



Eastern Interconnection Planning Collaborative

Phase 2 Report:

**Interregional Transmission Development and
Analysis for Three Stakeholder Selected
Scenarios
And
Gas-Electric System Interface Study**

**DOE Award Project
DE-OE0000343**

July 2, 2015

**Volume 3
Appendices to Sections 1-7**

FINAL

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Acknowledgement

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Disclaimers

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The information and studies discussed in this report are intended to provide general information to policy-makers and stakeholders but are not a specific plan of action and are not intended to be used in any state electric facility approval or siting processes. The work of the Eastern Interconnection States Planning Council or the Stakeholder Steering Committee does not bind any state agency or Regulator in any state proceeding.

Appendix 1

Inter-regional Tie Line Flow Comparisons

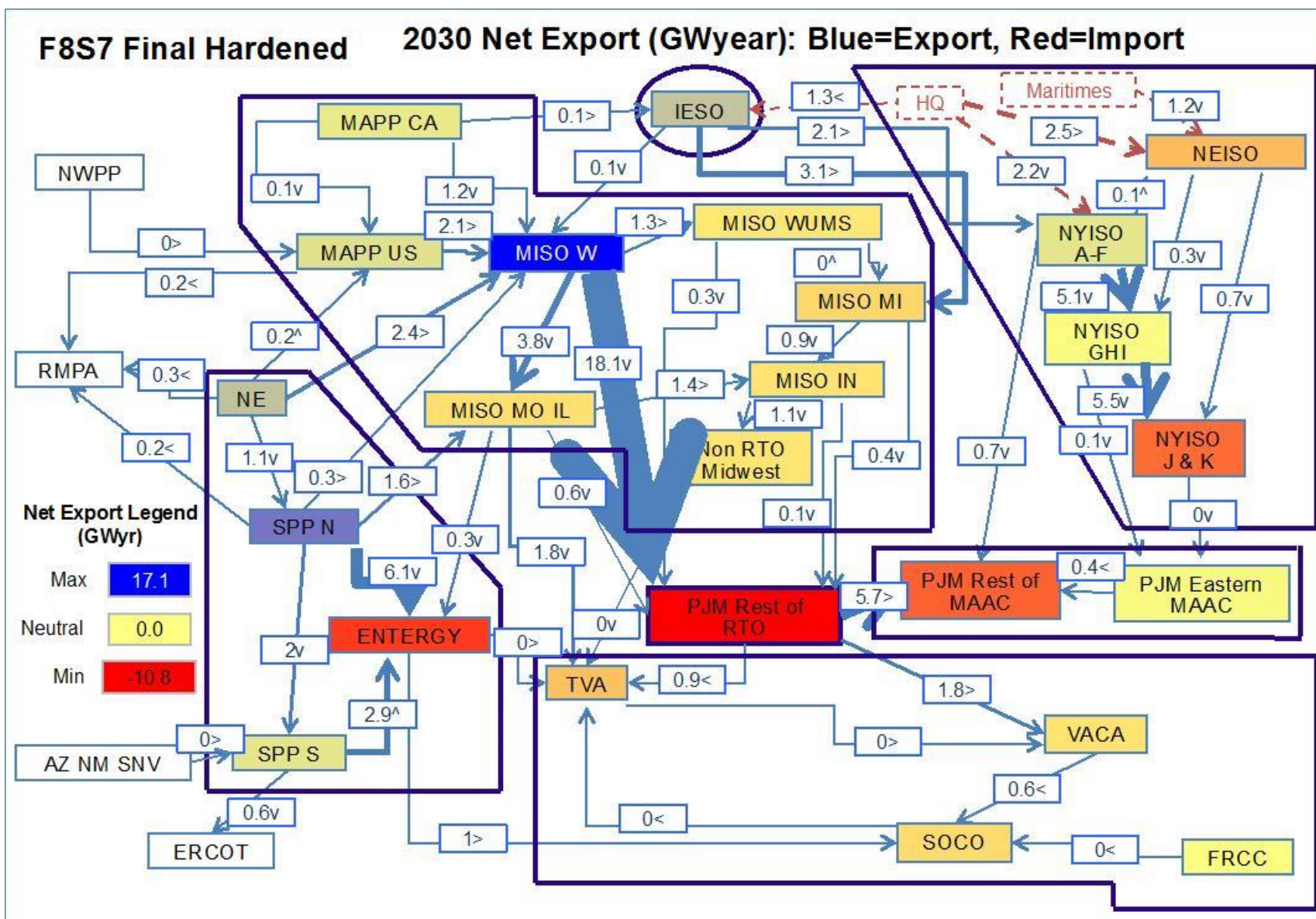


Figure A1-1. Average Inter-regional Tie-line flows – Phase 1 Future 8 (Scenario 1)

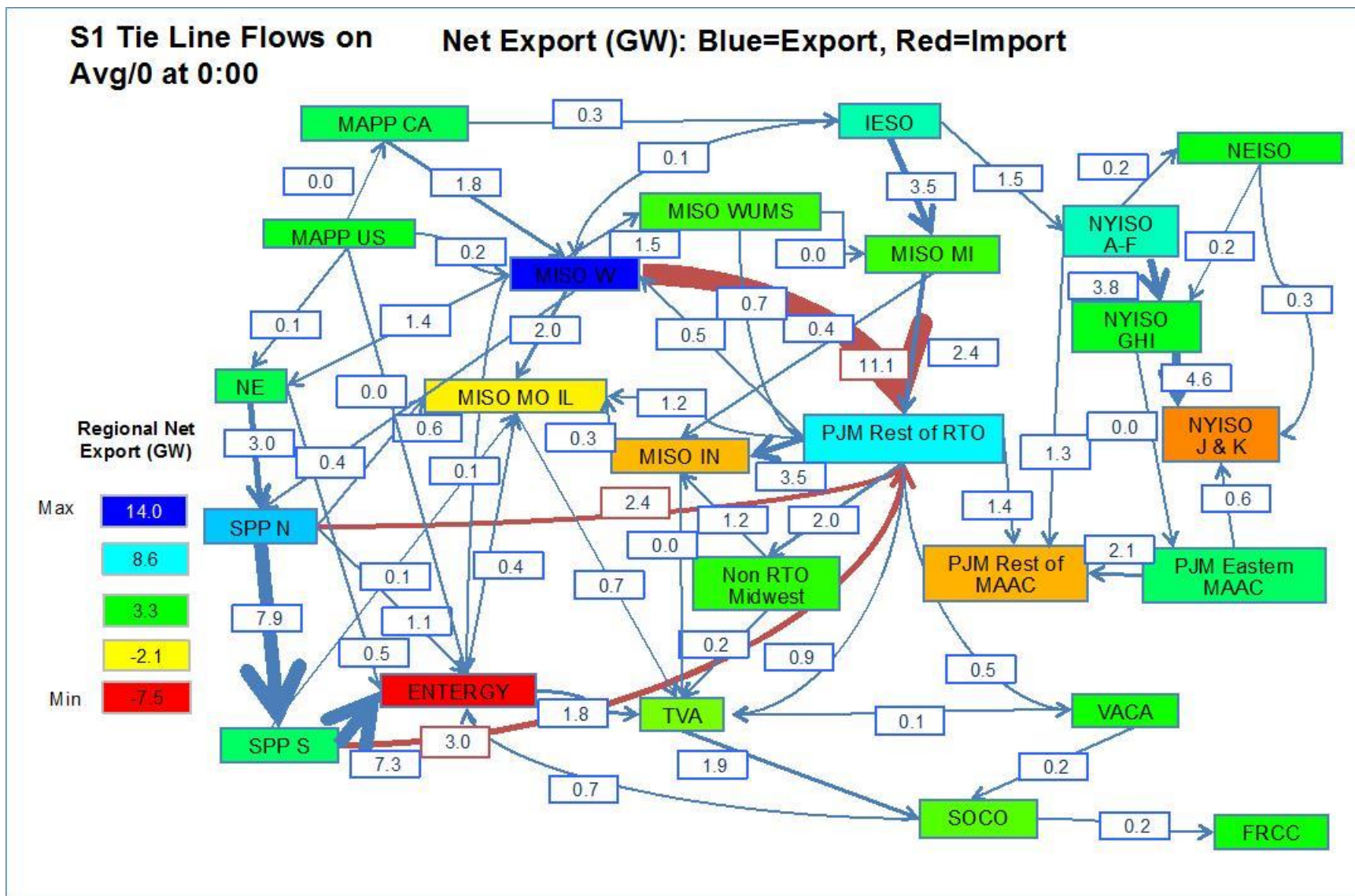


Figure A1-2. Average Inter-regional Tie-line Flows – GE MAPS Scenario 1 – Combined Policies

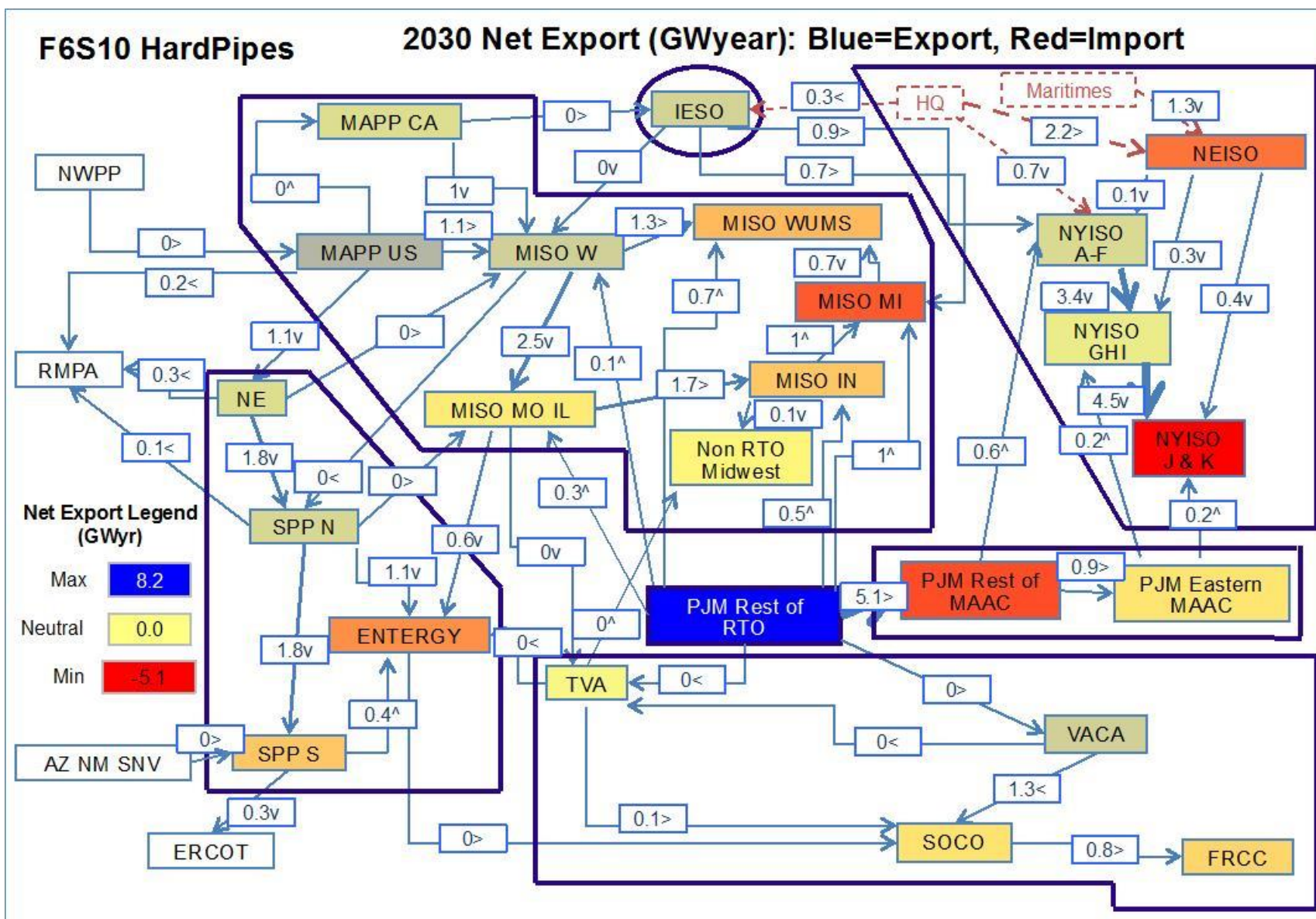


Figure A1-3. Average Inter-regional Tie-line flows – Phase 1 National RPS – Implemented Regionally

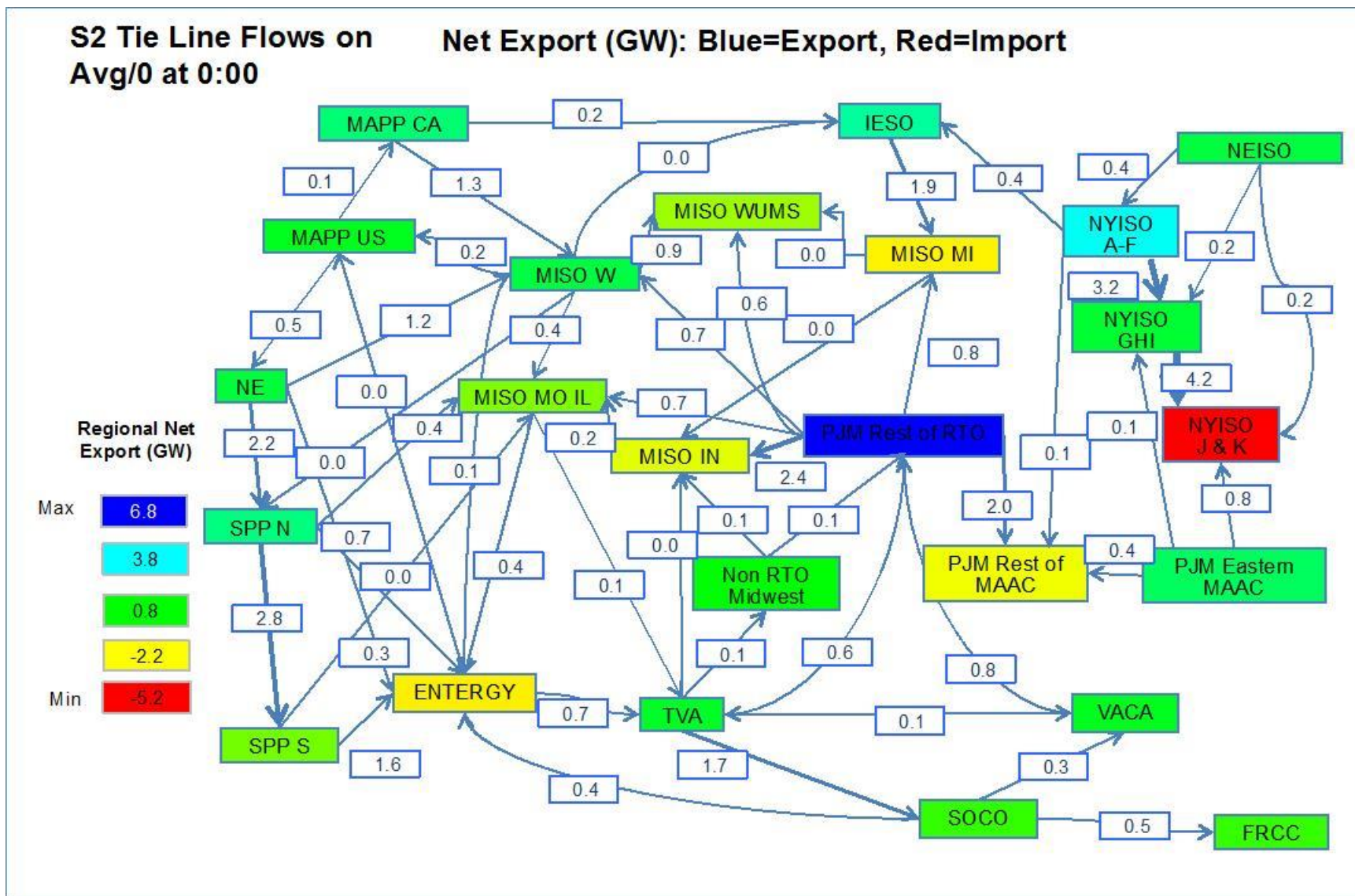


Figure A1-4. Average Inter-regional Tie-line flows – GE MAPS: Scenario 2 – National RPS Implemented Regionally

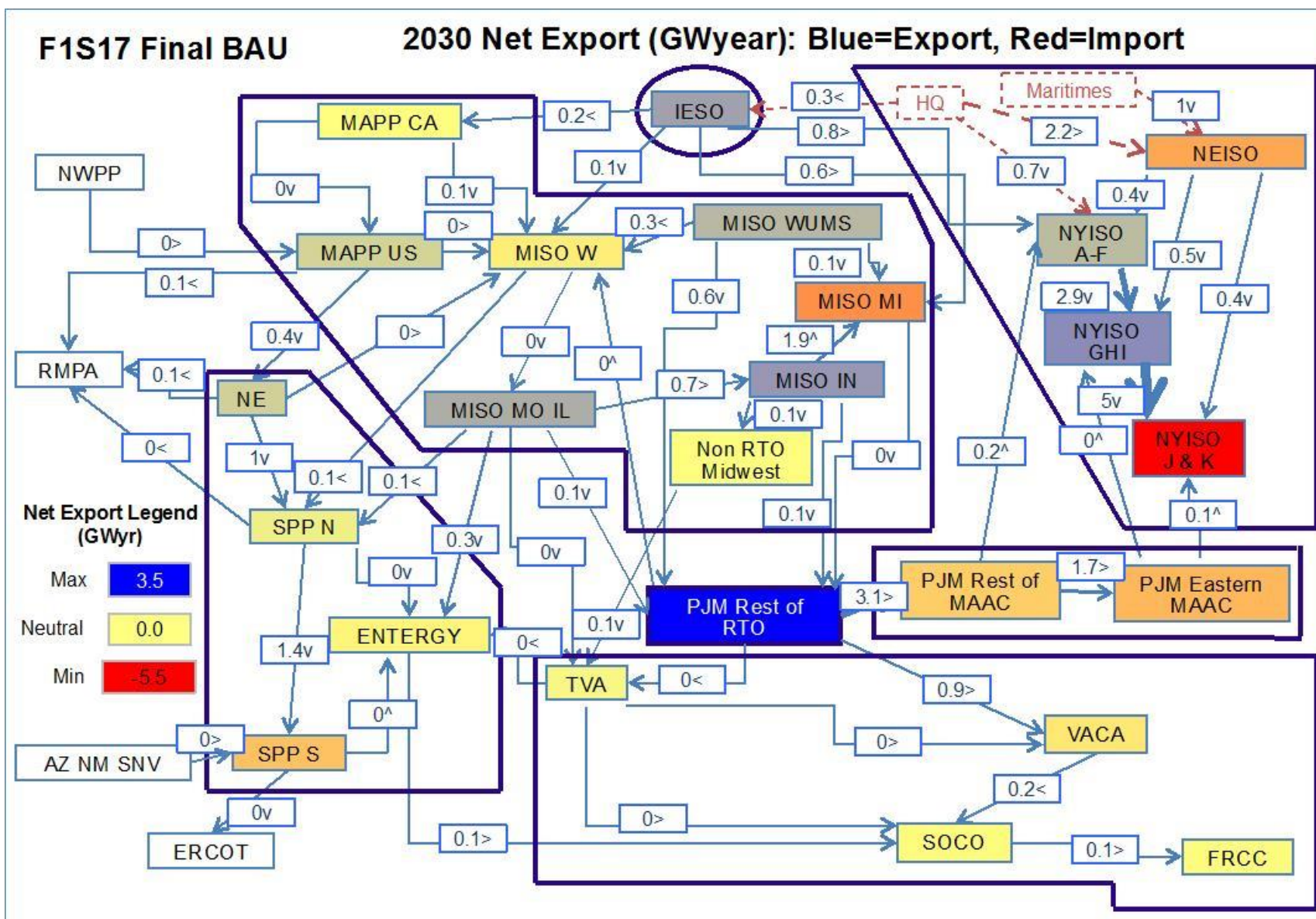


Figure A1-5. Average Inter-regional Tie-line Flows – Phase 1 Future 1 – Business as Usual (Scenario 3)

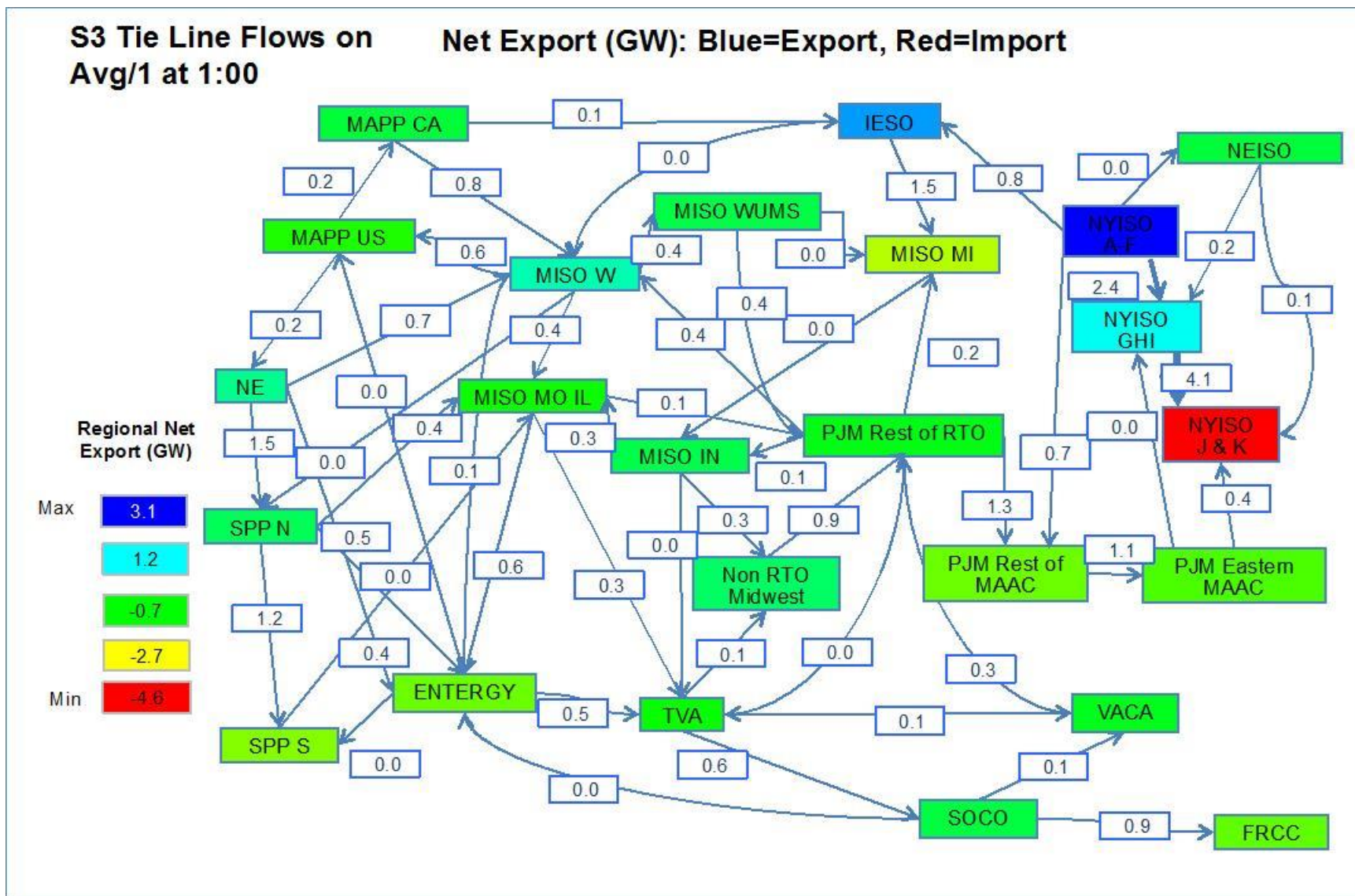


Figure A1-6. Average Inter-regional Tie-line Flows – GE MAPS Scenario 3: Business as Usual

Appendix 2
“All Transmission” Maps

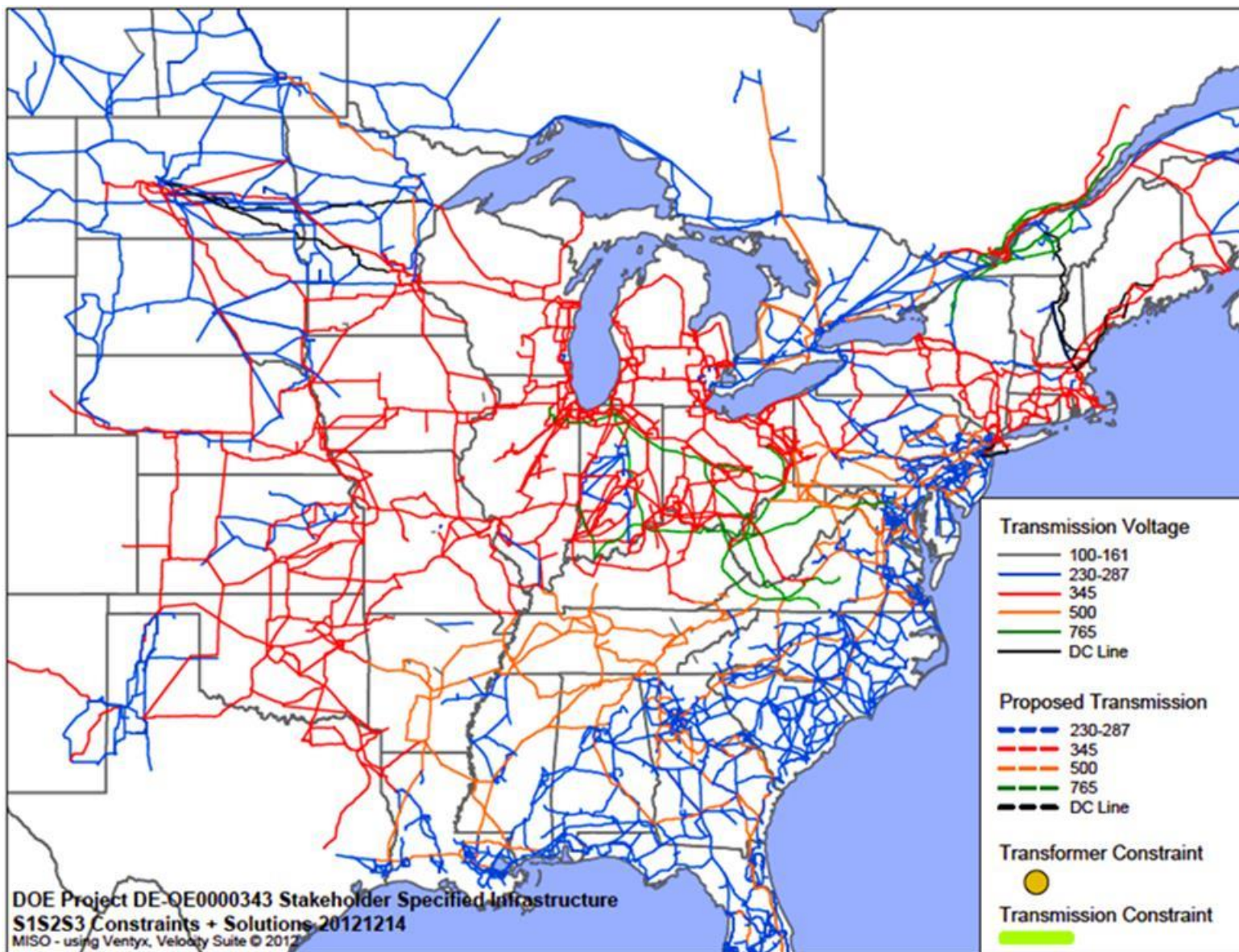


Figure A2-1. Existing and Stakeholder Specified Transmission

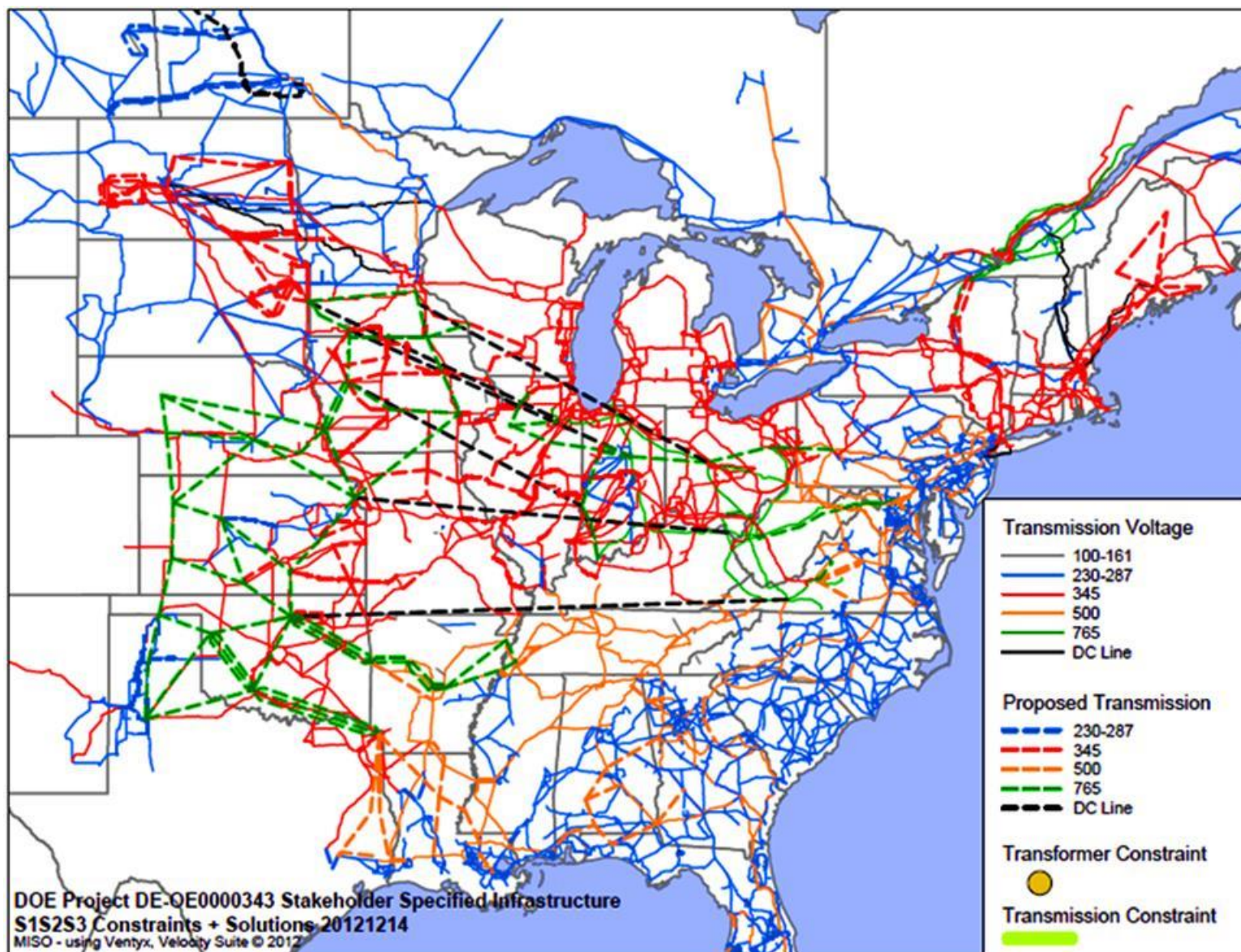


Figure A2-2. Scenario 1 – All Transmission

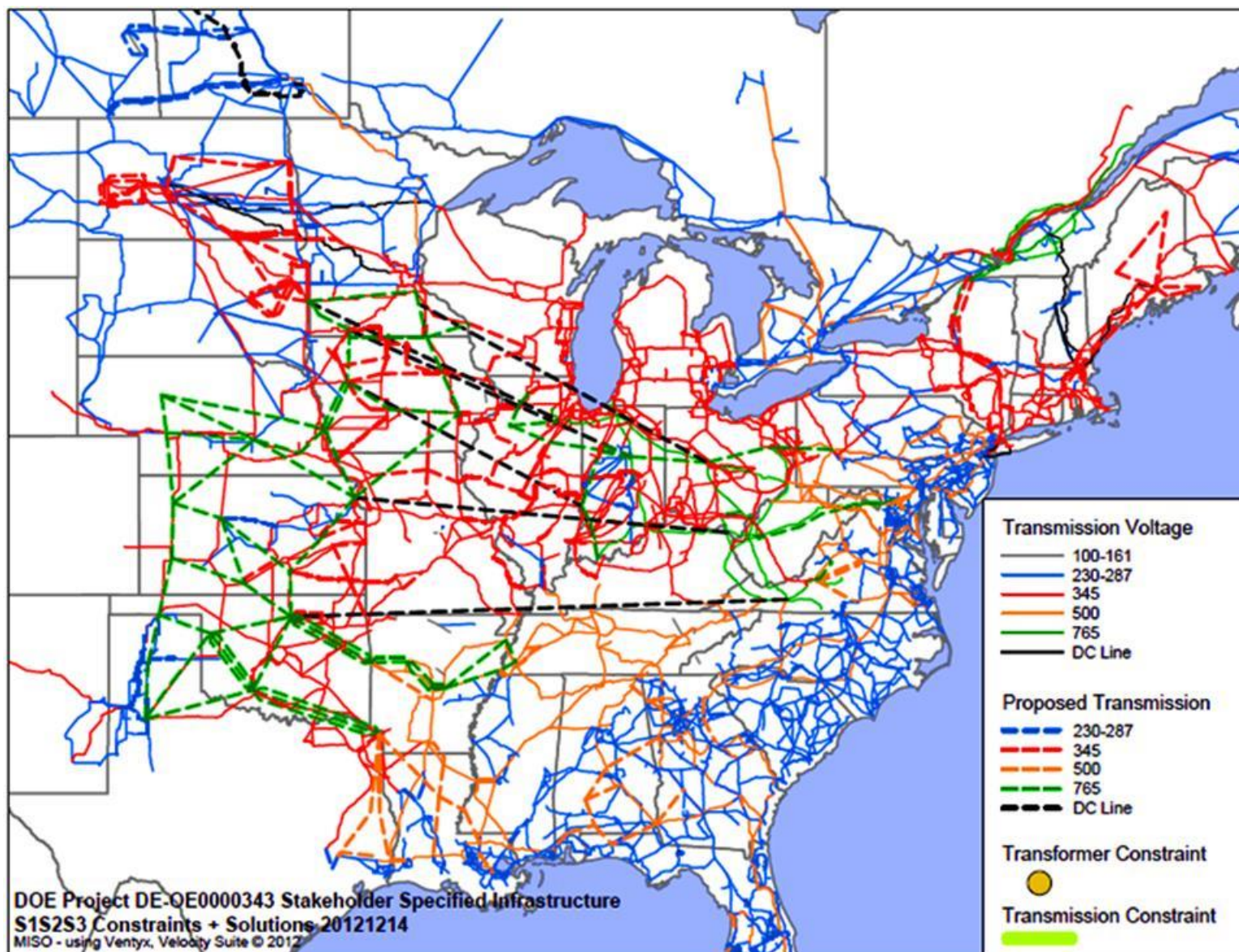


Figure A2-3. Scenario 2 – All Transmission

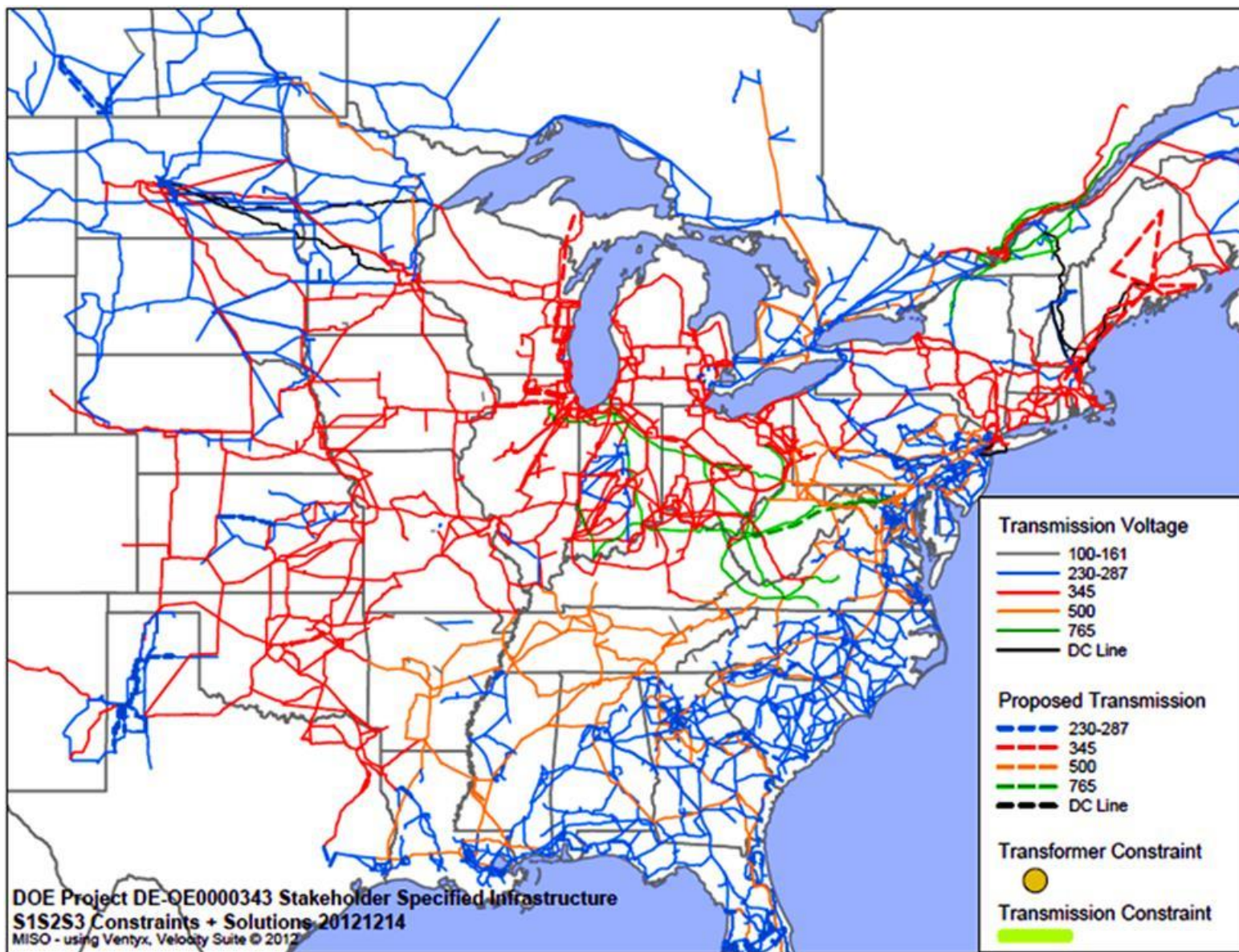


Figure A2-4. Scenario 3 – All Transmission

Appendix 3

Scenario 1 Daily Dispatch by Region

Phase II, Scenario 1

Daily Generation Dispatch Plots

- “The results presented herein use modeling assumptions developed by EIPC, EIPC stakeholders and CRA for purposes of EIPC capacity expansion modeling. As such, these results do not necessarily reflect the opinions or views of CRA or any individual EIPC stakeholder.”
- Scenario 1: Nationally-Implemented Federal Carbon Constraint with Increased Energy Efficiency/Demand Response (Based on F8S7)
- The following data file was used to create the daily generation dispatch plots.
 - [Scen 1 Hourly F Gen Report V2](#) (10-08-12)
 - http://www.eipconline.com/uploads/20121008_S1_Base_F_Hourly_GenReport_V2.xlsx
- One series of daily generation dispatch plots
 - Megawatt (MW) for each NEEM region (24 plots)

Generation Grouping Categories:

1. Other Renewable
 - a. Biomass
 - b. Solar Thermal (existing)
 - c. Geo – Geothermal
 - d. LFG – Landfill Gas
 - e. PV – Solar Photovoltaic
 - f. ST – Solar Thermal (new)
2. Combined Cycle
 - a. CC – Combined Cycle
3. Peakers
 - a. CT – Combustion Turbine (new)
 - b. PeakG – CT gas (existing)
 - c. PeakO – CT oil (existing)
 - d. STOG – Steam Turbine-Oil/Gas
 - e. STWD – Steam Turbine-Wood
4. Coal
 - a. Coal – Coal-fired (includes Pulverized coal, new IGCCs and new IGCC-CCs)
5. Hydro
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 - b. PS – Pumped-Storage Hydro
6. Nuclear
 - a. Nuc – Nuclear
7. Wind
 - a. WT – Wind Turbine On-shore
 - b. WT_off – Wind Turbine Off-shore
8. Demand Response
 - a. Demand Response – Demand Response (DR)
9. Other
 - a. Pseudo Unit -- HQ/Maritimes New Units
 - b. Fixed Interchange—HQ/Maritimes Fixed Interchange

