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NorthernGrid

**Regional Transmission Plan
for the 2022-2023
NorthernGrid Planning Cycle**

***NorthernGrid Member Planning Committee (MPC)
Anticipated Approval Date: December 14, 2023***

NorthernGrid Member Planning Committee

1 Acknowledgements:

NorthernGrid Members

Avista Corporation
BHE U.S. Transmission (MATL)
Bonneville Power Administration
Chelan County PUD
Idaho Power Company
NorthWestern Energy
NV Energy
PacifiCorp
Portland General Electric
Puget Sound Energy
Seattle City Light
Snohomish County PUD
Tacoma Power

Interregional or non-Incumbent Transmission Project Sponsors

PowerBridge – Cascade Renewable Transmission Project
Absaroka Energy, LLC – Loco Falls Greenline
TransCanyon, LLC – Cross-Tie Transmission Line
Great Basin Transmission, LLC – Southwest Intertie Project – North

Neighboring Regional Entities

CAISO
WestConnect

Participating State Agencies

Idaho PUC
Idaho OER
Montana PSC
Montana Consumer Counsel
Oregon PUC
Utah Department of Commerce
Utah Office of Energy Development
Washington UTC
Washington EFSEC
Wyoming PSC

Consultants and Other Contributors

Western Power Pool
Power Systems Consulting (PSC)
Western Electricity Coordinating Council – power flow and production cost model base cases



NorthernGrid

1 Copies of this report are available from:
2 Western Power Pool
3 7525 NE Ambassador Place, Suite M, Portland, OR 97220
4 nwpp_northerngrid_staff@westernpowerpool.org or
5 [WPP RTPS_Staff@westernpowerpool.org](mailto:WPP_RTPS_Staff@westernpowerpool.org)
6 (503) 445-1074
7
8
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25 Disclaimer: The data and analyses contained in this report are not warranted by NorthernGrid or any
26 other party, nor does NorthernGrid accept delegation of responsibility for compliance with any industry
27 compliance or reliability requirement, including any reliability standard. Any reliance on this data or
28 analyses is done so at the user's own risk.

1 Executive Summary

2 The NorthernGrid is an unincorporated association of entities that either own or operate, or that
3 propose to own or operate, electric transmission facilities in the Western Interconnection. The
4 NorthernGrid promotes coordinated, open, and transparent transmission planning and facilitates
5 compliance with Federal Energy Regulatory Commission (“FERC”) Orders No. 890 and 1000. The
6 NorthernGrid is comprised of entities regulated by FERC and those that are not. The regional
7 transmission planning process for the enrolled FERC jurisdictional Transmission Providers is defined in
8 each provider’s Open Access Transmission Tariff Attachment K – Regional Planning Process. The
9 NorthernGrid entities that are not regulated by FERC participate in the regional transmission planning
10 process through the NorthernGrid Planning Agreement for Planning Cycle 2022-2023.

11 The NorthernGrid 2022-2023 Regional Transmission Plan was developed according to the NorthernGrid
12 regional planning process. The load and resource assumptions, transmission power flow conditions,
13 analysis methods, and criteria used are described in the 2022-2023 Study Scope. A link to the Study
14 Scope is provided in Appendix B: Study Scope. The objective of the planning process is to identify the
15 projects that either cost-effectively or efficiently meet the needs of the NorthernGrid region in a 10-year
16 horizon.

17 The process began in the first quarter with each NorthernGrid Member submitting their 10-year
18 forecasted load, projected resource additions, retirements, public policy requirements, and projected
19 transmission additions. During this quarter, non-member entities were also permitted to submit
20 regional transmission projects for consideration. Four non-incumbent transmission project developers,
21 Absaroka Energy LLC, TransCanyon LLC, Great Basin Transmission LLC, and PowerBridge LLC, submitted
22 transmission projects. Three of these developers also submitted information that met the Qualified
23 Developer criteria for the purpose of project cost allocation. All this information was summarized and
24 incorporated into a Study Scope. The Study Scope also describes the process, assumptions, power flow
25 case selection, production cost modeling use, analysis methods, and criteria.

26 The Members chose several Western Electricity Coordinating Council (WECC) 2032 and 2033 power flow
27 base cases representing heavy summer, heavy winter, and light spring conditions for reliability analysis.
28 These cases were modified to achieve the following three transmission stress conditions:

- 29 • 2032 heavy summer loads with high power flow as follows: from Oregon to California, from
30 Washington and Oregon to Idaho, and Alberta to Montana,
- 31 • 2031-2032 heavy winter loads with typical seasonal generation resource dispatch and power flow
32 from Montana to Alberta, and
- 33 • 2033 light spring loads with high power flows from California to Oregon.

34

35 An additional heavy winter power flow case was developed through analysis of the 2032 Anchor Data
36 Set production cost model (PCM) to analyze westbound transmission flows from Wyoming wind
37 resources across the Northern Grid region. The hour with the heaviest westbound flows out of Wyoming

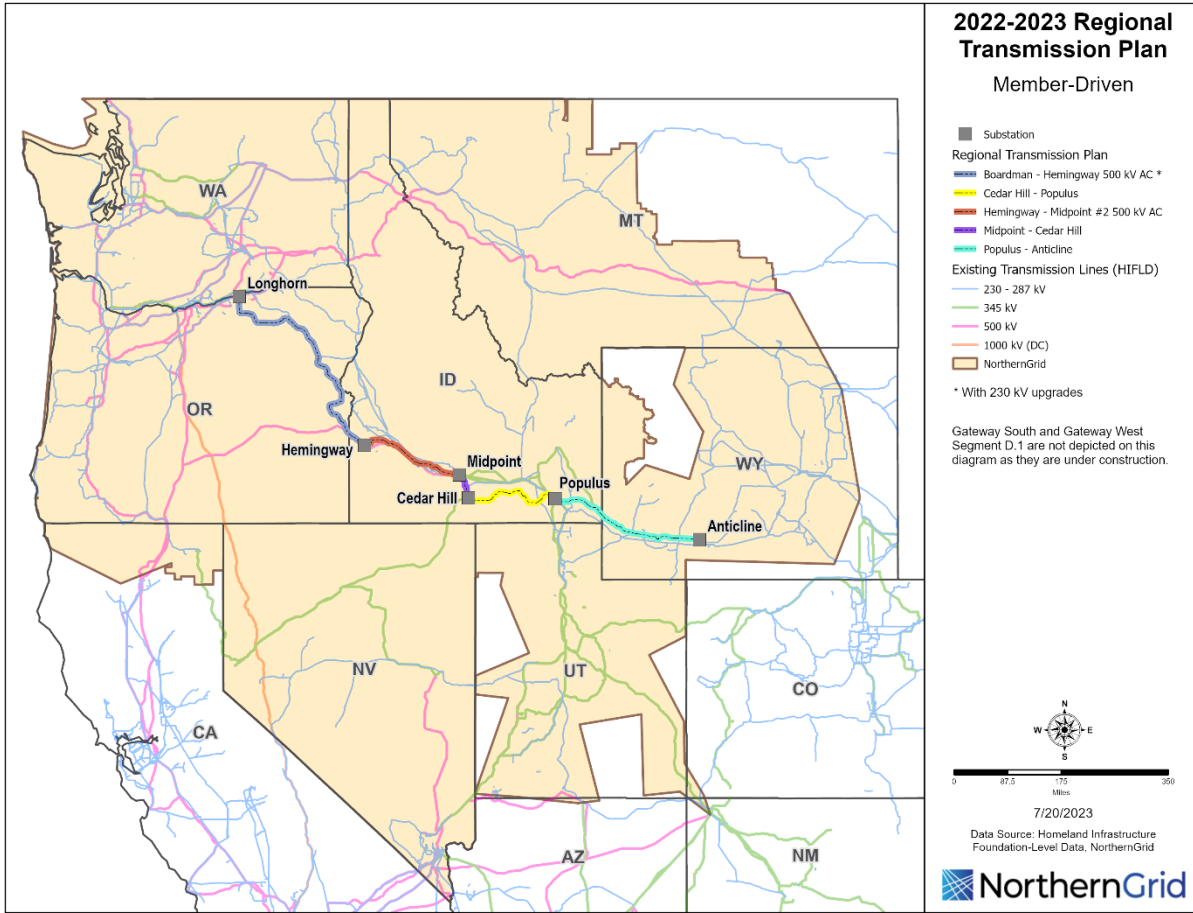
1 was selected to represent regional transmission stress conditions during high Wyoming wind
2 generation. This hour occurred at noon on December 11, 2032, in the PCM model.

