Needs Assessment for Changing Hydro Operations Scenario

October 14, 2025

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Northwest **Power** and **Conservation** Council

Today's Discussion

- Sharing out the results from the needs assessment analysis conducted for the Changing Hydro Operations Scenario
  - How is the hydro system responding to the different operations described in the sensitivities?
  - How are the needs changing across the sensitivities?

- Main goals of today:
  - Use these insights to help inform the discussion around hydro operations taking place as part of the Fish and Wildlife Program amendment process
  - Provide a general sense of the size and shape of the needs for new resources, and how staff will use this information to help guide resource optimization modeling for the region

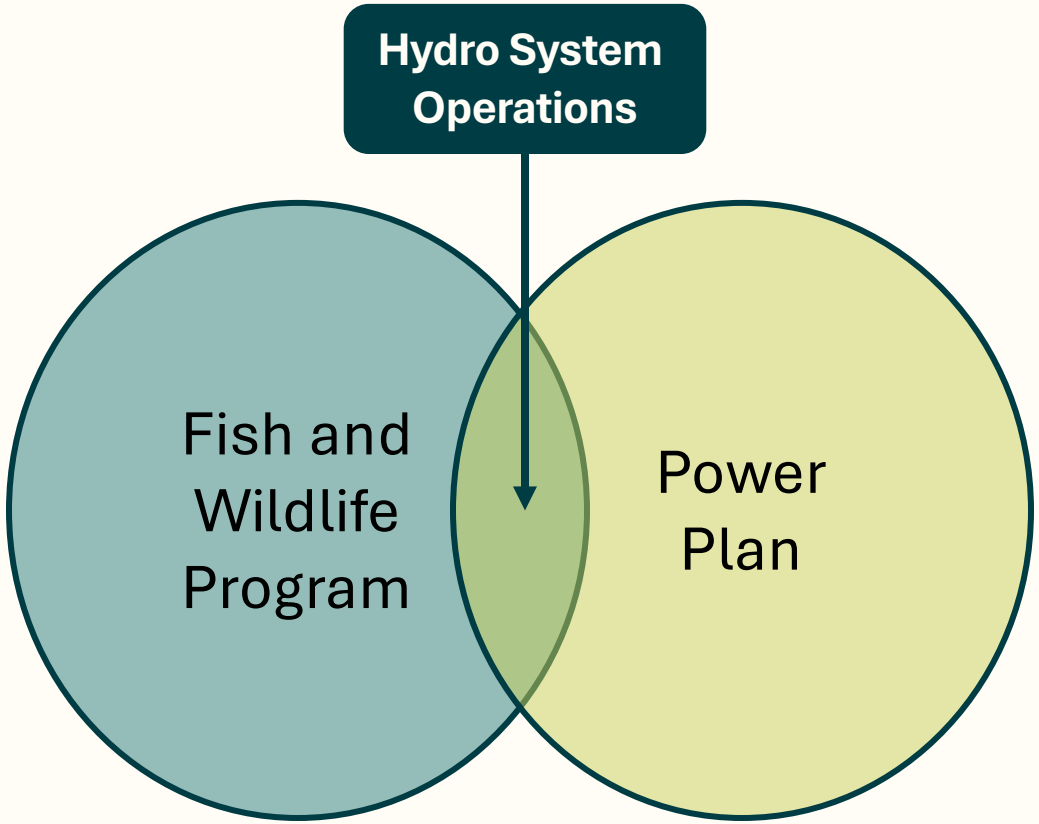
Discussion Outline:

1. Reminder of Scenario
2. Operational Differences Across Sensitivities
3. Reminder of Role of Needs Assessment
4. Needs Assessment Results
5. Timeline and Next Steps

Northwest **Power** and **Conservation** Council

Remember: Hydro System Operations is a Key Nexus in the Council's Work

Program based on recommendations, including operational changes to the hydro system for the benefit of fish. In doing so, the program must ensure the region can maintain an adequate, efficient, economical, and reliable power supply.



Power plan puts forward a scheme for resources to meet or reduce Bonneville's obligation, including its ability to implement the Council F&W program. This recognizes that there may be changes to operations for fish that require new resources.

Overlap in circles is bigger than it appears!

How Will This Scenario Support the Council's Work?

What this analysis does:

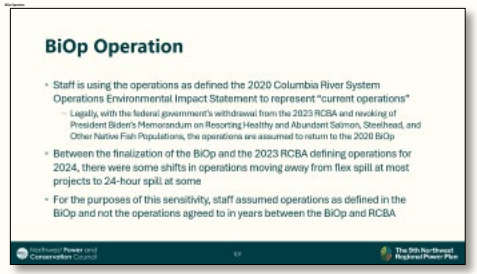
- Provides information on how different hydro system operations change power system needs
- Provides a **piece of information** to inform the Council's decision making on:
  - Recommendations into the Fish and Wildlife Program Amendment process
  - New resource recommendations included in the Ninth Power Plan

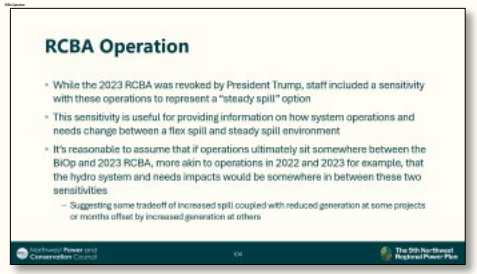
What this analysis does not do:

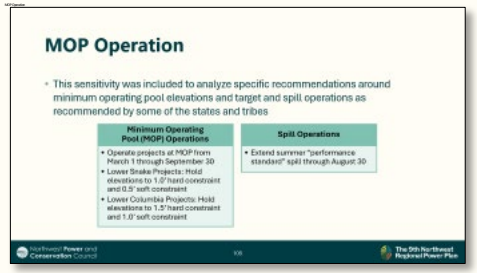
- Lock the Council into including any specific recommendations in the Fish and Wildlife Program
  - Power system impacts are only one piece of the many factors the Council will consider when deciding on the Fish and Wildlife Program
- Provide all the information needed to inform the Ninth Power Plan

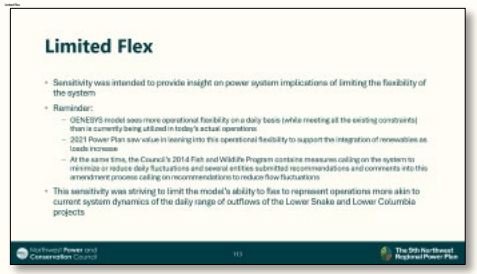
Reminder of Four Sensitivities

2020 BiOp "Flex Spill" Operation	Assuming operations based on the 2020 CRSO EIS to represent "current operations" and provide a basis for comparison
2023 RCBA Operation	Given uncertainty around 2026 operations, using RCBA defined operations to represent a "steady spill" option
Recommended MOP Targets	Analyzing specific minimum operating pool elevations and limits and spill operations recommended by some of the states and tribes
Limited Flex Operation	Analyzes power system implications of limiting the hydro system's ability to change daily elevations and outflows









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Council's GENESYS Model

- GENESYS model serves two important purposes in our system modeling:
  - Assess the region's resource adequacy across a range of future conditions
  - Provides insights on hydro system operations
- Key notes about the model:
  - Multi-stage decision making model that co-optimizes energy and reserves while accounting for fuel use, forecast error and system constraints.
  - Seeks to meet all the system requirements for energy, capacity, and ancillary services while also adhering to all the other resource operating constraints, including operations for fish and wildlife, flood control, etc.
- Keep in mind that while the model aims to capture representative operations, balancing operational level detail with planning, the model is tuned for adequacy specifically

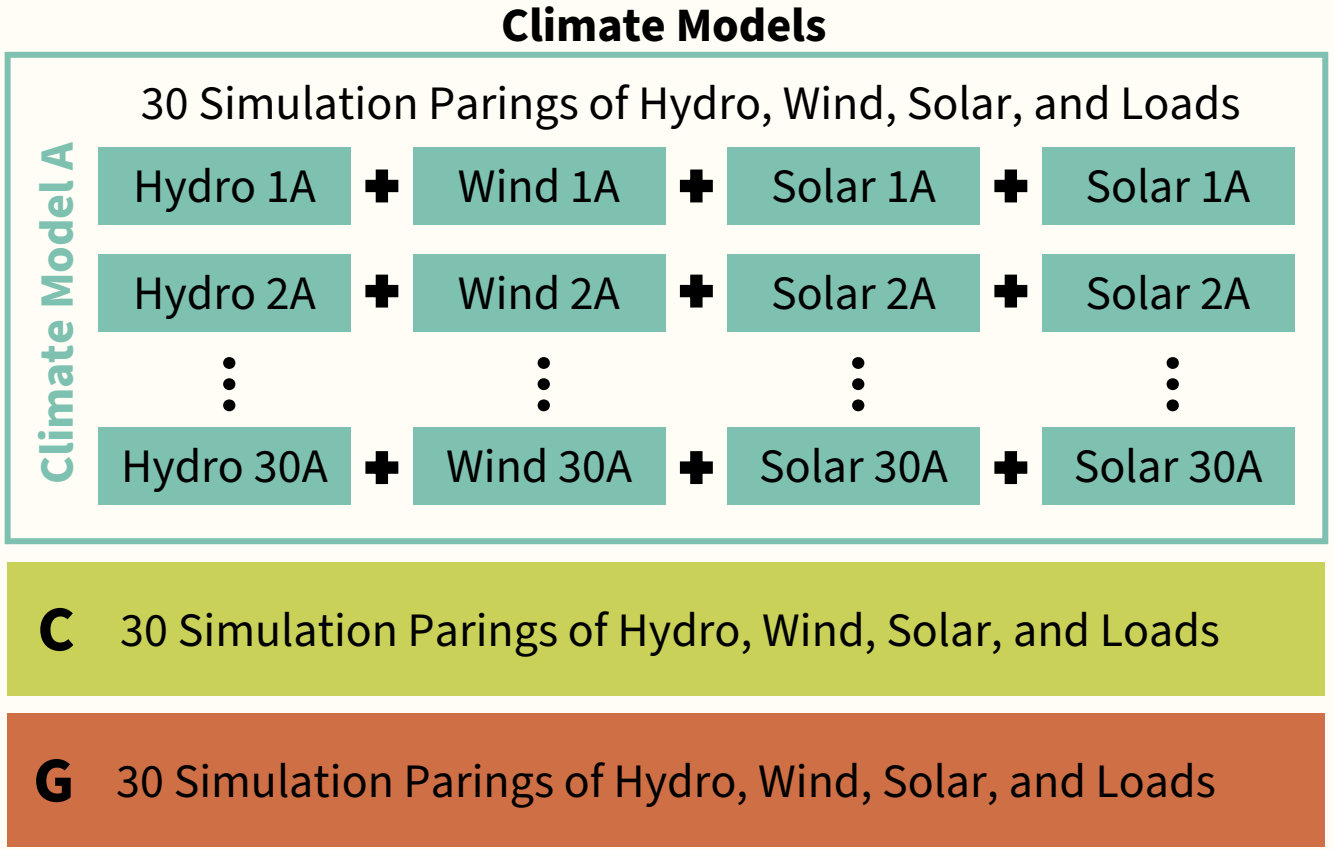
GENESYS Modeling Uses These Data Sources

Council's Fish and Wildlife Program	Biological Opinion (BiOps)	Water Management Plan	Fish Operations Plan
Fish Passage Plan	Columbia River Treaty	Assured Operating Plan	Resilient Columbia Basin Agreement – Appendix B*
Detailed Operating Plan	State and Provincial Energy & Environmental Departments	Project licenses	Utility operators

*RSBA Appendix B is used for some studies, not all.

Underlying Assumptions of Needs Assessment

- The needs assessment is a 2031 study that assesses a range of hydro conditions, loads, and wind profiles, all of which are connected based on the Council's three climate models
- This results in 90 different simulation years

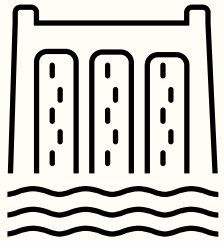


Climate model key: A = CanESM; C = CCSM; G = CNRM
More info: https://www.nwcouncil.org/fs/18943/2024_10_2.pdf

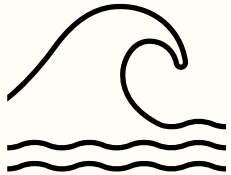
What's Consistent Across Sensitivities?

- Hydro operations as defined across these data sources are the basis for all modeling, including:
  - Operations as defined in the BiOps
  - Current Canadian River Treaty operations based on Agreement in Principle
  - Requirements for flood control, recreation, transportation, etc.
- These sources define requirements such as flows, operating range and elevation targets, minimum generation requirements, spill, etc.
- Assumed operational requirements for all projects beyond the lower Columbia and lower Snake
- All sensitivities use the same climate model informed hydro conditions

Multiple Obligations

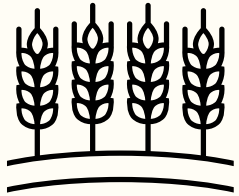


Hydropower

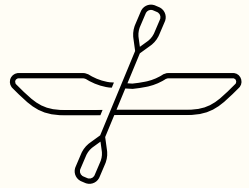


Flood control

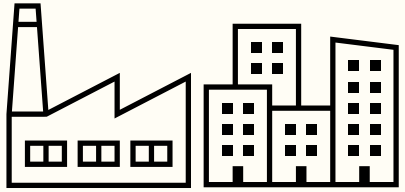
Fish passage & protection



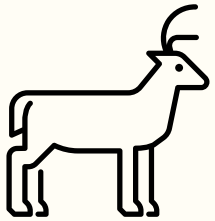
Irrigation



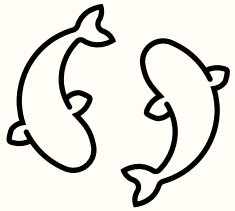
Recreation



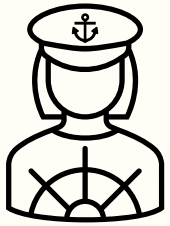
Municipal & industrial use



Wildlife habitat



Native American cultural resources



Navigation routes

Water quality & temperature

What's Changing Across Sensitivities?

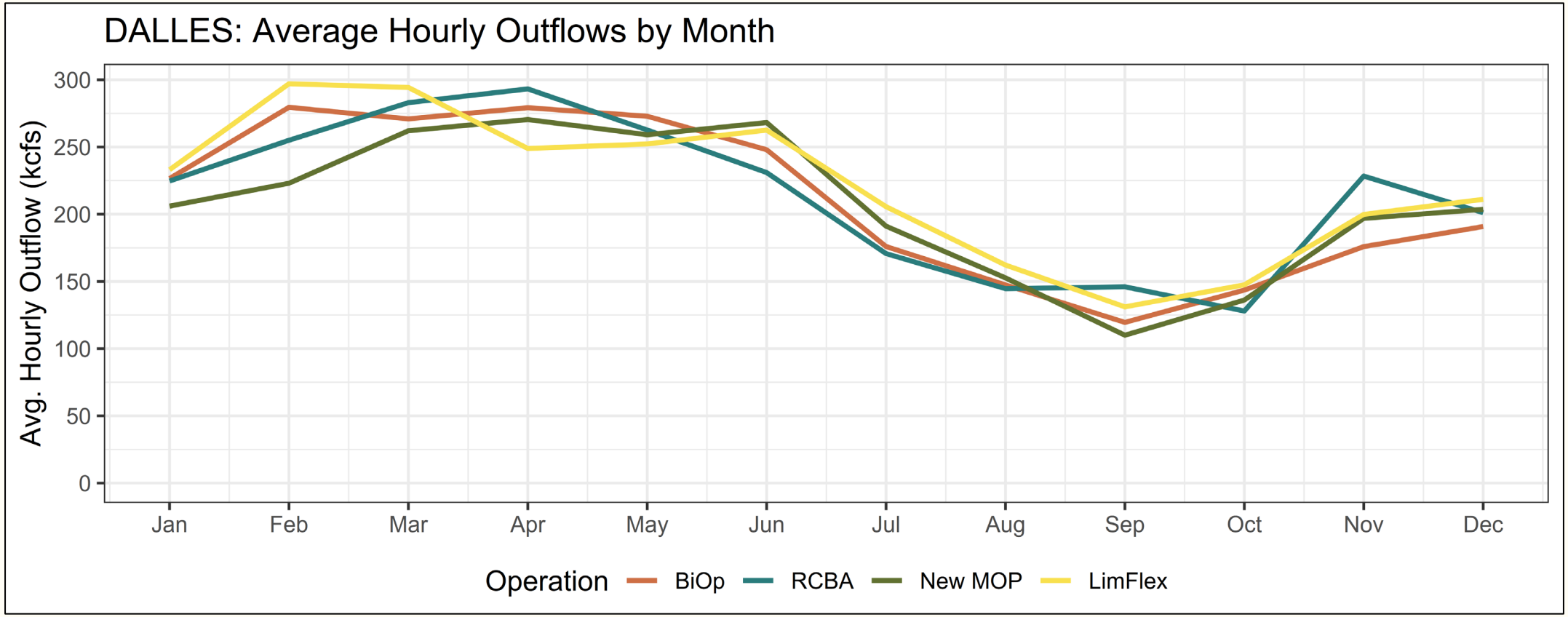
- All changes to operations in the scenario are focused on operations at the lower Columbia projects and the lower Snake projects
- Changing assumptions are connected to operations for fish and wildlife and are intended to have minimal to no impacts on other users
- These include:
  - Spill regime: There are different assumptions regarding the timing of spill and the amount of spill that change across the different sensitivities
  - Elevations: Setting target pool elevations for a portion of the year and/or otherwise limiting swings in elevation changes
  - Flows: Setting limitations to the daily fluctuations in flows

Modeling Changes to Lower Columbia and Lower Snake

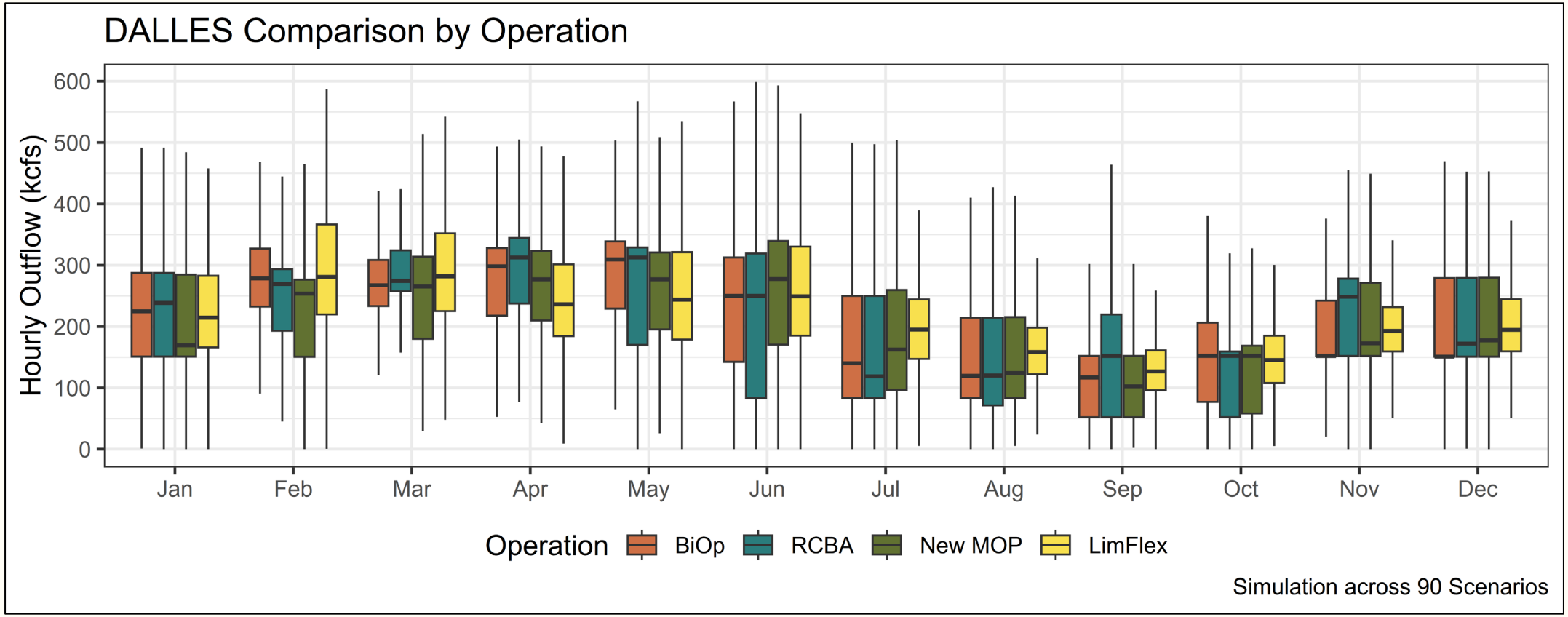
Sensitivity	Min Elevation	Elevation Target Sof-Constraint	Elevation Target Hard Constraint	Spill	Outflow Ramp	Reserves Allocation
2020 BiOp	2025 Water Management Plan (WMP)			BiOp spill	2025 WMP	Existing
2023 RCBA				RCBA spill	2025 WMP	Existing
New MOP & Spill	2025 WMP	+1 lower Columbia + 0.5 Lower Snake	+1.5 lower Columbia + 1 Lower Snake	RCBA spill with Aug 30 date	2025 WMP	Existing
Limited Flex	2025 WMP			BiOp Spill	2020-2024 avg.	Half

