WRI INDIA

Federal Ministry
for the Environment, Nature Conservation
and Nuclear Safety

of the Federal Republic of Germany

WEBINAR:

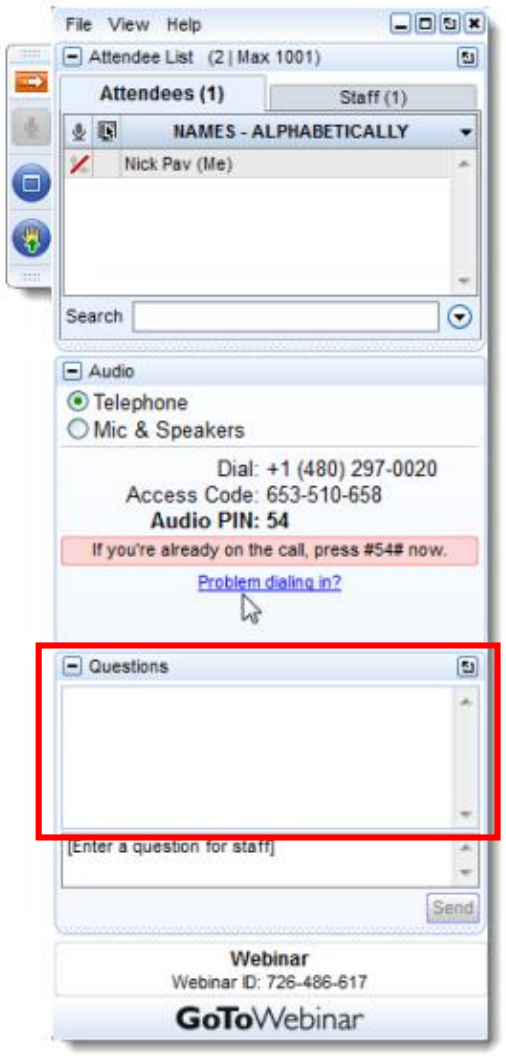
BRINGING SUSTAINABLE DEVELOPMENT CONSIDERATIONS TO RENEWABLE ENERGY DECISION-MAKING

03 October 2019 | 3:00 - 4:00 PM IST

INTRODUCTION

Attendee Participation

- Attendees remain in listen-only mode
- Please use the Questions pane to raise comments or questions during the webinar
- **Note:** Today's presentation is being recorded and will be shared with registered participants



IN TODAY'S WEBINAR

Introduction to Today's Topic	**Ulka Kelkar** Director - Climate Program **WRI India**
India's Energy Transition & Barriers to RE	**Dr. Rangan Banerjee** Head of Dept. - Energy Science & Engineering **IIT-Bombay**
Proposed Framework for Decision-making & Preliminary Findings from WRI's Ongoing Research	**Ashwini Hingne** Manager – Climate Program **WRI India**
Q&A	

Introduction to the topic

Ulka Kelkar

India’s Energy Transition and Barriers to RE

Rangan Banerjee
Dept of Energy Science and Engineering
IIT Bombay

WHAT IS AN ENERGY TRANSITION

A particularly significant set of changes to the patterns of energy use in a society'

(O'Connor 2010)

'Energy infrastructures are socio-technical systems. A system transition is a substantial change in the state of a socio-technical system'

(Chappin, 2011)

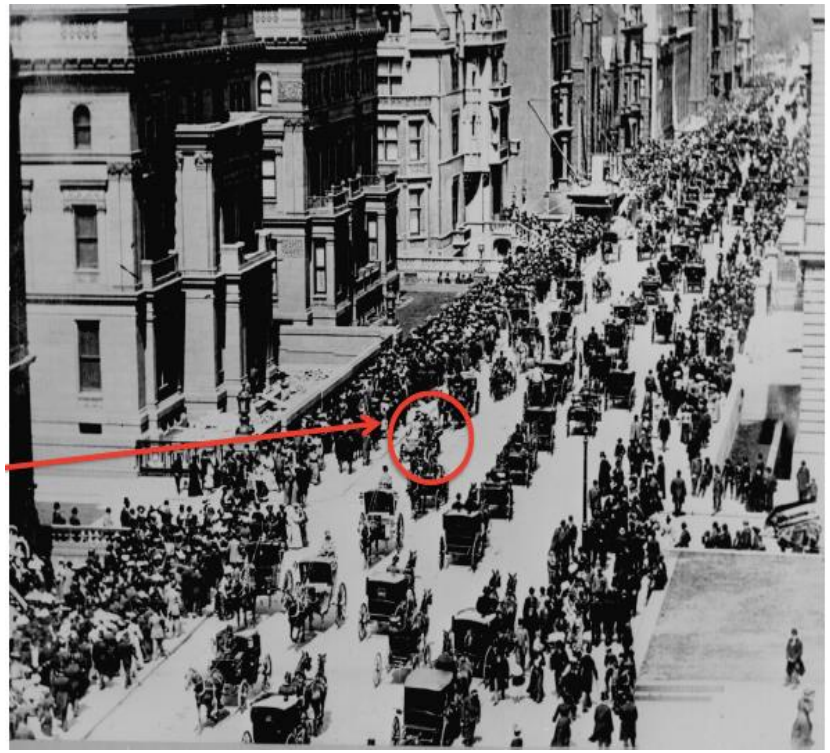
''Energiewende' (Morris and Pehnt, 2012)

Why is it important?

TRANSPORT TRANSITION

5th Avenue New York

15th April 1900



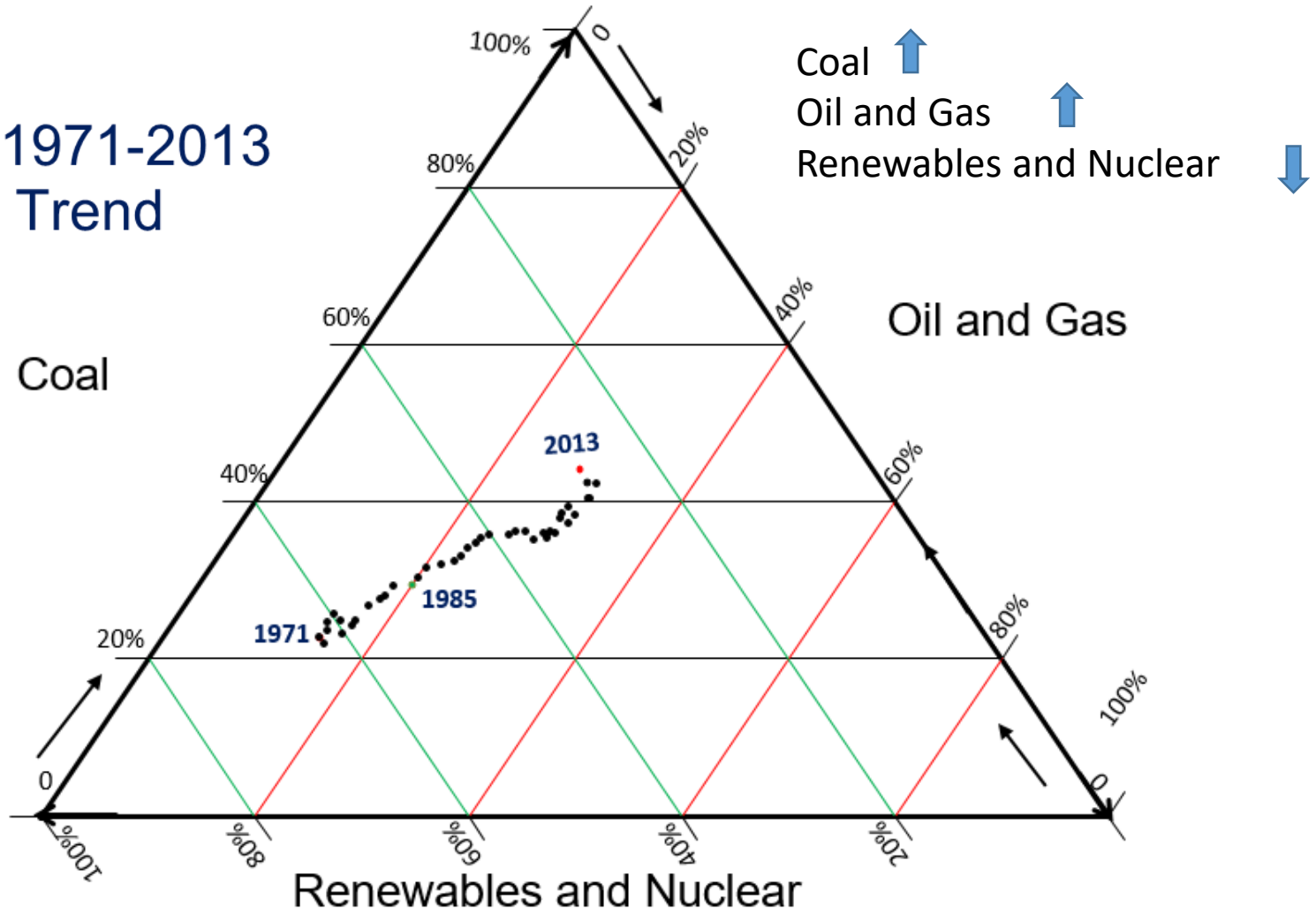
March 23, 1913

https://therationalpessimist.com/2015/03/22/charts-du-jour-21-march-2015-battery-banter/

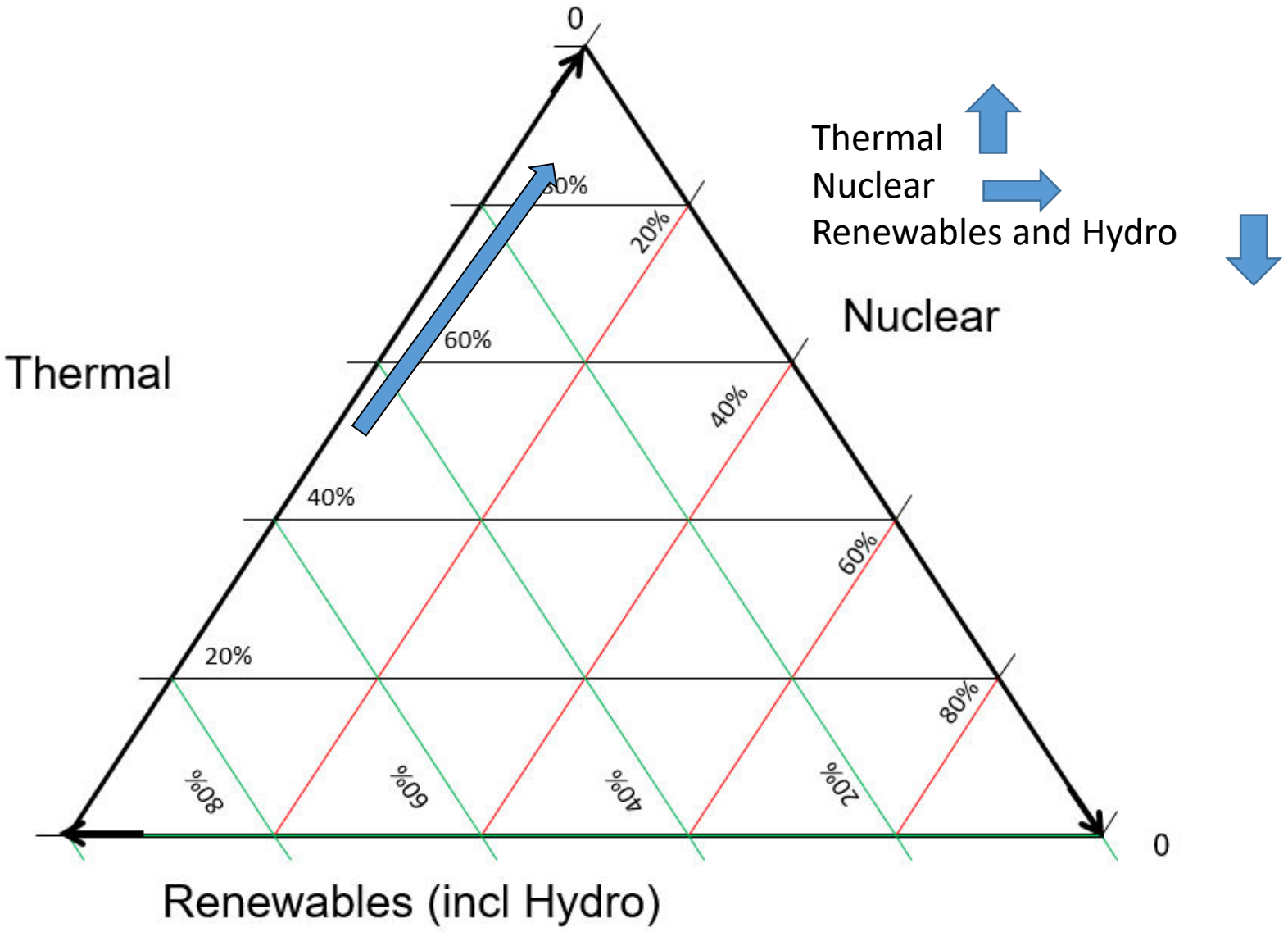
RENEWABLES IN INDIA SHARE

POLL

PRIMARY ENERGY MIX



POWER GENERATION – SUPPLY MIX



ENERGY TRANSITIONS IN THE PAST

- Transition from traditional fuels to modern, commercial fuels (mainly fossil)
- Investment in centralized energy supply and distribution infrastructure
- Centralised inter- connected electricity grid
- Large hydro and coal based thermal power plants
- Focus on supply growth
- Public sector and government investments

