ÖKOTEC
ENERGIEMANAGEMENT GMBH

EnPI-Connect:

Precise Monitoring with meaningful Indicators

Georg Ratjen

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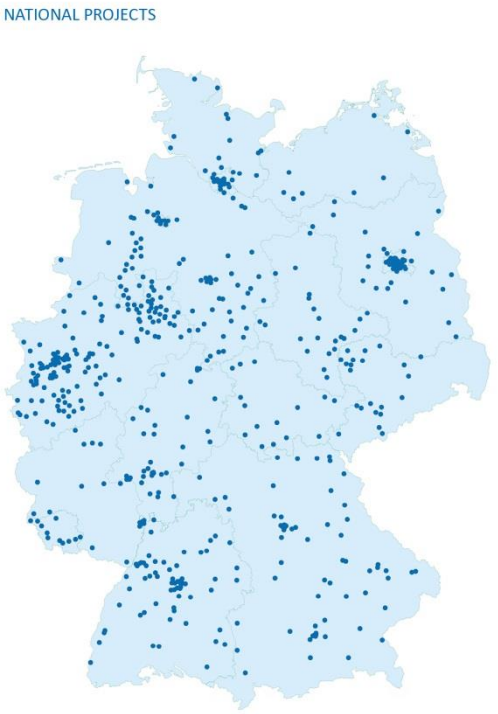
ÖKOTEC – Your Efficiency Experts

- Consulting in energy management since 1999
- Part of Veolia since 2016
- Improving energy efficiency with technological and organisational measures
- Experience in all relevant branches of industry, commerce and buildings
- Interdisciplinary team of 40 employees



A leading expert for energy efficiency with projects at over 800 national and international sites

An Overview of Our Services

Optimization Projects

Energy audit
Analysis of energy use and identification of optimal efficiency measures

Energy planning
Reliable planning for maximum savings while minimizing investment costs

Implementation
Measurable energy savings

Ongoing Optimization

Energy Management (EnM)
Ongoing improvement process in line with ISO 50001

Energy Efficiency Controlling (EnEffCo®)
Software and services for systematic monitoring, analysis and optimization

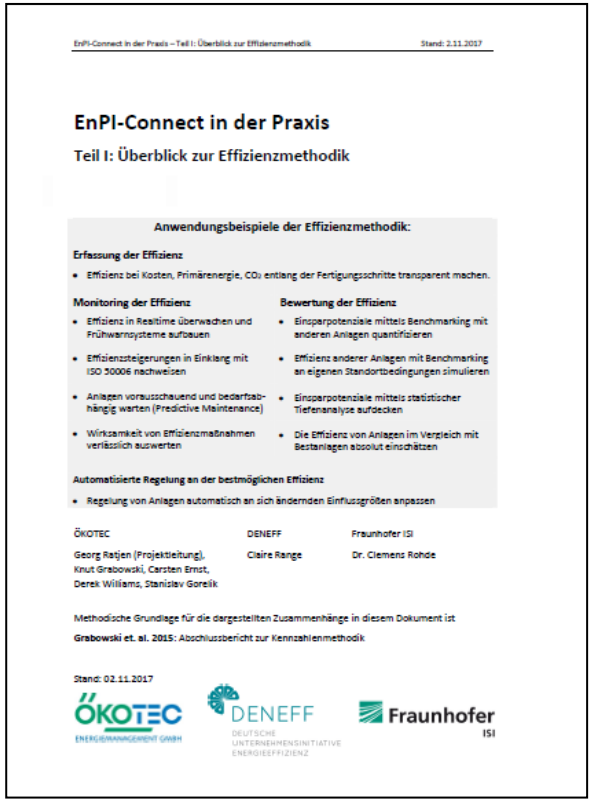
Networks
We maintain industry networks for knowledge exchange and collaborative learning on energy-related topics

Targeted training
Education of your staff on energy-related topics

Research and Development Projects (R&D)
The development of new ideas and application-based research on energy topics in collaboration with universities, research institutes and partners in industry

