

# System Balancing in an Evolving Grid – Perspective from the Trading Floor of a Vertically Integrated Municipal Utility

Energy Systems Integration Group  
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Jon Olson, Director, Energy Trading & Contracts  
Sacramento Municipal Utility District (SMUD)

Powering forward. Together.

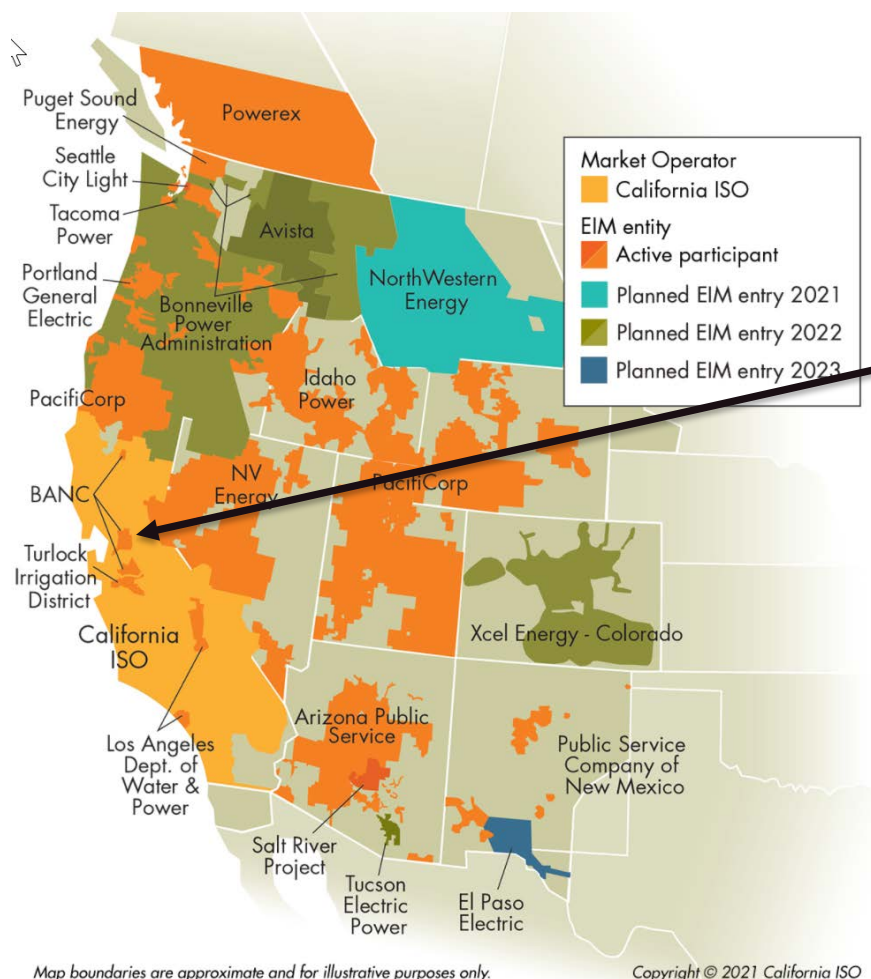


# Agenda

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- Background Information on SMUD
- Renewables, Distribution Energy Resources (DERs) & Reserves
- Role of Hybrids in System Balancing
- System Flexibility through Markets
- Conclusion

# Background Information: What is SMUD?



- Vertically integrated utility serving Sacramento, CA
- Member of the Balancing Authority of Northern CA (BANC)
- Participant in the California ISO's Energy Imbalance Market (EIM)

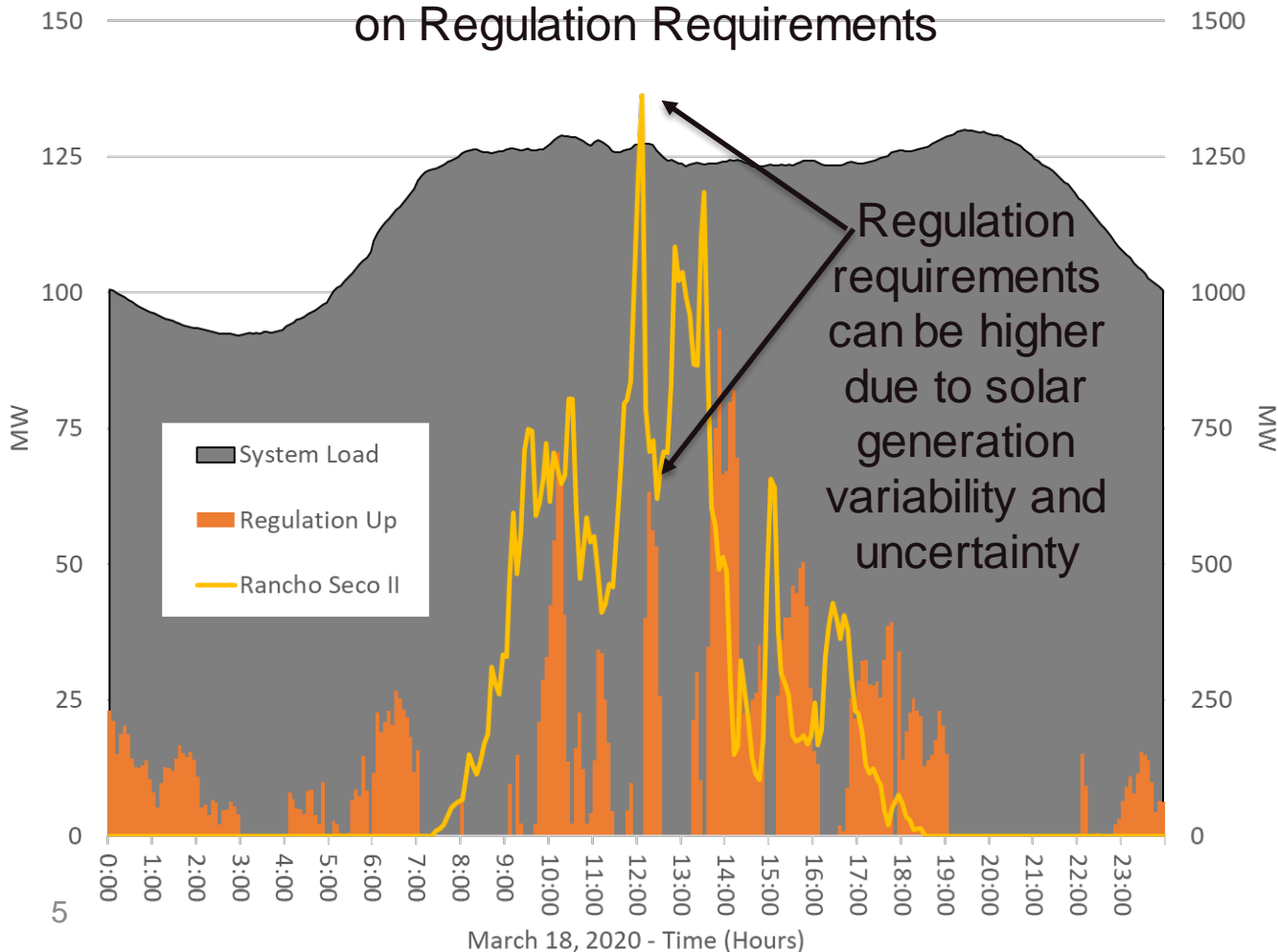
Map boundaries are approximate and for illustrative purposes only.

