Nuclear Energy and the Environment

Where We Are and Where Are We Going?

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ANS President-Elect

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The American Nuclear Society

The Society for the Advancement of Nuclear Science and Technology to Benefit Humanity

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Abundant Energy

- Is the daily bread of civilization
- Drives the economy
- Drives the quality of life
- Frees man to be creative

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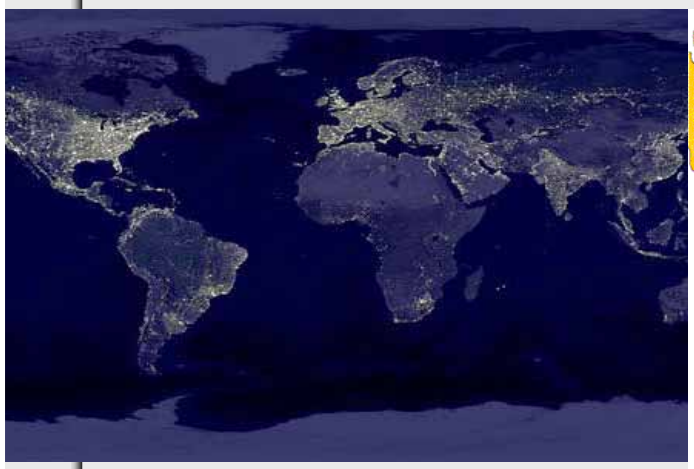
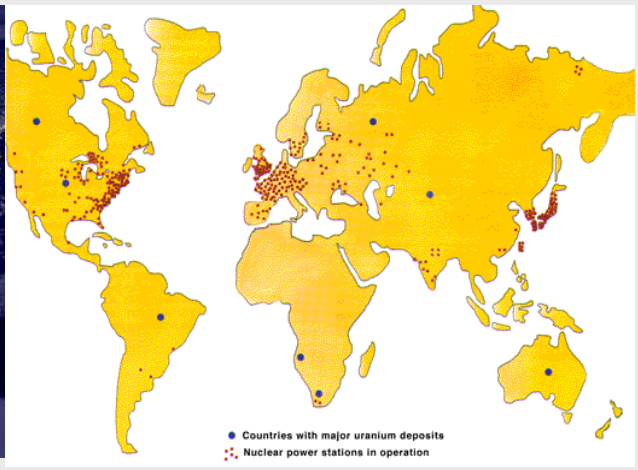
Let There Be Light





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World Nuclear Status 2002

441 operating nuclear plants → • 2574 terawatt hours

6 new reactors on line → • 5013 megawatts

7 new units under construction → • 32 total under construction

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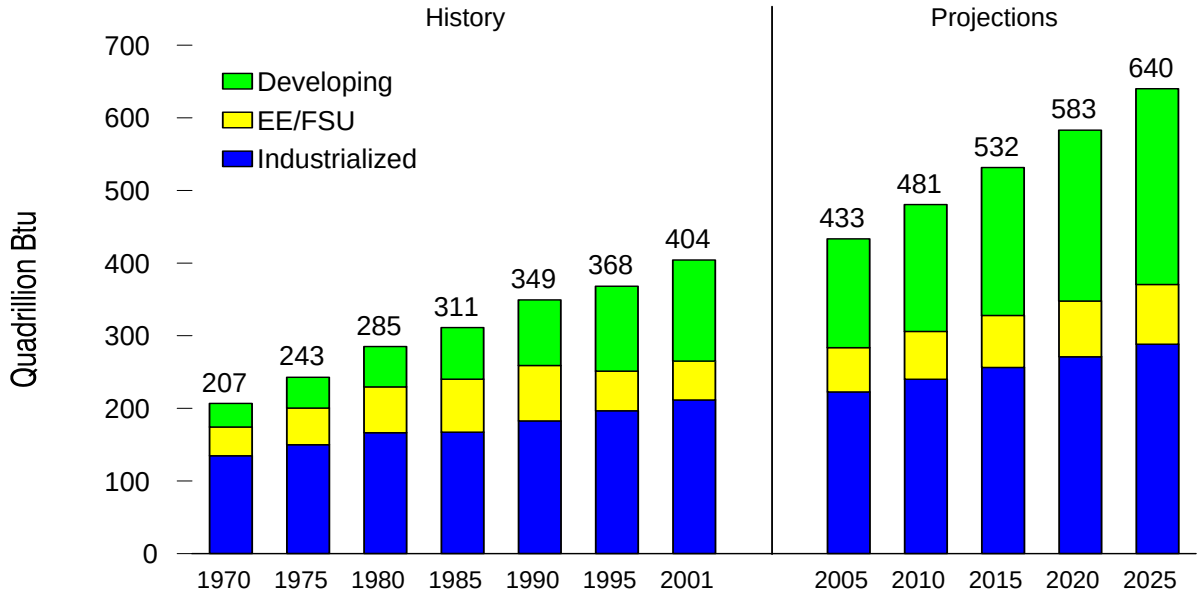
World Energy Consumption 1970-2025



