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# **Long-Term Nuclear Energy Policy in the United States**

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# Agenda

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- Current U.S. nuclear power role
- Long-term nuclear energy planning
- Government incentives and support
- Energy policy proposals
- Nuclear research and development
- Waste management plans
- Impact of Fukushima Daiichi
- Characteristics of U.S. energy plans



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# Current U.S. Nuclear Power Role

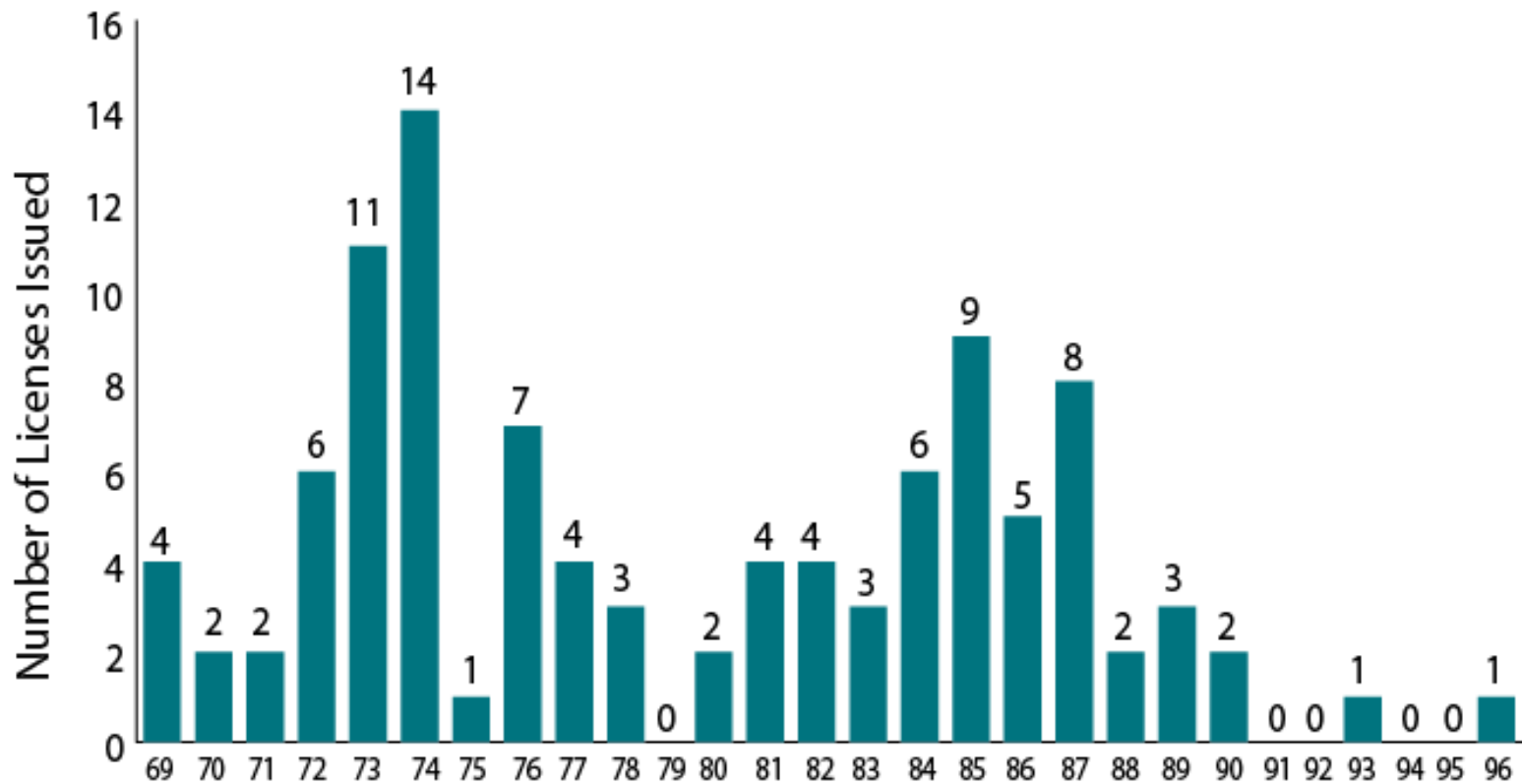
# Operating U.S. Reactors

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- 104 currently licensed to operate
  - 69 pressurized water reactors (PWRs)
  - 35 boiling water reactors (BWRs)
    - 23 GE Mark I containments (similar to Fukushima)
- All current reactors ordered from 1963-1973
- Oldest operating reactor is Oyster Creek (NJ), licensed in 1969
- Most recently licensed reactor was Watts Bar 1 (TN) in 1996 (23 years of construction)
- Reactors licensed for 40 years; most expected to receive 20 year extensions



