RECONNECT ENERGY

Presentation to CERC Expert Group

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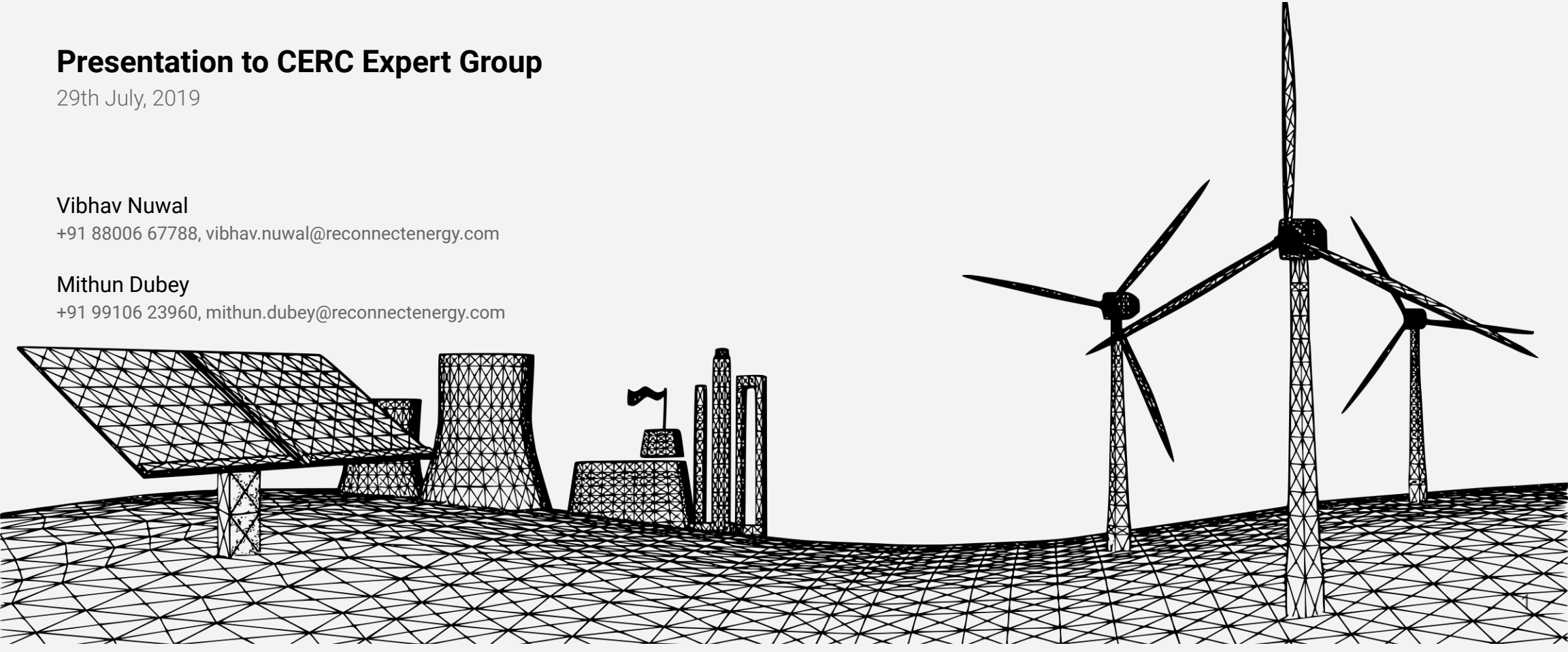

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Agenda

- **Setting the context**
  - Status of regulations
  - How do forecasting models work?
  - General scope of a QCA
- **Analysis of performance**
  - Case for aggregation
- **Experience as a QCA**
  - Issues and suggestions

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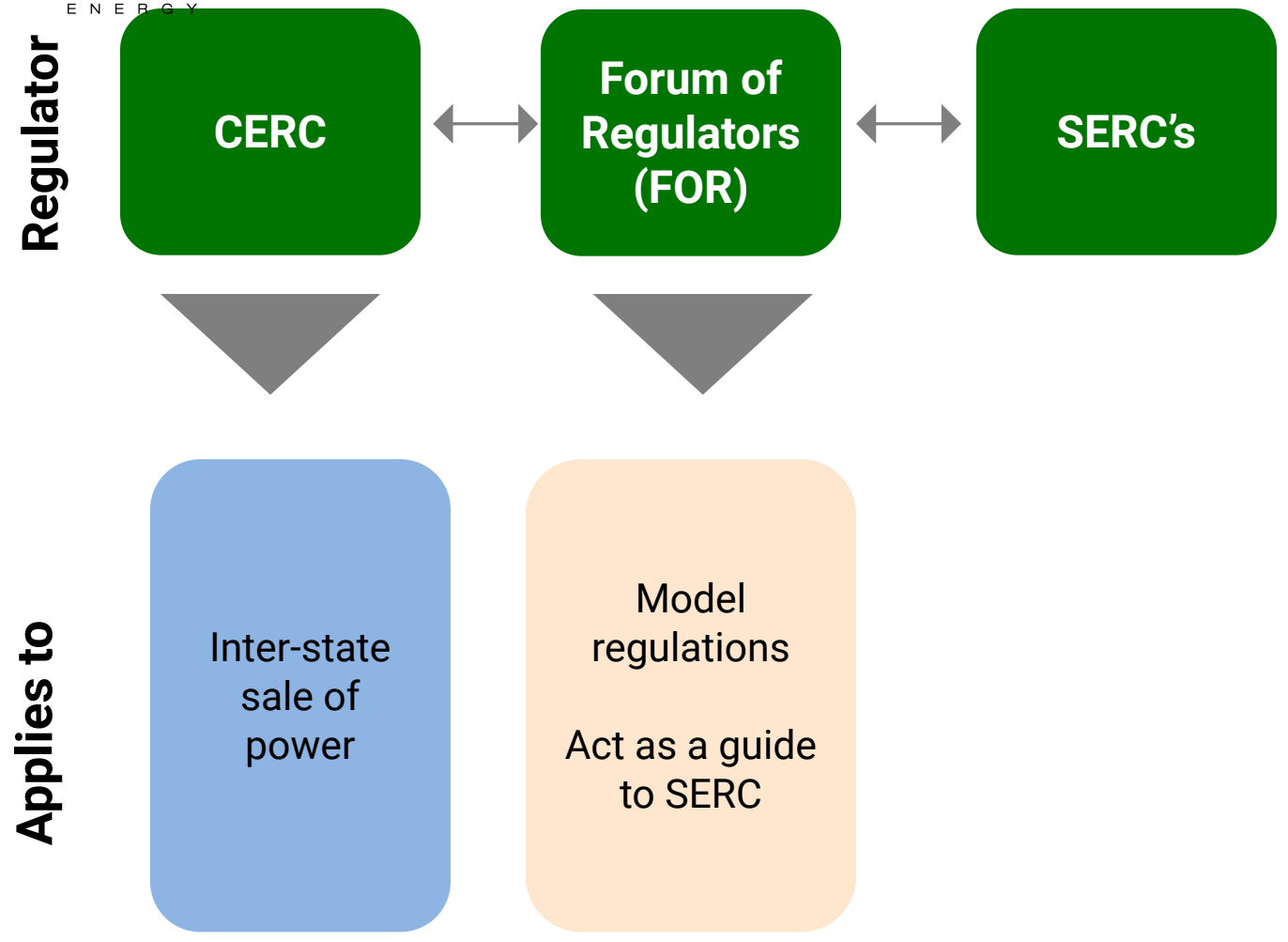
Status of DSM Regulations



Telangana	Tamil Nadu
Karnataka*	Rajasthan
Gujarat	Andhra Pradesh*
Chattisgarh	Jharkhand
MP	Maharashtra

*DSM collected

Different accuracy bands

Aggregation allowed

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Capacity that we work on

Utility Scale

~ 6,000 MW

REMC - RLDC and SLDC (11)

~ 4000 MW + Demand (Trial basis)

WRLDC & SRLDC (RE + Demand; on Trial basis)

MW Scale (Wind & Solar)

<u>As QCA:</u>

Karnataka ~ 5,200 MW (132 PSS, 350+ Generators)

