Global Challenges of Electric Vehicle Integration

ISGAN How2Guide
March 28, 2012

Current market forces will drive PEV Adoption

Automotive OEM

Increased regulation to reduce CO_2 emissions

Increased fuel efficiency standards

Decreased reliance on foreign oil supplies

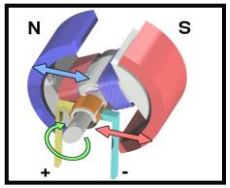
Improved technology and decreasing costs

Consumer

Increasing consumer concern with environmental issues

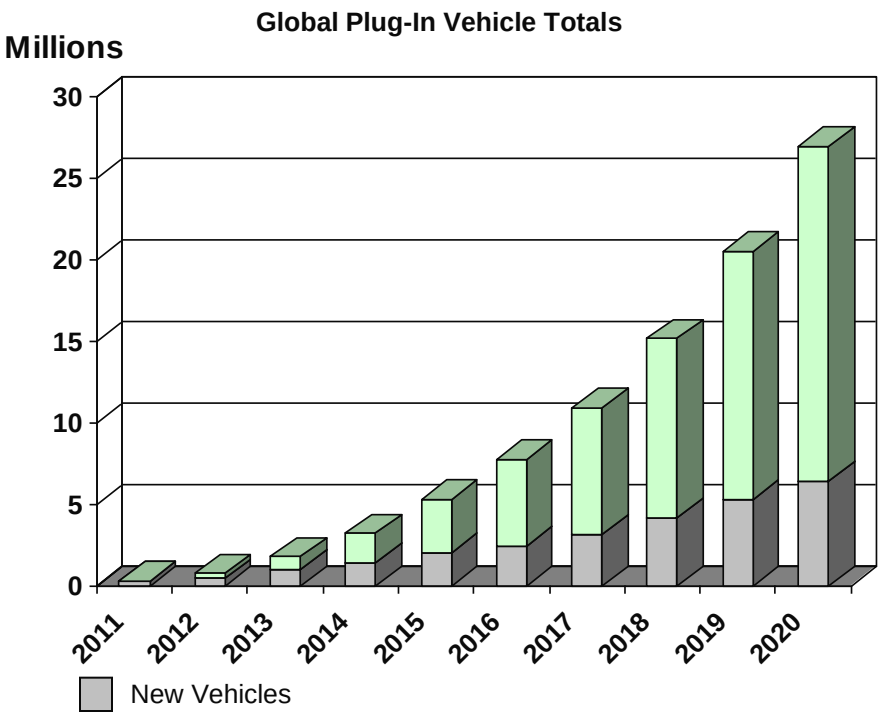
Consumer adoption increased by government subsidies

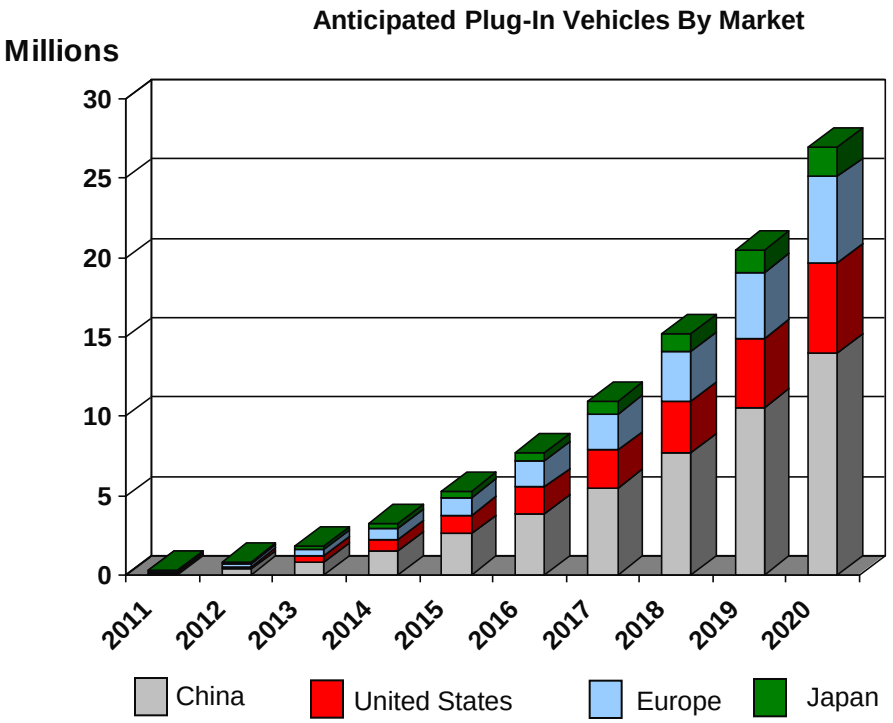
Increasing urbanization and last mile transport needs



