

IRENA INNOVATION WEEK ²⁰/₂₃

Electrifying road transport

Organised in partnership with



25 September 2023 | 15:30-17:00

#IIW2023

IRENA INNOVATION WEEK ²⁰₂₃

Keynote

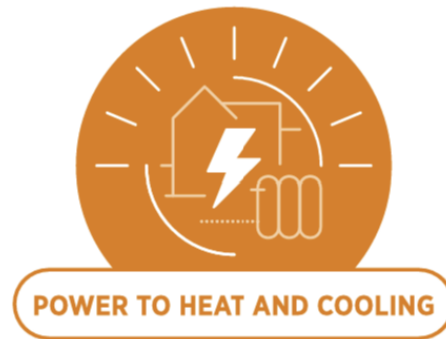


Arina Anisie

Analyst Renewable Energy Innovation
IRENA

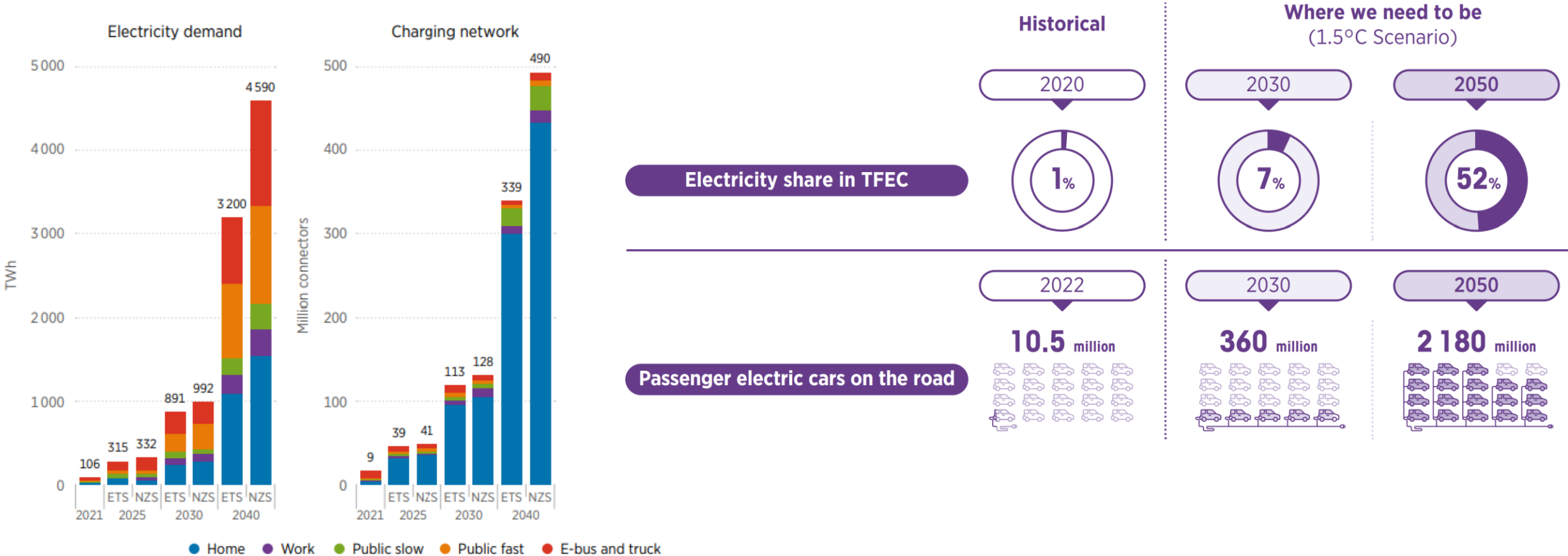
IRENA Innovation landscape for smart electrification

- The toolbox includes **100 innovations** that can play a role in transforming and decarbonising the energy use sector with smart electrification strategies



Electric vehicles — key for decarbonising road transport

Electricity demand from all EVs is expected to reach around 4000 TWh by 2040, up from 100 TWh in 2021



Source: (BloombergNEF, 2022).

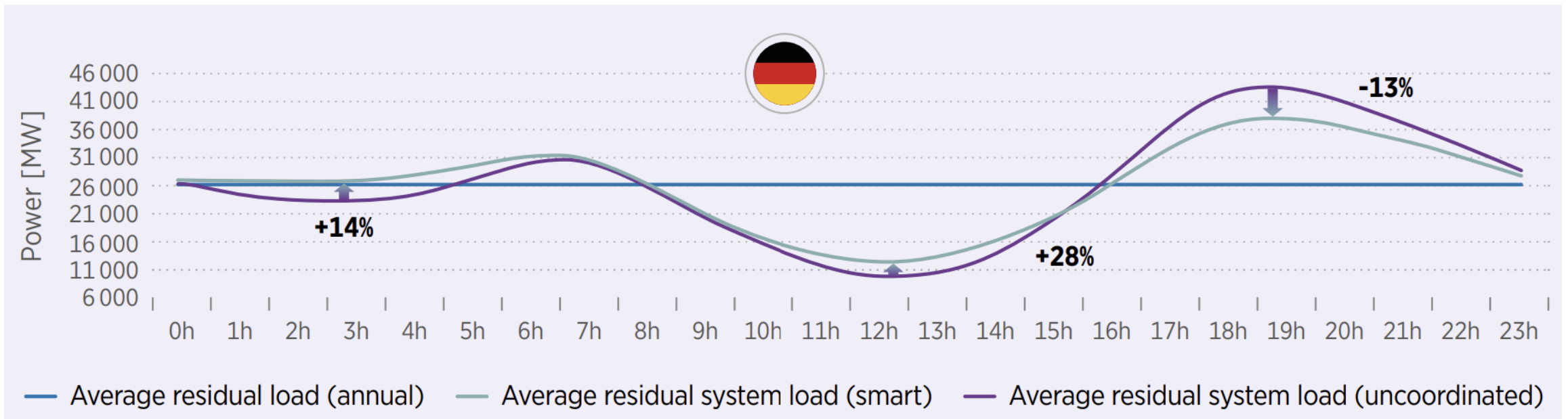
Electric Vehicles Smart Charging

Smart electrification strategies harness synergies between renewable electricity in the power system and the batteries of grid-connected EV.

Smart charging of EVs can:

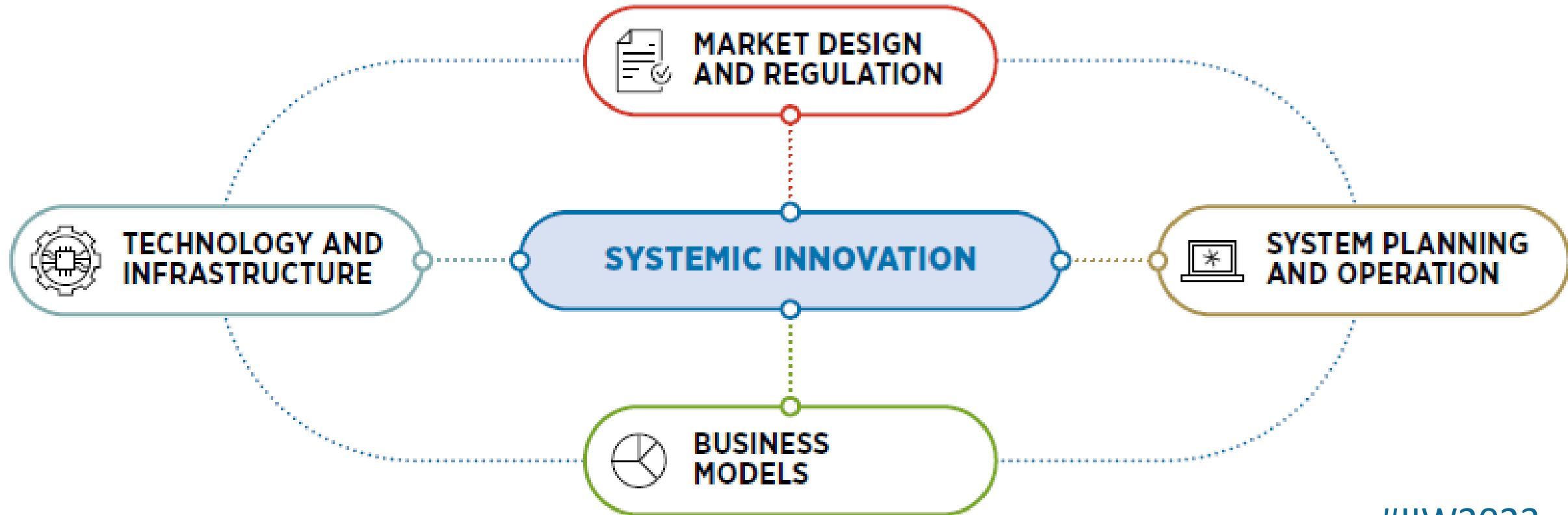
Integrate variable renewables in the grid |

Decrease peak load | Decrease grid congestion | Minimise grid investments needed



A smart approach requires systemic innovation

It is only by matching and leveraging synergies in innovations in all parts of the power system and end-use sectors and including all relevant actors and stakeholders that successful solutions can be implemented on the ground.



