



2026 Montana IRP

Response to deficiency notices

Electric Technical Advisory Committee

NWE, Energy Supply Planning

Agenda

Overview:

Deficiency Items:

- Local resource adequacy: events, duration and frequency
- Portfolio risk and the number of simulations
- Load forecast regression analysis and data
- Demand response
- PowerSIMM transparency and auditability

Extension:

Overview - Our approach to the response

Recognize the work

- Our team has put substantial care into this IRP. We appreciate the continued review and input.

Address the gaps directly

- We will add analysis, supply missing documentation and strengthen the record behind the results.

Build a repeatable and transparent process

- This is our first planning cycle under the new rules. The response will improve this filing, and the next planning cycle will continue IRP improvements.

Overview – IRP Process



Identify Needs

Forecast future demand



Compare Solutions

Supply, infrastructure & demand



Evaluate Risk

Test changing conditions



Inform Stakeholders

Clarify needs, options & trade-offs.

A few questions:

- Need Locally or Regionally?
- Compare risks with deterministic, stochastic, or both types of simulations?
- The model is complex – how do we make it auditable?

Reliable service • Affordable costs • Sustainability

Repeatable & Transparent Processes

Overview – Study Capabilities

Three Studies. Three Planning Questions.

Each study provides a different part of the answer.



ARS / Capacity Expansion

What should we add, and when?

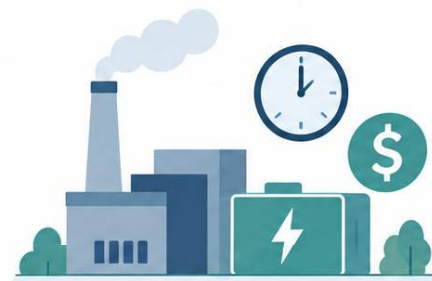
Select resources and timing
Compare long-term portfolio costs



LOLP / Resource Adequacy

Can we reliably serve load?

Measure shortage risk
Probability, frequency, duration & magnitude



PCM / Production Cost

How will it operate and
what will it cost?

Simulate dispatch, fuel use & purchases
Estimate operating costs & emissions

Select a portfolio • Test reliability • Evaluate operations • Refine the plan

WRAP still defines the short-term reliability needs. A local RA can be used to supplement a short-term analyses by determining if portfolios rely less on the region to maintain reliability.

Modeling

Planning Questions & Needs (Regional vs. **Local**?)



Define Portfolios (Constraints and ARS)



Portfolio Operations (PCM)



Portfolio Comparisons:

- Costs
- Risks (Deterministic vs. **Stochastic**)
- Sustainability
- **Local Reliability**

Modeling is not free. Takes time. Takes storage.

Additional studies as part of the deficiencies



Events, Frequency, and Duration

Local RA – Interpretation of meeting the rule:

9. To satisfy this rule, NorthWestern must demonstrate the duration, frequency, and timing of capacity deficits given forecasted loads and existing resources and evaluate scenarios with higher and lower loads, alternative load profiles, and alternative performance assumptions for existing resources.

Interpretation – Requires a local RA analysis.

- A local resource adequacy (RA) analysis determines when a portfolio of resources with no market access cannot meet load.
- Note an RA analysis is only performed for one year at time.
 - Events, Duration, and Frequency are identified.
 - A couple samples years need to be analyzed to assess the forecasted loads.
 - Using a Monte Carlo analysis, there are 100s of simulations that vary weather, loads, load profiles, renewable performances, and thermal outages.

ETAC Input/Discussion

- Any thoughts or concerns with a local RA approach?
- What are your thoughts on supplementing a local RA study in addition to WRAP (Need?, other thoughts)?

Local RA: what we did and what we will add

What we did

- We relied on the short-term regional resource adequacy and extrapolated “worst case” requirements for long term planning through WRAP.

