

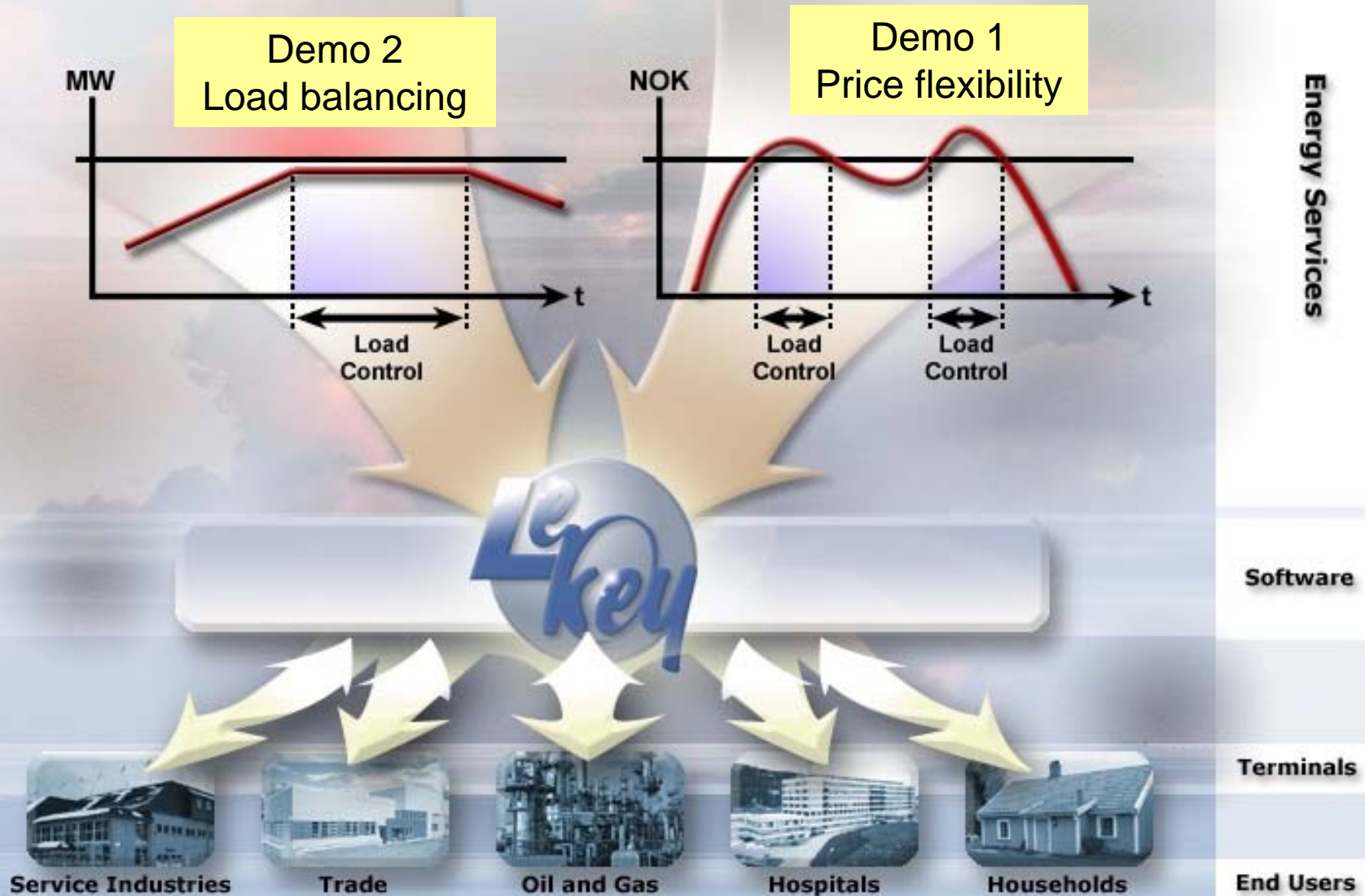
Norwegian DR demonstrators

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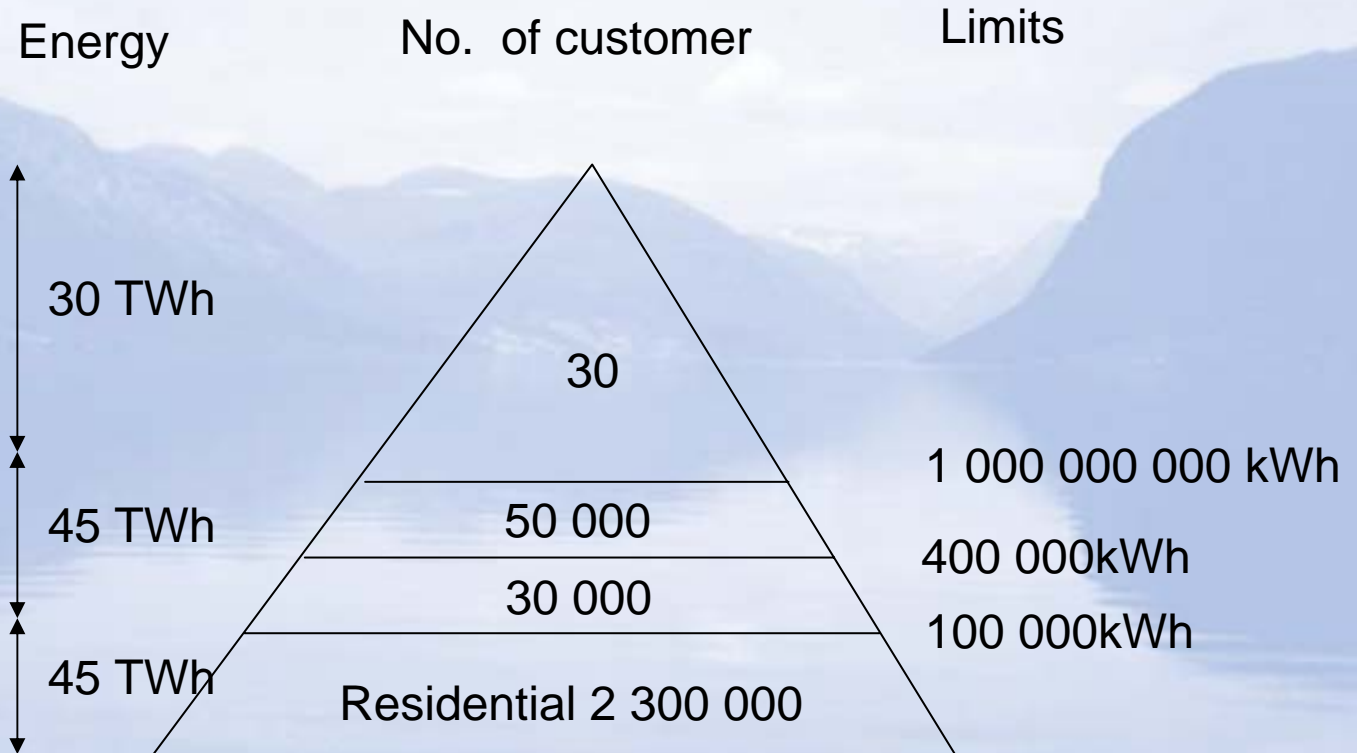
Dr. ing Kjell Øvrebø

- Customer segments in Norway
- Comment on technical specifications and investment constraints
- Demo 1: Solution for residential customers
- Demo 2: Solution for industrial customer

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Norwegian End-User Segments



Average residential approx: 20 000 kWh

Interesting End-User Loads

- Industry:
 - Heating
 - Electrical Boilers (with alternative oil supply)
 - Heating panels
- Residentials
 - Heating
 - Water Heating
 - Heating panels

Technology requirements for load management

- Price flexibility
 - Day ahead information
- Balancing
 - Real time information
 - Broadcast

Customers

- **Residential Customer**

- Energy 20 000 kWh
- Heating : 12 000kWh
- Power 4kW
- Balancing power: 3 kW , available 1 hour each day.
- Continues Load shedding: 0,5 kW , available 8 hours each day.
- Flexible spot control 3 kW, available 1 hour 50 days a year.

- **Industrial customer:**

- Energy 2 GWh
- Boiler 500 kW with alternative oil supply
- Balancing power : 500 kW , continuous available
- Continues load shedding: 50 kW available for 2 hours each day.

- **Base prices**

- Power: 0,5 NOK/kWh
- Transport : 0,5 NOK /kWh
- Extreme prices in balance market : 2 NOK/kWh 10 times each year
- Continues price difference in spot market 0,03 NOK in blocs of 4 hours.
- Spot peak prices 0,5 NOK above average price for 50 hours/yr

