February 2, 2021

MEMORANDUM

TO: **Power Committee Members**

FROM: **Ben Kujala, Power Division Director**

SUBJECT: **Robustness of Energy Efficiency Scenario in the 2021 Power Plan**

BACKGROUND:

Presenter: Ben Kujala

Summary: One of the scenarios explored in the 2021 Power Plan is the "Robustness of Energy Efficiency". This scenario is designed to explore the uncertainty in the acquisition rate of energy efficiency as well as efficiency's capacity contribution. Early results from the first part – uncertainty in the ramp rates and the impact on resource strategy – was presented at the January 28, 2021 Power Committee webinar. Portfolio analysis found that with increased (decreased) availability, additional (less) efficiency was acquired, initially at high cost levels to meet the short-term adequacy need, then in later years, at lower cost levels primarily for economics. The overall portfolio cost increased with accelerated ramps.

The second aspect of the scenario is to better understand the role of efficiency's capacity contribution in serving the system's needs. The supply curve is built on an energy contribution at a levelized cost of energy basis (dollar per megawatt-hour), but intrinsic in the energy contribution is a capacity contribution. This capacity impact is provided to the RPM by cost bin and differentiated by summer versus winter. By artificially varying the relative amount of capacity by quarter, we can better understand how this capacity is serving the power system, particularly the seasonality. The presentation will be focused on this aspect of the scenario.

Model analysis is ongoing for this scenario and results are not yet available to share. Presentation materials will be provided to the Power Committee members before the Power Committee meeting; they are not included in this packet.

Relevance: As a priority resource in the Power Act, it is critical to understand the impacts of uncertainty in energy efficiency acquisition.

Workplan: A.1.1. Power Planning – Develop and analyze scenarios for the Power Plan

More Info: The January 28, 2021 Power Committee webinar presentation that provided early results on the scenario findings is available here: https://nwcouncil.box.com/s/sb1jaorxm4hq48lisr782o205eormnzq

Robustness of EE Scenario Findings

THE 2021
NORTHWEST
POWER PLAN

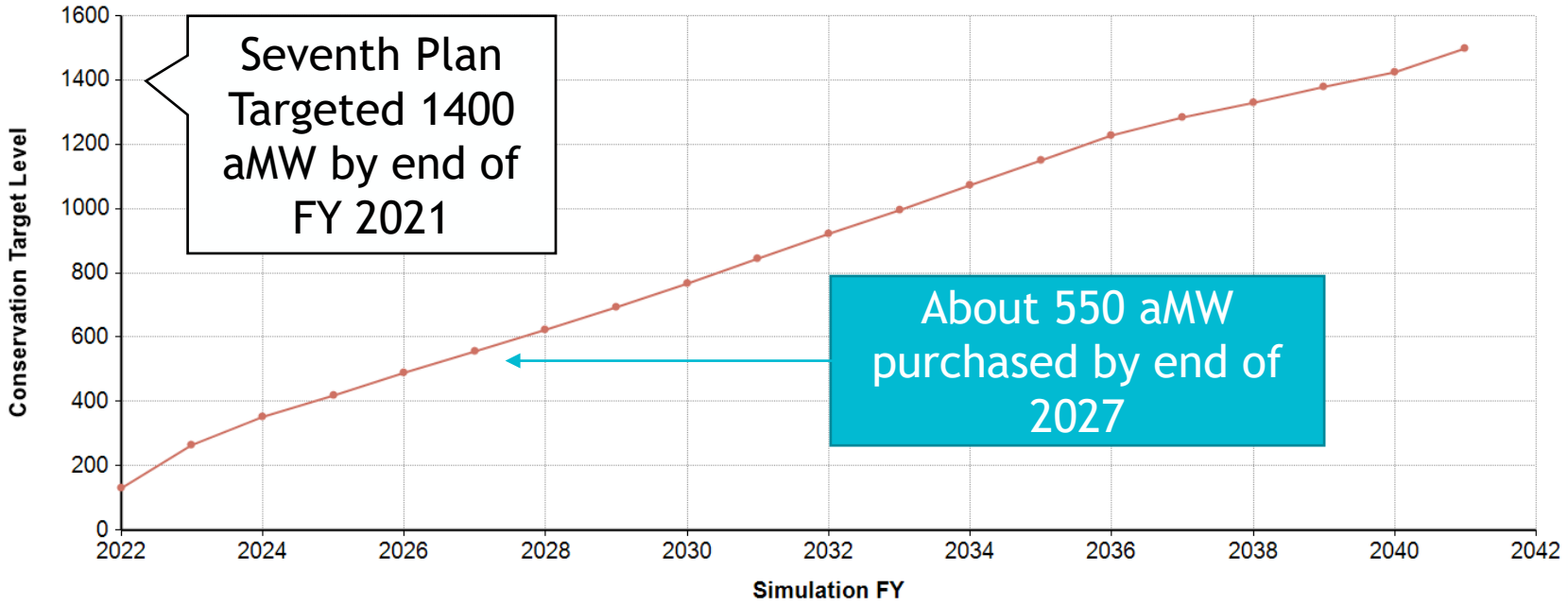
FOR A SECURE & AFFORDABLE
ENERGY FUTURE

Baseline Conditions

- Baseline Conditions are still being refined - especially relating to resource capacity contribution

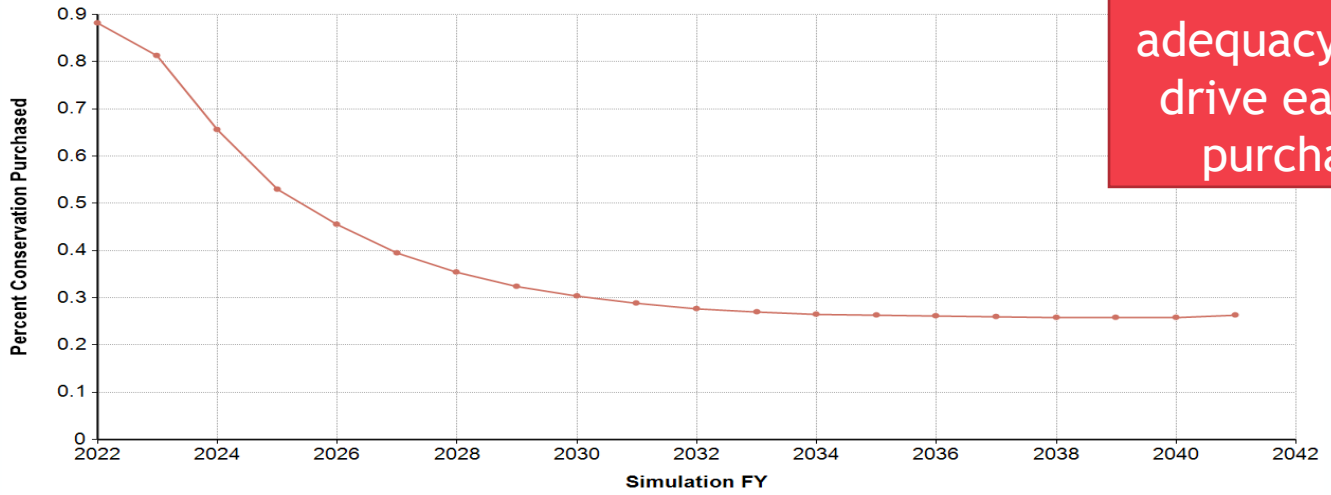
- Low to moderate EE acquisition

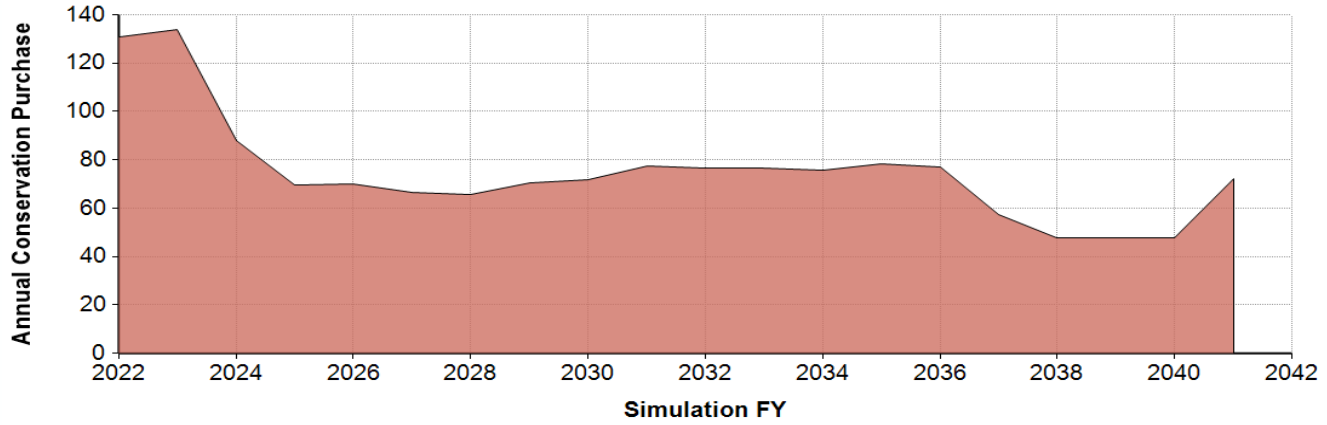
Maximum Amount of Conservation Purchased by FY



Percent of Conservation Supply Purchased

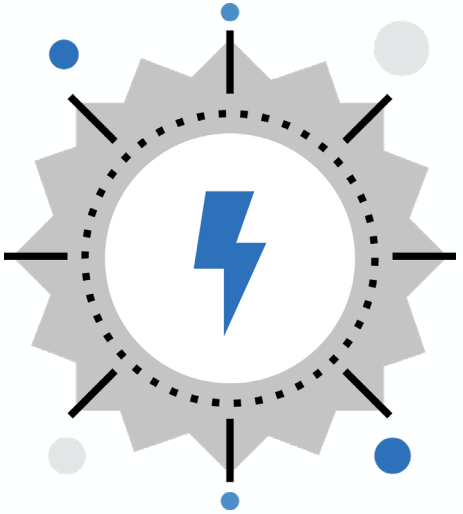
Near-term adequacy needs drive early EE purchases





Test robustness of energy efficiency

- Test sensitivity of the regional resource acquisition cost & risk to varying amounts of energy efficiency available
  - Change ramp rates assumption to reflect increased/decreased acquisition, due to:
    - Changes in EE budgets due to unforeseen policies
    - Uncertainty in impacts
  - Increase/decrease maximum acquisition over 20-years to reflect possible new technologies or slow downs
- Test varying the capacity contribution of EE
  - Analyze how EE's seasonal peak contribution is impacting its acquisition

