Electric Vehicles & Grid Integration

Prepared for CEC IEPR Workshop on Electric & Natural Gas Vehicles In California

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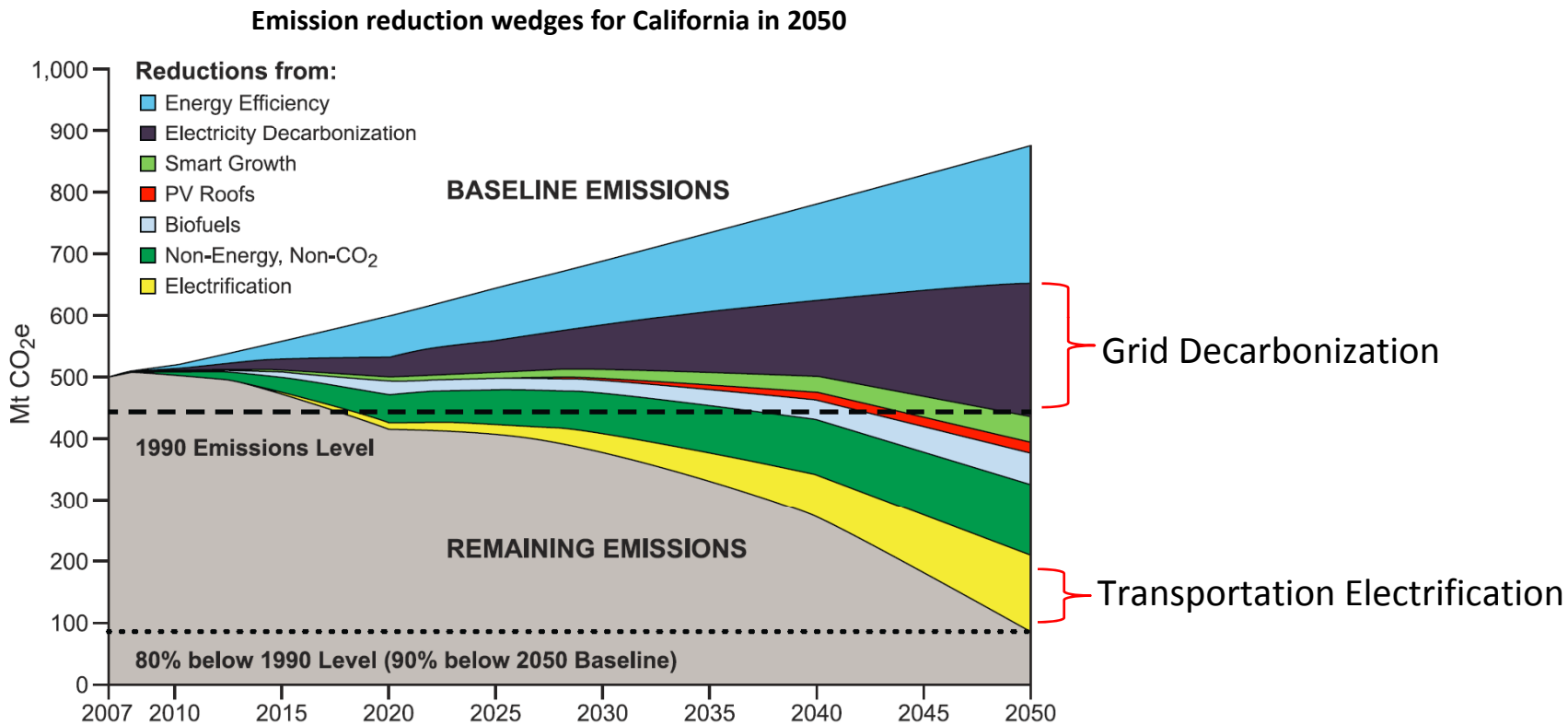
The Challenge

GHG reduction is a top policy priority – 80% reduction by 2050



Source: The Technology Path to Deep Greenhouse Gas Emissions Cuts by 2050: The Pivotal Role of Electricity; Science 335, 53 (2012); James H. Williams, et al.