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How Do We Get Our Energy

- Coal
- Gas
- Oil
- Nuclear
- Hydro

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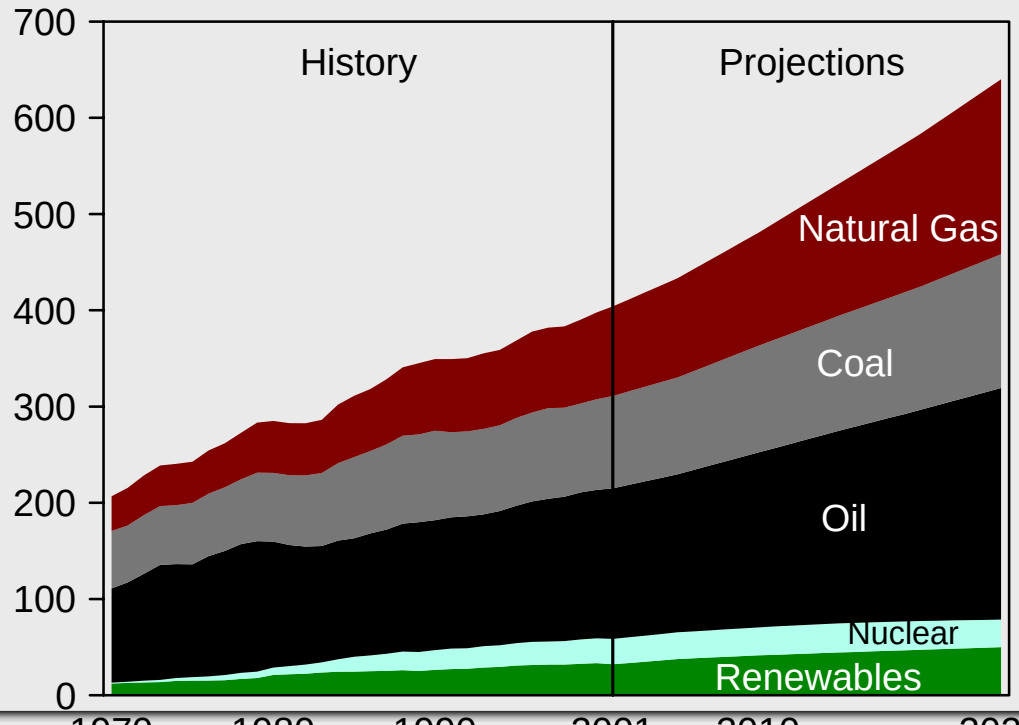
World Energy Consumption by Fuel 1970-2025 (quadrillion Btu)



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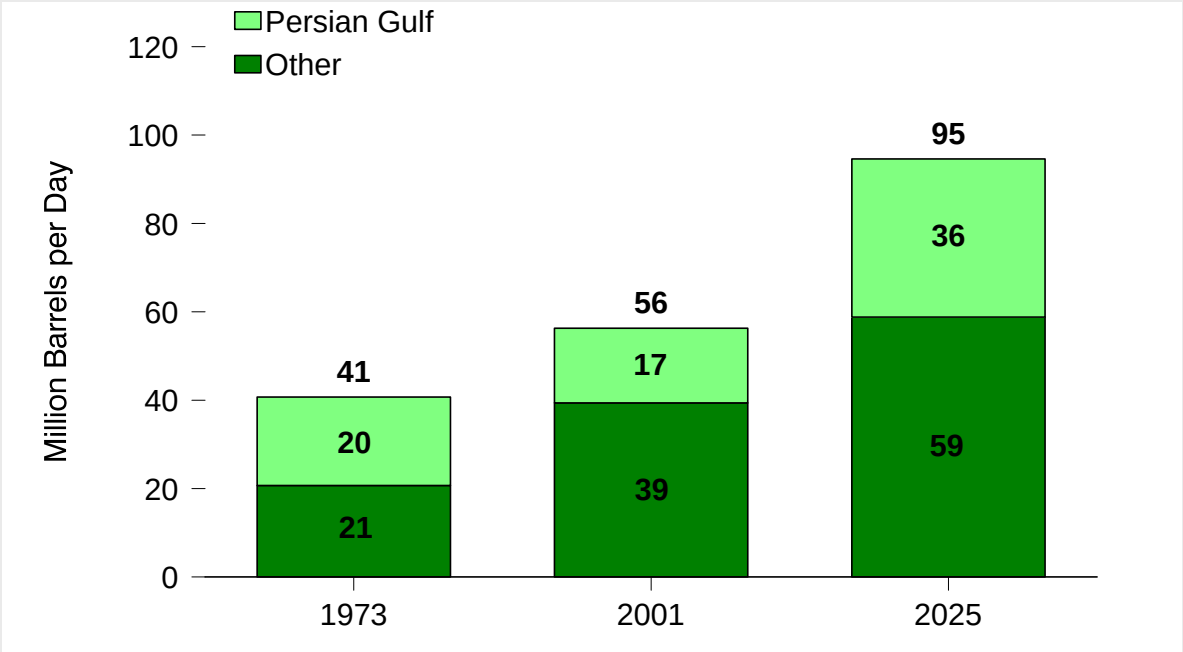
World Oil Trade: 1973, 2001 and projected 2025



