



**ANALYSIS GROUP**  
ECONOMIC, FINANCIAL and STRATEGY CONSULTANTS

# The Goals for an Electricity Grid for the 21st Century: Where You Stand Depends Upon Where You Sit



**Sue Tierney**

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**Aspen Institute Energy Policy Forum**

## **Our panel: Setting the table for the forum on transmission**

**Where you stand depends upon where you sit.....**

- Susan Tomasky
- John Podesta
- Rick Sergel
- Bill Hogan

### **My role on the panel:**

- Filling out some more of the “seating arrangements”

## Where you stand depends upon where you sit.... Characterizing transmission goals from different seats at the table

- The grid operator
- The economist
- The consumer advocate
- The environmentalist
- The green jobs advocate
- The technologist
- The national interest advocate
- The states' rights advocate
- The local land owner
- The Indian tribe
- The political scientist
- The mathematician



## Where you stand depends upon where you sit.... Characterizing transmission goals from different seats at the table

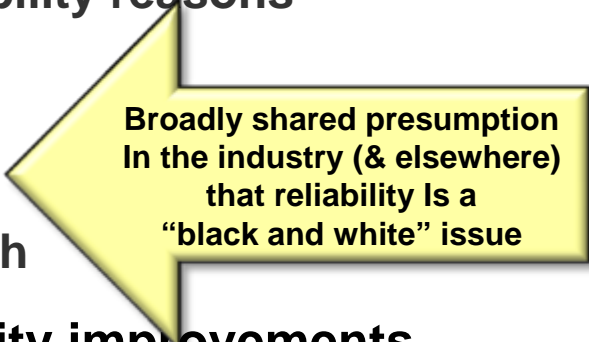
- In reality, most interested parties reflect a combination of these roles. For example,
  - A governor may have the same goals as the grid operator, the consumer advocate, the green jobs and states' rights advocates.
  - An organized RTO may have the same goals as the grid operator and the economist .
  - A congressman may have a variety of different goals at different times.



Like these chairs, the following characterizations are archetypes

## The grid operator's goal for transmission: Keeping the lights on

- **Various principles for reliability issues:**
  - **Bottom-up planning**
  - **Planning to meet industry reliability requirements –**
    - **Based on LOLL probabilities: is a standard violated?**
      - If yes, add transmission
      - If no, transmission is not needed for reliability reasons
    - **Not necessarily tied to:**
      - Economics of value of lost load
      - Expectations regarding economic dispatch
  - **Likely to lean in favor of socialization of reliability improvements**
    - **Implicit recognition: conditions change over time, as do beneficiaries**



Broadly shared presumption  
In the industry (& elsewhere)  
that reliability is a  
“black and white” issue

## The economist's goal for transmission: Making electric markets work better

- **Various principles for economic efficiency:**
  - **Transmission should be part of an industry structure that sends appropriate price signals for efficient investment & operations:**
    - Economic dispatch of generation based on bids to supply energy & AS
    - Prices & resource choices reflect effects of policy (e.g., carbon, RPS)
    - Locational prices for generation and loads
    - Transmission congestion contracts
    - Spot markets and bilateral contracts
    - Transmission planning provides information to market participants about future congestion patterns
    - Generation interconnections and economic upgrades supported by beneficiaries

Example:



Example:



## The consumer advocate's goal for transmission: Keeping rates low now, while keeping power flowing

- **Various principles to support consumers' interests:**
  - **Support for transmission planning & investment providing:**
    - Reliance on planning process with rigorous benefit/cost analysis
    - Robust, yet flexible system that provides consumers with reliable, stable and affordable electricity
    - Opportunity for consumer input into transmission plans
    - Regional variation in transmission approaches
    - Strong local regulation to assure affordable electricity
    - Resistance to lines that would equalize prices of low-cost regions with high-cost regions

Example:

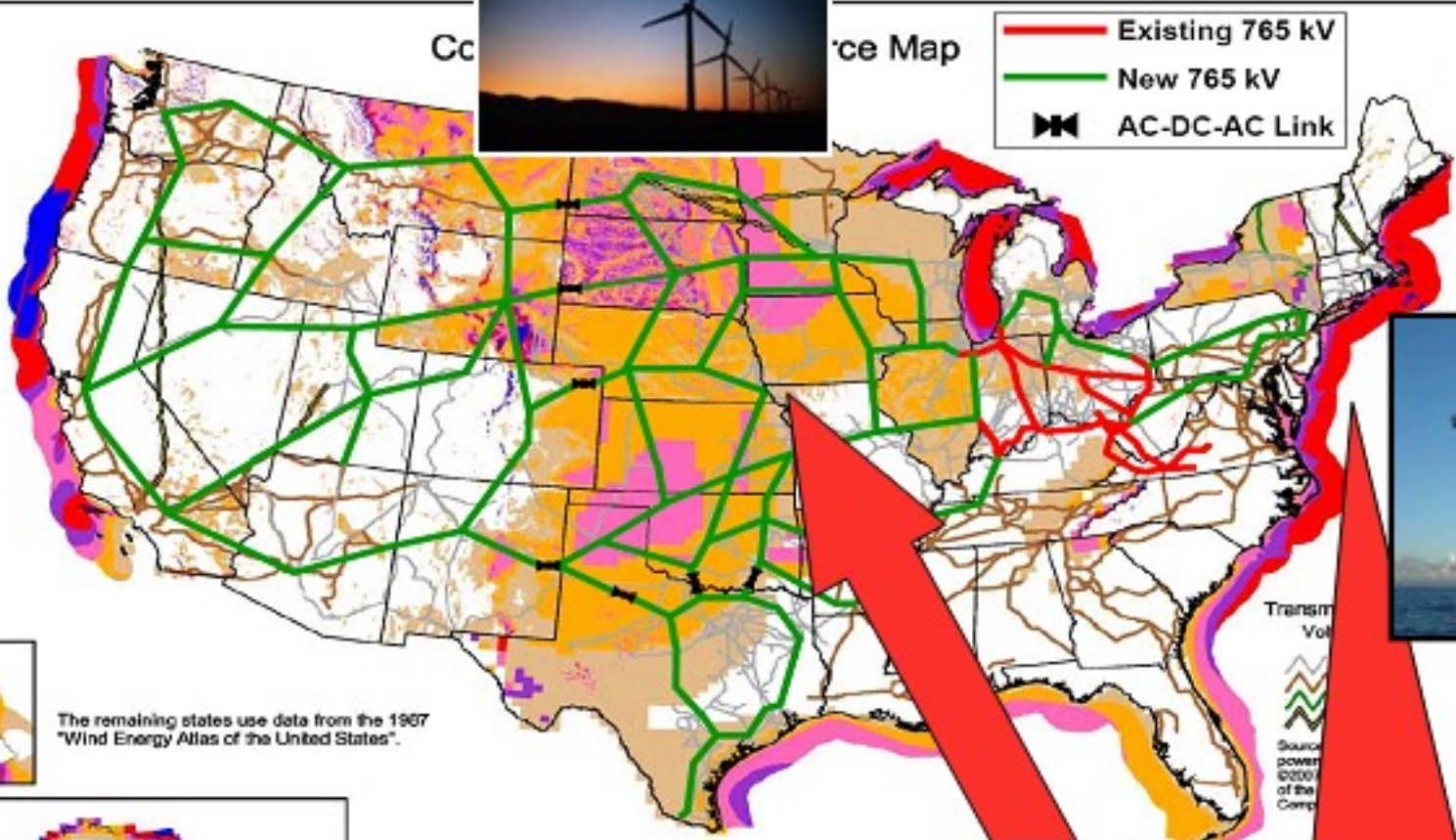


**Keeping the Power Flowing:**

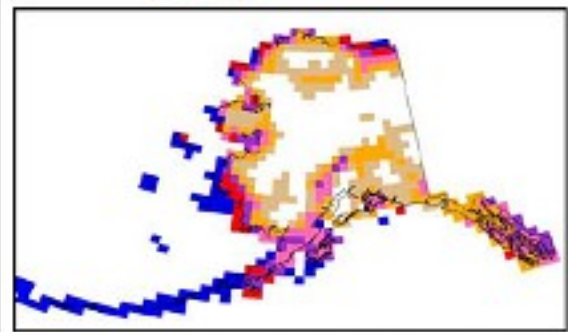
## The environmentalist's goal for transmission: Combating climate change with more renewables

