

**BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF COLORADO**

* * * * *

IN THE MATTER OF THE APPLICATION)
OF PUBLIC SERVICE COMPANY OF)
COLORADO FOR A CERTIFICATE OF)
PUBLIC CONVENIENCE AND)
NECESSITY FOR COLORADO'S)
POWER PATHWAY 345 KV)
TRANSMISSION PROJECT AND)
ASSOCIATED FINDINGS REGARDING)
NOISE AND MAGNETIC FIELD)
REASONABLENESS)

PROCEEDING NO. 21A-0096E

SUPPLEMENTAL DIRECT TESTIMONY OF JAMES F. HILL

ON

BEHALF OF

PUBLIC SERVICE COMPANY OF COLORADO

September 3, 2021

**BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF COLORADO**

* * * * *

**IN THE MATTER OF THE APPLICATION)
OF PUBLIC SERVICE COMPANY OF)
COLORADO FOR A CERTIFICATE OF)
PUBLIC CONVENIENCE AND)
NECESSITY FOR COLORADO'S)
POWER PATHWAY 345 KV)
TRANSMISSION PROJECT AND)
ASSOCIATED FINDINGS REGARDING)
NOISE AND MAGNETIC FIELD)
REASONABLENESS)** **PROCEEDING NO. 21A-0096E**

TABLE OF CONTENTS

<u>SECTION</u>	<u>PAGE</u>
I. INTRODUCTION AND PURPOSE OF TESTIMONY	4
II. BACKGROUND	6
III. ADDITIONAL CURTAILMENT ANALYSIS	11
IV. ANALYSIS RESULTS.....	20
VI. CONCLUSION.....	28

GLOSSARY OF ACRONYMS AND DEFINED TERMS

<u>Acronym/Defined Term</u>	<u>Meaning</u>
2021 ERP & CEP	The Company's 2021 Electric Resource Plan and Clean Energy Plan
ATB	National Renewable Energy Laboratory Annual Technology Baseline
CEC	Colorado Energy Consumers
CEP	Clean Energy Portfolio
Commission	Colorado Public Utilities Commission
ERP	Electric Resource Plan
GWh	Gigawatt Hour
ITC	Investment Tax Credit
MW	Megawatt
MWh	Megawatt Hour
NCF	Net Capacity Factor
NPV	Net Present Value
Pathway Project or Project	Colorado's Power Pathway 345 kV Transmission Project
PTC	Production Tax Credit
Public Service or Company	Public Service Company of Colorado
RAP	Resource Acquisition Period
Staff	Public Utilities Commission Trial Staff
UCA	Colorado Office of the Utility Consumer Advocate
XES	Xcel Energy Services Inc.
Xcel Energy	Xcel Energy Inc.

**BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF COLORADO**

* * * * *

**IN THE MATTER OF THE APPLICATION)
OF PUBLIC SERVICE COMPANY OF)
COLORADO FOR A CERTIFICATE OF)
PUBLIC CONVENIENCE AND)
NECESSITY FOR COLORADO'S)
POWER PATHWAY 345 KV) PROCEEDING NO. 21A-0096E
TRANSMISSION PROJECT AND)
ASSOCIATED FINDINGS REGARDING)
NOISE AND MAGNETIC FIELD)
REASONABLENESS)**

SUPPLEMENTAL DIRECT TESTIMONY OF JAMES F. HILL

I. INTRODUCTION AND PURPOSE OF TESTIMONY

Q. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.

A. My name is James F. Hill. My business address is 1800 Larimer Street, Denver, Colorado 80202.

Q. BY WHOM ARE YOU EMPLOYED AND IN WHAT POSITION?

A. I am employed by Xcel Energy Services Inc. ("XES") as Director, Resource Planning and Bidding. XES is a wholly-owned subsidiary of Xcel Energy Inc. ("Xcel Energy") and provides an array of support services to Public Service Company of Colorado ("Public Service" or "Company") and the other three utility operating company subsidiaries of Xcel Energy on a coordinated basis.

Q. ON WHOSE BEHALF ARE YOU TESTIFYING IN THE PROCEEDING?

A. I am testifying on behalf of Public Service.

1 **Q. HAVE YOU PREVIOUSLY PROVIDED TESTIMONY BEFORE THE COLORADO**
2 **PUBLIC UTILITIES COMMISSION (“COMMISSION”)?**

3 A. Yes. I provided Direct Testimony in this proceeding, which was filed on March 2,
4 2021.¹

5 **Q. WHAT IS THE PURPOSE OF YOUR SUPPLEMENTAL DIRECT TESTIMONY?**

6 A. The purpose of my Supplemental Direct Testimony is to describe the analysis that
7 the Company conducted to assess how different sequencing of renewable
8 resource additions interconnecting with the Colorado’s Power Pathway Project
9 (“Pathway Project” or “Project”) can impact the potential level of renewable energy
10 generated/delivered and renewable energy curtailments as the Project is built out.

11 **Q. WHY DID THE COMPANY PERFORM THIS ANALYSIS?**

12 A. The analysis was performed to address items identified through communications
13 with the Trial Staff of the Commission (“Staff”), the Colorado Office of the Utility
14 Consumer Advocate (“UCA”), and Colorado Energy Consumers (“CEC”), as
15 discussed in the Supplemental Direct Testimony of Ms. Brooke A. Trammell.

16 **Q. ARE YOU SPONSORING ANY ATTACHMENTS AS PART OF YOUR**
17 **SUPPLEMENTAL DIRECT TESTIMONY?**

18 A. No.

¹ Hearing Exhibit 103, Direct Testimony and Attachments of James F. Hill

1 **II. BACKGROUND**

2 **Q. WHAT IS THE PURPOSE OF THIS SECTION OF YOUR TESTIMONY?**

3 A. The purpose of this section of my Supplemental Direct Testimony is to provide a
4 general background on curtailments and attendant costs in the resource planning
5 context.

