

The Energy Supply–Side Challenge: Barriers to Innovation for Renewables, DG and Base Load Technologies

Conference on Bridging the Gap Between Science and Society

Rice University

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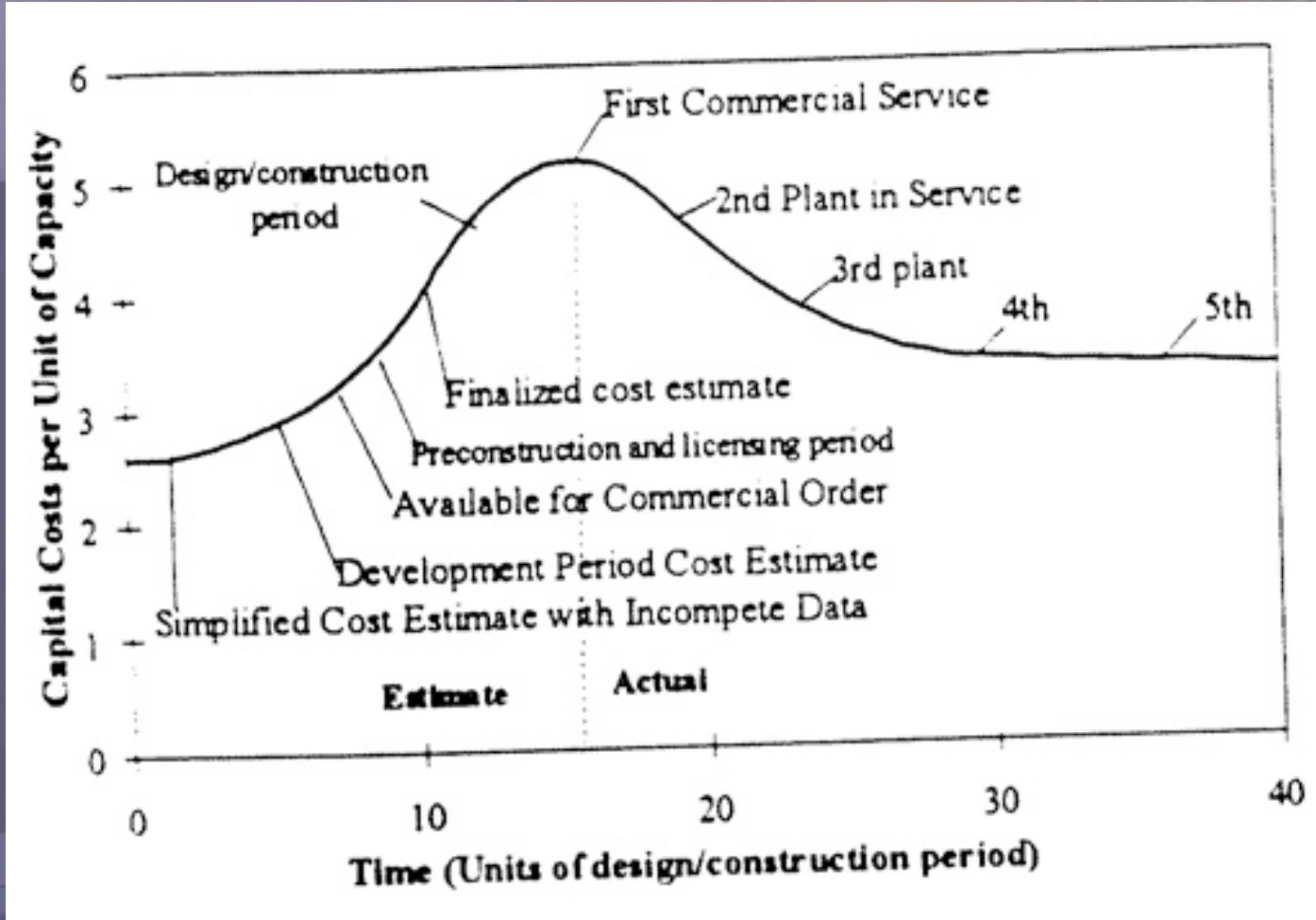
The Laws of Energy R&D

