





# Chiller and heat pump. Technology and market trends

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**RHOSS ...**





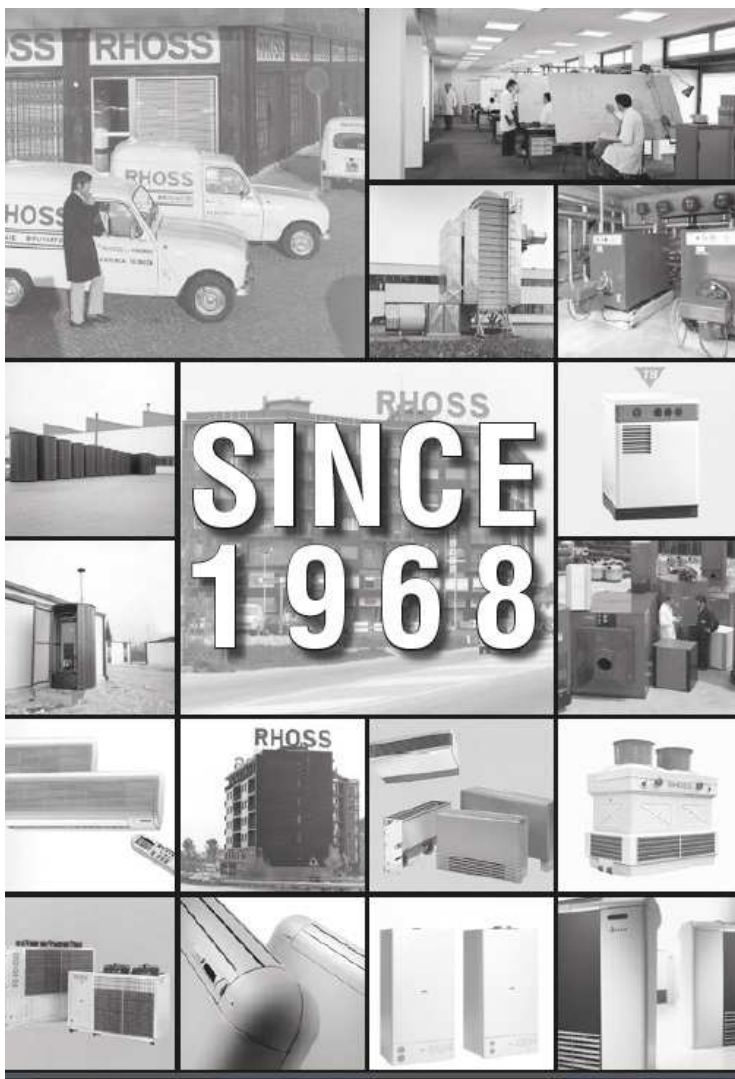
Headquarter:  
**ITALY**  
**CODROIPO – UD**

300.000 sm  
(48.000 indoor)

**A/C and Air Treatment Systems production**



Italian Production plants



## Our STORY

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**1968: Rhoss was founded in Codroipo (UD)**

**'70s: the company entered the air-conditioning sector** with the production of fan coils and refrigeration units for civil and industrial use

