DOCKETED	
Docket Number:	23-IEPR-03
Project Title:	Electricity and Gas Demand Forecast
TN #:	260154
Document Title:	Presentation - 2023 Demand Scenarios Project Insights and Future Work
Description:	N/A
Filer:	Bryan Hsieh
Organization:	California Energy Commission
Submitter Role:	Commission Staff
Submission Date:	11/19/2024 10:01:00 AM
Docketed Date:	11/19/2024

CEC Demand Scenarios Project – Insights and Future Work

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November 20, 2024

Acronyms and Initialisms

AAEE – Additional Achievable Energy Efficiency

ARCHES – Alliance for Renewable Clean Hydrogen Energy Systems

BAU – Business as Usual

BTM – Behind the Meter

CAISO – California Independent System Operator

CARB – California Air Resources Board

CC – Carbon Capture

CCUS – Carbon Capture, Utilization and Sequestration

CEC – California Energy Commission

CO2 – Carbon Dioxide

EV – Electric Vehicle

GHG – Greenhouse gas (emissions)

H2 – Hydrogen

IOU – Investor-owned utility

PV – Photovoltaic

SCE – Southern California Edison

TAC – Transmission Access Charge Area

VMT – Vehicle Miles Traveled

ZEAS – Zero-Emission Appliance Standard

Insights and Future Work

- Insights from the Initial Cycle of Demand Scenarios Project
  - ➢ Necessity to develop hourly projections by planning area to support electric generation resource and transmission planning
- Insights from this Cycle of Demand Scenarios
  - ➢ Need to Vet Load Modifier Assumptions with supply-side capabilities
  - ➢ Infrastructure for Production/Distribution of Hydrogen
- Topics Requiring Future Work
  - ➢ Long-term Fuel Blending Potential
  - ➢ Carbon Capture, Utilization and Sequestration

Insight: Load Modifier Assumptions

- The assumptions for the Enhanced Policy Scenario greatly expand the scale of load modifiers
- Key assumptions
  - Expanded Rooftop PV and BTM storage modifying grid-connected loads
  - AAEE scenarios reflecting more aggressive efficiency
  - CARB ZEAS greatly increase annual electricity consumption, but the hourly impacts vary greatly from season to season
  - Significant levels of passenger vehicle VMT reduction reduces energy and emissions from all vehicle types, including EVs
- Negative minimum load results have been uncovered that illustrate the need for electric generation and transmission planning studies to determine what minimum load thresholds the electricity system can accept for any future mix of generating and battery resources
- The impact of these inputs only come to light as the various components of the Enhanced Policy Scenario hourly electric load were integrated together (the last step of a scenario assessment)

