

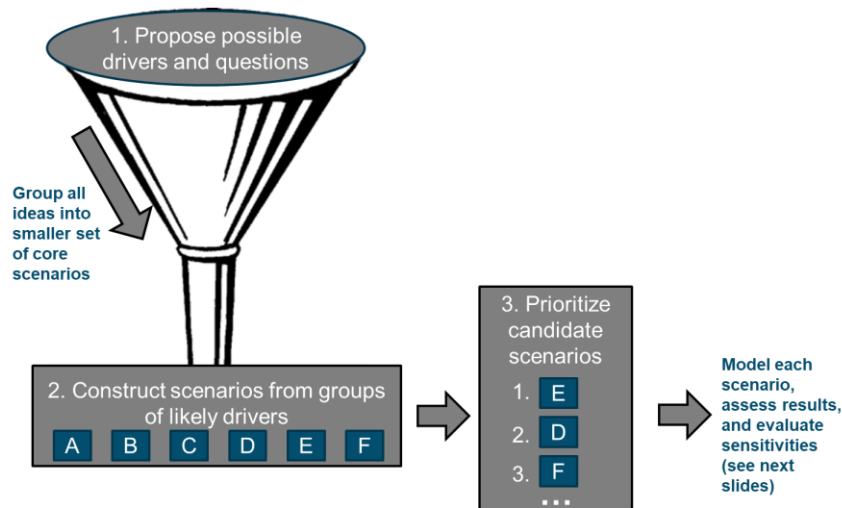
2020 Integrated Resource Plan Draft Scenarios & Modeling Plan



APPROACH

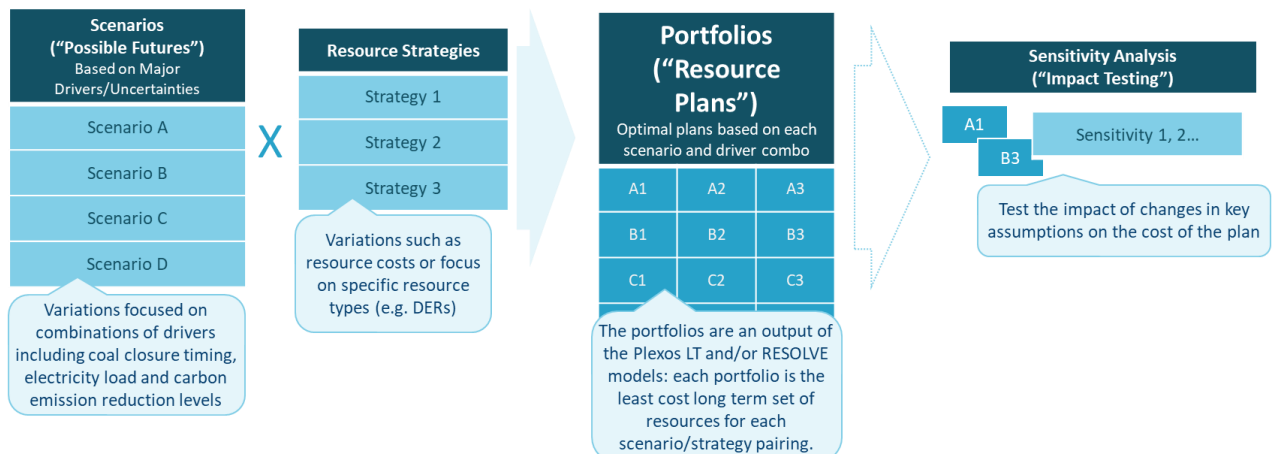
The approach for developing the specific scenarios and modeling plan for the 2020 IRP was outlined in the January 28th stakeholder engagement session, as shown in Figure 1:

Figure 1. Scenario Development Overview



In addition to the combinations of drivers into scenarios as illustrated above, NS Power has also proposed “Resource Strategies” to be paired with scenarios based on the feedback received from the IRP stakeholders to date, to ensure the appropriate breadth of potential future resources is captured. The modeling process for the Portfolio Study phase is illustrated below in Figure 2.