Modeled Hydro Operations: The Dalles

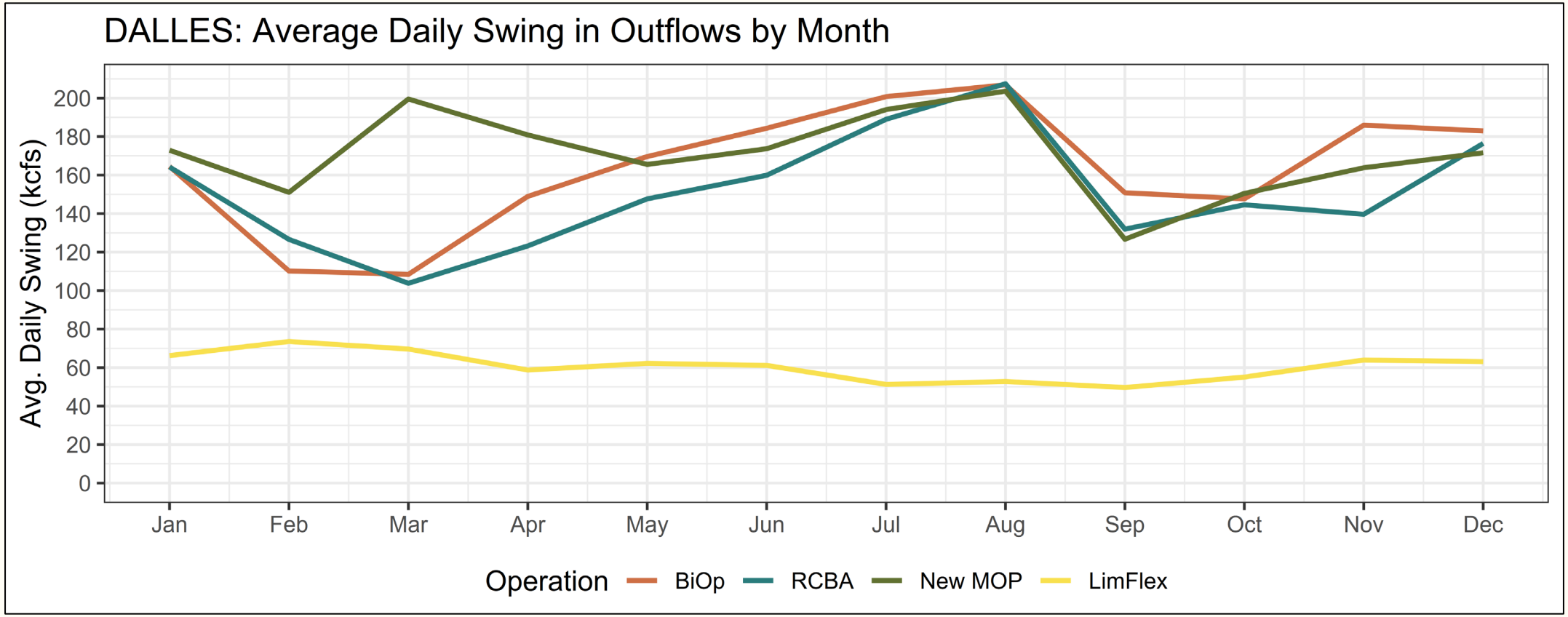
The Dalles: Average Hourly Outflows



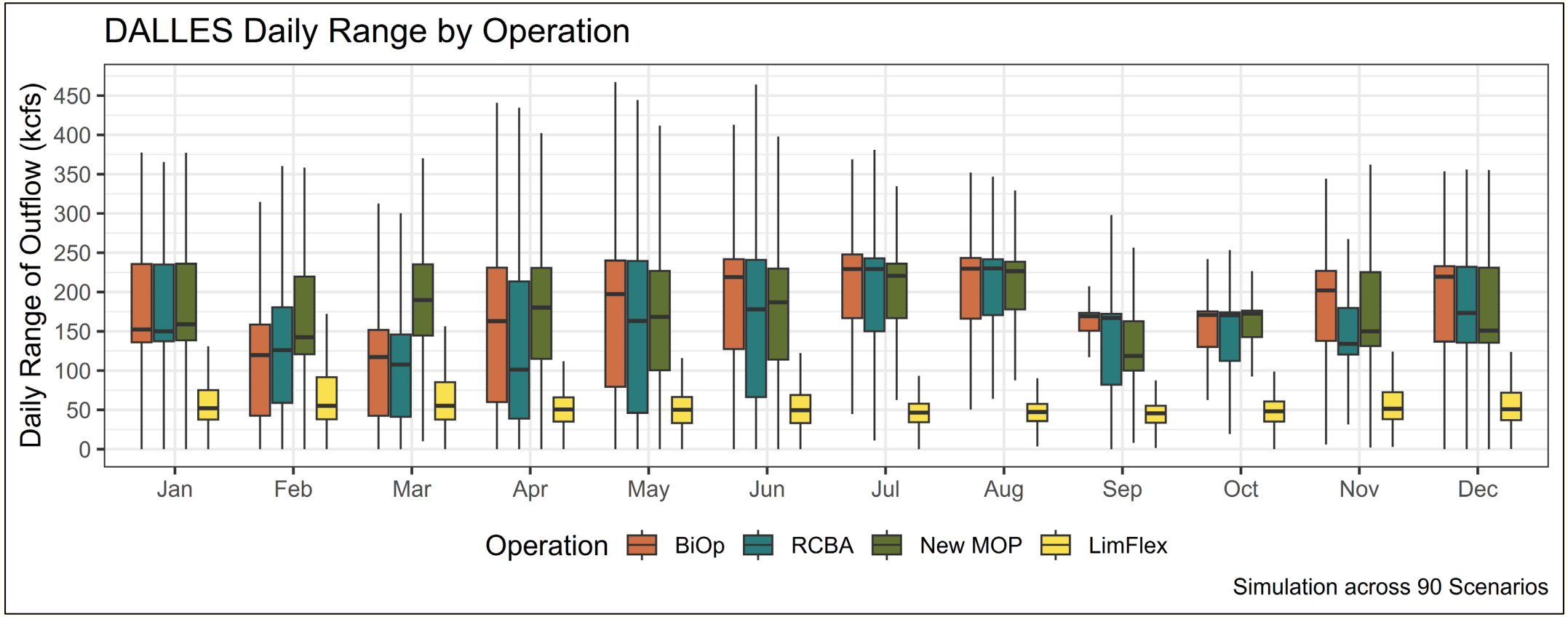
The Dalles: Hourly Outflows



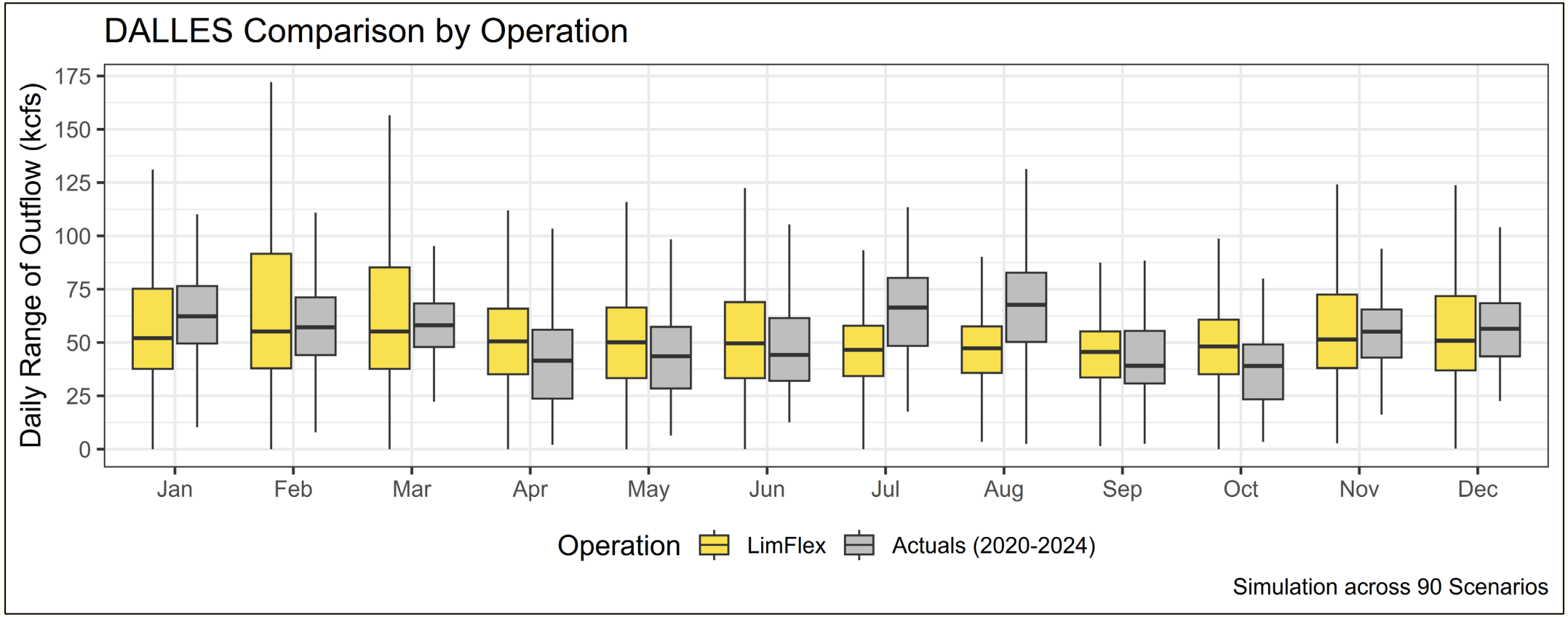
The Dalles: Average Daily Swing



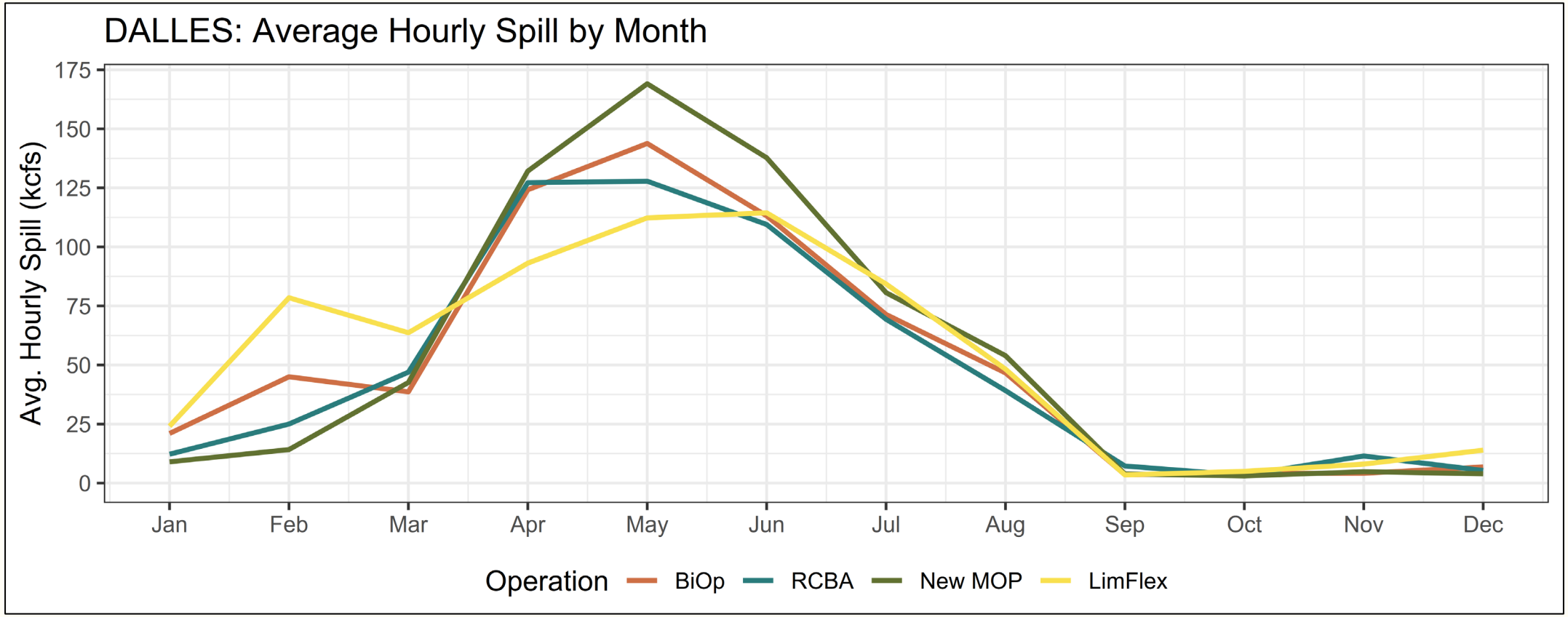
The Dalles: Daily Swing in Outflows



The Dalles Daily Outflow Range
Comparison of Limited Flex to 2020-2024 Actuals

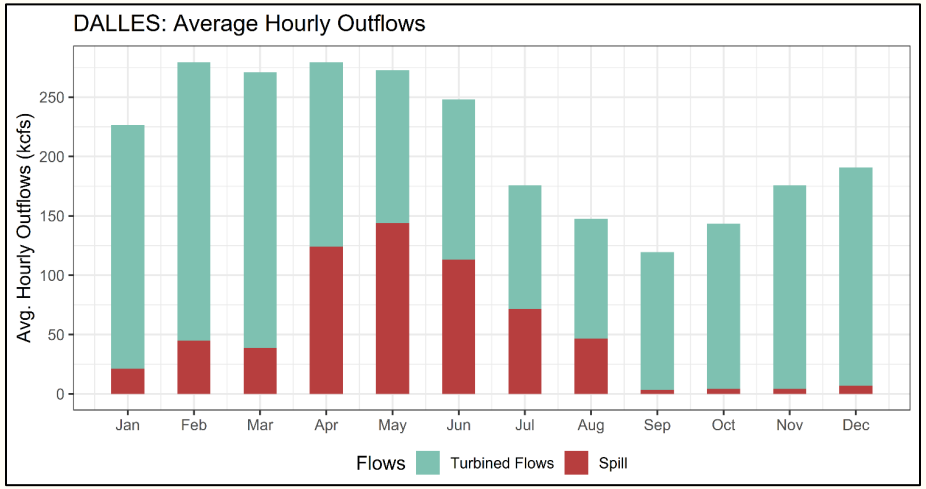


The Dalles: Average Hourly Spill



The Dalles: Spill Portion of Total Outflows

BiOp



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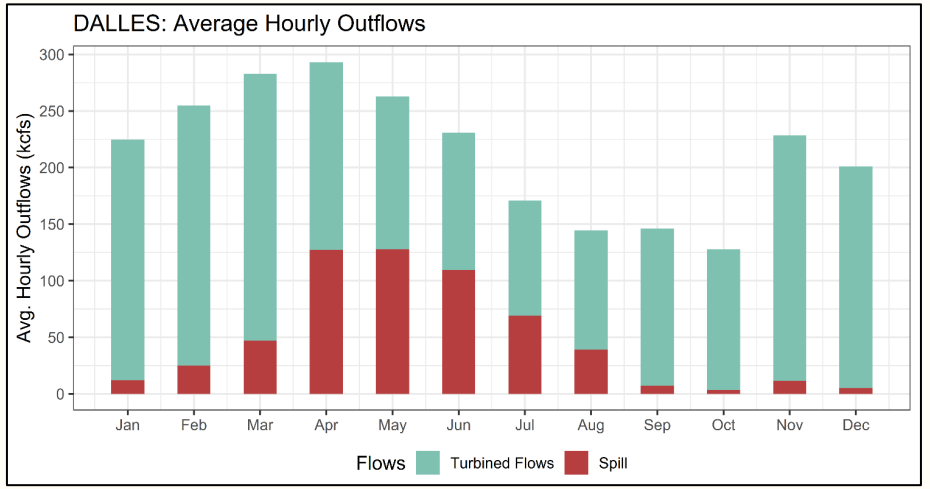
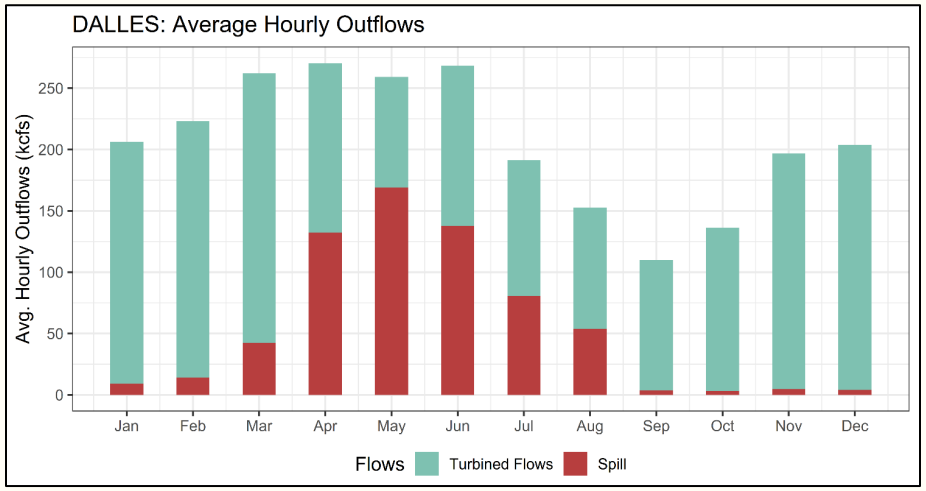
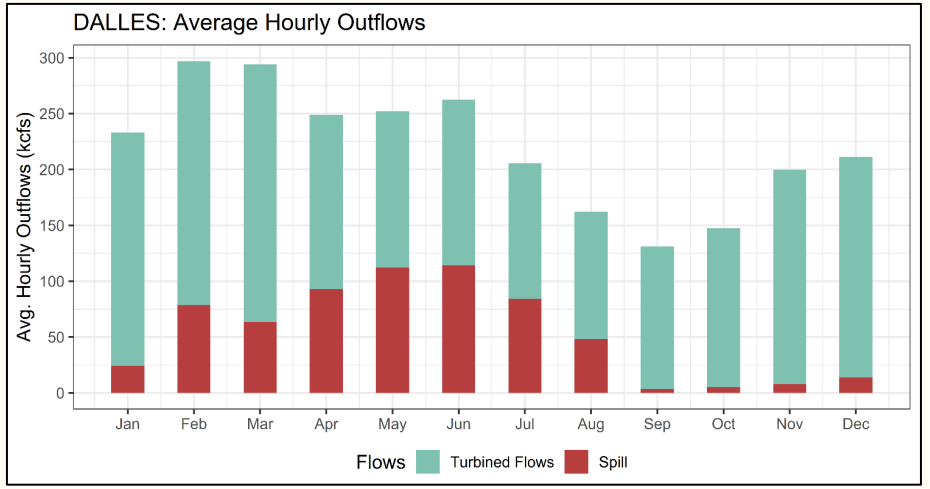


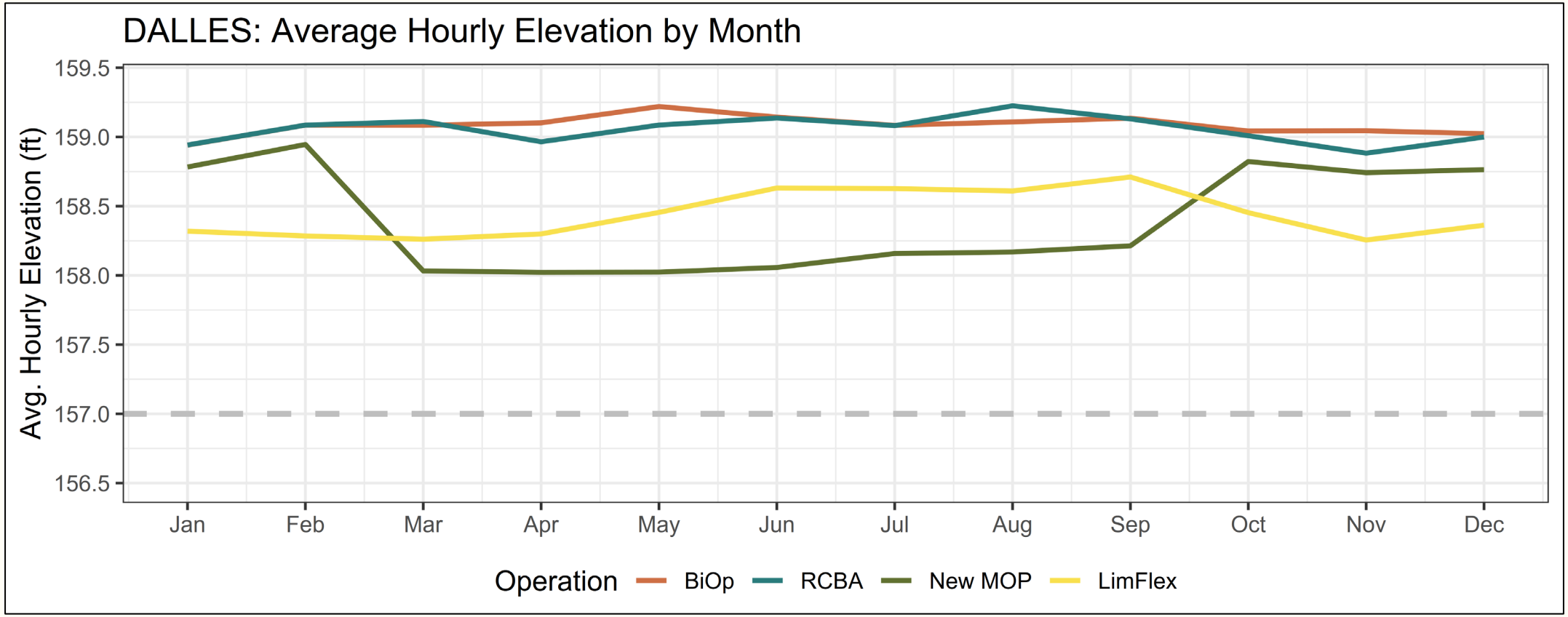
New MOP Op



Limited Flex



The Dalles: Average Hourly Pool Elevations



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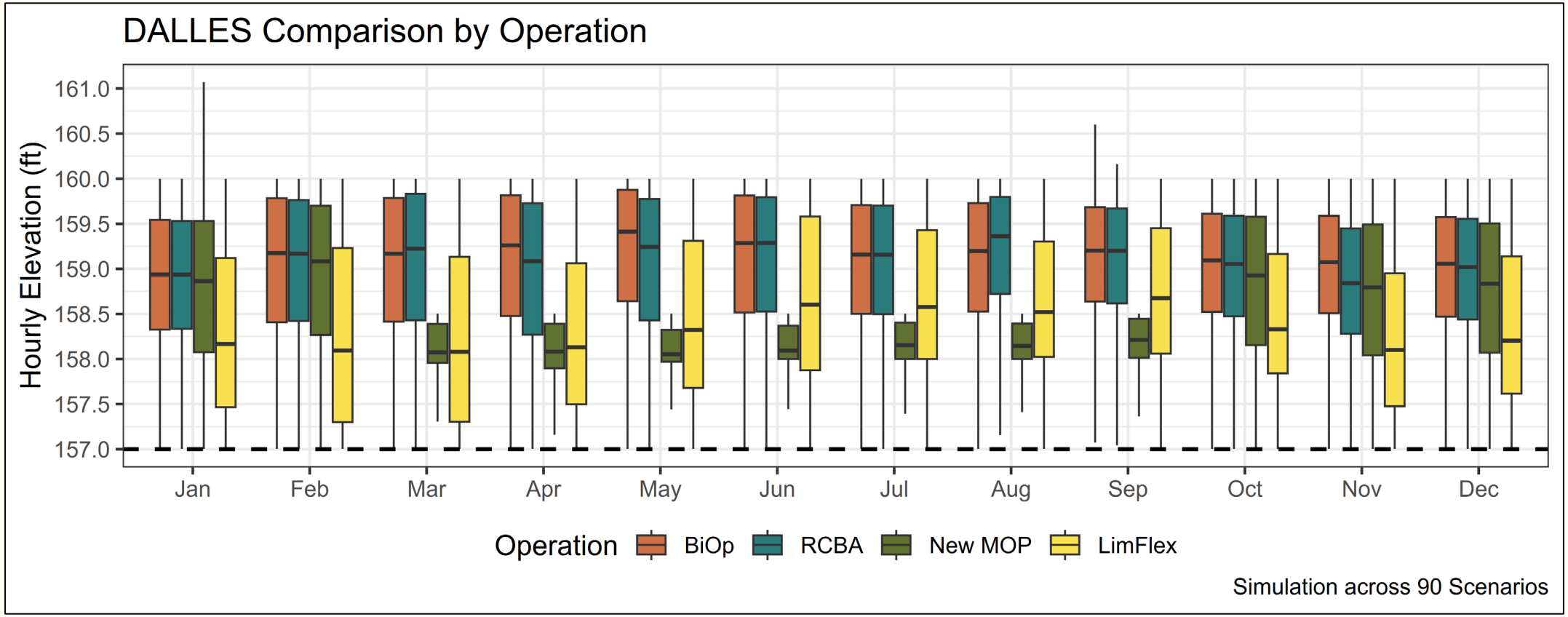
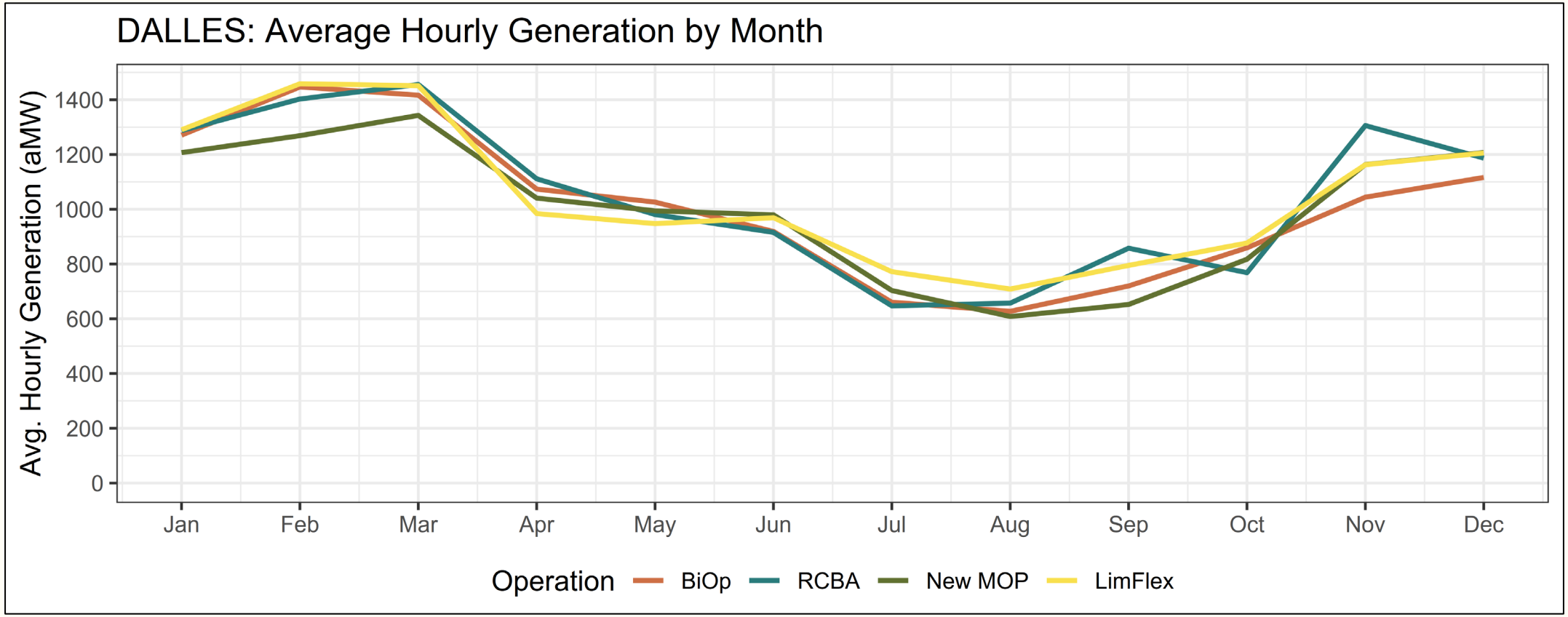
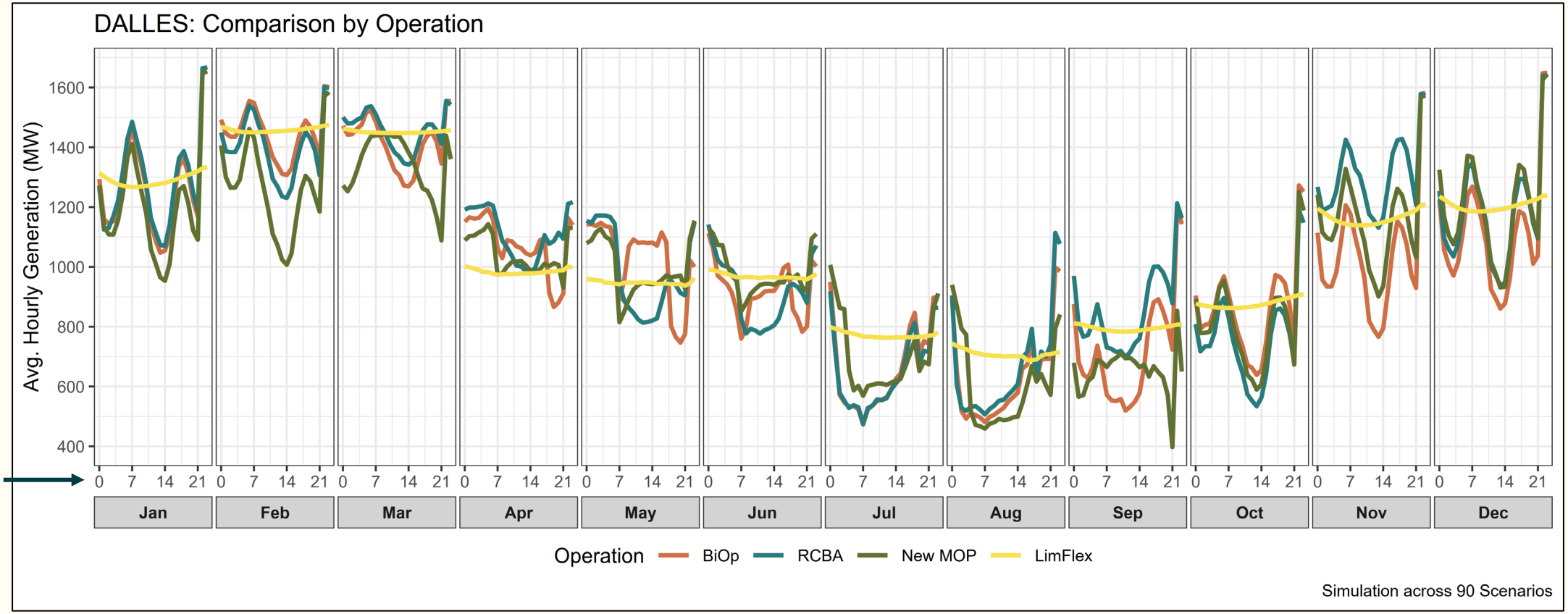


The Dalles: Average Hourly Generation (by month)

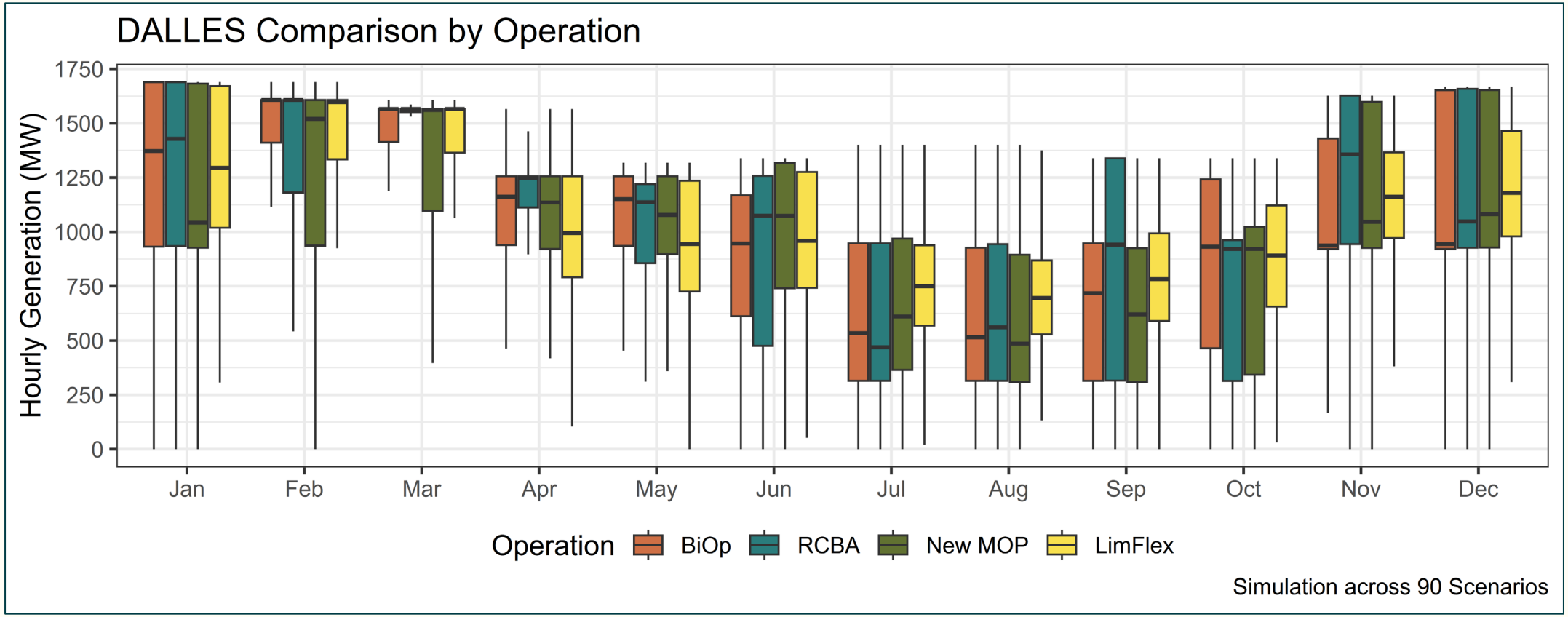


The Dalles: Average Hourly Generation (by hour)



