Energy research Centre of the Netherlands

Distributed Control Concepts using Multi-Agent technology and Automatic Markets

An indispensable feature of smart power grids

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Why decentralized control?

- Privacy
- Autonomy
- Scalability
- Communication overhead

Three stages of DG Growth

Growing DG Penetration →

Accommodation

- DG accommodated in the current system
- DG units running free
- DG treated as negative demand
- Central control unchanged

Decentralization

- Added value of clustered control of DG.
- Common ICT systems: Virtual Utilities,
  Virtual Power Plants.
- Central control still needed
- Decentralized, bottom-up control is added.

Dispersal

- Distributed power dominates the market
- Network of networks
- Local network segments self-supplying.
- Central controller becomes a coordinator.

- Source: IEA, 2002

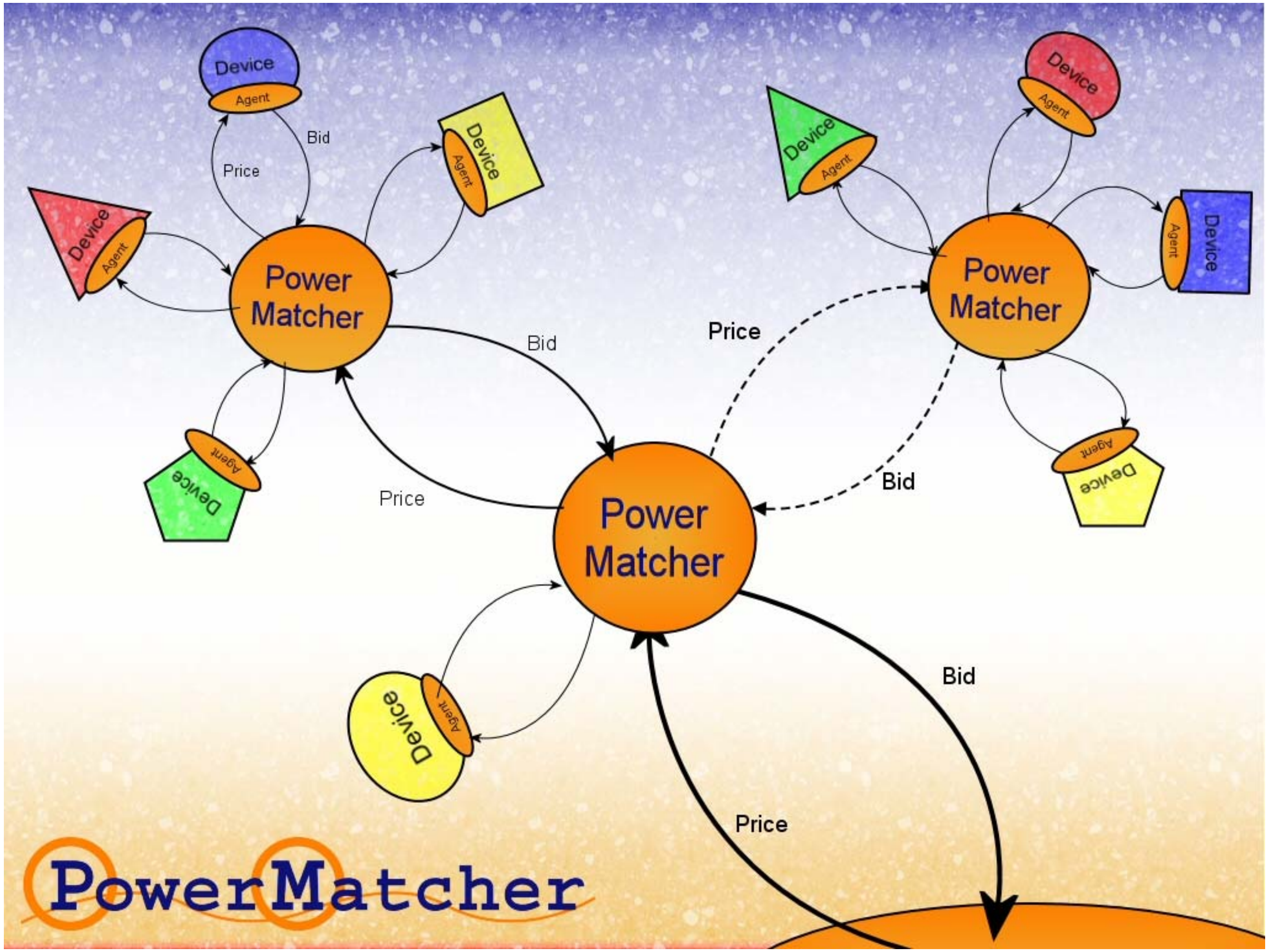
Current practice in load control

- Centralized control
- Reactive customers
- Traditionally focused on customer demand
- Undetermined outcome

