Hej!

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Joris van Rooij
AMI System specialist @ Göteborg Energi
Industrial Ph.D. student @ Chalmers

Göteborg Energi

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- Advanced Metering Infrastructure?
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Varje dag – för ett hållbart Göteborg!

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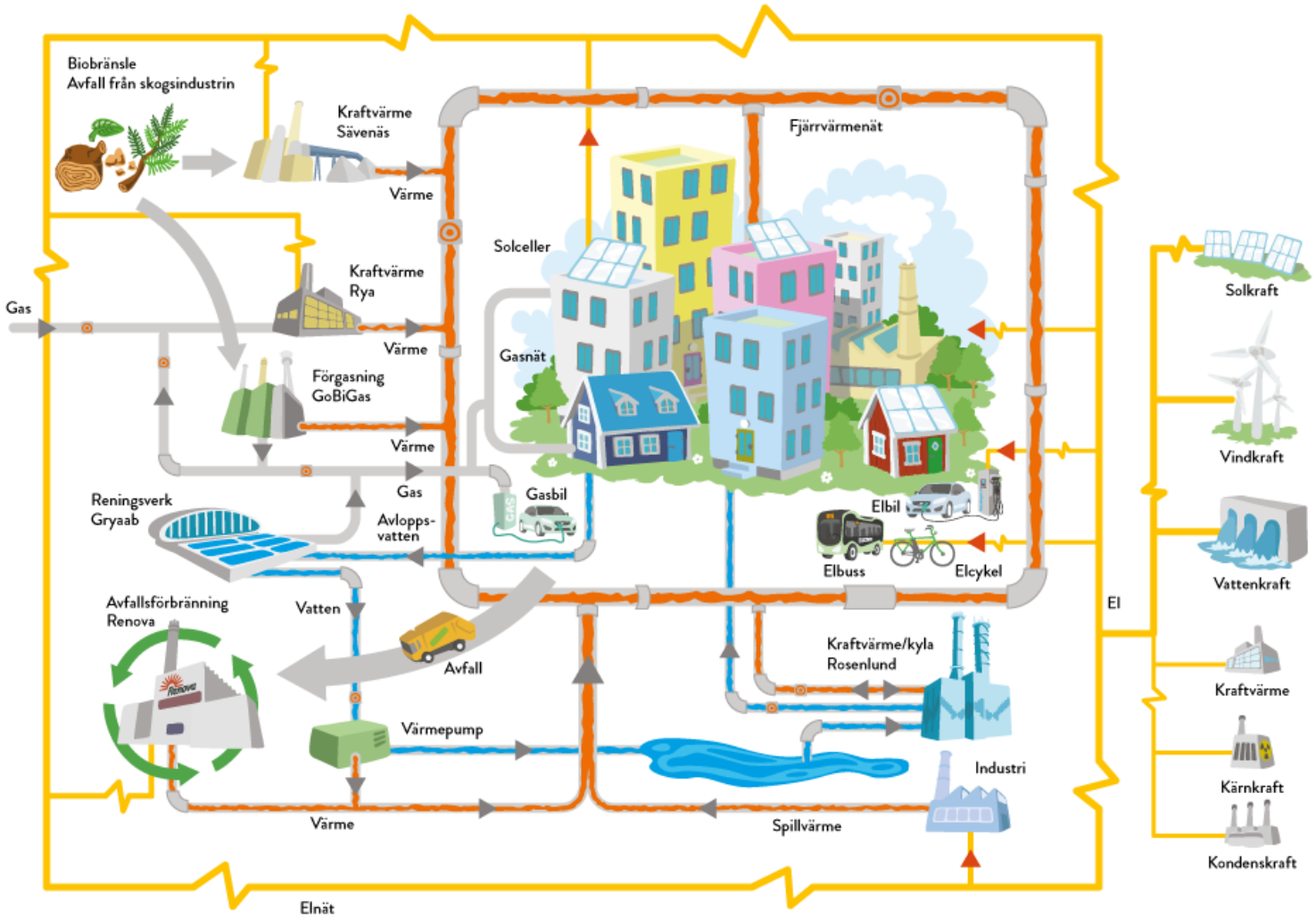
Hållbar energiförsörjning – attraktiva lösningar



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Goals

The city wants to:

- Integrate and develop the utility in city development in order to reach a sustainable göteborg-community.
- Have sustainable, reliable and affordable energy for the people in Göteborg.

