

Improving the Energy Efficiency, Reliability and Performance of AGOR Cyclotron 2013 Mariet Hofstee



outline

- History
- Approach
- Case Studies
- Outlook



History 2003-2013

- In 2003 a new separator was built for the TRI μ P program.
- In 2005 a Noctua monitoring system for the electrical power consumption was installed, and expanded in 2007
- Since 2005 the European space agency ESA uses the irradiation facility for radiation hardness testing.
- In 2006 the Irradiation beam line (H-line) was moved from the west to the east side of the building.
- In 2007 a SUPERNANOGAN ECR source was obtained on loan from HGB.
- In the 2007/2008 winter maintenance period a heat recovery system was installed on the big cryo-compressor.
- In 2008 the 1kW beampower requested by TRI μ P was achieved.
- In 2012 the power distribution system of the building was completely replaced.
- On 31-dec-2013 TRI μ P-funding will end



Approach

- Expectations
- Bounday conditions
 - Financial
 - Manpower
- Method
 - Measure Actual Usage
 - Identify Oportunities and Assess Risks
 - PLAN
- Goal
 - Same or better performance at less cost



Subsystems

- Cryo Compressors
- Magnet Power Supplies
- Vacuum
- Control Electronics
- RF
- Ion Sources
- Cooling and Heating
- Compressed Air
-



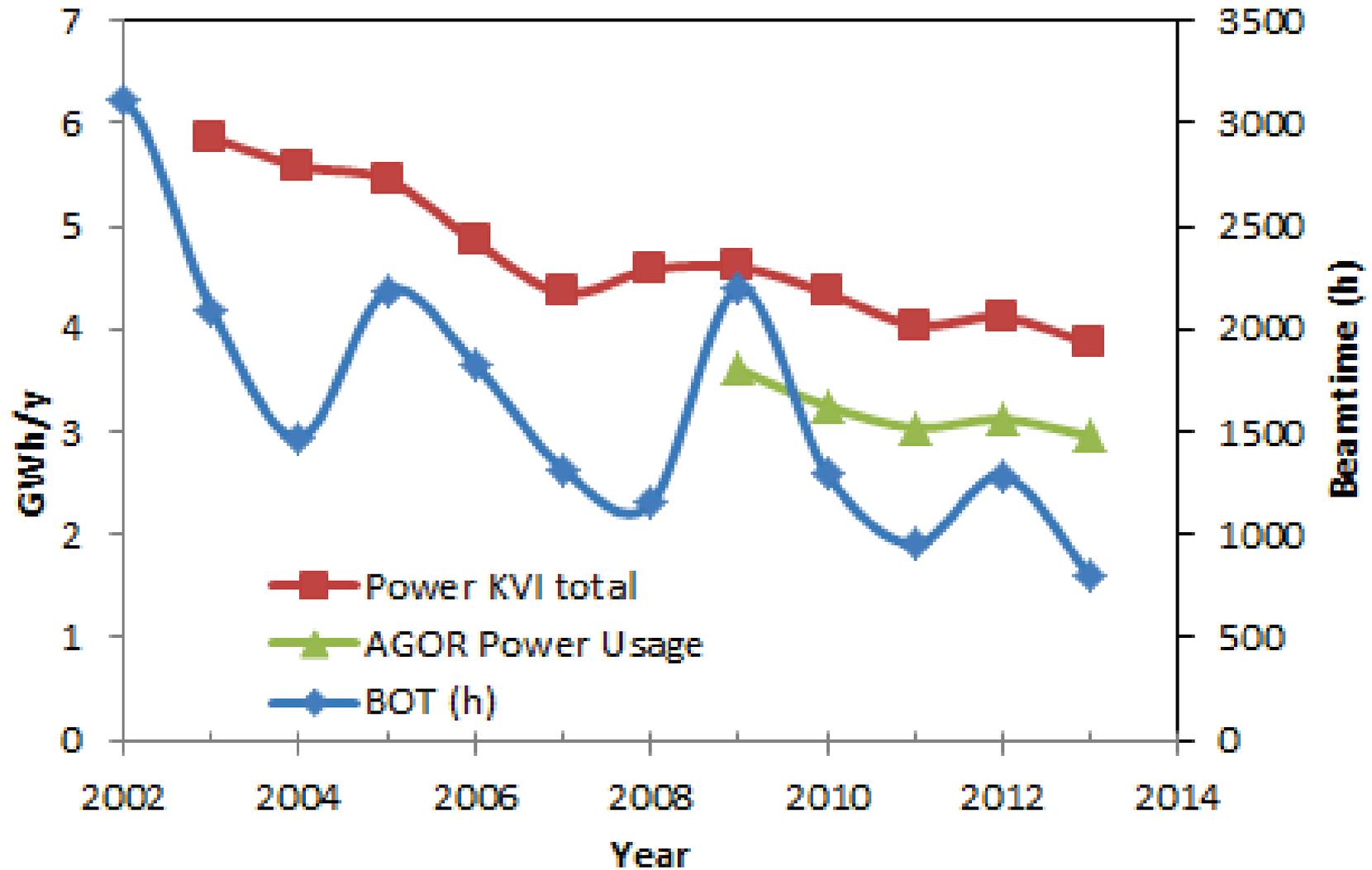
Case Study 1: Critical look at electrical power usage