» Transportation electrification can actually be quite complementary to cost effectively decarbonizing the grid, if done smartly.

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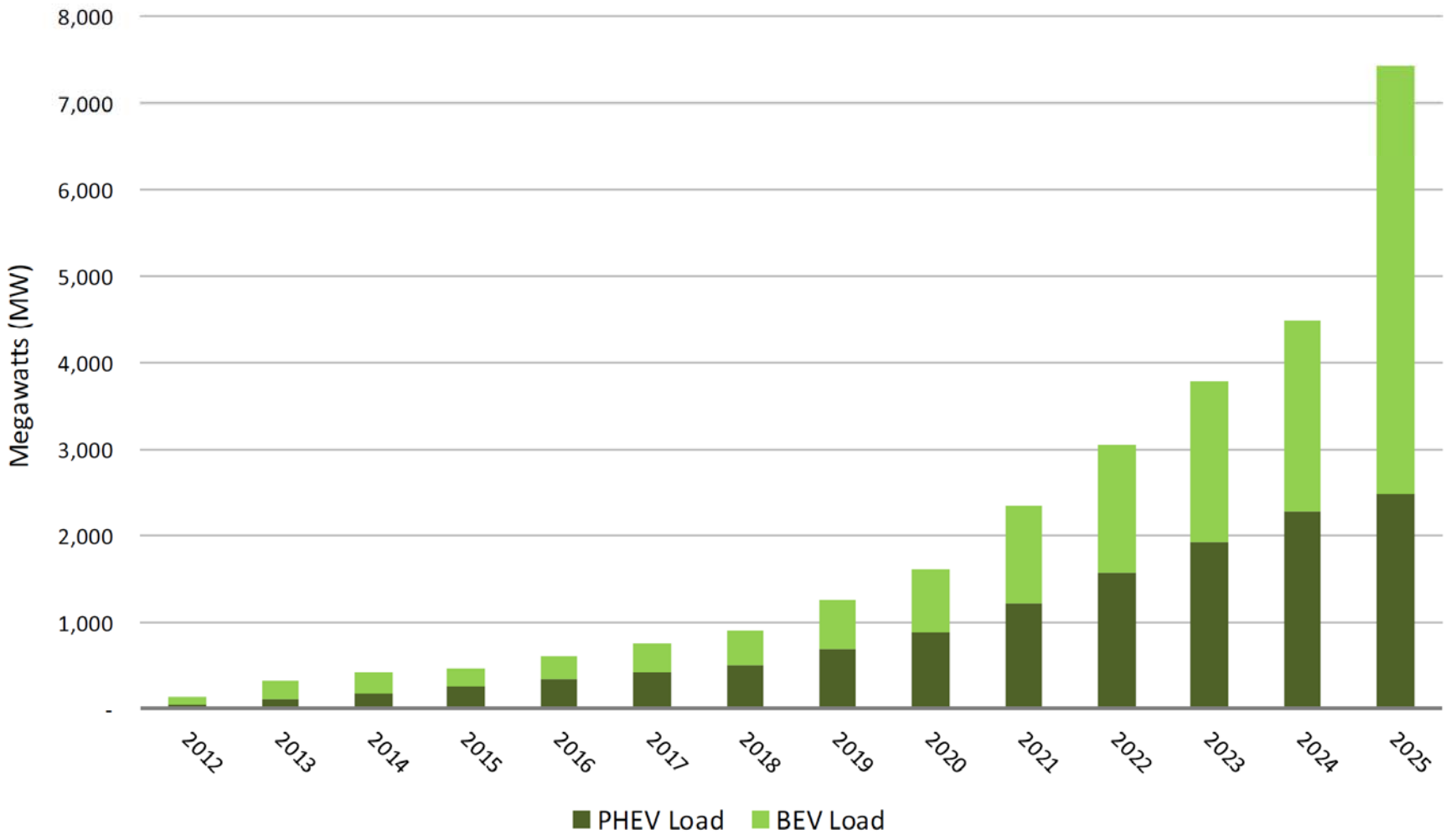
Forecast Load Growth from Electric Vehicles in California



Source: Vehicle - Grid Integration: A Vision for Zero-Emission Transportation Interconnected throughout California's Electricity System; California Public Utility Commission, March 2014. R.13-11-007. Pg. 3.

