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A New Energy Ecosystem

Securing sustainable sources of energy for a growing world population is one of the most pressing challenges of the century. Significant research and development dollars are currently being expended on developing renewable sources of energy. One new opportunity for addressing the energy challenge is to view our communities and businesses as energy ecosystems in which each calorie of energy that is spent can be maximized, always keeping an eye towards waste reduction.

The move to a new energy ecosystem is being driven by a new, interdisciplinary field called industry ecology that looks at the sustainable combination of the environment, economy and technology. A number of new eco-industrial parks using industrial ecology as a founding principal have been built in Europe and the United States to spur the concept of environmentally sustainable development. These parks intentionally link industries together into a complex ecosystem in which the waste from one industry becomes the input for another.

An example of industrial ecology in action is the Danish town of Kalundborg. At the nucleus of a series of interconnected industrial businesses sits the town's 1,500 mega-watt power plant. Surplus heat from the plant powers nearby homes and businesses. Steam from the power plant is also used by a nearby pharmaceuticals and chemical enzymes manufactory whose leftover waste is used a fertilizer in nearby farms. In addition, waste from the plant's sulfur dioxide scrubber is used by a local wallboard manufacturer while its waste fly ash and clinker are used to produce cement and road materials.
On the global scale, a great contribution to meeting the energy challenges of the future might be in integrating three industries that have previously operated in isolation: construction, transportation and electricity storage/transmission. For example, General Motors is researching plug-in electric hybrid cars and, if it survives the current credit crisis, could have a vehicle on the market as early as 2011. The Chevy Volt is expected to run on electricity power alone for up to 40 miles at which point it can then switch over to gasoline power for extended range. The car's electric battery can be recharged using a standard electricity outlet.

A key component of this new, expanded energy ecosystem is a smart power grid that allows fast, two way communications between energy producers and users. Consumers could then use computer systems in their home and cars to refuel their cars when electricity is cheap and sell power back to the grid during peak hours when demand is high. Businesses and consumers would also see a tangible, immediate return on investments for installing solar and wind systems into their buildings. The end result is a much more robust power system that works efficiently and integrates alternative energy sources.

ASME
SETTING THE STANDARD

One of the advantages of looking at energy expenditure as part of a complex ecosystem is that it does not require radically new technologies. For example, the technologies linked together in Kalunberg were not radically new. Rather, what was new was the application of existing technologies and methods in new and innovative ways. It's important to note that most of the technologies needed to create a new energy ecosystem - connecting cars, buildings and the electricity grid - already exist on the market or will be on the market within five years. What is needed now to move forward is collaboration across industries, policies that support the re-use of waste, a systems approach to solving problems and a change in mindset regarding innovation.

Creating a new energy ecosystem can also spark a sustainable source of economic development. Integrating what many consider "old" industries can increase efficiency and reduce costs. Investment in a new smart energy grid and alternative sources of power can provide good jobs while supporting a transition to plug-in hybrids. Increased energy efficiency from these changes provides ecological benefits to local communities, lowers greenhouse gas emissions and reduces dependence on oil and natural gas. Reducing the use of oil and natural gas in cars and for electricity generation leaves a larger share for machines such as construction equipment, semi trucks,

ASME Implications

Mechanical engineers are a vital part of the energy ecosystems of the future. They are key innovators for vehicles, energy generation, energy transmission, energy storage, heating and air conditioning, and other technologies. Mechanical engineers also have the technical knowledge and problem solving skills needed for integrating technologies into complex systems. Problem solving and systems skills will be incredibly important as each ecosystem will have different industries and unique challenges requiring unique solutions.

Mechanical engineers are uniquely positioned for a future of greater integration among industries. However, there will be important changes that will be required in education and professional training: mechanical engineers will need a strong education in complex systems, a strong foundation in other disciplines and the soft skills needed to collaborate effectively with colleagues in other industries (see also the May 2007 Strategic Issues and Trends Brief on Systems Engineering for more information).

ASME can work with its partners to encourage and develop curriculum for engineers that teach complex systems and define the standards needed for creating energy ecosystems. ASME and partner organizations can also play an important role in advocating for policies at the federal and state level that encourage the development and integration of technologies. The concept of creating energy ecosystems can also provide an opportunity for ASME to reach out to young engineers with educational products and programs around an issue of concern to them.

By taking a lead in this area, ASME can help meet the following strategic objectives:

- Better serve our core customers (C1)
- Secure, serve and incorporate emerging markets and technologies (C2)
- Develop new and expanded market relevant content (I2)
- Provide effective representation and advocacy for the engineering profession (I3)
- Create a volunteer-staff partnership that embodies innovation and diversity (L1)