RESULTS AND PERSPECTIVES

ATIC Leuven 14 April 1016

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Consider all steps of building life cycle:

- Design
- Commissioning
- Management
- Audit
- Retrofit

Design

- The building
- The HVAC plant
- « Primary » and « secondary » units
- Chillers, cooling towers, other heat exchangers…and « auxiliary » components!
- Inside each chiller: compressors, evaporators, condensers…
- Simulate!

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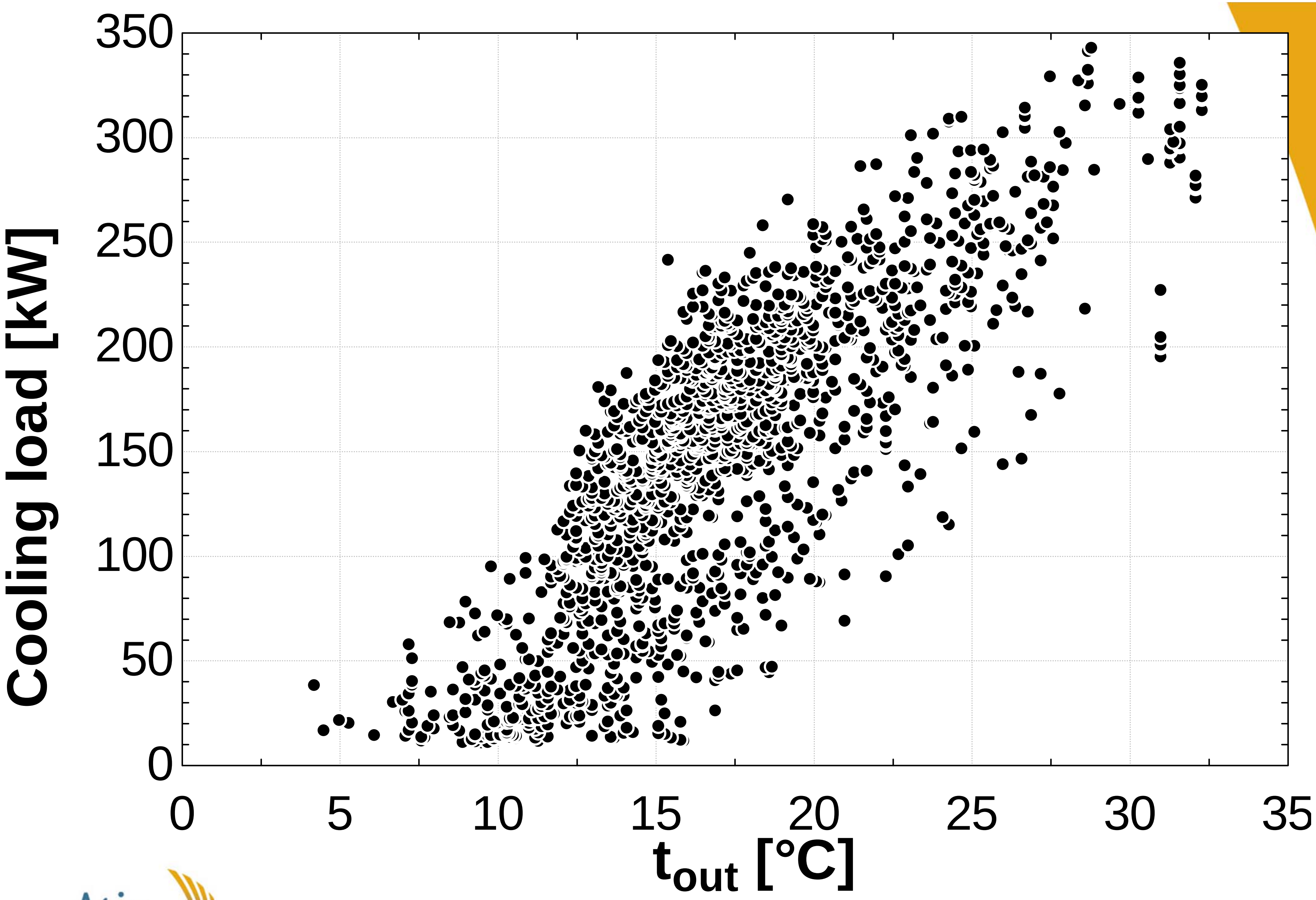

