



Scalable Energy Management Systems PowerMatcher

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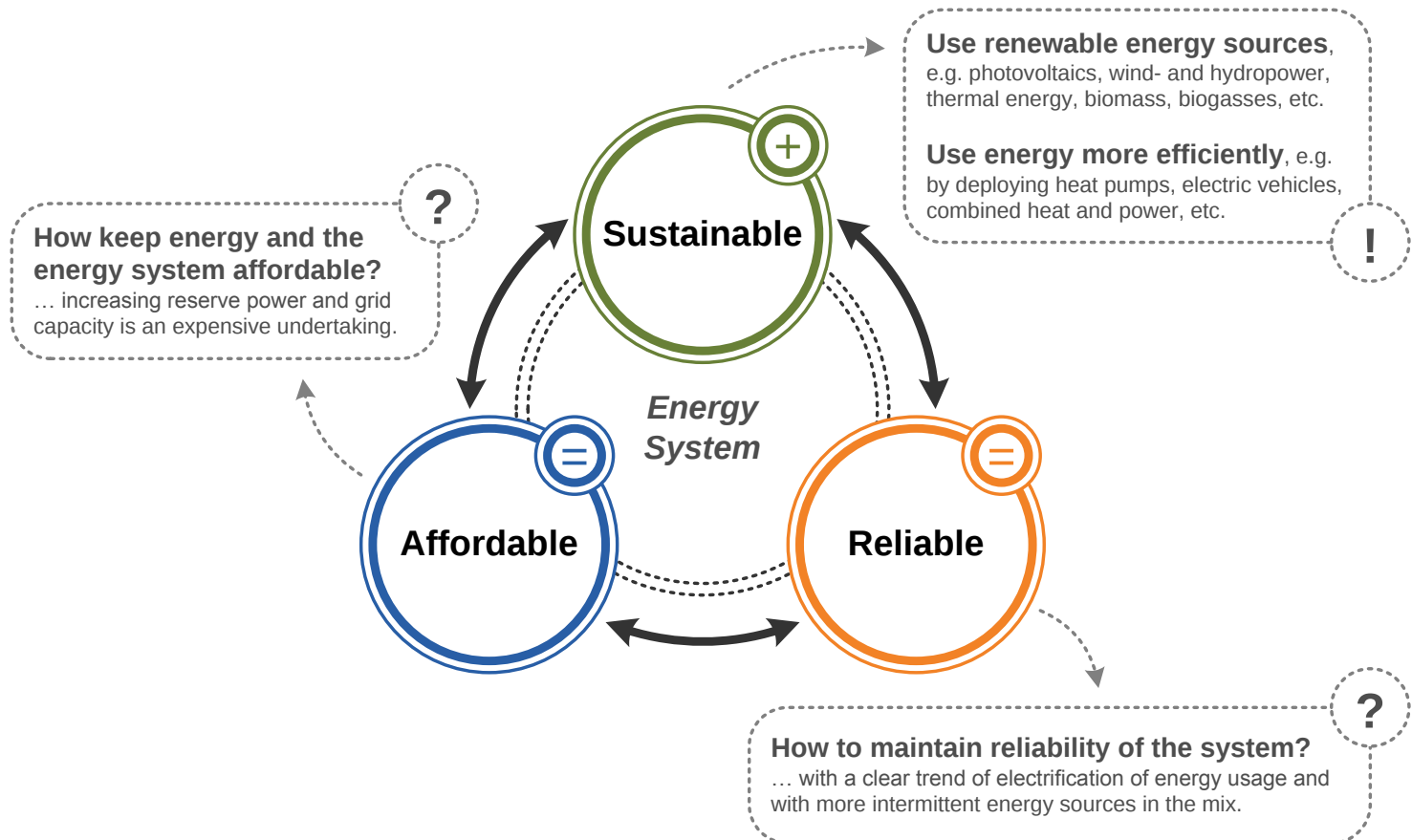
Amersfoort, November 21, 2012

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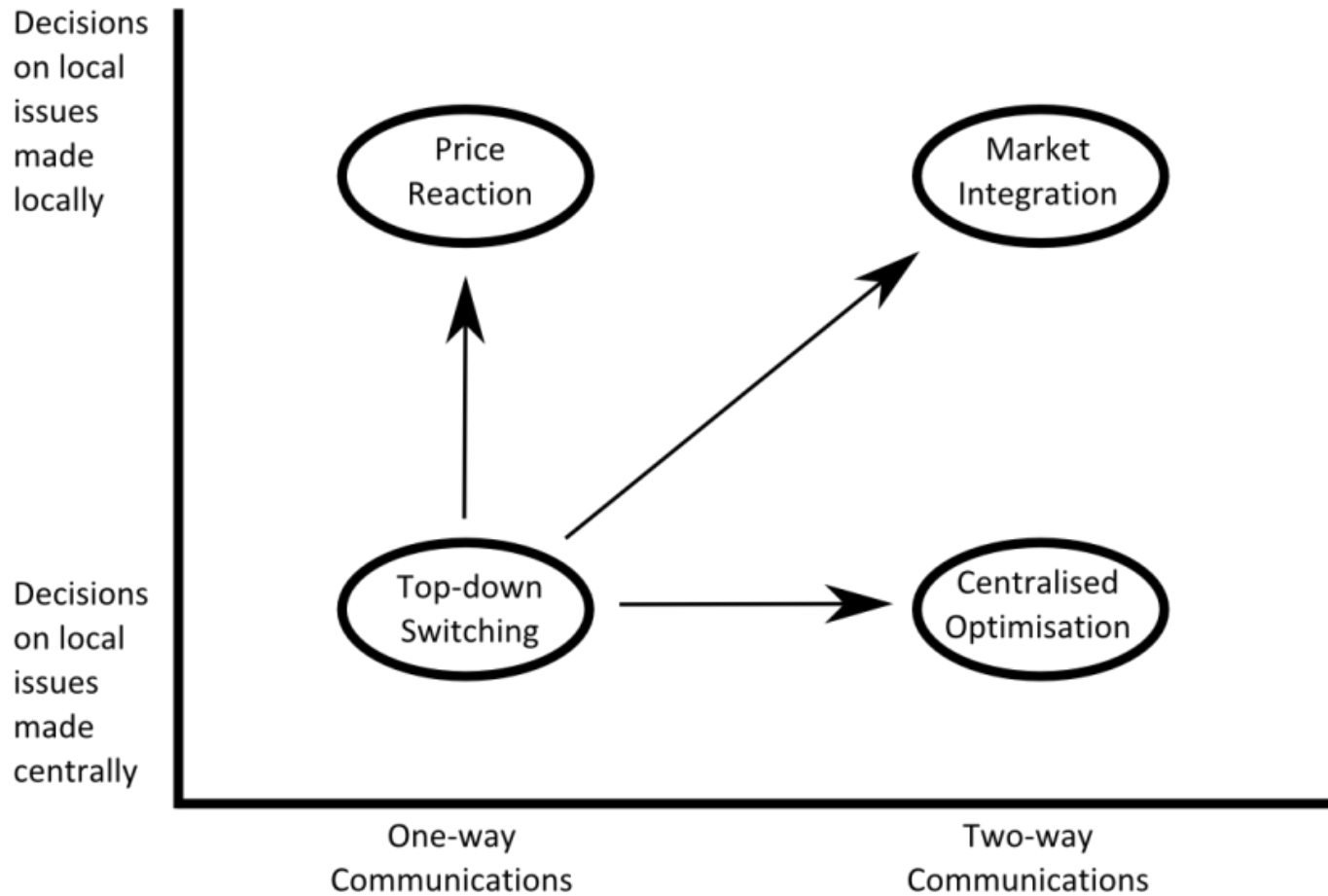


