Commercial and Professional Refrigeration Products: Promoting Energy Efficiency with Legislation, Empowered Stakeholders and Rebates

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Abstract

Commercial and professional plug-in refrigerated cabinets use much more energy than household products. Saving potentials are huge but there are barriers to improving efficiency. Standardised declaration of energy consumption does not exist; this makes comparing the electricity costs of products impossible. Coming EU legislation will overcome this lack of basic information. How effective the new legislation will be depends on the outcome of the ongoing draft and revision process. A rebate programme for efficient refrigerated cabinets in Switzerland and the European Horizon 2020 project "ProCold" work to empower market participants and overcome barriers to developing efficiency.

Introduction

Based on estimates for the year 2016, plug-in commercial and professional refrigerated cabinets use half as much energy compared to household refrigerators and freezers in the EU, even though there are 12 times less commercial / professional cabinets than household products (commercial / professional: >25 million units and >43 TWh/year[1] [1], household: 304 million units and 84 TWh/year [2]). Size and cooling capacity notwithstanding, the main reason commercial and professional cabinets use so much energy is that they are not energy efficient. Household refrigerating appliances have improved tremendously over the past 20 years thanks to the EU energy label and ecodesign requirements. In 1995, when the EU energy label for household refrigerating appliances was introduced, class G products were common. At present no refrigerator or freezer worse than class A+ can be introduced to the market[2]. Energy consumption was successfully reduced by more than 70% (for models with same size). The best products in class A+++ are twice as efficient as A+.

Energy consumption of plug-in commercial and professional refrigerated cabinets can easily be halved with best-available-technology products. This would bring energy savings of >20 TWh/year and save 4 billion Euros in electricity costs (at an electricity rate of 0.2 Euro/kWh). It is not only the direct users (retail, gastronomy etc.) but every market participant that gains from better energy efficiency:

- green procurement can help public authorities and private businesses reach their environmental targets and reduce spending
- the food and beverage industry can bring savings to their customers by buying efficient cabinets
- manufacturers and suppliers benefit from the higher value and purchase prices of energy efficient products while total costs for their customers are reduced

The coming chapters will discuss saving potentials, barriers to improving energy efficiency and three initiatives to overcome them: a rebate programme for efficient refrigerated cabinets in Switzerland, the European Horizon 2020 project "ProCold" empowering market participants, and coming EU legislation.

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[1] Estimates by Topten based on ecodesign preparatory studies and own research

[2] Exemptions include wine storage appliances, absorption-type and thermoelectric products

Saving potentials

The introduction noted an astounding difference in energy consumption between household and commercial/professional products. Figure 1 (below) illustrates this discrepancy. It depicts consumption values found in catalogues (not standardised). The EU labelling classes for household refrigerating appliances are shown for comparison. Consumption of commercial/professional products lays way outside the scale of household products. There is huge potential to improve.