- **Various principles for positive environmental outcomes:**
  - **Support for transmission planning and investment to deliver generation from geographic areas rich in location-dependent low-carbon resources**
    - Reliance on pro-active, top-down planning for large regions that span areas with renewables and areas with large loads
    - Broad socialization of costs of investment supporting renewables' access to markets
    - Careful regard for environmentally sensitive areas in planning, siting, construction, operations of facilities
    - “You can't like renewables and not like transmission”
  - That said, transmission planning should take into account energy efficiency, demand-response, and distributed generation

- NREL Updated Maps:
- Arizona (2003)
  - California (2002)
  - Colorado (2004)
  - Connecticut (2001)
  - Delaware (2002)
  - Hawaii (2004)
  - Idaho (2002)
  - Illinois (2001)
  - Indiana (2004)
  - Maine (2001)
  - Maryland (2002)
  - Massachusetts (2001)
  - Michigan (2004)
  - Missouri (2005)
  - Montana (2002)
  - Nebraska (2005)
  - Nevada (2003)
  - New Jersey (2002)
  - New Hampshire (2001)
  - New Mexico (2003)
  - North Carolina (2002)
  - North Dakota (2000)
  - Ohio (2004)
  - Oregon (2002)
  - Pennsylvania (2002)
  - Rhode Island (2001)
  - South Dakota (2001)
  - Texas (2000)
  - Utah (2003)
  - Vermont (2001)
  - Virginia (2002)
  - Washington (2002)
  - West Virginia (2002)
  - Wyoming (2002)



The remaining states use data from the 1987 "Wind Energy Atlas of the United States".



**Wind Power Classification**

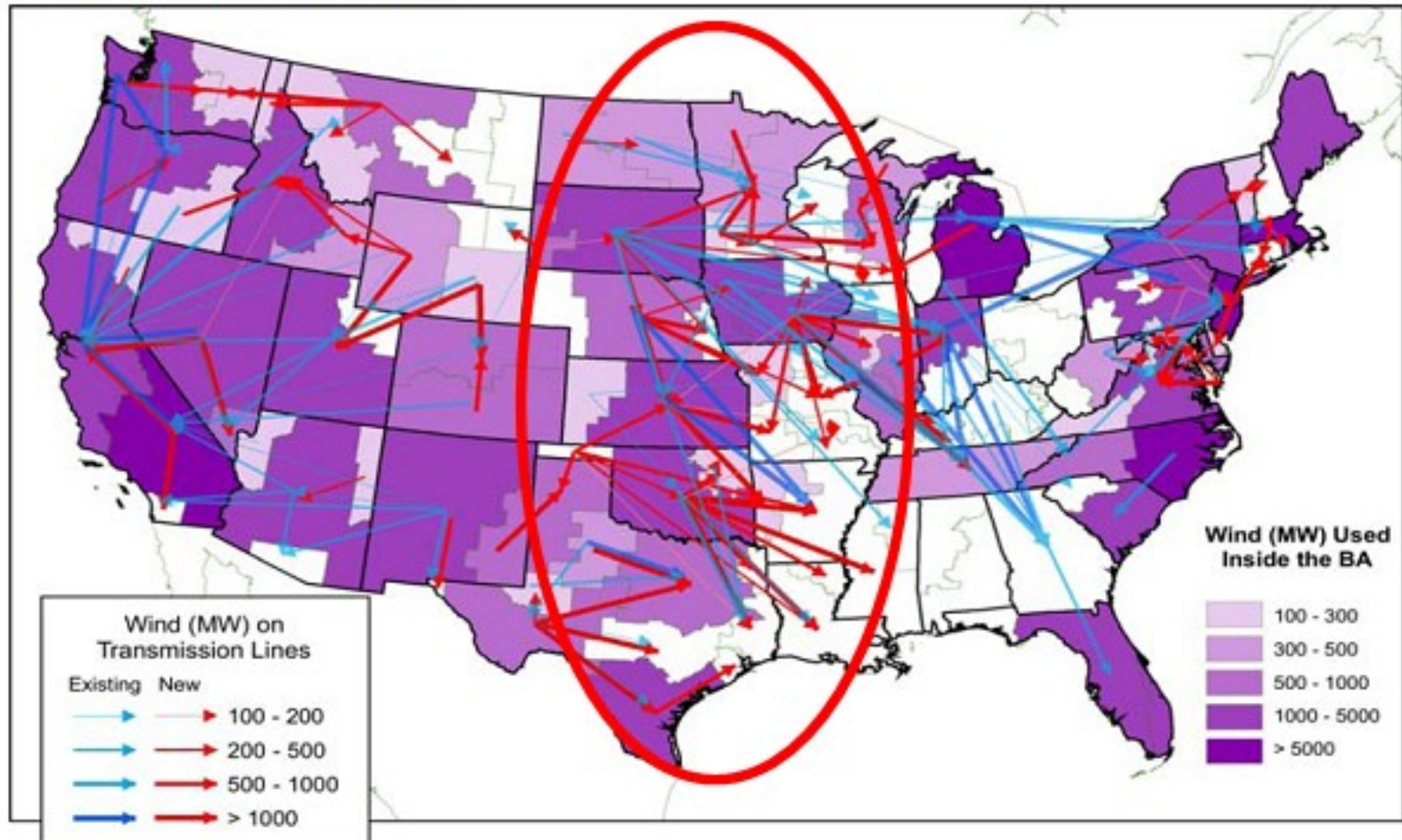
Wind Power Class	Resource Potential	Wind Power Density at 50 m W/m <sup>2</sup>	Wind Speed <sup>a</sup> at 50 m m/s	Wind Speed at 50 m mph
2	Marginal	200 - 300	5.6 - 6.4	12.5 - 14.3
3	Fair	300 - 400	6.4 - 7.0	14.3 - 15.7
4	Good	400 - 500	7.0 - 7.5	15.7 - 16.8
5	Excellent	500 - 600	7.5 - 8.0	16.8 - 17.9
6	Outstanding	600 - 800	8.0 - 8.8	17.9 - 19.7
7	Superb	800 - 1600	8.8 - 11.1	19.7 - 24.6

