operational excellence

with artificial *energy* intelligence (A*E*I)

ir. Rob Burghard

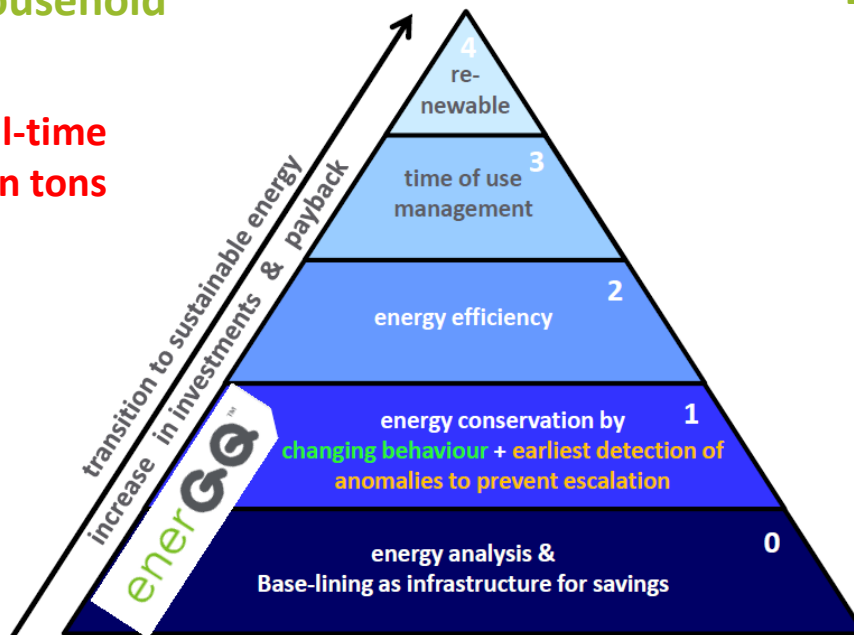## the problem from household to multinational:

Global CO$_2$ emissions all-time high in 2017: 36,8 billion tons

Human activity is the main cause of excess energy consumption:
- **Operation**
- **Housekeeping**
- **Maintenance**

Due to lack of
- **Self efficacy**
- **Knowledge**
- **Awareness**

transition to sustainable energy
increase in investments & payback

enerGQ™

4 re-newable

3 time of use management

2 energy efficiency

1 energy conservation by changing behaviour + earliest detection of anomalies to prevent escalation

0 energy analysis & Base-lining as infrastructure for savings

Based on Energy Pyramid from EnSave Inc.

Deviation energy monitoring is fundamental for transition

frequency

average

actual

best

++ + - -

energy consumption*
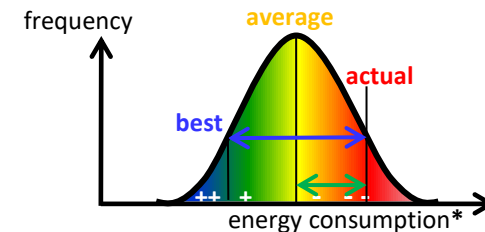
Added Values: Low Cost, payback: <1 year 5% - 30% savings

Development of awareness, knowledge, self-efficacy

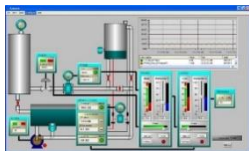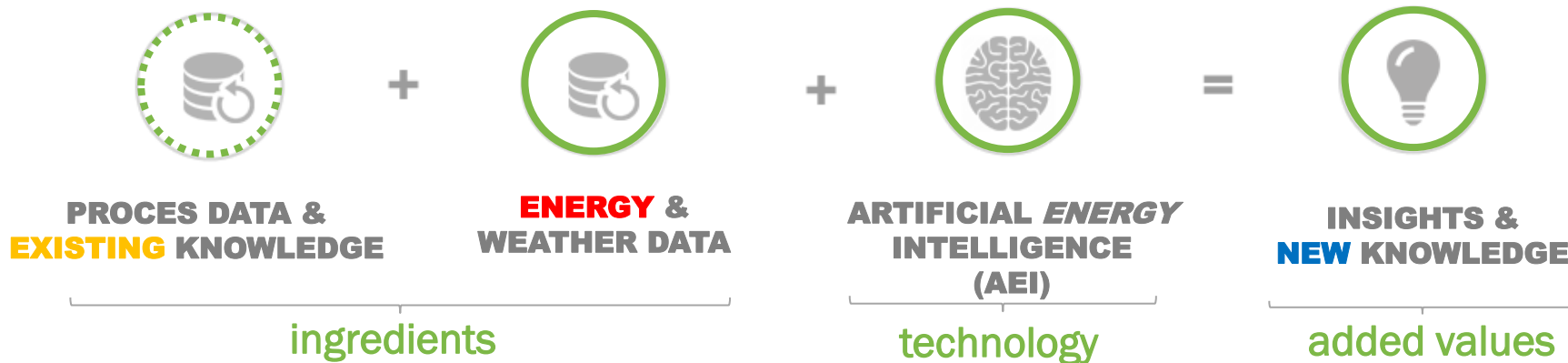PRODUCTIE PROCES AUTOMATISERING
PPA19
29-01-2019 • Hart van Holland in Nijkerk
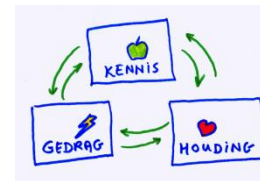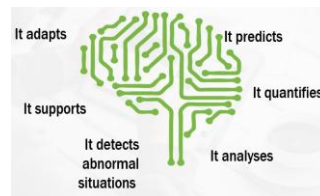
Industrie 4.0 Cyber Security
Industrial Internet of Things Data
Cloud IT/OT Integration

What is artificial *energy* intelligence ?

PROCES DATA &
EXISTING KNOWLEDGE

+

ENERGY &
WEATHER DATA

+

ARTIFICIAL *ENERGY*
INTELLIGENCE
(AEI)

=

INSIGHTS &
NEW KNOWLEDGE

ingredients

technology

added values

PRODUCTIE PROCES
AUTOMATISERING
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Added Values

Anomaly **detection** at the earliest possible stage. → **Prevent escalation** and loss of value

Secure and enrich **knowledge** → Savings through **behavioural changes**

Optimization of set-point combinations → **Best performance** all the time

PRODUCTIE PROCES AUTOMATISERING
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Why has using AEI become easy?

1. Energy consumption is a *holistic* parameter for every process that relates directly to asset and process *performance*. The same applies to power quality.

2. 'Tons' of *unused* process data available! (but little or no energy data from the process…….)