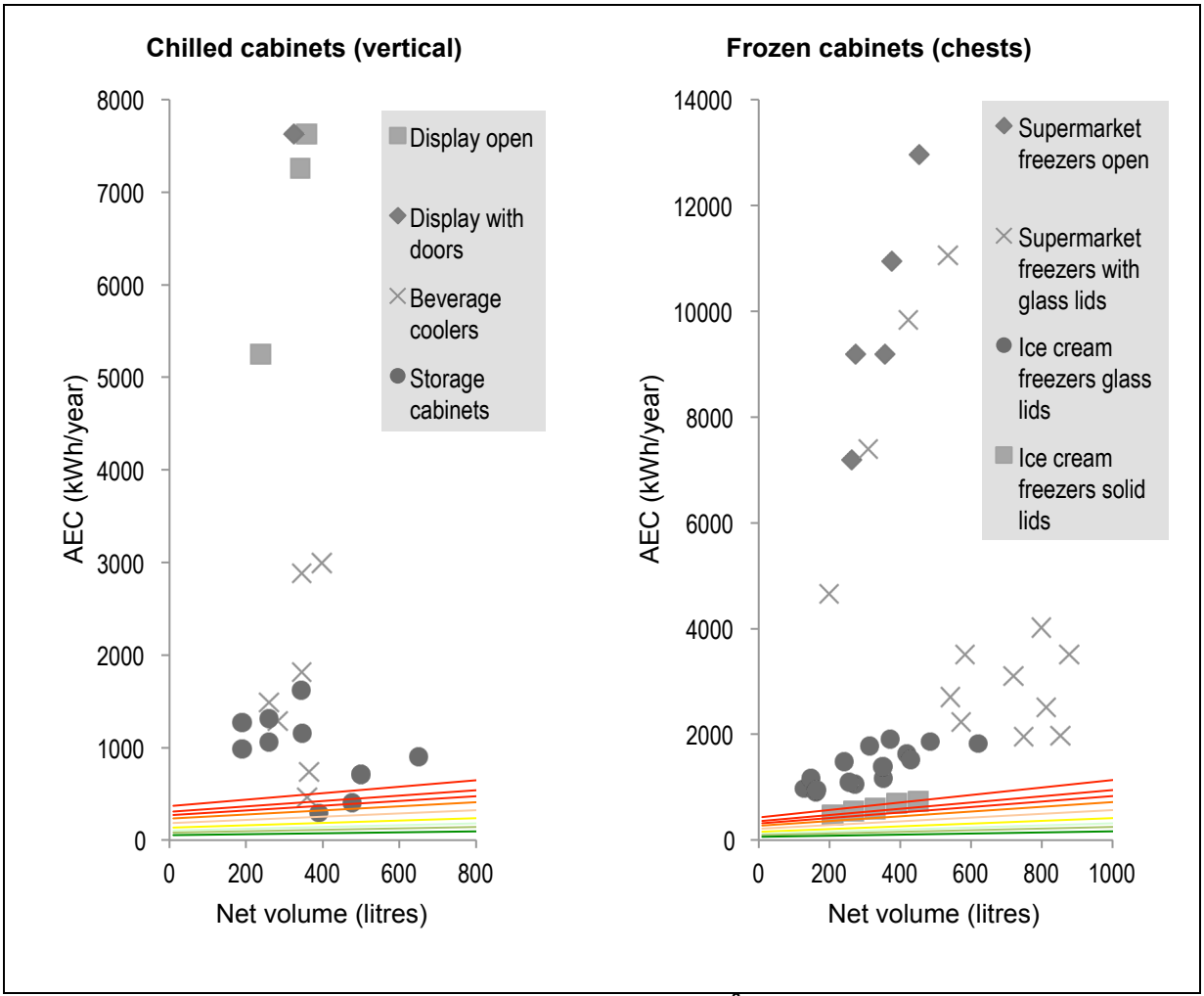


Figure 1: Energy consumption data from catalogues[3] for commercial and professional refrigerated cabinets (coloured lines = EU labelling classes for household refrigerating appliances)

The product comparison in Figure 2 is based on standardised data and shows closed cabinets use three times less energy than open cabinets. The best-available-technology closed products use up to eight times less energy.

[3] Current catalogues of two large suppliers in Switzerland (GKM and Kältering)

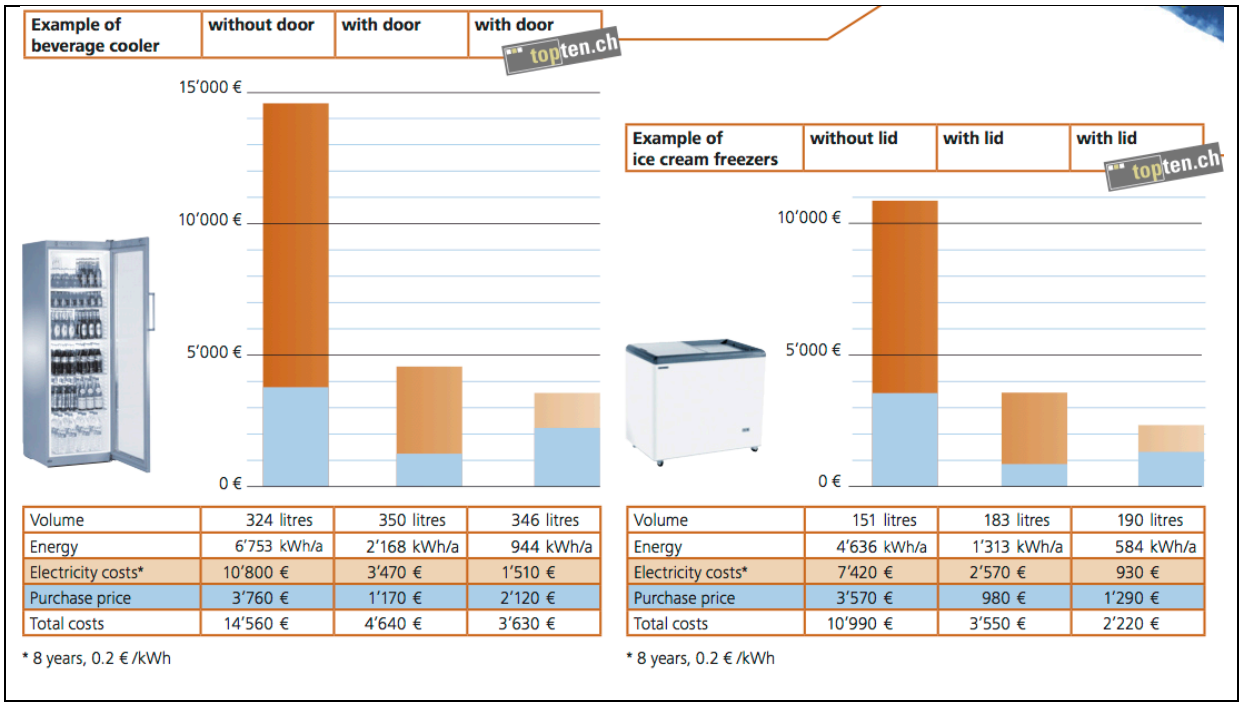


Figure 2: Product comparison with standardised data (source: ProCold brochure [3])

Figure 3 and Table 1 show the reference CO2eq emission savings used in the rebate programme in Switzerland [4]. CO2eq emissions are reduced by replacing ordinary refrigerants with green options, and by buying efficient products. Buying efficient products achieves CO2eq emission savings many times greater than replacing refrigerants (about by factor 4).