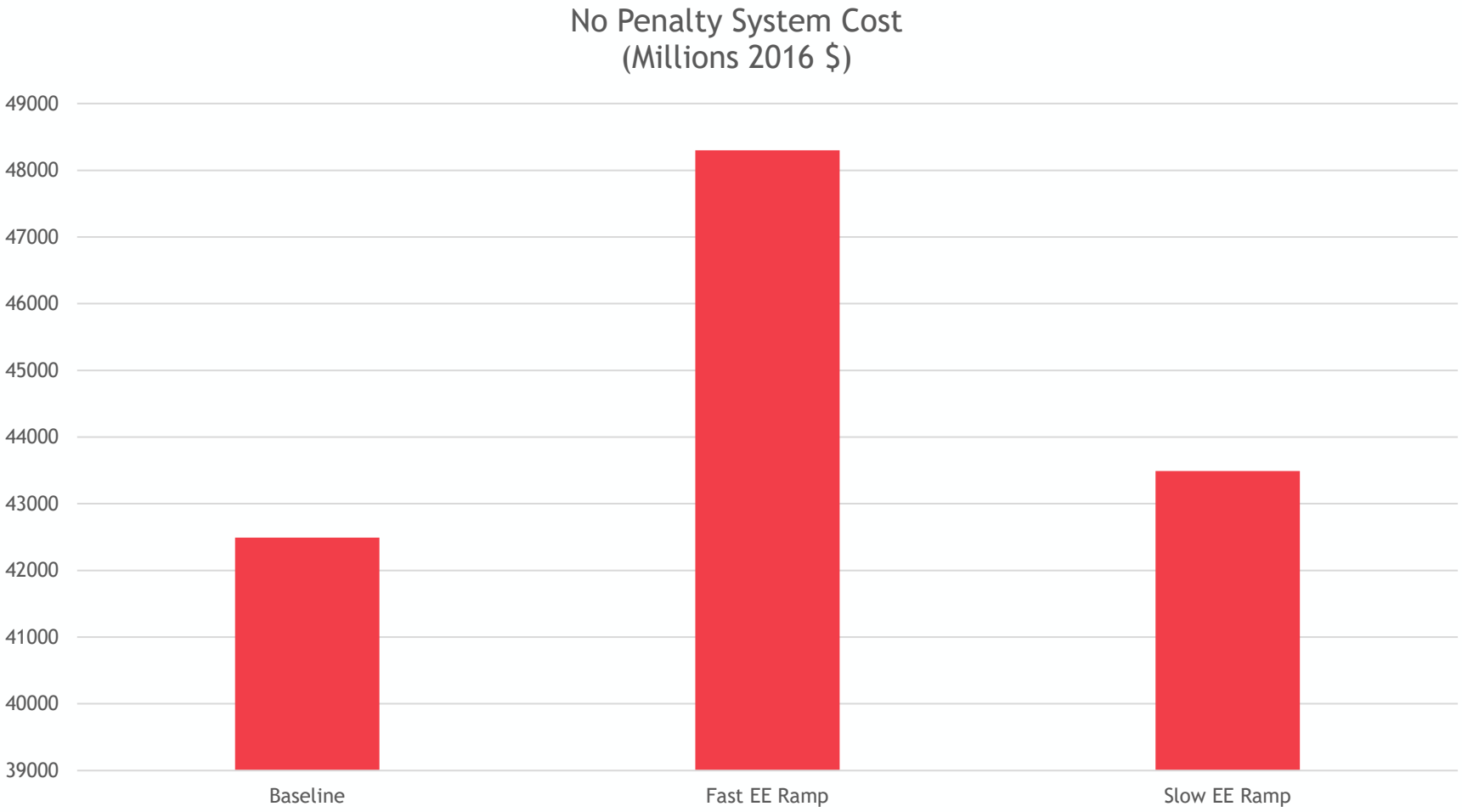


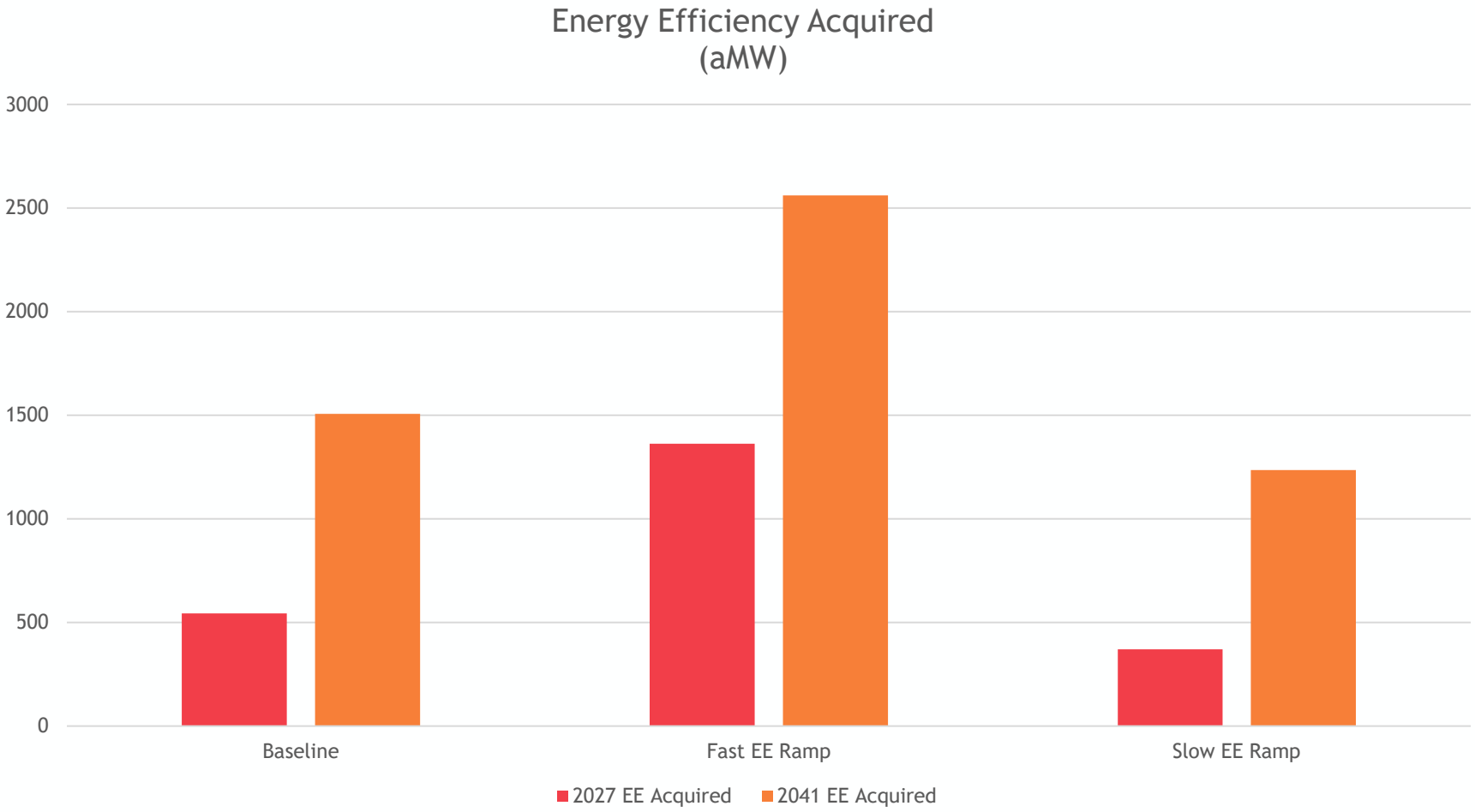
Comparing to Baseline

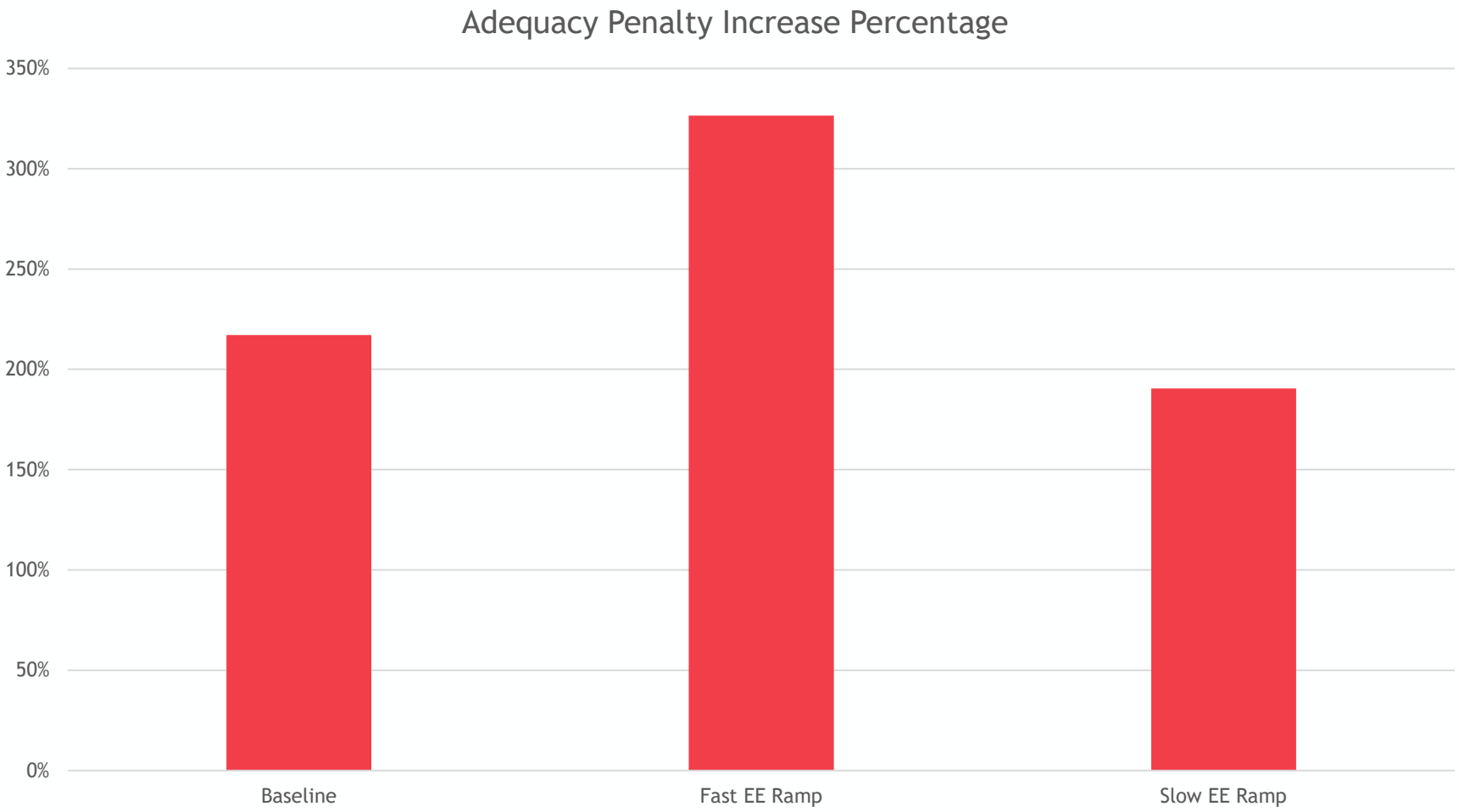
- What is the total system cost?
  - Numbers reported do not include penalties – adequacy is represented separately and other penalties are negligible
- How much EE is acquired?
- Does it increase or decrease adequacy?
  - All tests are driven by the same adequacy requirement – but penalties help drive toward those results and indicate how closely the requirements are followed
  - Penalties are relative to an unrestricted RPM build penalty amount
- What are the impacts on Greenhouse Gas Emissions?

