DG DemoNet Smart LV Grid

Increasing the DER Hosting Capacity of Distribution Networks - Voltage Control from Simulation to Field Test

Die Evolution der Elektrizitätsnetze – ein Status Quo

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Energy Department

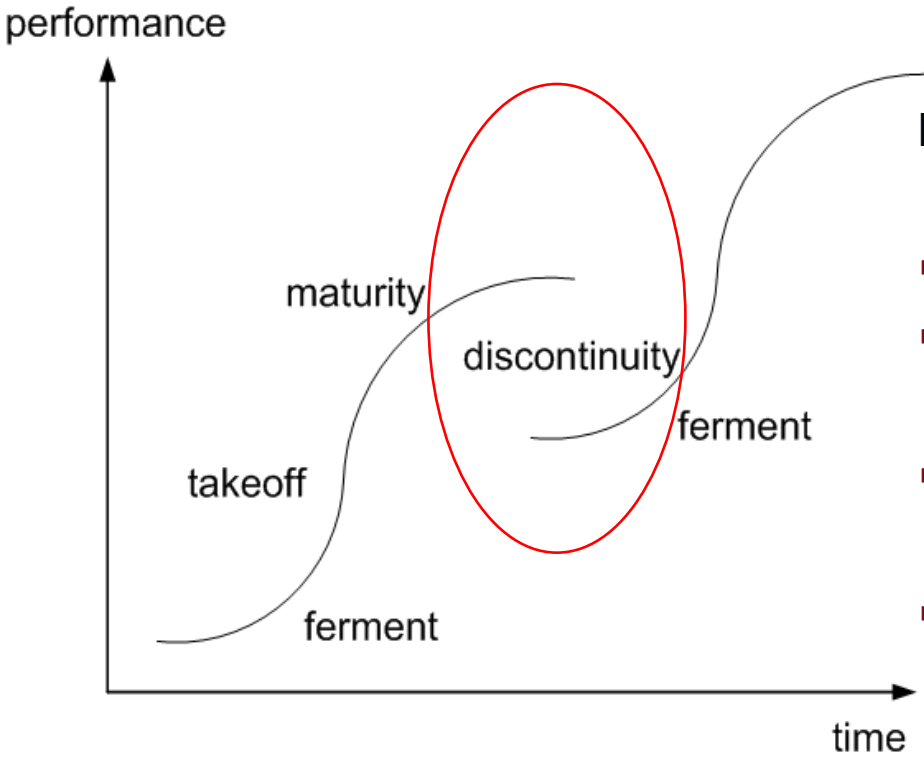
Austrian Institute of Technology

Austrian Institute of Technology

AIT Austrian Institute of Technology

Guiding radical innovation

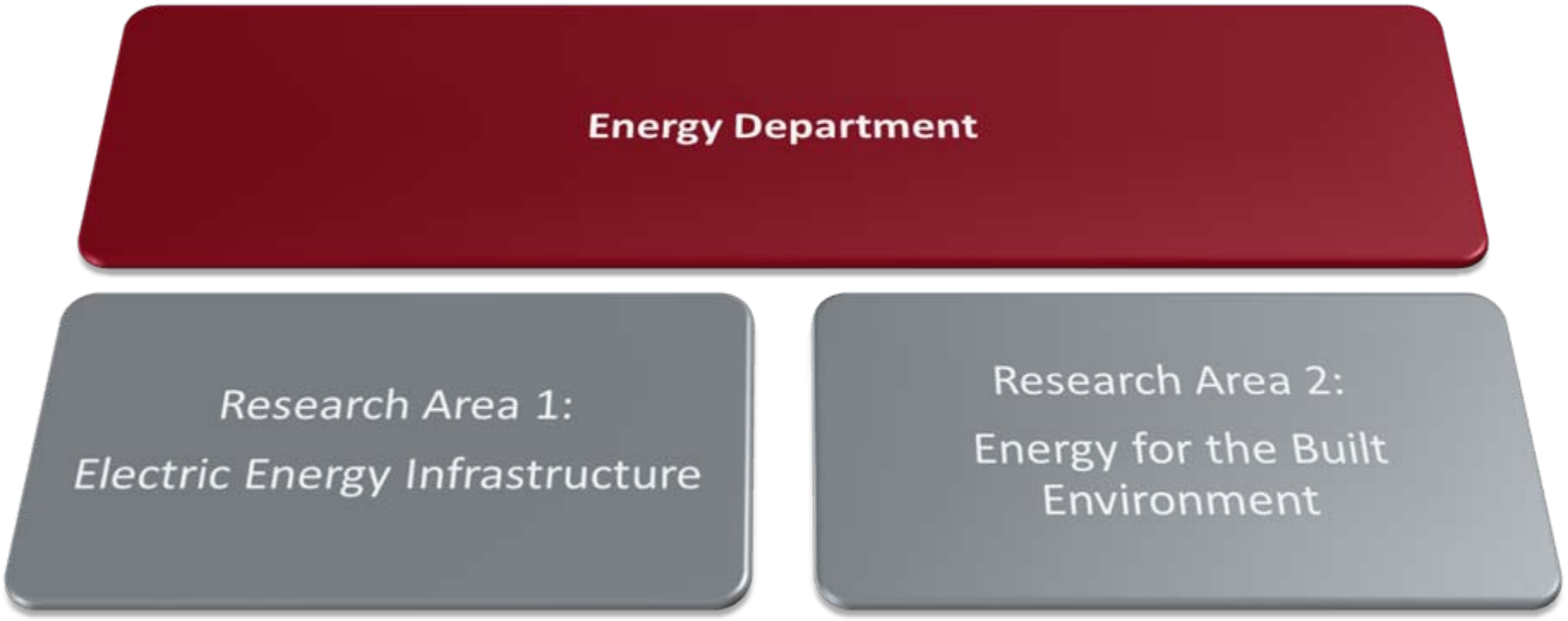
Position of AIT



Radical Innovations

- passive → active
- static systems → dynamic systems
- local → urban wide implementation
- single technologies → integrated approach
  (planning and management)

AIT Energy Department



Project DG DemoNet Smart LV Grid

Objectives

Increase the hosting capacity of LV networks based on:

1. **Intelligent planning**
   → new planning methods enabling higher DER densities

2. **Intelligent monitoring**
   → new monitoring solutions for grid planning and operation

3. **Active management and control** using communication infrastructures restricted in bandwidth and availability
   → new and cost-effective active control solution approach

