2016 Economic Studies Executive Summary

IMAPP

Michael I. Henderson

DIRECTOR, REGIONAL PLANNING AND COORDINATION

2016 Economic Study (NEPOOL Scenario Analysis)

Executive Summary

Today

- Present summary of Scenario Analysis metrics for the five base scenarios
- 2030 results will be emphasized because the differences among the cases are more evident
  - Total costs
  - Total Load Serving Entity expense costs
  - Wholesale energy market revenues and contributions to fixed cost by resource type
  - Key environmental metrics

Schedule

- Almost all detailed metrics and draft results were discussed with the PAC on August 18, September 21, and October 19
- Additional Scenario Analysis discussions are planned for the balance of PAC meetings during 2016
- Phase II analysis of Forward Capacity Auction prices, and regulation, ramping, and reserves is scheduled for 2017

Process and Scope of Work

- The scope of work and all draft results reflect input from the Planning Advisory Committee
- Phase I consists of production cost simulation results for five scenarios, which were examined for 2025 and 2030 with the transmission system constrained and unconstrained and with resource mixes meeting NICR

5 Scenarios Included in 2016 Economic Study

Approximately 25 metrics presented for each scenario

1. Generation fleet meeting existing Renewable Portfolio Standards (RPS) and retired units replaced with natural gas combined cycle (NGCC) units
2. Generation fleet meeting existing RPS and all future needs, including retirements, met with new renewable/clean energy resources
3. The “RPS-plus scenario” - Generation fleet meeting existing RPS plus additional renewable/clean energy resources, EE, PV, plug-in electric vehicles, and distributed storage
4. Generation fleet meeting existing RPS by resources currently under development and use of Alternative Compliance Payments with NGCC additions, and with no retirements (the “no retirement scenario”)
5. Existing fleet meeting existing RPS by resources currently under development and use of Alternative Compliance Payments and retirement replacement with NGCC additions