<sup>a</sup> Wind speeds are based on a Weibull k value of 2.0

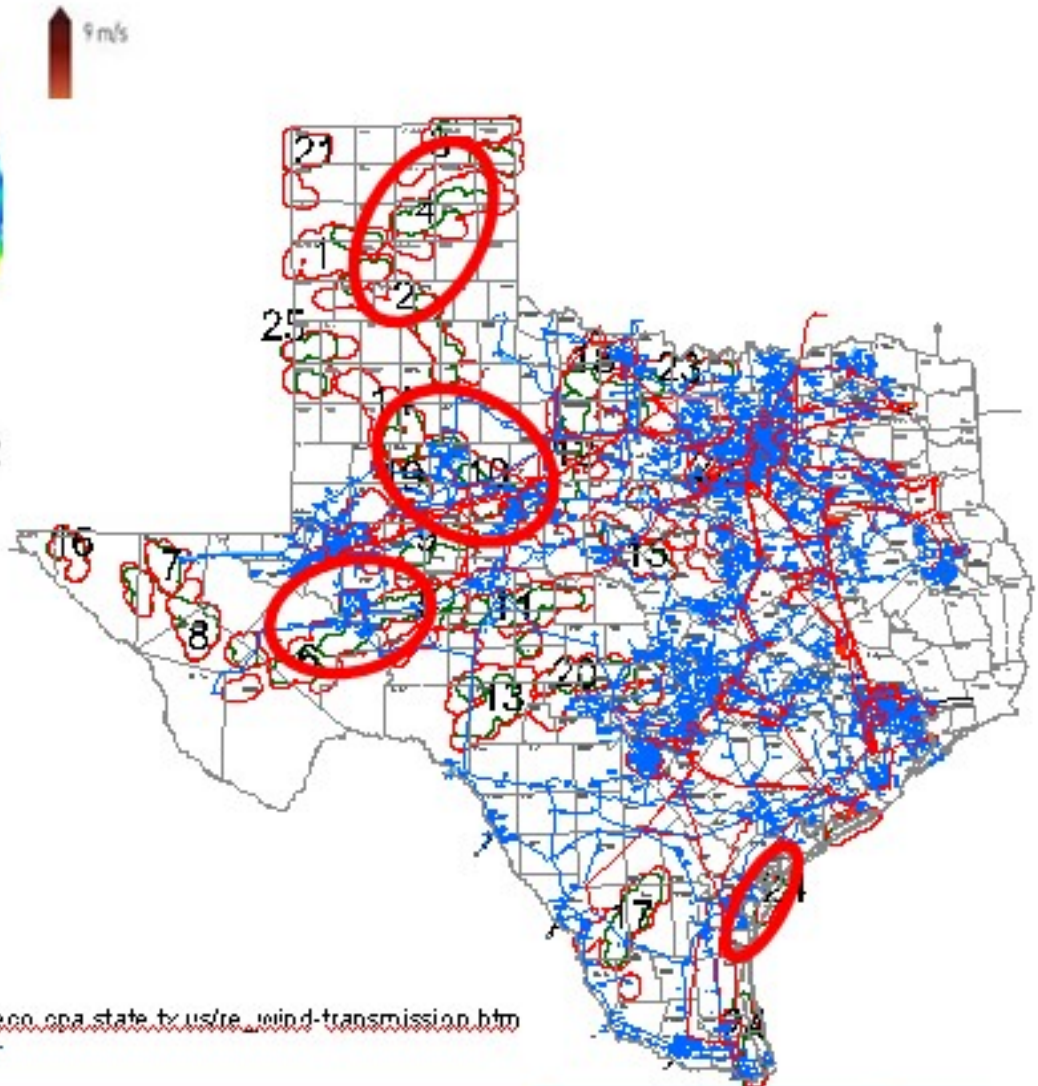
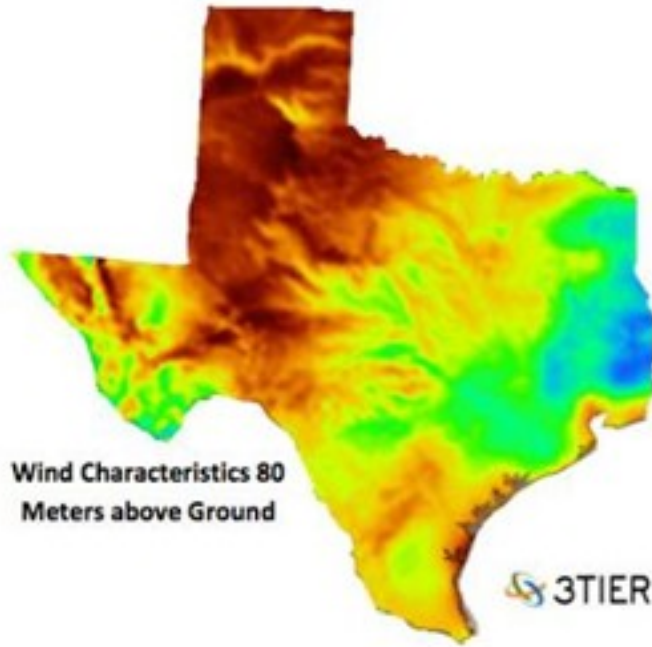
**Important national interest in developing renewable resources – with important respect for regional opportunities and plans**

# DOE's Study of Wind Energy: 20% by 2030

## What would it take?



Total Between Balancing Areas Transfer  $\geq 100$  MW (all power classes, land-based and offshore) in 2030. Wind power can be used locally within a Balancing Area (BA), represented by purple shading, or transferred out of the area on new or existing transmission lines, represented by red or blue arrows. Arrows originate and terminate at the centroid of the BA for visualization purposes; they

