

**ENABLING NEW BUSINESS MODELS FROM G2V AND V2G AND EVERYTHING IN BETWEEN**

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# 1. NEXTGEN EV MODEL



Higher utilization rate of existing LNG and PNG facilities.



Power generation has to increase to meet the demands of EVs.

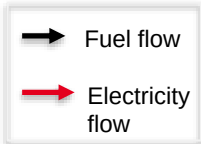
Deployment of distributed energy resources to reduce CO<sub>2</sub> emissions and provide grid ancillary services.



Vehicle-to-Grid (V2G) provides demand management services.

*Average Well-to-Wheel (WTW) statistics:*

- Efficiency: 11 – 30%
- Energy consumption:
  - 0.22kWh/km (renewables)
  - 0.55kWh/km (gas)
- CO<sub>2</sub> emissions:
  - 0g/km (renewables)
  - 119g/km (gas)



## 2. INDUSTRY VALUE CHAIN

*The value chain for EV charging is entirely different from that of conventional refuelling.*

### Grid Operator



- Factor in EV charging requirements in their network planning.
- Be transparent on the network constraints.

### Distributor Energy Resource Operator



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- Operate battery energy storage systems (BESS) and on-site generators (e.g. solar PV) for DC fast charging to relieve stress on grid.

### CAAS Provider



plugIt!

- Provide the software and hardware technology for EV charging.

### EV Charging Network Operator



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- Operate the EV charging network.
- Sell power to EV users.
- Aggregate the loads of EVs to perform demand management services.

### Consumer / DMS Participant



EV Users

- Buy power to charge their EVs.
- Consent to participation in demand management.

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### 3. OTHER STAKEHOLDERS

*EV charging operators need to work closely with automotive industry to ensure compatibility between EVs and charging stations. Furthermore, collaboration between EV charging operators and real estate industry participants will facilitate the development of effective industry practices and standards related to G2V and V2G technologies.*

#### Automotive Manufacturer



- Determine the vehicle models that are to be offered in Singapore and target sales volume.
- Adhere to the standards and regulations imposed on EVs.
- Introduce smart control algorithms to improve battery longevity and increase customer confidence in using V2G technology.

#### Building owner / MCST



- Approve the installation of EV charging stations at their properties.
- Approve the application of V2G technology at their properties.

#### Car Park Operator



- Allocate lots in their car parks for EV charging.
- Monitor the car parks to ensure the EV lots are not used by non-EVs.
- Include EV charging stations in their security checks.

#### Property Management Co.



- Facilitate the discussions between EV charging company and the MCST.
- Execute the legal and operational procedures at the facility end.

