Southwest Power Pool

ECONOMIC STUDIES WORKING GROUP

October 9th, 2015

Net Conference

• SUMMARY OF ACTIONS TAKEN •

1. None

Southwest Power Pool

ECONOMIC STUDIES WORKING GROUP

October 9th, 2015

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• MINUTES •

Agenda Item 1 – Administrative Items

Agenda Item 1a - Call to Order, Introductions

Chair Alan Myers (ITC Great Plains) called the meeting of the Economic Studies Working Group (ESWG) to order at 8:30 AM, welcomed those in attendance, and asked for introductions.

There were 45 web conference participants, representing 13 of 13 ESWG members. (Attachment 1 – October 9th, 2015 Attendance)

Agenda Item 1b – Receipt of Proxies

Alan Myers (ITC Great Plains) asked for any proxy statements. No proxies were identified.

Agenda Item 1c – Review of Agenda

Chair Alan Myers (ITC Great Plains) presented the agenda for review and asked for any additions or corrections. (Attachment 2 – October 9th, 2015 Agenda)

Kurt Stradley (LES) made a motion; seconded by Kip Fox (AEP-Transource) to adopt the agenda. The motion was approved unanimously.

Agenda Item 2 – 2017 ITP10 Resource Plan Phase Two

Josh Ross (SPP Staff) presented updated results of the Future 3 resource plan phase 2 simulations. Staff has incorporated some changes since the September 23rd meeting including the requested adjustment of wind capacity accreditation, addition of sub-regional interchange to reflect those subregions that are typical importers and exporters of power. The wind accreditation adjustments had minimal effect on the resource plan results, up to nearly 25% accreditation. The largest driver of the results seems to be the current natural gas price forecast, which is 40%-60% higher for any given year than the forecast utilized in the 2015 ITP10. After a debate about natural gas prices the ESWG agreed to keep using the NYMEX as an index to forecast natural gas prices, according some members NYMEX is the best public source available for the current study. The current results are similar to the preliminary, with mostly CC ant CT additions and slight wind additions into year 20. After discussion, the group agreed that the wind levels are much lower than expected. Steve Gaw (Wind Coalition) asked if the PTC was included in the prototype data and mentioned the driver of the Futures for competitive wind. Staff reported that the approved prototypes do not have the PTC reflected and agreed that we need to honor the drivers of the Futures. Staff suggested that if competitive wind is not being honored we should develop a methodology to add wind in the base model as done for solar generation. Staff suggested 20% of peak load by company for Future 3 and 25% of peak load by company for Future 1 and 2. The results of implementing this has not been calculated but expected to be less than 1 GW of additional wind for Future 3 in 2025. The group was concerned about the relative wind and solar additions, and that the wind additions should be at least as much as solar. Staff will investigate this concern and develop a reasonable level for all renewables. (Attachment 3 – 2017 ITP10 Resource Plan Phase 2)

Staff has posted detailed data from the Future 3 results and requested that members review these for anomalies or suspect input data, especially with the effect of the natural gas price on coal generation. (Attachment 4 – 2017 ITP10 Resource Plan Phase 2_Data)

ACTION ITEM: SPP members to review posted detailed results of the Future 3 resource plan.

Kelsey Allen (SPP Staff) presented preliminary results of the Future 1 resource plan phase 2 simulations. The Future 3 model was adjusted and combined into a single regional model and adjusted to meet Future 1 assumptions for solar. Staff ran multiple simulations testing the impact of different adjustments one at a time, including coal retirements, additional wind, and varying levels of a carbon cost adder. Staff also simulated two carbon cost adder scenarios with the natural gas price forecast utilized in the 2015 ITP10. (Attachment 5 - 2017 ITP10 Resource Plan Phase 2_F1)

Agenda Item 3 – 2017 ITP10 Assumptions

Agenda Item 3a – Data Inputs and Methodology

Kelsey Allen (SPP Staff) reviewed the hurdle rate methodology currently being developed through the benchmarking process. Staff has found that performing analysis in the context of the ITP study may not be the best way to develop hurdles between regions, as they are modeling tool to create a kind of friction between markets that exists in the operational realm. In discussion with ABB, Staff is suggesting utilizing one of two approaches used in their analysis, rates utilized in their nodal analysis or rates in their zonal analysis. The nodal hurdle rates are general numbers developed over time from industry analysis and are consistent across most pools. The zonal rates are developed from actual transmission tariff rates found on Oasis. The group generally agreed that moving forward with one of these approaches is reasonable. Staff is currently performing simulations comparing the options and plans to bring some results to the next meeting. (Attachment 6 - 2017 ITP10 Data Inputs and Methodology)

Agenda Item 3b – Siting Methodology Update

Chris Jamieson (SPP Staff) reviewed some of the methodologies and considerations being investigated and gave an update on the progress of the siting development. It is still a work in progress but analysis is currently being done to assess potential sites and more will be discussed in the future. (Attachment 7 - Siting Methodology Update)

Agenda Item 3c – Portfolio Consolidation Methodology

[This item was not covered]. (Attachment 8 - 2017 ITP10 Portfolio Consolidation)

Agenda Item 3d – Futures Assumptions

The discussion on the resource plan carried forward into the assumptions and modeling for Future 2 and the structure that would be implemented in the simulations. Chris Jamieson (SPP Staff) reviewed the different options Staff has discussed internally, including modeling the SPP portion of each state separately, modeling each state separately but disregarding Planning Authority (PA) boundaries. Some members were concerned with the lack of trading [of carbon allowances or emission reduction credits] that would be represented in either of the proposed options. A third option could be to model a subregional approach that would allow some trading but less than the regional approach. Staff agreed with the issue of trading but suggested that a state-by-state approach is more in line with the original future definition and while it may not be reflective of how the future may unfold, it would be more informative for stakeholders than implementing a subregional approach. The group did not take immediate issue with this; Staff will continue work assuming option 2, to build a model state by state disregarding PA boundaries. (Attachment 9 - 2017 ITP10 Futures Assumptions)

Closing Items

Chair Alan Myers (ITC Great Plains) requested other items meriting discussion.

Upcoming meetings and locations:

- October 22nd, 2015: NextEra HQ, Juno Beach, FL
- November 18th-19th, 2015: SPP Corporate Offices, Little Rock, AR
- December 10th, 2015: 8th Floor AEP Offices, Dallas, TX

List of action items from the meeting:

1. SPP members to review posted detailed results of the Future 3 resource plan.

The meeting was adjourned at 11:30 AM.

Respectfully Submitted,

Kelsey Allen
ESWG Secretary

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ECONOMIC STUDIES WORKING GROUP

October 9th, 2015

Net Conference

• A G E N D A •

8:30am – 11:30am

1. Administrative items
   a. Call to Order, Introductions .... Alan Myers (5 minutes)
   b. Receipt of Proxies .... Kelsey Allen (1 minute)
   c. Review of Agenda[1] .... Alan Myers (1 minute)
2. 2017 ITP10 Resource Plan Phase Two[1] .... SPP Staff (60 minutes)
3. 2017 ITP10 Assumptions .... SPP Staff (90 Minutes)
   a. Data Inputs and Methodology[1]
   b. Siting Methodology Update
   c. Portfolio Consolidation Methodology[1]
   d. Futures Assumptions[1]
4. Closing Items .... All (5 minutes)
   a. Future Meetings
      i. October 22nd, 2015: NextEra HQ, Juno Beach, FL
         1. Logistics (Don Le)
      ii. November 18th-19th, 2015: SPP Corporate Offices, Little Rock, AR
      iii. December 10th, 2015: 8th Floor AEP Offices, Dallas, TX

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[1] Background Material Included

