



The Regional Energy Deployment System (ReEDS): An Open-Access Model for the North American Electricity System

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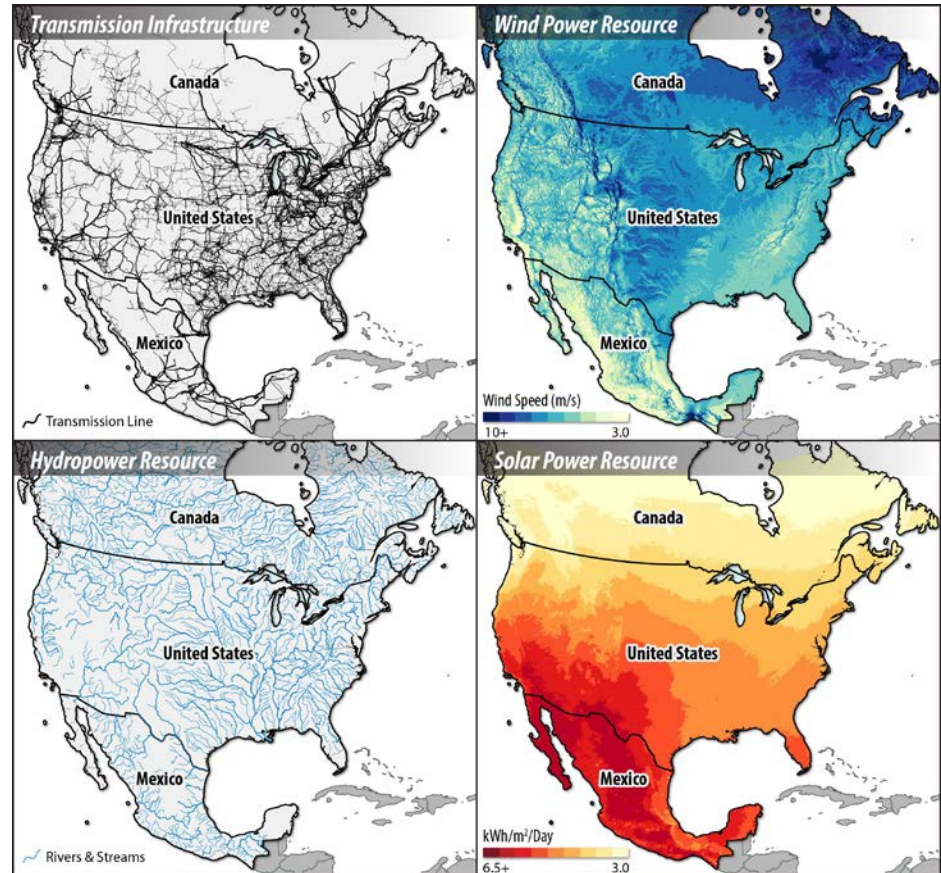
North America Is **Diverse** in Energy Resources and Load

Preliminary Findings, Not for Quotation or Distribution

The availability of natural resources varies widely across regions.

So does how and when energy is used on the grid.

A modern power system can take advantage of this diversity to provide reliable, affordable, sustainable power.





Goals of this presentation

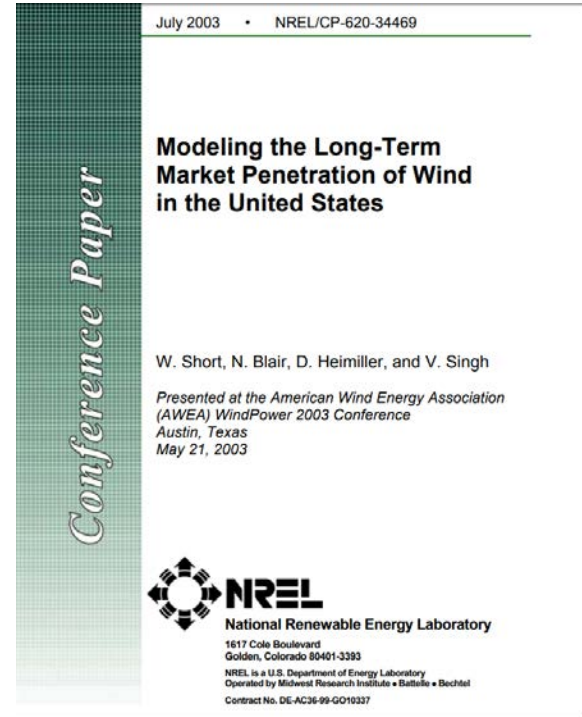
1. History and Overview of ReEDS
2. North American Modeling using ReEDS
3. Brief Introduction to Open Access ReEDS

History of ReEDS



In 2003, NREL identified a need for advanced tools for modeling emerging wind technologies.

