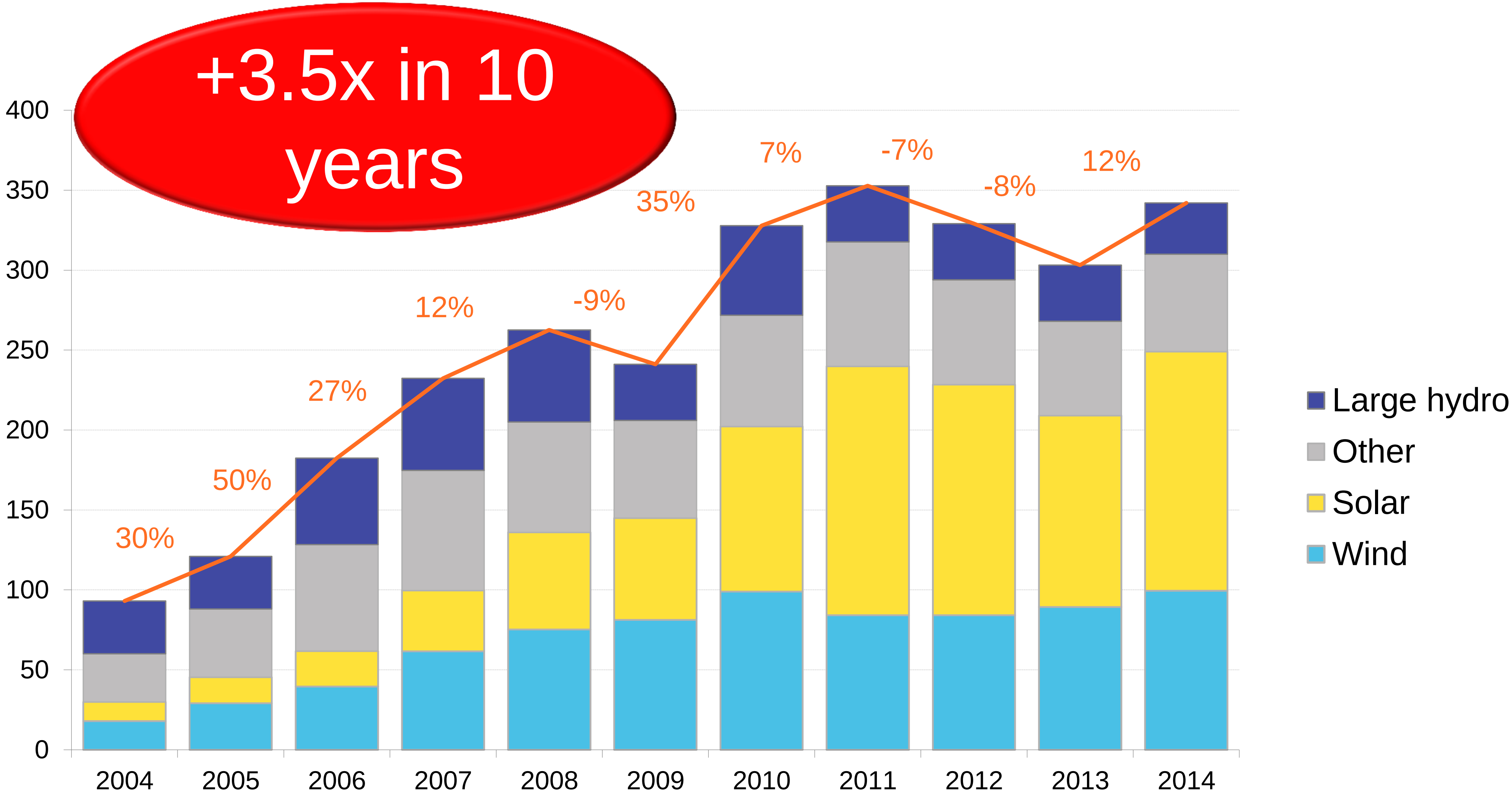
INDIA POWER GENERATION BY TECHNOLOGY,
2012-40 (TWH)

Bloomberg
NEW ENERGY FINANCE



Source: Bloomberg New Energy Finance

NEW INVESTMENT IN CLEAN ENERGY
2004–14 ($BN)

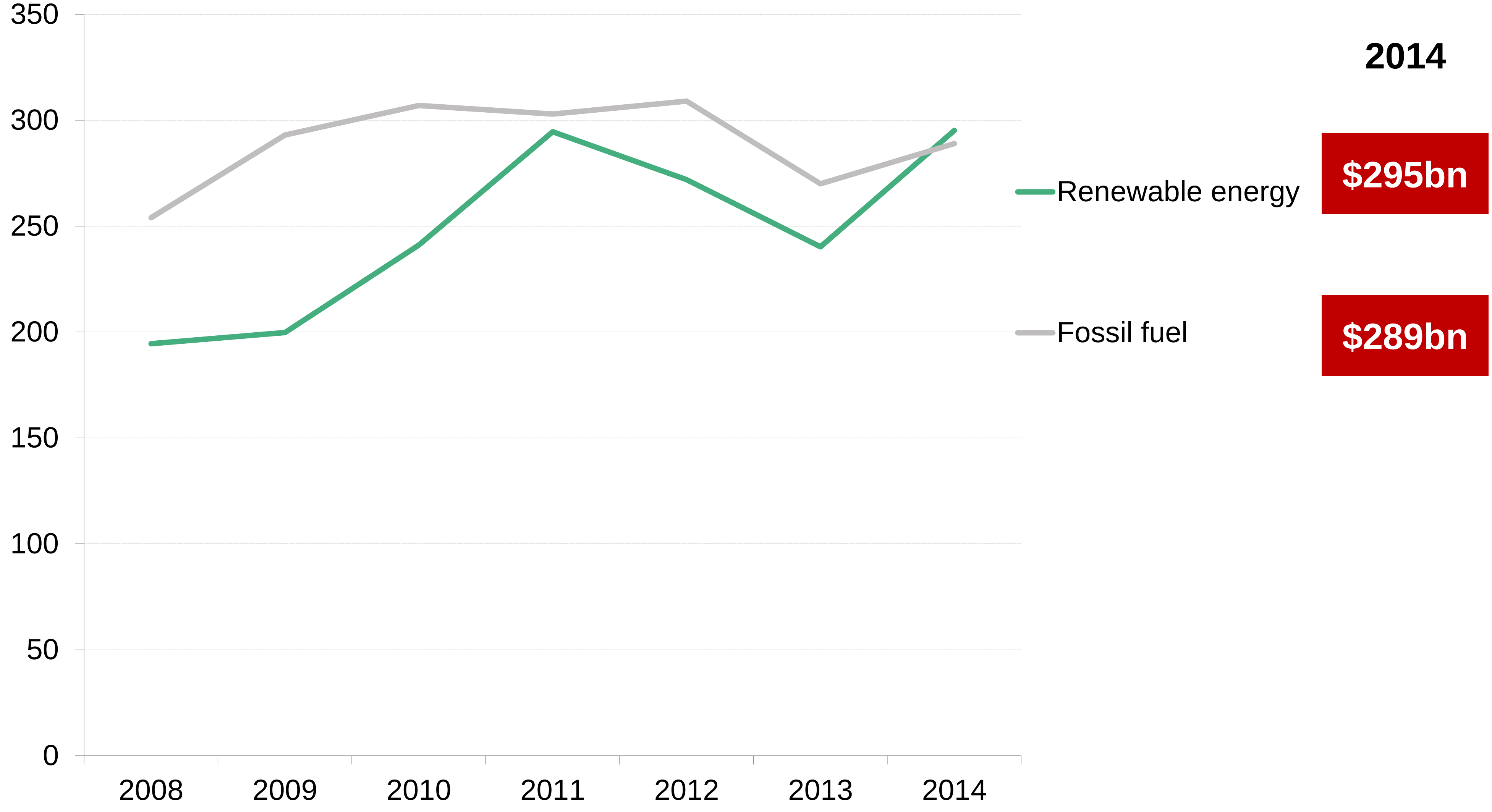


Note: Total values include estimates for undisclosed deals. Includes corporate and government R&D, and spending for digital energy and energy storage projects (not reported in quarterly statistics), as well as a BNEF estimate for large hydro investment.

Source: Bloomberg New Energy Finance

RENEWABLE ENERGY (INCL. LARGE HYDRO) AND FOSSIL FUEL INVESTMENT VOLUMES 2008-14 $BN

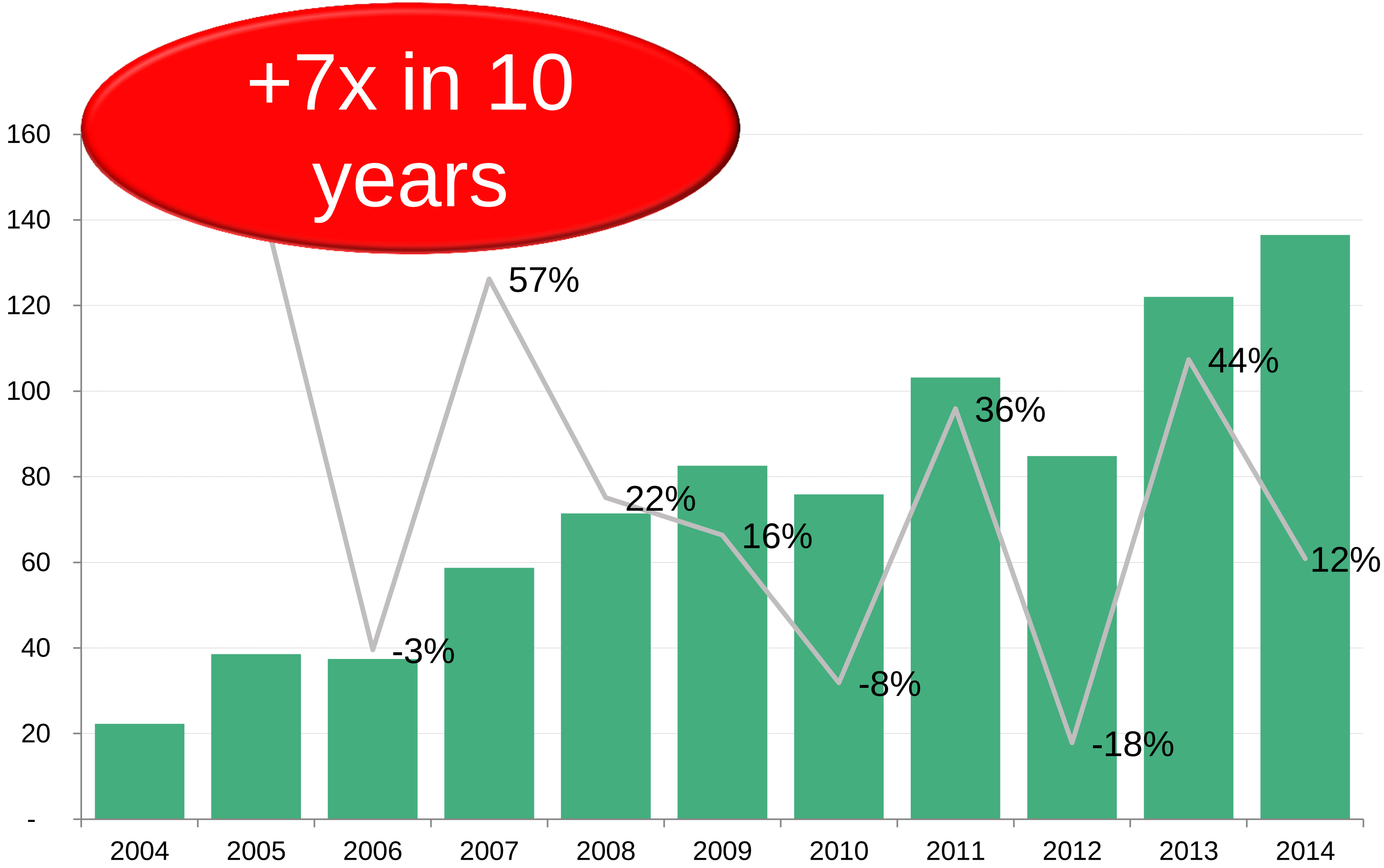
Bloomberg NEW ENERGY FINANCE



Source: Bloomberg New Energy Finance

NEW INSTALLATIONS IN CLEAN ENERGY
2004–14 (GW)

Bloomberg
NEW ENERGY FINANCE

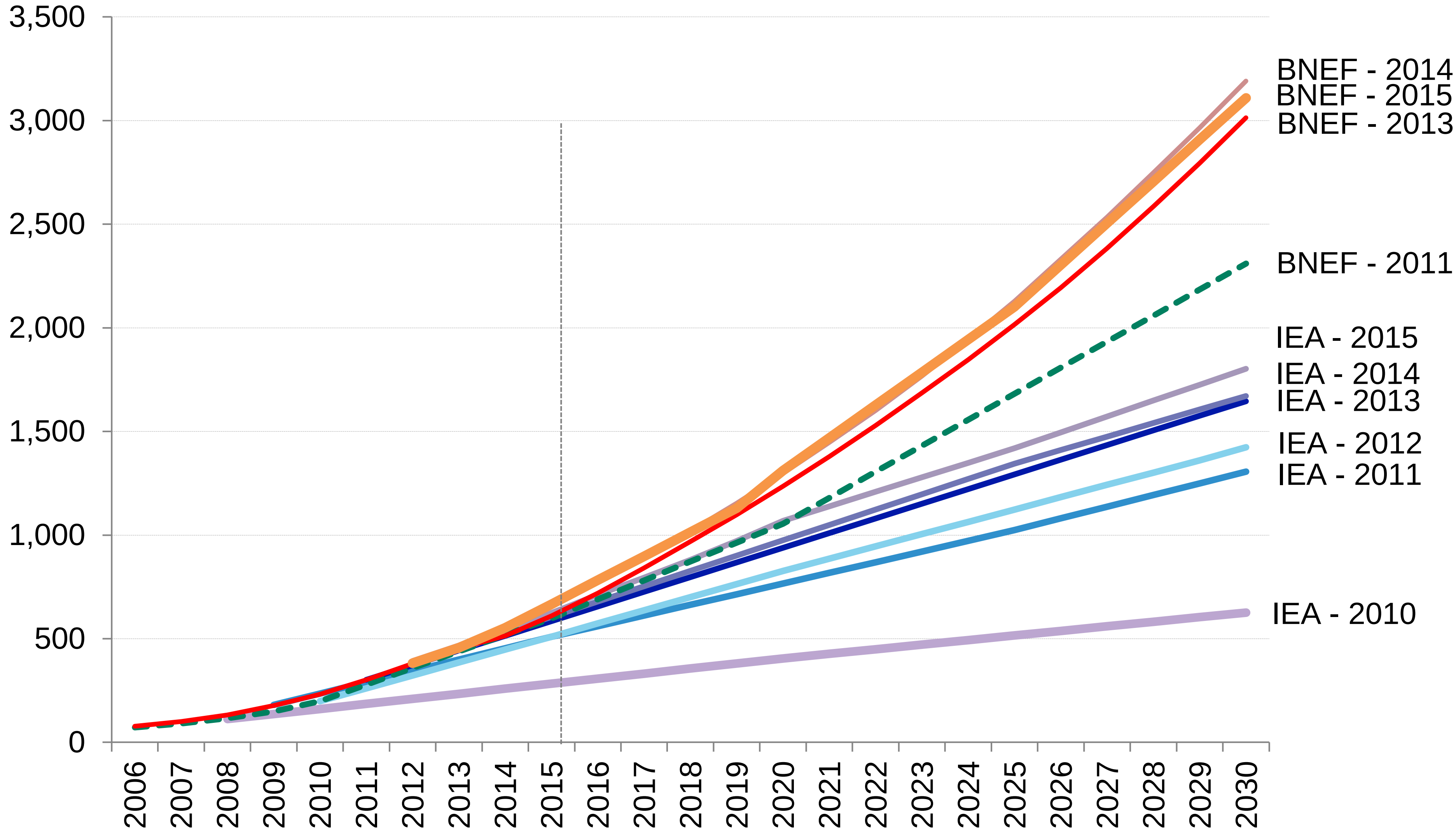


Note: include large hydro

Source: Bloomberg New Energy Finance

WIND AND SOLAR CAPACITY FORECASTS SINCE 2010
BNEF, IEA

Bloomberg
NEW ENERGY FINANCE

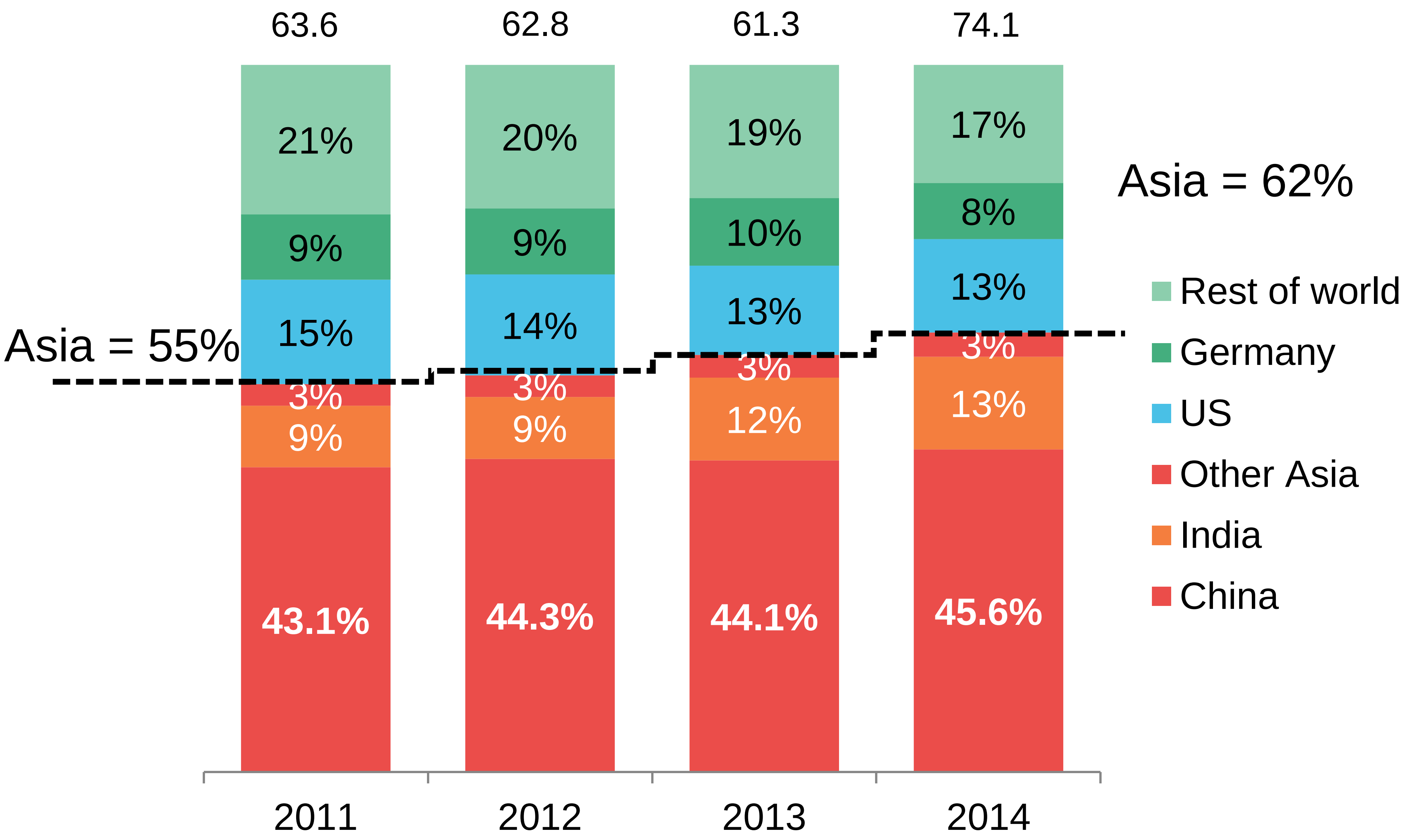


BNEF renewables forecasts have always outpaced IEA forecasts, and were closer to actual installed wind and solar capacity.

Source: Bloomberg New Energy Finance, IEA

ESTIMATED GLOBAL WIND TURBINE SUPPLY

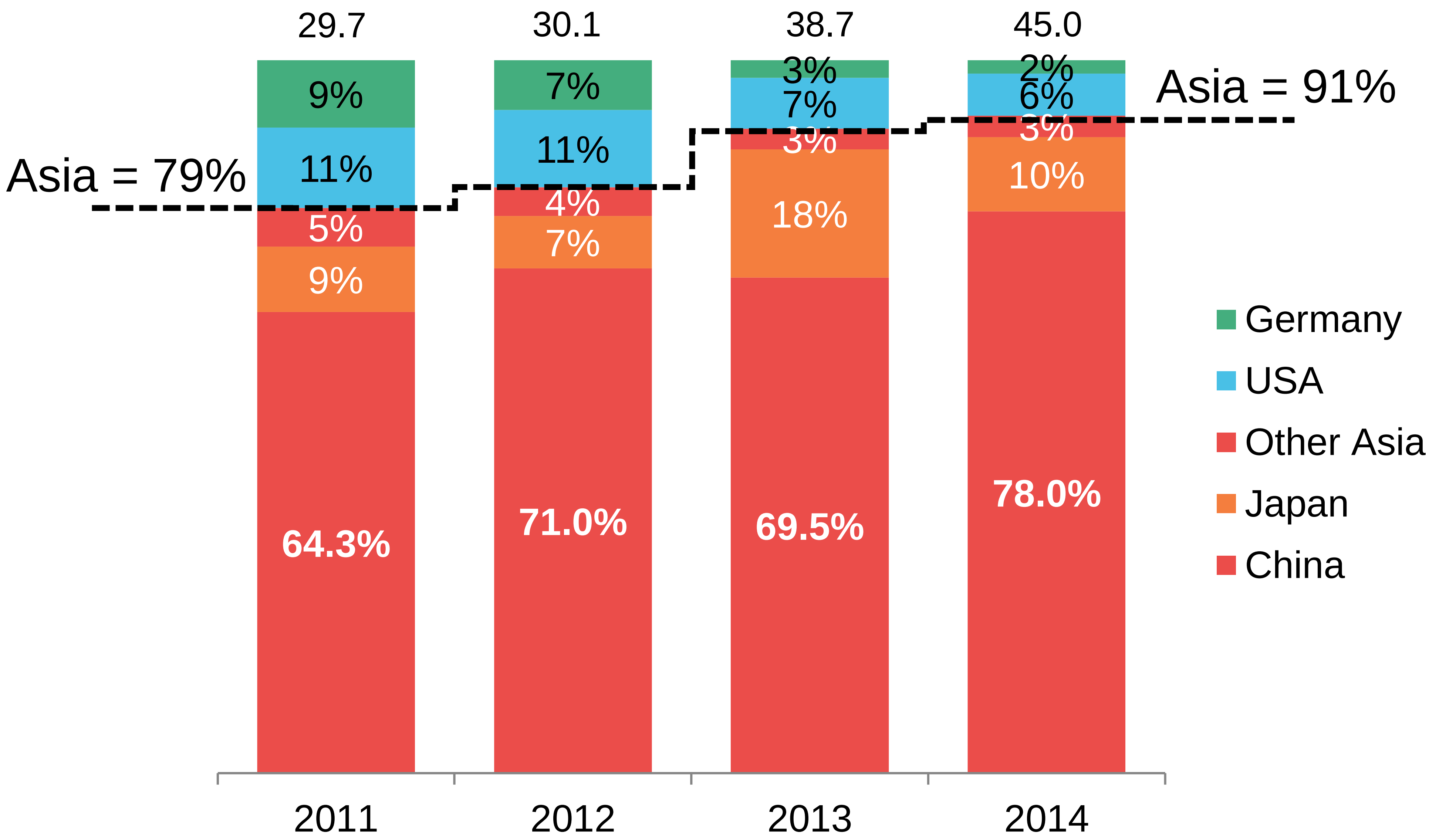
2011-14 (%, GW)



Source: Bloomberg New Energy Finance. Note: Nameplate capacity represents the companies' announced production capacity. Discounted capacity represents our best estimation of actual available capacity. For details see our Wind Turbine Manufacturing Supply Model

PV MODULE PRODUCTION BY COUNTRY

2011-2014 (%,GW)



Source: Company reports, statements and Bloomberg New Energy Finance estimates

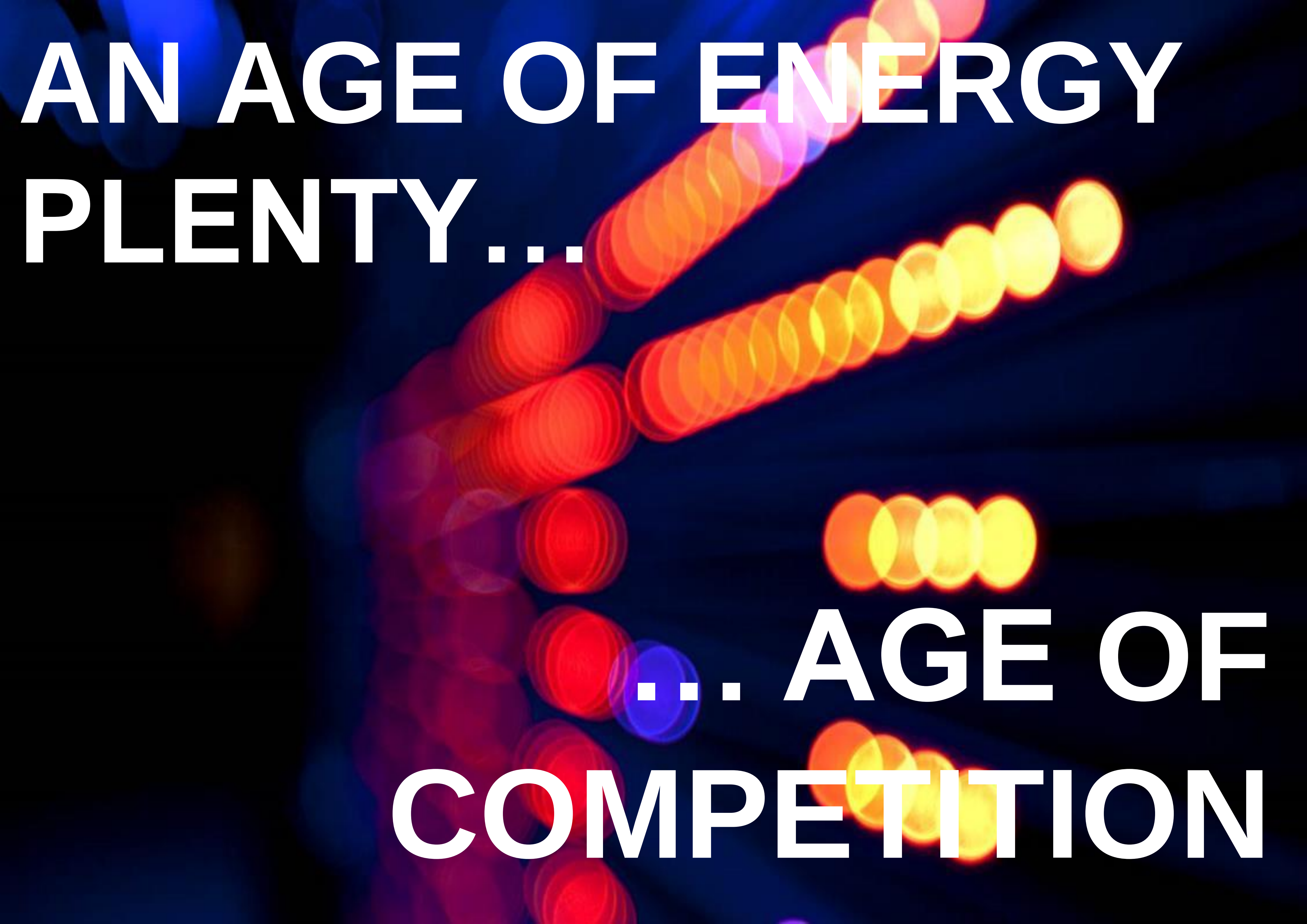
"There is an urgent need to develop sources of renewable energy"

Pope Francis

Picture: Wikimedia

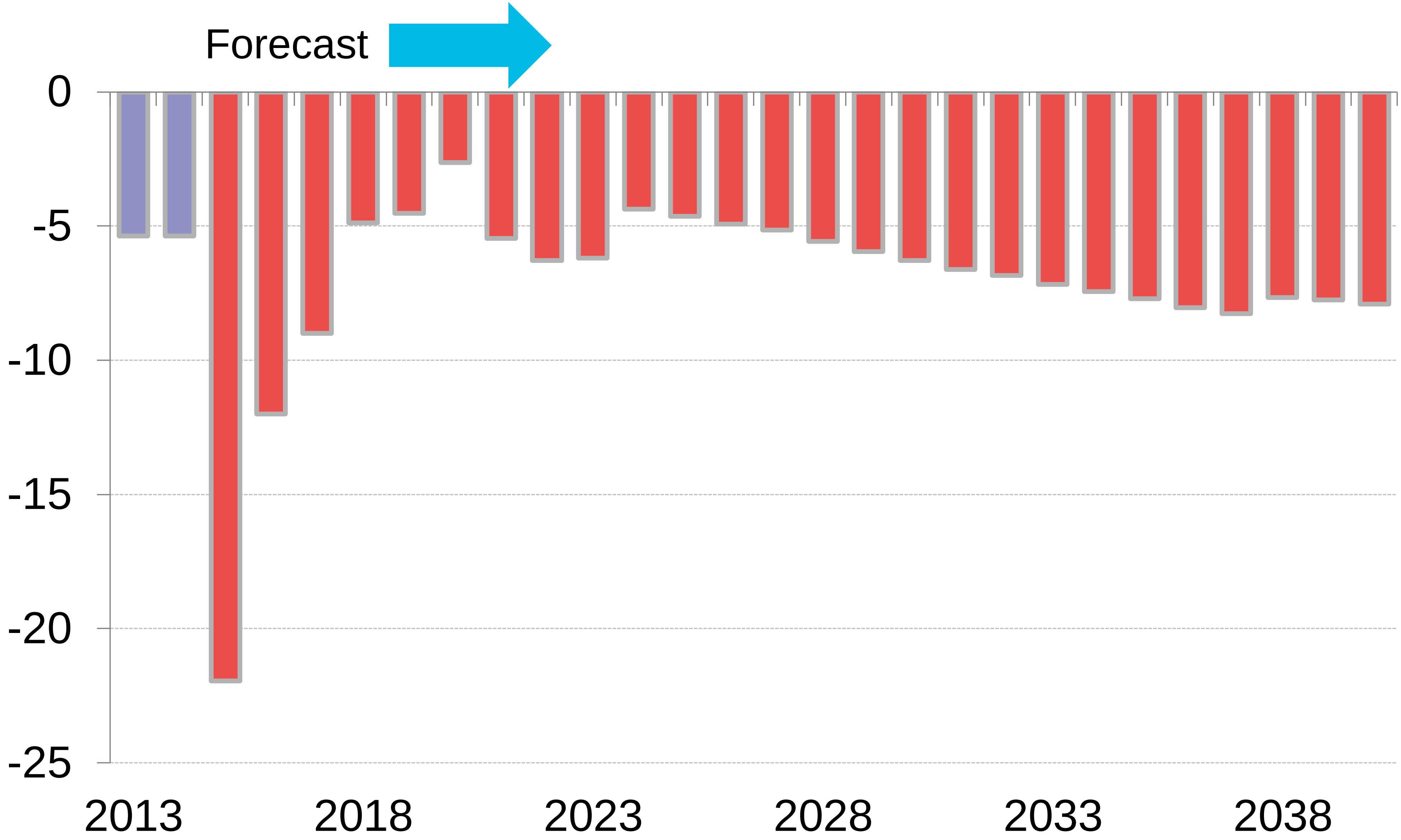
FOSSIL FUELS: SHIFTING BATTLEGROUNDS

Bloomberg
NEW ENERGY FINANCE


AN AGE OF ENERGY PLENTY…
… AGE OF COMPETITION

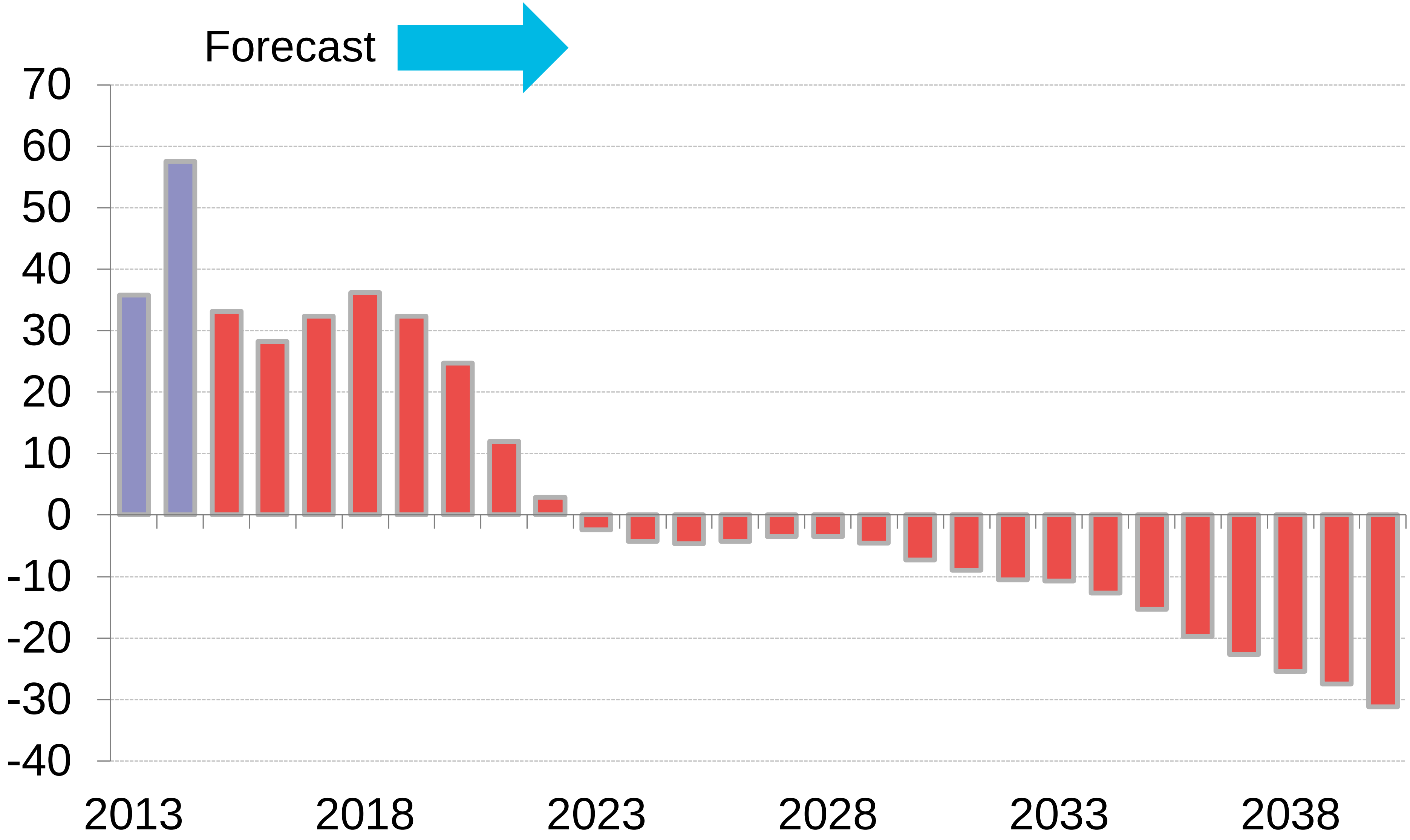
US NET COAL CAPACITY ADDITIONS

2013-40 (GW)



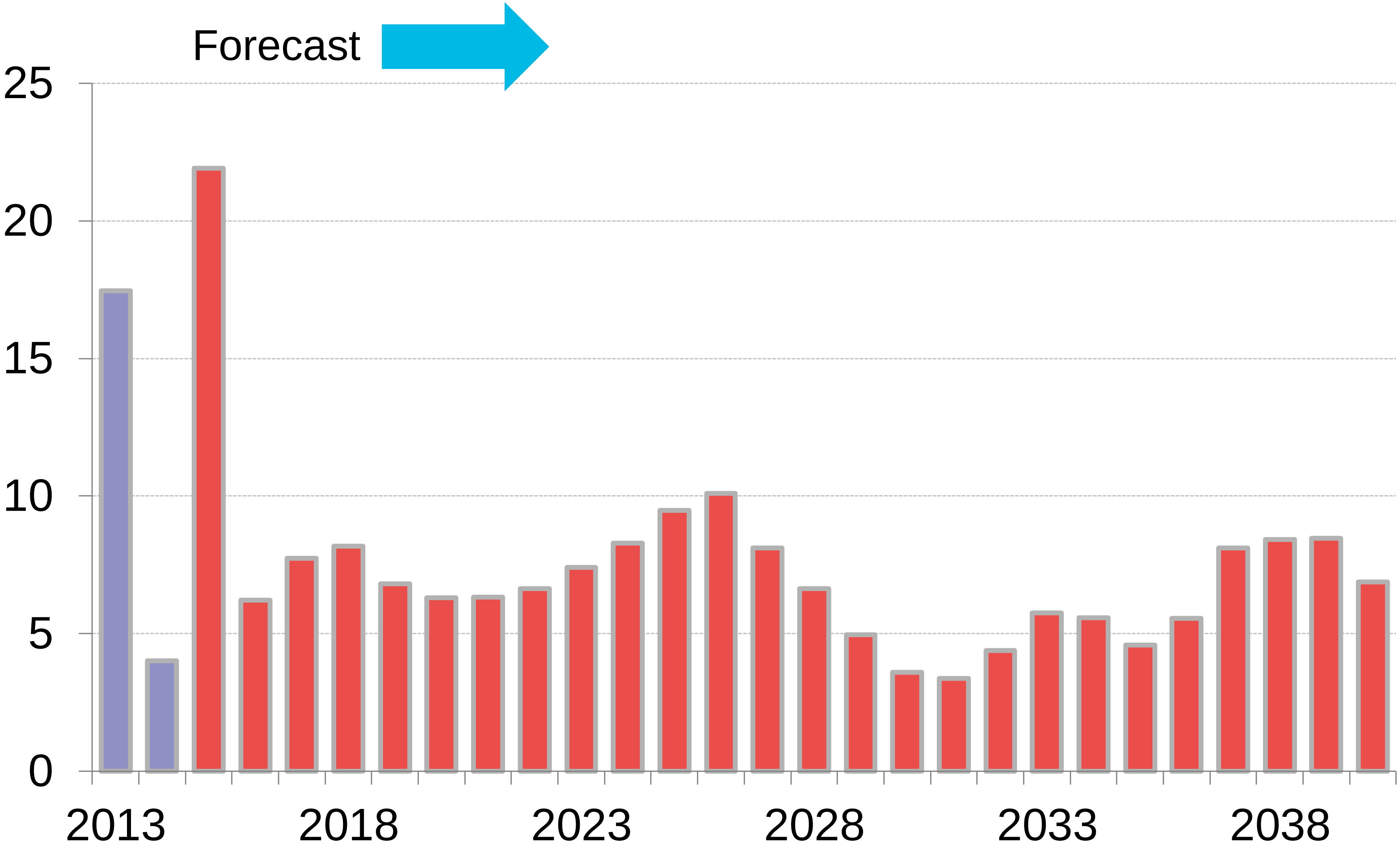
Source: Bloomberg New Energy Finance NEO 2015

CHINA NET COAL CAPACITY ADDITIONS
2013-40 (GW)



Source: Bloomberg New Energy Finance

INDIA NET COAL CAPACITY ADDITIONS
2013-40 (GW)

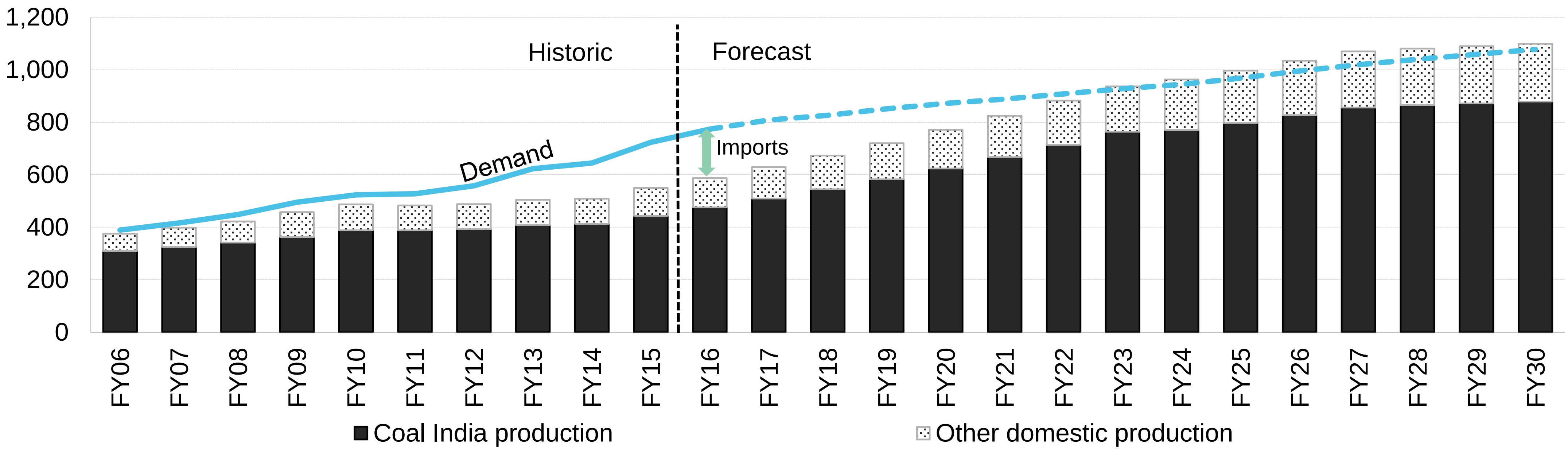


Source: Bloomberg New Energy Finance NEO 2015

INDIA WILL NOT BAIL OUT SEABORNE COAL

- **In FY2015 (April 14 – March 15), India imported the largest amount of thermal coal ever – 174Mt, 24% of its demand.** Some think that this trend will continue and India can act as a counterweight to the decreasing imports in China. Two issues will, however, make this impossible:
- **First: fast growth in renewable energy will reduce growth rates of coal power production (and hence coal demand)**. Our NEO2015 analysis predicts that India will produce 75% more electricity from coal-fired generation in 2030 than in 2015 – a 2.7% CAGR compared to 3.9% in the last decade. Moreover, improvements in thermal efficiency of India's coal-fired generation fleet will result in demand increasing only by 50% to 2030.
- **Second: government wants to obliterate thermal coal imports by 2017** by doubling production of Coal India Ltd (which already has a 80% market share) by FY2020. That may be too good to be true. However, our realistic base case production forecast reveals that **India's imports likely peaked in the last fiscal and it will cease thermal coal imports in the year 2022**.

Thermal coal demand and supply projections in base case production scenario (FY06-30), Mt

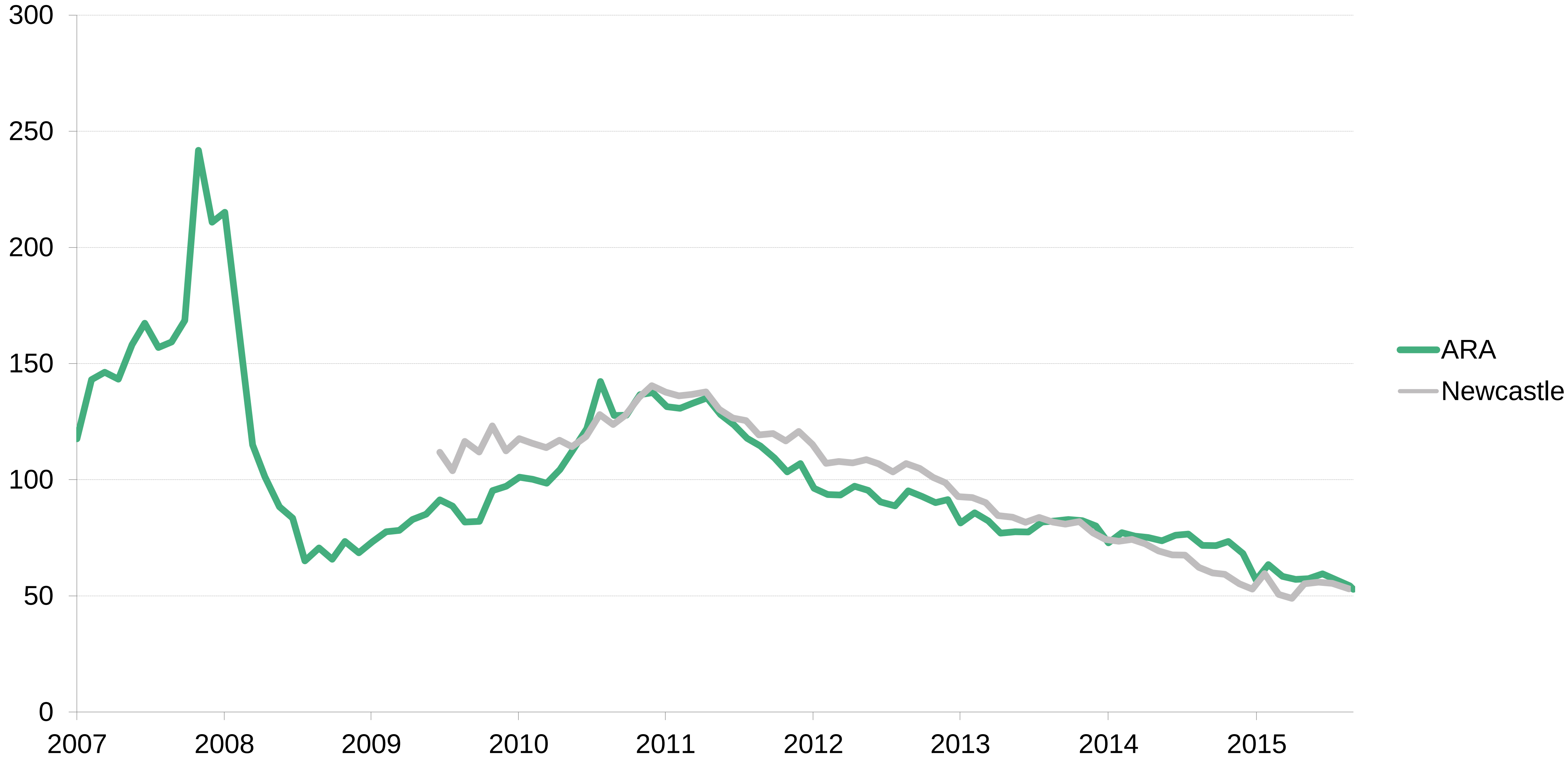


Note: our base case production forecast assumes a 7% CAGR in domestic coal production.

