



Energy Security in the 21st Century: New Approaches for New Problems

**International Association for Energy Economics
26th Annual Conference
“New Challenges for Energy Decision Makers”
Prague, Czech Republic**

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June 5, 2003**





Energy Security

- **The meaning of “energy security” has evolved over the years***
 - **Originally a military focus on oil**
 - **Evolved to an economic/national security focus on oil**

*** See Len Coburn’s excellent IAEE Newsletter article, Q1/03**



Energy Security

(continued)

- **Today a more inclusive approach to energy security is needed**
 - **One approach -- energy supply could be considered secure if the expected consequences of an interruption are militarily, politically, socially, and economically manageable**
 - **Interruptions include natural disasters, system failure, embargoes, insiders (e.g., angry employees), terrorists, wars, etc.**
 - **Consider concept of energy “surety”—safety, security, reliability**
 - **Implementation likely differ by country and region**



Framing the Concept



US Energy Policy & Energy Security 1970s

Focus:

**Oil and Natural Gas
Availability**

Events/Actions:

**OPEC
Saudi Embargo
Iran-Iraq War
US Price Controls
Laws & Regulations**



US Energy Policy & Energy Security 1980s

Focus:

Market Forces

Events/Actions:

De-control



US Energy Policy & Energy Security 1990s

Focus:

Environment

Events/Actions:

**Rio Declaration
Framework Convention
on Climate Change
US Clean Air Act**



US Energy Policy & Energy Security 1998-2003

Focus:

**Energy Infrastructure
Transmission, Distribution
Interconnections, Cyber**

Events/Actions:

**PDD 63*
Millennium Bug
9-11
Dept. of Homeland Security
DOE Office of Energy Assurance**

* Presidential Decision Directive 63



US Energy Policy & Energy Security 2010-2020+

Focus:

Energy Infrastructure
Environment

Oil, Natural Gas, LNG
Electricity, Transmission,
Distribution, Cyber



World Proven Fossil Fuel Reserves (Percent Share)

<u>Area/Share</u>	<u>Oil</u>	<u>Gas</u>	<u>Coal</u>
Key M. E.*	65	33	0
Saudi	26	4	0
Iran	9	16	**
Iraq	11	2	0
Kuwait	9	1	0
UAE	10	4	0
Qatar	**	6	0
Russia	5	33	16
China	2	1	12
US	2	3	25
Australia	**	1	9
ROW	<u>25</u>	<u>29</u>	<u>38</u>
Total	100	100	100