“The large scope and focus on today’s dominant conventional energy forms [in existing models] do not allow a detailed treatment of the more important issues for wind energy technologies.”



WinDS (2001) → ReEDS (2008) → ReEDS 2.0 (2019)

1999 – Spreadsheet model leveraging GIS data

2001 – Built an optimization model for wind called WinDS

2008 – Recast as ReEDS (expanded to more technologies)

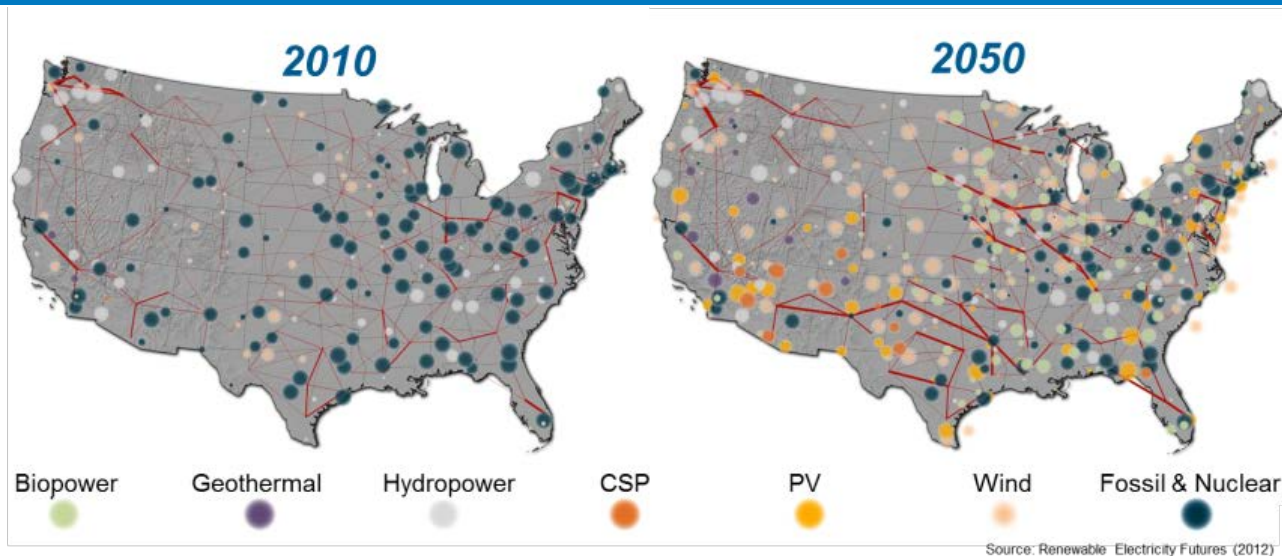
2016 – Incorporation of Canada and Mexico

2017 – ReEDS 2.0 development began (rewrite; new features)

2018 – North American Renewable Integration Study began

2019 – Open Access ReEDS (2.0) released

What does ReEDS 2.0 do?