Figure 2. IRP Portfolio Study Modeling Approach



KEY POLICY DRIVERS

Based on input from stakeholders at the January 28th 2020 IRP session, NS Power is proposing three key policy drivers to form the basis of scenarios:

1. Provincial clean energy policy (e.g. Sustainable Development Goal Act)

Policy Driver 1.1: Greenhouse gas emissions by electricity sector

Policy Driver 1.2: Load changes driven by varying degrees of electrification

2. Federal clean energy policy:

Policy Driver 2.1: Coal unit end dates

1. Provincial Clean Energy Policy Drivers

1.1 Greenhouse Gas Emissions by Electricity Sector

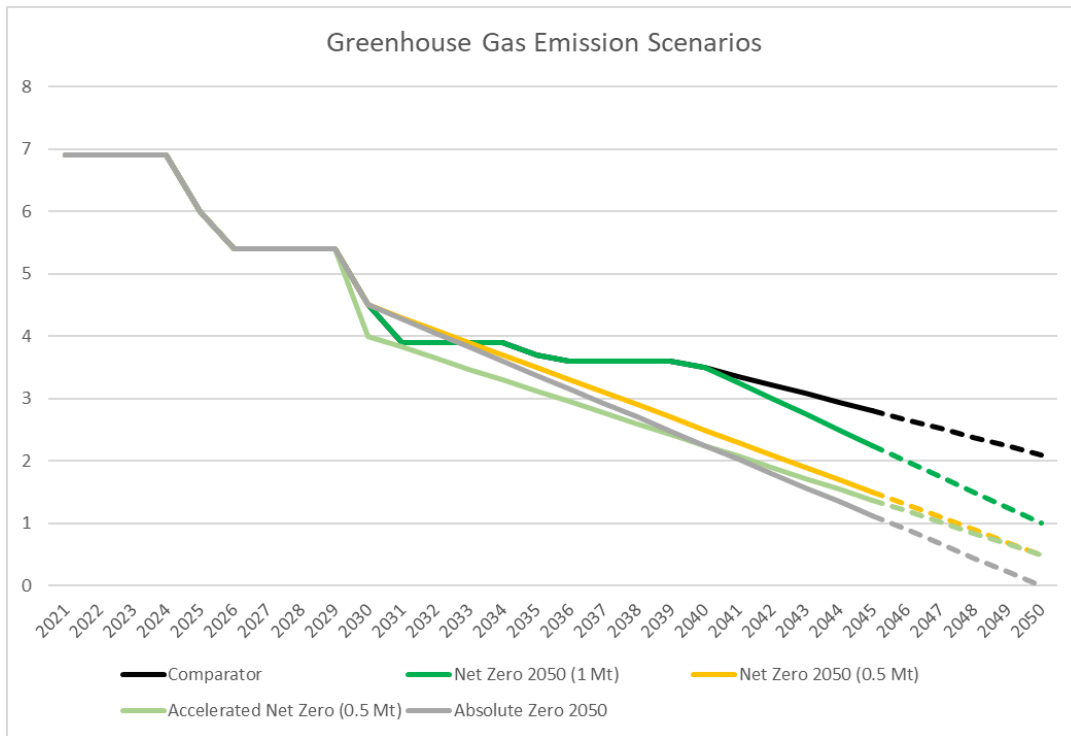
This driver represents the carbon dioxide emissions allowable by the electricity sector, which will be implemented as a constraint in the model. Based on stakeholder discussions, NS Power proposes five GHG scenarios for consideration to represent the range of the outcome of provincial carbon policy, as shown in Figure 3 and Figure 4.

Figure 3. Greenhouse Gas Emissions Scenarios Table

	CO2 2030	CO2 2040	CO2 2045	CO2 2050*
Comparator GHG Case	4.5	3.5	2.8	2.1
<i>Reductions consistent with equivalency agreement and continued future decline</i>	<i>(58% reduction from 2005)</i>	<i>(67% reduction from 2005)</i>	<i>(74% reduction from 2005)</i>	<i>(80% reduction from 2005)</i>
Net Zero 2050 (1 Mt)	4.5	3.5	2.3	1.0
<i>Reduction to 1 Mt by 2050 (assumes achievement of "net zero" via mechanism)</i>	<i>(58% reduction from 2005)</i>	<i>(67% reduction from 2005)</i>	<i>(78% reduction from 2005)</i>	<i>(91% reduction from 2005)</i>
Net Zero 2050 (0.5 Mt)	4.5	3.5	2.0	0.5
<i>Reduction to 0.5 Mt by 2050 (assumes achievement of "net zero" via mechanism)</i>	<i>(58% reduction from 2005)</i>	<i>(67% reduction from 2005)</i>	<i>(81% reduction from 2005)</i>	<i>(95% reduction from 2005)</i>
Accelerated Net Zero 2050 (0.5 Mt)	4.0	2.3	1.4	0.5
<i>Reduction to 0.5 Mt by 2050 with acceleration of pace beginning in 2030</i>	<i>(62% reduction from 2005)</i>	<i>(78% reduction from 2005)</i>	<i>(87% reduction from 2005)</i>	<i>(95% reduction from 2005)</i>
Absolute Zero 2050 (0 Mt)	4.5	2.3	1.1	0
<i>Reduction to 0 Mt by 2050</i>	<i>(58% reduction from 2005)</i>	<i>(78% reduction from 2005)</i>	<i>(90% reduction from 2005)</i>	<i>(100% reduction from 2005)</i>