* Sum of Saudi Arabia through UAE

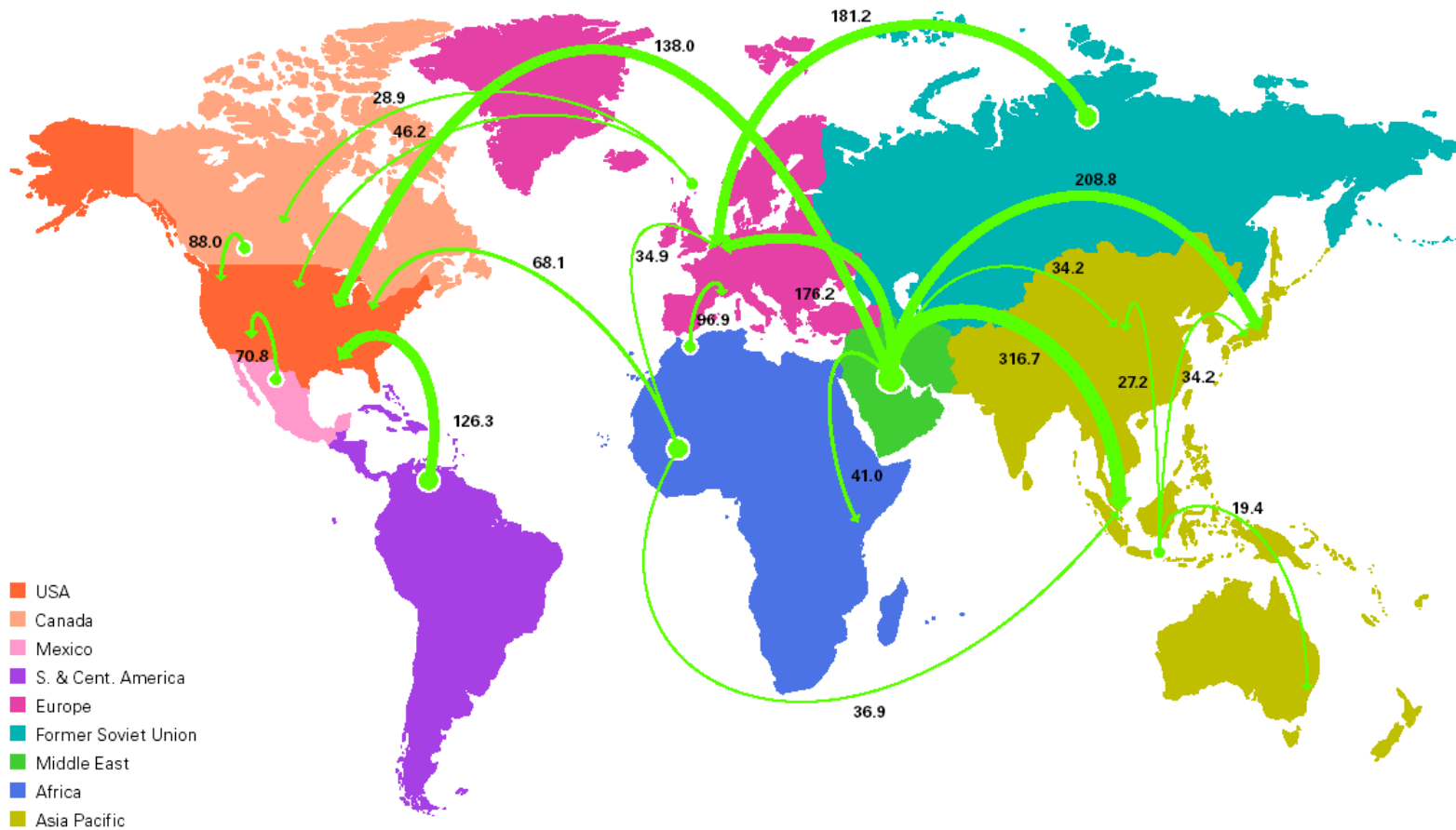
** Less than 0.5 %



Oil Interdependence Is Well Known

major trade movements

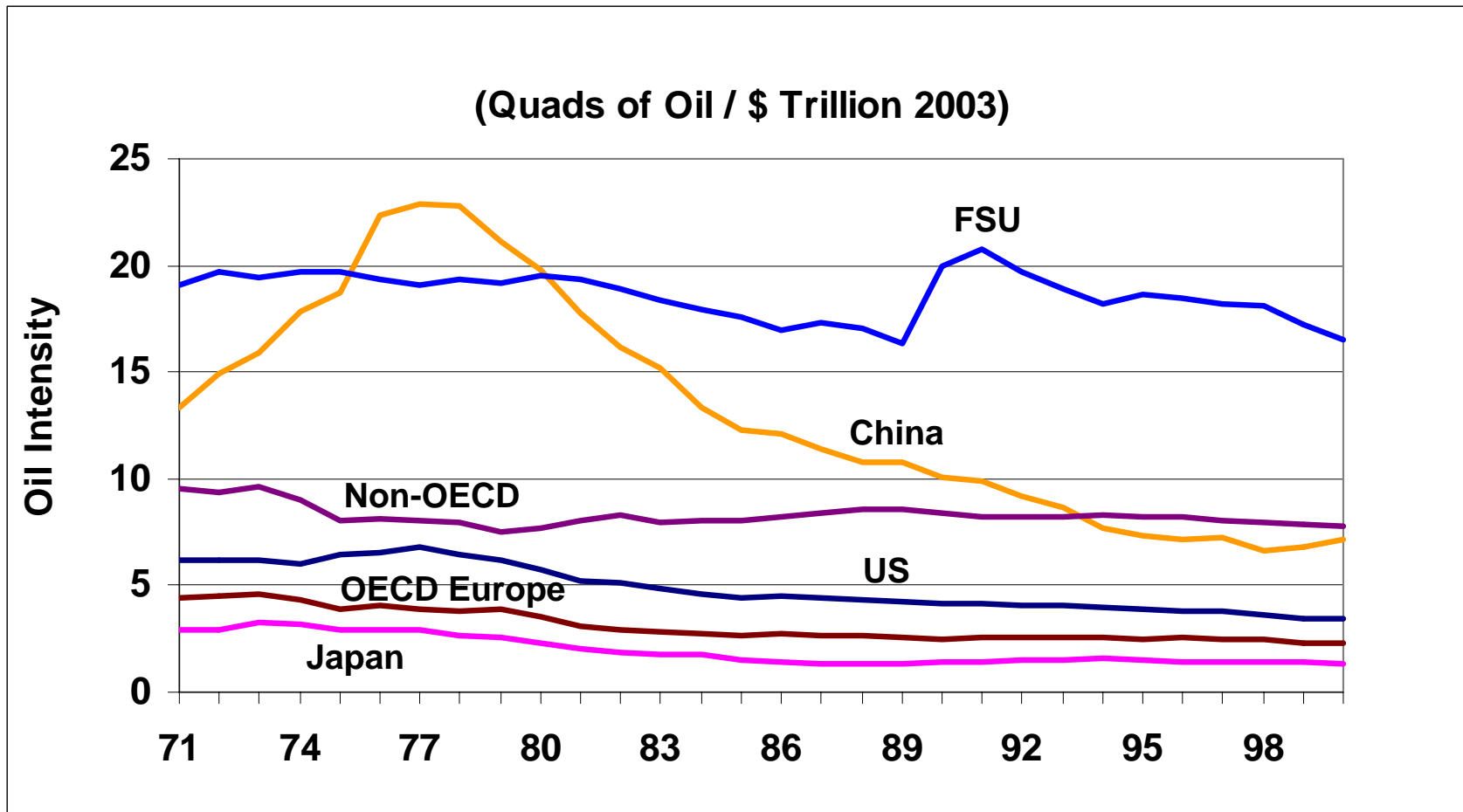
Trade flows worldwide (million tonnes)