**2000: Rhoss was purchased by Irsap Spa** and became part of the Group.

**2018: Rhoss become part of NIBE GROUP**



## GLOBAL BUILDING APPROACH ...





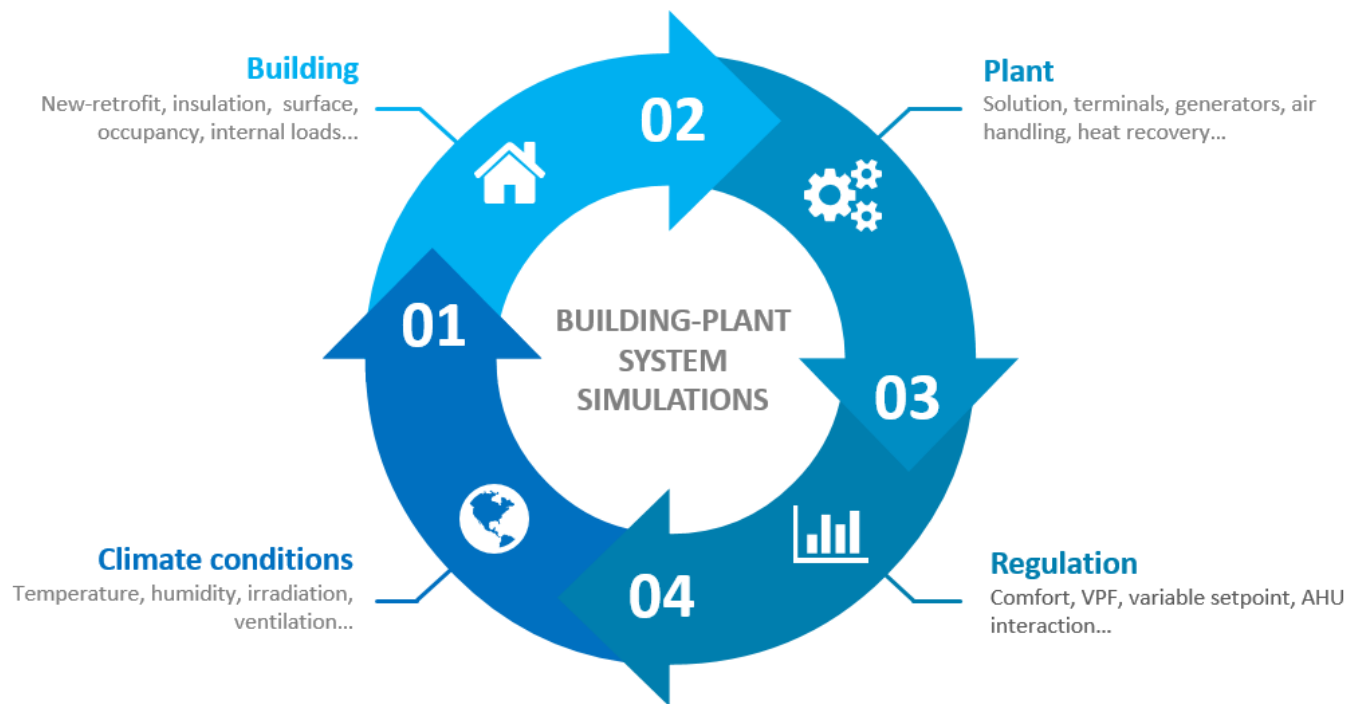
# GLOBAL BUILDING APPROACH

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## BUILDING ENERGY SIMULATION

Only an approach to the whole building-plant system can consider the interactions between all involved elements.

«...the sum of the best technologies often is not the best energy solution....»





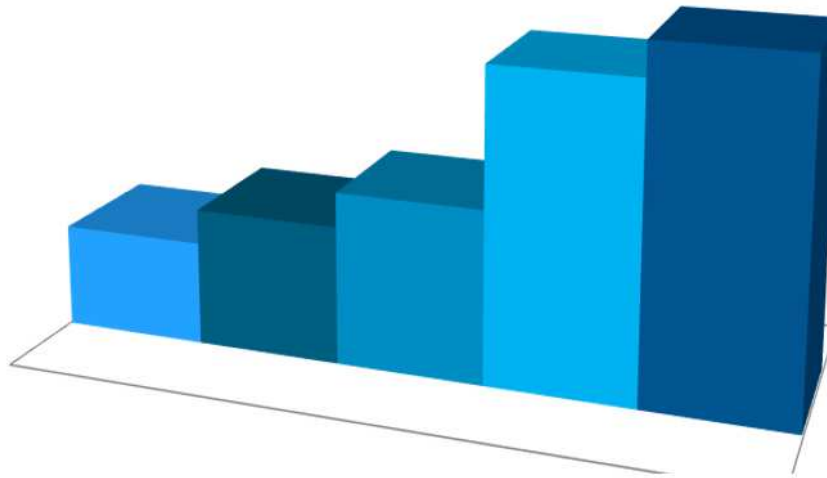


## GLOBAL BUILDING APPROACH

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### BUILDING ENERGY SIMULATION

Global building  
consumption:  
design choices  
influence



For every system solution it's possible to get a wide range of results, **from the best to the worst**, depending on the **design choices**.





## THE EFFICIENCY CONCEPT IS CHANGING ...





## EU REGULATIONS: SEER

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### *EN 14825 norm*

*Testing and rating at part load conditions and calculation of seasonal performance:*

- **SEER**: Seasonal cooling coefficient of performance (space cooling)