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Our mission

- Production, distribution and trade in the energy area
- Ensure affordable and reliable energy for the people in Göteborg
- Be responsible for improving energy efficiency in Göteborg

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Göteborg Energi i siffror 2016

	2016	2015
Employees	1 051	1 068
Result, mkr	610	-645
Turnover, mkr	5 963	5 641
Electricity production, GWh	735	389
Electricity distribution, GWh	4 436	4 326
Sold district heating, GWh	3 558	3 335
Sold gas, GWh	940	903

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Our fantastic
District Heating

- Provides warm water for 550 000 showers every day
- Gives warmth to over 90% of the appartment buildings in Göteborg.
- Has a reliability of 99,98%
- Transported by 1 350 km pipes through the city
- Mainly from waste heat
- Is an example in Europe

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Our stable
Electricity supply

- Runs 154 trams,
  200 000 hairdryers och 95 000 streetlights
- Distributed through 9 000 km of cables
- Reliability of 99,99%

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Every day…
vi also work with

- Gas
- District cooling
- Broadband
- Biogas
- Energy services
- Charge infrastructure
- City development

…and many new sustainable solutions for the future!

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Göteborg is growing - 2035

150 000

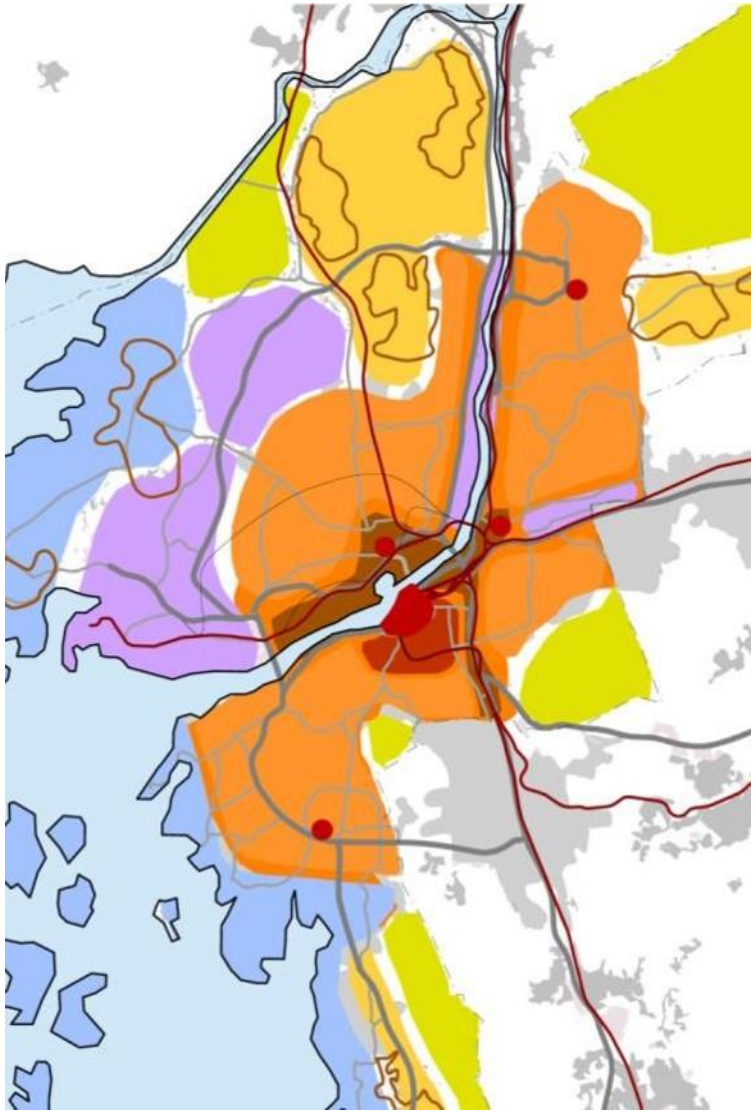
more citizens

70 000–80 000

new houses

80 000

new jobs



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Advanced Metering Infrastructure?

