



California ISO

GHG Accounting

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How GHG is accounted for in ISO dispatch

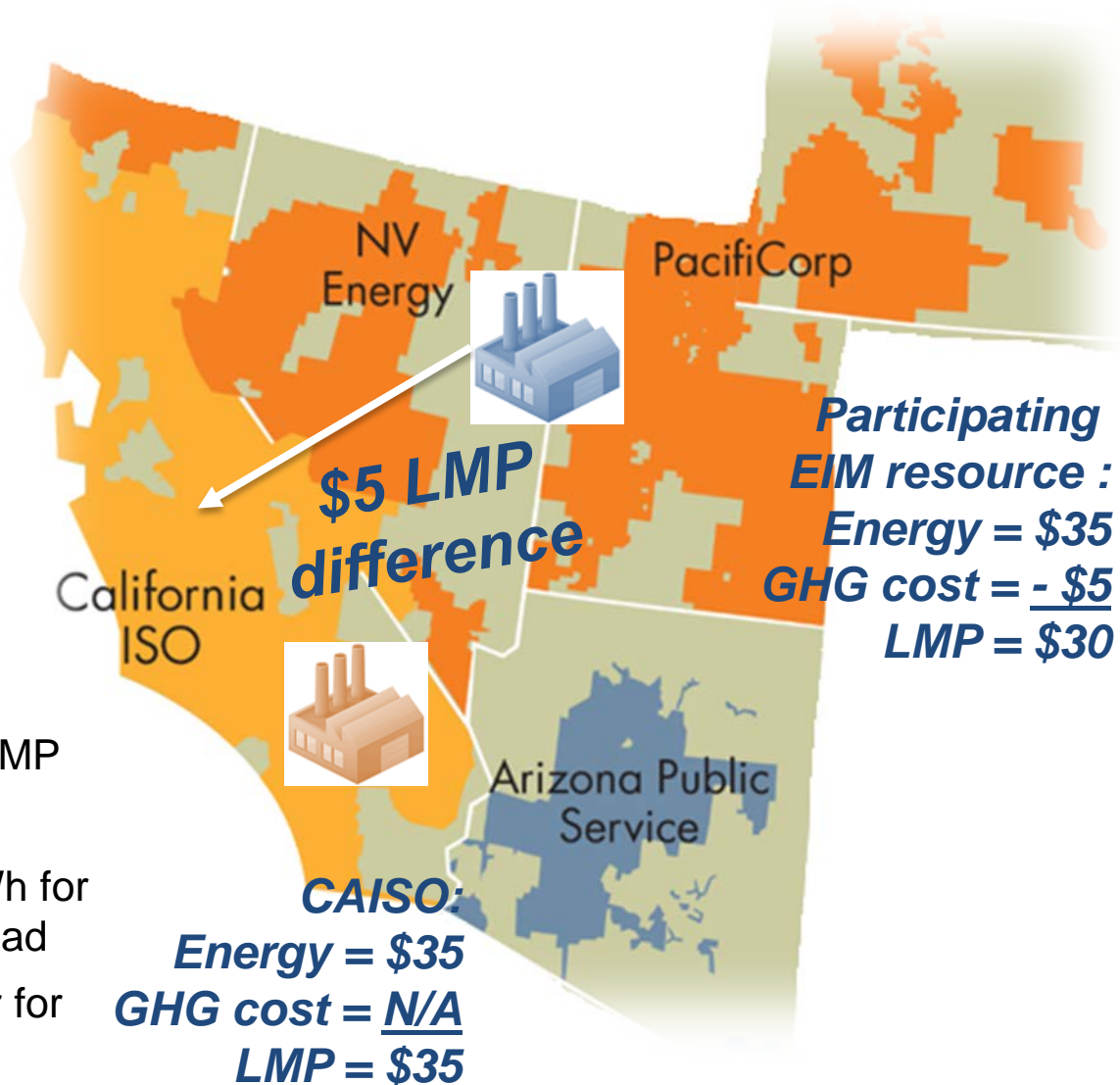
- Resources internal to California ISO have ability to incorporate GHG compliance costs into energy bid
- Imports into California ISO incorporate GHG compliance costs into their import bid.
 - Specified Resources responsible for their specific emission rate
 - Unspecified resources responsible for GHG compliance based on default emission rate (.428 mTCO₂/MWh)
 - Asset Controlling Supplier (ACS) responsible for GHG compliance based on their areas average emission rate
- Energy Imbalance Market transfers: CAISO optimizes EIM participating resources contributing to load service within the CAISO and EIM Entity balance areas wholly located within California based on resources GHG bid adder.

