shecco comments to California's Proposed First Update to the Climate Change Scoping Plan

April 2014

OVERVIEW OF COMMENTS

shecco welcomes California's Proposed First Update to the Climate Change Scoping Plan and the consideration of measures to limit emissions of short lived climate pollutants (SLCPs), and in particular hydrofluorcarbons (HFCs), the fastest growing sector of greenhouse gas (GHG) emissions in California[1].

We also commend California Air Resources Board for envisioning the drawing up in 2015 of a detailed strategy to address short-lived climate pollutants including HFCs.

Additional measures on HFCs have the potential to position California among the world leading regions for innovation in and implementation of climate friendly technology with HFC-free natural refrigerants. A package of measures would be necessary for effectively reducing HFC emissions in California, including:

- Minimising refrigerant leakage from HFC systems (as in California's existing Refrigerant Management Program)
- Low-GWP use requirements that would ensure that high-GWP HFC-based equipment is no longer placed on the market in sectors where they are no longer necessary (where alternatives are commercially available)
- A phase-down (or phase-out) of HFCs with GWP ≥ 150
- A fee on high-GWP HFCs (GWP ≥ 150) that would among other things reduce the chances of overallocation of HFC quotas and windfall profits under an HFC phase down
- Measures Incentivising the reclamation and recycling of HFCs (and ODSs)

In this briefing we provide comments in relation to the specific type of measures for addressing HFCs and promoting the use of HFC-free technology, drawing examples and best practices from other world regions with similar measures already in place. In addition we highlight the links and synergies between action on HFCs and other cross-cutting issues in the draft update (green buildings, public procurement, support for households and businesses).

Background & rationale for action on HFCs: BAU would mean a significant increase in HFC emissions

HFCs already accounted for 3% of California's emissions in 2010 using the 100-year horizon GWP, while using the more appropriate 20-year horizon GWP metric[2], HFC emissions amounted to 5% of total emissions. What is more, "in California, since CO2 emissions are decreasing due to AB 32 and other regulations, the fastest growing sector of GHG emissions are the high-GWP substitutes to ozone-depleting substances, primarily the HFCs"[3]. It is therefore crucial that additional measures targeting the HFC sector be taken.

[1] California Air Resources Board, Proposed First Update to the Climate Change Scoping Plan: Building on the Framework, February 10 2014, p. 17

[2] a."For the evaluation of short-term effects, a time horizon of a few decades could be taken […]", first Assessment report by the Intergovernmental Panel on Climate Change (IPCC, 1990, p.58); b. "The 20-year GWP is a better reflection of what can be achieved in the near term by mitigation", Proposed First Update to the Climate Change Scoping Plan, p. 17,; c. " The atmospheric lifetime of HFCs ranges from 1.4 years (HFC-152a) to 52 years (HFC-143a). Indeed with the average lifetime of the HFCs in use today is 21.7 years and therefore better suited to the 20 year GWP metric.", The Benefits of Basing Policies on the 20 Year GWP of HFCs, p.4

[3] Proposed First Update to the Climate Change Scoping Plan, p. 17

HFC phase-down (or HFC phase-out?)

As a stakeholder closely involved in the EU F-Gas Regulation legislative process, shecco supports the possible establishment of a California HFC phase-down aligned with the European Union (EU) phase-down schedule.

We assess that there could be room for making a national phase-down schedule proposal even more ambitious than the one agreed in the EU. Indeed during the EU legislative process, a more ambitious phase-down schedule was also considered, both in terms of the final reduction target but also the interim phase-down "steps". The final HFC phase down in the EU by 79% in 2030 represents a "compromise agreement" between the EU institutions, which takes into account the manifold regional, climatic, cultural and economic factors present in different EU Member States, ranging from those countries that are typically leaders in environmental protection and technologies to countries that pay less attention to this.

With California being a leader in environmental protection and technologies, in principle there is no reason to exclude the possibility of a more ambitious final reduction target of up to a 100% phase down (i.e. HFC phase out) by a certain date of fluorinated gases with global warming potential (GWP) ≥ 150, the GWP threshold already used in California's existing Stationary Equipment Refrigerant Management Program[4].