2017 ITP10 Resource Plan Phase 2

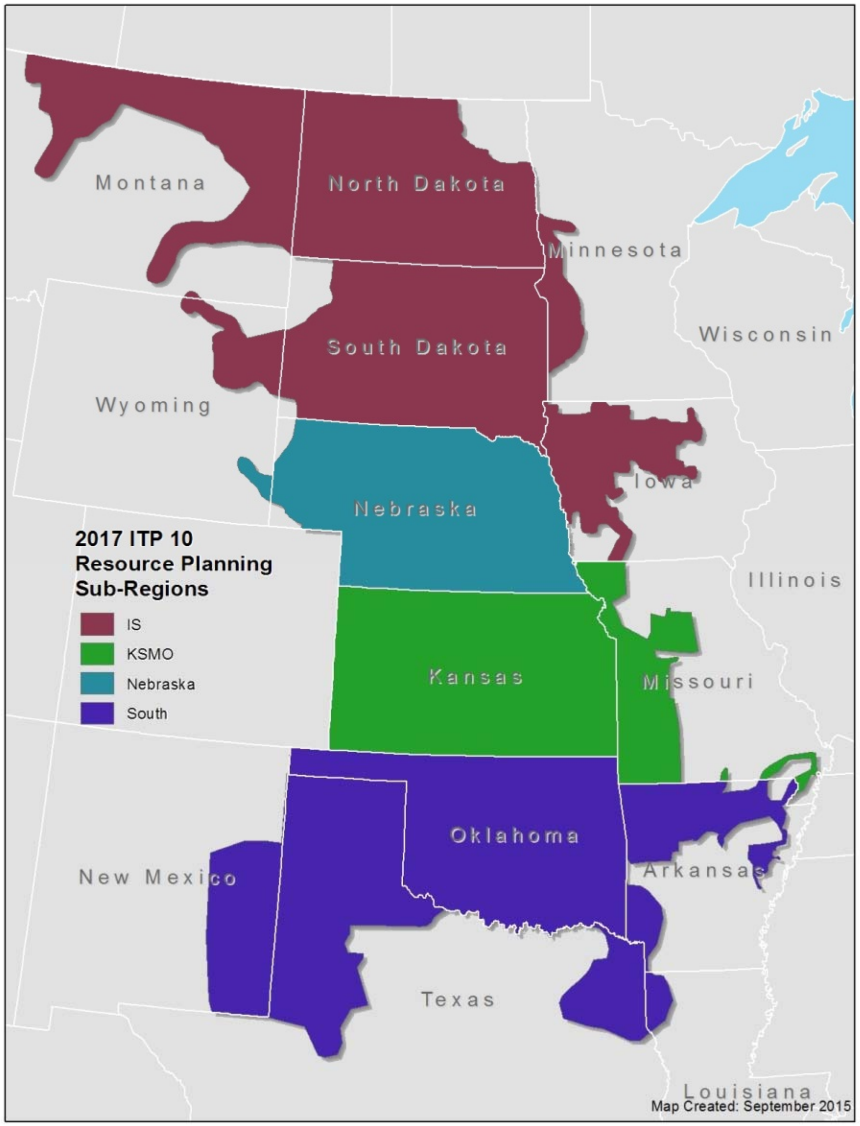
October 9th , 2015

SPP Southwest Power Pool

Helping our members work together to keep the lights on... today and in the future

Resource planning simulations

- Capacity expansion plan development for 4 sub-regions
  - IS, Nebraska, KSMO, South
  - Years 2020 – 2035



Resource planning simulations

- Model inputs
  - Load and generation review
  - Fuel prices
  - RP1 renewable units (387 MW in 2025)
  - Utility scale and rooftop solar units (2.4 GW in 2025)
- Constraints
  - Zonal load requirements and generation capacity
  - Zonal capacity margin requirement (12%)
- Model edits since 9/23
  - Wind prototype accreditation, sub-regional transactions, end effects setup

F3 Load and Generation by Sub-Region, 2025

	IS	NEB	KSMO	South	TOTAL
Accredited Installed capacity (MW)	6,954	7,722	18,594	31,703	64,973
Peak load (MW)	6,992	6,815	16,639	31,533	61,979
Capacity Additions (MW)*	1,198	550	1,650	6,658	10,056

*Capacity additions are based on zonal requirements, not sub-regional requirements

Unit Retirements, by Year

- Based on Generation Review

Retirements (MW)	2020	2025	2035
Coal	2,442	3,475	4,622
Nuclear	0	0	588
Gas	1,121	2,686	6,291
Oil	25	51	346
Other	3	3	28
TOTAL	3,592	6,215	11,876

Wind Accreditation

- Existing wind farms: Accreditation based on current SPP Criteria
  - Average wind accreditation in 2017 ITP10 is 20%
  - Strategist modeling now uses 20% wind accreditation for prototypes
- Analyzed capacity buildout with different wind accreditation inputs
  - Small to moderate changes (ex. 5% to 25%) had minimal impact
  - Only larger changes (ex. 20% to 75%) had noticeable impact

Natural Gas Prices

- NG prices derived from NYMEX futures and DOE growth rates in both 2015 ITP10 and 2017 ITP10
  - NYMEX futures prices have declined during the past two years
- Henry Hub comparison:

(nominal $)

	2017 ITP10	2015 ITP10	Difference
2019	$3.55	$5.01	($1.46)
2020	$3.66	$5.37	($1.71)
2021	$3.79	$5.72	($1.93)
2022	$3.93	$6.13	($2.20)
2023	$4.06	$6.51	($2.46)
2024	$4.19	$6.79	($2.60)
2025	$4.35	$7.03	($2.68)
2026	$4.54	$7.38	($2.85)
2027	$4.72	$7.63	($2.90)
2028	$4.90	$7.96	($3.05)
2029	$5.15	$8.23	($3.07)
2030	$5.49	$8.54	($3.05)
2031	$5.72	$8.92	($3.20)
2032	$6.01	$9.24	($3.22)

- This decrease in gas prices is impacting the dispatch of coal and gas in the simulations

F3 Unit Capacity Factors

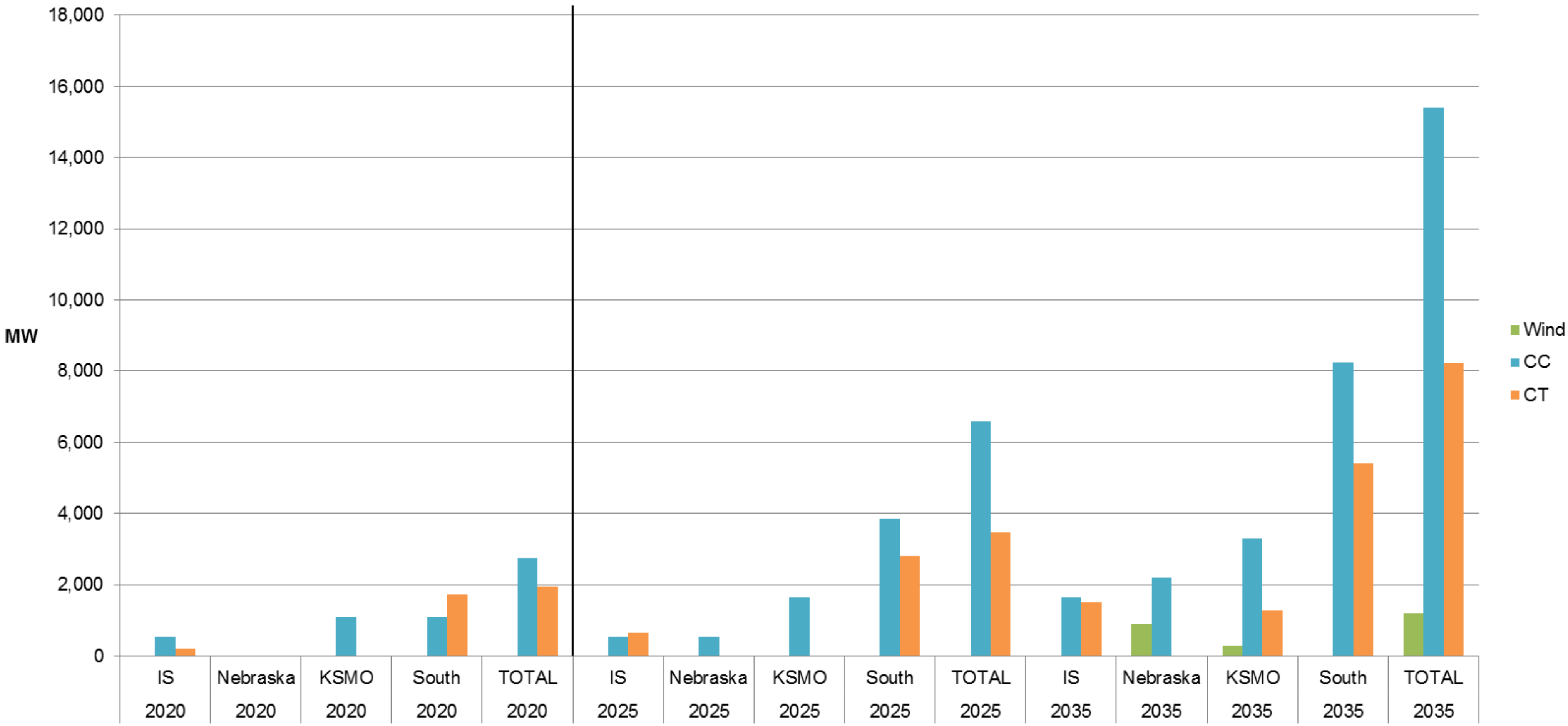
- Some of the more economical CCs are displacing some of the less economical coal units
- Capacity factors by unit are posted on TrueShare

