Southwest Power Pool

ECONOMIC STUDIES WORKING GROUP

January 30th, 2017

Net Conference

• SUMMARY OF ACTIONS TAKEN •

1. Approved SPP staff's recommendation to standardize high and low demand and high and low natural gas price sensitivities, typically using 1-2 standard deviations, on which to test the final portfolio of a given ITP study
2. Approved SPP staff's recommendation to leverage operational practices, powerflow modeling, and firm transmission service restrictions to determine operating parameters of phase shifting transformers in the ITP economic study model
3. Approved SPP staff's proposal for conventional resource additions and the resource expansion planning approach for study years 2, 5, and 10.
4. Approved SPP staff's amended recommendation for renewable curtailment pricing.

Southwest Power Pool

ECONOMIC STUDIES WORKING GROUP

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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 8:38 a.m., welcomed those in attendance, and asked for introductions of those who were not on the Webex.

There were 51 web conference participants and two phone participants representing 15 of 17 ESWG members. (Attachment 1 – January 30th, 2017 Attendance List)

Agenda Item 1b – Receipt of Proxies

Alan Myers (ITC Great Plains) asked for any proxy statements; one proxy was identified. Leon Howell (OGE) named Zac Hager (OGE) as his proxy. (Attachment 2 – Proxy Statements)

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 3 – January 30th, 2017 ESWG Agenda)

> **Kurt Stradley (LES) moved and Tim Owens (NPPD) seconded the motion to accept the agenda as posted. The agenda was approved with a unanimous vote.**

Agenda Item 2 – ITP Scope Standardization

Agenda Item 2a – Policy Survey Update

Liz Gephardt (SPP Staff) gave a quick update on the policy survey stating that she wants to wait until after CAWG meets next month to discuss due to their input on the percentages used within the policy survey. SPP staff is also looking to schedule a potential joint call with CAWG to complete discussion on the policy survey.

Agenda Item 2b – Sensitivity Analysis

Liz Gephardt (SPP Staff) reviewed the purpose of the sensitivity analysis and some of the previously scope sensitivities that were analyzed. She suggested that the language in the manual reflect that the group is not restricted from including any additional sensitivity to each study's scope that would be beneficial. Zac Hager (OGE) notes that we need to specify what is considered high and low with Bethany King (EDE) adding that the language should reflect that we typically use 1-2 standard deviations in order to have a baseline. (Attachment 4 – Sensitivity Analysis)

> **Bethany King (EDE) moved and Kurt Stradley (LES) seconded the motion to approve SPP staff's recommendation to standardize high and low demand and high and low natural gas price sensitivities, typically using 1-2 standard deviations, on which to test the final portfolio of a given ITP study. The recommendation was approved with a unanimous vote.**

Agenda Item 2c – DC Line Modeling

Kelsey Allen (SPP Staff) discussed the modeling of DC lines in the economic model. Though there are no DC lines in the SPP footprint, the addition of the Integrated System (IS) makes some electrically closer and a need for more modeling criteria. Kelsey suggested some improvements to allow more use of the

DC line capacity in the economic simulations. This topic needs more discussion and the group suggested coordination with the TWG. (Attachment 5 – DC Line Modeling)

Agenda Item 2d – Phase Shifting Transformers

Liz Gephardt (SPP Staff) gave a background of PSTs noting that there are three within SPP's footprint that are all operated differently. She noted that currently PSTs are potentially operated up to their thermal ratings utilizing the full angle range in the economic simulations instead of the typically more limited range in which they are operated in the AC powerflow. From a modeling perspective, the goal is to be more realistic and model them on a case by case basis with correct operational parameters. This topic has an economic phase and a powerflow modeling phase. (Attachment 6 – Phase-Shifting Transformers)

> **Tim Owens (NPPD) moved and Jeremy Severson (BEPC) seconded the motion to approve SPP staff's recommendation to leverage operational practices, powerflow modeling, and firm transmission service restrictions to determine operating parameters of phase shifting transformers in the ITP economic study model. The recommendation was approved by a unanimous vote.**