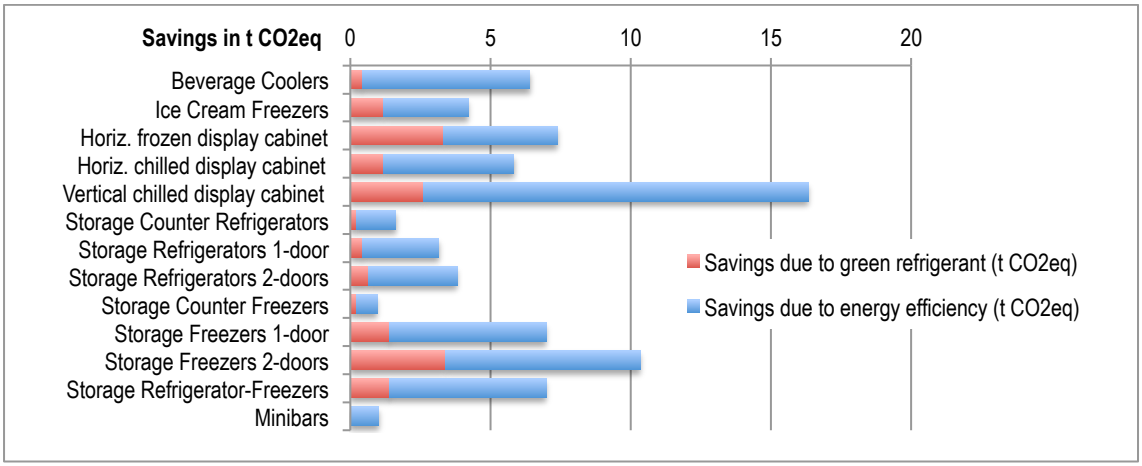


Figure 3: Greenhouse gas emissions saved with energy efficiency and green refrigerants

	Savings due to energy efficiency			Savings due to green refrigerant		Replaced refrigerant		
	kWh	t CO2eq		t CO2eq			kg	GWP
Beverage Coolers	14200	5.96	*93%*	0.43	*7%*	R134a	0.3	1430
Ice Cream Freezers	7192	3.02	*72%*	1.18	*28%*	R507	0.3	3920
Horiz. frozen display cabinet	9640	4.05	*55%*	3.33	*45%*	R507	0.85	3920
Horiz. chilled display cabinet	11024	4.63	*79%*	1.20	*21%*	R404A	0.3	3990
Vertical chilled display cabinet	32680	13.73	*84%*	2.59	*16%*	R404A	0.65	3990
Storage Counter Refrigerators	3352	1.41	*87%*	0.21	*13%*	R134a	0.15	1430
Storage Refrigerators 1-door	6472	2.72	*86%*	0.43	*14%*	R134a	0.3	1430
Storage Refrigerators 2-doors	7520	3.16	*83%*	0.64	*17%*	R134a	0.45	1430
Storage Counter Freezers	1760	0.74	*78%*	0.21	*22%*	R134a	0.15	1430
Storage Freezers 1-door	13288	5.58	*80%*	1.40	*20%*	R404A	0.35	3990
Storage Freezers 2-doors	16536	6.95	*67%*	3.39	*33%*	R404A	0.85	3990
Storage Refrigerator-Freezers	13288	5.58	*80%*	1.40	*20%*	R404A	0.35	3990
Minibars	2390	1.00	*100%*	0.00	*0%*	R717	0.1	0

Table 1: Greenhouse gas emissions saved with energy efficiency and green refrigerants[4]

Energy management systems

As part of the EU legislation process, new testing standards for beverage coolers (prEN 16902) and ice cream freezers (prEN 16901) have been developed. Energy-saving technologies like energy management systems (also called EMS or EMD) for beverage coolers and night covers for ice cream freezers[5] will be allowed and accounted for during testing. This will incentivise manufacturers to implement these technologies.

Energy management systems promise savings of 15-45%. Beverages do not need to be refrigerated at night; integrated EMS automatically switch beverage coolers into sleep-mode after opening hours. The European Commission Joint Research Centre (JRC), in its preparatory study update report on commercial refrigeration [15], says that EMS are the second most effective improvement option to achieve energy savings in beverage coolers and vending machines. The saving potential is estimated to be 26% on average and up to 45% in the best case. The most effective improvement option is using merchandisers with doors instead of open cabinets (yielding a reduction in energy costs by 40 – 50%). However, some beverage companies experienced that energy savings through EMS are lower (15% on average and up to 25% in the best case, based on 12 hours business-mode and 12 hours standby-mode per day, with a pull-down-phase of maximum 3 hours before business-mode). A field measurement in a canteen in Switzerland showed savings of 40% (Figure 4). The measurement was performed in December 2014. Energy consumption was reduced from 120 kWh per week to 71 kWh per week when the cooler is shut off over night and on Sunday (data was provided to Topten by the operator of the canteen anonymously).