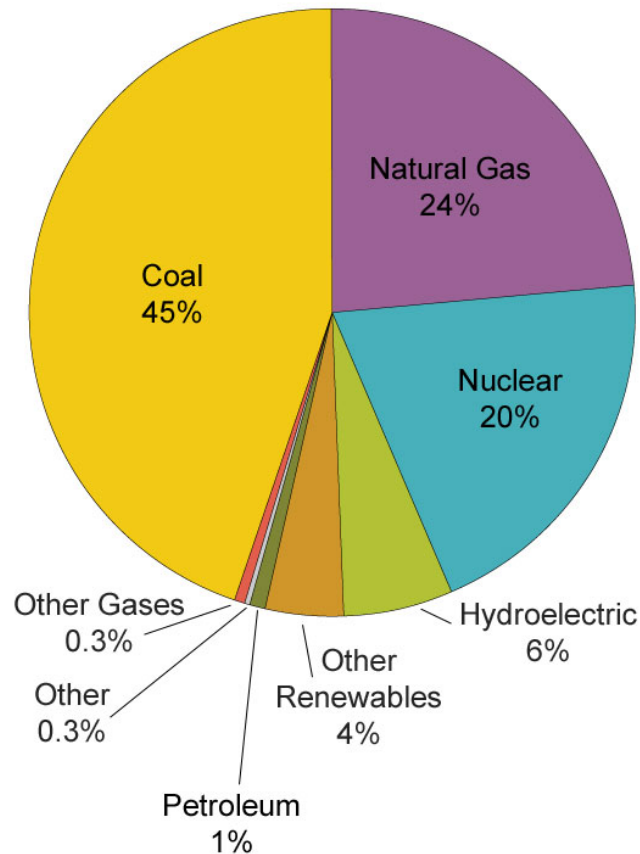
# Commercial Operating Licenses



Source: NRC Information Digest 2010-2011

# Current U.S. Electricity Sources

**U.S. Net Electricity Generation by Fuel, 2010**



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

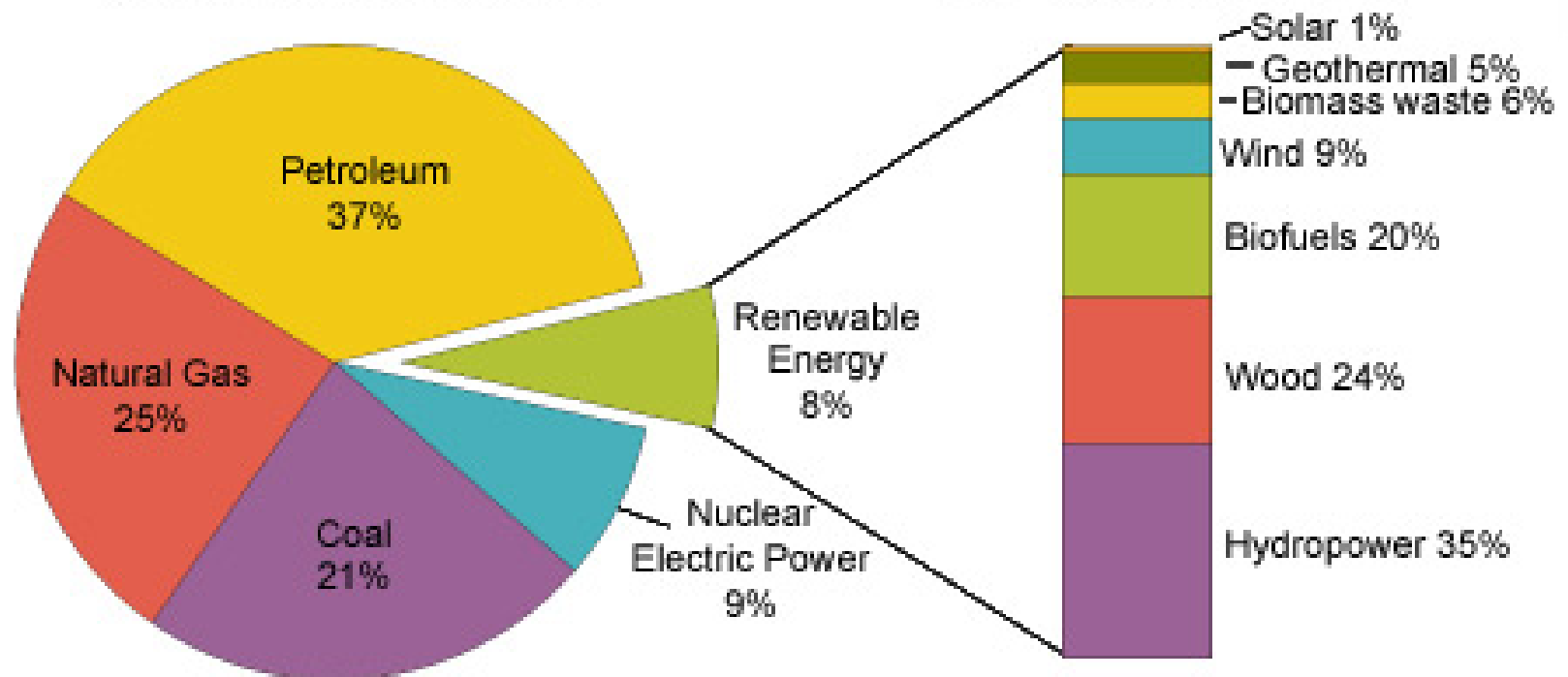


# Components of Total U.S. Energy Use

## U.S. Energy Consumption by Energy Source, 2009

Total = 94.578 Quadrillion Btu

Total = 7.744 Quadrillion Btu



Note: Sum of components may not equal 100% due to independent rounding.

Source: U.S. Energy Information Administration, *Annual Energy Review 2009*, Table 1.3, Primary Energy Consumption by Energy Source, 1949-2009 (August 2010).







# **U.S. Nuclear Power Outlook**

# Proposed New U.S. Reactors

Site	Reactor Type	Units	Licensing Schedule
Vogtle (GA)	Westinghouse AP1000	2	COL issued 2012, LWA 2009
Summer (SC)	Westinghouse AP1000	2	COL 2012, precon.
Levy County (FL)	Westinghouse AP1000	2	COL 2012
William States Lee (SC)	Westinghouse AP1000	2	COL 2013
