



Beyond the Map *Data and Tools for Renewable Energy Research*

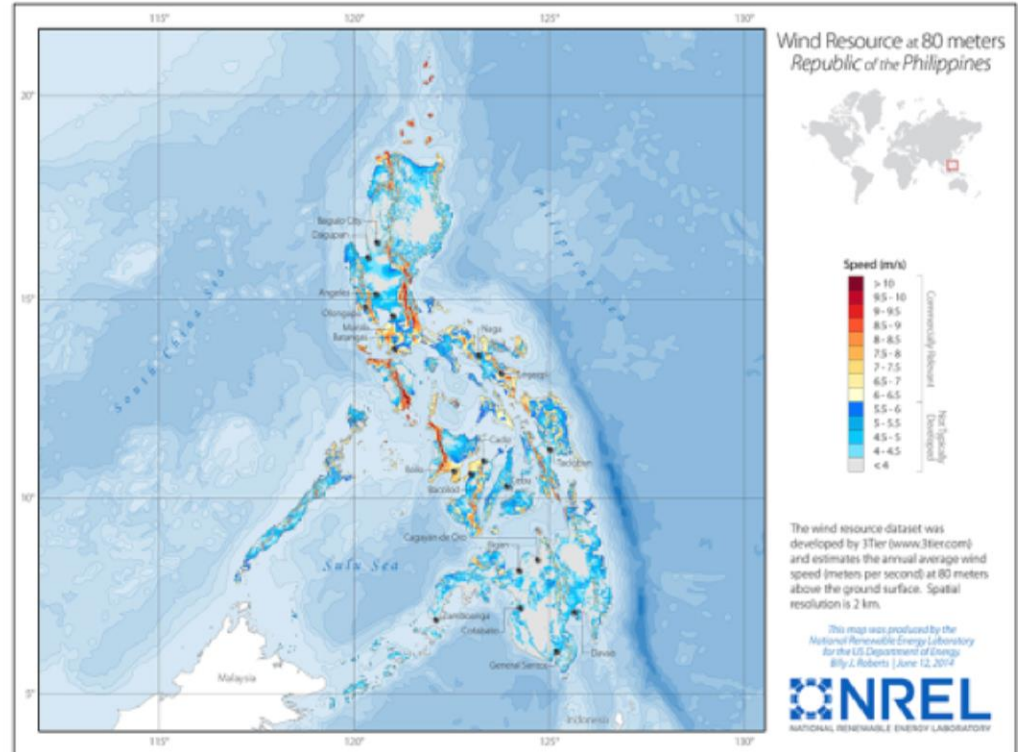
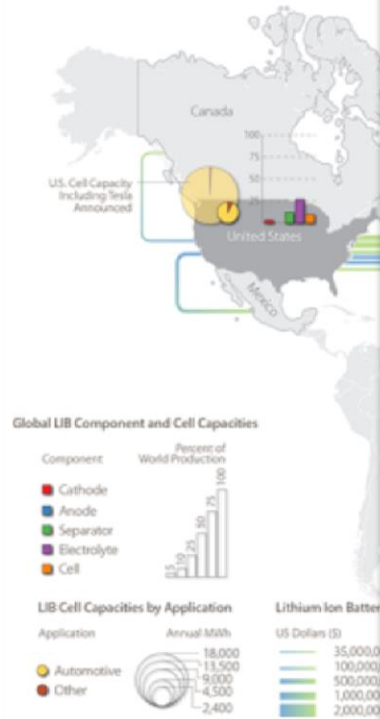
Anthony Lopez