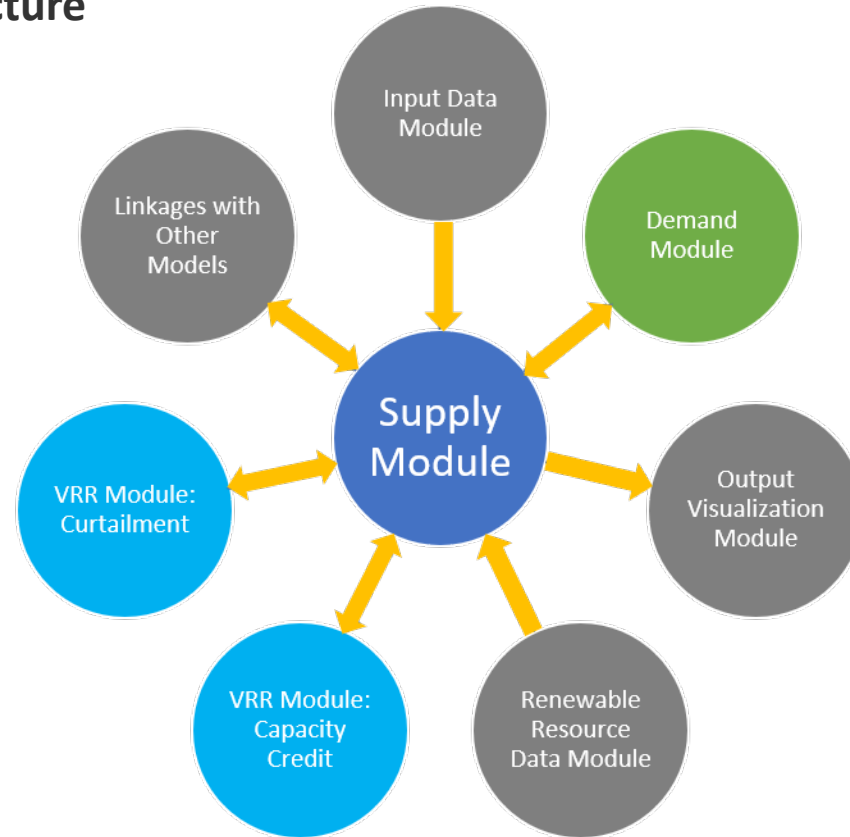


Given a set of input assumptions, ReEDS optimizes the evolution and operation of generation, transmission, and end-use demand and associated technologies.

ReEDS 2.0 Features

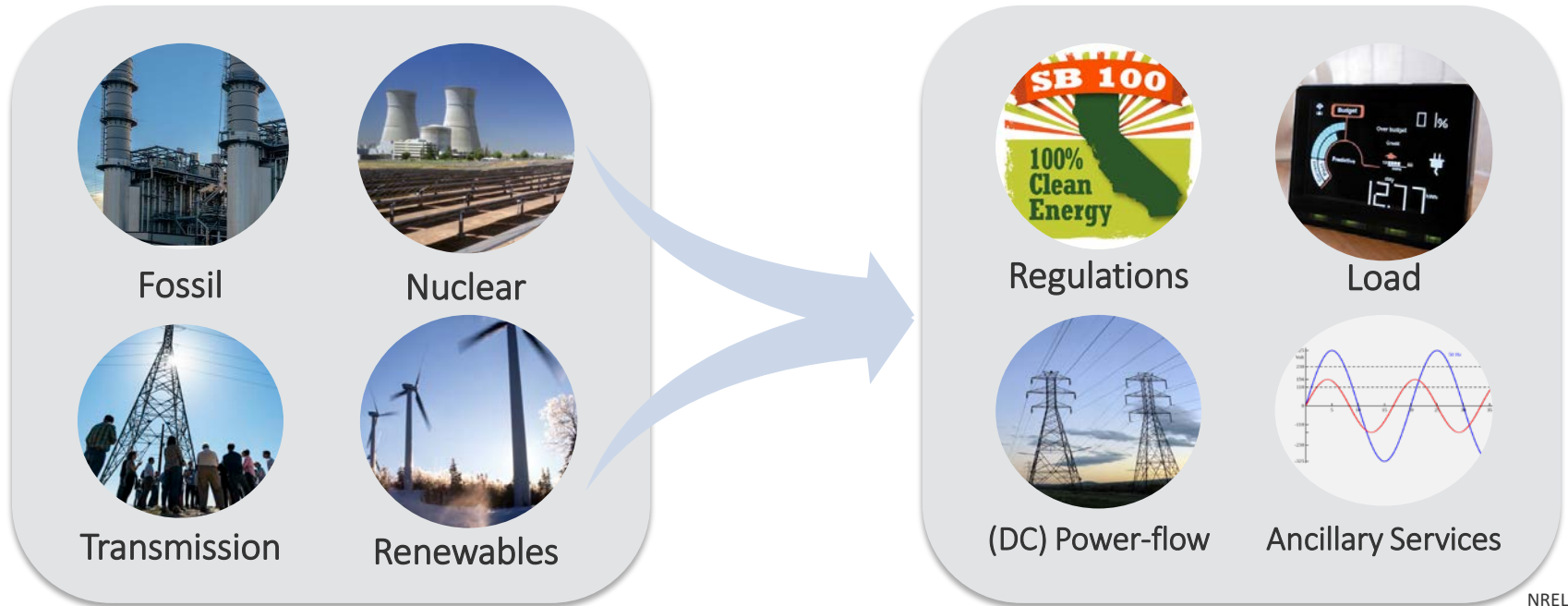
- **Uniform architecture**—highly generalized and flexible implementation
- **Flexibility in:**
 - Capacity detail—maintain high plant-level detail or aggregate; track vintages
 - Modeled years and time-horizon – user-defined resolution
 - Regionality – quickly shrink or expand model
 - Foresight – sequential (myopic), intertemporal (perfect), or sliding-window
 - Retirements – endogenous, exogenous, or mixed
- **Demand-side module:** includes a representation of consumer decision-making around energy service consumption, device adoption, and electricity consumption
- **Endogenous calculation of VRE integration challenges:** capacity credit and curtailment
- **Endogenous calculation of non-energy electricity service requirements:** e.g. frequency regulation, contingency, forecast-error