- When is it advanced?
- AMR Automatic Meter Reading
- Log and send events
- Send and receive control messages

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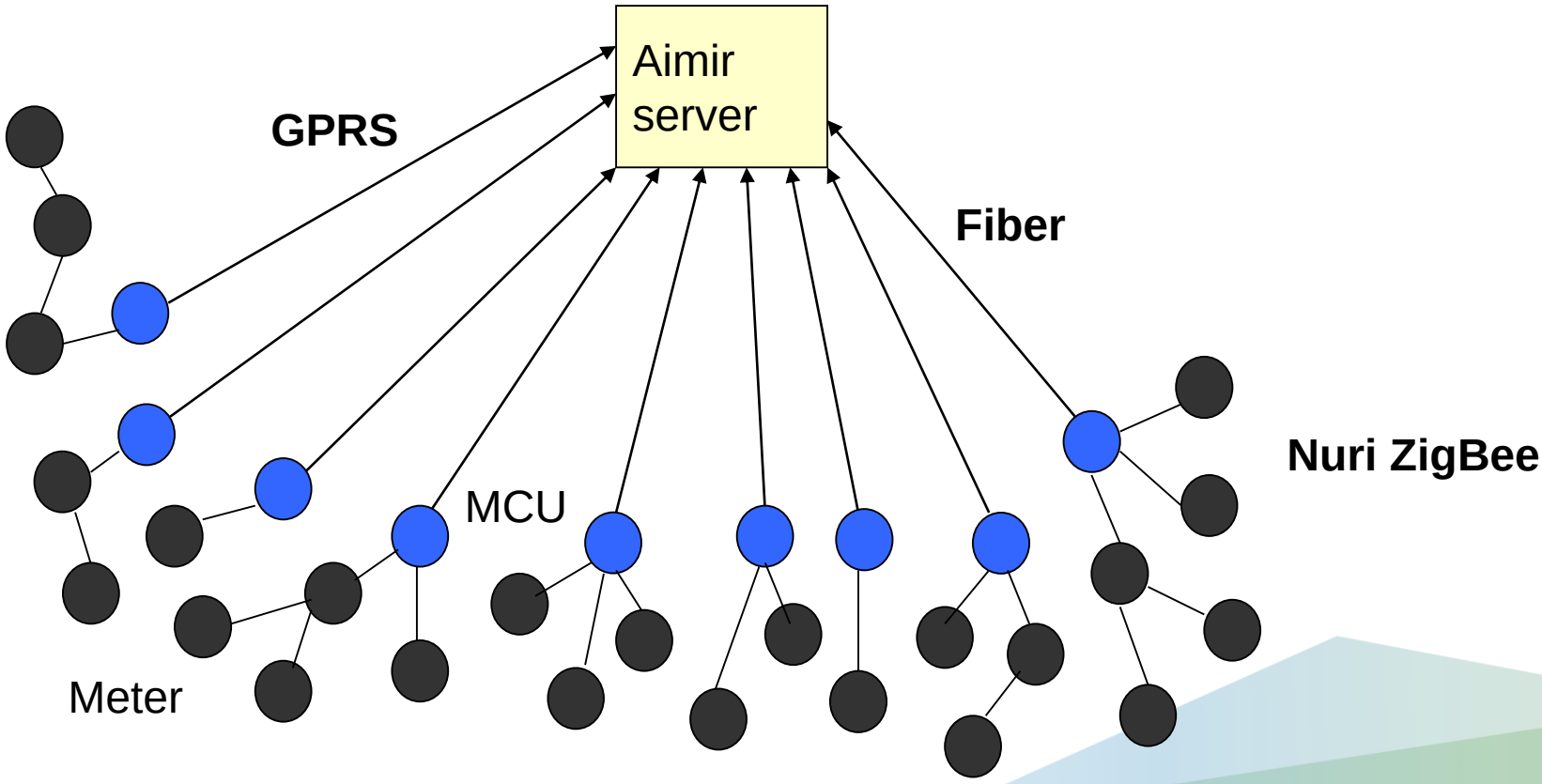
AiMiR