Agenda Item 2e – Resource Expansion Planning

Josh Ross (SPP Staff) reviewed the conventional additions portion of the resource expansion plan noting that no siting is involved. He also noted that resource expansion software would be used in all futures for new conventional resources, but not for new renewable resources. Natasha Henderson (GSEC) referenced the SPP resource adequacy process and the ability for entities to transfer capacity to meet reserve margin requirements, noting that some entities may take that risk as opposed to installing new capacity even in years 5 and 10. Zac Hager (OGE) noted that SPP staff's process to calculate reserve shortfalls on a pricing zone level rather than an entity level may alleviate some concerns. As the SPP resource adequacy process matures, this may be revisited in the future for potential methodology adjustments. (Attachment 7 – Resource Expansion Plan)

> **Tim Owens (NPPD) moved and Kurt Stradley (LES) seconded the motion to approve SPP staff's proposal for conventional resource additions and the resource expansion planning approach for study years 2, 5, and 10. The recommendation was approved by a unanimous vote.**

Agenda Item 2f – Renewable Pricing

Josh Ross (SPP Staff) reviewed and summarized the previous discussions regarding renewable pricing noting the two separate items, curtailment price and variable O&M (VOM). The goal was to wrap up the curtailment pricing and continue discussion on the VOM. The SPP staff recommendation on wind curtailment pricing was clarified with inclusion of language in the third criterion differentiating the two curtailment prices based on whether the developer opted for an investment tax credit (ITC) or production tax credit (PTC).

> **Kurt Stradley (LES) moved and Bennie Weeks (Xcel/SPS) seconded the motion to approve SPP staff's amended recommendation for renewable curtailment pricing. The recommendation was approved by a unanimous vote.**

Josh Ross (SPP Staff) continued discussion with renewable VOM pricing. Scott Benson (LES) suggested a blended PPA approach for wind in which those farms leveraging the PTC would utilize an approximate PPA price for VOM and those leveraging the ITC would use an operating cost, or $8. The group asked for SPP staff's thoughts on the impacts and what the results would look like utilizing the different options. Kelsey Allen (SPP Staff) stated that the higher the VOM pricing is for renewables, the less APC benefit would be realized from a transmission project mitigating renewable curtailment. SPP staff will bring results from implementing the different options to the next meeting. Steve Gaw (Wind Coalition) also asked SPP staff to investigate how other regions are modeling renewable VOM. (Attachment 8 – Renewable Pricing)

Agenda Item 2g – 40-Year Financial Analysis

Amber Greb (SPP Staff) began the discussion regarding how we calculate 40-year benefits noting in multiple examples that our calculations via extrapolation have been driven more by the slope than the 1-year benefit data. She introduced using a third data point via year 15 or year 2 as options for improvement as well as capping extrapolated benefit when the slope crossed $0. Yohan Sutjandra (TEA) suggested consideration of capping extrapolation of benefits at a set year, prior to the 20-year currently being utilized and also asked if SPP staff had compared their methodology and the proposed changes to other RTOs. This discussion will continue during the next meeting. (Attachment 9 – 40-Year Financial Analysis)

Agenda Item 2h – Benchmarking
[This item was not covered]. (Attachment 10 – Benchmarking)

Agenda Item 3 – Resource Expansion Software Tools Discussion
[This item was not covered].

Closing Items
We will continue the discussion of ITP scope standardization items at the next meeting.

The meeting adjourned at 11:00 AM.

Respectfully Submitted,

Kelsey Allen
ESWG Secretary

Name	Email	Attendance
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Yohan Sutjandra (TEA)	ysutjandra@teainc.org	Webex
Zac Hager	hagerzc@oge.com	Webex

ESWG Proxy Statements

1. Leon Howell proxy to Zac Hager

From: Howell, Leon
Sent: Monday, January 30, 2017 6:21 AM
To: Kelsey Allen
Cc: Hager, Zac
Subject: **External Email** ESWG

Kelsey,

Please give my proxy for today's meeting to Zac Hager.

