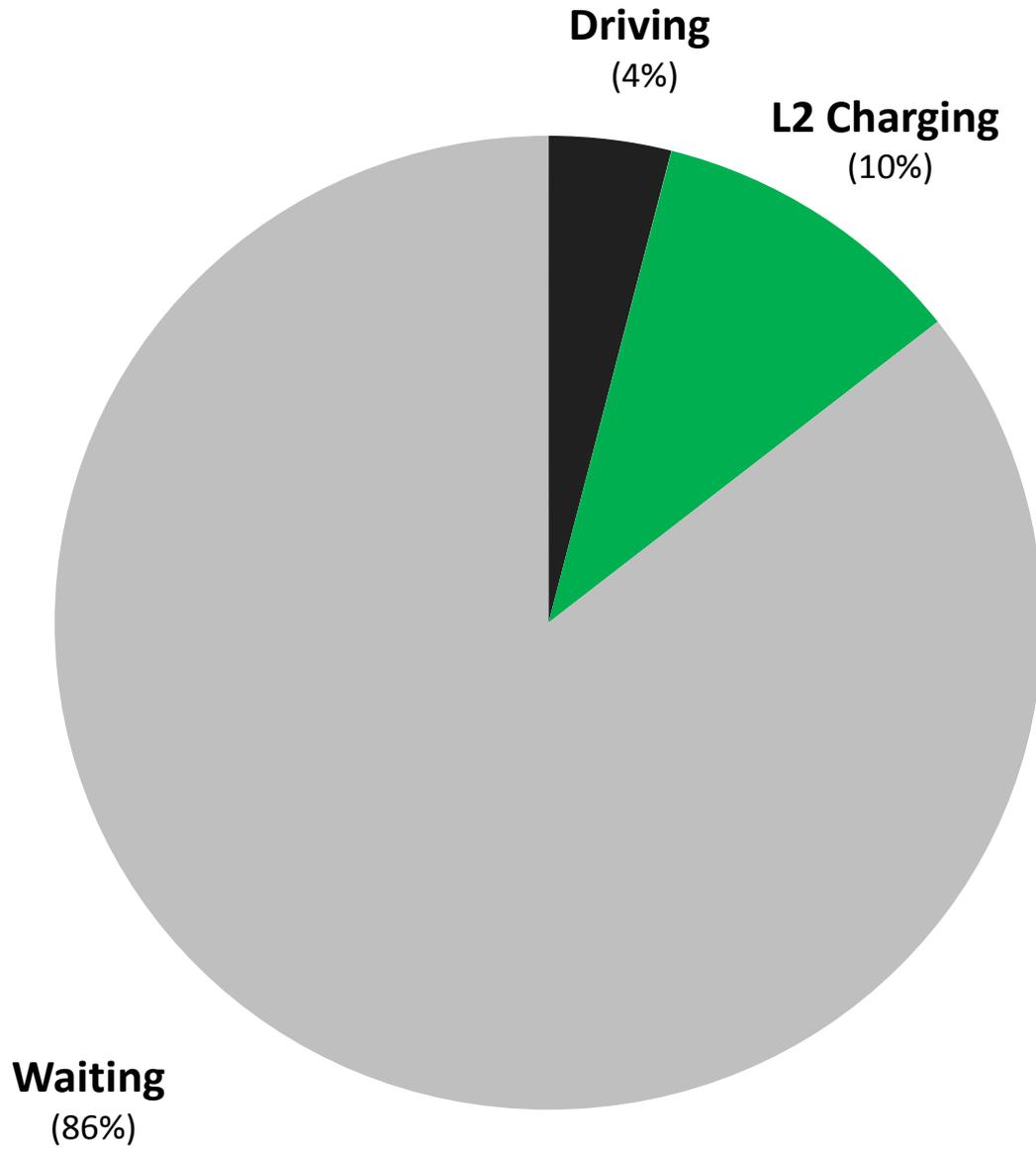


# **Vehicle-Grid Integration**

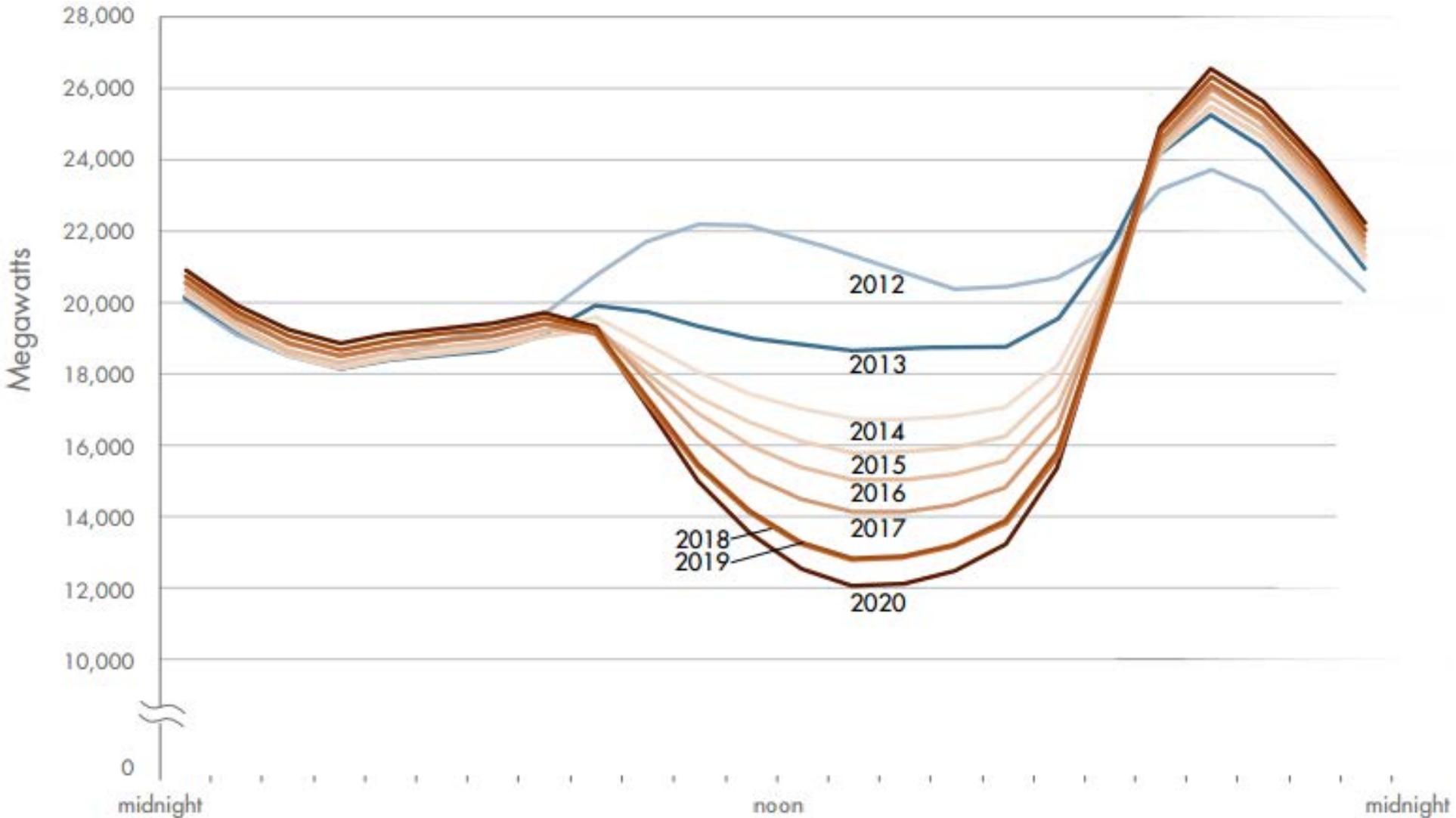
## **CPUC Staff Perspective**

Adam Langton