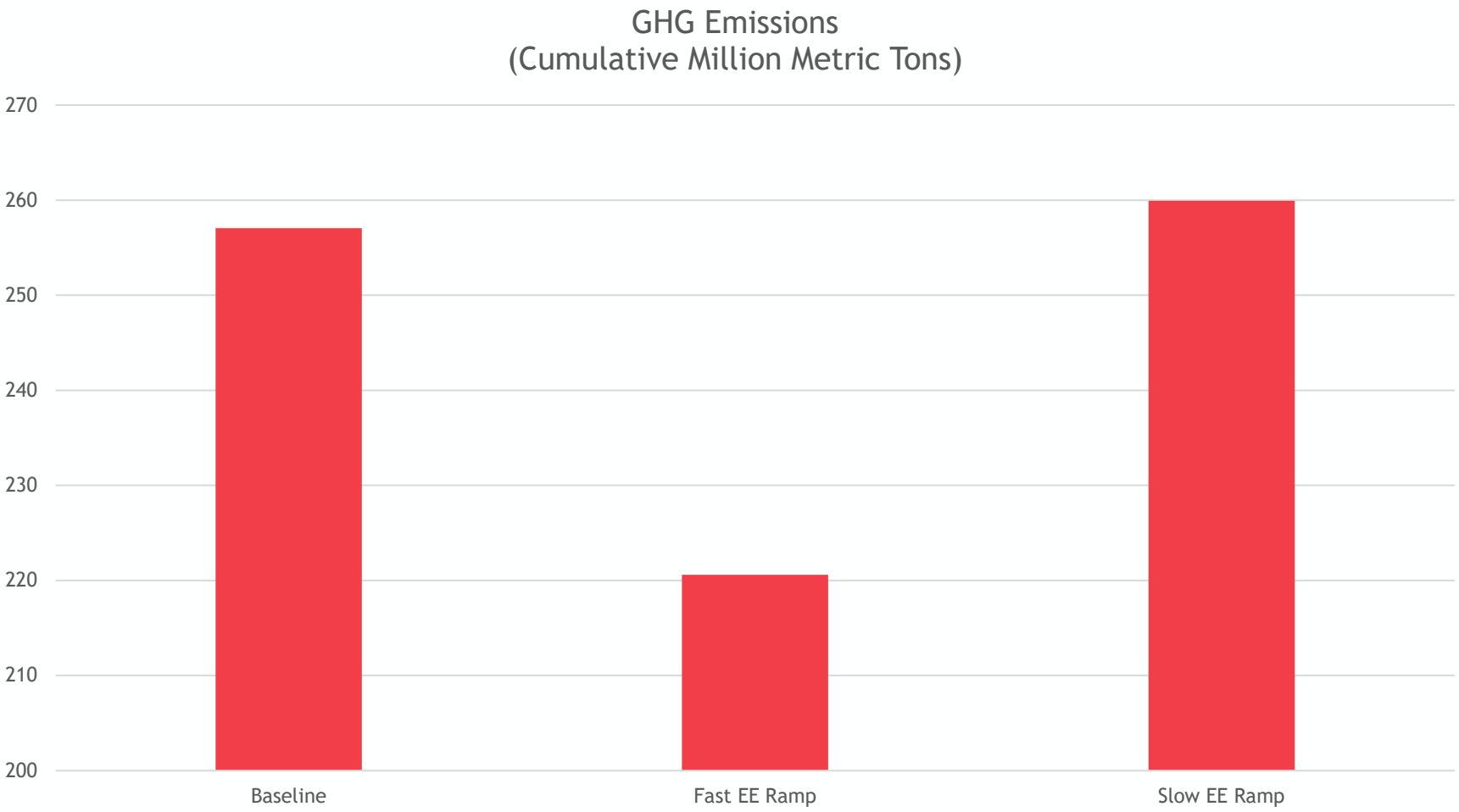
EE Ramping Test

- What if more or less EE is available? What if you can get it faster or slower?
- Observations:
  - Faster ramps respond to adequacy signal but do not necessarily make resource strategy more adequate
  - Slower ramps limit initial uptake of EE early but results in other resource builds that increase the overall cost


No Penalty System Cost
(Millions 2016 $)
49000
48000
47000
46000
45000
44000
43000
42000
41000
40000
39000
Baseline
Fast EE Ramp
Slow EE Ramp

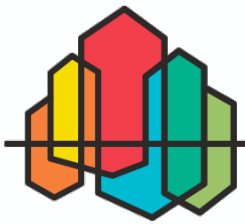

Energy Efficiency Acquired
(aMW)
3000
2500
2000
1500
1000
500
0
Baseline
Fast EE Ramp
Slow EE Ramp
2027 EE Acquired
2041 EE Acquired

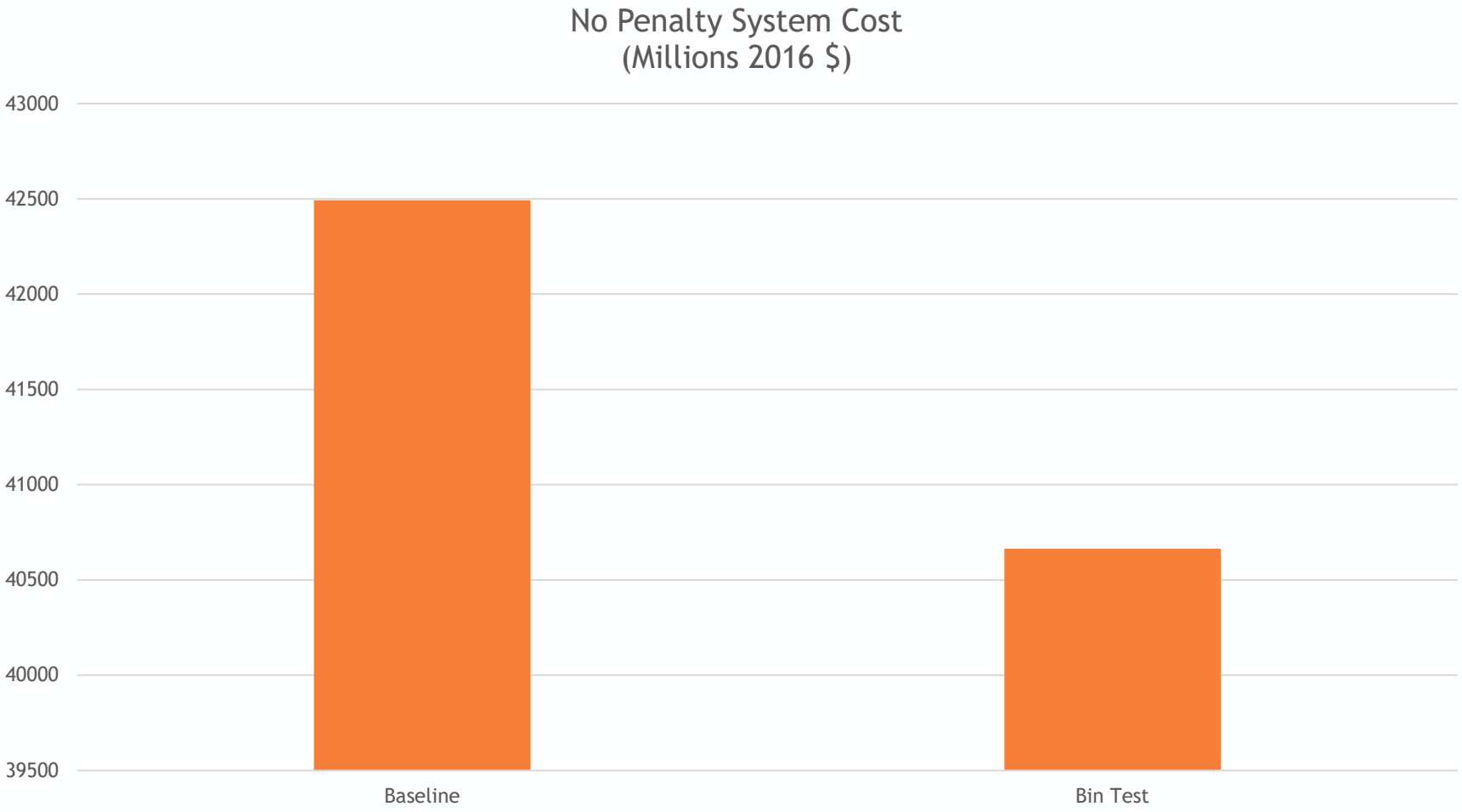

Adequacy Penalty Increase Percentage
350%
300%
250%
200%
150%
100%
50%
0%
Baseline
Fast EE Ramp
Slow EE Ramp

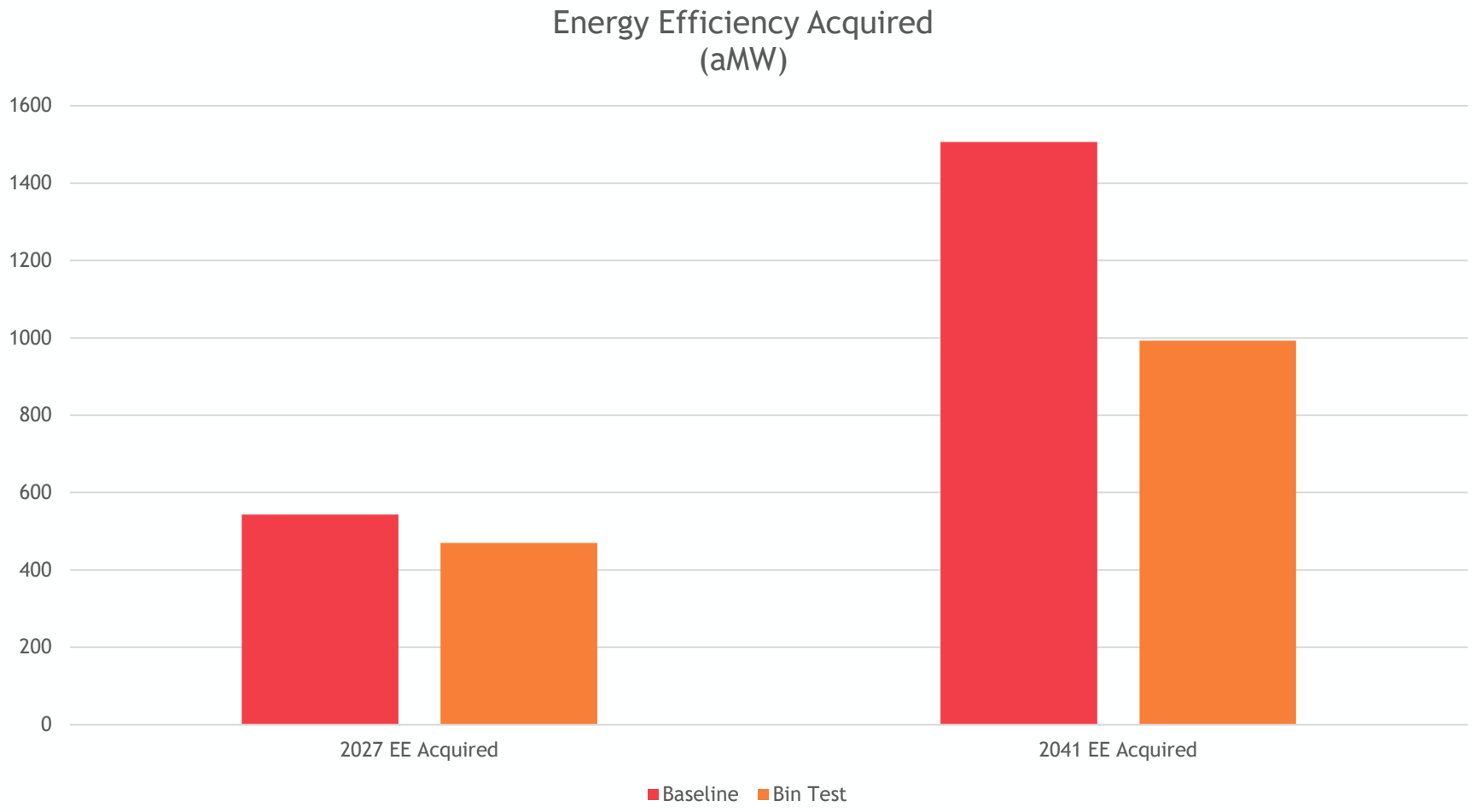

GHG Emissions
(Cumulative Million Metric Tons)
270
260
250
240
230
220
210
200
Baseline
Fast EE Ramp
Slow EE Ramp

