

Rigorous Soft Method

The National
Nuclear Power
Issue

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The Issue

- The following scenario is real: the identity of the industrialized country has been omitted, along with many factors contributing to the issue.
- Broadly, the issue is one of concern about future energy supplies and global warming, exacerbated by fossil fuel CO₂ emissions.
- The national government has already committed to dismantling its nuclear energy industry within a decade, while at the same time signing up to the 1997 Kyoto protocol, aimed at the international reduction in greenhouse gas emissions.

Article

- *“There is uncertainty about the future of nuclear power. Activists are protesting about both the dangers from power stations and the difficulty of waste disposal. Illnesses, particularly infantile leukemia, are being ascribed to radiation from power stations, although scientists are unable to detect any causal relationship.*
- *“Government is concerned, both about public opinion and about the massive costs of decommissioning power stations. The alternatives seem uncertain, too. Fossil fuel is problematic, with the cost of coal rising slowly but inexorably. The availability and cost of oil is always a problem, associated as ever with a volatile Middle East.*
- *“Government has committed, too, to reducing greenhouse gas emissions, and has signed up to the international Kyoto Accord. The major generator of CO₂ is fossil fuel. If CO₂ emission control is to be realized, it seems inevitable that fossil fuel burning will have to be reduced, but how, and if there is to be no nuclear industry, what is the future source of energy going to be?*
- *“A new factor has arisen: the rail link to the continent. This promises to reduce the cost and time of freight, but it also carries the threat of ingress from undesirable elements.*
- *“What to do? There seems to be no sensible way forward” (Anon.)*

Issue Symptoms?

- Reading through the situation, there seems to be no obvious solution and, in addition to that, precious few symptoms; that is, indications of change from a prior, supposedly satisfactory state. A short list follows:

List of Symptoms

<i>Symptom</i>	<i>Description</i>
1	Activists are protesting. Although the topics of protest may not be new, the act of protesting appears to be, and government is concerned over public opinion
2	There is a concern that radiation may be causing infantile leukemia, although there is no scientific evidence
3	Nuclear power stations are widely seen as dangerous and expensive, especially when decommissioning is considered
4	The cost of coal is rising slowly, while the international cost of oil fluctuates wildly and is quite beyond control
5	The government has committed, under the Kyoto Accord, to reduce greenhouse gases; mainly CO ₂
6	The new rail connection to the European continent is seen as a two-edged sword

Public Concern

Politics
Organization
Economics
Technology
Inertia/inactivity
Culture

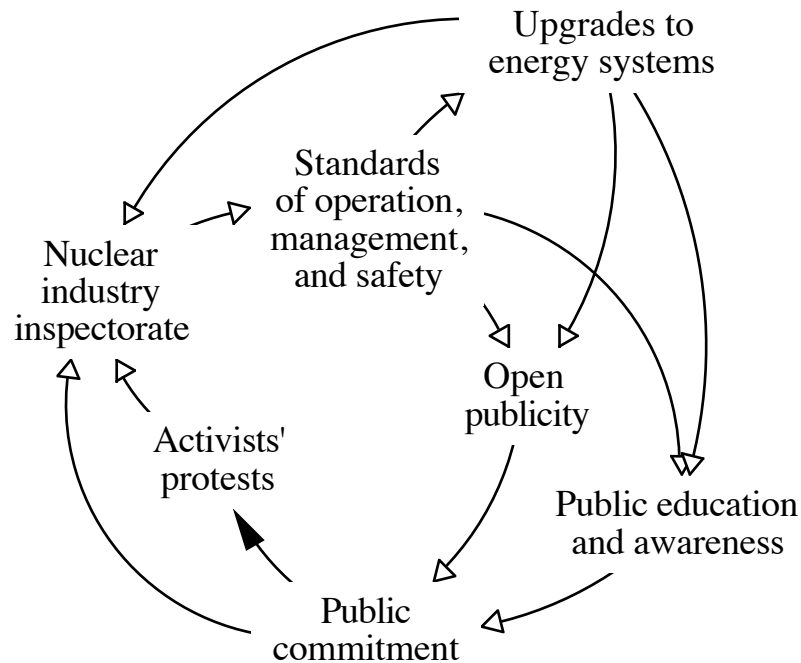
Possible Causes

- Fear of nuclear accidents/weapons
- Fear of radiation illnesses (e.g., leukemia)
- Concern over environment
- Wish to bypass democratic process
- Wish to impose minority viewpoint

