Mapping the Global Energy System using Wikis, Open Sources, WWW, and Google Earth

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We are increasingly being challenged by problems that have a number of characteristics in common. Examples of such challenges include access to modern energy (electric power and fuels) by the global population, environment, water resources, global climate change, pandemics, public health, terrorist networks, proliferation of nuclear materials, etc.. These problems are

1) Global in scope and impact, and their solution will require cooperation and possibly sacrifices in lifestyles and consumption.
2) They have very strong social, political, economic, technology, resource and environmental drivers.
3) Information on these systems is fragmented, hard to validate, evolving, incomplete, often proprietary and often misleading in direct or subtle ways.
4) They require continuous monitoring for many different parameters (ubiquitous sensing)
5) They require input from, and expertise in, many different disciplines to even comprehend, leave alone allow experts to plan sensibly or to develop ñsolutionsò.
6) Public participation and buy in is essential for rapid transformation. Thus, there is extreme need for transparency along with a firm commitment to common good.
7) Major breakthroughs in technology are required for a technological solution (economy of scale and/or improvements in efficiency will not lead to a significant solution)
8) There is urgency in addressing these challenges as the consequences and impacts could be extreme, highly disruptive and destabilizing and because we donôt yet know where the thresholds for runaway scenarios in such complex systems are.
9) It is not possible to do large scale controlled experiments to learn from.

The questions are: how does one even begin to assemble the vast body of data needed to analyze these challenges, convert this data into a form that makes storage, retrieval and analysis possible and efficient, inform and educate the public, and extract knowledge that will facilitate enlightened decision making? How would one pay for the cost of such an effort?

We believe that by leveraging the many advances in a number of fields (modeling and simulations, computer science and systems analysis), technologies (digital communications, sensor development, computer hardware and software) and software tools (worldwide web, Google, Google Earth, Wikipedia) we are now at a stage to begin to assemble a ubiquitous monitoring system that utilizes and combines the information obtained from open sources, people and sensors. Such a system has the inherent feature that it can be applied to a number of the above stated challenges.

The task at hand is enormously complex and gigantic. Even to contemplate how to approach the problem can be an overwhelming and numbing experience. It is our contention that, in spite of the enormity, complexity and the many hurdles, the revolutions in computational speed, ability to store and access terabytes of data by even individual desktop computers, digitally enabled and connected people, phones, laptops, personal computers, remote sensors, and fast evolving software tools have brought us to a point where we can start to develop ubiquitous systems that, over time, will grow in

capability, resolution and fidelity. We also show how such systems could be assembled with a reasonable budget using public participation and open software tools.

In the proposed talk we will describe this larger project using the already established global energy system mapping as a prototypical example. The project will

1) Geospatially map the existing global energy infrastructure (fuels, power generation, and transmission grid) and display the multi-sector data as layers using Google Earth. The data will also be time stamped for combined spatial-temporal analysis. Most of these data exist in public domain and can be assembled in one place with modest effort.
2) Connect the different sectors (from energy sources to useful forms like electricity and liquid fuels) to create a realistic representation of the interacting network at multiple scales of resolution. Different sectors will be maintained as a cross-referenced library and displayed as layers on Google Earth, a software tool utilizing satellite imagery for geo-spatial reference, which is available for free and has a built in feature of resolution at multiple scales.
3) Partner with agencies that can provide geo-spatially referenced data/maps of population, economic activity, energy demand, environmental impact and their rates of change that can be layered with the energy infrastructure data.
4) Engage the global population that is connected to the internet by making the data available in the public domain and encouraging them to become partners in completing/updating data. Engage the public and experts by providing simple tools to manipulate and visualize this data. Build and maintain the data as a moderated Wikipedia.
5) Develop graded layers of analysis tools to collect and collate this vast body of data, understand the system at different scales and evaluate risks, threats and lifecycle costs.
6) Engage the public and experts in developing realistic strategies for moving the system, at various scales, to carbon-neutral ones.
7) Develop an awareness and educational curriculum for schools and colleges
8) Provide a comprehensive tool to policy makers and planners for making informed decisions that have long-term viability.

We will also discuss many challenges to building and maintaining this system

1) Motivating people to provide data, analysis tools and models. To achieve this we believe transparency, constant endeavor to provide high quality data and analysis, and adherence to shared fate are essential.
2) Inexpensive sensors for detection of a variety of chemical, biological, radiological signals.
3) Developing automated tools to annotate and store data (convert data to metadata)
4) Developing automated tools to verify and validate data
5) Coupling data and model libraries for efficient multi-sector analysis
6) Engaging experts and building consensus.
7) Developing models that increasingly incorporate multi-sector drivers and their feedbacks faithfully.