Rajasthan ~3,600 MW

AP ~750 MW

MP ~1700 MW

Gujarat* ~ 1800 MW

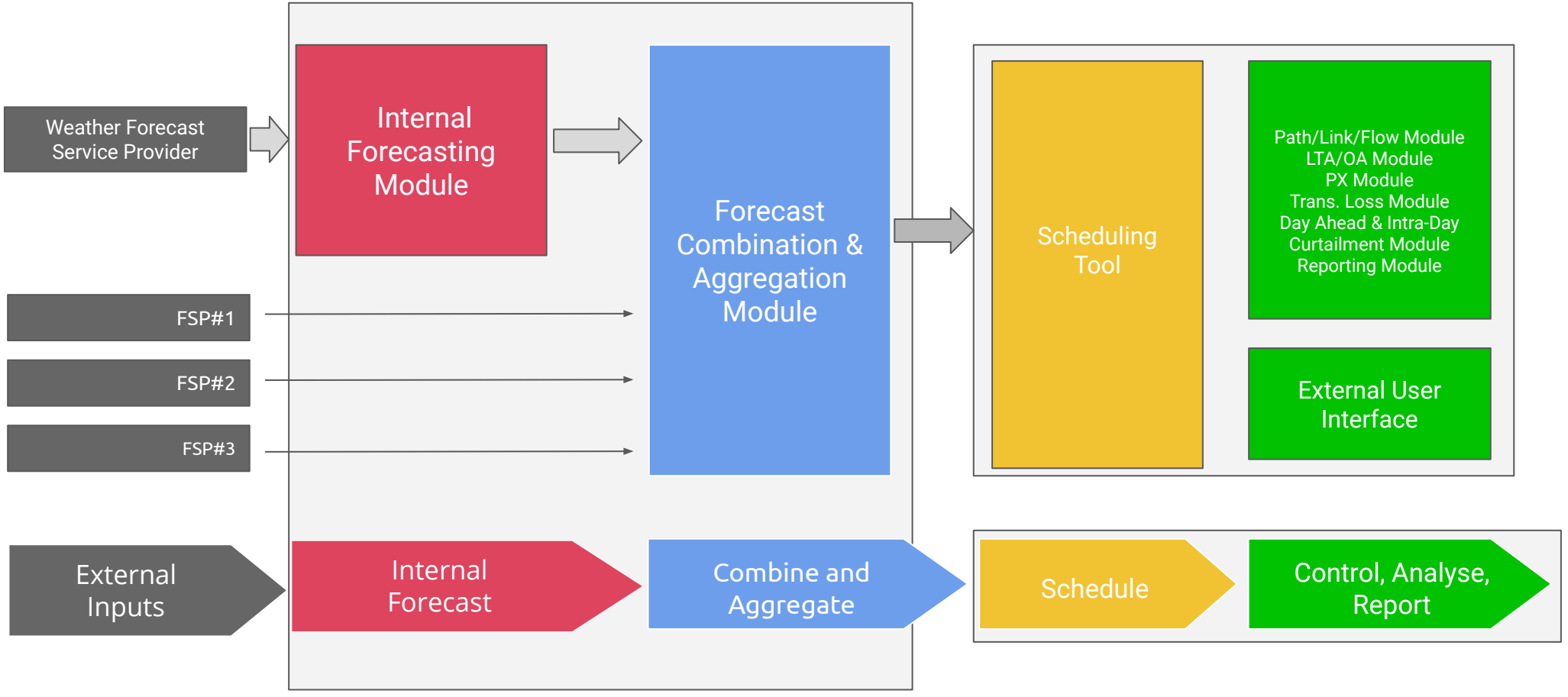
Maharashtra* ~ 900 MW

<u>In other states:</u>

~ 1,500 MW

** Registration as QCA in progress; estimated capacity*

REMC - Functional Architecture



Forecasting Tool (FT)

GRIDConnect

How it Works?

Static Data

- Turbine/Inverter specs
- Historical generation/demand data
- SCADA Data (turbine/inverter level)
- Grid Data (size, load zones, load profiles etc.)

Dynamic Data

- Weather Forecast
- Real-time generation/demand data

Special Events Data

- Plant maintenance info
- Special events like elections, holidays, festivals, local events etc.
- Grid back-downs, load shedding etc.

DATA INTEGRATION

All types of OEM specific SCADA/Meter data through API, OPC, ODBC, FSP/SFTP, HTTP/HTTPs. MySQL/MSSQL/NoSQL

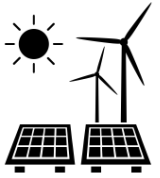
GRIDConnect

A Cloud Based application. Have also been deployed at Client's site in some of the large utility scale projects.

APPLICATION MANAGEMENT

Clients

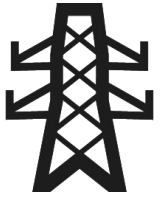
Private Clients



Wind/Solar Project Owners, Project Developers, OEMs

Wind/Solar Production Forecasts (intraday, day-ahead, week-ahead)

Utility Clients



Grid Operators, Distribution Licensees, Conventional Power Producers

Wind/Solar Production Forecasts, Electric Demand Forecasts (intraday, day-ahead, week-ahead)

General scope of a QCA

Forecasting	• Historical Weather/SCADA Data integration • Actual Generation/SCADA Data Integration • Calibrated, non-calibrated forecast & intra-day revisions
Scheduling	• Forecast data, generator specific availability data, weather data integration • Coordination with SLDC, RE OEMs, RE Generators
Physical Layer Integration	• **Hardware Layer** – meter/weather data integration • Integration of Input Data Layer (wind farm SCADA, Pooling Station SCADA, Meter Data etc.) • Communication Channel with DISCOMs, SLDC, OEMs and RE Generators
MIS and Information	• MIS, data reporting, data checks & balancing, quality control • Generator, SLDC, OEM, RE Farm specific modules
De-pooling & Settlement	• Intra-State RE DSM Settlement with SLDC and • Individual S/S or Generating Units

General Roles & Responsibilities

	Forecasting & Scheduling	Commercial settlement	DSM Charges
RE Generators	• Pay payment security as determined by SLDC • Work with/ assign responsibility to plant operator		Pay DSM charges to QCA within timelines specified by SLDC
QCA	• Create forecasts and schedule the power with SLDC	• Review and reconcile DSM statements • De-pool DSM amounts	Pay DSM charges to SLDC (only after receipt of the same from Generators)
Plant operator/ OEM	• Provide: real-time SCADA data • site information relating to maintenance, outages, etc (AvC) • month end meter data		