DRIVERS FOR ENERGY TRANSITION

- Climate Change – Paris commitments – global move away from fossil
- Significant drop in prices of Solar PV and wind
- Reduction in prices of shale oil and natural gas
- Success in public procurement of LEDs – rapid decline in prices
- Internet of Things – Technology developments, Intelligent sensors, control

INDIA'S ENERGY TRANSITION

#1 Reduce Emissions Intensity of GDP by 33-35% of 2005 level in 2030

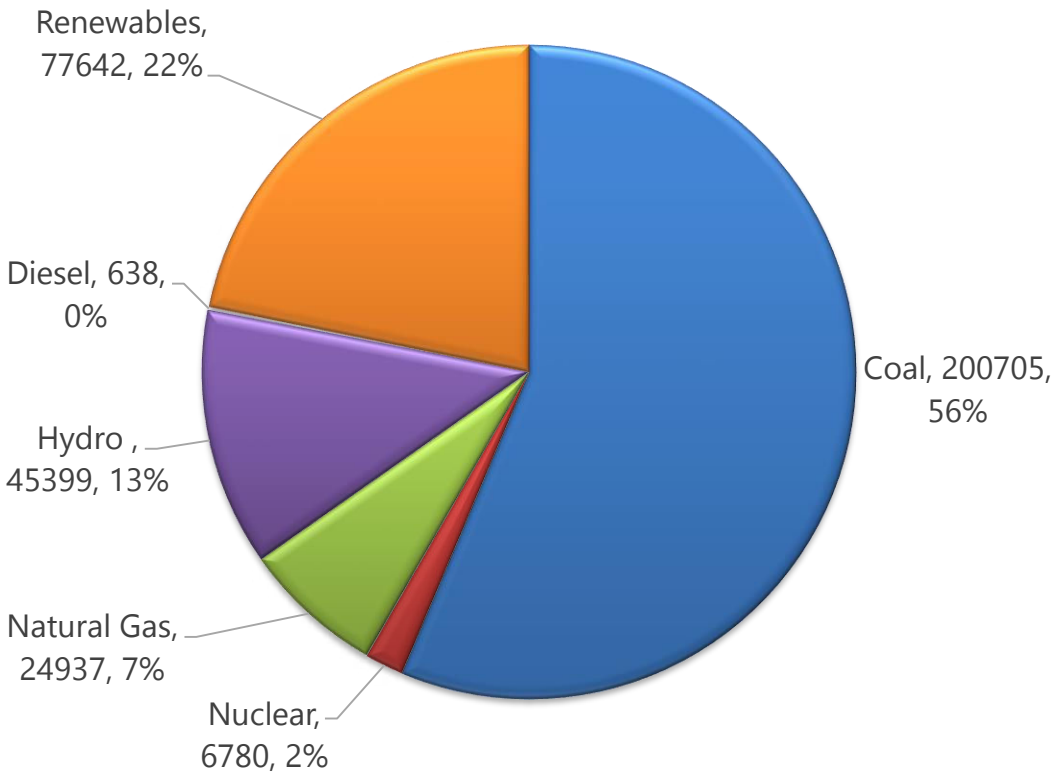
#2 Create 40% cumulative non fossil power by installed capacity by 2030 (using finance from Green Climate Fund)

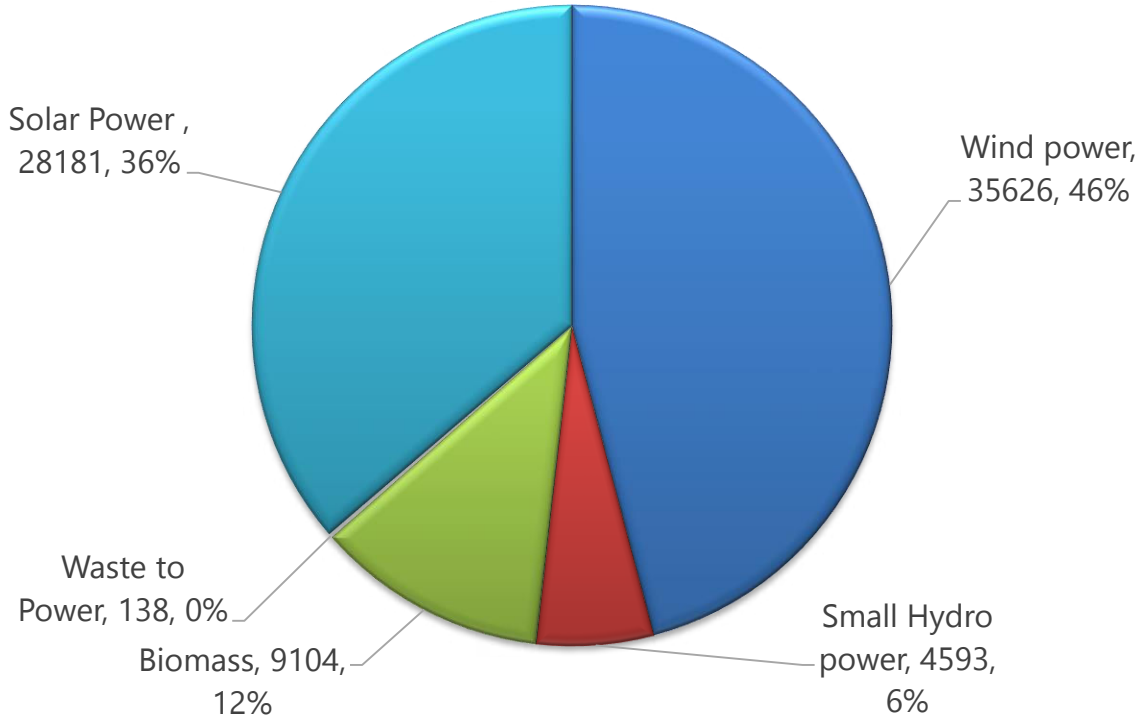
#3 Create an additional carbon sink of 2.5 to 3 billion tonnes of CO_2 equivalent through additional tree cover and forest

CHALLENGES FOR THE ENERGY TRANSITION

- Electricity Sector Transition – Supply mix, efficiency
- Transport Sector transitions – moving away from oil – CNG, Electric, Hydrogen, Bio-fuel, Methanol, Private to Public transport- reduce demand for travel – air travel
- Cooking Energy – LPG, Electricity, modern biomass

INDIA INSTALLED CAPACITY – AS OF 31.03.2019





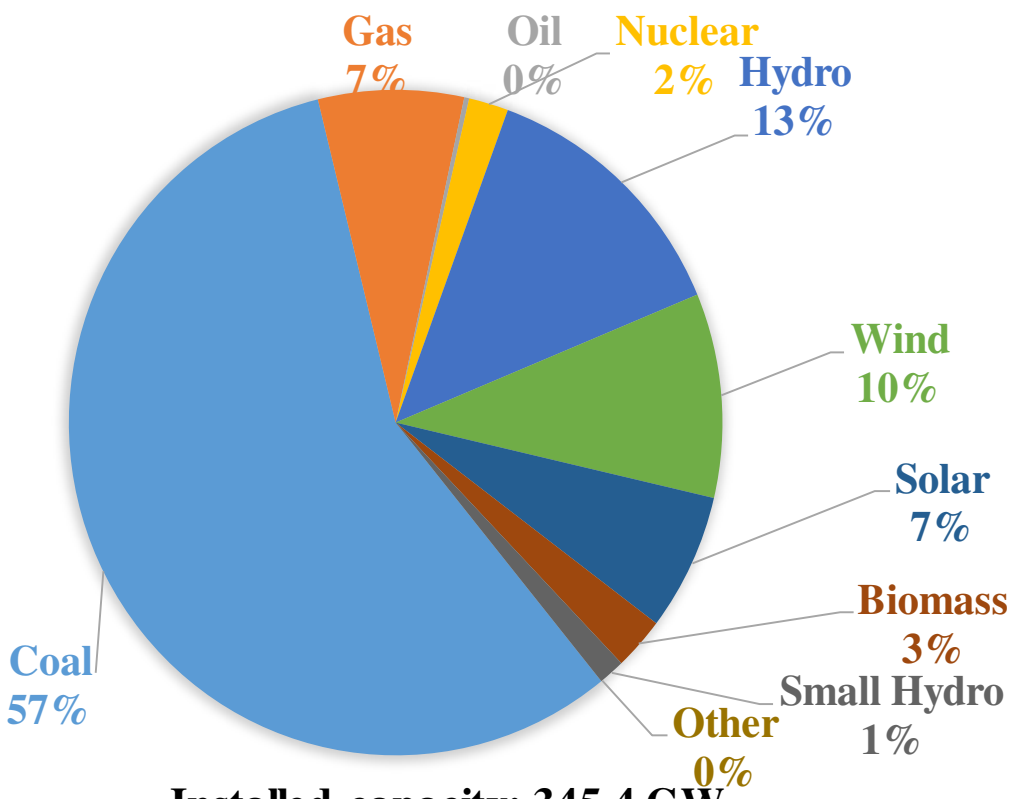
Total installed capacity:
356100 MW

Renewable installed capacity :
77642 MW

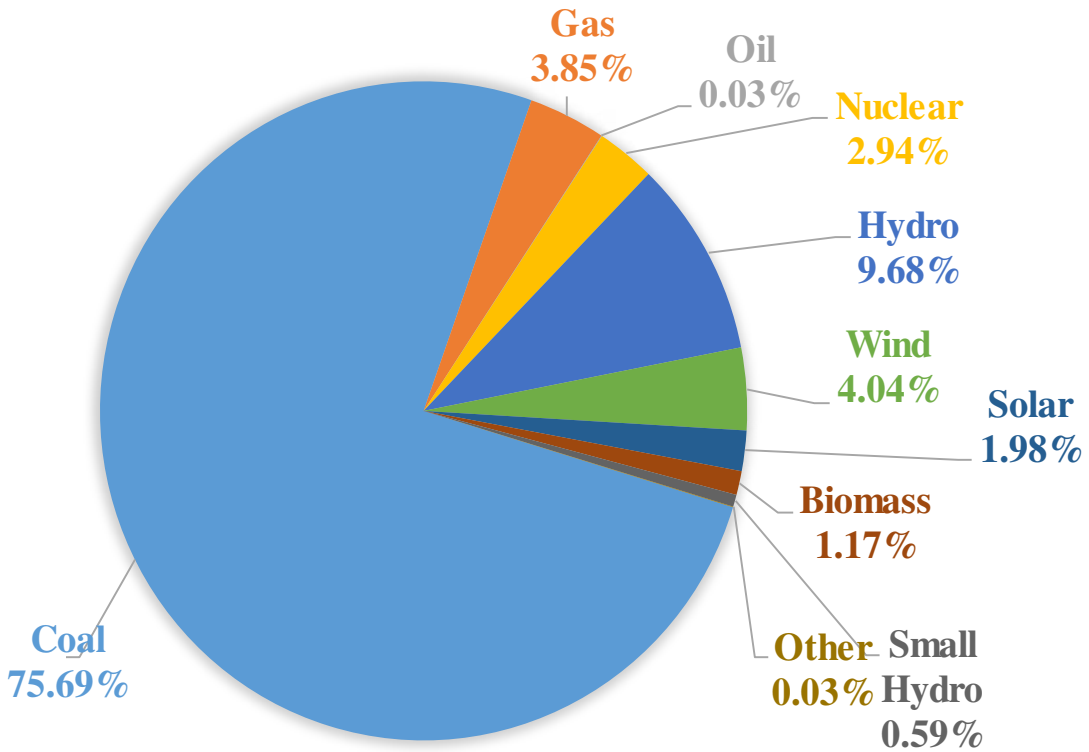
Source: Central Electricity Authority (CEA), GOI, Ministry of Power, India