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# Renewables, DERs and Reserves

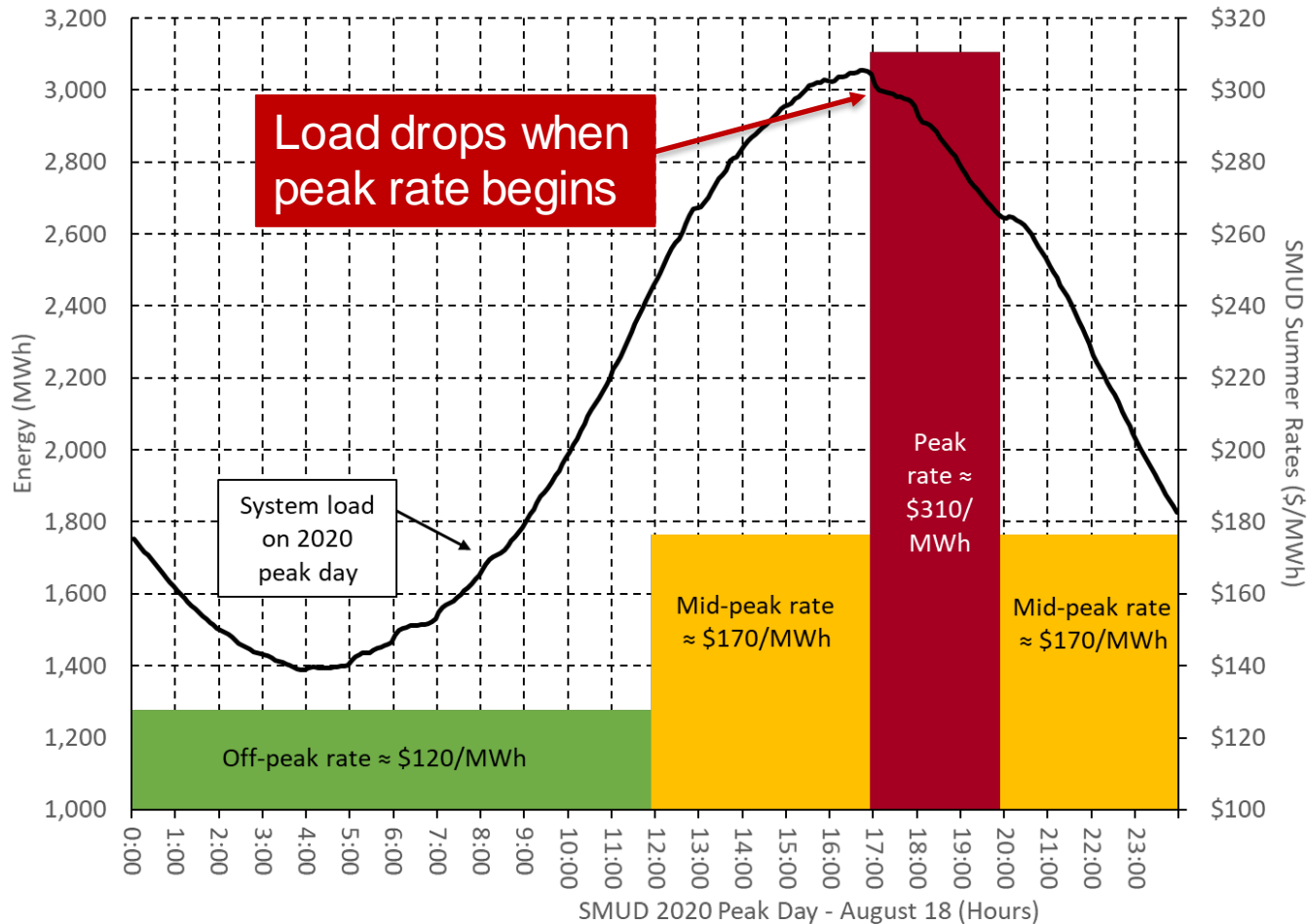
# Renewables & DERs can increase operating reserve requirements

Impact of Rancho Seco II Solar Project  
on Regulation Requirements



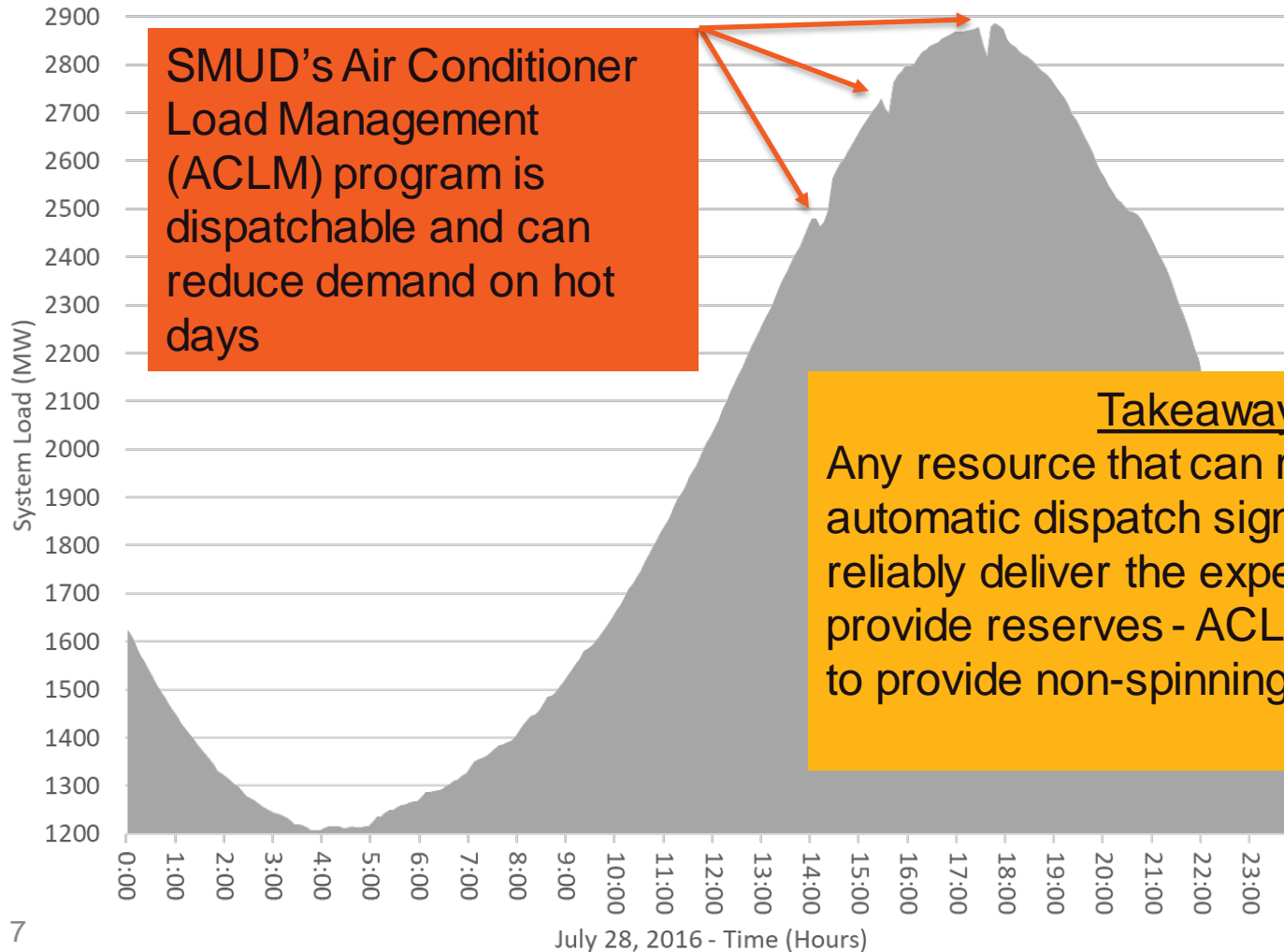
Takeaway:  
Any resource that has an energy delivery pattern that varies with nature (VERs) or behavior can increase reserve requirements, because they introduce greater variability

# Time of Use (TOU) rates can reduce the amount of required planning reserves



**Takeaway:**  
TOU rates are a form of DERs  
TOU rates impact customer load  
The more certain the impact, the greater the reduction in planning reserves

# Renewables & DERs can provide planning and operating reserves



# Co-optimize renewables and DERs with the market or portfolio to lower costs

Programs/Resources that alter supply or demand on the distribution system...