# 4. V2G – A NEW MODEL FOR ELECTRICITY?

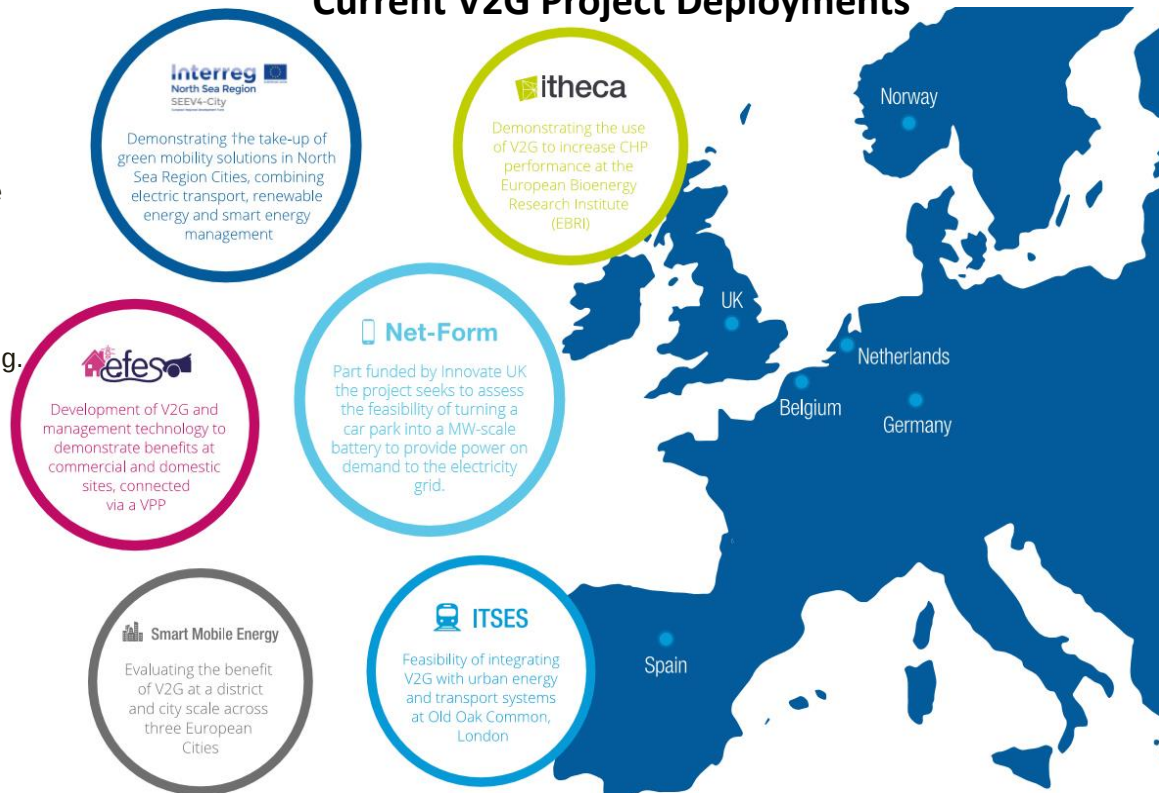
## Benefits

- Strengthens Electric Vehicle's commercial viability.
- Facilitates the increased use of localized renewable energy sources.
- Supplies energy to energy markets.
- Provides grid ancillary services such as load shaving.

## Opportunities in Singapore

- A mere 2% EV penetration in Singapore can offer storage capacity of up to 50MW.
- Supplying peak loads can earn profits over S\$2300/MWh.

## Current V2G Project Deployments



# 5. V2G: A MULTI-DISCIPLINARY CHALLENGE

## 1. Battery Life

More charge/ discharge cycles → faster degradation of battery life

## 2. Extensive EV charging network is a necessity

## 3. Warranties

Battery life, safety, power conversion units, performance degradation, car safety

## 4. Hardware

Increased cost of comm equipment, metering, communications and control

## 5. Data and Security

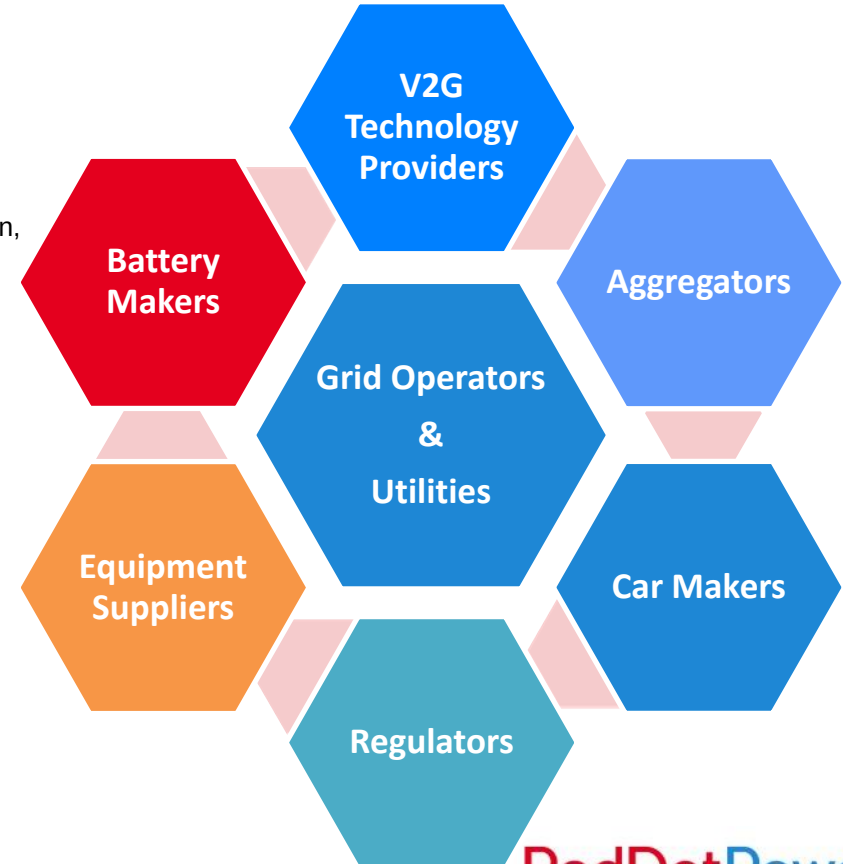
Increased costs on software, data management, data transfer

