



Energy imbalance market pricing

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California Independent System Operator

EIM Body of State Regulators, Monthly update

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Mission of independent market monitors

“Each independent system operator ... must include a mission statement ... that identifies the Market Monitoring Unit’s goals, including the protection of consumers and market participants by the identification and reporting of market design flaws and market power abuses.”

FERC Order 719

To provide independent oversight and analysis of the CAISO Markets for the protection of consumers and Market Participants by the identification and reporting of market design flaws, potential market rule violations, and market power abuses.

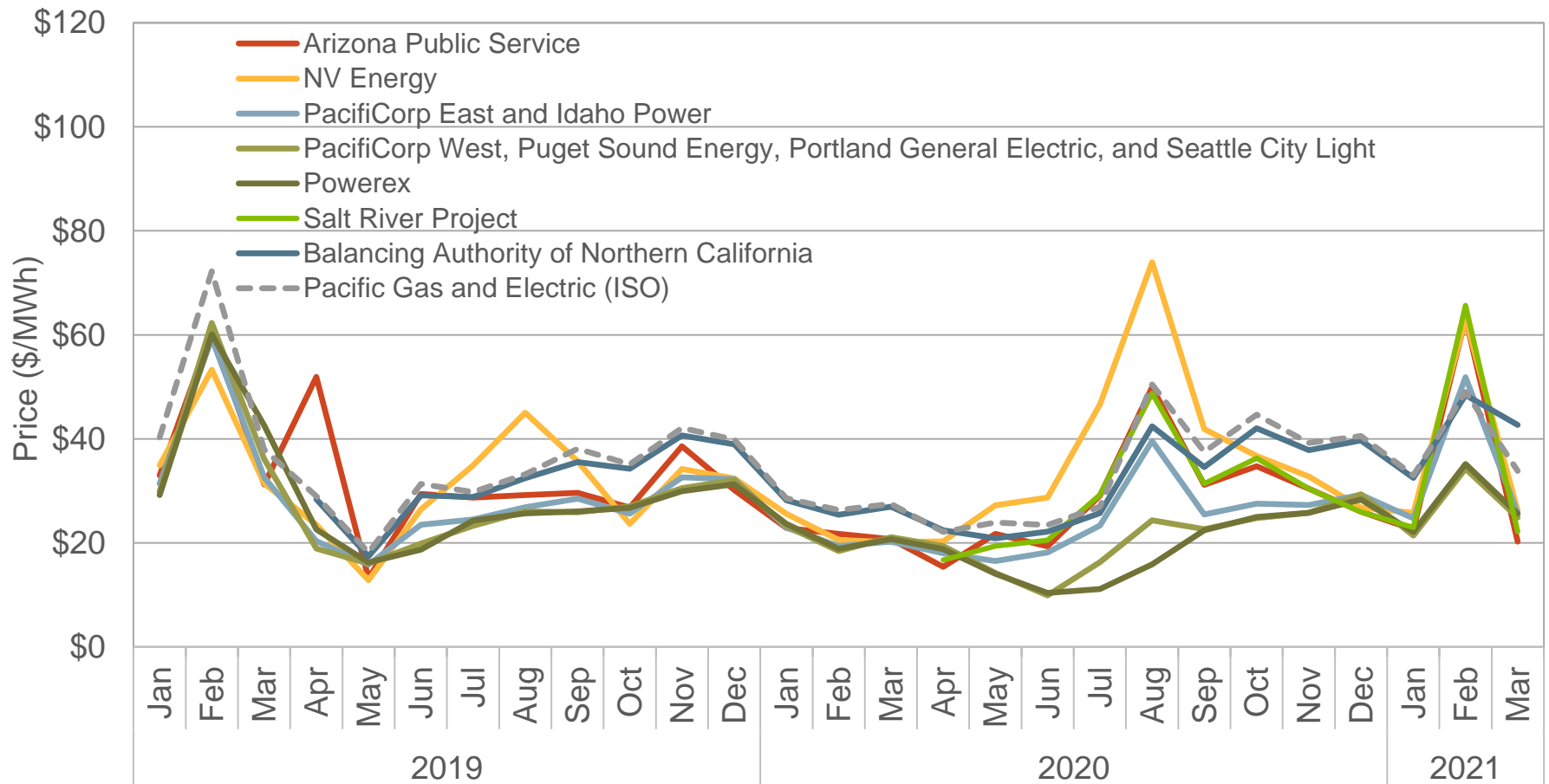
Department of Market Monitoring Mission Statement
CAISO Tariff, Appendix P

Core functions of independent market monitors (FERC Order 719)

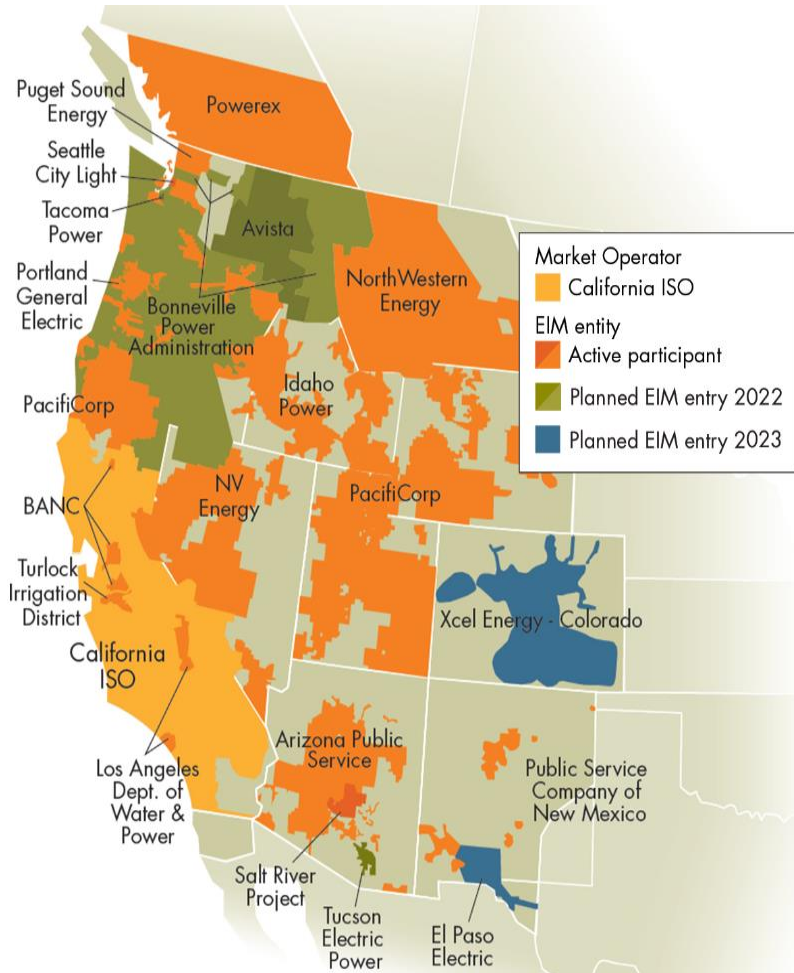
1. Review and report on the performance of wholesale markets, including quarterly and annual reports.
2. Evaluate existing and proposed market rules, and provide recommendations.
3. Notify FERC Office of Enforcement when a market participant or the ISO has engaged in conduct that may require investigation.
4. Market monitors may also perform functions related to inputs for market power mitigation.
 - Bids used in mitigation, cost review, etc.

