An Energy Security, Systems Context for Solar Energy Technologies

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Sandia National Laboratories

Our Children's Future

PEACE&PROSPERITY

Water

Energy

Sustainability

Environmental Protection

Security

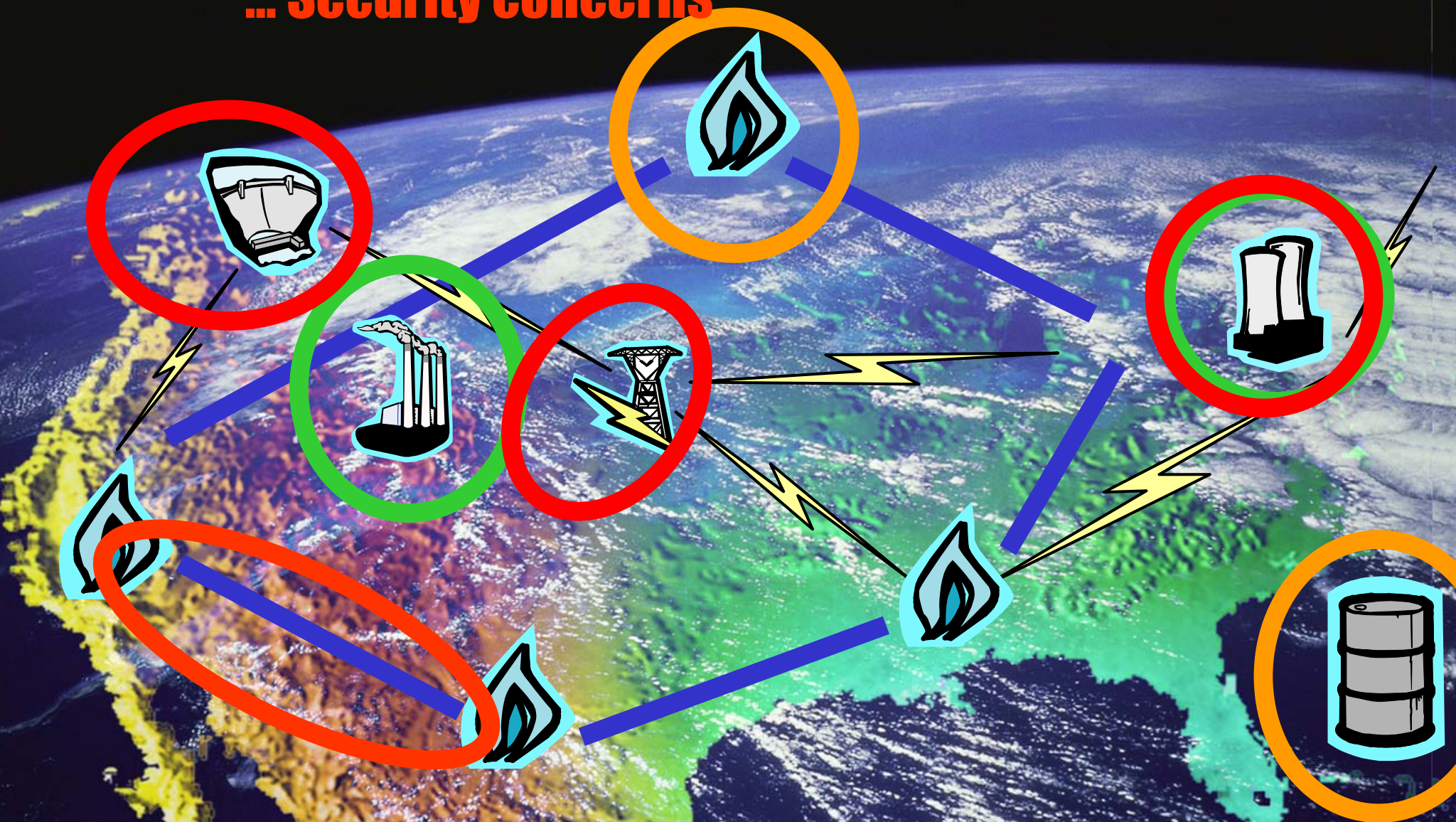
Economic Growth

Our current energy portfolio is vulnerable to...

... Supply disruption

... Environmental impacts

... Security concerns



Future systems can take advantage of...

... Indigenous sources of supply

... Clean technologies

... Distributed generation and storage

... Secure technologies

What is Energy Security?

Energy is available WHEN needed

at a predictable price.

- **Measured by:**
  - Investor and consumer confidence
  - Time to restore service following a disruption and other reliability metrics
- **Secondary indicators:**
  - Energy trade deficit, imports versus domestic production, diversity of sources and delivery mechanisms, and others
- **Includes Physical and Cyber Perspectives**

Security Impacts Can Be Simulated

Sel...

