IEA DSM Task XVII:

Integration of DSM, DG, RES and ES

An overview and comparison of current situation and future scenarios to integrate DSM in the participating countries of the IEA Implementing Agreement on Demand Side Management

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Content

- **Task XVII introduction**
  - Phase 1 (finished)
  - Phase 2 (on-going)

- **Comparison** of DER technologies and DSM examples
  - Heatpumps (HP)
  - Smart Meter (SM)
  - Electric Vehicles (EV)

- **Preliminary findings**

- **Outlook**

Introduction (1)

Implementing Agreement on Demand Side Management Task XVII

- **Objectives**
  - Optimal integration of DR + EE with SG
  - Ideally support electricity grid and market
- **Phase 1**
  - Inside the IEA DSM Agreement a scope study was carried out in cooperation with seven countries: Austria, Finland, Italy, Korea, Netherlands, Spain and USA.
    - Overview of the Situation
    - Pilot case studies
    - Vision and conclusion
- **Phase 2**
  - A assessment of **DER technologies in combination with DSM** is carried out:
    - Assessment of **techologies** and penetration (+ Pilot case studies)
    - **Stakeholders** involved and effects on the stakeholders
    - Assessment of **quantitative effects** on the power system and stakeholders
    - Conclusion and recommendations

Introduction (2)

Results of phase 1

Electricity supply	**Fossil fuel based technologies** ▪ fuel cells ▪ micro chp ▪ conventional chp	Young Existing Mature
	Renewables ▪ Wind ▪ pv ▪ small hydro ▪ waves, tidal ▪ biomass	Mature Existing/Mature Mature Young/Mature Young/Mature
	Renewable production forecasting	Young/Existing
	Electrical energy storage ▪ energy management ▪ bridging power ▪ power quality	Young/Mature Existing/Mature Early/Existing
	Economic dispatch, SCUC software	Mature
	Resource planning techniques, tools	Mature
	Real-time grid operation tools	Mature
Electricity demand	**Many DSM techniques**	Mature
	Automated DR devices	Young
	Pricing granularity (smart rates) ▪ Small customers ▪ Large customers	Early Existing
	Consumer response and production	Early

Introduction (3)

Results of phase 1

Communication, control and monitoring	**Communication networks**	Mature
	High-speed digital monitoring ▪ Generation ▪ Transmission (EU) ▪ Transmission () ▪ Distribution	 Mature Mature Young Early
	Smart meters deployment	Young/Existing
	Cyber-security	Young/Existing
	Interoperability	Existing
	Functional Automation/Monitoring ▪ for large assets ▪ for DER	 Mature Young
	Intelligence/Smart behaviour	Young
	User/primary process feedback	Young/Existing
	Intelligent agents and distributed controllers	Young
	Communication semantic and content	Young/Existing
Integration analytics	**Modelling electricity system impacts**	Young/Existing
	Understanding relative costs and benefits	Existing
	Controlling and coordinating parts	Young
	Good, real data	Early / Young
Regulation, policy and business	**How to capture benefits**	Young/Existing
	Incentives and subsidies	
	How to pay for everything	
	Taxation	
	Aggregator business	

Introduction (4)