3. Process performance is much closer to core business than energy saving alone.
   → → → Simply better business cases.

4. New technologies available:
   - state-of-the-art sub-metering and power quality monitoring technology
   - High performance streaming data base technology
   - Secure data interfacing solutions
   - Machine learning and other AI techniques

New generation energy monitoring, data transfer and analysis gives new generation solutions

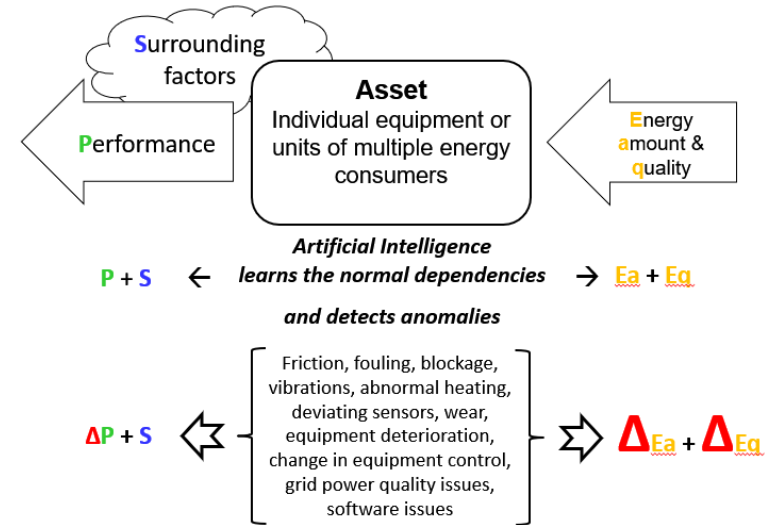PRODUCTIE PROCES AUTOMATISERING
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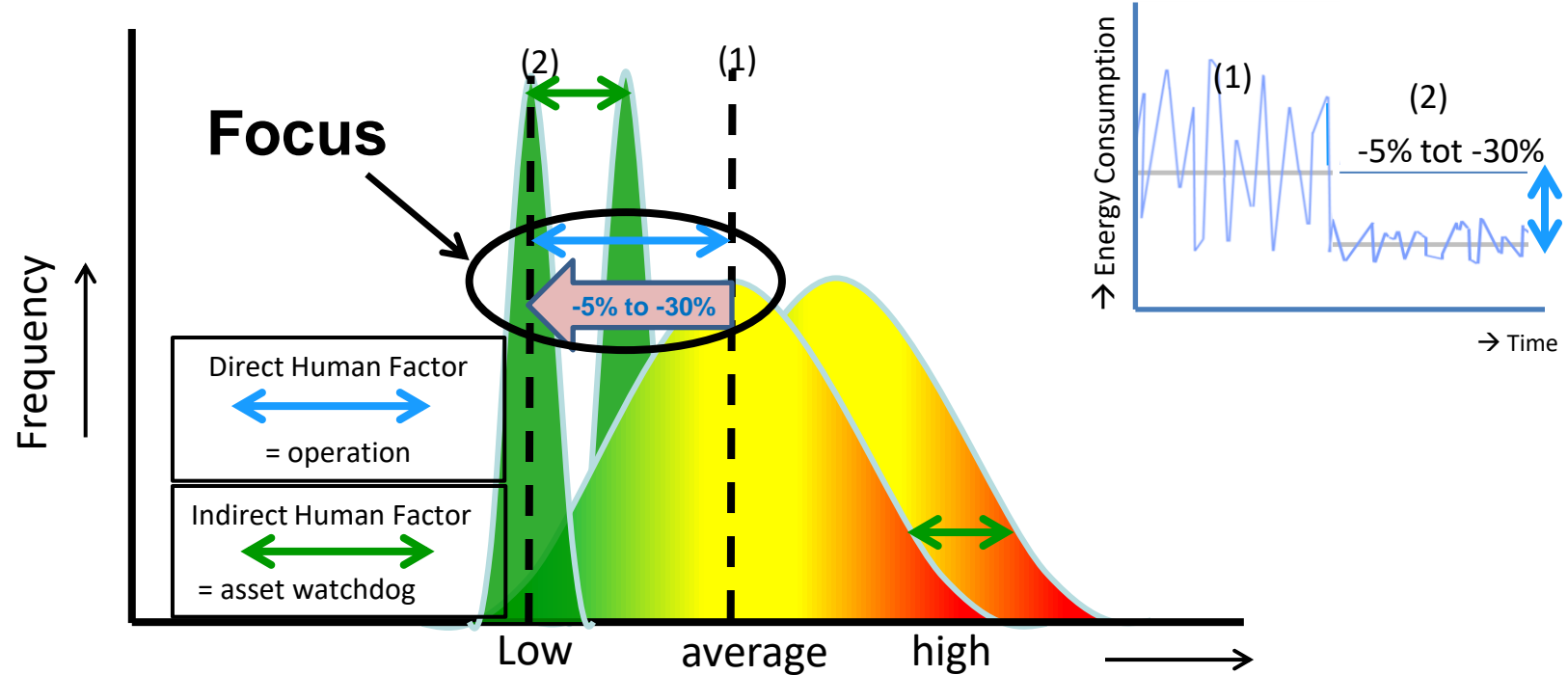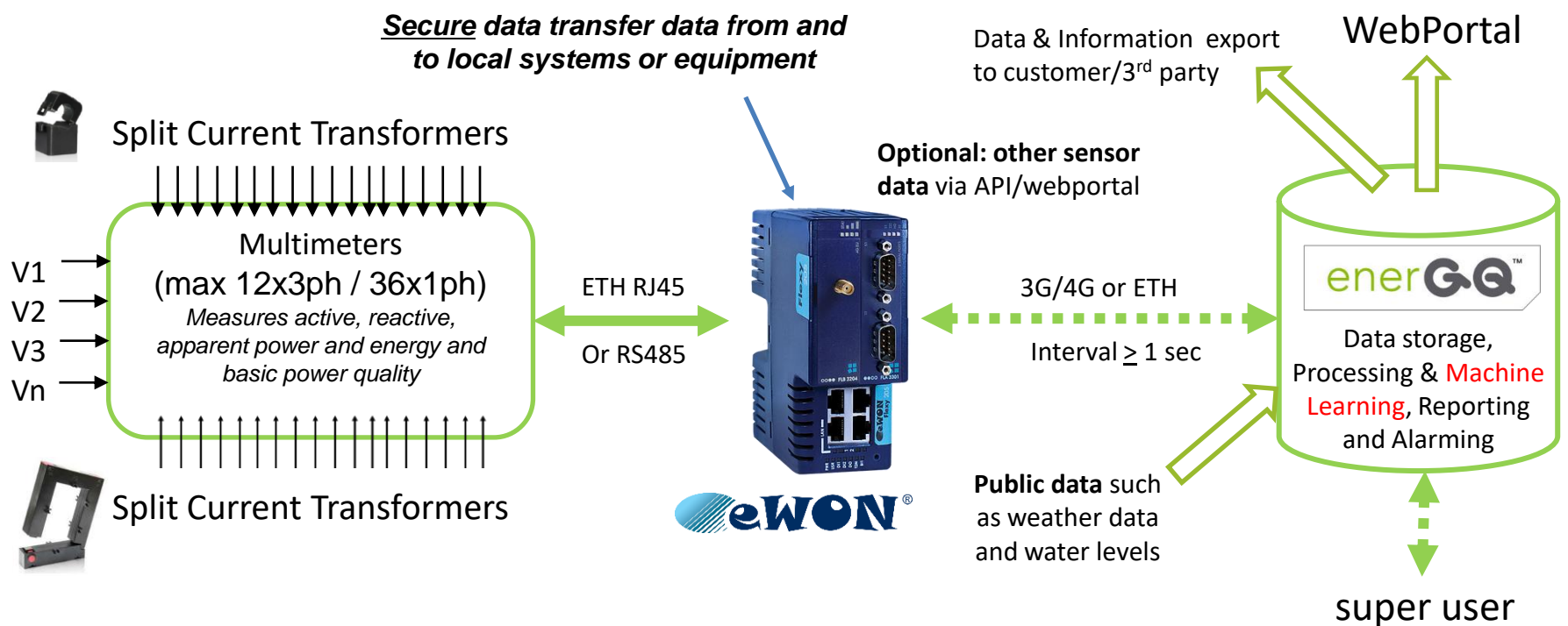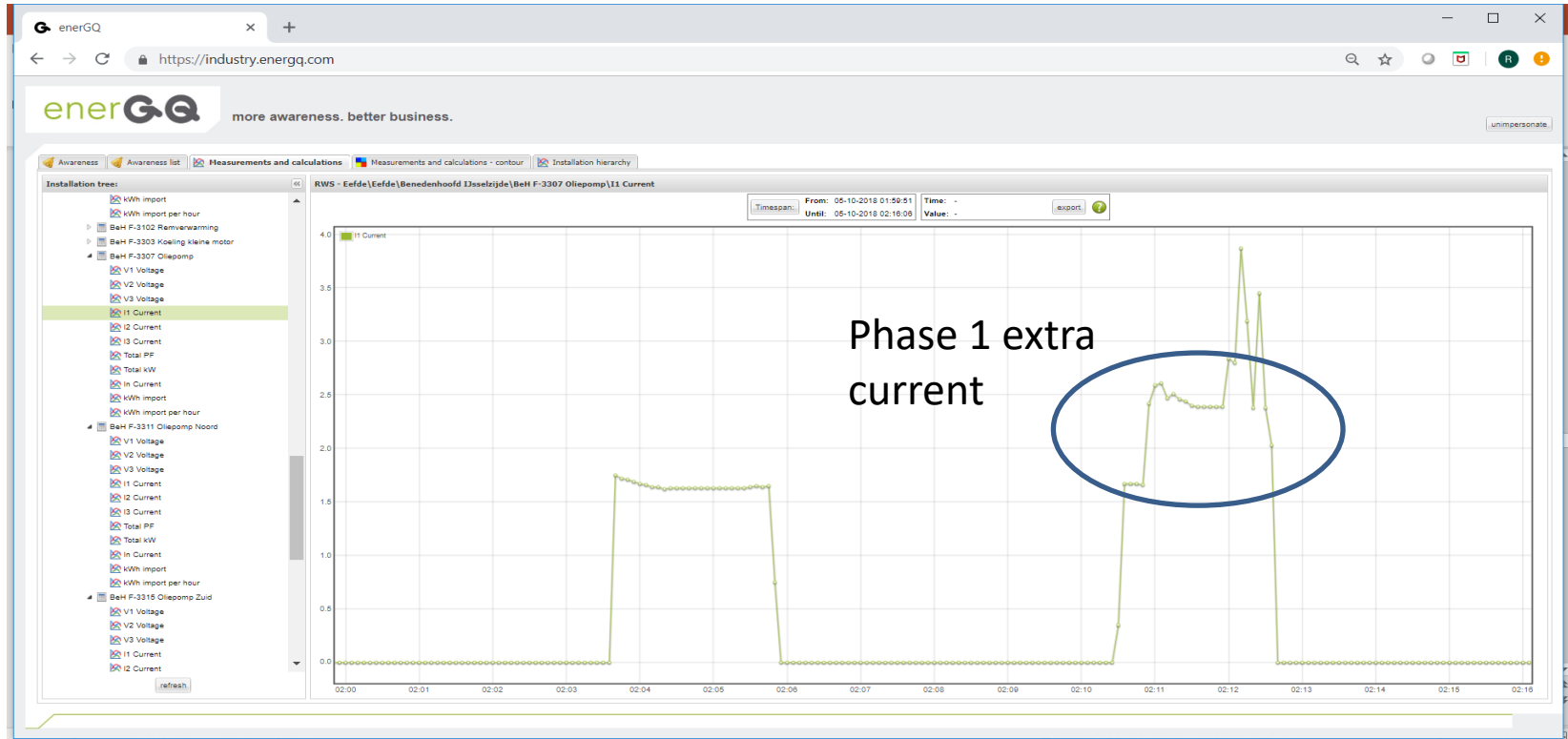Cloud   IT/OT Integration

