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CONSEQUENCES OF THE LOSS OF NUCLEAR POWER GENERATION IN THE U.S.

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Interdependency and Consequence Effects

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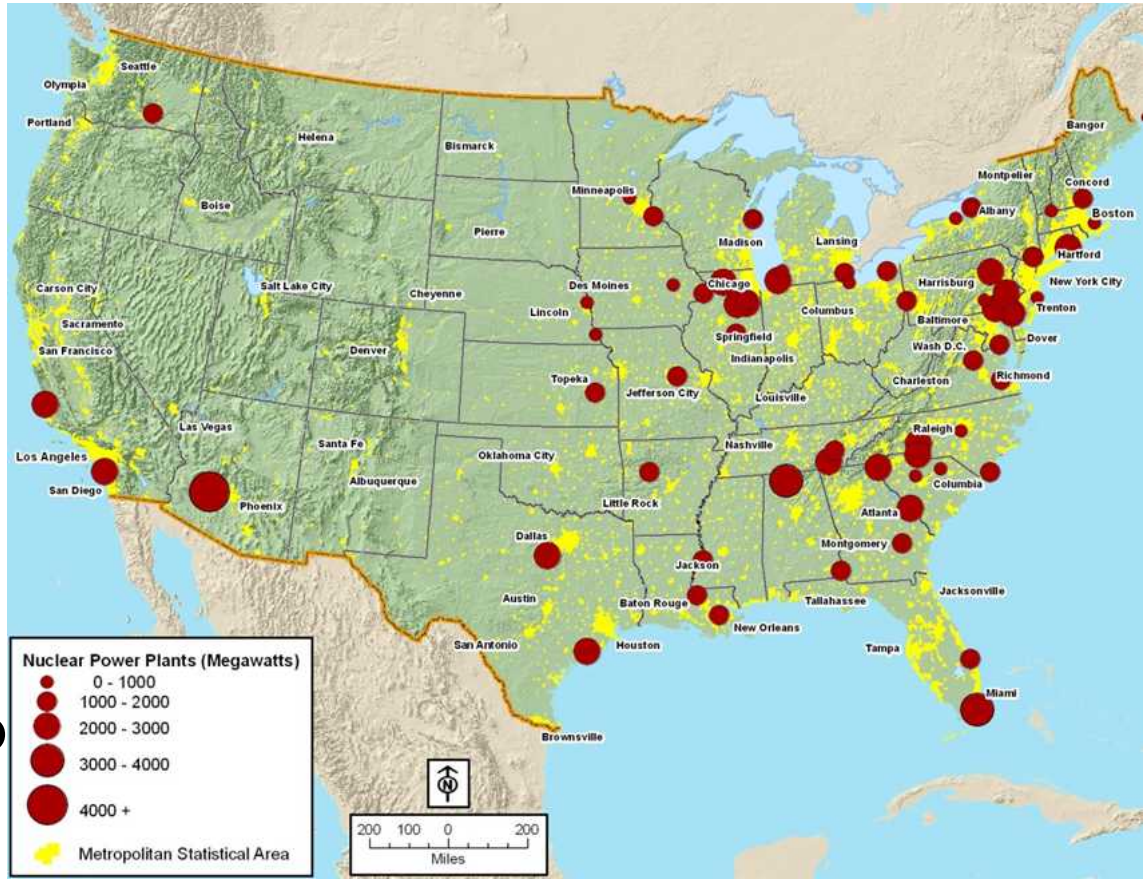
Background

- 104 operational nuclear power plants
- Capacity of approximately 100,000 MW
- 10% of installed generation
- Generate ~20% o EP