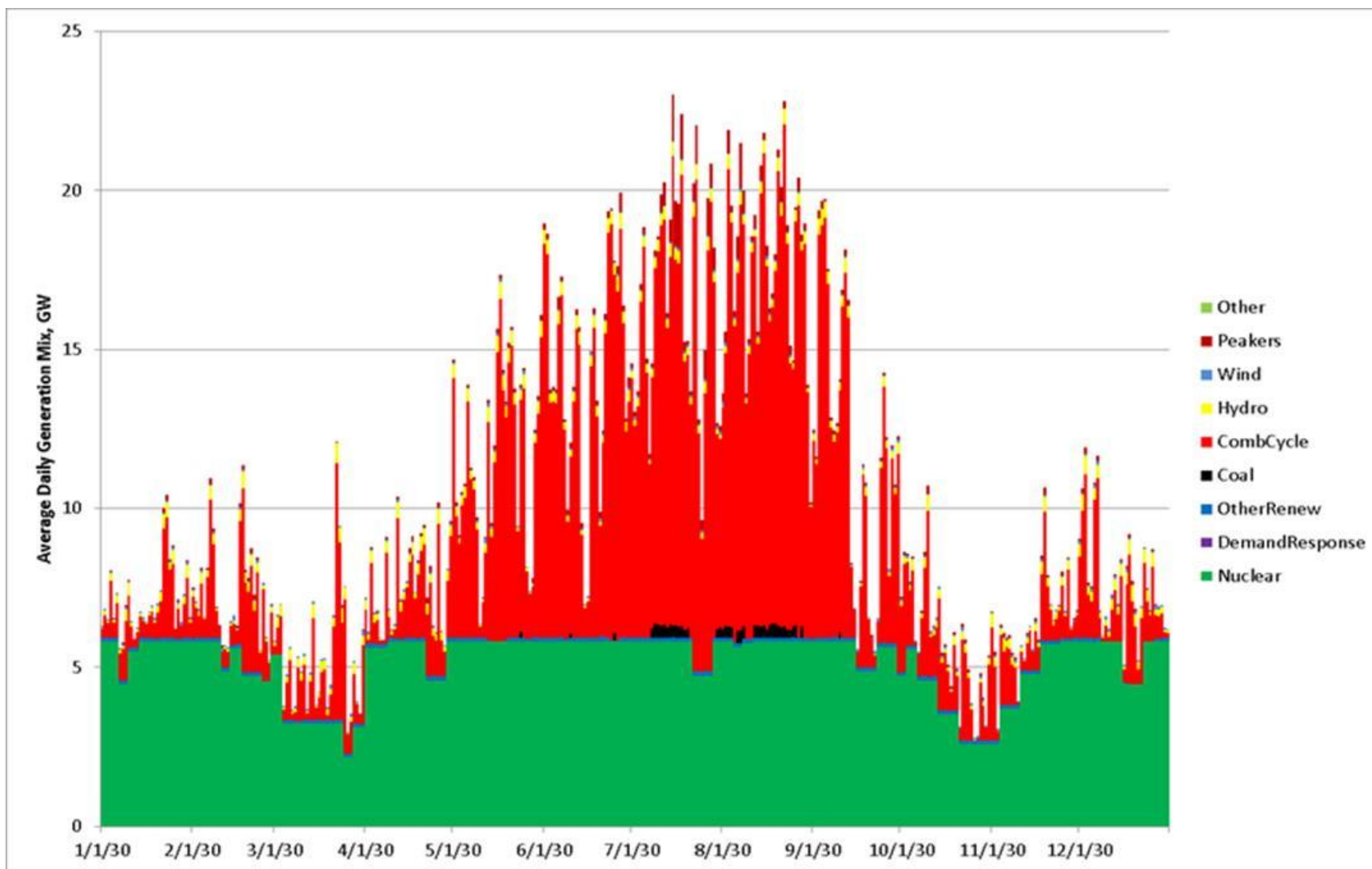


Figure A3-1. Daily Generation Dispatch for Scenario 1 ENT

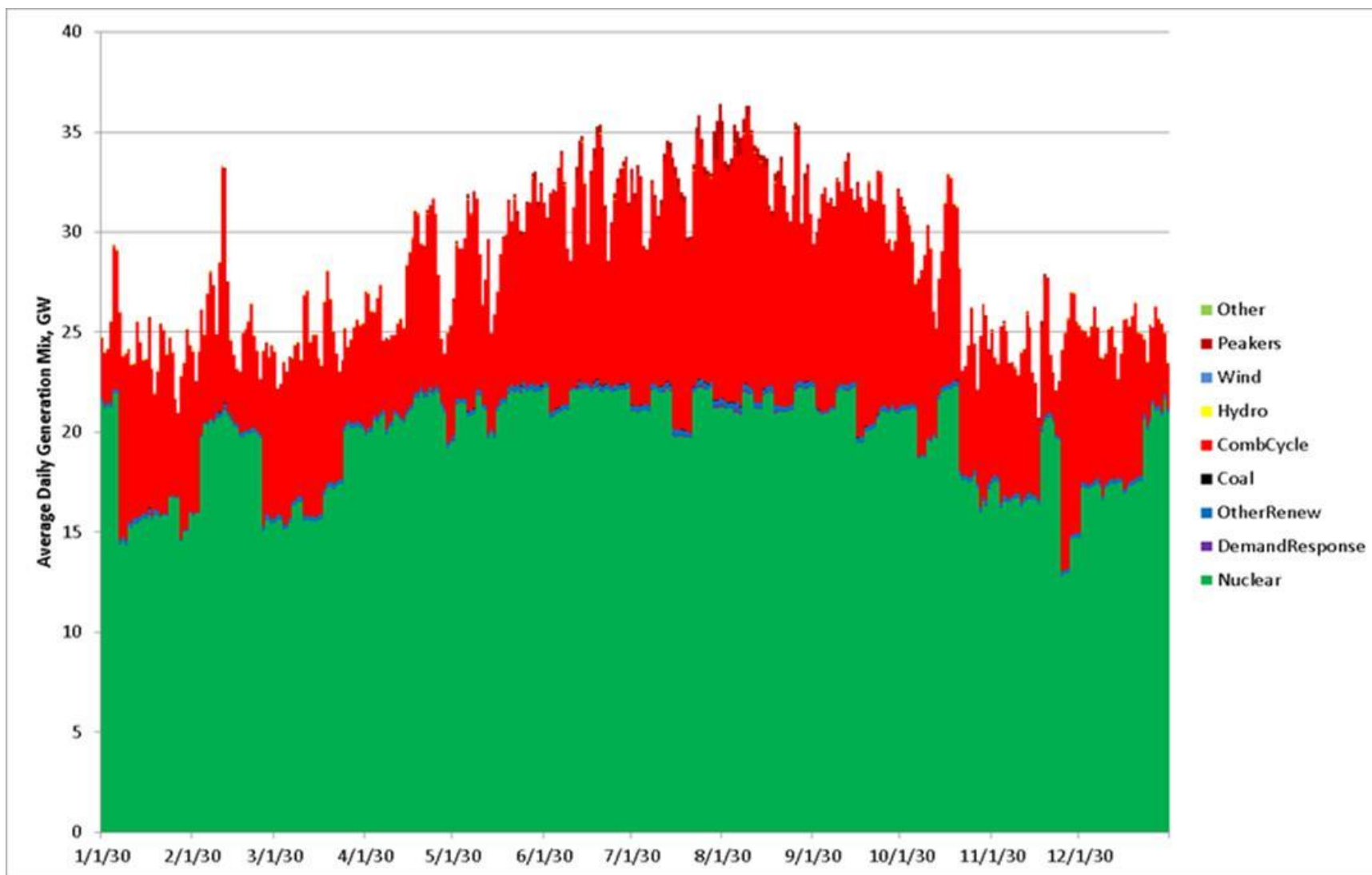


Figure A3-2. Daily Generation Dispatch for Scenario 1 FRCC

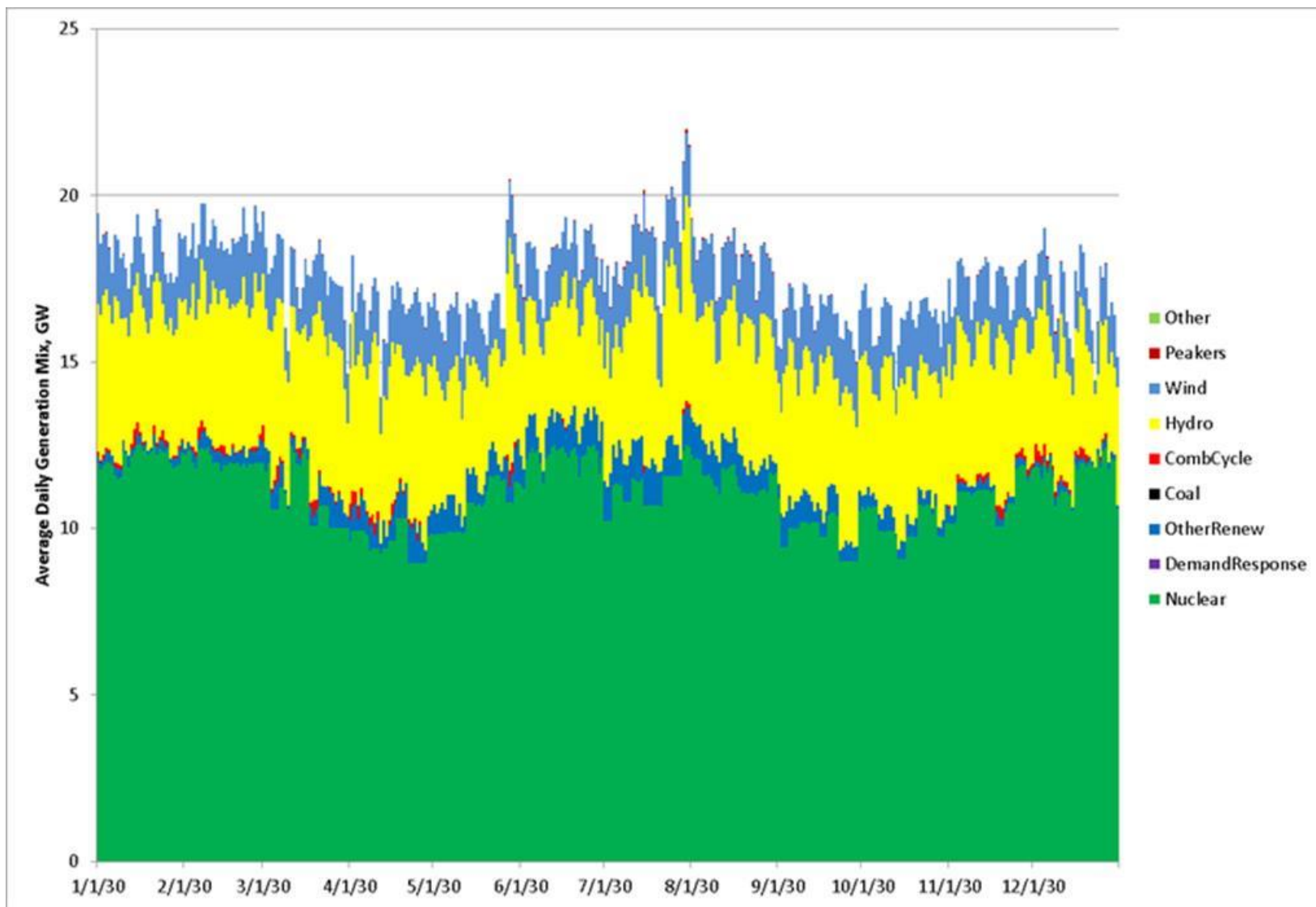


Figure A3-3. Daily Generation Dispatch for Scenario 1 IESO

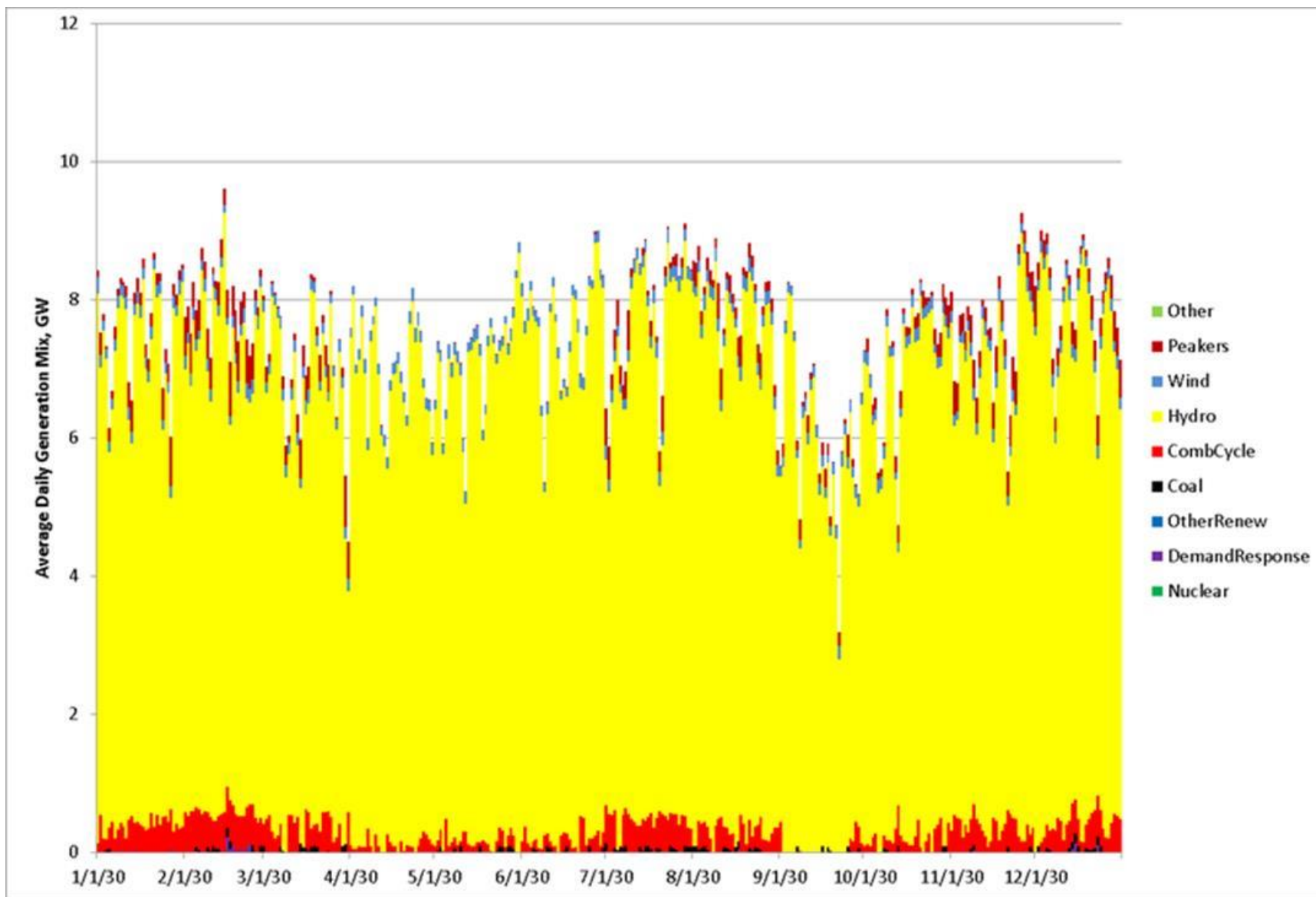


Figure A3-4. Daily Generation Dispatch for Scenario 1 MAPP_CA

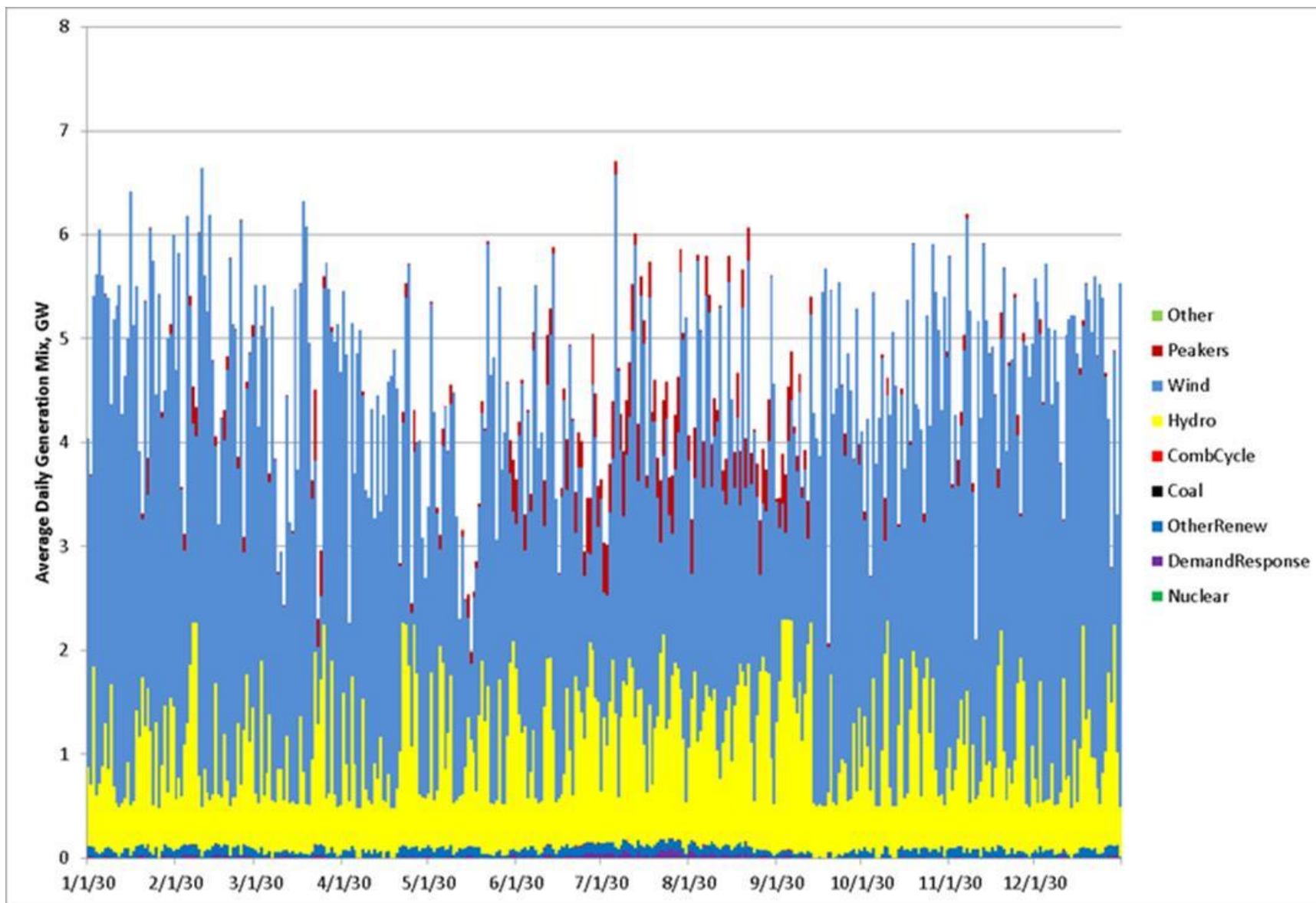


Figure A3-5. Daily Generation Dispatch for Scenario 1 MAPP_US

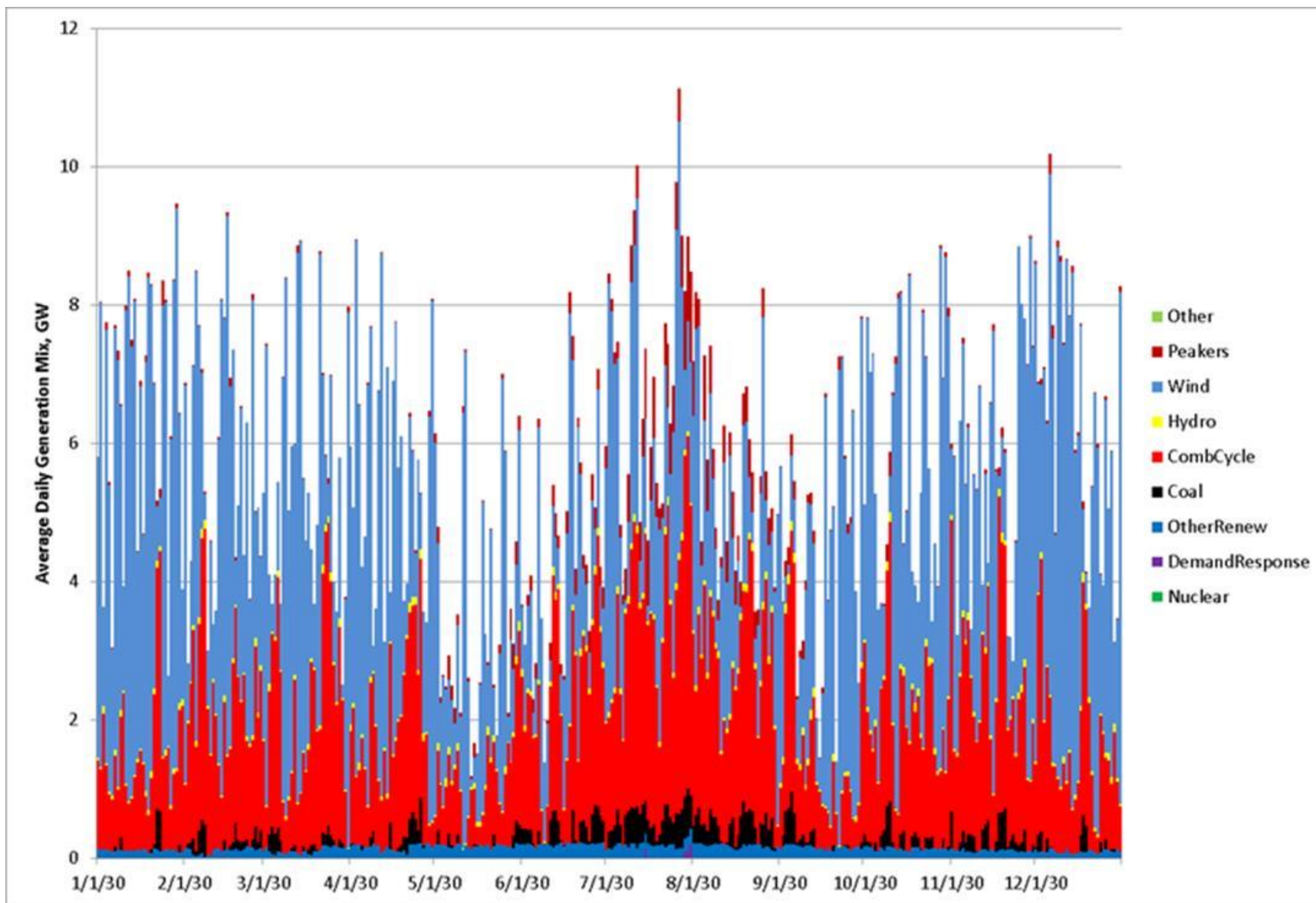


Figure A3-6. Daily Generation Dispatch for Scenario 1 MISO_IN

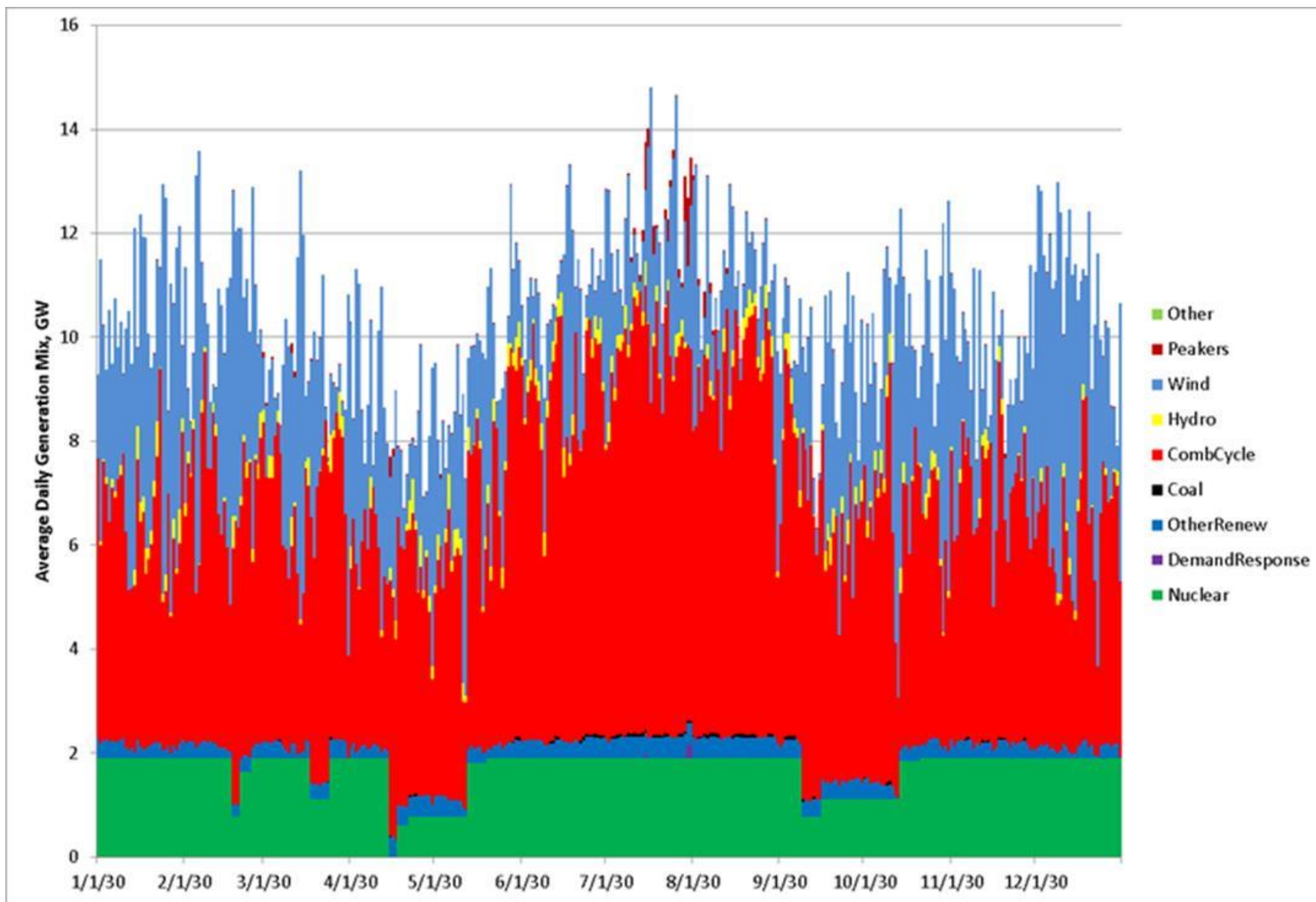


Figure A3-7. Daily Generation Dispatch for Scenario 1 MISO_MI

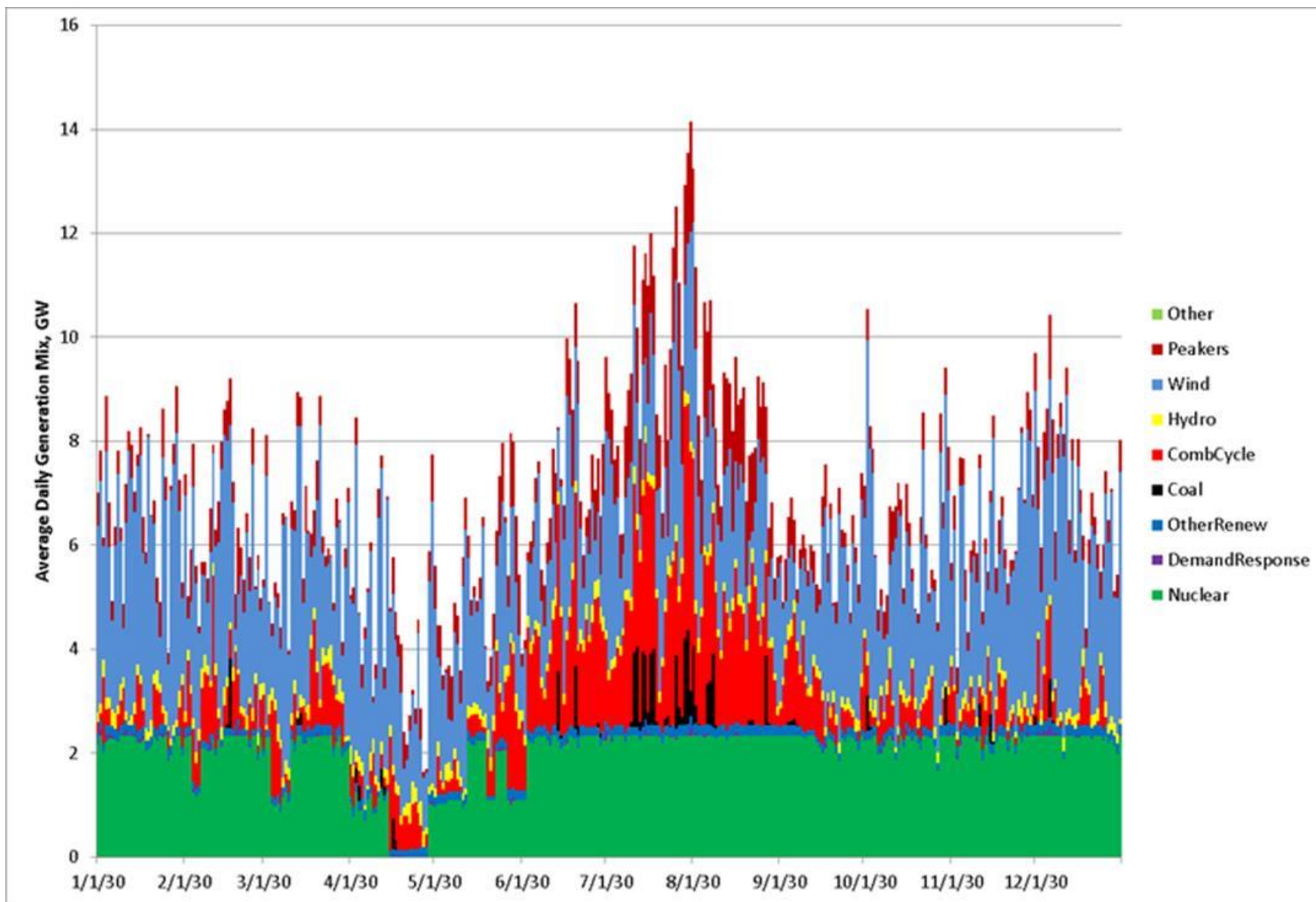


Figure A3-8. Daily Generation Dispatch for Scenario 1 MISO_MO_IL

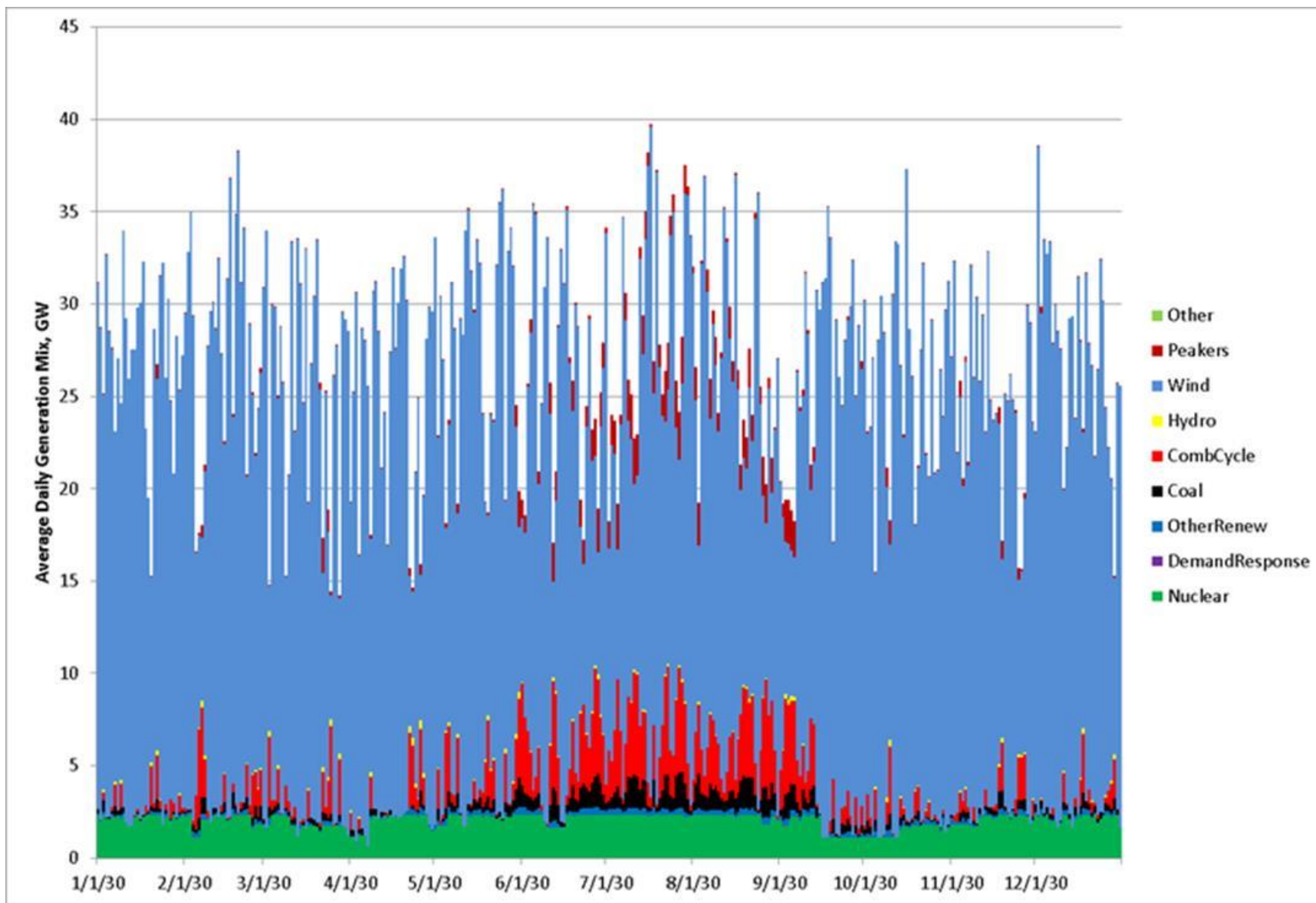


Figure A3-9. Daily Generation Dispatch for Scenario 1 MISO_W

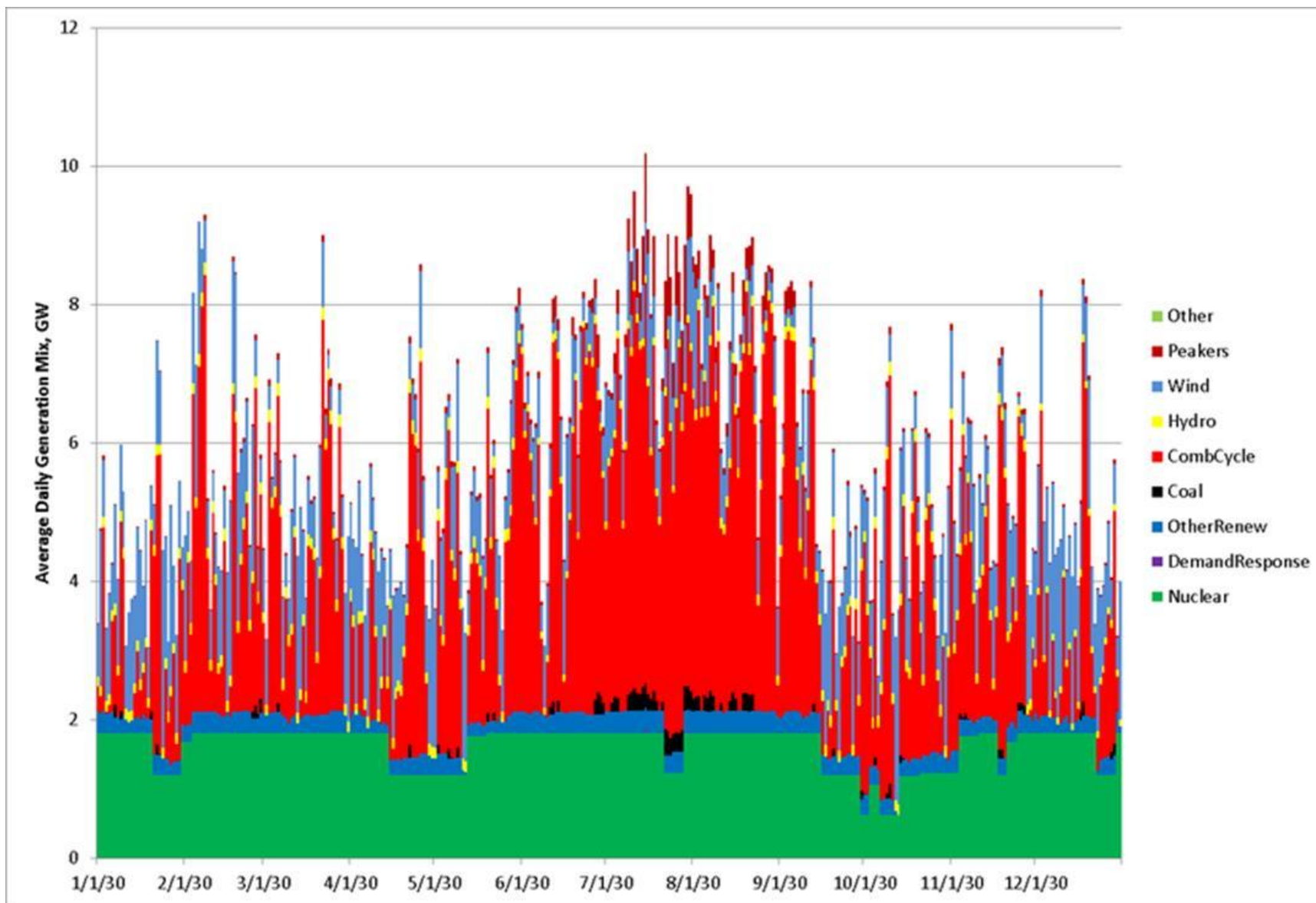


Figure A3-10. Daily Generation Dispatch for Scenario 1 MISO_WUMS

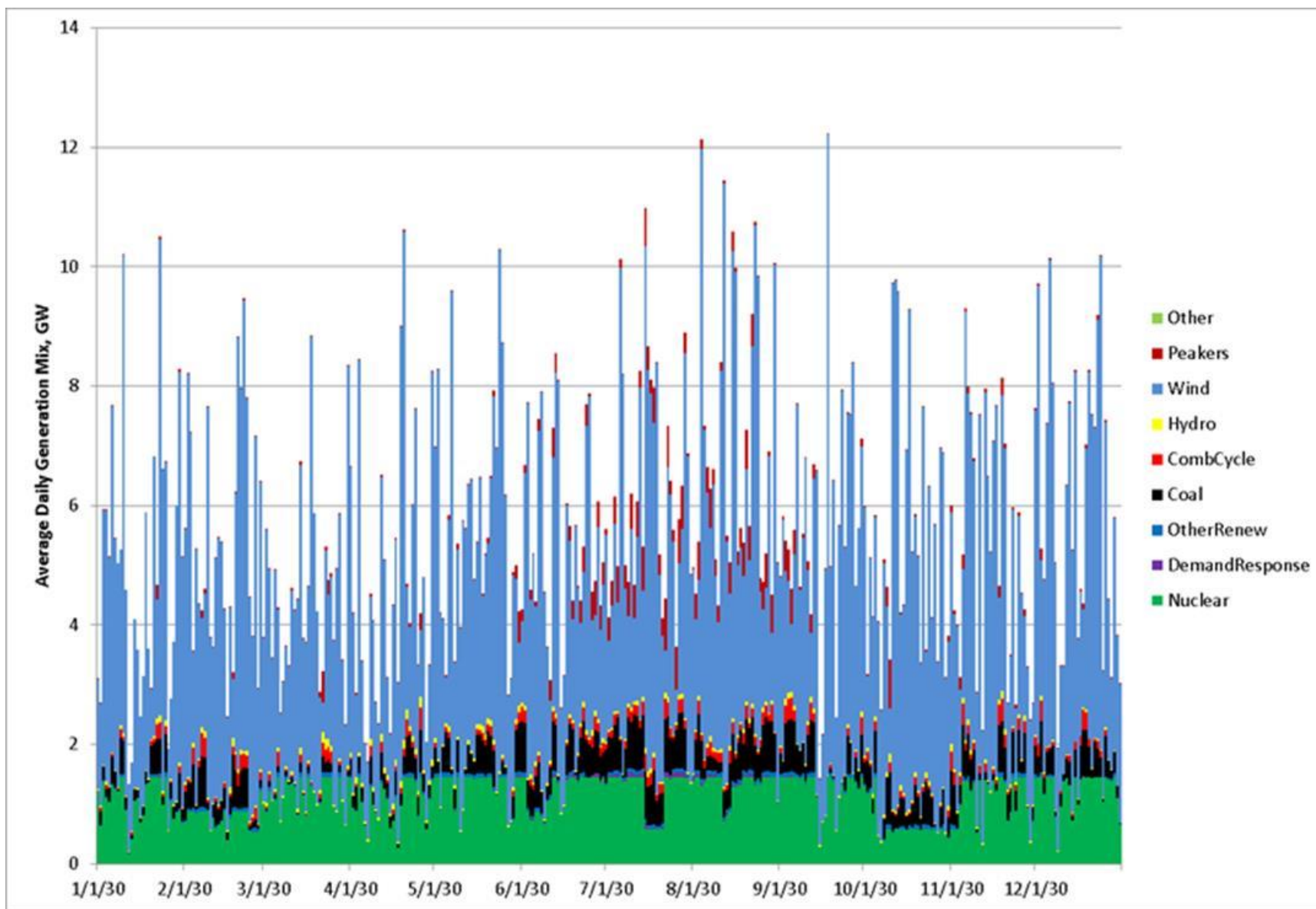


Figure A3-11. Daily Generation Dispatch for Scenario 1 NE

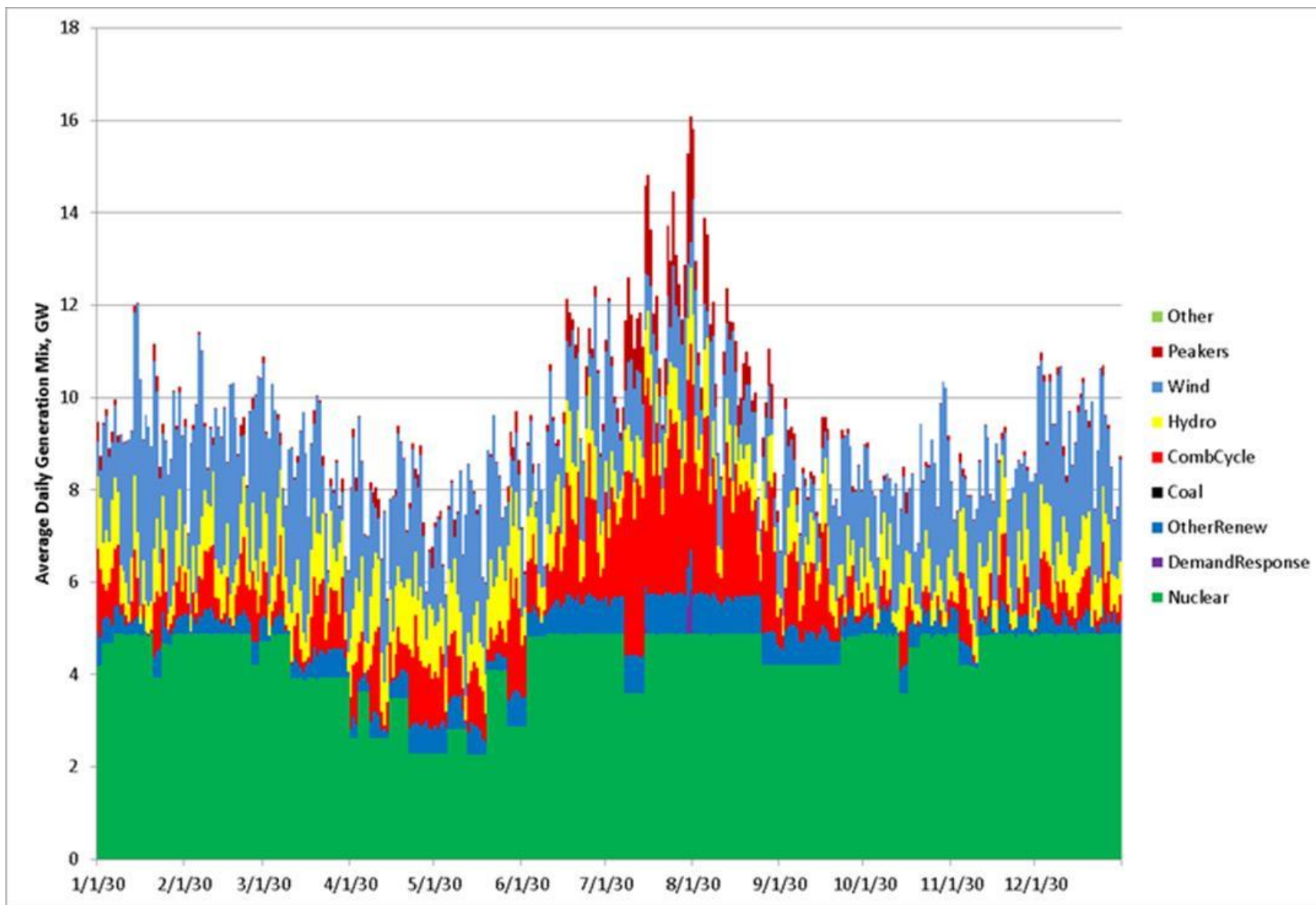


Figure A3-12. Daily Generation Dispatch for Scenario 1 NEISO

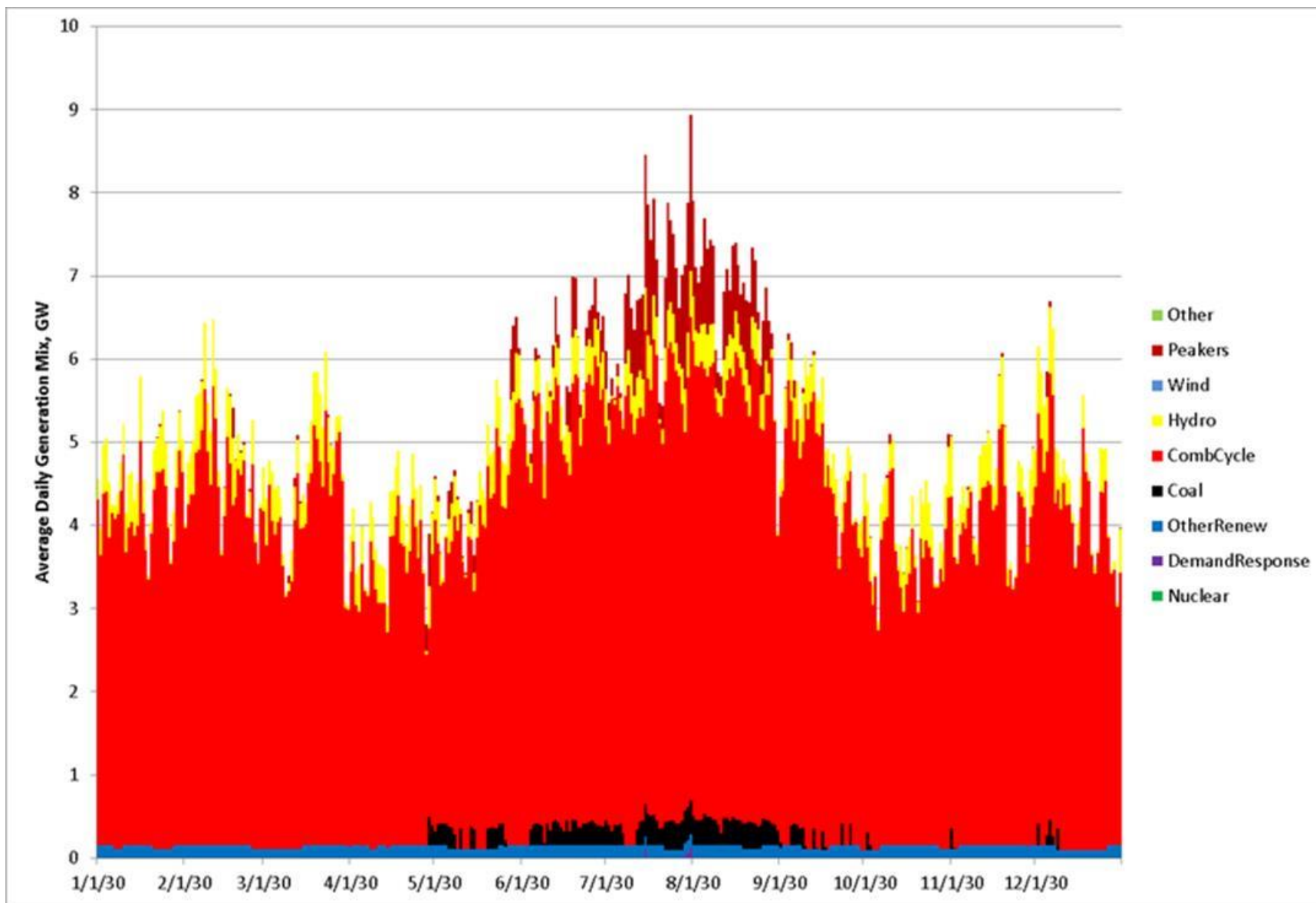


Figure A3-13. Daily Generation Dispatch for Scenario 1 NonRTO_Midwest

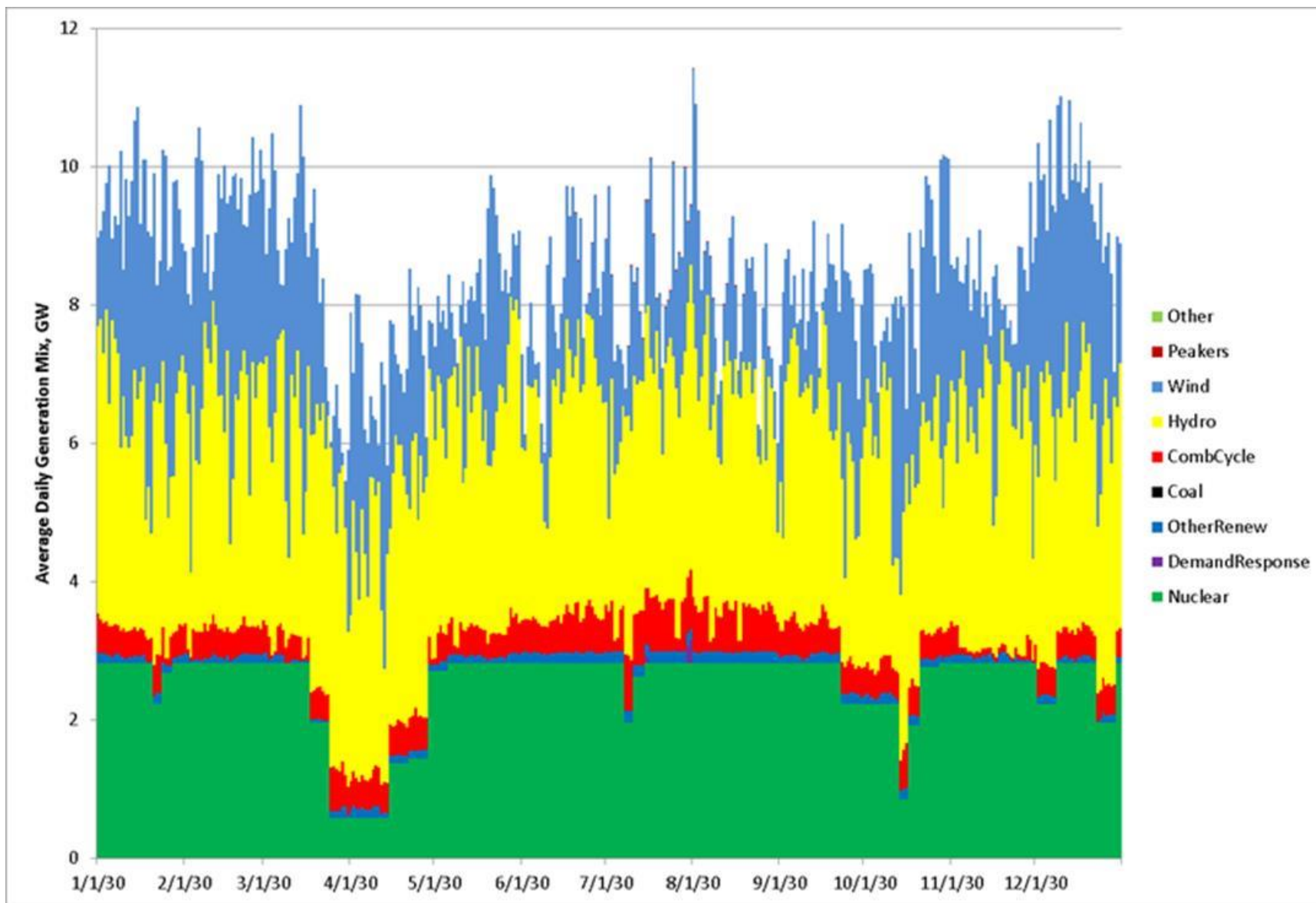


Figure A3-14. Daily Generation Dispatch for Scenario 1 NYISO_A_F

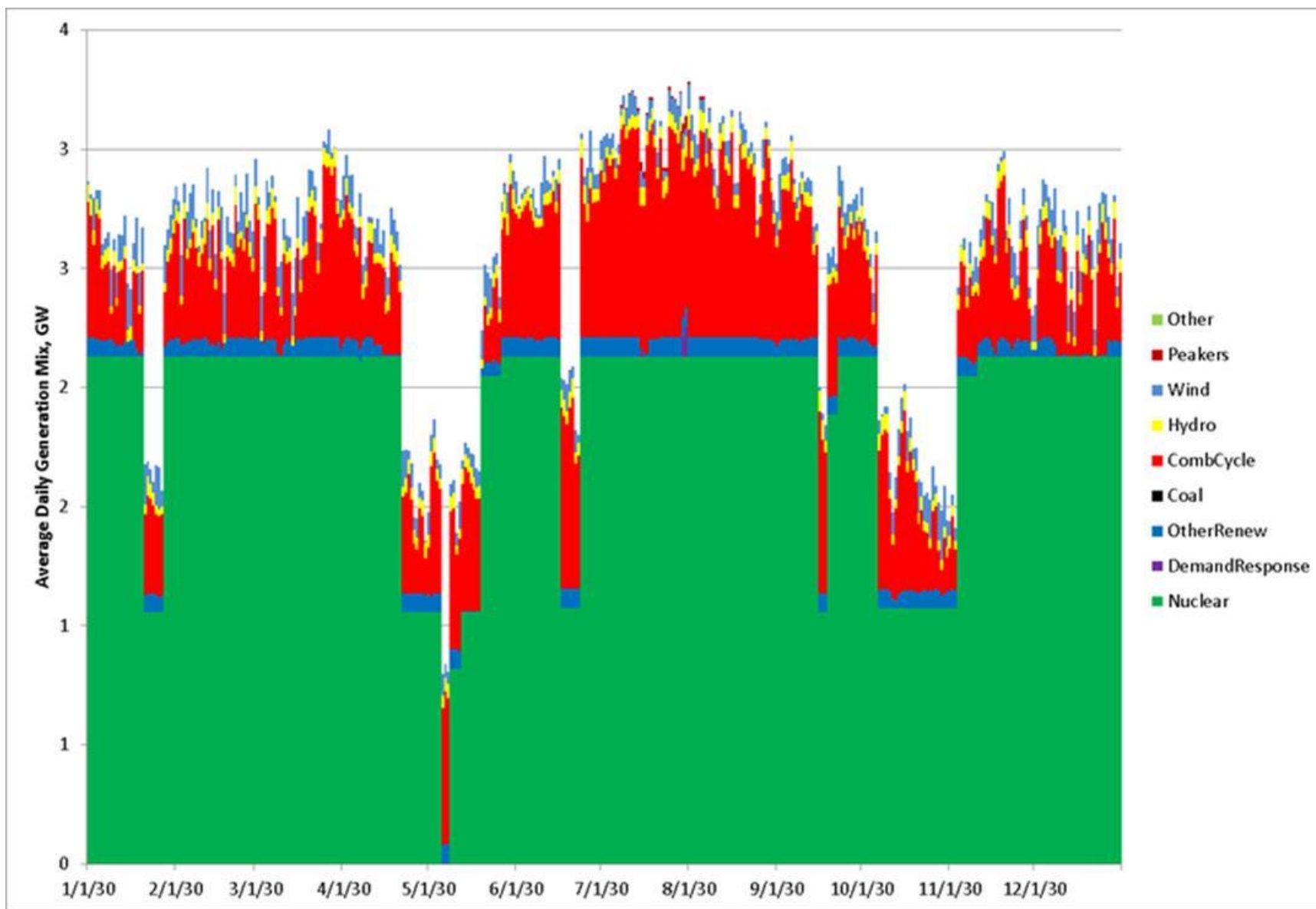


Figure A3-15. Daily Generation Dispatch for Scenario 1 NYISO_G_I

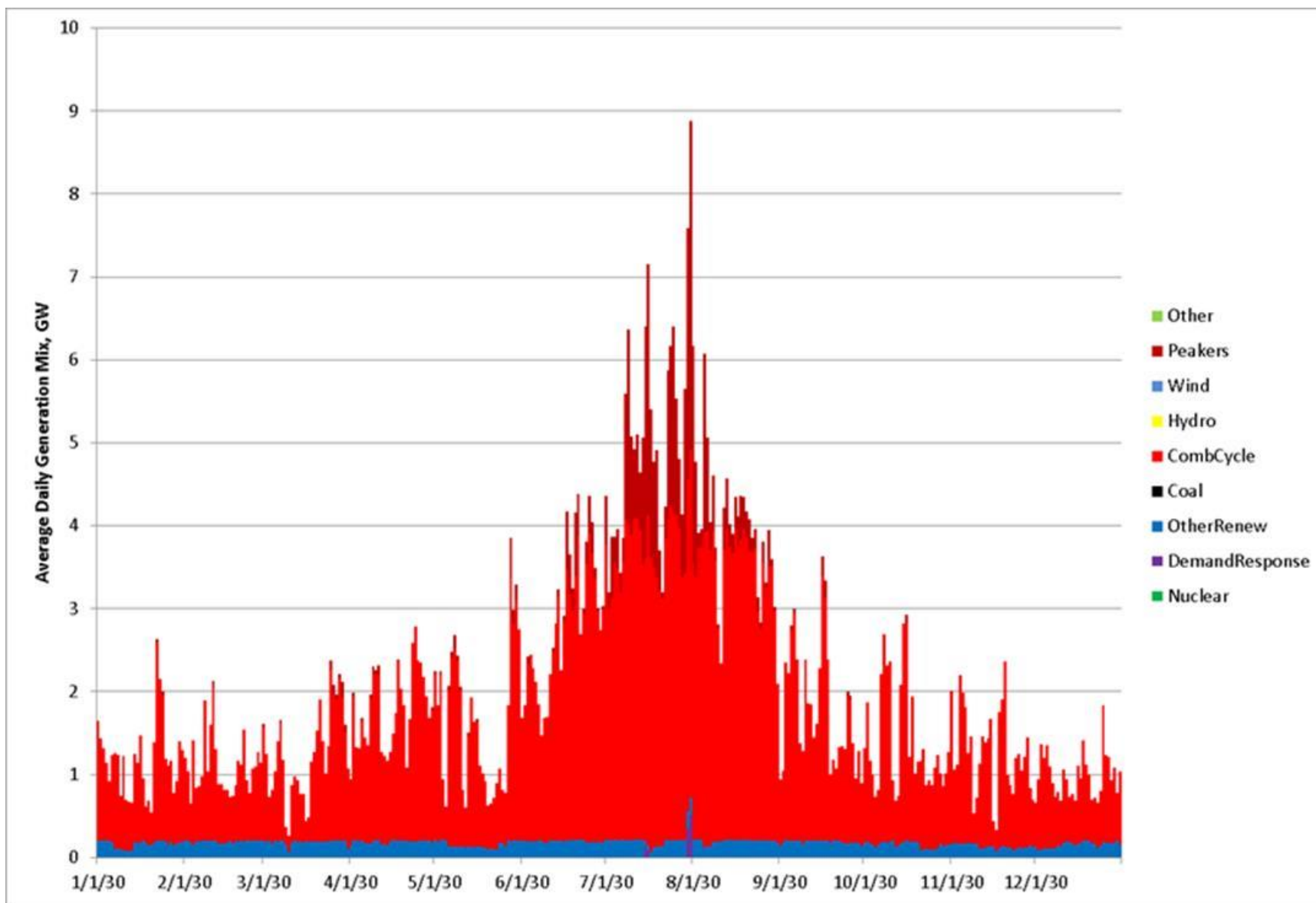


Figure A3-16. Daily Generation Dispatch for Scenario 1 NYISO_J_K

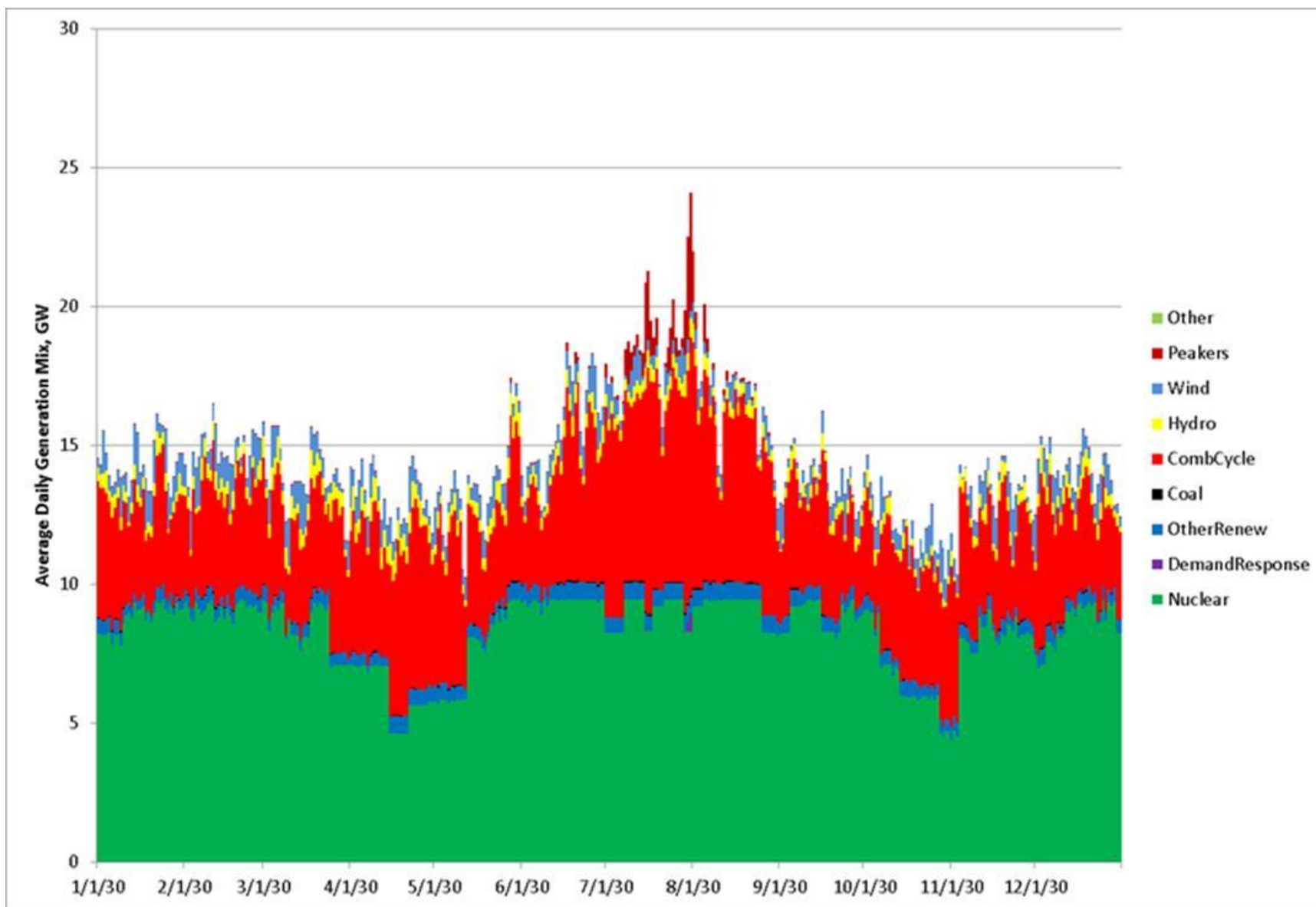


Figure A3-17. Daily Generation Dispatch for Scenario 1 PJM_E

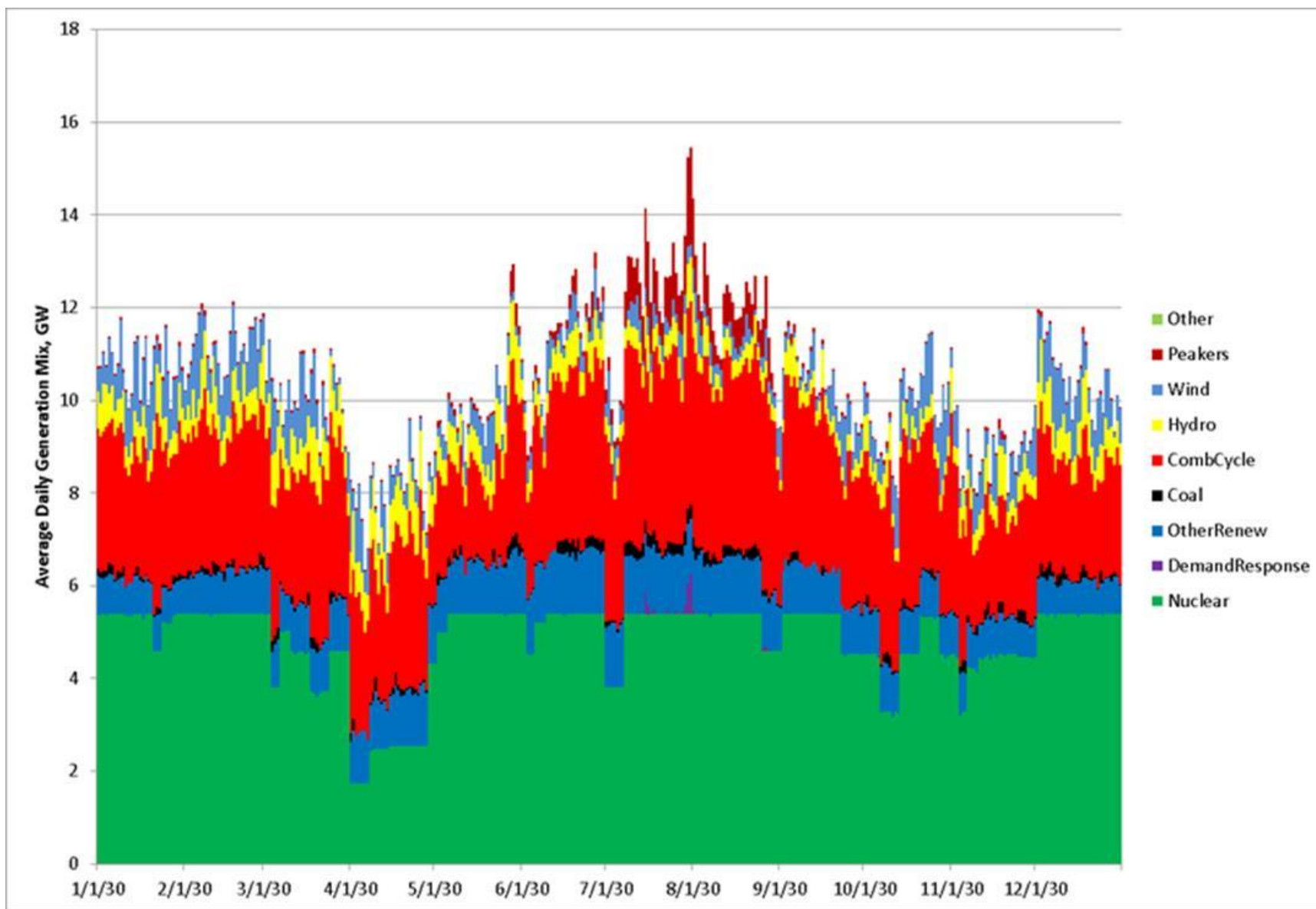


Figure A3-18. Daily Generation Dispatch for Scenario 1 PJM_ROM

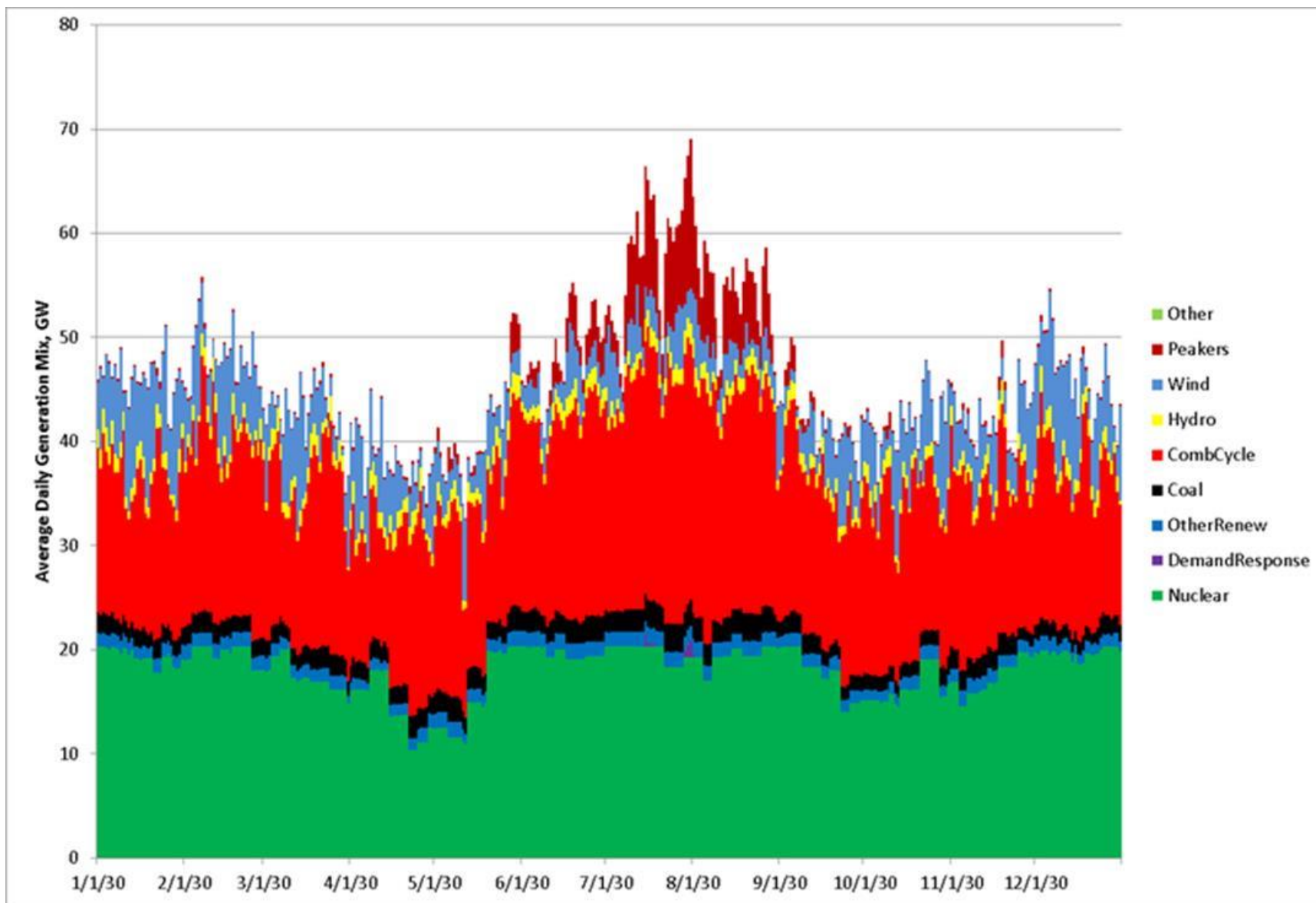


Figure A3-19. Daily Generation Dispatch for Scenario 1 PJM_ROR

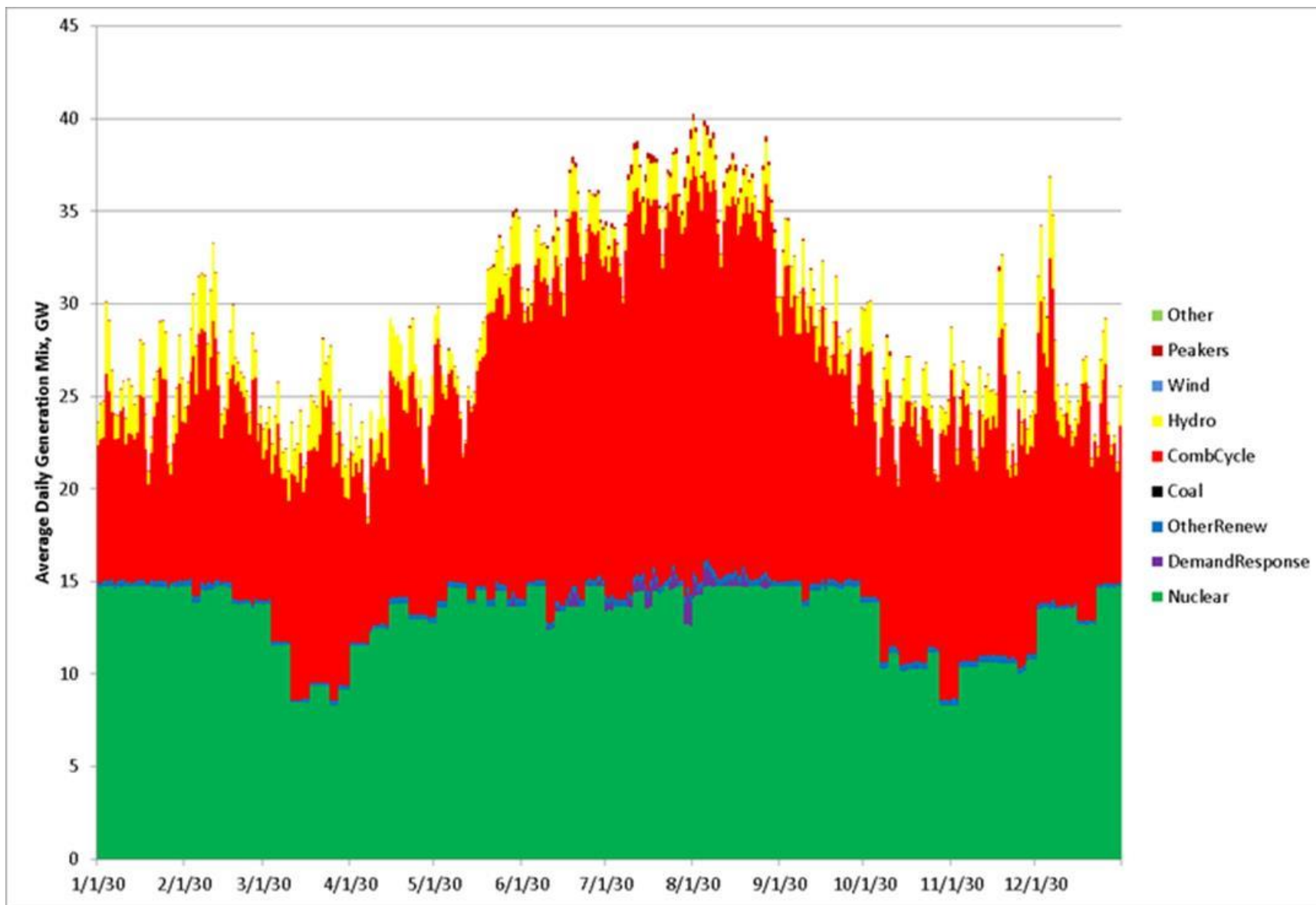