Finally, we note that an HFC phase down should be viewed as part of a package of measures for effectively reducing HFC emissions, and as such needs to be combined with other types of measures, in particular:

- Low-GWP use requirements that would ensure that high-GWP HFC-based equipment is no longer placed on the market in sectors where they are no longer necessary, and
- A fee on high-GWP HFCs that would among other things reduce the chances of overallocation of HFC quotas and windfall profits
- Incentivising the reclamation and recycling of HFCs (and ODSs)
- Other measures

Low-GWP Requirements

shecco supports the requirement of using refrigerants with GWP below < 150 and assesses that this type of measure should be one of the key pillars in California's approach to mitigate fluorinated gas emissions.

The advantage of low-GWP use requirements is that it ensures that high-GWP HFC-based equipment is no longer placed on the market in sectors where they are no longer necessary and for which HFC-free technologies are commercially available. At the same time, the inherent deadlines by when the transition to low-GWP susbstances is required, provide the industry with clarity for future investments, accelerating the pace of innovation.

[4] ""High-GWP refrigerant" means a compound used as a heat transfer fluid or gas that is: (A) a chlorofluorocarbon, a hydrochlorofluorocarbon, a hydrofluorocarbon, a perfluorocarbon, or any compound or blend of compounds, with a GWP value equal to or greater than 150 …", subparagraph 27, § 95382 (Definitions) in REGULATION FOR THE MANAGEMENT OF HIGH GLOBAL WARMING POTENTIAL REFRIGERANTS FOR STATIONARY SOURCES, http://www.arb.ca.gov/cc/reftrack/reftrackrule.html

For example, conference participants from around 100 innovative European companies working with natural refrigerant technologies had an opportunity to express their preference with regards to the different types of measures on HFCs during ATMOsphere Europe 2013 conference through answering to a "live polling" question. Nearly two thirds of those that participated in the polls indicated that they are eager to get clarity and support from policy-makers in the form of sector-specific low-GW requirements in new equipment as a key measure that will drive the uptake of natural refrigerant technology:

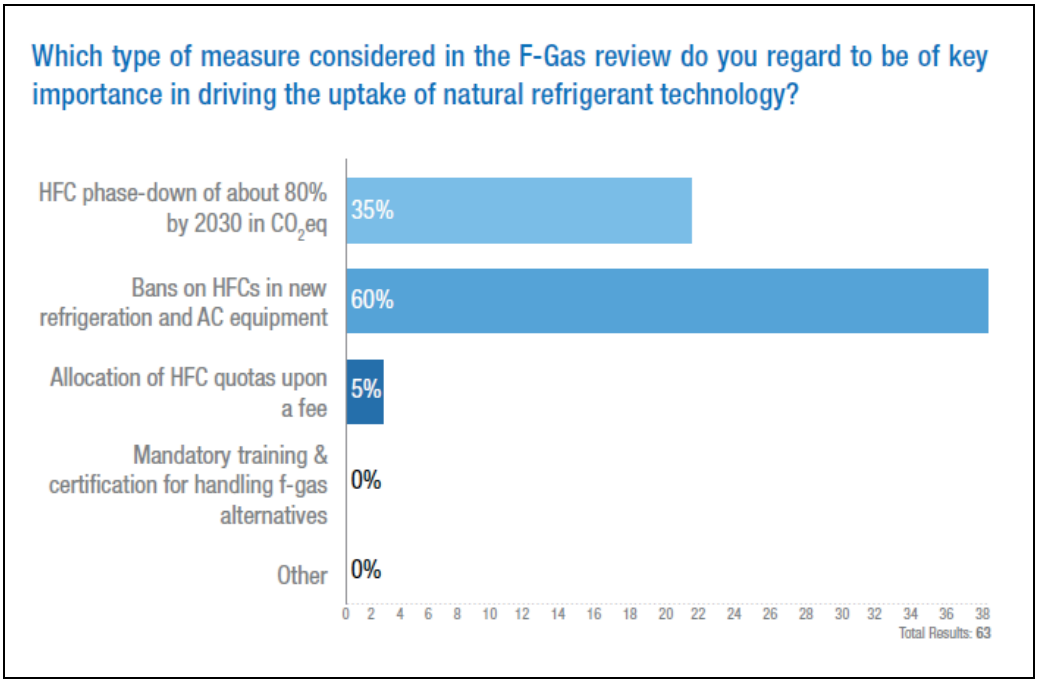
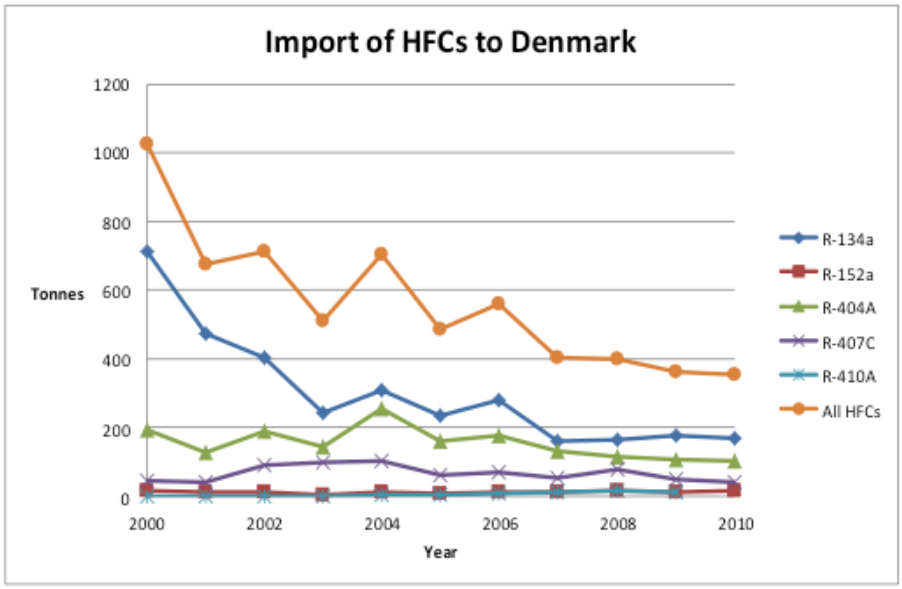


