

THE FUTURE BUSINESS OPPORTUNITY OF THE SERVICE SECTOR IS TO MEASURE AND OPTIMISE

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Future require us to be efficient – are we?



10 -30% saving potential and political pressure to improve

Rating has little to do with efficiency in the field.

Efficient unit does not equal efficient operation.

Efficiency require analysis of system, unit and controls.

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Who knows how system works?

- Focus on initial price – efficiency presumed.
- Manufacturer supply equipment with good ratings
 - Controls are smart and “easy to use” - intuitive
 - Commissioning is said to be easy = hardly any budget
 - Service contractors have a high level of competency
- Start-up rather than commissioning/optimisation

Keep it cool - should and will not be enough

Average energy saving of no/low investment 20% +

Regulations and end-user awareness increase slowly

Business opportunities in supplying efficiency/reliability

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Dull tools for evaluation - optimisation

- **COP** – Coefficient of Performance
 - Varies minute by minute with conditions/load > COP 2 can be good COP 6 can be bad ?
 - Benchmark at rating conditions – time consuming - require expert for field validation
- **IPLV** – Integrated Part Load Value
 - Take part load into account but basically no plant work as assumed standard
 - Better selection tool than COP for near standard climate, design and load pattern
- **SPF** - Seasonal Performance Factor
 - Varies with climate/load/temperature levels of system
 - Relevant to benchmark different designs in theoretical models
 - No guidance on where to start look for deviations

Not very useful to validate - communicate performance

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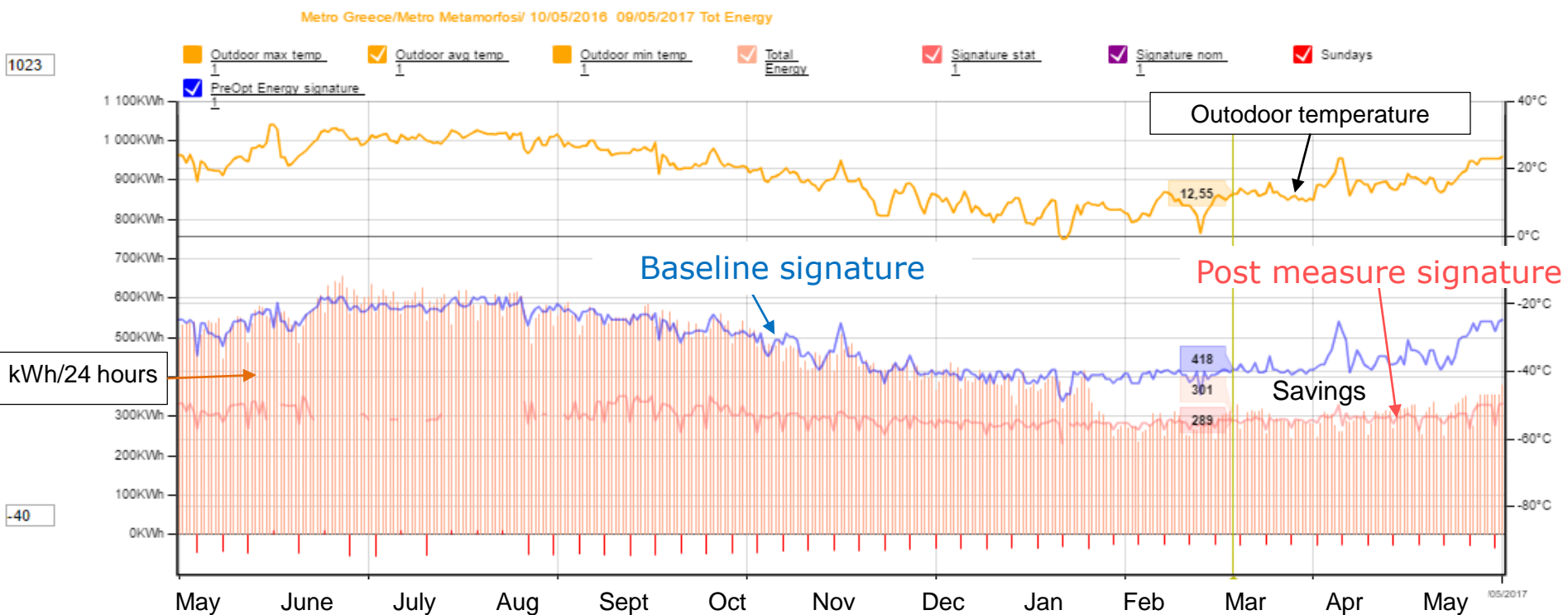