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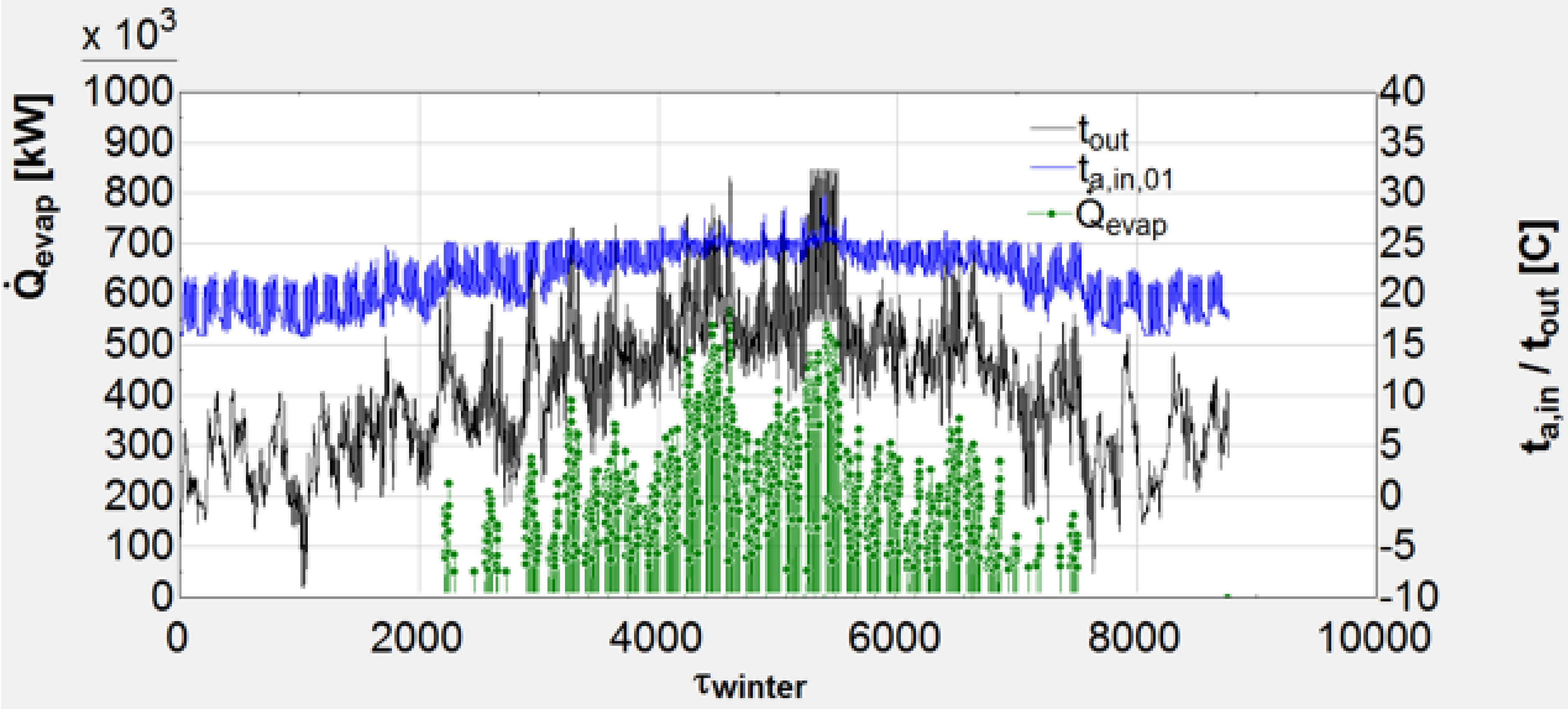
x 10^3
$\dot{Q}_{evap}$ [kW]
1000
900
800
700
600
500
400
300
200
100
0
0
2000
4000
6000
8000
10000
τ_{winter}
t_{out}
$t_{a,in,01}$
Q_{evap}
40
35
30
25
20
15
10
5
0
-5
-10
$t_{a,in}$ / t_{out} [C]

EES Professional: D:\Archives extraits JL1603047\JL160104\Annexe 59 JL160104\Reference case Frankfurt JL150519-04 corrected.EES - [Diagram Window]