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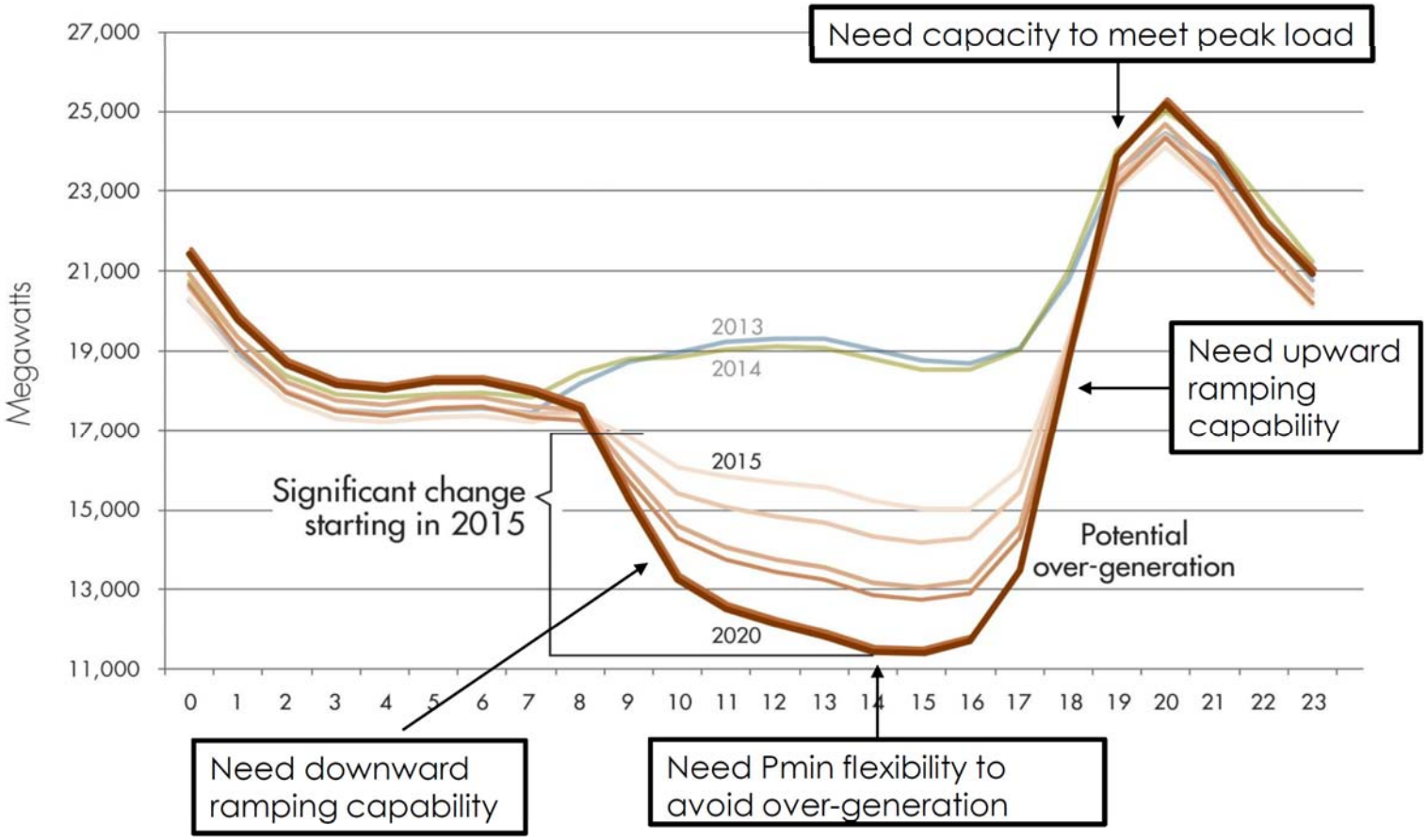
EVs – a part of the solution to meet a variety of grid needs