Source: BP Statistical Review of World Energy, June 2002



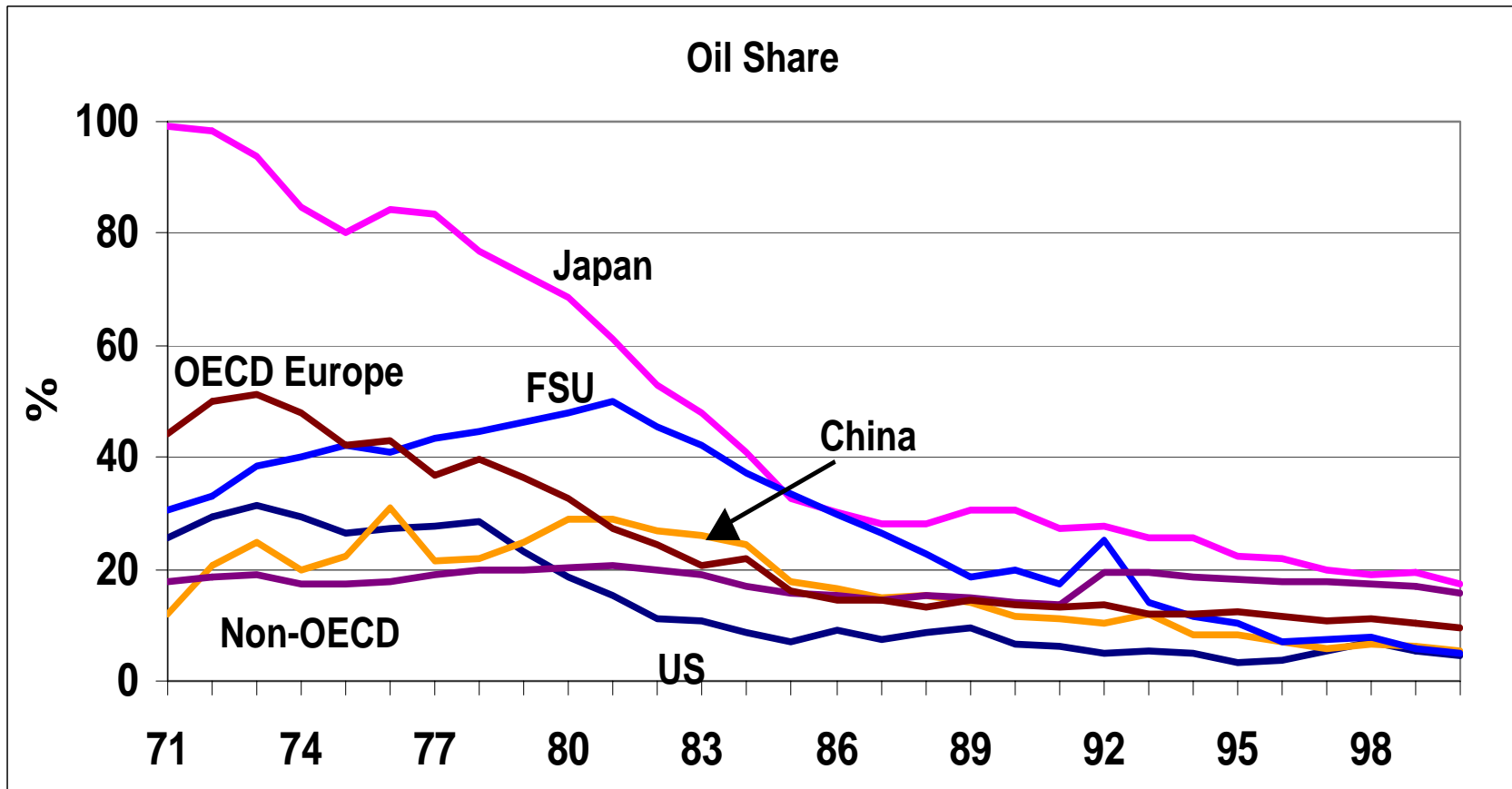
The Role of Oil in Economies



Source: Part I: IEA Statistics; Energy Balances of Non-OECD (and OECD) Countries, 1971-2000 (1960-2000). CD-ROM(s).