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Calculate

$\tau_{winter,1}$ = 0 [h]

$\tau_{winter,2}$ = 8760 [h]

Δtau_{winter} = 0.5 [h]

t_0 = 20 [C]

$Q_{preheatingcoil,kWh}$ = 371932 [kWh]

$Q_{postheatingcoil,kWh}$ = 98547 [kWh]

$Q_{TUheatingcoils,kWh}$ = 21527 [kWh]

$Q_{boiler,kWh}$ = 483582 [kWh]

$Q_{gas,consumed,kWh}$ = 563486 [kWh]

$\eta_{boiler,HHV,average}$ = 0.8582 [-]

$Q_{cooling,AHU,kWh}$ = 81592 [kWh]

$Q_{TUcoolingcoils,kWh}$ = 598596 [kWh]

$Q_{evaporators,kWh}$ = 766753 [kWh]

$W_{chillers,kWh}$ = 285190 [kWh]

$COP_{average}$ = 2.689 [-]

$W_{mainfan,kWh}$ = 63462 [kWh]

$W_{returnfan,kWh}$ = 21968 [kWh]

$W_{TUfans,kWh}$ = 68724 [kWh]

$W_{heatingpumps,kWh}$ = 8423 [kWh]

$W_{coolingpumps,kWh}$ = 86565 [kWh]

$Q_{sun,kWh}$ = 340658 [kWh]

$Q_{s,occ,kWh}$ = 165361 [kWh]

$W_{light,kWh}$ = 634279 [kWh]

$W_{appl,kWh}$ = 599046 [kWh]

$W_{total,kWh}$ = 1.768E+06 [kWh]

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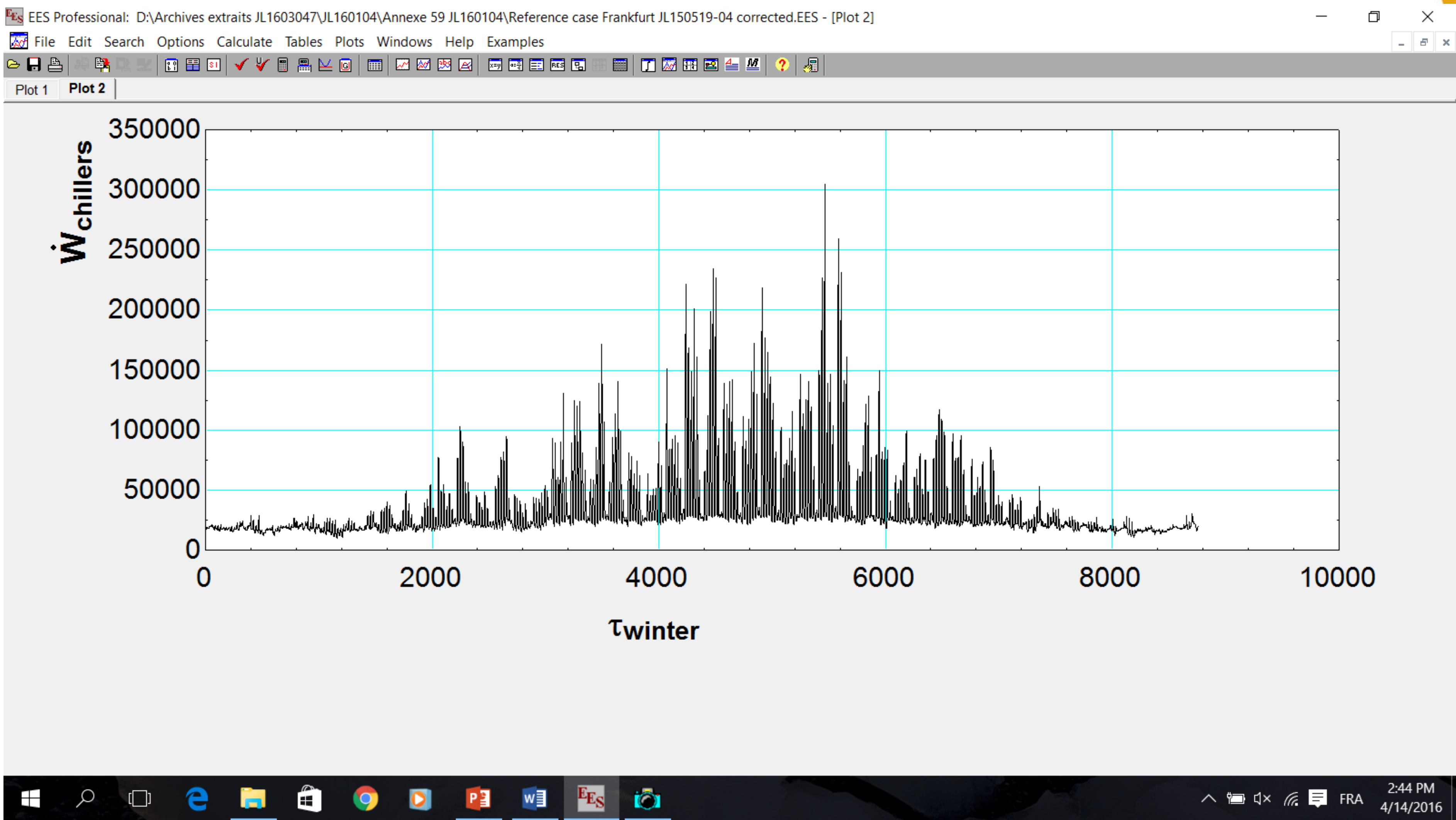