## 6. Permits

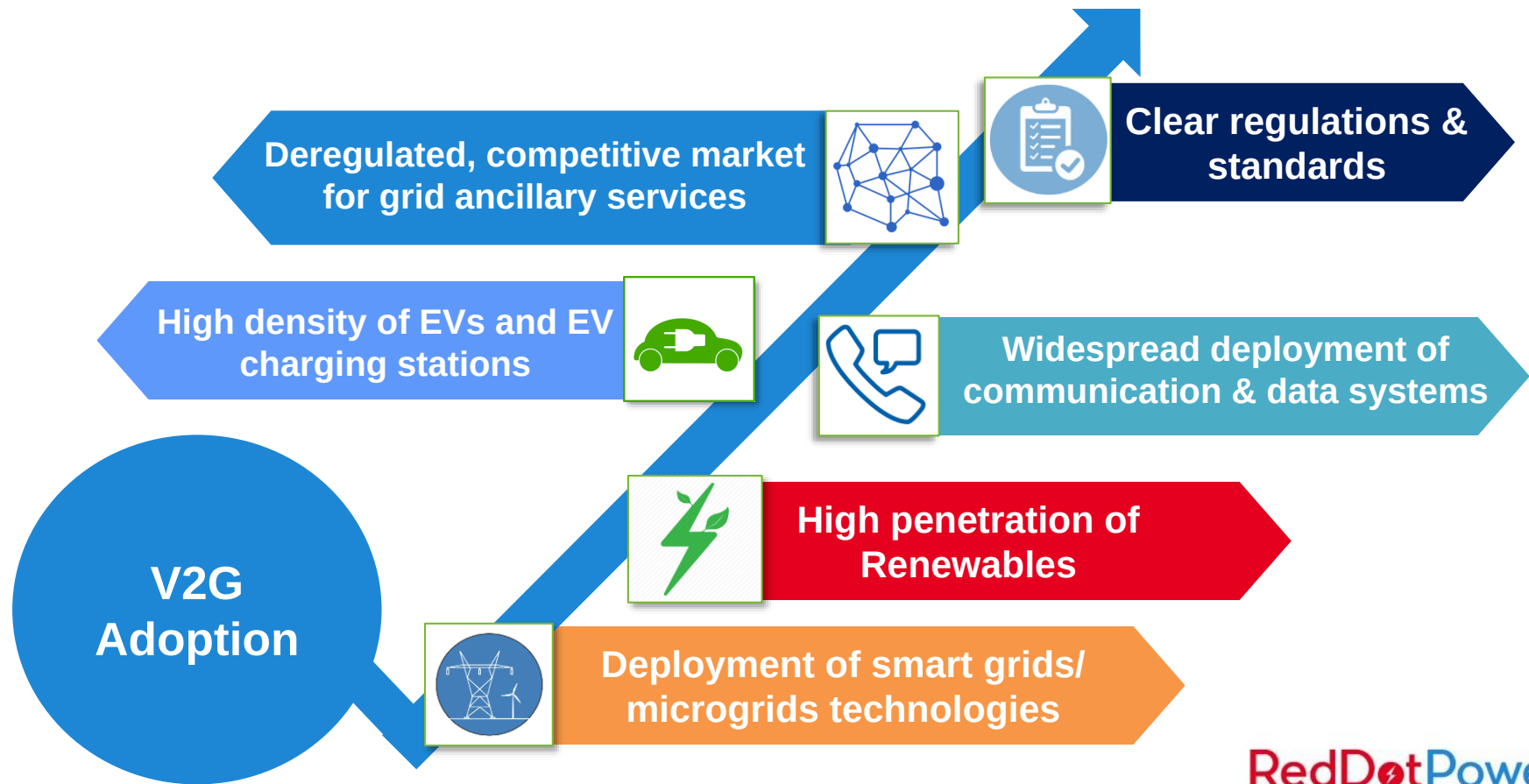
Time of use, building permits, installation permits, charging facility permits

## 7. Economics

Revenue estimates, services costs, competition from stationary energy storage systems



## 6. V2G – HOW CAN IT HAPPEN?



## 7. V2G: REVENUE STREAMS

“ Falling battery prices and increased grid scale adoption of ESS are direct competitors for V2G”