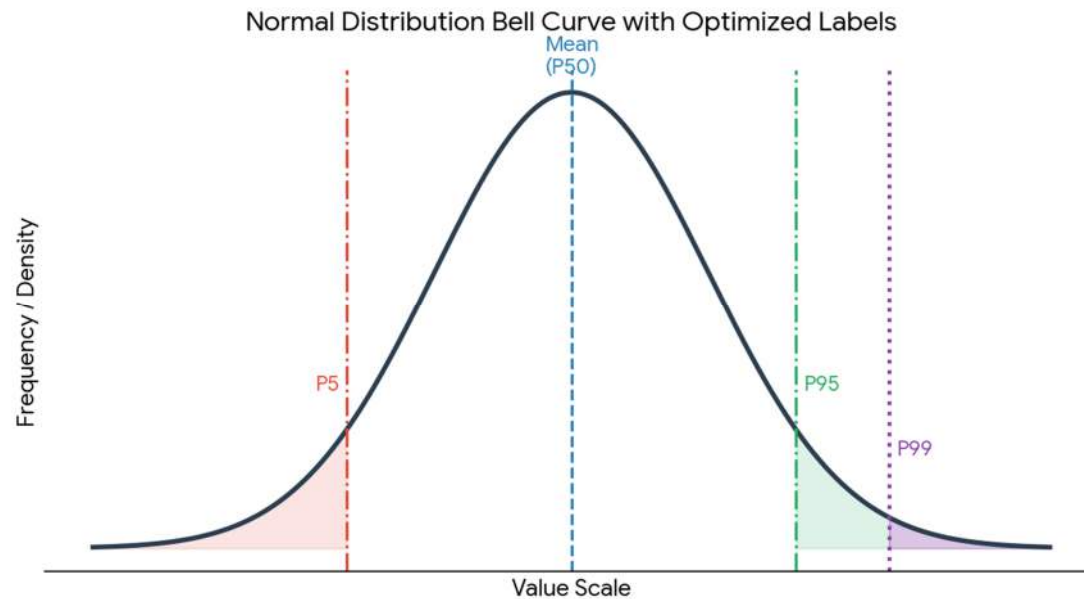
What we will add

- A local RA analysis of NorthWestern’s portfolio for:
 - Year 2028 (existing resources only)
 - Base case scenario – (2030,2040)
 - Sensitivity N (2030,2040)

What it will clarify

- When, how long and how often the portfolio needs regional support to meet a reliability standard.

Local Resource Adequacy: How they are reported



P50 – Mean EUE use case

P95 – Top 5% EUE use case

P99 – Top 1% EUE use case

Events, Duration, Magnitude

Objectives

- Minimize unserved energy

Main Variables:

- Weather Variations
- Random generator Outages
- Load adjustments to weather
- Renewable performance

Constraints

- Only uses portfolio to serve load (no market availability)

▮ The local RA reporting package

Question	Evidence we propose to report
How often?	Event count per simulated year and share of years with events
How long?	Average and maximum duration, plus the event-duration distribution
How large?	Maximum support MW and total support MWh
What about WRAP and associated risks.	So long as we meet WRAP short term responsibilities, we will have access to additional supply to meet industry reliability standards.

ETAC input/Discussion

- Doing all scenarios is extensive. Do the current recommended portfolio test events, frequency and magnitude question?
- Does WRAP establish the minimum short-term requirements?



Risk and Quantity of Simulations

▮ The risk questions we evaluated

Note: NWE Executed 10 simulations on each PCM and reported out the avg . NPV.

- “The 2026 IRP appears to have regressed in this area by running far fewer simulations and entirely omitting an explicit assessment of portfolio risk exposure. GDS Review 35-38, 45-46. Notably, the only information on the number of stochastic simulations underlying IRP portfolio results appears in a screenshot of the PowerSIMM modeling platform included in the GDS review, not the IRP itself. Id. at 46.”
- “Because the 2026 IRP does not allow for a comparison of the risks of the various modeled portfolio scenarios, it does not satisfy Mont. Admin. R. 38.5.2022(1)(i).”
- “To satisfy this rule, at a minimum NorthWestern should provide the calculated risk premium for each scenario in the 2026 IRP and address the Commission’s request for additional support for the methodology underlining the calculation.”

Interpretation – Calculate Portfolio Risk Premiums

▮ The risk questions

Current IRP: PCM deterministic sensitivities

- If fuel costs were high, would resource selection still favor a similar resource selection? What if market costs were low? How do these sensitivities, on average, compare against base case assumptions?

2023 IRP: PCM stochastic comparisons

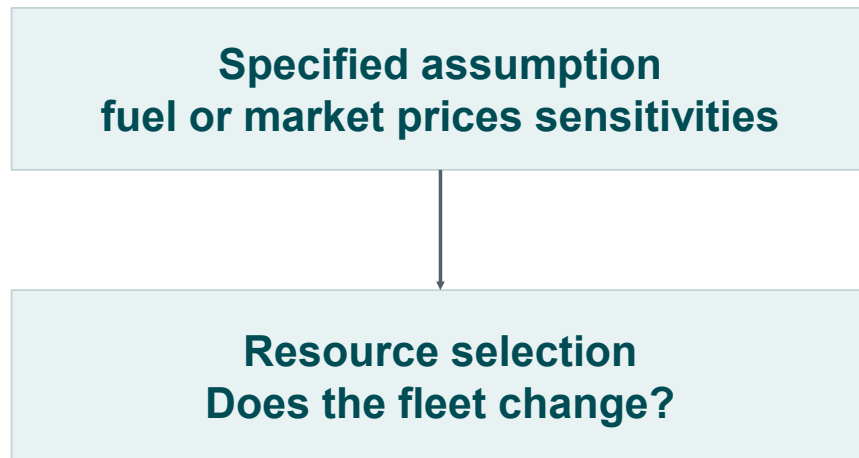
- Across simulated conditions, how much did portfolio NPV vary, and how did that variation differ among portfolios?