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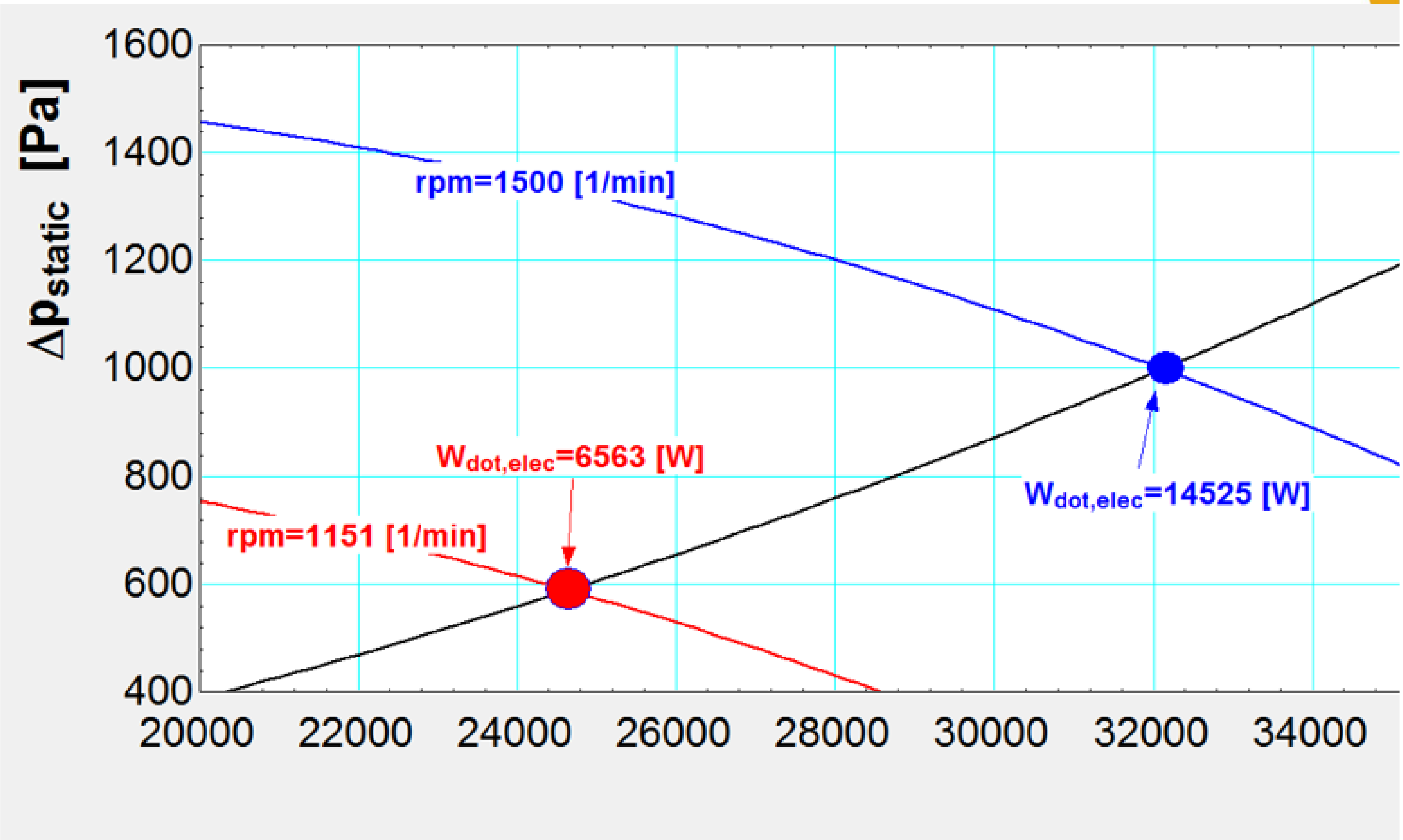
Comissioning