Accounting approach for Energy Imbalance Market

- Under EIM, external specific resources are being optimized instead of unspecified imports
- External resources are expected to bid their marginal costs
 - To extent a resource outside of California voluntary makes itself available and is attributed to serve load in California GHG compliance area – resource will have a GHG compliance obligation
 - To extent a resource outside of California is serving load outside of California GHG compliance area – No GHG Compliance Costs
- GHG bid adder allows participating resource to inform the market what the cost of GHG compliance the resource needs to recover if resource is economically determined to serve California load

How EIM accounts for California's GHG costs

- Both generators
 - Fuel cost = \$30/MWh
 - GHG cost = \$5/MWh
- CA generator
 - \$35/MWh energy bid
 - Sets \$35/MWh ISO LMP
 - Covers \$5/MWh GHG cost
- PacifiCorp generator
 - Imported to CA
 - Sets \$30/MWh EIM Area LMP
 - Sets \$5/MWh GHG price
 - ISO collects "extra" \$5/MWh for transfer to ISO from ISO load
 - Pays \$5/MWh to generator for its GHG costs



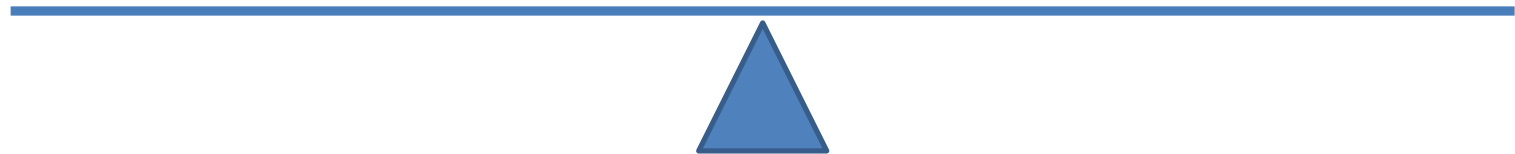
Observations of EIM dispatch optimization

- GHG accounting does not determine what specific resource is serving what specific load, rather determines if resource is serving load in California GHG compliance area
- Least cost dispatch with a mix of GHG accounting areas can result in sending low emitting resources to GHG compliance area, while not accounting for secondary dispatch of other resources to serving demand in non-GHG compliance area
- Least cost dispatch can also result in avoided curtailment of ISO renewables by displacing emitting resources to serve external demand

Accounting for GHG from external supply has competing objectives which must be balanced

Efficient
Dispatch

Accurate
Accounting for
GHG compliance



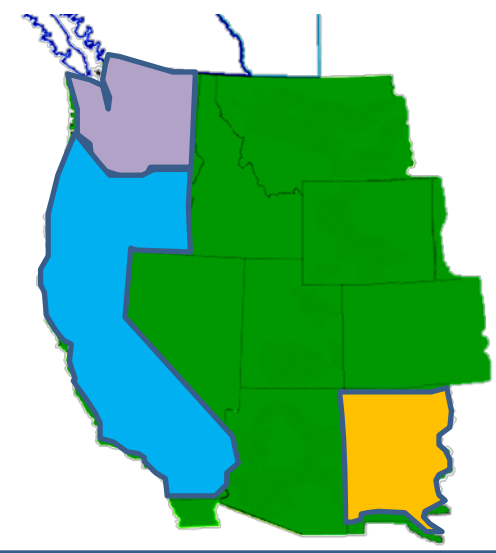
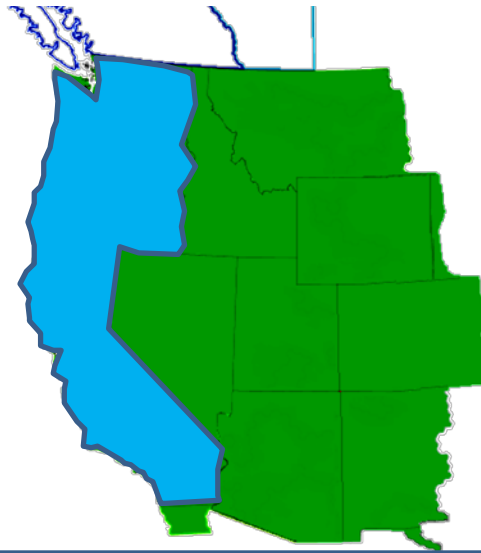
EIM approach of attributing specific resources needs reviewed under extended Day-Ahead Market (EDAM)

