Scenarios Addressing United Parcel Service's Energy Acquisition:

A methodology for performing a comparative analysis of alternative fuels

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Outline

- Introduction
  - United Parcel Service (UPS)
  - Research Motivation & Questions
  - Application of Systems Theory
- Methodology
  - Multi-Scale Integrated Analysis
  - Stakeholder Matrix
- 3 Scenarios
- Conclusion

Understanding UPS

- **Why UPS**
  - Essential role in society
  - Demand increase
    - $19.7billion increase in 7 years
  - Dependent upon petroleum resources
  - Elaboration of the system over time
    - Problem solving tool has been to increase efficiency
- **Today**
  - Present in 200 countries
  - Control every aspect of the operation
    - 88,000 package cars (brown trucks)
    - Semi-truck fleet
    - Airline- 8th largest worldwide
    - Ocean Cargo Fleet

UPS: *UPS Sustainability Report* 2004 & 2007

Research Question

- Why systems theory is necessary
  - Complex Problem
    - Uncertainty: changing context of resource acquisition
    - Lots of variables at multiple scales
    - Social values
- Alternative Fuels & UPS a Narrow Topic?
  - Multitude of replacement options
  - Multitude of perspectives about alternative fuels
  - Decision making process convoluted:
    - All alternative fuels have benefits and drawbacks
    - One choice doesn't outweigh another
- How can UPS design flexibility in their system, allowing adaptation to a changing context?

Allen, T. F. H., & Thomas Hoekstra.1992; Schneider, Eric D., Kay. 1994; Ahl, Valerie & Allen, T. F. H.1996; Allen, Tainter, Hoekstra.1999; Allen, T. F. H., Tainter, Pires, Hoekstra. 2001; Tainter, Joseph 2000; Zellmer, A. J.,Giampietro, & Allen, T. F. H.2005.

Making Decisions about the System

- Bounding the system
  - Biological perspective
  - Investigate gradients
  - Comprehensive description of Alternative Fuels
  - Soft Systems Methodology: CATWOE Technique
- Need for a decision support tool to layer information
- Developed methodology and applied it to the case study of UPS

Allen, T. F. H., & Thomas Hoekstra.;Checkland, Peter. 1981

Methodology Overview: Models

- Investigated the Options
  - 7 Alternative fuels and petroleum diesel
    - Biodiesel (BD20), Natural Gas (CNG & LNG), Synthesis Gas (FT Diesel & DME), Hydrogen (Compressed and Liquid)
- Multi-Scale Integrated Analysis (MSIA)
  - 4 Criteria
  - 20 Indicators
- Stakeholder Matrix
  - Matrix of questions
    - Quantify values
    - Developed by using SSM CATWOE

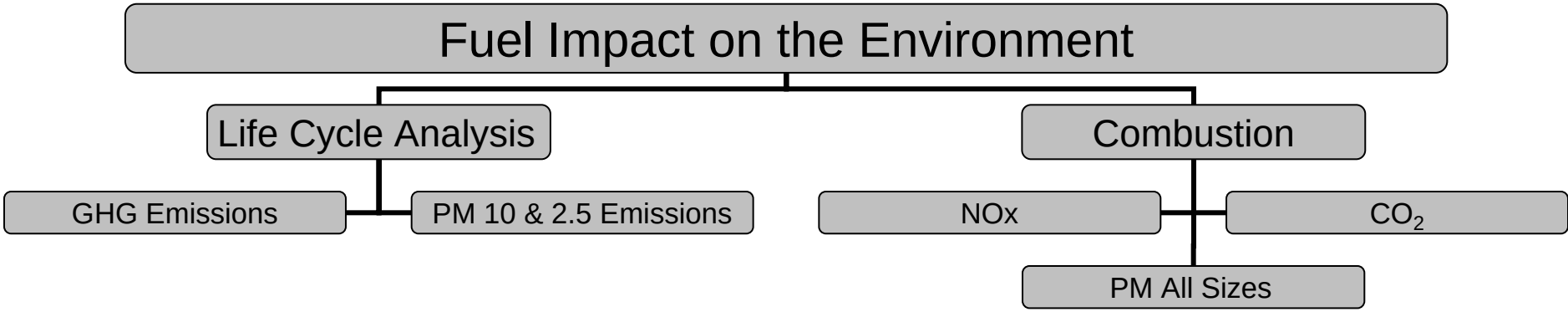
Checkland, Peter.1981; Giampetro, Mario. **2004.**

Multi-Scale Integrated Analysis Criteria

MSIA Criteria	Observed Scale of Alternative Fuel Choice Effect
Fuel Impact on the Environment	Global, Regional & Local
Feasibility	Local
Infrastructure	Local
Strategic Relationships	Regional

- Synthesizing Information
  - Interdisciplinary Approach
  - Life Cycle Analysis Model (GREET), Primary Research, Databases