Figure A3-20. Daily Generation Dispatch for Scenario 1 SOCO

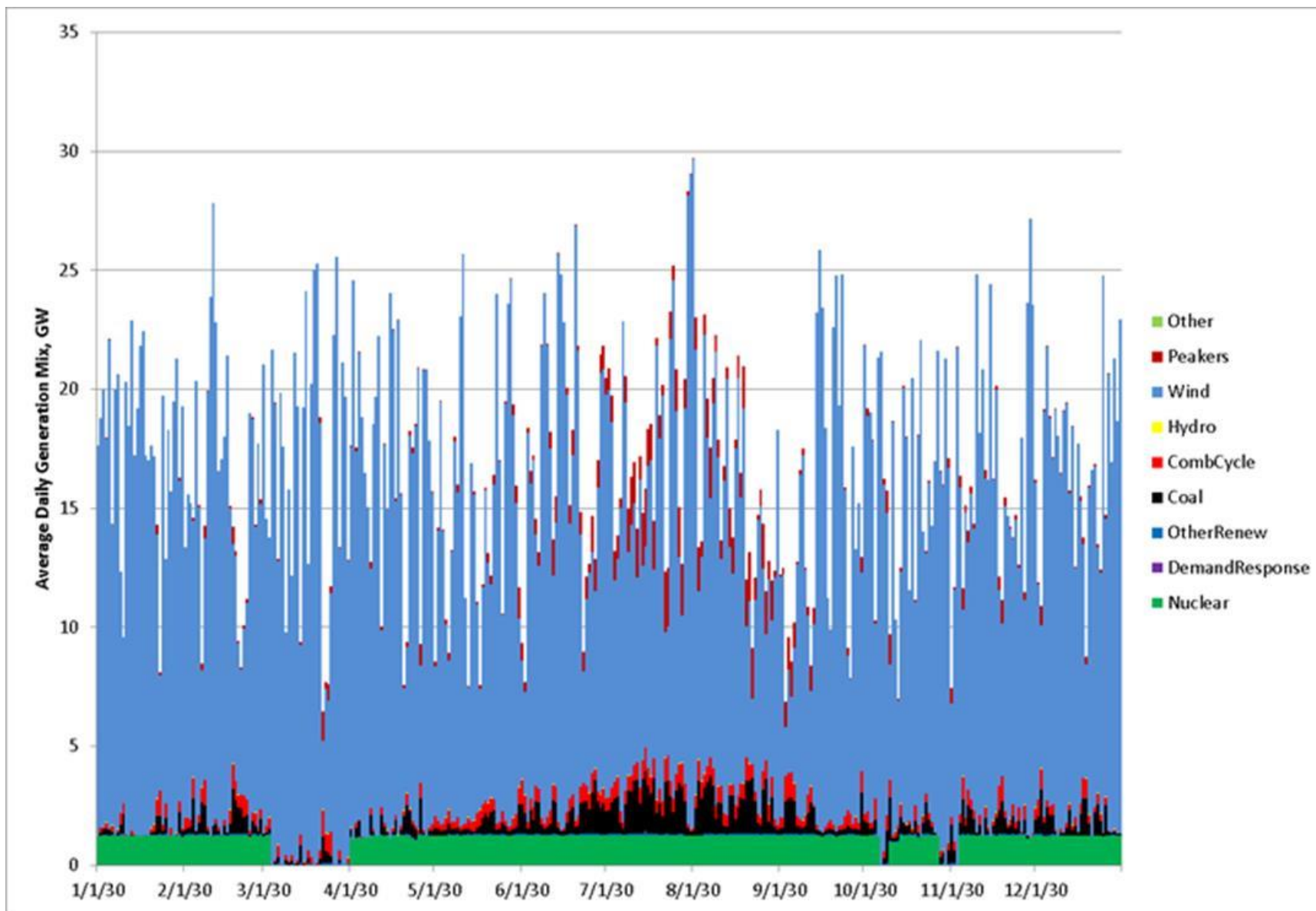


Figure A3-21. Daily Generation Dispatch for Scenario 1 SPP_N

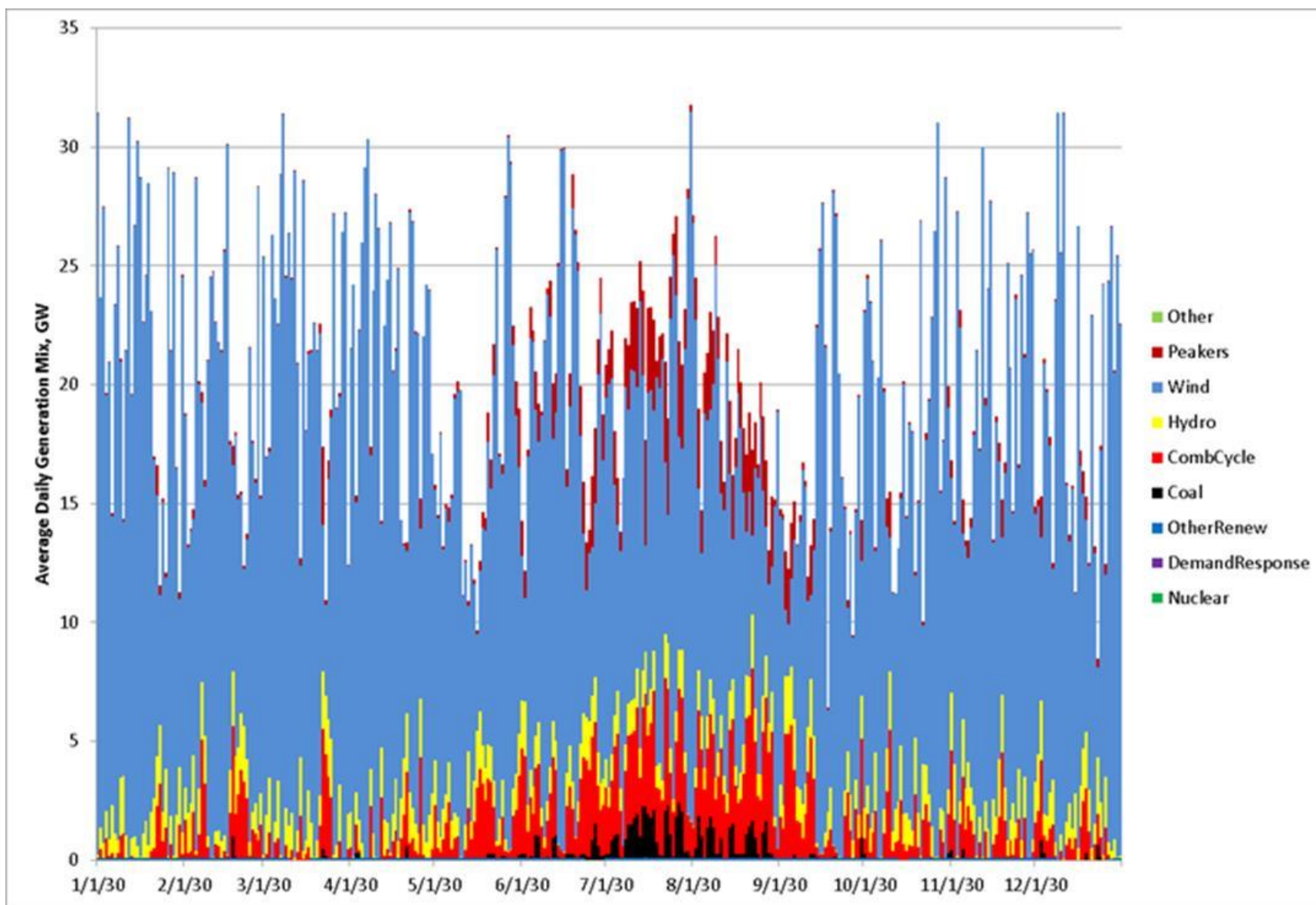


Figure A3-22. Daily Generation Dispatch for Scenario 1 SPP_S

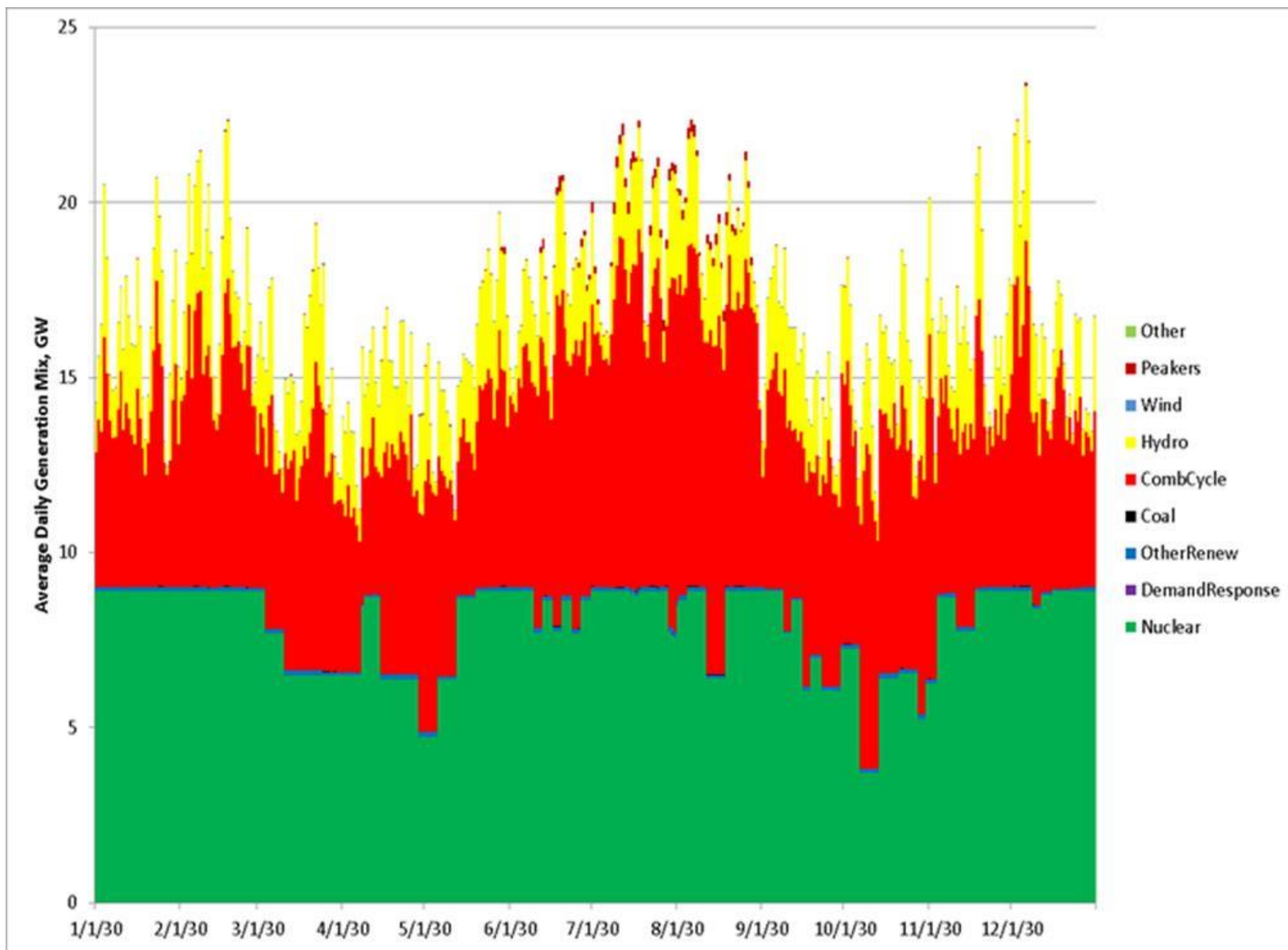


Figure A3-23. Daily Generation Dispatch for Scenario 1 TVA

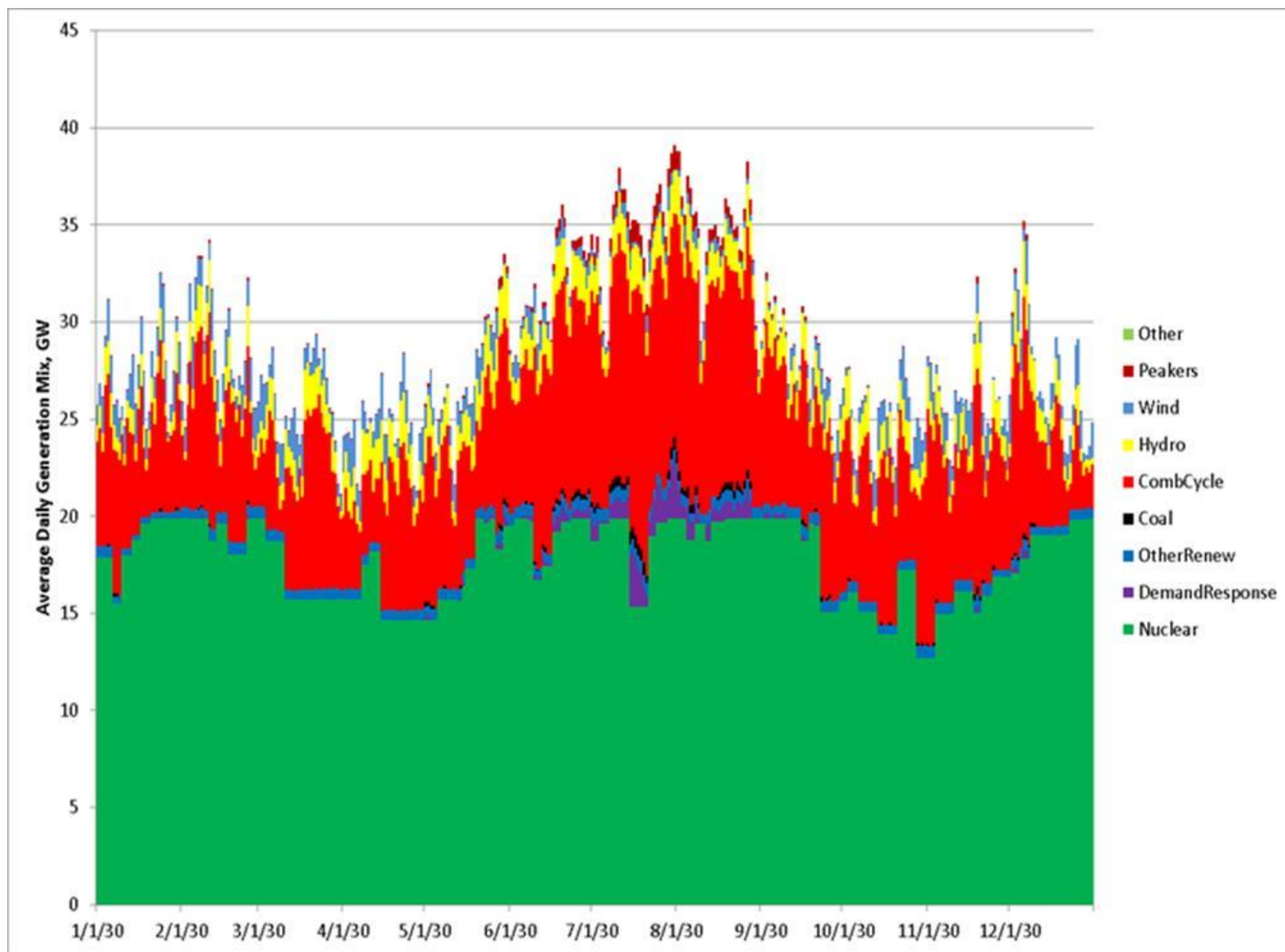


Figure A3-24. Daily Generation Dispatch for Scenario 1 VACAR

Appendix 4

Scenario 2 Daily Dispatch by Region

Phase 2, Scenario 2

Daily Generation Dispatch Plots

- “The results presented herein use modeling assumptions developed by EIPC, EIPC stakeholders and CRA for purposes of EIPC capacity expansion modeling. As such, these results do not necessarily reflect the opinions or views of CRA or any individual EIPC stakeholder.”
- Scenario 2: Regionally-Implemented National Renewable Portfolio Standard (Based on F6S10)
- The following data file was used to create the daily generation dispatch plots.
 - S2 Base F Hourly GenReport 9-29-12.xlsx
- One series of daily generation dispatch plots
 - Megawatt (MW) for each NEEM region (24 plots)

Generation Grouping Categories:

1. Other Renewable
 - a. Biomass
 - b. Solar Thermal (existing)
 - c. Geo – Geothermal
 - d. LFG – Landfill Gas
 - e. PV – Solar Photovoltaic
 - f. ST – Solar Thermal (new)
2. Combined Cycle
 - a. CC – Combined Cycle
3. Peakers
 - a. CT – Combustion Turbine (new)
 - b. PeakG – CT gas (existing)
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 - d. STOG – Steam Turbine-Oil/Gas
 - e. STWD – Steam Turbine-Wood
4. Coal
 - a. Coal – Coal-fired (includes Pulverized coal, new IGCCs and new IGCC-CCs)
5. Hydro
 - a. H – Conventional Hydro
 - b. PS – Pumped-Storage Hydro
6. Nuclear
 - a. Nuc – Nuclear
7. Wind
 - a. WT – Wind Turbine On-shore
 - b. WT_off – Wind Turbine Off-shore
8. Demand Response
 - a. Demand Response – Demand Response (DR)
9. Other
 - a. Pseudo Unit -- HQ/Maritimes New Units
 - b. Fixed Interchange—HQ/Maritimes Fixed Interchange

