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NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

Interregional Transfer Capability Study

WECC RAC Meeting

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July 11, 2024

RELIABILITY | RESILIENCE | SECURITY




ITCS Scope: Fiscal Responsibility Act of 2023

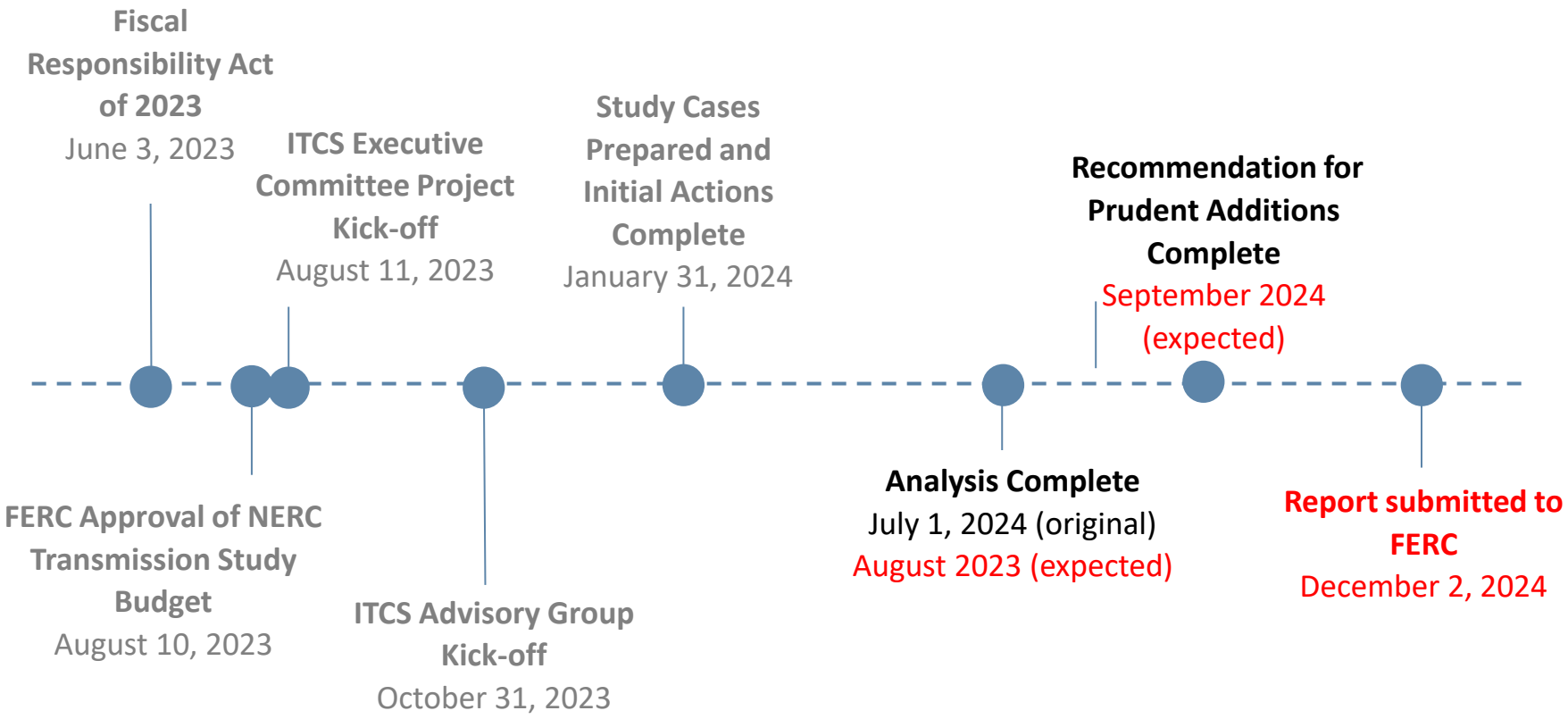
Part I: Calculate current transfer capability

Part II: Recommend prudent additions to transfer capability

Part III: Recommend how to meet and maintain transfer capability

ITCS Timeline Overview

The following is a timeline of key activities:



ITCS Objectives

ITCS aligns with ERO's obligations to perform reliability assessments

- Independent and objective
- System-wide perspective
- Reliability focus
- Collaboration and coordination
- Strategic planning
- Repeatable process

What This Study is NOT

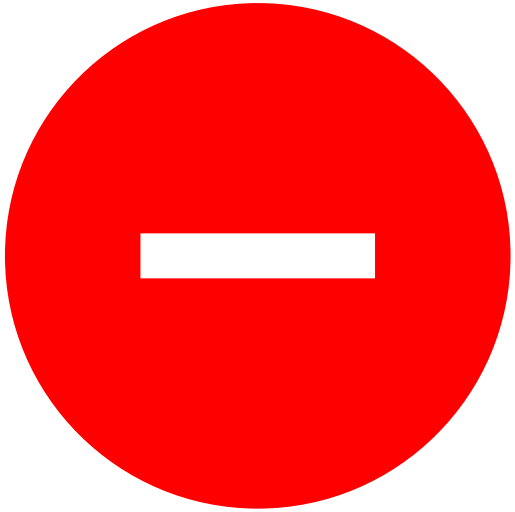
Planning Study

Replacement for Transmission Expansion Analysis and Interregional Planning Groups

No recommendations for specific projects (generation, transmission, etc.)

Focus on WHAT…not HOW

A complete solution



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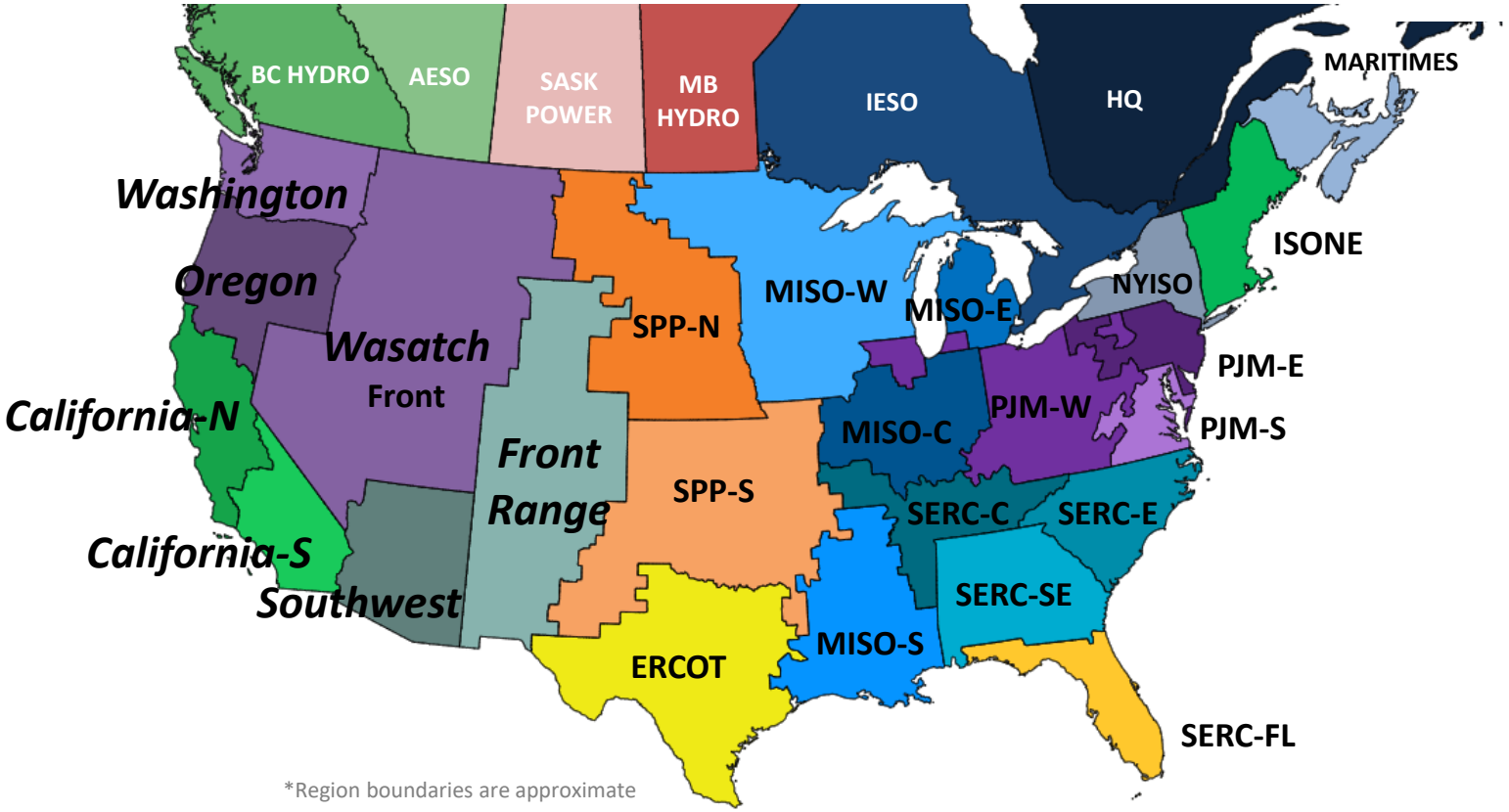
Analysis Regions



