Integrated Resource Planning: History and Principles

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The Regulatory Assistance Project
100 Years of Solitude

- For most of the 20th Century, the electric industry exhibited the characteristics of natural monopoly – that is, it was marked by increasing economies of scale such that demand for service is most efficiently served by a single provider
  - So long as average costs (prices) went down as demand increased, policymakers weren’t overly concerned about how planning and investment in the sector were carried out
Changing Priorities: Federal Legislation

- In our parents’ lifetimes, corporate and political corruption, inequity, and regulatory unpredictability were the among the objects of government action
  - Federal Power Act, 1935
    - Federal Power Administration, now the Federal Energy Regulatory Commission, created
  - Public Utilities Holding Act, 1935
  - Natural Gas Act, 1938

- In our lifetimes, environmental damage, resource scarcity, risk, and economic efficiency have been key issues:
  - Clean Air Act, 1970
    - National Ambient Air Quality Standards, State Implementation Plans to achieve NAAQS
    - Grandfathering of existing plants and new source review (still subject of contention)
  - Public Utility Regulatory Policies Act, 1978
    - Qualifying facilities (renewables and cogeneration): the beginning of independent power
  - Clean Air Act Amendments, 1990
    - Acid Rain Program: SO₂ cap-and-trade regime
  - Energy Policy Act, 1992
    - Wholesale open access to the transmission system
  - Energy Policy Act, 2005
    - Repeal of PUCHA, and a provision to avoid QF requirements
WE HAVE A NEW ENERGY BILL.
Changing Technology and Economics of Electricity

- As early as the 1960s, arguments in favor of competitive provision of generation were heard
- Although less than 2% of the nation’s electricity is generated by burning oil, the energy crisis in the 70s nevertheless affected thinking about resource selection and risk
  - Especially in New England, where more than 10% of the electricity comes from oil-fired generation
- Alternative energy resources: PURPA, 1978
- The nuclear cost overruns in the ’70s and ’80s showed that the economies of scale were not forever increasing
  - This was also found to be true of large conventional units
    * Thermal efficiency of delivered kWh around 30%
Changes in the Natural Gas Market

1970s: Gas shortages
- FERC price ceilings, little new exploration and investment, and energy crisis generally

PURPA, Fuel Use Act, Natural Gas Policy Act
- Assumed future shortages of gas
- Prohibited use of gas for electricity generation
  - Inadvertently made coal the only viable supply alternative
  - This provision was repealed in 1987
- These acts initiated the nearly two decades long process of gas deregulation
The Conventional Approach to Planning

- Load growth during the ’50s and ’60s was in the 5-7%/year range. Planners simply assumed a straight-line continuation of these trends.
- In the Northeast and West, a significant number of nuclear power plants were planned; after 1973, plagued by massive cost overruns and facing greatly reduced demand projections, most were cancelled, even though, in many cases, construction had begun
  - In the Northwest, 20 nuclear and coal units were planned. 9 nuclear and 5 coal were scrapped, at a cost to consumers of $7 billion
  - Worst of the lot: Shoreham in NY – In 1968, Long Island Lighting Co. had estimated the cost of the 820 MW plant to be $350 million. When completed 20 years later, its final cost was $5.4 billion, or 15 times the original estimate. The plant never went into commercial operation and was sold to the state for $1 in 1989. The estimates of both Lilco and the NY PSC were that the present value of running the plant was minimally higher than not running it. No other nuclear plant overran its original cost estimate by a factor of 15, but several did so by a factor of 10.
The ’80s and ’90s

- Significant price increases associated with rising oil prices and the costs of nuclear units
  - Public outrage and environmental activism

- State Regulatory Responses
  - Increased investment in renewables under PURPA
  - Integrated resource planning and the development of comprehensive end-use energy efficiency programs

- Significant new investment in natural gas-fired generation
  - Combined cycle units: waste heat from gas-fired turbines used to create steam to turn second set of turbines
    - Thermal efficiencies well over 50%

- Other technological changes
  - Wind turbines, micro-turbines, reciprocating engines whose costs began to compete with central generation
    - Size doesn’t matter (as much)
A Policy Response: IRP