- Under EDAM there may be more than one GHG state compliance policy
 - Scaling simplified if state policies are linkable
 - Scaling complicated if state policies not linkable
- Day-Ahead Market does not start with balanced base schedules
- Need to ensure accounting approach treats comparable resources similarly

GHG policy effect on electricity market

- **Cap-and-Trade (Allowances) vs Tax (Cost)**
 - Cap-and-Trade: separates allowances from a GHG price, allowing suppliers to incorporate their costs into their bids
 - Tax: establishes a specific price per jurisdiction
- **Point of Regulation**
 - Energy suppliers: Allows suppliers to incorporate GHG costs into their supply bids for optimized use
 - End users: Requires knowing how end user energy needs being met. (contractual, self-supplied...)
- **Interplay with Renewable Energy Credits**
 - De-coupled: Allows for resource to be optimized considering GHG
 - Coupled: Limits ability to optimize supply to meet regional demand

Different GHG polices and benefits of linkable policies



Spectrum of Carbon Accounting vs Optimal Market Dispatch

Single Region

- Same allowance or GHG price applies
- Point of regulation on delivers
- No need to track imports/exports

GHG and Non GHG

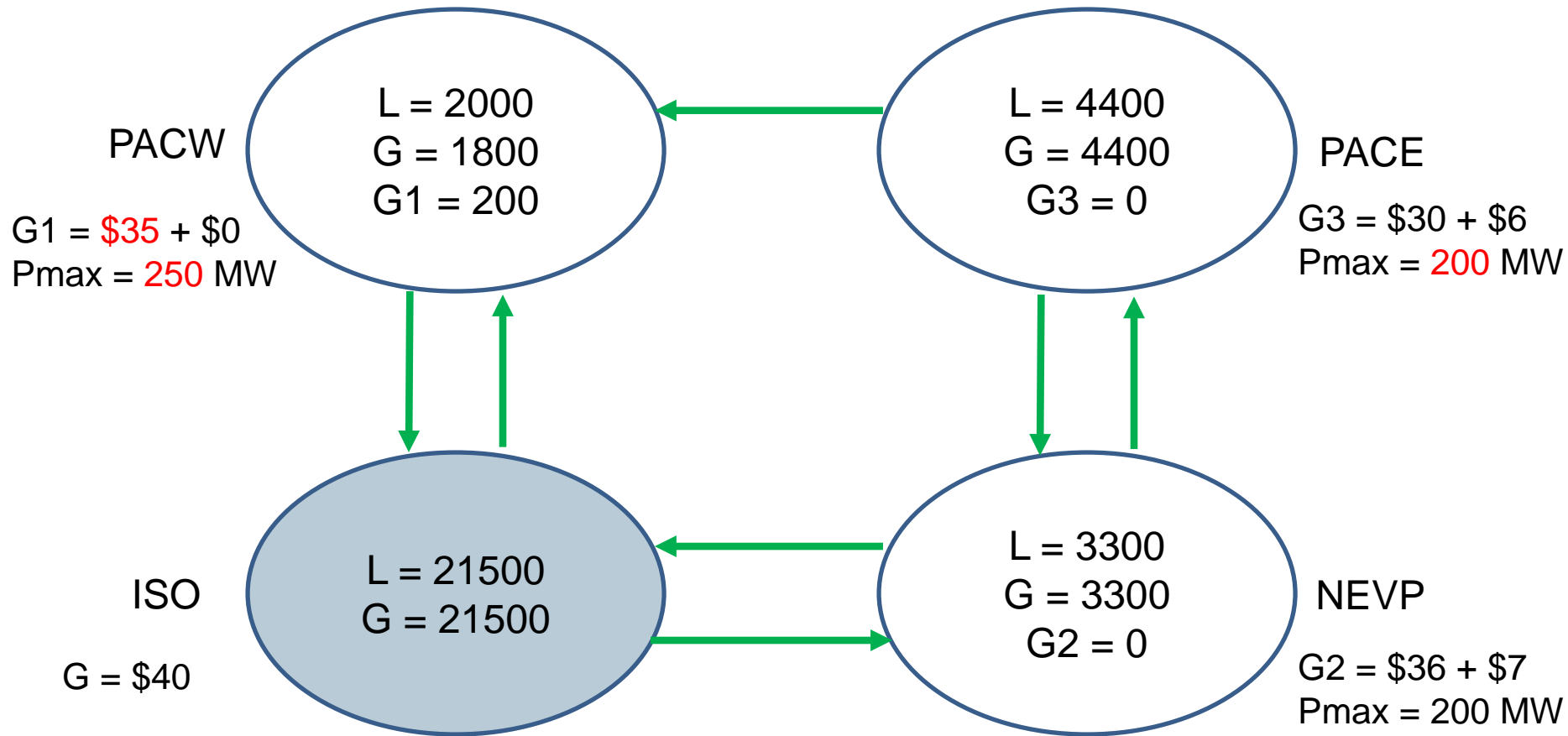
- Same allowance or price in GHG region. No price in non-GHG region
- Common point of regulation resource within region
- Track imports or external source serving load within GHG region
- Supply in non-GHG region must provide a bid adder or GHG transfer rate reflecting GHG compliance cost of serving load in the GHG area

