



# Memorandum

## The Commission of Inquiry Respecting the Muskrat Falls Project

Date: September 10, 2018

To: The Commission of Inquiry Respecting the Muskrat Falls Project

From: Grant Thornton LLP

Re: Sensitivity Analysis on the CPW model

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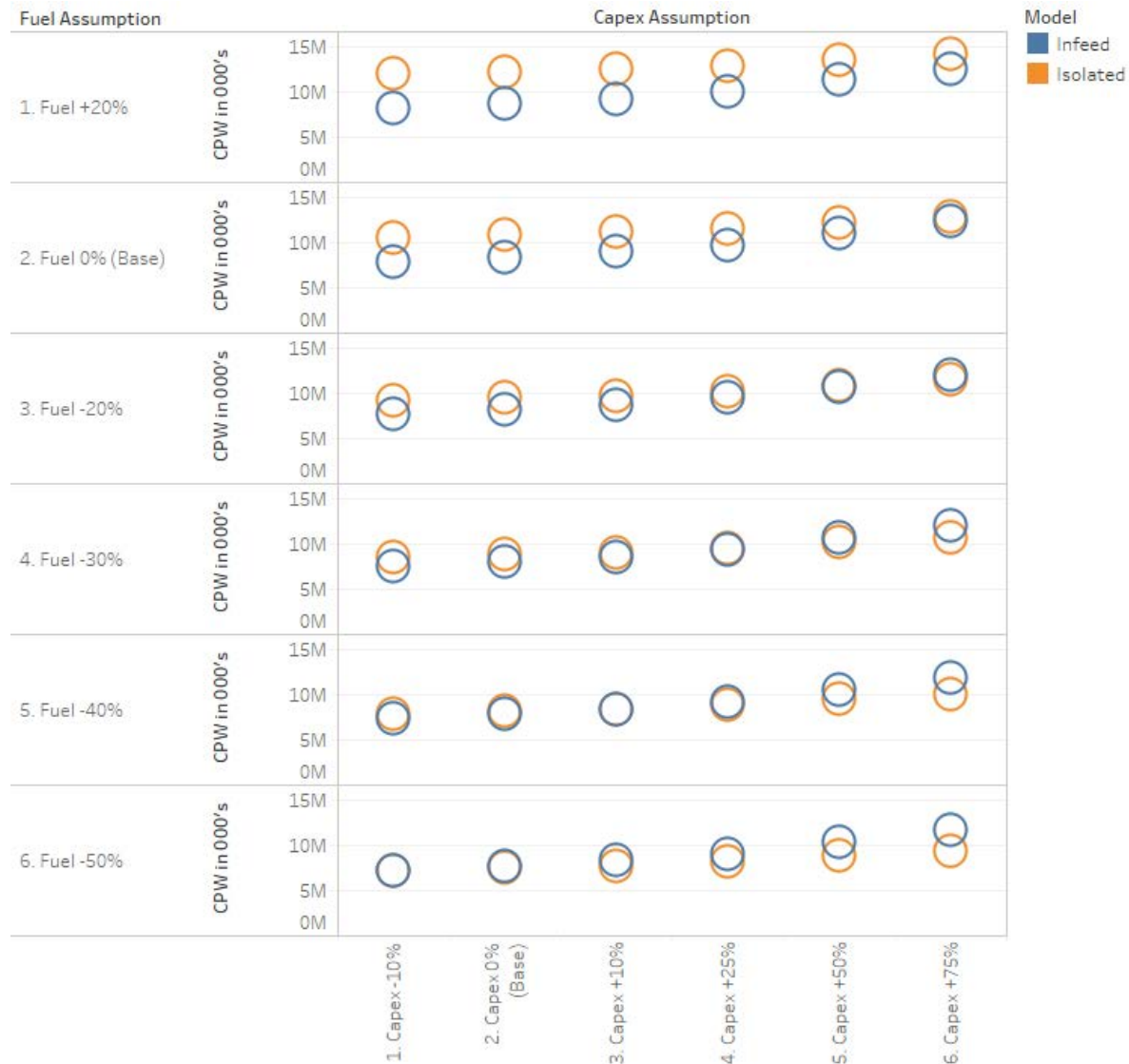
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### Background

