

Pathways to 100% Renewables across the MISO region

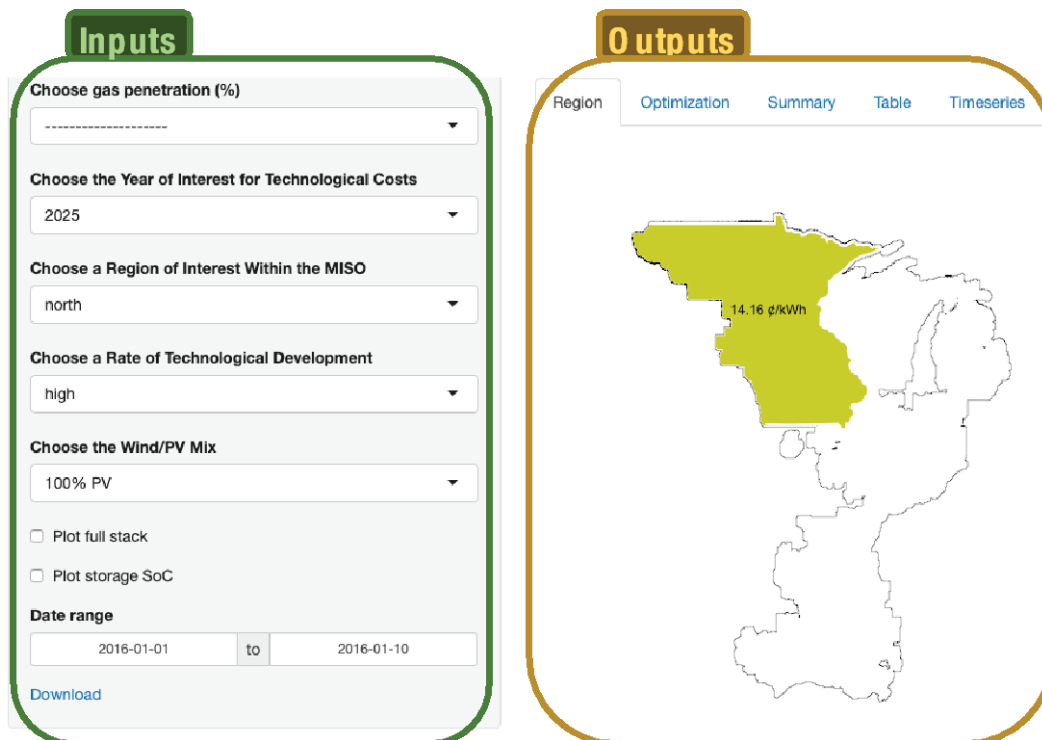
Full Study Results Webservice: UI Guide for <https://marcp.shinyapps.io/misov2/>

Intro

This project attempted to answer the fundamental question: how do we achieve 100% renewables across the MISO region while not breaking the bank? The project team used the Clean Power Transformation (CPT) model to optimize capacity expansion and dispatch across 14 distinct geographic zones, each with their own unique load and renewable resource characteristics. Optimal capacities of wind, PV and storage are identified and change depending on the underlying cost assumptions. In light of this, four cost scenarios were derived from the latest (2019) NREL Annual Technology Baseline (ATB.)

A presentation recapitulates a handful of these results but given time constraints, a UI has been developed for users to change assumptions related to cost and geographic scope. Thereby, users can reveal how these changed assumptions affect optimal capacity allocations and dispatch.

UI Intro



The screenshot displays the user interface for the MISO optimization tool, divided into two main sections: **Inputs** and **Outputs**.

Inputs Panel:

- Choose gas penetration (%):** A dropdown menu with a dashed line indicating the current selection.
- Choose the Year of Interest for Technological Costs:** A dropdown menu set to "2025".
- Choose a Region of Interest Within the MISO:** A dropdown menu set to "north".
- Choose a Rate of Technological Development:** A dropdown menu set to "high".
- Choose the Wind/PV Mix:** A dropdown menu set to "100% PV".
- Plot full stack
- Plot storage SoC
- Date range:** A date range selector showing "2016-01-01" to "2016-01-10".
- [Download](#) button.

Outputs Panel:

- Navigation tabs: **Region** (selected), Optimization, Summary, Table, Timeseries.
- A map of the MISO region with the northern portion highlighted in yellow.
- A data label on the map indicates a cost of "14.16 c/kWh".

The above figure highlights the general UI for viewing results. The left side of the UI is input-related and the right side is output-related.

Inputs

A shaded section on the left of the above plot allows users to change inputs. Five dropdown menus allow the user to change key assumptions underlying a given scenario while two radio buttons and the date-range selector are related to plotting of a portion of the dispatch stack under the timeseries tab.

Scenario-Related

- (1) The fixed percentage of gas in the final energy mix
→ Options are 0 and 5 %
- (2) The year of interest to query technological costs for storage, wind or PV
→ Options are 2025 and 2050
- (3) The region of interest within the MISO
→ Options are north, south, central, 1 – 10 and miso .
→ Each of these regions becomes highlighted in the map of the miso region at right upon selection.
- (4) The rate of technological development, which also influences technological cost
→ Options are high and low
→ high technological development yields lower projected costs and vice-versa
- (5) The wind/PV mix : Influences the relative energy contribution of wind and solar towards meeting load in the selected zone.
→ Options are 100% PV, 100% Wind and optimal which searches and optimizes the relative allocation

Timeseries-Related

The final options (two radio buttons, a date-range selector and a download link) are linked to the timeseries tab.

- Plot Full Stack – allows the user to see what happens to renewable energy when it exceeds load: is it curtailed or is it put into storage?
- Plot storage SoC – allows the user to see the state of charge of energy storage associated with the given scenario on a second y-axis to the right of the plot on the timeseries tab.
- Date range – A date range selector allows the user to see how dispatch is taking place at different times of year.

A download button allows the user to download a csv containing key dispatch timeseries for a given scenario.

Outputs

The following outputs corresponding to the chosen parameters are viewable in the series of tabs at right initialized with the map tab.

- (1) Region tab

→ Visualizes the region of interest superimposed upon the greater encompassing MISO region. Region color indicates the percentage of wind versus solar and the optimized LCOE is printed in the center of the region of interest.

(2) *Optimization Tab*

→ Visualizes the optimization of implicit storage (overbuilding + curtailment use) via a stacked area plot. Y axis is LCOE for firmly guaranteeing load and the components contributing to this LCOE are highlighted by different colors.

(3) *Summary Tab*

→ Summarizes the system characteristics underpinning the scenario in question.

(4) *Table Tab*

→ The same data as presented in the optimization tab but in tabular format.

(5) *Timeseries Tab*

→ Visualizes dispatch for a date range selected by the user. Storage state of charge is also available as a viewable option.