Senior Geospatial Data Scientist

National Renewable Energy Laboratory

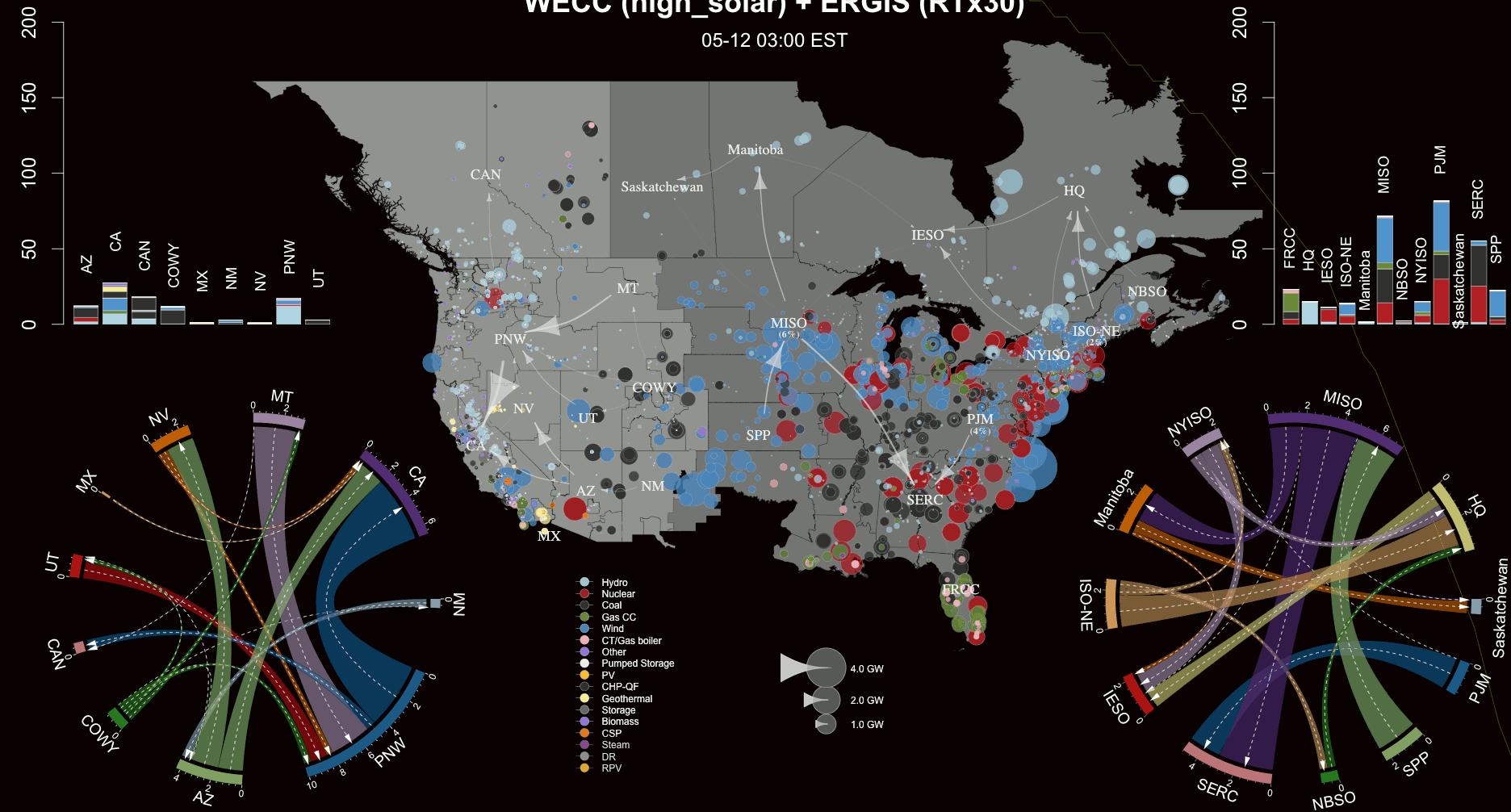