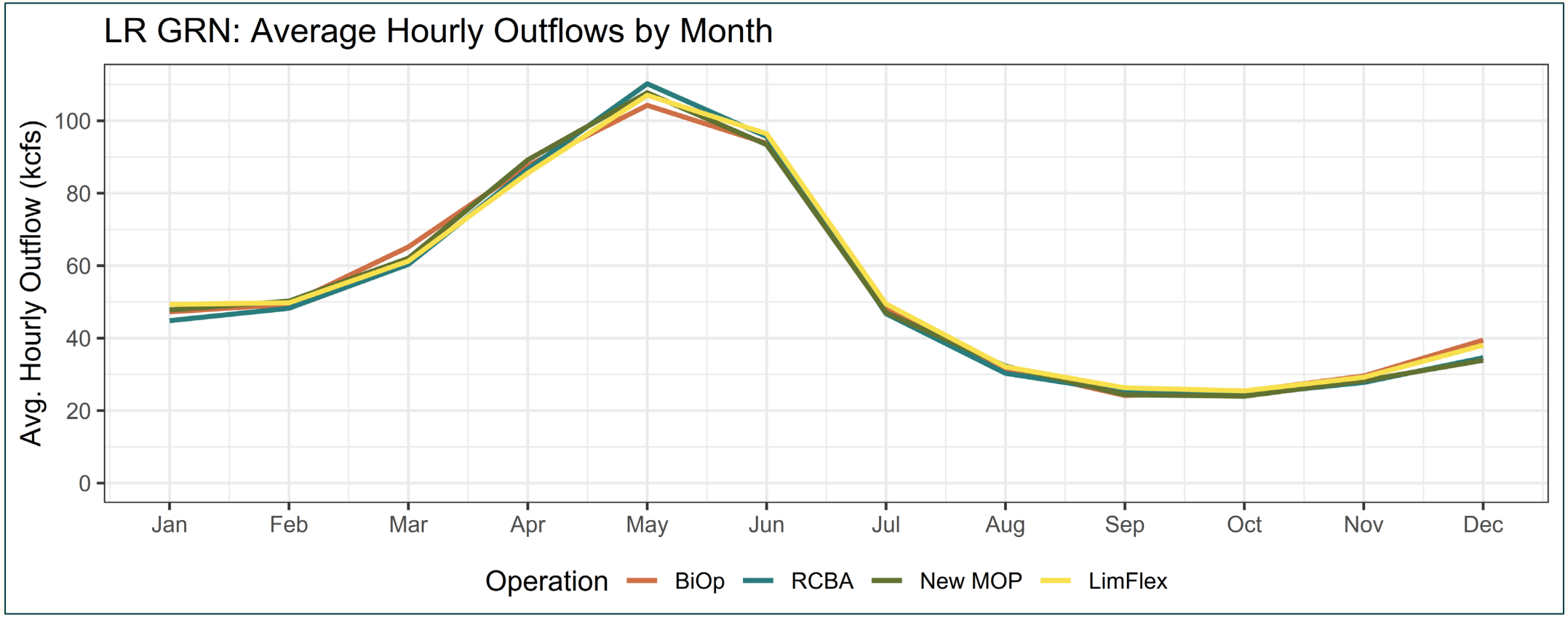
Hours →

The Dalles: Hourly Generation

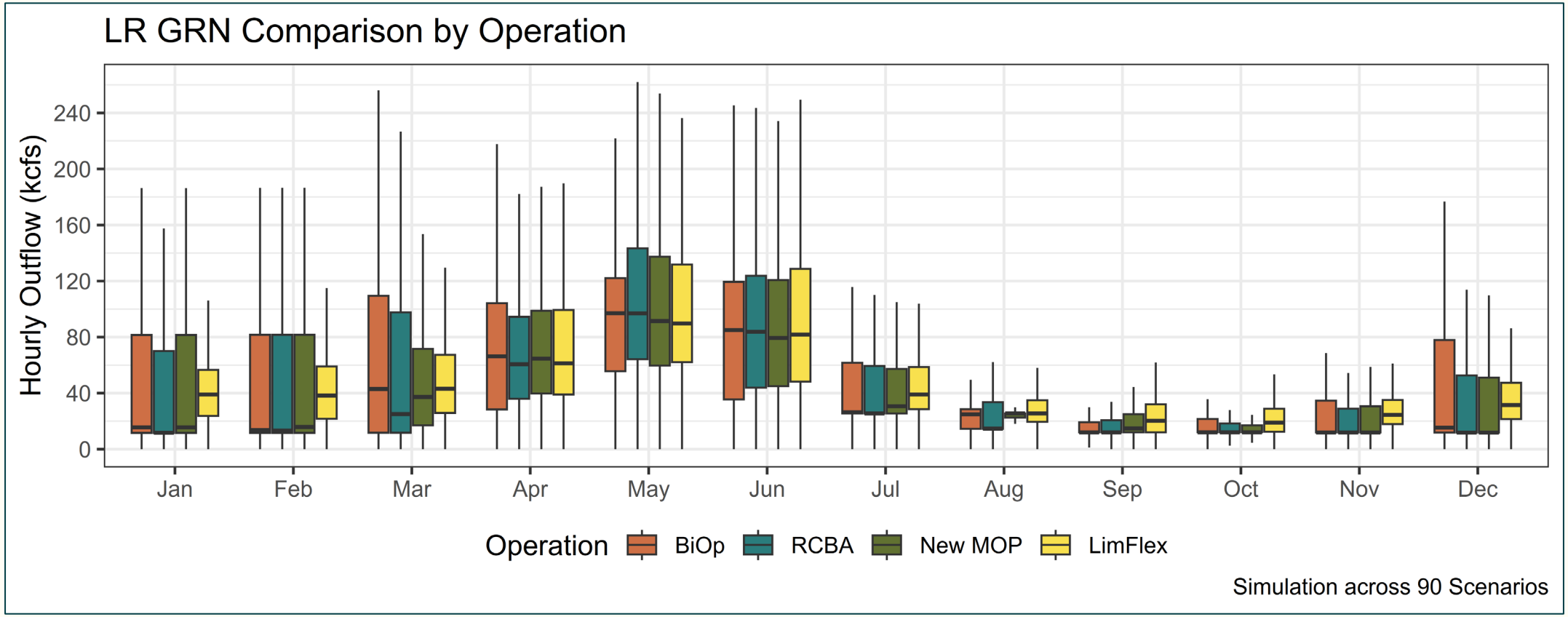


Modeled Hydro Ops: Lower Granite

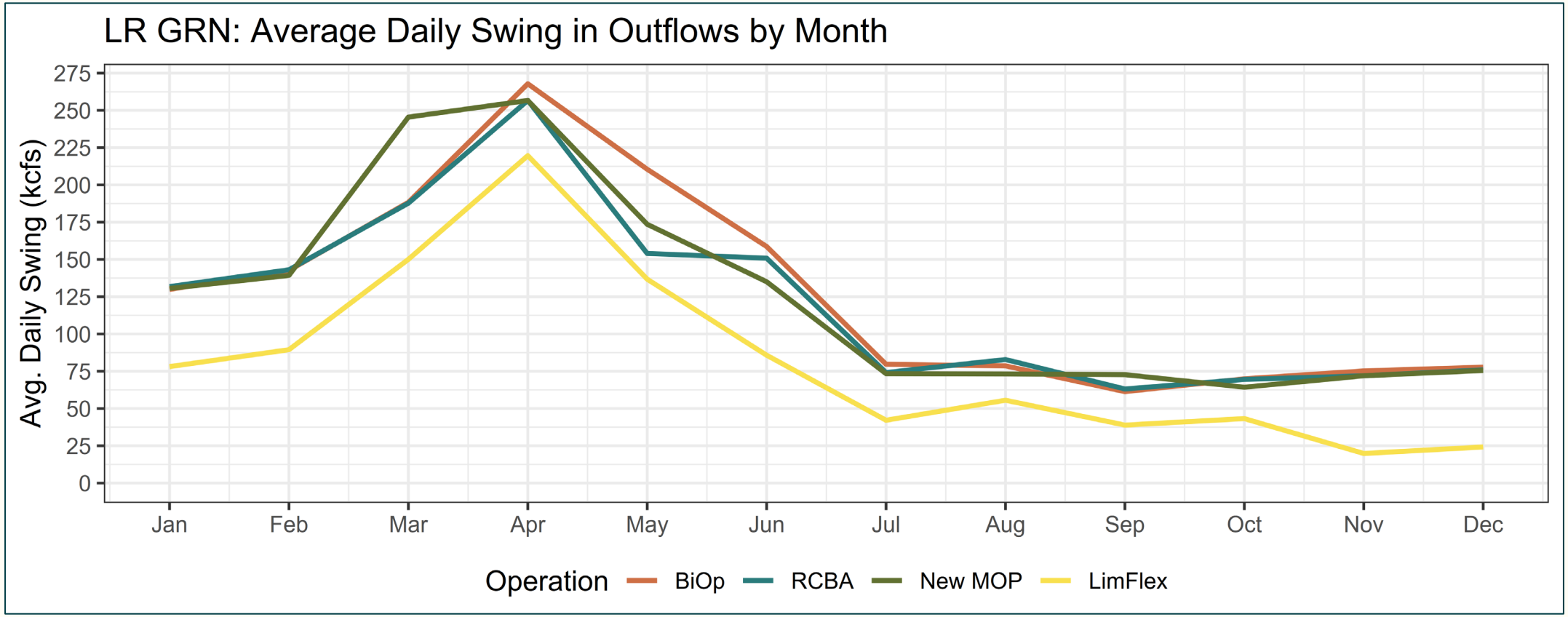
Lower Granite: Average Hourly Outflows



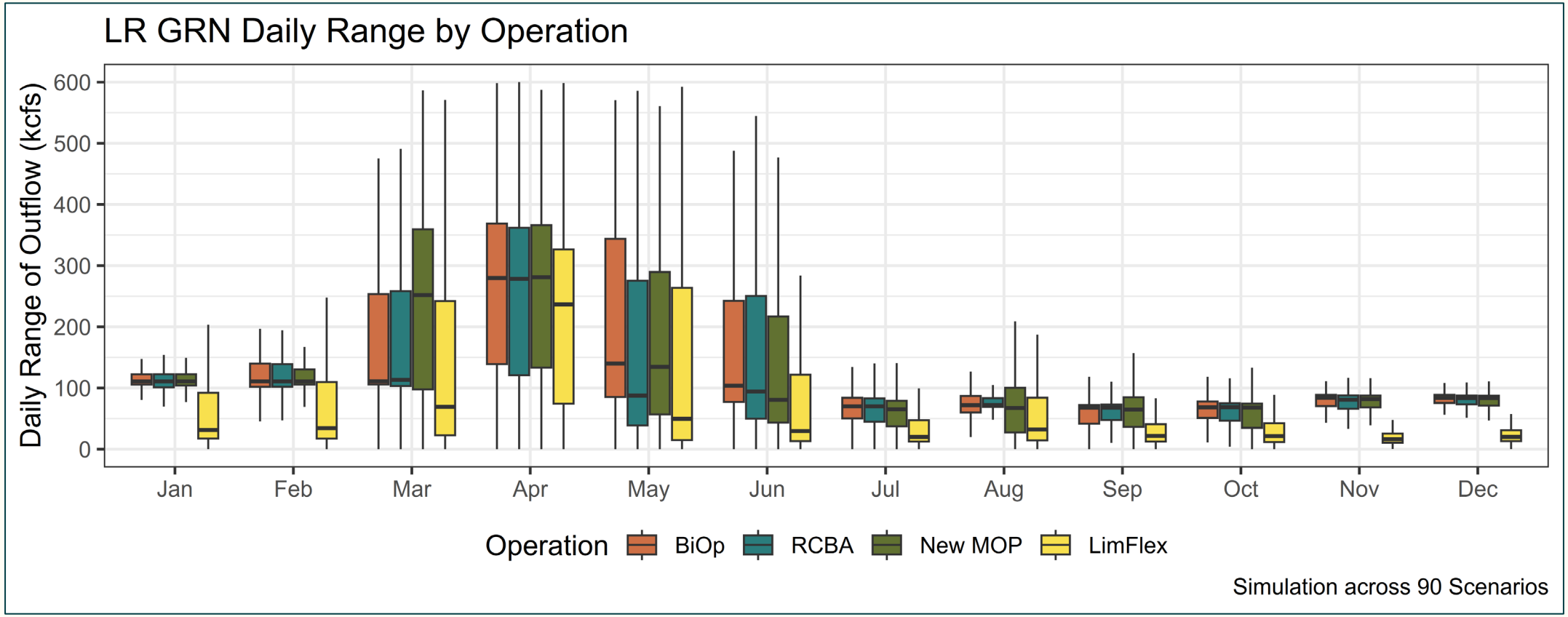
Lower Granite: Hourly Outflows



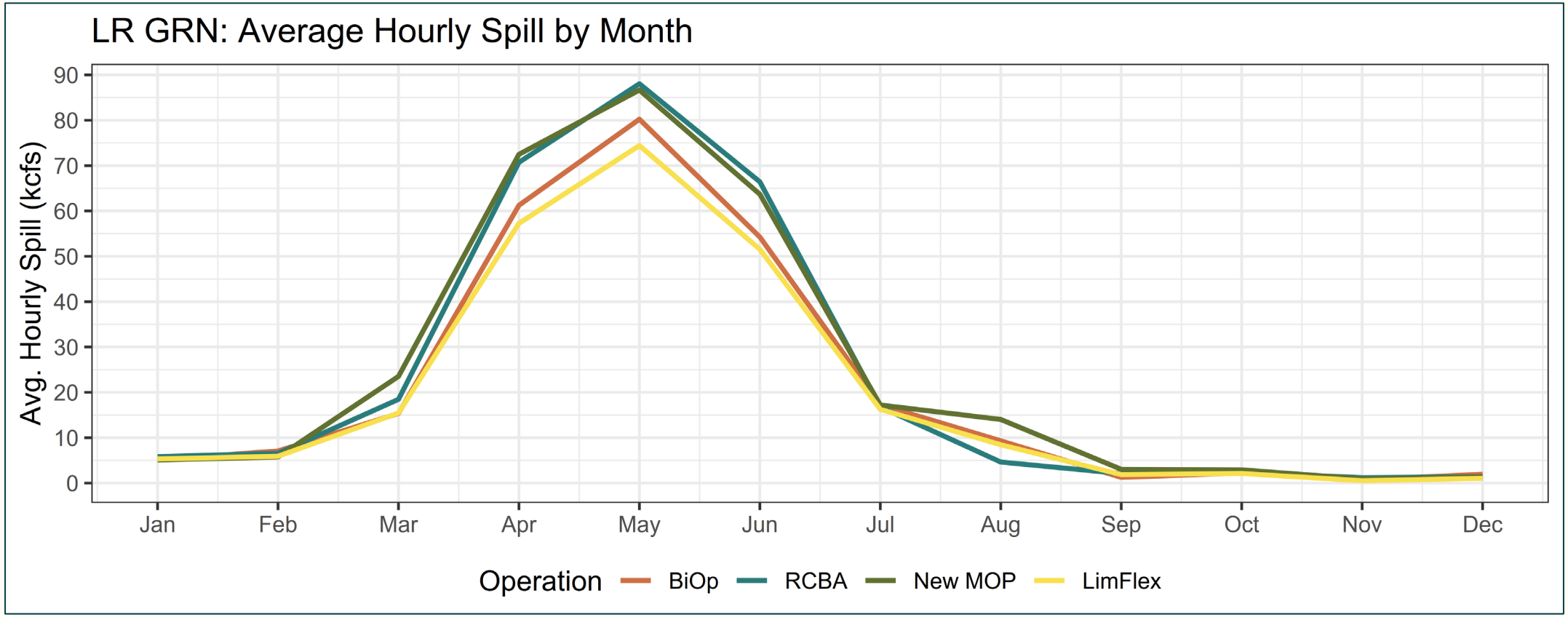
Lower Granite: Average Daily Swing



Lower Granite: Daily Swing in Outflows

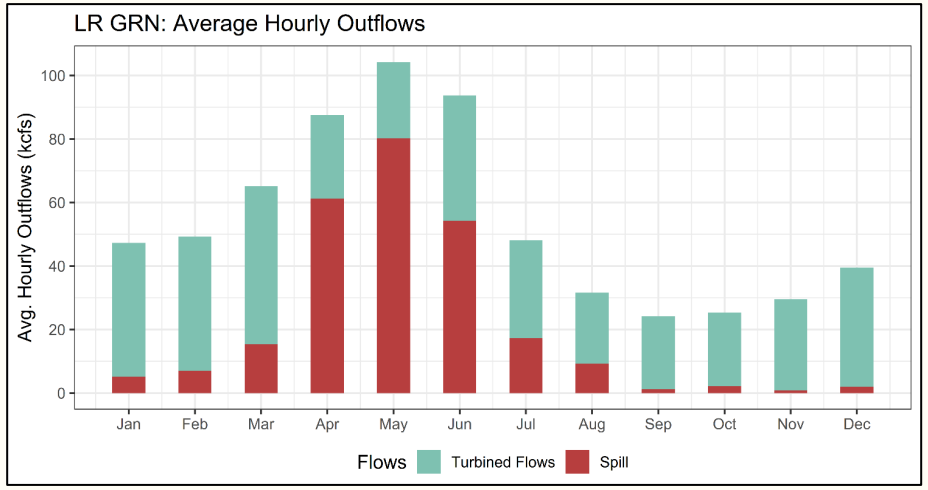


Lower Granite: Average Hourly Spill

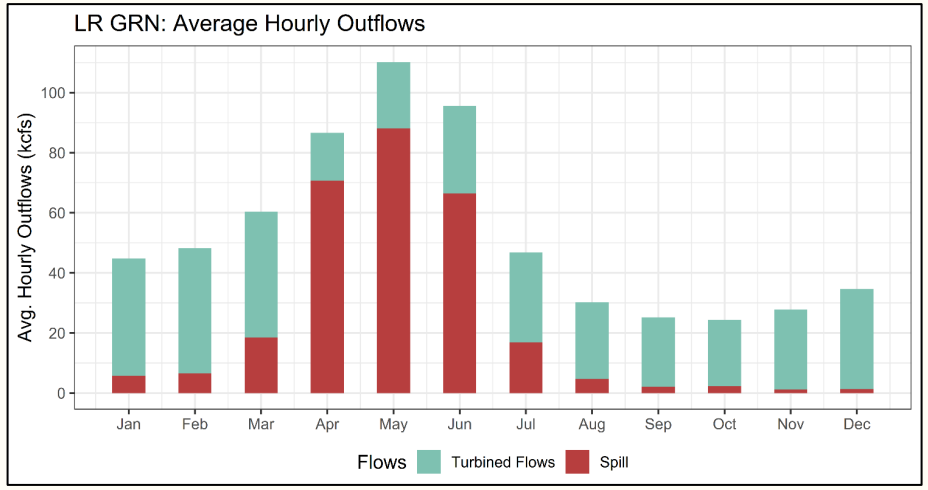


Lower Granite: Spill Portion for BiOp

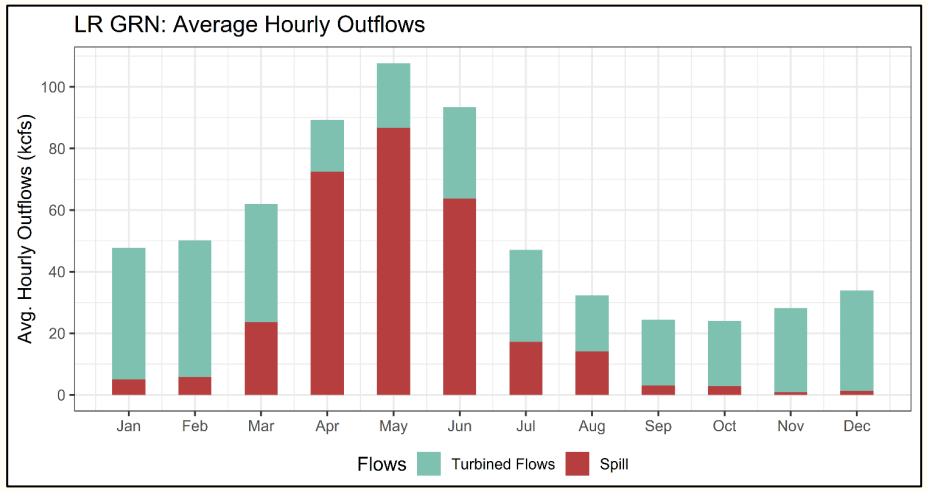
BiOp



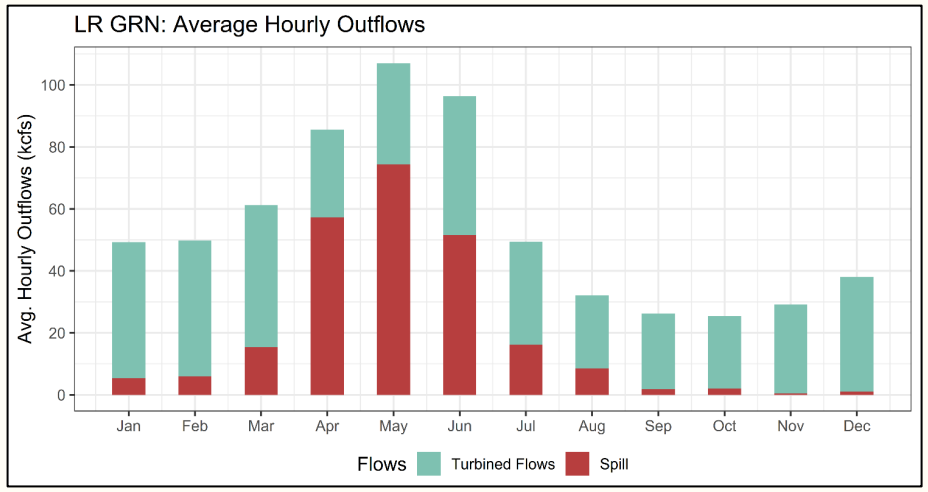
RCBA



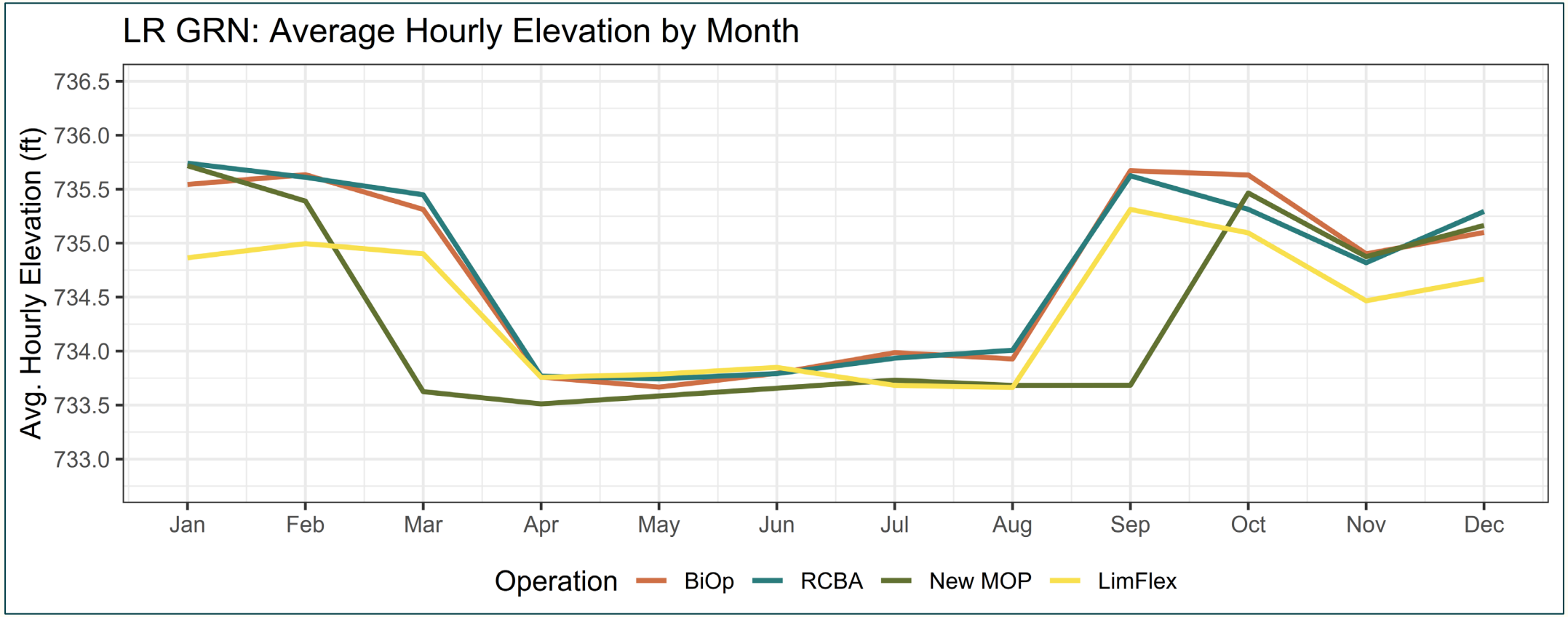
New MOP Op



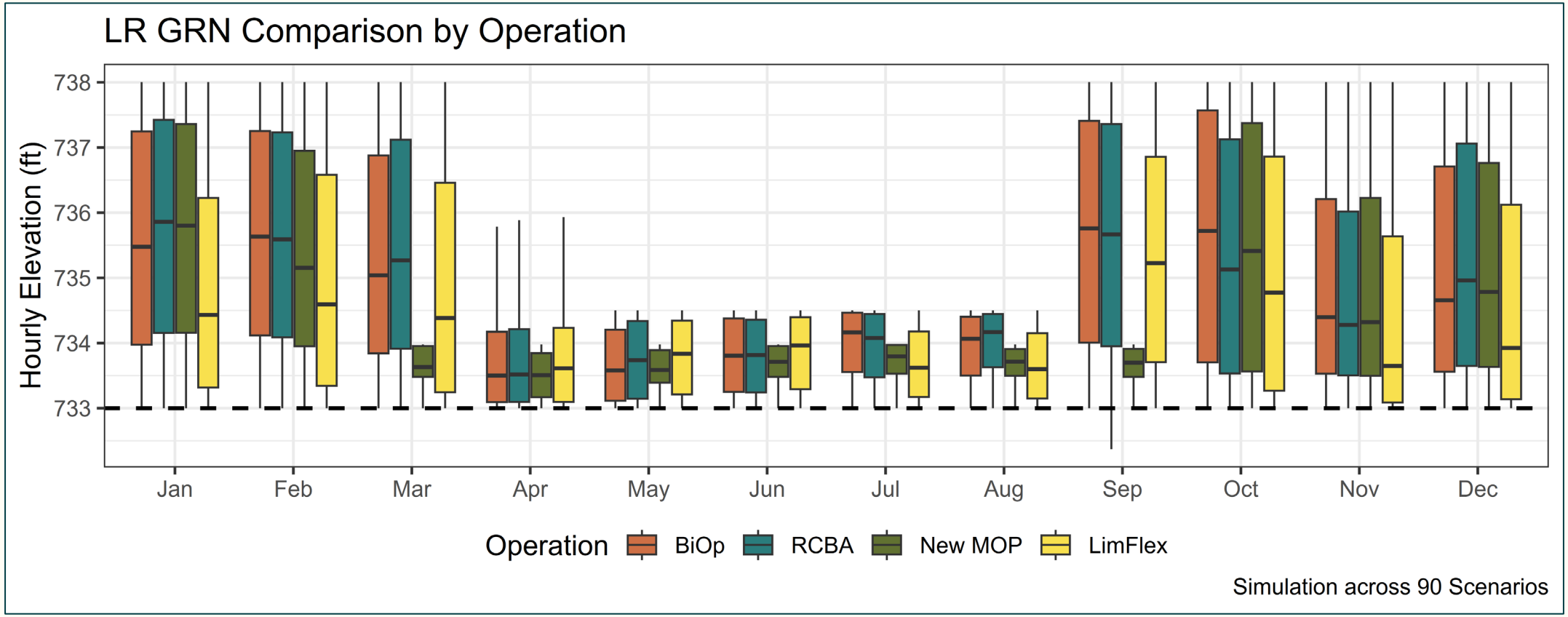
Limited Flex



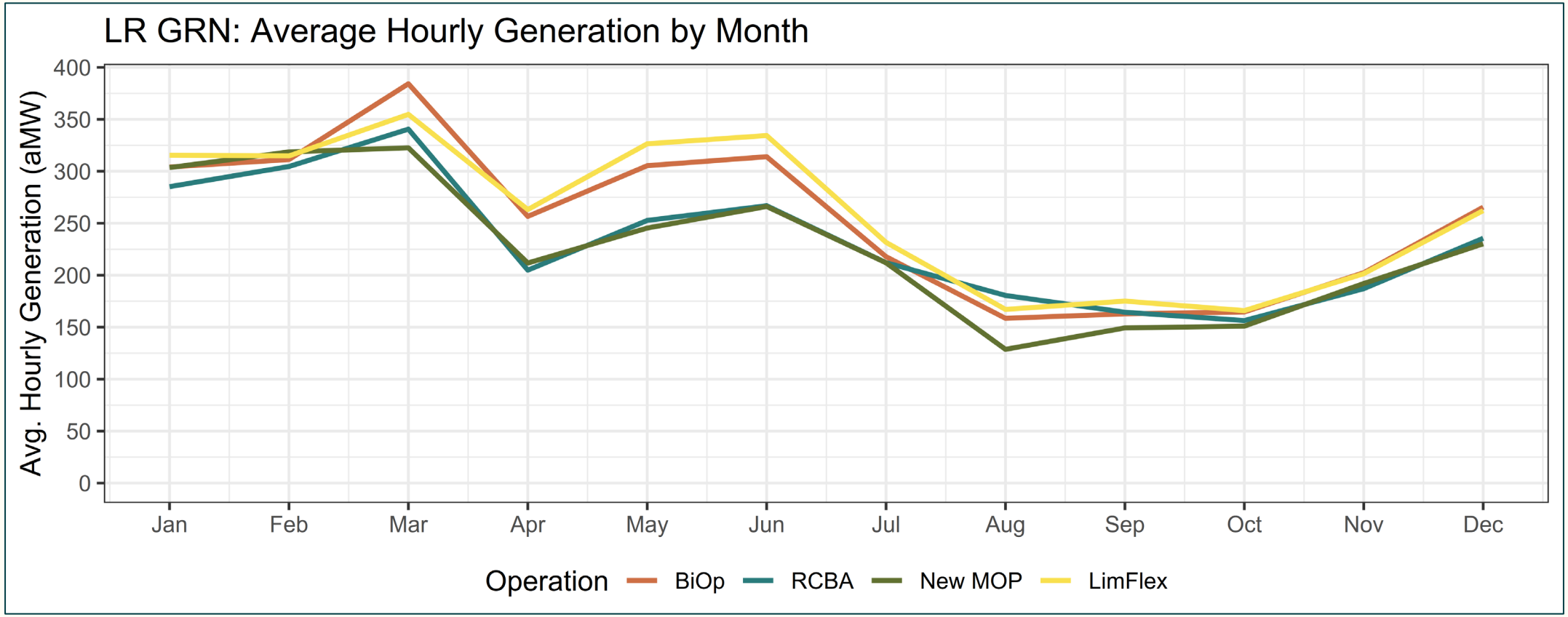
Lower Granite: Average Hourly Pool Elevations



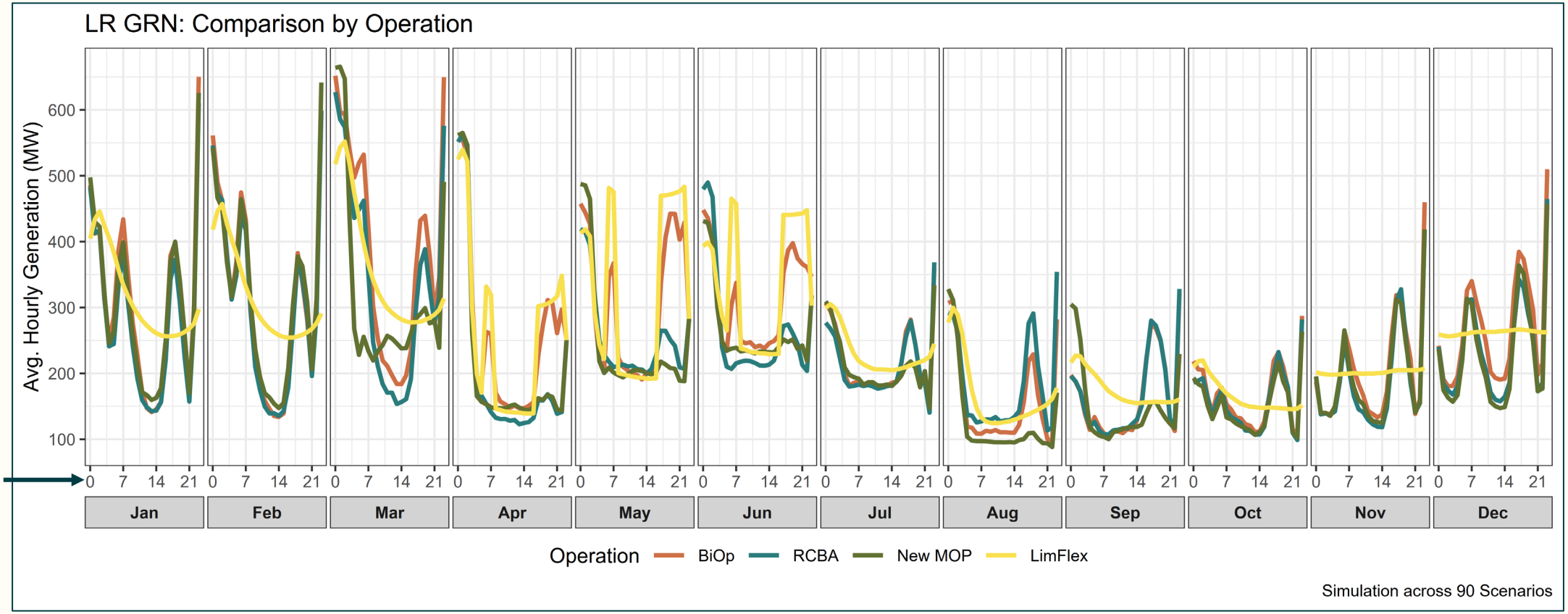
Lower Granite: Pool Elevations



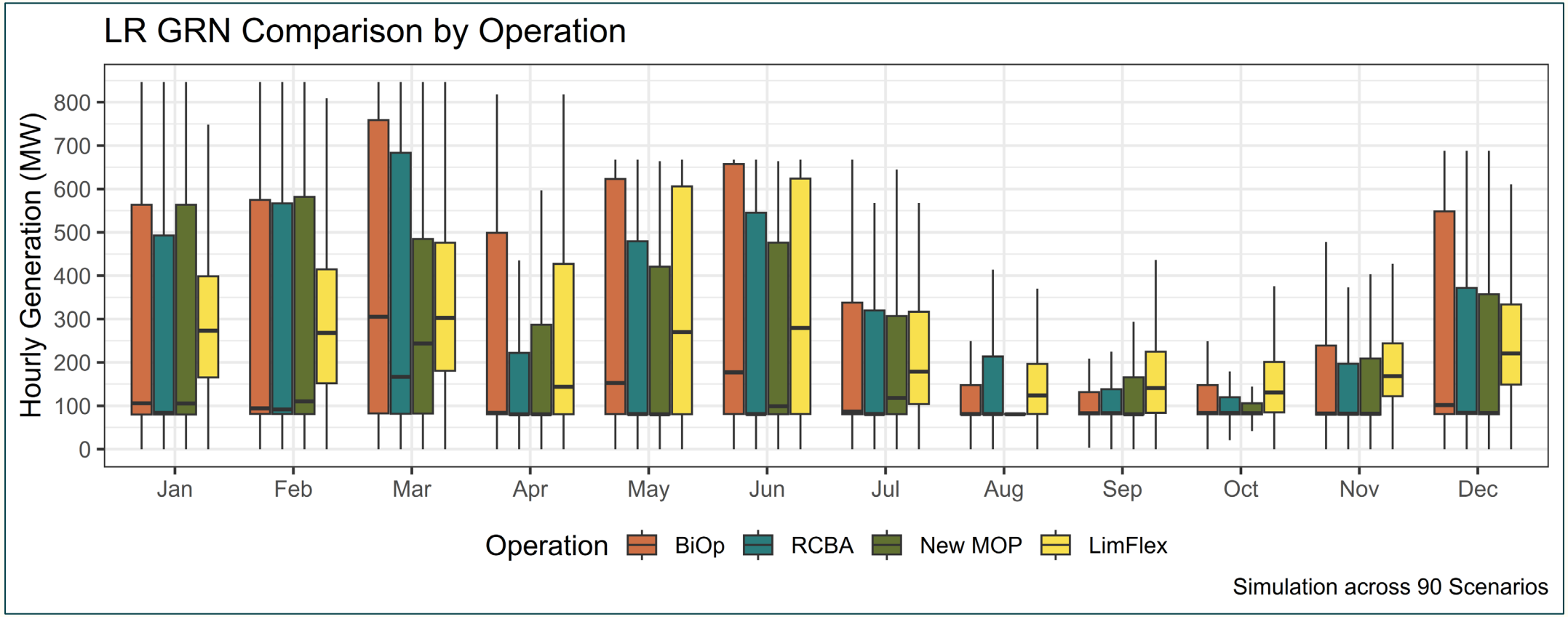
Lower Granite: Monthly Generation (by month)



Lower Granite: Hourly Generation (by hour)

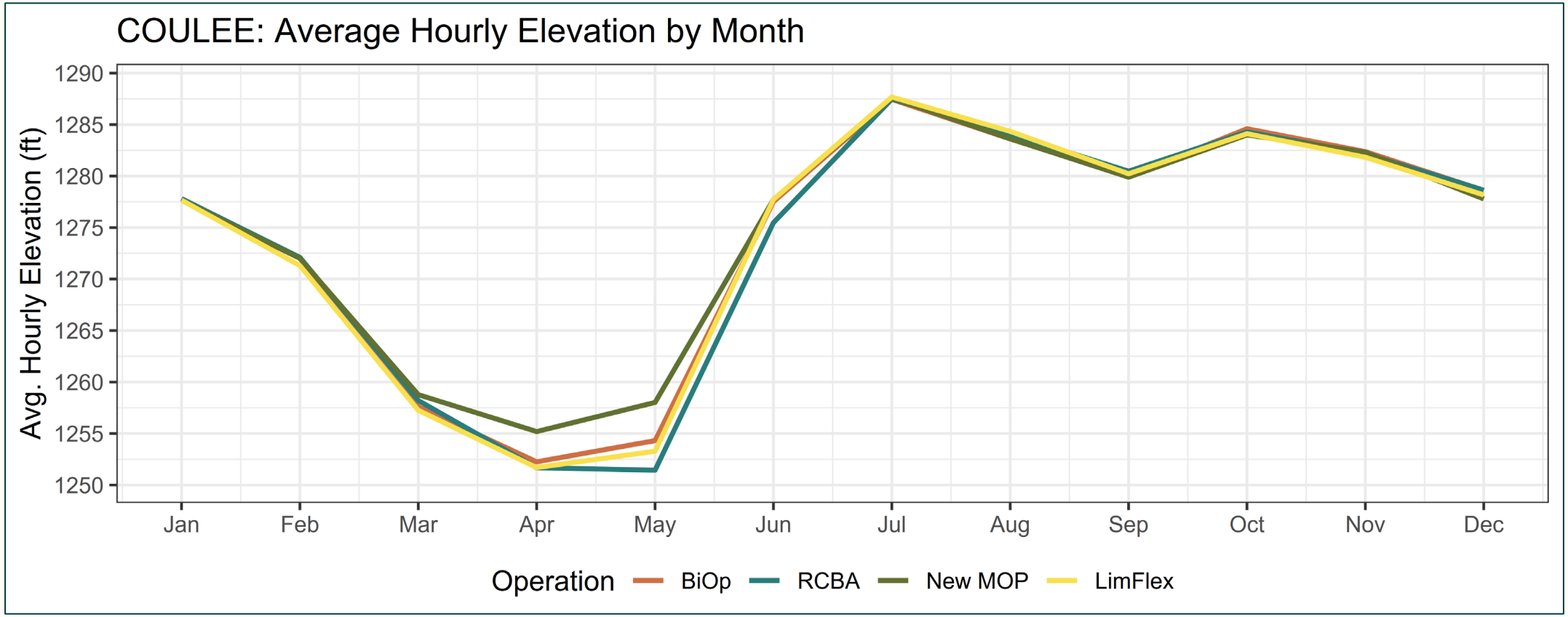


Lower Granite: Hourly Generation

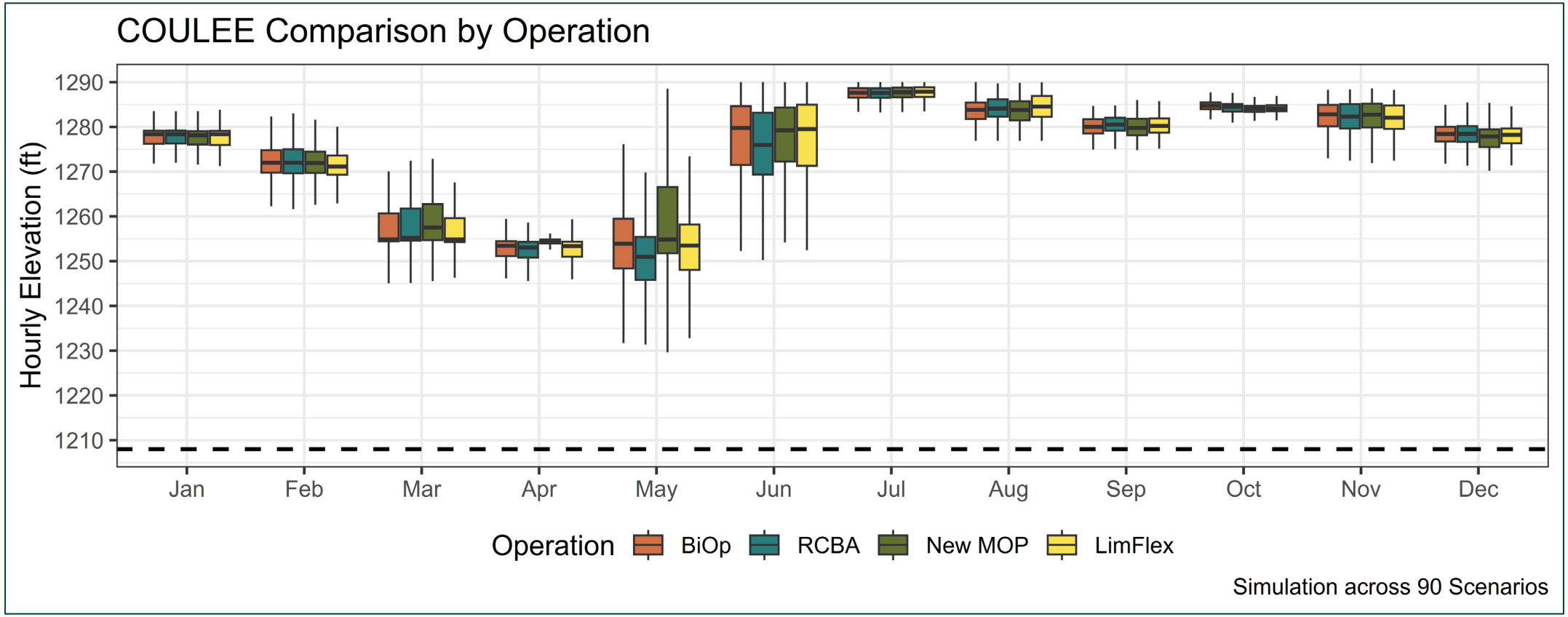


Modeled Hydro Ops: Grand Coulee

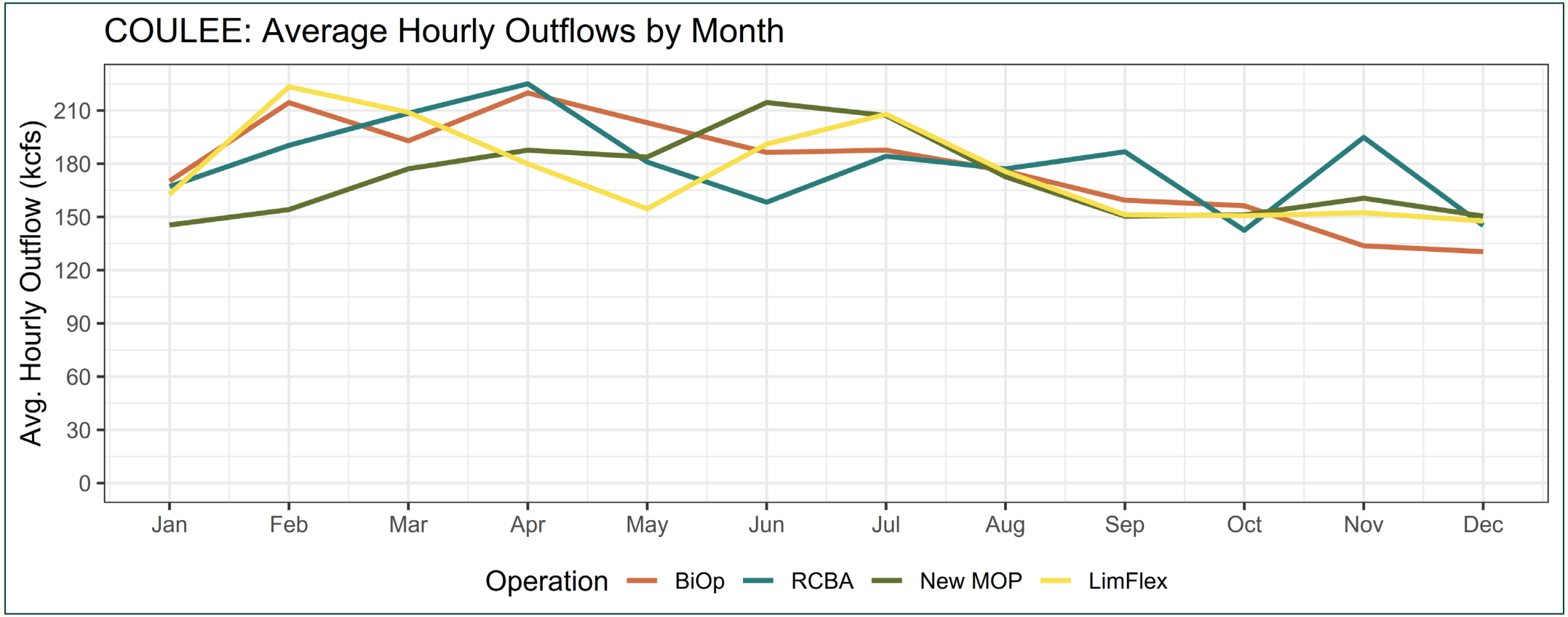
Grand Coulee: Average Hourly Pool Elevations