PowerMatcher control

- Decentralized control
- Active customers
- Transparency with respect to demand and supply
- Determined outcome by ‘real-time’ contract
- Dynamic response

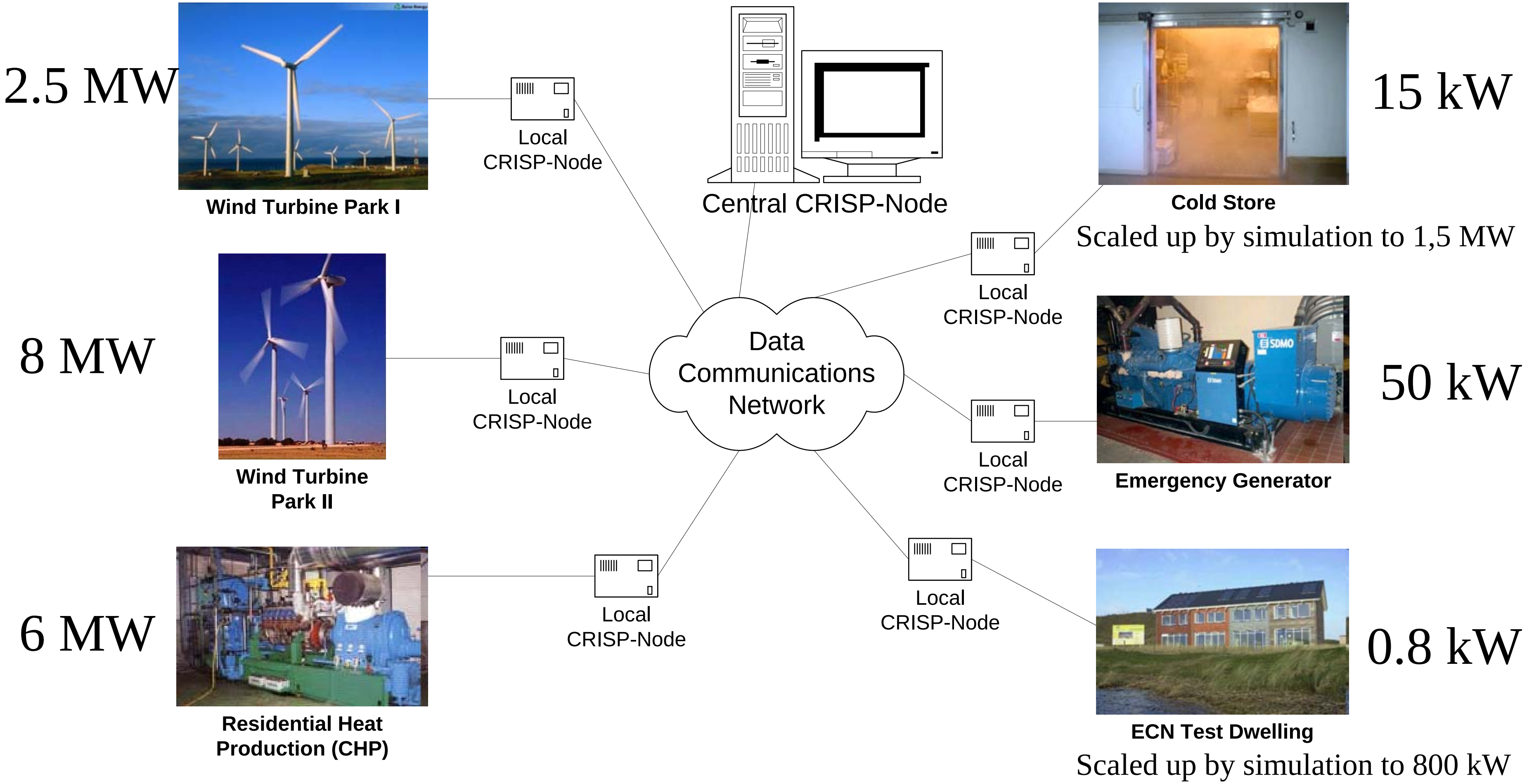
PowerMatcher cells - networks of networks



