



Small Modular Reactors and American Competitiveness

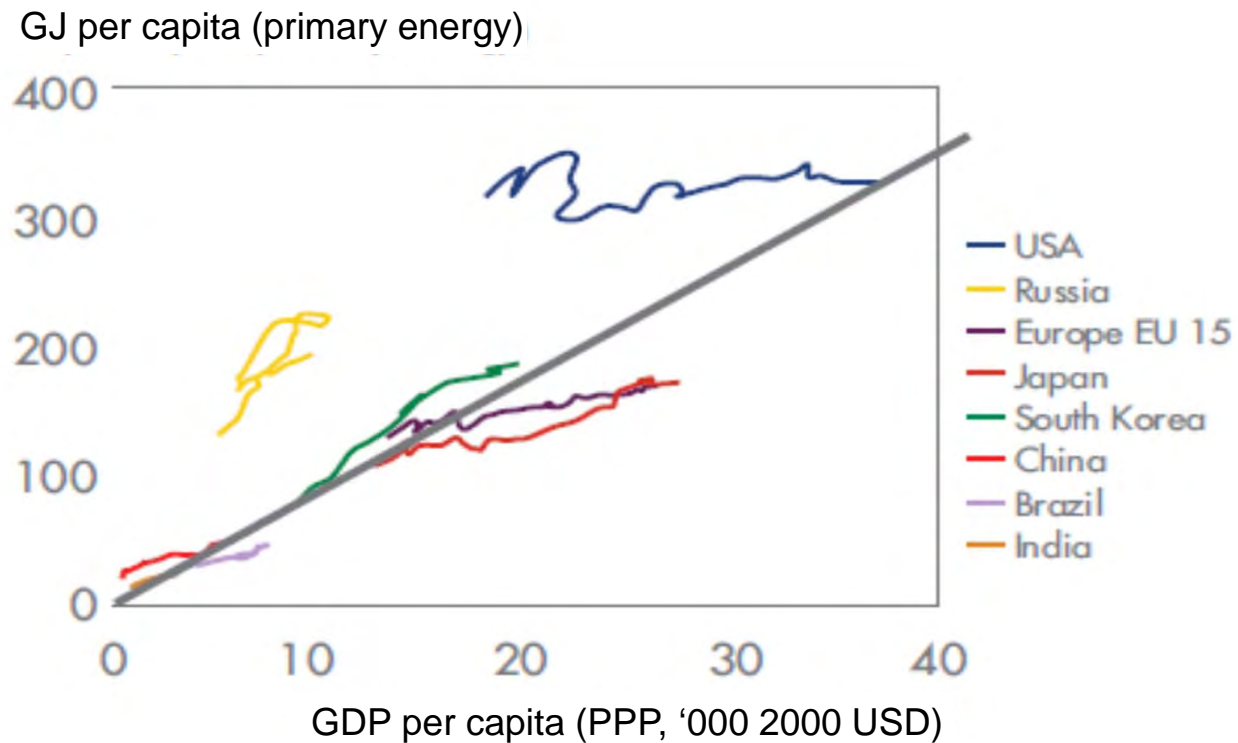
Dr. Thomas Sanders
Associate Laboratory Director
Savannah River National Laboratory



MCARE Conference – February 27, 2012

Addressing our energy future is on the critical path to global peace and prosperity.

Climbing the energy ladder



Date shown 1970-2005

Source: Energy Balances of OECD and Non-OECD Countries© OECD/IEA 2006

Background

- Since the beginning of the first nuclear era, the objective of nonproliferation policy (including safeguards and security) has always been to ensure that access to the beneficial uses of nuclear energy does not increase the risk of the spread of nuclear weapons.
- Today, the world has changed dramatically. There are now 31 countries with 435 nuclear power reactors with ~63 more under construction.
- There are also ~250 research reactors in 56 countries around the world.

The need to manage the likely spread of nuclear know-how and technology through the pre-eminence of the U.S. nuclear industry (and, DOD became the "Market Initiator").

However, the global nuclear picture has become increasingly complex.