Source: Ministry of coal, Coal India, Bloomberg New Energy Finance

ARA AND NEWCASTLE COAL PRICE 2007–2015
(2014 US$/TONNE)

Bloomberg
NEW ENERGY FINANCE

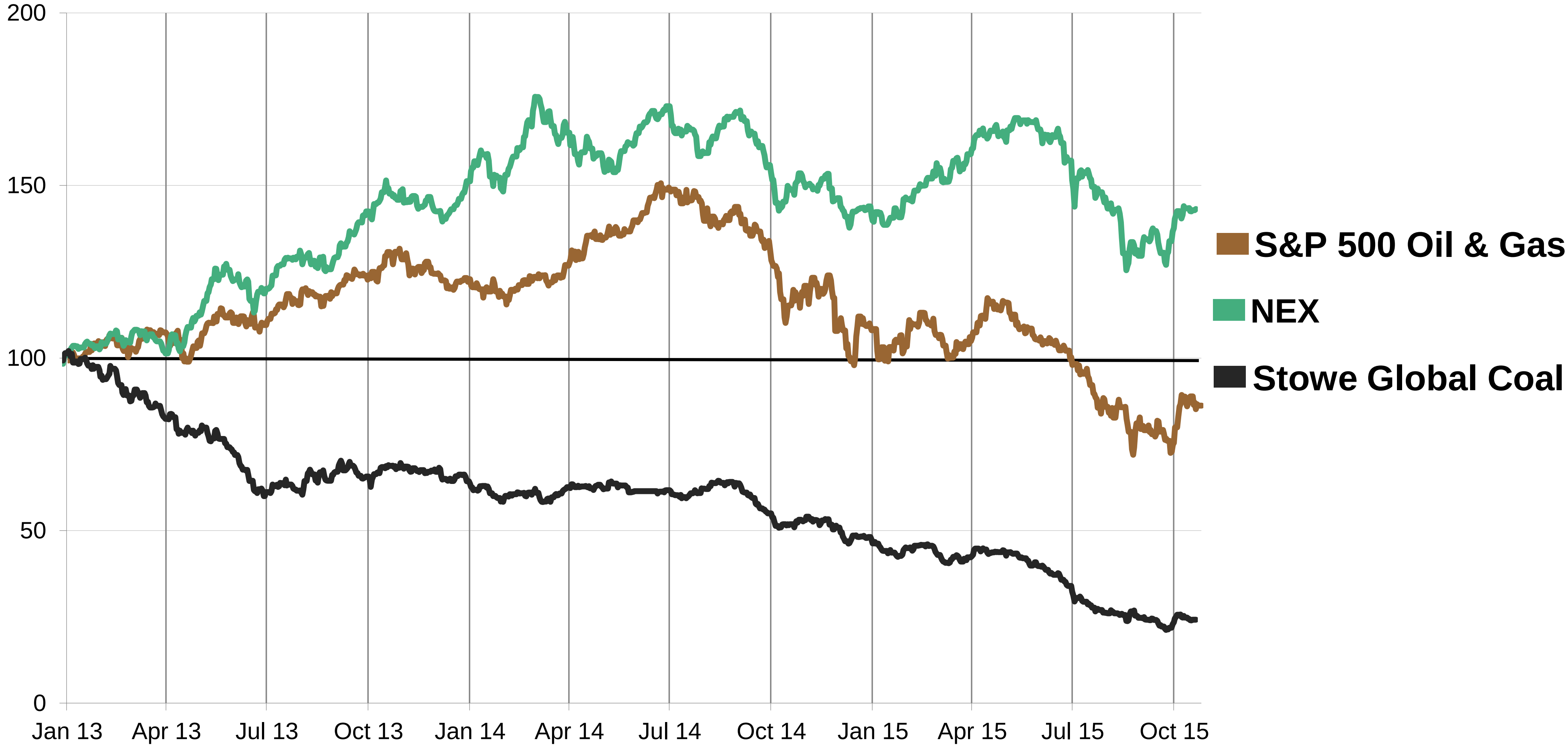


Note: Prices have been adjusted for inflation according to YoY CPI Index from UK Office of National Statistics

Source: Bloomberg New Energy Finance, ONS

NEX CLEAN ENERGY INDEX 2013 – 2015 YTD

Bloomberg
NEW ENERGY FINANCE



Note: Values as of 26 October 2015; Stowe and S&P 500 rebased to 100 on 01 Jan 2013

Source: Bloomberg New Energy Finance

COAL BANKRUPTCIES

WALTER ENERGY®

Alpha Natural Resources

We fuel progress around the world.®

JamesRiver
COAL COMPANY

BUMI
Investment Pte

PATRIOT
COAL

Image: various company sources

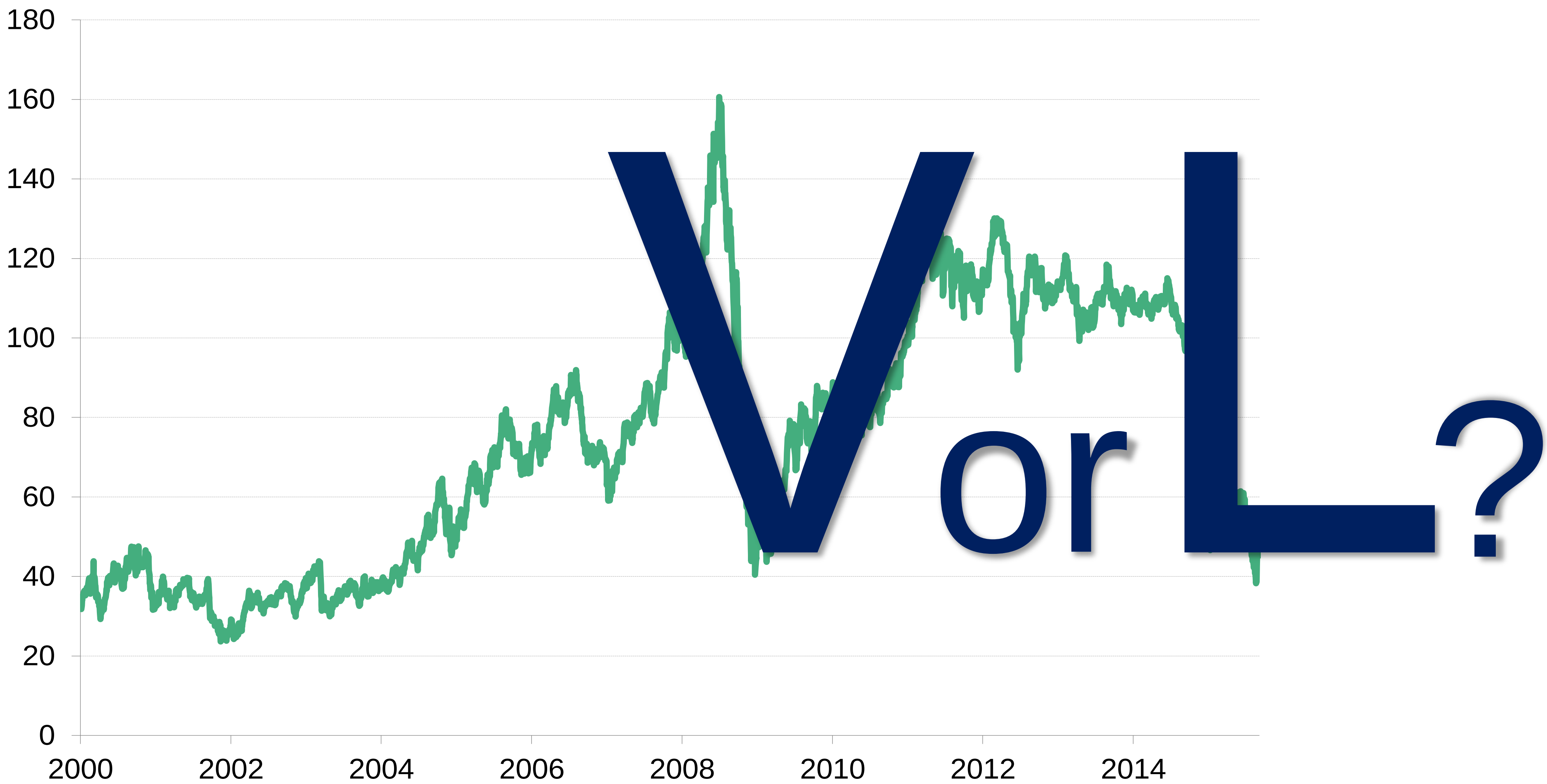
THE ECONOMIST COVER, "SHEIKHS VERSUS SHALE" DECEMBER 2014

Bloomberg NEW ENERGY FINANCE

Source: *The Economist*

WTI CRUDE OIL PRICES, 2000–2015
($2015 / BARREL)

Bloomberg NEW ENERGY FINANCE

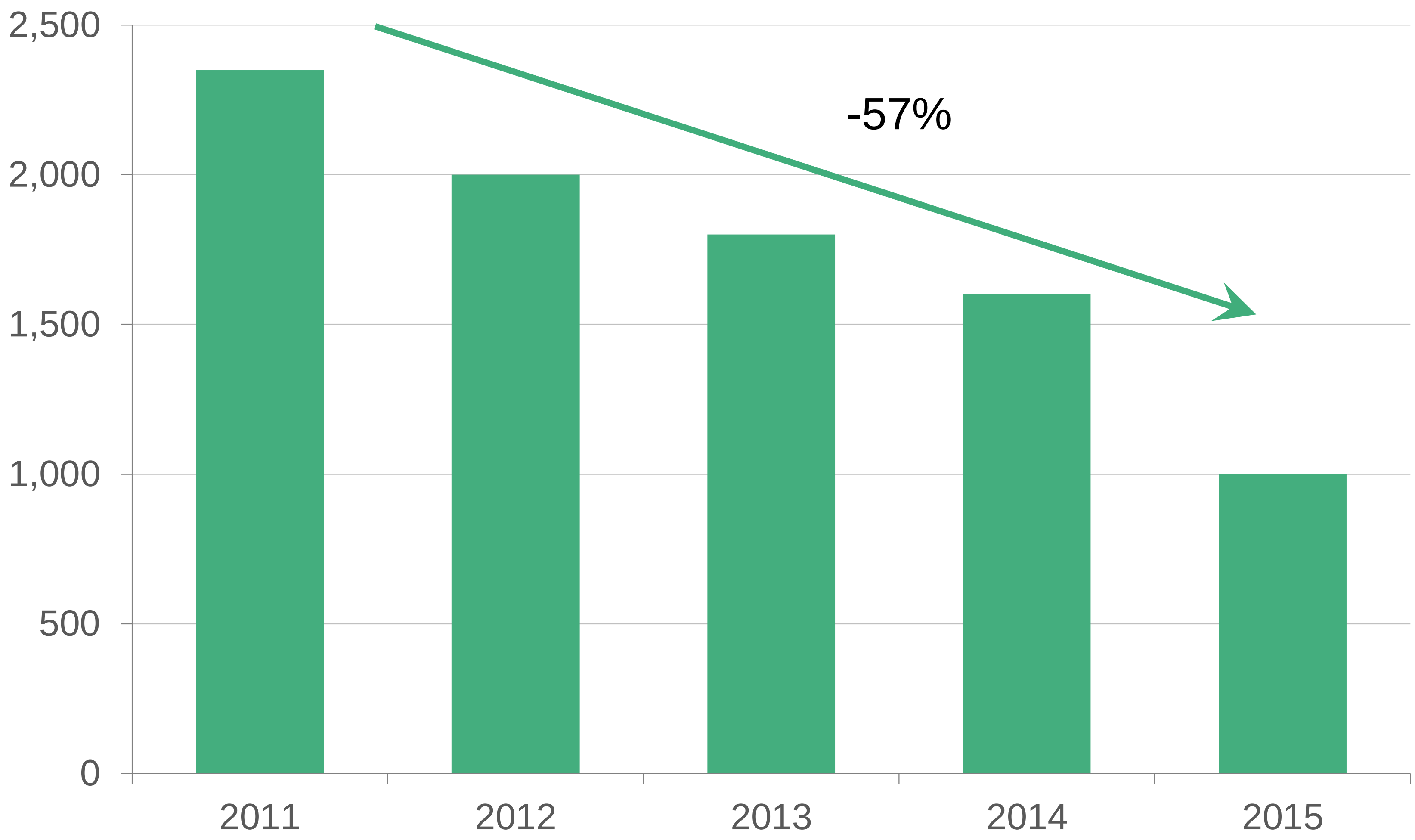


Note: The Green line represents the WTI Spot price, and has been adjusted for inflation and is represented here in real 2015 US$

Source: Bloomberg New Energy Finance, EIA, World Bank

WELL COST/LATERAL LENGTH ($/FOOT)

Bloomberg NEW ENERGY FINANCE



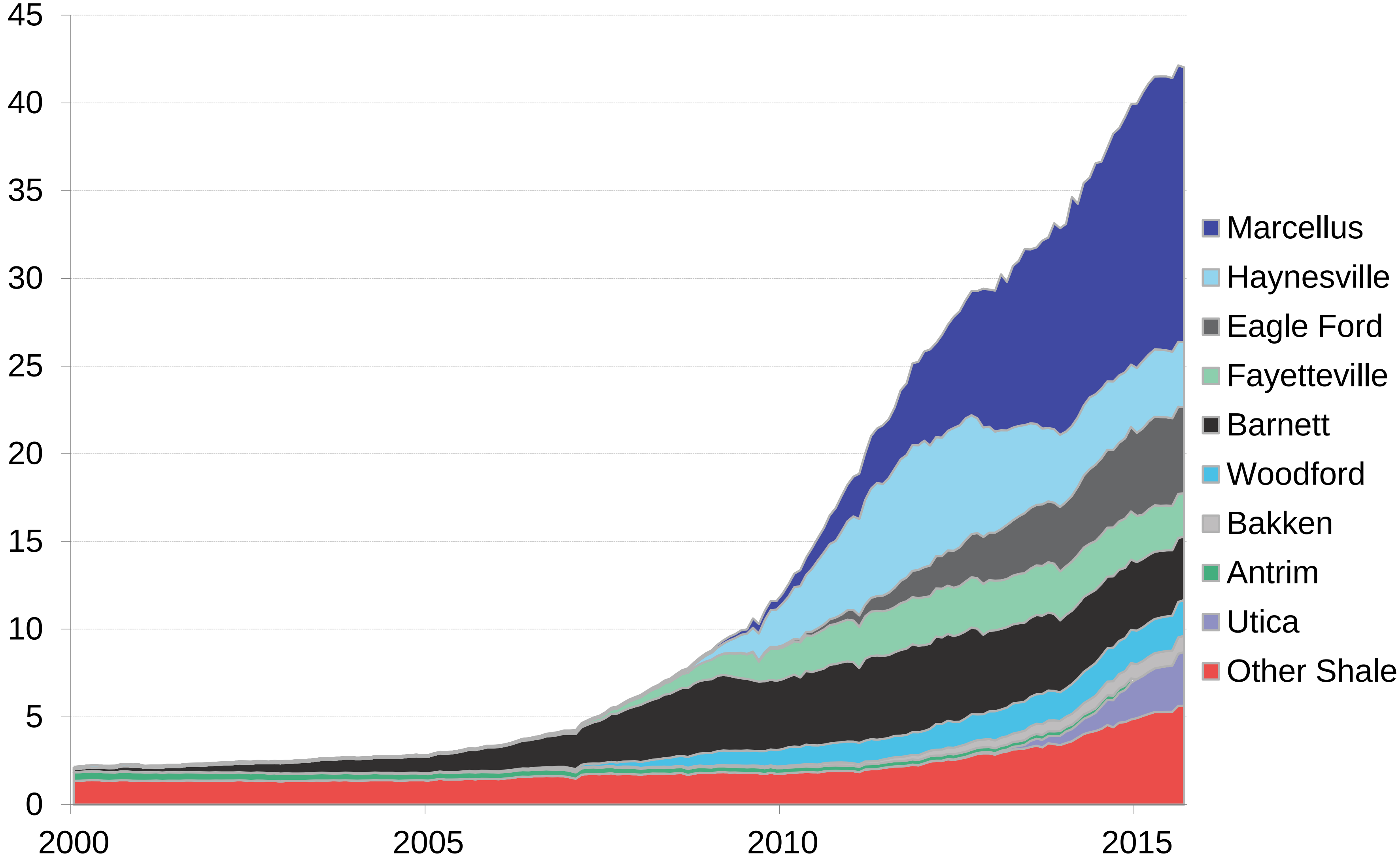
Range Resources, 28 July 2015 , Bloomberg New Energy Finance

http://www.slideshare.net/MarcellusDN/range-resources-company-presentation-july-28-2015

US SHALE GAS PRODUCTION BY FIELD

2000–2015 (BCFD)

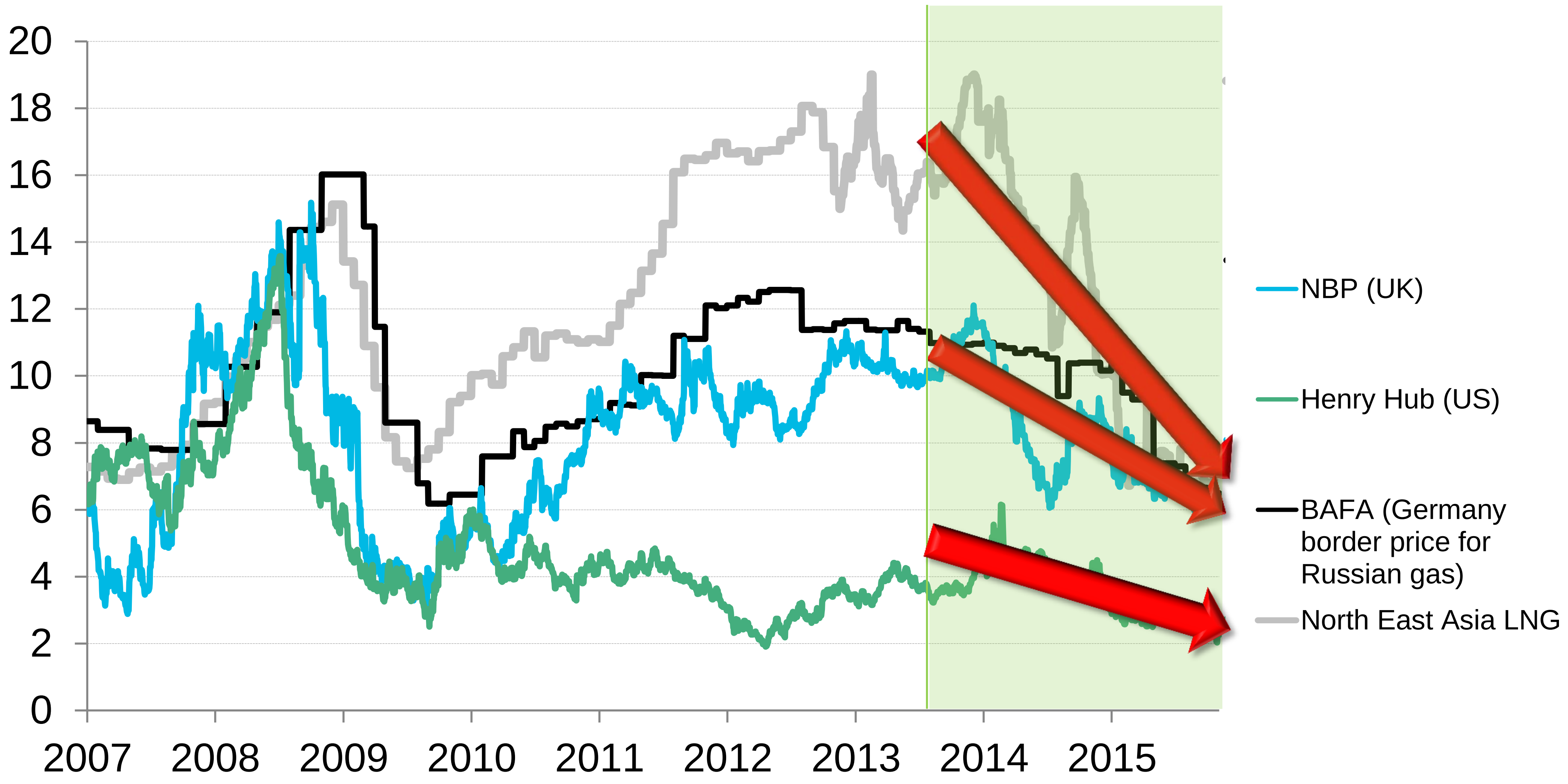
Bloomberg NEW ENERGY FINANCE



Source: Bloomberg New Energy Finance, EIA

OIL AND GAS PRICES: HENRY HUB, NBP, BAFA, AND NE LNG, 2004–15 (US$/MMBTU)

Bloomberg NEW ENERGY FINANCE

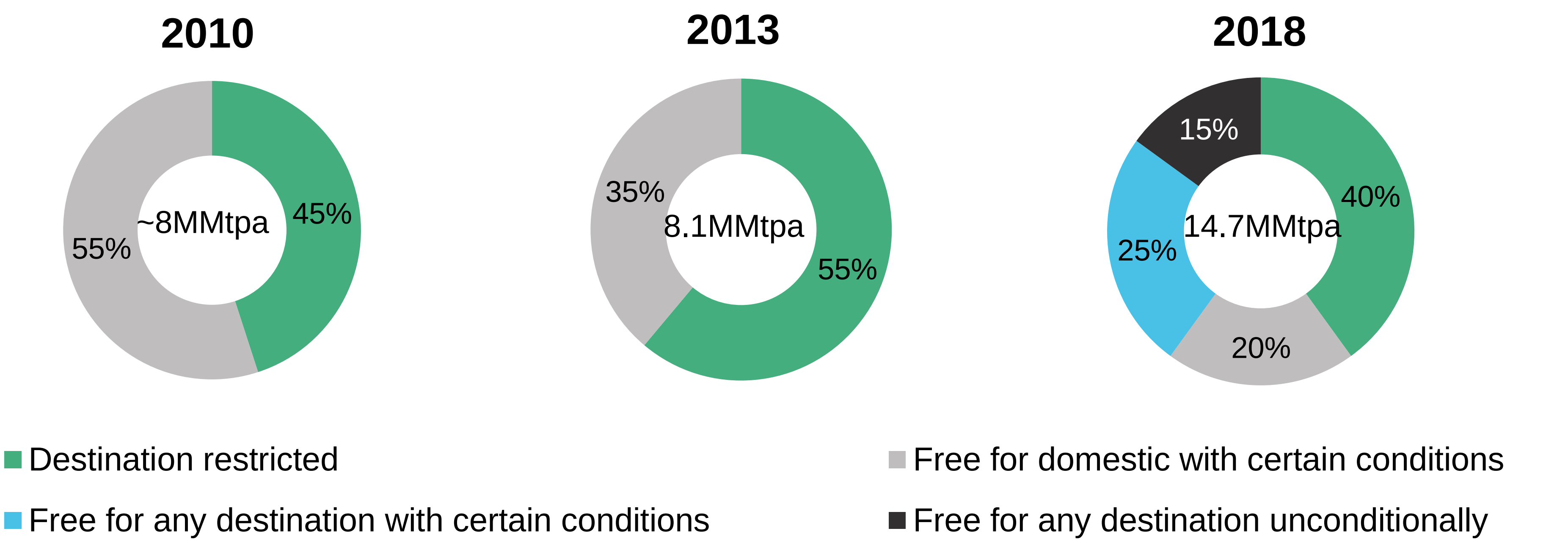


Note: Japan-Korea Marker is based on broker assessments of the spot price of un-contracted LNG cargoes delivered into the Northeast Asia market.

Source: Bloomberg New Energy Finance, ICAP, Platts

DESTINATION FLEXIBILITY IN CHUBU ELECTRIC'S LNG PURCHASES (%, MMTPA)

Bloomberg NEW ENERGY FINANCE



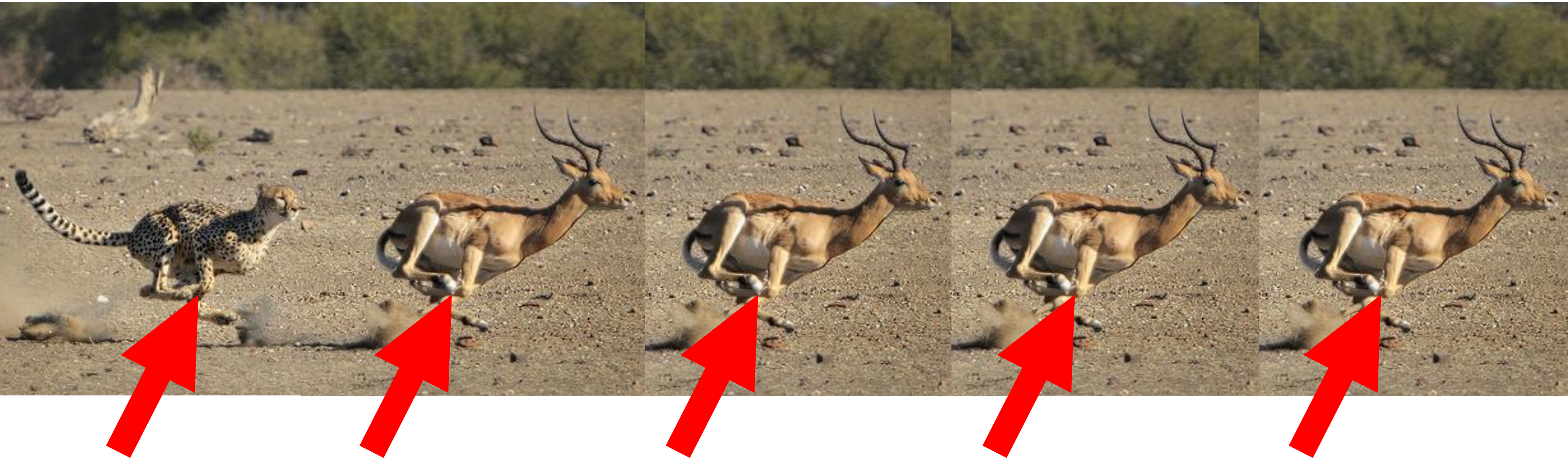
- Destination flexibility opens up new possibilities
  - Portfolio optimisation by teaming up with other buyers (minimise take-or-pay charges)
  - Reselling/allocation to trading teams

Note: Note: 2018 numbers are estimates provided by Chubu Electric.

Source: Chubu Electric (Singapore, October 2014), Bloomberg New Energy Finance

Bloomberg NEW ENERGY FINANCE

"The gazelle does not have to outrun the cheetah It has to outrun the slowest gazelle"



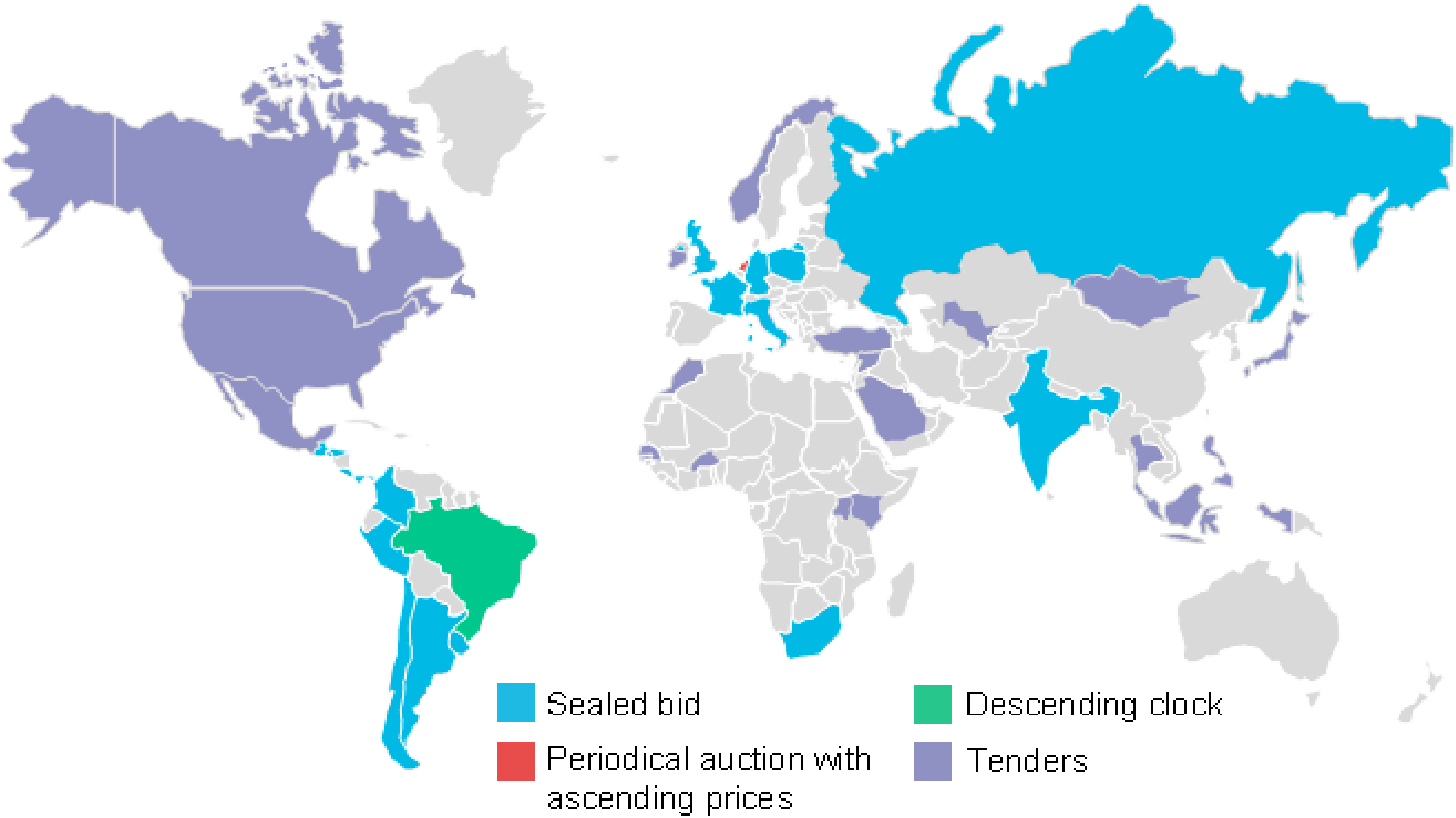
Clean energy — Coal — Oil Sands — Oil — Gas

Image: Denis Donohue / Shutterstock

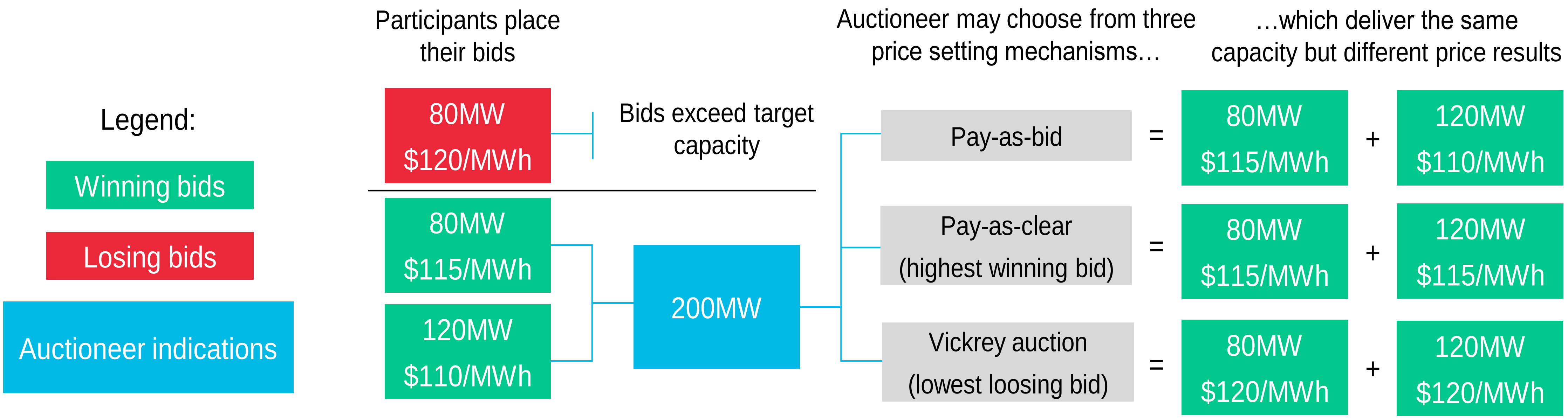
CLEAN ENERGY AUCTIONS

Bloomberg
NEW ENERGY FINANCE

GLOBAL OVERVIEW OF RENEWABLE ENERGY AUCTIONS, Q2 2015



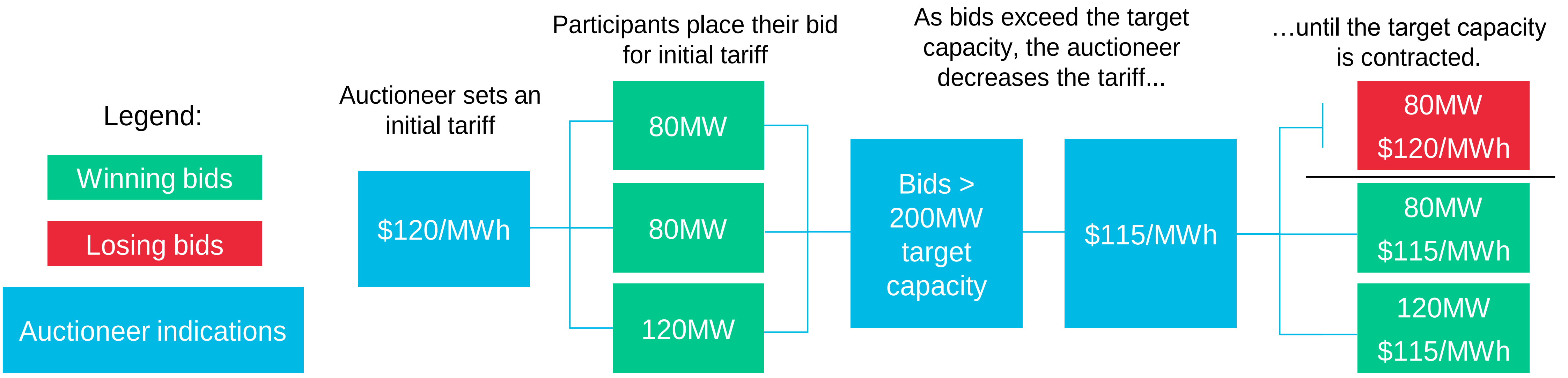
SEALED BID AUCTION



- Bidders submit a capacity offer (in MW) and the tariff ($/MWh) they require to deliver a project.
- All bids are then ordered by price, starting with the cheapest bid. The auctioneer selects the most price-competitive offers – in this case starting with 120MW at $110/MWh – until the cumulative amount of bid capacity reaches the target total of 200MW – in this case with the 80MW at $115/MWh. The auctioneer then has three main price-setting options:
  - The **‘pay-as-bid’** design gives each successful bidder the tariff offer they submitted.
  - The **‘pay-as-clear’** design gives all successful bidders the tariff offer submitted by the last successful bidder, also known as the clearing price.
  - The **‘Vickrey auction’** design pays all successful bidders the tariff offer submitted by the first unsuccessful bidder.

DESCENDING CLOCK AUCTION

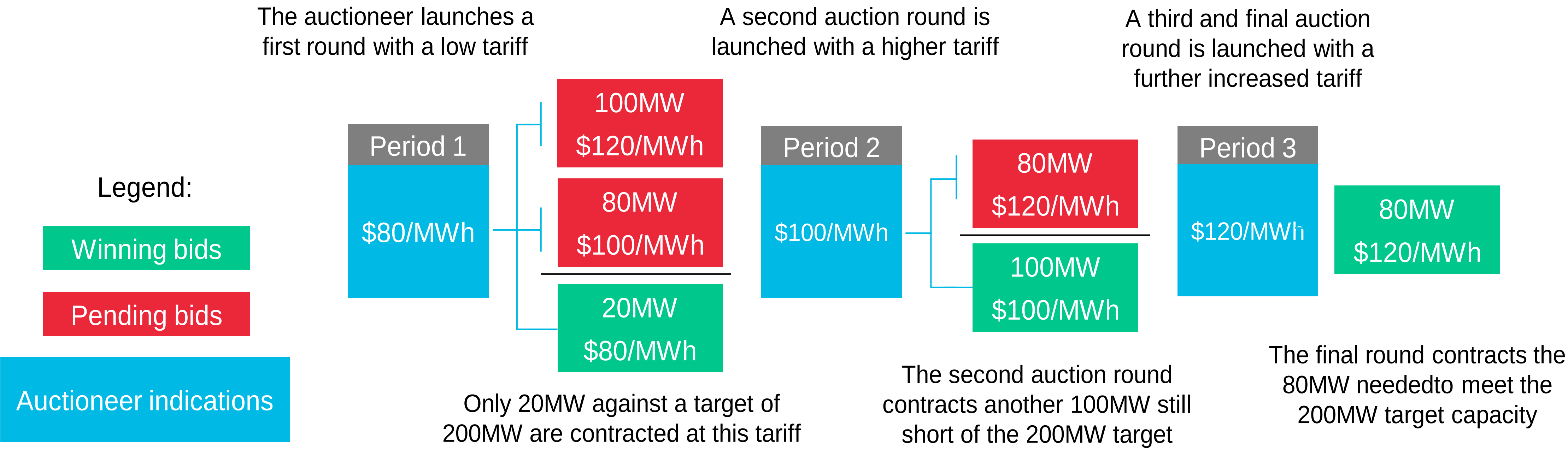
Bloomberg NEW ENERGY FINANCE



- In the descending clock auction model (also called Dutch auction), the auctioneer announces an initial tariff – in this case $120/MWh.
- Bidders respond with the capacity they can deliver at that price – in this case a cumulative amount of 280MW.
- The tariff is lowered as long as the cumulative capacity of all the bids exceeds the auctioneer's 200MW target – in this case to $115/MWh.

PERIODICAL AUCTION

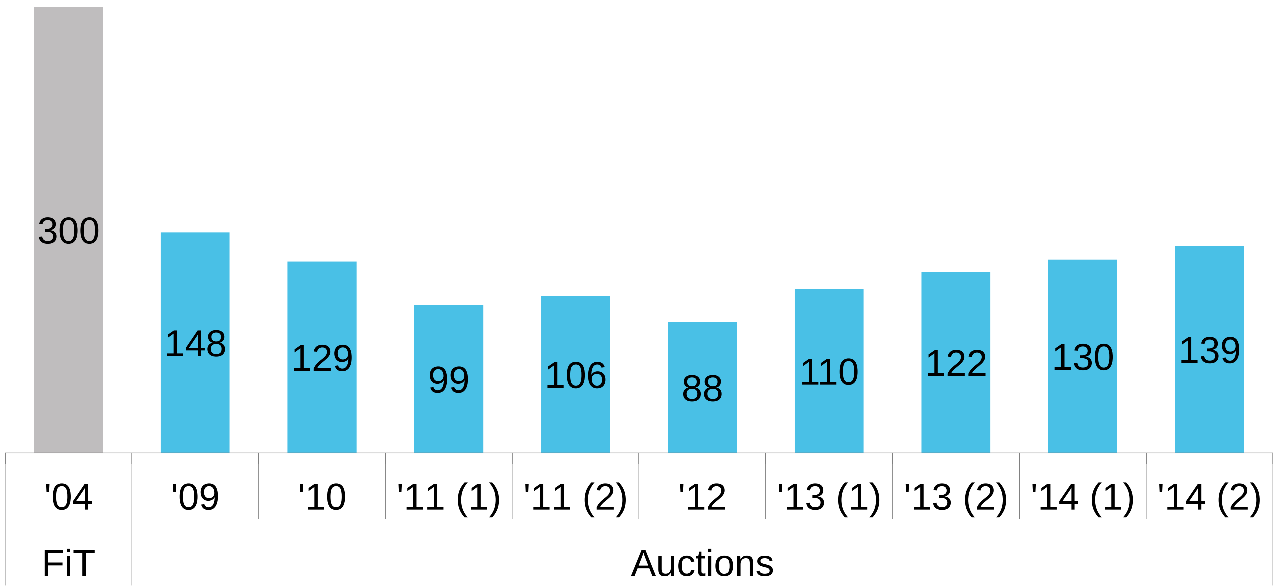
Bloomberg NEW ENERGY FINANCE



- The periodical auction with ascending prices is the least common of the main auction models in the renewable energy sector.
- The model consists of a series of descending clock auctions with ascending prices.
- The fact that bidders know that there will be several tariff periods but that winning bids are capped by the capacity target affects their bidding behaviour.
- A bidder might want to hold back to place his bid in the highest tariff period – in this case $120/MWh – but faces the risk of losing out completely if the 200MW target capacity is reached in the lower tariff periods – in this case $80/MWh and $100/MWh.

BRAZIL ONSHORE WIND SUBSIDY (BRL/MWH, NOMINAL)

Bloomberg NEW ENERGY FINANCE

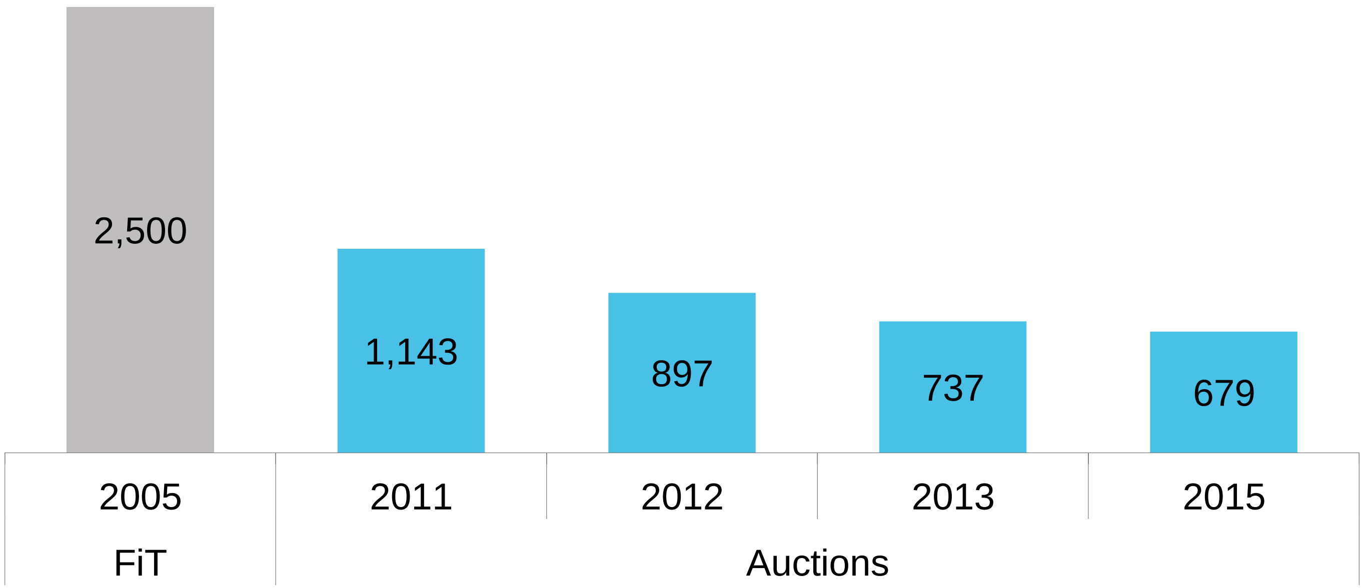


- In 2004, the Proinfa feed-in tariff was granted to 1.4GW of onshore wind developed over 2004-11.
- The introduction of auctions as an allocation mechanism prompted tariffs to be cut in half in 2009.
- Thereafter, auctions have acted as a price discovery mechanism and have led to the award of tariffs to around 13GW of onshore wind.
- Prices have moved in both directions reflecting, for example, the impact of movements in the foreign exchange rate, turbine shortages and local content rules.

Note: read all you need to know on Brazil's latest auction round in our in our Analyst Reaction (26 August 2015).

Source: Bloomberg New Energy Finance, CCEE

SOUTH AFRICA ONSHORE WIND (ZAR/MWH, NOMINAL)



- South Africa only had a single commercial grade onshore wind project (5MW), commissioned in 2008, before launching its first auction.
- Unsurprisingly, the first auction round awarded 634MW of onshore wind projects a tariff that was half as costly as that on the original project.
- A more remarkable achievement came from future rounds. As the renewables sector responded to the stability provided by the auction programme with increased competition and higher participation, tariffs in 2015 were 40% lower than in 2011.
- In total, South Africa's auctions have awarded tariffs to 7GW of onshore wind.

Note: read all you need to know on South Africa's latest auction round in our in our Analyst Reaction (21 April 2015). Source: Bloomberg New Energy Finance

CHILE 2015/02 AUCTION OVERVIEW

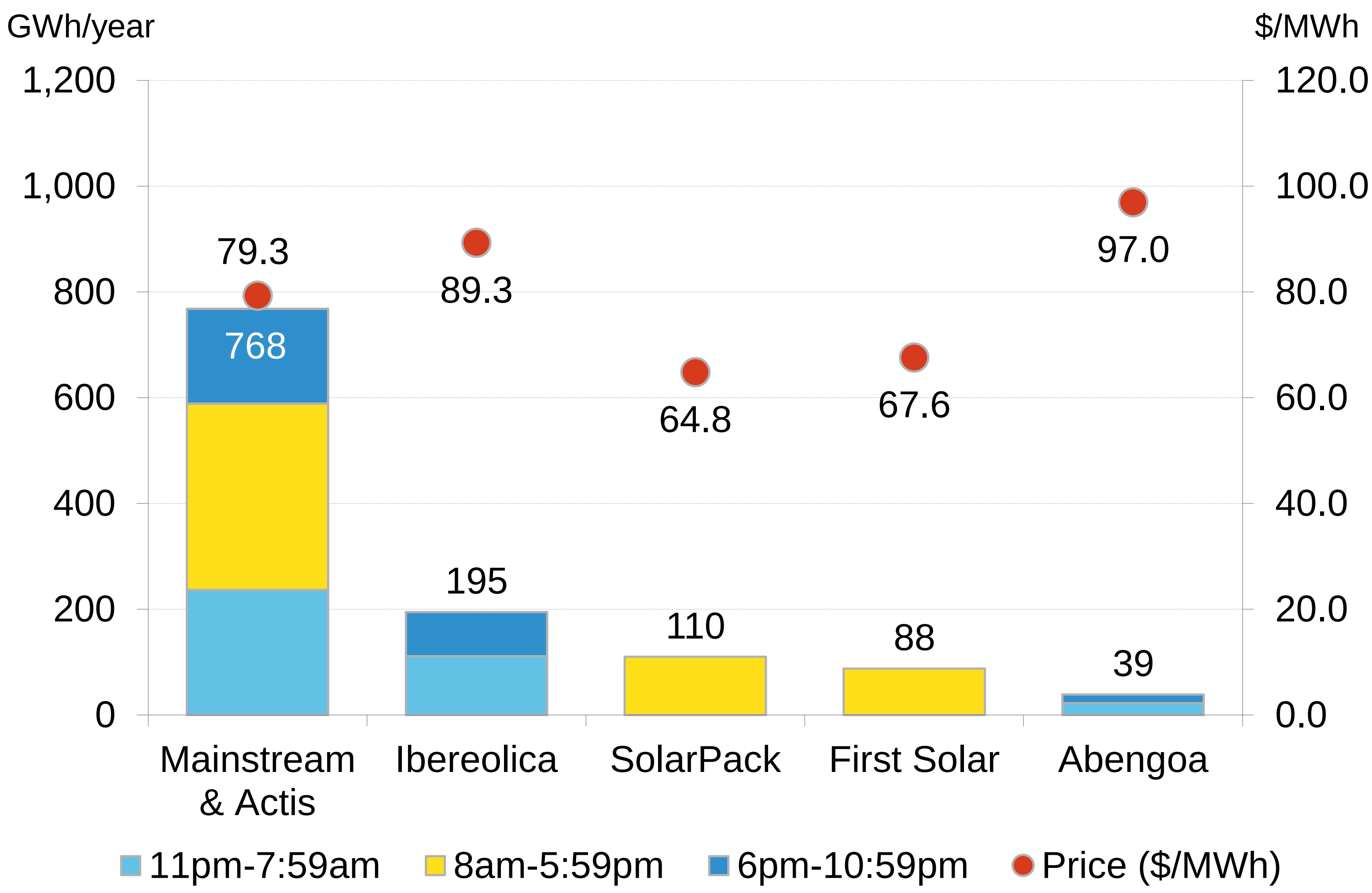
- On 15 June 2015, Chile's National Energy Commission (CNE) published resolution 311, which sets the rules for Auction 2015/02 to contract electricity from generators for delivery starting 1 January 2017.
- **This tender falls within Chile's new auction guidelines under which generators must supply power during blocks of time during the day under 20-year power purchase agreements (PPAs).** The auction offered contracts for three portions of the day as listed below.
- Tender contracts mandate that generators supply a given base demand and a variable demand (10% of base demand) curve at a determined time block. For example, in Block A, generators must supply 336GWh from 11pm to 7:59am with a possible variation of 10%.
- All power contracted must be delivered at the Polpaico (220kV) node located in the Central Interconnected System (Sistema Interconectado Central, SIC). The offtakers will be 26 distribution companies located in the SIC and the SING system.

Chile Power Tender 2015/02 – Demand (GWh/year) per time block

Demand (GWh/year)	A – 11pm-7:59am	B – 8am-5:59pm	C – 6pm-10:59pm
Base	336	500	255
Variable	34	50	25
Total	370	550	280

Source: CNE

CHILE POWER TENDER 2015/02 – WINNERS BY VOLUME CONTRACTED (GWH/YEAR) AND PPA ($/MWH)



Source: Bloomberg New Energy Finance, CNE

CORPORATE PROCUREMENT

Bloomberg
NEW ENERGY FINANCE

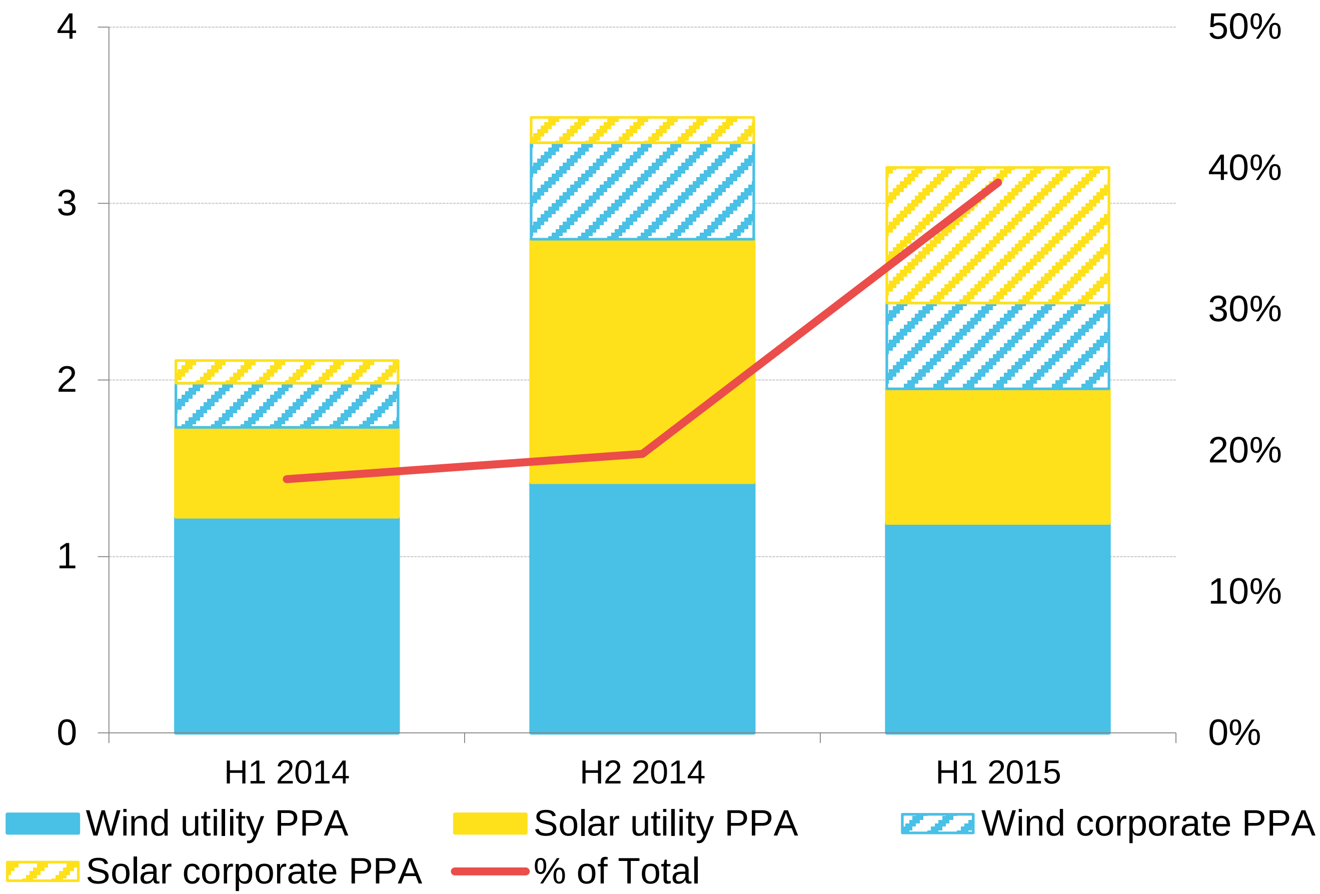
KEY NON-TRADITIONAL PPA OFFTAKERS BY INDUSTRY

Bloomberg NEW ENERGY FINANCE

COMPANY TYPE	KEY PLAYERS
Retail	KOHL'S, IKEA, amazon.com, Walmart
Financial & Insurance	KAISER PERMANENTE, BNP PARIBAS, BARCLAYS, Prudential, Bloomberg
Tech	intel, Google, f, Microsoft, Sprint, YAHOO!
Food and Beverage	MARS incorporated, WHOLE FOODS MARKET, Nestlé, US FOODS, Coca-Cola, STARBUCKS COFFEE
Government & University	OKLAHOMA STATE UNIVERSITY, Alberta Education
Manufacturing	P&G, GM, Johnson & Johnson
Other	Six Flags, MGM GRAND

Source: Bloomberg New Energy Finance

PPA CAPACITY BY CONTRACT SIGNING DATE (LEFT AXIS – GW) AND CORPORATE PPAS AS A PERCENTAGE OF TOTAL RENEWABLE PPAS (RIGHT AXIS), H1 2014-H1 2015



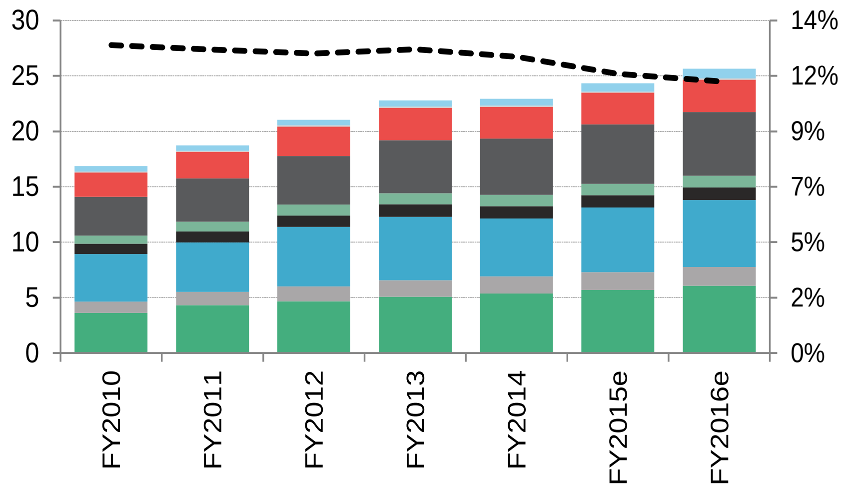
Note: capacity for both corporate and utility PPAs is estimated based on known contracts.

Source: Bloomberg New Energy Finance.

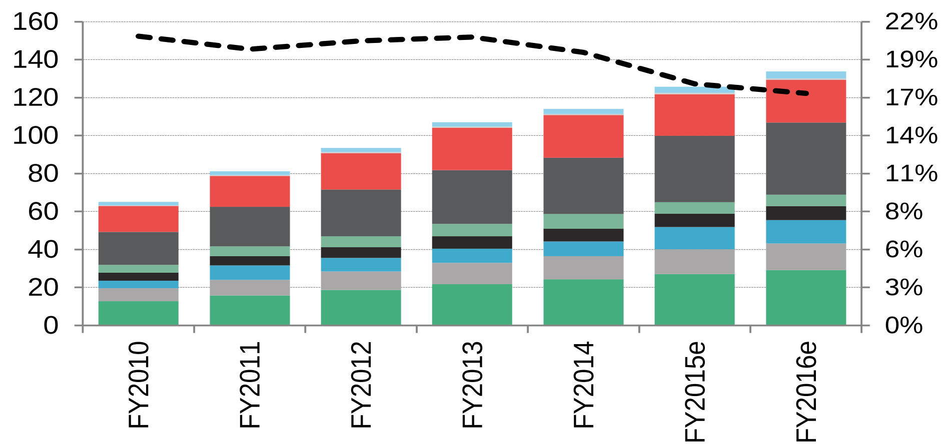
UNITS SOLD AND REVENUES BY CUSTOMER CATEGORY

Bloomberg NEW ENERGY FINANCE

Units sold to different customer segments (TWh)



Revenues by customer category (INR bn)



Note: FY2015 and FY2016 numbers are estimates from BESCOM

Source: Bloomberg New Energy Finance, Bangalore Electricity Supply Company

CUSTOMERS WHO HAVE PARTIALLY/FULLY OPTED-OUT FROM BUYING POWER FROM BESCOM

Information technology and communications	Energy	Industrials and Healthcare	Food & Beverages and Hospitality

Note: this is a sample list

Source: Bloomberg New Energy Finance

KEY PLAYERS SUPPLYING POWER FOR OPTED-OUT CUSTOMERS IN APRIL 2014

Bloomberg NEW ENERGY FINANCE

Renewable independent power producer

ReNew POWER

GREEN INFRA empowering naturally!