- Characteristics and functional performance verifications
- Correcting actions
- Tuning and balancing
- Reception procedures
- Analysis

Example of correcting action



Management

- Optimal control (example: cooling tower fan…)

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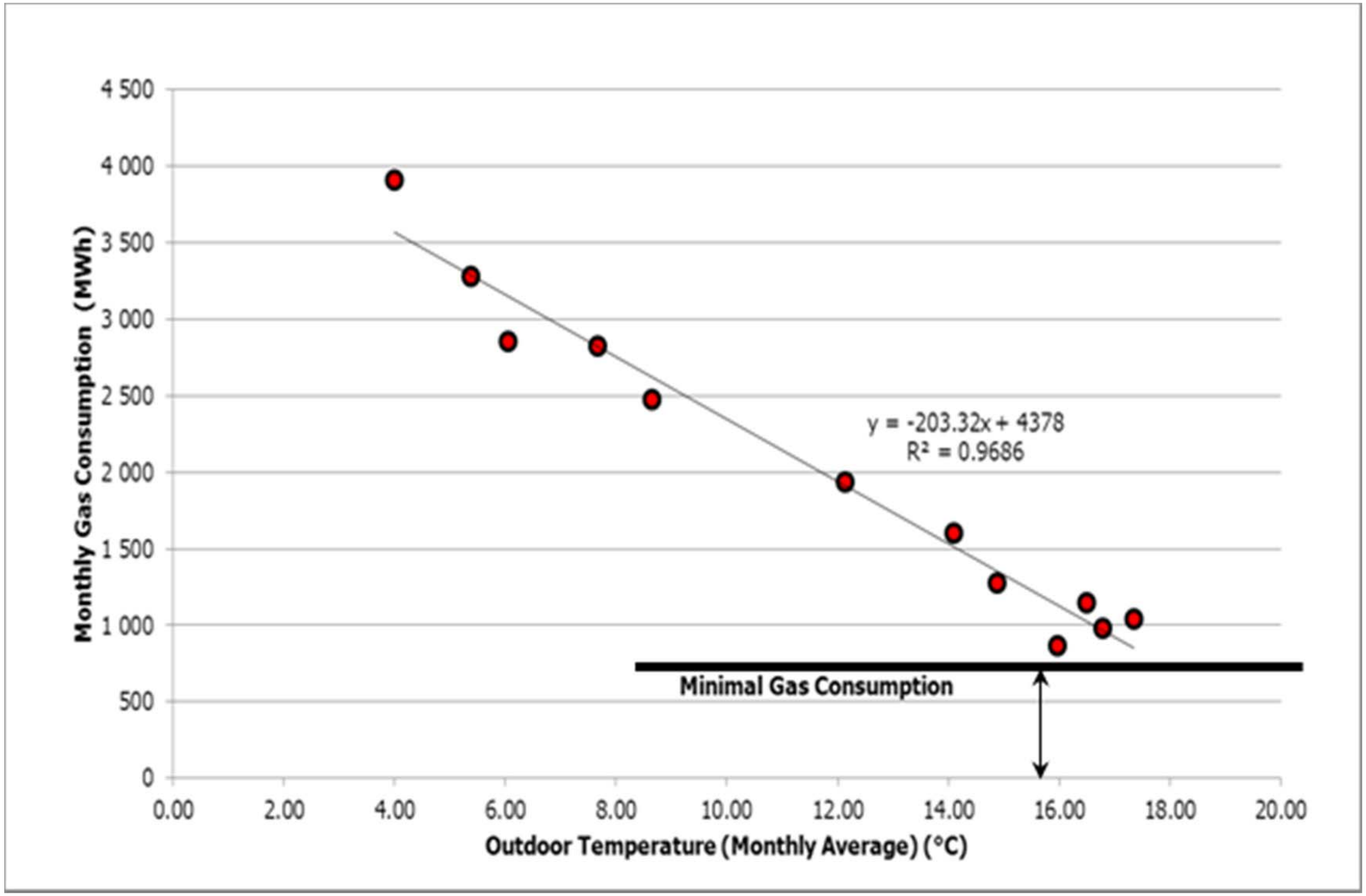