- Installation of 32 meters
- Analysis of usage
- Optimizations
 - scheduling
 - Cryo operations
 - lower anode voltage RF
 - choice of favorable beam properties when developing new beams

Result: Reduction energy cost/beam hour

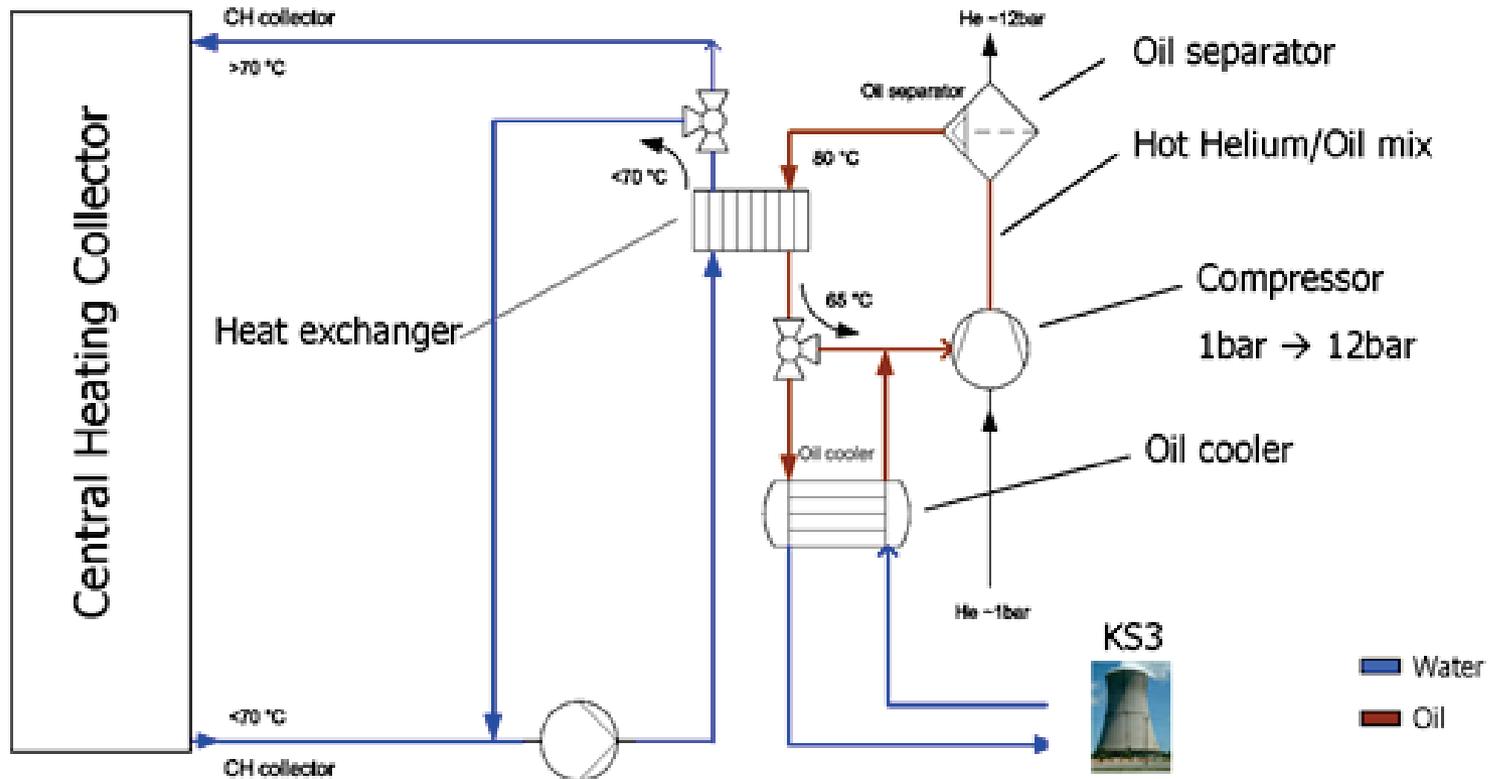


Electrical Power Usage

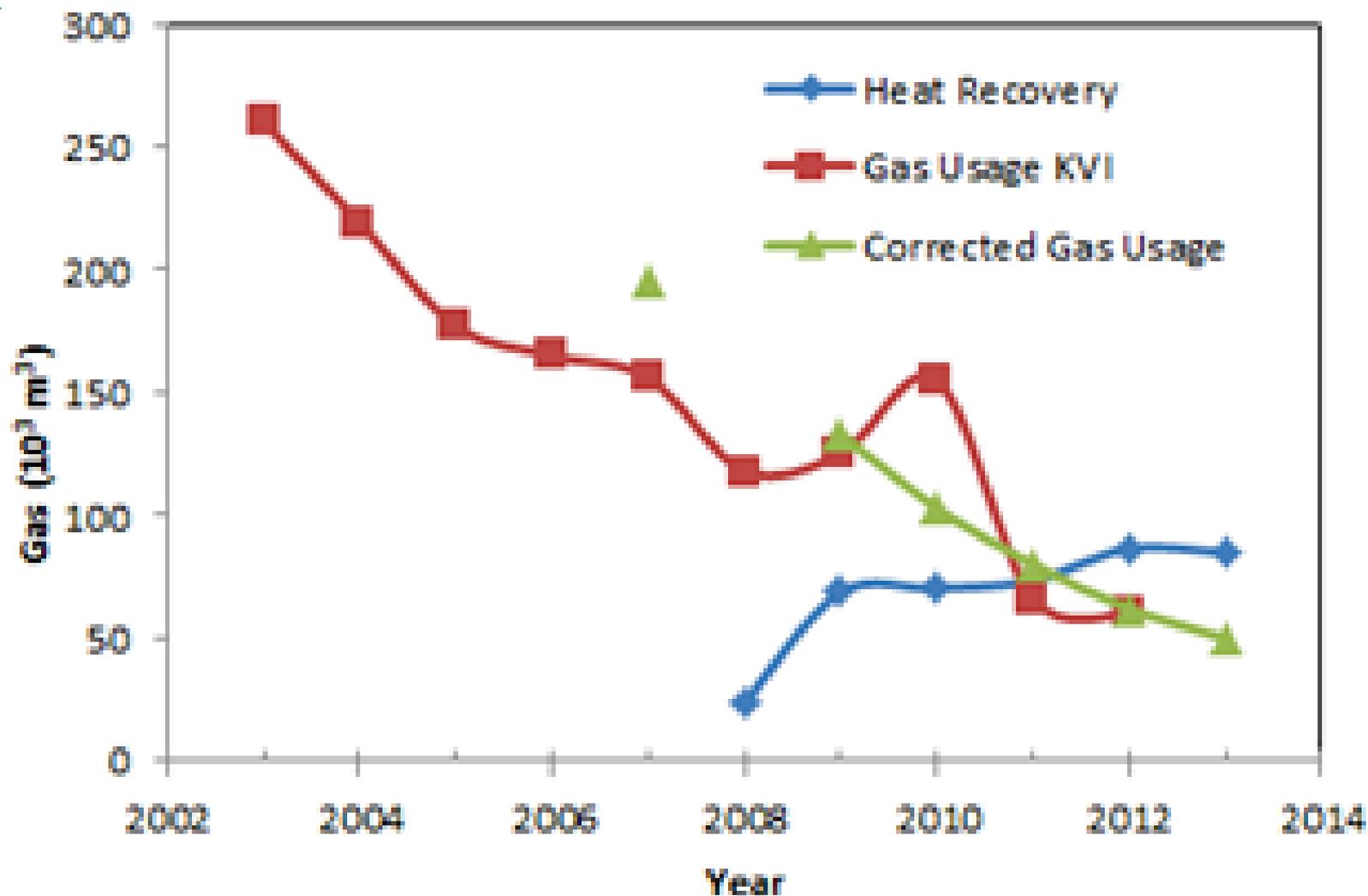