ReEDS Module Structure

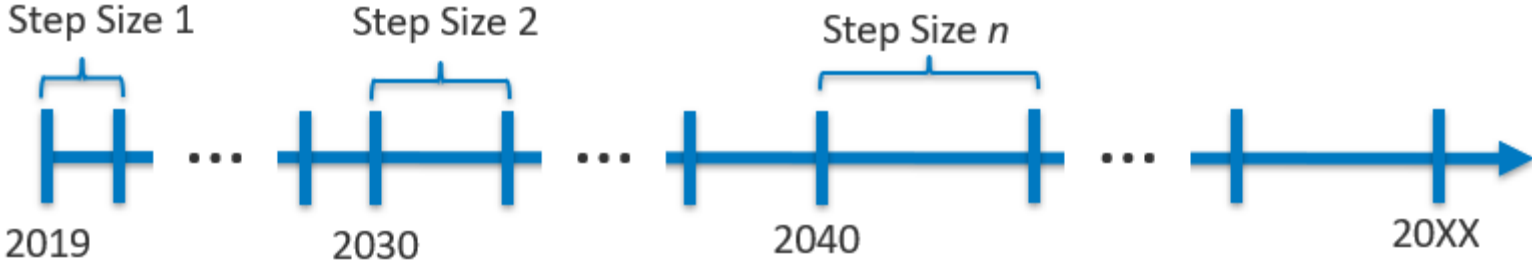


How the supply-side module work?

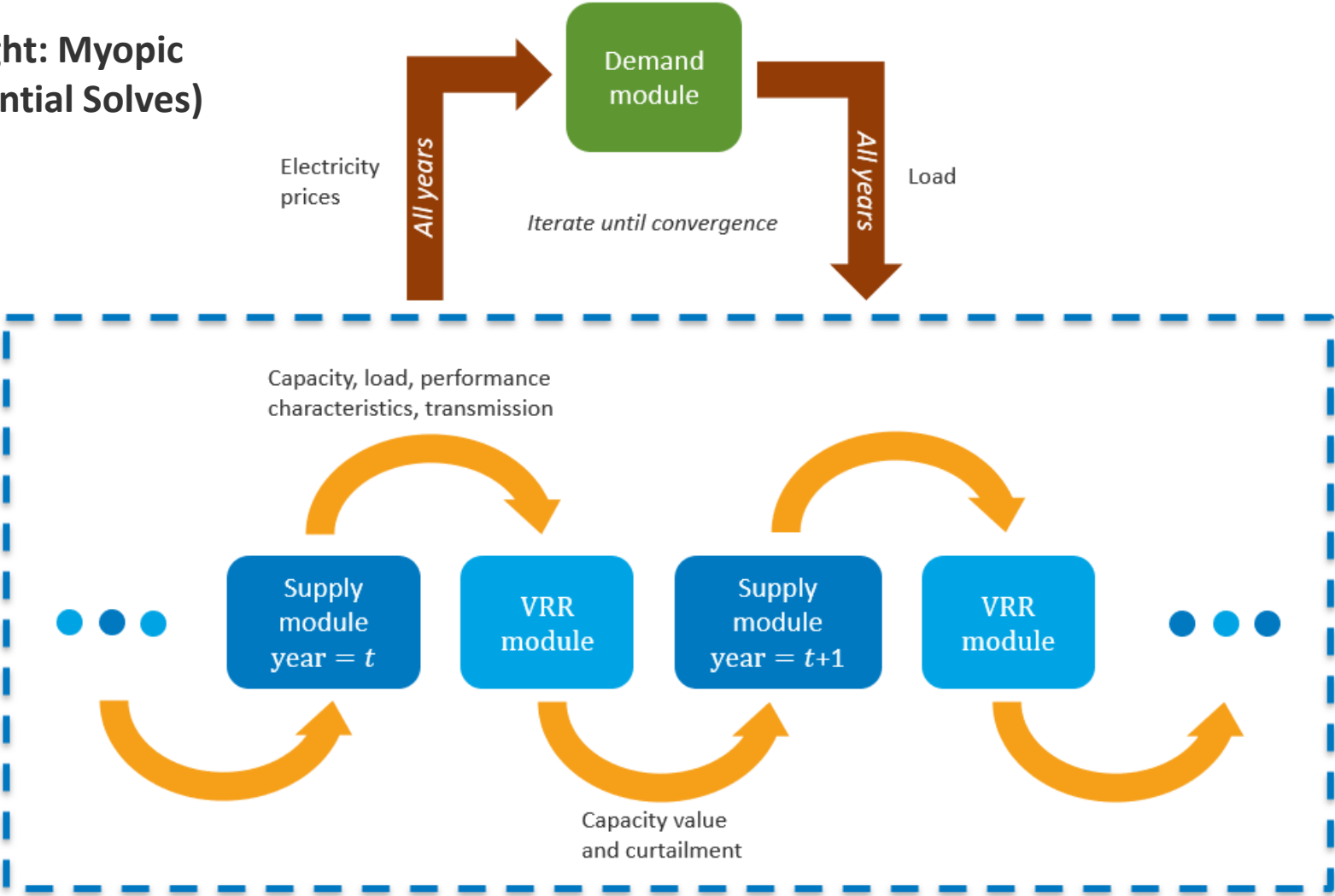
The ReEDS supply-module identifies the *least cost mix and operation* of resources that simultaneously meets load, all other electricity service requirements (planning reserves, operating reserves), and physical and environmental constraints.



