Through a Glass Darkly: On Predicting the Future

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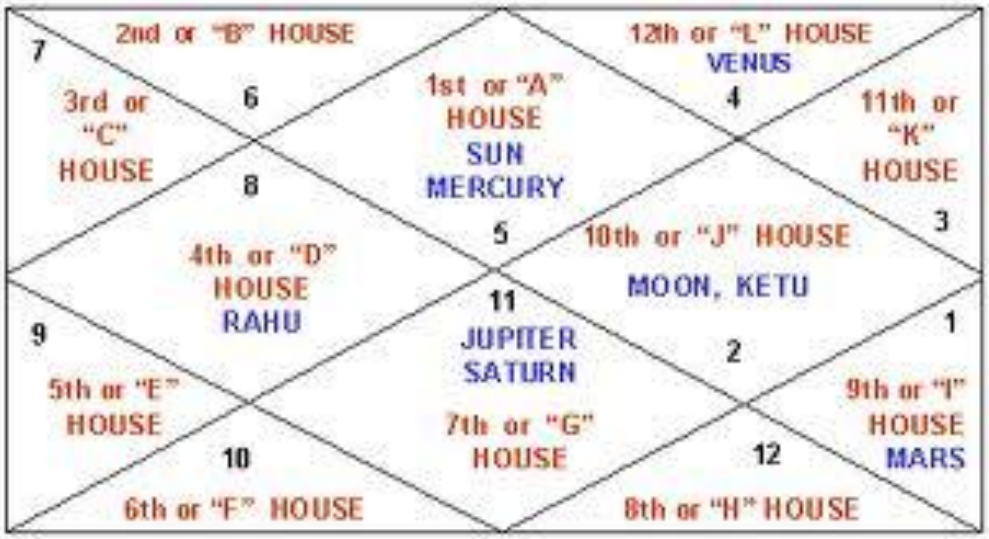
How do we Predict the Future?

How do we Predict the Future?

This is one way!



Computing and Modeling

- High Speed computation
  - Modeling complex systems
- Powerful visualizations
  - Explore numerous scenarios
  - What If?
- Provide platform for experts and stakeholders to engage
- Satisfysing Options:
  - Robust, but not necessarily not optimal

Two Illustrations from India

- Developing Scenarios for India:
  - A Systems Dynamics Approach

- Large Scale wind integration in Karnataka

Developing Scenarios for India

India's Five Year Plans

- Concerns:
  - Mechanical exercise
  - Doesn't identify with citizen's aspirations
  - Economic growth not generating social value
  - Political compulsions creating policy logjam

- Innovations in 12th Plan (2012 – 2017):
  - Systems and scenario planning
  - CSTEP worked with Planning Commission

http://planningcommission.nic.in/reports/genrep/scenarios_v10712.pdf

Question

- Which key forces shape India’s destiny?
- Which are the key leverage points?
- What are the likely scenarios?

Major Forces

Aspirations of Citizens
Middle Class
Marginalized Communities
Youth

Demographics
Young Population
Regional Differences

Impatience and Protest
Restive Population
Violence
Social conscience

Democracy & Institutions
Lack of Trust in institutions
Corruption
Elite Vs. Common Man
Coalition Politics

Earth's Resources
Land
Water
Food
Energy

Climate Change
Stochastic Events
Long Term Impact

Innovations: Science & Technology
Big Ticket Break through

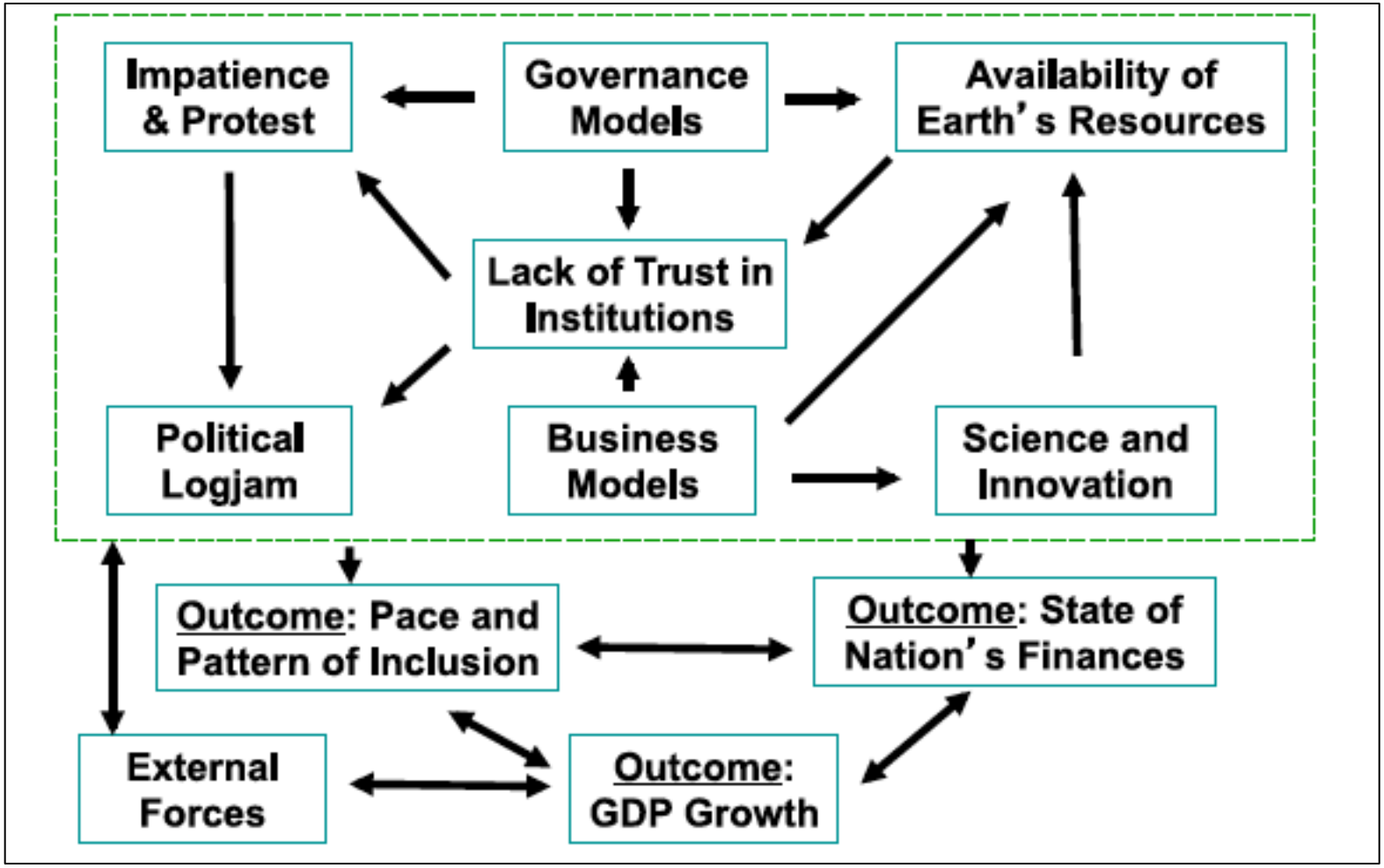
Innovations: Business Models
Service Delivery
Inclusion