Smart Energy Systems Challenges





Smart Energy Management Matrix





Smart Energy Management Matrix

Decisions
on local
issues
made
locally

Price Reaction

- + Full Use of Response Potential
- Uncertain System Reaction
- Market Inefficiency
- + No Privacy Issues

Market Integration

- + Full Use of Response Potential
- + Certain System Reaction
- + Efficient Market
- + No Privacy Issues

Decisions
on local
issues
made
centrally

Top-down Switching

- Partial Use of Response Potential
- Uncertain System Reaction
- Autonomy Issues

Centralised Optimisation

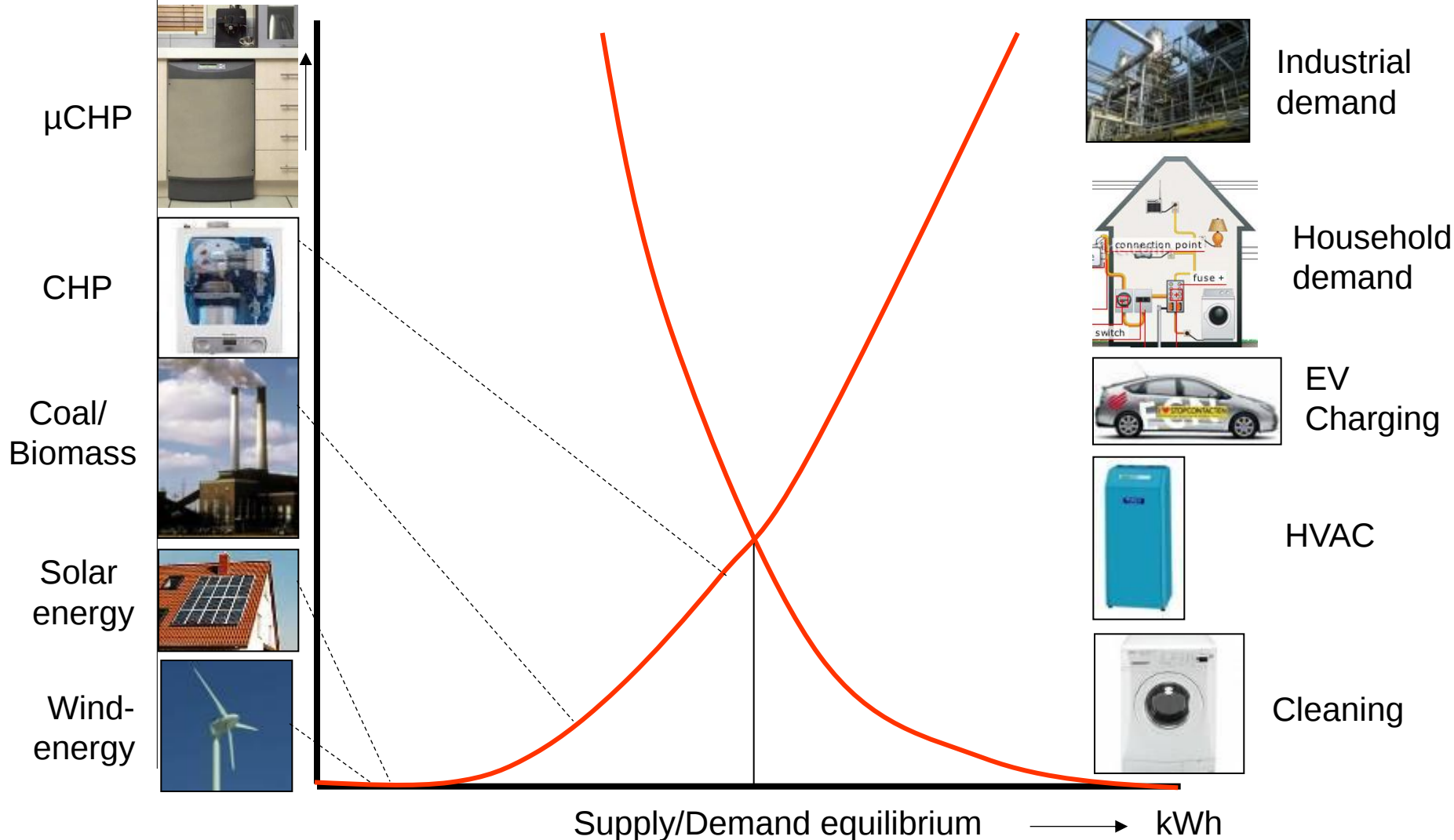
- + Full Use of Response Potential
- + Certain System Reaction
- Privacy and Autonomy Issues
- Low Scalability