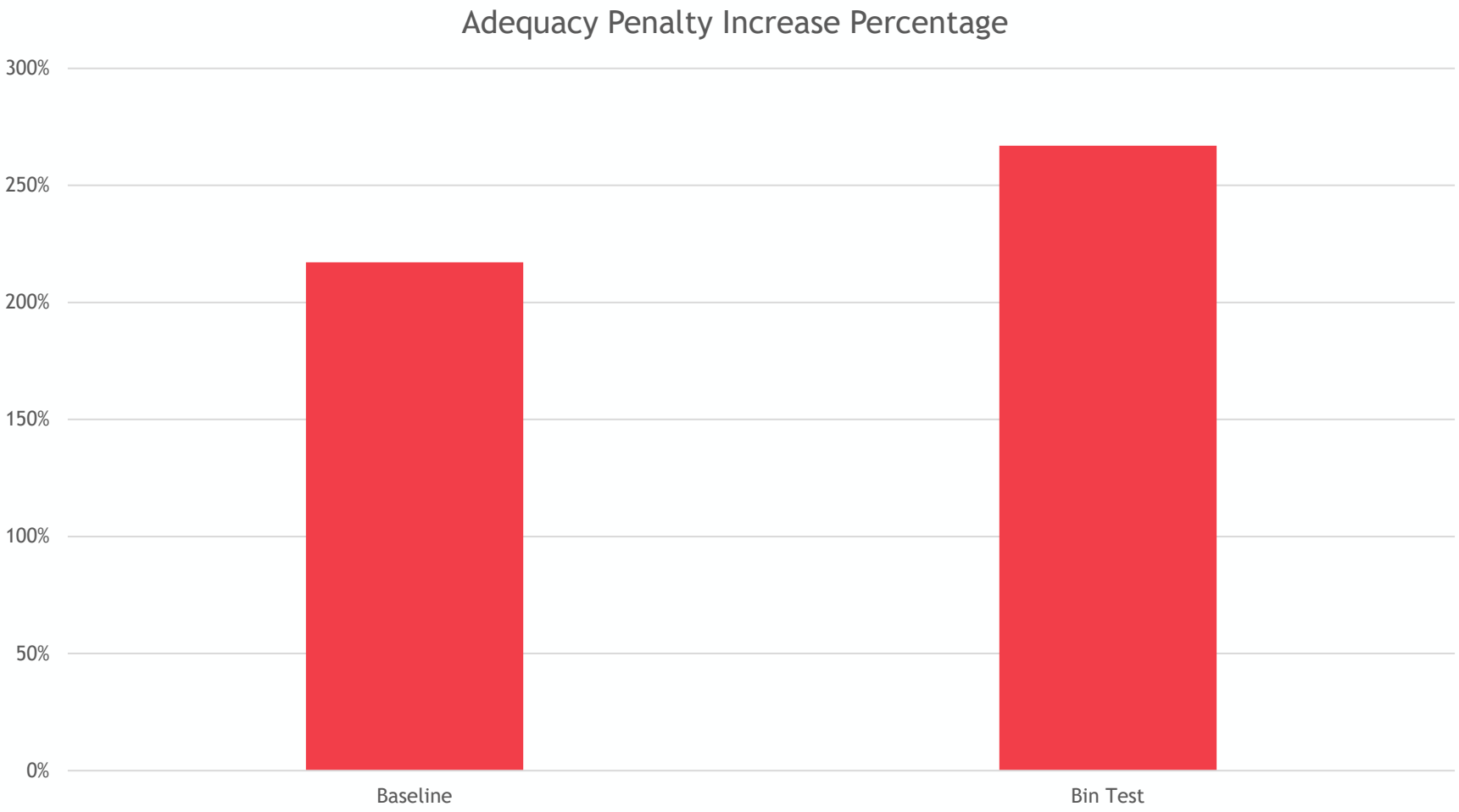
Bin Test

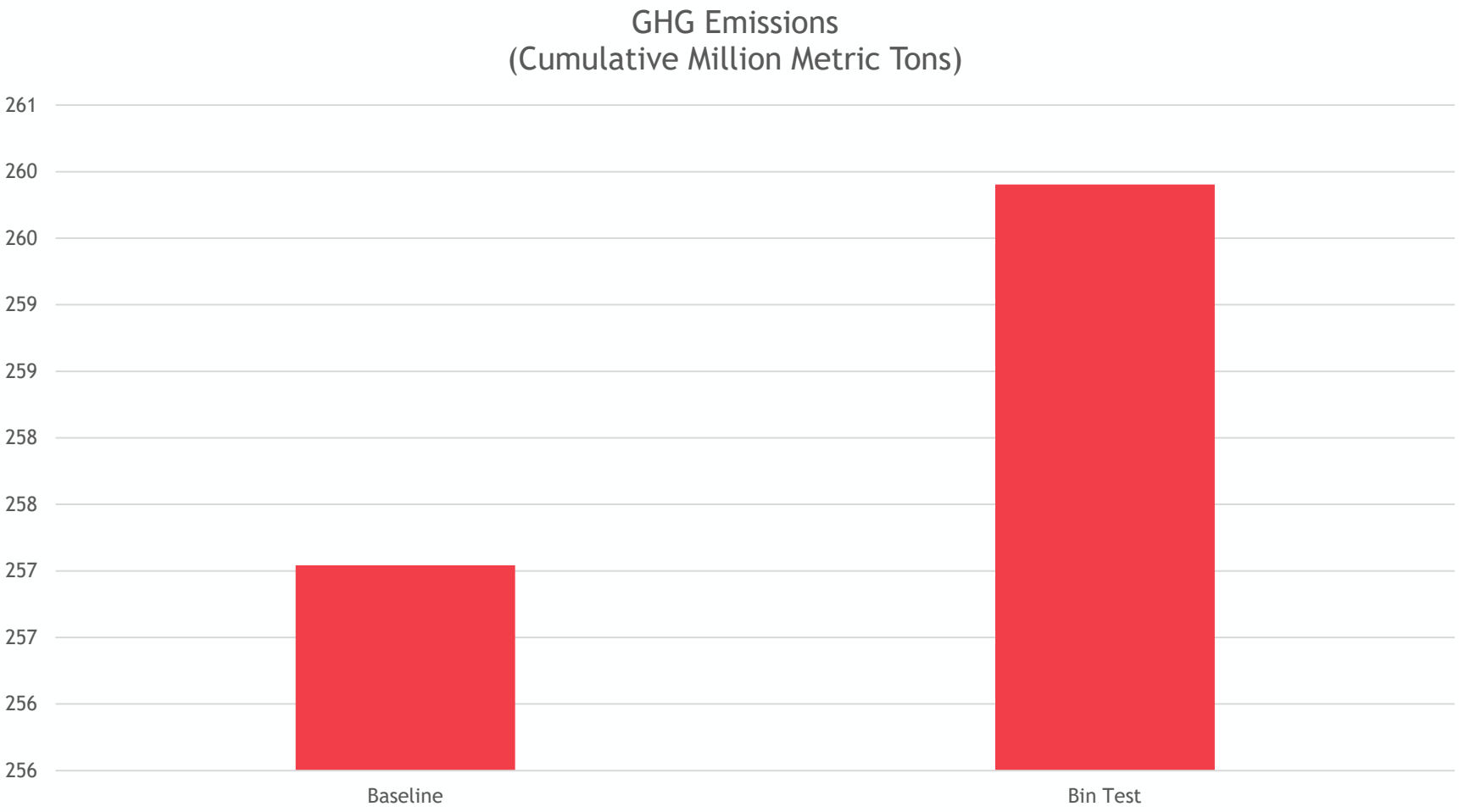
- How much does how we formulate the EE supply curves impact the results?
- Bins in baseline are collected based on the cost of the EE measures
- This test changed the bins to size them based on keeping roughly equal sized increment on the EE supply up to $130 per MWh
- Observations:
  - EE acquired results from RPM are very sensitive to how we represent the supply curves




No Penalty System Cost
(Millions 2016 $)
43000
42500
42000
41500
41000
40500
40000
39500
Baseline
Bin Test

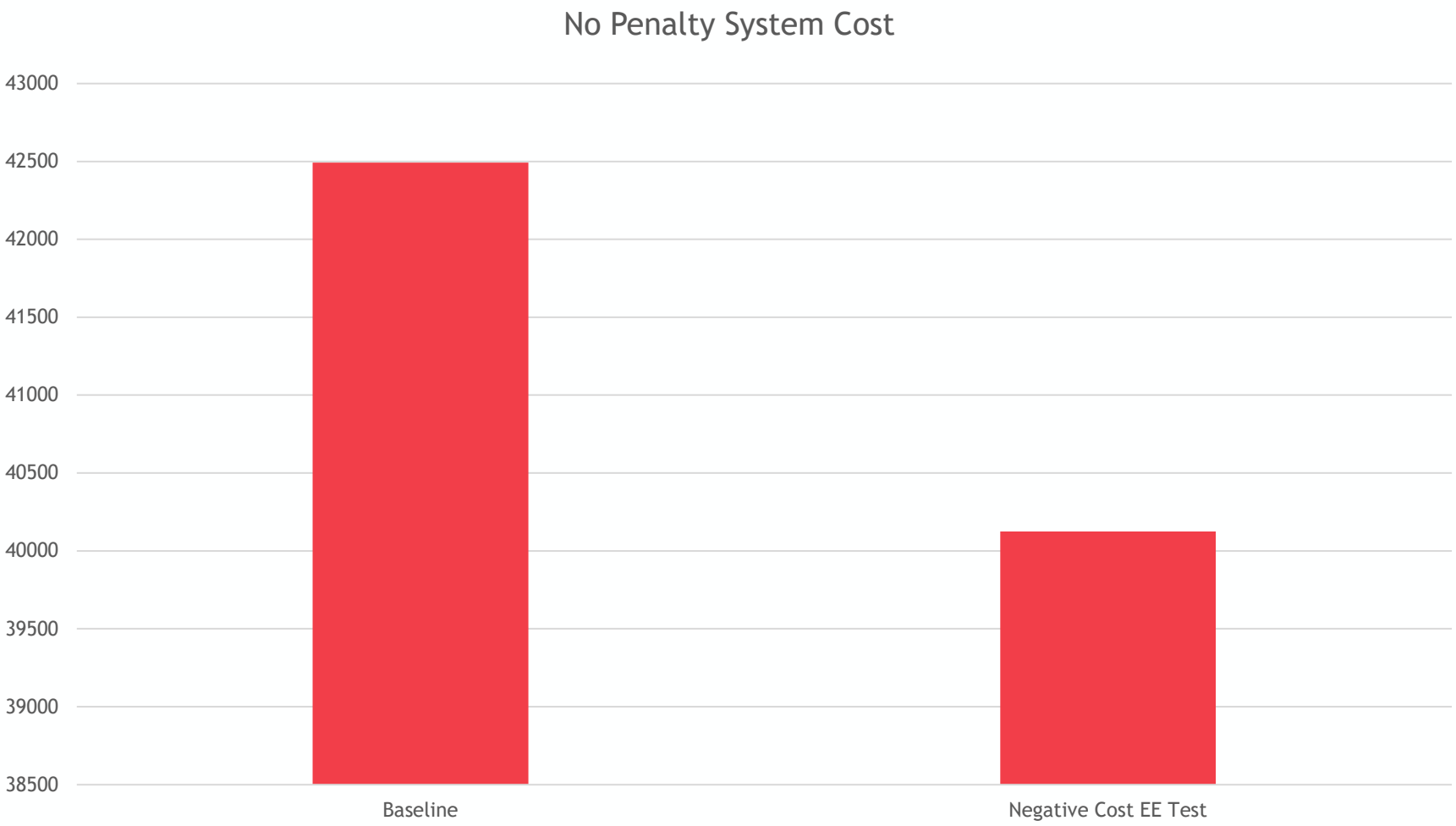

Energy Efficiency Acquired
(aMW)
1600
1400
1200
1000
800
600
400
200
0
2027 EE Acquired
2041 EE Acquired
Baseline
Bin Test