*Region boundaries are approximate

Part I Transfer Analysis - Scope

- **Total Transfer Capability = Base Transfers + FCITC (First Contingency Incremental Transfer**
- **Transfer Directions**
  - Non-simultaneous and simultaneous transfer analysis being performed between the neighboring regions
  - Transfers into or between Canadian provinces will be included as part of the Canadian Analysis to be published in early 2025
- **Modeling of Transfer Participation**
  - Each transfer simulated until a valid thermal limit is reached
  - A voltage screening performed for each transfer direction at the FCITC limit

Study Process Map and Scenario Matrix

Part 1: Transfer Analysis

Identify interregional transfer capability

Transfer Capability

Part 2: Prudent Additions

A North American Weather Event Dataset
(correlated and consistent load, wind, solar, weather dependent outages)

B Energy Margin Assessment
(Hourly energy margins by region throughout reliability events)

C Prudent Transfer Capability Additions
(Required transfer capability to mitigate shortfalls and reliability events)

	Current System	10-year Outlook
Summer Peak	*Quantify existing transfer capability*	
Winter Peak		
↓ ↓ ↓		
Cold Snap		
Heat Wave	*Identify prudent additions to transfer capability to mitigate reliability events*	
Renewable Drought		
Combined Risk		

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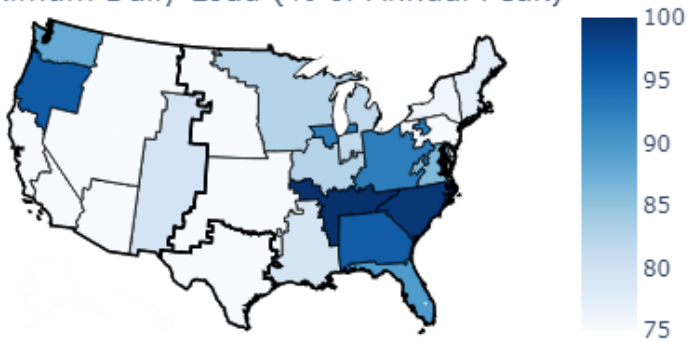
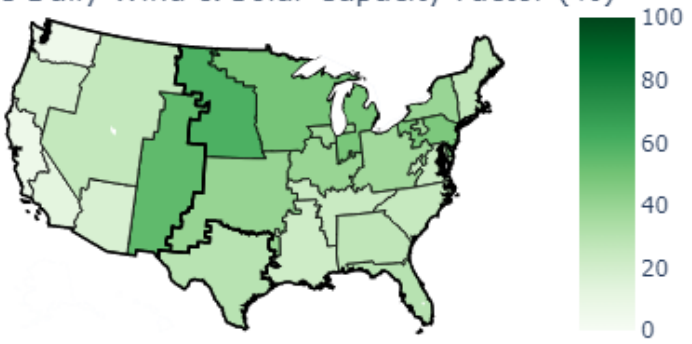
Energy Assessment Example: Cold Snap

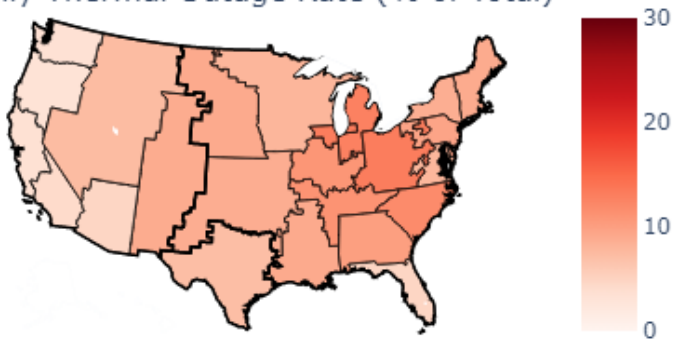
Maximum Daily Load (% of Annual Peak)



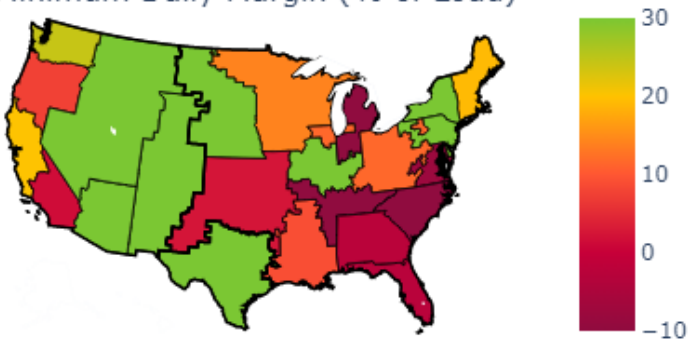
Average Daily Wind & Solar Capacity Factor (%)



Daily Thermal Outage Rate (% of Total)



Minimum Daily Margin (% of Load)



Assumes not interregional transfer. Deficit does not imply shortage, but rather reliance on neighbors

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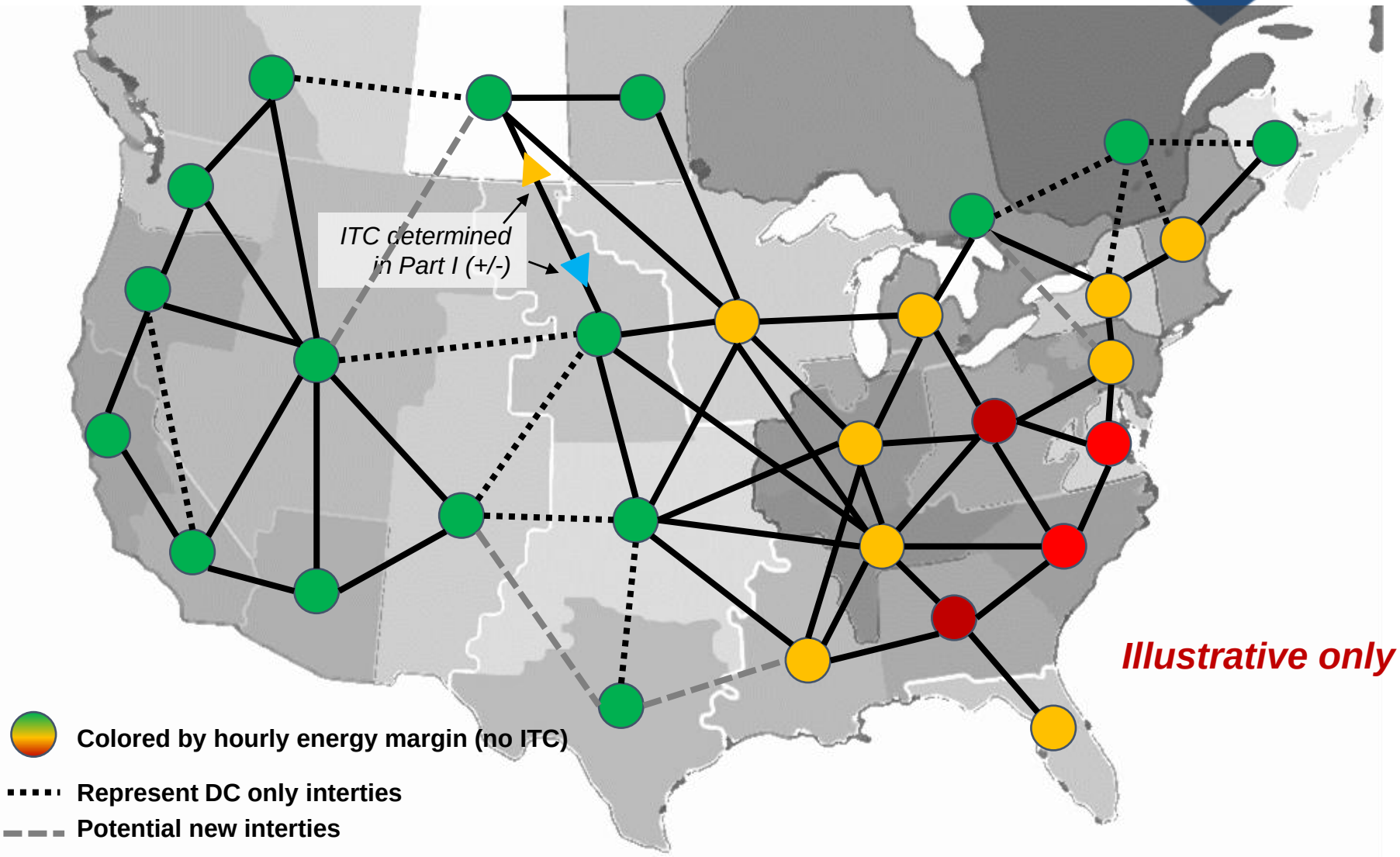
Pipe and Bubble Model