The Spring Partial Peak "Duck" is but one of the flock…



Source: California Independent System Operator

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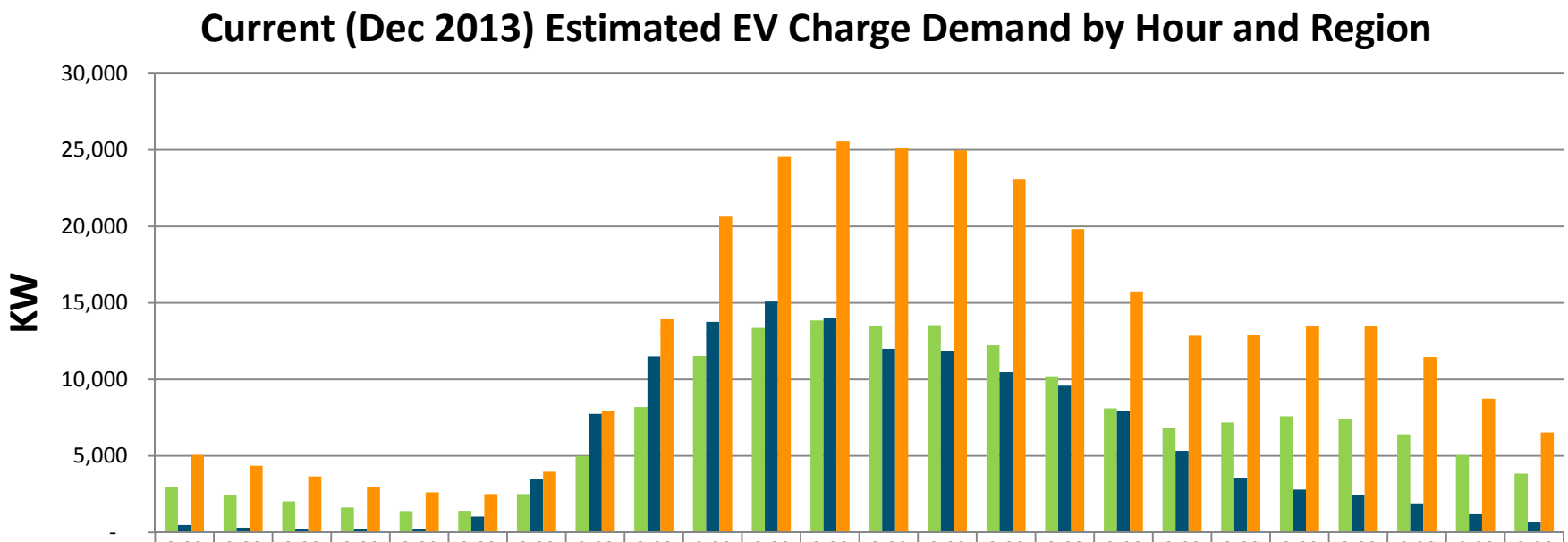
EVs – already part of the solution to meet grid needs



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Series1	2,92	2,46	2,03	1,62	1,39	1,41	2,50	4,98	8,19	11,5	13,3	13,8	13,4	13,5	12,2	10,2	8,10	6,84	7,17	7,58	7,39	6,40	5,04	3,83
Series2	480	301	240	236	239	1,03	3,46	7,74	11,5	13,7	15,0	14,0	11,9	11,8	10,4	9,58	7,95	5,32	3,56	2,79	2,42	1,89	1,18	651
Series3	5,05	4,35	3,65	2,99	2,61	2,50	3,96	7,93	13,9	20,6	24,5	25,5	25,1	24,9	23,0	19,8	15,7	12,8	12,8	13,5	13,4	11,4	8,73	6,52

Chart used with express permission of PowerTree Services.
Data aggregated from publicly available ChargePoint and Ecotality usage information over 2 years on 5 minute intervals..

