



Transformation pathways for safe and sustainable refrigeration.

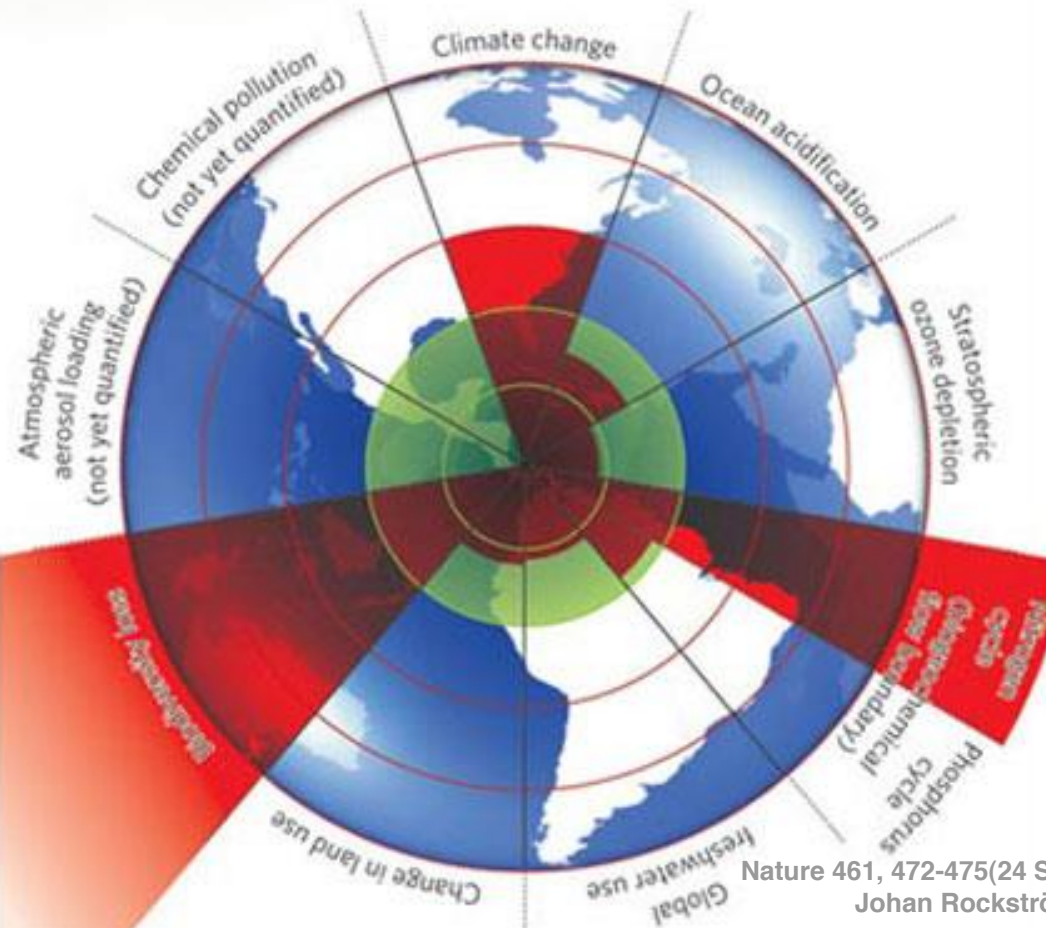
Jürgen Usinger
*GIZ Proklima,
Germany*



3-4th June, Vienna

Mankind is the dominating geological force in the earth system (Paul Crutzen)

- Three of nine interlinked planetary boundaries already overstepped
- Crossing biophysical thresholds could have disastrous consequences



Nature 461, 472-475(24 September 2009)
Johan Rockström et al

RAC Sector impact on

- Ozone and Climate --
- Chemical Pollution (persistent wastes) -
- Basic biochemical cycles (fluor) -
- Biodiversity (food chains) +

MP applied precautionary approach in 1982-1987 when ozone depletion was still not scientifically proven