*Note: IRP modeling period ends in 2045; 2050 is shown here to demonstrate "end value" of curve (relative to SDGA 2050 target year). All scenarios are proposed to use existing hard caps 2021 – 2029.

Figure 4. Greenhouse Gas Emissions Scenarios Graph



1.2 Load Changes

This driver represents the impact provincial greenhouse gas reduction and/or “net zero” policy (e.g. the SDGA) has on the expected load for the electricity sector. The electrification cases will be based on E3’s Pathways assessment of the potential impact of economy-wide decarbonization on the electricity sector. The Pathways Study contains further information on the load impact of electrification scenarios.

Three load cases are proposed for evaluation within the IRP scenarios:

- Business as usual: *represents the 2019 Load Forecast as filed with the UARB in April 2019 (adjusted where required to reflect E1’s 2019 DSM Potential Study profiles to reflect potential demand side resources).*
- Moderate degree of electrification: *represents the 2019 Load Forecast, adjusted to reflect the incremental load due to partial electrification of buildings as indicated in E3’s “Moderate Electrification” Pathways scenario (adjusted where required to reflect E1’s 2019 DSM Potential Study profiles to reflect potential demand side resources).*
- High degree of electrification: *represents the 2019 Load Forecast, adjusted to reflect the incremental load due to broad electrification of buildings and transportation as indicated in E3’s “High Electrification” Pathways scenario (adjusted where required to reflect E1’s 2019 DSM Potential Study profiles to reflect potential demand side resources).*

2. Federal Clean Energy Policy Drivers

2.1 Coal Closure Policy

The two states of this driver are:

- All coal units retired by 2040 – assumes retention of the ongoing Equivalency Agreement
- All coal units retired by 2030 – assumes adherence to the applicable Federal regulations

Note: Coal units can be economically retired by the IRP model in any year earlier than the end dates described above.

SCENARIO SCREENING: IDENTIFYING KEY SCENARIOS OF INTEREST

Qualitative Screening

Combining all the variants of the major scenario drivers produces 30 potential candidate scenarios listed in Figure 5.

Figure 5. Potential Candidate Scenarios

GHG Scenario	Load Driver	Coal End Date
2.1 Mt 2050 ("Comparator")	High Electrification	2030
2.1 Mt 2050 ("Comparator")	Moderate Electrification	2030
2.1 Mt 2050 ("Comparator")	Business as Usual	2030
2.1 Mt 2050 ("Comparator")	High Electrification	2040
2.1 Mt 2050 ("Comparator")	Moderate Electrification	2040
2.1 Mt 2050 ("Comparator")	Business as Usual	2040
Net Zero - 1 Mt 2050	High Electrification	2030
Net Zero - 1 Mt 2050	Moderate Electrification	2030
Net Zero - 1 Mt 2050	Business as Usual	2030
Net Zero - 1 Mt 2050	High Electrification	2040
Net Zero - 1 Mt 2050	Moderate Electrification	2040
Net Zero - 1 Mt 2050	Business as Usual	2040
Net Zero - 0.5 Mt 2050	High Electrification	2030
Net Zero - 0.5 Mt 2050	Moderate Electrification	2030
Net Zero - 0.5 Mt 2050	Business as Usual	2030
Net Zero - 0.5 Mt 2050	High Electrification	2040
Net Zero - 0.5 Mt 2050	Moderate Electrification	2040
Net Zero - 0.5 Mt 2050	Business as Usual	2040
Accelerated 0.5 Mt 2050	High Electrification	2030
Accelerated 0.5 Mt 2050	Moderate Electrification	2030
Accelerated 0.5 Mt 2050	Business as Usual	2030
Accelerated 0.5 Mt 2050	High Electrification	2040
Accelerated 0.5 Mt 2050	Moderate Electrification	2040
Accelerated 0.5 Mt 2050	Business as Usual	2040
Absolute Zero 2050	High Electrification	2030
Absolute Zero 2050	Moderate Electrification	2030
Absolute Zero 2050	Business as Usual	2030
Absolute Zero 2050	High Electrification	2040
Absolute Zero 2050	Moderate Electrification	2040
Absolute Zero 2050	Business as Usual	2040

Qualitative screening was used to eliminate scenarios with unlikely combinations of drivers (shown in Figure 6 in strikethrough), as well as identify five key scenarios of interest (highlighted in green in Figure 6). Consistent with the scenarios in E3’s Pathways Report, higher levels of load are paired with larger carbon budgets, which reflects overall economy decarbonization resulting from the removal of emissions from other sectors.