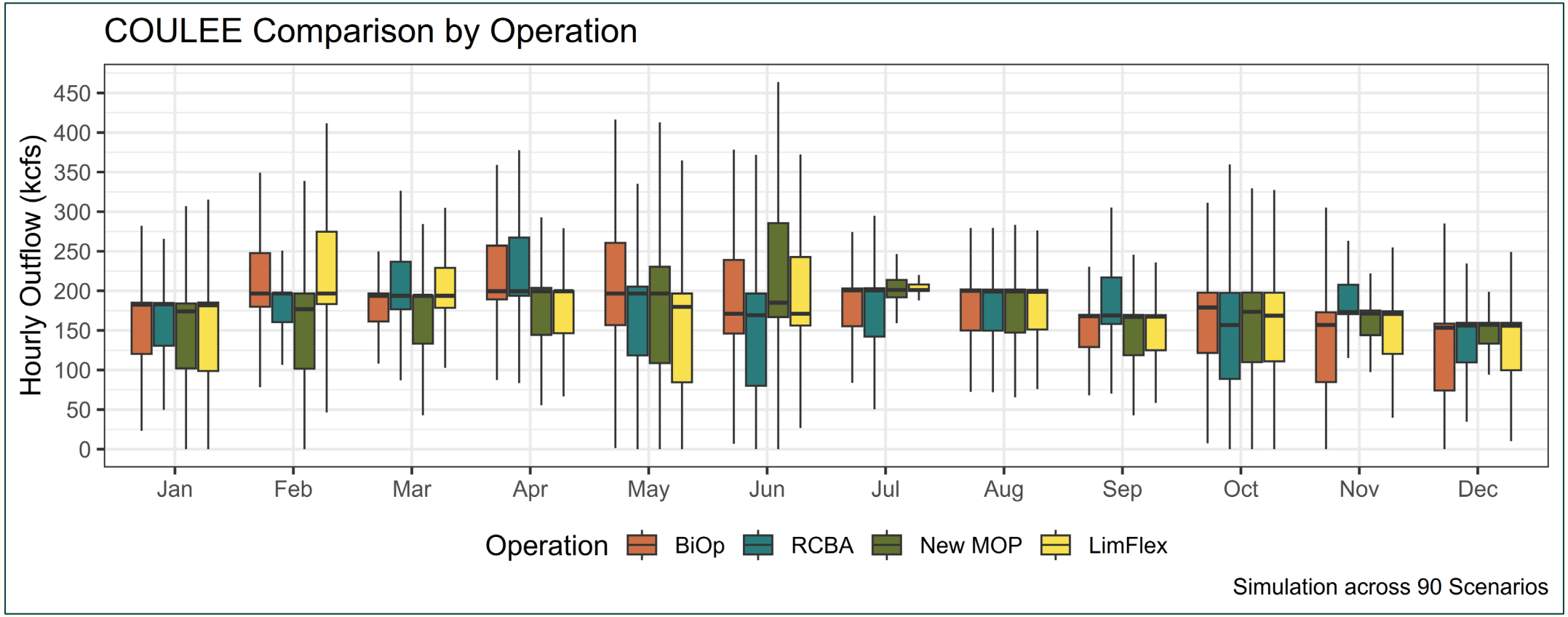
Grand Coulee: Hourly Pool Elevations



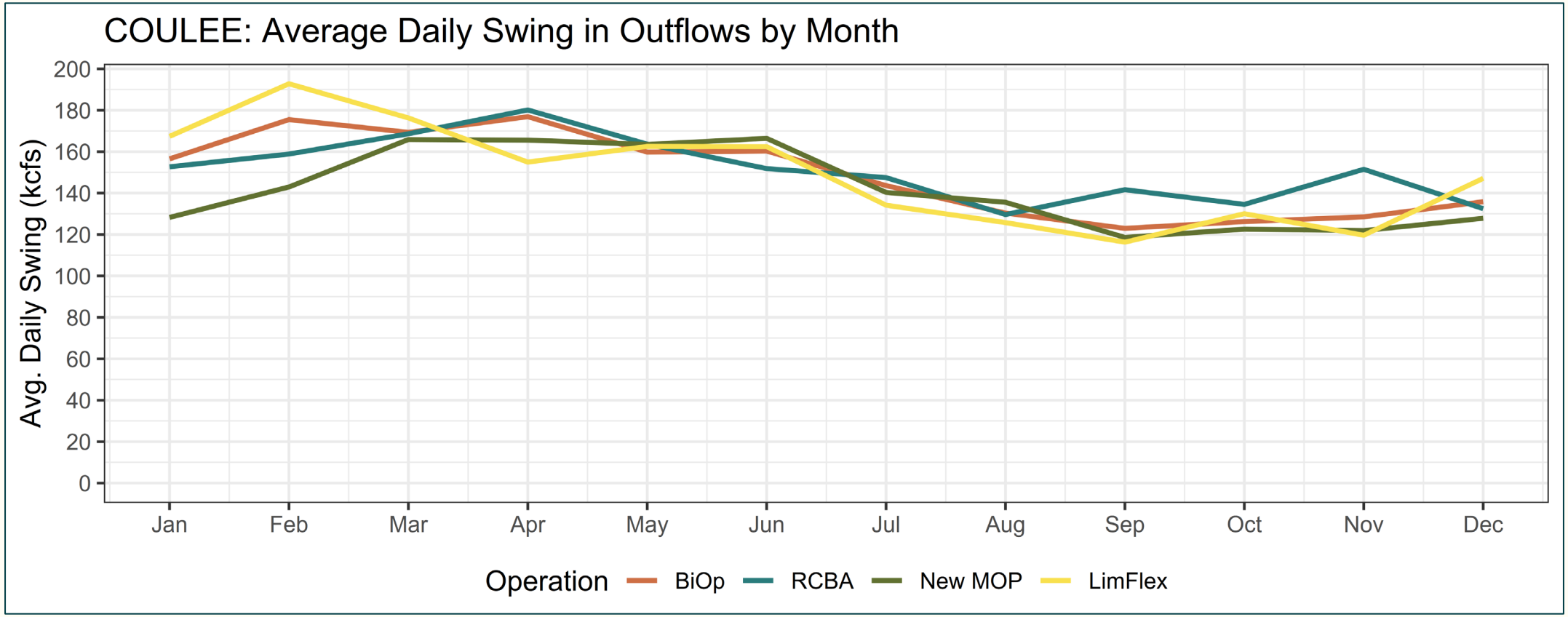
Grand Coulee: Average Hourly Outflows



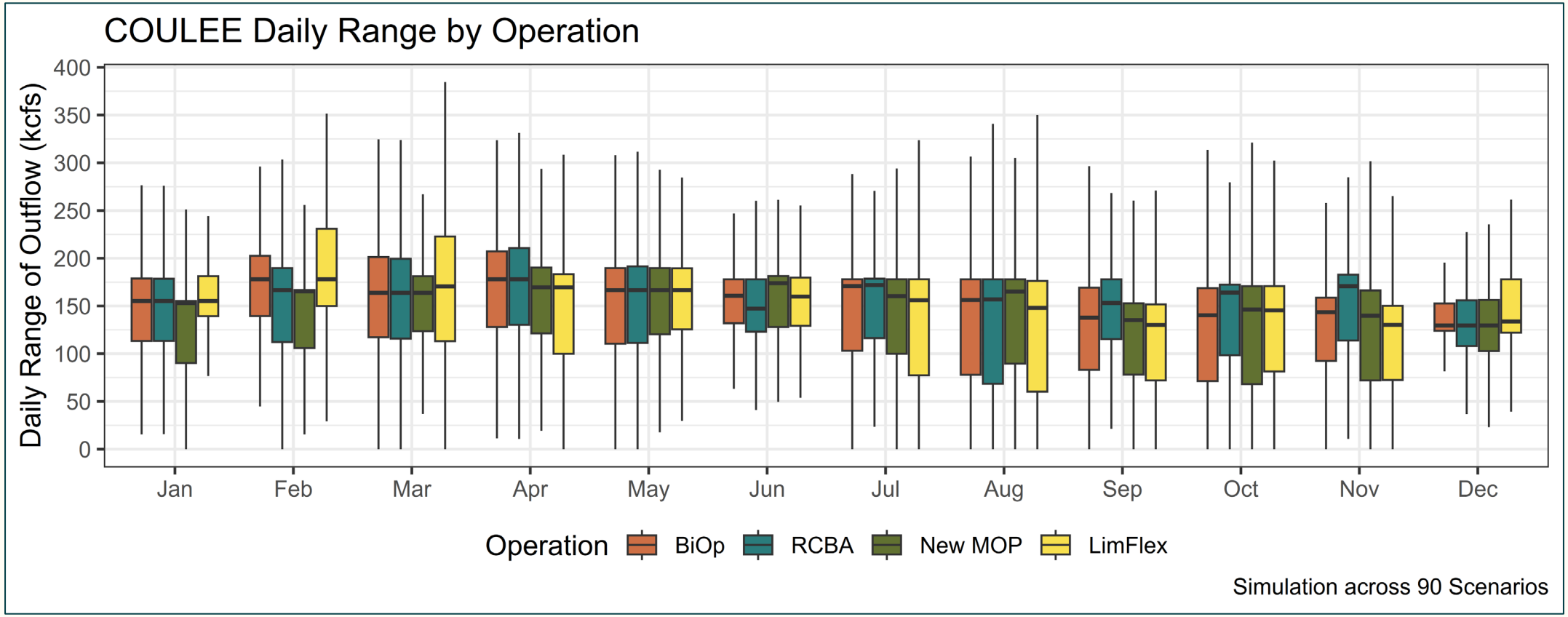
Grand Coulee: Hourly Outflows



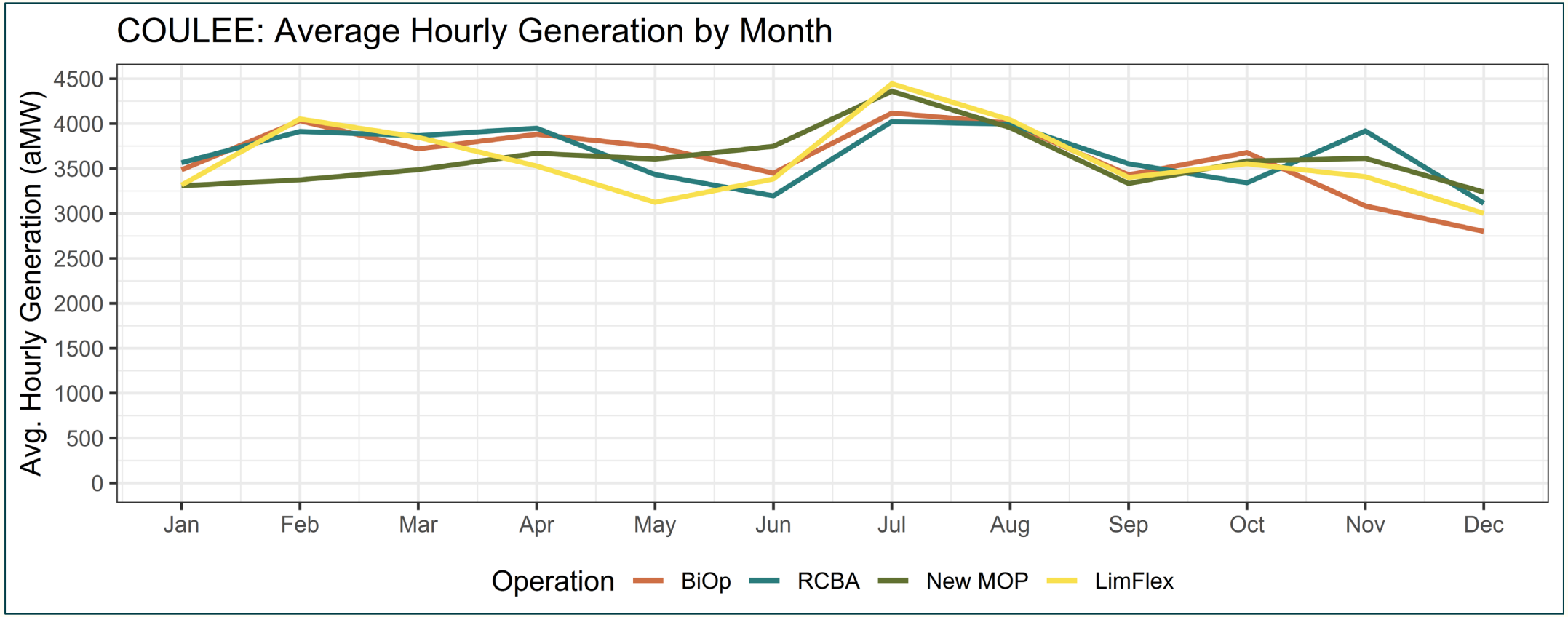
Grand Coulee: Average Daily Swing



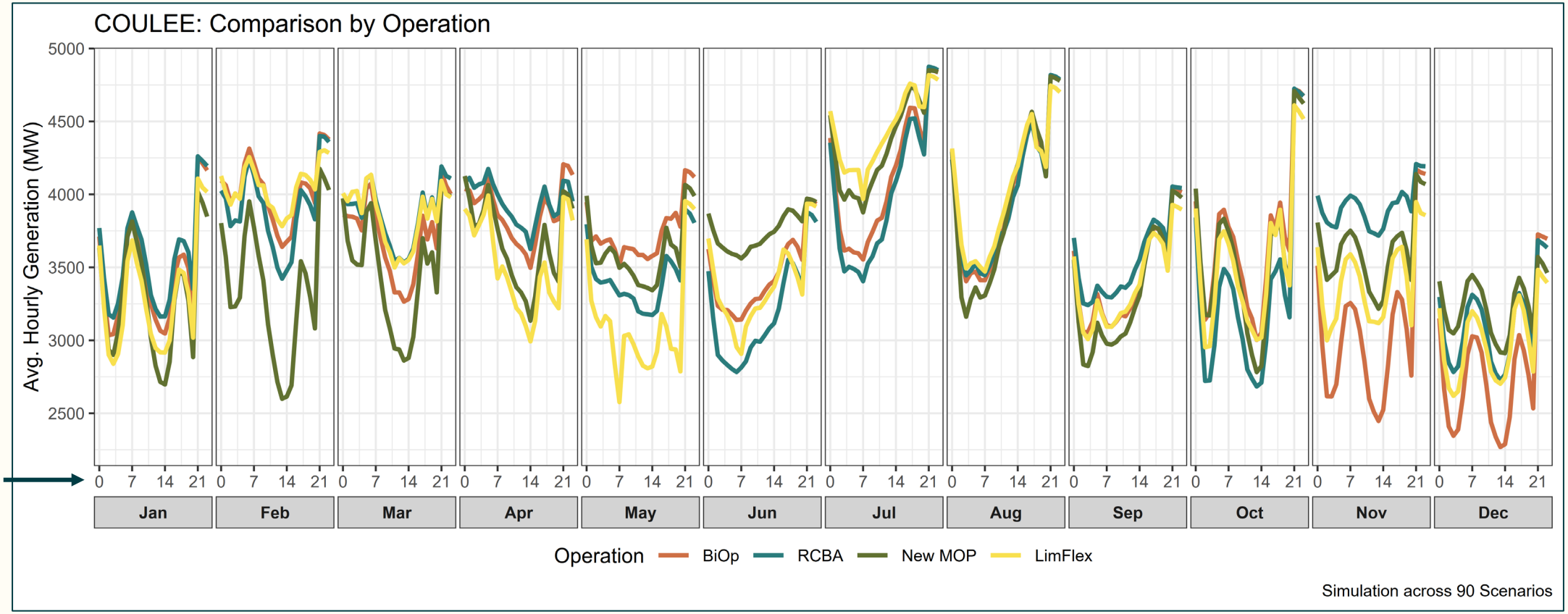
Grand Coulee: Daily Swing in Outflows



Grand Coulee: Average Hourly Generation (by month)

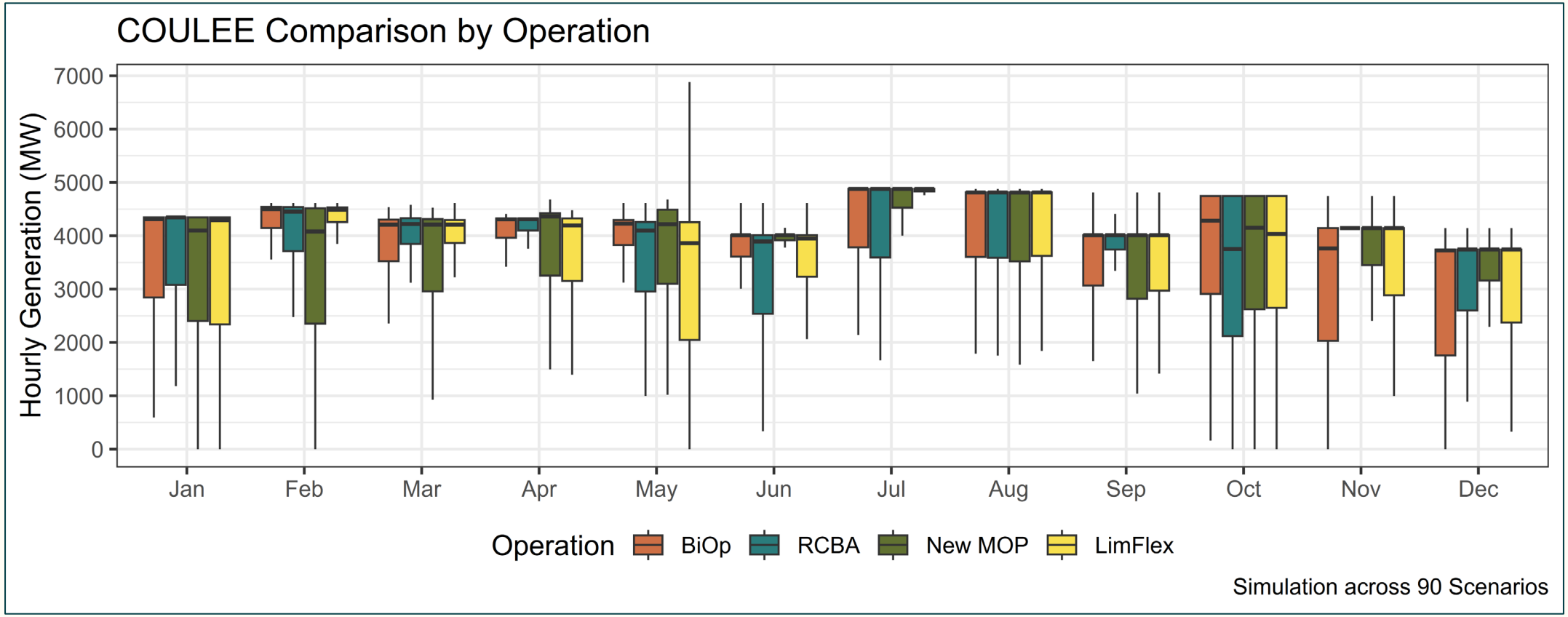


Grand Coulee: Average Hourly Generation (by hour)



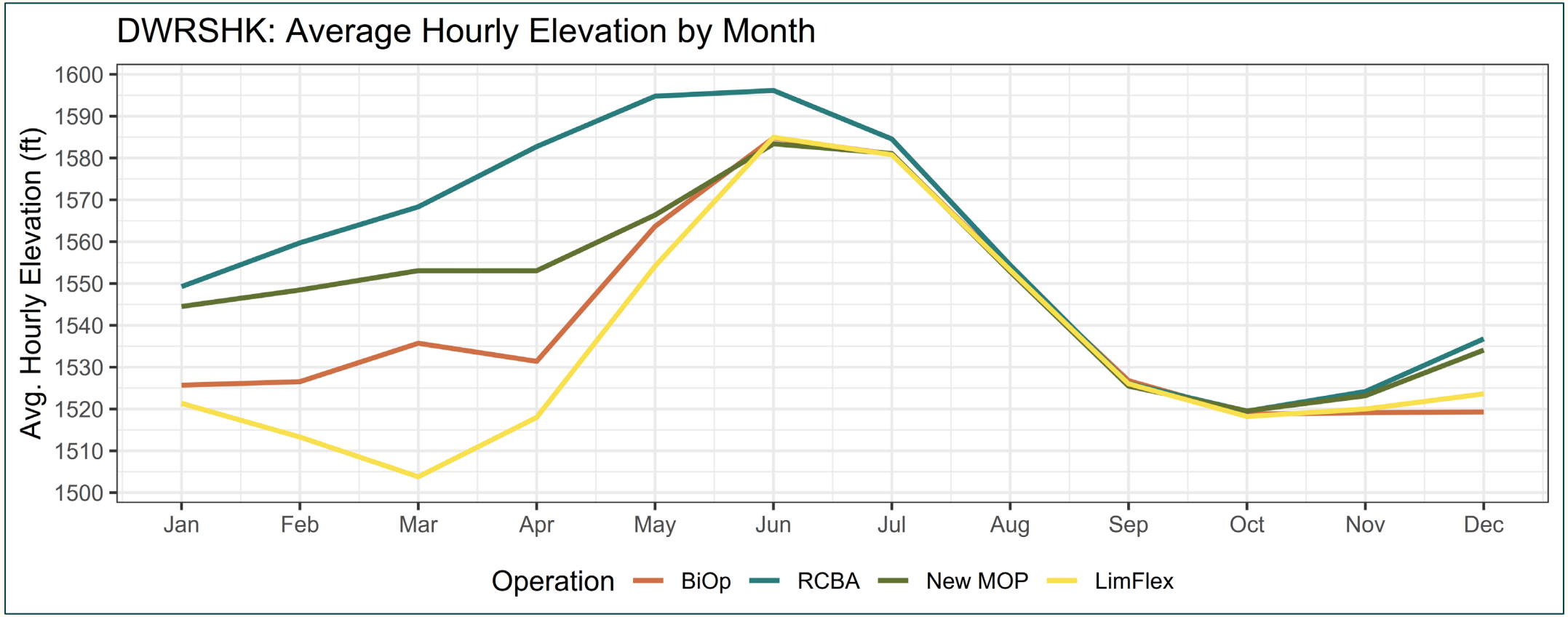
Hours →

Grand Coulee: Hourly Generation

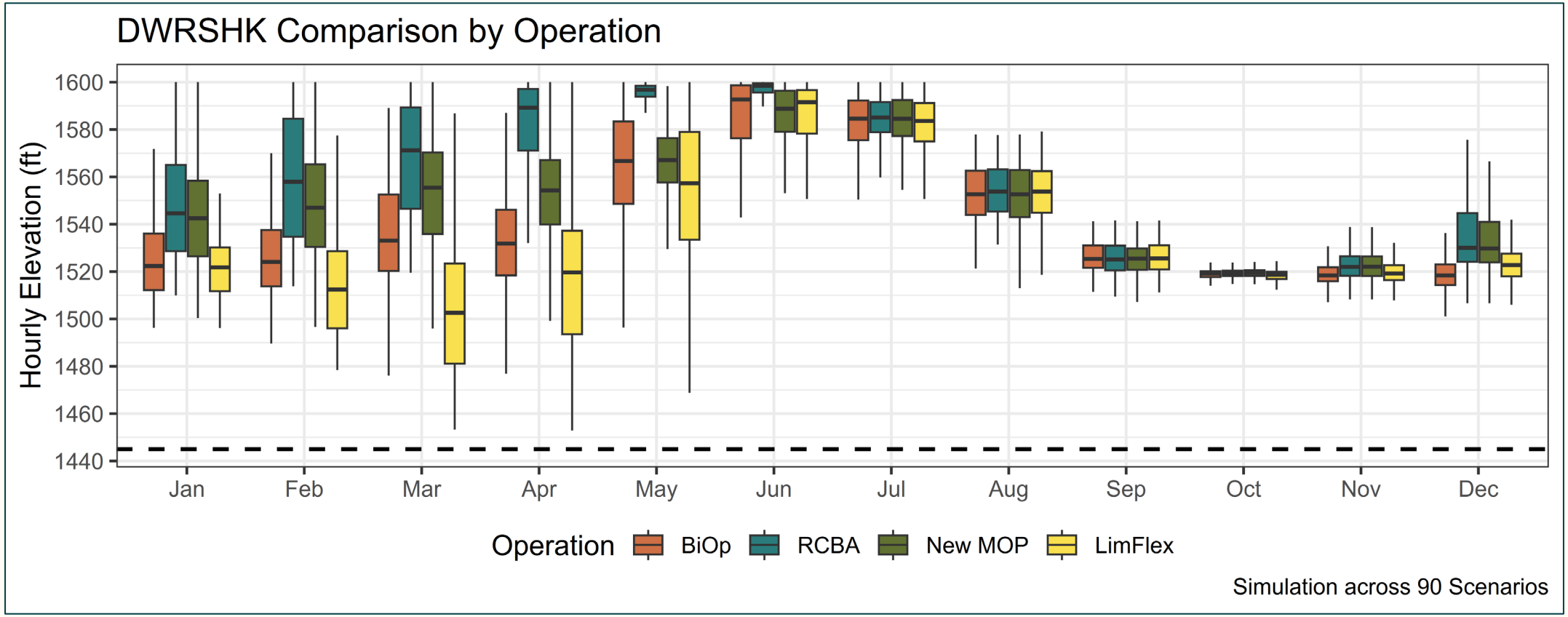


Modeled Hydro Operations: Dworshak

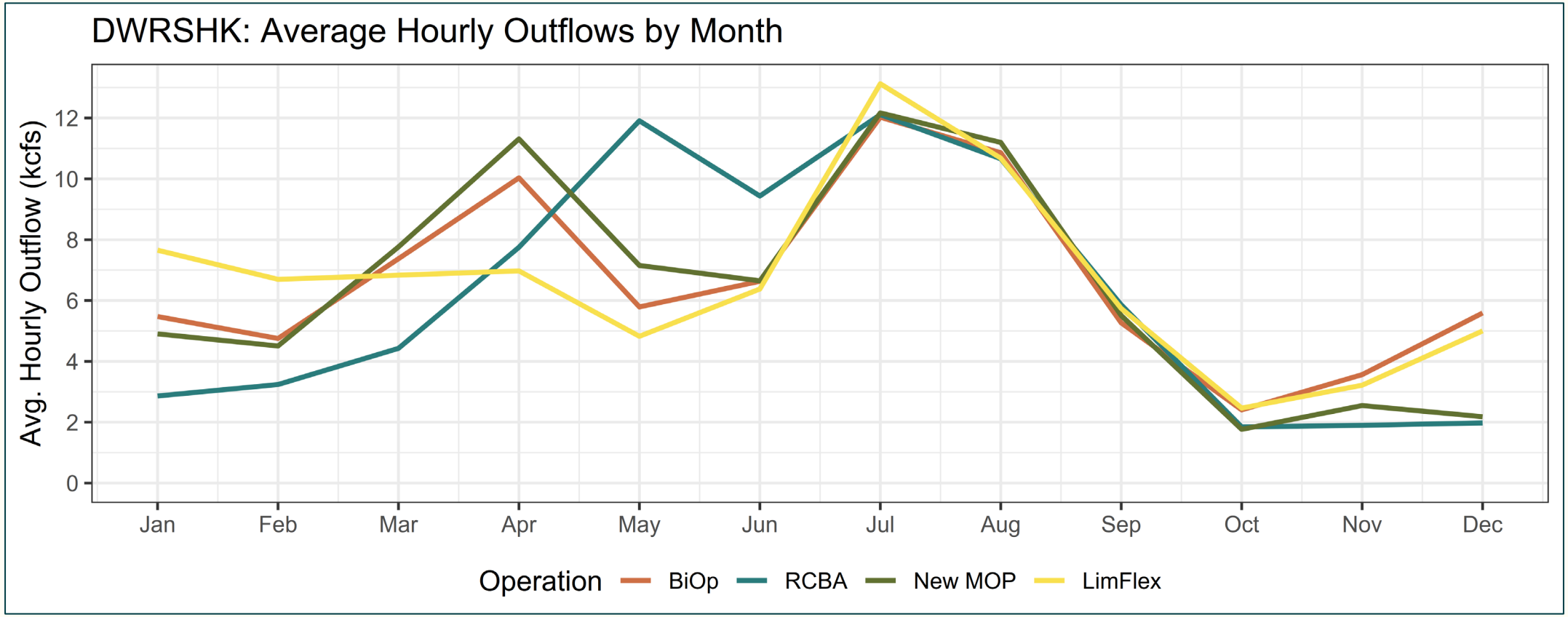
Dworshak: Average Hourly Pool Elevations