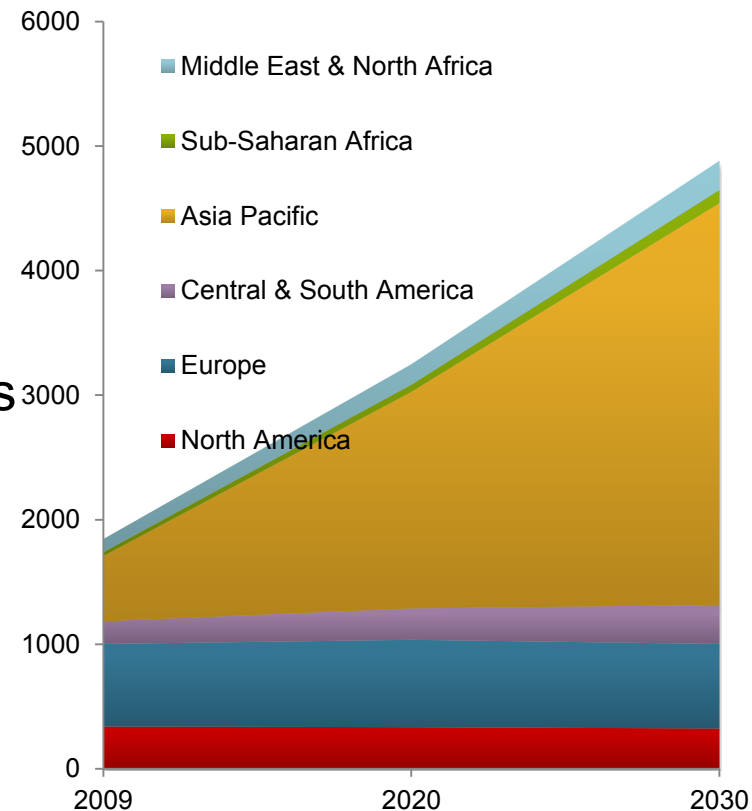


Is it possible to scale up existing growth patterns?

- > 9 bio people in 2050, GDP triple until 2030
- 80% of consumers are in DC and emerging economies, OECD share drops from 55 to 20% (2030)
- RAC market today ~ 200 bio. US \$, AC demand growths by factor 14 until 2050 (IEA)
- Pressing time constraint to avoid tipping points
- Need to secure valuable planetary resources for future generations
- Developing countries are in the process to replace HCFCs, HFCs are not sustainable

→ Choosing sustainable alternatives is essential to reach the common goals

Development of worlds middle class





Scaling up depends on the sustainable systems and behaviour

Strategies

- Decarbonisation of energy supply
- Reduce, reuse, recycle materials
- Use of renewable materials
- Establish environmental safe systems and behaviours
- Accelerate innovation cycles
- Eliminate use of environmentally critical substances

→ Choosing natural alternatives is a precautionary approach for transformation, in terms resource efficiency and environment



Transforming to a knowledge based economy

- Resolving complexities is a typical starting point of environmental sound technologies
- Safety & best practice is not refrigerant specific, it is a general requirement when competently managing RAC systems
- Continued education and knowledge sharing is essential for transformation, e.g. engineers, technicians, mechanics require to update their knowledge and need to learn to think systems.



Lessons learned:

- HC refrigerators just one example for global acceptance, incl. know-how & infrastructure, RefNat example in commercial refrigeration
- **Establishing qualification and controls for safe behaviour is essential for public safety when introducing sustainable alternatives**



Key factors of safety management

Required changes and instruments :