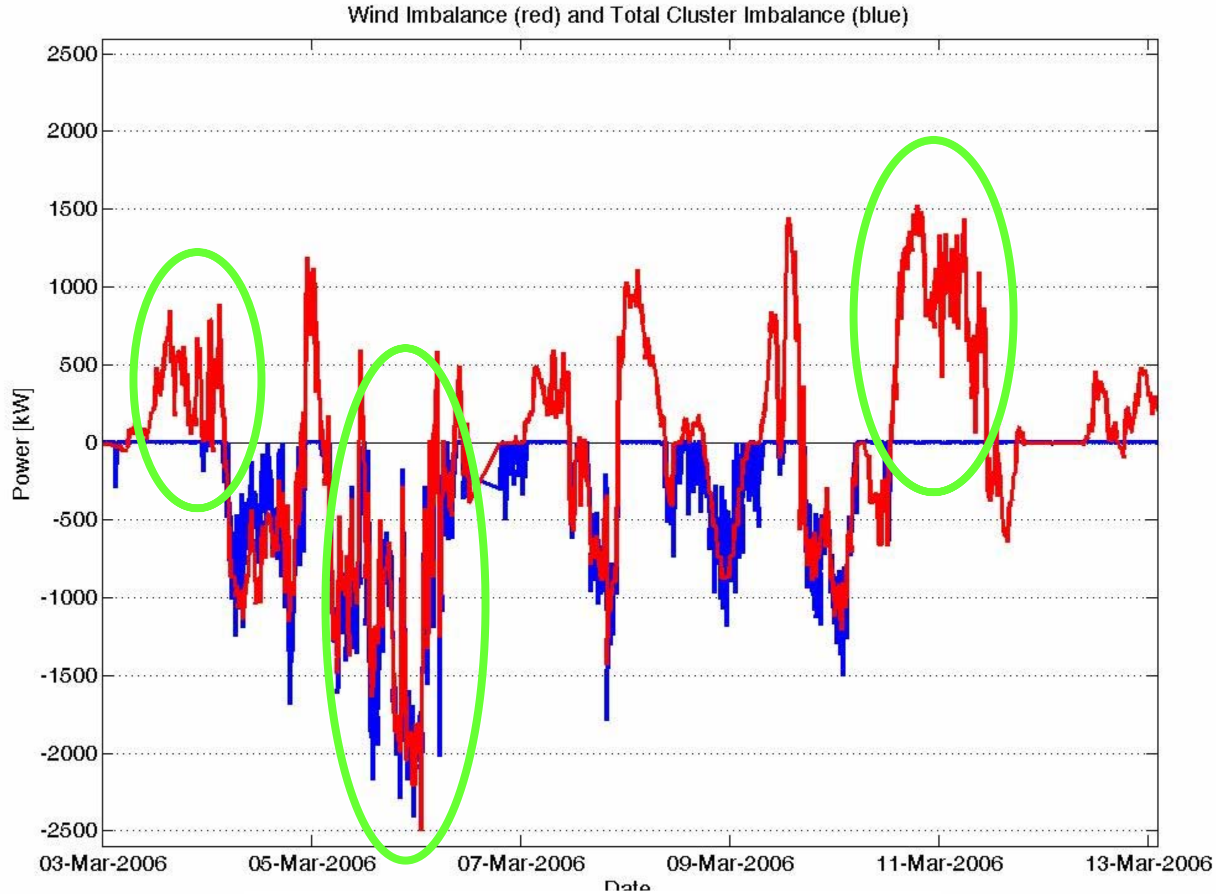
Business cases

- Imbalance reduction for responsible party (CRISP)
- Keeping self-generated power in-house (UPM)
- Flattening generation and consumption patterns
- Intelligent substation control:
  peak reduction (SPS First trial); towards islanding
- Virtual Power Plant control (FENIX)
- Storage optimization (plug-in hybrids)
- …