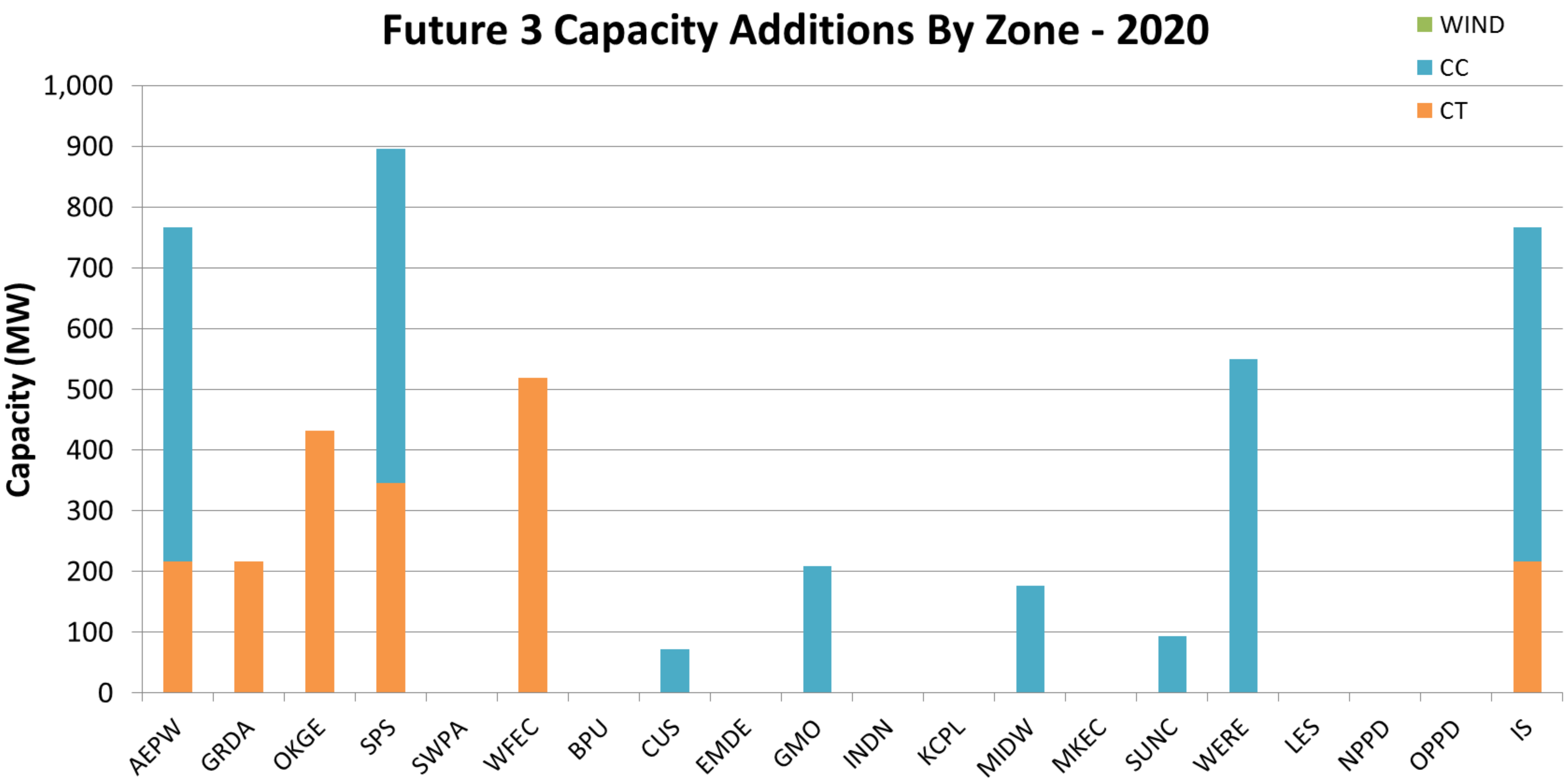
	2020	2025	2035
ST Coal	58.23%	60.66%	72.72%
CC	42.29%	51.97%	48.90%
CT Gas	4.90%	6.13%	9.73%
ST Gas	2.44%	3.91%	9.05%
IC Gas	18.92%	25.84%	31.60%
Nuclear	89.17%	89.20%	89.48%
CT Oil	1.26%	2.29%	7.98%
IC Oil	0.62%	0.93%	5.31%
Internal Combustion	4.88%	7.08%	16.95%
ST Other	42.59%	42.65%	43.31%
CT Other	30.23%	30.21%	92.65%

Future 3 Resource Additions

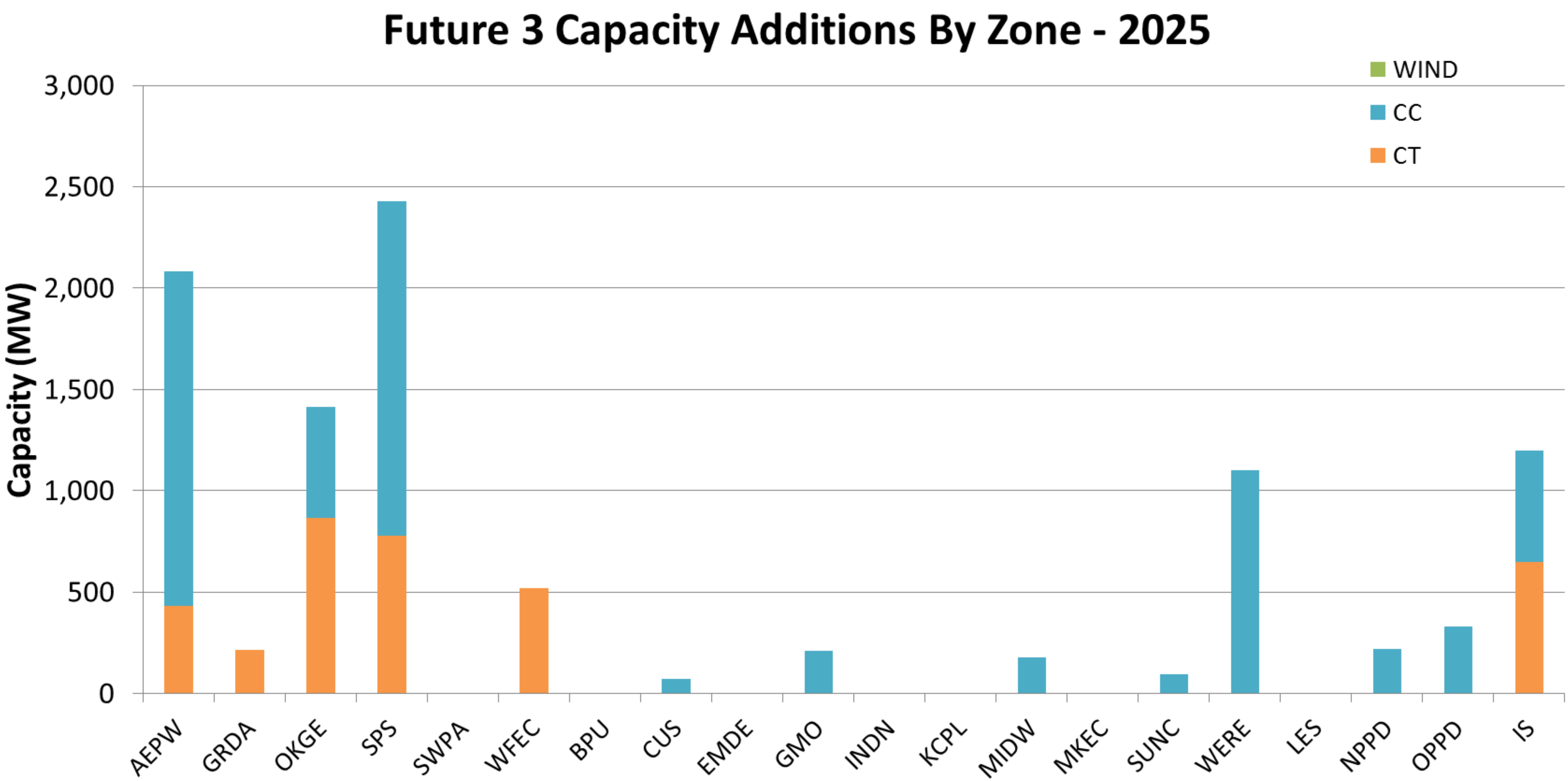
F3 Resource Additions, Cumulative MW:

2020	4,694
2025	10,056
2035	24,808

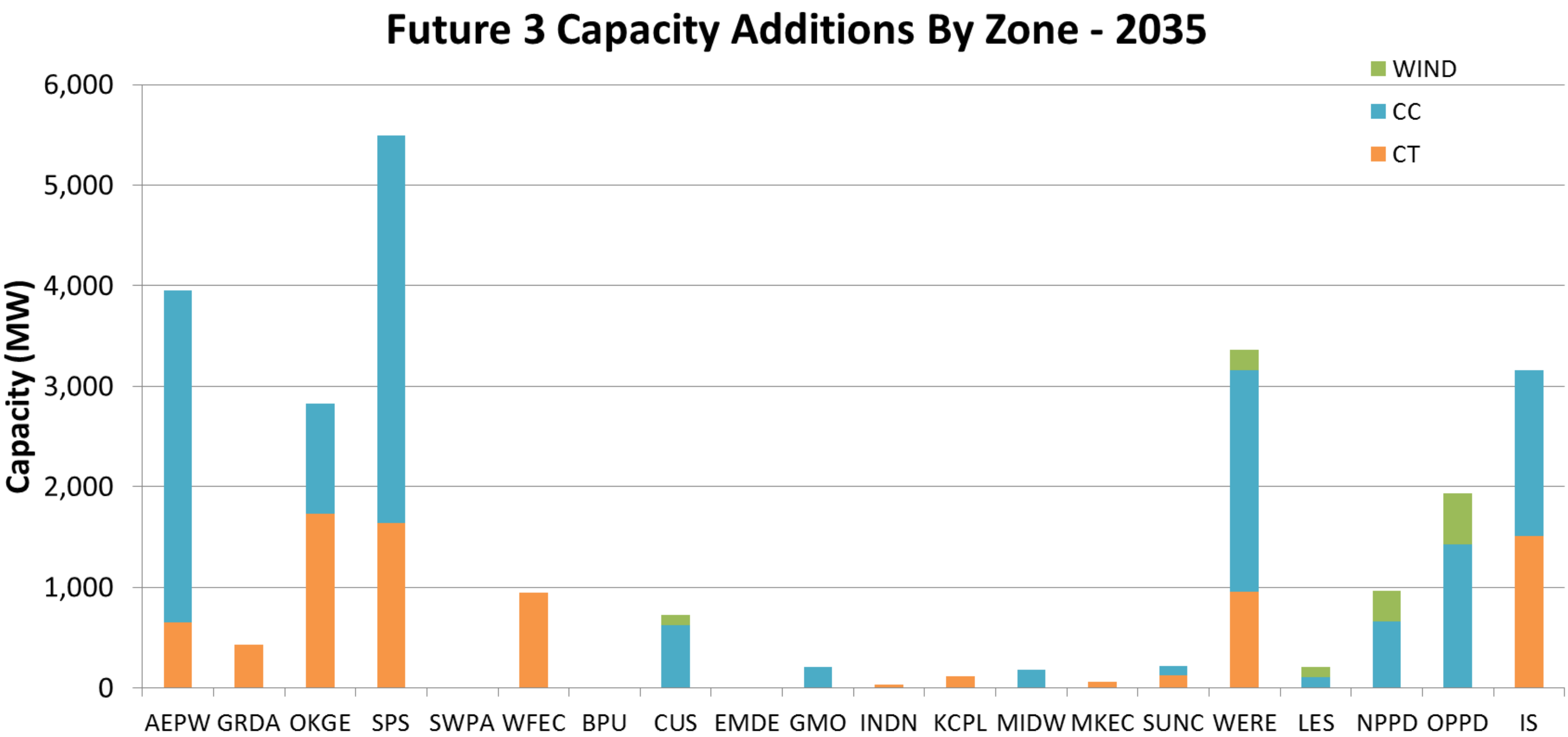




Future 3 Capacity Additions By Zone - 2020
WIND
CC
CT
Capacity (MW)
1,000
900
800
700
600
500
400
300
200
100
0
AEPW
GRDA
OKGE
SPS
SWPA
WFEC
BPU
CUS
EMDE
GMO
INDN
KCPL
MIDW
MKEC
SUNC
WERE
LES
NPPD
OPPD
IS



Future 3 Capacity Additions By Zone - 2025
WIND
CC
CT
Capacity (MW)
3,000
2,500
2,000
1,500
1,000
500
0
AEPW
GRDA
OKGE
SPS
SWPA
WFEC
BPU
CUS
EMDE
GMO
INDN
KCPL
MIDW
MKEC
SUNC
WERE
LES
NPPD
OPPD
IS


Future 3 Capacity Additions By Zone - 2035
WIND
CC
CT
Capacity (MW)
6,000
5,000
4,000
3,000
2,000
1,000
0
AEPW GRDA OKGE SPS SWPA WFEC BPU CUS EMDE GMO INDN KCPL MIDW MKEC SUNC WERE LES NPPD OPPD IS

Interchange Method

- 2015 ITP10: No interchange between sub-regions
- 2017 ITP10: Implemented fixed transactions for each sub-region to model interchange
  - Based on load/gen output from 2015 ITP10 PROMOD dispatch
  - Includes hourly profiles
  - No impact on capacity needs; impact on energy needs only

Subregion	Average Export (Import) (MW)
SPP IS	(229)
SPP KSMO	112
SPP Nebraska	1,189
SPP South	(4,659)

Next Steps

- Bring results for all 3 futures to 10/22 meeting
- Final approval for all 3 futures at 11/18 meeting

10/7/2015
Green tabs show resource planning inputs and outputs, related to new resources
Other tabs show other miscellaneous inputs and outputs, related to gas prices, retirements, etc.
Results for futures 1 and 2 are still being developed

Additional data with capacity factors by unit, and $/MWh by unit, are posted on TrueShare:
ITP - Confidential and Protected…. -> 2017 ITP10 -> Resource Planning Data ->

2017 ITP10 Resource Plan Phase 2

October 9th , 2015

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Future 1 Resource Planning Simulations

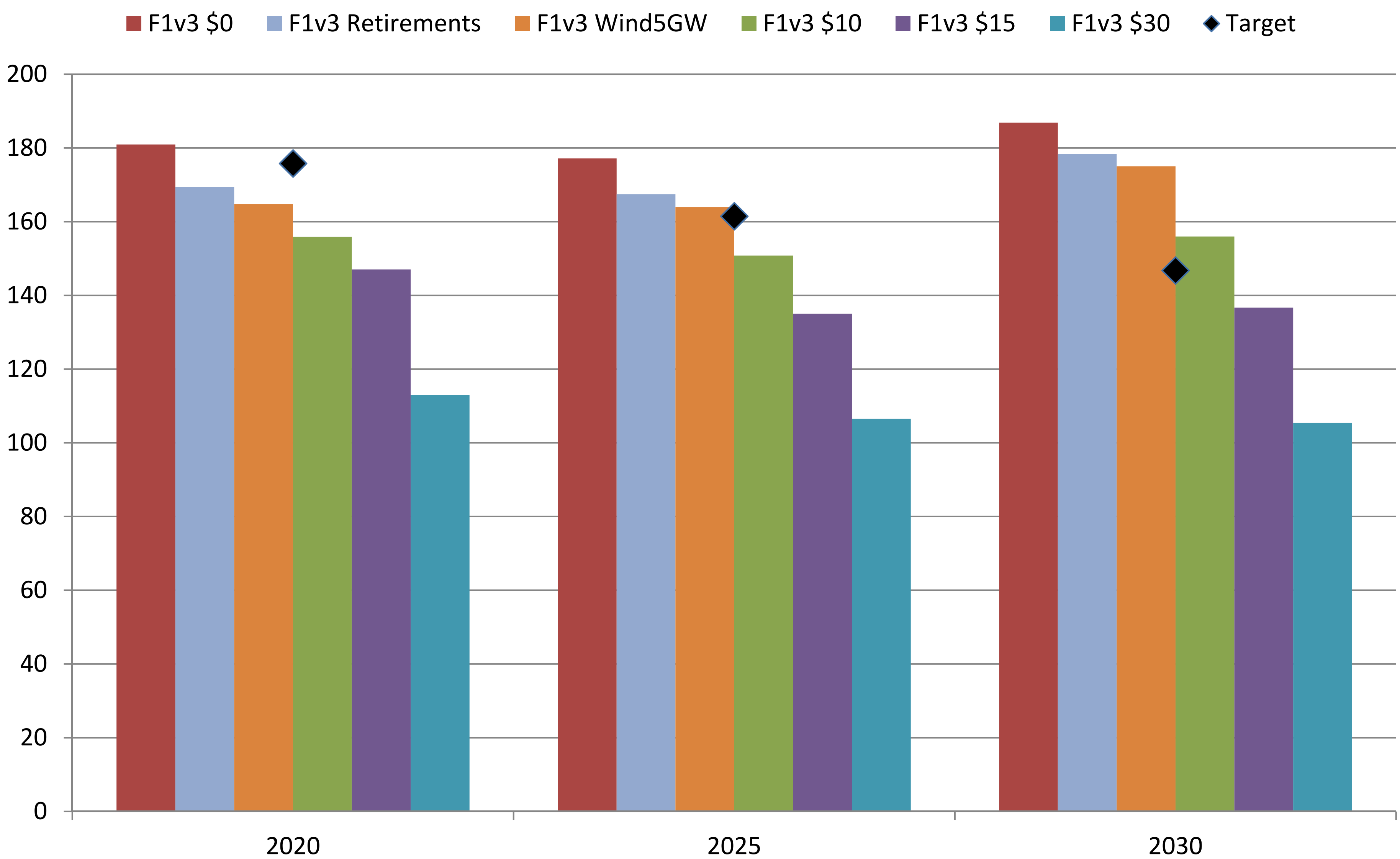
- Model changes from F3
  - Regional structure
    - IS, Nebraska, KSMO, South combined
  - Adjusted utility scale solar units (3.1 GW in 2025)
  - Removed rooftop solar
  - Removed sub-regional transactions (not needed)