October 2013

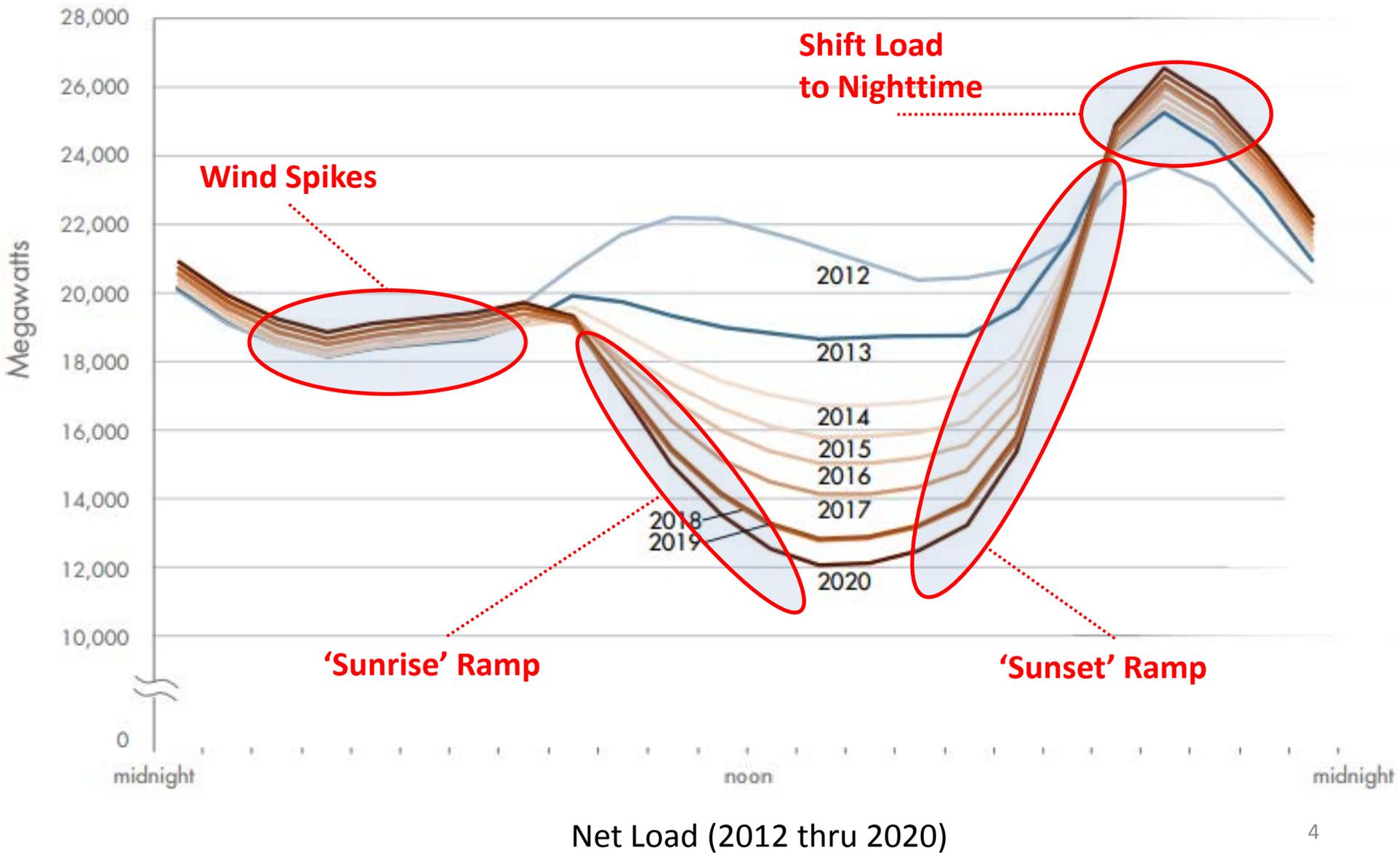


# California's Changing Grid Needs



Net Load (2012 thru 2020)