SHARE OF ELECTRICITY BY SUPPLY IN INDIA

2017-18

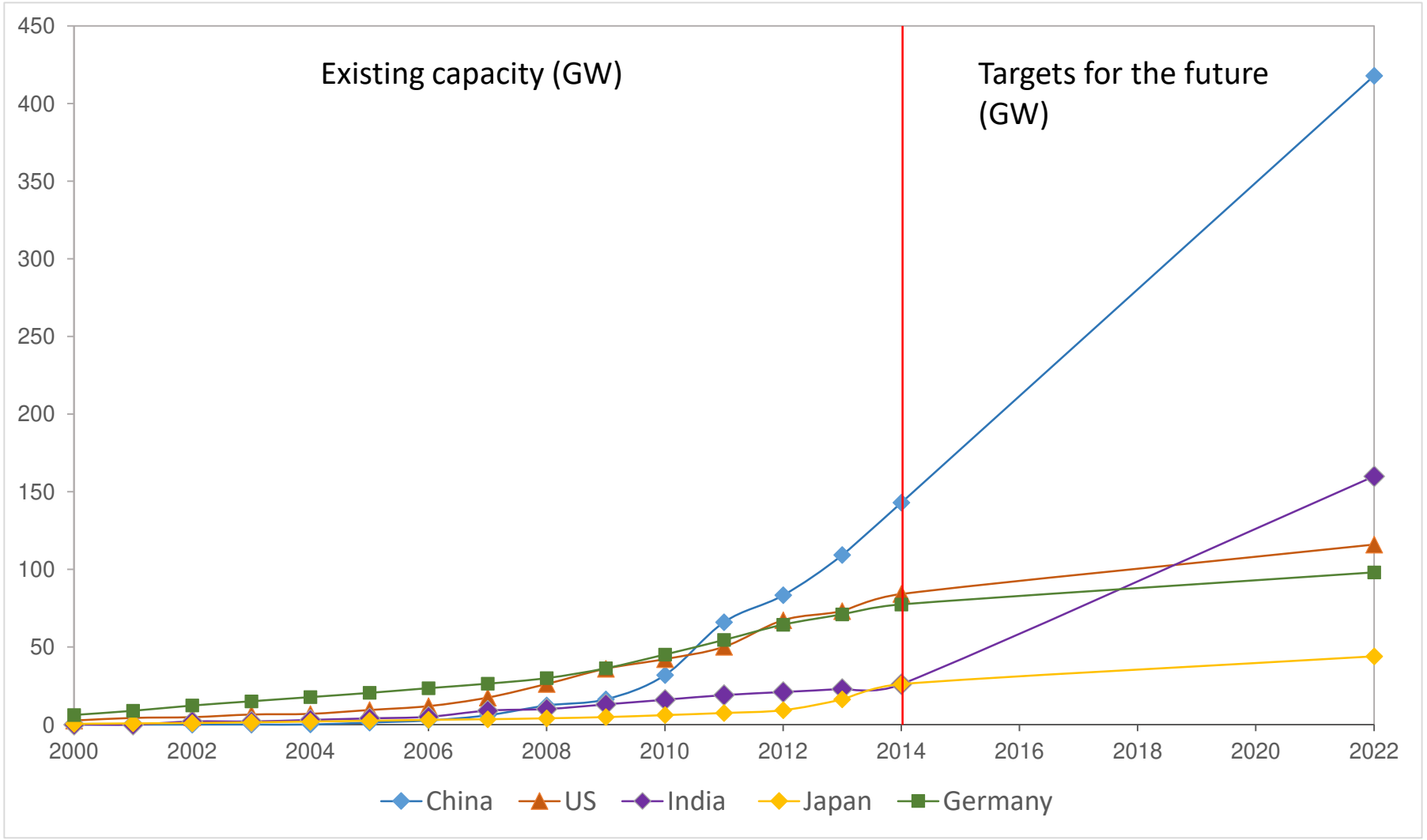


Installed capacity: 345.4 GW

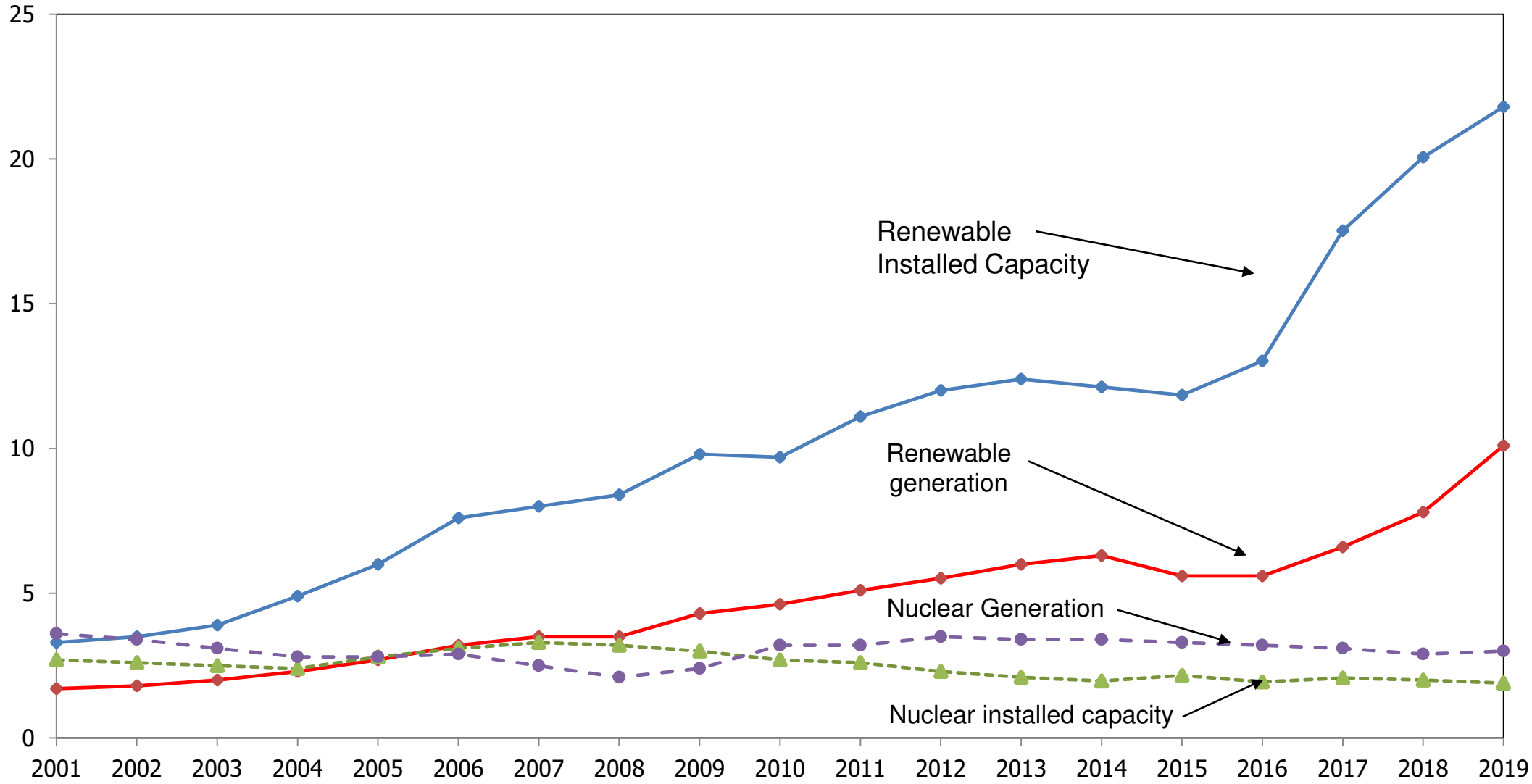


Annual generation: 1303.4 TWh

SOLAR AND WIND GROWTH



RENEWABLE SHARE IN POWER

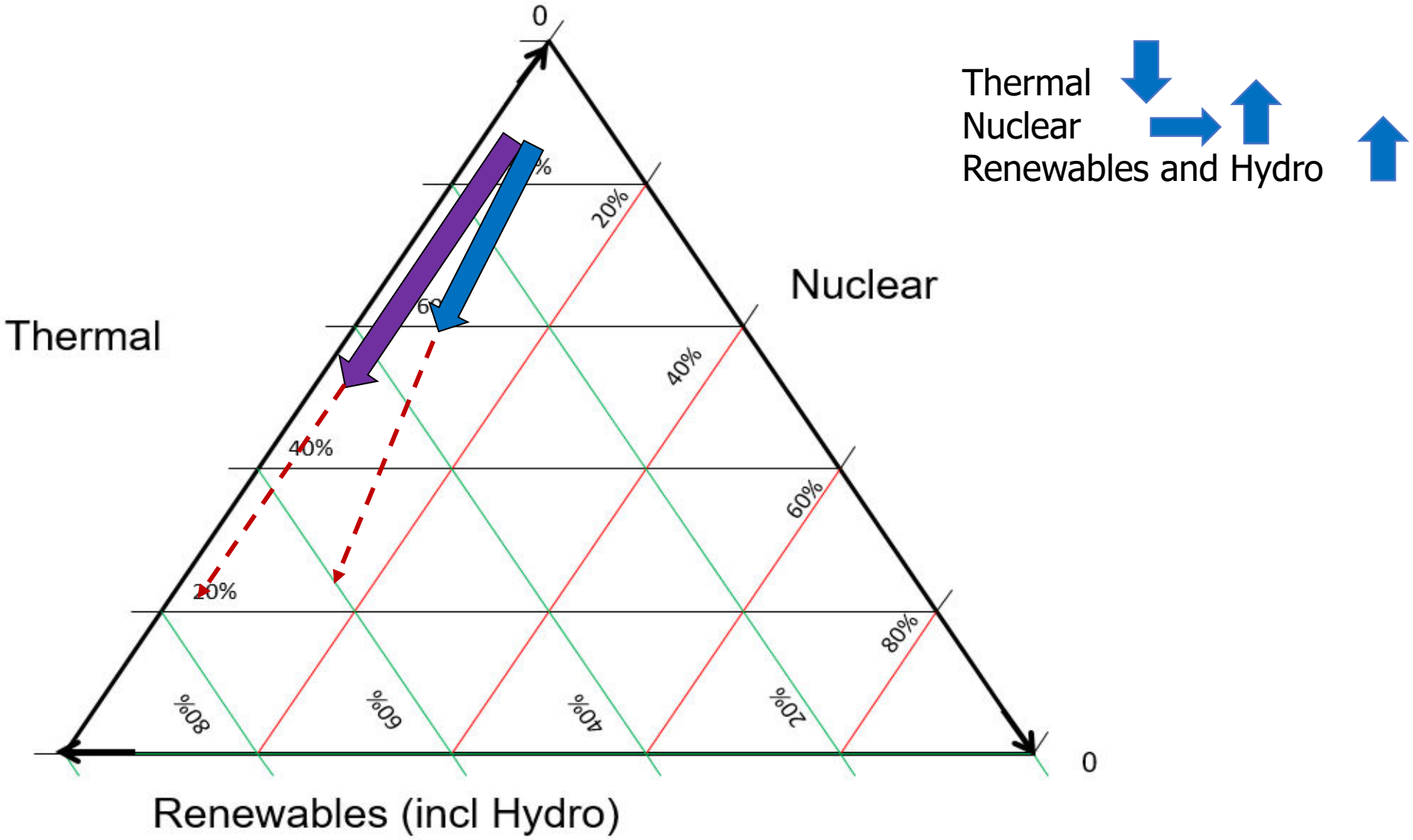


RENEWABLE INSTALLED CAPACITY AND GENERATION

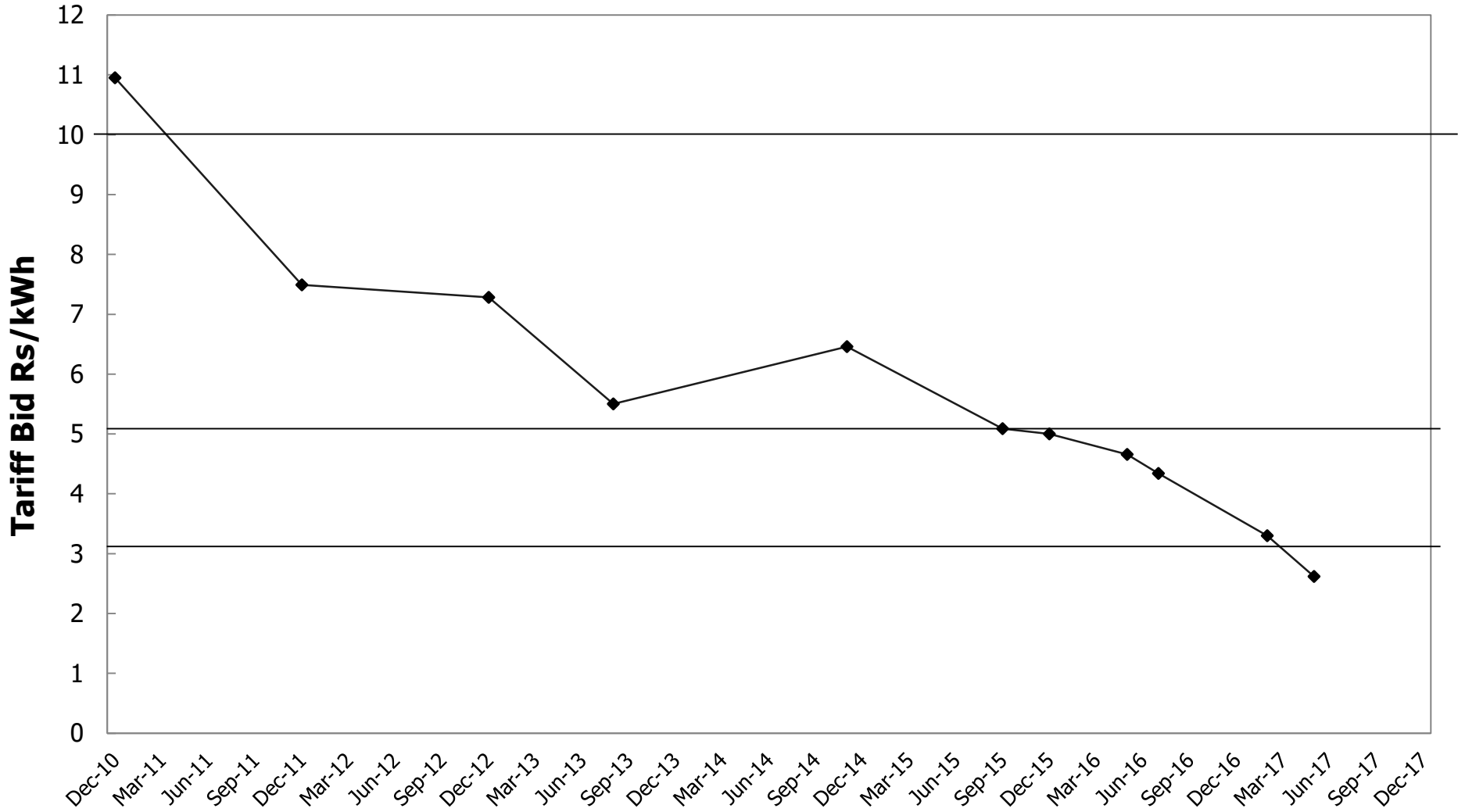
Source	Installed Capacity* (MW)	Estimated Capacity factor	Estimated Generation (GWh)
Wind	35816	14%	43925
Biomass & Bagasse	9807	70%	52133
Small Hydro	4594	40%	16098
Waste to Energy	138	50%	606
Solar PV	28679	19%	47733
Total	79034	25%	160495

*as on 30.04.2019 MNRE website: www.mnre.gov.in

POWER GENERATION – SUPPLY MIX



VARIATION IN SOLAR BID PRICES

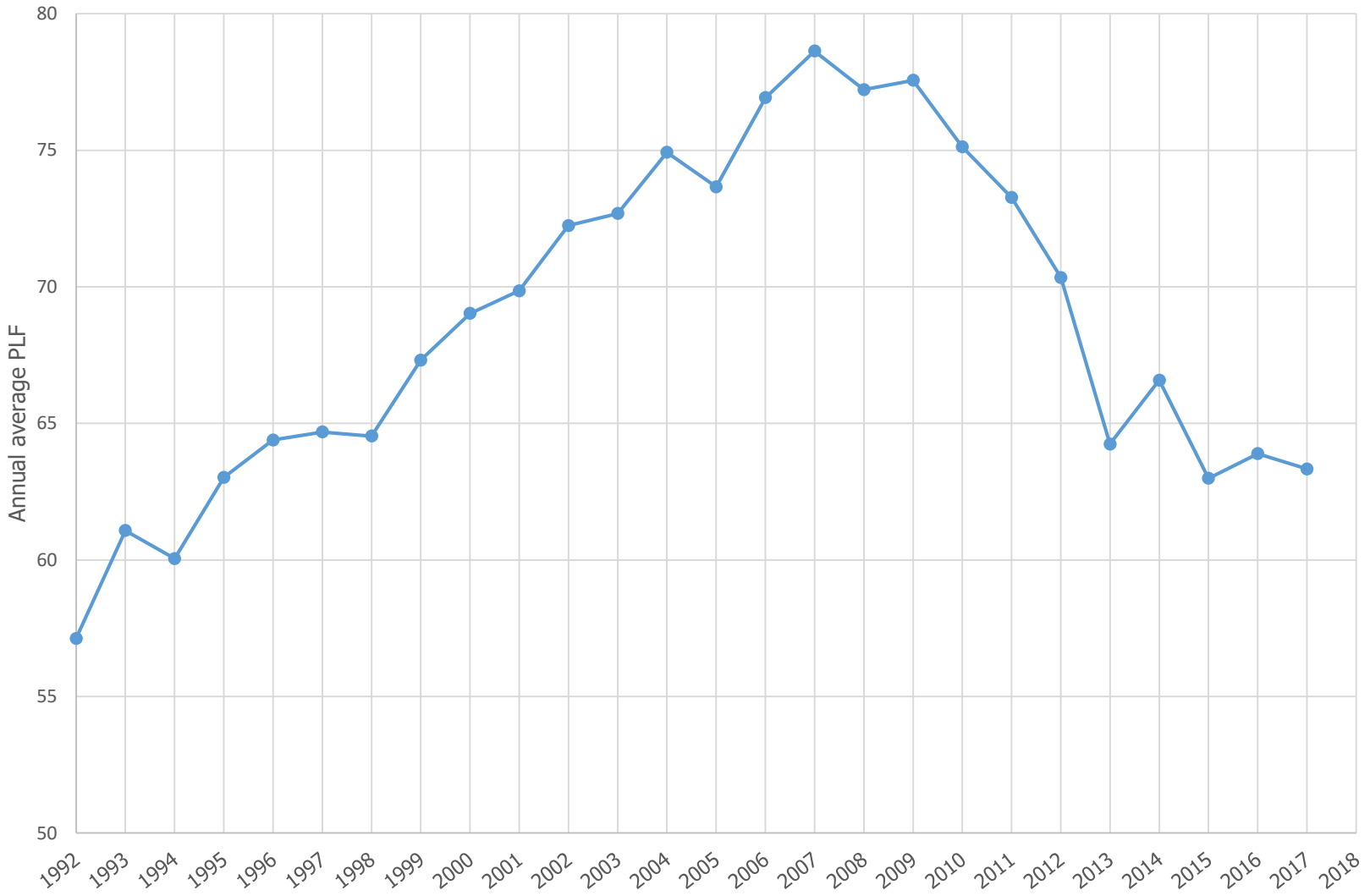