DMM reports include coverage of prices in EIM

Average 15-minute market prices



Prices and transfers reflect differences in regional supply conditions and transfer limitations



- EIM optimization dispatches resources and schedules transfers between areas in real-time
- Northwest prices regularly lower than the rest of the system due to limited transfer capability
- Peak California area prices exceed other areas due to GHG and congestion
- Prices in the Southwestern areas averaged over \$60/MWh in February, due to gas supply limitations

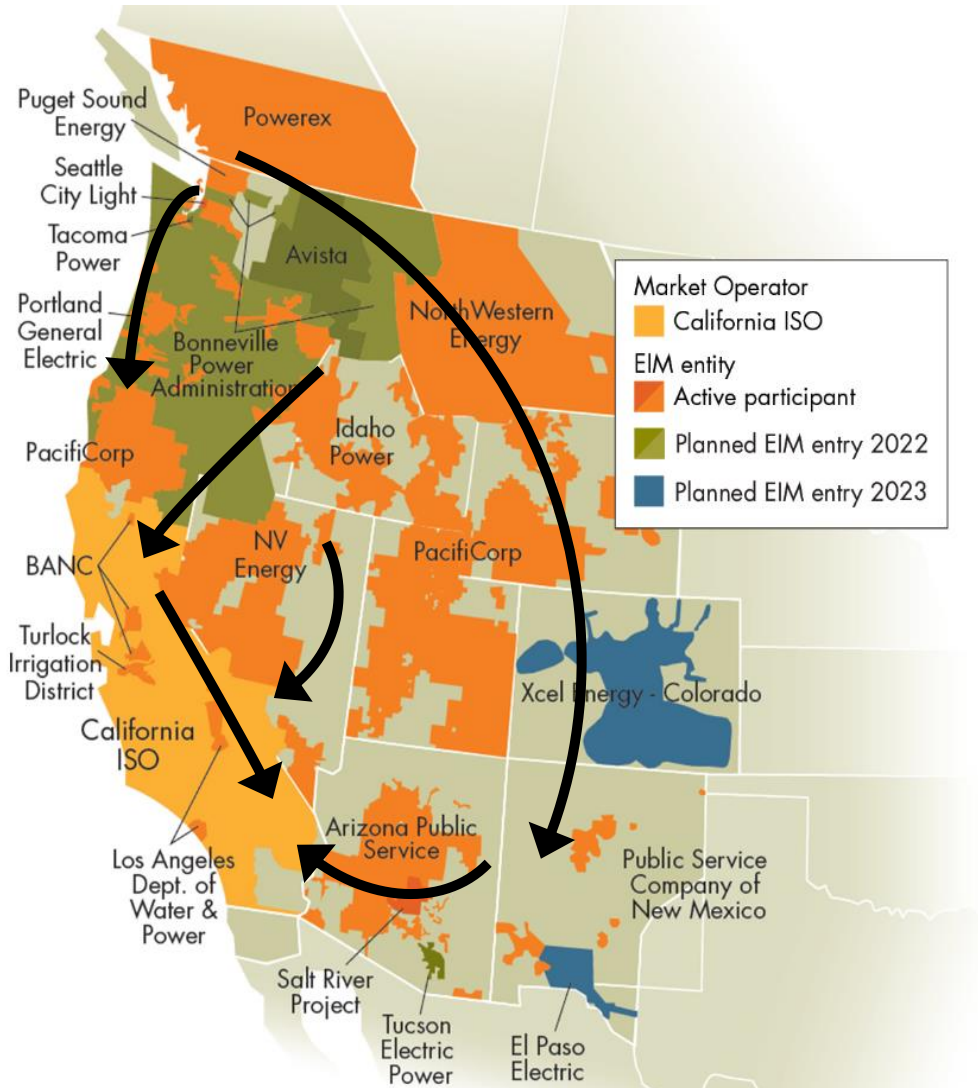
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The ability to transfer energy between areas is one of the key benefits of the EIM

Average 15-minute market limits between January 1 and March 24, 2021

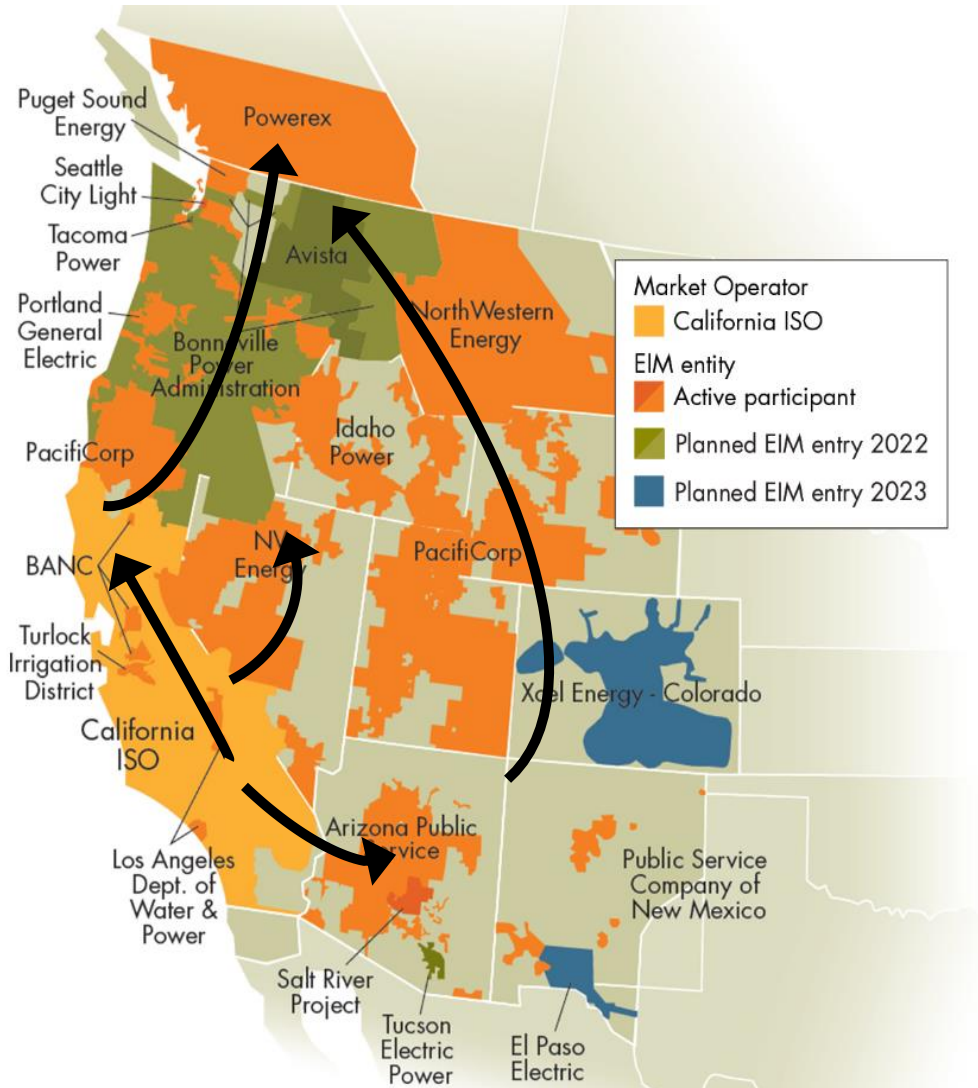
		To Balancing Authority Area											Total export limit	
		CISO	BANC	NEVP	AZPS	SRP	PACE	IPCO	PACW	PGE	PSEI	SCL		PWRX
From Balancing Authority Area	California ISO		1,580	3,470	1,080	1,860			50	100	0		130	8,270
	BANC	1,590												1,590
	NV Energy	3,710			400		790	500						5,400
	Arizona Public Service	2,260		380		7,970	630							11,240
	Salt River Project	2,470			5,030		0							7,500
	PacifiCorp East			650	610	0		900	430					2,590
	Idaho Power			500			1,920		450		0	30		2,900
	PacifiCorp West	120					260	350		410	150	10		1,300
	Portland GE	90							410		150	10		660
	Puget Sound Energy	0						10	90	150		350	150	750
	Seattle City Light							30	30	10	450			520
Powerex	0									300			300	
<i>Total import limit</i>		10,240	1,580	5,000	7,120	9,830	3,600	1,790	1,460	670	1,050	400	280	



- Transfers in EIM vary a lot by hour-of-day and season.
- General flow of transfers in net peak hours is from northwest to CAISO and southwest.