U.S. Nuclear Power Plants*

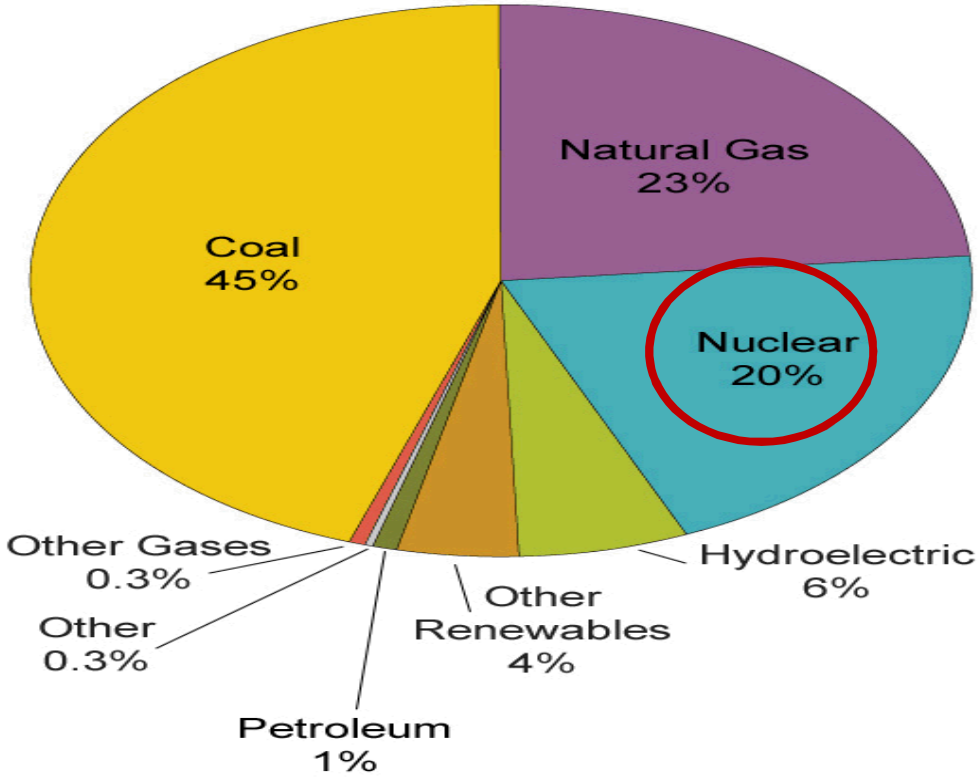
*NISAC-generated map from Platt's data, version Q4, 2010

Licensing

- The *Atomic Energy Act of 1954* gave the Nuclear Regulatory Commission (NRC) authority to issue commercial power reactor licenses to operators
  - up to 40 years
  - no restriction on license is renewal
- As of August 2012 the NRC had issued extensions for 73 reactors
- It is expected that approximately 90 will reach 60-year lifetimes

Net Electricity Generation

United Sates



Source: U.S. Energy Information Administration, *Electric Power Monthly,* Table 1.1 (March 2011), preliminary data.

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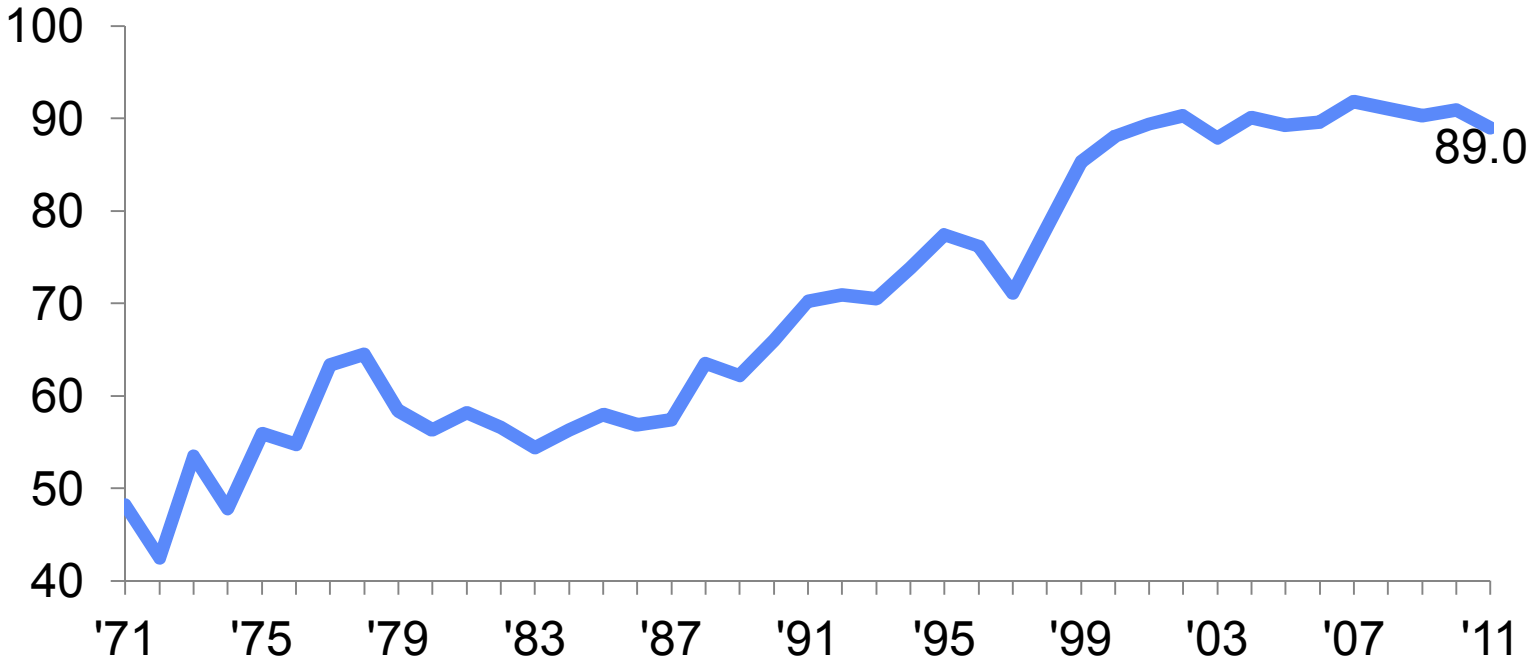
Nuclear Industry Capacity Factors