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Powerful tool 1 – Energy signature

- Energy consumption – this is what user actually pay = kWh
- The signature is key for optimisation - validation



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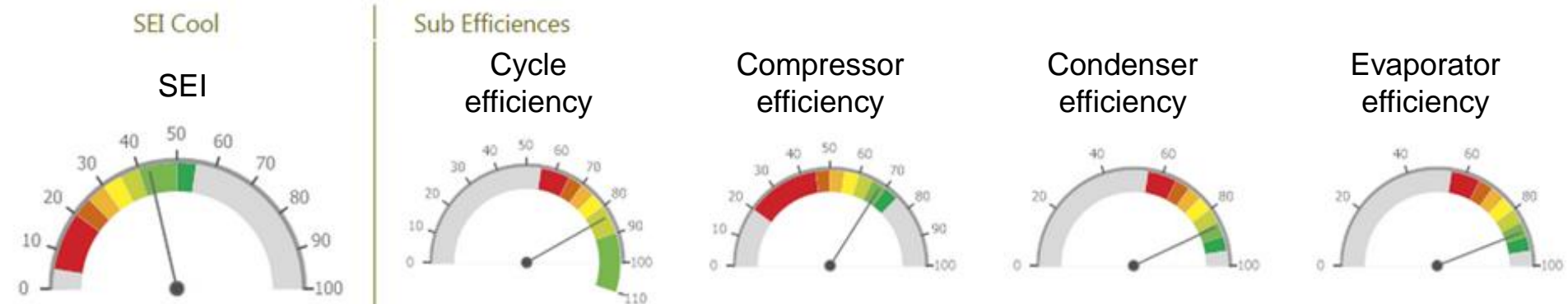


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Powerful tool 2 - SEI

- System Efficiency Index – how efficient is the system?



- How close to a 100% efficient system is the system at current conditions.
- Where is the saving potential?

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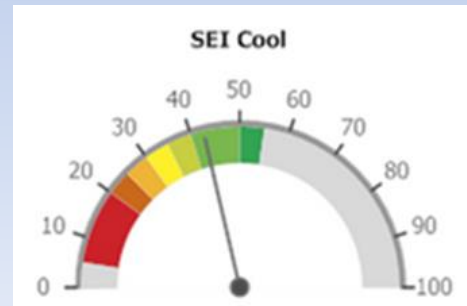
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System Efficiency Index

1. Establish "Reference temperatures" system operate between
2. Define "System boundaries" (e.g. with or without fans/pumps)
3. Calculate ideal COP = Carnot COP for reference temperatures
4. Measure COP at reference temperatures
5. SEI = Measured COP /Ideal COP at reference temperature

$$SEI_{c,i} = \frac{COP_{c,i}}{\frac{T_{ref,h,i} - T_{ref,c,i}}{T_{ref,c,i}}}$$



Read more: <http://effsysplus.se/wp-content/uploads/2012/02/EP18-Slutrapport-20140630rev0704.pdf>

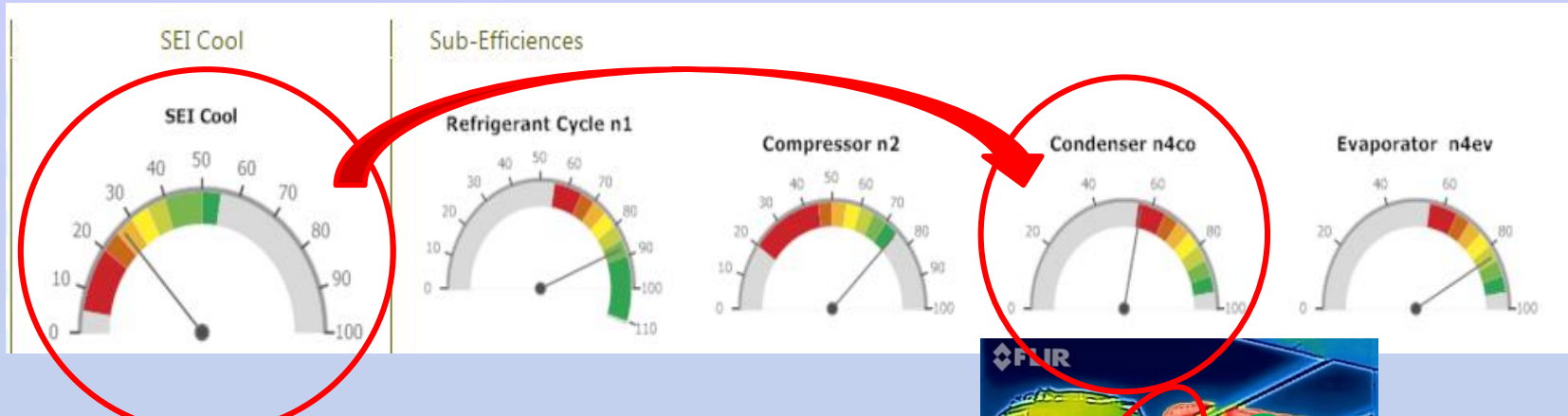
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Efficiency offer understanding and fast pin-pointing