Impact the net load

And any changes in net load directly impact the wholesale portfolio

Automatic Dispatch Signal?

Yes then optimize directly in the wholesale market

No then optimize within the wholesale portfolio

# Takeaways:

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- Renewables & DERs impact reserves
- Their variable nature tends to have an increasing impact on operating reserves
- The greater the certainty of their impact to net load, the more likely they can provide planning and operating reserves
- Co-optimizing renewables and DERs with the market or wholesale portfolio lowers cost to serve load

# Role of Hybrids

# The role of hybrids in system balancing

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- Batteries can contribute to system balancing by reducing solar variability
- Operational flexibility of batteries is reduced with the current form of the Federal Income Tax Credit (ITC)



Two of the 6 energy storage units destined for our Hedge site in south Sacramento County.



Wildflower Solar Farm (Dec. 2020)

# What does the ITC deliver?

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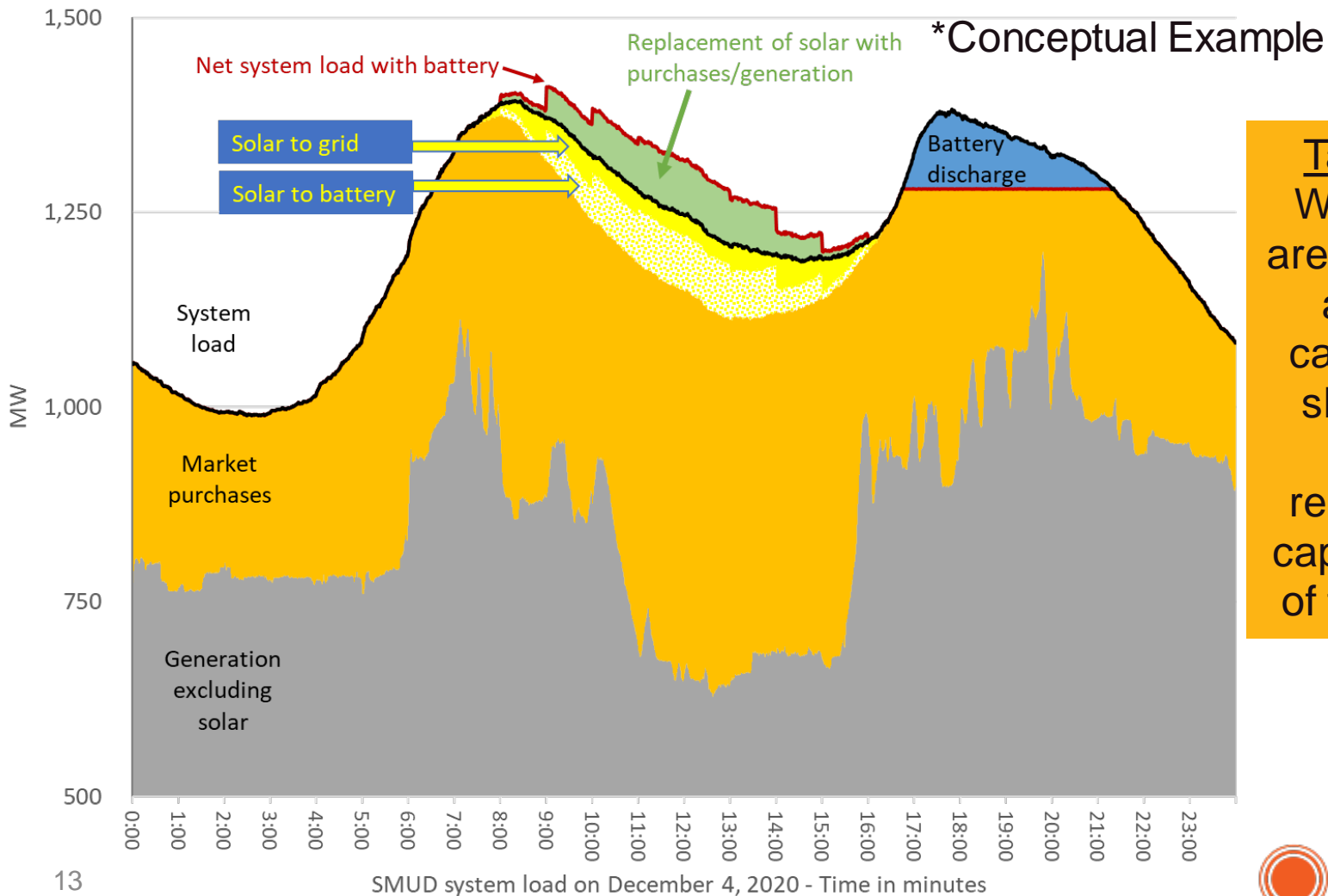