Leon

ECONOMIC STUDIES WORKING GROUP

January 30th, 2017

Net Conference

• A G E N D A •

8:30am – 11:00am

1. Administrative Items
    a. Call to Order, Introductions ..... Alan Myers
    b. Receipt of Proxies ..... Kelsey Allen
    c. Review of Agenda[1] ..... Alan Myers
2. ITP Scope Standardization ..... SPP Staff
    a. Policy Survey Update (Liz Gephardt)
    b. Sensitivity Analysis[1] (Liz Gephardt)
    c. DC Line Modeling[1] (Kelsey Allen)
    d. Phase-Shifting Transformer Modeling[1] (Liz Gephardt)
    e. Resource Expansion Plan[1] (Josh Ross)
    f. Renewable Pricing[1] (Josh Ross)
    g. 40-Year Financial Analysis[1] (Amber Greb)
    h. Benchmarking[1] (Nikki Roberts)
3. Resource Expansion Software Tools Discussion ..... Juliano Freitas

[1] Background Material Included


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ITP Scope Standardization – Sensitivity Analysis

Liz Gephardt

ITP Sensitivity Analysis

- Current Process
  - Test final portfolio under different states of the system
  - Goal is to assess versatility of portfolio
  - Previously scoped sensitivities
    - High and Low Demand*
    - High and Low Natural Gas Price*
    - HVDC Facility Interconnections
    - Increased Fuel and Emissions Prices
- Natural gas and demand forecasts are most unpredictable
- Different trends or areas of interest may arise from study to study
  - Not restricted from performing non-standardized sensitivities

* 2017 ITP10 scoped sensitivities

ITP Standard Sensitivity Analysis Recommendation

SPP staff recommends standardizing the high and low demand and high and low natural gas prices on which to test the final portfolio of a given ITP study.

For the ITP Manual, Staff recommends softening the language to allow flexibility for varying numbers of final portfolios and futures. For example, "Generally, the process will be to test a single portfolio in the approved futures."


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ITP Scope Standardization – DC Line Modeling

ESWG

January 12, 2017

DC Transmission Lines

- DC lines in Eastern Interconnect are not SPP facilities
  - With IS membership, lines are electrically closer to SPP than in previous studies
- Historical modeling practice
  - DC line data comes from powerflow import into PROMOD
  - PROMOD defaults bi-directional ratings to MW line flow (DCSETVAL) set in powerflow model
    - DC lines always monitored in SCUC/SCED
    - Locks DC line flow to powerflow value for annual simulation
  - Some exceptions for 2017 ITP10
- Proposed improvements
  - Allow SCUC/SCED to utilize line capacity within reasonable expectation
    - Determine seasonal line flows from powerflow model series
    - Set minimum and maximum directional line rating limits based on upper and lower seasonal expected flow bounds (e.g. summer peak, winter peak, light load)
  - Case by case for certain lines


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ITP Scope Standardization – Phase Shifting Transformers

Liz Gephardt

Phase Shifting Transformers

- Goal to vet modeling technique
- ITP Manual language generic
- How PSTs are operated
  - SPP PSTs
  - External PSTs
- Previous modeling
  - Defaults to limited settings in PROMOD from powerflow import
  - Allows for utilization of full angle range during simulation
- Potential improvements
  - Incorporate other modeling options in PROMOD that are available in PSS/E
  - Consideration of operational practices, powerflow modeling, and firm transmission service restrictions

ITP Standard PST Recommendation

SPP staff recommends leveraging operational practices, powerflow modeling, and firm transmission service restrictions to determine operating parameters of phase shifting transformers in the ITP study models.

ITP Scope Standardization – Resource Expansion Plan

ESWG

January 30th, 2017

Conventional Additions – SPP

- Identify conventional generation prototype parameters using publicly available data
- Assess resource shortfall by pricing zone, based on reserve margin
  - Account for existing load, existing generation, new wind and solar additions, and renewable accreditations
- Resource expansion tool(s) will be utilized to identify additions
- No siting involved in conventional additions process

Conventional Additions – SPP

- Resource expansion software will be used in all futures to identify the optimum mix of new conventional resources to add
  - Unit additions selected by software will be allocated to zones such that each zone approximately meets the reserve margin requirement
  - Joint ownerships of unit additions may be used in order to avoid excessive additions of new resources to individual zones
- Resource expansion software will not be utilized to identify new renewable resources
  - These additions identified through renewable additions process

Conventional Additions – External

- MISO – use conventional resource additions from the most current MTEP model (future-specific)
  - If the MTEP does not have a comparable future to the ITP, MISO conventional additions would be determined consistent with the process used for other regions (below)
- AECI, TVA, SaskPower, Manitoba, any others – calculate resource additions by spreadsheet for all types of futures
  - Start with capacity shortfall calculations
  - Add conventional units with a resource mix that is as close as possible to the SPP resource addition mix for that future
    - For example, if SPP additions include 60% CCs and 40% CTs, use as close as possible to a 60/40 ratio for additions in these external regions