Broader O&M Contract

Contracts

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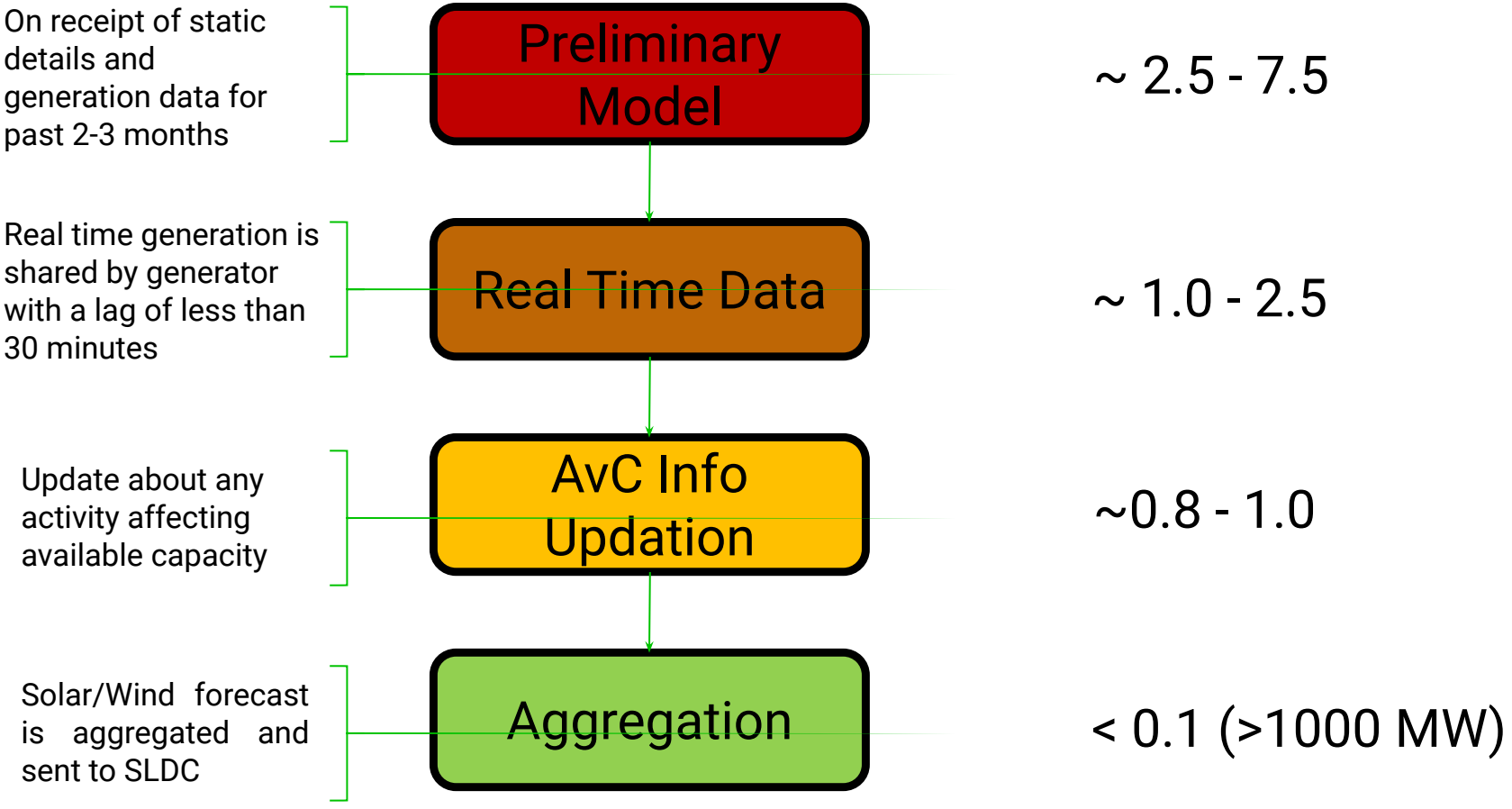
DSM Impact



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Executive Summary

Key issues/ suggestions:

- Aggregation
- Develop metering, data sharing protocol
- Standardisation of QCA’s scope of work
- Enhance infrastructure/ tech at LDCs
- Allow more frequent revisions (upto 96; at par with conventional; need tech to enable)

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Why Aggregation?

Case for aggregation:

- For grid operations:
  - Higher accuracy
    - Pooling Sub-station size vary widely - from 5 MW to >500 MW
    - Achieving high accuracy at small PSS is impossible even with very responsive models and high-quality data
    - At the same time, variation at a small PSS have no impact on the grid (most RE states have > 10,000 MW grid)
  - Significantly higher accuracy for day-ahead - better for grid operations and planning
    - Aggregation provides a much higher accuracy for day-ahead forecasts
    - This is significantly more useful for SLDC/ Discom’s for planning
  - Ease of use of data

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Why Aggregation?

For RE generators:

- High variation within 1.5 hour time-blocks
  - Very high variation is observed during low wind season (for wind) and monsoon (for solar)
  - This variation cannot be scheduled due to regulatory constraints
  - Such intermittency is plant specific and does not impact the overall grid, but has a very high cost impact on generators

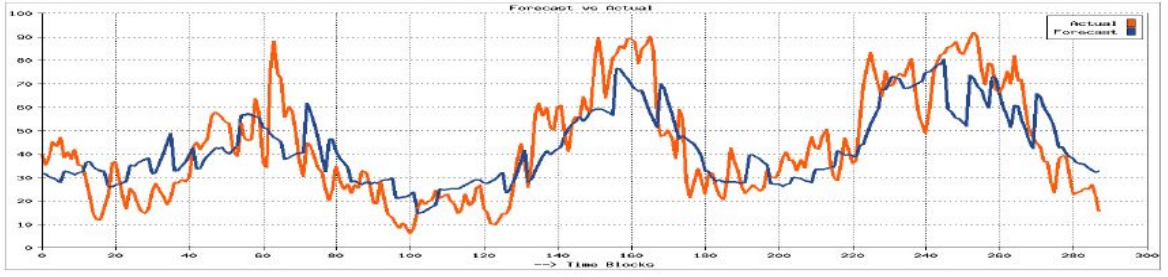
- Data intermittency/ AVC issues
  - Data lag and breaks cause forecasts to be revised without actual change in generation
  - This may give wrong picture of the plant/ have high DSM charges, without impacting the grid

- ***Only states that allow aggregation have been able to collected DSM charges***

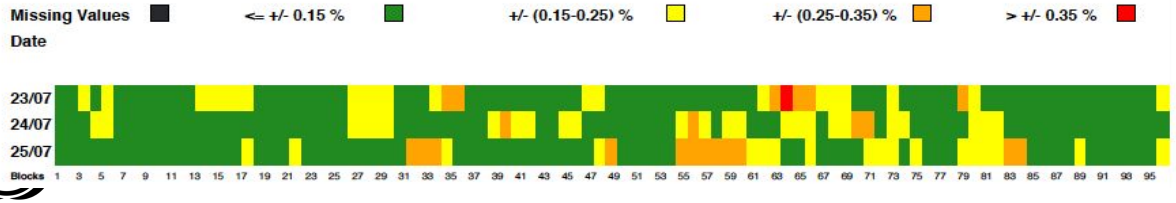
High Fluctuations at Small PSS

- Despite a very responsive model and high quality data, errors still persist due to:
  - Significant fluctuations within 1.5 hour range
  - Very small size of pooling stations
- High DSM charges for RE generator as a result

a. Forecast v/s Actual Trend (Figures in MW)



b. Performance heat map for 96 time blocks of each day



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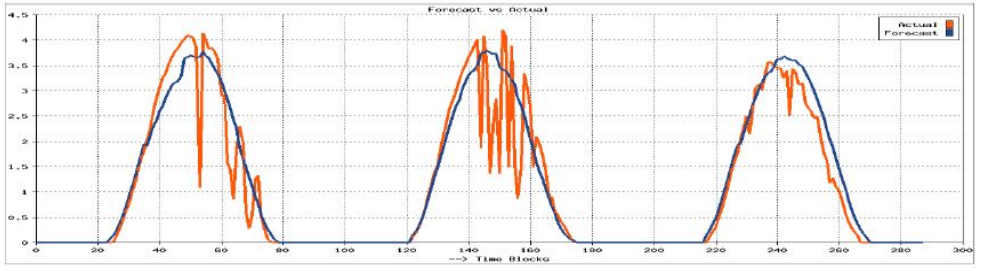

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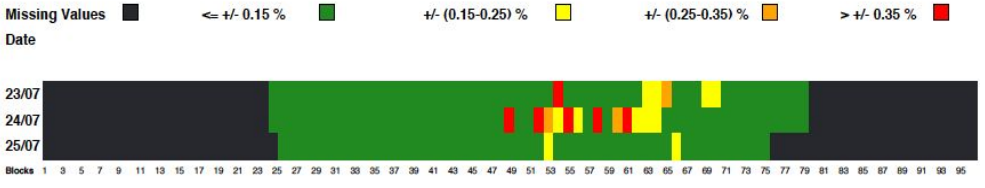


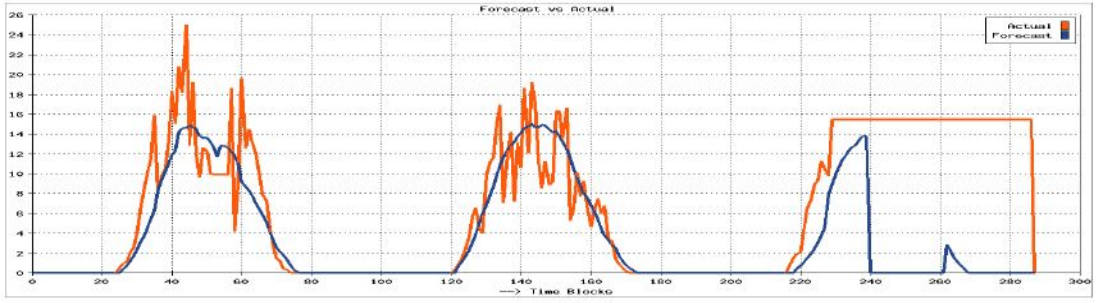
Data Intermittency and AvC Issues Impact Accuracy