Greenko

IL&FS Energy

Key investor

Goldman Sachs

IDFC PRIVATE EQUITY

IFC

Standard Chartered

GLOBAL ENVIRONMENT FUND

BLACKROCK

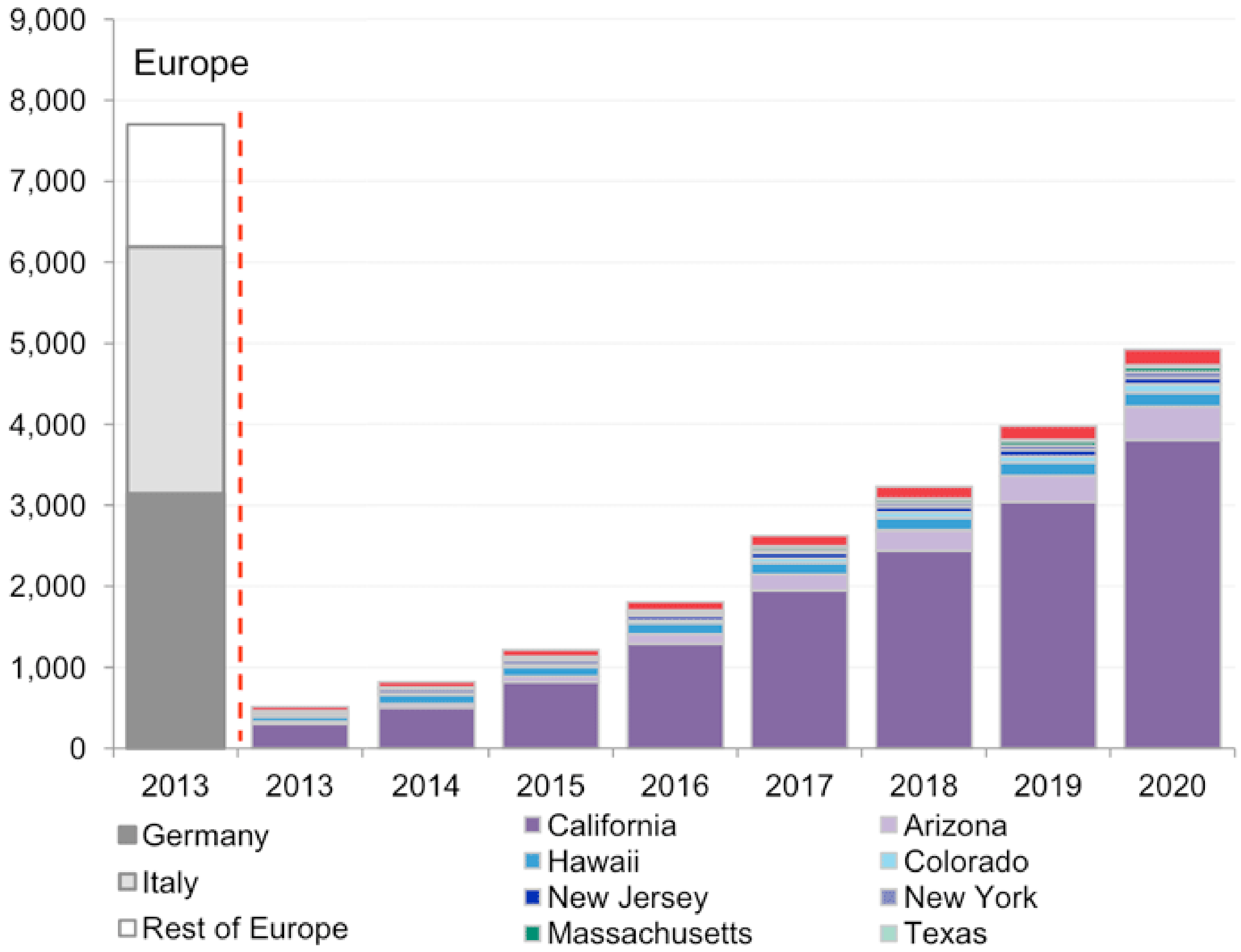
IL&FS

Source: Bloomberg New Energy Finance, Bangalore Electricity Supply Company

UTILITY BUSINESS STRATEGY

ESTIMATED GROSS REVENUE LOSS TO UTILITIES FROM RESIDENTIAL PV ($M)

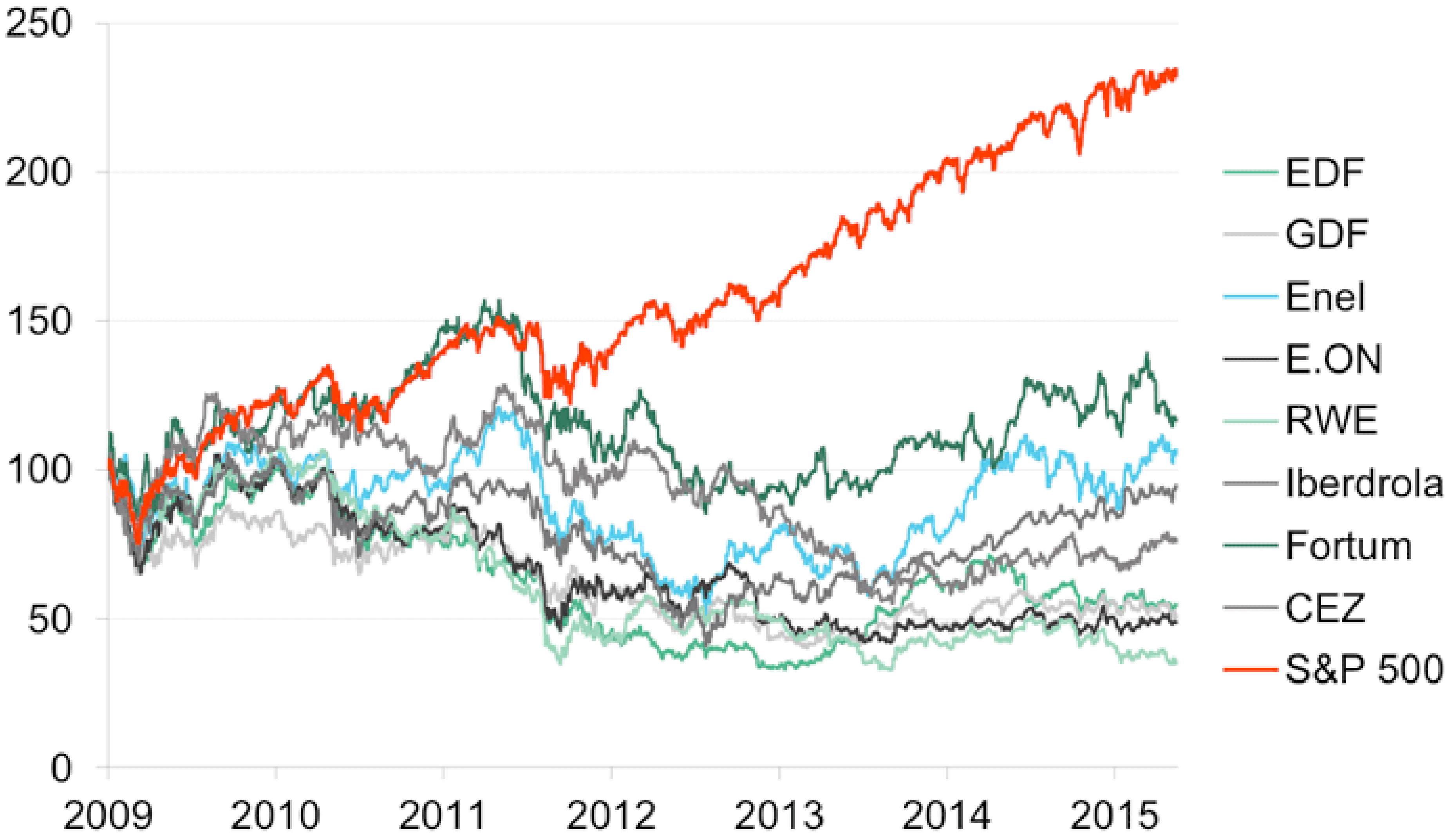
Bloomberg NEW ENERGY FINANCE



Source: Bloomberg New Energy Finance

EUROPEAN UTILITY STOCK PRICE DEVELOPMENTS (NORMALISED TO DECEMBER 2008)

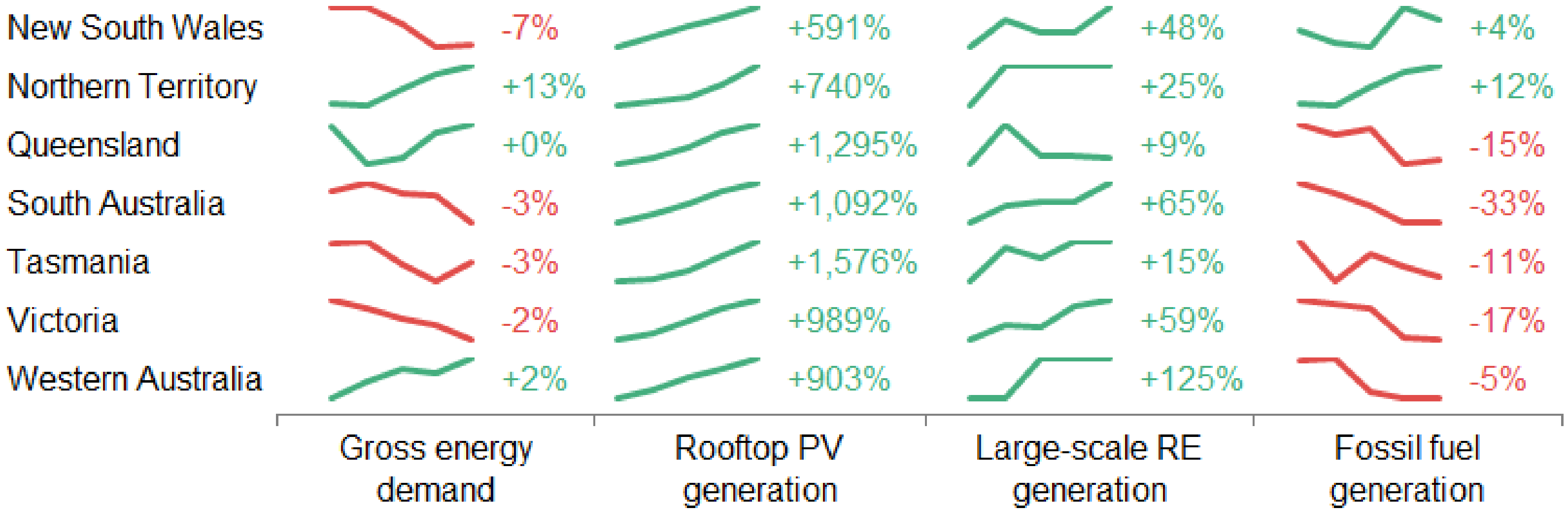
Bloomberg NEW ENERGY FINANCE



Source: Bloomberg New Energy Finance

HISTORICAL DEMAND AND GENERATION INDICATORS, FY2010-14 (% CHANGE - CUMULATIVE)

Bloomberg NEW ENERGY FINANCE



Note: New South Wales includes Australian Capital Territory

Source: Bloomberg New Energy Finance

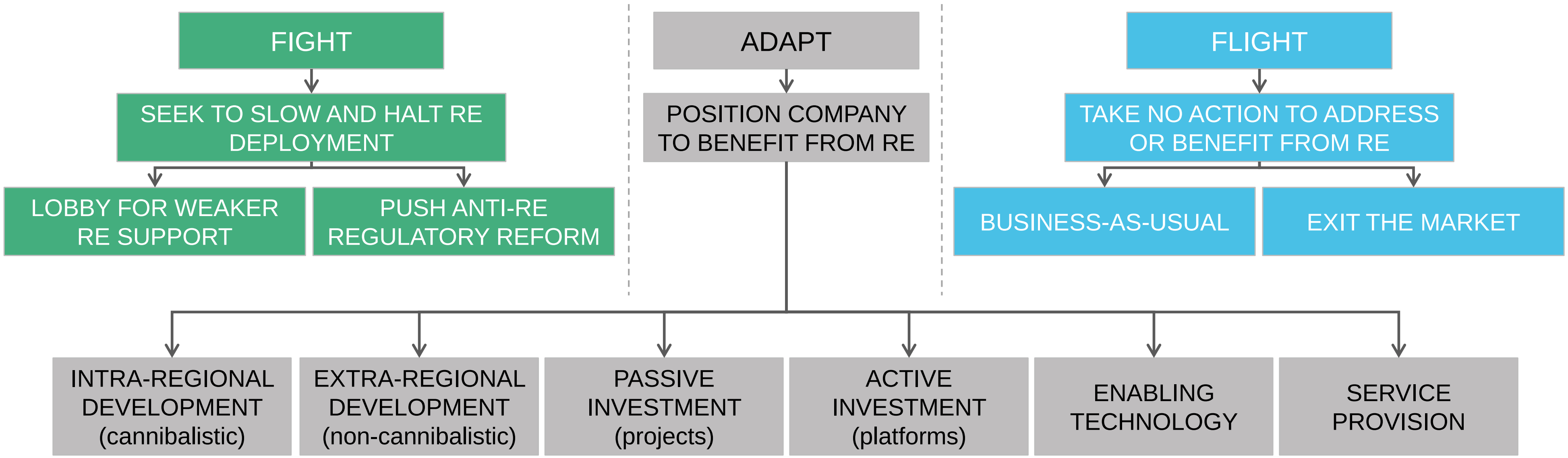
E.ON SPLIT

e.on

e.off

UTILITY STRATEGY DECISION TREE

Bloomberg NEW ENERGY FINANCE



Source: Bloomberg New Energy Finance

A POTENTIAL DEATH SPIRAL FOR INDIAN DISTRIBUTION UTILITIES

Big customers paying high tariffs opt-out due to:

- increasing retail tariffs and poor service
- falling costs of renewables/socket parity
- supportive regulation for grid access
- cash availability
- environmental concerns

Creating problems in

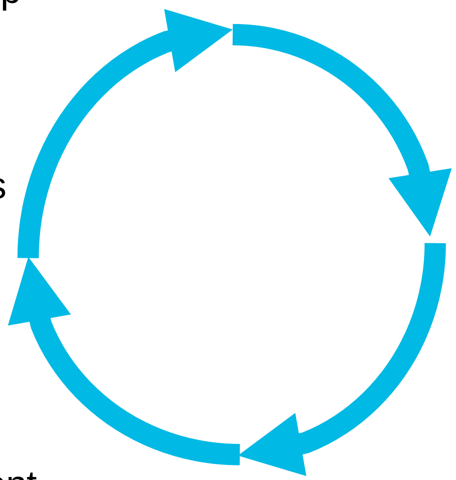
- capital availability for grid augmentation/management
- increasing retail tariffs for all customers (highest rise in households and agriculture due to lack of cross subsidy)

Leading to

- reduced grid reliability
- deteriorating services
- stranded assets/investment programmes

Causing

- increased interest in rooftop solar/net metering
- smaller consumers to opt-out
- further capex requirements for grid management



Source: Bloomberg New Energy Finance

POTENTIAL *ADAPT* STRATEGIES FOR INDIAN DISCOMS

Bloomberg NEW ENERGY FINANCE

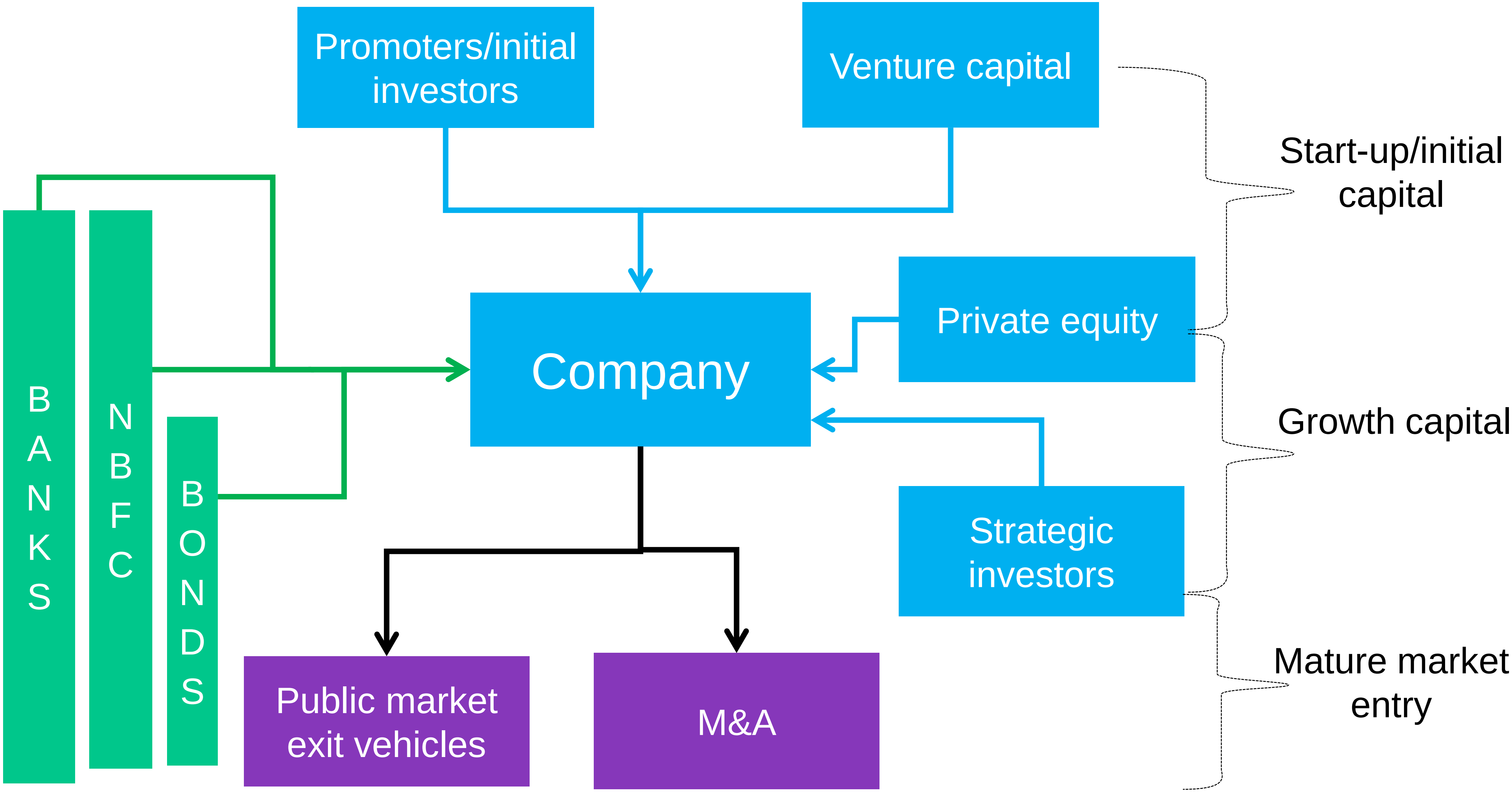
Strategy	Description	Pros	Cons
Service provision for large consumers	Provide the option to large commercial and industrial consumers to consume clean energy through tie-ups with renewable power producers	• Low capital investment option • Avoid fuel price escalations on consumer bills as clean energy producers agree to a long-term $/MWh rate • Existing billing and customer relationship systems can be modified to meet the needs	• Utility may still not be the lowest cost provider • Staff training needed
Investments in enabling technology	Discom invests in assets or companies that enhances the grid's ability to absorb higher penetration of renewable energy	• Benefit from growth of renewable energy • Can be viewed as favourable by the regulators who can allow specific return on equity on such investments	• Higher growth in renewable energy can further cannibalise core business of power sales • Increase in power prices due to capital investments may aggravate consumer relationship (particularly with non-PV/renewables consuming ones)
Service provision for small consumers	Partner with PV system providers to increase use of rooftop solar	• Low capital investment option • Leverages discoms's core competence in dealing with end consumers	• Can cannibalise core business of power sales • Requires training of staff • Partner's performance effects reputation

Source: Bloomberg New Energy Finance

FINANCIAL INNOVATION IN CLEAN ENERGY

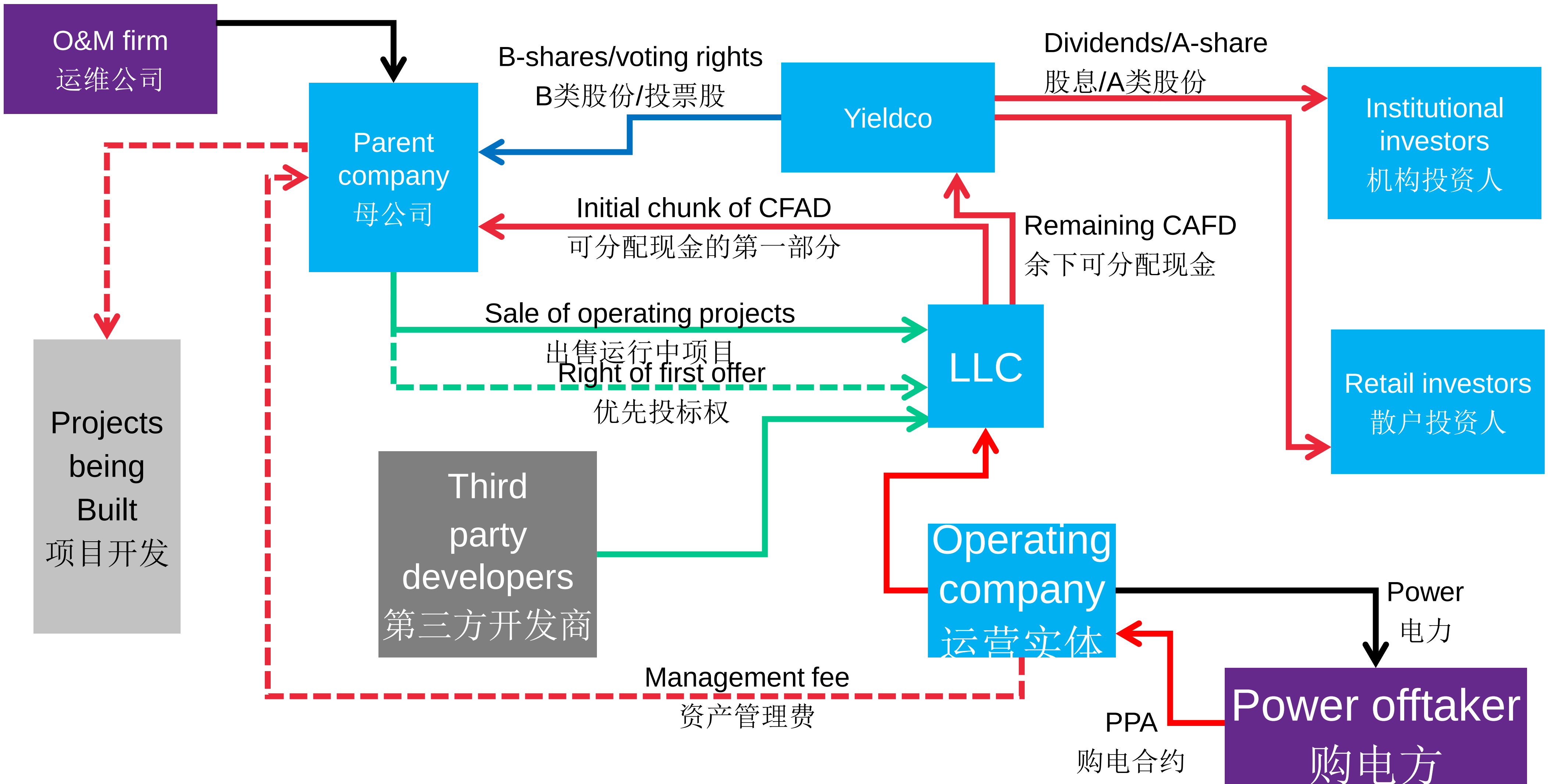
Bloomberg
NEW ENERGY FINANCE

FUNDING TIMELINE



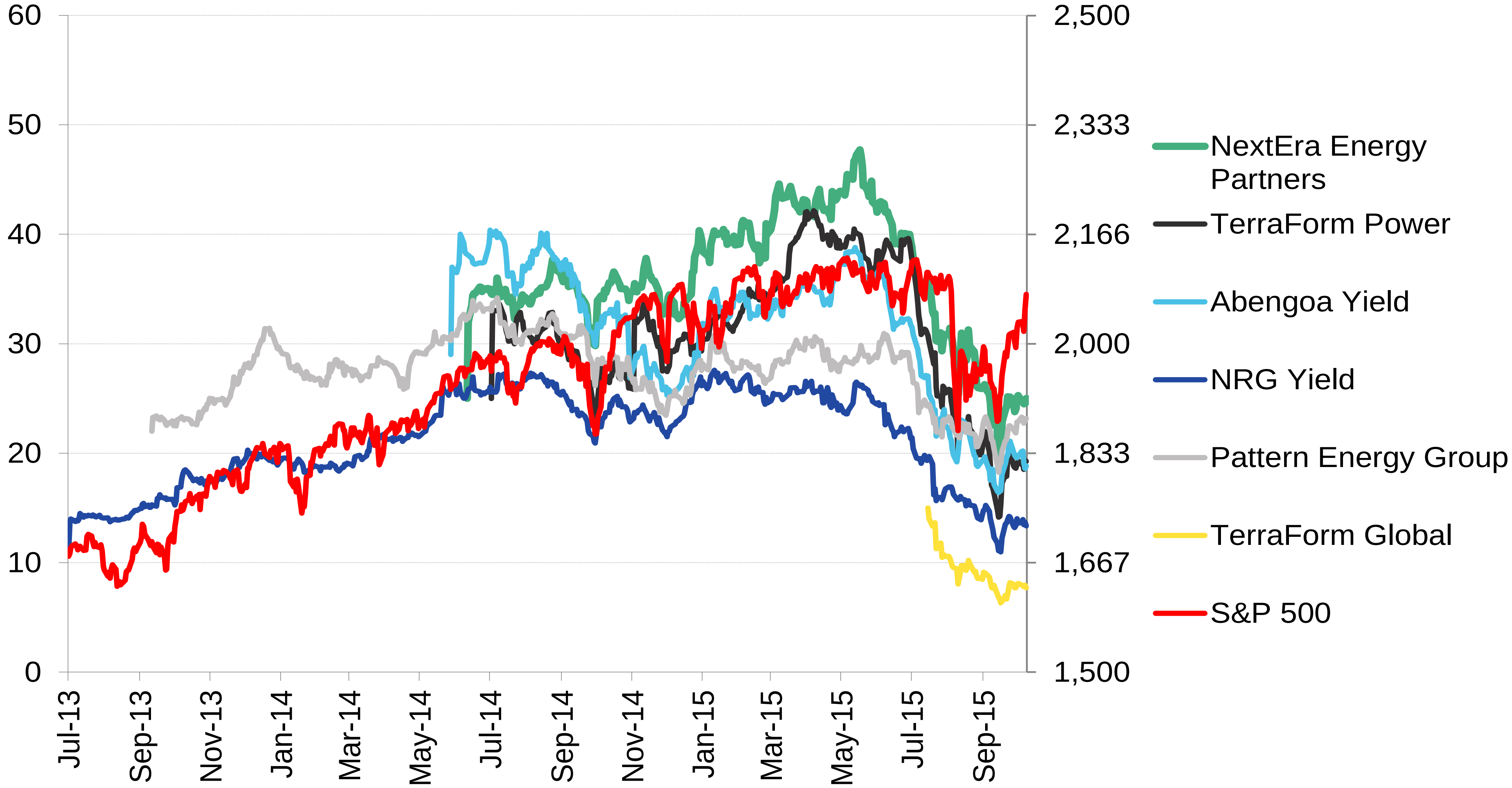
Source: Bloomberg New Energy Finance

Bloomberg NEW ENERGY FINANCE



Note: CFAD is cash flow available for distribution. PPA is power purchase agreement. LLC is limited liability company.

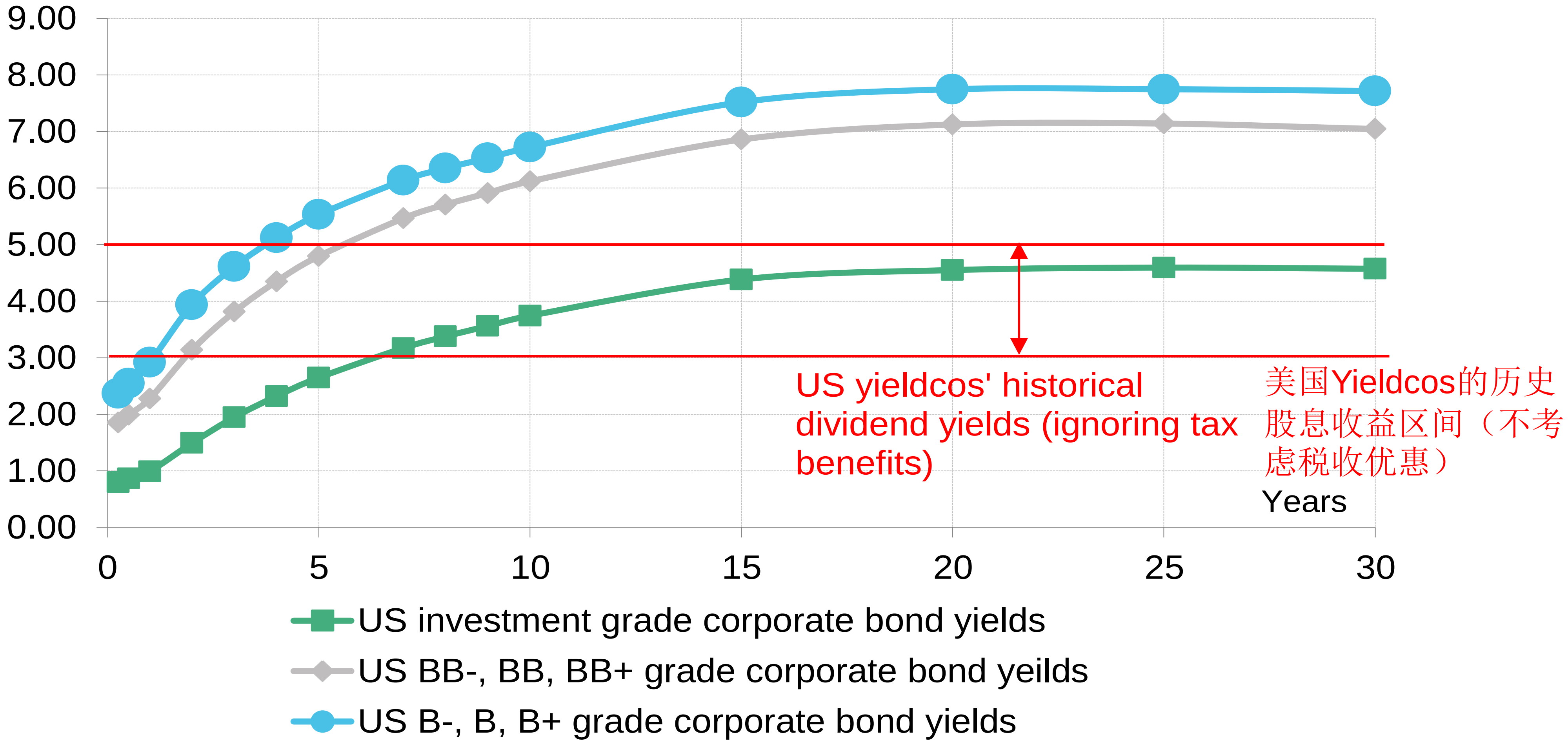
US YIELDCOS' STOCK PRICE PERFORMANCE SINCE RESPECTIVE IPOS ($, INDEX)



LISTING STRATEGY

Strategy 策略	Location of assets 资产位置	Location of listing 上市地点
An **offshore** yieldco with **overseas assets** **海外资产海外上市**	Overseas 海外	Overseas 海外
An **offshore** yieldco with **domestic assets** **境内资产海外上市**	Local 境内	Overseas 海外
A **near-shore** yieldco 近岸市场上市	Local 境内	HK/Singapore 香港/新加坡
An **onshore** (local) yieldco 境内上市	Local 境内	Local 境内

COMPARING YIELDS BETWEEN YIELDCOS AND BONDS IN THE US

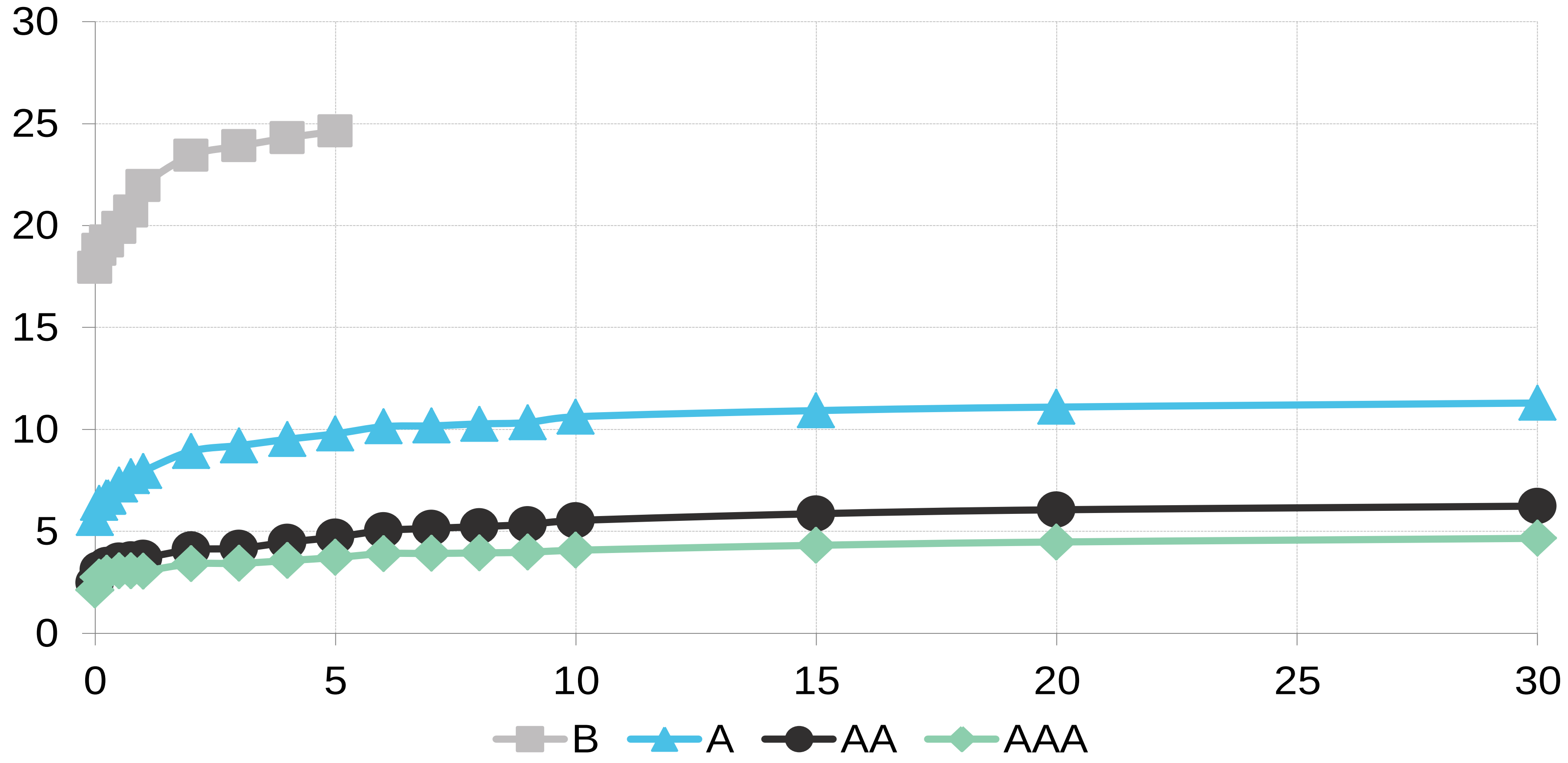


Note: yields as of as of 28 October 2015.

Source: Bloomberg New Energy Finance

CHINA'S CORPORATE BOND YIELDS (%)

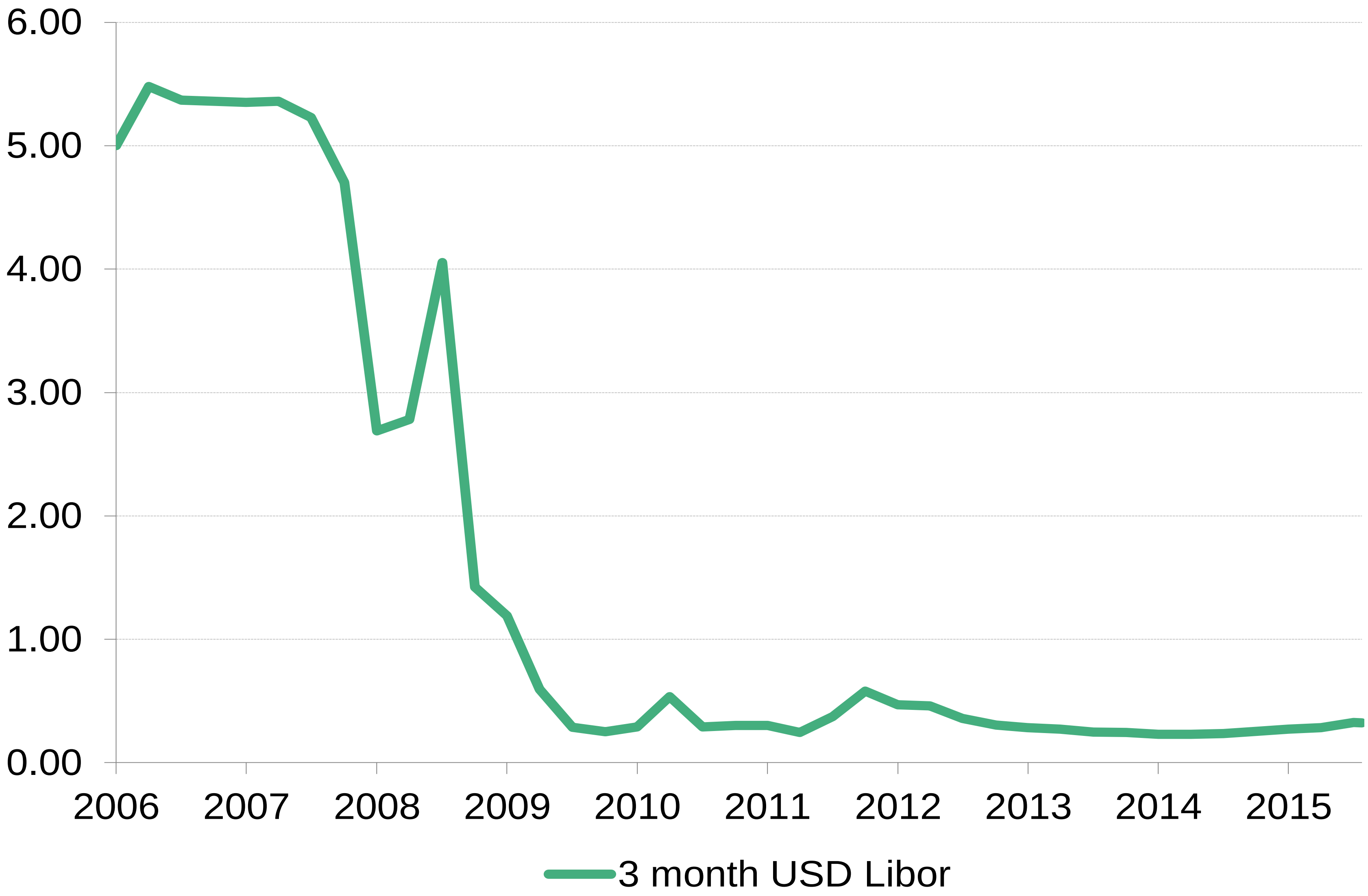
Bloomberg NEW ENERGY FINANCE



Note: yields as of as of 29 October 2015.

Source: Bloomberg New Energy Finance

DECLINING INTEREST RATES OF USD SINCE 2009, JAN 2006 - MAY 2015 (%)



Source: Bloomberg

WHAT IS A GREEN BOND

Green Bonds are like any other infrastructure bonds but with a condition that the proceeds of these bonds would be used as per the "Green Bond" definition that one follows. There is no standard definition of Green Bonds as of now and many people/organizations define it differently and include activities such as clean energy, energy efficiency, carbon reduction activities and more.

Type	Definition
Labelled green bonds	A labelled green bond is a bond issued with a clear intent to use proceeds for green initiatives.
Unlabelled green bonds	Bonds that are issued by companies promoting green initiatives but have chosen not to market their issuances as green are called unlabeled bonds. These bonds may not be branded as green as the issuer may find no additional benefit of doing so or because a part of the proceeds would be used for activities which may not be strictly considered as green.

Source: Bloomberg New Energy Finance

CLASSIFICATION OF GREEN BONDS BASED ON ISSUER

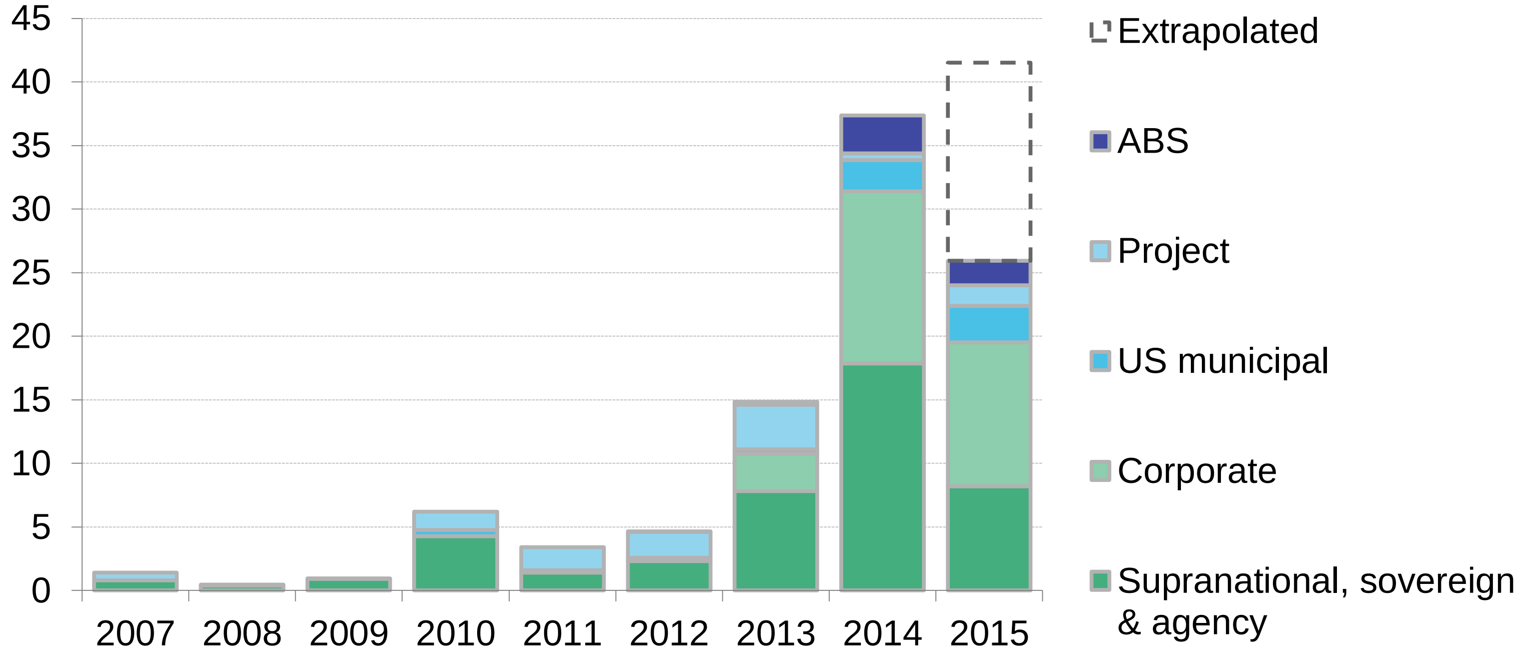
Bloomberg NEW ENERGY FINANCE

Type	Definition
Corporate self-labelled	Bonds issued by corporations and explicitly labelled as green
Green ABS	Asset-backed securities whose cashflows come from a portfolio of underlying receivables such as loans, leases and PPAs. The receivables are associated with green (eg, renewable energy, energy efficiency) projects.
Project bonds	Bonds backed by the cashflows of an underlying renewable energy project or portfolio of projects
Sovereign & supranational	Bonds issued by multilateral banks, development finance institutions and export credit agencies to finance green projects. This includes bonds issued by national development banks.
State & municipal	Bonds issued by state, municipal and provincial (ie, sub-sovereign public sector) entities to finance green projects

Source: Bloomberg New Energy Finance

GREEN BOND ISSUANCE BY TYPE, BY YEAR, 2007-2015 ($BN)

Bloomberg NEW ENERGY FINANCE

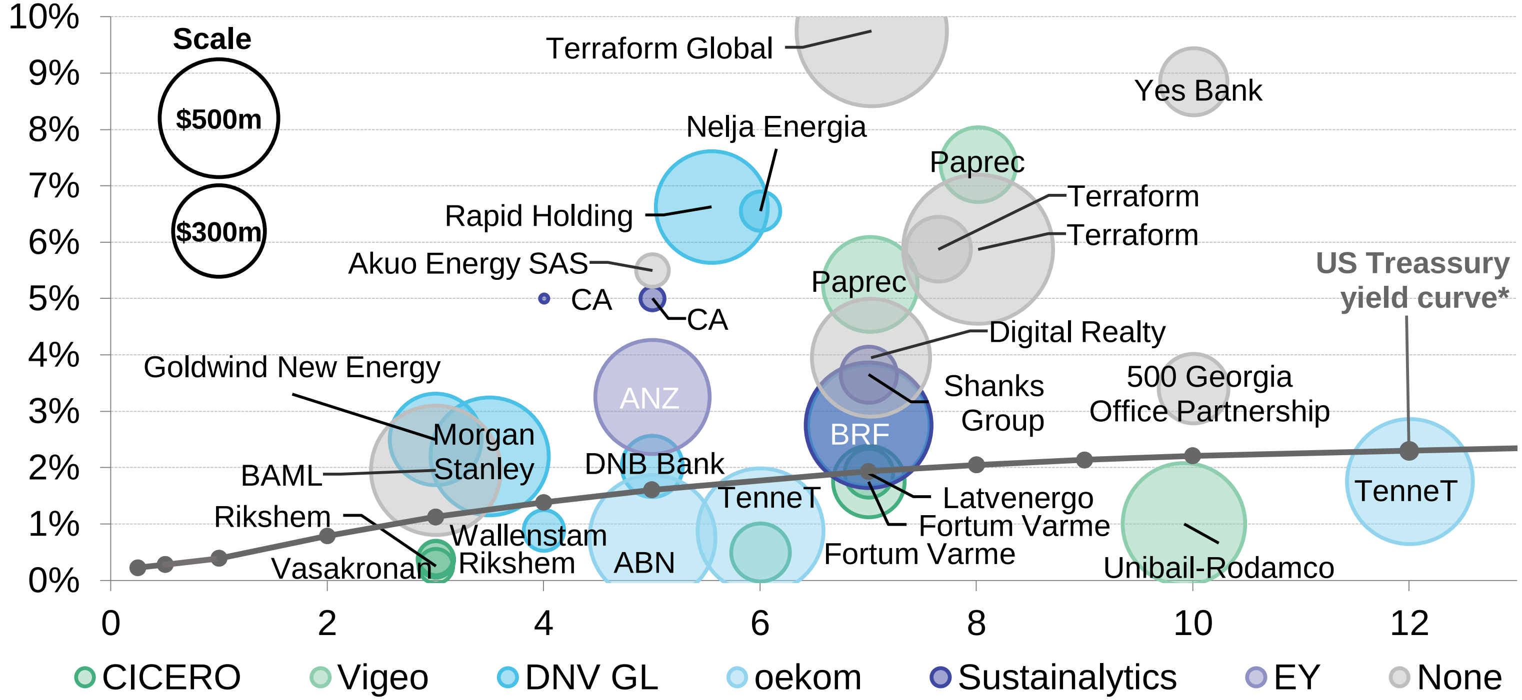


Notes: See Section 2 of the accompanying report for methodology and sources.

Source: Bloomberg New Energy Finance, Bloomberg Terminal

SELECT CORPORATE GREEN BONDS, JANUARY-AUGUST 2015

How to interpret: Coupon on y-axis, tenor on x-axis, bubble size based on issuance size, bubble colour based on second opinion provider

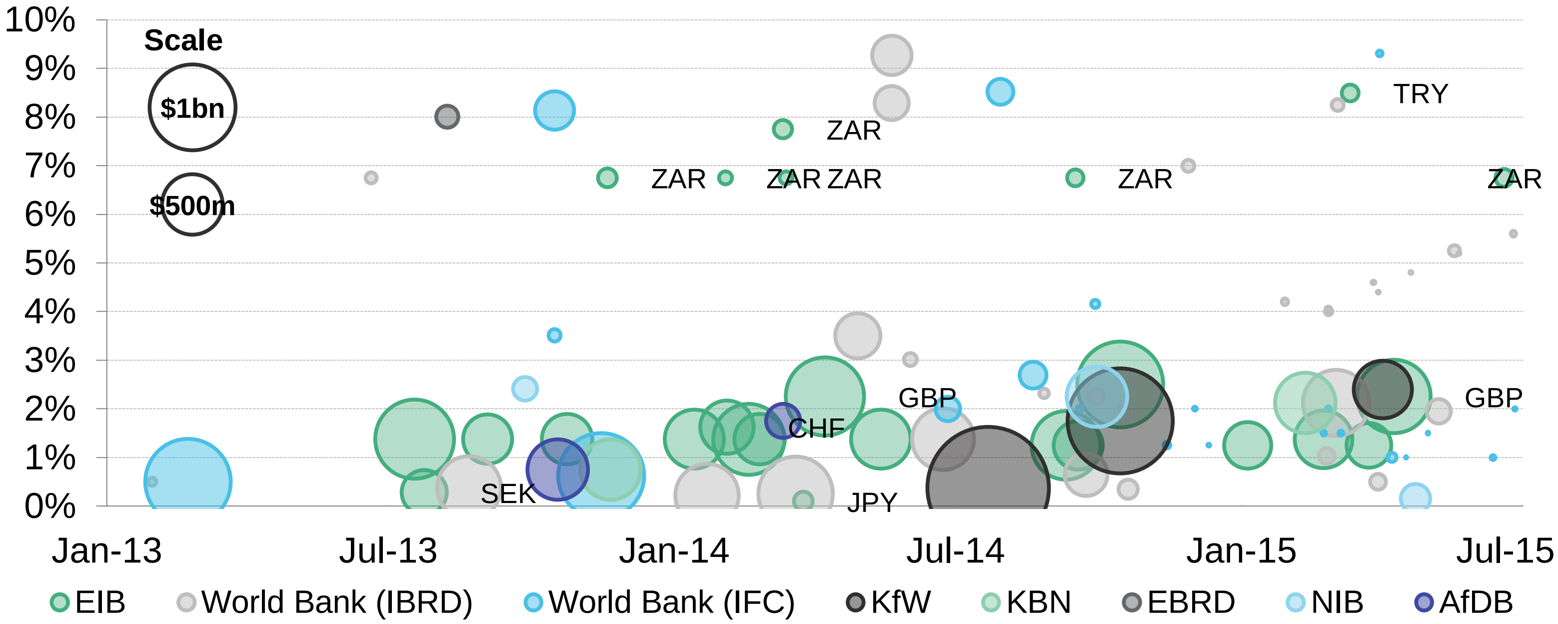


Notes: (*) Yield curve as of 17 August 2015. Section 2 for methodology and sources.

Source: Bloomberg New Energy Finance, Bloomberg Terminal

DEVELOPMENT BANK GREEN BONDS, JANUARY 2013-JULY 2015

How to interpret: Coupon on y-axis, tenor on x-axis, bubble size based on issuance size, bubble colour based on second opinion provider

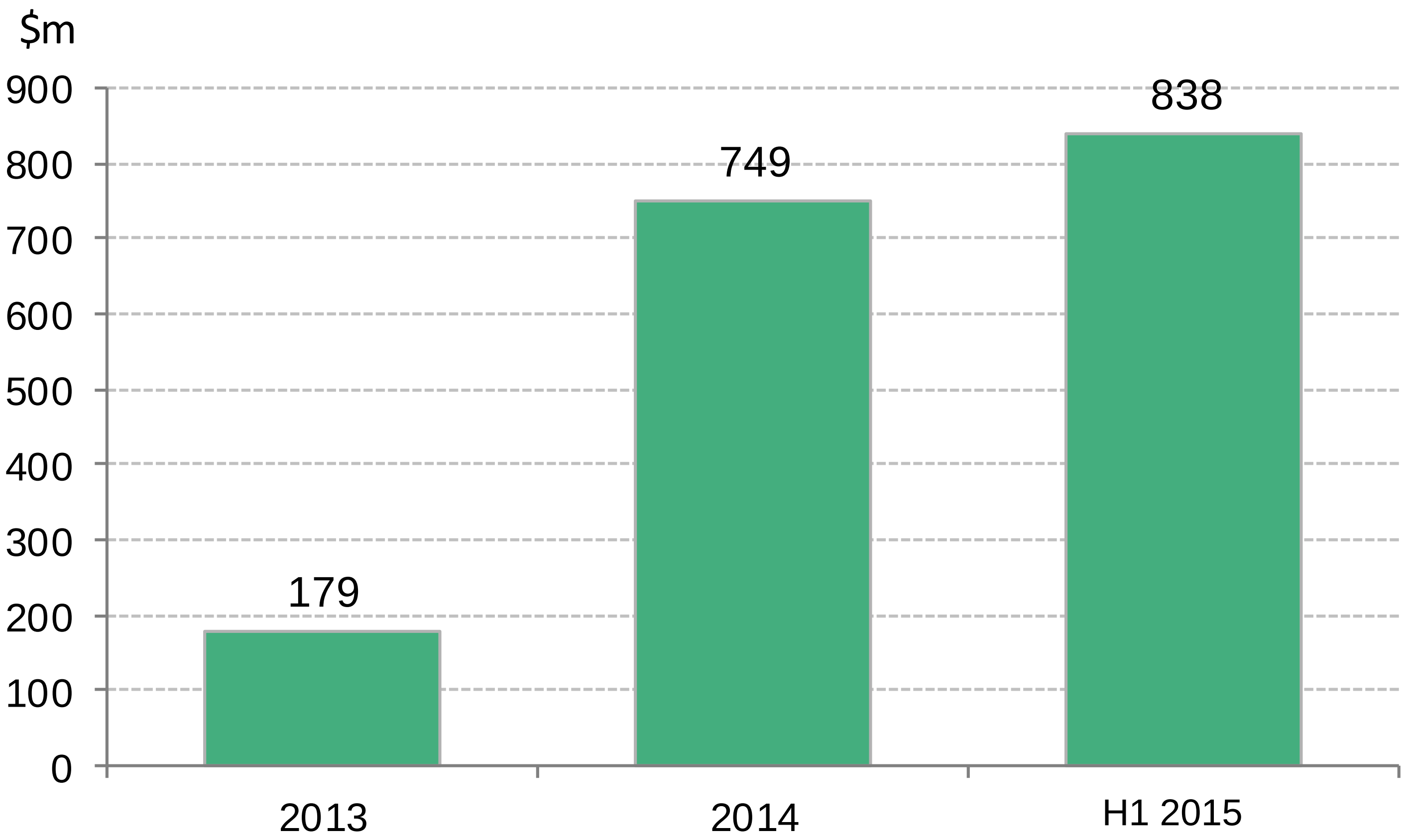


Notes: Currencies labelled only where issuance was not in USD or EUR. (The currency is relevant as most of these non-USD issues are either Uridashi or dual currency issues.) EIB: European Investment Bank; IBRD: International Bank for Reconstruction and Development; IFC: International Finance Corporation; KfW: Kreditanstalt für Wiederaufbau; KBN: Kommunalbanken; EBRD: European Bank for Reconstruction and Development; NIB: Nordic Investment Bank; AfDB: African Development Bank.