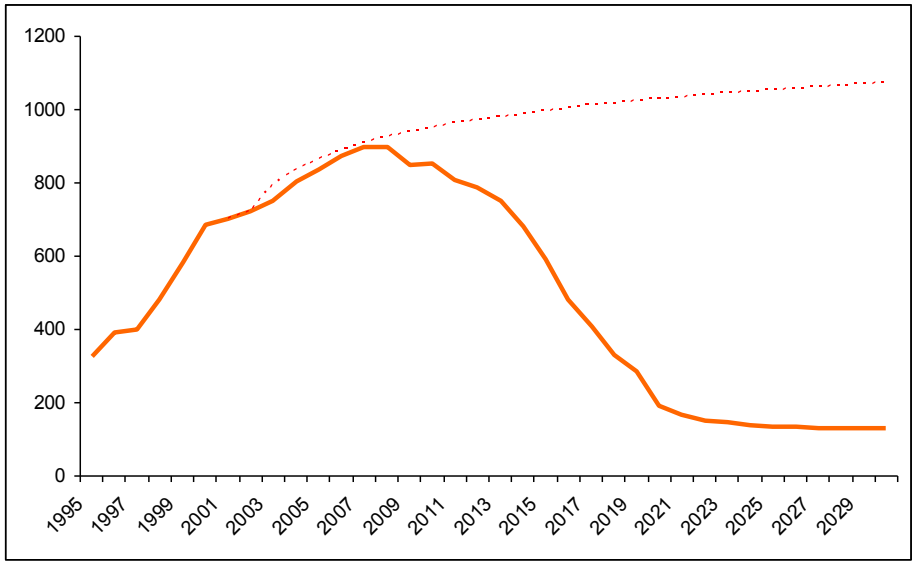
image: live polling results among 63 ATMOsphere Europe 2013 conference participants for question on "Which type of measure considered in the F-Gas review do you regard to be of key importance in driving the uptake of natural refrigerant technology?
source: ATMOsphere Europe 2013, conference summary report, http://www.atmo.org/files/reports/20131028_guide_2013_natural_refrigerants_europe_small.pdf

Overall, countries with low-GWP requirements in certain sectors have achieved considerable reduction in HFC emissions while at the same time national industry has gained competitiveness with respect to low-GWP technologies.