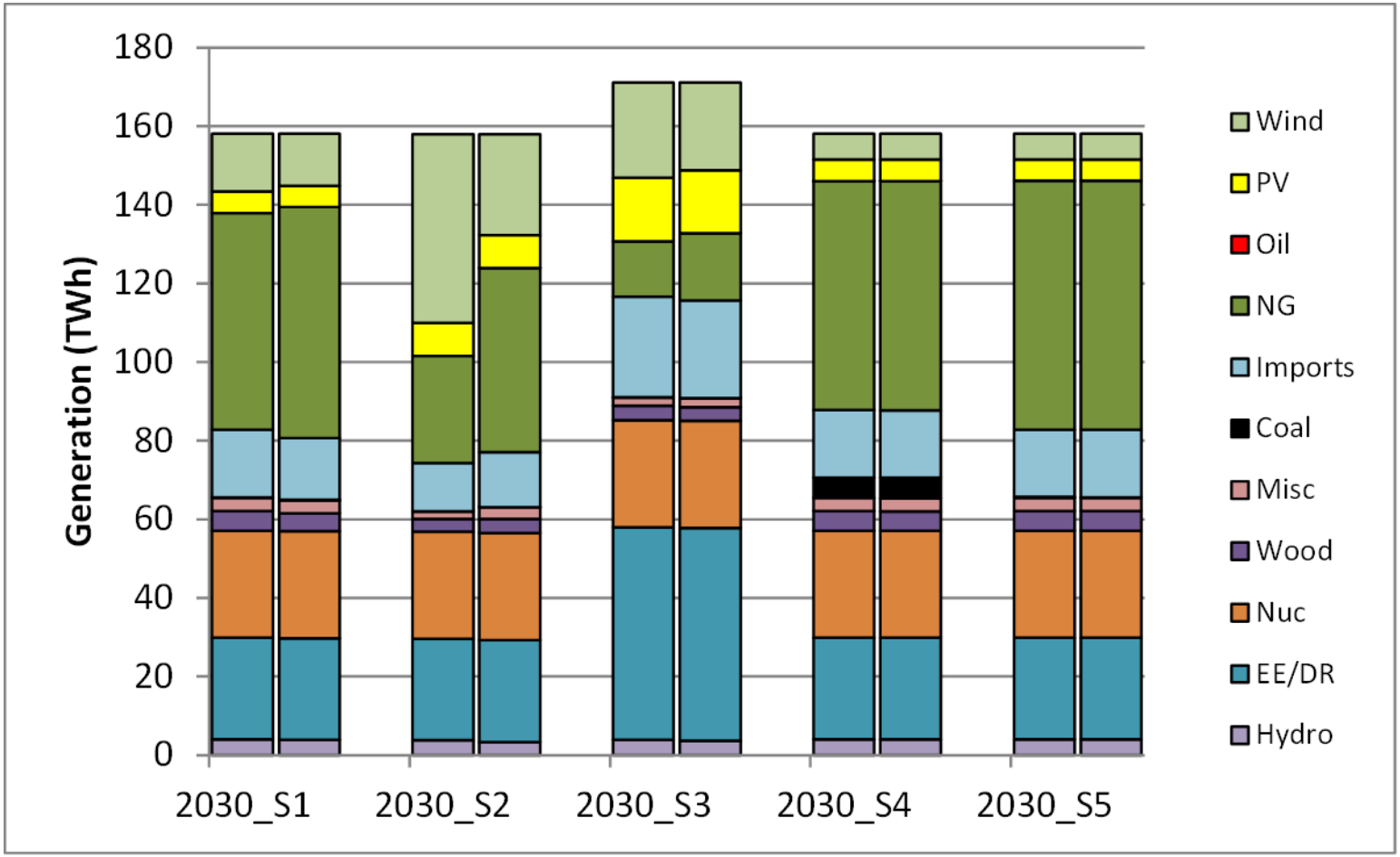
EXECUTIVE SUMMARY

Review of Results Previously Discussed by the Planning Advisory Committee

Energy By Source 2030 (TWh)

Unconstrained (Left) vs. Constrained (Right)

Note differences in wind generation and PV among cases. Oil units run under 0.5%, even in S4. Coal is competitive with NGCC in Scenario 4. NG capacity factors range from a high of 35% in S5 to a low of 10% in S3.

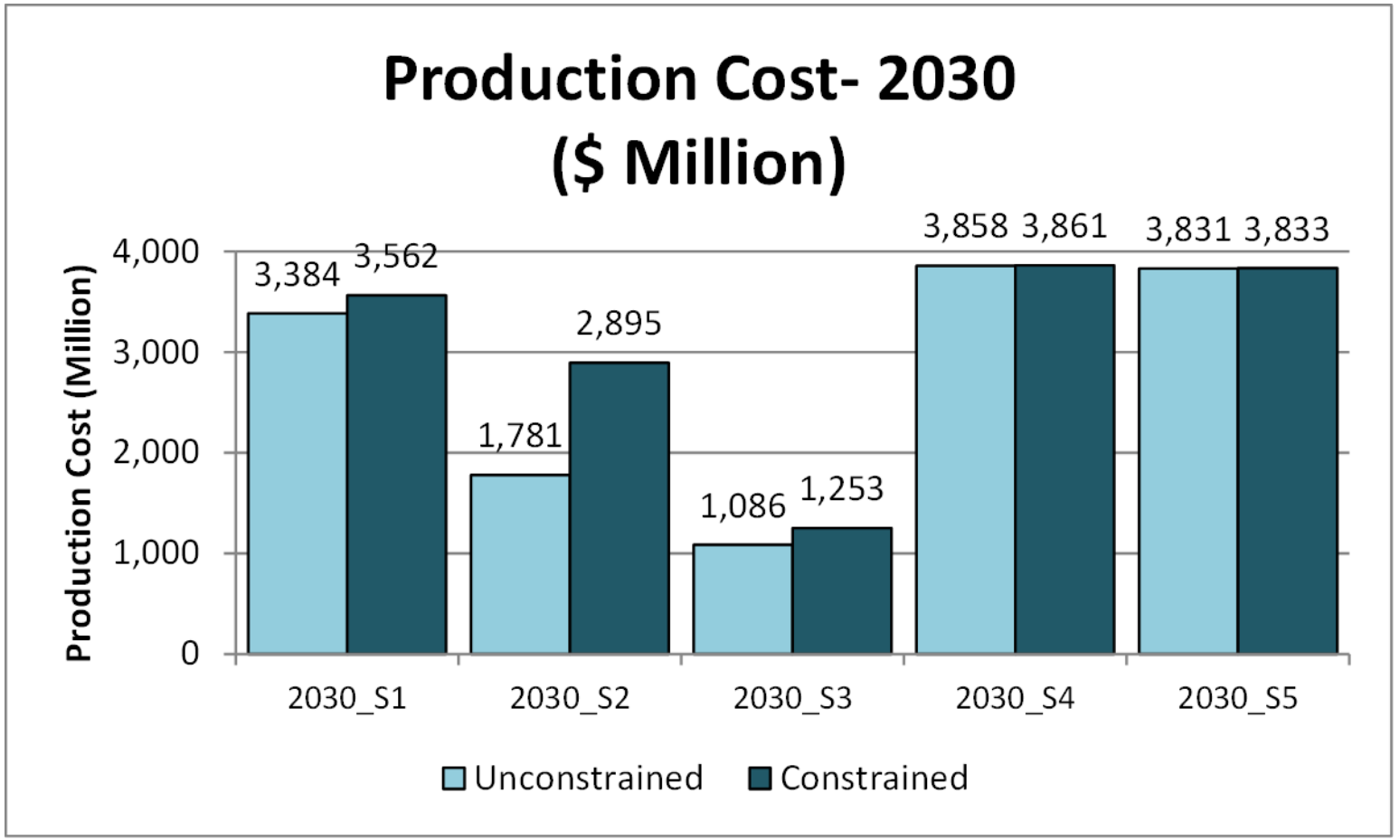


Annual System-Wide Production Costs ($M/Year) – 2030

Transmission Interfaces Unconstrained and Constrained

Large penetrations of $0 cost resources reduce production costs (S1, S2, and S3)

