BUILDING A WORLD OF DIFFERENCE®

BLACK & VEATCH



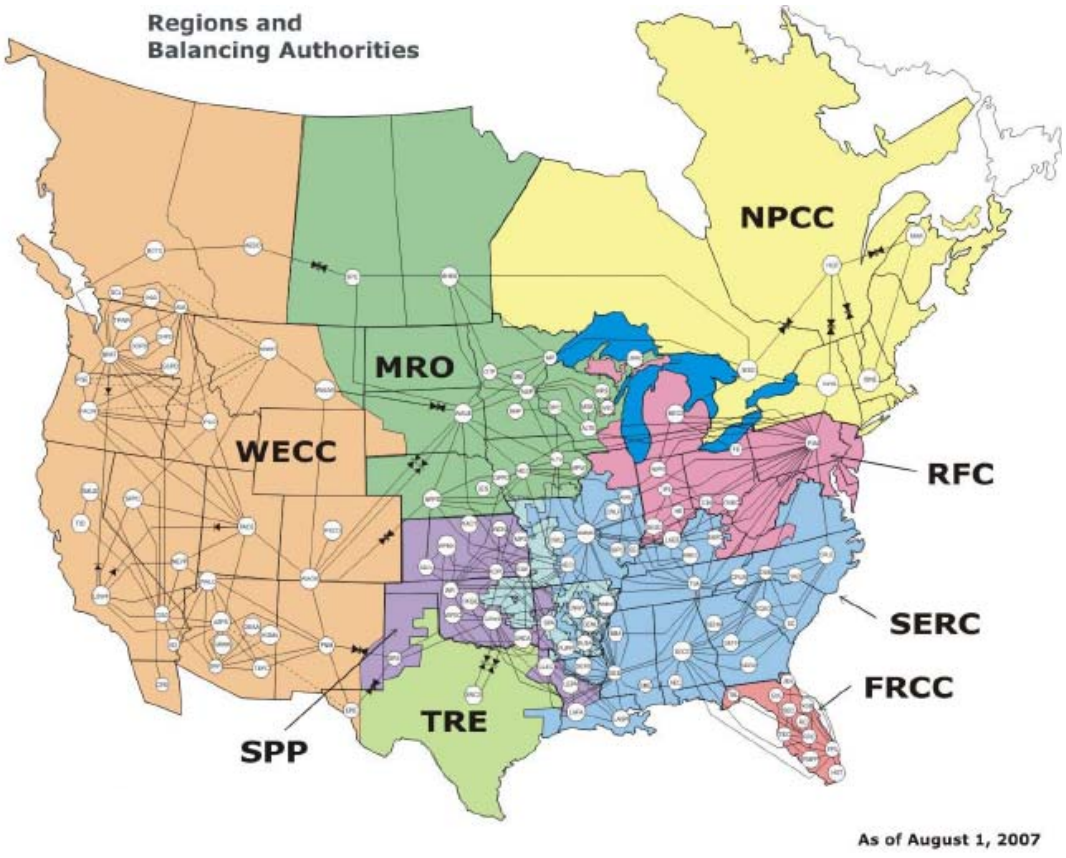


4: Transmission Planning for Renewables

U.S. Approach and Case Studies

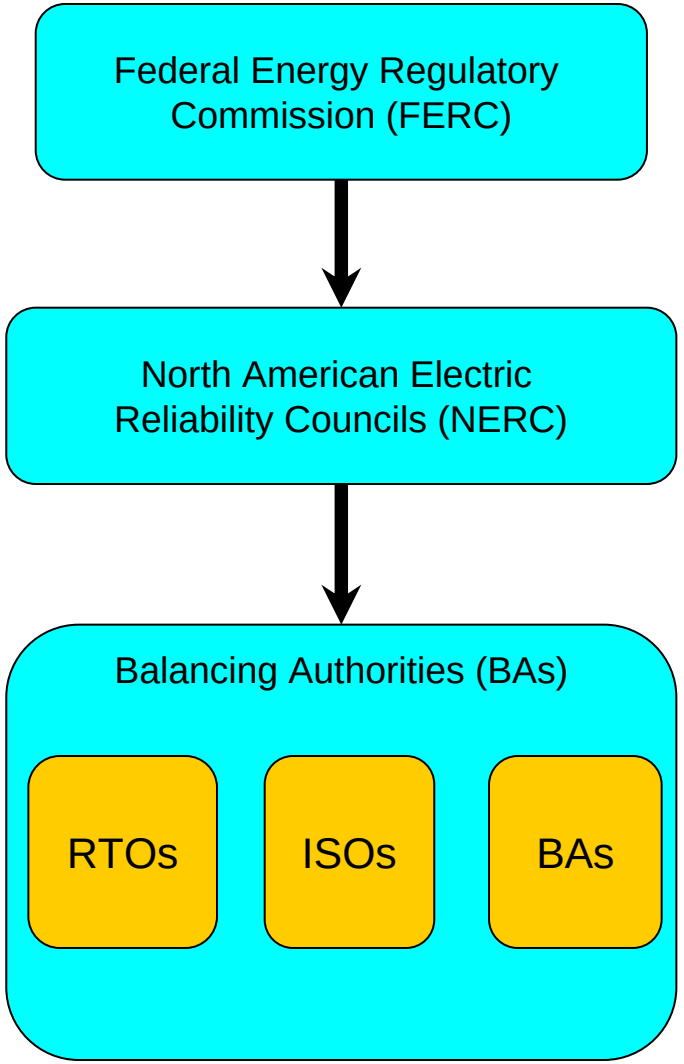
Background of U.S. Transmission System

- **Federal Energy Regulatory Commission (FERC)**
  - Regulates interstate transmission grid, approves market rules, and regulates rates for transmission service.
- **NERC Regional Councils**
  - Establish operating standards to ensure system reliability
- **Balancing Authorities (BA)**
  - Manage system operation
  - Establish specific operating requirements and criteria for participants



Background of U.S. Transmission Planning for Renewables: Challenges

- Transmission planning and approval process is fractured
  - FERC, NERC, Balancing Authorities
  - State permitting processes, Environmental considerations
  - Coordination for planning among authorities and agencies can be challenging
- Public opposition to new lines
  - NIMBYs – “Not In My Backyard”
  - BANANAs – “Build Absolutely Nothing Anywhere Near Anything”



Background of U.S. Transmission Planning for Renewables: Challenges

- Transmission for renewables different than conventional generation—not always “least cost” option.
  - Oftentimes renewables are policy-driven additions rather than lowest system cost resources
  - Transmission needed to deliver these resources to loads may not satisfy usual requirements for transmission need and economics
  - Variable delivery resources require additional operating requirements of balancing authorities
- Many renewables are remote – long-distance transmission to deliver this energy requires:
  - Close coordination among Balancing Authorities to develop transmission to access these resources
  - New rules and products by Balancing Authorities and NERC regions to operate systems to integrate these resources
  - New FERC policies to allow for transmission development criteria and cost recovery

Need for Collaborative Transmission Planning Approach

- **Engage all stakeholders in planning** process prior to developing specific transmission proposals (utilities, regulators, developers, environmental, transmission operators, etc.)
  - Develop shared understanding of requirements and goals
  - Identify important development issues
  - Build consensus for transmission *before* permit applications filed to reduce permitting time and litigation
- **Coordinate resource development and transmission expansion** to satisfy multiple needs
  - Prioritize development to access most cost effective resources
  - Minimize environmental and social impact of development
  - Prioritize goals for regulators
  - Provide signals to developers to focus development

Analytical Approach in Support of Conceptual Transmission Planning for Renewables