Fermi (MI)	GE ESBWR	1	COL 2013
Turkey Point (FL)	Westinghouse AP1000	2	COL 2014, preconstruction
Comanche Peak (TX)	Mitsubishi US-APWR	2	COL 2014
South Texas Project	Toshiba ABWR	2	Under revision
Calvert Cliffs (MD)	Areva EPR	1	Under revision
Bell Bend (PA)	Areva EPR	1	Under revision
Harris (NC)	Westinghouse AP1000	2	Under revision
North Anna (VA)	Mitsubishi US-APWR	1	Reactor change



# Proposed U.S. Reactors (cont'd)

Site	Reactor Type	Units	Licensing Schedule
Grand Gulf (MS)	Not specified	1	Has ESP; COL suspended
Victoria County (TX)	Not specified	2	COL withdrawn; ESP under review
Callaway (MO)	Areva EPR	1	Suspended
River Bend (LA)	Not specified	1	Suspended
Bellefonte (AL)	Westinghouse AP1000	2	Suspended
Nine Mile Point (NY)	Areva EPR	1	Suspended
Blue Castle (UT)	Not specified	1	Application anticipated
Not specified	Not specified	1	Application anticipated
Clinch River (TN)	B&W mPower modular reactor	6	Application anticipated
Total units		36	
Active COL units		20	

