



# Vehicle to Grid Implementation Around The World

Gregory Poilasne, Chairman and CEO



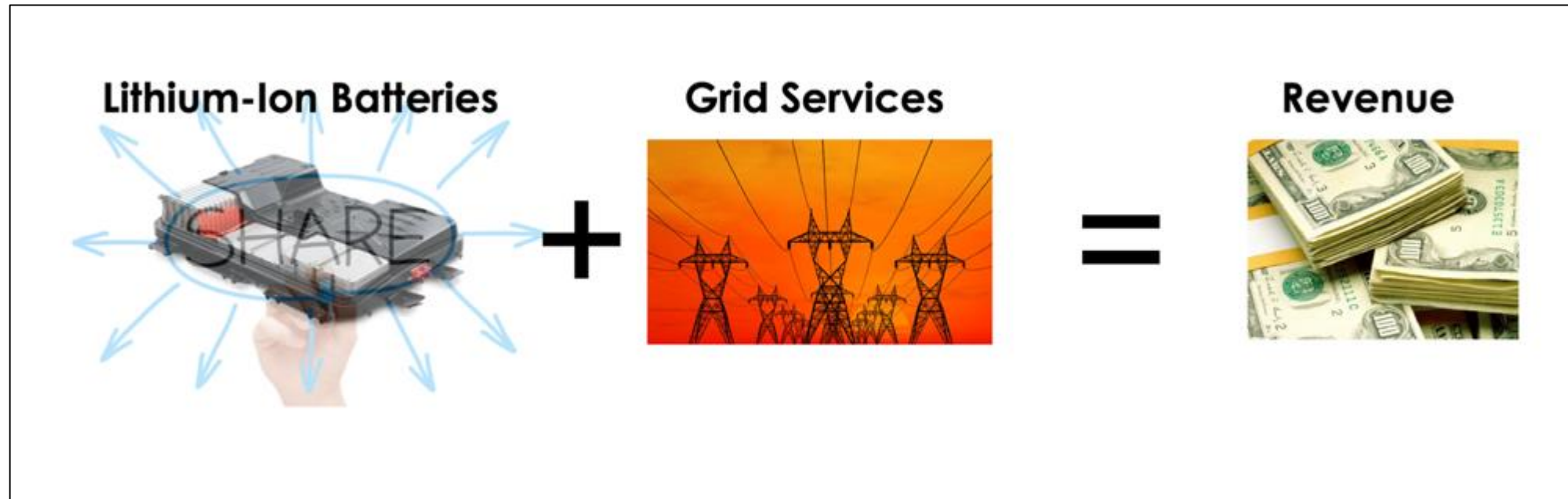
## Who is Nuvve ?