excess energy consumption 10 important causes and the solution

1. Lack of insight in deviation from normal energy consumption
2. Equipment is switched on too early or switched off too late.
3. Sub-optimal combinations of set-points
4. Sub-optimal settings of controllers (often resulting in "by hand" modus)
5. Sensors for measurement and control becoming in accurate with time
6. Sub-optimal housekeeping & maintenance
7. Overheating and/or vibrations of rotating equipment due to e.g. cavitation
8. Unnecessary friction due to fouling and blockage or semi closed valves
9. Sub-optimal production planning
10. Unnecessary high level of harmonics (reactive power)

By comparing in real-time the actual energy consumption against the normal & best performance ever realized under comparable circumstances, excess consumption is detected and can be prevented and energy is saved: 5% - 30%

Surrounding factors

Asset
Individual equipment or units of multiple energy consumers

Performance

Energy amount & quality

Artificial Intelligence learns the normal dependencies and detects anomalies

P + S ← → Ea + Eq

Friction, fouling, blockage, vibrations, abnormal heating, deviating sensors, wear, equipment deterioration, change in equipment control, grid power quality issues, software issues
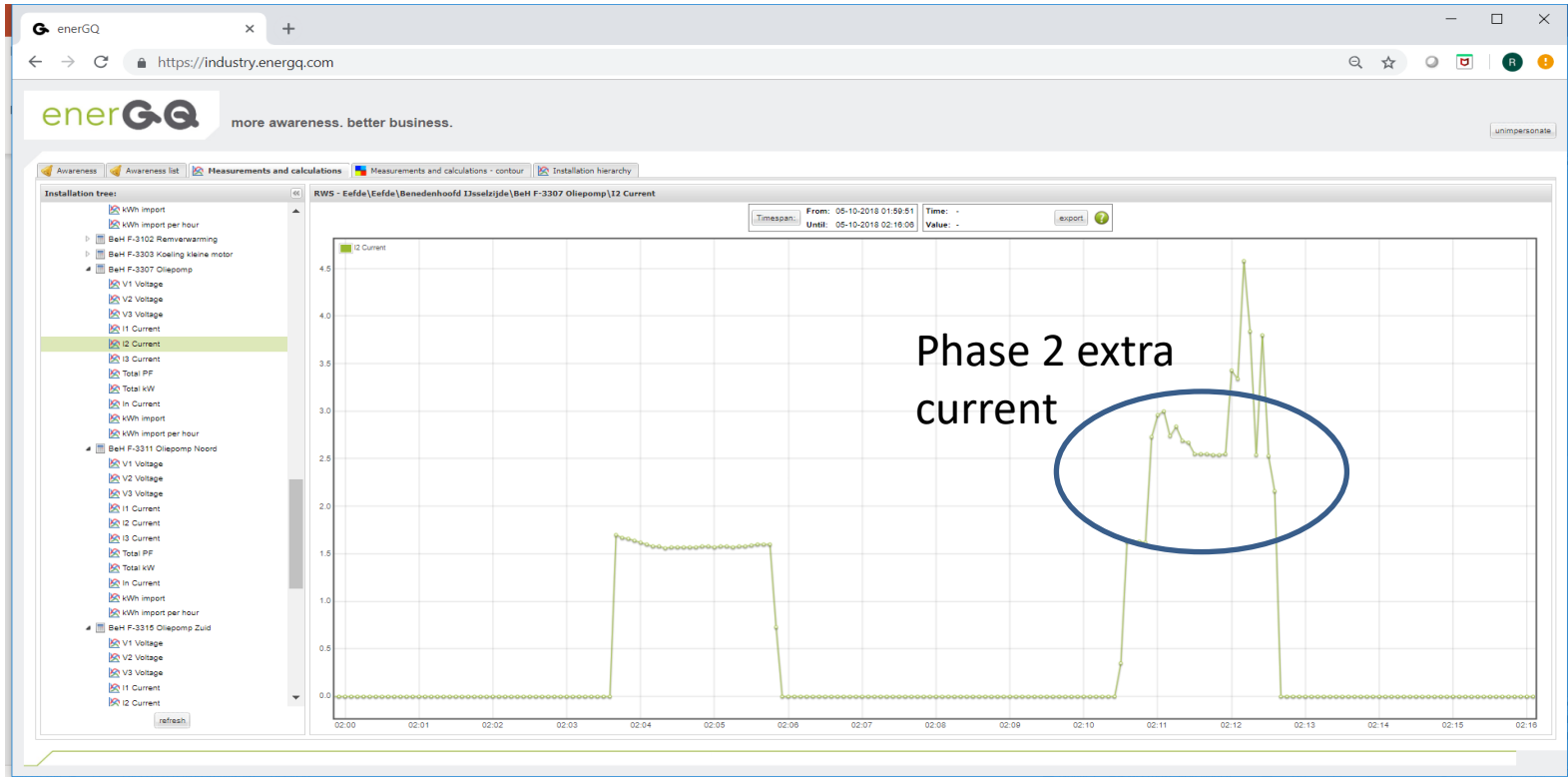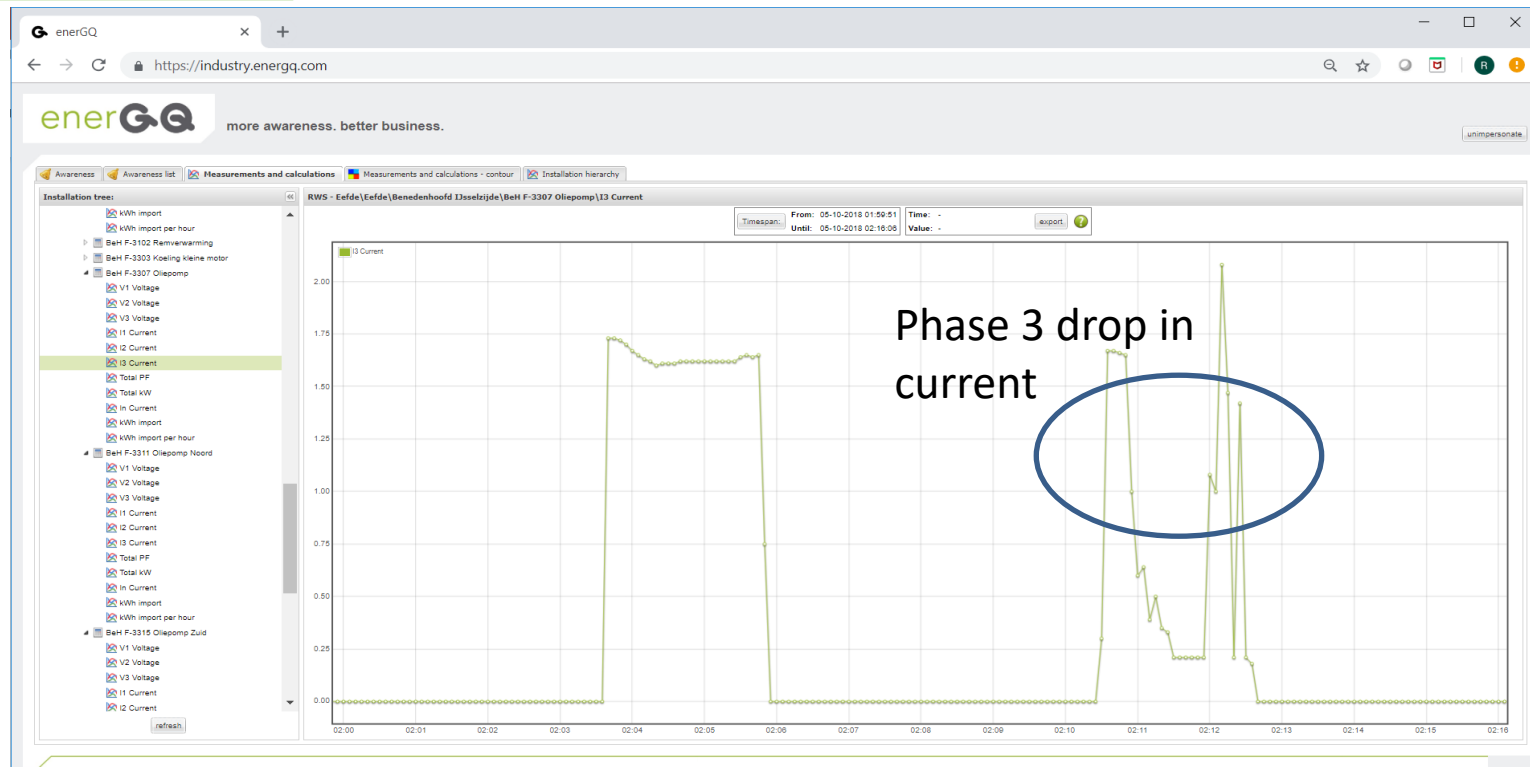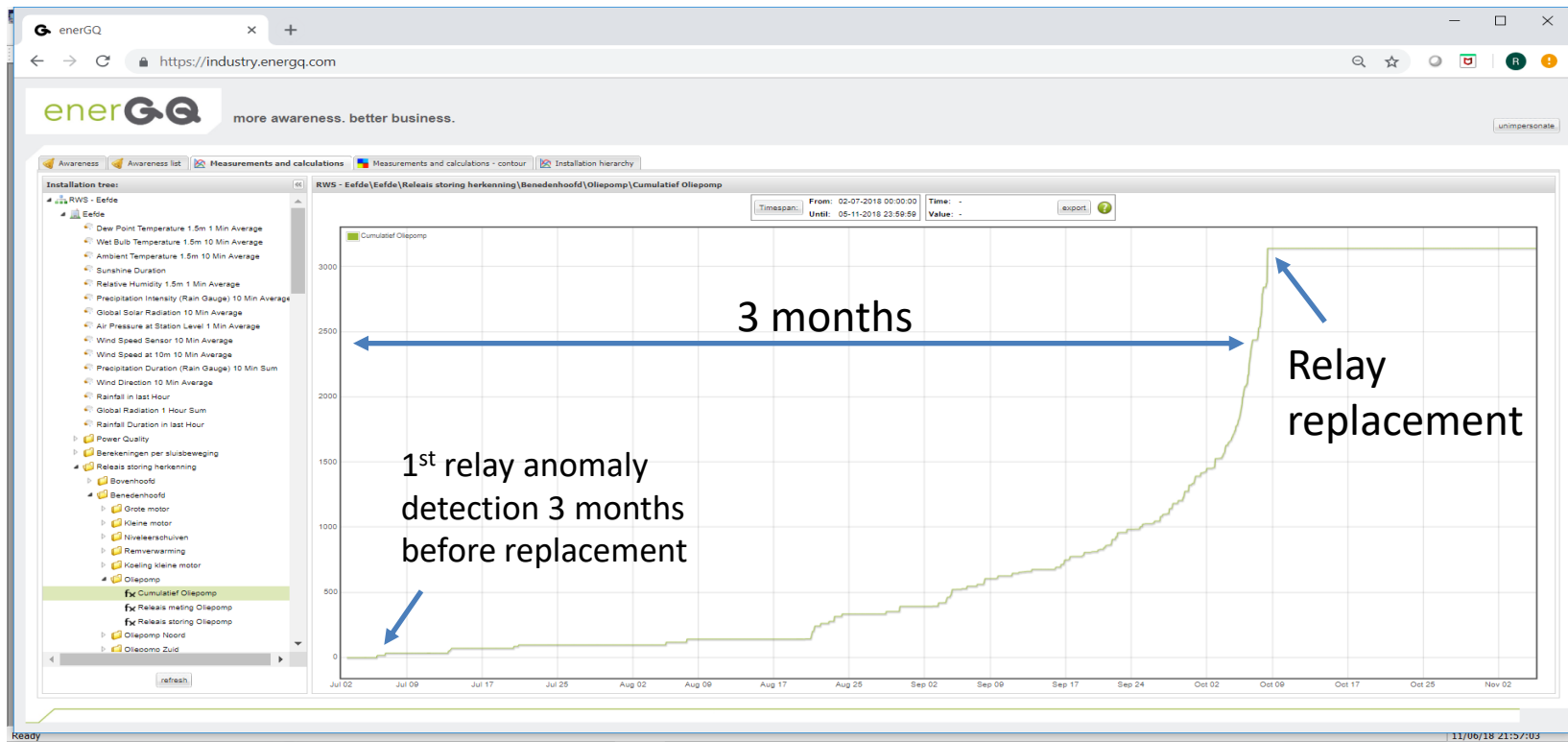
ΔP + S → ΔEa + ΔEq