Overview

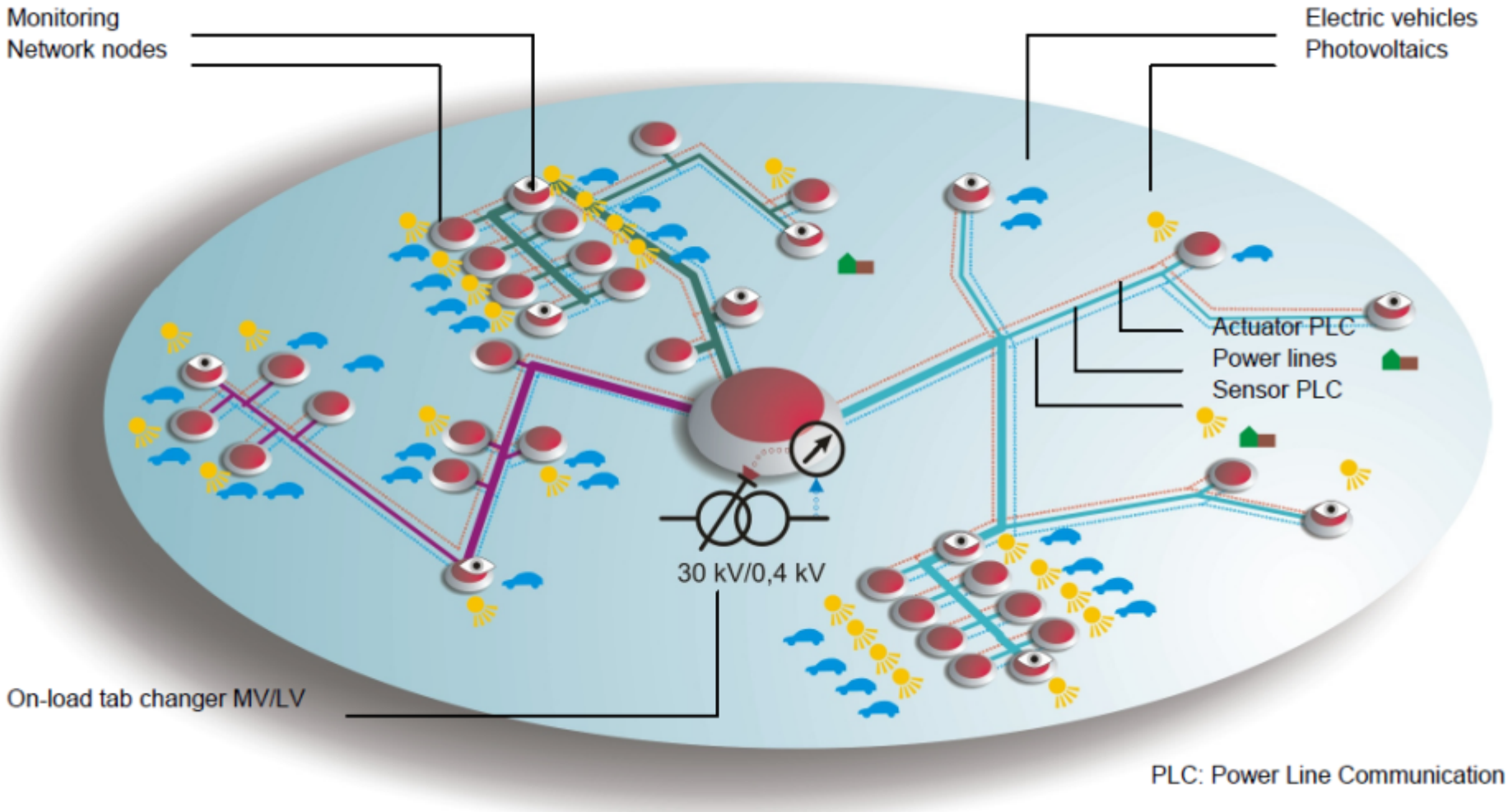
DG DEMO NET SMART LV GRID

- **Applicant** Austrian Institute of Technology
- **Partner** Siemens AG Österreich
  Fronius International GmbH
  Energie AG Oberösterreich Netz GmbH
  Salzburg Netz GmbH
  Linz Strom Netz GmbH
  BEWAG Netz GmbH