6 **Q. WHAT GENERAL TYPES OF RENEWABLE ENERGY CURTAILMENTS CAN
7 OCCUR ON AN ELECTRIC POWER SUPPLY SYSTEM?**

8 A. There are two general types of curtailments associated with renewable energy
9 generation: (1) system balancing-related curtailments; and (2) transmission
10 congestion-related curtailments.

11 **Q. PLEASE DESCRIBE EACH TYPE OF CURTAILMENT.**

12 A. For the analysis discussed in my Supplemental Direct Testimony, I refer to system
13 balancing-related curtailments as those that occur when conditions on the electric
14 system require that some portion of the generation output from wind and solar
15 resources must be curtailed in order to maintain the balance between customer
16 load and generation resource output. The primary example of system balancing
17 curtailments involves situations where there is more generation output from wind
18 and solar resources than there is customer load. When excess generation output
19 cannot be sold and transmitted to others in the market, it is curtailed. I refer to
20 transmission congestion-related curtailments as those that occur when there is
21 insufficient transmission capacity available in real-time to reliably deliver all of the
22 generation output being produced by wind and solar resources.

1 **Q. IN DEVELOPING THE RESOURCE PORTFOLIOS IN PROCEEDING NO. 21A-**
2 **0141E, WHICH OF THESE TYPES OF RENEWABLE ENERGY**
3 **CURTAILMENTS WERE FACTORED INTO THOSE ANALYSES?**

4 A. System balancing curtailments were factored into the development of all portfolios,
5 including the Clean Energy Plan (“CEP”) portfolios that meet the 2030 clean
6 energy target of Senate Bill 19-236. These curtailments are reflected in both the
7 Present Value Revenue Requirement costs of portfolios as well as the overall
8 system carbon dioxide reductions achieved by a plan in any given year.
9 Transmission congestion-related curtailments were not included as part of the
10 development of CEP portfolios, but the Company did anticipate transmission
11 limitations in its EnCompass modeling.

12 **Q. PLEASE EXPLAIN.**

13 A. In developing portfolios, the Company limited the nameplate amount of renewables
14 that could be added to the system each year within the EnCompass model for
15 years 2025, 2026, and 2027. Renewable resources were limited to 1,000
16 megawatts (“MW”) in each of these years in order to better align the timing of
17 commercial operation of new wind and solar generation resources with estimates
18 at the time as to when incremental transmission capacity would be provided from
19 the Pathway Project. As the Project is constructed and placed in-service,
20 additional incremental transmission capacity becomes available, and this
21 approach sets the pace of renewable additions to align with the pace of
22 transmission buildout, thereby reducing transmission congestion-related
23 curtailments. This approach is referred to as a “tunnel” modeling constraint or

1 convention. This modeling convention provided a proxy within EnCompass to
2 simulate transmission availability and limitations as the Pathway Project was
3 developed through its staged construction.

4 **Q. WHAT LEVELS OF SYSTEM BALANCING CURTAILMENT ARE FACTORED**
5 **INTO THE PREFERRED PLAN DURING THE RESOURCE ACQUISITION**
6 **PERIOD?**

7 A. Table JFH-SD-1 below summarizes the estimated gigawatt hour (“GWh”) of
8 system balancing related curtailments from the EnCompass modeling of the
9 Preferred Plan during the Resource Acquisition Period (“RAP”), which runs through
10 2030.

11 **Table JFH-SD-1 - Preferred Plan Annual System Balancing Curtailments**
12 **from EnCompass Modeling**

	2025	2026	2027	2028	2029	2030
GWh	2,179	1,958	2,587	2,835	2,824	3,667
% of Total System Renewable Energy	8.8%	7.9%	9.7%	9.9%	9.6%	11.0%

13 **Q. WHAT WERE THE RESULTING YEAR BY YEAR NAMEPLATE ADDITIONS OF**
14 **WIND AND SOLAR RESOURCES IN THE RAP OF THE PREFERRED PLAN**
15 **GIVEN THE 1,000 MW PER YEAR LIMITATION PLACED ON THESE**
16 **RESOURCES FOR YEARS 2025, 2026, AND 2027?**

17 A. Table JFH-SD-2 below shows the renewable resource additions in each year as
18 modeled for the Company’s Preferred Plan.

1
2

TABLE JFH -SD-2-Preferred Plan Renewable Resource Additions in the RAP

EOY=>	2025	2026	2027	2028	2029	2030
60% PTC Wind MW (only available for 2025)	1000					
0% PTC Wind MW (available beyond 2025)			150	650	150	350
26% ITC Solar MW (only available for 2025)						
10% ITC Solar MW (available beyond 2025)			600	100		850

3 **Q. DID THIS 1,000 MW PER YEAR LIMITATION WITHIN THE ENCOMPASS**
 4 **MODELING OF THE PREFERRED PLAN RESTRICT THE AMOUNT OF TAX-**
 5 **ADVANTAGED GENERIC WIND AND SOLAR ADDED IN THE PLAN?**

6 A. Yes. As shown in Table JFH-SD-2 above, the model made the economic decision
 7 to fill the entire 1000 MW of new Pathway Project transmission capacity by end of
 8 year 2025 limitation with 60 percent production tax credit (“PTC”) wind. Beyond
 9 2025, it was assumed that the pricing of wind and solar would increase as a result
 10 of PTCs being reduced to 0 percent and the investment tax credit (“ITC”) to 10
 11 percent. With these increased generic wind and solar prices, the 1000 MW
 12 limitation for years 2026 and 2027 did not appear to be a binding constraint given
 13 less than 1000 MW of wind and solar were added in these years. Additional wind
 14 and solar additions in years 2028-2030 were needed to achieve the 2030 clean
 15 energy target.