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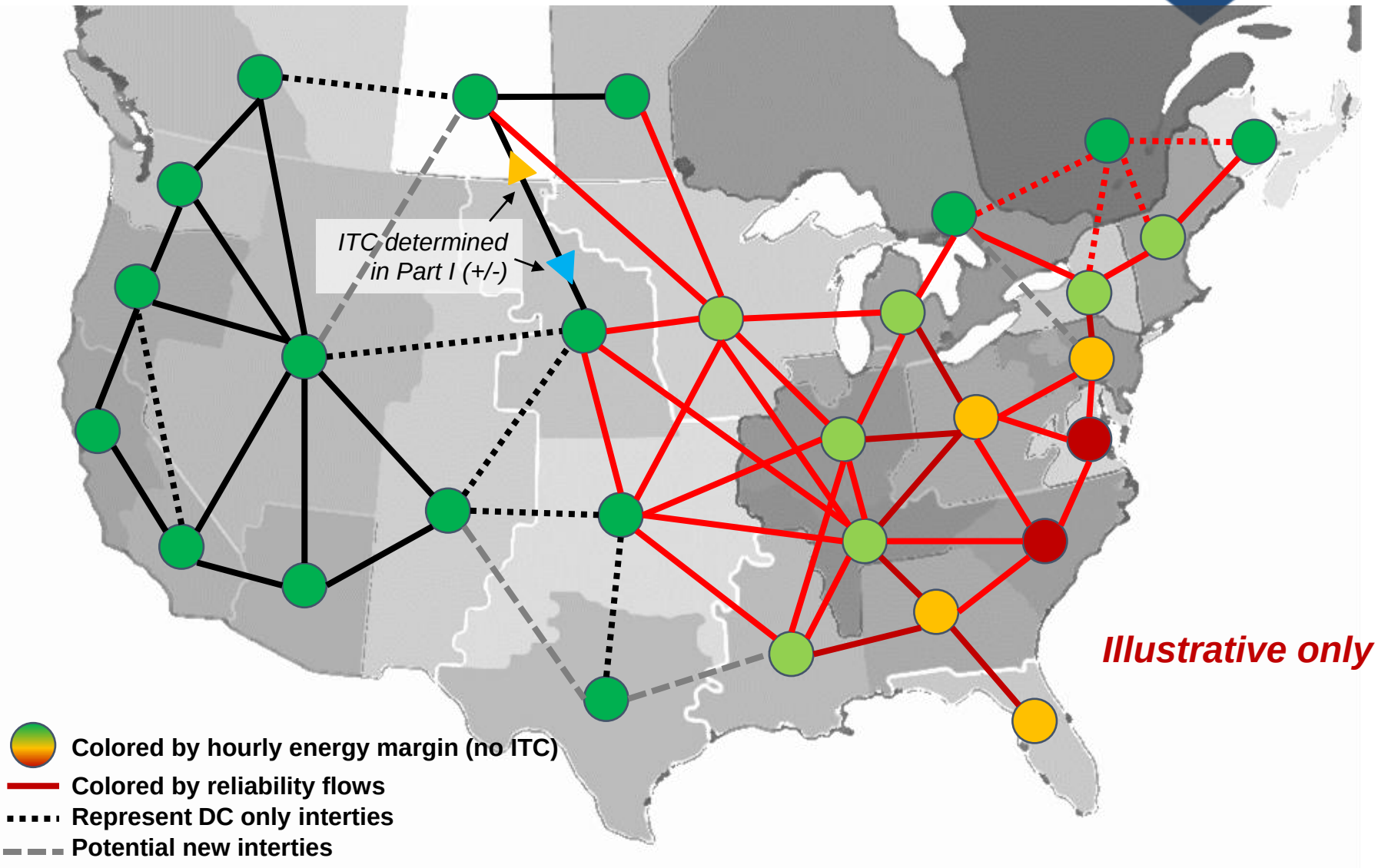


Hourly Energy Margin Calculation

Hourly Energy Margin =
- ***+ Available Wind & Solar***
- ***+ Seasonal Hydro Capacity***
- ***+ Available Thermal***
- ***– Weather Dependent Outages***
- ***+ Storage Net Gen***
- ***– (Load + Reserves)***

- ✓ *Hourly*
- ✓ *Time-synchronized*
- ✓ *Locational*
- ✓ *Consistent*

Hourly capacity factors by Source/Sink based on meteorological conditions.

Monthly maximum hydro output for normal and drought conditions

Seasonal rated capacity for coal, gas, oil, and nuclear generators

Forced outages based on daily temperature observations, plus normal planned maintenance

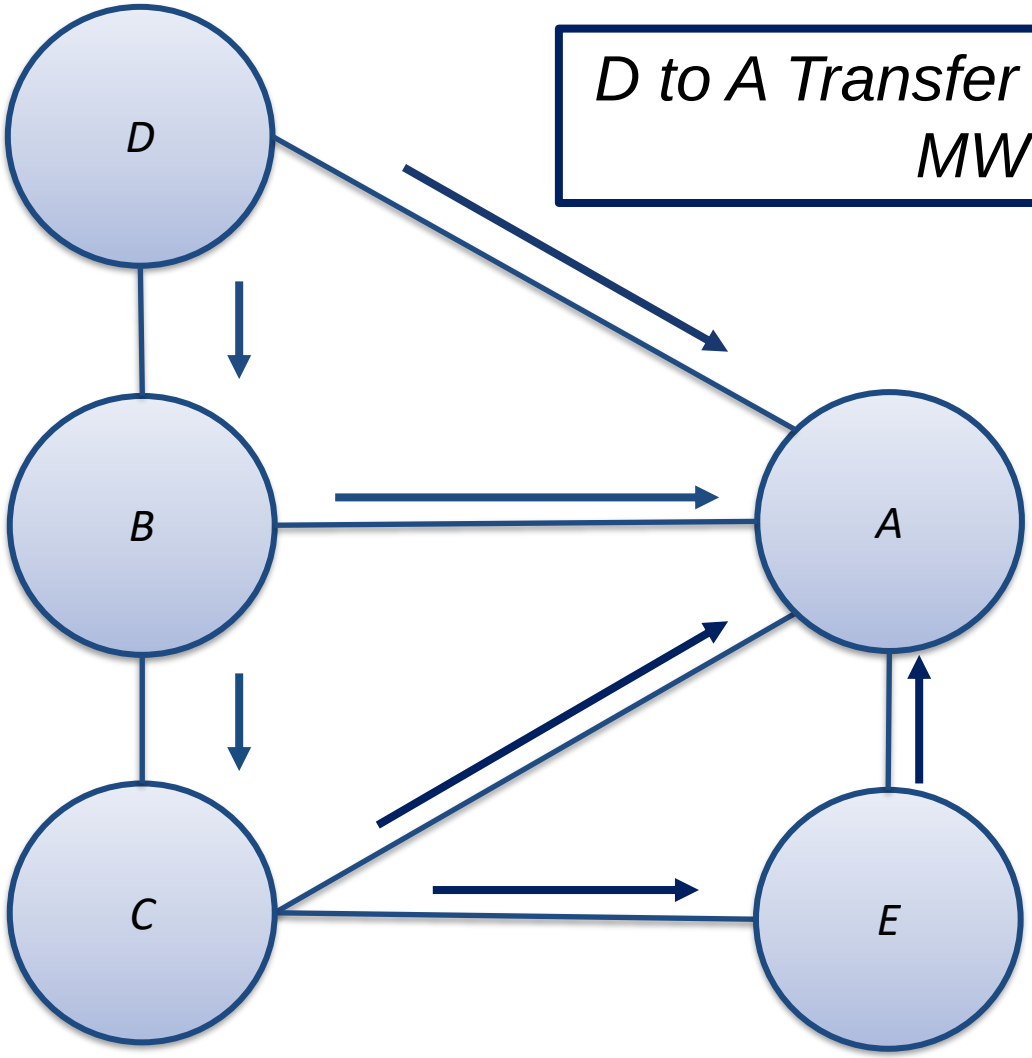
Storage charge and discharge schedules to arbitrage net load