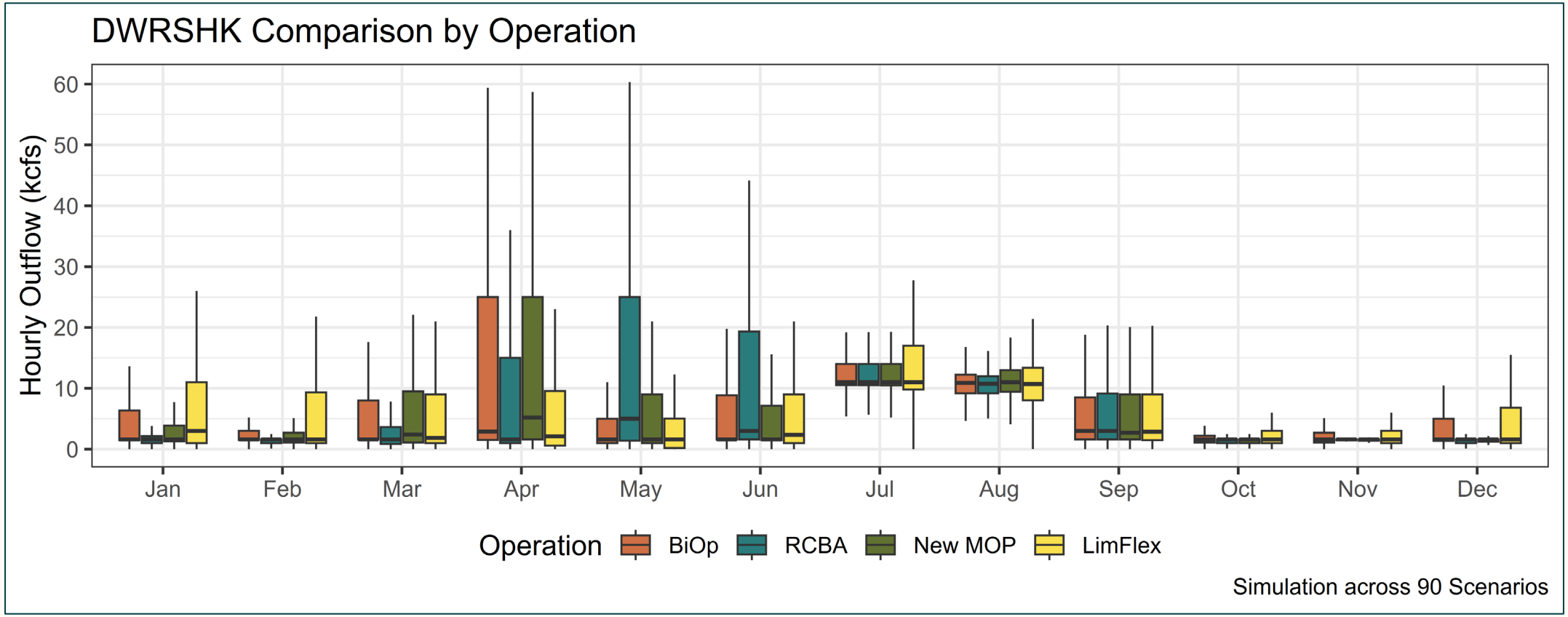
Dworshak: Hourly Pool Elevations



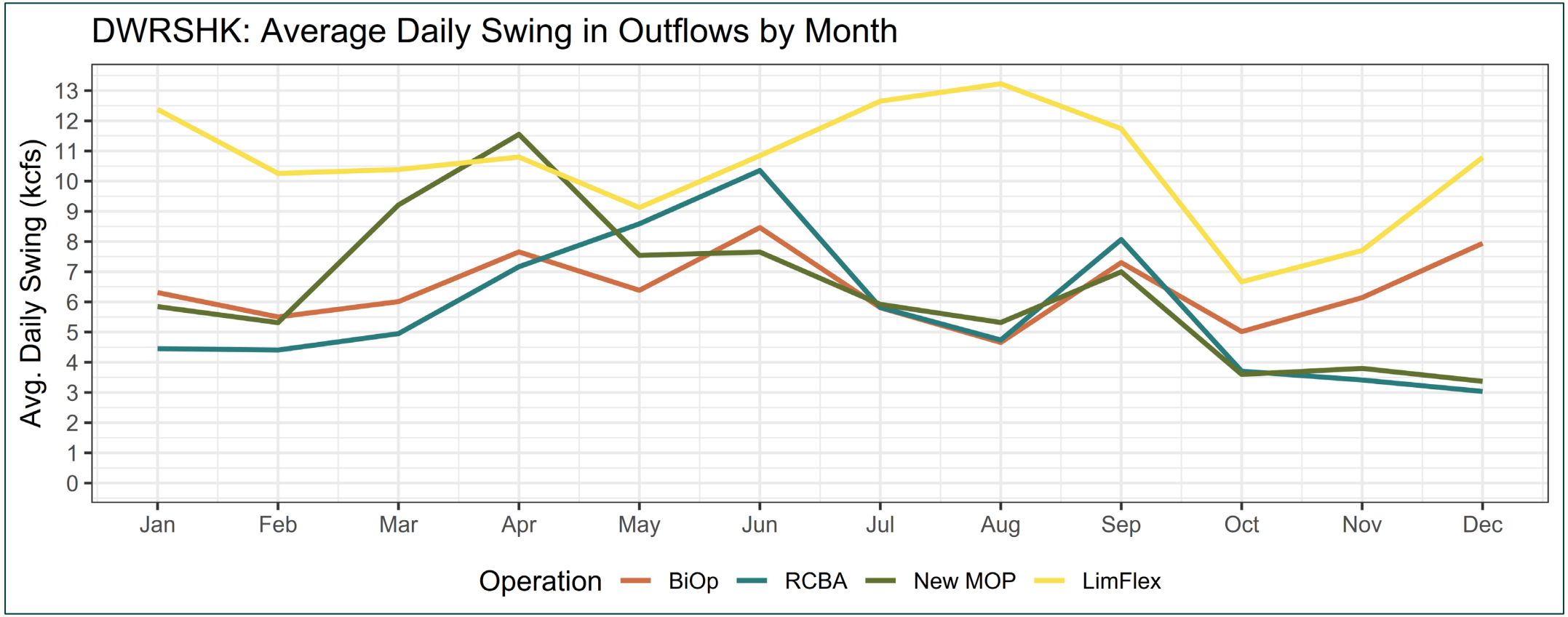
Dworshak: Average Hourly Outflows



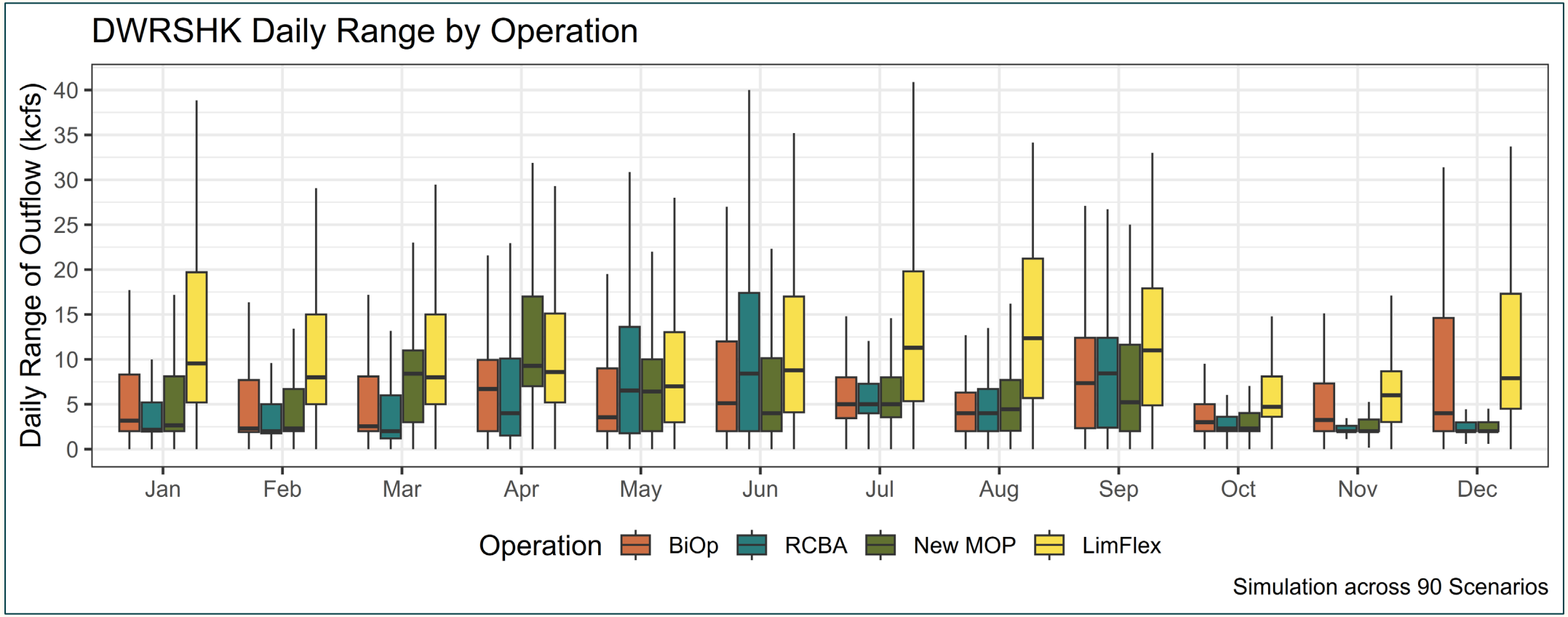
Dworshak: Hourly Outflows



Dworshak: Average Daily Swing

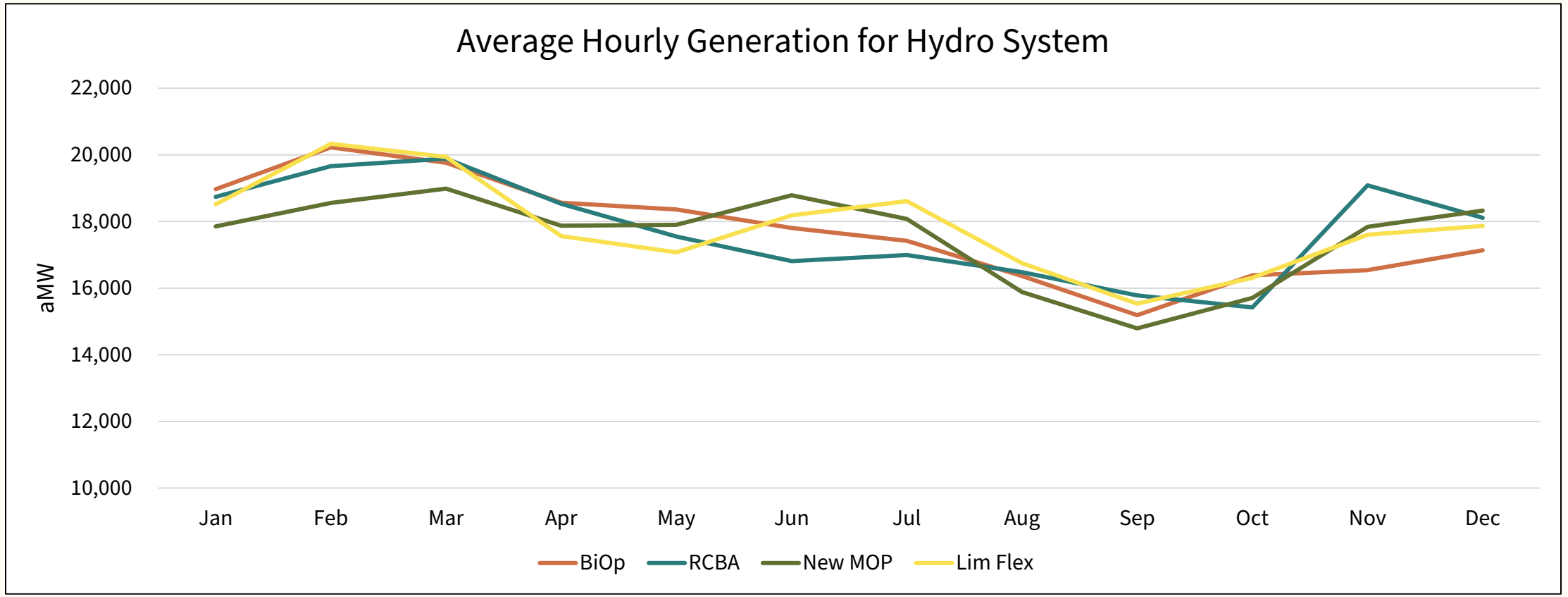


Dworshak: Daily Swing in Outflows

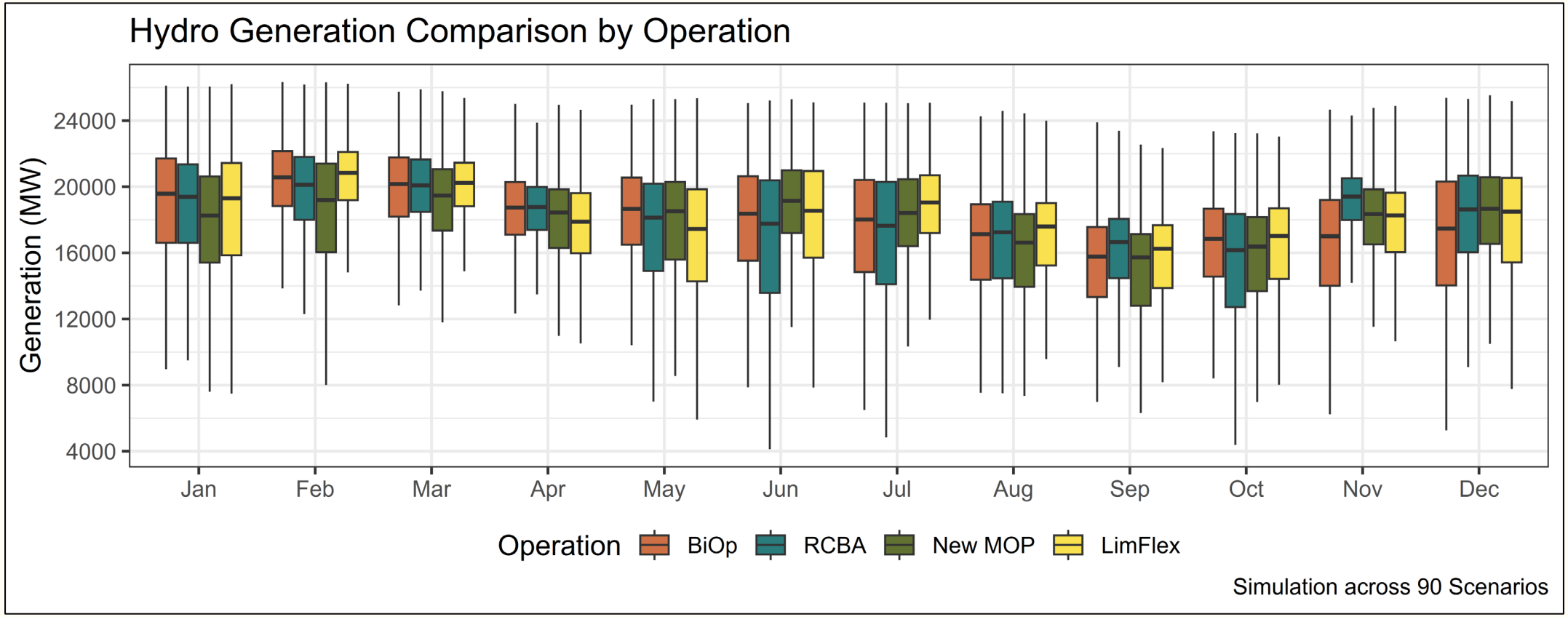


Additional Charts

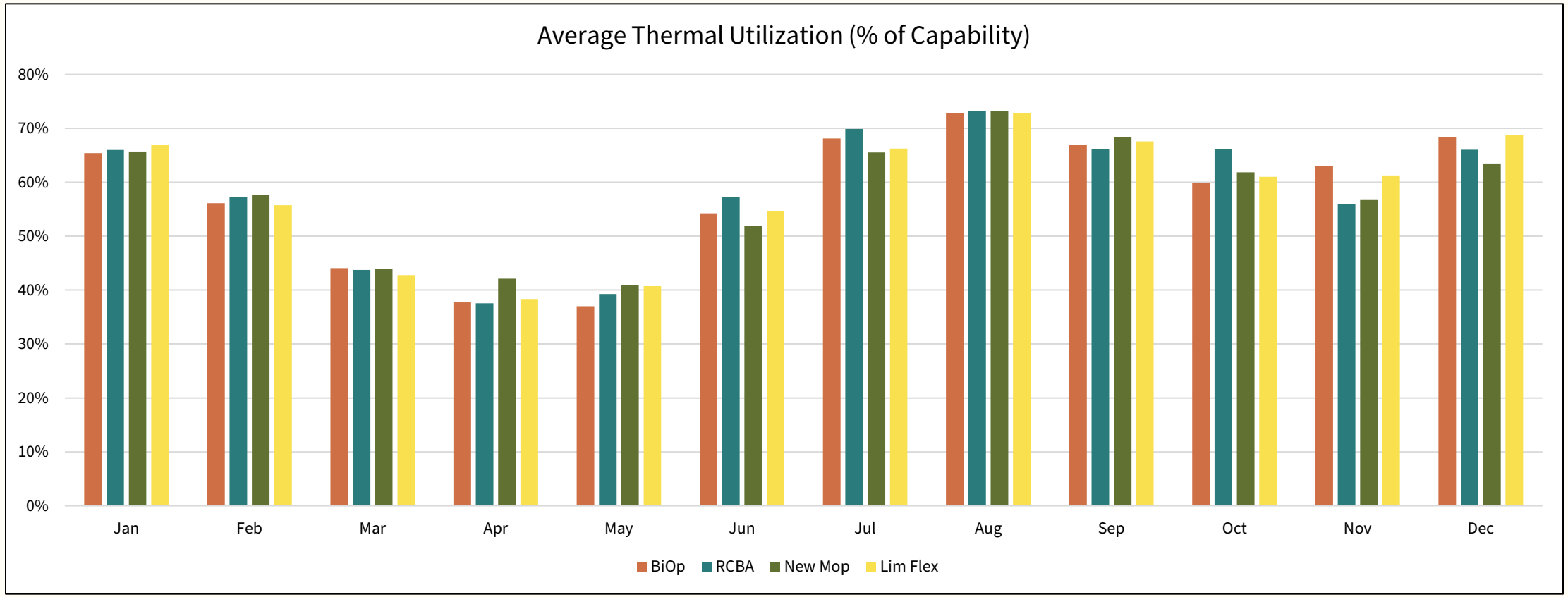
Average Hourly Hydro System Generation



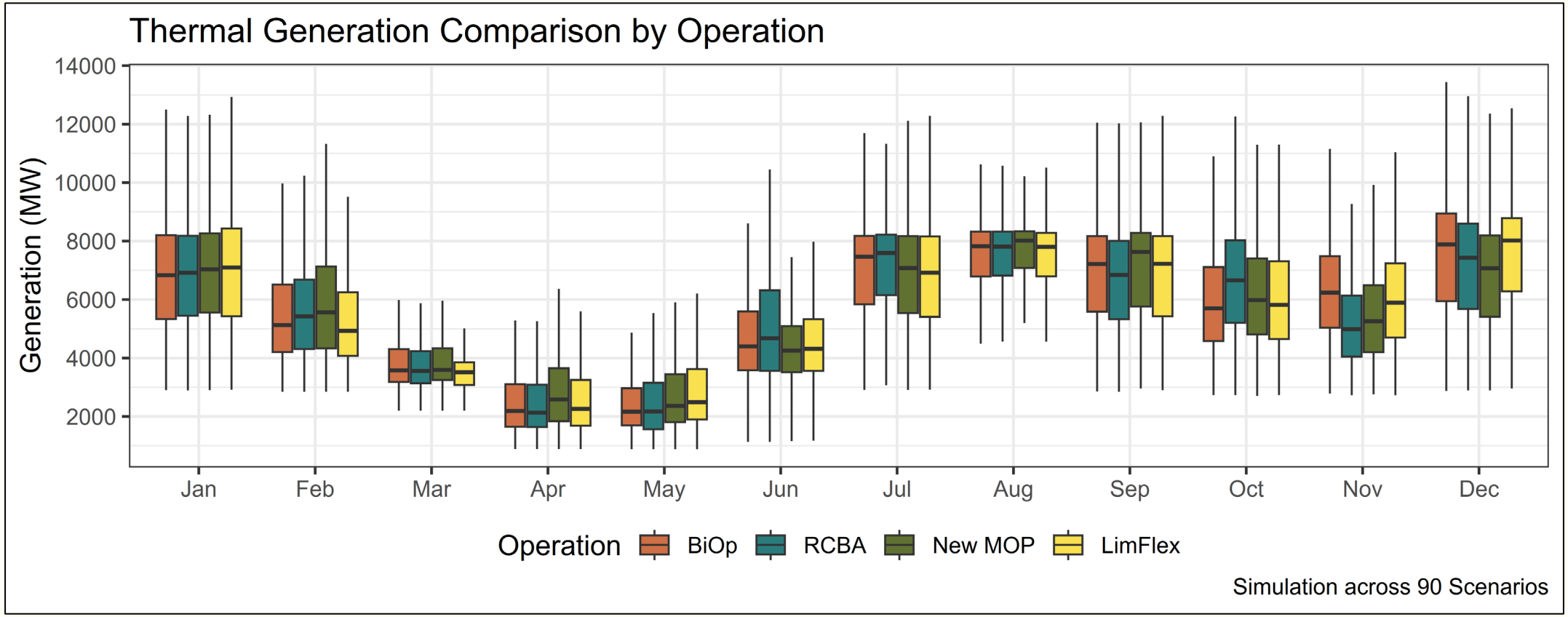
Hydro Generation



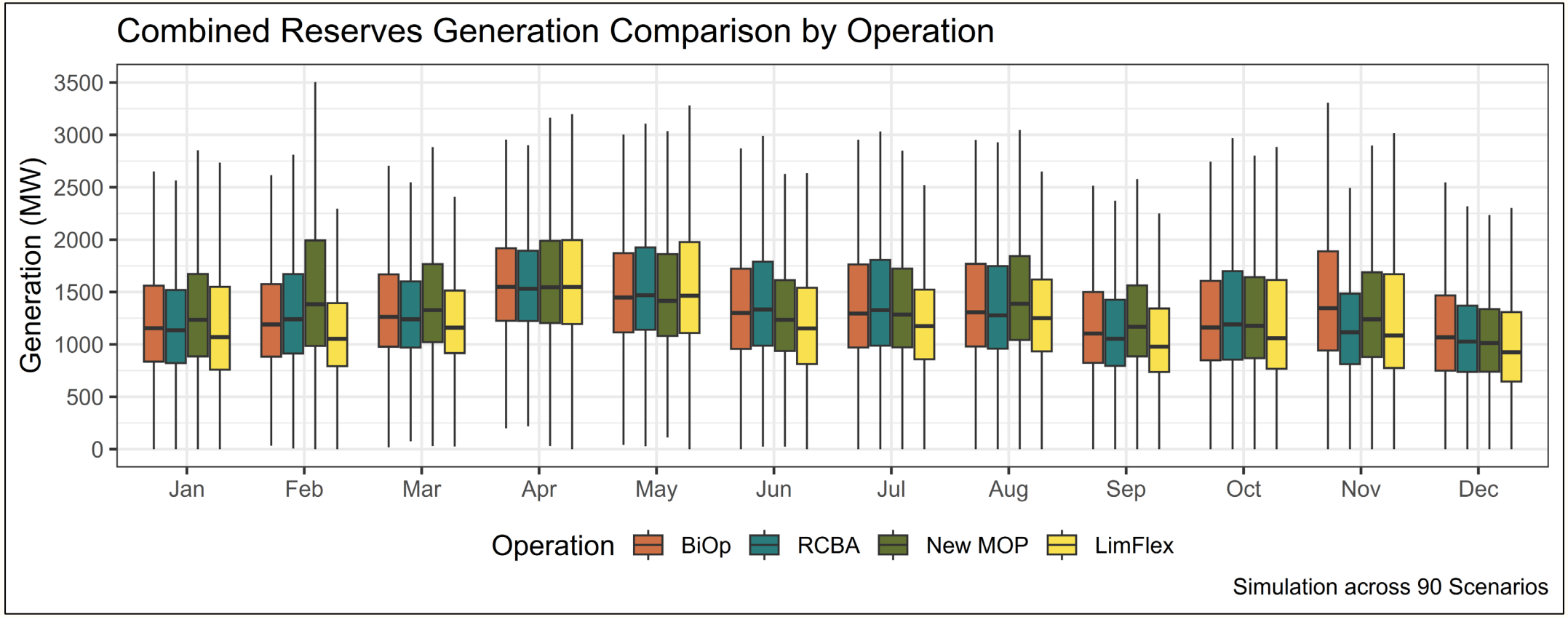
Average Thermal Utilization



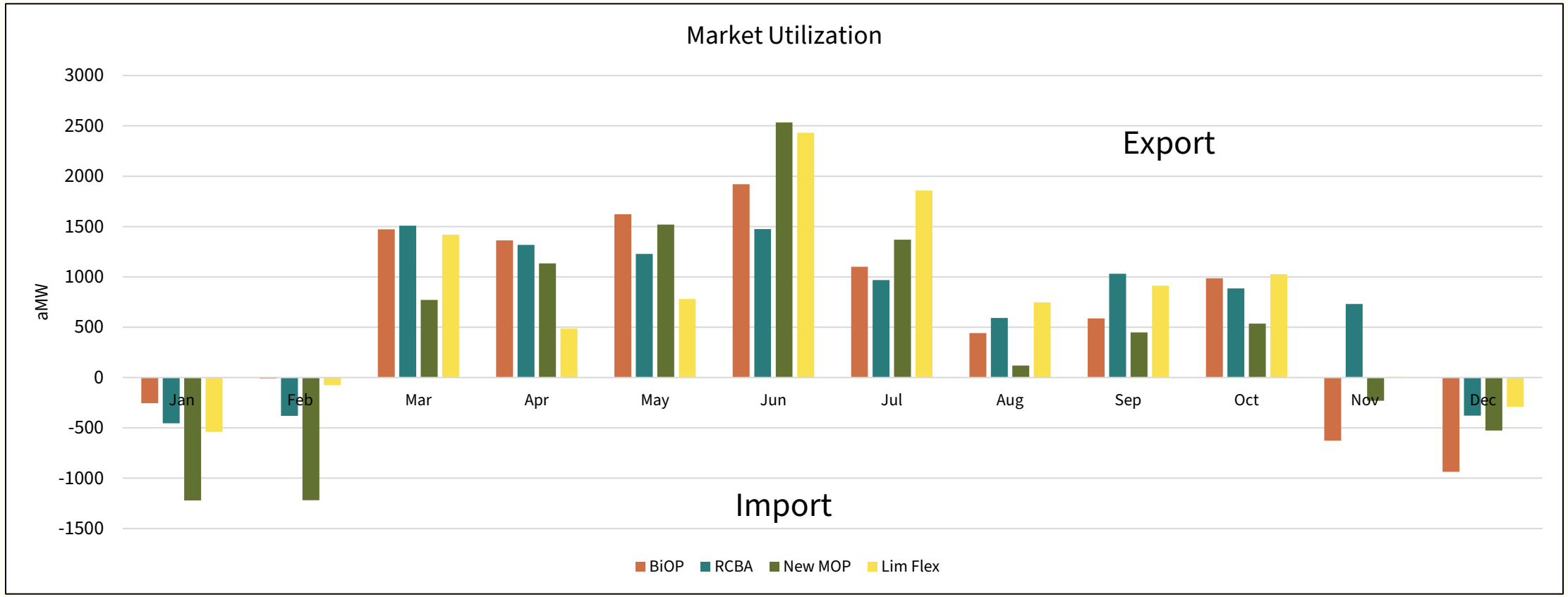
Thermal Generation



Hydro Balancing & Contingency Reserves



Average Market Dynamics

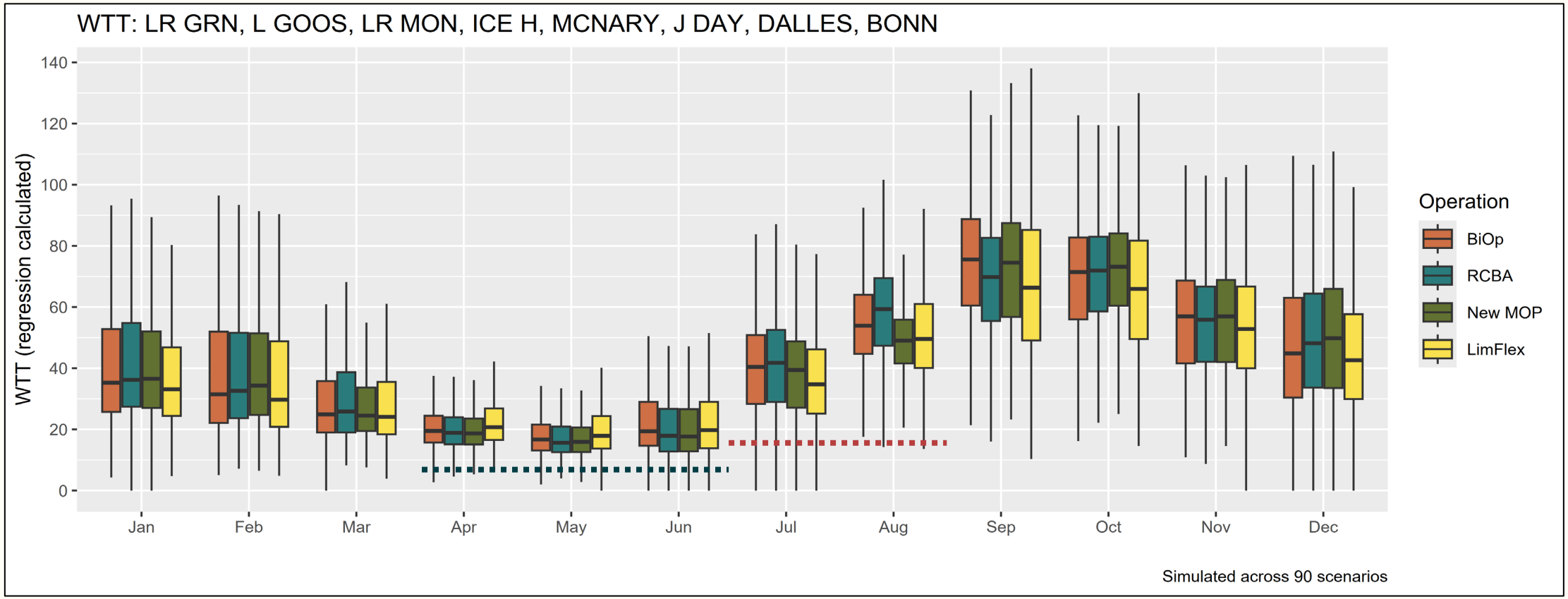


Water Transit Times

Water Transit Time Calculations

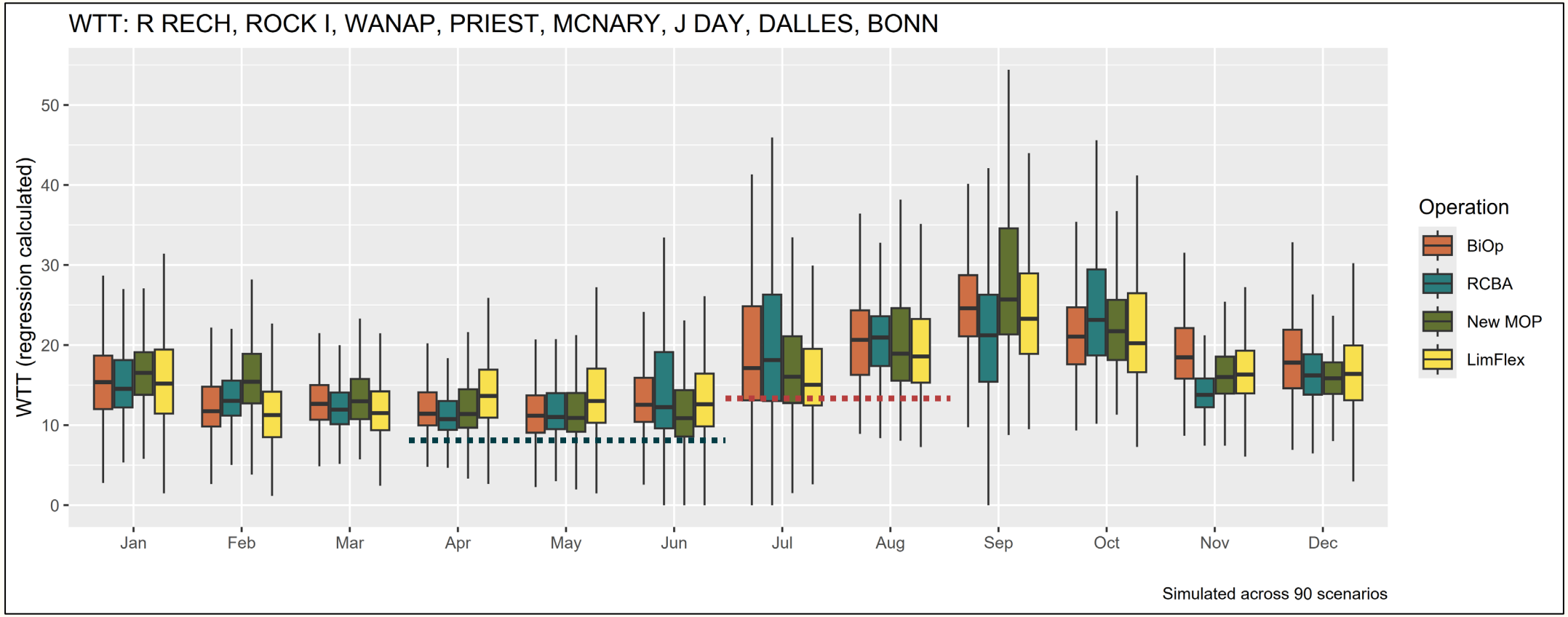
- Several recommendations from states and tribes focused on reducing water transit time (WTT)
- WTT are not a modeled output of GENESYS, but rather an auxiliary calculation based on Fish Passage Center work that uses GENESYS modeled outputs of elevation, storage, and outflows from the sensitivities
- Staff is working closely with the Fish Passage Center to ensure that we are applying their work appropriately

