

## Topic

EcoDesign Directive Minimum Energy Efficiency Standards for Refrigeration Systems – How does the new legislation affect chiller efficiency?

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## EcoDesign Directive Minimum Energy Efficiency Standards for Refrigeration Systems – How does the new legislation affect chiller efficiency?

For the last seven years, the European Commission (EC) has been consulting with the industrial refrigeration industry to establish EU-wide rules for minimum energy efficiency and labelling requirements for refrigeration and cooling products.

The EcoDesign Directive, which is enacted in UK law via the Ecodesign for Energy Related Products Regulations, sets requirements for **minimum efficiency performance standards (MEPS)** and forces manufacturer to improve the energy efficiency of their systems to help reduce this.

Fundamentally, the new efficiency requirements will allow refrigeration end-users to easily compare chiller efficiency performance by looking at two well-defined and straightforward set of figures based on the Minimum Energy Performance Standards (MEPS) requirement established by the directive:

- a) Seasonal Energy Performance Ratio (**SEPR**) for **industrial process chillers**, and
- b) Seasonal Space Cooling Energy Efficiency (**SSCEE**) for **comfort cooling chillers**.

This set of data required by the EcoDesign Directive is expected to supersede other energy efficiency indices in Europe, such as Eurovent's European Seasonal Energy Efficiency Ratio (ESEER), and the Carbon Trust's Energy Technology List (ETL), which have been criticised for relying on ideal laboratory conditions to test energy performance, leading to a lack of real world data.

It is expected that through the use of standardised, reliable and application-based energy performance ratios, users will be able to make better and more

informed decisions, which take into account 75% of the total life cycle costs as opposed to focusing on capital costs alone. Energy consumed during refrigeration plant operation normally amounts to 60% of the plant's total life cycle cost. Only a further 15% is attributed to initial capital investment and the remaining 20-25% is accounted for by maintenance and aftercare.

Chiller equipment produces greenhouse gas emissions via '**Indirect emissions**' which are linked to the chiller's power consumption and therefore the energy efficiency's measures taking by the EU's Ecodesign Directive; and by '**Direct emissions**' which are associated with refrigerant leaks and counteracted by the EU's F-Gas Regulation.

The EcoDesign Directive has the potential to save end-users millions of pounds on energy bills and will have a great impact on cutting carbon emissions to achieve Europe's 80% carbon reduction targets by 2050.

The Directive encompasses all electrical appliances which are going into the market place.

### EcoDesign Directive and chiller application ranges

Under the EcoDesign Directive (2009/125/EC), the European Parliament set a framework for development of minimum requirements for the energy and environmental performance of energy-using products (EuP) and energy-related products (ErP) throughout their life-cycle.

In terms of cooling and heating products, the decision to act came after the EC identified the "high potential" for energy savings that refrigeration equipment had due to its high energy consumption and long operating times.

The EcoDesign and Energy Labelling Directives provide end users with clear information that allows them to choose more efficient products; to increase energy efficiency and, therefore, the

the level of protection of the environment; and finally, to ensure the free movement of energy-related products in the European Union.

The actual minimum-energy and performance requirements of the Directive for EuP and ErP were developed for each specific product group – depending on application – instead of the previous one-size-fits-all approach, which led to buyer’s confusion when chiller performance data was used to compare and measure efficiency of refrigeration systems for applications they were not originally built for or for ambient conditions not relevant to their particular location. For example, the regulations now define separate chiller utilisation rates in recognition of the fact that a process chiller is much more likely to operate at higher load in lower ambient conditions than a comfort chiller.

With the introduction of the EcoDesign Directive, the different product categories are separated into groups called LOTS. The key issues and legislation that affect industrial refrigeration end-users are collected in two product groups, referred to as ENTR Lot 1 (Refrigeration and Freezing equipment, in particular Medium Temperature (MT) and Low Temperature (LT) process chillers and condensing units) and ENER Lot 21 (High Temperature (HT) process chillers and comfort cooling (HVAC)).