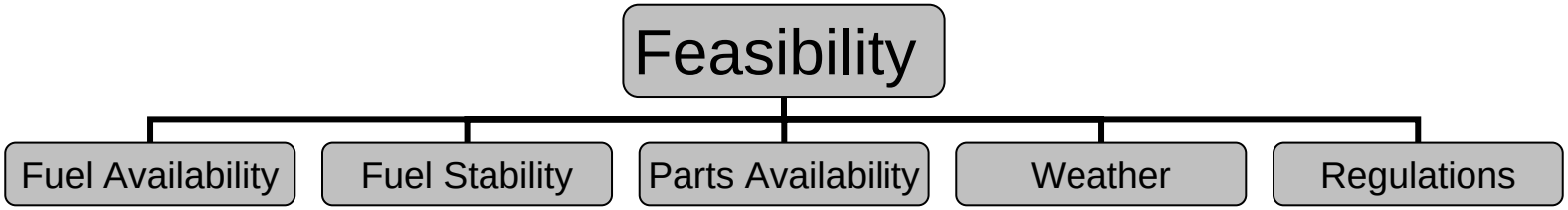
Criteria & Indicators



Indicator	Unit	Cmprs Nat. Gas	Liquid Nat. Gas	Liquid H_2	Comprs H_2	FT Diesel	DME	BD20	Diesel
LCA Emissions (GHG)	DI	6.10%	9.30%	-1003.10%	-518.30%	69.40%	-50.70%	58.80%	0%

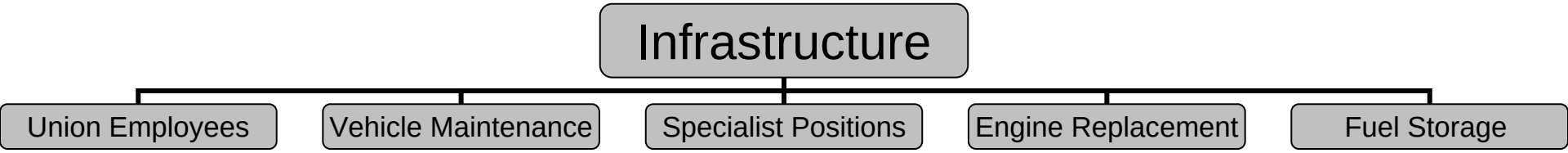
U.S. DOE & National Renewable Energy Labs, 2002; Burnham, Andrew, Wang, & Ye WU. 2007

Criteria & Indicators



Indicator	Units	Cmprs Nat. Gas	Liquid Natural Gas	Liquid H_2	Cmprs H_2	FT Diesel	DME	BD20	Diesel
Local Constraints: Weather	0=No 1=Yes	1	0	0	0	0	0	1	0

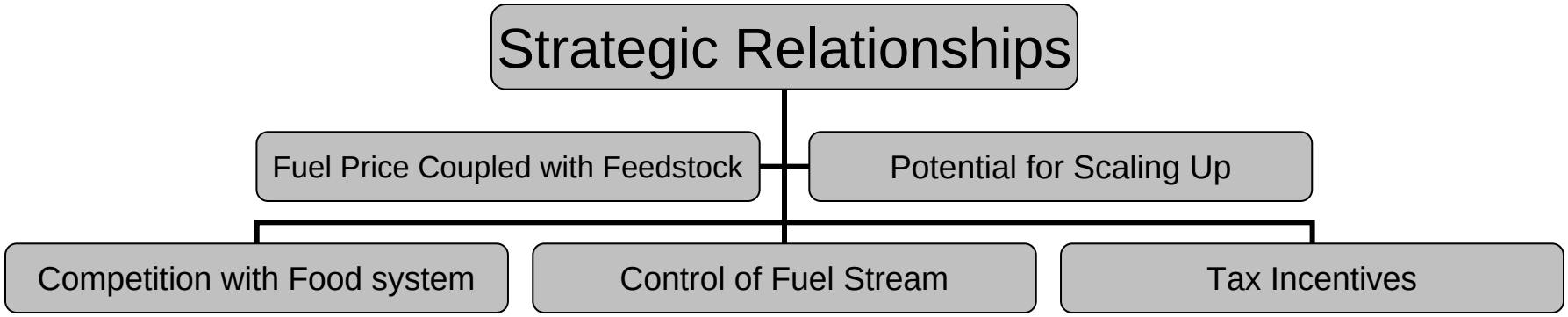
Criteria & Indicators



Indicator	Units	Cmprs Nat. Gas	Liquid Natural Gas	Liquid H_2	Cmpres H_2	FT Diesel	DME	BD20	Diesel
Engine Replacement	0-3 scale	2	3	3	2	1	2	1	0

Chandler, Kevin, Walkowicz, & Clark. 2002

Criteria & Indicators



Indicator	Units	Cmprs Nat. Gas	Liquid Natural Gas	Liquid H_2	Cmprs H_2	FT Diesel	DME	BD20	Diesel
Competition w/ Food System	0=No 1=Yes	0	0	1	1	0	0	1	0

Stakeholder Matrix

- Stakeholder: Group of people with a vested interest in UPS
- Dissimilar points of view
  - All observing the system
  - Different criteria for making a decision
- Non-equivalent perspectives
  - Groups observe UPS
  - Different perceptions
- Weight in the model
  - Equal importance as a necessary abstraction

Giampetro, Mario. 2004; Porritt, Jonathon.2007.

