Environmental Aspects of Nuclear Energy

Connecticut Energy Advisory Board

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NUCLEAR ENERGY INSTITUTE

Topics

- Permitting and Licensing
- Emissions Comparison
- Water Usage and Habitat

Sample List of Agencies Involved in Nuclear Plant Licensing and Monitoring

Nuclear Regulatory Commission

Environmental Protection Agency

US Federal Wildlife Service

Army Corps of Engineers

Federal Aviation Administration

Department of Homeland Security

Federal Emergency Management Agency

State Department of Environmental Quality

State Marine Resource Commission

State Department of Historic Resources

Local and county permitting authorities

State and local emergency management and law enforcement agencies

NRC Environmental Impact Statement

- Analyzes proposed facility in accordance with National Environmental Policy Act (NEPA)
  - Final EIS for Vogtle Early Site Permit over 1100 pages
- Evaluates environmental impact vs. proposed alternatives
- Evaluates mitigation measures that will be in place to limit environmental impact

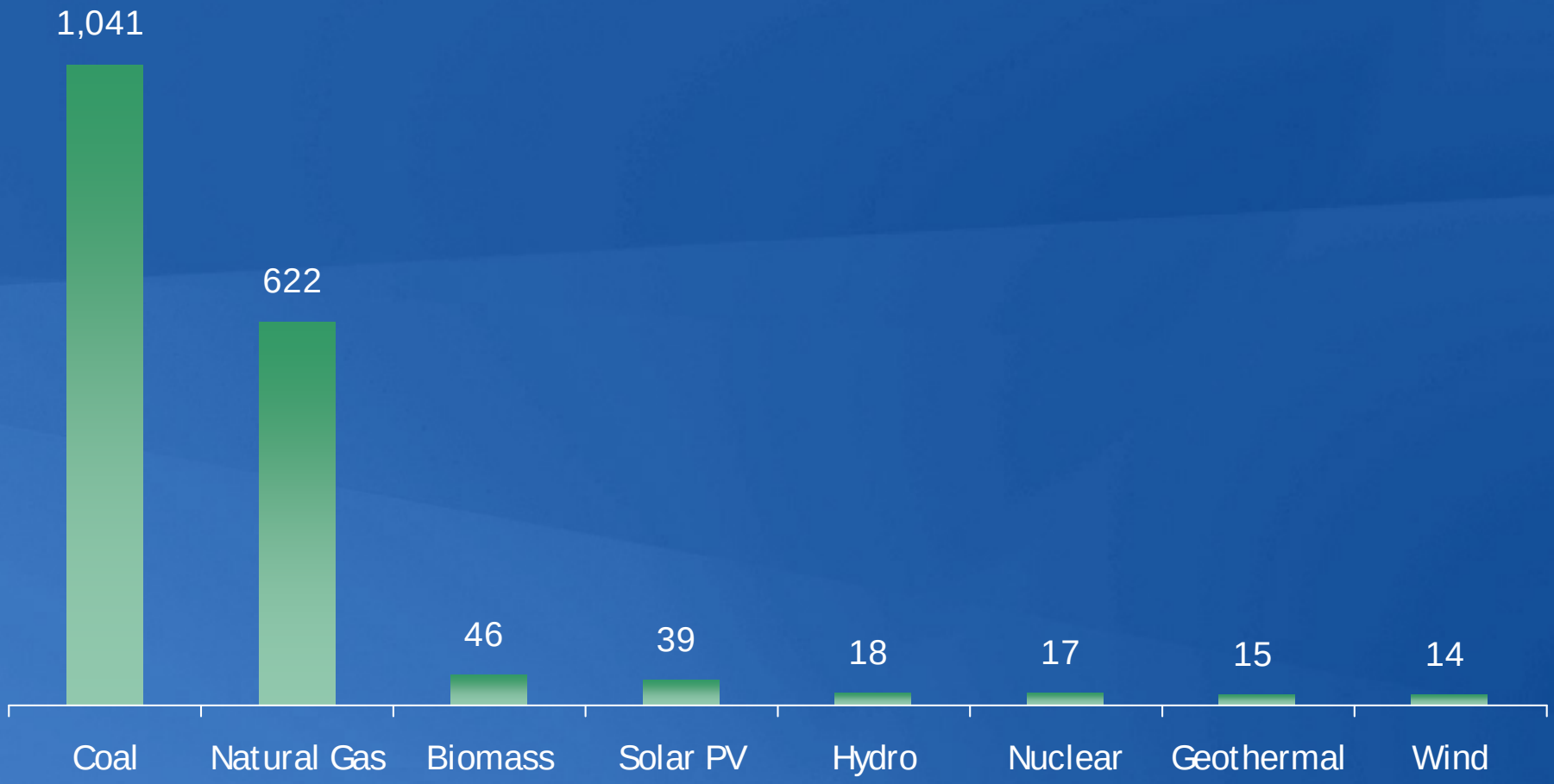
Radiation

- Annual radiation dose to public living within 50 miles of nuclear plant: 0.009 mrem
- 0.1 mrem per year working at a computer terminal
- Eating a banana 0.01mrem
- Chest x-ray 8mrem
- Roundtrip flight DC-LA 5mrem
- Watching TV 1 mrem per year

Emissions Comparisons

Comparison of Life-Cycle Emissions

Tons of Carbon Dioxide Equivalent per Gigawatt-Hour



Source: "Life-Cycle Assessment of Electricity Generation Systems and Applications for Climate Change Policy Analysis," Paul J. Meier, University of Wisconsin-Madison, August 2002.

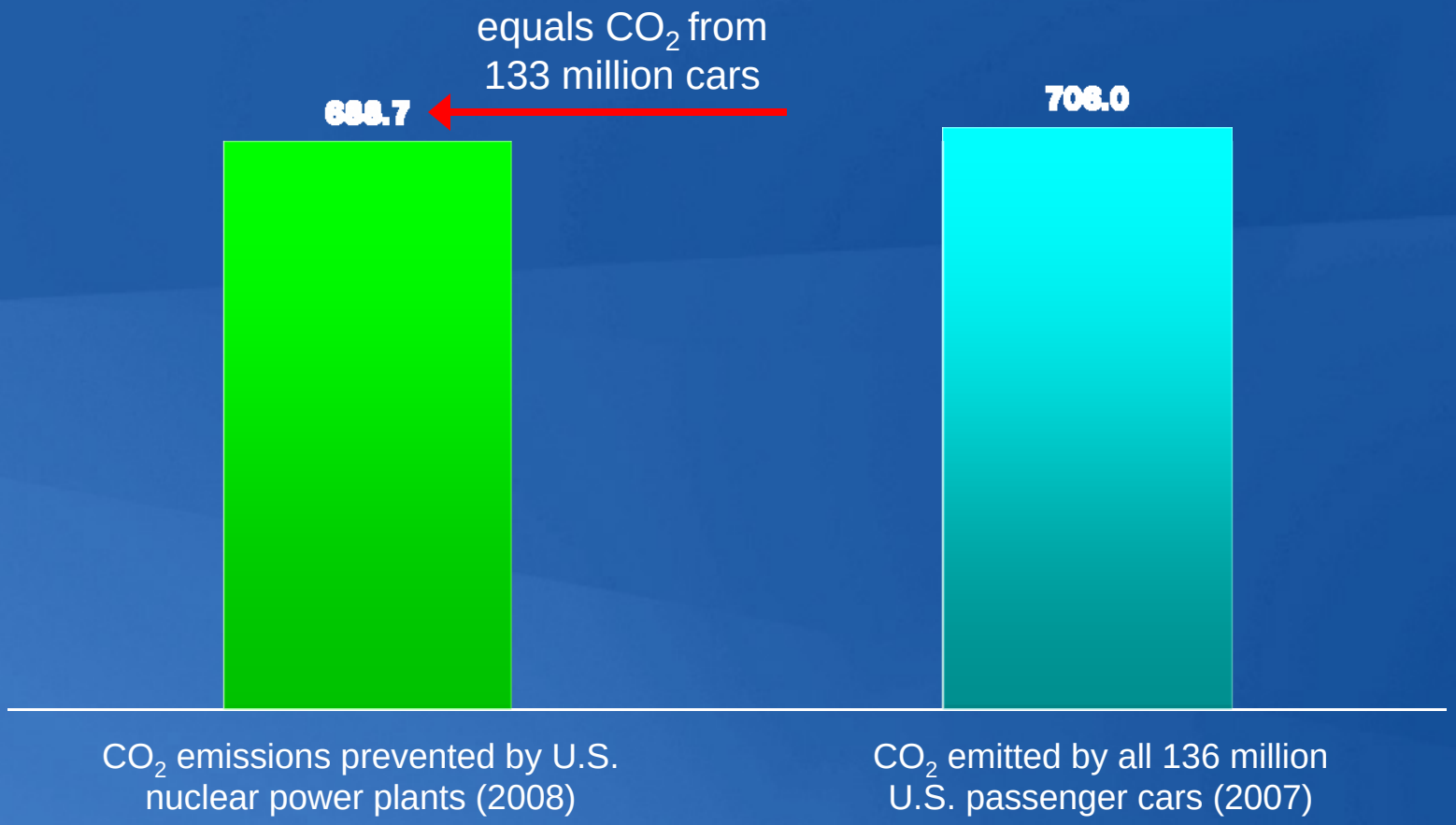
Lifecycle Emissions for Electricity Generation in Germany Grams per MWh