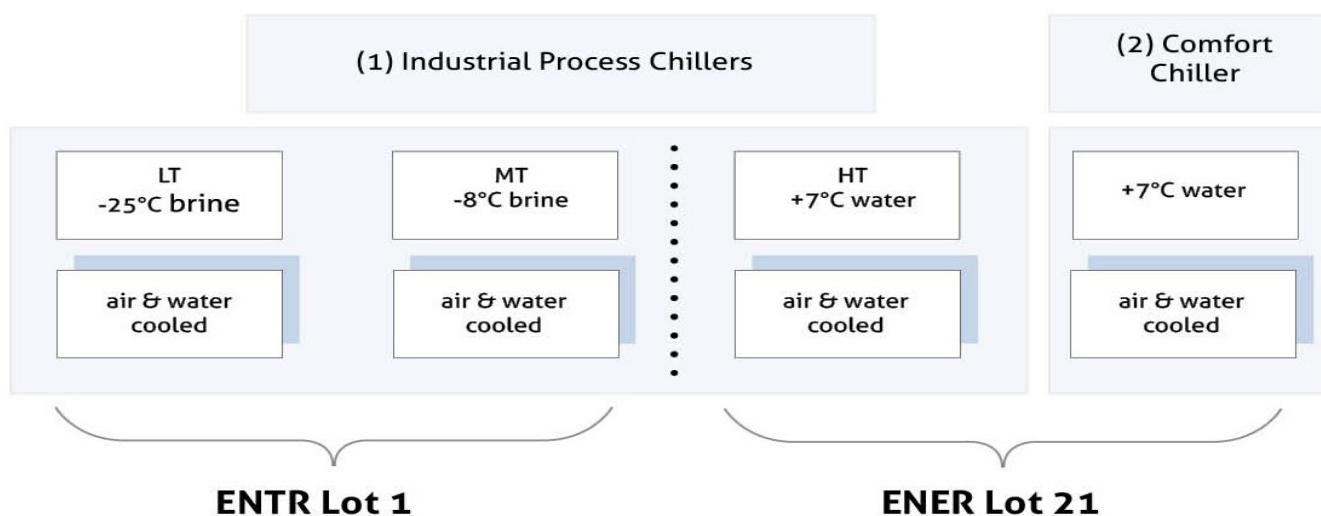
outlet temperature of -25°C. This product falls under Commission Regulation (EU) 2015/1095 with minimum energy efficiency requirements which have been in place since July 2016.

A medium temperature (MT) process chiller is capable of delivering its rated capacity with a process fluid outlet temperature of -8°C. This product also falls under Commission Regulation (EU) 2015/1095 with minimum energy efficiency requirements which have also been in place since July 2016.

A high temperature (HT) process chiller is capable of delivering its rated capacity with a process fluid outlet temperature of +7°C. The system being cooled by the HT process chiller shall not have the purpose of cooling of a space for the thermal comfort of people. This product falls under the same regulation as comfort chillers, Commission Regulation (EU)2016/2281, which enforces minimum energy efficiency requirements from January 2018.

A comfort chiller is defined as a cooling product which may use a vapour compression or sorption cycle to cool a water based cooling system to a temperature not lower than +2°C. The condenser may reject heat to the ambient air, a water/brine circuit or to the ground. A comfort chiller would typically have the purpose of cooling of a space for the thermal comfort of people.

## ErP related Chiller



*The different product categories are separated into groups called LOTS*

A process chiller is defined as a product consisting of at least one compressor and evaporator capable of cooling down and continuously maintaining the temperature of a liquid in order to provide cooling to a refrigerated appliance or system. It may or may not integrate the condenser, coolant circuit hardware and other ancillary equipment. The Directive does not, however, apply to custom made chillers assembled on site and made on a one off basis, or HT chillers exclusively using evaporative condensing.