[4] Calculated with 0.42 kg CO2eq/kWh for EU electricity mix. Green refrigerants like R290 and R600a have GWP values of <4; thus their CO2eq emissions are very small compared to ordinary refrigerants and they were neglected in this calculation; Total refrigerant emission in EU was set to 100% assuming that there is no recycling (assumptions for Switzerland: about 26% with 1% annual emission during use phase of 8 years (10 years for minibars) and 80% recycling at end of life).

[5] Small ice cream freezers can be equipped with night covers that provide additional insulation for glass lids. Under the condition that they be fixed to the cabinet, night covers will be applied for the energy consumption test. The saving potential of night covers is yet unknown.

These predictable efficiency improvements should be considered when setting the stringency of the EU label classes.

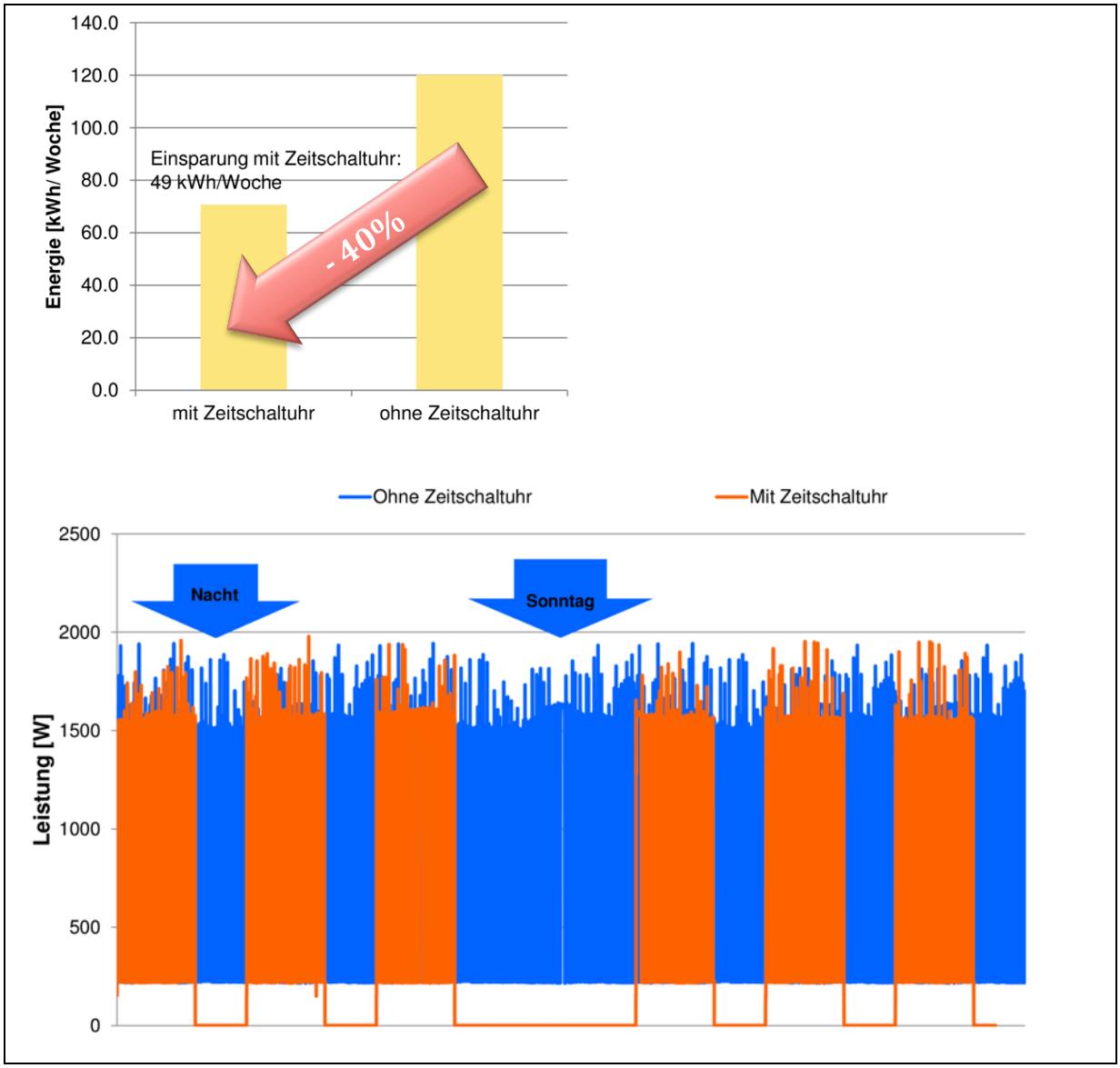


Figure 4: Field measurement of beverage cooler in a canteen shows 40% savings by shutting off at night and on Sundays (top: energy consumption in kWh/week, left with EMS, right without EMS; bottom: power in W, load profile over one week, orange with EMS, blue without EMS)

Barriers to energy efficiency gains

The biggest barrier for both manufacturers and buyers of commercial/professional refrigerated cabinets is that no standardised product information is available to compare the energy costs of different models. Energy consumption values are only found sporadically in catalogues and not suited for comparison because testing conditions are unknown. Figure 5 shows standardised energy consumption values compared to catalogue data for the same models. It becomes clear that energy consumption values declared in catalogues are typically lower than standardised energy consumption. An individual manufacturer has little incentive to declare standardised data because the values would be considerably higher. New product information requirements and EU energy labels are absolutely essential (recently adopted for professional refrigerated storage cabinets, still being developed for commercial refrigerated display cabinets, see later chapter).