EnPI-Connect: Project information

- Project on behalf of Federal Ministry for the Environment: Demonstration of meaningful approach for EnPIs and Baselines in companies
- Company Partners for Implementation: Daimler Berlin, Stockmeyer, City Clean
- Brochures „EnPI-Connect in Practis“
  - Overview over EnPI-Methodology
  - Step by Step Implementation Plan


EnPI-Connect in der Praxis – Teil I: Überblick zur Effizienzmethodik Stand: 2.11.2017

EnPI-Connect in der Praxis

Teil I: Überblick zur Effizienzmethodik

Anwendungsbeispiele der Effizienzmethodik:

Erfassung der Effizienz

- Effizienz bei Kosten, Primärenergie, CO_2 entlang der Fertigungsschritte transparent machen.

Monitoring der Effizienz

- Effizienz in Realtime überwachen und Frühwarnsysteme aufbauen
- Effizienzsteigerungen in Einklang mit ISO 50006 nachweisen
- Anlagen vorausschauend und bedarfsabhängig warten (Predictive Maintenance)
- Wirksamkeit von Effizienzmaßnahmen verlässlich auswerten

Bewertung der Effizienz

- Einsparpotenziale mittels Benchmarking mit anderen Anlagen quantifizieren
- Effizienz anderer Anlagen mit Benchmarking an eigenen Standortbedingungen simulieren
- Einsparpotenziale mittels statistischer Tiefenanalyse aufdecken
- Die Effizienz von Anlagen im Vergleich mit Bestanlagen absolut einschätzen

Automatisierte Regelung an der bestmöglichen Effizienz

- Regelung von Anlagen automatisch an sich ändernden Einflussgrößen anpassen

ÖKOTEC: Georg Ratjen (Projektleitung), Knut Grabowski, Carsten Ernst, Derek Williams, Stanislav Gorelik

DENEFF: Claire Range

Fraunhofer ISI: Dr. Clemens Rohde

Methodische Grundlage für die dargestellten Zusammenhänge in diesem Dokument ist **Grabowski et. al. 2015:** Abschlussbericht zur Kennzahlenmethodik

Stand: 02.11.2017

ÖKOTEC ENERGIEMANAGEMENT GMBH · DENEFF DEUTSCHE UNTERNEHMENSINITIATIVE ENERGIEEFFIZIENZ · Fraunhofer ISI

Brochures can already be downloaded at:

https://www.oekotec.de/de/kennzahlen-in-der-praxis-bmub-vorhaben-enpi-connect/

EnPI-Connect: Areas of application e. g.

Tracking Efficiency

- ✓ Making efficiency of cost-, energy - and CO_2 efforts transparent across supply chain

Monitoring Efficiency

- ✓ Keep efficiency under surveilence in realtime and establish early alarm systems
- ✓ Give evidence on improving energy Performance in accordance to ISO 50006
- ✓ Evaluate effects of energy efficiency measures reliably

Evaluating Efficiency

- ✓ Quantify saving potentials on behalf of Benchmarking
- ✓ Simulate efficiency of other applications on real site conditions
- ✓ Uncover efficiency potentials on behalf of deep statistical analysis

Automated control

- ✓ Automated control of operations to maximise efficiency at different external conditions

EnPI-Connect: Problems adressed

Typical Practice in Monitoring

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Problems e.g.:

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- Overal, often meaningless EnPIs for large company areas
- Baseline as a simple ratio between benefits and efforts
- Energy Accounting only includes purchased energy

- No quantitative efficiency targets on system level for people in charge
- External influencing Factors (weather etc.) and base load ignored
- Incomplete accounting as purchased efforts are only part of the picture

EnPI-Connect: Solutions

Topics of EnPI-Connect e.g.