Symptom

Activists' protests

Causal Loop Model



Imbalanced Systems

System for...		System for...
Nuclear inspection	↔	Standards
Standards	↔	Upgrades
Upgrades	↔	Public education
Public education	↔	Public confidence
Public confidence	↔	Public commitment
Public commitment	↔	Nuclear inspection

Leukaemia Scares

Politics
Organization
Economics
Technology
Inertia/inactivity
Culture

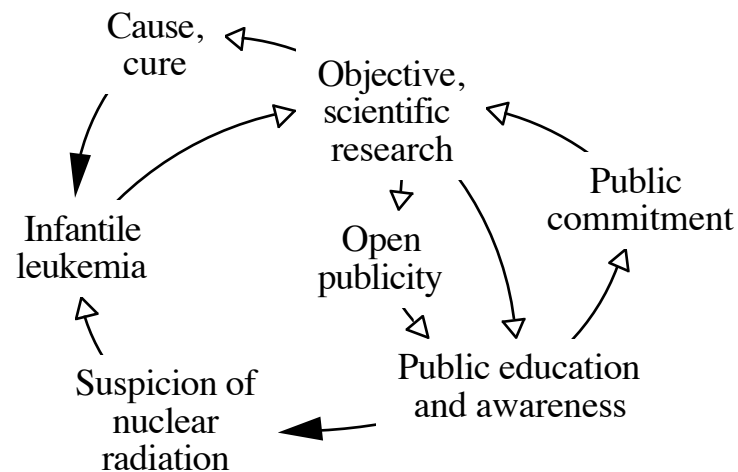
Possible Causes

Fear of radiation
Lack of scientific evidence
Need for scapegoat

Symptom

Concern over
"radiation
illnesses"