Information Technologies
24 x 7 news
Cell phones, internet

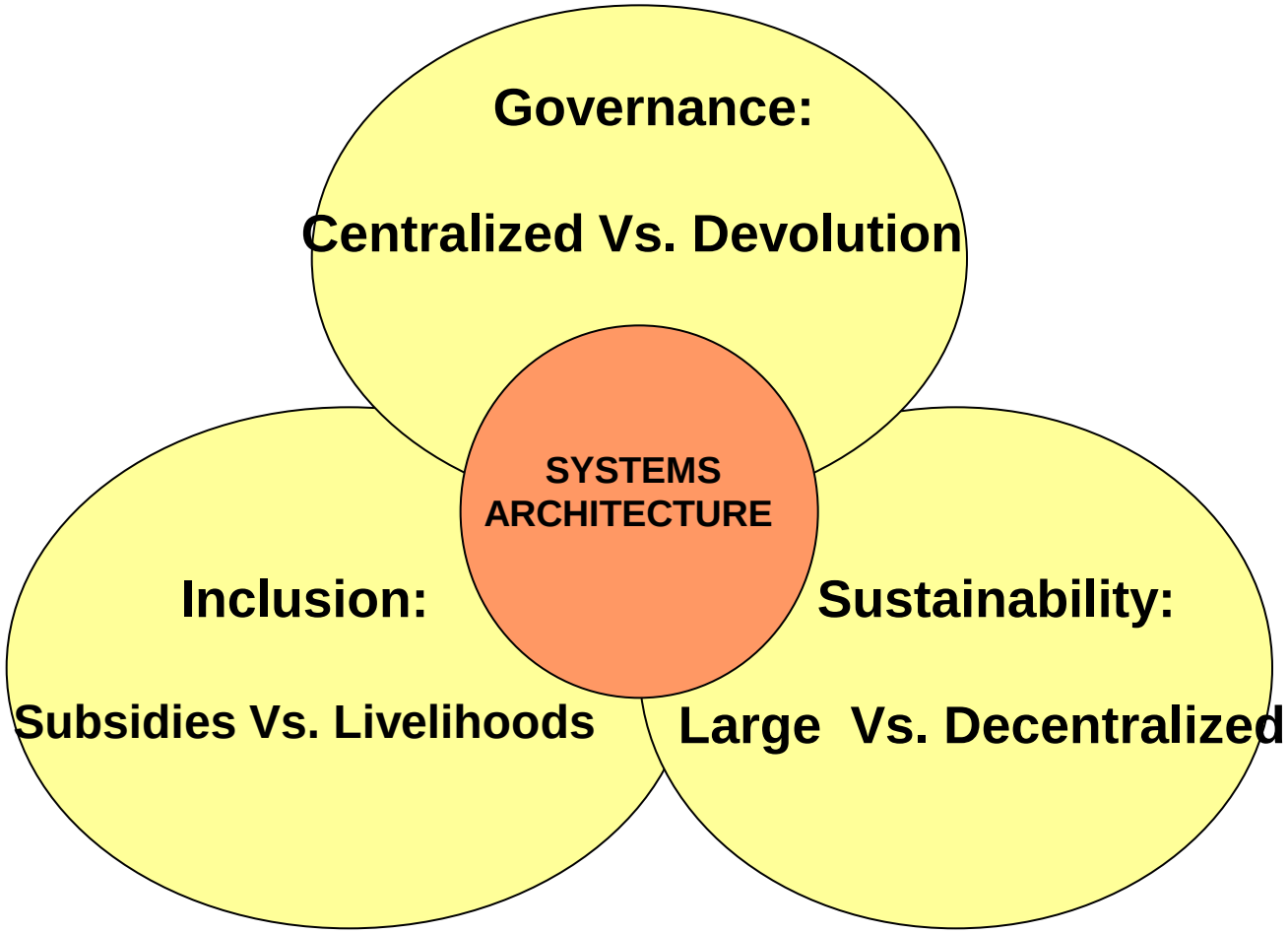
Global Forces
Neighborhood
Geo – politics