WORLD'S LARGEST SOLAR PLANT

648 MW 46540 Million~ Rs 72 Million/ MW
Area 10 km^2 Kamothi, Tamil Nadu
Robotics for automatic panel cleaning
Plant built in 8 months

http://www.indiatimes.com/news/india/india-is-now-home-to-the-world-s-largest-solar-power-plant-it-s-big-enough-to-power-150-000-homes-266449.html

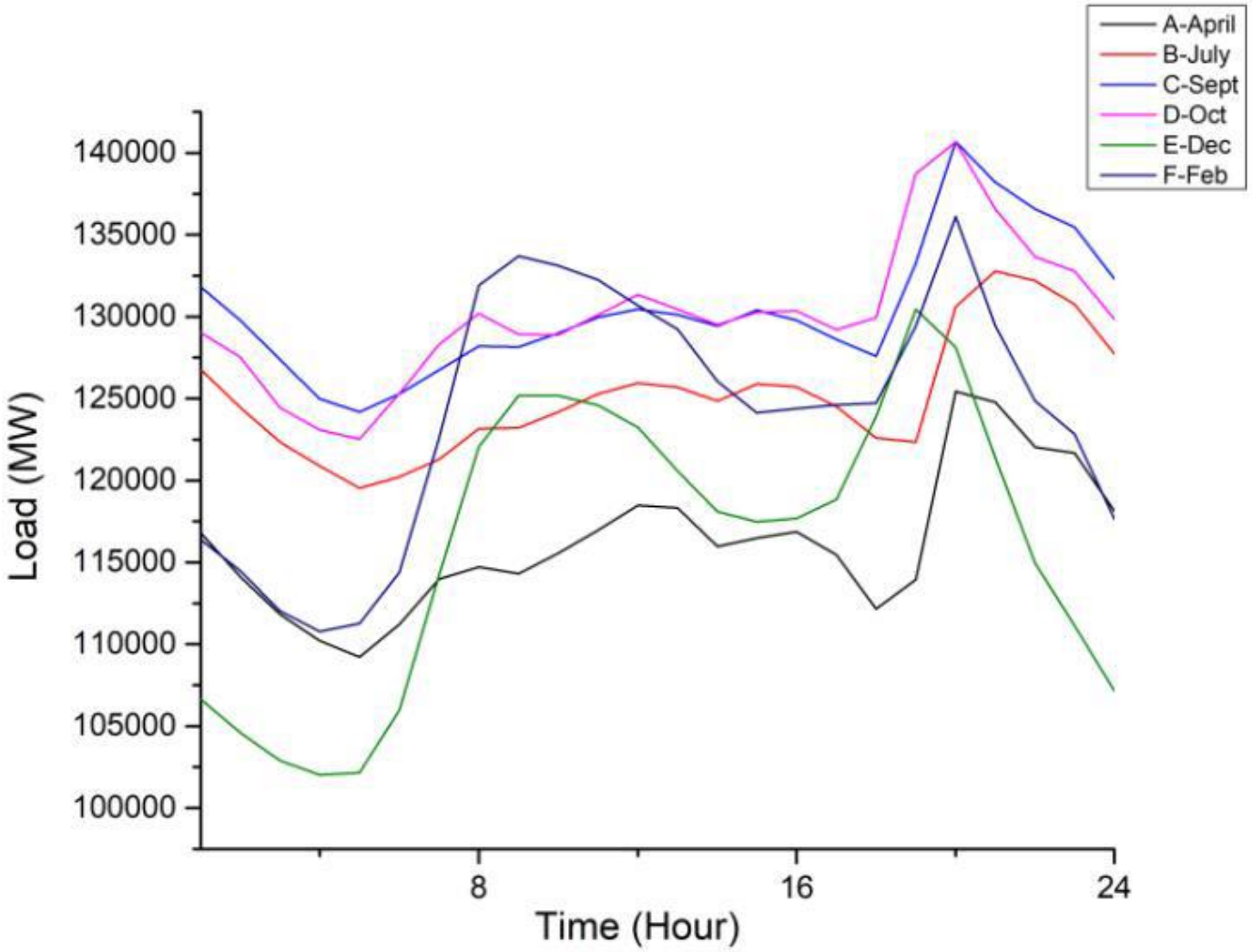
COAL POWER PLANTS PLF



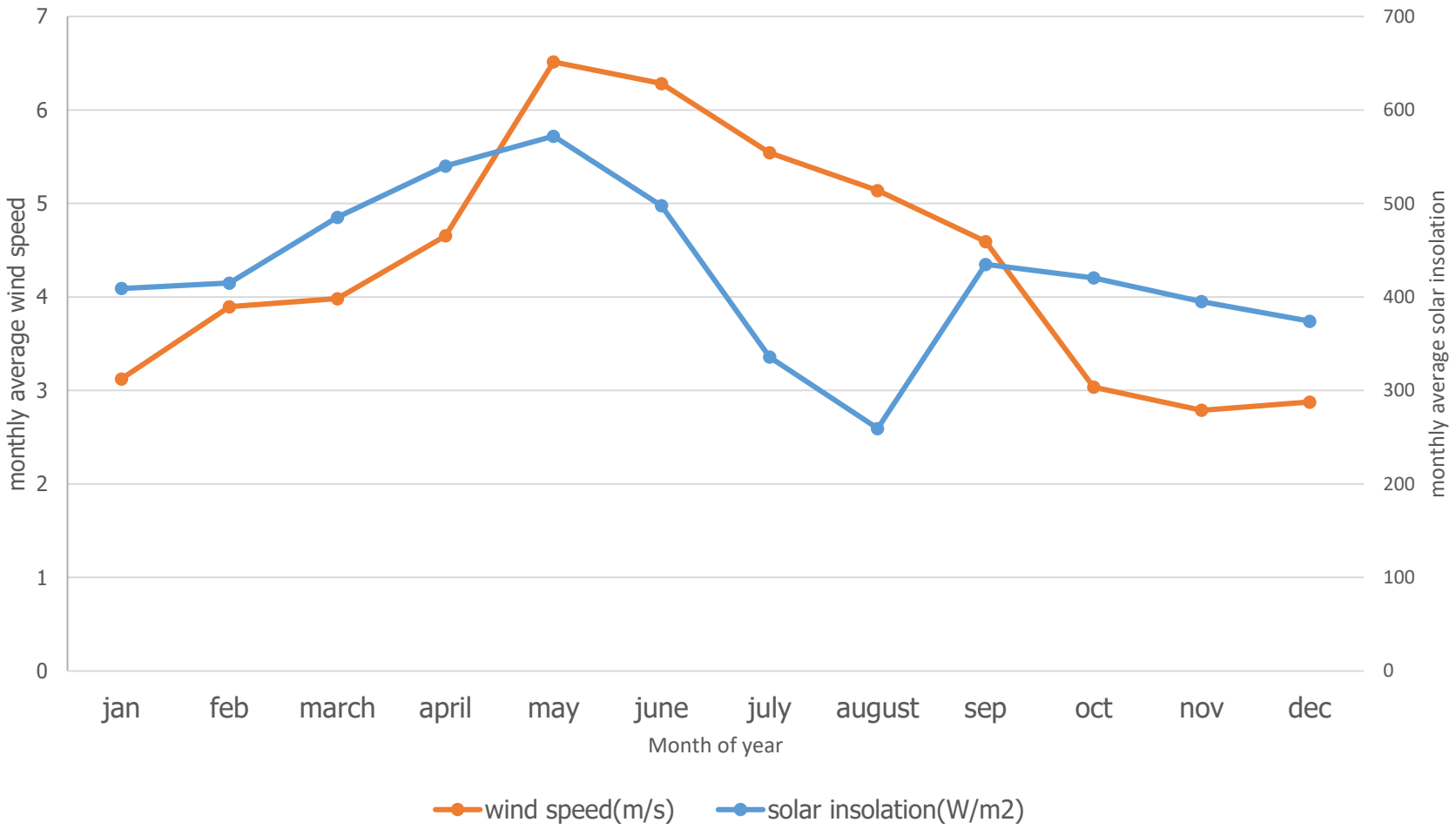
ELECTRICITY SECTOR TRANSITIONS

- Optimal operating strategy – planning for grid operation
- Strategies for flexibility in thermal power operation
- Impact of higher penetration of PV, Wind on grid operations
- Strategies for existing power plants, infrastructure
- Regulation- balancing loads, new tariff policies