- Data intermittency of individual site has a significant impact on accuracy and DSM cost, but may have no impact on grid operations

- AvC reporting is very patchy, especially on sites with AD clients (personnel, site ops issues)

- Examples of small sites with data intermittency

a. Forecast v/s Actual Trend (Figures in MW)



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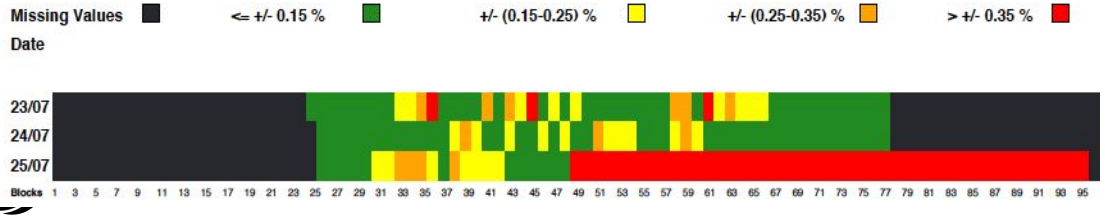

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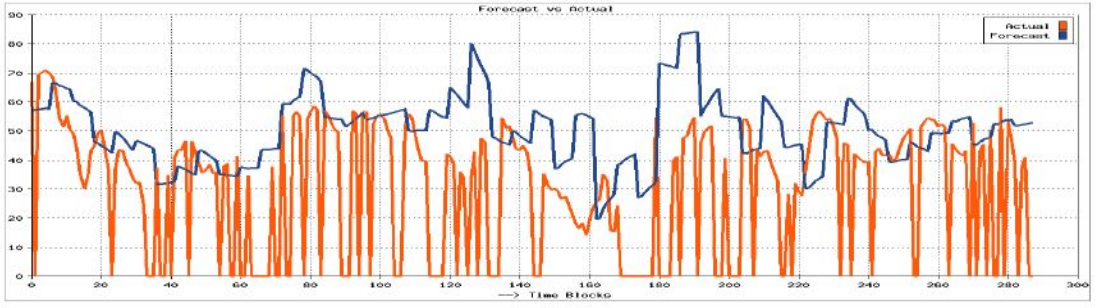

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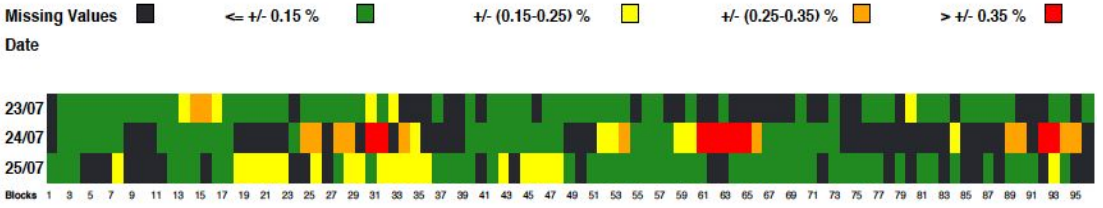
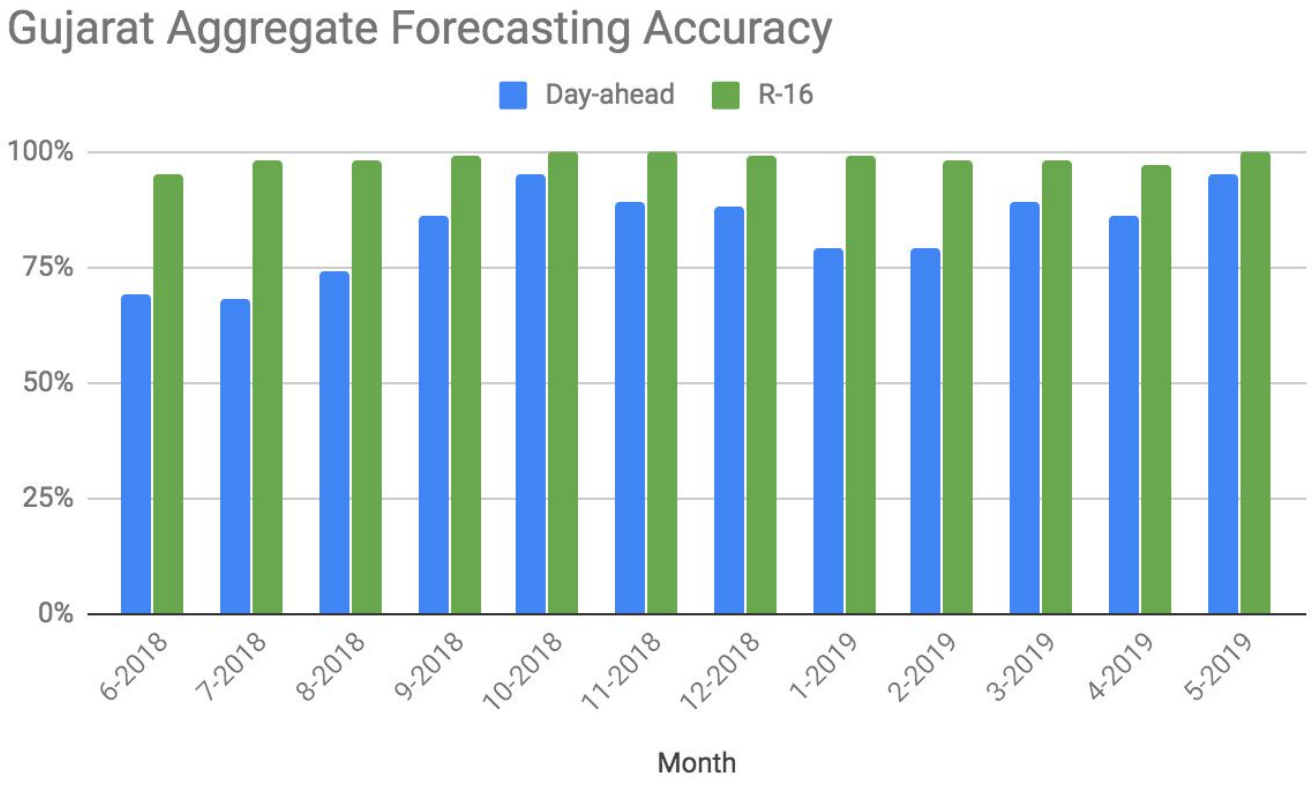


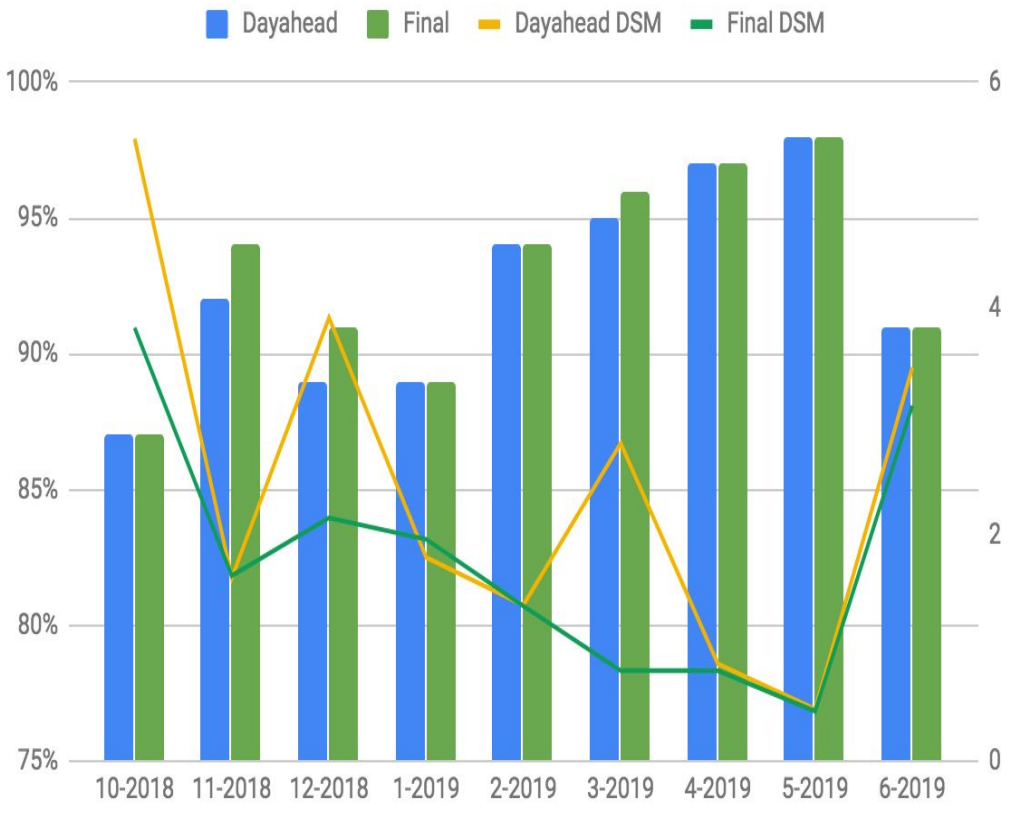
Gujarat - Aggregate Accuracy of Wind Capacity