A low temperature (LT) process chiller is capable of delivering its rated capacity with a process fluid

The directive is not only to establish the MEPS but to further limit the environmental impact of professional refrigeration products; it also states that manufacturers should provide instruction manuals on installation to optimise energy efficiency and information on disassembly, recycling or disposal.

How does the new EcoDesign Directive affect the current chiller market?

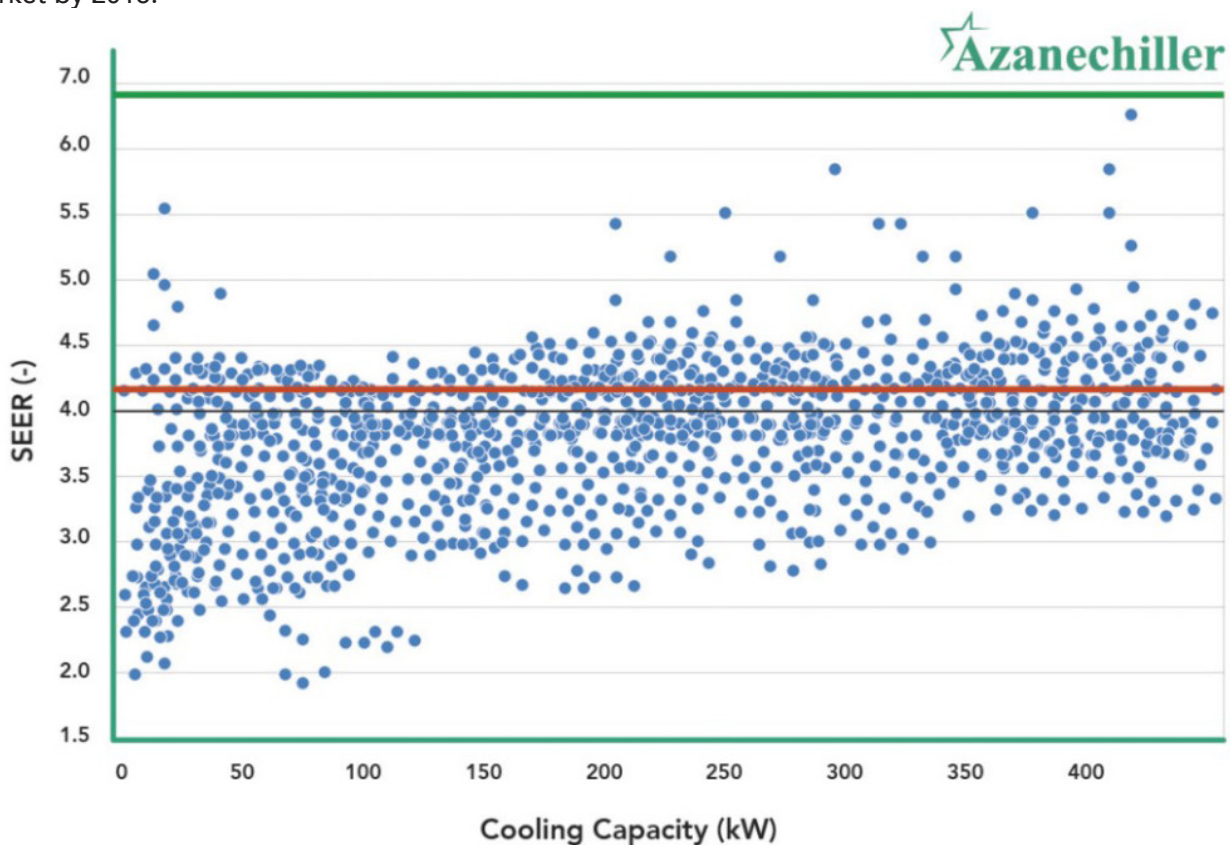
The EcoDesign Directive will have a dramatic impact on cutting our carbon emissions and will provide massive savings for Europe’s businesses as the less energy efficient products are driven out of the market and substituted for lower energy consuming chillers. For manufacturers, the EU targets will no doubt

present great challenges as all non-compliant chillers will not be allowed to be sold on the European market, but also opportunities, as this will mean going back to the drawing board and redesigning new, more technologically advanced energy efficient chillers .