Source: Bloomberg New Energy Finance, Bloomberg Terminal

LABELLED AND UNLABELLED GREEN BOND ISSUANCES IN INDIA

Bloomberg NEW ENERGY FINANCE



Source: Bloomberg New Energy Finance

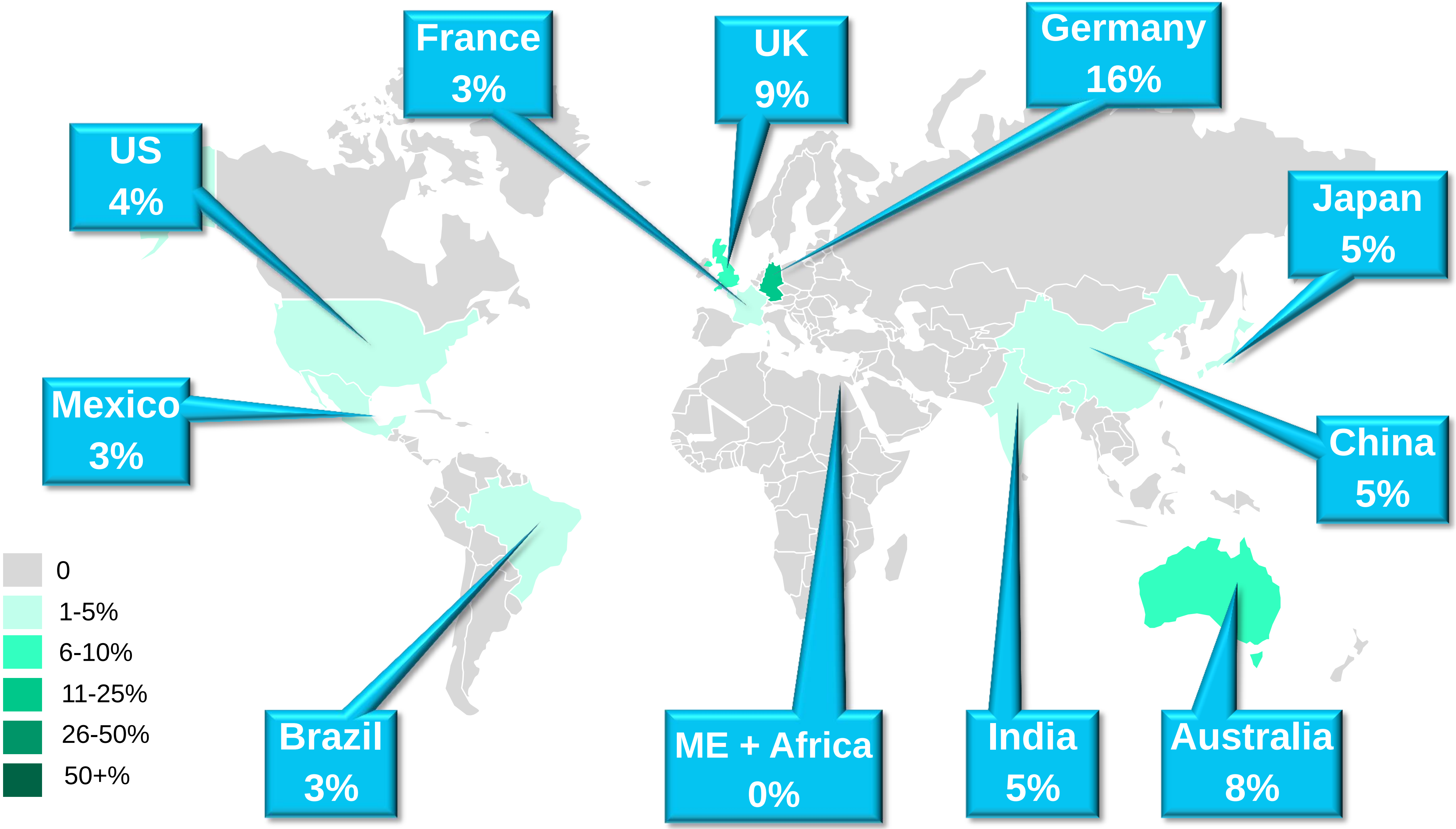
GREEN BONDS ISSUED IN INDIA, H1 2015

Issuer	Date	Value (INR m)	Currency	Value (USD m)	Coupon	Tenor
Yes Bank Ltd	2/24/15	10000	INR	161	8.85	10
Export-Import Bank of India	4/1/15		USD	500	2.75	5
TOTAL				**661**		
ReNew Power Ventures Pvt Ltd	3/23/15	1000	INR	16	12.29	5
ReNew Power Ventures Pvt Ltd	3/23/15	1000	INR	16	12.29	5
ReNew Power Ventures Pvt Ltd	3/23/15	500	INR	8	12.00	5
ReNew Power Ventures Pvt Ltd	3/23/15	1000	INR	16	12.00	5
ReNew Power Ventures Pvt Ltd	3/24/15	500	INR	8	13.07	5
ReNew Power Ventures Pvt Ltd	3/24/15	1000	INR	16	13.07	5
ReNew Power Ventures Pvt Ltd	3/24/15	500	INR	8	12.68	5
ReNew Power Ventures Pvt Ltd	3/24/15	1000	INR	16	12.68	5
Mytrah Energy India Ltd	3/31/15	3447	INR	55	12.00	5
Tata Cleantech Capital Ltd	4/22/15	500	INR	8	9.05	3
Tata Cleantech Capital Ltd	5/20/15	600	INR	9	9.15	3
TOTAL				**176**		

Source: Bloomberg New Energy Finance

STORAGE: GRID BALANCING & ELECTRIC VEHICLES

RENEWABLE ENERGY PROPORTION OF POWER GENERATION- INTERMITTENT ENERGY (WIND & SOLAR), 2014 (%)

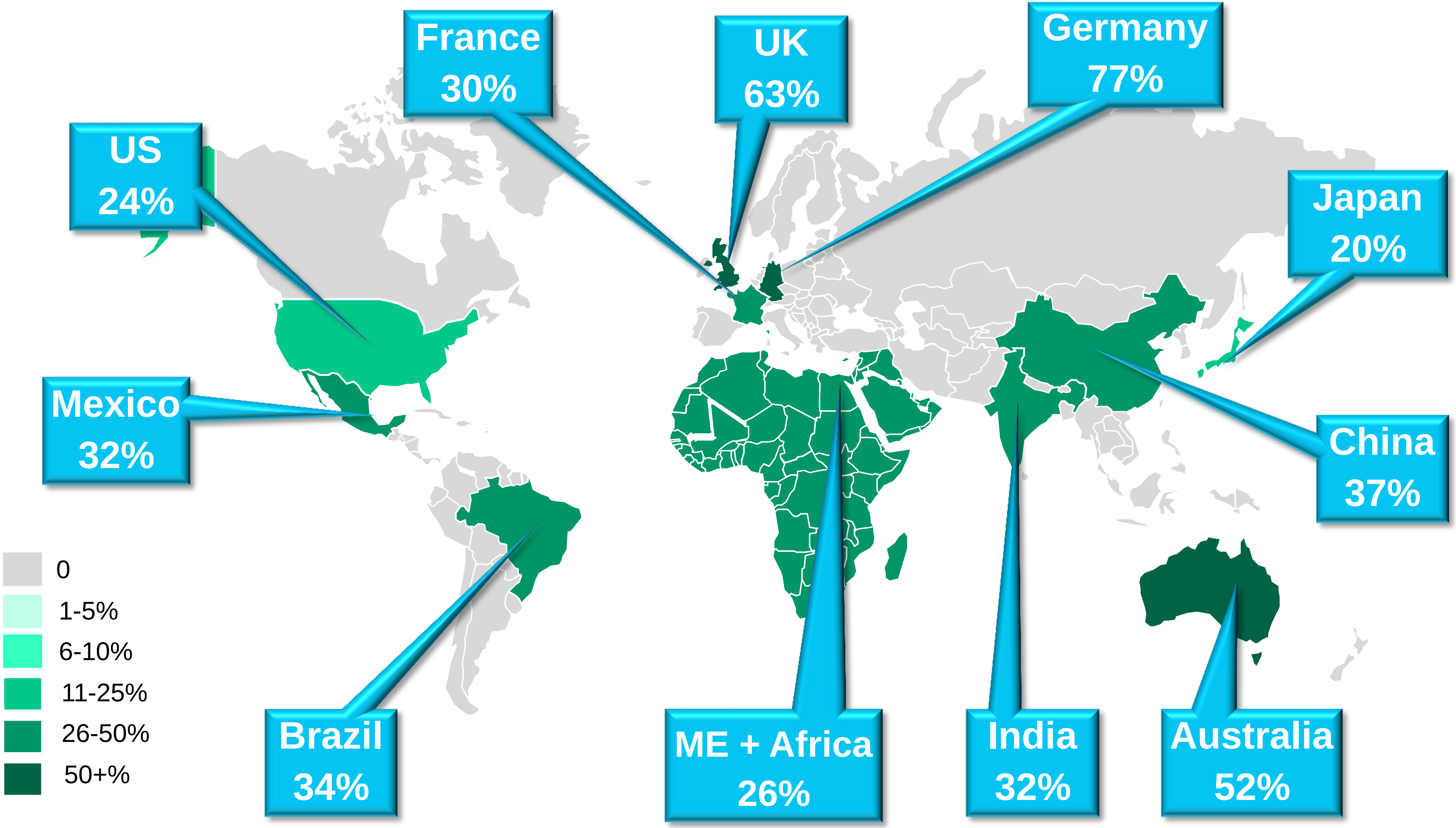


Note: This only shows the combination of wind and solar energy generation. All numbers come from BNEF's New Energy Outlook 2015

Source: Bloomberg New Energy Finance

RENEWABLE ENERGY PROPORTION OF POWER GENERATION- INTERMITTENT ENERGY (WIND & SOLAR) , 2040 (%)

Bloomberg
NEW ENERGY FINANCE



Note: This only shows the combination of wind and solar energy generation. All numbers come from BNEF's New Energy Outlook 2015

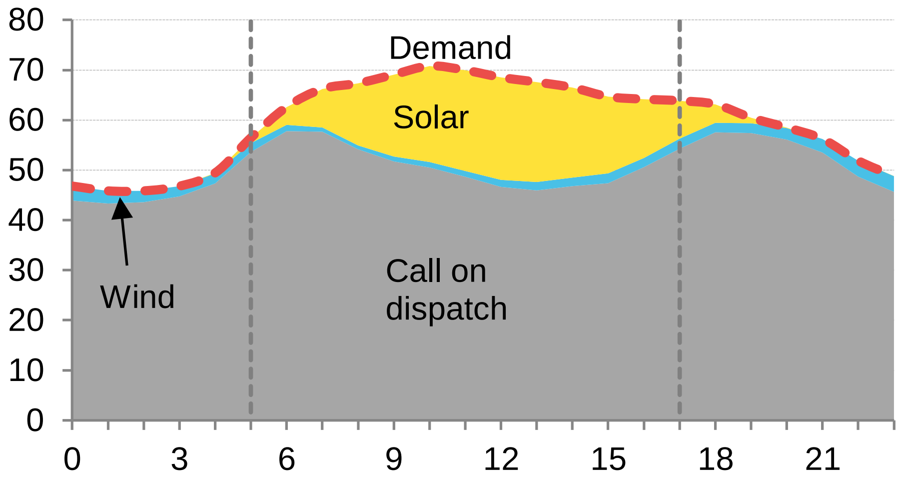
Source: Bloomberg New Energy Finance

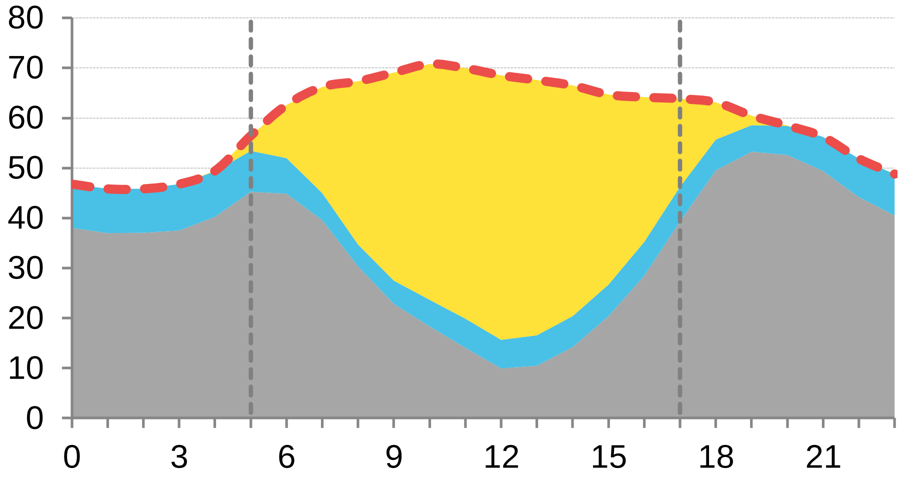
ALTHOUGH SOLAR ASSISTS WITH THE MORNING PEAK, ITS DROP OFF AT NIGHT WILL CAUSE RECORD RAMPING.

Bloomberg NEW ENERGY FINANCE

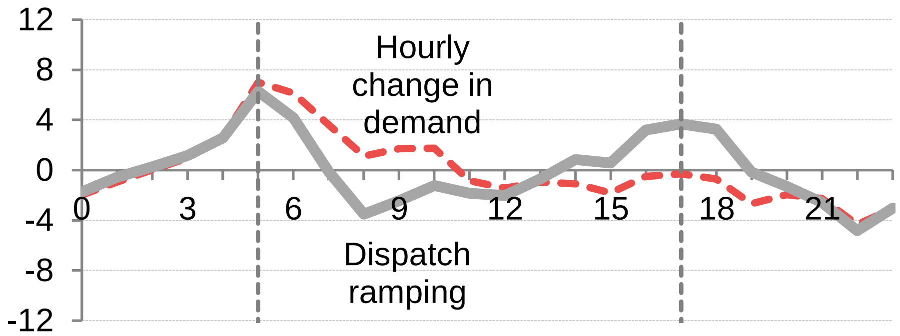
2013	2033

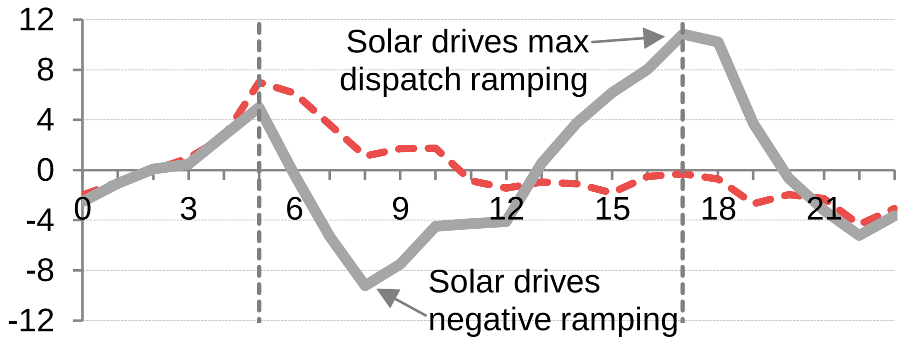
July median German generation profile (GW)





July median hourly dispatch ramping



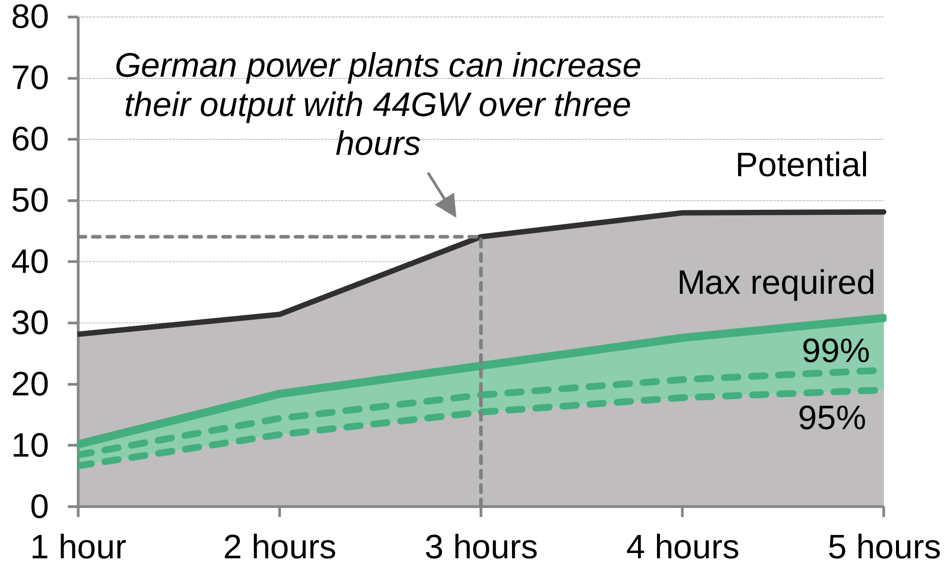


Source: Bloomberg New Energy Finance, EEX, Bnetza, Destatis Note: assumes equal demand profiles in 2013 and 2033.

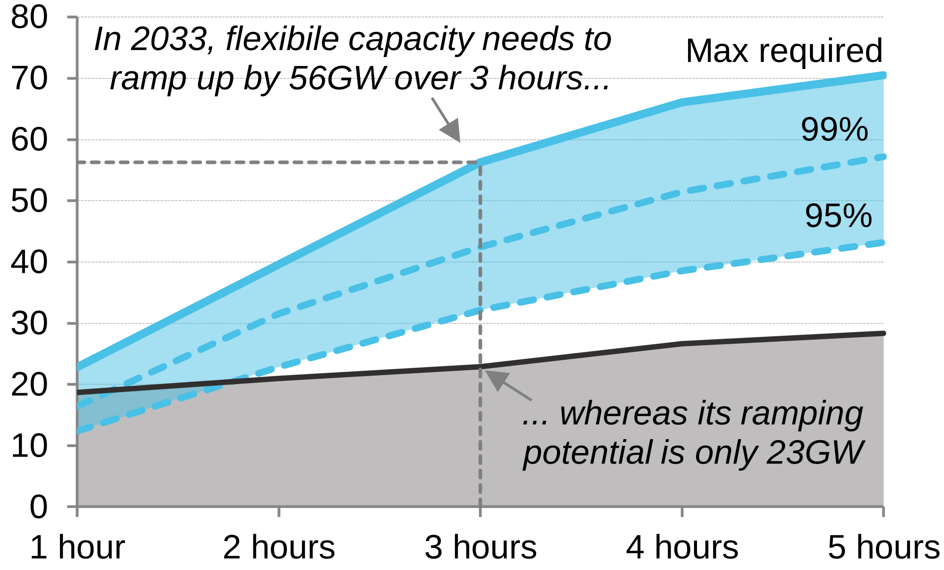
BY 2033, GERMAN POWER PLANTS ALONE WILL NOT BE ABLE TO RESPOND QUICKLY ENOUGH TO RECORD DROPS IN RENEWABLE OUTPUT

Bloomberg NEW ENERGY FINANCE

2013 dispatch maximum cumulative ramping requirements compared to ramping potential (GW)



2033 dispatch maximum cumulative ramping requirements compared to ramping potential (GW)

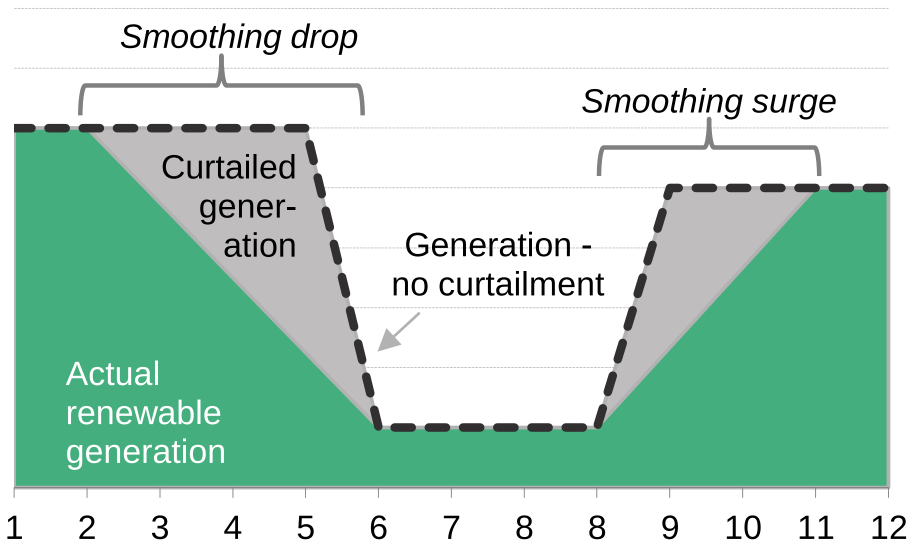


Source: Bloomberg New Energy Finance, EEX, Destatis, Bnetza
Note: 99% and 95% are confidence intervals and should be read as: ramp requirements do not exceed y GW in 99% or 95% of the hours in the year.

CURTAILING LESS THAN 1% OF RENEWABLES MIGHT CUT MAXIMUM RAMP RATES BY 57%

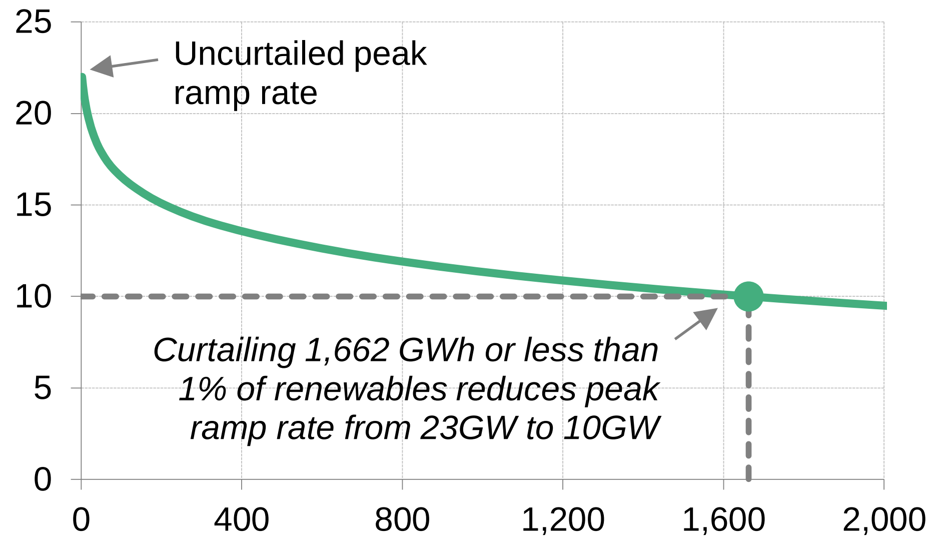
Bloomberg NEW ENERGY FINANCE

Smoothing steep drops or surges in renewable output through curtailment (x-axis = hours)



Source: Bloomberg New Energy Finance
Note: illustrative example, not based on actual data.

2033 maximum projected ramp up rates (y axis, GW/hour) for different levels of curtailment (x axis, GWh)

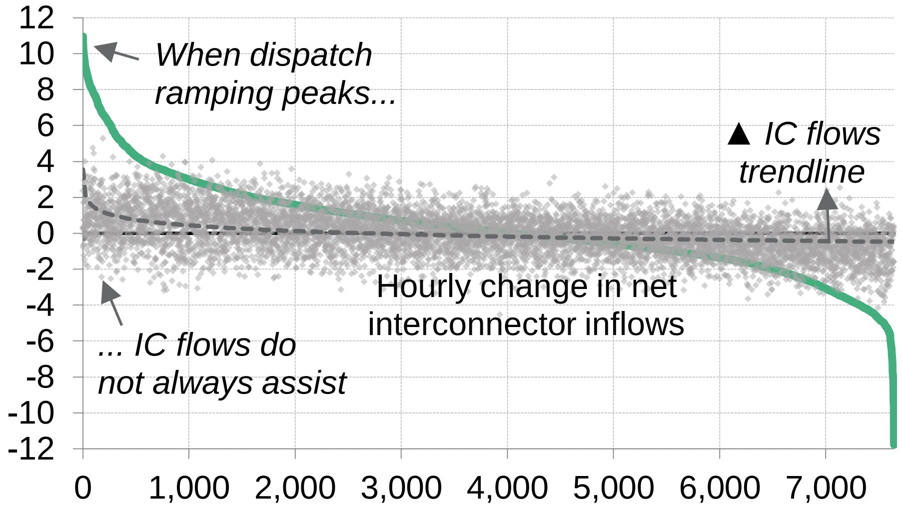


Source: Bloomberg New Energy Finance, EEX, Destatis, Bnetza

INTERCONNECTORS ARE A SOURCE OF FLEXIBILITY BUT MIGHT BE UNRELIABLE TO COVER PEAK RAMPING.

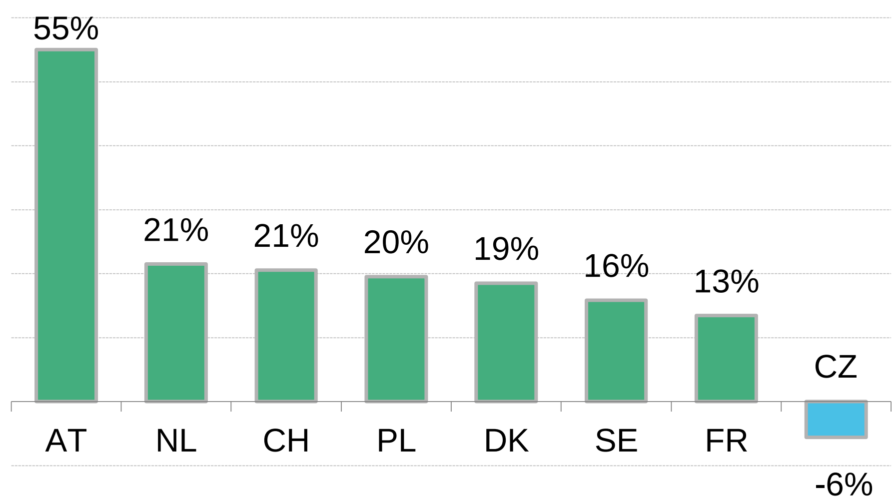
Bloomberg NEW ENERGY FINANCE

2012 hourly dispatch ramping duration curve and associated change in total interconnector inflows (GW/hr)



Source: Bloomberg New Energy Finance, EEX, Destatis, Bnetza
Notes: The ramping duration curve should be read as: x-axis value is the number of hours in 2012 where dispatch ramping exceeded the associated y-axis value. Dataset based on 7643 hours in 2012.

Contribution of interconnector flows to dispatchable capacity ramping (correlation)



Source: Bloomberg New Energy Finance, EEX, Entso-e

Bloomberg NEW ENERGY FINANCE

“There is still a need to develop adequate storage technologies.”

Pope Francis

Picture: Wikimedia

MANAGING INTERMITTENCY

Bloomberg NEW ENERGY FINANCE

1. Efficiency
2. Forecasting
3. Demand management
4. Interconnection
5. Storage
6. Backup

MANAGING INTERMITTENCY

Save money, reduce the scale of the problem

1. Efficiency
2. Forecasting
3. Demand management
4. Markets and Interconnection
5. Storage
6. Backup

MANAGING INTERMITTENCY

- Efficiency
- Forecasting
- Demand management
- Markets and Interconnection
- Storage
- Backup

“Bits are always cheaper than kit”

MANAGING INTERMITTENCY

Bloomberg NEW ENERGY FINANCE

Efficiency

Forecasting

Demand management

Markets and Interconnection

Storage

Backup

Eliminate curtailment

INTERMITTENCY MANAGEMENT MERIT ORDER

Efficiency

Forecasting

Demand management

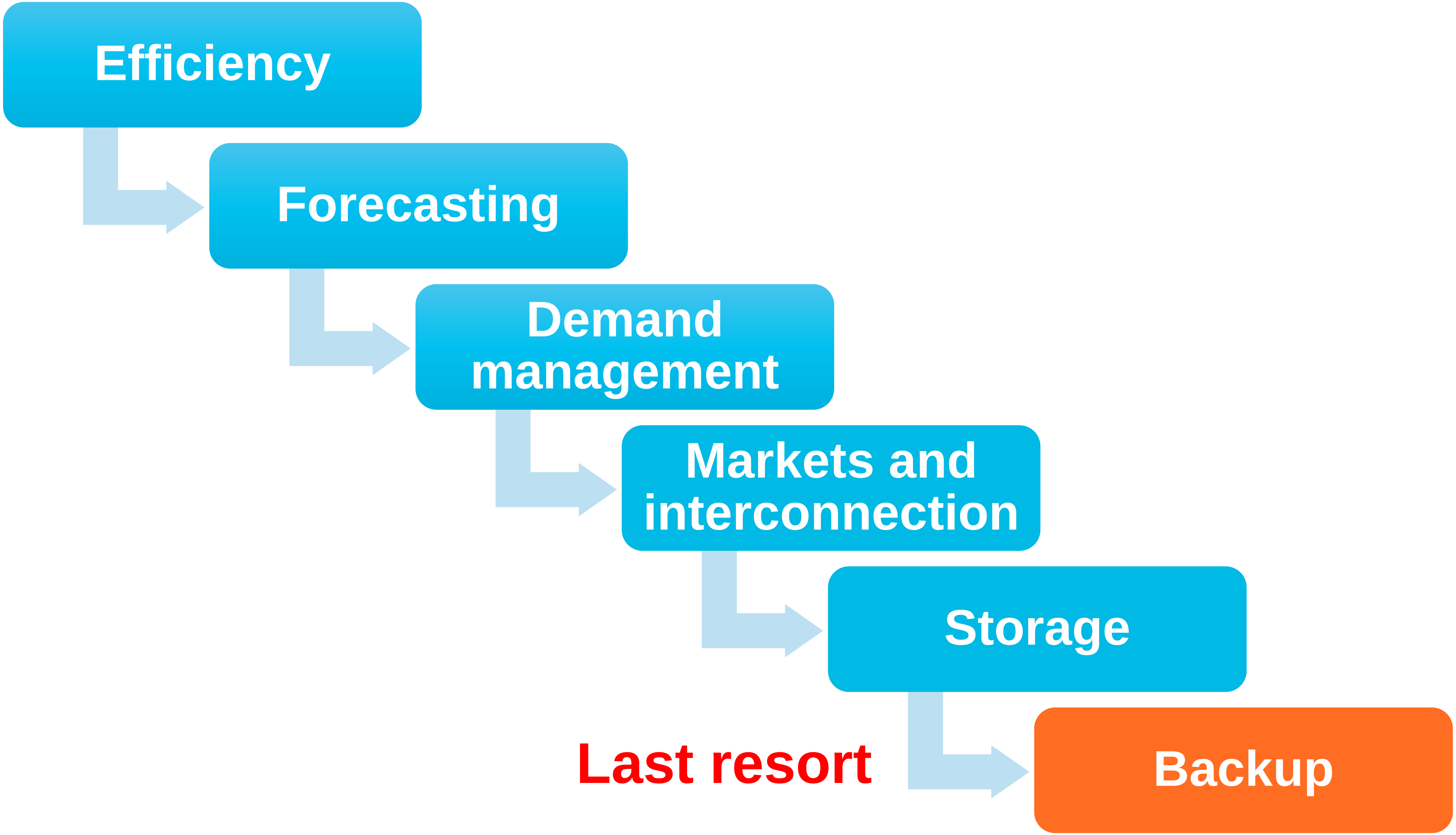
Markets and interconnection

Storage

Backup

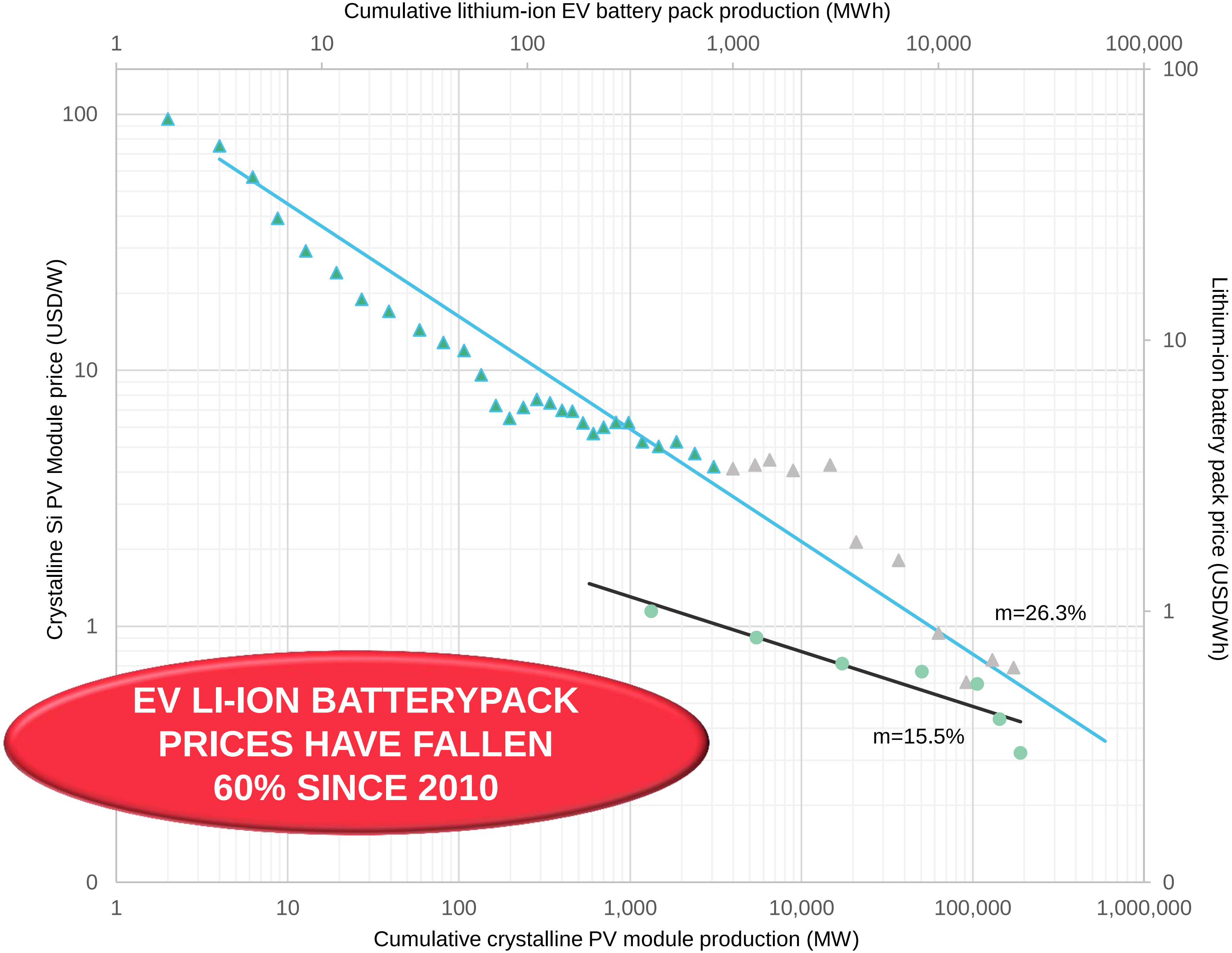
“Only needed at 70% renewable penetration”

(CEO, 50 Hertz Germany)


Efficiency
Forecasting
Demand management
Markets and interconnection
Storage
Last resort
Backup

EV LITHIUM-ION BATTERY PACKS & CRYSTYALLINE SI PV MODULES: HISTORICAL COST REDUCTIONS

Bloomberg
NEW ENERGY FINANCE



Note: Values from 2010-2014 are based on BNEF's annual battery price index, *2015 based on H1 data. For more see here: https://www.bnef.com/Insight/10299. Cumulative production is based on total EVs sold and their respective battery pack size.

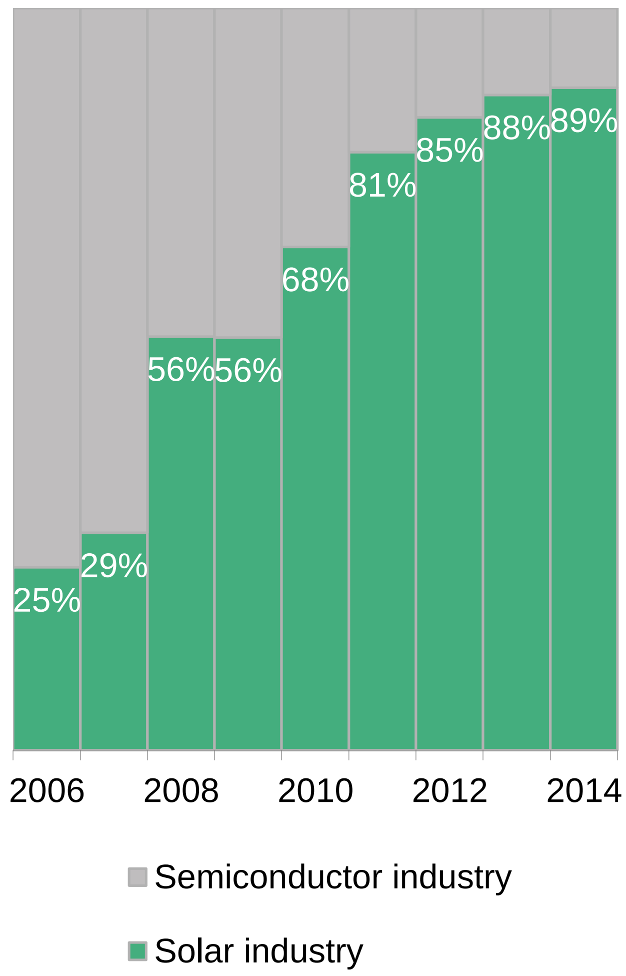
Source: Bloomberg New Energy Finance

PV AND LITHIUM-ION SUPPLY CHAINS

Bloomberg NEW ENERGY FINANCE

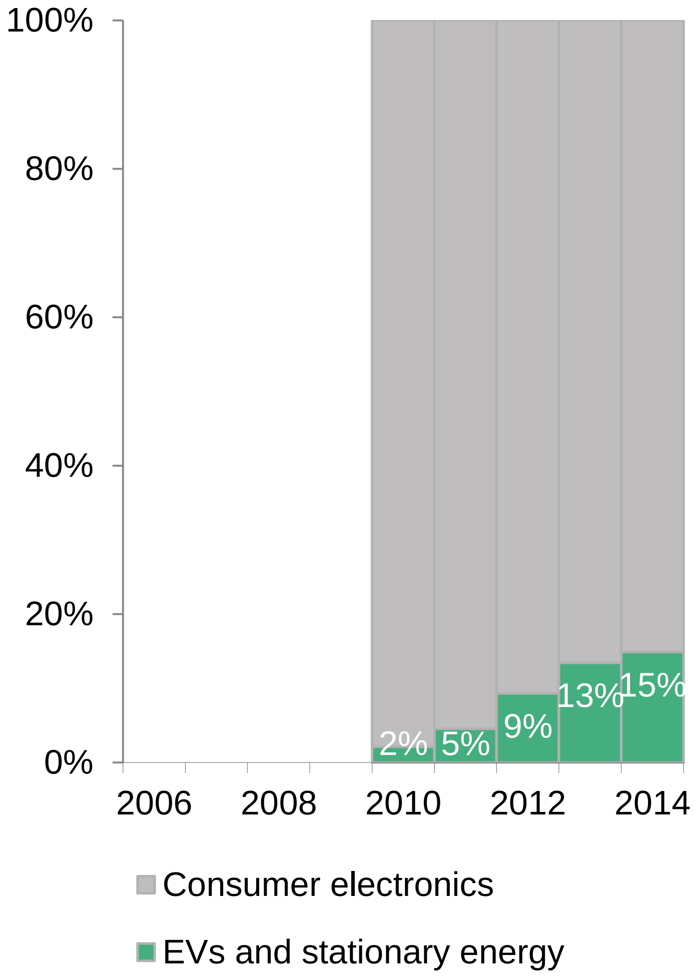
SILICON CONSUMPTION BY SECTOR

% of production



LITHIUM-ION BATTERY SALES BY SECTOR

% of capacity sold

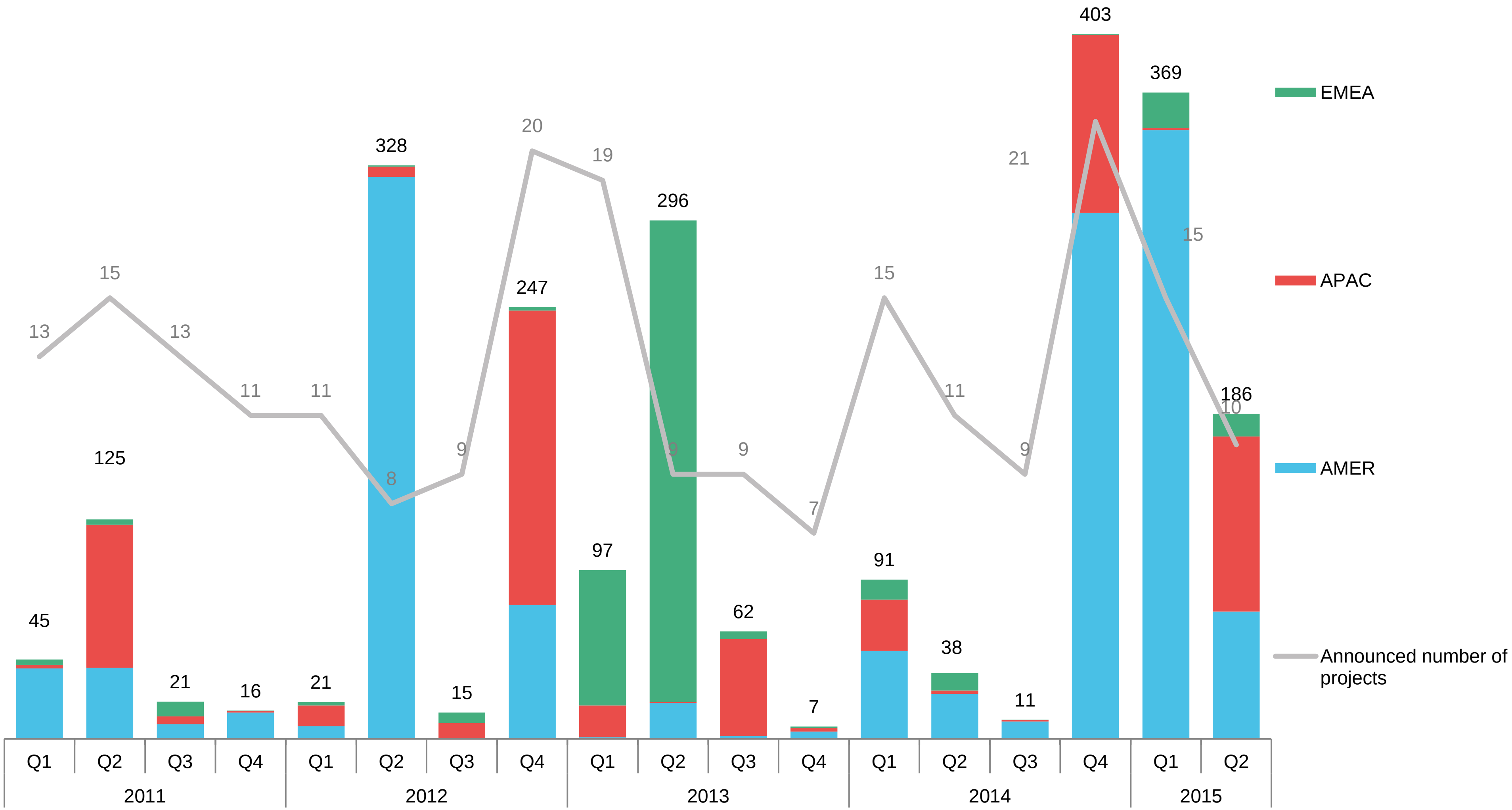


Note: Electric vehicles includes hybrid, plug-in-hybrid and fully electrified.

Source: Bloomberg New Energy Finance.

ANNOUNCED ENERGY STORAGE PROJECTS WORLDWIDE (MW AND NUMBER OF PROJECTS)

Bloomberg
NEW ENERGY FINANCE

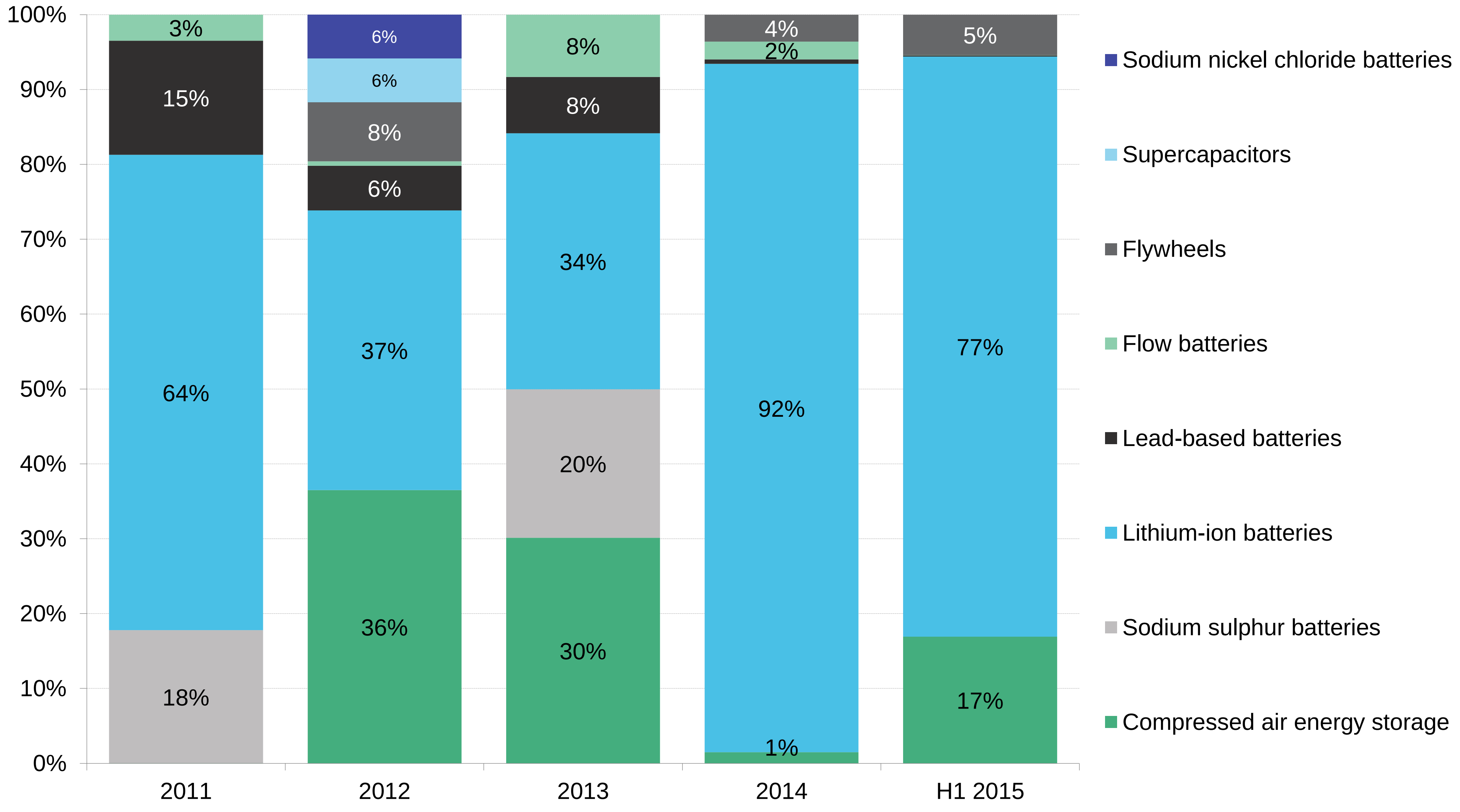


Note: Q2 2015 numbers are provisional since this Market Outlook is published mid quarter. For underlying data, including 2009 – 2010, click [here].

Source: Bloomberg New Energy Finance

TECHNOLOGY MIX OF ANNOUNCED ENERGY STORAGE PROJECTS (% BY MW)

Bloomberg NEW ENERGY FINANCE

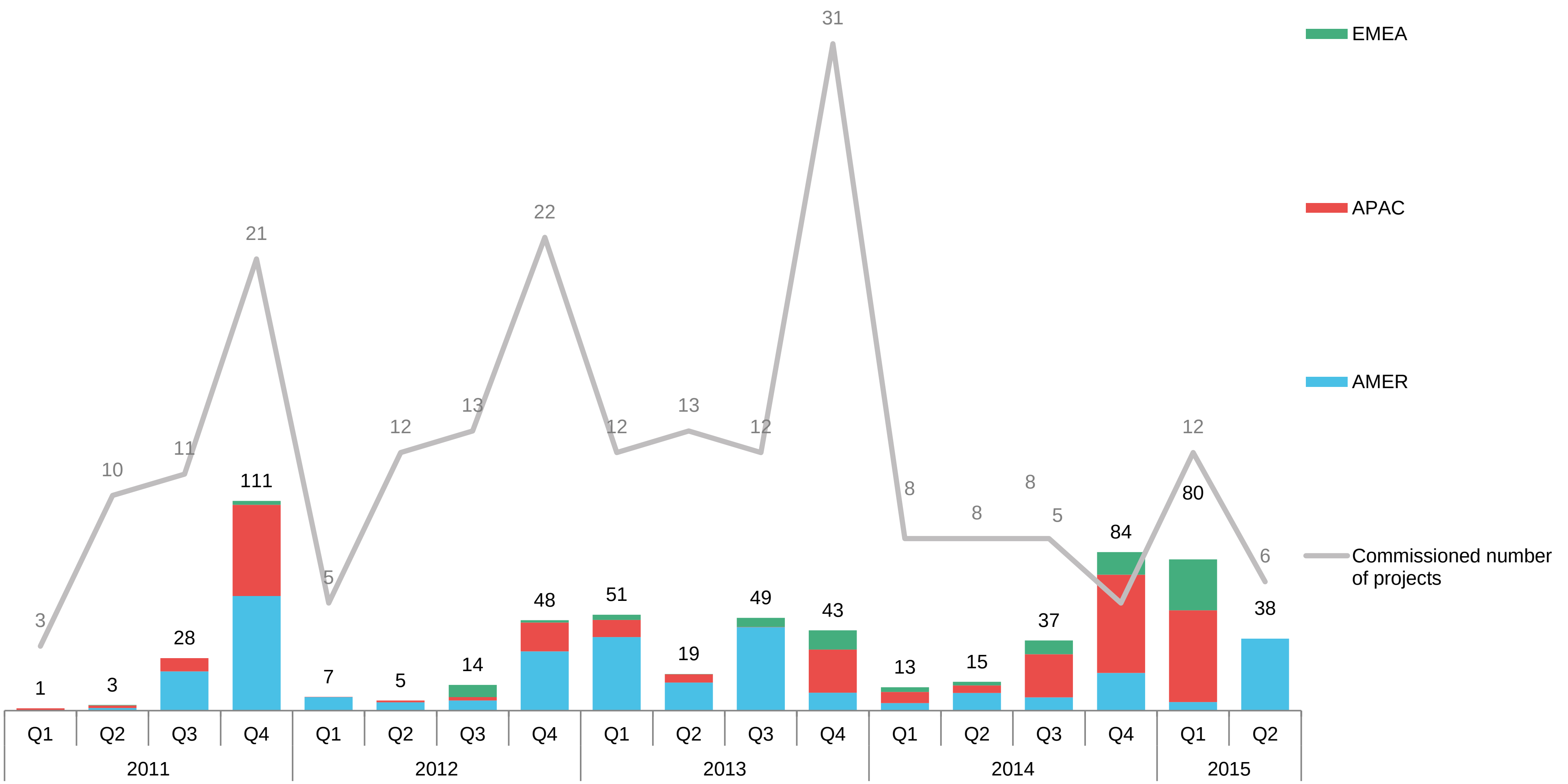


Note: Q2 2015 numbers are provisional since this Market Outlook is published mid quarter. For underlying data, including 2009 – 2010, click here.