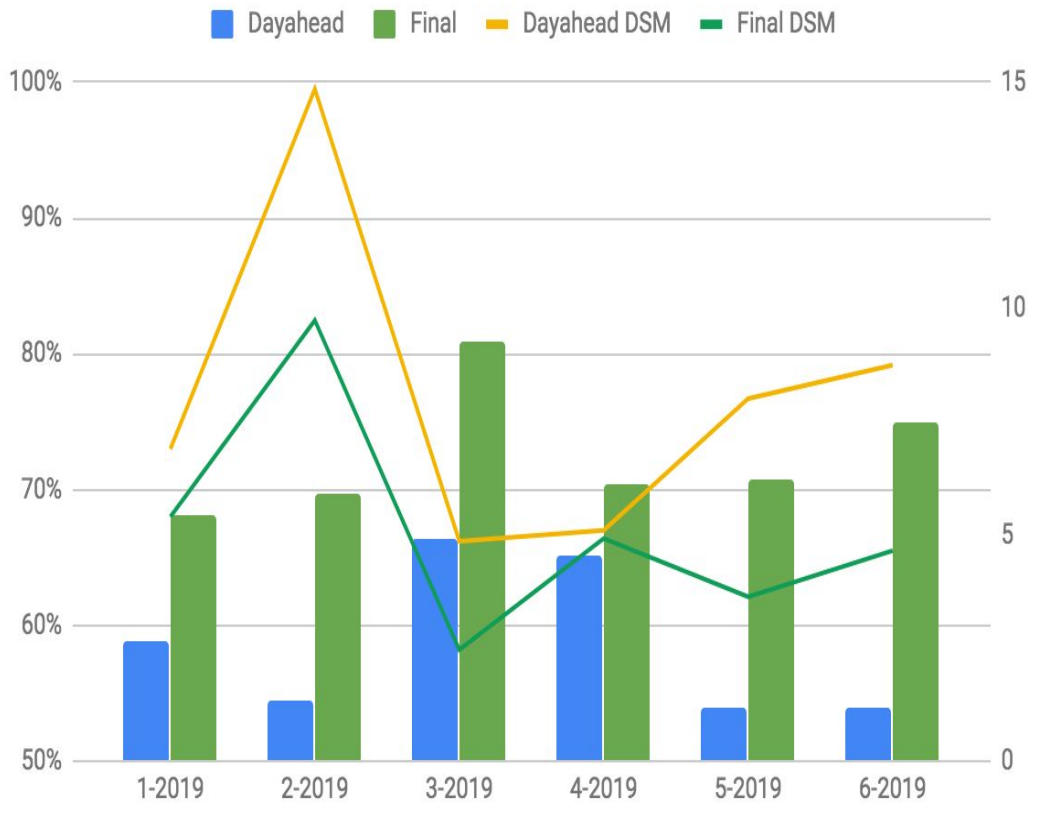
- Accuracy at state level was significantly higher as compared to that of individual PSS
- Average day-ahead accuracy was 83% (based on revised accuracy range)
- Average DSM charge (R-16 basis) was <0.1 p/u compared to wind (3.9 p/u) and solar (1.8 p/u) on a standalone basis

Gujarat - Accuracy of Individual PSS

Solar



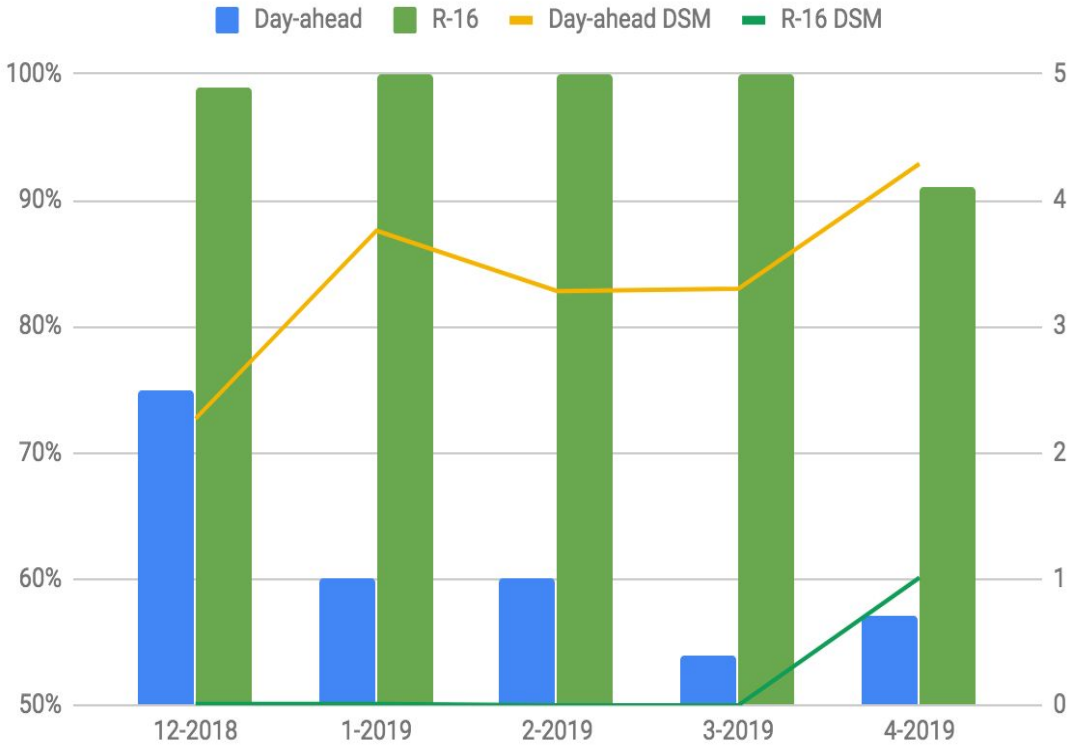
Wind



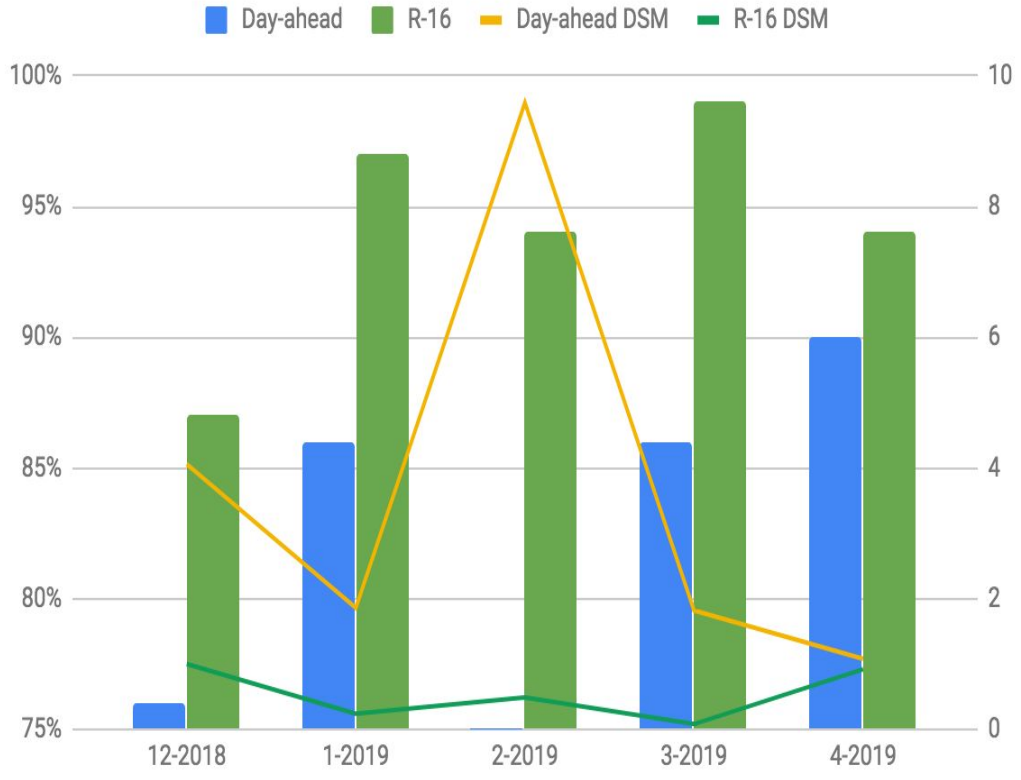
Note: Different axis on both graphs

Karnataka - Aggregate Accuracy

Wind & Solar (Day hours)