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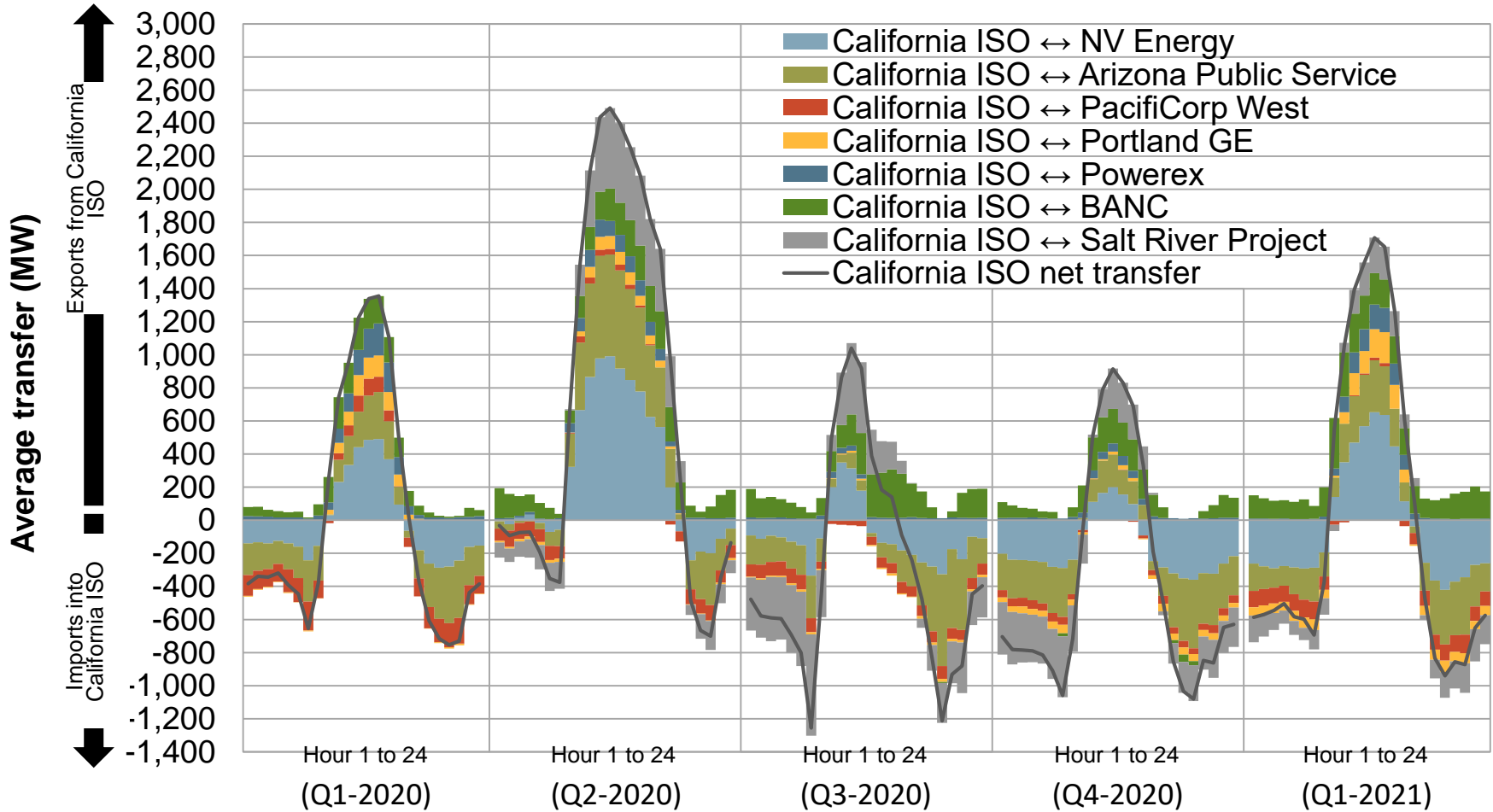


- During peak solar hours, CAISO exports excess to other EIM areas.
- Flows can change quickly due to changes in short-term conditions.

