Building the Business Case to Achieve Regional and Inter-regional Bulk Transmission Expansion

Digaunto Chatterjee
Lead Expansion Planning – Midwest ISO
EEI – October 14, 2009

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Drivers behind Change

- Existing transmission planning processes are constructed around traditional drivers for transmission needs
  - Load growth
  - Market congestion
  - Localized generation Interconnections
- Policy changes on State and potentially Federal level driving transmission plans need to address *Energy* Delivery to meet mandates
  - Renewable resources are generally located distant from load centers which require more regional and multi-regional collaborating planning
  - Benefits of such plans are realized in the future. Analysis therefore needs to capture potential future scenarios cognizant of potential policy shifts
    - Analyses focus is on yearly ~8760 hour simulations not restricted to select hour snapshot powerflow simulations (Traditional Peak / Off-Peak). Plans still have to be compliant with NERC and regional RRO standards

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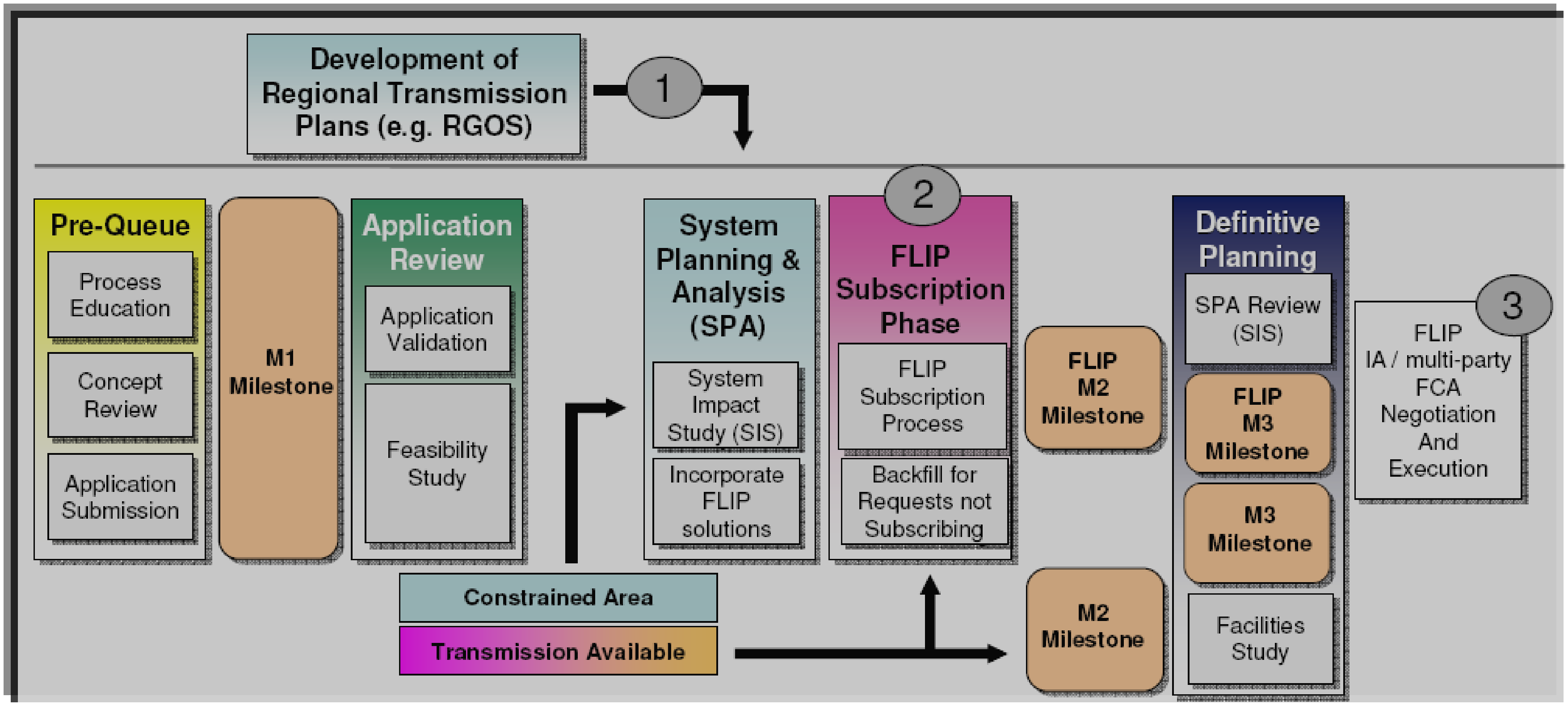
Planning Processes to study Large Scale Projects

- Regional Planning
  - Challenge
    - Existing tariff and processes built around only subsets of the beneficial attributes of regional transmission expansion needs: Reliability and Market Congestion
    - Does not adequately translate to the single greatest current driver for transmission expansion today: development of large volumes of localized constrained renewable resources distant from load centers
  - Recent Initiatives
    - Forward Looking Interconnection Process (FLIP)
    - Regional Generation Outlet Study (RGOS)

Regional Planning Process Initiatives

- Generator Interconnection – Forward Looking Interconnections Projects (FLIP)



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Forward Looking Interconnection Projects

- Modify current provisions used to allocate capacity to pending requests by incorporating a new subscription phase that will allow for more cost and timing certainty for those requests depending on required network upgrades
  - Increase optimization of transmission investment by leveraging the increased economies of scale that occur when transmission is planned regionally rather than on one off basis
  - Ensure at least the minimum level of generation required to meet system needs, including Resource Adequacy or RPS requirements, is able to move more quickly through the process
  - Properly incorporate transmission projects which have been identified outside the direct queue process, but are intended to meet the need for generator outlet (RGOS transmission projects)
  - Achieve appropriate level and timing of generator project commitment to FLIP's once identified, to ensure upgrades are built.

