
# Market Models for Rolling-out Electric Vehicle Public Charging Infrastructure

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# Outline

1. Some words on EURELECTRIC
2. Scope of the EURELECTRIC paper
3. Possible locations for EV infrastructure and their specific characteristics
4. Explanation of the 4 identified Market Models for rolling out public charging infrastructure
5. Conclusion

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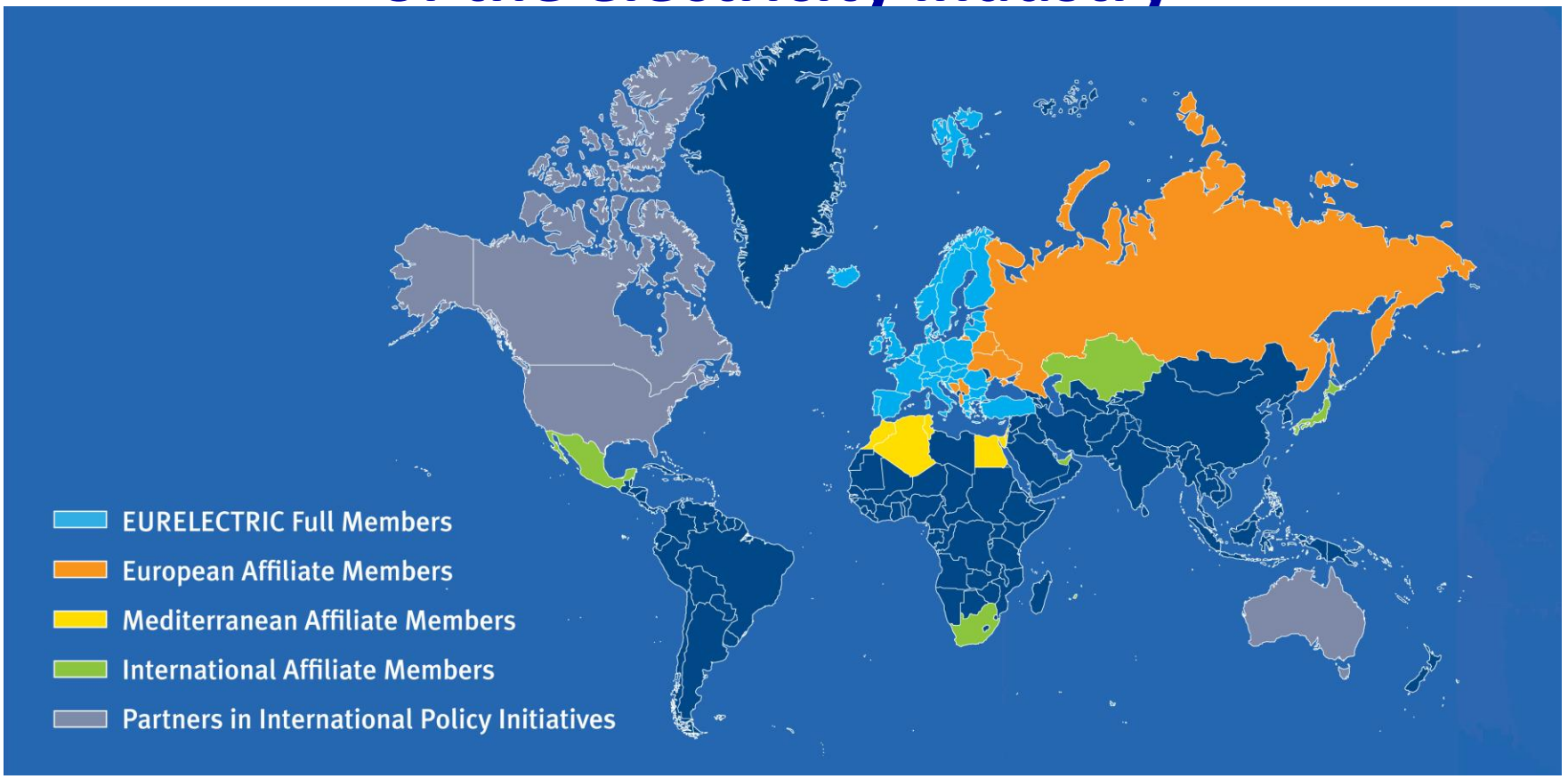
# EURELECTRIC – a pan-European and internationally oriented association of the electricity industry



# What do those members represent?

- **National industry associations representing all participants in the electricity value chain:**

**ENERGY POLICY & GENERATION**

**MARKETS**

**ENVIRONMENT & SUSTAINABLE DEVELOPMENT**

**NETWORKS & DISTRIBUTION**

- **Electricity industries of 33 European countries are full members (EU 27 & NO, CH, TR…)**