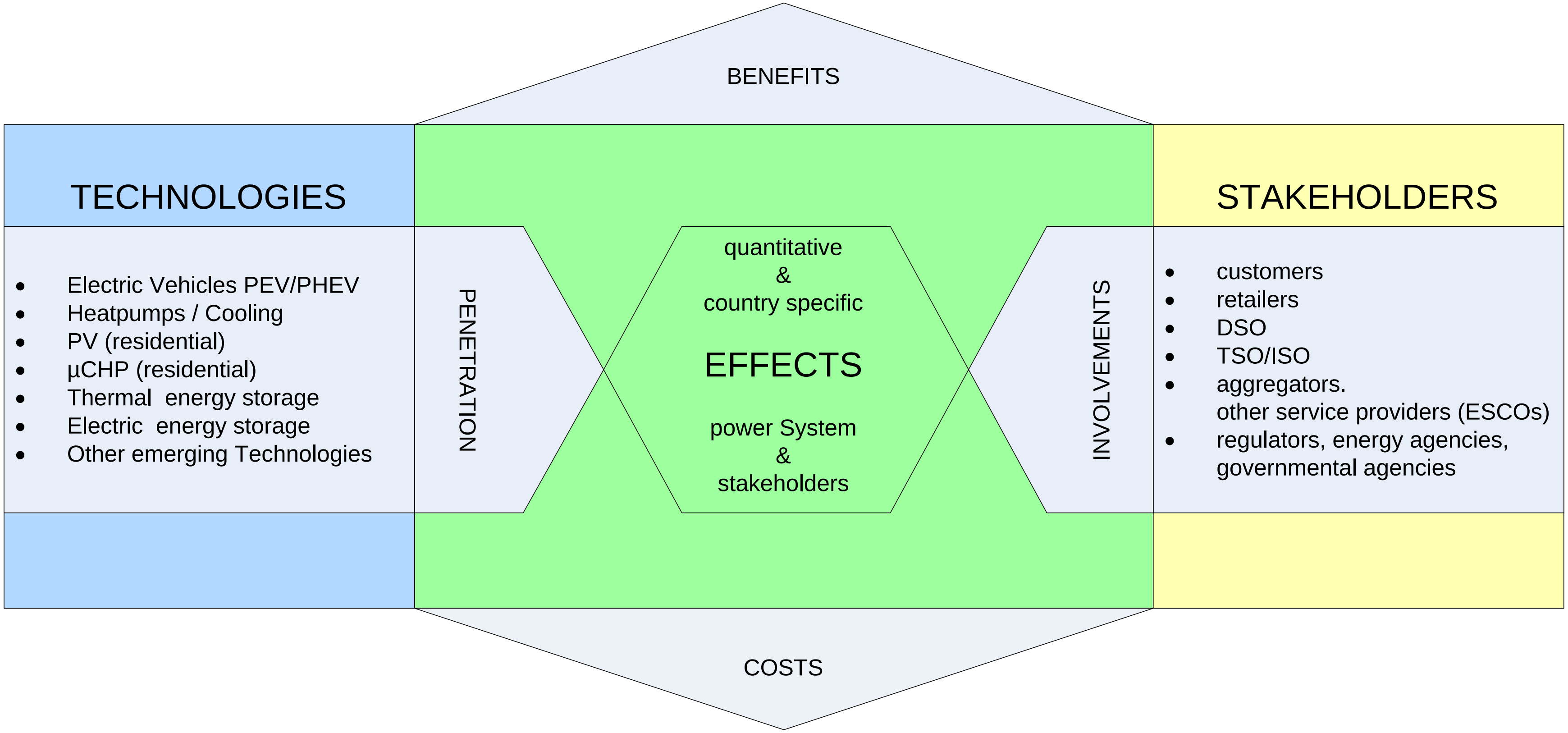
Methodology of Phase 2

1. Analyse the **status quo of DER penetration** at customer's premises
2. Derive **future penetration scenarios** for 2020 and 2030
3. Estimate the **DSM/DR potential** based on future scenarios
4. Analyse the **impact** of future penetration scenarios and the **benefits** of DSM/DR.
5. Estimate of **costs** which are necessary **to facilitate** DSM/DR potentials
6. Evaluate the **effects** on the involved **stakeholders**.

Introduction (5)

Phase 2

- Concept of the extension



Comparision of DER penetrations

In the participating countries: Austria, Finland, France, Netherlands and Spain

Comparision of DER penetrations

DER technologies at customer premises

- Heatpumps (HP)
- Smart Meter (SM)
- Electric Vehicles (EV)
- Photovoltaic (PV)
- Micro-Combined Heat Power (µCHP)
- Electric Energy Storages (ES)

Heatpumps (1)

Country situation in Austria

- Mean and total electrical power consumption (Biermayr 2010)

	Use water HP	Heating HP	Air condition HP	Sum
Thermal Power (mean) [kWth / HP a]	2,75	10,8	2,67	
Thermal Power (total) [MWth]	224	862	9	1.096
Electrical power (mean / HP) [kWel/ HP a]	1.1	3	1.07	
Electrical power (total) [MWel]	90	240	4	333

- Status quo and future scenarios (Haas 2007)

HP power classification	Percentage on the total share [%]	2009 [MWel] Status quo	2020 [MWel] Baseline scenario	2020 [MWel] Accelerated scenario	2030 [MWel] Base scenario	2030 [MWel] Accelerated scenario
Installed HP		164.000	250.000	233.000	343.000	455.000
< 20kW	90%	300	457	426	627	831
20kW-80kW	9%	30	46	43	63	83
> 80 kW	1%	3	5	5	7	9
Total	100%	333	508	473	696	924