Consumer interest in alternative fuels and power trains

Anticipated PEV Market Size





2011

2012

PEUGEOT
CHERY
TESLA
Ford
RENAULT

2013

Audi
VOLVO
FIAT
TOYOTA
smart

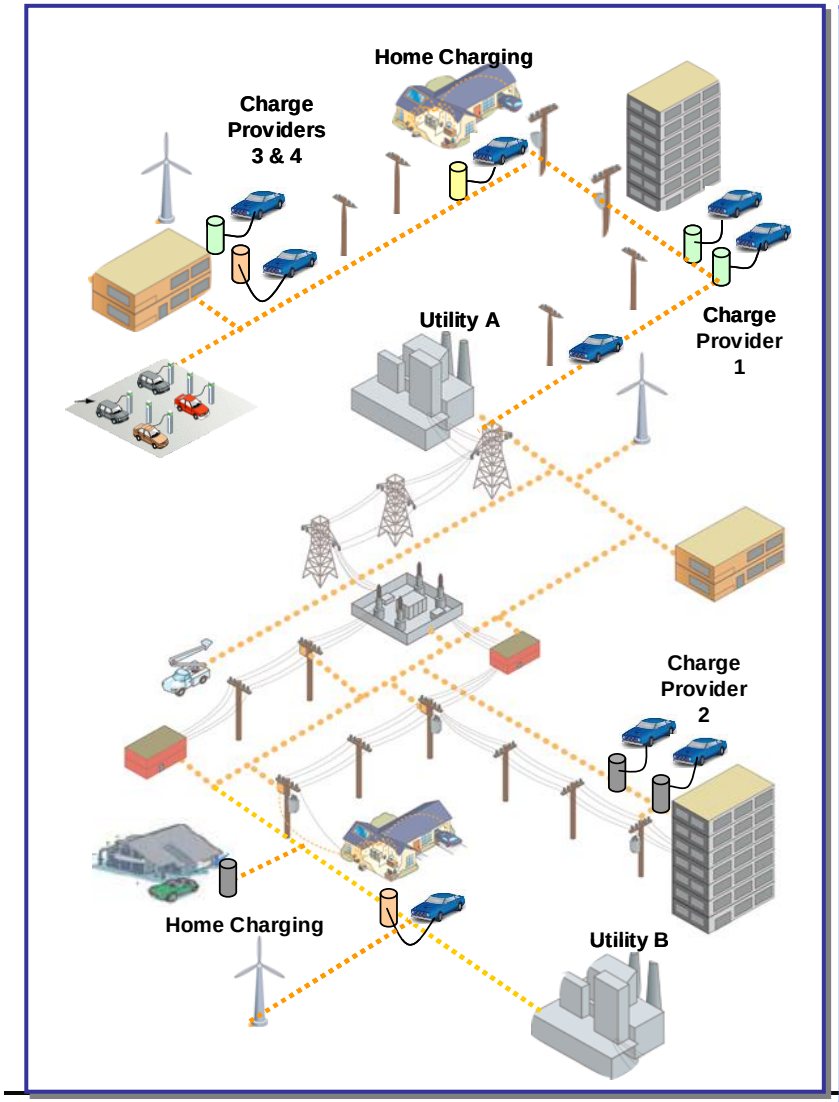
30 Chinese BEV models

2014

2015

1st gen refresh /
2nd gen testing

The EV Market Will Create New Challenges for Participants



Market Challenges	Utility	Service Prov	Automotive	Government	Consumer
Large and mobile load requires proper management to minimize impact on grid operations	●	●	◑	◑	●
New services and customer interactions require new business processes	●	●	●	○	●
Recharging times & transactional complexity require new metering and charge calculation capabilities to support PEVs	●	◑	○	○	◑
High volume of sensitive transaction data requires data security	●	●	◑	●	●
Multiple Charge Service Operators leads to interoperability issues	◑	●	◑	○	●