Renewable and Conventional Resource Plan – Years 2, 5, 10

- Year 2
  - High Certainty for any planned resource additions
  - Ensure region meets reserve margin requirements
    - SPP will not identify resource additions
    - IPP resources assigned to resource deficient zones
- Years 5 and 10
  - Could have Less Certainty for forecasted resource additions
  - Wind and solar unit additions based on uniform criteria
  - Add conventional resource plan units as needed to meet reserve margin requirements in these years

Recommendation

- Staff recommends the ESWG approve the Staff proposal for conventional resource additions and the Resource Planning approach for years 2, 5, and 10

ITP Scope Standardization – Renewable Pricing

ESWG

January 30th, 2017

Renewable Pricing

- Have expanded this topic to include both wind and solar
  - There is similar modeling between the two. Both follow an hourly profile for MWh output, unless the LMP goes lower than the curtailment price input
- Wind/solar curtailment price
  - Defines the trigger price at which the resource will curtail
- Wind/solar variable O&M
  - Defines the operating cost per MWh
- Renewable hourly profiles
  - Recommend use of publicly available data

Curtailment Price

Wind Curtailment Price

- Wind units will have $0/MWh curtailment price (reflecting PTC is not a factor in its operation) if any of these are true:
  - Unit placed in service over 10 years prior to the study year,
  - Construction on the unit has not started prior to 1/1/2020
  - An entity has provided feedback that the ITC, rather than PTC, is applicable
- Wind units will have a -$35/MWh curtailment price (reflective of a PTC) if all of these are true:
  - Unit placed in service less than 10 years prior to the study year,
  - Construction on the unit has started prior to 1/1/2020
  - No utility has provided feedback during the study that the ITC, rather than PTC, is applicable
- $35/MWh is an approximation of the "grossed up PTC" – the PTC plus compensation for income taxes that the developer will be responsible for upon receipt of the lost PTC payment
  - It is also in line with some historical offer data from 2016