What the additional stochastic analysis answers

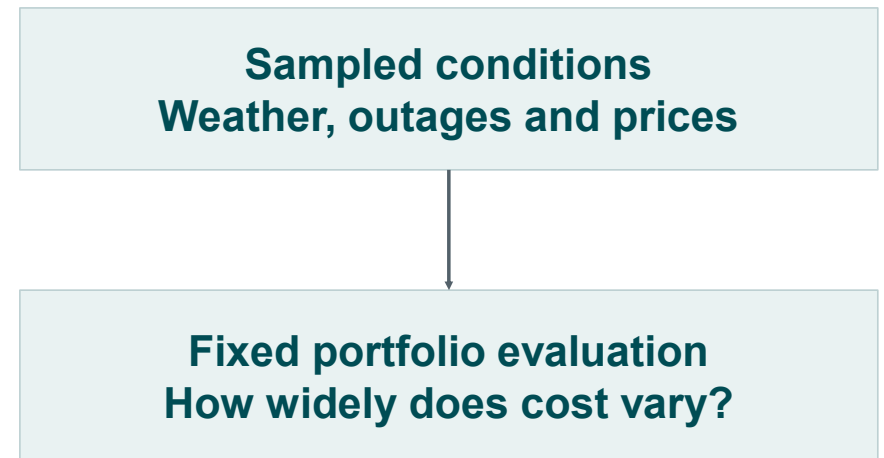
- How much uncertainty remains in portfolio cost, including exposure to modeled market conditions?

Note, going from 10 to 100 PCM simulations increases run times and storage requirements.
Long duration storage adds run time with long “look ahead” periods.

■ Deterministic and stochastic risk comparison



Average model run
(10 simulations)
(10 hours | 4.3 GB of Data)



Stochastic market tail risk
assessment
(100 simulations)
(137 Hours | 134 GB of Data)

PCM - 10 versus 100 simulations

Average outcomes

Typically, within a few percent execution of new studies (same inputs – Monte Carlo Behavior).

We will show a 10-versus-100 comparison average comparison for results (works well in deterministic use case).

High-cost/Tail risk outcomes

A similar average can hide different tail risk in PCM.

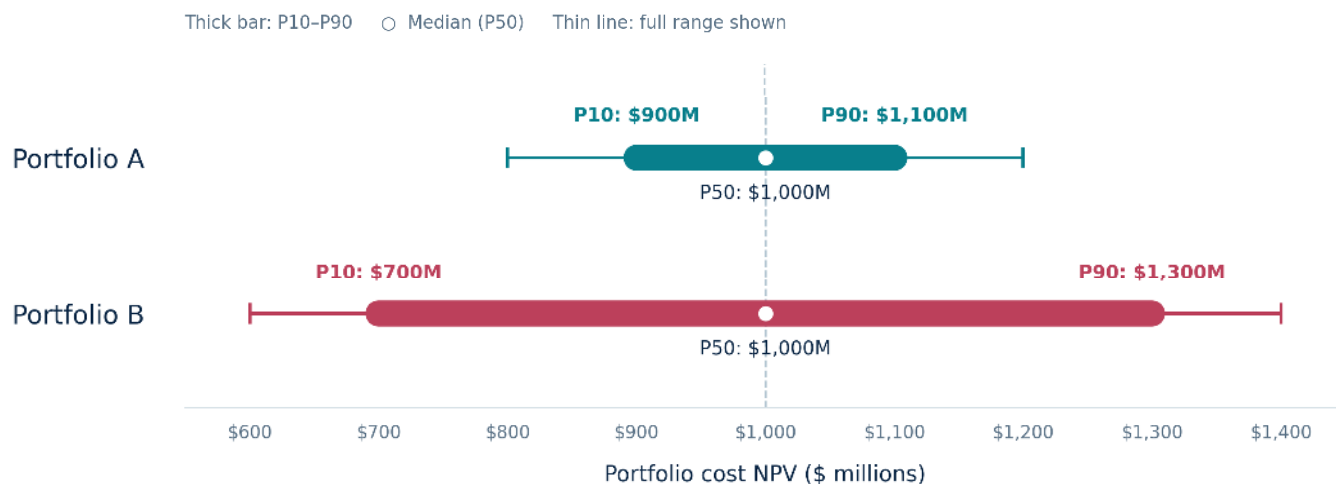
We will complete the required risk assessment with 100 simulations.