# California's Changing Grid Needs



# Types of Grid Needs Vehicles Can Serve

## Wholesale Market Needs

Frequency Regulation

Spinning Reserve

Non-Spinning Reserve

Load Following/Ramping  
for Renewables

## Distribution Infrastructure Needs

Distribution Upgrade Deferral

Congestion Relief

Voltage Support

Improve Load Factor

## Customer Needs

Power Quality

Power Reliability

Retail Energy Time-Shift

Demand Charge  
Mitigation

# Controlled Charging (V1G)

# Controlled Charging + Battery Discharge (V2G)

**Unified  
Actors**

One  
Resource



Many  
Resources

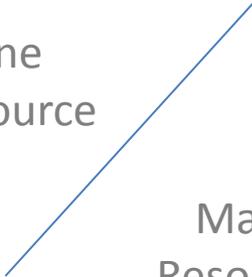
One  
Resource



Many  
Resources

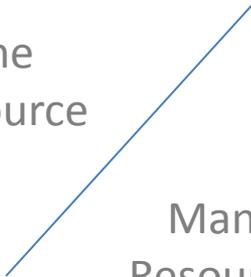
**Fragmented  
Actors**

One  
Resource

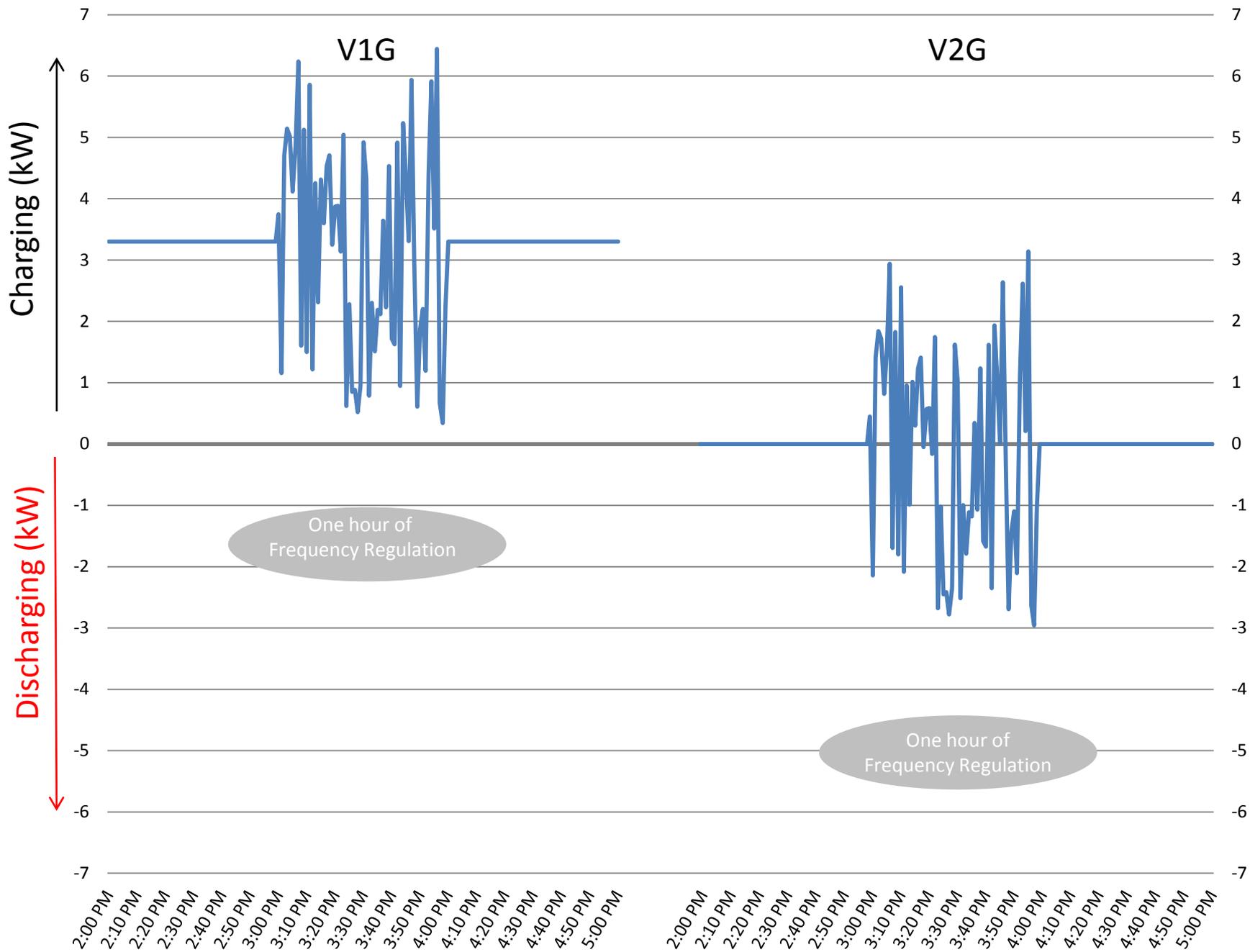


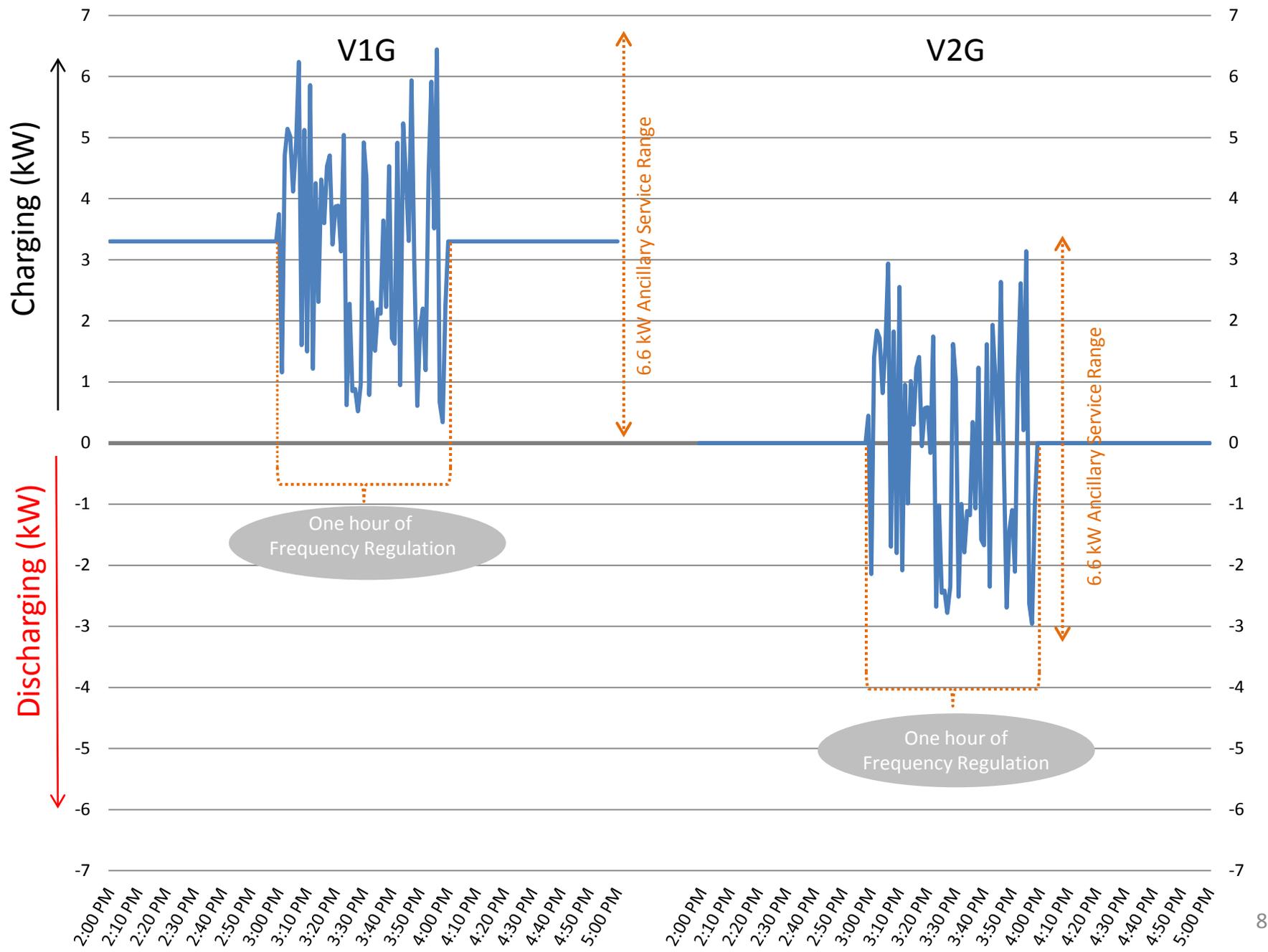
Many  
Resources

One  
Resource



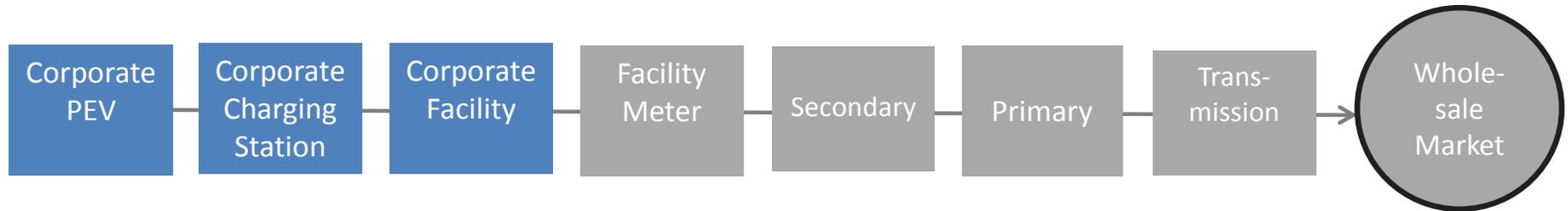
Many  
Resources