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- Systematical development of EnPIs and EnBs for Energy Applications
- Application for Monitoring and Benchmarking
- Aggregation of EnPIs and EnBs in Supply Chains / Supply Networks

Monitoring Improvement e.g.:

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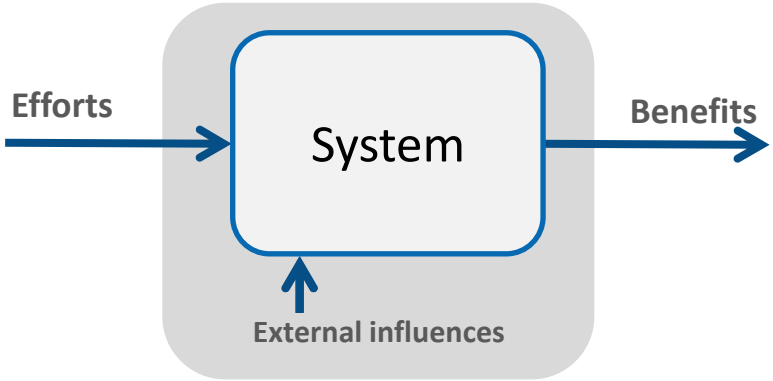
- Quantitative targets according to responsibility areas of people
- Precice Monitoring usable for many applications (efficiency surveilence,…)
- Efforts of Systems reflect the full energy related „backpack“

EnPI-Connect: Understanding of Energy Applications

In EnPI-Connect we think of all kinds of Energy Applications as Systems



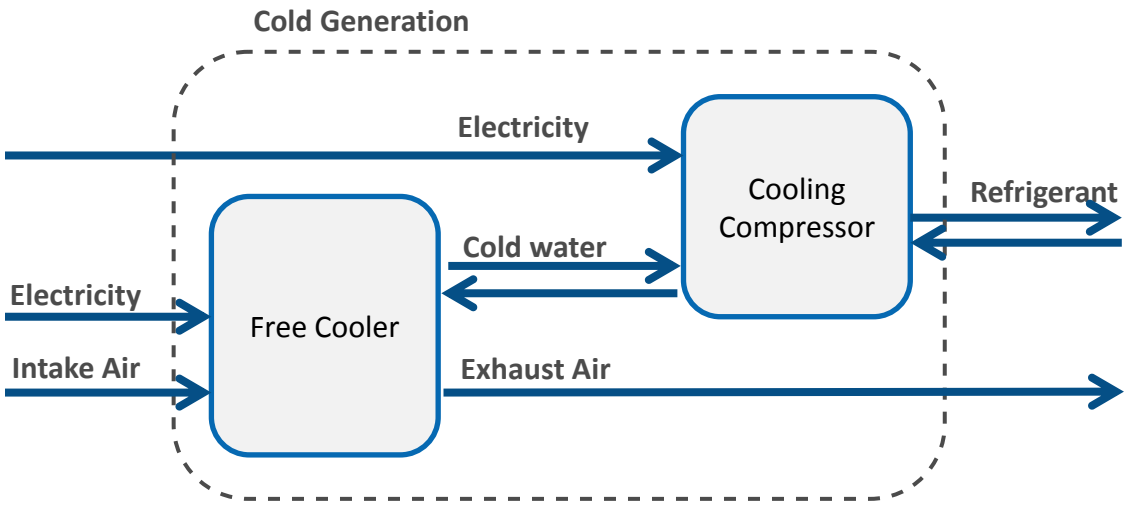
Systems:

- use efforts to generate benefits
- are exposed to external influences that cannot be sensefully adjusted

For Monitoring: Efforts, Benefits and External influences must be **correctly defined** and **measured** to establish **suitable statistical models**.

Baselines, EnPIs and Application for Monitoring

Step 1: Draw Energy and Material Flow scheme (Carry out a Workshop!)



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Corinna Schmidt:
in Charge of
Cooling system