Travel to different utility service territory leads to charge roaming challenge	●	●	○	◑	◑
Theft and vandalism of public charge posts	◑	◑	○	◑	○
Anticipated PEV 'fueling' taxes will require report and audit to government entities	◑	◑	○	●	○
Public charge posts will require appropriate siting, installation and maintenance	○	◑	○	◑	○
Need to capture data on vehicle and battery performance for future improvement	○	◑	●	○	○
Consumers will likely demand multiple payment options– an expensive challenge for service providers and utilities;	●	●	●	○	●
Secondary Uses for batteries, battery disposal / recycling	◑	◑	◑	○	◑
Insufficient public charge spots will lead to range anxiety	●	●	●	◑	●
Consumer anxiety on seamless payment availability & security	●	●	●	◑	●

Impact: High ● Moderate ◑ Low ○

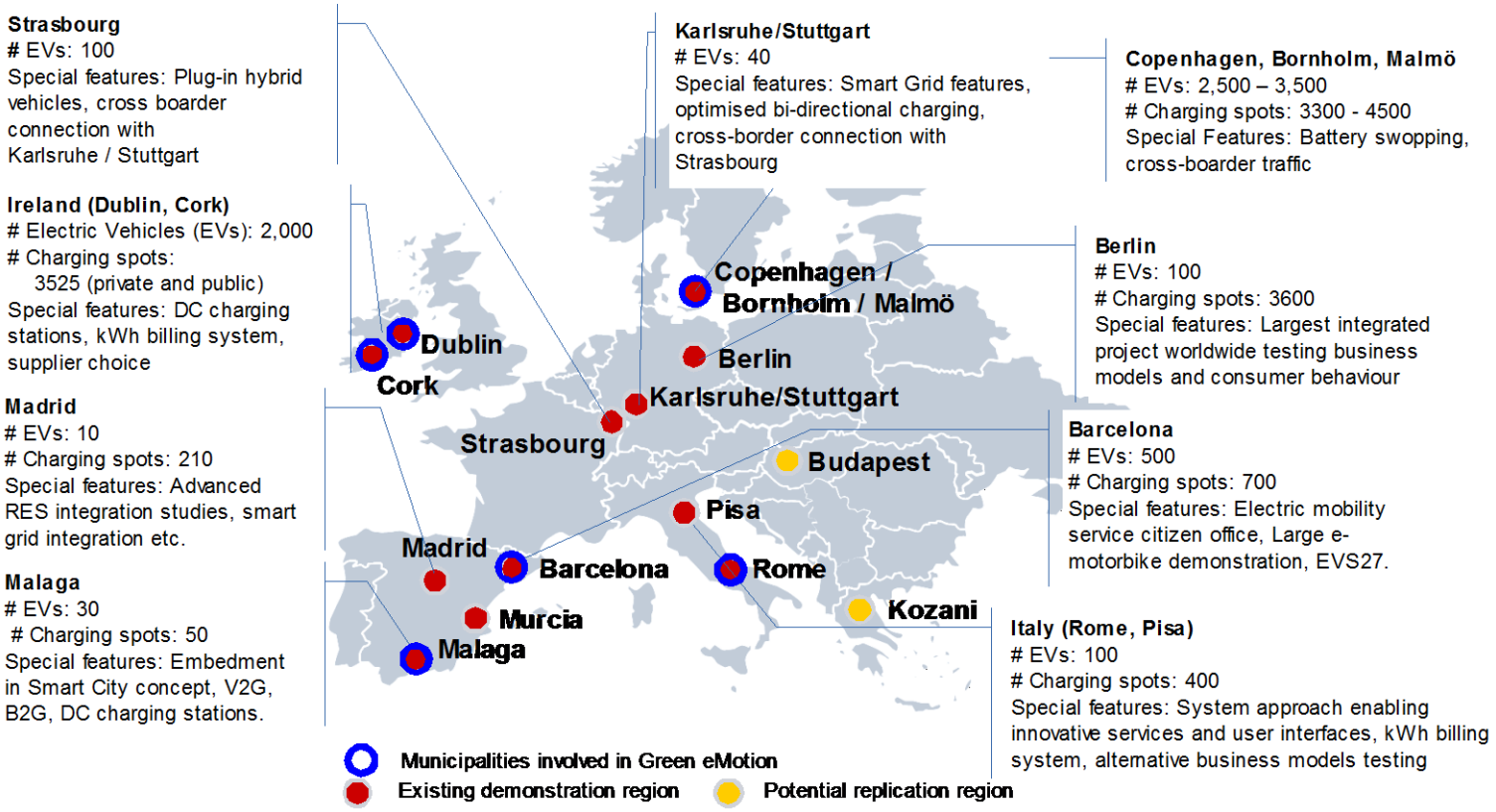
Challenge of Integration & Interoperability