Explicitly Addressing Values

STAKEHOLDER	QUESTIONS ASKED BY GROUP
Stockholders	Is this fuel considered a "green" fuel?
Customers	Will the cost of shipping a package cost more due to higher fuel and labor costs?
Employees	Is the safety of the alternative fuel comparable to petroleum diesel?
Outside Relationships	By forming a relationship with UPS will I benefit from economies of scale?
Regulatory Committees	Are regulations for fuel handling, storage and distribution already in existence?

Stakeholder Matrix Results

Stakeholders	Cmpress Natural Gas	Liquid Natural Gas	Liquid H_2	Cmprss H_2	FT Diesel	DME	BD20	Diesel
Stockholders	3	2	2	2	2	2	4	1
Customers	0	0	1	1	0	0	2	0
Employees	3	3	3	2	2	2	2	1
External to UPS Relationships:	2	2	0	0	2	2	0	2
Regulatory Committees	1	1	0	0	0	0	2	2
Total Yes Answers	**9**	**8**	**6**	**5**	**6**	**6**	**10**	**6**

Three Scenarios

- Business as Usual:
  - Minimum Change
  - Wait for cost to drive decision: Reactionary
  - Not supported by Matrixes

- Redefine the System: A new vision of UPS
  - Maximum Change
  - Move People: Airline
  - Move Information: Supply-Chain Management
  - Move Financial Resources: Financial Lending
  - Package cars become symbolic
  - Unacceptable to existing employees

Three Scenarios

- Flexibility Scenario:
  - Intermediate change
  - Maintain identity
  - Integration of the MSIA & Stakeholder results shows:
    - Series of engine modifications
    - Relinquish control
      - Fuel varies based on each center's needs
      - Local relationships with multiple fuel vendors

Conclusion

- Developed a methodology
  - Investigating persistence of an existing structure
  - Layering information
    - Biological perspective
    - Define the material system
    - Multi-Scaled Integrated Analysis
    - Stakeholder Matrix
    - Scenarios
  - Combined information from many disciplines
  - Methodology incorporates
    - Diverse values and scales
    - Environmental impacts
    - Economic pressures

References

1. Ahl, Valerie, and Allen, T. F. H. *Hierarchy Theory.* New York: Columbia Press University, 1996. .
2. Allen, T. F. H., and Thomas Hoekstra. *Toward a Unified Ecology.* New York: Columbia University Press, 1992.
3. Allen, T. F. H., Joseph A. Tainter, and T. W. Hoekstra. "Supply-Side Sustainability." *Systems Research and Behavioral Science* 16, no. 5 (1999): 403.
4. Allen, T. F. H., Joseph A. Tainter, Chris Pires, and Thomas W. Hoekstra. "Dragnet Ecology--"just the Facts, Ma'Am": The Privilege of Science in a Postmodern World." *Bioscience* 51, no. 6 (2001): 475.
5. Burnham, Andrew, Michael Wang, and Ye WU. "Development and Applications of the GREET 2.7- the Transportation Vehicle-Cycle Model." (August, 2007).
6. Chandler, Kevin, Kevin Walkowicz, and Nigel Clark. *United Parcel Service CNG Truck Fleet: Final Results.* U.S. DOE & National Renewable Energy Labs, 2002.
7. Checkland, Peter. *Systems Thinking, Systems Practice.* New York: Wiley, 1981.
8. Giampetro, Mario. *Multi-Scale Integrated Analysis of Agroecosystems.* Boca Raton, FL: CRC Press, 2004.
9. Holling, C. S. "Understanding the Complexity of Economic, Ecological, and Social Systems." no. 4 (2001): 390-405.
10. Kay, James J., and Eric Schneider. "Embracing Complexity: The Challenge of the Ecosystem Approach." *Alternatives* 20, no. 3 (1994): 32.
11. Porritt, Jonathon. *Capitalism as if the World Matters.* Sterling, VA: EarthScan Publishers, 2007.
12. Schneider, Eric D., and James J. Kay. "Complexity and Thermodynamics: Towards a New Ecology." *Futures* 26, no. 6 (1994): 626.
13. Tainter, Joseph A. "Problem Solving: Complexity, History, Sustainability." *Population and Environment* 22, no. 1 (2000): 3. UPS. "Company History." Available from http://www.ups.com/content/corp/about/history.
14. UPS (authors not listed). *UPS Sustainability Report: Environmental: Fuel use and Emissions: Ground Fleet.*2004.
15. UPS (authors not listed). *UPS Corporate Sustainability Report.* internal presentation: http://www.ups.com, 2006.
16. Zellmer, A. J., Mario Giampietro, and Allen, T. F. H. *The Two Faces of Complexity.* 1st ed.In Press 2005.