Implied WTT from Lower Granite to Bonneville Based on GENESYS Modeling



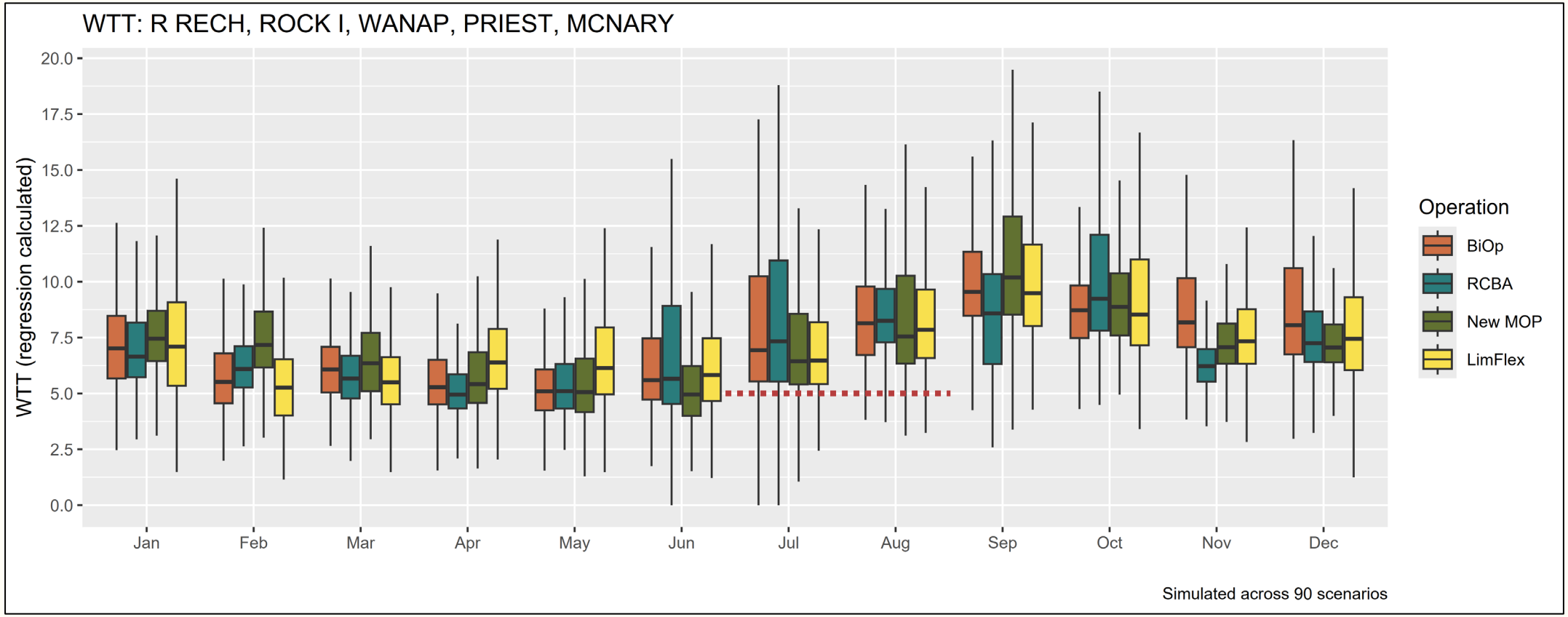
Spring 8 day Recommendation; **Summer** 13 day Recommendation

Implied WTT from Wells to Bonneville Based on GENESYS Modleing



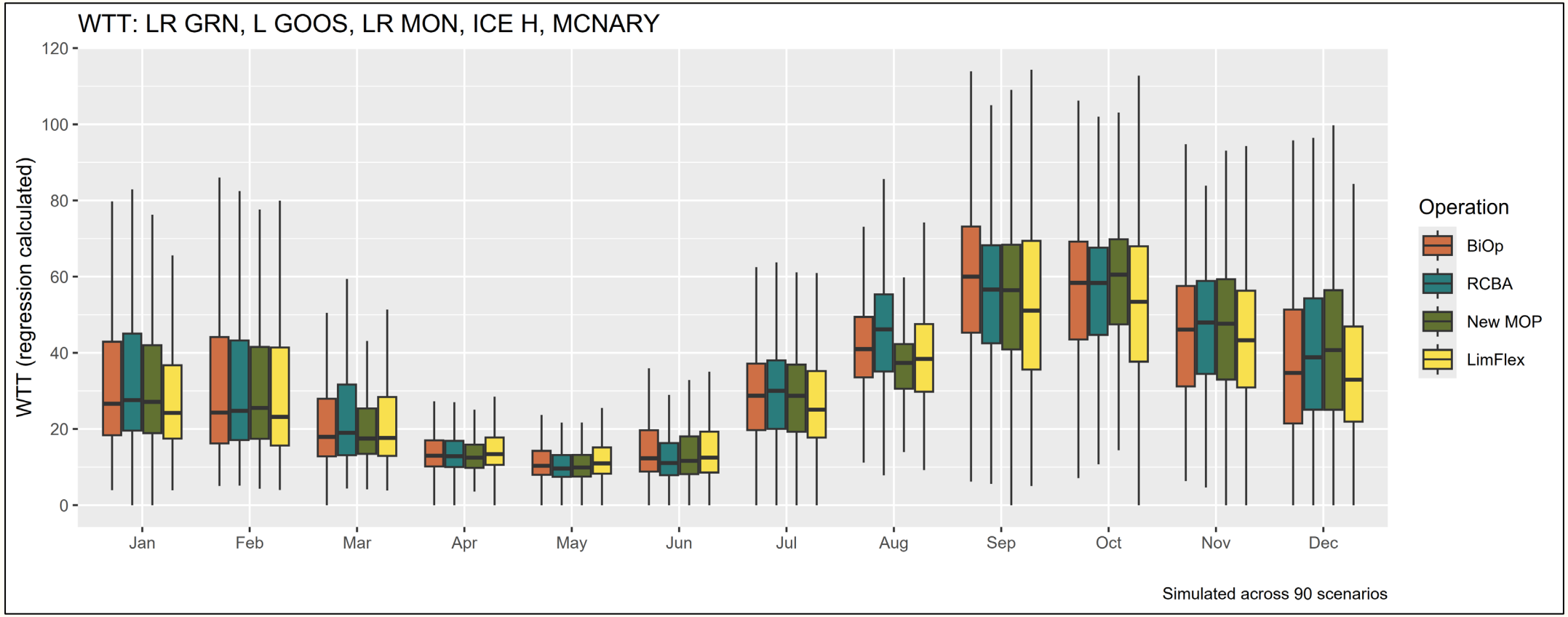
Spring 8 day Recommendation; **Summer** 13 day Recommendation

Implied WTT for Mid-C Reach Based on GENESYS Modeling

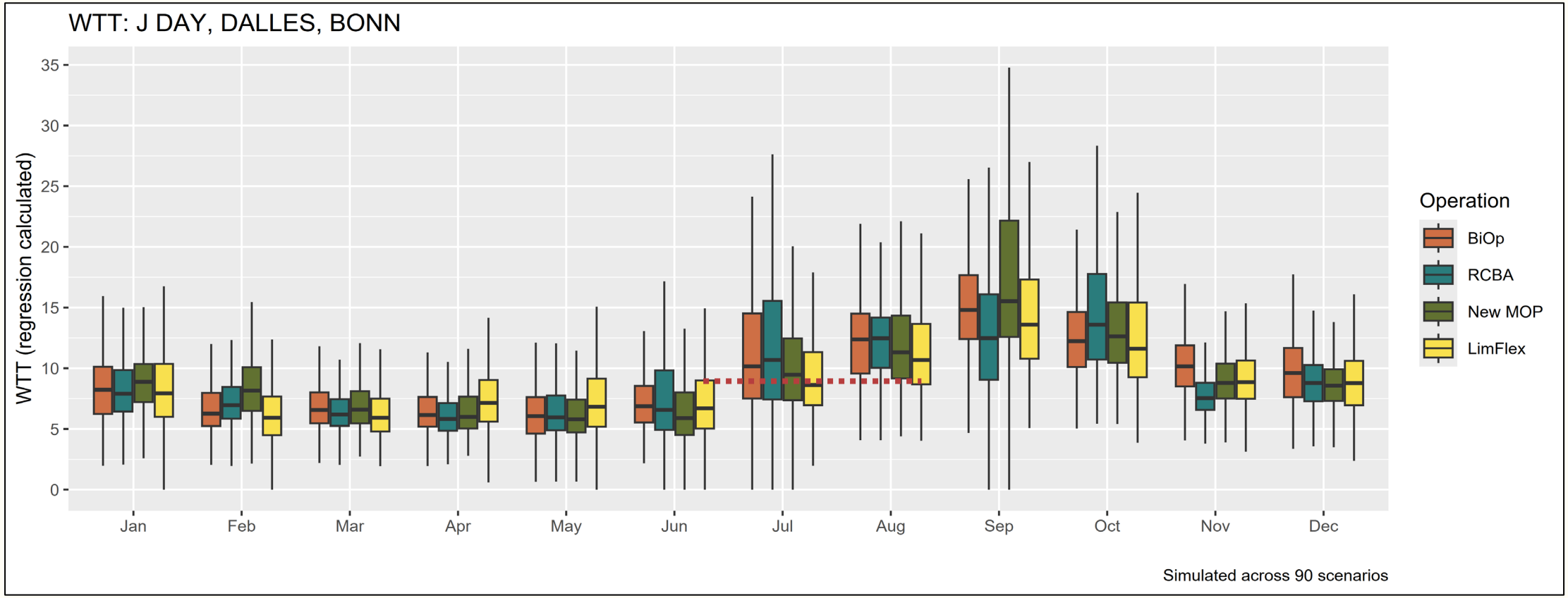


Summer 5 day Recommendation

Implied WTT for Lower Snake Based on GENESYS Modeling

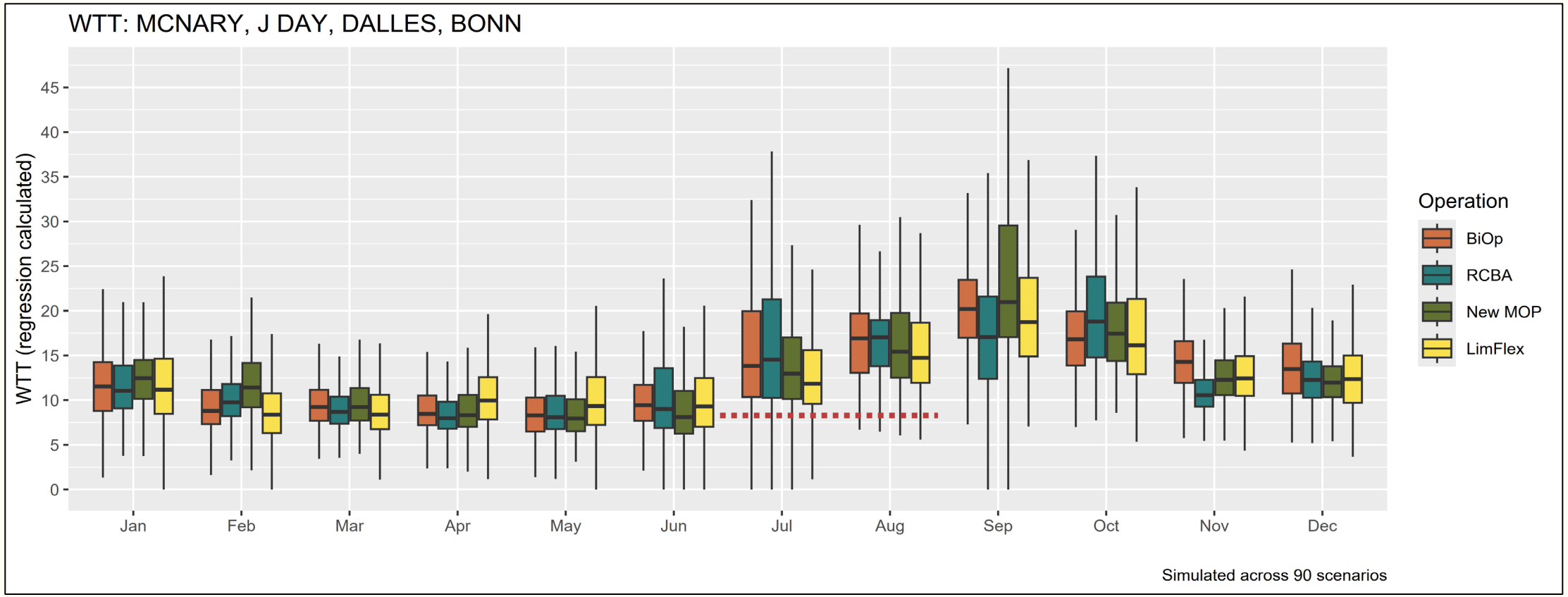


Implied WTT for Lower Columbia (after McNary) Based on GENESYS Modeling



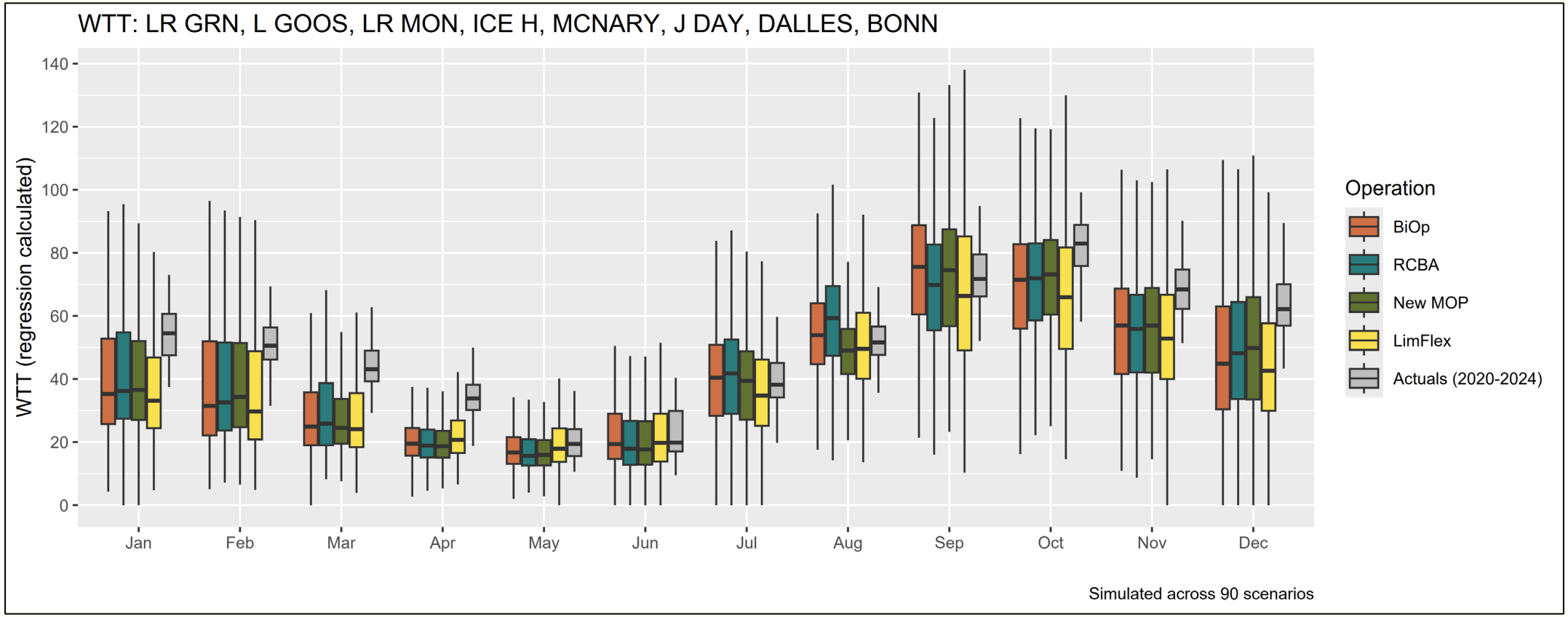
Summer 8 day Recommendation

Implied WTT for Lower Columbia (including McNary) Based on GENESYS Modeling



Summer 8 day Recommendation

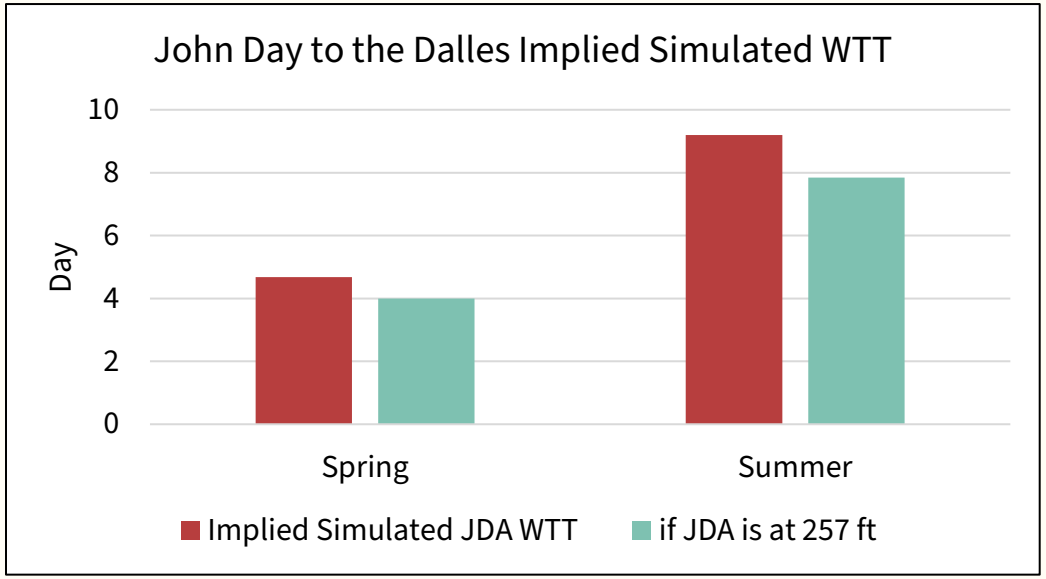
Implied WTT for Lower Eight Projects Comparison to Actuals (2020-2024)



Implied WTT of Operating John Day at 257 ft in Spring and Summer

- Some recommenders also requested the Council analyze modeling John Day at 257' as part of the MOP sensitivity
  - This elevation is considered spillway crest and is above minimum operating pools
  - This was outside the scope of the GENESYS analysis for this scenario, but staff were able to estimate an implied WTT assuming this operation
- Holding John Day elevations at 257 ft throughout the spring and summer suggests a ~15% faster WTT between John Day and the Dalles, roughly 0.8-1.4 days shorter.
  - Assuming identical outflow outputs

Season	New MOP	JDA 257*	% Reduction	Day Difference
Spring	4.676	3.997	15%	0.680
Summer	9.201	7.841	14.8%	1.360

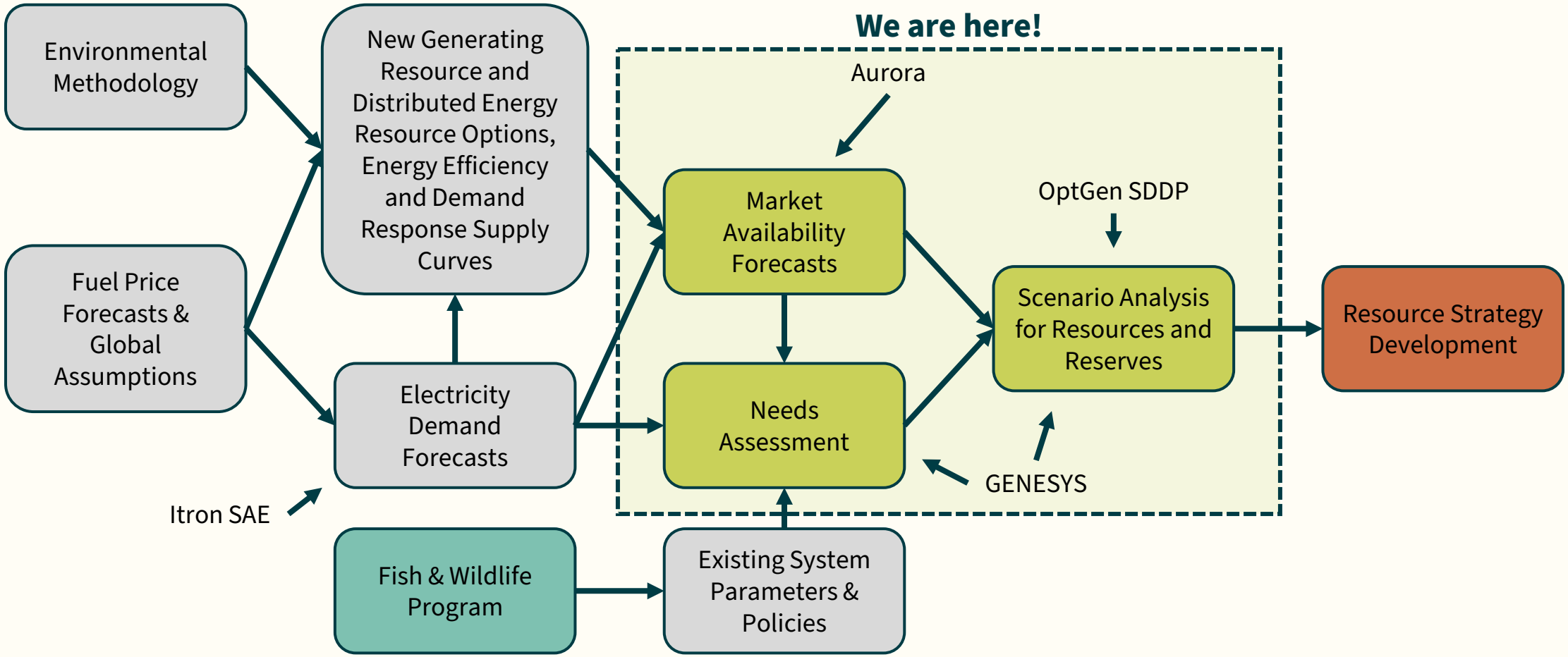


Discussion Outline:

1. Reminder of Scenario
2. Operational Differences Across Sensitivities
3. **Reminder of Role of Needs Assessment**
4. Needs Assessment Results
5. Timeline and Next Steps

Northwest **Power** and **Conservation** Council

Power Plan Elements and Analytical Flow



Reminder on Scenario Modeling

Changing Hydro Operations Scenario

Conduct a study for each sensitivity where **new resource** and transmission options change.

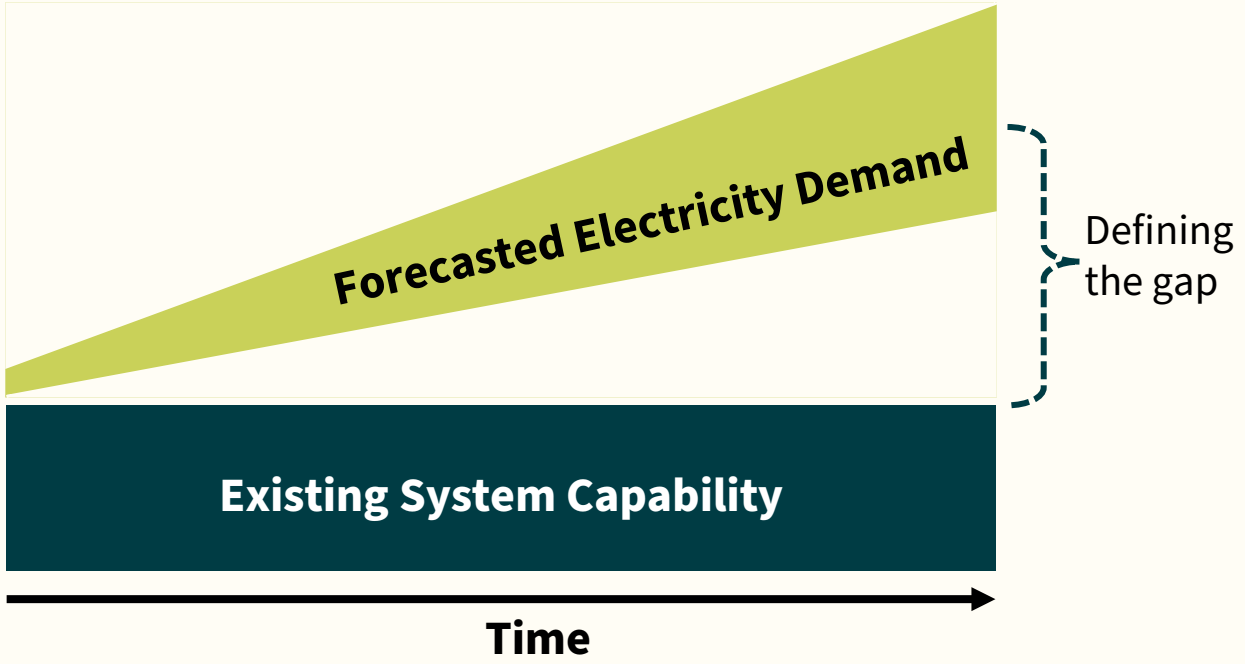
Conduct a study for each sensitivity where **existing system** operations change.

Conduct a study for **every** sensitivity.

Conduct a study for **every sensitivity & final recommended strategy**.

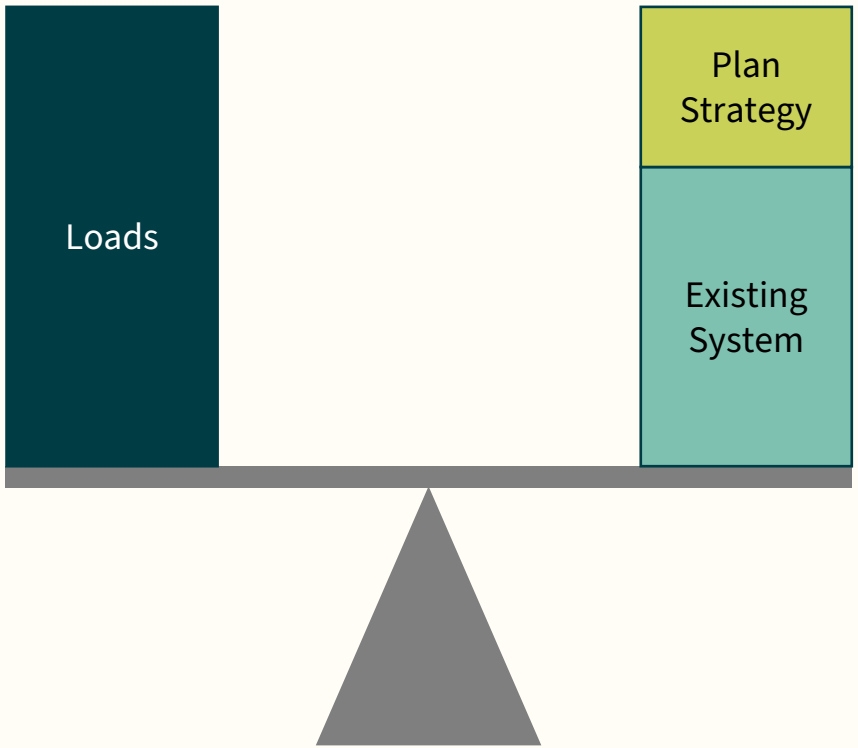
Super Simplified Description of the Power Plan Needs Assessment

- **Step 1:** Defining existing system capability (resources in the ground or under construction)
  - This may change over time due to owner announced retirements or conversions, policies, changes to river operations, etc.
- **Step 2:** Forecasting future electricity demand
- **Step 3:** Understanding the gap between the existing system and future load growth
- **Step 4:** Translating this into an adequacy reserve margin to inform next phase

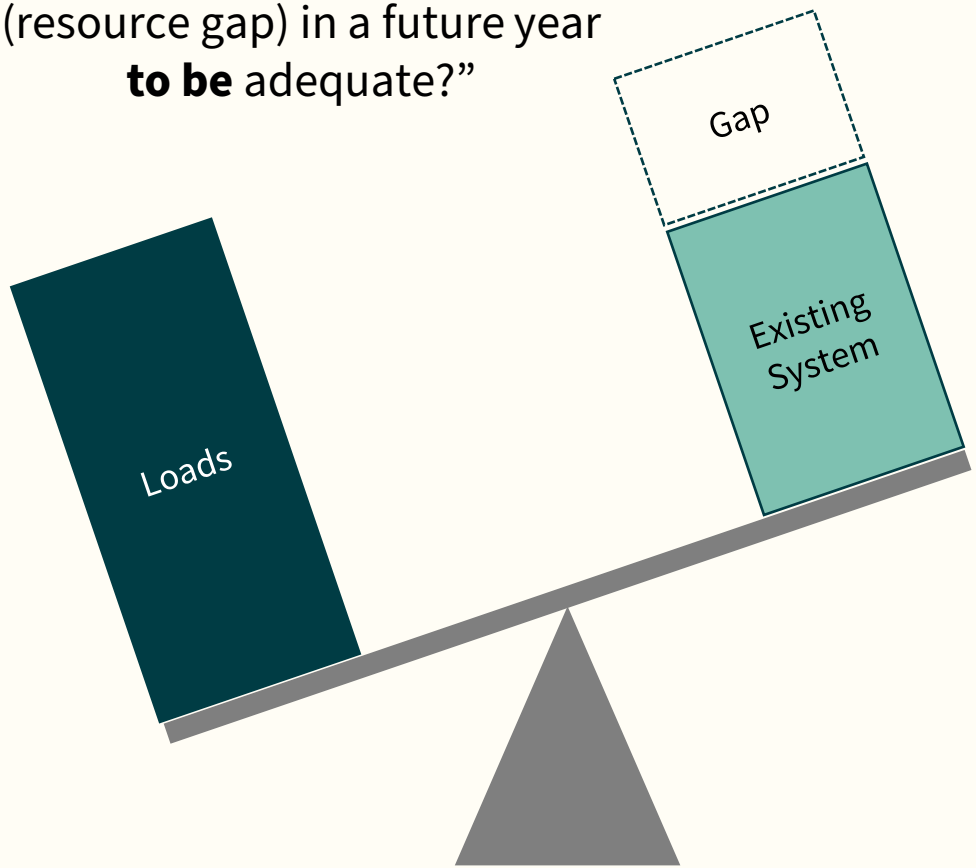


Adequacy Assessment vs Needs Assessment

Adequacy Assessment asks:
"Is the region adequate in a future year **WITH** the Plan Strategy?"

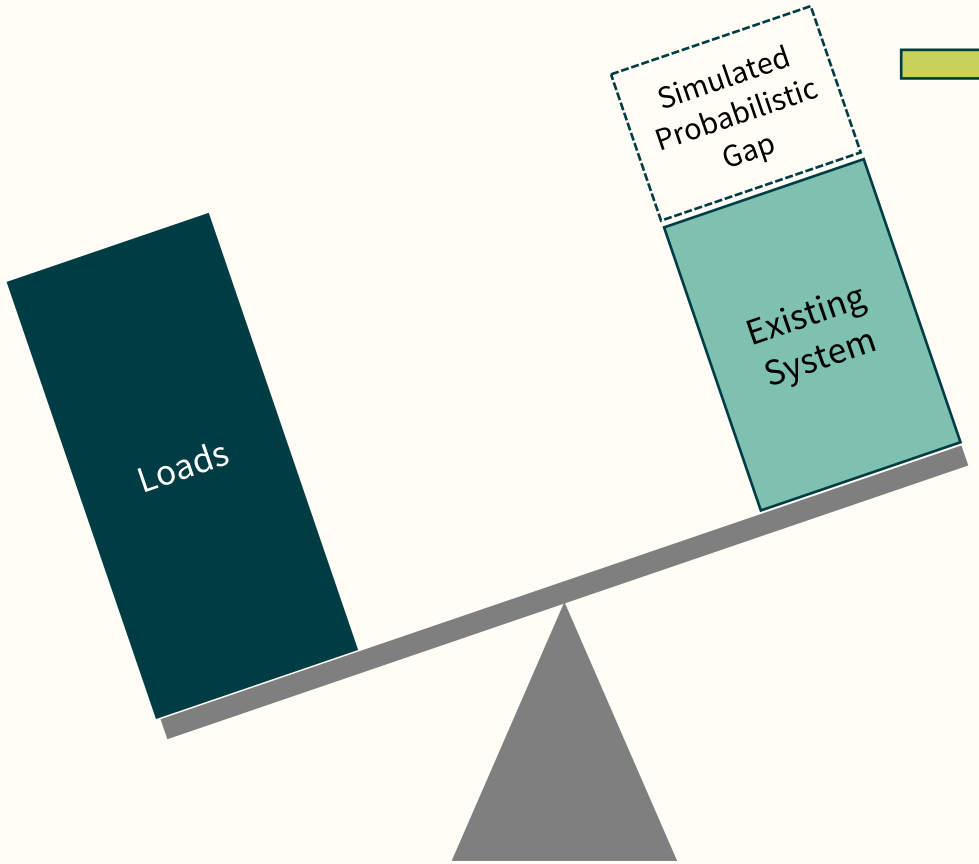


Needs Assessment asks:
"What does the region need (resource gap) in a future year **to be** adequate?"