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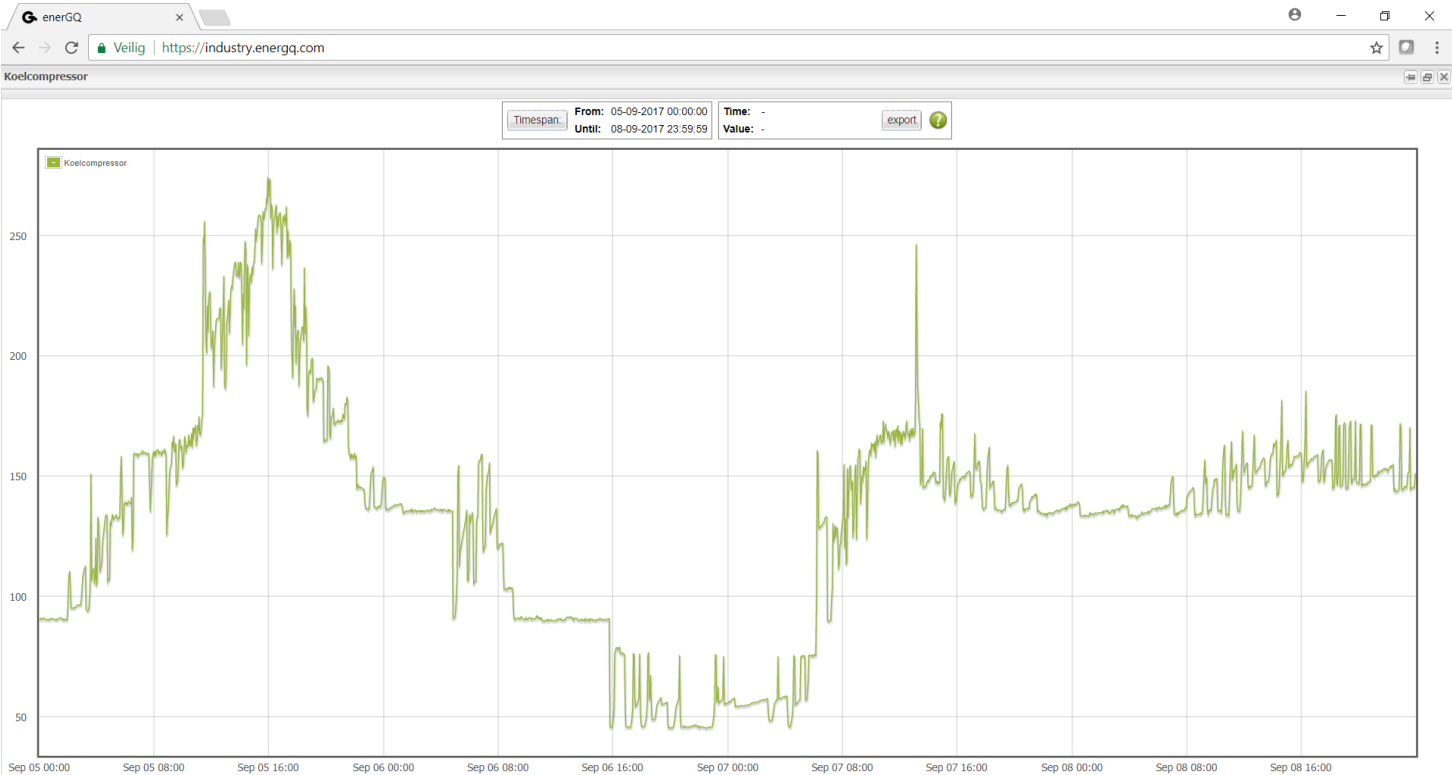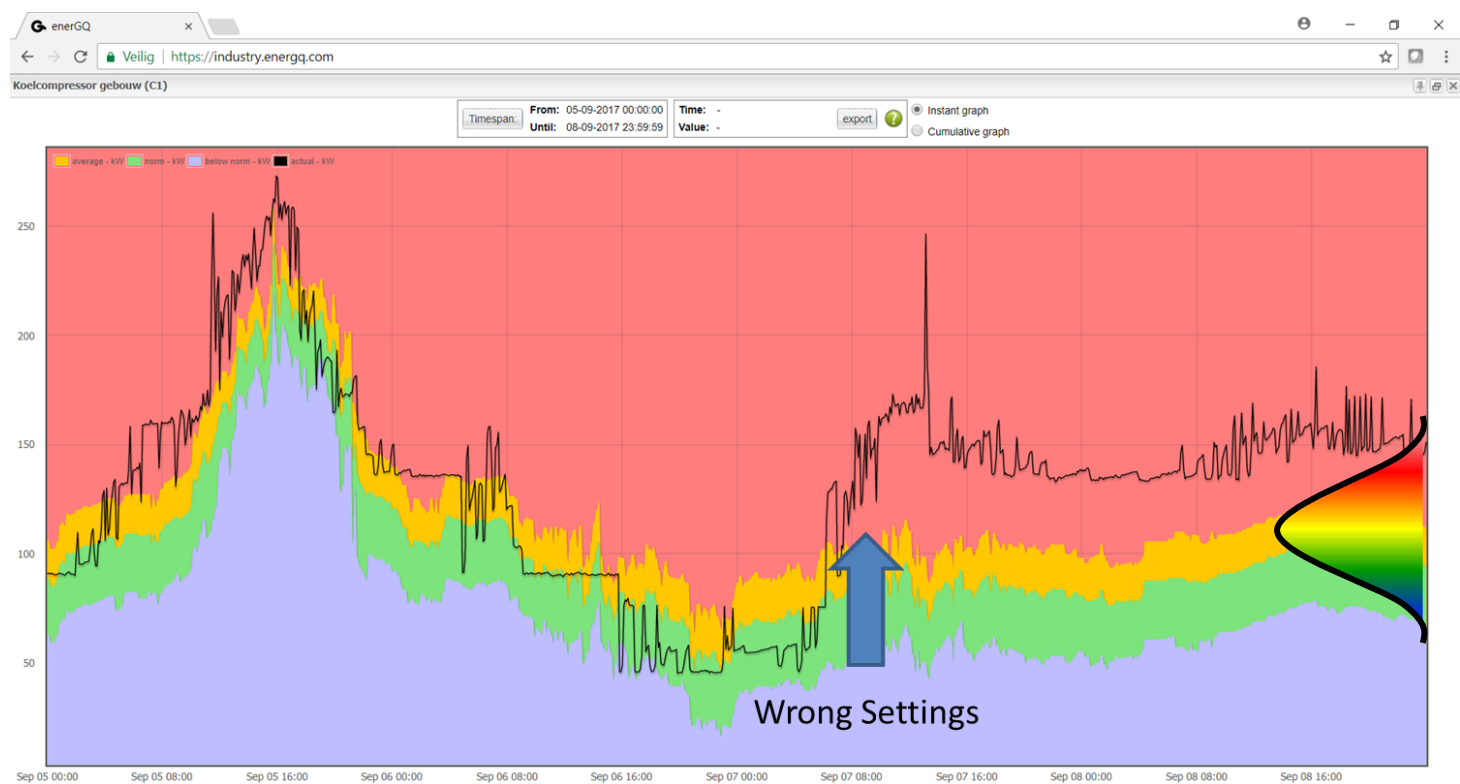29-01-2019 • Hart van Holland in Nijkerk

