DG and Utilities:
Sweet Spots in the Distributed Generation Grid

Energynet® High-definition
Power System Simulation

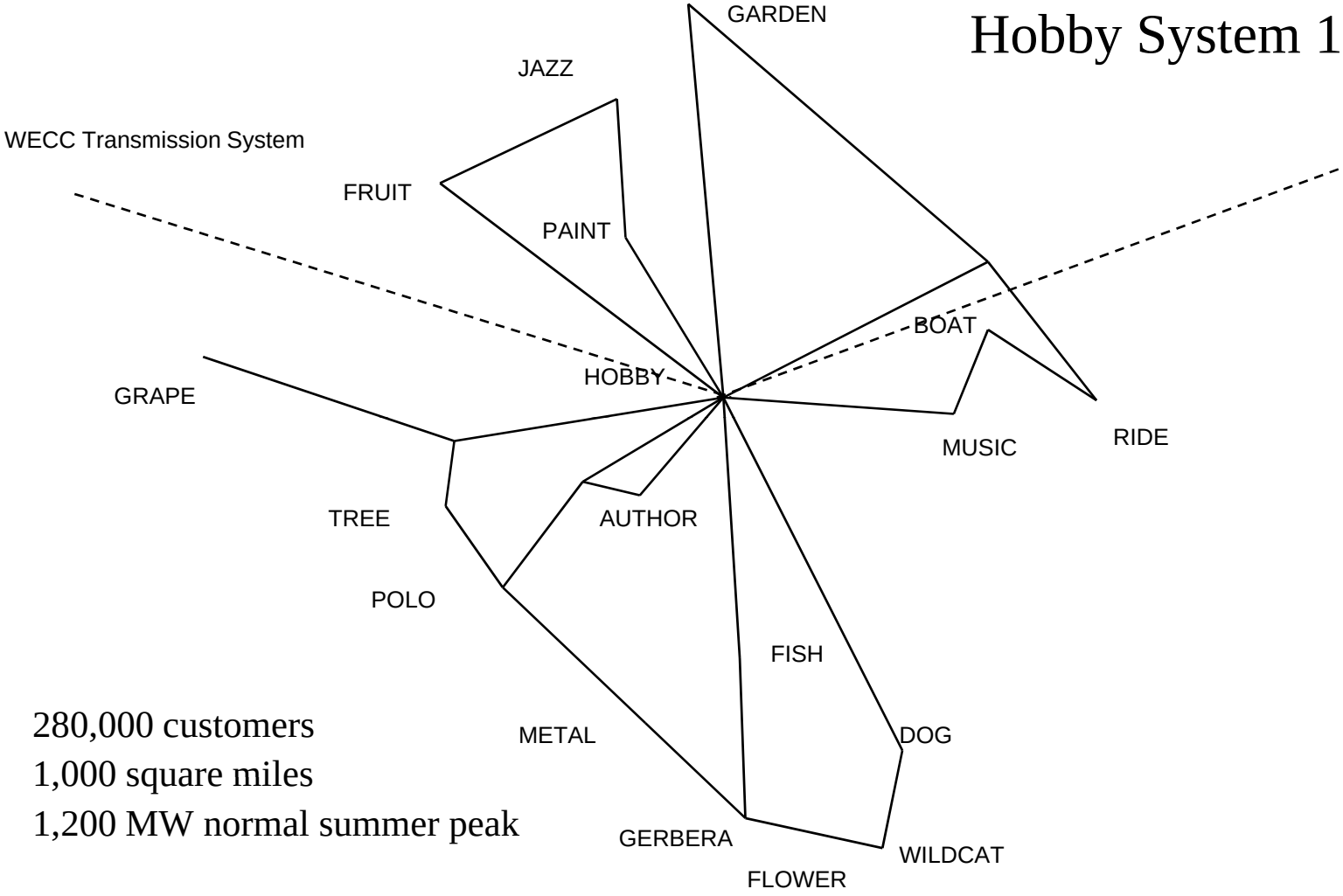
NEW POWER TECHNOLOGIES

May, 2011

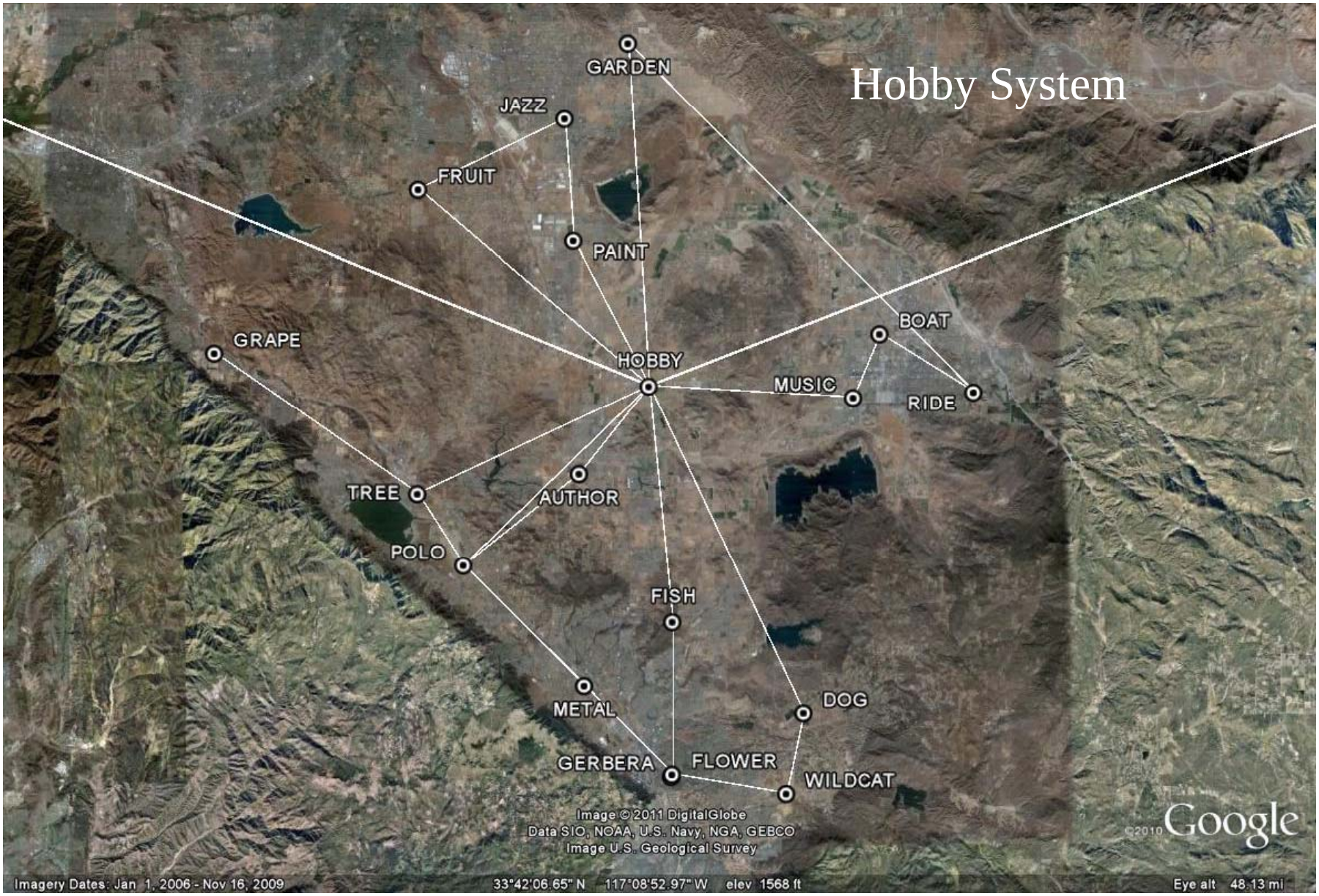
Key Questions

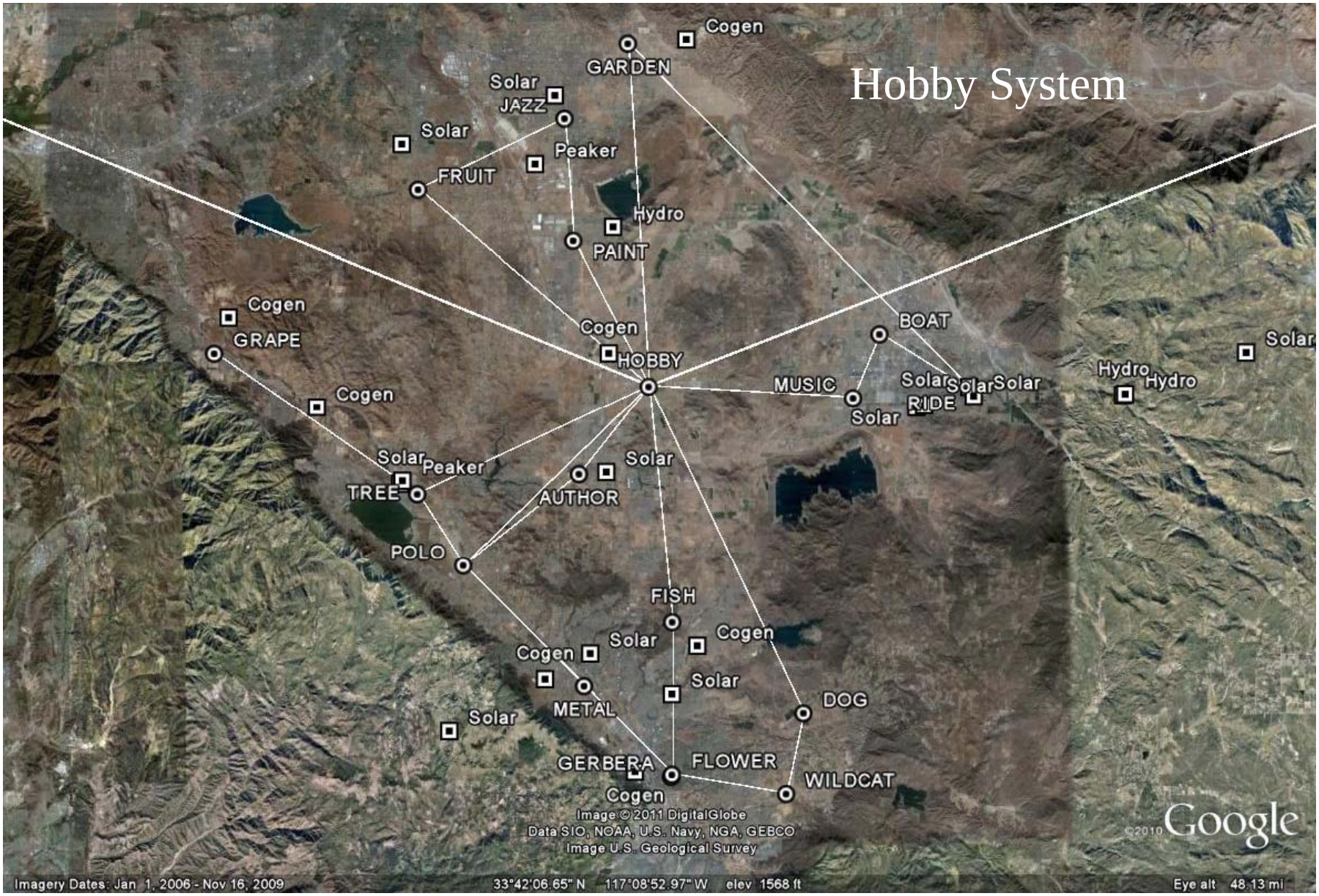
- **c. 2002: Is DG "good" or "bad" for the power delivery network?**
- **How exactly does a particular DG project affect the grid?**
- **Where can DG projects connect without the need for costly grid upgrades?**
- **Which DG projects improve grid performance?**
- **Can we rigorously value a DG project's direct benefits?**