Source: Bloomberg New Energy Finance

COMMISSIONED ENERGY STORAGE PROJECTS WORLDWIDE (MW AND NUMBER OF PROJECTS)

Bloomberg NEW ENERGY FINANCE



Note: Q2 2015 numbers are provisional since this Market Outlook is published mid quarter. For underlying data, including 2009 – 2010, click here.

Source: Bloomberg New Energy Finance

ELECTRIC VEHICLES – THE PROMISE

Bloomberg NEW ENERGY FINANCE

"Prices on electric cars will continue to drop until they're within reach of the average family."

The Washington Post, 1915

Images: BMW, Detroit Electric, 2015, courtesy of EVASD

ELECTRIC VEHICLE – THE UPTAKE SO FAR

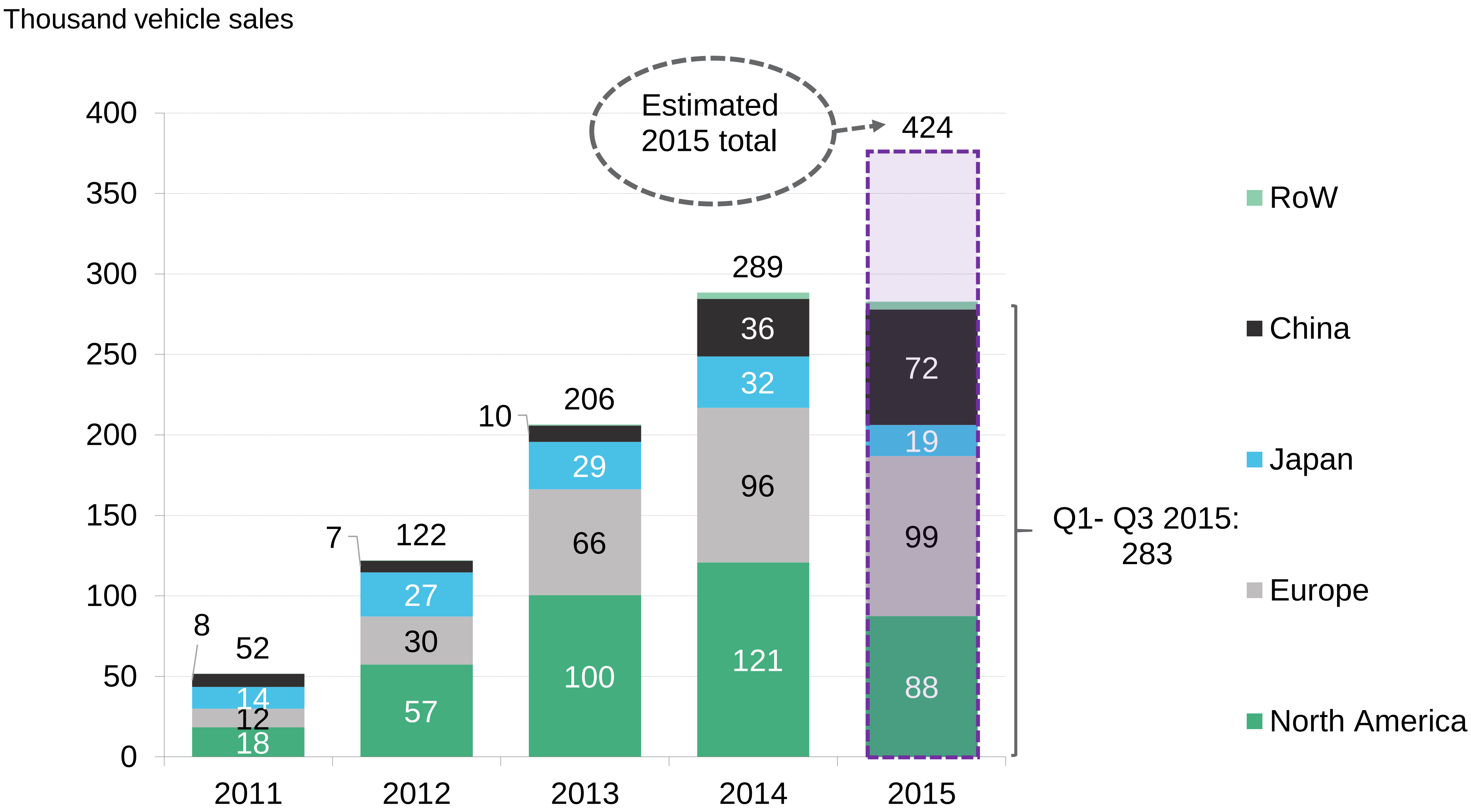
CARS AND TRUCKS IN USE WORLDWIDE, 2013
1.2 billion

ELECTRIC VEHICLES IN USE WORLDWIDE, 2014
0.75 million (to scale)

Source: Bloomberg New Energy Finance, International Organization of Motor Vehicle Manufacturers

GLOBAL EV SALES, BY REGION 2011- H1 2015 (THOUSAND UNITS)

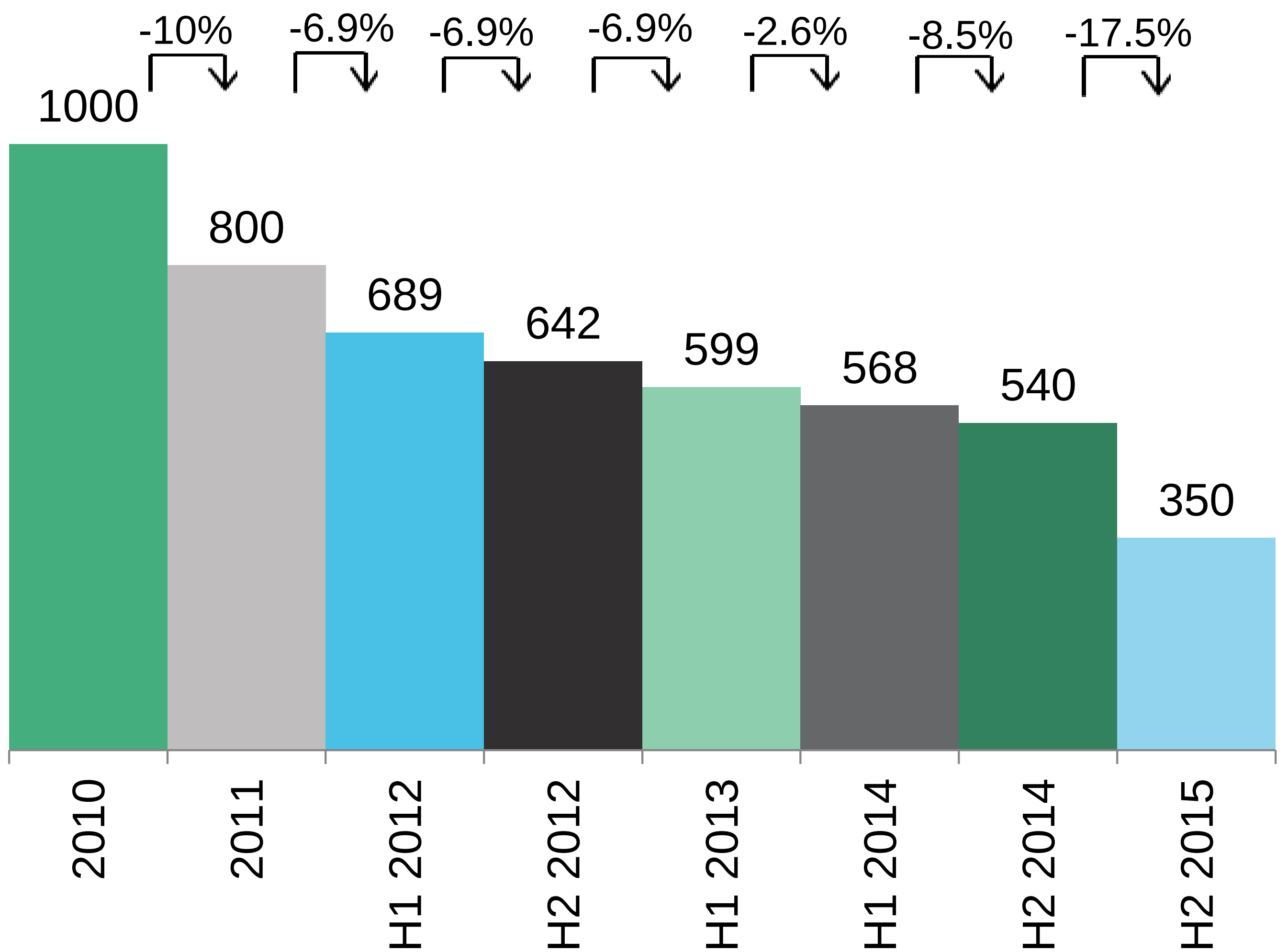
Bloomberg NEW ENERGY FINANCE



The EV penetration rate of total new car sales in Q1-Q3 2015 was 0.63% - up from 0.49% at the end of 2014

Bloomberg New Energy Finance

BNEF BATTERY PRICE SURVEY, 2010-15 ($/KWH)



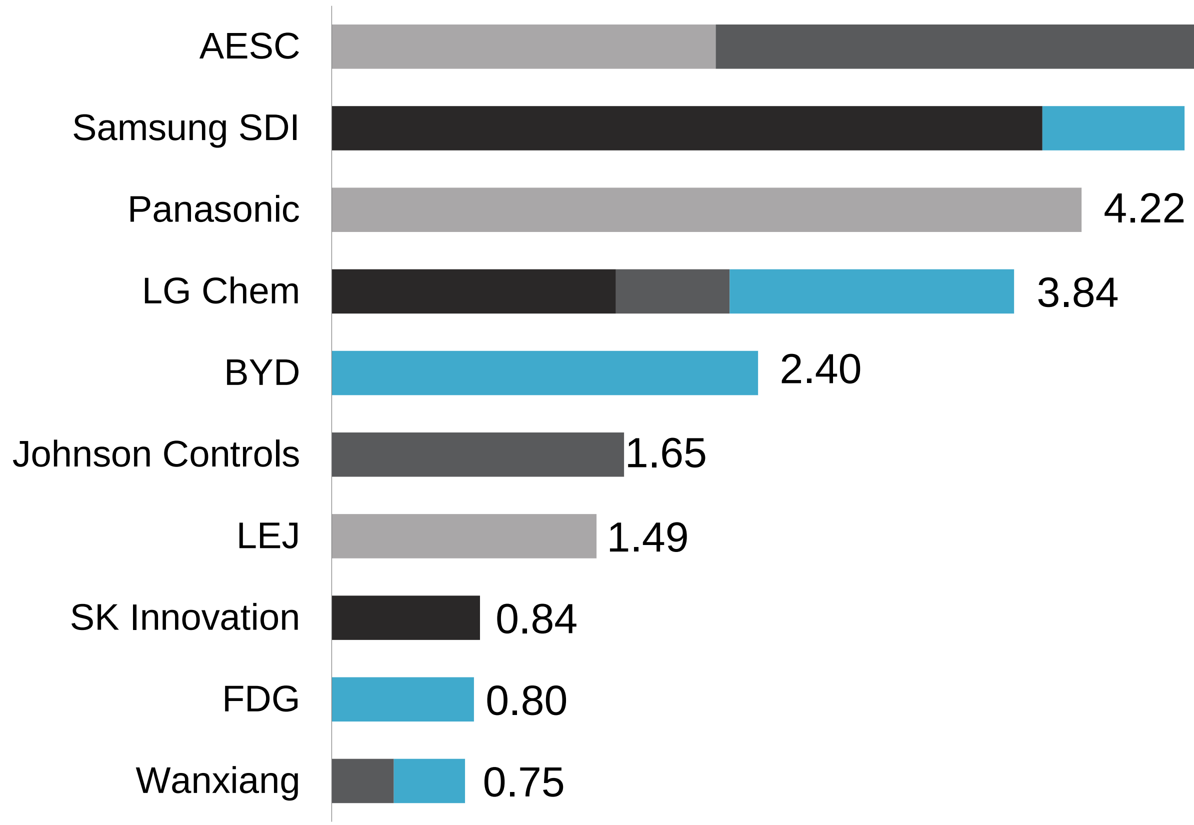
Battery prices are falling faster than battery production costs, as a result of significant overcapacity and the predatory pricing tactics of the largest five battery suppliers

Source: Bloomberg New Energy Finance

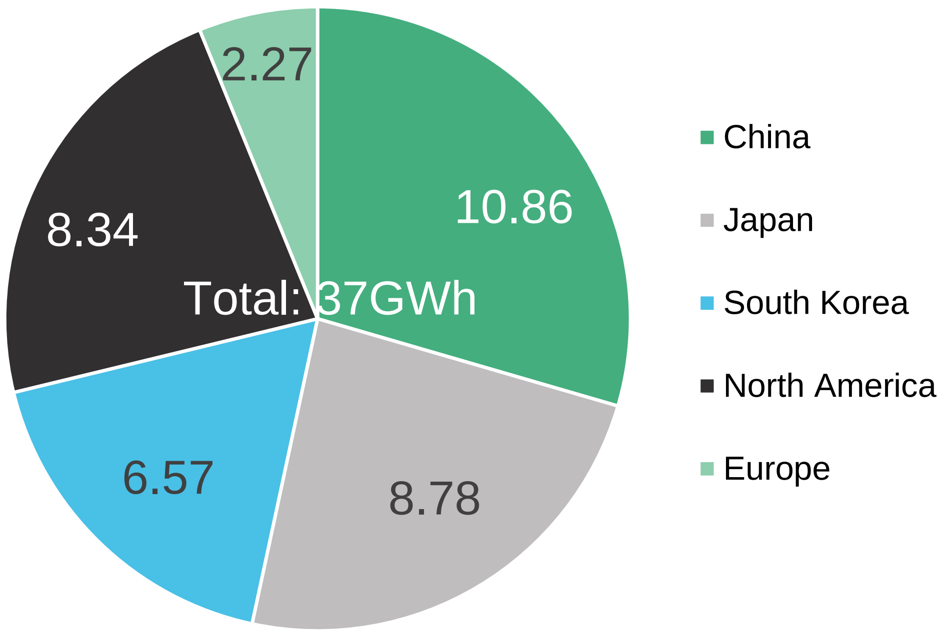
THE MAJORITY OF TOP 10 BATTERY COMPANIES HAVE CAPACITY IN ONLY ONE REGION

Bloomberg NEW ENERGY FINANCE

10 largest li-ion battery manufacturers globally, showing geographical location, 2015 (GWh)



Geographical split for li-ion battery manufacturers



Source: Bloomberg New Energy Finance. Notes: See the notes slides for further details.

COPYRIGHT AND DISCLAIMER

The Future of Energy

MARKETS
Renewable Energy
Energy Smart Technologies
Advanced Transport
Gas
Carbon and RECs

SERVICES
Americas Service
Asia Pacific Service
EMEA Service
Applied Research
Events and Workshops

Ashish Sethia
asethia5@bloomberg.net

Energy Efficiency Potential and Initiatives

Presented to: Regulators Forum

Presented by: Ram Bhaskar
Director, Energy Efficiency and Conservation Department

24 Nov 2015

National Environment Agency
Safeguard · Nurture · Cherish

Outline of Presentation

1. Singapore's Energy Profile

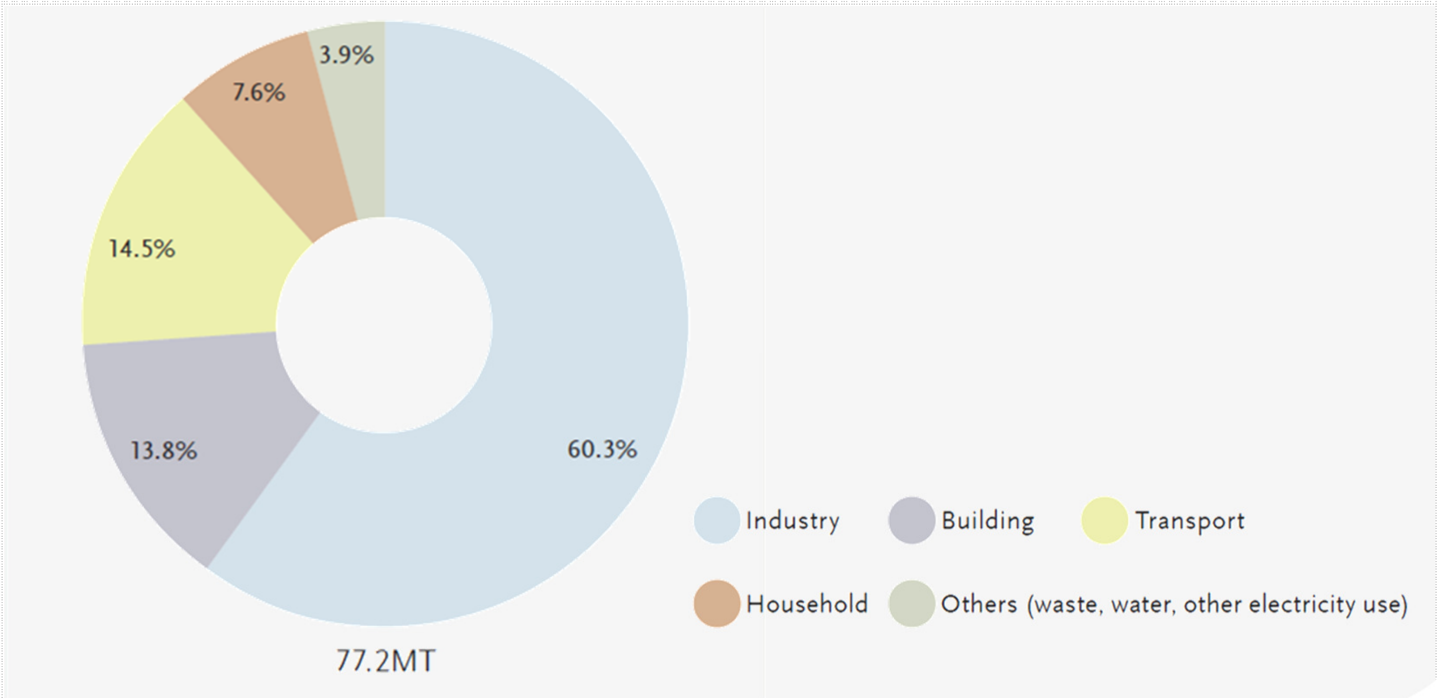
2. Energy Efficiency Initiatives

1 Singapore's GHG Profile

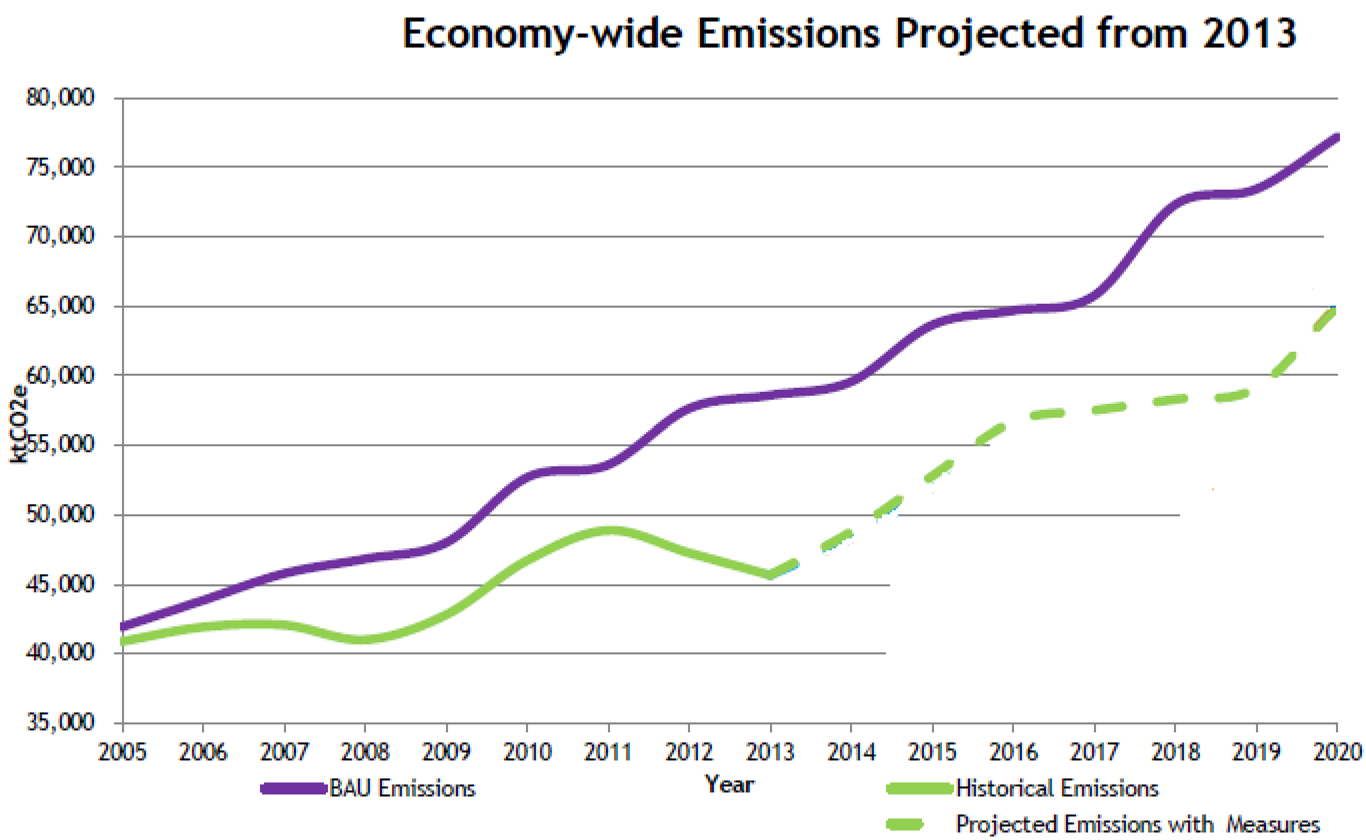
Greenhouse Gas Emissions in Singapore

- Singapore's GHG emissions stood at around 43 MT in 2010 & BAU GHG emissions are expected to reach 77 MT in 2020

- Breakdown of projected 2020 BAU emissions:

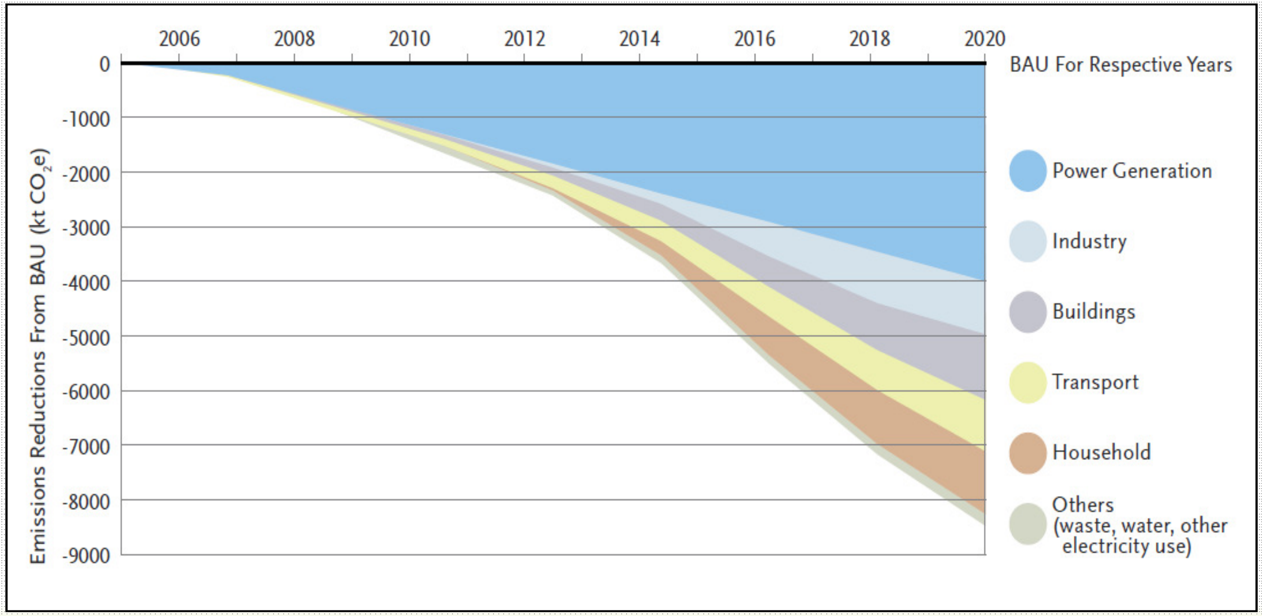


Greenhouse Gas Emissions in Singapore



Mitigation Measures To Reduce Emissions

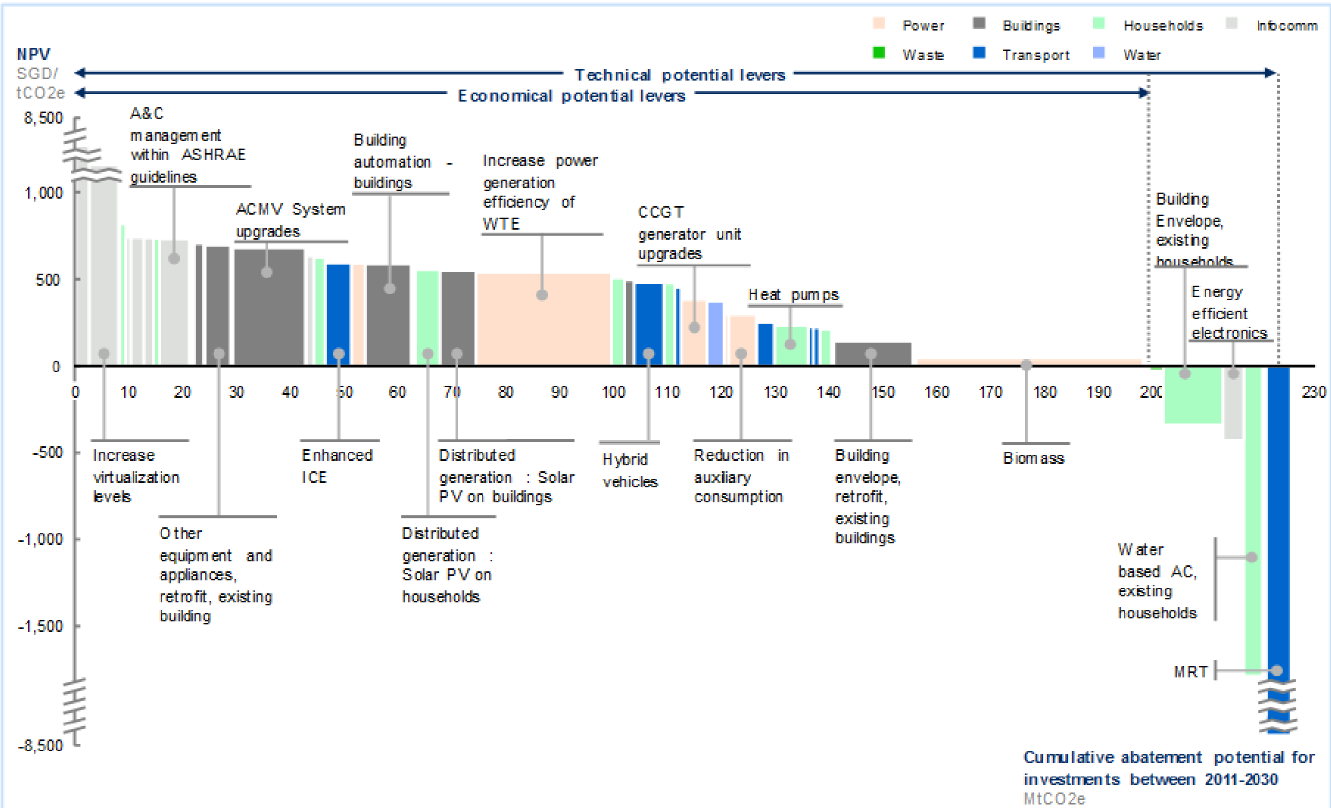
- Key mitigation measures are energy efficiency & fuel switching
- Singapore targets to reduce emissions by 7% to 11% below 2020 BAU levels
- Sectoral contributions to emissions reductions (from BAU)



Mitigation Potential

- All sectors, except manufacturing industry

NPV curve : seven non-industrial sectors

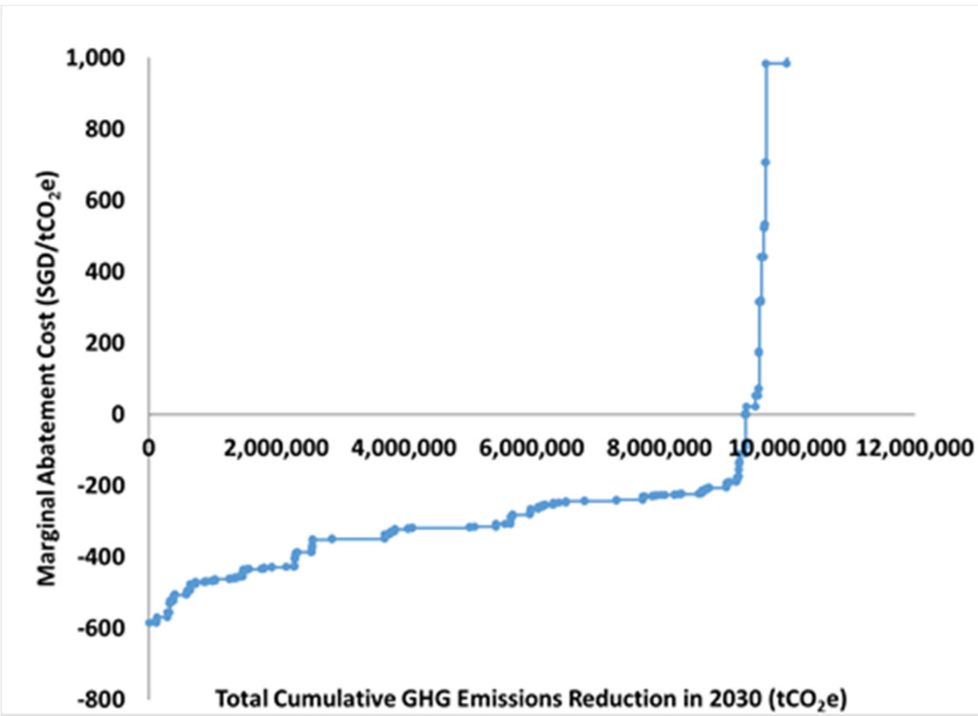


Note: Excludes the cumulative abatement achieved due to demand reduction resulting in avoiding new builds in the power sector

SOURCE: McKinsey analysis

Mitigation Potential

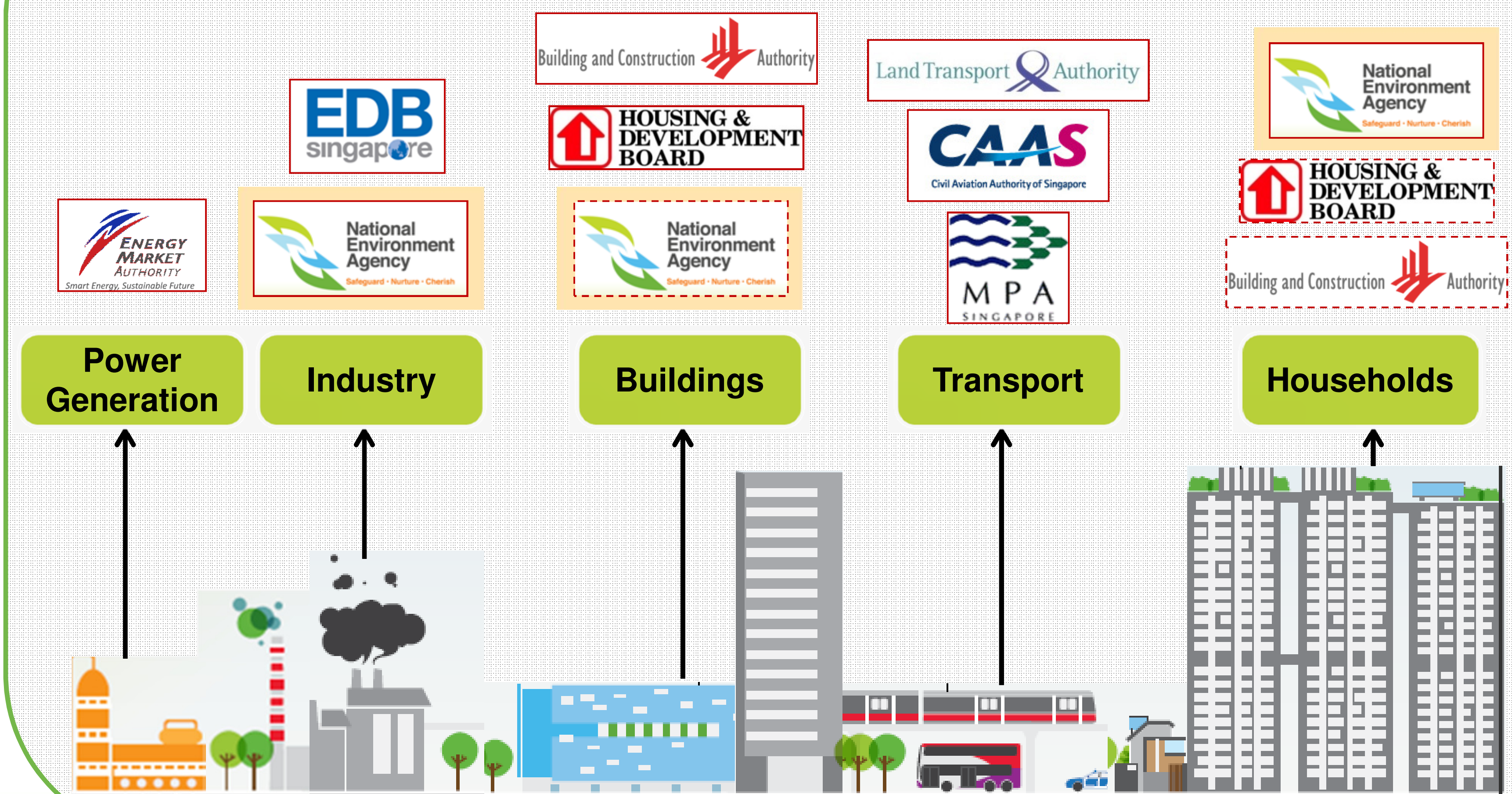
- Manufacturing



Top Ten Measures	MAC in 2030 (SGD$/t CO_2e)	GHG Savings in 2030 (tCO_2e)
Minimize operating air pressure	-586	10, 722
Low Grade Waste Heat Recovery (Electricity generation: ORC and comparable technologies)*	-586	109, 404
Preventative Pump Maintenance	-579	413
Preventative refrigeration/cooling system maintenance	-579	48
Preventative Compressor Maintenance (pneumatic system)	-579	650
Preventative Compressor Maintenance (process air or gas system)	-579	244
Preventative Packaged HVAC Maintenance	-579	1, 245
Optimized chilled water temperature and/or optimized condenser temperature	-579	1, 290
Optimized condenser pressure	-579	4, 014
Impeller Trimming or Inlet Guide Vanes	-569	7, 342

WOG Approach on Energy Efficiency

- **Whole-of-government approach to improve energy efficiency**



2 Energy Efficiency Initiatives

Industry

Household

Buildings

Transport

Regulations and Standards

Industry

Mandatory Requirements

✓ Energy Conservation Act

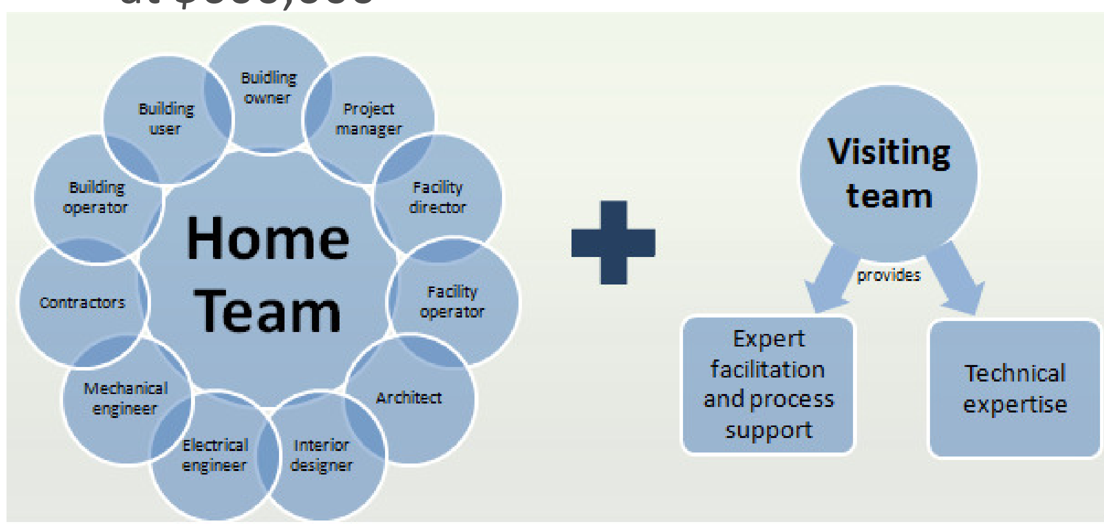
- New requirements on energy management practices introduced for industry and transport sectors in Apr 2013 and Jan 2014 respectively
- Requires energy-intensive users in industry and transport sectors consuming more than 54 TJ of energy each year to
  - Appoint an energy manager;
  - Monitor and report energy use and GHG emissions; and
  - Submit energy efficiency improvement plans

Incentives

Industry

✓ **Design for Efficiency Scheme (DfE)**

- Encourages investors in new facilities in Singapore to integrate energy and resource efficiency improvements into manufacturing development plans early in the design stage
- Co-funds up to 50% of a design workshop, capped at $600,000



Incentives

Industry

✓ **Energy Efficiency Improvement Assistance Scheme (EASe)**

- Encourages companies to engage accredited energy services companies
  - To conduct the detailed energy audit
  - To identify potential areas for energy efficiency improvement
- Co-funds up to 50% of energy audit fee, capped at $200,000

Incentives

Industry

✓ **Grant for Energy Efficient Technologies (GREET)**

- Encourages the installation of energy efficient technologies or equipment
- Co-funds up to 20% of the qualifying cost, capped at $4 million

Incentives

Industry

✓ **Investment Allowance (IA)**

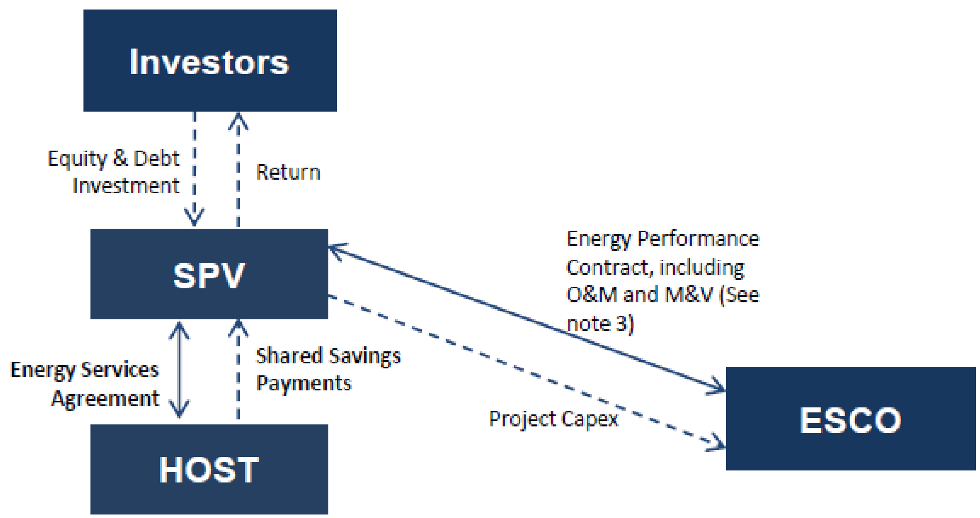
- Encourages industry to invest in capital equipment that allows them to be more energy – efficient in their operations
- Provides an allowance of 30% or more approved fixed capital expenditure on top of normal 100% capital allowance depending on the % in EE improvement at the facility , equipment or system level

Incentives

Industry

✓ **Energy Efficiency Finance Pilot**

- Encourages owners and operators of existing industrial and manufacturing facilities to implement EE projects
- Provides project finance to EE projects



Capability Development

Industry

Energy Efficiency National Partnership

Energy Management Systems

- Promote the adoption of Energy Management Systems among partner companies

EENP Learning Network & National Energy Efficiency Conference

- Provide partners with opportunities to learn and share energy efficiency ideas, strategies, technologies, best practices, standards and case studies

EENP Recognition Scheme

- Accord recognition to companies through annual national awards

ENERGY EFFICIENCY NATIONAL PARTNERSHIP

Capability Development

Industry

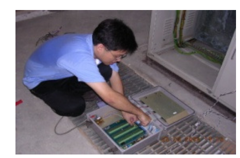
Singapore Certified Energy Manager (SCEM) Programme & Training Grant

- Training and certification system in energy management
- Training grant to encourage companies to train their employees under SCEM

SCEM
SINGAPORE CERTIFIED ENERGY MANAGER

Energy Services Companies (ESCO) Accreditation Scheme

- 19 accredited ESCOs and 27 Qualified Energy Services Specialist (QuESS)



* Requirement for energy managers under the ECA

Regulations and Standards

Households

Mandatory Requirements

✓ **Minimum Energy Performance Standards (MEPS)**

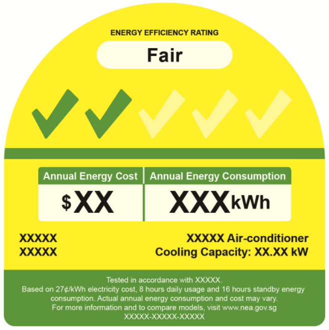
- Improve average efficiency of household appliances by setting minimum energy efficiency standards
- Implemented for air-conditioners and refrigerators in Sep 2011
  - Standards raised in Sep 2013
- Extended to clothes dryers in Apr 2014

Regulations and Standards

Households

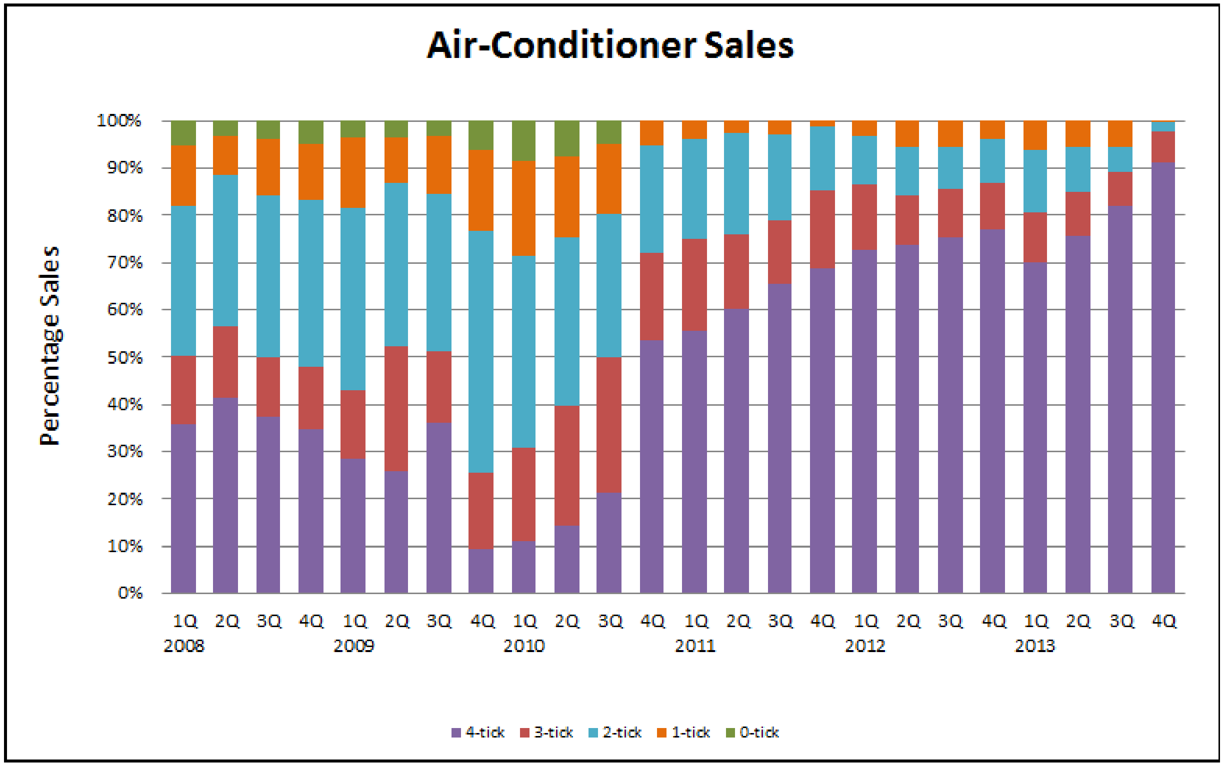
✓ **Mandatory Energy Labelling Scheme (MELS)**

- Allows consumers to compare energy efficiency performance and lifecycle costs of different appliance models in order to make informed purchasing decisions
- Revised energy label and rating system introduced in Sep 2014
- Covers air-conditioners, refrigerators, clothes dryers, televisions and lighting



Regulations and Standards

Households



Public Messaging

Household

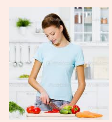
✓ **10% Energy Challenge**

- Programme to help households reduce electricity bills by educating them on simple energy saving measures and habits.
- 6 Key EE Tips for Publicity

- Use a fan instead of an air-conditioner to keep cool.
- Consider running the air-conditioner for a short while and switch to a fan after that to cool the room.
- Switch off home appliances at the power socket
- Switch off the water heater after a shower
- Choose EE lighting
- Choose EE models of household appliances that have more ticks on the energy label.