  TU Wien – EEG + Institut für Computertechnik

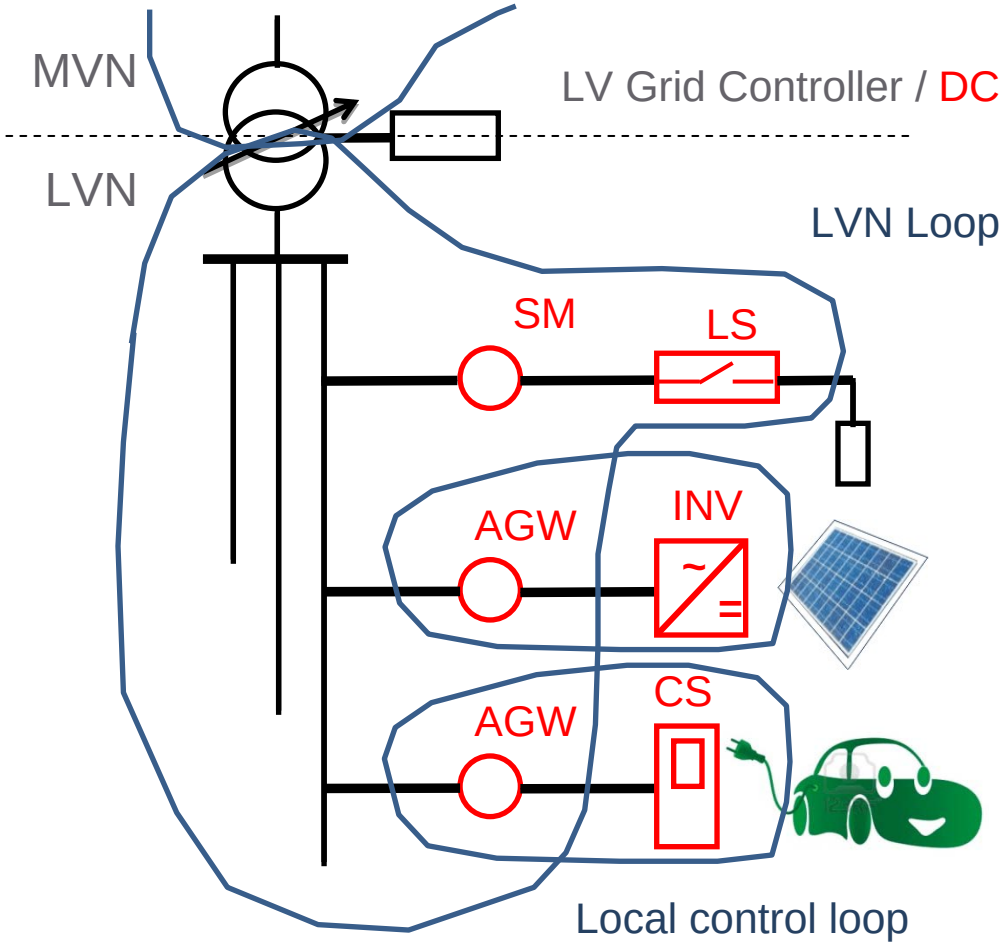
- **Project Type** Industrial Research (IF)
- **Project Costs** ca. 3,2 Mio € (Total Costs >4.5 Mio €)
- **Requested Grant** ca. 2,2 Mio €
- **Additional funding** Land Oberösterreich: 1 Mio €
  Land Salzburg: up to 0,3 Mio €