Regional Planning Process Initiatives

- Upper Midwest Transmission Development Initiative (UMTDI)
  - Led by Governors of Minnesota, North Dakota, South Dakota, Iowa and Wisconsin to coordinate sub-regional transmission planning and related cost allocation issues
  - Provides input to Midwest ISO Regional Generation Outlet Study (RGOS)
    - Renewable Energy Zone Selection
    - Transmission Scenarios
      - 345 kV, 765 kV and DC lines and combinations
- Other study assumptions collaboratively formalized by Technical Review Group
- RGOS has been broken down into two phases: RGOS I and RGOS II.
  - RGOS I seeks to determine the transmission necessary to interconnect and deliver wind to load for the western portion of our region.
  - RGOS II builds upon the work that RGOS I started, extending the transmission plans developed for the western part of the region east into a cohesive plan for the entire Midwest ISO area.
  - Process underway to combine RGOS I and II

Regional Generation Outlet Study (RGOS)

- Study Assumptions
  - Delivery
    - Scenario 1: Self-Contained within operating territories cost to meet RPS mandates and goals, no export – 20 Energy Zones within UMTDI plus 9 zones added in Illinois (15 GW)
    - Scenario 2: Export to all Midwest ISO loads from the West to take advantage of High Capacity Factor Renewable Resources (25 GW)
  - Reliability
    - 345 kV and 765 kV Line Ratings
  - Economic
    - Discount and Inflation Rates
    - Cost of Capital
    - Escalation Rate for Transmission
    - Levelized Fixed Charge Rate for Transmission and Generation
    - Line and Substation Costs (per mile costs differ by state)
    - Escalation Rate for Generation
    - PROMOD assumptions on Fuel Costs, Heat Rates, Variable O&M, Fixed O&M

http://www.midwestmarket.org/page/Renewable%20Energy%20Study

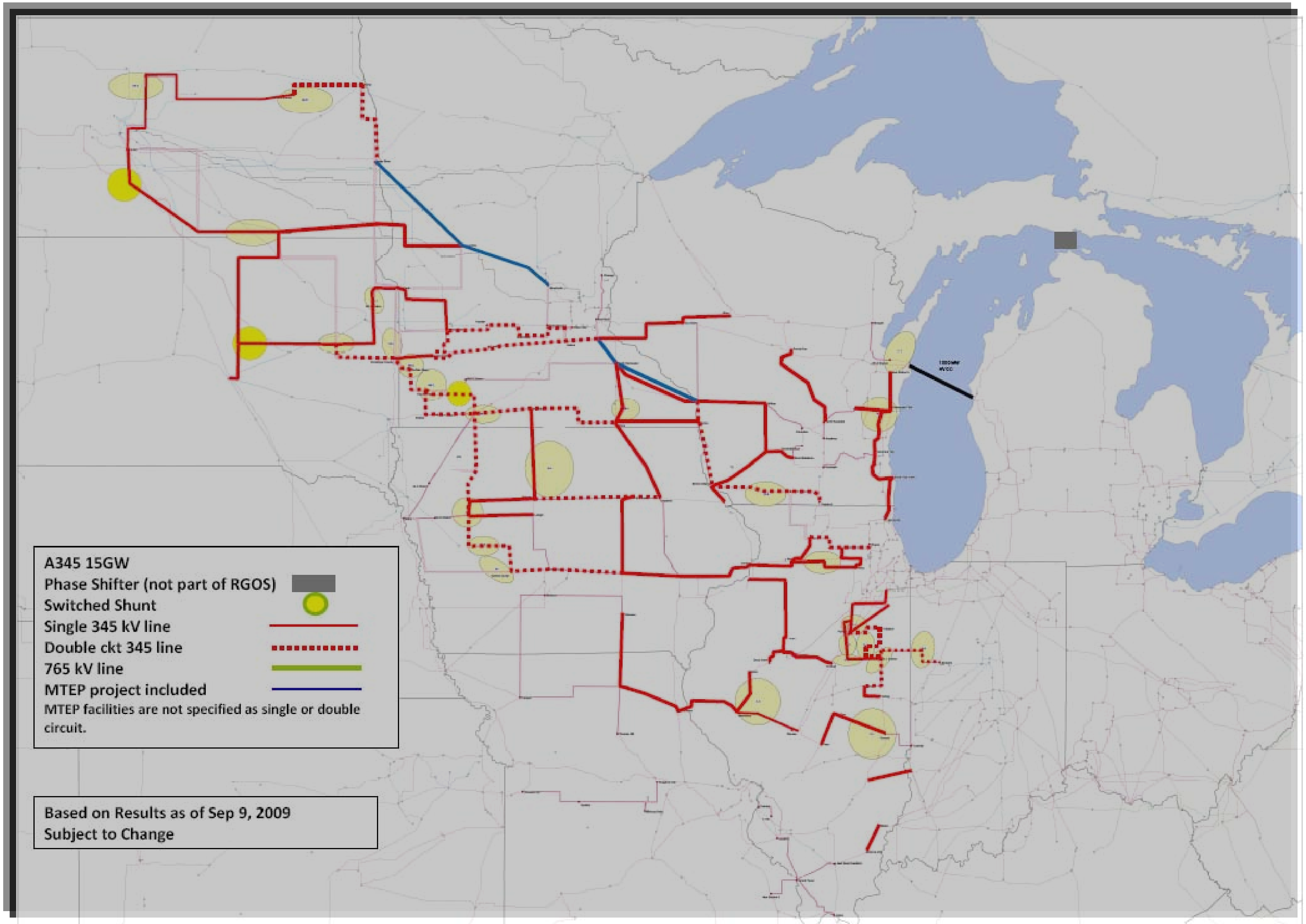
Regional Generation Outlet Study (RGOS)