16 **Q. PLEASE EXPLAIN HOW THESE TAX CREDITS BENEFIT CUSTOMERS.**

17 A. As I discuss in my Direct Testimony, if a project qualifies for either the PTC or the
 18 ITC, it reduces the cost or price passed forward to customers, and the potential

1 magnitude of these customer savings can be significant. For example, the
2 estimated present value of customer savings associated with acquiring 1000 MW
3 of new wind resources that qualify for the 60 percent PTC is over \$300 million
4 compared to that same 1,000 MW of new wind receiving no PTCs. Similarly, the
5 estimated present value of customer savings associated with acquiring 1,000 MW
6 of new solar resources that qualify for the 26 percent ITC is over \$100 million
7 compared to that same 1000 MW of new solar receiving a 10 percent ITC.

1 **III. ADDITIONAL CURTAILMENT ANALYSIS**

2 **Q. WHAT IS THE PURPOSE OF THIS SECTION OF YOUR TESTIMONY?**

3 A. The purpose of this section of my Supplemental Direct Testimony is to describe
4 the additional analysis the Company performed to explore the tradeoffs between
5 timing, price, and curtailment volumes of different approaches for acquiring the
6 new wind and solar resources needed to meet the 2030 clean energy target.

7 **Q. WHAT LEVELS OF WIND AND SOLAR DID THE COMPANY ANALYZE?**

8 A. For this analysis, we used the total levels of wind and solar added by 2030 that are
9 contained in the Company's Preferred Plan, i.e., 2,300 MW of wind and 1,550 MW
10 of utility-scale solar. We then developed three different approaches with
11 assumptions about resource timing and interconnection location on the Pathway
12 Project. The resources ultimately selected will be determined in the Phase II
13 process in Proceeding No. 21A-0141E, but the Company made assumptions about
14 where different levels of wind and solar would interconnect for purposes of this
15 analysis.

16 **Q. BASED ON THESE ASSUMED RESOURCE LOCATIONS, WHAT**
17 **RENEWABLE ACQUISITION APPROACHES DID THE COMPANY**
18 **EVALUATE?**

19 A. The Company looked at three different approaches to renewable resource
20 acquisition, all based on timing. The first approach is a "wait" approach, i.e., wait
21 until the Pathway Project completes construction and then acquire renewable
22 resources beginning in 2028. The second approach is an incremental approach,

1 similar to that seen in the Company's resource portfolios in Proceeding No. 21A-
2 0141E, where renewable resources are brought online over the course of the RAP
3 and the early resources capture tax advantages and the later resources do not.
4 This second approach is meant to serve as a middle ground between the first and
5 third approaches with an incremental renewable resource acquisition approach.
6 While it does not mirror the Preferred Plan in Proceeding No. 21A-0141E, this
7 approach allows for an evaluation of how an incremental approach performs from
8 a curtailment and cost perspective. The third approach is a "front load" approach
9 where renewable resources are loaded early to capture tax advantages. All of
10 these resource acquisition approaches assume the staged construction of the
11 Pathway Project as put forward in the Company's Direct Case. Accordingly, and
12 from a curtailment analysis perspective, the different approaches the Company
13 analyzed can generally be described as follows:

- 14 • Approach 1 ("Wait"): Minimize total curtailment of renewables;
- 15 • Approach 2 ("Incremental"): Minimize transmission congestion curtailment
16 of new renewables; and
- 17 • Approach 3 ("Front Load"): Maximize acquisition of tax advantaged
18 renewables.²

² Please note that for purposes of these analyses, and particularly Approach 3, the Company assumes that the hypothetical resource portfolio(s) can be reliably and timely interconnected. As explained in more detail in the Direct Testimony of Ms. Amanda R. King at page 67, line 23 - page 68, line 4, all approved generation resources will need to be evaluated through the Company's Large Generator Interconnection Process in order to ensure they can be reliably interconnected.

1 **Q. PLEASE EXPAND ON APPROACH 1 THAT MINIMIZES TOTAL**
2 **CURTAILMENT OF NEW RENEWABLES.**

3 A. Under this approach, the Company does not bring additional wind and solar
4 resources on-line until year 2028. In 2028, all segments of the Pathway Project
5 are constructed and placed into service. This approach would act to minimize both
6 transmission congestion-related curtailments and system balancing-related
7 curtailments. Transmission congestion curtailments would be minimized as a
8 result of the entire transfer capacity of the Pathway Project being available to
9 interconnect and deliver the output of the new renewables to customer load.
10 System balancing curtailments would be minimized because, by end of year 2027
11 Hayden 2 is retired and Pawnee is converted to gas, and by end of year 2028 Craig
12 2 and Hayden 1 are retired (under the Preferred Plan).

13 **Q. PLEASE EXPAND ON APPROACH 2 THAT MINIMIZES TRANSMISSION**
14 **CONGESTION CURTAILMENT OF NEW RENEWABLES.**

15 A. Under this approach, additional wind and solar resources are brought on-line in
16 equal MW increments during the segmented construction of the Pathway Project.
17 More specifically, in years 2025, 2026 and 2027, Craig 2, Hayden 1 & 2, and
18 Pawnee would continue to operate on coal with minimum-loading requirements.
19 As a result, this approach would experience higher levels of curtailments as
20 compared to the first approach described above. This approach, as I describe
21 later in my Supplemental Direct Testimony, results in transmission congestion-
22 related curtailments in addition to system balancing-related curtailments.