National Security
Cyber security,
Terrorism

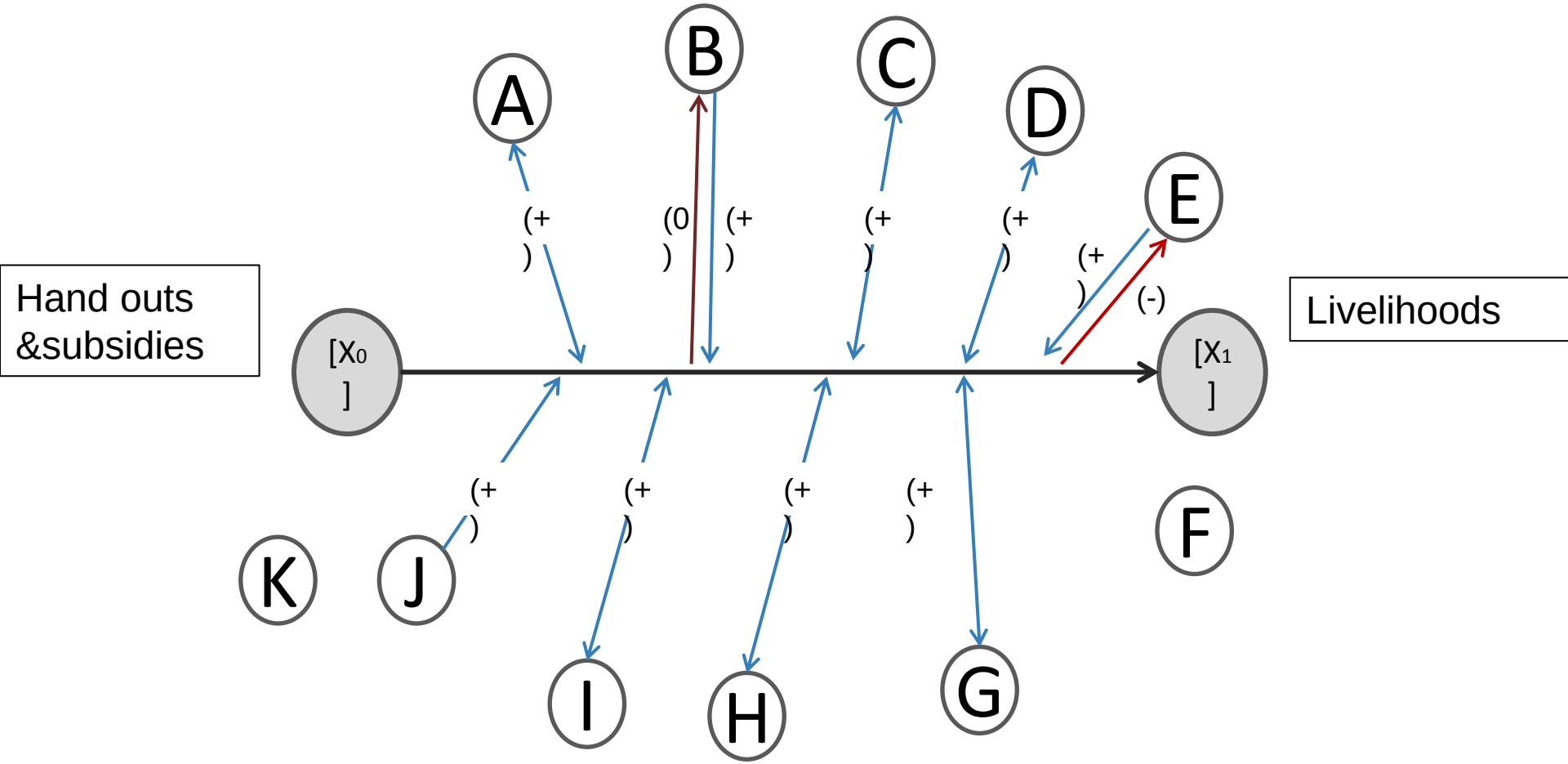
Simple Causal Relationships



Three Main Paradigms

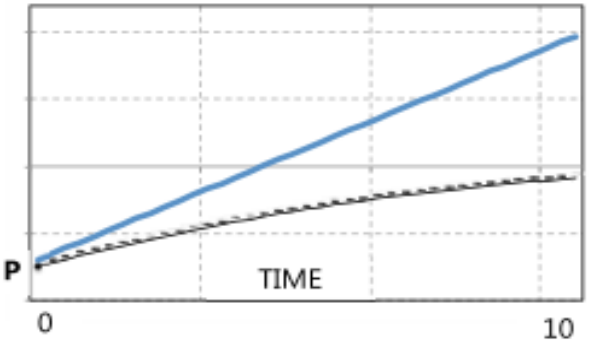


Paradigm of Inclusion



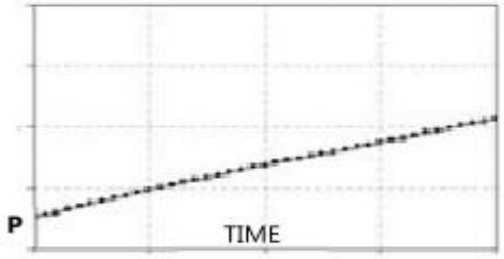
Scenario 1- Muddling Along

Potential Growth / Actual GDP



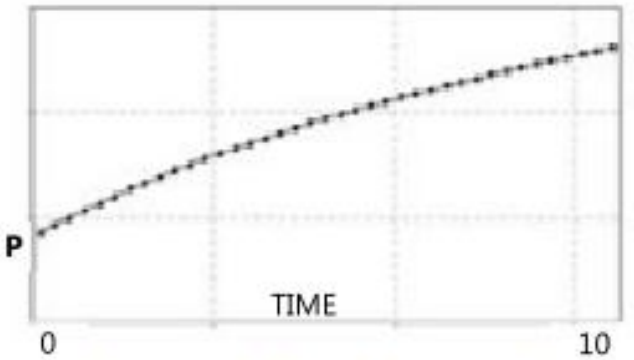
GDP Growth below potential and expectations

Political Logjam



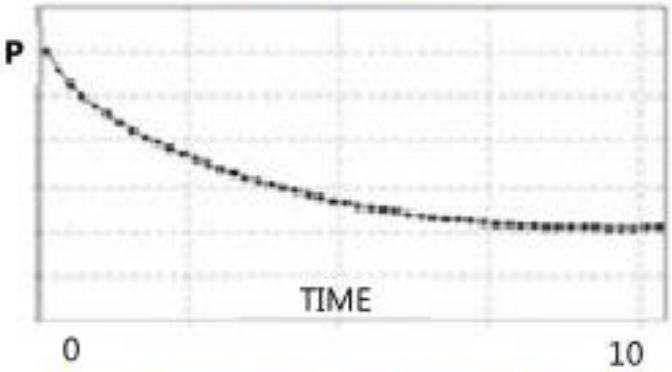
Insufficient institutional reforms, along with rising impatience create political logjams

Budget Deficit



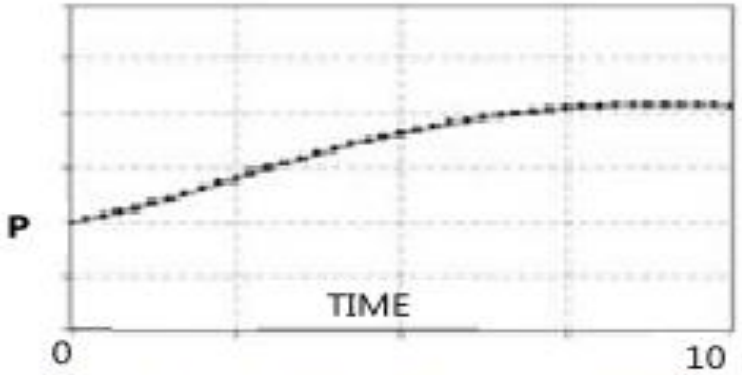
Inadequate and slow reforms continue to put pressure on budget deficits

Pace of Inclusion



While more people come out of poverty, many remain behind, and the sense of unfairness increases

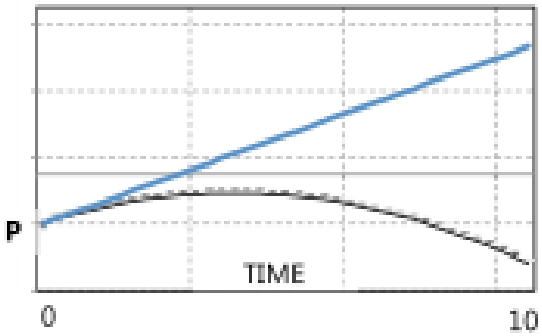
Impatience and Protest



Aspirations rise faster than growth of good livelihood opportunities

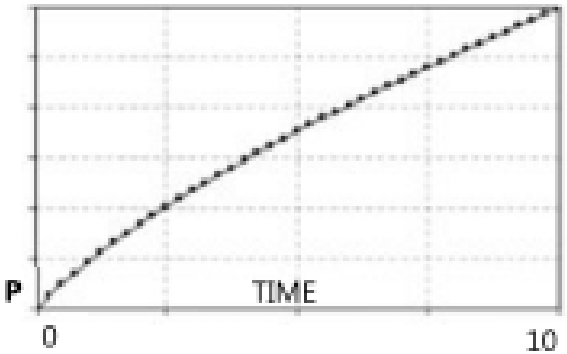
Scenario 2- Falling Apart

Potential Growth / Actual GDP



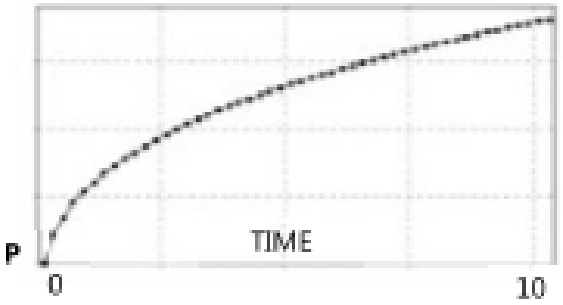
GDP growth continues to fall further below potential