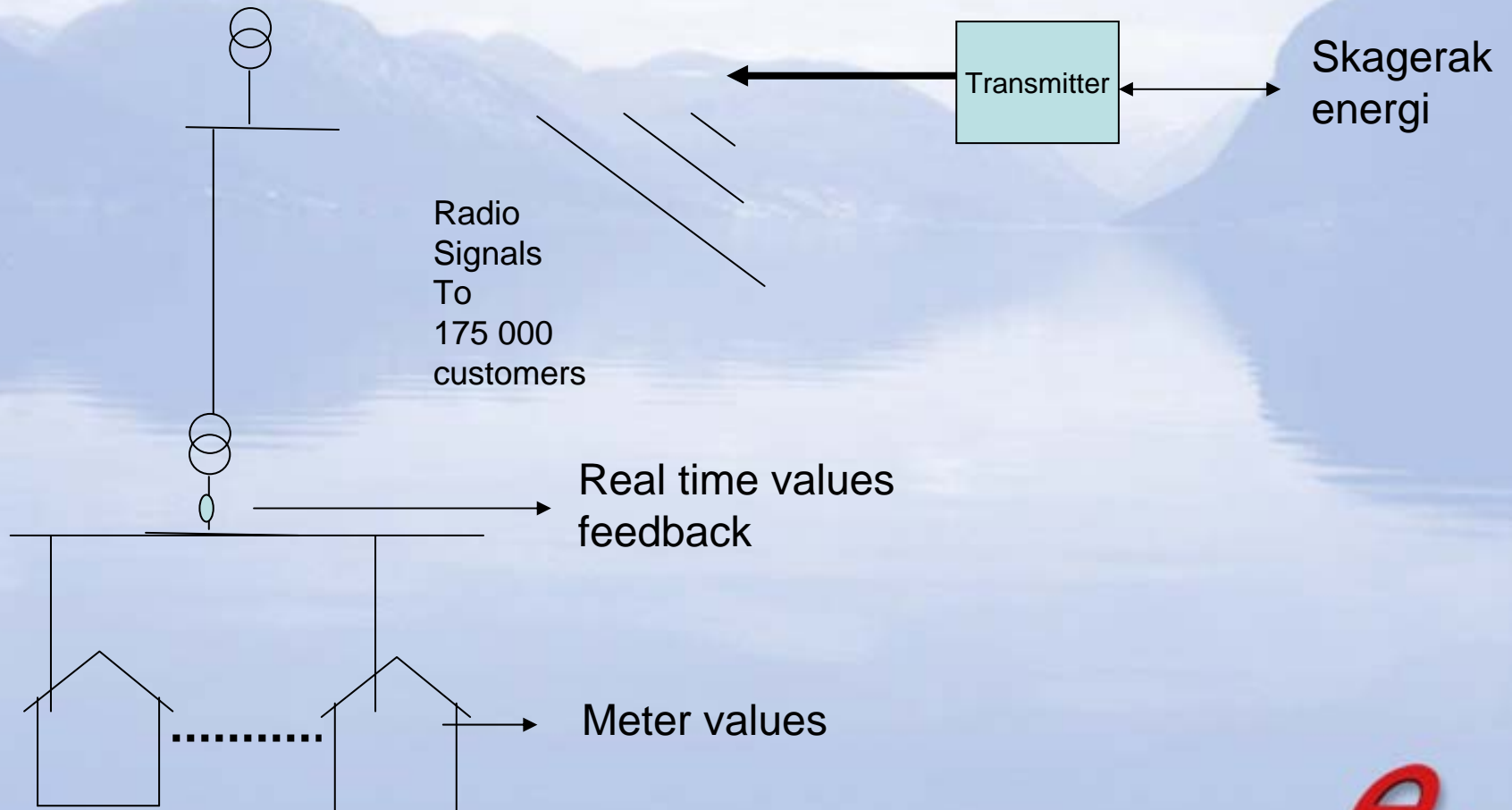
Load management values.

- Average residential (20 000kWh):
 - Balancing: 200NOK/yr
 - Local Tariff (0,5 kW load limit reduction): 240 NOK/yr
 - SPOT: 96 NOK/yr
 - Total : 550 NOK/yr
 - **Heavy investment constraints related to payback(< 500 NOK)**
- Industrial (2 GWh/500kW boiler):
 - Balancing: 32 500NOK/yr
 - Spot: 13 500NOK/yr
 - Total: 46 000 NOK/yr
 - **No investment constraint related to payback**

Demo1

- Residential customers at Skagerak Energi
 - Spot market adaptation
 - Customer density - High
 - Technology for load management
 - Local Radio >> Three transmitters covers three cities and 175 000 customers. Transmitters accessed through broadband and GPRS.
 - Independent of metering system(s)
 - Real time and broadcast functionality.
 - One Way communication.
 - Billing information received through existing hour meters.
 - Real time feedback from separate meters on aggregated grid levels.
 - Infrastructure investment cost approx. 2 NOK pr customer.