Public Messaging

Households

Target audience		Key Benefit	Platforms to Engage
Primary Homemakers/ Working adults*		Monetary savings*	• Retail stores • Community platforms
Secondary Students		Environment/ Climate change	• Schools

* *MEWR COMBI study shows female homemakers and working adults are the main influencers of EE behaviours in households, and monetary saving is the main motivation for households EE practices.*

Public Messaging

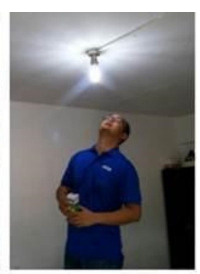
Households

✓ Mobile applications

- Life Cycle Cost Calculator & Home Energy Auditor mobile phone apps

✓ Community Outreach Programmes by 5 Regional Offices






Regulations and Standards

Buildings

Mandatory Requirements

✓ **Green Mark (GM) Certification**

- Minimum environmental sustainability standard (Green Mark Certified Level) is required for new buildings with an area of at least 2,000 m^2, and existing buildings comprising hotel, retail or office with an area of 15,000m^2 or more, when the building cooling systems is installed or replaced

✓ **Building Control (Environmental Sustainability Measure for Existing Buildings) Regulations**

- Require building owners to :
  - Submit building info & energy consumption data
  - Achieve min GM Standard for existing buildings
  - Submit periodic EE audit of building cooling system

Regulations and Standards

Buildings

Voluntary Standards

✓ **Green Mark Certification**

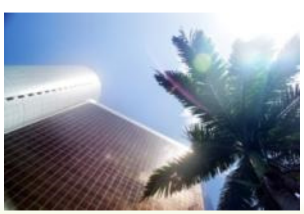
- Assess environmental performance of buildings and other infrastructure
- 4 Green Mark levels
  - ➢ Certified, Gold, Gold^{PLUS}, Platinum

✓ **SS564: Singapore Standard for Data Centres (DC)**

- Management system standard that provides DC with a recognised framework & logical and consistent methodology to achieve EE

Regulations and Standards

Buildings



Mandatory Standards

✓ **Public Sector Taking The Lead in Environmental Sustainability (PSTLES)**

- Public agencies to adopt environmentally sustainable practices that are cost beneficial

Energy	Water	Waste
Energy Audits	Water Efficient Building	Recycling Programme
Chiller Plant Eff.		
Indoor Air Temp.		
Data Centre		
Energy Star		
Training		
Eco-Office		
Green Mark		

Incentives

Buildings

✓ Green Mark Incentive Schemes

❖ **Gross Floor Area**

➢ Allows developers to build additional floor area if they achieve higher-tier Green Mark levels

❖ **Existing Buildings and Premises (*NEW)**

➢ Provides building owners & tenants with grants to undertake Energy Efficiency Improvement Works involving the installation of energy efficient equipment

❖ **Design Prototype**

➢ Provides developers and building owners with grants to focus effort at the design stage to strive for higher energy efficiency levels beyond Green Mark Platinum standards

❖ **Building Retrofit Energy Efficiency Financing (BREEF)**

➢ Provides loans to building owners and energy services companies to carry out energy retrofits

Promoting EE in Transport Sector

Transport

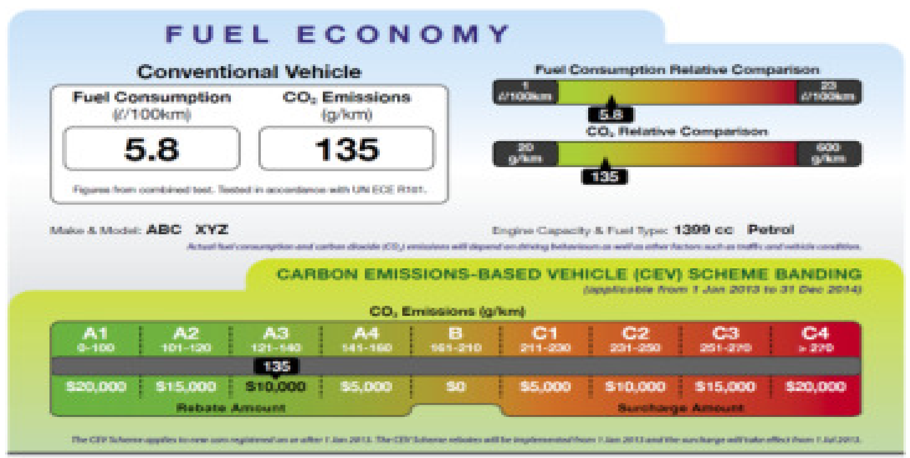
- ✓ **Promote public transportation via bus and rail**
- ✓ **Promote non-motorised transport like cycling and walking**
  - Through provision of off-road cycling path network in selected towns to improve connectivity from their homes to MRT stations, bus interchanges and key amenities

Regulation and Standards

Transport

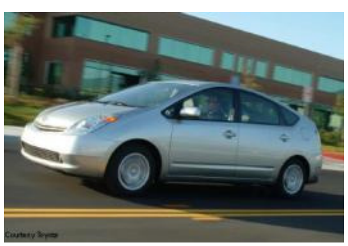
✓ Fuel Economy Labelling Scheme (FELS)

- Helps car buyers to choose fuel-efficient vehicles by highlighting each vehicle model's fuel consumption per 100 km



Incentives

Transport



✓ Carbon Emissions-based Vehicle Scheme (CEVS)

- Fee-bates to encourage consumers to shift to fuel efficient and low emission vehicle models

Band	Previous CEVS (Till 30 Jun 2015)			Revised CEVS (From 1 Jul 2015)			Rebates/ Surcharges
	Carbon Emission (CO_2 g/km)	Cars	Taxis	Carbon Emission(CO_2 g/km)	Cars	Taxis	
A1	Up to 100	$20,000	$30,000	Up to 95	$30,000	$45,000	Rebates
A2	101-120	$15,000	$22,500	96-105	$15,000	$22,500	
A3	121-140	$10,000	$15,000	106-120	$10,000	$15,000	
A4	141-160	$5,000	$7,500	121-135	$5,000	$7,500	
B	161-210	$0	$0	136-185	$0	$0	
C1	211-230	$5,000	$7,500	186-200	$5,000	$7,500	Surcharges
C2	231-250	$10,000	$15,000	201-215	$10,000	$15,000	
C3	251-270	$15,000	$22,500	216-230	$15,000	$22,500	
C4	Above 270	$20,000	$30,000	Above 230	$30,000	$45,000	

Information

Industry

Household

Buildings

Transport

✓ **E2 Singapore Website**

- One-stop website for all EE information in Singapore
- Platform to educate and inspire web users to internalize the need for efficient use of energy

For more information

Our Environment

Safeguard • Nurture • Cherish

National Environment Agency

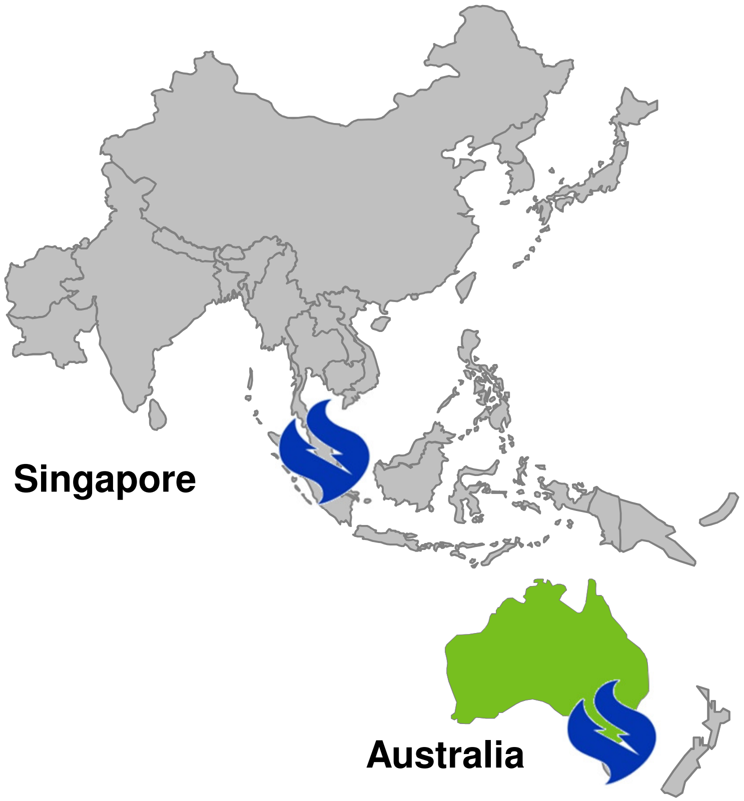
Safeguard • Nurture • Cherish

Retail Competition for Electricity Supply in Singapore

25 Nov 15

Co-Confidential

Singapore Power Group



Total Assets: S$16B

SINGAPORE POWER

- **Singapore Operations**
  - SP PowerAssets
  - PowerGas
  - SP PowerGrid
  - SP Services
  - Singapore District Cooling
- **Australia Operations**
  - SGSP (Australia) Assets (40%)
  - SP AusNet (31%)

Presentation Outline

- Singapore Electricity Market
- Singapore Regulatory Framework
- Customer Services, Metering and Billing
- Electricity Supply
- Standards of Performance

Singapore Electricity Market

Co-Confidential

Industry Restructuring

SINGAPORE POWER

Pre-1995

Public Utilities Board (PUB)

- Water
- Gas (Town gas/ gas T&D)
- Electricity Generation
- Electricity T&D
- Retail

1995

PUB

- Water
- Regulator

SINGAPORE POWER

- Gas (Town gas/ gas T&D)
- Electricity Generation
- Electricity T&D
- Retail

Present

EMA (Regulator)

SINGAPORE POWER

- Electricity and Gas T&D
- Market Support Services

Generation Companies	Electricity Generation
Retailers	Electricity & Gas Retail
Gas	Natural gas import

Co-Confidential

Singapore Electricity Market Structure

SINGAPORE POWER

Energy Market Authority (Regulator & system operator)

Energy Market Company (Wholesale market operator)

Generation

Transmission & Distribution (T&D)

Retailing

Competitive Gencos (wholesale market)	Regulated Grid Company	Competitive Retailers (contestable market)

Competitive sectors separated from monopoly sector

SINGAPORE POWER

Legislative Framework

Electricity Act

Licences

- Generation Licence
- Wholesale Licence
- Retail Licence

- Transmission Licence
- Transmission Agent Licence
- MSS Licence

Market Rules

Manage transactions & dealings of wholesale market

Codes

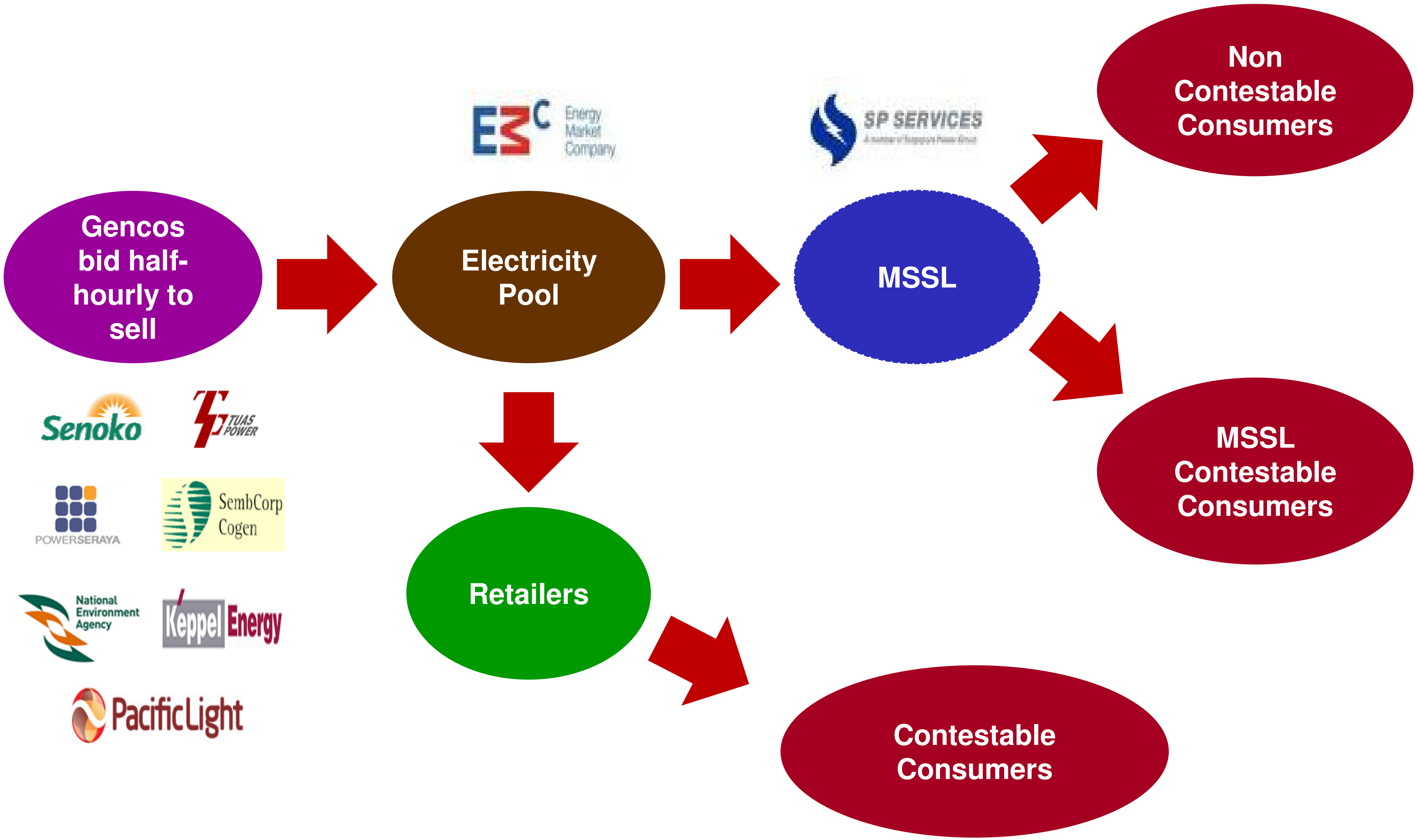
- Transmission Code
- Market Support Services Code
- Metering Code
- Regulated Supply Services Code
- Retailer's Code of Conduct

Regulatory Agreements

Examples
- Generation Connection Agreements
- Consumer Connection Agreements
- MSSL-PowerGrid Services Agreement

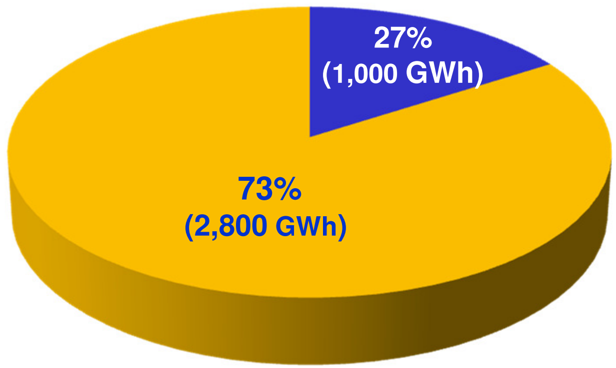
SP Group's obligations

National Electricity Market

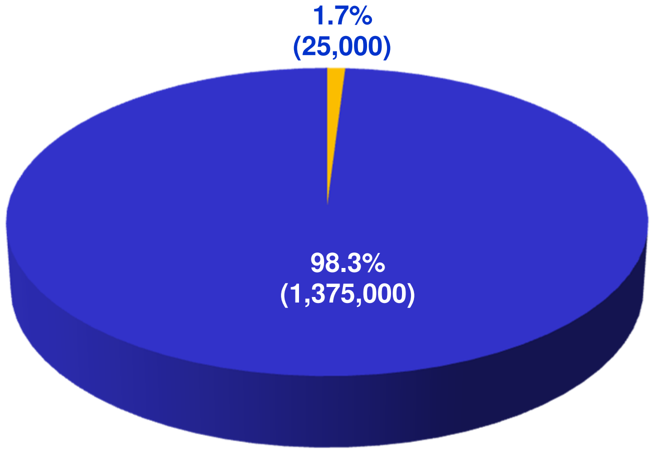


Consumer Consumption

Monthly Total Consumption: 3,800 GWh



No. of Accounts: 1.4m

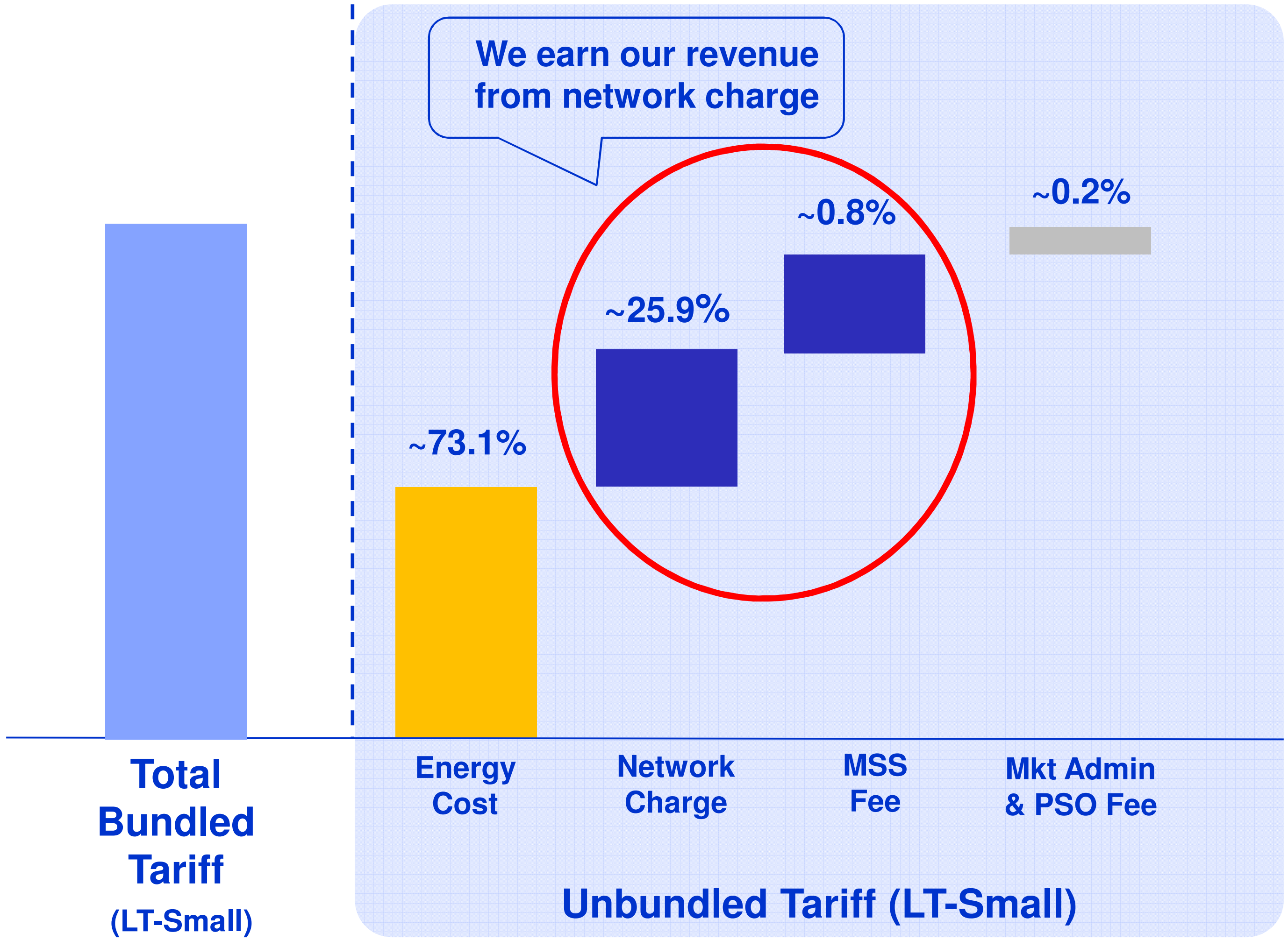


Contestable Consumers | Non Contestable Consumers

Singapore Regulatory Framework

Co-Confidential

Singapore Tariff Composition



As of 1 Oct 15

Network Charge Computation

SINGAPORE POWER

Regulated Revenue = WACC X Regulated Asset Base + Operating & Maint. Exp + Deprec'n + Incentive Payment + Tax

WACC: Market returns to our investors and lenders

Regulated Asset Base: Value of existing assets + new capex ~ $6B

Operating & Maint. Exp: Salaries, maintenance, other expenses, etc

Incentive Payment: Our efficiency gains are shared with consumers

$$\text{Network charge } (¢/\text{kWh}) = \frac{\text{Regulated Revenue}}{\text{5-year Sales Volume Forecast}}$$

Co-Confidential

Regulatory Reset Cycle

SP submits to EMA

5Y Biz Plan "Reset Proposal"

EMA reviews and approves Regulated Revenue

SP sets network and MSS charges and obtains EMA approval

1st Reset

2nd Reset

3rd Reset

4th Reset

Tariff components determined by regulator once every 5 years

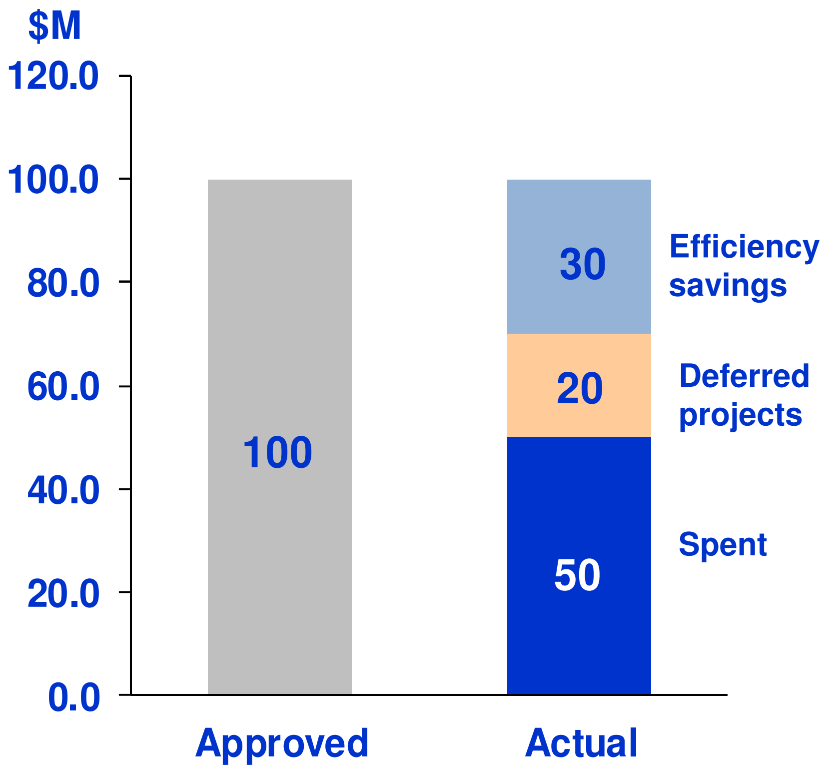
The Customers We Serve

	Customer Number as at 31 Mar 15	Sales Volume FY14/15 (%)	Example of Customers
Ultra High Tension	1	1%	Large industrial customer
Extra High Tension	45	19%	Large industrial customers
High Tension Large	700	37%	Large industrial customers
High Tension Small	600	5%	Small industrial customers
Low Tension Large	19,500	11%	Small and Medium-sized Enterprises
Low Tension Small	1.42 million	27%	Households & Small Businesses
Total	**1.44 million**	**44,866GWh**	**-**

As of 3 Jul 15

Efficiency Scheme

Capex



Example

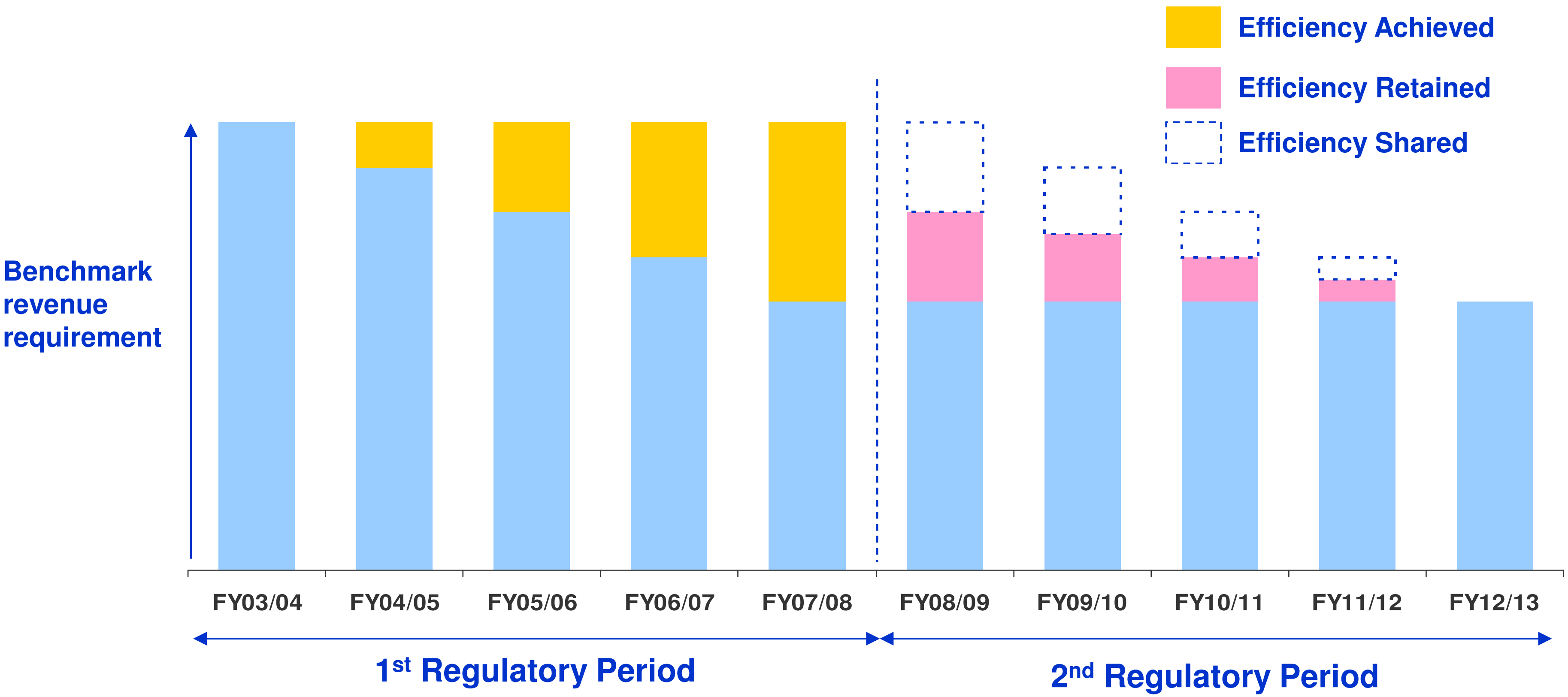
Approved Capex	$100m
Actual Capex	$50m
Difference	$50m
- Due to deferrals	$20m
- Due to efficiency	**$30m**

Efficiency savings based on 50:50 share in next regulatory period

Scheme promotes drive for efficiency and sharing of benefits to consumers

Capex & Opex Efficiency Carryover Incentive

- 50/50 share with customers in next regulatory period
  - Capex efficiency = WACC x allowed variances
  - Opex efficiency = allowed variances
  - 40-30-20-10-0 Glide Path



Customer Services, Metering and Billing

Introduction to SP Services

SINGAPORE POWER

Regulated Business

- Tuas Power
- Senoko
- PowerSeraya
- SembCorp Cogen
- PacificLight
- Keppel Energy
- National Environment Agency

• Market Support Services Licensee
• Supplier for Non Contestable Consumers

✓ Installation
✓ Metering
✓ Consolidated Billing
✓ Payment Collection
✓ Customer Services
✓ Debt Management

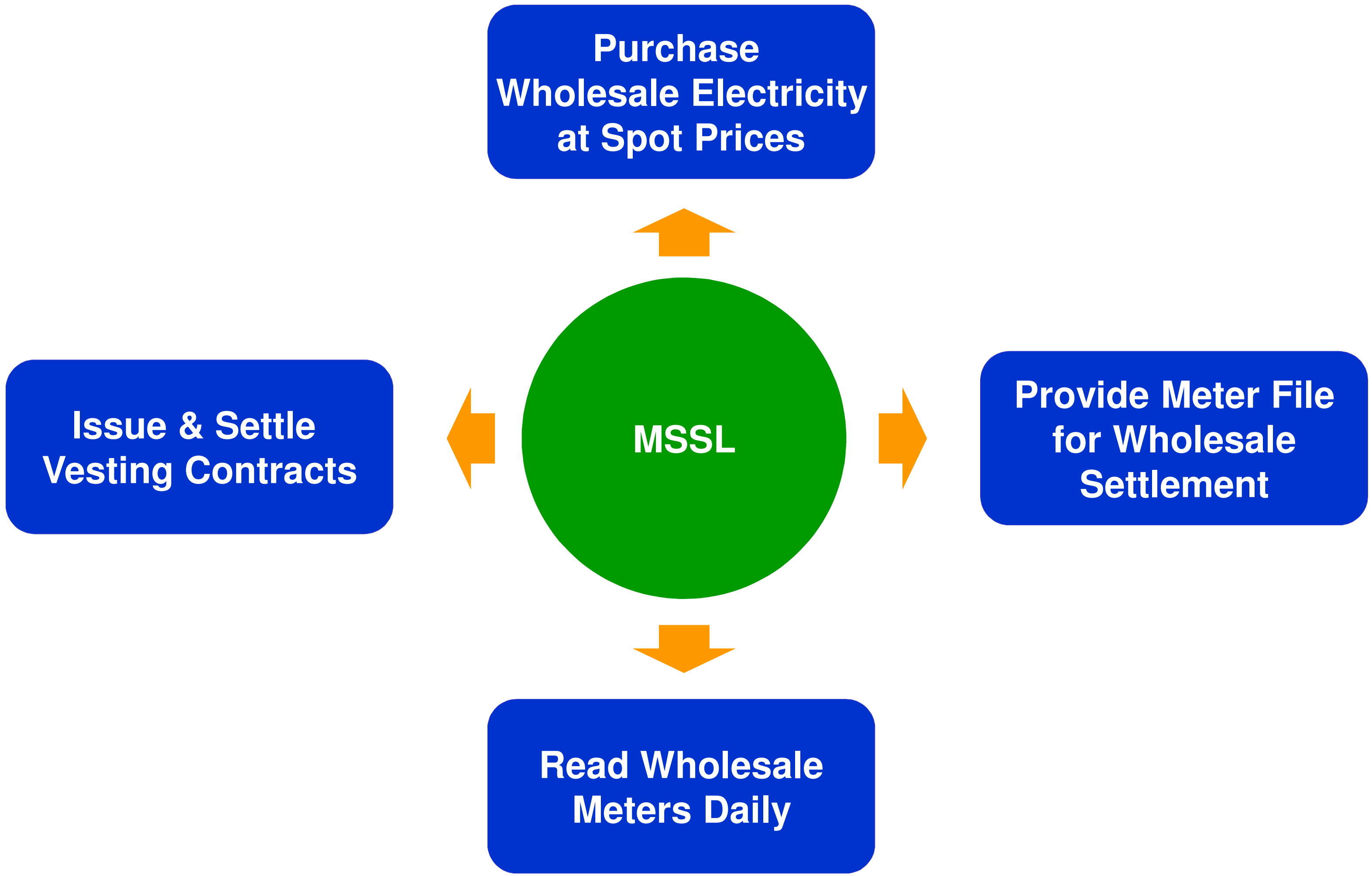
Non-regulated Business

- PUB — Water for All: Conserve, Value, Enjoy
- CityGas
- Veolia Environmental Services
- Colex
- Sembcorp Enviro
- Super 800

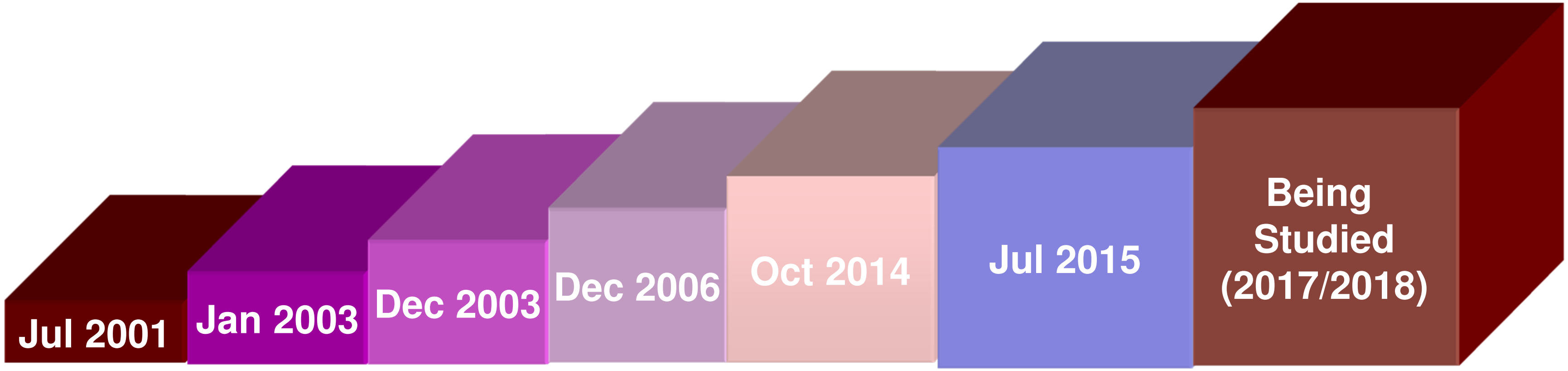
• Billing and Collection Agent

Provides convenient and cost-efficient customer service

Role of Market Support Services Licensee



Retail Contestability



Consumer with contracted capacity of 2MW	Consumers taking HT and EHT	HT Consumers LT Consumers Consumption 20,000kWh	HT Consumers LT Consumers Consumption 10,000kWh	HT Consumers LT Consumers Consumption 4,000kWh	HT Consumers LT Consumers Consumption 2,000kWh	Remaining 1.3 million LT Consumers **F** **R** **C**
44 Consumers	278 Consumers	About 5,000 Consumers	Another 4,000 contestable consumers	Another 70,000 contestable consumers	Another 16,000 contestable consumers	

Full Retail Contestability

- **Enables remaining 1.3m consumers to buy electricity from retailer of their choice**
  - Smart meters to be installed for non-residential
  - Load profiling to be used for settlement for residential
- **Small contestable consumers allowed to return to non-contestable status buying electricity at tariffs**
- **SPS to continue providing metering & billing services & acting as default supplier for non-contestable consumers**

Electricity Supply

Electricity Network System

SINGAPORE POWER

400kV Network

230kV Network

66kV Network

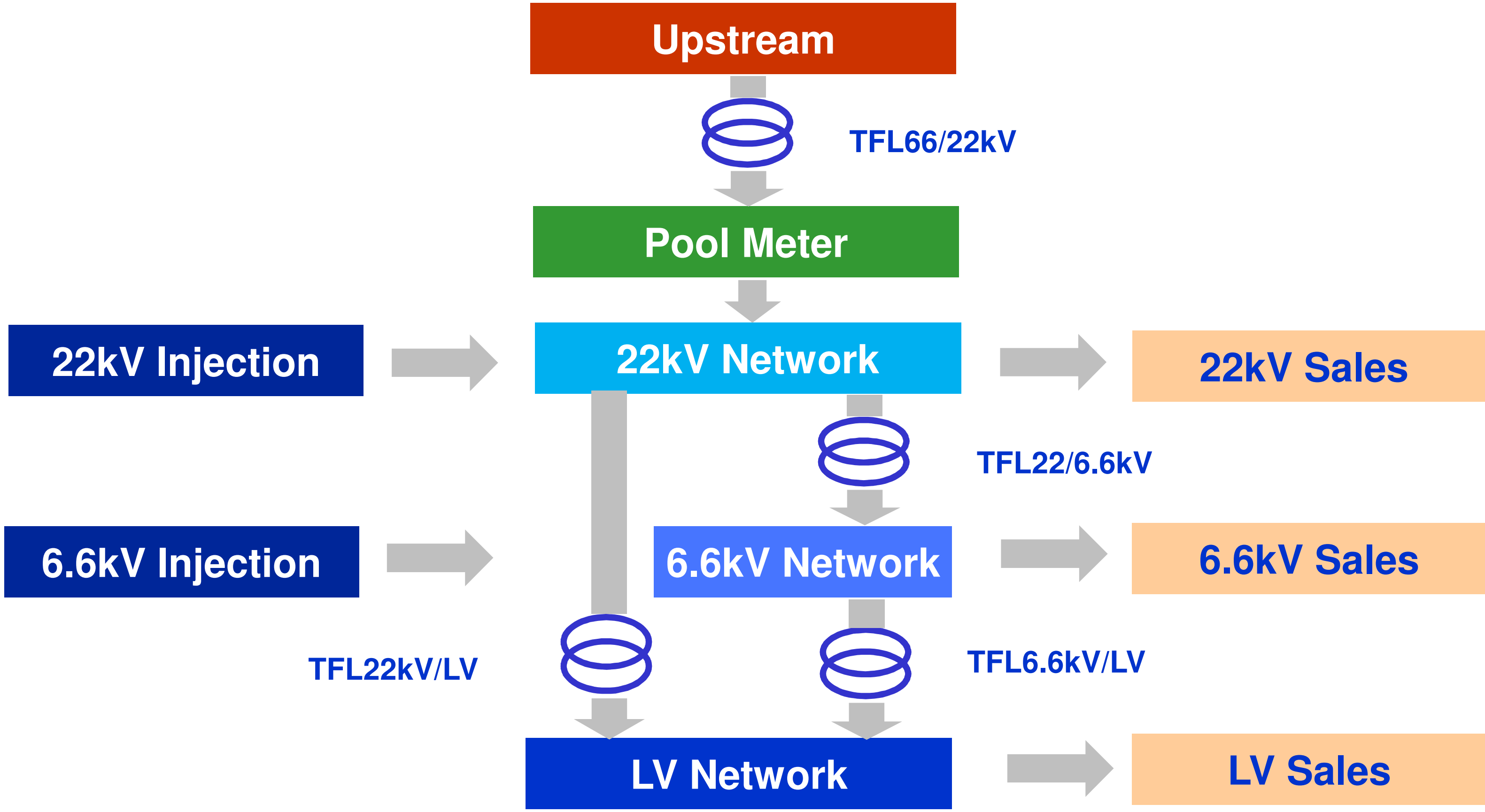
22kV and 6.6kV Network

Low Tension Network 400/230 Volts

Low Tension Consumers

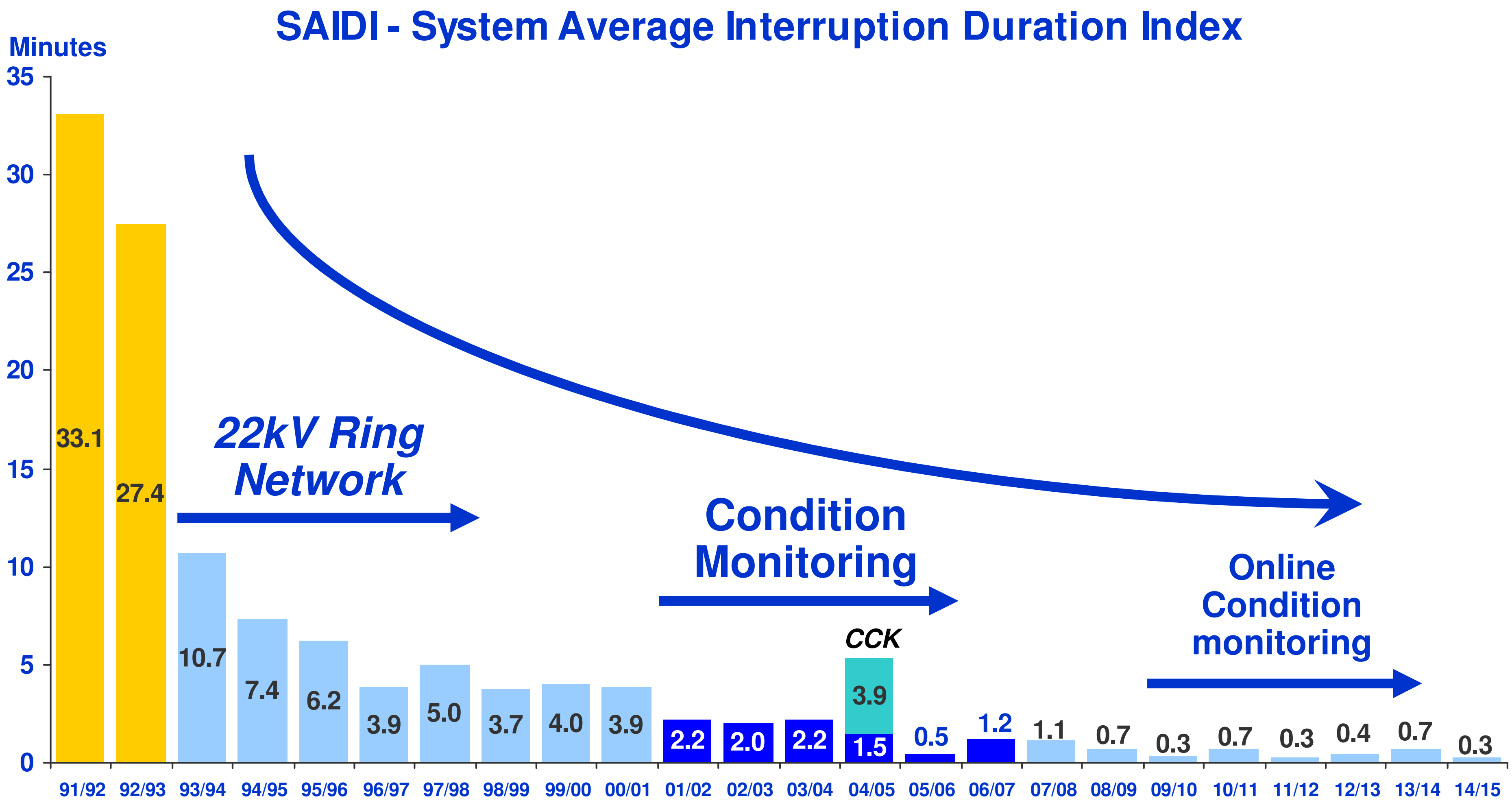
Electricity Transmission & Distribution Assets of ~$9B

Transmission and Distribution Losses



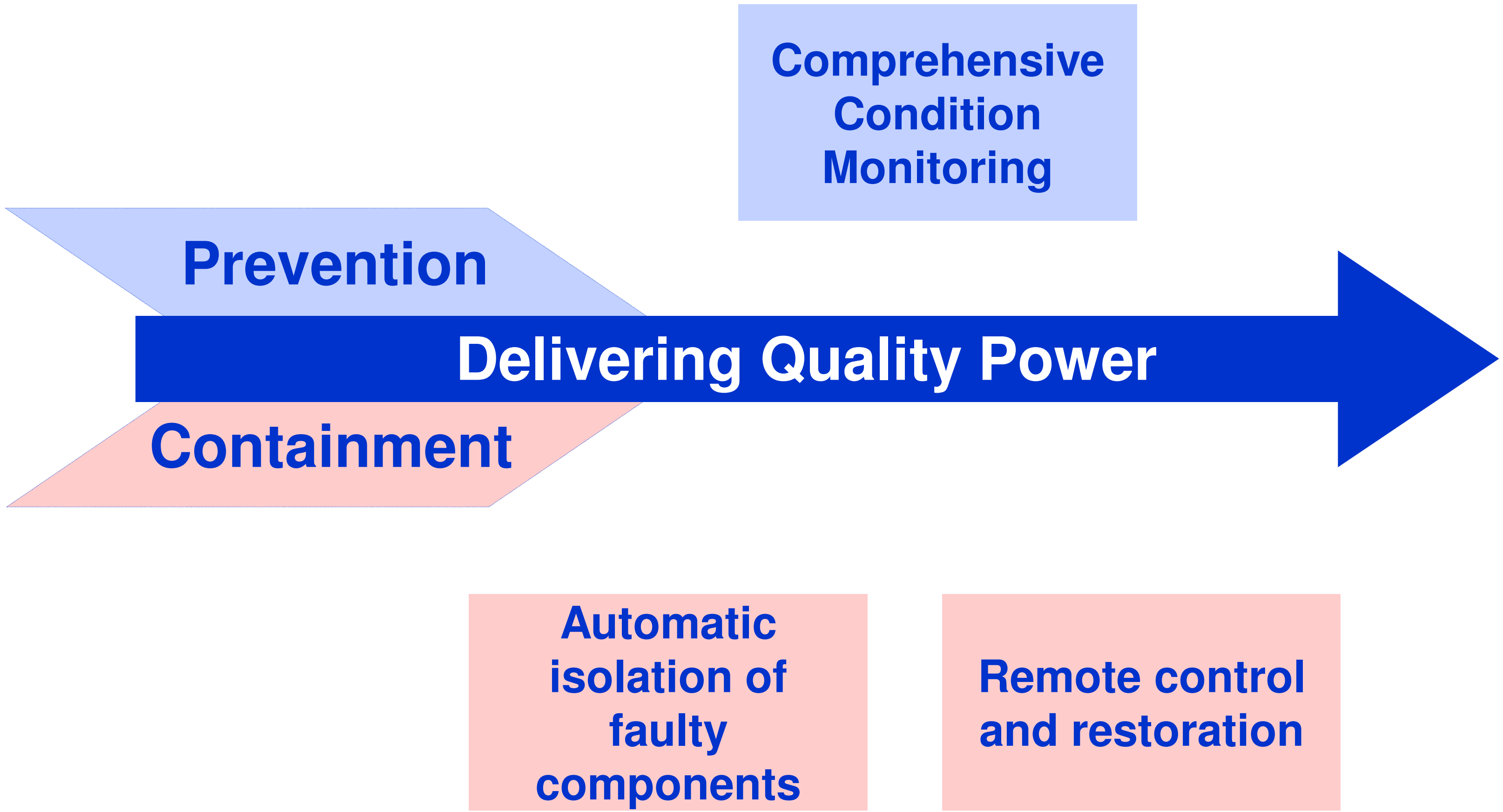
Losses = Injection – Sales ~ 3%

Quality of Supply



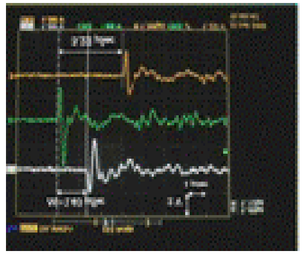
< 1 minute of outage per customer per year

Quality Roadmap



Two-pronged approach to deliver quality power

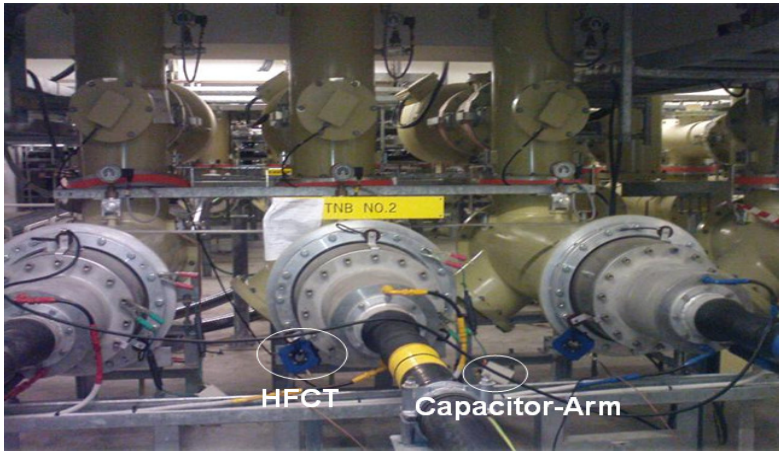
Network Health Screening



Condition Monitoring Systems	What They Detect
Thermal Scanning	Overheating
Oil Pressure Monitoring	Low pressure
Dissolved Gas Analysis	Abnormal oil contents
Distributed Temperature Sensing	Hot spots
Very Low Frequency Test	Low insulation
Partial Discharge Monitoring	Minute current leakage
Operating Mechanism Monitoring	Abnormal operation

Technology Applications

400kV/230kV Potential Transformers
Zero Sequence Measurement



400kV/230kV Cable Terminations
High Frequency CT & Capacitor-Arm method

230kV Cables
Oscillating Wave Test System

Oscillating Waveform Testing Fleet

Standards of Performance

Co-Confidential

SPPA's Regulatory Performance Standards (with Penalty)

SINGAPORE POWER

Service Dimension	Description	Service Standard	Performance Target
Reliability of Supply	Number of power failure incidents* caused by failure of, damage to, or operation of Licensee's equipment or cables rated at 6.6kV and above, and power transformers rated at 22kV and above	0	100%
Quality of Supply	Number of voltage dip incidents* due to failure of, damage to, or operation of Licensee's equipment or cables rated at 22kV and above	0	100%
Restoration of Supply	Time taken to restore electricity supply for each power failure due to failure of, damage to, or operation of Licensee's equipment or cables rated at 22kV and below	3 hours 2 hours	100% 90%

* Only incidents where the Licensee is determined by EMA to be at fault will be counted

SPPA's Regulatory Performance Standards (without Penalty)

SINGAPORE POWER

Service Dimension	Description	Service Standard	Performance Target
Availability of Supply	Minimum advance notice for planned interruption of electricity supply	7 calendar days	95%
Quality of Supply	Time taken to rectify voltage complaint or limit violation	2 calendar days	95%
	Time taken to correct a voltage complaint that requires network reinforcement	6 months	99%

SPPA's Regulatory Performance Standards (without Penalty)(cont'd)

SINGAPORE POWER

Service Dimension	Description	Service Standard	Performance Target
Providing Supply	Time taken to implement electrification scheme requiring new substations after takeover of substation (up to 22kV)	10 weeks	90%
	Time taken to implement service connection requiring cable installation work, after premises to be supplied with electricity is ready to receive cable	6 weeks	90%
Customer Contact	Time taken to reply to a written complaint	7 working days	95%
Metering Services	Time taken to attend to meter problem at site upon notification	8 calendar days	95%

SINGAPORE POWER

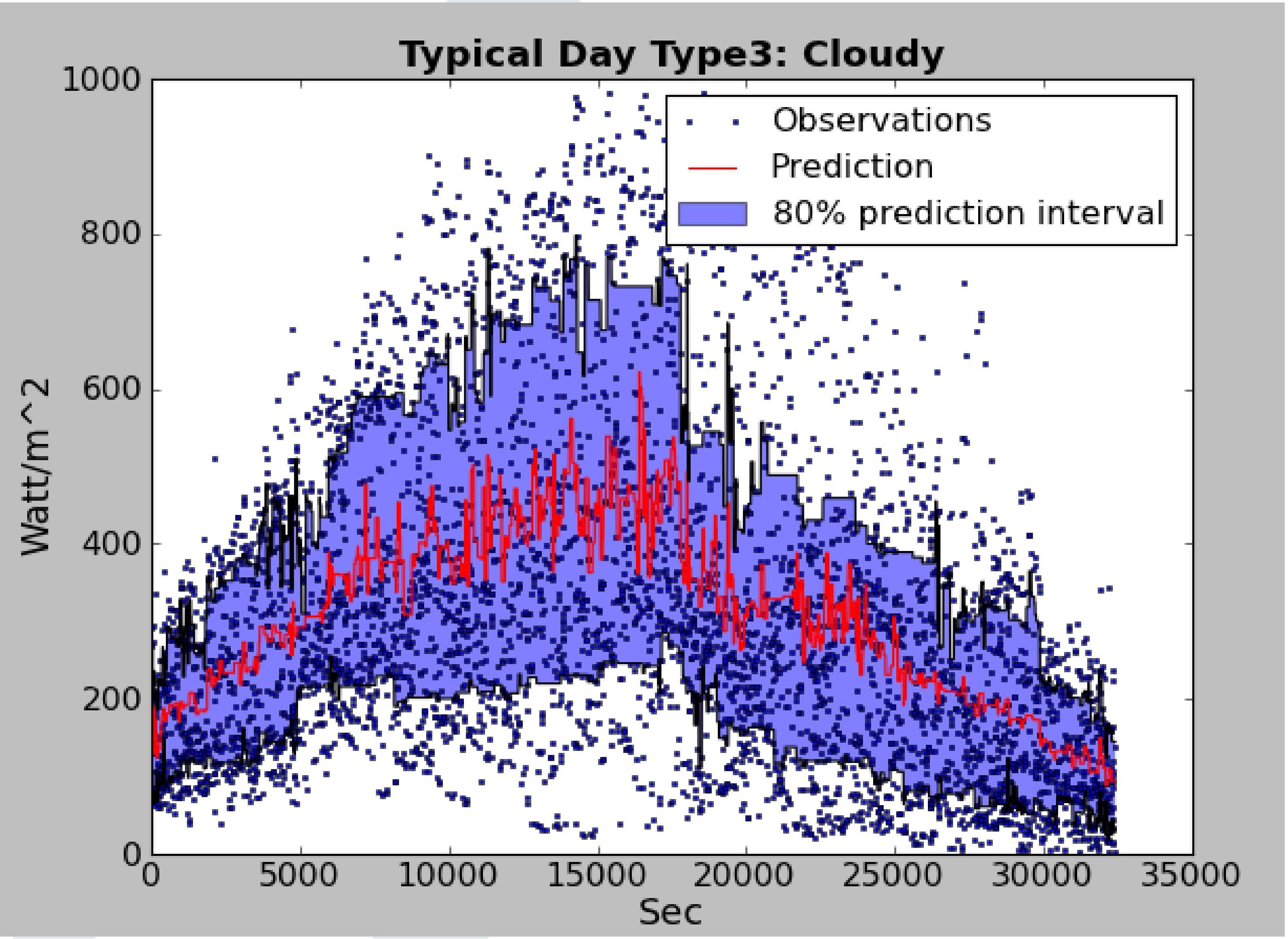
POWERING THE NATION

Renewable energy penetration in Grids: Issues and Solutions

Ashwin M Khambadkone
ECE, NUS &
Programme Director EPGC A*STAR

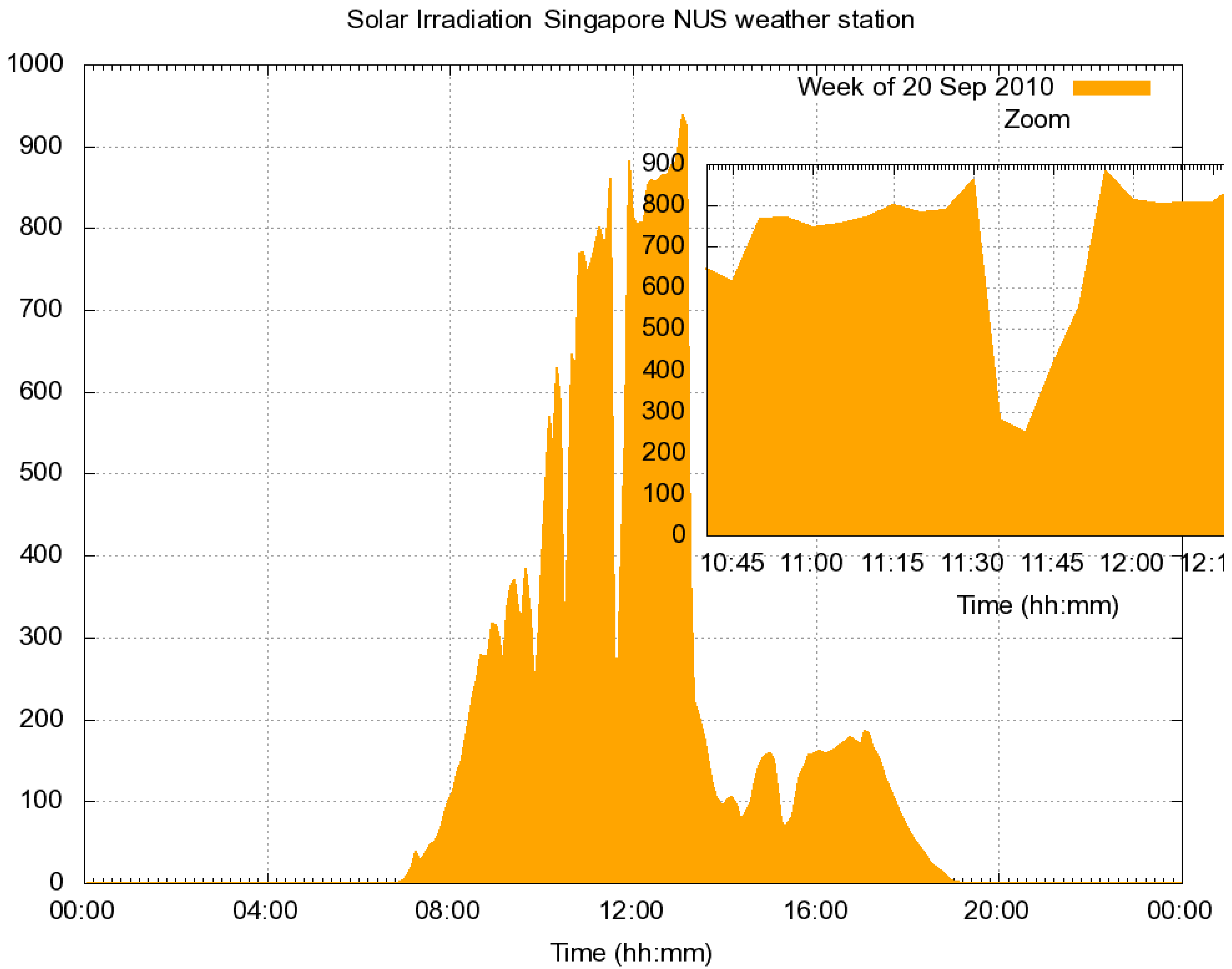
HOW DOES HIGH RENEWABLE ENERGY PENETRATION IMPACT THE GRID

Uncertainty: There is a difference between the actual value and the predicted value



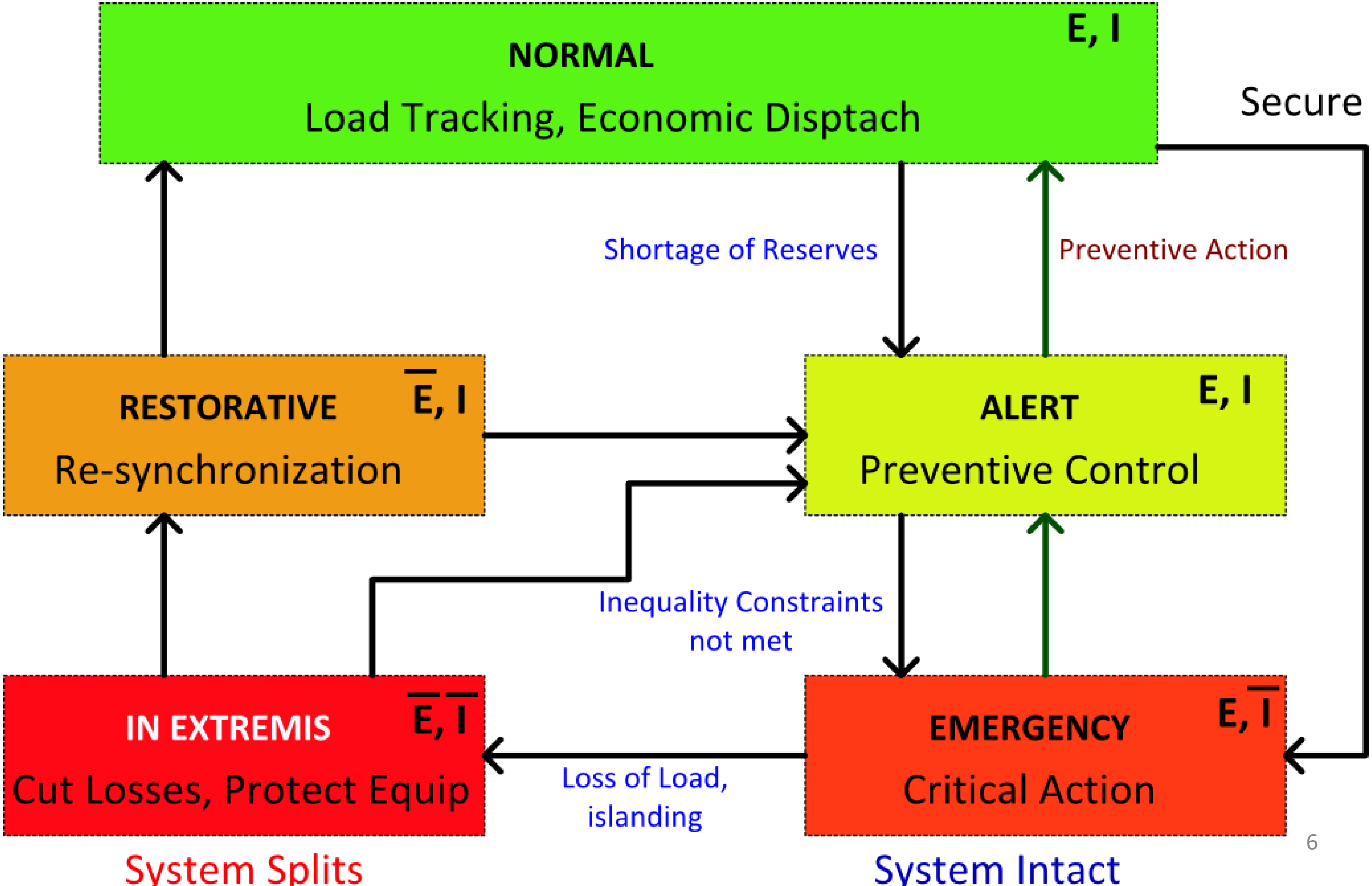
EPGC
A*STAR

Renewables from Solar PV is variable – to counter variability we need other sources

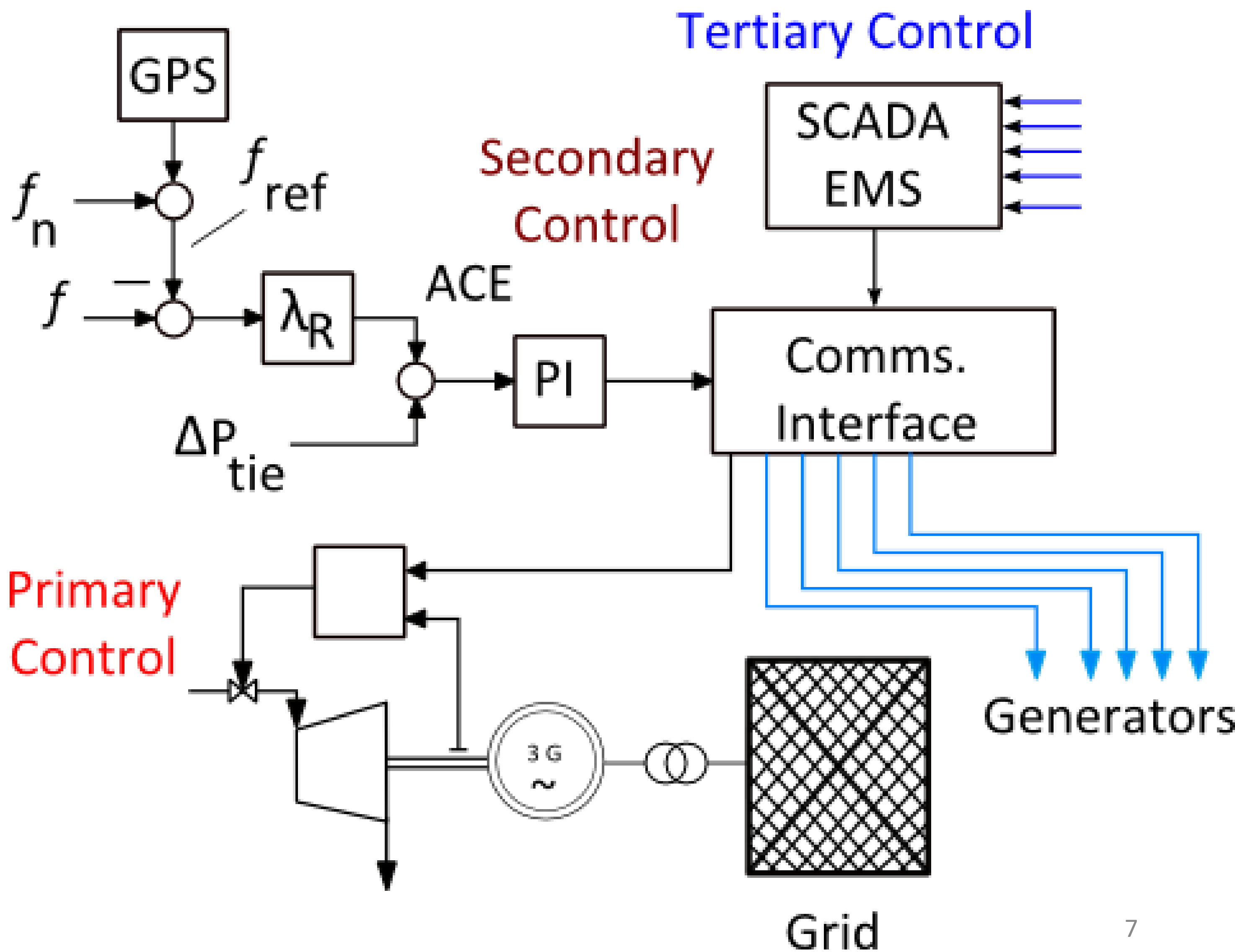


HOW DOES IT AFFECT GRID STABILITY?