NATIONAL DAILY LOAD PROFILES 2016



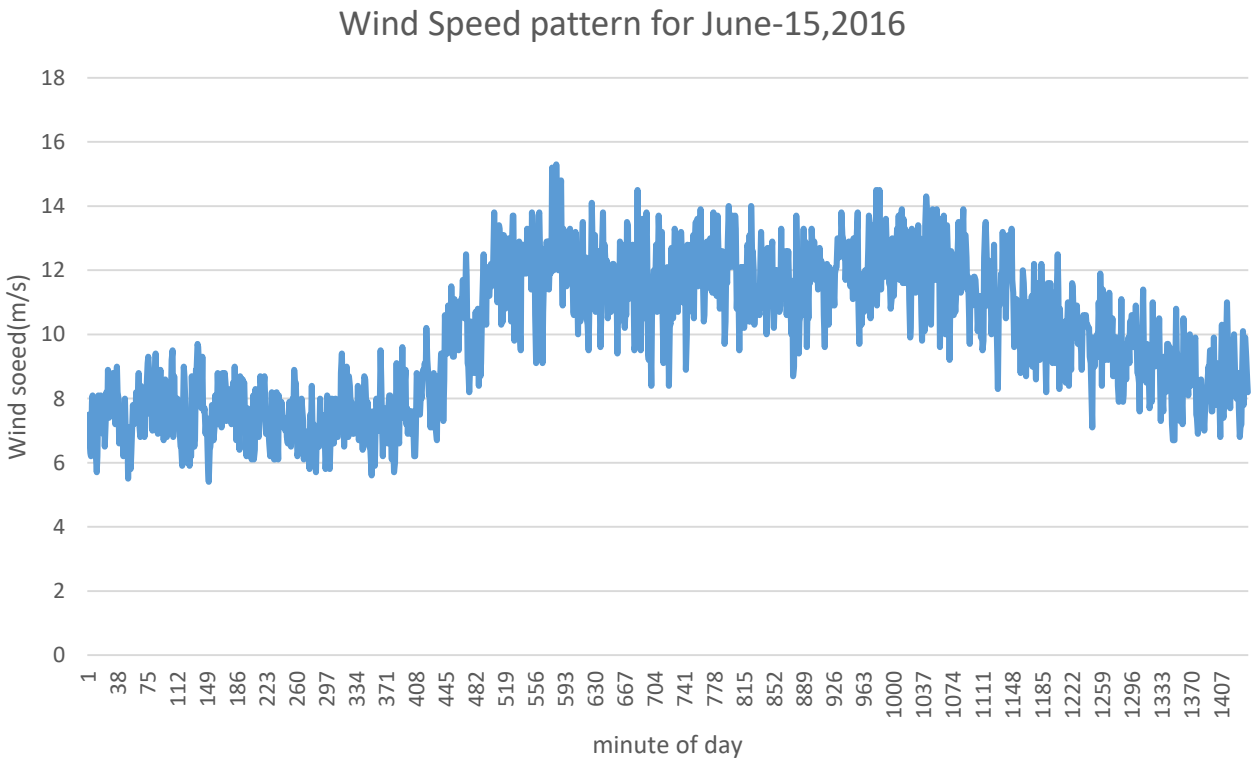
MONTHLY VARIATION OF WIND SPEED AND SOLAR ISOLATION FOR 2016

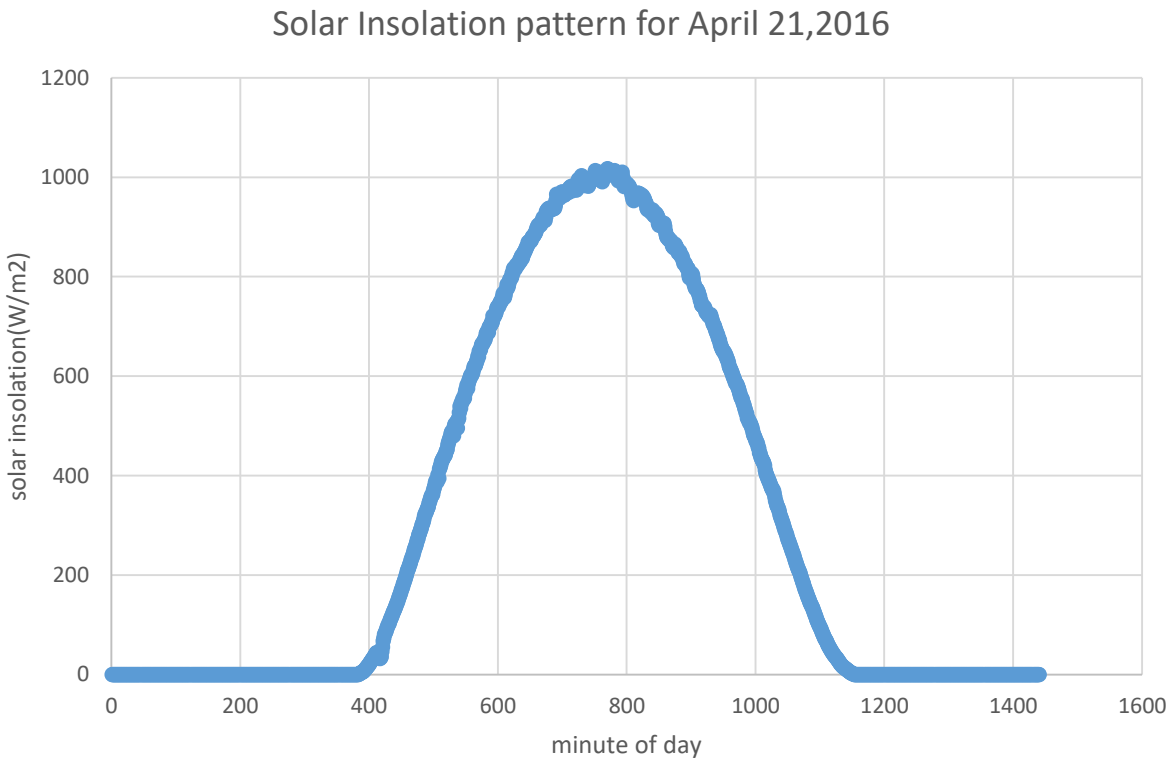


Source: NIWE

Wind speed(m/s) measured at 10m and GHI (W/m^2) , Chandrodi, Kutch Gujarat

MAXIMUM WINDY AND SUNNY DAYS FOR 2016

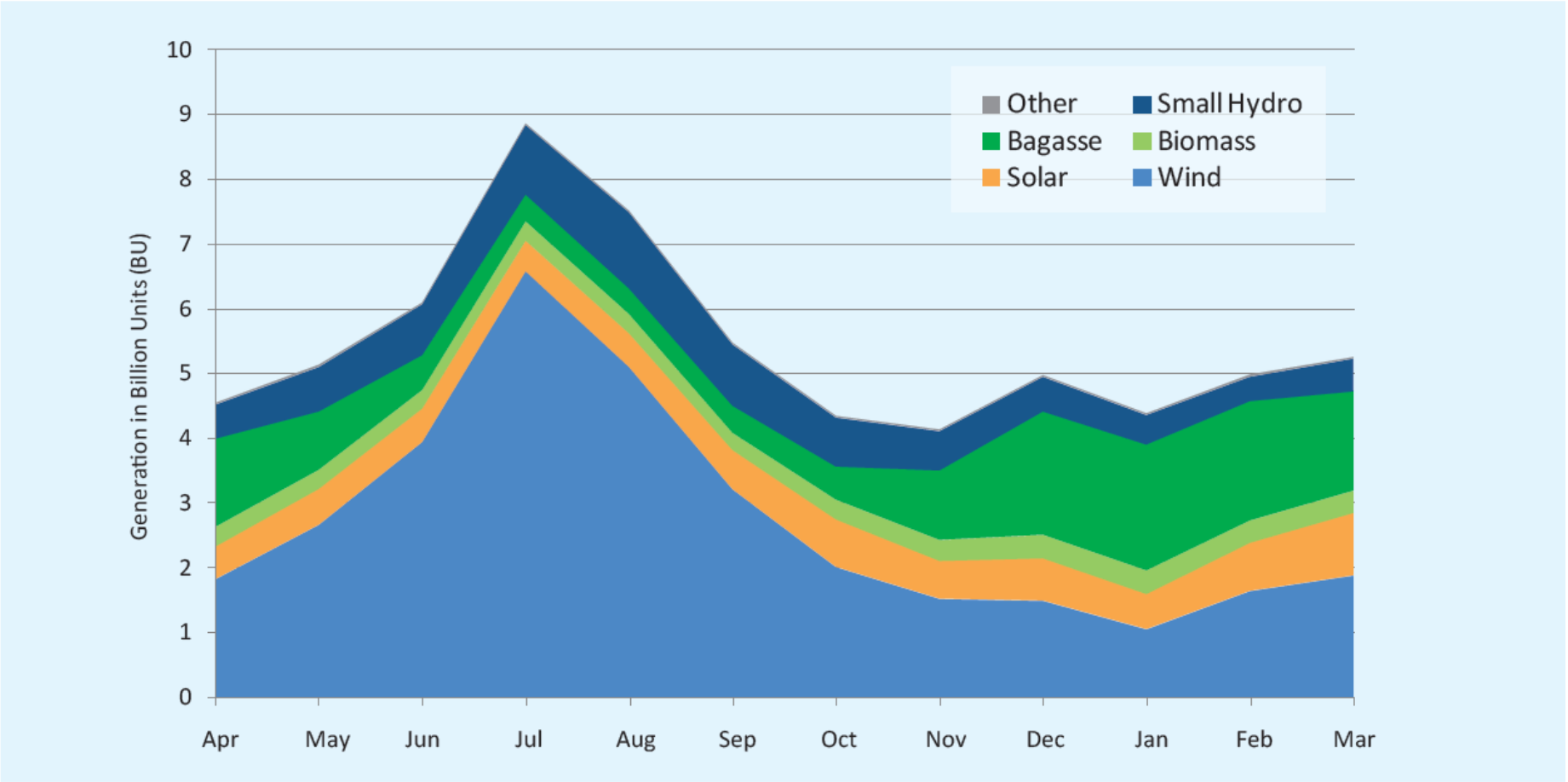




Source: NIWE

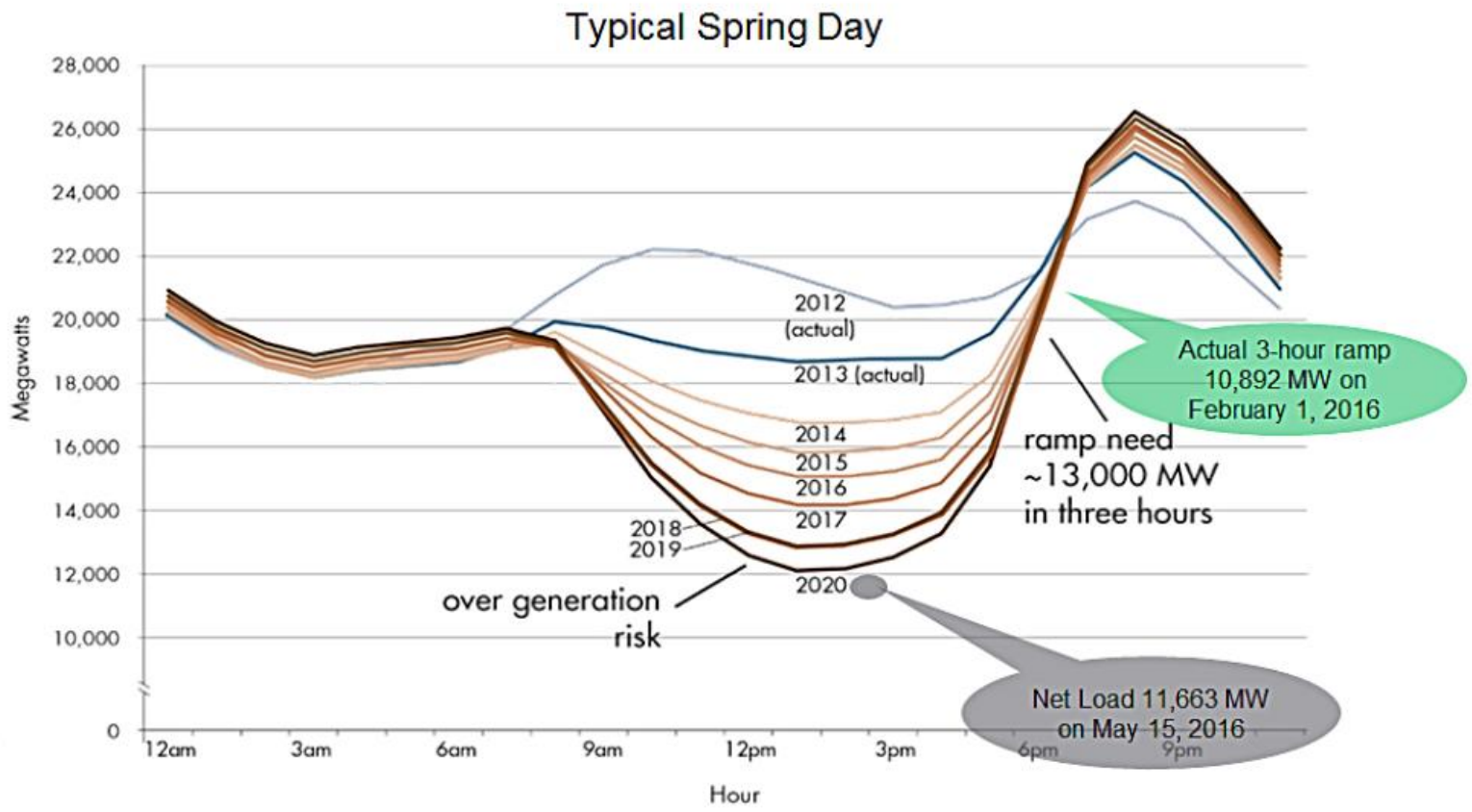
Chandrodi, Kutch Gujarat

RENEWABLE GENERATION 2016



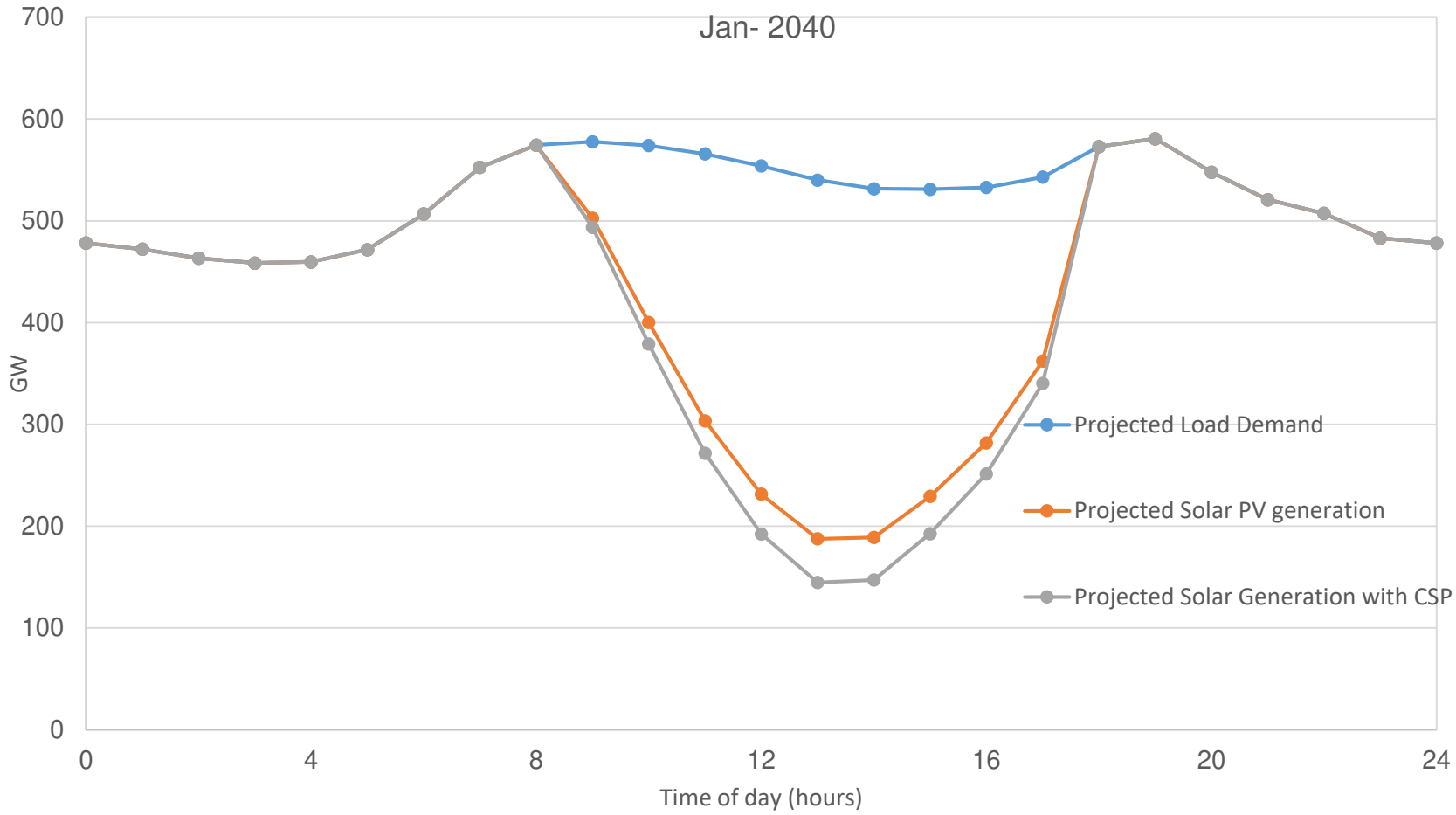
Source: Prayas Oct 2016 India's journey towards 175 GW

