Bavarian Environment Agency

The EU F-Gas Regulation :

Best Practice from Bavaria

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Unit 76, Analysis of Substances and Chemicals

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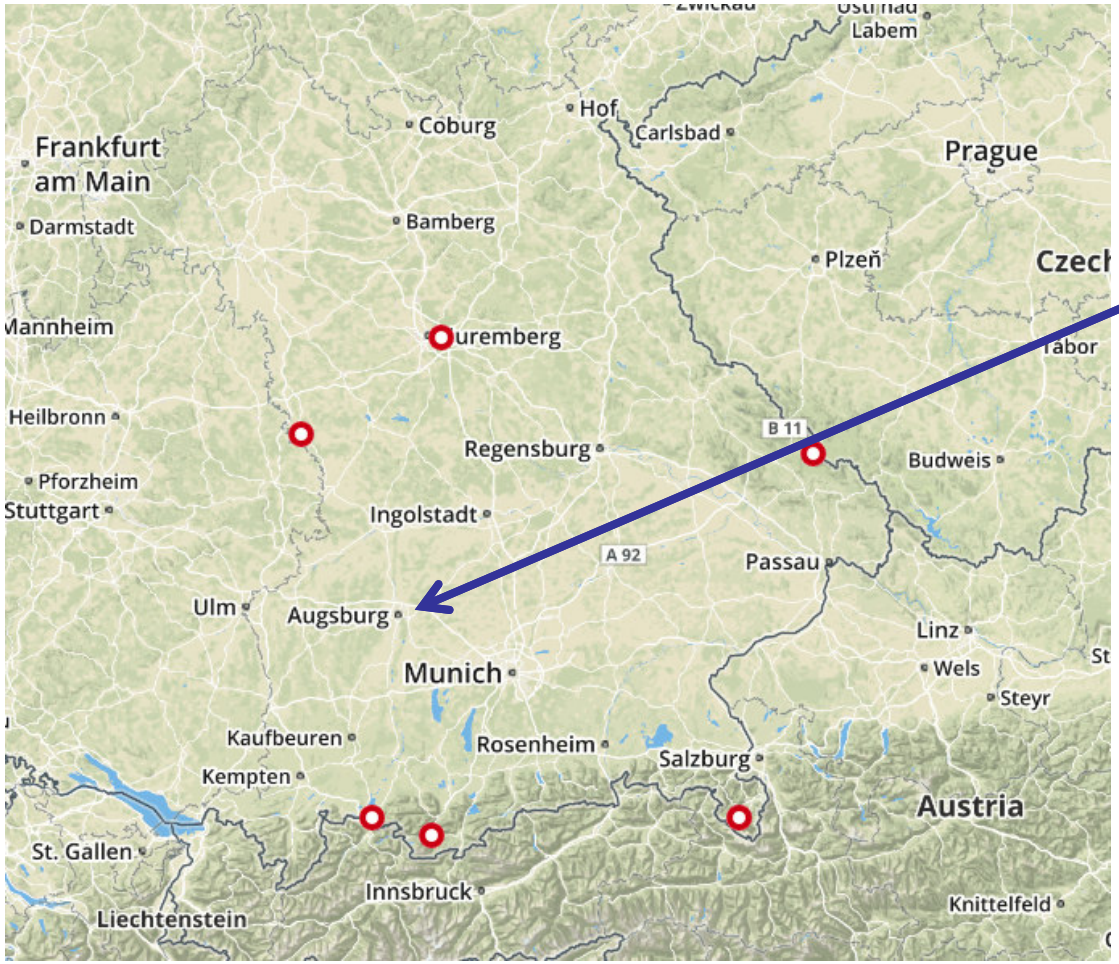
Introducing the Bavarian Environment Agency

Introducing the Bavarian Environment Agency



Map: lonely planet.com

- >1100 employees
- 7 offices in Bavaria
- 11 departments
- 64 speciality units

Bavarian Environment Agency- The Departments

1. Environmental Information
2. Air, Noise, Plant Safety
3. Closed Substances Cycles
4. Radiation Protection
5. Nature Conservation, Landscape Management and Ecology of Waters
6. Hydro Engineering, Flood Protection, Water Protection
7. Analytical Laboratories, Evaluation of Chemicals
8. Hydrological Services
9. Groundwater Protection, Water Supply, Contaminated Sites
10. Geological Survey
11. Central Administrative Services



