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Production Cost Model Common Case Input Assumptions and Select Results

2019 Integrated Energy Policy Report **California Energy Commission**

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California Energy Commission

Date: March 4, 2019





Topics

- Common Case Overview
- Load Forecast for CA and Rest of WECC
- Significant Retirements / Additions
- Updated Hydro Generation Input
- Natural Gas Price Comparison
- Select Simulation Results
 - Natural Gas Demand for Electric Generation
 - GHG Emissions Projections



Preliminary 2019 IEPR

Common Cases

Common Case	2018 IEPR Update Load Forecast	2018 IEPR Update AAEE	RPS Target
High Energy Consumption	High	Low	60% by 2030
Mid Energy Consumption	Mid	Mid	60% by 2030
Low Energy Consumption	Low	High	60% by 2030



Preliminary 2019 IEPR Load Forecast

- California Loads - IEPR 2018 Update

https://www.energy.ca.gov/2018_energypolicy/documents/

- Rest of WECC Loads – TEPPC 2028 Common Case

<https://www.wecc.org/SystemStabilityPlanning/Pages/AnchorDataSet.aspx>

- Years 2029 & 2030 load forecast created using average annual growth rate from 2017-2028 applied to 2028 loads



Preliminary 2019 IEPR Load Forecast Development

Revised 2019 IEPR simulations will use the Demand Office hourly profiles for California IOUs.

Hourly Load Profile Update – Mr. Load Shape Tool

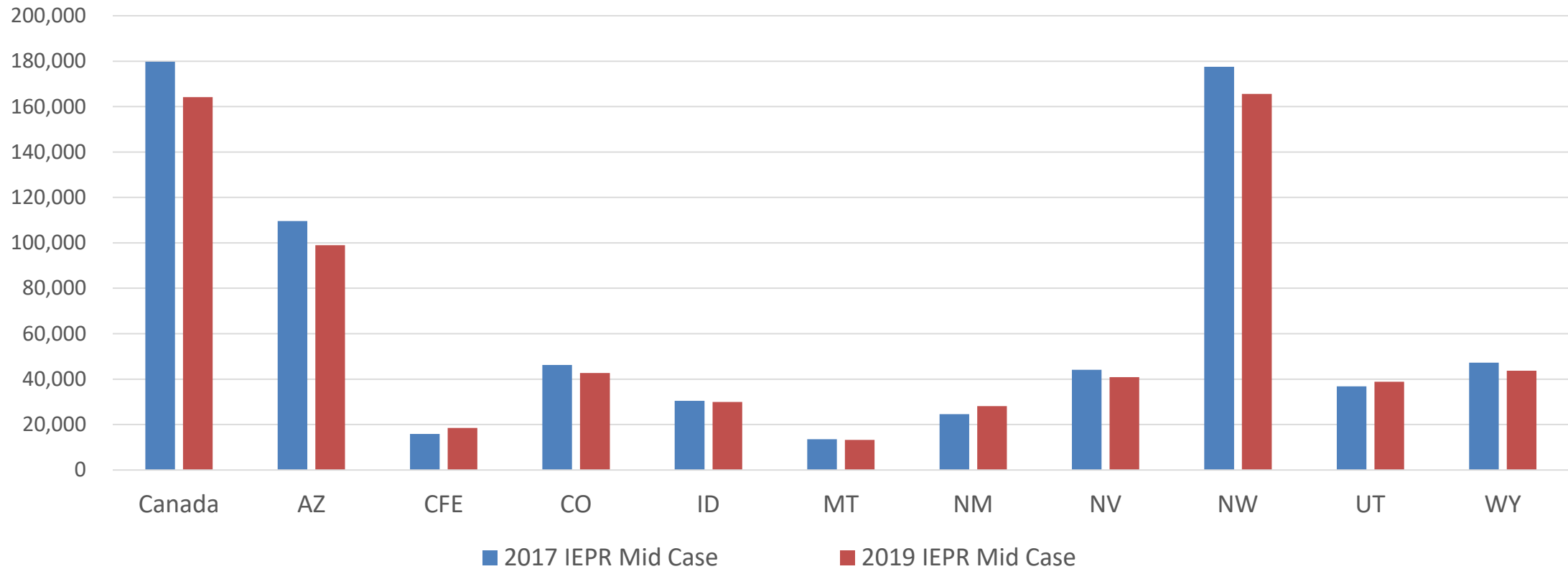
Spreadsheet tool that develops synthetic hourly load profiles based on the most recent 5 years historic loads.