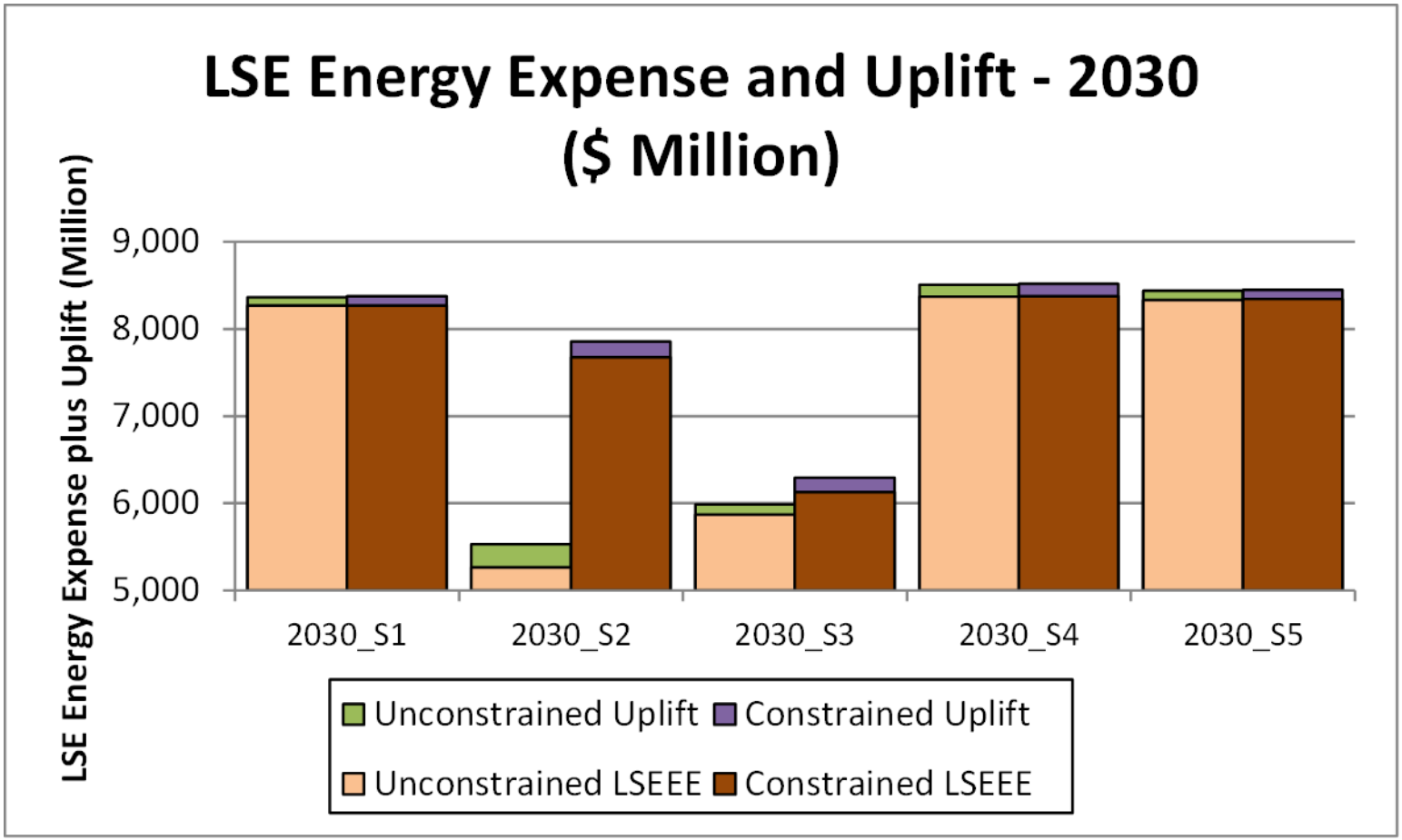
Transmission constraints bottle inexpensive resources in ME (S2 especially)



Load Serving Energy Expenses and Uplift - 2030

Uplift shows payments made to resources when the unit is running and the total unit cost is higher than the cleared LMP as calculated by the GridView Program

Transmission development provides access to less expensive resources in ME that lower Load Serving Energy Expense costs