System

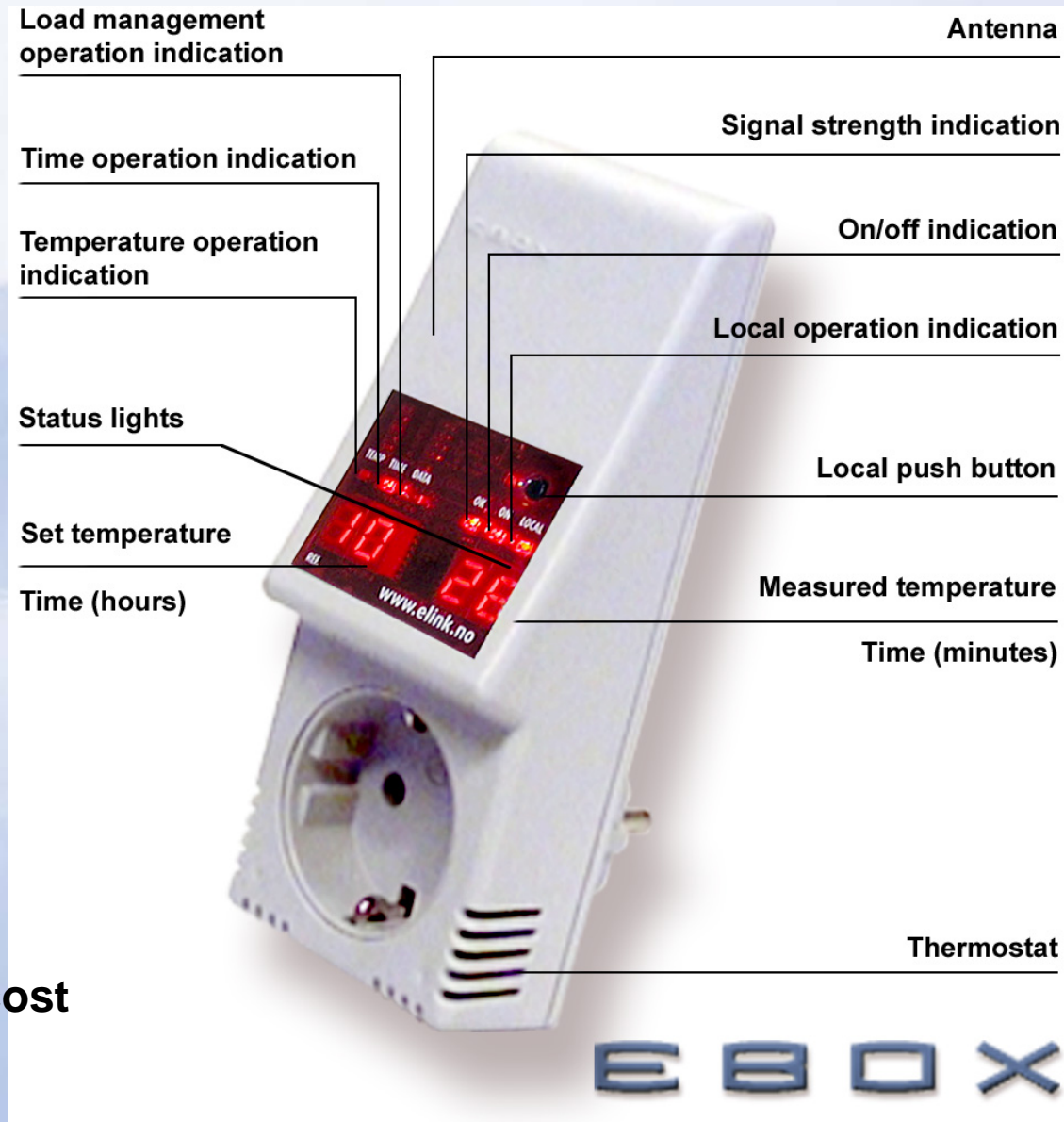


Solution to

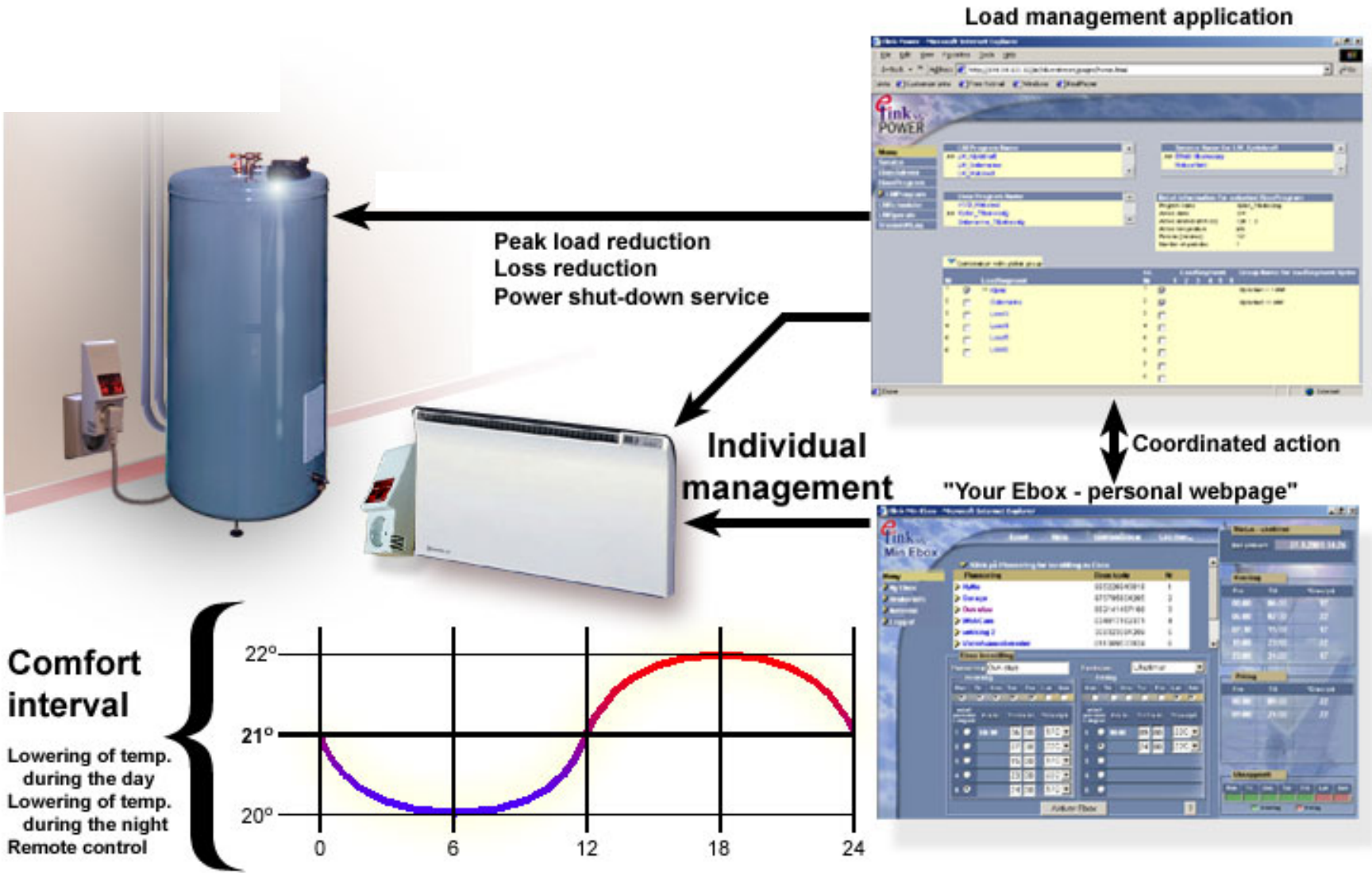
- Investment constraint.
- Real time demand