- Object: to minimize the total societal cost of energy production and use over the long-term
  - Evaluation of all potential resources—G, T, D, and demand-side investments—as complements and substitutes
  - Twenty- to thirty-year planning horizons, sophisticated computer modeling, application of asset and risk management tools
  - Environmental and other external costs and benefits recognized
  - Regulatory mechanisms to overcome utility and customer barriers to demand-side efficiency
  - Innovative rate structures

- Was put into effect in a number of states in the northeast, mid-west, and west
  - *Demonstrated that investment in comprehensive end-use energy efficiency was the most cost-effective resource available*
A "least cost integrated plan" for a regulated electric or gas utility is a plan for meeting the public's need for energy services, after safety concerns are addressed, at the lowest present value life cycle cost, including environmental and economic costs, through a strategy combining investments and expenditures on energy supply, transmission and distribution capacity, transmission and distribution efficiency, and comprehensive energy efficiency programs.

- Title 30, Vermont Statutes Annotated, §218c (a)(1)

Northwest Power and Conservation Planning Act, 1980
IRP Forces Us to Evaluate the Wider Array of Resources

- **Generation**
  - Conventional thermal
  - Nuclear, hydro
  - Renewables
  - New technologies

- **Transmission and distribution**

- **Distributed and demand response resources**
  - Customer-sited
    - Short-term load management (LM)
    - Distributed generation, combined heat and power, small-scale renewables (net metering)
    - Long-term end-use energy efficiency (EE)
    - Consumer response to prices and other demand response programs

- All of these can be substitutes for each other
Environmental Issues

- Land use, water use
  - Siting, thermal needs, etc.
- Emissions
  - Nitrogen oxides, sulfur dioxide, particulate matter, carbon monoxide, volatile organic compounds, unburned hydrocarbons, heavy metals, and carbon dioxide
  - Climate change
- Waste: nuclear, coal ash, etc.
- How are costs not easily quantified best accounted for in the planning exercise?
  - Unquantified costs are not zero costs
The Essential Question

- How do we determine what resources we need?
  - “Need” is an economic concept
  - If something is less costly than the alternative, it’s needed
- Always ask “Compared to what?”
The Gay Nineties: Restructuring

➢ Early ’90s: Recession
  - Significant drops in electricity use due to weakening economy and success with energy efficiency
  - Cost of new generation less than the average cost of existing
    • Gas prices low, thermal efficiencies high
  - C&I demand direct access to lower-cost competitive suppliers
  - The argument that competition will reduce costs and do a better job than regulation of allocating risk appeals to policymakers

➢ Mid- to late ’90s: Restructuring
  - Monopoly elements of the system—T&D—remain price-regulated
  - G is unbundled from T&D—divestiture or corporate separation
  - G is competitively supplied through contracts with load-serving entities and through the short-term wholesale market
  - The overall system is operated by an independent system operator, to maintain reliability in the short and long terms
The Aughts

- In restructured states:
  - Retail competition not working for residential and small commercial customers
  - Default service contracted for on short-term bases
  - Neither competition nor planning is protecting consumers: at the mercy of the short-term markets
  - Response: IRP for default service – portfolio management

- Most states still vertically integrated
  - Interest in IRP is growing; now the law in 28 states
Technology, Economics, and Politics: a Time Line

Future Trends?:
- Customer Generation
- IGCC and sequestration
- New Nuclear
- New Renewables
- Climate Change Caps
- Mercury and PM limits
- Efficiency Costs stable
- Smart Grid
- Regulatory Reform

Horizon affected by imminent big supply decisions

1990
- The Energy Crisis
- TMI
- Clean Air Acts
- QFs

1990-2000
- Wholesale competition, RTO
- Retail competition nearby

2000-2007
- Natural Gas Gen Prevails
- Gas Prices Rise
- Energy efficiency $
IRP in the Future

- Federal carbon regulation is imminent
- The objective function of IRP will not merely be least cost, but least cost given a constraint on greenhouse gas emissions
Questions

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