One-way
Communications

Two-way
Communications

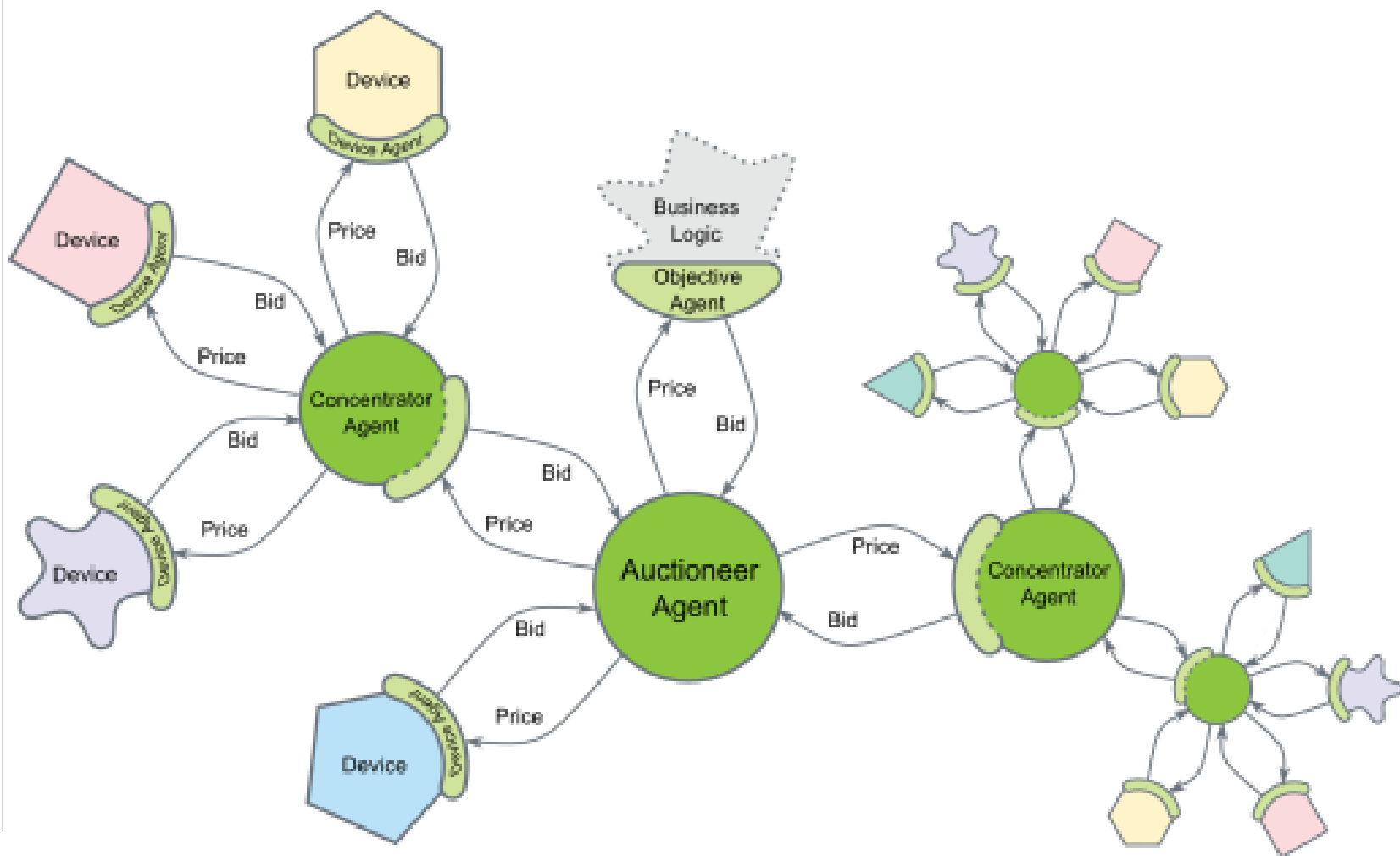


Energy Management





PowerMatcher agent interaction





PowerMatcher Coordination for the Smart Grid

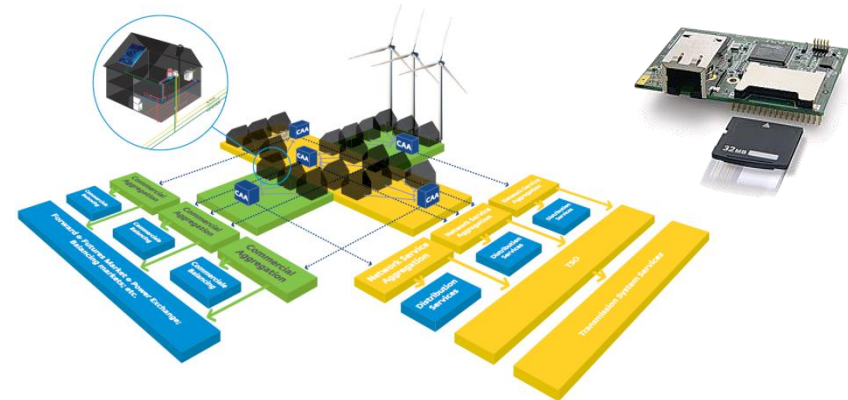
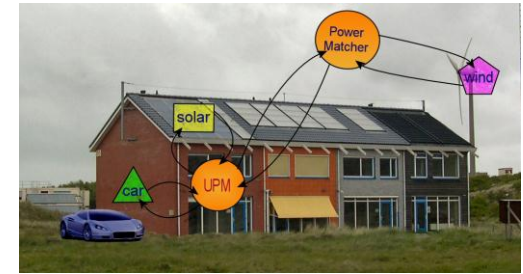
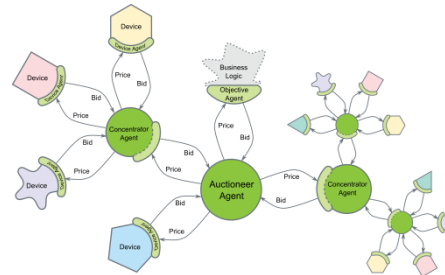
Energy optimization of high
numbers small units (<5MW)

Demand
Response

Distributed
Generation

Storage
(Electrical
Vehicles)