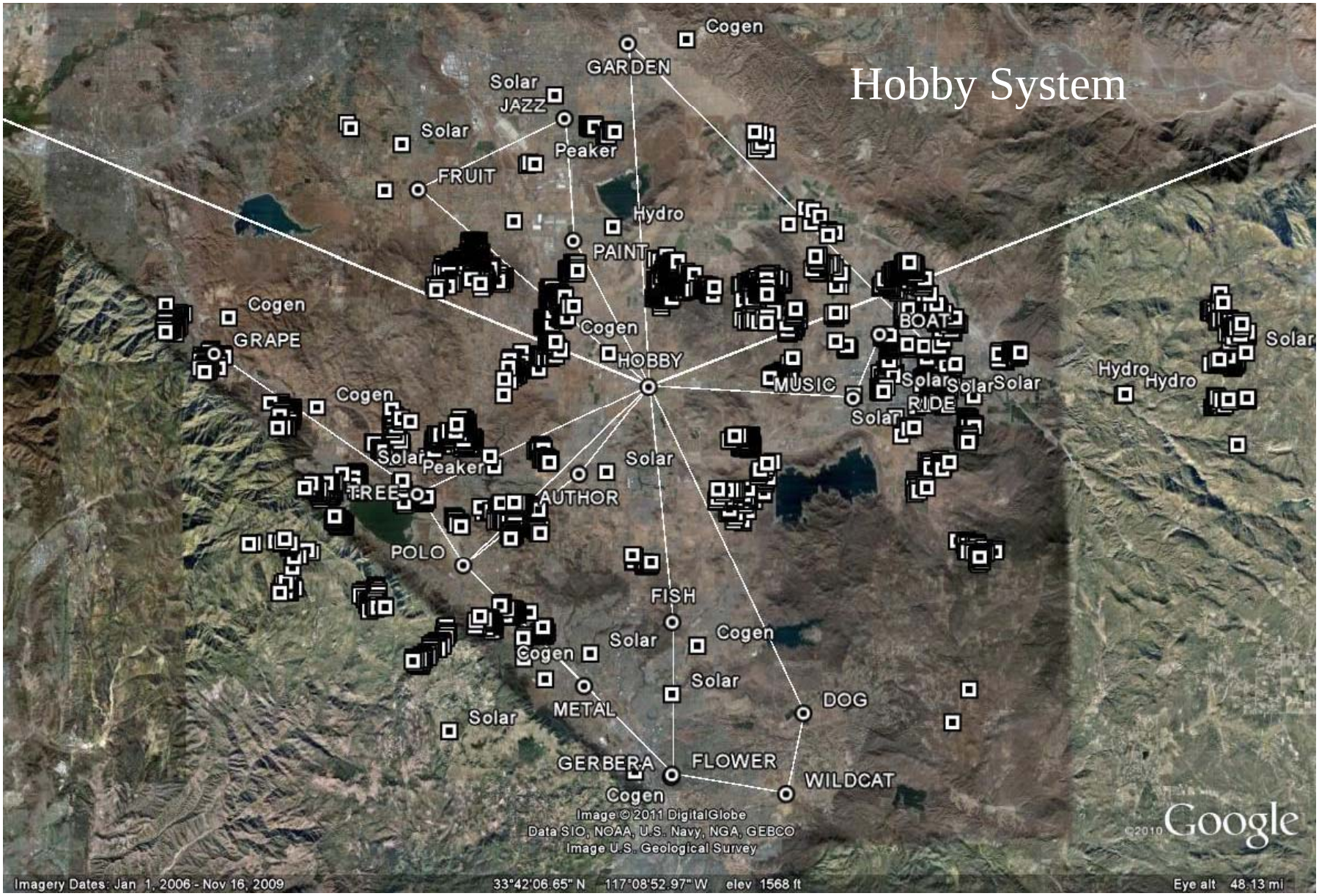
Hobby System 115 kV

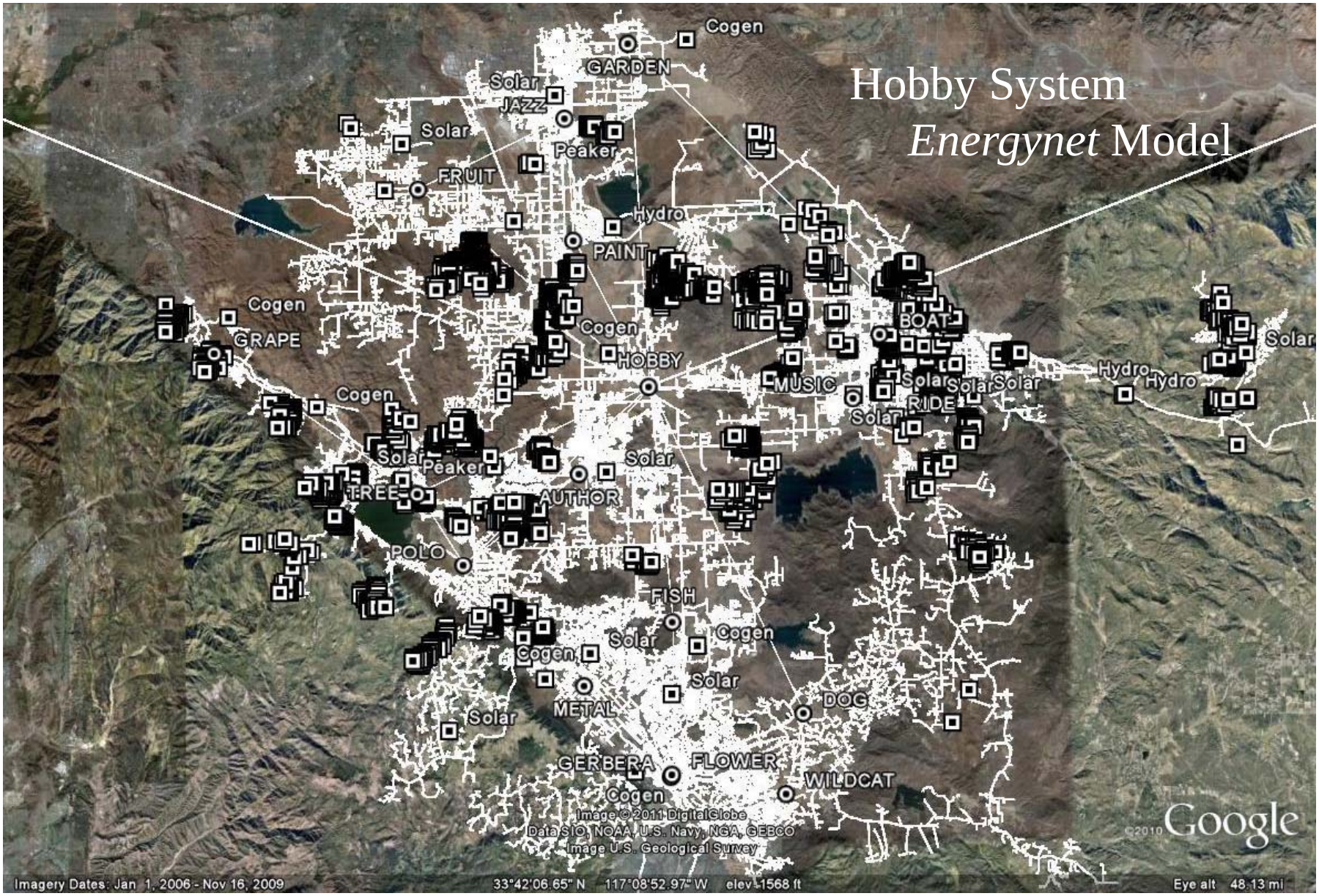


- 280,000 customers
- 1,000 square miles
- 1,200 MW normal summer peak









Key Questions

- c. 2002: Is DG “good” or “bad” for the power delivery network?
- How does a particular DG project affect the grid?
- Where can DG projects connect without the need for costly grid upgrades?
- Which DG projects improve grid performance?
- Can we rigorously value a DG project’s direct benefits?

=> Each DG project of a particular size at a particular connection point in the grid has unique impacts.