+ ITC =



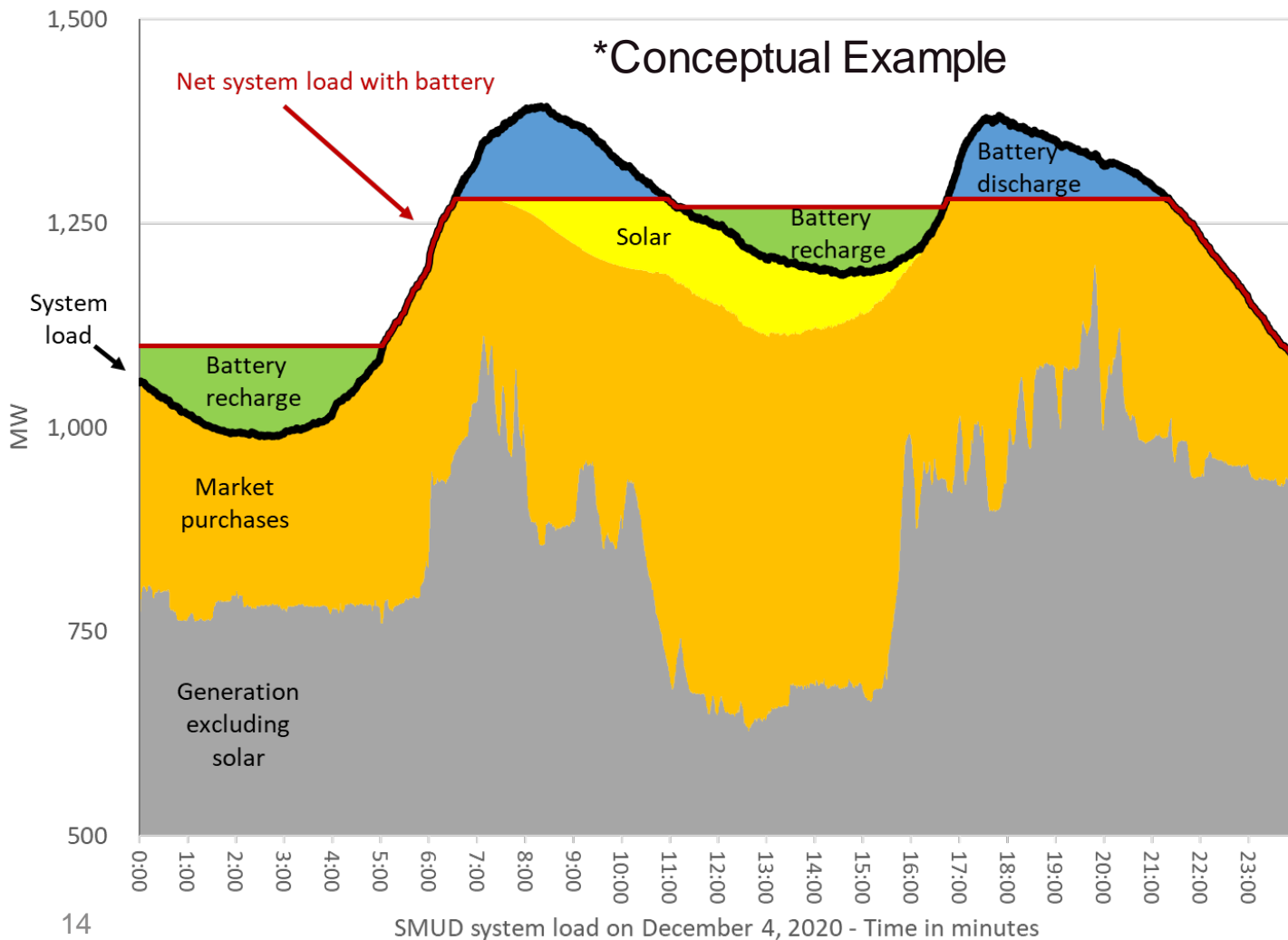
Discount on initial cost, but higher portfolio operating cost due to less grid operational flexibility

# Example 1a: ITC reduces available battery capacity on winter day



**Takeaway:**  
When there are dual peaks a battery cannot peak shave both peaks, reducing the capacity value of the battery

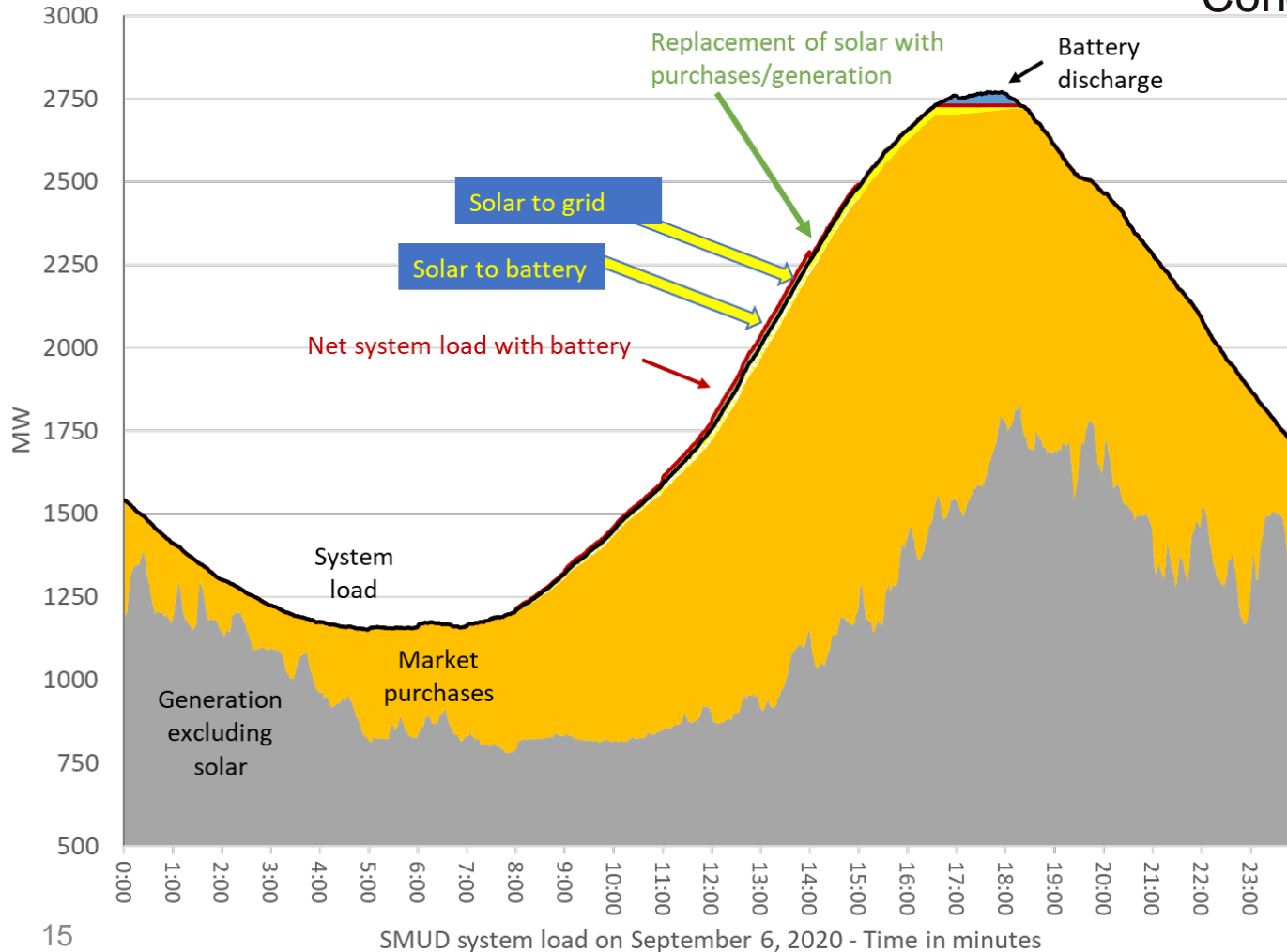
# Example 1b: Grid or Portfolio Charging enables the battery to shave both peaks