- **Project run time** 36 months, Start 03/2011

Approach

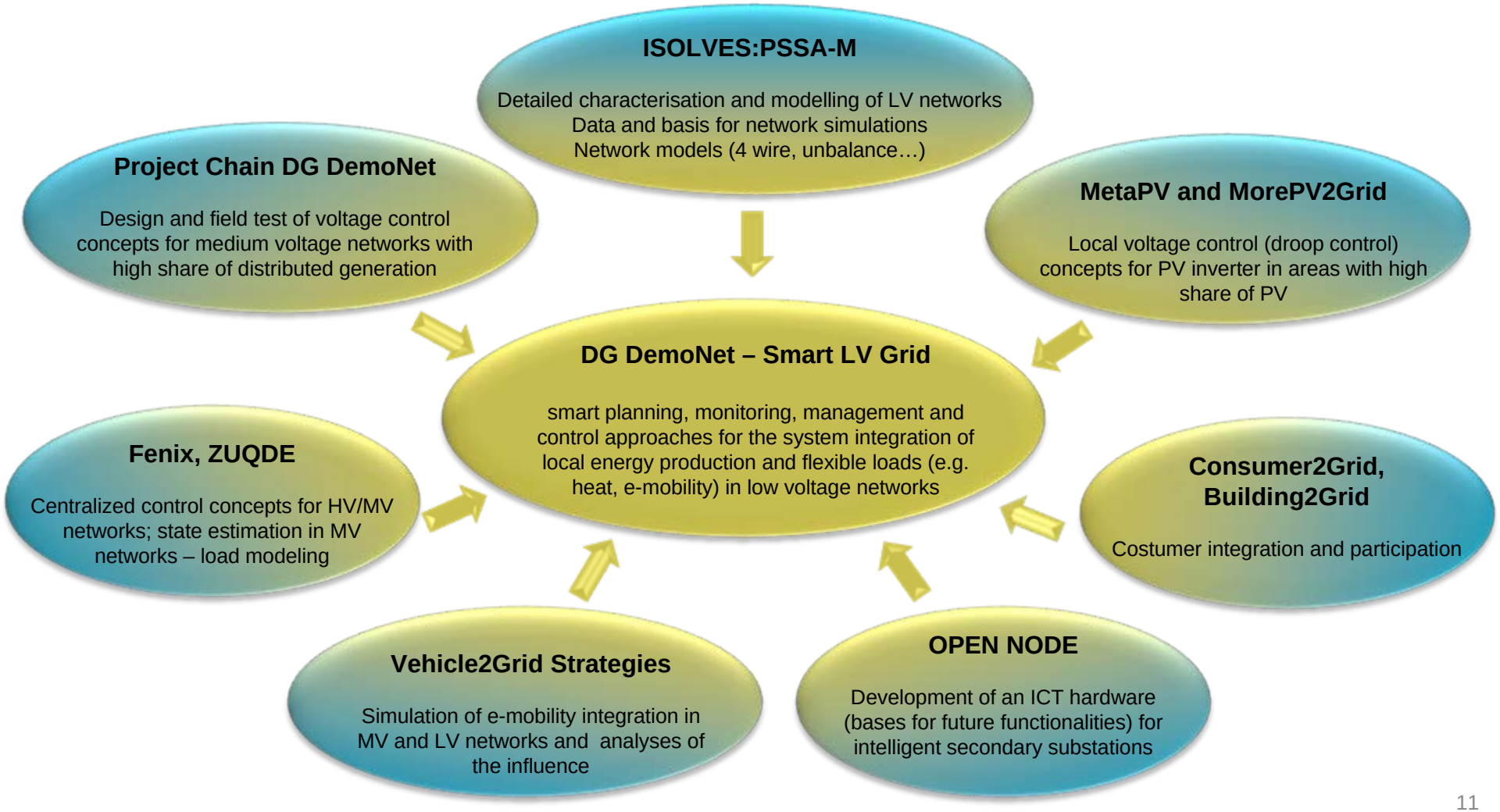

Monitoring
Network nodes
Electric vehicles
Photovoltaics
Actuator PLC
Power lines
Sensor PLC
30 kV/0,4 kV
On-load tab changer MV/LV
PLC: Power Line Communication