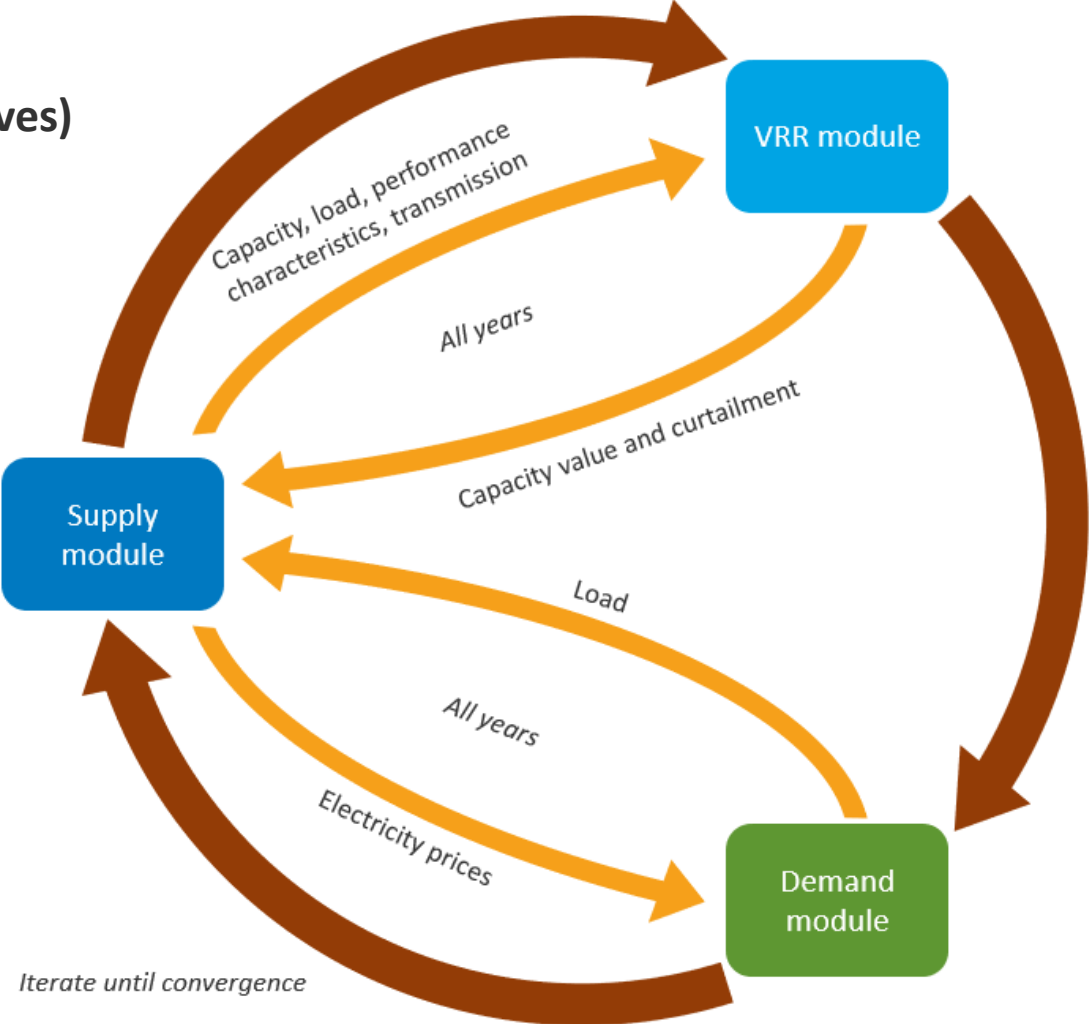
User-specified model years



Foresight: Myopic (Sequential Solves)