1 **Q. PLEASE EXPAND ON APPROACH 3 THAT MAXIMIZES ACQUISITION OF TAX**
2 **ADVANTAGED RENEWABLES.**

3 A. Under this approach, a substantial portion of the additional wind and solar
4 resources of the preferred plan are brought on-line before year-end 2025.
5 Renewable resource acquisitions are thus front-loaded to maximize the amount of
6 low-cost wind (60 percent PTC) and solar (26 percent ITC) as a way to reduce
7 customer costs. In years 2025, 2026 and 2027, Craig 2, Hayden 1 & 2, and
8 Pawnee would again continue to operate on coal with minimum-loading
9 requirements. As a result, this approach would experience higher levels of
10 curtailments as compared to Approach 1 or Approach 2. In addition, under
11 Approach 3 there would be higher levels of transmission congestion-related
12 curtailments in the years in which front-loaded renewable additions exceed the
13 pace at which transmission capacity is built out with the Pathway Project.

14 **Q. FOR PURPOSES OF THIS ANALYSIS PRESENTED IN YOUR**
15 **SUPPLEMENTAL DIRECT TESTIMONY, WHAT DID THE COMPANY ASSUME**
16 **FOR INCREMENTAL MW OF TRANSMISSION CAPACITY EACH YEAR AS**
17 **THE PATHWAY PROJECT IS BUILT OUT?**

18 A. Table JFH-SD-3 below reflects the assumed MW of transmission injection capacity
19 made available by the Pathway Project.

1 **Table JFH-SD-3-Pathway Project Incremental Transmission Capacity**

EOY =>	2025	2026	2027	2028 and Beyond
Cumulative Simultaneous Pathway Injection Capability	1,000	1,000	3,000	3,000
Pathway Segments Completed	2,3	1	4,5	All

2 **Q. WHAT DID THE COMPANY ASSUME FOR WIND AND SOLAR RESOURCE**
 3 **ADDITIONS UNDER EACH APPROACH?**

4 A. Table JFH-SD-4 shows the assumed resource nameplate MW additions for each
 5 approach. Under each approach, the total MW additions for wind and solar are
 6 the same—only the timing differs.

7 **Table JFH-SD-4-Renewable Resource Nameplate Additions by Year of RAP**

EOY=>		2025	2026	2027	2028
Approach 1 (Wait)	Wind			2,300	
	Solar			1,550	
Approach 2 (Incremental)	Wind	1,300	500	500	
	Solar		800	750	
Approach 3 (Front Load)	Wind	2,300			
	Solar	800	750		

8 The MW included in Table JFH-SD-4 were assumed to be placed in-service at the
 9 end of the year indicated. For example, under Approach 1, all 2300 MW of wind
 10 in the preferred CEP are placed in-service at the end of 2027. It is important to
 11 note that the amounts and timing of wind and solar additions in these approaches
 12 are examples that were developed for purposes of the analyses discussed in my

1 Supplemental Direct Testimony. The amount and timing of wind and solar
 2 additions ultimately acquired through the 2021 Electric Resource Plan & Clean
 3 Energy Plan (“2021 ERP & CEP”) will be dependent on the bids received and the
 4 evaluation of those bids in Phase II of the resource planning process. Table JFH-
 5 SD-5 below shows which Pathway Project segment the nameplate MW additions
 6 in Table JFH-SD-4 above were assumed to tie into in the analysis.

7 **Table JFH-SD-5-Renewable Resource Additions by Pathway Segment**

EOY=>		2025	2026	2027	2028
Approach 1 (Wait)	Wind			Seg 2,3	
	Solar			Seg 3,4,5	
Approach 2 (Incremental)	Wind	Seg 2,3	Seg 2,3	Seg 2,3	
	Solar		Seg 3	Seg 4,5	
Approach 3 (Front Load)	Wind	Seg 2,3			
	Solar	Seg 3	Seg 3		

8 **Q. HOW DID THE COMPANY ANALYZE THESE DIFFERENT RENEWABLE**
 9 **ACQUISITION APPROACHES?**

10 A. For each approach, the Company calculated an estimate of: (1) the volume of
 11 renewable energy that would be added (and potentially curtailed) each year as a
 12 result of system balancing requirements and as a result of transmission congestion
 13 on the Pathway Project; and (2) the total cost of new wind and solar resource
 14 additions. Each of the three approaches allow for a unique curtailment and total
 15 cost look and comparison between one another. The Phase II bids will ultimately
 16 determine what acquisition timelines make the most sense from an economic and

1 environmental perspective, but these approaches show the trade-offs between
2 curtailments and costs during the time period in which the Pathway Project is built.

3 **Q. HOW DID THE COMPANY ESTIMATE THE VOLUME OF SYSTEM**
4 **BALANCING-RELATED RENEWABLE CURTAILMENTS FOR EACH OF THE**
5 **THREE APPROACHES?**

6 A. The Company determined system balancing curtailments by taking a forecast of
7 the Public Service system hourly loads (i.e., 8,760 hours) for each year studied
8 and subtracting an 8,760 pattern of dispatchable generation that would be
9 expected to operate as a result of various requirements to meet minimum-loading
10 requirements, flexible reserves, and contingency reserves. The result is an 8,760
11 pattern of net-load that can be served by non-dispatchable resources such as wind
12 and solar. This 8,760 pattern of net-load was then compared with an 8,760 pattern
13 of expected generation from the existing and planned levels of wind and solar
14 resources on the system. Renewable generation from wind and solar resources
15 that exceed the net-load in any hour was labeled curtailed.