3 Each power flow case's regional transmission configuration was modified to represent 28 unique
4 regional combinations of the submitted regional transmission projects. The combinations ranged from
5 including no to all submitted regional transmission projects. Then, contingency analysis was performed
6 on these power flow cases using 230 kV and above electrical facility contingencies submitted by the
7 Members. Facilities within the NorthernGrid region and adjacent regions were monitored for reliability
8 criteria violations.

9 The regional combinations were ranked based on the weighted number of reliability criteria violations
10 occurring during the contingency analysis. The regional combination with the fewest violations received
11 the highest ranking. The 2023 Regional Transmission Plan was selected based on the regional
12 combination ranking and total estimated cost of the projects included in the regional combination.

13 The regional combination of Boardman to Hemingway, Gateway West Phase 1, and Cascade Renewable
14 Transmission Project received the highest contingency analysis ranking. A review of the violations
15 identified that the eliminated violations changed from slightly above to slightly below the criteria
16 threshold. When considering this minimal improvement and the additional project cost, the
17 combination including Cascade Renewable Transmission Project was deemed less cost effective than the
18 regional combination of Boardman to Hemingway and Gateway West Phase 1. A cost allocation
19 analysis was not required because no Qualified Developers' projects were selected into the Regional
20 Transmission Plan. Figure 1 below depicts the projects evaluated and those, with pink highlight, that
21 were determined to be the most efficient and cost-effective combination for the NorthernGrid region
22 given the analysis performed as described in this report.

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Figure 1: Regional Transmission Plan, regional combination 11

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10 Regional Transmission Plan Development

11 Transmission Planning Requirements

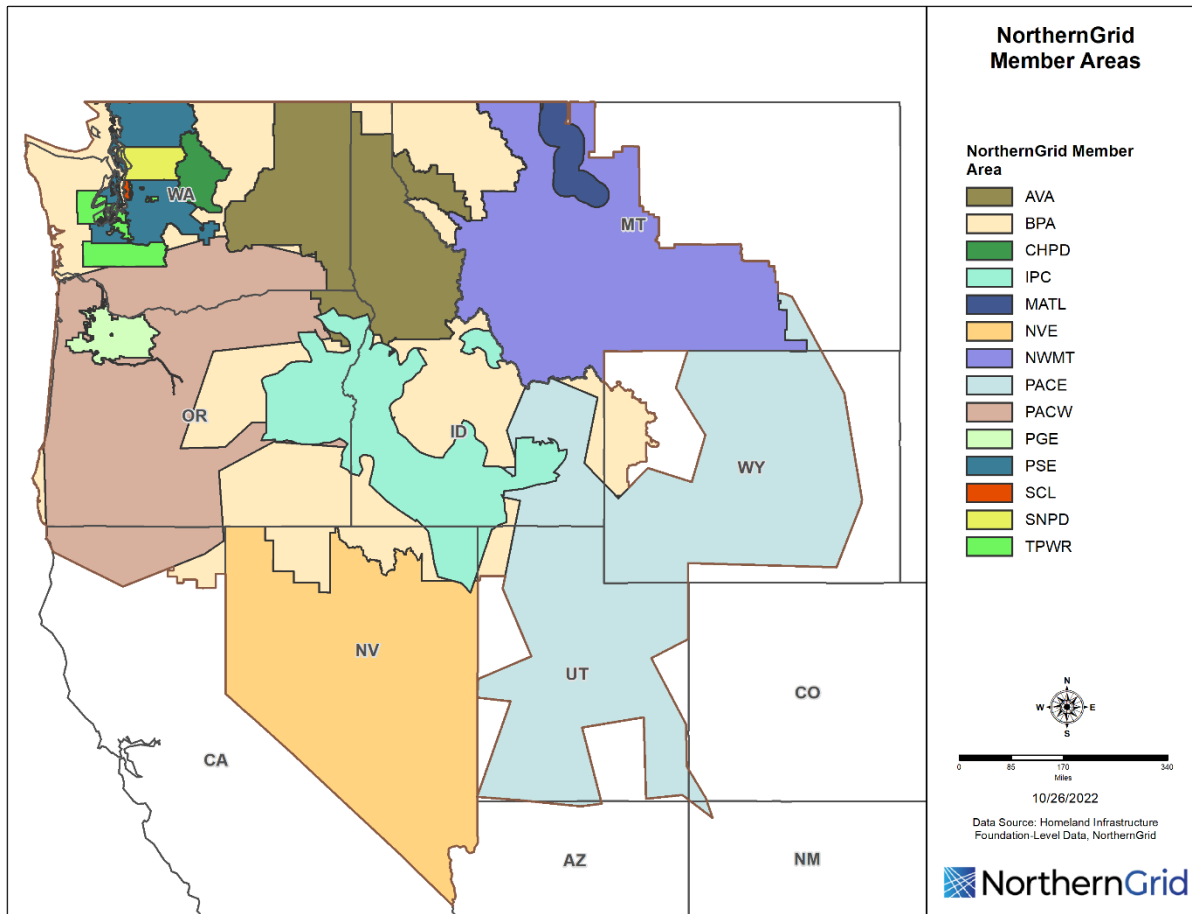
12 The Federal Energy Regulatory Commission (“FERC”) requires, through orders 890 and 1000, each
 13 Transmission Provider (“TP”) to publish local and regional transmission plans on a periodic basis using
 14 open and transparent processes. FERC requires that each Transmission Provider develop and file their
 15 transmission planning processes for FERC’s acceptance. Once accepted, the processes are published in
 16 the provider’s Open Access Transmission Tariff Attachment K – Transmission Planning Process.

17 Additionally, FERC requires all TPs to participate in transmission planning regions to develop these
 18 regional transmission plans. For the NorthernGrid, TPs who meet certain requirements may enroll in the
 19 region to become an Enrolled Party. The regional transmission planning process for the Enrolled Parties
 20 is defined in each Enrolled Party’s Open Access Transmission Tariff Attachment K.

21 Federal, municipality, and public utility district electric utilities are not subject to FERC regulation, but
 22 also perform local and regional transmission planning to meet their load, resource, and transmission
 23 requirements. These entities voluntarily participate in regional transmission planning with the TPs
 24 through the NorthernGrid Planning Agreement for Planning Cycle 2022-2023.