50% 1970s

70% 1990s

90% 2000s

Source: Energy Information Administration

Accessed: 8/12

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Nuclear Energy Policy: Opinions Matter

Proponents

- Energy security
- Resource efficiency
- No climate relevant emissions
- Can provide reliably large amounts of power
- New small modular reactors

Opponents

- Nuclear power production is costly
- Technologically complex
- Use of highly toxic dangerous materials
- No permanent safe disposal of spent fuel
- Human and environmental risks

Externalities

Externality- an unintended cost or benefit, not transmitted through the market, that is incurred by a party who did not agree to the action causing the cost or benefit.

Negative

- Waste disposal
- Activities related to decommissioning
- Meltdown or release
- Residual health and environmental impacts

Positive

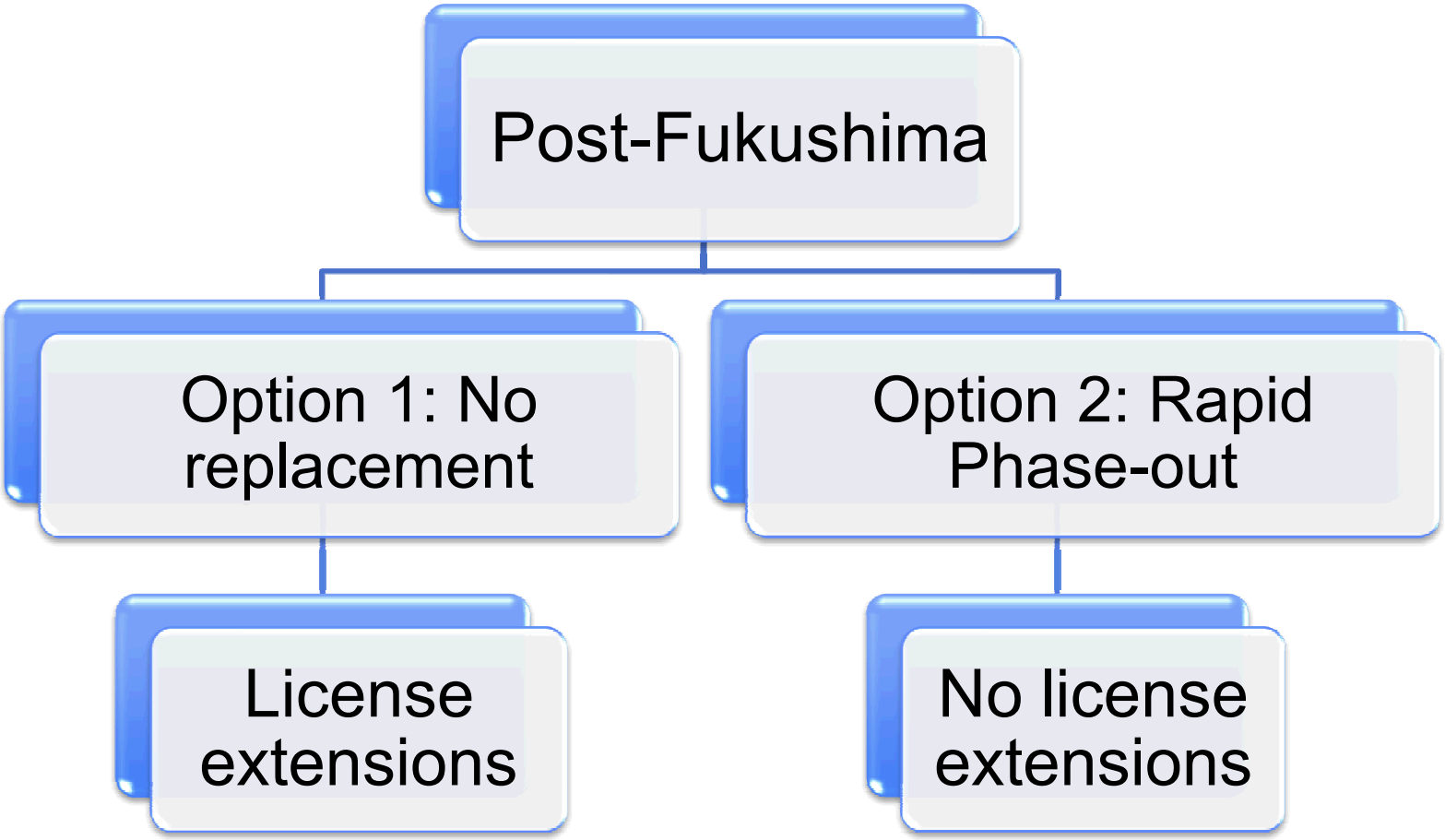
- Reduced green house gas emissions
- Nuclear power as hedge against uncertain fossil fuel and CO_2 prices
- Increased energy independence