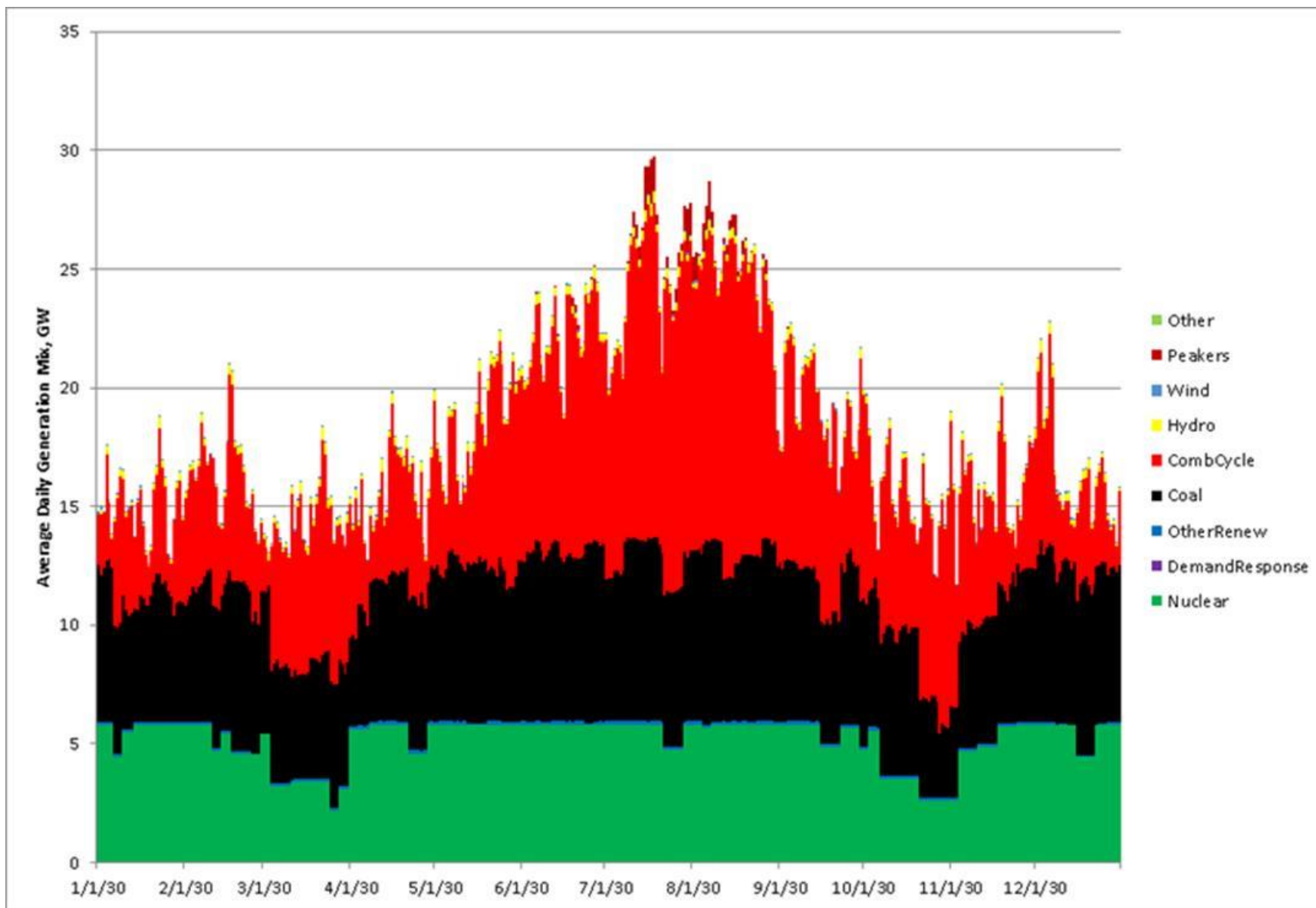


Figure A4-1. Daily Generation Dispatch for Scenario 2 ENT

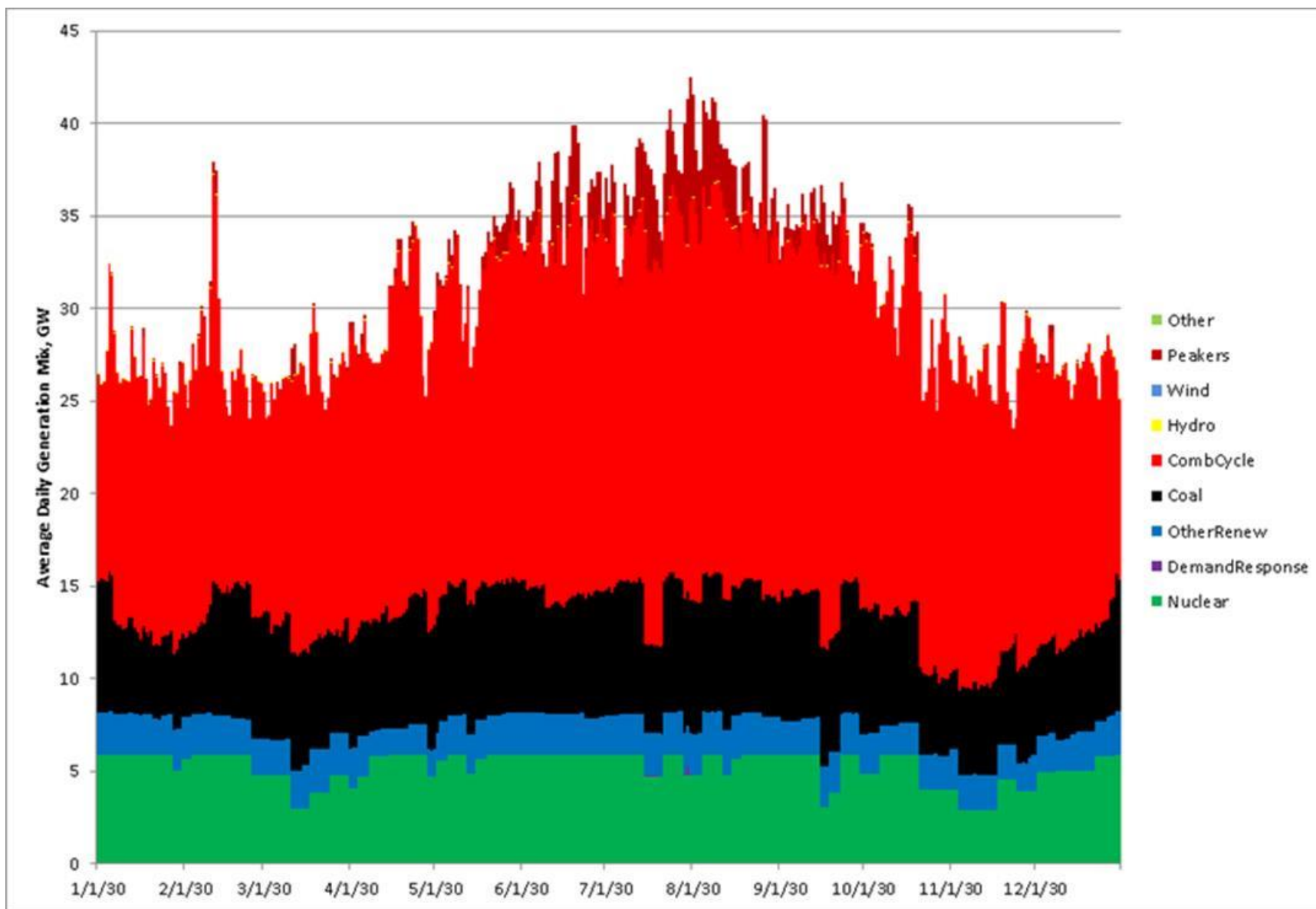


Figure A4-2. Daily Generation Dispatch for Scenario 2 FRCC

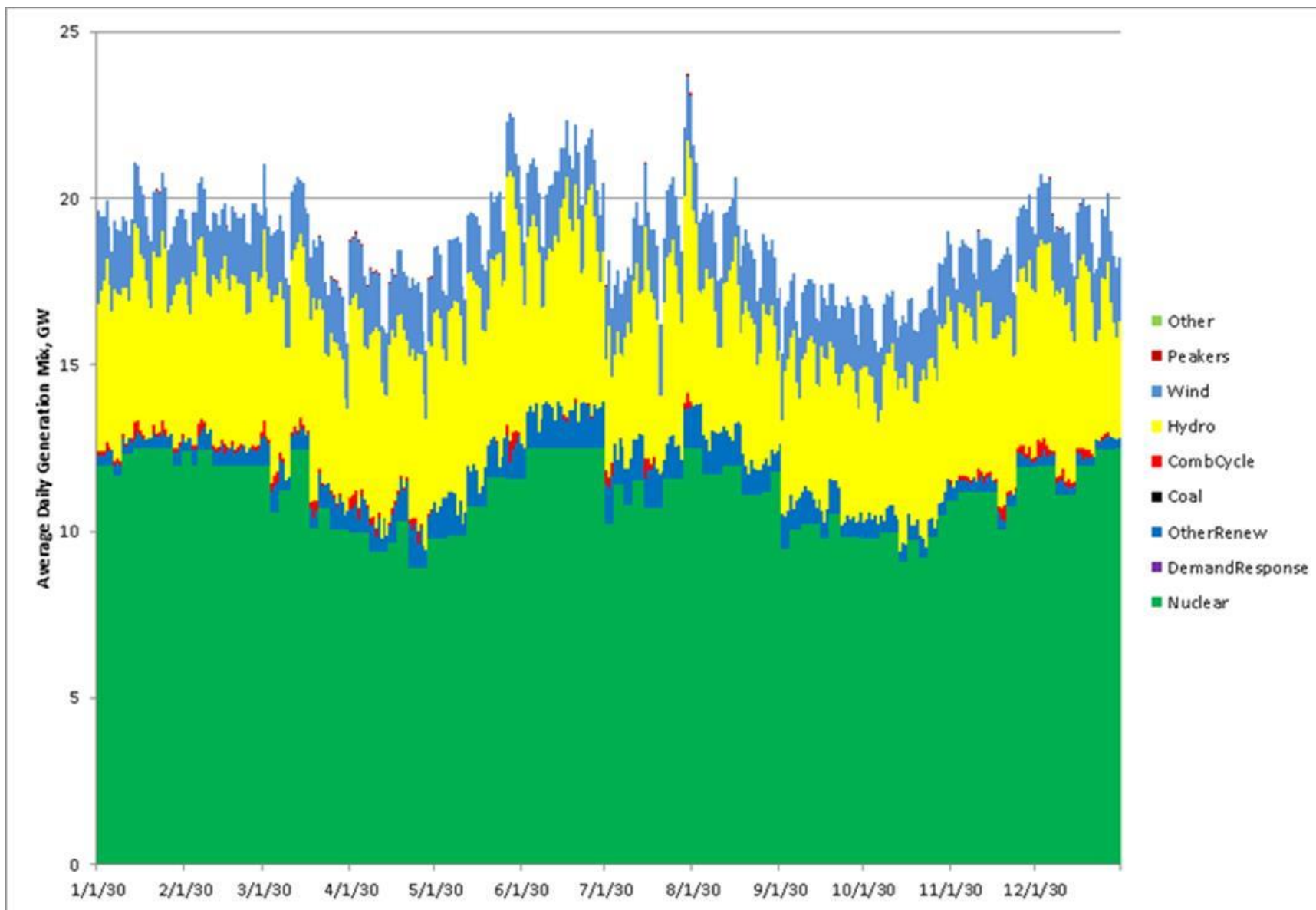


Figure A4-3. Daily Generation Dispatch for Scenario 2 IESO

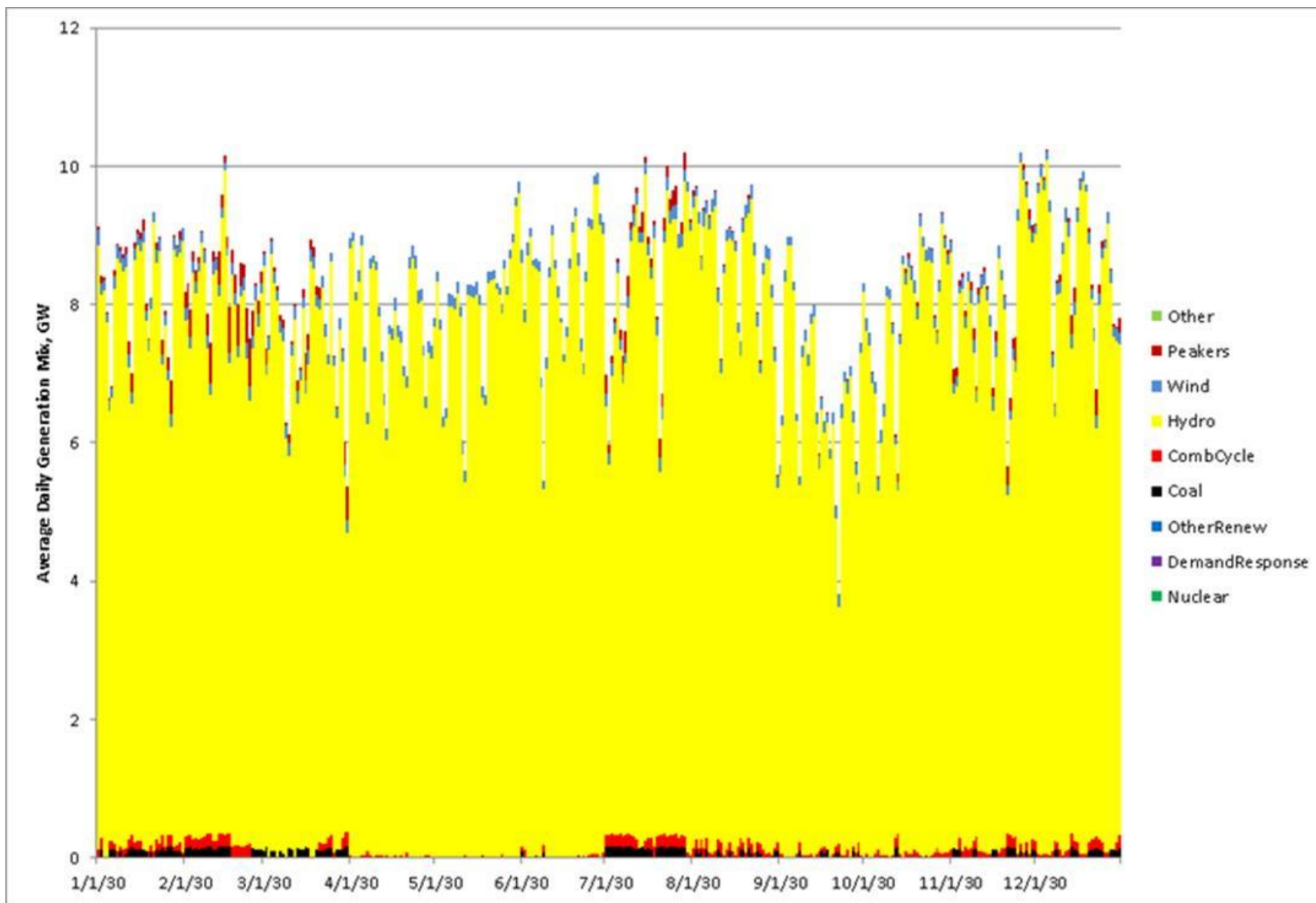


Figure A4-4. Daily Generation Dispatch for Scenario 2 MAPP_CA

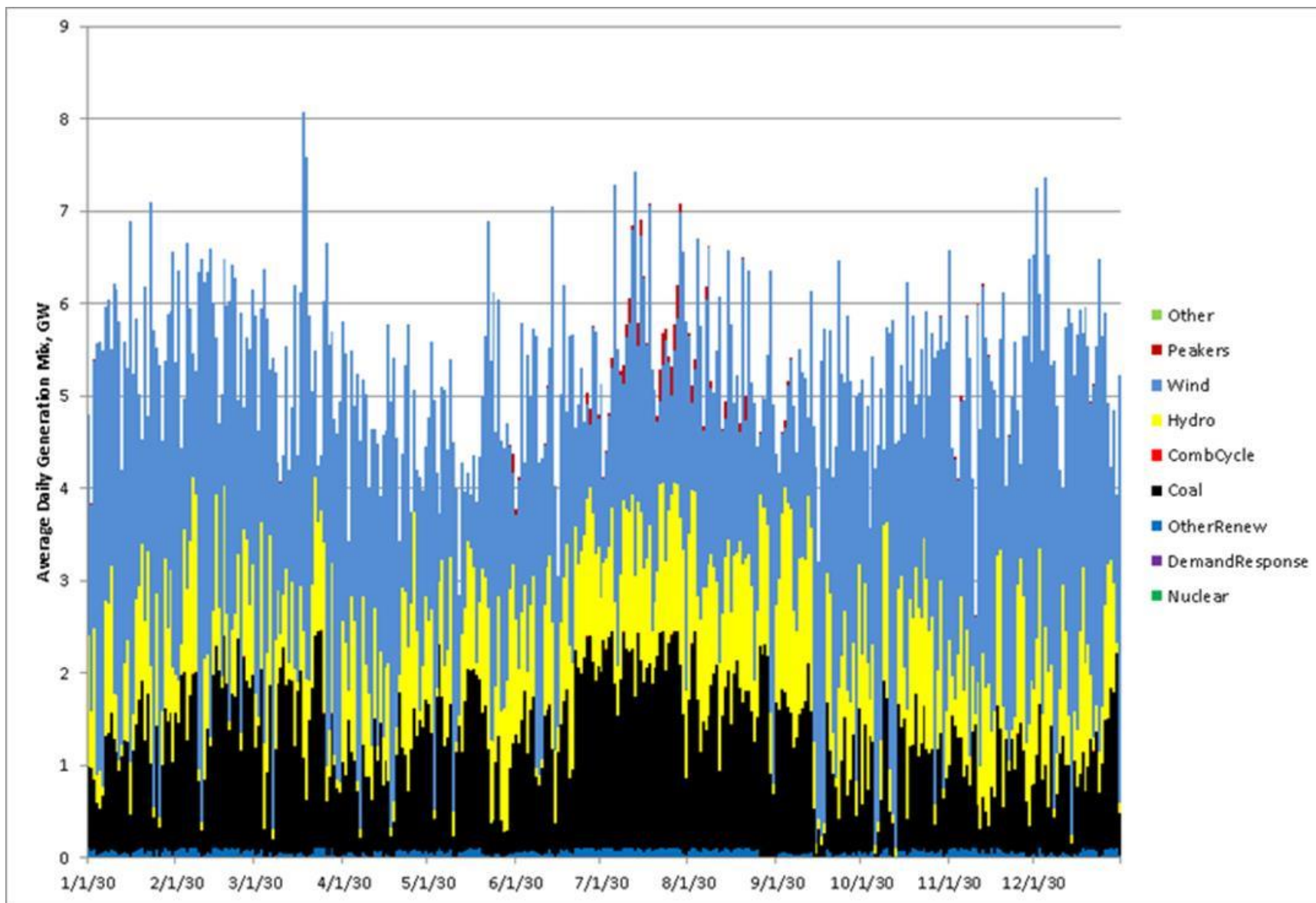


Figure A4-5. Daily Generation Dispatch for Scenario 2 MAPP_US

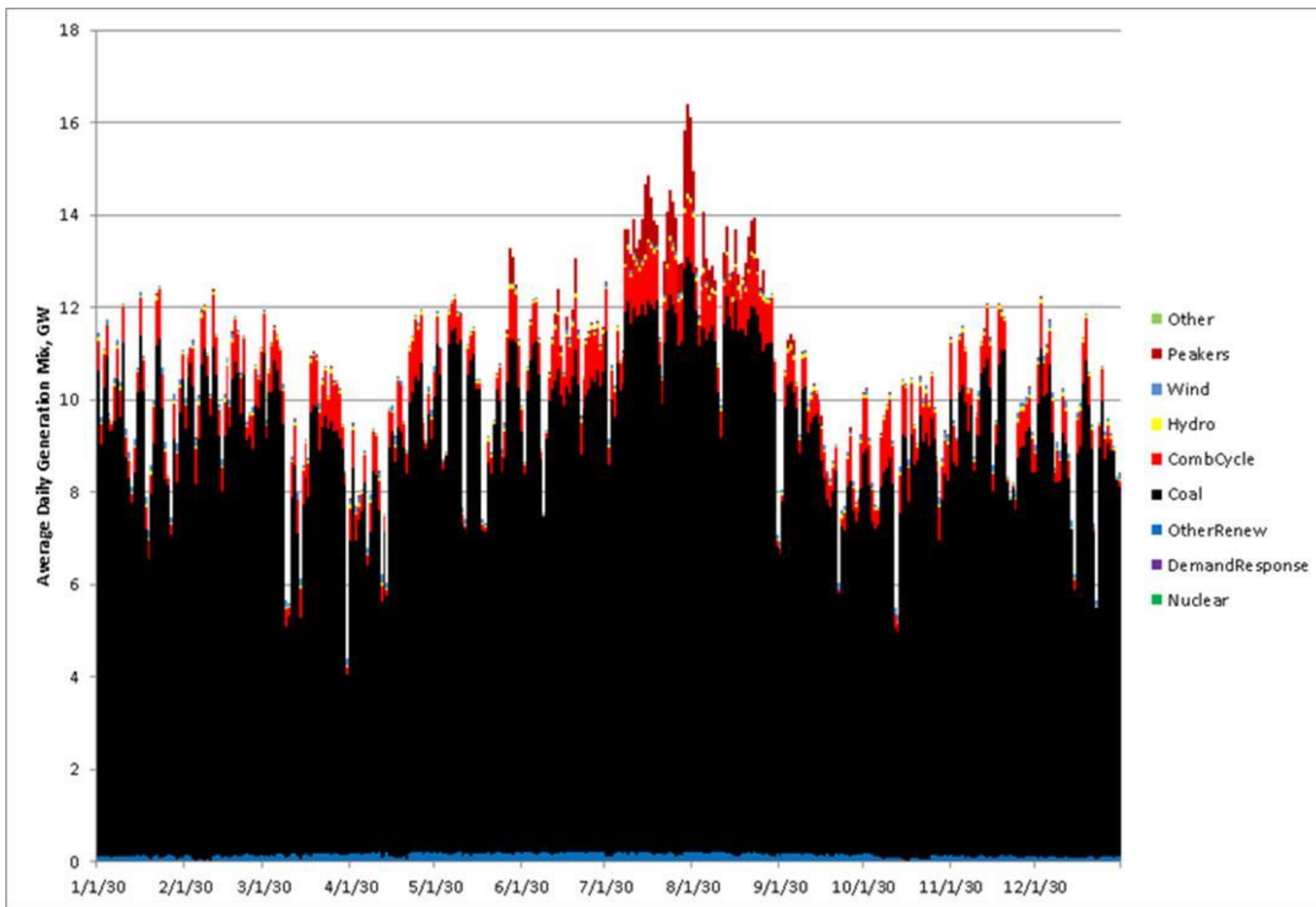


Figure A4-6. Daily Generation Dispatch for Scenario 2 MISO_IN

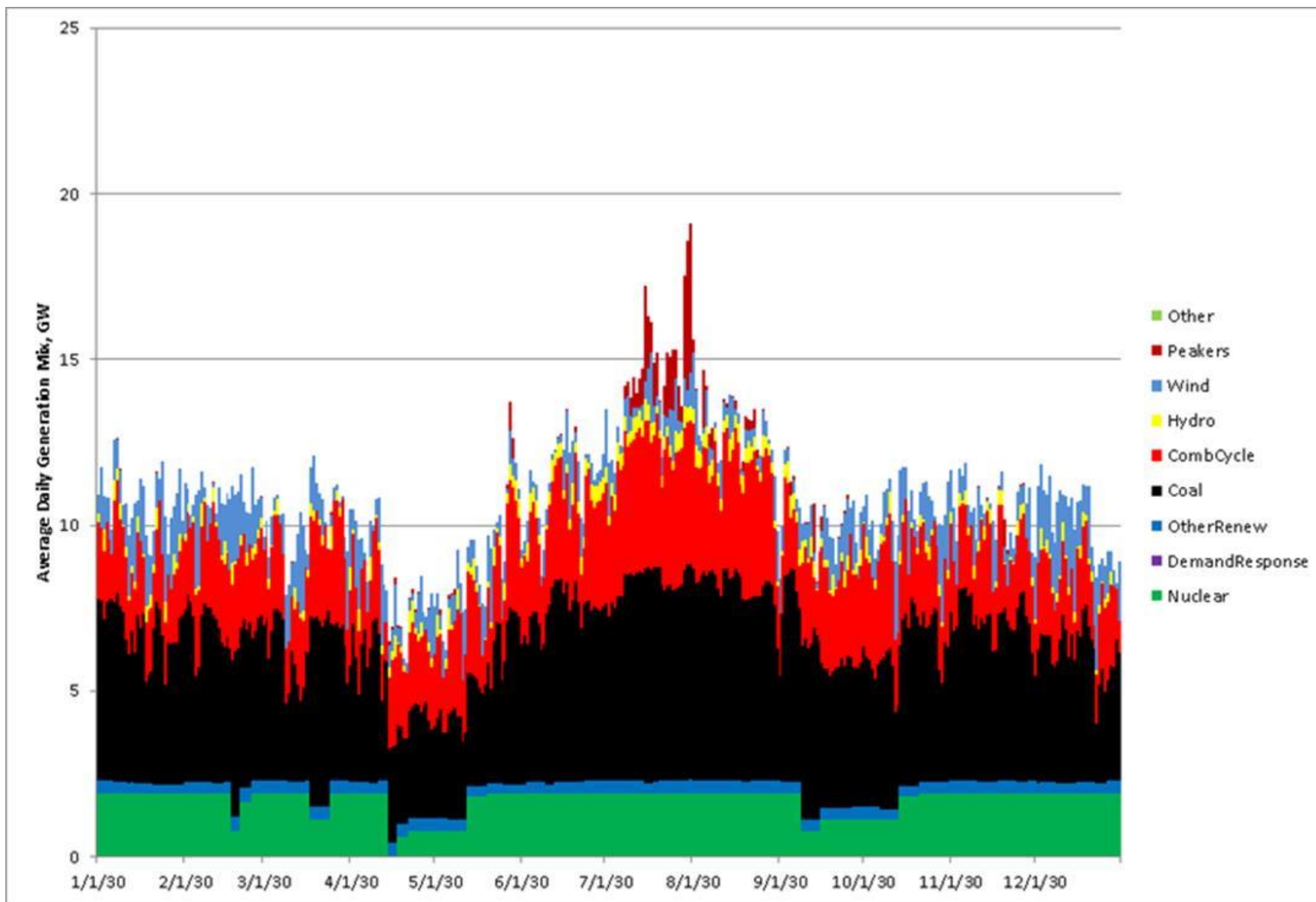


Figure A4-7. Daily Generation Dispatch for Scenario 2 MISO_MI

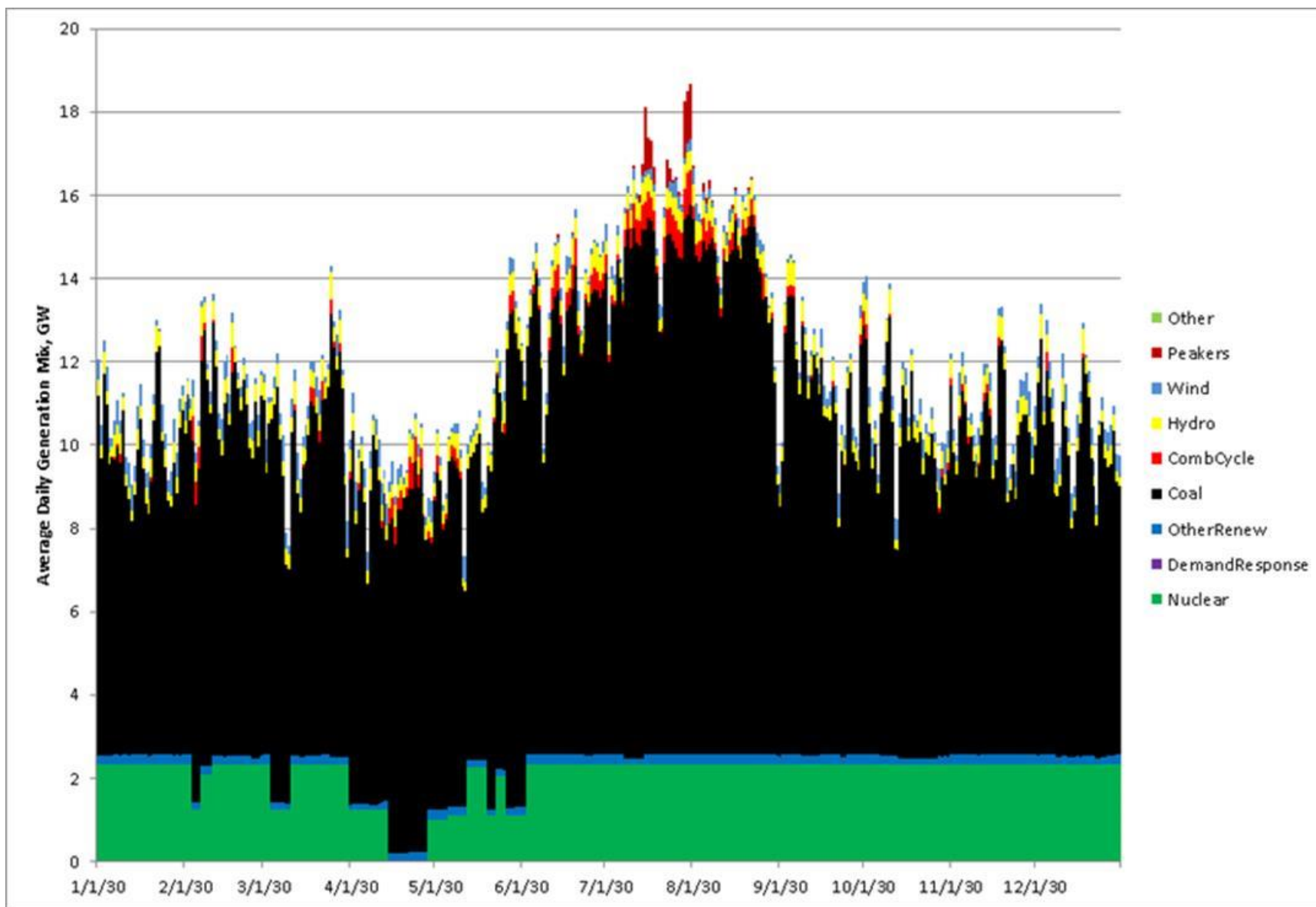


Figure A4-8. Daily Generation Dispatch for Scenario 2 MISO_MO_IL

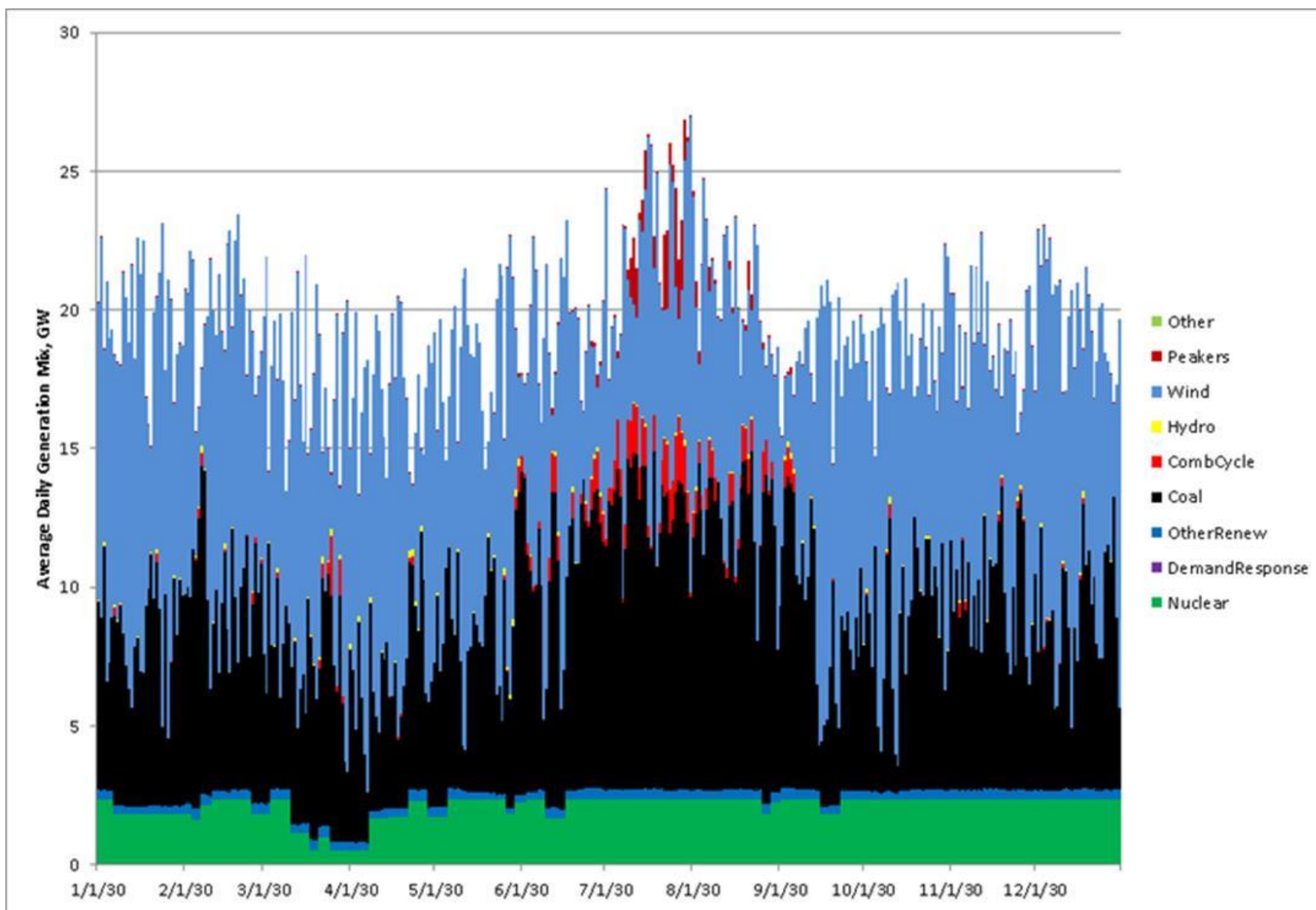


Figure A4-9. Daily Generation Dispatch for Scenario 2 MISO_W

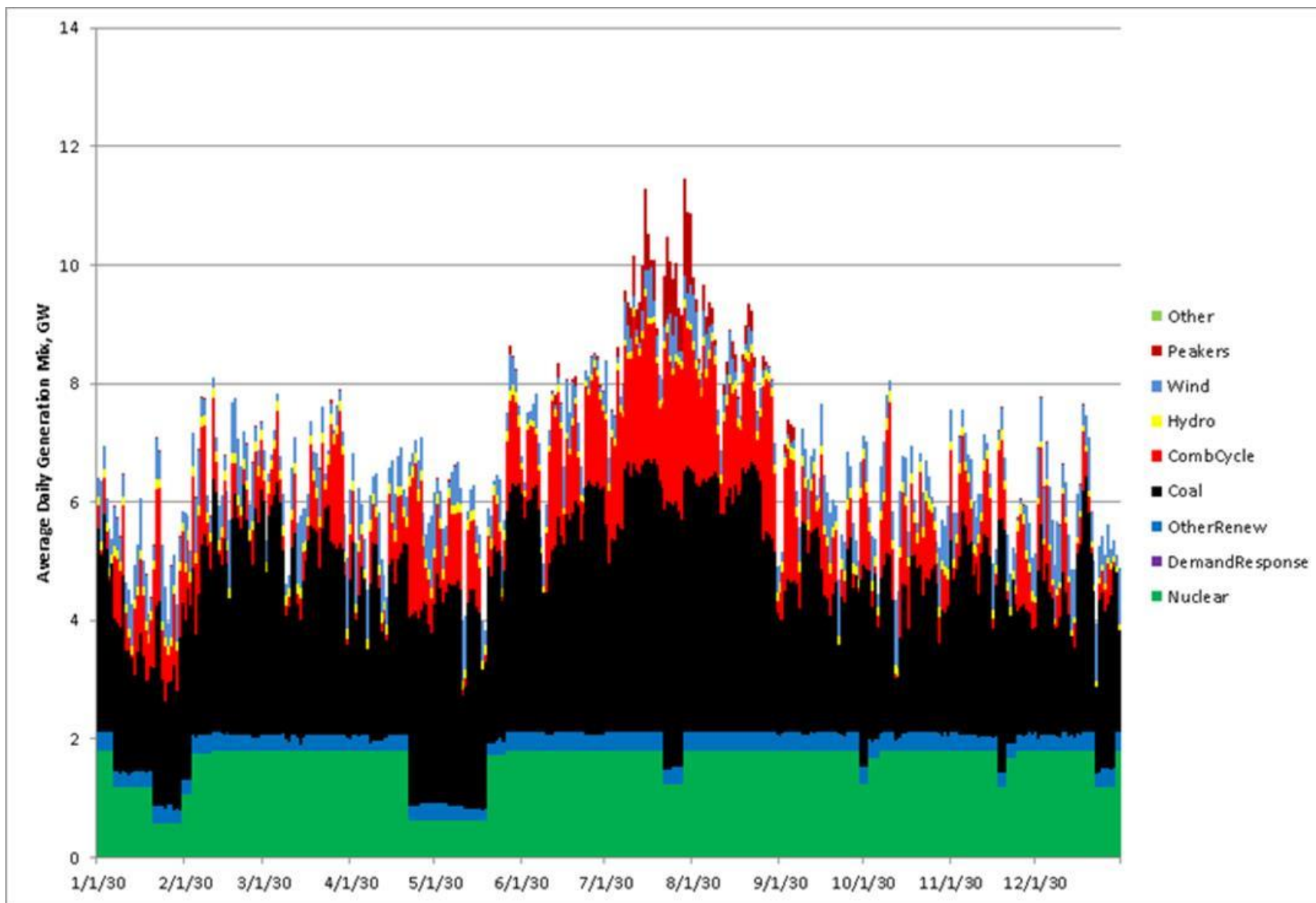


Figure A4-10. Daily Generation Dispatch for Scenario 2 MISO_WUMS

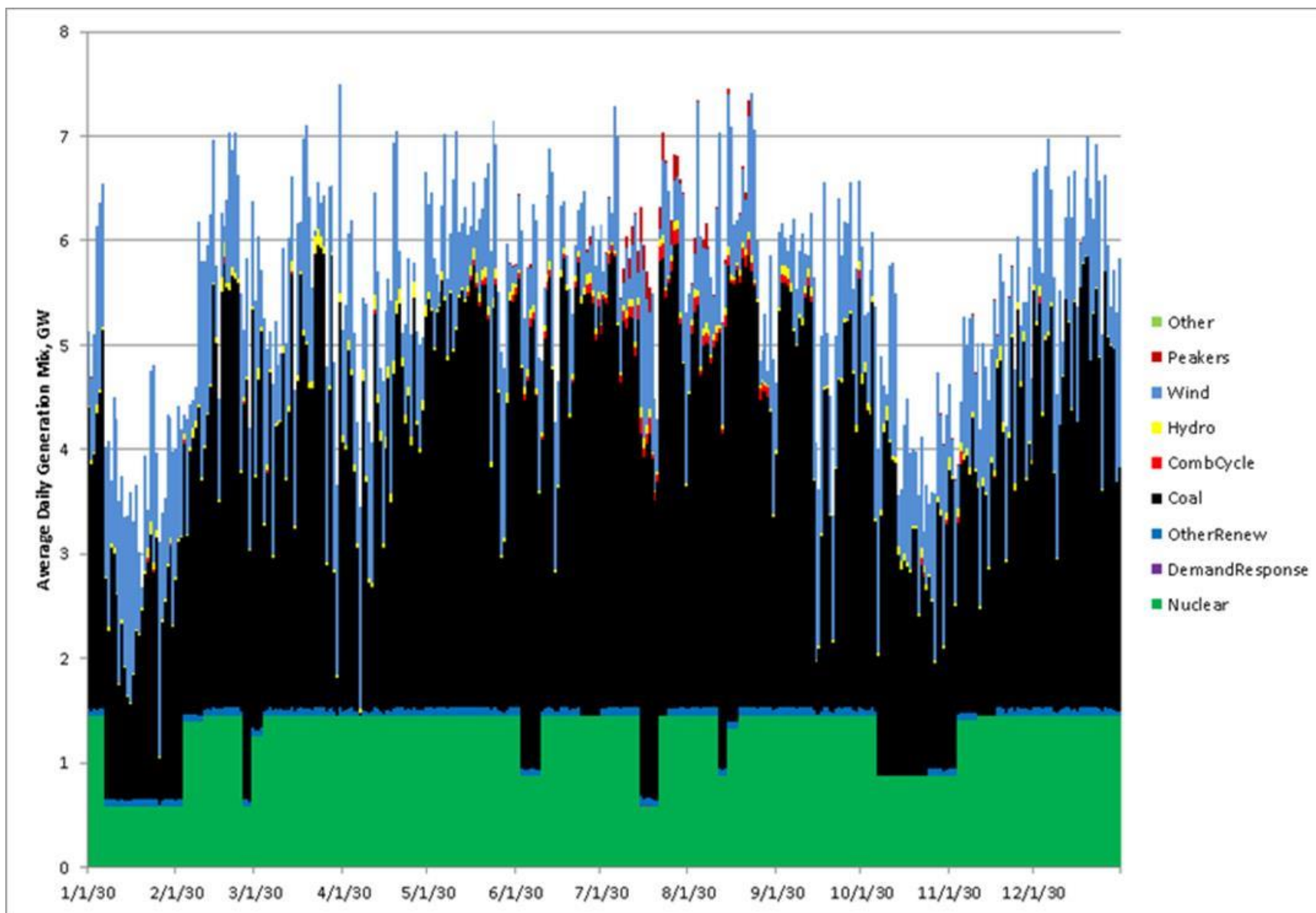


Figure A4-11. Daily Generation Dispatch for Scenario 2 NE

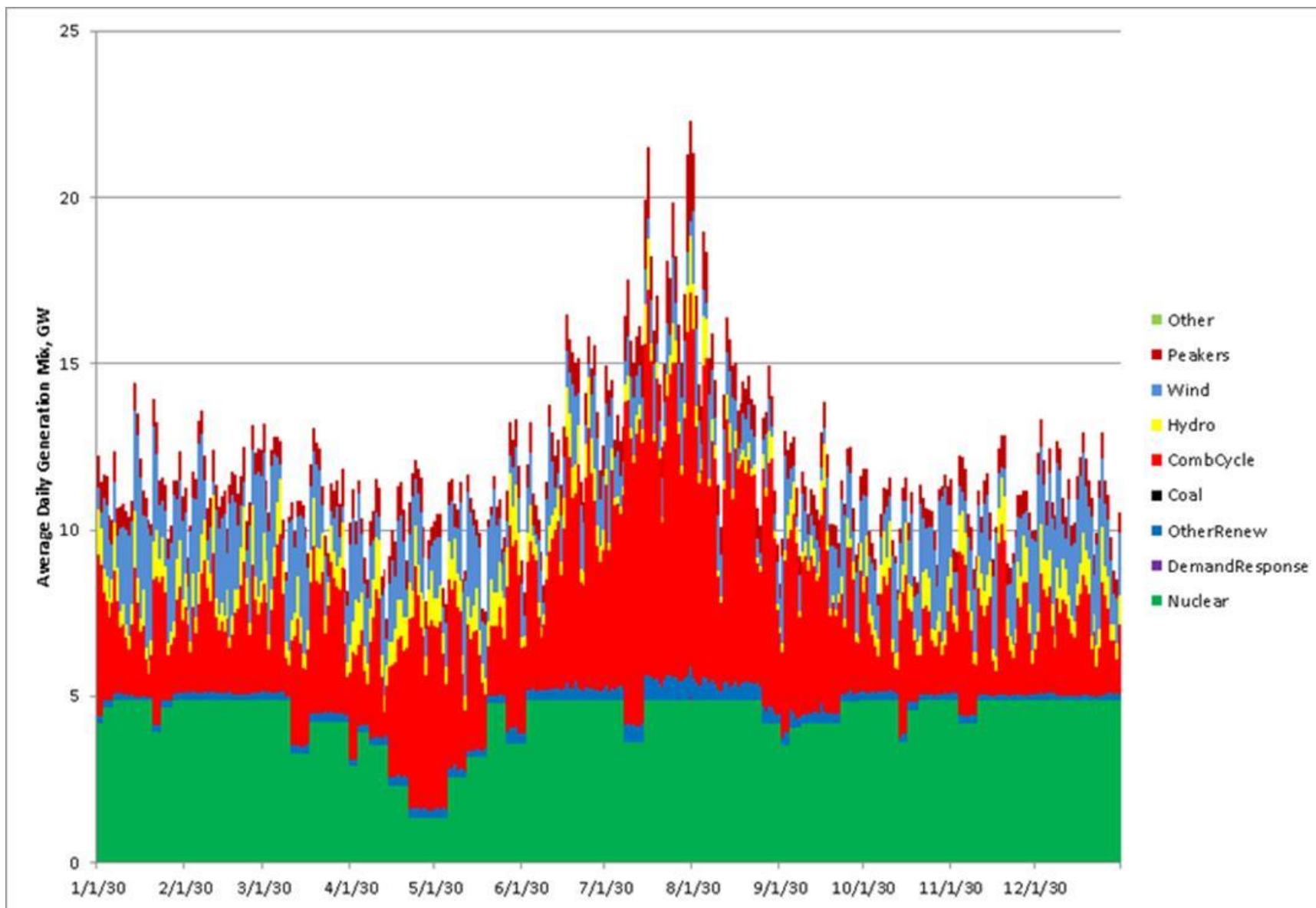


Figure A4-12. Daily Generation Dispatch for Scenario 2 NEISO

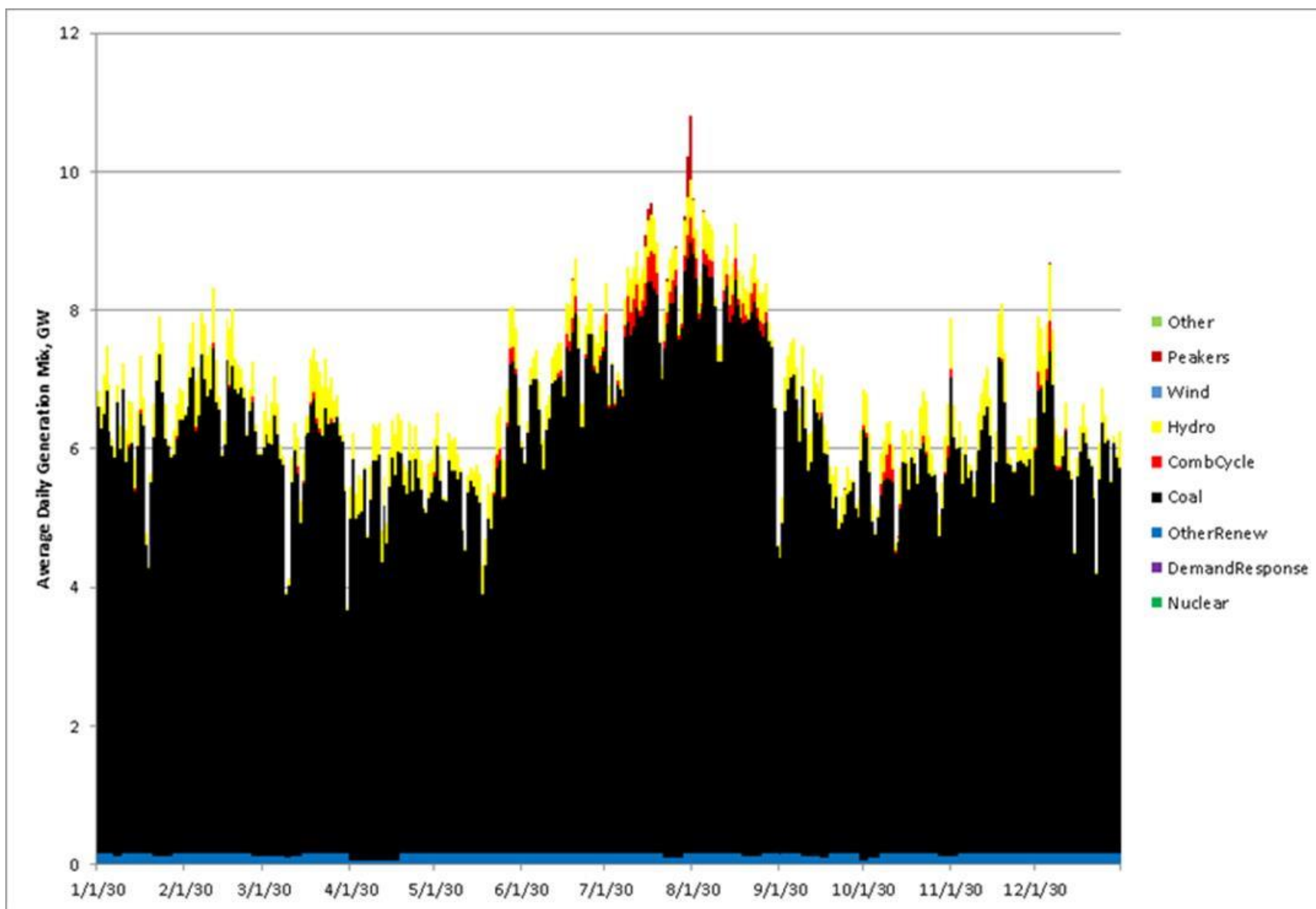


Figure A4-13. Daily Generation Dispatch for Scenario 2 NonRTO_Midwest

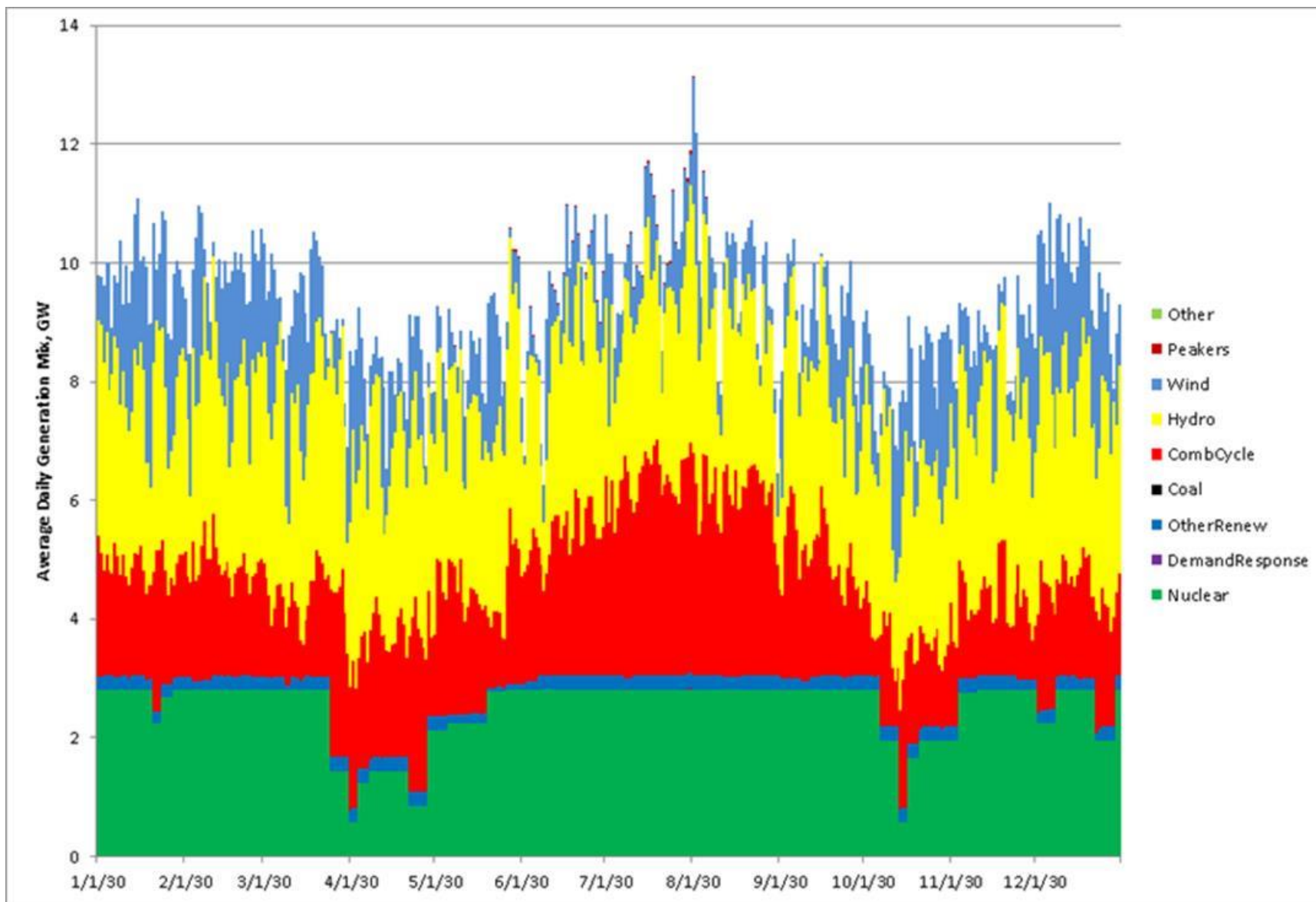


Figure A4-14. Daily Generation Dispatch for Scenario 2 NYISO_A_F

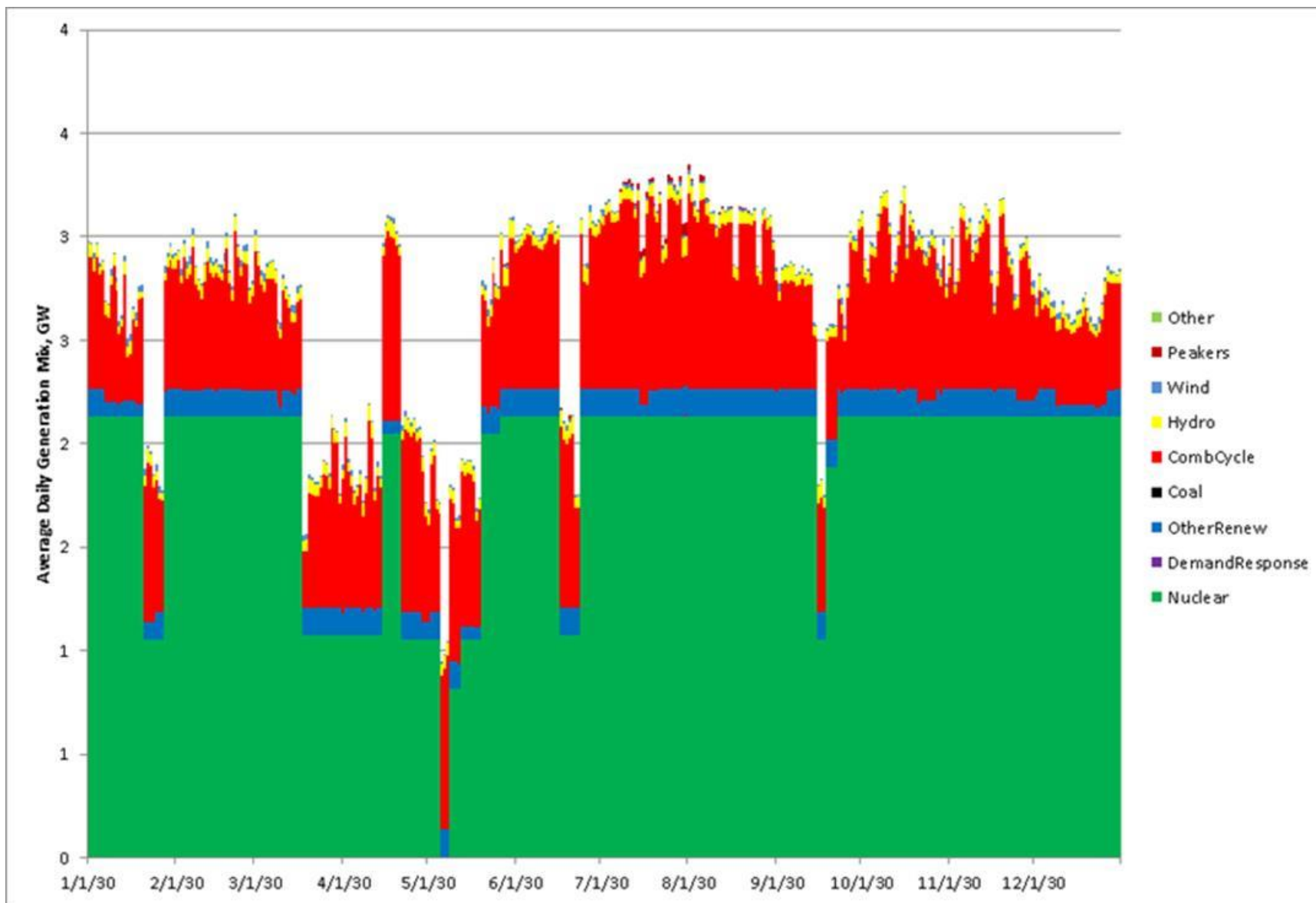


Figure A4-15. Daily Generation Dispatch for Scenario 2 NYISO_G_I

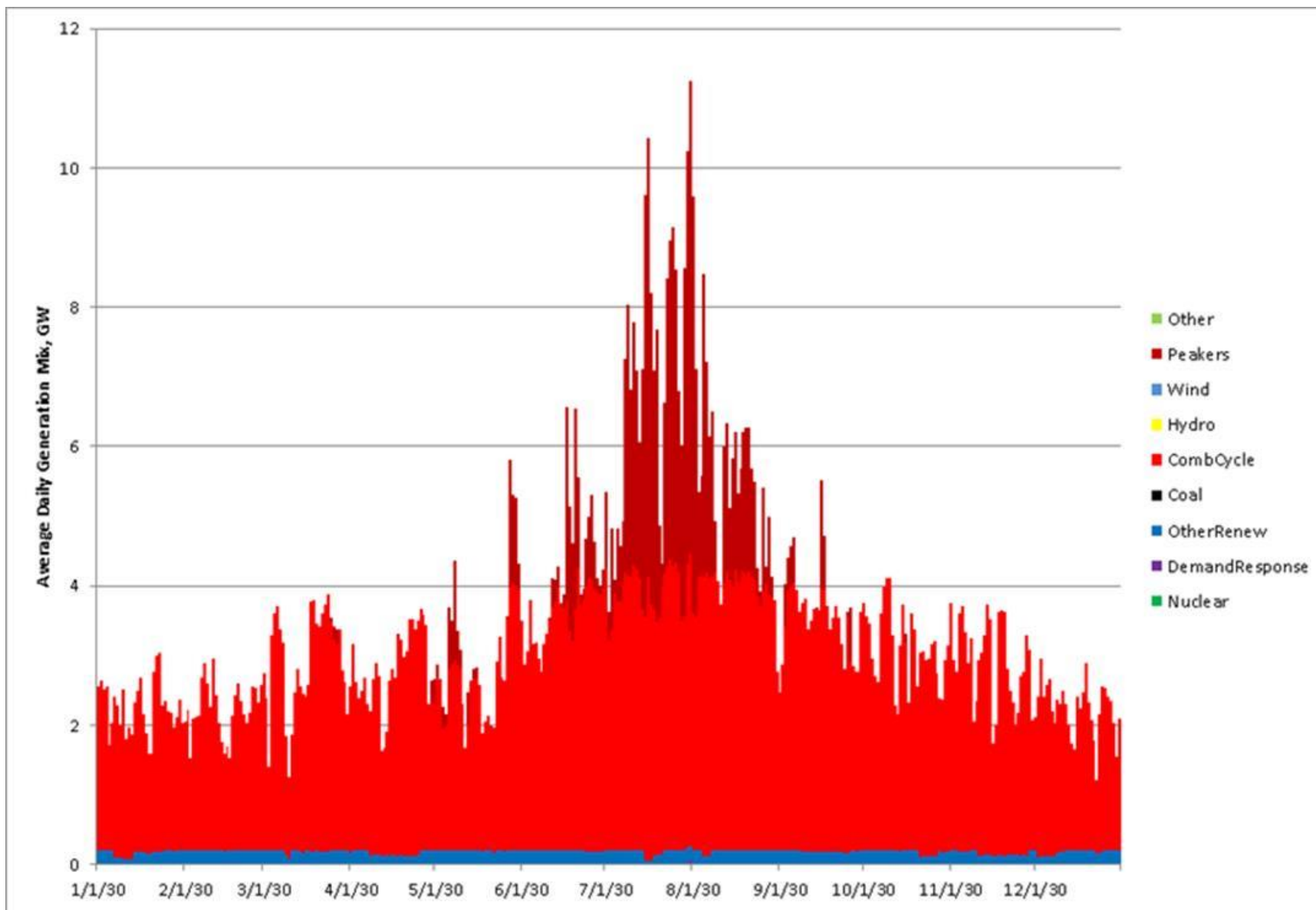


Figure A4-16. Daily Generation Dispatch for Scenario 2 NYISO_J_K

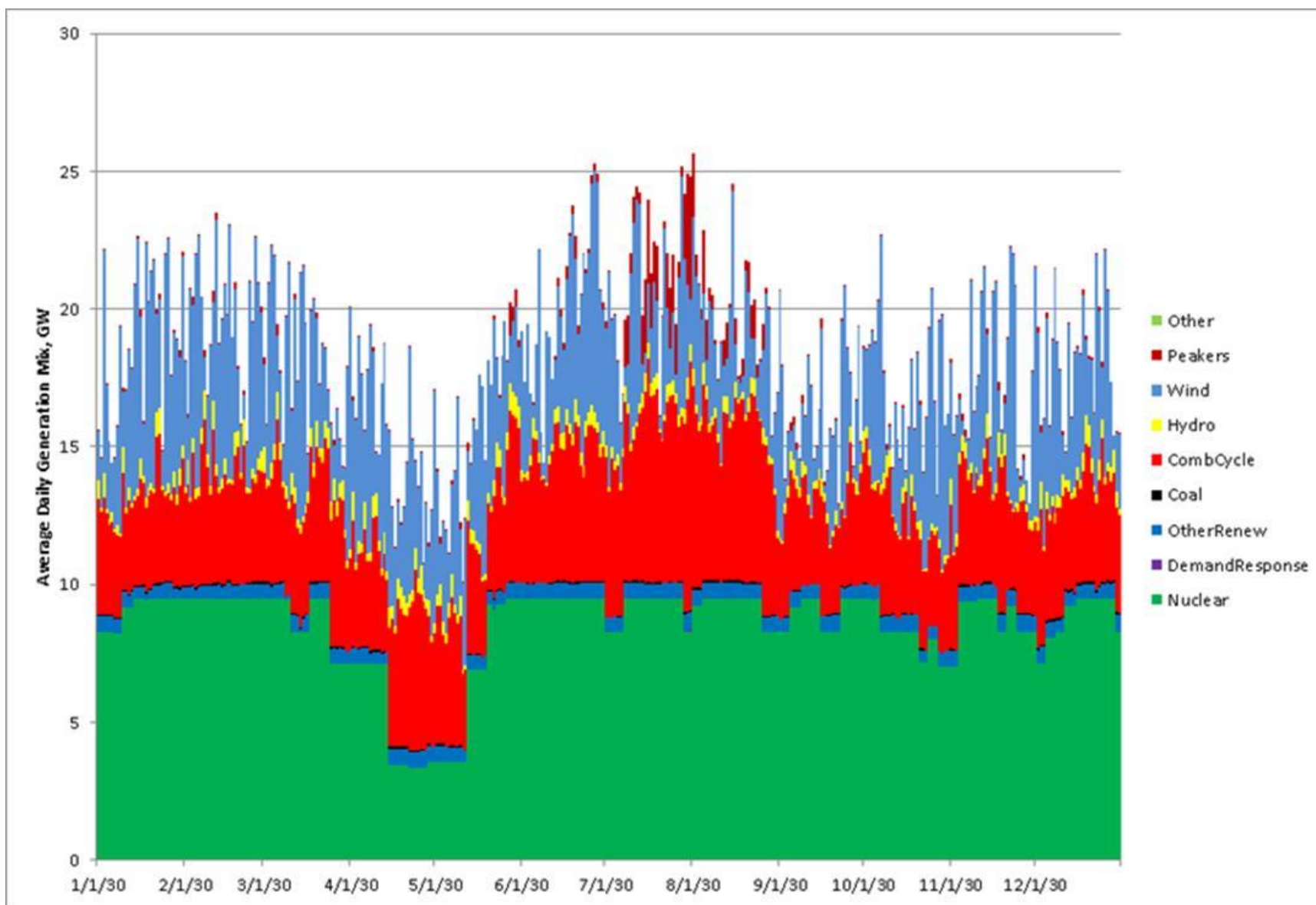


Figure A4-17. Daily Generation Dispatch for Scenario 2 PJM_E

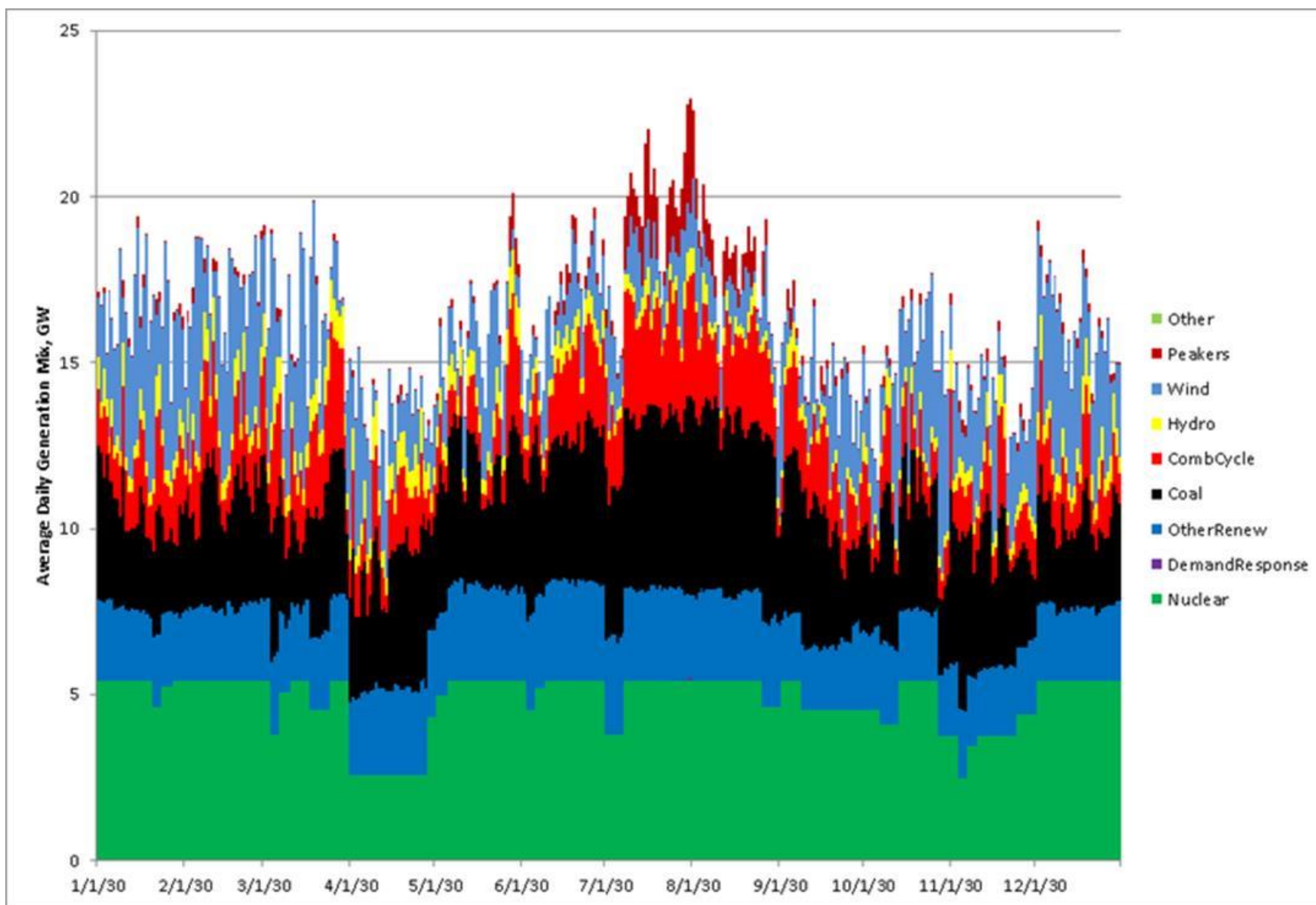


Figure A4-18. Daily Generation Dispatch for Scenario 2 PJM_ROM