CRISP Field test: Portfolio

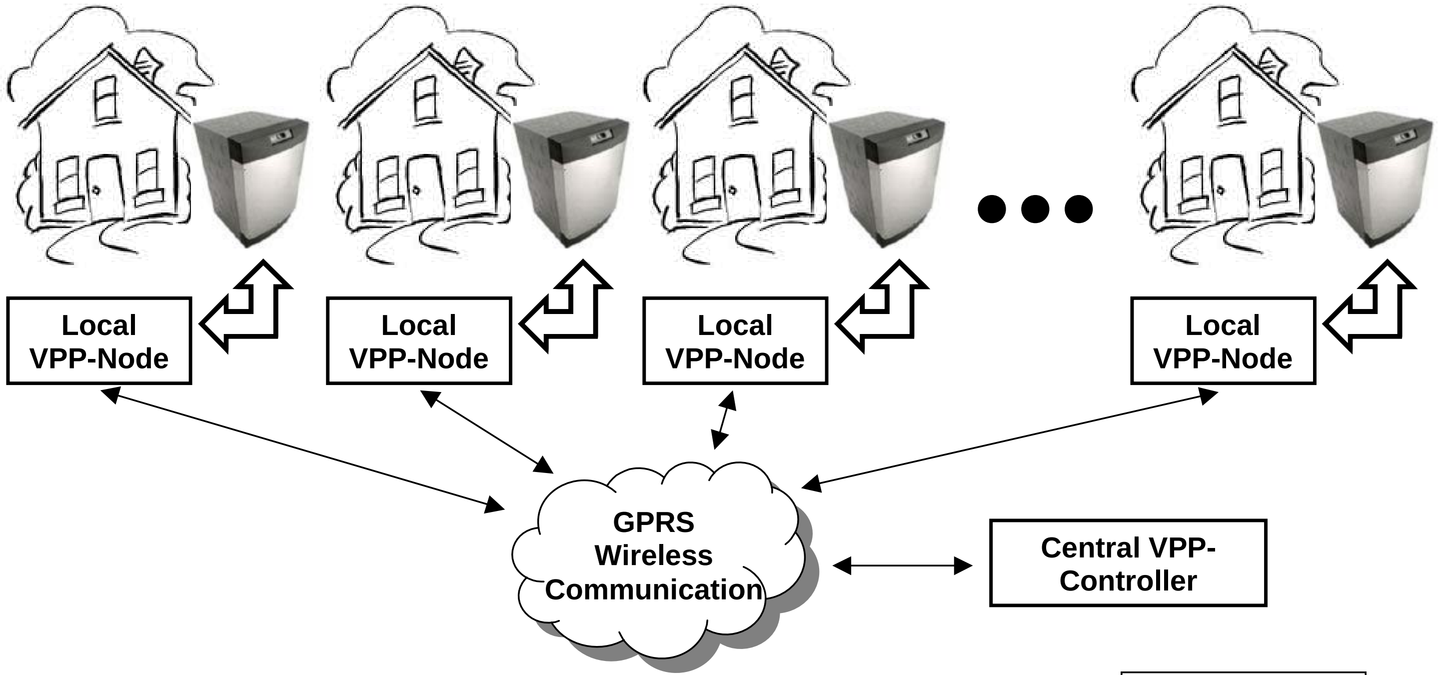


CRISP



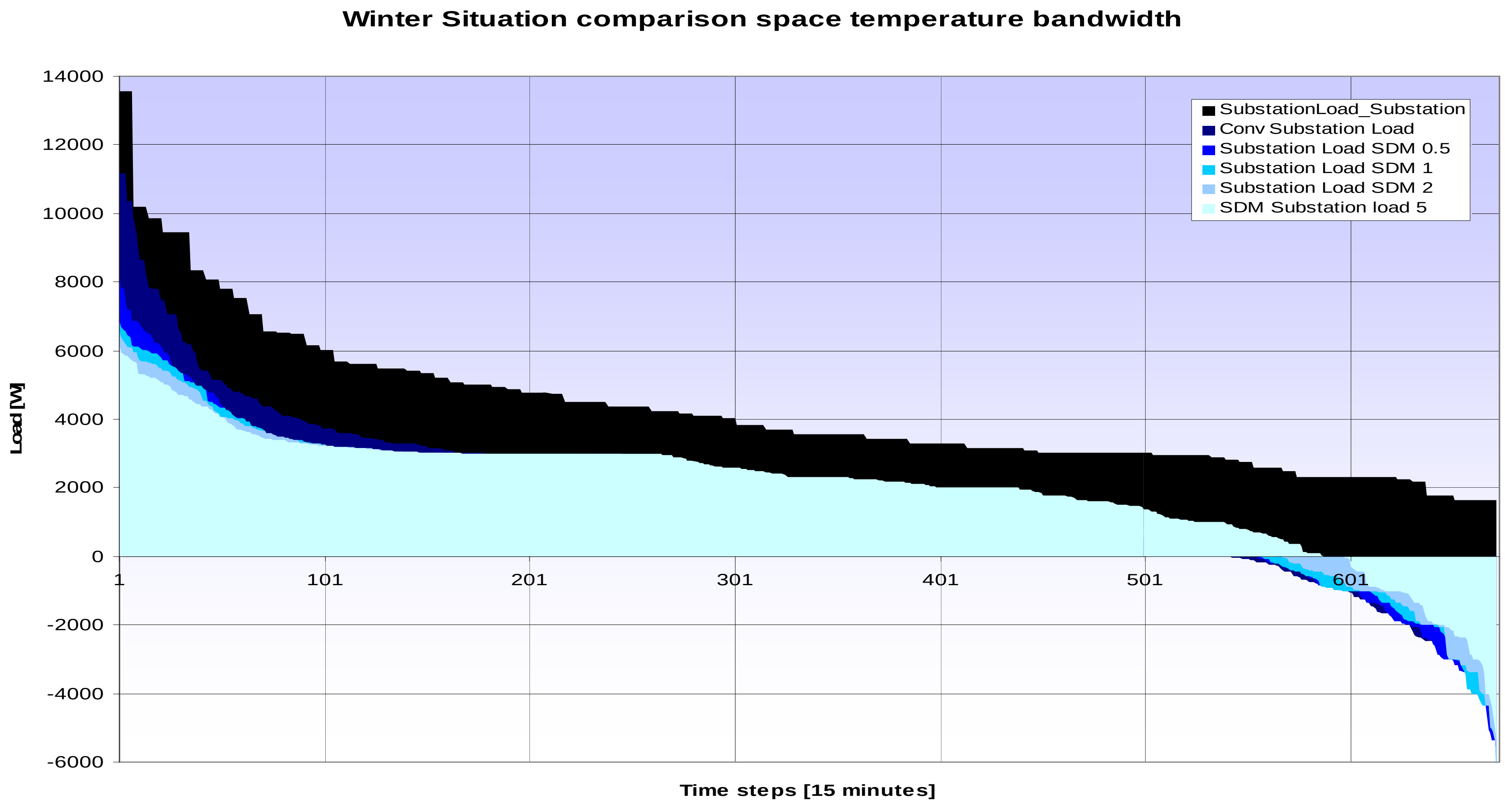
→ 43.5 % imbalance reduction

SPS First trial



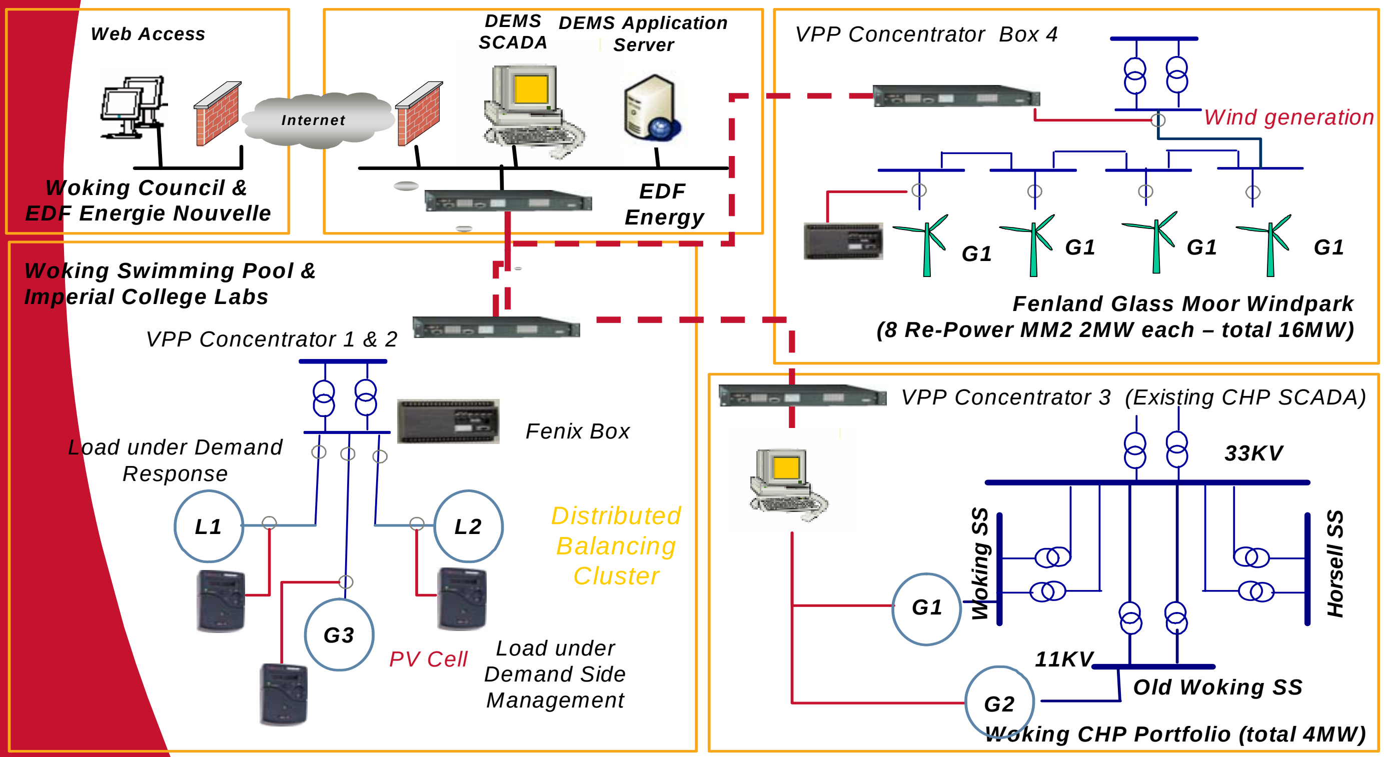
GPRS Supplier:

SPS First trial



FENIX (Northern demo)

Overall System Architecture