The mean and the tail are separate checks.

PCM assess financial risk exposure, while a RA analysis is used to assess tail risk reliability.

Similar average cost, different uncertainty

A wider range means more opportunity for savings—and more exposure to high costs.



Same mean
\$1,000 million

Portfolio B has a
wider range of
possible costs.

Chance of cost exceeding \$1.2 billion

A: 0%

B: 15%

Illustrative example only (not results).

▮ The planned portfolio risk assessment

100 simulations for each selected portfolio

- We will use common financial assumptions and comparable simulated conditions.

Uncertainty of the selected portfolio

- The additional analysis measures the range of costs for a fixed resource mix.

ETAC input/Discussion

- Doing all scenarios is extensive. Do the current recommended scenarios test logical portfolio risk assumptions?
- What are your thoughts on deterministic approaches vs. stochastic approaches?



Load Regression

Notice of Commission Action

IV Load Forecasts

- 23. Because the IRP omits regression model specifications, diagnostics, and supporting data, it does not resolve the transparency and documentation concerns the Commission identified with the 2023 IRP and is deficient in meeting the requirements of Mont. Admin. Rs. 38.5.2022(1)(b) *[explanation...]* and 38.5.2022(1)(j)(ii) *[computer model description...]*, as well as Mont. Code Ann. § 69-3-1204(2)(b) *[fully explain...]*.
- 24. To satisfy these requirements, NorthWestern must provide the regression model specifications, diagnostics, and data to support and explain the load forecast that NorthWestern develops pursuant to Mont. Admin. R. 38.5.2022(1)(b) *[explanation...]*.

▮ Load forecast regression and backcasting

The missing attachment

- The regression equations are missing in the attachment. We will include the equations, coefficients and supporting documentation.

Today's focus: Time-series cross-validation

- How well does our current method predict the next year it hasn't seen yet.
 - Fit through 2021 → test 2022
 - Fit through 2022 → test 2023
 - Fit through 2023 → test 2024

The evidence to discuss

- Observations of regression analysis vs. actual observed results.

Summer Peak Demand Forecast

- NorthWestern's retail load peak demand forecast was developed using a linear regression model with weather (*max temperature, T*), monthly energy (*E*), and total customers (*C*) serving as the explanatory variables.

$$2025 \text{ Summer Peak Demand} = 0.00102E + 0.00130C + 4.96T - 394$$

Forecast Year	Coefficients from Regression				Forecasted Inputs			Forecasted Peak	Actual Peak	Date	Difference	
	Monthly Energy	Customers	Max Temp	Const	Monthly Energy	Customers	Max Temp				MW	%
2024	0.00104	0.00135	5.07	-436	652,331	410,875	96	1,277	1,285	7/23/2024	-8	-1%
2023	0.00103	0.00131	5.65	-476	652,994	403,676	95	1,265	1,224	8/15/2023	41	3%
2022	0.00110	0.00136	5.27	-497	617,264	396,271	95	1,221	1,250	8/1/2022	-29	-2%
2021	0.00118	0.00143	5.67	-603	600,658	390,286	95	1,201	1,248	7/27/2021	-47	-4%
2020	0.00116	0.00158	6.34	-703	602,206	384,435	95	1,201	1,171	8/17/2020	30	3%

Forecast Year	Coefficients from Regression				Actual Values			Calculated Peak	Actual Peak	Date	Difference	
	Monthly Energy	Customers	Max Temp	Const	Monthly Energy	Customers	Max Temp				MW	%
2024	0.00104	0.00135	5.07	-436	645,387	408,472	99	1,282	1,285	7/23/204	-3	0%
2023	0.00103	0.00131	5.65	-476	593,337	404,614	99	1,224	1,224	8/15/2023	0	0%
2022	0.00110	0.00136	5.27	-497	641,668	397,763	98	1,266	1,250	8/1/2022	16	1%
2021	0.00118	0.00143	5.67	-603	667,851	391,246	96	1,286	1,248	7/27/2021	38	3%
2020	0.00116	0.00158	6.34	-703	588,924	385,230	97	1,197	1,171	8/17/2020	26	2%

Winter Peak Demand Forecast

- NorthWestern's retail load peak demand forecast was developed using a linear regression model with weather (*heating degree days, HDD**), monthly energy (*E*), and total customers (*C*) serving as the explanatory variables.