Figure 6. Key Scenarios

GHG Scenario	Load Driver	Coal End Date
2.1 Mt 2050 ("Comparator")	High Electrification	2030
2.1 Mt 2050 ("Comparator")	Moderate Electrification	2030
2.1 Mt 2050 ("Comparator")	Business as Usual	2030
2.1 Mt 2050 ("Comparator")	High Electrification	2040
2.1 Mt 2050 ("Comparator")	Moderate Electrification	2040
2.1 Mt 2050 ("Comparator")	Business as Usual	2040
Net Zero - 1 Mt 2050	High Electrification	2030
Net Zero - 1 Mt 2050	Moderate Electrification	2030
Net Zero - 1 Mt 2050	Business as Usual	2030
Net Zero - 1 Mt 2050	High Electrification	2040
Net Zero - 1 Mt 2050	Moderate Electrification	2040
Net Zero - 1 Mt 2050	Business as Usual	2040
Net Zero - 0.5 Mt 2050	High Electrification	2030
Net Zero - 0.5 Mt 2050	Moderate Electrification	2030
Net Zero - 0.5 Mt 2050	Business as Usual	2030
Net Zero - 0.5 Mt 2050	High Electrification	2040
Net Zero - 0.5 Mt 2050	Moderate Electrification	2040
Net Zero - 0.5 Mt 2050	Business as Usual	2040
Accelerated 0.5 Mt 2050	High Electrification	2030
Accelerated 0.5 Mt 2050	Moderate Electrification	2030
Accelerated 0.5 Mt 2050	Business as Usual	2030
Accelerated 0.5 Mt 2050	High Electrification	2040
Accelerated 0.5 Mt 2050	Moderate Electrification	2040
Accelerated 0.5 Mt 2050	Business as Usual	2040
Absolute Zero 2050	High Electrification	2030
Absolute Zero 2050	Moderate Electrification	2030
Absolute Zero 2050	Business as Usual	2030
Absolute Zero 2050	High Electrification	2040
Absolute Zero 2050	Moderate Electrification	2040
Absolute Zero 2050	Business as Usual	2040

Preliminary Key Scenarios

The proposed five key scenarios resulting from the qualitative screening are:

1. **Comparator Case** (GHG at 2.1 Mt 2050, business as usual load, 2040 coal closure)
2. **Net Zero – High Electrification** (GHG at 1 Mt 2050, high electrification, 2040 coal closure)
3. **Net Zero – Moderate Electrification with Early Coal Closure** (GHG at 0.5 Mt 2050, moderate electrification, 2030 coal closure)

4. **Net Zero – Moderate Electrification** (GHG at 0.5 Mt 2050, moderate electrification, 2040 coal closure)
5. **Absolute Zero World** (GHG at 0 Mt 2050, moderate electrification, 2030 coal closure)

Quantitative Screening

E3's RESOLVE capacity expansion model can also be used to assess additional scenarios. This screening can provide insight into whether potential scenarios produce similar portfolios, and as a result reduce or expand the candidate scenario list as appropriate.

Additional scenarios of interest to screen using RESOLVE include:

- Accelerated 0.5 Mt 2050 / Moderate Electrification / Coal End 2030
- Net Zero – 1 Mt 2050 / High Electrification / Coal End 2030
- Net Zero – 0.5 Mt 2050 / Business as Usual / Coal End 2040
- Net Zero – 0.5 Mt 2050 / Moderate Electrification / Coal End 2030

NS Power welcomes input on other scenarios of interest stakeholders would request be screened using RESOLVE for consideration in the Portfolio Study phase.

RESOURCE STRATEGIES

Four resource strategies are proposed to ensure the IRP analysis covers key areas of importance and interest:

- A. **Current Landscape**
New in-province supply and demand resources available, with no new interconnections to other regions.
- B. **Distributed Resources Promoted**
Distributed supply and demand resources are preferred where possible (e.g. distributed solar and battery storage) and high uptake of DERs is assumed. DERs prioritized in the resource screening stage.
- C. **Regional Integration**
New interconnections to other regions and corresponding access to out-of-province resources for energy and capacity are available, in addition to in-province supply and demand resources.
- D. **No New Emitting Resources**
New in-province and imported supply and demand resources must be non-emitting.