SEI > low condenser efficiency

IR picture show:

- A. Left circuit - high discharge temperature
- B. Low temperature in bottom of left condenser e.g. sub cool is higher and in larger part of condenser. This reduces surface for condensing.

System over charge



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Energy signature - design

- Most refrigeration, cooling and heat pump systems are dependent outdoor temperature
 - Most systems has high/low, open/closed hours affecting load
 - In design stage
 - Design load is normally temperature dependent
 - Design Performance is normally temperature dependent
 - Climate data is available and prerequisite to annual consumption
 - kWh at different ambient conditions = design “Energy Signature”
- Energy signature and climate data required input for LCC/LCA

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Energy signature easy to measure in real life

- Measure kWh and ambient temperature
- Energy signature is built continuously
- Selecting start/end date create “base line” / “pre-optimisation” signatures
- Without signature Case studies are often meaningless
 - No day, week or month are the same
- Energy signature is a sharp tool for:
 - Do we reach design performance
 - Optimisation & Validation

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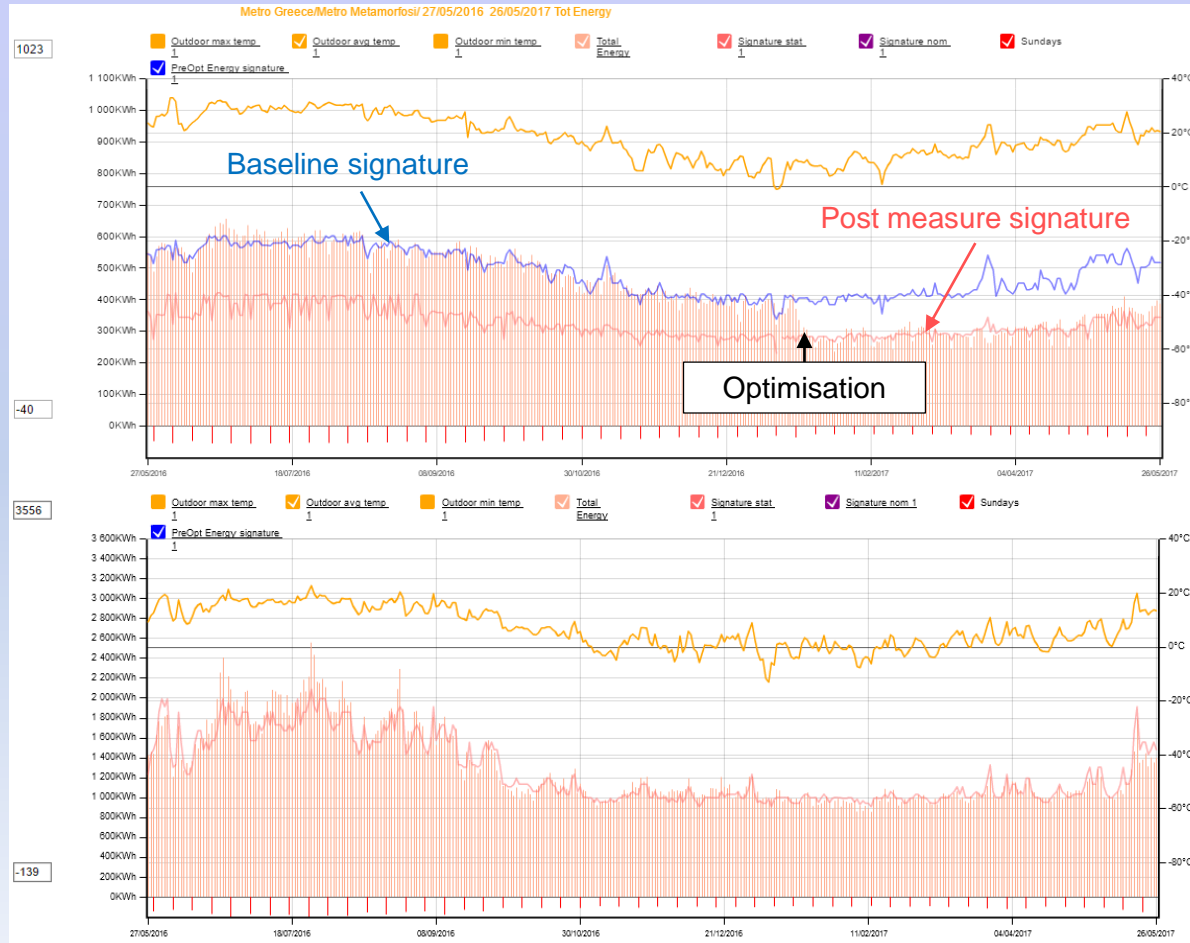
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Energy statistics is part of the key



