Renewable Energy Zone (REZ) Transmission Planning Process

Nathan Lee
National Renewable Energy Laboratory
Transmission Planning for a High Renewable Energy Future
Greening the Grid Webinar
September 6, 2017
NREL/PR-7A40-70755
Outline

1. What is the Renewable Energy Zone (REZ) Transmission Planning Process?
2. Overview of the REZ Process
3. The REZ Toolkit
What is a Renewable Energy Zone (REZ)?

A REZ is a geographical area that enables the development of profitable, cost-effective, grid-connected renewable energy (RE).

A REZ has:

• High-quality RE resources
• Suitable topography and land-use designations
• Demonstrated interest from developers

All of these support cost-effective RE development.
What is the REZ Transmission Planning Process?

The REZ Transmission Planning process is a proactive approach to plan, approve, and build transmission infrastructure connecting REZs to the power system.

- Helps increase the share of solar, wind and other RE resources in the power system while maintaining reliability and economics.

- Focuses on large-scale wind and solar resources that can be developed in sufficient quantities to warrant transmission system expansion and upgrades.

REZs and transmission infrastructure to access zones – Western Renewable Energy Zones Initiative (Schwartz 2012)
Traditional transmission planning may not align with RE development as transmission decisions need to be made well in advance of RE generation development decisions.

The REZ process can help overcome this challenge.

**Circular Dilemma**

- Regulators need to see RE generator
- RE generator needs financing
- Transmission needs regulatory approval
- Financiers need to see transmission

**Approximate planning and construction time (years)**
- 2-3 years
- 5-10 years
- 10-20 years

Images left-right: iStock-155353280, Photo by Wknight94 / CC BY-SA 3.0, & iStock-515803636
Overview of the REZ Process

STEP 1. PROCESS DESIGN & VISION STATEMENT

STEP 2. RENEWABLE ENERGY RESOURCE ASSESSMENT

Summary:
- Assess resource
- Screen exclusion areas
- Identify the areas with the highest quality, developable resource

Output:
- Study areas map and supply curves

STEP 3. CANDIDATE ZONES SELECTION

Summary:
- Gauge commercial interest
- Identify areas where high quality resources intersect with commercial interest

Output:
- Candidate zone map and supply curves (one per area)

STEP 4. TRANSMISSION OPTIONS DEVELOPMENT

Summary:
- Select scenario creation (bundling) methodology
- Conduct cost-benefit analysis of options
- Steady-state, dynamic stability, production cost, and reliability analysis

Output:
- Bundle candidate zones and conduct analyses of the options

STEP 5. FINAL TRANSMISSION PLAN DESIGNATION

Summary:
- Select transmission option that best complies with predetermined criteria, including reliability standards, economic benefits, and environmental goals

Output:
- Select transmission option according to pre-set criteria
- Final transmission order

STEP 6. TRANSMISSION SYSTEM UPGRADE

Step 1 - The Importance of Stakeholder Engagement

**LEAD ENTITY**
Initiates and oversees the planning activity
Convenes relevant parties and ensures the process will meet the project vision—i.e., that transmission expansion and upgrades occur.

**TECHNICAL ADVISORY COMMITTEE (TAC)**
Guides and reviews the outputs of the working groups
Ensures the technical validity and relevance of the integrated clean energy transmission and generation planning efforts

**WORKING GROUPS (WG)**

- **ZONE IDENTIFICATION AND TECHNICAL ANALYSIS WG**
  Responsible for the identification of study areas and candidate zones
  Identifies and validates candidate renewable energy zones

- **TRANSMISSION AND GENERATION MODELING WG**
  Responsible for defining and analyzing new transmission and generation expansion and upgrade options
  Conducts development and modeling of transmission system expansion and upgrade options

**Example REZ Process Decision Makers and Stakeholders**

<table>
<thead>
<tr>
<th>Decision Makers</th>
<th>Stakeholders</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy ministry or agency officials</td>
<td>RE developers</td>
</tr>
<tr>
<td>Environment ministry and other relevant ministry officials</td>
<td>Electric Utilities</td>
</tr>
<tr>
<td>Regulators</td>
<td>Environment, resource, land use authorities</td>
</tr>
<tr>
<td>Power system planners</td>
<td>Environment and other interest groups</td>
</tr>
<tr>
<td>Transmission system operators</td>
<td>Non-governmental organizations</td>
</tr>
</tbody>
</table>

General REZ Process Organizational Structure  
(Lee, Flores-Espino, and Hurlbut 2017)
Overview of the REZ Process


(Lee, Flores-Espino, and Hurlbut 2017)
Overview of the REZ Process

STEP 1. PROCESS DESIGN & VISION STATEMENT

STEP 2. RENEWABLE ENERGY RESOURCE ASSESSMENT
Summary: Select areas with highest potential
Output: Study areas map and supply curves
- Assess resource
- Screen exclusion areas
- Identify the areas with the highest quality, developable resource

STEP 3. CANDIDATE ZONES SELECTION
Summary: Identify zones with highest probability of development
Output: Candidate zone map and supply curves (one per area)
- Gauge commercial interest
- Identify areas where high quality resources intersect with commercial interest

STEP 4. TRANSMISSION OPTIONS DEVELOPMENT
Summary: Bundle candidate zones and conduct analyses of the options
Output: Cost, benefit, and reliability impacts for each transmission alternative
- Select scenario creation (bundling) methodology
- Conduct cost-benefit analysis of options
- Steady-state, dynamic stability, production cost, and reliability analysis

STEP 5. FINAL TRANSMISSION PLAN DESIGNATION
Summary: Select transmission option according to pre-set criteria
Output: Final transmission order
- Select transmission option that best complies with predetermined criteria, including reliability standards, economic benefits, and environmental goals

STEP 6. TRANSMISSION SYSTEM UPGRADE


(Lee, Flores-Espino, and Hurlbut 2017)
Step 3 - Screening Zones Based on Developer Interest

Areas with excellent RE resources may not be attractive to private developers.