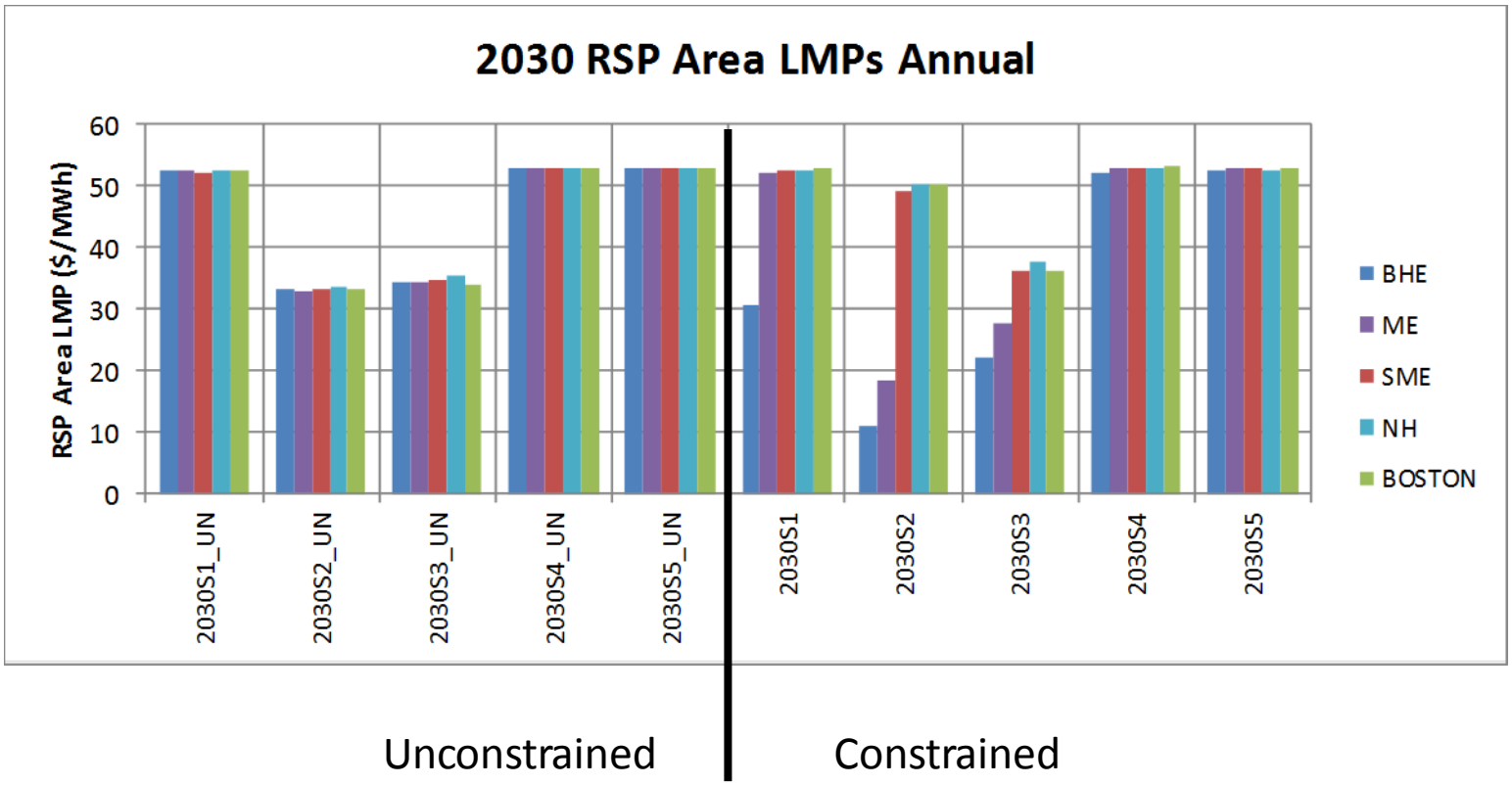


RSP Area LMP - 2030

Transmission Interfaces Unconstrained and Constrained

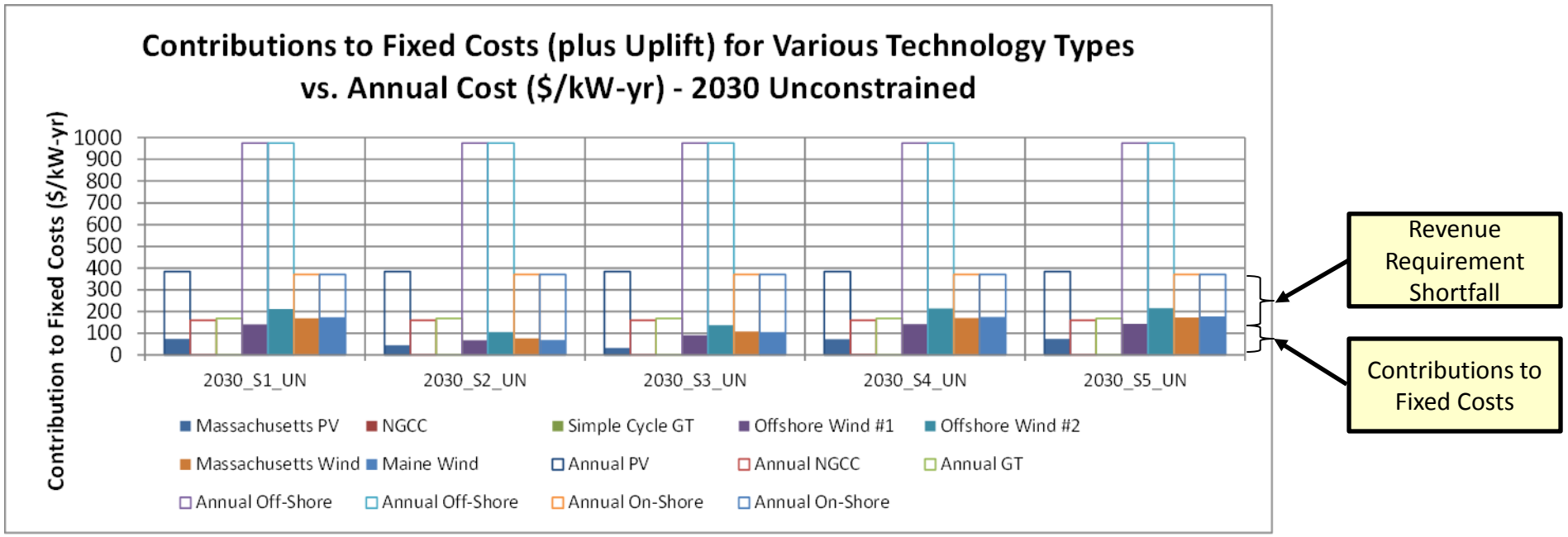
Natural gas is typically on the margin for S1, S4, and S5, but less so