- 1st Law: The Further off into the Future before Commercialization, the Lower the Estimated Cost
- 2nd Law: The Further off into the Future before Widespread use, the More Benign the Technology
- 3rd Law: If you do not Know Where You are going, You will not know when you get There

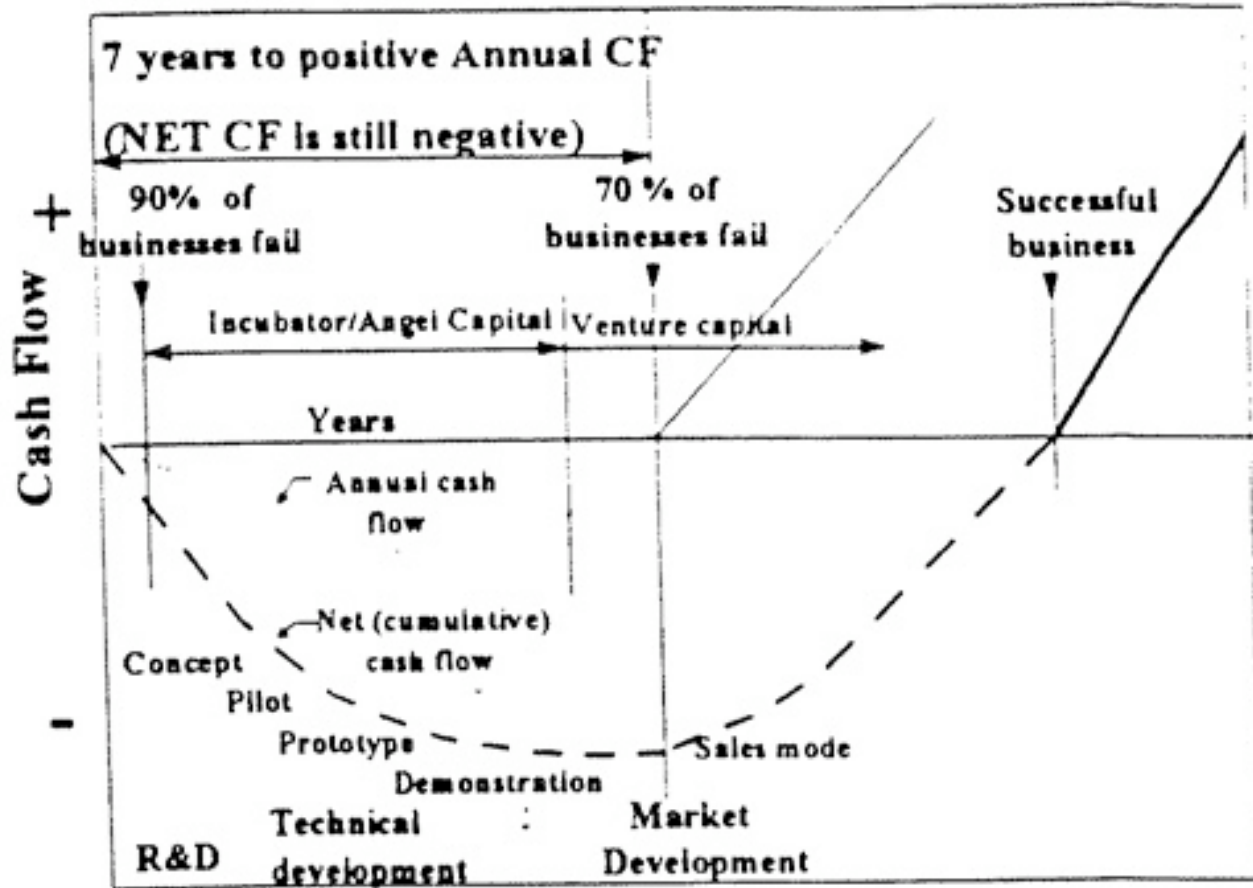
The Twin Dilemmas of Energy R&D

The “Mountain of Death” and the “Valley of Death”
Associated with the Technological Innovation
Process

