Climate Change – Nuclear Must be Part of the Answer

Michigan State University
Bioeconomy and Global Climate Change
April 26, 2010
U.S. Economic Growth Is Linked To Electricity Growth

Source: U.S. Department of Energy, Energy Information Administration (EIA)
Addressing climate change will cost more – Structure of requirements will determine by how much.

Percentage of U.S. GHG Emissions (all gases), 2006
Ref: U.S. Dept. of Transportation
www.climate.dot.gov

National Fuel Mix
Source: U.S. Department of Energy, Energy Information Administration, 2005 data
What are our options for new generation?

(EPRI projections – Program on Technology Innovation: Integrated Generation Technology Options 1018329)

Levelized Cost of Electricity, $/MWh

- Biomass
- NGCC ($10/MMBtu)
- IGCC
- Wind (32.5% Capacity Factor)
- NGCC ($8/MMBtu)
- PC
- Nuclear

Renewables “out of the money” without incentives, cost reduction

95% confidence level values based on EPRI Report 1018329

All costs are in December 2007 $
Prism technical potential approximates MERGE results for economy-wide 80% reduction in 2050 from 1990 levels.
## MERGE Technology Scenarios

<table>
<thead>
<tr>
<th>Supply-Side</th>
<th>Limited Portfolio</th>
<th>Full Portfolio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon Capture and Storage (CCS)</td>
<td>Unavailable</td>
<td>Available</td>
</tr>
<tr>
<td>New Nuclear</td>
<td>Existing Production Levels ~100 GW</td>
<td>Production Can Expand</td>
</tr>
<tr>
<td>Renewables</td>
<td>Costs Decline</td>
<td>Costs Decline Faster</td>
</tr>
<tr>
<td>New Coal and Gas Generation</td>
<td>Improvements</td>
<td>Improvements</td>
</tr>
</tbody>
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### Demand-Side

<table>
<thead>
<tr>
<th></th>
<th>Limited Portfolio</th>
<th>Full Portfolio</th>
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</thead>
<tbody>
<tr>
<td>Plug-in Electric Vehicles (PEVs)</td>
<td>Unavailable</td>
<td>Available</td>
</tr>
<tr>
<td>End-Use Efficiency</td>
<td>Improvements</td>
<td>Accelerated Improvements</td>
</tr>
</tbody>
</table>
MERGE U.S. Electric Generation Mix

Limited Portfolio

- Coal
- New CCS
- Oil
- Hydro
- Biomass
- Retrofit
- Gas
- Nuclear
- Wind
- Solar

Full Portfolio

- Demand with No Policy
- Demand Reduction
- New Coal + CCS
- CCS Retrofit
- Coal
- Gas
- Nuclear
- Hydro
- Wind
- Biomass
- Solar
MERGE Wholesale Electricity Cost Results

Substantial increases in the cost of electricity

Limited Portfolio

Full Portfolio

2007 U.S. Average Wholesale Electricity Cost

210% increase

80% increase

$/MWh (2007$)

2020 2030 2040 2050
Remarkably different futures…and only 20 years away!

**Limited Portfolio**

- **+90% COE***
  - Wind
  - Biomass
  - Hydro
  - Nuclear
  - Gas

**Full Portfolio**

- **+50% COE***
  - Wind
  - Biomass
  - Coal CCS Retrofit
  - Coal + CCS
  - Gas
  - Nuclear

* Cost of electricity increase relative to 2007
Generation Mix and Electricity Cost* in 2050 per EPRI Analysis

Totally different futures in 2050

**Limited Portfolio**
- **Biomass**: +210% COE*
- **Wind**: 
- **Solar**: 
- **Gas**: 
- **Nuclear**: 
- **Hydro**: 

**Full Portfolio**
- **Biomass**: 
- **Wind**: +80% COE*
- **Coal + CCS**: 
- **Hydro**: 
- **Nuclear**: 
- **Gas**: 

* Cost of electricity increase relative to 2007
In the United States…

104 nuclear power plants currently operate in the United States and generate about 20% of the nation’s electricity.

18 license applications for new plants have been filed with the Nuclear Regulatory Commission with several more expected.

Site preparation has begun on several of these new plants

Worldwide…

Over 400 nuclear power plants operate in 31 countries.