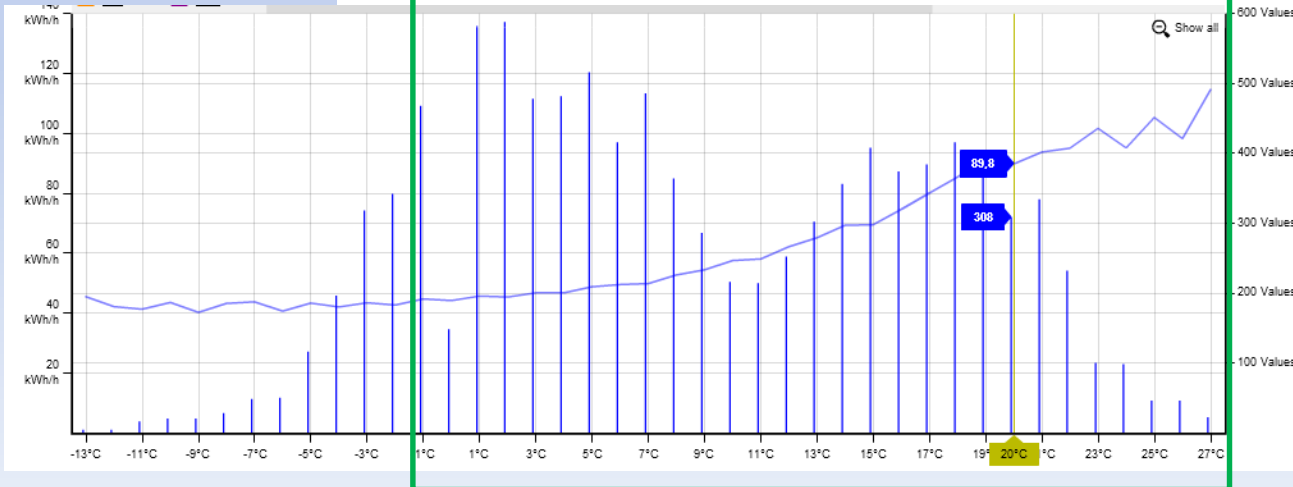
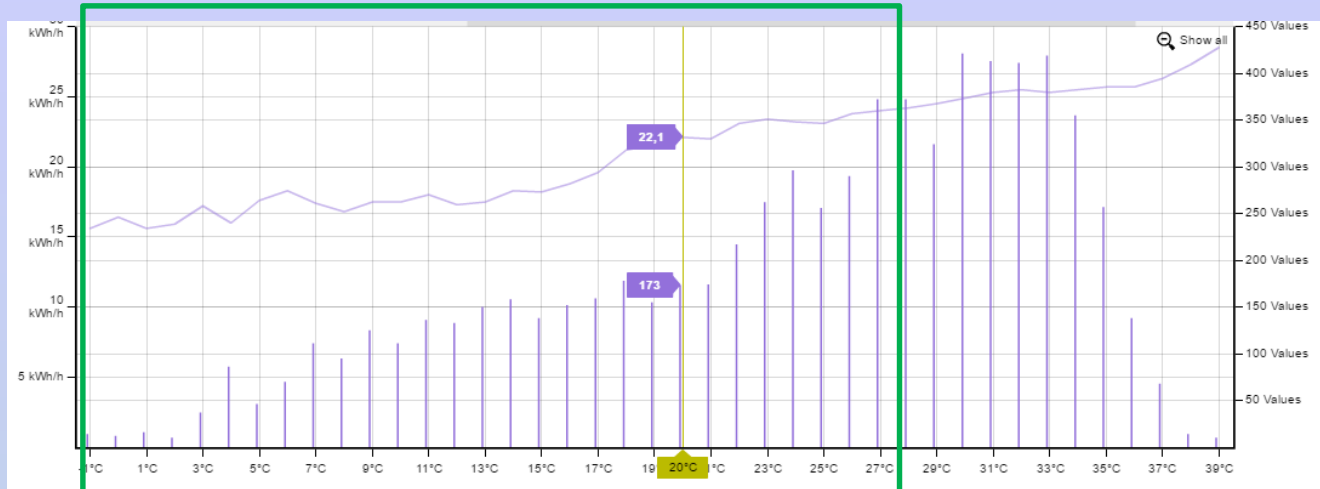
Supermarket
Greece
Proof of
optimisation