1. Identify goals/objective for analysis and geographic scope
2. Identify, quantify and value renewable energy resources
3. Develop resource and transmission scenarios
4. Evaluate scenarios based on objective

Examples of Recent Planning Efforts and Goals

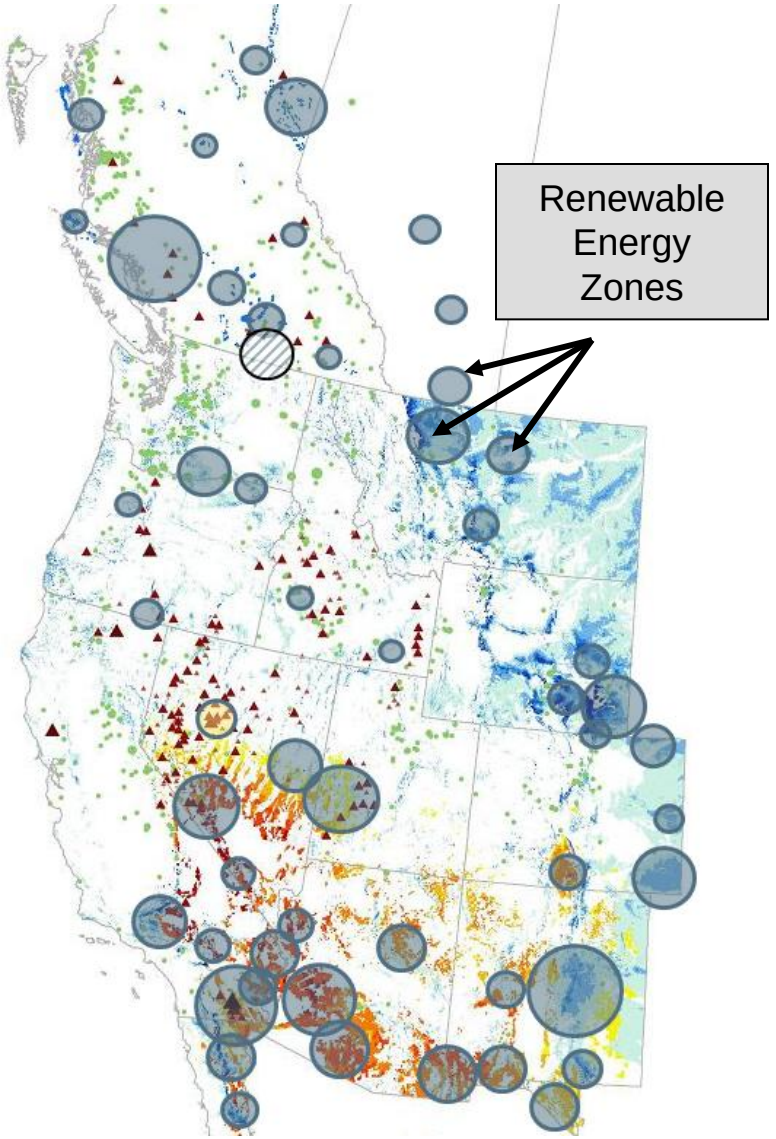
- **Western Renewable Energy Zones (WREZ)**
  - **Goal:** Provide entities within the Western Interconnection with information and tools to identify attractive opportunities for transmission development
  - **Coverage area:** WECC
  - Collaborative process coordinated by the Western Governors' Association, including 11 U.S. States, Western Canada and Baja Del Norte Mexico

- **California Renewable Energy Transmission Initiative (RETI)**
  - **Goal:** Identify least cost and least impact development zones and transmission projects required for California to meet renewable development targets.
    - Ensure competition, generation diversity
    - Are developable now and in next 10 years
  - **Coverage area:** California and surrounding states
  - Collaborative process involving state agencies, utilities, ISO, public interest groups, project developers and many other stakeholders