16 **Q. HOW WAS ENERGY STORAGE CONSIDERED IN ESTIMATING SYSTEM**
17 **BALANCING-RELATED CURTAILMENTS?**

18 A. Energy storage charging or pumping is added to the 8,760 net-load pattern.
19 EnCompass hourly dispatch of energy storage systems were assumed in the
20 analysis. The consideration of this energy storage includes the Cabin Creek
21 pumped hydro facility, the additions of solar plus storage occurring under the
22 Colorado Energy Plan approved in the previous electric resource plan (“ERP”) in

1 Proceeding 16A-0396E, and the Company's forecasted energy storage from its
2 Preferred Plan.

3 **Q. DID THE ANALYSIS ASSUME THAT INCREMENTAL SYSTEM BALANCING**
4 **CURTAILMENTS RESULTING FROM ADDING THE PREFERRED PLAN WIND**
5 **AND SOLAR RESOURCES WOULD COME SOLELY FROM THOSE NEW**
6 **WIND AND SOLAR RESOURCES?**

7 A. No. All renewable resources are eligible for system balancing curtailments,
8 provided that whether a facility is eligible or not for PTC true-up payments is
9 considered in whether to curtail a resource. Renewable resources that are eligible
10 for PTC true-up payments are more expensive to curtail, and thus the analysis
11 generally curtailed renewable resources that are *not* eligible for PTC true-up
12 payments. Generators would not be eligible for PTC true-up payments where PTC
13 eligibility has expired or if PTC payments are non-compensable due to Purchase
14 Power Agreement provisions, and these resources are curtailed before renewable
15 resources that *are* eligible for PTC true-up payments.

16 **Q. HOW DID THE COMPANY ESTIMATE THE VOLUME OF TRANSMISSION**
17 **CONGESTION-RELATED RENEWABLE CURTAILMENTS FOR EACH OF THE**
18 **THREE APPROACHES?**

19 A. The Company evaluated transmission congestion curtailments on the Pathway
20 Project by comparing an estimated 8,760 generation pattern of the new wind and
21 solar resources assumed to be interconnected to the Pathway Project each year
22 to an estimate of the year-to-year injection capability of the Pathway Project as it
23 is built out. Renewable generation from wind and solar resources in any year that

1 exceed the estimated injection capability of the Pathway Project was labeled
2 curtailed.

3 **Q. HOW DID THE COMPANY ESTIMATE THE COST OF NEW WIND AND SOLAR**
4 **RESOURCES FOR EACH OF THE THREE APPROACHES?**

5 A. The cost of new wind and solar resources were based on the \$/Megawatt Hour
6 (“MWh”) levelized costs that were applied to generic wind and solar resources in
7 the preferred plan as filed in Proceeding No. 21A-0141E. These \$/MWh levelized
8 costs were developed from the 2020 National Renewable Energy Laboratory
9 Annual Technology Baseline (“ATB”) and multiplied by the estimated energy
10 generated each year from new wind and solar resources over an assumed 25-year
11 life to develop an estimate of total customer cost in dollars for the energy from
12 these new resources over their asset lives. The Company assumed that wind and
13 solar resources generate at an annual net capacity factor (“NCF”) of 50 percent
14 and 28 percent, respectively. Wind resources placed in-service by the end of 2025
15 were priced at \$22.65/MWh levelized to reflect a 60 percent PTC level. Wind
16 resources placed in-service beyond the end of 2025 were priced to reflect 0
17 percent PTCs at \$30.93/MWh for the end of 2026, \$31.55/MWh for the end of
18 2027, and \$32.18/MWh for the end of 2028. Similarly, solar resources placed in-
19 service by the end of 2025 were priced at \$25.20/MWh levelized to reflect a 26
20 percent ITC level. Solar resources placed in-service beyond the end of 2025 were
21 priced to reflect 10 percent ITCs at \$30.09/MWh for projects brought online in
22 2026, \$30.69/MWh for projects brought online in 2027, and \$31.30/MWh for
23 projects brought online in 2028.

1 **IV. RESULTS OF ADDITIONAL CURTAILMENT ANALYSIS**

2 **Q. WHAT IS THE PURPOSE OF THIS SECTION OF YOUR TESTIMONY?**

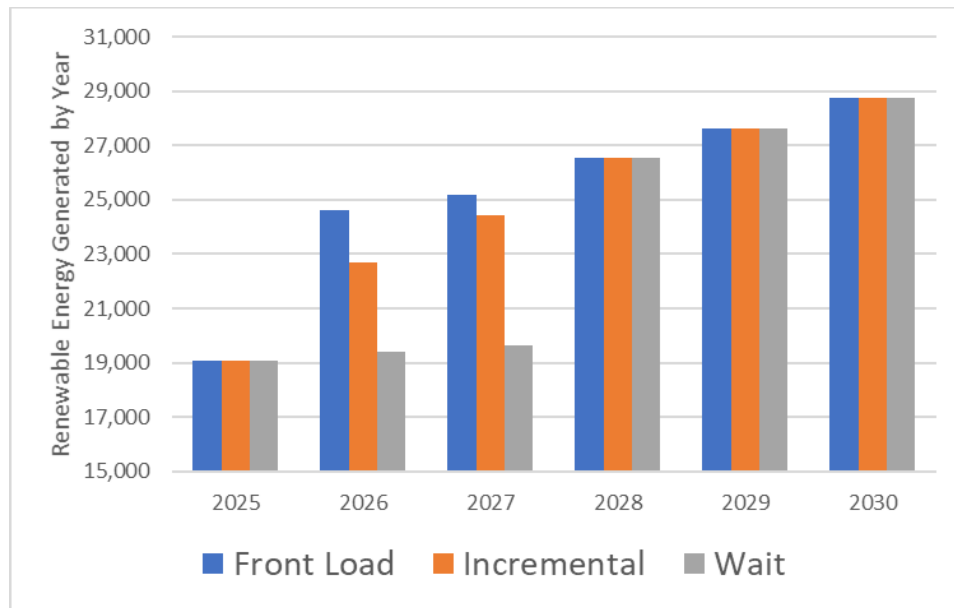
3 A. In this section of my Supplemental Direct Testimony, I describe the results of the
4 analysis of the three different renewable acquisition approaches described in the
5 previous section of my testimony. Specifically, I provide comparisons of the levels
6 of renewable energy, levels of renewable energy curtailment, and total cost of each
7 approach.