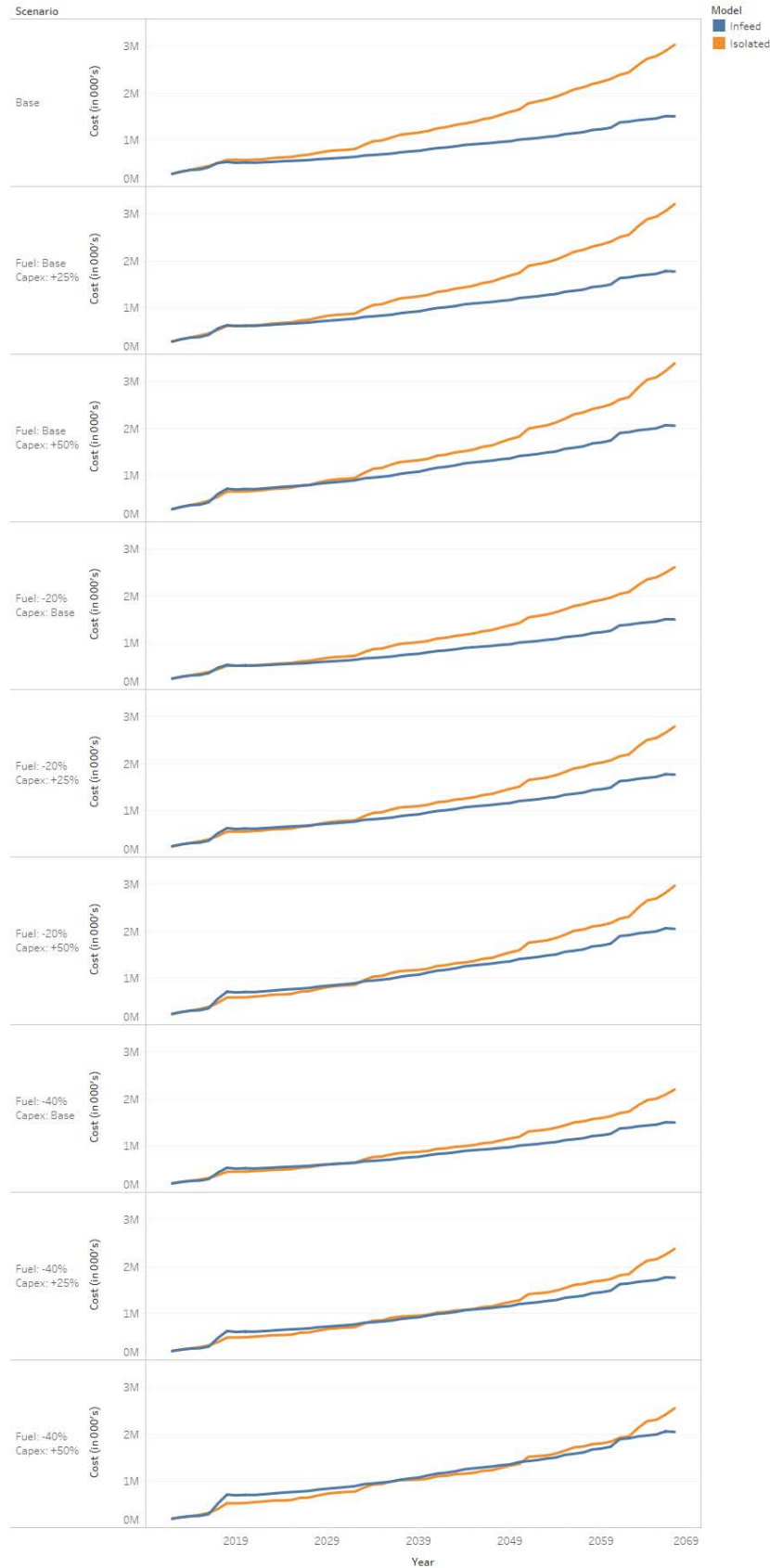
We have been asked by The Commission of Inquiry Respecting the Muskrat Falls Project (the “Commission”) to perform sensitivity analysis on the Cumulative Present Worth model (the “CPW Model”, “Base Model”, or “Base”) created by Nalcor Energy (“Nalcor”). Specifically, the Commission was interested in changes to the CPW Model output if the capital expenditures and/or fuel costs (“Model Inputs”) differed from their original assumptions or the sensitivity models that Nalcor had originally created (the “Nalcor Sensitivity Models”).

### Summary

Below is a graph comparing different Model Inputs (from adjustments to Base capital expenditures (“Capex”) and Base fuel) to the CPW Model in comparing the Infeed and Isolated scenarios:



We have selected and graphed some of the above scenarios to illustrate the costs over time. This is shown in the graphs below (larger graphs are available in Appendix A of this memo):



Below are the outputs of the CPW Model in the Infeed and Isolated scenarios under various assumptions for fuel price and Capex (amounts are in 000's):

Infeed	Fuel -50%	Fuel -40%	Fuel -30%	Fuel -20%	Fuel 0% (Base)	Fuel +20%
Capex -10%	\$ 7,179,184	\$ 7,310,855	\$ 7,442,522	\$ 7,574,195	\$ 7,837,527	\$ 8,100,863
Capex 0% (Base)	\$ 7,707,654	\$ 7,839,325	\$ 7,970,992	\$ 8,102,665	\$ 8,365,997	\$ 8,629,332
Capex +10%	\$ 8,223,745	\$ 8,355,416	\$ 8,487,083	\$ 8,618,756	\$ 8,882,088	\$ 9,145,424
Capex +25%	\$ 8,995,337	\$ 9,127,008	\$ 9,258,675	\$ 9,390,348	\$ 9,653,680	\$ 9,917,016
Capex +50%*	\$ 10,294,417	\$ 10,426,088	\$ 10,557,755	\$ 10,689,428	\$ 10,952,760	\$ 11,216,096
Capex +75%*	\$ 11,590,381	\$ 11,722,052	\$ 11,853,719	\$ 11,985,392	\$ 12,248,724	\$ 12,512,060

Isolated	Fuel -50%	Fuel -40%	Fuel -30%	Fuel -20%	Fuel 0% (Base)	Fuel +20%
Capex -10%	\$ 7,175,721	\$ 7,845,126	\$ 8,514,530	\$ 9,183,935	\$ 10,522,745	\$ 11,861,554
Capex 0% (Base)	\$ 7,431,315	\$ 8,100,720	\$ 8,770,125	\$ 9,439,529	\$ 10,778,339	\$ 12,117,148
Capex +10%	\$ 7,686,909	\$ 8,356,314	\$ 9,025,719	\$ 9,695,124	\$ 11,033,933	\$ 12,372,743
Capex +25%	\$ 8,070,301	\$ 8,739,706	\$ 9,409,110	\$ 10,078,515	\$ 11,417,325	\$ 12,756,134
Capex +50%	\$ 8,709,286	\$ 9,378,691	\$ 10,048,096	\$ 10,717,501	\$ 12,056,310	\$ 13,395,120
Capex +75%	\$ 9,348,272	\$ 10,017,677	\$ 10,687,082	\$ 11,356,486	\$ 12,695,296	\$ 14,034,105

\*Note that for the Infeed CPW Model Output in the Capex +50% and +75% scenarios, the LITL and MF amounts in the Power Purchases component of the CPW Model were estimated using a simple linear regression model. See the 'Assumptions' section of this memo for details.