Future 1 Resource Planning Simulations

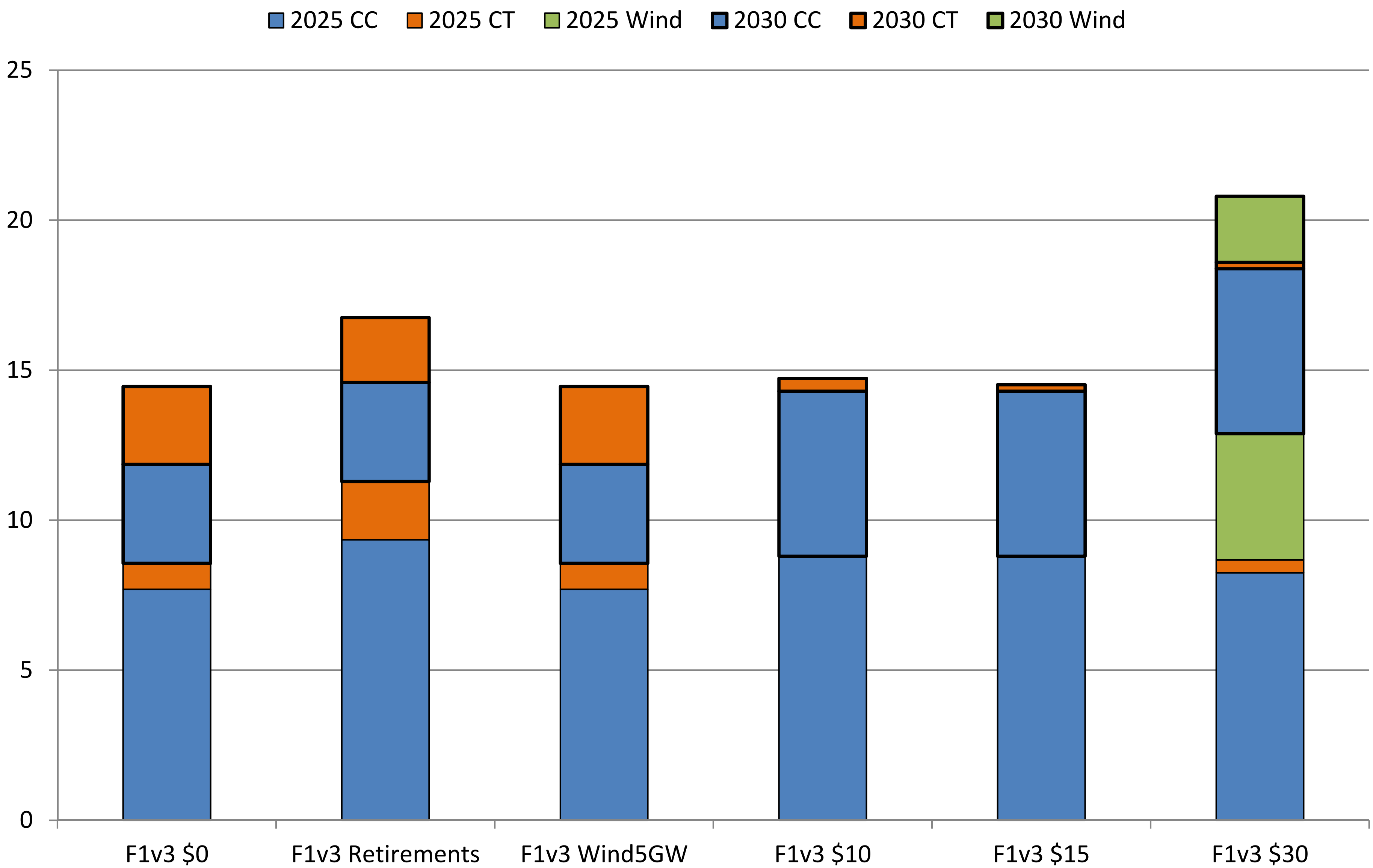
- Simulated multiple scenarios
  - F1v3 $0 – Base case, regional version of F3 model
  - F1v3 Retirements – Base case + ~2GW retirements*
  - F1v3 Wind5GW – Base case + 5GW wind
  - F1v3 $10 – Base case + $10 carbon cost adder
  - F1v3 $15 – Base case + $15 carbon cost adder
  - F1v3 $30 – Base case + $30 carbon cost adder

*Similar to SPP Regional CPP Analysis

Future 1 Emissions Summary (MM Tons)



Future 1 Resource Additions (GW)



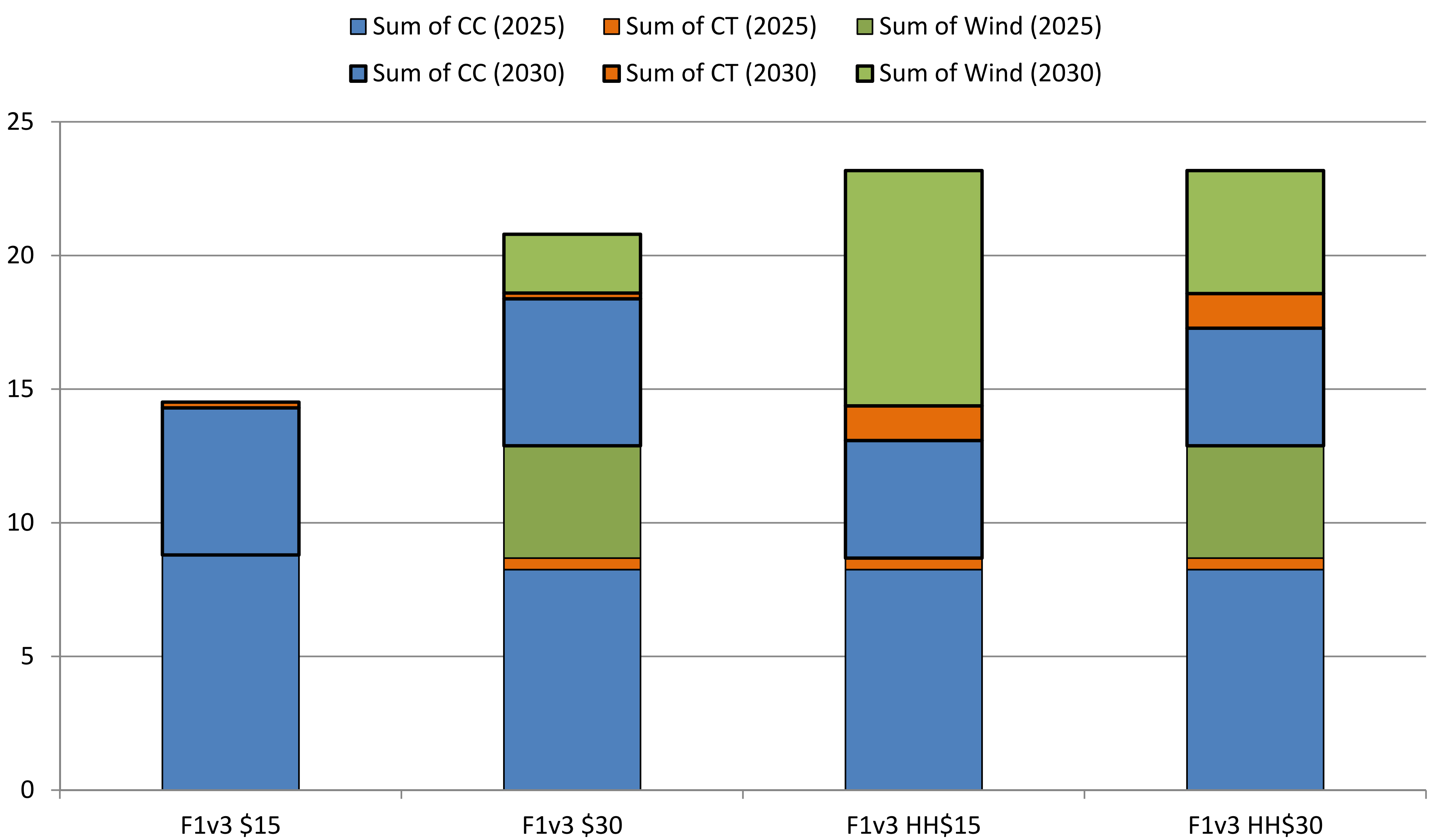
Future 1 Resource Planning Simulations

- **Additional Natural Gas Sensitivities**
  - **F1v3 HH$15 – Base case + $15 carbon cost adder + Henry Hub gas prices from 2015 ITP10**
  - **F1v3 HH$30 – Base case + $30 carbon cost adder + Henry Hub gas prices from 2015 ITP10**