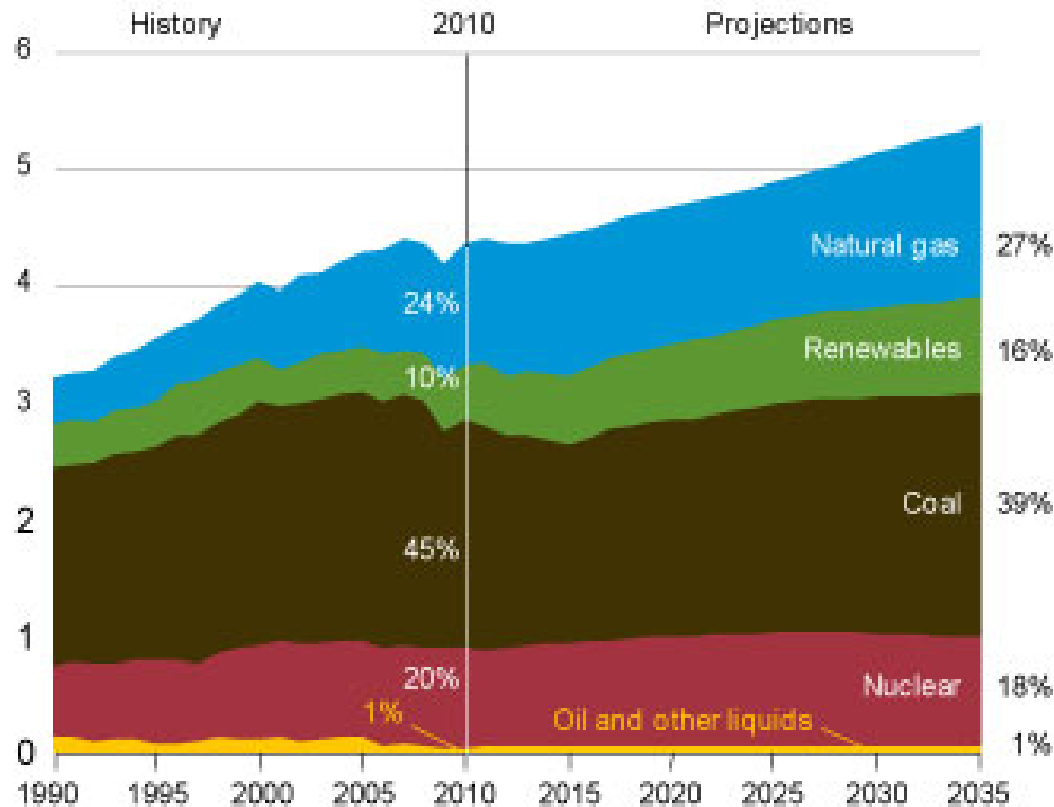


Source: Nuclear Regulatory Commission

# U.S. Nuclear Energy Projections Under Current Law

Figure 3. Electricity generation by fuel, 1990-2035

(trillion kilowatthours per year)





# Existing U.S. Long-Term Nuclear Energy Policy

# U.S. Energy Policy is Market Oriented

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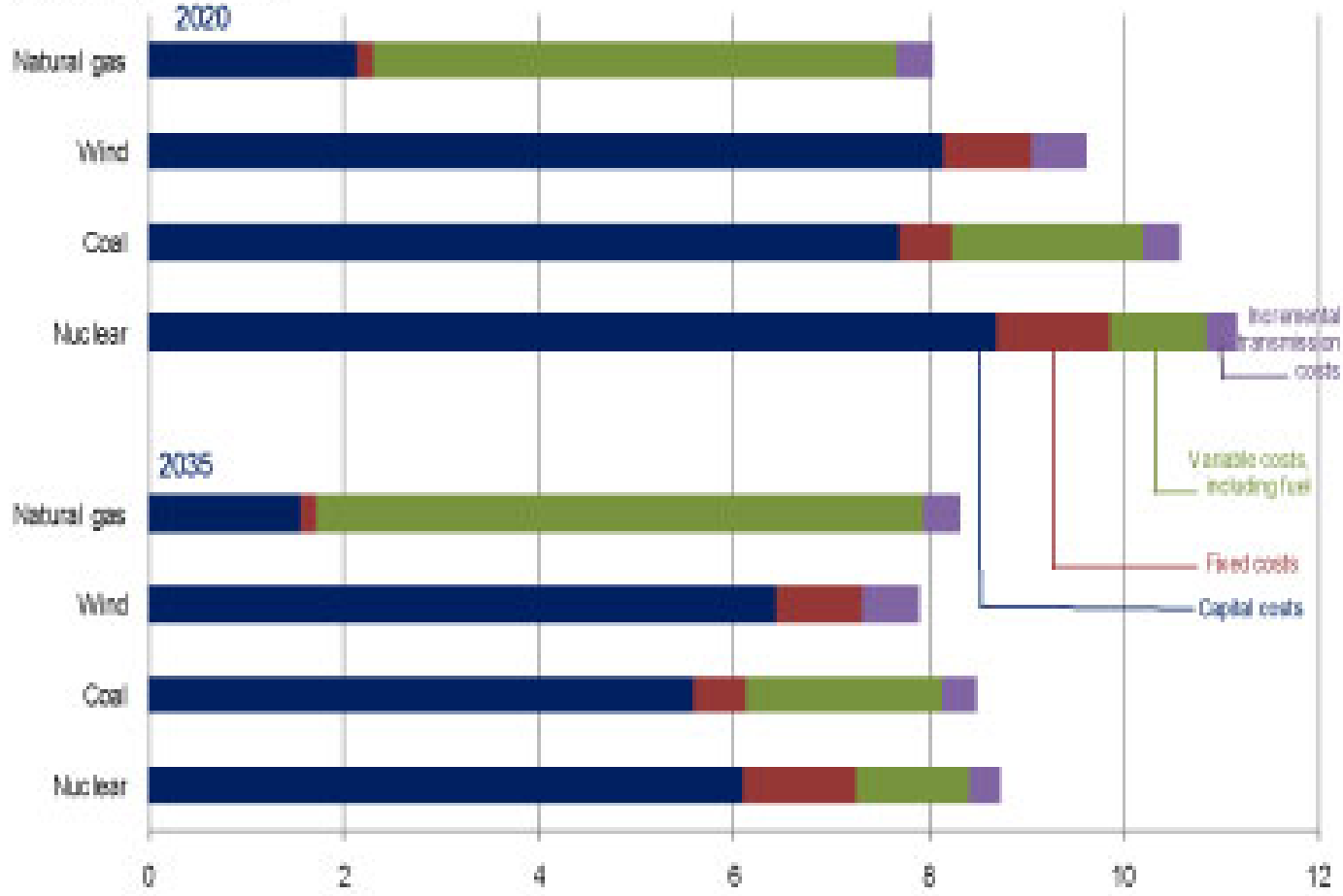
- No federal central planning
- No dominant state-owned utilities
- No specific goals or targets for nuclear energy
- Most federal planning for nuclear energy focuses on R&D
  - Primarily a federal government activity
- Licensing and permitting of nuclear plants
  - Federal: licenses focus on safety
  - State: rate regulation