## Scope

In performing our analysis, we have reviewed the following:

- “PLF12 Iter1 CPW Analysis 2012Aug1 - received 05.01.18.xlsx” (the CPW Model or Base Model)
- Six models created by Nalcor as variations of the Base Model (the Nalcor Sensitivity Models) with respect to fuel and capital expenditure changes, consisting of:
  - Recreated expected fuel PLF12 Iter1 CPW Analysis 2012Aug1 SRG.xlsx
  - Recreated high fuel PLF12 Iter1 CPW Analysis 2012Aug1 SRG.xlsx
  - Recreated low fuel PLF12 Iter1 CPW Analysis 2012Aug1 SRG.xlsx
  - Recreated PLF12 Iter1 CPW Analysis 2012Aug1 +10% Other Strategist Capital.xlsx
  - Recreated PLF12 Iter1 CPW Analysis 2012Aug1 +25% Other Strategist Capital.xlsx
  - Recreated PLF12 Iter1 CPW Analysis 2012Aug1 -10% Other Strategist Capital.xlsx

We have not verified the accuracy of Nalcor's models as part of the work performed for sensitivity analysis addressed under this memo, and this analysis is not intended to provide any commentary on the validity of the models themselves.

### Assumptions

In preparing our analysis, we have made the following assumptions in addition to those noted elsewhere in this memo:

1. The effect that a Model Input has on the CPW Model is based on the Nalcor Sensitivity Models. For example, if the Nalcor Sensitivity Model for fuel sensitivity did not impact the Power Purchases component of the CPW Model then we have assumed that different fuel predictions would also not impact the Power Purchases component of the CPW Model.
2. We have assumed that the Model Inputs that were used in this sensitivity analysis (fixed changes to Base Capex and Base fuel price) were appropriate. Note that the Model Inputs that were used in the analysis was not intended as commentary on the likelihood of those scenarios occurring.
3. We understand that Nalcor used more complicated models to determine the impact of capital expenditure changes to the Labrador Island Transmission Link ("LITL") and Muskrat Falls ("MF") model input amounts in the Power Purchases component of the CPW Model. In performing our analysis for scenarios which the Nalcor Sensitivity Models did not account for (i.e. Capex of +50% and +75%), we have made the simplifying assumption that it would be reasonable for the purposes of a sensitivity analysis to assume a linear relationship (using simple linear regression) between the LITL and MF amounts in the Power Purchases component of the CPW Model and the capital expenditure changes, based on the outputs of the Nalcor Sensitivity Models. The regression model we conducted for LITL had a Standard Error of \$5,723,355 and  $R^2$  measure of 0.99972, and the regression model we conducted for MF had a Standard Error of \$143,066 and  $R^2$  measure of 0.99999. In situations where a year-specific output was needed from either the LITL or MF models, we have assumed that a fixed percentage change could be applied to each of the years that would result in an equivalent CPW that we arrived at using our regression model described above.