in S2 and S3 that have large penetrations of $0 cost resources

Large amounts of wind energy development bottles resources in Northern ME



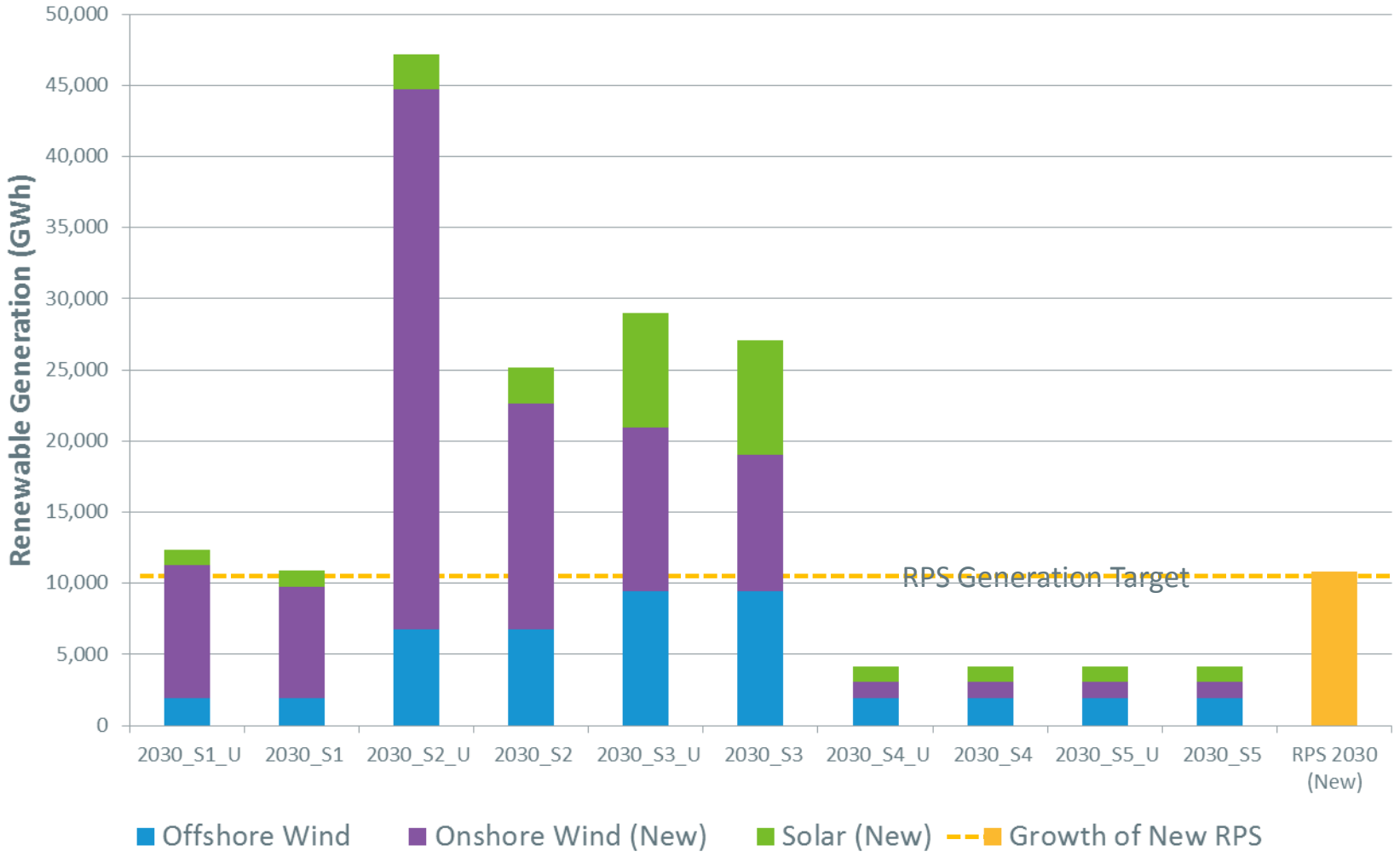
Net Resource Revenues from the Energy Market 2030