Interpreting Needs

Post GENESYS simulation:



Define Risk by Multi-Metric Adequacy Framework:

Peak
Energy
Duration
Frequency

Define Adequacy Reserve Margin to signal Portfolio Expansion model

Adequacy Criteria for Ninth Power Plan

Protection against frequent deficits

Protection against extreme (tail-end) deficits

Frequency (LOLEV)

0.1 in summer
0.1 in winter
0.2 annual

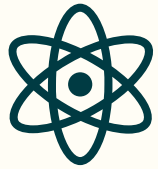
Limit to 1 in 10 years summer and winter events, Limit to 1 in 5 years overall

Duration

8-hour

Peak

1,200 MW



Energy

9,600 MWh

39 out of 40 years, protecting against events that are too big or too long

Reminder of Existing System

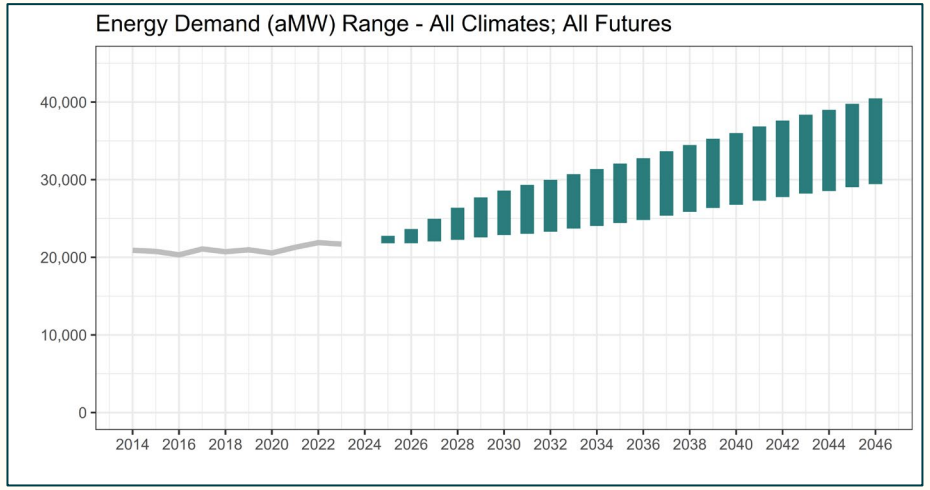
- Existing system assumes all the existing resources, including those under construction today and their capabilities
  - Any owner announced unit conversions are accounted for

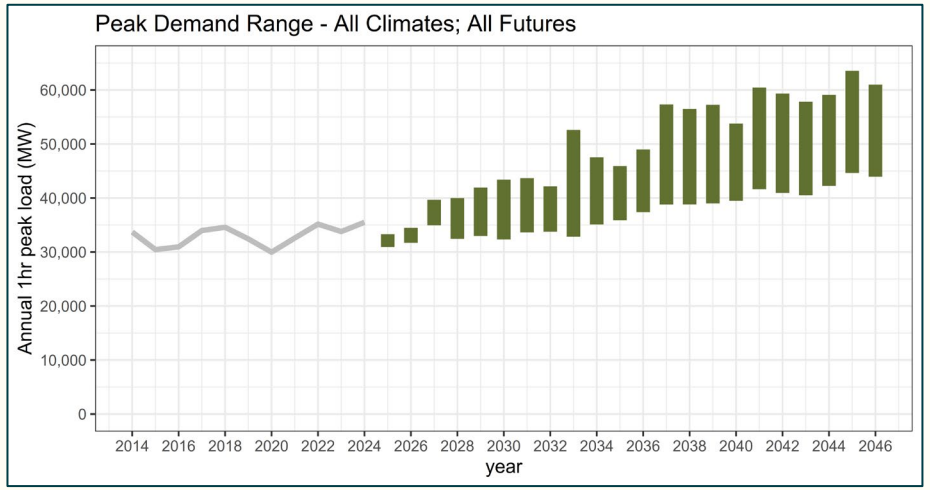
- Two caveats to this for this scenario are:
  - Hydro operations: These are varied in each sensitivity as described earlier
  - Transmission: This assumes the “Transmission Plus” view of transmission, which includes four projects that align with the WestTEC 10-year study

Reminder of Load Forecast

- Needs assessment assumes the 2031 load forecasts from the “Mixed Bag” pathway

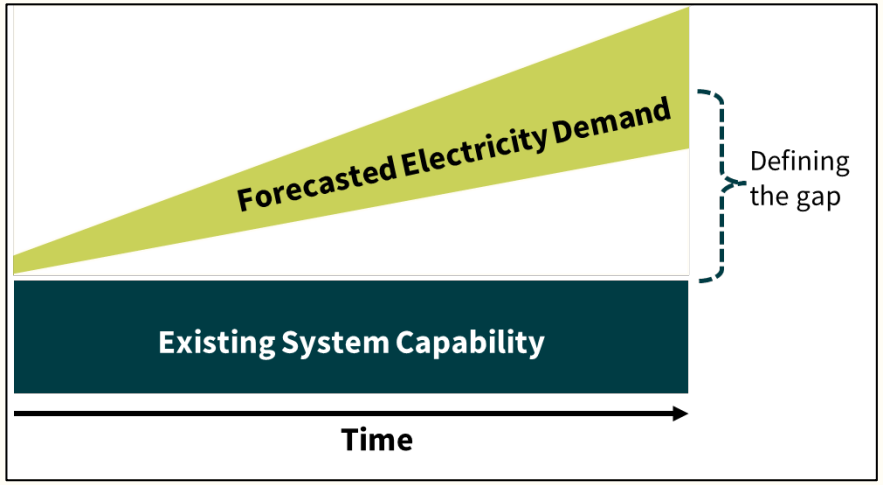
Pathways	Economics	Transportation	Data Centers	Building Electrification	Hydrogen
Persistent high growth	Medium	Higher	Higher	Higher	Higher
Persistent low growth	Lower	Lower	Lower	Lower	Lower
Early growth	Medium	Lower	Higher	Lower	Lower
Late growth	Medium	Higher	Medium	Higher	Higher
Mixed bag	Medium	Higher	Medium	Lower	Lower





Before We Get to the Results

- Reminder: This is a needs assessment with the purpose being to define the gap between the existing system and future load growth



- In other words, we will see needs, and that is point

Discussion Outline:

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Key Takeaways on Needs

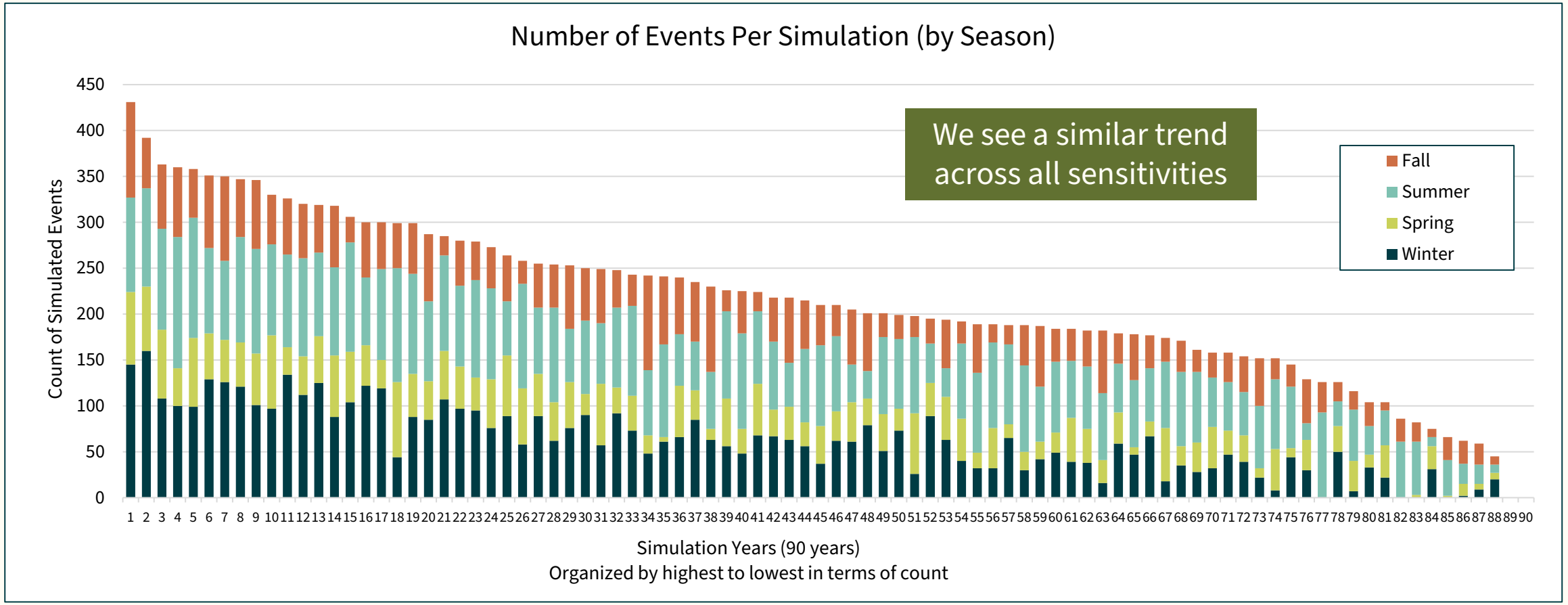
- The modeling shows significant needs for the region in 2031
- Needs are seen across all seasons, but the largest and longest gaps appear in the winter
- The expected load growth is the largest driver of the needs seen in this study
- There are differences between the sensitivities in terms of needs, with some of the operations showing greater needs than others
  - Note: These differences are not necessarily intuitive, meaning some operations that might be more tuned towards supporting fish mitigation do not necessarily show greater needs
  - Reminder: The Power Act was set up to first do the F&W Program, which might result in derating the hydro system to mitigate for fish, which then allows the Council to identify resource solution that support those and other Bonneville obligations; all while maintaining an adequate, efficient, economical, and reliable power supply
- Peak challenges are greater than energy challenges, meaning that a portfolio of resources will be needed to meet both peak and energy needs identified in these studies throughout the year

Frequency of Modeled Events

- There are a significant number of events across the different sensitivities
- These are seen across all the seasons, with the most in summer

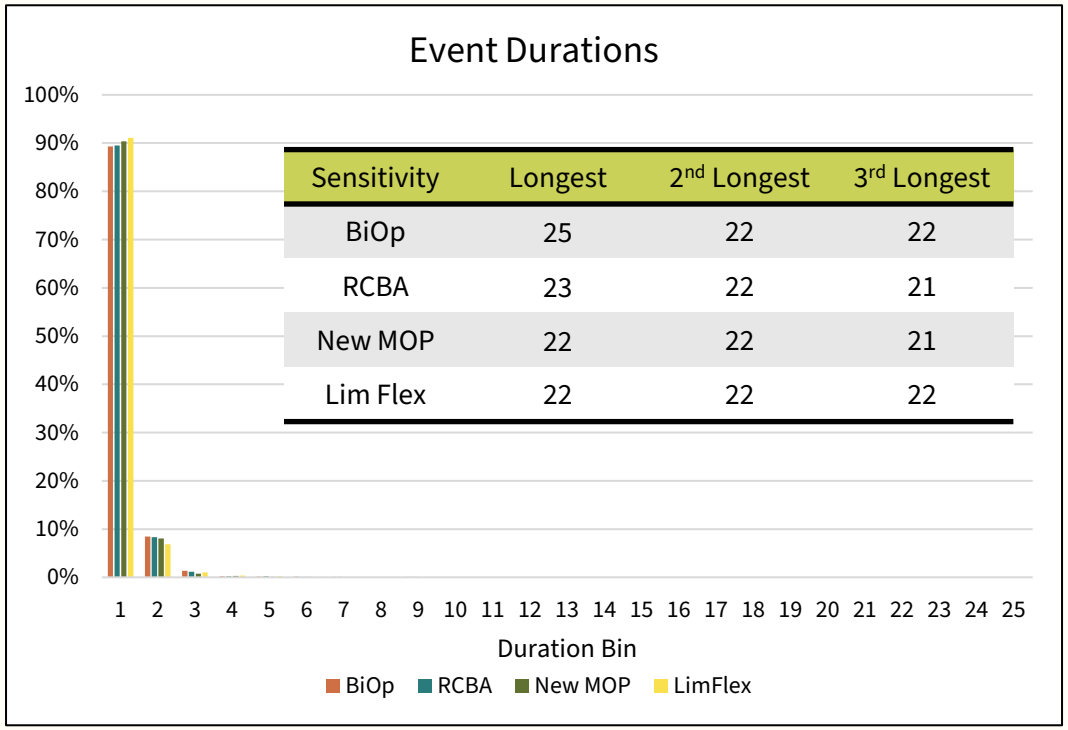
Season	Metric		Results
	Criteria	Allowed # of Events in 90 different simulation years	# of Events in 90 different simulation years
Annual	1 in 5 years	18	15,132 – 19,595
Winter	1 in 10 years	9	4,446 – 6,195
Summer	1 in 10 years	9	4,776 – 7,628

Example Simulated Event Record

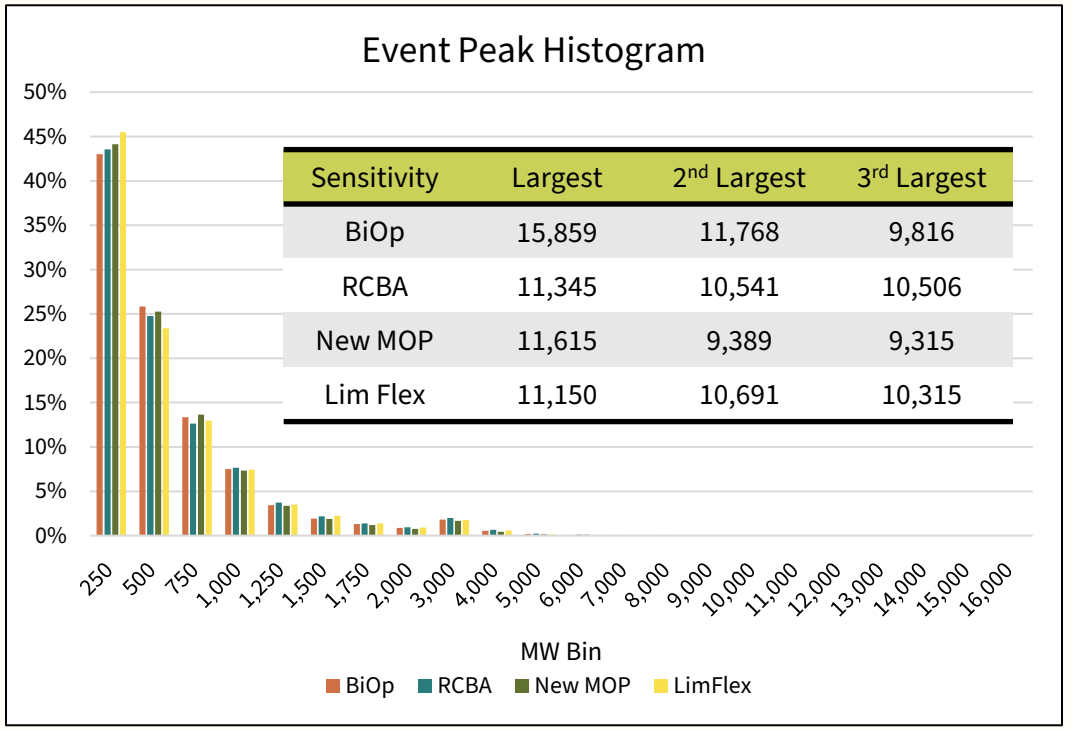


Most Events are Short and Small

- In each sensitivity, 90% of these are 1 hour and ~93% are less than 1250 MW

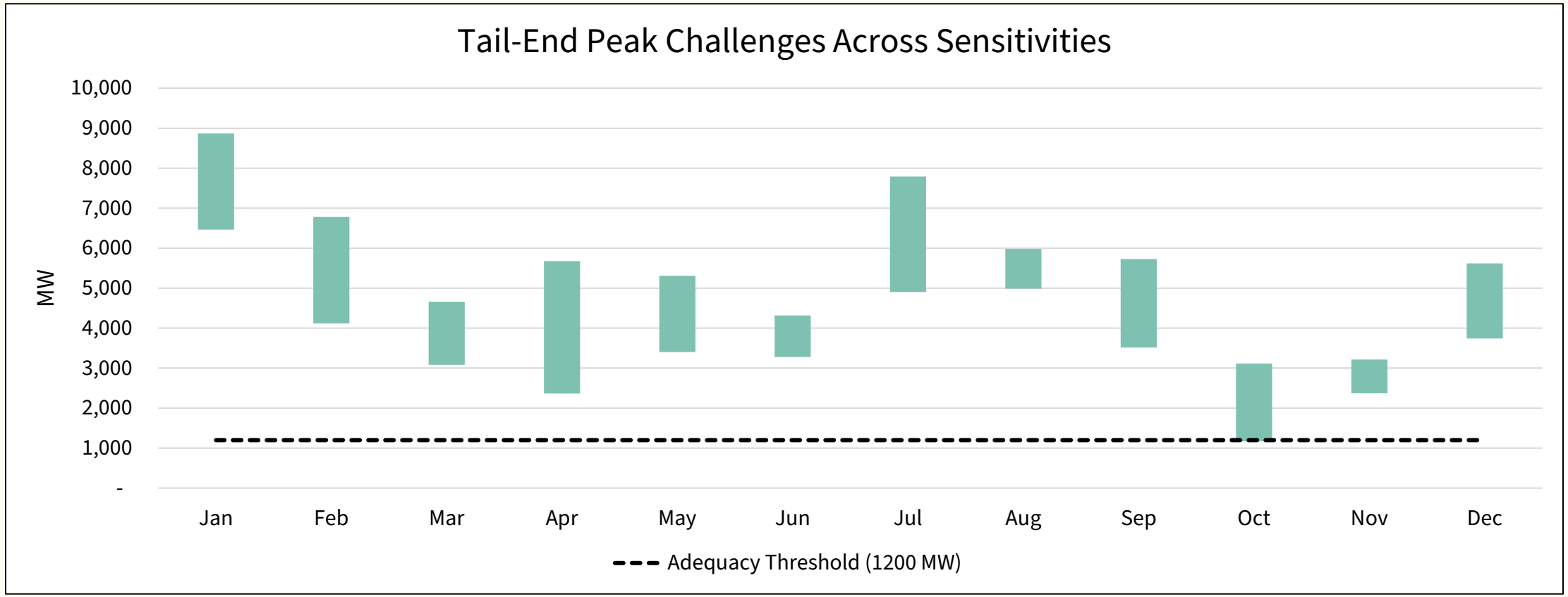


Sensitivity	Longest	2nd Longest	3rd Longest
BiOp	25	22	22
RCBA	23	22	21
New MOP	22	22	21
Lim Flex	22	22	22

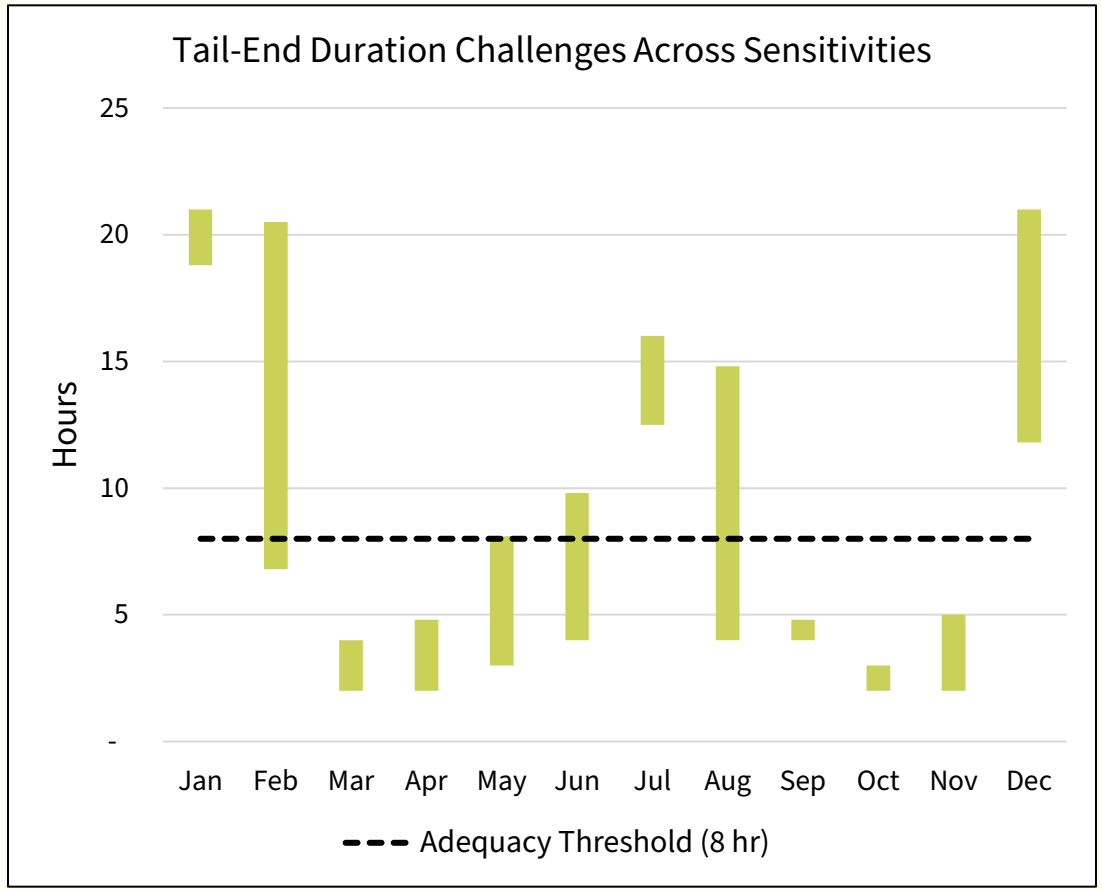


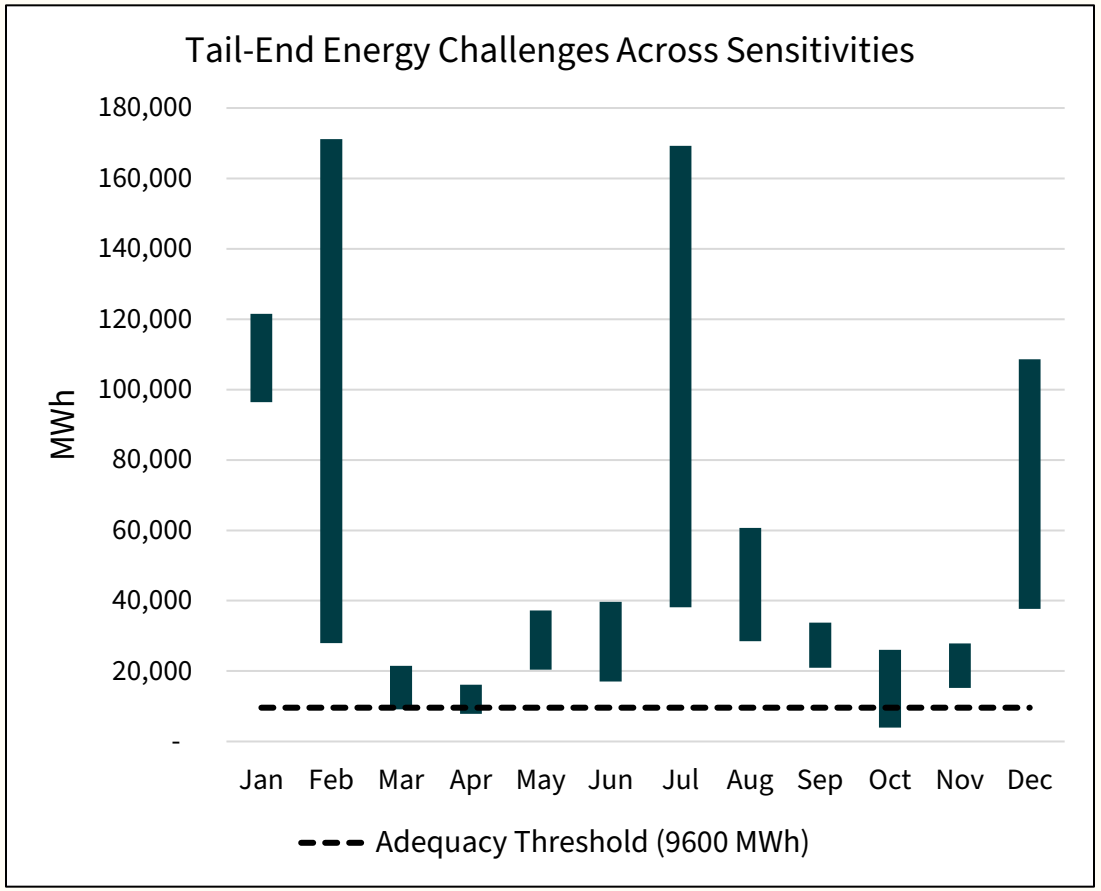
Sensitivity	Largest	2nd Largest	3rd Largest
BiOp	15,859	11,768	9,816
RCBA	11,345	10,541	10,506
New MOP	11,615	9,389	9,315
Lim Flex	11,150	10,691	10,315

Peak Challenges are Seen Across the Year



Energy Challenges are Greatest in the Winter, but also Seen in the Summer

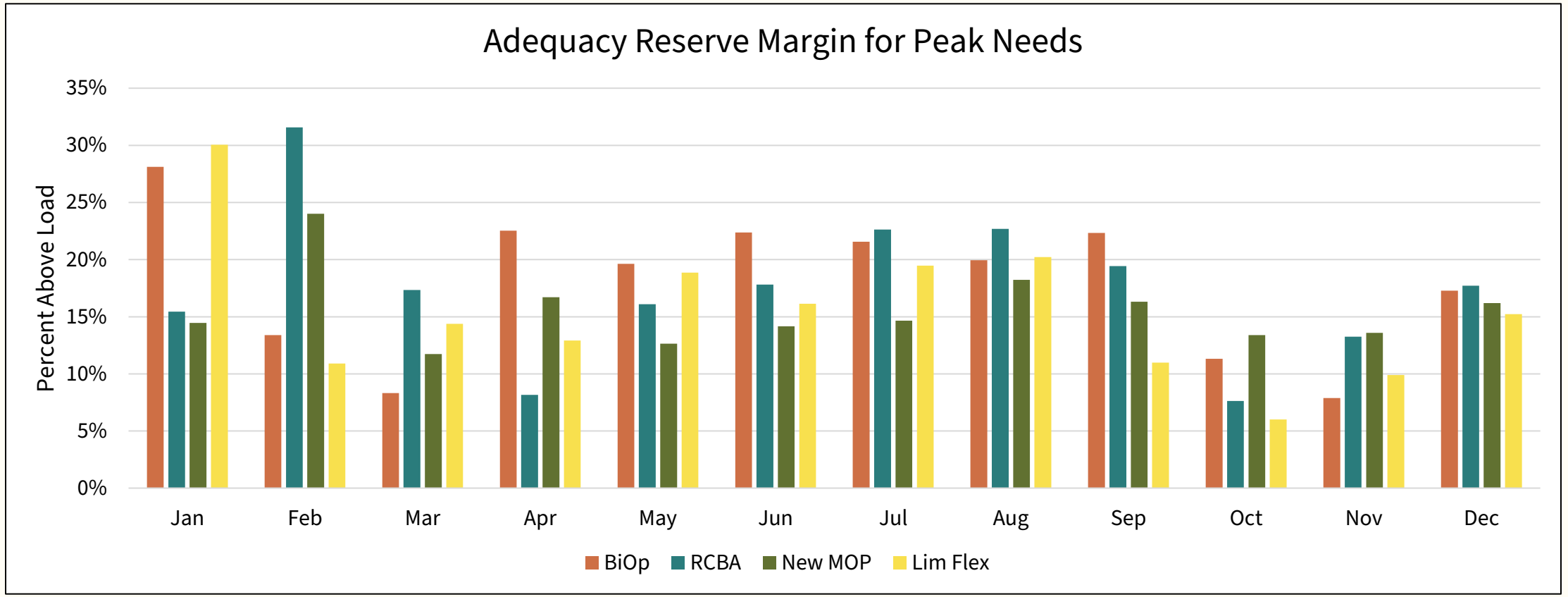




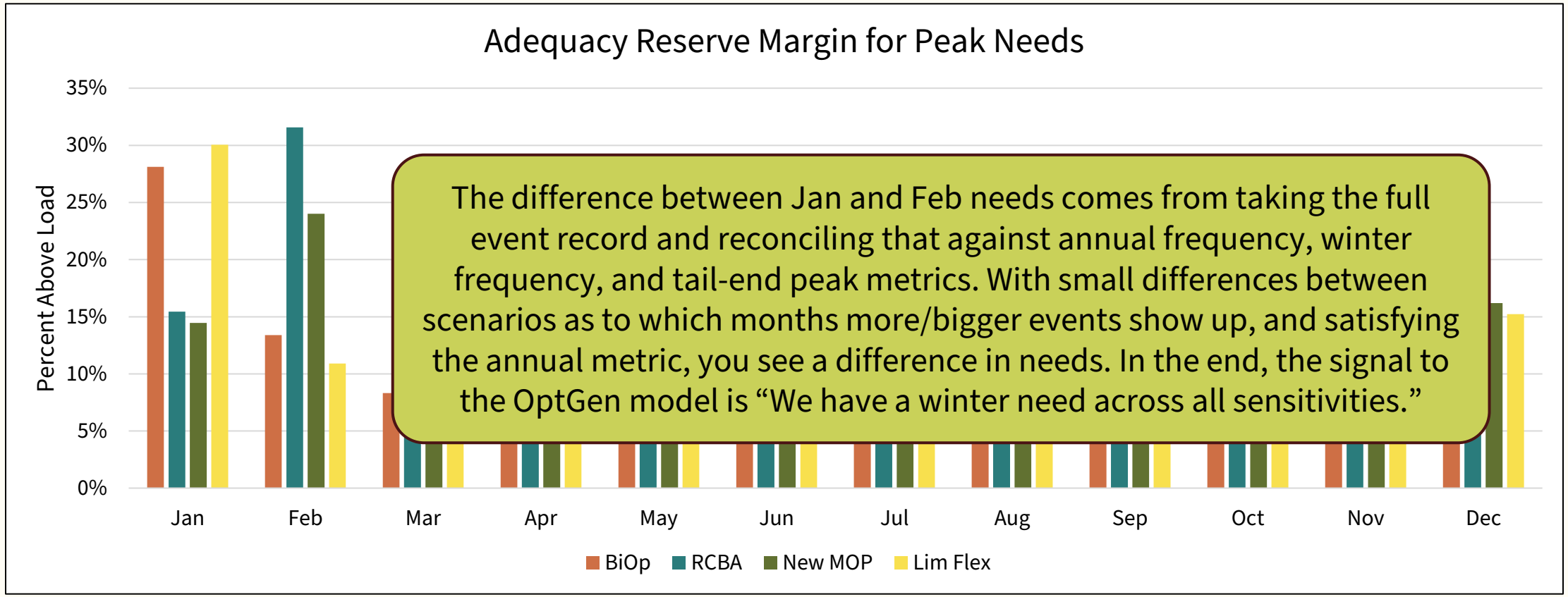
Overall Results Compared to Metrics

	Frequency			Extreme Deficits		
	Annual LOLEV (events)	Winter LOLEV (events)	Summer LOLEV (events)	VaR Duration (hr)	VaR Peak (MW)	VaR Energy (MWh)
Adequacy Criteria	0.2	0.1	0.1	8	1,200	9,600
BiOp	218	61	75	22	9,681	354,192
RCBA	210	57	85	21	10,366	348,771
New MOP	189	59	55	21	8,917	326,858
Limited Flex	168	49	53	22	10,200	327,008

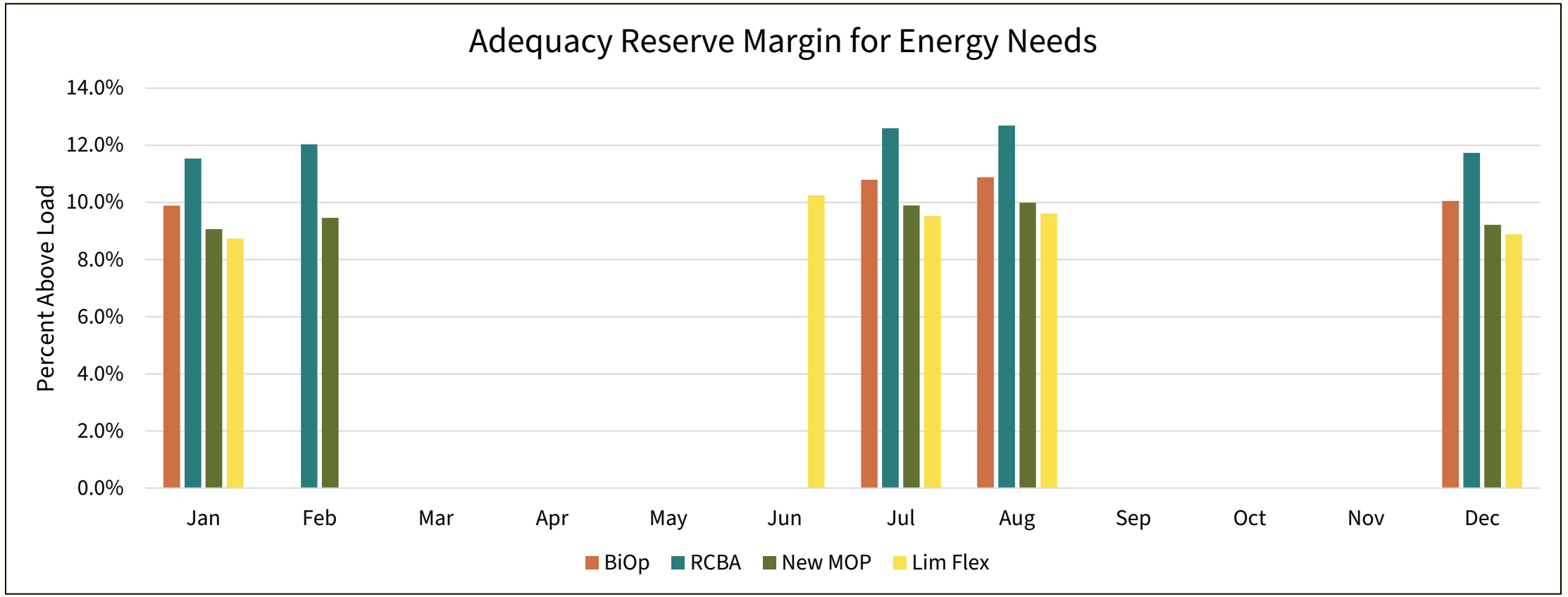
Peak Needs Across the Sensitivities



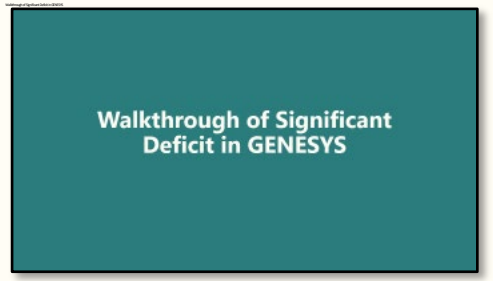
Peak Needs Across the Sensitivities



Energy Needs Across the Sensitivities



Initial Conclusions



- The modeling shows significant needs across all seasons, with the largest and longest gaps appear in the winter
- The expected load growth is the largest driver of the needs seen in this study
- There are differences between the sensitivities in terms of needs, and these differences vary by month
- Peak challenges are greater than energy challenges, meaning that a portfolio of resources will be needed to meet both peak and energy needs identified in these studies throughout the year

Discussion Outline:

1. Reminder of Scenario
2. Operational Differences Across Sensitivities
3. Reminder of Role of Needs Assessment
4. Needs Assessment Results
5. **Timeline and Next Steps**

Northwest **Power** and **Conservation** Council

Next Steps

- Continue working on the Changing Hydro Operations Scenario
  - Use the adequacy reserve margins from these needs assessments to guide the OptGen modeling for the resource optimization
- Start modeling for the New Resource and Transmission Risk Scenario
  - Working towards having the market studies for this scenario ready to present to the Council at the November meeting
  - Conducting any additional needs assessments for this scenario where required (e.g. different transmission system looks, different hydro operations if required by F&W program or other information)
  - Use the market studies and appropriate adequacy reserve margins from the existing needs assessments to guide OptGen modeling for resource optimization

Further Discussion?