System Architecture



DC	Data Concentrator
AGW	AMIS Gateway
SM	Smart Meter
LSD	Load Switch
CS	Charging Station
INV	PV Inverter
NVN	Low Voltage Network
MVN	Medium Voltage Network

Related Projects



DG DemoNet Smart LV Grid – Field Tests

DG DEMO NET SMART LV GRID

Smart LV Grid Concepts

Smart planning, monitoring, control approaches

Photovoltaic

on every 2nd roof

Field test area

Low voltage grid section

validation of solutions for future problems

e-vehicels

in every 2nd garage

ELECTRODRIVE SALZBURG

Salzburg Netz Ein Unternehmen der Salzburg AG
SMARTGRIDS Modellregion Salzburg
ENERGIE AG Netz
LINZ AG STROM
BEWAG NETZ
SIEMENS
Fronius
TU WIEN ICT Institute of Computer Technology
Energy Economics Group
AIT AUSTRIAN INSTITUTE OF TECHNOLOGY

Field test regions and focus

- Oberösterreich: Energie AG OÖ Netz GmbH
  - **Use case "smart sensing and coordinated generation control“** - testing of the control- and monitoring solutions in a grid with **high penetration of PV** based on smart metering communication infrastructure
  - Eberstalzell (in Upper Austria): appr. 70 PV units in total appr. 400 kW

Field test regions and focus

- Salzburg: Salzburg Netz GmbH
  - **Use case "smart sensoring and coordinated load control“** - examination of effectivity of the control- and monitoring solutions in a grid with high penetration of **PV linked with a high penetration of electric vehicles**
  - Köstendorf (in Salzburg): appr. 35 PV units in total appr. 125 kW and appr. 30 e-vehicles with home charging stations

Field test regions and focus

- Oberösterreich: Linz AG
  - **Use case "intelligent planning and smart monitoring“**
    - verification of the **probabilistic planning** method by measurements in a grid with high penetration of PV
  - network area is not selected yet (2 candidates close to Linz): appr. 15 PV units in total appr. 70 kW

First Results

- 2 Field test regions selected
  - Köstendorf in Salzburg
  - Eberstalzell in Upper Austria
  - 2 potential LV network areas close to Linz (under discussion)

- Overall control concept and system architecture finalized

- Co-Simulation of communication network and power network as development environment is tested

- Next steps:
  - PV and e-mobility Roll-Out in the field test regions
  - Clarifying and definition of all necessary communication interfaces
  - Detailed designed of the control concepts

Cost Allocation

- Smart Metering Infrastructure (PLC vs. IP based)
  - Power Line Carrier (PLC) Technology
  - Transactions Server
  - Data Concentrator
  - Load Switch
  - AMIS Gateway
  - Additional Functionalities (for network monitoring)
- Low Voltage Grid Controller (LVGC)
- OLTC Secondary Substation Transformer (Prototype)
- PV Inverters
- Charging Stations
- Communication Interfaces (LVGC, Transformer, Inverter, Charging Station…)
- Costs for additional space (e.g. OLTC needs more space)

Cost Allocation

- Infrastructure investments to increase DER hosting capacity for avoiding or delaying grid reinforcement (mainly network driven)

vs.

- Additional investments to enable new services, markets and business models (mainly market driven)

- Who is going to finance investments in order to enable new services, markets and business models?

Experiences from Medium Voltage Network Projects

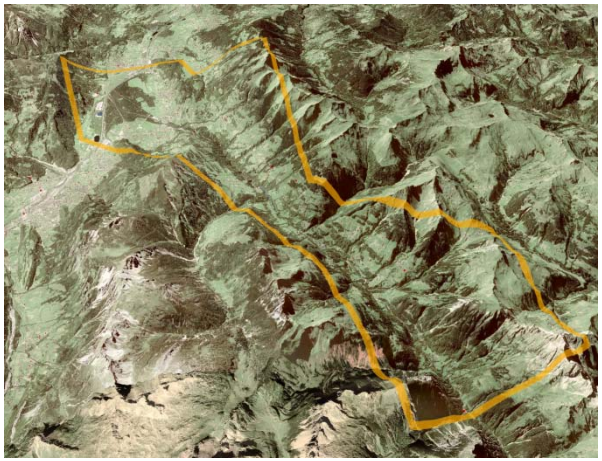
Objective of DG DemoNet Validation

DG DEMO NETZ KONZEPT → DG DEMO NETZ VALIDIERUNG

Objective:

Development, planning, implementation and demonstration of voltage control concepts allowing a cost-effective integration of very high shares of distributed generation in medium voltage networks,

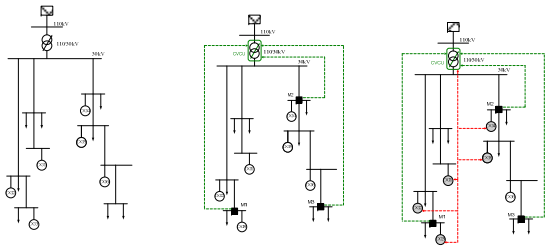
- maintaining a high level of quality of supply
- achieving economic benefits in comparison to network reinforcement



Project chain - DG DemoNet

Influence of distributed generation on the paramater of power quality

DG DEMO NETZ KONZEPT



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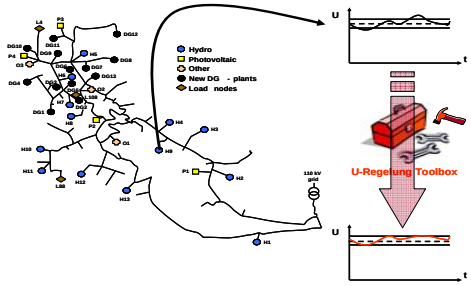


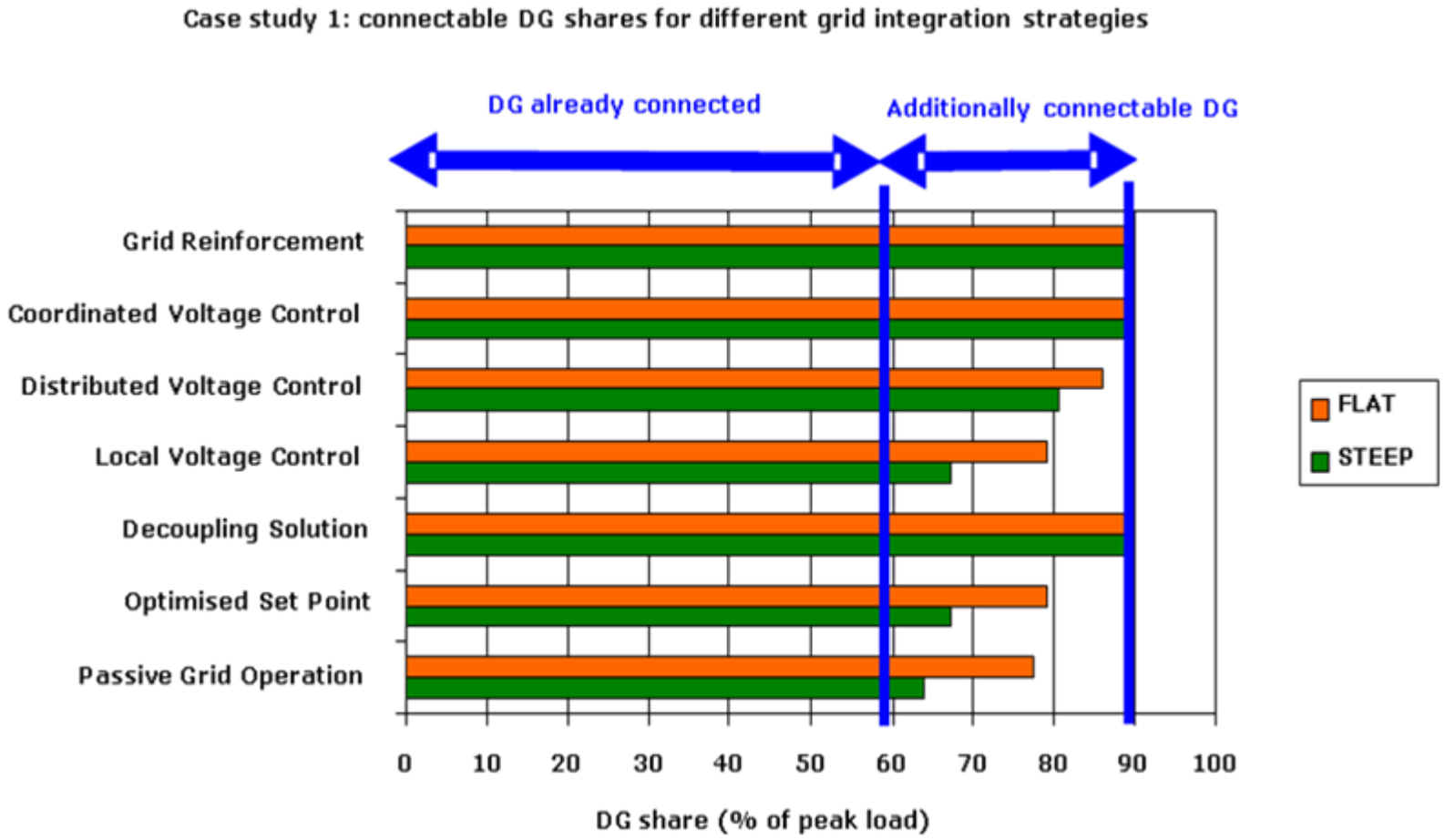
Design of voltage control concepts to increase the hosting capacity of networks, Technical and economical assessement