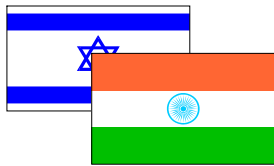
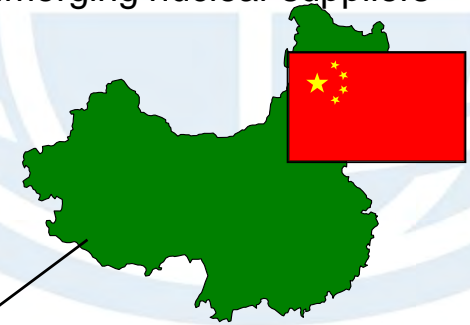
Civilian nuclear energy as an arms reduction vehicle



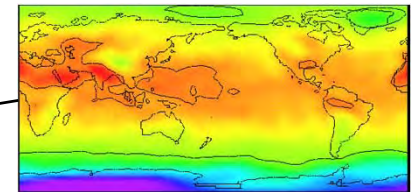
Reapplication of defense nuclear assets



Emerging nuclear suppliers



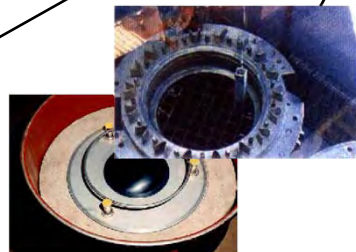
All but 3 countries have signed the nonproliferation treaty



World-wide pressures changing the energy cost/risk picture



Iran, North Korea, and terrorism



Excess material: liabilities or assets?



End of the cold war

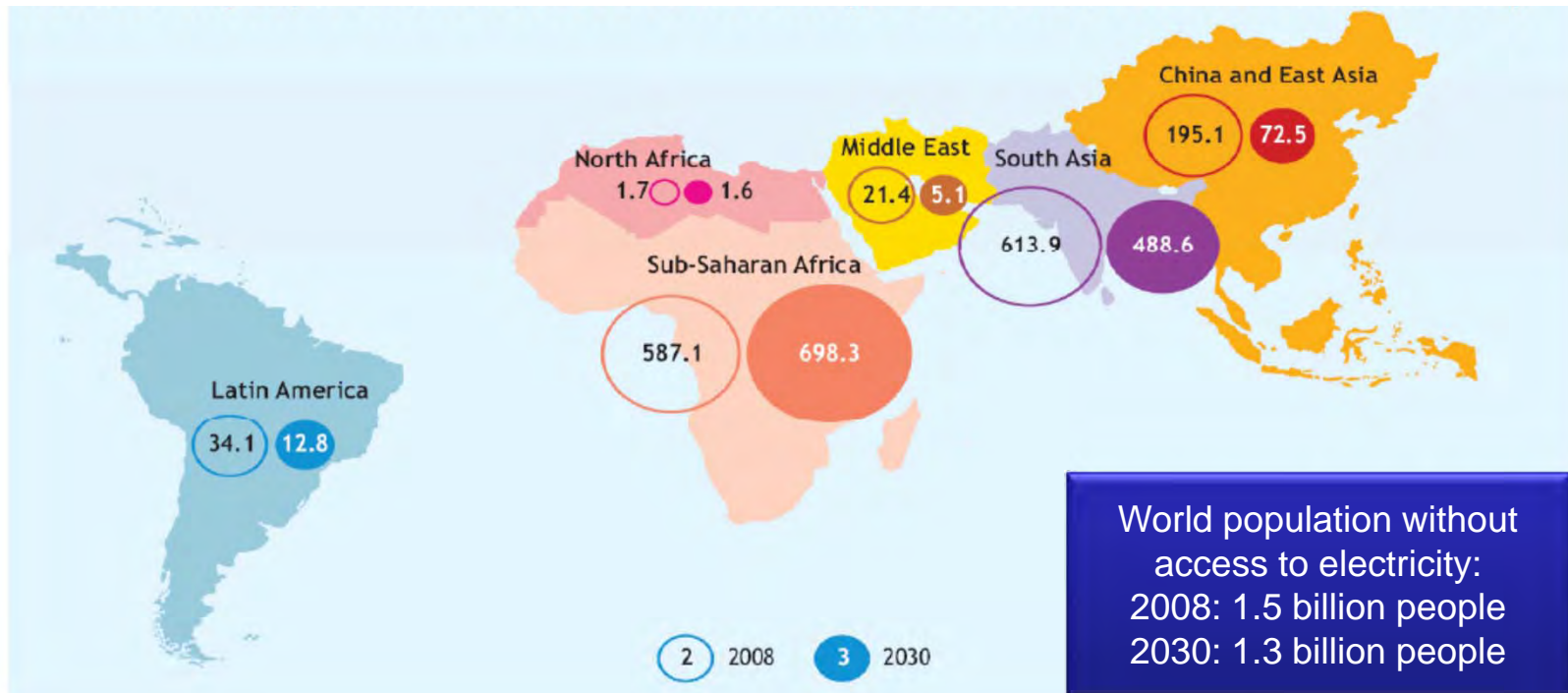


Clandestine nuclear trade

What is the global market opportunity?