Hourly load as a function of weather, plus reserves

Non-simultaneous Transfer Capability (Area D to A)

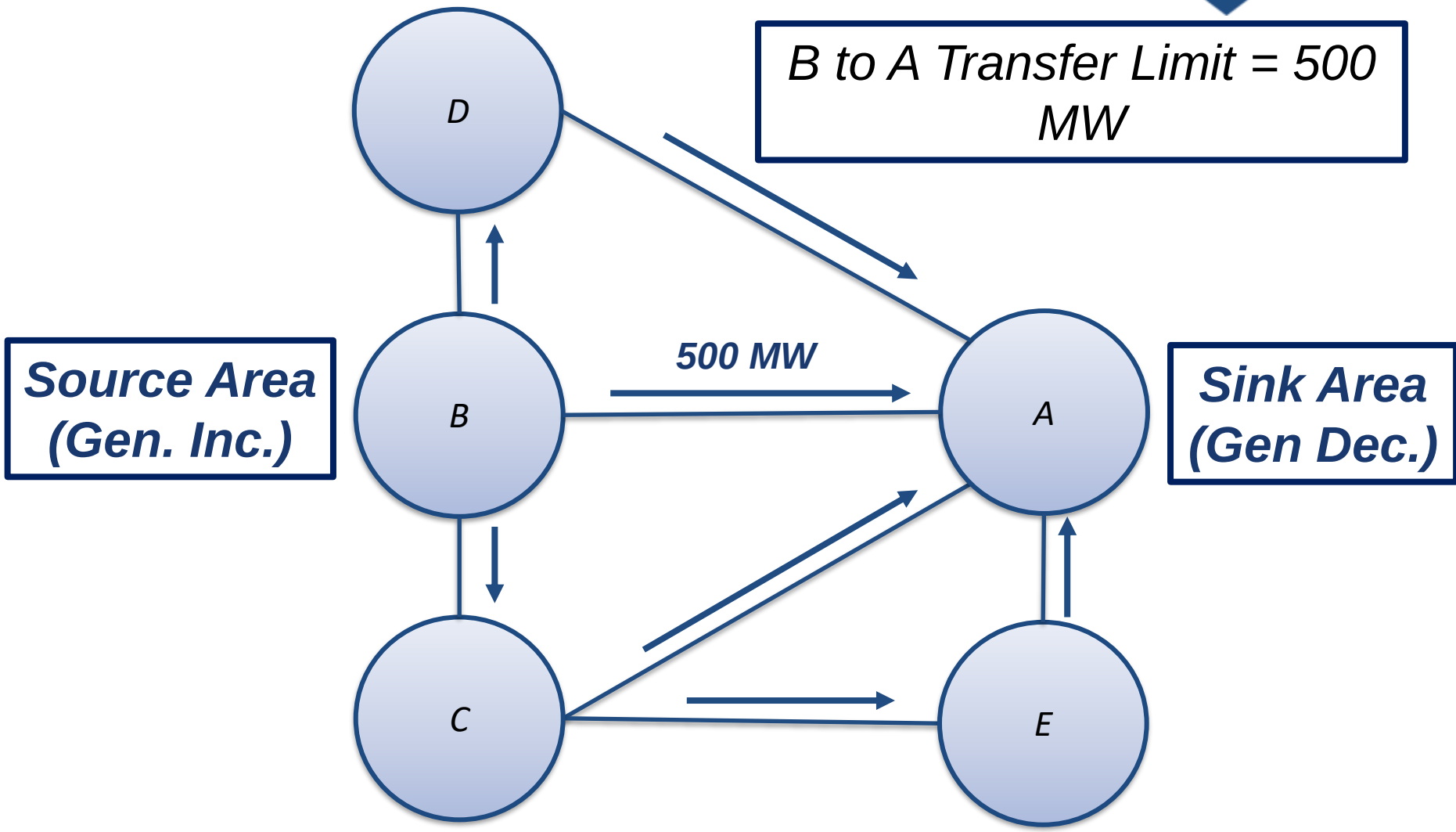
Source Area (Gen. Inc.)

D to A Transfer Limit = 500 MW



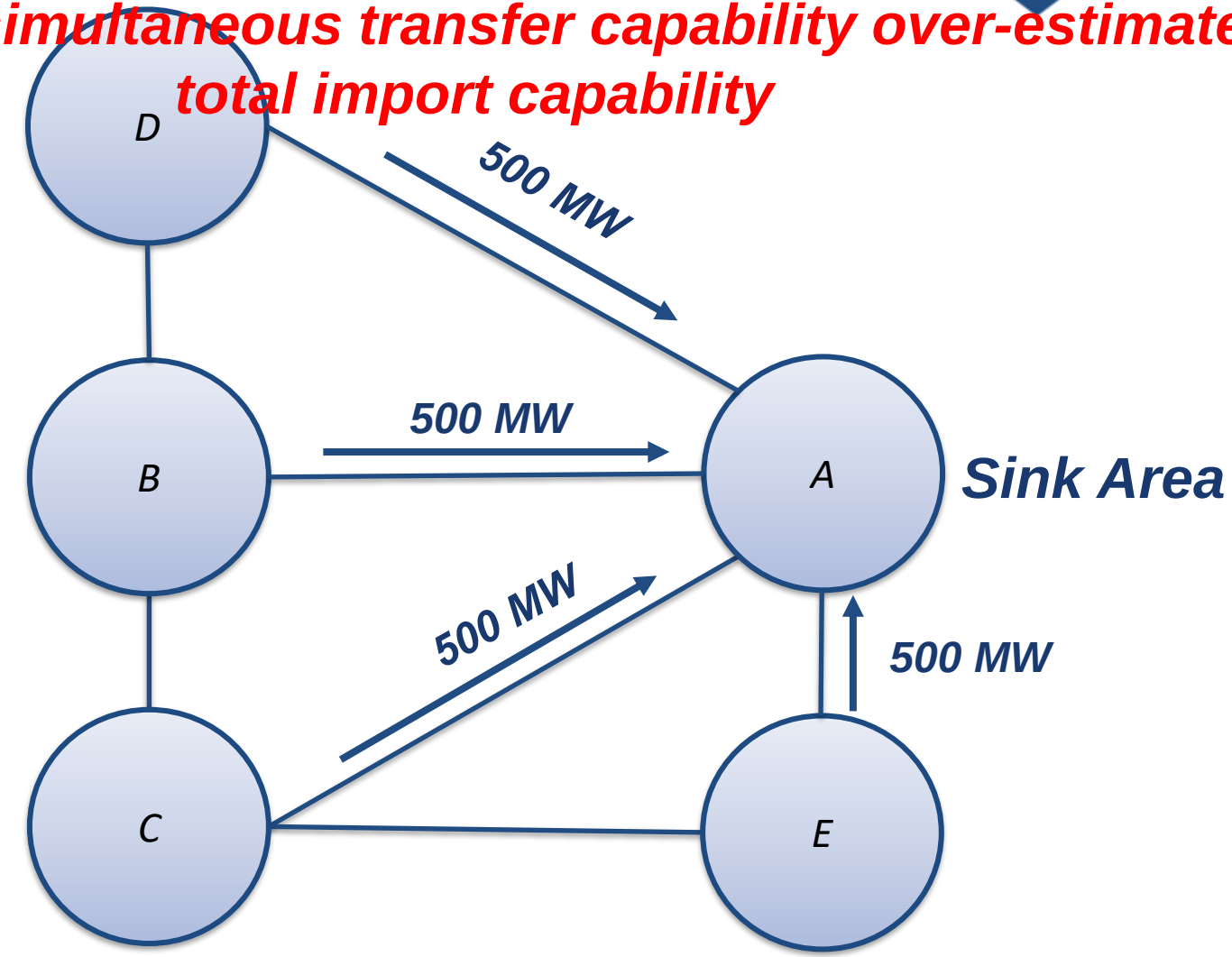
Sink Area (Gen Dec.)