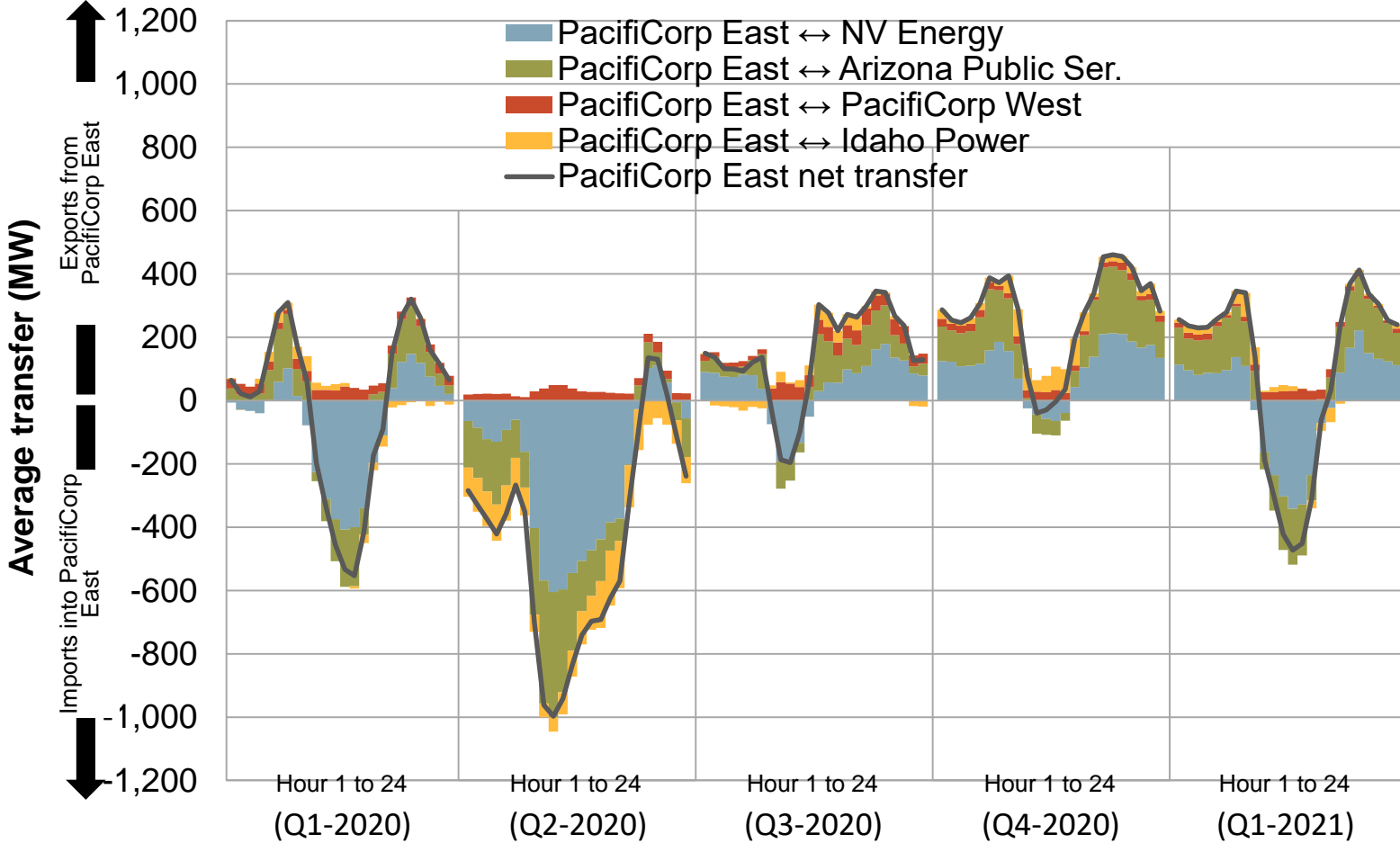
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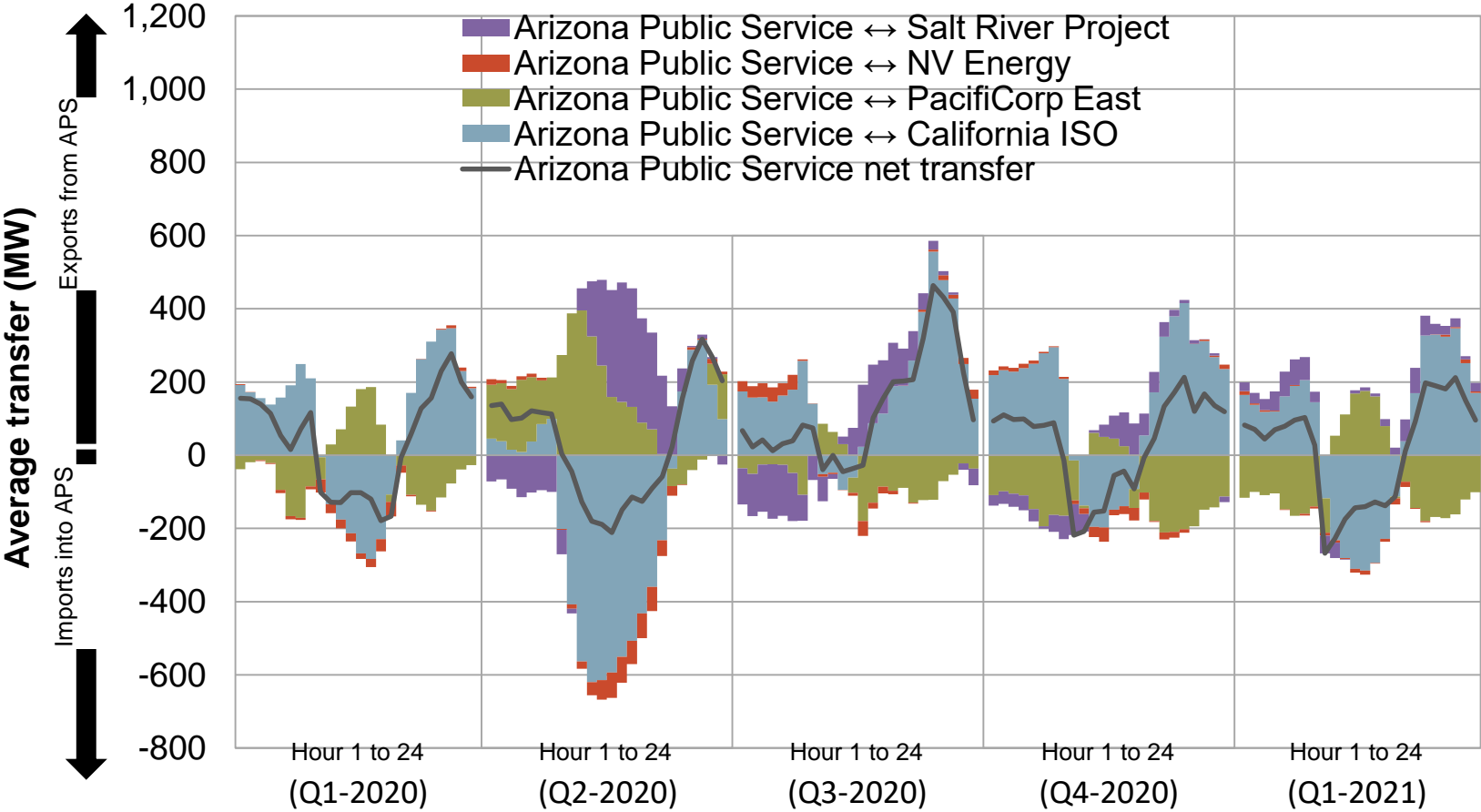
Transfers between ISO and EIM balancing areas



Transfers between PacifiCorp East and other balancing areas

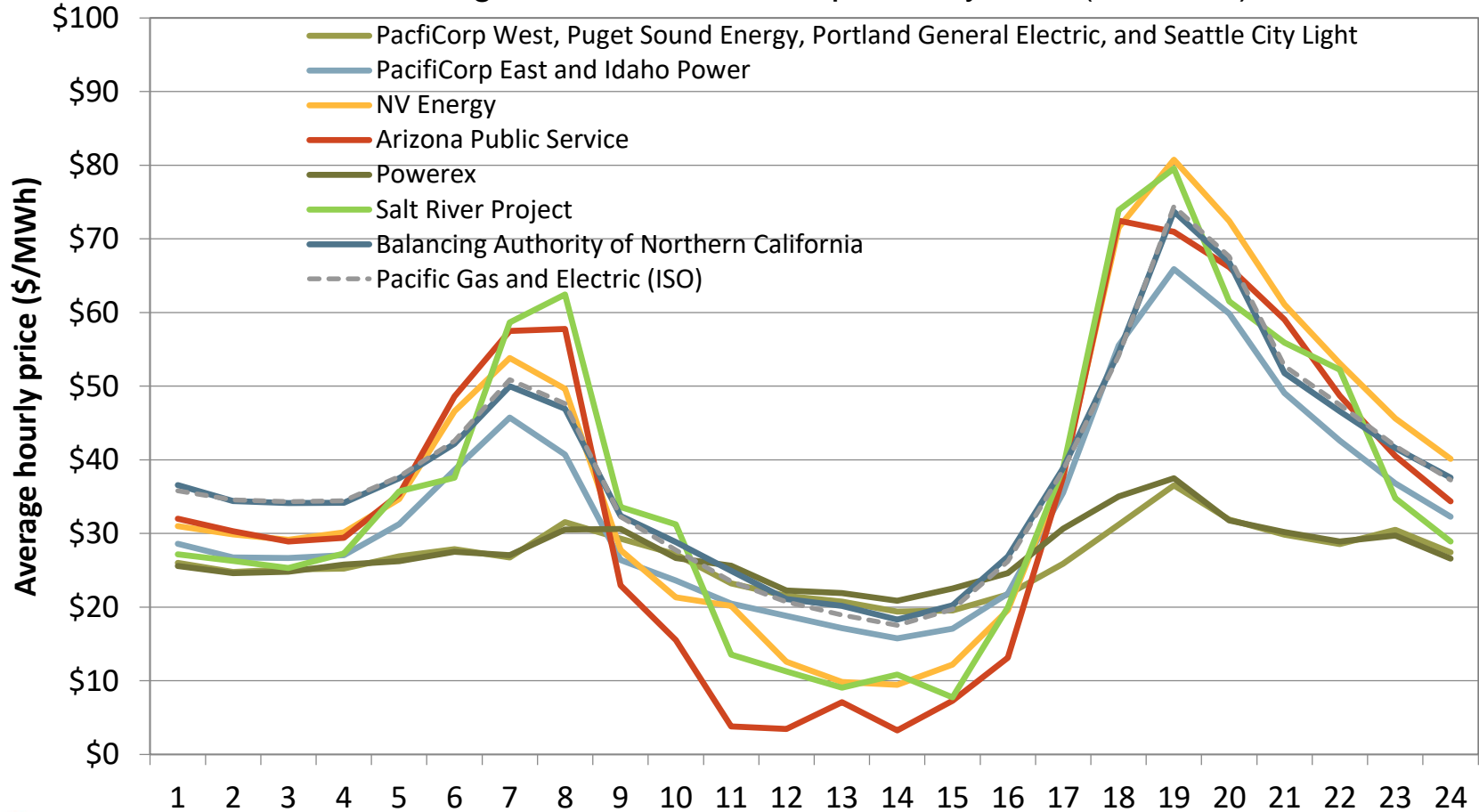


Transfers between APS and other balancing areas



EIM market prices reflect impact of transmission constraints and California's GHG program