Energynet Power System Simulation

- **Area-wide simulation of an integrated transmission and distribution network**
- **Model produced and updated by software directly from routinely-maintained legacy utility data**
- **Legacy field sensor data fully-integrated**
- **Simulation results validated with field measurements**

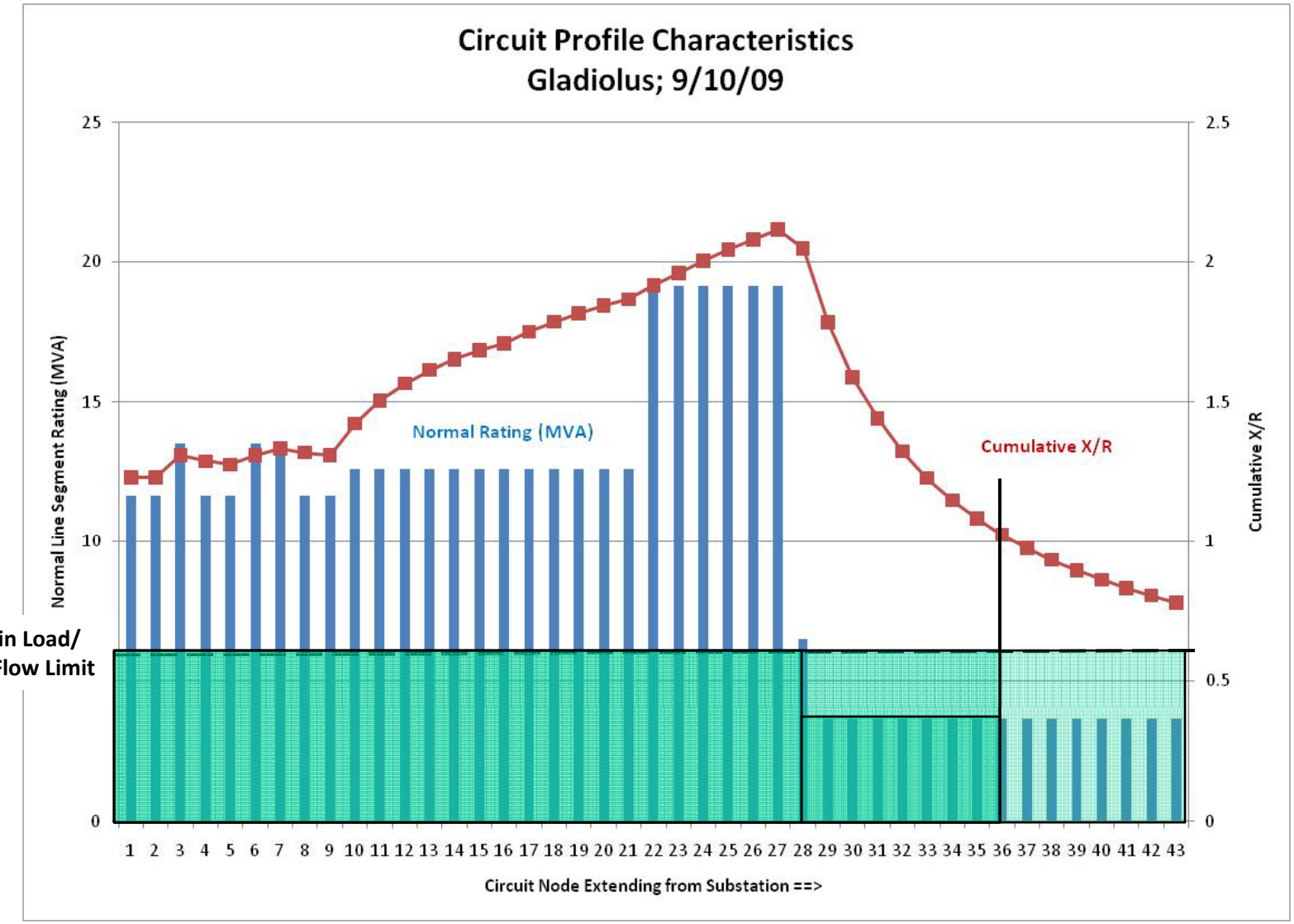
- **Assess grid conditions at any point in the network under any operating scenario**
- **View the direct impact of any change at any point in the network**

New Power Technologies, “Verification of Energynet® Methodology”, CEC 2010
http://www.energy.ca.gov/2010publications/CEC-500-2010-021/CEC-500-2010-021.PDF

DG Impact Categories

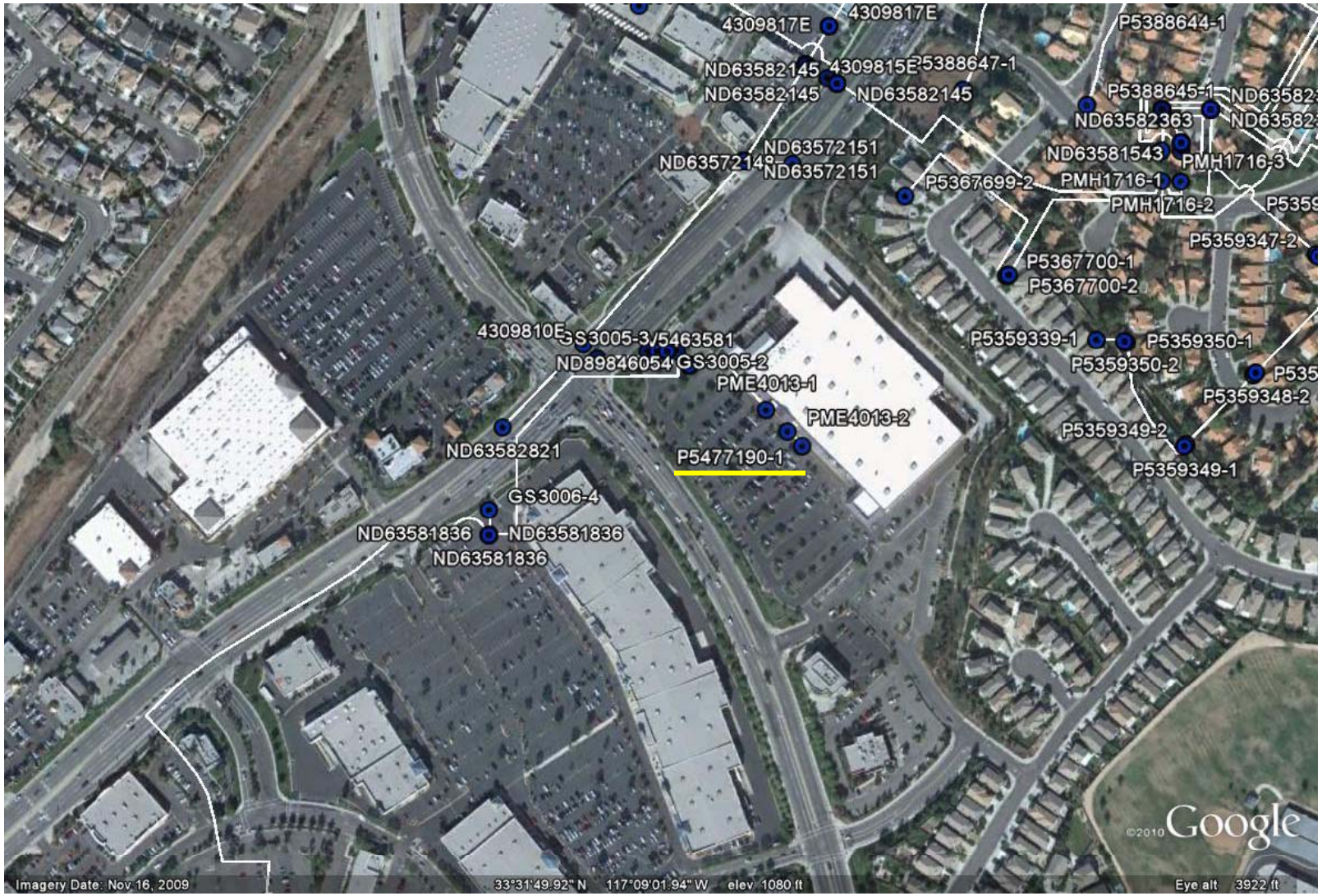
- **Energized Island**
- **Increased/Decreased Equipment Loading**
- **Fault Currents and Protection Coordination**
- **Operating Voltage Change or Variability**
- **Voltage fluctuations**

Where *within* a circuit can DG be connected with minimal impact?