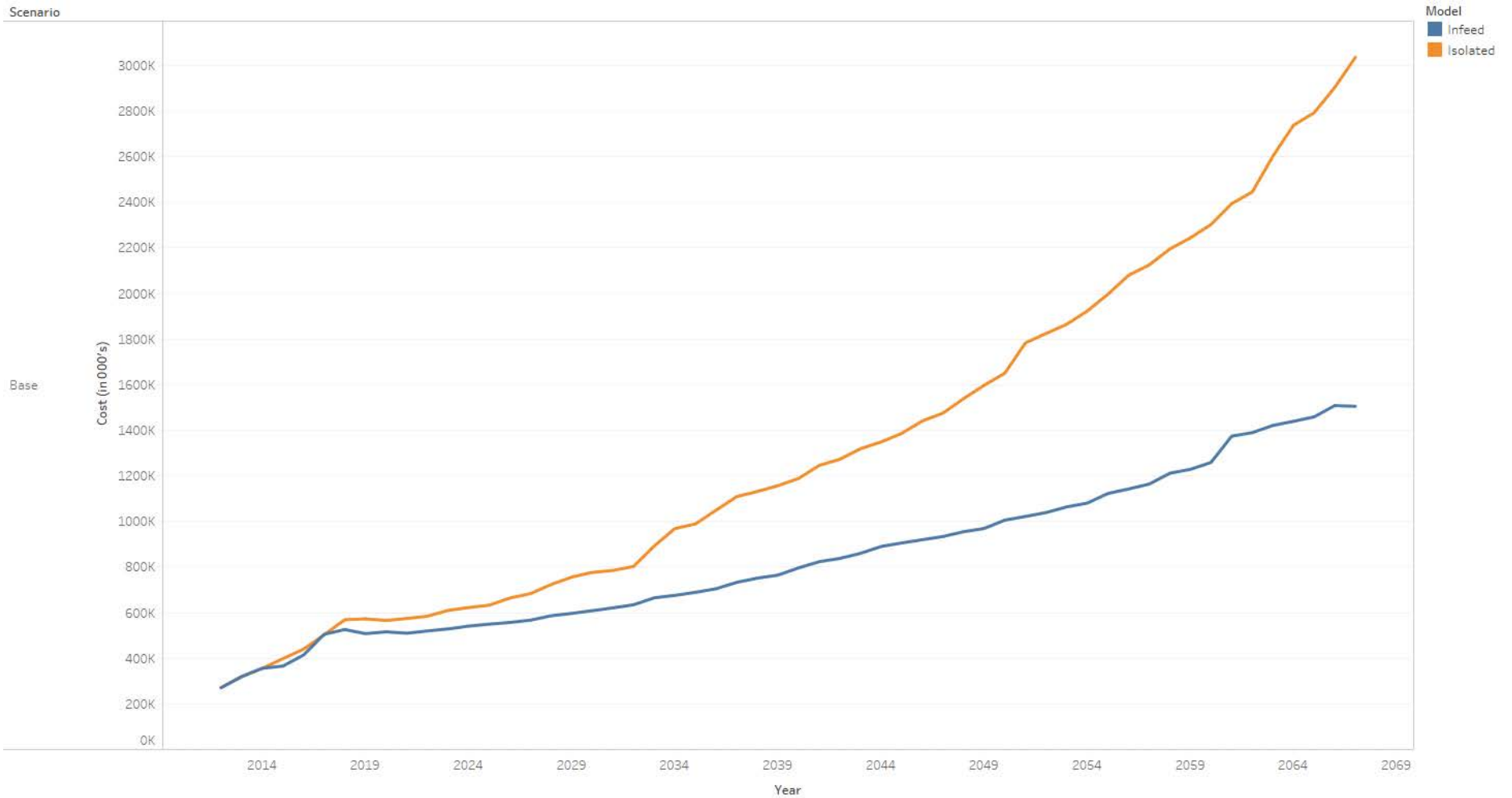


# Appendix A

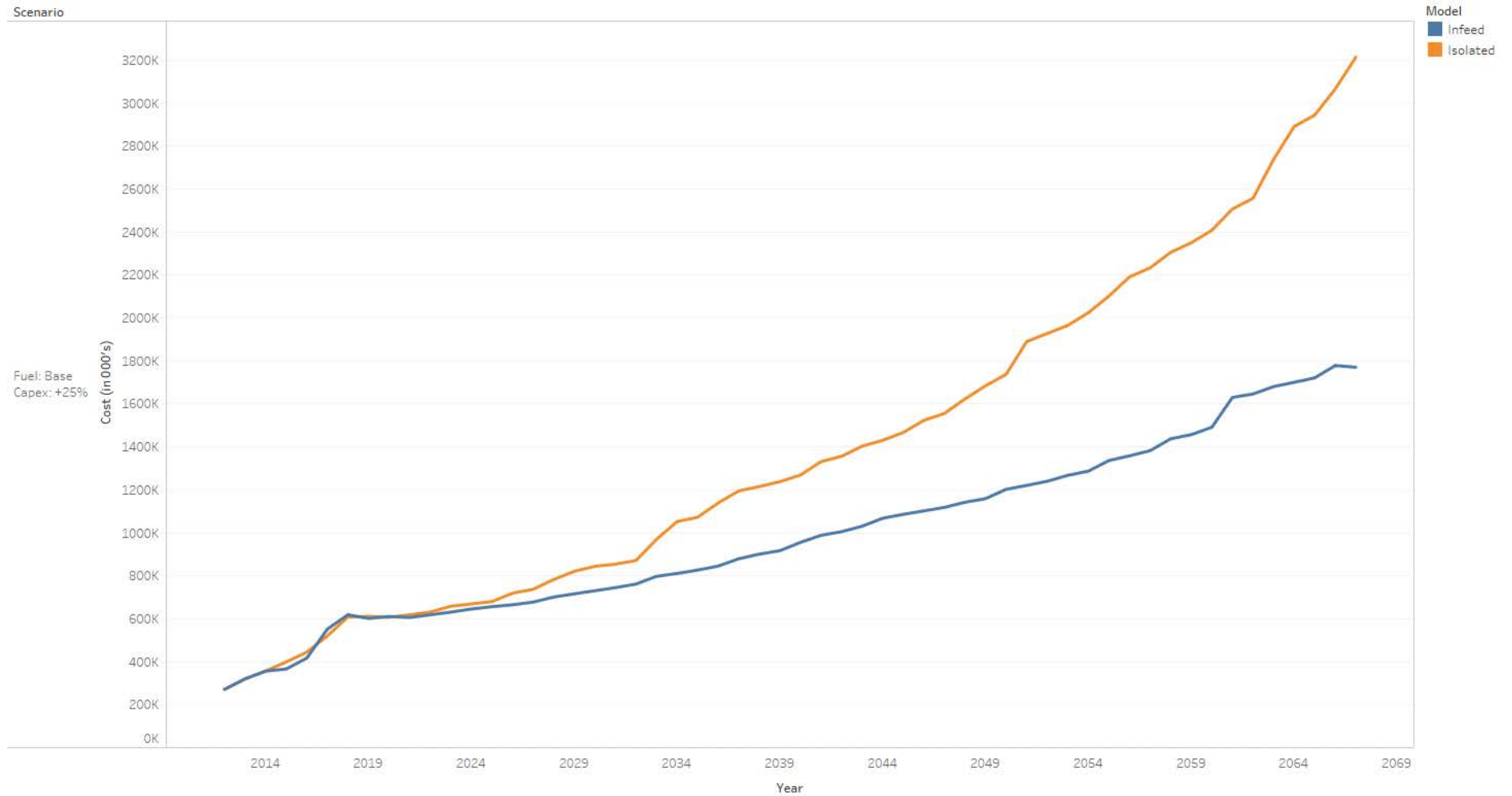
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Base