**According to data set published by standards organisation EUROVENT in May 2015, 80% of comfort chillers above 400kW will not make the first cut of the EcoDesign Directive as the proposed minimum energy performance standards are not met, with a further 8% of chillers expected to be withdrawn from the market by 2021** when the proposed minimum energy performance standards for comfort chillers are further tightened. This effectively means that the majority of refrigeration chillers for comfort cooling applications currently being manufactured must be dropped from the market by 2018.

a chiller must have in order to comply with legislation. Use the figures provided on the tables below to compare different chiller solutions and boost your business' bottom line – the higher the performance figures, the more energy efficient the chiller and the higher the energy and carbon savings.

From now on, the efficiency of refrigeration products will be measured by the Seasonal Energy Performance Ratio (SEPR) for LT, MT and HT processchillers and the Seasonal Space Cooling Energy Efficiency (SSCEE) for comfort chillers, resulting from multiplying the Seasonal Energy Efficiency Ratio (SEER) by 0.4 with further corrections to account for energy consumption related to temperature control and electricity consumption of ground water pumps where applicable. The final value is expressed as a percentage.



Eurovent database 05.2015: ESEER translated into SEER NET

Tier – 1 (2018): MEPS are not achieved by ~80%

Tier – 2 (2021): MEPS are not achieved by ~88%

The EcoDesign Directive has set as its ultimate aim to reduce the energy consumption (and therefore reduce CO2 emissions) and other negative environmental impact, particularly at the design stage.

**EcoDesign Directive Minimum Energy Performance Standards**

The Minimum Energy Performance Standards (MEPS) are the minimum energy requirements

Calculation of the efficiency measures are completed by manufacturers and are in accordance with the methodologies set out in the regulations which also references other recognised methods of calculation e.g. EN14825.

The following tables show the minimum energy efficiency threshold requirements. You can refer to these two MEPS figures, by which refrigeration products sold in the EU are to be declared, to compare the energy efficiency of different solutions.

**ENTR Lot 1: LT & MT Process chiller**  
**SEPR MEPS energy efficiency TIER 1**

From July 2016

Heat transfer medium at the condensing side	Operating temperature	Rated cooling capacity $P_A$	Minimum SEPR value	* Minimum SEPR for ammonia
Air	Medium (MT) - 8 °C	$P_A \leq 300$ kW	2.24	2.02
		$P_A > 300$ kW	2.80	2.52
	Low (LT) - 25 °C	$P_A \leq 200$ kW	1.48	1.34
		$P_A > 200$ kW	1.60	1.44
Water	Medium (MT) - 8 °C	$P_A \leq 300$ kW	2.86	2.58
		$P_A > 300$ kW	3.80	3.42
	Low (LT) - 25 °C	$P_A \leq 200$ kW	1.82	1.64
		$P_A > 200$ kW	2.10	1.90

\* 10% lower statement for GWP < 150.

**ENTR Lot 1: LT & MT Process chiller**  
**SEPR MEPS energy efficiency TIER 2**

From July 2018

Heat transfer medium at the condensing side	Operating temperature	Rated cooling capacity $P_A$	Minimum SEPR value	* Minimum SEPR for ammonia
Air	Medium (MT) - 8 °C	$P_A \leq 300$ kW	2.58	2.32
		$P_A > 300$ kW	3.22	2.90
	Low - 25 °C	$P_A \leq 200$ kW	1.70	
		$P_A > 200$ kW	1.84	
Water	Medium (MT) - 8 °C	$P_A \leq 300$ kW	3.29	
		$P_A > 300$ kW	4.37	
	Low - 25 °C	$P_A \leq 200$ kW	2.09	
		$P_A > 200$ kW	2.42	

\* 10% lower statement for GWP < 150.