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# Task Force Electric Vehicles

edp

SVENSK energi

EDF

RWE
The energy to lead

ESB

IBERDROLA

endesa

Electrabel
GDF SUEZ

e·on

Hafslund

ČEZ

gasNatural
fenosa

ALPIQ

ENEXIS

Enel

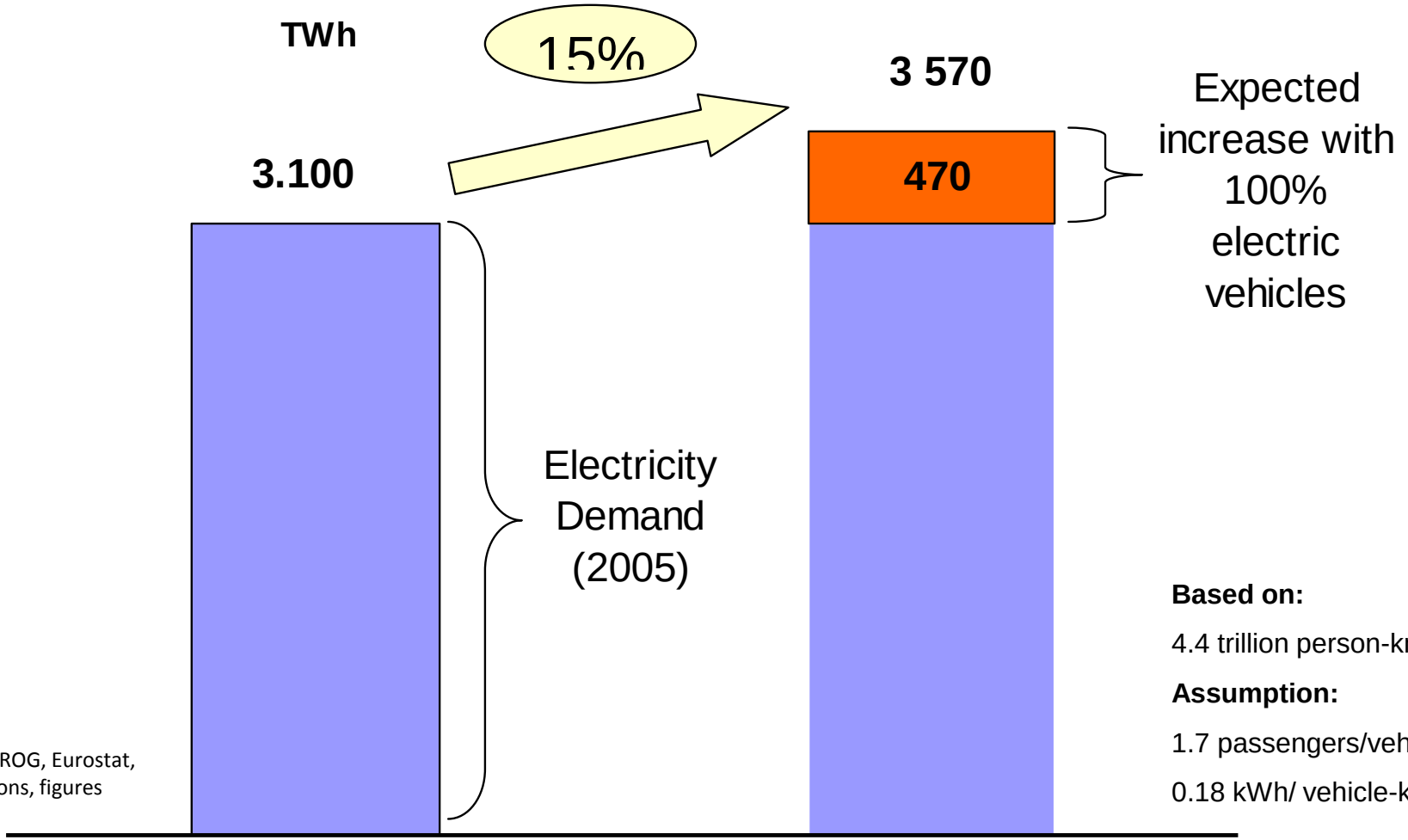
Verbund

SSE

ERDF
ÉLECTRICITÉ RÉSEAU DISTRIBUTION FRANCE

DONG
energy

# 100% electric vehicles as of tomorrow would increase EU-27 electricity demand by 15%




**Based on:**

4.4 trillion person-km (2005, Eurostat)