8 **Q. PLEASE SUMMARIZE THE RESULTS OF THE ANALYSIS IN TERMS OF**
9 **RENEWABLE ENERGY ADDED BY YEAR.**

10 A. Please see Figure JFH-SD-1 below that summarizes the renewable energy added
11 by year under each approach. As might be expected, the approaches that add
12 more renewable resources to the system earlier also result in more renewable
13 generation earlier. The Company presents this view to provide context for the
14 curtailment levels shown later in this section of my Supplemental Direct Testimony.

1

Figure JFH-SD-1-Renewable Energy Additions by Year

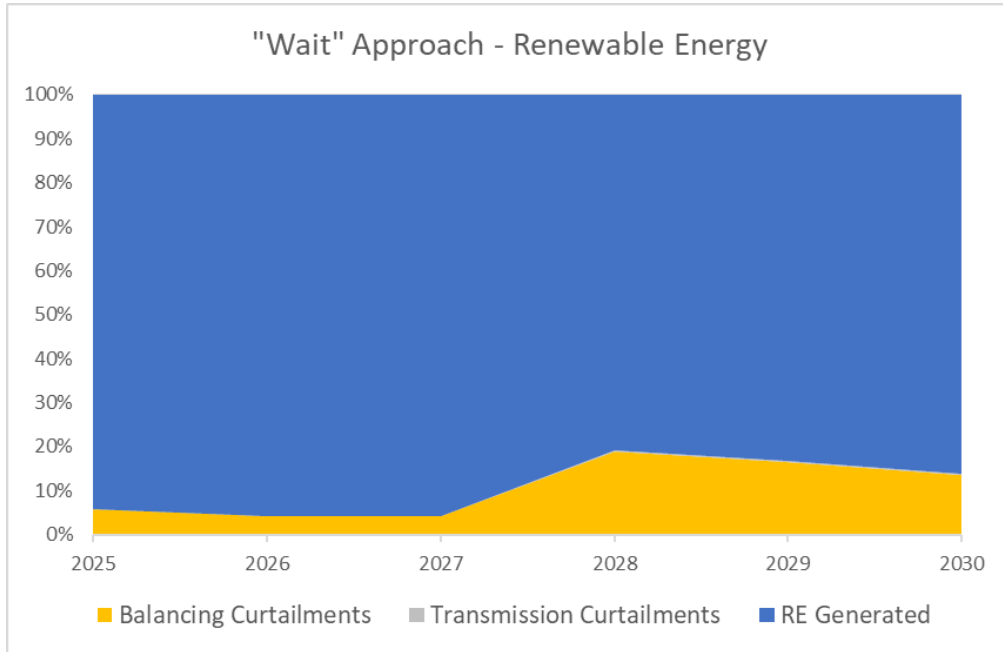


2 **Q. PLEASE SUMMARIZE THE RESULTS OF THE ANALYSIS FROM THE**
3 **PERSPECTIVE OF RENEWABLE ENERGY CURTAILMENT.**

4 A. Figures JFH-SD-2 through JFH-SD-4 below provide a summary of the estimated
5 level of renewable energy curtailment that would occur under each of the studied
6 Approaches for acquiring new wind and solar resources. Curtailed renewable
7 energy is provided in terms of a percentage of the total potential amount of
8 renewable energy on the Public Service system under each approach. I provide
9 a graphic for each Approach and then explain what the graphic shows.

1
2

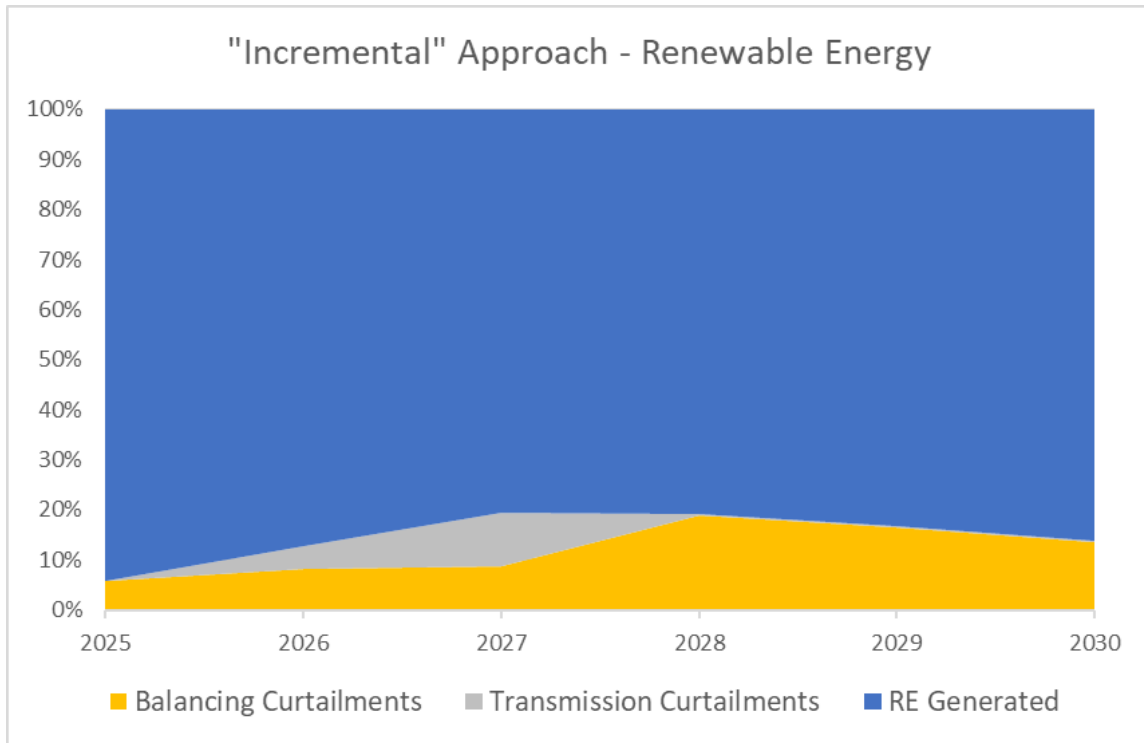
Figure JFH-SD-2-Estimated Curtailed Renewable Energy Approach 1 (“WAIT”)