# Current Policies Favor Gas and Wind

Figure 63. Levelized electricity costs for new power plants, 2020 and 2035

2008 cents per kilowatt-hour



# Current Plans that Include Nuclear

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- “Strategic Plan 2011,” Department of Energy
  - [http://energy.gov/media/DOE\\_StrategicPlan.pdf](http://energy.gov/media/DOE_StrategicPlan.pdf)
- “Report to the President on Accelerating the Pace of Change in Energy Technologies Through an Integrated Federal Energy Policy,” President’s Council of Advisors on Science and Technology (PCAST)
  - <http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast-energy-tech-report.pdf>
- “Report on the First Quadrennial Technology Review,” Department of Energy
  - [http://energy.gov/sites/prod/files/QTR\\_report.pdf](http://energy.gov/sites/prod/files/QTR_report.pdf)
- “Nuclear Energy: Policies and Technology for the 21st Century”
  - [http://www.ne.doe.gov/neac/neacPDFs/NEAC\\_Final\\_Report\\_Web%20Version.pdf](http://www.ne.doe.gov/neac/neacPDFs/NEAC_Final_Report_Web%20Version.pdf)
- “Nuclear Energy Research and Development Roadmap”
  - [http://www.ne.doe.gov/pdfFiles/NuclearEnergy\\_Roadmap\\_Final.pdf](http://www.ne.doe.gov/pdfFiles/NuclearEnergy_Roadmap_Final.pdf)
- “Department of Energy FY 2013 Congressional Budget Request,”
  - <http://www.cfo.doe.gov/budget/13budget/Content/Volume3.pdf>, p. 279
- “2010 Performance Plan,” Department of Energy
  - <http://www.ne.doe.gov/pdfFiles/NEPerformancePlanFY10.pdf>
- “Report to the Secretary of Energy,” Blue Ribbon Commission on America’s Nuclear Future
  - [http://brc.gov/sites/default/files/documents/brc\\_finalreport\\_jan2012.pdf](http://brc.gov/sites/default/files/documents/brc_finalreport_jan2012.pdf)





# Government Influence on the Market: Nuclear Incentives and Other Support

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- Incentives in the Energy Policy Act of 2005
  - Loan guarantees (currently up to \$18.5 b.)
  - Nuclear production tax credit (1.8 cent/kwh)
  - Regulatory risk insurance (standby support)
  - Price-Anderson Act extension (liability system)



# Role of State Utility Regulation

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- Traditional rate regulation may include some elements of state planning
  - Consideration of fuel diversity
  - Environmental issues
- Prudent costs passed through to ratepayers
- Many states have renewable portfolio standards (excluding nuclear)





# **U.S. Energy Policy Proposals**

# U.S. Energy Policy Process

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- Policy plans are generally at a broad level
- No specific goals and targets for specific types of energy (such as nuclear)
- Energy policy involves all branches of government
  - Legislative (Congress)
  - Executive (Administration)
  - Judicial (Courts)