» Current charging demand patterns of shared public charging stations <u>already</u> complementary to "raising the belly" of the duck- absent VGI solutions in place.

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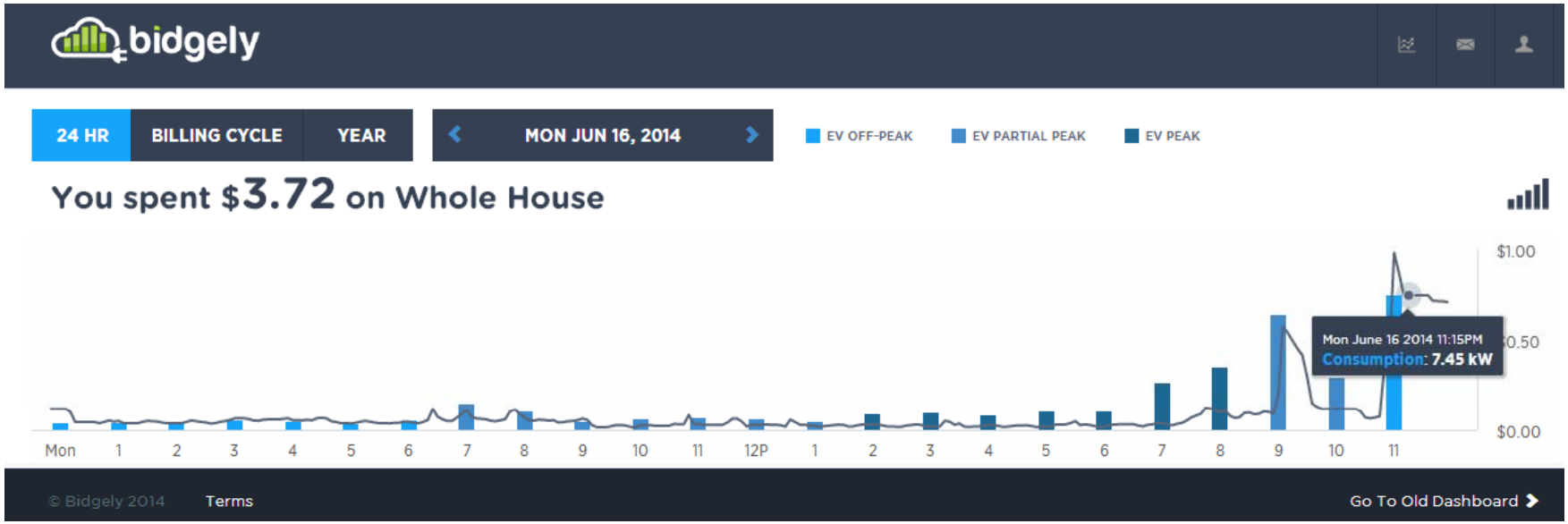
Single Family Home EV Usage Patterns Tend to Look Different



Individual home case study – not aggregate data. Chart used with permission of Bidgely. © Bidgely 2014.

» Residential EV usage highly correlated to time-of-use EV rates

» Neighborhoods with high EV penetration = huge demand spike at 11pm???
- …even though residential users just want a fully charged car in the morning

» Smart charging at home makes sense – but consumers won't pay more for equipment if there aren't economic benefits for doing so

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Vehicle Grid Integration (VGI) benefits

» Depends on **duration**, **speed**, and **availability** of resources

» System (Bulk) Benefits
- Managing duck curve
- Providing Ancillary Services (AS)

» Local Issues
- Peak shaving
- Voltage regulation
  - Helps address issues associated with high penetration of DG solar
- Phase balancing
  - Managing localized distribution constraints
  - Lowering facility upgrade requirements

» Rates
- Better utilization of existing generation and T&D assets → lower consumer cost per kWh