Continue to use the Mr. Load Shape synthetic hourly load profiles for CA non-CAISO and rest of WECC.



2028 Rest of WECC Demand Forecast

Preliminary 2019 IEPR to 2017 IEPR



Sources: AESO and EIA Form 714



Preliminary 2019 IEPR

Retirements / Additions

- CA OTC Compliance Schedule @ https://www.energy.ca.gov/renewables/tracking_progress/documents/once_through_cooling.pdf
- CAISO Retired & Mothball List @ <http://www.caiso.com/Documents/AnnouncedRetirement-MothballListPosted011019.html#search=retired%20and%20mothballed>
- Subscription Database / Trade Press / 40-year “rule” / WECC ADS

Compliance plans are identical across all common cases



CA and WECC Retirements

Type	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	Total
CA NG	3,051	4,820	179	29	239	201	358	383	276	317	638	1,013	11,504
CA Nuclear						1,140	1,140						2,280
CA Coal					22								22
WECC Coal	3,367	1,288	380	2,121	0	1,660	1,545	1,349	1,449	2,171	1,170	370	16,869



Preliminary 2019 IEPR

Retirements / Additions

- CEC Siting Division
- Subscription Database / Trade Press / WECC ADS
- “Generic” Thermal Additions for PRM
- “Generic” Renewable Additions for RPS Requirements



Mid Demand Projected In-State Renewables (for ~70% of RPS req.)

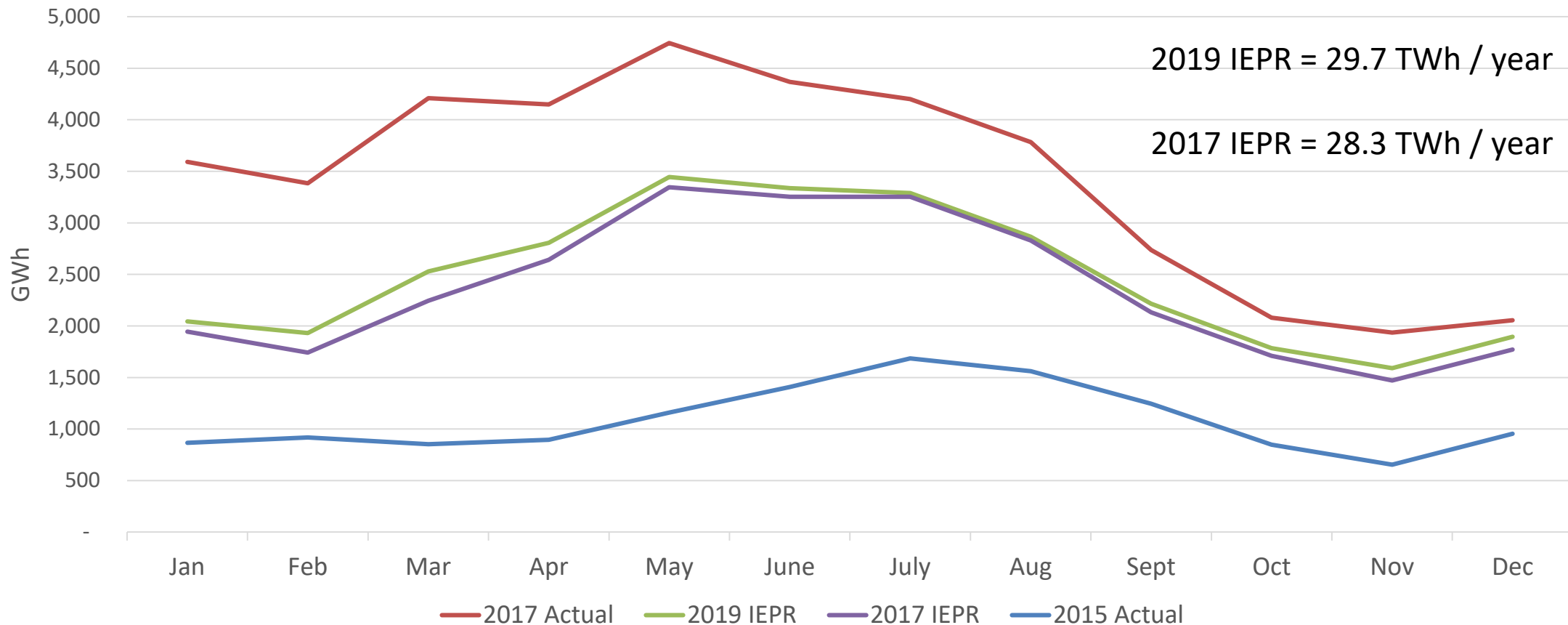
- Capacity by Resource Type (MW)