Non-simultaneous Transfer Capability (Area B to A)



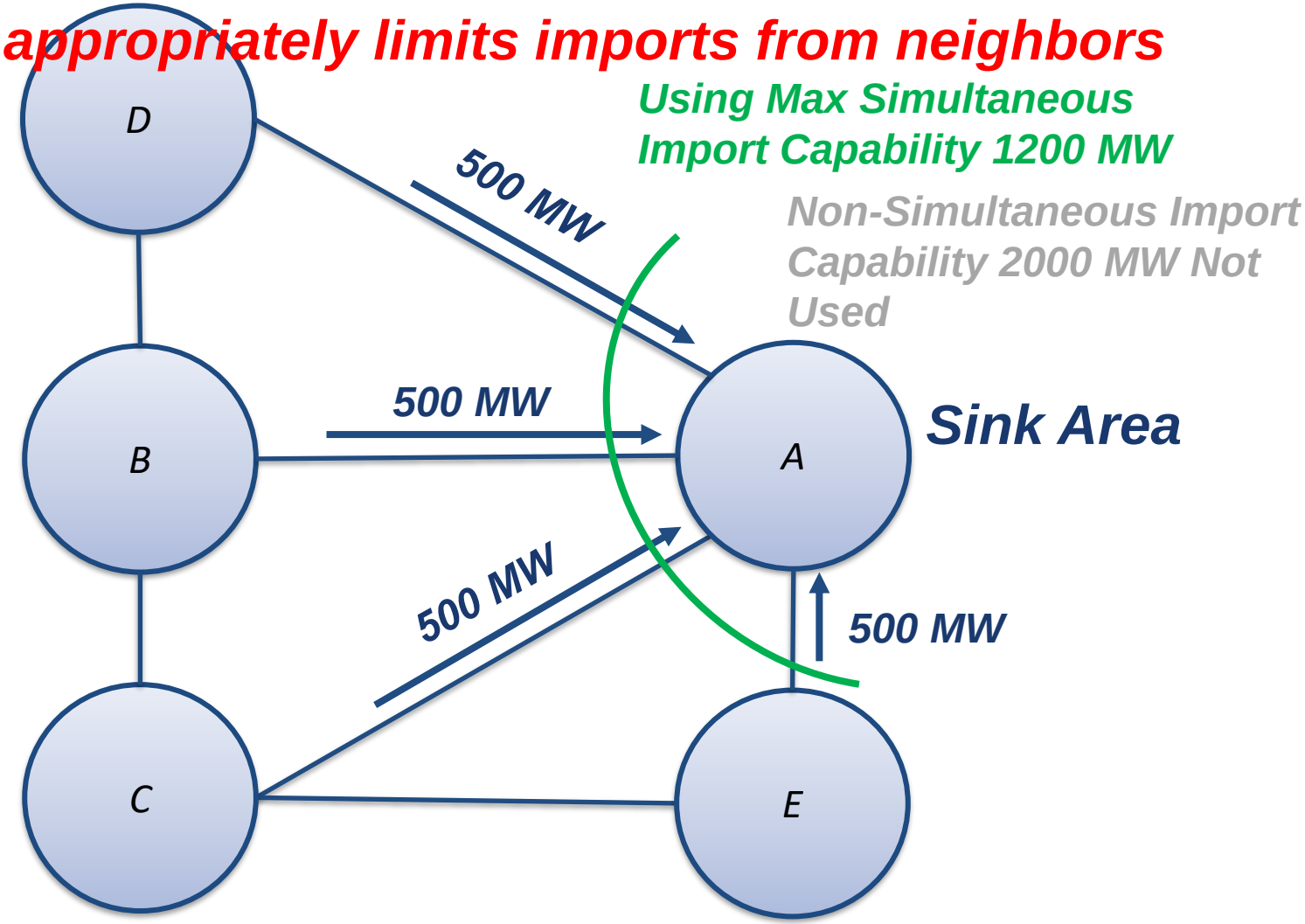
Transfer Capability Modeling (Pipe and Bubble Model)

- ***Using non-simultaneous transfer capability over-estimates total import capability***

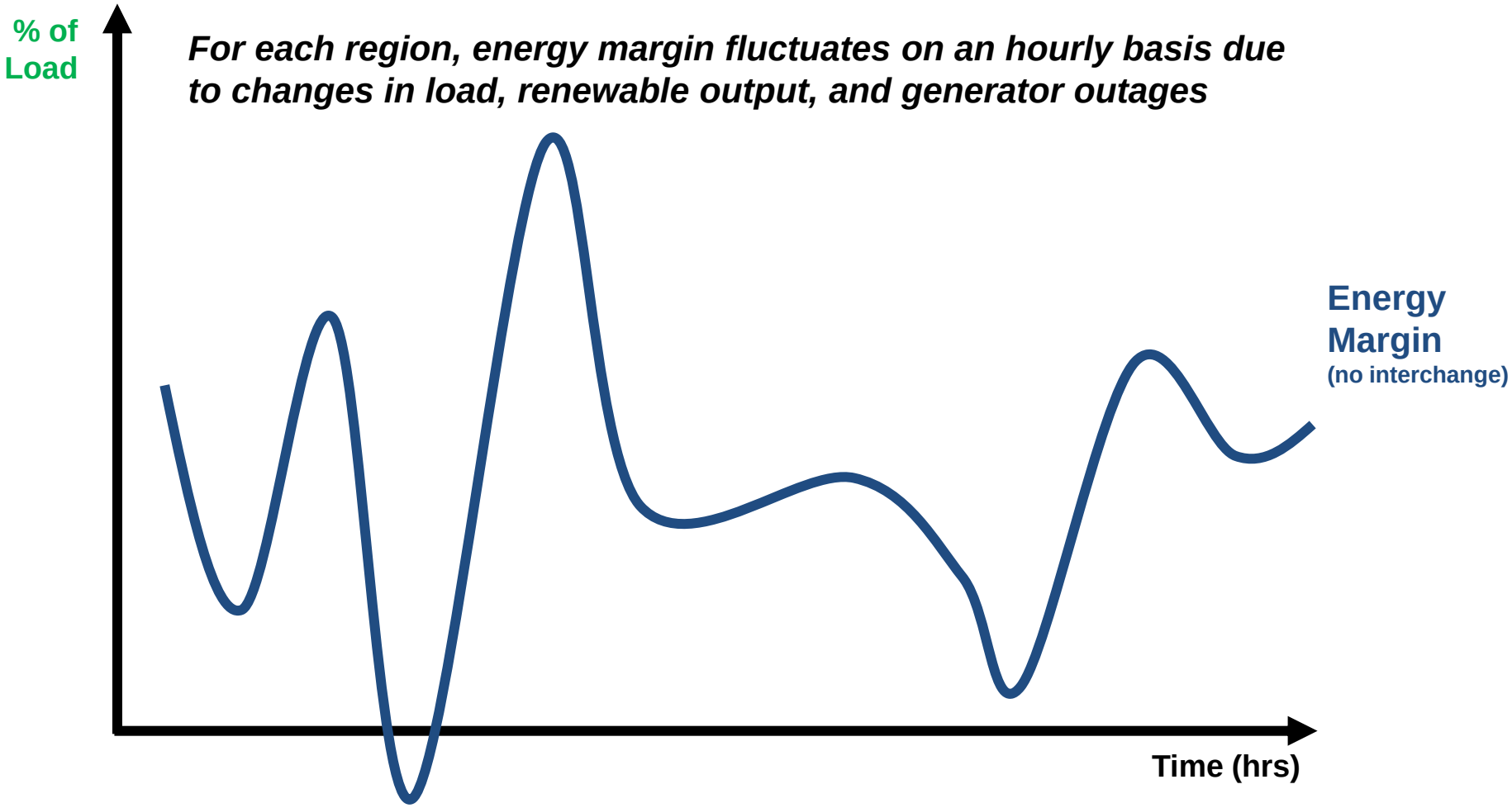


Transfer Capability Modeling (Pipe and Bubble Model)

- ***Using both non-simultaneous and simultaneous transfer capability appropriately limits imports from neighbors***