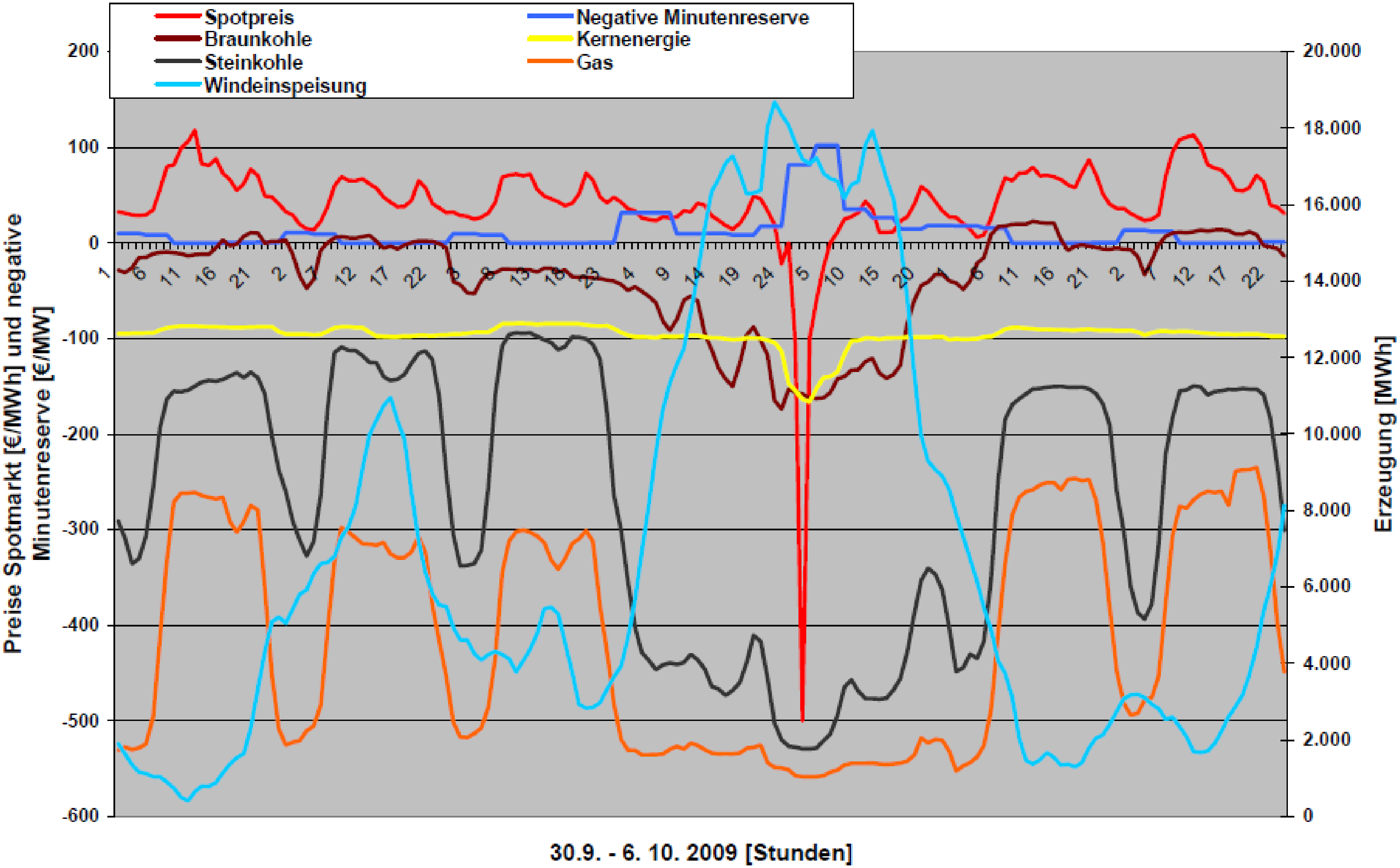
Classification of Power Systems operating states based on CIGRE Rep. No 325



Control of Grid Frequency has three layers

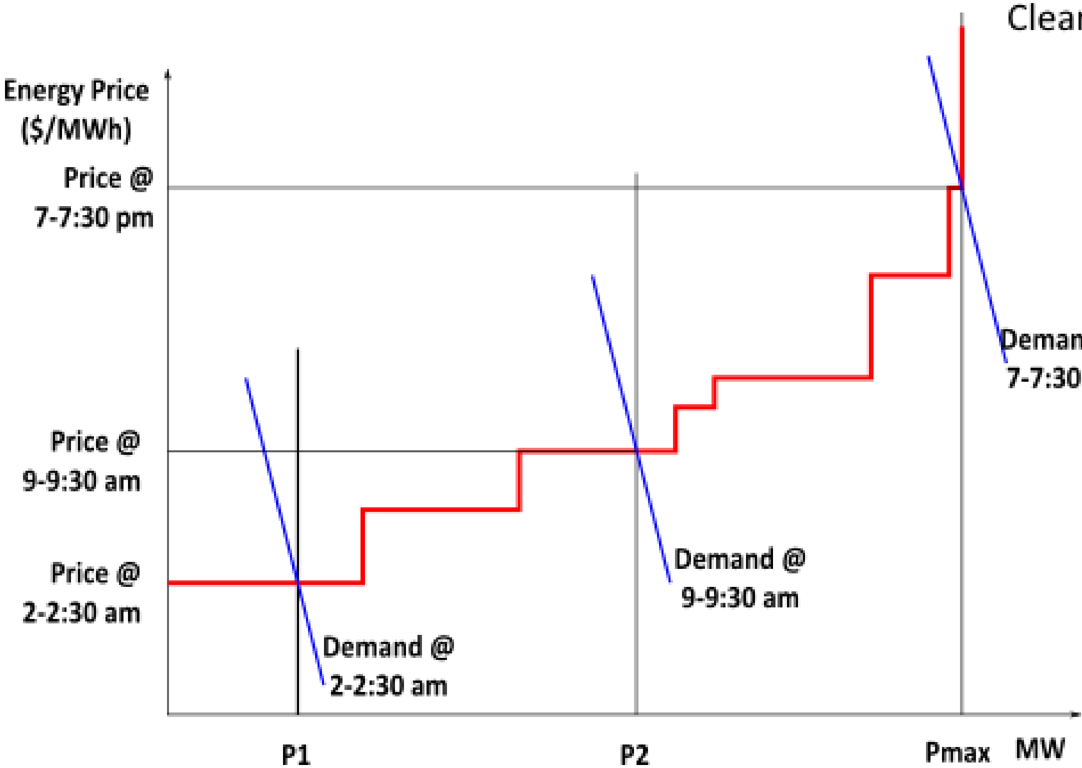


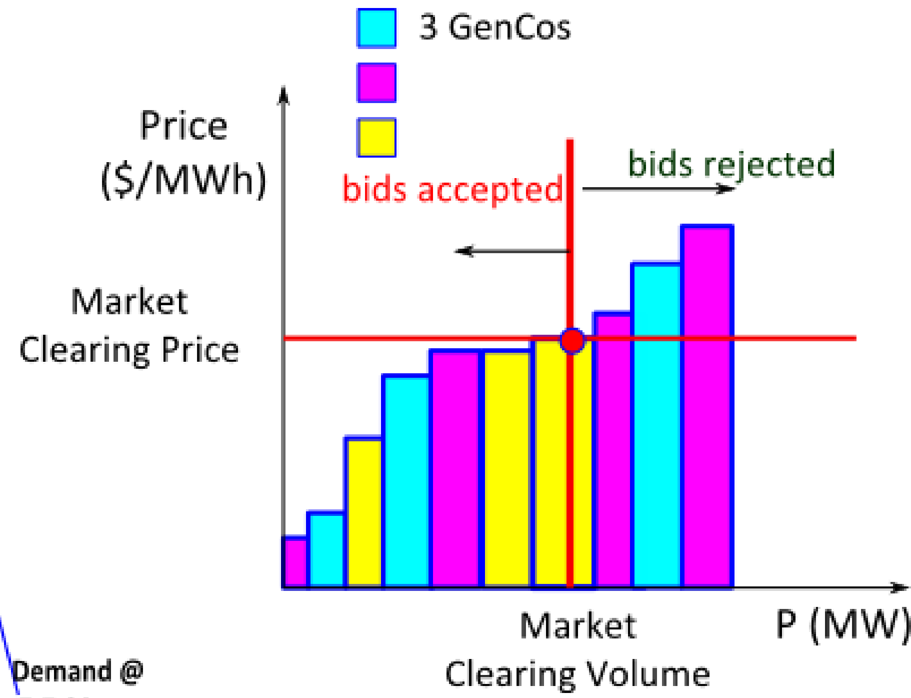
What to do in case of surplus? Case of negative spot price 3-4 October 2009 in Germany



Analyse der Ursachen fuer negative Strompreise am 3-4 Oktober 2009 und moeglicher Abhilfemassnahmen
Studie im Auftrag des Bundesministeriums fuer Wirtschaft und Technologie, EWI and der Uni Koeln

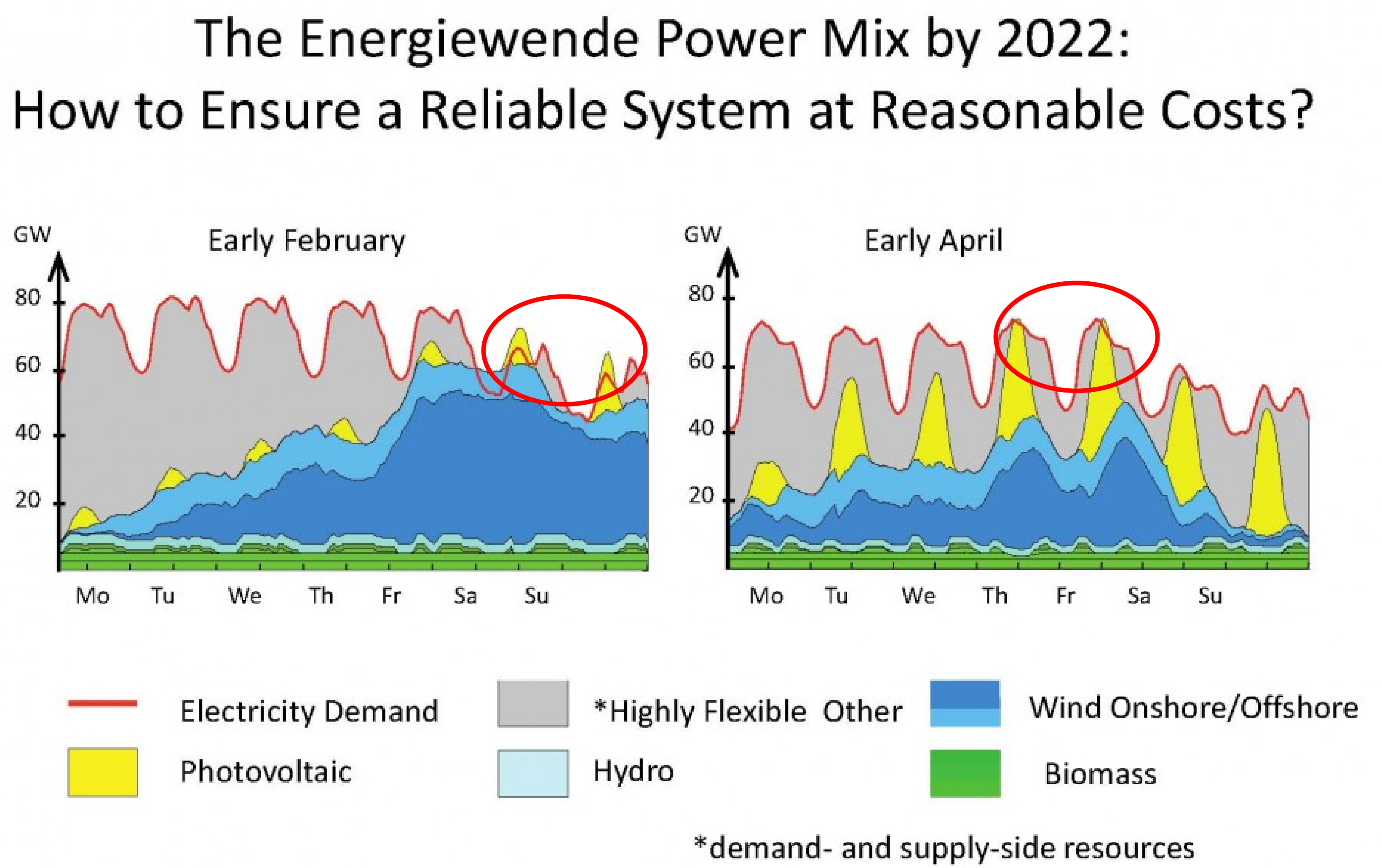
Market Dynamics influences the actual power flow in the system





How to maintain stability?

Surplus Power from Renewables and Global stability reflects in fall in price….or curtailment….=Storage?



Illustrations from Agora Energiewende "Insights on Germany's Energiewende"

http://www.raponline.org/featured-work/making-germanys-energiewende-energy-transition-a

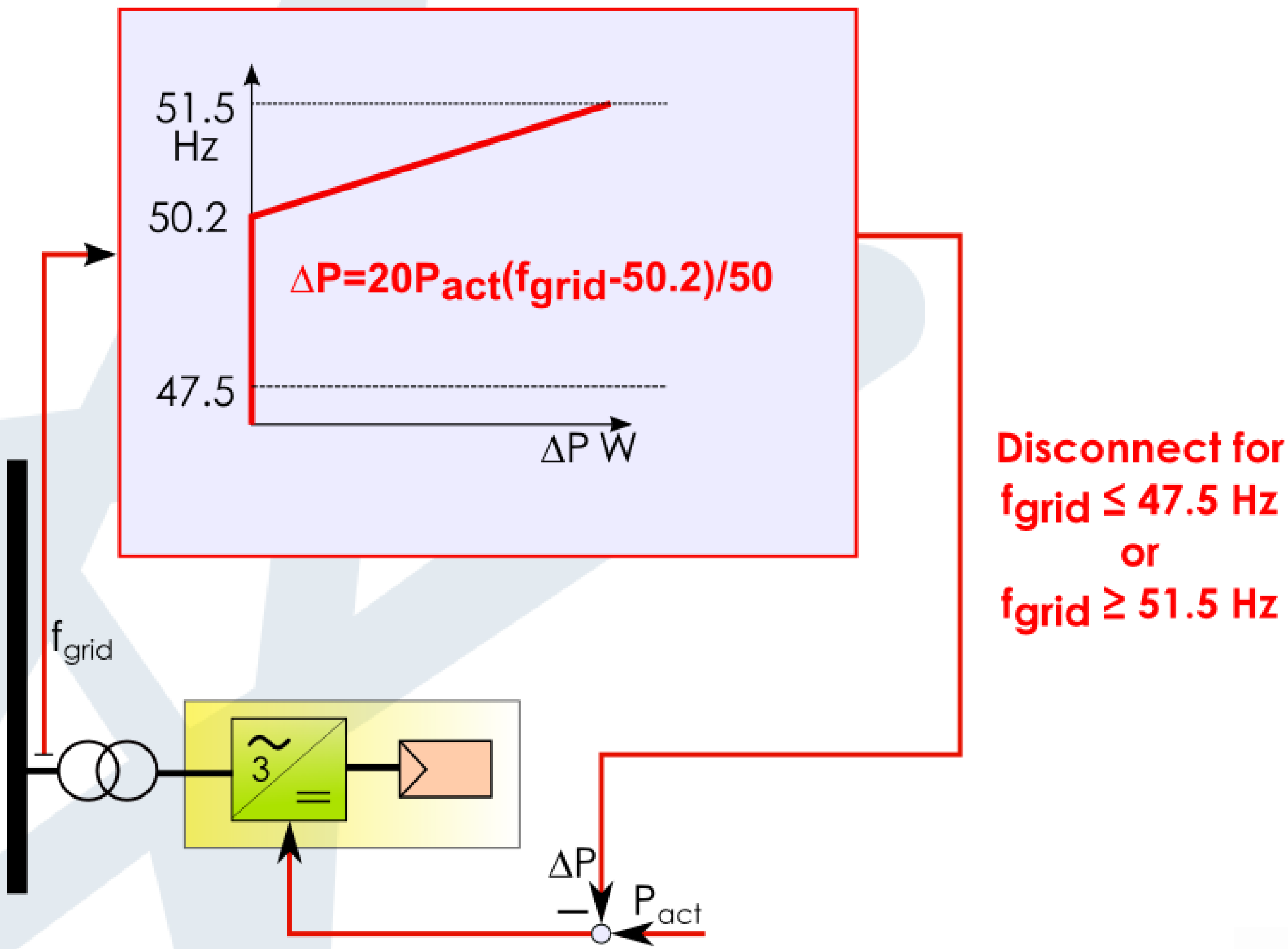
Fast change in power dP/dt due to high penetration of renewables

Germany 50% penetration needs 6 GW in 15 mins

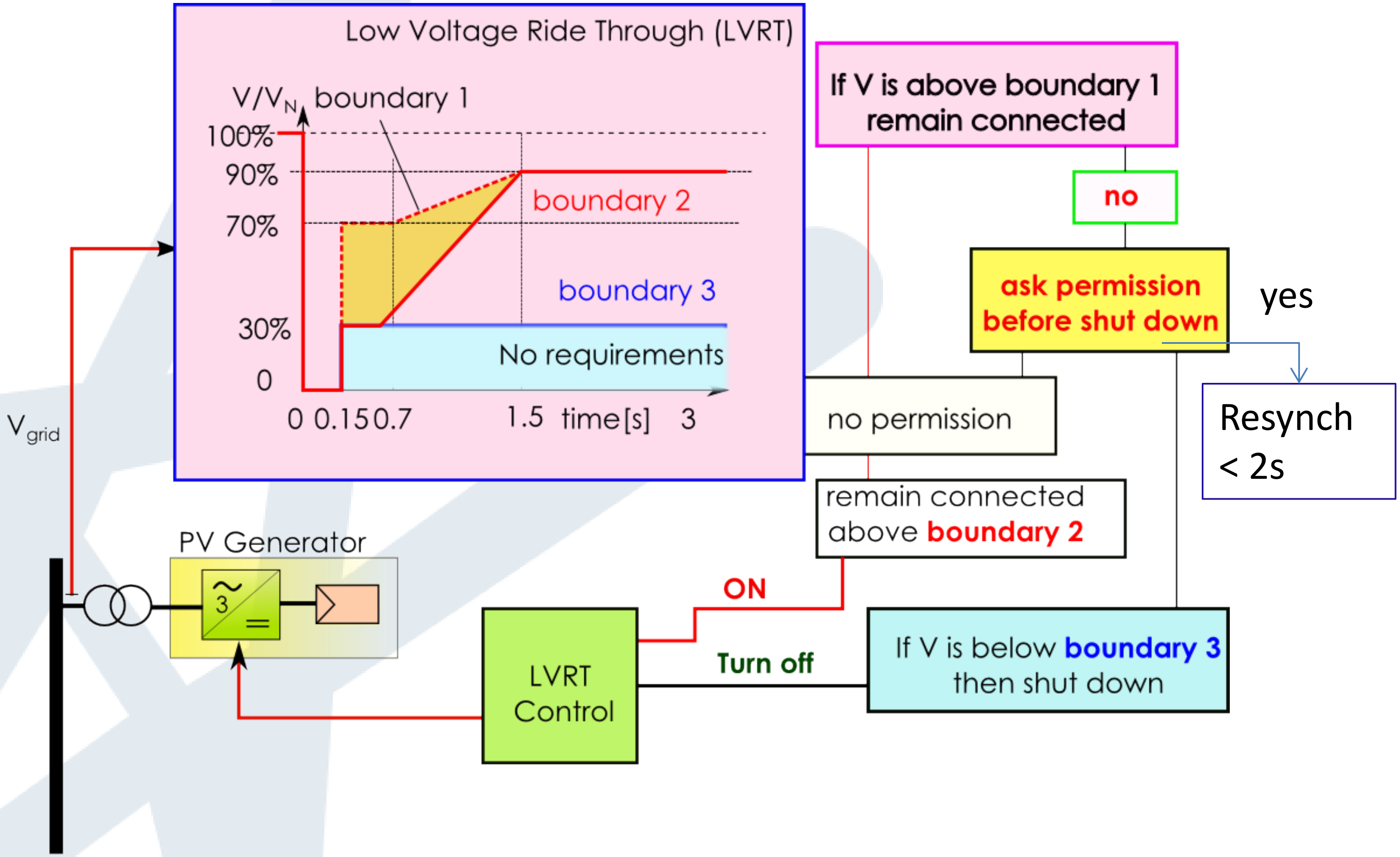
Rates will depend on the penetration and nature or irradiation

	Capacity	Coal	CCPP	GT
Minimum Load	MW	400	500	500
P change in 5 min	MW	50	100	400
Start-up Cold	h	10	4	<0.1

DER inverters at MV level need to have active power reduction at over frequency (1 Jul 2010)



Low Voltage Ride through requirement for MV connected Distributed Generators



+ reactive current
  100% of nominal current within 20ms

THE LOCAL BOTTLENECK

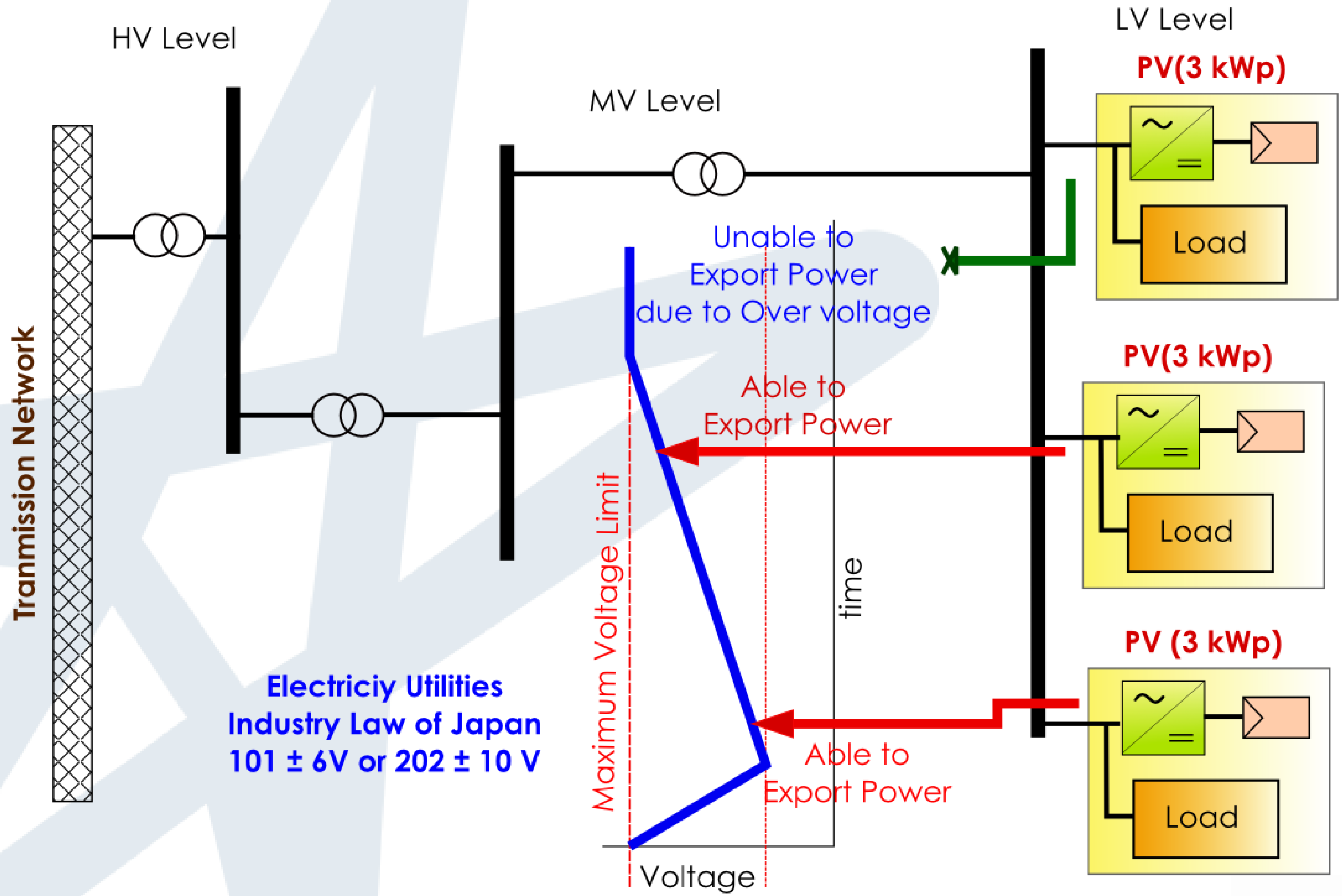
Local problems: Ota Project in Japan funded by NEDO

http://www.pvdatabase.org/urban_view_details.php?ID=32

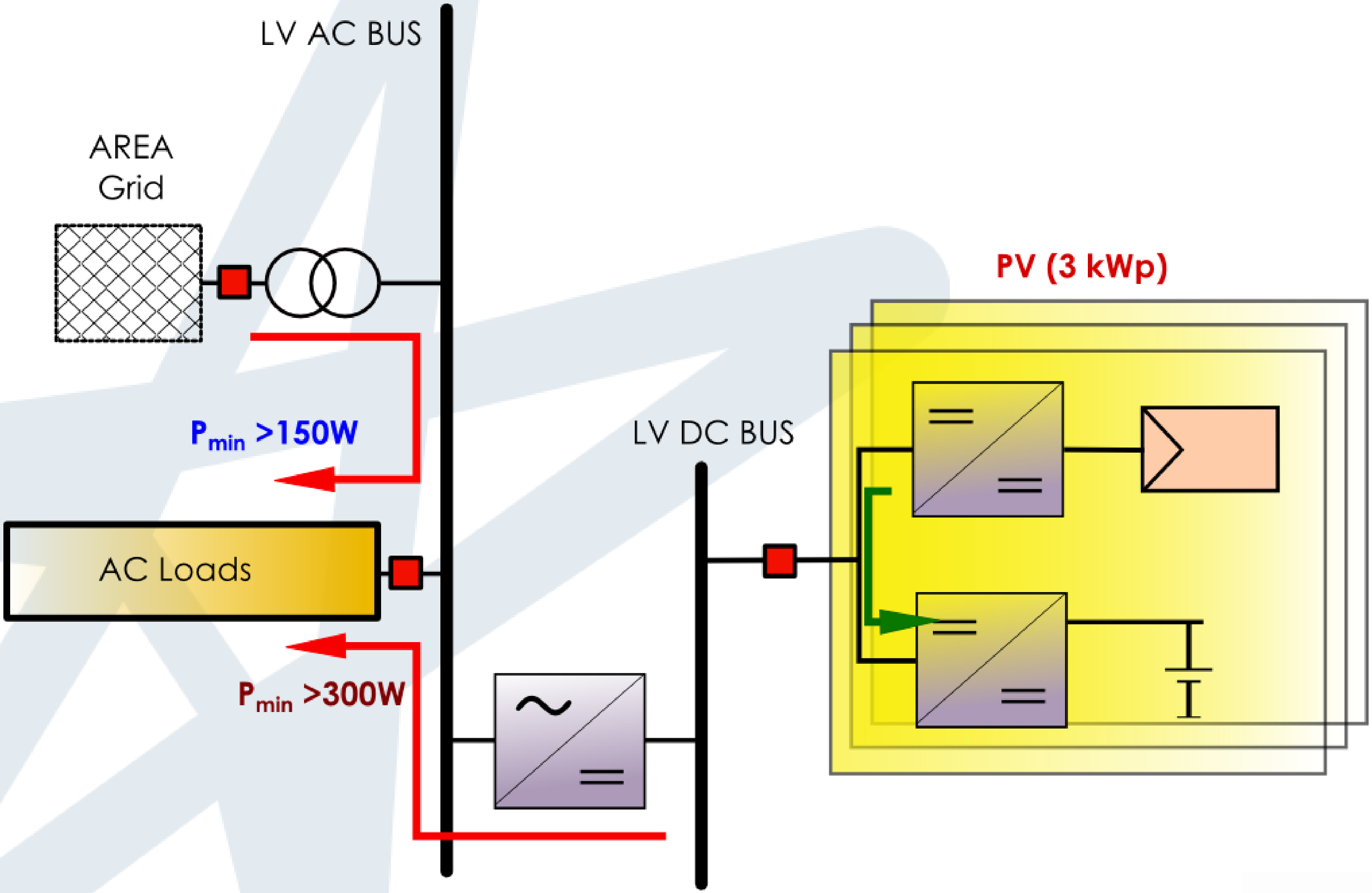
Pal Town Josai-no-Mori , Ota Japan Latitude 3618’32’’N

2160kWp Inclined Roof Top, Flat Roof Mechanically fixed
Project Lead: Kandenko CO Ltd & NEDO, Units 553 PV power per unit 3kWp
Operation 2006

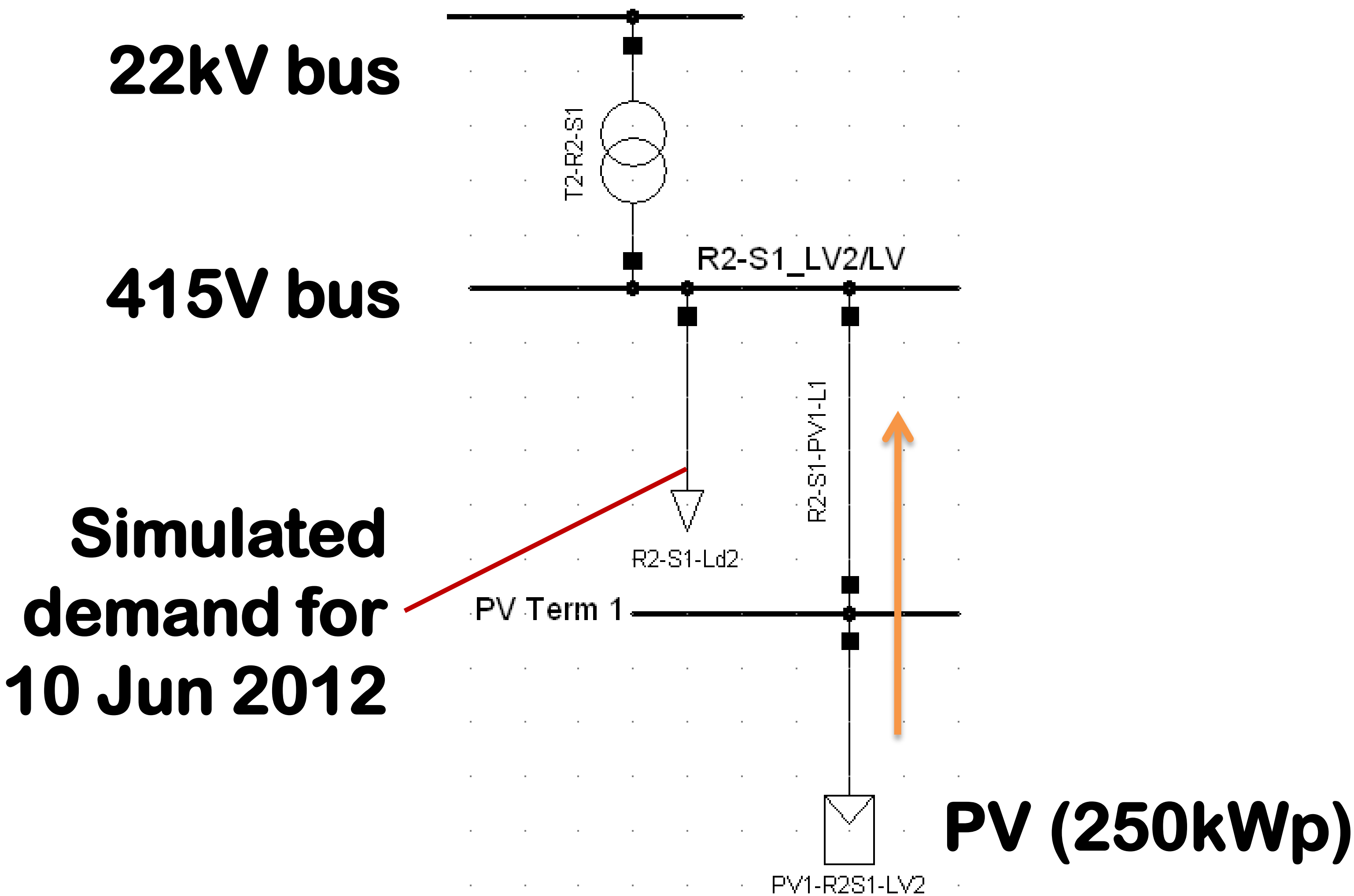
Excessive Power Export increases Voltage causing power export limitation



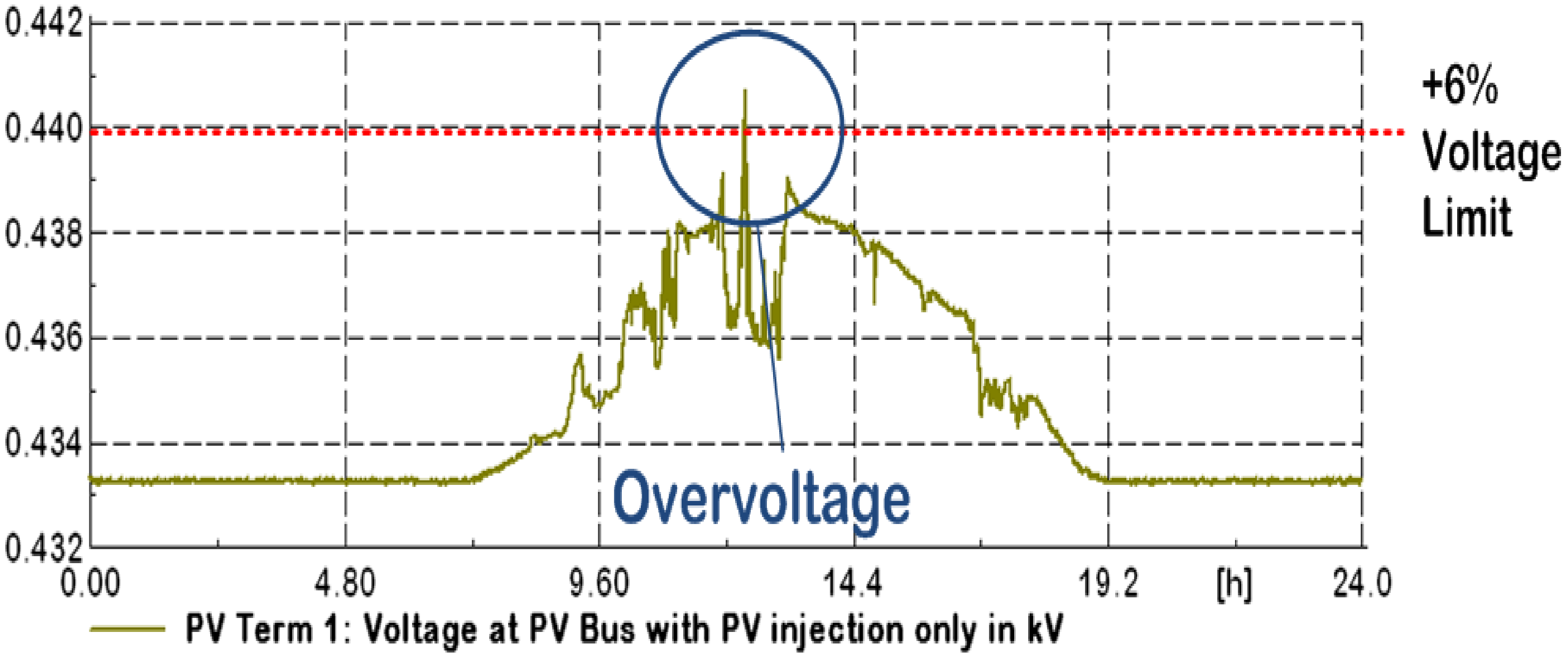
Each unit has Battery storage and Export power to the Grid



Voltage rise during PV power Generation: Voltage for 10 Jun 2012



Voltage variation at PV Bus over 24 hours

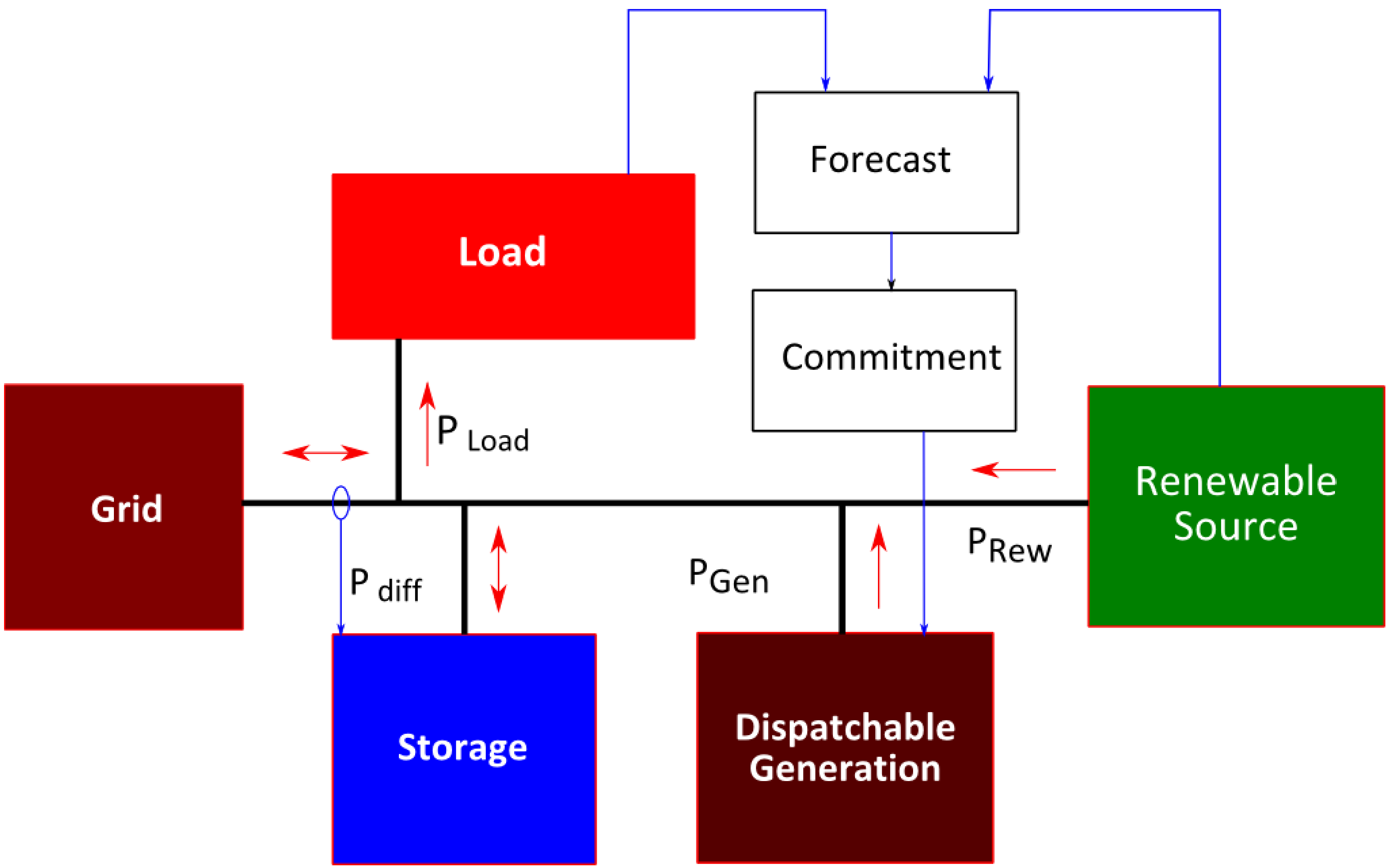


During low loading conditions, high PV production may cause <u>overvoltage</u> to occur.

Why do we need Energy Storage

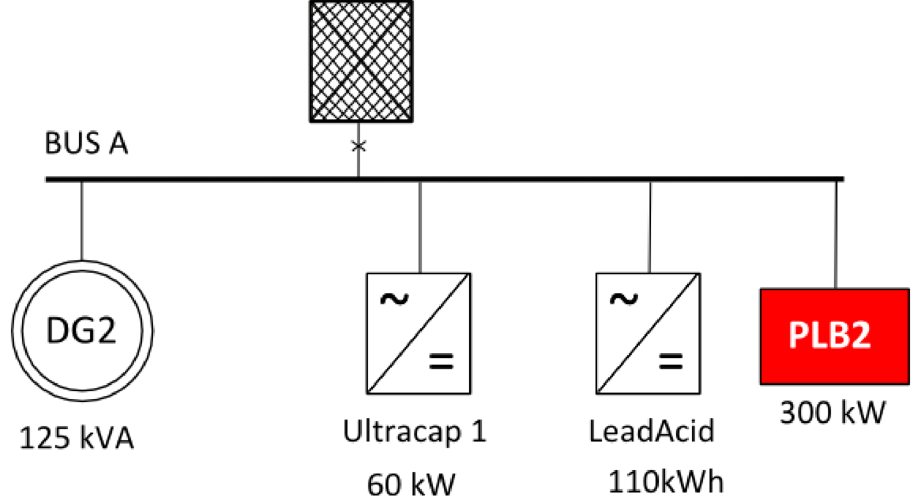
- Renewable Integration problems
  - Seasonal: will occur when penetration is very large
  - Load following: Fast changing response needed
  - Intermittency: Short term storage
- Power Quality problems: small capacity
- Transmission network problems – congestion and frequency regulation

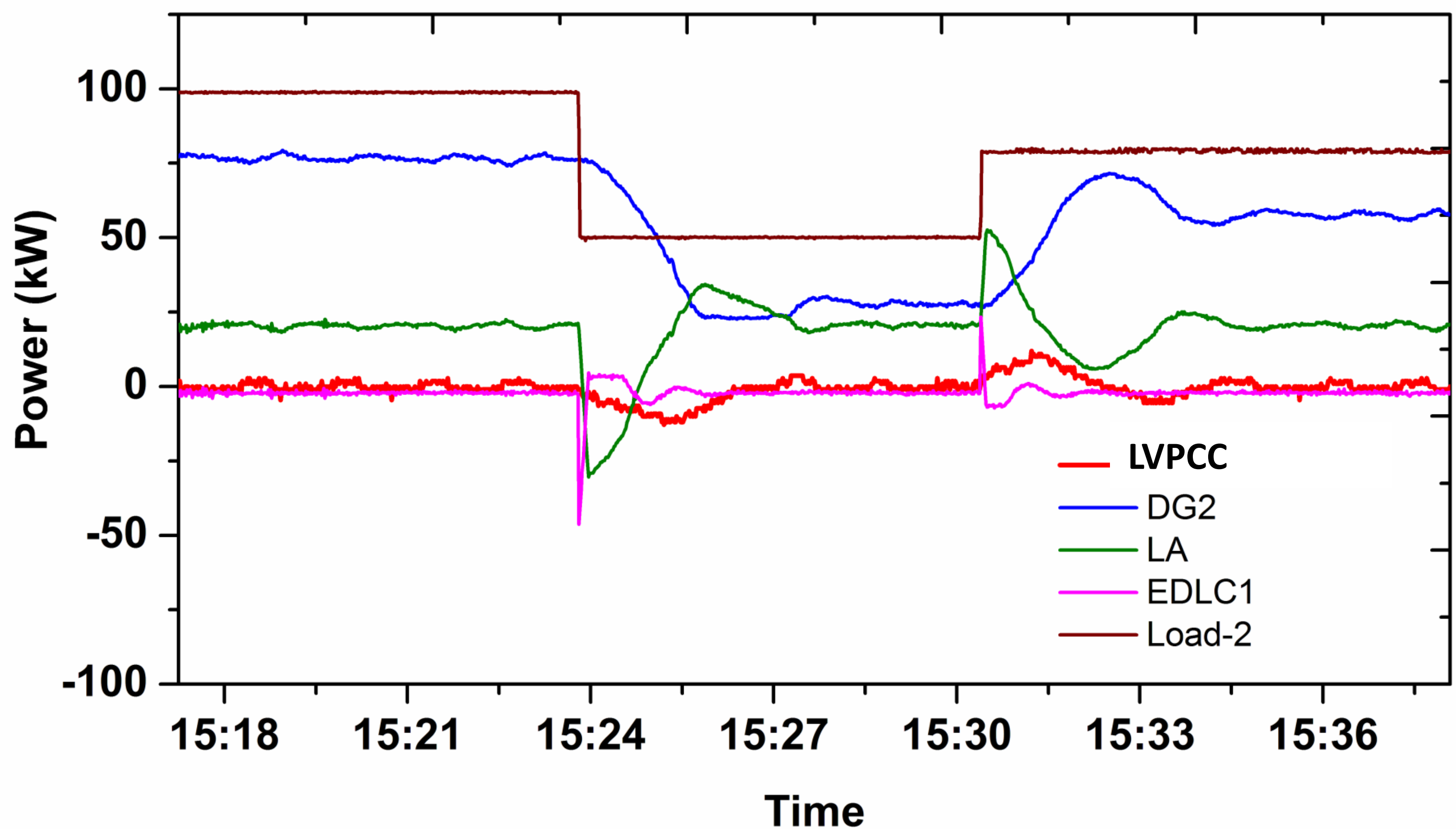
Storage as load balancing resource



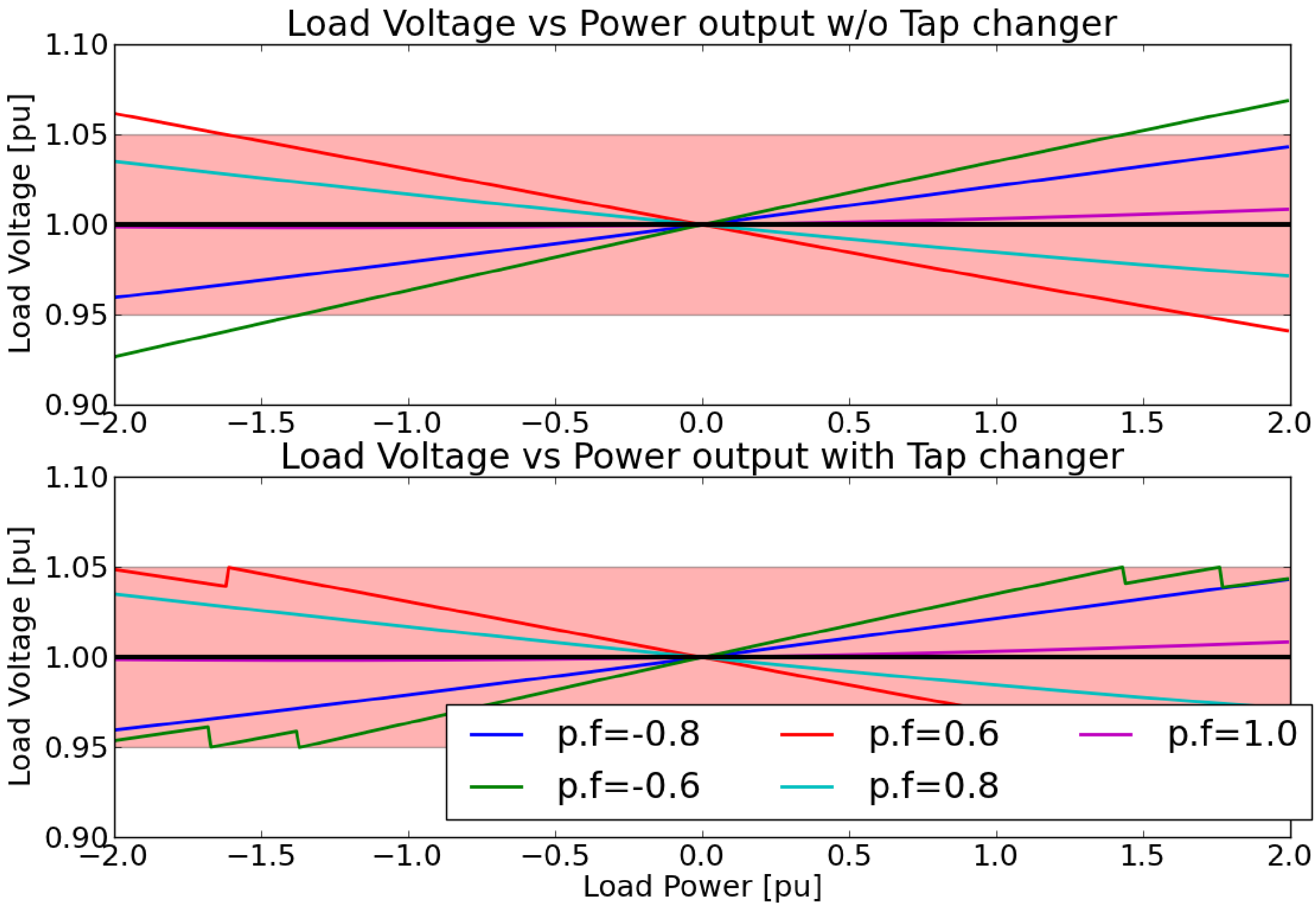
EPGC enables test-bedding of research at close to power grid conditions

Ultracapcitor is being used to compensate faster dynamics





Voltage variation at the sending end can become greater than the limits

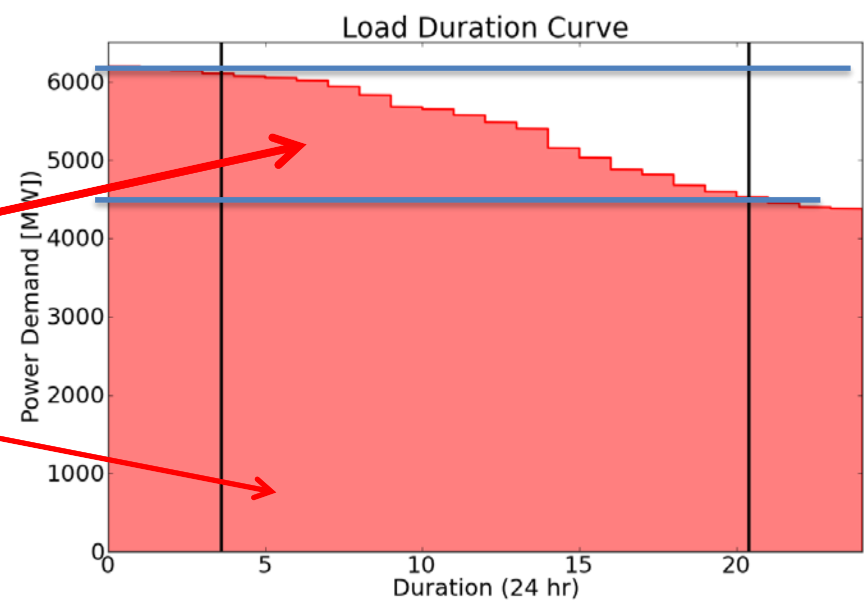


WHAT TYPE OF STORAGE DO WE USE?