Innovation landscape for smart electrification of road transport


- Two- and three-wheelers
—

- Passenger cars
—

- Light commercial vehicles
—

- Heavy-duty vehicles
—

- Buses
—

TECHNOLOGY AND INFRASTRUCTURE

ELECTRIC VEHICLE

- 1 EV model evolution
- 2 EV batteries
- 3 Battery recycling technology

CHARGING INFRASTRUCTURE


- 4 Diversity and ubiquity of charging points
- 5 Wireless charging
- 6 Overhead charging
- 7 Portable charging stations
- 8 V2G systems

DIGITALISATION

- 9 Digitalisation for energy management and smart charging
- 10 Blockchain-enabled transactions

POWER SYSTEM ENABLERS

- 11 Smart distribution transformers
- 12 Smart meters and submeters




MARKET DESIGN AND REGULATION

ELECTRICITY MARKET DESIGN

- 13 Dynamic tariffs
- 14 Smart charging for local flexibility
- 15 Smart charging for system flexibility

REGULATION FOR CHARGING INFRASTRUCTURE

- 16 "Right to plug" regulation
- 17 Streamlining permitting procedures for charging infrastructure
- 18. Standardisation and interoperability
- 19 V2G grid connection code




SYSTEM PLANNING AND OPERATION

STRATEGIC PLANNING

- 20 Cross-sectoral co-operation and integrated planning
- 21 Including EV load in power system planning
- 22 Grid data transparency
- 23 Clean highway corridors
- 24 Operational flexibility in power systems to integrate EVs

SMART OPERATION

- 25 Management of flexible EV load to integrate variable renewable energy
- 26 Management of flexible EV load to defer grid upgrades
- 27 EV as a resilience solution



BUSINESS MODELS

SERVICES FOR THE POWER SYSTEM

- 28 EV aggregators
- 29 Shaving of EV peak loads using DERs
- 30 Battery second life

SERVICES FOR THE TRANSPORT SECTOR

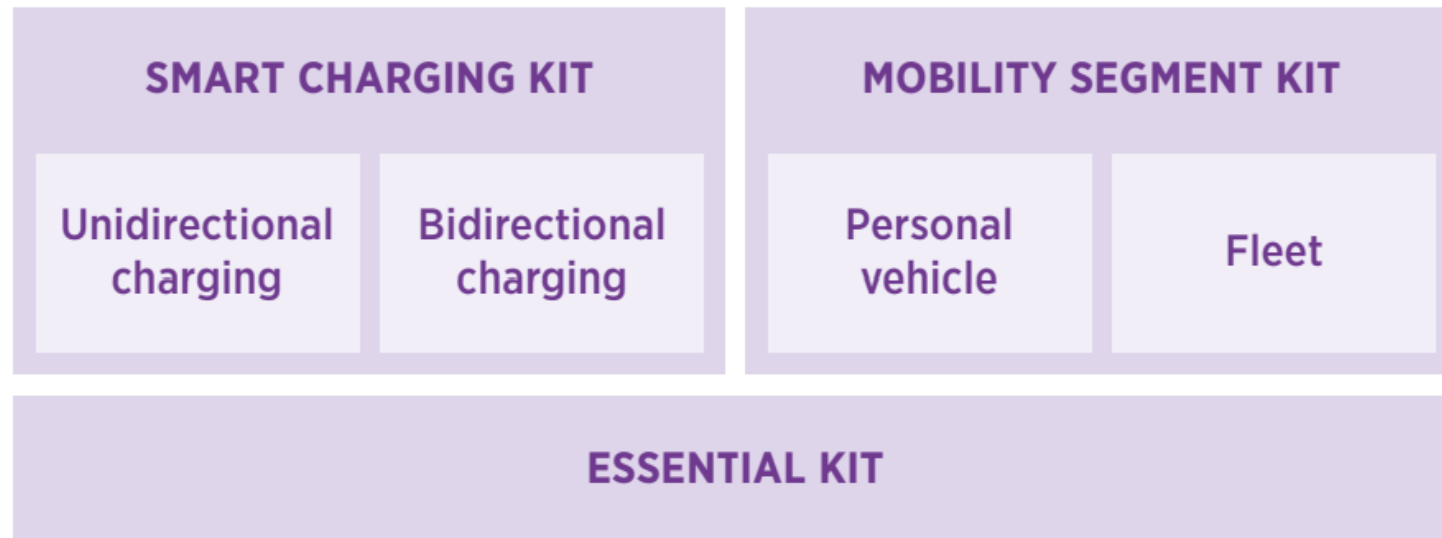
- 31 EV charging as a service
- 32 E-mobility as a service

MODELS TO ENABLE DEPLOYMENT

- 33 Ownership and operation of public charging stations
- 34 A single bill for EV charging at home and on the go
- 35 Battery swapping



Toolbox to build smart strategy for EVs





Toolbox to build smart strategy for EVs

ESSENTIAL KIT



TECHNOLOGY AND INFRASTRUCTURE

- **1** EV model evolution
- **2** EV batteries
- **4** Diversity and ubiquity of charging points
- **11** Smart distribution transformers
- **12** Smart meters and submeters



MARKET DESIGN AND REGULATION

- **16** "Right to plug" regulation
- **17** Streamlining permitting procedures for charging infrastructure
- **18** Standardisation and interoperability



SYSTEM PLANNING AND OPERATION

- **20** Cross-sectoral co-operation and integrated planning
- **21** Including EV load in power system planning
- **22** Grid data transparency
- **24** Operational flexibility in power systems to integrate EVs