Wind (Night hours)



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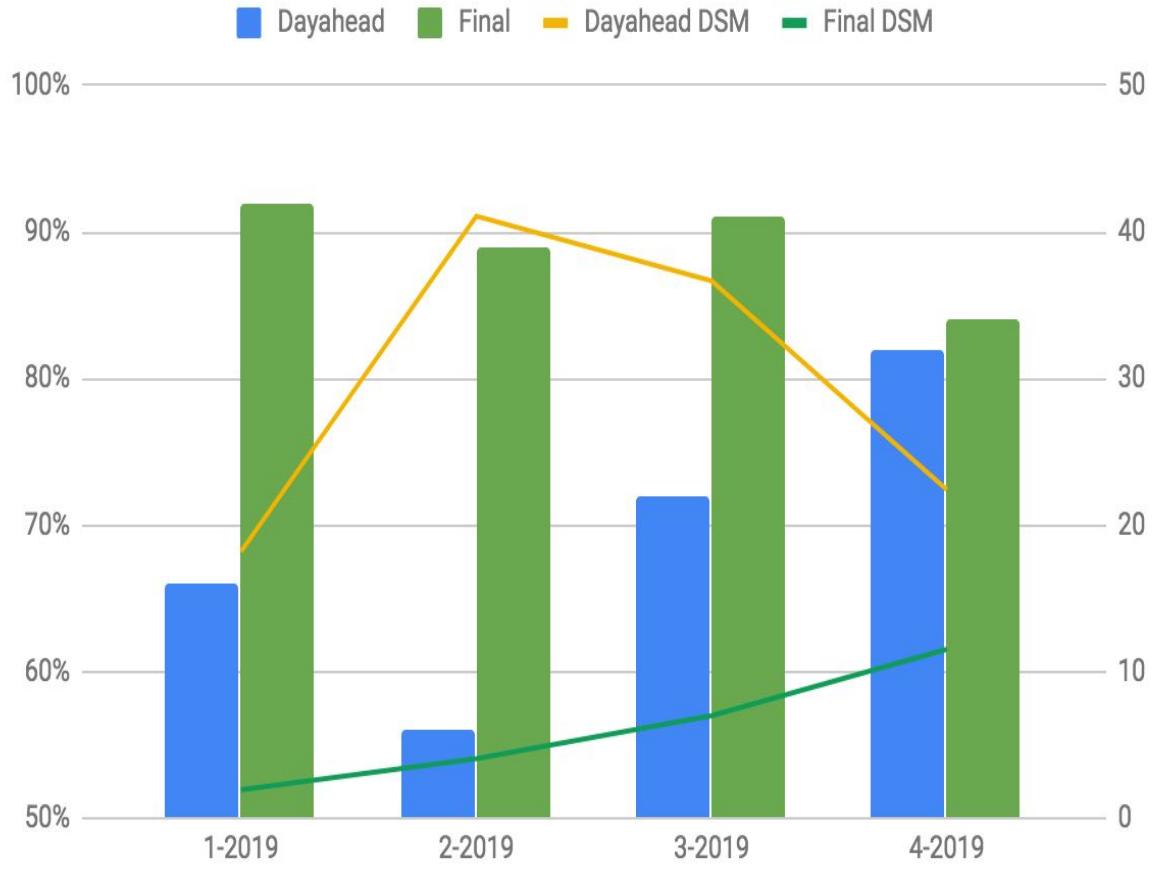
Karnataka - Accuracy of Individual PSS



- Average DSM charge (R-16 basis) was <0.5 p/u compared to wind (6 p/u; small project as an example)

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Experience of working as a QCA

Issues faced:

- Scope of work of a QCA
  - Scope of work of QCA expanded beyond the normal F&S activities in many states
  - Examples:
    - MP: Recording and transmitting LVRT data
    - TN & Maharashtra: 24 hour control center with voice recording facility; “complete control” over injection feeders
    - TN: Responsibility for giving effect to curtailment
    - MP: “Any other charges” to be collected/ settled by QCA
  - QCA’s do not have skills, infrastructure and site-presence for these activities
  - Need to rationalise and standardize scope of work of the QCA

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Experience of working as a QCA

Issues faced:

- Metering
  - Meter data collection is the responsibility of the QCA
  - Lack of AMR results in this requiring physical presence at sites
  - Some states also require “weekly” meter data (eg. TN, MAH); this is impractical
  - QCA’s/ developers should be allowed to instal modems/ data communication on revenue meters
    - Several advantages - meter data available on real-time basis with SLDC
    - Higher accuracy (as RT data will be available to QCA as well)
    - Faster DSM calculation and settlement process

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Experience of working as a QCA

Issues faced:

- Data availability
  - Many sites have poor/ no data availability
    - Various reasons for this - old sites, infra issues, poor communication network availability
  - Results in poor accuracy/ high DSM charges
  - Possible solutions:
    - Share meter data/ RTU data with QCA
    - Allow installation of modem on revenue meters
    - Aggregation

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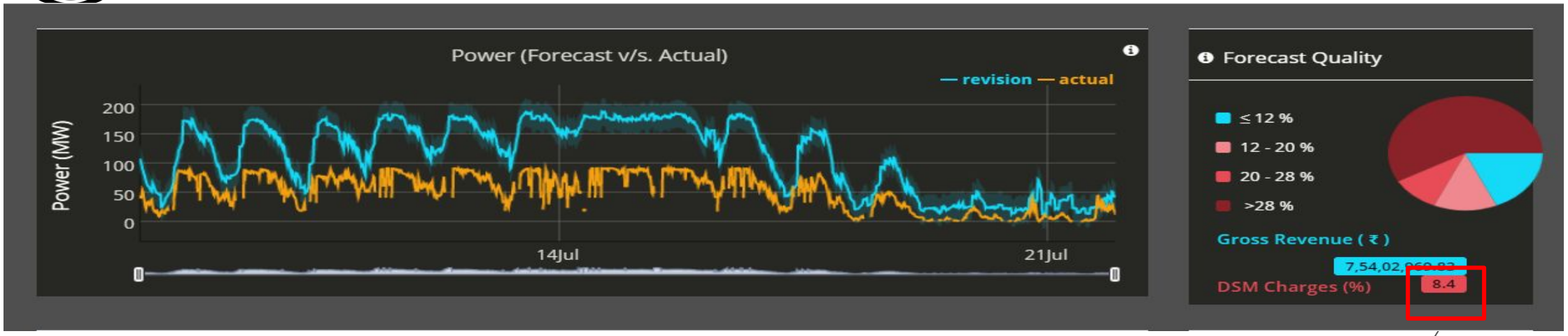
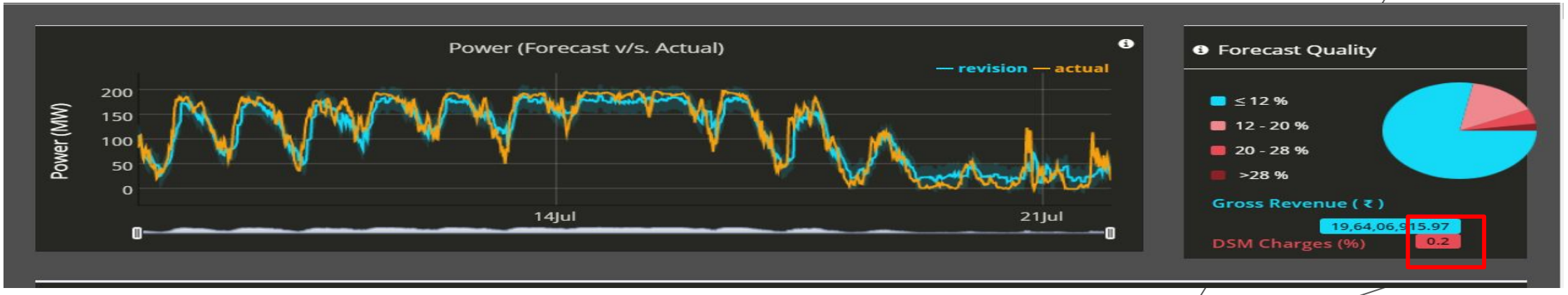
Case Studies - Impact of Meter Data

