Future Needs for Dynamic Modeling and Analysis

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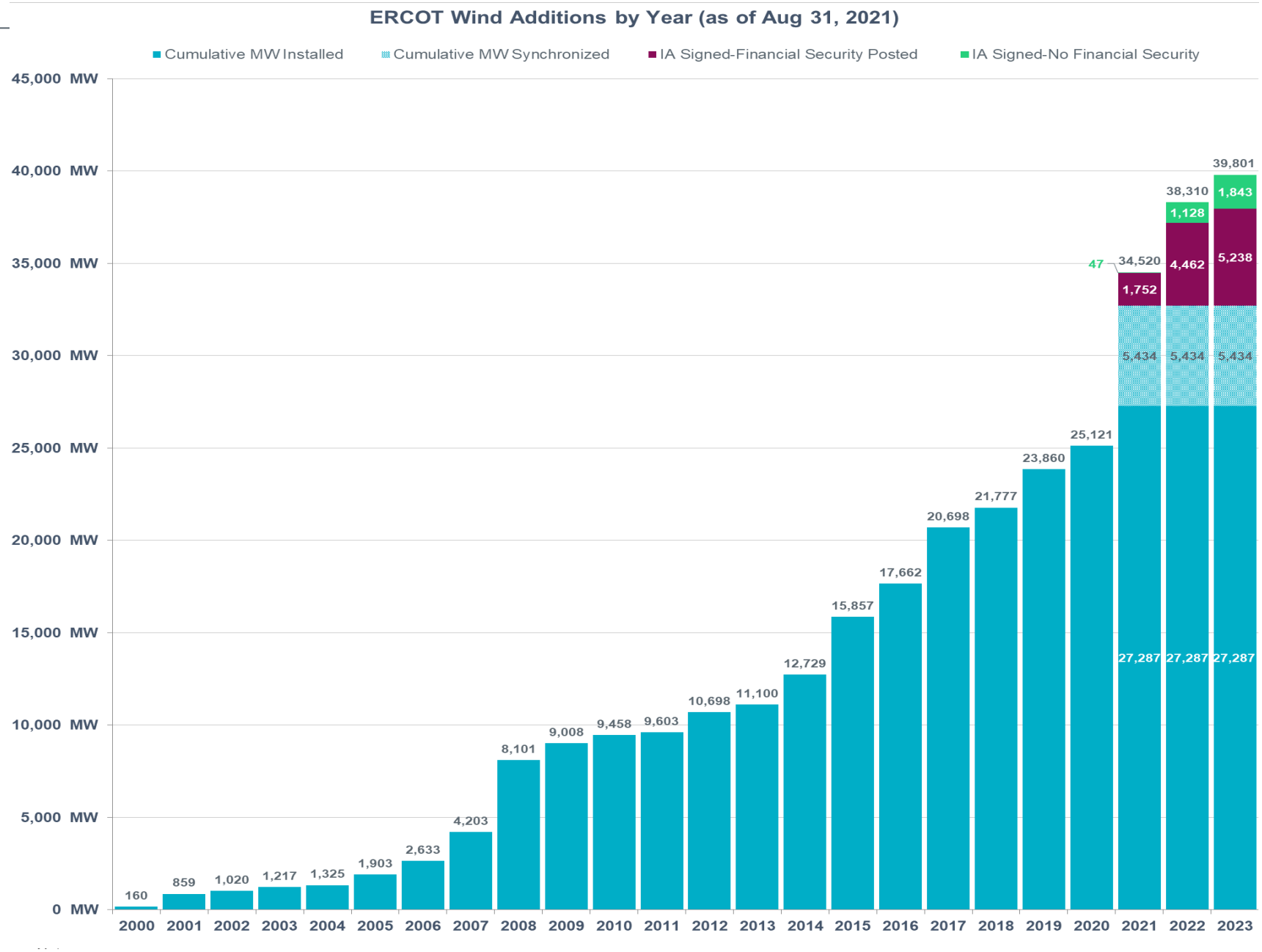
ERCOT Transmission Planning