For example, provisions in Denmark stipulate a general ban on the import, sale and use of new refrigeration, heat pumps and air conditioning units containing either less than 150g or more than 10kg of f-gases. A package of measures addressing HFCs in Denmark, including low-GWP requirements, coupled with a tax on HFCs of about $20/tCO2eq, as well as support for the development of alternative technologies (through R&D support, increase in education capacity, HFC-free knowledge centre, etc), has enabled Denmark to slash HFC consumption and emissions as shown in the following two graphs respectively:



graph: Import (= consumption) of HFCs in Denmark
source: Mikkel Aaman Sørensen, Danish Environmental Protection Agency (2013). "Lessons learned from phasing out HFCs in Denmark", presentation at European Commission's side event to UNFCCC COP19, Warsaw, Poland, http://www.r744.com/web/assets/paper/file/EC_sideevent_COP19_Denmark.pdf



graph: f-gas emissions in Denmark
source: Mikkel Aaman Sørensen, Danish Environmental Protection Agency (2013). "Lessons learned from phasing out HFCs in Denmark", presentation at European Commission's side event to UNFCCC COP19, Warsaw, Poland, http://www.r744.com/web/assets/paper/file/EC_sideevent_COP19_Denmark.pdf

Following the example of Denmark, Switzerland introduced bans on synthetic refrigerants (HFCs) in new equipment in certain applications that are applicable as of December 2013. The amended Swiss Ordinance on Chemical Risk Reduction (ORRChem) introduces HFC bans in medium and large capacity stationary applications, including:

1) air-conditioning with cooling capacity > 600kW,
2) commercial refrigeration
   - With cooling capacity > 40kW for plus cooling
   - With cooling capacity >30kW for minus cooling;

- With cooling capacity >8kW for minus cooling if it is a combined plus & minus system

3) industrial refrigeration systems (cooling capacity > 400kW; > 100kW for deep freezing)
4) ice rinks.

Moreover, already since 2005 the Swiss Ordinance foresees HFC bans for domestic plug-in appliances and motor vehicle air-conditioning:

a. household refrigerators and freezers;
b. dehumidifiers;
c. air conditioners;
d. air conditioning systems used in motor vehicle

It is probably no coincidence that both Denmark and Switzerland's national industry has gained competitiveness with respect to low-GWP technologies and enjoy a high market share in the use of HFC-free technologies using natural refrigerants in several sectors. For example in the sector of supermarket refrigeration, the use of state-of-the-art transcritical CO2 refrigeration is now the "standard" rather than the "alternative" technology, with more than 700 stores using the technology in Denmark by the end of 2013, and close to 400 stores in Switzerland:

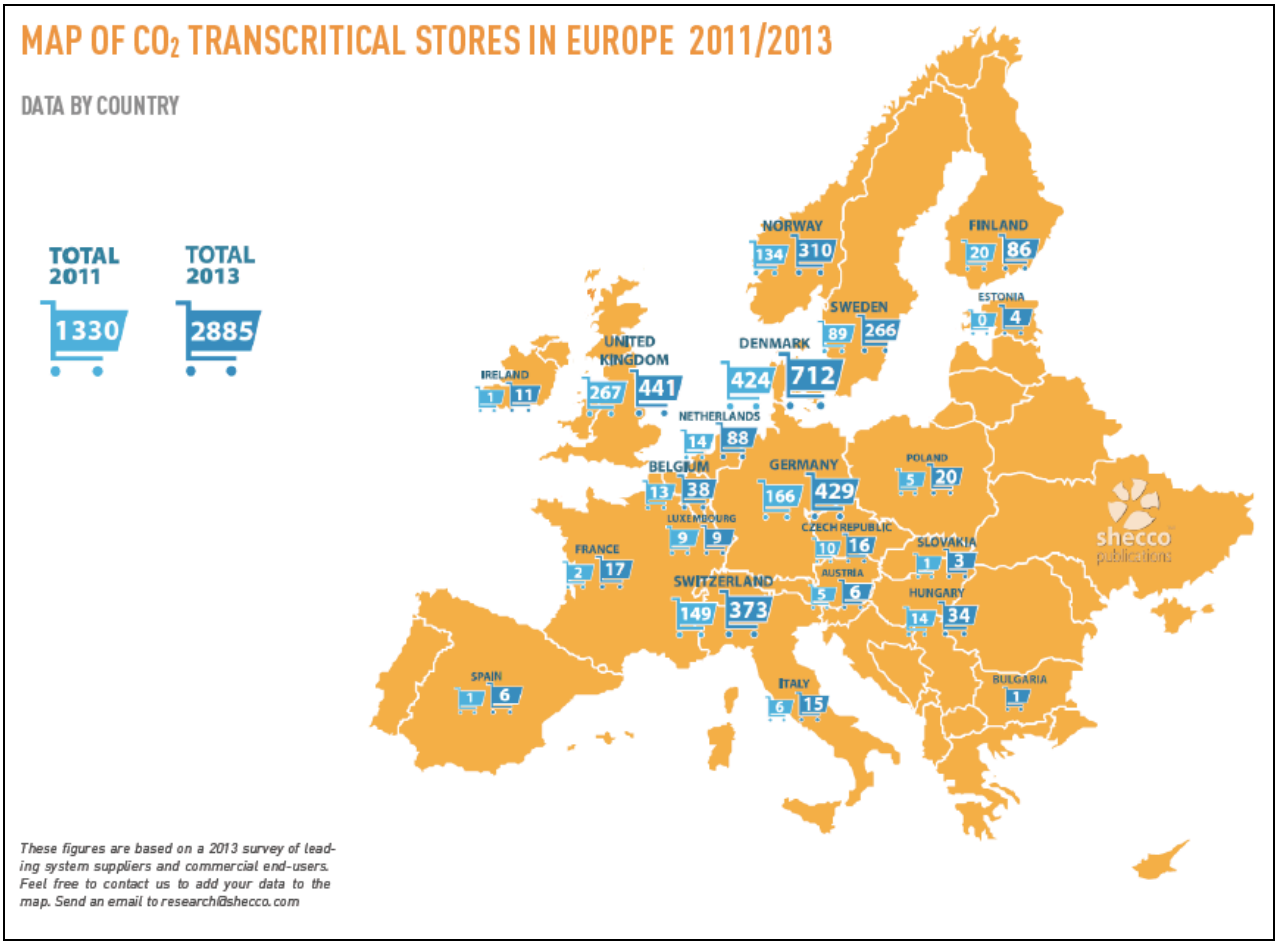


image: Map of CO2 transcritical stores in Europe, end of 2011 and end of 2013 figures
source: shecco (2014), GUIDE 2014: Natural Refrigerants - Continued Growth & Innovation in Europe, http://publication.shecco.com/publications/view/2014-guide-natural-refrigerants-europe

Moreover, at the European Union level, low-GWP requirements are included in the reviewed EU F-Gas rules that will enter into force as of January 2015. The previous EU F-Gas Regulation (Regulation

No 842/2006 on certain fluorinated greenhouse gases) that had been in place since 2006 relied primarily on containment and recovery measures to prevent hydrofluorocarbon (HFC) emissions from the HVAC&R sector, and additional action was deemed necessary for the EU to meet it long-term greenhouse gas emissions reduction targets. The new rules, among other measures include so called "placing on the market prohibitions" (bans) of HFCs in new equipment for certain applications. The sector of commercial refrigeration is the sector for which the informal agreement entails the strongest signals, in terms of placing on the market prohibitions (bans) of HFCs in new equipment. The informal agreement foresees the following HFC bans (low-GWP requirements):

- Ban on HFCs with GWP ≥ 150 in domestic refrigeration as of 2015
- Ban on HFCs with GWP ≥ 150 in hermetically sealed commercial refrigeration equipment as of 2022
- Ban on HFCs with GWP ≥ 150 in centralised commercial refrigeration systems with a capacity of 40kW or more as of 2022, except in the primary refrigerant circuit of cascade systems where HFCs with a GWP < 1,500 will still be allowed
- Ban on HFCs with GWP ≥ 150 in movable room air-conditioning appliances as of 2020
- Ban on HFCs with GWP ≥ 750 in small single split air-conditioning systems (containing less than 3kg of f-gases)
- Moreover, HFCs with GWP ≥ 2,500 will not be permitted neither in new stationary refrigeration equipment as of 2020, nor for the servicing of large refrigeration systems (as of 2020 for virgin HFCs, as of 2030 for reclaimed or recycled HFCs), bringing essentially an end to the use of R404A in the refrigeration sector.