Seasonal space cooling energy efficiency

$$\eta_{sc} = (100/CC) \times SEER - \Sigma F(i)$$

**CC** - Conversion coefficient (CC=2,5)

**SEER** - Seasonal coefficient of performance according EN 14825

**7/12°C** with variable outlet water temperature according the cooling demand

or

**18/23°C** fixed water temperature

**$\Sigma F(i)$**  – Sum of the negative contribution to efficiency

F(1) = 3% due to adjusted contributions of temperature controls

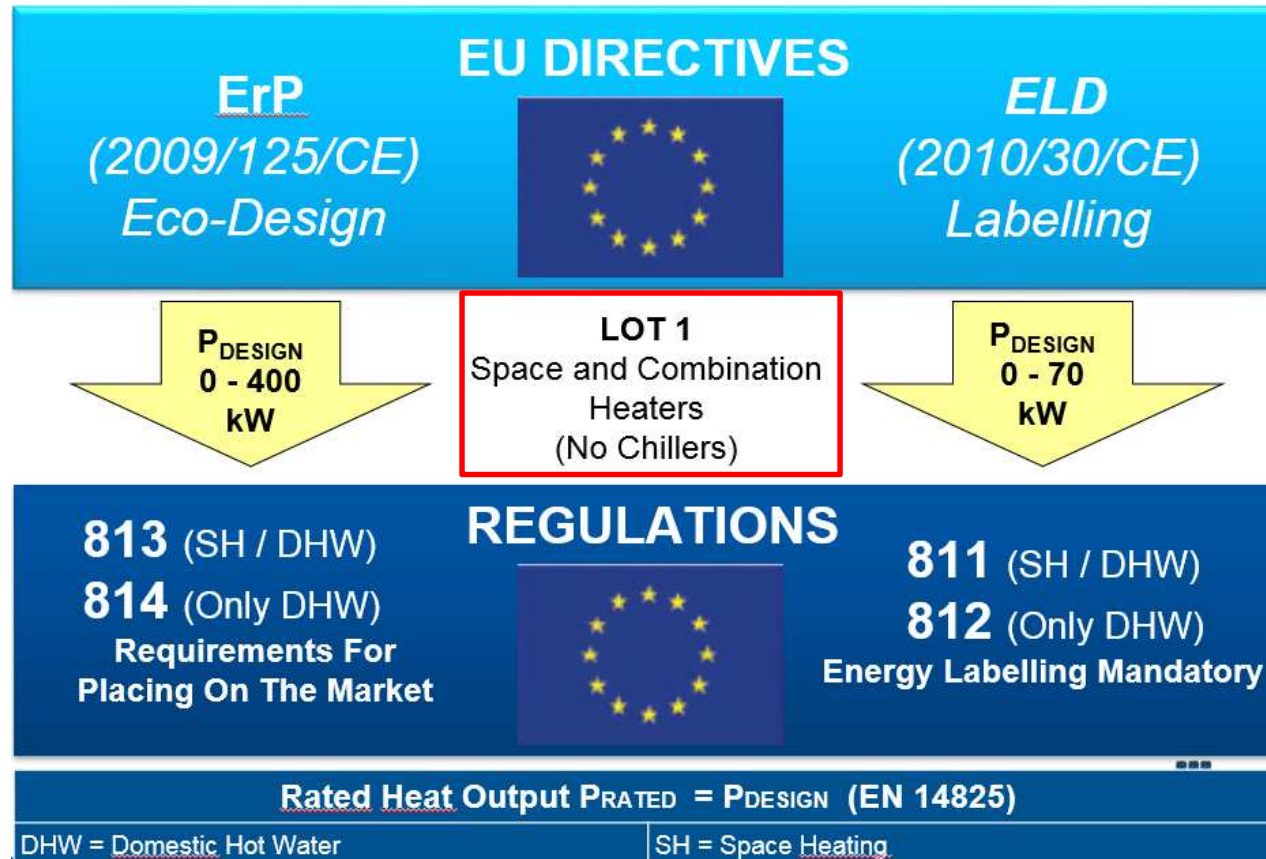
F(2) = 5% by electricity consumption of ground water pump in the water-/brine-to-water





## EU Directives and Regulations: *Heat pumps - heating*

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## EU Directives and Regulations: *Heat pumps - heating*

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### ECODESIGN - 813/2013



- Space heaters and combination heaters with  $P_{des}^* \leq 400$  kW
- Average climate

$\eta_s$   
SCOP

#### REQUIREMENTS

1. Seasonal space heating energy efficiency
  - $\eta_s \geq 115\%$  from 26/09/2015
  - $\eta_s \geq 125\%$  from 26/09/2017
2. Sound power level LWA[dB]
3. Product information

Classes

### ECOLABEL - 811/2013



- Space heaters and combination heaters with  $P_{des}^* \leq 70$  kW
- Average climate

#### REQUIREMENTS

1. Seasonal space heating efficiency classes (low temperature)
  - **Class A** from 26/09/2015
  - **Class A+** from 26/09/2017
  - **Label changes from G->A++ to D-> A+++ from 26/09/2019**
2. Sound power level LWA[dB]
3. P design



\*  $P_{design}$  = Rated heat output (UNI EN 14825)





## EU Directives and Regulations: *Chillers*

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**EU DIRECTIVES**  
**ErP**  
(2009/125/CE)  
*Eco-Design*