Generation type	SO2	NOx	Particulates	CO2
Nuclear	32	70	7	19,700
Coal	326	560	182	815,000
Gas	3	277	18	362,000
Oil	1,611	985	67	935,000
Wind	15	20	4.6	6,460
PV (Home Application)	104	99	6.1	53,300

Source: "*ExternE - Externalities of Energy. National Implementation in Germany*"; W. Krewitt, P. Mayerhofer, R. Friedrich, A. Trukenmüller, T. Heck, A. Greßmann, F. Raptis, F. Kaspar, J. Sachau, K. Rennings, J. Diekmann, B. Praetorius; IER, Stuttgart; 1998.

Perspective on CO_2 Emissions Prevented By U.S. Nuclear Plants

Million Metric Tons, 2008



Source: Emissions avoided by nuclear power are calculated using regional fossil fuel emission rates from the Environmental Protection Agency and plant generation data from the Energy Information Administration. Car emissions from EPA, Office of Transportation and Air Quality Emissions Facts (April 2000).
Updated: 5/09

New Nuclear Power Plants Necessary To Meet Waxman-Markey CO_2 Goals – EPA Analysis

		2030	2040	2050
	Output (billion kWh)	1,154 - 1,257	1,758	2,081
Assumes all existing US nuclear power plants continue to operate	New Capacity (GW)	44 - 57	121	162
	Number of New Plants	31 - 41	86	116
Assumes all existing US nuclear power plants retire after 60 years	New Capacity (GW)	48-61	169	262
	Number of New Plants	34 - 44	121	187

Analysis of H.R. 2454, American Clean Energy and Security Act of 2009, Environmental Protection Agency

Water Usage and Habitat

Water Usage in Perspective

- Irrigation accounts for 81% of U.S. freshwater consumption
- Thermoelectric power plants account for 3.3% of U.S. freshwater consumption, half of residential consumption, at 6.7%
- Thermoelectric power plants return 98% of the water they withdraw

Water Use Definitions

- *Water Use* consists of two processes that can occur separately or in sequence.
- *Consumption*—water either ceases to exist as a liquid (evaporation) or is not fit to be returned directly to its original source (degradation)
- *Withdrawal*—water is removed from a source and may be consumed or returned in practically the same condition

Water Consumption by Energy Source

Energy Source for Electricity Generation	Water Consumption Gallons / Megawatt-Hour	
Natural Gas	Once-Through Cooling	100
	Combined Cycle with Cooling Towers	370
Coal	Minimal Pollution Controls & Once-Through Cooling	300
	Advanced Pollution Controls & Wet Cooling Towers	714
Nuclear	Once-Through Cooling	400
	Wet Cooling Towers	720
Hydro		4,500
Geothermal		1,800-4,000
Biomass		300-480
Solar-Thermal		1,040
Solar Photovoltaic		30
Wind		1

Sources: EPRI, NETL, Peter Gleick

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Water Quantity

- Once-through systems consume 1% of water withdrawn
- Cooling-tower systems consume 70%-90 % of water withdrawn
- Cooling tower systems consume twice as much water as once-through systems

Water Quality

- Cooling system discharge water temperatures and impurities conform to EPA or state regulations
- Once-through system thermal pollution is mitigated by cooling canals or after-bays before discharge to the main water body

Aquatic Life

- Once-through systems impinge on average 1%-2% of species populations in waterbody
- Once-through systems entrain on average .01% to 4% of potential adult fish of species populations in waterbody
- Scientific study demonstrates that cooling water systems do not have an adverse impact on aquatic life populations

Land Use—Habitat

Nuclear Power Plant Land Use		
Peach Bottom (2 reactors)	2,200 MW	400 acres
Millstone (2 reactors)	1,900 MW	220 acres
Robinson (1 reactor)	700 MW	240 acres
Pilgrim (1 reactor)	700 MW	140 acres
Renewables Land Use Required to Generate Same Amount of Electricity as 1,000 MW Nuclear Plant		
Wind Farm		150,000-180,000 acres
Solar Park		54,000 acres