August 30, 2017

Disclaimer... I love maps

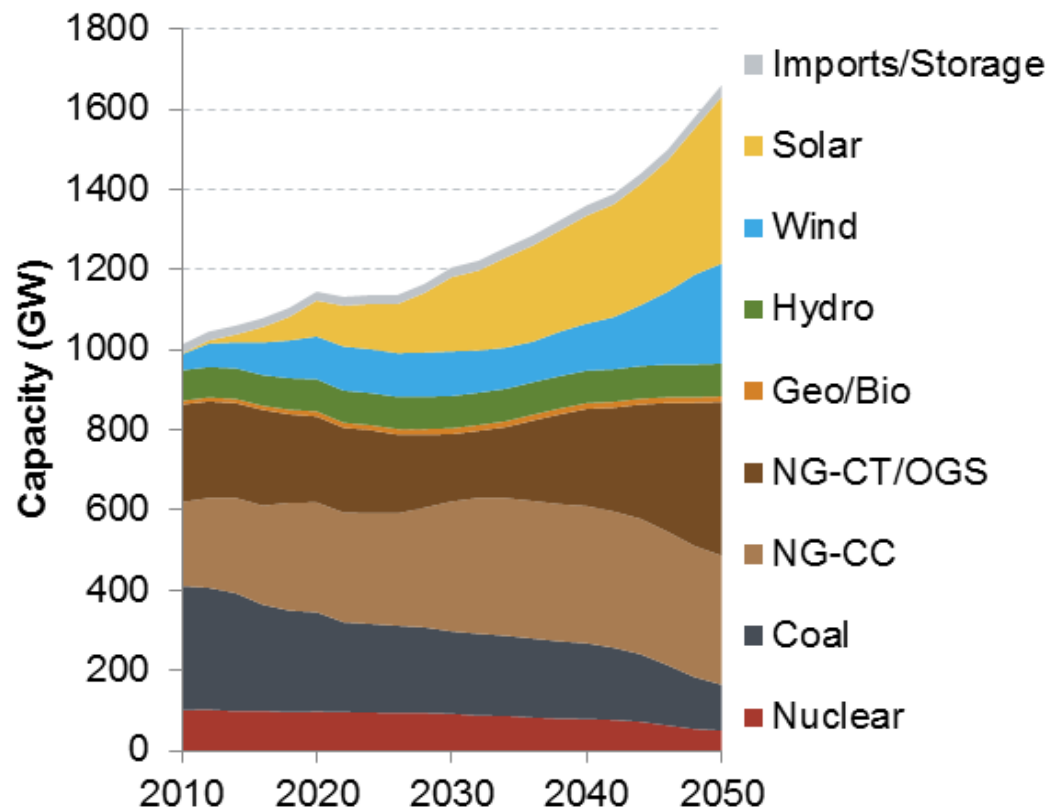
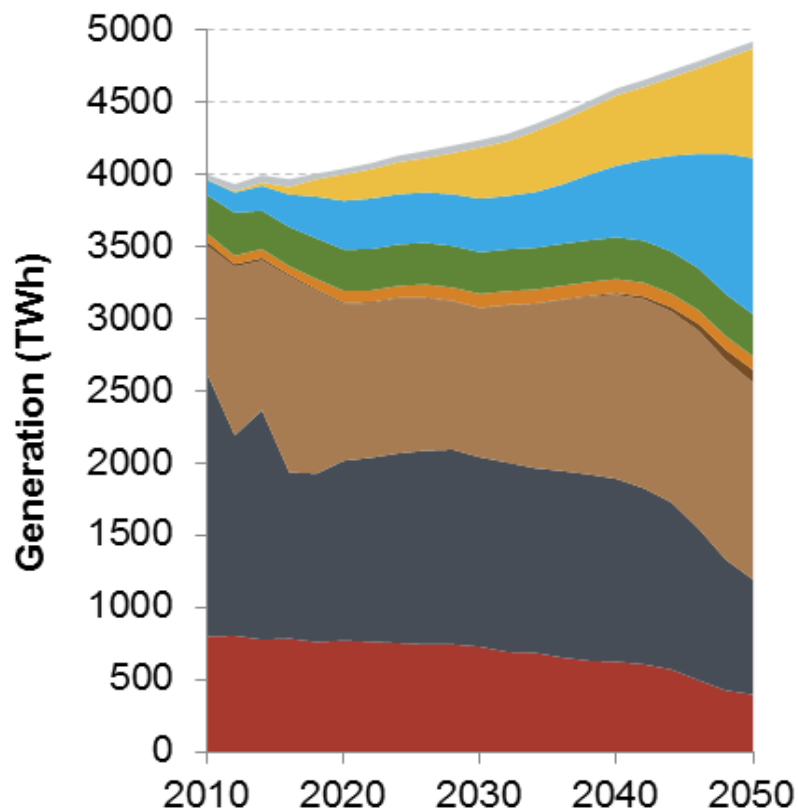