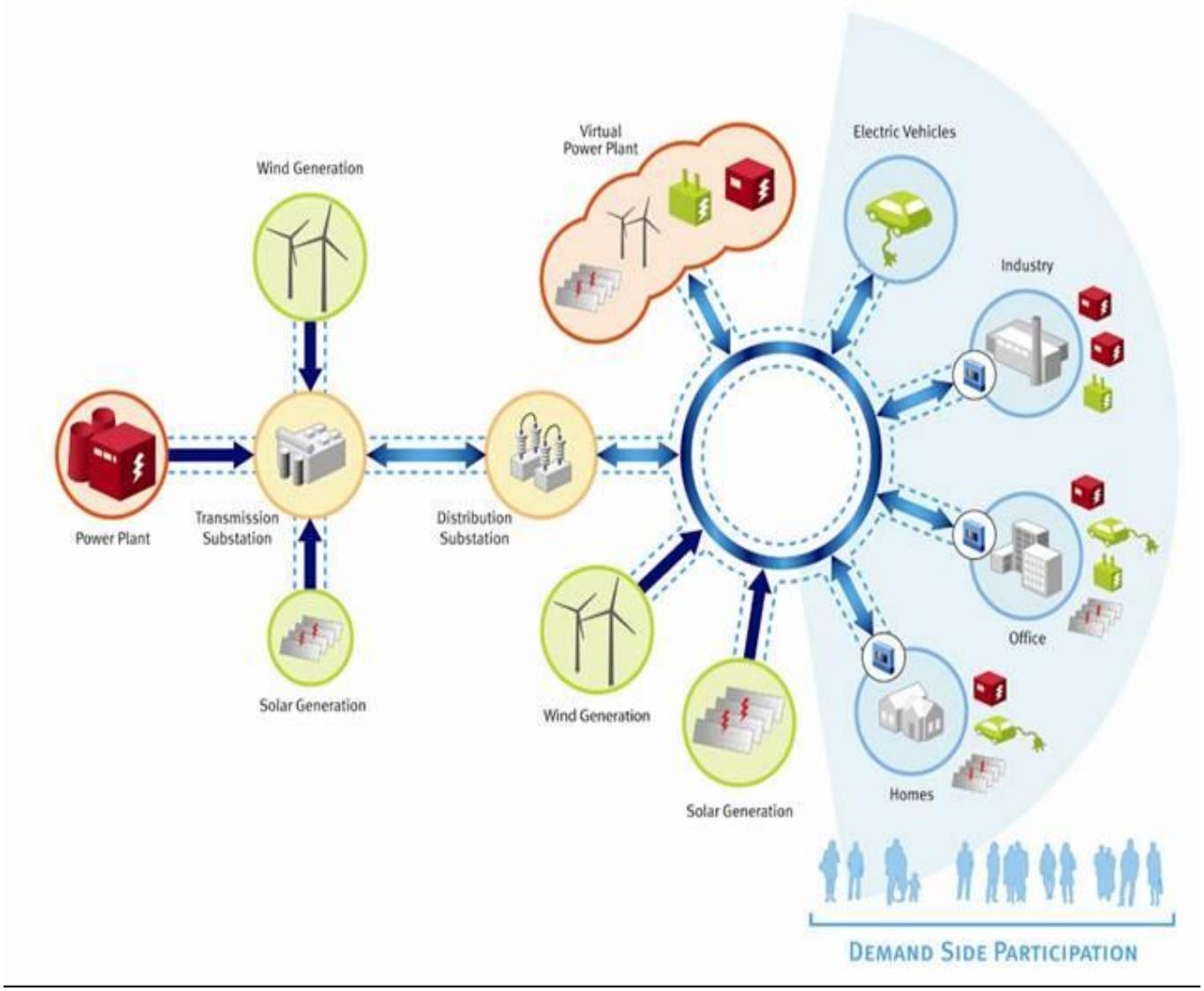
**Assumption:**

1.7 passengers/vehicle

0.18 kWh/ vehicle-km

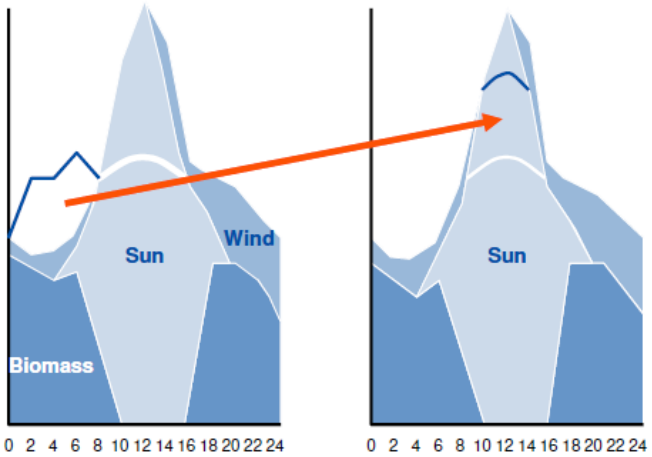
Source: EURPROG, Eurostat, own calculations, figures rounded

**Tomorrow's smart system will be characterised by large-scale integration of intermittent decentralised generation and new types of loads connected by the distribution grid**