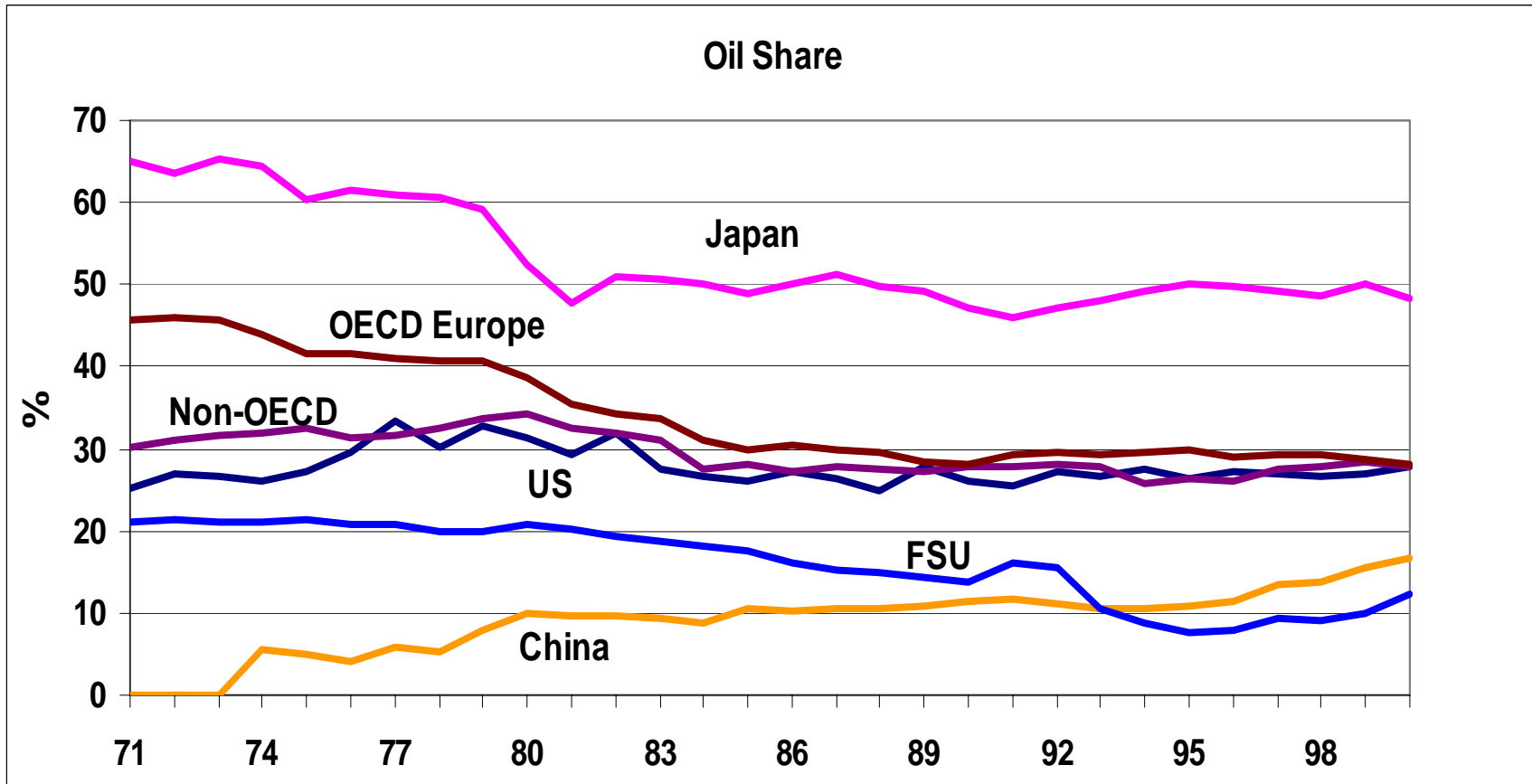
Share of Electricity Generated by Oil



Source: Part I: IEA Statistics; Energy Balances of Non-OECD (and OECD) Countries, 1971-2000 (1960-2000). CD-ROM(s).



Oil as an Industrial Fuel



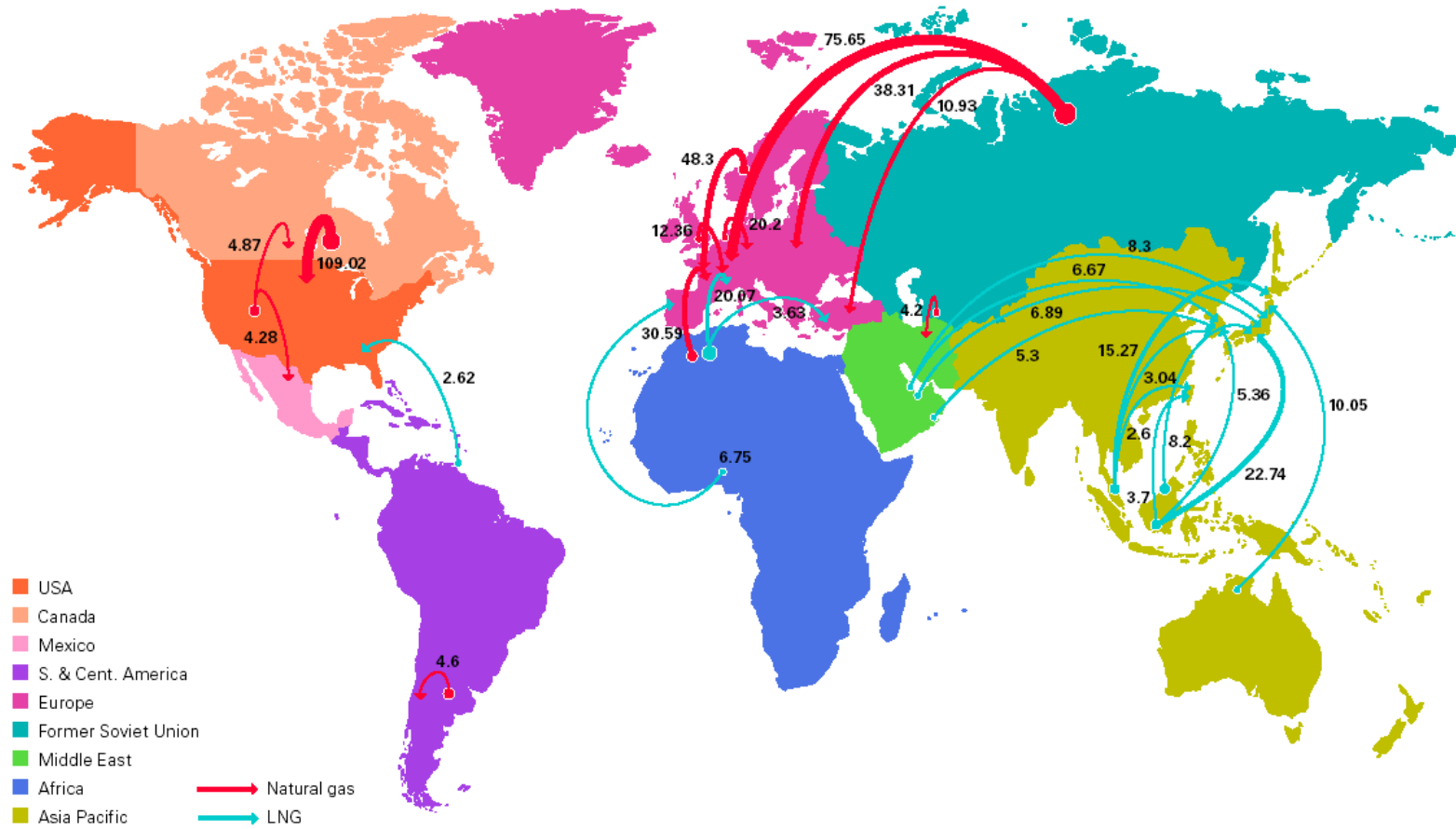
Source: Part I: IEA Statistics; Energy Balances of Non-OECD (and OECD) Countries, 1971-2000 (1960-2000). CD-ROM(s).