- Introduction
- Summary
- GDP
- Price Controls
- El & Elect Controls
- Oil Price
- Fuel Demands
- Fuel Prices
- Electric Generation
- Oil Imports
- Energy Consumption
- Carbon Emissions

Summary

U. S. Energy and Greenhouse Gas Model

Energy Drivers

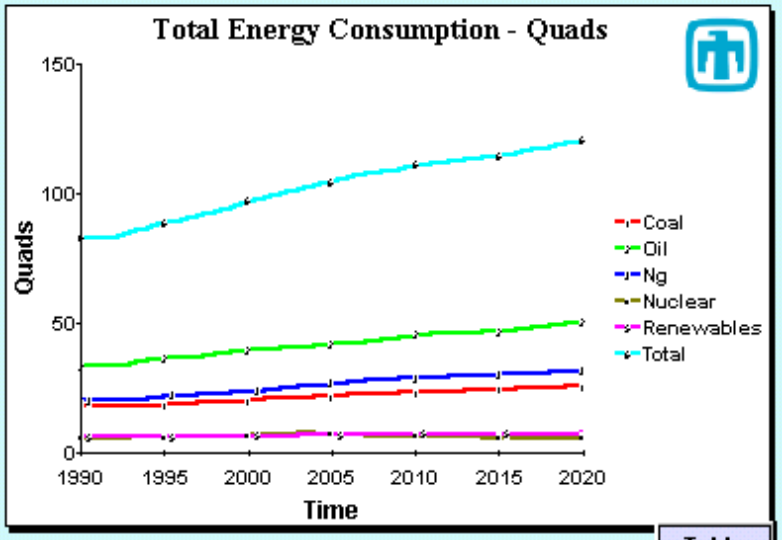
GDP - Bil 98$	14,441.35
Population - Millions	323.40

Energy Balance Sheet - Quads

Total Q	121.02	Total Energy Consumed	121.02
Industrial	42.17	Coal	25.76
Commercial	18.25	Oil	50.89
Transportation	37.57	Natural Gas	31.35
Residential	23.02	Renewables	7.46
		Nuclear	5.57

Carbon Emissions

Total Carbon - mtC	1,978.23
Per Capita - tC	6.12



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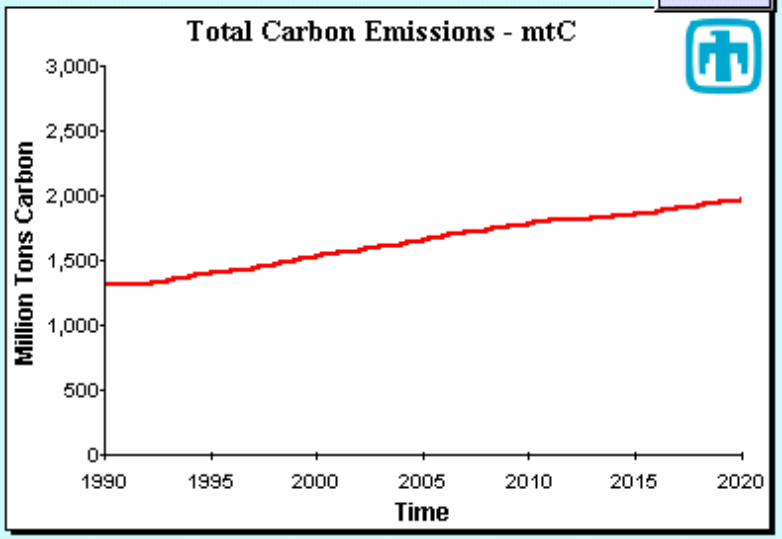


Why Solar Energy is Key

Finite energy stores, originally from the sun or resident in the earth: oil, gas, coal, nuclear, biomass and geothermal.

SOLAR ENERGY:

The ONLY persistent source of the earth's energy

Energy Conversion and Delivery

Losses and sinks

Usable Energy

The Systems Challenge for Solar Technologies

Conversion Optimization

Codes and Standards

Safety

SURETY

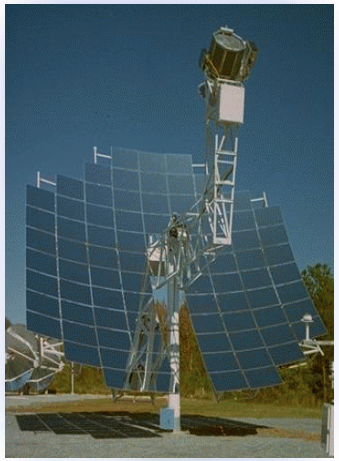
Manufacturing Advances

Security

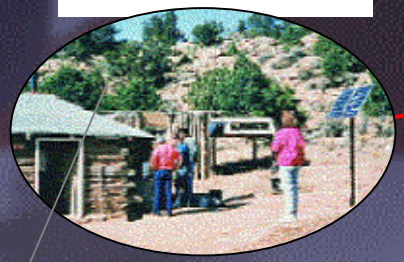
Reliability

Long-term Field Test Data

Integrated Off-Grid Energy and Communications Systems Improve Health, Education, Standard of Living



Communications



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Education

Healthcare
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