Different actors, devices, and business models creates an interoperability challenge

- **M**ultiple ‘charge operators’ acting in the market place including: utilities, municipalities, business owners, etc.
- **D**istinct business models emerging
  - “*Low Cost Public*”: Initiatives taken on by municipalities and public entities. Focused on ‘seeding’ the market with low cost and ‘open’ access to charge posts
  - “*Private & Differentiated*”: For profit business ventures by utilities and enterprise. Private access to chargers and value add services. Includes alternative models such as vehicle/battery licensing
- **M**ultiple device manufacturers, types, and communications methods
- **N**eed to ensure interoperability across providers and utility service territories
- **T**hink of the current ATM Network as a model for electric vehicles

Roaming and Interoperability Project Example in the EU

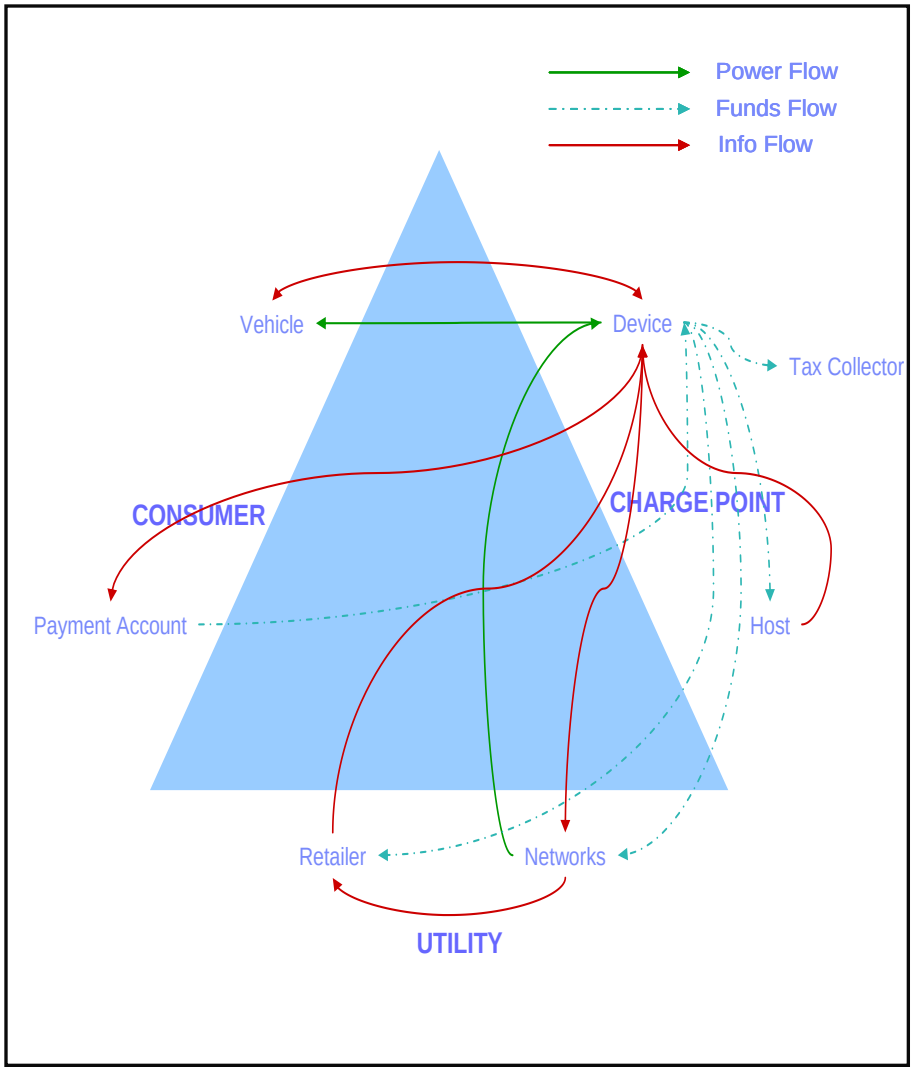
- **P**rovision and proving of a Clearing House, to create interoperability of 13 different pilot projects (data and charge calculation)
- **I**ntroduction of centralized marketplace and advanced services
- **F**uture proofing of protocols and interface
- **F**orty consortium partners spanning automotive, energy, and technology providers