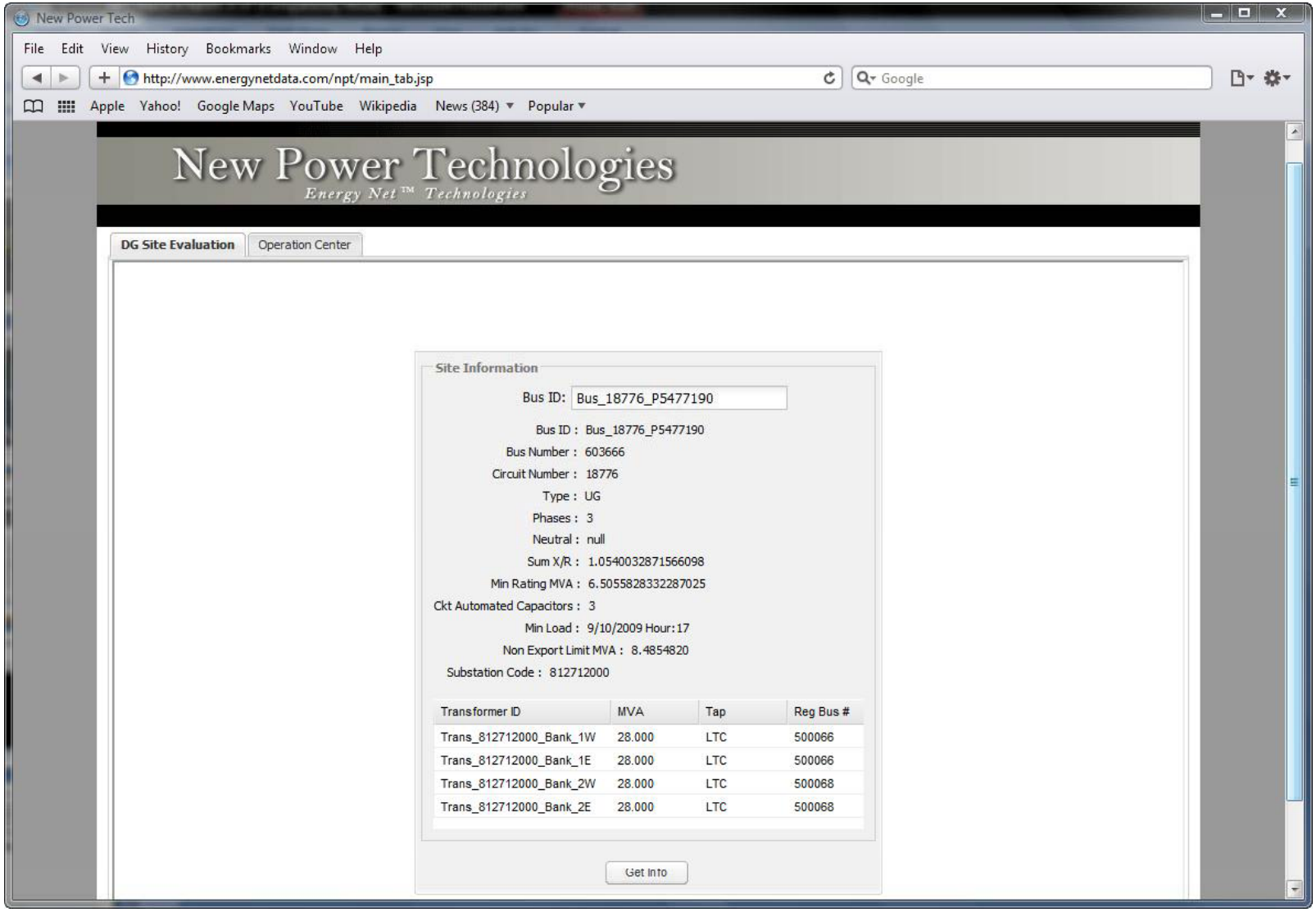


Circuit Min Load/ Reverse Flow Limit

DG Site Evaluation

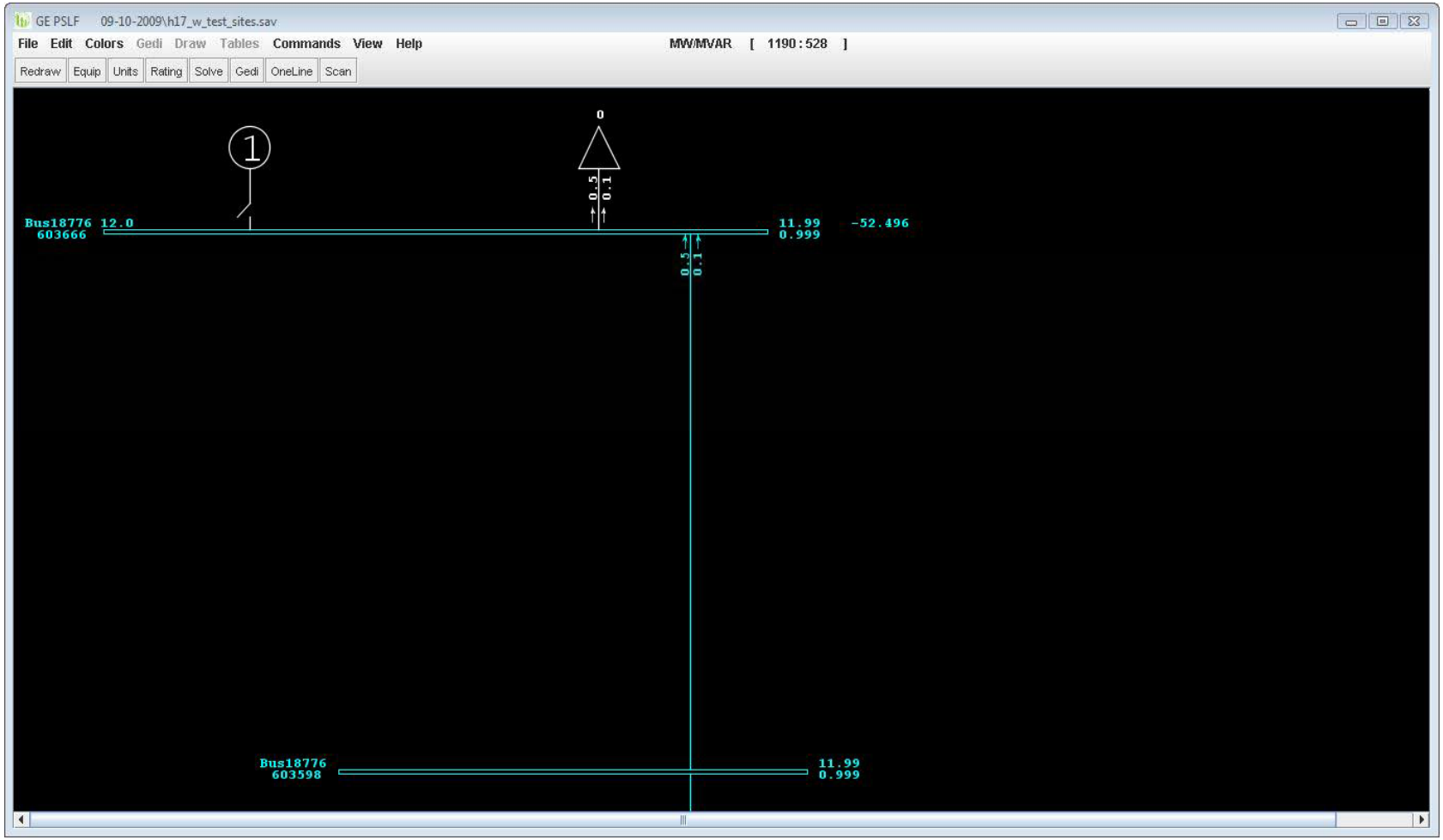


DG Site Evaluation (cont.)



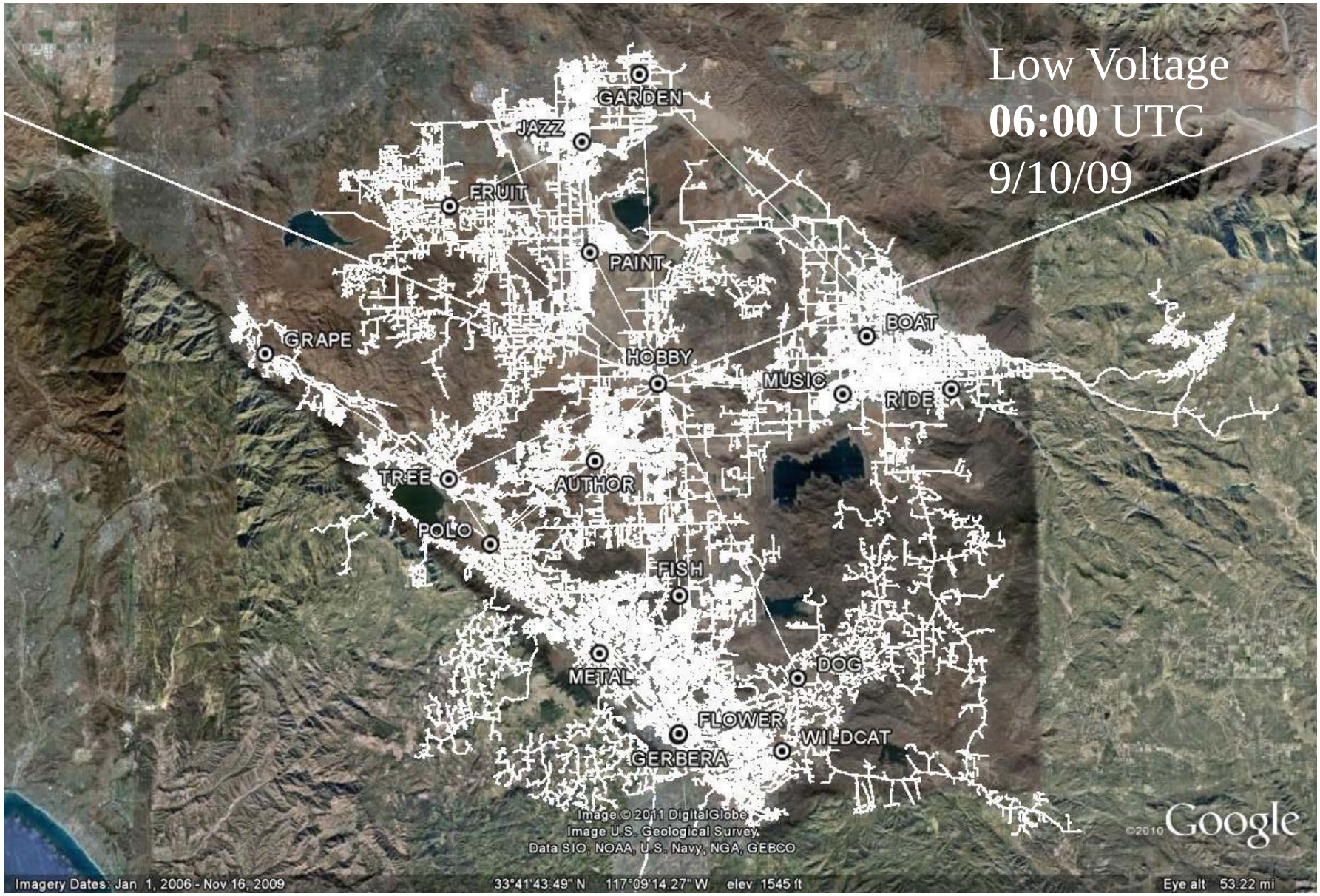
DG Site Evaluation (cont.)

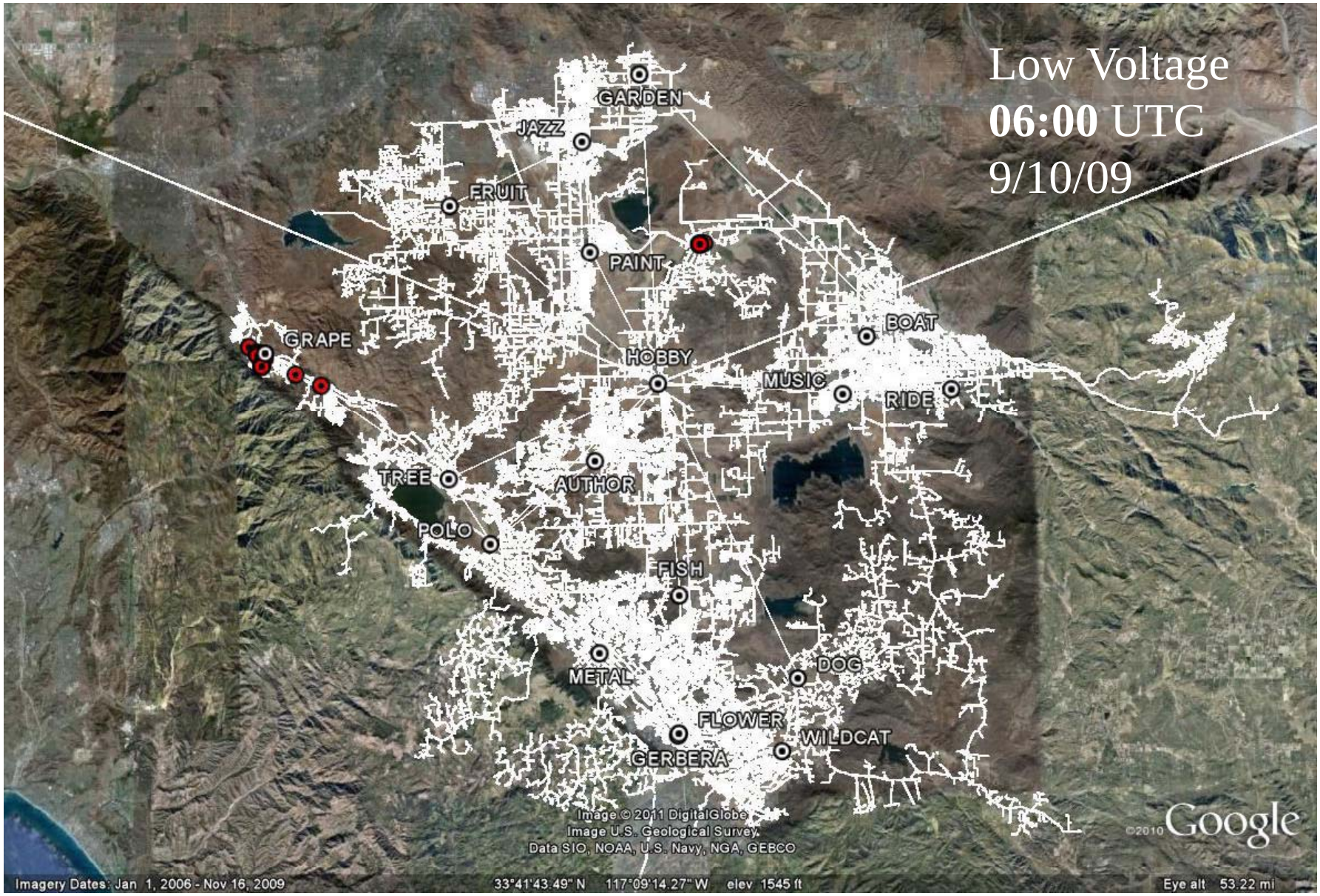
- **Direct voltage and power flow impact evaluation**