*Similar to SPP Regional CPP Analysis

Future 1 Emissions Summary (MM Tons)

Future 1 Resource Additions (GW)



2017 ITP10 Data Inputs & Study Methodology

SPP Staff

September 23rd, 2015

Data Inputs & Study Methodology

- Load & Gen Review
- Renewable Survey
- System Topology
- Fuel Prices
- Emissions Prices
- DC Ties
- Hourly Load Profiles
- Hourly Renewable Profiles
- Resource Plan
  - Capacity accreditation
  - Capacity margin
- Needs Assessments (Economic & Policy)
- Resource plan
  - Prototypes
- Conventional minimum capacity
- Constraint Assessment

*Complete Discussing Today Reference

Data Inputs & Study Methodology

- Benchmarking
  - Hurdle Rates
- Siting
- Generator Outlet Facilities
- Project Selection
- Project Grouping
- Portfolio Consolidation
- Project Staging
- Benefit Metrics
- Sensitivities

*Complete Discussing Today Reference

BENCHMARKING

ESWG Approved Recommendation

- Focus Benchmarking efforts toward quality assurance and validation of the study year economic model
- Use one set of hurdle rates from SPP to all regions
- Omit 2014 Economic Model build
- <u>*New hurdle rate methodology*</u>

Hurdle Rate Methodology Options

1. Utilize the nodal hurdle rates in Ventyx East Nodal F14 data release
2. Utilize the zonal hurdle rates as calculated by ABB for the 2017 ITP10 area structure

Hurdle Rates- Option 1

Utilize the nodal, hurdle rates in the Ventyx East Nodal F14 data release

- **Leverage ABB years of research and modeling of hurdle rates**
- **Traditionally used in nodal simulations**
- **These nodal hurdle rates have simply been developed over time in various nodal studies**

Hurdle Rates- Option 2

Utilize the zonal, hurdle rates as calculated by ABB for the 2017 ITP10 area structure

- **Leverage ABB years of research and modeling of hurdle rates**
- **Traditionally used in zonal simulations**
- **These zonal hurdle rates have been developed from the bottom up using published Oasis tariffs and a friction adder**

Option 1- Hurdle Rate Values

Interface	Fwd Energy	Off-Peak Fwd Energy	Back Energy	Off-Peak Back Energy	Commit Fwd Energy	Off-Peak Commit Fwd Energy	Commit Back Energy	Off-Peak Commit Back Energy
	($/MWh)							
MISO_MH	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SASK_SPP	10.24	5.12	10.24	5.12	19.20	19.20	19.20	19.20
TVA_DELTA	38.40		10.24	5.12			19.20	19.20
MISO_TVA	10.24	5.12	38.40		19.20	19.20	38.40	38.40
MH_SASK	10.24	5.12	10.24	5.12	19.20	19.20	19.20	19.20
SPP_DELTA	10.24	5.12	10.24	5.12	19.20	19.20	19.20	19.20
MISO_DELTA	10.24	5.12	10.24	5.12	19.20	19.20	19.20	19.20
MISO_SPP	10.24	5.12	10.24	5.12	19.20	19.20	19.20	19.20

Option 2- Hurdle Rate Values

Interface	Fwd Energy	Off-Peak Fwd Energy	Back Energy	Off-Peak Back Energy
	($/MWh)			
MISO_MH	0.00	0.00	0.00	0.00
SASK_SPP	12.60	4.38	9.14	2.65
TVA_DELTA	38.40	38.40	10.20	6.36
MISO_TVA	14.12	4.88	38.40	38.40
MH_SASK	16.50	6.02	12.60	4.38
SPP_DELTA	9.05	2.48	10.20	6.36
MISO_DELTA	14.12	4.88	10.20	6.36
MISO_SPP	14.12	4.88	9.05	2.48

Hurdle Rate Comparisons (1 of 2)

- Compares both options to 2015 ITP10 hurdle rates
- Due to differing pool structures between ITP10s, hurdle rates cannot be compared one to one

Interface	Fwd Energy Tariff ($/MWh)			Back Energy Tariff,($/MWh)			Off-Peak Fwd Energy Tariff ($/MWh)			Off-Peak Back Energy Tariff ($/MWh)		
	2015 ITP10	*Option 1*	*Option 2*	*2015 ITP10*	*Option 1*	*Option 2*	*2015 ITP10*	*Option 1*	*Option 2*	*2015 ITP10*	*Option 1*	*Option 2*
MAPP Non-MISO_SERC	8.27			7.22			8.27			7.22		
MH_SASK		10.24	16.50		10.24	12.60		5.12	6.02		5.12	4.38
MISO_DELTA*		10.24	14.12		10.24	10.20		5.12	4.88		5.12	6.36
MISO_SERC*	9.71			10.89			9.71			10.89		
MAPP Non-MISO_MISO~	8.27			7.22			8.27			7.22		
MISO_MH~		0.00	0.00		0.00	0.00		0.00	0.00		0.00	0.00
MISO_SPP	13.12	10.24	14.12	3.28	10.24	9.05	13.12	5.12	4.88	3.28	5.12	2.48
MISO_TVA		10.24	14.12		38.40	38.40		5.12	4.88		38.40	38.40
SASK_SPP		10.24	12.60		10.24	9.14		5.12	4.38		5.12	2.65
SPP_MAPP Non-MISO	6.56			13.12			6.56			13.12		
SPP_DELTA^		10.24	9.05		10.24	10.20		5.12	2.48		5.12	6.36
SPP_SERC^	1.97			13.12			1.97			13.12		
TVA_DELTA		38.40	38.40		10.24	10.20		38.40	38.40		5.12	6.36

*The two interfaces with this symbol can be directly compared
~The two interfaces with this symbol can be directly compared
^The two interfaces with this symbol can be directly compared
Interfaces not in bold font indicate the interface is a 2015 ITP10 interface without an exact match to a 2017 ITP10 interface

Hurdle Rate Comparisons (2 of 2)

- Compares both options to 2015 ITP10 hurdle rates
- Due to differing pool structures between ITP10s, hurdle rates cannot be compared one to one

Interface	Commit Fwd Energy ($/MWh)			Commit Back Energy ($/MWh)			Off-Peak Commit Fwd Energy ($/MWh)			Off-Peak Commit Back Energy ($/MWh)		
	2015 ITP10	*Option 1*	*Option 2*	*2015 ITP10*	*Option 1*	*Option 2*	*2015 ITP10*	*Option 1*	*Option 2*	*2015 ITP10*	*Option 1*	*Option 2*
MAPP Non-MISO_SERC	13.12			13.12			13.12			13.12		
MH_SASK		19.20	16.50		19.20	12.60		19.20	6.02		19.20	4.38
MISO_DELTA*		19.20	14.12		19.20	10.20		19.20	4.88		19.20	6.36
MISO_SERC*	13.12			13.12			13.12			13.12		
MAPP Non-MISO_MISO~	13.12			13.12			13.12			13.12		
MISO_MH~		0.00	0.00		0.00	0.00		0.00	0.00		0.00	0.00
MISO_SPP	13.12	19.20	14.12	13.12	19.20	9.05	13.12	19.20	4.88	13.12	19.20	2.48
MISO_TVA		19.20	14.12		38.40	38.40		19.20	4.88		38.40	38.40
SASK_SPP		19.20	12.60		19.20	9.14		19.20	4.38		19.20	2.65
SPP_MAPP Non-MISO	13.12			13.12			13.12			13.12		
SPP_DELTA^		19.20	9.05		19.20	10.20		19.20	2.48		19.20	6.36
SPP_SERC^	13.12			13.12			13.12			13.12		
TVA_DELTA		38.40	38.40		19.20	10.20		38.40	38.40		19.20	6.36

*The two interfaces with this symbol can be directly compared
~The two interfaces with this symbol can be directly compared
^The two interfaces with this symbol can be directly compared
Interfaces not in bold font indicate the interface is a 2015 ITP10 interface without an exact match to a 2017 ITP10 interface

QUESTIONS?