Improvement of concepts, advanced planning tools

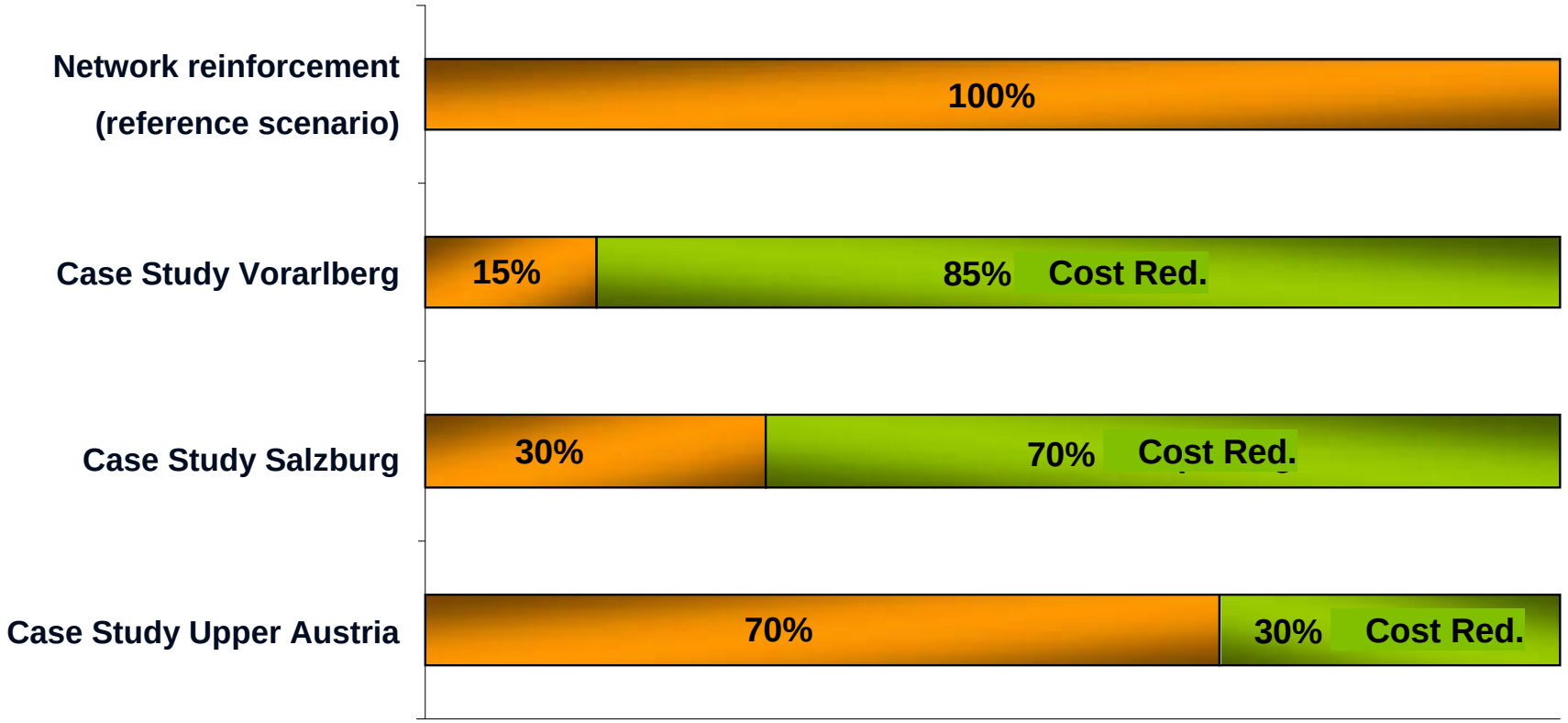
DG DEMO NETZ VALIDIERUNG

Development, field test, analysis and validation – proof of concept

Technical Investigations (Case Study 1)