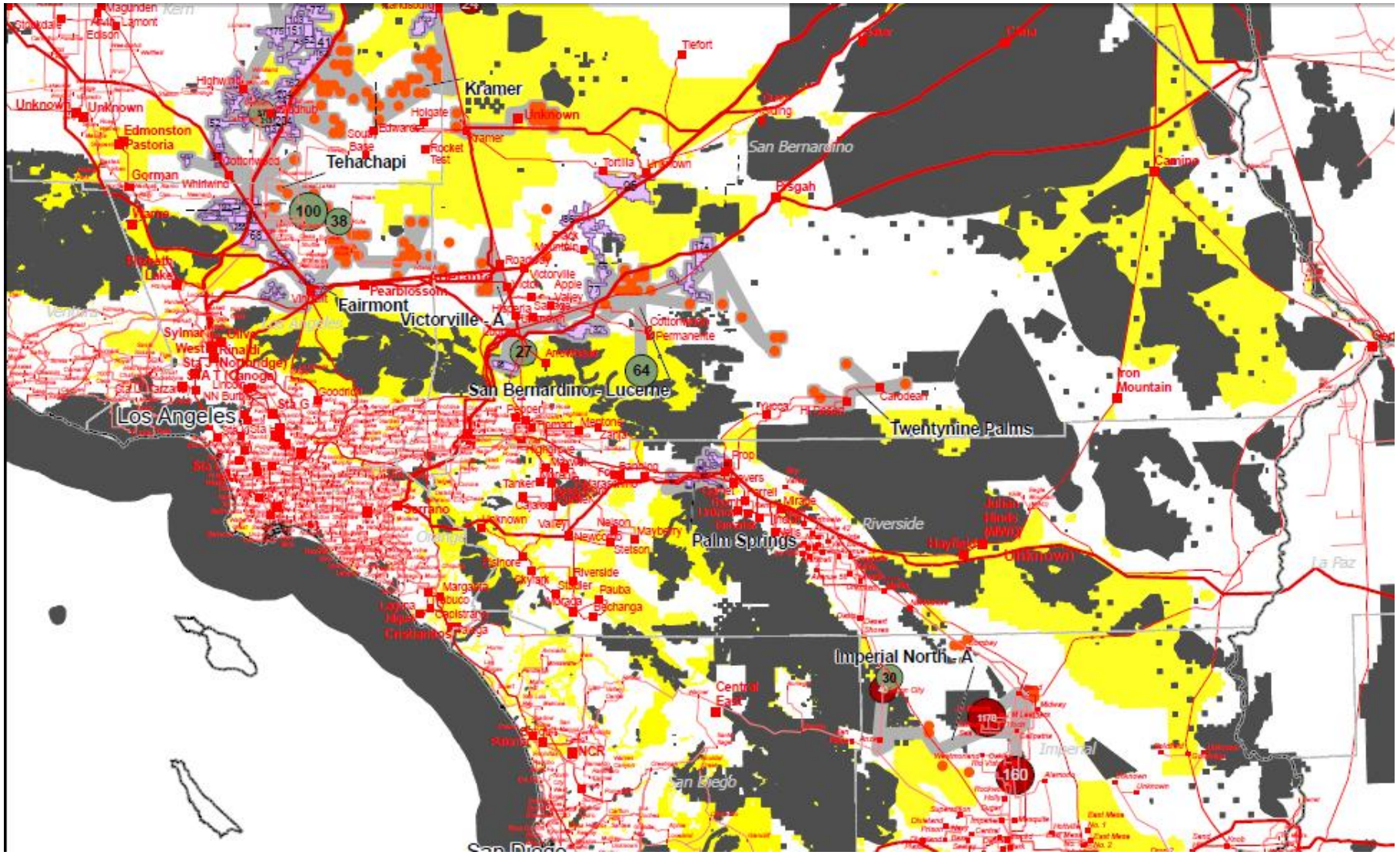
Identify Renewable Energy Resources

- Assess raw resource
- Determine developable potential
  - Practical limitations
  - Environmental considerations
- Characterize and model renewable generator performance
  - Generating capacity
  - Time-of-day (TOD) and seasonal energy production profile