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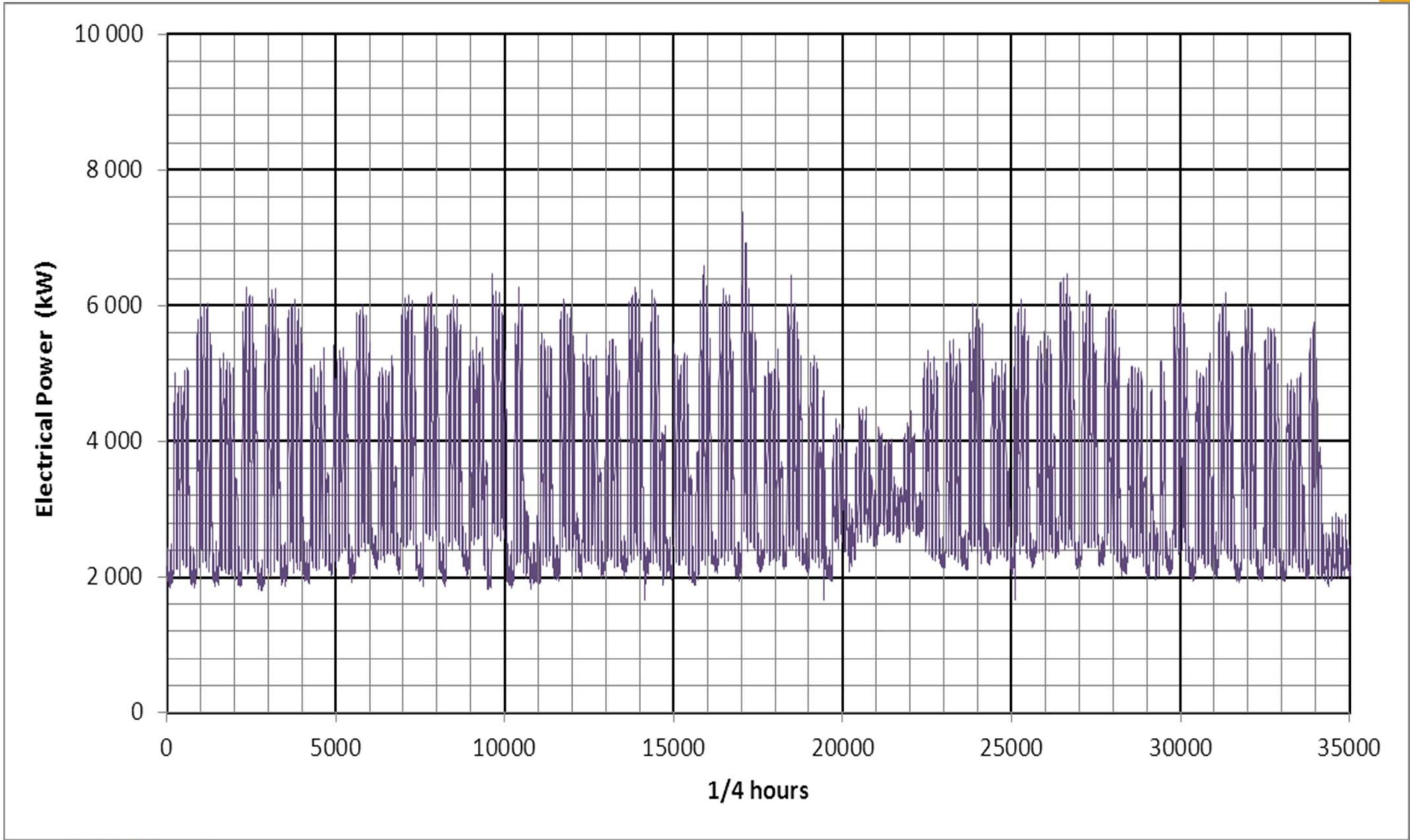

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Audit

- Use main components as measuring devise (including the refrigeration compressors!)

