# Scaling for Large EV Infrastructure Deployments

## Market data

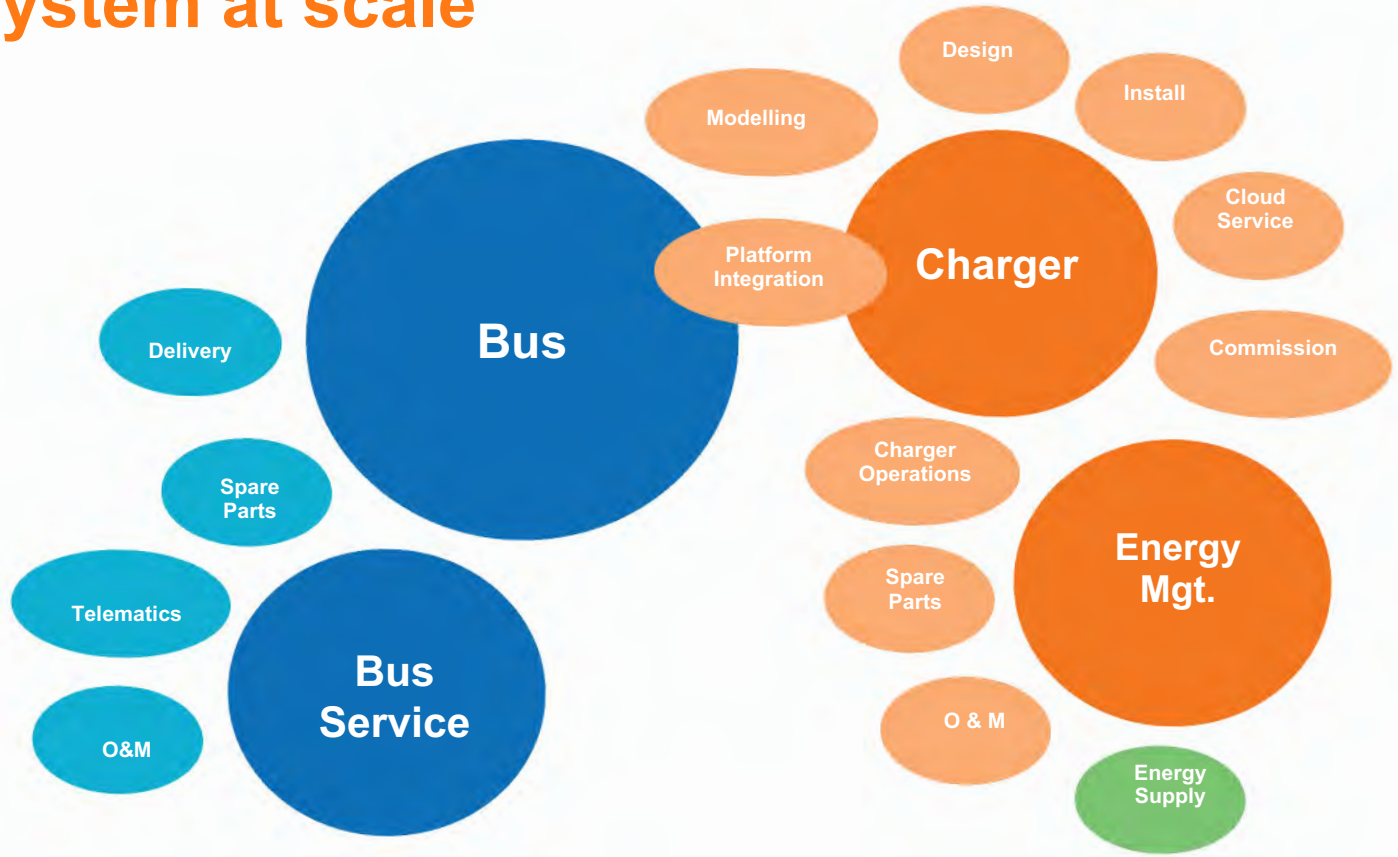
The numbers speak for themselves

Los Angeles, September 11 2018

# Agenda

1. BEB eco system at scale
2. Power versus Energy
3. Depot design and fuelling footprint
4. System design and configuration modelling
5. Hardware considerations scale and cost
6. Hardware performance
7. Charger management