It has been estimated that within a decade nearly 80% of the world's middle-income consumers would live in nations outside the currently industrialized world.

Number of people without access to electricity, IAEA Reference Scenario (millions)



1.3 billion people – or 16% of the world's population – still lack access to electricity in 2030, despite more widespread prosperity & more advanced technology

Source: OECD/IEA- World Energy Outlook 2009

Internationally, some are already “getting it done” in the U.S. and abroad.

- Many companies are pushing the nuclear interest and are developing infrastructure in the U.S.
 - AREVA is investing in the U.S.
 - Toshiba and Westinghouse are building fuel and reactor components
 - These companies train and employ thousands of U.S. citizens
- The Russians are advancing “supply and return” policies with multiple countries.

However, many multi-national companies are not exporting U.S. technology and they do not empower the U.S. government to negotiate non-proliferation policy to other countries.

Almost all components for large U.S. plants will be imported from other countries.

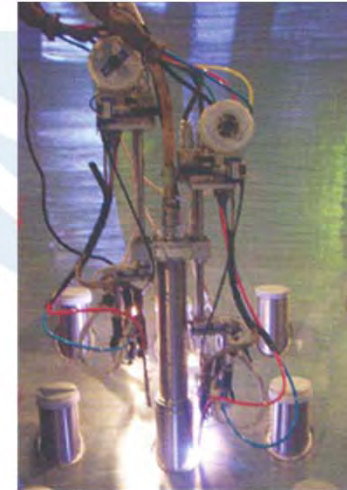
**Kobe Shipyard & Machinery Works
Mitsubishi 600-1200MWe PWR**



Super Miller



NC Horizontal Boring Machine



J-Groove Welding Equipment
for Reactor Vessel Head



Dome Cladding Equipment

Source: Mitsubishi Heavy Industries, Ltd., Kobe Shipyard & Machinery Works, 2007

U.S. industry must become a major supplier to the global nuclear expansion.

For National Security Reasons

- The “**user-supplier**” example addresses a major potential proliferation concern with expanded use of nuclear power.
- Developing a comprehensive reactor and supply/return fuel cycle service capability:
 - Provides market advantages superior to our current and future competitors, virtually defining how nuclear trade in the 21st century will evolve.
 - Eliminates the need for customers of U.S. nuclear systems to have enrichment and reprocessing capabilities.
 - Enables the U.S. to help the developing world acquire the energy resources necessary for achieving a prosperous future and for globally controlling environmental impacts.
 - Reduces potential for future conflict over access to energy resources.

U.S. industry must become a supplier of choice for the global nuclear expansion.

Energy Security Benefits

- Investing in advanced recycle and SMR technologies will result in minimal nuclear waste and assured sustainability of nuclear resources at home.
- Rebuilding our nuclear supply infrastructure will ensure a diverse domestic nuclear energy supply source is available.