Challenge of Fee Calculation / Billing

Charging for electricity as a fuel source

- **I**n a given public charge event up to 5 entities need to be factored and settled:
  - Energy
  - Distribution
  - Charge Post
  - Parking
  - Taxes
- **T**he number of permutations that will need to be accounted for when calculating fees for a public charge event will likely be immense
- **N**eed for low cost multiparty settlement system
- **N**ew Tax implications forcing changes to billing systems
  - Electrons per mile
  - Clean fuels tax

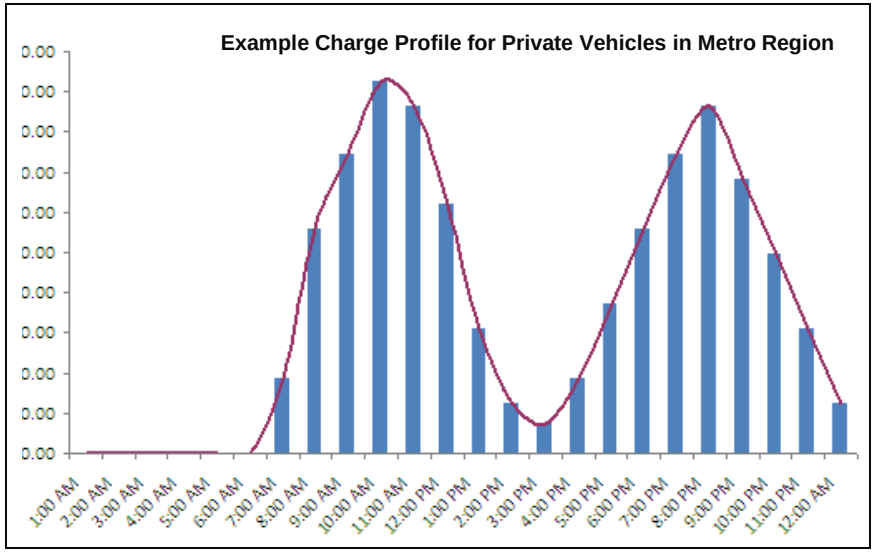


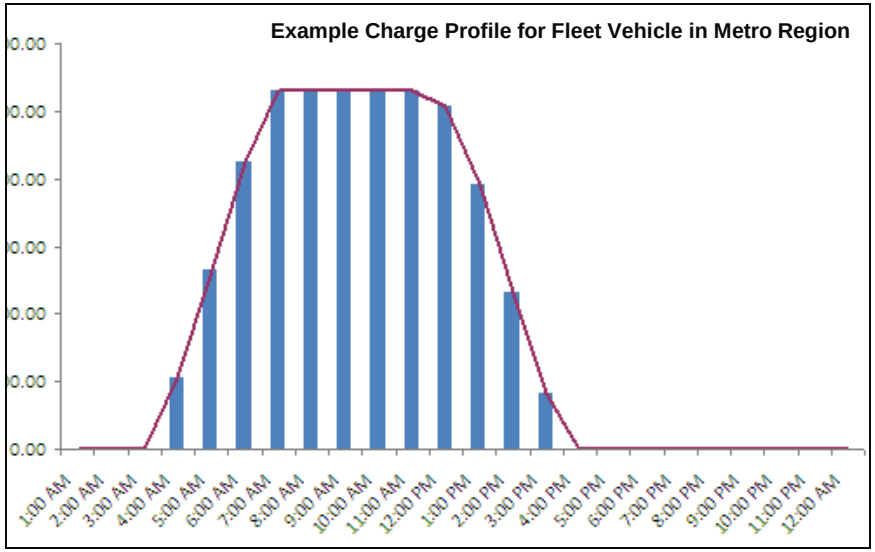
Grid Support & Need for Analytics

Successful integration means requires deep insight into vehicle charging

- **D**ifferent charge rates cause different grid impacts