November 17, 2021


ERCOT Wind Additions by Year (as of Aug 31, 2021)
Cumulative MW Installed
Cumulative MW Synchronized
IA Signed-Financial Security Posted
IA Signed-No Financial Security
45,000 MW
40,000 MW
35,000 MW
30,000 MW
25,000 MW
20,000 MW
15,000 MW
10,000 MW
5,000 MW
0 MW
160
859
1,020
1,217
1,325
1,903
2,633
4,203
8,101
9,008
9,458
9,603
10,698
11,100
12,729
15,857
17,662
20,698
21,777
23,860
25,121
47
34,520
1,752
5,434
27,287
38,310
1,128
4,462
5,434
27,287
39,801
1,843
5,238
5,434
27,287
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
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2017
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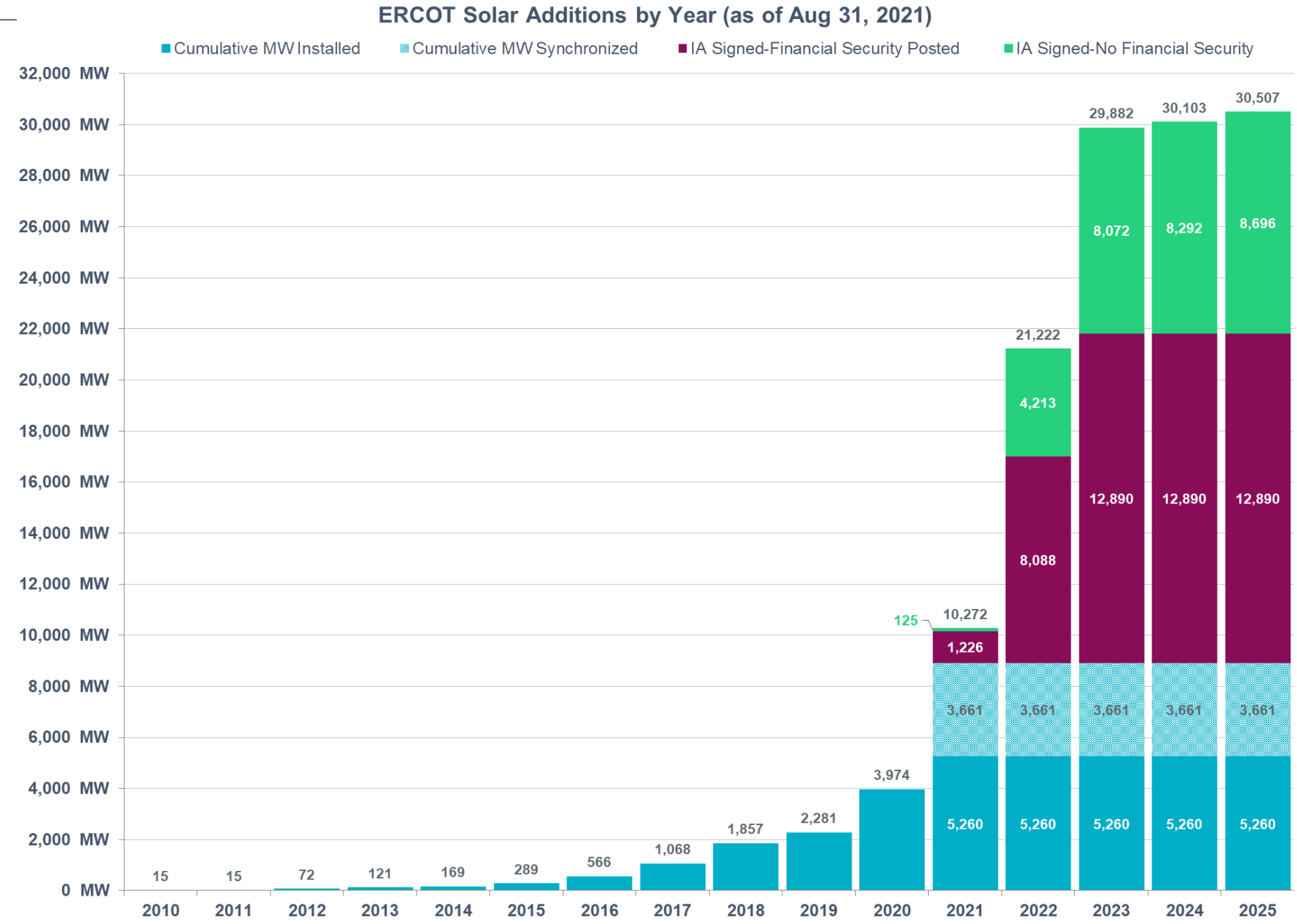
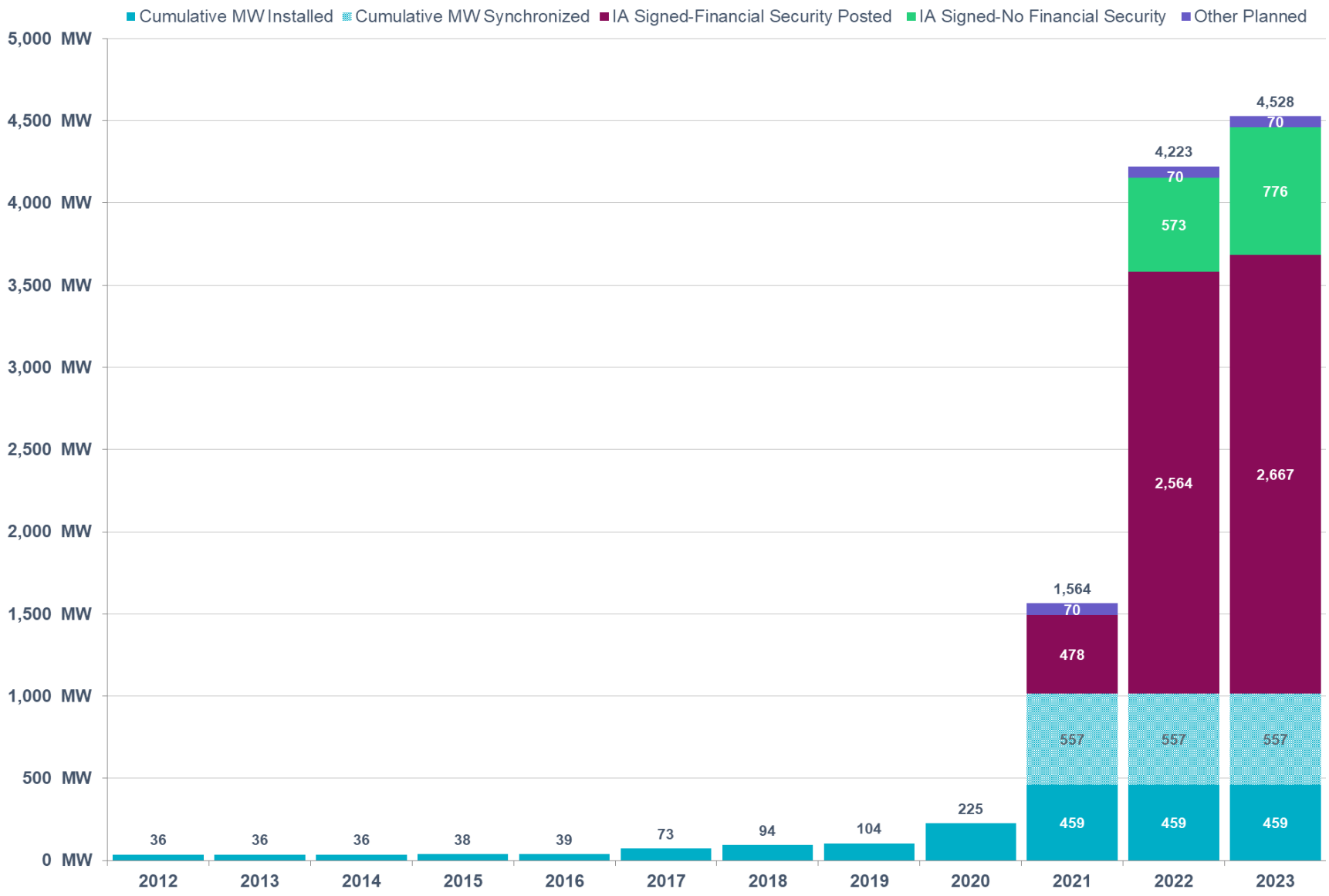
2019
2020
2021
2022
2023


