Qualified Resource Areas

SELECTION METHODOLOGY
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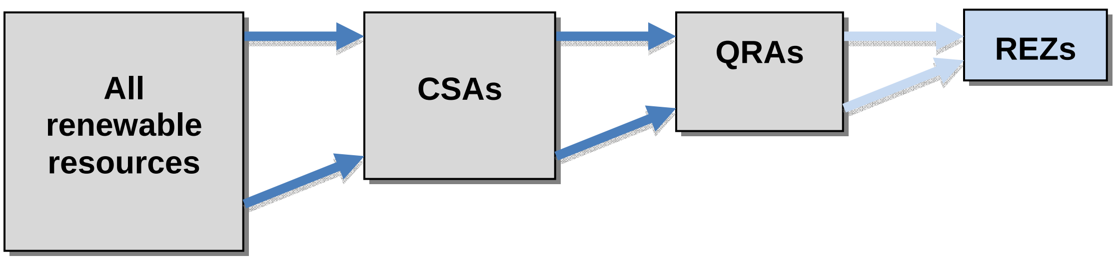
Summary

Qualified resource areas (QRAs) represent the most-screened stage to date in the process of identifying renewable energy zones (REZs). QRAs were selected from the previously identified candidate study areas (CSAs) and are based on each resource's potential as quantified and visualized using GIS technology. A QRA excludes any lands with statutory or regulatory development limitations for which data have been received and incorporated and limitations related to topography, ground cover, or urban development. At the outset, the Zone Identification and Technical Analysis work group (ZITA) developed quantitative rules by which all renewable resources in the Western Interconnection were screened to reach a manageable subset of CSAs. From November 2008 through mid-January 2009, ZITA developed even more selective criteria to identify QRAs.



Objective

Further refine the CSAs into manageable set of areas that identifies justification for regional transmission. These areas will not reflect all wildlife sensitivities, but will have this information incorporated before final REZ designation.

Quantification of CSA Resources

CSA resources were quantified so that areas with renewable energy resources could be compared, and the largest and most dense resource areas could be identified. Resource areas that did not meet a minimum threshold (class 3 or greater wind or greater than or equal to a solar DNI[1] level of 6.5 kWh per square meter per day) were excluded from the analysis. Additional technical development screens were also applied to identify areas that could likely be developed. For solar, the land slope criteria eliminated all lands with greater than 2 percent slope. Anything greater than this was assumed not to be economically viable for development. Other land exclusions applied included water bodies, urban areas, airports, and military lands.

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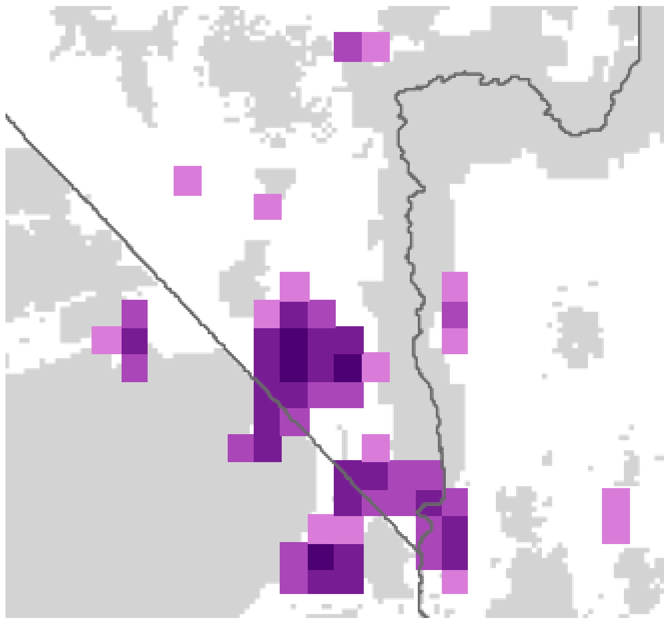
[1] Direct Normal Insolation. This is the term used to describe the radiation that comes directly from the sun onto a given area

A grid of 50 square kilometer squares (approximately seven km on a side) was overlaid on the entire WREZ study area. The amount of screened renewable energy resource potential within each grid square was quantified, and grid squares were shaded based on the total megawatts (MW) of resource inside of each square. This allowed for a standard comparison of areas across the WREZ study area based on the density of renewable energy resource in each grid square. An example for Southern Nevada is shown below.



Example "Gridded" Wind Resource in Southern Nevada evaluated for MW potential. Darker colors represent greater MW potential.

It is reasonable to expect that not all of the resource within a grid cell can be developed. Various constraints, such as land ownership, presence of structures, local zoning restrictions or other factors will limit the "developability" of resources. For this reason, developability discounts were applied to the screened resources to account for the likelihood that within any grid square, only a portion of the total resource potential is developable. Based on other work done in the field, 25 percent of the wind resource potential was quantified, and 3.5 percent of the solar thermal resource potential was quantified. This mathematical adjustment did not change the area covered by a CSA, only the amount of resource assumed to be developable within each grid square.