3 The yellow area in Figure JFH-SD-2 represents the amount of total renewable
4 energy potential on the system that would be curtailed as a result of system
5 balancing issues. Total renewable energy potential in this instance is the amount
6 that could theoretically be produced from all renewables on the system absent any
7 curtailment. The blue area represents the amount of total renewable energy that
8 is delivered and consumed by customers. Since this approach waits for the full
9 Pathway Project to be completed before interconnecting new wind and solar
10 resources, there are no transmission congestion-related curtailments.

1
2

**Figure JFH-SD-3-Estimated Curtailed Renewable Energy Approach 2
("INCREMENTAL")**

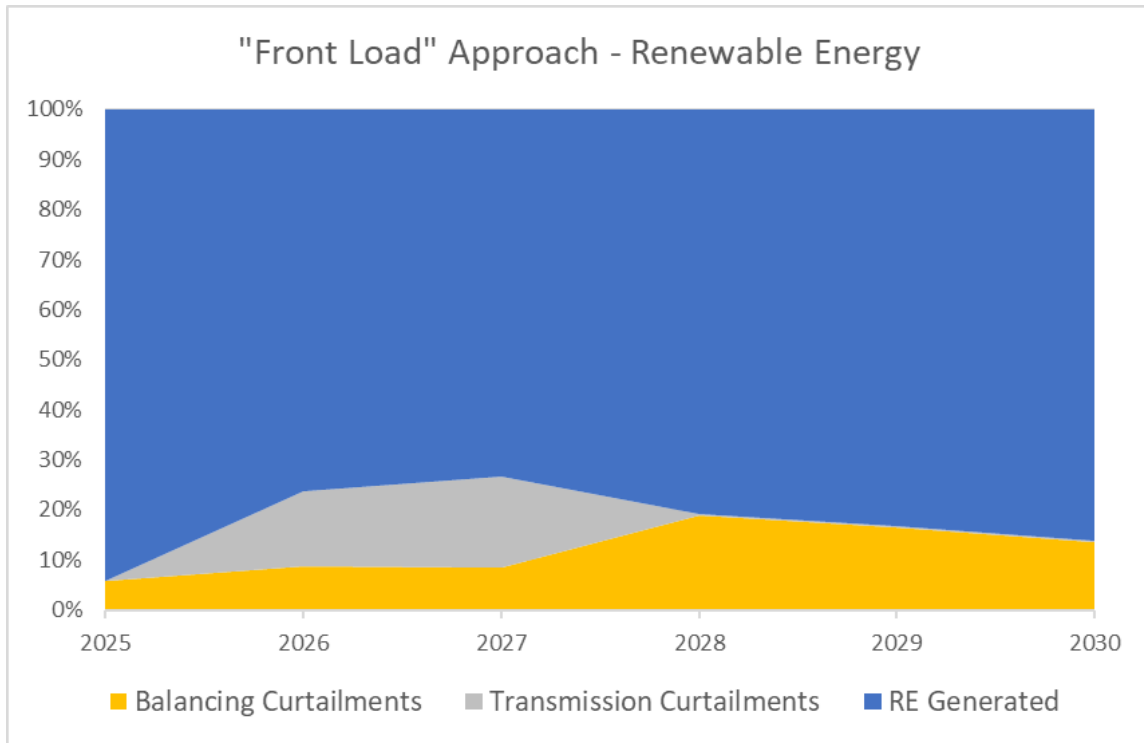


3 The Incremental Approach adds new wind and solar resources at a rate of ~1,300
4 MW nameplate (total) each year as earlier illustrated in Table JFH-SD-4. This
5 annual rate of additions exceeds the incremental injection capability provided by
6 the staged construction of the Pathway Project, resulting in transmission
7 congestion-related curtailments as shown in the gray area of the figure, along with
8 system balancing related curtailments shown in yellow.³

³ The Company notes that some of the transmission-related curtailments shown in Figure JFH-SD-3 and JFH-SD-4 would occur regardless of the temporary transmission constraints arising from the Pathway Project construction staging sequence, as these curtailments would be needed due to insufficient load to absorb the renewable generation at certain times in our analysis. These curtailments might reasonably be viewed as being caused by either transmission constraints, or by system bottoming or supply/demand mismatch between load and renewable energy.

1
2

**Figure JFH-SD-4-Estimated Curtailed Renewable Energy Approach 3
("FRONT LOAD")**



3 The "Front Load" Approach adds 2,300 MW of new wind and 800 MW of new solar
4 end of year 2025, and 750 MW of additional new solar end of year 2026. These
5 additions exceed the incremental injection capability provided by the staged
6 construction of the Pathway Project, resulting in the highest amount of
7 transmission congestion-related curtailments of the three approaches analyzed,
8 as shown in the gray area of the figure.