Scenario

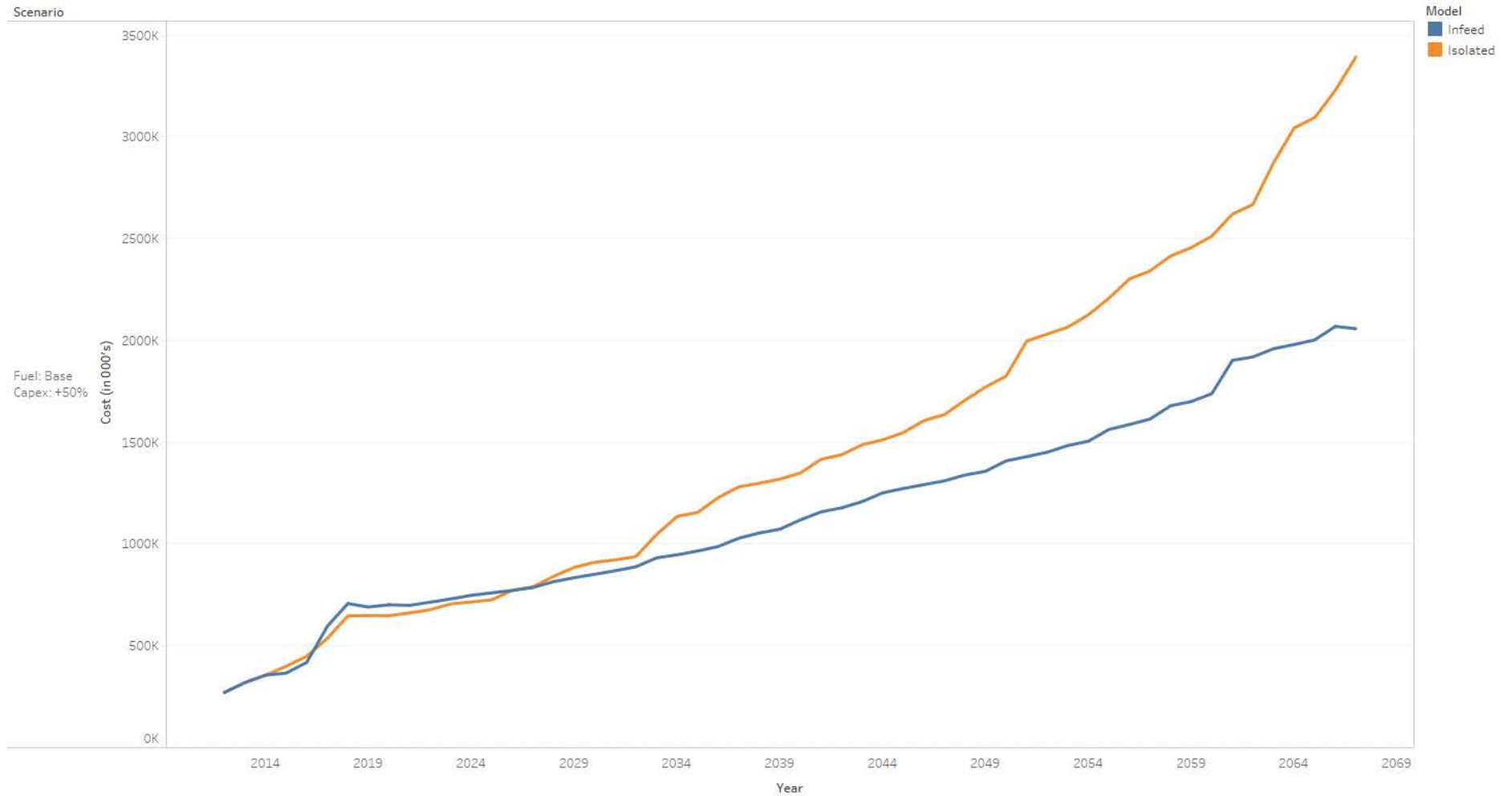


Fuel: Base, Capex: +25%

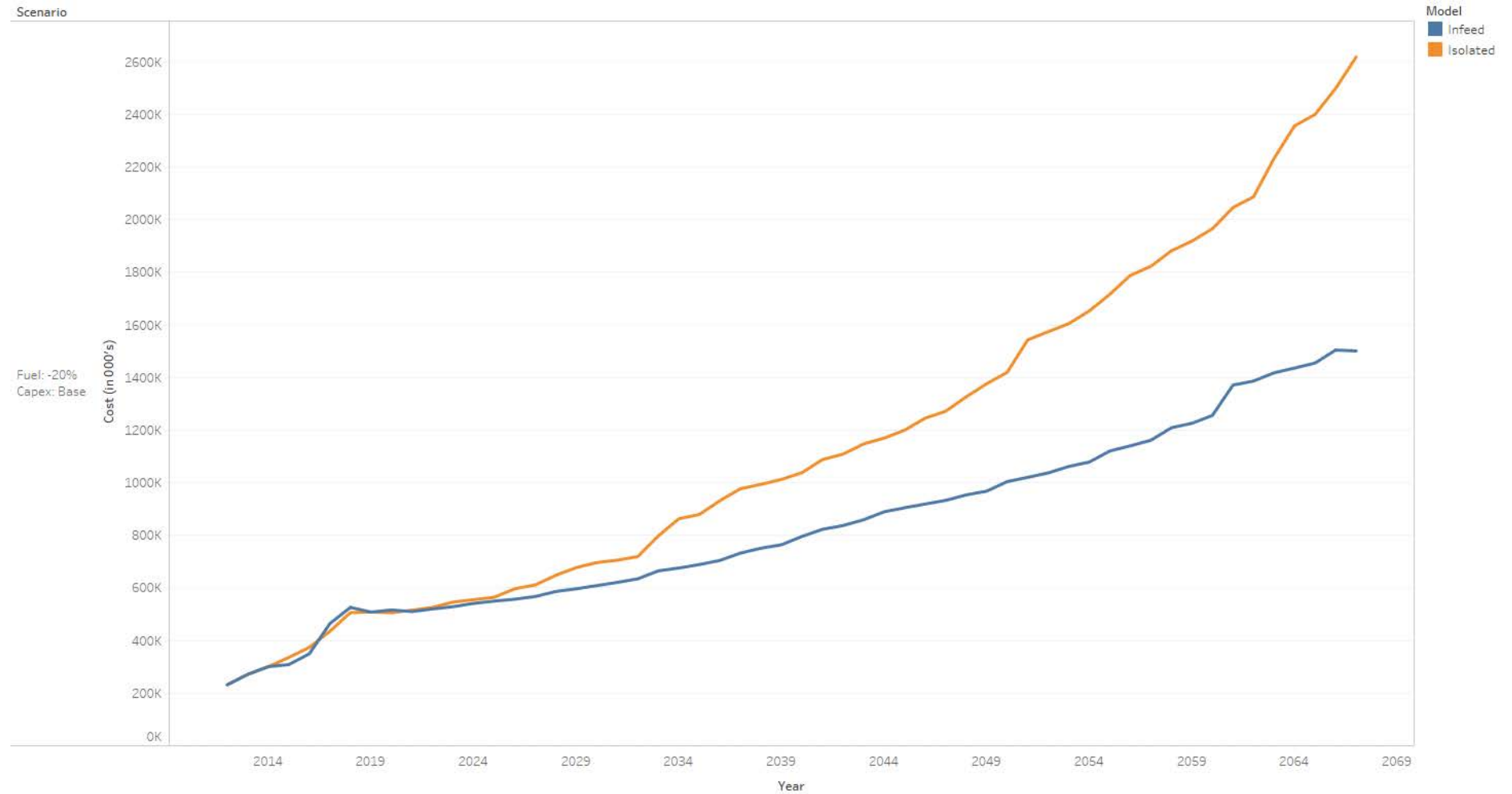