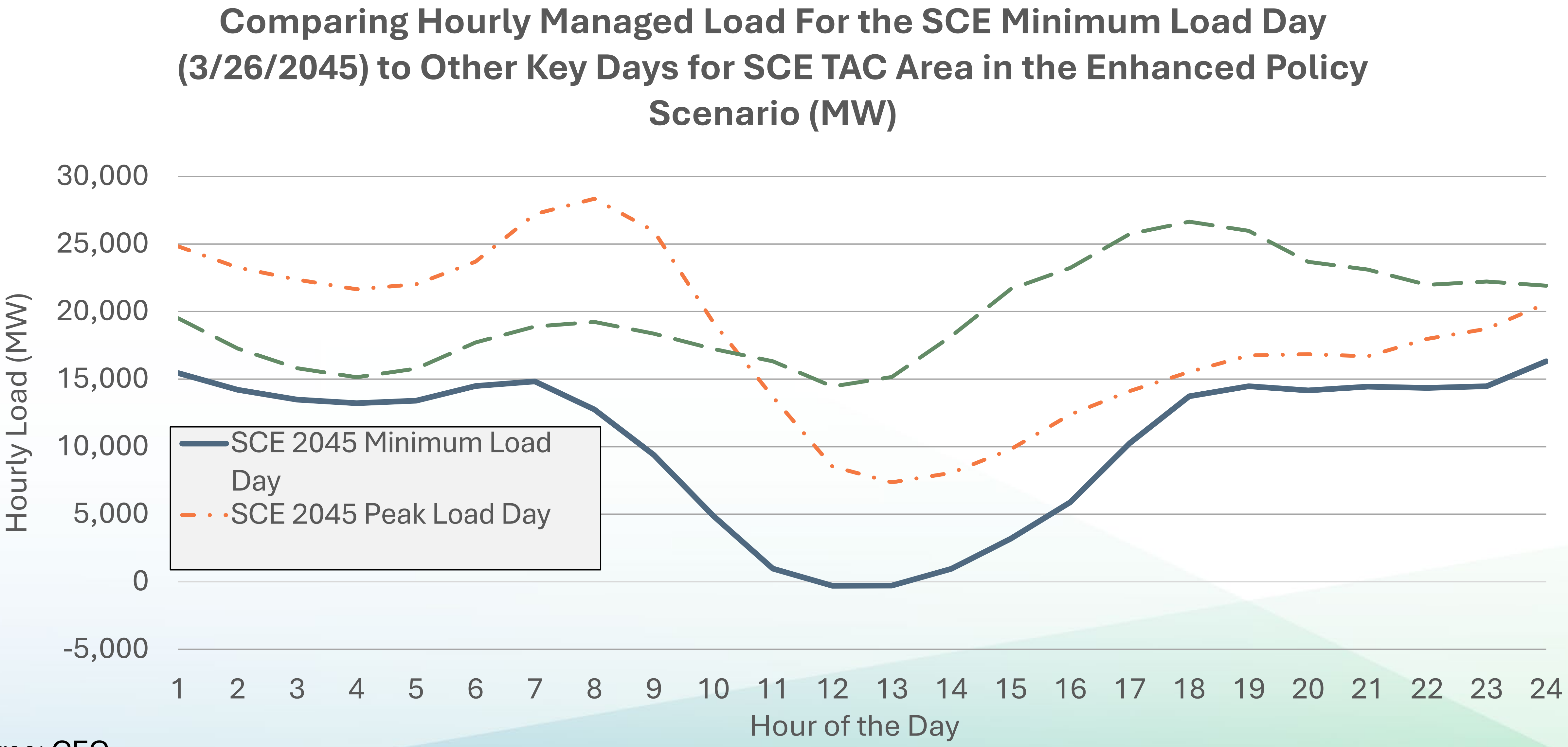
Insight: IOU Minimum Load Results

Year	PGE Peak (MW)	PGE Min	SCE Peak (MW)	SCE Min	SDGE Peak (MW)	SDGE Min
2025	21112	4357	23011	5598	4478	569
2026	21162	3718	22479	4857	4456	440
2027	21118	3120	22370	4226	4460	308
2028	21250	2597	22407	3481	4490	178
2029	21482	2067	22294	2969	4491	83
2030	21760	1574	22265	2296	4560	-33
2031	22059	1272	22452	1794	4587	-122
2041	27692	650	25816	41	5393	-298
2042	28442	763	26559	-96	5334	-358
2043	29209	613	27758	-57	5417	-378
2044	29666	584	28220	-35	5564	-377
2045	30033	565	28348	-295	5672	-380
2046	30455	398	28582	-161	5677	-397
2047	30663	205	28518	-537	5762	-368
2048	30893	153	29159	-643	5847	-463
2049	31277	-63	29645	-666	5933	-469
2050	31432	-92	29788	-848	5987	-514

Red font denotes a **negative** minimum hourly load that was found in each year for each IOU planning area