- ZigBee based AMI system



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AiMiR facts

- 270 000 electricity meters
- 5000 district heating meters
- ~~3000 water meters~~
- 8000 collector units

- Self-healing radio network
- Redundancy in metering values
- Power quality data
- Power outage events
- Breaker function

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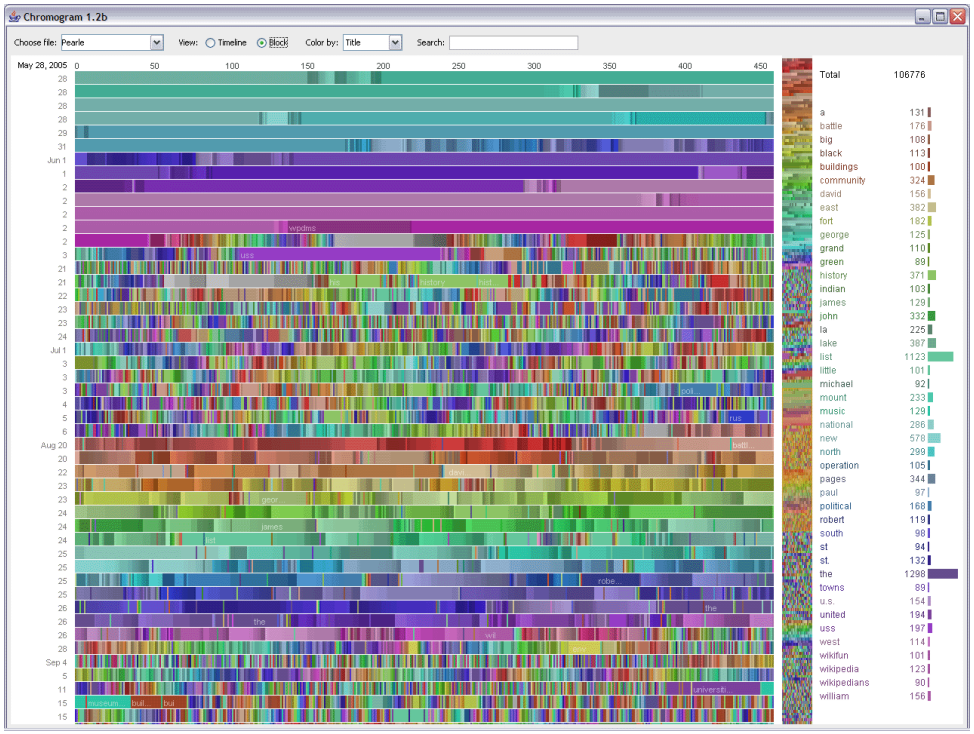
Challenges

- **Big data**
- 270000 x 24 meter values + some extra
- 270000 x 6 x 2 power quality values
- Loads of events
- Topology data
- Noise
- Every day…