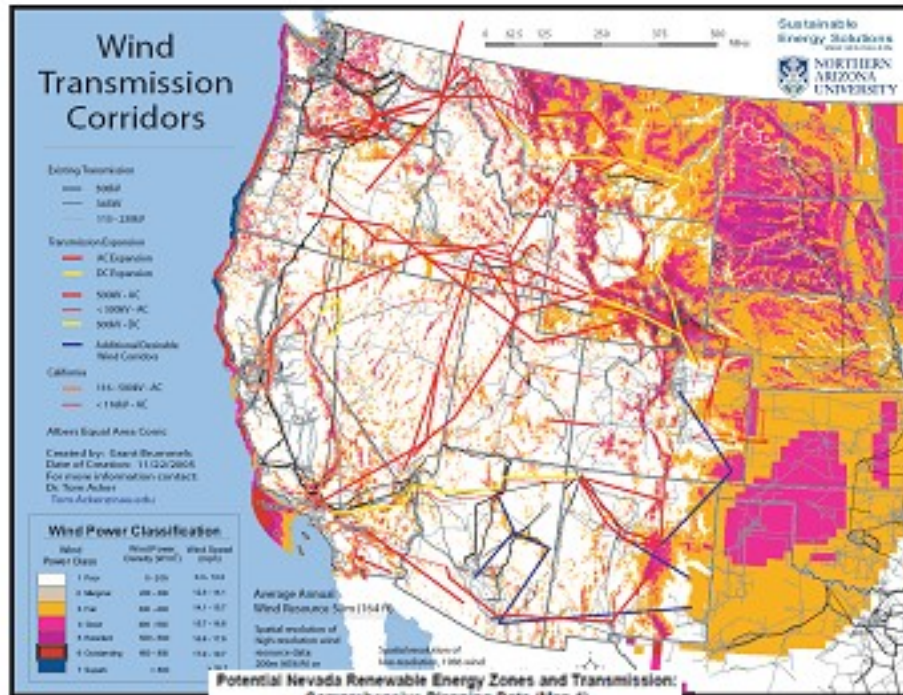


<http://www.windcoalition.org/policy/transmission>



[http://www.secc.opa.state.tx.us/re\\_wind-transmission.htm](http://www.secc.opa.state.tx.us/re_wind-transmission.htm)