Natural Gas Interdependence Is Growing

major trade movements

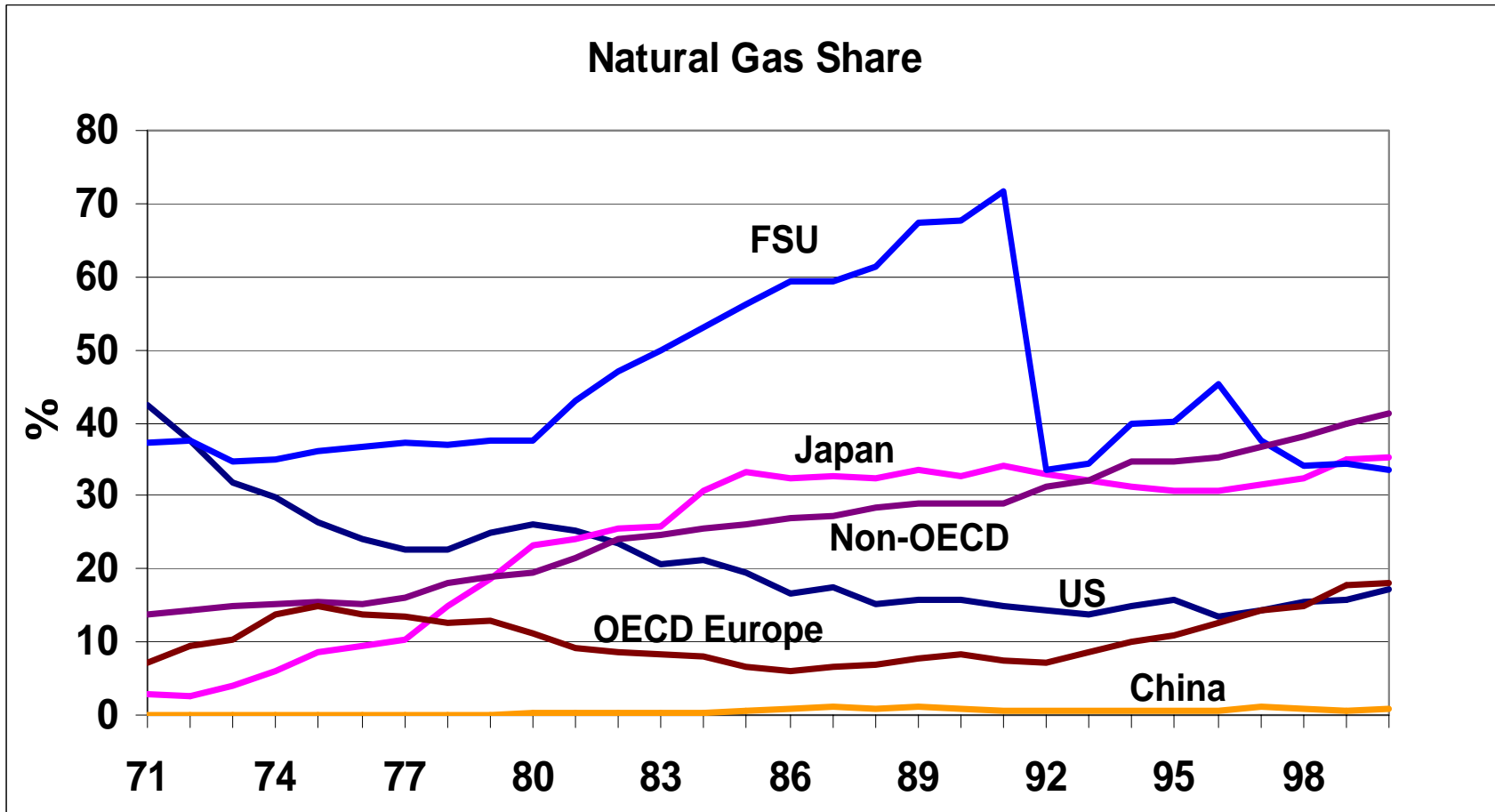
Trade flows worldwide (billion cubic metres)