CALIFORNIA DUCK CURVE

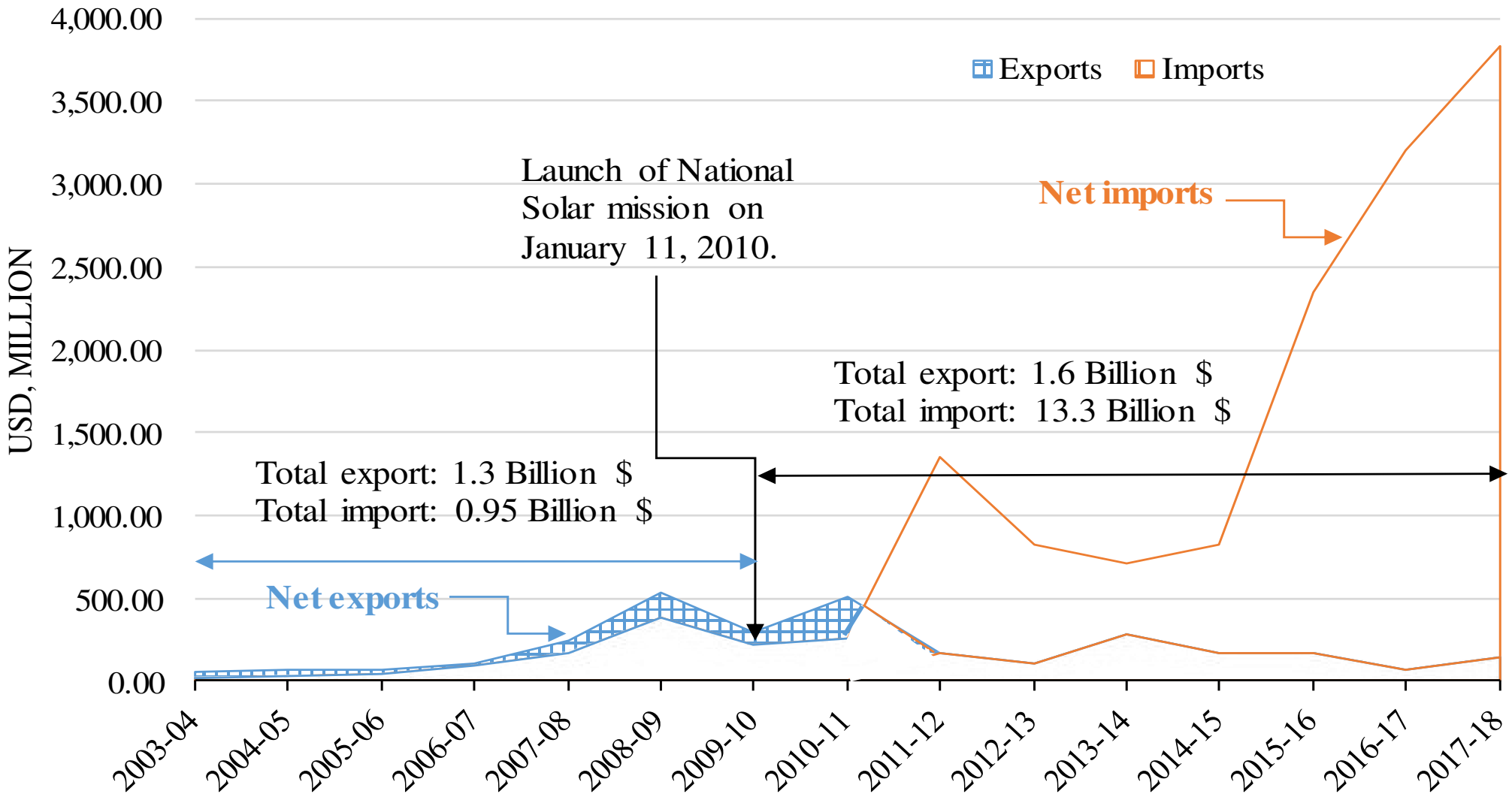


https://www.caiso.com/Documents/FlexibleResourcesHelpRenewables_FastFacts.pdf

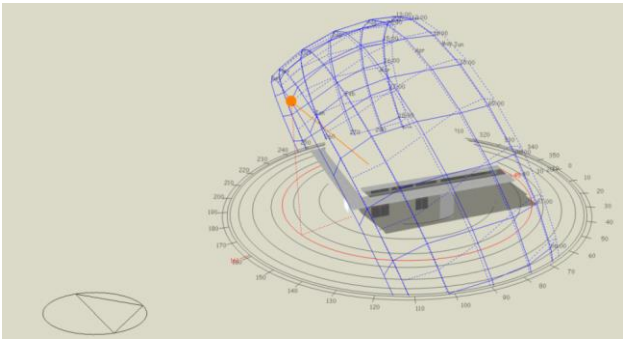
INDIA DUCK CURVE: NITI AAYOG SCENARIO



INDIA PV EXPORTS/IMPORTS

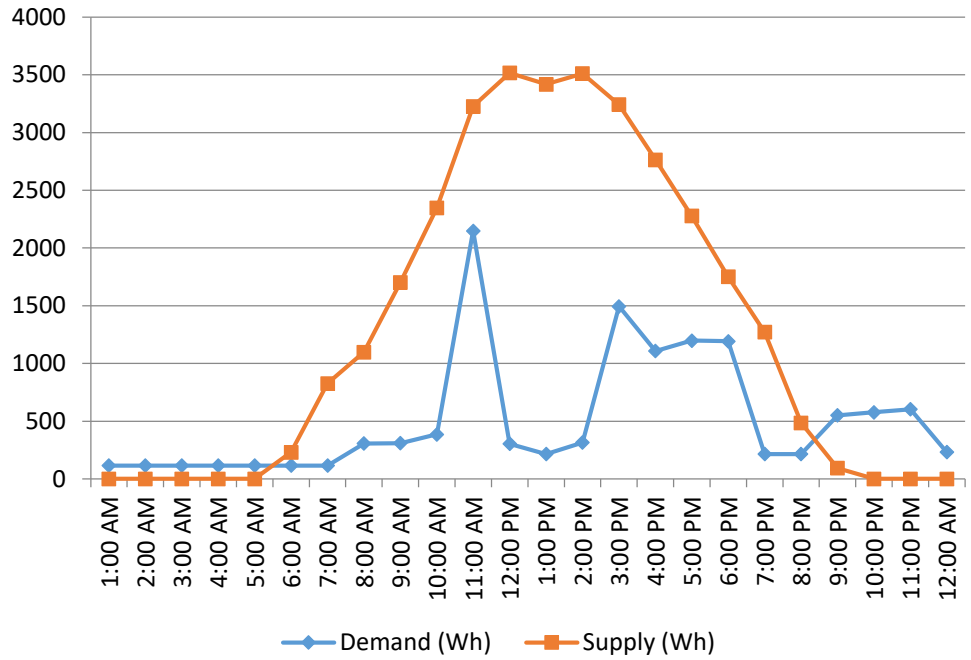


TEAM SHUNYA HOUSE

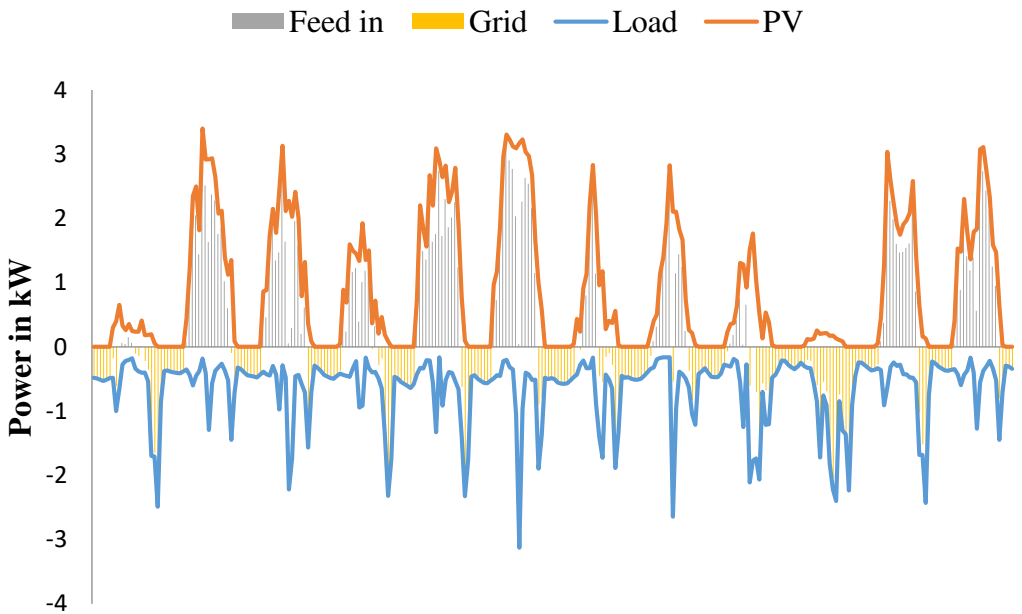


TEAM SHUNYA
Building a sustainable future

HOUSE SUPPLY-DEMAND



Generation-Consumption Profile for Competition Day 1, June 30th 2014



Generation Consumption Profile for the competition duration

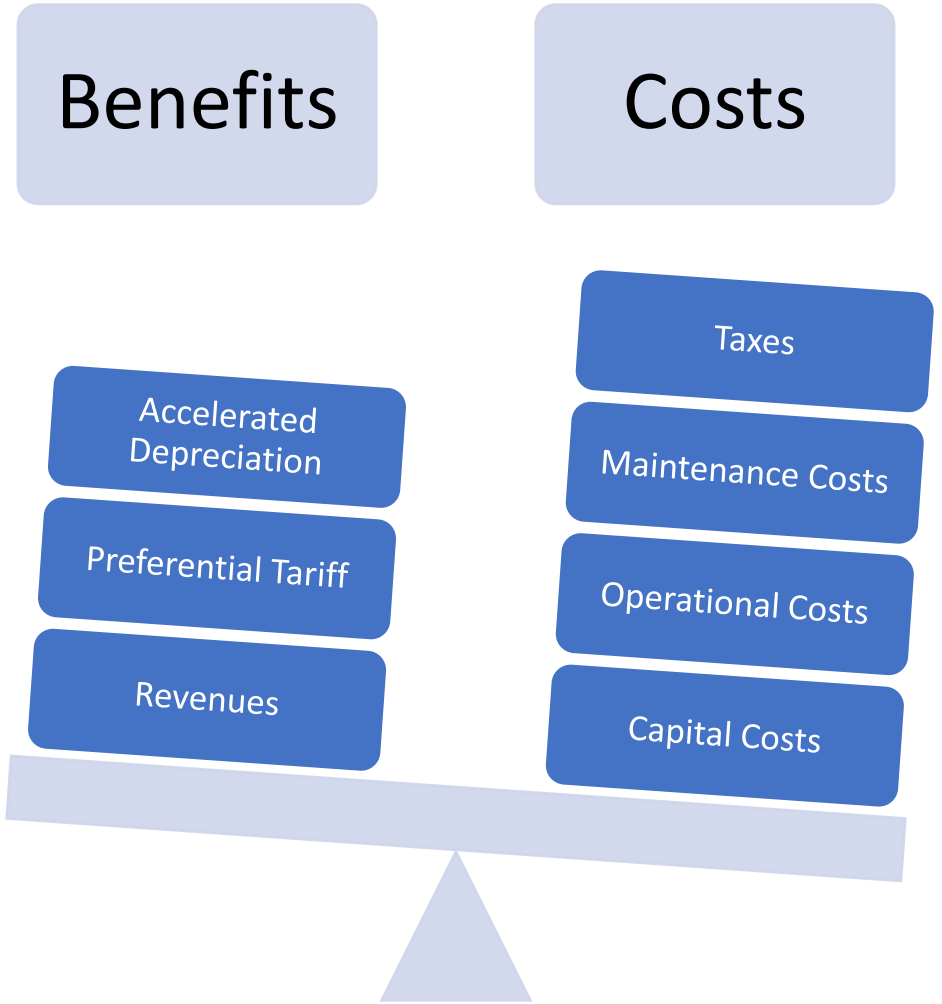
BARRIERS TO RENEWABLE ENERGY DEPLOYMENT

- Energy transitions imminent
- Dependance on Imports – Uncompetitive manufacturing
- Distribution companies- Losses, purchasing power
- Large scale penetration –storage, Demand Response, affordability
- Need to apriori assess impacts – equity, income, quality of life
- Technology development , R&D and jobs, alternate strategies
- Socio-technical problem – stranded assets regional imbalances, jobs lost
- Water, Land, Sustainability

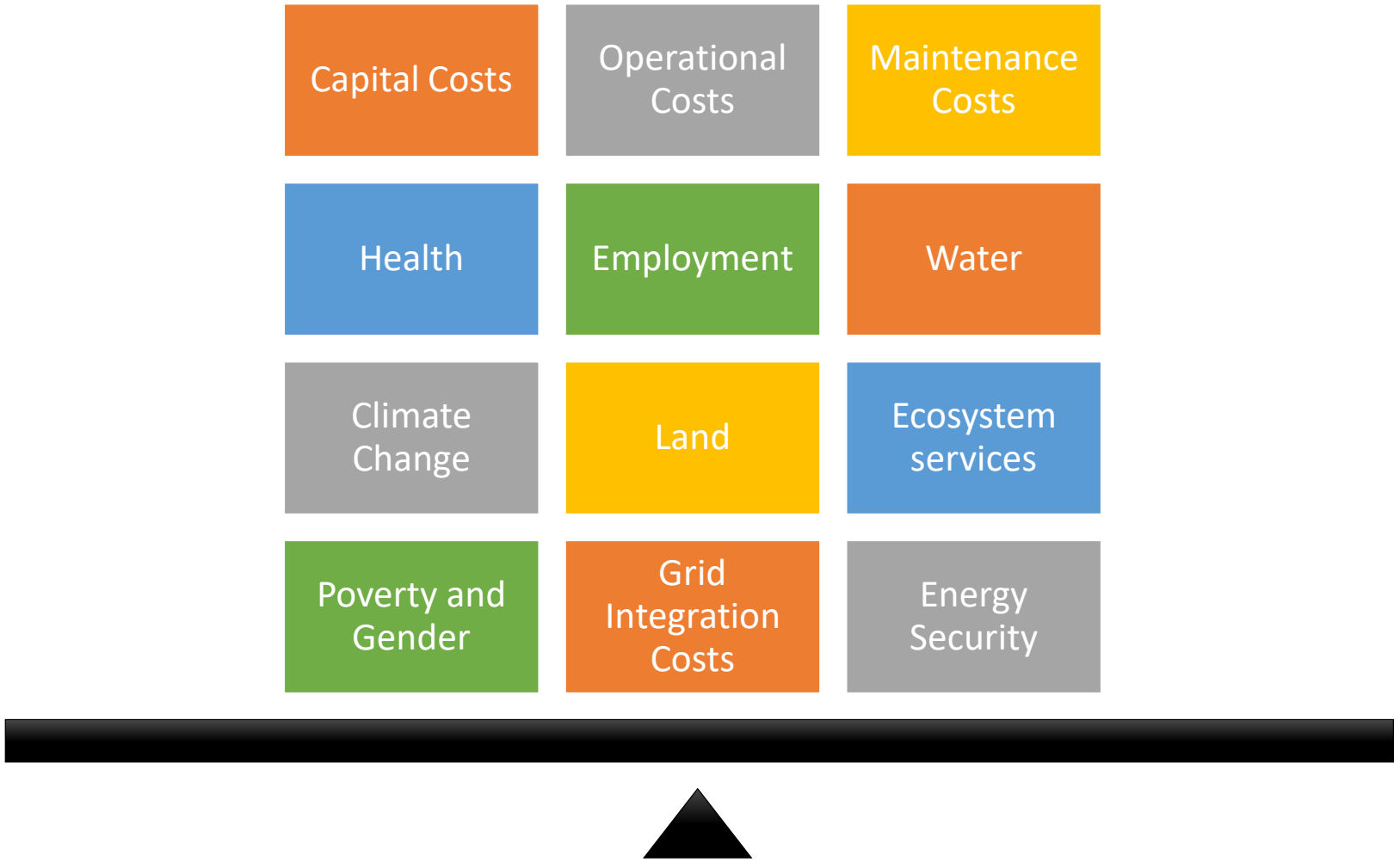
Enhanced Framework for RE Decision-making

Ashwini Hingne

POWER GENERATION – FINANCIAL CONSIDERATIONS