Bavarian Environment Agency- F-Gas Certification

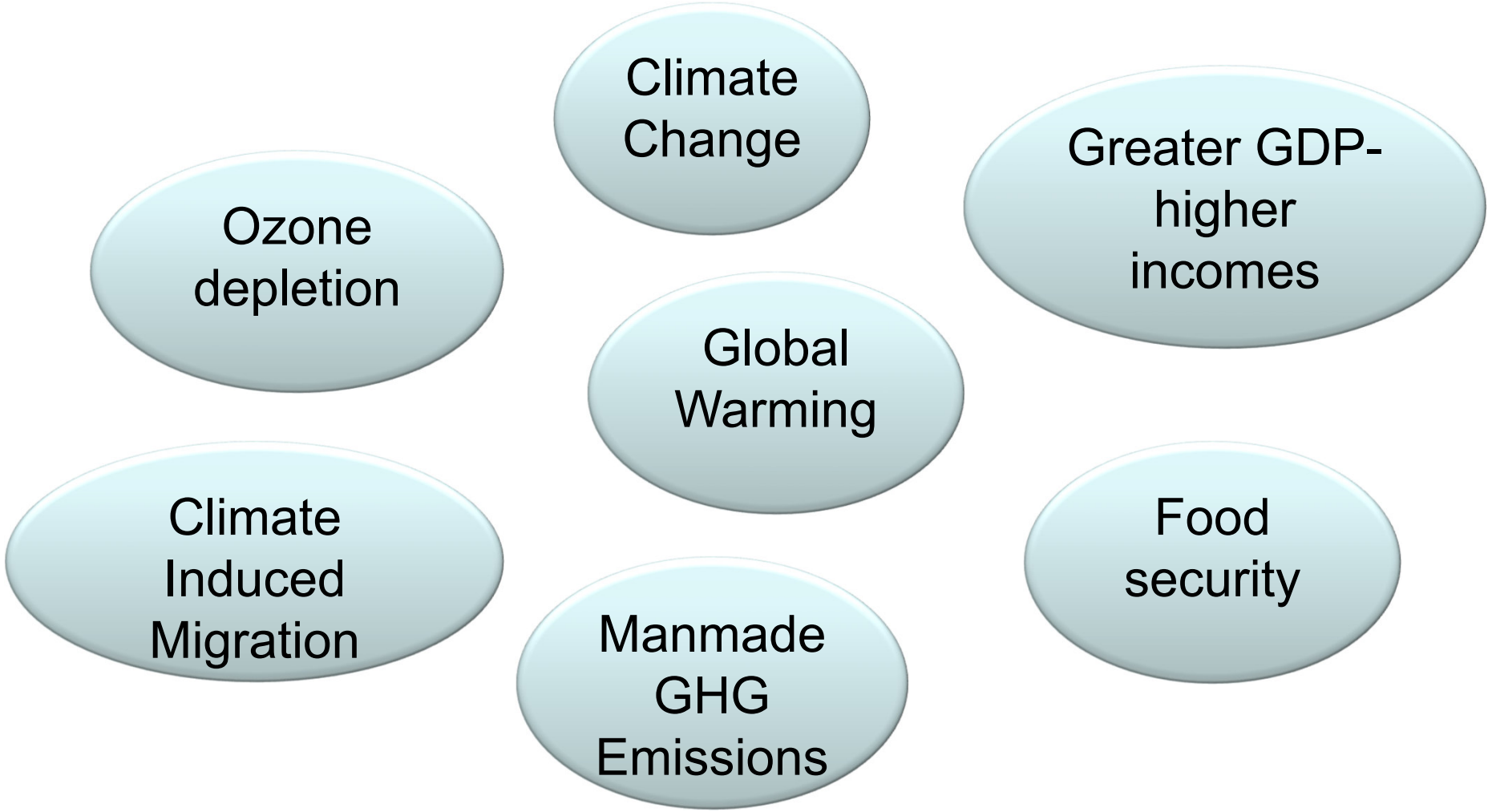
EU
- EU F- Gas Regulation (EU Nr. 517/2014)

German
- National Regulation- ChemKlimSchutzV

State
- Bavarian Environment Agency- F-Gas Certificate

Local
- Commercial Inspectorates at District Govt. level

Why are fluorinated gases an issue?

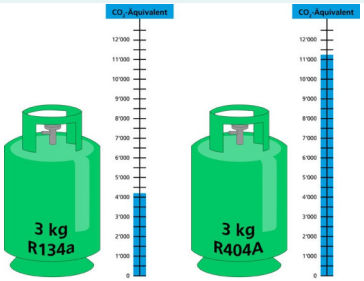


Global Warming Potential of HFC

Name of F-Gase	Atmospheric life	GWP 20 year	GWP 100 year	GWP 500 year
HFC-23	270	12,000	14,800	12,200
HFC-32	4.9	2,330	675	205
HFC134a	14	3,400	1,100	335
HFC-125	29	6,350	3,500	1,100
Carbon dioxide (CO_2)	Variable	1	1	1
Methane (CH_4)	12	72	25	7,6
Sulphurhexafluoride (SF_6)	3,200	16,300	22,800	32,600

F-gas emissions- a comparison

Emission source	CO_2 emissions
1 PAX Flight: Munich Int. Airport to Cape Town Int. Airport & back	~4228 kg
Drive an Automobile for 12,000 km	~2000 kg
1 kg of R134a	1430 kg CO_2 - equivalent
1 kg of R507	3990 kg CO_2 - equivalent
3 kg of R404a	11,766 tonnes CO_2-equivalent