WECC (high_solar) + ERGIS (RTx30)

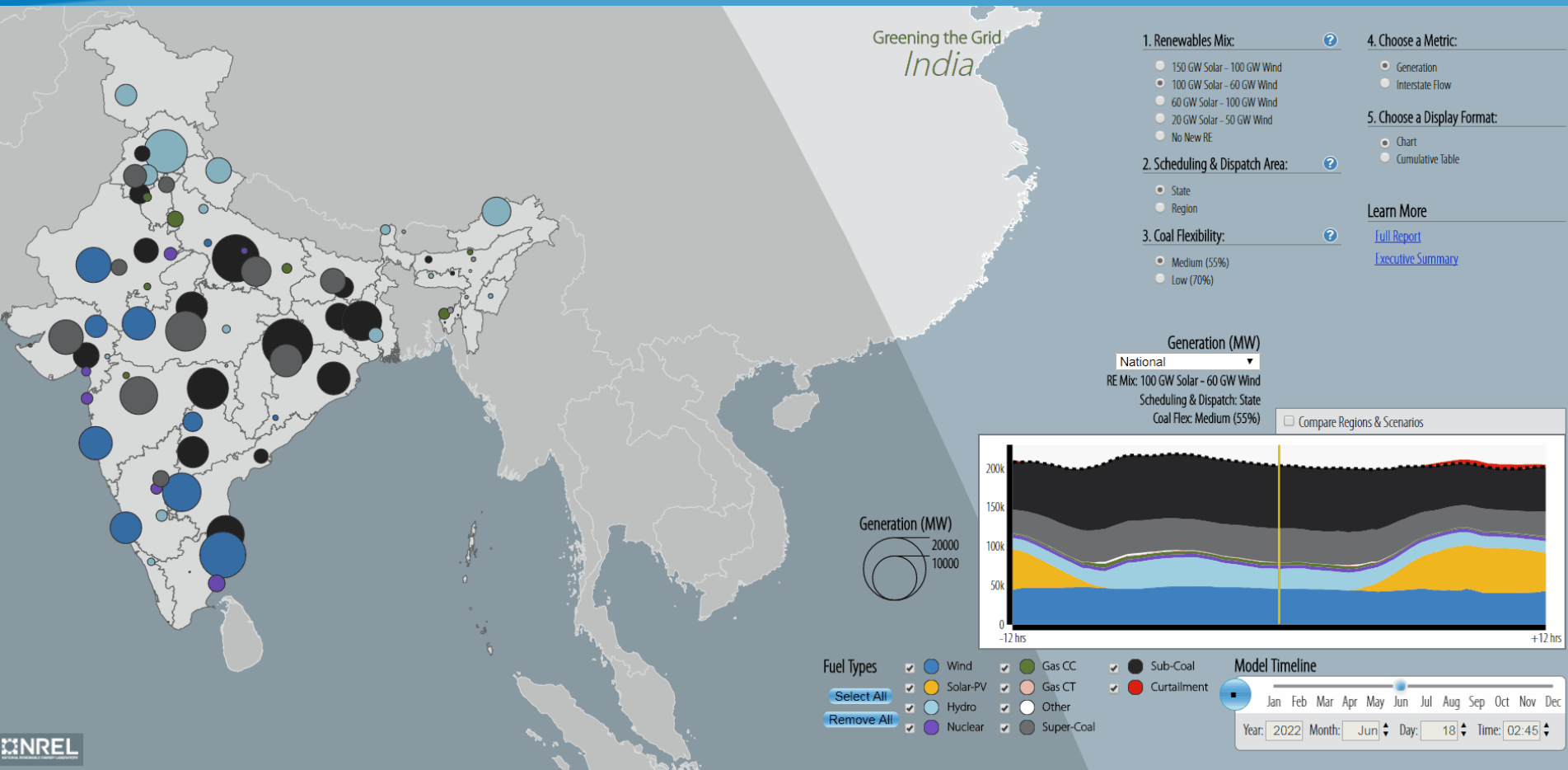
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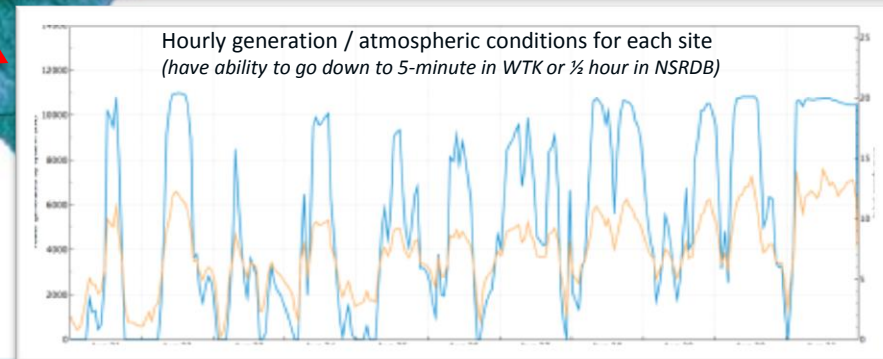