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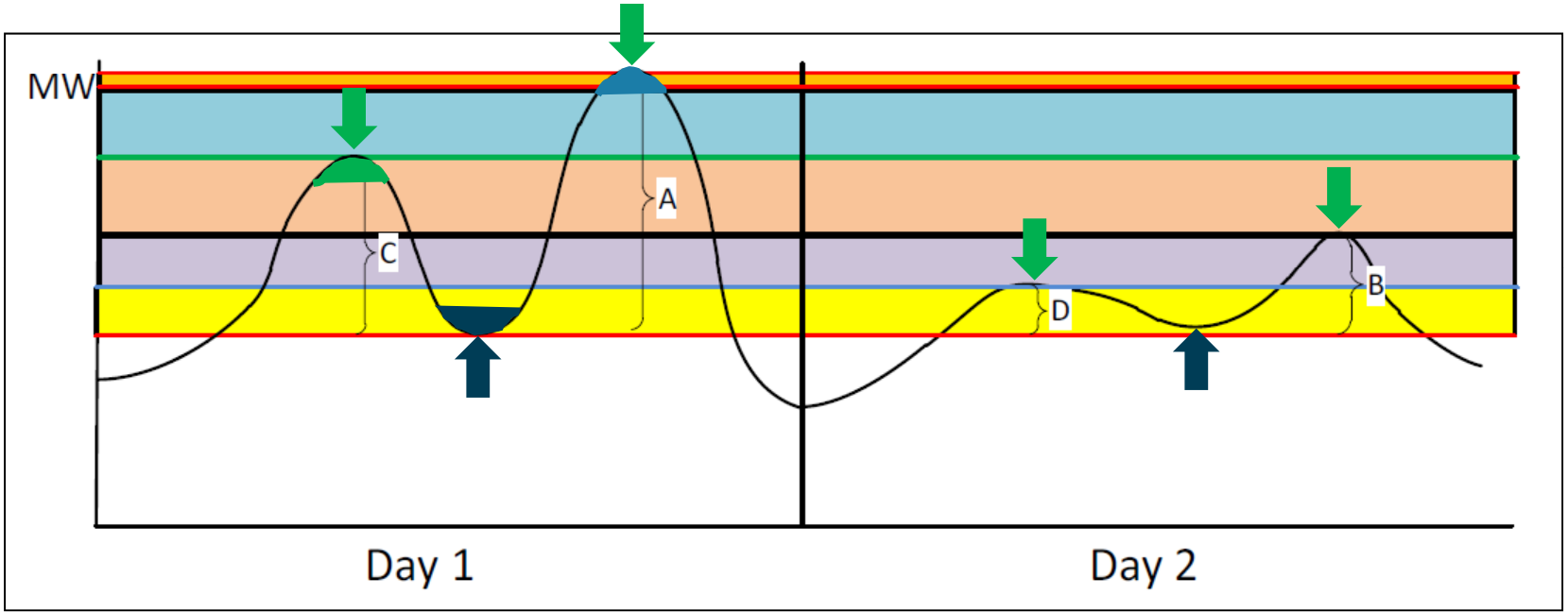
Duration

Longer duration energy storage can shift large amounts of energy



- **Leads to a cleaner grid due to lowering the need for min dispatch & ramping of fossil gen**
- **Lowers consumer costs by reducing the need for peakers**

1. **Using** CAISO's proposed structuring of flexible capacit**y, from the fifth FRAC-MOO straw proposal**