France, Japan and Great Britain get as much as 75 percent of their electricity from nuclear energy.

Over 50 new nuclear power plants are under construction.

Over 130 plants are on order and an additional 300 under consideration.
Nuclear Power is Safe...

OSHA statistics show that Nuclear Power has one of the best worker safety records of any industry.

Results from the NRC’s reactor oversight process, posted on the agency’s web site, show a similar high level of reactor safety performance.

**U.S. Nuclear Industrial Safety Accident Rate**

One-Year Industry Values

<table>
<thead>
<tr>
<th>Year</th>
<th>ISAR</th>
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<tr>
<td>1997</td>
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<tr>
<td>1998</td>
<td>0.26</td>
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<tr>
<td>2006</td>
<td>0.12</td>
</tr>
<tr>
<td>2007</td>
<td>0.12</td>
</tr>
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</table>

ISAR = Number of accidents resulting in lost work, restricted work, or fatalities per 200,000 worker hours.

Source: World Association of Nuclear Operators, Updated: 4/08
Nuclear Power is Reliable...

The average capacity factor for the U.S. nuclear fleet has risen steadily since the 1970’s.

In 2007, the U.S. fleet achieved an all-time high capacity factor of 91.8%.

Source: Global Energy Decisions / Energy Information Administration
Updated: 4/08
U.S. nuclear plants are the lowest-cost source of base-load generation, producing electricity for about 1.7 cents per kilowatt-hour.

A nuclear plant will save $ billions in fuel costs over its lifetime vs. fossil fuel alternatives.

Any form of future carbon reduction requirement will widen this gap significantly.
The Brattle Group, under contract to Connecticut Light and Power and United Illuminating, recently published an IRP for the state of Connecticut with the following information:

Although nuclear project costs are undeniably large, total project cost does not measure a project’s economic viability.

Lifecycle cost is a key determinant when deciding the optimal plant for customers.

In addition to being clean, efficient and reliable, nuclear plants also provide the least costly power to customers among base load technologies.

The savings as compared to other base load plants measure in the $billions throughout a nuclear plant’s life.
Nuclear energy currently accounts for nearly three-quarters of emission-free U.S. generation.

General Electric estimates that new plant output will offset 7.4 million tons of greenhouse gases and 5.1 million tons of coal each year.

In 2007, U.S. nuclear power avoided carbon emissions equivalent to that released from all U.S. passenger cars combined.
Economic Benefits of Nuclear Power

The Nuclear Energy Institute (NEI) estimates that a new nuclear power plant will create up to 2,400 construction jobs and 400 to 700 permanent high tech jobs.

This is in addition to another 400 to 700 local non-plant jobs related to goods and services.

NEI also estimates that the average U.S. nuclear plant generates approximately $430 million in sales of goods and services in the local community and nearly $40 million in total labor income each year.

74% of all Americans now favor the use of nuclear energy, while 82% of those living in close proximity to a nuclear plant are in favor.

Those who strongly favor the use of nuclear energy now outnumber those who strongly oppose by nearly four to one.
Steady Growth in Public Favorability of Nuclear Energy

Source: Bisconti Research Inc.
Support for “Definitely Building More Nuclear Power Plants”

Source: Bisconti Research Inc.
New Nuclear Licensing Process

The Design Certification process allows vendors to secure NRC approval of advanced plant designs. This is the key to design standardization. Design certification is required before a COL can be issued.

The Early Site Permit process enables companies to obtain advance approval for a nuclear power plant site before deciding to build a plant or even what kind of plant to build. ESPs resolve environmental and safety concerns associated with the site.

The licensing process for new nuclear power plants provides for issuance of a combined construction permit and operating license (COL). Granting a COL signifies resolution of all environmental and safety issues associated with the plant.

ITAAC are Inspections, Tests, Analysis, and Acceptance Criteria established as a condition of the combined license that must be completed before the plant is allowed to operate. ITAAC cover design, construction, operational, and various site specific aspects of the plant.
For the U.S. to benefit fully from nuclear power it will require a combination of financing mechanisms, appropriate risk sharing by all stakeholders and supportive government policies.

To date, three Engineering, Construction & Procurement (EPC) contracts have been executed for new plants.