Political Logjam



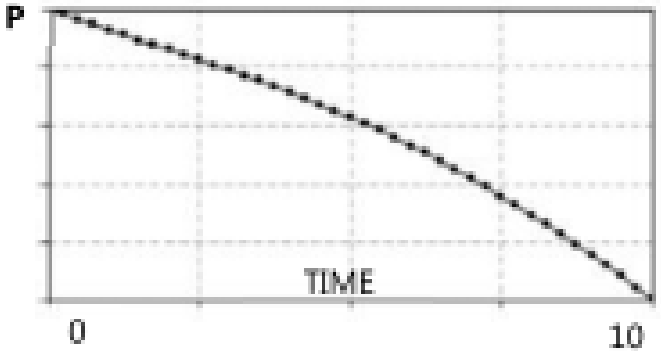
Falling trust in institutions contributes to the political logjam

Budget Deficit



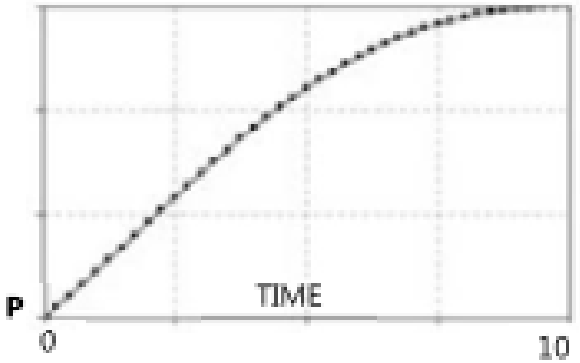
A crisis in the government's financial position breaks down confidence in the economy

Pace of Inclusion



A handout culture persists; slow growth of livelihoods and increasing budgetary constraints slow the pace of inclusion

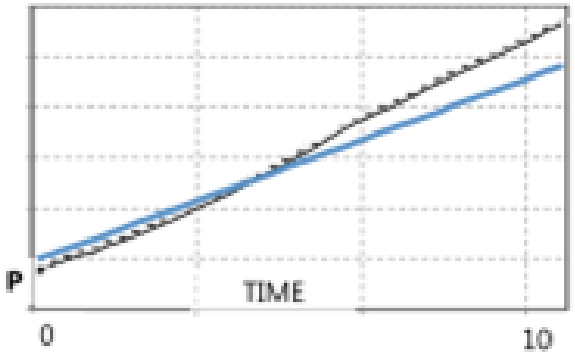
Impatience and Protest



Aspirations not met leading to rise in impatience and protest

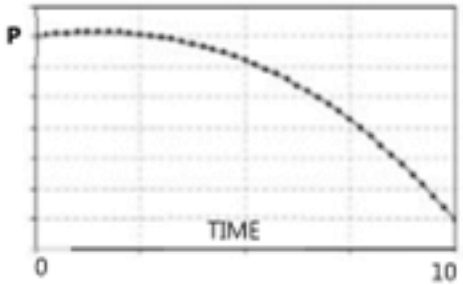
Scenario 3: Flotilla Advances

Potential Growth / Actual GDP



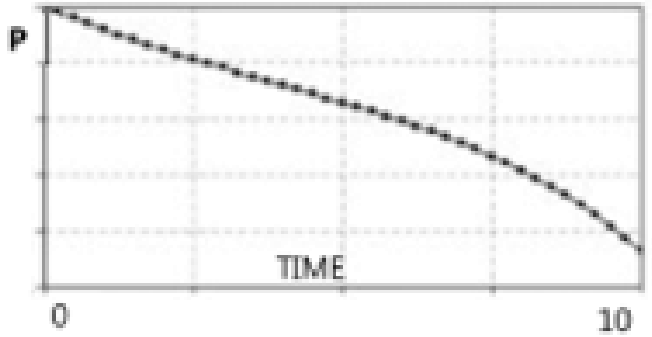
GDP growth catches up with potential and is sustained

Political Logjam



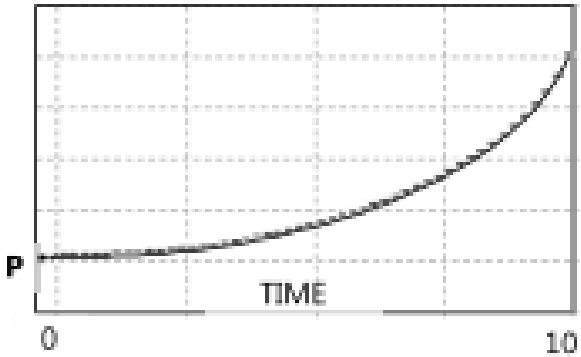
Successful implementation of local projects by empowered local governments increases trust in institutions

Budget Deficit



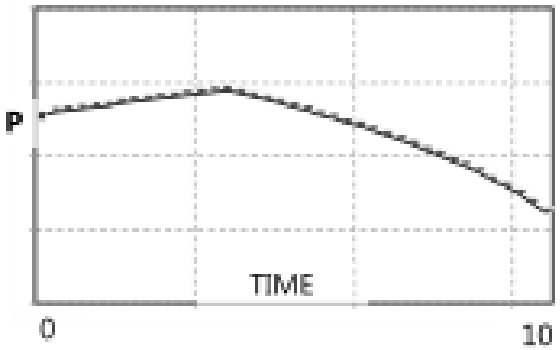
With India fulfilling its growth potential, the government's finances improve

Pace of Inclusion



Strong inclusionary growth is a byproduct of localized skill development and innovation in business models

Impatience and Protest



Impatience continues till citizens begin to perceive benefits of reforms and improving livelihoods

Conclusions

- Business as Usual is not an option
- Policy logjam will lead to chaos
- Large centralized model not sustainable
- Social unrest will lead to chaos
- Need innovations in business models for:
  - Move away from subsidies towards livelihoods
  - Efficient use of resources
  - Service delivery

Large Scale Wind Power in Karnataka

Question

- How much wind power can Karnataka add?
- How Fast?