Mountain of Death



Valley of Death





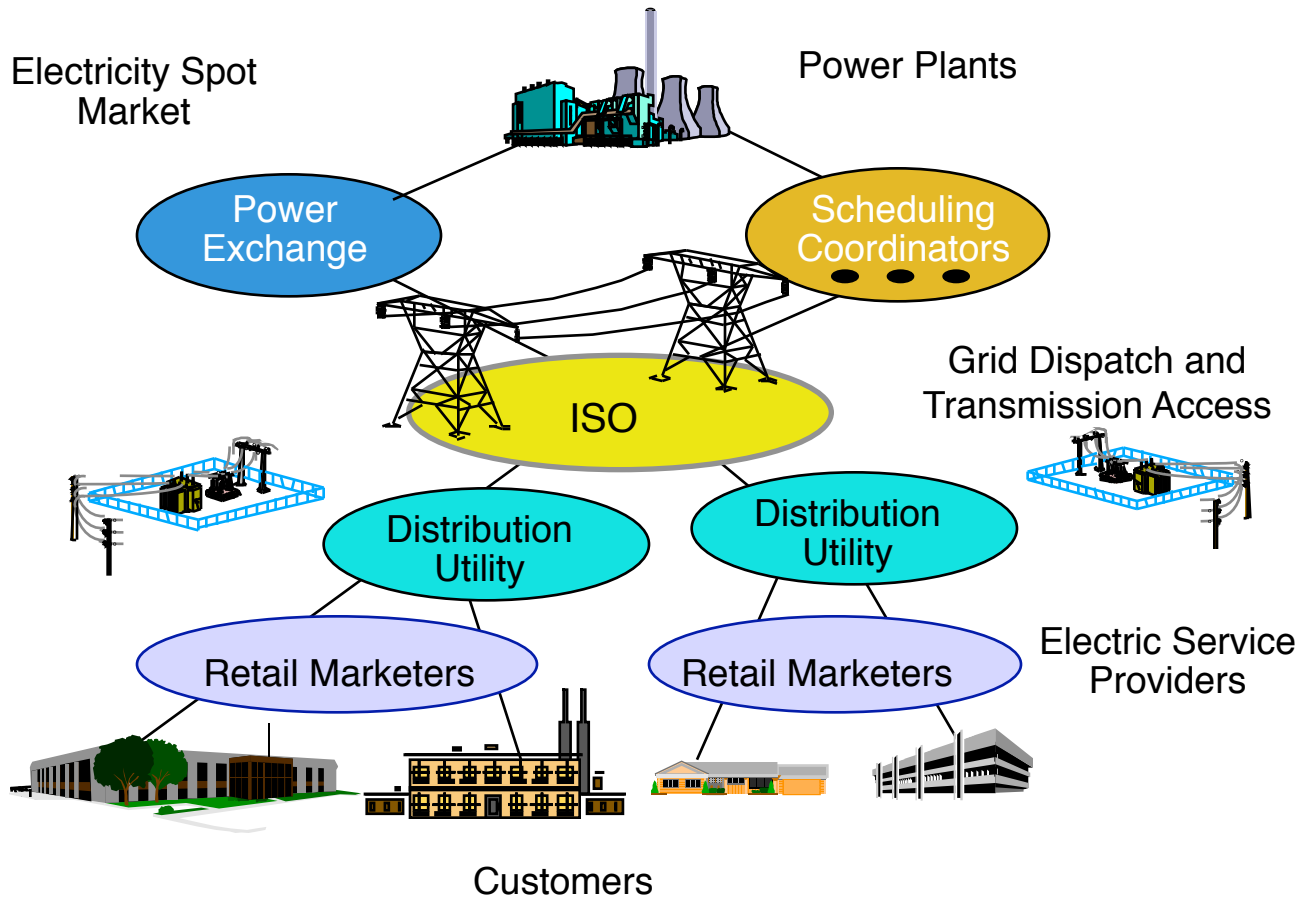
Dimensions for Supply-Side Technological Considerations