Case Study 2: Heat Recovery System

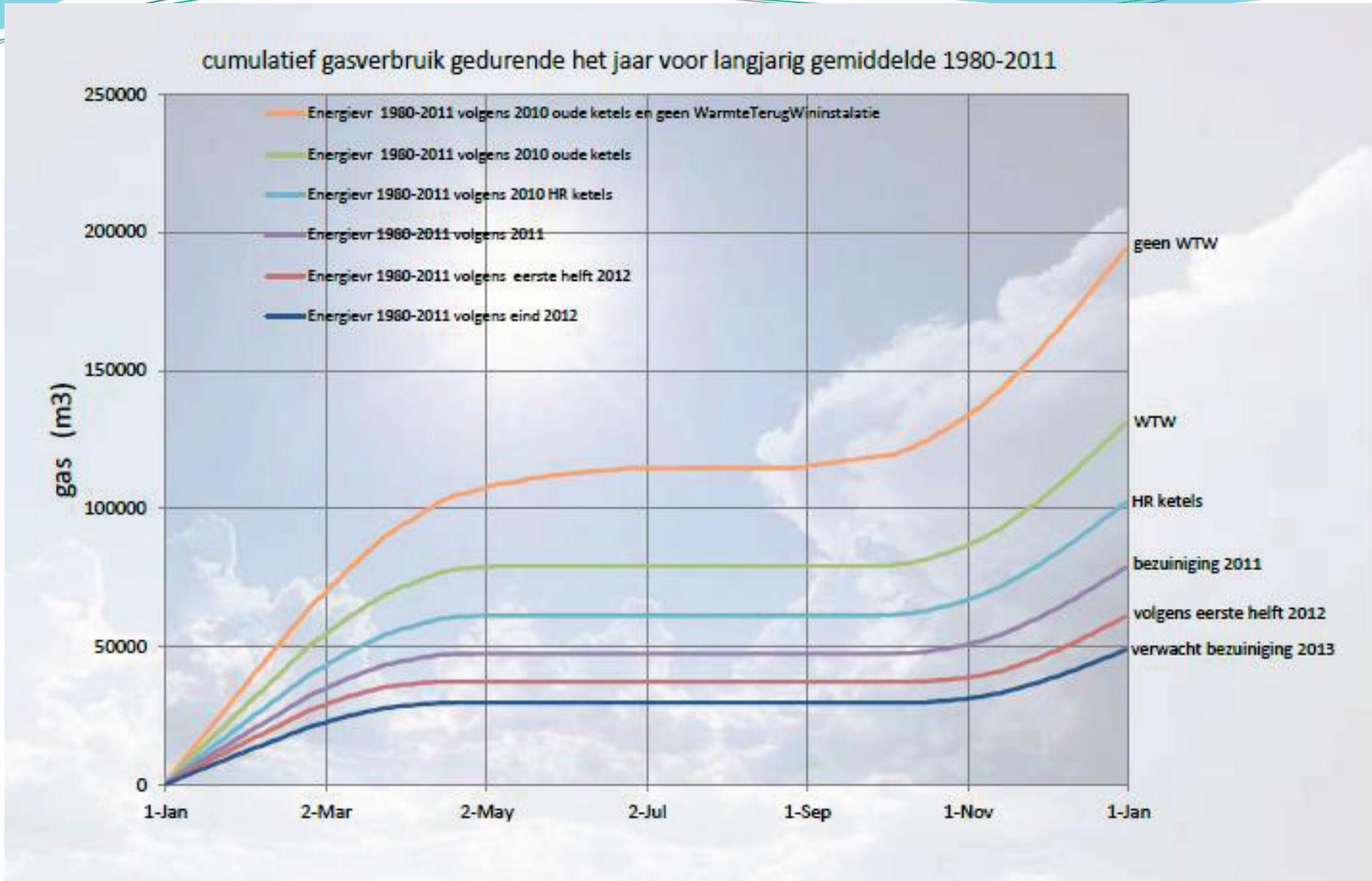
- Suggested in Annual Report 2006
- Investments estimated at 40k EURO