ERCOT Solar Additions by Year (as of Aug 31, 2021)
Cumulative MW Installed
Cumulative MW Synchronized
IA Signed-Financial Security Posted
IA Signed-No Financial Security
32,000 MW
30,000 MW
28,000 MW
26,000 MW
24,000 MW
22,000 MW
20,000 MW
18,000 MW
16,000 MW
14,000 MW
12,000 MW
10,000 MW
8,000 MW
6,000 MW
4,000 MW
2,000 MW
0 MW
15
15
72
121
169
289
566
1,068
1,857
2,281
3,974
125
10,272
1,226
3,661
5,260
21,222
4,213
8,088
3,661
5,260
29,882
8,072
12,890
3,661
5,260
30,103
8,292
12,890
3,661
5,260
30,507
8,696
12,890
3,661
5,260
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025

ERCOT Battery Additions by Year (as of Aug 31, 2021)

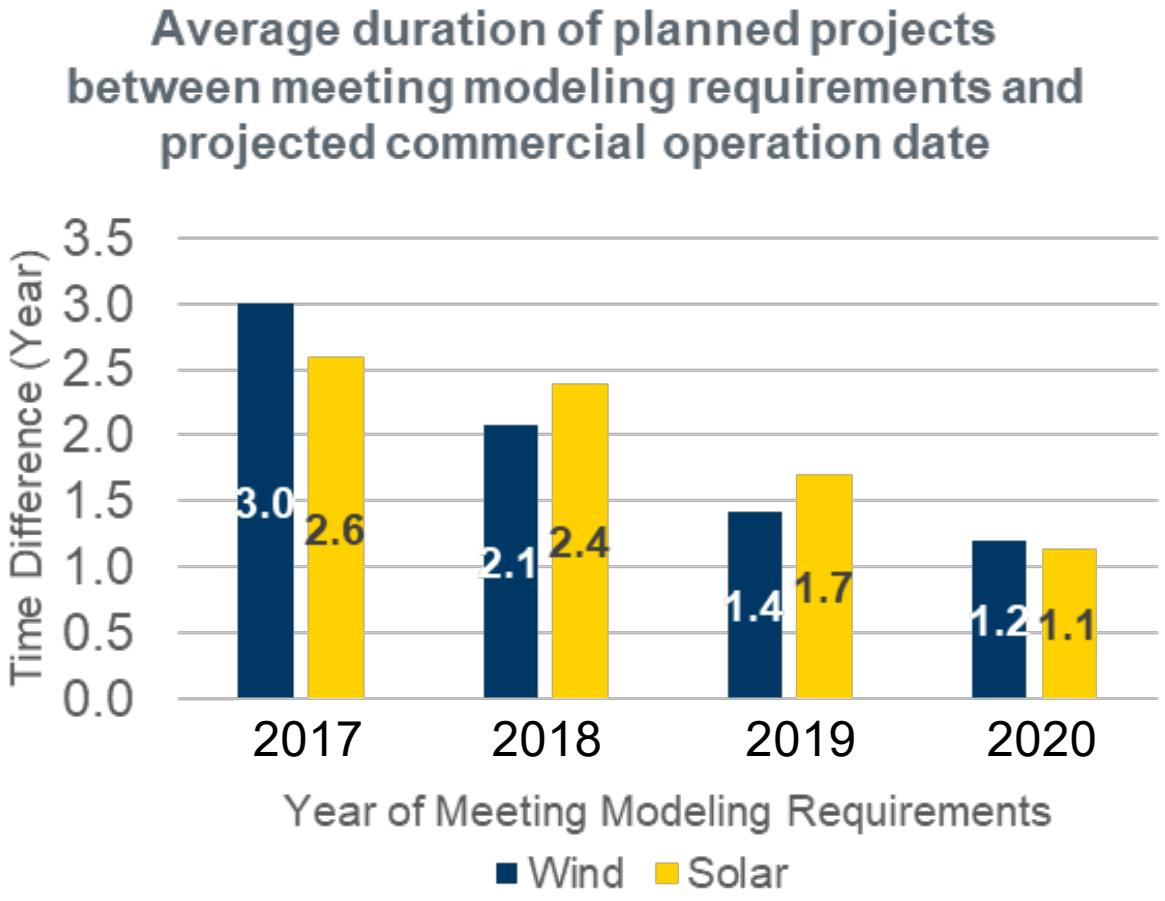


Stability Assessments

- Need for more scenarios/sensitivities?
  - Intermittent resources
  - Distribution connected resources (DER)
- Need for more detailed/complex EMT analysis?
  - High IBR penetrations
  - Low system strength
- New interconnections
  - These needs appear to conflict with shorter duration interconnection timelines