No Installation cost

No variable communication cost

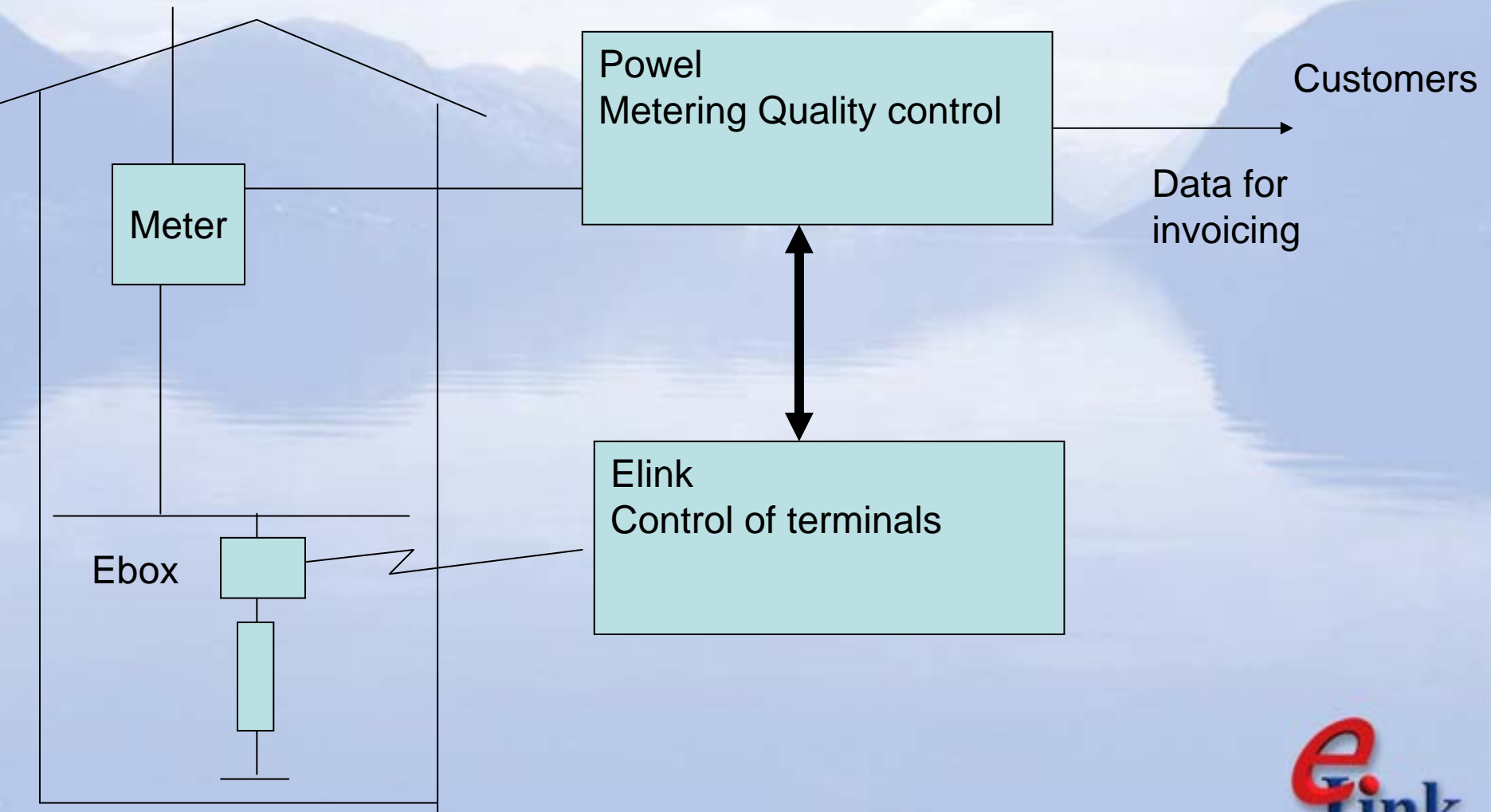


Demo 1: Solving technical flexibility.