Source: BP Statistical Review of World Energy, June 2002



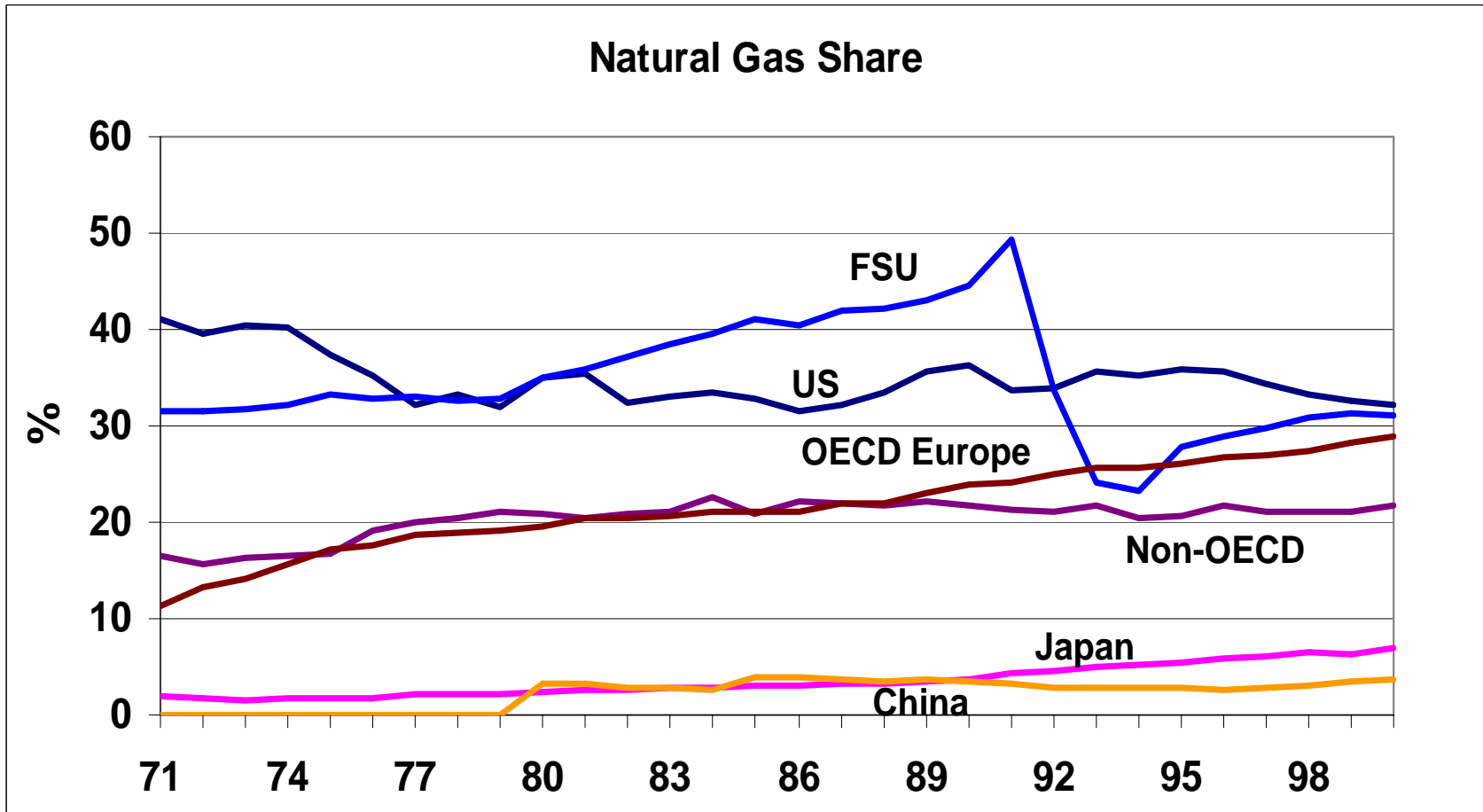
Share of Electricity Generated by Natural Gas



Source: Part I: IEA Statistics; Energy Balances of Non-OECD (and OECD) Countries, 1971-2000 (1960-2000). CD-ROM(s).



Natural Gas as an Industrial Fuel



Source: Part I: IEA Statistics; Energy Balances of Non-OECD (and OECD) Countries, 1971-2000 (1960-2000). CD-ROM(s).



Oil, Natural Gas and Electricity Demand are Expected to Grow Considerably

World Primary Energy Demand (BTOE)

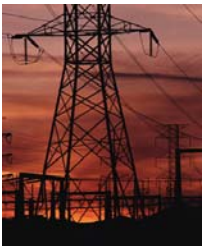
	<u>2000</u>	<u>2030</u>	<u>Diff.</u>	<u>Percent</u>
Coal	2.4	3.6	1.2	50
Oil	3.6	5.8	2.2	61
Gas	2.1	4.2	2.1	100
Nuclear	0.7	0.7	0	0
Hydro	0.2	0.4	0.2	100
Oth. Renew	0.2	0.6	0.4	200
Total	9.2	15.3	6.1	66
Electricity	3.6	6.5	2.9	81