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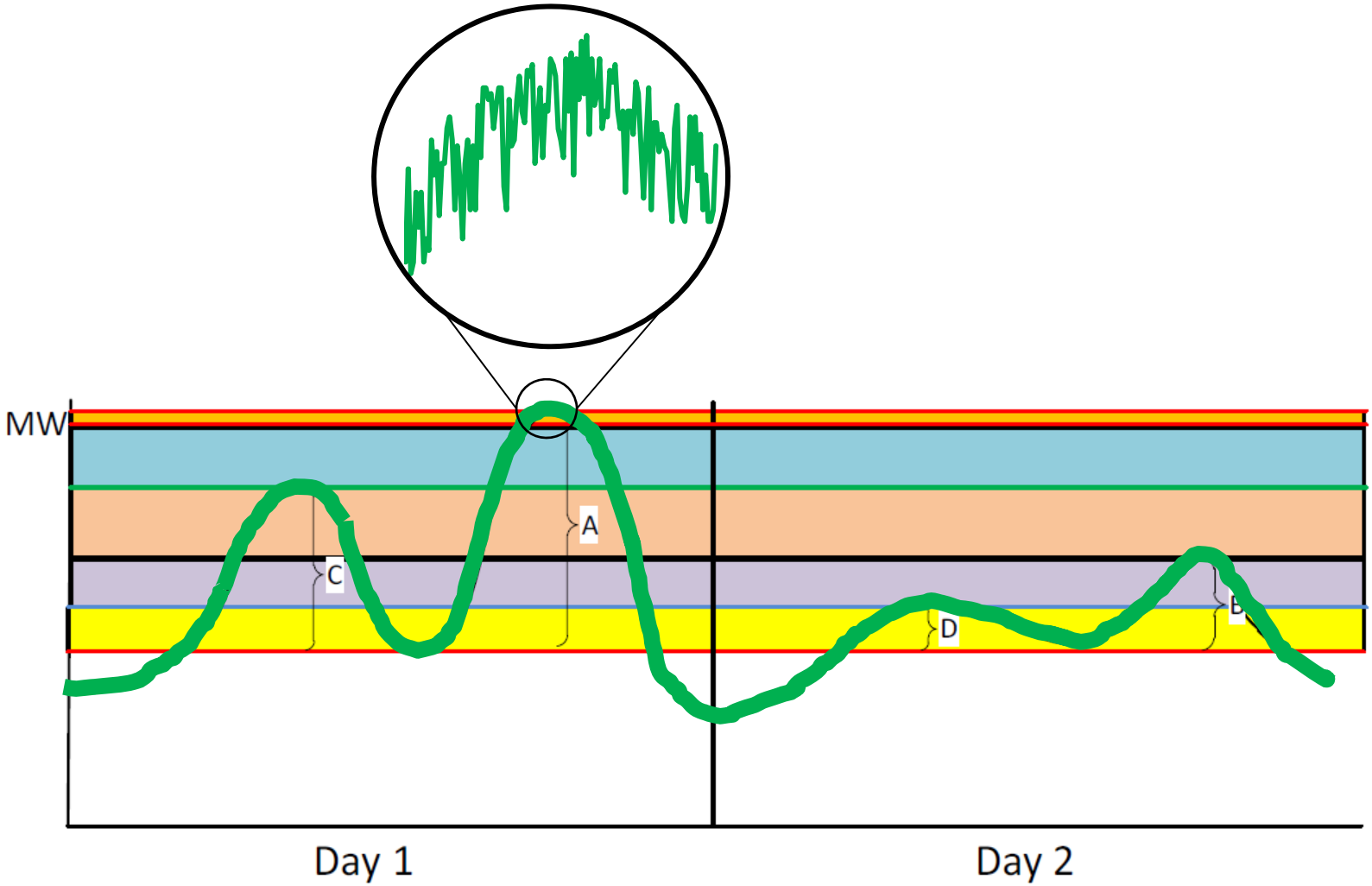
Speed