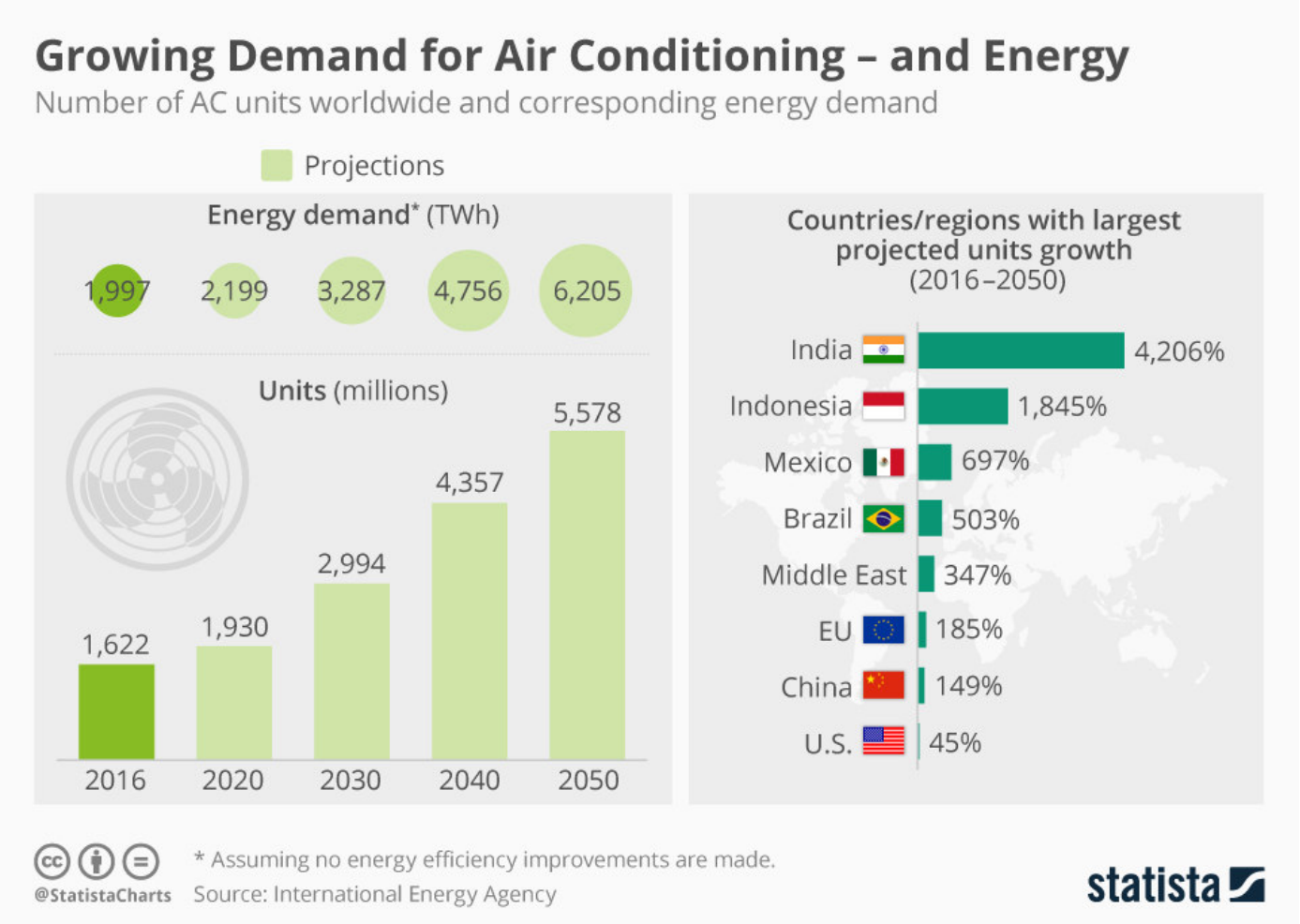
Picture credits: geology.com, kaelte-klima-gmbh.de, autoevolution.com

RAC Sector Worldwide- Units in operation

Application	Sector	Equipment	Number of Units in operation
Refrigeration & Food	Domestic	Refrigerators and freezers	1.5 Billion
	Commercial	Commercial refrigeration equipment (including condensing units, stand-alone equipment and centralized systems)	90 Million
	Refrigerated Transport	Refrigerated vehicles (vans, trucks, semi-trailers or trailers)	4 Million
		Refrigerated containers (reefers)	1.2 Million
Air conditioning	Air conditioners	Air cooled systems	600 Million
		Water chillers	2.8 Million
	Mobile air conditioning	Air-conditioned vehicles (passenger cars, commercial vehicles and buses)	700 Million
Heat pumps		residential, commercial and industrial equipment, including reversible air-to-air air conditioners	160 Million
Medicine		Magnetic Resonance Imaging (MRI) machines	25,000
Ice rinks			13,500

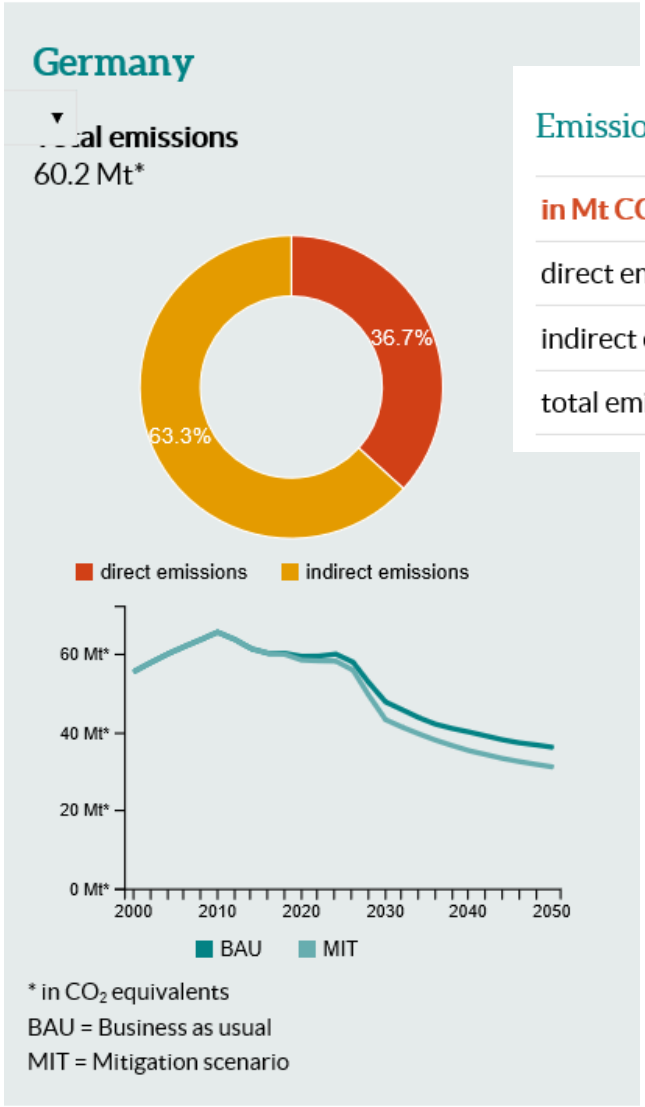
Source: International Institute of Refrigeration, iifiir.org