**ENER Lot 21: HT Process chiller**  
**SEPR MEPS energy efficiency TIER 1**

From 1st January 2018

Heat transfer medium at the condensing side	Operating temperature	Rated cooling capacity $P_A$	Minimum SEPR value
Air	High (HT) +7 °C	$P_A < 400$ kW	4.5
	High (HT) +7 °C	$P_A \geq 400$ kW	5.0
Water	High (HT) +7 °C	$P_A < 400$ kW	6.5
	High (HT) +7 °C	$P_A \geq 400$ kW & $1500 < kW$	7.5
	High (HT) +7 °C	$P_A \geq 1500$ kW	8.0

# ENER Lot 21: HT Process chiller

## SEPR MEPS energy efficiency TIER 2

From 1st January 2021

Heat transfer medium at the condensing side	Operating temperature	Rated cooling capacity $P_A$	Minimum SEPR value
Air	High (HT) +7 °C	$P_A < 400$ kW	5.0
	High (HT) +7 °C	$P_A \geq 400$ kW	5.5
Water	High (HT) +7 °C	$P_A < 400$ kW	7.0
	High (HT) +7 °C	$P_A \geq 400$ kW & $1500 < kW$	8.0
	High (HT) +7 °C	$P_A \geq 1500$ kW	8.5

### Implementation of the EcoDesign Directive

The regulation for each LOT will be implemented in two phases – a more lenient Tier 1 will be upgraded with stricter and final Tier 2 following a scheduled programme of action which started in July 2016 and will conclude on 5th May 2020 for LT and MT chillers, and by 1st January 2022 for HT and Comfort chillers. The regulations make provision for the inclusion of a review at a later date but not later than 1st Jan 2022 which may further tighten requirements or extend the scope of existing regulations to incorporate additional products (e.g. process chillers using evaporative condensers may be incorporated at a later date).

The EC Regulation for MT and LT Process Chillers and Condensing Units has become applicable since 1st July 2016. Since then it is mandatory for refrigeration manufacturers of these products to declare performance and other technical details in accordance with the regulations. Some products covered by this regulation also require specific labelling under the Energy Labelling Directive (2010/30/EU), though this does not apply to process chillers or condensing units. Products not meeting the requirements of the regulations in any respect, may no longer be placed on the market in Europe. The directive also introduced an energy efficiency bonus for condensing units and

process chillers that use refrigerants with GWP < 150. Unlike the regulation for LT and MT process chillers, which has a 10% bonus for MEPS to encourage use of low GWP (< 150) refrigerants, the new regulations for HT and comfort chillers has no incentive for selection of refrigerant.

More information can be found at

2009 Ecodesign Directive 2009/125/EC :

<https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32009L0125&from=EN>

2015 LT & MT Regulations 2015/1095 :

<https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32015R1095&from=EN>

2016 HT & Comfort Regulations 2016/2281 :

<https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32016R2281&from=EN>

# Time tables ENTR Lot 1 & ENER Lot 1 & ENER Lot 21

## Entry into force

Heat transfer medium at the condensing side	Tier	Year
LT & MT Process Chiller	Tier 1	July 2016
	Tier 2	July 2018
HT Chiller	Tier 1	January 18
	Tier 2	January 21
COMFORT Chiller	Tier 1	January 18
	Tier 2	January 21

The regulations also make provision for each Member State to perform market surveillance checks i.e. any chiller placed on the market post-introduction of the regulations may be selected for testing by a body appointed by the Member State to verify that the chiller achieves the stated performance within an agreed tolerance. In the UK, this function is administered by the National Measurement and Regulation Office (NMRO). End users can therefore have confidence that the energy efficiency claimed by a manufacturer is indeed achieved.

### **How does the EcoDesign regulation affect end-users of cooling equipment?**

The Directive has set very high energy efficiency requirements for the future. So much so that during consultations industry stakeholders voiced concerns about the Minimum Energy Performance Standards targets being "overstated." Targets were seen to be "very challenging" and a call to the EU Commission for lowering them was made without success – MEPS will be mandatory across Europe and it will be unlawful to place products within the EU market that fail to achieve the prescribed minimum energy performance standard.