Full-cost accounting provides a dollar valuation of externalities.

Influence of Fukushima (3/11/2011)

- Caused policymakers around the world to rethink nuclear power policies.
- A loss of a quarter of Japan's nuclear power generation.
- Pre-Fukushima, the IAEA predicted nuclear would grow from 6% to 11% of total global energy supply by 2035.

Two Scenarios



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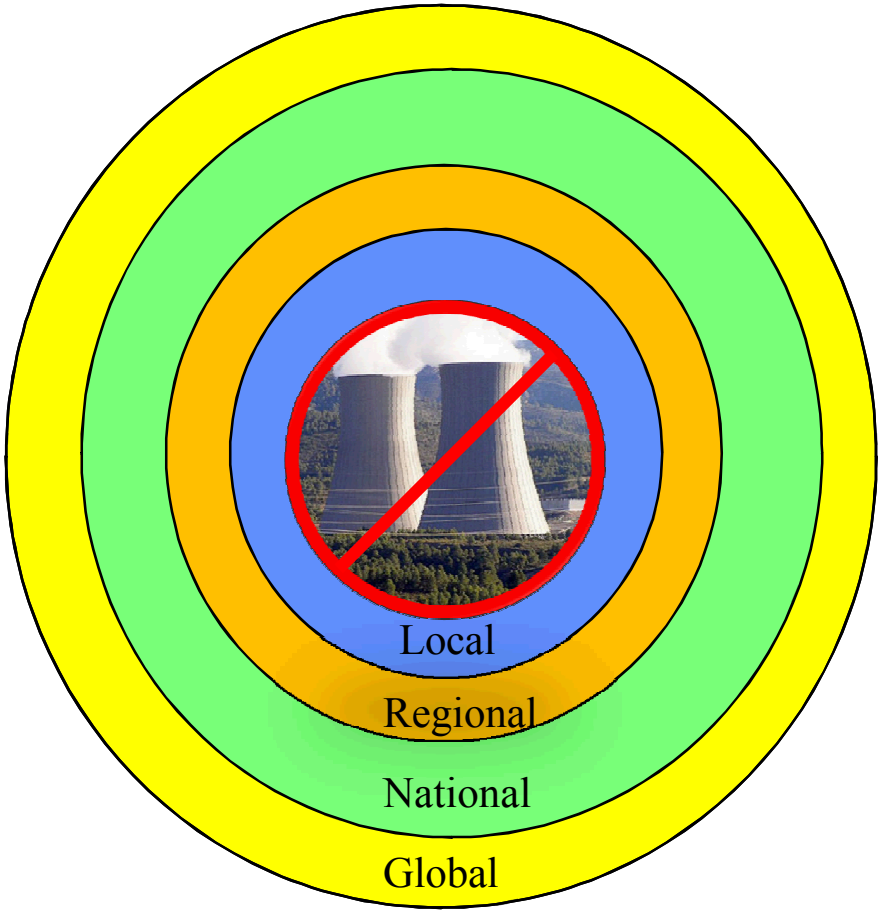
A Future Without Nuclear

- **Phase out of nuclear power has potential significant consequences**
- **An informed decision requires:**
  - **Generation capacity**
  - **Alternatives**
  - **Regional and national effects**
  - **Shifts in international dependence and relations**



Impacts may go beyond local consequences.