Source: IEA World Energy Outlook 2002



Critical Infrastructures are Increasingly Linked by Electricity

Each Critical Infrastructure Insures Its Own Integrity



Electric Power



Oil & Gas, Pipelines & Terminals



Communications



Transportation



Water



Banking & Finance

Interdependencies Between and Among Critical Infrastructures are Key

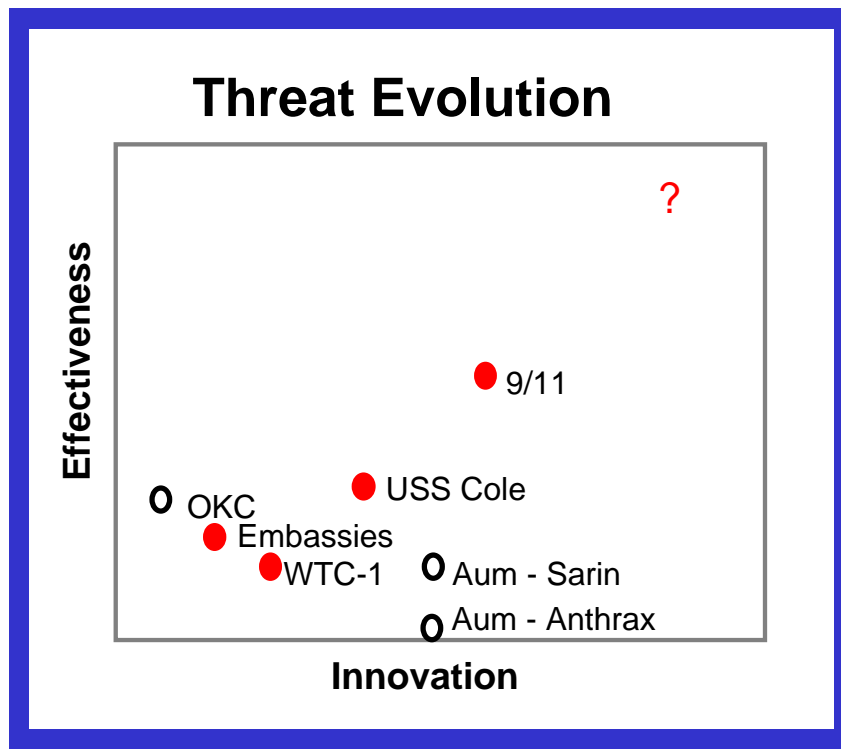


Energy System Vulnerabilities Will Grow

- **More facilities in more countries**
 - **Greater energy systems interdependencies and complexity**
 - **Scale economies & system efficiency vs. distributed facilities**
 - » **Production: refineries, power plants, etc.**
 - » **Transportation: wires, pipelines, rail, terminals, tankers, etc.**
 - » **Storage/distribution: wires, substations, tankage, reservoirs, etc.**
- **Cross border security will become increasingly important**
- **Cyber/Internet management systems (e.g., SCADAS) will grow, providing operating advantages, but also providing multi-point access and potential systemic failure**
- **Increasing Internet use will significantly expand data and communications access**



Terrorist Threats Are Evolving



- **Multi-dimensional and complex**
- **Demonstrating novel capabilities**
- **Becoming more effective and innovative**



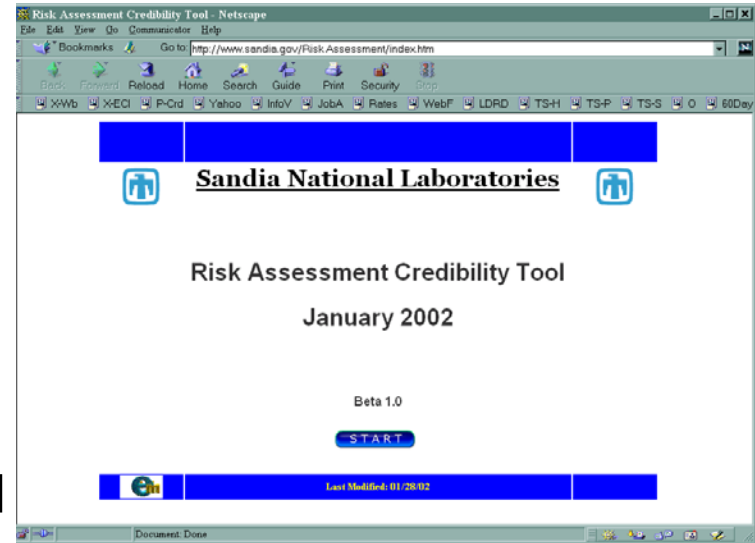
Towards a “Solution” Process



SNL Study: “A Scalable Systems Approach for Critical Infrastructure Security”, April 2002

Findings:

- No simple approach to national level infrastructure security prioritization
- Government agencies & private sector lack common terminology/ standards for security assessments
- New technologies & systems needed



Recommendations:

- Agree on Office of Homeland Security integrated approach and terminology, and socialize with key federal agencies
 - Extend to state & local level, and the private sector
- Develop 5-10 year strategic plan & technology roadmap with high level critical infrastructure security objectives and priorities

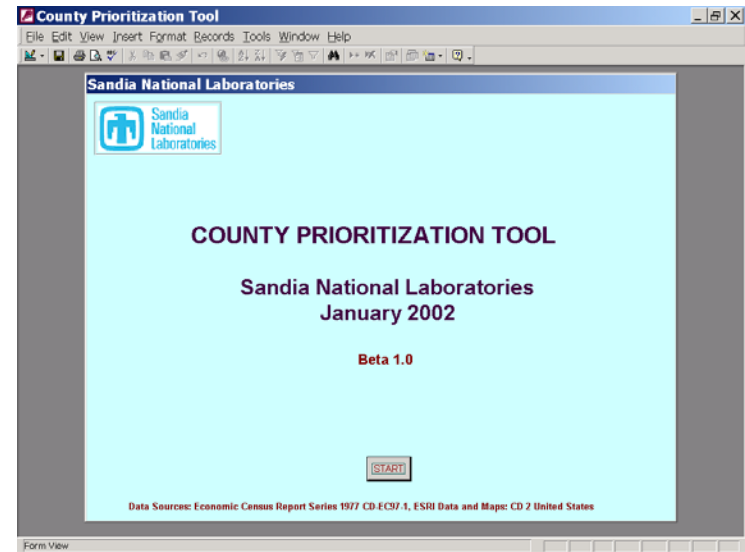


SNL Study

(continued)

Findings:

- Significant knowledge base deficiencies exist
- Balance between private sector information security and the public need for infrastructure protection



Recommendations:

- Integrate public and private information
- Establish protocols for public/private information dissemination

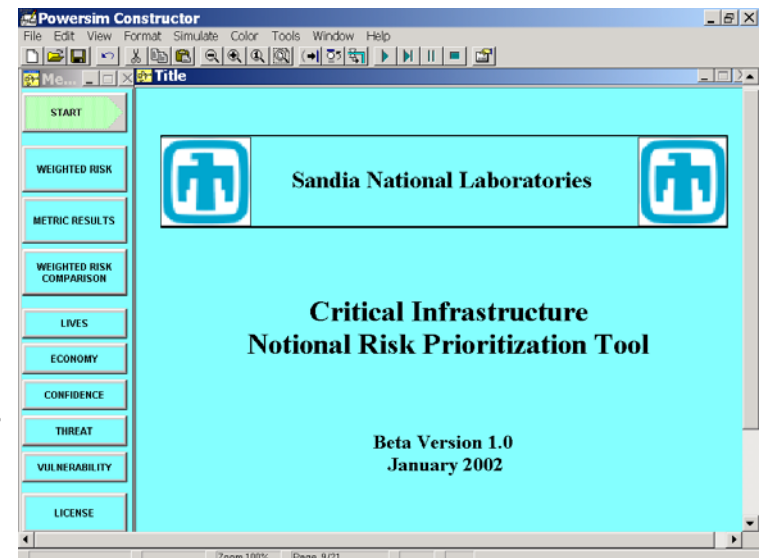


SNL Study

(continued)