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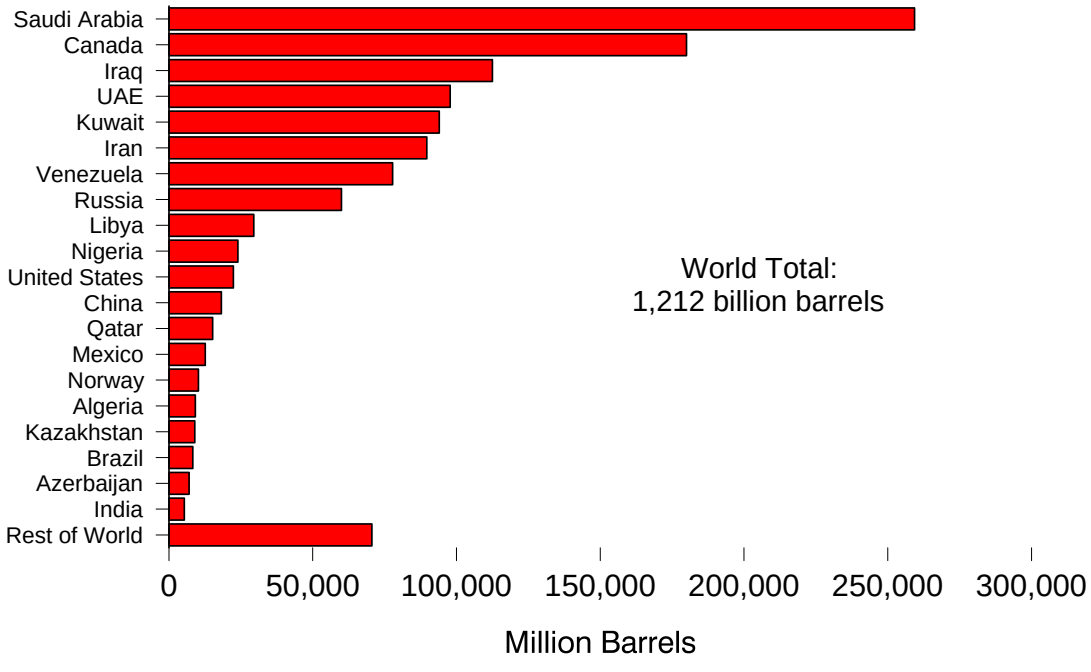
World Oil Reserves by Country January 1, 2003



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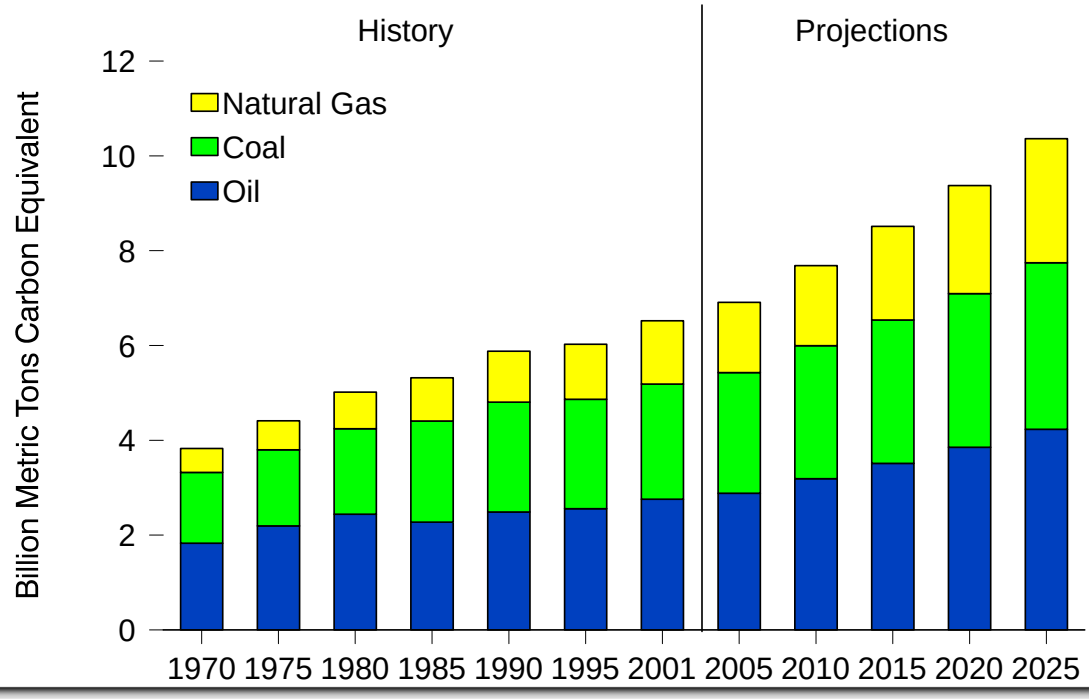
World Carbon Emissions by Fossil Fuel 1970-2025