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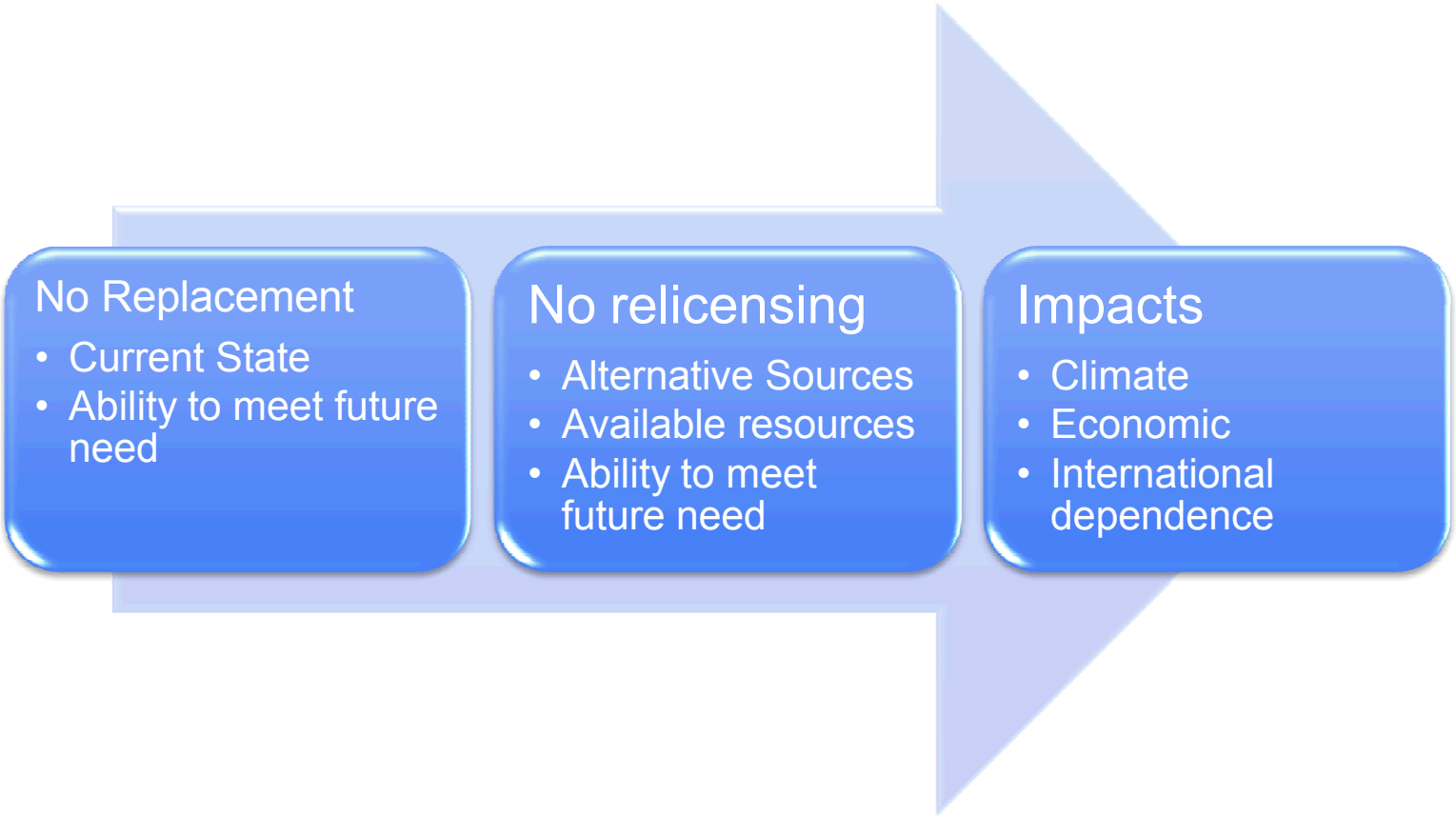
System Analysis Approach



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Recommendations for Integrating Uncertainty and Risk

Sensitivity Analysis	• Impacts of variations in parameter values
Probabilistic Scenario Analysis	• Multiple contributors to risk and uncertainty
Monte Carlo Simulation	• Estimate future outcomes as functions of multiple inputs

Aging Infrastructure

- Eventually, all currently operating nuclear power reactors will need to be decommissioned
- As of the end of 2008, companies owning the nation's 104 nuclear power reactors had $41 billion in decommissioning funds
- Re-licensing is expensive
- Re-licensed facilities will require capital investments
- High cost of construction
  - Estimates range from $6 - $16 billion

Summary

- **Policy changes should be informed by comprehensive analyses that consider:**
  - **systems level interdependencies,**
  - **unintended consequences,**
  - **risks and uncertainties.**

- **Cross-disciplinary expertise in Nuclear Energy, Fuel Cycle issues, climate, probabilistic risk assessment, economic analysis, are required to fully assess the impacts of long-term planning.**