Causal Loop Model

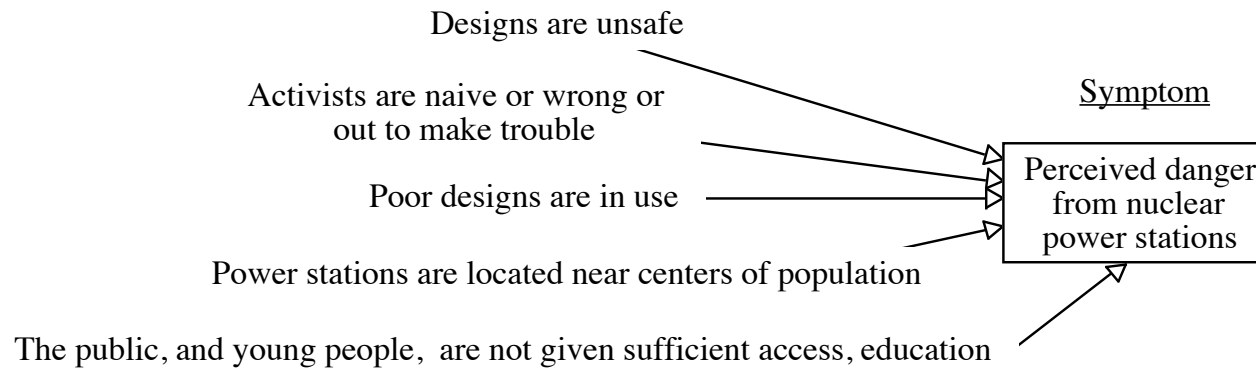


Imbalanced Systems

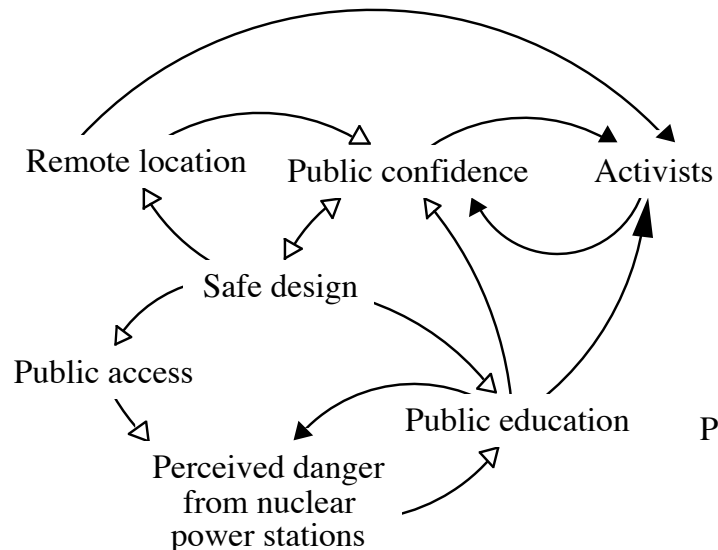
<i>System for...</i>		<i>System for...</i>
Objective research	↔	Medical understanding
Medical understanding	↔	Public understanding
Public understanding	↔	Public commitment
Public commitment	↔	Objective research

Nuclear Dangers

Laundry List of Possible Causes

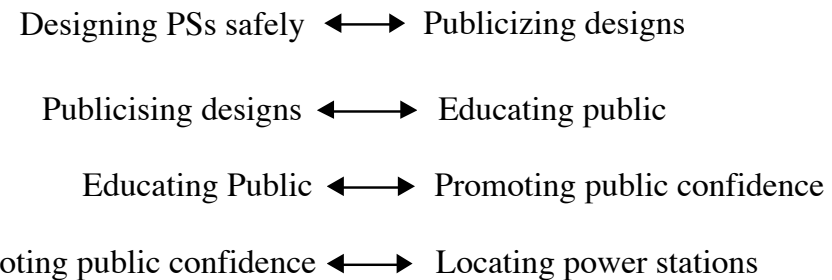


Causal Loop Model



Imbalanced Systems

Systems for...

