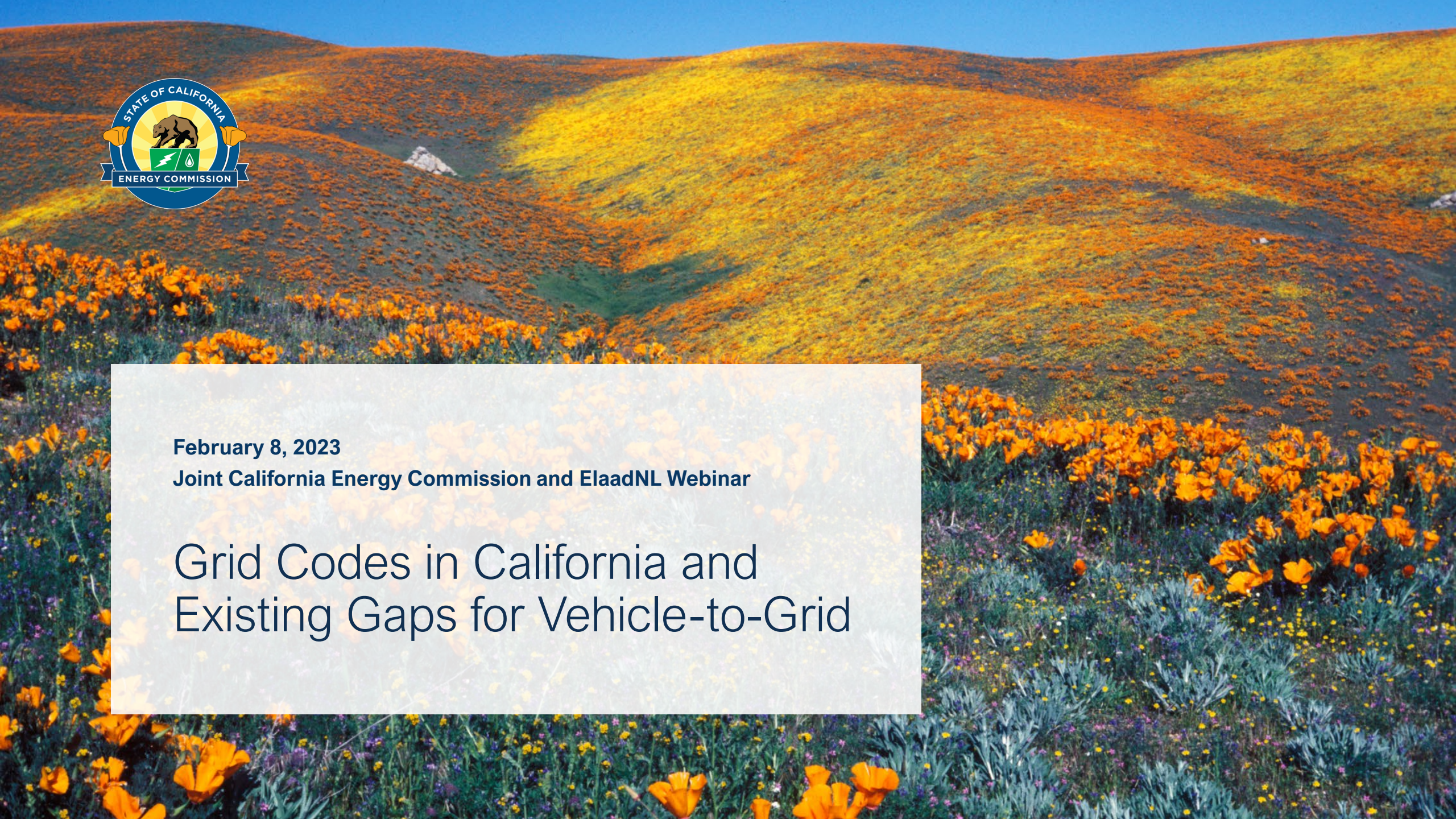
DOCKETED	
Docket Number:	22-EVI-06
Project Title:	Vehicle-Grid Integration
TN #:	248683
Document Title:	Presentation - Grid Codes in California and Existing Gaps for Vehicle-to-Grid
Description:	N/A
Filer:	Spencer Kelley
Organization:	California Energy Commission
Submitter Role:	Commission Staff
Submission Date:	2/7/2023 9:22:47 AM
Docketed Date:	2/7/2023



