

# UC Berkeley

## Electric Grid

### Title

Transmission Technology Research for Renewable Integration

### Permalink

<https://escholarship.org/uc/item/6px9q5gn>

### Author

Brown, Merwin

### Publication Date

2008-10-31



**ELECTRIC GRID RESEARCH PROGRAM**

**Project Summary**

**TRANSMISSION TECHNOLOGY RESEARCH FOR RENEWABLE INTEGRATION**

**Context**

California has established aggressive Renewables Portfolio Standards (RPS) goals to increase the fraction of electricity generated from renewable energy resources and to decrease greenhouse gas emissions. Renewable generators will be integrated into the electric grid at both the transmission and distribution levels, but most are expected to connect to the transmission system in locations remote from load centers and existing transmission infrastructure, thus requiring transmission extensions. Some of this renewable generation will exhibit properties quite different from traditional generation and loads, which pose special challenges for providing timely adequate grid delivery capacity, maintaining reliability, and avoiding economic inefficiencies. Finally, power flow constraints through transmission “gateways” into population centers must be relieved before the electricity from renewables can reach customers.

Meeting these challenges for the successful integration of renewables into the electric delivery system will require new or expanded capabilities for the grid. At higher RPS levels, the conventional “build” solutions alone will prove inadequate. New transmission technologies offer the prospect of providing a substantial portion of these new or expanded capabilities.

**Goals and Objectives**

The goal of this project was to survey technology research and development that could assist in the integration of the renewable generation capacity required to meet the renewables portfolio standard goals of California. Particular attention was given to the 33% penetration level targeted for 2020.

Specific objectives were to identify the technology gaps and research required to close those gaps and to make recommendations with regard to research in promising areas of technology.

**Description**

This research linked technology development needs to product development. The “products” were the new technology systems or platforms which would be deployed to enable the new transmission infrastructure capable of integrating the renewable generation required

to meet the California RPS goals and beyond.

Three categories of new functions or capabilities required defined the new technologies required: access to the transmission system, accommodation of renewable energy characteristics, and increased transmission capacity. For each technology surveyed, the new functions or capabilities that it could address were identified, its current status, the technology gaps needed to be filled and the research recommended to advance the technology.

**Key Results/Conclusions**

A number of technologies were reviewed and needed research identified. Those that offered the prospect of meeting major objectives were recommended as high priority:

For providing faster access to the grid, technologies such as undergrounding that reduce the visual profile of a transmission line or that help communicate the values and costs of various alternatives, putting new transmission additions in a new light.

To mitigate unique behaviors of renewables, technologies such as wind forecasting; and energy storage and intelligent agents that help buffer the variable behavior.

For increasing the capacity of transmission pathways, interties and gateways, technologies that (1) remove operational reliability constraints, such as real-time nomograms and power flow control devices; and (2) allow for higher current density flows or voltages, such as new transmission line materials or configuration designs, including DC.

Finally, important across all three objectives are technologies, such as probabilistic and statistical analytics, for improved planning under growing complexities and uncertainties.

**Why It Matters**

New technologies can be deployed in the transmission system to endow it with expanded or new capabilities that, at a minimum, will make renewable integration easier and less costly, and ultimately at some higher renewable penetration level, will most likely be required to achieve California’s renewable energy goals.

{More details}



**ELECTRIC GRID RESEARCH PROGRAM**

***Project Summary***

---

**TRANSMISSION TECHNOLOGY RESEARCH FOR RENEWABLE  
INTEGRATION (Pg 2)**

**Participating Organizations**

**Principal Investigator:**

California Institute for Energy and Environment

**Research Advisory Assistance:**

California Energy Commission  
California Independent System Operator  
California Public Utility Commission  
Oak Creek Energy  
Sempra Energy  
Southern California Edison

**Project Start Date:** May 1, 2008

**Project End Date:** October 31, 2008

**CEC Work Authorization No.:** BOA 99-192-P

**Reports**

Final Report: *Transmission Technology Research  
for Renewable Integration*

**Funding**



Funds for this project came from a \$203,000 awarded to the CIEE under contract 500-99-013 by the California Energy Commission (CEC) through the Public Interest Energy Research program (PIER)

**For More Information, Contact**

Dr. Merwin Brown,  
CIEE Electric Grid Research Program Director  
(916) 551-1871  
[merwin.brown@uc-ciee.org](mailto:merwin.brown@uc-ciee.org)