Technology

Fuel

Grid

Changing Industry Structure



Key Considerations

- Market Drivers
 - Deregulation/Disaggregation has removed corporate economies of scale
 - Increased energy market complexity / rising energy prices / increased need for reliability forcing major consumers to manage energy supply
- Implications
 - Technological innovation tends to be incrementally driven
 - Breakout technologies are difficult at best
- Consequences
 - Domestic introduction of technologies requires incentive mechanisms
 - International opportunities abound, but cooperative mechanisms are needed

How Can We Proceed?

- Demand Creation
 - Important policy for large social issues
 - Develop technological options for future demand
- Look to Forces Shaping the Future Demand
 - Developing countries with urban, economic growth
 - Global change with climate the leading issue
 - Digital society and the need high reliability

World Urban and Rural Population Projections

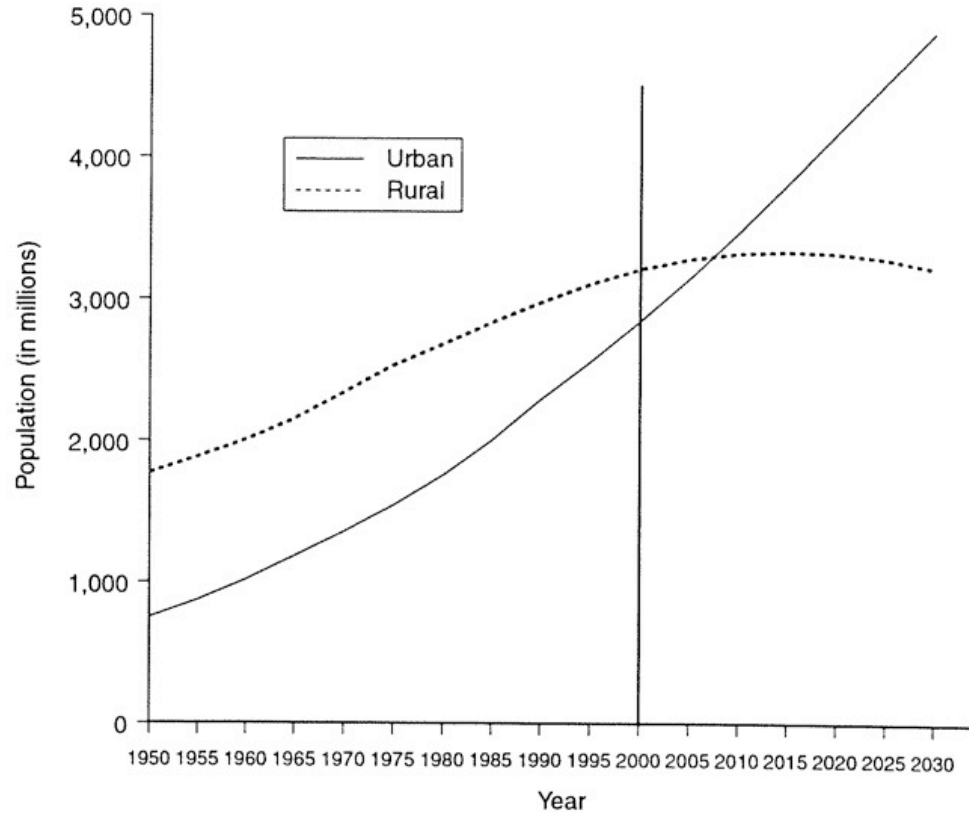


FIGURE 1-1 Estimated and projected urban and rural populations, world totals 1950–2030.

SOURCE: United Nations (2002a).