Foresight: Perfect (Intertemporal Solves)



Modeling the North American Power Systems with ReEDS



ReEDS US + Canada (2013, 2015, 2017)

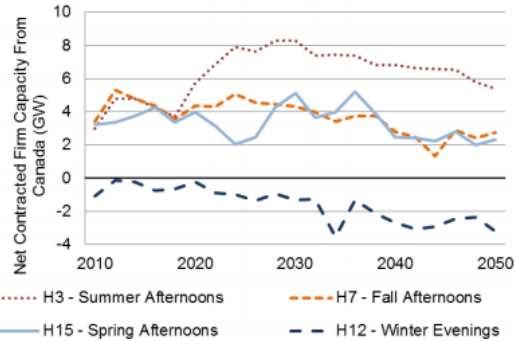


Figure 21. Net exported contracted firm capacity from Canada for the reference scenario



Goals:

- Demonstrate the Canada-US modeling capability
- Analyze international transfers of grid services
- Quantify the potential value of cross-border transmission

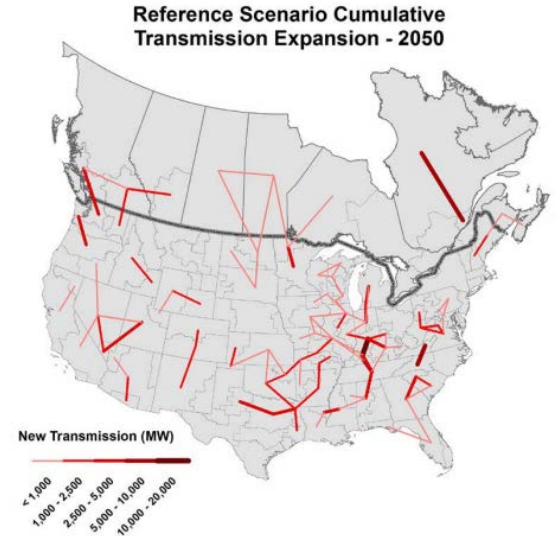


Figure 19. Inter-BA transmission lines deployed between 2010 and 2050 in the reference scenario

ReEDS Mexico (2017)

Transmission investments in MEXICO



Figure 16. Transmission investments up to 2050 under Reference scenario

Final UPV & DUPV capacity in MEXICO

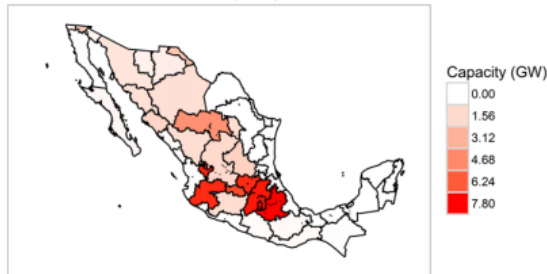


Figure 18. 2050 Wind capacity per region under Reference Scenario

Goals:

- Demonstrate the ReEDS Mexico modeling capability
- Final step in preparation for North American analysis

Generation at busbar by year in MEXICO

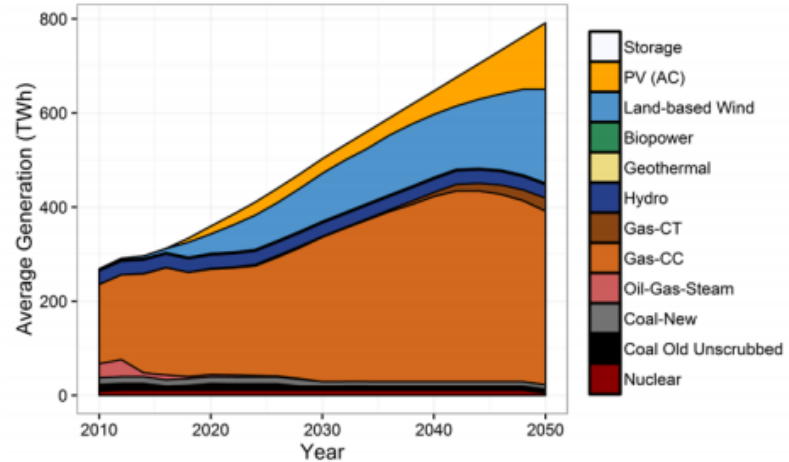


Figure 15. Mexican power system generation mix from 2010-2050 under Reference scenario.