Products covered by the new regulations which were installed before the date the regulations became effective are not affected by these requirements and need not be replaced or upgraded. MEPS will also trigger investment in cost effective solutions, thereby reducing energy use and associated cost and carbon emissions.

With such a stringent legislative environment, it will be essential that industrial refrigeration manufacturers commit to R&D in order to develop solutions that meet the normative and offer customers a better alternative than existing cooling products. This will

stimulate market changes to speed up the rate at which energy efficiency upgrades to inefficient industrial cooling and heating systems take place

Star's Azanechiller 2.0 goes above and beyond even the tightest MEPS of the directive, with efficiency figures that are up to 146% higher than the European EcoDesign Directive requirement for Medium Temperature chillers, up to 100% higher for comfort cooling chillers and up to 74% higher for High Temperature chiller applications.

For refrigeration end-users, these measures mean good news all round. EU targets will positively impact business owners' use of energy, who should be able to see a reduction of the energy bill as soon as chillers that meet the directive are installed at their facilities.

End-user businesses will benefit from:

More energy efficient equipment from manufacturers of industrial cooling equipment. More efficient chillers will help organisations manage their Carbon Reduction Commitment compliance and avoid penalties.

The Directive will allow end users to use the information provided by manufacturers effectively in order to be able to make informed decisions that directly contribute to business success. The SEPR and Seasonal Space Cooling Energy Efficiency must be declared and technical documentation provided by the manufacturers – however, there is not a set energy rating label.

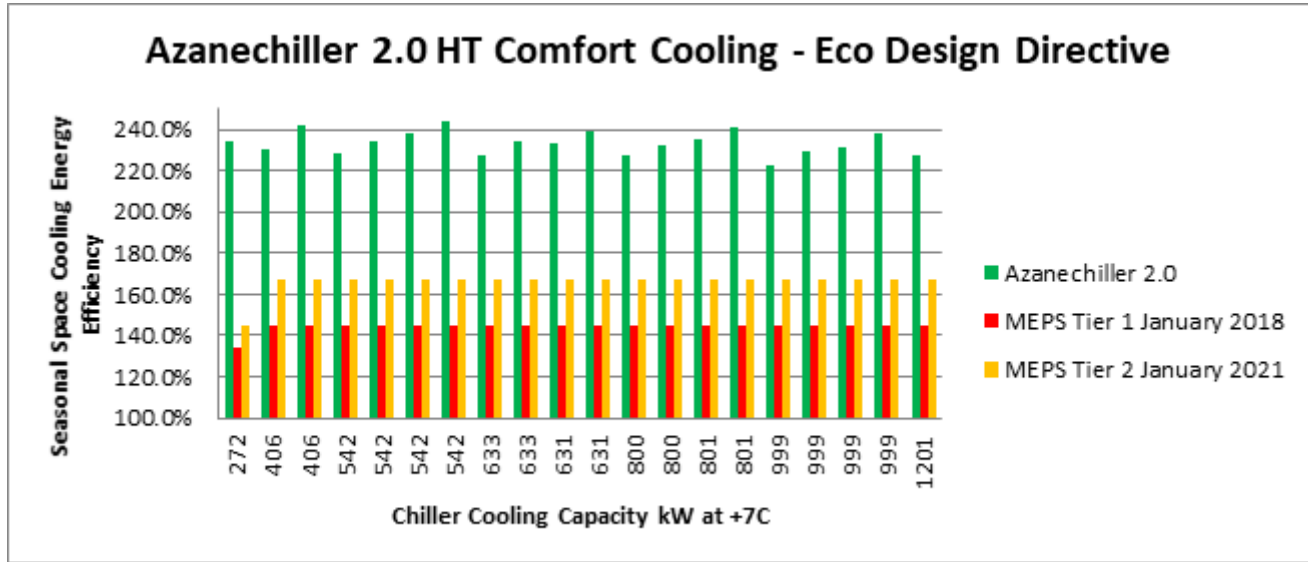
The SEPR and Seasonal Space Cooling Energy Efficiency figures are based on more realistic conditions compared to other currently used ratios and provide the refrigeration end-user with more data to identify the most efficient solution. More efficient solutions will result in higher operating efficiency