- Cost:

Total Scenario*	Transmission Miles (Reference)		$/MWH**			Installed Costs ($B)***	
			Trans	Gen	Total	Trans	Gen
Indicative Transmission (2/17/09)	345	4,263-7,095	35-133	99-180	106-248	10.8-22.8	24.3-30.8
	765	4,464-6,056	50-174	99-180	118-288	18.7-29.8	24.3-30.8
A 15 GW 345 kV		5208	35-58	124-177	158-235	12.1-14.4	43.5
B 15 GW 345 kV		4912	33-57	124-177	157-233	11.8-13.9	43.5
A 15 GW 765 kV - Alt 1		4478	39-67	124-177	163-244	13.8-16.5	43.5
B 15 GW 765 kV - Alt 1		4328	39-67	124-177	162-243	13.6-16.4	43.5
A 15 GW 765 kV - Alt 2		4525	41-71	124-177	164-247	14.4-17.4	43.5
B 15 GW 765 kV - Alt 2		4375	40-70	124-177	164-247	14.2-17.3	43.5

* Ranges based on Assumptions Sets: Reference vs DST
**$/MWH based on 2018 in Indicative, 2019 for Scenarios A/B
*** Transmission and Generation (2009 dollars, pay cash today)

RGOS Wind Zone – Transmission Scenario 1



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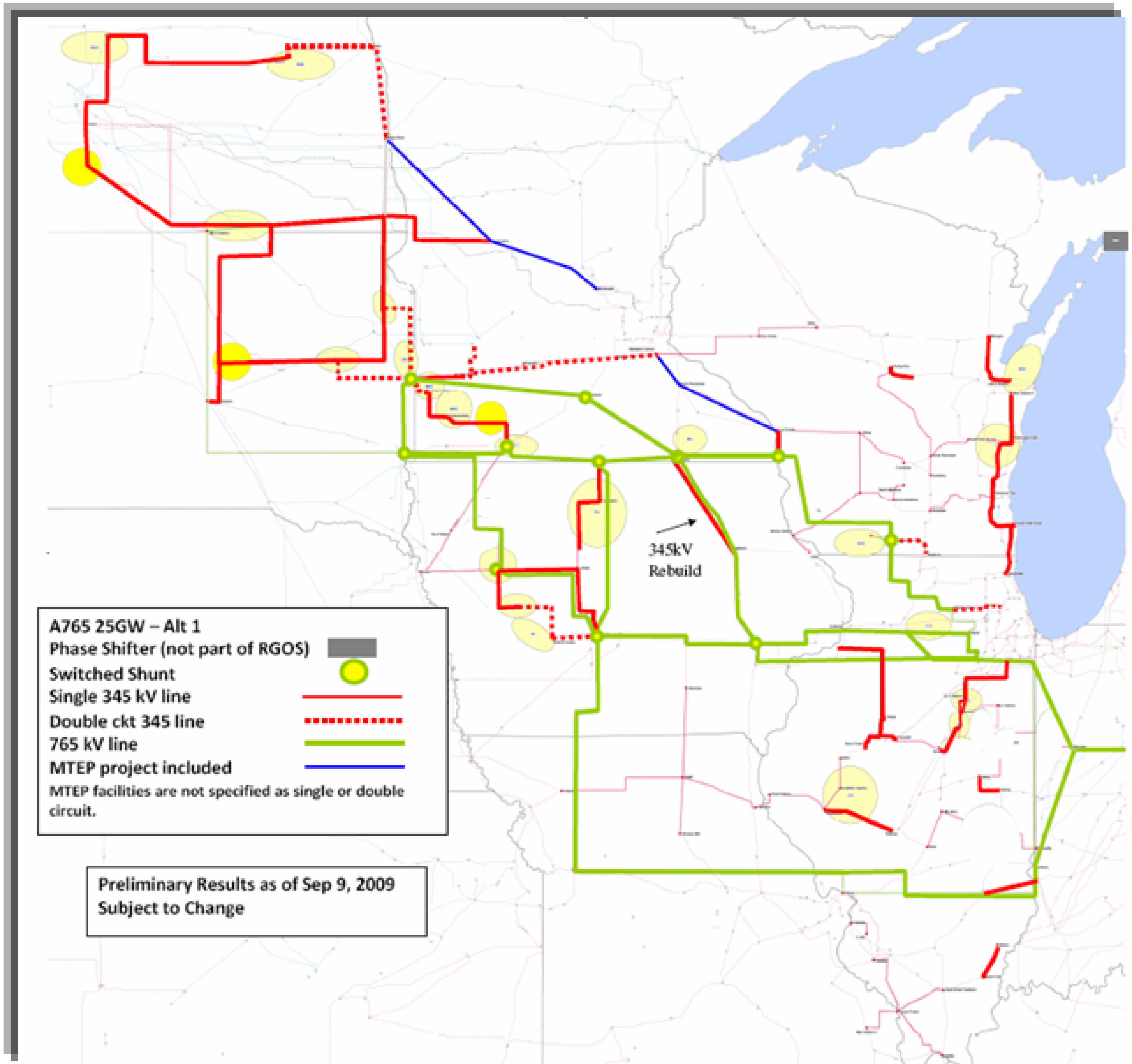
RGOS Wind Zone – Transmission Scenario 2



