ENERGISING DATA-DRIVEN POLICY MAKING AND INVESTMENT IN RENEWABLE POWER: Lessons from India
CSTEP: Key Research Areas

**Energy**
- Renewables, Nuclear
- Smart Grid, Energy Efficiency

**New Materials**
- Energy Storage
- Rare-earth Elements

**Urban Infrastructure**
- Smart Cities
- Sanitation

**Security Studies**
- Tools for Disaster Management

**Climate Policy**
- Adaptation
- Green House Gas Mitigation

**Governance: Initiated**
CSTEP: Select Policy Impact Examples

**NITI Aayog**
- Expert Group on Renewable Energy
- Energy Modelling – Scenarios for India’s Energy needs (IESS 2047)
- Rare Earth and Energy Critical Elements
- Knowledge Partner for Smart Cities

**Ministry of New and Renewable Energy**
- Re-assessment of India’s Wind Potential
- GIS-based Assessment of Suitable Renewable Energy Zones

**Bureau of Energy Efficiency**
- National Mission for Enhanced Energy Efficiency: PAT Scheme for Industry
- PAT Sectors: Cement, Iron & Steel, Refineries, Railways, Discoms

**Govt. of Karnataka**
- Technology Resource Partner to Government
- Roadmap for Karnataka’s Power Sector
- Rooftop PV for Bangalore
India’s Power Sector Targets

• 175 GW of Renewable Energy (RE) Capacity by 2022
  – 100 GW Solar (60 GW utility scale, 40 GW of RTPV)
  – 60 GW Wind
• Electricity for all 1.2 Billion People by 2019
• 40% Energy from Fossil-Free Sources by 2030
• 33 – 35% Reduction in CO₂ Intensity

*Transition towards a new low-carbon energy infrastructure*
India’s Unique Challenges

Challenges

- Land Availability
- Grid Infrastructure Issues
  - 23% T&D losses
  - Tower collapses
- DISCOM Financial Crisis
- Power Theft
- Social Programs
- Evolving Market Mechanism

Power Sector Inefficiency


*transmission and distribution losses as percent of power output*

*Source: World Bank, World Development Indicators*
RE Planning

- Resource Potential
- Site Suitability
- Evacuation Infrastructure
- Intermittency & Storage
- Engineering Economics
Opportunities in RE Planning

- Solar/Wind Estimated Outputs (Power and Energy)
- Co-location of Wind & Solar Sites for Hybrids
- Engineering-Economic Assessment of RE
- Power Flows and Visualization
Features

Sensitivity Analysis

• Choice of Technology (PV/CSP)

• User Inputs
  – Capacity
  – Land utilization

• Choice of Sub-Technology
  – CdTe, Poly CSi, Cigs, Mono Csi
  – PT, ST, LFR

Illustration
Solar PV Modelling

Location, site details

Plant layout

Weather inputs

Module datasheets

Financial inputs

PV model

Realistic solar power profiles

Plant area

Plant layout

Realistic CUF

Project cost, LCOE
Utility Scale PV & Storage Analysis

- Analyse PV intermittency (site specific)
- Identify appropriate storage technology
- Calculate storage size
  - Adhering to CERC DSM regulations
  - Limit power fluctuations < ±15%

Data analysis  PV plant modelling  Simulate PV power profiles  Choice of storage tech  Estimate storage size
State/ National-Scale Energy Modelling

Supply-demand mismatch on sample days for the state of Karnataka, India

Load Schedule in Jan 2012

Load Schedule in Aug 2012
Technical Challenges

• **Data Availability**
  – Are the data required available? Are they cheap?
  – Has it been digitised?
  – Is it primary/secondary in nature?

• **Data Quality**
  – When were the data collected? Are they still valid?
  – Are the data accurate? Are they complete?
  – Are the data bankable?

• **Data Maintenance**
  – Collate from various sources
  – Convert into a meaningful database
  – Digitise and update the database
Other Challenges

• Administrative Boundaries & PPAs
  – Deviation and payment settlement mechanisms have to be reworked

• Limited Information on Substation Capacities and Right of Way Access

• Incomplete Allocation Information

• Incorrect Topographical Analyses/Contour Mapping
  – Variation is high if incorrect
Tech to Policy & Future Work

• Policy Impact
  – MNRE wind potential re-assessment
  – Offshore wind in India
  – RE Act and national wind mission

• Future Opportunities
  – Siting of RE micro-grids for remote/undeveloped villages
  – Electric vehicles: transport routes, power exchanges
THANK YOU