Heatpumps (2)

Practical potentials scenario for HPs in Austria

- Assumptions:
  - Relative share of HP power classes stay the same
  - Full load hour from (Biermayr 2010):
    1540h → 35-40% availability in 6 month of cold season

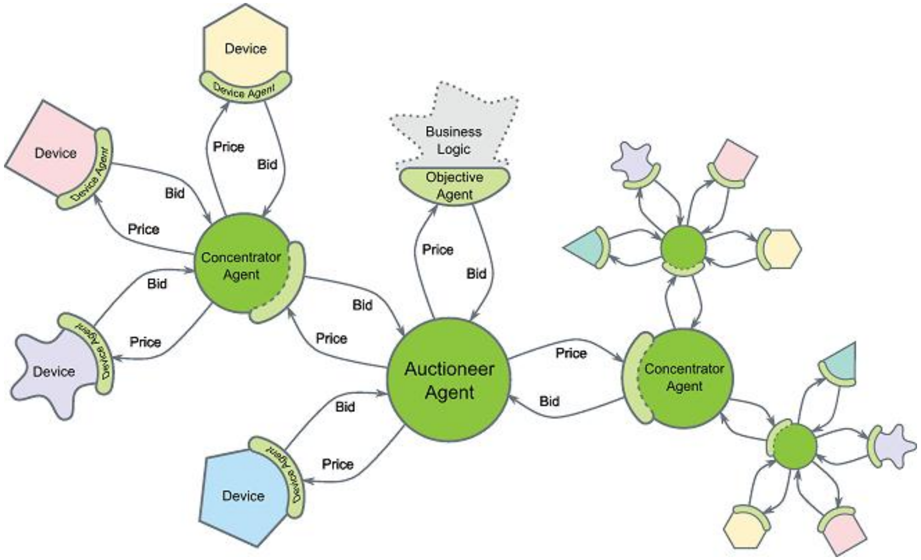
- DSM facilitation:
  - Start with facilitating the big HPs (> 80kW to 20kW class):
    approx. 2000 HPs = **92MW** in 2030
    (Total el. power per class / mean per class)

→ **Practical potential** according to concurrency would be **36,8MW** (40% availability)
(Assuming **thermal energy storage** and thermal capacity **to shift demand**)

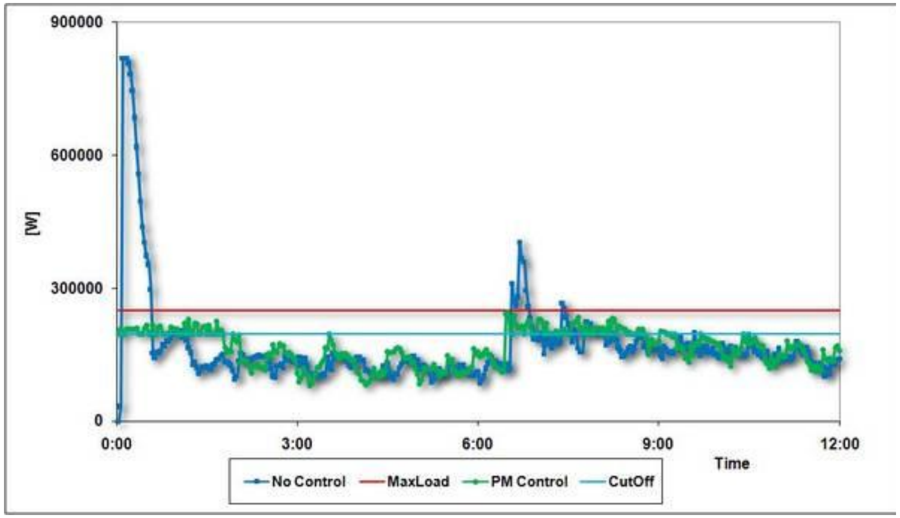
Heatpumps (3)

Pilot projects: Netherlands

- PowerMatching City – Hoogkert: 25 households with ‚smart' home gateways



- „Black-start"in „hotspot" areas: Intelligent control of restart with 100 HPs



Load on a transformer station with HP and coordination

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Heatpumps (4)