Findings:

- Threat effectiveness and innovation among adversaries appears to be increasing
- Complexity of infrastructure ownership/responsibility makes system security prioritization difficult

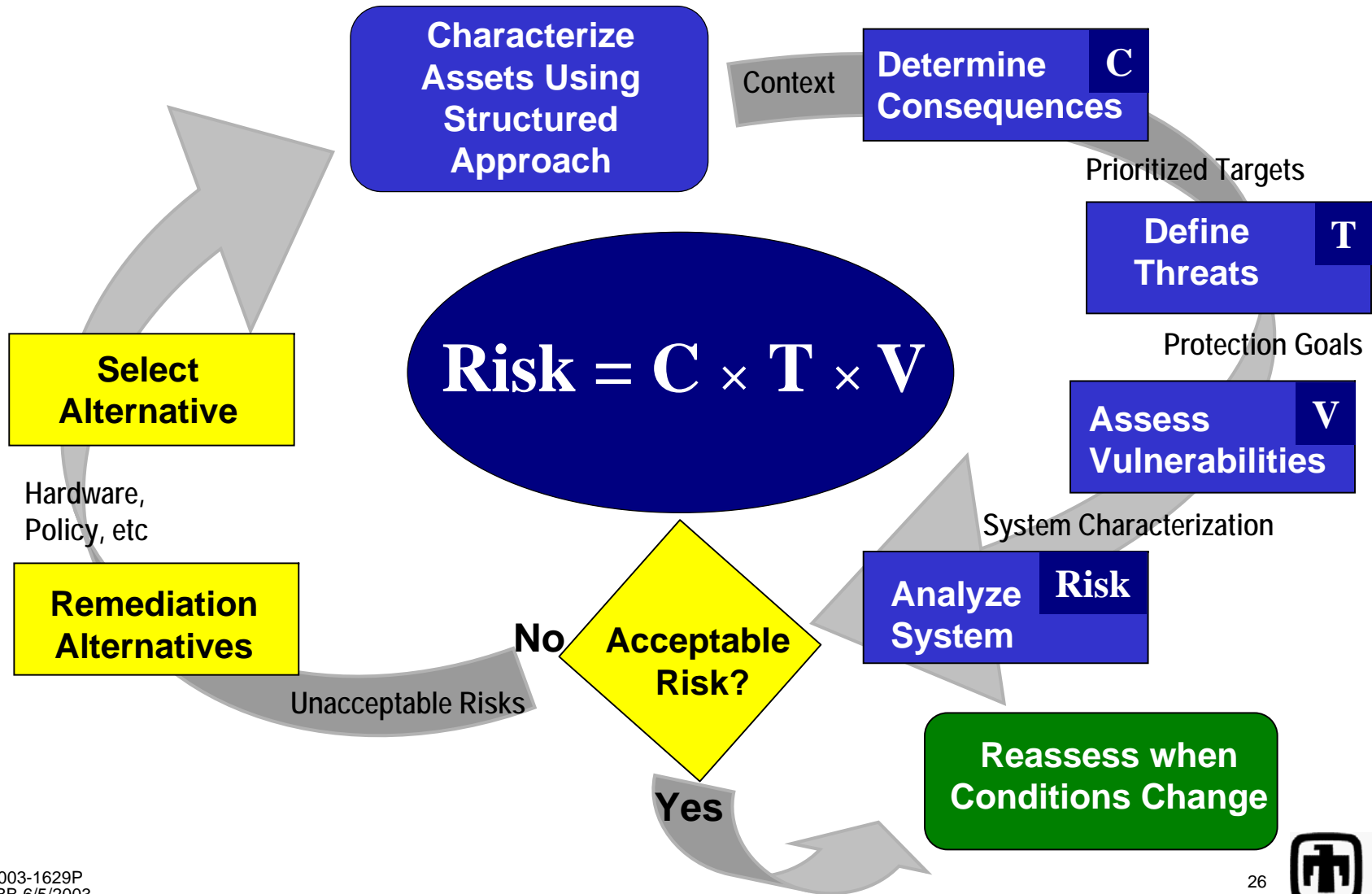


Recommendations:

- Utilize best available data and expert teams to help establish priorities
- Identify and update best practices and establish standards for threat, vulnerability and consequence assessments



SNL Integrated Security Framework





Conclusions



Conclusions

- **Energy security challenges are becoming increasingly complex and intertwined**
 - Increasing oil and natural gas dependence on potentially insecure regions
 - Extended global energy production, transmission and distribution systems, raising physical and cyber security risks
 - Growing electricity related interdependencies and complexities among key infrastructures
- **Some tools, technologies and systems are available, but others will need to be developed**



Conclusions

(continued)

- **Need to establish systematic national and international energy surety priorities, using best available data and expertise**
 - **Improve communication among responsible parties**
 - **Establish, disseminate and improve current best practices**
 - **Consider both the near term and the long term**
 - **Provide adequate, cost effective, private and public resources**
 - **Need to better understand the energy surety impacts of**
 - » **Current laws and regulations**
 - » **Environmental and economic issues**