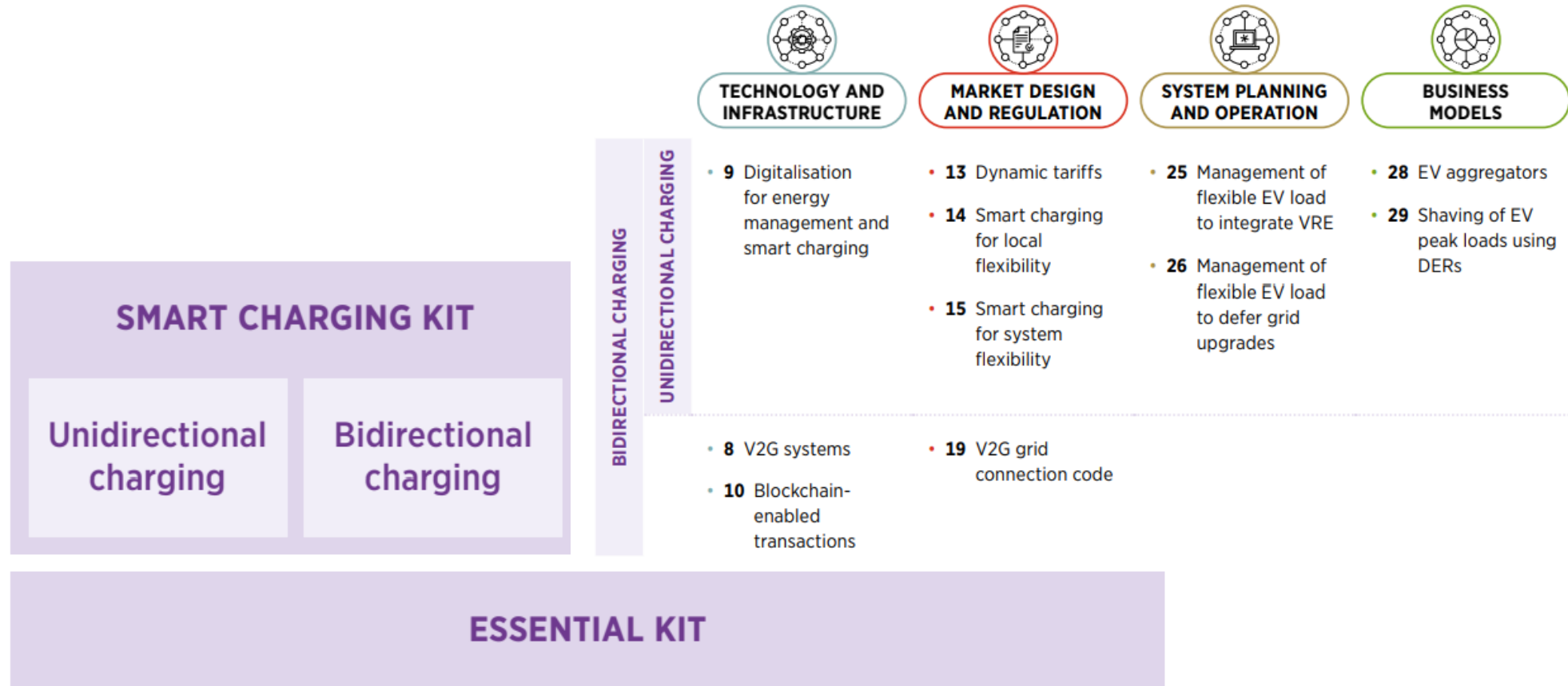
BUSINESS MODELS

- **33** Ownership and operation of publicly available charging stations
- **34** A single bill for EV charging at home and on the go
- **35** Battery swapping

ESSENTIAL KIT

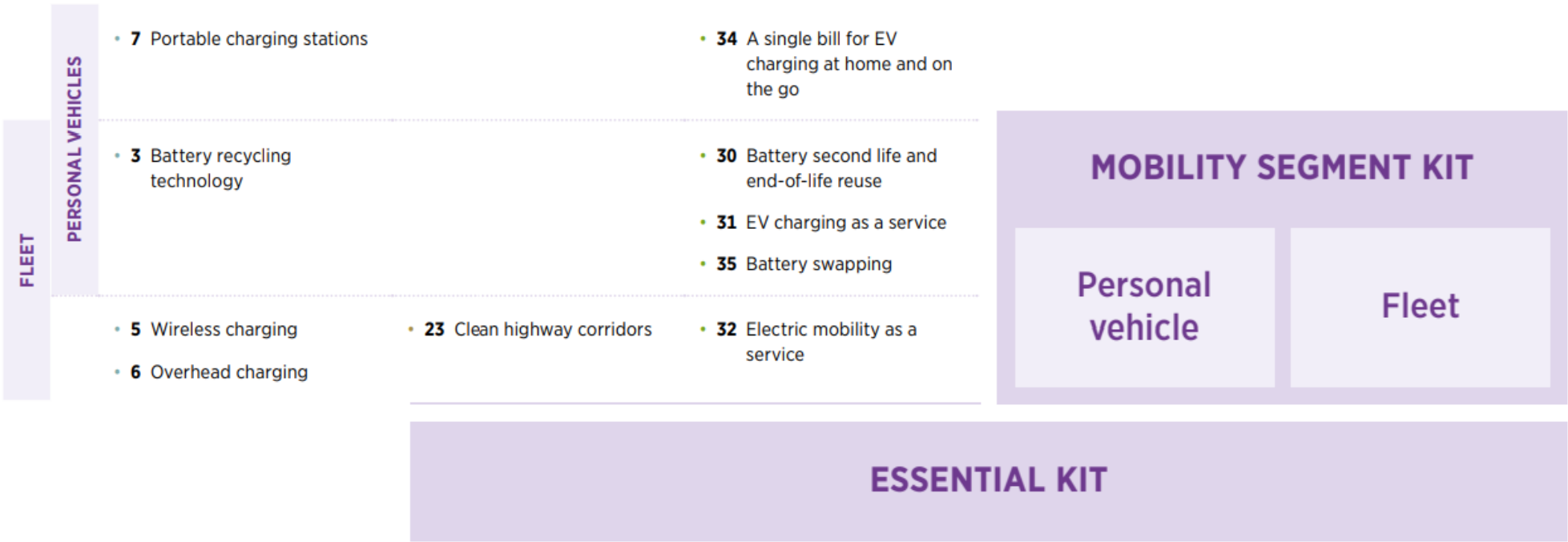


Toolbox to build smart strategy for EVs





Toolbox to build smart strategy for EVs





Power to mobility: Blind spots for policymakers

- Smart charging does **not necessarily** mean **bidirectional** charging (V2G).
- Development of charging infrastructure should **not mimic the petrol filling** stations nor focus only on fast charging.
- Ensure that charging infrastructure is **standardised** and interoperable.
- **Planning** for EV **charging infrastructure** deployment should be inclusive and reflect the local setting.
- **Mobility trends** need to be considered in electrification strategies.
- **Co-locating** EV **charging** points with **solar** generation to minimise impact on grids
- **State agencies** should coordinate and maintain **consistency**

Keynote



Siva Gunda

Vice Chair of the California Energy Commission



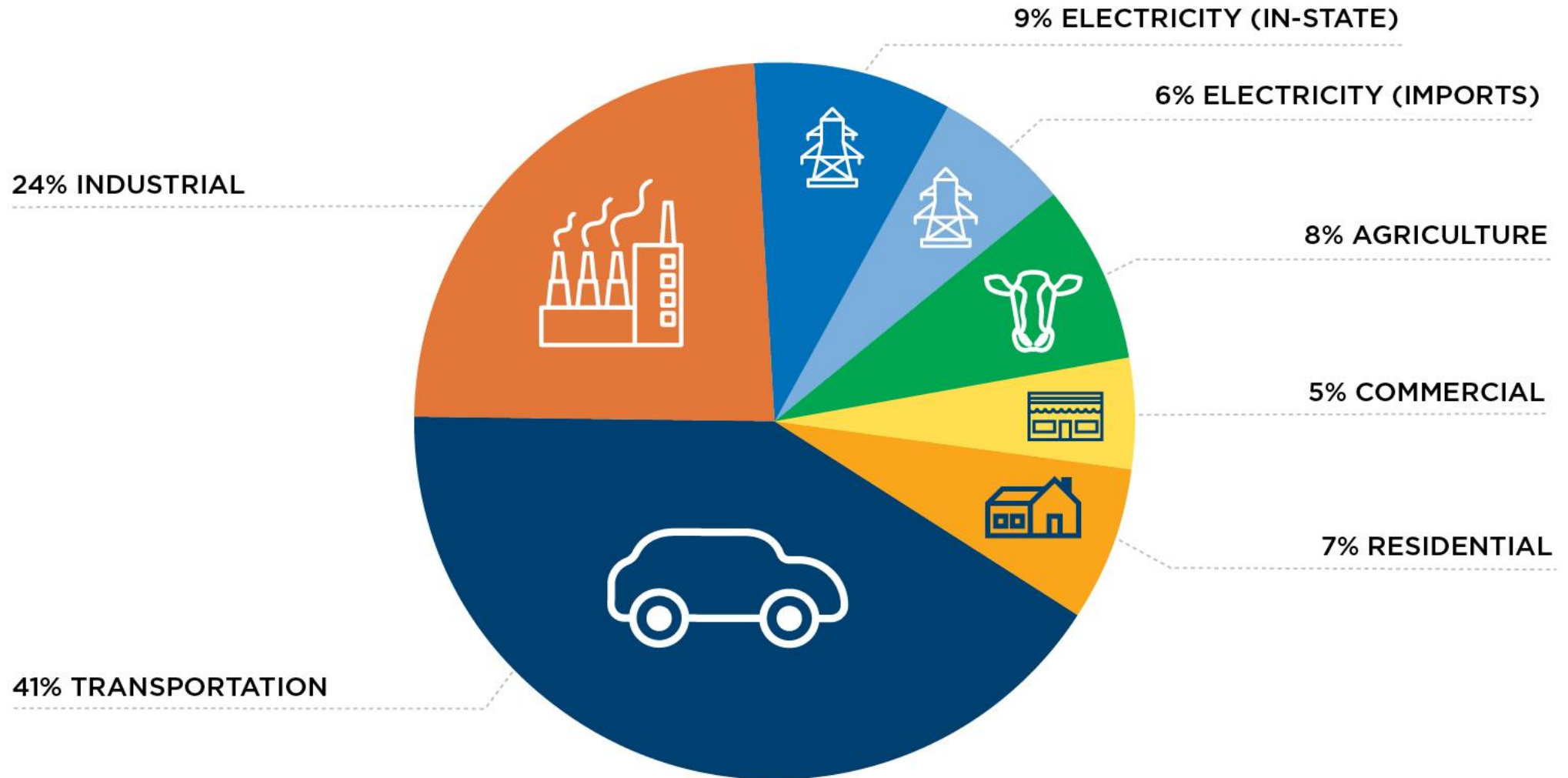
Electrifying Transportation while Supporting Grid Reliability