	2019		2025		2030
Biomass/LFG	1,563		1,708		1,909
Geothermal	1,697		1,867		2,137
Solar	13,593		17,319		22,412
Wind	6,742		8,152		9,158
Total MW	23,595		29,046		35,616

CA 2030 RPS Req: 143,707 GWh

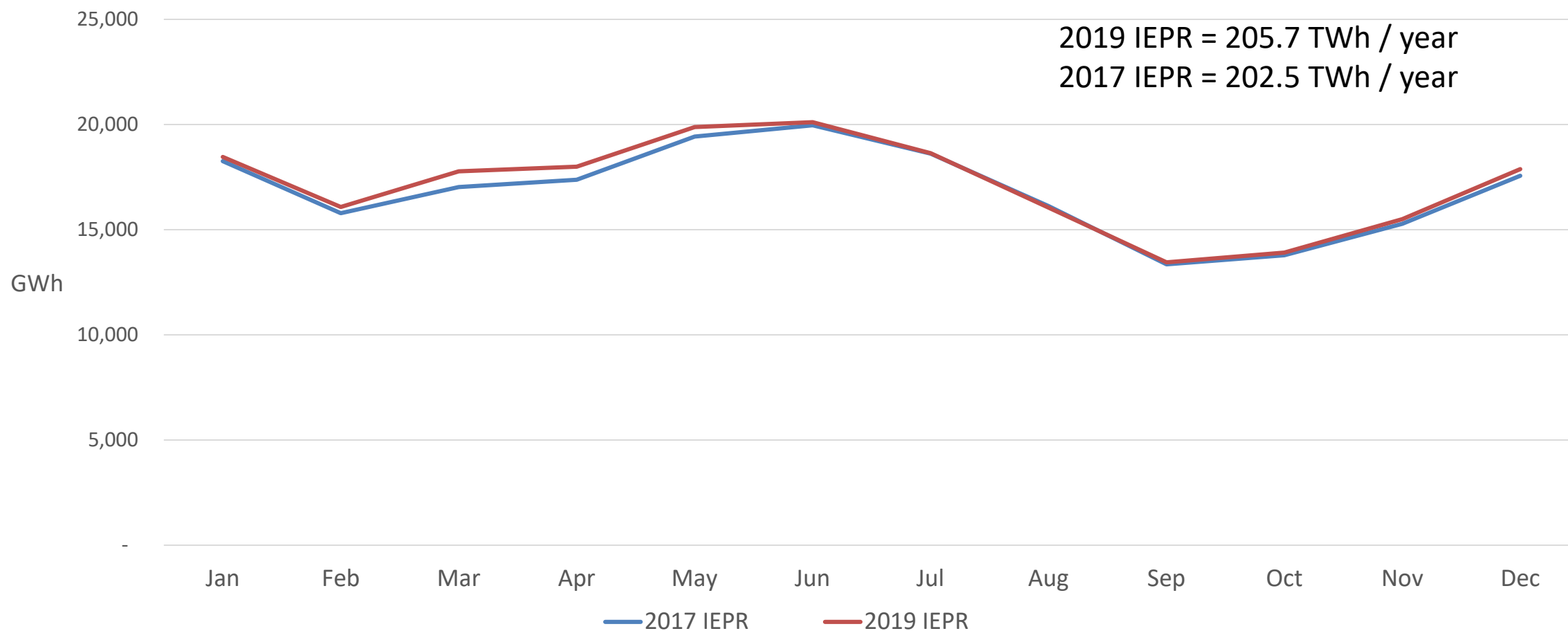


Preliminary 2019 IEPR California Average Monthly Hydroelectric Generation





Rest-of-WECC Monthly Hydro Generation



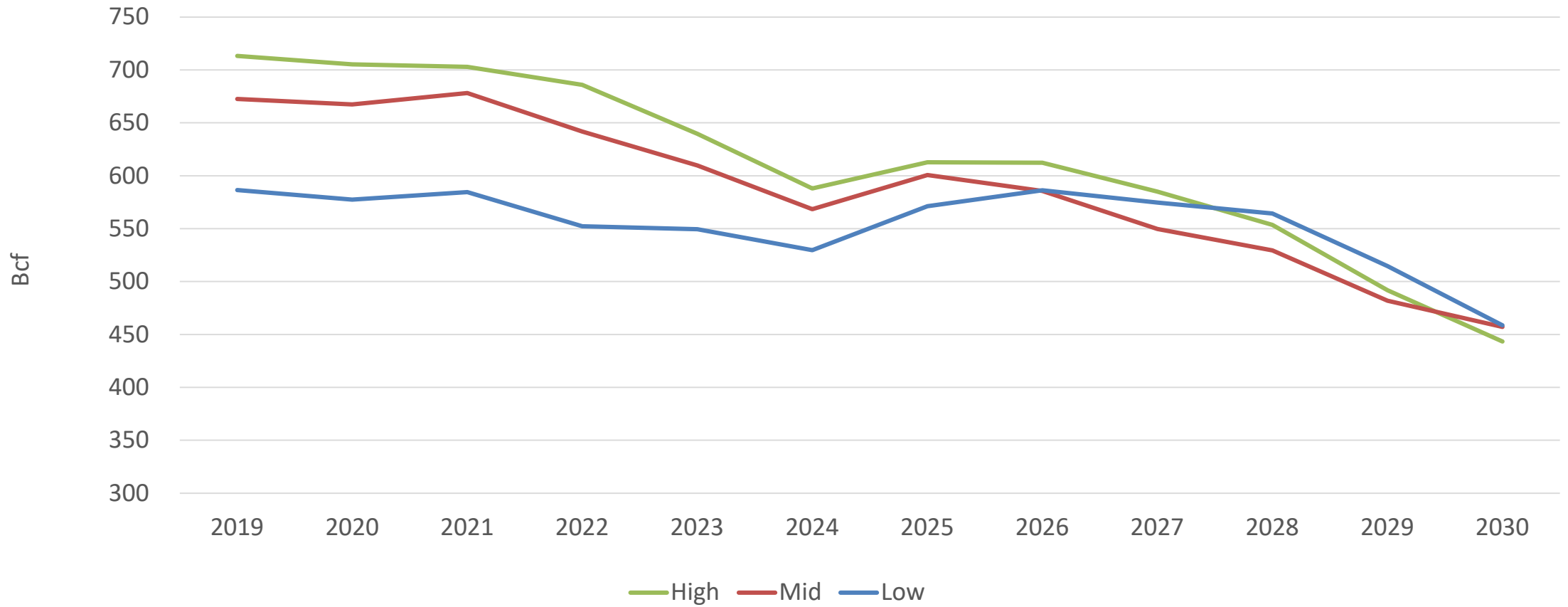


Select Natural Gas Prices High-Mid-Low 2019 IEPR