- **U**nderstanding the usage patterns and users will be important:
  - Private Vehicle: Significant off peak charging but will also likely to plug in as often as possible (e.g., workplace, shopping centers, etc.) creating potential for significant on peak charge
  - Fleet Vehicle: Predominately off peak charging to capture cost savings. Route planning will allow for optimization of recharge schedule
- **K**nowing when and where these vehicles plug in will be imperative
- **U**nderstanding charge load will be difficult given profusion of device types, operators, and communications methods

SEGMENTATION IMPACT FOR DISGUISED CLIENT

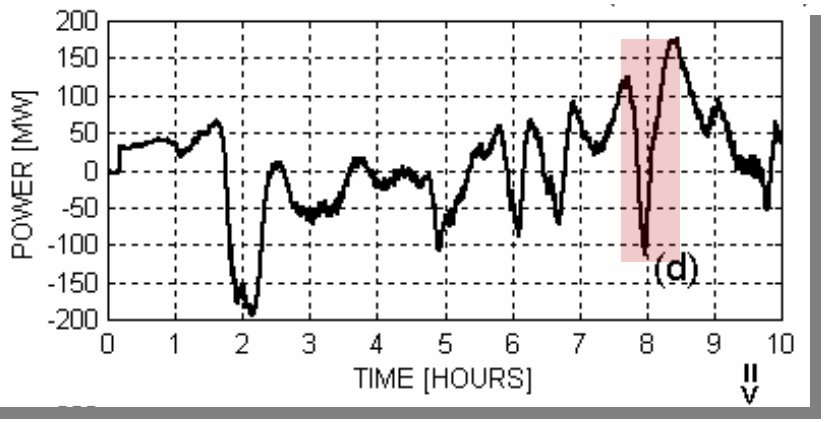




Grid Support & Need for Managed Charge

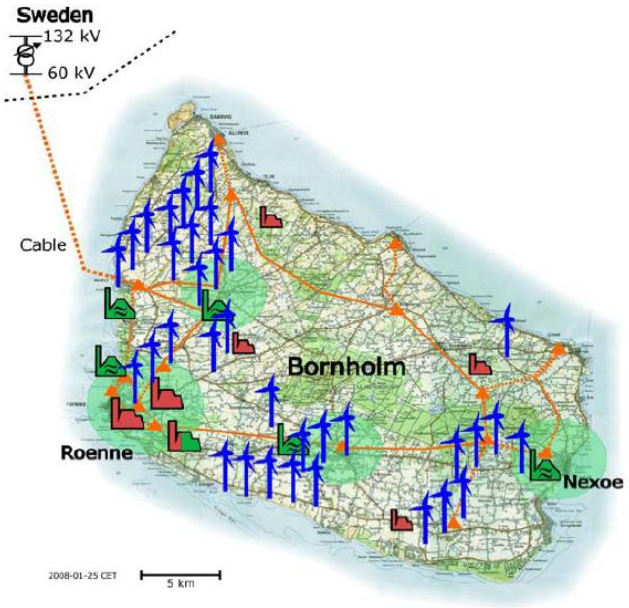
Ultimately, managed charging will be essential