Analyse Flow scheme

- Electricity
- Air
- Refrigerant
- Backflow

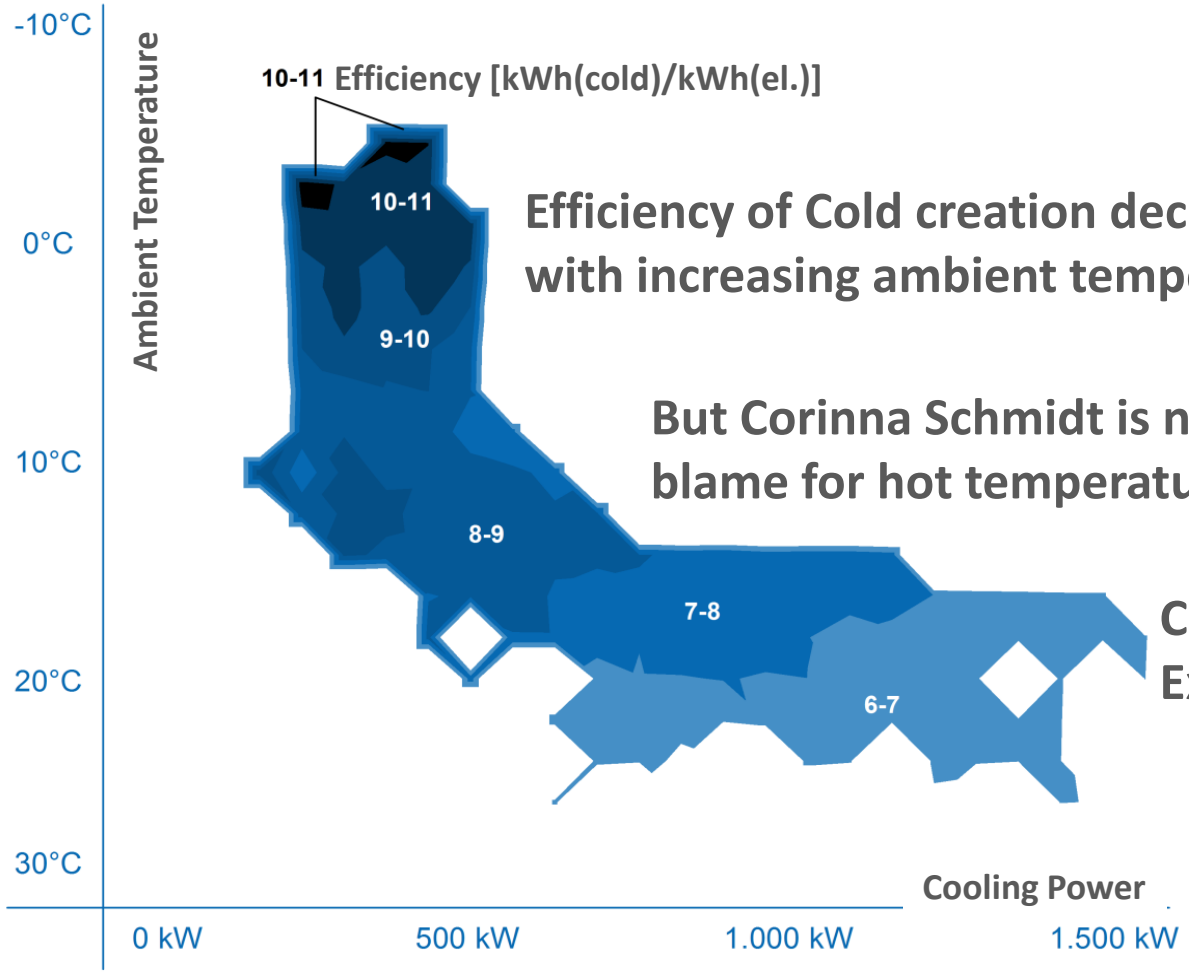
Identify

Efforts
- Electricity

Benefits
- Cooling energy

External Influences
- Ambient temperature

Example: Influence of Ambient Temperature



Efficiency of Cold creation declines with increasing ambient temperature!

But Corinna Schmidt is not to blame for hot temperatures!