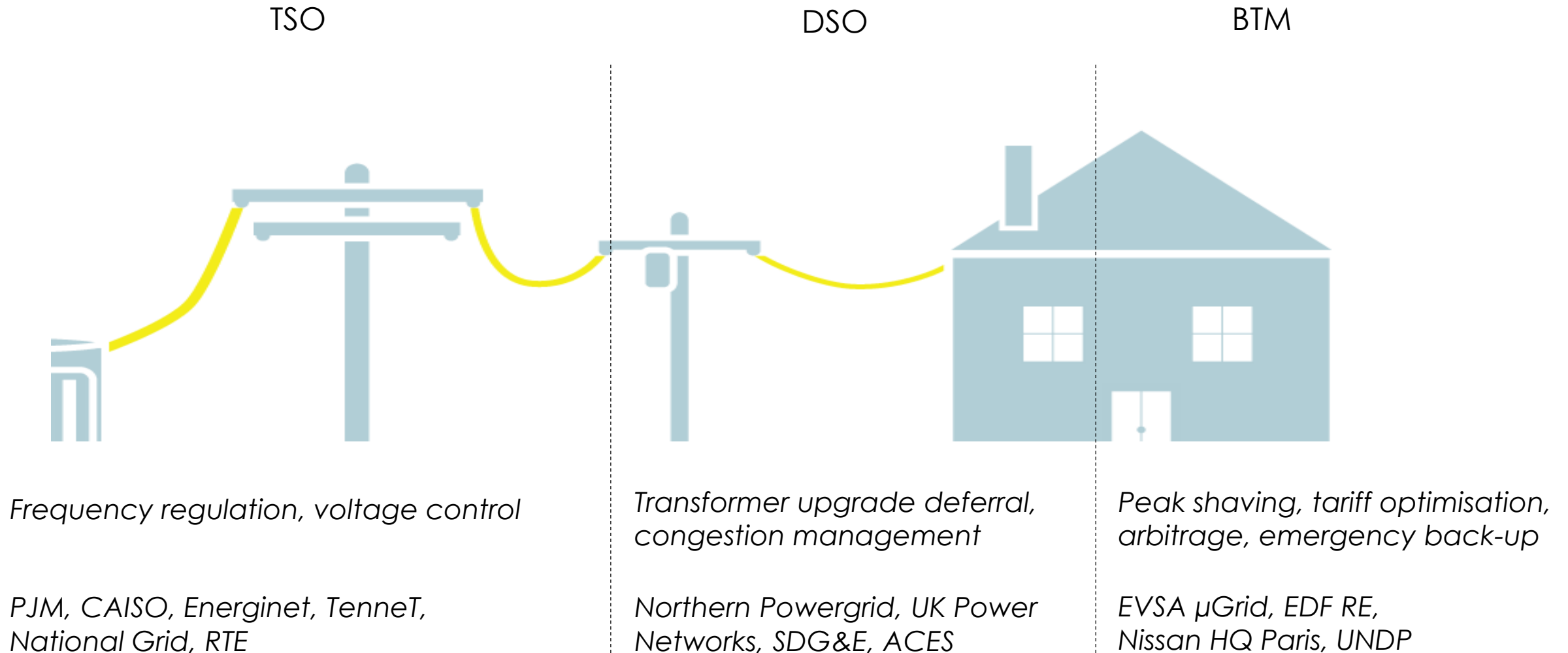
- Headquartered in San Diego California
- Nuvve provides Energy and Transportation Services
- Aggregates electric vehicles in order to allow them to participate in Energy markets and services such as frequency response
- Nuvve is using technology developed over the last 20 years at the University of Delaware (Prof. Willett Kempton)
- We are now rolling out V2G services in Western Europe and North America