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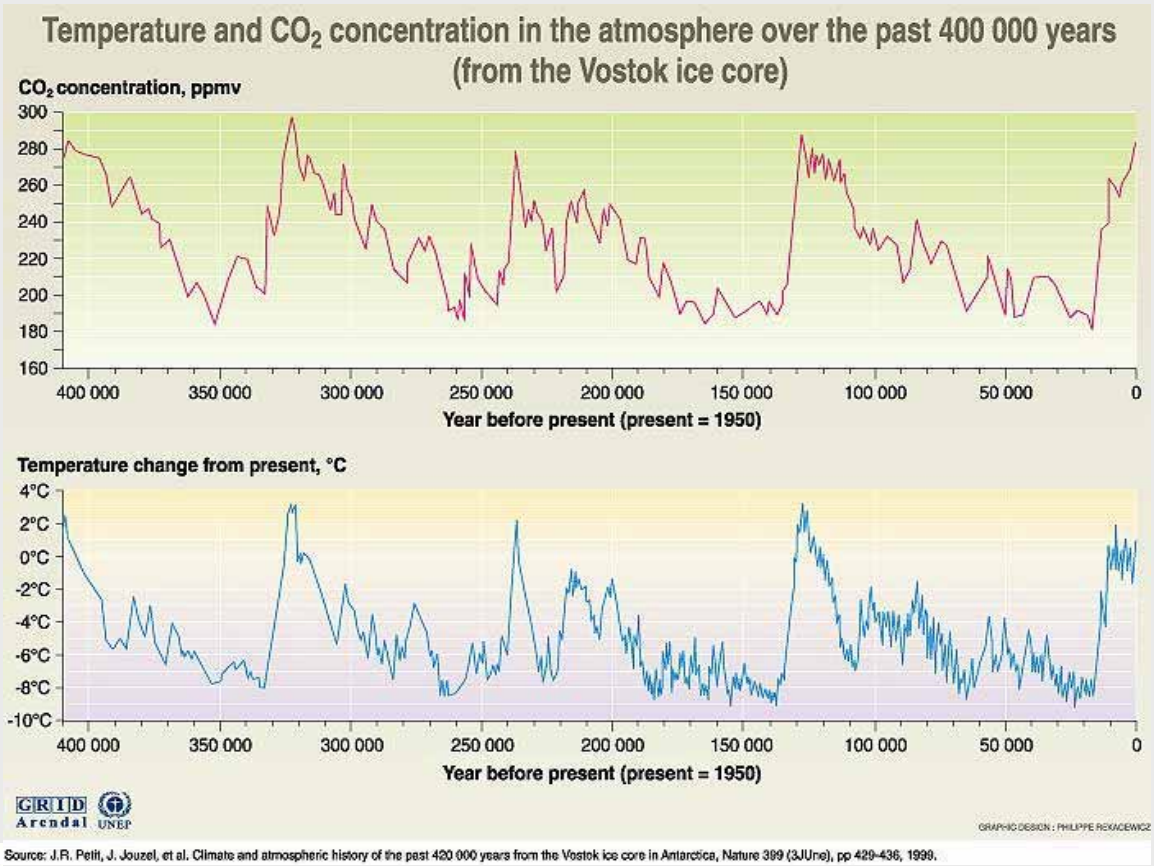

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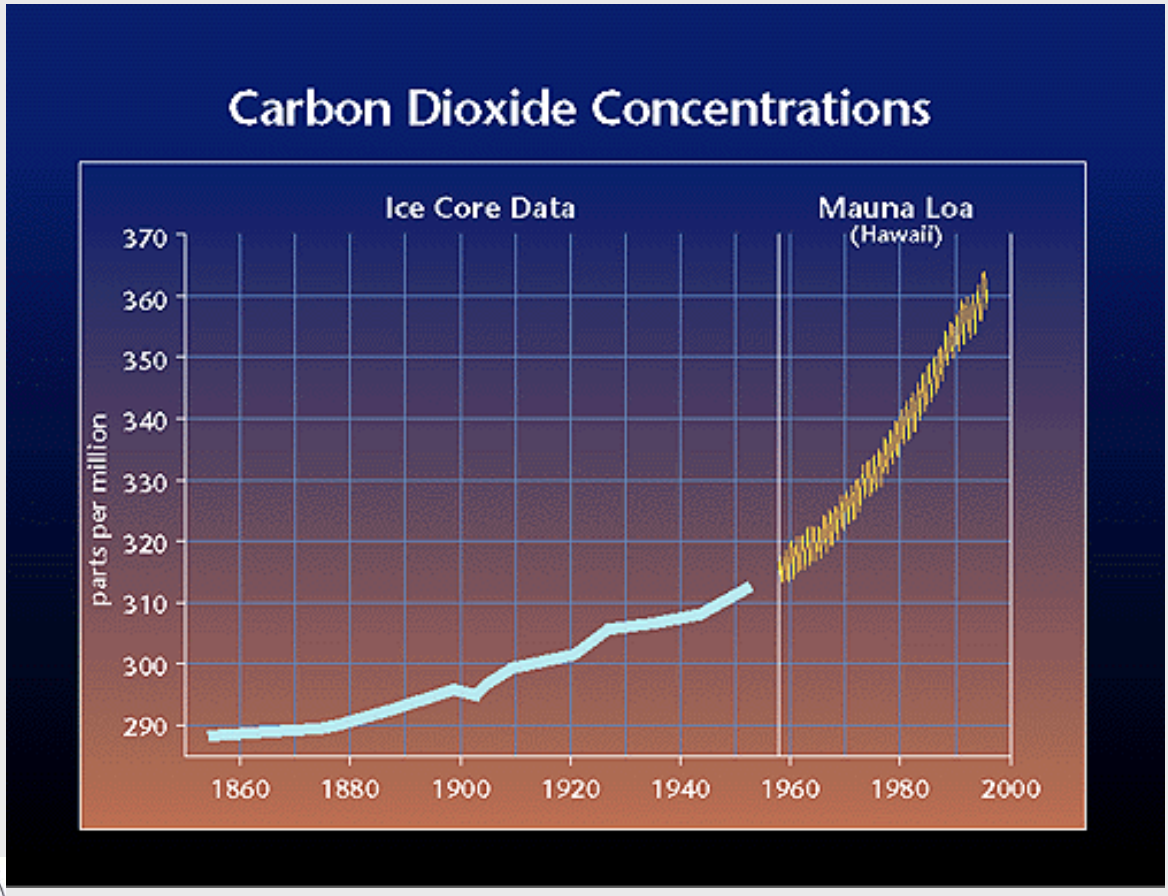