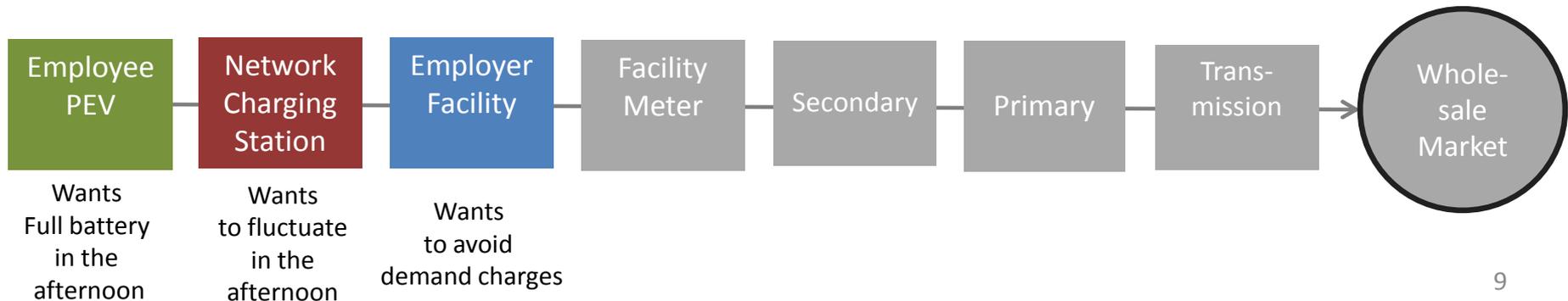


# Actors: Unified vs. Fragmented

Unified Actors: Corporate Fleet charging at corporate facility



Fragmented Actors: Employee charging at work



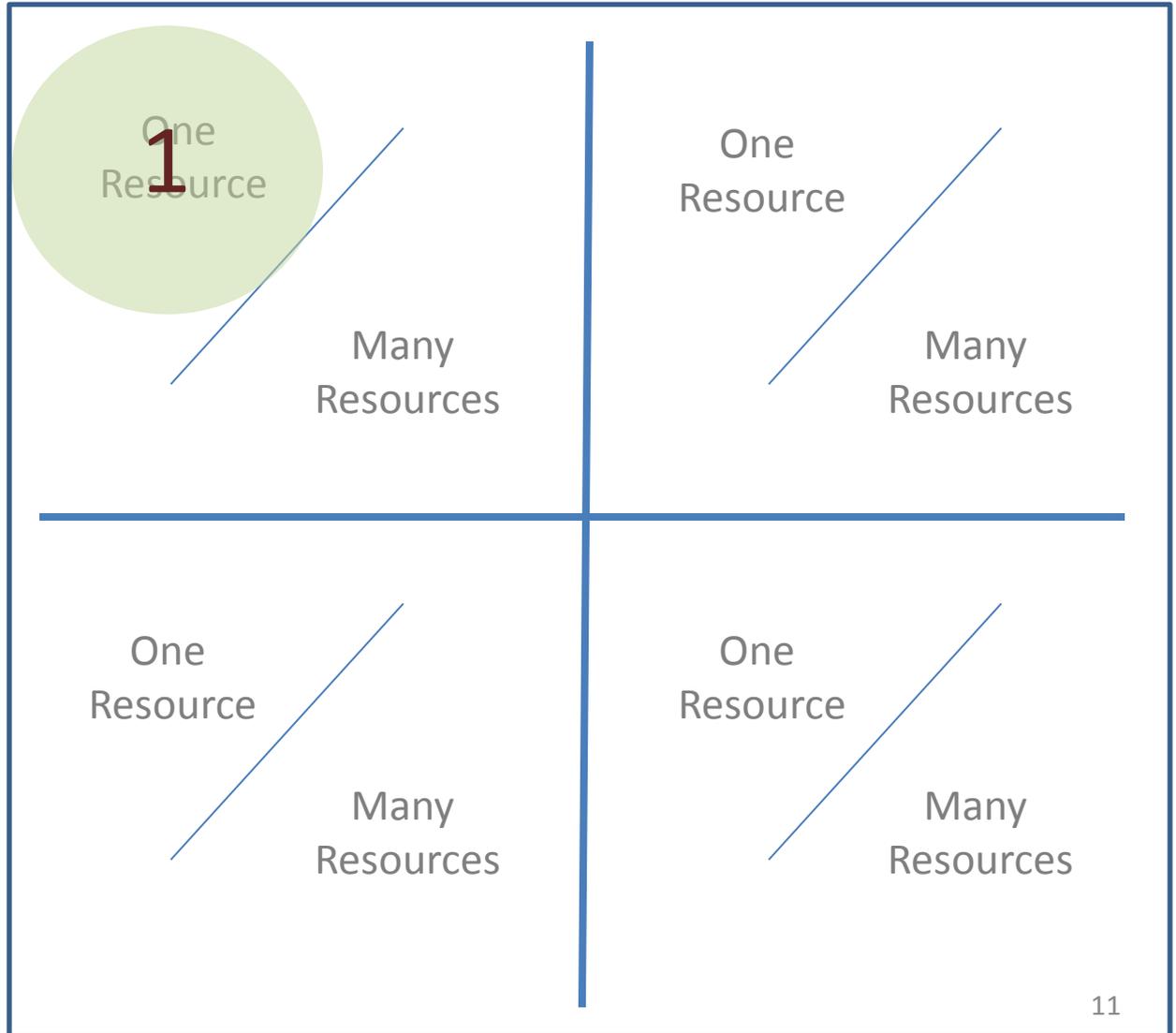
# Key Regulatory Questions

1. Do we need to define the resource?
2. Who aggregates?
  - Only the utility?
  - Only third parties?
  - Both?
3. How do we monetize distribution benefits?
4. How do we determine primacy among VGI activities?