Planning Processes to study Large Scale Projects

- Cross Border / Inter-Regional Planning
  - Challenge
    - Cross Border cost sharing protocols revolve around sharing cost of cross border projects meant to relieve Baseline Reliability Constraints and Market Congestion
    - Cross Border Overlays designed to transfer energy from distant renewable resources to load centers without curtailing large Baseload generation up to the point of non-operation in Day Ahead Market
  - Recent Initiatives
    - Organization of Midwest ISO states (OMS) Planning Initiatives - Bottom up approach to get broad based consensus on state level with states taking lead on developing processes consistent with policies
      - Upper Midwest Transmission Development Initiative (UMTDI)
      - Cost Allocation Regional Planning (CARP)

Cross Border Planning Process Initiatives

- Cost Allocation and Regional Planning (CARP)
  - Led by Governors of Minnesota, North Dakota, South Dakota, Iowa and Wisconsin to coordinate sub-regional transmission planning and related cost allocation issues
  - Developing preferred cost allocation mechanisms within the context of regional plans
  - Developed a number of future energy policy scenarios around questions such as level of renewable integration, implementation of a carbon cap and trade program and impacts of a smart grid
    - Discussion of what transmission is required in support of the future scenarios will be the next step
  - From a cost allocation perspective, the group is currently evaluating a number of alternative cost allocation methodologies
    - Injection / Withdrawal
    - Add a new category to the current sharing protocols
    - California's Tehachapi model
  - Group will be finished with its efforts in December and make a recommendation to Midwest ISO's RECB Task Force

Cost Allocation and Regional Planning (CARP)

- Potential Future Modeling Assumptions
  - Aggressive Demand Response
  - Aggressive Carbon Reductions
  - Moderate Carbon Reductions
  - Renewable with High Carbon Policy
  - Renewable with Moderate Carbon Policy
  - Aggressive State Only RPS
  - Federal RPS
  - Low Demand Growth with High Energy Growth (moving load off the peak – the electric car scenario)
  - High Green (20% RPS plus high carbon reduction)
  - Moderate Green (20% RPS plus low carbon reduction)
  - Low Green (current RPS)
  - Cap and Trade
  - Carbon Reduction

Planning Processes to study Large Scale Projects

- Multi Regional Planning
  - Challenge
    - Joint Operating Agreements designed to ensure multi-regional reliability by addressing seams issues with neighboring RTO's is not adequate
  - Recent Initiatives
    - Joint Coordinated System Plan (JCSP)

    ↓

    - Eastern Interconnect Planning Collaborative (EIPC)