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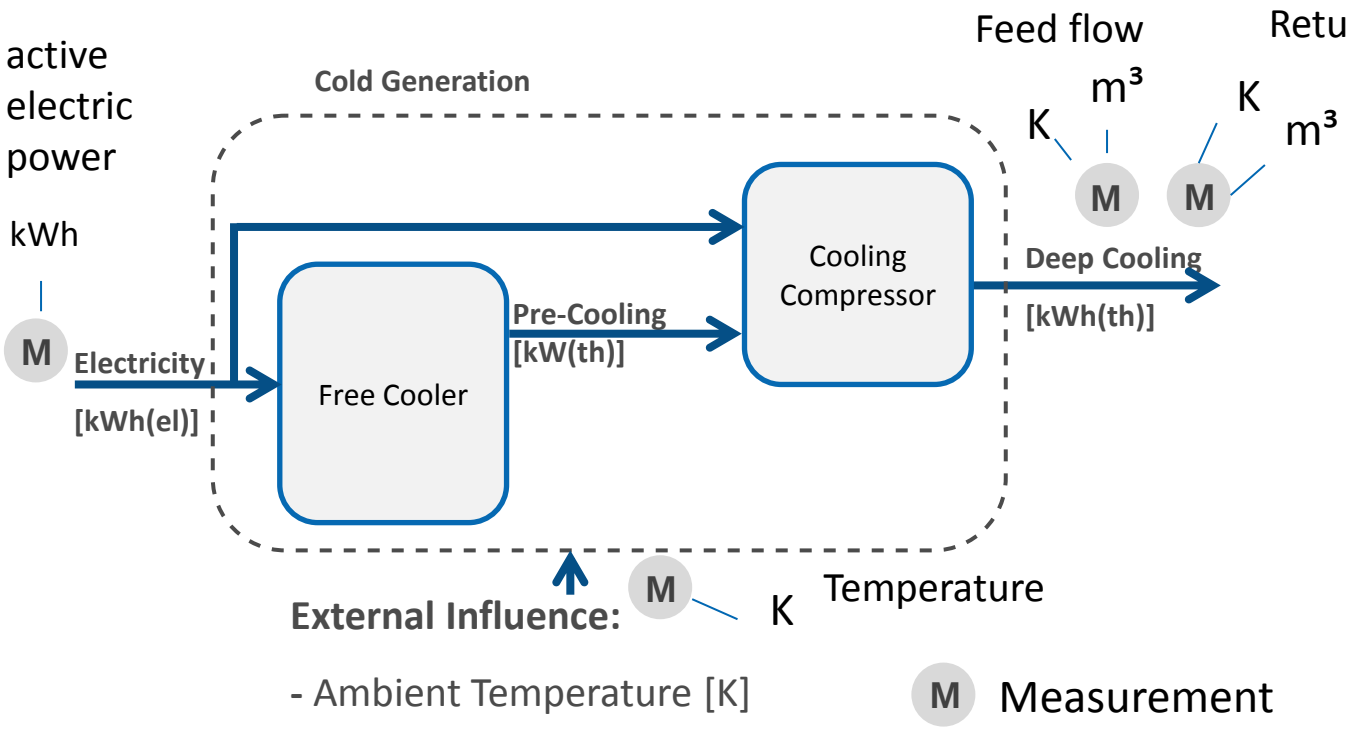
Corinna Schmidt:
In Charge of Process and Cooling (**not** in Charge of weather)

Change of temperatures is an External Influencing Factor!

We need to consider this in the Baseline!