Find the information in the data

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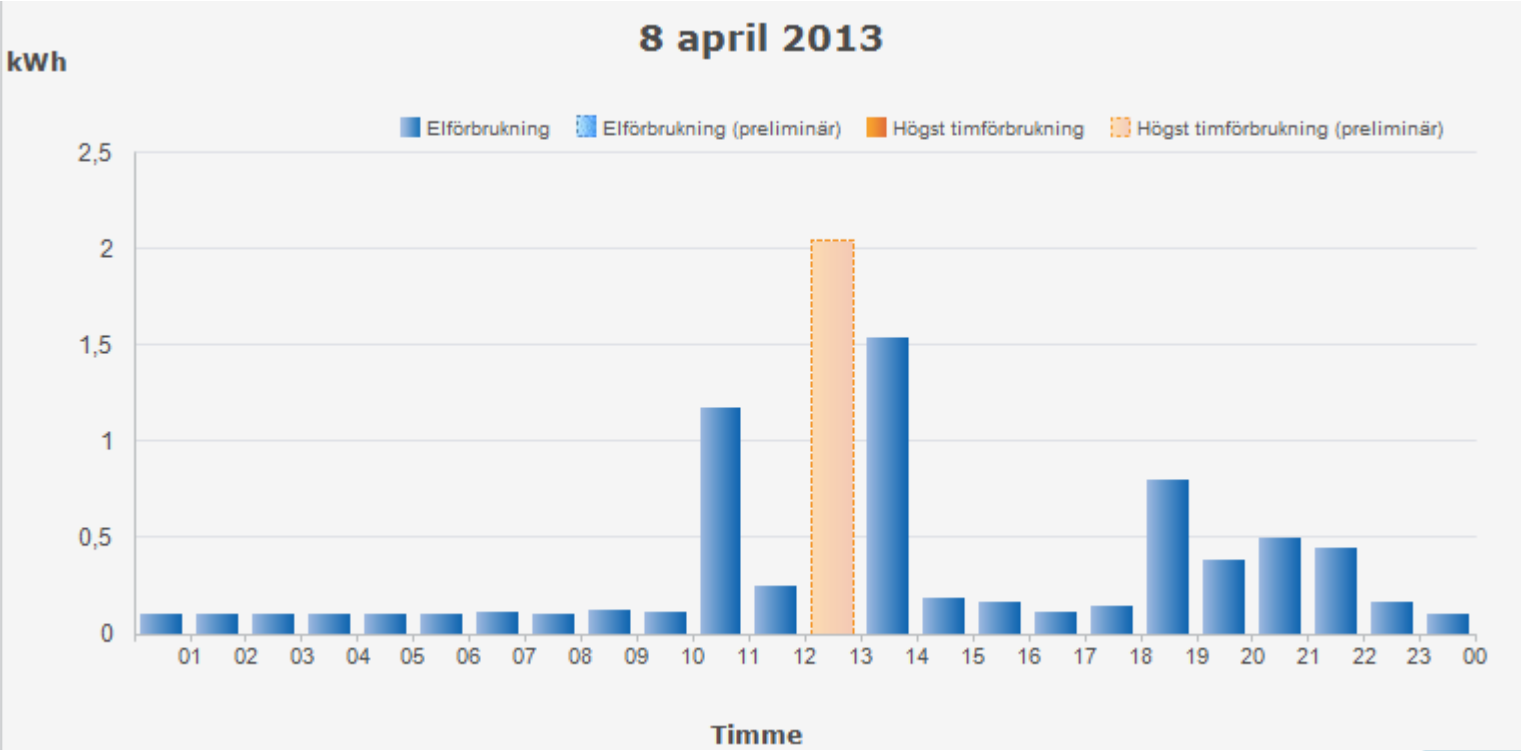
Challenges