SCREENING SCENARIOS & STRATEGY PAIRS

Similar to the scenario screening exercise above, NSP has qualitatively identified the key combinations of scenarios and resources strategies to initially examine, as highlighted in Figure 7.

Figure 7. Key Pairs of Scenarios and Resource Strategies

Scenario	Resource Strategy
Comparator Case	Current Landscape
Comparator Case	Distributed Resources Promoted
Comparator Case	Regional Integration
Comparator Case	No New Emitting Resources
Net Zero - High Electrification	Current Landscape
Net Zero - High Electrification	Distributed Resources Promoted
Net Zero - High Electrification	Regional Integration
Net Zero - High Electrification	No New Emitting Resources
Net Zero - Moderate Electrification	Current Landscape
Net Zero - Moderate Electrification	Distributed Resources Promoted
Net Zero - Moderate Electrification	Regional Integration
Net Zero - Moderate Electrification	No New Emitting Resources
Net Zero - Moderate Electrification w Early Coal Closure	Current Landscape
Net Zero - Moderate Electrification w Early Coal Closure	Distributed Resources Promoted
Net Zero - Moderate Electrification w Early Coal Closure	Regional Integration
Net Zero - Moderate Electrification w Early Coal Closure	No New Emitting Resources
Absolute Zero World	Current Landscape
Absolute Zero World	Distributed Resources Promoted
Absolute Zero World	Regional Integration
Absolute Zero World	No New Emitting Resources

These pairs represent the proposed ten preliminary modeling runs to be conducted in Plexos LT in the Initial Portfolio Study Phase. Consistent with the scenario screening discussed above, additional combinations of scenarios and strategies can be tested using E3's RESOLVE model to assess if they should be included as a key modeling run.

SENSITIVITY ANALYSES

Following completion of the portfolio studies and operability and reliability screening phases, NS Power will work with stakeholders to prioritize the sensitivities and identify applicable portfolios and/or scenarios for them to be paired with, based on emerging insights from the ongoing analysis throughout the IRP modeling phase.

Potential sensitivities to be evaluated include:

- Increase in Renewable Energy Standard policy
- Low capital cost of wind
- Low capital cost of storage
- Low pricing of import energy
- High pricing of import energy
- High pricing of natural gas
- Carbon tax/pricing
- Fuel security sensitivities
- Resiliency testing (e.g. apply lower carbon constraints to “comparator case” portfolio to quantify exposure to policy risk)

SUMMARY

The major policy drivers which emerged from scenario discussions are:

- 1. Provincial clean energy policy (e.g. Sustainable Development Goal Act)
 - Policy Driver 1.1: Greenhouse gas emissions by electricity sector
 - Policy Driver 1.2: Load changes driven by varying degrees of electrification
- 2. Federal clean energy policy:
 - Policy Driver 2.1: Coal unit end dates

Variants of these drivers have been combined to form the following “scenarios”:

1. Comparator Case
2. Net Zero – High Electrification
3. Net Zero – Moderate Electrification with Early Coal Closure
4. Net Zero – Moderate Electrification
5. Absolute Zero World

The potential resource strategies, to be paired with scenarios to influence the constraints around portfolios, also emerged from scenario discussions:

- A - Current Landscape
- B - Distributed Resources Promoted
- C - Regional Integration
- D - No New Emitting Resources

Modeling scenarios with various resource strategies will result in economically optimal portfolios for each scenario/strategy combination. NS Power proposes ten preliminary scenario and strategy combinations for the initial portfolio modeling:

- 1A Comparator Case / Current Landscape
- 2A Net Zero – High Electrification / Current Landscape
- 2B Net Zero – High Electrification / Distributed Resources Promoted
- 2C Net Zero – High Electrification / Regional Integration

- 3C Net Zero – Moderate Electrification with Early Coal Closure / Regional Integration
- 4A Net Zero – Moderate Electrification / Current Landscape
- 4B Net Zero – Moderate Electrification / Distributed Resources Promoted
- 4C Net Zero – Moderate Electrification / Regional Integration
- 5C Absolute Zero World / Regional Integration
- 5D Absolute Zero World / No New Emitting Resources

Additionally, several potential sensitivities to be tested on key portfolios of interest have been identified. The specific sensitivity analysis plan will be refined once the insights from the preliminary modeling have emerged.