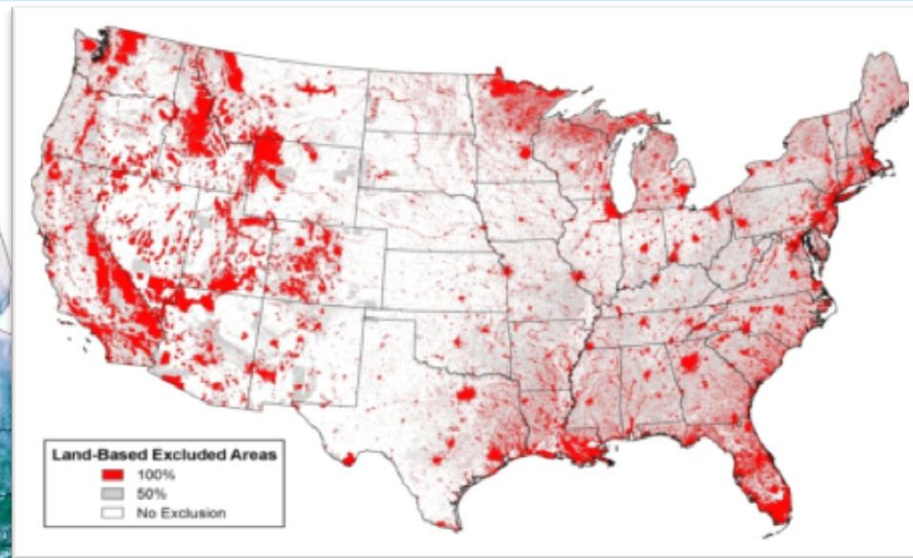
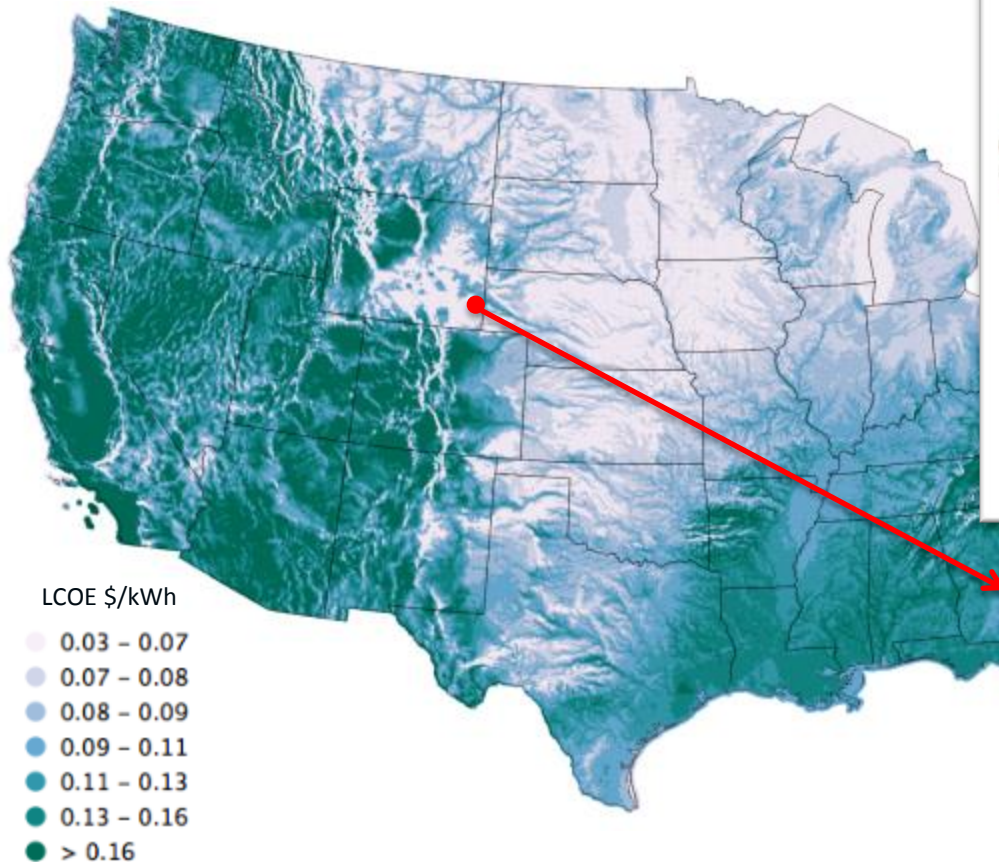
Technology Cost and Deployment Projections