## Comfort Chillers

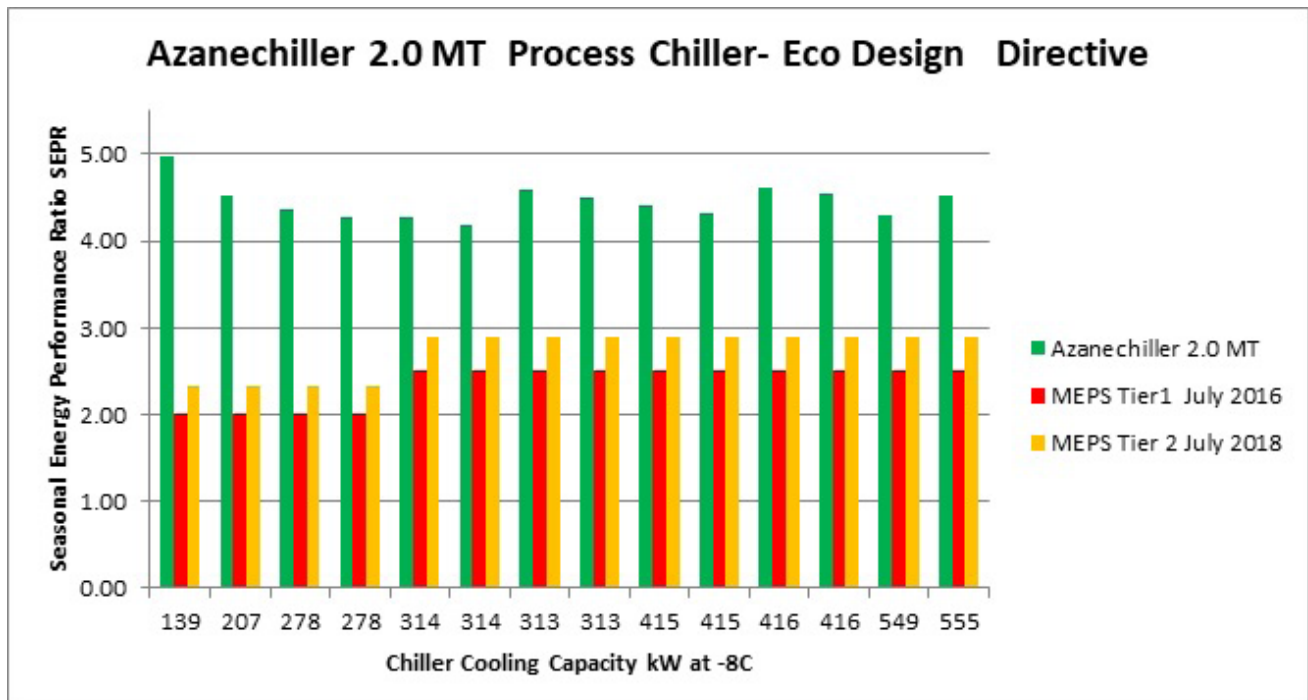
For high temperature +7°C chillers used for comfort cooling, typically for building services, the metric used by the EcoDesign Directive is called Seasonal Space Cooling Energy Efficiency (SEER \* 0.4) and it is expressed as a percentage. The graph shows cooling capacity across the bottom and Seasonal Space Cooling Energy Efficiency for comfort chillers on the vertical axis.

The minimum energy performance standard is between 149% and 161% for all air cooled chillers. All of the high temperature (HT) Azanechillers 2.0 exceed the benchmark by at least 77%.