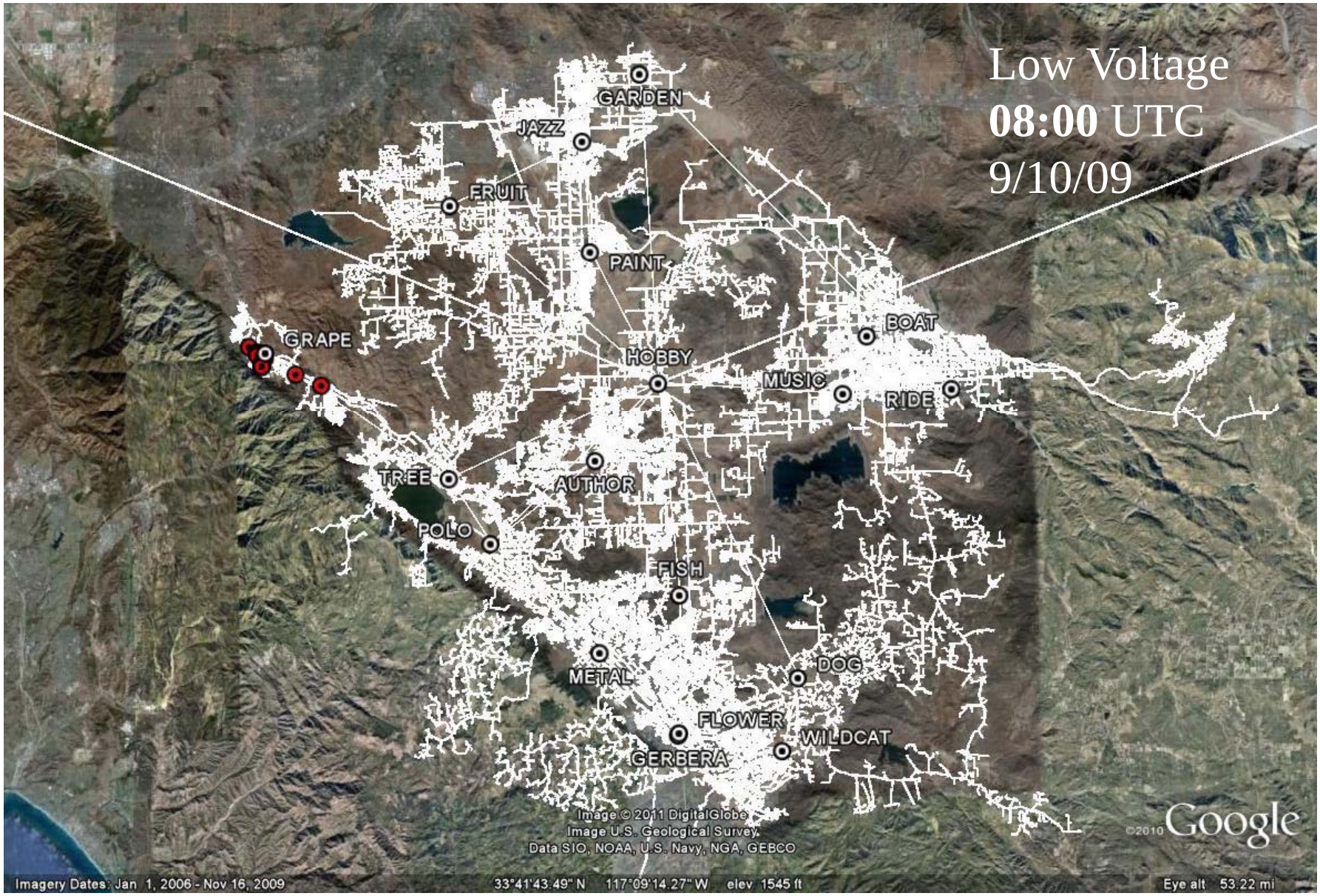


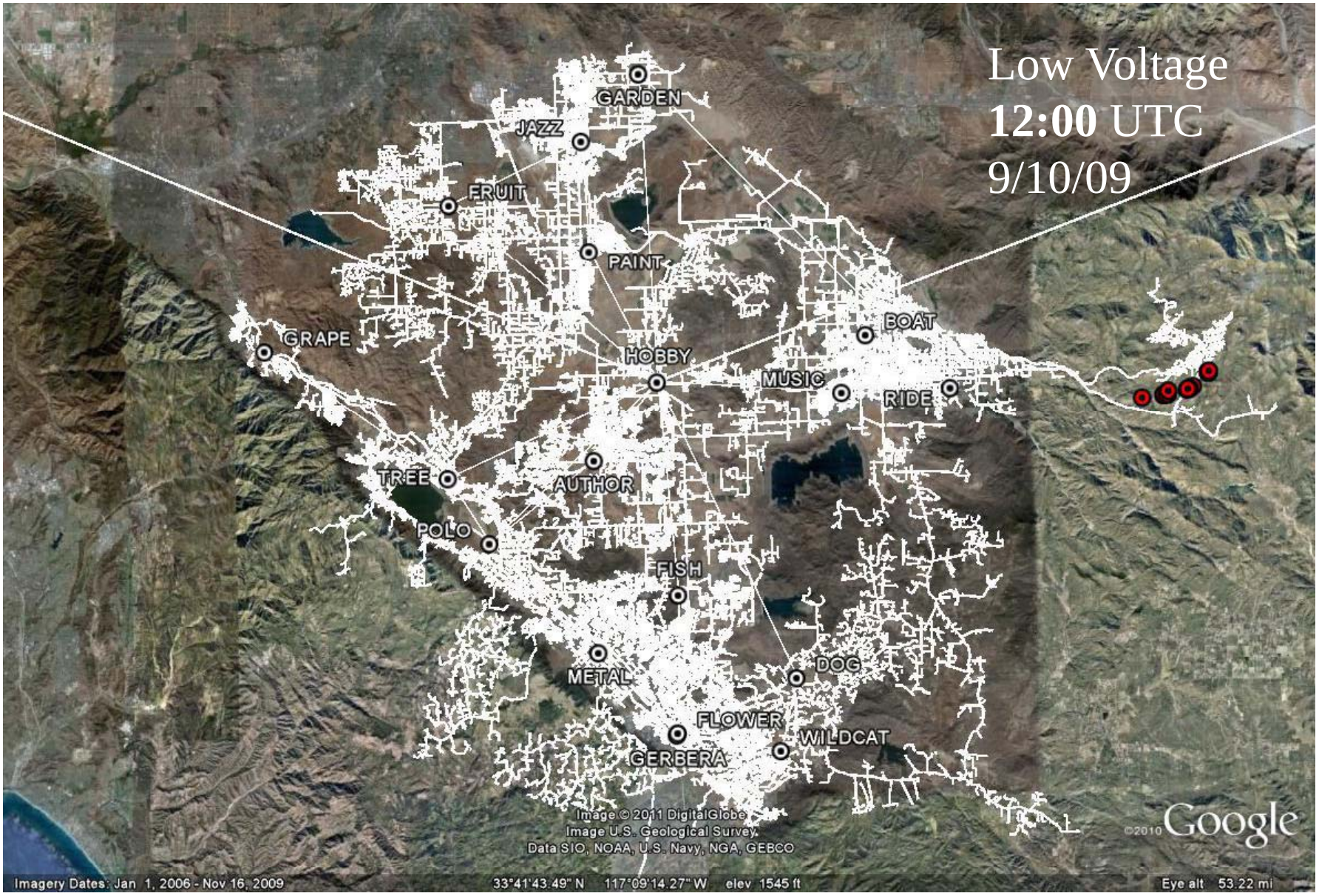
Opportunity:

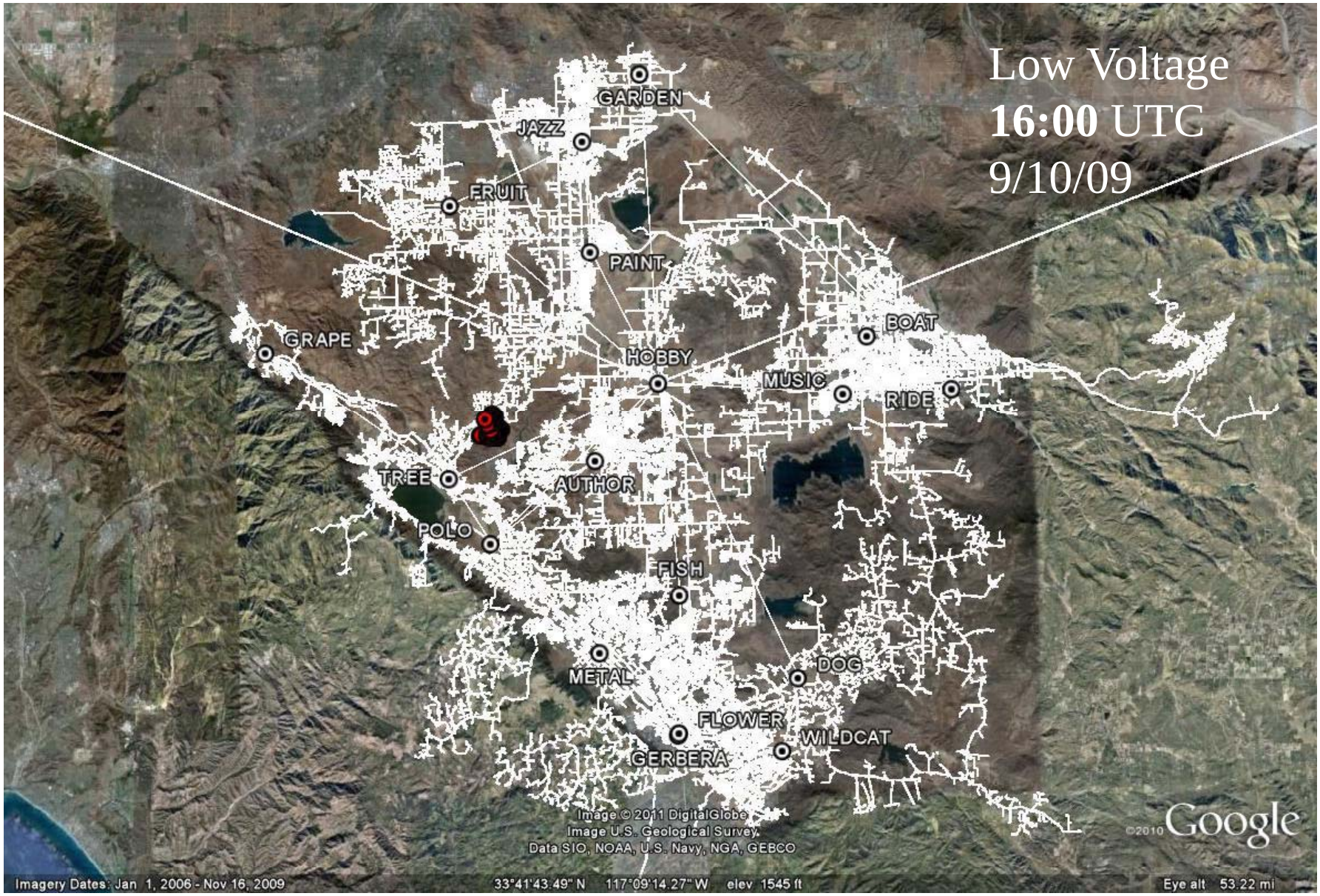
- **Sub-circuit details and hourly load variation supports better preliminary review of DG interconnections.**
- **A detailed system-wide model and appropriate analytics can identify “low-impact” DG sites throughout an entire regional power delivery system.**
- **A detailed system-wide model and appropriate applications can quickly assess the impacts of a particular DG in a particular grid location.**