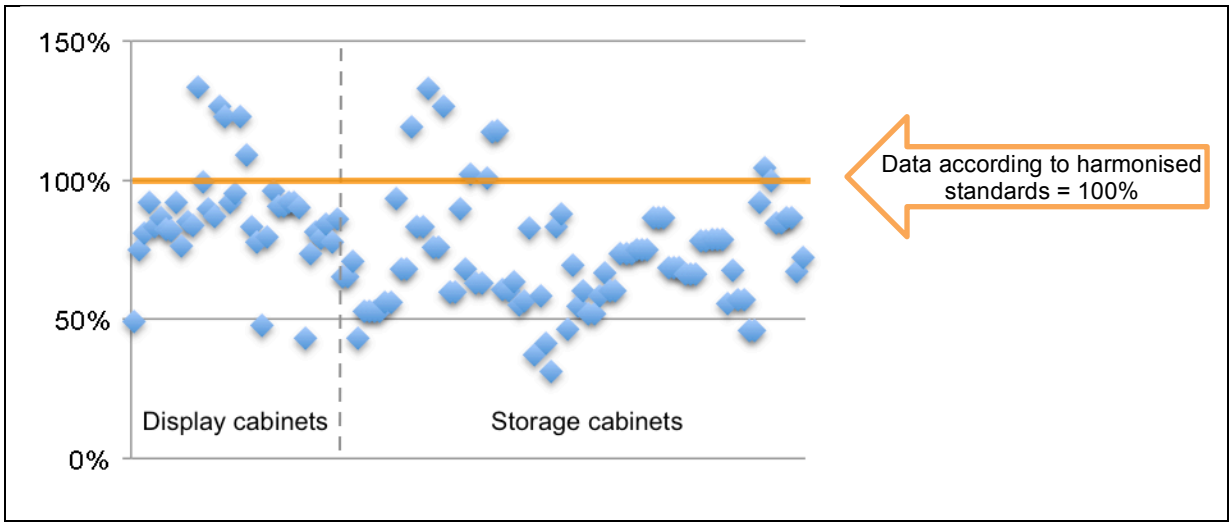


Figure 5: Energy consumption values found in catalogues in relation to data according to harmonised standards

The standardised energy consumption data was collected for the rebate programme in Switzerland. An overview of accepted testing standards, climate classes and temperature classes can be found on the programme website [4] [5].

Using cabinets with glass doors and lids instead of open cabinets would bring the greatest savings achieved by a single measure. The advantages are not only savings, but better hygiene and shopping climates. There are already retailers that implement a closed cabinet strategy, but for many others the fear of selling less is a barrier.

Barriers to introducing green refrigerants

Green refrigerants (with global warming potential, GWP, below 150) have been promoted for many years by numerous projects and campaigns[6]. These activities have successfully started to transform the market. Today there are commercial/professional products that use green refrigerants available for all cabinet types in all sizes. The only exception is large, 2.5 meter, open plug-in cabinets because their cooling capacity is too high[7]; they can use green refrigerants when fitted with glass doors and thus improve cooling capacity. So far the commercial/professional market has failed to follow the market for household refrigerating appliances in which green refrigerants have become common and are now mandatory due to the F-gas regulation [6]. Experiences with the rebate programme in Switzerland and interviews with Swiss industry experts lead to the conclusion that the main barrier for green refrigerants is not lack of awareness or training for professionals but instead the additional effort and expense that come along with the switch to green refrigerants. Professionals need to transport additional gear for maintenance (gas containers, manometer, specific tools) and invest in an expensive precision balance (R290 and R600a must be filled precisely to the gram). This extra effort and expense leads to a situation where many professionals do not recommend and offer products with green refrigerants to their customers.

With the new F-gas regulation [6], the EU decided to phase out climate-damaging refrigerants in commercial refrigerators and freezers by 2022 (see Table 2). The coming ban of climate-damaging

[6] To name four examples: 1) Greenpeace's Greenfreeze project initiated the use of climate-friendly refrigerants in household refrigerators and freezers [7], 2) Environmental Investigation Agency's annual report and retailer survey on natural refrigerant use [8], 3) Shecco supports industry in using green refrigerants with online technology platforms, market research, events etc. [9] 4) ProCool innovation competition in 2005 to support development and market introduction of products with green refrigerant (and energy efficiency) [10]

[7] The common green refrigerants for plug-in cabinets are isobutane (R600a) and propane (R290). Their use is restricted to 150g per cooling circuit because they are flammable. CO2 is more commonly used for remote cabinets and is not flammable / restricted.