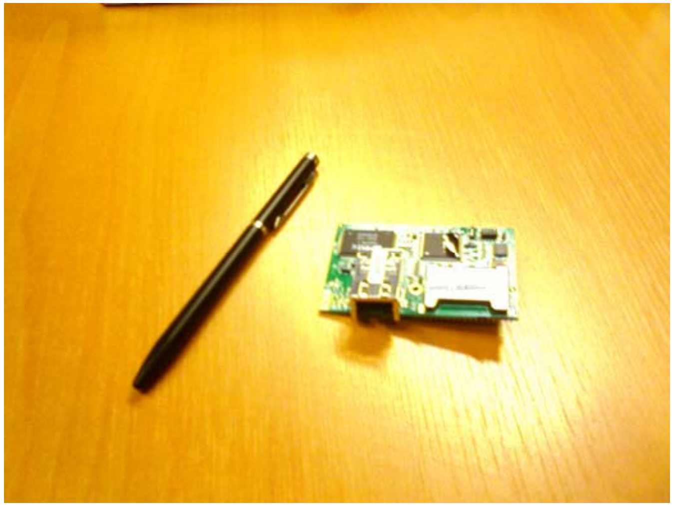


UPM

- Connectivity for:
  - Small scale wind
  - PV(T)
  - µCHP
  - Heat pumps
  - Household appliances

- UPS Functionality on a household level

- Connectivity with other UPMs



Upcoming research

- Integral
- Active houses
- 6 scenario simulations
- Network constraint handling

Conclusions

- Distributed control concepts create:
  - scalability
  - local autonomy
  - market integration

- The PowerMatcher provides a flexible concept to implement a variety of business cases

- Different business cases proven in Field tests

- Embedded trajectory as a first step to commercial products