**Takeaway:**  
A system balance with lower costs is achieved when the battery can shave both peaks

# Example 2a: ITC reduces available capacity on a smoke day

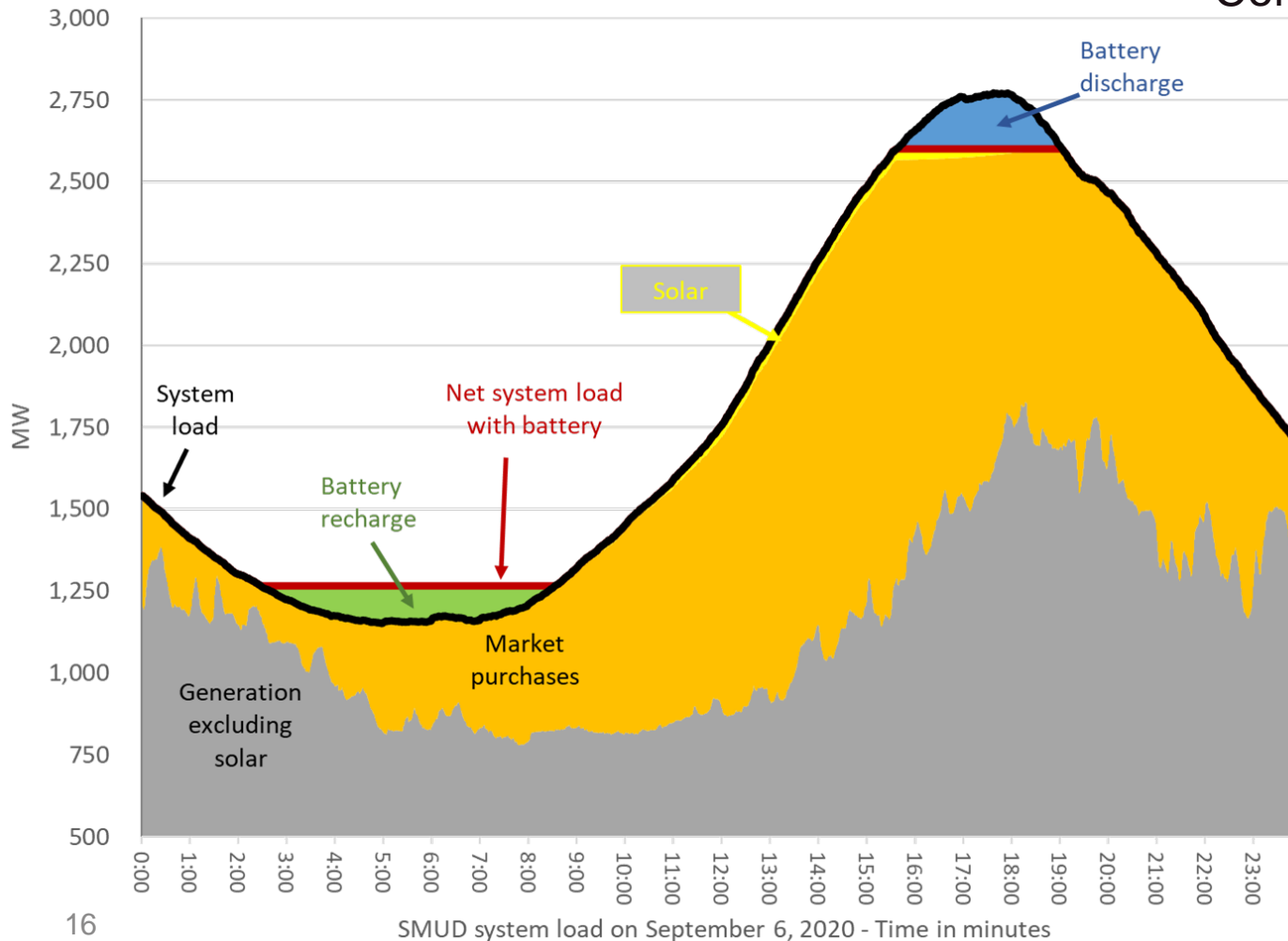
\*Conceptual Example



Takeaway:  
When the sun doesn't reach the solar panels the battery doesn't charge

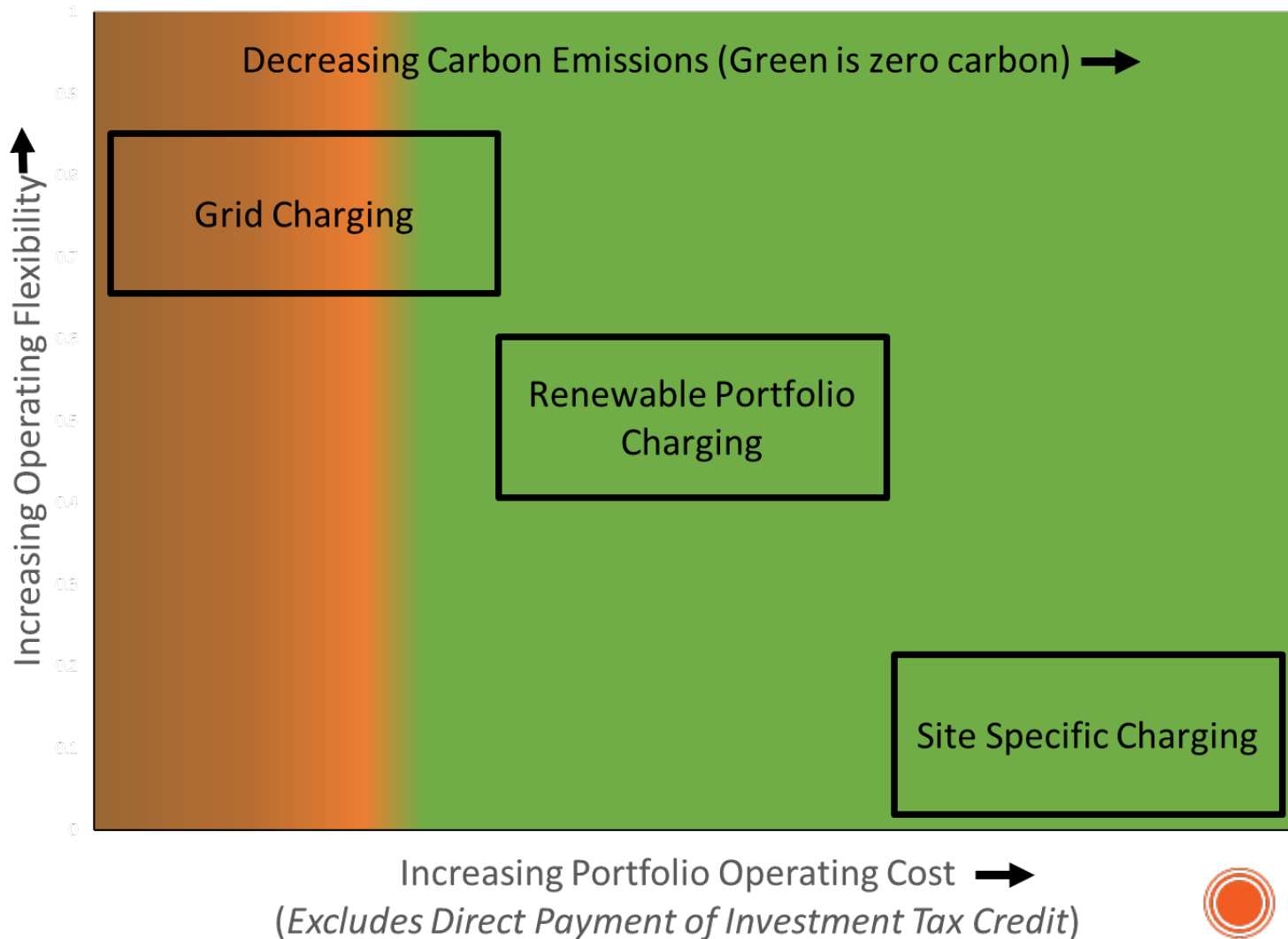
# Example 2b: Grid or Portfolio Charging increases peak shaving capability

\*Conceptual Example



**Takeaway:**  
A system balance with lower costs is achieved when the battery can be grid charged so that the battery is fully charged prior to the peak