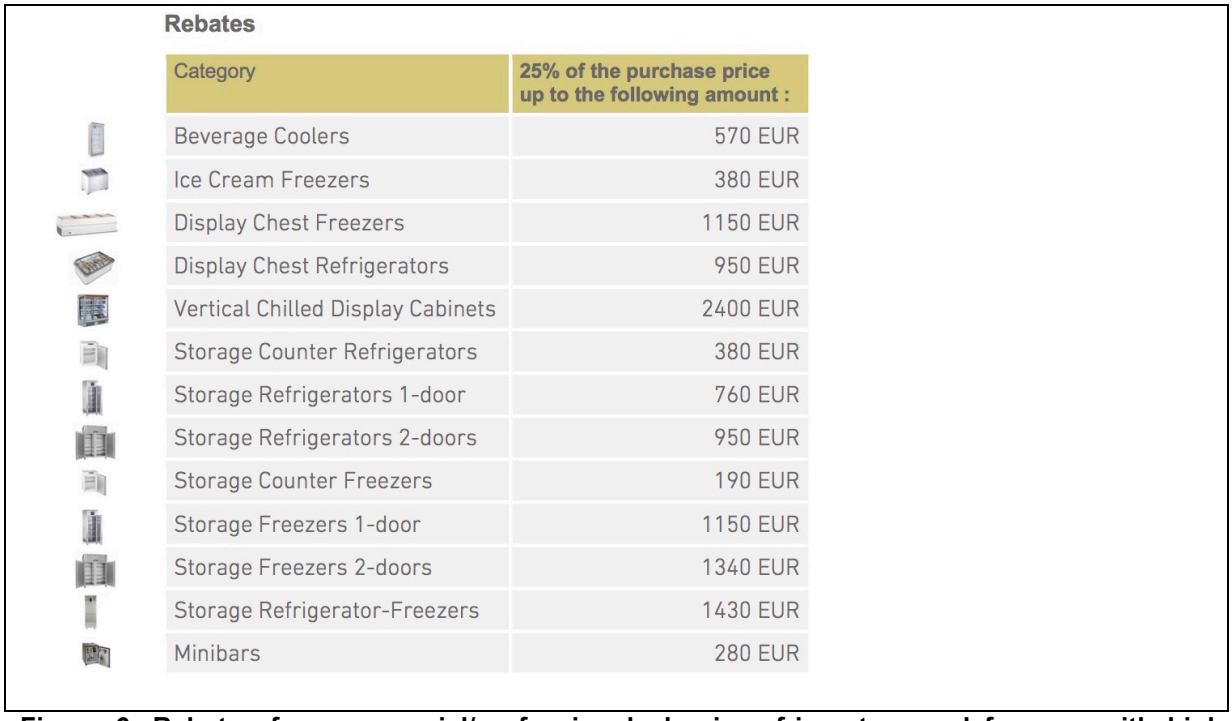
refrigerants is absolutely essential to overcome the barrier that currently impedes widespread uptake of green refrigerants in commercial/professional refrigerated cabinets.

10. Domestic refrigerators and freezers that contain HFCs with GWP of 150 or more		1 January 2015
11. Refrigerators and freezers for commercial use (hermetically sealed equipment)	that contain HFCs with GWP of 2 500 or more	1 January 2020
	that contain HFCs with GWP of 150 or more	1 January 2022

Table 2: Prohibitions for placing on the market in the f-gas regulation (excerpt) [6]

Rebate programme in Switzerland

Since September 2013, Swiss cities, cantons and utilities, with significant financial support from the Swiss Federal Office of Energy, operate a rebate programme for energy efficient commercial/ professional plug-in refrigerated cabinets with green refrigerants [4]. To overcome the described barriers and increase the market share of best-available-technology refrigerators and freezers, the programme pays back rebates of up to 25% of the purchase price for eligible models (Figure 6). With a budget of 3.7 million Euros, the aim is to subsidize about 5000 high-efficiency refrigerators and freezers until 2017. The projected electricity savings of the programme are 42 million kWh.



Rebates

Category	25% of the purchase price up to the following amount :
Beverage Coolers	570 EUR
Ice Cream Freezers	380 EUR
Display Chest Freezers	1150 EUR
Display Chest Refrigerators	950 EUR
Vertical Chilled Display Cabinets	2400 EUR
Storage Counter Refrigerators	380 EUR
Storage Refrigerators 1-door	760 EUR
Storage Refrigerators 2-doors	950 EUR
Storage Counter Freezers	190 EUR
Storage Freezers 1-door	1150 EUR
Storage Freezers 2-doors	1340 EUR
Storage Refrigerator-Freezers	1430 EUR
Minibars	280 EUR

Figure 6: Rebates for commercial/professional plug-in refrigerators and freezers with high efficiency and green refrigerants in Switzerland

Eligible models must be tested according to harmonised standards at defined climate and temperature classes [5]. The technical criteria for eligibility are 1) using green refrigerants (GWP <150) and 2) complying with minimum energy efficiency benchmarks whose stringency is dynamically strengthened as the market develops. The technical criteria are closely aligned with the respective EU legislation (e.g. calculation of energy efficiency indices) in order to achieve a harmonized methodology. All eligible products are published on the Topten.ch website with technical data and standard energy consumption. Thereby the rebate programme aims to create market transparency (at least for the top products on the market) and overcome one of the strongest barriers to efficiency development.