Region (\$MMBtu)	High Case			Mid Case			Low Case		
	2020	2025	2030	2020	2025	2030	2020	2025	2030
NG Colorado	2.05	2.35	2.88	3.16	3.76	4.45	5.14	5.89	6.96
NG Malin	1.88	2.26	2.82	3.08	3.69	4.52	5.21	6.16	7.35
NG PG&E BB	2.51	2.91	3.51	3.77	4.44	5.34	5.85	6.85	8.11
NG S Nevada	1.92	2.32	2.92	3.23	4.17	5.05	5.45	6.45	7.73
NG SCG	2.67	3.06	3.65	3.85	4.51	5.40	6.07	7.08	8.35

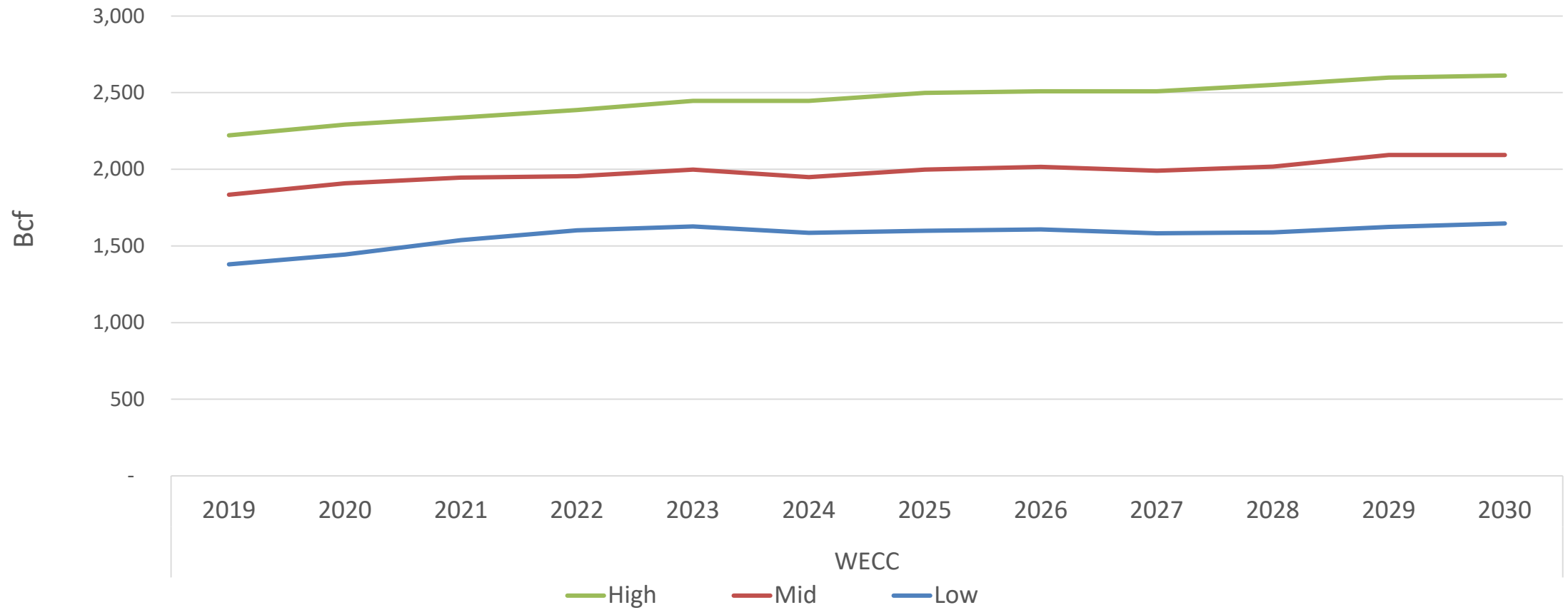


CA Natural Gas Burn for Electric Generation





Rest-of-WECC Natural Gas Burn for Electric Generation





Method for Calculating Statewide GHG Emissions

- Preliminary 2019 IEPR simulation projections of statewide hourly generation and imports
- Simulations provide hourly fuel use (MMBtu) for all generation located in California – easily converted to CO₂e
- Simulation results provide hourly imports to California in terms of energy (MWh) not fuel use (MMBtu)
- Import emissions – not easily converted to CO₂e