# Relationship between operational flexibility, charging source, cost and carbon



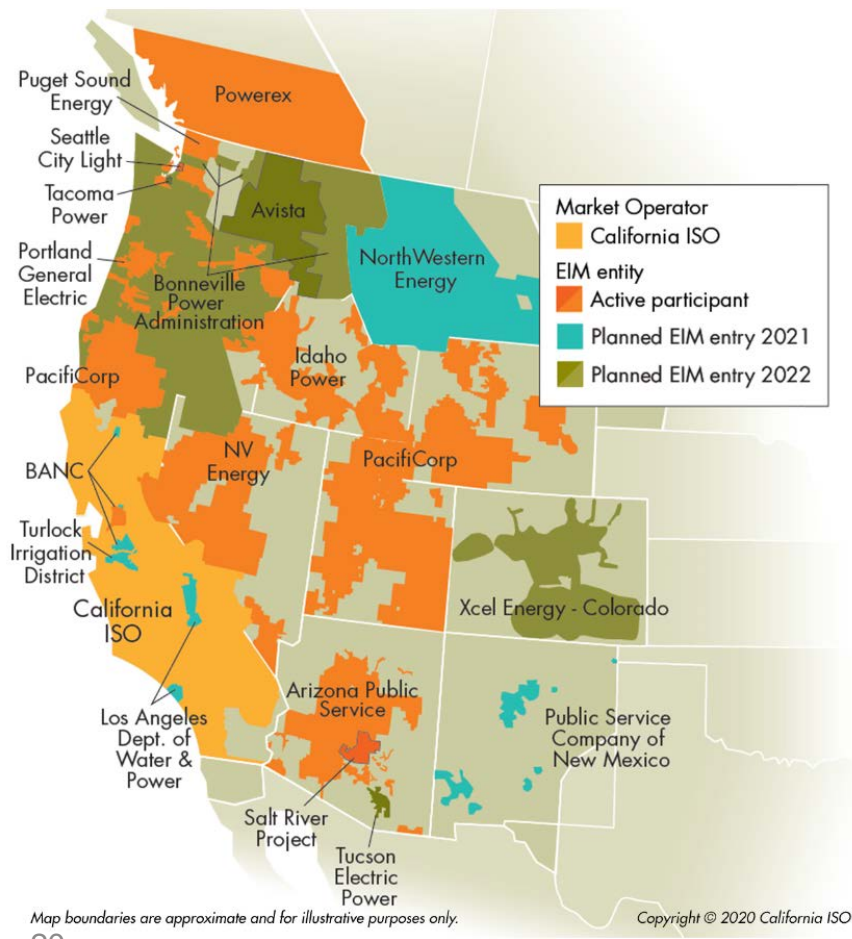
# Takeaway

- Modifying the ITC to allow other forms of battery charging could increase operational flexibility and lower costs with minimal to no effect on carbon.



# System Flexibility through Markets

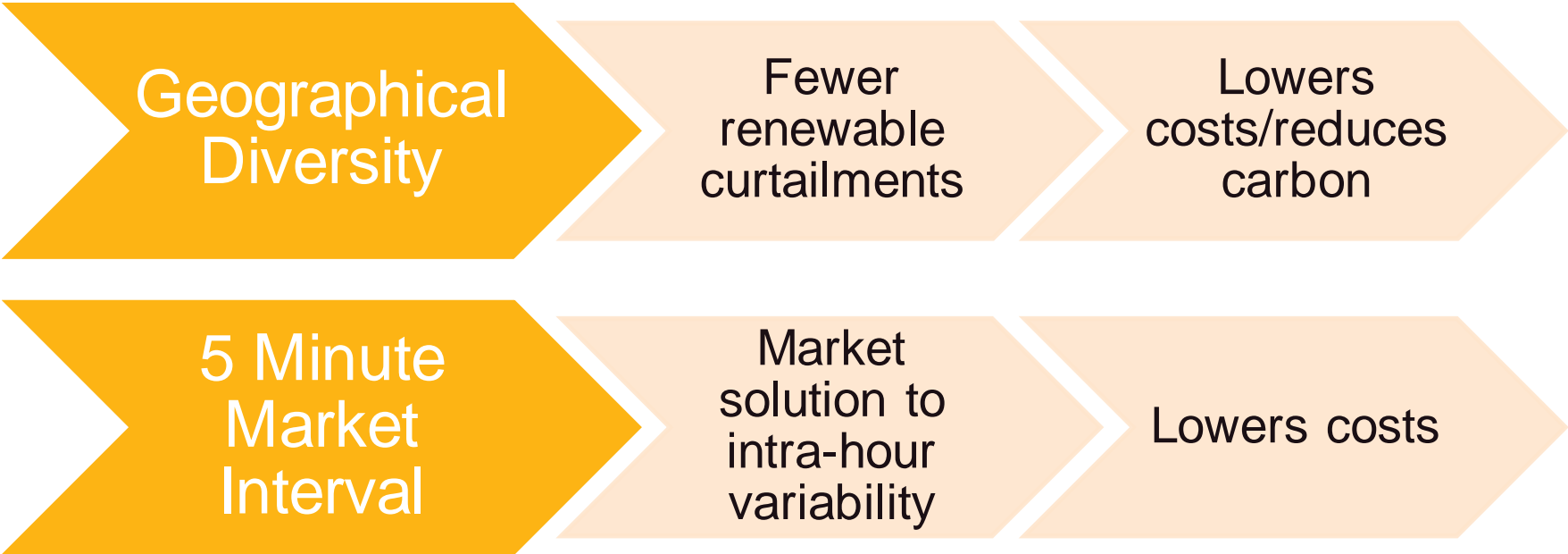
# What is the Energy Imbalance Market (EIM)?