Fast storage can help address ramping and frequency regulation



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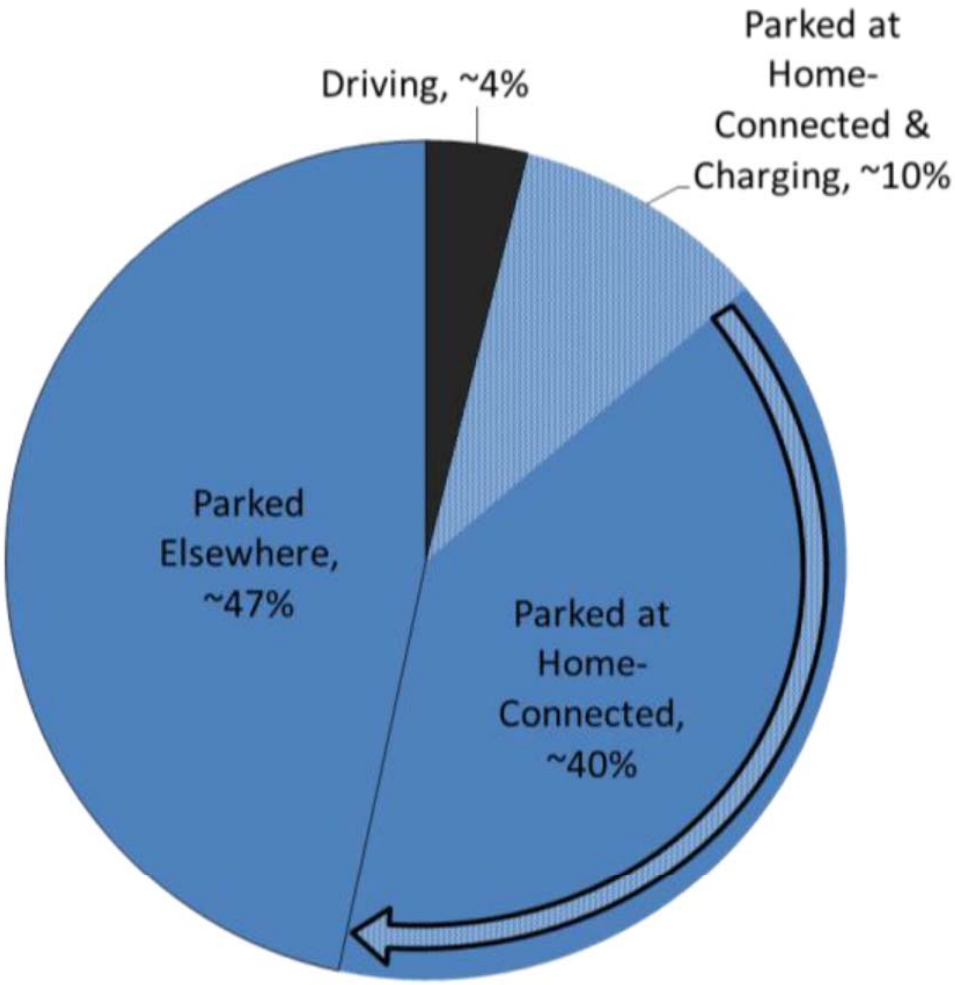
Availability

» EVs are only driving 4% of the time
  - But availability of vehicular storage may not always align with local/system needs, and may require consumer behavioral changes

» Fixed storage co-located with VGI can help maximize availability of the resource for grid benefits



Estimated percent of time PEVs spend by location and activity.

Source: *Source: Vehicle - Grid Integration: A Vision for Zero-Emission Transportation Interconnected throughout California's Electricity System; California Public Utility Commission, March 2014. R.13-11-007. Pg. 5.*

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Stationary Storage: Key Component of VGI

» **Stationary storage is a key tool to manage demand spikes from EVs**

» Consumers generally don't like to change their behavior
- Some will if the incentives are right – but problematic in some circumstances

» Cost to manage worst case scenarios can be prohibitive in some use cases
- Especially DC fast charging and high capacity Level 2 charging

» Stationary storage should manage grid impact as EV penetration increases.
- Makes demand management possible without requiring consumer behavior change –helping enable V1G and V2G for many use cases

» Rate redesign alone cannot keep up with EV adoption
- Storage + V1G/V2G can keep pace with system and insulate the consumer.

POWERTREE

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Vehicle to Grid Integration: Critical Roadblocks

» Wholesale rates for wholesale uses
- Charging for wholesale market participation should pay wholesale rates
- Retail load rate treatment is for end uses, not power resale

» Interconnection
- Which tariffs apply under which use cases?
- Interconnection, metering & telemetry needs to be vastly simplified
- Software as a solution to manage network upgrade affordability

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Vehicle to Grid Integration: Other Issues

» Retail Rate Design

» Market Participation

» Get past utility "pilots" ASAP

The good news: The grid won't break… but with the right policies, VGI can accelerate deployment, be complementary to state goals, <u>and</u> lower consumer costs.

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More Information

THANK YOU!

For questions, please contact:

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