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The Opportunity early failure detection and operational energy saving

Focus

(2) (1)

-5% to -30%

Frequency

Direct Human Factor
= operation

Indirect Human Factor
= asset watchdog

Low   average   high

energy consumption per unit of time related to a specific performance

Energy Consumption

(1)   (2)
-5% tot -30%

→ Time

Integrated building blocks typical set-up for off/on-premise solutions

Secure data transfer data from and to local systems or equipment

Data & Information export to customer/3rd party

WebPortal

Split Current Transformers

Optional: other sensor data via API/webportal

Multimeters
(max 12x3ph / 36x1ph)
Measures active, reactive, apparent power and energy and basic power quality

V1
V2
V3
Vn

ETH RJ45

Or RS485

3G/4G or ETH

Interval ≥ 1 sec

enerGQ™

Data storage, Processing & Machine Learning, Reporting and Alarming

Split Current Transformers

eWON®

Public data such as weather data and water levels

super user

Early warning relay failure

Phase 1 extra current

Early warning relay failure

Early warning relay failure

Phase 3 drop in current

Early warning relay failure

plain power consumption cooling in kW

plain power consumption cooling in kW with learned reference

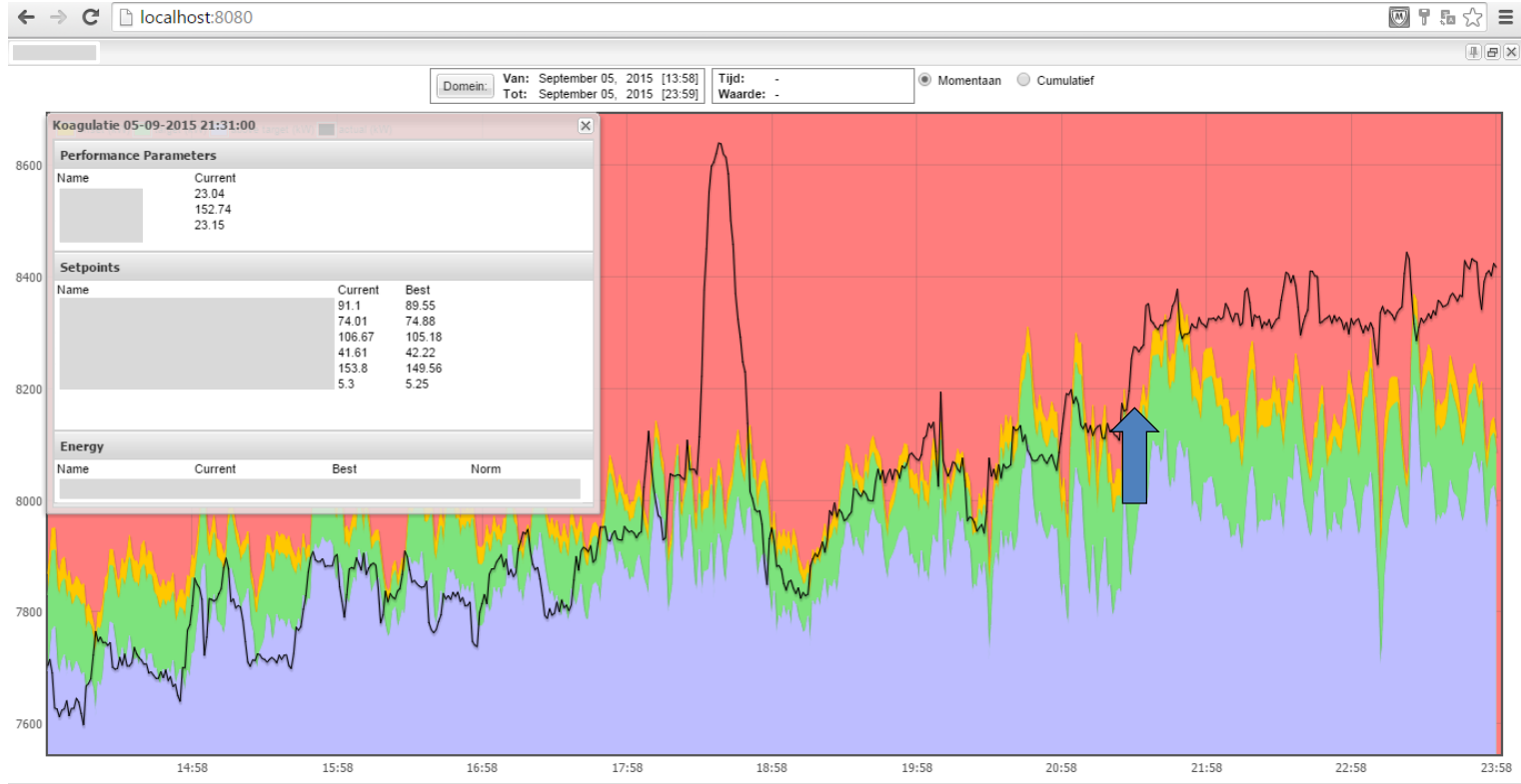# Cumulative Sum of Power Consumption minus Reference Consumption
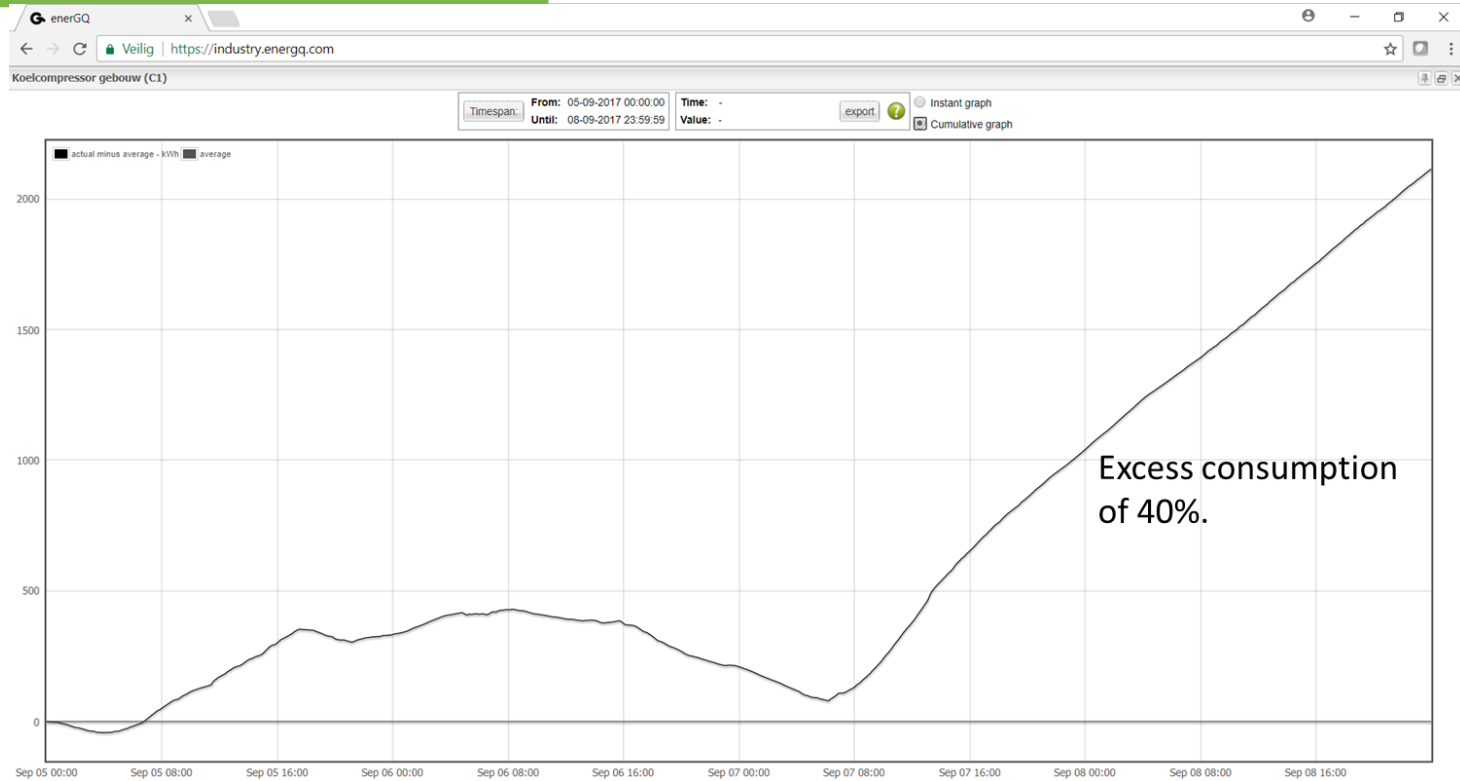
Energy Saving set-points & early warning anomaly steam flow