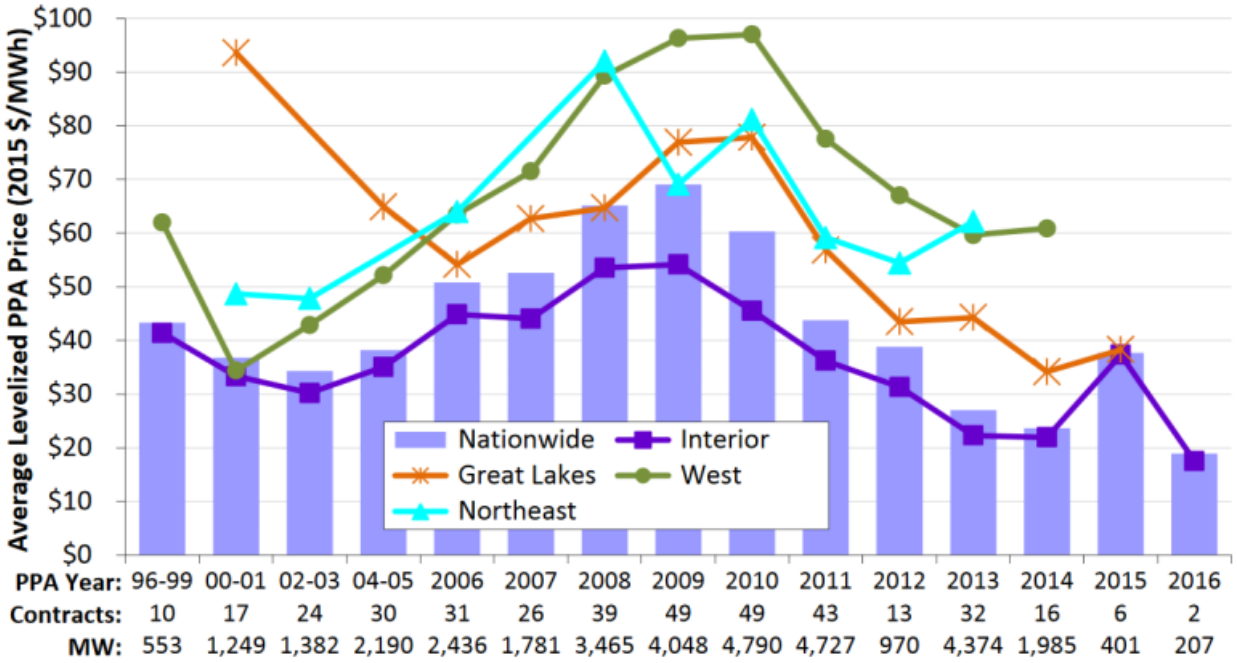
Solar Curtailment Price

- Solar will have $0/MWh curtailment price reflecting PTC is not a factor
  - Solar may receive Investment Tax Credit (ITC) but not PTC

Variable O&M Price

Wind Variable O&M – Option 1

- Units will have a variable O&M cost based on approximate wind PPA prices
- Representative PPA pricing by year will be derived from up-to-date, publicly available data
- For illustrative purposes, here is an example of such data, from the 2015 Wind Technologies Market Report (DOE):

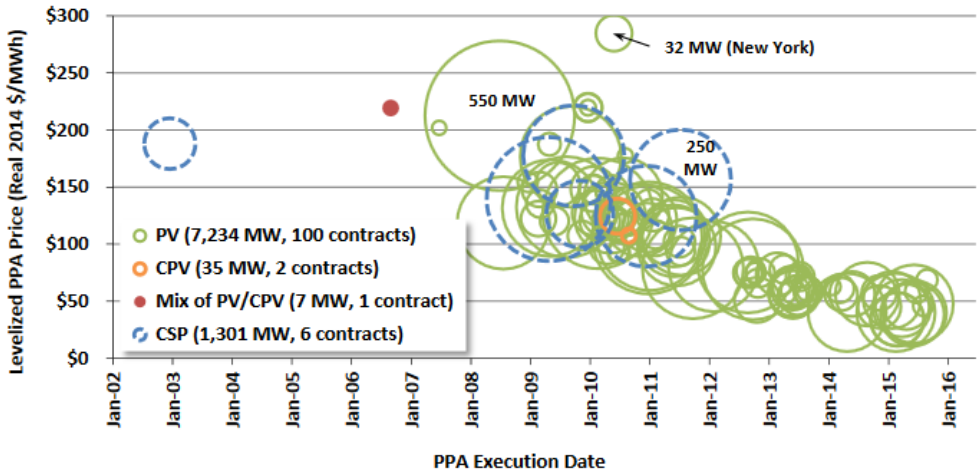


Wind Variable O&M – Option 2

- Use $8/MWh for variable O&M
  - Reflects the actual operating cost of wind
- Status Quo

Solar Variable O&M – Option 1

- Units will have a variable O&M cost based on approximate solar PPA prices
  - More accurately reflects the cost that an LSE pays for each MWh of wind
- Representative PPA pricing by year will be derived from up-to-date, publicly available data
- For illustrative purposes, here is an example of such data, from Berkeley Lab Utility-Scale Solar 2014:



https://emp.lbl.gov/sites/all/files/lbnl-1000917.pdf, page 36

Solar Variable O&M – Option 2

- Use $8/MWh for variable O&M
  - Reflects the actual operating cost of solar
- Status Quo