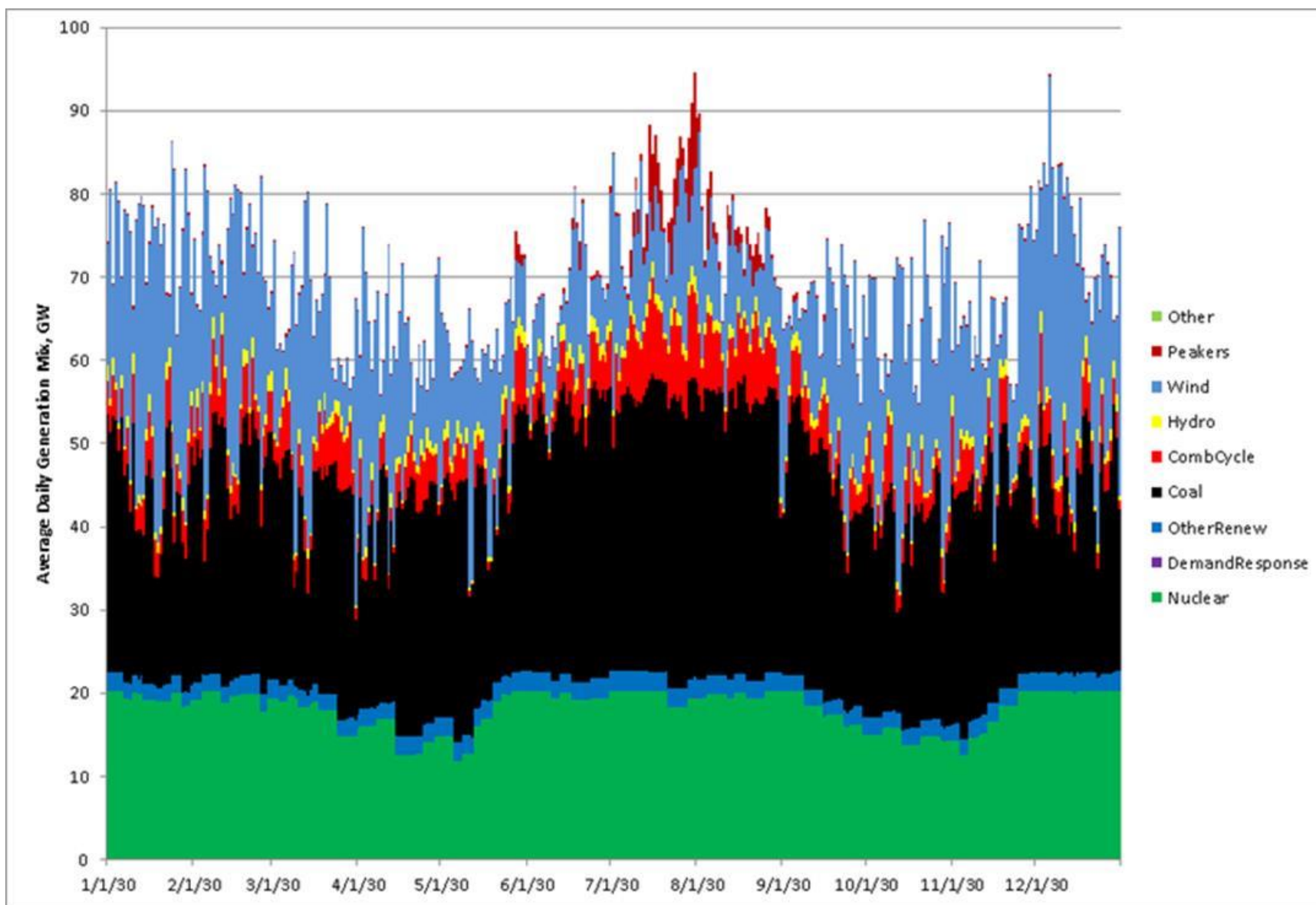


Figure A4-19. Daily Generation Dispatch for Scenario 2 PJM_ROR

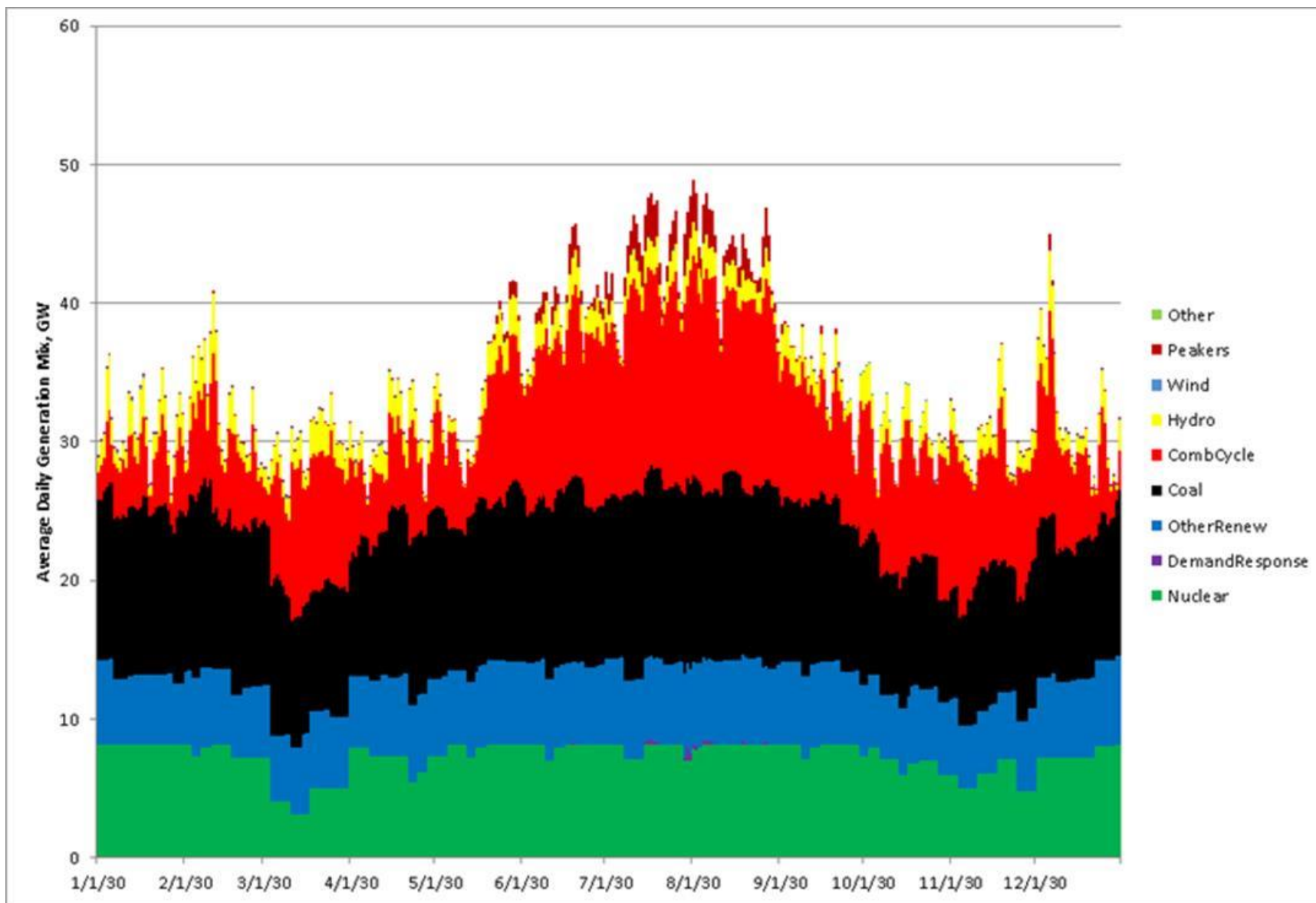


Figure A4-20. Daily Generation Dispatch for Scenario 2 SOCO

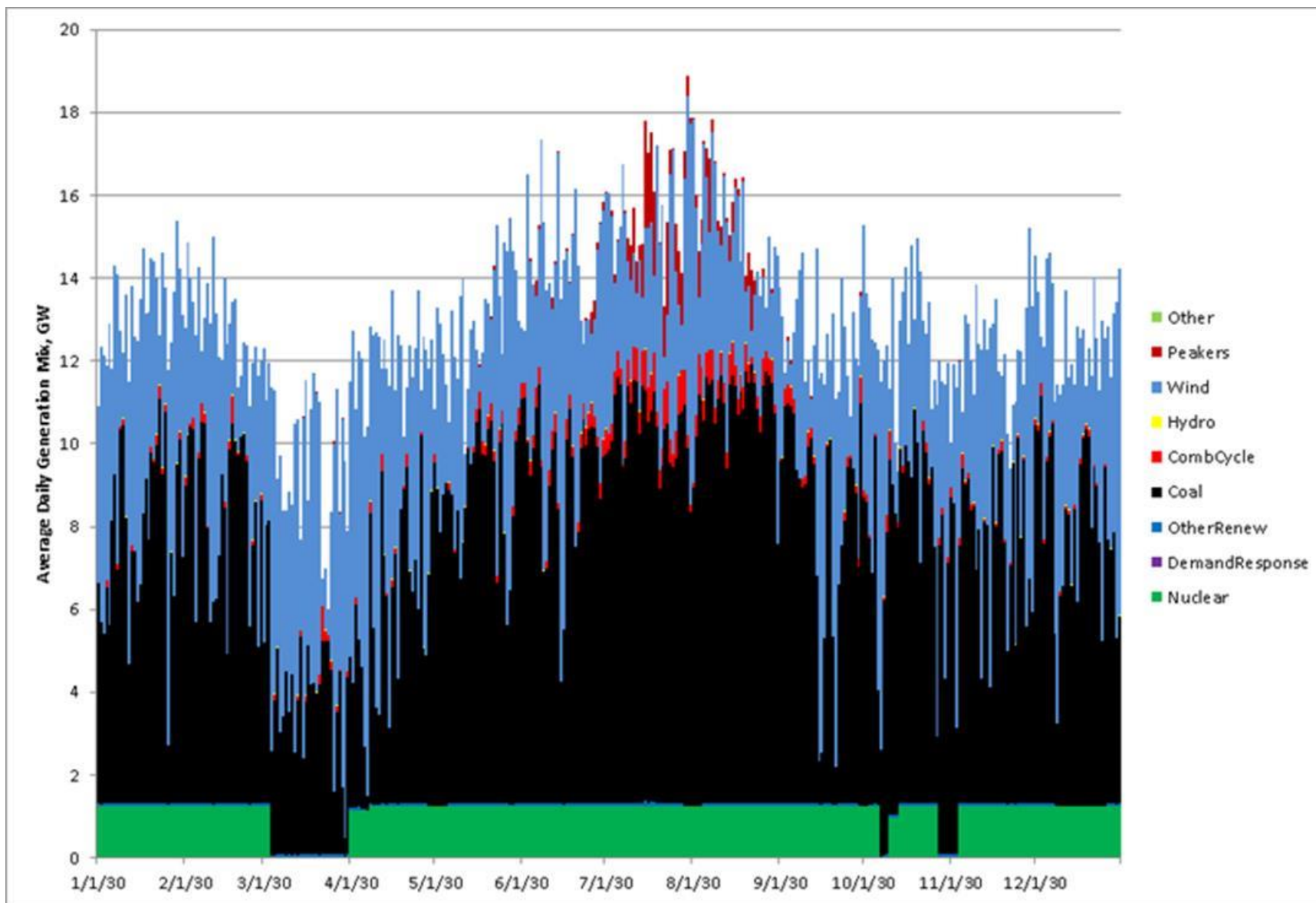


Figure A4-21. Daily Generation Dispatch for Scenario 2 SPP_N

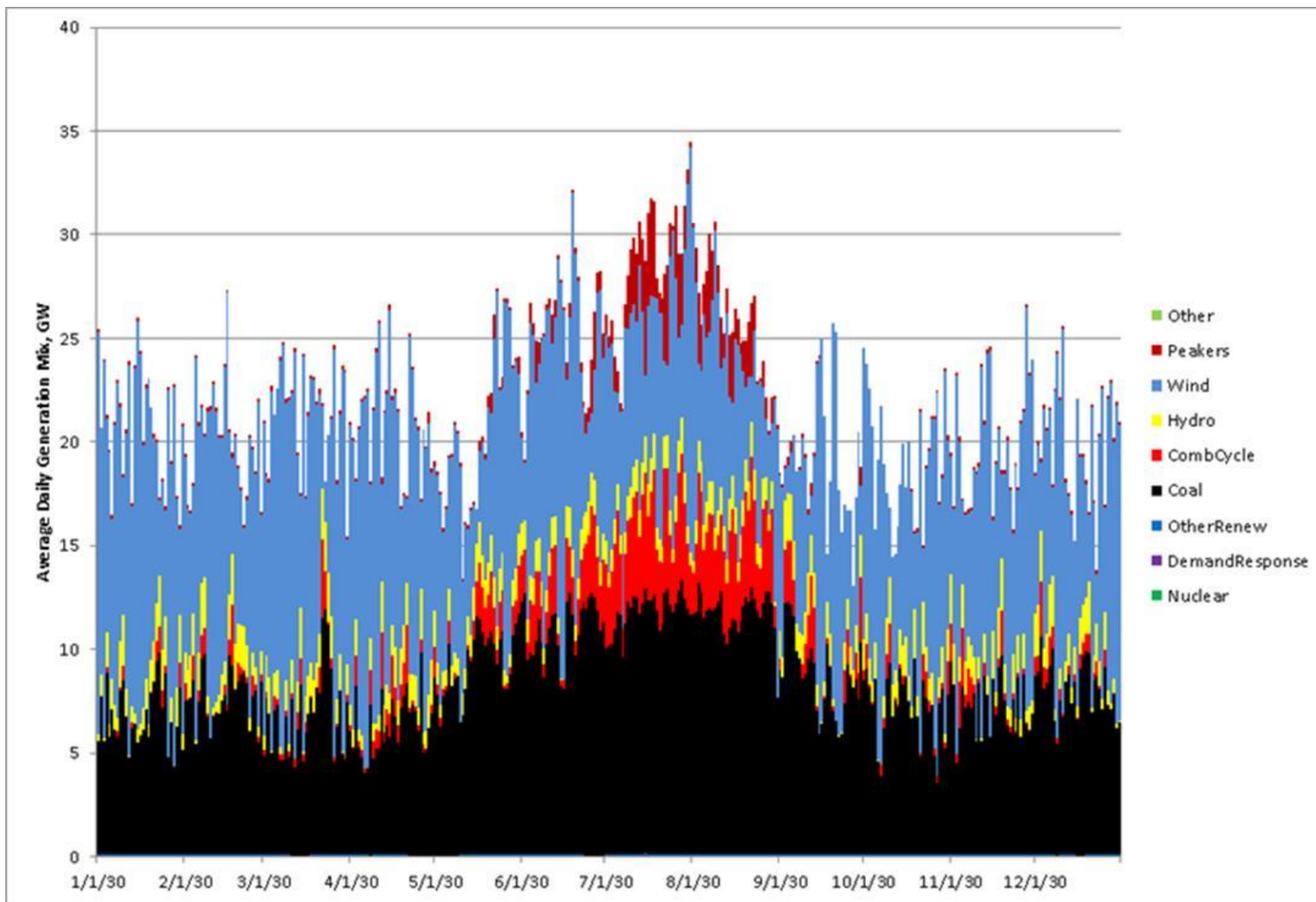


Figure A4-22. Daily Generation Dispatch for Scenario 2 SPP_S

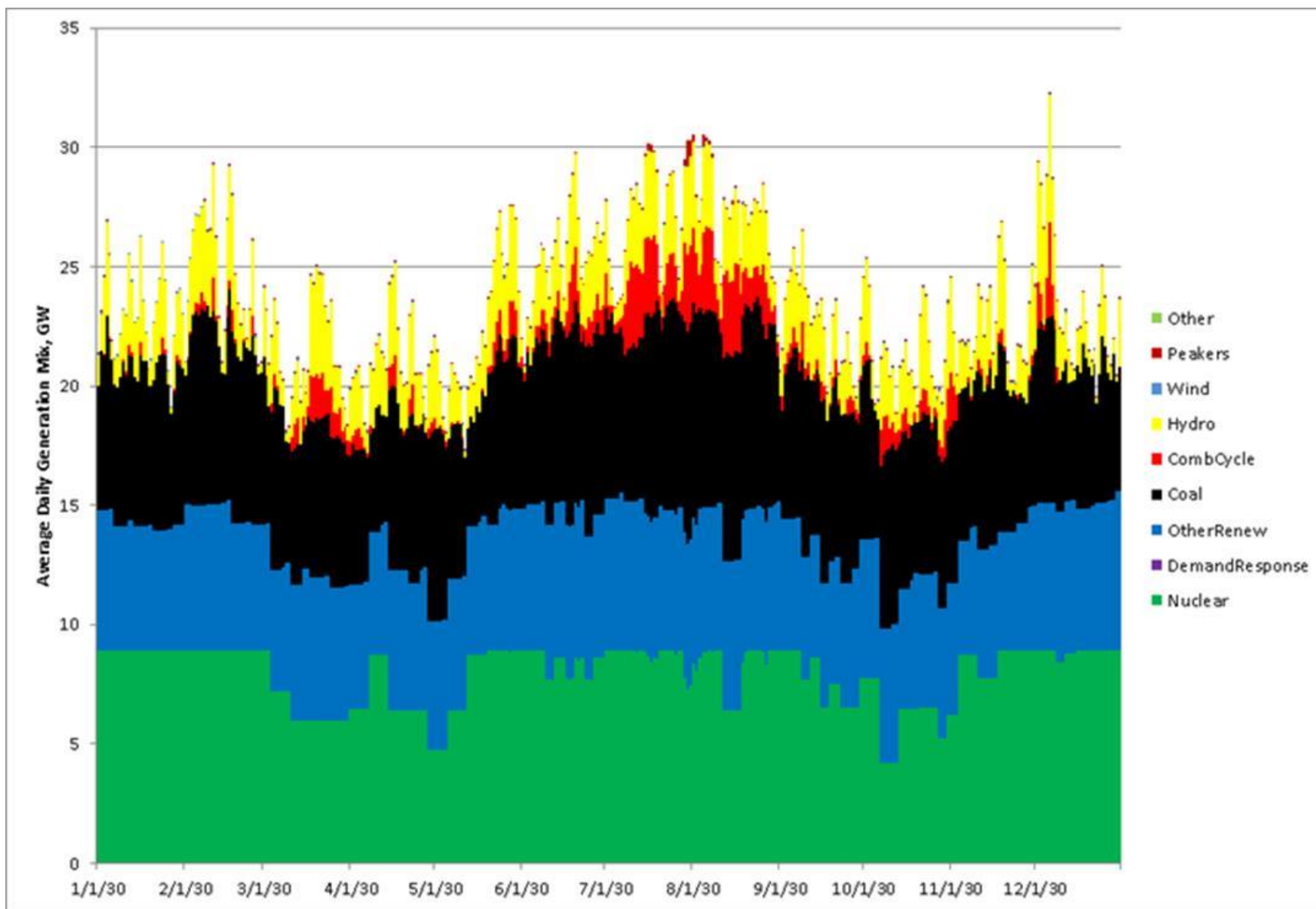


Figure A4-23. Daily Generation Dispatch for Scenario 2 TVA

Appendix 5

Scenario 3 Daily Dispatch by Region

Phase 2, Scenario 3

Daily Generation Dispatch Plots

- “The results presented herein use modeling assumptions developed by EIPC, EIPC stakeholders and CRA for purposes of EIPC capacity expansion modeling. As such, these results do not necessarily reflect the opinions or views of CRA or any individual EIPC stakeholder.”
- Scenario 3: Business As Usual (Based on F1S17)
- The following data file was used to create the daily generation dispatch plots.
 - [Scen 3 F Hourly Gen Report V2 \(10-01-12\)](#)
 - http://www.eipconline.com/uploads/20121001_S3_Base_F_Hourly_GenReport_V2.xlsx
- One series of daily generation dispatch plots
 - Megawatt (MW) for each NEEM region (24 plots)

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 - a. CT – Combustion Turbine (new)
 - b. PeakG – CT gas (existing)
 - c. PeakO – CT oil (existing)
 - d. STOG – Steam Turbine-Oil/Gas
 - e. STWD – Steam Turbine-Wood
4. Coal
 - a. Coal – Coal-fired (includes Pulverized coal, new IGCCs and new IGCC-CCs)
5. Hydro
 - a. H – Conventional Hydro
 - b. PS – Pumped-Storage Hydro
6. Nuclear
 - a. Nuc – Nuclear
7. Wind
 - a. WT – Wind Turbine On-shore
 - b. WT_off – Wind Turbine Off-shore
8. Demand Response
 - a. Demand Response – Demand Response (DR)
9. Other
 - a. Pseudo Unit -- HQ/Maritimes New Units
 - b. Fixed Interchange—HQ/Maritimes Fixed Interchange