Economic Competitiveness Benefits

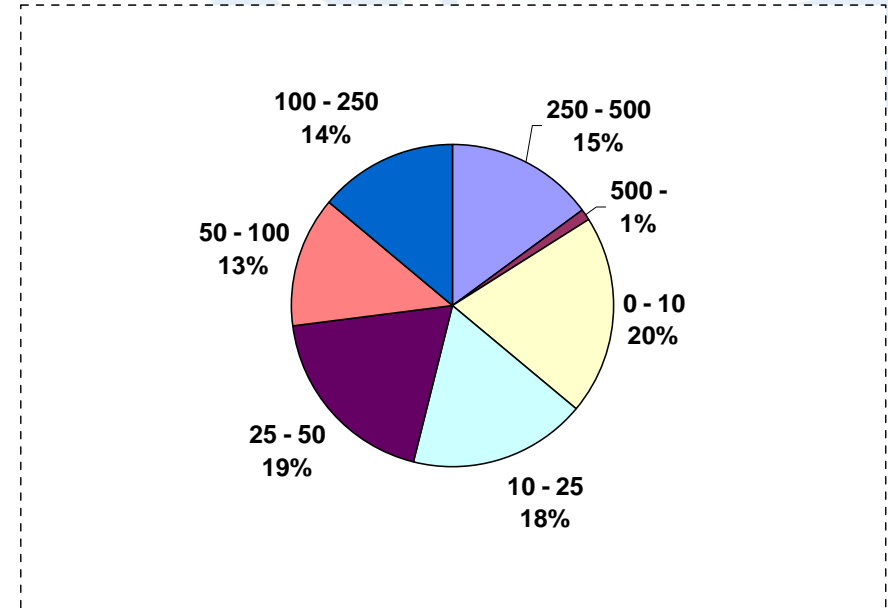
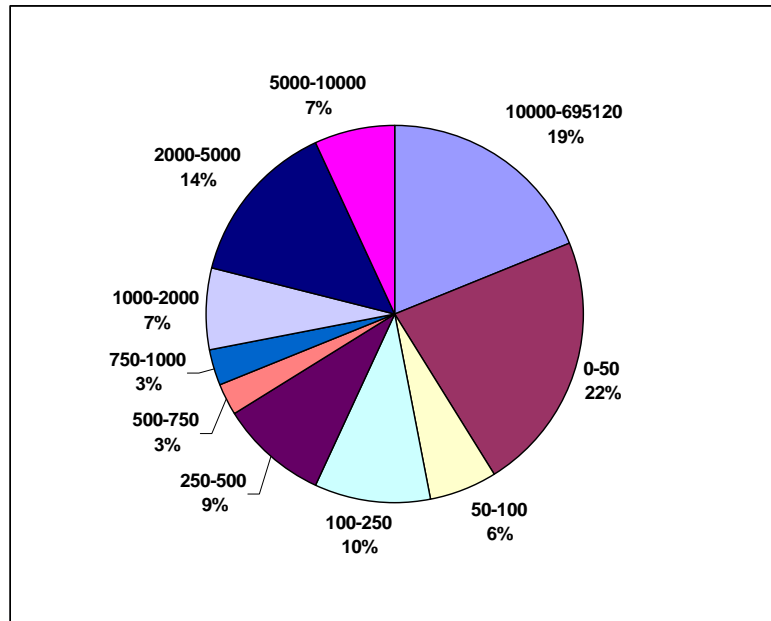
- Becoming a major supplier will enable:
 - Revitalized manufacturing capability for high value systems.
 - Penetration of a growing market worth several trillion dollars.
 - Generation of thousands of high-tech jobs at home with smart manufacturing systems eliminating the low cost labor advantages our emerging competitors enjoy.

Relying more on nuclear energy domestically and globally will reduce the environmental impacts of economic growth.

Most of the emerging market opportunity is for smaller reactors.

(1) Total Capacity of Electrical Generation in 226 Countries (MWe)

Example: Mexico



(Data collected by A. Minato (CRIEPI) for a joint CRIEPI/ANL/LLNL study for the 4S reactor)

The right-sized concept has been used for the last two decades in the U.S.

The Last 20 Years: Investment in electric infrastructure collapsed except for small power systems

- Living off of nuclear and coal investments made during 1960s, 1970s, 1980s.
- Since 1992, almost **311** gigawatts of right-sized natural gas capacity have been added in 100-300 MW “chunks.”

New Generating Capacity: 2009-2015	
Gas	309,576 MW
Renewables	9,983 MW
Coal	8,044 MW
Oil	4,933 MW
Hydro	2,629 MW
Nuclear	2,485 MW
Other	223 MW

Source: Energy Information Administration

(R. Myers, NEI)

Conclusion: SMR enterprise is a “disruptive” or game changing technology whose time has come.

- Reduces proliferation risks
- Reduces potential for future conflict over access to energy resources
- Assures sustainability of resources at home
- Could be an affordable domestic alternative to natural gas
- Enables carbon-free exploitation of water, fossil resources
- Revitalizes manufacturing capability for high-value system
- Enables U.S. penetration of growing export market
- Results in truly renewable, affordable energy resource