$$2025 \text{ Winter Peak Demand} = 0.000692E + 0.00103C + 5.47HDD$$

Forecast Year	Coefficients from Regression				Forecasted Inputs			Forecasted Peak	Actual Peak	Date	Difference	
	Monthly Energy	Customers	Max Temp	Const	Monthly Energy	Customers	HDD				MW	%
2024	0.000725	0.00105	5.01	0	671,011	410,875	70	1,271	1,207	1/20/2025	64	5%
2023	0.000592	0.000859	4.46	188	666,782	403,676	69	1,239	1,296	1/12/2024	-57	-4%
2022	0.000865	0.000967	4.58	-22.2	624,450	396,271	66	1,205	1,316	12/22/2022	-111	-8%
2021	0.000864	0.00104	4.59	-47.5	613,672	390,286	66	1,191	1,185	2/22/2022	6	1%
2020	0.000815	0.00125	5.08	-122	632,290	384,435	65	1,204	1,190	2/11/2021	14	1%

Forecast Year	Coefficients from Regression				Actual Values			Calculated Peak	Actual Peak	Date	Difference	
	Monthly Energy	Customers	Max Temp	Const	Monthly Energy	Customers	HDD				MW	%
2024	0.000725	0.00105	5.01	0	674,987	408,472	66	1,251	1,207	1/20/2025	44	4%
2023	0.000592	0.000859	4.46	188	673,910	404,614	84	1,309	1,296	1/12/2024	13	1%
2022	0.000865	0.000967	4.58	-22.2	689,666	397,763	87	1,356	1,316	12/22/2022	40	3%
2021	0.000864	0.00104	4.59	-47.5	631,685	391,246	65	1,204	1,185	2/22/2022	19	2%
2020	0.000815	0.00125	5.08	-122	588,119	385,230	76	1,224	1,190	2/11/2021	34	3%

*HDD = 65°F – T_{average}

Residential Customer Forecast

- NorthWestern's residential customer forecast (C_{res}) uses population (P) in the service territory as the explanatory variable and known-change information in all other classes.

$$2025 C_{Res} = 0.493P - 111,502$$

Forecast Year	Coefficients from Regression		Forecasted Input	Forecasted Customers	Actual Customers	Difference	
	Population	Const	Populaton			Customers	%
2024	0.495	-113,588	890,826	327,698	328,421	-723	0%
2023	0.502	-118,171	877,040	321,819	322,489	-670	0%
2022	0.505	-119,965	863,161	315,597	316,968	-1,371	0%
2021	0.498	-114,890	852,283	309,914	311,922	-2,008	-1%
2020	0.486	-105,546	844,416	304,943	307,390	-2,447	-1%

Forecast Year	Coefficients from Regression		Actual Values	Calculated Customers	Actual Customers	Difference	
	Population	Const	Populaton			Customers	%
2024	0.495	-113,588	892,652	328,603	328,421	182	0%
2023	0.502	-118,171	885,904	326,266	322,489	3,777	1%
2022	0.505	-119,965	878,220	323,196	316,968	6,228	2%
2021	0.498	-114,890	864,459	315,983	311,922	4,061	1%
2020	0.486	-105,546	847,005	306,202	307,390	-1,188	0%

GS-1 Secondary Customer Forecast

- NorthWestern's GS-1 Secondary customer forecast (C_{GS1sec}) uses population (P) in the service territory as the explanatory variable and known-change information in all other classes.
- A backcasting exercise was not performed for the GS-1 Secondary customer forecast because the 2025 forecast uses a regression model with population as the only independent variable, and the previous GS-1 Secondary customer forecasts used regression models with two independent variables – population and total service territory employment.
- The transition of the GS-1 Secondary customer forecast in 2025 was due to not being able to keep the total service territory employment forecast current when only purchasing the Woods and Poole forecast every few years.

$$2025 C_{GS1sec} = 0.139P - 47,567$$

Residential Energy Forecast

- NorthWestern's residential annual energy forecasts are based on regression models using the specific customer-class forecast (C_{res}) and normal weather (W) as the explanatory variables that produce the annual load forecasts.

$$2025 \text{ Residential Annual Energy} = 8.347C_{Res} + 8.328W$$

Forecast Year	Coefficients from Regression			Forecasted Inputs		Forecasted Energy	Actual Energy	Difference	
	Customers	Degree Day	Const	Customers	Weighted Total Degree Days			MWh	%
2024	8.46	3.72	0	327,198	8,002	2,797,525	2,807,807	-10,282	0%
2023	8.56	-1.76	0	321,819	8,046	2,739,661	2,787,610	-47,948	-2%
2022	8.44	0.96	0	315,597	7,937	2,672,806	2,868,454	-195,648	-7%
2021	8.24	7.35	0	311,414	7,975	2,623,743	2,738,048	-114,305	-4%
2020	8.14	10.3	0	306,943	8,010	2,580,439	2,634,967	-54,528	-2%