ProCold

In February 2015, a consortium of nine energy agencies, research institutes, a university and environmental organisations located in eight countries took up working to improve energy efficiency of commercial/professional plug-in refrigerators and freezers [3]. The three-year project called “ProCold” is funded by the European Commission’s Horizon 2020 programme.

Having recognised that lack of information and comparable product data is one of the strongest barriers for efficiency improvements, the project will empower Europe’s key stakeholders in distinguishing efficient products. One thousand players with leverage on the market will be personally contacted and provided with tools to stimulate both the supply and demand side. Tools and services of the project include:

- Lists of best-available-technology products are provided for national markets in Austria, Czech Republic, France, Germany, Italy, Portugal, Sweden and Switzerland (Figure 7).
- Logos to showcase best-available-technology models in catalogues or on the cabinets themselves.
- Procurement guidelines including texts to copy-paste into enquiries and calls for tender.
- Calculation tools for comparing costs between products and reporting energy and CO2 savings from green procurement.
- Key information is published in printed brochures, target-tailored to various stakeholder groups (Figure 7).
- The best model in various product categories will be recognised with an award, two years into the project.

The main stakeholder groups with leverage on the market include public authorities (policy making and public procurement), manufacturers and suppliers (manufacturing, researching and developing, marketing, branding and managing logistics of products), food and beverage industry (leasing or providing majority of ice cream freezers and beverage coolers), retailers and other direct users like gastronomy businesses, vending service providers, professional associations, organisations, media and events.

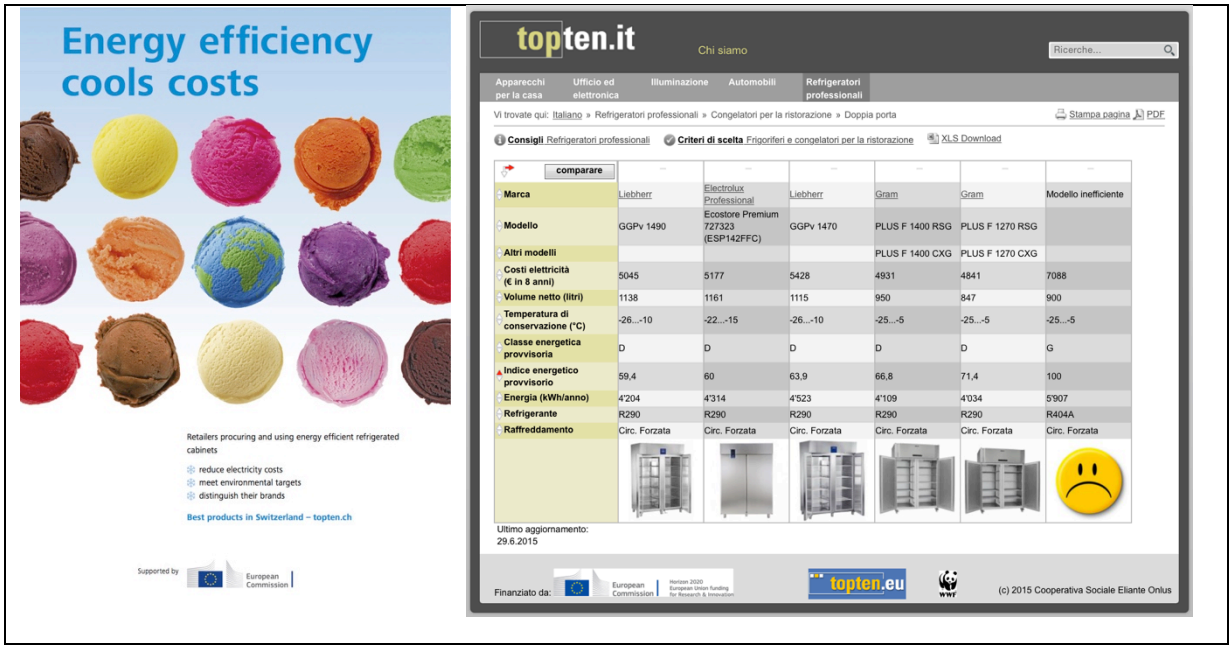


Figure 7: Left: ProCold brochure, right: list of best-available-technology products in Italy

EU legislation

New EU legislation for commercial/professional refrigeration products will, for the first time, create transparency regarding energy consumption and efficiency. This is 20 years after the EU introduced its energy label for household refrigerating appliances in 1995. There are three lots to consider:

- ENER Lot 13 (household refrigerating appliances)
- ENTR Lot 1 (professional storage refrigeration products)
- ENER Lot 12 (refrigerated commercial display cabinets)

EU legislation for professional storage products has just recently been adopted, with the first stage applying from July 2016 [11] [12]. A review of existing regulations covering household products is going on now and new regulations for commercial display products are being drafted [1] [13] [14] [15]. 2015 offers the opportunity to align the scopes so all important products are covered.