Comparision of participating countries

- Defined criteria

Criteria	Austria	Finland	Spain	Netherlands
Primary usage	Use water, Heating system		Heating system, cooling	Use water and heating in utility (30-40%) and residential
Control and flexibilty	PLC and Interruptable Tariff			
Impact on power system	Penetration for HP low, Currently 333MW electrical Power, Potential for 100MW controllable load in 2030			“hotspots” overload on cold days exceed designed connection power - blackouts
Impact on stakeholders / services	Energy contracting			APX 1h; imbalance market 15min; High tariff customers;
Drivers / incentives	Lower price tariff, investment incentives	25% of renovation costs; deduction of taxes		Incentives for investment
Electricity demand	506 GWh per year 333MW	1996 GWh total[1] (2007)		
DSM potential	Theoretical: 696 – 924MW Practical: 92MW/36,8MW permanent available[3]	Between 1 and 3 GWh/h depending on time of day		

Smart Meter (1)

Country Situation in Austria (vs. M/441) – Enabling DSM with SM

- Mandate M/441 – main functionalities
  - Remote reading
  - Two-way communication
  - Support advanced tariffs and payment systems
  - Allow remote disablement
  - **Communicate with (and where appropriate directly controlling) individual devices within the building**
  - Provide information via web portal / gateway to an in-home / building display

- E-Control consultation paper on SM
  - Minimum of 4 registers for different tariffs per day (time of use).
  - Communicate with at least 4 external meters - possible use as synergy for energy management systems
  - Interface to external system
  - It is explicit stated, that the SM would **not act as a gateway to home automation system to directly control external devices.**

Smart Meter (2)

Comparision of participating countries

Criteria	Austria	Finland	France	Spain	Netherlands
Functionalities which enable DSM	No, (Interface to display)	Yes	Yes	Yes	Yes
Penetration scenario	80% (2020)	90% (2020)	100% (2020)	50% (2020)	100% (2020)
Impact on power system	Reduction of consumption 3,2%			Wind is driving Spain to look at DR	Wind is a big issue; DNOs will adopt them

Electric Vehicle (1)

Country situation: Austria

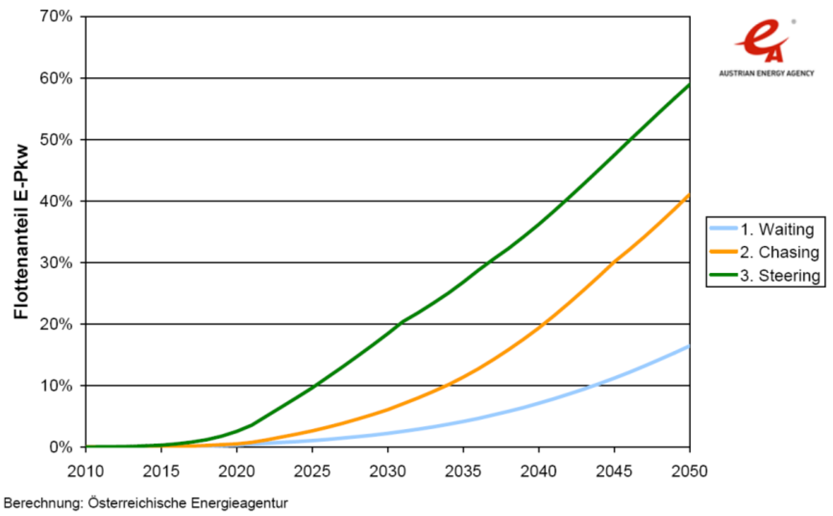
- Number of EVs in Austria (Source: Statistics Austria)

	2006	2007	2008	2009
Passenger cars	4.204.969	4,245.583	4.284.919	4.359.944
Hybrid cars	481	1.264	2.592	3.559
Electric cars	127	131	146	223

- Future scenarios (Source: Vision 2050 – Austrian Energy Agency)

	2010	2020	2030	2040	2050
Waiting	310	15.441	114.505	394.112	966.686
Chasing	310	24.520	307.309	1.031.575	2.262.029
Steering	310	115.473	886.703	1.740.253	2.685.443