The North American Renewable Integration Study

State-of-the-art analysis of the U.S., Canada, and Mexico power systems, from planning through operations

WHAT WE'RE STUDYING

- Long-term pathways to a modern power system in North America
- Operational feasibility of very high-penetration scenarios
- Weather variability and uncertainty
- Value of enabling technologies: flexible hydro, thermal generation, demand response, storage, transmission
- Value of operating practices: interchange, enhanced scheduling, local generation, reserve provisions



Canada

SENER
SECRETARÍA DE ENERGÍA



How it Works: Modeling Flow

SCENARIO CREATION MODELS

DETAILED SCENARIO ANALYSIS TOOLS

DATA



wind



water



solar



thermal



power system

CAPACITY EXPANSION MODEL: NREL ReEDS

Transmission and generation buildout

DISTRIBUTED GENERATION MODEL: NREL dGen

Behind-the-meter buildout

SCENARIOS

What gets **built** and where?

How does it **compare** to other scenarios?

OPERATIONAL (PRODUCTION) MODEL: Energy Exemplar PLEXOS

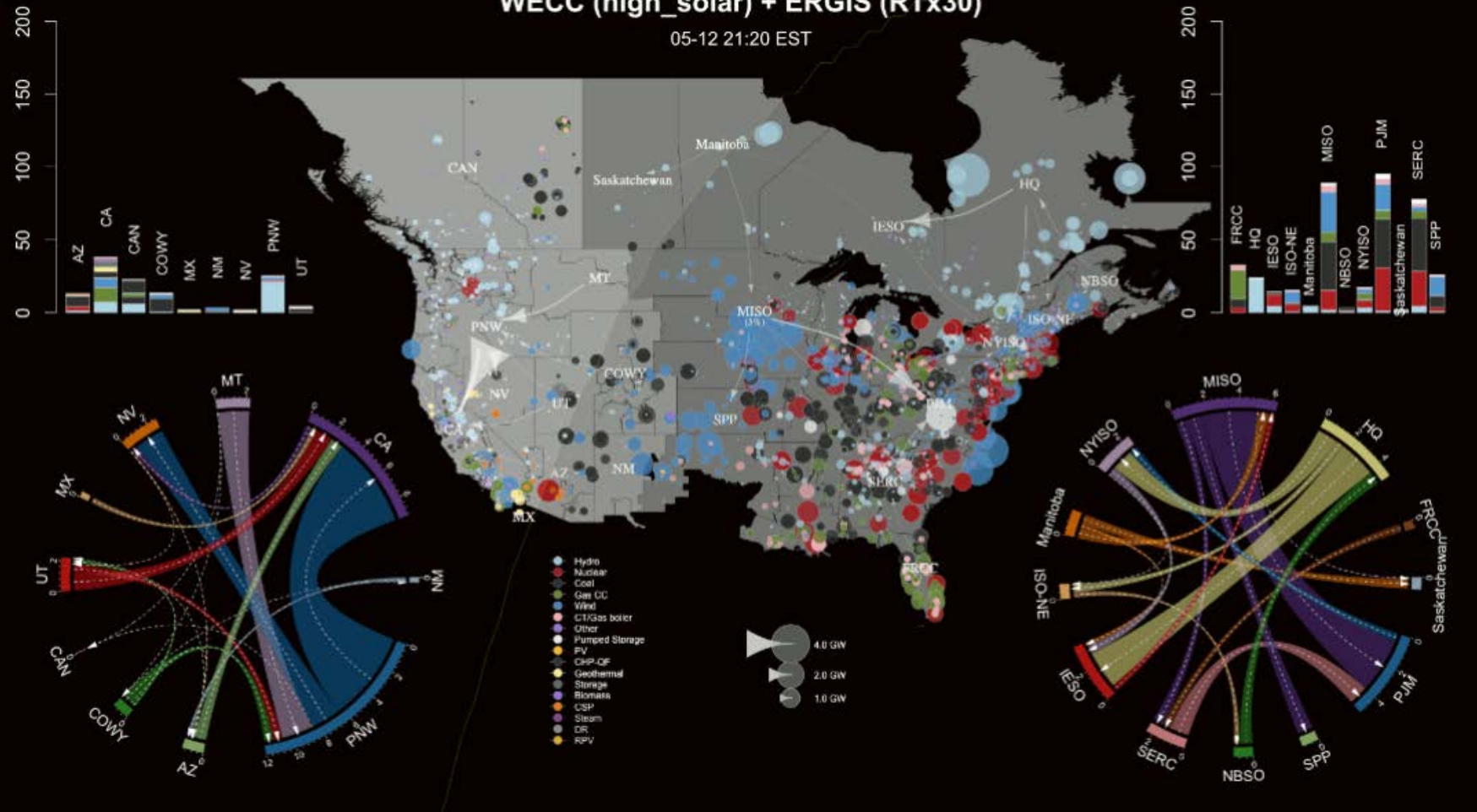
Operational analysis:
Unit commitment and dispatch at 5-minute resolution

DEEPER ANALYSIS:

Power flow
Reliability / resource adequacy
Electrification (hourly profiles)
Generation siting

WECC (high_solar) + ERGIS (RTx30)

05-12 21:20 EST



Open Access ReEDS

Requesting Access

U.S.-Only ReEDS Model Available

The U.S.-only version of the ReEDS model is now publicly available. To use, you must request access to NREL's Github repository.