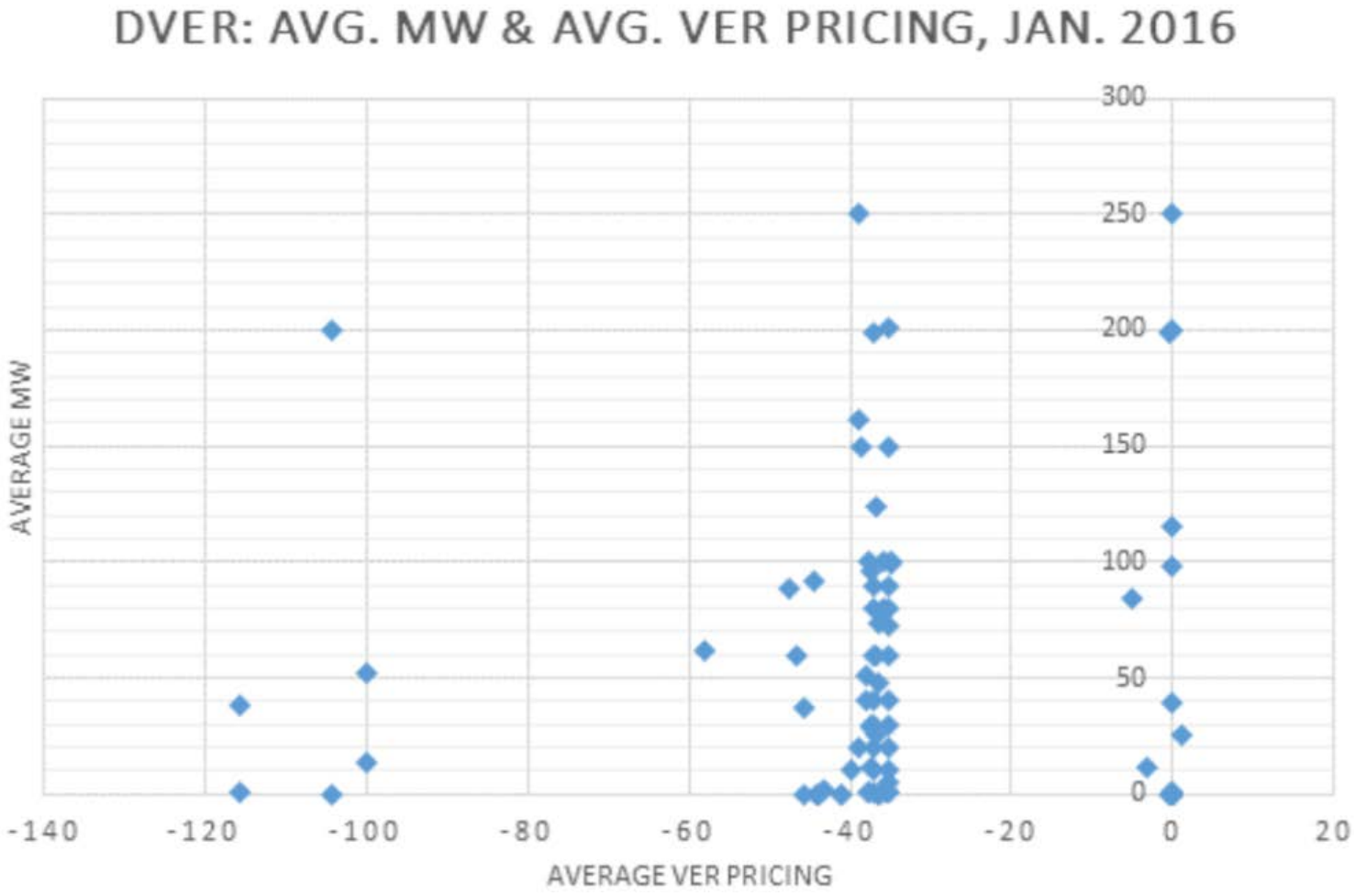
Appendix

PTC ($/MWh)

Current Year	PTC %	ITC %	Wind Farm Construction (In-Service Year)														
			2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Jan. 1, 2020
2006	100%		$ 23														
2007	100%		$ 23	$ 23													
2008	100%		$ 23	$ 23	$ 23												
2009	100%		$ 23	$ 23	$ 23	$ 23											
2010	100%		$ 23	$ 23	$ 23	$ 23	$ 23										
2011	100%		$ 23	$ 23	$ 23	$ 23	$ 23	$ 23									
2012	100%		$ 23	$ 23	$ 23	$ 23	$ 23	$ 23	$ 23								
2013	100%		$ 23	$ 23	$ 23	$ 23	$ 23	$ 23	$ 23	$ 23							
2014	100%		$ 23	$ 23	$ 23	$ 23	$ 23	$ 23	$ 23	$ 23	$ 23						
2015	100%	30%	$ 23	$ 23	$ 23	$ 23	$ 23	$ 23	$ 23	$ 23	$ 23	$ 23					
2016	100%	30%		$ 23	$ 23	$ 23	$ 23	$ 23	$ 23	$ 23	$ 23	$ 23	$ 23				
2017	80%	24%			$ 23	$ 23	$ 23	$ 23	$ 23	$ 23	$ 23	$ 23	$ 23	$ 18			
2018	60%	18%				$ 23	$ 23	$ 23	$ 23	$ 23	$ 23	$ 23	$ 23	$ 18	$ 14		
2019	40%	12%					$ 23	$ 23	$ 23	$ 23	$ 23	$ 23	$ 23	$ 18	$ 14	$ 9	
2020	0%	10%						$ 23	$ 23	$ 23	$ 23	$ 23	$ 23	$ 18	$ 14	$ 9	-
2021	0%								$ 23	$ 23	$ 23	$ 23	$ 23	$ 18	$ 14	$ 9	-
2022	0%									$ 23	$ 23	$ 23	$ 23	$ 18	$ 14	$ 9	-
2023	0%										$ 23	$ 23	$ 23	$ 18	$ 14	$ 9	-
2024	0%											$ 23	$ 23	$ 18	$ 14	$ 9	-
2025	0%												$ 23	$ 18	$ 14	$ 9	-
2026	0%													$ 18	$ 14	$ 9	-
2027	0%														$ 14	$ 9	-
2028	0%															$ 9	-
2029	0%																-