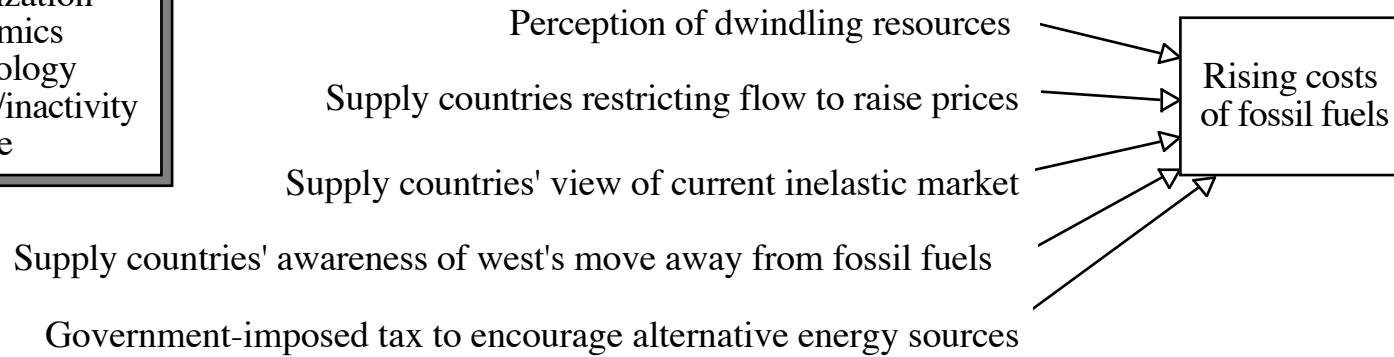


Fossil Fuel Costs

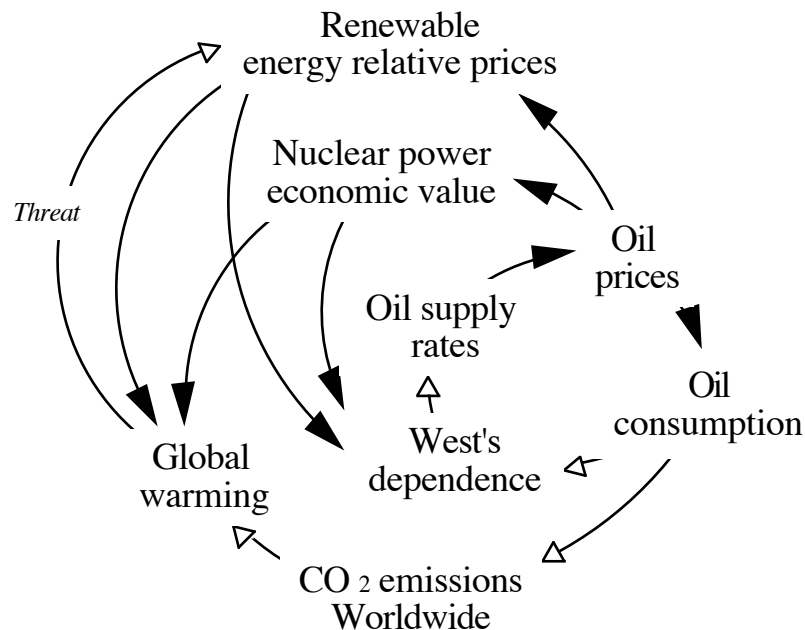
Politics
Organization
Economics
Technology
Inertia/inactivity
Culture