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Back to some questions and facts…

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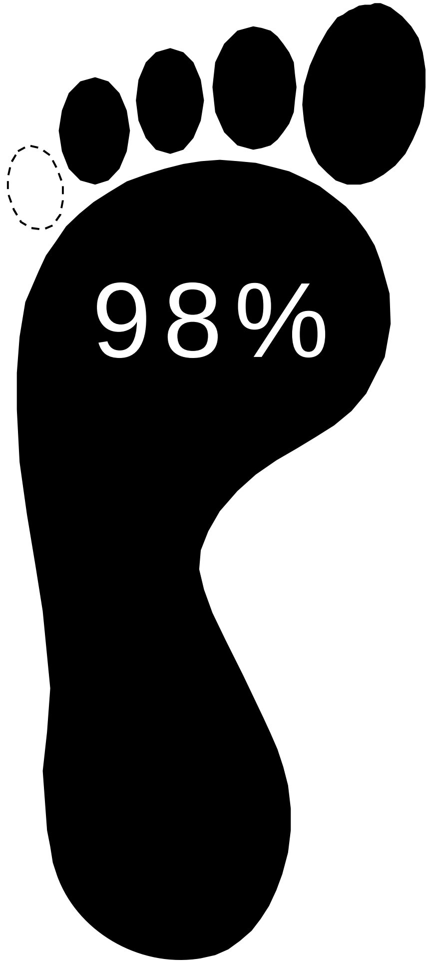
A Typical Chiller’s Carbon Footprint



98% of the total global warming impact is indirect emissions of CO_2 due to electric energy usage, production and disposal of the equipment

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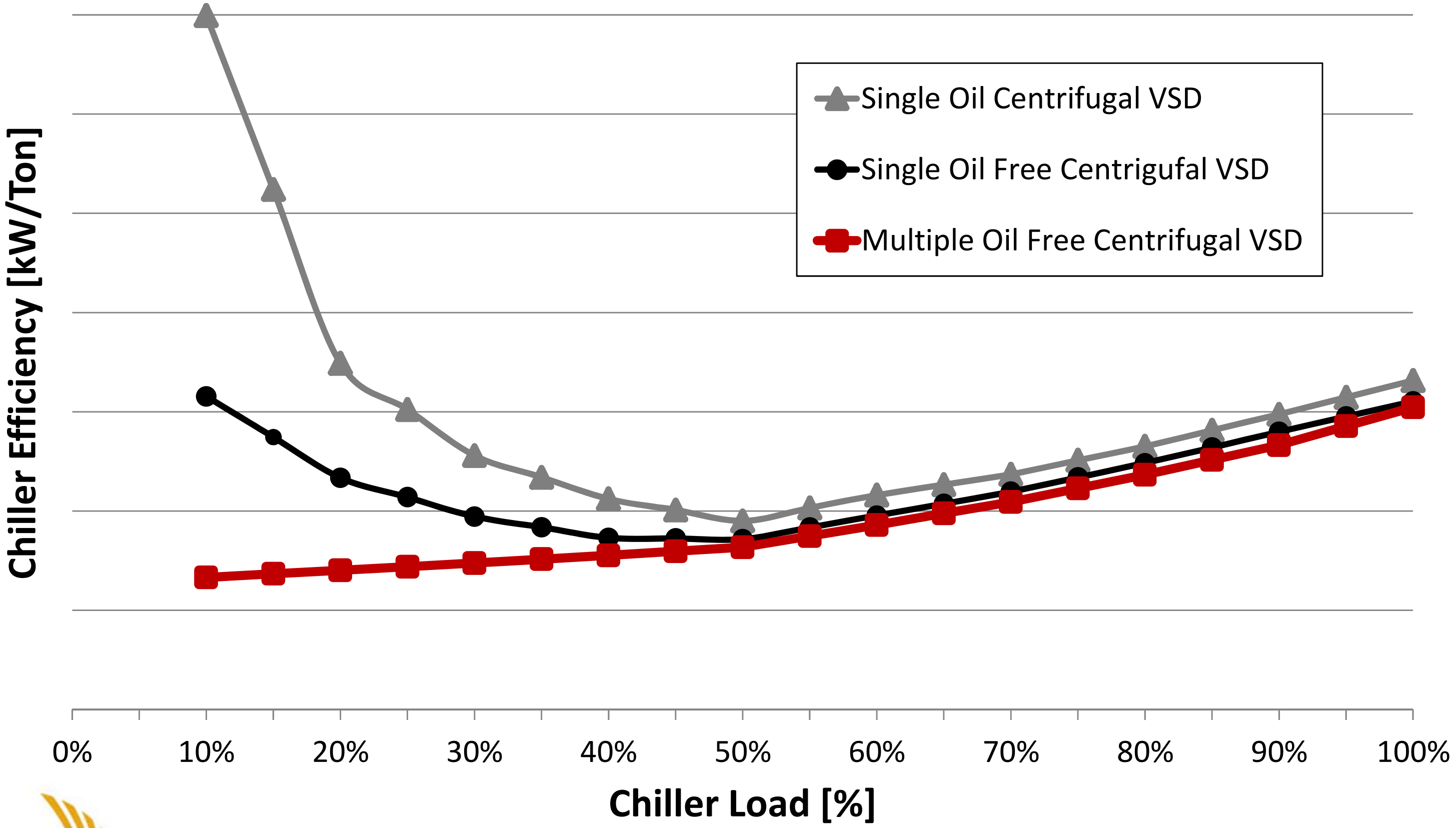
- That is why air cycles reverse Brighton cycles are of little interest here!