A thorough and objective sector-by-sector assessment of status and potential of HFC-free technology with involvement of different stakeholders preceded the establishment of low-GWP requirements in Denmark, Switzerland and the EU, and a similar process would be needed for the case of California.

In the EU in particular, an official study assessing the status of HFC alternatives in different sectors preceded the revision of the EU F-Gas Regulation: Prior to publishing a proposal on the EU F-Gas Regulation Review in November 2012, the European Commission carried out an extensive analysis regarding the availability of alternatives with low GWP (GWP < 150) and expected use in the future as well as the potential impact (economic, social and environmental) of different measures in consultation with a large number of industry experts. The examination had started almost 2 years before the actual proposal was published, which means that from today's perspective the information is already out of date given the fast technological progress. The data is nonetheless valuable and indicative of what the situation was a few years ago and can be interpreted as a "conservative" estimation of the role that HFC-free gases can play in meeting future heating and cooling needs.

More specifically, the "Preparatory study for a review of Regulation (EC) No 842/2006 on certain fluorinated greenhouse gases"[5] evaluated the possible market penetration rate of low-GWP solutions (GWP < 150) for different sectors for the case of industrialised (A2) as well as developing countries (A5). The "penetration rate" is defined as the maximum market potential of a technical choice to replace new products or equipment relying upon HFCs in a particular sector, while taking into

[5] Preparatory study for a review of Regulation (EC) No 842/2006 on certain fluorinated greenhouse gases, http://ec.europa.eu/clima/policies/f-gas/docs/2011_study_en.pdf

account cost effectiveness, energy efficiency, safety, availability of materials and components. The table below denotes the market penetration of key low-GWP alternatives to HFCs in industrialised countries by 2030 in some key refrigeration and air-conditioning sectors.

Refrigeration sectors	Key low-GWP option	Market penetration of key low-GWP options in 2030 in **A2 (industrialised) countries** (%)
Domestic refrigeration	R600a CO2 HFC1234yf	95 (100 in EU already in 2015) 5 0
Commercial refrigeration		
Centralised systems	R290 indirect + CO2 cascade R290 + CO2 + CO2 cascade CO2	90 10 0
Condensing units	R290 direct R290 indirect CO2	40 30 30
Stand-alone units	R290 direct CO2	85 15
Industrial refrigeration		
Small equipment	Ammonia	95
Large equipment	Ammonia	95
Transport refrigeration		
Refrigerated trucks	R290 direct CO2	80 20
Refrigerated vans	CO2 HFC1234yf	50 50
Reefer containers	CO2	100
Fishing vessels	Ammonia + CO2 cascade	95
AC sectors	Key low-GWP option	Market penetration of key low-GWP options in 2030 in **A2 (industrialised) countries** (%)
Stationary AC		
Moveable AC	290 direct CO2 HFC1234yf	40 20 40
Single Split AC	R290 direct CO2 HFC1234yf	40 15 45
Multi split AC	R290 direct CO2 HFC1234yf	70 30 0
Rooftop AC	R290 direct CO2	65 35
Small chillers	R290 direct CO2 Ammonia	60 20 20
Large chillers	R290 direct CO2 Ammonia Water (R718)	15 0 60 25
Centrifugal chillers	R290 HFC1234ze Water (R718)	20 50 30
Heat pumps	R290 direct CO2	60 20

	HFC1234yf	20
Mobile AC – road vehicles		
Passenger cars (incl. trucks)	HFC1234yf CO2	(100) (100)
Buses	HFC1234yf R744	100 0

Table: Market penetration of key low-GWP options in 2030 in industrialised countries
Source: Preparatory study for a review of Regulation (EC) No 842/2006 on certain fluorinated greenhouse gases, http://ec.europa.eu/clima/policies/f-gas/docs/2011_study_en.pdf