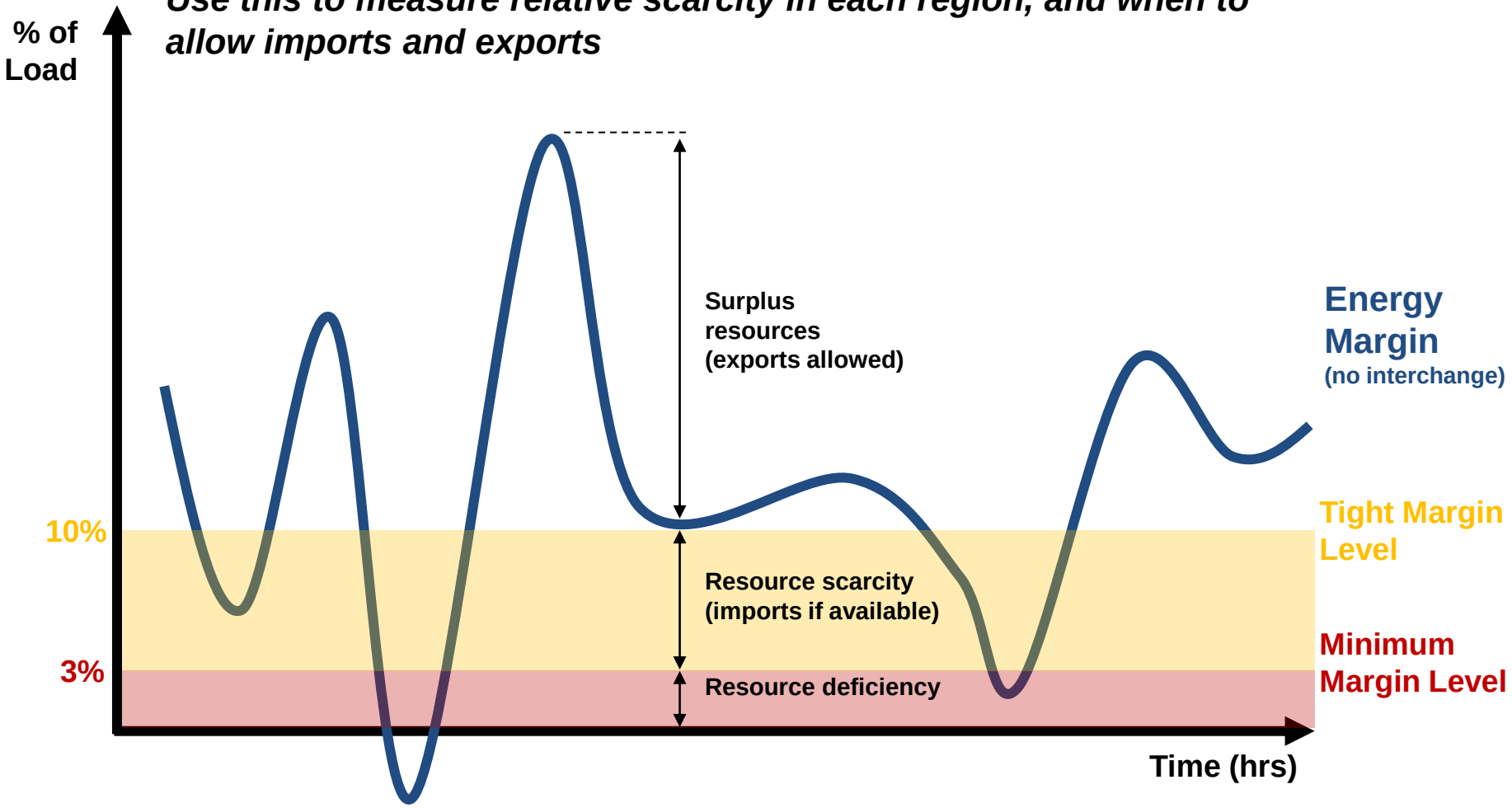


Energy margin illustrative example



Energy margin illustrative example

Use this to measure relative scarcity in each region, and when to allow imports and exports



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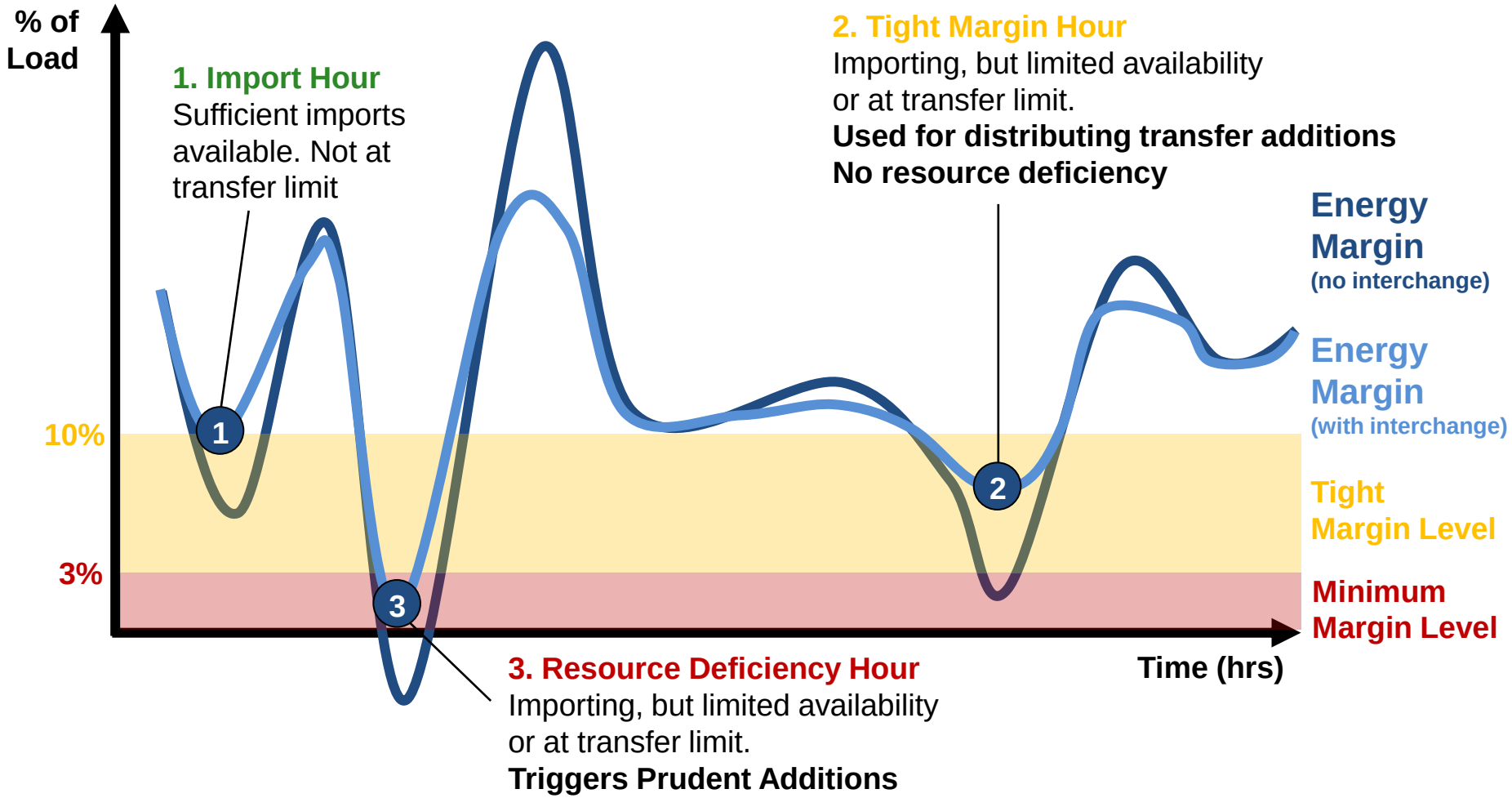
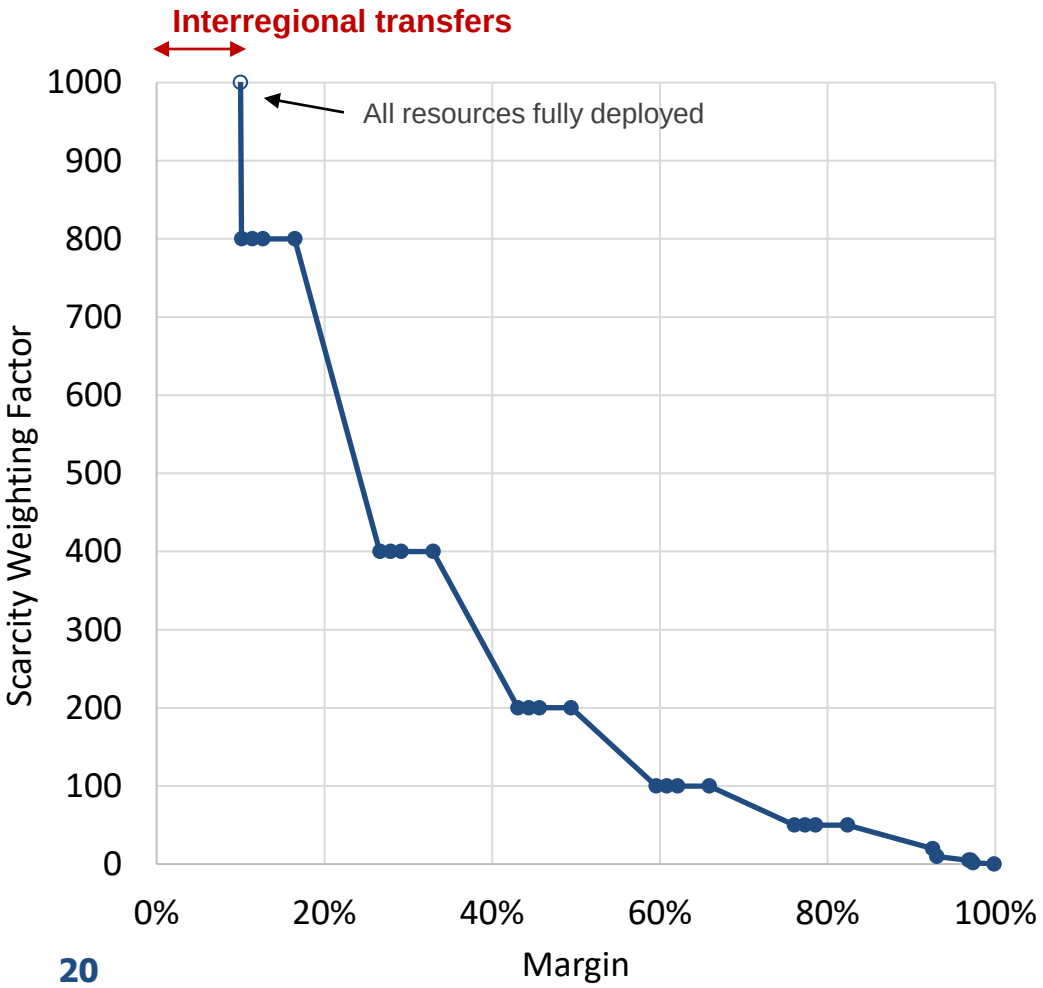
Step 1 - Identify