**LOT 21**  
Space cooling  
Process cooling  
Chillers

$P_{\text{DESIGN}}$   
Da 0 - 2  
MW



**REGULATION**  
**2016/2281**  
Requirements For  
Placing On The Market

**Rated Cooling Output  $P_{\text{RATED}} = P_{\text{DESIGNc}}$  (EN 14825)**





## EU Directives and Regulations

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| Units           | Application   | Directive           | Regulation   | Reference capacities        | Efficiency index (EN14825) | Implementation                   |
|-----------------|---------------|---------------------|--|-----------------------------|----------------------------|----------------------------------|
| Heat pumps      | Space heating | Ecodesign Directive | 813  | $P_{des} \leq 400\text{kW}$ | $\eta_s, SCOP$             | Tier1:26/09/15<br>Tier2:26/09/17 |
|                 |               | Ecolabel            | 811  | $P_{des} \leq 70\text{kW}$  | ENERGY LABELLING           | 26/09/15                         |
| Heat pumps      | Space cooling | Ecodesign Directive | 2016/2281  | $P_{des} \geq 400\text{kW}$ | $\eta_{sc}, SEER$          | Tier1:01/01/18<br>Tier2:01/01/21 |
| Comfort Chiller | Space cooling | Ecodesign Directive | 2016/2281  | $P_{des} < 2\text{MW}$      | $\eta_{sc}, SEER$          | Tier1:01/01/18<br>Tier2:01/01/21 |
| Process Chiller | Space cooling | Ecodesign Directive | 2016/2281 (high temperature process chiller)<br>2015/1095 (medium and low t. process chillers) | $P_{des} < 2\text{MW}$      | SEPR                       | Tier1:01/01/18<br>Tier2:01/01/21 |



**Rated output =  $P_{design}$  UNI EN 14825**

*(It represents the capacity at  $T_{design}$  temperature, required by an ideal building where the heat pump is virtually installed)*





# EU Directives and Regulations

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## SCOP/SEER/SEPR Tier

APPLIED- CHILLER & HP



| Lot1 Ecodesign reg. 813 – SCOP thresholds |           |                                   |                                      |
|---|-----------|-----------------------------------|--------------------------------------|
| HPs                                       | Pdes [kW] | $\eta_s$ /SCOP TIER1<br>(09/2015) | $\eta_{sc}$ /SCOP TIER2<br>(09/2017) |
| A/W                                       | <400      | 115/2,95                          | 125/3,2                              |
| W/W                                       | <400      | 115/3,08                          | 125/3,33                             |

| Lot21 Ecodesign reg. 2016/2281 – SEER thresholds |                          |                                      |                                      |
|--|--------------------------|--------------------------------------|--------------------------------------|
| Chiller  | Pdes [kW]                | $\eta_{sc}$ /SEER TIER1<br>(01/2018) | $\eta_{sc}$ /SEER TIER2<br>(01/2021) |
| A/W  | <400                     | 149/3,8                              | 161/4,1                              |
|  | $\geq 400$               | 161/4,10                             | 179/4,55                             |
| W/W  | <400                     | 196/5,10                             | 200/5,20                             |
|  | from $\geq 400$ to <1500 | 227/5,88                             | 252/6,50                             |
|  | $\geq 1500$              | 245/6,33                             | 272/7,00                             |

| Lot21 Ecodesign reg. 2016/2281 - SEPR thresholds |                          |                             |                             |
|--|--------------------------|-----------------------------|-----------------------------|
| Chiller  | Pdes [kW]                | SEPR min TIER1<br>(01/2018) | SEPR min TIER2<br>(01/2021) |
| A/W  | <400                     | 4,50                        | 5,00                        |
|  | $\geq 400$               | 5,00                        | 5,50                        |
| W/W  | <400                     | 6,50                        | 7,00                        |
|  | from $\geq 400$ to <1500 | 7,50                        | 8,00                        |
|  | $\geq 1500$              | 8,00                        | 8,50                        |







# EU Directives and Regulations

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## SCOP/SEER/SEPR Tier

APPLIED- CHILLER & HP



### Comfort A/C Chillers – $\eta_{s,c}$ / (SEER) Analysis – $\eta_{s,c}$ based on PEF 2.5

|              | Cooling capacity | $\eta_{s,c}$ (SEER) Tier-1 | $\eta_{s,c}$ (SEER) Tier-2 |
|--------------|------------------|----------------------------|----------------------------|
| air-cooled   | < 400 kW         | 149% (3,8)                 | 161% (4,1)                 |
|              | $\geq 400$ kW    | 161% (4,1)                 | 179% (4,6)                 |
| water-cooled | < 400 kW         | 196% (5,0)                 | 200% (5,1)                 |
|              | $\geq 400$ kW    | 227% (5,8)                 | 252% (6,4)                 |
|              | $\geq 1500$ kW   | 245% (6,2)                 | 272% (6,9)                 |
|              |                  |                            |                            |

up to  
+ 11%





## Consequences ...

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Source: database Eurovent for water chilling packages, cooling only & reversible, Jan. 2015

| Published Units | Total        | ≤ 400kW      | %Phase out T1 | %Phase out T2 | > 400kW      | %Phase out T1 | %Phase out T2 |
|-----------------|--------------|--------------|---------------|---------------|--------------|---------------|---------------|
| R134A           | 2 530        | 813          | 60%           | 67%           | 1 717        | 71%           | 80%           |
| R410A           | 7 213        | 6 304        | 73%           | 81%           | 909          | 80%           | 97%           |
| R407C           | 165          | 154          | 94%           | 95%           | 11           | 64%           | 100%          |
| <b>Total</b>    | <b>9 908</b> | <b>7 271</b> | <b>72%</b>    | <b>79%</b>    | <b>2 637</b> | <b>74%</b>    | <b>86%</b>    |