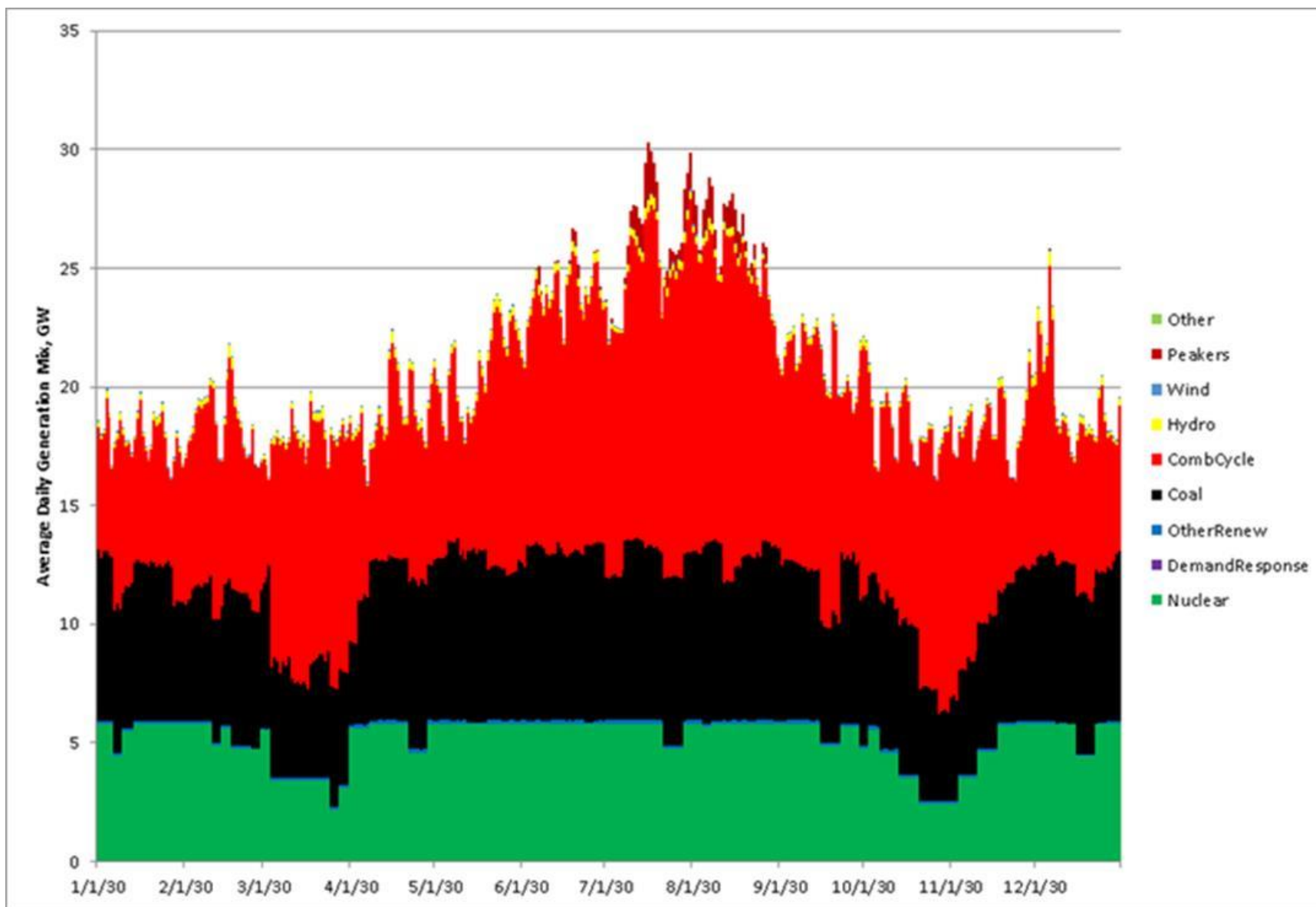


Figure A5-1. Daily Generation Dispatch for Scenario 3 ENT

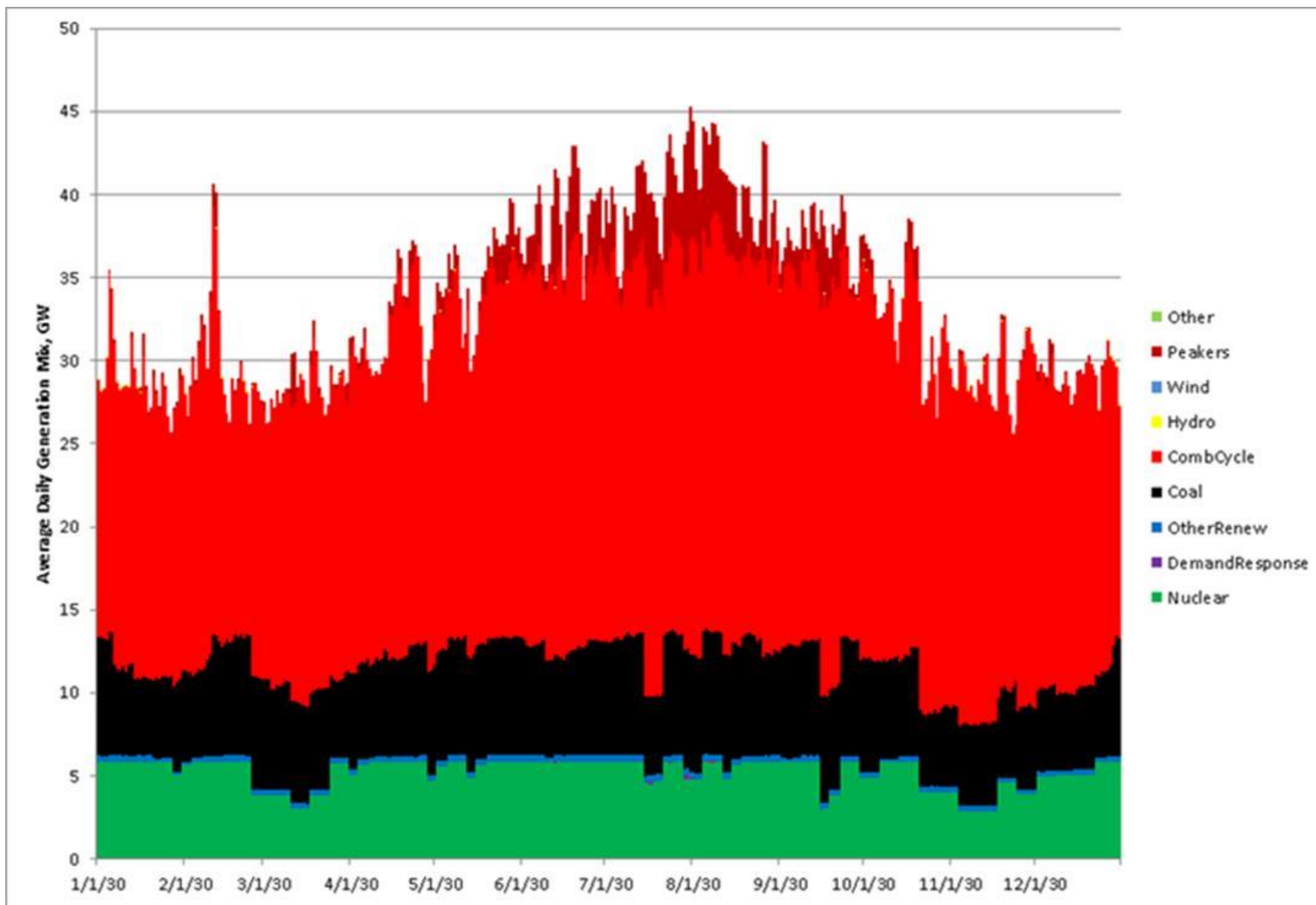


Figure A5-2. Daily Generation Dispatch for Scenario 3 FRCC

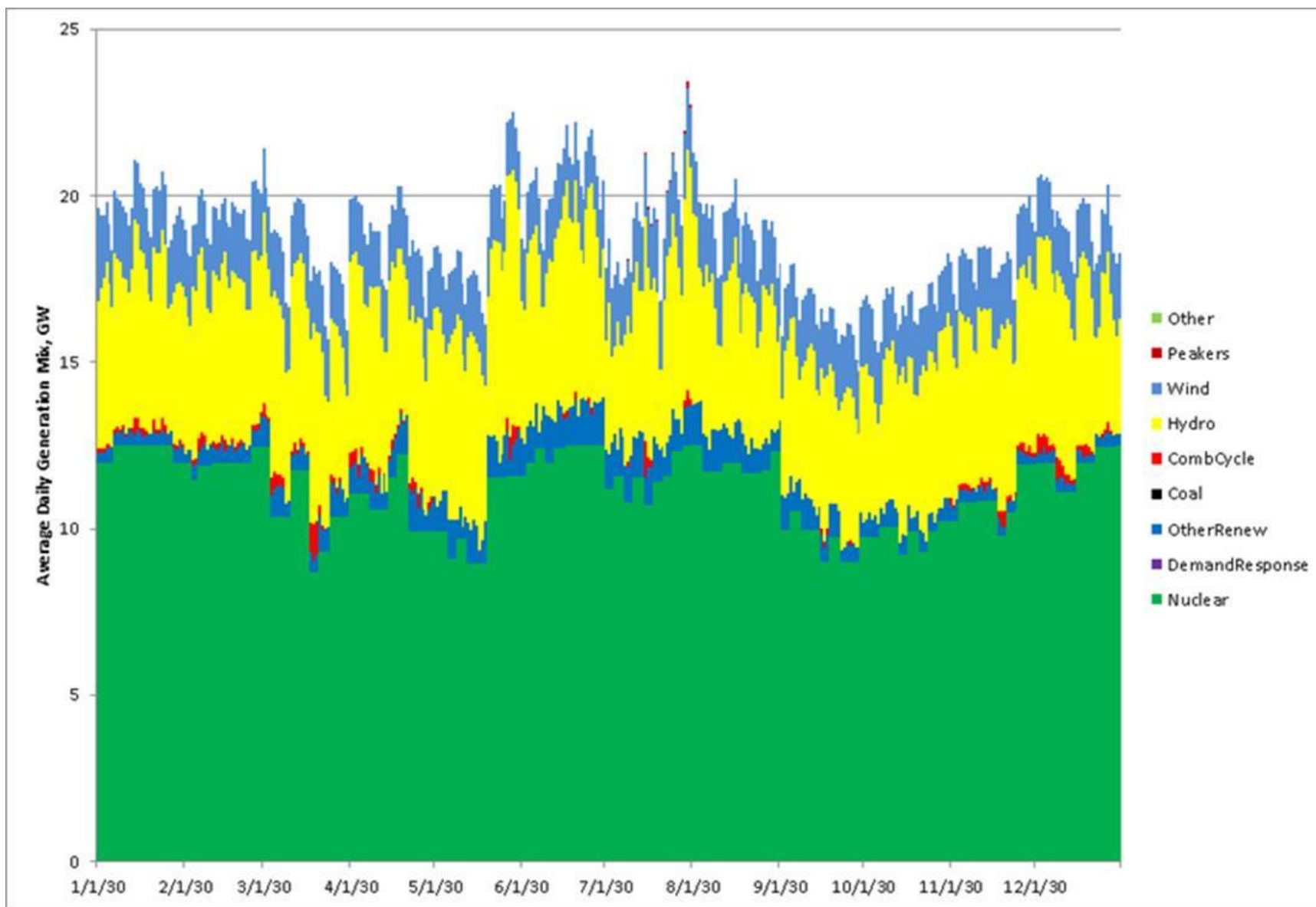


Figure A5-3. Daily Generation Dispatch for Scenario 3 IESO

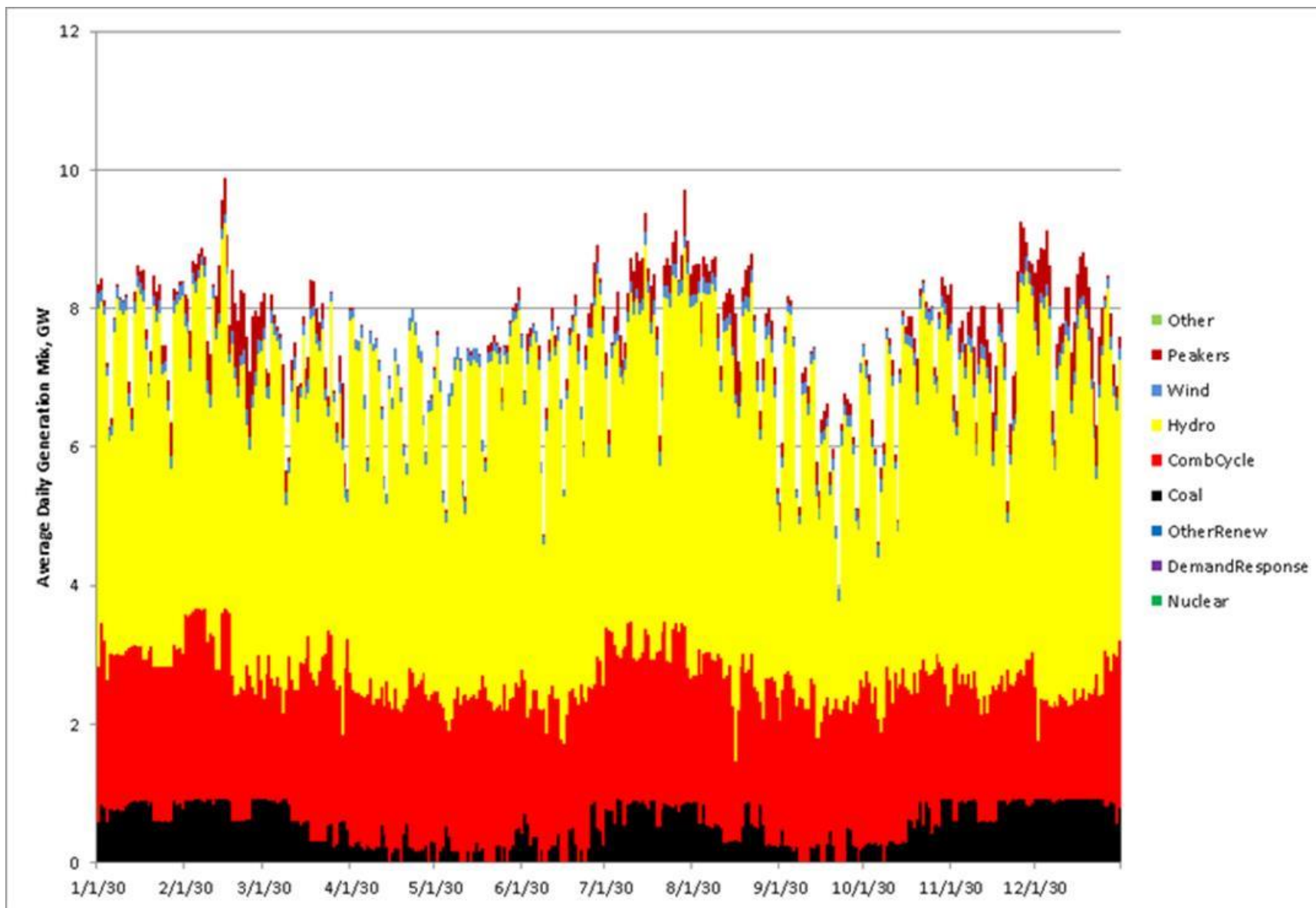


Figure A5-4. Daily Generation Dispatch for Scenario 3 MAPP_CA

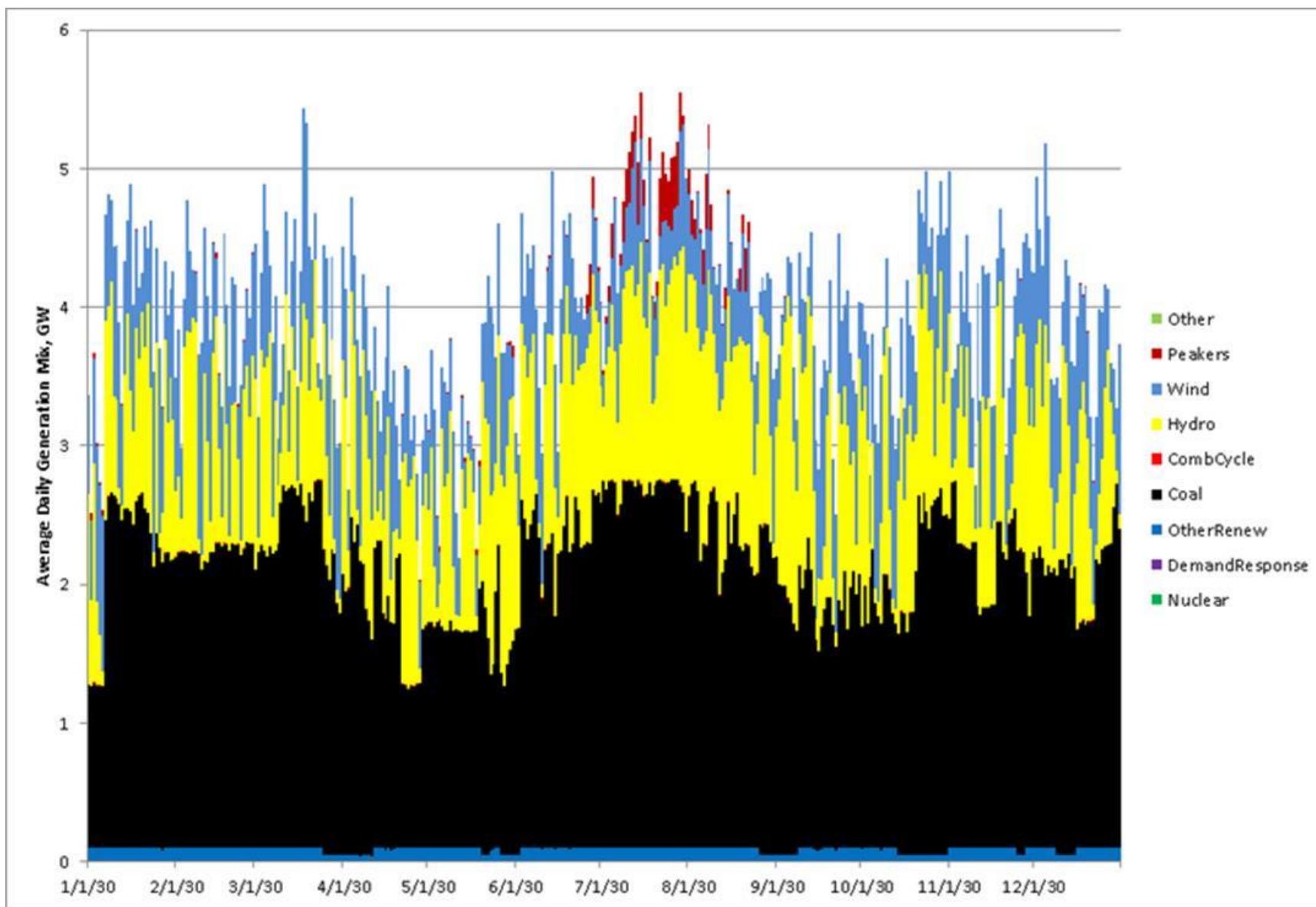


Figure A5-5. Daily Generation Dispatch for Scenario 3 MAPP_US

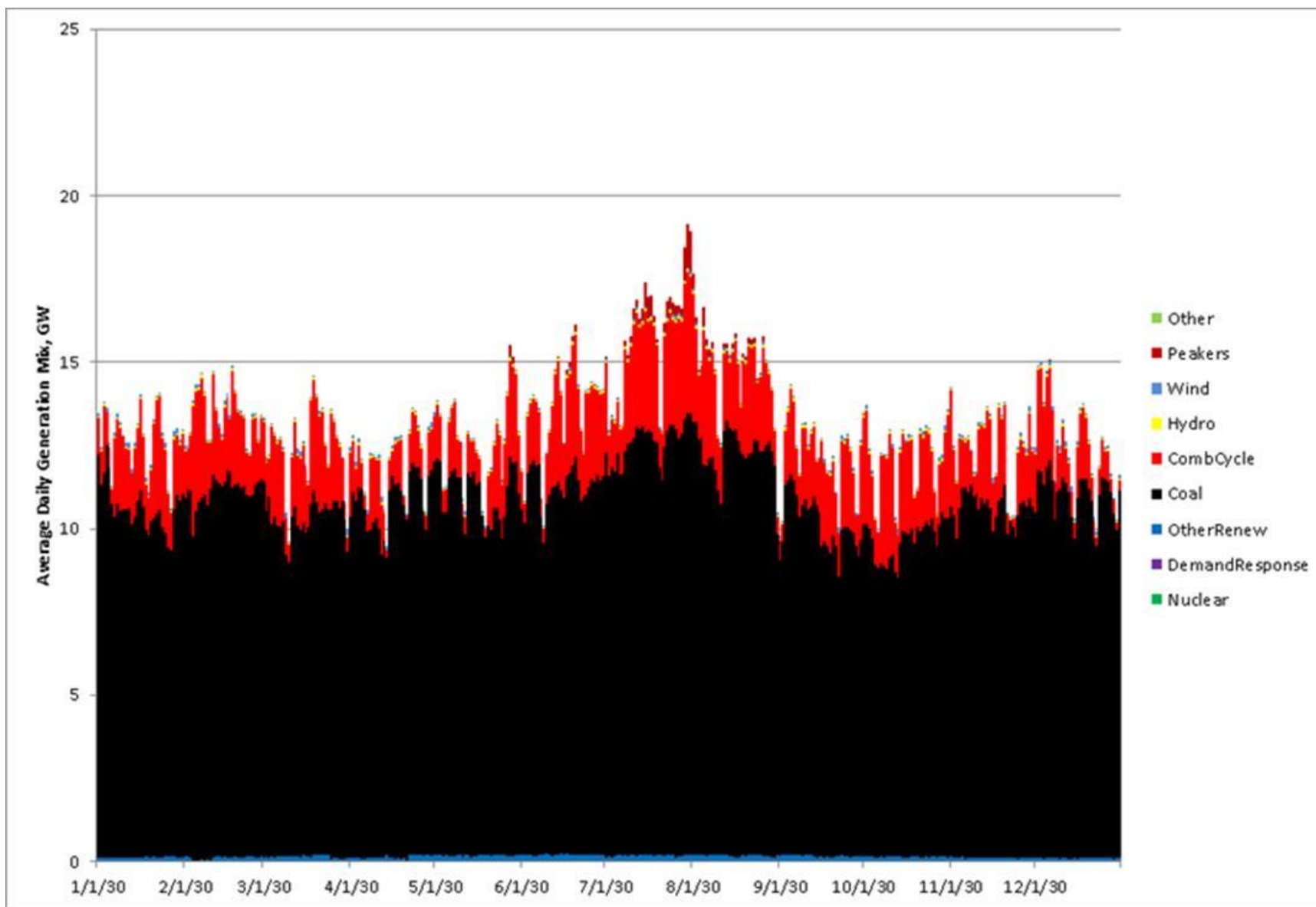


Figure A5-6. Daily Generation Dispatch for Scenario 3 MISO_IN

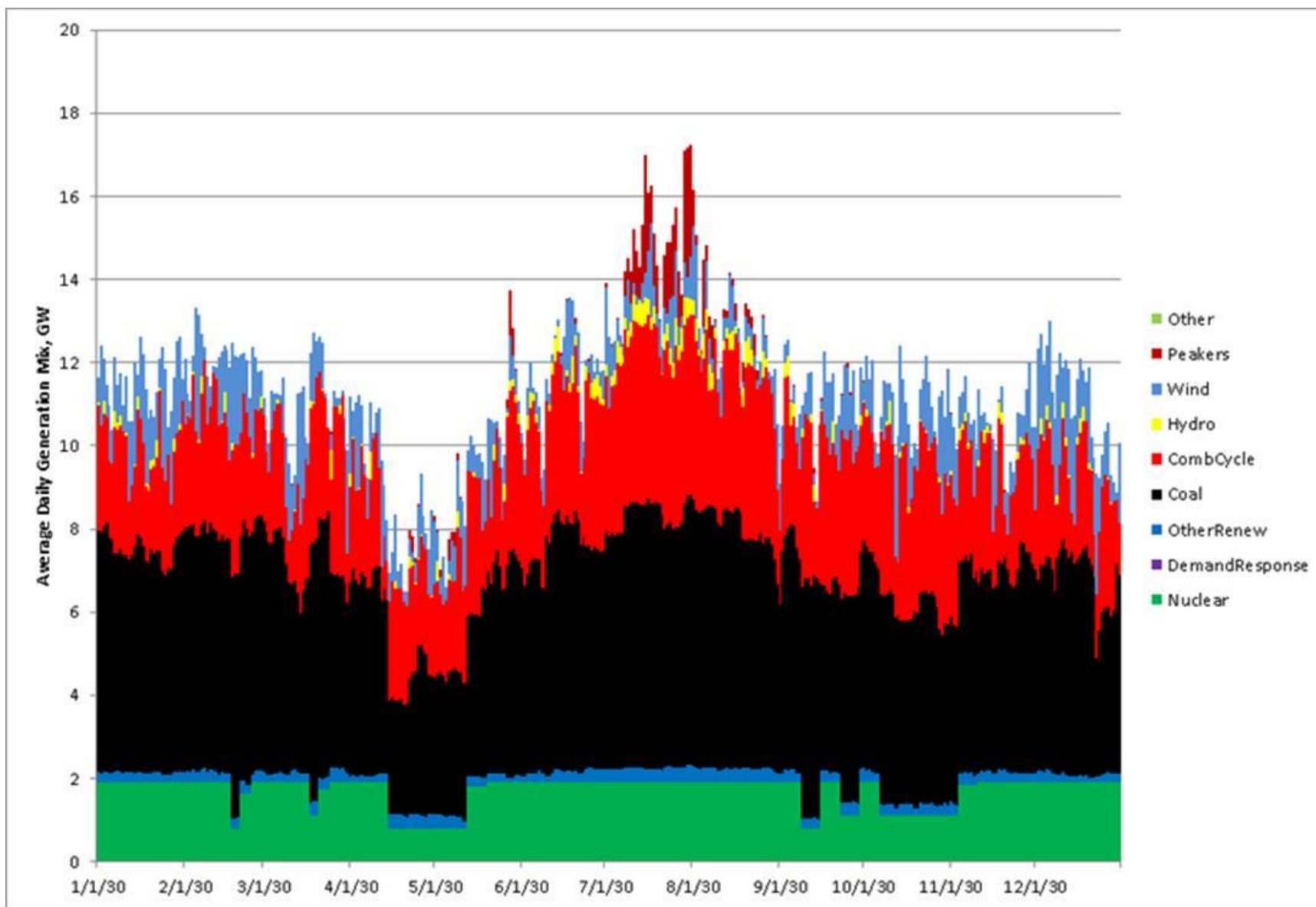


Figure A5-7. Daily Generation Dispatch for Scenario 3 MISO_MI

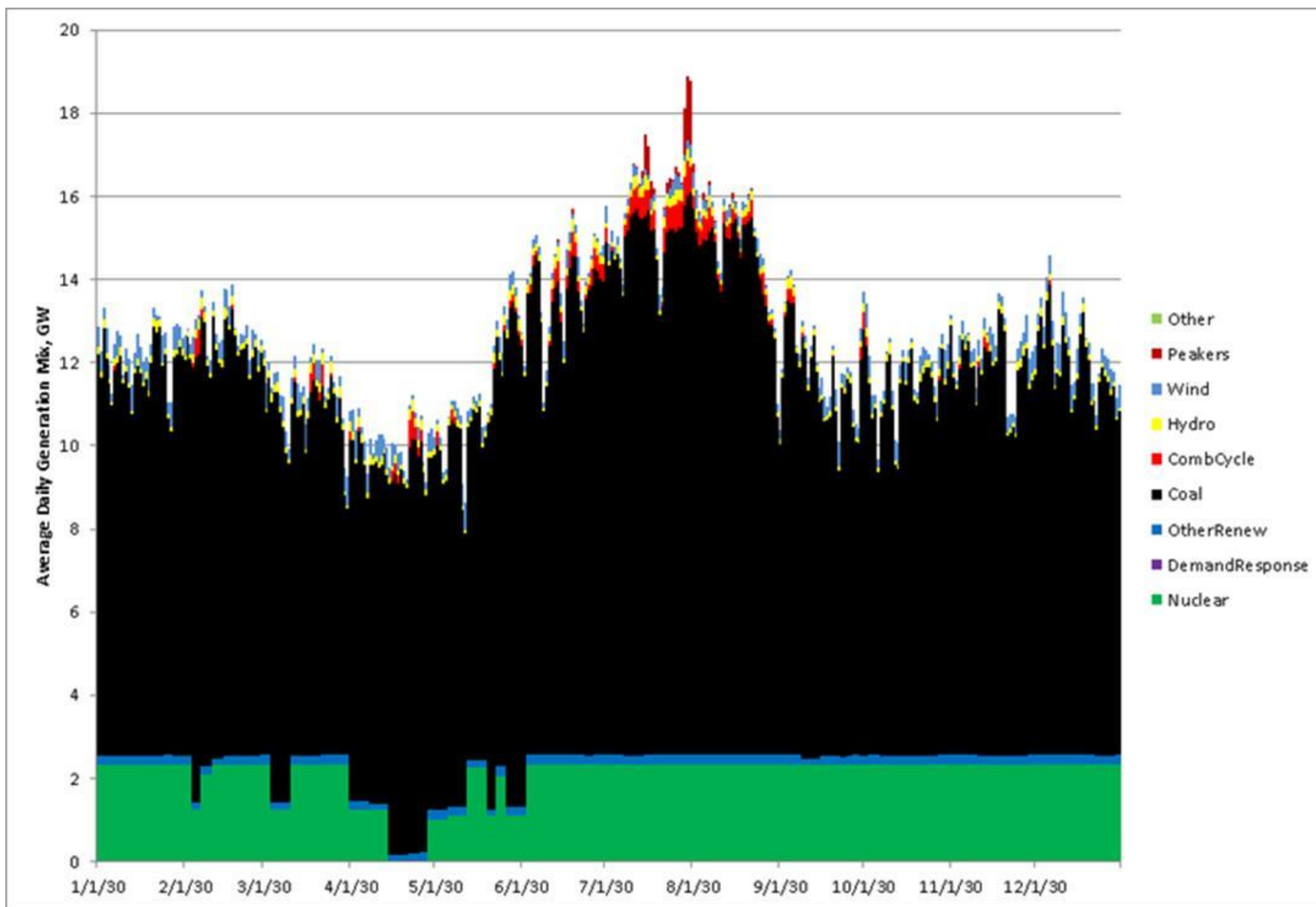


Figure A5-8. Daily Generation Dispatch for Scenario 3 MISO_MO_IL

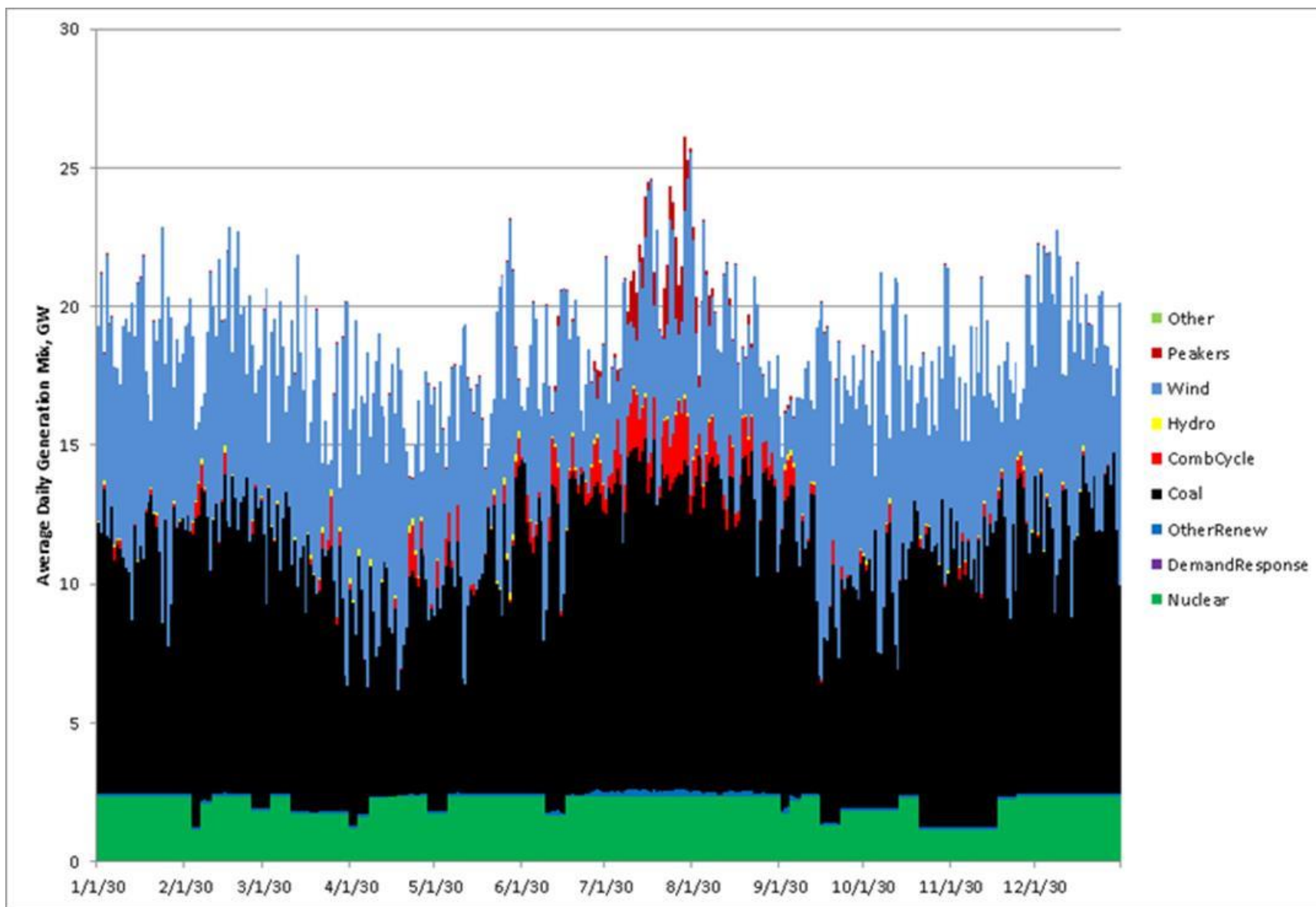


Figure A5-9. Daily Generation Dispatch for Scenario 3 MISO_W

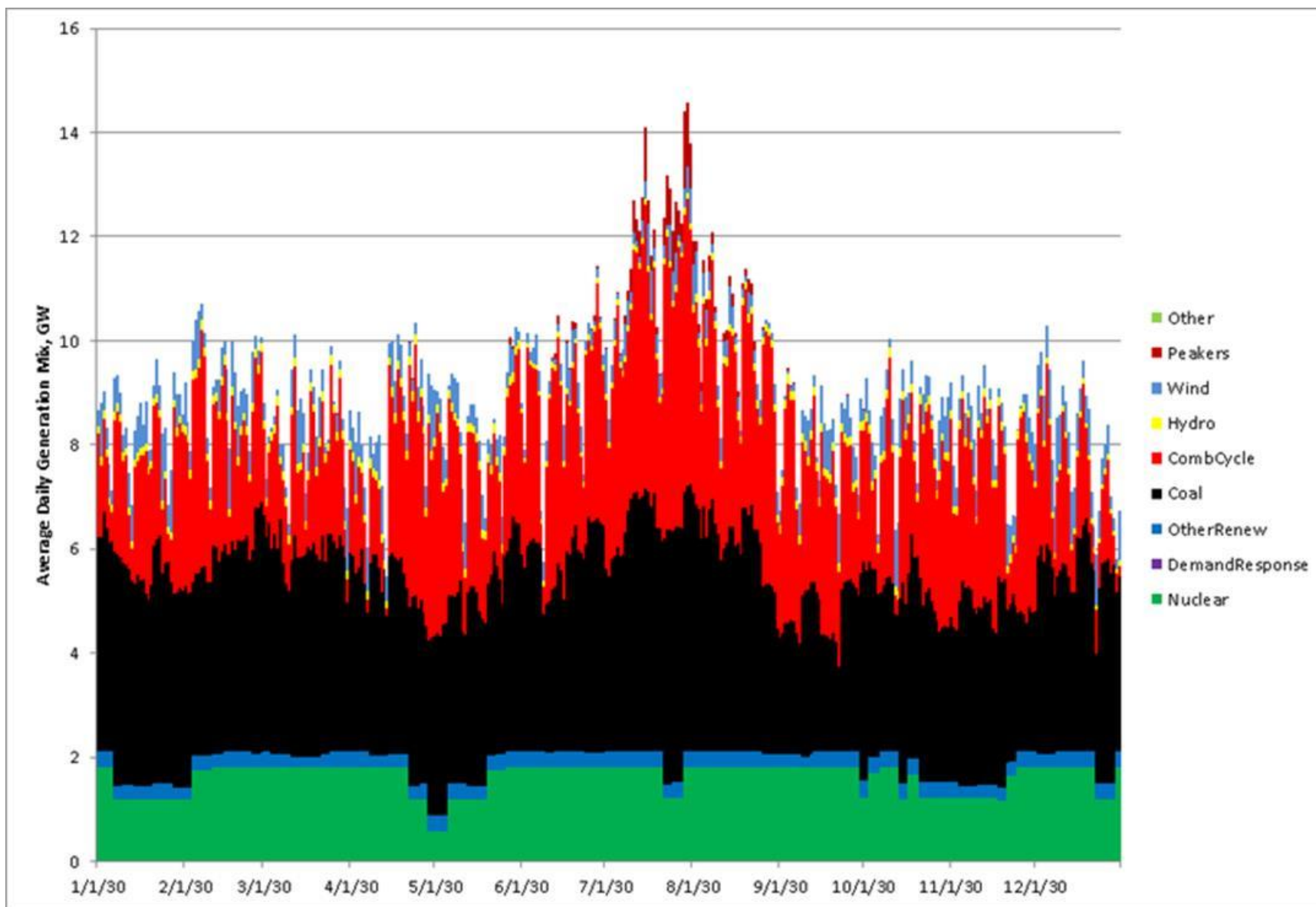


Figure A5-10. Daily Generation Dispatch for Scenario 3 MISO_WUMS

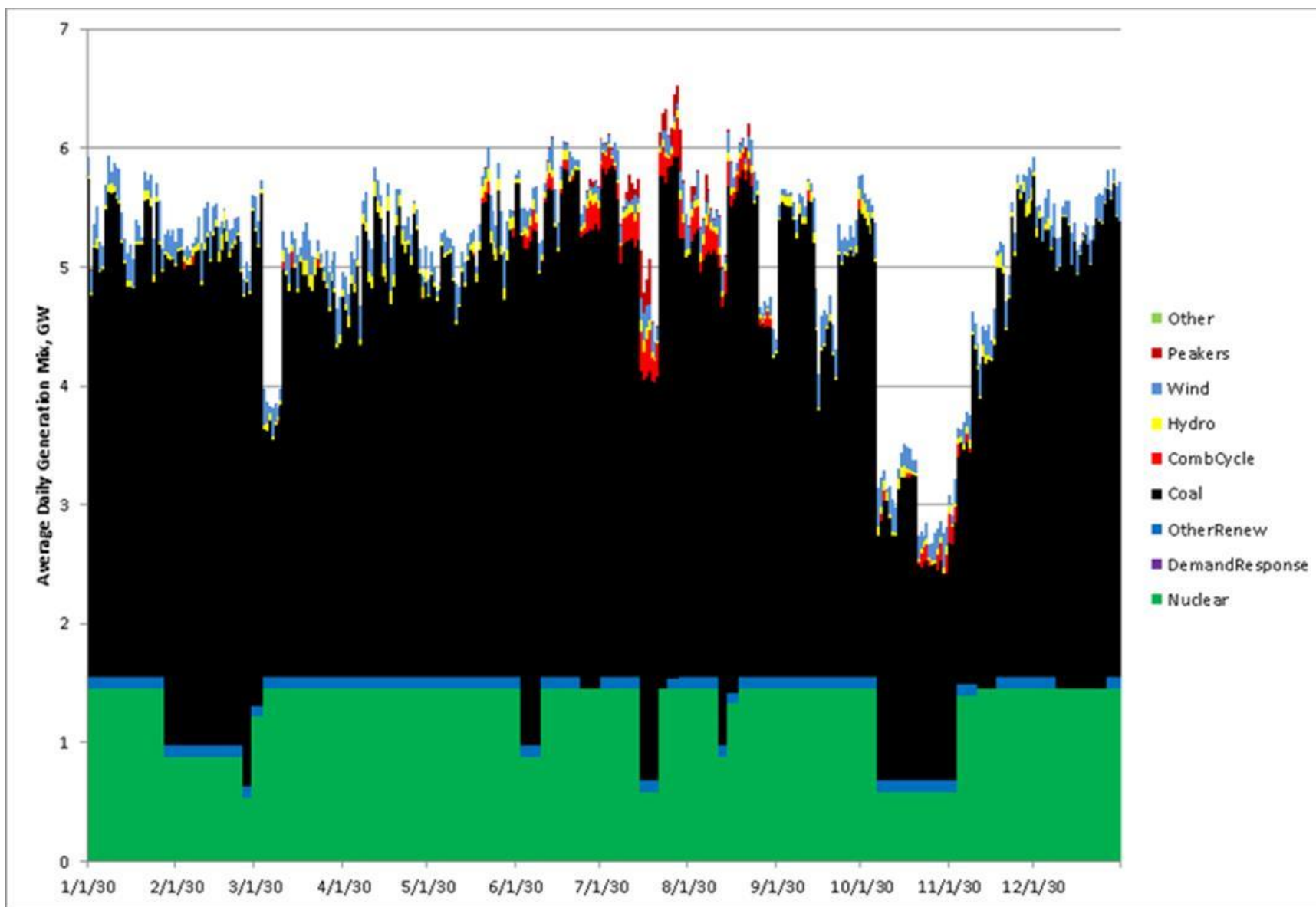


Figure A5-11. Daily Generation Dispatch for Scenario 3 NE

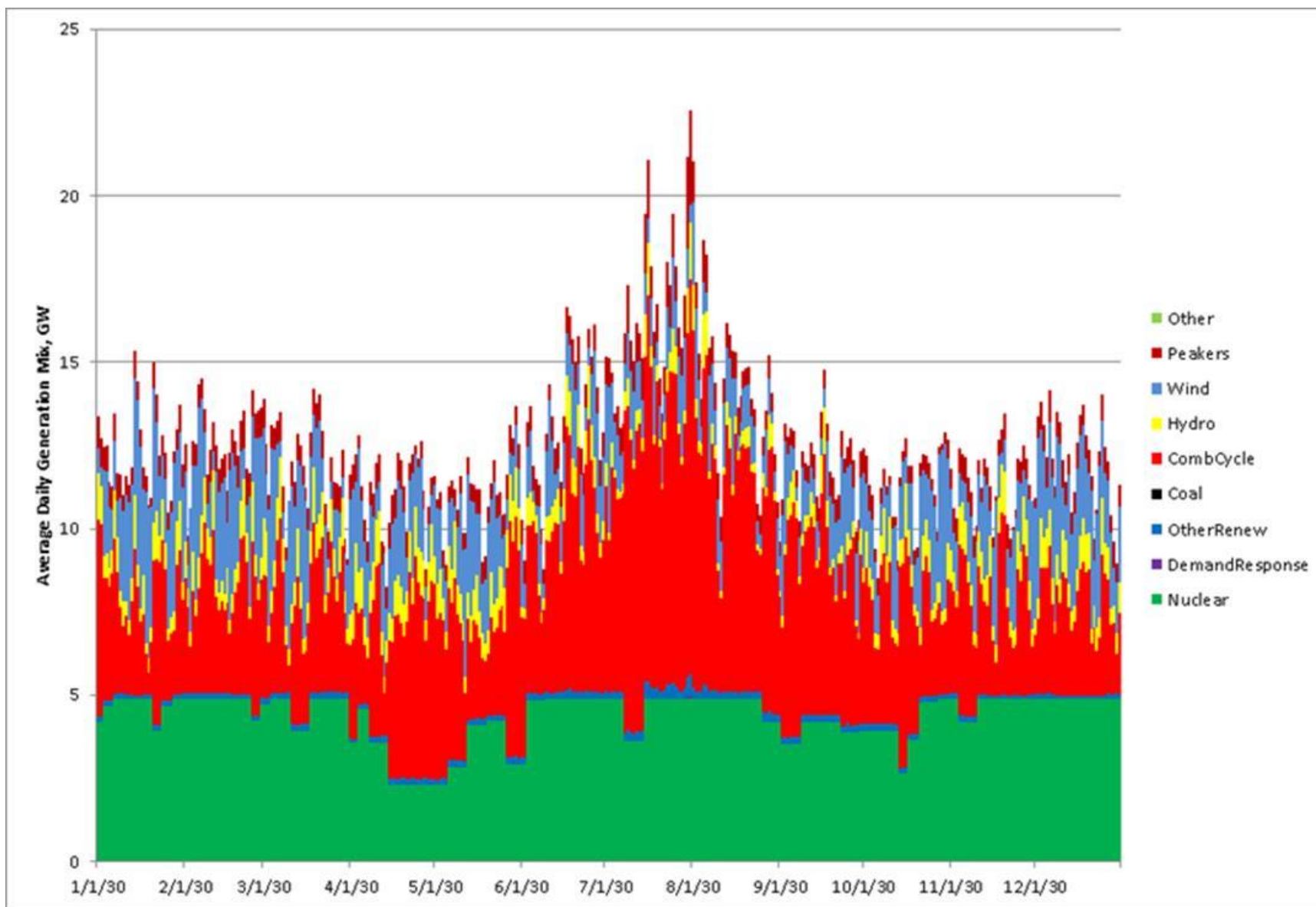


Figure A5-12. Daily Generation Dispatch for Scenario 3 NEISO

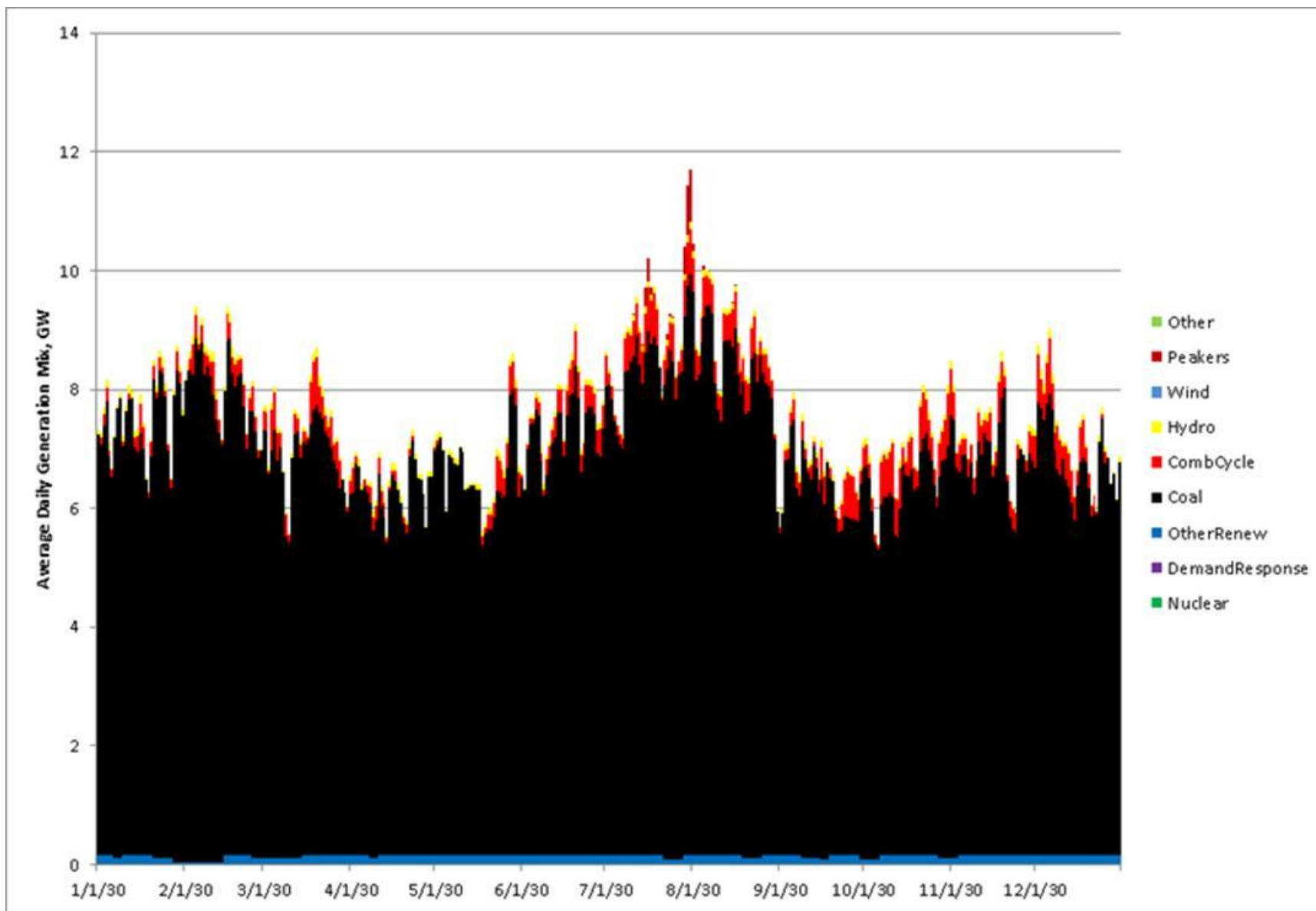


Figure A5-13. Daily Generation Dispatch for Scenario 3 NonRTO_Midwest

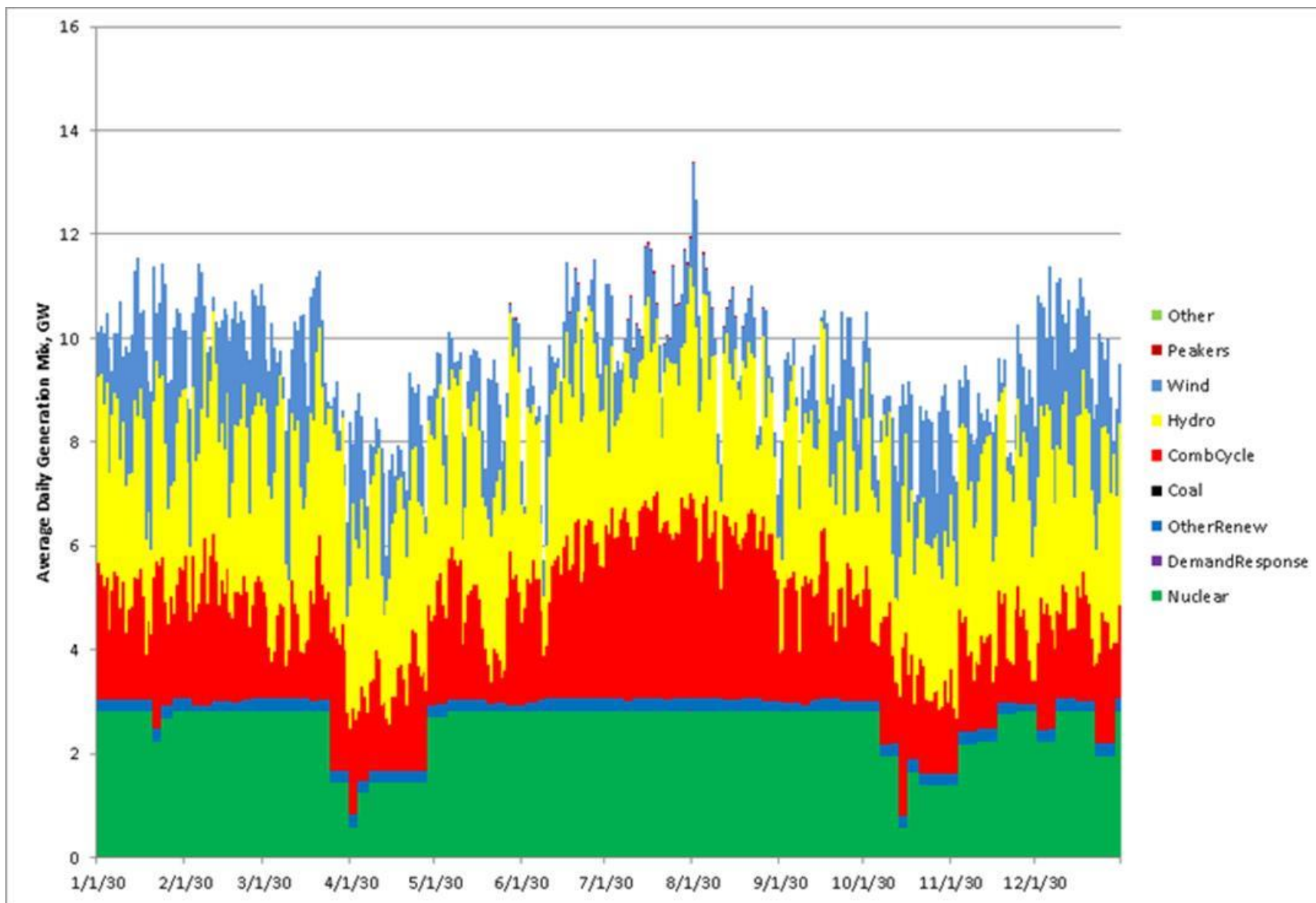


Figure A5-14. Daily Generation Dispatch for Scenario 3 NYISO_A_F

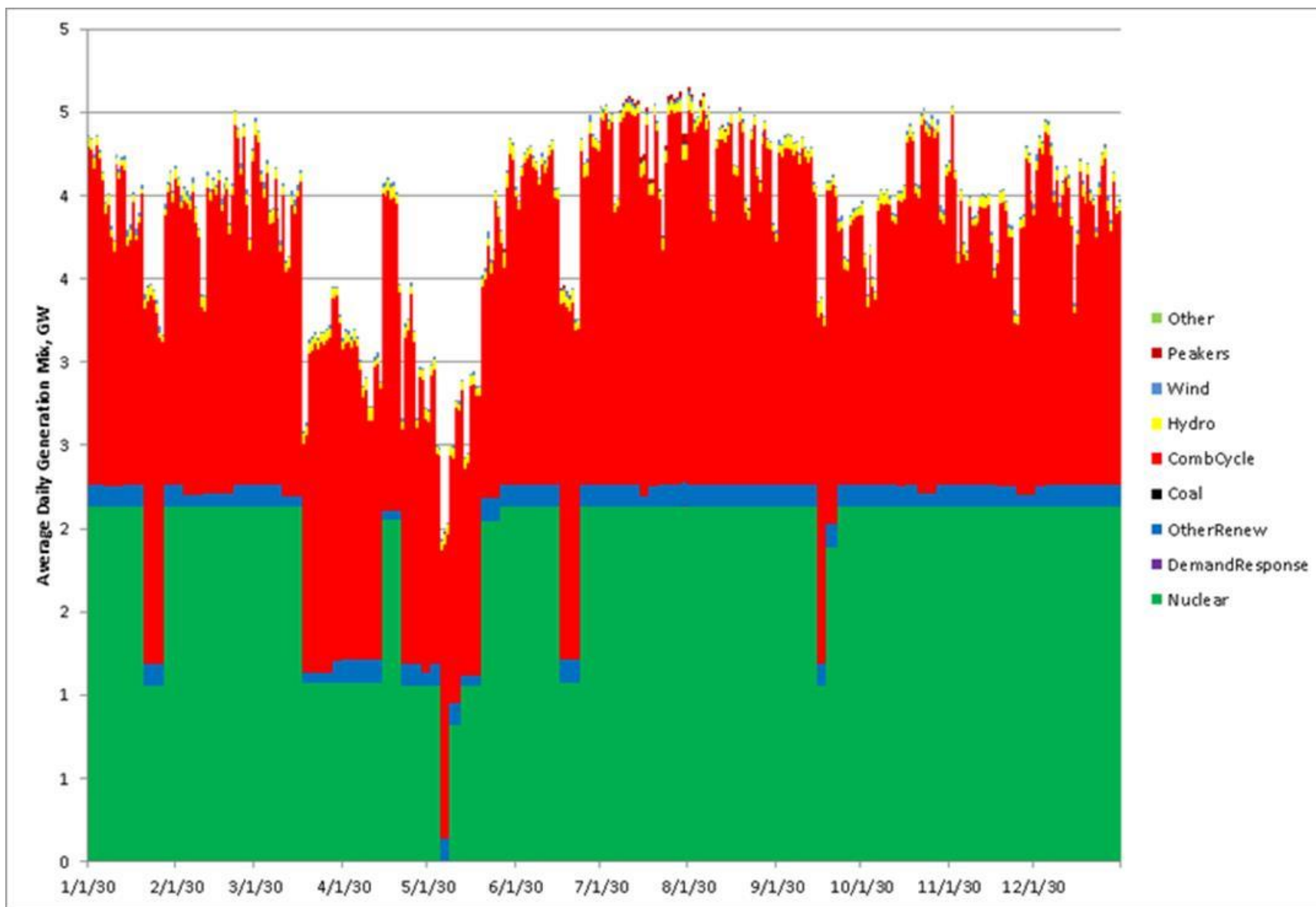


Figure A5-15. Daily Generation Dispatch for Scenario 3 NYISO_G_I