Depends On

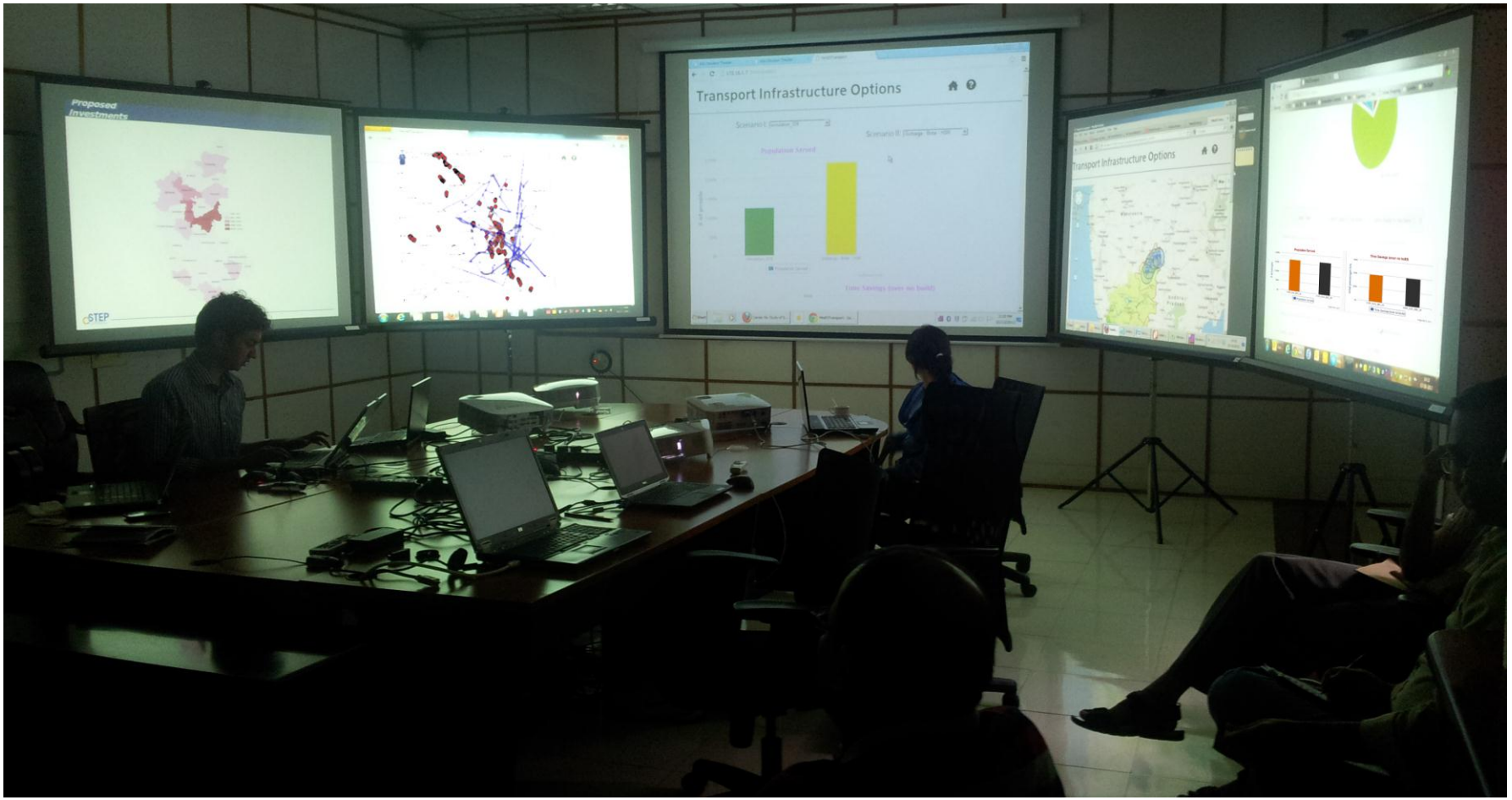
- Wind resource
- Land availability
- Economics
- Transmission infrastructure
- Managing intermittency
- Road network

We could write a report examining these

Or ……

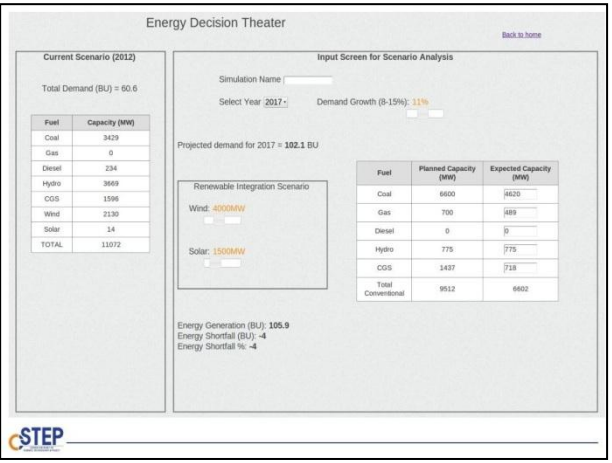
Decision Analysis for Research and Planning (DARPAN)

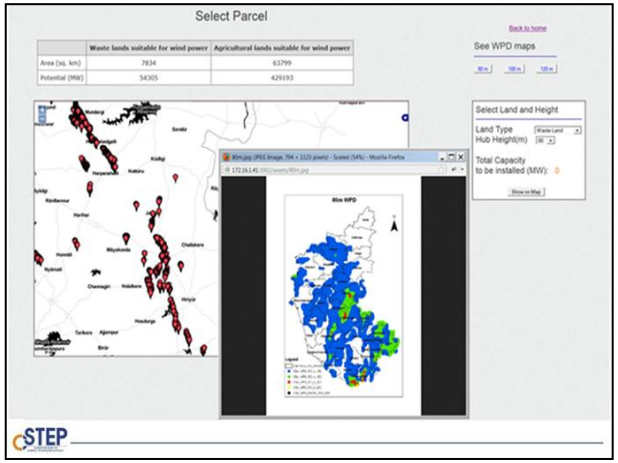
DARPAN = Mirror (in Hindi)

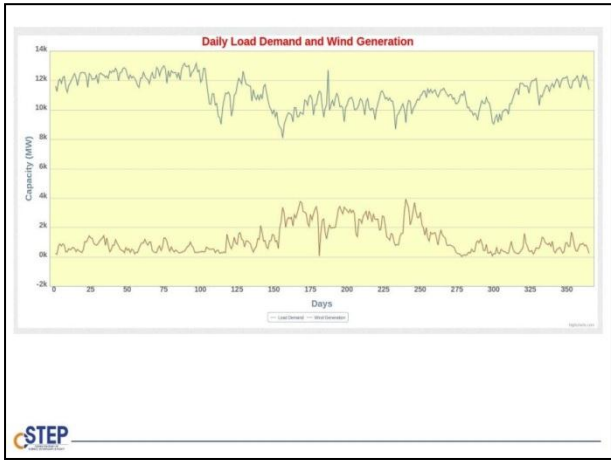


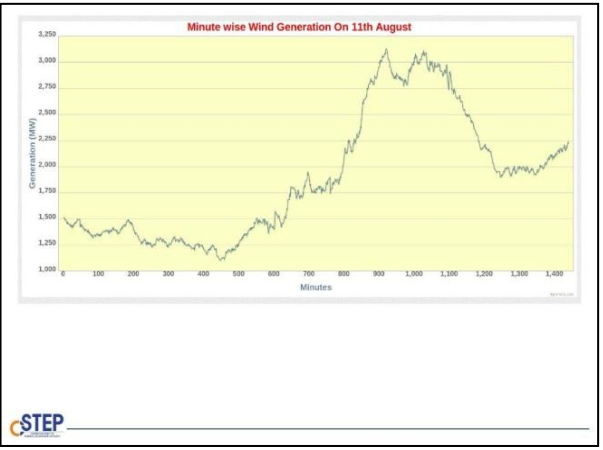
Motivation from “Decision Theater” of Arizona State University