Industrial Installations
Domestic Appliances



Business Cases

Energy Trading

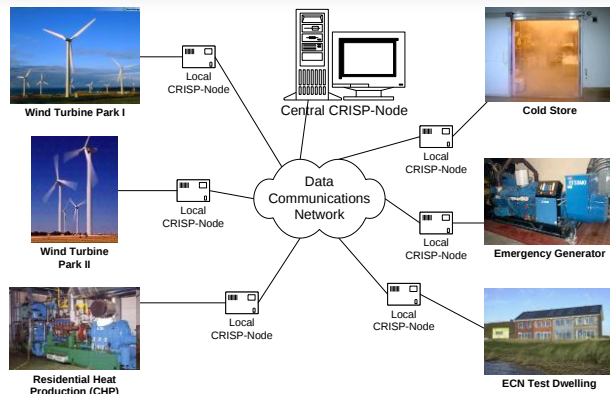
Active Distribution

Virtual
Power Plant

Imbalance
Reduction

Congestion
Management

Black-Start
Support





Tangible Results from Trails and Simulations

Service/Characteristic	Result	From
Trade & Supply		
Portfolio Balancing	Wind imbal. reduction: 40 to 60%	Field Trial
→ Balancing Market Reaction	Realisation of desired reaction	Field Trial
Active Network Management		
Congestion Management		
Coordination of μ -CHPs	Peak reduction: 30–50%	Field Trial
→ Smart charging of EVs	Peak reduction: up to 30%	Simulation
Smart charging of EVs	Peak reduction: 35%	Field Trial
VPP & Congestion Mgmt	Proof of Principle of FastLMP	Field Trial
Black-Start Support		
→ Coordination of HPs	Grid capacity can be 3× lower	Simulation
RES Integration		
→ Increased RES utilisation	Uncommitted RE used: 65–90%	Simulation
Avoided gray energy usage	Reduced use of gray: 14–21%	Simulation
Scalability		
→ Large-scale VPP reaction	1M households in < 1 min.	Field Trial



Congestion Management with Heat Pumps

Question: Can the PowerMatcher aid to ride through extreme situations with a lower network capacity?

Simulation Features:

- 100 households, each with Heat Pump and auxiliary Heater
- MV/LV transformer

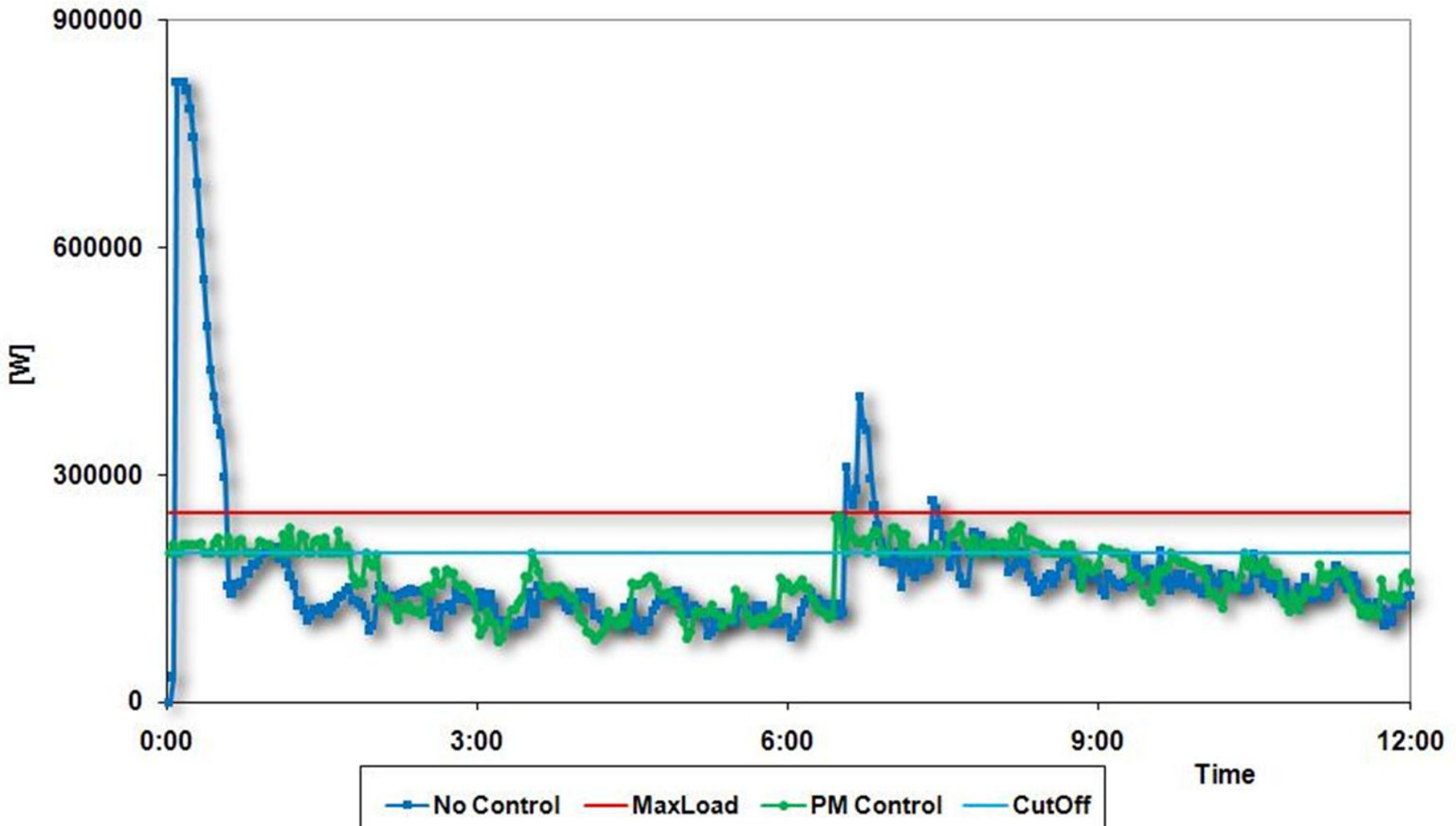
Two Extreme Scenarios:

- Black Start Recovery
- Cold Winter Morning





Congestion Management with Heat Pumps





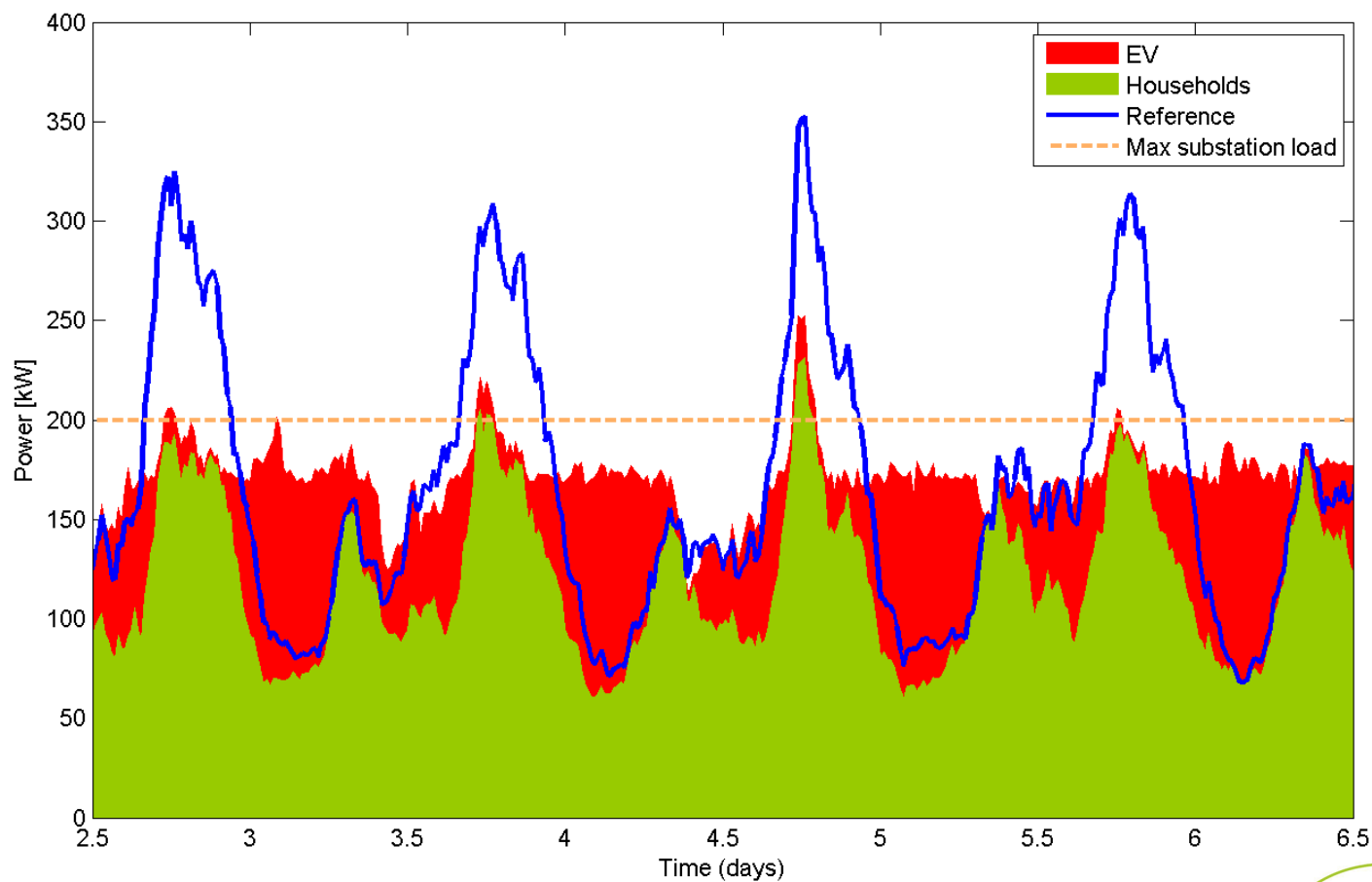
Smart Charging of Electric Vehicles



**POWER
MATCHER
READY**

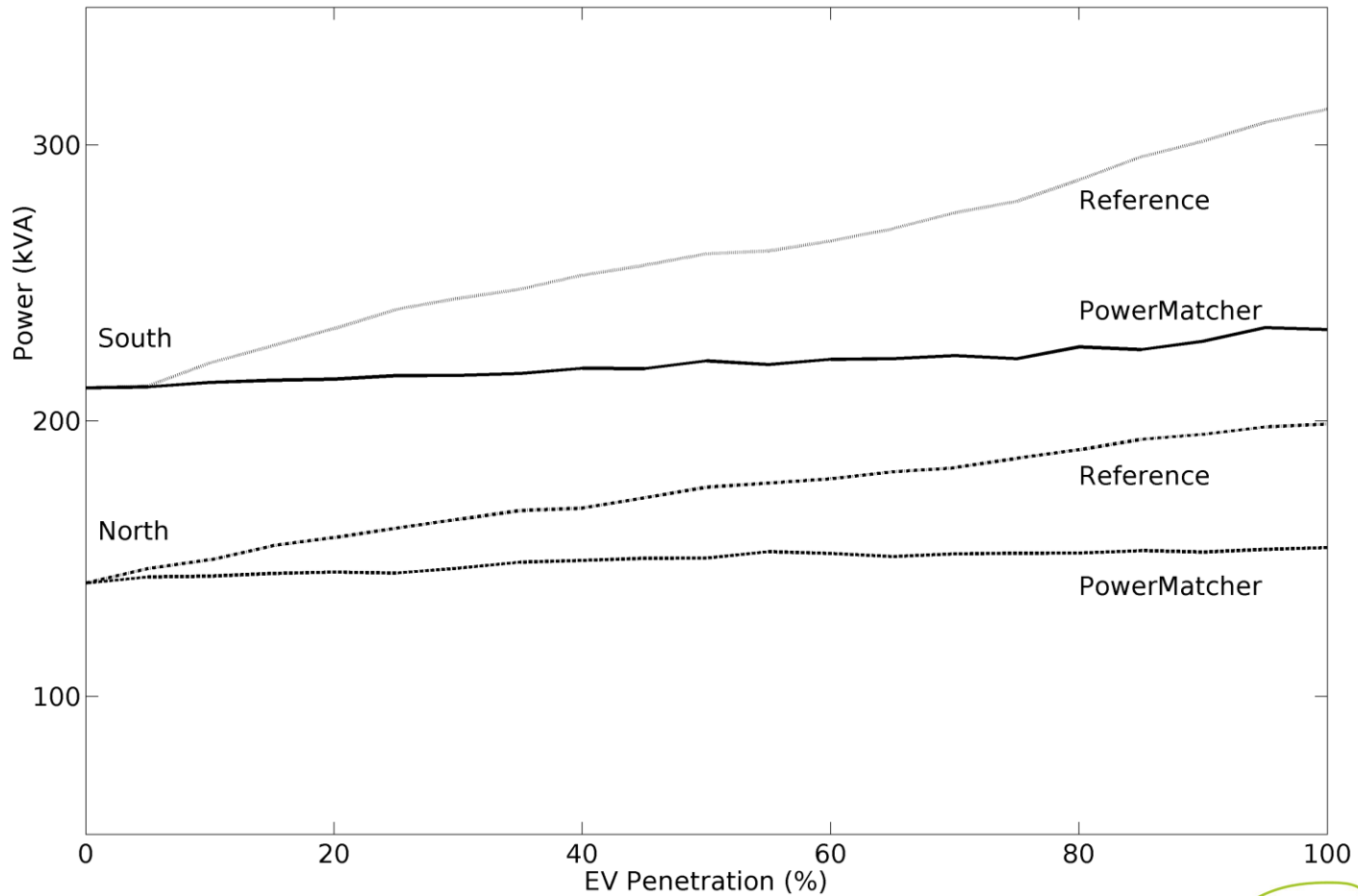


Intelligent Charging Results





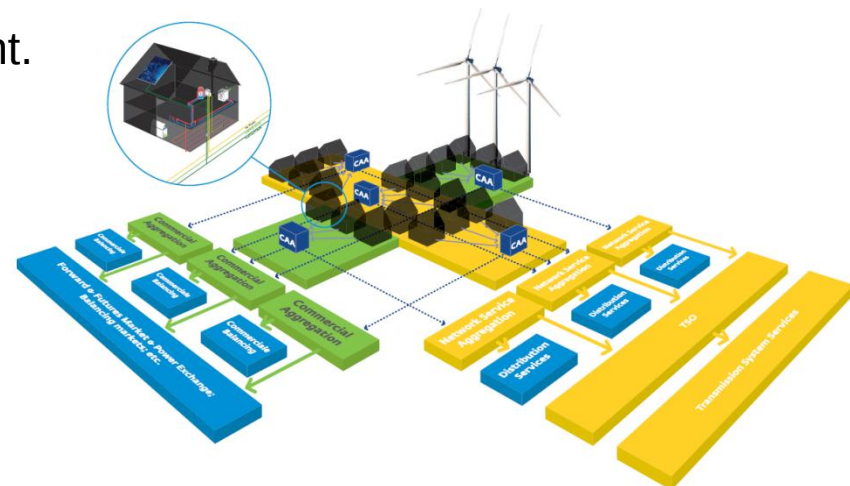
EV Penetration and Distribution Peak Loading





PowerMatching City I

- › 22 family homes in a Smart Grid
 - › Create Win-win-win:
 - › Trading optimization (Supplier)
 - › Grid operation optimization (DSO)
 - › Prosumer local optimization (End-customer)
 - › Heat pumps, micro-Cogen, Home appliances, Renewables, Electric Vehicles
- › Partners: KEMA, Humiq, Essent.





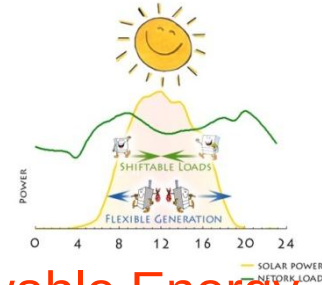
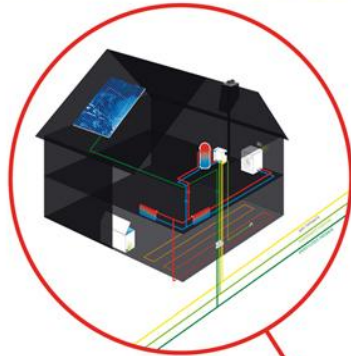


Multi Goal Optimization

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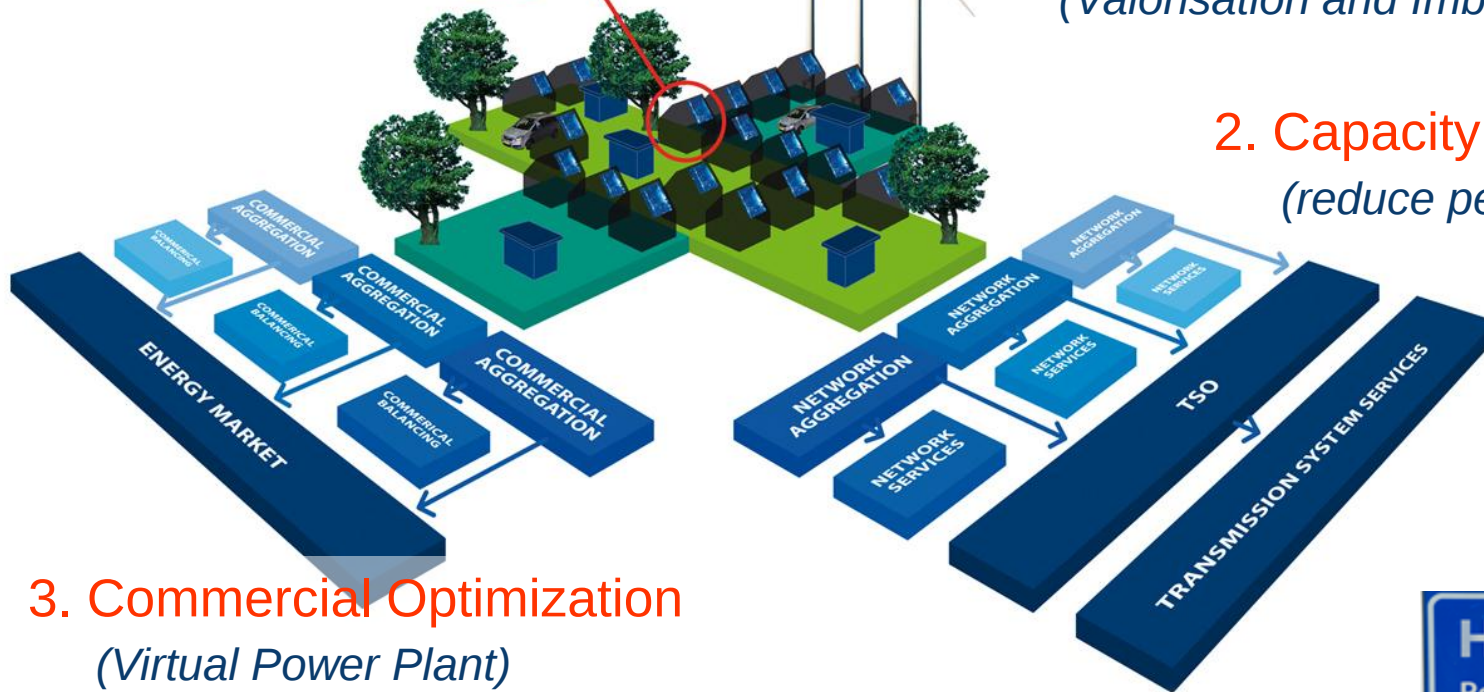
Corporate story