**Vice Chair Siva Gunda
IRENA Innovation Week 2023**



California's

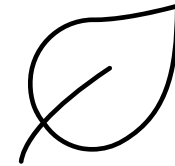
2018 Greenhouse Gas Emissions



Source: California Air Resources Board

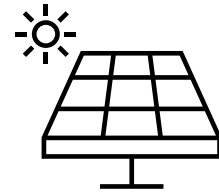


California's Bold Climate Actions



AB 1279

Carbon neutrality by 2045



SB 100

100% clean electricity by 2045



EO N-79-20

All new cars and trucks sold in CA will be ZEVs by 2035



California Climate Commitment | Multiyear Budget Agreement



\$13.8 Billion
Clean Transportation



\$10.1 Billion
Zero-Emission Vehicles



\$8.7 Billion
Drought & Water Resilience



\$8.2 Billion
Clean Energy & Reliability



\$2.8 Billion
Wildfire & Forest Resilience



\$1.5 Billion
Community Resilience



\$1.4 Billion
Nature Based Solutions



\$1.2 Billion
Sustainable Agriculture



\$1.1 Billion
Coastal Resilience



\$975 Million
Climate Homes



\$723 Million
Climate Schools & Research



\$477 Million
Climate Innovation



\$443 Million
Circular Economy



\$404 Million
Extreme Heat



\$321 Million
Climate Health



\$315 Million
Climate Jobs

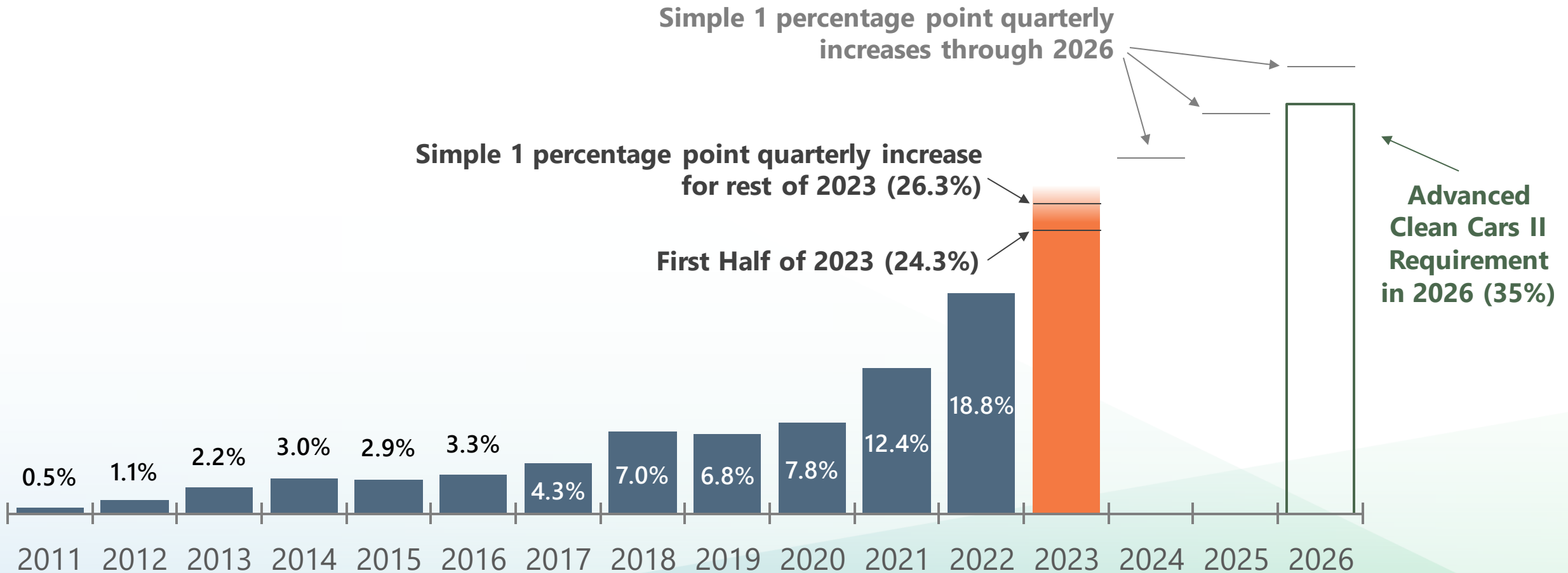
\$52.3 BILLION TOTAL

July 2023



ZEV Market Share is Outpacing Expectations

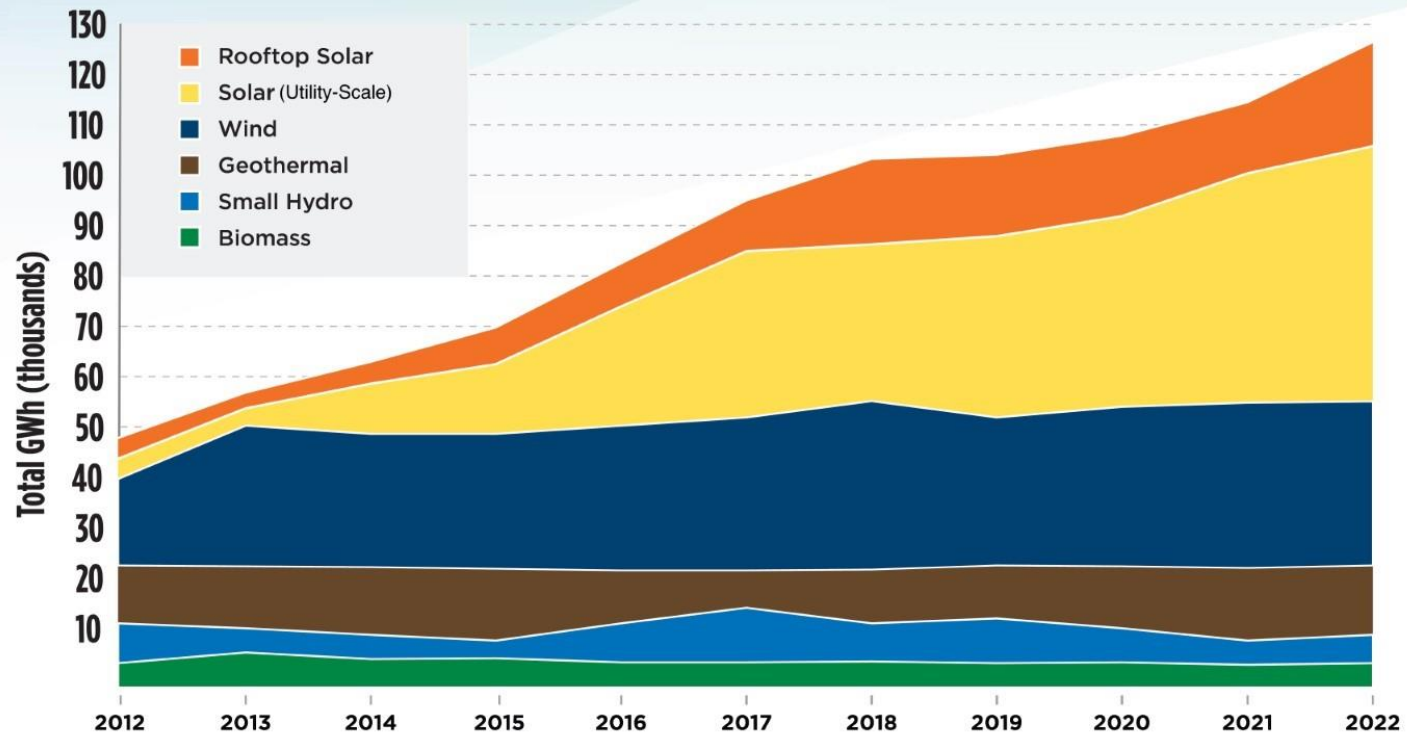
ZEV Market Share of New Passenger Vehicle Sales, 2011 to H1 2023