Water distribution Test 13/14 April P-dis from 3.2 to 3.3 barg - plain

13/4 7:30 – 14/4 16:30
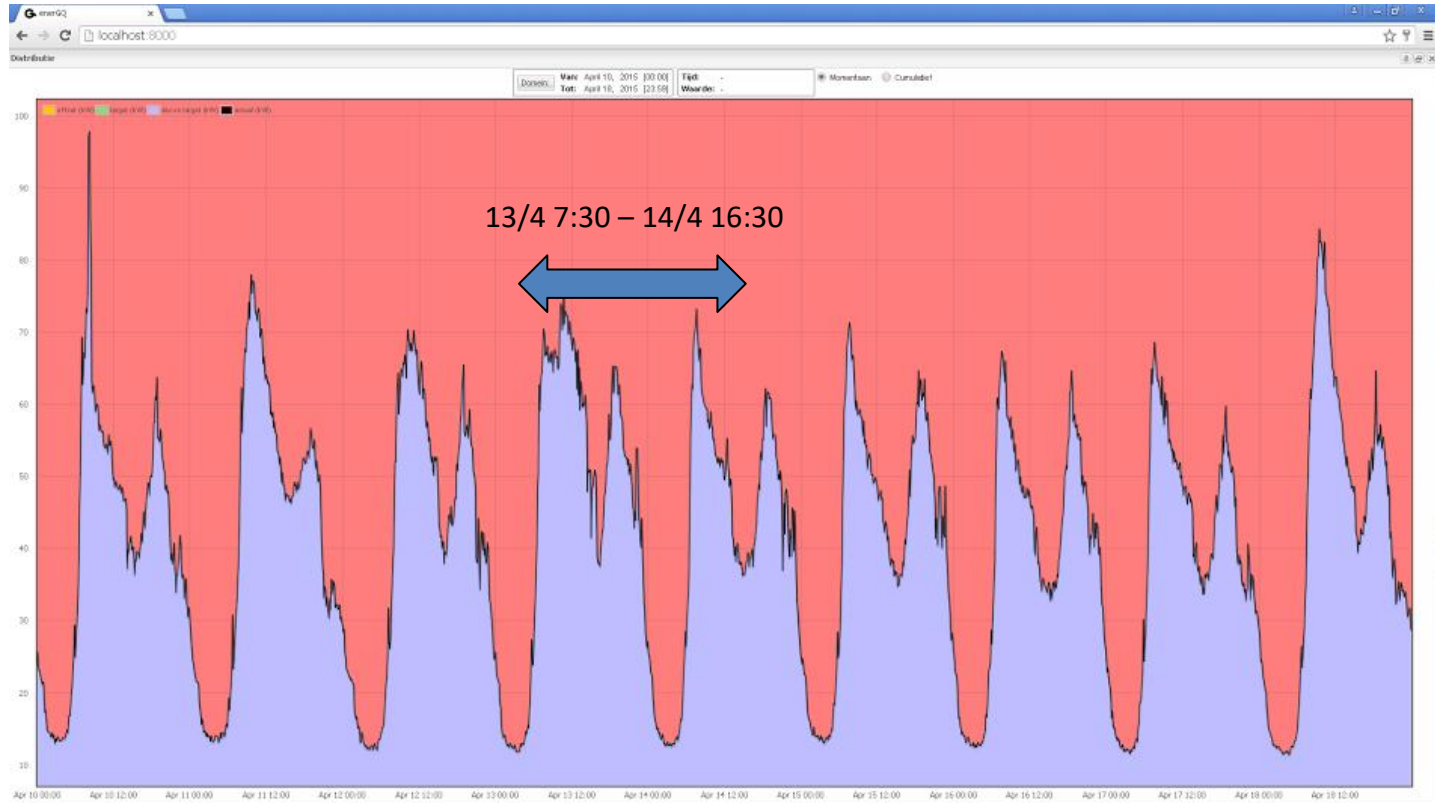
Water distribution Test 13/14 April P-dis from 3.2 to 3.3 barg - normalised
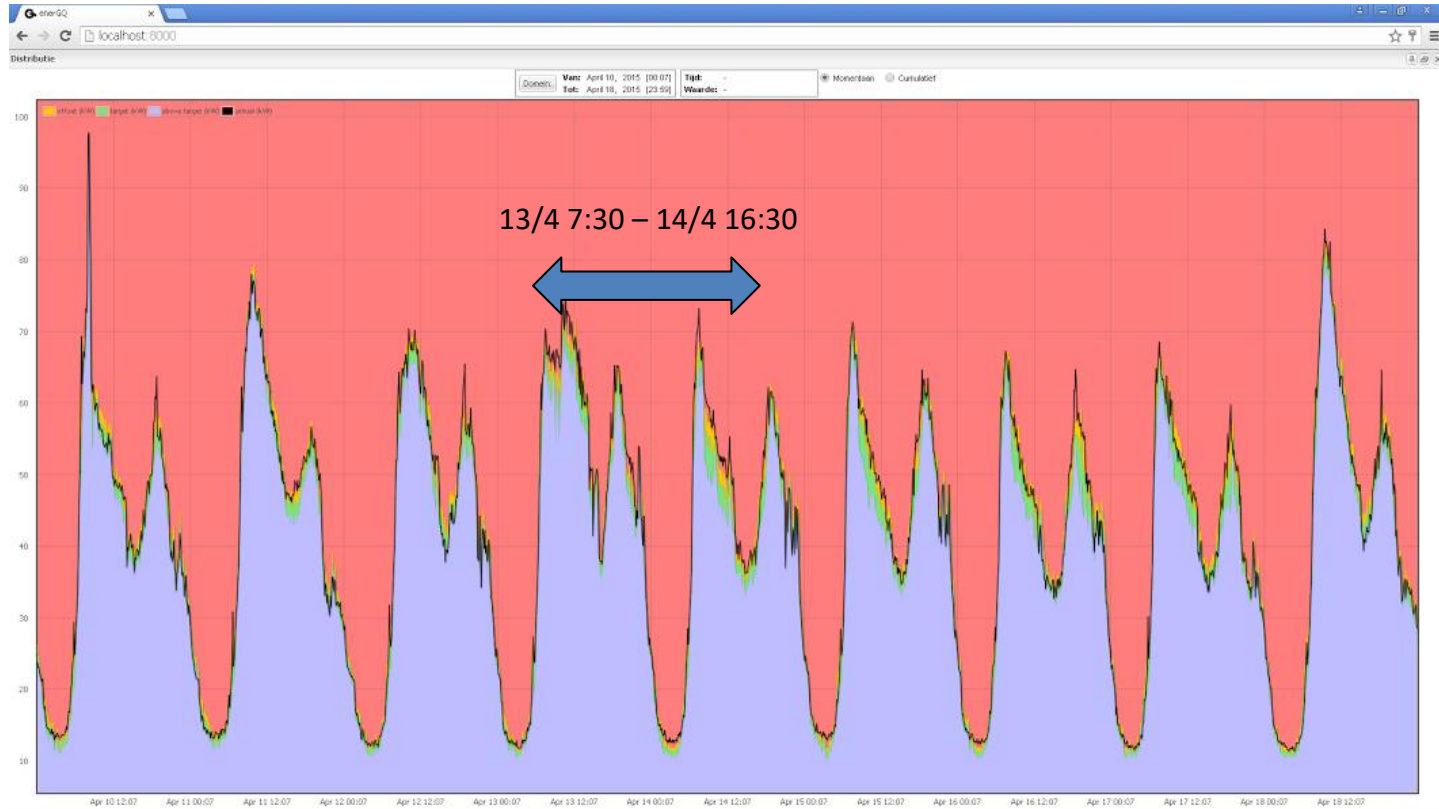
13/4 7:30 – 14/4 16:30