Global Energy Demand: Air Conditioning



Video: International Energy Agency, youtube
https://www.youtube.com/watch?v=OJCKOuMx1TY

Emissions from RAC Sector - Germany



Emission reduction potential

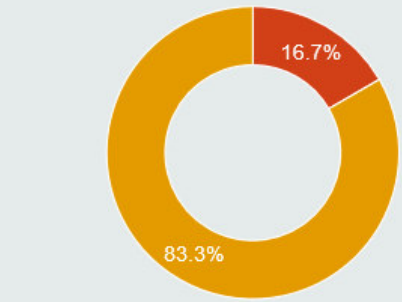
in Mt CO2 eq	2020	2030	2040	2050
direct emissions	0.681	2.01	0.398	0.0815
indirect emissions	0.281	2.52	4.37	4.93
total emissions	0.962	4.53	4.77	5.01

Source: green cooling initiative

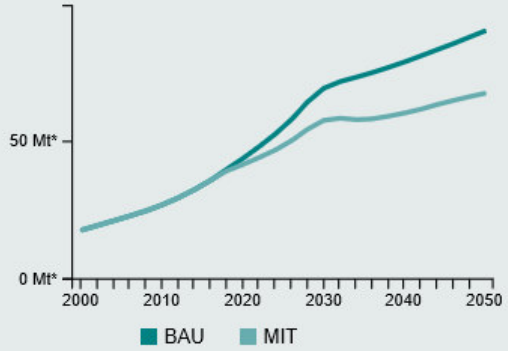
Emissions from RAC Sector- South Africa

South Africa

al emissions
36.1 Mt*



direct emissions indirect emissions



* in CO_2 equivalents
BAU = Business as usual
MIT = Mitigation scenario

Emission reduction potential

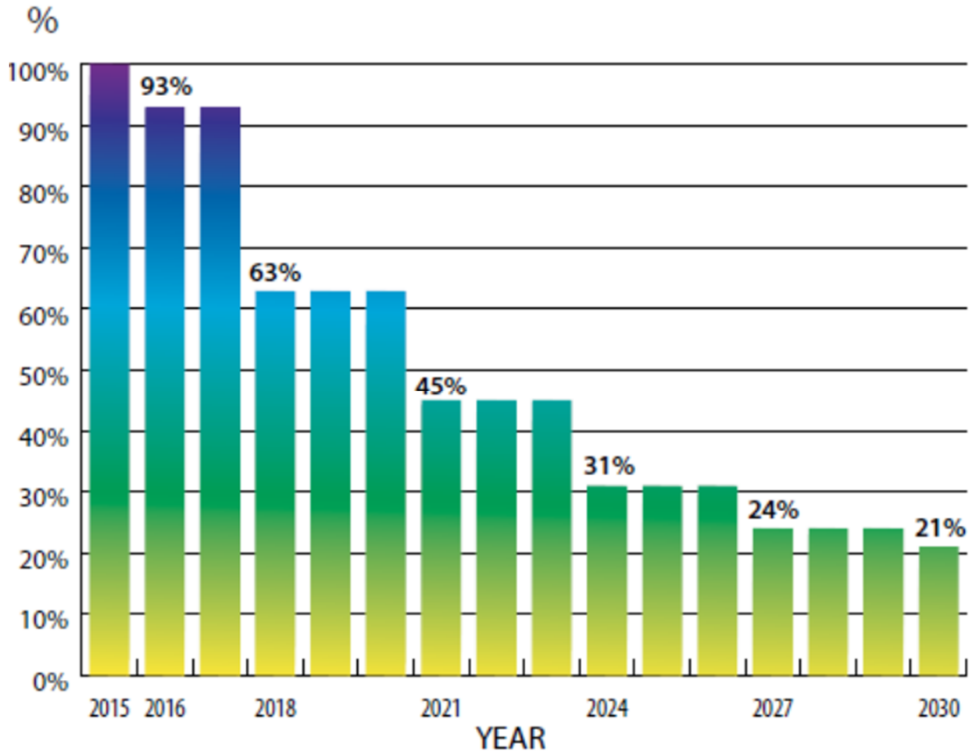
in Mt CO2 eq	2020	2030	2040	2050
direct emissions	0.928	3.14	5.57	5.53
indirect emissions	1.27	8.56	13.1	17.3
total emissions	2.20	11.7	18.7	22.8

Source: green cooling initiative

The EU F-Gas (HFC) Regulation : Subject Matter (Article 1)

- Establish rules on containment , use & recovery & destruction of fluorinated greenhouse gases (f-gases)
- Impose conditions on placing products and equipment containing f-gases on the market
- Impose conditions on specific uses of f-gases
- Establish quantitative limits for placing equipment & products on the market