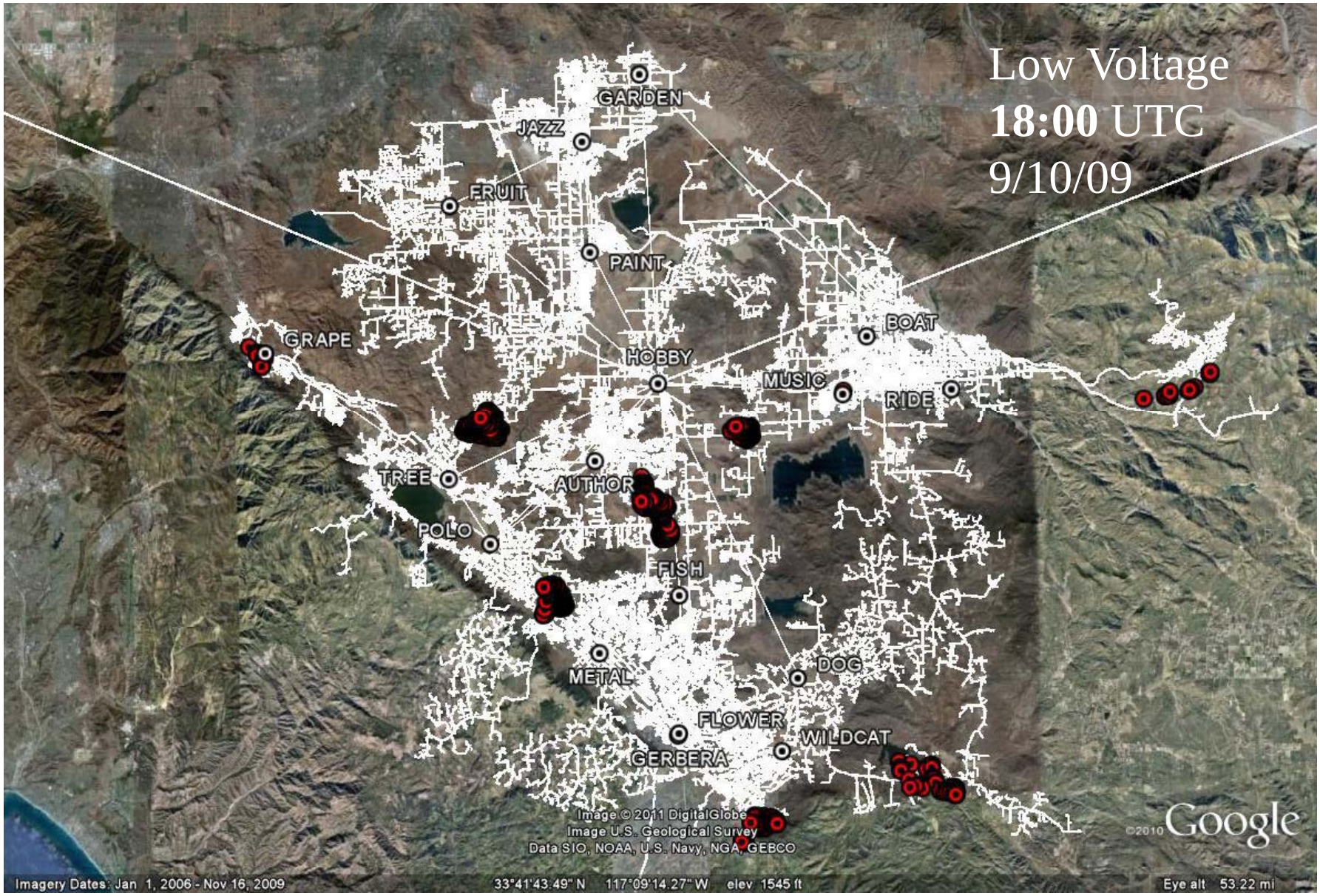


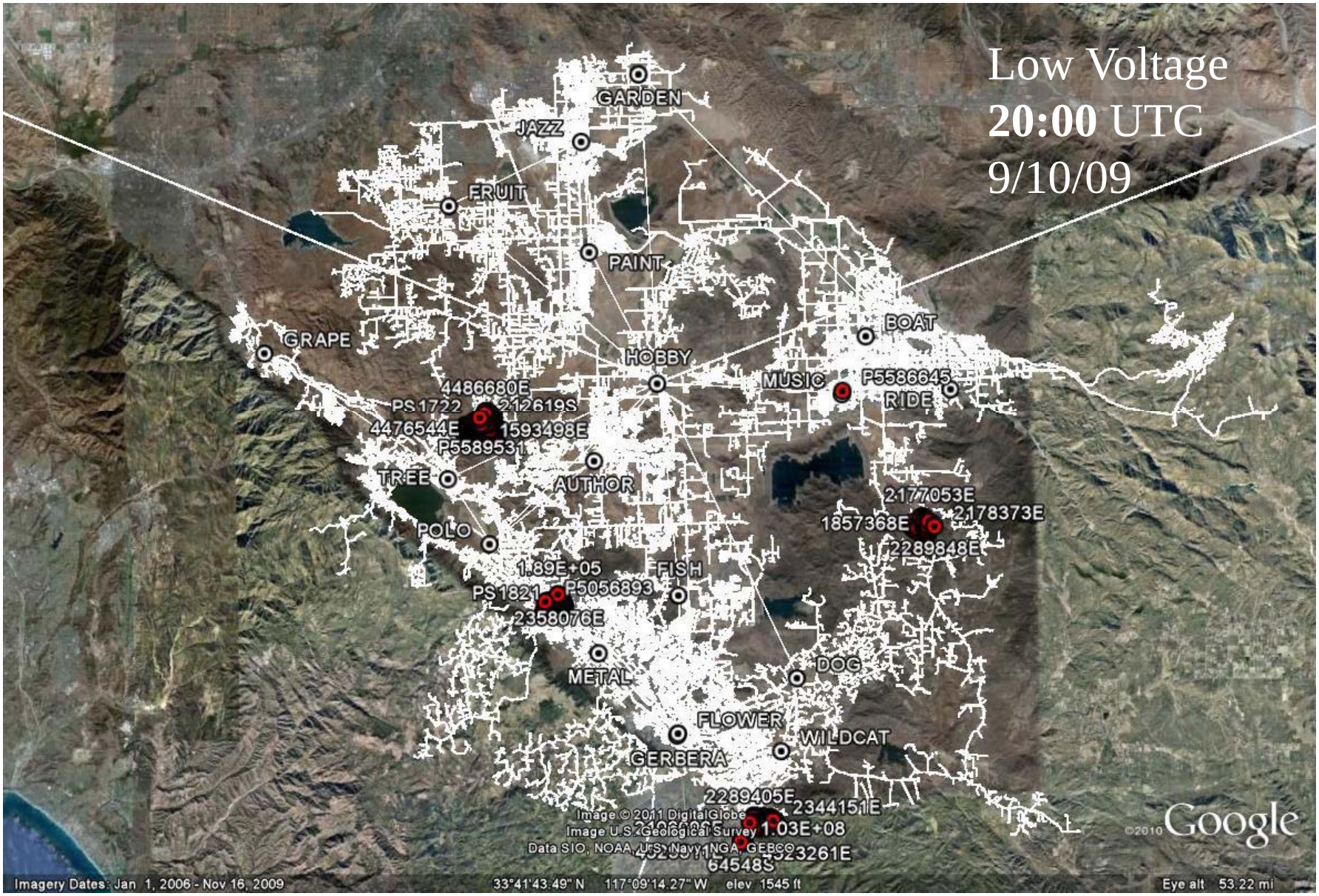


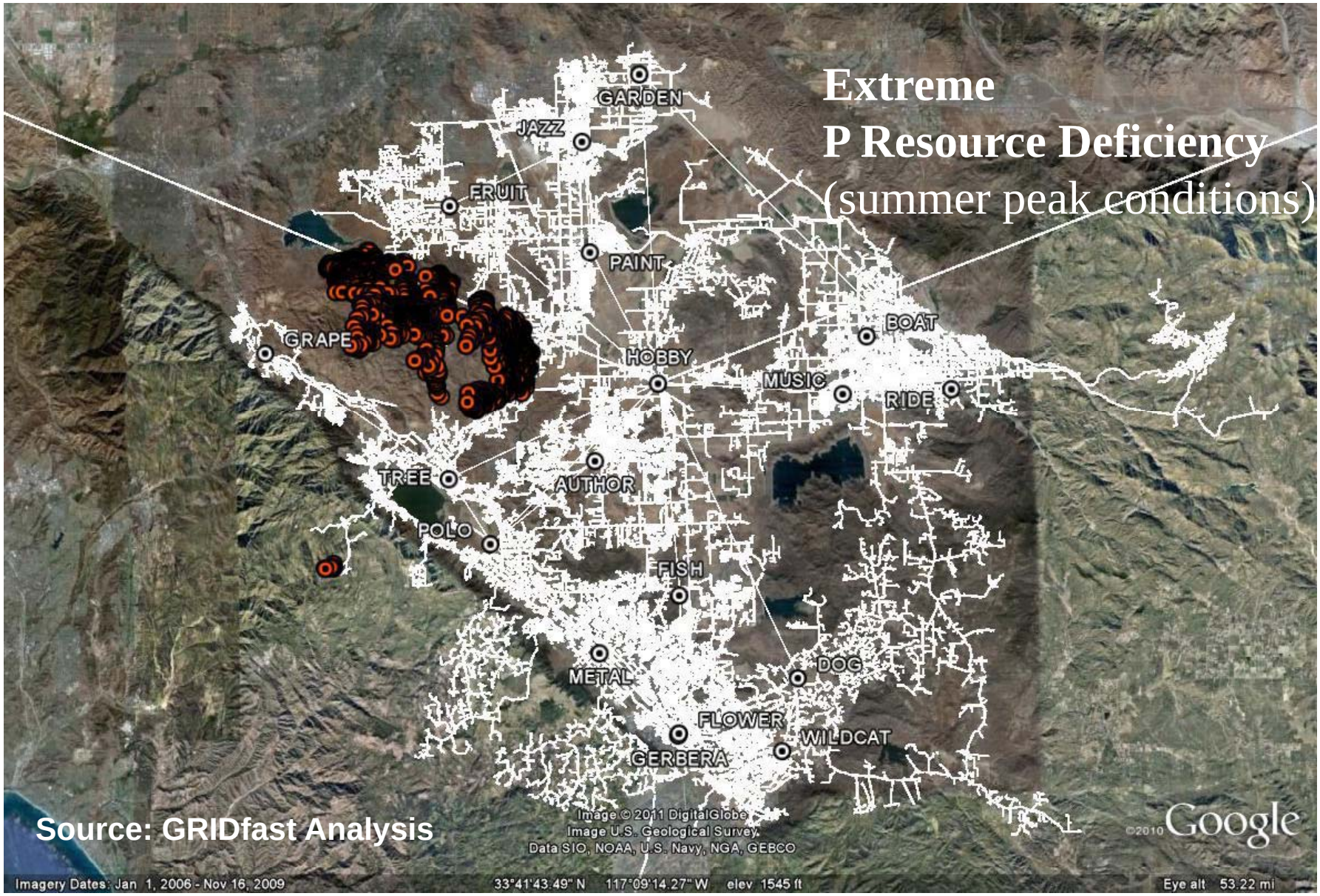




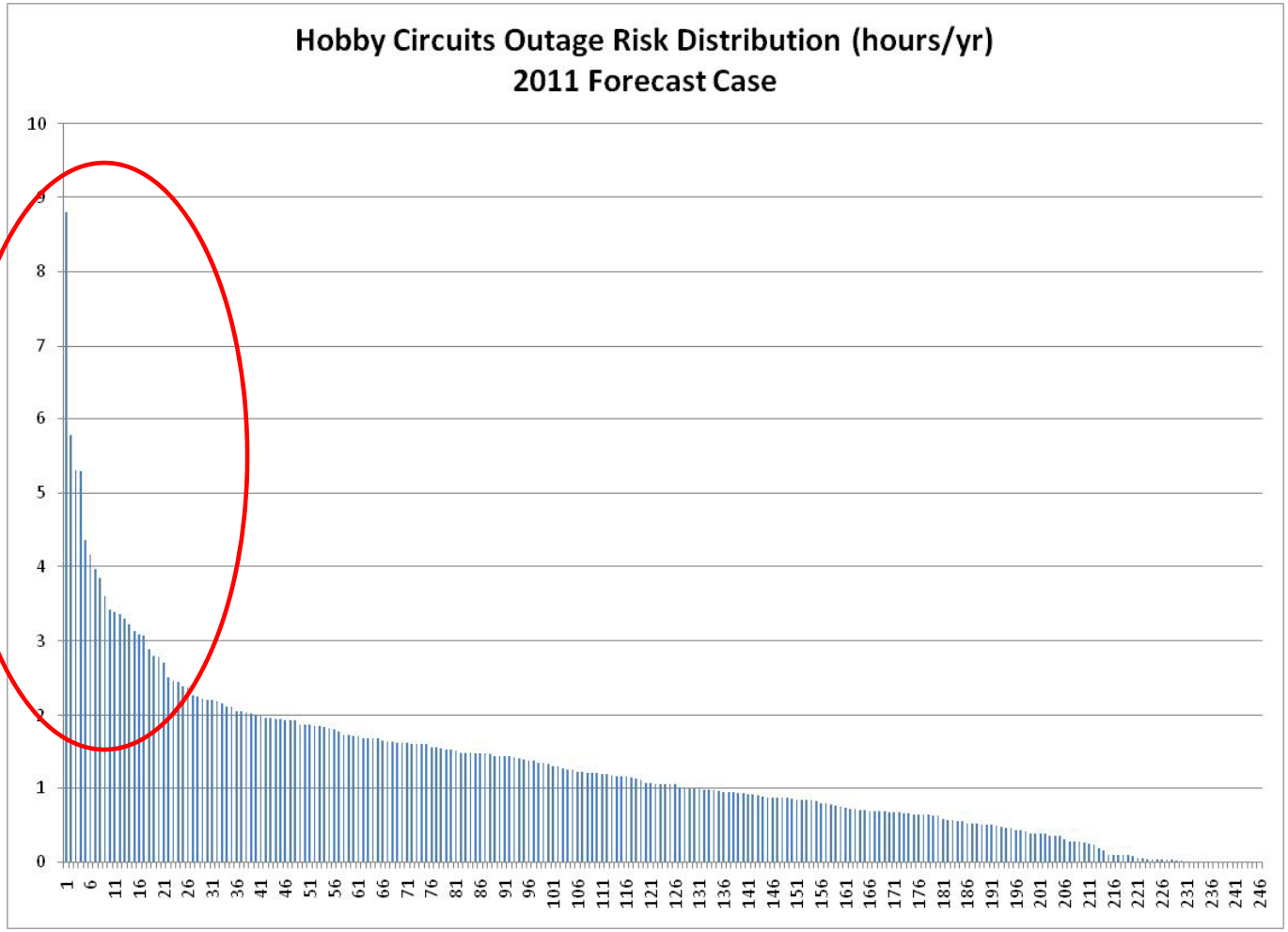








Circuit-level Reliability Assessment



Opportunity:

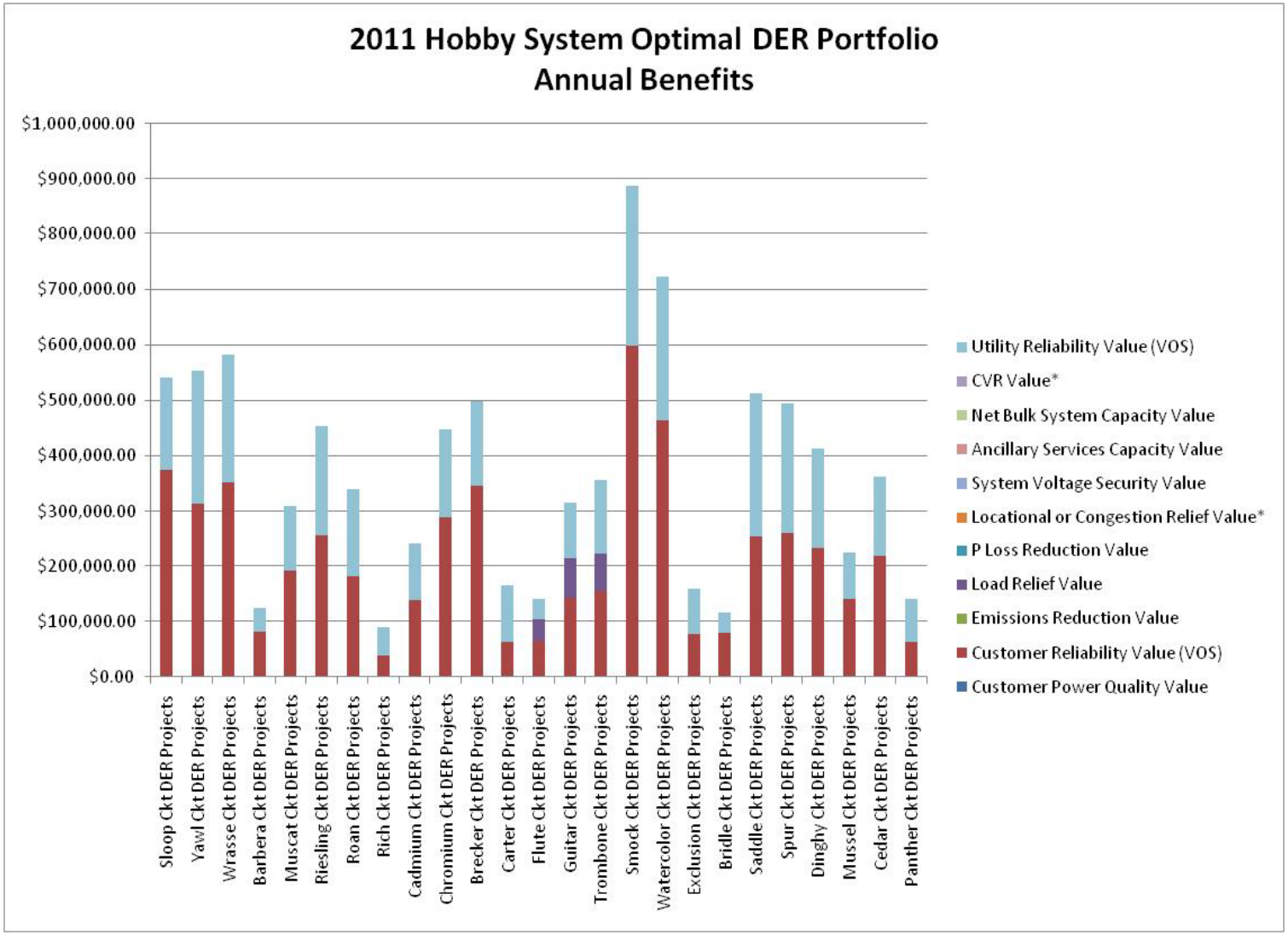
- **DG in specific grid locations can improve reliability, improve circuit voltage, and reduce losses.**
- **A detailed system-wide model and appropriate analytics can identify these projects and quantify their benefits.**