1. Cost Effective Use of Energy
(In home optimization)



4. Integration of Renewable Energy
(Valorisation and Imbalance Reduction)

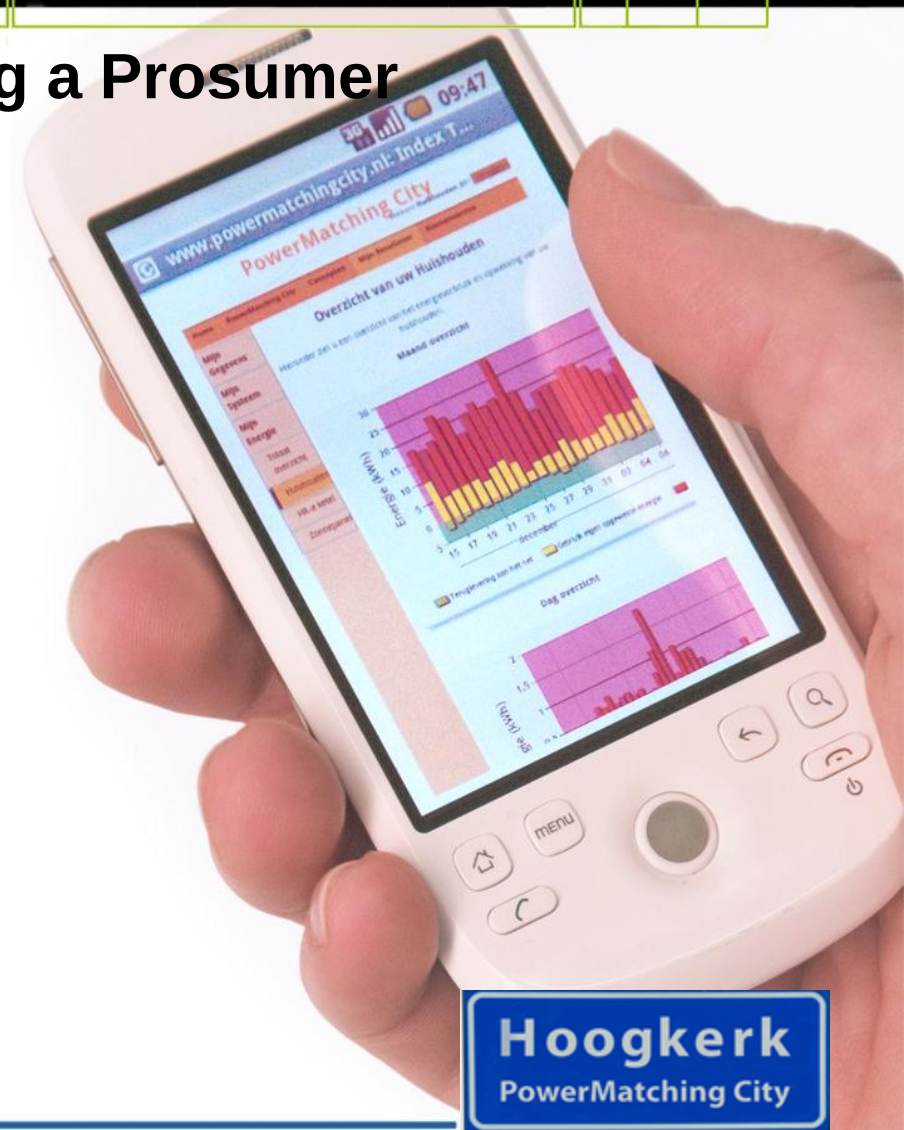
2. Capacity Management
(reduce peak loads)