Forecast Year	Coefficients from Regression			Actual Values		Calculated Energy	Actual Energy	Difference	
	Customers	Degree Day	Const	Customers	Weighted Total Degree Days			MWh	%
2024	8.46	3.72	0	328,421	7,518	2,806,065	2,807,807	-1,742	0%
2023	8.56	-1.76	0	322,489	7,678	2,746,041	2,787,610	-41,569	-1%
2022	8.44	0.964	0	316,968	8,607	2,685,028	2,868,454	-183,425	-6%
2021	8.24	7.35	0	311,922	7,851	2,627,020	2,738,048	-111,028	-4%
2020	8.14	10.3	0	307,390	7,701	2,580,898	2,634,967	-54,069	-2%

GS-1 Secondary Energy Forecast

- NorthWestern's residential annual energy forecasts are based on regression models using the specific customer-class forecast (C_{GS1sec}) and normal weather (W) as the explanatory variables that produce the annual load forecasts.

$$2025 \text{ GS1 Secondary Annual Energy} = 24.48C_{GS1sec} + 132.3W$$

Forecast Year	Coefficients from Regression			Forecasted Inputs		Forecasted Energy	Actual Energy	Difference	
	Customers	Degree Day	Const	Customers	Weighted Total Degree Days			MWh	%
2024	22.6	151	0	75,819	8,002	2,920,258	2,809,888	110,370	4%
2023	20.4	172	0	74,424	8,046	2,906,169	2,807,001	99,167	4%
2022	20.9	173	0	72,809	7,937	2,893,738	2,830,911	62,826	2%
2021	23.2	156	0	71,044	7,975	2,892,999	2,750,722	142,278	5%
2020	32.1	95.4	0	69,751	8,010	3,005,310	2,635,940	369,370	14%

Forecast Year	Coefficients from Regression			Actual Values		Calculated Energy	Actual Energy	Difference	
	Customers	Degree Day	Const	Customers	Weighted Total Degree Days			MWh	%
2024	22.6	151	0	75,737	7,518	2,845,306	2,809,888	35,418	1%
2023	20.4	172	0	74,267	7,678	2,839,574	2,807,001	32,572	1%
2022	20.9	173	0	72,923	8,607	3,011,702	2,830,911	180,791	6%
2021	23.2	156	0	71,459	7,851	2,883,311	2,750,722	132,589	5%
2020	32.1	95.4	0	70,014	7,701	2,984,346	2,635,940	348,406	13%



Demand Response

Demand Response

“Because the 2026 IRP does not evaluate DR as a resource option in capacity expansion and production cost modeling, and because the DSM acquisition plan in the 2026 IRP does not address DR, the IRP does not satisfy the requirements of Mont. Admin. R. 38.5.2022(1)(k) and Mont. Code Ann. § 69-3-1204(2)(a)(i). “

“To satisfy these requirements, NorthWestern must describe a plan for demand-side resource acquisition over the planning period, to the extent such demand-side resources are not included in the evaluation that NorthWestern conducts pursuant to Admin. R. Mont. 38.5.2022(1)(i). “

▮ Demand response

We hear the DR message.

ETAC input/Discussion

- Let's discuss this further.
- There is a lot of history on this too.



PowerSIMM – Transparency and Auditability

PowerSIMM

“To remedy this deficiency in part, NorthWestern should provide calculations of resource capital costs per unit of accredited capacity, found in Tables 52 and 53, and candidate resource revenue requirements. NorthWestern should explicitly address the Commission’s prior concerns about whether the stochastic modeling process involves inconsistent load shapes across modeled scenarios and should clarify and justify the number of simulations run for each scenario.”

“The Commission is attuned to the Legislature’s, and NorthWestern’s, interest in faster regulatory review of IRPs. Given the extent to which NorthWestern’s modeling process resists independent audit and having run through the 120-day review period specified Mont. Code Ann. § 69-3-1204(5) and the majority of its budget appropriation for IRP consultants, the Commission is unable to offer a clear remedy for fully meeting the requirements of Mont. Admin. R. 38.5.2022(1)(j) without adding substantial time and cost to the regulatory review process. Therefore, the Commission invites NorthWestern to identify potential remedies that could timely satisfy model access and verification requirements.”