# BEB eco system at scale



# Power versus Energy


**Dispensed energy = cost of electricity per kWhr delivered to the battery**

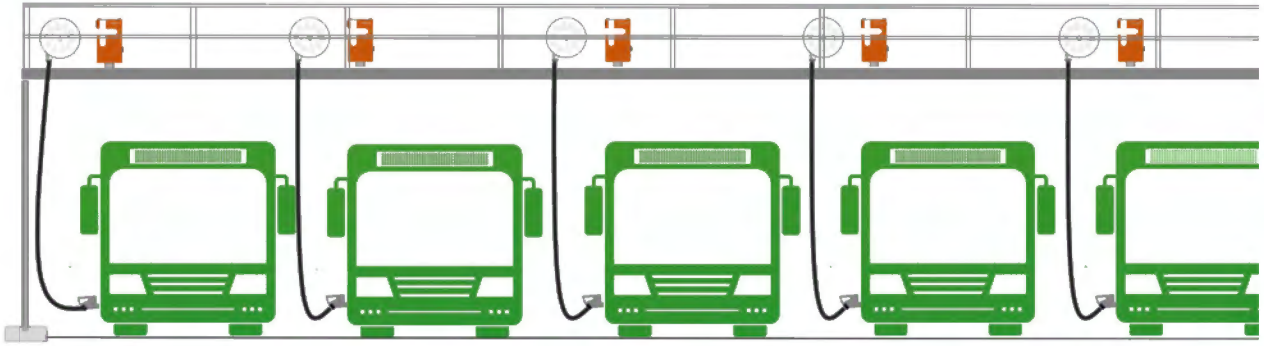
**OPEX - cost of fuel**


**Power = cost per kW of capacity to provide the electricity service**

**OPEX - cost of service**

# Depot design and fueling footprint

**Ground Based Systems Require Extensive Real Estate & Underground Cabling**



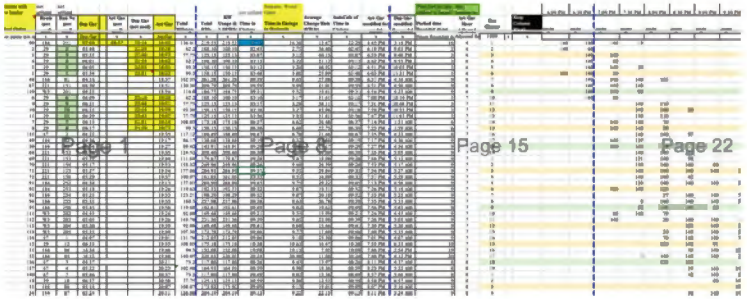
**Gantry Systems Save Space, Keep Cables Above Ground & Assist Cable Management**

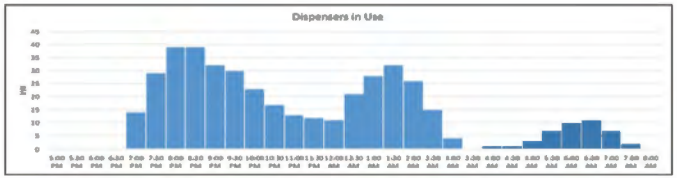
# System design and configuration modelling

+ Modelling is used to determine overall charging system requirements

+ Multi dimensional modelling supports system design, depot layout and provides the Fleet Energy Profile

+ The Fleet Energy Profile is used to configure and size the charging system




# Hardware considerations, scale and cost

**AC charging for early pilots now superseded by greater DC HW availability**

DC provides configuration flexibility, vehicle and EVSE supplier choice, more interoperability

**Monolithic DC systems trend toward being inflexible with higher power demands**

Power sharing in large increments, with capacity lock in and large footprint

**Modular DC systems offer greater flexibility and reduce overall power demand through maximized utilization**

Operational modelling supports optimized design, power & capacity is shared

# Hardware performance

+ Depot charging cannot be slow and also provide operational flexibility

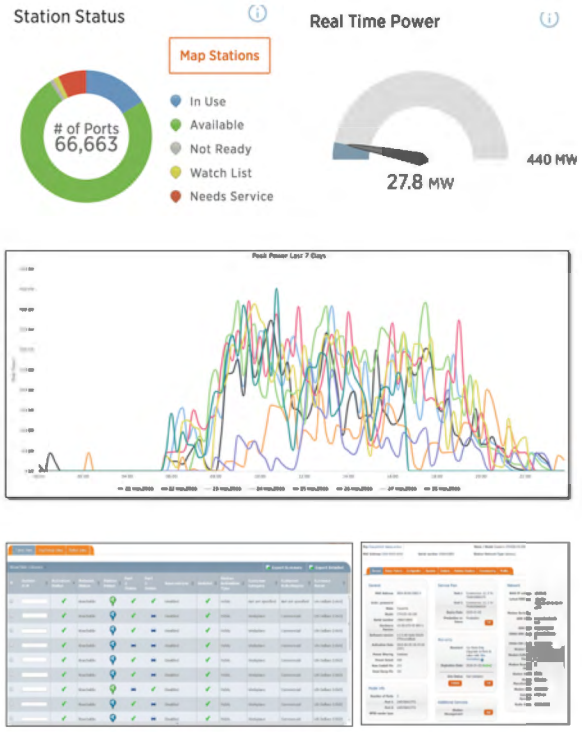


+ Recharging a 450kWhr battery in 5hr or less is a reasonable operational requirement

+ 150kW at 200A using standard CCS connectors avoids cooled cables, while providing sufficient power across typical BEB voltage ranges

# Charger management

- The charging system is now a critical component of vehicle operations
- Chargers and grid service devices need to be networked for proactive monitoring and to ensure system uptime
- Large depot monitoring comprises remote back up servers, sophisticated cyber security, performance monitoring at component level
- Multi system integration including with vehicle telematics, fleet and depot management platforms are required



# Thank You

For further information on this topic,
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