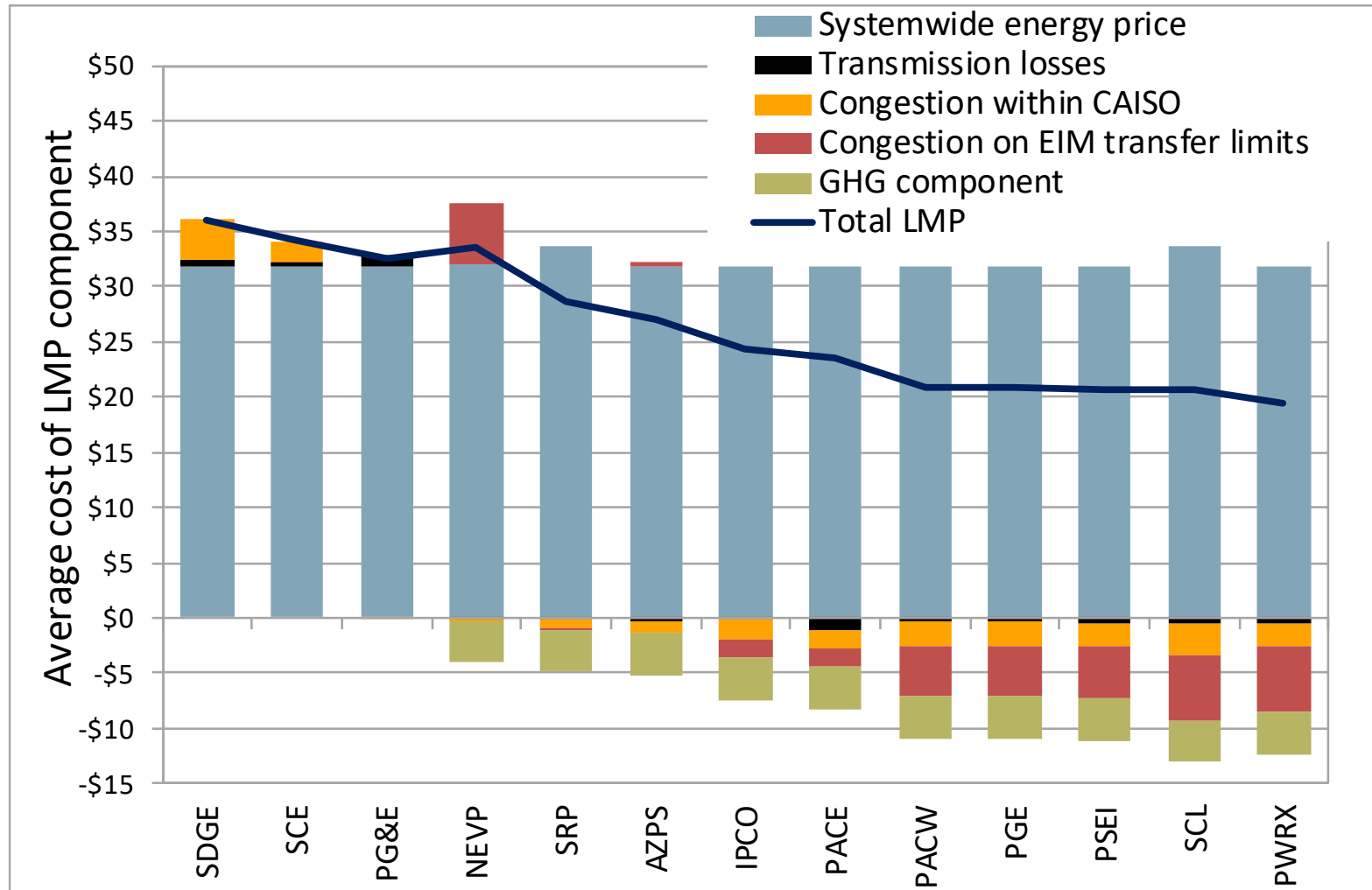
Average 15-minute market prices by hour (Q1 2021)



Key drivers of price differences between EIM areas

- Congestion on EIM transfer constraints between EIM areas
 - Revenues from congestion on EIM transfers are returned to transmission owners in each EIM area.
- Congestion on internal constraints within different balancing areas.
 - Main impact is congestion within CAISO area (typically North to South).
- California greenhouse gas emissions (GHG) costs/constraints built into EIM dispatch and pricing model.
 - GHG price reflects cost for marginal EIM resources delivered to CA to comply with California's GHG trading program.
 - GHG constraint drives down prices paid to EIM entities for transfers to CA.
 - But EIM resources delivered to CA receive GHG price back through separate GHG payment.
 - For “greener” low emission resources delivered to CA, GHG payment is more than compliance cost (or premium for green power).

Impact of congestion and greenhouse gas on prices (2020)



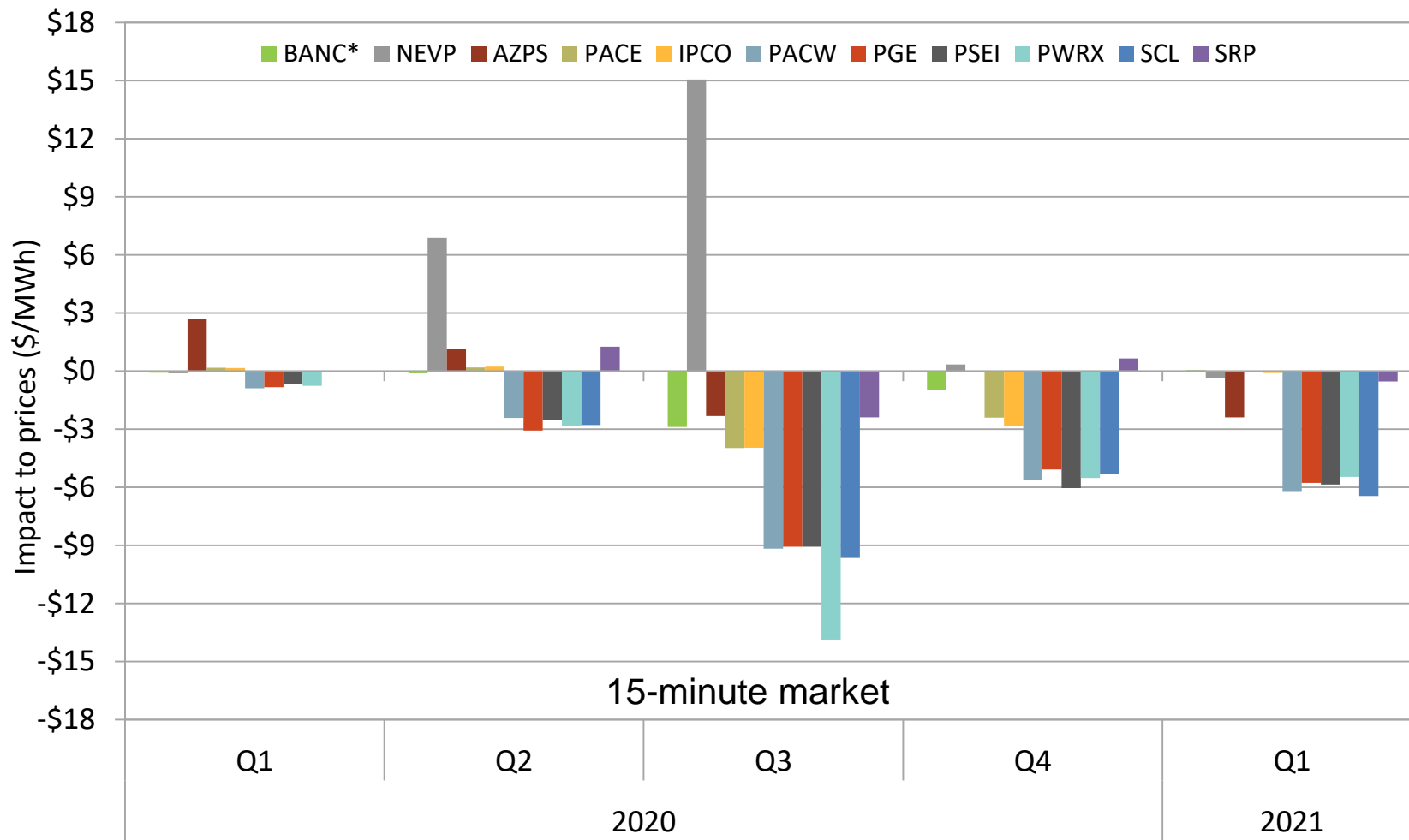
Frequency of import and export congestion on EIM transfer constraints (Q1 2021)