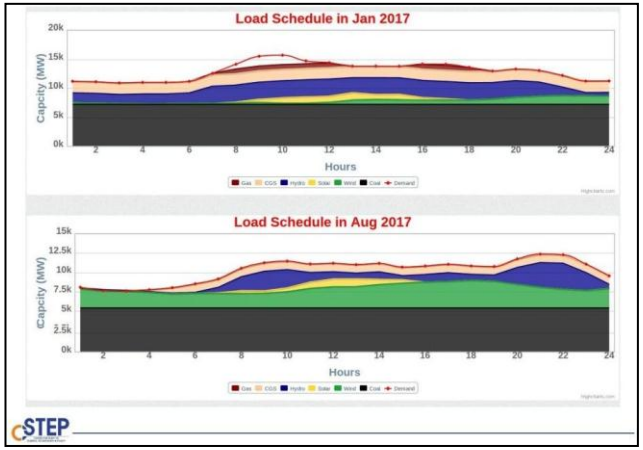
Integrated Model Screenshots

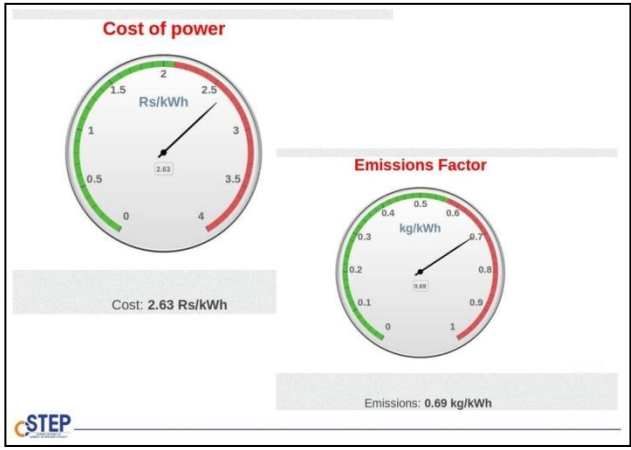




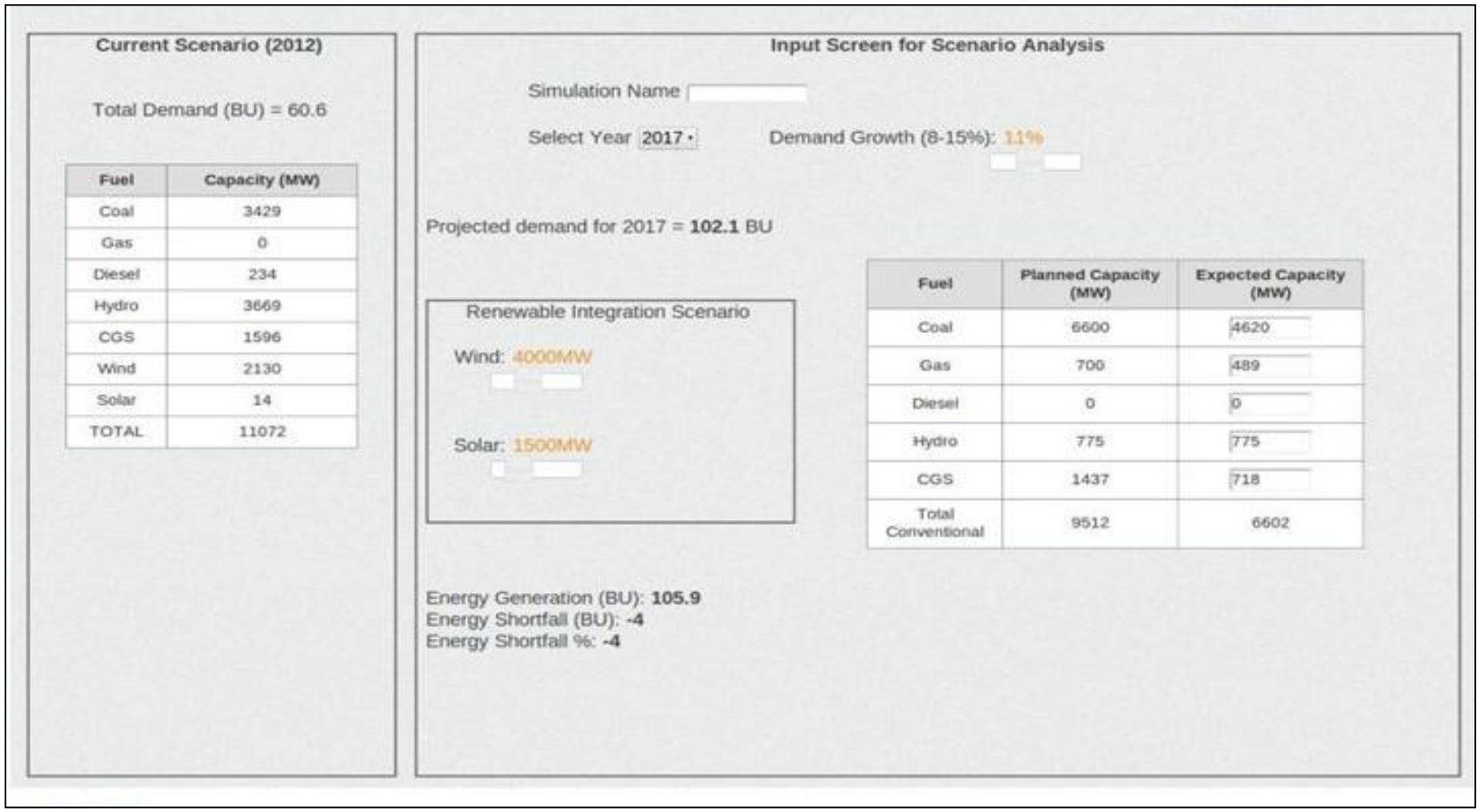








Energy Demand Projections



Current Scenario (2012)

Total Demand (BU) = 60.6

Fuel	Capacity (MW)
Coal	3429
Gas	0
Diesel	234
Hydro	3669
CGS	1596
Wind	2130
Solar	14
TOTAL	11072