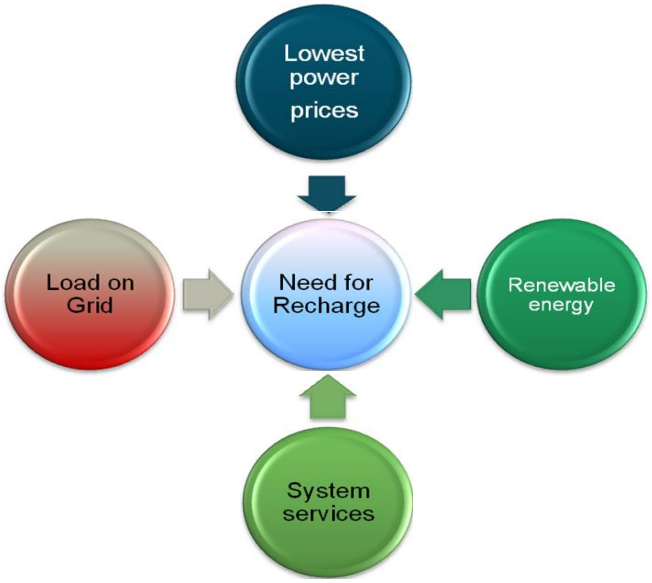
- **I**ncentive based pricing strategies to motive off peak charging important but not sufficient
- **M**anaged charging will be needed to prevent distribution asset overload
- **M**anaged charging to capture benefits of electric vehicles
  - Renewable energy intermittency
  - Ancillary services and grid support
- **H**ow to make managed charging acceptable to end user?
  - Likely require charge guarantees / SLAs with participants
  - Will require shared economic benefit through decreased cost, payment, etc.