GHG Emission Intensity of Specified and Southwest Imports

- Ownership shares of energy from power plants outside California use reserved transmission capacity
- Using fuel specific emission factors (metric tons/MWh) and simulated hourly imports (MWh) from out of state specified sources to calculate CO₂e from imports (metric tons)
- All other unspecified imports from the Southwest are given the ARB default emission factor (0.428 metric tons/MWh)



GHG Emission Intensity of Northwest & RPS Imports

- California imports from the Northwest are assumed 80% hydro and 20% unspecified.
- 20% of RPS imports are assumed Portfolio Content Category 2 and 3 resources and assigned ARB default emission factor.
 - Emissions Northwest Imports and Generic RPS Imports receive 0.086 Metric Ton/MWh factor
 - $0.086 \text{ Metric Ton/MWh} = 0.428 * 20\%$



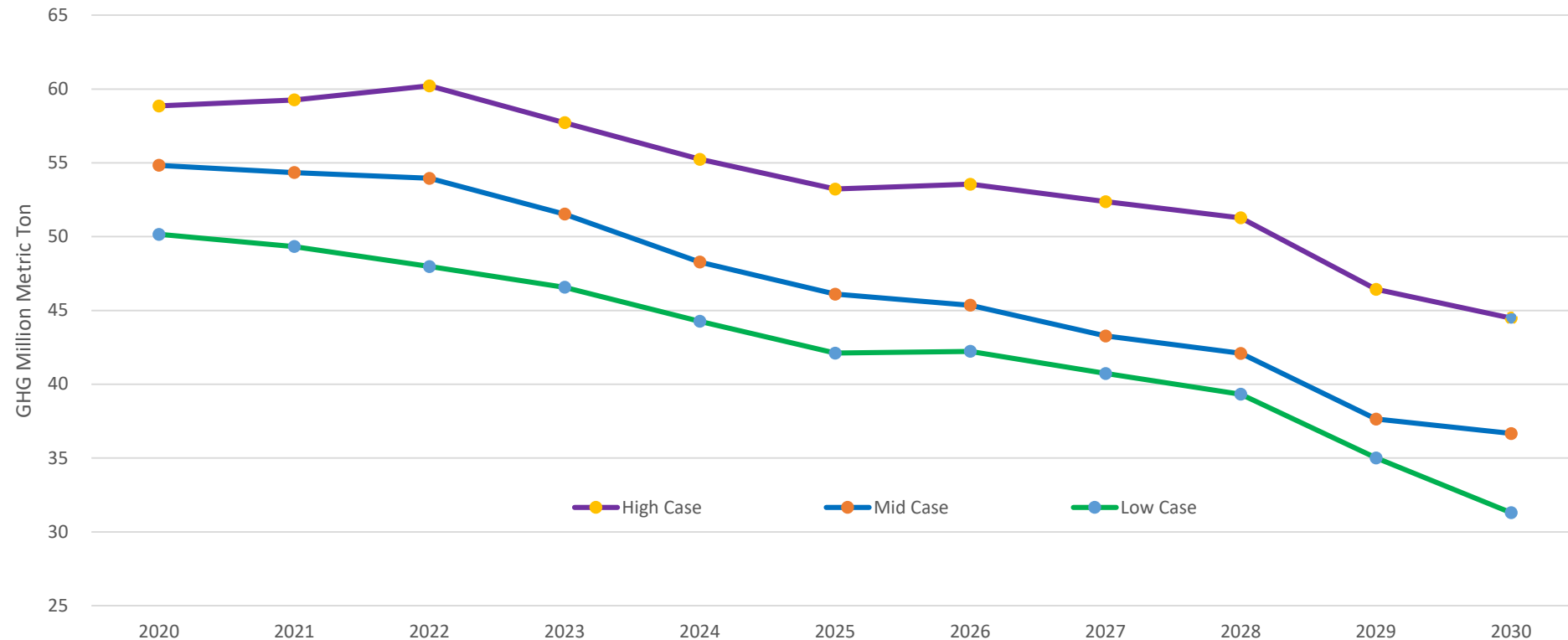
Import Emission Intensity Assumptions

Imports To California		GHG Emission Intensity Rate (Metric Ton/MWh)
From Pacific Northwest Region		0.086
From RPS Renewables		0.086
From Specified Natural Gas		0.402
From Palo Verde, Southwest Hydro		0
From Specified Coal		0.956
From Unspecified Imports		0.428
Exports Out of California		GHG Emission Intensity Rate (Metric Ton/MWh)
Exports		0



California GHG Emission Projections

Preliminary 2019 IEPR Common Case



Source: PLEXOS 2019 Preliminary IEPR Results February 17, 2019 SB 100 and SB 350 assumptions



California GHG Emission Projections Total, In State and Imports Emissions

Import, In State and Total Emissions by 2019 IEPR Common Case Million Metric Ton (MMT)											
Total California Emissions MMT	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Low Demand Case	50	49	48	47	44	42	42	41	39	35	31
Mid Demand Case	55	54	54	52	48	46	45	43	42	38	37
High Demand Case	59	59	60	58	55	53	54	52	51	46	44
Import Emissions MMT	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Low Demand Case	19	17	18	17	16	11	10	10	9	7	7
Mid Demand Case	18	17	19	18	17	13	14	13	13	12	12