## High Temperature Process Chillers

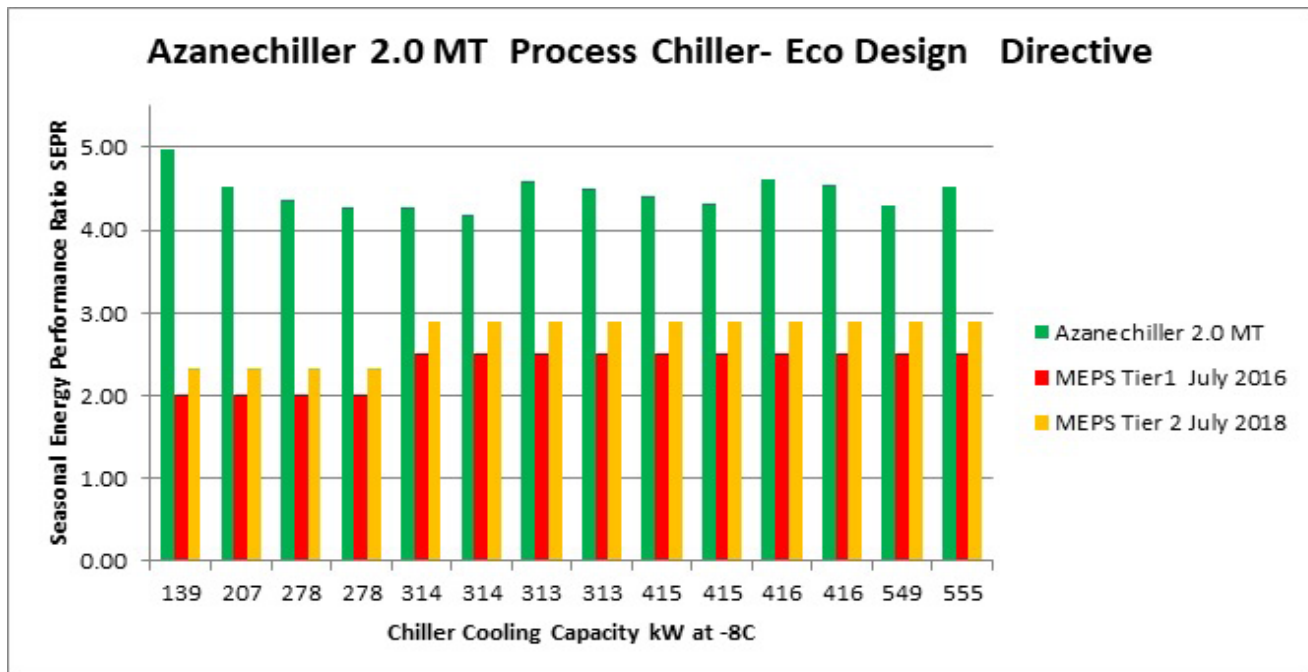
For the high temperature (HT) process chillers operating with water temperatures of +7°C off, the metric used is the SEPR. The graph below shows the range of HT process chillers which have a minimum efficiency performance standard of between 4.5 and 5, introduced from January 2018. Star Refrigeration's ammonia chillers exceed this benchmark also by a wide margin, with the best unit being above 8.00, against a standard of 5.00.





## Low and Medium Temperature Process Chillers

For low temperature (LT) and medium temperature (MT) process chillers with a nominal design glycol off-temperature of -25°C and -8°C respectively, the metric used to measure efficiency is the Seasonal Energy Performance Ratio (SEPR). The minimum efficiency performance standard introduced from July 2016 is between 2.02 and 2.52 for MT process chillers, accounting for the bonus applied where the refrigerant has GWP < 150. The first Star MT process chiller manufactured for 415kW has an SEPR 74% higher than the standard.



For further information, contact [awalkinshaw@star-ref.co.uk](mailto:awalkinshaw@star-ref.co.uk)

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### The Star Refrigeration Group