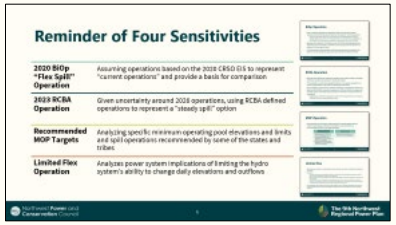
Additional Slides

BiOp Operation

BiOp Operation

- Staff is using the operations as defined the 2020 Columbia River System Operations Environmental Impact Statement to represent “current operations”
  - Legally, with the federal government’s withdrawal from the 2023 RCBA and revoking of President Biden’s Memorandum on Resorting Healthy and Abundant Salmon, Steelhead, and Other Native Fish Populations, the operations are assumed to return to the 2020 BiOp
- Between the finalization of the BiOp and the 2023 RCBA defining operations for 2024, there were some shifts in operations moving away from flex spill at most projects to 24-hour spill at some
- For the purposes of this sensitivity, staff assumed operations as defined in the BiOp and not the operations agreed to in years between the BiOp and RCBA

2020 BiOp Spill Operations (i.e. Flex Spill)



Project	Spring Operation Lower Snake: 4/3-6/20 Lower Columbia: 4/10-6/15	Summer Operation Lower Snake: 6/21-8/14 Lower Columbia: 6/16-8/14	Summer Operation 8/15-8/31
Lower Granite	16 hr: 125% TDG; 8 hr: 20 kcsf	18 kcsf	RSW or 7 kcsf
Little Goose	16 hr: 125% TDG; 8hr: 30%	30%	ASW or 7 kcsf
Lower Monumental	16 hr: 125% TDG; 8 hr: 30 kcsf	17 kcsf	RSW or 7 kcsf
Ice Harbor	16 hr: 125% TDG; 8 hr: 30%	30%	RSW or 8.5 kcsf
McNary	16 hr: 125% TDG; 8 hr: 48%	57%	20 kcsf
John Day	16 hr: 125% TDG; 8 hr: 32%	35%	20 kcsf
The Dalles	24 hr: 40%	40%	30%
Bonneville	16 hr: 125% TDG; 8 hr: 100 kcfs	95 kcsf	50 kcsf

RSW = removable spillway weir
ASW = auxiliary spillway weir

RCBA

RCBA Operation

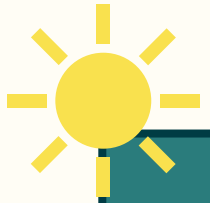
- While the 2023 RCBA was revoked by President Trump, staff included a sensitivity with these operations to represent a “steady spill” option
- This sensitivity is useful for providing information on how system operations and needs change between a flex spill and steady spill environment
- It’s reasonable to assume that if operations ultimately sit somewhere between the BiOp and 2023 RCBA, more akin to operations in 2022 and 2023 for example, that the hydro system and needs impacts would be somewhere in between these two sensitivities
  - Suggesting some tradeoff of increased spill coupled with reduced generation at some projects or months offset by increased generation at others

RCBA Operation

- 2023 Resilient Columbia Basin Agreement included changes to spill operations at several projects, as well as the allocation of reserves at some.

Spring

Change from the “Flex Spill”(16 hr/8 hr) regime under the BiOp to a steady 24-hour spill at 125% TDG



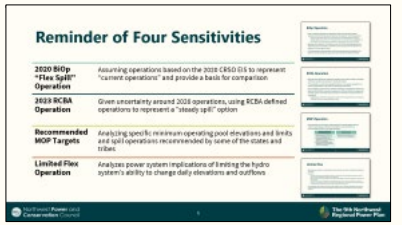
Summer

Change in date for the end of performance spill from August 14 under the BiOp to July 31 under RCBA

Fall

Updated spill values in the RCBA for lower Snake and McNary and John Day in the lower Columba

See changes in spring spill, change in summer operations dates, and small changes in late summer spill



2023 RCBA Spill Operations

To compare to the 2020 BiOp spill operations, those are included in the crossed-out text

Project	Spring Operation Lower Snake: 4/3-6/20 Lower Columbia: 4/10-6/15	Summer Operation Lower Snake: 6/21-7/31 ~~8/14~~ Lower Columbia: 6/16-7/31 ~~8/14~~	Summer Operation ~~8/15~~ 8/1-8/31
Lower Granite	24 hr: 125% TDG ~~16 hr: 125% TDG; 8 hr: 20 kcsf~~	18 kcsf	SW flow ~~RSW or 7 kcsf~~
Little Goose	24 hr: 125% TDG ~~16 hr: 125% TDG; 8hr: 30%~~	30%	ASW or 7 kcsf
Lower Monumental	24 hr: 125% TDG ~~16 hr: 125% TDG; 8 hr: 30 kcsf~~	17 kcsf	SW flow or 8 kcsf ~~RSW or 7 kcsf~~
Ice Harbor	24 hr: 125% TDG ~~16 hr: 125% TDG; 8 hr: 30%~~	30%	SW flow or 9 kcsf ~~RSW or 8.5 kcsf~~
McNary	24 hr: 125% TDG ~~16 hr: 125% TDG; 8 hr: 48%~~	57%	20 kcsf
John Day	16 hr: 40%; 8 hr: 125% TDG ~~16 hr: 125% TDG; 8 hr: 32%~~	35%	20 kcsf
The Dalles	24 hr: 40%	40%	30%
Bonneville	24 hr: 125% TDG ~~16 hr: 125% TDG; 8 hr: 100 kcfs~~	95 kcsf	50 kcsf

MOP Op

MOP Operation

- This sensitivity was included to analyze specific recommendations around minimum operating pool elevations and target and spill operations as recommended by some of the states and tribes

Minimum Operating Pool (MOP) Operations	Spill Operations
• Operate projects at MOP from March 1 through September 30 • Lower Snake Projects: Hold elevations to 1.0’ hard constraint and 0.5’ soft constraint • Lower Columbia Projects: Hold elevations to 1.5’ hard constraint and 1.0’ soft constraint	• Extend summer “performance standard” spill through August 30

MOP Operations Modeled for Lower Snake Projects

- In the lower Snake there are current MOP operations with a 1.5’ hard constraint and a 1.0’ soft constraint from April 3 – August 14
- Joint entity recommended operations would tighten these elevations to a 1.0’ hard constraint and a 0.5’ soft constraint and extend the period to March 1 – September 30

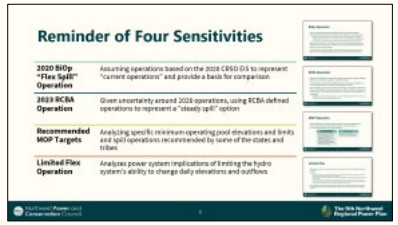
Project	Current Pool Elevation Operations (ft)	MOP Operations Modeled (ft)
Lower Granite	733-734.5	733-734
Little Goose	633-634.5	633-634
Lower Monumental	537-538.5	537-538
Ice Harbor	437-438.5	437-438

MOP Operations Modeled for Lower Columbia Projects

- There are currently no spill season MOP targets for the lower Columbia projects
- Joint entity recommended operations keep elevations to a 1.5’ hard constraint and a 1.0’ soft constraint

Project	Current Pool Elevation Operations (ft)	MOP Operations Modeled (ft)
McNary	337-340	337-338.5
John Day	262-266.5	262.5-264
The Dalles	157-160	157-158.5
Bonneville	71.5-76.5	71.5-73

Spill Recommendations



- As noted above, several entities also included recommendations for spring and summer spill to “achieve the greatest biological benefit while avoiding biological harm” and to achieve powerhouse encounter rates below 1 in support of the 2-6% SAR goal
- Key to these recommendations is that they extend summer spill through August (currently ends on July 31 under RCBA and August 14 under the 2020 BiOp)
- For this sensitivity, staff molded these spill operations, making them additive to what was the spill operation in the RCBA, by modeling 125% TDG for 24 hours a day in the spring and performance standard spill in the summer

Limited Flex

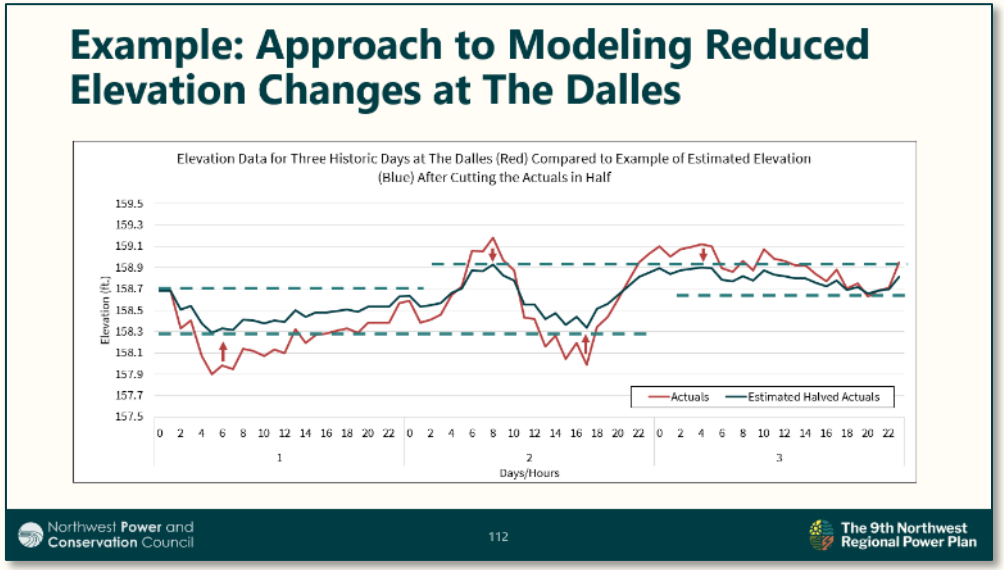
Limited Flex

- Sensitivity was intended to provide insight on power system implications of limiting the flexibility of the system
- Reminder:
  - GENESYS model sees more operational flexibility on a daily basis (while meeting all the existing constraints) than is currently being utilized in today's actual operations
  - 2021 Power Plan saw value in leaning into this operational flexibility to support the integration of renewables as loads increase
  - At the same time, the Council's 2014 Fish and Wildlife Program contains measures calling on the system to minimize or reduce daily fluctuations and several entities submitted recommendations and comments into this amendment process calling on recommendations to reduce flow fluctuations
- This sensitivity was striving to limit the model's ability to flex to represent operations more akin to current system dynamics of the daily range of outflows of the Lower Snake and Lower Columbia projects

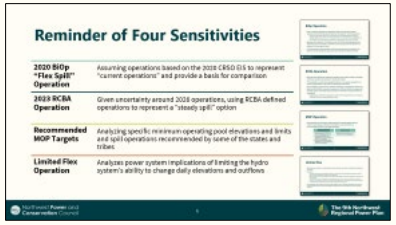
Initial Approach

- Recognizing the model sees more flexibility than is used in actual operations, staff planned to set flexibility limits based on 2020-2024 changes in elevations and flows
- The initial approach was to take this historical operations and to cut those fluctuations in half
- After initial runs, staff realized it needed to modify the approach somewhat

Reminder from August:



Updated Approach



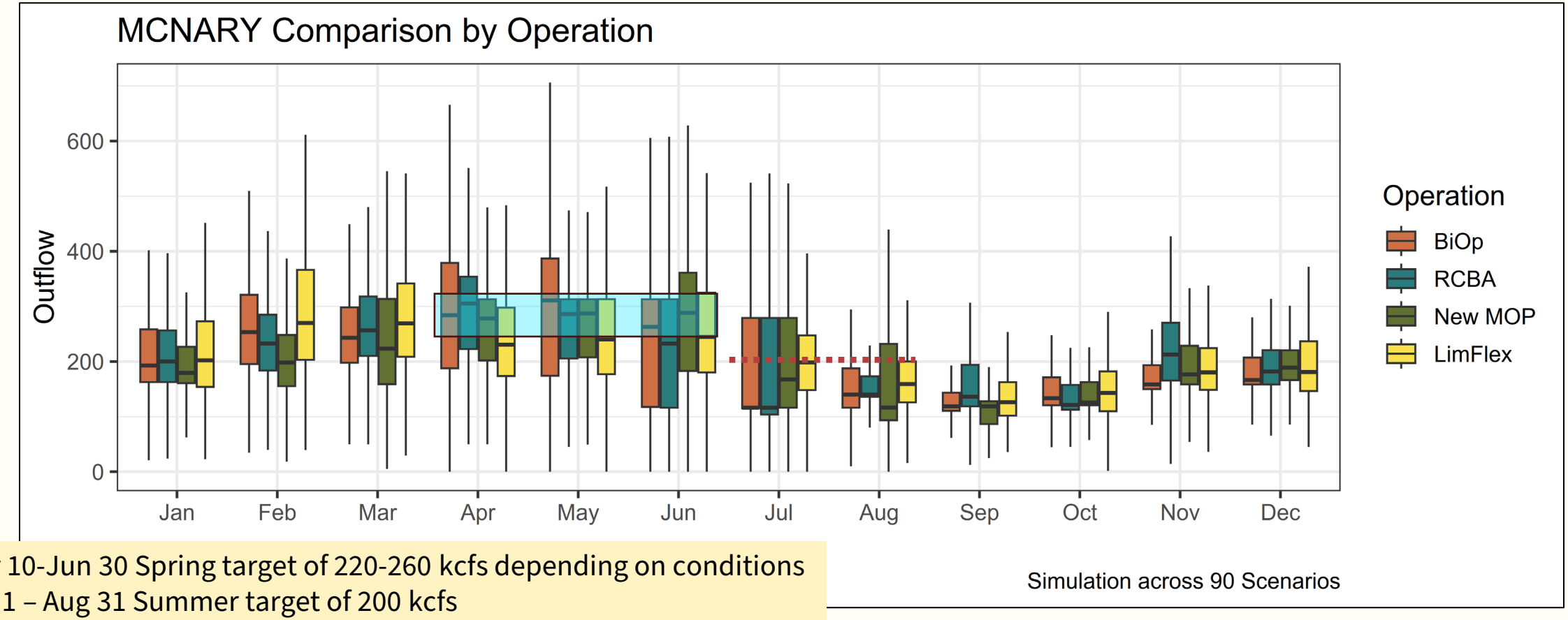
- Rather than trying to get fluctuations to less than where they have been historically based on 2020-2024 actuals, staff updated the target to more closely mimic the daily ranges seen in the historical data
  - A tighter bound on fluctuation was challenging to test in a model at this point in time with no new resource additions; this could be something to test more at a later date if the goal is to indeed reduce daily elevation/outflow changes from where they have been historically
- To mimic these flows, staff incorporated an adjusted average daily range as a new discharge rate limit:

Current	LWG	LGS	LMN	ICH	MCN	JDA	TDA	BON
Water Management Plan allowed discharge (kcfs/hour)	70	70	70	20	150	200	150	25
Limited Flex scenario (kcfs/hour)	0.96	0.96	0.96	0.96	2.40	2.40	2.40	2.40

Flow Targets

McNary Flow Target vs Simulated Outflows

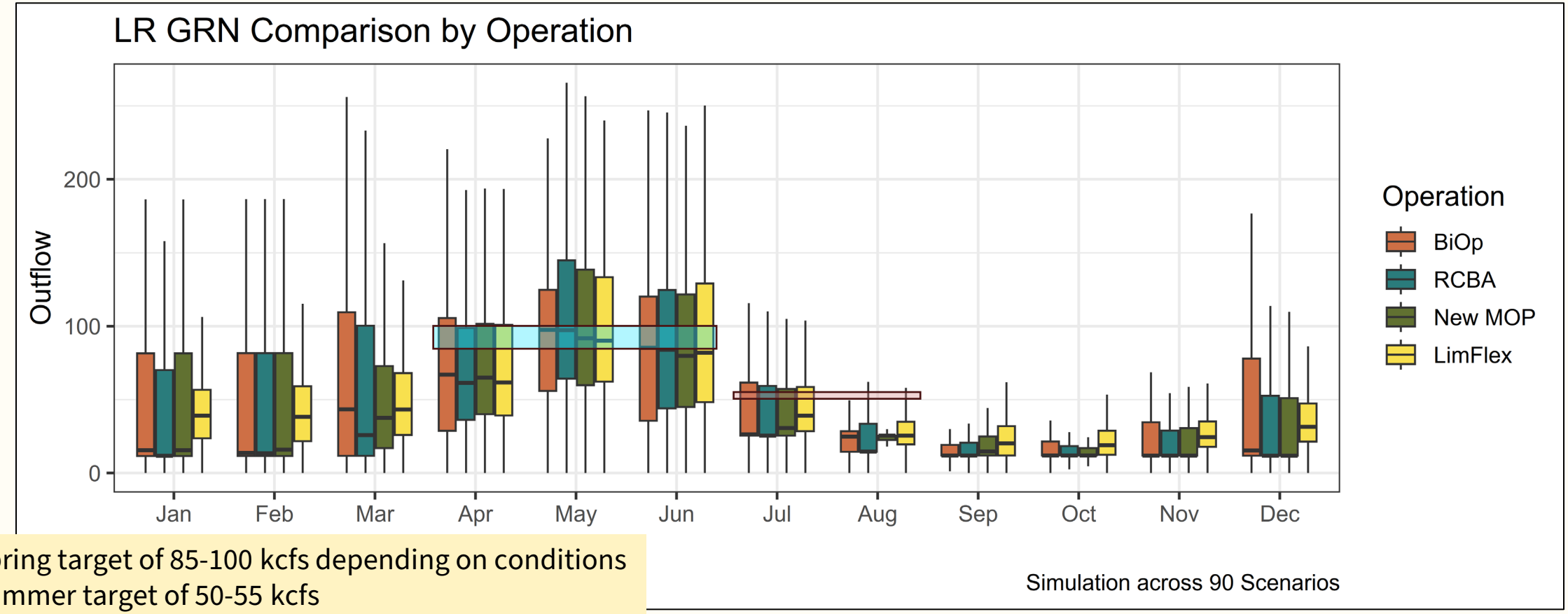
McNary Flow Meeting Objective		
Operation	**Spring**	**Summer**
Actuals	~80% (since 1953)	~ 21% since 1975
BiOp	64.8%	32.8%
LimFlex	57.5%	36.7%
New MOP	67.8%	37.0%
RCBA	64.9%	27.3%



Apr 10-Jun 30 Spring target of 220-260 kcfs depending on conditions
Jul 1 – Aug 31 Summer target of 200 kcfs

Lower Granite Flow Target vs Simulated Outflows

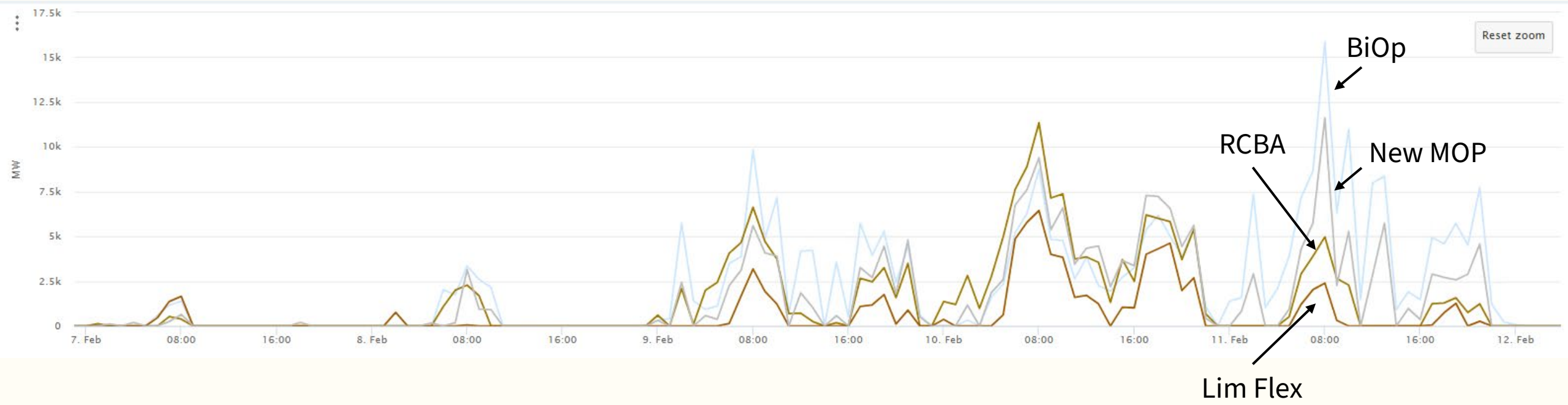
Lower Granite Flow Meeting Objective		
Operation	**Spring**	**Summer**
Actuals	~61% since 1995	~28% since 1975
BiOp	49.4%	22.8%
LimFlex	46.2%	22.5%
New MOP	46.8%	20.1%
RCBA	49.0%	23.2%



Spring target of 85-100 kcfs depending on conditions
Summer target of 50-55 kcfs

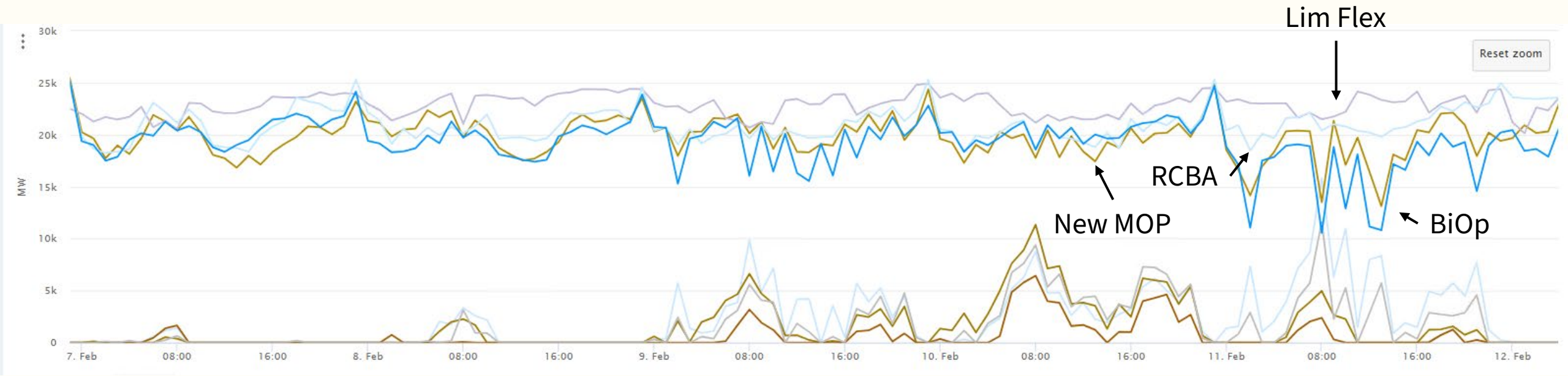
Walkthrough of Significant Deficit in GENESYS

The same hydro and load conditions drive the worst deficits across sensitivities



Example of largest deficit – in February - under the highest load conditions and average water conditions

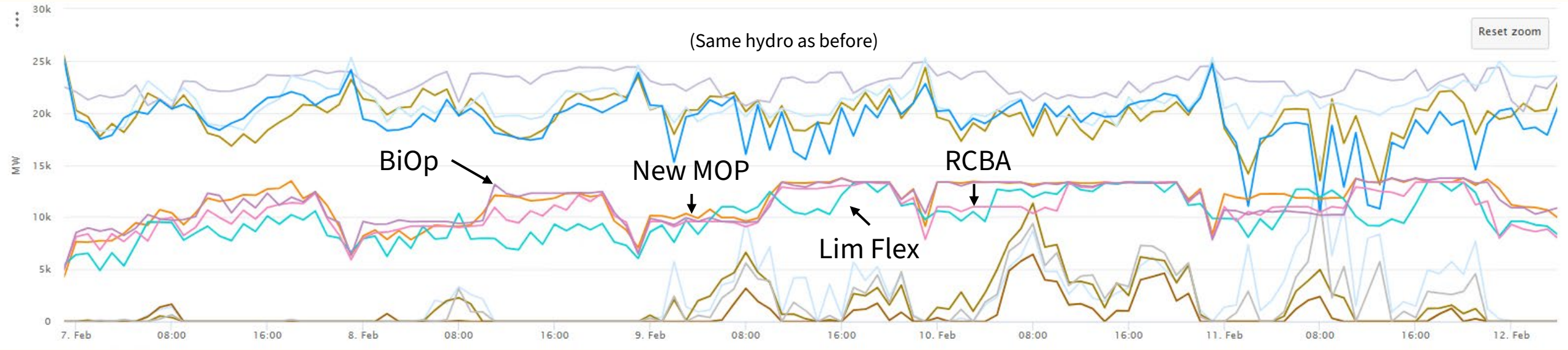
Hydro generation varied across most operations, but is more consistent with Lim Flex



(Same deficits as before)

In the days leading up to the deficit, BiOp, RCBA, and New MOP fluctuated their regional hydro generation, whereas Lim Flex did not ramp up and down as much. This may be why the event was smaller in the Lim Flex sensitivity compared to the others

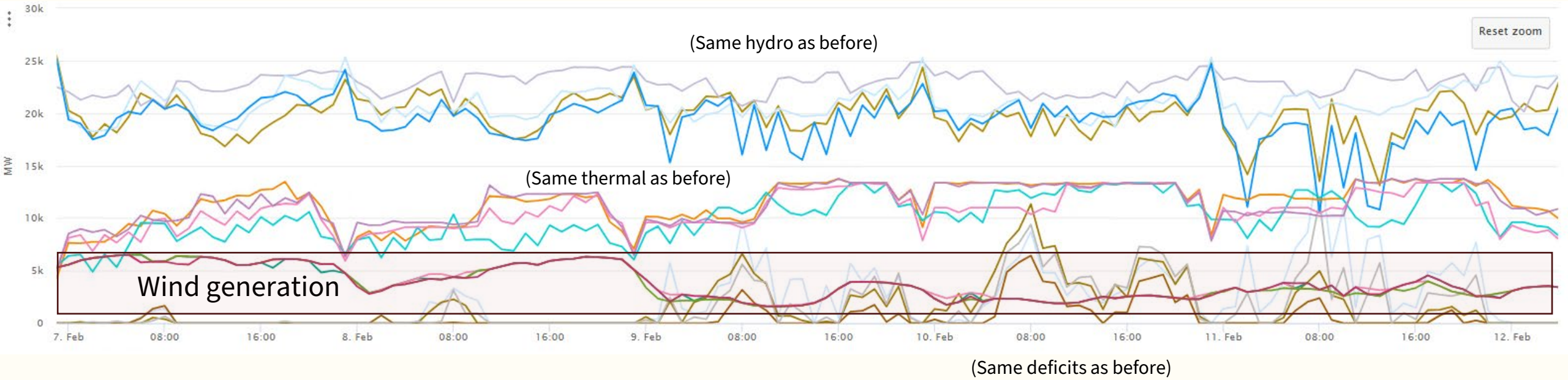
Thermal generation followed hydro usage



(Same deficits as before)

All operations heavily relied on thermal generation, with LimFlex using less thermal generation the day before

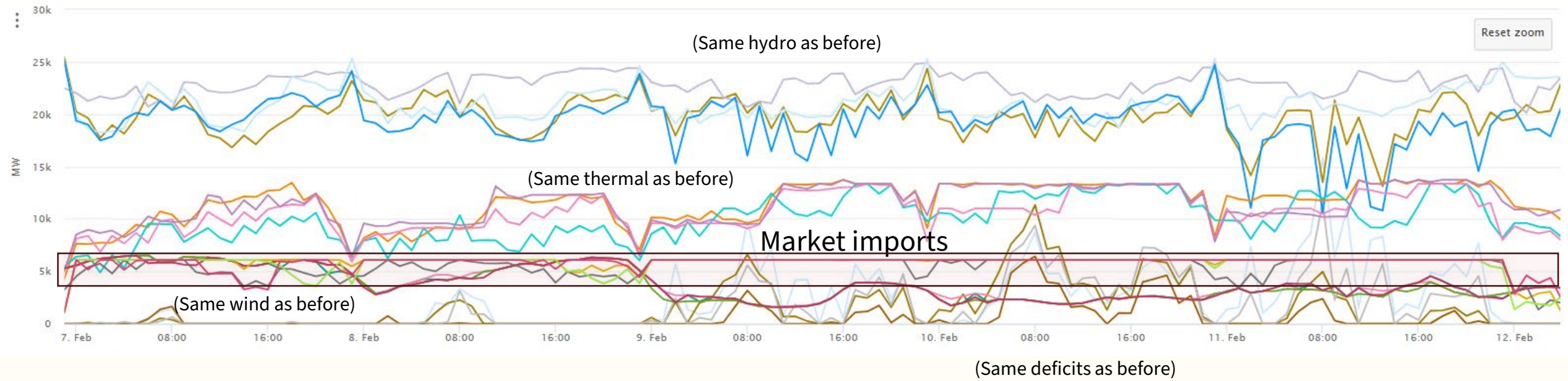
Low wind conditions across all sensitivities throughout the deficit



(Same deficits as before)

Marginal wind generation differences between the operations

Market imports capped during event



(Same deficits as before)

All operations imported to the market reliance limit (2,500 MW) during the event.
The day before some import variability depending on hydro and thermal

The week before experienced less challenging hydro & wind conditions