1. Identify regions that are import constrained during tight margin hours



Reliability Dispatch Curve

Objective: Perform a reliability "dispatch" for each region



- Each region will serve its own load prior to importing or exporting, which helps isolate **reliability interchange** rather than economic interchange.
  (this is done by setting a high hurdle rate on ties between regions)
- Operating costs are NOT assumed for resources
- An operating constraint will increase "Scarcity Weighting Factor" in the region as margin gets tighter (model dispatch will be based on relative surplus/scarcity, not resource costs)
- If a region cannot serve its own load, it will import from a neighbor that has relatively more surplus (lower scarcity weighting factor), subject to resource availability and tie-line capacity

Energy Margin Methodology scope and limitations

What this method DOES	What this method DOES NOT
✓ Prioritize regions for interregional transfer capability	× Represent actual physical power flows across the network
✓ Tracks daily and hourly availability of all resource types	× Track individual resource performance
✓ Calculates relative surplus and deficit in each region, at the same time	× Calculate relative costs or prices between regions
✓ Performs a reliability-only dispatch of resources	× Perform an economic, least-cost (production cost) dispatch
✓ Allows regions to import from one region while exporting to another	× Only evaluate “neighbor” flows

Steps to the reliability dispatch

Incremental Steps for Reliability Dispatch

1. Use own resources to serve load first. As region gets tighter, increase the relative scarcity factor.
2. When regions fall below **10% Tight Margin Level**, import from neighbors. Decision on which neighbor to import from is based on their respective energy margin (scarcity factor).
3. If sufficient imports are unavailable (due to transfer capability or lack of resources available) go below **10% Tight Margin Level** but maintain a **3% Minimum Margin.**
4. If sufficient resources are unavailable and energy reserves are fully utilized, call out resource deficiency.

Two types of margin levels

Tight Margin Level: only being used to dictate when and where regions should import from. Sets the priority for interregional transfers.

Currently set to 10% (3% minimum + 7% energy)

Minimum Margin Level: holding back some capacity for ancillary services (that would be held even if there was unserved energy) and forecast uncertainty.

Currently set to 3%

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Reported Metrics

- **Energy margin:** can track the hourly energy margin over the course of the year, both in MW and % of load) [avg, min, etc.]
- **Interchange Hours:** number of hours in a year when a system requires imports to keep hourly energy margin >= 10%
  tells us how often a region needs to import
- **Tight-Margin Hours:** number of hours in a year when minimum reserves are below tight levels
  tells us how often a region's transfer capability is limited due to transfer capability – or- lack of resources
- **Hours Congested:** hours when an import interface is at its limit.
  Tells us how often a region's transfer capability is insufficient due to the transfer limit.
- **Scarcity Hours:** number of hours with resource deficiency

Metrics can be reported as hours, energy (MWh), or max power (MW)

Technically Prudent Additions for Reliability

What is technically prudent addition to transfer capability?

- *Strengthens reliability*
- *Serve load under extreme conditions*
- *Without creating other reliability problems*

FERC precedent provides that "prudence" means a determination of whether a reasonable entity would have made the same decision in good faith under the same circumstances, and at the relevant point in time.

Six-Step Prudent Addition Process

Identify

1. Identify regions that are import constrained during **Resource Deficiency** hours (region is unable to keep its energy margin above 3%)

Quantify

2. Calculate maximum shortage (MW) during **Resource Deficiency** hours

Prioritize

3. Identify constrained interfaces during **Tight Margin hours**
   Scarcity Factor Difference = measures relative resource surplus on the sending end (source) relative to the importing region (sink)

Allocate

4. Increase all constrained interfaces at **20%** of max shortage (MW),
   - Only increase by a portion (20%) of the max shortage to capture interactive effects between regions (increase in one interface affects flows across others)
   - Increase for each interface proportional to the scarcity factor difference
   - Interfaces with relatively high surplus on sending end available during tight margin hours get proportionally larger increase

Iterate

5. Iterate until **all resource deficiencies** are mitigated, or until improvement stops because there are no available resources on sending end