REQUEST ACCESS

<https://www.nrel.gov/analysis/reeds/>

The screenshot shows the 'Request Access' page on the NREL website. The navigation bar includes 'Home', 'About', 'Request Access' (highlighted), 'Staff', 'Publications', and 'Contact Us'. The main heading is 'Request Access to Download Model'. Below this, a paragraph states that the ReEDS model and standard scenario inputs are available in NREL's private repository on GitHub, and that users must agree to the user agreement's terms before requesting access. A section titled 'The user agreement intends to:' lists three bullet points: protecting NREL against misuse, encouraging transparency in model implementation, and documenting changes to the model construction, input data, and assumptions. To the right, a 'Model Resources' box provides information and resources to help get started, with a link to 'about the ReEDS model'. Below this, the 'End User Software License Agreement' section is visible, starting with a paragraph about the agreement between the Alliance for Sustainable Energy, LLC and the user.

Home About **Request Access** Staff Publications Contact Us

Request Access to Download Model

The Renewable Energy Deployment System (ReEDS) model and standard scenario inputs are available in NREL's private repository on GitHub. To request access to the repository, you first must agree to the user agreement's terms below.

The user agreement intends to:

- Protect NREL against misuse or inappropriate use of the model
- Encourage transparency in model implementation; i.e., if you publish results, document the changes you made to the model construction, input data, and assumptions.

Model Resources
For information and resources to help you get started, see [about the ReEDS model](#).

End User Software License Agreement

This License Agreement ("Agreement") is between the Alliance for Sustainable Energy, LLC ("Alliance"), the manager and operator of the National Renewable Energy Laboratory ("NREL") for the U.S. Department of Energy (the "DOE") and you ("Licensee") hereinafter "Party" or collectively the "Parties." By clicking "I Agree" on the form from which you accessed this Agreement, or by accessing or using the Software described hereunder, you agree to be bound by the terms of this Agreement.

NREL GitHub Repository Access Request

Complete and submit this form to request access to NREL's GitHub repository that contains the Regional Energy Deployment System (ReEDS) model and inputs.

Note: A GAMS (General Algebraic Modeling System) license and appropriate solver will be required to run the model. Learn more [about the model](#).

First Name (Required)

Last Name (Required)

Email Address (Required)

GitHub Username (Required)

Please read the [terms of user agreement](#)

I accept the terms of the user agreement (Required)

Yes

https://github.com/NREL/ReEDS_OpenAccess

NREL / ReEDS_OpenAccess Private

Watch 23 Star 4 Fork 1

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No description, website, or topics provided. Edit

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6 commits 1 branch 0 releases 3 contributors

Branch: master New pull request Create new file Upload files Find file Clone or download

File/Folder	Description
wesleyjcole Bug fixes: ...	
bokehpivot	Initial Commit of Version 2019 of ReEDS 2.0
demand	Initial Commit of Version 2019 of ReEDS 2.0
images	Add new README.md
input_processing	Initial Commit of Version 2019 of ReEDS 2.0
inputs	Bug fixes:
.gitignore	Initial Commit of Version 2019 of ReEDS 2.0
README.docx	Add README.docx

ReEDS 2.0

Welcome to the Regional Energy Deployment System (ReEDS) Model!

This GitHub repository contains the source code for NREL's ReEDS model. Users of this source code agree to the ReEDS licensing agreement <https://nrel.gov/analysis/reeds/request-access.html>. The ReEDS Version 2019 source code is available at no cost from the National Renewable Energy Laboratory. The ReEDS model can be downloaded or cloned from https://github.com/NREL/ReEDS_OpenAccess. New users must request access to the ReEDS repository through <https://nrel.gov/analysis/reeds/request-access.html>.

Get a ReEDS 101 on Oct. 31

- On Thursday, Oct. 31, at 11 a.m. Mountain Time, NREL will host a free webinar explaining the ReEDS model and its uses, as well as opening the floor for Q&As.
- Please join us to learn more about how ReEDS can lead to better-informed energy decisions, policies, and infrastructure planning.

Thank you!

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NREL/PR-6A20-75170

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