Multiple GHG Regions

- Different GHG prices by regions
- Point of regulation: various
- Different points of regulation, make tracking supply from area serving load in other GHG and non-GHG areas very difficult
- Assuming point of regulation is supply: Supply bids need multiple bid adder or have different GHG transfer rates applied to different the different GHG areas resource could serve load in.

APPENDIX

Base assumptions for example to show allocation to base schedule correctly reflect atmospheric effect



Maximum reduction in ISO supply is 200 MW

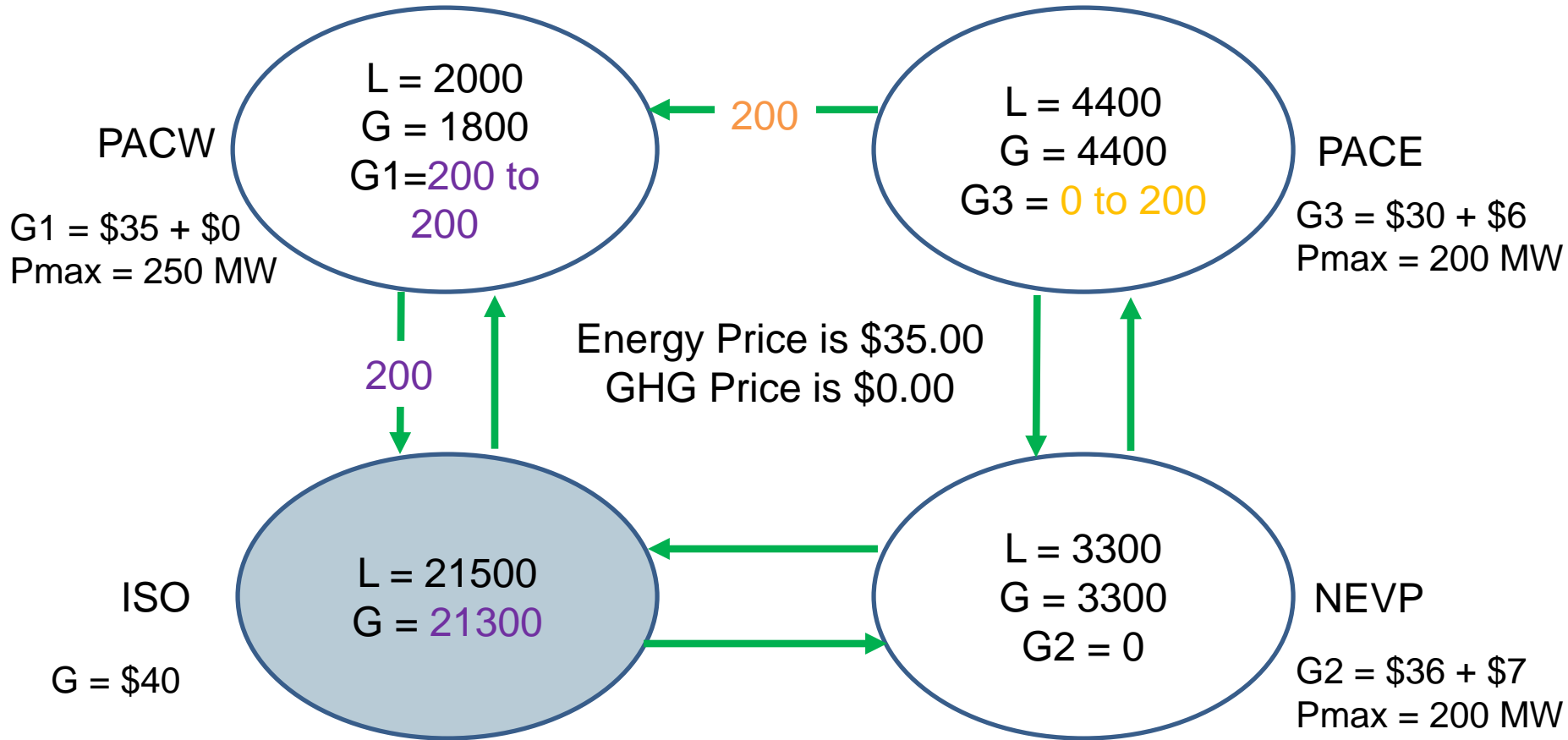
EIM Generator = Energy Bid + GHG Bid

$G1-G3 P_{min} 0 \text{ MW}$

GHG MW for all is 200 MW

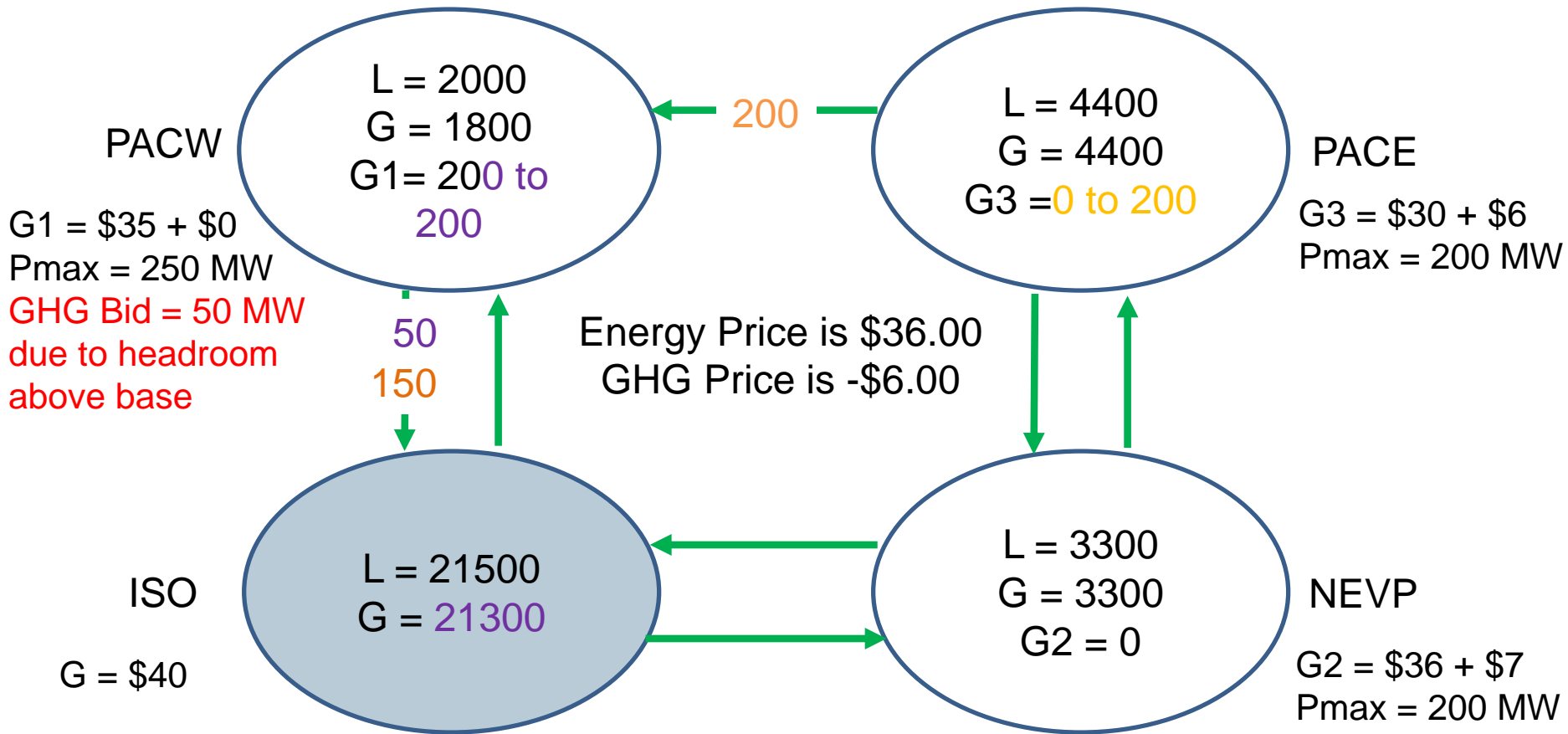
Transfer limit into ISO is 201 MW

Let's solve the market for the EIM footprint using the implementation prior to 11/1/2018