# Bi-directional communication between vehicle and charge spot enables synergies with RES

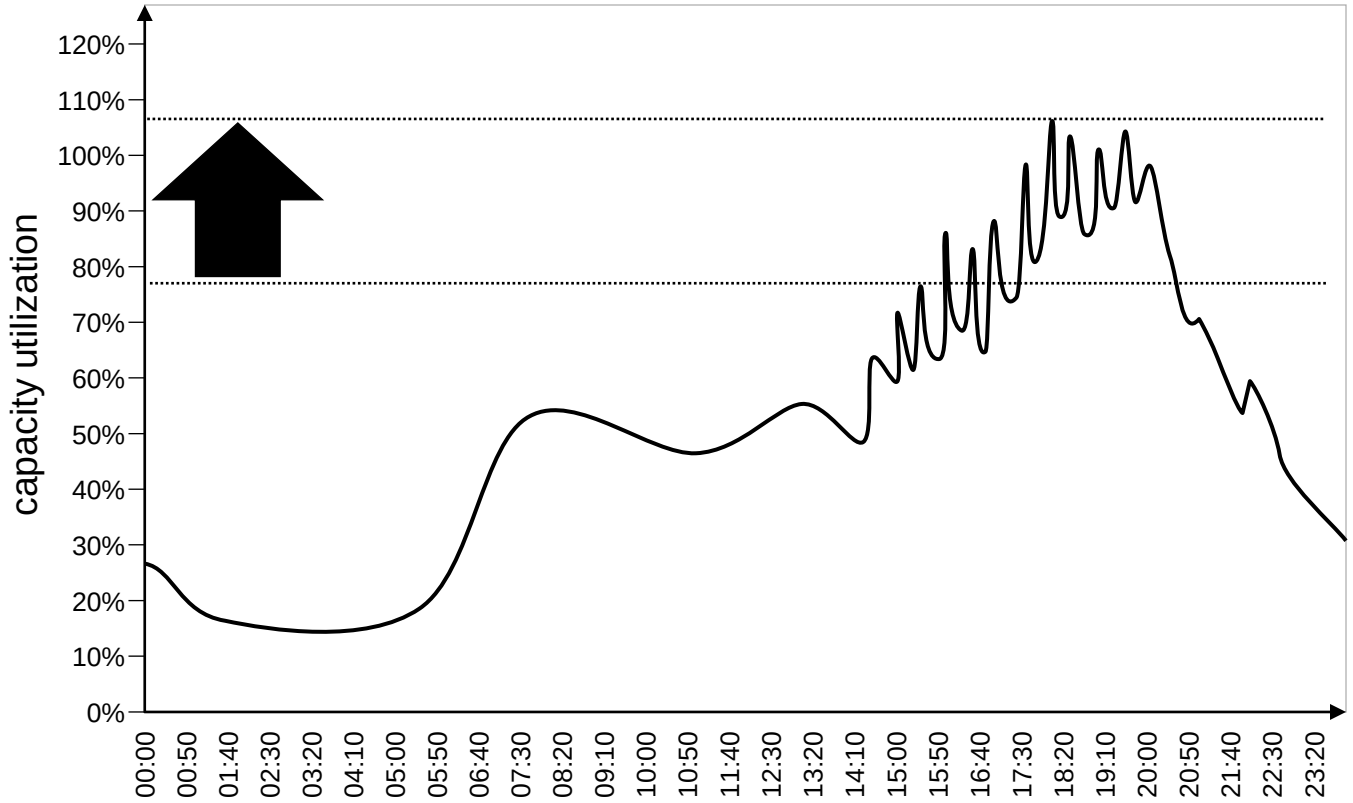
- **Vehicle and charge spot communicate:**
  - **EV user inserts information on desired charge time and mileage**
  - **Flexible charge process is being set up according to EV users desired services and taking in account electricity system capabilities**




**Intelligent coordination of charging through bidirectional communication leads to reducing peaks in the grid as well as constant capacity utilisation**