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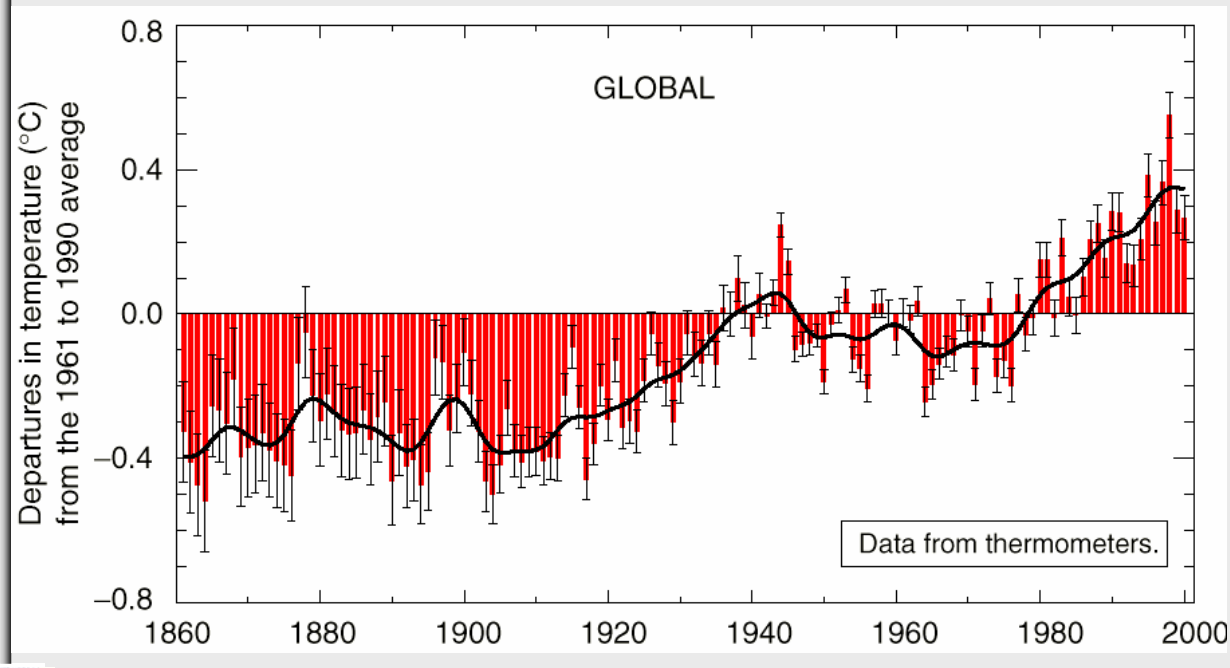
The Earth's Surface is Warming