PowerSIMM transparency: the gap to close

What we provided

- Material inputs exported and full model access for the reviewing consultant, with access to Ascend, manuals, and NWE's team to address questions and concerns.

Items that were a miss

- We did not understand independent review requires the ability re-run simulations. Additionally, there is currently no documented review process to perform, so it was an exploratory effort on all parties within a short time-frame.
- We did not add additional calculations of resource capital costs per unit of accredited capacity, found in Tables 52 and 53, and candidate resource revenue requirements.

What we are working on

- A repeatable and documented review/audit process that captures inputs, provides necessary details, a reconciliation record of what inputs provided the results, and the evidence behind each final study.
- Adding capacity costs per unit of accredited capacity and resource revenue requirements calculations.

▮ The transparency package we propose

Explain the model

- A plain-language overview and diagrams that clearly depict the steps from inputs to results.

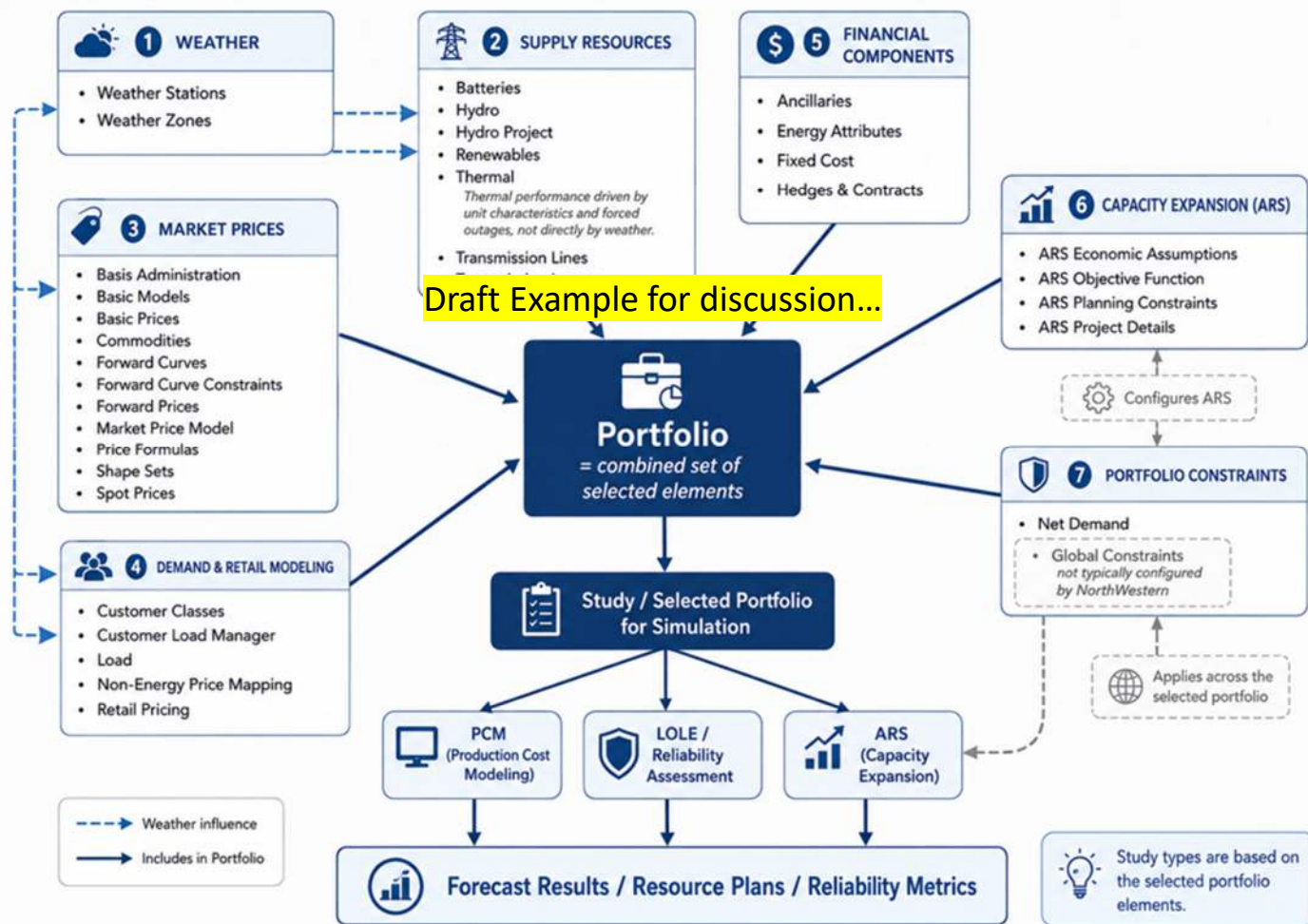
Expose the analytical record

- Input workbooks and mappings, configuration screenshots, module lineage and final study identifiers.