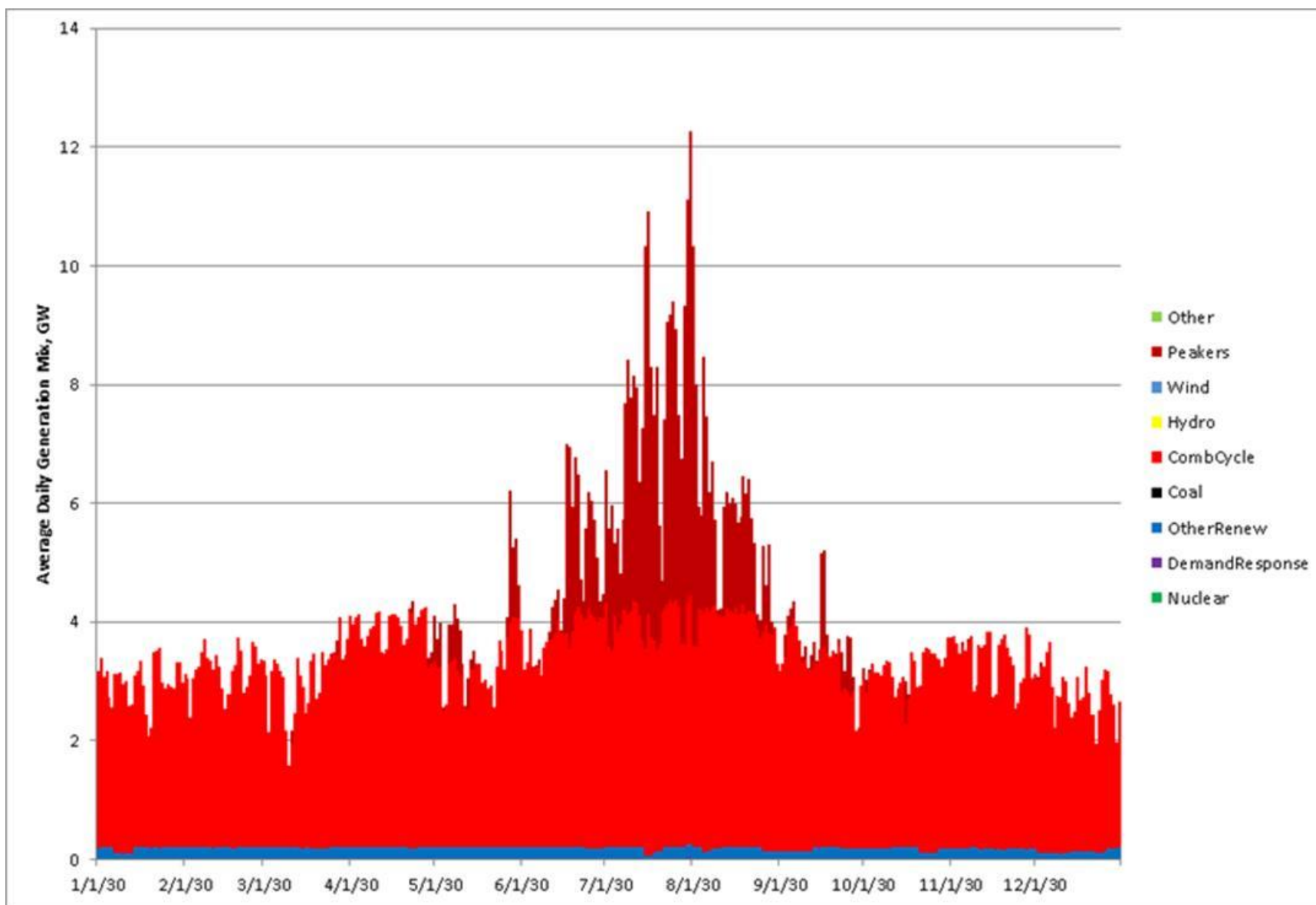


Figure A5-16. Daily Generation Dispatch for Scenario 3 NYISO_J_K

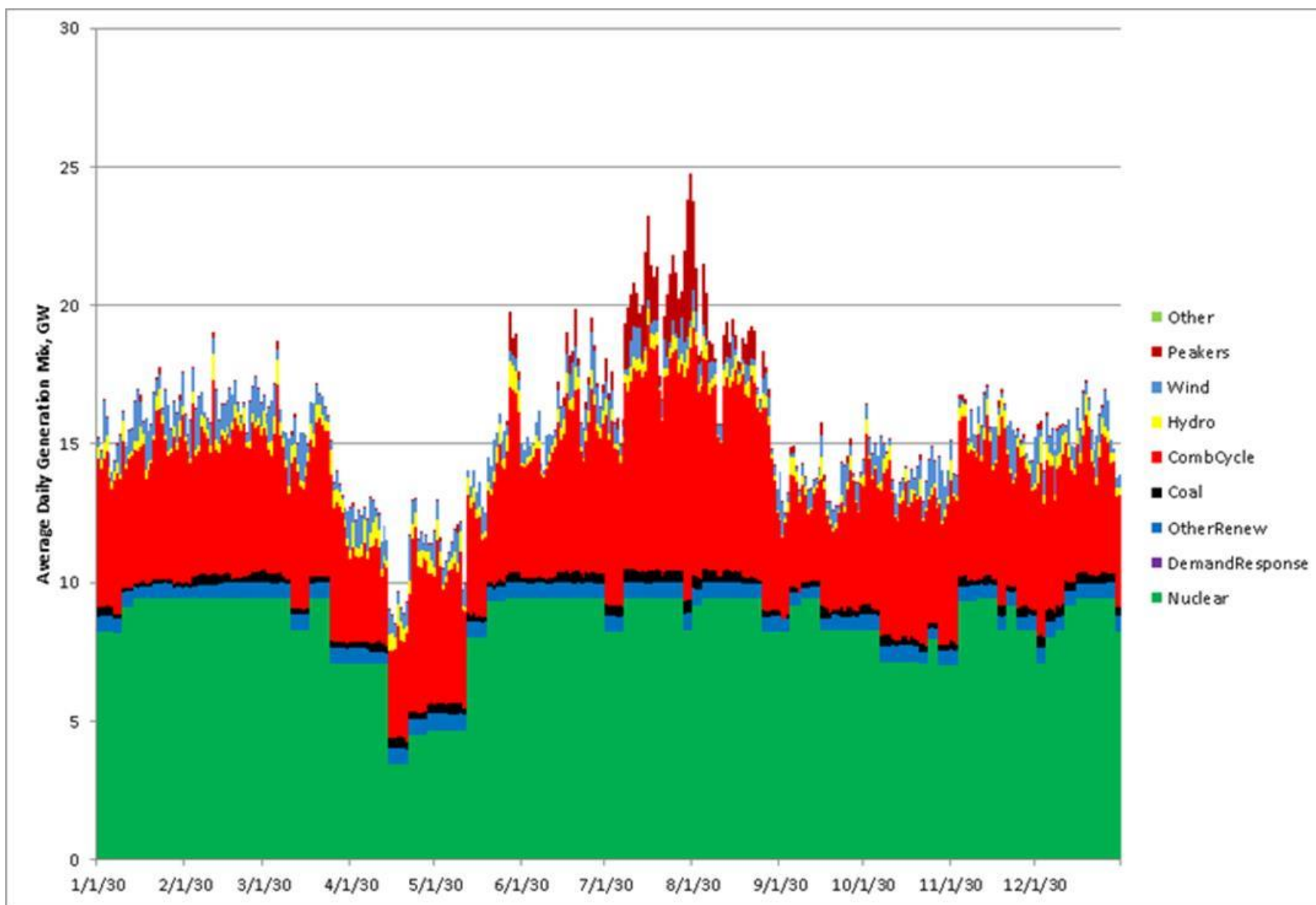


Figure A5-17. Daily Generation Dispatch for Scenario 3 PJM_E

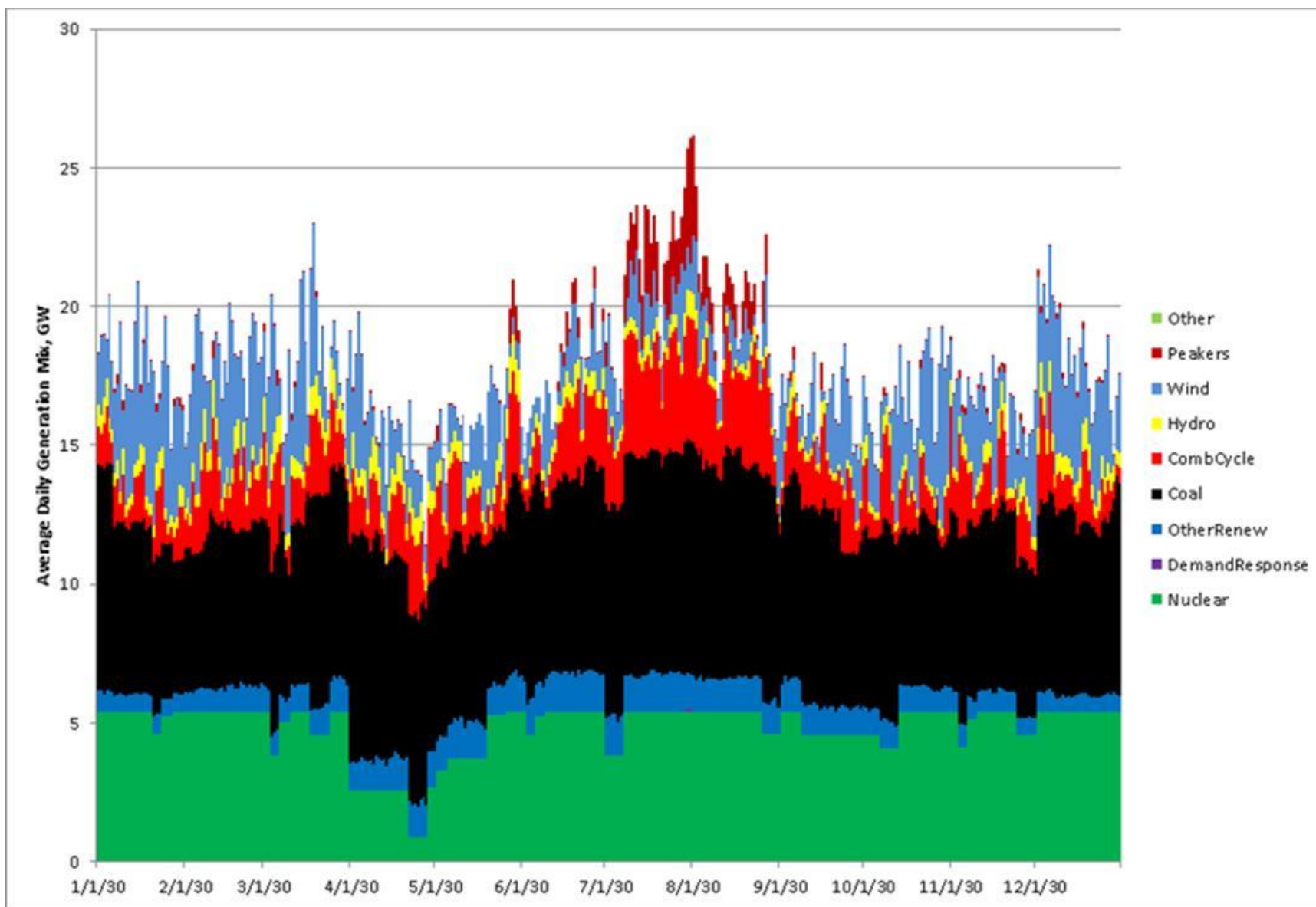


Figure A5-18. Daily Generation Dispatch for Scenario 3 PJM_ROM

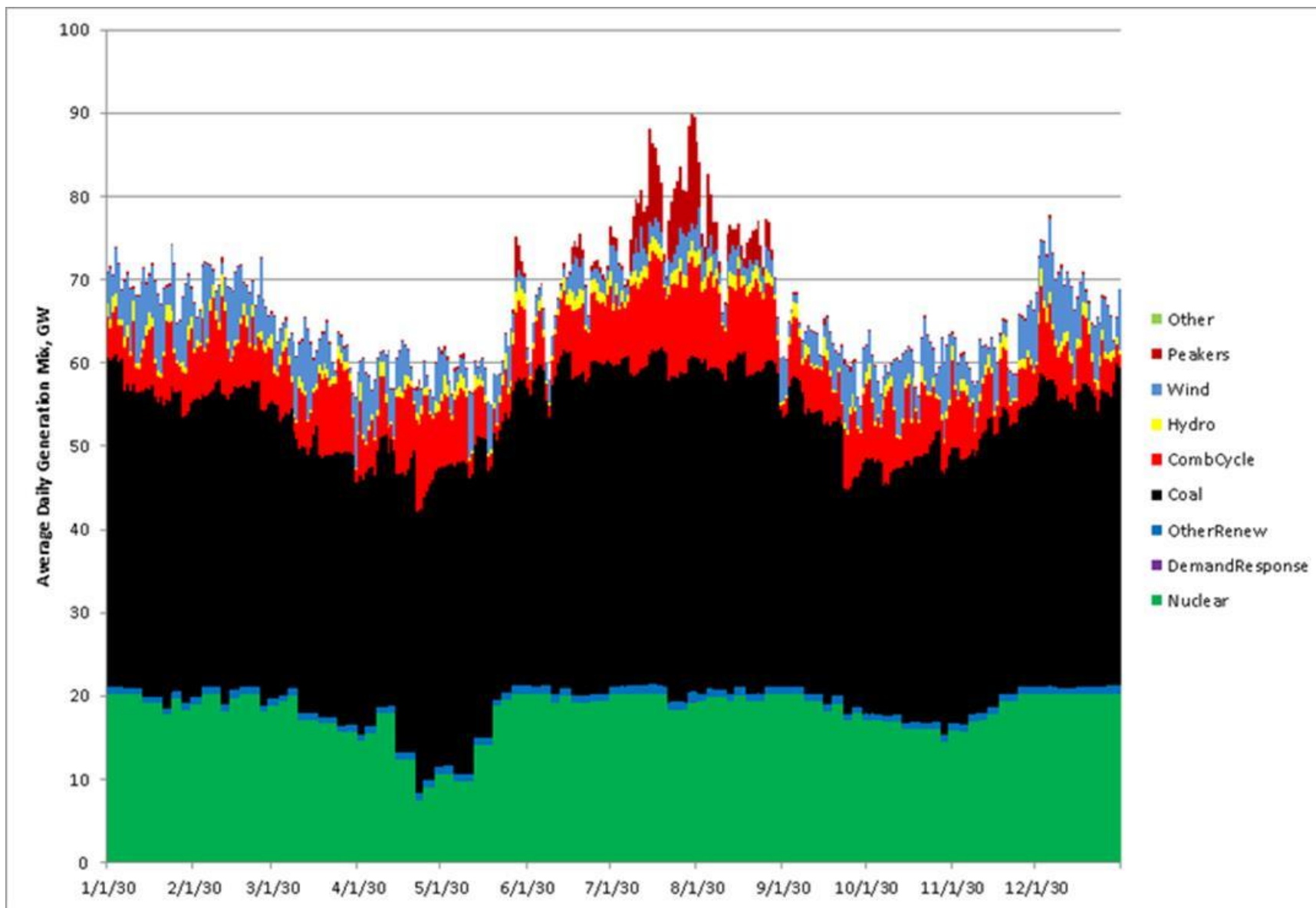


Figure A5-19. Daily Generation Dispatch for Scenario 3 PJM_ROR

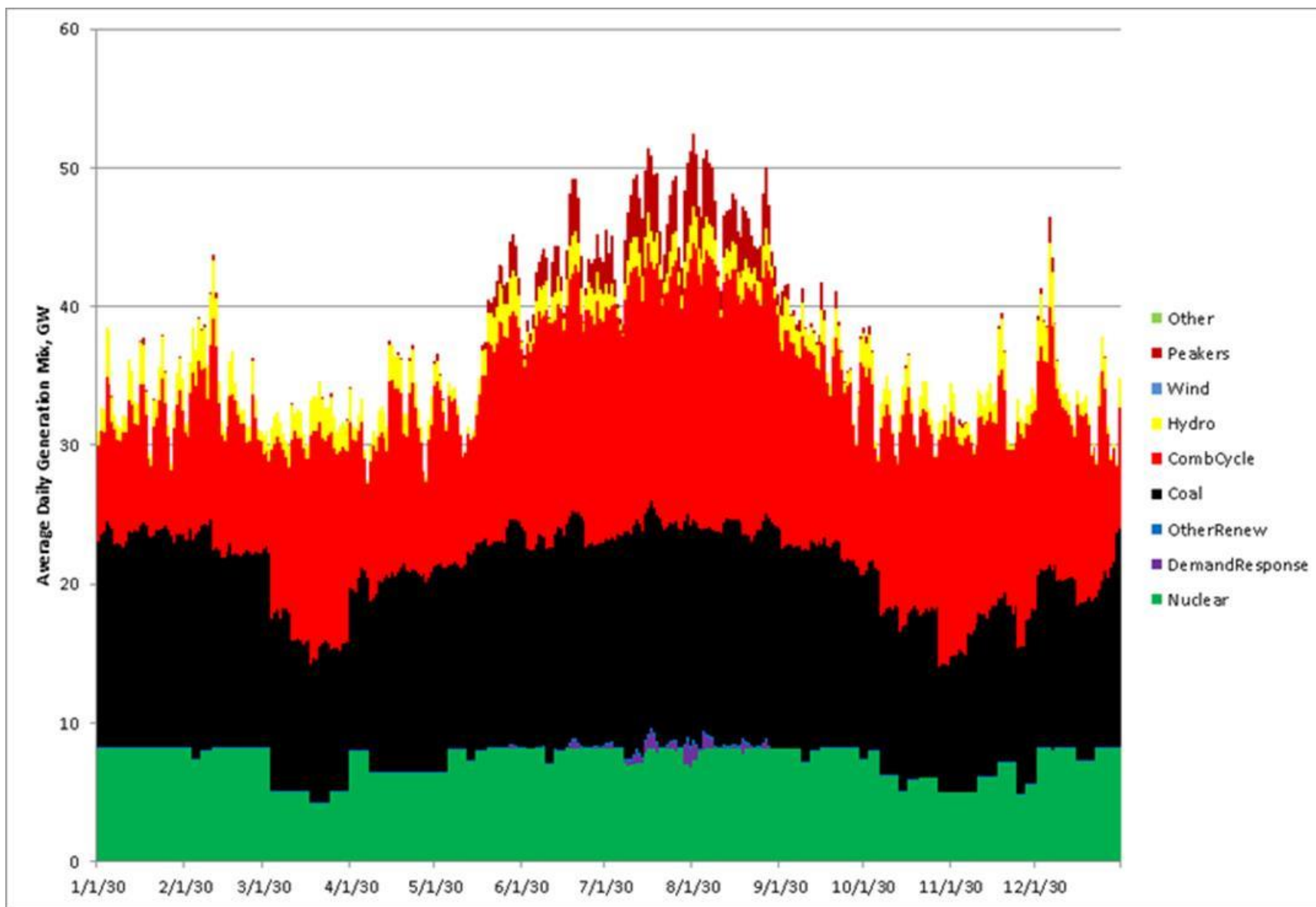


Figure A5-20. Daily Generation Dispatch for Scenario 3 SOCO

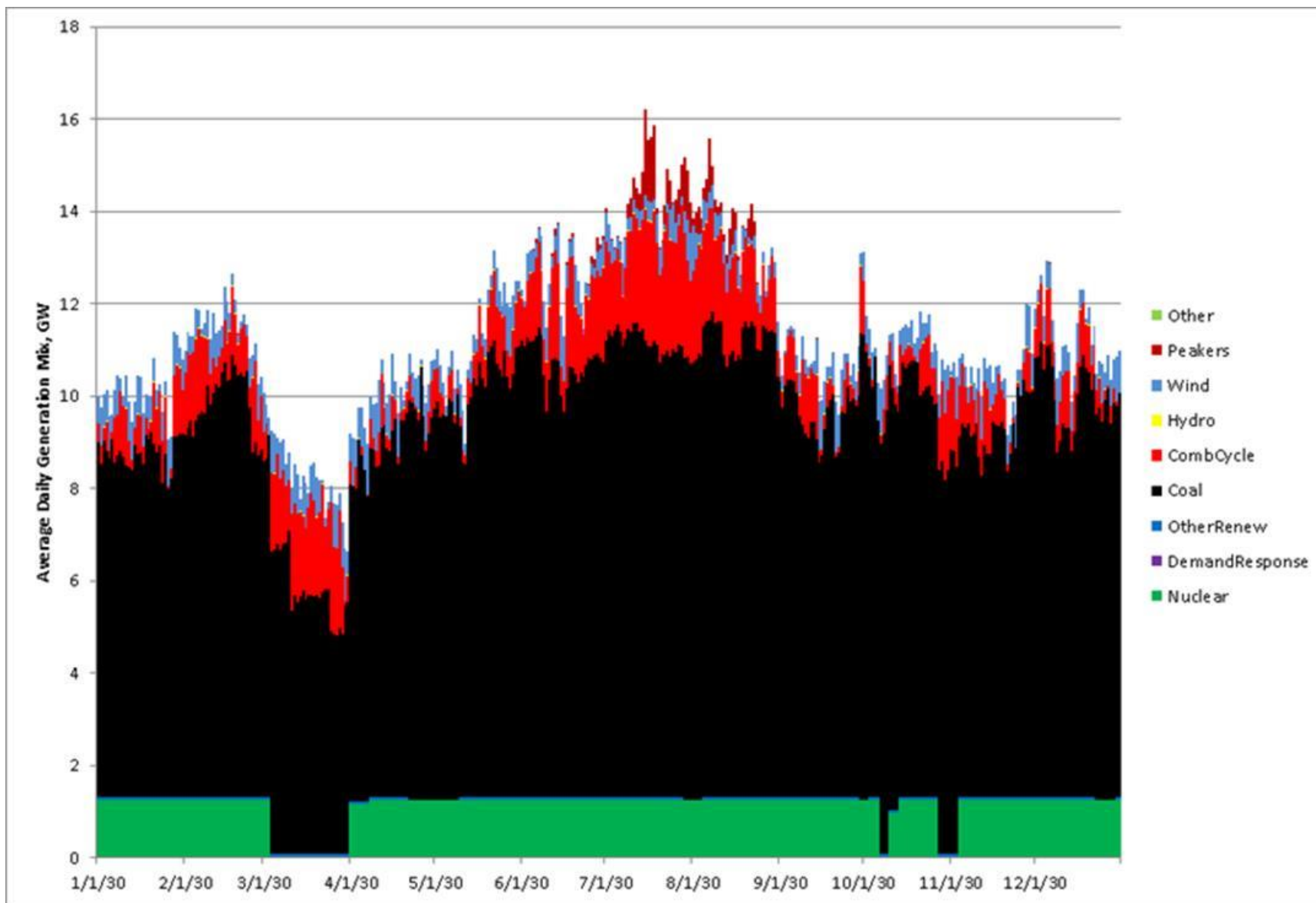


Figure A5-21. Daily Generation Dispatch for Scenario 3 SPP_N

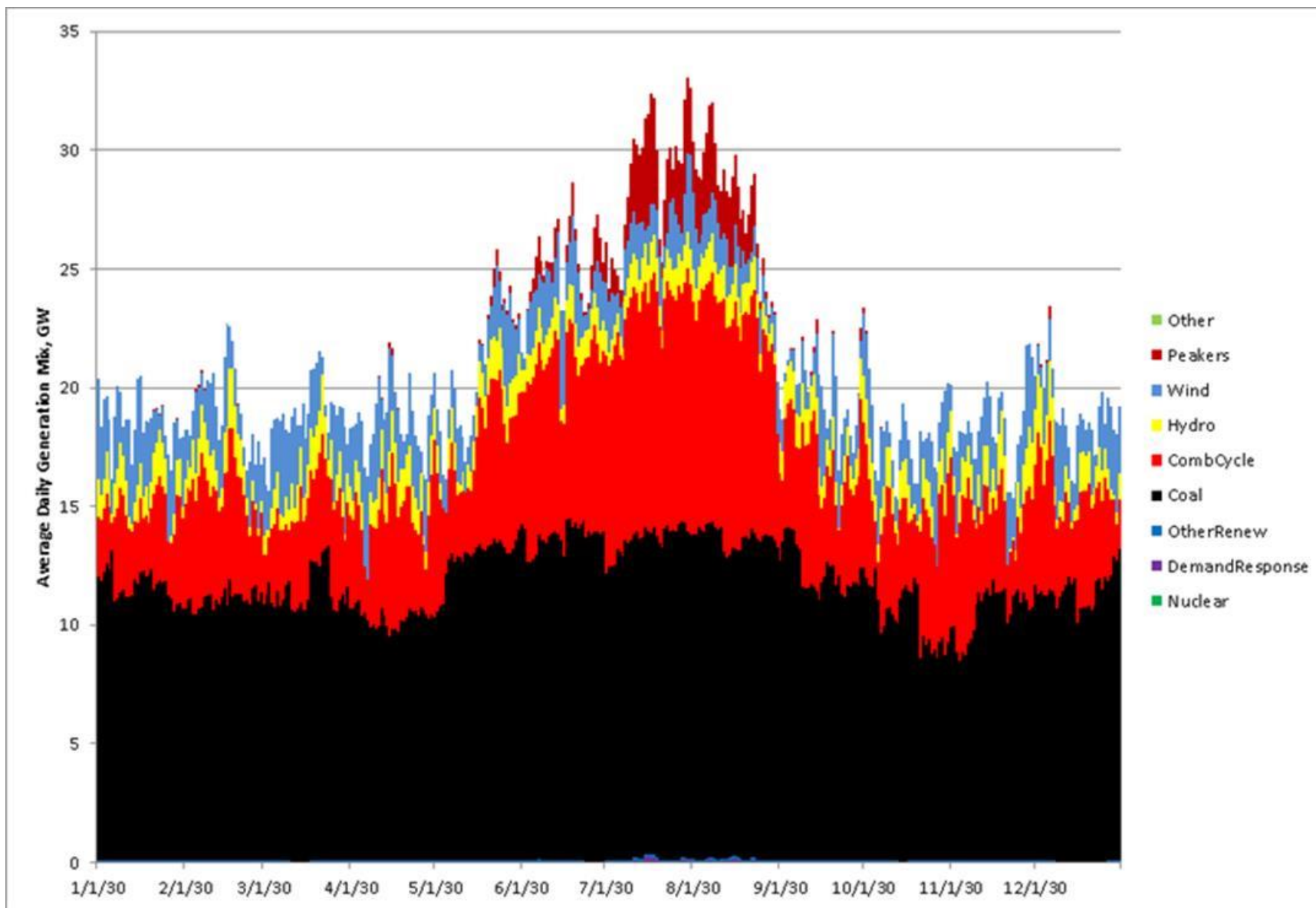


Figure A5-22. Daily Generation Dispatch for Scenario 3 SPP_S

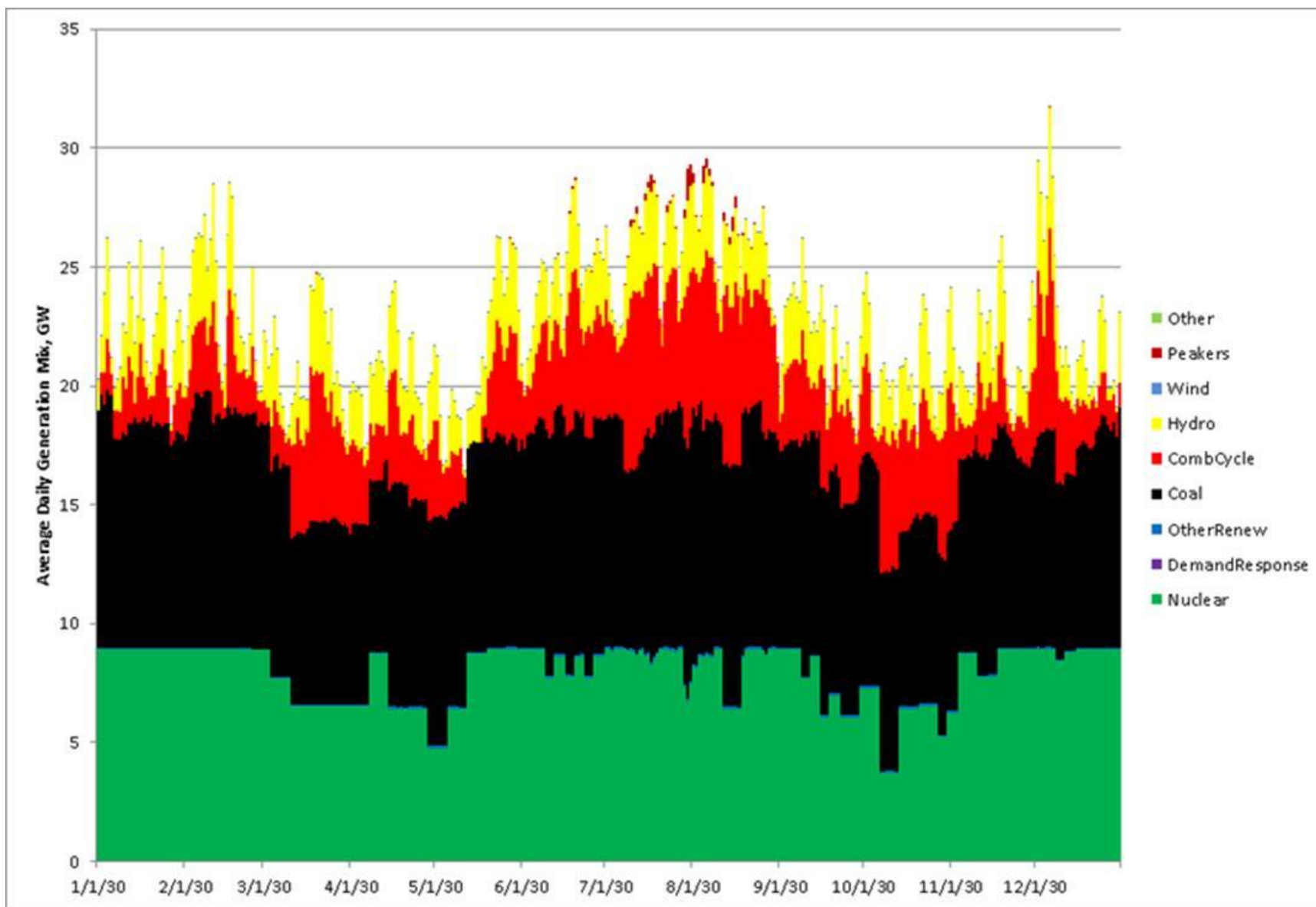


Figure A5-23. Daily Generation Dispatch for Scenario 3 TVA

Appendix 6

Regional Metrics

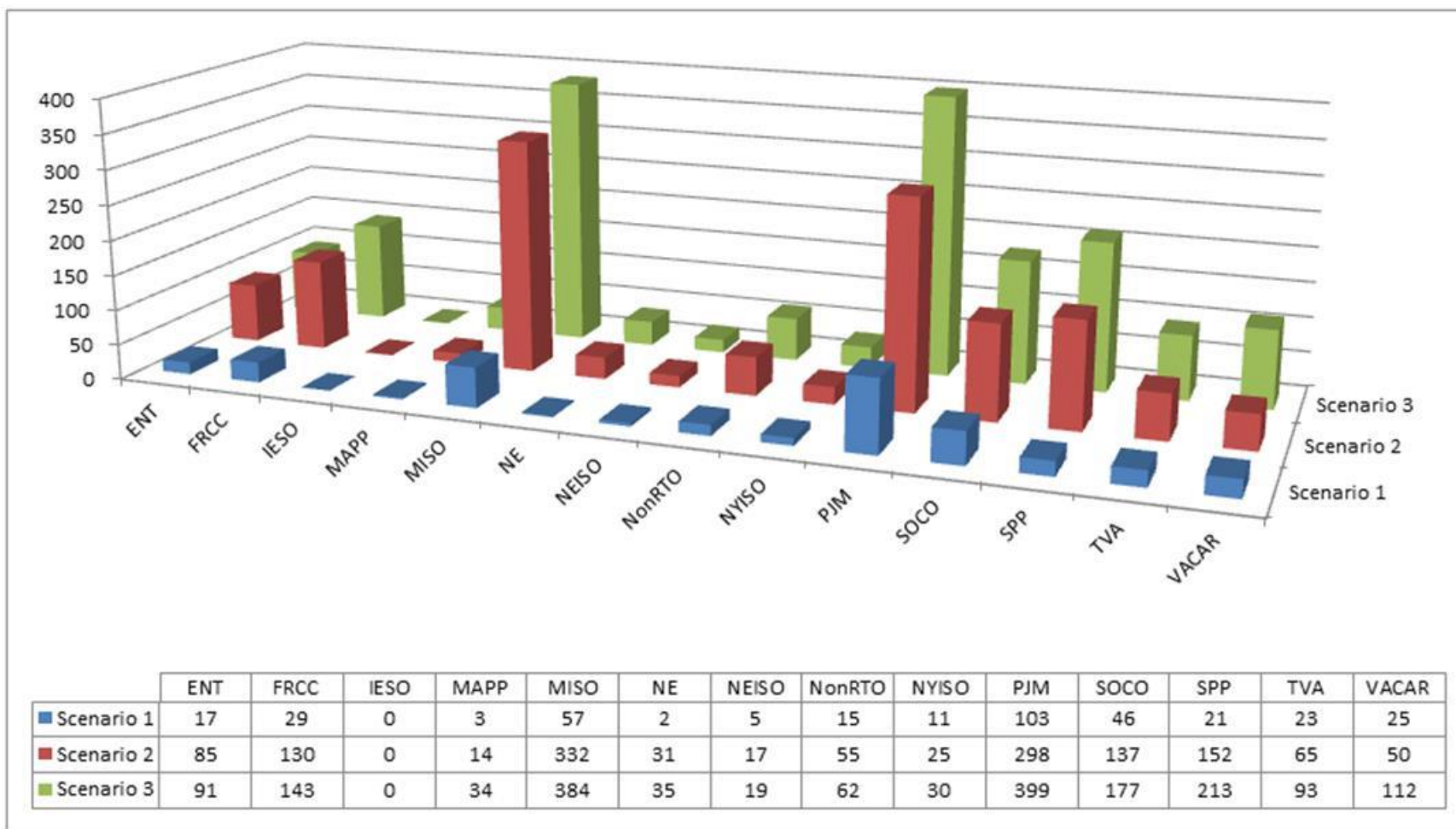


Figure A6-1. CO₂ Emissions by Region (Million Tons)

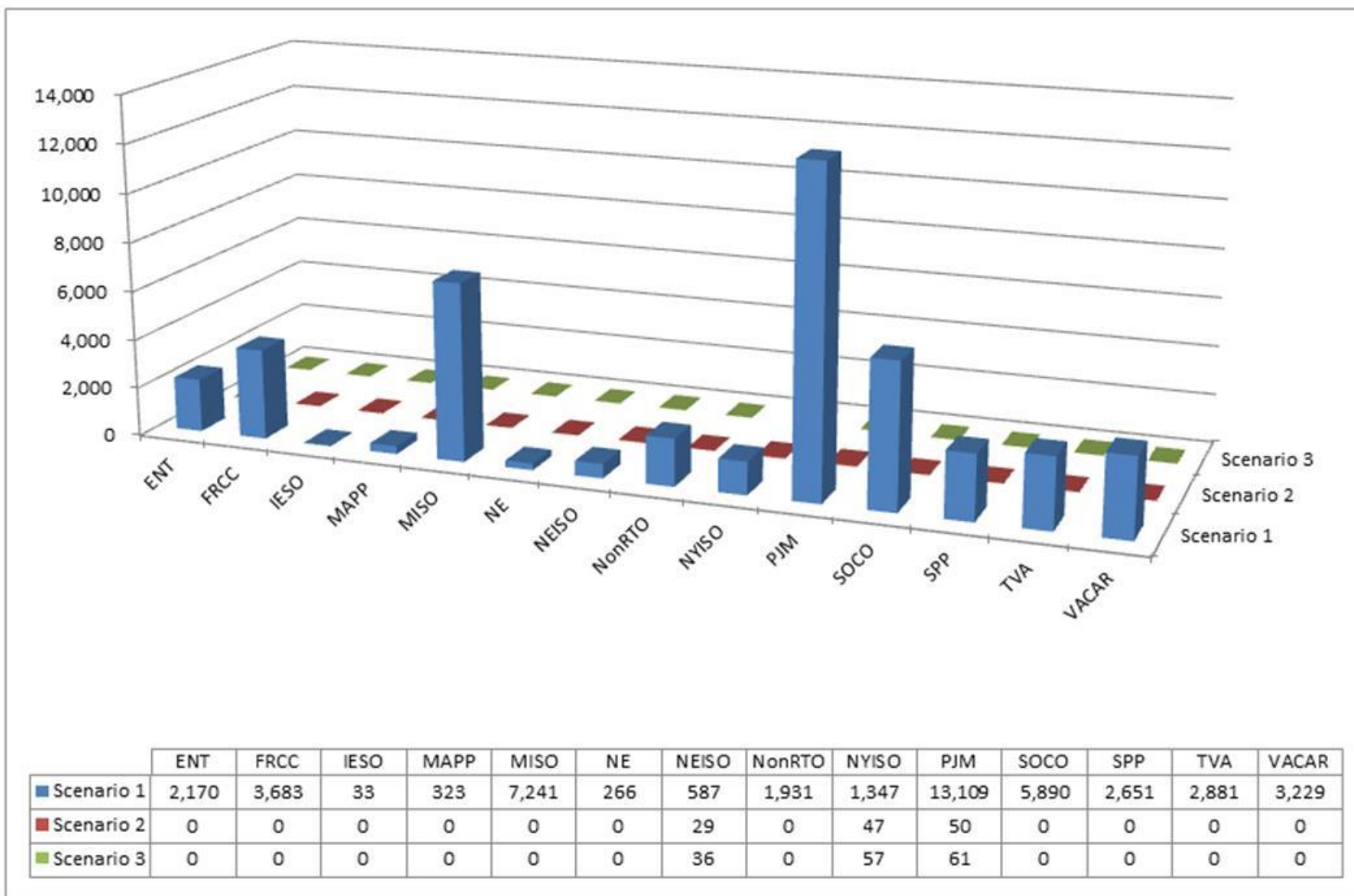


Figure A6-2. CO₂ Cost by Region (M\$)

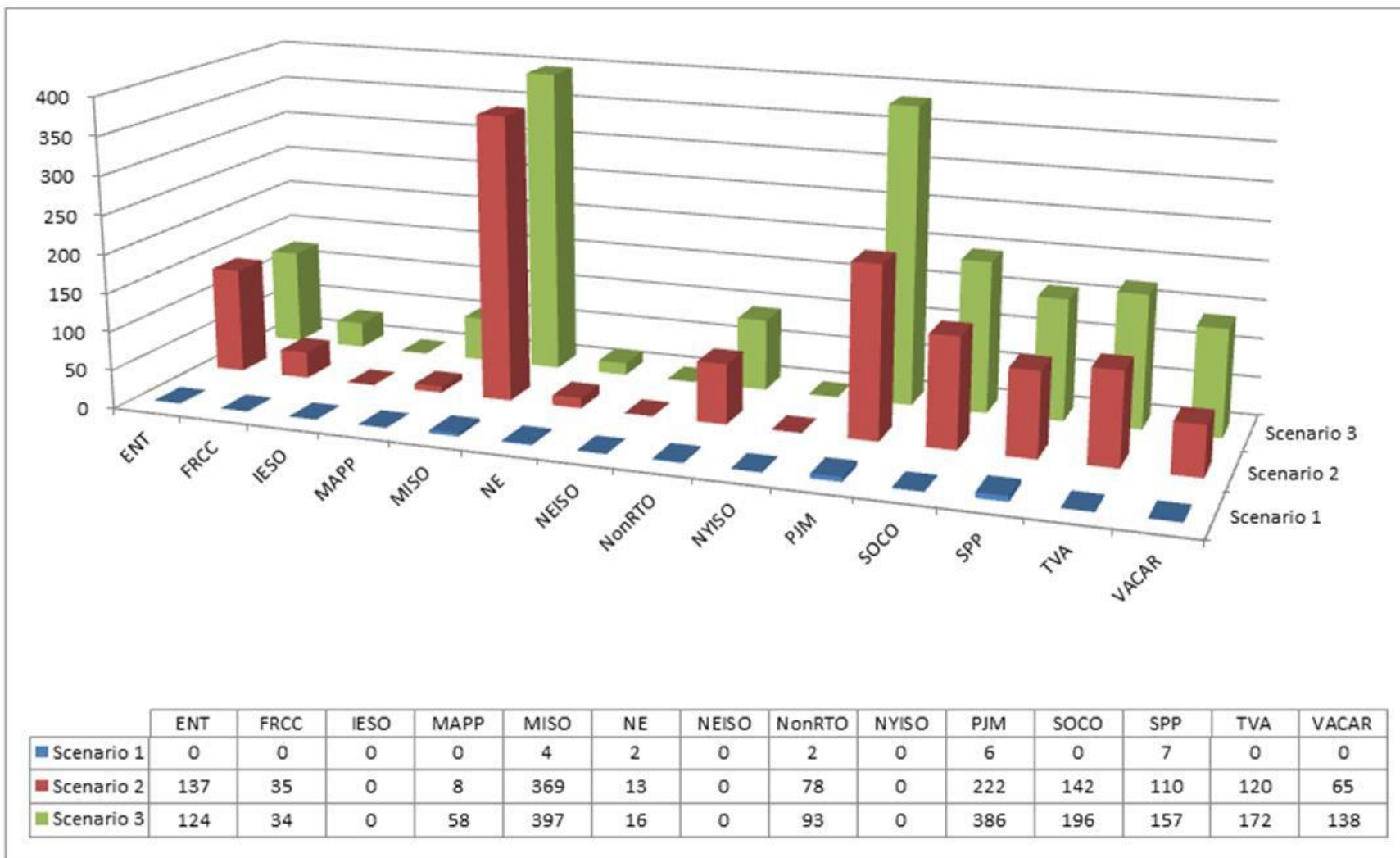


Figure A6-3. SO₂ Emissions by Region (Thousand Tons)

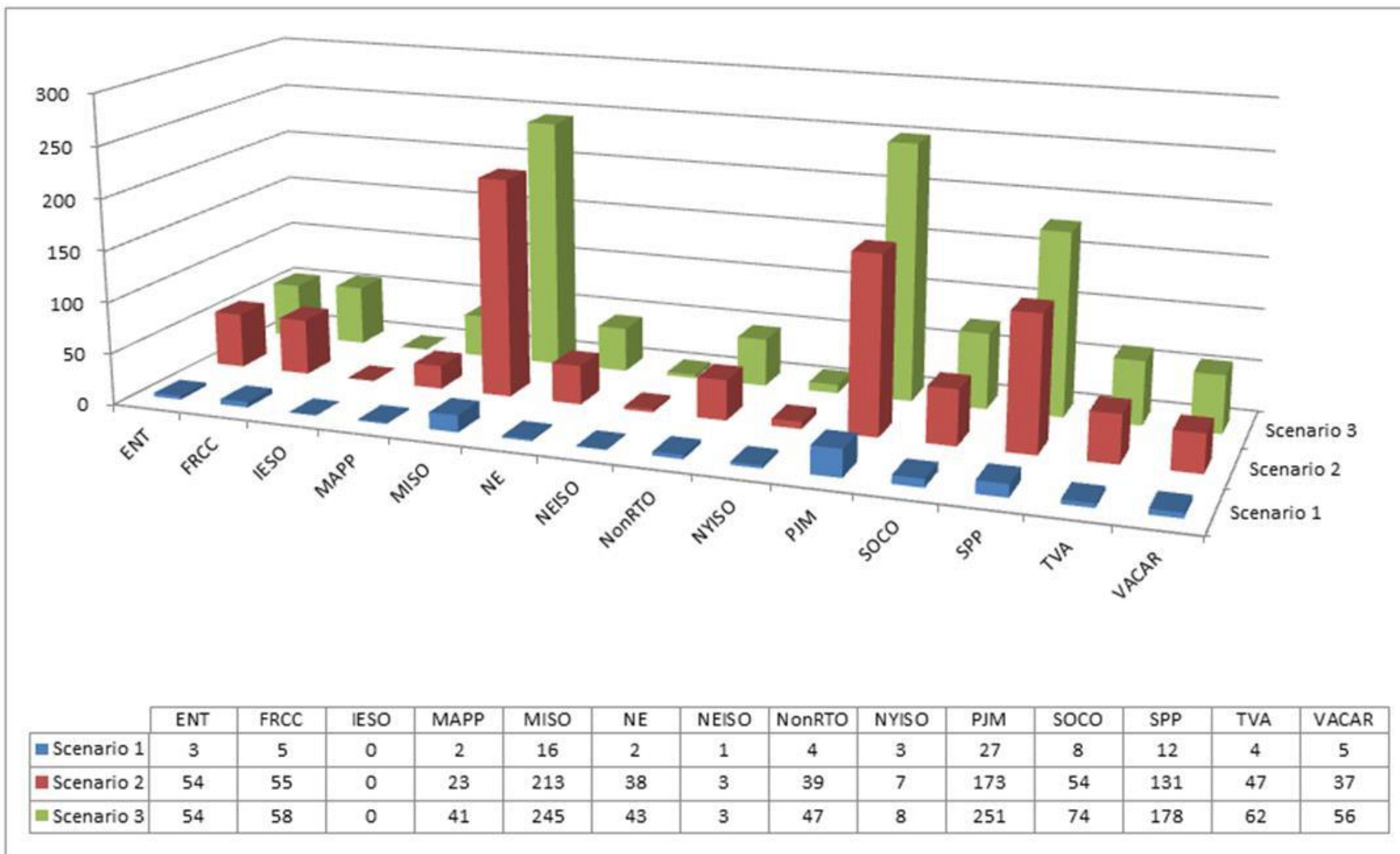


Figure A6-4. NO_x Emissions by Region (Thousand Tons)

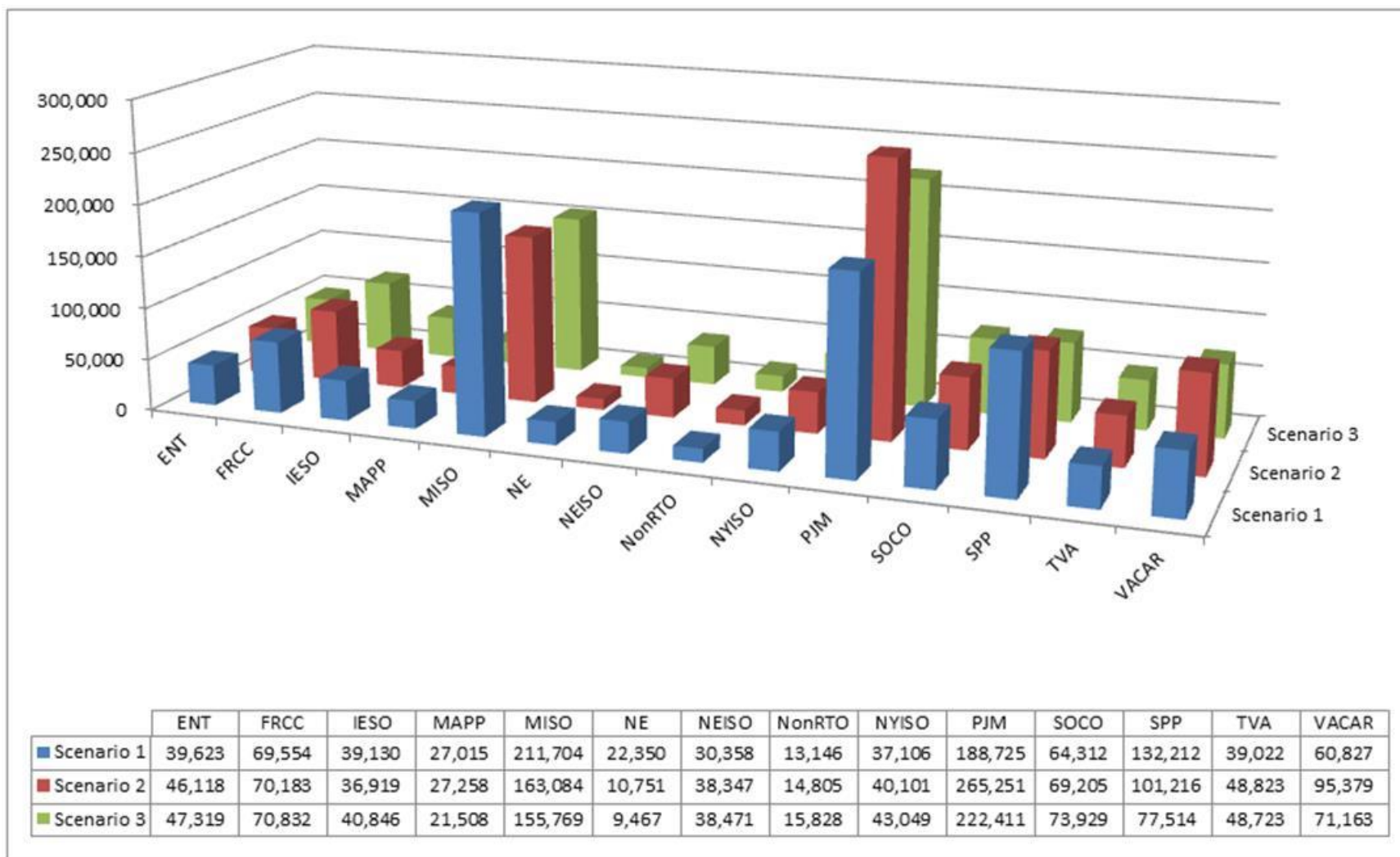


Figure A6-5. Installed Capacity by Region (MW)

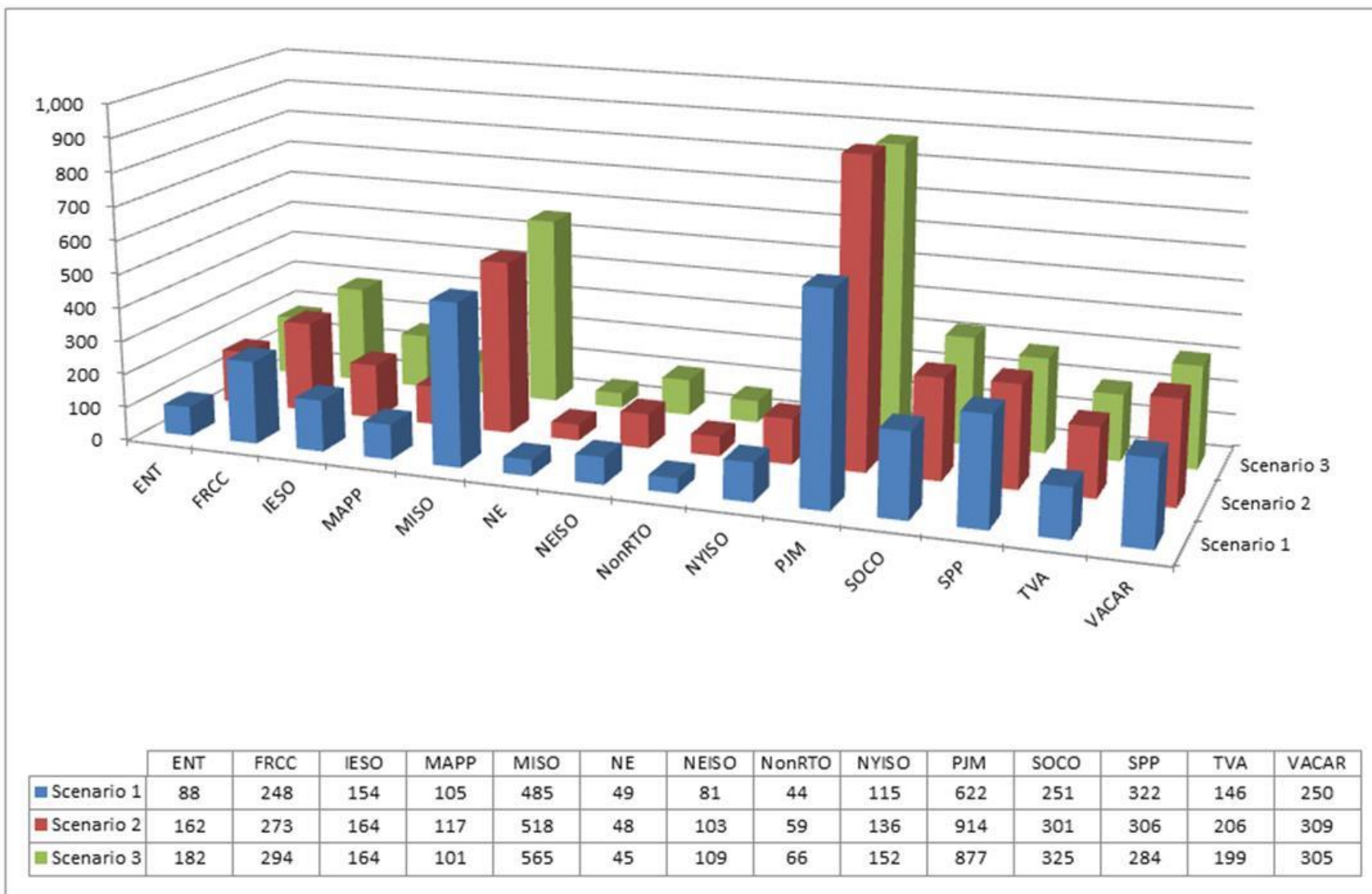


Figure A6-6. Annual Generation by Region (GWh)

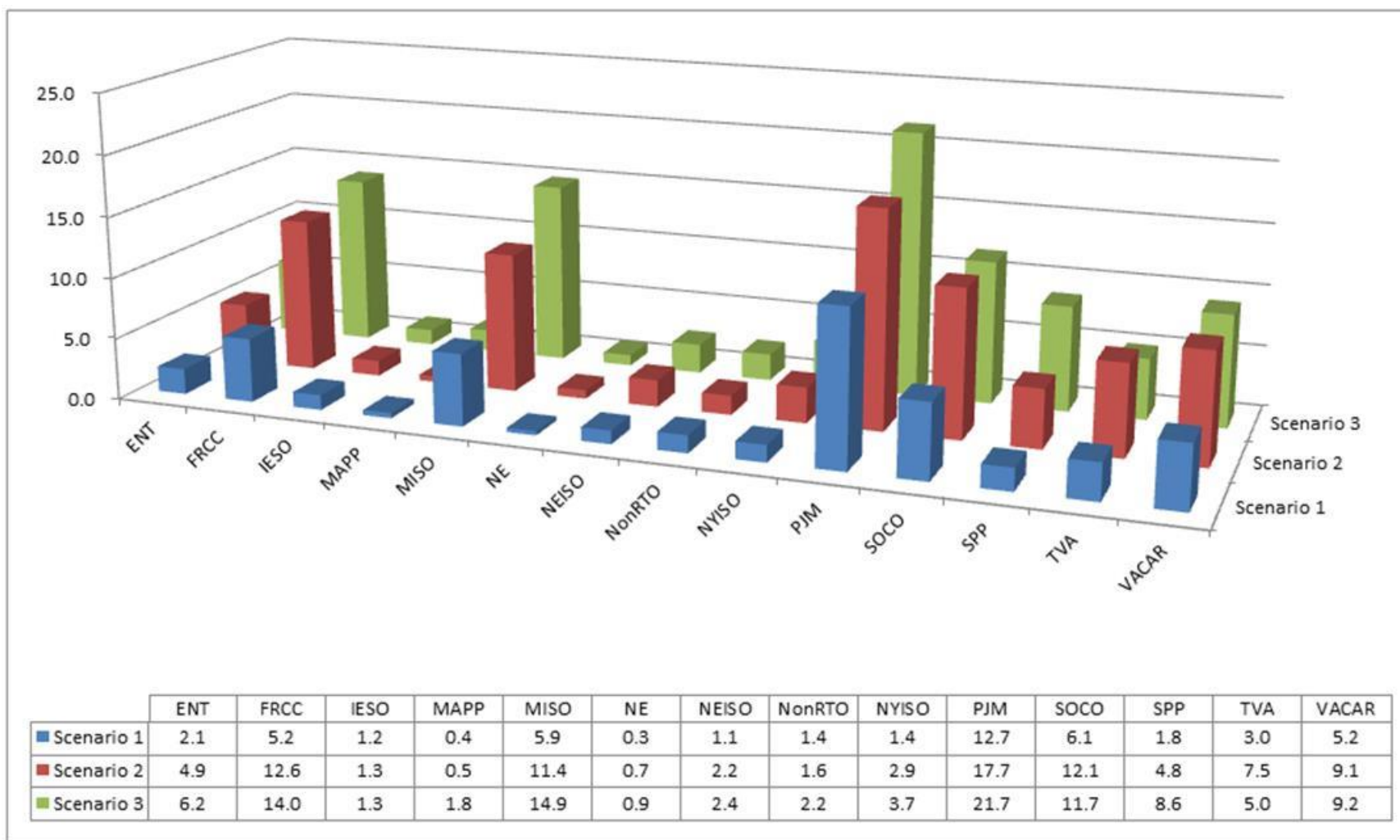


Figure A6-7. Annual Production Cost by Region (B\$)

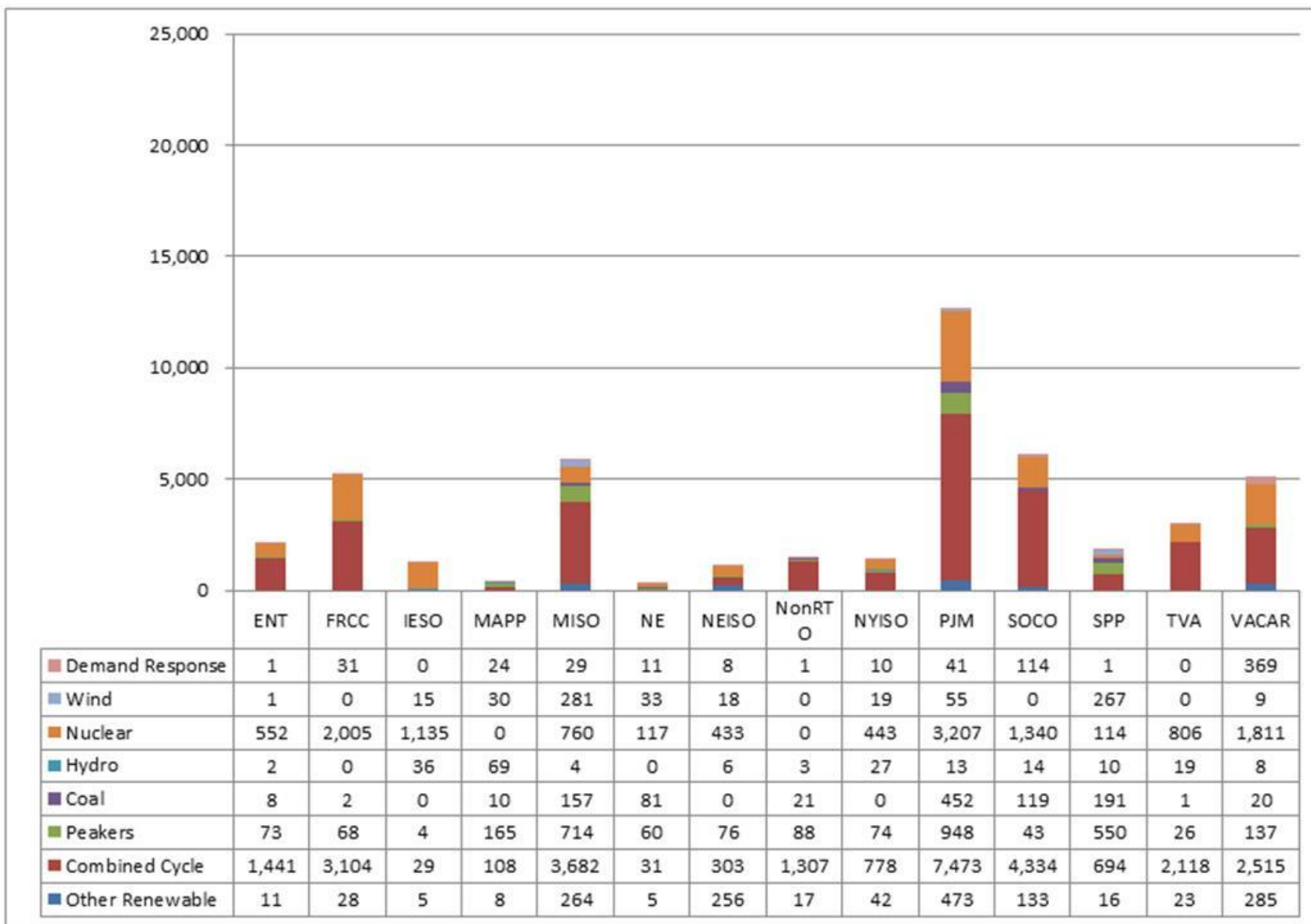


Figure A6-8. Scenario 1 Production Cost by Type (M\$)