In this step developers demonstrate their interest in the screened areas to ensure that the candidate REZs are commercially attractive for development.

Examples of commercial interest and financial commitment (Lee, Flores-Espino, and Hurlbut 2017)

- Pending or signed interconnection agreements
- Leasing agreements
- Letters of credit
- Interconnection studies by a transmission owner or grid operator
- Other indications deemed appropriate by the regulatory authority
Overview of the REZ Process

STEP 1. PROCESS DESIGN & VISION STATEMENT

STEP 2. RENEWABLE ENERGY RESOURCE ASSESSMENT

Summary: Select areas with highest potential
Output: Study areas map and supply curves
- Assess resource
- Screen exclusion areas
- Identify the areas with the highest quality, developable resource

STEP 3. CANDIDATE ZONES SELECTION

Summary: Identify zones with highest probability of development
Output: Candidate zone map and supply curves (one per area)
- Gauge commercial interest
- Identify areas where high quality resources intersect with commercial interest

STEP 4. TRANSMISSION OPTIONS DEVELOPMENT

Summary: Bundle candidate zones and conduct analyses of the options
Output: Cost, benefit, and reliability impacts for each transmission alternative
- Select scenario creation (bundling) methodology
- Conduct cost-benefit analysis of options
- Steady-state, dynamic stability, production cost, and reliability analysis

STEP 5. FINAL TRANSMISSION PLAN DESIGNATION

Summary: Select transmission option according to pre-set criteria
Output: Final transmission order
- Select transmission option that best complies with predetermined criteria, including reliability standards, economic benefits, and environmental goals

STEP 6. TRANSMISSION SYSTEM UPGRADE


3/8/2018

(Lee, Flores-Espino, and Hurlbut 2017)
## Overview of the REZ Process

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Summary</strong></td>
<td>- Assess resource</td>
<td>- Select areas with highest potential</td>
<td>- Identify zones with highest probability of development</td>
<td>- Bundle candidate zones and conduct analyses of the options</td>
<td>- Select transmission option that best complies with predetermined criteria, including reliability standards, economic benefits, and environmental goals</td>
<td>-</td>
</tr>
</tbody>
</table>
Step 5 – Designation of a Transmission Plan

The appropriate authority designates the final transmission plan to be implemented.

This designation:

• Includes a geographic description of the REZs

• Identifies major transmission improvements to cost-effectively deliver electricity

• Identifies who will pay for the improvements

• Updates any estimates on the maximum generation capacity in the REZs
# Overview of the REZ Process

**Overview of the REZ Process**

<table>
<thead>
<tr>
<th>STEP 1. PROCESS DESIGN &amp; VISION STATEMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Summary:</strong> Select areas with highest potential</td>
</tr>
<tr>
<td><strong>Output:</strong> Study areas map and supply curves</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>STEP 2. RENEWABLE ENERGY RESOURCE ASSESSMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Summary:</strong> Identify zones with highest probability of development</td>
</tr>
<tr>
<td><strong>Output:</strong> Candidate zone map and supply curves (one per area)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>STEP 3. CANDIDATE ZONES SELECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Summary:</strong> Identify areas with highest quality, developable resource</td>
</tr>
<tr>
<td><strong>Output:</strong> Screen exclusion areas</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>STEP 4. TRANSMISSION OPTIONS DEVELOPMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Summary:</strong> Gauge commercial interest</td>
</tr>
<tr>
<td><strong>Output:</strong> Identify areas where high quality resources intersect with commercial interest</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>STEP 5. FINAL TRANSMISSION PLAN DESIGNATION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Summary:</strong> Select scenario creation (bundling) methodology</td>
</tr>
<tr>
<td><strong>Output:</strong> Conduct cost-benefit analysis of options</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>STEP 6. TRANSMISSION SYSTEM UPGRADE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Summary:</strong> Select transmission option that best complies with predetermined criteria, including reliability standards, economic benefits, and environmental goals</td>
</tr>
<tr>
<td><strong>Output:</strong> Final transmission order</td>
</tr>
</tbody>
</table>


(Lee, Flores-Espino, and Hurlbut 2017)
Renewable Energy Zones (REZ) Toolkit

Online platform with information and tools to aid practitioners in successfully deploying the REZ Process around the world.

Toolkit Resources for REZ:

- Process guidebook for practitioners [www.nrel.gov/docs/fy17osti/69043.pdf](http://www.nrel.gov/docs/fy17osti/69043.pdf)
- Technical assistance for the REZ Process
- Learning and training sections
- Topical quick-reads and in-depth resources
- Tools, templates, and exercises

Coming Soon! [Greeningthegrid.org](http://Greeningthegrid.org)
REZ Process: A Guidebook for Practitioners

• Helps power system planners, key decision makers, and stakeholders apply the REZ process

• Presents an organizational structure for an effective, stakeholder-inclusive REZ Process

• Details each step of the REZ process from identifying a vision to transmission upgrades

• Based on the Texas Competitive Renewable Energy Zones (CREZ) initiative and may be modified based on each country’s or application’s unique circumstances.
Key Takeaways on the REZ Process and REZ Toolkit

1. The REZ Process is a transmission planning process. It is not (just) a mapping exercise to develop an RE resource atlas.

2. Successful implementation of the REZ Process enables integrated transmission and RE generation development to harness the best and most developable RE resources and deliver the lowest possible cost electricity from renewable generation.

3. The REZ Toolkit offers resources and technical assistance to help practitioners understand and implement the REZ Process.
Thank You!

Nathan Lee
nathan.lee@nrel.gov