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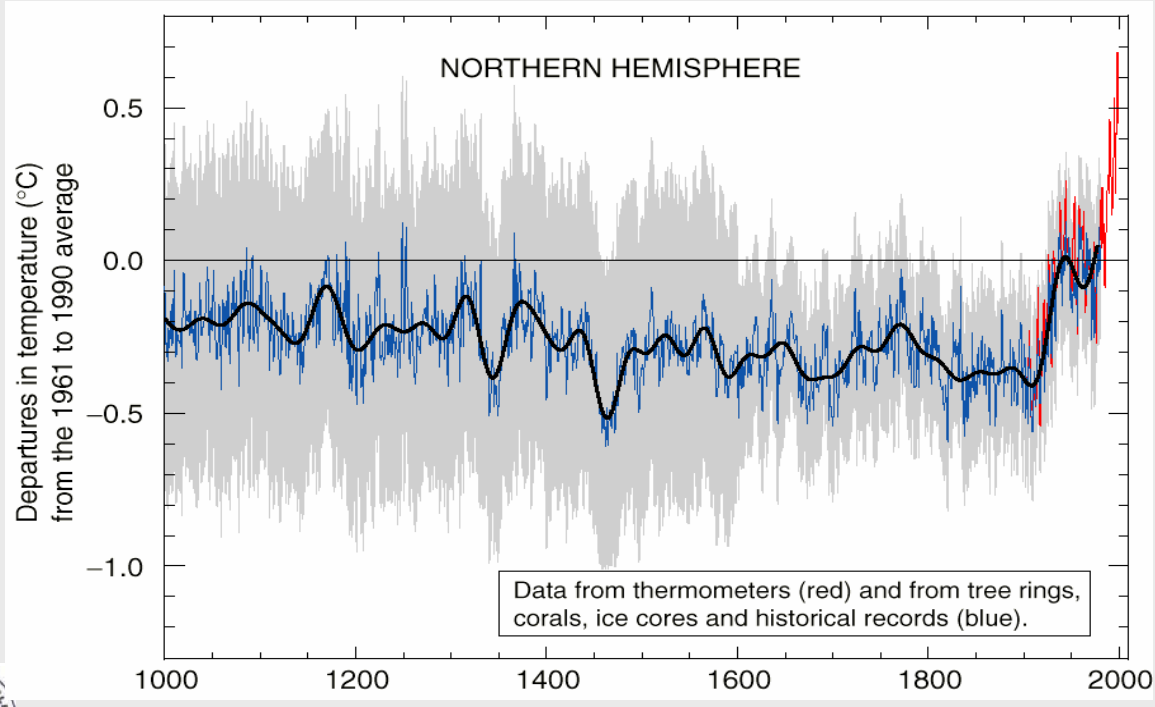
The Earth's Climate is Changing



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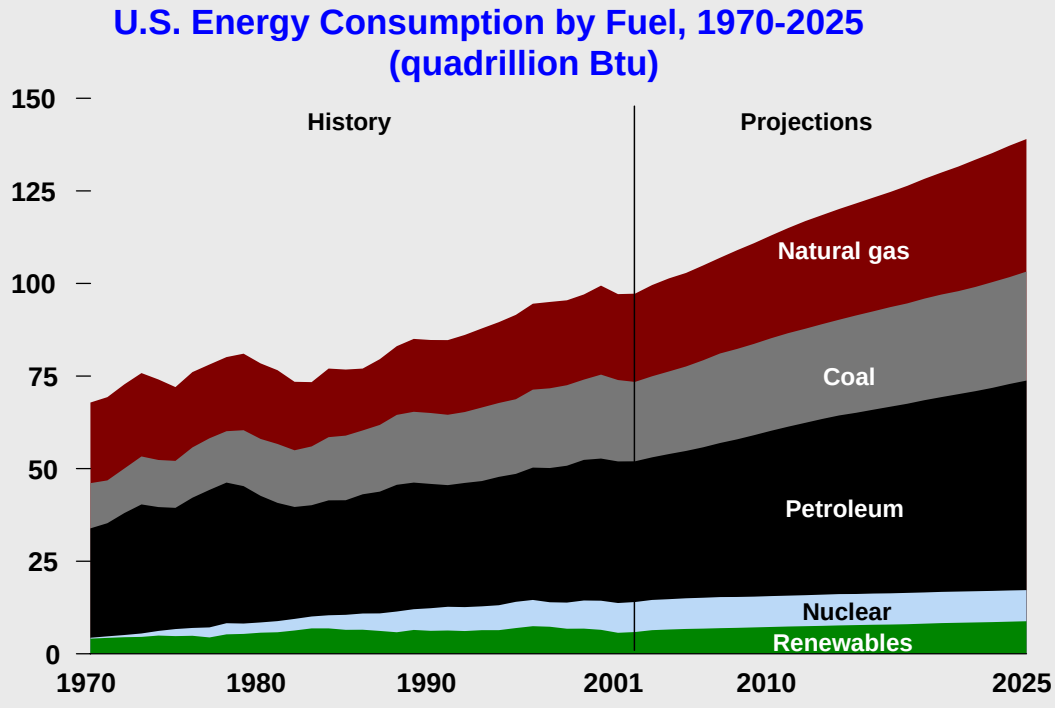
US Energy Consumption by Fuel 1970-2025