# Electric Vehicle Monetization

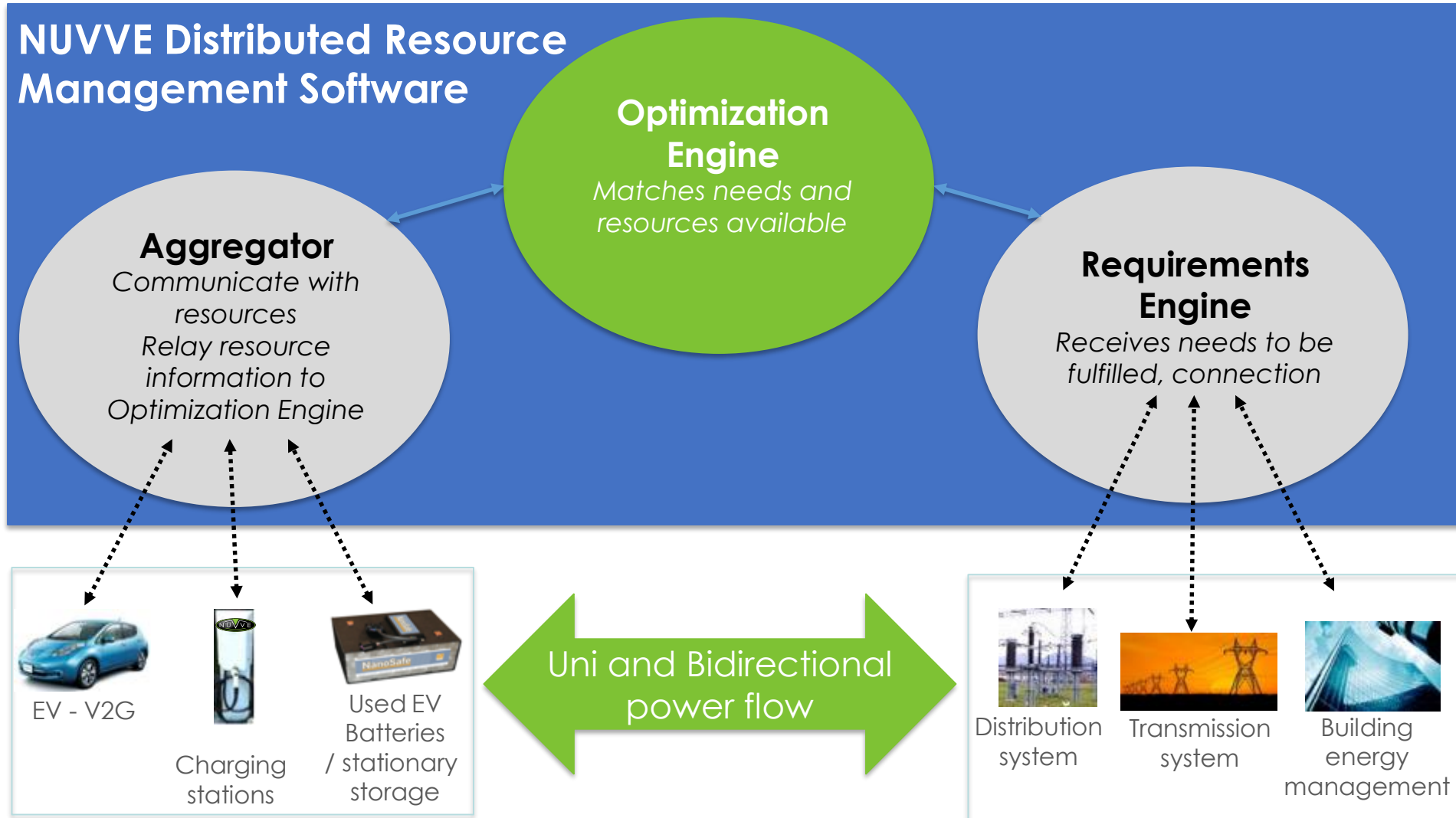
- Cars are parked 80% of the time
- While parked, an electric car battery can be used to support the electric grid
- EVs already generate Eur. 1,400 per car per year



# Storage Behind The Meter Advantage



# NUVVE GIVE™ Platform – The Technical Solution



# Nuvve - World's first commercial V2G services

*Copenhagen – Start of operation September 6, 2016*



**Production vehicles**  
Standard communications

# The Road To 100% EV: Fleet EV Penetration Management

Site connection: 65kW  
Two electric bus: 40kW  
Total number of buses on site: 38  
Potential connection: 760kW



# The Road To 100% EV: Fleet EV Penetration Management

## ***Revenue opportunity:***

- Frequency response
- Other grid wide services

## ***Cost optimization:***

- Demand charge management
- Energy cost optimization

## ***Cost mitigation:***

- Local generation
- Stationary storage







# NUVVE GIVE™ – V2G Aggregation Platform Characteristics



Highly distributed assets



Highly volatile and unreliable assets (strong agility)



With high resolution (kW or even sub-kW scale capacity)



With proven scalability (nearly 20,000 EVs controlled)



At the end of the distribution system

# NUVVE Energy And Data Configuration

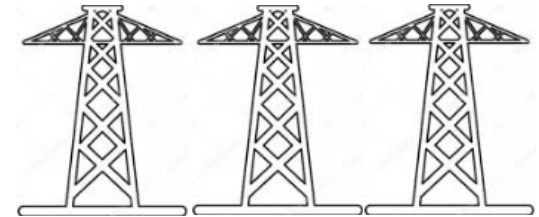
Nuvve utility-grade frequency meters



Other optimization signals (building, solar, distribution grid)