## Controlled Charging (V1G)

## Controlled Charging + Battery Discharge (V2G)

**Unified  
Actors**

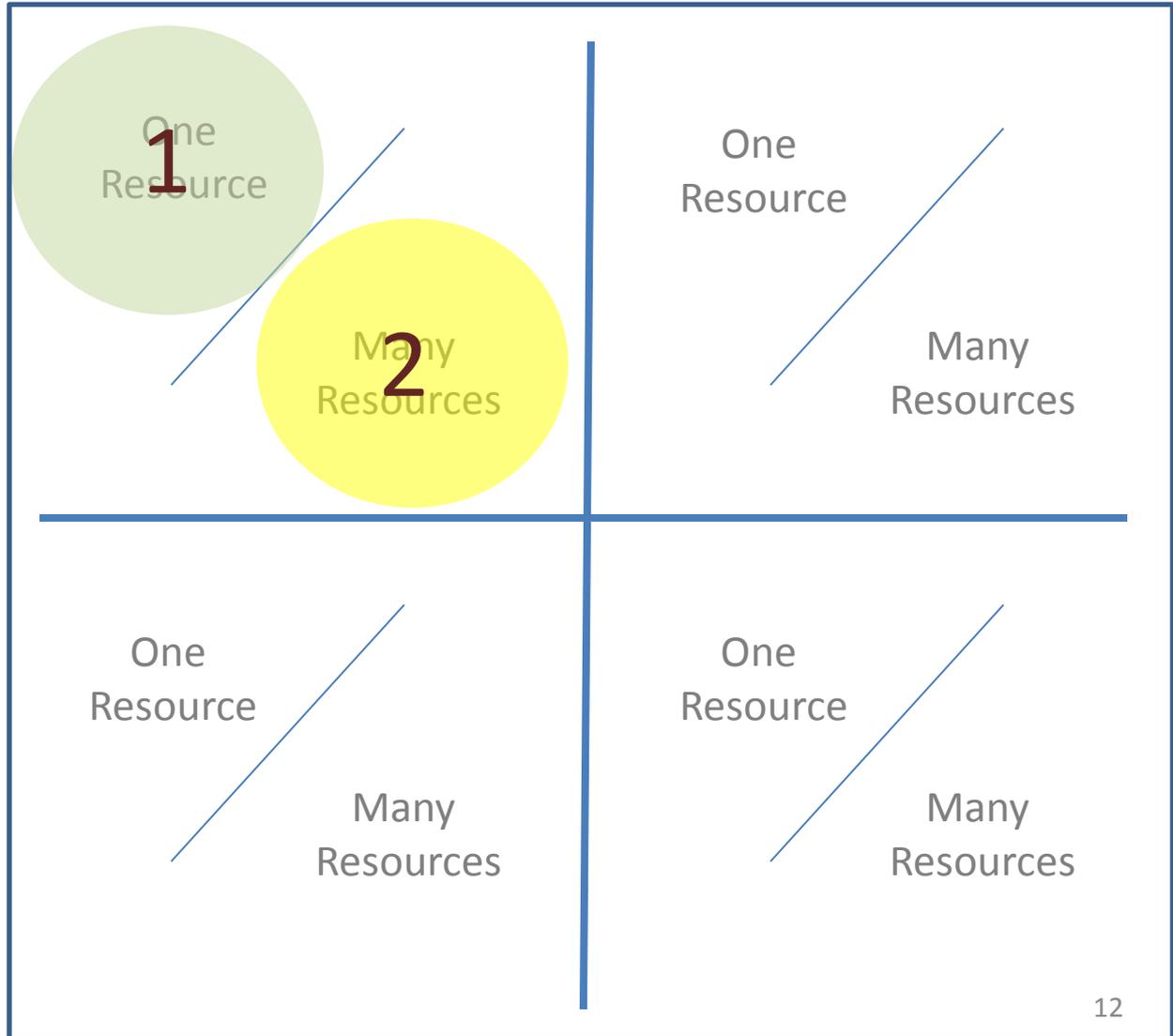


**Fragmented  
Actors**

# Controlled Charging (V1G)

# Controlled