Source: CEC Staff analysis of DMV Data

Clean Energy Progress

Renewable Energy Generation Growing in California



Source: California Energy Commission, Total System Electric Generation | August 2023

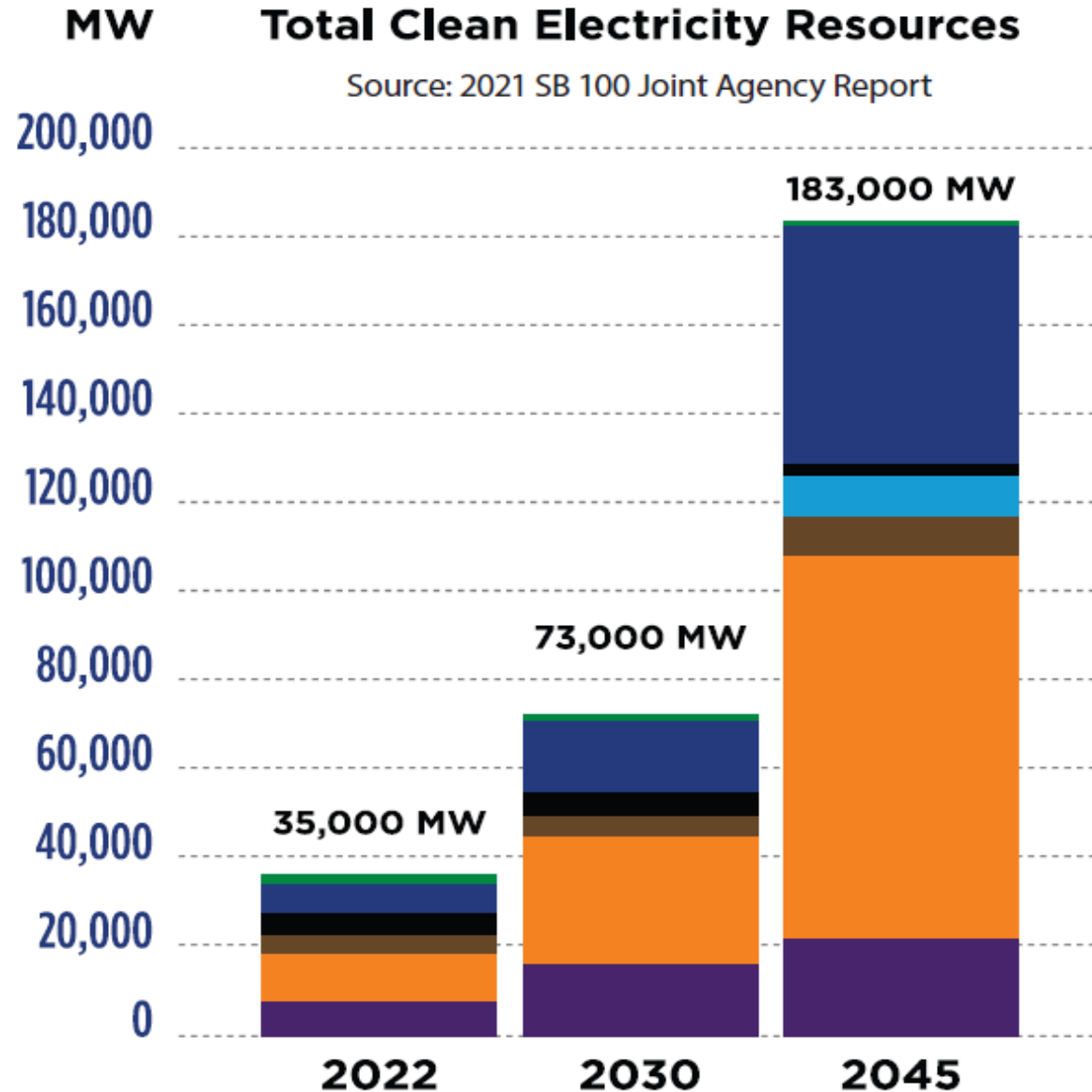
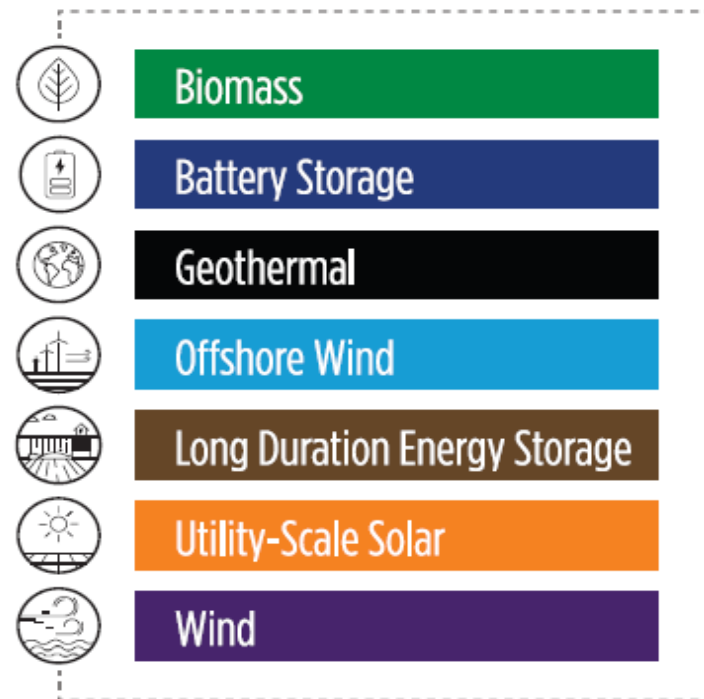
- In 2021 electric generation was 59% zero carbon
- Bulk Grid Storage grew from 200 MWs in 2019 to 5,600 MWs at the start of July 2023
- Over the last decade:
 - Solar generation surged 20x
 - Wind generation expanded by 63%
 - Natural Gas usage declined by 20%

To provide 100% clean electricity by 2045,

California will build an unprecedented amount of new utility-scale clean energy resources

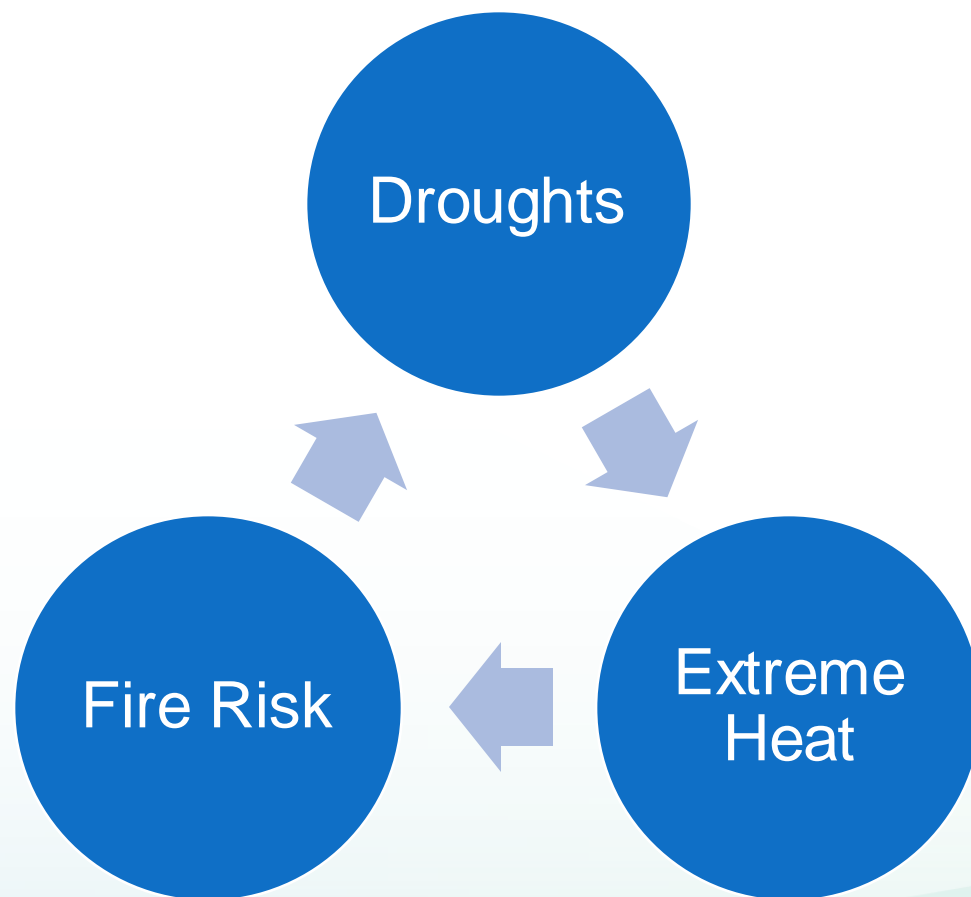
Totals represent new and existing resources. The 2021 SB 100 Joint Agency Report projects the need for 148,000 MW of new resources by 2045.