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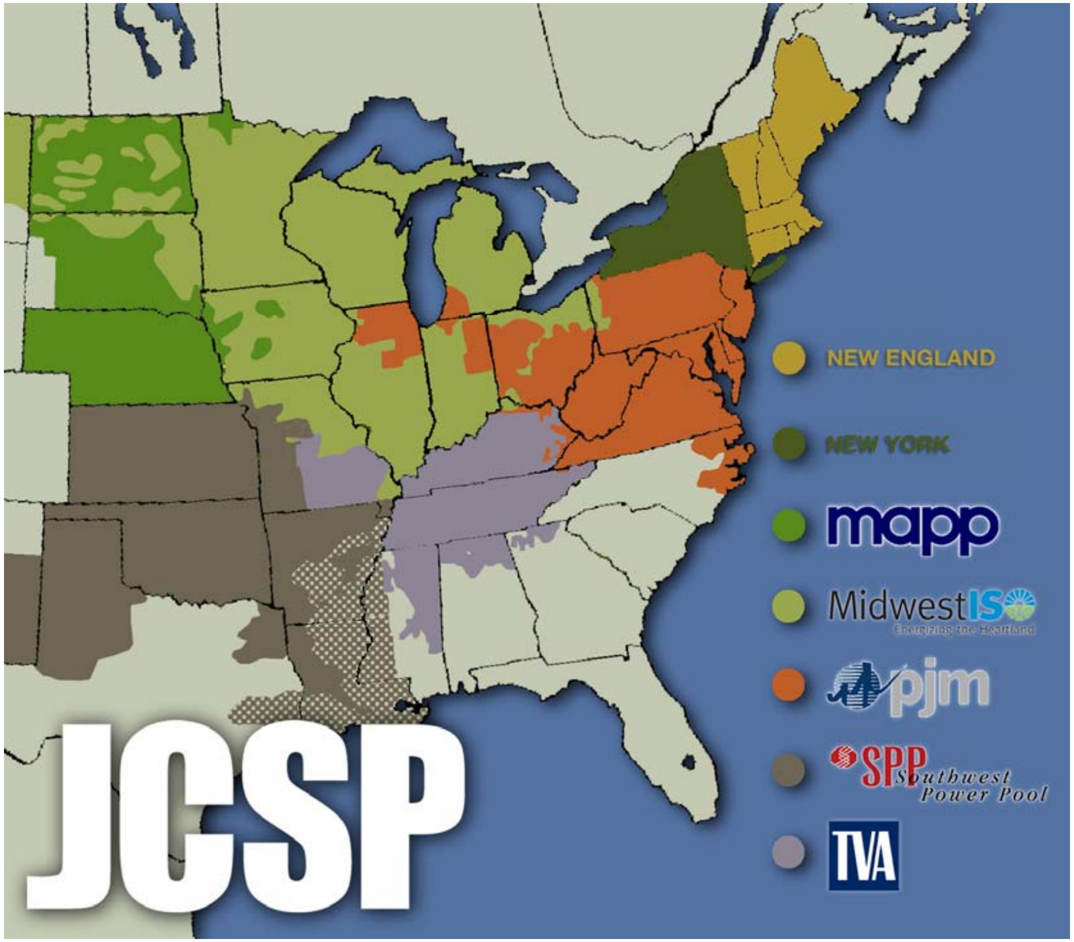
Multi Regional Planning Process Initiatives

- Joint Coordinated System Plan (JCSP 2008)
  - Study began as collaboration between the Midwest ISO, MAPP, Pennsylvania, New Jersey, Maryland Interconnection (PJM), Southwest Power Pool (SPP) and the Tennessee Valley Authority (TVA) to meet the requirements of the Joint Operating Agreements each organization has with the Midwest ISO.
  - Conceptual regional transmission and generation system plan for a large portion of the Eastern Interconnection in the United States.
  - Initial effort looked at two scenarios that expand transmission and generation opportunities between 2008 and 2024 - a Reference Scenario and a 20% Wind Energy Scenario in support of the U.S. Department of Energy's Eastern Wind Integration and Transmission Study.
- Eastern Interconnect Planning Collaborative (EIPC)

Plans Developing Based on this Approach
Joint Coordinated System Plan (JCSP) 2008

http://www.jcspstudy.org



Joint Coordinated System Plan (JCSP 2008) participants included Midwest ISO, SPP, PJM, TVA, MAPP and other interested parties

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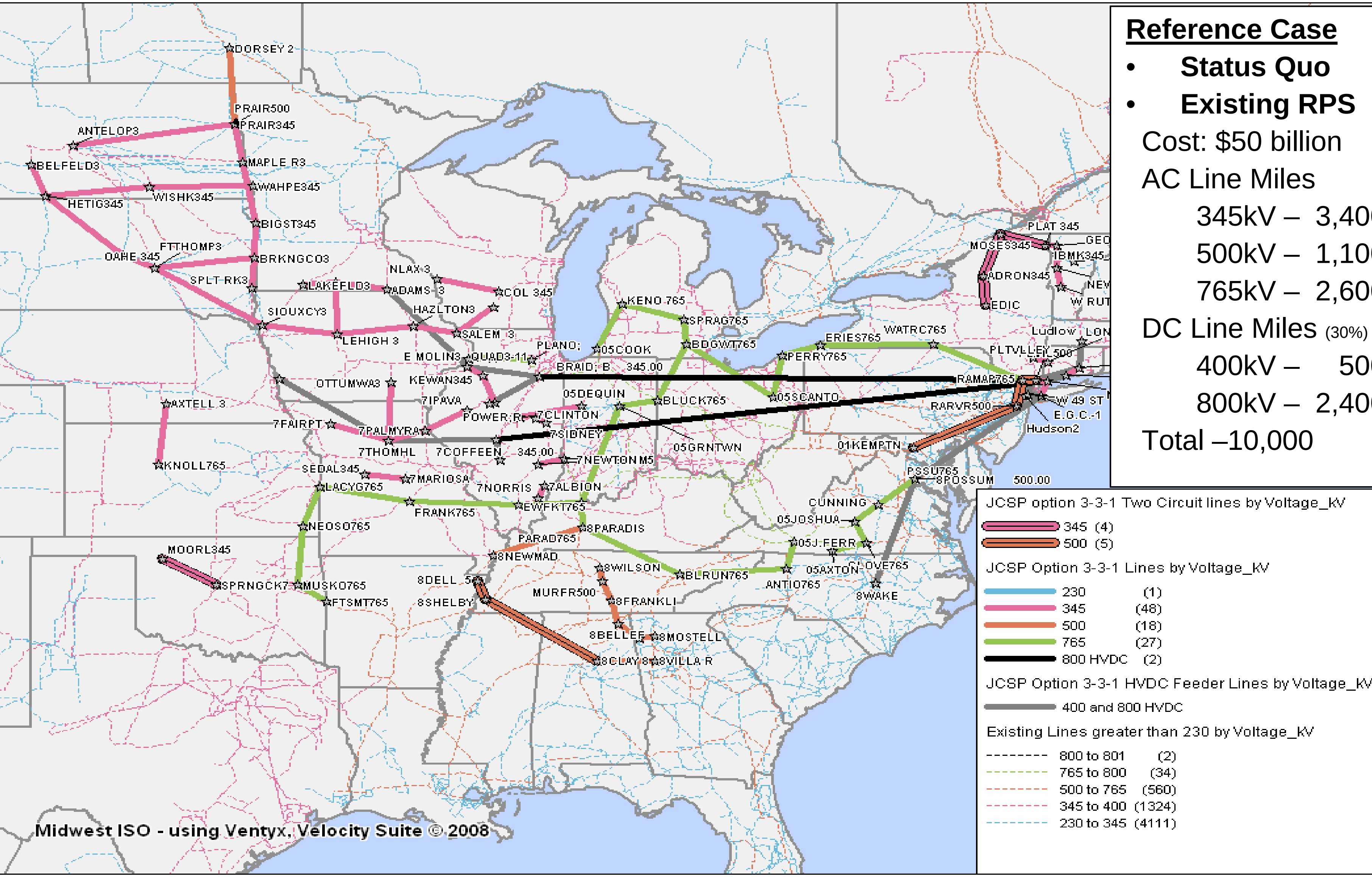
Reference Case – Representative Overlay Needs