Input Screen for Scenario Analysis

Simulation Name

Select Year 2017

Demand Growth (8-15%): 11%

Projected demand for 2017 = **102.1** BU

Renewable Integration Scenario

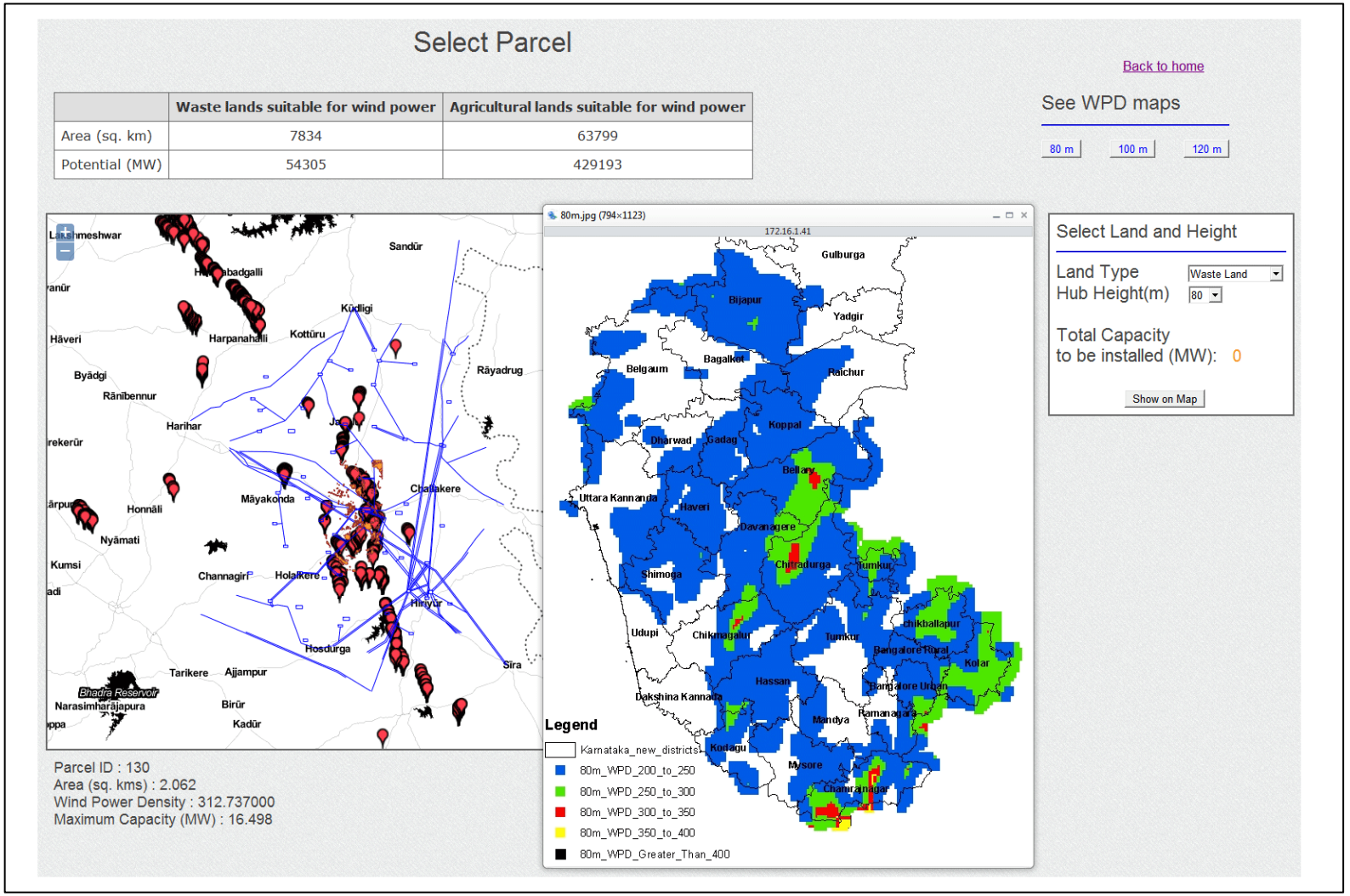
Wind: 4000MW

Solar: 1500MW

Fuel	Planned Capacity (MW)	Expected Capacity (MW)
Coal	6600	4620
Gas	700	489
Diesel	0	0
Hydro	775	775
CGS	1437	718
Total Conventional	9512	6602

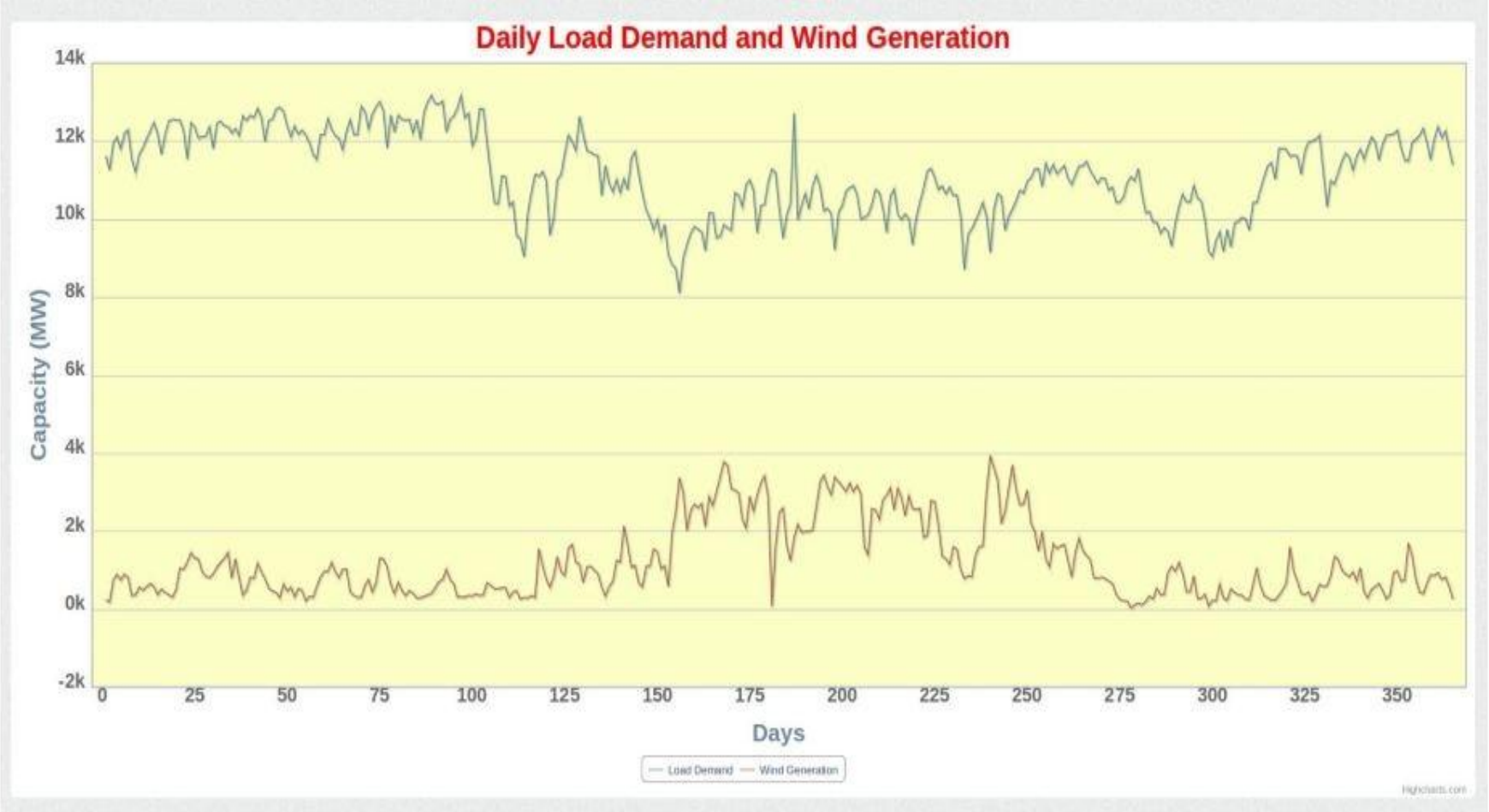
Energy Generation (BU): **105.9**
Energy Shortfall (BU): **-4**
Energy Shortfall %: **-4**