# Transformer collapses at 25% market share of EV -

## assumption one daily load on arrival at home and charging immediately

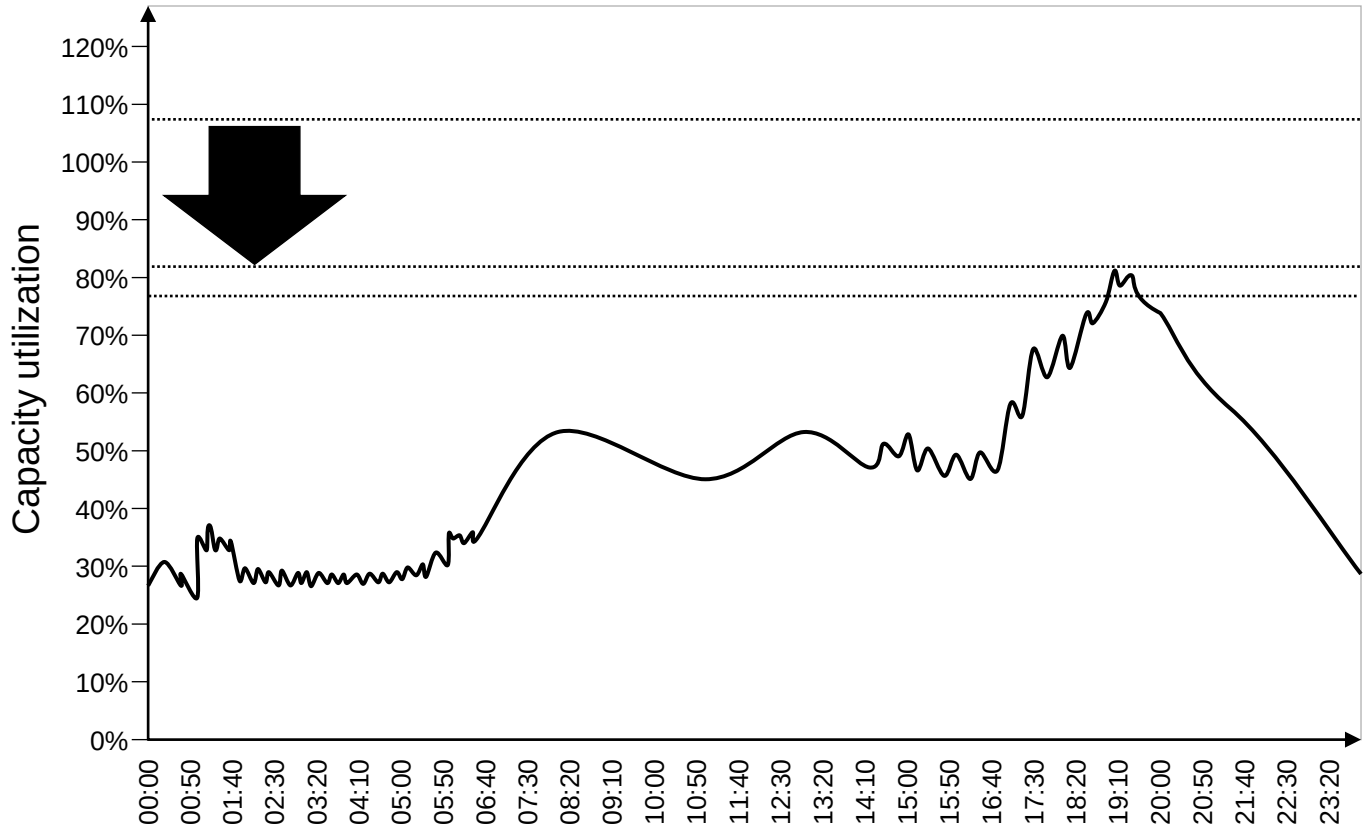



Capacity utilization of transformer increase more than 30%

Assumptions: One daily load on arrival at home in the afternoon; Daily mileage of 65km; average consumption of vehicles 20kWh/100km; Charging at 400V/32A/22kW for ~36min; 25% market share of EV's; 120 Households per local transformer

Source: RWE

# High investments could mainly be avoided with "Smart Charging" by coordinating the additional loads




No significant impact to transformer with Smart Charging

Assumptions: Daily mileage of 65km; average consumption of 20kWh/100km; Charging at 400V/32A/22kW for ~36min; 25% market share of EV's; 120 Households per local transformer; Differentiation of the charging location: 25% At home after arriving in the afternoon 50% At home but scheduled according to grid load 25% Different sides (Office, Supermarket, Hobby Locations [e.g. gyms])

Source: RWE


# EURELECTRIC Smart Charging Paper

**Smart Charging*: "controlled charging process that optimises the use of the grid and the available electrical energy to minimise additional investments in the grid and facilitate the integration of RES*"**

**Benefits:**

- **facilitate the integration of RES in electricity system;**
- **enable grid management that introduces flexibility in system**
- **optimise efficient use of generation capacity**
- **ensure a cost-effective solution by avoiding unnecessary grid investments**
- **maximise consumer convenience through use of available infrastructure**

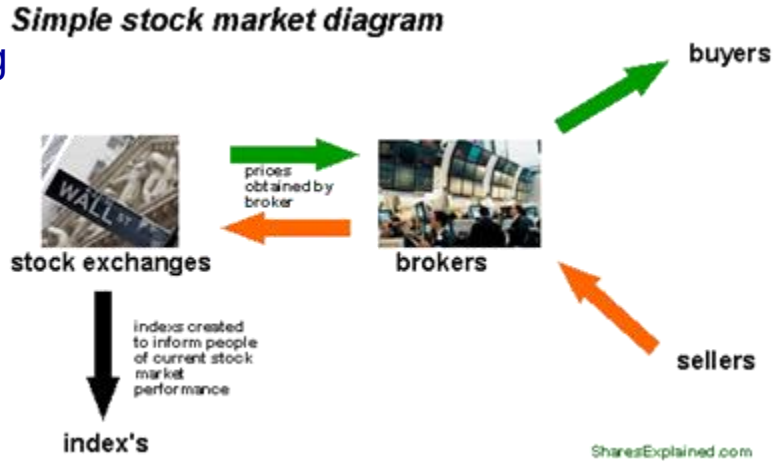
# 1. Scope of the Paper

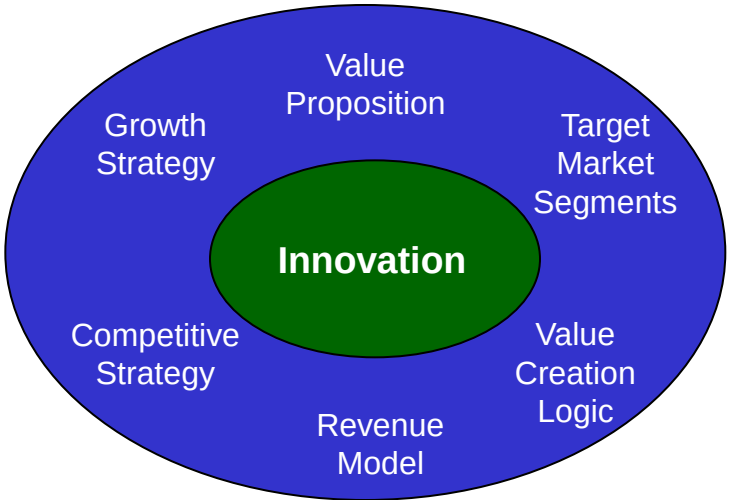
- **A Market model** represents the different interactions among the various market players, defined according to their roles, under the given economic market forces, including necessary regulatory elements.

- A Market Model sets a background of rules but with still many degrees of freedom that allow innovation, integration and a prize for initiative and risk taking.