Finalize

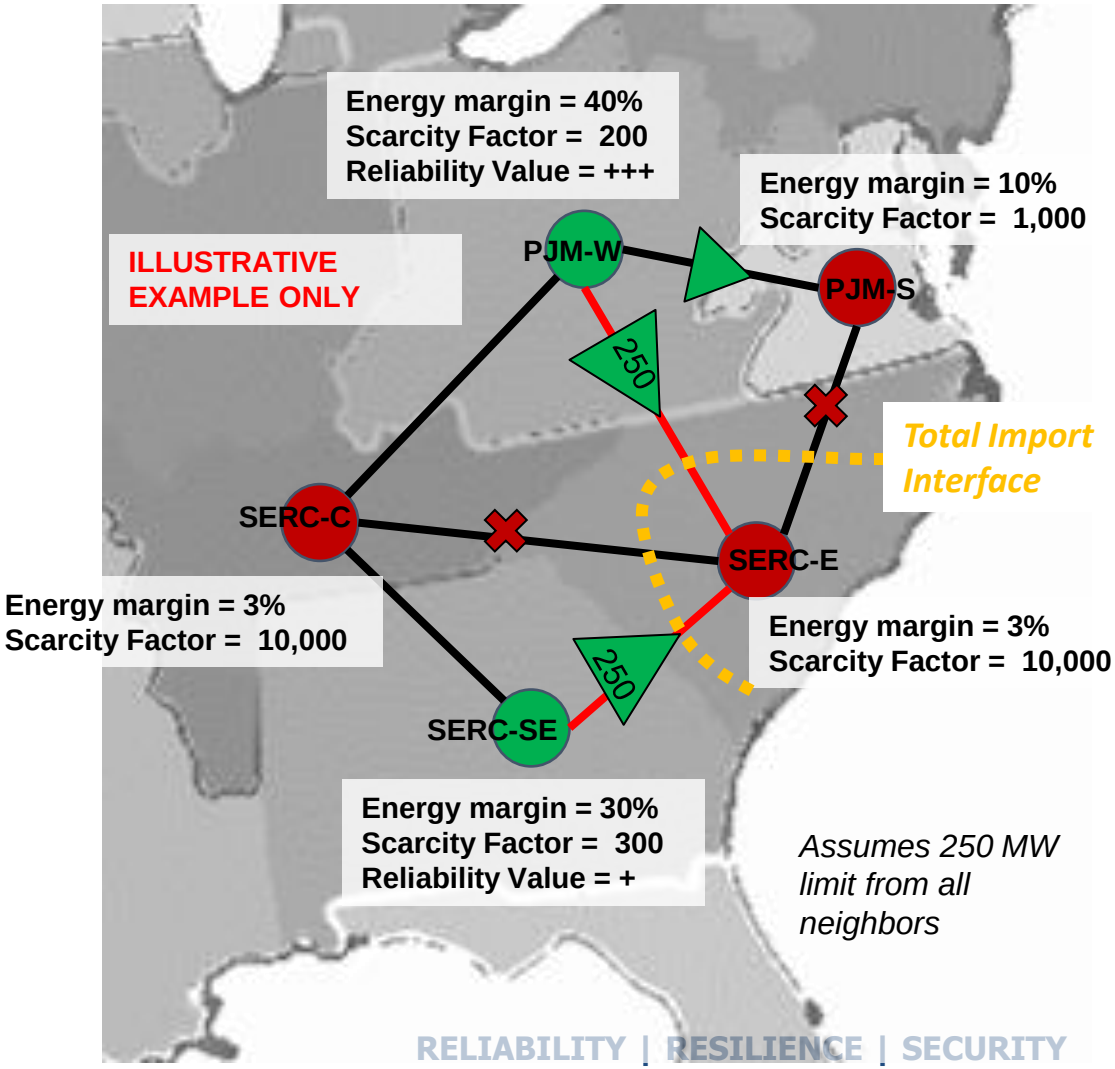
6. Determine "prudent" level after all runs are complete based on resolving shortfalls

Prioritize Prudent Additions

Identify constrained interfaces during tight margin hours

Example B

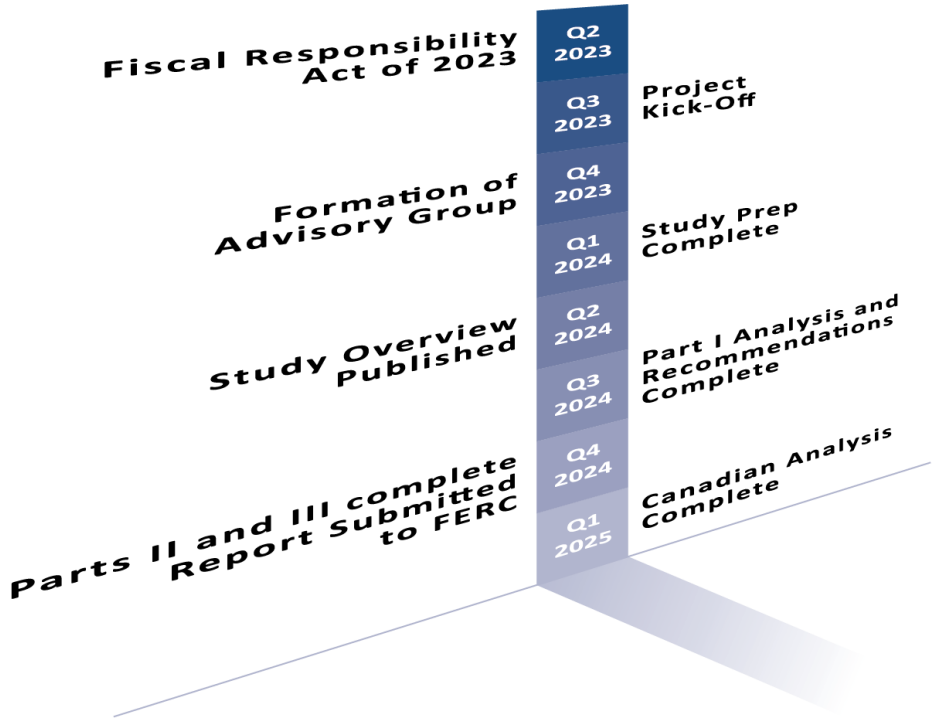
- SERC-E is in a resource deficiency hour (scarcity factor of 10,000)
- PJM-S is in a tight margin hour (scarcity factor of 1,000) and SERC-C is in a resource deficiency hour (scarcity factor of 10,000)
- PJM-W and SERC-SE all have surplus available (scarcity factor 200 and 300 respectively)
- SERC-E imports from SERC-SE and PJM-W at max 250 MW
- **SERC-E is 100 MW below Minimum Margin Level. Requires additional transfer capability from PJM-W and SERC-SE.**

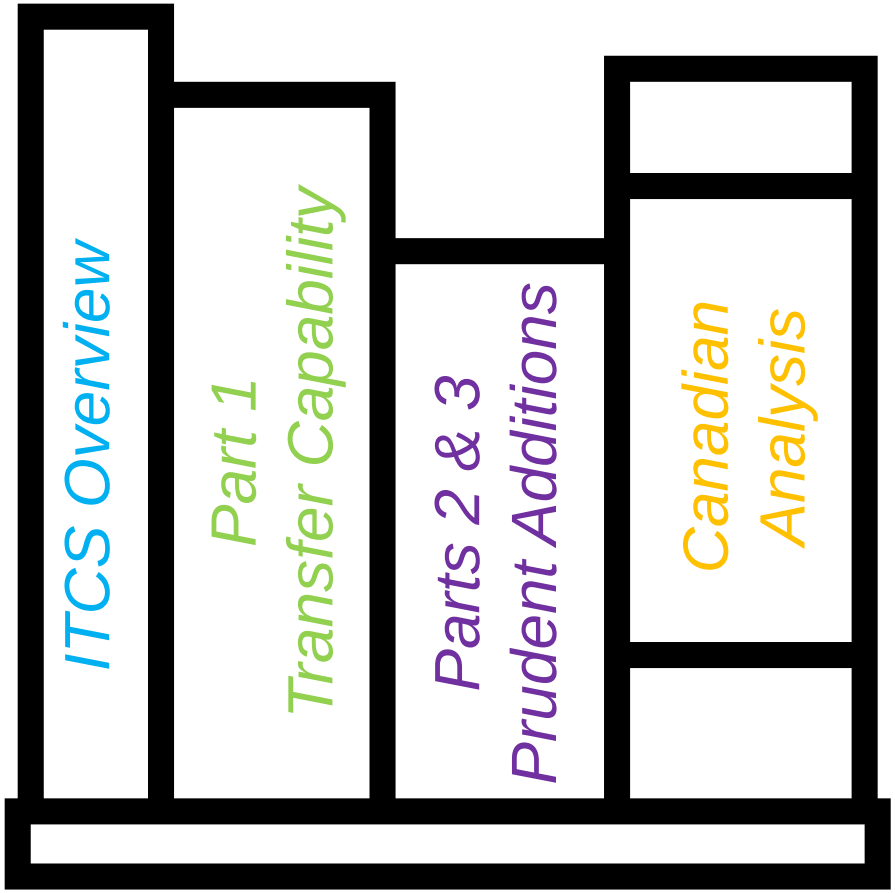


Part 3 Scope: Meet and Maintain

- Mandate calls for:
  - "Recommendations to meet and maintain total transfer capability together with such recommended prudent additions to total transfer capability..."
- Report will describe measures and general actions needed to achieve and sustain the identified transfer capability and any recommended enhancements.
  - Additional Analysis
  - Capital & Infrastructure
  - Grid Enhancing Technologies
  - Markets & Regulatory
  - Resource Additions

ITCS Timeline and Report Strategy





Stakeholder Input and Feedback Channels

MONTHLY ADVISORY GROUP MEETINGS

NERC AND REGIONAL TECHNICAL COMMITTEES

PRESENTATIONS TO STATE AND PROVINCIAL REGULATORS

PRESENTATIONS TO INTERESTED INDUSTRY GROUPS

For more information:

- *https://www.nerc.com/pa/RAPA/Pages/ITCS.aspx*
- *itcs@nerc.net*

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Questions and Answers