25 NorthernGrid Overview

26 The NorthernGrid regional planning association is composed of Avista (AVA), Bonneville Power
 27 Administration (BPA), Chelan PUD (CHPD), Idaho Power Company (IPC), BHE U.S. Transmission as the
 28 owner of the Montana Alberta Tie Line (MATL), NorthWestern Energy (NWMT), NV Energy (NVE),
 29 PacifiCorp East and West (PACE and PACW), Portland General Electric (PGE), Puget Sound Energy (PSE),
 30 Seattle City Light (SCL), Snohomish PUD (SNPD), and Tacoma Power (TPWR). The Member Balancing
 31 Authority Areas and SNPD load service footprint are illustrated in Figure 2 below.



1
2 *Figure 2: NorthernGrid region*

3 **Planning Development**

4 The intent of FERC Order No. 1000 is to improve the regional planning process and identify
 5 opportunities for any transmission developer, incumbent or non-incumbent, to coordinate and develop
 6 solutions that are both beneficial to the developer as well as the regional system to which that
 7 developer interconnects. Given proper coordination and communication, only the necessary facilities
 8 would get identified, and those facilities would become the Regional Transmission Plan (“RTP”). The
 9 RTP is not a construction plan, and the Members have no obligation to build the facilities identified in
 10 the RTP.

11 There are many factors that get considered in a long-term planning process. Utilities are charged with
 12 maintaining the reliability of the transmission system as well as ensuring there are sufficient resources
 13 and/or transmission service arrangements to serve their respective loads. FERC No. 890 and No. 1000
 14 mandate long-term, coordinated planning at both the local and regional levels. North American Electric
 15 Reliability Corporation (NERC) planning standards TPL-001-4 and 5.1 provide criteria for performing
 16 contingency analysis on facilities 100 kV and above and is used in the FERC planning process.

1 Integrated resource planning is a complex process that each utility undertakes to identify and meet its
2 respective generation portfolio needs. Resource planning may contemplate market-driven transmission
3 sales, public policy requirements and/or considerations, environmental impacts, corporate business
4 goals, resource adequacy, load growth and/or any other slew of topics that consider or influence the
5 relationship between the consumer and the utility.

6 The timelines for resource and reliability planning are not one and the same; each follows its own cycle
7 according to its respective requirements. The timeline for reliability planning is prescribed, cyclical, and
8 regular: in January of every even-numbered year, a twenty-four-month cycle is initiated for the
9 purposes of producing a regional transmission plan by the end of December in every odd-numbered
10 year. This twenty-four-month cycle is listed in the open access transmission tariffs of all the FERC-
11 jurisdictional utilities and is specified in the NorthernGrid Planning agreement for those non-FERC-
12 jurisdictional utilities that are Members of the NorthernGrid planning process.

13 The cycle for resource planning is not necessarily “universal” in that all utilities adhere to the same
14 schedule; the timelines for resource planning are not as prescribed or regular and may be dependent on
15 external factors such as changes to public policy. Resource planning cycles that initiate at or near the
16 beginning of a transmission planning cycle or make a shift during the two-year transmission planning
17 cycle may not necessarily get reflected in the current transmission planning cycle. Once a new resource
18 need is identified, utilities not only need to identify the public policy-driven resource need for their
19 system, they often also have to start an open and transparent bidding process to notify all of their need
20 for resources. There are many mechanisms that drive the need for resource procurement; a change to
21 public policy requirements is a simple example that illustrates the inherent complexity in any given
22 resource procurement process.

23 There is a relationship between resource planning and reliability planning. Once the results of the
24 resource bid are known, the reliability analysis needed to incorporate the results of the resource bid can
25 begin. Transmission models can then be updated to analyze the impacts of the resources identified in
26 the resource procurement process.

27 The resource procurement process involves many intricacies. From the identification of the resource
28 through to the identification of the transmission facilities needed to support the output of the selected
29 resource, there is the possibility that resources that are identified in a resource procurement process
30 are not necessarily yet reflected in the current regional planning study.

31 Annually, the Member utilities each compile their collective needs into the form of a Loads and
32 Resources data submittal which gets submitted to Western Electric Coordinating Council (WECC) as part
33 of WECC’s base case building process. NorthernGrid uses those WECC base cases in the planning
34 process.

35 [Interregional Coordination](#)

36 NorthernGrid met with WestConnect and CAISO to coordinate power flow cases, assumptions, and
37 methodologies at the Annual Interregional Information Exchange. No interregional projects were
38 submitted for consideration into the NorthernGrid region in the 2022-2023 cycle. Representatives from

1 the regions met on a near-monthly basis with some of them being on-site to discuss study efforts,
2 inform one another on any new developments, and identify opportunities for stakeholder engagement.

3 State Agency Engagement

4 Several state agencies participated in the planning process through the Enrolled Parties and States
5 Committee (EPSC). The EPSC reviewed and actively participated in the development of the study scope.

6 Stakeholder Engagement

7 Stakeholders are invited to participate in the public meetings and comment periods. They will also have
8 active involvement in the development of the regional transmission plan. The first period for
9 stakeholder comments begins with the publishing of the Draft Study Scope. There are three main
10 opportunities to provide comment, and they are in response to the following publications: the proposed
11 Study Scope, the Draft Regional Transmission Plan, and the Draft Final Transmission Plan. Members of
12 the public are invited to Subscribe to NorthernGrid activities through the subscription feature on the
13 northerngrid.net website.

14 Study Process

15 The Regional Transmission Plan (“RTP”) is the result of the work performed as outlined in the study
16 scope for the NorthernGrid 2022-2023 regional transmission planning process.

17 The regional planning process is a “bottom up” approach that begins with a compilation of the
18 Members’ loads, generation resources, local area plans, and regional transmission projects. The
19 Members who are Transmission Providers, in conjunction with participation from stakeholders, public
20 service commissions, and interested parties, have developed local area plans that meet the regulatory
21 requirements for their respective areas. The projects that have been identified in the local area planning
22 process are assumed to be in service for the regional planning effort.

23 To develop the Plan, the NorthernGrid members (“Members”) established the Baseline Projects which
24 were then evaluated for inclusion in the final Regional Transmission Plan. NorthernGrid used power flow
25 contingency analysis to assess which projects could best meet system reliability performance
26 requirements and transmission needs for the NorthernGrid region in a 10-year future. Members
27 submitted updated Load and Resource information which was incorporated into the study effort.

28 This regional planning process is intended to focus on those projects that are of “regional significance”.
29 “Regional significance” is not a defined term; rather, it is used to describe those projects whose
30 presence, or lack thereof, would influence the overall reliability of the NorthernGrid region. A local
31 project may improve the ability to serve native load or decrease the number of unplanned outages for a
32 specified subsystem, but typically is not going to influence larger transmission paths. However, it is
33 possible that a project that is more regional in nature may both increase the ability to serve native load
34 as well as influence a larger transmission path.

35 The production of a Regional Transmission Plan satisfies FERC Order 1000 requirements for each region
36 to produce a plan.

1 Study Scope

2 The objective of the transmission planning study is to produce the NorthernGrid Regional Transmission
3 Plan, through the evaluation and selection of regional and interregional projects that effectively satisfies
4 all the transmission needs within the NorthernGrid region. The regional needs were sourced from
5 member data submissions, including load forecasts, generation resource additions and retirements,
6 projected transmission additions, and public policy requirements. The study scope identifies different
7 power flow conditions and different regional transmission project combinations to assess and develop
8 the RTP. A link to the Study Scope is provided in Appendix B: Study Scope.