Possible Causes

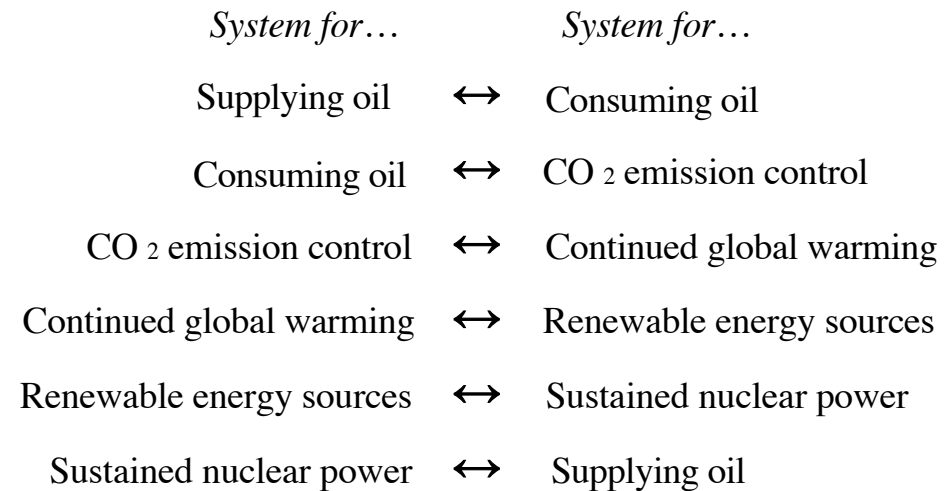
Symptom



Causal Loop Model



Imbalanced Systems



Kyoto Accord

Politics
Organization
Economics
Technology
Inertia/inactivity
Culture

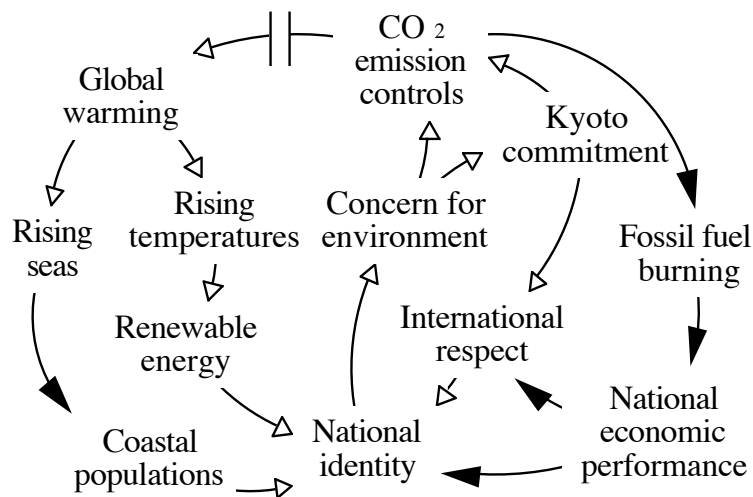
Possible Causes

International pressure
Need to pacify environmental lobby
Maintenance of national image
Need to avoid danger from global warming

Symptom

Government
commitment
to reduce
greenhouse
gases

Causal Loop Model



Imbalanced Systems

<i>System for...</i>		<i>System for...</i>
Maintaining national Identity	↔	Environmental concern
Environmental concern	↔	Controlling CO ₂ emissions
Controlling CO ₂ emissions	↔	Reduced fossil fuel burning
Reduced fossil fuel burning	↔	Meeting increasing energy needs
Meeting increasing energy needs	↔	Maintaining economic credibility
Maintaining economic credibility	↔	Maintaining national identity

Rail Link

Possible Causes

Symptom

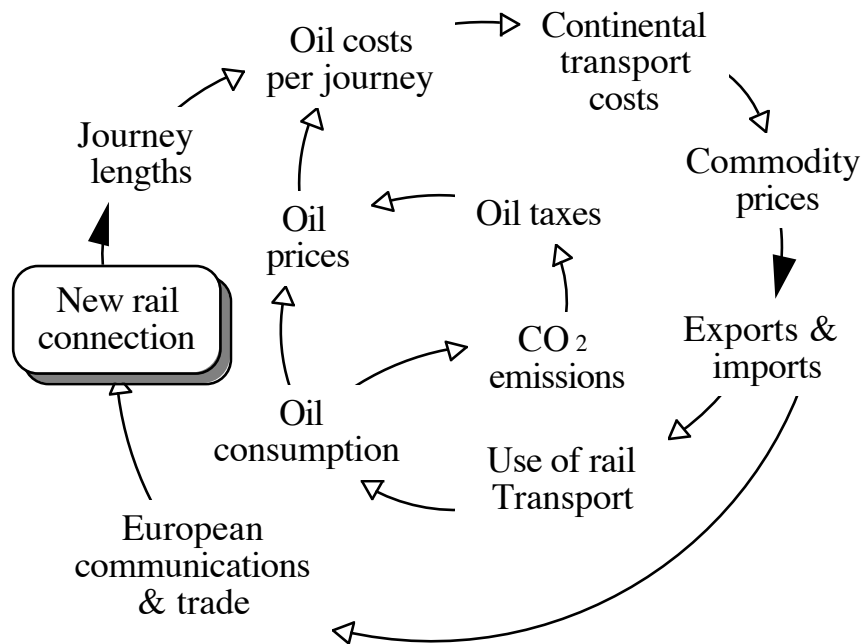
Politics
Organization
Economics
Technology
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Culture