Trading on TSO / DNO / wholesale markets



Grid services  
Bi-directional Energy Flow



Bi-directional energy flow CHAdeMo standardized protocol

Bi-directional energy flow proprietary protocol

Control signals

Bi-directional energy flow



Vehicle System Link™ Software – Software Defined Charging Station

[www.nuvve.com](http://www.nuvve.com)

#NUVVEgives

## Key Issues

- *Interconnection*
- *Market participation*
- *Customer value proposition*

# Interconnection to the grid



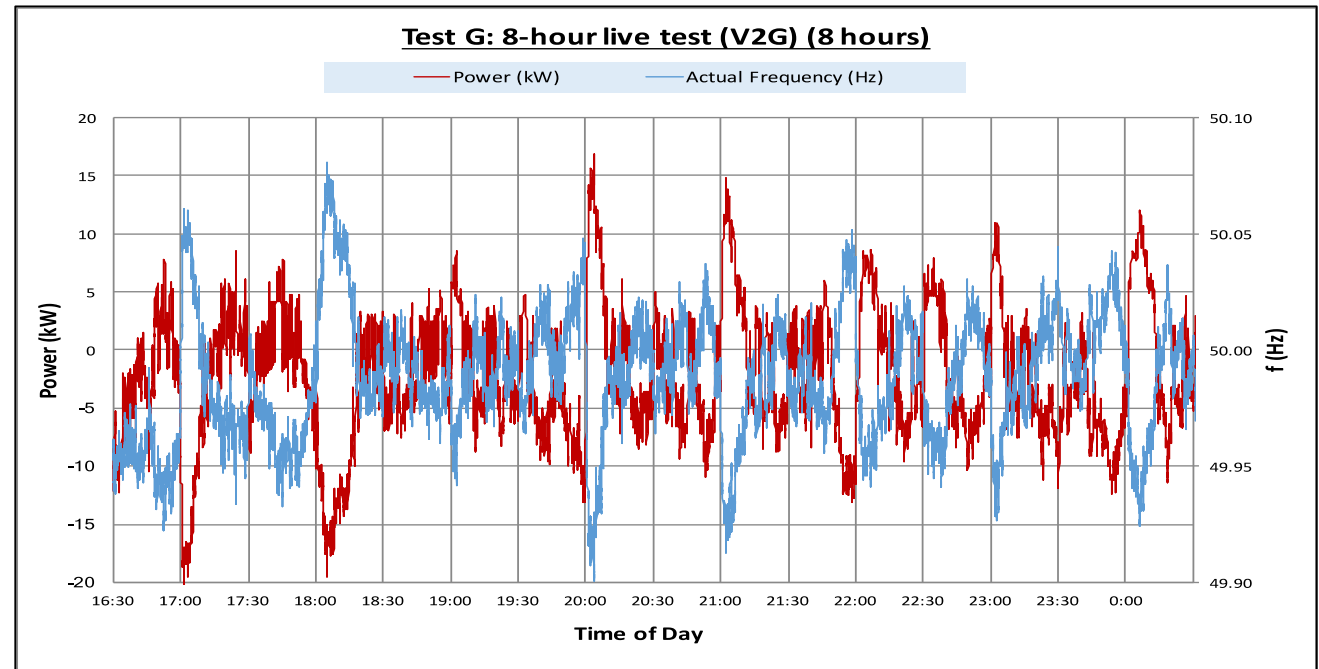
## Interconnection to the grid

- This is not a simple task!
- Bringing together automotive and energy industries: differing safety specifications
- Installing and operating V2G fleets requires understanding of DSO interconnection requirements
  - Typical installation can take months to move through the process
  - This process must be streamlined for 100,000s of EVSE installations per country
- California example:
  - A DC system with inverter in EVSE can meet all existing interconnection standards
  - An AC system with inverter in EV has no regulatory framework for a “mobile inverter”
    - Society of Automotive Engineers J3072 addresses this