Two weeks F&S performance with partial SCADA



Two weeks F&S performance with real-time meter data



Data Quality and Forecast improvement

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Experience of working as a QCA

Issues faced:

- De-pooling
  - Most states require generators to depool charges based on mutually agreed methodology
  - We have seen very little consensus on this
  - Also resulting in disputes due to varying availability of RT data
    - Example of wind and solar sites in Rajasthan & MP
  - Depooling methodology may be prescribed in the regulations
    - Eg: Gujarat

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Experience of working as a QCA

Issues faced:

- Infrastructure for scheduling
  - Every state has a different portal/ format/ procedure for schedule submission
    - Eg: Gujarat - each PSS to be submitted separately
    - Rajasthan, AP, Karnataka - all have different file formats
    - No state as API/ FTP based submission
  - Results in operational complexity
  - Likely to be standardised after the REMC project

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Regulatory Issues - Summary

Rajasthan (Challenged in Raj HC & RERC)	• Methodology for adjustment of intra and inter-state power. • Billing on schedule. • Lack of proper metering infrastructure. • Virtual pool not being addressed in the regulation. • No clarity on depooling methodology.
Madhya Pradesh (Amendement proposed by MPERC, challenged in MP HC)	• Procedures not notified by Hon'ble MPERC • No clarity on the number of revisions applicable. • Virtual pool not being addressed in the regulation. • Partial or no data availability at several pooling stations. • Payment security
Maharashtra (Proposed to be challenged in Mah HC*) ** basis discussions with RE generators*	• Setting up round the clock Control Room and take complete control of over feeders connected to pooling station(s). • Mandatory setting up of communication protocol with each generator under QCA's scope. • Weekly DSM settlement. • Imposition of UI based DSM at state periphery. • Billing on schedule. • Irrational payment security charges (Rs 50,000/MW for wind and Rs 25,000/MW for solar).

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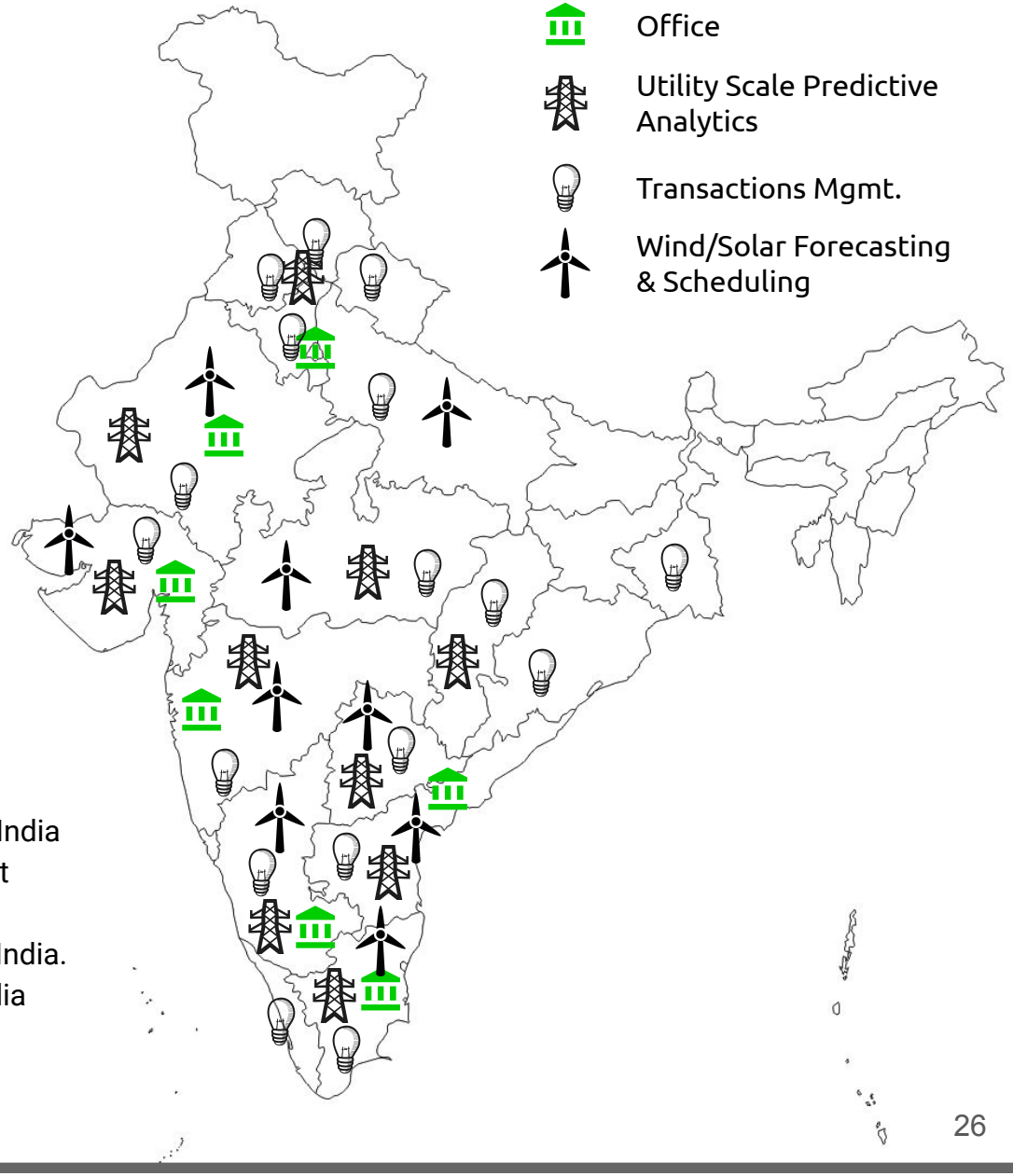
Service Portfolio

Transactions Management

- **45% market share** in Environmental Markets (Renewable Energy Credits, Energy Saving Certificates - ESCERTs)
  - **~3GW** Portfolio Size, 440 clients
- **~200MW of Green Energy Transactions** facilitated between buyers and sellers
  - 83 Clients

Predictive Analytics

- **55% market share** Wind/Solar Forecasting in IPP category clients.
  - **~14 GW** Forecasting Portfolio, 910 active clients
- **~100% market share** of wind/solar forecasting for utility scale projects in India
  - Awarded all 11 Renewable Energy Management Centers (REMCs) at national level.
  - Project is under execution. Expected to go-live by Mid 2019 across India.
- Ongoing Demand Forecasting Trials with all the major grid operators in India



Largest in India in all service areas!