Resource revenues from the energy market contribute little to fixed costs across all technologies due to $0 cost resources and NGCC on NGCC competition. Capacity factors of fossil units are low.



2030 New Renewable Generation (GWh)

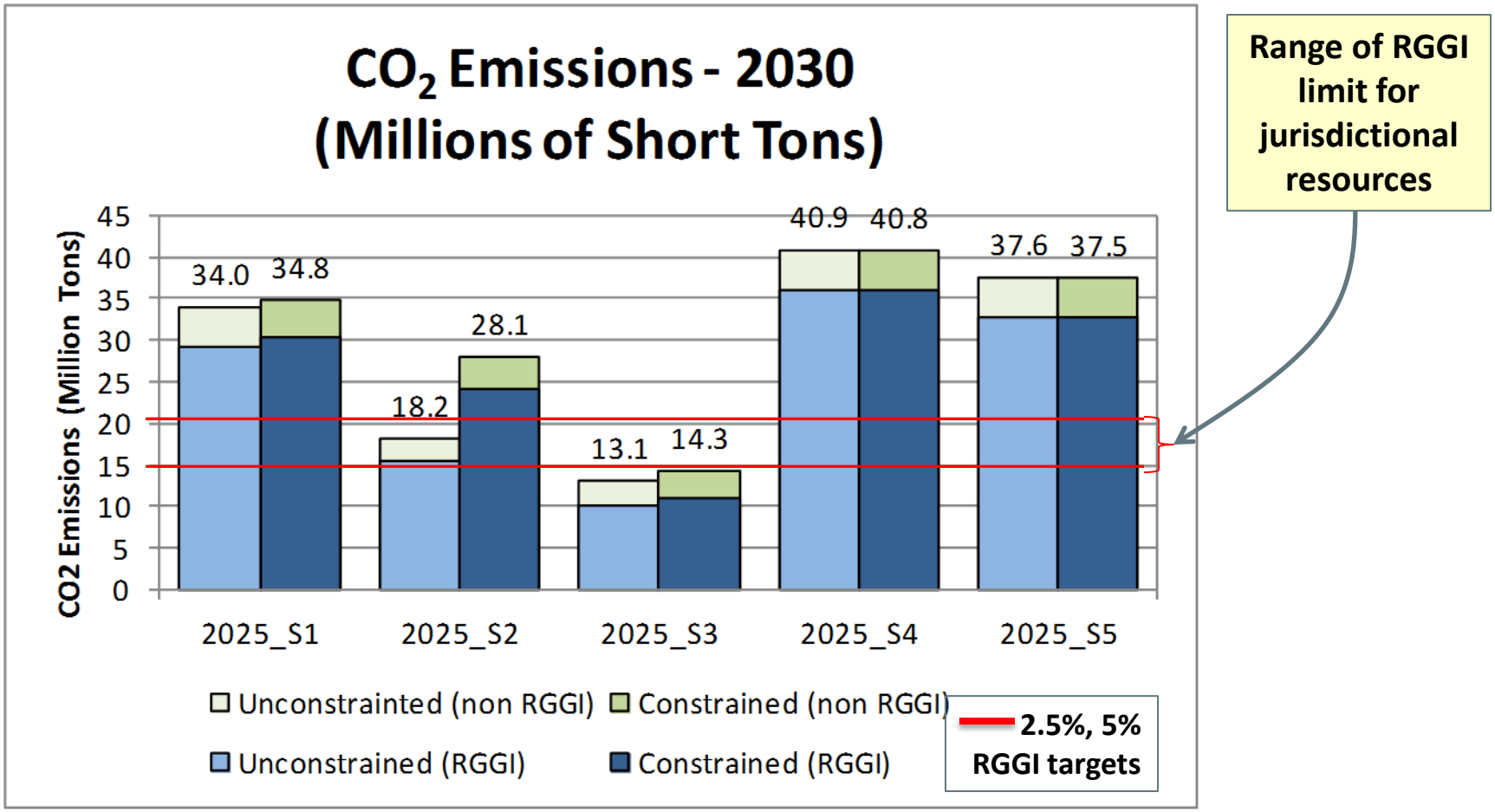
S1, S2, and S3 physically meet RPS, even with transmission constraining wind generation in Maine. S4 and S5 assume use of Alternative Compliance Payments