9 **Q. PLEASE SUMMARIZE THE RESULTS OF THE ANALYSIS FROM THE**
10 **PERSPECTIVE OF TOTAL COST TO CUSTOMERS.**

11 A. Table JFH-SD-6 provides cost estimates for each of the Approaches.

1 **Table JFH-SD-6-Cost of Wind Energy, Solar Energy, and Curtailment**

	Cost of Wind Energy, Solar Energy, and Curtailment	
	Nominal Sum \$ M	Net Present Value ("NPV") \$ M
Approach 1 (Wait)	\$8,767	\$3,323
Approach 2 (Incremental)	\$7,715	\$3,005
Approach 3 (Front load)	\$6,753	\$2,718

2 Table JFH-SD-6 illustrates that the costs associated with Approach 2 and
3 Approach 3—notwithstanding the higher levels of curtailments seen in those
4 approaches as compared to Approach 1—are lower cost than Approach 1, where
5 no new renewable energy is added until the Pathway Project construction is
6 complete. The values in Table JFH-SD-6 also do not include any additional cost
7 or savings that would be associated with the timing of avoided carbon emissions
8 and their associated costs.⁴ Including such costs would act to show increased
9 savings (both nominal and NPV) of the approaches that add renewables earlier
10 (e.g., Approach 2 and Approach 3) as compared to the other approaches studied.
11 Moreover, the emission reductions under Approach 2 and Approach 3 would result
12 in a steadier decline in emissions over the course of the RAP as we move forward
13 in time toward the 2030 clean energy target.

⁴ If the PTC and ITC were extended, it would result in lower costs of renewable resources depending upon the length of the extension.

1 **Q. WHAT CONCLUSIONS DO YOU DRAW FROM THESE RESULTS?**

2 A. The analysis indicates that the segmented buildout of Pathway Project as
3 proposed by the Company will allow the opportunity to acquire tax advantaged
4 wind and solar resources in Phase II of Proceeding No. 21A-0141E. In turn, the
5 lower price of tax-advantaged wind and solar resources results in customer cost
6 savings, earlier additional renewable generation, and earlier emissions reduction.
7 The cost savings of the lower-priced renewables more than offsets the additional
8 curtailments and associated costs that might occur in years 2026 and 2027 until
9 the Pathway Project is fully built out. I note that this is true even without attempting
10 to estimate emissions reduction benefits through an externalities analysis such as
11 applying the social cost of carbon to those benefits.

12 The analysis supports the Company's planning in two ways. First, within
13 this proceeding, it supports the Company's proposed Pathway Project construction
14 sequence, specifically building Segments 2 and 3 first to create the option to
15 capture PTC and ITC benefits sooner. Second, within the context of the 2021 ERP
16 & CEP currently pending in Proceeding No. 21A-0141E, the Company's proposed
17 approach to apply a "tunnel" constraint in order to pace renewables adoption from
18 2025 to 2027 also makes sense. The tunnel approach was proposed in
19 anticipation of the temporary transmission limit effects that have been further
20 analyzed here. Should the Commission approve the Pathway Project and our
21 2021 ERP & CEP, as we respectfully request both in this proceeding and
22 Proceeding No. 21A-0141E, we will consider the staged construction sequence of

1 the Pathway Project in conjunction with actual renewable resource bids to bring
2 the best portfolios forward in Phase II of the ERP.

1 **V. CONCLUSION**

2 **Q. PLEASE SUMMARIZE YOUR RECOMMENDATIONS.**

3 A. I recommend that the Commission approve the staged build-out approach for the
4 Pathway Project proposed by the Company in its Direct Case. The analysis of
5 actual bids coupled with the staged construction of the Pathway Project will allow
6 the Company to balance the need to capture tax benefits for customers, reduce
7 emissions in a timely and gradual manner, and manage curtailment costs to
8 develop a cost-effective resource plan. The analysis conducted for purposes of
9 the Company's Supplemental Direct Case establishes the potential benefits of the
10 staged approach to Pathway Project construction and the resource acquisition
11 timing optionality that this approach enables. Doing so will afford the opportunity
12 to bring customer value through tax advantaged wind and solar resources in Phase
13 II of the Company's 2021 ERP & CEP.

14 **Q. DOES THIS CONCLUDE YOUR SUPPLEMENTAL DIRECT TESTIMONY?**

15 A. Yes, it does.

BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF COLORADO

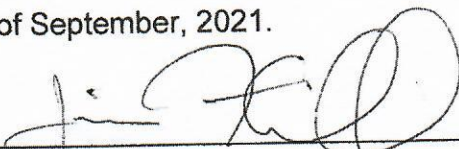
* * * * *

IN THE MATTER OF THE APPLICATION)
OF PUBLIC SERVICE COMPANY OF)
COLORADO FOR A CERTIFICATE OF)
PUBLIC CONVENIENCE AND NECESSITY)
FOR COLORADO'S POWER PATHWAY) PROCEEDING NO. 21A-XXXXE
345 KV TRANSMISSION PROJECT)
REGARDING NOISE AND MAGNETIC)
FIELD REASONABLENESS)

AFFIDAVIT OF JAMES F. HILL
ON BEHALF OF
PUBLIC SERVICE COMPANY OF COLORADO


I, James F. Hill, being duly sworn, state that the Supplemental Direct Testimony was prepared by me or under my supervision, control, and direction; that the Supplemental Direct Testimony is true and correct to the best of my information, knowledge and belief; and that I would give the same testimony orally and would present the same if asked under oath.

Dated at Denver, Colorado, this 3rd day of September, 2021.

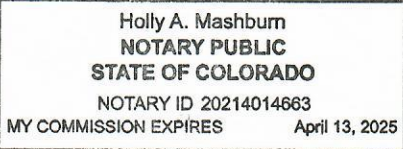


James F. Hill
Director, Resource Planning and Bidding

Subscribed and sworn to before me this 3rd day of September, 2021.



Notary Public



My Commission expires 4/13/2025