Oil free enables multiple compressor benefit

Multiple oil-free compressors improve energy efficiency at low load operation



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I. The interest behind variable speed compressors

- Comfort application runs most of the time at part load*

	ESEER parameters		
Part Load Ratio	Air temperature (°C)	Water temperature (°C)	Weighting coefficients
100	35	30	3 %
75	30	26	33 %
50	25	22	41 %
25	20	18	23 %

&

ESEER is calculated as follows:
ESEER = A.EER100% + B.EER75% + C.EER50% + D.EER25%
With the following weighting coefficients:
A = 0.03 ; B = 0.33 ; C = 0.41 ; D = 0.23

Importance of part load efficiency

- Better capacity modulation
- Start/stop's reduced considerably — ***Up to 45% reduction***
- Lower inrush current — ***Starting current reduced by 5***

*Source: www.eurovent-certification.com

CO_2 comme réfrigérant

Désavantages:

- Des niveaux de pression relativement élevés
- Les aspects de sécurité (règlements) et la conception des composants
- Équipement pour éviter des pressions excessives pendant les périodes d'arrêt**!!!**
- Température critique à 31,1 ° C
  propriétés thermodynamiques défavorables pour les systèmes avec des températures de sortie des pressions de refoulement plus élevées / de refroidisseur de gaz

HC comme réfrigérant

Désavantages:

- Inflammable et explosif "Safety Group A3«
  - Des mesures de sécurité spécifiques (exigeant des règles de sécurité)
    - l'augmentation des coûts d'investissement
    - les questions de responsabilité (conception, installation, d'exploitation et de service!)
  - limitations de charge et de l'emplacement de l'installation
    - peut nécessiter des boucles secondaires. Augmentation des besoins en énergie et les coûts d'investissement
- Particulièrement forte solubilité avec des huiles de réfrigération habituelles
  - Forte dilution et l'effet solvant
    - Caractéristiques de lubrification défavorables
    - Danger d'une usure excessive et réduit la durée de vie
  - Exige des mesures supplémentaires, comme une supérieur de viscosité d'huile, résistance carter plus forts (sécurité!), cycle pompe a vide, échangeur de chaleur interne.

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System optimalisation

- Operational considerations
- “Free” Cooling ???
- COP objectives / water consumption
- Lay out flexibility
- ROI / TCO analysis

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In (very) short..

- Look to global (direct + *indirect*) Impact
- Look to the whole HVAC system
- Include reliable simulation at design stage
- Make corrections on site
- Include real optimization in the management
- Use compressors (and other components as measuring devices)

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- Thank you or your attention!

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