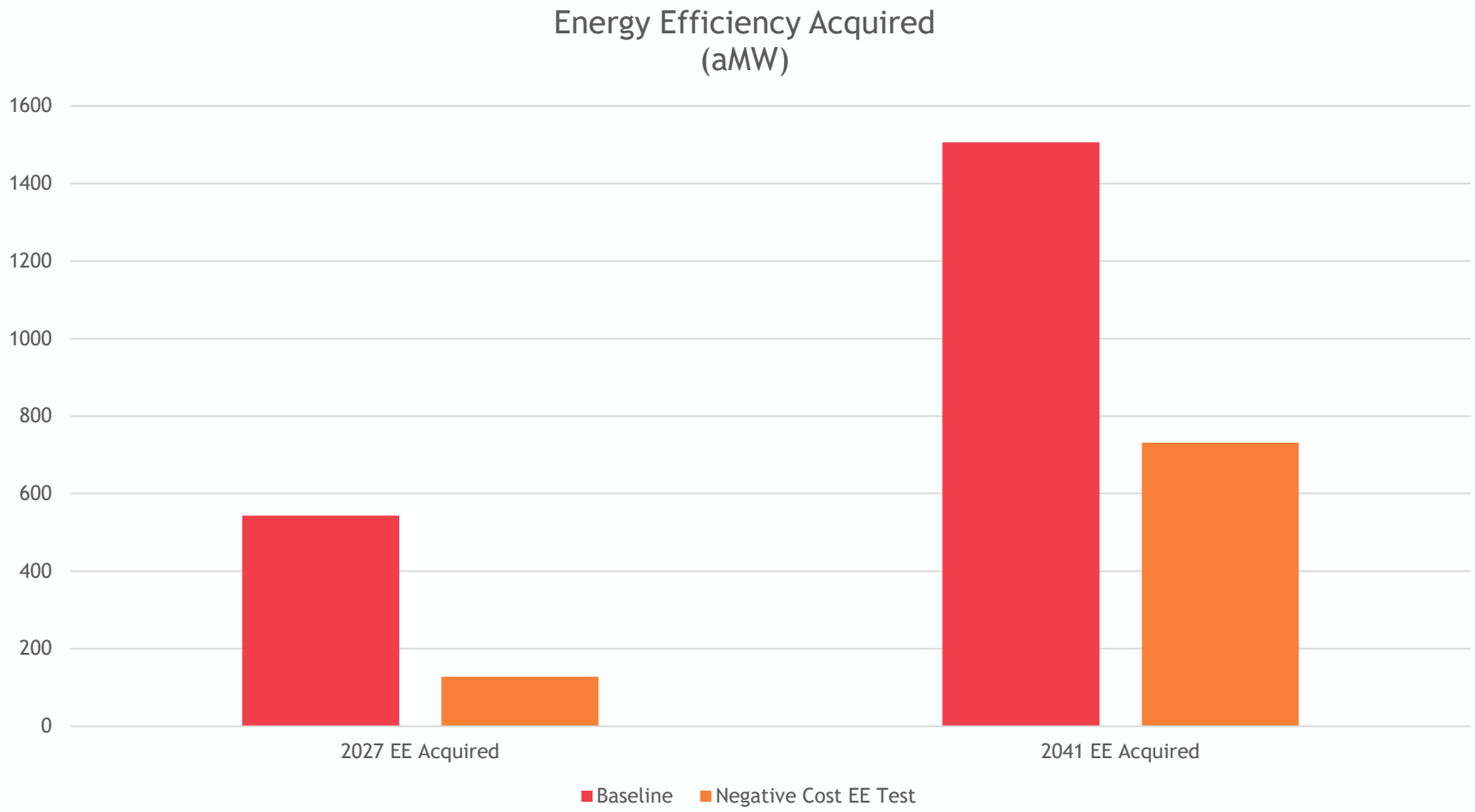

Adequacy Penalty Increase Percentage
300%
250%
200%
150%
100%
50%
0%
Baseline
Bin Test

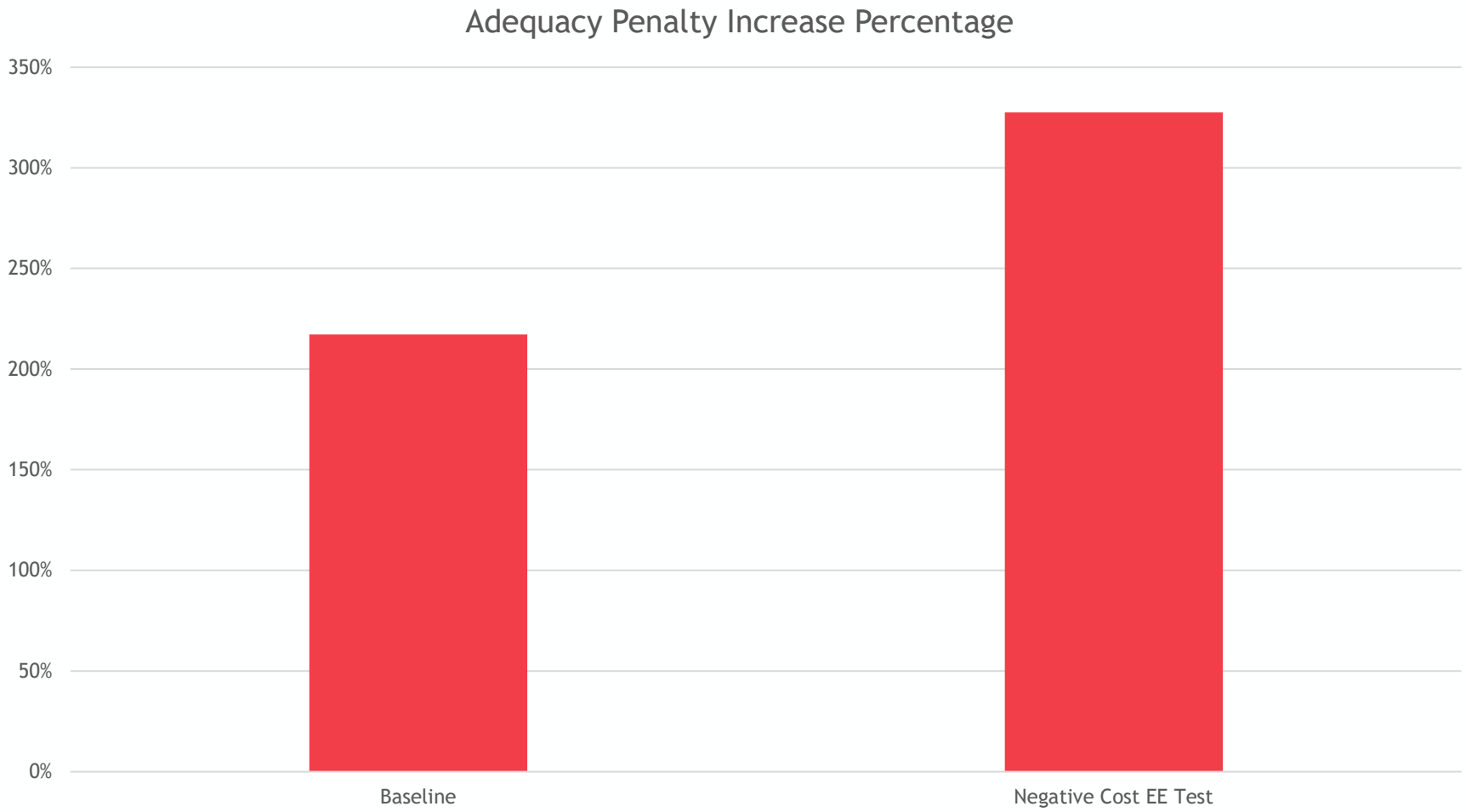

GHG Emissions
(Cumulative Million Metric Tons)
261
260
260
259
259
258
258
257
257
256
256
Baseline
Bin Test

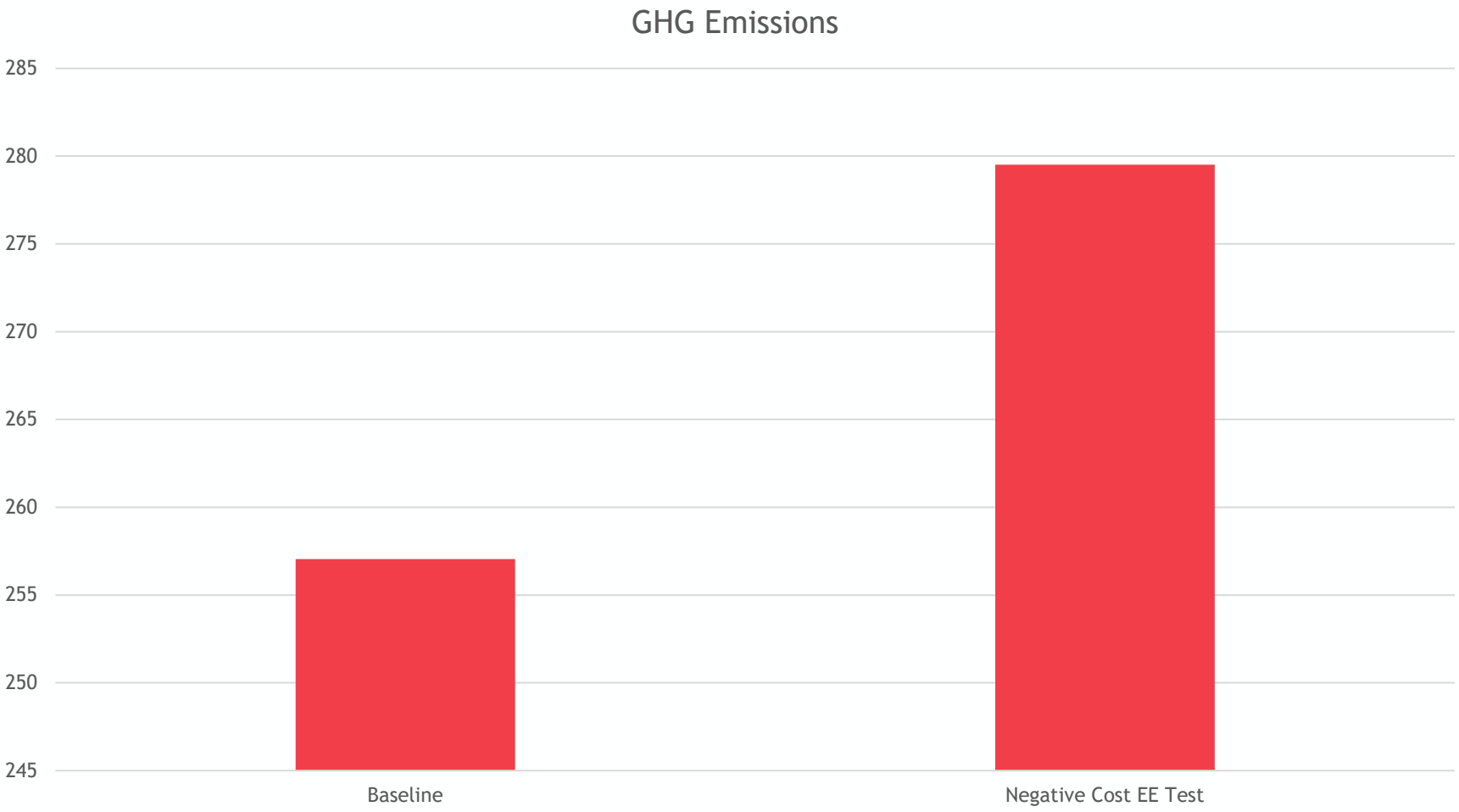
Negative Cost EE Only Test

- What if we only buy EE that has a negative cost?
- Observations:
  - Hardest time getting to a similar adequacy result - substantially higher penalties
  - Significantly reduces no penalty system costs to limit early EE purchases


No Penalty System Cost
43000
42500
42000
41500
41000
40500
40000
39500
39000
38500
Baseline
Negative Cost EE Test


Energy Efficiency Acquired
(aMW)
1600
1400
1200
1000
800
600
400
200
0
2027 EE Acquired
2041 EE Acquired
Baseline
Negative Cost EE Test