Approved Assumptions

- Status quo hourly load profiles
- Maintain a 13.6% reserve margin for resource planning (As currently outlined in SPP criteria)
- Use actual calculated values for accreditation of wind resources with 3 years of historical data and follow SPP criteria for accreditation of future wind resources
- Follow SPP criteria for accreditation of solar resources

Approved Assumptions

- Utilize the status quo methodology for modeling of fuel, wind, and emissions prices. (Ventyx Reference Case for coal, oil, uranium and emissions prices. NYMEX futures and DOE growth rates for natural gas prices. $8/MWh VOM and curtailment price for wind)
- Remove PROMOD must run flag on all base load units except nuclear for all futures

Approved Assumptions

- Approved the use of new "Other GI Firm" resources [not designated to a utility] to meet any potential renewable Mandate or Goal shortfalls
- Approved the use of prototypes from Lazard's 2014 Levelized Cost of Energy Study (Version 8)
- Approved the use of 2012 hourly wind profiles from the NREL 2012 WIND toolkit dataset

Other Assumptions Discussed

- **Wind capacity factors for Phase 1 Resource Plan (Policy driven additions)**
  - **Utilize Regional, State, Zonal, or bus information provided for siting considerations in renewable survey**
    - **Use average of SPP capacity factors for each siting consideration type (existing modeled wind, NREL data)**
    - **Site specific NREL data for supplied bus level data**

Approved Assumptions

- **Approved to define up to 25 congested constraints with greater than $50,000 in annual congestion cost as economic needs**
- **Approved the status quo methodology for identifying policy needs**
  - **Shortfall of deliverable energy mandates or goals by utility, by state**

Approved Assumptions

- Approved recommendation for benchmarking
  - Focus Benchmarking efforts toward quality assurance and validation of the study year economic model
    - No development of current year model
  - Develop new methodology to determine one set of hurdle rates for the SPP region

Approved Assumptions

- Approved recommendation for prototypes
  - Use of the parameters associated with the low-end levelized cost of energy for Lazard prototypes

2017 ITP10 Resource Plan Siting Milestone Update

Chris Jamieson
9/23/2015

Southwest Power Pool

Use Previous Study Resource Sites

- Leverage 2013 ITP20 and 2015 ITP10 sites previously approved by stakeholders for conventional resources
- Work with Upper Missouri Zone (UMZ) stakeholders to develop potential hypothetical sites
- Investigating how historic average LMPs can be utilized for ranking
- Rank sites by transmission pricing zone
  - Give priority to brownfield sites with retirements where adequate gas supply exists nearby (pipelines within 32 miles)
  - Prescreen 2015 ITP10 and 2013 ITP20 sites for GOF requirements
  - Give priority to 2015 ITP10 sites unless Generator Outlet Facilities(GOFs) determined in the 2015 ITP10 well exceed historic average cost of Network Upgrades experienced in the SPP Generation Interconnection process
- Post site prioritization for stakeholder review and feedback

Use GI Queue and Study Results

- Provides potential sites and statistics for both conventional and renewable resources to draw reasonable conclusions
- Use historical grouping results to inform siting of both conventional and renewable generation in aggregate to avoid exceeding transmission interconnection limits associated with geographical concentration of interconnections
- Primarily addresses more probable siting of wind resources given historic and present demand for generation interconnection of wind resources, more stringent GI application requirements, and more definitive study results
- Prioritize GI queue statuses and prioritize interconnections by capacity factor and historic average LMPs
- Work with Upper Missouri Zone (UMZ) transmission provider as needed to supplement SPP GI Queue

Future 1 and 2 Wind Siting

- Investigating NREL technical wind potential by state versus existing wind installed by State to leverage remaining technical wind potential by state to balance sites across SPP
- Investigating GI queue statuses Network Upgrade requirements, capacity factors, and historic average LMPs for prioritization
  - IA on-schedule
  - IA on-suspension
  - Facility Study
  - IA commercial operation not fully on-line

Wind Siting Example

- Multiple level prioritization example
  - **Level 1 Remaining wind potential by state coupled with GI queue availability by state**
    - For example, Future 1 requirement is 6,000 MW of additional wind to be compliant with EPA emissions targets resulting in siting 24% of 6000 MW in Nebraska.
  - **Level 2 Rank GI queue availability by state by highest capacity factor and highest Average historic LMP**
    - For example, site 1440 MW of 1500 MW GI sites in Nebraska based on Level 2 ranking
- Options for ranking GI queue
  - **Ranking of GI queue by GI queue**
  - **Ranking of GI queue by GI status**
  - **Ranking of GI queue by lowest Network Upgrades and highest LMP**
- Rank sites including but limited to wind potential, generation queue, transmission impact, and wind assignment by pricing zone
- Post site prioritization for stakeholder review and feedback

Wind Siting Example

	DOE						
State	Potential Installed capacity[1] (MW)	SPP % of State	SPP Potential Installed Capacity (MW)	Current Installed Wind Power Capacity[2] (MW)	SPP Wind Siting Potential (MW)	State % of Potential	SPP/IS GI Queues GI Queue Availability for Siting (MW)
KS	884,359	100%	884,359	2,967	881,392	24.1%	2527.3
NE	881,369	100%	881,369	812	880,557	24.1%	1497.4
SD	844,019	70%	590,813	882	590,196	16.1%	1159
TX	1,418,439	30%	425,532	15,635	420,841	11.5%	2168.2
OK	390,592	100%	390,592	3,932	386,660	10.6%	4119.8
TX	1,418,439	30%	425,532	15,635	420,841	11.5%	2168.2
OK	390,592	100%	390,592	3,932	386,660	10.6%	4119.8
ND	742,276	40%	296,910	1,886	296,156	8.1%	1419.9
NM	340,116	30%	102,035	812	101,791	2.8%	110
MO	58,020	30%	17,406	459	17,268	0.5%	300
IA	464,787	10%	46,479	5,708	45,908	1.3%	0
MN	354,998	10%	35,500	3,035	35,196	1.0%	0
AR	2,126	30%	638	0	638	0.0%	0
MT	687,803	0%	0	665	0	0.0%	266
WY	422,713	0%	0	1,410	0	0.0%	0
LA	0	20%	0	0	0	0.0%	0

Future 1, 2, and 3 Solar siting

- Investigating theoretical solar potential by State
- Investigating NREL Solar Integration National Dataset Toolkit/sites and potential by geographic location
- Multiple level approach based on solar potential by state or geographic
- Tasks
  - Map NREL sites to SPP buses
  - Prescreen SPP buses for GOF requirements
- Rank sites including but limited to solar potential, generation interconnection availability, and solar assignment by pricing zone
- Post site prioritization for stakeholder review and feedback

Level 1 Solar Siting Example

- Technical Rural utility-scale PV Potential by SPP State

State	GW	GWh	Capacity Factor	%SPP	GW (SPP)	GWh (SPP)	%Potential By GW	%Potential By GWh
Kansas	6960	14500149	0.237826	100%	6960	14500149	20%	22%
Texas	20411	38993582	0.218084	30%	6123.3	11698074.6	18%	18%
Oklahoma	4783	9341920	0.222962	100%	4783	9341920	14%	14%
Nebraska	4870	9266757	0.217217	100%	4870	9266757	14%	14%
South Dakota	5345	10008873	0.213763	70%	3741.5	7006211.1	11%	11%
New Mexico	7087	16318543	0.262854	30%	2126.1	4895562.9	6%	7%
North Dakota	5483	9734448	0.20267	40%	2193.2	3893779.2	6%	6%
Missouri	3157	5335269	0.19292	30%	947.1	1600580.7	3%	2%
Arkansas	2747	4986389	0.207216	30%	824.1	1495916.7	2%	2%
Minnesota	6510	10792814	0.189256	10%	651	1079281.4	2%	2%
Louisiana	2394	4114605	0.1962	20%	478.8	822921	1%	1%
Iowa	4021	6994159	0.198563	10%	402.1	699415.9	1%	1%
Wyoming	2854	5727224	0.229079	0%	0	0	0%	0%
Montana	4403	8187341	0.212271	0%	0	0	0%	0%