9 Study Methodology and Criteria

10 To assess the 2032 loads, resources, and transmission projects anticipated for the NorthernGrid region,
11 a combination of power flow and production cost model techniques were used.

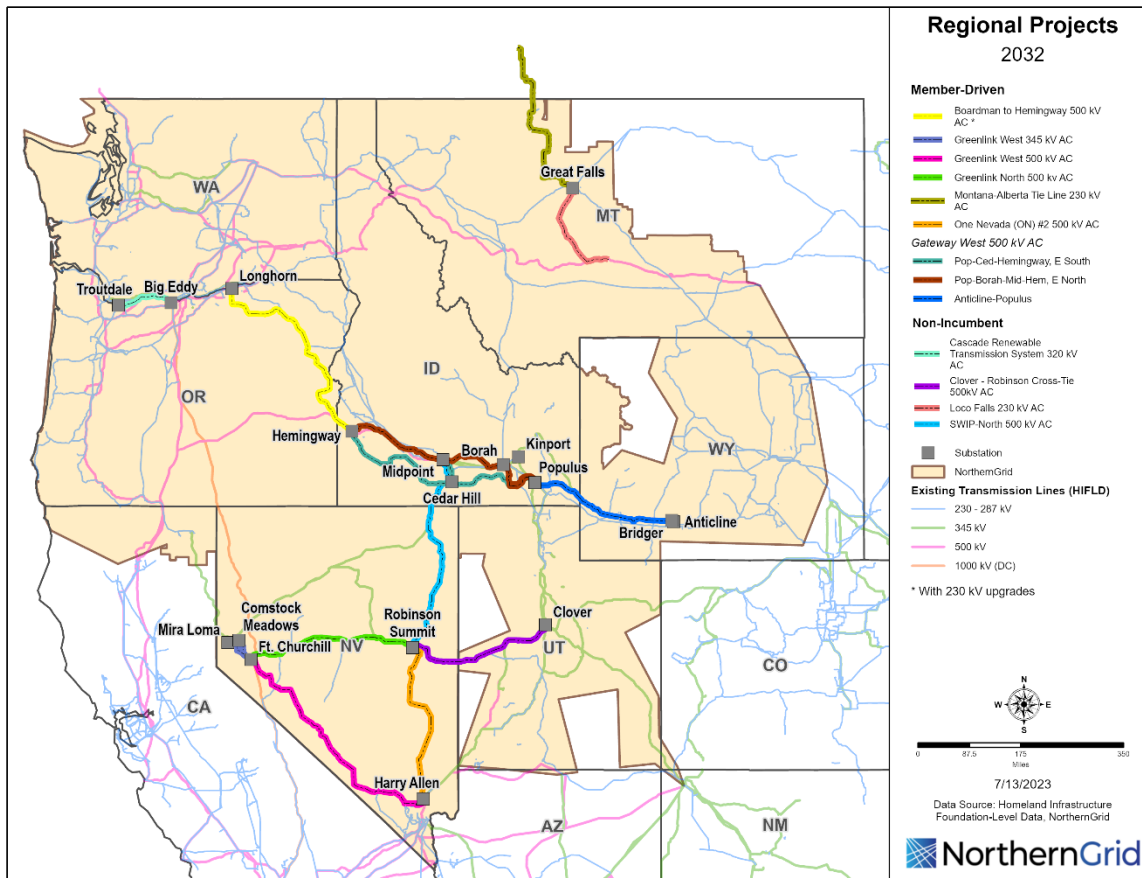
12 A WECC base case was then put through a production cost modeling effort to identify stressed
13 conditions on the NorthernGrid region based on the economic dispatch of planned resources. The
14 stressed conditions were translated into base cases which became the basis for the analysis effort. The
15 selected base cases were run through a contingency analysis using member-supplied contingencies. All
16 contingencies were categorized per the NERC transmission planning criteria document, "TPL-001-4".
17 The NorthernGrid region as well as immediate neighboring regions were monitored. The analysis of the
18 contingency results accounted for any area-specific member utility criteria, otherwise, the Western
19 Electric Coordinating Council's (WECC) and NERC TPL-001-4 criteria was used.

20 Submitted Loads and Resources

21 Members submitted Loads and Resources data along with their current transmission plans in the first
22 quarter; this data was consolidated and used to develop the Study Scope. The needs of the
23 NorthernGrid region were identified through these submittals. The NorthernGrid region load is forecast
24 to grow at a 0.6 percent annual rate with the Members needing 29,274 MW of new generation capacity
25 to replace the 8,236 MW planned resource retirements. Additionally, Puget Sound Energy submitted
26 updated resource data in the fifth quarter which increased the new generation. All loads and resources
27 characteristics are captured in the Study Scope which is available in Appendix B: Study Scope.

28 Submitted Projects

29 The following projects were submitted by the Members and are identified as having the potential to
30 impact the reliability of the NorthernGrid region.



1

2 *Figure 3: NorthernGrid region with regional project overlay. Proposed 345 kV and 500 kV facilities are displayed.*

3 Figure 3 provides a visual demonstration of the projects that have been submitted for consideration in
 4 the Regional Transmission Plan. The legend delineates the member and non-incumbent submitted
 5 projects.

6 **Member Regional Transmission Projects**

7 The regional projects submitted by Members are as follows:

8 **Longhorn to Hemingway (Formerly known as Boardman to Hemingway and referenced as B2H)**

9 Longhorn to Hemingway 500 kV, Hemingway to Bowmont 230 kV, and Bowmont to Hubbard 230 kV.
 10 Includes three sections of series compensation. The Oregon end of the line was terminated at the
 11 Longhorn station, which is near the town of Boardman, Oregon. While the figures do not visually display
 12 the 230 kV facilities associated with the B2H project, the 230 kV facilities are included in the model for
 13 B2H as they are needed to integrate B2H into Idaho Power’s system. The B2H project was selected into
 14 the 2020-2021 NorthernGrid Regional Transmission Plan.

15 **Gateway West-** A suite of project segments were evaluated for Gateway West. These are:
 16 Populus-Cedar Hill-Hemingway 500 kV

1 Populus-Borah-Midpoint-Hemingway 500 kV
 2 Midpoint-Cedar Hill 500 kV
 3 Anticline-Populus 500 kV

4 Of the Gateway West projects, only the Populus-Cedar Hill-Hemingway and Anticline-Populus 500 kV
 5 lines were selected into the 2020-2021 NorthernGrid Regional Transmission Plan. The Gateway West
 6 projects were grouped per Table 4 in the Study Plan

8 **Greenlink West and North**

9 West: Northwest – Harry Allen 500kV, Harry Allen – Fort Churchill 500 kV with series compensation,
 10 Fort Churchill – Comstock Meadows 345 kV & Fort Churchill – Miraloma 345kV. Also includes upgrades
 11 to the 345 kV system.

12 North: Fort Churchill –Robinson Summit 500 kV with series compensation.

13 **One Nevada #2-** 500 kV #2 from Harry Allen to Robinson Summit. This 235-mile line project provides a
 14 second parallel path from the NV Energy South system into Robinson Summit, effectively strengthening
 15 the existing ON line 500kV.

16 **MATL-** MATL proposed a conversion of the MATL alternating current (AC) to direct current (DC). The
 17 rating will increase to a maximum of 500 MW. MATL was not selected into the 2020-2021 Regional
 18 Transmission Plan.