Supermarket
Sweden
Maintaining
Performance

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Benchmark regardless of climate



Greek store can be compared with store in Sweden.
kWh can be normalised to sales and/or size.
Information contain no help to optimise but necessary to benchmark and validate.
 Early detection.

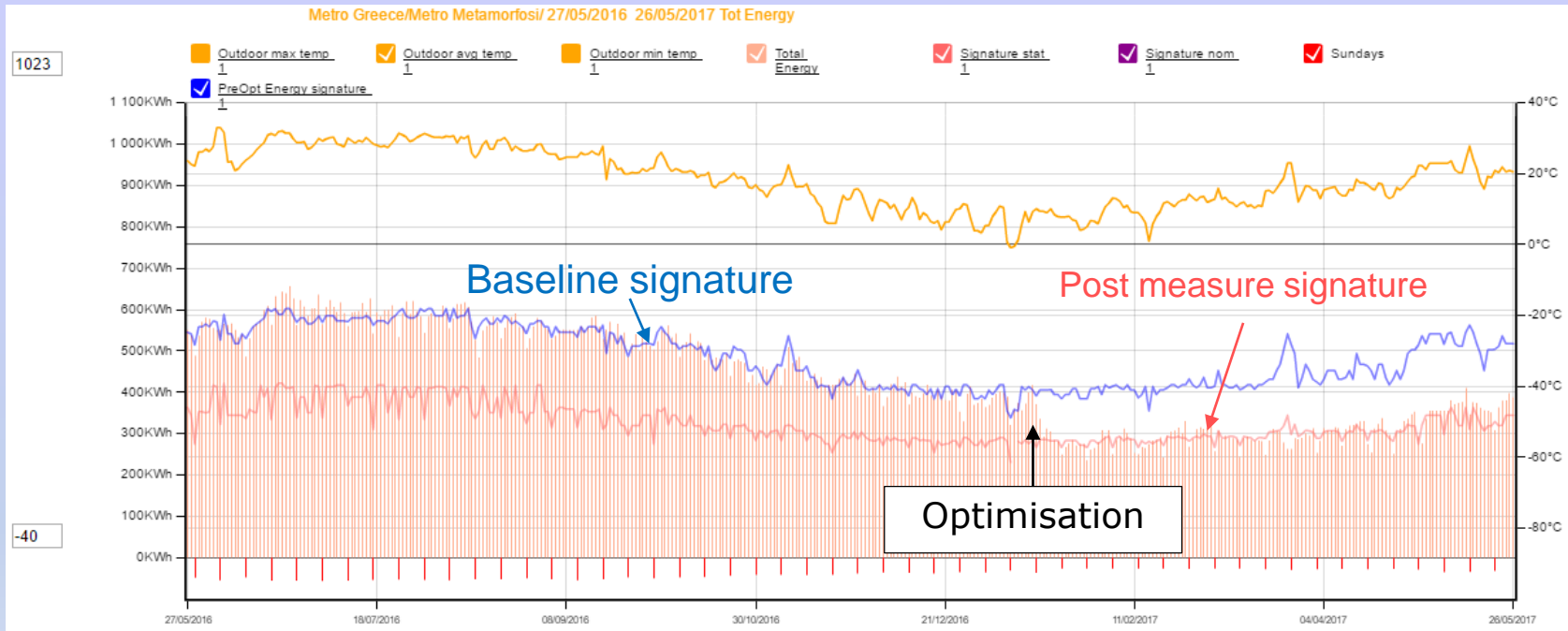
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Case from Greek Supermarket