## Consequences ...

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Source: database Eurovent for water chilling packages, cooling only & reversible, Jan. 2015

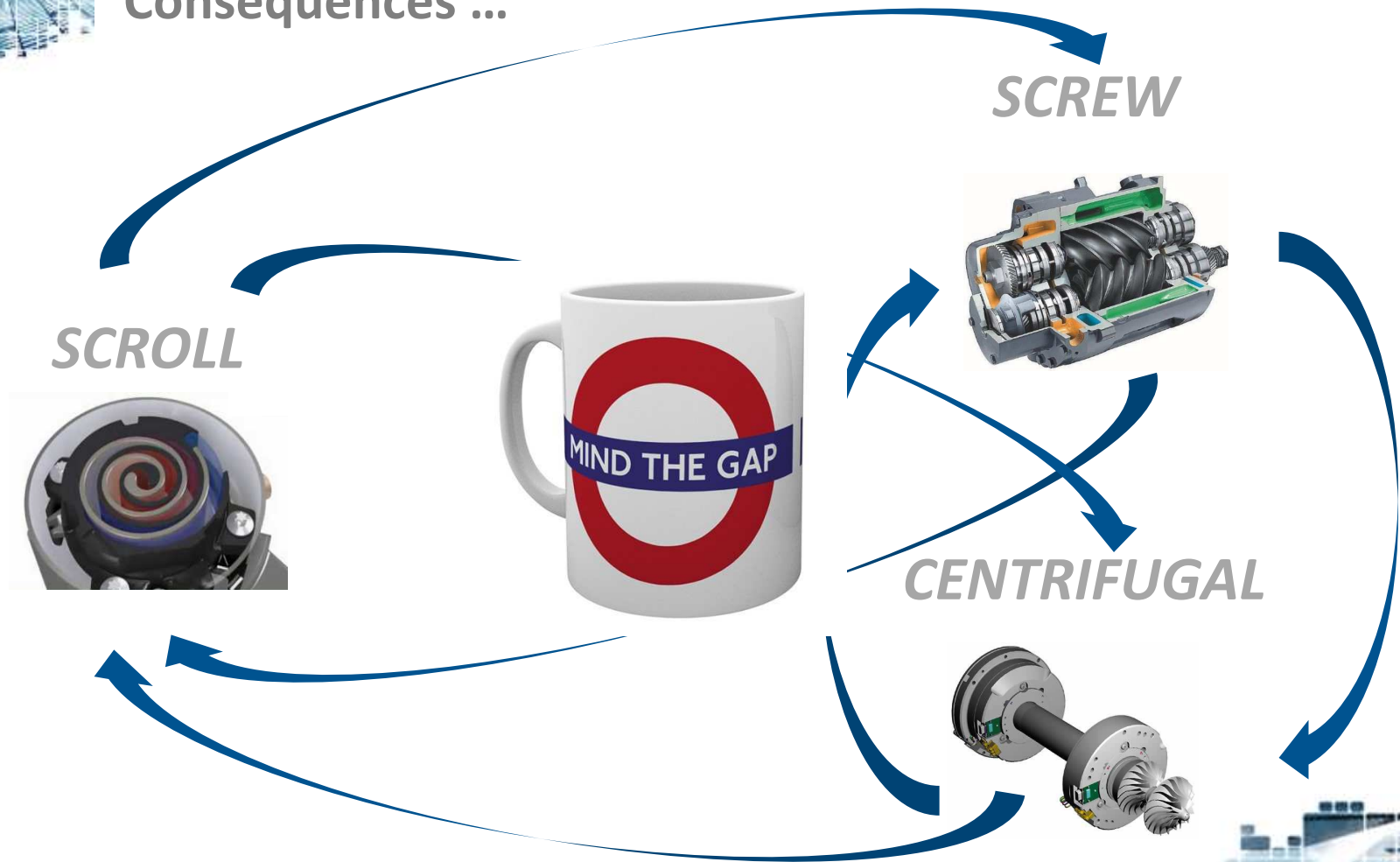
| Published units   | Total        | ≤ 400kW      | %Phase out T1 | %Phase out T2 | > 400kW      | %Phase out T1 | %Phase out T2 |
|-------------------|--------------|--------------|---------------|---------------|--------------|---------------|---------------|
| R134A             | 1 188        | 287          | 46%           | 50%           | 901          | 75%           | 83%           |
| R410A             | 1 505        | 1 266        | 52%           | 56%           | 239          | 97%           | 100%          |
| R407C             | 133          | 126          | 97%           | 98%           | 7            | 100%          | 100%          |
| <b>Total 2015</b> | <b>2 826</b> | <b>1 679</b> | <b>54%</b>    | <b>58%</b>    | <b>1 147</b> | <b>80%</b>    | <b>86%</b>    |





## Consequences ...

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## Consequences ...