Baselines, EnPIs and Application for Monitoring

Step 2: Draw Efforts-Benefits-Scheme with external influences

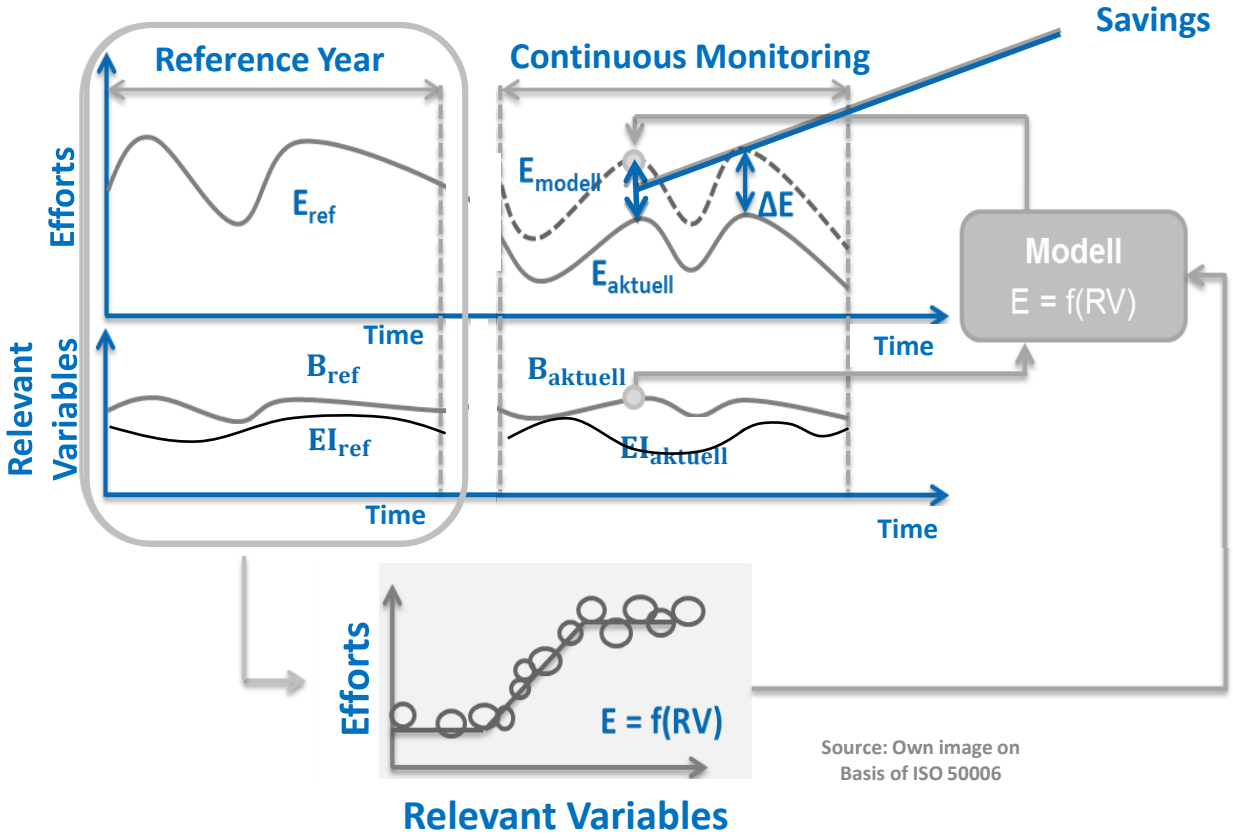


Corinna Schmidt:
in Charge of
Cooling system

Step 3: Quantify Efforts, Benefits and external Influences continuously

Baselines, EnPIs and Application for Monitoring

Step 4: Develop a Baseline (statistics) and apply for monitoring



Source: Own image on Basis of ISO 50006

Continuous Monitoring

To model the

- Electricity consumption
  Effort (E_{model})

of the „old“ System (in baseline state) under actual conditions, she applies actual values of relevant variables

- Cold production
  Benefit (B_{actual})
- Ambient Temperature
  External influance
  (EI_{actual})

to the Baseline function

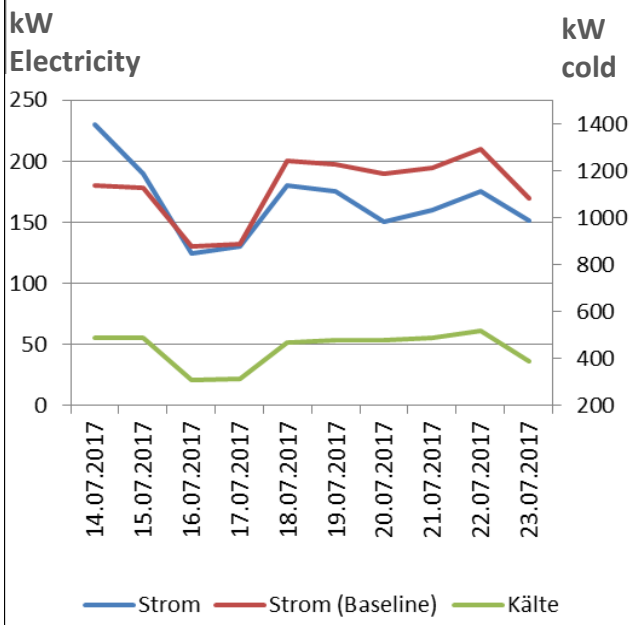
Baselines, EnPIs and Application for Monitoring