Demonstrate the result

- Final studies can be audited to the inputs used in those studies.

PowerSIMM Portfolio Elements and Study Relationships

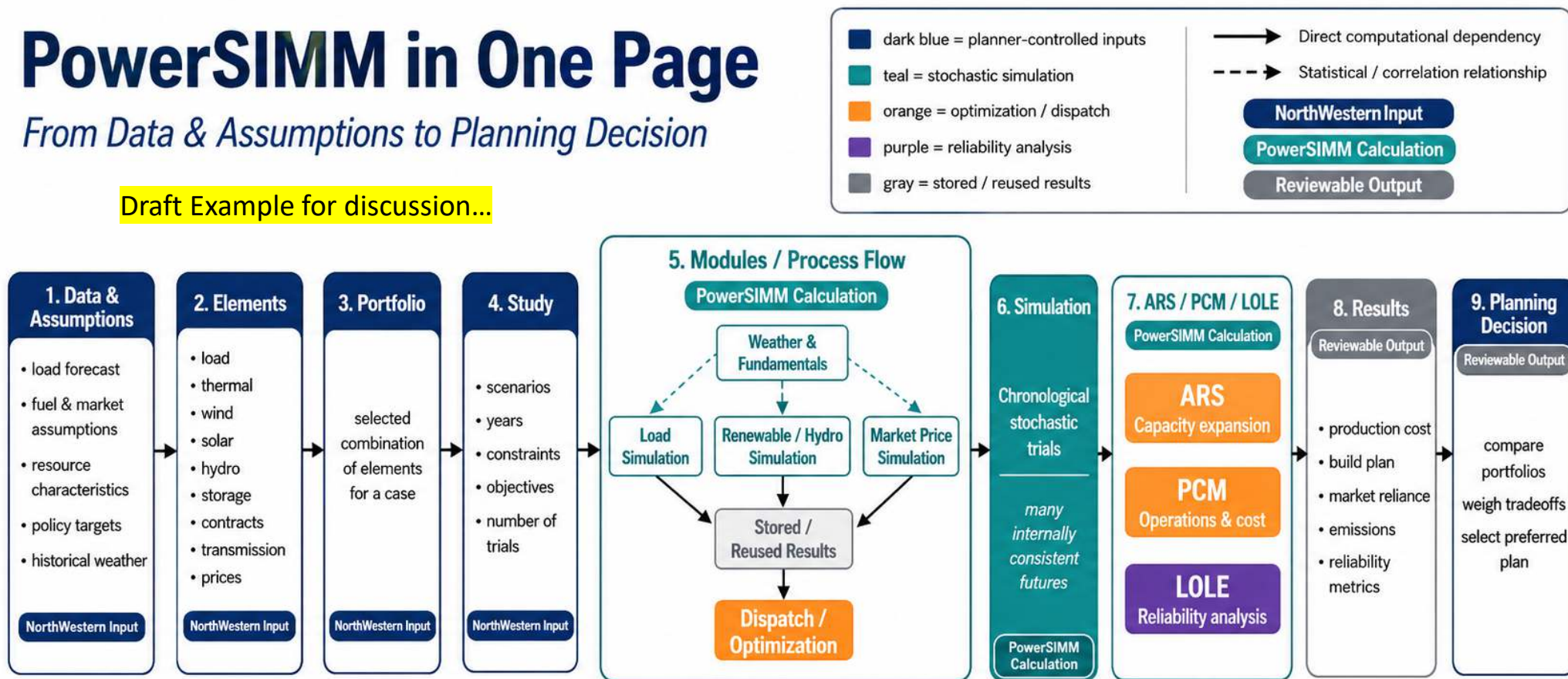


DRAFT (To be Updated)

PowerSIMM in One Page

From Data & Assumptions to Planning Decision

Draft Example for discussion...



DRAFT (To be Updated)



60-day extension

Why we will request a 60-day extension

- **We want to execute well and provide a transparent, verifiable response.**

Where ETAC input will help

Topic	Specific input requested
Local reliability	- Any thoughts or concerns with a local RA approach? - What are your thoughts on supplementing a local RA study in addition to WRAP (Need?, other thoughts)?
Portfolio risk	- Doing all scenarios is extensive. Do the current recommended scenarios test logical portfolio risk assumptions? - What are your thoughts on deterministic approaches vs. stochastic approaches?
Load forecast	Please provide any concerns
Demand response	Discussion
Transparency	Thoughts on suggested approach. Any alternatives? May need to review documentation.