New regulations for professional storage refrigeration products (Lot 1)

The ecodesign regulation covers four product groups: professional refrigerated storage cabinets, blast cabinets, condensing units and process chillers. The labelling regulation only concerns professional refrigerated storage cabinets.

The EU energy label (see Figure 8) will be mandatory from 1 July 2016. Manufacturers can already use the second label with plus classes. From 1 July 2019 all storage cabinets must be labelled with the second label.

Planned regulations for refrigerated commercial display cabinets (Lot 12)

The draft ecodesign and labelling regulations cover five product groups: supermarket segment refrigerated display cabinets, beverage coolers, small ice-cream freezers, soft scoop ice-cream cabinets and refrigerated vending machines. The current draft of the EU energy label for display cabinets adheres to the traditional A-G scale and does not include plus classes (see Figure 8).

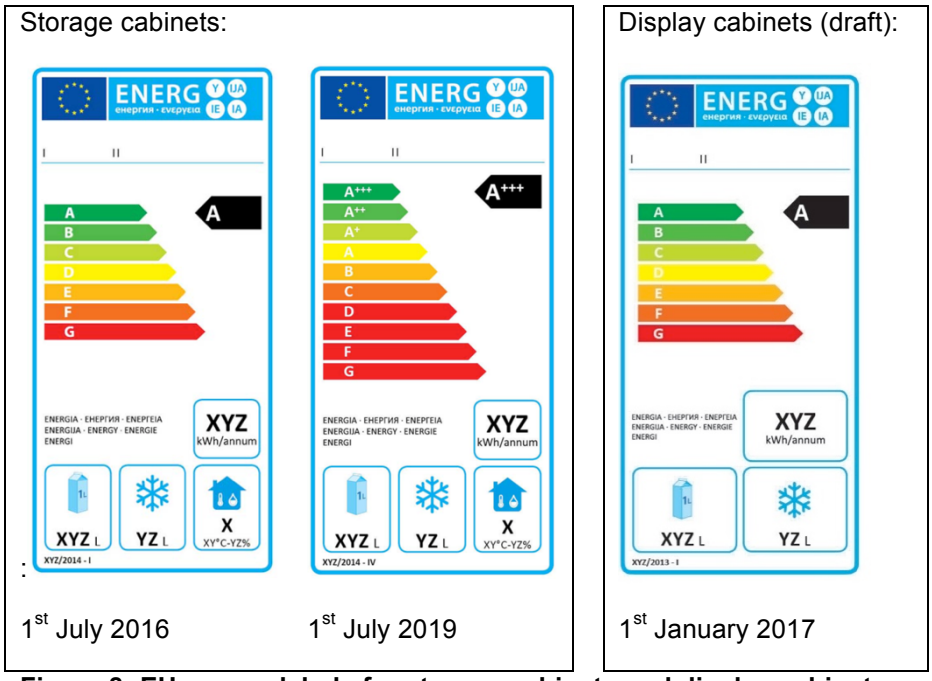


Figure 8: EU energy labels for storage cabinets and display cabinets

Gaps in the scope of the legislation

Considering how crucial product information is for efficiency development, it is important that the new EU legislation supports standardised declarations of energy consumption for all products. Good examples are storage refrigerator-freezers and blast cabinets: even though it was not possible to introduce minimum energy efficiency requirements in the recently adopted EU regulation, mandatory

declaration of energy consumption has been included. This will provide a basis for voluntary actions (i.e. in the frameworks of the rebate programme and ProCold project) and ensure that the next revision of the legislation will happen on a well-informed basis.

Product types currently excluded from legislation that would ensure standardised declaration of energy consumption:

- Storage chest freezers
- Storage static-air cabinets
- Display vertical static-air cabinets
- Commercial wine storage appliances
- Commercial minibars

It is important they are included in coming regulations during the ongoing legislation process for household and commercial products. Their exemption would lead to awkward gaps in the declaration. Products that are technically and functionally the same will be arbitrarily covered by legislation or not, depending if they are marketed for domestic or commercial/professional use.

Green refrigerants could be showcased on the label

A simple and effective measure could be to showcase cabinets using green refrigerants (with global warming potential below 150) with an icon and/or note on the label (Figure 9). This would ease market transition towards the ban high-GWP refrigerants in 2022.

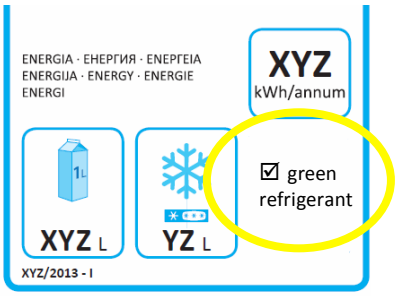


Figure 9: The labels could showcase cabinets using refrigerants with global warming potential below 150

Conclusions

That energy consumption is declared in a standardised way is absolutely crucial for the market to develop towards efficiency. New EU legislation will for the first time create market transparency for commercial and professional refrigeration products. It is important that the scopes of the three legislation lots are well aligned. Currently there are gaps in the scopes that should be addressed during the ongoing draft and revision process.

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