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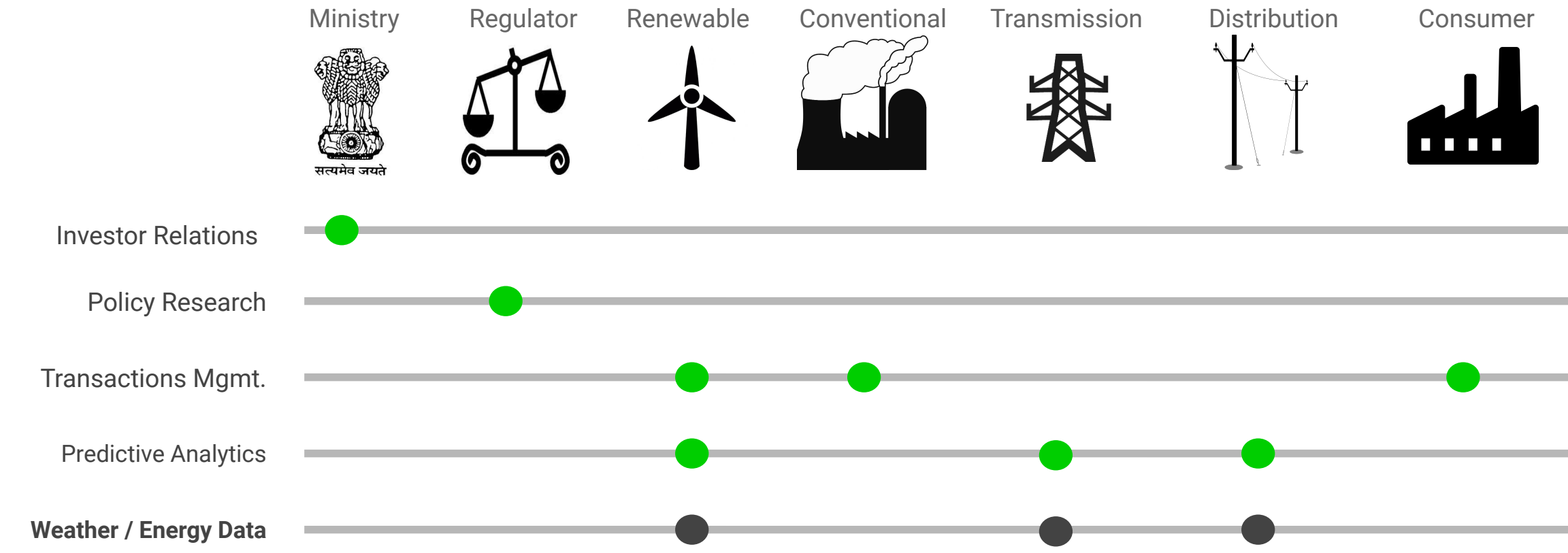
Cutting across the entire value chain of Indian Power Market



Corporate Engagements/Relationships/Idea Exchanges

Data Collection/Exchange

1430+ B2B Clients, 11 Grid Operators

Vishal Pandya,
13Y Work Exp. in Power Markets, (M.Tech, Power Systems, IIT Bombay)

Vibhav Nuwal,
17Y Work Exp. in Finance, Energy, (Chartered Accountant, MBA, Columbia Uni)

Asim Ahmed,
5Y Work Exp, (M.Sc, Uni. of Manchester, UK)

Madhusudan Chakrapani
19Y Work Exp. in IT Platforms (MBA: RSM, the Netherlands)

Ram Kumar,
15Y Work Exp in Business Development, (MBA,: Symbiosis)

Best Indian Start-up, Indo-German Boot Camp (GIZ), Social Impact Lab - **Berlin, Germany**

Top 30 Global Energy Start-ups, NewEnergy Expo-2017, **Astana, Kazakhstan**

Top 50 Indian Start-ups, The Smart CEO - 2016, Bangalore, India

Best Wind Energy Forecaster of the Year (2014/15/16/17/18), Indian Wind Energy Forum

Technology Start-up Enterprise of the Year (Energy & Utilities) - 2017, 24MRC Network, India

Top 100 Global Energy Start-ups, Start-up energy transition Awards, Berlin, Germany

Digital India Awards, Digital Energy Solutions - 2017, Times Network, India

Industrial IoT Awards, IoTNext2017, Bangalore

Smart Startup of the Year, ISGF 2018, New Delhi, India

Outstanding Contribution in the field of IoT, IPPAI Power Awards 2018

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Equity Partner

INFUSE VENTURES

- India's First Cleantech Venture Fund
- An MNRE + IIM Ahmedabad initiative
- Core Focus – To promote innovation in Indian Cleantech space with focus on Energy & Renewables
- Key venture fund partners of INFUSE are...

Ministry of New and Renewable Energy

IIM AHMEDABAD

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IFC International Finance Corporation WORLD BANK GROUP

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RECONNECT ENERGY

Aim: A Global Leader in **Digital Energy Services**

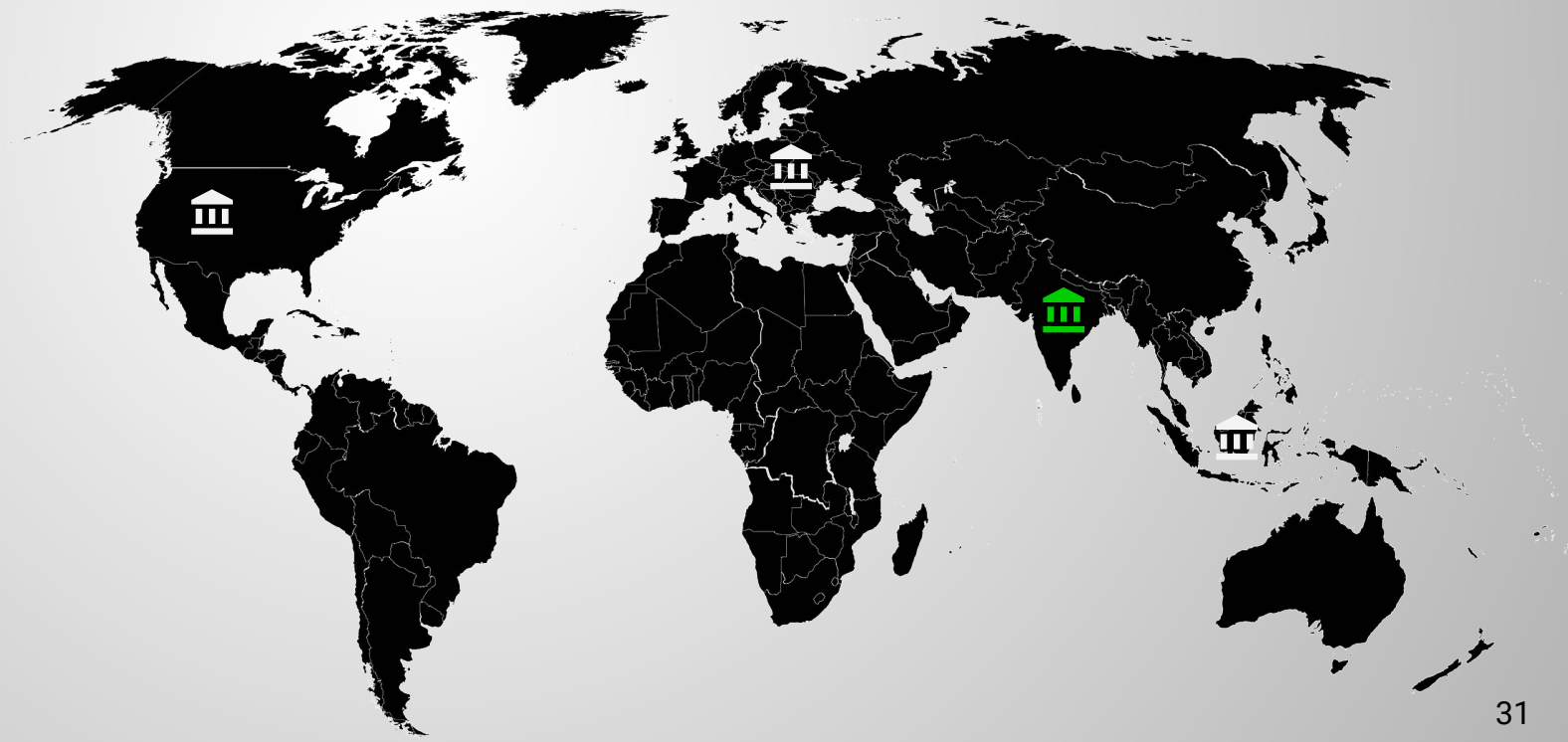
Experience:

- Audit & Finance
- Power Markets
- IT and Machine Learning

Education:

- Columbia Univ - USA
- RSM - the Netherlands
- IIT Bombay, India
- Uni. of Manchester, UK

Demand-Supply Aggregation	Grid Management Solutions	Predictive Analytics



Current Presence

Future Presence