The EU F-Gas (HFC) Regulation : Phase Down



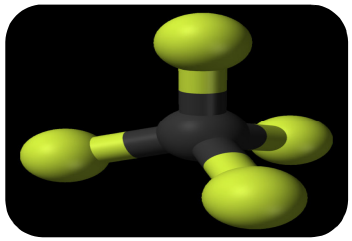
Source: European Partnership for Energy and the Environment (EPEE)

Baseline for the Phase-Down = the annual average of total quantity(CO_2-equivalent) placed on the EU market from 2009 to 2012

The EU F-Gas Regulation: EU No. 517/2014. Substances

Picture: the truth about cars.com

Hydrofluorocarbons – HFCs like R- 134a



Perfluorocarbons – PFCs like R- 14 , Carbon tetra fluoride

Unsaturated Hydro(chloro)fluorocarbons / HFO like R-1234yf

Fluorinated ethers and alcohols like HFE-143a

Perfluorinated compounds like SF_6

Other greenhouse gases containing fluorine like NF_3

Photo credits: fensternorm.com, allsciences.com, esa.int

Equipment containing f-gases covered by the EU F-gas Regulation (517/2014)

- Stationary air- conditioning
- Stationary refrigeration (domestic & commercial)
- Stationary freezers
- Mobile refrigeration in trucks & trailers
- Insulating materials (pipes, boards, plates)
- Fire extinguishing systems
- Electrical switchgear
- Heat pumps
- Foams (XPS for e.g.)

Regulation of F-gases in Automobiles (EU)

MAC Directive 2006/40/EC

- Approval of vehicles regarding emissions, functioning, retrofitting and refilling of car air conditioning systems
- From Jan 2017 onward refuse registration & prohibit sale of new vehicles in which air conditioning has F-gases with GWP >150
- No retrofitting air conditioning with F-gases having a GWP > 150
- Leakage rates fixed if using air conditioning with GWP > 150, at < 40gms / year for single evaporator and <60gms / year for dual evaporator system

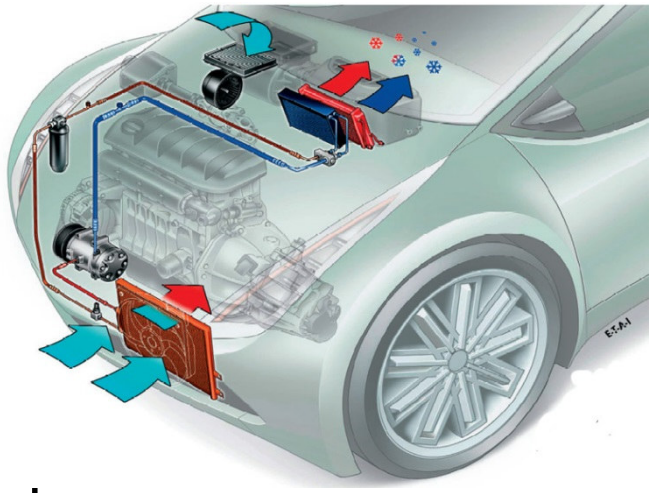


Photo source: www.krafthand.de

The EU F-Gas (HFC) Regulation : excerpts of Articles (§)

§ 3 Containment	• **Prevent leakages** • **Operator to repair equipment without delay** • **Certified persons to prevent leakage**
§ 4 Leakage checks	• **Operators of equipment containing f-gases > 5T CO_2-eq (for e.g. 1.3kg of R404A)** • **Not hermetically sealed equipment < 10T CO_2-eq**
§ 6 Record Keeping	• **Specific details of all equipment should be recorded** • **Suppliers record details of purchasers and save for 5 yrs**
§ 8 Recovery	• **Recovery by certified persons under § 10** • **Recovery of residual gases for recycling, reclaimation or destruction**
§ 10 Training & Certification (of persons and undertakings)	• **Certification programs covering: installation, servicing , maintenance, repair, decommissioning , leak checks, recovery of f-gases**

The EU F-Gas (HFC) Regulation : Articles (§)

§ 11 **Restrictions –placing on the market**	• Prohibitions for new equipment on the market • Selling and purchasing of f-gases by firms holding certificates or employing persons holding an attestation
§ 12 **Labelling & product information**	• Marking products containing f-gases as such • CO2-equivalents • GWP • Located adjecent to charging / recovery ports
§ 13 **Control of use**	• Use of SF_6 in magnesium die-casting & recycling magnesium die-casting alloys prohibited & in vehicle tyres • From Jan 2020, f-gases with GWP > 2500 for maintenance of equipment with 40 T CO_2-eq or more (R404a)
§ 15 **Reduction on HFC quantities placed on the market**	•Producers and importers are restricted on HFC amounts sold or imported •Allocated a quota which must not be exceeded

The EU F-Gas (HFC) Regulation : Articles (§)

§ 16, § 17 **Quota allocation, Registry**	• Quota allocated to producer/importer based on data from 2009- 2012 • Quotas allocated from 2015 onward, transfer possible • Electronic registry for quotas for placing HFCs into the market
§ 19 **Reporting**	• Producer, importer, exporter of 1 metric tonne or 100 T CO_2-eq • Destroying 1 metric tonne or 1000 CO_2-eq • Importers of pre-charged equipment • Undertaking using 1000 T CO_2-eq f-gas as feedstocks
§ 21 **Review**	• EU Commission to report on the availability of HFCs on the market • In 2022, shall report on the effects of the regulation
§ 25 **Penalties**	• EU member states to implement penalties • Firms exeeding their quota recieve reduced quotas in future