	15-minute market		5-minute market	
	Congested from area	Congested into area	Congested from area	Congested into area
BANC*	0%	0%	0%	0%
NV Energy	2%	0%	2%	0%
Arizona Public Service	3%	1%	2%	1%
PacifiCorp East	2%	2%	1%	2%
Idaho Power	2%	3%	1%	3%
Salt River Project	4%	2%	3%	2%
PacifiCorp West	41%	6%	28%	6%
Portland General Electric	41%	6%	28%	6%
Puget Sound Energy	44%	8%	35%	12%
Seattle City Light	44%	8%	35%	12%
Powerex	43%	12%	36%	20%

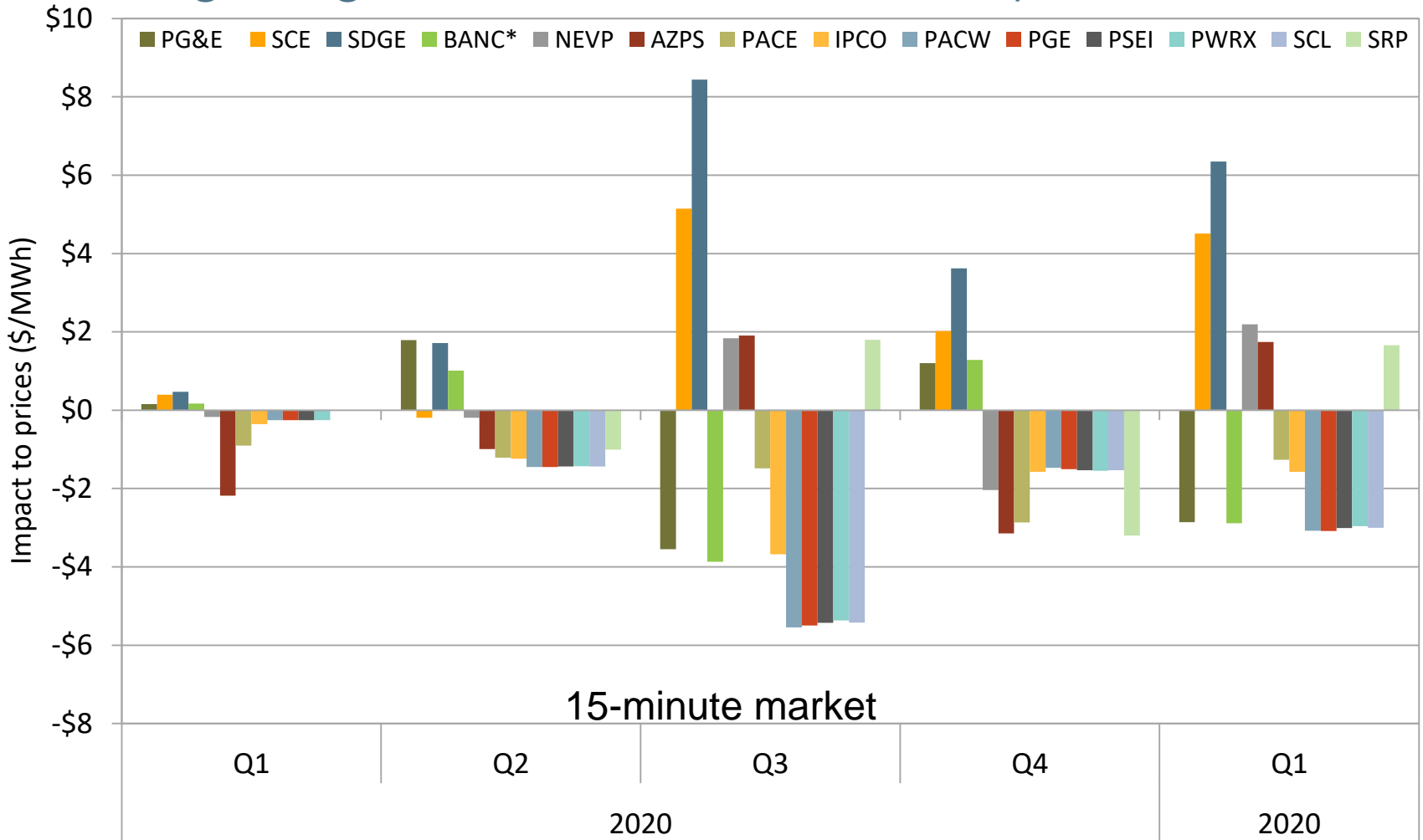
Net price impact of congestion on EIM transfer constraints (Q1 2021)

	15-minute market		5-minute market	
	Congestion Frequency	Price Impact (\$/MWh)	Congestion Frequency	Price Impact (\$/MWh)
BANC*	1%	\$0.04	1%	\$0.16
NV Energy	3%	-\$0.37	2%	-\$0.35
Arizona Public Service	4%	-\$2.39	3%	\$0.49
PacifiCorp East	4%	-\$0.05	3%	\$0.44
Idaho Power	5%	-\$0.10	4%	\$0.12
Salt River Project	6%	-\$0.54	5%	\$2.35
PacifiCorp West	47%	-\$6.24	33%	-\$3.03
Portland General Electric	47%	-\$5.78	34%	-\$2.82
Puget Sound Energy	52%	-\$5.86	47%	-\$2.54
Seattle City Light	52%	-\$6.45	47%	-\$3.07
Powerex	55%	-\$5.46	56%	-\$2.63

Price impact of congestion on EIM transfer constraints



Overall impact of congestion on average prices (including congestion within CAISO area)