19 Non-Incumbent Transmission Projects

20 The NorthernGrid regional planning process allows non-incumbent and merchant transmission
 21 developers to submit projects for analysis. Several non-incumbent or merchant transmission projects
 22 were received during the submission period. They are further classified into regional and interregional
 23 transmission projects based on whether the project terminals are within the region or interconnect
 24 between regions, i.e. interregional. For the 2022-2023 planning cycle, none of the submitted non-
 25 incumbent projects were deemed interregional.

26 **Cascade Renewable Transmission Project-** PowerBridge LLC is proposing to construct the Cascade
 27 Renewable Transmission Project. This Project is an 80-mile, 1,100 MW transfer capacity +/- 400 kV HVDC
 28 underground cable (95 percent installed underwater) interconnecting with the AC grid through two +/-
 29 1100 MW AC/DC converter stations at Big Eddy and Harborton substations. There are no proposed
 30 generation resources associated with the transmission line.

31 **Loco Falls Greenline-** Absaroka Energy LLC is proposing a merchant transmission project connecting
 32 Great Falls 230 kV substation to the Colstrip 500 kV Transmission System. The project consists of two
 33 230 kV transmission circuits and a new Loco Mountain Substation with 230 to 500 kV transformation.
 34 There are no proposed generation resources associated with the transmission line.

35 **Cross-Tie Transmission Project-** TransCanyon, LLC is proposing the Cross-Tie Project, a 1,500 MW, 500
 36 kV, series compensated, single circuit HVAC transmission project that will be constructed between
 37 central Utah and east-central Nevada. The project connects PacifiCorp’s planned 500-kV Clover

1 substation with NV Energy’s existing 500 kV Robinson Summit substation; both substations reside in the
2 NorthernGrid footprint.

3
4 **Southwest Intertie Project North (SWIP)**- Great Basin Transmission, LLC (“GBT”), an affiliate of LS
5 Power, submitted the 275-mile northern portion of the Southwest Intertie Project (SWIP) to the
6 California ISO and NorthernGrid. The SWIP-North Project connects the Midpoint 500 kV substation to
7 the Robinson Summit 500 kV substation with a 500-kV single circuit AC transmission line. With the
8 addition of NV Energy into the NorthernGrid footprint, the SWIP project is now fully within the
9 NorthernGrid footprint. The SWIP is expected to have a bi-directional WECC-approved path rating of
10 approximately 2000 MW.

11 [Sponsored Projects Request for Cost Allocation](#)

12 The NorthernGrid Cost Allocation Task Force evaluated the information submitted by PowerBridge LLC,
13 Great Basin Transmission LLC, and TransCanyon LCC. The committee determined each to be a Qualified
14 Developer for their request for their Sponsored Project to be considered for cost allocation.

15 [Power Flow Case Development](#)

16 Three Western Electricity Coordinating Council (WECC) power flow base cases were selected from the
17 WECC published cases for the 10-year horizon. The 2032 heavy summer and 2031-2032 heavy winter
18 were chosen to represent the two peak region load conditions. The 2031-2032 heavy winter and 2033
19 light spring were chosen for their ability to represent high power flow transfers from the eastern to
20 western portions of the region. The resource dispatch in these base cases were adjusted as described
21 below to reflect significant NorthernGrid region transmission stressing conditions.

22 [Power Flow Case Conditions](#)

23 These cases were modified to achieve the following transmission stress conditions:

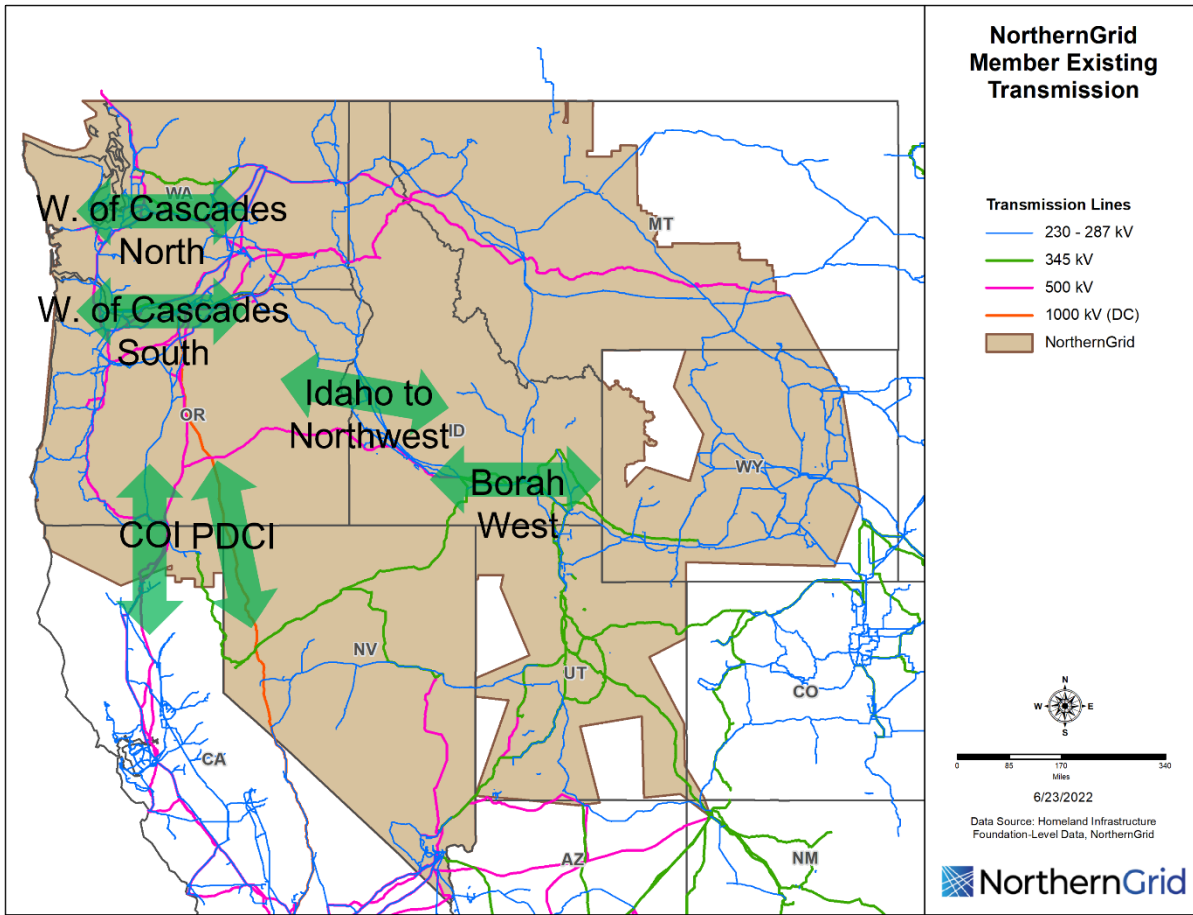
24 Summer Peak loading conditions. The 2032 Heavy Summer WECC base case was modified to
25 have high southbound flows on the COI and PDCI, high eastbound Northwest to Idaho flows, and
26 southbound MATL flows.

27 Winter Peak loading conditions. The 2031-2032 Heavy Winter WECC base case was modified to
28 have typical seasonal dispatch for the generation resources, and northbound MATL flows.

29 California export case. The 2033 Light Spring case was modified to have high northbound flows
30 on the COI and PDCI as well as 2032 loading for the NorthernGrid region.