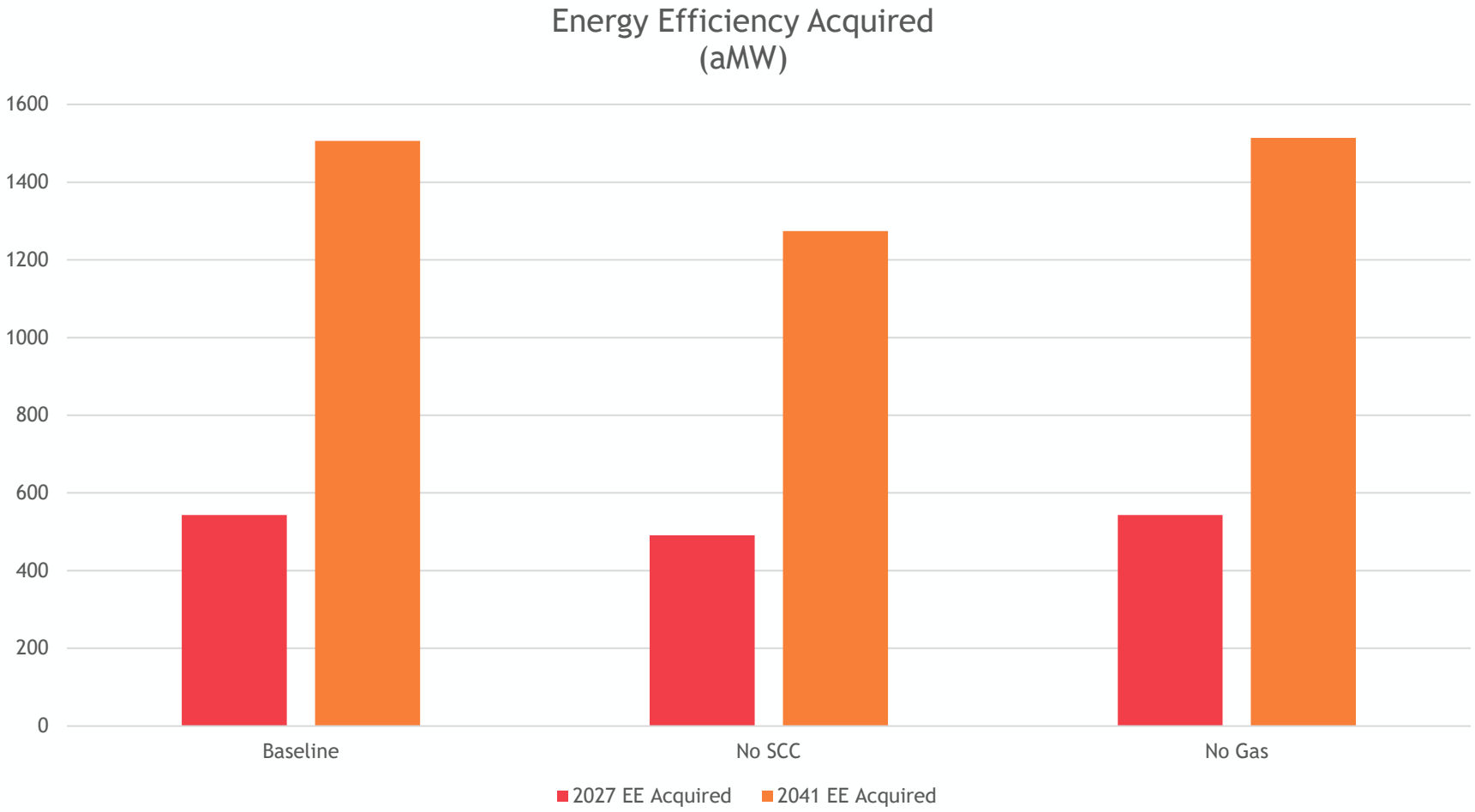

Adequacy Penalty Increase Percentage
350%
300%
250%
200%
150%
100%
50%
0%
Baseline
Negative Cost EE Test

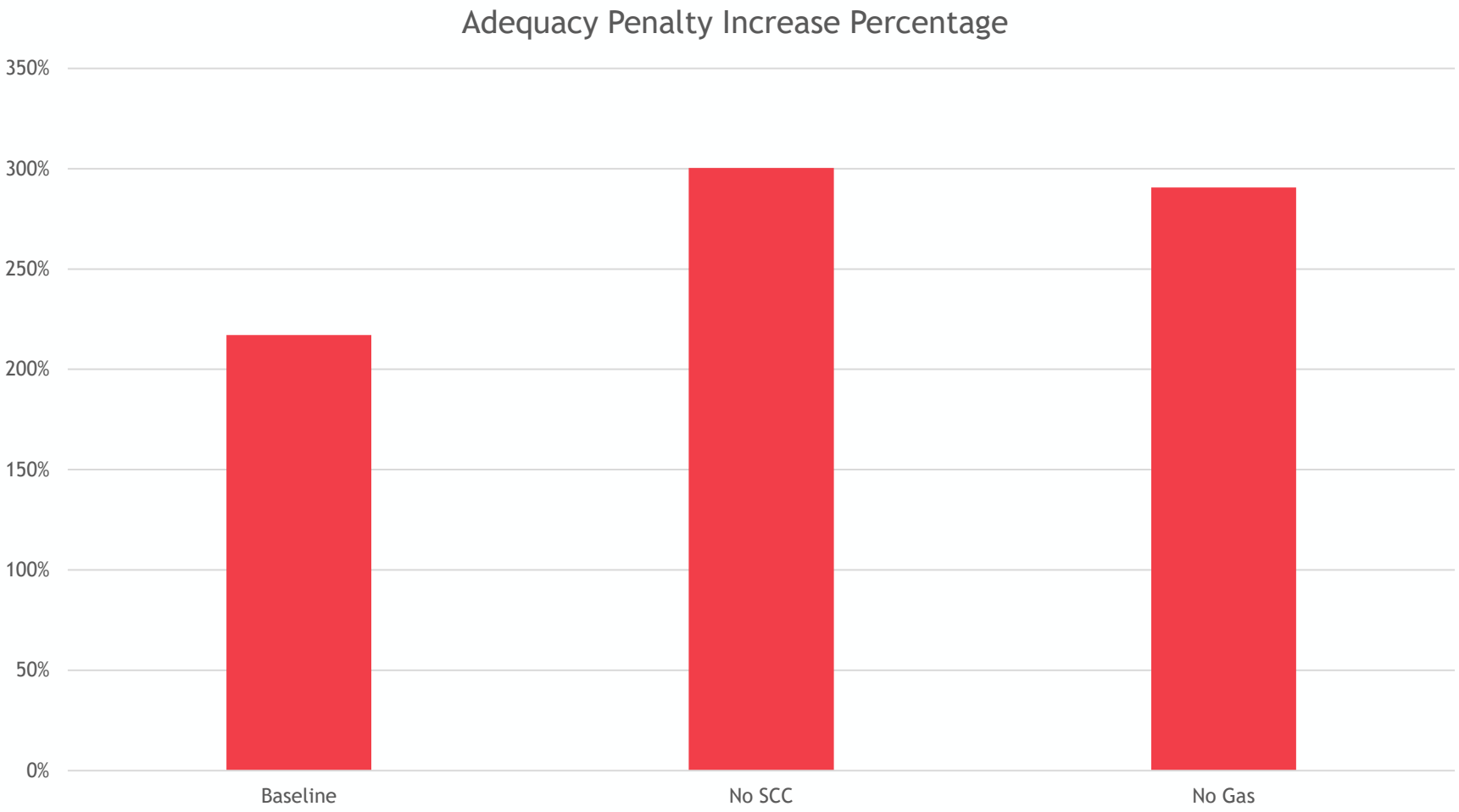

GHG Emissions
285
280
275
270
265
260
255
250
245
Baseline
Negative Cost EE Test

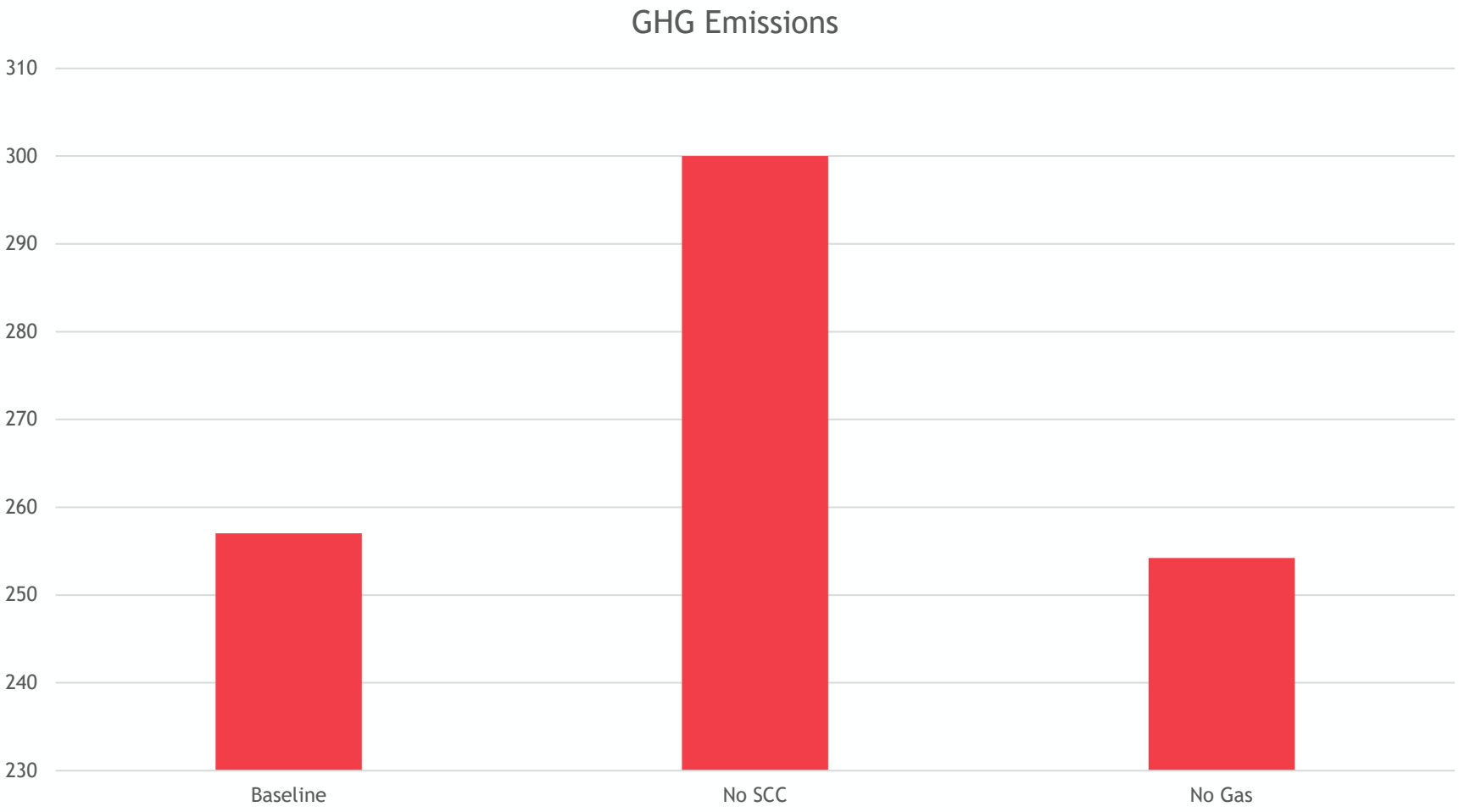
GHG Testing

- What happens when the Social Cost of Carbon is excluded? What if you cannot build new natural gas generation?
- Observations:
  - Similar action plan period results – EE is less responsive to SCC change in the near-term with updated adequacy information
  - Minimal reduction in emissions from the no gas test
  - Challenges in converging on adequacy for both no Social Cost of Carbon and no new natural gas generation tests


No Penalty System Cost
44000
42000
40000
38000
36000
34000
32000
30000
Baseline
No SCC
No Gas


Energy Efficiency Acquired
(aMW)
1600
1400
1200
1000
800
600
400
200
0
Baseline
No SCC
No Gas
2027 EE Acquired
2041 EE Acquired

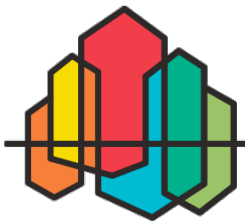

Adequacy Penalty Increase Percentage
350%
300%
250%
200%
150%
100%
50%
0%
Baseline
No SCC
No Gas