Greening the Grid in India



Detailed Earth Observations Required for Detailed Research of RE





More Data, Better Resolution

- 1,000 times more wind and solar data, from GBs to TBs
- Transmission models have moved from 10s of nodes to nearly 100,000
- Every generator in North America, and many more around the world
- It's not just the data, it's the tools to use the data: Renewable Energy Potential model reV (above)

National Solar Radiation Database (NSRDB)

Select and Query Data

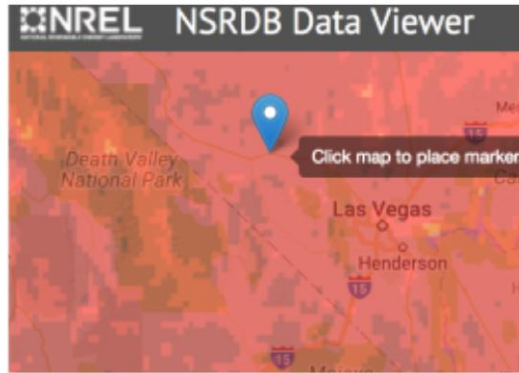
Download Data

NSRDB Data Download (Point)

Download resource data from the National Solar Radiation Database by point. This tool will return data for the station closest to the point drawn.

NSRDB Data Download (Box)

Download resource data from the National Solar Radiation Database by box. This tool will return data for all stations falling within the drawn region.



- Western Hemisphere
 - 2 million pixels
 - 19 years of ½-hourly irradiance and met
- South Asia
 - 100,000 pixels
 - 15 years of hourly irradiance and met
- GUI interface to download
- API for programmatic access

Data Download Wizard

Spectral TMY PSM SUNY MTS3 MTS2 MTS1

Physical Solar Model (PSM)

The National Solar Radiation Database (NSRDB) is a serially complete collection of hourly and half-hourly values of the three most common measurements of solar radiation—global horizontal irradiance, direct normal, and diffuse horizontal irradiance—and meteorological data. These data have been collected at a sufficient number of locations and temporal and spatial scales to accurately represent regional solar radiation climates.

Supported by the U.S. Department of Energy's SunShot Initiative, the NSRDB is a widely used and relied-upon resource. The database is managed and updated using the latest methods of research by a

[Documentation](#)

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[Contact](#)

Select Years

Select All Clear All

☐ 1998 ☐ 1999 ☐ 2000 ☐ 2001 ☐ 2002 ☐ 2003
☐ 2004 ☐ 2005 ☐ 2006 ☐ 2007 ☐ 2008 ☐ 2009
☐ 2010 ☐ 2011 ☐ 2012 ☐ 2013 ☐ 2014 ☐ 2015

Select Attributes

The minimum required attributes for the SAM PV and CSP models have been selected by default.