Annual GHI Map & Sample Sub-Regions for Siting

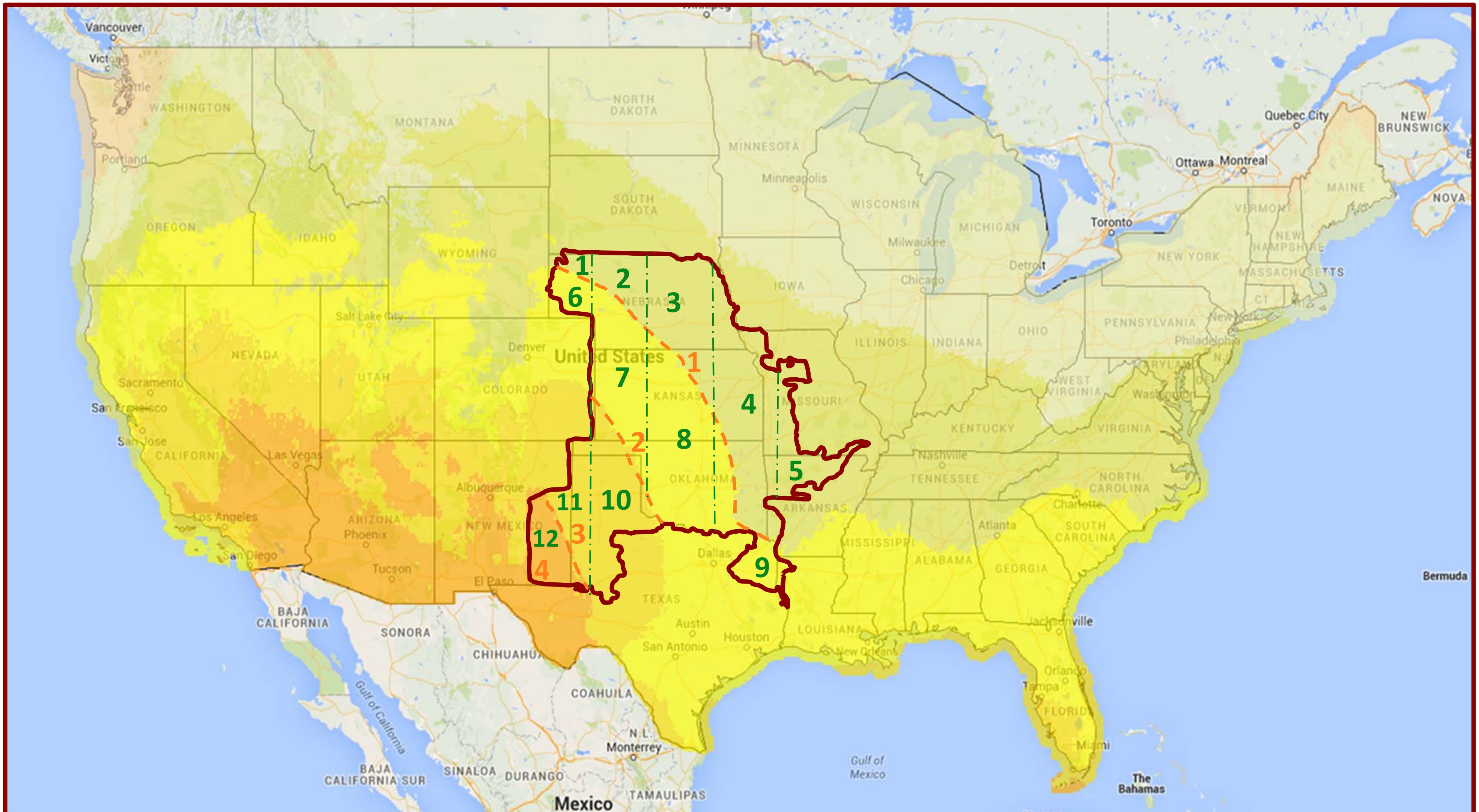


Figure 4.1 | *"NREL Solar Prospector: GHI"*

2017 ITP10 Portfolio Consolidation

SPP Staff

September 23rd, 2015

Consolidation Discussion

- **Criteria 1: Projects in at least 2 of 3 future portfolios are included in the consolidated portfolio**
  - **Possible modification would be if the project in both CPP futures**
  - **Future 1 and Future 2 may be very different answers depending on how they are modeled, resulting in big differences in the portfolios**
- **Criteria 2: Projects in only 1 future portfolio must have a Weighted sum APC B/C ratio above 0.9 and a 1-year B/C greater than 0.7 in a second future**
  - **Possible addition would be to invoke a no negative impact criteria**
    - For example, no negative 1-year B/C or B/C less than 0.5 in remaining future

Consolidation

		1-year B/C Ratio Included in Future portfolio?			Consolidated Portfolio
Project ID	**1-Year Cost**	**Future 1**	**Future 2**	**Future 3**	
Project 1	$ 39,152,000	1.12 Yes	2.83 Yes	0.98 Yes	**Yes**
Project 2	$ 12,745,000	0.70 No	2.83 Yes	0.25 No	**No ***
Project 3	$ 989,000	3.60 Yes	1.20 Yes	0.30 No	**Yes**
Project 4	$ 800,000	0.25 No	1.60 Yes	0.75 No	**No ***
Project 5	$ 1,700,000	1.50 Yes	0.40 No	0.70 No	**No ***

*Project will move on for further assessment, per criteria 2

Weighted APC Threshold Options

Example 1

- Each Future is weighted equally at 1/3

Example 2

- 50% weighting for Future 2 (state by state implementation), 25% for Futures 1 and 3

Weighted APC Performance Example

		1-Year Benefit B/C Ratio			Example 1*	Example 2*
Project ID	1-Year Cost	Future 1	Future 2	Future 3	Weighted B/C ratio	
Project 2	$ 12,745,000	$ 8,921,500 0.70	$ 25,247,845 **2.83**	$ 6,311,961 0.25	**1.26**	**1.65**
Project 4	$ 800,000	$ 200,000 0.25	$ 1,280,000 **1.60**	$ 600,000 0.75	**0.87**	**1.05**
Project 5	$ 1,700,000	$ 2,550,000 **1.50**	$ 680,000 0.40	$ 1,190,000 0.70	**0.87**	**0.75**

*Example 1 reflects all Futures weighted equally, Example 2 reflects Future 2 weighted 50%

APPENDIX

Additional Weighted APC Performance Example

		1-Year Benefit B/C Ratio			Example 1*	Example 2*
Project ID	1-Year Cost	Future 1	Future 2	Future 3	Weighted B/C ratio	
Project 1	$ 1,943,000	$ 445,249 0.23	$ (756,522) -0.39	$ 2,226,243 1.15	0.33	0.15
Project 2	$ 1,454,000	$ (8,947) -0.01	$ 4,111,481 2.83	$ (15,560) -0.01	0.94	1.41
Project 3	$ 979,088	$ 12,378,000 12.64	$ (160,000) -0.16	$ 442,000 0.45	4.31	3.19
Project 4	$ 800,000	$ (80,000) -0.10	$ (400,000) -0.50	$ 9,000,000 11.25	3.55	2.54
Project 5	$ 1,385,174	$ 1,200,000 0.87	$ 1,289,000 0.93	$ 1,210,000 0.87	0.89	0.90
Project 6	$ 478,000	$ 328,944 0.69	$ 648,248 1.36	$ 119,500 0.25	0.76	0.91
Project 7	$ 1,632,500	$ 4,066,002 2.49	$ 643,784 0.39	$ 409,989 0.25	1.05	0.88
Project 8	$ 140,000	$ 314,905 2.25	$ (29,236) -0.21	$ 88,978 0.64	0.89	0.62

*Example 1 reflects all Futures weighted equally, Example 2 reflects Future 2 weighted 50%

2017 ITP10 Futures Assumptions

September 23rd, 2015

Southwest Power Pool

2017 ITP10 Futures

CONVENTIONAL RESOURCE PLAN

Futures Drivers

Driver	Future 1	Future 2	Future 3
111D	Regional 111D	State 111D	No 111D
Competitive Wind	Yes	Yes	Yes
NG Supply - High Supply Due to Fracking	Yes	Yes	Yes
Severe Weather	Sensitivity	Sensitivity	Sensitivity
Long-Term Drought			
Winter impacts			
Load Growth	Normal	Normal	Normal
Cost of Capital Changes (Significant Increase)	Sensitivity	Sensitivity	Sensitivity
Limited ability to build			
8-12% interest payments			
Solar Development (Substantial)	Large Scale	Large Scale	Large Scale/Roof Top
Impact on Generation Due to Constraints	Modeling Issue	Modeling Issue	Modeling Issue

EPA Goal Implementation

Staff Recommends

- 2020 Model
  - Implementation of the 2022-2024 EPA goals
    - EPA interim goals begin in 2022
    - 2020 model is needed for RCAR II
    - Improves staging
- 2025 Model
  - Implementation of the 2025-2027 EPA goals

CPP techniques to employ

- Emission price for CO_2
- Unit retirements
- Renewable additions
- Energy efficiency
- Unit fuel switching

Model Structure and EPA Goal Computation

F1-Regional

- Create regional model from sub-regional model
- Calculate regional mass targets using EPA goal computation
  - SPP, MISO, and TVA Region

F2-State-by-State

- Option 1 create state models for SPP portion of state
- Option 2 create state models for SPP and Non-SPP portion of state
- Calculate state mass targets using EPA goal computation

Monitor mass targets of effected units to determine if goals are met

Implement external resource modifications in proportional amounts

2017 ITP10 Futures

APPENDIX

Potential Scenario Analysis – Key Drivers

Scenario 1

Input	Low Range	Mid Range	High Range
Renewables	X		
Energy Efficiency		X	
Retirements			X
Dispatch (CO2 Cost)	Slider	Slider	Slider

Scenario 2

Input	Low Range	Mid Range	High Range
Renewables			X
Energy Efficiency	X		
Retirements	X		
Dispatch (CO2 Cost)	Slider	Slider	Slider

Potential Scenario Analysis – Key Drivers

Scenario 3

Input	Low Range	Mid Range	High Range
Renewables	X		
Energy Efficiency		X	
Retirements		X	
Dispatch (CO2 Cost)	Slider	Slider	Slider

Scenario 4

Input	Low Range	Mid Range	High Range
Renewables		X	
Energy Efficiency		X	
Retirements		X	
Dispatch (CO2 Cost)	Slider	Slider	Slider