Stability Constraints in Planning Horizon

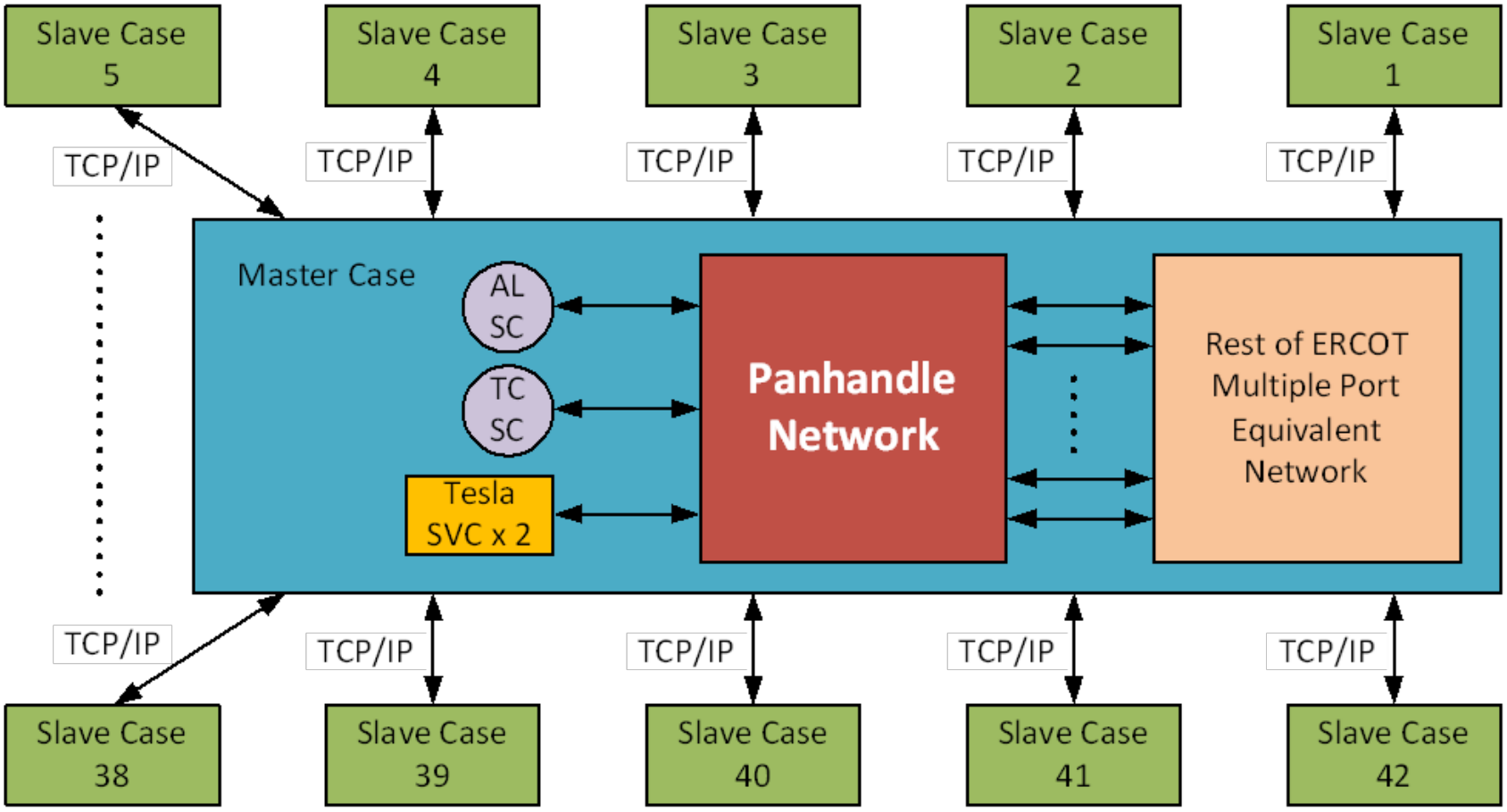
Shorter generation interconnection timelines create challenges to identifying stability constraint in the planning horizon.



EMT Stability Studies

- Labor-intensive case set up
- Model/study complexity and computational burden
  - Black-boxed models create trouble-shooting challenges
  - EMT model ≠ accurate model
  - Parallel processing
- Use based on engineering judgment
  - Low system strength areas/potential IBR control instabilities
  - Supplements analysis with positive sequence tools

Illustration of EMT Study Case Set up



Grid Forming Technologies

- No precise industry definition for “grid forming”

- Model availability
  - Proprietary
  - EMT versus traditional positive sequence
  - Validation

- How to properly incentivize/mandate?
  - Ensure sufficient “grid forming” capacity in the right locations
  - Can there be too much “grid forming” capacity?

Summary of Challenges

- System Planning
  - A dying concept?

- Larger scale EMT assessments
  - Sustainable study processes?
  - Potential for positive sequence modeling improvement?

- Incorporating grid forming technologies
  - Modeling?
  - Effectiveness?

Questions