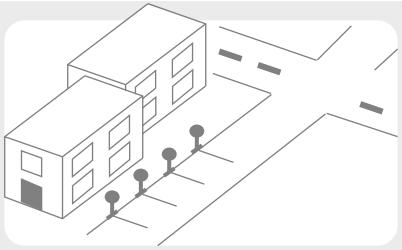
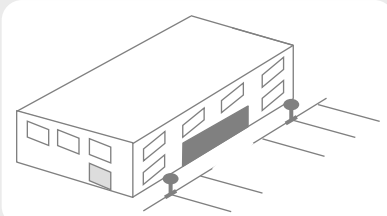
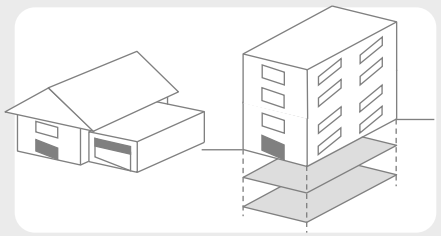
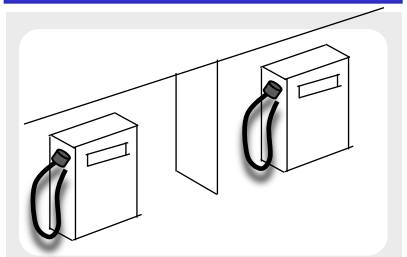
- **A Business Model** is what market players develop to capture the value in a given market model, under its imposed limits.

- The business model describes the logic and the different components and operation of a certain business together with the revenues and expenses the business generates.

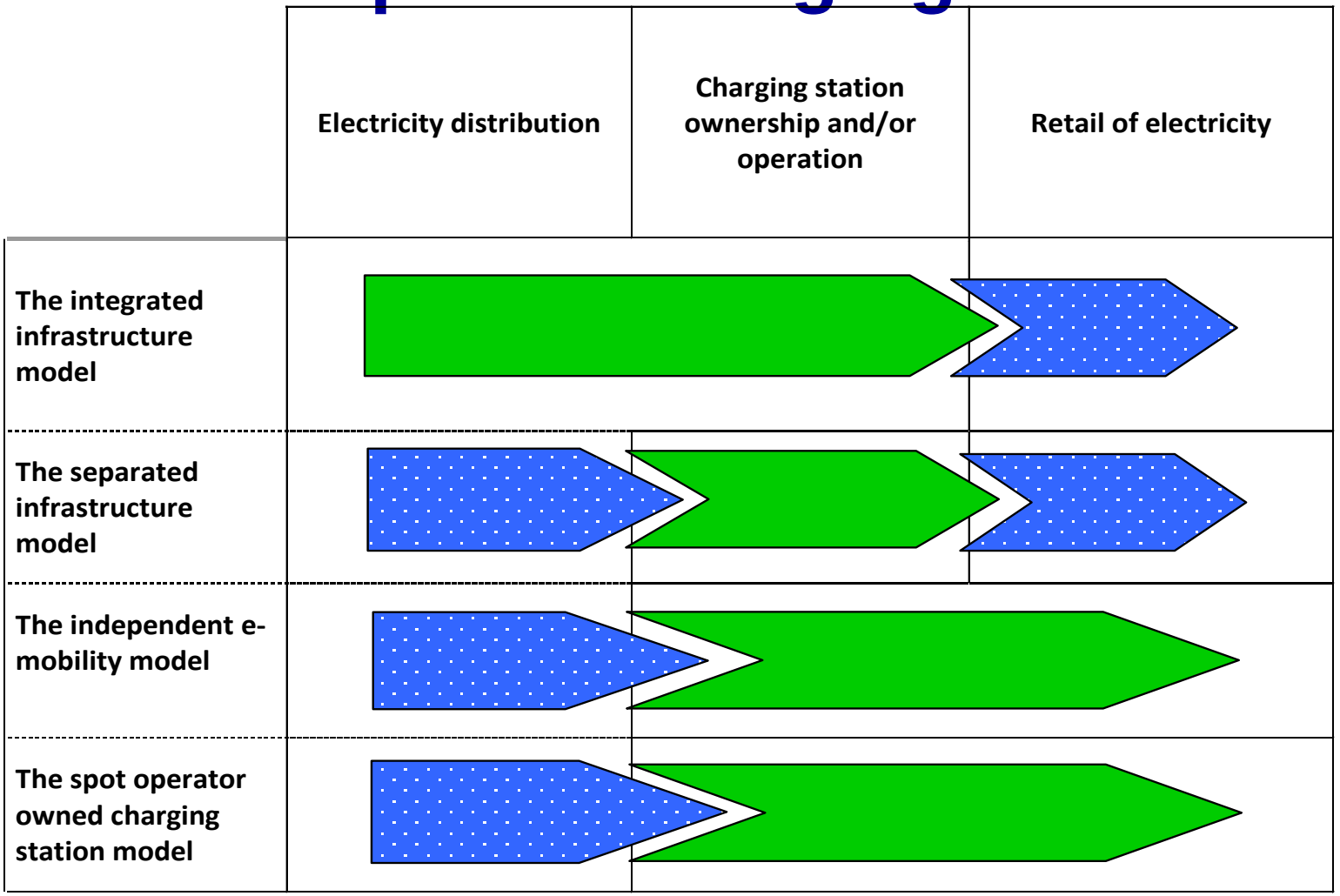


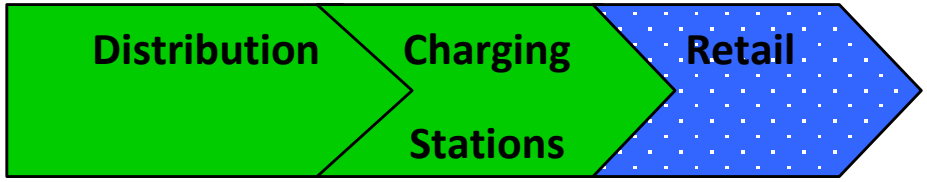
# 2. Possible locations for EV infrastructure and their specific characteristics