High Demand Case	21	21	23	23	23	20	20	21	21	20	20
In State Emissions MMT	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Low Demand Case	32	32	30	30	29	31	32	31	31	28	25
Mid Demand Case	36	37	35	33	31	33	32	30	29	26	25
High Demand Case	38	38	37	35	32	33	33	32	30	27	24
Source: PLEXOS 2019 Preliminary IEPR Results February 17, 2019 SB 100 and SB 350 assumptions											



California Annual GHG Emission Intensity Projections Preliminary 2019 IEPR Compared to 2017 IEPR

2017 IEPR Mid Demand	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
California CO ₂ e MMT	54	52	52	51	49	48	50	49	48	48	46
Emission Intensity MMT/MWh	0.19	0.19	0.19	0.18	0.17	0.17	0.18	0.18	0.17	0.17	0.17
2019 IEPR Preliminary Mid Demand	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
California CO ₂ e MMT	55	54	54	52	48	46	45	43	42	38	37
Emission Intensity MMT/MWh	0.20	0.20	0.19	0.18	0.17	0.16	0.16	0.15	0.15	0.13	0.13

Source: PLEXOS 2019 Preliminary IEPR Results February 17, 2019 SB 100 & SB 350 assumptions. PLEXOS 2017 IEPR Results April 2018 - SB 350 assumptions

- Preliminary 2019 IEPR emission intensity projections decline more rapidly due to higher RPS target in later forecast years
- Early years Preliminary 2019 IEPR emission intensity are slightly higher due to accounting of additional banked RECs



WECC Wide GHG Emissions Preliminary 2019 IEPR Compared to 2017 IEPR

IEPR Common Case Million Metric Ton (MMT)			
2017 IEPR	2020	2025	2030
Low Demand Case	283	271	260
Mid Demand Case	296	287	269
High Demand Case	303	298	284
2019 IEPR Preliminary	2020	2025	2030
Low Demand Case	267	245	223
Mid Demand Case	245	239	232
High Demand Case	234	241	247

- Preliminary 2019 IEPR lower WECC wide GHG emissions than 2017 IEPR
 - ↓ Higher actual and projected coal plant retirements
 - ↓ Higher RPS targets
- Preliminary 2019 IEPR Low Demand Case WECC GHG emissions are highest 2020-2025
 - ↕ Significant coal (~\$2/mmBtu) to gas (~\$5/mmBtu) price differential and delayed RPS build due to bank REC's



Thank You

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