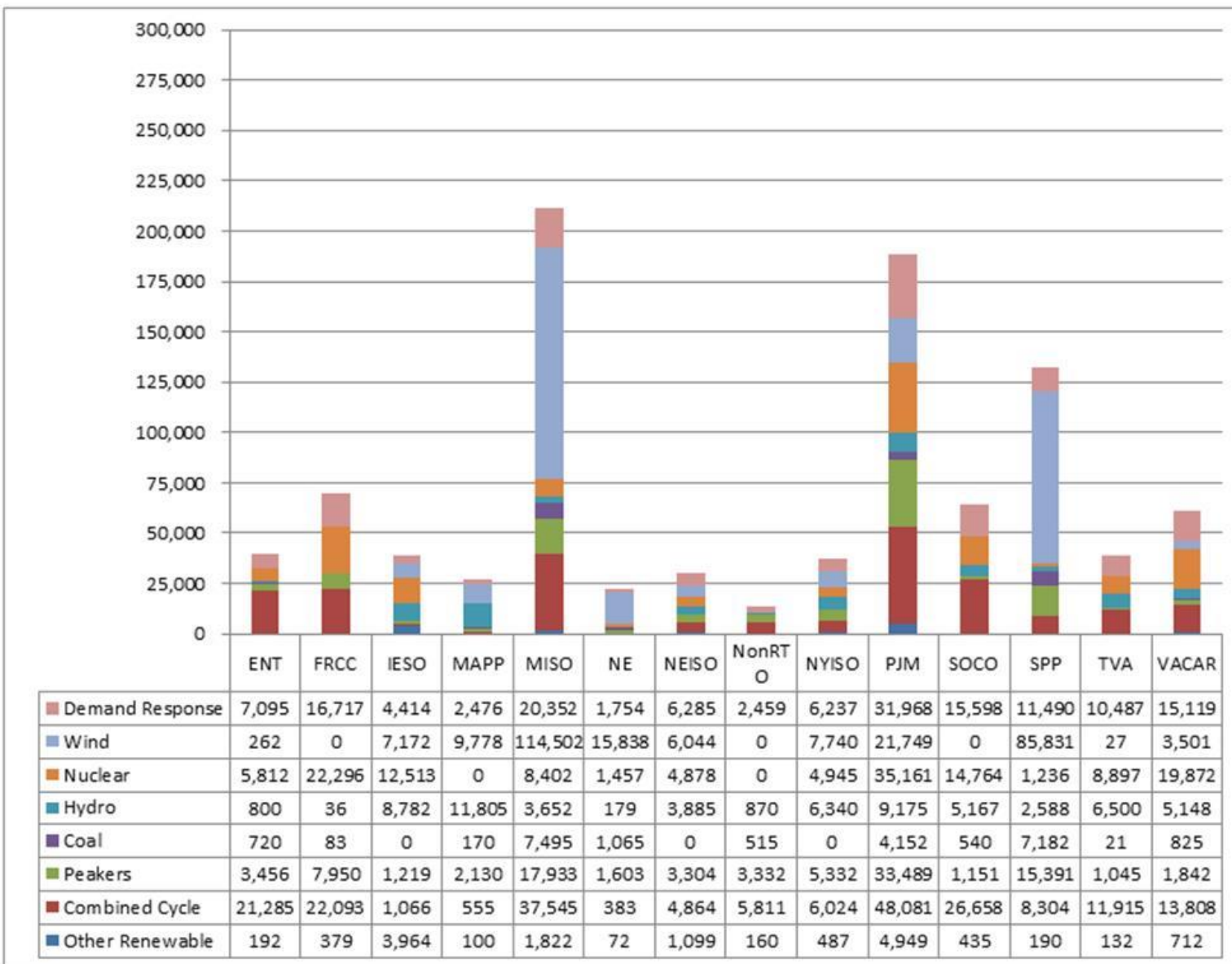


Figure A6-9. Scenario 1 Installed Capacity by Type (MW)

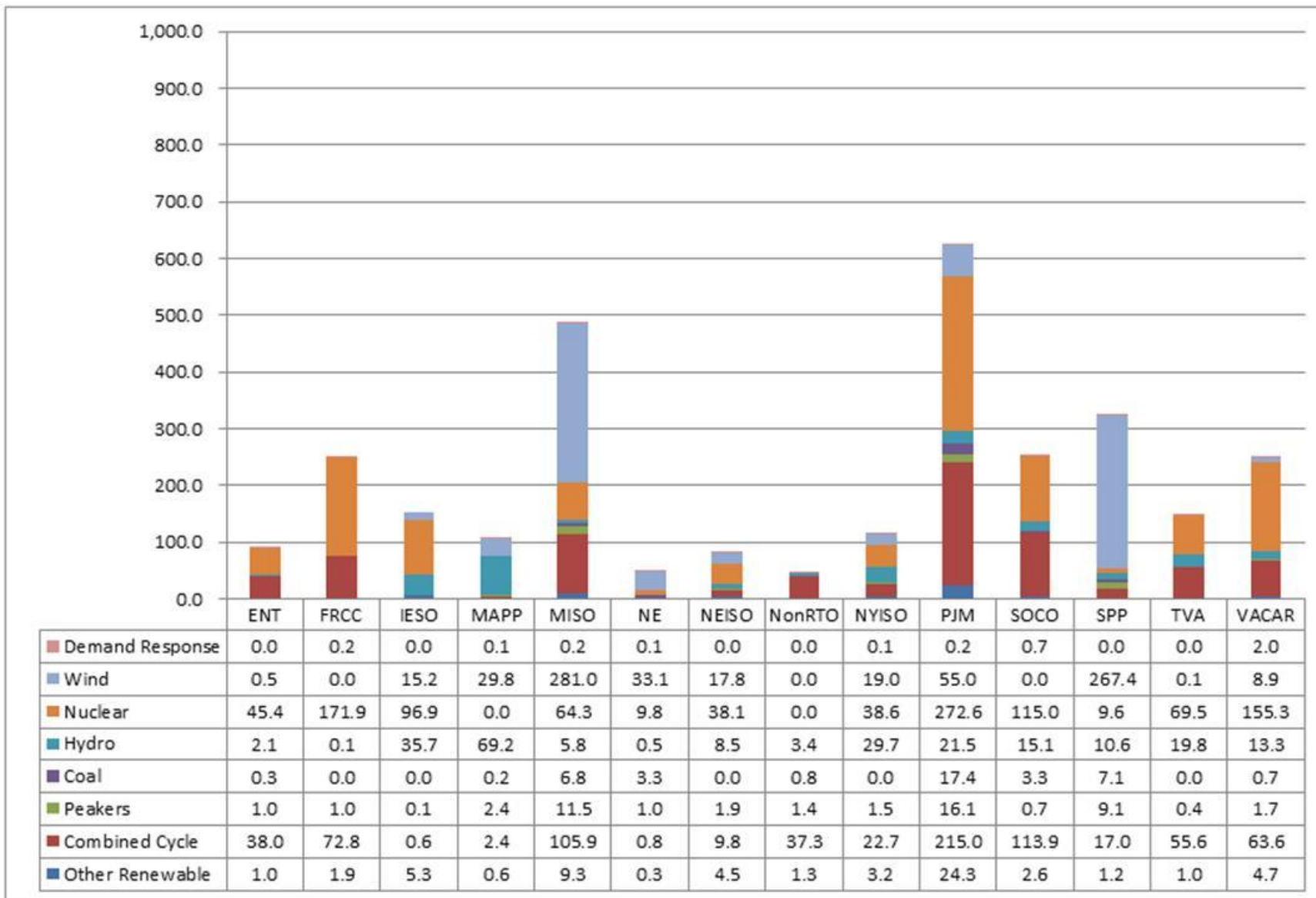


Figure A6-10. Scenario 1 Annual Generation by Type (GWh)

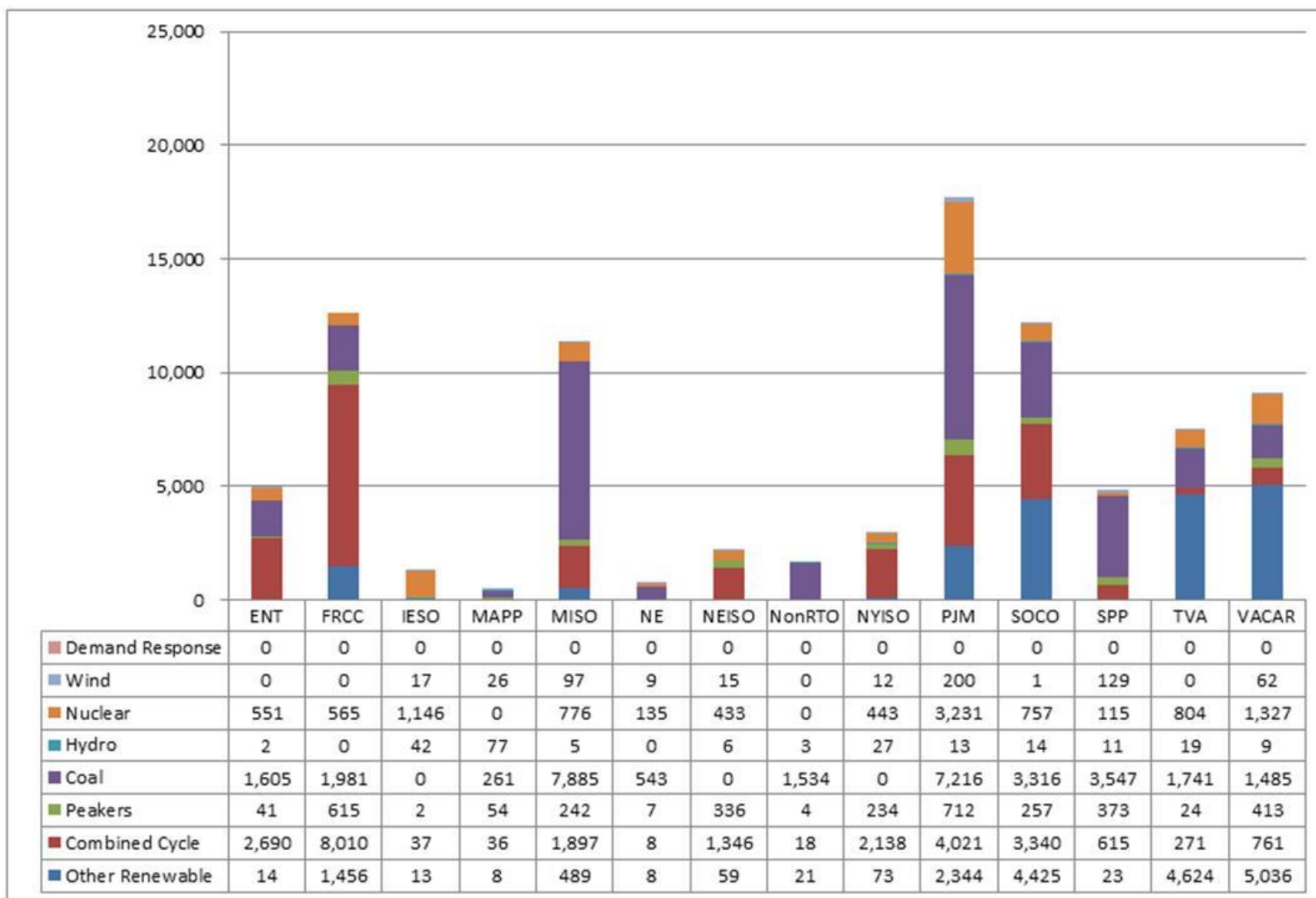


Figure A6-11. Scenario 2 Production Cost by Type (M\$)

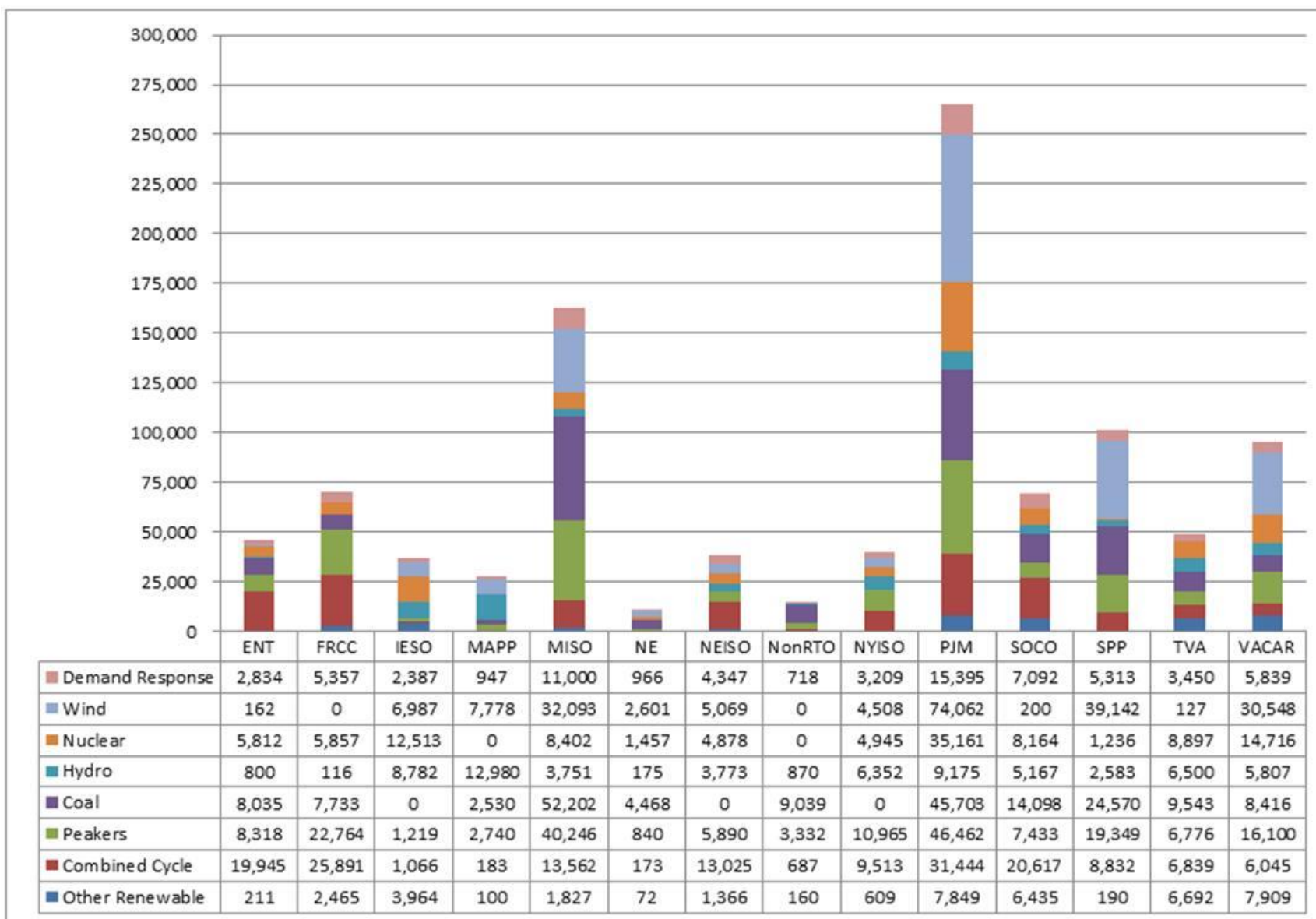


Figure A6-12. Scenario 2 Installed Capacity by Type (MW)

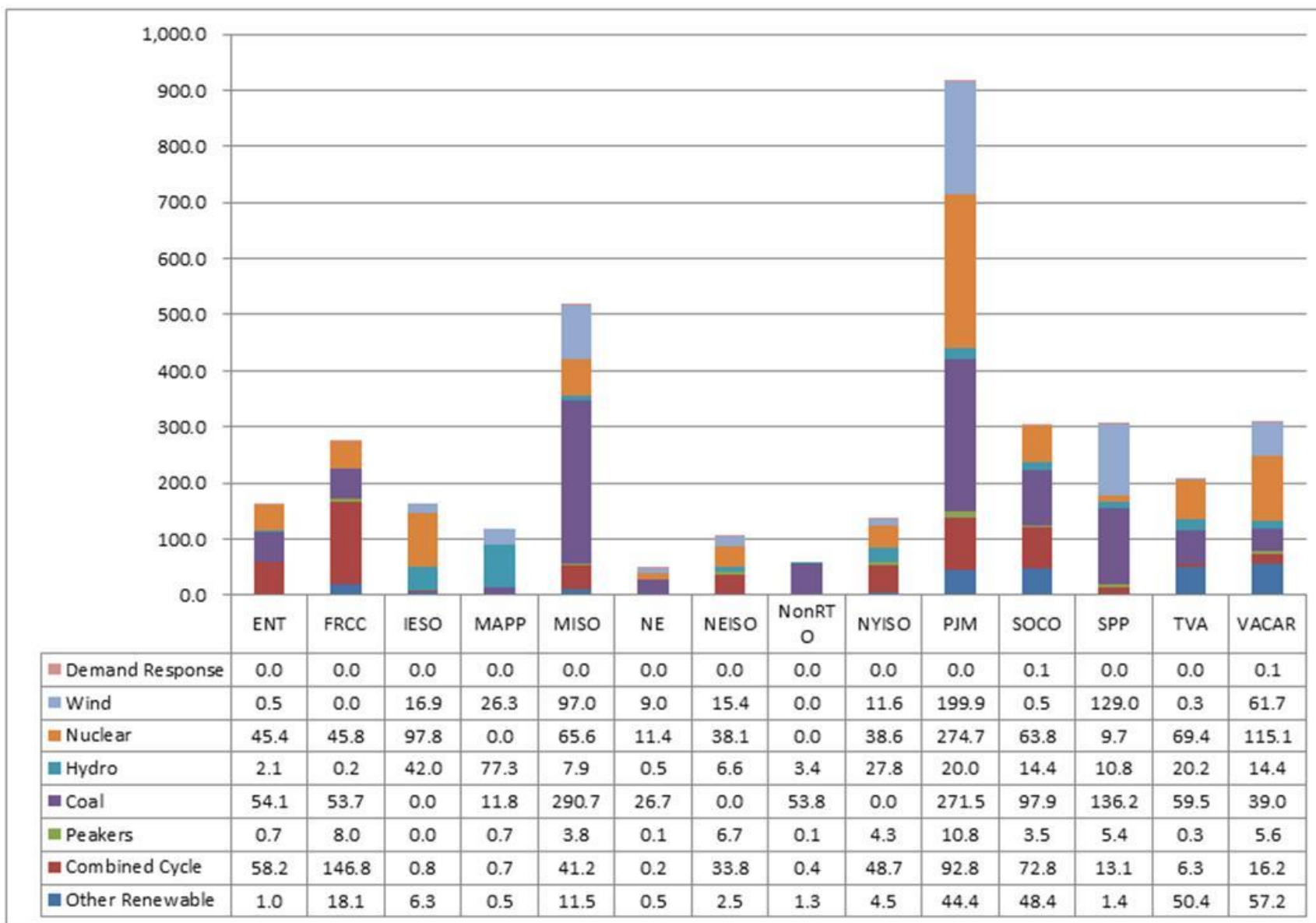


Figure A6-13. Scenario 2 Annual Generation by Type (GWh)

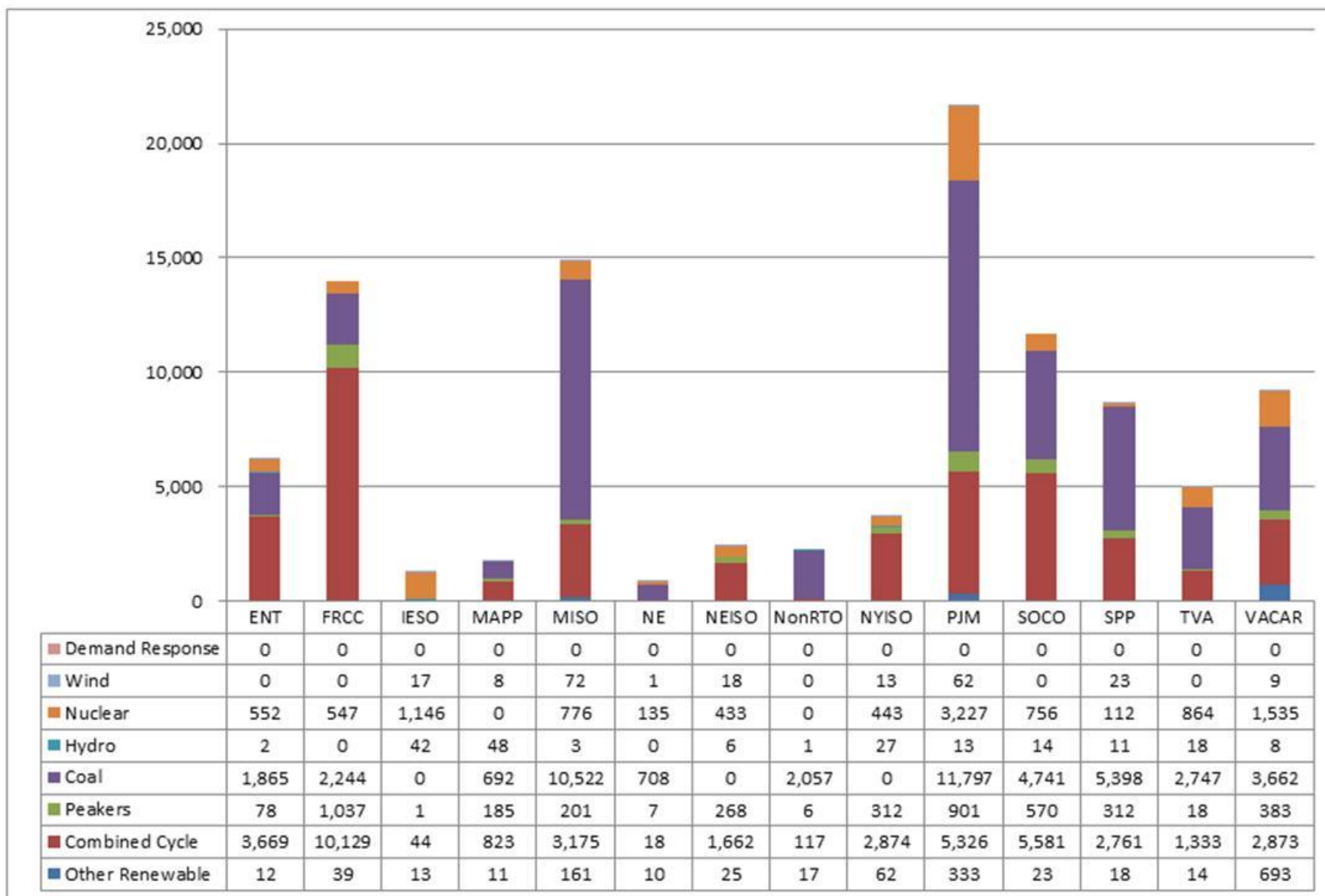


Figure A6-14. Scenario 3 Production Cost by Type (M\$)

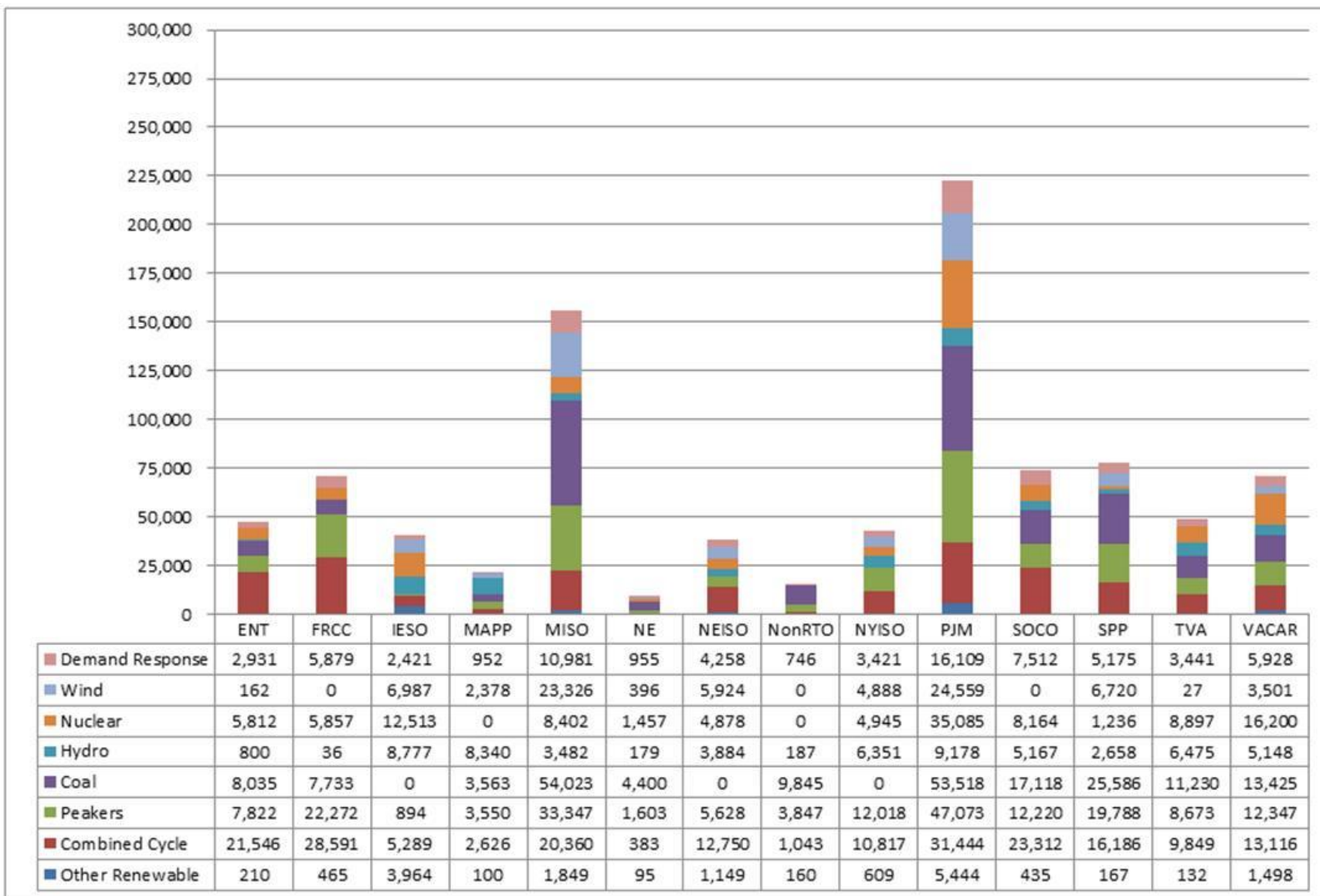


Figure A6-15. Scenario 3 Installed Capacity by Type (MW)

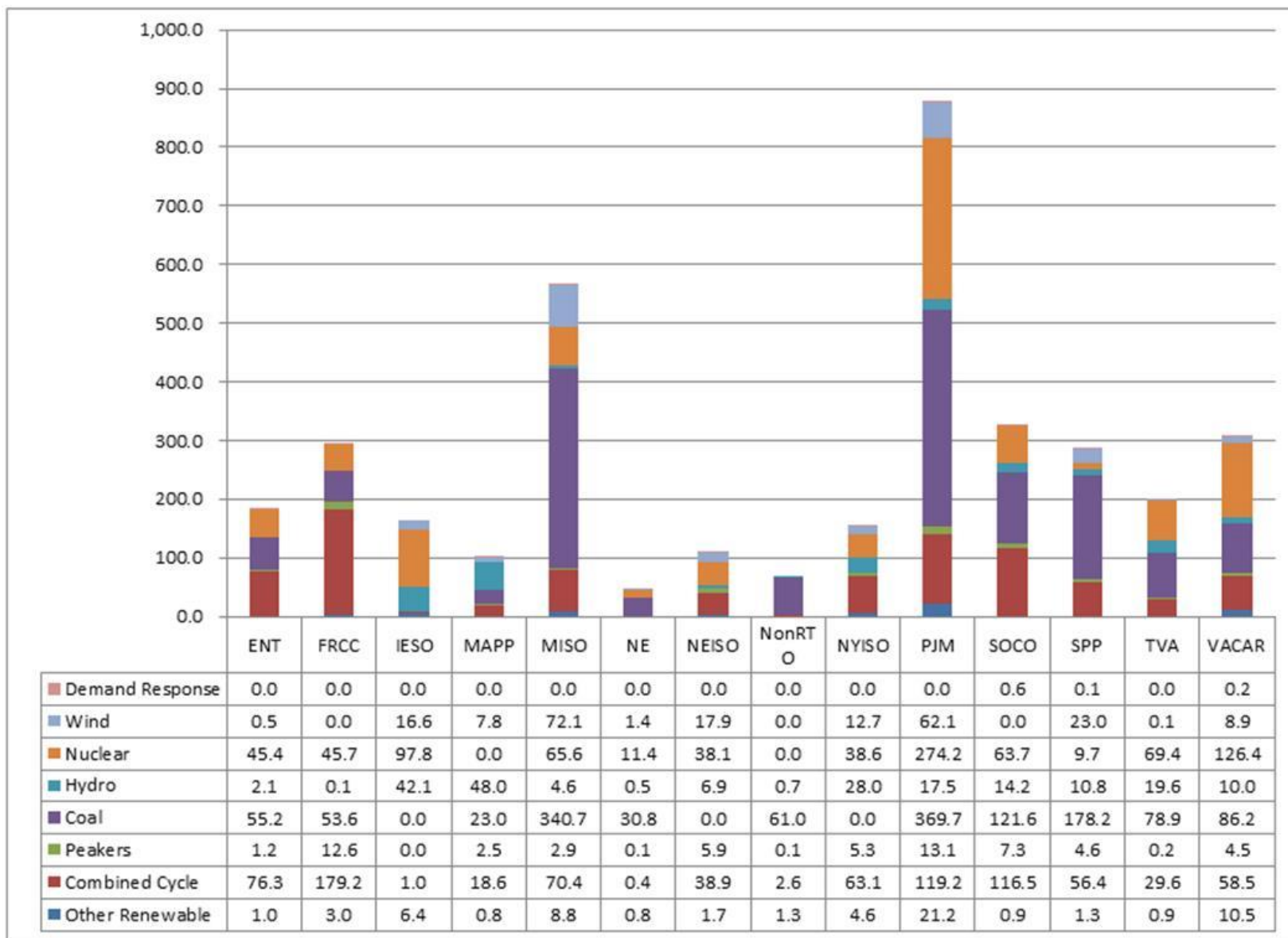


Figure A6-16. Scenario 3 Annual Generation by Type (GWh)

Appendix 7

Production Cost Sensitivity Results

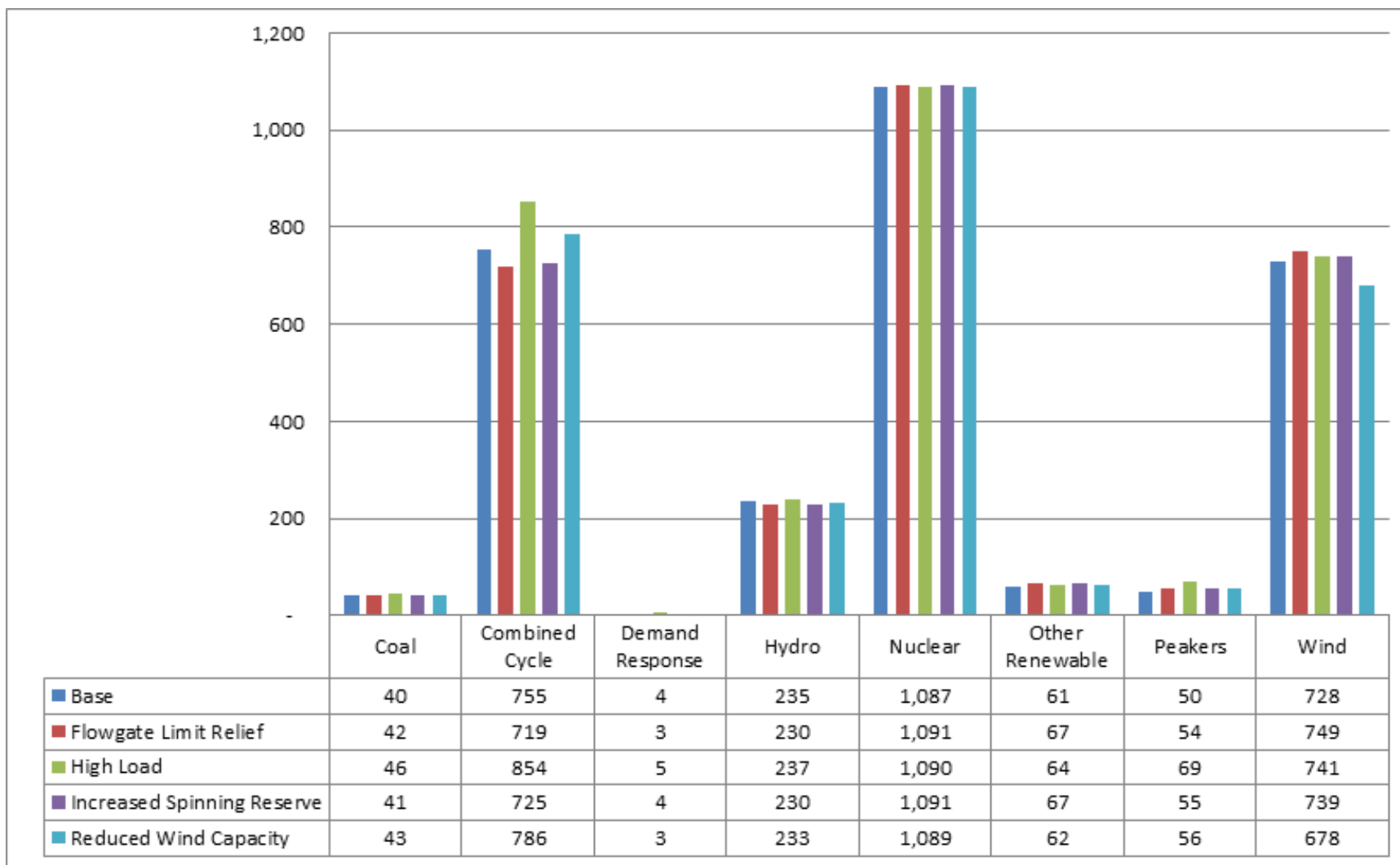


Figure A7-1. Scenario 1 Sensitivity Comparison – Eastern Interconnect Generation by Type (TWh)

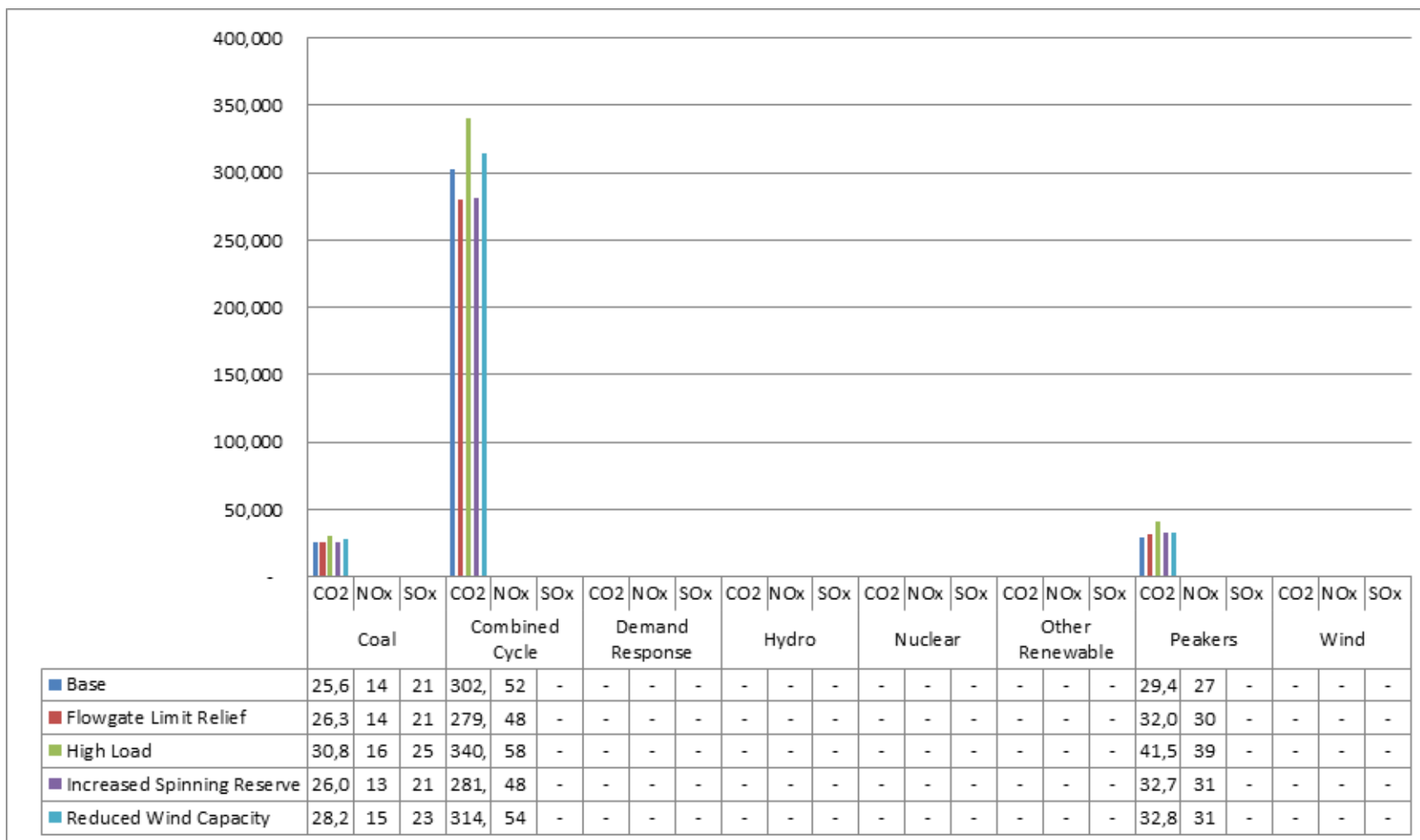


Figure A7-2. Scenario 1 Sensitivity Comparison – Eastern Interconnect Emissions by Type (1000x Tons)

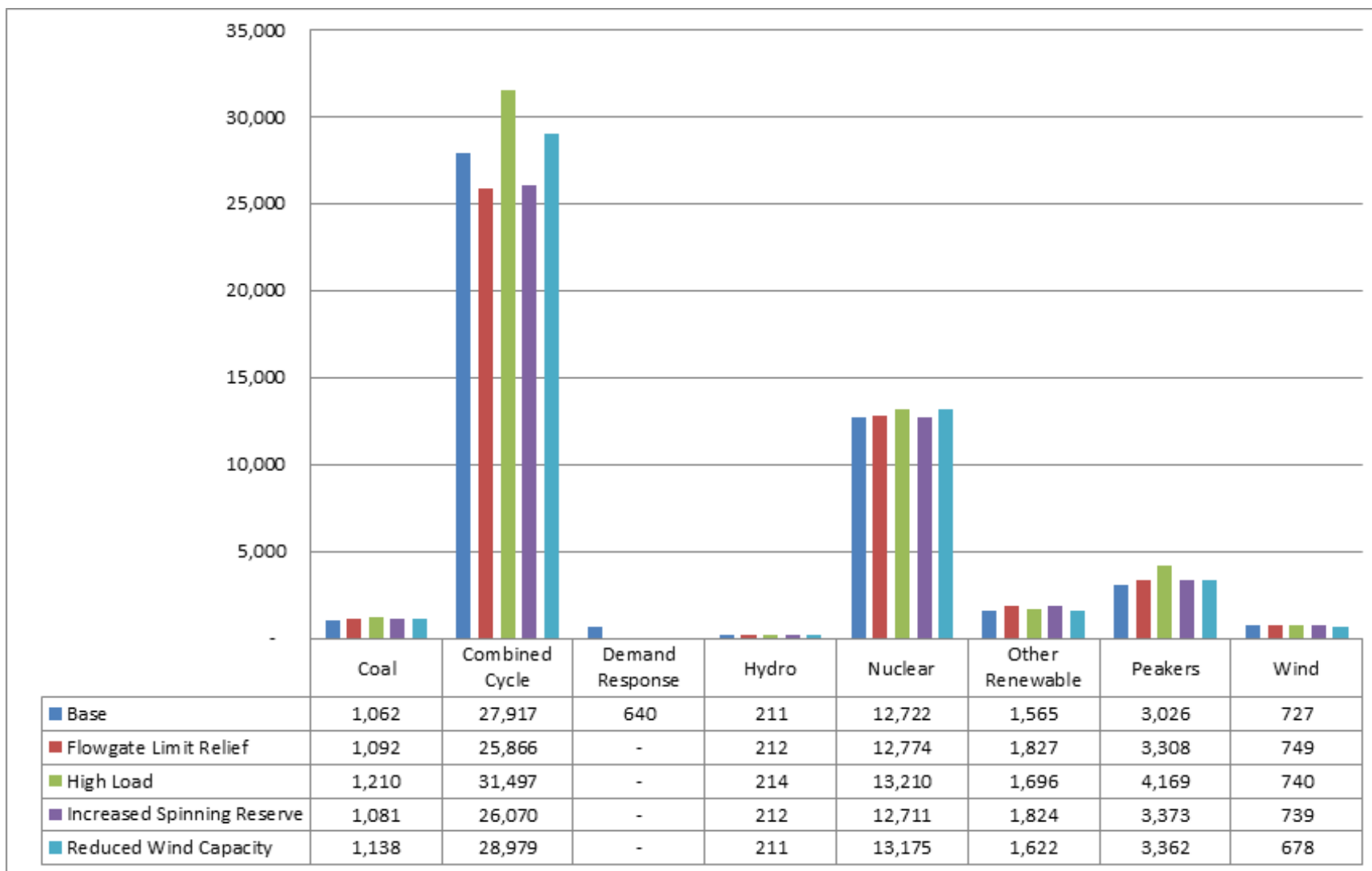


Figure A7-3. Scenario 1 Sensitivity Comparison – Eastern Interconnect Production Cost by Type (M\$)

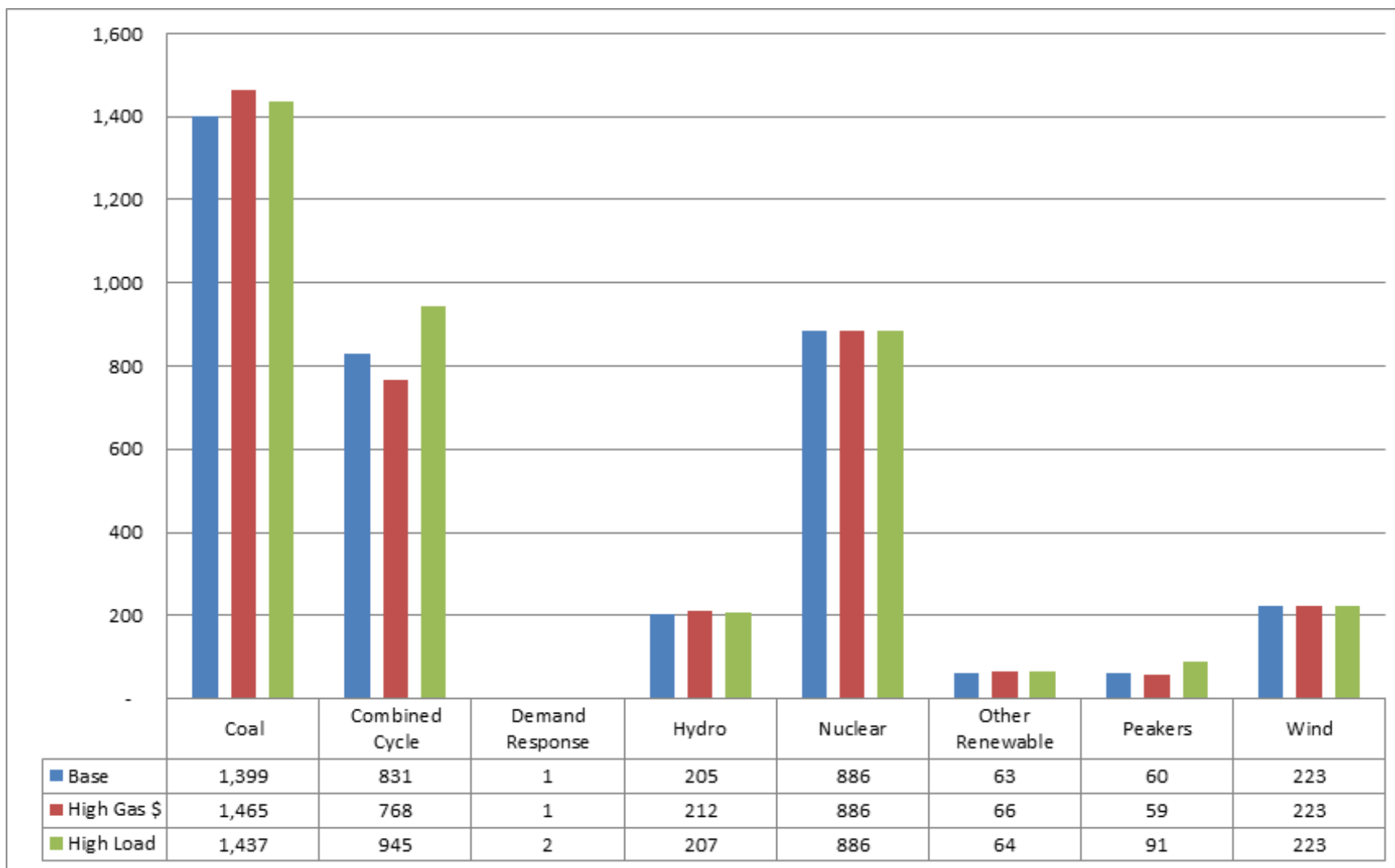


Figure A7-4. Scenario 3 Sensitivity Comparison – Eastern Interconnect Generation by Type (TWh)

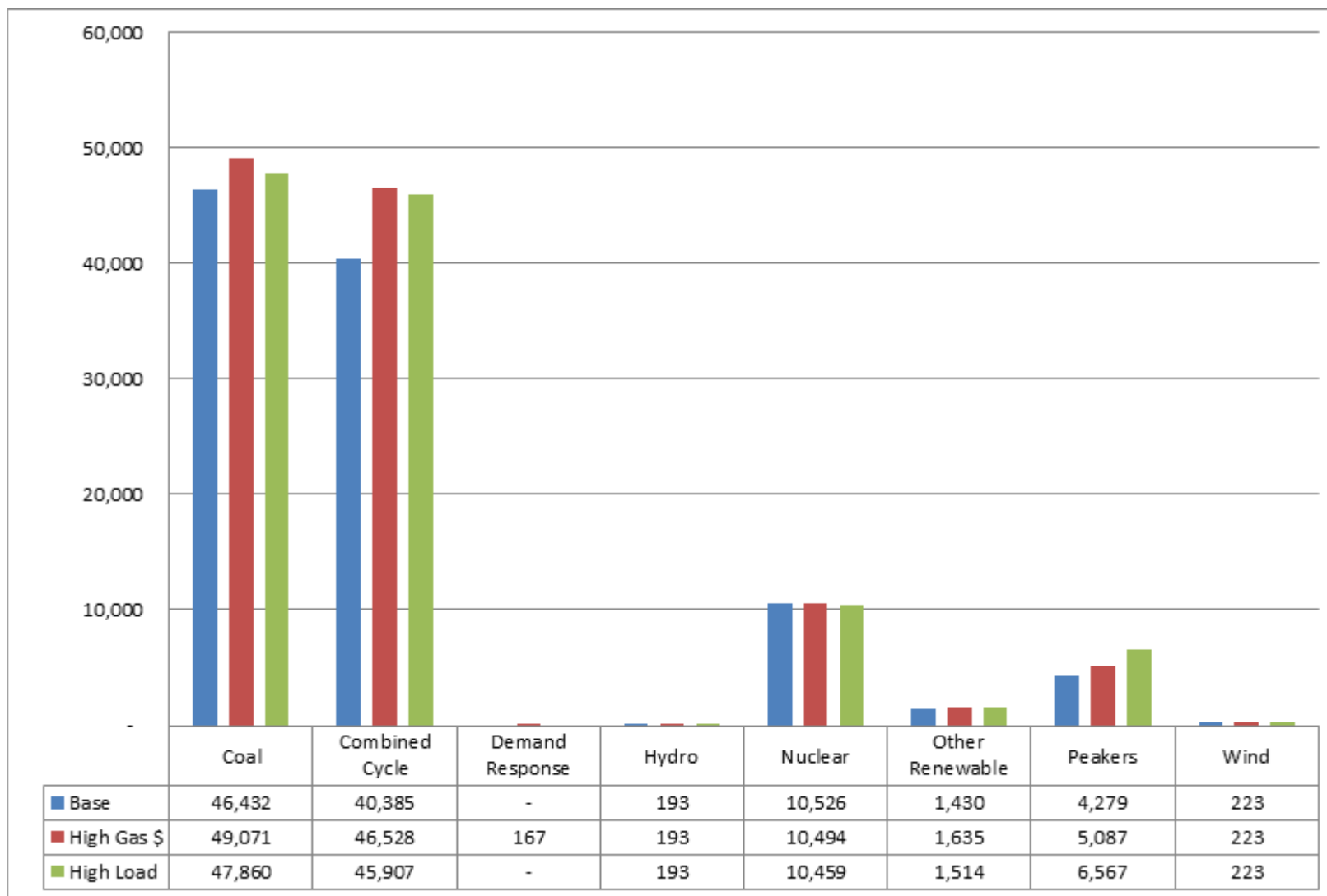


Figure A7-5. Scenario 3 Sensitivity Comparison – Eastern Interconnect Production Cost by Type (M\$)