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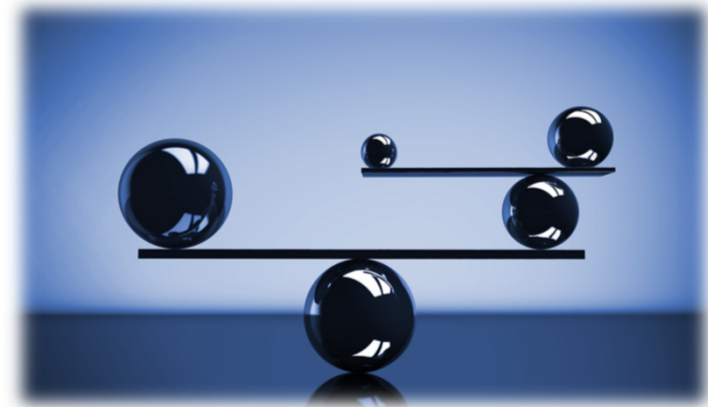
*New Efficiency Bans ...*

*New way to design chillers*



*COP (kW)*


*GWP (Refrigerant)*



A New Way  
of Thinking







**THE NEW  
EFFICIENCIES ARE  
REACHABLE: BUT IT  
WON'T BE A WALK IN  
THE PARK ...**





## REFRIGERANTS EVOLUTION ...

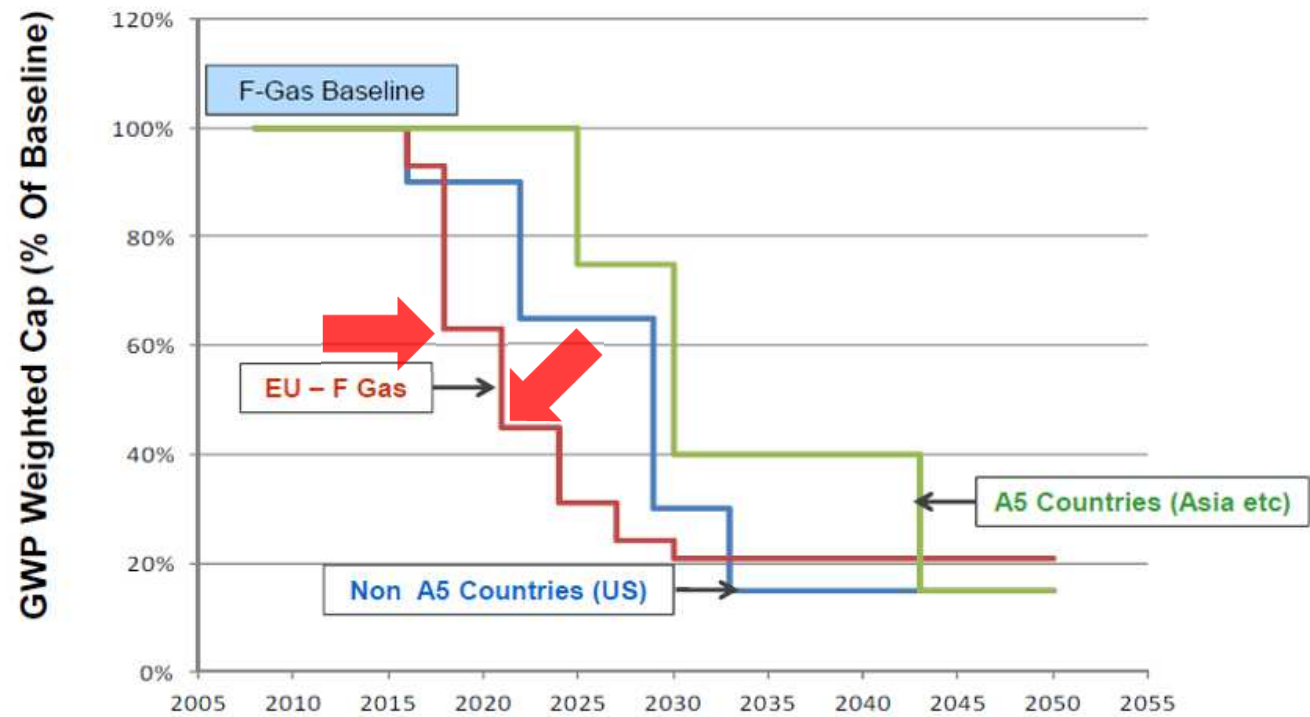




## NEW REFRIGERANTS ...

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### EU's F-Gas vs US & Asia








## NEW REFRIGERANTS ...

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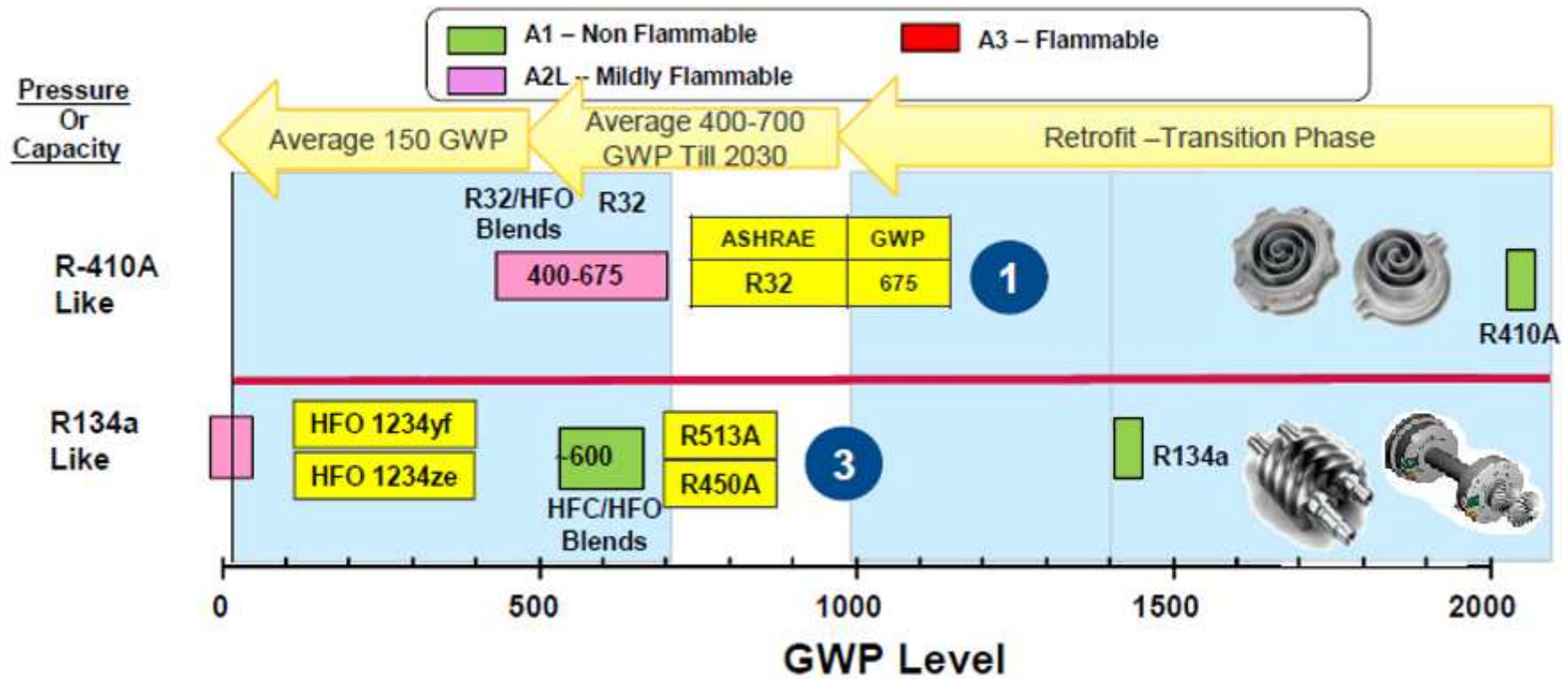
| Applications Industries  | Present          | Short term<br>2016-2020                     | Long term<br>2020-2030                       |
|--|------------------|---|--|
| <div>Centrifugal &amp;<br/>Screw Chillers</div> <div></div> | R134a<br>R1234ze | R1233zd<br>R1234xx<br>HFO Blends            | R1233zd<br>R1234xx<br>HFO Blends             |
| <div>Scroll Chillers &amp;<br/>Rooftops</div> <div></div> | R410A<br>R407C   | R410A<br>R454B,<br>R452B, R32<br>HFO Blends | R454B,<br>R452B<br>R32<br>R290<br>HFO Blends |





## NEW REFRIGERANTS & FLAMMABILITY ...

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## FLAMMABILITY ...

