Large Wind Systems
New Wind Additions

- Capacity Additions (through 1Q09)
- Additions 2Q09
- Projected Installations
- Cumulative Capacity
Geothermal
Central Solar
“Transmission is the Achilles heel of Renewable Energy.”

Bennett Johnson
Transmission Initiatives Adapt to US Wind Growth
Transmission Project Examples

United States transmission grid
Source: FEMA
Transmission Initiatives Adapt to US Wind Growth

Transmission Project Examples

Source: NREL, Emerging Energy Research
Wind Penetration as % of Peak Load - WECC

The graph shows the percentage of wind penetration for various utilities in the Western Electricity Coordinating Council (WECC) region. The utilities include Sierra Pacific Power, Tucson, Nevada Power, Salt River Project, Jumbo Power, Casso, PNM, Northwest Energy, Pacificorp, BPA, and a combination of all utilities. The highest percentage of wind penetration is observed for a combination of utilities, reaching 30%, followed by 12%, 8%, 3%, and 6% for other utilities.
• From Iceland (Northwest) to Israel (Southeast) = 3,200 mi

• Concept of grid is 25,000 miles of line

The new high-voltage network would range from the Sahara to the polar cap. The concept calls for main lines that are 40,000 kilometers long. And parts of it already exist.
Demonstration of Regulation Services
Regulation Service While Charging

Regulation Supply (incidental charging)

- Blue: Regulation Signal
- Red: Vehicle Power
- Green: Battery SoC (%)

Power (kW) vs. Time

State of Charge (%) vs. Time

Time:
- 22:00
- 23:00
- 00:00
- 01:00
- 02:00
- 03:00
- 04:00
Years After Purchase

Cumulative Cost

LI-ION BATTERIES

$4.00/gal.
$0.08¢/kWh (off-peak rate)
Maintenance costs not included, no discount rate applied

Payments to CBH Owners for Regulation Services. Assume $1,500/year

Gasoline ICE
Hybrid
PHEV
CashBack PHEV

Years After Purchase
Distributed Energy
A mobile application from Tendril, a start up in Boulder, CO will make it possible to control appliances and heating-and-cooling systems from an iPhone. The app is designed to work with Tendril’s smart outlets (which monitor and control individual appliances and lighting) and smart thermostats. The devices communicate wirelessly into an internet connection-household hub, through which they can be...
Many utilities are considering tiered pricing based on demand at different times. GE Smart Refrigerators and other appliances going on sale this year can connect with energy management systems to receive real-time pricing information and do things like delay a defrost cycle until prices go down.
21st Century Electric Grid

Dynamic Systems Control

Distributed Generation & Storage

Grid Operator

Customer Portal

PHEV

TWO-WAY FLOW OF INFORMATION AND POWER