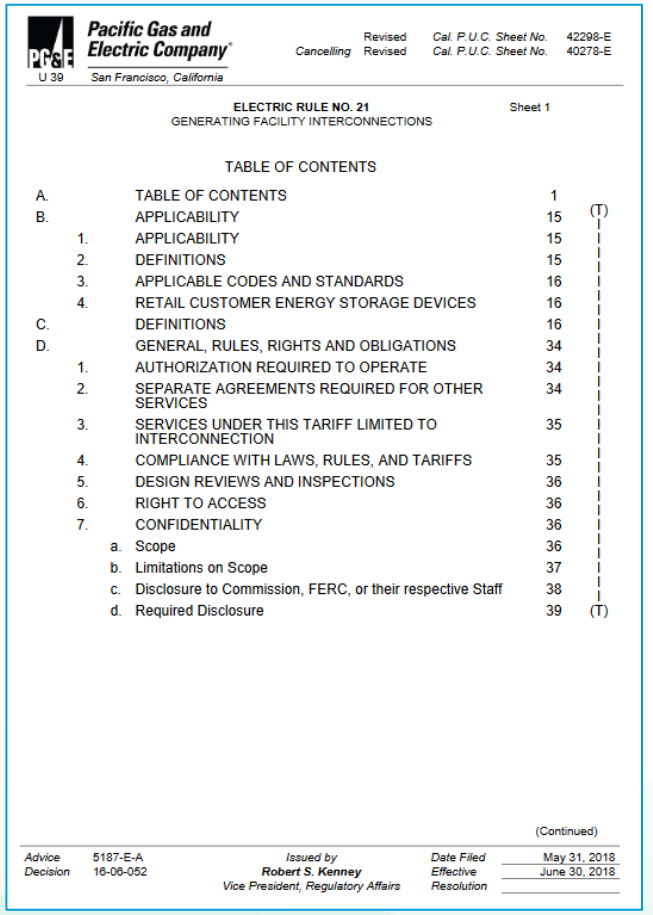
February 8, 2023

Joint California Energy Commission and ElaadNL Webinar

Grid Codes in California and Existing Gaps for Vehicle-to-Grid

In California, grid codes are typically outlined in **“Rule 21”**

- Electric Rule 21 defines requirements for generating devices connected to the distribution system
- Utilities individually maintain a Rule 21 document
  - California’s largest investor-owned utilities are regulated by the California Public Utilities Commission (CPUC)
  - CPUC oversees these utilities’ development of Rule 21
- The grid codes in Rule 21 are derived from the **Institute of Electrical and Electronics Engineers (IEEE) 1547 standard**



Pacific Gas and Electric Company
U 39 San Francisco, California

Revised Cal. P.U.C. Sheet No. 42298-E
Cancelling Revised Cal. P.U.C. Sheet No. 40278-E

ELECTRIC RULE NO. 21 Sheet 1
GENERATING FACILITY INTERCONNECTIONS

TABLE OF CONTENTS

(Continued)

Advice 5187-E-A
Decision 16-06-052

Issued by
Robert S. Kenney
Vice President, Regulatory Affairs

Date Filed May 31, 2018
Effective June 30, 2018
Resolution

For example: PG&E’s Rule 21 document

Rule 21 specifies smart inverter communication protocols and certification requirements

- During vehicle-to-grid (V2G) discharge, smart inverters ensure that electricity exported from the vehicle conforms to grid requirements
- Rule 21 requires that smart inverters, including those used for V2G:
  1. Be certified to **Underwriters Laboratory (UL) 1741 Supplement A**[1]
  2. Be capable of communication using the **IEEE 2030.5** standard by default, and that "other application-level protocols may be used by mutual agreement"
- SunSpec's Common Smart Inverter Profile certification verifies IEEE 2030.5 communication capability