2030 Annual System-wide CO_2 Emissions RGGI and Other Generators (Million Short Tons)

Transmission Interfaces Unconstrained and Constrained

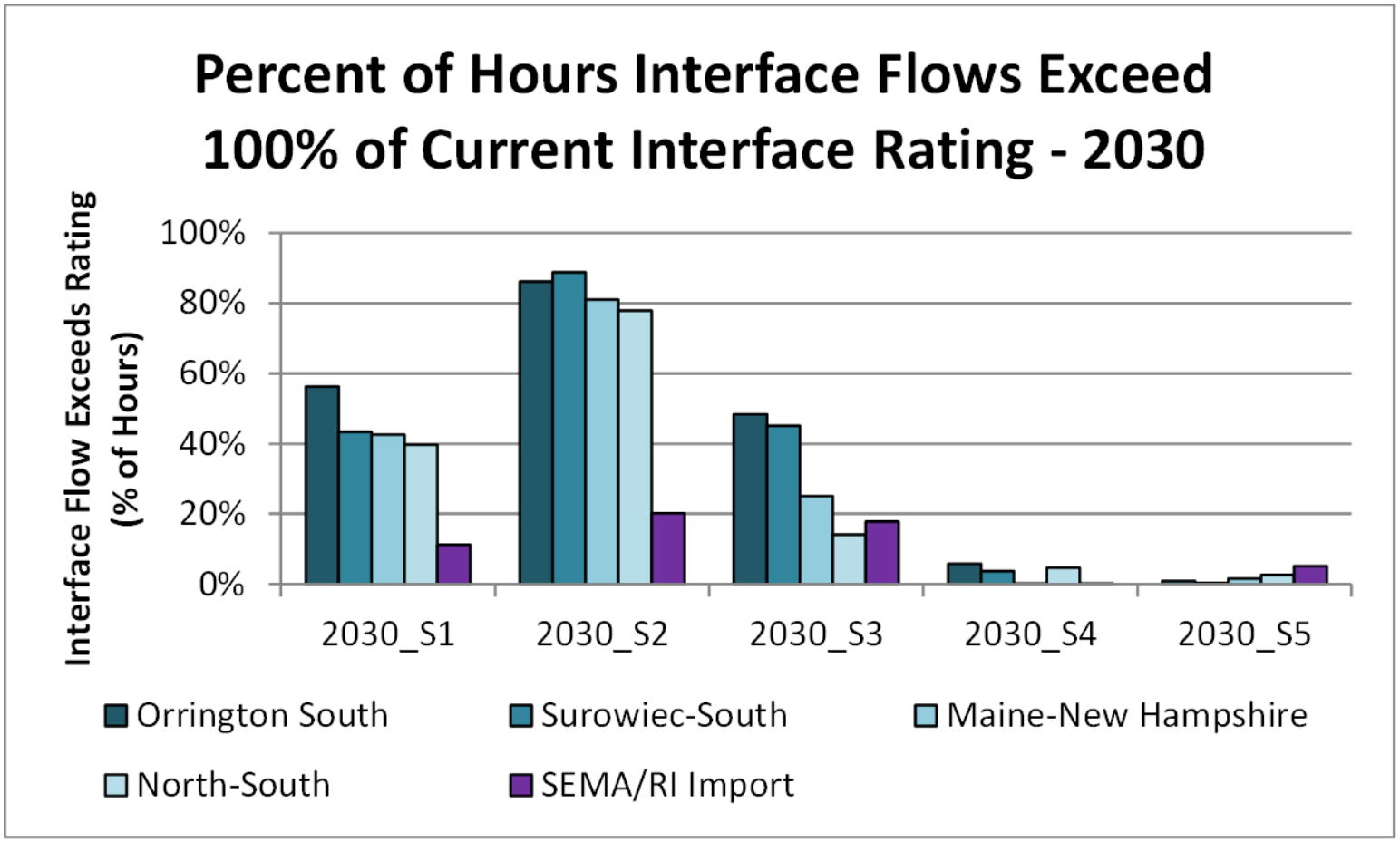
Meeting current RGGI goals with primary auction allowances for the six New England states may prove challenging



Interface Flow Metric - 2030

Transmission Interfaces Unconstrained

Without transmission system expansion, wind resources developed in ME bottle inexpensive resources