Some resources were quantified without discount because high-level resource assessment data were not available. In these cases, more reliable, site-specific data are available to estimate the potential of these resources. Geothermal resources are quantified based on an estimated developable MW potential at each site. As a result, no developability discount was applied to discovered, conventional geothermal resources. Likewise, Canadian wind and hydropower resources are quantified based on investigations of each site and no developability discounts are applied.

After each resource was separately quantified, the shaded grid maps were then combined to show one composite map combining wind, solar, geothermal and (in Canada) all hydropower resources, large and small. These are the resources that are used to define QRA boundaries. Hydropower resources that did not define QRA boundaries were then quantified when they fell inside QRA boundaries. Biomass resources will be quantified when it is better defined. Additionally, the presence of undiscovered conventional geothermal will be noted when it exists inside a QRA. Lower quality wind and solar resources will potentially be quantified when they fall inside of REZ boundaries.

Criteria for QRA Selection

ZITA developed quantitative rules for identifying QRAs from the groupings of shaded grid squares. These rules specify the minimum and maximum QRA size. They also include assumptions about the general location of substations that connect QRAs with the bulk transmission system.

<u>Minimum QRA Size Criteria</u>

The minimum QRA size was based on electrical generating potential. ZITA adopted a minimum QRA size of 1,500 MW because it is the approximate carrying capacity of a 500 kV transmission line.

A different methodology was applied for geothermal and British Columbia and Alberta. QRAs made up of only geothermal resources could be as small as 500 MW, and REZs in British Columbia and Alberta could be less than 1500 MW. Because geothermal is a 24/7 baseload resource, it has on average two to three times the capacity factor of variable wind and solar resources. This means it would produce two to three times as much usable energy over the course of a year. British Columbia and Alberta resources were identified based on project development activity and site-level resource assessments, rather than large-scale wind power maps. There is higher certainty that these resources will be developed than those identified in the United States. To account for this difference in development probability and to ensure QRAs in the United States and Canada are comparable, this refinement in the MW thresholds was made.

<u>Maximum QRA Size Criteria</u>

The maximum QRA size was based on geographical extent (and not electrical capacity). ZITA adopted a maximum QRA size of approximately 100 miles radius. A larger area would increase the estimated levelized cost of a hypothetical collector system to more than $10/MWh, which ZITA concluded would be the maximum cost that a project developer would be willing to incur for grid interconnection.

This maximum collector line distance was calculated for wind and solar separately. This was done assuming a standard capacity and capacity factor for each technology, a per-MW-mile cost for a 115 kV collector line, and a generation project life of 20 years. It

was determined that the distance from project to collector substation at which the collector line cost was $10/MWh was 100 miles.

The maximum QRA size limit and the developability discounts discussed earlier results in most zones containing less than 10,000 MW.

QRA Interconnection Point Location Criteria

Each QRA requires a point at which it interconnects with the bulk transmission system. It was assumed that the interconnection point for a QRA would be located at the intersection of a QRA and a transmission line or transmission corridor, when such an intersection occurs. The Generation and Transmission Modeling work group (GTM) provided ZITA with a GIS layer of the transmission corridors that will be used in its transmission model. GTM will verify these locations and assist in identifying interconnection points for and transmission segments to zones without transmission line intersections. These interconnection points will be used to estimate the transmission cost of energy from a zone to load.

QRA Selection Process

QRAs were identified using a GIS map of the shaded grid squares and the GTM transmission corridors. The underlying assumption for the conceptual transmission assumed that existing transmission corridors would be used for calculating transmission distances. As such, these conceptual corridors were used to guide the outlines for QRAs. These outlines are preliminary and will be refined once wildlife data are incorporated. In many cases, isolated contiguous clusters of resource large enough to be QRAs were easily identified. In other cases, contiguous clusters of resource needed to be broken into multiple parts, or multiple smaller clusters needed to be combined to form a QRA exceeding the minimum MW size threshold.

When a contiguous cluster of resource covered too large an area to be a single QRA, it was divided into multiple QRAs based on its position in relation to transmission lines. A point was selected on the nearest transmission line and a radius of 100 miles from that point was measured. All of the resource that fell within that radius was considered the extent of that QRA. The remaining resource in the large contiguous cluster of resource was considered one or more QRAs. When a contiguous cluster of resource larger than 200 miles across intersected multiple transmission lines, multiple anchor points were used to break up the cluster. In a small number of cases, a very dense and very large QRA was partitioned into smaller areas that still greatly exceeded the minimum threshold of 1,500 MW.

In several cases, there was not enough resource in a single contiguous block to meet the minimum size threshold. In these cases several separate clusters were aggregated to meet the minimum MW size threshold while still staying within the 200 mile size constraint.