Desire for closer European association

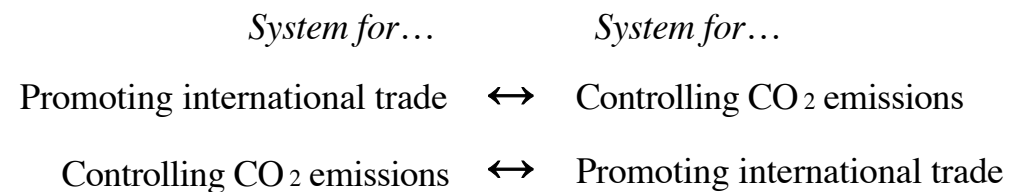
Desire for cheaper, faster transport

New rail link to continent

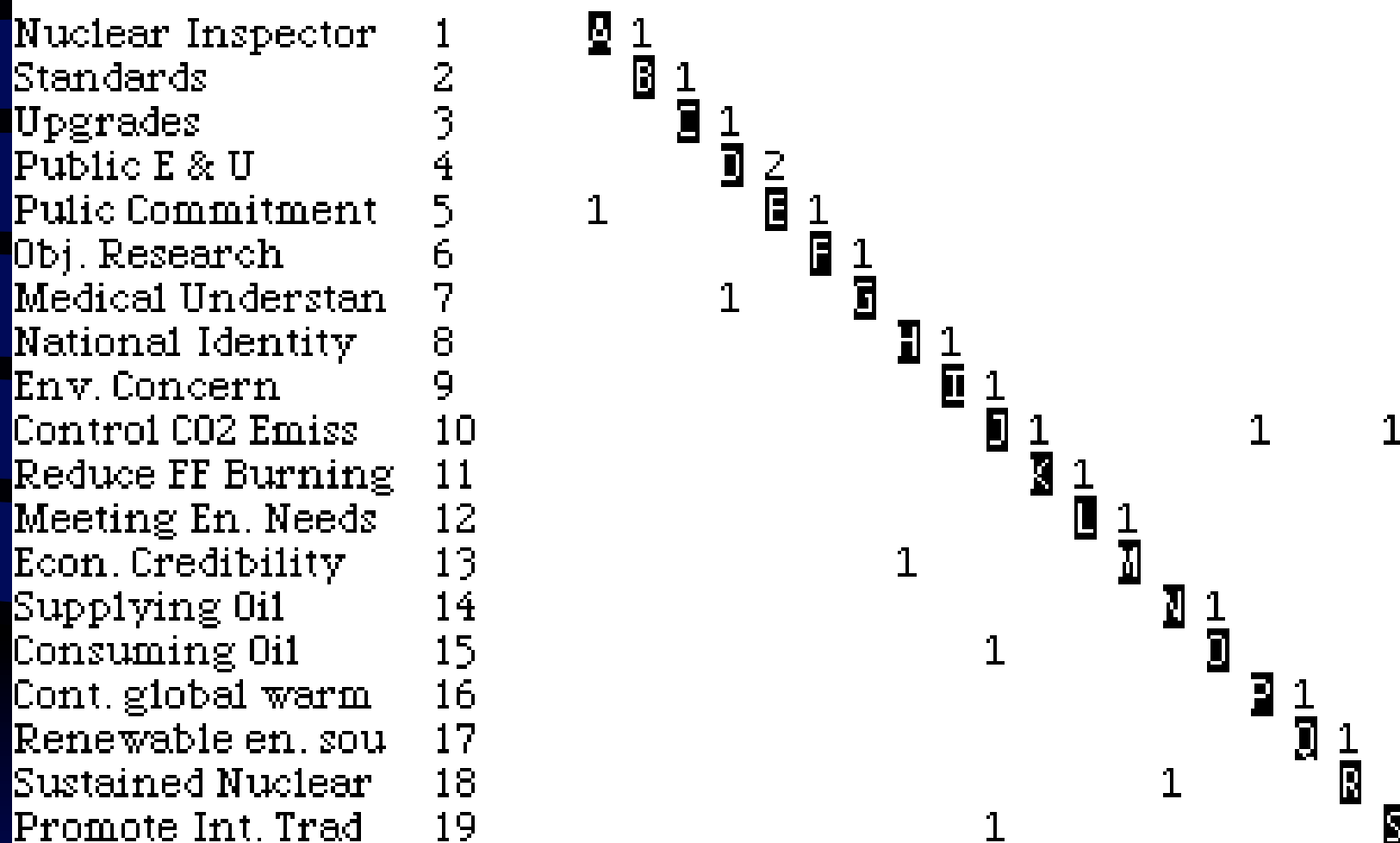
Causal Loop Model



Imbalanced Systems



Implicit Systems in N2 Chart



Systems and Nexus

Nuclear Energy	Standards	1	1	1																		
	Upgrades	2	1		1																	
	Nuclear Inspector	3	1			1																
	Public E & U	4		1			2	1														
	Public Commitment	5			1	2			1	1												
	Medical Understan	6				1					1											
	Obj. Research	7					1	1														
	Sustained Nuclear	8				1			1	1												
Environment & Energy	Supplying Oil	9							1		1											
	Renewable en. sou	10							1			1										
	Consuming Oil	11							1				1									
	Cont. global warm	12								1				1								
	Promote Int. Trad	13													1							
	Control CO2 Emiss	14									1	1	1		1	1	1					