Analyses of performance during baseline period resulted in the following measures:

- A. Optimisation of condenser fan controls.
- B. One scroll compressor on LT with poor efficiency was replaced before failure.
- C. Adjustment of controls to decrease start/stop.
- D. Correction of charge

Reduced energy consumption **29%** - yearly financial savings: over **5.000 euros** with zero capital cost of investment.

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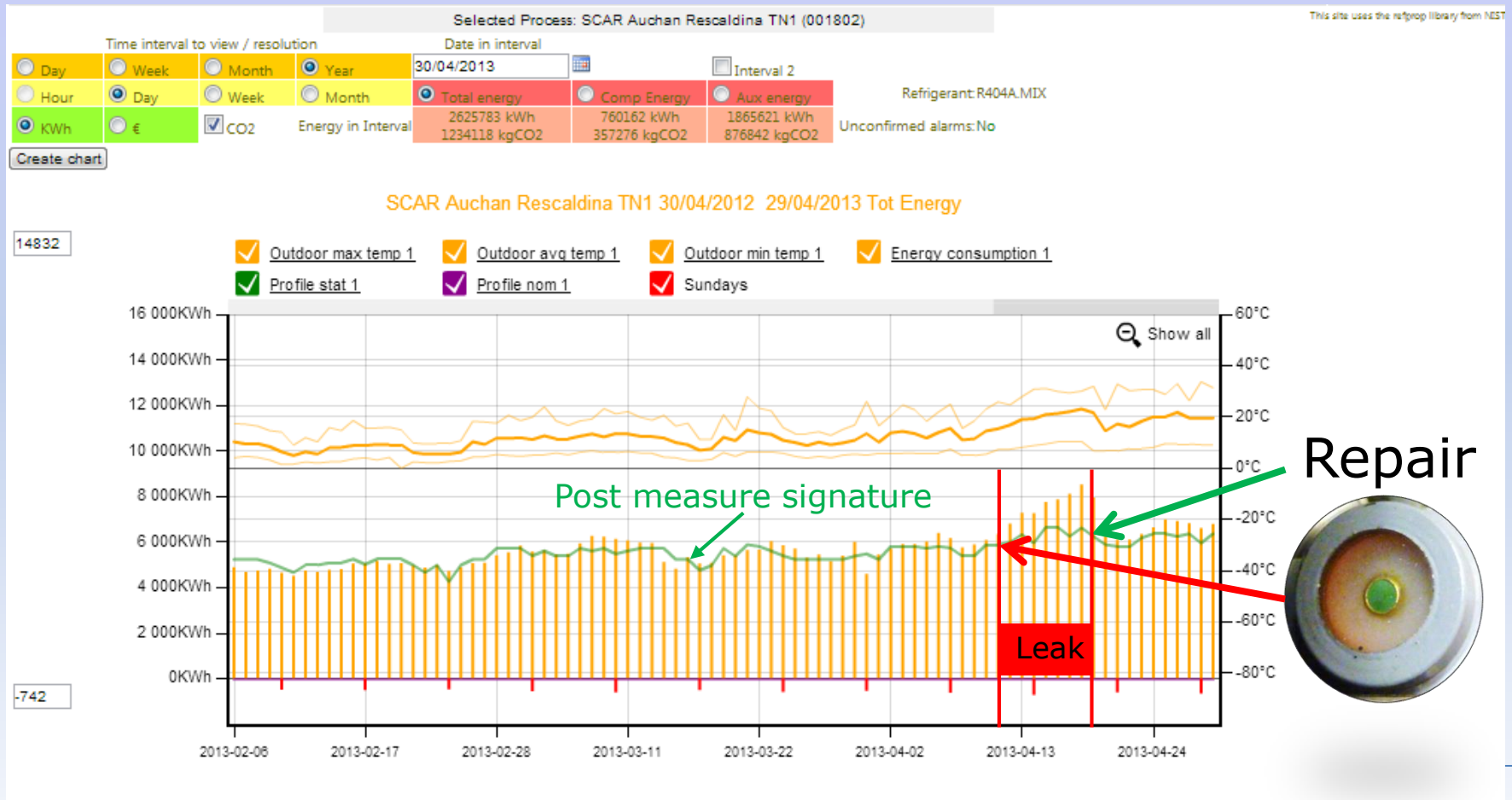
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Indirect leak detection