☒ DHI ☒ DNI ☐ GHI
☐ Clearsky DHI ☐ Clearsky DNI ☐ Clearsky GHI
☐ Cloud Type ☒ Dew Point ☒ Temperature
☒ Pressure ☒ Relative Humidity ☐ Solar Zenith Angle

Select Download Options

Select All Clear All

☐ Include Leap Day ☒ Convert UTC to Local Time ☒ Half Hour Intervals

Download Limit Indicator

[Edit User Info](#)

[Download Data](#)

Coming Soon...

- Google Storage and BigQuery
- Amazon S3
- Spectral for any pixel

Wind Toolkit (WTK)

Select and Query Data Analysis & Downloads

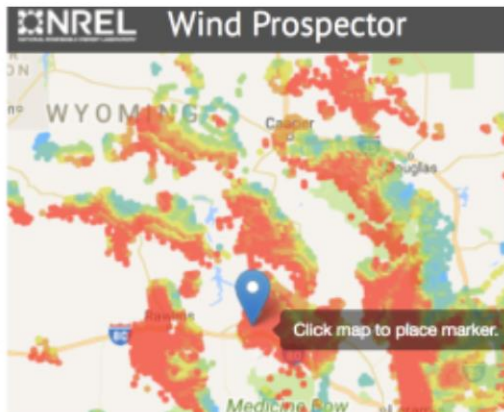
Wind Power Analysis

Run an analysis on the amount of yield that can be produced in a specific area

Wind Resource Data Download (Point)

Download resource data from the [Wind Integration National Dataset \(WIND\) Toolkit](#), [Western Wind Dataset](#) or [Eastern Wind Dataset](#) (where available) by point. This tool will return data for the station closest to the point drawn.

Wind Resource Data Download (Box)



- Contiguous U.S.
 - ~150,000 locations
 - 7 years of 5-minute wind speed & power
- Philippines
 - ~? Locations
 - TMY
- GUI interface to download
- API for programmatic access

[Data Download Wizard](#)

WTK EWIS WWIS

Wind Integration National Dataset (WIND) Toolkit

The Wind Integration National Dataset (WIND) Toolkit is an update and expansion of the Eastern and Western Wind Datasets, and is intended to support the next generation of integration studies. The WIND Toolkit includes meteorological conditions and turbine power for more than 126,000 sites in the continental United States for the years 2007–2015.

The WIND Toolkit has been funded by the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Wind and Water Power Technologies Office, and was created through the collaborative efforts of the NREL and STIer.

[📄 Documentation](#)

Bri-Mathias Hodge
National Renewable Energy Lab
[Contact](#)

Select Years

[Select All](#)

[Clear All](#)

© 2007

© 2008

© 2009

© 2010

© 2013

© 2012

Select Attributes

[Select All](#)

[Clear All](#)

☒ Wind Power (MW)☒ Wind Direction (deg)☒ Wind Speed (m/s)☒ Temperature☒ Surface Air Pressure (Pa)☒ Density (kg/m³)

Select Download Options

Select All

[Clear All](#)