Charging + Battery Discharge (V2G)

**Unified  
Actors**

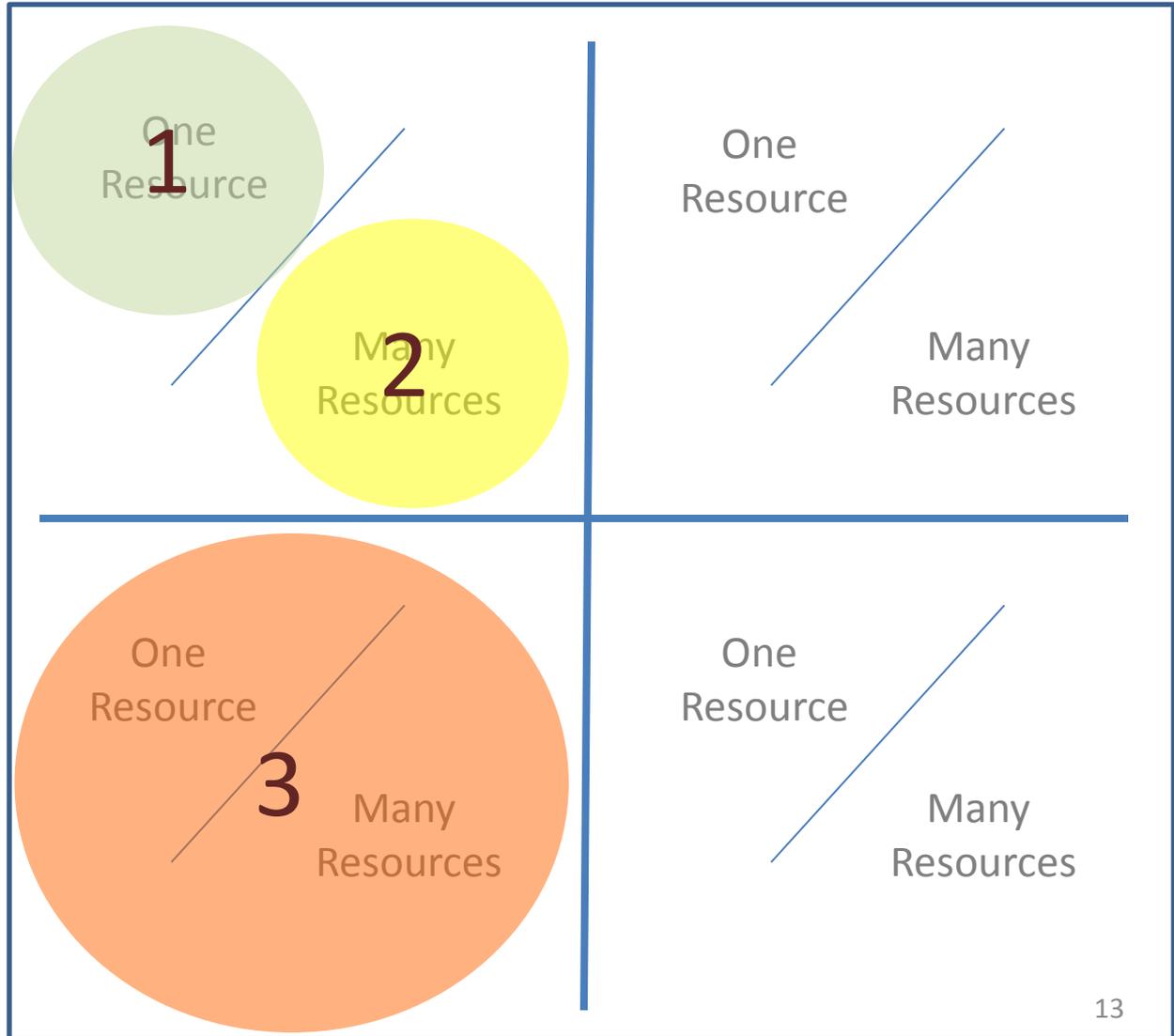


**Fragmented  
Actors**

# Controlled Charging (V1G)

# Controlled Charging + Battery Discharge (V2G)

**Unified  
Actors**