Skagerak Energi

Logistics and System Integration are critical

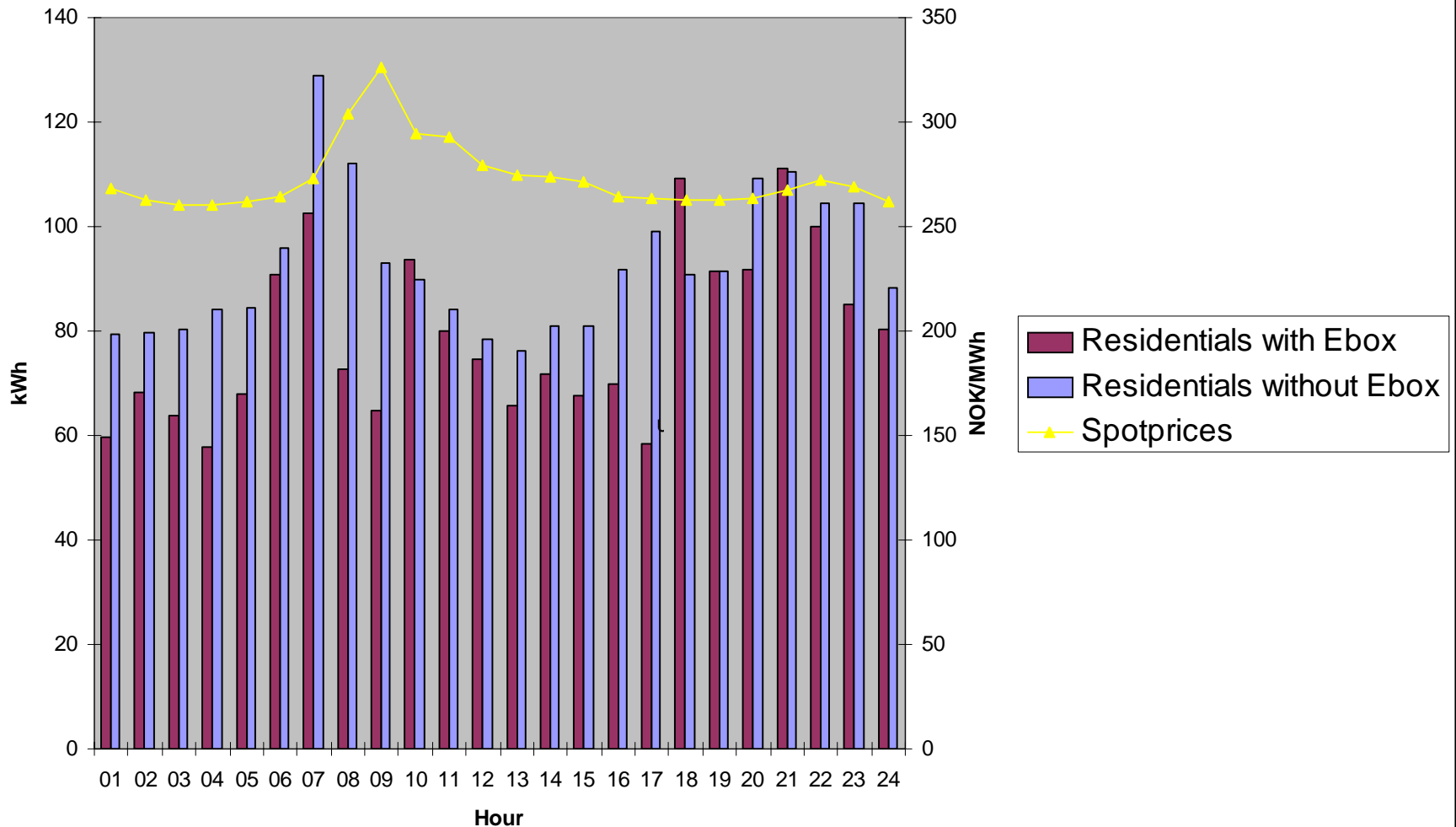


Automatic spotmarket control

- Customer contract
 - Load is available for control:
 - 07:00 – 10:00 and 16:00 – 19:00
 - Maximum active control in the intervalls is 2 hours.
- Control constraints
 - The customer contract makes the constraint for optimal cost performance.