| | Public areas on public property | Public areas on private property | Private areas on private property | Fast Charge |
|---|---|---|---|---|
| **Type of location** |  |  |  |  |
| **Available Grid** | • DSO MV/LV network runs under pavements, close to building walls or on elevated cables, and connects private installations on private property, | • Electric installation is dimensioned for building load with some margin. Buildings with high loads will have their own MV transformer | • Electric installation of building is dimensioned for average households and common services. Collectively financed required upgrades are rare. | • A MV connection will be required in most cases. Either the property owner or the DSO will need to install an MV/LV dedicated transformer |
| **Electric customer installation** | • all for public purposes: street lighting, traffic lights, advertisement structures, etc. Exceptions for some private contracts and temporary feeding of events | • Probably a single ECI exists for the publicly accessible area, with contract with a retailer. The ECI owner controls connections and pays for the energy | • One ECI for each apartment. There is also the possibility for other individual ECIs in garage floors, but normally only the common services ECI exists which is managed and paid by the condominium | • Depends on physical location, will be either under an existing MV ECI or a dedicated new one |

# Four main Market Models for rolling out public charging



# Model 1 - The integrated infrastructure




**Market organization**

- The infrastructure is integrated into the DSO's assets which ensures open access.
- Fee retail: all retailers are free to offer their products and services;
- The commercial relationship for the supply of electricity is between the users and the retailers. The main difference to a normal electricity contract is the fact that is mobile and can connect to any location within the charging network managed by the DSOs while still receiving the same bill from the retailer

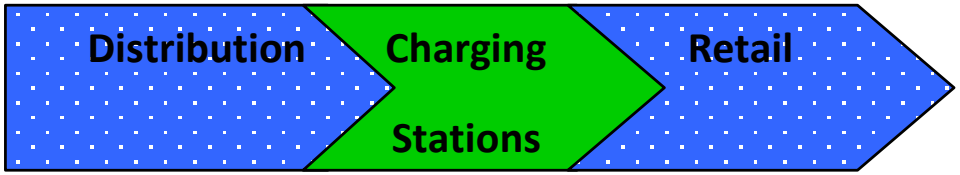
**Financing of Investments**

- The deployment of the charging infrastructure is collectively financed.
- Costs of the infrastructure reflected in the regulated tariff for LV/MV network usage;

**Possible solutions**

- The DSOs may provide users with an ID key which is associated with an e-mobility power contract with one retailer. The user may have more than one such contract and ID key, just like a mobile phone user may have more than one SIM card.
- Alternatively, users could have the ID key but be able to choose the retailer each time they charge their EV, or the system may even use existing debit/credit card systems to charge users directly.

# Model 2 - The separated infrastructure




**Market organization**

- The EV infrastructure is conceived as a new, separate and independent step in the value chain for e-mobility, with the creation of the new role of charging infrastructure operator.
- The infrastructure is of open access rules to all retailers over all infrastructure operators.
- The Market is structured by a regulated or non-regulated e-mobility infrastructure developed by one or more independent operators, who need to have licenses to install and run the EV charging sockets conceded by the municipalities.

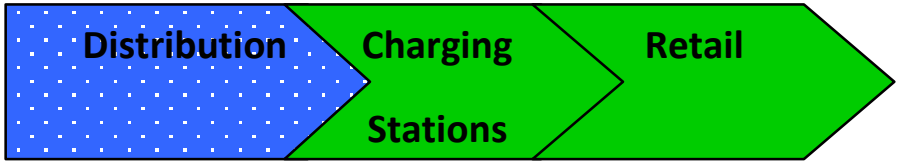
**Financing of Investments**

- Under this model the charging infrastructure is financed by the “user pays” principle.
- Therefore the charging network operator will add an access fee onto the retailer’s price, resulting in a final user e-mobility electricity higher than the normal electricity price.

**Possible solutions**

- Operators will have to create a new billing and authentication system for their own network, with interfaces to all other networks and retailer data systems (just like a DSO),
- They may cooperate and share one central IT system that manages the entire network. The model thus creates two roles: the central network management responsible for information and clearing, and the operators which only physically operate and maintain the charging points.

# Model 3 - The independent e-mobility




**Market organization**

- New role for an independent e-mobility provider that installs a proprietary network of EV charging sockets and provides electricity bundled with other services, including the charging. This new entity only sells services within its national network.
- The market structure consists of an integrated network of charging stations and e-mobility electricity retail operations. At least during the initial phase, the market is dominated by a national or regional monopoly which encompasses all the assets of the network operation.

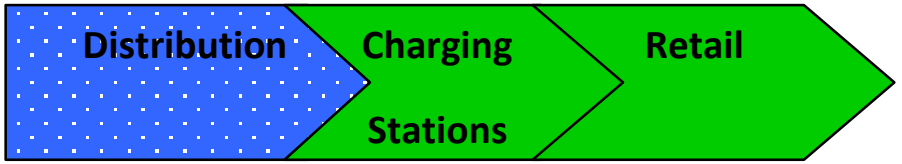
**Financing of Investments**

- Under this model the charging infrastructure is financed by the “user pays” principle.
- The single entity acquires the electricity from retailers at liberalized market prices. Final e-mobility prices will include the costs of financing the network. In this scenario fast charging may or may not imply an additional premium on the market price/tariff.