Step 5: Choose EnPI for Visualisation in Monitoring (according to preference)

EnPI as Effort

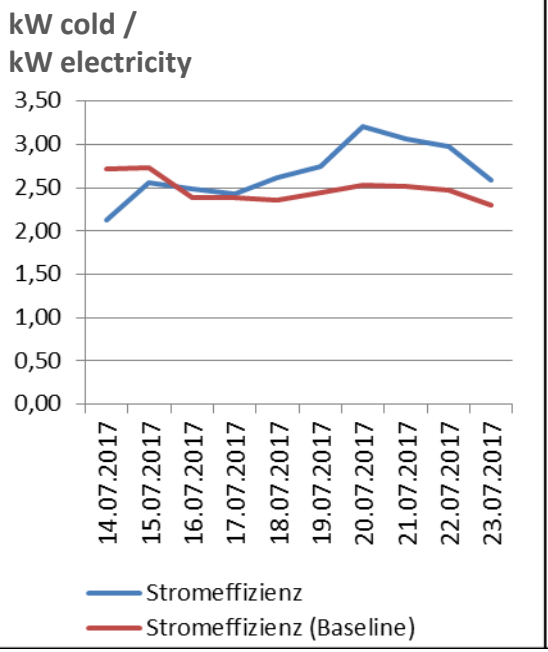
$$Effort$$

(and Benefits informative in Diagramm)