31 High Wyoming wind export case. The 2031-2032 Heavy Winter WECC base case resource
32 dispatch was modified to match a production cost model that resulted in peak Wyoming wind
33 conditions. This condition occurred at noon December 11, 2032, in a NorthernGrid modified
34 WECC 2032 Anchor Data Set Production Cost Model (ADS-PCM). NorthernGrid modified the
35 ADS-PCM with the addition of the NorthernGrid submitted transmission projects.

1



2

3 *Figure 4: Paths of interest in the NorthernGrid region*

4 Figure 4 above identifies the WECC paths of most interest to the NorthernGrid region for purposes of
 5 stressing the transmission system. Not all WECC paths relating to NorthernGrid are displayed, only
 6 those that are particularly useful in describing the flow patterns on the NorthernGrid transmission
 7 system for the different stressed conditions. The California-Oregon Intertie (COI) is needed for
 8 interregional transfers between the California Independent System Operator (CAISO) and NorthernGrid.
 9 West of Cascades, Idaho to Northwest, and Borah West are all key flowgates for transmitting energy
 10 from resources to loads within the NorthernGrid region and to California. The power flow case
 11 NorthernGrid region load, generation, and transmission path transfers are listed in Appendix G: Power
 12 Flow Case Summary Table 5.

13 **Contingencies and Criteria**

14 Contingency analysis is the modeling of systematically removing specified transmission facilities from
 15 service and measuring the resulting impact to the transmission system.

1 Thermal overloads occur when the power flowing through a facility exceeds the capability of the facility
2 which causes heat to build up; excess heat occurs which can then damage the facility. Typically, a
3 thermal overload results from the loss of a transmission line or transformer. Operationally, there are
4 multiple ways to mitigate thermal overloads. For example, remedial action schemes are designed to
5 respond to specific events on the transmission system to help preserve reliability and load service; these
6 actions are programmed and the outcomes to the transmission system are expected. Generators may
7 be programmed to reduce their output in response to specific changes on the transmission system.
8 These operational mitigation actions decrease the loading on the overloaded facility by either reducing
9 the power or redirecting the power to facilities with larger capabilities.

10 Voltage excursions occur when the reactive support of the transmission system changes, as can happen
11 during the loss of a facility. Voltage excursions can be high or low, either of which causes undue stress
12 on the facility experiencing the excursion. Due to the interplay of all the facilities in a transmission
13 system, the loss of any facility has the potential to cause a voltage excursion on the transmission system.
14 Voltage excursions can be mitigated automatically through switching schemes on capacitor and/or
15 reactor banks. Inserting capacitor banks acts to increase the voltage and inserting reactor banks acts to
16 reduce the voltage. These switching sequences do not add further stress or burden to the transmission
17 system as they compensate for the reactive need on the transmission system.

18 Members submitted regionally significant contingencies used for reliability analysis to develop the Plan.
19 Contingencies on major WECC Paths relevant to the NorthernGrid region as well as contingencies on
20 facilities in the 200 kV and above voltage classes were the primary focus. These regionally significant
21 contingencies were selected for their criticality to the NorthernGrid region. The contingencies were
22 categorized using Table 1 from NERC TPL-001-4. The post-contingency system analysis was performed
23 using applicable NERC and WECC criteria while accounting for any member provided thermal or voltage
24 criteria.

25 The NorthernGrid region as well as neighboring regions were monitored during the contingency analysis
26 to determine if any negative impacts occur to the reliability of the transmission system due to the
27 introduction of the regional projects. If negative impacts to the transmission system of neighboring
28 regions could not be mitigated through operational changes for any regional combination, coordination
29 would have to occur to identify the appropriate mitigation and the costs of that mitigation would be
30 added to the cost of the regional project. No negative contingency results were observed in the
31 neighboring regions and as such no Material Adverse Impacts were identified for any of the
32 combinations considered.

33 Evaluation of Regional Transmission Project Combinations

34 To determine whether transmission needs within the NorthernGrid may be satisfied by regional
35 transmission projects, NorthernGrid evaluates the proposed regional and interregional (if any)
36 transmission projects independently and in regional combinations. The regional combinations are
37 determined by the MPC based on their knowledge of the NorthernGrid Region. A total of 26 regional
38 combinations were evaluated. The regional combinations are shown in Appendix C: Full list of the
39 Regional Combinations.
40

1 Impacts on Neighboring Regions

2 As stated above, the power flow cases represent the entire western interconnection. Therefore, during
3 the power flow analysis NorthernGrid will monitor for NERC standard and WECC criterion violations
4 occurring in the neighboring regions. Upon identification of a violation in a neighboring region,
5 NorthernGrid will coordinate with the region to confirm validity and whether the violation is due to an
6 existing condition. Mitigation plans for a violation will be determined in accordance with the
7 NorthernGrid Member tariffs and planning agreement.
8

9 Selection of Projects

10 The objective of the regional transmission analysis is to identify a set of transmission projects that cost-
11 effectively or efficiently meet the transmission service and reliability needs of the NorthernGrid region
12 ten years in the future. To accomplish this goal, NorthernGrid started with base cases that include
13 member planned future regional projects modeled as “in-service”, as displayed below in Figure 4.
14 Planned future regional projects is an undefined term that generally refers to transmission projects that
15 have been identified and possibly funded, but are typically not yet in construction. Collectively, these
16 regional projects comprise the Baseline Member Projects, or the “BLMP”. Sensitivity cases based on
17 combinations of various regional project components being systematically removed from the BLMP
18 cases created a set of Regional Combination cases to test against the performance of the BLMP cases.
19 While the BLMP includes the highest number of regional projects, the analysis will evaluate whether a
20 subset of the BLMP may cost-effectively or efficiently meet the needs of the NorthernGrid region while
21 maintaining system reliability.

22 After the contingencies were run, the raw counts of violations were ranked using weighting criteria
23 developed by the NorthernGrid Member Planning Committee, Appendix C: Rankings. The rankings give
24 less weight to those contingency categories that either have system adjustments available, can be
25 addressed locally – such as reconfiguring a station to avoid a breaker failure issue, or have been
26 determined to be less likely to occur. The results were further ranked by voltage class and severity of the
27 violation; Appendix C: Rankings lists the full complement of ranking factors used.

28 The selection of the regional projects in the Plan is determined by the combination of projects that
29 results in a transmission system that most cost-effectively or efficiently exceeds the reliability
30 performance of the other possible combinations of submitted projects.