Is this an example of “secondary dispatch” because the base schedule of G1 is attributed to ISO?

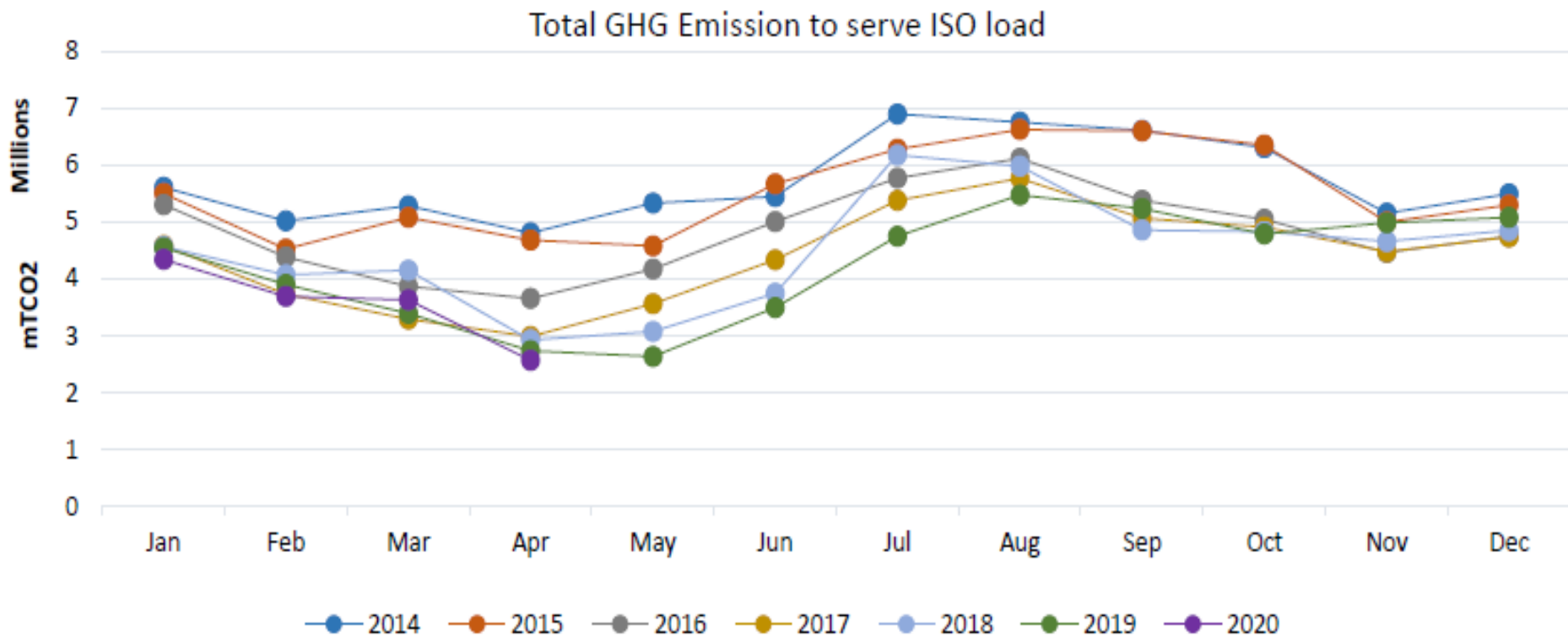
Now let's optimize from the prior slide's starting point and include the ISO



This is the same dispatch level, but there is no secondary dispatch.

LMP inside ISO is \$35. LMP outside ISO is \$35.

GHG emissions to serve ISO load reduced 26% between 2019 and 2014



Energy imbalance market helps avoid curtailment