Price flexibility

Spotmarket flexibility

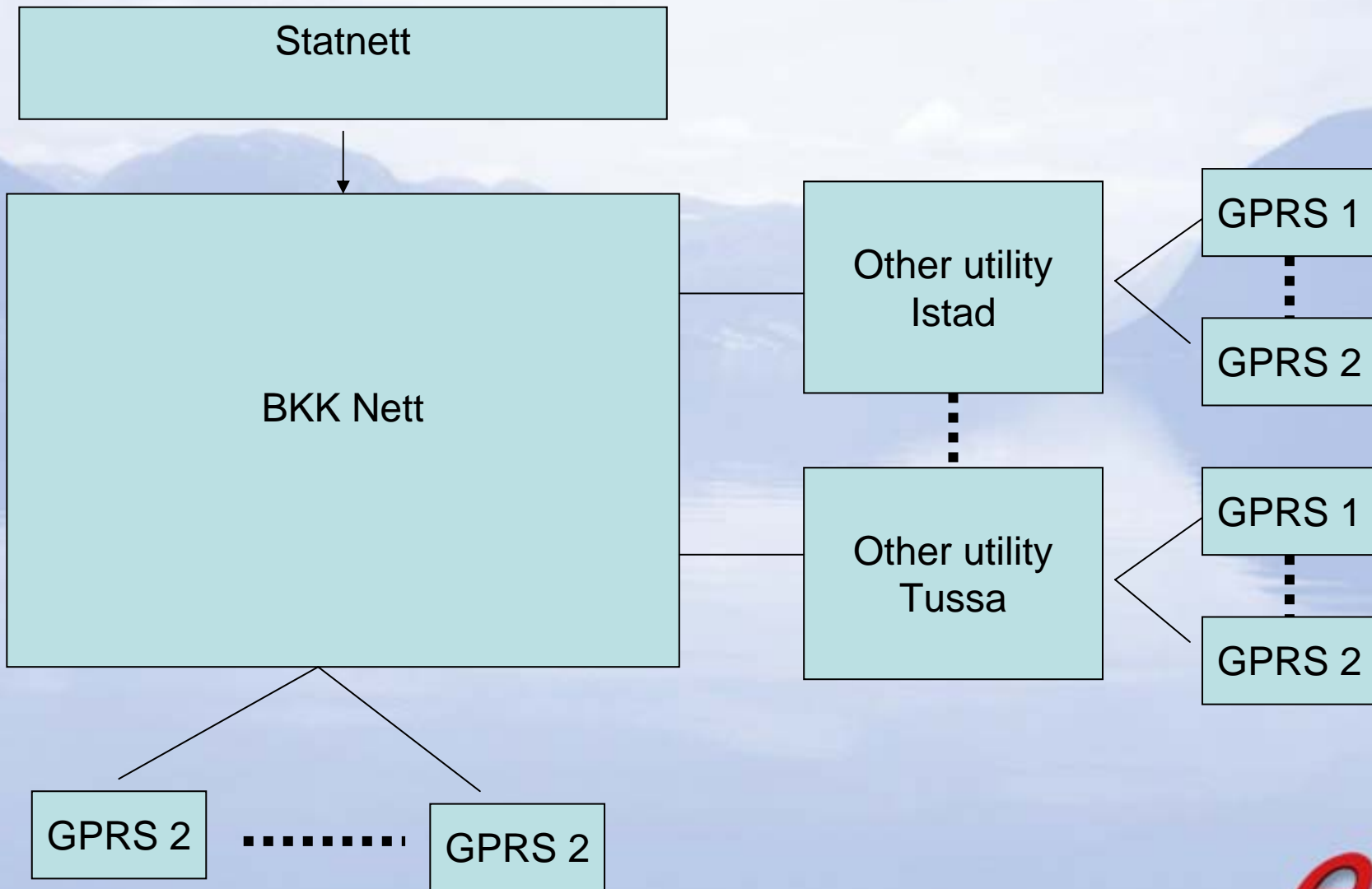


Demo 2: BKK Nett

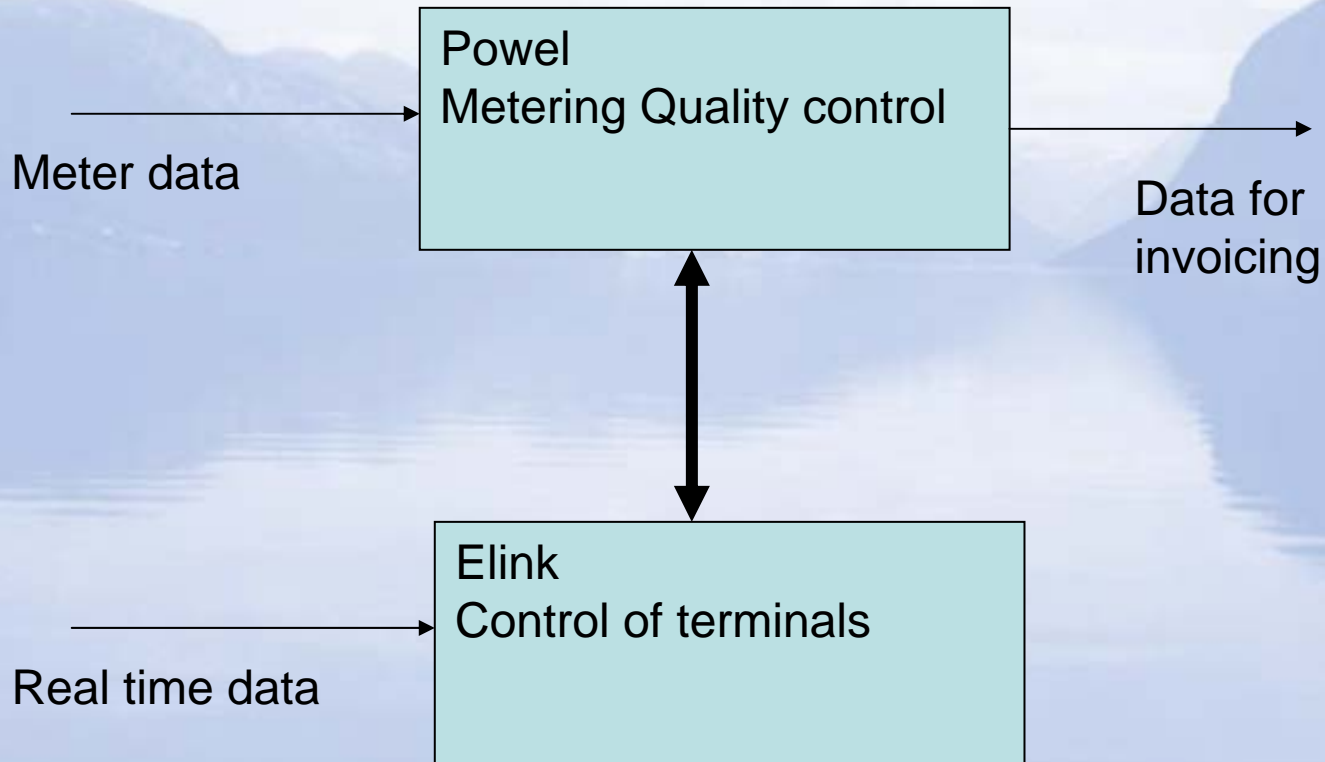
- Industrial customer
 - Balancing market
 - Customer density low
 - Technology for load management
 - GPRS – Public network.
 - Independent or integrated with metering system(s)
 - Real time and broadcast (packet radio) functionality.
 - Operation on behalf of several Grid utilities