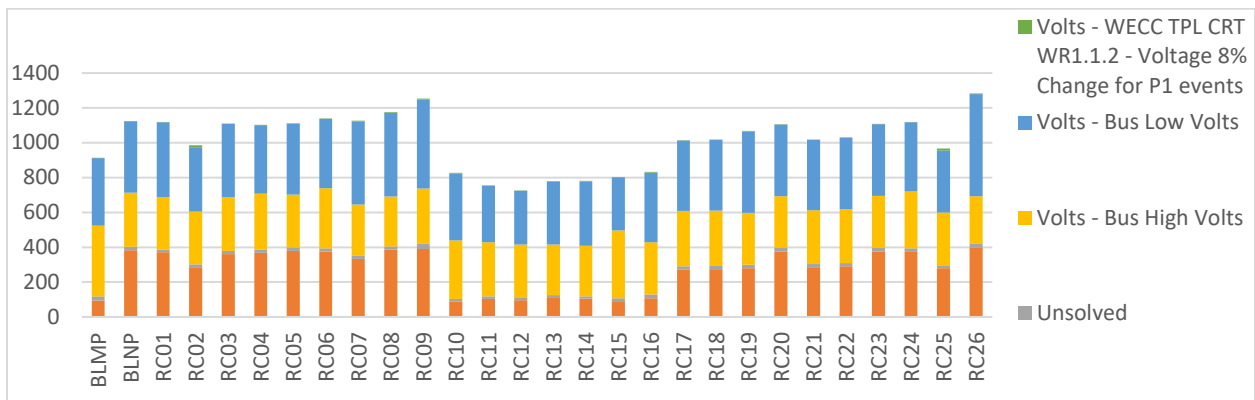
31 Analysis Results

32 Once the base cases were updated to include the submitted loads, resources, and projects along with
33 adjusting the generation dispatch to match the regional transmission flows described above, they were
34 run through contingency analysis. When running contingency analyses, both the type of contingency
35 and the impact of the contingency are vital to ascertaining the reliability of the transmission system.
36 The type and the impact of the contingency are considered in conjunction with the voltage class of the
37 facility. In general, an outage of higher voltage facilities has a greater impact on the transmission
38 system than the loss of lower voltage facilities. From a NorthernGrid perspective, the contingencies that

1 result in the loss of large amounts of load or the inability to honor transmission arrangements are those
 2 that are regionally significant and warrant further scrutiny.

3 To help identify regionally significant contingencies, each contingency result was multiplied by ranking
 4 factors: voltage class, type of the contingency, and the severity of contingency impact. An overall
 5 contingency ranking is the product of the sum of each ranking factor. The larger the resulting ranking,
 6 the more regionally significant the contingency. Voltage class refers to the kV rating of the facility: the
 7 larger the rating, the larger the ranking factor. Type of the contingency refers to the NERC TPL-001-4
 8 criteria which is the guiding document used to classify all contingencies analyzed. The contingencies in
 9 NERC TPL-001-4 contain scenarios that range from outages of single facilities to severe outages that
 10 impact multiple facilities. It is quite common for a transmission system to have a single facility out of
 11 service, either planned or unplanned, and it is less common for a transmission system to experience
 12 events that result in the loss of multiple pieces of facility. Because of this, single outage contingencies
 13 were given a larger ranking factor than multi-outage contingencies. The impact of a contingency refers
 14 to what happens to the transmission system when a contingency occurs. Contingencies that caused
 15 minor violations were given a smaller ranking factor than those that led to major violations. From a
 16 NorthernGrid perspective, a minor violation is one that can be readily mitigated operationally with no
 17 anticipated damage to facility. A major violation may cause cascading outages or facility damage. Each
 18 contingency from each base case and each regional combination was ranked per the ranking factors.
 19 Ranked contingency results are unitless and are only used as a comparison of performance between
 20 power flow cases.

21 Figure 5 displays the summed rank of contingency violations for each regional combination. Regional
 22 combinations with the lowest sum of ranked violations represent better transmission reliability
 23 performance than those with higher values. Regional combination 12 provides the best reliability
 24 performance while regional combination 26 provides the worst performance for the given set of
 25 contingencies applied to the power flow cases.

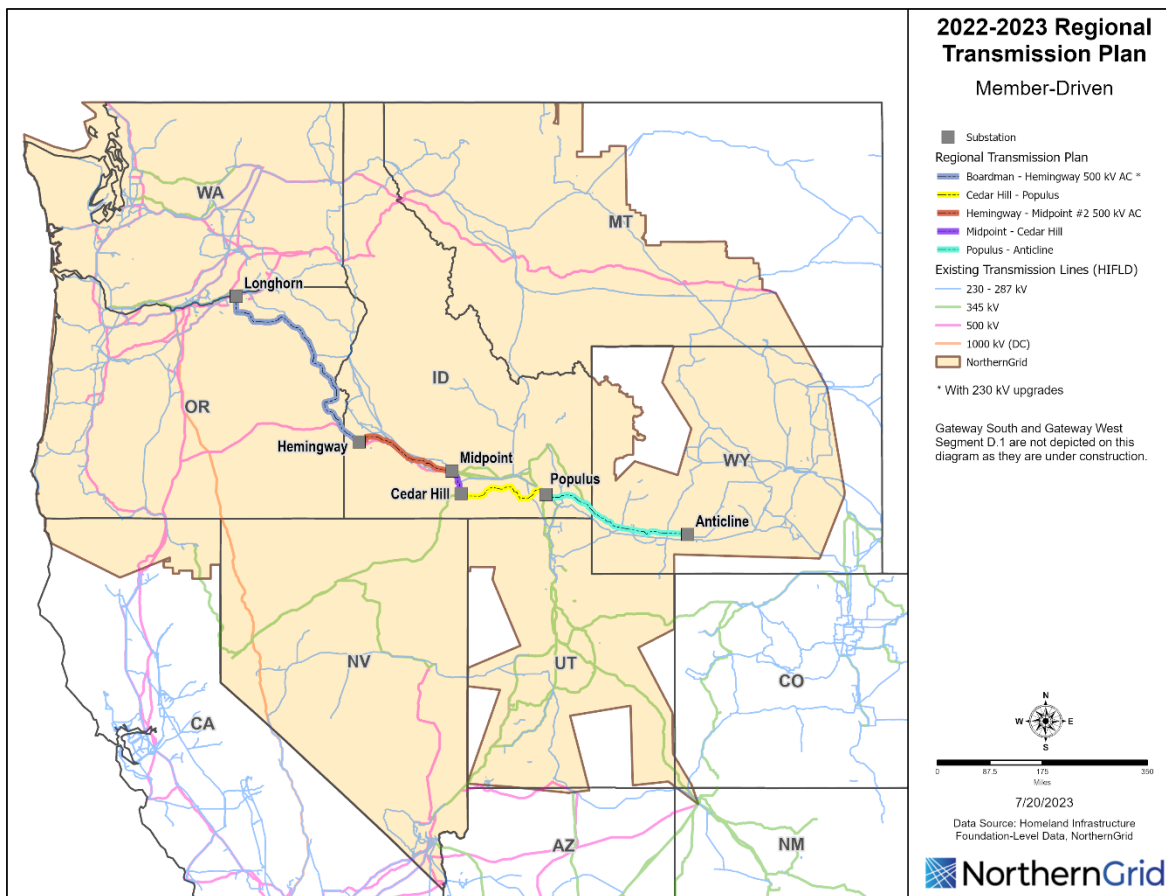


26
 27 *Figure 5 Regional Combination Reliability Performance Chart*

28 Regional Transmission Plan

29 The regional combination 12 composed of Boardman to Hemingway, Gateway West Phase 1, and
 30 Cascade Renewable Transmission Project received the most favorable contingency analysis ranking. A

1 review of the violations identified that the eliminated violations changed from slightly above to slightly
 2 below the criteria threshold. When considering this minimal improvement and the additional project
 3 cost, the combination including the Cascade Renewable Transmission Project was deemed less cost
 4 effective than the regional combination 11 containing Boardman to Hemingway and Gateway West
 5 Phase 1. A cost allocation analysis was not required because no Qualified Developers' projects were
 6 selected into the Regional Transmission Plan. Figure 6 below depicts the projects that were determined
 7 to be the most efficient and cost-effective combination for the NorthernGrid region given the analysis
 8 performed as described in this report.