- WREZ identified generalized ‘zones’ of renewable energy potential
- RETI identified individual projects, including planned and ‘proxy’ projects



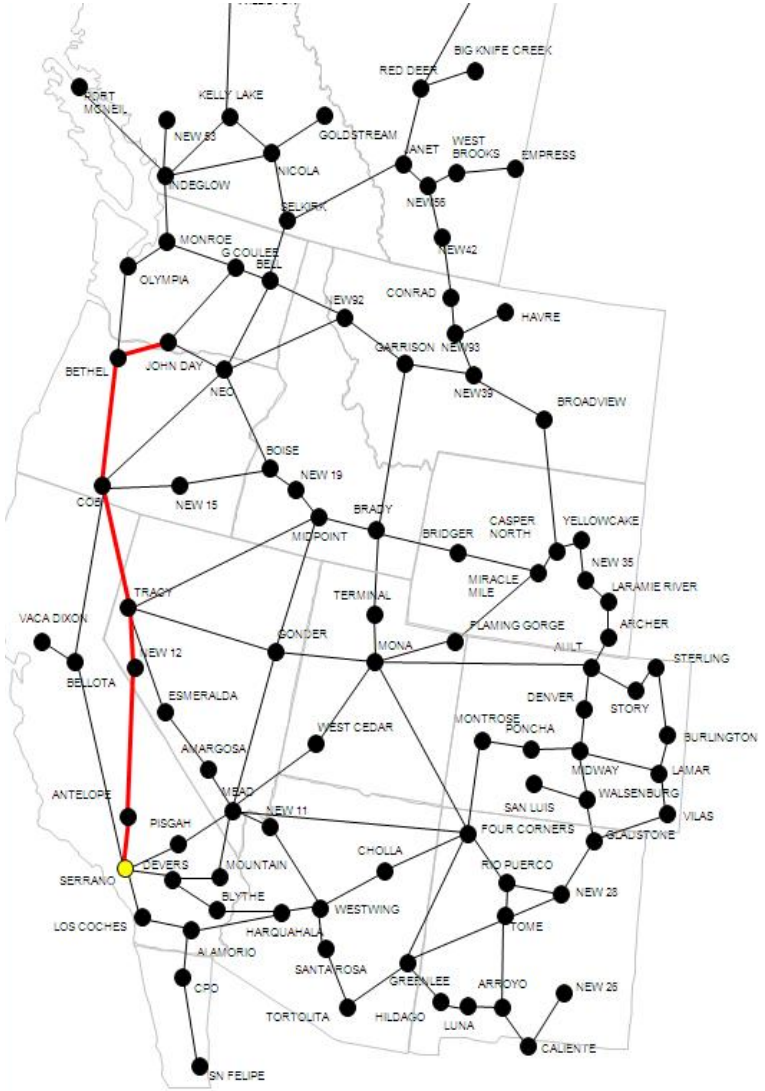
Identify Renewable Energy Resources



Develop Resource and Transmission Scenarios

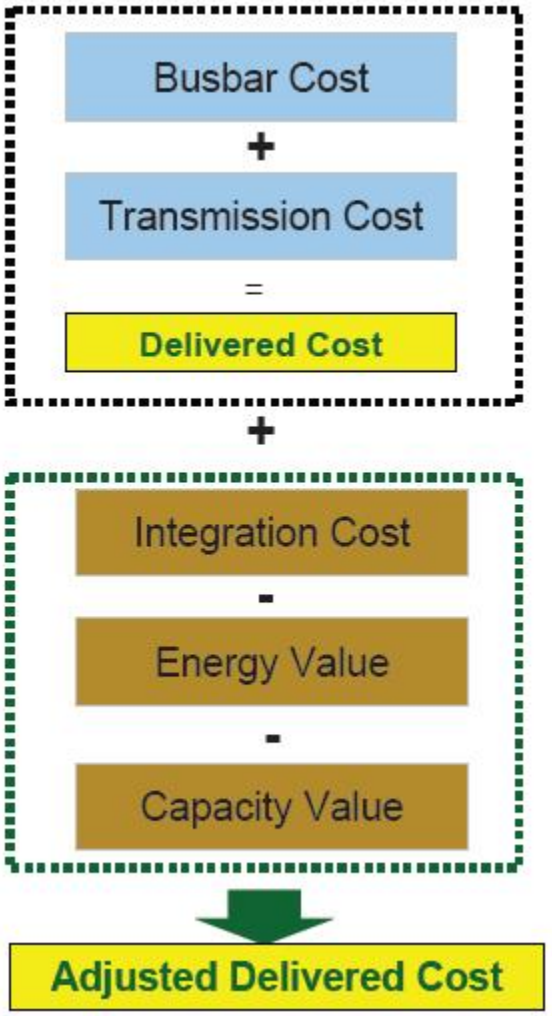
- Develop “conceptual” transmission system based on existing and planned rights-of-way
- Identify load sinks