## Market access: TSO acceptance for V2G

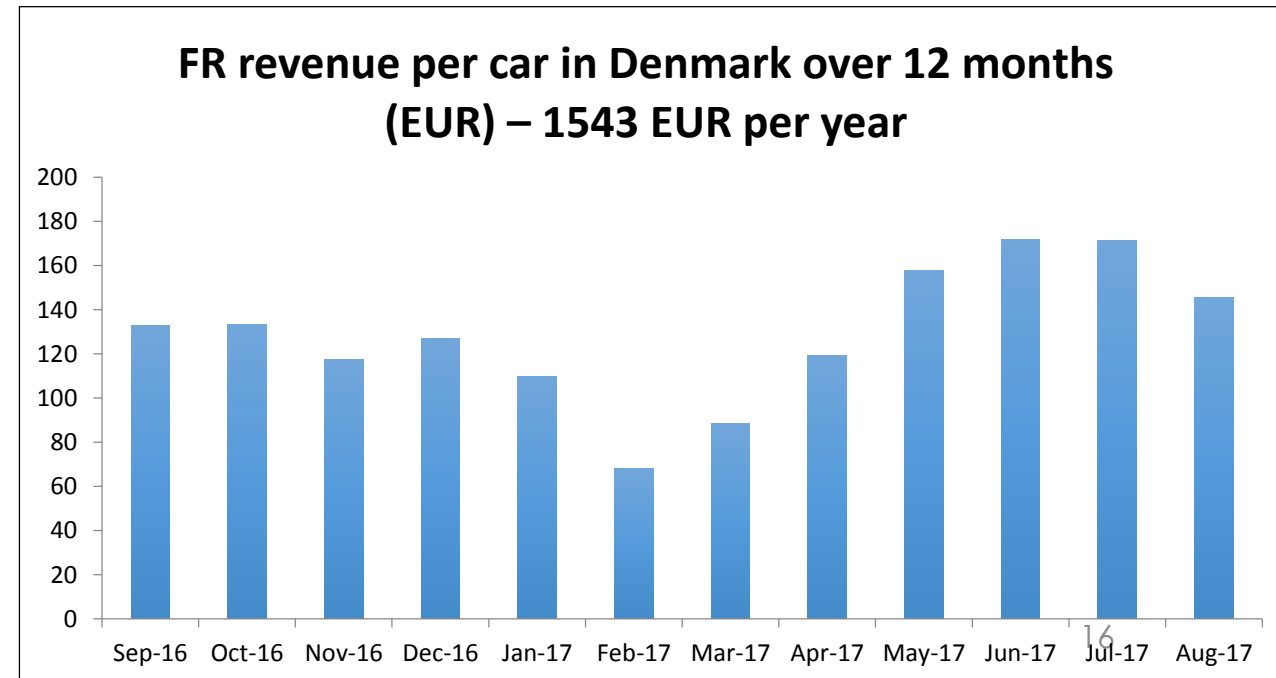
- This is not a simple task either !
- Installing and operating V2G fleets requires extensive experience and knowledge of TSO qualification.
- Nuvve has experience with 3 TSO qualifications for primary frequency regulation

- Once prequalified, access to open SO markets is also a challenge
- Redefining markets for distributed resources is key
  - Hourly bids & short lead times
  - ENTSO-E



## Customer Benefits of V2G

- Nuvve has been running V2G operations in Denmark, USA and Netherlands
- Revenue share with EV owners or fleet managers
- Financing opportunities (EV + Charger + V2G)
- Customer offers can be derived from V2G earnings such as:
  - Free energy for driving, or
  - Lower cost of chargers, or
  - Lower total cost of ownership (TCO)





Thanks for listening, question?

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