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Bounding Energy Prices

A proposal to develop economic/policy analysis capability to control energy prices

Challenge

Gain understanding of how, when, and where DOE investment can have desired impact on U.S. energy prices.

Approach

The price of energy fluctuates over time due to numerous variables as indicated in Figure 1. Both technology and policy can be used to constrain the price fluctuations with technology providing an upper bound while policy provides the lower bound. For example, technology that makes energy more efficient or more accessible can control upper bounds, while policy can be used to set a price floor. At each point in time, the energy price shown in Figure 1 is the resulting equilibrium between demand and supply (Figure 2). Again, technology and policy bound the energy price.

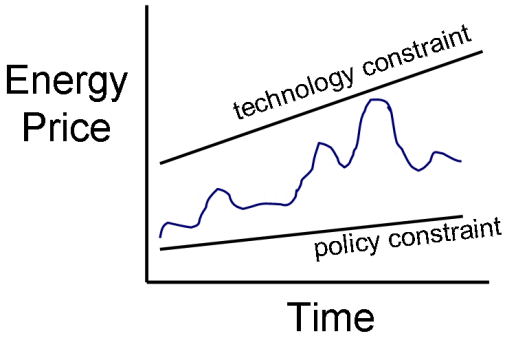

Figure 1. Energy price bounded by technology and policy constraints

Unfortunately, the behaviors of these price constraints are not precisely known. Existing models do not have the capability to accurately predict the current price bounds and they do not have the capability to offer insight as to how desired results may be achieved. Rather, they may be based on historically-based time trends projected into the future rather than a systems assessment that dynamically addresses future scenarios. (e.g., NEMS)

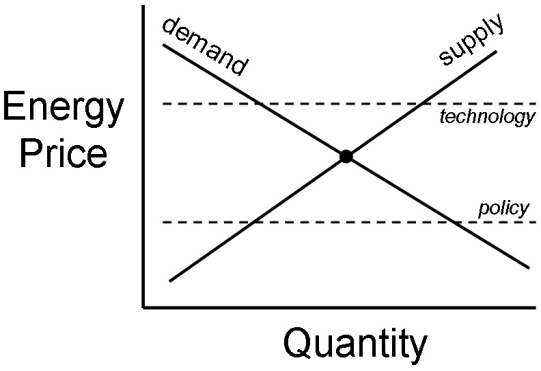

Figure 2. Equilibrium of demand and supply

A new approach is needed to provide insight with regards to how DOE R&D investment dollars (input shaping) may be allocated to achieve desired bounds on the price of energy. This new approach must answer questions relating to how much control DOE investment policy has with respect to energy price, what impacts various investment options have on energy price, and whether certain investments have any effect at all.

Sandia proposes to demonstrate the modeling and analysis approach and develop this needed capability by leveraging technology developed for other research programs at Sandia. The intelligent utilization of System Dynamics and Dynamic Programming/Input Shaping may be used to answer the R&D investment questions without endless scenarios based on input-guessing. System Dynamics (SD) is a methodology for studying and managing complex feedback systems and is described in some detail. Dynamic Programming (DP) is a method for constrained optimization. To demonstrate Dynamic Programming, an example analysis is presented. This example demonstrates how the proposed approach can generate the desired solution directly – without countless iterations. Utilizing this powerful analysis approach, this proposal includes analyzing the energy price bounding problem, extending the model/analysis with respect to policy controls, and producing a software tool to automate the process.

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