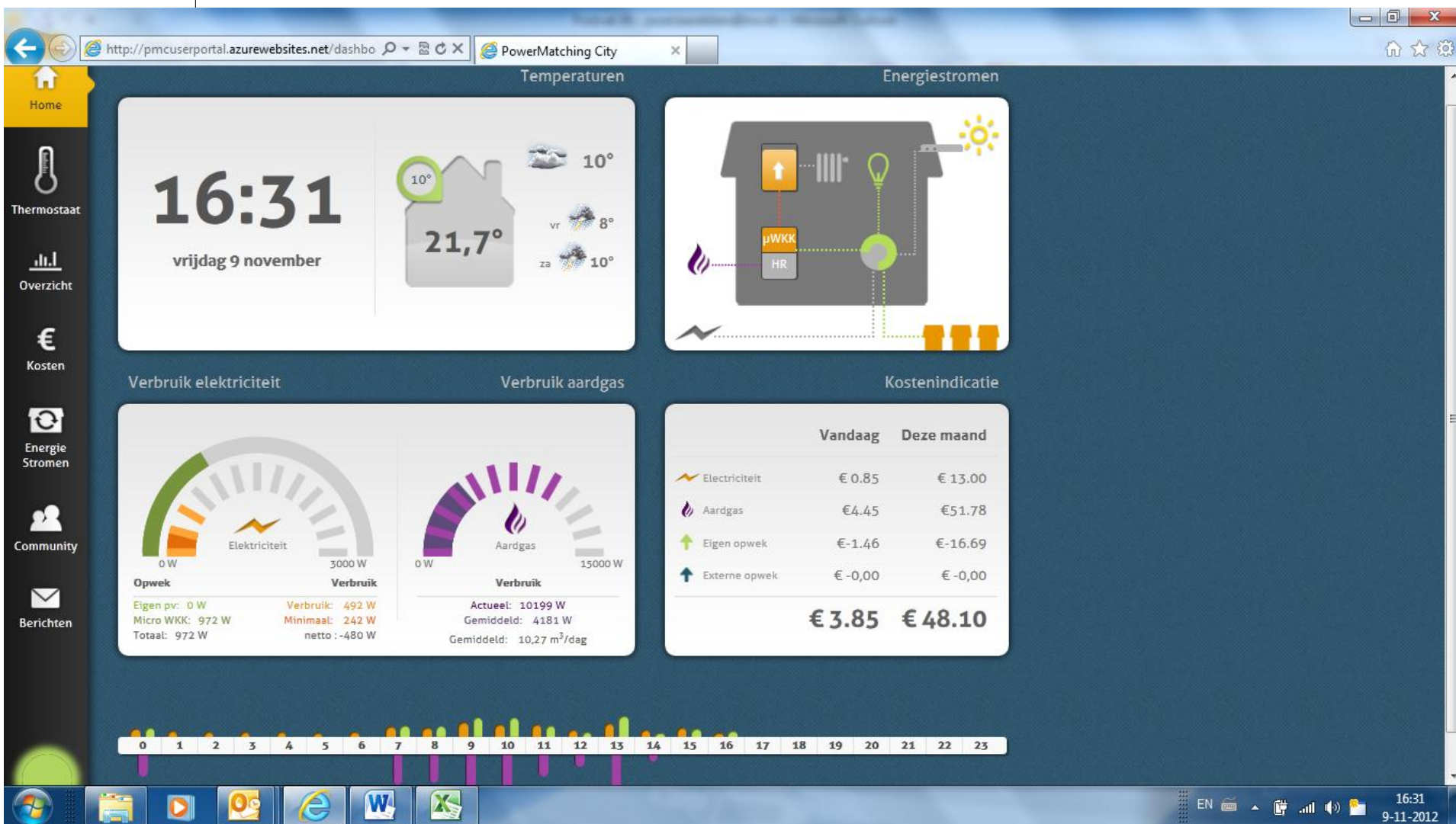


3. Commercial Optimization
(Virtual Power Plant)

Hoogkerk
PowerMatching City

The Customer becoming a Prosumer







PowerMatcher: “A World-Top Sustainable Solution”

- › Sustainia100: the most powerful sustainable solutions in the world
- › UN Conference on Sustainable Development, Rio de Janeiro
- › PowerMatcher has two entries: “PowerMatching City” & “Ecogrid”





Thank You for your Attention

www.PowerMatcher.net
www.tno.nl





Wind Generation Integration

Can end user response support the integration of wind power?

Simulation Features:

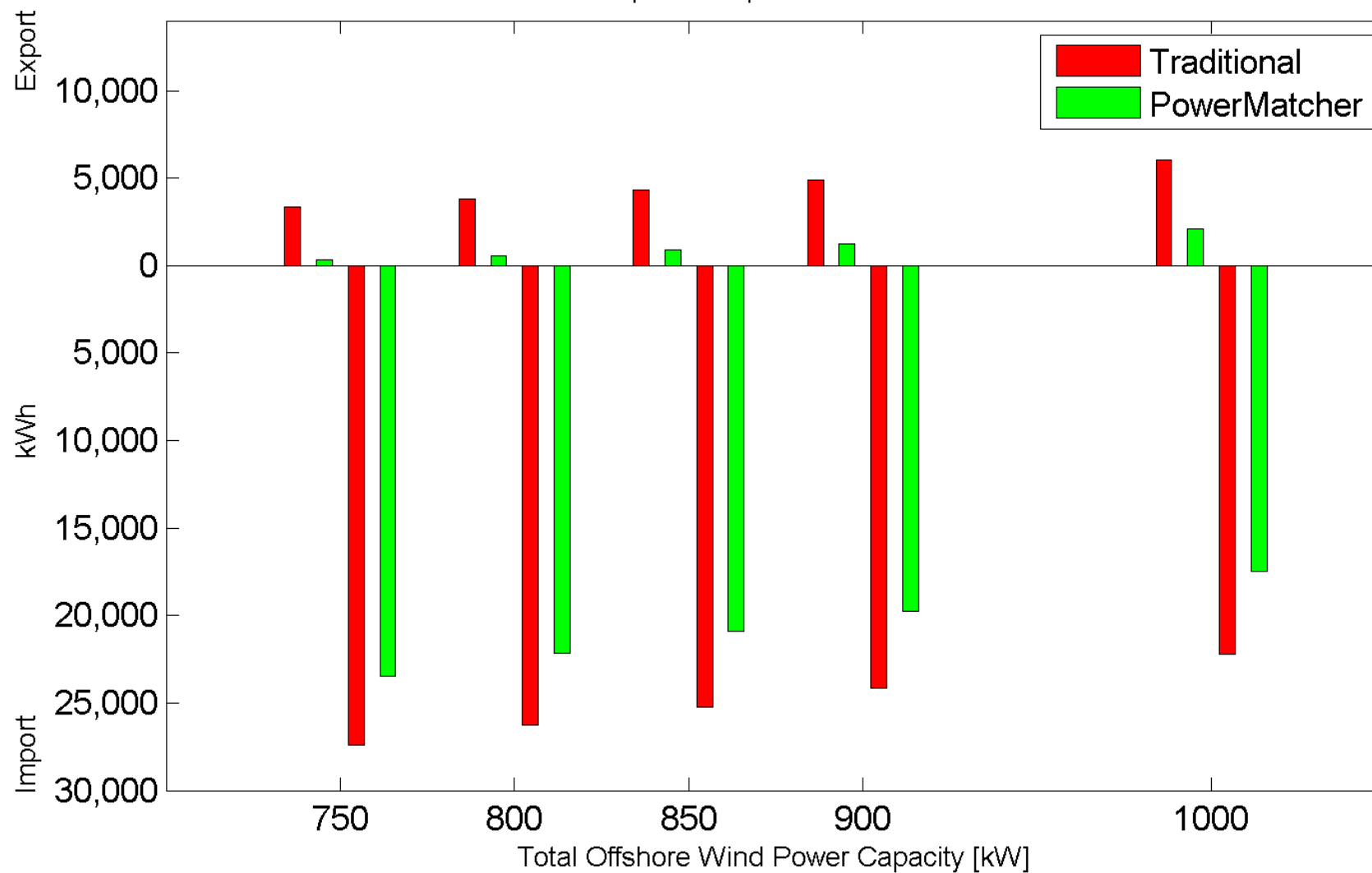
- 3000 households
- Inputs & Configuration based on Scenario Studies

Real world circumstances

- Field validated models:
 - Devices, heat demand patterns
- Measured time series for wind & solar power
- Measured time series for firm household demand



Difference in Total Import & Export of the 3000 Household Cluster





Suppliers and Network Operators involved in Current Deployment Projects