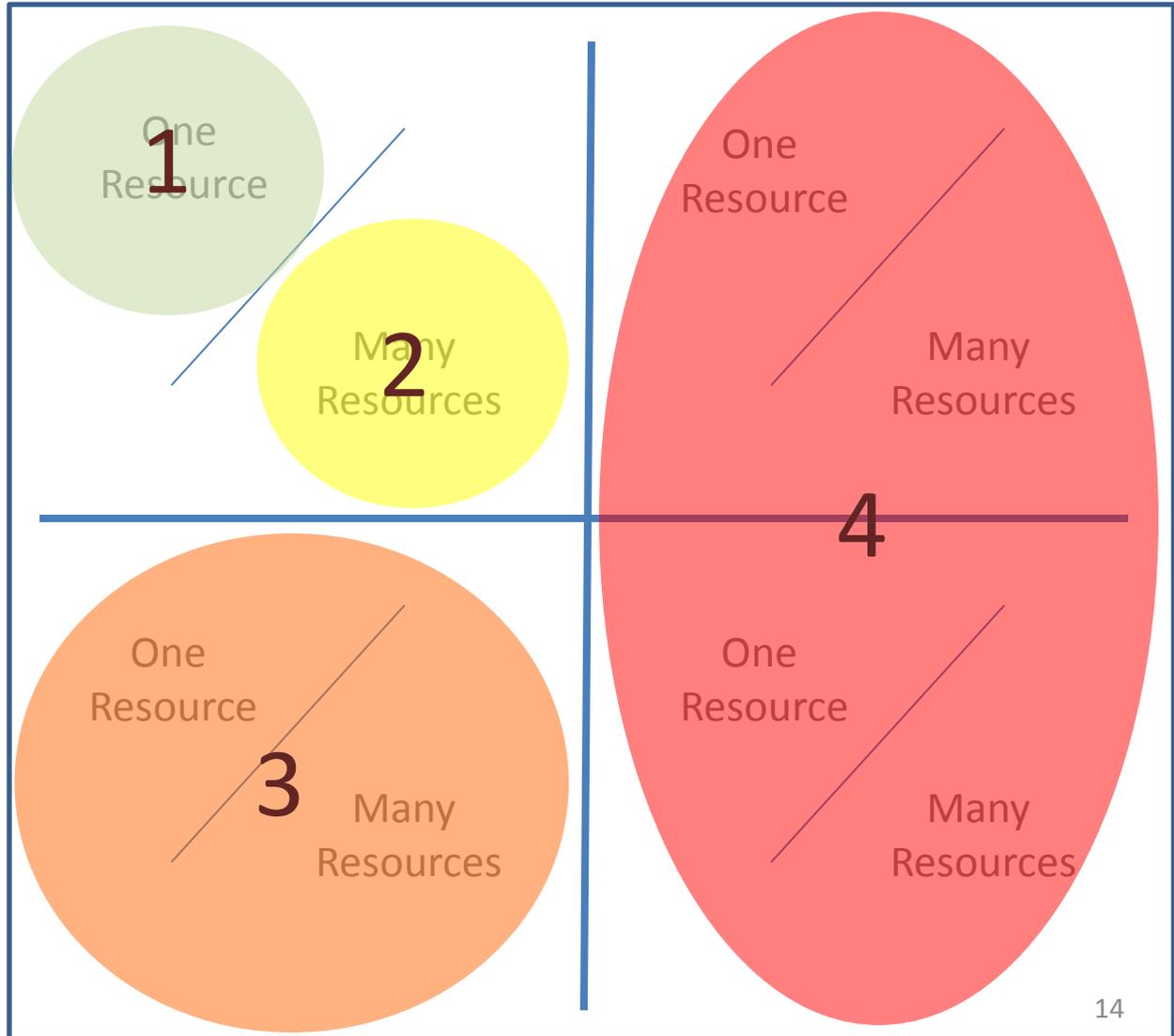


**Fragmented  
Actors**

# Controlled Charging (V1G)

# Controlled Charging + Battery Discharge (V2G)

**Unified  
Actors**



**Fragmented  
Actors**