# Western planning for renewables & transmission





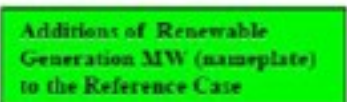


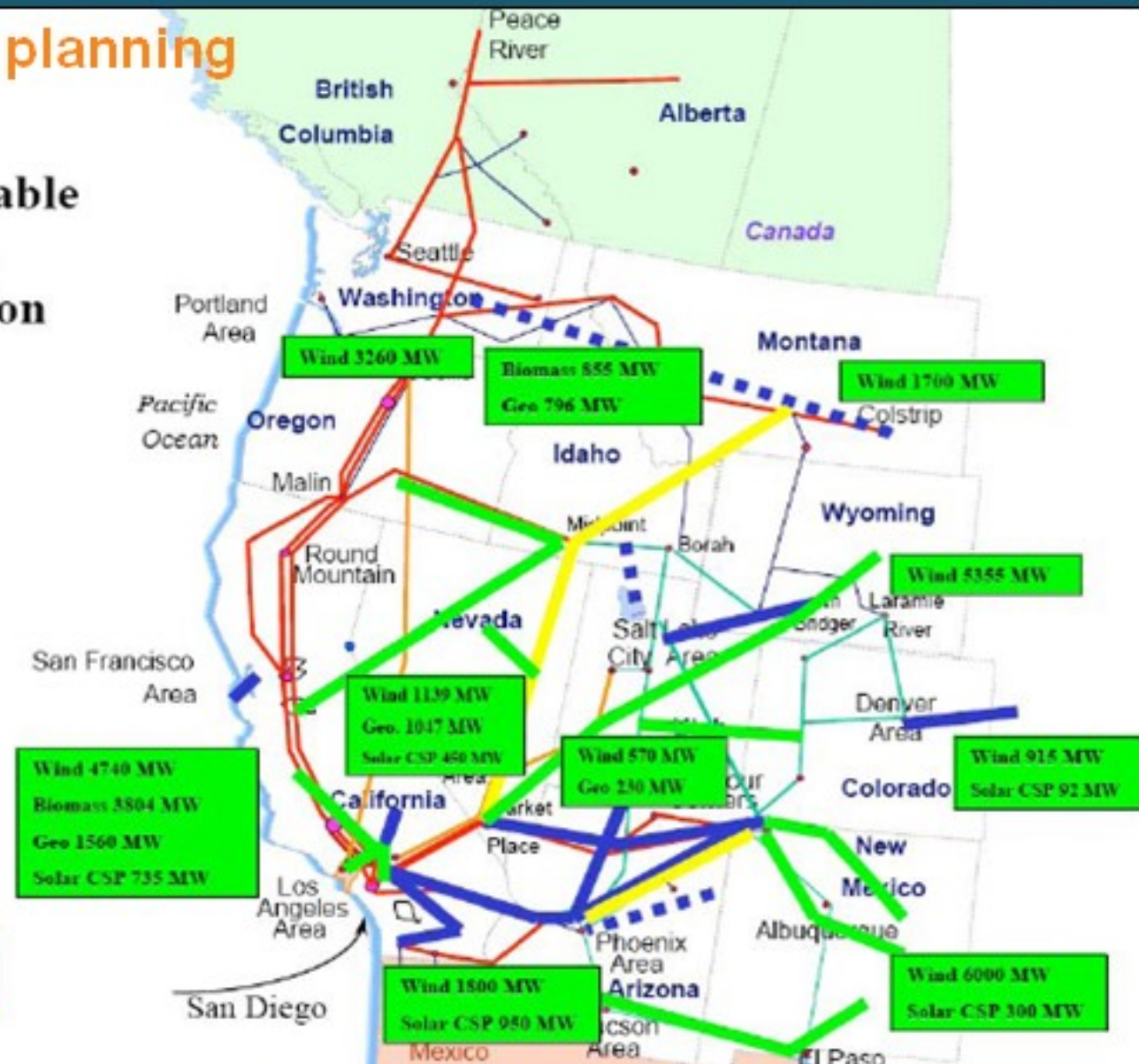
Potential Nevada Renewable Energy Zones and Transmission: Comprehensive Planning Data (Map 1)