Overall impact of congestion on prices, 2020*

Constraint Location	Constraint	PGAE	SCE	SDGE	BANC	NEVP	AZPS	SRP	PACE	IPCO	PACW	PGE	PSEI	PWRX	SCL
NEVP	CAL-DRM_2 120	-\$0.01	\$0.00	\$0.00	-\$0.03	\$0.09	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
PACE	TOTAL_WYOMING_EXPORT	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	-\$0.09	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
	WYOMING_EXPORT	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	-\$0.22	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
CAISO	Internal Constraints	-\$0.20	\$1.82	\$3.31	-\$0.33	-\$0.03	-\$0.87	-\$0.57	-\$1.12	-\$1.65	-\$2.13	-\$2.15	-\$2.11	-\$2.09	-\$2.74
	Other	\$0.11	\$0.03	\$0.26	\$0.00	-\$0.20	-\$0.23	-\$0.23	-\$0.19	-\$0.07	-\$0.06	-\$0.03	-\$0.07	-\$0.07	-\$0.06
Internal Total		-\$0.10	\$1.85	\$3.58	-\$0.36	-\$0.14	-\$1.10	-\$0.80	-\$1.62	-\$1.72	-\$2.19	-\$2.18	-\$2.17	-\$2.16	-\$2.80
Transfers					-\$1.02	\$5.55	\$0.34	-\$0.17	-\$1.52	-\$1.61	-\$4.54	-\$4.53	-\$4.60	-\$5.77	-\$5.94
Grand Total		-\$0.10	\$1.85	\$3.58	-\$1.38	\$5.41	-\$0.76	-\$0.97	-\$3.14	-\$3.33	-\$6.73	-\$6.71	-\$6.77	-\$7.93	-\$8.74

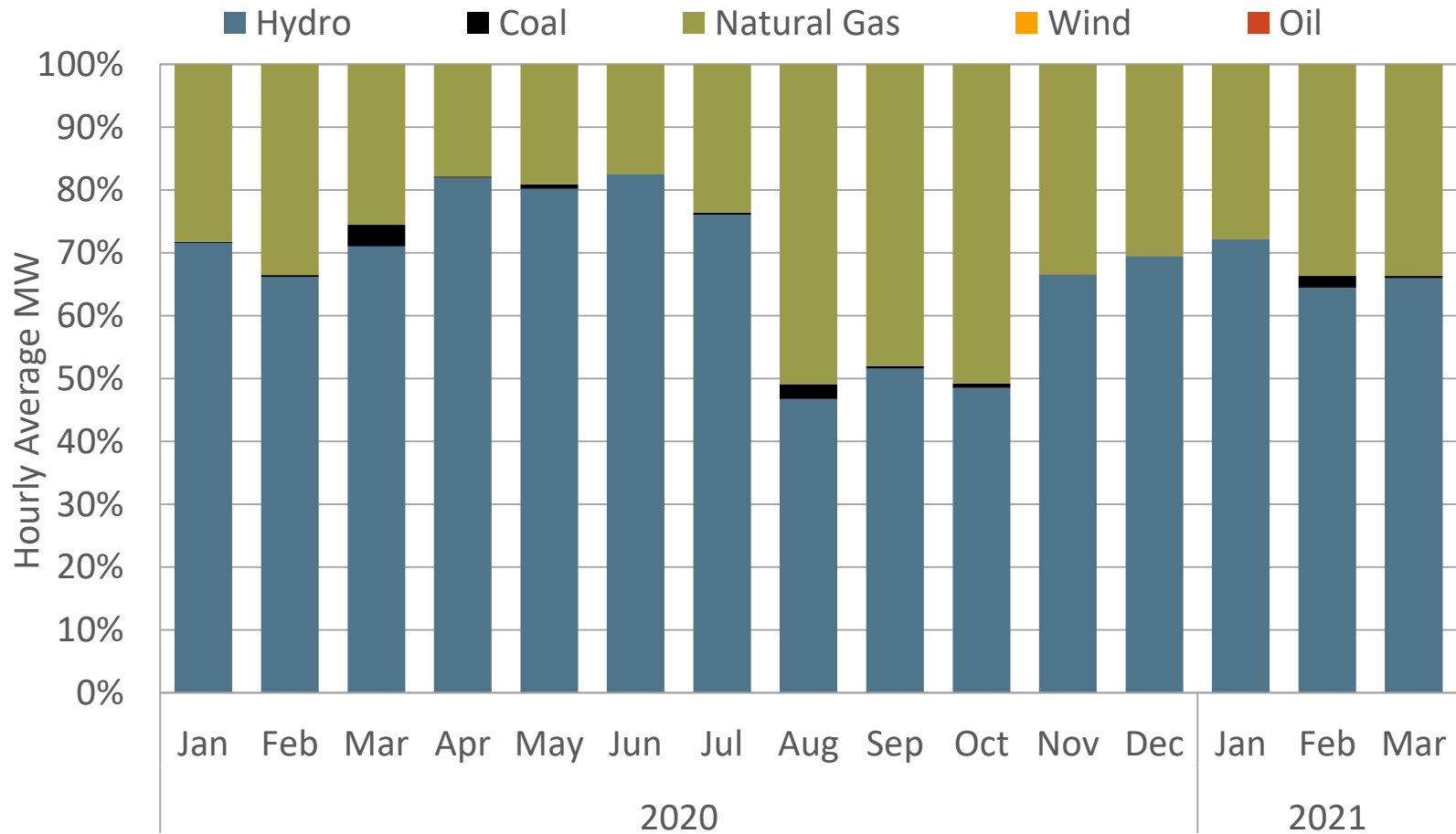
- Transfer constraints have a greater impact than internal congestion in most EIM areas
- Internal congestion in CAISO has a greater impact than internal congestion in other areas

* Summarized version of DMM's forthcoming annual report

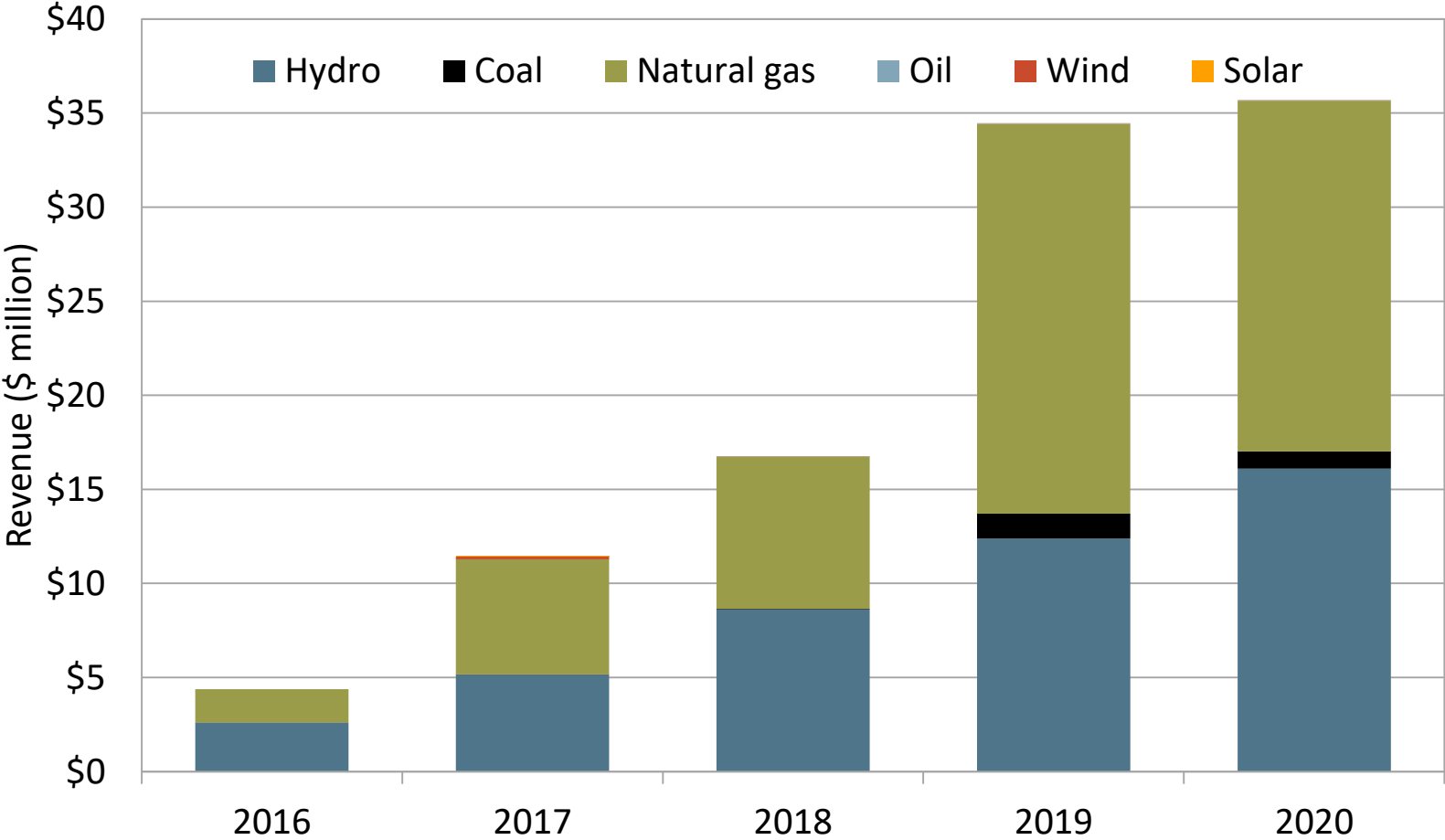
California greenhouse gas emissions (GHG) costs/constraints in the EIM

