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Featured Faculty Research

“Systems Thinking for Sustainability: A Decision-Support Approach for Electrical Utility Executives Addressing Climate Change”

By Andrew Jones

Consider the challenge an electrical utility executive faces when designing a financially robust strategy that addresses global climate change. When will a federal or state carbon tax or limit be imposed? What, if anything, should she do before that time? Invest in renewables like wind or biomass, trusting that costs will continue to fall? Coal gasification, natural gas, or nuclear, with its other pollution concerns? Distributed generation? Can she actively close polluting plants and build new, cleaner ones? Can she spark her customers to increase electrical use efficiency and reduce demand? What are the interactions and synergies between such strategies? Then add in the secondary effects. How will gas and coal prices respond to a carbon tax? How might investments in wind accelerate the reduction in the cost of wind?

Put it all together, and you have a managerial challenge with high degrees of complexity and uncertainty.

In such domains, there is no single optimal strategy that a smart analyst with a spreadsheet can generate. Instead, what managers need is an approach and tool that can support management team conversations about how various strategies would play out over time, and whether they would meet financial and environmental goals.

In a project funded by the Concordia Foundation, a team of experts from the Sustainability Institute and the Rocky Mountain Institute are working to create just such a tool. The project will push our own thinking about effective utility strategies, while supporting innovative utility leaders who are struggling with the same questions.

To do this, we are using an approach called System Dynamics (SD) Modeling, which is the more technical wing of the broader field of Systems Thinking. SD Modeling grew out of MIT in the 1950s and has evolved in recent decades into a practical, flexible thinking tool that managers use to address a wide range of strategic questions.

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“Systems Thinking for Sustainability” continued from page 1

SD modeling includes three core tools. The first tool supports diagramming the interrelationships and accumulations in systems. For example, diagramming tools might help a management team explore how future carbon regulations could affect prices of coal and natural gas, which would affect the “dispatching” or use of the different capacity types, which, in turn, would affect utility CO$_2$ emissions.

The second tool is the creation of formal mathematical models that bring numerical rigor to the diagrams and lead a modeling team to use data and expert opinion to quantify important relationships in the system. For example, what are the likely future costs of carbon offsets on the open market? How much do we expect wind farm prices to fall? How much global warming pollution can be abated through coal gasification with carbon sequestration?

The third tool is the creation of a user-friendly interface onto the model that turns it into a “management flight simulator.” Using the analog from pilot training, such a simulator allows a utility executive to “fly” his company for the next 20 years, experimenting with a wide range of strategies given a wide range of regulatory and market scenarios. In such a setting, the rate of learning is accelerated; instead of waiting 10 years to see how a strategy actually works, one can see a (much-simplified) set of results in 10 seconds. For example, a leader could see how a 50/50 mix of wind and natural gas (continued next page)

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SD diagramming tools such as this can be used to help management teams understand the interrelationships between different components of complex systems.

**Carbon Regulation Scenarios**
- $/ton, allocation
- Amount/year

**Utility Control Panel**
- Key outputs:
  - Emissions
  - Cost producing power
  - Profitability
  - Risk (?)
  - Reliability

**Investment Decisions**
- Existing portfolio
- New Capacity
- Retire and Replace
- Offsets

**New Capacity**
- Coal gas w/geologic seq
- Coal
- Gas combined cycle
- Nuclear
- Dispatchable renewable (biomass)
- Non-D renewable (wind)

**Existing Capacity**
- Coal
- Gas CC
- Nuclear
- Hydro

**Net Emissions**
- Production–offsets and credits

**Fuel Prices**
- Gas
- Coal
- Biomass
- Nuclear

**Carbon Offsets**
- Biological sequestration
- Carbon market credits (buying or selling)

**Net DSM invest**
- DSM adoption
- Demand elasticity from price

**Baseline Load and Load Growth**
- Demand

**Emissions**
- Forecasted demand
- New Cap investments
- Invest in efficiency, retrofit, or retire
- Offset investments

**Dispatching**
- Energy production by capacity type

**Fuel Prices**
- Variable costs
- Carbon tax

** Competitive fuel response to carbon tax**

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investments along with a modest demand-side management program fares amidst regulation that brings a carbon tax by 2009. He doesn’t like the result? He will try another approach in the next experiment.

The overall approach takes a unique angle on the use of technical models to support decision-making. It starts with the premise that all managerial decisions, about sustainable practices or other matters, are made with models. Usually these are our “mental models,” the understandings we have in our heads about how the system works. The trouble is, in complex domains such as utility strategy for addressing climate change, such models are typically fraught with errors as we misunderstand time delays, feedback interactions, and other features of the system. Thus, SD modeling works to supplement our “mental” models with more formal ones that do not spew out answers as much as support effective conversations about strategy that are grounded in the real mechanics of the system.

The desired end result is that leaders who are struggling with the most challenging questions of our time—for example, how to address climate change in a way that makes business sense—have the technical and conversational support that matches the level of courage they bring to the challenge of creating a sustainable world. ♦

The CSE will host its first annual conference on March 30-31, 2006. The focus will be “Reinventing Today’s Business for the Challenges of Tomorrow”, featuring the latest research on and application of sustainable business practices. More info will be available soon. Interested participants and sponsors may contact CSE executive director Katie Kross.

Hunter Lovins and Stephen Self of Natural Capitalism Inc. will be on campus to discuss sustainable business practices with Kenan-Flagler students and faculty on Sept. 21. Ms. Lovins will give a public lecture on “Implementing Natural Capitalism” to a large audience in the evening.