Privacy



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Challenges

- Time
  - 278001 clocks in the network
  - How to deal with disagreements

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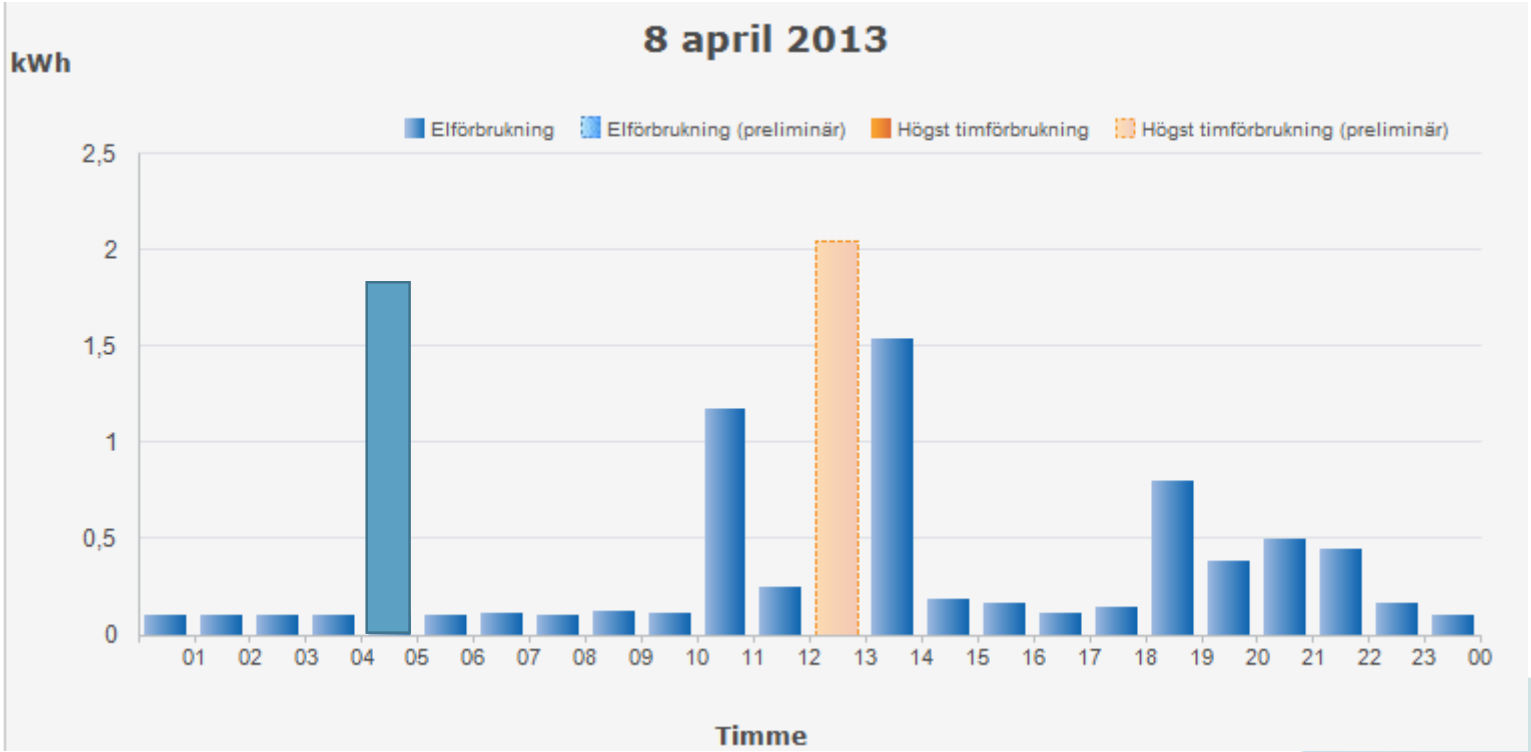
Some time implementation

- Central server
  - NTP
- Collector units
  - Resets daily @ 8:00
  - Syncs twice a day against the central server (after reset and 12 hours later)
  - System clock with hardware clock as backup
  - Hardware clock syncs with system clock right after system clock sync
- Meters
  - Receive a broadcast with the current time once every hour

What could possibly go wrong?

Challenges

- Validation



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Challenges

Emergence

Wikipedia:
emergence is the way complex systems and patterns arise out of a multiplicity of relatively simple interactions.

- In other words:
- Put lots of smart meters on a small area and unexpected things might happen.

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Thesis opportunity!!

Goal:
- Identify small scale power outages from the meter alarms and present these to the network operators

Challenges:

- Alarms are noisy
- Unreliable communication network
- Wildly varying rate of messages

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Questions?

Joris van Rooij
joris.vanrooij@goteborgenergi.se

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Tack!

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