**Possible solutions**

- Instead of charging users per kWh, e-mobility providers might base their charges for giving users access to the network on a different marketing metric or on a monthly or annual rate, in a similar way to a mobile phone network provider.
- The network operator can be a public company, a publicly regulated company or a private operator with a national concession or licence.

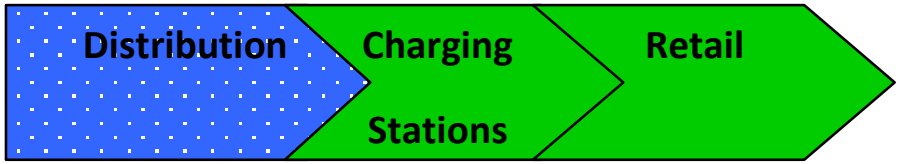
# Model 4 - The spot operator owned charging stations




**Market organization**

- The infrastructure and the selling of electricity are conducted by the parking spot owner or operator,
- These entities build the EV charging sockets and control the selling or reselling of electricity in their spots.
- A new type of electricity actor would emerge, enabling customers to install EV charging equipment on public property fed by a normal market power contract and resell electricity to mobile customers
- In this model multiple low-scale market players, together with existing players like electricity retailers and DSOs (outside their regulated activity), compete for the high-potential spots, but are less interested in installing charging stations at less utilized locations unless forced to do so by license.
- Municipalities own the spots on public pavements, but they can introduce a licensing scheme for multiple companies to bid for high-interest locations.
- The model may allow the creation of “local monopolies” similar to the current fuel distribution model, where EV customers cannot choose their spot operator freely because of an EV’s limited range or local restrictions

# Model 4 (cont.) - Spot operator owned charging stations




**Financing of Investments**

- Under this model the charging infrastructure is financed by the “user pays” principle.
- The network remuneration is included in the final e-mobility electricity price. Possessing the most effective spots will allow operators to charge a premium above other electricity prices. It may also be the case that spot operators charge for a bundled product (e.g. parking) and do not specifically measure the electricity consumption.

**Possible solutions**

- The model may also require an EV customer to sign up to more than one spot operator in order to access EV charging equipment in adjacent areas.
- Alternatively “roaming” might be foreseen:
- In a market where IDs are not required easy park-and-charge solutions may be be developed.
- Infrastructure operation and maintenance companies may offer their services to different spot owners in order to benefit from a larger scale effect in managing these sockets.

# Identification of the market players

- **Current electricity customers** - Households, companies, municipalities, etc currently using electricity in their applications, with existing power supply connection contracts.
- **E-mobility electricity customers** - Existing and future users of EVs
- **National governments** – Are interested in promoting EVs and the creation of a freely accessible and job-creating market, whilst maintaining control of transport sector efficiency and tax-related income.
- **DSOs** – They are currently holding and managing the assets for MV and LV networks, responsible for connecting all loads to the electric system and maintaining a stable, safe and reliable network for the supply of electricity to all customers.
- **Retailers of electricity** - These are the present and future companies that are active on the market to sell electricity that they produce themselves or purchase on the electricity markets to end users, with whom they have power contracts with fixed locations for the supply.

# Identification of the market players

- **National and international electric grid control entities** - State-owned or private entities with the responsibility of managing national and international electric systems as a whole, ensuring an equilibrium between electricity generation and the use and flow of energy and power between regions. Depending on the country these entities may be the national TSO and may also have dispatch control over large generation.

- **Electricity regulators**: Regulate the electricity market to protect electricity consumers by promoting on a European level a single, competitive, efficient and sustainable internal market for electricity.

- **Equipment and service providers**: Companies that provide a service or equipment to the e-mobility market, e.g. telecom or ICT industries that enable communication between the EV and the electricity grid.

- **New entrants** - These are entities or companies that are currently not performing any of the previous roles and are willing to take up the e-mobility paradigm.

# Impact dimensions

- Integration and compatibility with existing electricity market in Europe
- Required licensing schemes to implement and deploy infrastructure in the field
- Social model for remuneration
- Competition (on infrastructure, on retail, etc)
- Synergies with existing businesses
- Investment risks on charging infrastructure
- Financial conditions for investments of stakeholders
- Network Coverage
- Load Management and V2G implementation
- Differentiation possibilities of e-mobility electricity
- E-mobility electricity price
- Price transparency of e-mobility electricity
- User convenience
- Electric vehicle fleet take up

# Conclusions

- The paper takes three major roles within the value chain of e-mobility electricity - distribution, operation of infrastructure, and retail - as a point of departure to identify and describe four major market models;
- The models are not necessarily mutually exclusive and could co-exist alongside one another and shift in time, according to the take-up phase;
- Setting the rules for the market structures (which can be no rules) is fundamental for stability and risk management by the entities that want to invest on infrastructure;
- Companies can  develop their innovative business models looking for getting the value and assuming the risk if they know what to expect from regulators.

**Thank you for your attention!**

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