NOTE: After construction begins the tax payer has 4 years to complete construction, e.g. a wind facility starting construction in 2019 could begin operation in 2023, and the PTC would expire in 2033.
https://www.irs.gov/irb/2016-23_IRB/ar07.html

Historical Wind Offer Pricing, Jan 2016



Source: Strategic Planning Committee background materials, 12/1/16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ITP Scope Standardization – 40-Year Financial Analysis

Amber Greb

ITP 40-Year Financial Analysis

Current Process

- Calculate 2 data points
- Interpolate between 2 points
- Use slope of 2 data points to extrapolate out to year 20
- Use terminal value (rate of inflation) for years 21-40
- Take NPV of 40 years of data

Issues with Current Methodology

	2020	2025	40-year Ben
Zone A	-$1.4M	$0.4M	$25.3
Zone B	$0.5M	$0.5M	$7.4

- Which zone has higher benefit in 2020?
- Which zone has higher benefit in 2025?
- Which zone has higher 40-year benefit?

Is 40-year benefit driven more by 1-year benefit data, or slope?

Issues with Current Methodology

	2020	2025	40-year Ben
Zone A	$1.4M	$0.5M	-$3.9M
Zone B	-$0.9M	-$0.3M	$3.0

- Zone A is showing positive benefit in both years
- Zone B is showing negative benefit in both years
- 40-year benefits are opposite polarity

Is 40-year benefit driven more by 1-year benefit data, or slope?

Options for Improvement

- Use a third data point
  - Year 15
    - Same transmission, retirements, etc.
    - Includes only increased load and additional resources
    - Allocation and Siting of resources
  - Year 2
    - Model Available – No additional work
    - Assumes entire portfolio in year 2
    - Introduces uncertainty to trend line due to step changes
- Cap extrapolated benefit at zero if data points are all positive or all negative
- Terminal Value after final data point or five years after (Year 15)

Methodology Comparison

Current

	2020	2025	40-year Ben
Zone A	$1.4M	$0.5M	-$3.9M
Zone B	-$0.9M	-$0.3M	$3.0M

Capping at Zero

	2020	2025	40-year Ben
Zone A	$1.4M	$0.5M	$4.0M
Zone B	-$0.9M	-$0.3M	-$3.0M


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ITP Scope Standardization – Benchmarking

ESWG

January 30, 2017

SPP Staff

Why Benchmark?

- Assess reasonability of PROMOD simulations
- Catch errors and fine tune the results of PROMOD runs
- Build confidence in the model through comparisons to historical data

Approaches to Benchmarking

- Build a current year economic model, and validate outputs against historical data.
  - Requires building an additional economic model.
  - Closer comparison of historical data to simulated data.

- Compare current study year economic model to previous study year economic model and historical data.
  - Additional economic model build not required.
  - Study year model not easily compared to historical data.

Benchmarking Considerations

- Follow a process from a previous ITP10 study.
- May not be necessary to benchmark the model with every study.
  - Benchmarking process could take place outside of the ITP process.
  - Incorporate reasonableness checks to take place during model build milestone.
- Possibly work with a developer to come up with an extensive process later on.
- SPP Staff periodically provide reports from economic model(s) to Stakeholders for review and feedback during model build process.