	Reduce FF Burning	15												1		1						
	Meeting En. Needs	16												1	1				1			
		Env. Concern	17											1					1			
	Sovereignty	Econ. Credibility	18													1				1		
National Identity		19																1	1			

Systems Interaction Diagram (SID)

Nuclear energy

- Failure to educate the public
- Ineffective inspection / standards
- Failure to continually improve
- Unsuccessful research into links between radiation and infantile illnesses
- Lack of public commitment

Failure to sustain nuclear energy

Environment & Energy

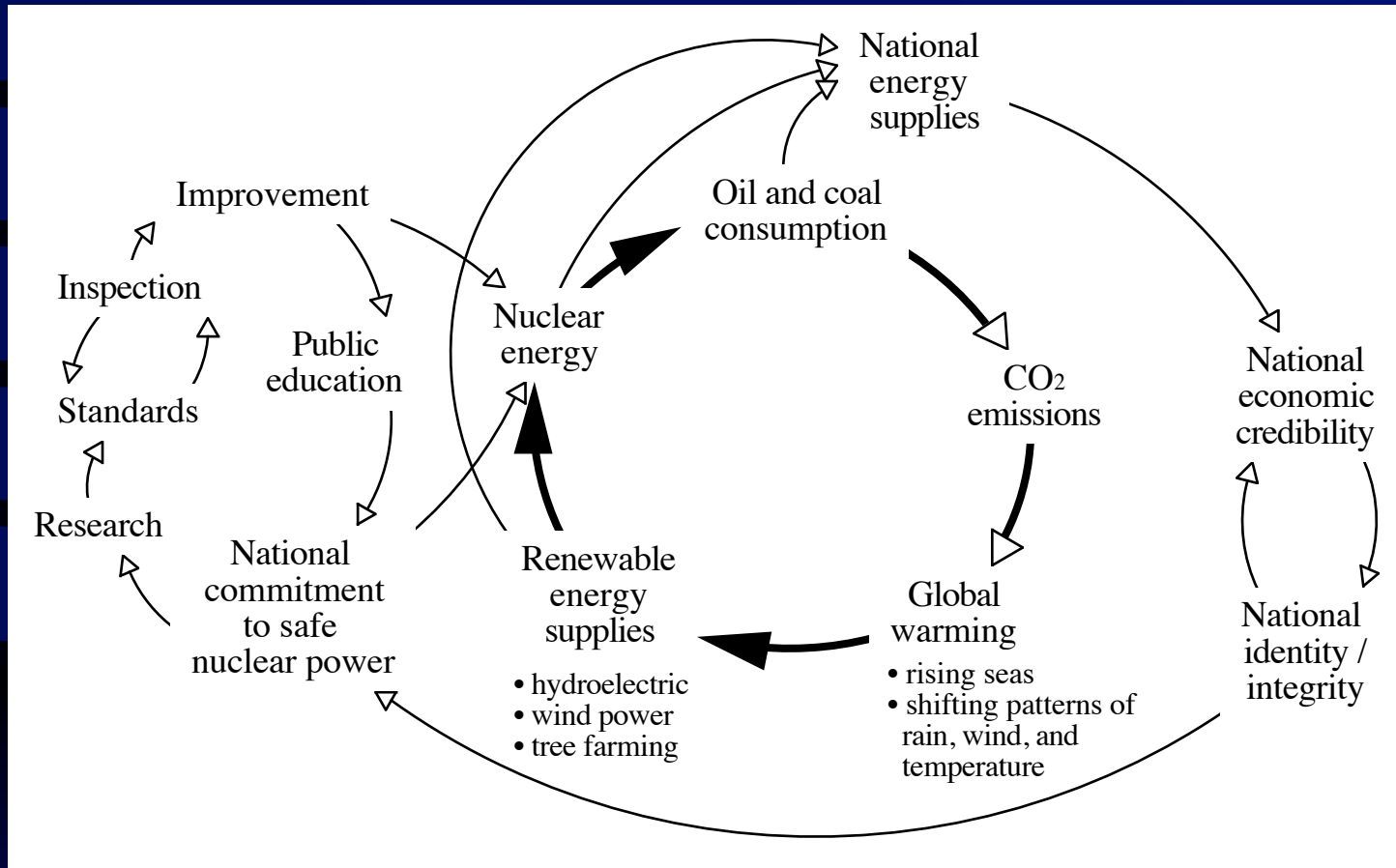
- Dependence on expensive & unreliable oil supplies
- Inadequate renewable energy sources
- Uncomfortably high Oil and fossil fuel consumptions
- Continued Global Warming
- Ineffective control of CO2 emissions
- Impending inability to meet national energy needs
- Impending prejudice to International Trade