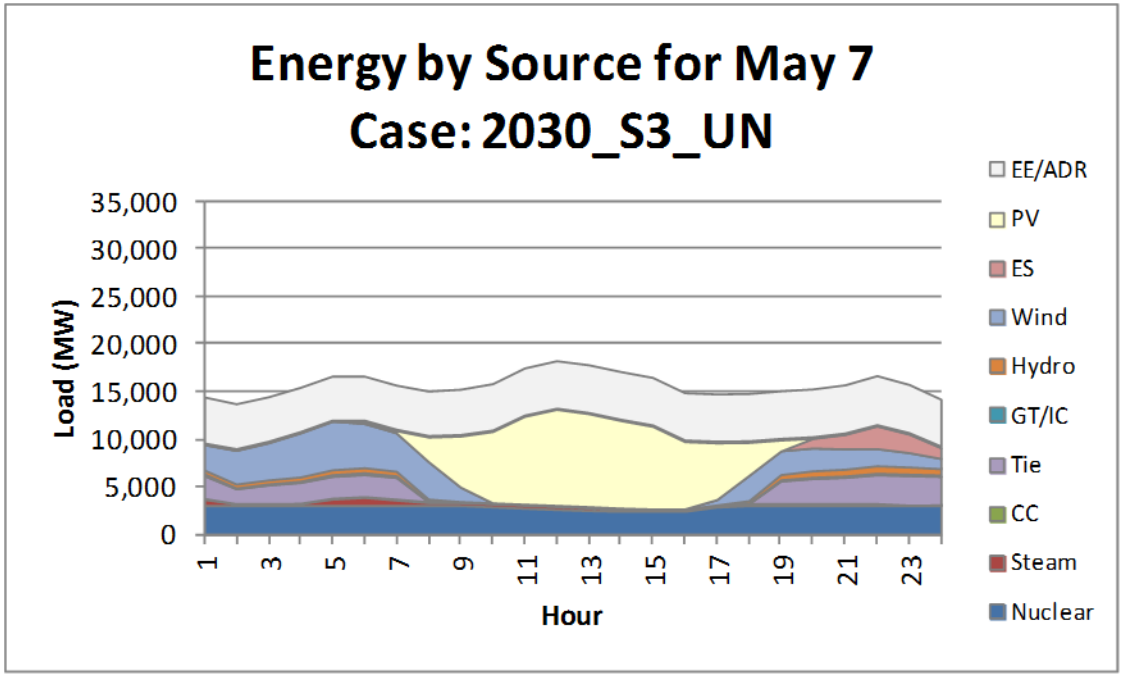
Transmission Cost Summary

	Scenario 1	Scenario 2	Scenario 3
2030 Maine Nameplate Wind Injection (MW)	2,955 MW	12,872 MW	3,652 MW
Needed Congestion Relief Capacity (MW)	1,471 MW	9,043 MW	1,839 MW
Integrator System (Description)	1 AC parallel 345 kV path	---	2 AC parallel 345 kV paths
Integrator System (Cost $ Bn)	1.5	---	3
Congestion Relief System (Description)	Connecting Larrabee 345 kV to the Millbury hub	Connecting POIs directly to the Millbury hub	Connecting Larrabee 345 kV to the Millbury hub
Congestion Relief System (Cost $ Bn)	3.7	20.0	3.7
Total Cost ($ Bn)	5.2	20.0	6.7
Total Cost ($ Bn) + 50% margin	7.8	30.0	10.0

Costs described here are preliminary high-level order of magnitude costs and are based on judgement.
Also, they do not account for individual plants' interconnection costs or potential costs from system operational issues.

Technical Challenges with Renewable Integration

- The large scale addition of asynchronous resources (EE, PV, wind, and HVDC imports) poses physical challenges
  - Special control systems may be required, especially to stabilize the system and provide frequency control
  - Protection system issues resulting from lack of short circuit availability could require major capital investment
  - Many other issues with power quality, voltage regulation, etc.



NEXT STEPS

PAC Comments Requested

- This presentation discusses several high level observations
- Stakeholders are invited to examine detailed results on the PAC website
  - https://www.iso-ne.com/committees/planning/planning-advisory
- Please provide the ISO with additional observations by participating in the PAC
  - Comments may be submitted to PACmatters@iso-ne.com

Schedule

- November 16 PAC
  - Summary of high level Phase I observations and key messages
  - Draft results of natural gas pipeline analysis, which is a Phase II item advanced from 2017 deliverable
- November 29 PAC
  - Discussion of sensitivity analysis results, assuming a limited number of cases (otherwise the schedule will slip)
  - Discussion of Phase II Scope of Work for Regulation, Ramping, and Reserves Analysis (May slip to December PAC)
- December 16 PAC
  - Discussion of Phase II Scope of Work for Forward Capacity Auction Pricing
  - Additional discussion of sensitivity analysis results as may be warranted

Schedule cont.

- 1st Quarter 2017
  - Discuss draft and then finalize the Scenario Analysis Report (for the five base scenarios)
  - Discuss draft and then finalize Sensitivity Case Scenario Analysis Report as may be required
  - Phase II Analysis to be conducted in 2017
  - Examine representative Forward Capacity Auction (FCA) clearing prices for several scenarios
  - Analyze hourly and intra-hourly ramping, regulation, and reserve requirements

Questions