- GHG constraint used to determine which EIM resources are “deemed” to be imported into CA and are therefore required to obtain GHG emissions credits.
- Based on GHG bid adders submitted by EIM resources willing to be delivered to California.
 - GHG bid adder based on cost of emissions credits for each resource.
 - GHG price reflects GHG emission cost for marginal EIM resource delivered to CA.
- GHG constraint drives down prices paid to EIM entities for transfers to CA.
 - Payments fully offset costs of any GHG emission required.
 - For “greener” lower emission resources delivered to CA, GHG payment can exceed compliance costs as an extra profit margin.

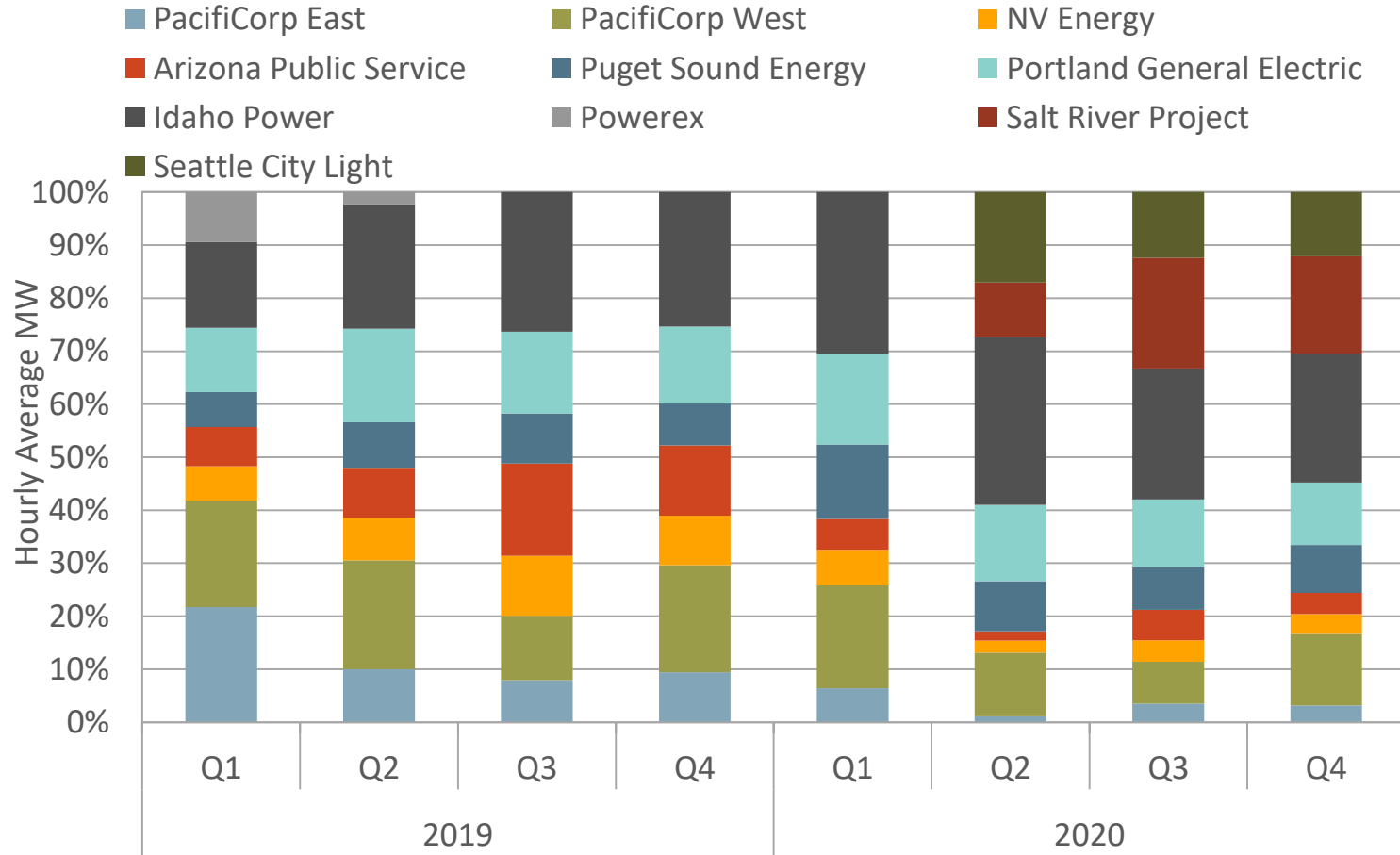
EIM transfers into CA by fuel type based on GHG modeling



Annual greenhouse gas payments for generation deemed delivered to California



EIM transfers into CA by EIM area



Note: From DMM's forthcoming 2020 Annual Report

Resources:

- Online training and references:
 - <https://www.westerneim.com/Pages/About/HowItWorks.aspx>
 - <http://www.caiso.com/participate/Pages/LearningCenter/WesternEnergyImbalanceMarket.aspx>
 - <https://www.westerneim.com/Pages/Resources.aspx>
- Track prices in real-time on the phone app or website:
 - OASIS: <http://oasis.caiso.com/mrioasis/logon.do>
 - Price map: <http://www.caiso.com/TodaysOutlook/Pages/prices.html>
- DMM reports:
 - **Annual, Quarterly and new EIM participant reports:**
<http://www.caiso.com/market/Pages/MarketMonitoring/AnnualQuarterlyReports/Default.aspx>
 - **Special reports cover competitiveness and other EIM issues:**
 - <http://www.caiso.com/market/Pages/MarketMonitoring/MarketMonitoringReportsPresentations/Default.aspx>

For more information on DMM:

- Department of Market Monitoring webpage
 - <http://www.caiso.com/market/Pages/MarketMonitoring/Default.aspx>
 - CAISO Tariff, Appendix P
 - http://www.caiso.com/Documents/AppendixP_CAISODepartmentOfMarketMonitoring_asof_Apr1_2017.pdf
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