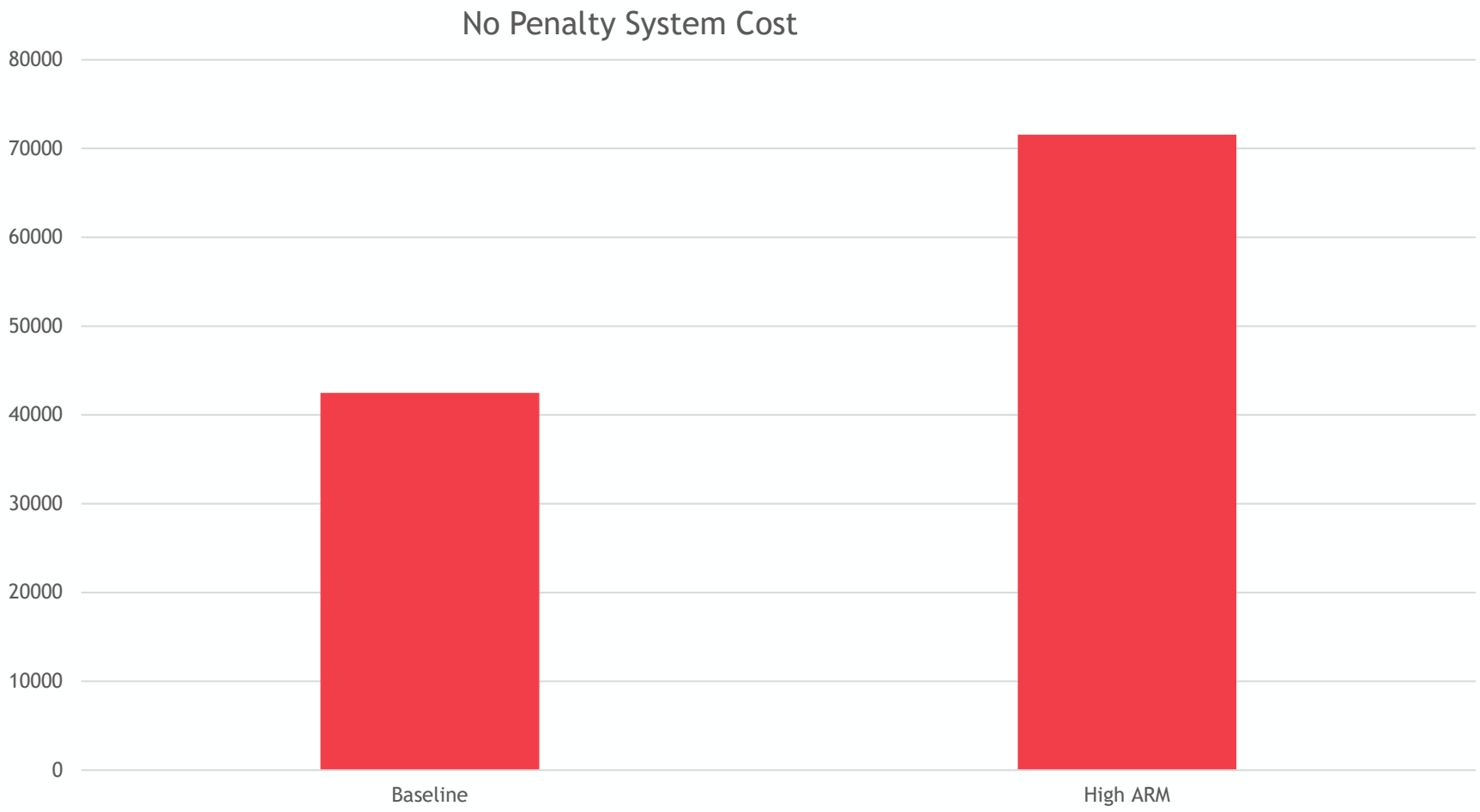

GHG Emissions
310
300
290
280
270
260
250
240
230
Baseline
No SCC
No Gas

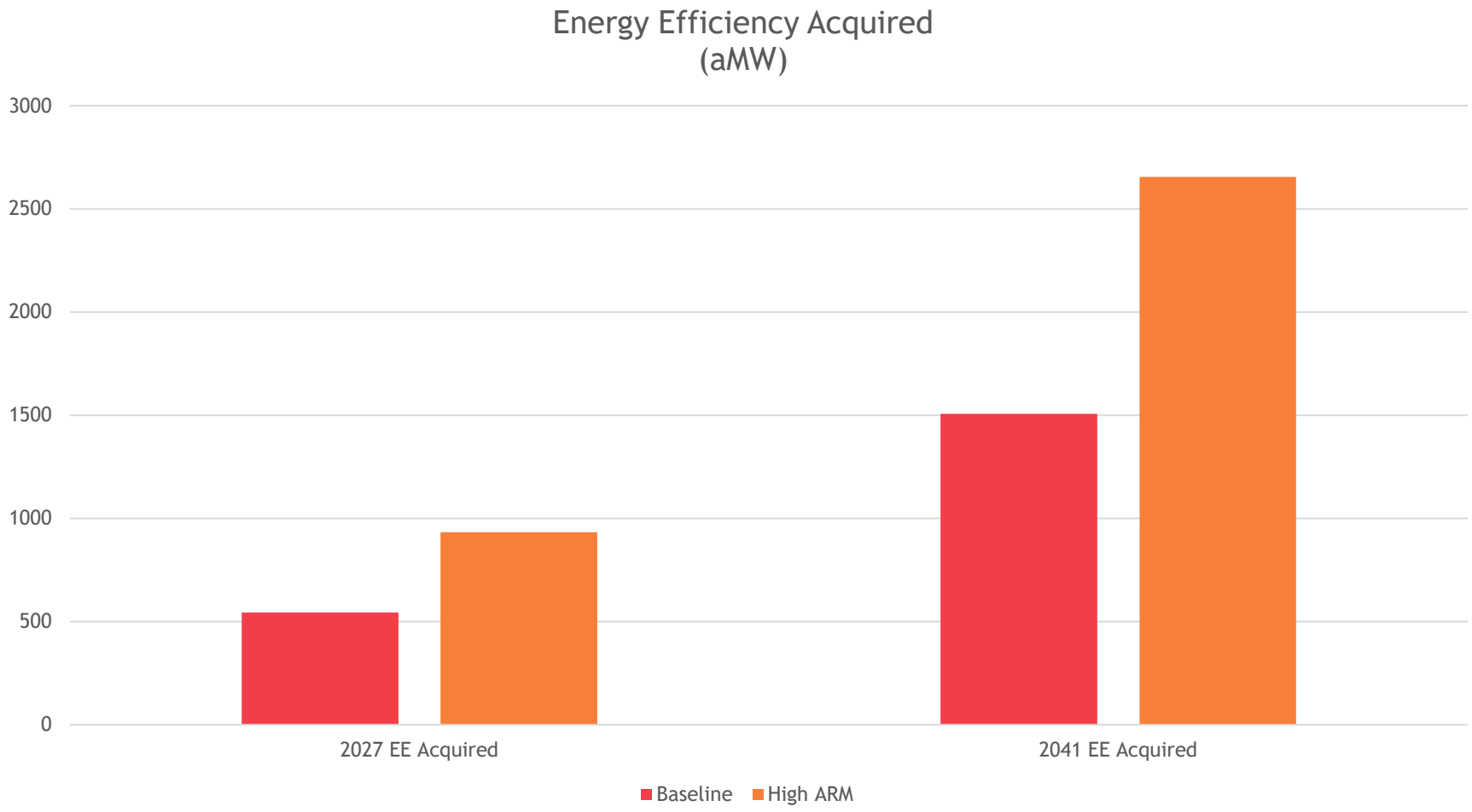
Higher Adequacy Need

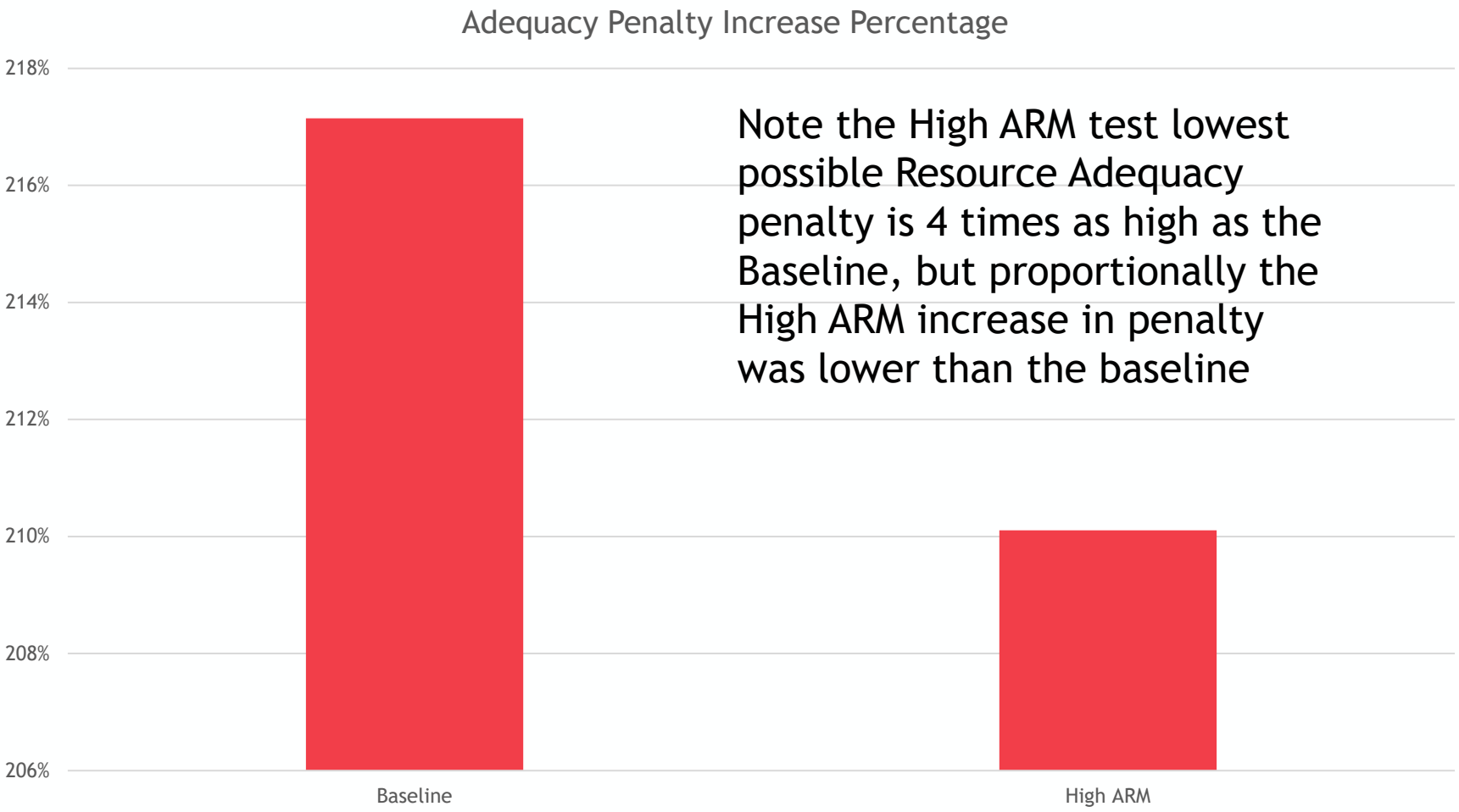
- How sensitive is EE to the adequacy need? What if the adequacy needs seen in our 2023 study persisted through 2027 & 2031?

- To test this we fixed the Adequacy Reserve Margins (ARMs) based on the 2023 results which show a higher need than the later runs