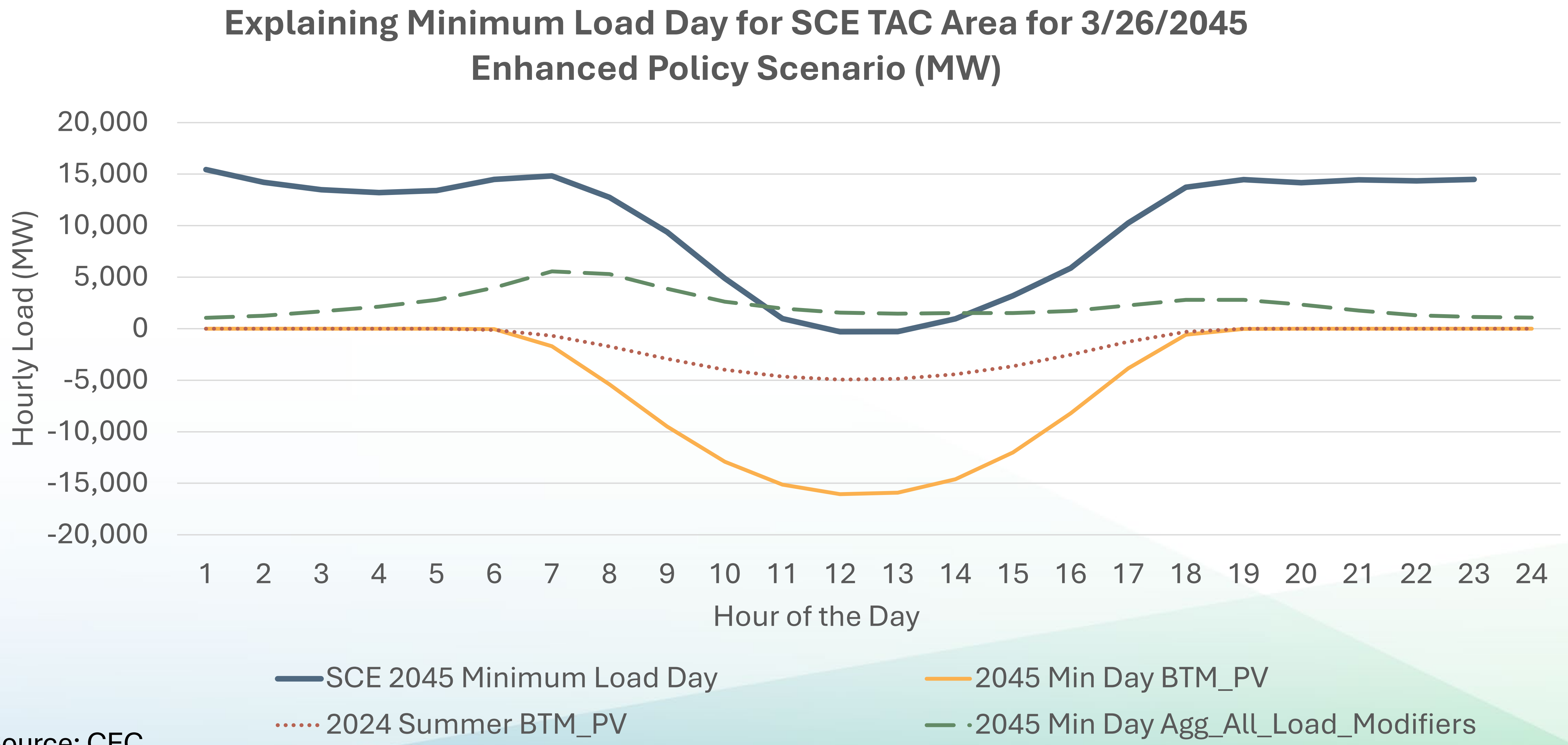
The coincident hourly loads for the CAISO area also reveal negative minimum loads in 2049 and 2050