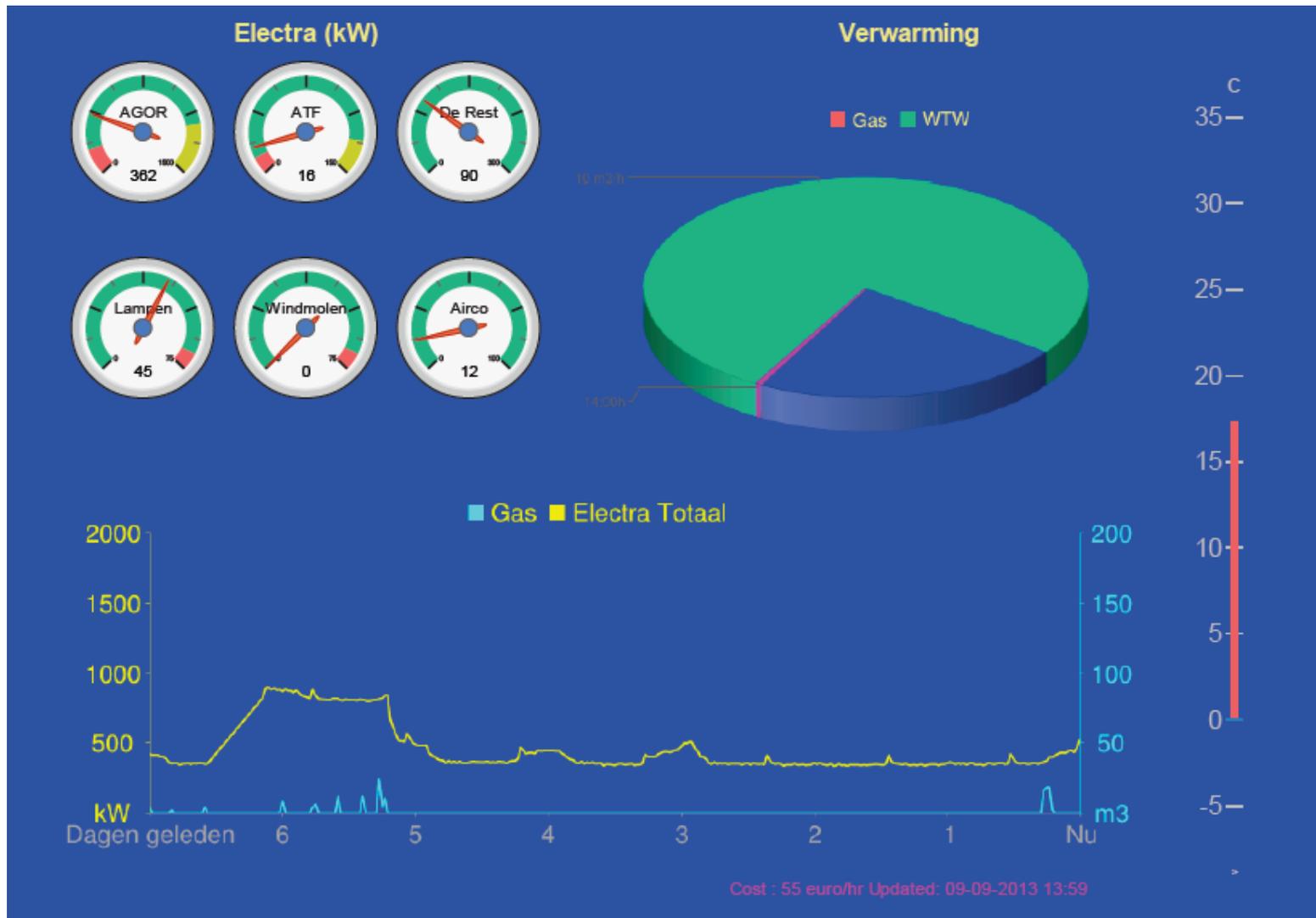
Improvement in Gas consumption of KVI as a whole



Extensive Modeling



Control Room Display



Food for thought

- Some improvements seem trivial, yet were not implemented
- KVI is not unique/special
- Measure to know what you use
- DO TRY THIS AT HOME



Outlook

- Keep looking for more opportunities
- Vigilance
- Creativity