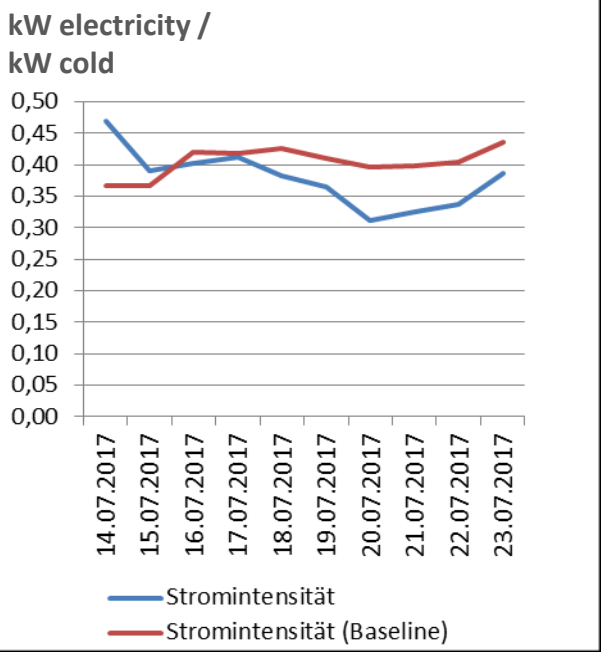
EnPI as Efficiency

$$\frac{Benefits}{Effort}$$



EnPI as Intensity

$$\frac{Effort}{Benefits}$$



Baselines, EnPIs and Application for Monitoring

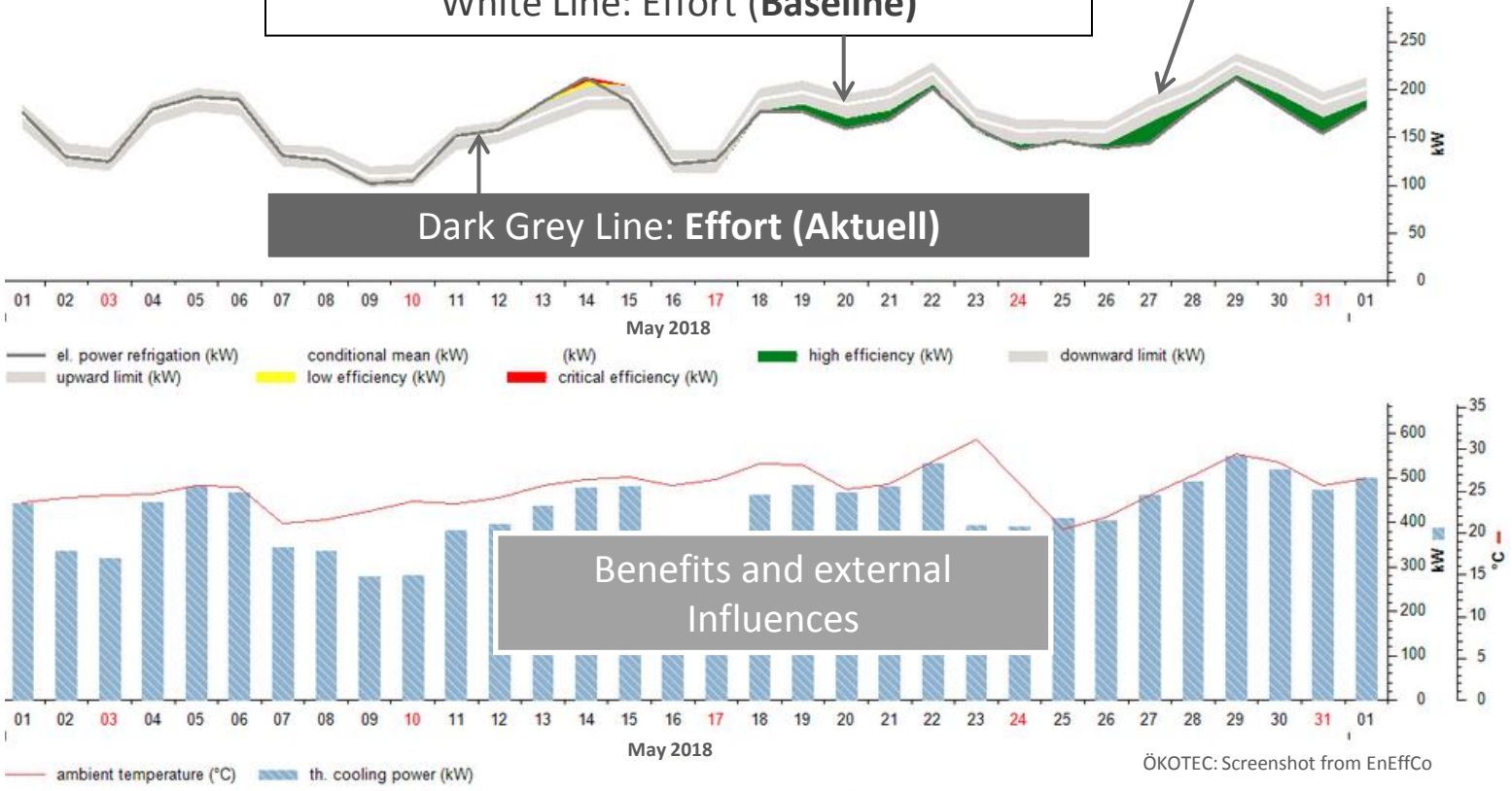
Step 6: Energy Efficiency Surveilance

EnEffCo

Grey area: Tolerance for early detection system

White Line: Effort (**Baseline**)

Dark Grey Line: **Effort (Aktuell)**



Benefits and external Influences

ÖKOTEC: Screenshot from EnEffCo

Baselines, EnPIs and Application for Monitoring

Areas of Application in Pilot Companies of EnPI-Connect e.g.

- Compressed air systems: Realtime Energy Efficiency Benchmarking
- Dryers: Realtime Energy Efficiency Benchmarking
- Combined heat and power generation: energy efficiency surveilance
- Steam Systems: Energy Efficiency Surveilance
- Parts washer: Baseline to Verify Energy Savings measures
- …

Event on project results is set for May 2019 at Fraunhofer Forum in Berlin

Many Thanks!

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