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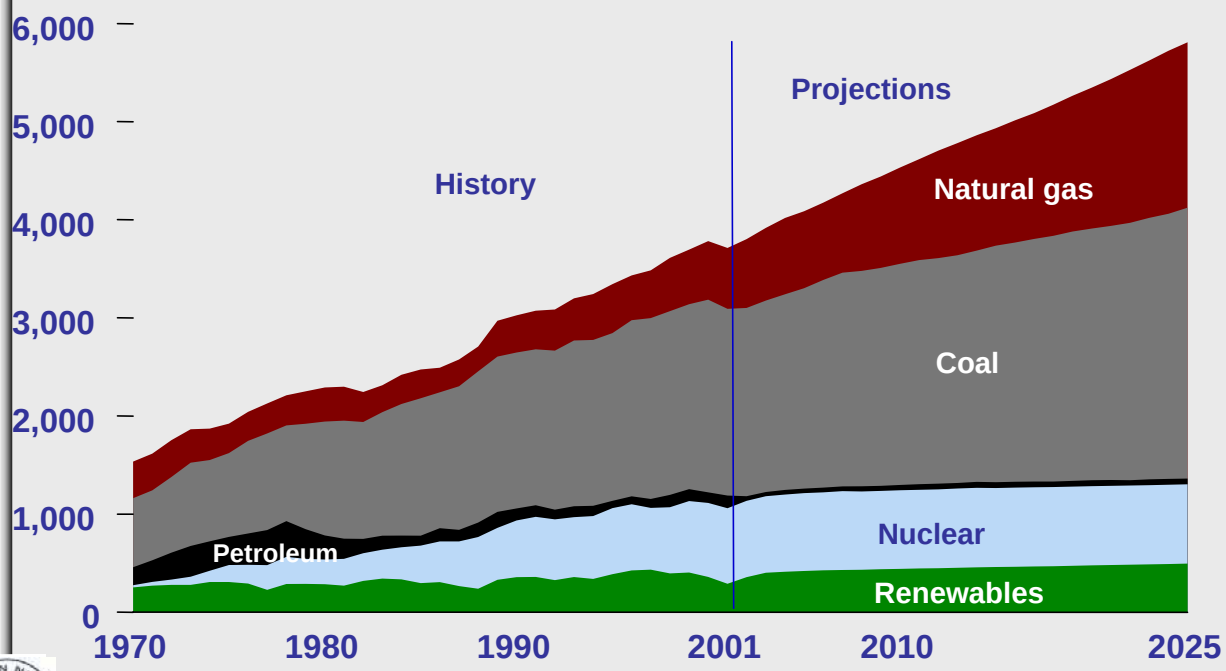
US Generation by Fuel History and EIA AEO-2003 Projections (billion kh)



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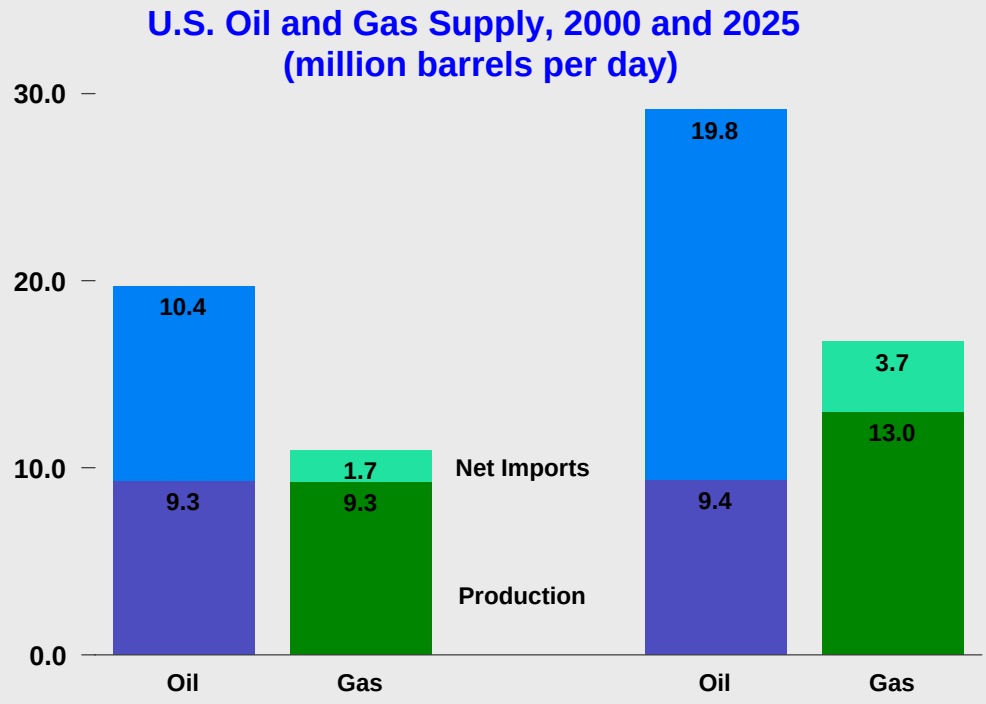
US Oil and Gas Supply, 2000 & 2025 (million barrels/day)