- Share of passenger EVs

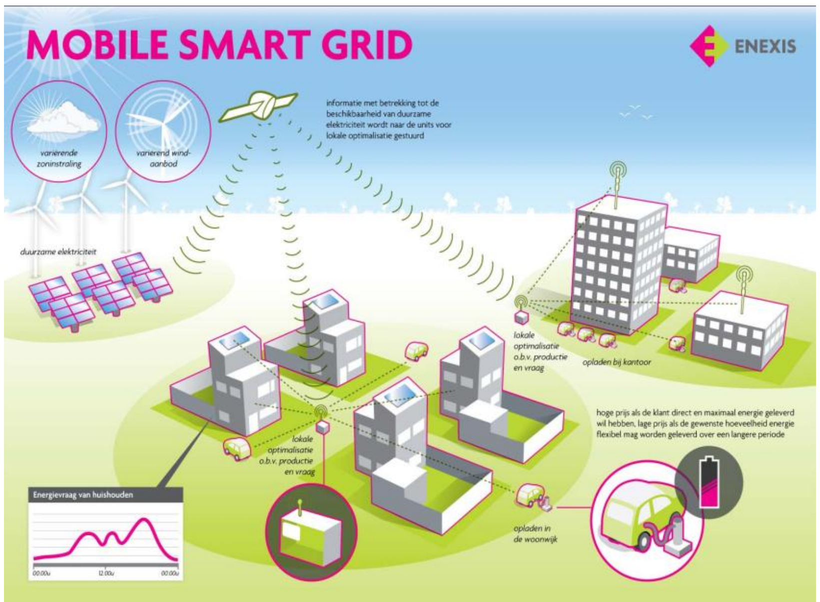


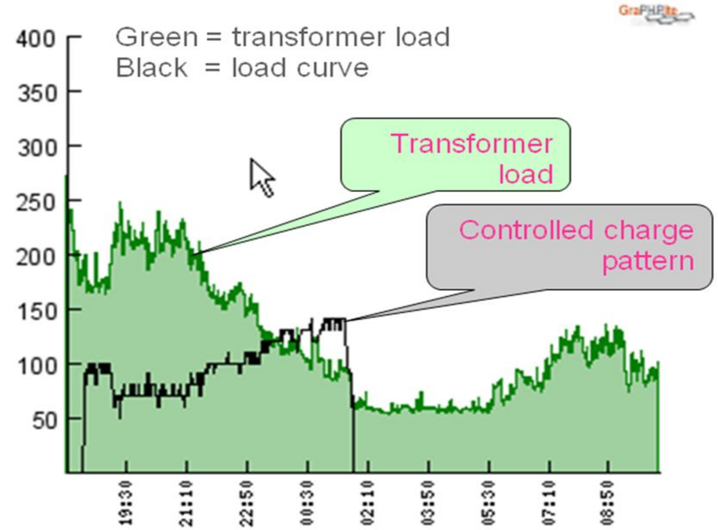
Source: Vision 2050 - Austrian Energy Agency

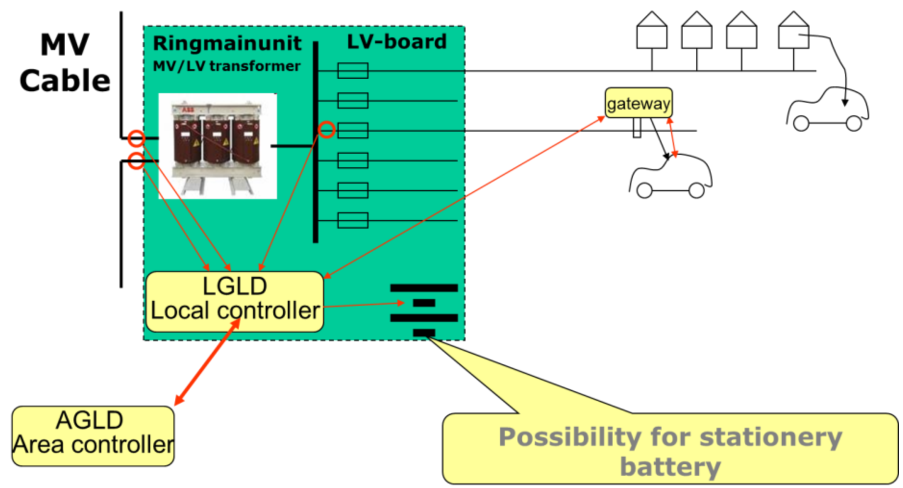
Electric vehicle (2)