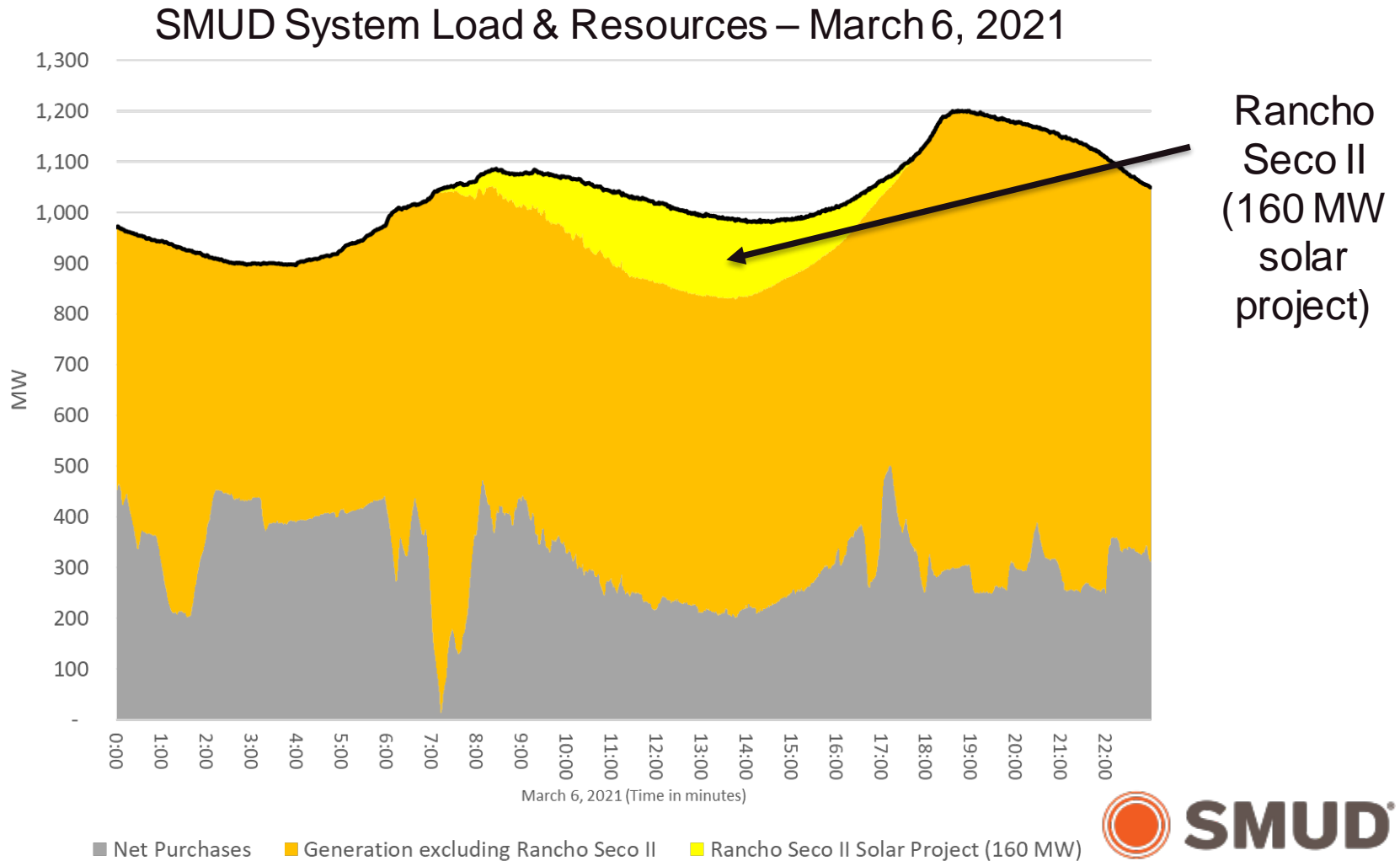
- Structured and regulated market
- CAISO is the market operator
- Geographically diverse
  - Demand diversity
  - Supply diversity
- 5 minute optimization interval

# Markets improve system flexibility

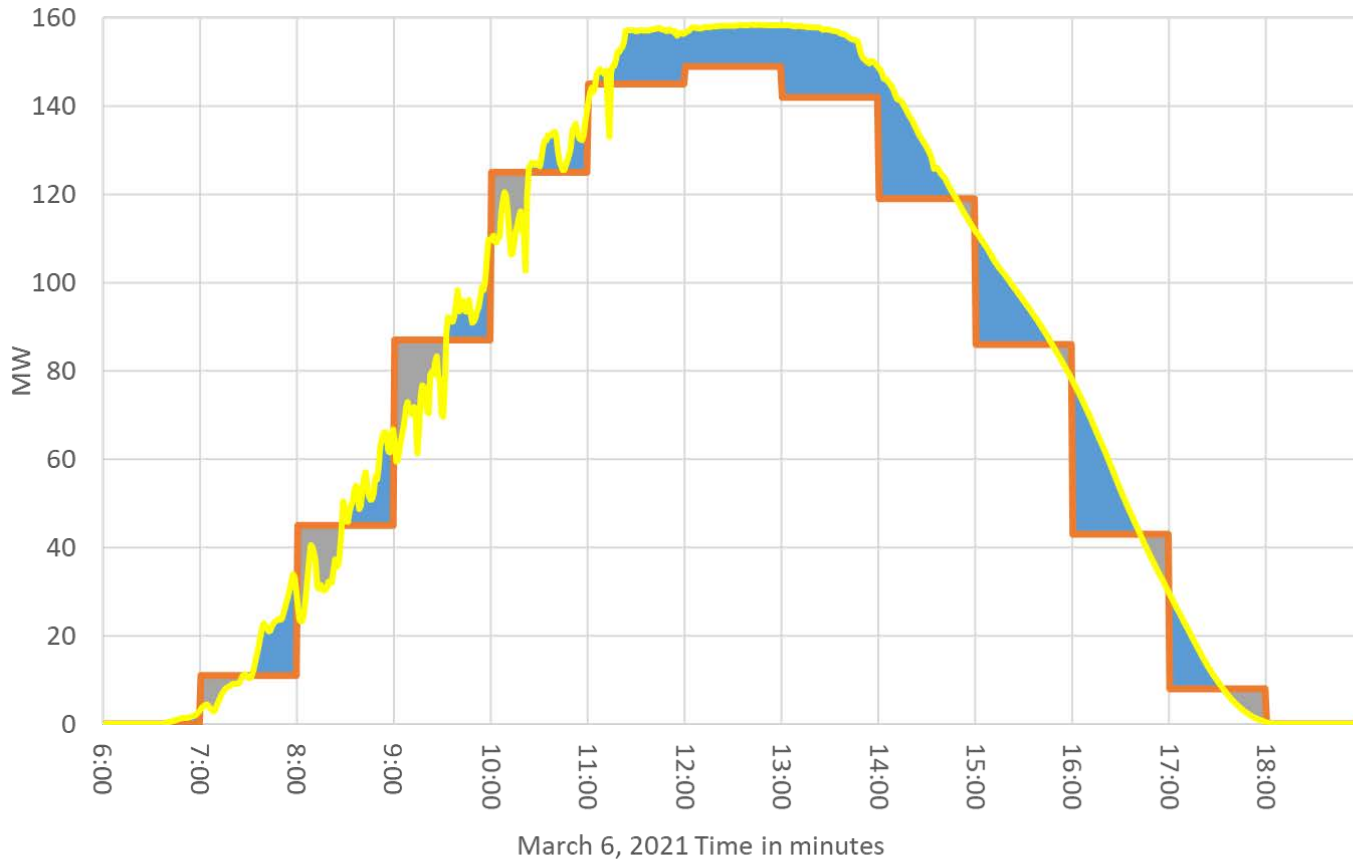
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# Example to demonstrate how markets help integrate renewables