9
 10 Figure 6: The Regional Transmission Plan for the 2022-2023 NorthernGrid cycle

11 Regional combination 11, depicted in Figure 6, forms the basis of the Regional Transmission Plan. The
 12 plan is composed of the Boardman – Hemingway, Hemingway – Midpoint #2, Midpoint – Cedar Hill,
 13 Cedar Hill – Populus, and Populus – Anticline projects. The route selected through southern Idaho
 14 changed from the last planning cycle from Hemingway – Cedar Hill – Populus to Hemingway – Midpoint
 15 – Cedar Hill – Populus. The construction sequencing change to the northern Gateway West sections
 16 west of Cedar Hill (Cedar Hill – Midpoint and Midpoint – Hemingway #2) was driven by recent changes in
 17 Idaho Power’s load and resource forecasts. New industrial loads east of Boise and the need for the
 18 integration of anticipated renewable resources east of Boise necessitate the change. The more northern

1 Midpoint – Hemingway #2 line is closer to the new loads and existing lines where resources likely would
2 integrate with the more built out network. The combination of Cedar Hill – Midpoint and Hemingway –
3 Midpoint #2 is only approximately 8 miles longer than Cedar Hill – Hemingway. Therefore, the cost
4 impact of the Gateway West sequencing change is limited. This selection of projects supports the
5 NorthernGrid system for a 10-year future and is more efficient to build than the entire set of projects
6 that comprise the BLMP.

7 Impacts on Neighboring Regions

8 There were no Material Adverse Impacts within neighboring regions identified for any of the projects
9 evaluated.

10 Cost Allocation

11 The projects submitted for cost allocation consideration in the NorthernGrid region were not selected
12 into the RTP. For this cycle, there are no projects that meet the criteria for cost allocation.

13

14 Conclusion

15 The NorthernGrid planning effort for the 2022-2023 cycle culminated in the identification of a regional
16 plan that is more efficient than a plan composed of a simple concatenation of all the Members’
17 proposed projects. The transmission needs of the NorthernGrid transmission system: loads, resources,
18 and regional projects including expected transmission arrangements, were provided by the Members
19 which collectively formed the basis for the Study Scope. There were no projects submitted for cost
20 allocation consideration selected into the Regional Transmission Plan. NorthernGrid analyzed 112
21 different power flow cases where each base case represented a selected hour combined with a selected
22 set of transmission projects. Altogether, the set of transmission projects that resulted in a more
23 efficient transmission system is that identified as regional combination 11.

24

1 Appendix A: Definitions and Terms

2 Attachment K from NorthWestern Energy is provided here for reference to the process or definitions
3 and can be accessed by double-clicking on the icon.

4

5

6 Appendix B: Study Scope

7 The entire study scope for the 2022-2023 cycle can be accessed by double-clicking the icon below or by
8 clicking on this link: [northerngrid.net/private-media/documents/NG_Study_Scope_2022-](https://northerngrid.net/private-media/documents/NG_Study_Scope_2022-2023_Approved.pdf)
9 [2023_Approved.pdf](https://northerngrid.net/private-media/documents/NG_Study_Scope_2022-2023_Approved.pdf)

10



Study Scope for the 2022-2023 NorthernGrid Planning Cycle

Member Planning Committee Approval Date: September 21, 2022

1 Appendix C: Rankings

2 *Table 1: Voltage Class for Ranking*

From	To	Rank
0 kV	50 kV	0.1
50 kV	100 kV	0.1
100 kV	200 kV	0.3
200 kV	300 kV	0.5
300 kV	400 kV	0.8
400 kV	1000 kV	1

5 *Table 2: NERC TPL Category for Ranking*

Category	Rank	Description
P0	1	All lines in service
P1	0.5	Single element loss results in single element outage
P2	0.1	Single element loss results in multiple element outage
P3	0.075	Loss of generator followed by system adjustments
P4	0.1	Stuck breaker results in multiple element outage
P5	0.1	Delayed fault clearing results in multiple element outage
P6	0.075	Loss of single element followed by system adjustments
P7	0.1	Multiple element loss results in multiple element outage

7 *Table 3: Violations for Ranking*

LV_Type	Rank	Description
Interface MW	0.5	Mild overload of path rating.
Interface MW	1	Heavy overload of path - potential stability problems.
Branch Amp	0.5	Mild overload of line.
Branch Amp	1	Heavy overload of line. Possibility of automated tripping.
Branch MVA	0.5	Mild overload.
Branch MVA	1	Heavy overload.

1 Appendix D: Complete list of all RC combos

2 Table 4 Working version of the Regional Combinations Table

RC Name	BUMP	BNP	R01	R02	R03	R04	R05	R06	R07	R08	R09	R10	R11	R12	R13	R14	R15	R16	R17	R18	R19	R20	R21	R22	R23	R24	R25	R26
CCX			x									x		x		x												x
B2H	x			x								x	x	x	x	x	x	x										x
GWWD.3	x				x							x	x	x	x	x	x	x										
GWWD.2	x											x					x											
GWWD.1	x					x						x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
GWS F	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
ON2	x						x					x							x	x		x	x	x			x	
GNLK N-W	x						x					x							x	x		x	x	x	x	x	x	
CrossTie									x			x							x	x	x	x	x	x	x	x	x	
SWIP-N										x		x			x	x			x	x	x	x			x			
Loco Falls												x																x
MATL	x										x							x										x
RobinsonPS									x	x		x			x	x			x	x	x	x	x	x	x			
ON1SC									x	x		x			x	x			x	x	x	x	x	x	x			

3 Project Abbreviations

4 CCX – Cascade Renewable Transmission Project

5 B2H – Boardman to Hemingway Transmission Project

6 GWWD.3 – Gateway West Transmission Project

7 D.3 Anticline to Populus

8 Phase 1 – Hemingway – Midpoint #2, Midpoint – Cedar Hill, Cedar Hill – Populus segments

9 Phase 2 – Hemingway – Cedar Hill, Midpoint – Borah 345 to 500 kV, Borah – Populus segments

10 D.1 Windstar to Aeolus 500 kV segment (under construction)

11 GWS F – Gateway South Transmission Project

12 ON2 – One Nevada “Online” Phase 2 Transmission Project

13 CrossTie – Cross-Tie Transmission Project

14 GNLK N-W – Green Link Northwest Transmission Project

15 SWIP-N – Southwest Intertie Project – North

16 MATL – Montana Alberta Transmission Line Upgrade Project

17 RobinsonPS – Robinson Summit Phase Angle Regulating Transformer “Phase Shifter” Project

18 ON1SC – One Nevada “Online” Phase 1 Series Compensation Addition

19

20

21

22 Appendix F: NorthernGrid Contingencies

23 The entire list of contingencies analyzed can be accessed by double-clicking the icon below.

24

1 Appendix G: Power Flow Case Summary

 2 *Table 5 Power Flow Case Load, Generation, and Path Transfer Summary*

Base Case Name	Generation (MW)	Load* (MW)	West of Cascades -North (MW)	West of Cascades -South (MW)	Idaho-to-North-west (MW)	Borah West (MW)	Pacific DC Intertie (PDCI) (MW)	California-Oregon Intertie (COI) (MW)
32HS	61,539	57,308	4,209	3,984	-2,204	197	2,712	3,793
32HW	61,539	53,000	7,272	5,041	-890	364	-1500	901
32HW PCM	61,539	55,832	4,936	3,598	2851	3691	491	264
32LSP	31,603	35,151	4,057	2,682	901	756	-938	-2,728

3

 4 *Load: The NorthernGrid load represented in the table above may or may not reflect station service
 5 loads or third-party loads served by NorthernGrid members.

6