Total Integration

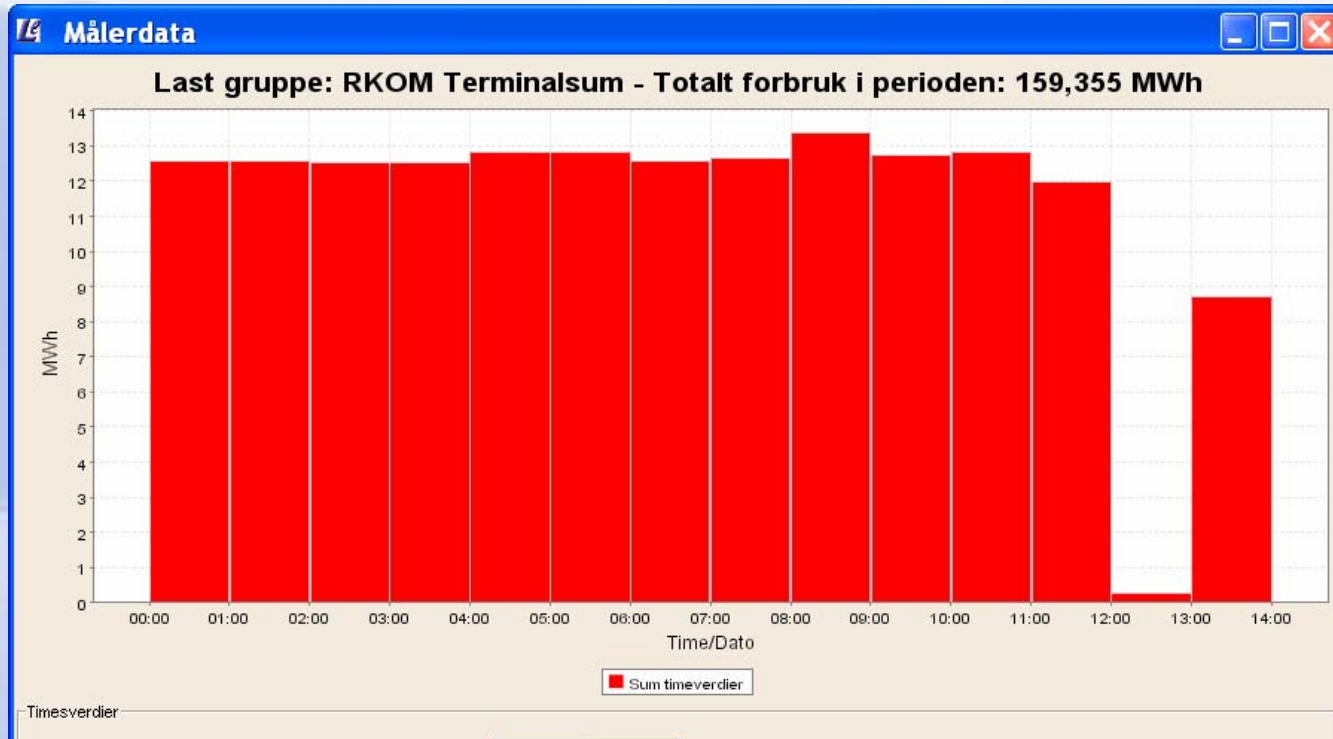
Option and balance market (RKOM)



System integration at BKK



Power control



***Power reduction for a group of BKK customers
The follow up of each load are in real time.***



Load management value 1.

- Balancing market:

- Option 50 NOK / kW
- Balancing power (2 NOK/kWh) 10 times a year

- Residential:

- $3 \text{ kW} * 50\text{NOK} / \text{kW} = \text{NOK } 150$
- $3\text{kWh} * 1,5 \text{ NOK/kWh} * 10 = 45$
- **Total: NOK 195 /Year**

- Industrial:

- $500\text{kW} * 50\text{NOK/kW} = \text{NOK } 25\ 000$
- $500\text{kW} * 1,50\text{NOK/kW} * 10 = \text{NOK } 7\ 500$
- **Total = 32 500 NOK/Year**

- Spot market

- Price difference 0,03NOK
- Peak price (1 NOK/kWh) 50 times a year

- Residential:

- $0,03 \text{ NOK/kWh} * 0,5\text{kWh} * 4 * 365 = \text{NOK } 21/\text{year}$
- $0,5 \text{ NOK/kWh} * 3 \text{ kWh} * 50 = 75\text{NOK}/\text{year}$
- **Total: 96 NOK /Year**

- Industrial:

- $0,03 \text{ NOK/kwh} * 50\text{kWh} * 2 * 365 = 1095\text{NOK}/\text{yr}$
- $0,5 \text{ NOK}/\text{yr} * 500\text{kWh} * 50 = 12500\text{NOK}/\text{yr}$
- **Total = 13 5095NOK /Year**

Comment: If the alternative fuel (oil) price is below or equal to the equivalent elspotprice the savings will increase significantly.