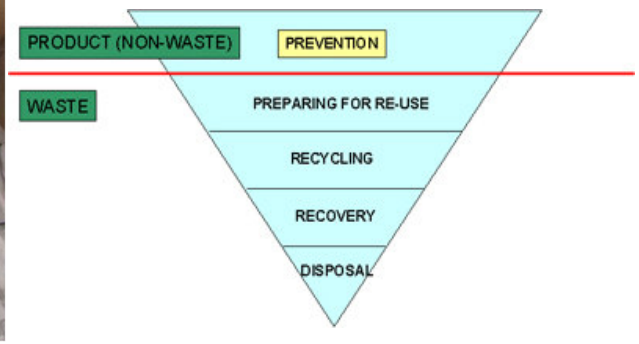
The EU F-Gas Regulation : Some Prohibitions (Annex (III)

- Latest upcoming prohibitions

Equipment Type	GWP Limit	Prohibition Date
Commercial refrigerators and freezers (hermetically sealed)	>2500	01.01.2020
Commercial refrigerators and freezers (hermetically sealed)	>150	01.01.2022
Stationary refrigeration equipment (except for cooling below -50° C)	>2500	01.01.2020
Movable room air-conditioners	>150	01.01.2020
Single split air-conditioning with less than 3kg of f-gases	>750	01.01.2025
XPS polystyrene Foams with HFC (exceptions national safety standards)	>150	01.01.2020

Related EU Regulations

- Waste Electrical and Electronic Equipment (WEEE) Directive 2012/19/EU
- Waste Framework Directive 2008/ 98/ EC (oils)
- Eco-Design Directive 2009/125/EC (considering life-cycle costs and energy consumption of products over the life-time)
- Energy Labelling Directive (EU) 2017/1369



Pictures: LFU, Jürgen Beckmann

Bavarian Environment Agency- F-Gas Certification

EU
- EU F- Gas Regulation

German
- National Regulation- Chemicals Climate Protection Directive

State
- Bavarian Environment Agency- F-Gas Certificate

Local
- Commercial Inspectorates at District Govt. level

Bavarian Environment Agency- Certification according to Chemicals Climate Protection Regulation (ChemKlimSchutzV)

Regulations covering requirements for

- operators of equipment with f-gases (refrigeration, air-conditioning, heat pumps)
- Persons and firms carrying out activities such as repairs, installation on the systems
- F-gases can only be delivered/sold to certified firms
- About 950 firms are registered in Bavaria alone

Bavarian Environment Agency- Certification of firms according to Chemicals Climate Protection Regulation

Details required for the application:

- Name and location of the company (all branches)
- Description of the activities of the company
- Proof of certification of staff
- Technical equipment available , equipment & tools list
- Declaration on sufficient certified staff in relation to volume of orders

Bayerisches Landesamt für Umwelt

Bayerisches Landesamt für Umwelt
Abteilung 7 – Zentrale Analytik, Stoffbewertung
Bürgermeister-Ulrich-Str. 160
86179 Augsburg

Bitte bevorzugt per E-Mail an poststelle@lfu.bayern.de. Die Unterlagen sind einzuscannen!

Antragsformular – Zertifizierung von Betrieben

Zertifizierung von Betrieben nach § 6 der Verordnung zum Schutz des Klimas vor Veränderungen durch den Eintrag bestimmter fluorierter Treibhausgase (ChemKlimaschutzV) / Zertifikat nach Art. 8 der Verordnung (EG) Nr. 303/2008 (ortsfeste Kälteanlagen, Klimaanlagen und Wärmepumpen)

1. Antragsteller

Name des Betriebes	
Adresse (Hauptsitz)	
Ansprechpartner	Name: E-Mail: Tel.-Nr.:
ggf. weitere Betriebsstandorte	

2. Beschreibung der Tätigkeit des Betriebes

2.1 Die Bescheinigung wird für folgende Tätigkeiten beantragt:
Dichtheitskontrollen mit Eingriff ☐ / ohne Eingriff ☐ in den Kältekreislauf, Rückgewinnung ☐, Installation ☐, Instandhaltung und Wartung ☐ der Anlagen.

2.2 An welchen ortsfesten Anlagen/Anlagentypen arbeitet ihr Unternehmen
☐ Klimaanlagen, Kälteanlagen und/oder Wärmepumpen mit einem Kältemittelfüllgewicht **kleiner 3 kg (kleiner 6 kg** bei hermetisch geschlossenen Systemen, die als solche gekennzeichnet sind)
☐ Klimaanlagen, Kälteanlagen und/oder Wärmepumpen aller Größenordnungen

Bayerisches Landesamt für Umwelt

Zertifizierung
gem. § 6 ChemKlimaschutzV

Gemäß § 6, Abs. 1 und 2 der Chemikalien-Klimaschutzverordnung (ChemKlimaschutzV) in Verbindung mit Art. 6 der Verordnung (EU) Nr. 2015/2067 wird der Firma

Kälte-Schankanlagenservice GRENCI
Ludlringstr. 40
90491 Nürnberg

die

Anerkennung

Nummer: 7-6730-73384/2016

als zertifizierter Betrieb erteilt.