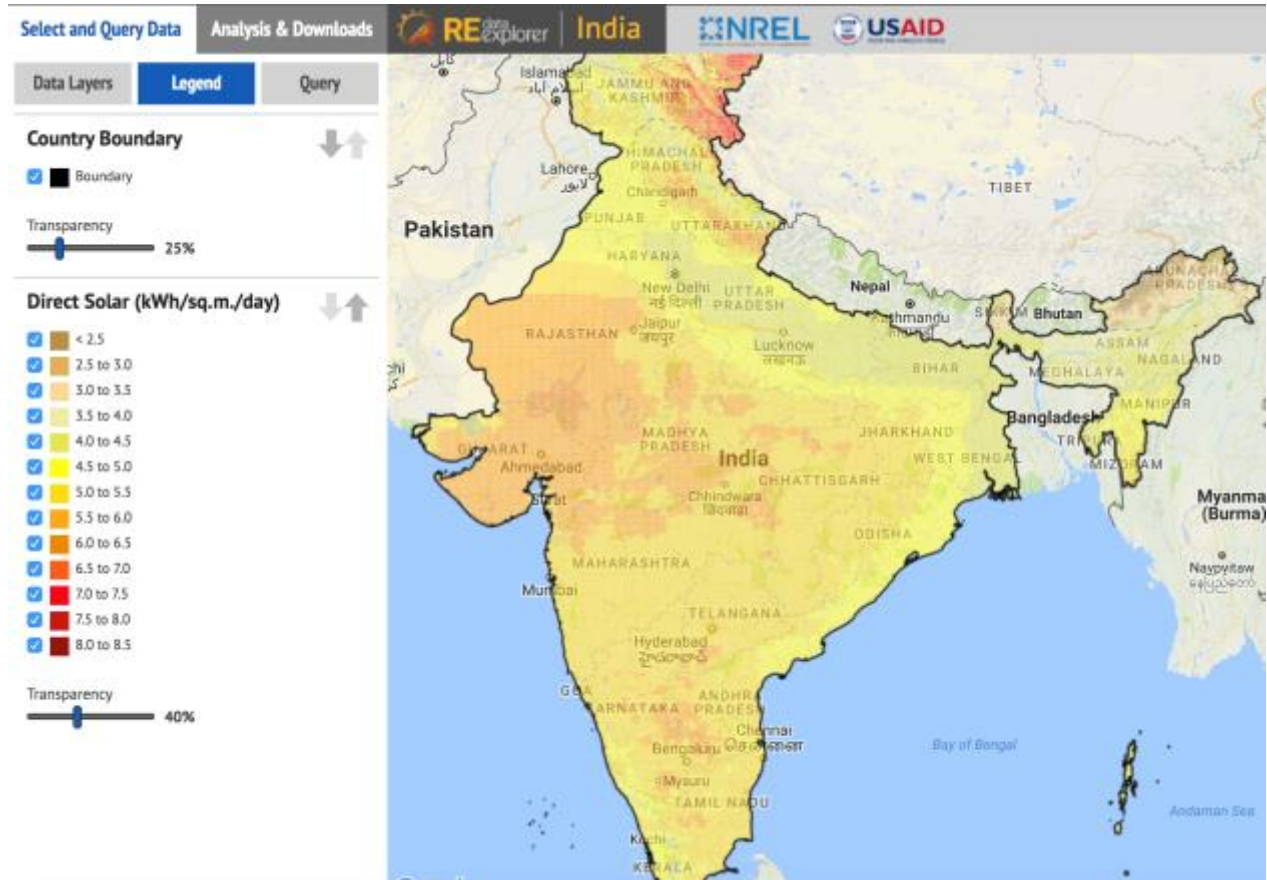
☐ Include Leap Day☒ Convert UTC to Local Time

Download Limit Indicator

[Edit User Info](#)Downloaded from <http://www.jstor.org/stable/2346092>

Renewable Energy Data Explorer (RED-E)

- No-cost, web-based application that enables energy resource exploration and decision-making for non-GIS experts
- Map-based platform for data visualization, geospatial analysis, and discovery to inform energy policy, planning, and investment
- Platform for distributing publicly available GIS data (many layers are downloadable)
- Available for 16 countries



Remaining Challenges...

- **Higher temporal resolution resource**
 - *1-minute is the new hourly*
- **Long-term resource data**
 - *What are the potential risks of climate variability?*
- **Load data is a key constraint**
 - *Coincident solar and wind resource are not enough, need synchronous load profiles for accurate modeling*
- **Increased spatial coverage of high resolution data**
 - *Modeling and detailed research opportunities are limited only by data availability*

Thank You

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NSRDB Viewer

<https://maps.nrel.gov/nsrdb-viewer>

Wind Prospector

<https://maps.nrel.gov/wind-prospector>

Renewable Energy Data Explorer

<https://www.re-explorer.org>

www.nrel.gov