Wind Resource Assessment

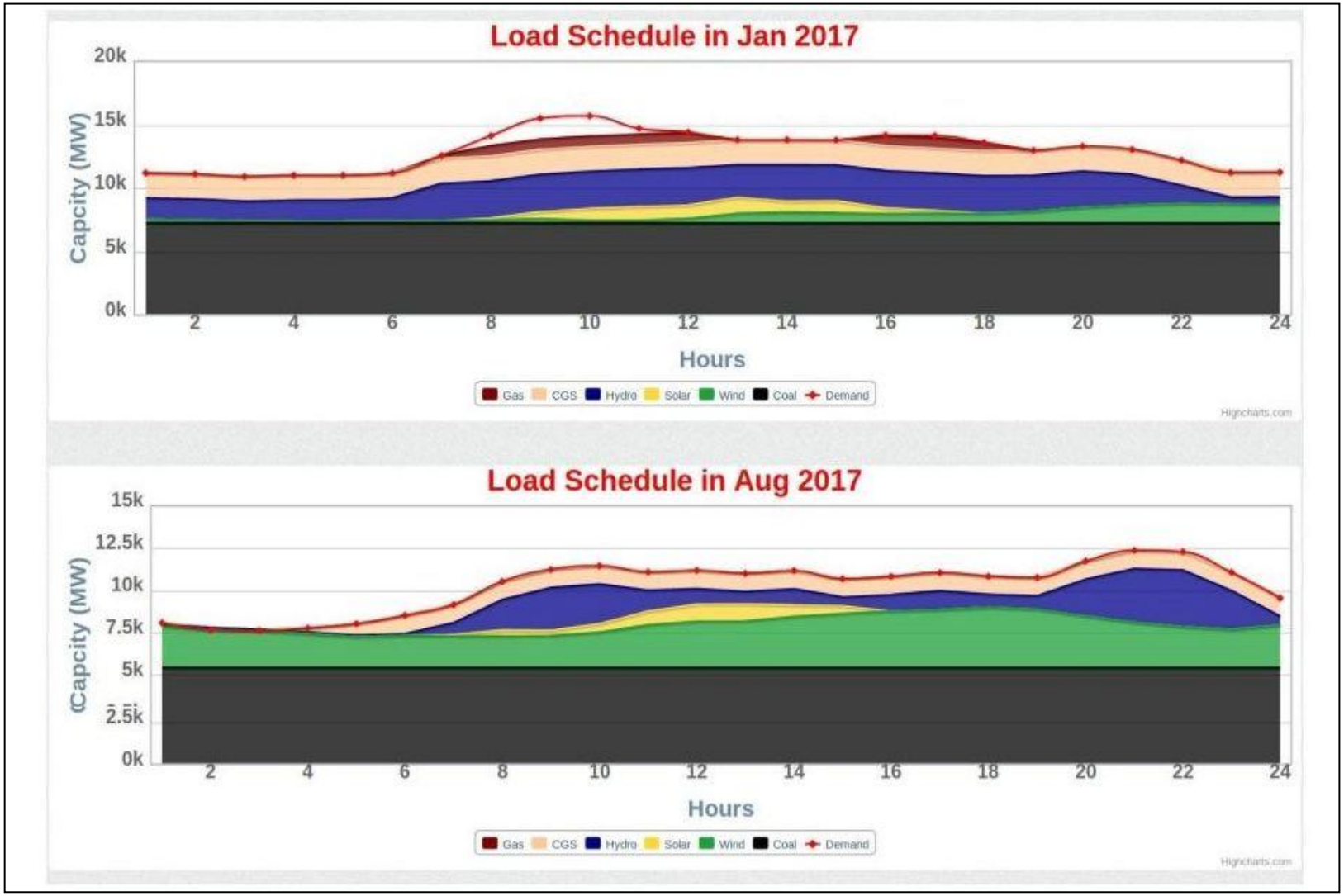


Karnataka's wind power potential > 50,000 MW

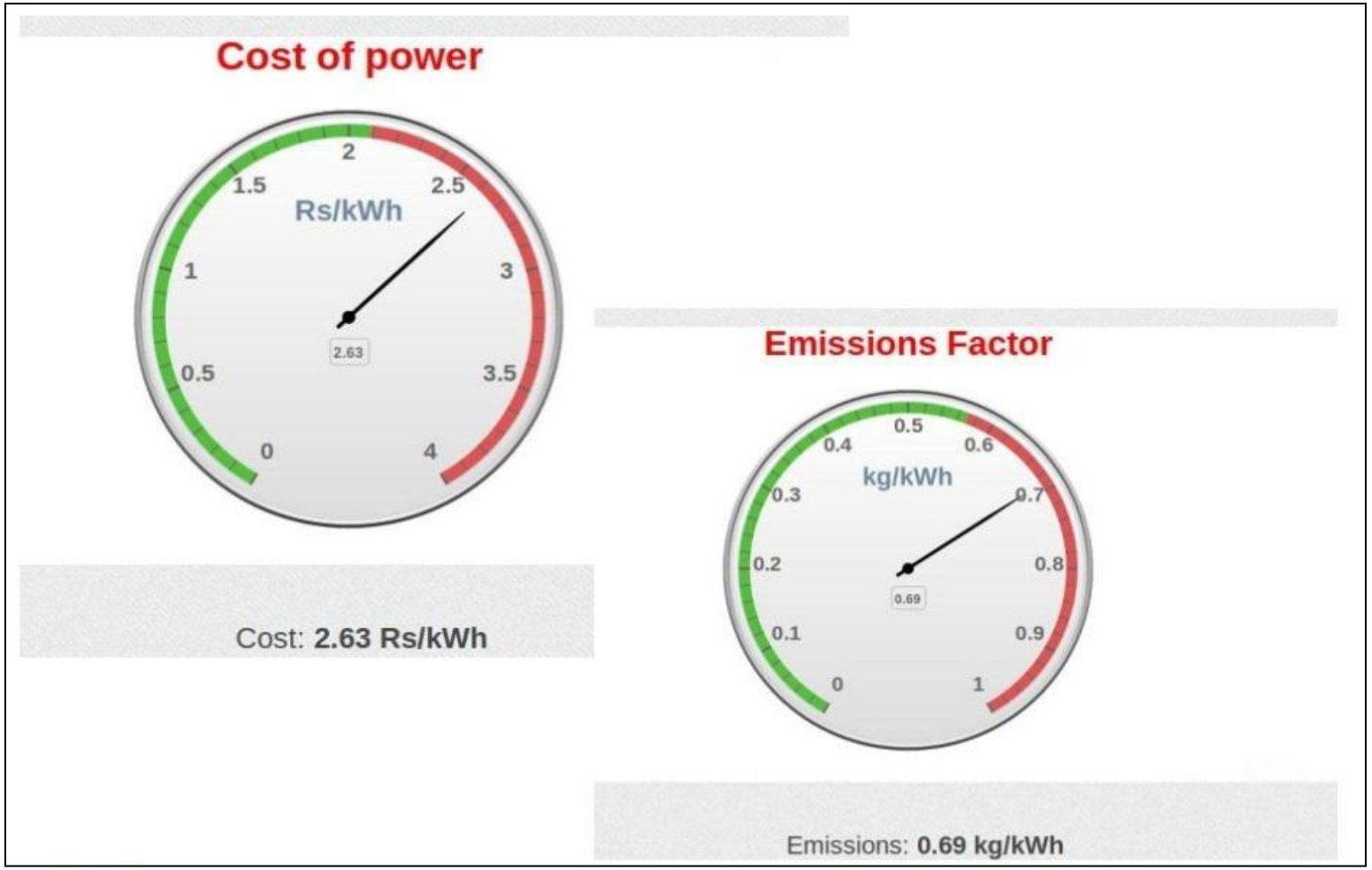
Intermittency



Load Dispatch Planning



Impact on Cost and Emissions



Conclusions

- Karnataka has large wind power potential
  - @ 80 m hub height
  - Wastelands > 50,000 MW
- Cost of generation reasonable: 6 – 8 ¢/per kWh
- Managing intermittency is the main challenge
  - Difficult to go beyond 10,000 MW of wind power
- Options
  - Pumped hydro storage
  - Open cycle gas turbines
  - Integration with national grid
  - Grid level storage batteries

Thank You