Reference Case

- **Status Quo**
- **Existing RPS**

Cost: $50 billion

AC Line Miles

345kV – 3,400

500kV – 1,100

765kV – 2,600

DC Line Miles (30%)

400kV – 500

800kV – 2,400

Total –10,000

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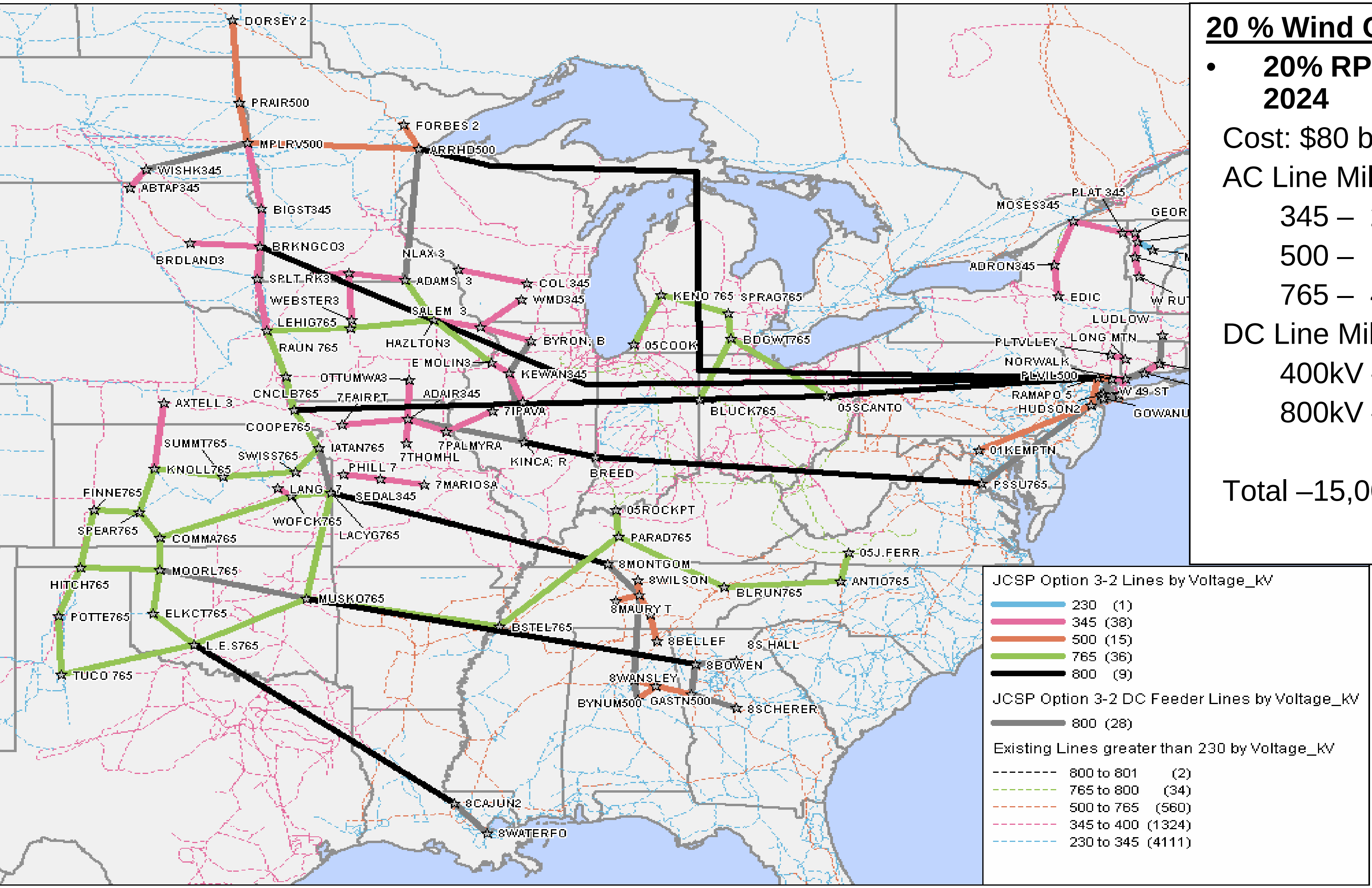
20% Wind Energy - Representative Overlay Needs