- Determine transmission requirements to connect resources to load
- Quantify the cost of incremental transmission

- WREZ model allows user to define scenarios (resource, load area, transmission route) and find cost
  - Able to create supply curve of all resources available to a load area
- RETI determined cost of transmission from each project to nearest load zone



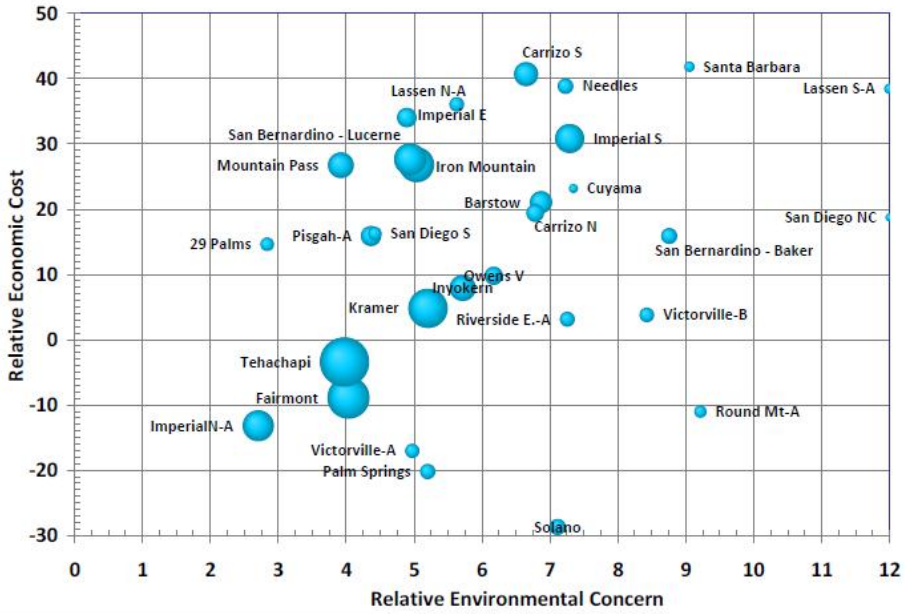
Evaluate Results – Resource Cost Determination