Distribution of World Population Growth

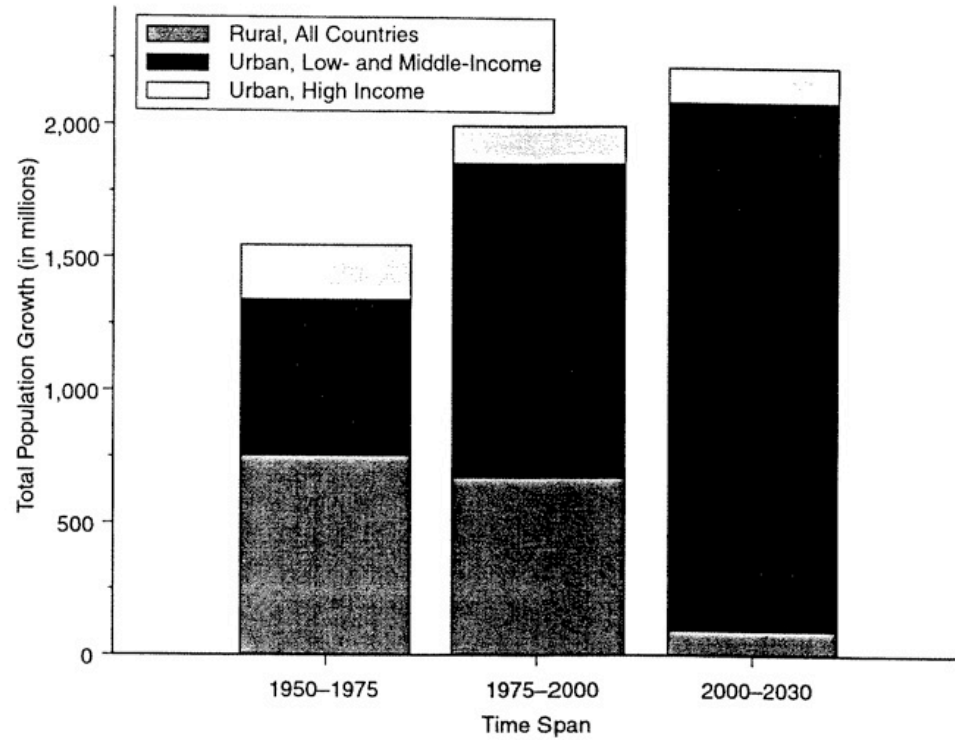


FIGURE 1-2 Distribution of world population growth by urban/rural and national income level. Estimates and projections for 1950-2030.
SOURCE: United Nations (2002a).