DG Benefit Categories

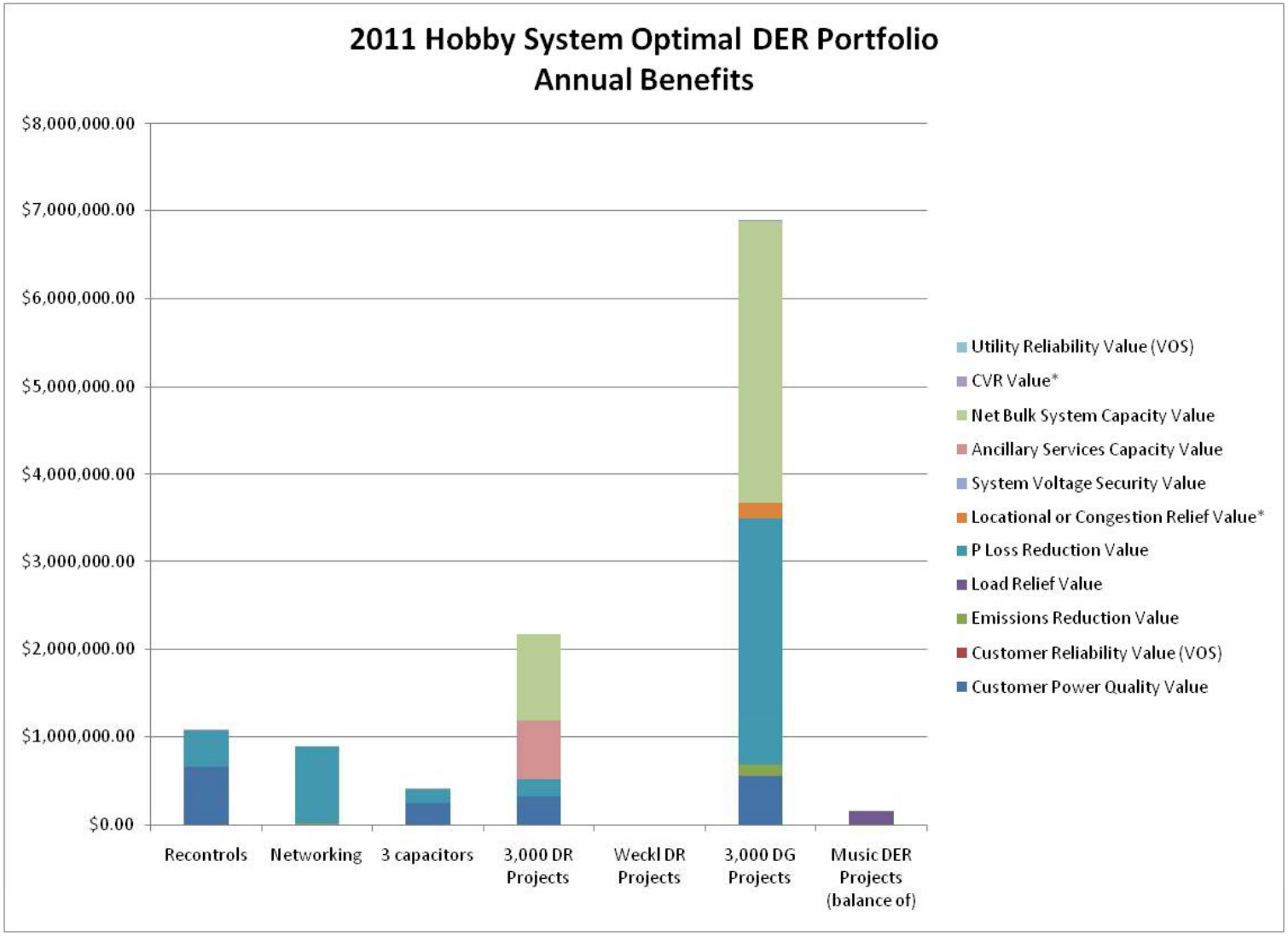
- **Reduced un-served energy (utility cost reduction)**
- **Reduced un-served energy (customer benefit)**
- **Expanded conservation voltage reduction (CVR) opportunity**
- **Reduced customer impacts from voltage variability (“power quality”)**
- **Load relief**
- **Bulk system capacity**
- **Ancillary services capacity**
- **System security capacity**
- **Congestion relief**
- **Loss reduction**
- **Emission reduction**

Adapted from:
Navigant Consulting, Inc., “Value of Distributed Energy Resources in Distribution Infrastructure, Phase II”,
US Department of Energy, October, 2008

Network Measures Evaluation



Network Measures Evaluation



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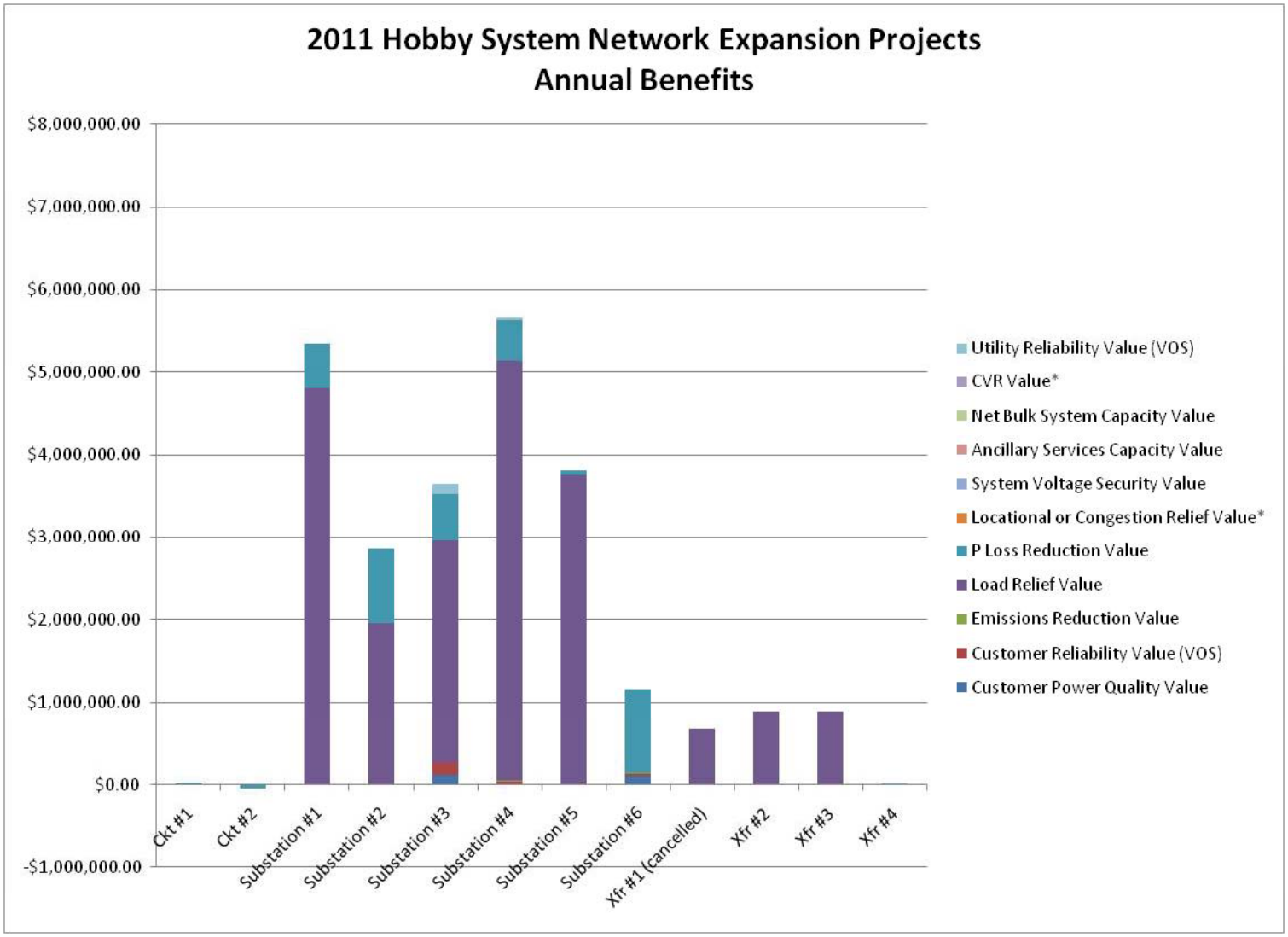

Opportunity:

- **A detailed system-wide simulation reveals the direct grid impacts of a particular DG project.**
- **The benefits of dissimilar projects can be directly compared across a common set of benefit categories.**
- **These tools can be applied to any grid investment or grid operational measure to support robust project justification.**

Conclusion: Advancing DG

- **RD&D:**
  - **Understanding and managing* the interplay between the grid and DG requires better grid visibility and improved tools.**
    - **Managing =**
      - Maximizing DG benefits
      - Minimizing adverse DG impacts
      - Accommodating DG integration efficiently and safely
  - **Leveraging legacy systems and data and ease of adoption are critical for any new methods.**
- **Policy:**
  - **DG proponents and utility customers realize most of the benefits of DG while utilities bear most of the risk.**
  - **Rigorous measures of the *direct* costs and benefits of DG enable value-sharing incentives.**

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New Power Technologies is dedicated to moving advanced energy technologies from theory to practical application. The company's *Energynet*® technologies enable power delivery network analysis and management with unprecedented transparency, precision, and ease of integration to support high-performance and high-efficiency network operation and planning.

Peter Evans, President of New Power Technologies, has extensive professional experience with electric power generation, delivery, and use, as well as power marketing, plant engineering, corporate and project finance, and energy technology commercialization, having held executive positions at Catalytica Energy Systems, Inc., Enron Capital & Trade Resources Corp., US Generating Company, and PG&E. Mr. Evans serves on the IEEE P1547.7 and P1547.8 working groups and the NIST Smart Grid Interoperability Panel. Mr. Evans holds BS degrees in Chemical and Nuclear Engineering and an MBA from the University of California at Berkeley. Mr. Evans holds U.S. Patents in distributed energy resources and power system analysis. He is a Professional Mechanical Engineer in California and a Chartered Financial Analyst.

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