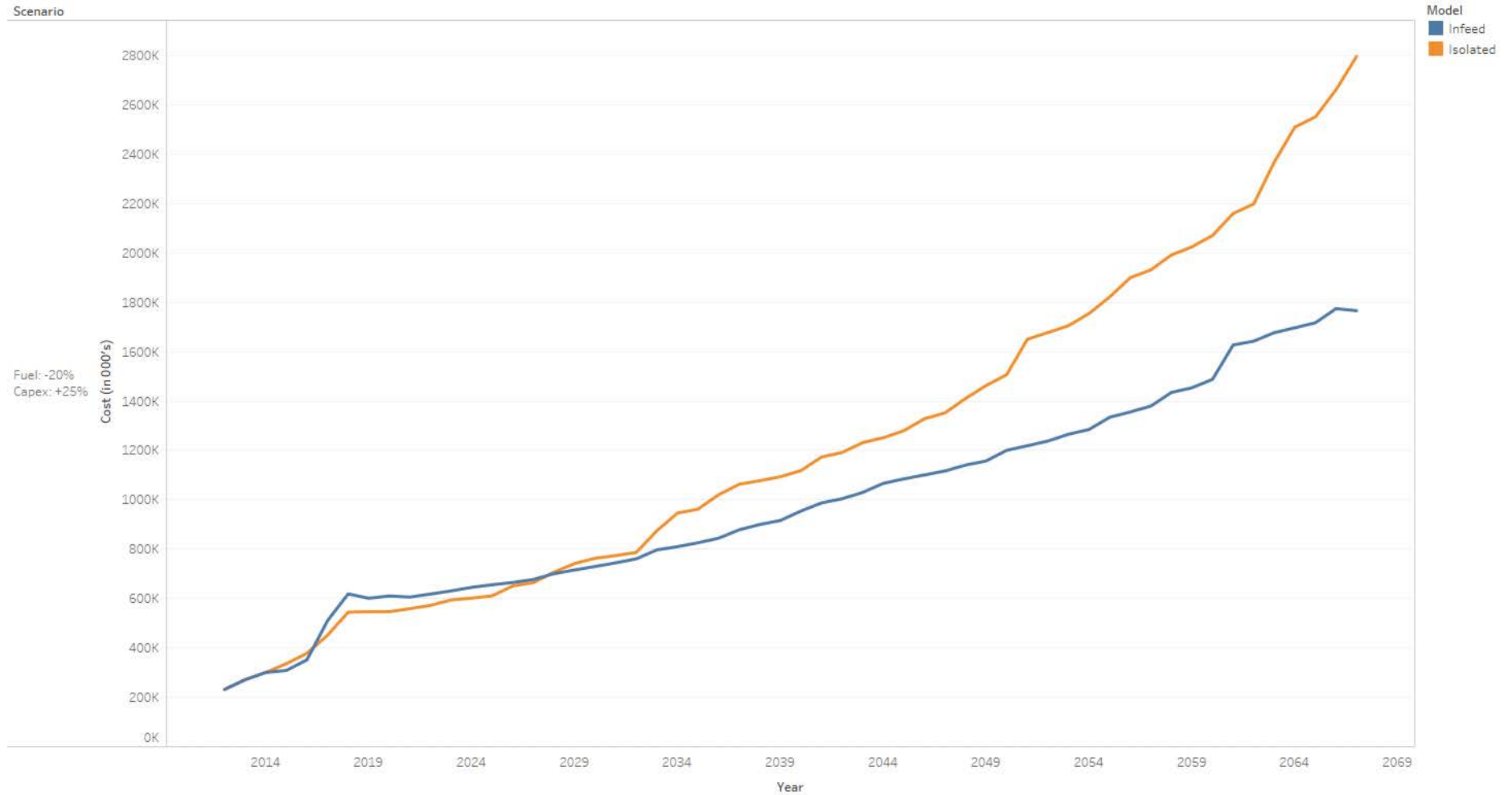
Fuel: Base, Capex: +50%



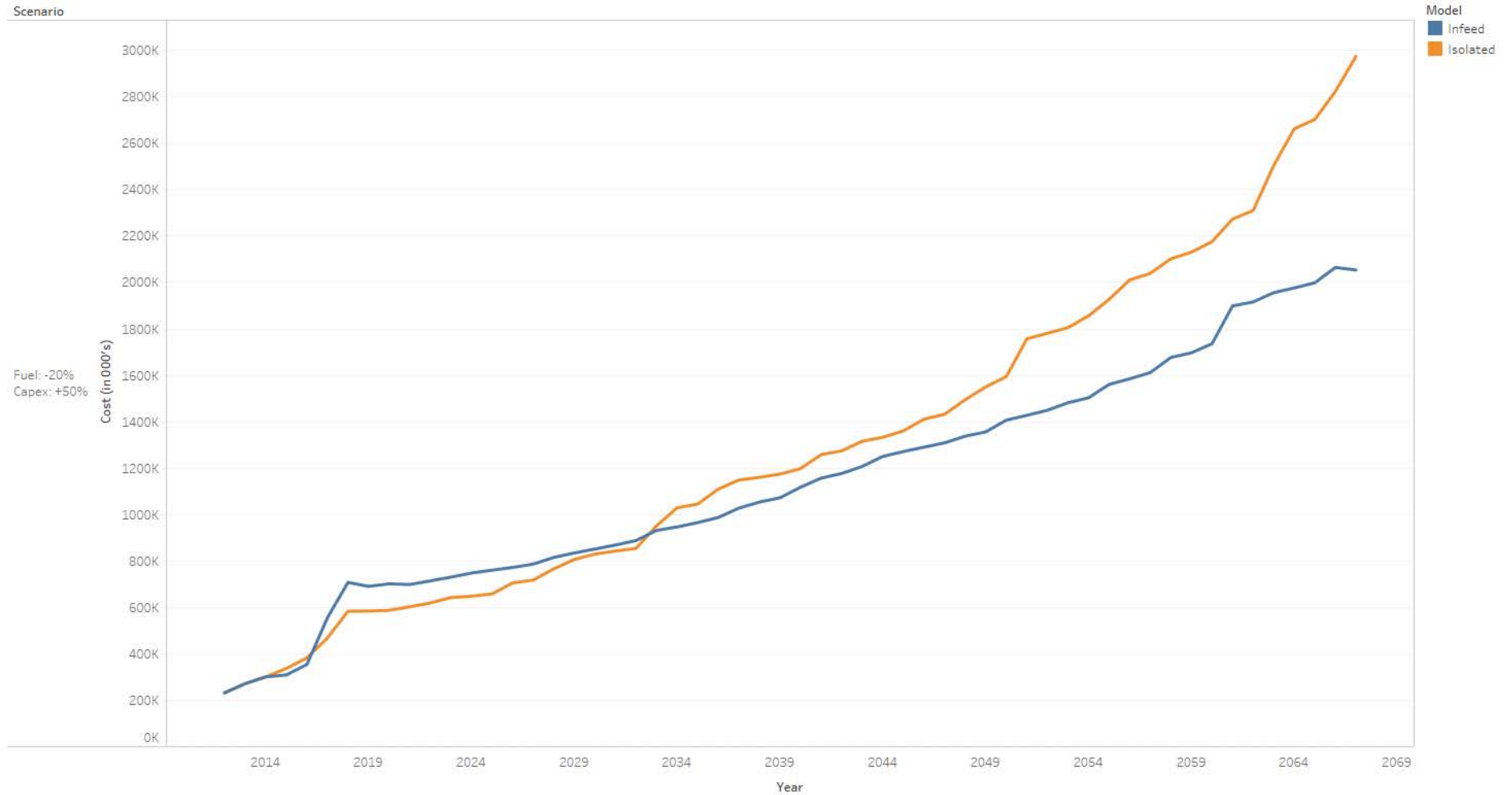