Net Additions to Urban Population

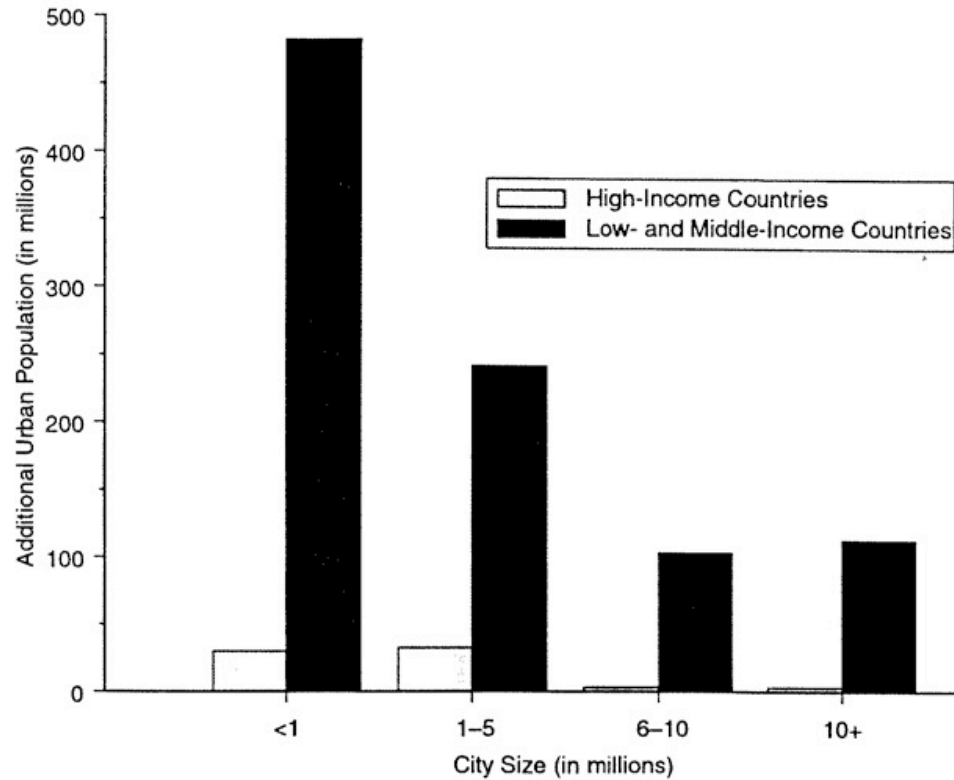


FIGURE 1-5 Net additions to urban population, by city size and national income level, 2000–2015.

SOURCES: United Nations (2002a); World Bank (2001).

Cities with a Million Residents

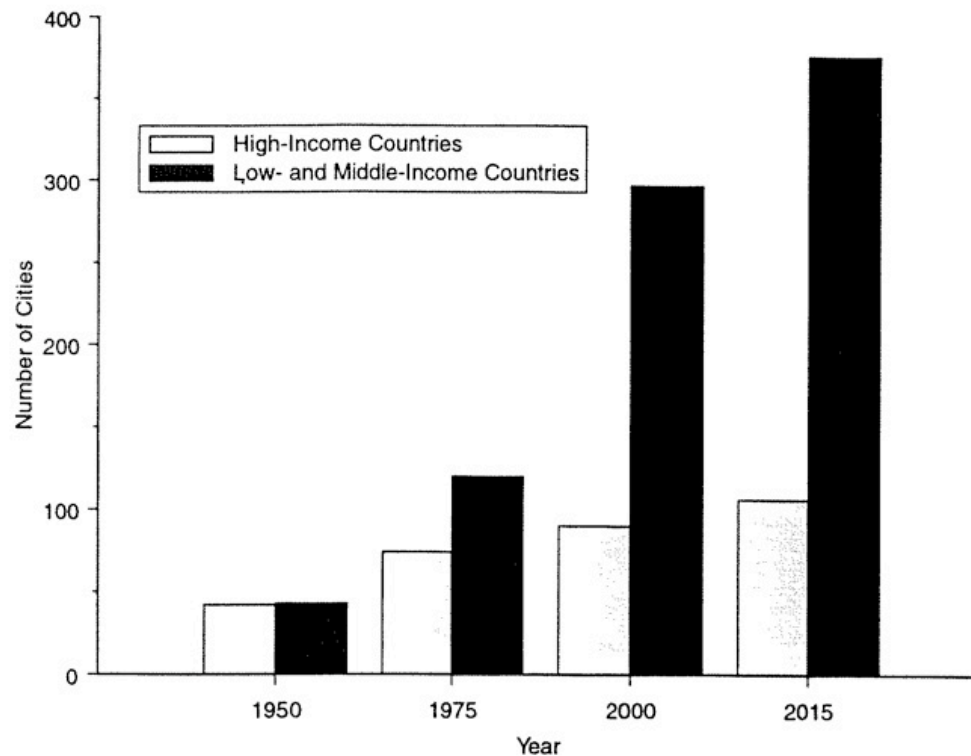


FIGURE 3-2 Number of cities with a million residents or more, 1950–2015.
SOURCES: United Nations (2002a); World Bank (2001).

What Can Be Done?

- Apply the 3rd Law
 - Design the power system the way it should be done
 - Use a “neighborhood” approach for the grid/local (DG) mix
 - Optimize the system based on future needs
- Mechanisms to Accomplish This (Global Reach and Local Touch)
 - Policy issues and the use of bi-and multi-lateral agreements
 - Retain IP while using the local work force
 - Use a “Spiral Development Approach” to insert advanced technologies as they become available

Corollaries to the 3rd Law

- If You are in a Hole, Stop Digging
- If You Are in a Very Deep Hole, the Horizon is Much Closer Than You Think