Integrated System Dynamics Model to Assess Options for Emissions Reductions Related to Energy-Water Sustainability in Sonoma County

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Sonoma County Sustainability Initiative

- County goal: reduce GHG emissions by 25% below 1990 levels by 2015 (more aggressive than CA AB32)
- Moving to C-free water system:
  - Hydroelectricity – 2.5 MW
  - Solar PV – 2 MW
  - Landfill Biogas – 6 MW
  - Wastewater geo-exchange
  - Wind
- County (Municipality) level funding capability
- County level energy aggregation
- Develop systems-level understanding of technology insertion, economics, behavior…

Carbon Free Water by 2015
The Challenge

In order to meet the goals of carbon footprint reduction outlined in AB32 and Sonoma County’s GHG reduction targets…

• Map out a course towards energy sustainability and resilience, carbon neutrality, and economic vitality, given projections of future climate change

• Define solutions to serve as an example for the state of California, the U.S., and international organizations

• Develop a web portal that will
  – build community among sustainability-minded communities in the U.S.
  – interest, inform, enlist, and retain input from Sonoma regional citizens

“Change in energy use and GHG emissions must begin with local efforts.”
Approach

- Develop an understanding of the interrelationships among important natural, built, and social systems, and ways to enhance their collective resilience
- Engage public and build community through social networking features
- Collect and analyze public ideas to inform decision making

Stakeholders: Sonoma County public, business community, environmental community, municipal and county governments, external counties and regions
Content Management System (CMS)

Example: Drupal

- Information
- Interactivity
- News feeds
- Presence & Social networking
- Content awareness
- Surveys
- Interactive models
- Data animation
- Consensus building

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User Input Analysis

Goal: provide actionable understanding of changing attitudes and priorities of site users (citizens)

Mindmap (undirected graph)

Statistics

Interactive Graphs

Tag Cloud

User comments, blogs, and survey responses can be analyzed and visualized in a variety of ways
System Dynamics Model

Investigate non-intuitive interrelationships among important systems that affect energy-water sustainability and resilience

Models energy flows and tracks CO2 emissions

- Policy selection
- Scenario comparison
- Nonlinear feedbacks
The model is designed to track the CO2 flow across sectors. In this first version of the model, we considered two CO2 emissions sources.
Model Applet embedded in web page

Users set RE and transportation policies to meet GHG emissions reduction goals

Next steps:
• Capture user ideas via mini-survey
• Capture model state
Demonstration
RE Pilot Project

**Microgrids** - identify neighborhoods, business parks or other sites that can benefit from dedicated energy supply resources

Beneficial reuse of treated wastewater, wind, PV, storage in PEV fleet, biogas, combined heat and cooling, building retrofit

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**Sonoma County Water Agency Demonstration Project**

The Sonoma County Water Agency is studying the feasibility of a pilot project that would use recycled wastewater to heat and cool buildings as well as irrigate landscaping and vineyards. The network, which they believe would cut traditional natural gas and electricity use dramatically, would cost between $50 million and $70 million and be installed at the Airport Business Center over the next two years. Proponents are traveling to Washington this week to seek funding for the system.

**Heat exchange**

Draws cold or warm water to maintain building temperature.

**Wastewater treatment plant**

Pump station

Water travels underground to maintain steady temperature of 55° to 60°

**Airport / Larkfield / Wikup Sanitation Zone Treatment Plant**

**Airport Business Center**

Water temperature 40° up to 150°

**Wastewater reservoirs**

Reuse of water; possible irrigation water for landscaping, vineyards and for flushing toilets.

Sources: Sonoma County Water Agency, ESRI

The Chronicle
How does the SD Model Fit In?

*Sonoma RE integration project*

- Assess and simulate RE mixes supporting required electrical demand and low-carbon emission goals
- Quantify the key factors involved in implementing a mixed renewable energy resource strategy
  - reduction of GHG emissions
  - implementation and integration of renewable sources to meet energy demand
  - increased energy efficiency to reduce demand
  - sustained economic viability and quality of life in the County
- Simulate the complex interactions between technology deployment, economics and social behavior
- Enhance web portal to help stakeholders and policy makers understand options for technology implementation.