There are three time duration ranges energy storage can perform – Grid

Power [MW]	Time	Energy	Function
10 - 1000	1 – 8 hrs	10-8000 MWh	Spinning Reserve
0.1-2	0.5-4 hrs	5kWh-8MWh	Peak Shaving, Deferral
0.1-2	1-30 sec	0.03-20kWh	Power Quality

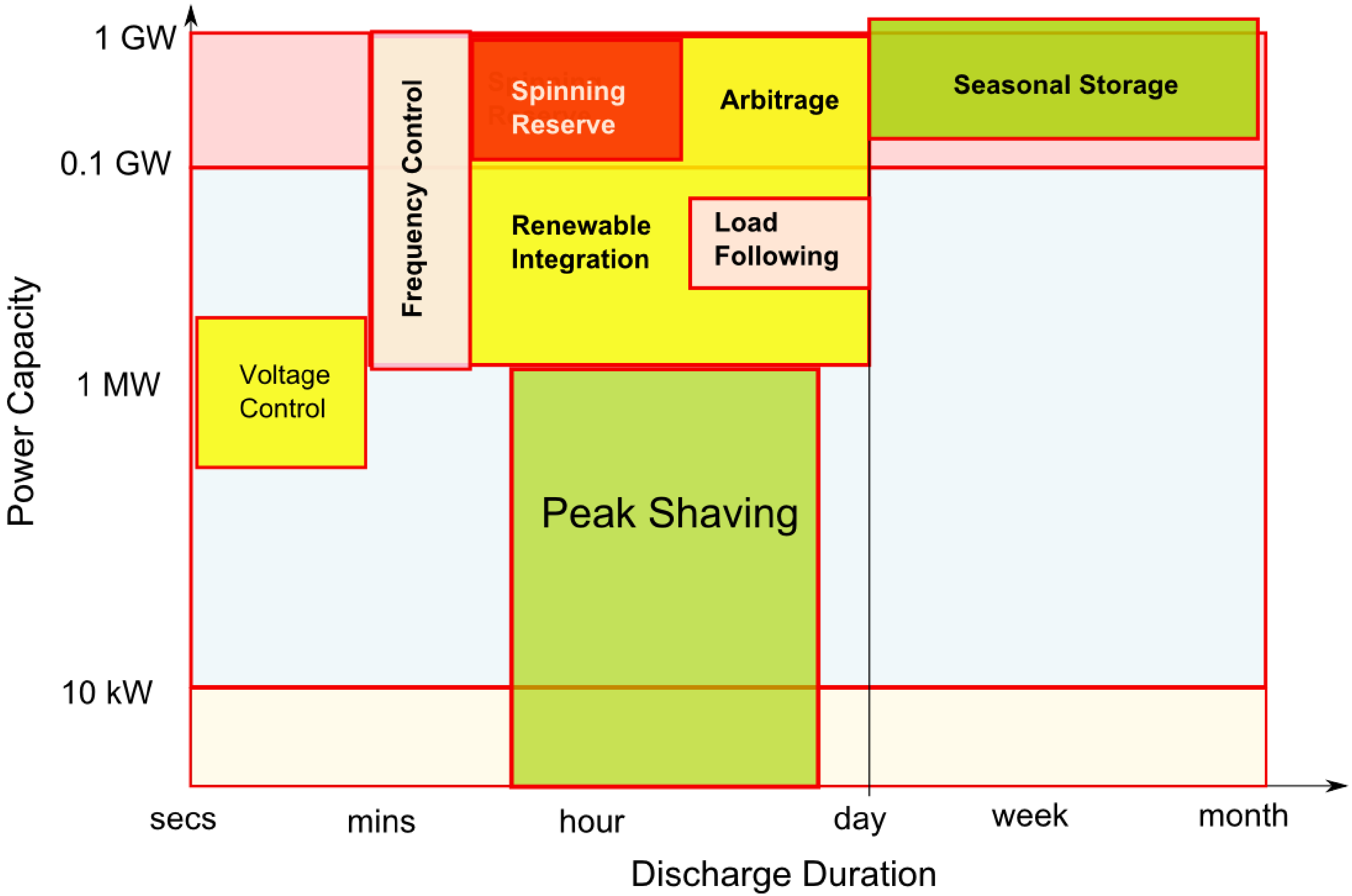
- Peaking plants
- Mid-merit plants
- Base plant operation



Impact of storage and wind in Europe scenario

- Size of storage has an impact on merit order of plants
- Small storage size increases base plant input and reduces mid-merit plants operation
- Large storage size reduces base plant contribution and increases mid-merit plant operation
- Revenues generated can support profitability, cost of storage is very high at present.
- The price ratio between peak and off peak should be large enough to generate profits

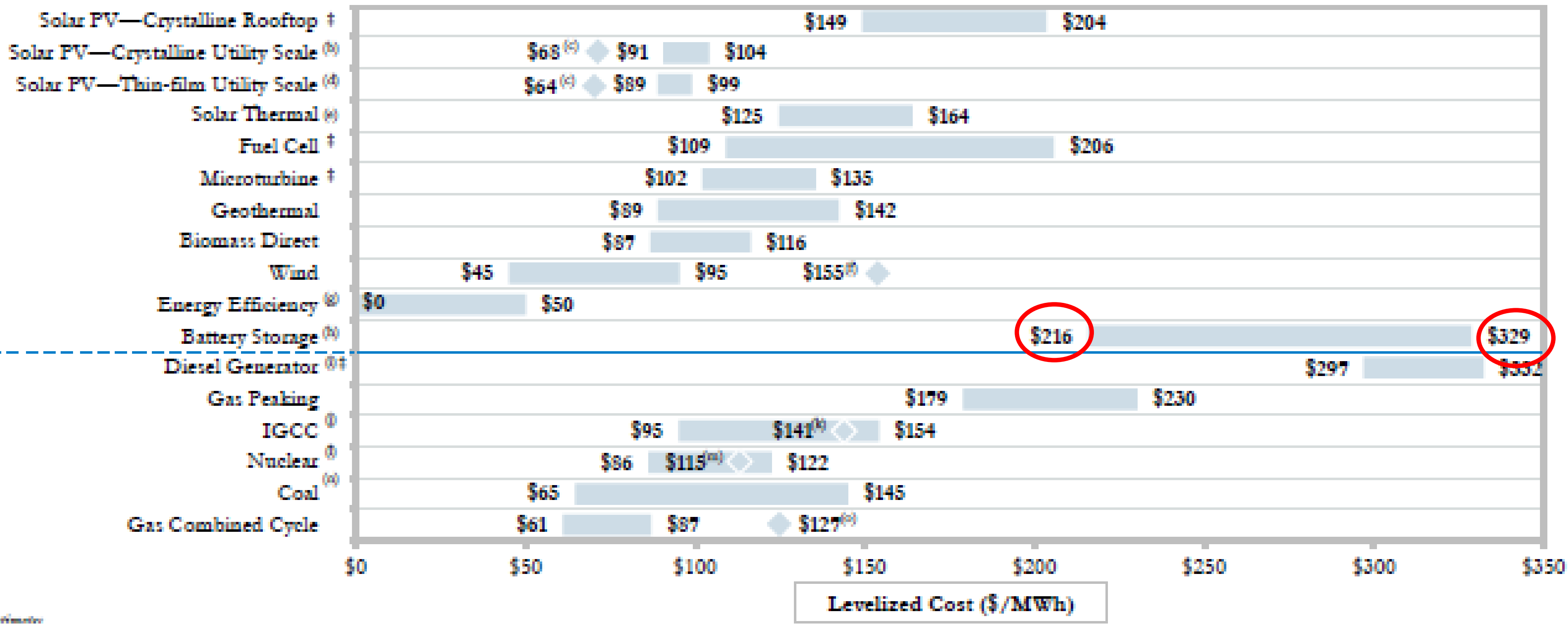
Energy Storage Functions and their characteristics



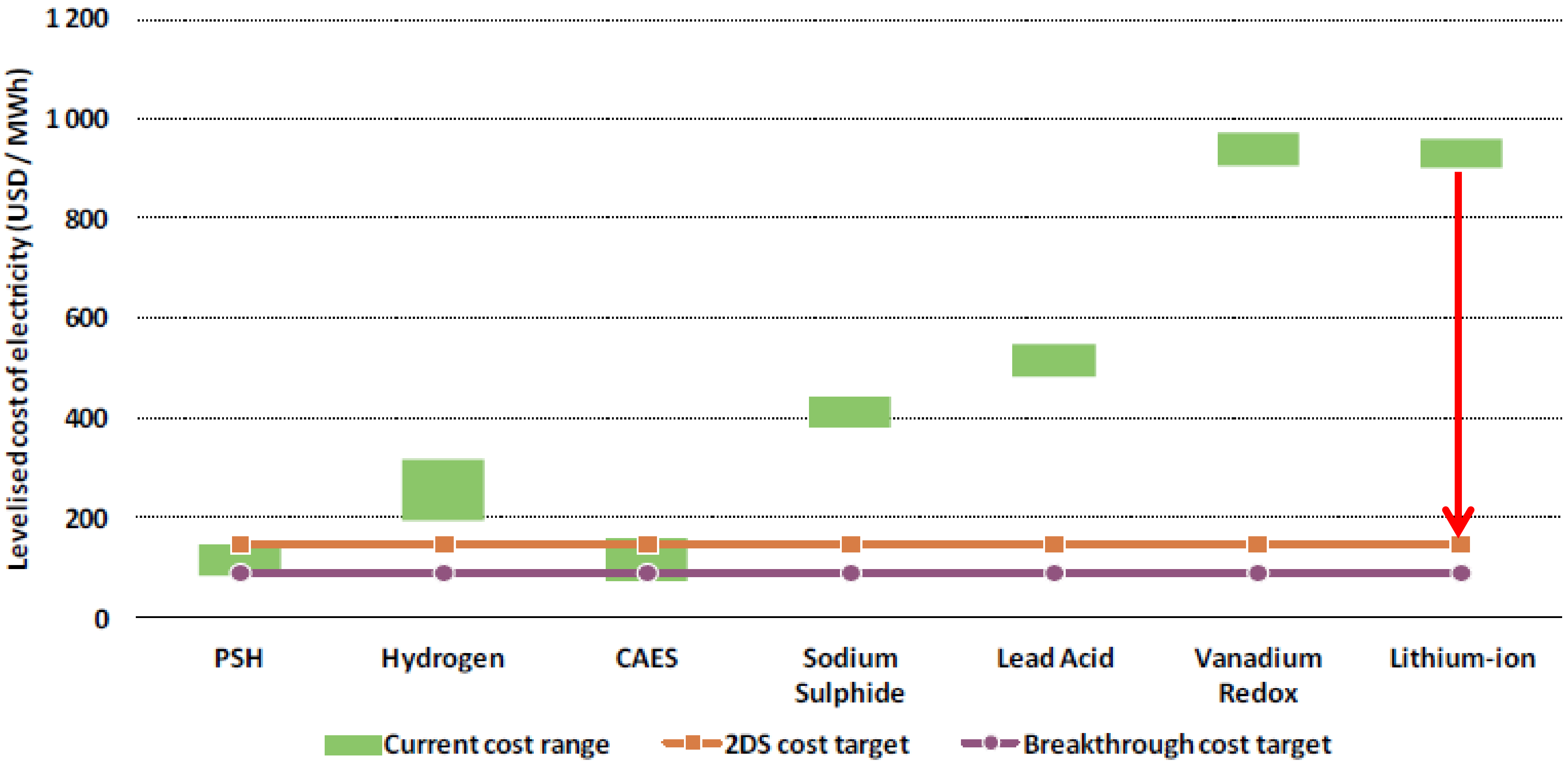
How Can Storage be used for Grid Applications

SUMMARY

Cost of some of the technologies is high



IEA Roadmap says steep decrease in prices is needed, But we need Reliability and Security



Technology Roadmap Energy storage IEA, 2015

Some References

- The viability of balancing wind generation with large scale energy storage: Batsaikhan Nyamdash , EleanorDenny , MarkO'Malley: Energy Policy 38 (2010) 7200–7208
- 12 Insights on Germany's *Energiewende* "12 Thesen zur Energiewende. Ein Diskussionsbeitrag zu den Herausforderungen im Strommarkt", Agora Energiewende 2012 (original: German language).
- IEA Technology Roadmap Energy Storage 2015
- State-of-the-art electricity storage systems Indispensable elements of the energy revolution Josef Auer josef.auer@db.com, DB research, www.dbresearch.com

"9th Capacity Building Programme for Officers of
Electricity Regulatory Commissions"
21-22 Nov. 2015 at IIT Kanpur
24-26 Nov. 2015 at Singapore

Developing a Regional power market in South Asia

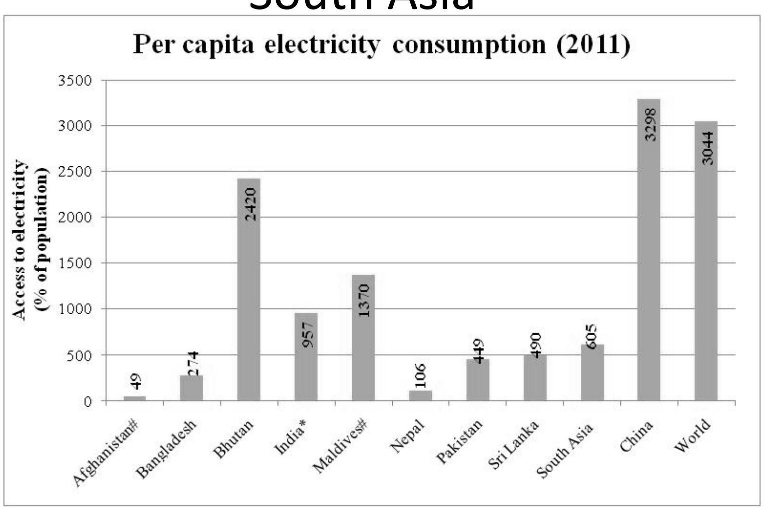
Anoop Singh
Associate Professor
Dept of Industrial and Management Engg.
IIT Kanpur

Outline

- Energy and Socio-economic development
- Drivers
- Status and Opportunities for Electricity Trade
- International experience
- Cross Border Electricity Trade in SA
- Strategy for South Asia
- Conclusions

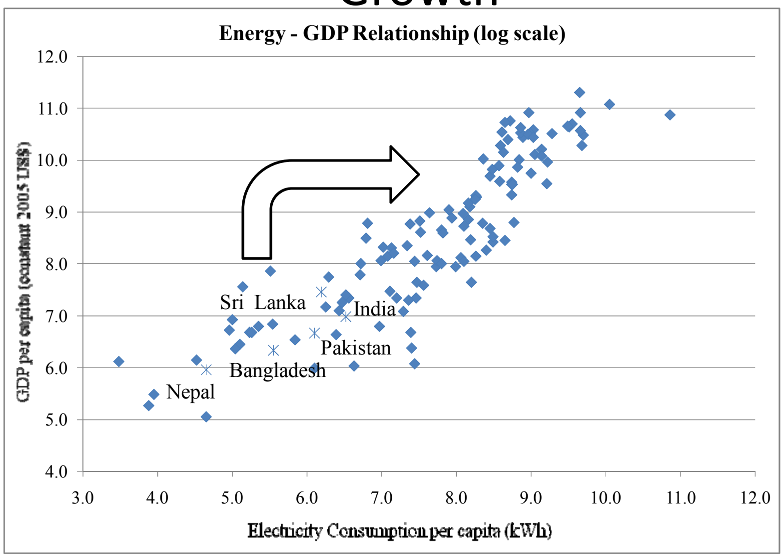
Energy and Socio-economic Development

Per capita electricity consumption in South Asia

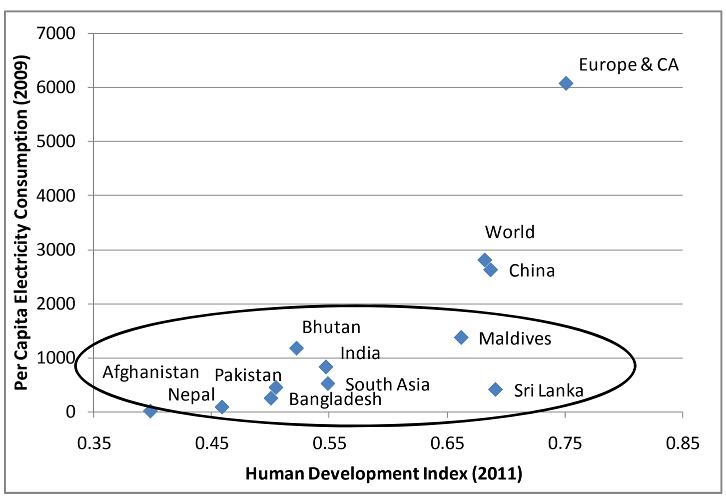


So: WDI (2015), RGoB (2012), CEA (2015)

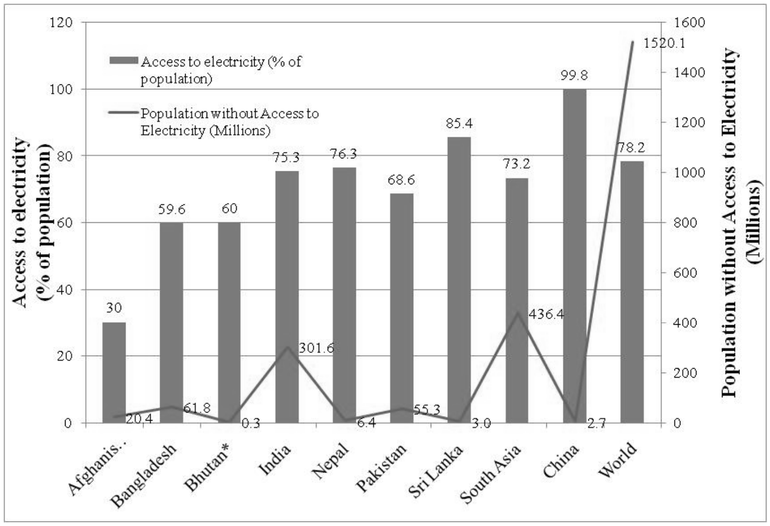
Electricity Consumption and Economic Growth



Electricity Consumption and Human Development Index

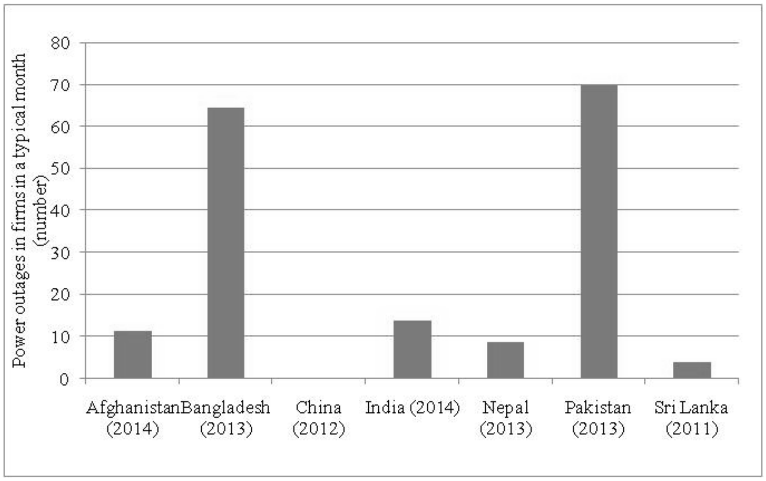


Access to Electricity in South Asia (2011, So: WD)



Drivers for Energy Cooperation in South Asia

Power outages in firms in a typical month (number)



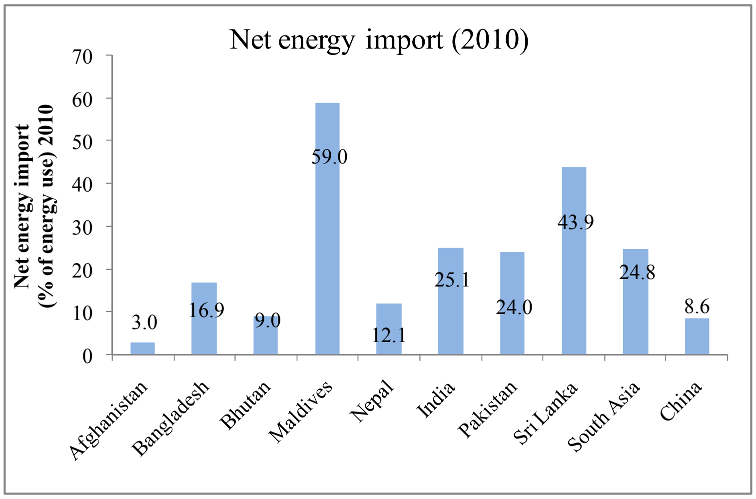
So: WDI (2015)

Economic growth continues to suffer

Country	Value lost due to electrical outages (As a % of sales)
Afghanistan (2007)	6.49
Bangladesh (2007)	10.56
Bhutan (2009)	4.33
India (2006)	6.62
Nepal (2009)	26.95
Pakistan (2007)	9.16
Sri Lanka (2011)	3.0

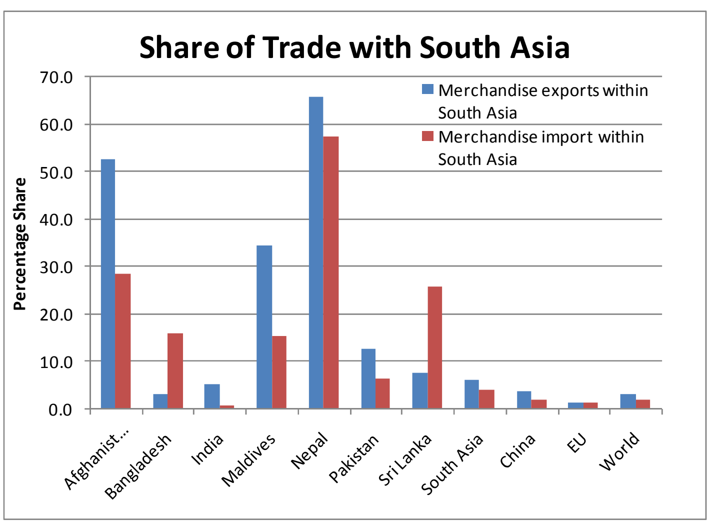
So: World Development Indicators (2013)

Concerns for Energy Security

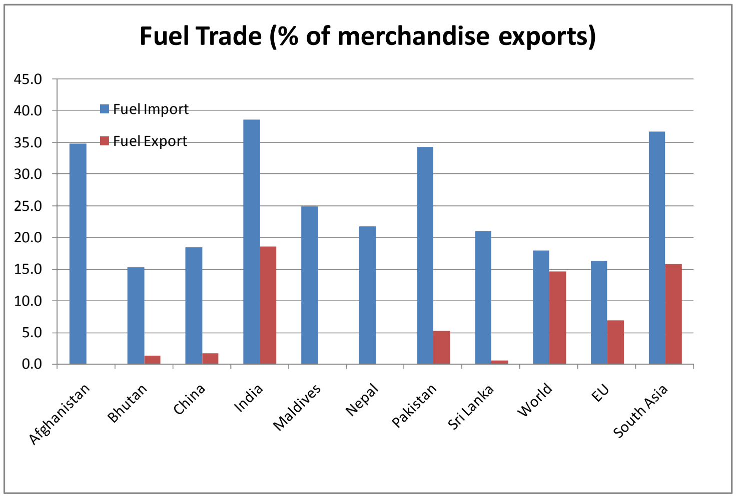


So: World Development Indicators, 2013

Economic Integration in South Asia – Share of Merchandise Trade



Fossil fuel led energy import draining forex earning



Current and Forecasted Peak System Demand (MW) in SA

	Nepal	Bangladesh	India	Bhutan	Pakistan	Sri Lanka
	Existing Peak System Demand (MW)					
2012-13	1163.2	8349	144225*	276.24 @	31348	2451
	Projected Peak System Demand (MW)					
2021-22	2363	18838	283470	1500#	70163	4125
2027-28	3679	28487			121649	5369
2029-30		33708	541823&	2500	145304	5893
CAGR (%)	7.98	8.53	7.80	12.29	8.41	4.73

So: Compiled by the Author from CEA (2013a, b, 2012), NTDC (2013), CEB (2013), NEA (2013, BPDB (2013)
Notes: * - 2013-14; @ - 2011; # - 2019-20; & - 2029-30

Energy Resource Endowments in South Asia – An Indicator for Potential Trade?

Country	Coal (million tons)	Oil (million barrels)	Natural Gas (trillion cubic feet)	Biomass (million tons)	Hydropower* (Gigawatts)
Afghanistan	440	NA	15	18–27	25
Bhutan	2	0	0	26.6	30
Bangladesh	884	12	8	0.08	0.33
India	90,085	5,700	39	139	150
Maldives	0	0	0	0.06	0
Nepal	NA	0	0	27.04	83
Pakistan	17,550	324	33	NA	59
Sri Lanka	NA	150	0	12	2
Total	108,961	5,906	95	223	349.33

Source: ADB (2012), SAARC Secretariat (2010), CWC (2005), WAPDA (2011)

Common Energy Sector Goals for South Asia

- Improve Quality of Life (Human Development Index)
- Sustainable Energy Access to All (2012 – UN's "International Year of Sustainable Energy for All")
- Improve energy security
- Optimal utilisation of region's energy resources
- Greater economic and energy cooperation
- Share best practices in the energy sector

Status of Reform in the Electricity Sector

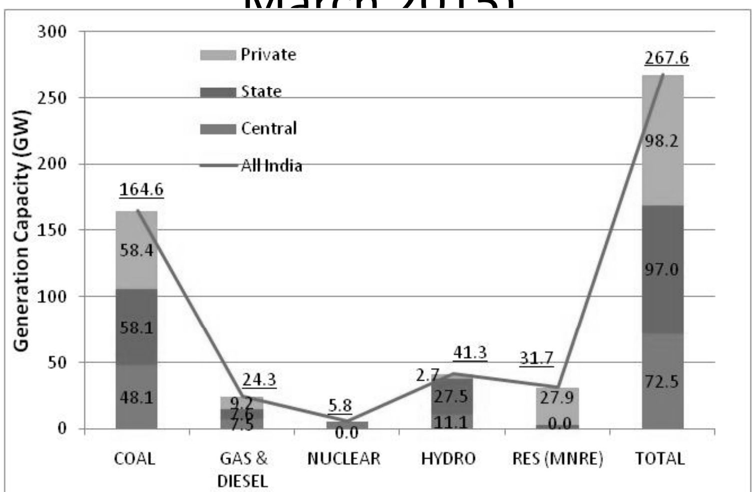
Electricity Sector in SA – A Status

	Installed capacity (MW)	Peak demand met (MW)	Peak demand (MW)	IPPs/Private Sector share in installed capacity (%)	Electrification access rate (%)*	T & D (%)	Per capita electricity consumption (kWh)
Bangladesh	8537	6434	8349	16.35	60	14.36	213
India #	243028	126793 $	131943 $	34.0	75	23.65	917
Nepal	720	569.6**	1094.6	33.33	76	25.03	106
Pakistan	23412	13445	18467	35.56	69	17	450
Sri Lanka	3312	2112***	2146	33.15	85	14	490

Sources: Bangladesh (BPDB, 2014); Nepal (NEA, 2013); Sri Lanka (CBSL, 2013), India (CEA, 2014); Pakistan (Kessides, 2013), * IEA (2011), ** excludes electricity imports capacity from India, *** based on 1.2 GW hydro plant not running during drought seasons, # As on March 2014, $ For March 2014

So: Singh et al. (Forthcoming) as WB's PRWP

Installed Electricity Generation Capacity in India (GW) (As on 31 March 2015)



So: CEA (2015)

Status of Electricity Sector Reform

Country	*Nominal generation market structure*	*Initiation of private ownership and/or participation:* Genera-tion	Trans-mission	Distri-bution	*Introduction of legally independent regulator*	*Transmission Arrangement*
Afghanistan	Vertically integrated monopoly					Vertically integrated
Bangladesh	Multiple sellers, single buyer	1992			2003	Unbundled transmission owner
Bhutan	Multiple sellers, single buyer	2009 @			2002*, 2010**	Vertically integrated
India	Competition with organized trading and power exchanges	1991	2000	1999 (Orissa); 2002 (Delhi)	1996 (Orissa); 1998 (national)	Independent system operator
Nepal	Multiple sellers, single buyer	1992	PPP mode (Year?)		1994/2011 (ETFC Independence?)	Vertically integrated
Pakistan	Multiple sellers, single buyer	1994		1998 (KESC)	1995	Unbundled transmission owner
Sri Lanka	Multiple sellers, single buyer	1996			2002	Vertically integrated

So: Singh et al. (Forthcoming) as WB's PRWP

Status and Opportunities for Electricity Trade

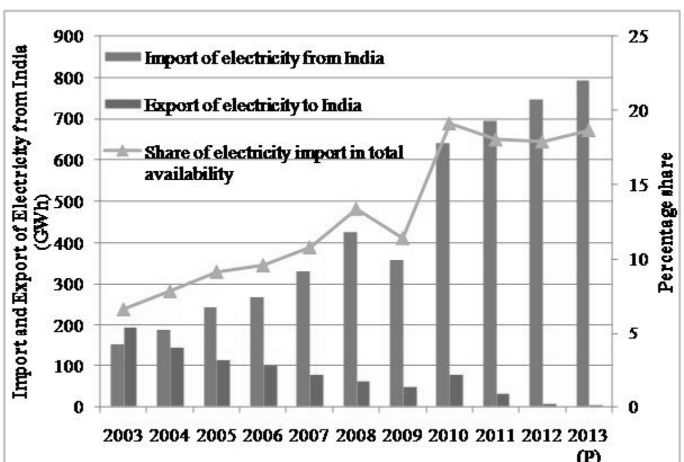
Status of Electricity Trade in SA

Participants	*Capacity*
India – Nepal	Nepal imported 793 GWh electricity in 2013 from India over multiple interconnections. (Singh, 2014)
India-Bhutan	Electricity import from Bhutan to India was 5556 GWh in 2013-14 (4627 GWh in 2012-13) from Hydro power stations at Tala, Chukha and Kurichu with a total export led capacity of 1416 MW. (ERLDC, 2014) As per an umbrella agreement between the two countries, India assures a minimum of 5000 MW electricity import by 2020.
Pakistan-Iran	Pakistan imported 419 GWh electricity in 2014 from Iran, up from 375 GWh in the previous year (NTDC, 2014). A MOU, signed in 2014, could enable Pakistan to import up to 3000 MW and electricity costing Pakistan PKRS 3 million per month. CASA-1000 expected to enhance trade with Central Asia.

Status of Electricity Trade in SA (Contd.)

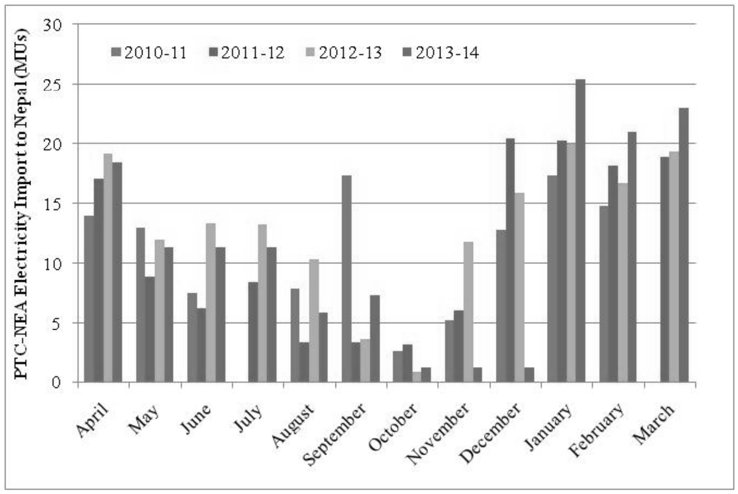
Afghanistan-Central Asia	Import of 2,246.2 GWh electricity from Iran, Uzbekistan, Turkmenistan, and Tajikistan in 2011. CASA-1000 expected to enhance this trade.
Pakistan-India	Pakistan has submitted a draft MoU to India on importing electricity using a 1200 MW interconnection. There are also possibilities of CASA-1000 tp be extended up to India.
India-Sri Lanka	Feasibility studies for a 400-kV India-Sri Lanka have been conducted to support import of up to 1000 MW electricity from India.
India-Bangladesh	In 2013, power systems of India and Bangladesh were interconnected through a HVDC line that can support electricity export of up to 500 MW (expandable to 1000 MW in future) from India to Bangladesh based on negotiated price and market based price.

Growing Import Dependency in Nepal

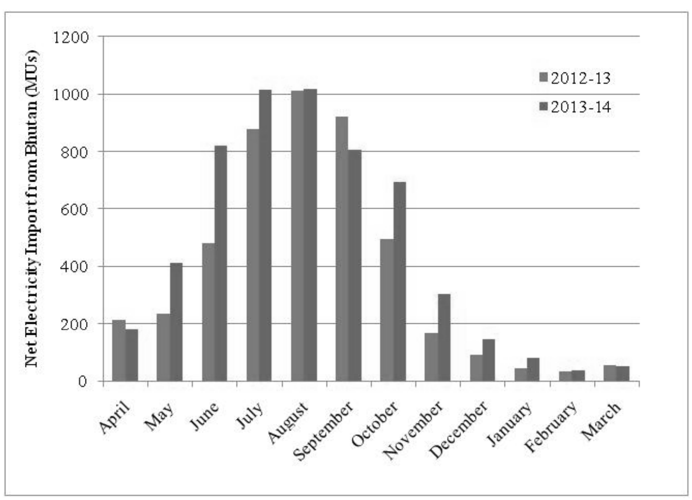


So: NEA (2012, 13)

Winter dependency of electricity import of Nepal



Seasonality of Export of Electricity from Bhutan



Cost-Benefit Estimation of Six Interconnection Projects in SAARC

S. No.	Case study	Key assumption	Total and annualised cost of transmission (USD million)	Annual benefit in 2016-17 (USD million)
1	India-Bhutan grid reinforcement	To evacuate Puna I & II, Mangdechhu and Dagachhu (3,066 MW) power to India	Total cost - USD 140-160 million. Annualised cost - USD 18-20 million pa is	Up to USD 1,840 million pa including USD 336 million in fuel/capacity benefit and USD 1,504 million savings due to unserved energy.
2	Nepal-Bihar (India) 400 kV link	(1) Surplus scenario - construction of all planned projects (2000 MW) to reach surplus state; and (2) Deficit scenario - 650 MW of planned capacity addition is delayed	Total cost USD 186 million including internal transmission upgrade costs. Annualised cost USD 20 million pa	Surplus scenario - Benefit of USD 105 million pa; Deficit scenario - Benefit of USD 215 million
3	India-Sri Lanka HVDC link	Addition of Puttalam Stage 2 (630 MW) and 400 MW by 2016. Trinco (1,000 MW) coal station is not considered is	Total cost - USD 339 million (2006 estimate) Annualised cost - USD 50 million pa (2010 estimate)	USD 186 million pa, including USD 96 million in benefits from reduction in unserved energy and USD 90 million in fuel/capacity benefits

So: ADB

Cost-Benefit Estimation of Six Interconnection Projects in SAARC (Contd.)

4	India-Bangladesh HVDC link	Three demand growth scenarios in Bangladesh between 9,000 MW to 12,000 MW in 2016-17	Total cost - USD 192 million to USD 250 million. Annualised cost - USD 25 million pa	Annual benefits of USD 145 to 389 million for three demand growth scenarios
5	India-Pakistan 220/400 kV link	Two scenarios: (1) Short term 250 MW transfer at 220 kV (2) Medium/long term, hundred megawatt transfer at 400 kV	Total cost (1) max USD 50 million for 220 kV option (45 km); and (2) Max USD 150 million for 400 kV. Annualised cost (1) USD 6 million (220 kV) (2) USD 18 million (400 kV).	Annual benefit (1) USD 335 million including USD 122 million in fuel cost savings (2) USD 491 million including USD 163 million in fuel cost savings
6	CASA 1000 and India-Pakistan 400 kV link	Two scenarios (1) Base Case CASA 1000; (2) Additional 850 MW hydro in Afghanistan	Total cost - (1) USD 893 million (2) USD 195 million for expanded India-Pakistan power transfer Annualised cost - USD 110 million	Combined Annual benefit - USD 1,250 million including USD 906 million in USE reduction and USD 306 million in fuel cost savings. Additional annual benefit of USD 90 million for the additional hydro scenario.

Regional Power Sector Cooperation – International Experience

Regional Electricity Arrangements

- Gulf Coast Countries (GCC)
- Greater Mekong Sub-region (GMS)
- Nile Basin Initiative (NBI)
- Nordpool
- Southern African Power Pool (SAPP)
- South East Europe (SEE)
- European Network of Transmission System Operators for Electricity (ENTSO-E)
- Central American Electrical Interconnection System (SIEPAC)

International Experience

Regional Entity	Formal Creation	Participating Members
ENTSO-E	2011	41 Transmission System Operators (TSOs) from 34 countries
GCC	2001	(6) United Arab Emirates, Bahrain, Saudi Arabia, Oman, Qatar, and Kuwait
GMS	1995	(7) Cambodia, PRC (Yunnan and Guangxi Zhuang), Lao PDR, Myanmar, Thailand, and Viet Nam.
NBI	1999	(9) Egypt, Sudan, Ethiopia, Uganda, Kenya, Rwanda, Burundi, DR Congo and Tanzania. Eritrea (Observer)
SAPP	1995	(9) Botswana, Democratic Republic of the Congo, Lesotho, Mozambique, Namibia, South Africa, Swaziland, Zambia, and Zimbabwe; (3 non-operating members)
SEE	2005	(9) Albania, Bosnia & Herzegovina, Bulgaria, Croatia, Kosovo, Macedonia, Montenegro, Romania, and Serbia
SIEPAC	1999	(6) Guatemala, El Salvador, Honduras, Costa Rica, Nicaragua and Panama

International Experience (contd.)

Regional Entity	Motivation / Drivers	Trading Status
ENTSO-E	Security of supply, seamless pan-European electricity market, secure integration of renewable resources ,and reliable future-oriented grid and adequate to meet energy policy goals.	428161 GWh (2012)
GCC	Share reserve capacity, thereby reducing generation investment needs in the region.	First in 2010 and intermittent
GMS	Efficient, environmentally sound growth of power sector; support to regional projects and electricity trade.	34139 GWh (2010)
NBI	Coordinated investment in power sector to meet region’s social and economic development objectives in the region.	
SAPP	Development of a safe, efficient, reliable, and stable interconnected electrical system and of a regional power trading mechanism.	10409 MWh (2011-12)
SEE	Create a regionally integrated electricity market, forming part of the wider EU single market.	Dry run (2006 – 09), 2010
SIEPAC	Create an integrated regional electricity market in Central America.	

Electricity Trade in GMS Region (GWh) - 2010

	Import	Export	Total Trade	Net Imports
Cambodia	1,546	–	1,546	1,546
Lao PDR	1,265	6,944	8,210	(5,679)
Myanmar	–	1,720	1,720	(1,720)
Thailand	6,938	1,427	8,366	5,511
Viet Nam	5,599	1,318	6,917	4,281
PRC	1,720	5,659	7,379	(3,939)
Total	17,069	17,069	34,139	

So: ADB, 2012

Bilateral to Regional Approach

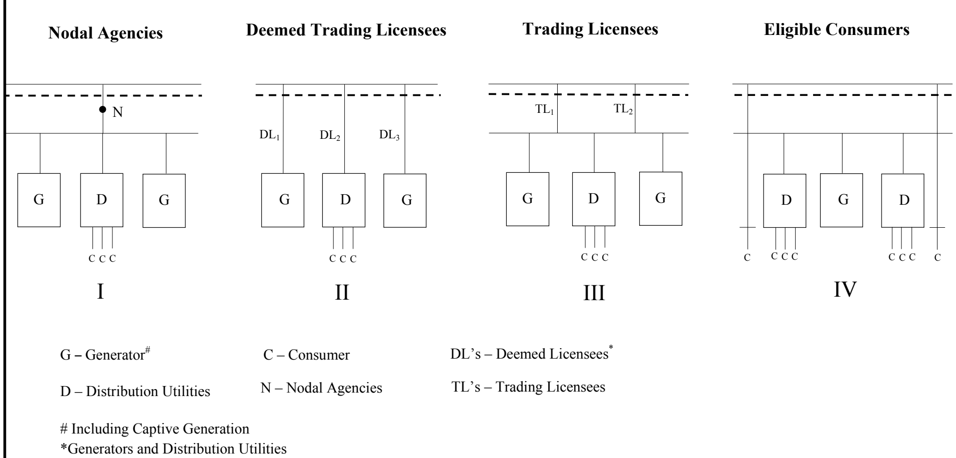
- SAPP was built upon historical bilateral interconnections in the 1950s and 1960s which witnessed development of interconnections projects between Democratic Republic of the Congo (DRC) and Zambia, and Zambia and Zimbabwe. Later, in 1975, between Mozambique and South Africa
- GMS' historical foundations can be traced back to 1971 with export of power from the Nam Ngum hydropower plant (HPP) in Lao PDR to northeast Thailand.

Options for Regional Power Market Development in South Asia

Choice of Being Cautious or Aggressive

- Stage I - Nodal Agency Based Market Structure
- Stage II - Participation of Deemed Trading Licensees
- Stage III - Participation of Trading Licensees
- Stage IV - All eligible consumers

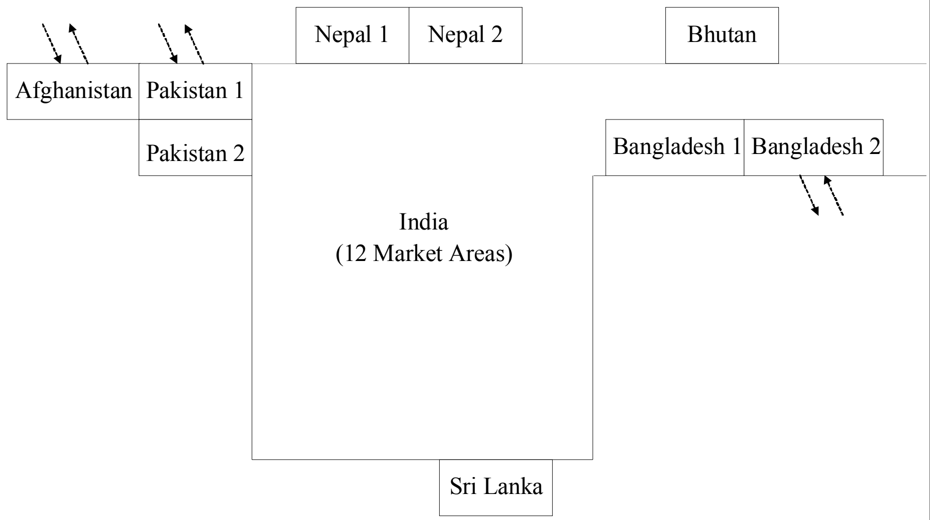
Choice of Being Cautious or Aggressive (Contd.)



Options for Market Design

- South Asian Regional Power Exchange (SARPX) or South Asian Power Exchange (SAPX)
- "Regional Contracts" on the Power Exchanges in India
- New 'Market Areas' on the Indian Power Exchanges
- Volume and/or Price coupling of All Power Exchanges across South Asia

New 'Market Areas' on the Indian Power Exchanges



Towards Regional Power Market Development in South Asia

Prerequisites for Development of a SA power market

- Accessible Energy Resources & easy licensing
- Transmission inter-linkages (who would invest?), and its access
- Coordinated scheduling and despatch
- Treatment of imbalances from schedule
- Metering and Energy Accounting
- Clearing and Settlement, and banking transactions
- Export / Import licensing
- Common currency and currency risk
- Treatment of export tax, import duty and transit tax
- Harmonised regulatory and policy framework
- Dispute Settlement

Evolving cross-border electricity trade

- Government to Government – Bhutan & India
- Power utility and trader (short-term) - Nepal & India (PTC)
- Power utility and trader (long-term) - Bangladesh (BPDB) & India (NVVN)

- Traders can offer relatively long-term supply contracts but price discovery is an issue. Useful for Short to medium agreements.
- Indian experience demonstrates short-term opportunities. PXs can play a crucial role – transparent and competitive price discovery.
- SA Contractual breakthrough - PPA between NVVN and BPDB, as it addresses many critical issues including currency, balancing, UI and dispute resolution.

Key regulatory/legal changes needed to facilitate cross-border trading

S. No.	Key Changes
	SHORT TERM MEASURES
1	Nodal agency for cross-border trading/ Access to PX
2	Investment framework
3	Regulation of Power Procurement from a PX
4	Settling imbalances
5	Duties and taxes
6	Commerce trading license restrictions
7	Dispute resolution
8	Tariff determination

	MEDIUM TERM MEASURES
1	Deemed trading licenses
2	Open access in transmission
3	Regulatory guidelines
4	Commercial mechanism to Settle imbalances
5	Transmission charges
6	Grid code
7	Transmission plan
	LONG TERM MEASURES
1	Trading license to other parties
2	Open access in distribution

So: Singh (2013) – Project Report Submitted to ADB

Approach to Develop Regional Power Market

- Socialising initial investment in cross-border inter-connections backed by medium/long-term bilateral between governments/government entities.
- Early demonstrated 'benefits' to bring in political acceptability.
- From 'power exchange' to 'Power Exchange'.
- Different stage of reform and unbundling
  - Accommodate differences in terms of licensing and market access
- Long-term regional transmission plan
- Regional coordination forum to harmonise technical, and regulatory framework.
- Dispute settlement mechanism

'Disruptive' Suggestions on the table!

- Coordinated Investment in Generation (South Asia Power Generation Co Ltd.?)
- Agreement for transit of (hydro) power between India and Bangladesh reciprocated with easing physical congestion at the chicken's neck for setting up transmission linkages.
- Multi-country owned cross-border transmission interconnections to reduce exposure to financial and operational risk. (South Asia Power Transmission Co Ltd.?)
- Regional mechanism/forum for coordination and dispute resolution.

Thank You

www.iitk.ac.in/ime/anoops

anoops@iitk.ac.in

Output

Anoop Singh, Tooraj Jamasb, Rabindra Nepal, and Michael Toman, Cross-Border Electricity Cooperation in South Asia, **World Bank Policy Research Working Paper (PRWP) #7328 http://documents.worldbank.org/curated/en/2015/06/24687043/cross-border-electricity-cooperation-south-asia**	Published
Anoop Singh & Michael Toman, , International Experiences in Regional Electricity Market Development: Lessons for South Asia. **World Bank Policy Research Working Paper (PRWP)**	Drafts under review
Anoop Singh & Michael Toman, Benefits of and Barriers to Regional Electricity Cooperation: A Review of the Literature. **World Bank Policy Research Working Paper (PRWP)**	
Anoop Singh, Options for Market Design and Strategy for Developing a Regional Electricity Market in South Asia.	

Selected Readings

(some accessible from www.iitk.ac.in/ime/anoops)

- "Towards a Competitive Market for Electricity and Consumer Choice in Indian Power Sector", Energy Policy Vol. 38 4196-4208, 2010. (Elsevier)
- "A Market for Renewable Energy Credits in the Indian Power Sector", Renewable and Sustainable Energy Review journal, Elsevier, 2009.
- "Economics, Regulation and Implementation Strategy for Renewable Energy Certificates in India" in India Infrastructure Report 2010, Oxford Univ. Press.
- "Analysing Efficiency of Electric Distribution Utilities in India: a Data Envelopment Analysis" (with Dilip Kumar Pandey), IAEE International Conference, Stockholm 19-23 June, 2011.
- "Modelling Economic Efficiency of Renewable Energy Policies: A Multi-State Model For India", Accepted for World Renewable Energy Congress, 17-19 Oct. 2011, Bali, Indonesia. (with Sundeep Chowdary).
- "Economics of Iran-Pakistan-India Natural Gas Pipeline: Implications for Energy Security in India", Economic & Political Weekly, V. XLIII, No. 7 2008.
- "Power Sector Reform in India: Current Issues and Prospects", Energy Policy, Elsevier, Volume 34, Issue 16, November 2006.

Selected Readings (Contd.)

- “Estimating the Impact of Restructuring on Electricity Generation Efficiency: The Case of the Indian Thermal Power Sector”, NBER Working Paper 17383, 2011 (with Maureen L. Cropper, Alexander Limonov and Kabir Malik)
- “Analysing Efficiency of Electric Distribution Utilities in India: a Data Envelopment Analysis” (with Dilip Kumar Pandey), IAEE International Conference, Stockholm 19-23 June, 2011.
- “Directions for Effective Regulation for Renewable Energy: An Analysis of Renewable Energy Certificates”, India Energy Security Summit: Energy Security for a sustainable future, 3-4 March 2011, New Delhi, IPPAI.
- “At a Crucial Juncture: A perspective on development of electricity and REC markets in India”, 3 years of Indian Energy Exchange: Vision and Views of Industry Leaders, 2011, Powerline / IEX, New Delhi.
- “Economics, Regulation and Implementation Strategy for Renewable Energy Certificates in India” in *India Infrastructure Report 2010*, Oxford Univ. Press.

Selected Readings (Contd.)

- “A Policy for Improving Efficiency of Agriculture Pump sets in India: Drivers, Barriers and Indicators”, Climate Strategies, UK, Working Paper 2009
- “Climate Co-benefit Policies for the Indian Energy Sector: Domestic Drivers and North-South Cooperation”, *Climate Policy* 9 (5) 529-543 2009
- “Informal Markets for Electricity: Economics of lighting for Hawkers in India”, *International Journal of Energy Sector Management: Special Issue on India, 3(3), 308-323,* 2009.
- “A Market for Renewable Energy Credits in the Indian Power Sector”, *Renewable and Sustainable Energy Review,* Elsevier, 2009.
- “Rural Electrification in India: Economic and Institutional aspects of Renewables”, with James Cust and Karsten Neuhoff, EPRG WP 0730, University of Cambridge, UK., 2007