Modeling the Renewable Energy Transition in the state of Vermont

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One of the most important dilemmas confronting the developed world this century is determining how to adapt our current energy infrastructure system to meet the demands of modern civilization. The energy infrastructure that enabled the unprecedented economic development of the past 75 years is increasingly ill suited to cope with decentralized and intermittent energy generation, net energy supply constraints, shifting demand dynamics, and weather volatility due to climate change. Reconceptualizing the energy system, including realizing the promise of renewable energy systems and smart grid technology and information systems, is crucial for the future development and prosperity of regions, states, and nations far beyond the state of Vermont.

Vermont has set forth an ambitious vision for the transformation of the energy system to 90% renewable energy generation (currently 23%) by 2050. Precisely how this transformation occurs is a matter of intense debate among many stakeholders, with many differing views of what long-term policy scenarios are most feasible and desirable for Vermont.

To address the need to evaluate complex policy and planning scenarios, the *Energy Futures Simulation* (EFS) system dynamics model was developed. Using input from a range of expert and non-expert stakeholders, EFS simulates the long-term dynamics of different scenarios aimed at contributing towards the energy transition. The strength of this model is that EFS incorporates interrelationships, feedbacks, and time lags related to energy prices, energy intensity, population, and economic activity. Recognizing that Vermont's energy system is a complex dynamic system, the EFS allows for the exploration and analysis of the non-linear dynamics of supply and demand at a time when the fundamental structure of this system is starting to undergo a transformation with the proliferation of decentralized renewable energy generation, the roll-out of the first wave of smart grid technology and information systems, and the escalation of energy conservation programs.