Der Betrieb ist berechtigt, gemäß der Verordnung (EU) 2015/2067, Kategorie I, zertifizierungspflichtige Tätigkeiten wie Installation, Reparatur, Instandhaltung, Wartung und Stilllegung an allen Kälte- und Klimaanlagen sowie Wärmepumpen durchzuführen.

Augsburg, den 11.10.2016

Dr. Markus Scheithauer
Oberregierungsrat

- Certificate has unlimited validity
- Certificate can be repealed
- Costs around 2080 Rand

Bavarian Environment Agency- Certification of training schools (ChemKlimSchutzV)

Persons can receive training at chambers of trade/craftsmenship, guilds, training schools certified under the ChemKlimSchutzV

Details required for the application:

- Name und location of training school (each branch)
- Training concept and handbook
- Examination questions catalogue
- Details of the teachers/trainers (qualifications, further learning courses)
- Technical facilities & equipment for training
- Exemplary certificate for participants

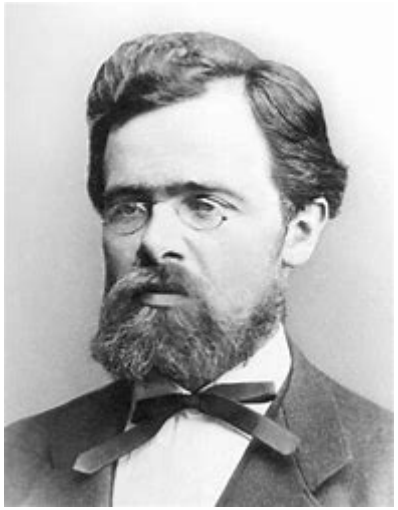
German Chemicals Climate Protection Regulation- Certification of persons- Categories I- IV

Category	Equipment	Scope
I	Stationary refrigeration, air-conditioning, heat pumps, refrigerated transport trucks and trailers	Leak checks, recovery, installation, repairs, maintenance, decommissioning
II	Stationary refrigeration, air-conditioning, heat pumps, refrigerated transport trucks and trailers having less than 3kg of f-gases or hermetically sealed systems with less than 6kg f-gas	Recovery, installation, repair, maintenance, decommissioning + leak checks without intervention in the refrigeration system for all kinds of systems
III	Stationary refrigeration, air-conditioning, heat pumps, refrigerated transport trucks and trailers having less than 3kg of f-gases or hermetically sealed systems with less than 6kg f-gas	Recovery of refrigerant
IV	Stationary refrigeration, air-conditioning, heat pumps, refrigerated transport trucks and trailers	Leak checks without intervention in the refrigeration system

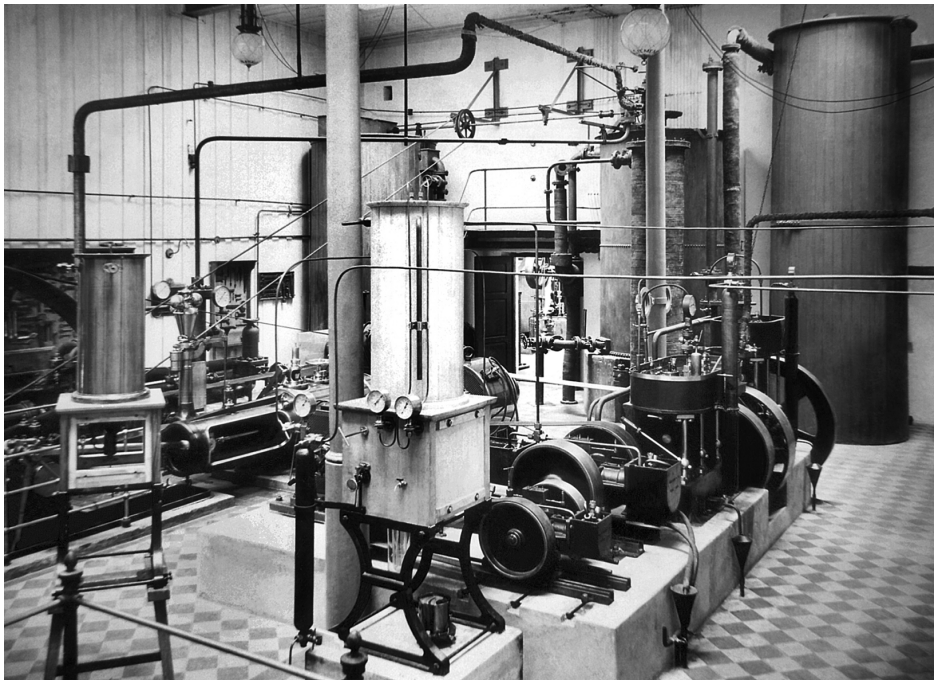
Best Practice from Bavaria – Early examples

- Carl von Linde

(1842- 1934)



Inventor and pioneer of natural refrigerant machines since 1876



1888: an experimental laboratory for refrigeration machines in Munich. The first studies on liquefaction of air were done here.