In addition, California also expects new capacity from energy efficiency, customer solar and demand response.



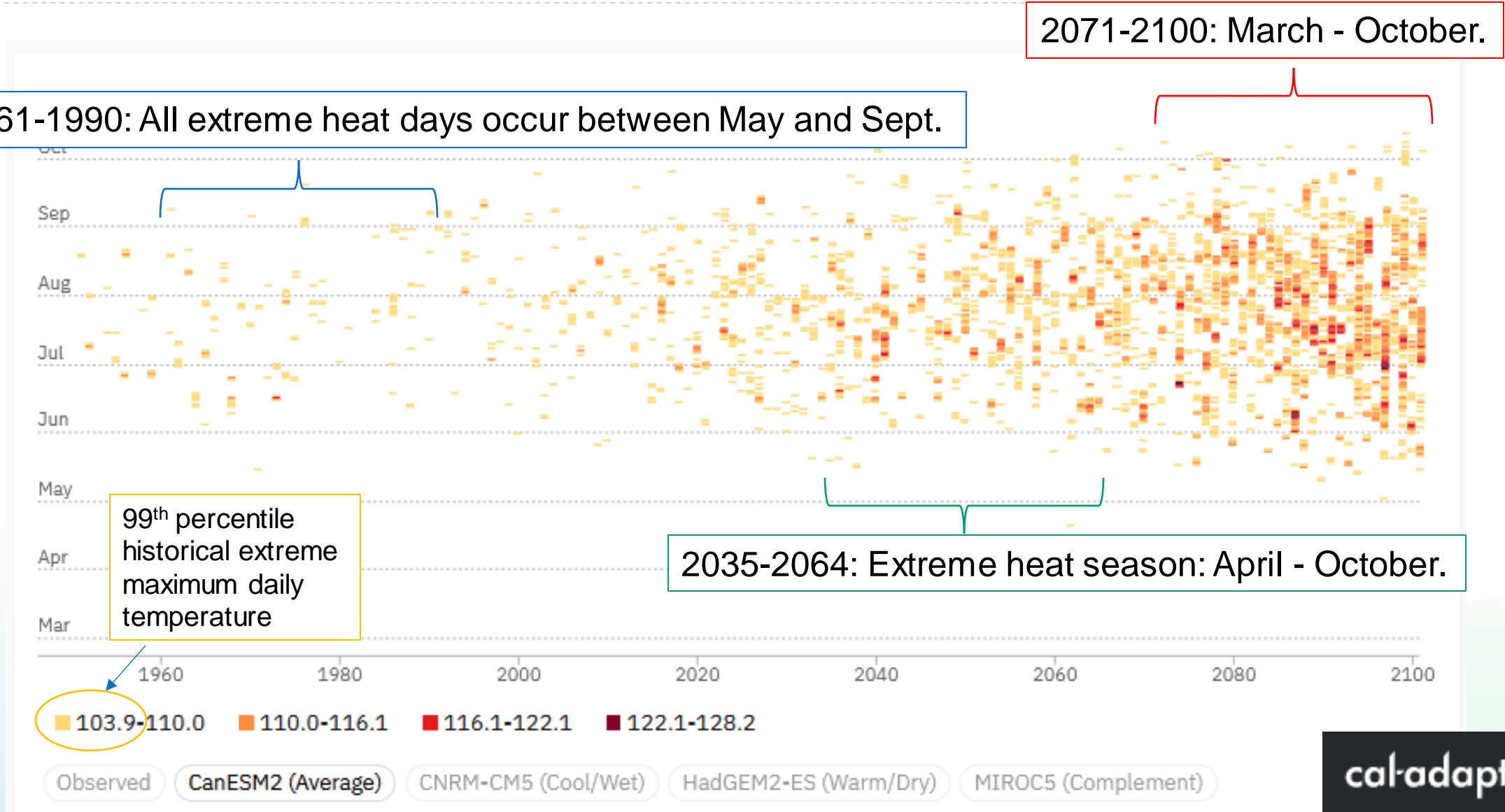


Climate Change is Making It Difficult to Fight Climate Change



Expected changes in magnitude and timing of extremes

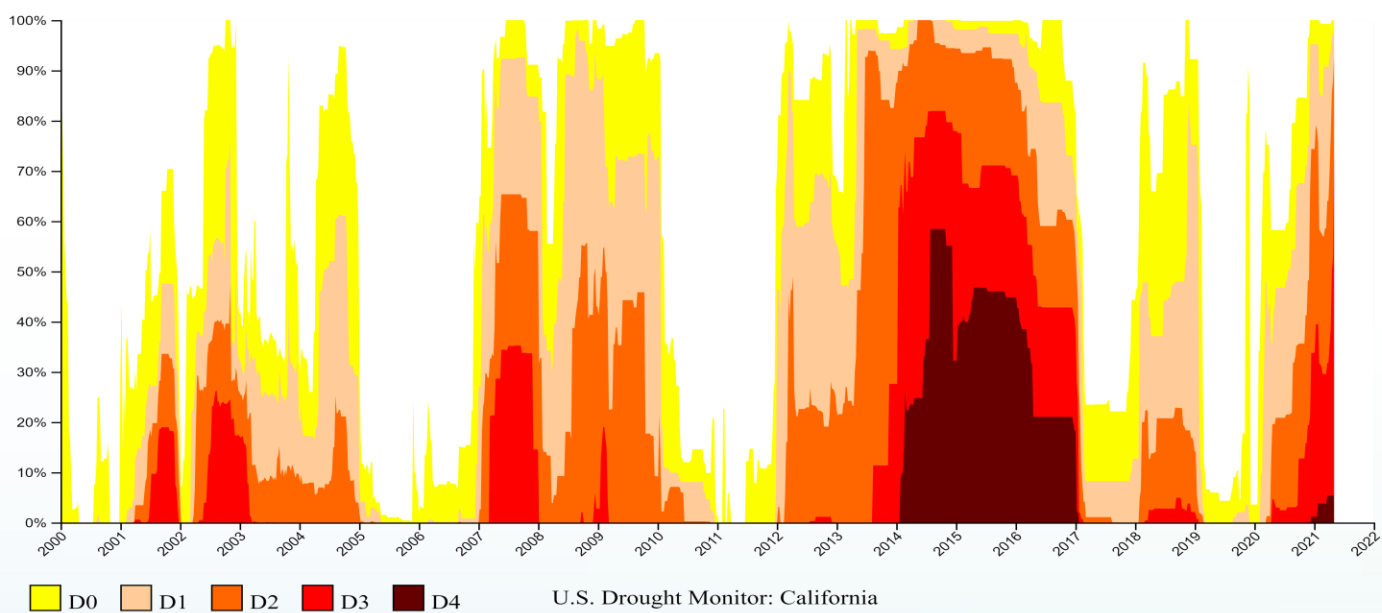
Visual from Cal-Adapt.org





Drought and Wildfires Pose Additional Threats to Reliability

Drought Reduces Hydro Availability



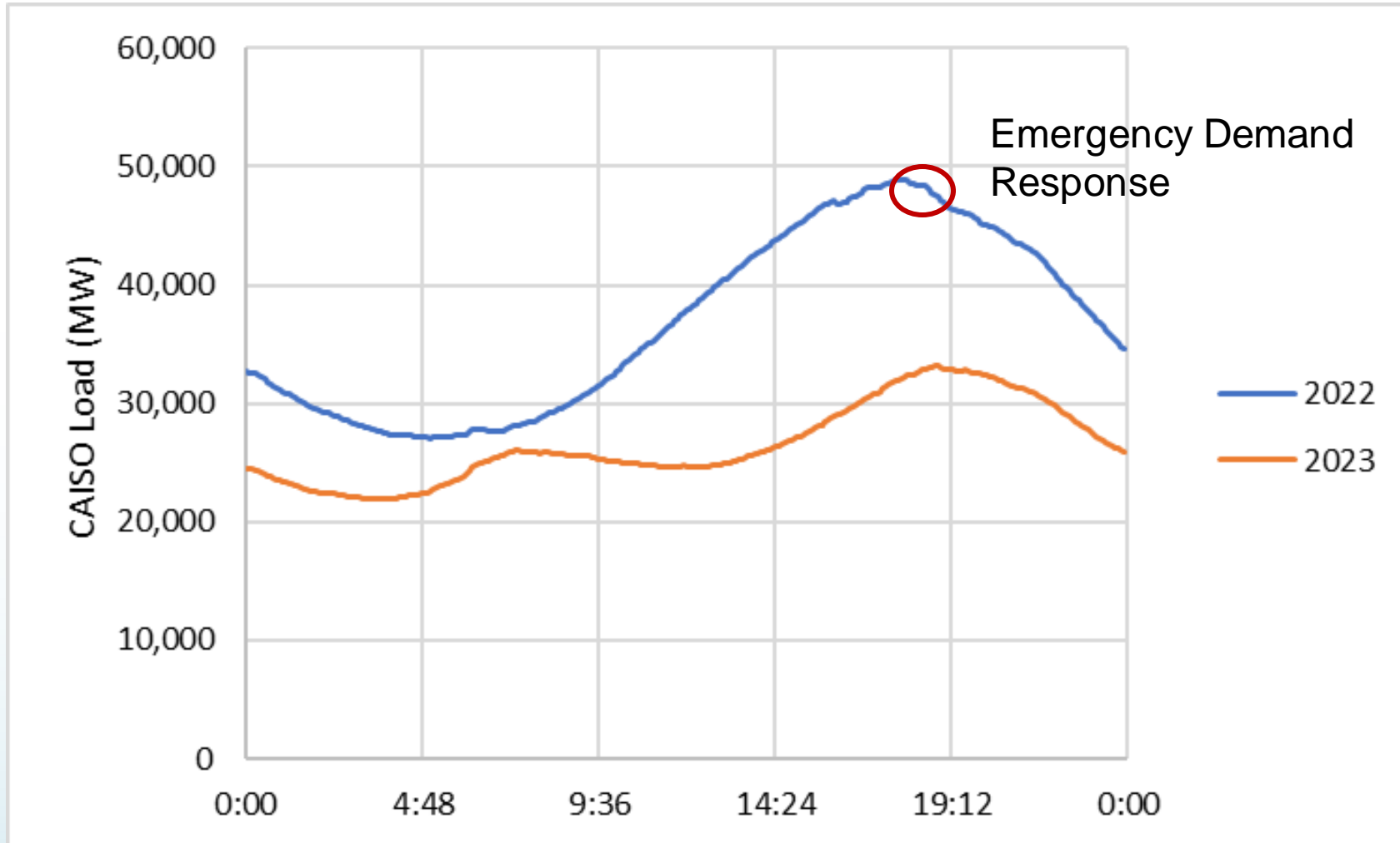
Wildfires Threaten Transmission





Extreme Weather Impact on Peak Load

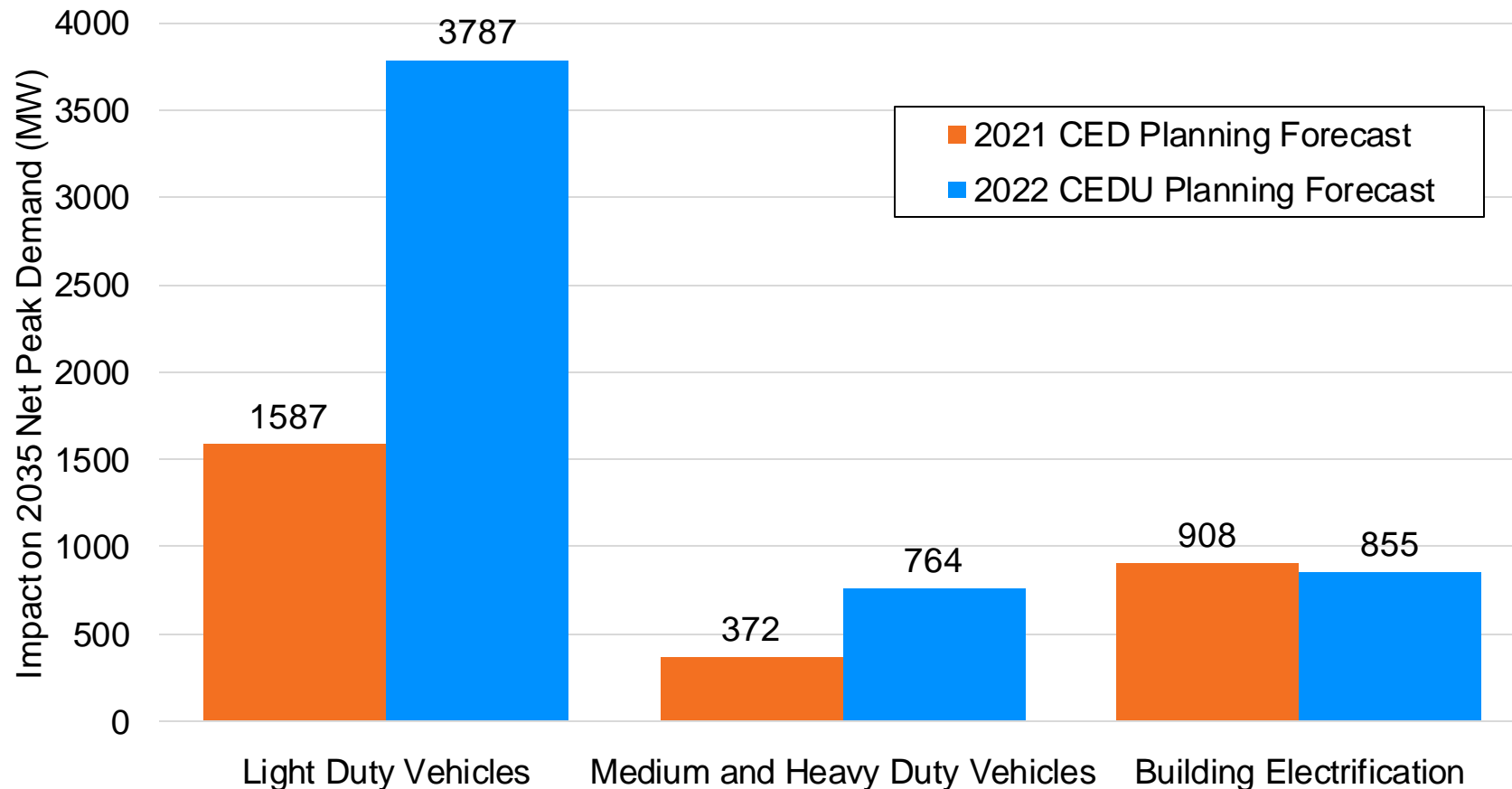
Sept 6th: 2022 vs 2023



Actions - Grid Reliability & Clean Energy Transition

- **Improving Grid Planning Processes**
 - Improvements to forecasting for climate change-induced weather variability and electrification
 - Ordering sufficient and diverse procurement
 - Improve Resource Adequacy process
- **Scaling Supply & Demand-Side Clean Energy Resources**
 - Track procurement
 - Improve interconnection & permitting process
 - SB 846 requirements, including demand flexibility goal and Clean Energy Reliability Investment Plan
- **Preparing for Extreme Events (Contingencies)**
 - Retain existing and construct new assets & procure imports to backstop uncertainties
 - Create emergency demand flexibility opportunities