These have occurred under the following commercial circumstances, inter alia:

- Compelling analyses supporting nuclear power as the most cost effective solution for customers (Certificate of Need)
- Mechanisms at the state levels to encourage the development of nuclear power (e.g. early funding/CWIP, premium ROE’s)
- Collaborative contracting strategies by all parties
- The prospect of Department of Energy Loan Guarantees
Nuclear Plant Financing

Multiple Financing Tools Could be Utilized and will at Least Partially Drive Total Cost

- Capital markets
- Equity
- Debt
- Federal government
- Loan guarantees
- Export agency financing
- State/customers
- CWIP
- Securitization
- Joint venture/partnerships

*In addition to financing structure, cost can vary significantly by project, nuclear technology selection and over time due to escalation

$7-$10Bn*
We Need A Reasoned Approach to Used Fuel Management

- Three-part strategy
  - Long-term technology development to recycle nuclear fuel
  - Eventually … permanent disposal facility
  - Centralized interim storage
- Create “blue ribbon” commission to conduct reasoned reassessment of the government’s program
DTE Energy Has Already Achieved Successes on Reducing GHGs – More to be done

- Electricity generation has grown 1.5% annually since 1974 while emissions since 1990 have been stable
- Further emission reductions will occur as DTE Energy responds to 2008 Michigan Energy Legislation:
  - 5.5% efficiency improvement by 2015
  - 10% renewable energy by 2015
- Other actions taken or planned to avoid, reduce or offset GHG emissions:
  - Increase nuclear utilization (license application for Fermi 3 submitted 9/08)
  - Continue forestry & agricultural offset opportunities
  - Develop carbon capture and storage technologies
  - Expand methane recovery operations (landfill and coal bed)
The Planning Process

• Nuclear remains a viable option even as The Integrated Resource Planning process is revised with new information.

• Detroit Edison has not announced intent to build a new nuclear plant, but is simply pursuing a license to do so if and when that decision is to be made.

• Before that decision is made, Detroit Edison will file for a Certificate of Necessity with the Michigan Public Service Commission asking for Commission approval of the need for a new plant as well as the cost and schedule.
The underlying goal of the long term energy planning process is to identify the most effective and least cost plan for supplying the energy needs of customers.

In 2006, Detroit Edison’s completed a preliminary Integrated Resource Planning effort that integrated customer demand forecasts, electricity supply forecasts, and the construction and operating costs of adding new capacity.

The purpose of this study was to assess when a new power plant might be needed and determine what type of plant should be built.

By evaluating reliability, environmental impact, lifecycle costs, and other considerations, it was determined that nuclear was a very strong candidate worthy of further consideration.

In February, 2007, Detroit Edison announced its intention to begin preparing a Combined License Application (COLA) for a new nuclear unit at the Fermi site.
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A COLA was filed with the Nuclear Regulatory Commission (NRC) in September 2008 that referenced the General Electric-Hitachi Economic Simplified Boiling Water Reactor (ESBWR) design.

By filing a Combined License Application before the end of 2008, Detroit Edison maintains eligibility for Federal Production Tax Credits on behalf its customers.

Formal review of the application is proceeding on schedule with the NRC and we expect to receive the Combined License in 2012.

General Electric – Hitachi is also proceeding with Design Certification of the ESBWR. Design Certification will be completed before a Fermi 3 Combined License will be issued.

Detroit Edison has not announced or committed to build a new unit, but is keeping that option open given the long term environmental and economic advantages of nuclear power.
Detroit Edison has selected the General Electric-Hitachi ESBWR for reference in the COLA.

The ESBWR is currently proceeding through the Design Certification process (2011)

Selection of the ESBWR resulted from internal and 3rd party evaluation of the various available reactor technologies and included numerous aspects

- Technical
- Safety
- Operational
- Commercial
- Strategic
A 3rd generation advanced design boiling water reactor (BWR) with a capacity ~1,560 MW.

Employs modular integrated structure construction, saving construction time and cost

Designed to meet demanding security requirements.

Employs 25 percent less pumps, valves and motors than previous BWR’s

Utilizes advanced safety features utilizing natural circulation, gravity powered cooling systems and non-mechanical safety features.