# More Western planning

## CDEAC High Renewable Scenario Transmission

-  Added Transmission-SSGWI Reference Case
-  Upgraded Transmission SSG-WI Reference Case
-  Added Transmission-CDEAC Reference
-  Added Transmission-CDEAC High Renewable
-  Additions of Renewable Generation MW (nameplate) to the Reference Case



Source: Western Governor's Association CDEI Transmission Task Force Report

## The green jobs advocate's goals for transmission: Getting people back to work in new energy jobs

- **Various principles for clean tech jobs:**
  - **The nation's vitality depends upon shifting to a green-tech energy system**
    - Relying on domestic, low-carbon energy supplies
    - Most of those supplies are located far away from customers
  - **Plan for transmission as part of a shift to low-carbon, domestic energy production systems**
    - Transmission is a relatively low-cost element of the overall set of costs within in the electric industry
    - We can't develop (and get jobs from) renewables without transmission
    - Err on the side of adding transmission



## Transmission and the economy

### Vice President Joe Biden:

“Anything we put in this economic recovery plan has to be designed to create jobs, to stimulate the economy quickly, get jobs moving quickly. And it has to be for something that has a long-range impact on our economic health. Case in point, we want to spend a fair amount of money investing in a new smart grid. That is, the ability to transmit across high-tension wires in the minds of most people in the public, or underground in these wires, wind and solar energy. You can’t do that now. That would create tens of thousands of new jobs, high-paying jobs. It needs to be done and it will have a long-range payoff not just for next year and the following year, keeping the economy from nose-diving, begin to turn the nose of that stuff up, but it will also change our energy picture. It will deal with global warming.”

“...Case in point, we want to spend a fair amount of money investing in a new smart grid...”

“... the ability to transmit across high-tension wires ...wind and solar energy. ... That would create tens of thousands of new jobs, high-paying jobs...”

### ARRA funding for transmission enhancement

\$4.5 b	Smart Grid
\$7.5 b	BPA and WAPA (add'l borrowing authority)
\$6.0 b	Renewables and transmission projects (add'l loan guarantees)



## The technologist's goal for transmission: Making it smart, nimble, robust, cool

- **Various principles for advanced technology:**
  - **Upgrade the grid in order to help transform America's energy economy, improving:**
    - **Grid operator's ability to manage the reliability of the grid as the economy becomes even more**
    - **Consumers' ability to manage their energy use**
    - **The integration of various advanced technologies (e.g., PHEV, energy storage)**



## The “smart, nimble, robust, cool” grid

### Wired Magazine: “Fix the Grid! 7 Ways to Transform America” (4-09):

▪ “....considering how wasteful, unresponsive, and just plain dumb the grid is, it isn’t surprising that outages – which have been increasing steadily over the last quarter century – cost us \$150 billion a year. The real shock is that the damn thing works at all.”

▪What we need the grid to do:

- 1.Generate electricity everywhere (e.g., including DG generation)
- 2.Deliver clean energy to distant cities.
- 3.Store power in super batteries.
- 4.Monitor electrons in real time.
- 5.Trade electricity like pork bellies.
- 6.Think negawatts, not megawatts.
- 7.Make conservation simple (and easy)