Pilot projects: Netherlands

- Enexis: controlled charging of EVs



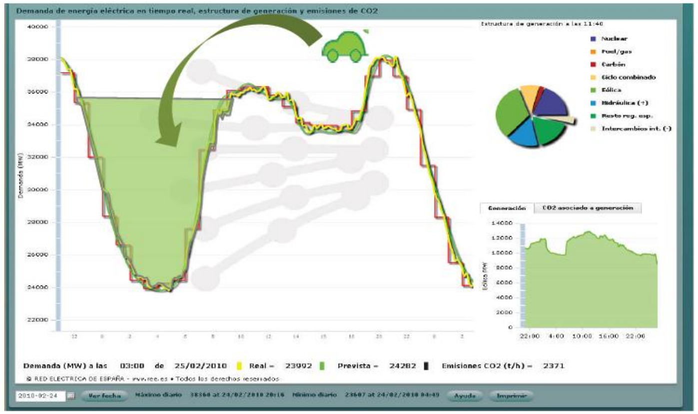


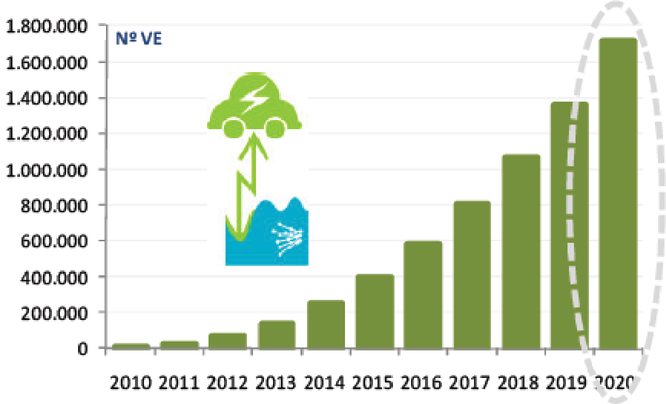


Electric Vehicle (3)

Pilot projects: Spain

- High ratio peak vs. off peak
- The new subject **"Charge Manager"** and the new activity **"Energy charging services"** have been established.





2.000 MW of demand in off-peak hours.

25% of curtailment reduction.

Electric Vehicles (2)

Comparison of participating countries

Criteria	Austria	Finland	Spain	Netherlands
Control and flexibility	Wireless is discussed (AMP)	PLC and GSM are under discussion TCP/IP is recommended		
Charging stations	IEC 62196 (to be likely) > 30 kW: solely DC charging (CHadeMO-Standard18 with a YAZAKI-Plug)	IEC 61851 (phase 1) at private premises		16A – 230 16A – 400 32A – 400
Impact on power system	Uncontrolled vs. controlled charging, 2% of total el. Consumption with 20% penetration, stress of distribution grid in case of high power charging. In urban / city regions a distribution up to 60% doesn't make a problem		Intelligent Management is needed to integrate renewables and for efficient system operation	DSR, load control , peak shaving; Impact on power system utilitzation
Impact on stakeholders / services	EV service provider Energy must be provided from renewables,		EV aggregator Charge Manager	EV aggregator
Incentives/Subsidies	Tax exclusion / incentives Subsidies	benefit in the taxation system fuel-tax increases EV costs		

Conclusion and Outlook

Preliminary findings

Conclusion

Preliminary DER technologies findings

- **Heatpumps** (HP):
  - Experiences from field tests („hotspots“)
  - Potential in Finland is higher (direct electrical peak heating)
  - Need for graduate control in respect of grid impact
  - Hybrid (reversible) HPs to enable more potential
- **Smart Meters** (SM)
  - No commonly agreed functionality for enabling DRs with SM
- **Electric Vehicles** (EV)
  - Different approaches for incentives exist
  - Experiences from demonstration projects
  - Introduction and change of law („Charge Manager“, „Energy charging service“)

Outlook

IEA-DSM Task XVII – Phase 2

- **Next steps**:
  - Completion of penetration scenarios of other DER technologies:
    - PV
    - MicroCHP
    - Thermal and electric energy storages
  - Estimate potential for DSM / DR from the scenarios
  - Derive impact on power system
  - Effects on stakeholders
    - Workshop in France
  - Discuss benefits and costs

- **Analysis and full report** will be available in spring/summer 2011

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