Environmental concern

Sovereignty

- Threatened economic credibility
- Prejudiced National Identity/Integrity

High Level CLM



Reveals fallacy. Global warming will change weather patterns.
May well negate current renewable energy sources
Central loop breaks...

National Options

1. **Continue/increase using fossil fuels:**
 - Phase out nuclear power; increase CO₂ emissions;
 - Maintain international trade, national economic performance using increasing amounts of fossil fuels;
 - Renege on the Kyoto Accord.
2. **Retain, sustain, and enhance nuclear energy:**
 - Reduce oil, and reduce greenhouse gas emissions, using mixed energy sources;
 - Maintain international trade national economic performance;
 - Educate the public to the advantages and safety of modern/future nuclear power;
 - Introduce a new generation of nuclear power stations of safer design, remotely sited and under even tighter control;
 - Ratify the Kyoto Accord.
3. **Phase out nuclear and fossil energy, and control CO₂ emissions:**
 - Accept reduced industrial and transport capability;
 - Accept reducing international trade and national economic performance;
 - Ratify the Kyoto Accord.
4. **Retain nuclear energy as in 2, but:**
 - Seek alternative sources of energy that do not prejudice the environment or the people;
 - Inform the public of the reasons and research progress;
 - Educate the public to the advantages of retaining nuclear power in the near term, and of switching to advanced energy sources when available;
 - Ratify the Kyoto Accord.

Assessing Energy Options

Rank Matrix Analysis

Options ranked in order of goodness.

Ranks are summed
Lowest sum gives preferred option...

*

A non-viable option for economic and global stability

	Option 1 Continue with fossil fuels	Option 2 Retain and enhance nuclear energy	Option 3 Phase out nuclear and fossil fuels; depend on alternative energy	Option 4 Retain nuclear energy until clean source available; e.g. solar umbrellas, nuclear fusion
<u>Symptoms and Factors</u>				
Activists are protesting	4	2	3	1
Concerns about radiation and leukemia	4	2	3	1
Nuclear energy seen as dangerous	4	2	3	1
Fossil fuel prices rising and fluctuating	4	1.5	3	1.5
Government signed up to Kyoto agreement	4	1.5	3	1.5
New rail connection to the Continent	4	2	3	1
<u>Factors</u>				
Alternative energy inadequate to sustain economy <i>and</i> threatened by Global Warming	3	2	4*	1
Intent to maintain national sovereignty, identity and integrity	3	2	4*	1
	30 4 th	15 2 nd	26 3 rd *	9 1 st

Conclusion

- Retain/enhance nuclear fission energy until clean source available
- Increase research effort into clean sources:
 - Dyson spheres—use solar nuclear fusion
 - Solar umbrellas—use solar nuclear fusion
 - Nuclear Fusion energy
 - Hot
 - Cold?
- No other option meets the national and global need...