Power Market Reforms, Climate Change and Distributed Power Generation

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Outline

• Definition of Distributed Power Generation
• Market Reform and DG
• Climate Change and DG
• Example: India
• Policy Implications
What is Distributed Power Generation?

- No consistent definition
- Some potential characteristics:
  - Small-scale (how small is small?)
  - Located near point of demand
  - Connected at distribution level (how defined?)
- Some non-relevant characteristics often used:
  - Operation mode (dispatchable, scheduled, etc.)
  - Generation Technology and Fuel (renewable or non-renewable)
  - Ownership
Examples of Distributed Generation

• MW scale off-grid turbine fueled with natural gas providing heat and power for a large facility (e.g. university, hospital, factory) with grid back-up. Ownership and operation rests with the private owners.

• Grid-connected internal combustion engine fueled with natural gas (hundreds of kW) providing heat and power with surplus sales to the grid and purchases from the grid at peak load. Ownership is through a joint venture agreement between the facility owner and the local distribution utility.

• kW scale off-grid biomass combustor supplying small agricultural producer plus limited lighting to village users. The system is owned by the village community but run by the agricultural producer.
A 250 KW Electrical and 200 KW Thermal Gasifier Power Plant installed at Narayanpur, 24 Parganas (N), West Bengal

A solar photovoltaic pump installed in Haryana.

Solar power plant (8.4 kWp) at a hospital at Darhal, District Rajouri, Jammu & Kashmir

Source: MNES Website
Sources:
CAT website and ORNL website
Elements of Market Reform That Impact DG

• Opening for private entry in generation
  – Expansion beyond back-up or completely captive
• Changes in transmission access
  – Options for wheeling
  – Options for partnerships
• Portfolio and hedging options for utilities and customers
  – Deferred transmission investments
  – Mix of grid and self-generation
• Differentiated markets
  – Power reliability and quality
• Relationship to rural electrification
• Subsidies and incentives
Regulatory Reforms

• Market reforms require favorable regulatory structure
• Regulatory changes may also be undertaken that are not necessary for functioning country or state level markets
• Elements of Regulatory Reforms Impacting DG:
  – Change in licensing requirements
    • DG and central station plants require different rules
  – Change in tariff structure
    • Changes financial calculations for DG projects
  – Change in access regulations
    • Ability to sell power (wholesale and contract)
    • Wheeling and other surcharges
Climate Change and DG

- Non-fueled Renewables (solar, wind)
  - Potentially expensive ($/tC)
- Fueled Renewables (biomass)
  - Carbon neutral
- Non-renewable (diesel, gasoline, natural gas)
  - Positive:
    - Can be efficient (combined heat and power)
    - Cost competitive
  - Negative:
    - Can be inefficient
    - Local air pollution
- Competition for greenhouse gas reductions with centralized solutions (e.g. carbon capture and sequestration)
FIGURE 8.3 The cost of electricity versus carbon intensity. The x-axis shows CO₂ emissions (in kilograms of carbon per unit of electricity generation [in gigajoules]). The y-axis shows the approximate cost of electricity from new generating units including costs for capital, fuel, and operations. The likely cost of ICM technologies is on par with the estimated cost for large-scale wind or new nuclear. Currently, coal dominates fossil electricity supply, so replacement of coal with natural gas-fired electrical generation achieves substantial CO₂ mitigation at minimal cost, but this effect depends strongly on the price of natural gas as shown in Figure 8.4. Costs of intermittent renewables do not reflect the additional costs, such as storage, due to their intermittency.

Source: NRC 2001
Does Climate Change Drive DG

• OECD context
  – Renewable portfolio standards, favorable provisions for combined heat and power, other incentives for “green” technologies

• Non-OECD context
  – Cost is paramount
  – Rural electrification is a stated priority
  – Reliability is chronically poor
  – Result is both very clean and very dirty distributed power according to need, cost and availability of technology and fuel
Impact of DG on Distribution Voltages

Fig 6. Impact of a decentralized generator placed centrally at Bus # 73 on the voltage profiles. The generator is varied from 0 MW to 3 MW. (On-Line load is 60%, theft 15%, power factor 0.8)

Source: Bharadwaj and Tongia, 2003
DG in India

• Pre-Electricity Act 2003
  – High levels of industrial and commercial captive power due to poor reliability and high tariffs
  – Some renewables in rural areas

• Electricity Act 2003
  – Complete overhaul of electricity system
  – Generation de-licensed
  – Distribution in rural areas de-licensed
  – Cross-subsidization being removed
  – Open access
  – Policy on rural electrification required (goal: 2012)
  – State level implementation not complete
Implications of Reforms and Climate Change

• Alignment of Market Reform, Regulatory Reform, Climate Change and Rural Electrification Policies?
  – Could open up space for DG as market player
  – Financial Viability versus Economic Desirability and Social Needs
  – Macro versus micro markets
  – Use of CDM for DG projects
  – Need to differentiate between DG applications

• Changing Subsidy Structure
  – Capital versus O&M versus direct customer support
  – Reduction of cross-subsidy reduces I/C exit incentive

• Role of Local Institutions in DG-RE