# Examples of Energy Policy Proposals

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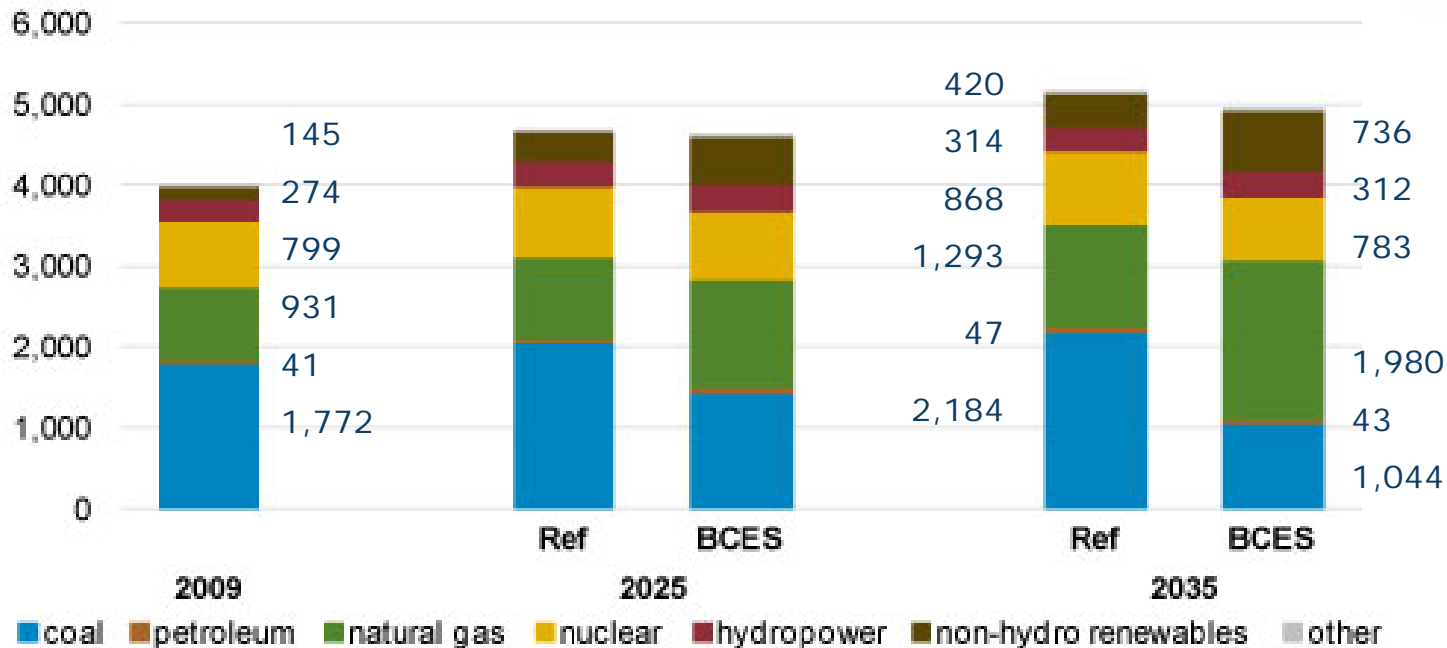
- DOE Strategic Plan
  - Based on Obama Administration policy
  - 80% “clean energy,” including nuclear, by 2035
  - Reduce GHG emissions by 83% by 2050
  - 1 million electric vehicles by 2015
- Clean Energy Standard, CES (S. 2146)
- 200 new reactors by 2040 (H.R. 909, H.R. 3302)



# Electricity Projections Based on CES Bill (S. 2146)

Figure 1. Total Net Electricity Generation

billion kilowatthours



Source: U.S. Energy Information Administration. National Energy Modeling System, runs refhall.d082611b and cesbingbk.d100611a



# Other General Proposals

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- General incentives and regulations may encourage nuclear growth without specific targets or goals
  - Cap and trade regulation for CO2 emissions
  - Carbon taxes
  - Other environmental regulations
    - Air emissions
    - Hydrofracturing regulations or restrictions



# Nuclear Research and Development

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- R&D may change nuclear economics
- DOE program based on Nuclear Energy R&D Roadmap
  - Science-based approach
  - Existing reactor reliability, safety, and life extension
  - Reduce costs of new reactors
  - Sustainable fuel cycles
  - Study and minimize proliferation and terrorism risk





# R&D Guided by Annual Appropriations

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- FY2013 congressional budget request
  - Based on Nuclear R&D Roadmap
  - \$770 million for nuclear energy
  - \$65 million for small modular reactors (about \$452 million over 5 years)
  - Includes near-term milestones and performance measures
    - Similar to Performance Plan
  - Reduction of \$90 million from FY2012