ODS AND HFC Recovery and Destruction

In addition to the measures stated in the draft update of the Scoping Plan (adjustments to current ODS destruction protocols, implementing a mitigation fee, and/or using cap-and-trade revenue to help pay for higher costs), the following types of measures can also be considered to incentivise recovery and destruction of ODSs at the end-of-life:

1. Requiring the use of recycled/reclaimed HCFCs when servicing HCFC equipment, effectively banning the use of "virgin" HCFCs: such a measure will create a market for recycled/reclaimed HCFCs, increasing their economic value, and therefore incentivising the recovery and destruction of ODSs at the end-of-life. Similar measures can be envisioned also for certain types of HFCs (similar to the provisions of Article 13 (Control of use), paragraph 3 in the new EU F-Gas Regulation).

2. Moreover, California could consider encouraging the development of producer responsibility schemes for the recovery, recycling, reclamation or destruction of both ODSs and fluorinated greenhouse gases. In the EU, Article 9 of the new EU F-Gas Regulation stipulates that EU "Member States shall encourage the development of producer responsibility schemes for the recovery of fluorinated greenhouse gases and their recycling, reclamation or destruction".

High-GWP Fee

An increasing number of countries are looking at high-GWP fees and taxation of fluorinated gases as a way to internalise their environmental cost, while raising revenues. In Denmark, Norway and Slovenia, such measures have been in place for several years, while Spain has started implementing an f-gas tax as of January 2014. In addition, more and more European countries are considering or have at some point looked at the possibility of introducing such a fee. Outside Europe, both Australia[6] and New Zealand[7] have HFC taxes (levy) in place.

The following graph provides a comparison of tax levels (expressed in €/tCO2eq) in those European countries for which a tax/fee on f-gases is already in place.

[6] Australia's HFC levy one year on http://www.hydrocarbons21.com/articles/australia_s_hfc_levy_one_year_on_part_1
[7] Synthetic Greenhouse Gas Levy enters into force in New Zealand http://www.ammonia21.com/articles/synthetic_greenhouse_gas_levy_enters_into_force_in_new_zealand

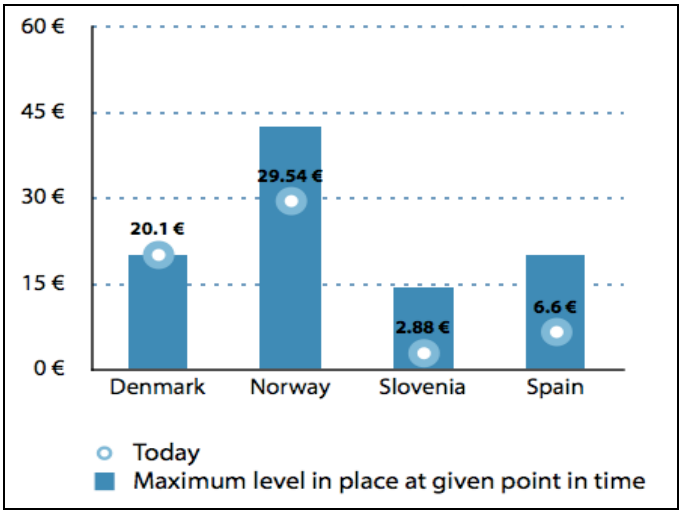


Figure: Comparison of level of tax on f-gases in €/tCO2eq in Denmark, Norway, Slovenia, Spain
Source: Maratou, A., Skačanová, K., Vanaga, G. (2013) GUIDE+: HFC taxes & fiscal incentives for natural refrigerants in Europe. shecco publications. Available at: http://publications.shecco.com/publications/view/8

The blue dots represent the current tax levels in Denmark, Norway, Slovenia and Spain. The column bars denote the maximum tax level that was in place at some point in time (Slovenia) or is already agreed for a future point in time (e.g. agreed tax level in Spain starting in 2016). Norway leads the way in terms of the highest level of tax currently in place, by recently raising tax levels from about €30/tCO2eq to about €42/tCO2eq, a trend that can be expected to continue in the future. The tax in Denmark amounts to about €20/tCO2eq, a level that also the HFC tax in Spain will amount to as of 2016 (tax in Spain is gradually being phased in).