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### TIMELY – Safety Standard Development – recognizing **the need for flammable refrigerants**





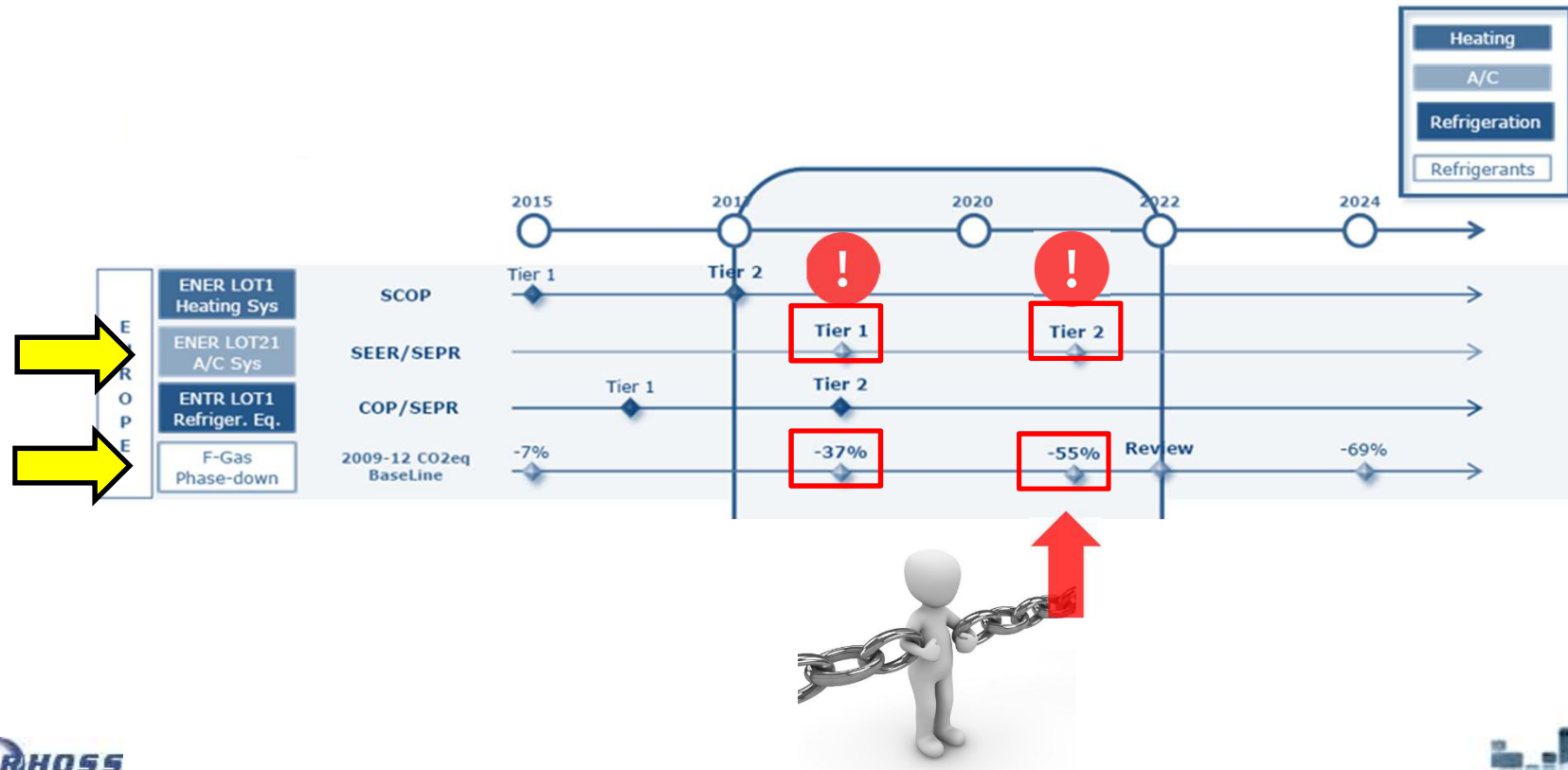
**TO SUMMARIZE ...**





## TO SUMMARIZE ...

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**IN THE FUTURE THE  
SMART BUILDING  
APPROACH MUST  
BECOME ONE OF THE  
MAIN DRIVERS FOR  
THE NEW EFFICIENCY  
REGULATIONS OF  
SINGLE PRODUCTS !!!**





תודה  
Dankie Gracias  
Спасибо شكراً  
Merci Takk  
Köszönjük Terima kasih  
Grazie Dziękujemy Děkojame  
Ďakujeme Vielen Dank Paldies  
Kiitos Täname teid 谢谢  
**Thank You** Tak  
感謝您 Obrigado Teşekkür Ederiz  
Σας Ευχαριστούμ 감사합니다  
ขอบคุณ  
Bedankt Děkuje vám  
ありがとうございます  
Tack