Picture: Linde Healthcare

Best- practice case studies from Bavaria

- Commercial refrigeration mainly supermarkets (R290, R744)

- Beverage industry, breweries, dairies (R717)

- Chiller based on water (R718) suitable for data centres, industrial cooling & central air conditioning in + temperature ranges (efficient energy GmbH)

- German Cooling Prize 2016- Competition for climate-friendly cooling technology by the Federal Ministry for Environment. Five winners from Bavaria

Photo: phil dera

Best Practice: Hops Processing Facility Hallertau

- R404a vs R290

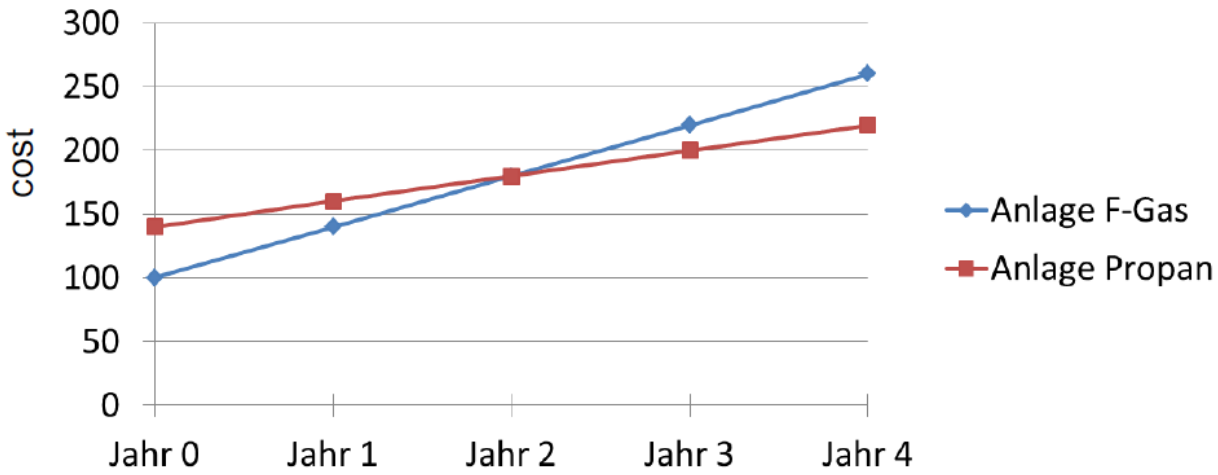
Safety Features (44kg of R290)

✓Components with propane approval

✓Gas sensor in the plant room at the floor

✓Gas sensor 2-stages pre alarm, main alarm

✓Main alarm at 25% lower flammable limit



Slide credits to Robert Baust, DKV e.V

Best Practice – Roche Diagnostics

- The Roche Group has committed to replace all fluorinated refrigerants by natural refrigerants for all cooling processes and for all locations worldwide
- Roche biotechnology centre- for production and research in Bavaria (at Penzberg near Munich) having more than 5.000 employees is committed to this goal.
- Cooling technologies in use with carbon dioxide, propane, methane and ammonia as refrigerants and for applications for cooling products upto -40 degrees

CASE STUDIES
Best practice

Roche – 'Fluorinated gases will be replaced by natural refrigerants for all cooling processes'

Facts about the Facility

Location:	Roche Diagnostics GmbH, Nonnenwald 2, 82377 Penzberg
Companies involved:	Planning: IB Mayer AG Ottobeuren, Facility construction: WESKA Kälteanlagen GmbH
Contact:	klaus.matschl@roche.com
Website:	www.roche.de

Facility – Use, cooling capacity, refrigerant, refrigerant charge

The focus of the activities of the Roche Group is the discovery and development of novel diagnostics and medicines together with their production. In Bavaria, Roche is represented in Penzberg and operates one of the largest biotechnology centres in Europe at this location. Reliable refrigeration technology is indispensable for the storage of feedstocks for production as well as for the bioengineered reagents for diagnostic tests and active ingredients – exclusively proteins – for medicines. Nearly all refrigeration systems are operated with natural refrigerants. Several large refrigeration plants with a capacity exceeding 20 MW are solely operated with the refrigerant ammonia (R-717). The temperature ranges lie between 3 °C (cold water) and –15 °C (cold brine). In addition, there are several refrigeration systems in the medium output range between 3 and 100 kW that have been operated solely with carbon dioxide (R-744) or propane (R-290) since 2005. One such plant is mentioned here as an example. The temperatures are in the range of 4 °C, –20 °C and –40 °C. For special applications at low temperatures (down to –90 °C) refrigeration systems are also operated with the refrigerant methane (R-170). For special cases absorption chillers are available.

Top: A refrigeration plant in one of the buildings at Roche in Penzberg
Below: The plant room for the refrigeration system

Technical Data of the Facility

Power required:	About 65,000 kWh per year
Cooling capacity:	28 kW at a room temperature of –40 °C
Costs:	The maintenance and operating costs have remained about the same compared to the old systems with HFC refrigerants
Challenges:	It is important that well-trained service staff is available for refrigeration plants.

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Commercial Refrigeration in Supermarkets

- Major supermarket chains have transitioned to climate-friendly alternatives like Propane (R290), Isobutane (R600a) and CO_2 (R744)
- Considerable economic benefits regarding energy savings (upto 15% savings on energy bills or more), heat recovery and lower operational costs as compared to conventional refrigeration systems with f-gases
- Natural refrigerant technologies implemented for higher ambient temperatures in countries such as Greece, Spain, Italy etc…

Summary – looking forward

- Natural refrigerants are paving the way especially in the commercial refrigerant sector
- Energy efficiency must be optimised, for e.g. through heat recovery, correct sizing of equipment and controls
- Security aspects have to be sharpened & no compromises should be made, including training of technicians and mechanics
- Natural refrigerants have high return-on – investment through energy efficiency measures and lower operating costs
- Low GWP F-Gase options are available, however harmful for environment and human health in the long term

Copywrite: someecards

Thank you for listening! enige vrae?

Cartoon credits: cartoonmovement.com