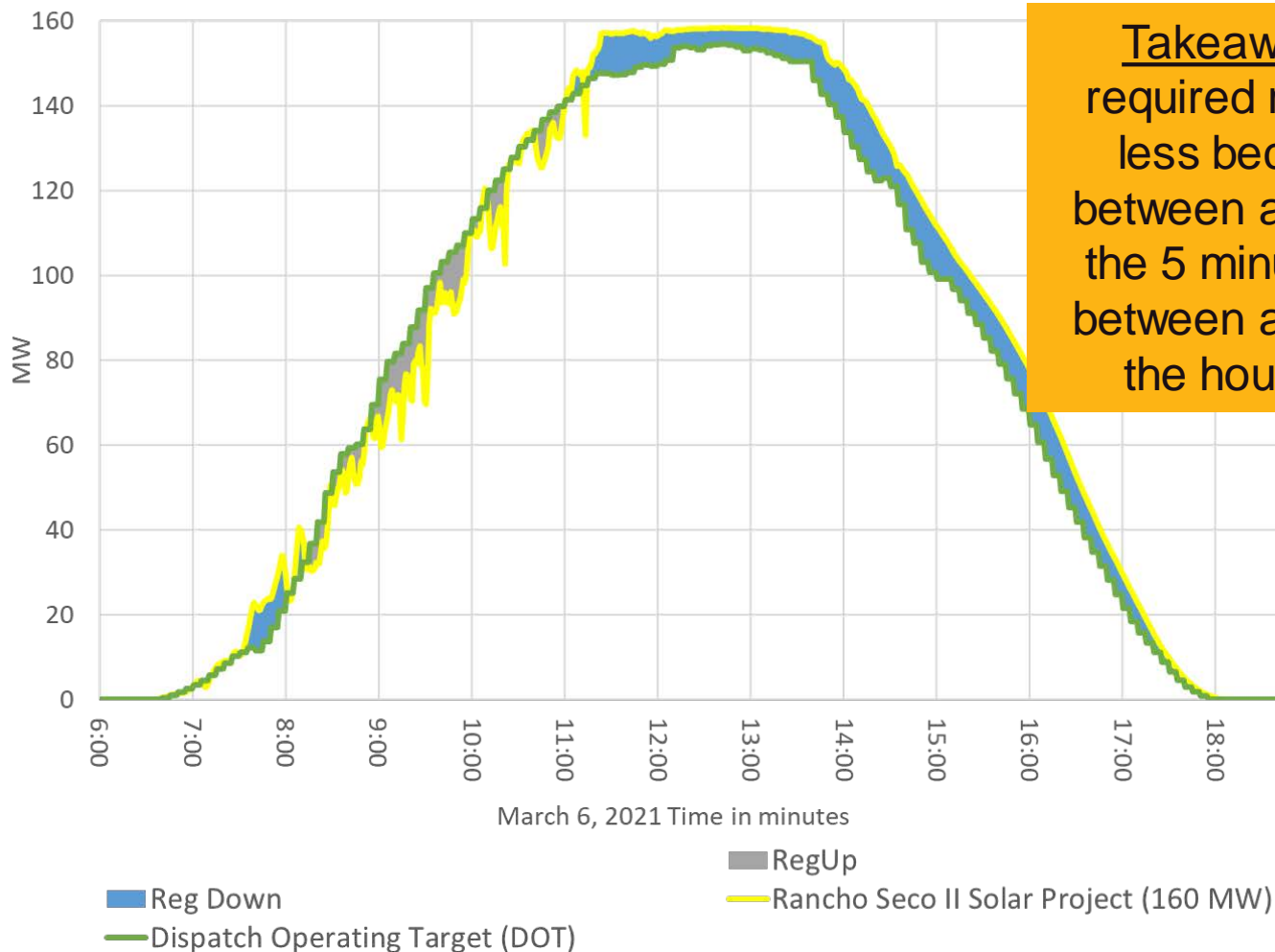
# Regulation required for Rancho Seco II assuming no EIM



**Takeaway:**  
Without EIM participation, the difference between the hourly base schedules and actual generation is met only with SMUD power plants

RegUp Reg Down Base Schedule Rancho Seco II Solar Project (160 MW)

# Regulation required for Rancho Seco II assuming EIM

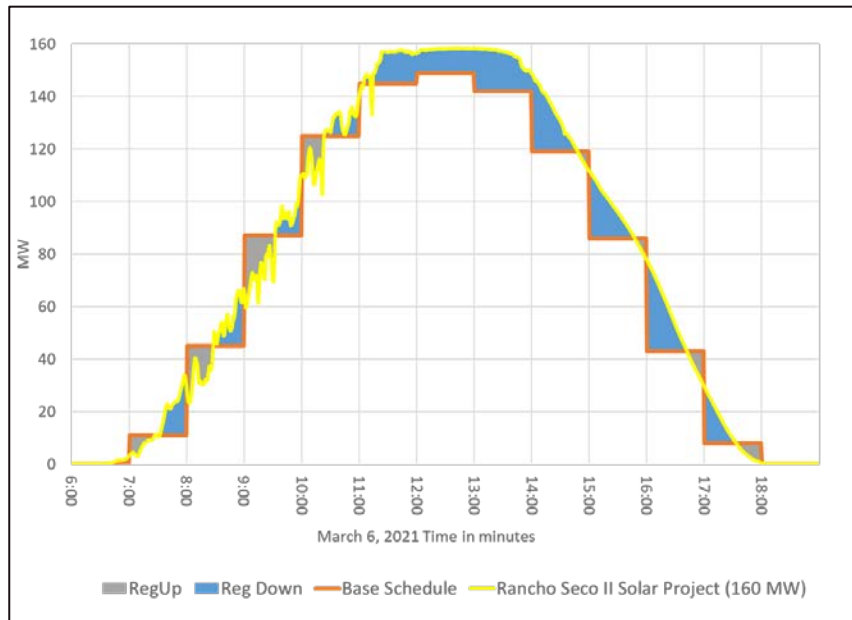


Takeaway: The amount of required regulation is typically less because the variance between actual generation and the 5 minute DOT is less than between actual generation and the hourly base schedule.

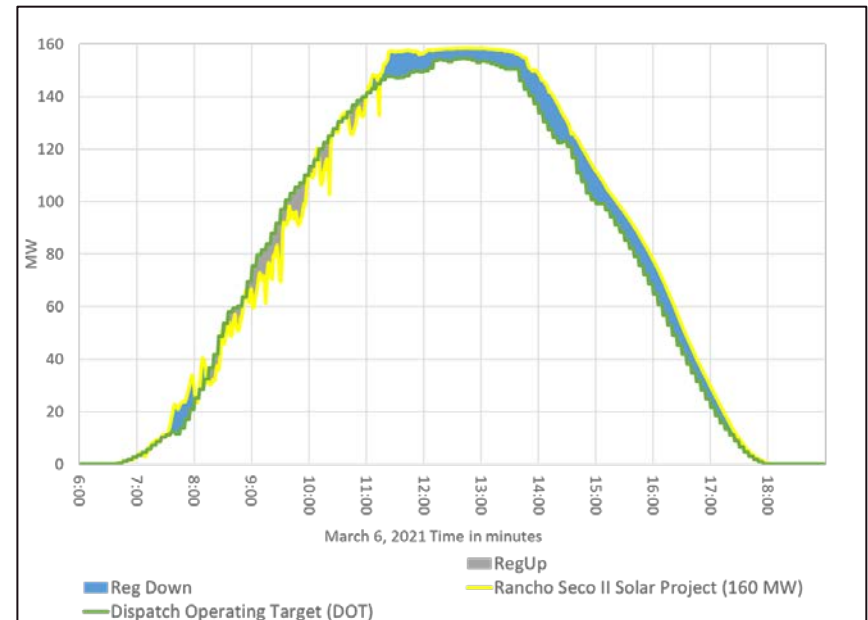
Takeaway: The difference between the DOT and the hourly base schedule is met through the market, yielding a system balance with lower costs

# A market solution to variable renewable generation lowers costs

## Without EIM



## With EIM



# Final thoughts from the trading floor

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- Renewables and DERs can be most valuable to a portfolio if:
  - Impacts to net load are more certain
    - Reducing the need for operating reserves
    - Increasing the capability to provide operating and planning reserves
  - Resources are co-optimized with the wholesale portfolio
    - Automatic dispatch signal capability → offer curve and market dispatch
    - No automatic dispatch signal capability → portfolio optimization only
- ITC reform could add operational flexibility and reduce costs with little to no effect on carbon
- Markets can be an instrument to ease the integration of renewables by providing a market solution to VERS variability and reducing the amount of renewable curtailments