The following graph looks at how tax levels translate in terms of €/per kg of commonly used refrigerant R410A. An impressive €73 is payable in 2014 for each kilo of R410A in Norway. This is more than ten times the level payable in Slovenia on f-gases used for servicing and maintenance of equipment (€5.7 per kilo of R410A).

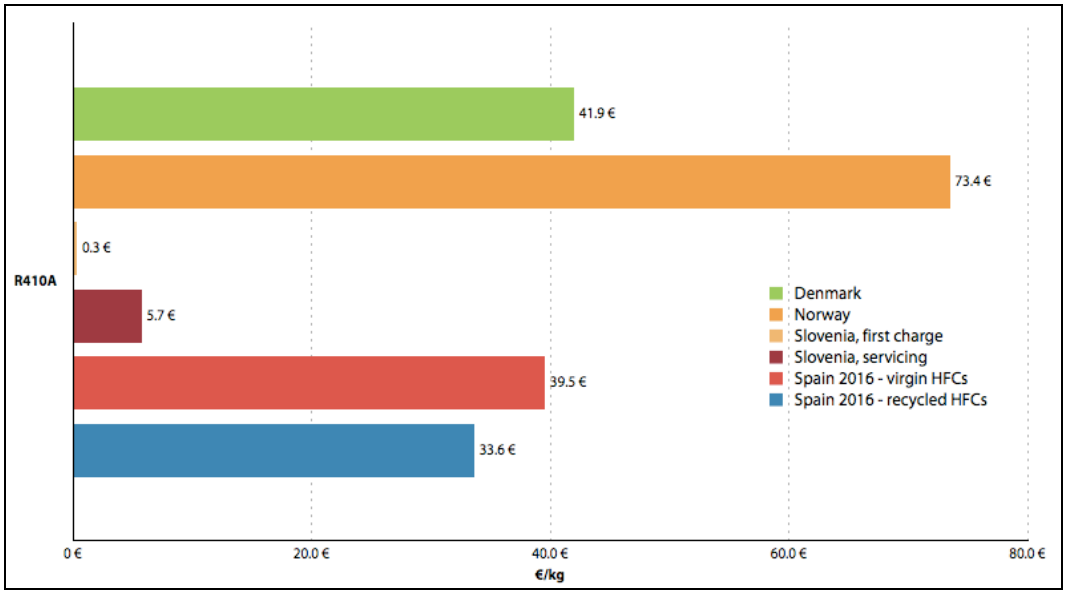


Figure: Comparison of level of tax on f-gases in €/kg of R410A in Denmark, Norway, Slovenia, Spain (levels for Spain are for year 2016)
Source: Maratou, A., Skačanová, K., Vanaga, G. (2013) GUIDE+: HFC taxes & fiscal incentives for natural refrigerants in Europe. shecco publications. Available at: http://publications.shecco.com/publications/view/8

Finally, a fee on HFCs at the EU level was considered during the EU F-Gas Regulation legislative process as a means to avoiding the overallocation of HFC quotas under the EU HFC phased-down. Given the complexity of agreeing on how the revenues from the fee would be distributed among the 28 EU Member States, the fee was not included in the final agreement on the new EU F-Gas Regulation. However, Paragraph 5 of Article 21[8] (Review clause) of the new Regulation specifies that by July 2017, the European Commission should assess the HFC phase-down quota allocation method and the impact of allocating quotas for free, and if appropriate issue a legislative proposal for amending the quota allocation method and establishing an appropriate method of distributing any possible revenues from a fee.

Cross cutting issues

Finally, we encourage California to give close consideration of the opportunities to address HFCs in the context of cross cutting issues of California's Updated Scoping Plan, including:

- Public procurement: minimise the use of high GWP HFCs, by specifying low-GWP criteria
- Green buildings: incentivise and reward the use of low-GWP refrigeration and air-conditioning
- Support for households and businesses: end-user support for investment in low-GWP technologies

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[8] Paragraph 5, Article 21 Review, Regulation on fluorinated greenhouse gases and repealing Regulation (EC) No 842/2006, http://register.consilium.europa.eu/doc/srv?l=EN&f=PE%201%202014%20INIT