Grid Integration Project Example: Project EDISON

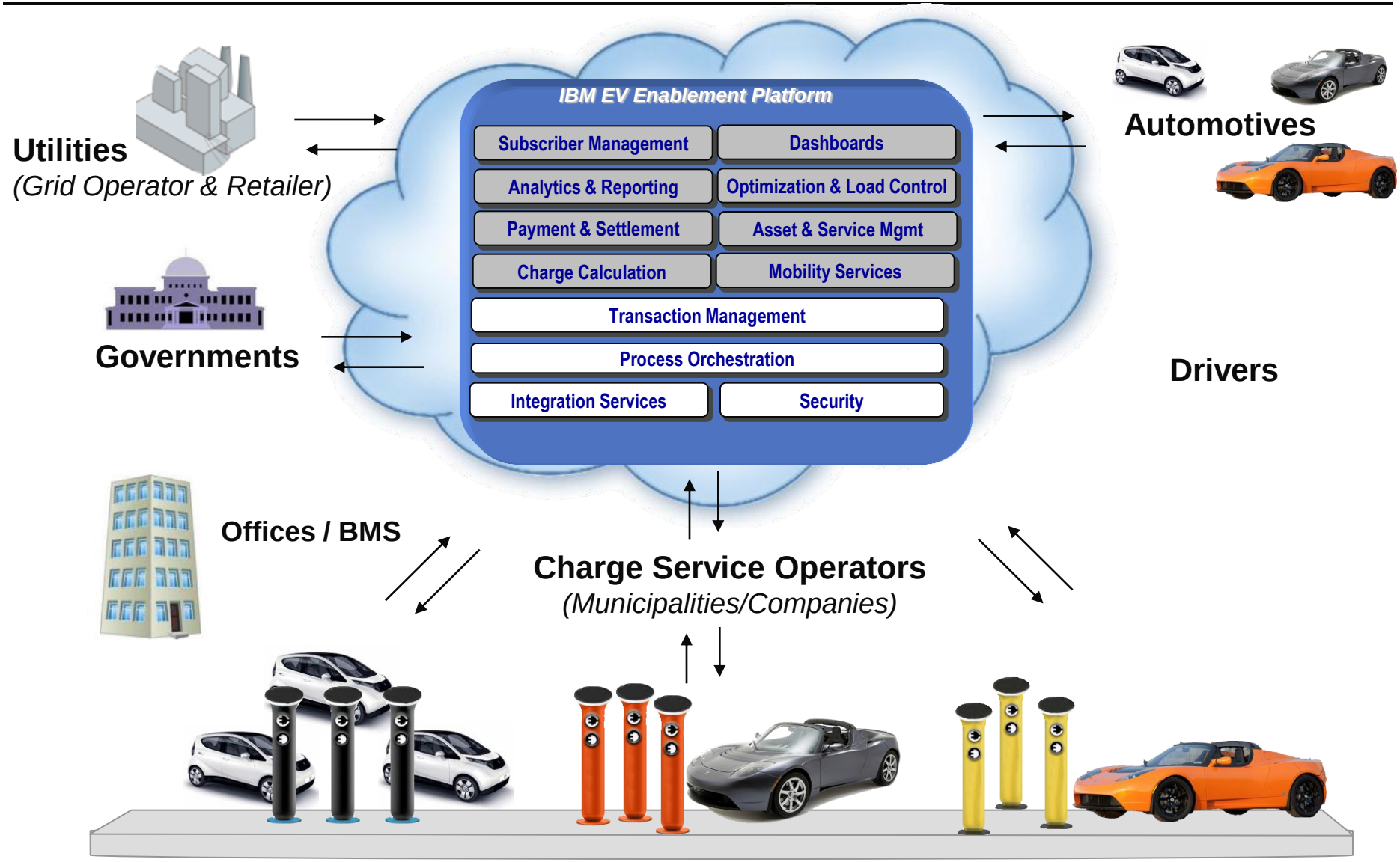
- **D**esign of an energy system for an entire country with support for large % EVs.
- **N**ational interest to optimize wind energy → prevent subsidized excess wind energy from crossing national borders
- **I**nitial phase: Real-life testbed on the Danish Island of Bornholm (pop. 40,000)
- **I**n scope: how do user profiles (e.g., ”Charge Guarantees” follow user when charging outside of ’home network’





IBM’s contribution:
Development of management system to control charging of cars in accordance with the availability of wind energy while enabling optimal use of the electricity grid and enablement of charge roaming

Conceptual Overview: *IBM EV Enablement Platform*



Policies and Regulatory changes required

TARRIFF CHANGES FOR MANAGING CHARGE

- Initiate and complete rulemaking on qualifying EV standby and TOU tariffs
- Adopt state specific TOU rates for EV off peak charging through FERC and NERC guidelines
- Establish guidelines for a reduced electric charging tariff and standard regulatory oversight

INCENTIVE APPROACH

- United Kingdom: subsidies and tax incentives of up to aprox $8000 USD
- Italy: tax incentives of aprox. $5,000 USD
- Ireland: tax incentives of aprox. $8,000 USD
- Denmark: no registration tax and no road tax for PEVs
- China: maximum subsidy of up to $10,000 USD (aprox)

CHARGING INFRASTRUCTURE

- Extend consumer tax credits for home charging equipment for 220V fast charging ports
- Establish tax credits equal to 75 percent of the cost to construct public charging infrastructure
- Finalize all low and high speed charging standards for manufacturers

ありがとう * شكرا * 謝謝 * Merci * Danke * धन्यवाद * תודה * terima kasih * با تشکر از شما * gracias * tack * آپ کا شکریہ * σας ευχαριστώ * спасибо * gratias agimus tibi * *Thank you!*

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