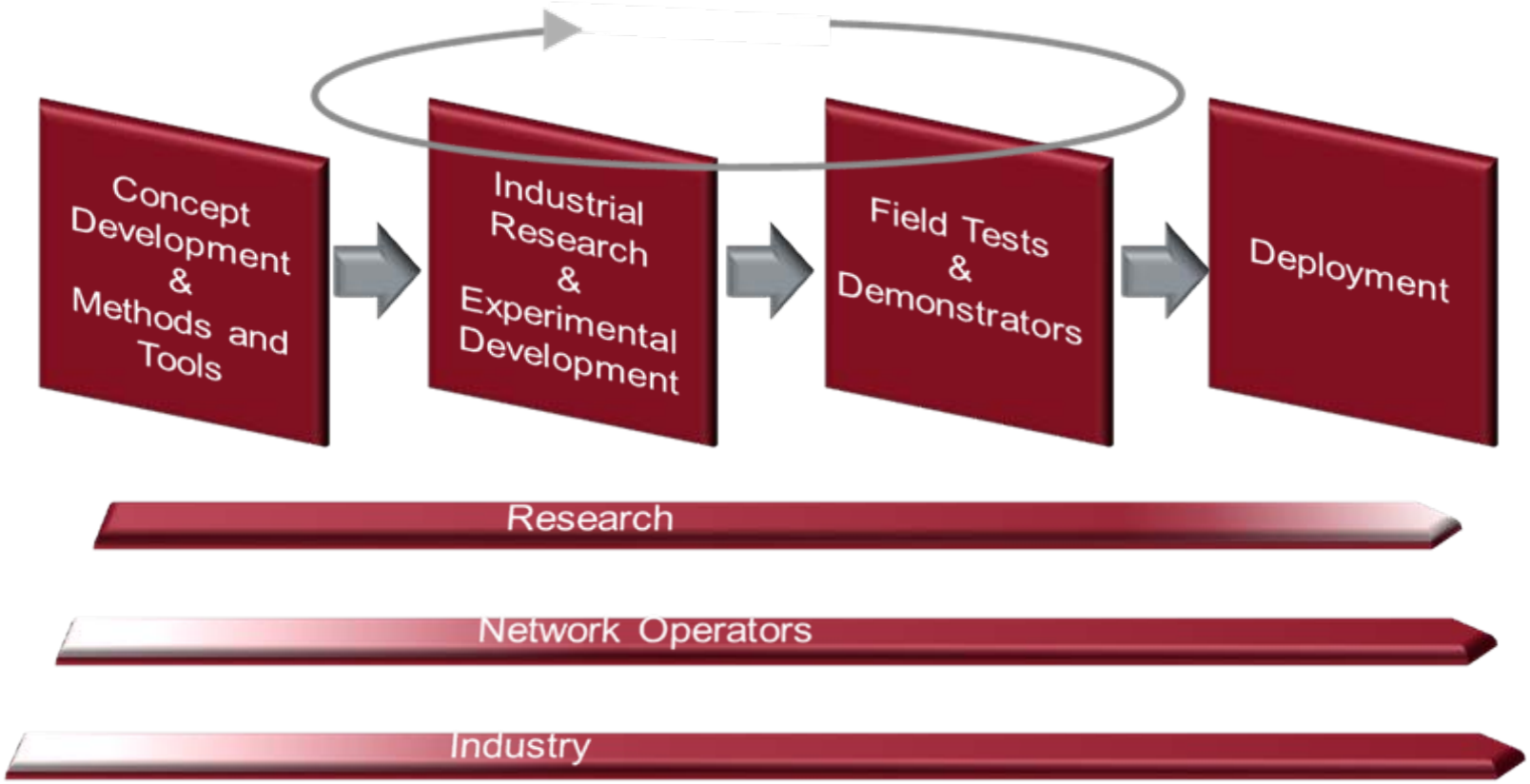
High economical advantages are expected



Costs and cost reductions compared to the reference scenario network reinforcement

Smart Grids R&D and Deployment

Smart Grids R&D and Deployment



Conclusions

Conclusions

- Smart Grid is not a single technology → system approach
- Smart Grid is a evolutionary process
- Smart Grid deployment is not a sequential process
- Do not base deployment costs on full engineering costs
- Cost for increased hosting capacity vs. cost for additional services
- Thus at the moment it is difficult to determine actual costs for a smart grid deployment

Acknowledgment

- All presented projects are financed by the Austrian climate and energy fund

AIT Austrian Institute of Technology

your ingenious partner

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