### **Bulk storage to reduce “duck curve”**

A feed-in tariff could make V2G for storage economically attractive for vehicle owners

### **Peak shaving**

C&I electricity users can mitigate highest single demand period and charges with in-house EV network

### **Grid operator's compensation**

Grid operators compensate vehicle owners for providing regulation services based on their capacity and response: real-time & day-a-head bidding

### **Charging network models**

- Installation, O&M of charging networks
- Pay per use & Contractual payments
- Energy Management Services
- Aggregator Services

### **Renewable support compensation**

Microgrid operators can compensate vehicle owners for supporting renewable intermittency

### **Battery second life applications**

Resale of battery for exchange of power after automotive retirement



## 8. PAVING THE WAY FOR G2V AND V2G

### Actions required to facilitate growth:



EV charging network operators must **work with the grid operator** to ensure the grid is able to handle the high power consumption, especially for DC charging.



Analysis of **traffic data flow is vital for proper planning** of EV charging networks in Singapore. This could be done in either a centralized or free-market manner.



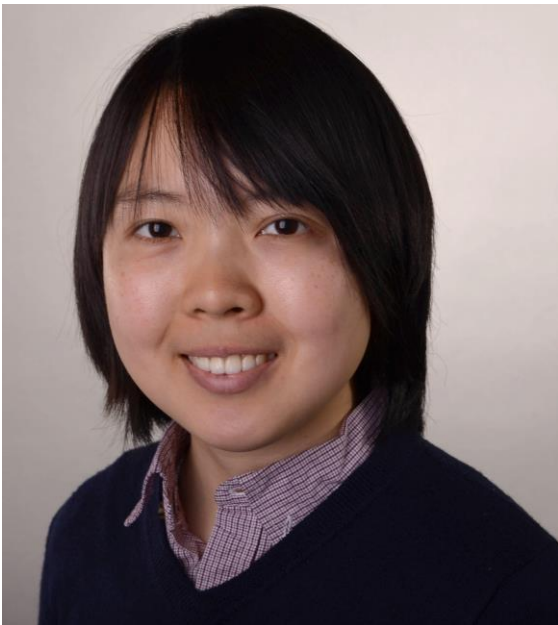
The Electricity **Codes and Standards needs to be clear** on the integration of distributed energy resources with EV stations.



Clear and simple energy market rules which encompass **equitable risk sharing amongst parties** are essential for distributed energy operators and EV users to participate in the energy market.



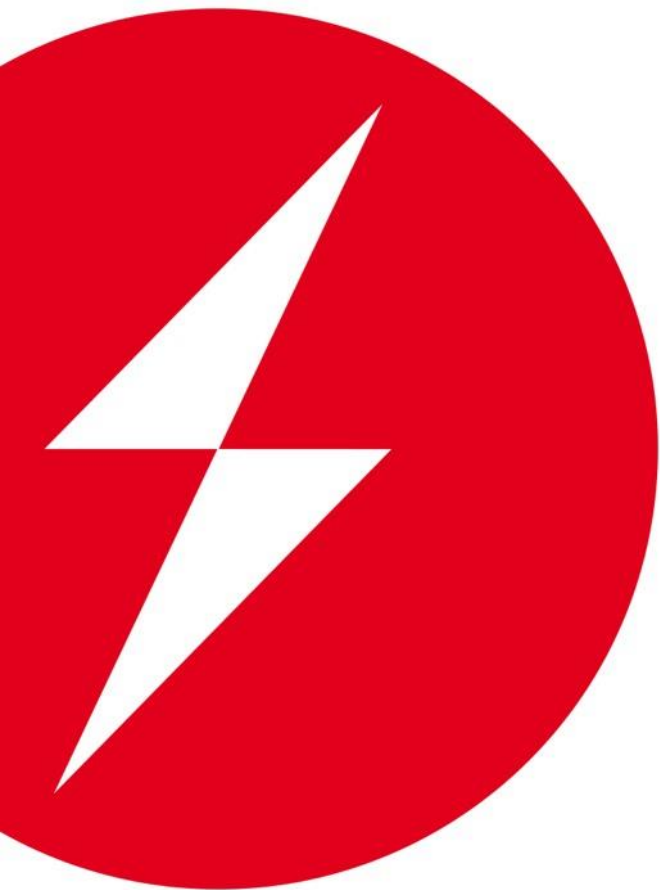
State authorities should support **trial and subsequent commercialization** of V2G projects by providing financial and regulatory support to market participants.



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**THANK YOU!**