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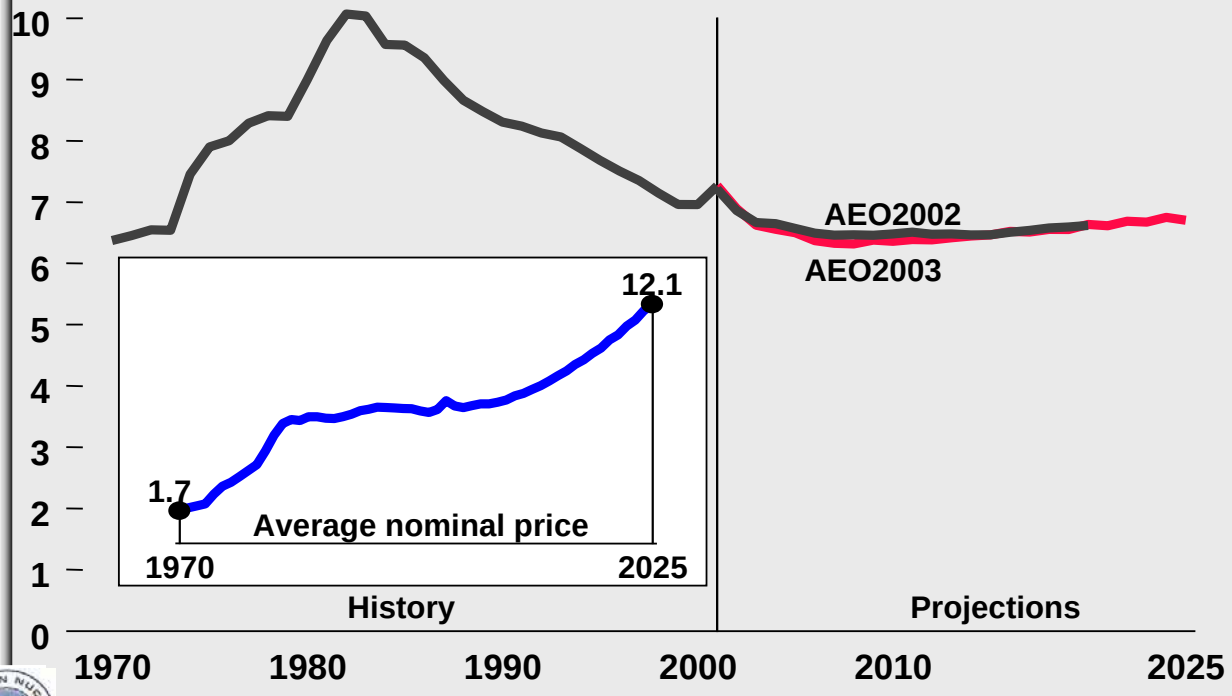
Electricity Price, 1970-2025 (2001 cents/kilowatt hour)



External Costs of Power European Commission Study

EUR-20198

	Coal	Oil	Gas	Nuclear	Bio	Hydro	Wind
UK	4-7	3-5	1-2	0.25	1		1.5
FR	7-10	8-11	2-4	0.3	1	1	
GR	5-8	3-5	1	0.35	0-0.8		0.25

What are these External Costs

- Damage Costs - Noise, Health, Material, and Crops
- Avoidance Costs - Ecosystems (acidification and eutrophication) and Global Warming

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Example of these External Costs

Values Estimated for Germany

	Noise	Health	Mat.	Crops	Ecosystems	Global Warm.	Tot.
Coal	0	.73	.02	0	0.2	1.6	2.55
Gas	0	.34	.00	0	0.04	0.73	1.11
Nuc.	0	.17	.00	0	0.05	0.03	0.25

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Emergy Analysis

The University of Florida has adopted the EMERGY analysis process developed by Howard T. Odum[1,2,3] to perform a self-consistent study of energy production to assess the full range of environmental, social and economic costs of each form of energy production. The EMERGY method of analysis makes the ordering of energy values and the assignment of a set of self-consistent energy units (emjoules) to environmental and economic costs possible.

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Emergy Analysis

The reported study analyzes the integrated economic, energy, and environmental costs involved in the construction, maintenance, operation, and decommissioning of a steam nuclear power electric generating facility. Data were collected or calculated on the energy, economic, and environmental costs (emergy inputs) associated with the construction, operation, and decommissioning of a 1000 MW_e nuclear power plant. These total energy cost data were analyzed and compared to the electrical output of a power plant utilizing different fuel

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Emergy Results

This study yielded a ratio of 8.45 for a 1000 MW_e nuclear power plant. Previous studies showed a ratio of 2.5 for coal, 0.48 for solar and 0.25 for wind. The numbers for solar and wind have improved as newer designs have improved their efficiency. However, nuclear still surpasses other power sources by a wide margin.

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Items in Emergy Analysis

1) Research and Regulation

2) Construction

3) Materials

4) Fuel for Materials

5) Fuel for Construction Goods & Services

6) Fuel Cycle: Mine, Mill, Conversion, Enrich, Fabricate, Waste Disposal

7) Operation & Maintenance

8) Decommissioning

9) Emergy Charge for Accident Risk

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Advanced Fuel Cycle Initiative

Develop reprocessing and recycling of Actinides to eliminate the Nuclear Waste concerns by eliminating long lived isotopes

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Conclusions

- Nuclear is environmentally friendly compared to all other forms when analyzed by unbiased individuals
- Nuclear is striving to be even a better environmental neighbor
- We must tell the Nuclear environmental story

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The Future

"The optimist thinks that this is the best of all possible worlds, and the pessimist knows it is."

J. Robert Oppenheimer

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