1. Utilities have proposed a transition to UL 1741 Supplement B certification beginning April 2023

Rule 21 implications for bidirectional charging

- **Direct current (DC) vehicle-to-grid (V2G)** is allowed under Rule 21 today
  - Inverter is off-board the vehicle and treated like any other inverter under Rule 21
  - Inverter is typically part of the electric vehicle supply equipment (EVSE or “charger”)
- With **alternating current (AC) V2G**, the inverter is on-board the vehicle
  - Different certification procedures apply to automotive and stationary equipment
  - There is no interconnection pathway for AC V2G under Rule 21 today

Default architecture for DC V2G implied by Rule 21 today:

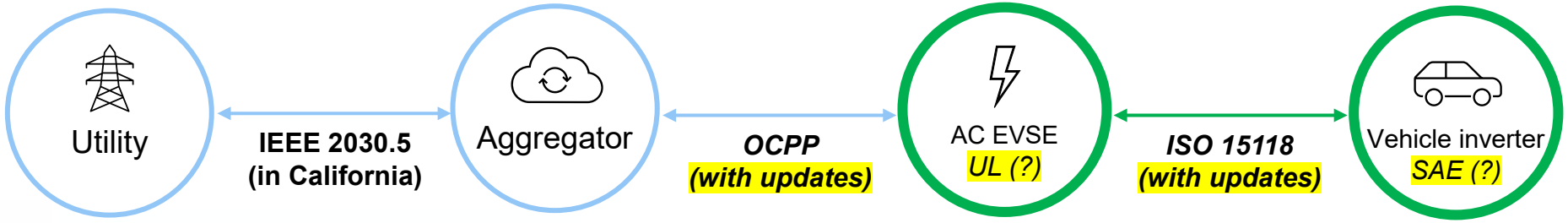
Gap: EV industry implementation differs from Rule 21 defaults

- While IEEE 2030.5 has been the Rule 21 default for years, the EV and charging industries have not adopted this communication protocol
  - Today, no commercially available vehicles and few EVSE use IEEE 2030.5
  - The industry has standardized around **Open Charge Point Protocol** (between network and EVSE) and **ISO 15118** (between vehicle and EVSE)
- Rule 21 specifies minimum capabilities for certification, whereas the protocols used in practice may differ from the Rule 21 defaults
- Pending industry efforts will update both ISO 15118 and OCPP to support grid code communication
  - These updates may help ISO 15118 and OCPP meet Rule 21 requirements
  - These updates to **globally-aligned protocols** may support greater V2G adoption, implementation, and economies of scale

Updated technical solutions ***paired with*** regulatory acceptance may help break through a V2G stalemate

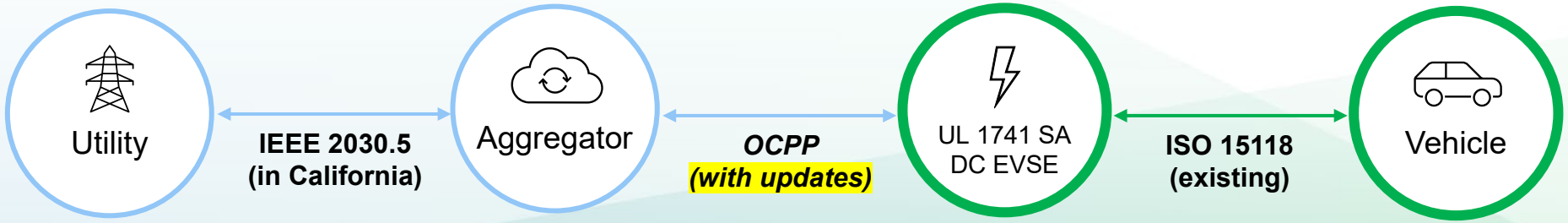
AC V2G: Updated ISO 15118 + OCPP (with grid codes) may provide a V2G pathway using existing, globally-aligned protocols. Even so, Rule 21, other standards, and associated certifications would need to accommodate this pathway.

Possible globally-aligned AC pathway:



DC V2G: Updated OCPP (with grid codes) may lower barriers to V2G for charger manufacturers and charging networks who already use OCPP today.

Possible globally-aligned DC pathway:



Highlight indicates pending developments or unclear certification requirements.

Thank you!

Questions?

Please direct questions after the webinar to jeffrey.lu@energy.ca.gov