Smart eCar in its Infrastructure
smart Traffic and smart Grid
- Mobility of the Future beyond 2020?

Smart Grids Week 2012
Bregenz, 24.5.2012

Corporate Technology
Prof. Dr.- Ing. Gernot Spiegelberg CT T P
Smart eCar in smart Traffic Management and smart Grid Connection
Will eMobility be the future? Where is the business?

Will this happen? Where is the money?

3 requirements:
1. same price or lower than ICE-car in LCC
2. no disadvantage in usage of range (max 150 km, commuter-car)
3. meet the requirements of global megatrends better than ICE
Global Megatrends strongly influence the future of mobility

- Climate change
  - Spend less energy in total for mobility
- Urbanization
  - Utilize sustainable power source for mobility
- Demographic change

"Zero Emission" by EV
The electric car is changing the relation between automotive industry and utility.

Generation of energy

Intelligent energy distribution and transmission

Interaction

Water pump station

the battery cost can be refinanced while connected at parking over LC of battery with business of grid stabilisation in power peak
Power Distribution Solutions (current situation)

1) Combined Heat and Power

Wind <20 MW
Solar <20 MW
Where does the prognosis error come from?

\[ P \sim V^3 \]
Power Distribution Solutions (current situation)

1) Combined Heat and Power

- **HV Transmission System**: >110 kV
- **Primary MV Distribution System**: 10 kV / 20 kV
- **Secondary MV Distribution System**: Ring Main Units
- **LV Distribution System**: 0.4 kV

**Load Flow**

- **MV-Swgr**: 110 kV
- **LV-Switchgear**: 0.4 kV

**E-Car Fast Charging Station**

**Wind <20 MW**

**Solar <20 MW**
Power Distribution Solutions (current situation)

1) Combined Heat and Power

- Primary MV Distribution System:
  - 10 kV / 20 kV
  - MV-Swgr >110 kV

- Secondary MV Distribution System:
  - MV-Swgr
  - Ring Main Units

- LV Distribution System:
  - LV-Switchgear
  - 0.4 kV
  - eCar = 22 kWp

Load Flow:

- E-Car Fast Charging Station
- Wind <20 MW
- Solar <20 MW
Power Distribution Solutions (future smart grid)

1) Combined Heat and Power

HV Transmission System

Primary MV Distribution System

Secondary MV Distribution System

LV Distribution System

Load Flow

Load Flow

10 kV / 20 kV

MV-Swgr

Ring Main Units

0.4 kV

LV-Switchgear

E-Car Fast Charging Station

Wind <20 MW

Solar <20 MW

Solar <200 kWp

CHP 1) <50 kVA

1) Combined Heat and Power
Electricity production of a 314 kWp PV-installation near Erlangen, Germany

Sunny day in April: 1.9 MWh

Cloudy day in April: 1.2 MWh

Source: Michael Weinhold & friends
Power Distribution Solutions (future smart grid)

- **HV Transmission System**: >110 kV
- **Primary MV Distribution System**: 10 kV / 20 kV
- **Secondary MV Distribution System**: MV-Swgr
- **LV Distribution System**: LV-Switchgear

**Load Flow**

- **Wind <20 MW**
- **Solar <20 MW**

**Business-model**: serve the **power-peaks** in low-voltage grid with ecar's batteries

- **1) Combined Heat and Power**
- **eCar <10 kWp**
- **eCar Charging Spot**
- **Solar <200 kWp**
- **CHP 1) <50 kVA**
Electric car and infrastructure
Siemens *TIEM* approach – *Total Integrated eMobility*

**eCars and their infrastructure have to be considered as an integrated system:**

- eCars need an infrastructure for charging
- Growing share of renewable power challenges grid stabilization
- The eCars could stabilize the grid as movable batteries
- Information and communication technologies will enable the interaction between eCars, buildings and power grid

Electricity market

Bi-directional connection to grid

Residential energy monitoring
# Electromobility Infrastructure for “smart grid connection”

<table>
<thead>
<tr>
<th>AC Wall Box</th>
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<th>AC Park and Charge</th>
<th>AC Satellite System</th>
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**Integrated Electromobility by Siemens**
Global Megatrends strongly influence the future of mobility

- Climate change
  - Spend less energy in total for mobility
  - "Zero Emission" by EV
- Urbanization
  - Utilize sustainable power source for mobility
  - "Intelligent mobility" through, telematics and Smart Grid integration
- Demographic change
  - Use intermodality to handle peoples demand for mobility
  - Support people to get from A to B hassle free
Smart Traffic: integrated traffic concepts
Solutions to increase traffic and energy efficiency

Airport links provide a reliable, traffic-jam-free way to reach the center city

Attractive mass transit with high operating frequency, high capacity and great comfort

Intelligent parking control systems guide cars to available parking spaces

Telematics applications ensure a smooth flow of traffic

Electrical cars integrated in the infrastructure
Easy request of personalized mobility service

Mobility services will combine several mobility concepts to secure the best offer

PDA request

willness to pay price

increasing comfort

increasing speed

mobility solution = f (price, comfort, speed)

passengers

goods
Complete Transportation combined know how for intelligent infrastructure solutions „smart traffic“

- Urbanisation
- Outdated infrastructure
- Competition of the cities

**Urban Traffic**
- Urban traffic management
- Urban Traffic Control

**Interurban**
- Highway traffic management
- Tunnel Traffic Control

**Electronic Tolling**
- Open road tolling
- Congestion Charging

**Services**
- "Service for sure"
- Customer Support Center

**Electromobility**

- Complete Transportation
- Intelligent Traffic Systems
Project 4Sustain-eMobility@Siemens (4S)

smart eMobility

smart grid connection  |  smart traffic  |  smart eMobiles
Global Megatrends strongly influence the future of mobility

- **Climate change**
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- **Urbanization**
  - Utilize sustainable power source for mobility
  - "Intelligent mobility" through, telematics and Smart Grid integration

- **Demographic change**
  - Use intermodality to handle peoples demand for mobility
  - Support people to get from A to B hassle free
  - Safely extend mobility of elderly people
  - "Zero Accidents" by stability control and predictive ADAS systems

Will lead to new kinds of mobility concepts
Integrated drive train

Locally drives concepts

Fully new vehicle design concepts
Putting into operation and Test of Complete Drive System on Siemens Test Bench

Drive System consists of:
- Transmission
- 2 inverters, 2 motors
- Control unit

- Peak Power: 125 kW
- Continuous Power: >50 kW
- 9,000 rpm
- Weight: 52 kg
- Dimension: 280 mm x 255 mm

- Voltage: 590 V–840 V
- Power: 125 kW
- Cooling: 60 °C
- Weight: 15 kg
- Efficiency: ~96%
- Power density: 10 kW/Kg
- Dimensions: 280 x 350 x 150 mm
Electrical drivetrain with electronical torque vectoring
Vehicle with wheel hub motors and w/o mechanical brake on rear axle on testbench to calibrate and measure brake blending
This is amazing new fun to drive  (not feasible for family)
More functionalities need more technology in future „smart eCars“
One main actor in the game .......

...... special e-cars with advantages
The real car is looking like this ..... ?

Low Cost will be made by high technology, not low technology
The Project Roadshow of Innovations with Innotruck “Diesel reloaded”
Some impressions of Innotruck
Thanks for your attention
Communication and power supply are the backbone to increase quality of life for people in the smart eCity