20 % Wind Case

- **20% RPS by 2024**

Cost: $80 billion

AC Line Miles

345 – 2,200

500 – 1,100

765 – 4,000

DC Line Miles

400kV – 0

800kV – 7,500

Total –15,000

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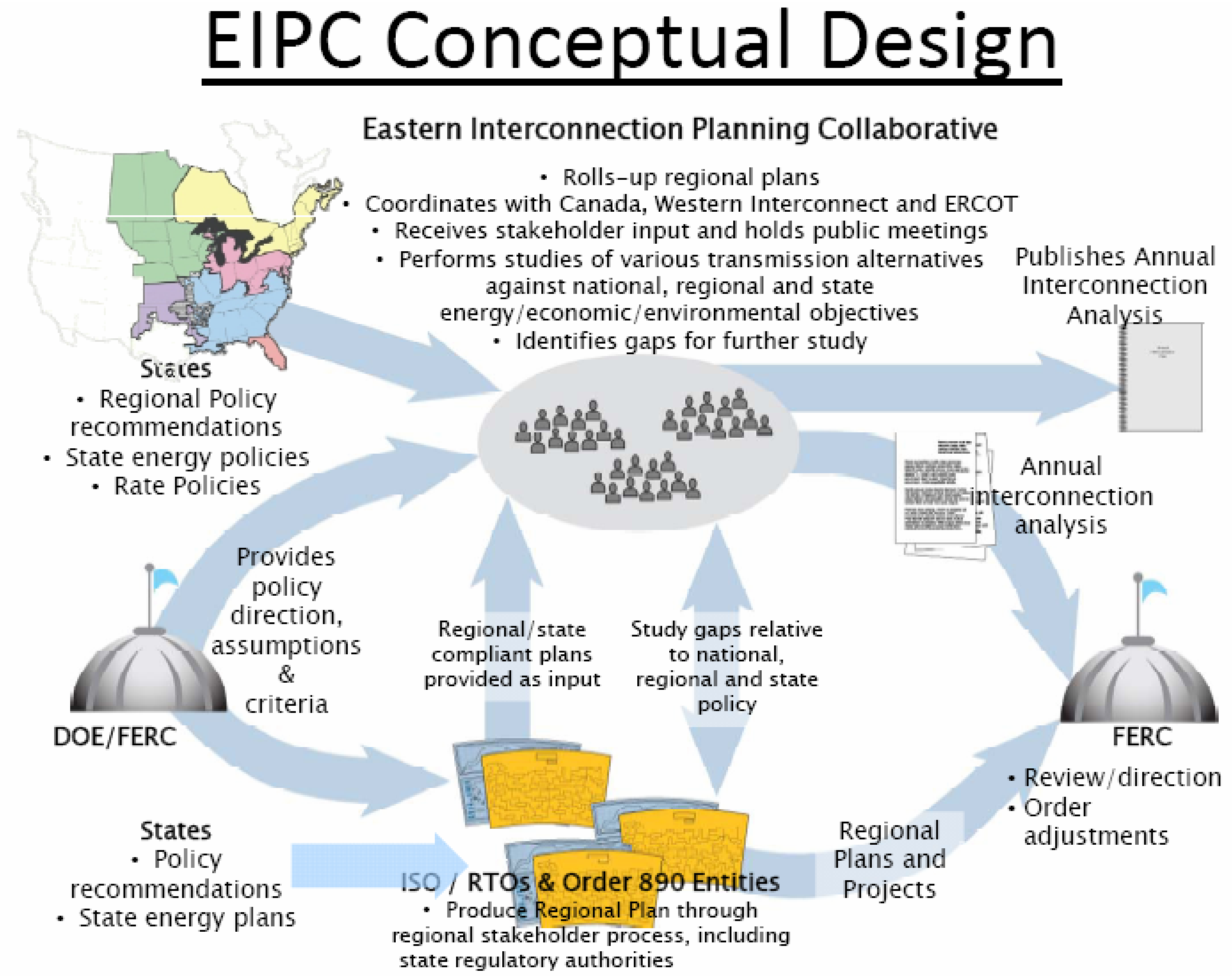
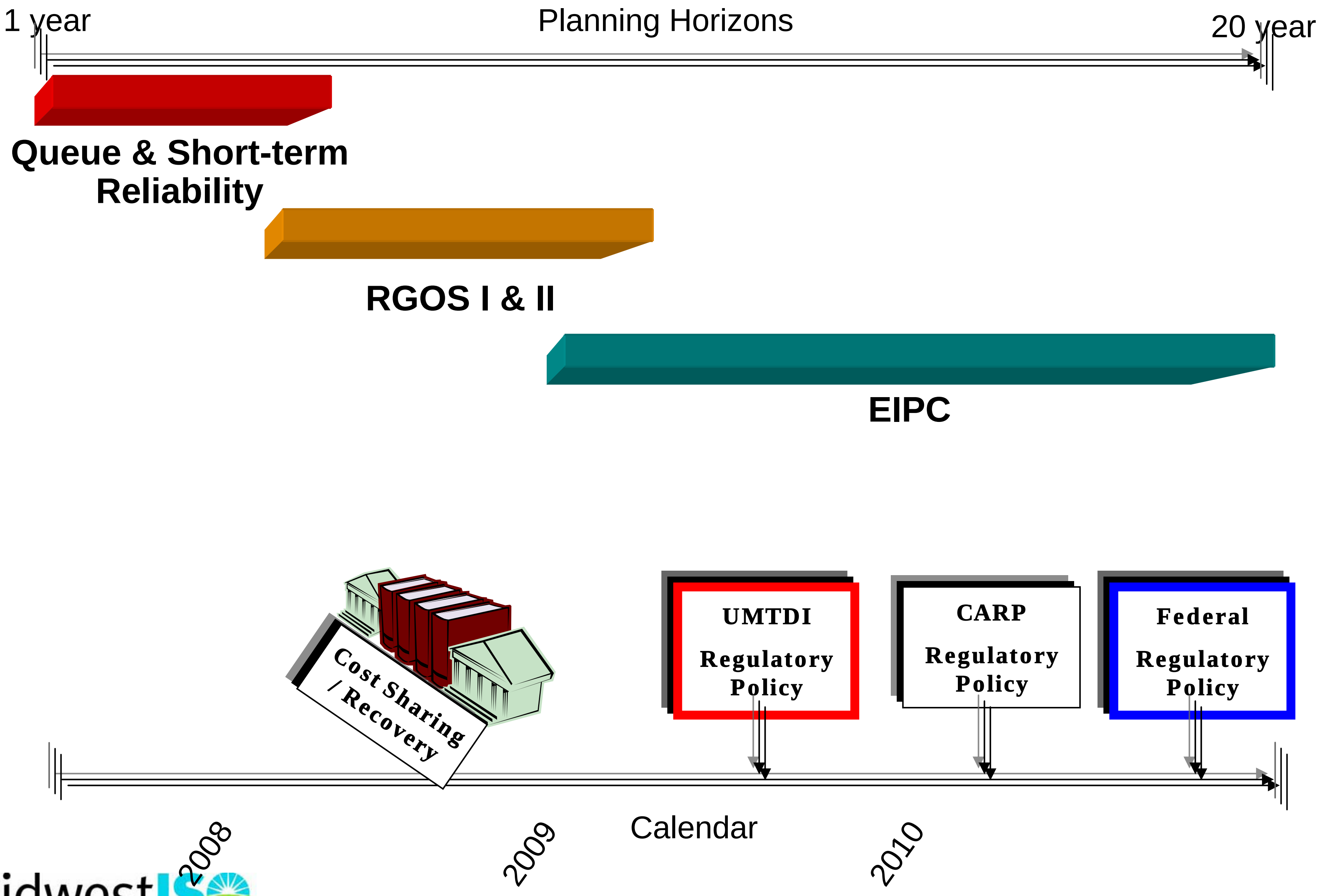
Eastern Interconnect Planning Collaborative (EIPC)