# Impact of Fukushima Disaster

# Impact of Fukushima Disaster

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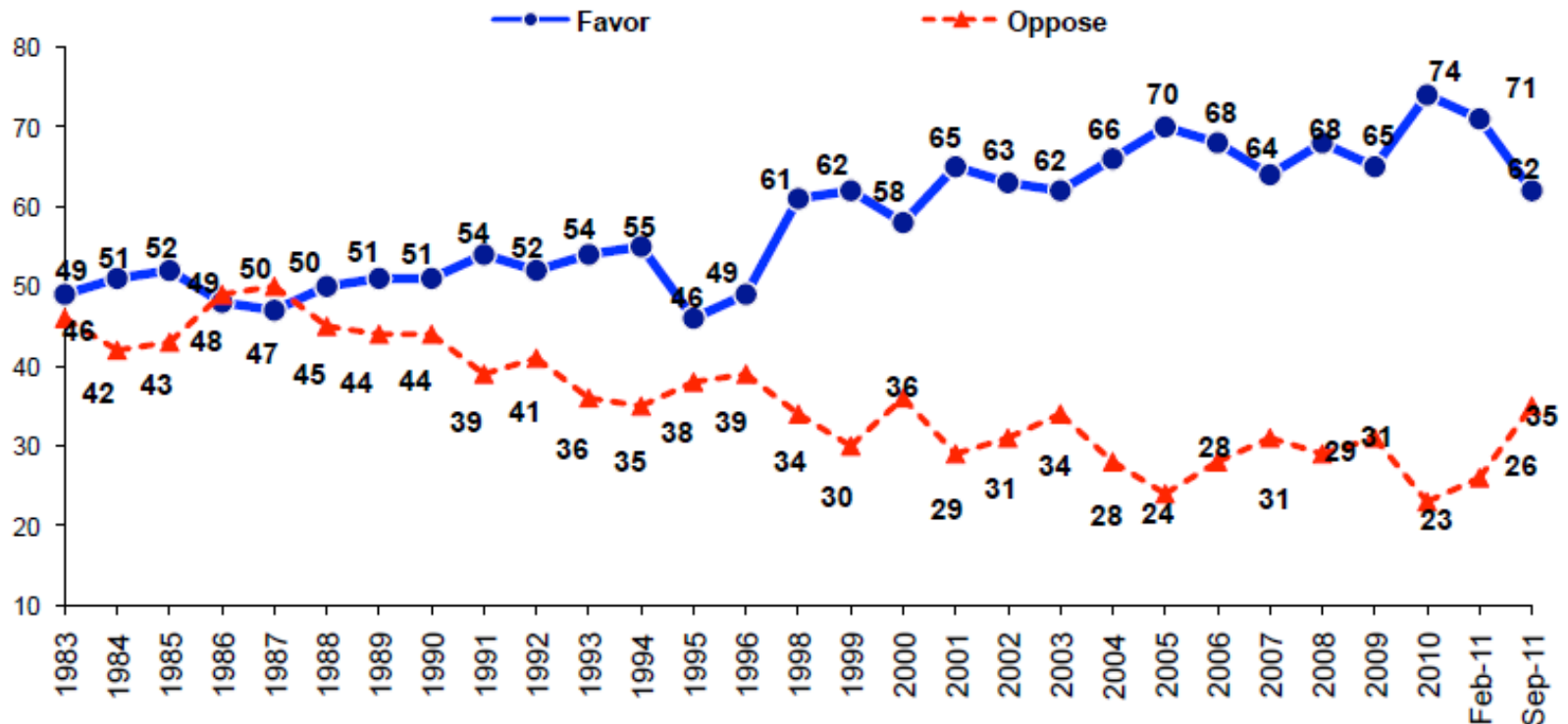
- TEPCO immediately pulled out of South Texas Project, which had been leading candidate for DOE loan guarantees
- Other leading projects (Vogtle and Summer) continue moving forward
- Most other projects already delayed before Fukushima because of changing economics
- Obama Administration continues to support nuclear power as part of “clean energy” program



# U.S. Public Opinion on Nuclear Energy

Percent Who Favor and Oppose Nuclear Energy: Annual Averages 1983 to 2010

"Overall, do you strongly favor, somewhat favor, somewhat oppose, or strongly oppose the use of nuclear energy as one of the ways to provide electricity in the United States?"