POWER GENERATION – SD CONSIDERATIONS



OBJECTIVE OF THE FRAMEWORK

SYSTEMATIC STEPWISE APPROACH

CHOOSE TECHNOLOGY OPTIONS

IDENTIFY RELEVANT & SIGNIFICANT IMPACTS

ASSESS ECONOMIC VALUE OF IMPACTS TO THE SOCIETY

COMPARATIVE STATISTIC SUMMARIZING THE COSTS & BENEFITS

GUIDE DECISIONMAKING FOR POLICY & INVESTMENTS

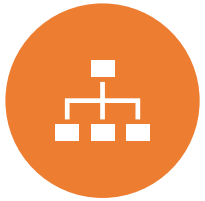
PLAN IMPLEMENTATION TO MINIMIZE COSTS TO SOCIETY

DECISIONMAKING FRAMEWORK WITH SD IMPACTS

GUIDANCE FOR APPLYING THIS FRAMEWORK

Identify and include all SD impacts relevant to the local priorities

Include relevant technologies options in the local context



Include wider aspects of value chain including upstream and downstream operations, where possible

Use technology and location specific data as far as possible

Include alternate scenarios

For large scale projects or policies, include wider ecological or integration impacts

POLICY APPLICATIONS

- Assess relative returns to the society from different RE technologies
- Level of policy support required
- Deploy RE at least social/environmental cost to society
- Adopt improved RE deployment norms & best practices
- Measure co-benefits
- Map progress on SDGs