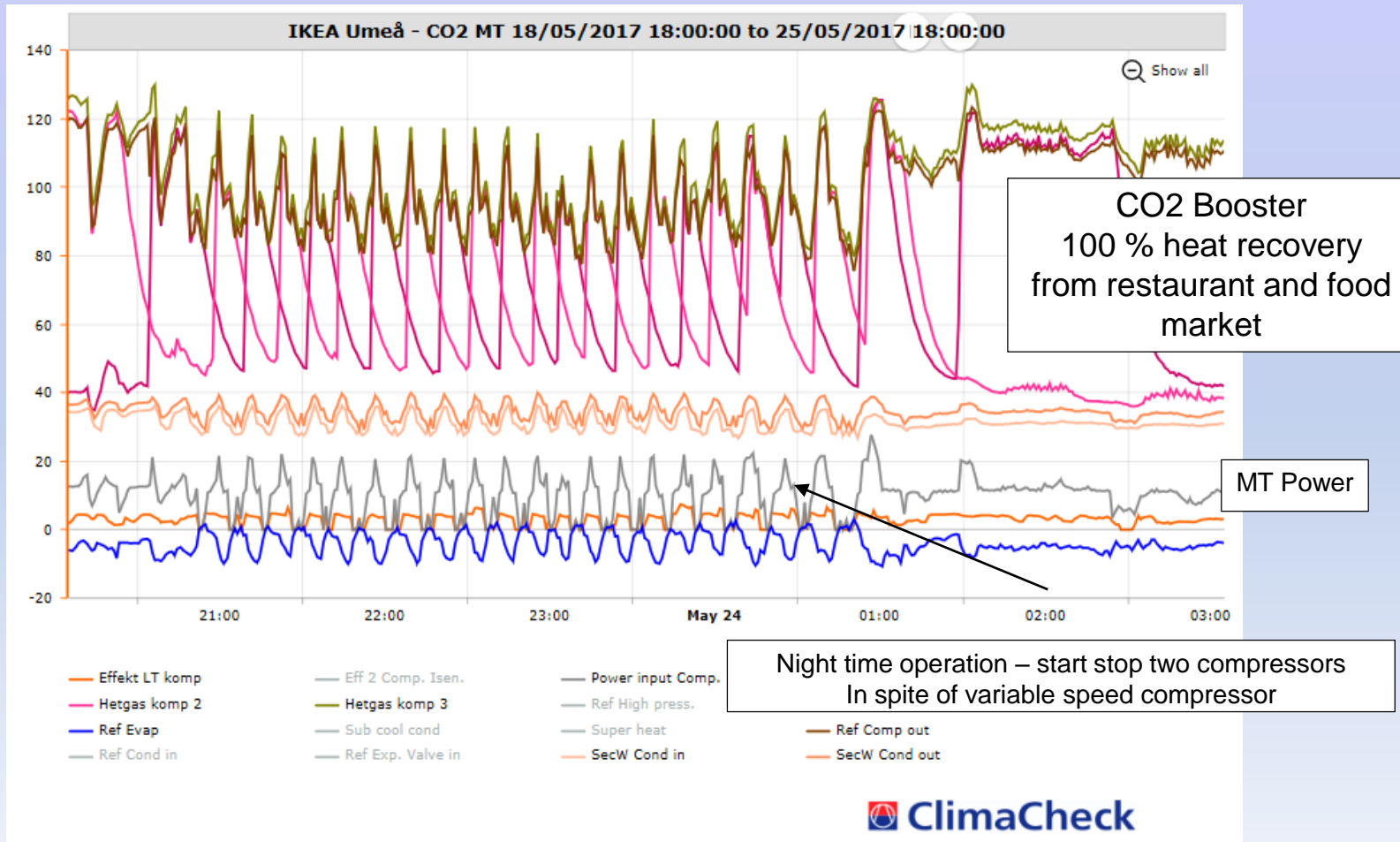
Energy signatures and SEI – sub efficiencies detect leakage

Monitoring give “Indirect leak detection” > reduce required number of leak check to 50%