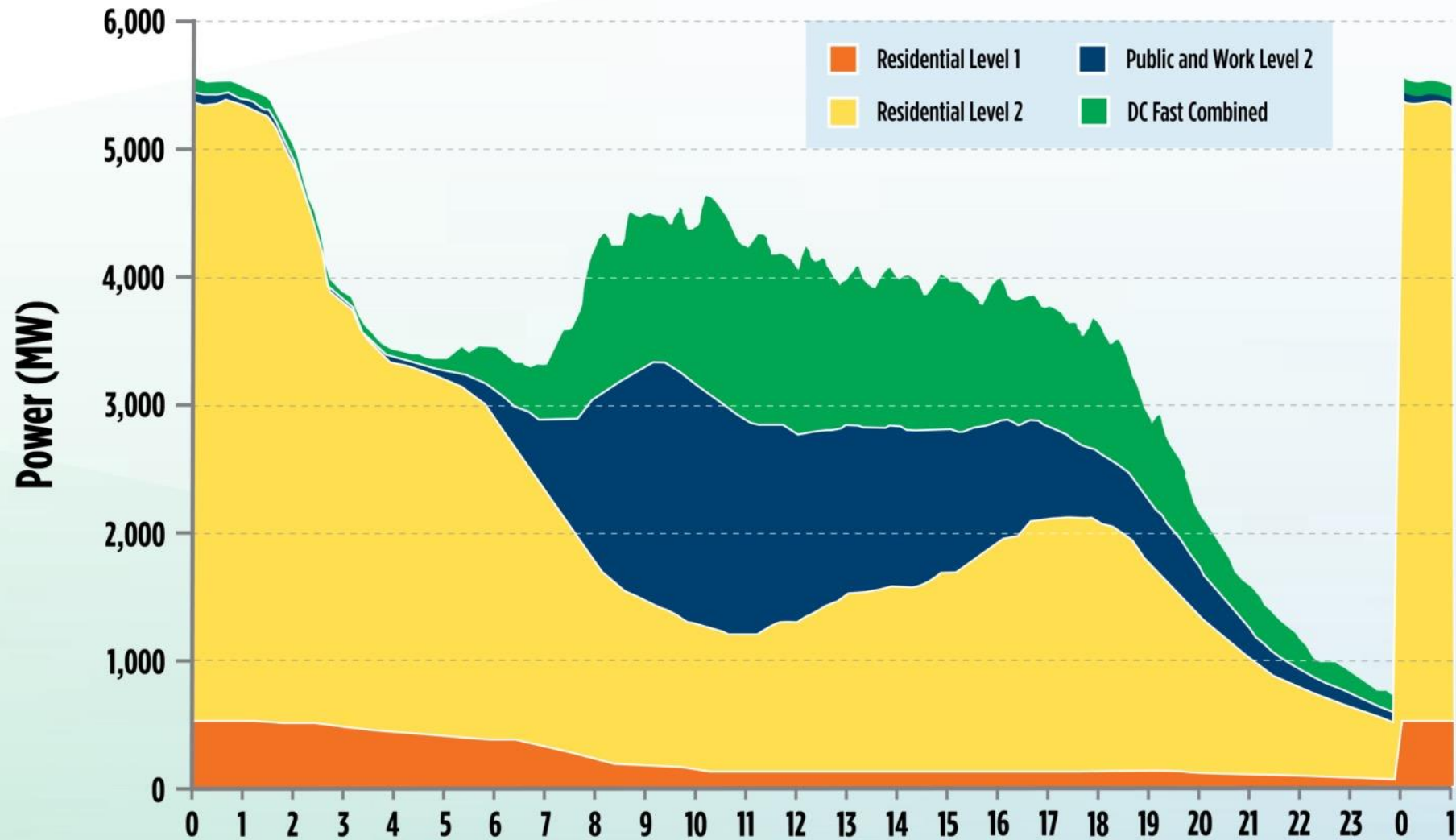
Scenario – 2035 Electrification Impact on Summer Peak Hour



- Peak occurs in hour 19
- CARB's regulations for Advanced Clean Fleets 2 and Advanced Clean Fleets were added to the 2022 Forecast

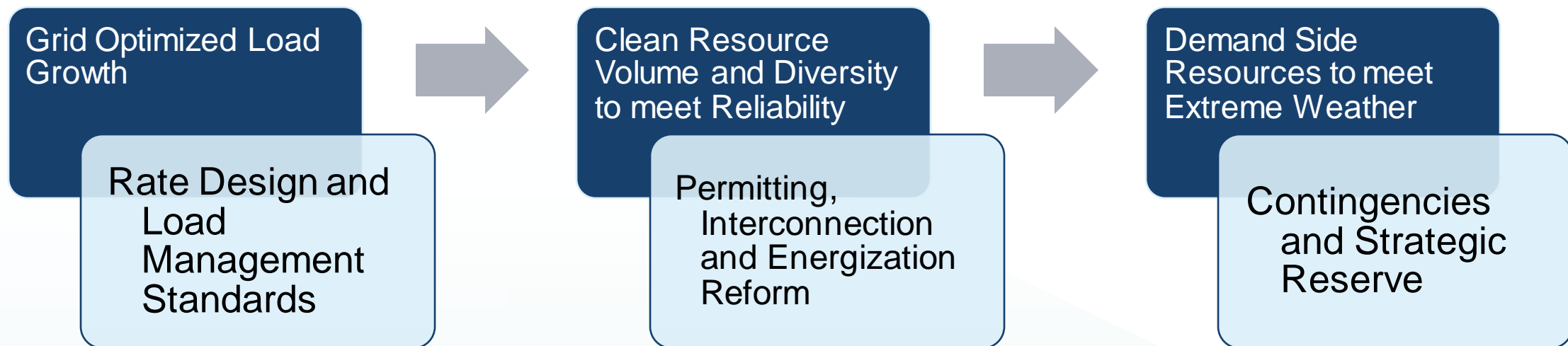
Aligning Charging with Peak Renewable Energy

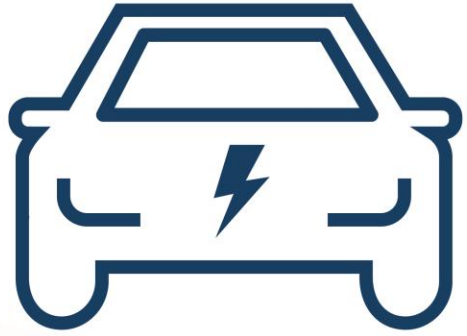
Projected 2030 Weekday Energy Demand, 8 Million Light-Duty ZEVs





Demand Flexibility Is Critical





Types of VGI Smart Charging



V1G = UNIDIRECTIONAL CONTROLLED CHARGING
Vehicles or charging infrastructure adjust their rate of charging



V2G = VEHICLE-TO-GIRD
Smart grid controls vehicle charging and returns electricity to the grid



V2H/B = VEHICLE -TO-HOME/-BUILDING
Smart grid controls vehicle charging and returns electricity to the grid



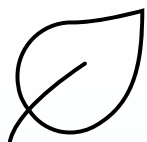
Transition Planning Must Be Holistic



Transition Away from Fossil Fuels: Petroleum, Natural Gas



Electrify End Uses



Clean Fuels for Hard to Electrify End Uses



Equitable Transition for All



Thank You



IRENA INNOVATION WEEK ²⁰₂₃

Panel discussion

Moderator



**Daniel
Bowermaster**
EPRI



Gilles Dillen
City of Amsterdam



Luis Cunha
EU DSO Entity
EDP



Henrik Engdahl
Volvo Trucks



**Michael
Mohnhaupt**
The Mobility House



Gregory Poilasne
Nuvve



Jan-Peter Sasse
Bundesnetz-
agentur
Germany

#IIW2023

Closing



Daniel Bowermaster
Sr. Program Manager, Electric Transportation
EPRI



Arina Anisie
Analyst Renewable Energy Innovation
IRENA