Source: Nuclear Energy Institute





# **Nuclear Waste Management Policy and Planning**

# Current Law and Policy

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- Nuclear Waste Policy Act names Yucca Mountain, Nevada, as sole candidate site for permanent geologic repository
- Obama Administration wants to terminate Yucca Mountain
- Yucca Mountain repository license application currently before Nuclear Regulatory Commission (NRC)
  - NRC consideration suspended for lack of funding
  - Lawsuits pending



# Nuclear Waste Proposals

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Blue Ribbon Commission recommends new policy

- Consent-based siting process
- Prompt action to develop storage and disposal facilities
- New, independent government corporation to run program
- Continue R&D on long-term technologies





# Characteristics of U.S. Plans



# DOE Strategic Plan, 2011

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- Required by Government Performance and Results Act
- Time frame
  - GPRA requires at least four years
  - Most goals are general and have no stated time frame
  - Specific goals range from 2012 to 2035
- Process for generation and approval
  - Prepared by DOE and possibly contractors
  - Approved by Energy Secretary
  - Reviewed by White House (OMB)
  - Consultation with Congress at least every 2 years
- Frequency of updates: annual
- Level of detail: mostly general, some specific goals
- Scope
  - Broad plan for DOE activities
  - Nuclear mentioned as part of clean energy goal
  - Explicitly states “this document is not a national energy plan”
  - Quadrennial Technology Review “will be the a first step in developing a national energy plan”
- No direct connection to national sustainable development plan



# PCAST Report on Integrated Federal Energy Policy

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- Time frame: 2015
- Process for generation and approval: prepared and approved by PCAST
- Frequency of updates: none
- Level of detail: general energy policy
- Scope
  - Lays out plan and scope for developing national energy policy
  - Includes some specific recommendations
  - Mentions need for nuclear power technology development and demonstration
- Could lead to development of national sustainable development plan



# DOE Quadrennial Technology Review

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- Time frame: 2030
- Process for generation and approval
  - Federal Register notice and public comment
  - 14 Technology Assessment Teams with DOE and national laboratory personnel
  - Focus groups with DOE and outside experts
  - Five technical workshops around the country
  - Capstone workshop in Washington, DC
  - Policy established by high-level DOE steering committee
- Frequency of updates: four years
- Level of detail
  - Describes potential DOE role in developing new energy technologies
  - Greater detail to be provided in forthcoming Volume II
- Scope:
  - Evaluates specific energy technologies, including nuclear
- Could lead to development of national sustainable development plan



# Nuclear Energy: Policies and Technology for the 21st Century

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- Time frame: 2030
- Process for generation and approval: prepared and approved by Nuclear Energy Advisory Committee
- Frequency of updates: none
- Level of detail: relatively detailed focus on nuclear energy policy
- Scope:
  - Focuses specifically on nuclear energy policy
  - Discusses policy issues affecting nuclear power growth
  - Recommends DOE R&D programs aimed at identified policy issues
- No specific connection to national sustainable development plan



# DOE Nuclear Energy Research and Development Roadmap

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- Time frame: 2020
- Process for generation and approval: prepared by DOE Office of Nuclear Energy
- Frequency of updates: uncertain
- Level of detail: describes broad nuclear R&D objectives and interim goals
- Scope: activities within DOE nuclear energy R&D program
- No specific connection to national sustainable development plan



# DOE FY2013 Congressional Budget Request

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- Time frame: Fiscal Year 2013
- Process for generation and approval
  - Prepared by DOE
  - Approved for submission to Congress by OMB
  - Congress enacts final appropriation with signature of President
- Level of detail: substantial detail about current and planned DOE expenditures
- Scope
  - All DOE activities, including nuclear power
  - Includes program milestones that are to be achieved with the requested funding
- No specific connection to national sustainable development plan



# DOE Office of Nuclear Energy Performance Plan 2010

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- Required by Government Performance and Results Act (GPRA)
- Similar to DOE Nuclear Energy R&D Roadmap
- GPRA performance goals also included in Congressional Budget Request
- Time frame: one year
- Process for generation and approval: prepared by DOE Office of Nuclear Energy
- Level of detail: general nuclear R&D program performance measures
- Scope: DOE nuclear energy R&D
- No specific connection to national sustainable development plan



# Blue Ribbon Commission on America's Nuclear Future Report to the Secretary of Energy

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- Time Frame: three to four decades
- Process for generation and approval
  - Numerous open public meetings
  - Public comments
  - Approval by Commission members
- Level of detail: relatively high detail
- Scope: issues related to nuclear waste management
- No specific connection to national sustainable development plan





# Questions?

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