State of the art systems

Controls need commissioning - optimisation



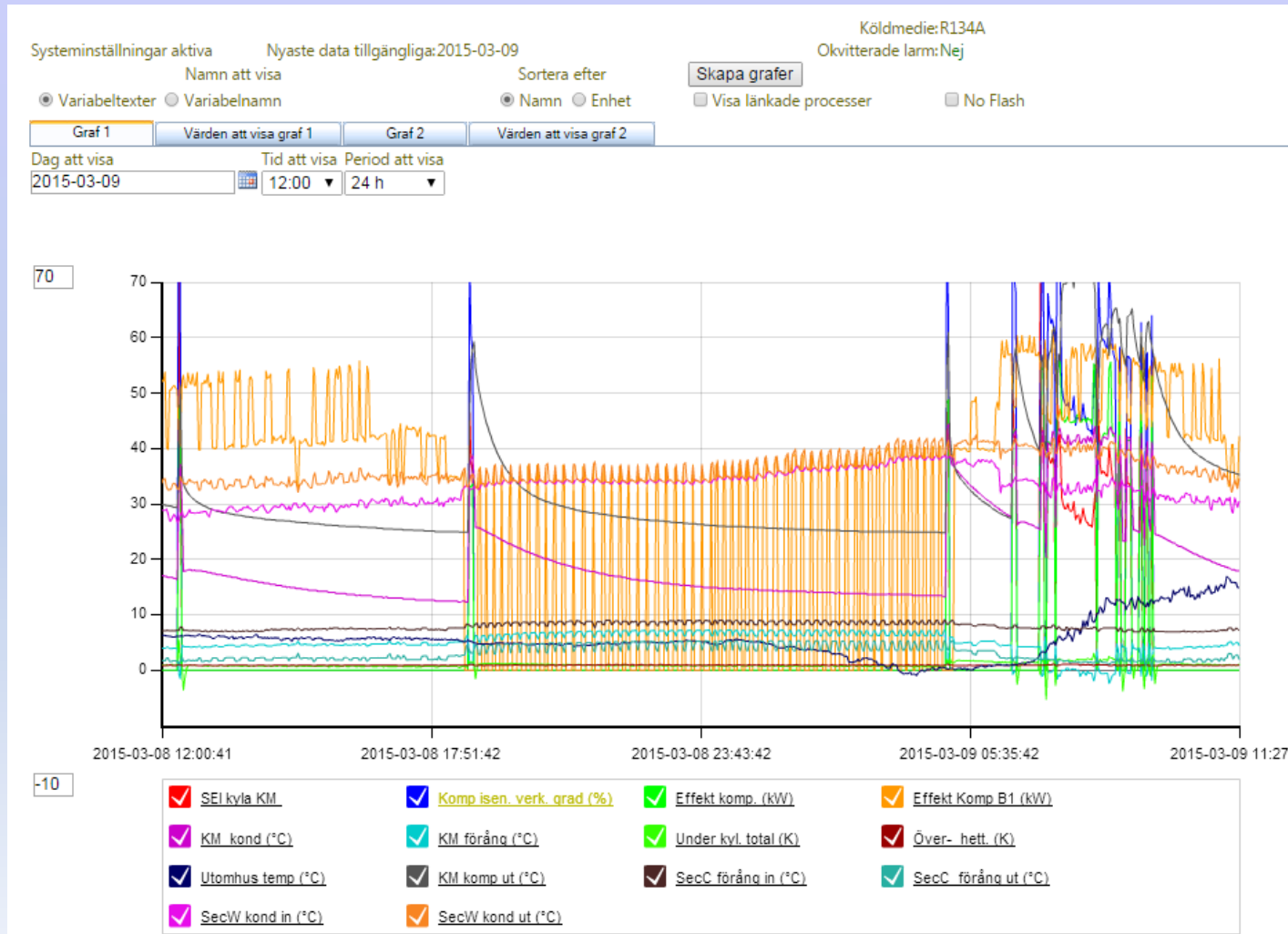
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Low load control often neglected



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Conclusions

- Measure and Validate is key for energy efficiency
- 20% of global electricity is used by our industry
- Government/regulatory pressure is increasing
- Equipment owners still rarely aware of saving potential
 - But sustainability/energy is entering the board rooms as a priority
 - Business as usual does not include optimisation&validation
- Service sector in general lack experience of energy focus

Increasing focus and interest among equipment owners

= Business Opportunities for those that take the lead

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Thank you – Questions?



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