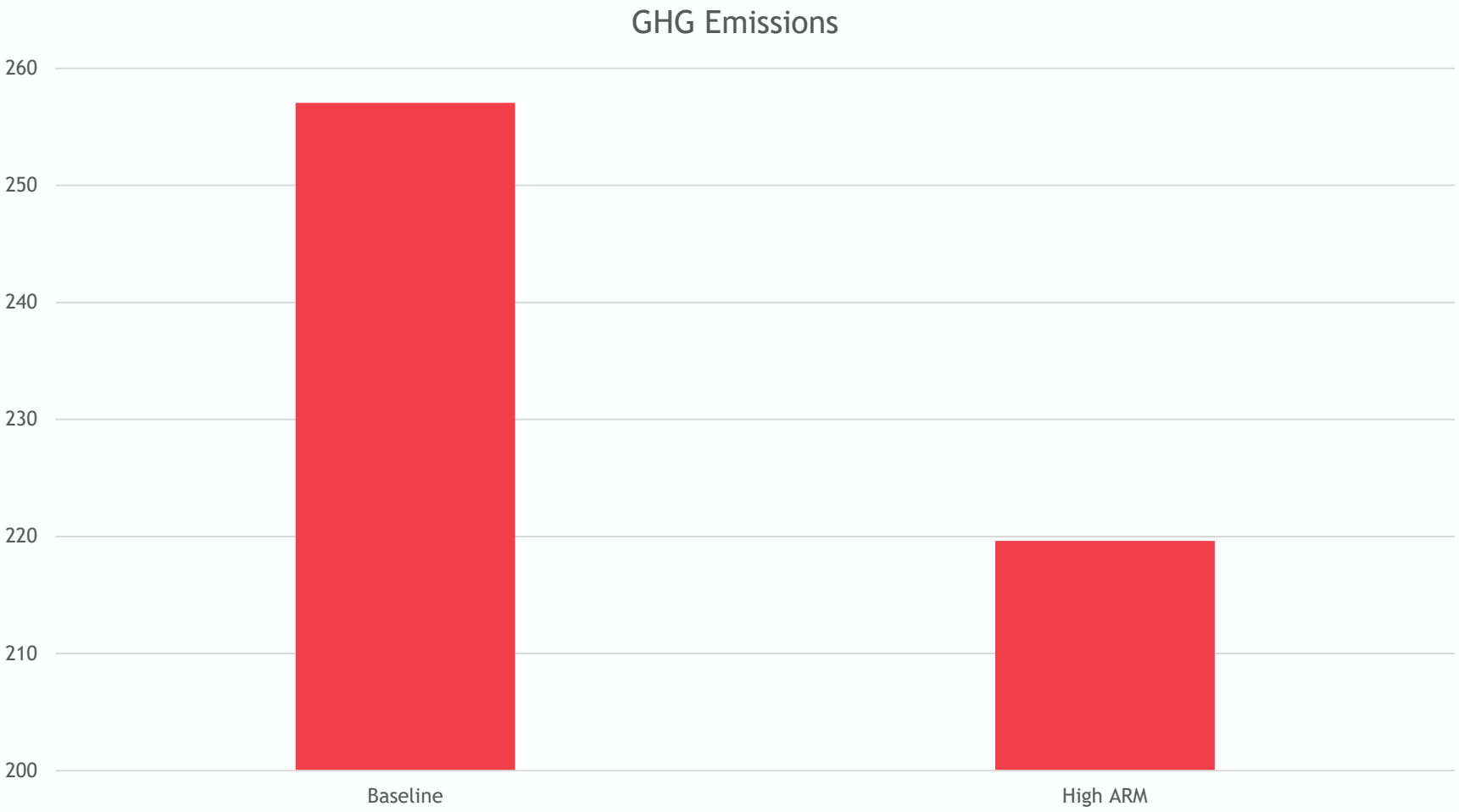



No Penalty System Cost
80000
70000
60000
50000
40000
30000
20000
10000
0
Baseline
High ARM


Energy Efficiency Acquired
(aMW)
3000
2500
2000
1500
1000
500
0
2027 EE Acquired
2041 EE Acquired
Baseline
High ARM

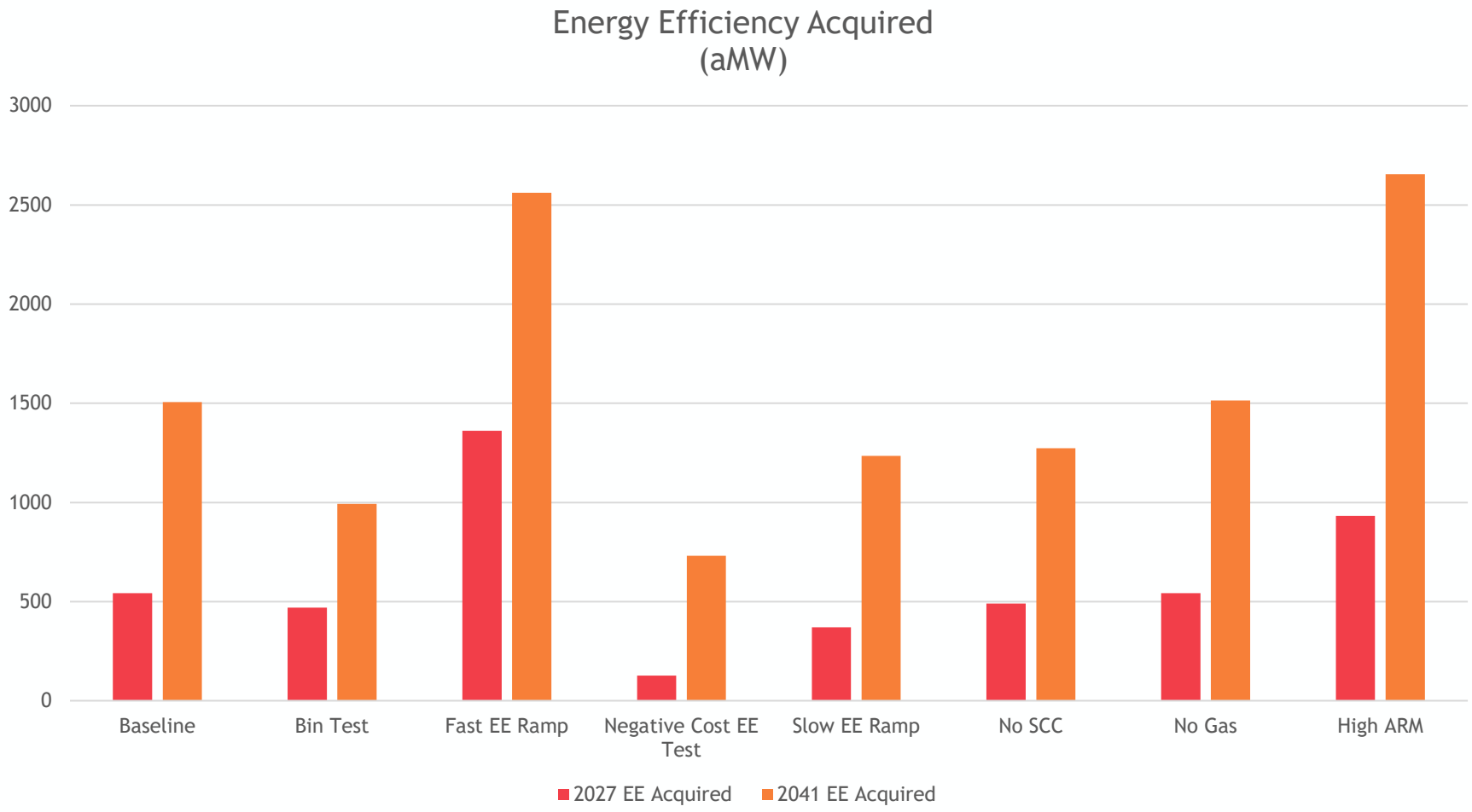


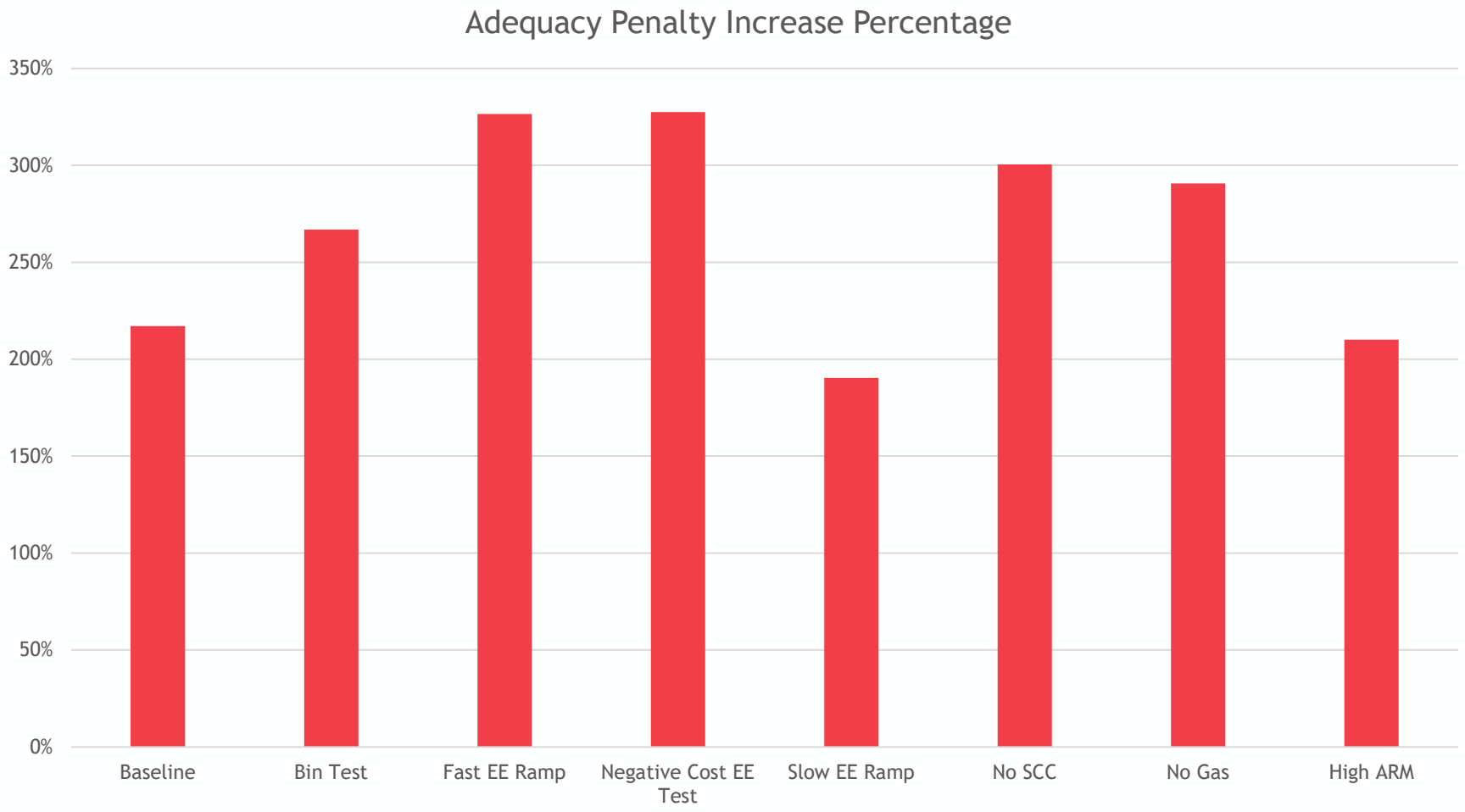
Note the High ARM test lowest possible Resource Adequacy penalty is 4 times as high as the Baseline, but proportionally the High ARM increase in penalty was lower than the baseline


GHG Emissions
260
250
240
230
220
210
200
Baseline
High ARM

Summary Results


No Penalty System Cost
80000
70000
60000
50000
40000
30000
20000
10000
0
Baseline
Bin Test
Fast EE Ramp
Negative Cost EE Test
Slow EE Ramp
No SCC
No Gas
High ARM


Energy Efficiency Acquired
(aMW)
3000
2500
2000
1500
1000
500
0
Baseline
Bin Test
Fast EE Ramp
Negative Cost EE Test
Slow EE Ramp
No SCC
No Gas
High ARM
2027 EE Acquired
2041 EE Acquired


Adequacy Penalty Increase Percentage
350%
300%
250%
200%
150%
100%
50%
0%
Baseline
Bin Test
Fast EE Ramp
Negative Cost EE Test
Slow EE Ramp
No SCC
No Gas
High ARM


GHG Emissions
350
300
250
200
150
100
50
0
Baseline
Bin Test
Fast EE Ramp
Negative Cost EE Test
Slow EE Ramp
No SCC
No Gas
High ARM

Conclusions

- The amount of EE acquired is surprisingly sensitive to how the supply curves are assigned to bins and to how quickly the bins ramp
- Adequacy needs can drive higher EE acquisition but this tends to happen when other options have been exhausted in the current RPM setup
- System costs are extremely low, most of these NPVs translate to approximately 2 to 3 billion 2016 $ fixed annual payment – the region currently spends around 14 billion 2016 $ per year which includes some costs captured in these NPV figures
  - A similar calculation for the Seventh Plan scenario including the social cost of carbon translated to a 4.5 billion 2012 $ fixed annual payment


Questions

Extra Slides

Caveats

- Results on capacity contribution from Redeveloped GENESYS are not available and vetted yet – these will be needed to complete this scenario and may change the results observed
- Tests were meant to be indicative of the impacts on Energy Efficiency Acquisition and were not designed or analyzed to look at other impacts

Annual payments equivalent to NPV

Recall the formula for NPV:

$$NPV = \sum \frac{R_t}{(1+d)^t}$$

Where t is time, d is the discount rate, and R_t is the payment at time t. To get an equivalent annual payment assume $R_i = R_j = R$ for all times $i \neq j$ then rearrangement gives:

$$R = \frac{NPV}{\sum \frac{1}{(1+d)^t}}$$

Given our real discount rate of 3.8% per year and our time horizon of 30 years (including end effects), this translates to approximately

$$R \approx \frac{NPV}{17.72}$$