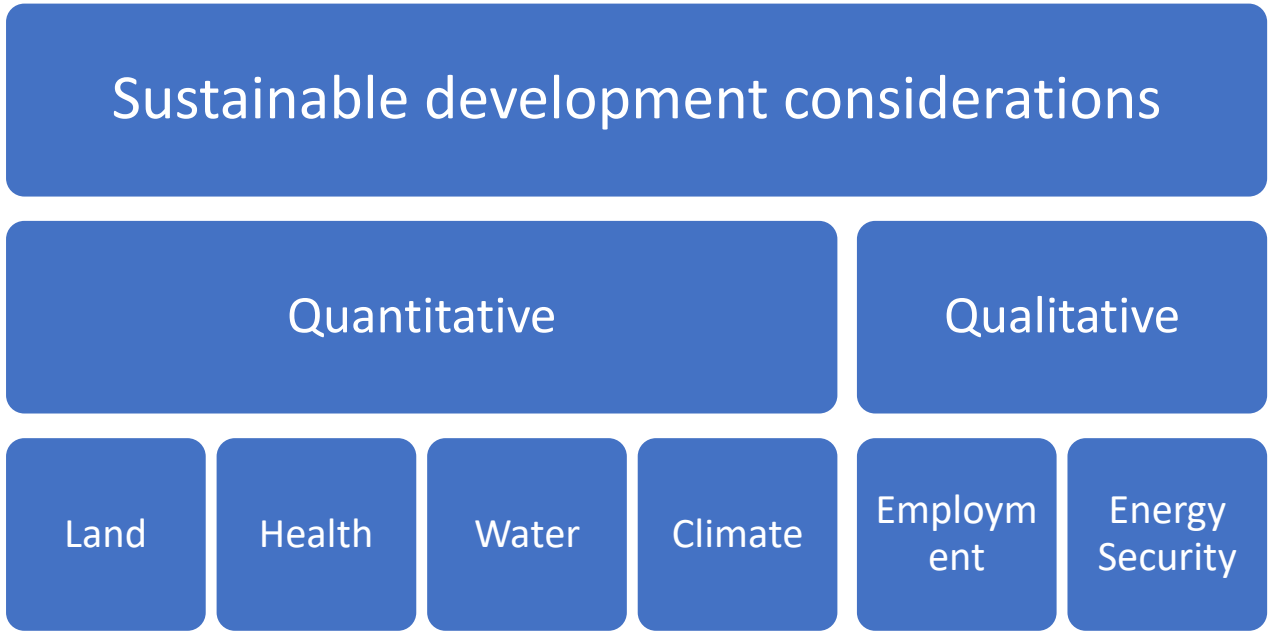
Preliminary Estimates for RE in India

Ashwini Hingne

APPLICATION TO NATIONAL LEVEL

Technologies Considered

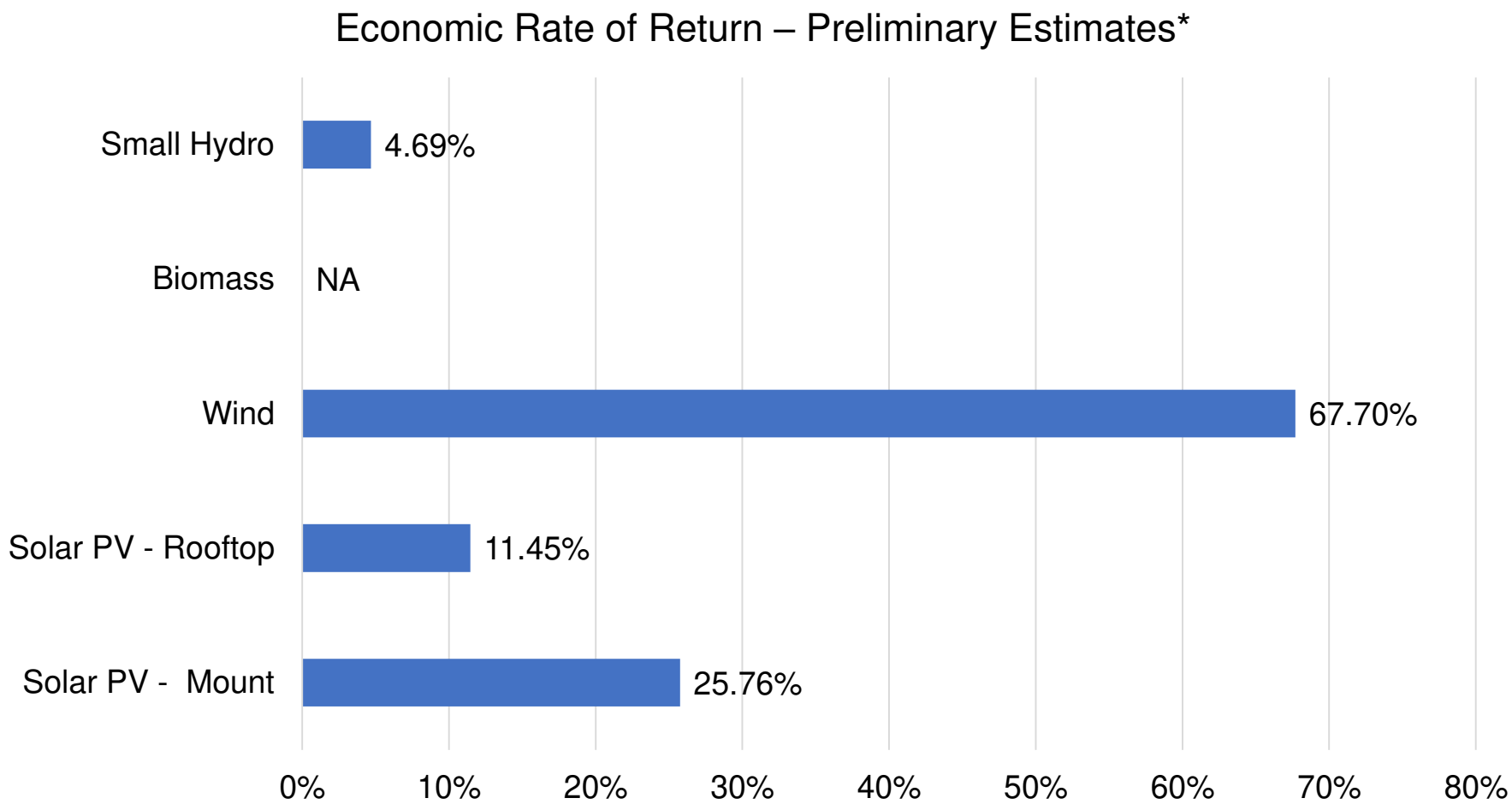
- Solar PV – Ground Mounted & Rooftop
- Wind
- Biomass
- Small Hydro



Scope & Limitations

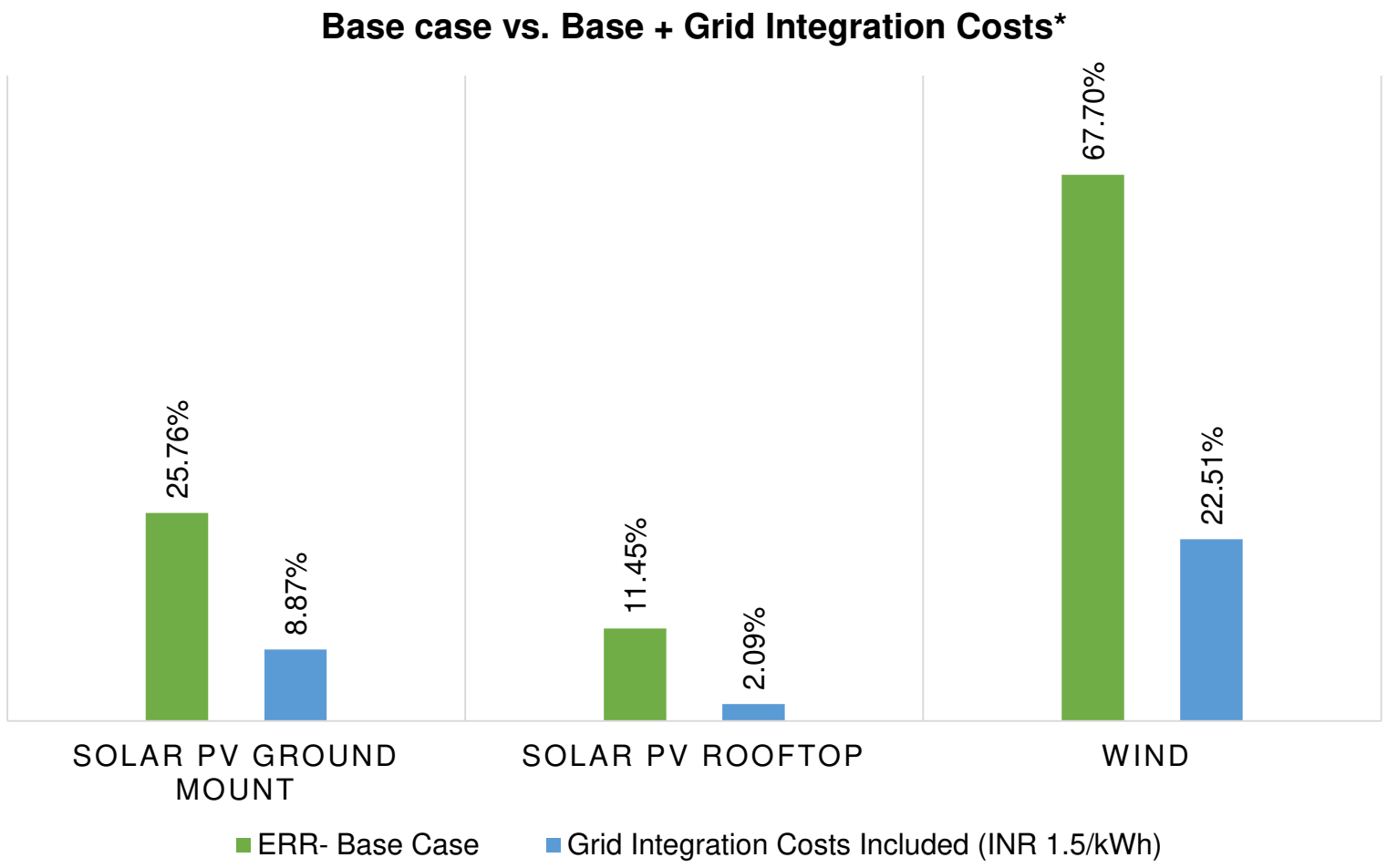
- **Installation and generation phase only**
- Assumes **average/benchmark technology norms**
- **1** MW size deployment
- Impacts at the margin – not system impacts
- **Grid integration costs are not considered for base case**

PRELIMINARY RESULTS FOR KEY RE TECHNOLOGIES IN INDIA



*In review

RETURNS WITH GRID INTEGRATION COSTS



*Based on initial analysis

ONE OF THE DECISIONMAKING TOOLS

Results Depend on –

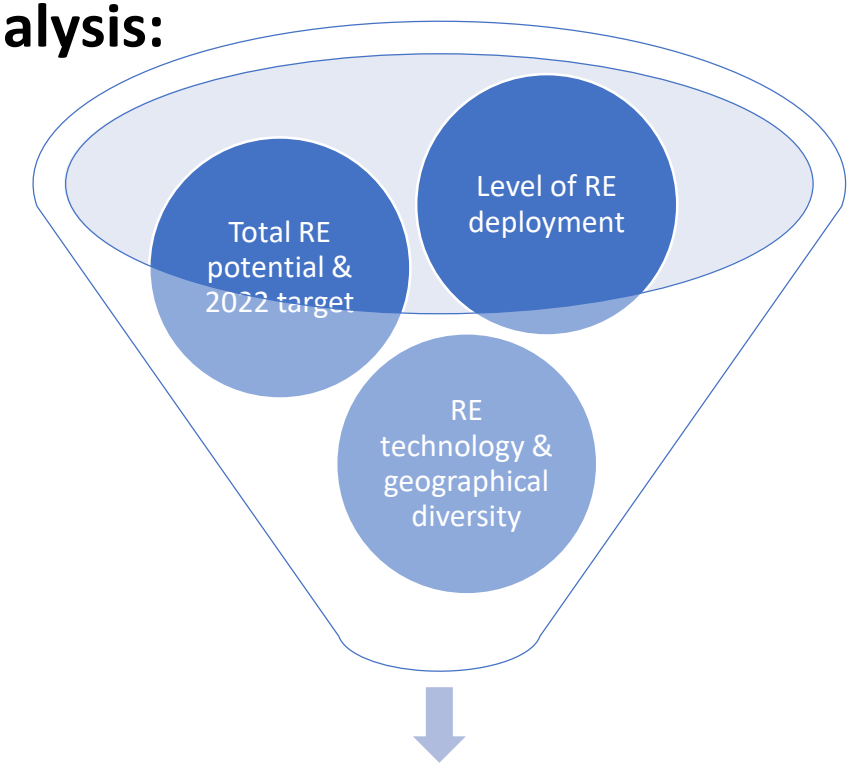
- Baseline Chosen
- Comprehensiveness of impacts across value chain
- Project Costs – Investment and Operational
- Technology Specifications – emissions, efficiency, resource use
- Economic Valuation of costs and benefits

NEXT STEPS

Working Paper on the Proposed Framework and National level Analysis – IN REVIEW

Authors: *Ashwini Hingne, Juan-Carlos Altamirano, Apurba Mitra, Neelam Singh and Ranping Song*

State level Analysis:



- Maharashtra – *high RE & FF mix, high potential of both*
- Jharkhand – *high fossil fuel intensity, high RE potential, low deployment*
- Assam – *different region & technology perspective, high RE potential, low deployment*

Discussion

QUESTIONS?

THANK YOU

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