Timelines for Planning Processes / Policy



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Smart Grid

- The Department of Energy announced October 27th that the Midwest ISO is receiving $17.4 million in federal funds aimed at furthering President Barack Obama's effort to modernize the nation's electric grid through Smart Grid technologies.
  - The Midwest ISO Synchrophasors Project is a collaborative effort involving the Midwest ISO, several of our transmission owning members, the University of Tennessee, North Dakota State University and other stakeholders.
  - PMU measurements will provide a precise, comprehensive view of an entire interconnection and enable advanced monitoring and analysis to identify changes in grid conditions, including the amount and nature of stress on the system. The data from PMUs, or Synchrophasors, will further enhance the Midwest ISO's ability to predict possible disturbances in time to remedy them and will help system operators coordinate the use of intermittent wind resources more efficiently than possible today.
- Improved long-term planning of the electric system (increasing system reliability and reducing costs)
- Improved real-time monitoring of the electric system (increasing reliability), and
- Improved integration of large amounts of renewable energy resources (such as wind) that have highly variable generation characteristics, furthering Midwest ISO's efforts to efficiently provide clean energy resources when they are available and make adjustments when they are not.

Summary

- Collaboration between the states and the planning entities, such as RGOS hold, the promise for developing equitable and workable cost allocation policies within and between regions.
- It is essential to attain consensus at the state level on predictions for the longer term outcomes of the policy changes taking place.
- Successful cost sharing for the resulting regional plans will require an understanding and acceptance by key stakeholders of the implications for mutual benefits that various transmission built-outs may provide.
  - Requires a process that is broad in its regional and inter-regional scope, and that fosters buy-in by those impacted by the outcomes.
  - Process currently underway by the Organization of Midwest ISO States' *Cost Allocation and Regional Planning group* is a good example of such a process. By holding the discussion on cost allocation in the context of potential energy outcomes, and with every state involved, the prospects for buy-in are greatly improved.