Fuel: -20%, Capex: Base



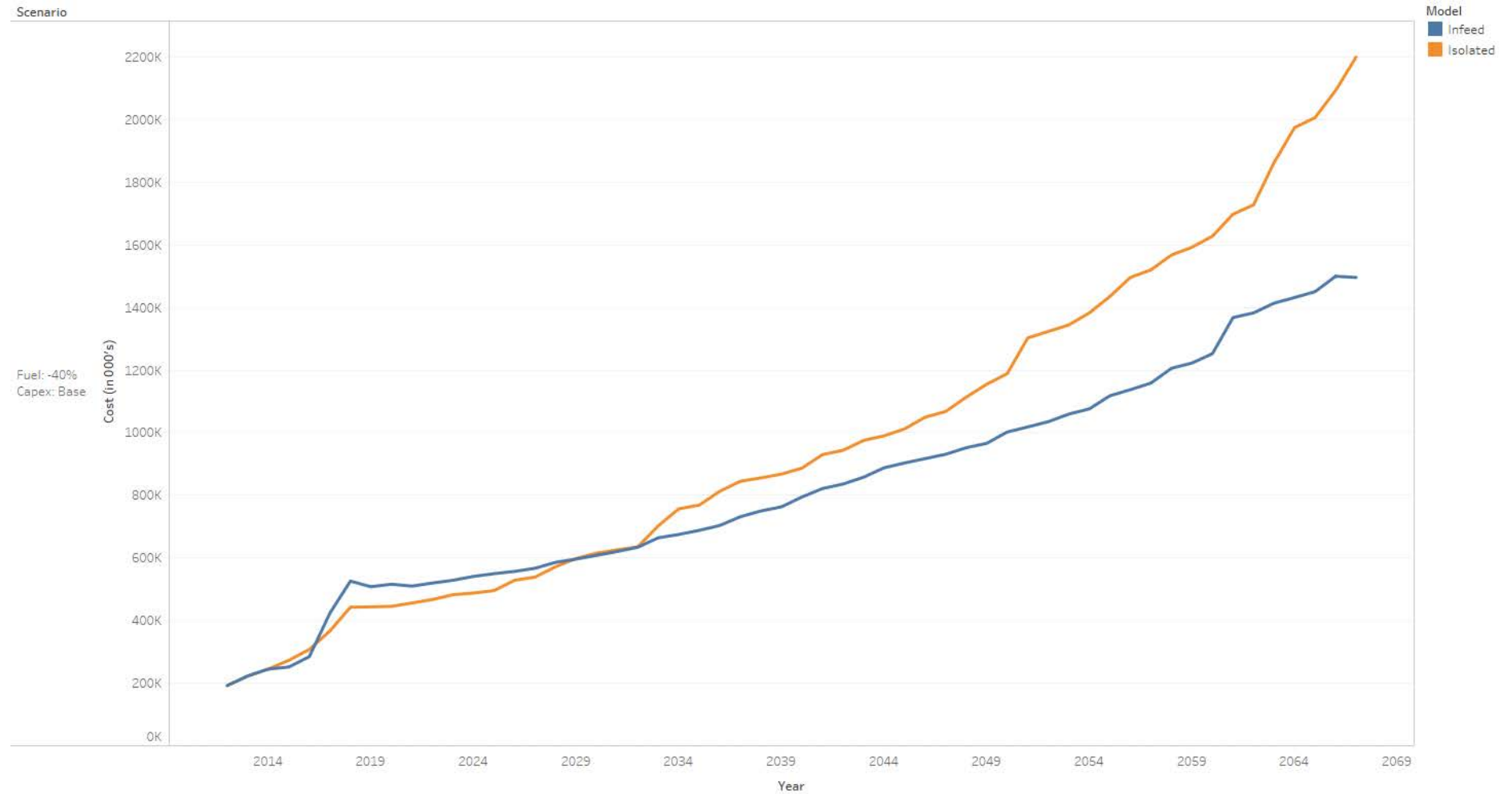
Fuel: -20%, Capex: +25%



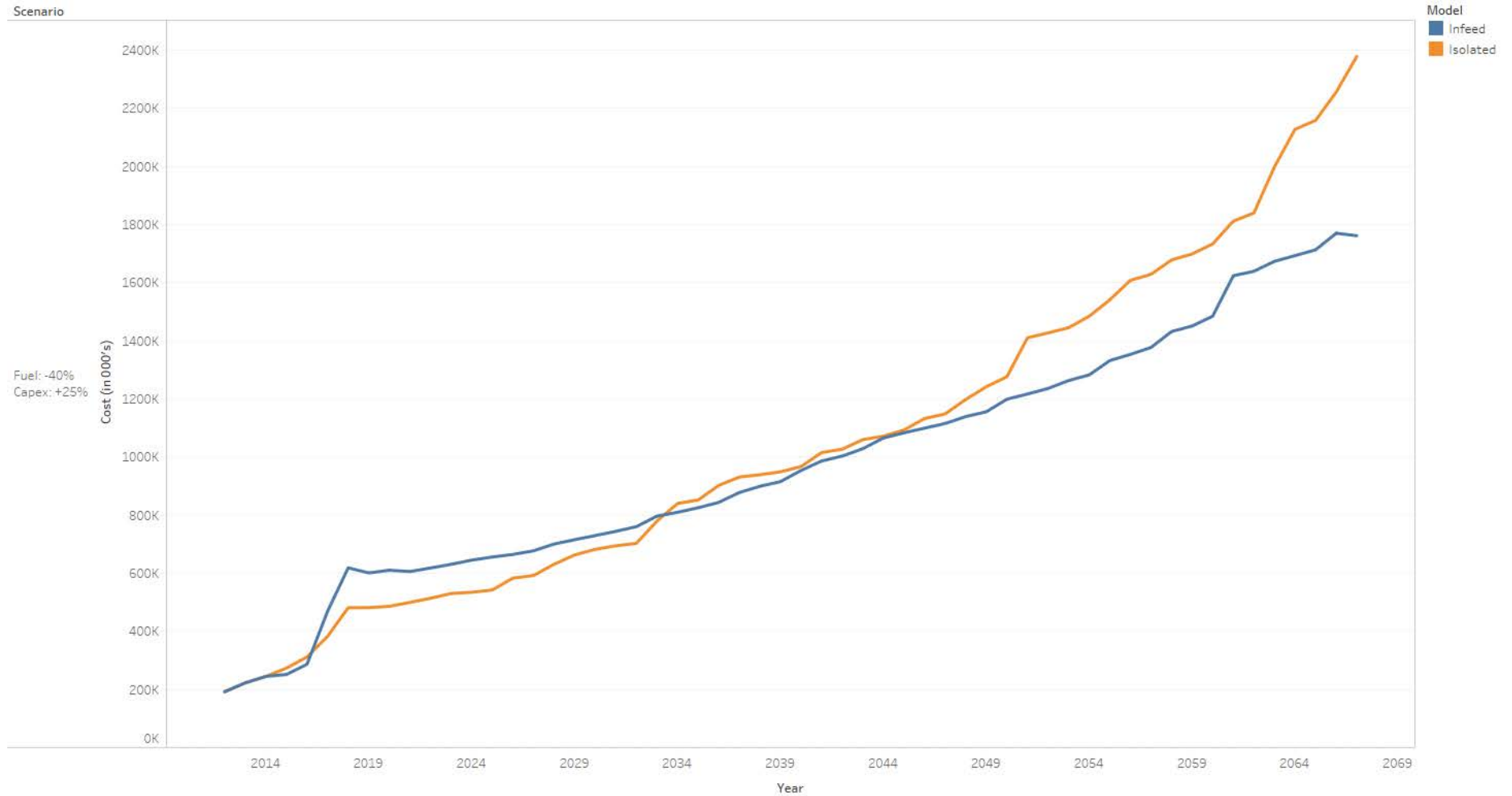
Fuel: -20%, Capex: +50%



Fuel: -40%, Capex: Base



Fuel: -40%, Capex: +25%



Fuel: -40%, Capex: +50%