Water distribution Test 13/14 April P-dis from 3.2 to 3.3 barg - CUSUM

13/4 7:30 – 14/4 16:30

35 kWh per 0,1 bar per day
Average reduction = 0,8 – 0,9 bar based on
principe: Delta P is proportional to square of
Flow.
Savings: 35 x 8 x 365 = 110.000 kWh
This is 6% of total: 1.800.000 kWh
This is 30% of energy consumption of
distribution.

24 h
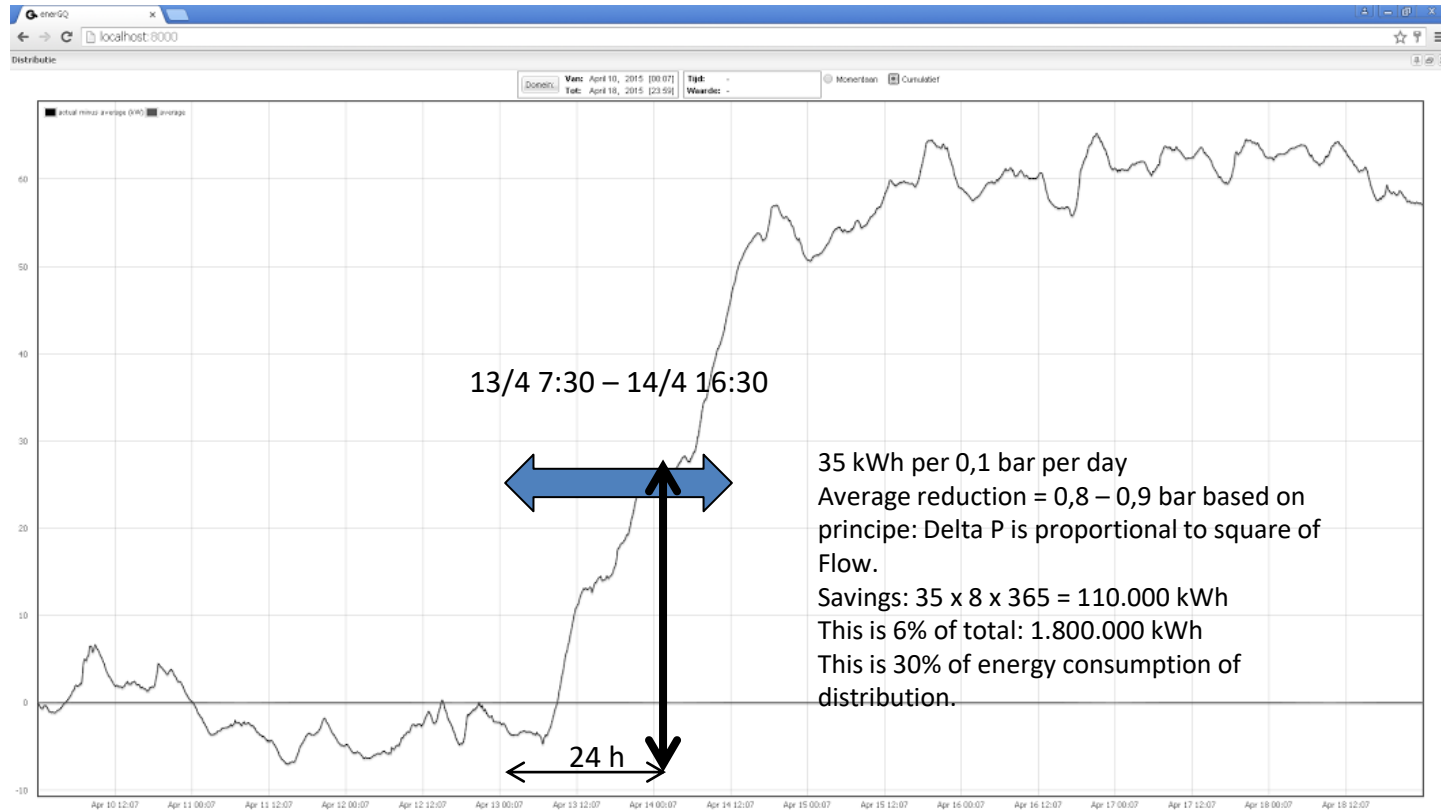
Vragen?

Contactinformatie

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