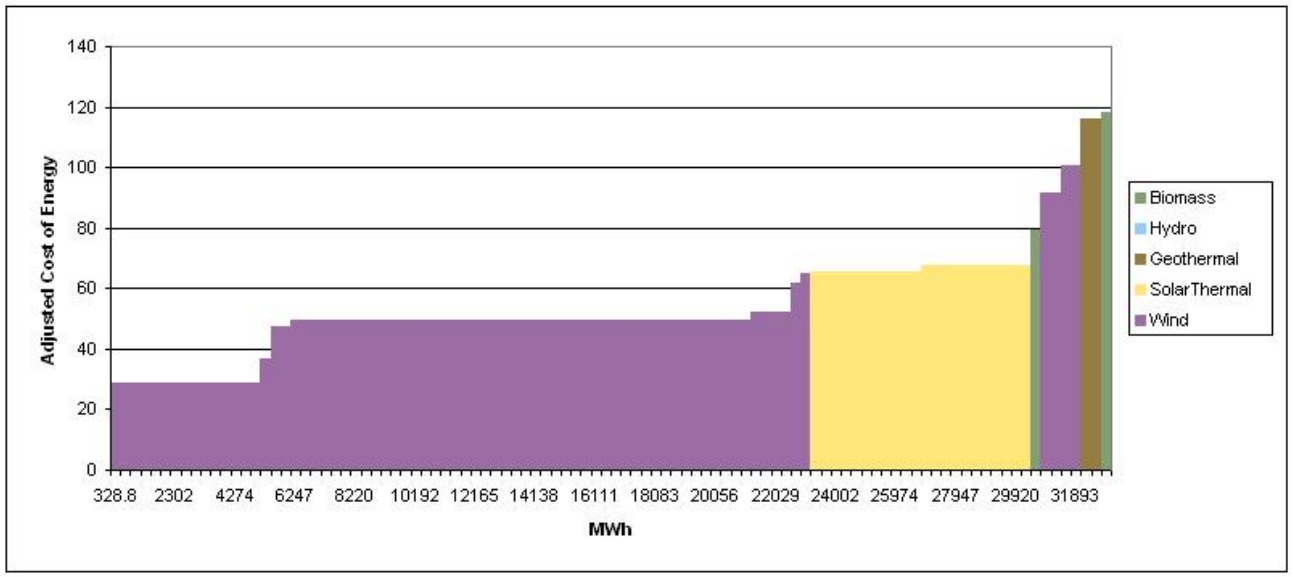
- Busbar Cost: levelized cost of generation
- Transmission cost: levelized cost of getting energy to load
- Adjusted delivered cost: the net cost of the energy to a load zone
  - Considers value and cost of generation profile



Evaluate Results

Bubble chart ranks RETI zones based on adjusted cost and environmental impact





Supply curve ranks the adjusted cost of a portfolio of resources to a load zone in the WREZ model

Other Transmission Planning Initiatives

- In addition, several Initiatives Completed and Underway to Promote Regional Transmission Development for Renewables
  - DOE-sponsored NERC-Region Initiatives - Regional Transmission Expansion Planning (RTEP)
  - Clean Renewable Energy Zones (CREZ) ERCOT
  - JCSP
  - SPP
- Note: to date all initiatives have been voluntary organizations

Lessons Learned from Planning Efforts

- Wide regional coverage of interconnected areas, especially for development of renewables that are distant from load centers
- Stakeholder involvement from the beginning, so goals and understanding of issues are aligned
- Establish shared goals and objectives for study (early)
- Renewable energy “zones” rather than specific projects is appropriate level of detail for planning purposes
- Quantitative assessment of goals and objectives

Evolution and Future of Transmission Planning Tools

- Conceptual planning has evolved from basic resource assessments and spreadsheet models
  - Resource assessments and transmission are analyzed though GIS mapping tools.
  - Newer models are user-friendly, more interactive, scenario-development tools.
- Future of conceptual renewable planning may begin to incorporate grid considerations such as:
  - Consideration of existing capacity
  - Grid integration/operational issues
  - Grid reliability planning

Designing a Method for Use in China

- Engage stakeholders in planning process prior to developing transmission expansions
- Coordinate resource/project development and transmission expansion to satisfy multiple needs
- Identify goals/objective for analysis and geographic scope
- Identify, quantify and value renewable energy resources
- Develop resource and transmission scenarios
- Evaluate scenarios based on objective