Drew Jones, of the Sustainability Institute, joins UNC Kenan-Flagler as an Adjunct Professor for 2005-06. Drew will teach the MBA elective course “Systems Thinking for Sustainable Enterprise” this fall.

In its first year, CSE Consulting has surpassed expectations and achieved tremendous success in providing top-notch sustainability consulting to six different organizations over the summer. The CSE would like to thank our summer consultants for jobs well done! Clockwise from top right: Grayson Jones, Bruce Herzer, Supitcha Phithayanont, and Galyna Vasylevska, all MBA Class of 2006

A new elective is available to MBAs this semester: “Global Corporate Social Responsibility in the US and EU” will be taught by Susan Aaronson (Kenan Institute, Washington).

The CSE is pleased to announce the addition of an MBA Intern, Ogemdi Ike (MBA ’06), to its staff to assist us as we develop and expand the CSE Knowledge Bank, an online resource of white papers, cases, and research resources.

Attended by more than 90 students, faculty and staff, the CSE’s fall social was indicative of the overwhelming interest in sustainable enterprise by the incoming MBA class. The Net Impact Club is likewise experiencing record numbers of new members from the Class of 2007.
National Public Radio’s Marketplace Morning Report interviewed David Kirkpatrick (EMBA ’91), founder and managing director of SJF Ventures; intern Deborah Parsons (MBA ’06); and Kenan-Flagler ethics professor Bob Adler in “Community Venture Investing” on Aug. 15. Listen

The International Society of Logistics Engineers (SOLE) presented CSE director Al Segars with their Best Paper Award for, “Building Smart Supply Chains for Agility: the Logistics Matrix,” which looks at logistics from both a forward and reverse perspective—a method being used by the Navy and Army Material Command as well as Dell and Apple Computer.

An innovative new UNC program supports social entrepreneurship on campus; undergraduate students can apply for admittance in the Social Justice Entrepreneurship Incubator, which provides financial, academic, and networking support to the student projects.

Jim Johnson’s Center for Urban Investment Strategies held its second Entrepreneurship Boot Camp in July, bringing together 40 entrepreneurs, faculty scholars, and guests from across the nation to discuss leading research in entrepreneurship in an effort to promote minority and women’s entrepreneurship.

CSE director Al Segars will speak about “Strategic Change through Technology and Business Innovation” at the upcoming Society of Human Resource Management conference in New York City (Oct. 26-28).

John Edwards, director of the UNC School of Law’s Center on Poverty, Work and Opportunity was the first speaker in a new lecture series sponsored by the center that will feature faculty and national public policy experts to examine how to move more Americans out of poverty… more

Chancellor James Moeser announced plans for a proposed UNC-Chapel Hill nutrition research center that will be part of the newly announced North Carolina Research Campus in Kannapolis, NC, part of the Kannapolis community revitalization efforts… more

CSE Opportunities

The CSE, in partnership with UNC’s CIBER is offering $5,000 Faculty Grants to support leading-edge academic research in the topics of sustainable business practice. Grants are open to faculty at any university. Applications now being accepted… details and application

This Fall, UNC Kenan-Flagler Business School will be seeking an adjunct faculty member to teach on topics of sustainability and finance. Stay tuned to our website for details later this month.
Whirlpool Corp., Colgate-Palmolive, DaimlerChrysler and Goldman Sachs are among the new additions to the Dow Jones Sustainability Index (DJSI World); results of the 2005 DJSI Review were announced on Sept. 7… more

This month, the DJSI also launches two new indexes: DJSI United States and DJSI North America…. more

Wal-Mart opened its first "green" store in July—a 206,000-square-foot building including features such as a 120-foot tall wind turbine and a rainwater harvesting pond for irrigation… more

The 5th International SAM/SPG Sustainability Leadership Awards were presented on Sept. 8 to Lars Rebien Sørensen, CEO of Novo Nordisk (Denmark) and Bob Welsh, CEO of VicSuper (Australia)… more

Ashoka announced a new competition to recognize global "Market-Based Strategies that Benefit Low-Income Communities”… more

Toyota, Matsushita Electric, and Hitachi were among the winners of the Global 100 Eco-Tech awards presented at the 2005 World Expo in Aichi, Japan… more winners … The expo, which showcases advanced technologies for transportation, communications, buildings and more around the theme of “Nature’s Wisdom” will conclude on Sept. 25…. more

Related: The next World Expo is planned for Zaragoza, Spain in 2008 around the theme of "water and sustainable development”… more

The Ethical Corporation conference, “The New Role for Business in Developing Countries,” will be held in London on Oct. 18-19… more

John Deere & Co. announced plans to invest up to $60 million in wind energy projects in the U.S. by the end of 2005… more

The American Stock Exchange has begun publishing the Palisades Water Index, a new index of publicly traded companies that stand to benefit from the burgeoning global demand for safe drinking water… more

Companies can now apply for “Cradle to Cradle Product Certification” as a means to differentiate products based on their environmental/human health implications… more

Bank of the West announced that it would boost its community support to offer $75 billion in loans, investments, contributions and services to help improve the economic health of the communities it serves…. more

Shell has set up a new fund to pay U.K. small businesses up to £40,000 for innovative, commercially viable projects to reduce greenhouse gas emissions… more

Brooklyn Bridge is now accepting nominees for the 2005 TBLI (Triple Bottom Line Investing) Award, to be given to an organization whose efforts further the cause of sustainable investment… more

On Sept. 15, Brazil announced the launch of the region’s first carbon credit market in cooperation with the Brazilian Stock Exchange… more

The Business for Social Responsibility (BSR) Annual Conference will happen Nov. 1-4 in Washington, DC… more

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