Insight: Negative Minimum Loads



Source: CEC

Insight: Illustration of Role of BTM Solar PV



Source: CEC

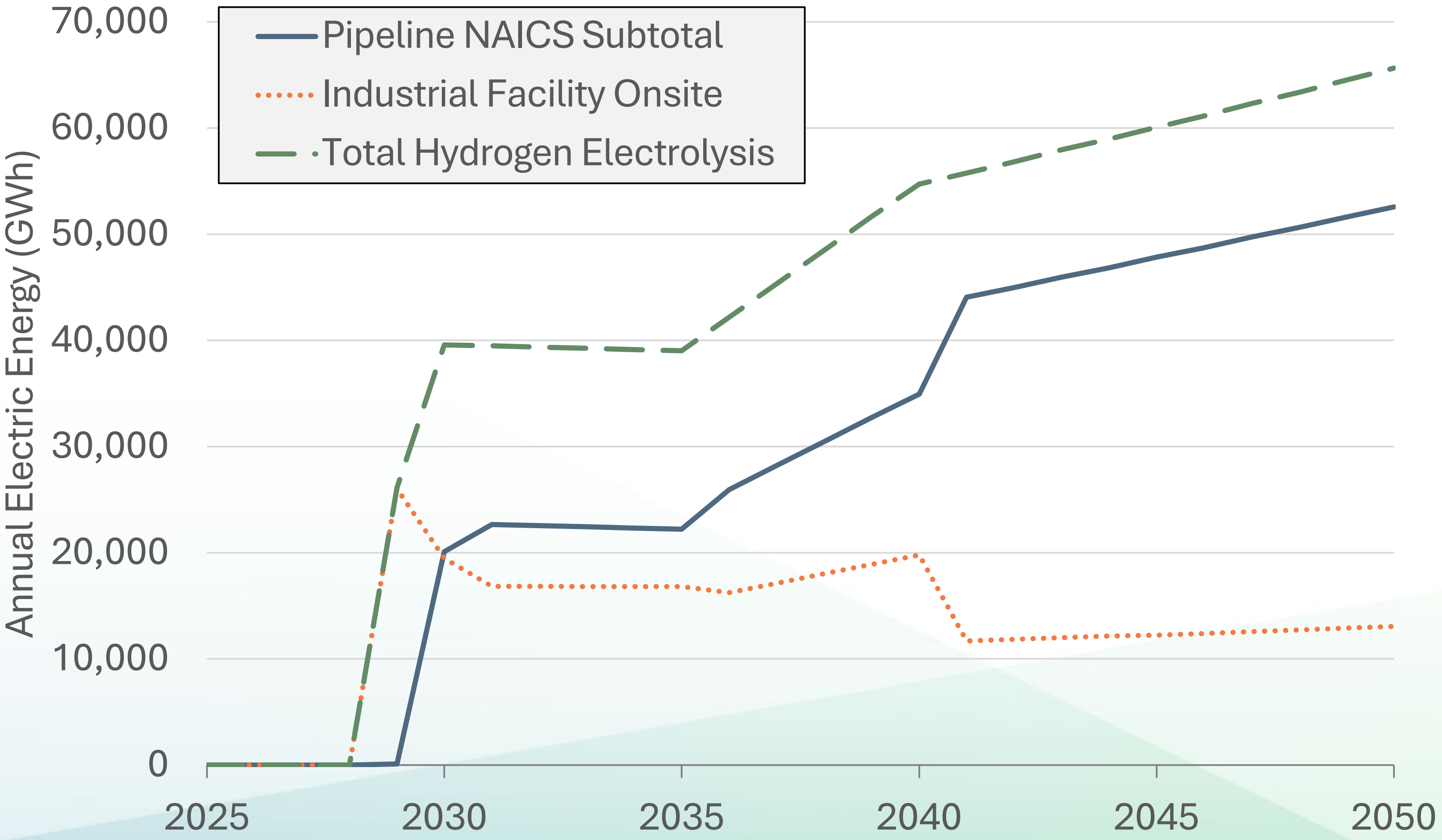
Insight: EPS H2 Pipeline Sensitivity

- Much of the support for a "Hydrogen Economy" rests on the requirement that Hydrogen be produced by electrolysis supported by renewable electricity generation
- Virtually all hydrogen produced and consumed in California today uses steam methane reforming
- Devising scenarios for the expansion of hydrogen consumption necessarily confronts what mixtures of technologies are assumed for its production and delivery
- Collaborations of producers, pipeline developers, and numerous consumers need to be created to turn "talk" into financial commitments to build infrastructure
- The public-private ARCHES partnership is an example that emphasizes consumption by powerplants, ports, and trucking
- The EPS H2 Pipeline Sensitivity was developed to explore industrial-oriented hydrogen usage to replace pipeline gas used for industrial Process Heat-High applications
- The results of this sensitivity are illustrative of many possible futures, and the Ag and Industrial FSSAT module can be used to examine more of them. **These results are not a forecast!**

Insight: Electricity Usage - EPS H2 Pipeline Sensitivity

- Hydrogen delivery pipelines allow H2 electrolysis location in areas favorable to renewable generation
- H2 pipelines carry H2 from point of production to end-users
- In the EPS H2 Pipeline Sensitivity the majority of electric load is assumed to come from renewables located and operated in a "grid-friendly" manner
- Like the SB100 High Hydrogen Use sensitivity, this requires supply-side assessments that are not yet available
- Alternative sets of H2 usage and production assumptions would have different results

Electric Load from Methods of Hydrogen Production through Electrolysis Statewide, EPS H2 Pipeline Sensitivity (GWh)



Source: CEC

Future Work: Decarbonization via Fuel Blending

- The Demand Scenarios projects uses the term fuel blending to describe how the composite properties of fuel types evolve through time as non-carbon, low-carbon components or carbon products with no net GHG emissions are blended with traditional components inputs.
- Although the Demand Scenarios project mainly investigates the consequences of fuel substitution, such as pipeline gas replaced by electricity in buildings, some fuel types can be decarbonized with little or no change in end-user equipment.
  - As an example, diesel fuel has reached about 56% bio-diesel and renewable diesel components, greatly changing the emission factor for the “blended” product used mainly by trucks
- There is a wide range of methods by which traditional fuel types can be partly or fully decarbonized.
  - Low Carbon Fuel Standard is a CARB program (supported by the CEC) that is designed to decrease the carbon intensity of California's transportation fuels
  - Other programs could be devised to utilize fuel blending as either a transitional or long-term means to achieve California’s GHG reduction goals
- Unfortunately, making long term projections for fuel blending is beyond the scope of the demand scenarios project and requires much more extensive supply-side analysis capabilities than the CEC currently possesses to assess feasibility or cost-effectiveness compared to straight fuel substitution

Future Work: Carbon Capture, Utilization and Sequestration

- CARB's 2022 Scoping Plan includes GHG emission reductions from Carbon Capture in the refinery and cement industries, but does not address how the carbon is captured or sequestered
- The DS project team considered assessing CCUS but determined that capability was limited to assessing only the incremental increase in electricity and waste heat required to operate CC technologies
- The DS project did not have the resources to examine utilization and sequestration, and the energy impacts of these two "downstream" uses for captured CO2
- CCUS and direct air capture technologies require new assessment capabilities, especially the geoengineering aspects of piping captured CO2 from "source" to "sink" and the engineering aspects of transforming CO2 into useful products or sequestering it in suitable reservoirs

Thank You!

Questions?

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