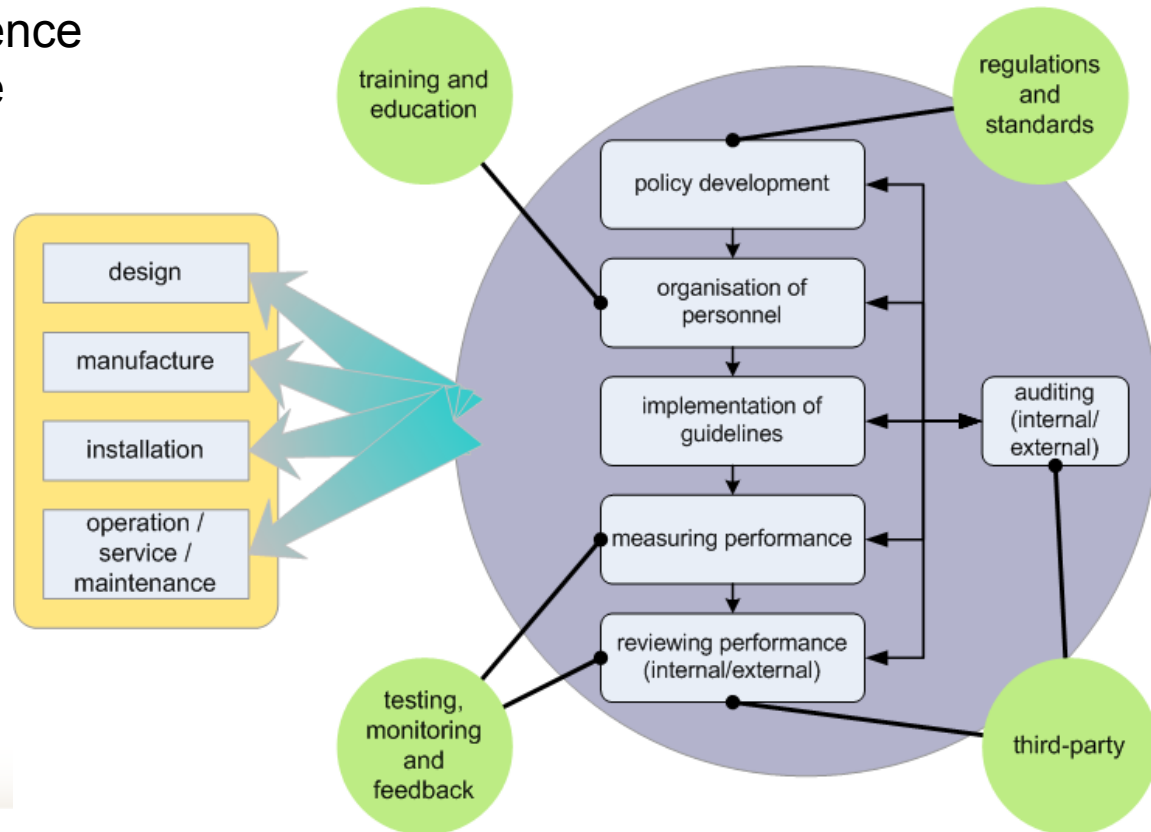
- Innovative technology/know how → demonstrate application
- Awareness → provide information
- Education → build competence
- Skills → practical guidance



- Behavioral aspects



- Normative action
- certification/registries
- regulation/standards
- quality assurance
- monitoring
- enforce controls






GIZ series on safe use of natural refrigerants

More than 30 national training programmes under MLF since 1996

Proklima International




PROKLIMA

Guidelines for the safe use of hydrocarbon refrigerants

A handbook for engineers, technicians, trainers and policy-makers - For a climate-friendly cooling

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

On behalf of **BMZ** Federal Ministry for Economic Cooperation and Development




Operation of split air conditioning systems with hydrocarbon refrigerant
A companion guide for technicians, trainers and engineers

Seed Practices in Refrigeration

Natural Foam Blowing Agents
Sustainable, Green- and Climate-Friendly Alternatives to HFCs

Production conversion of domestic refrigerators from halogenated to hydrocarbon refrigerants
A Guidebook

Natural Refrigerants
Sustainable, Green- and Climate-Friendly Alternatives to HFCs

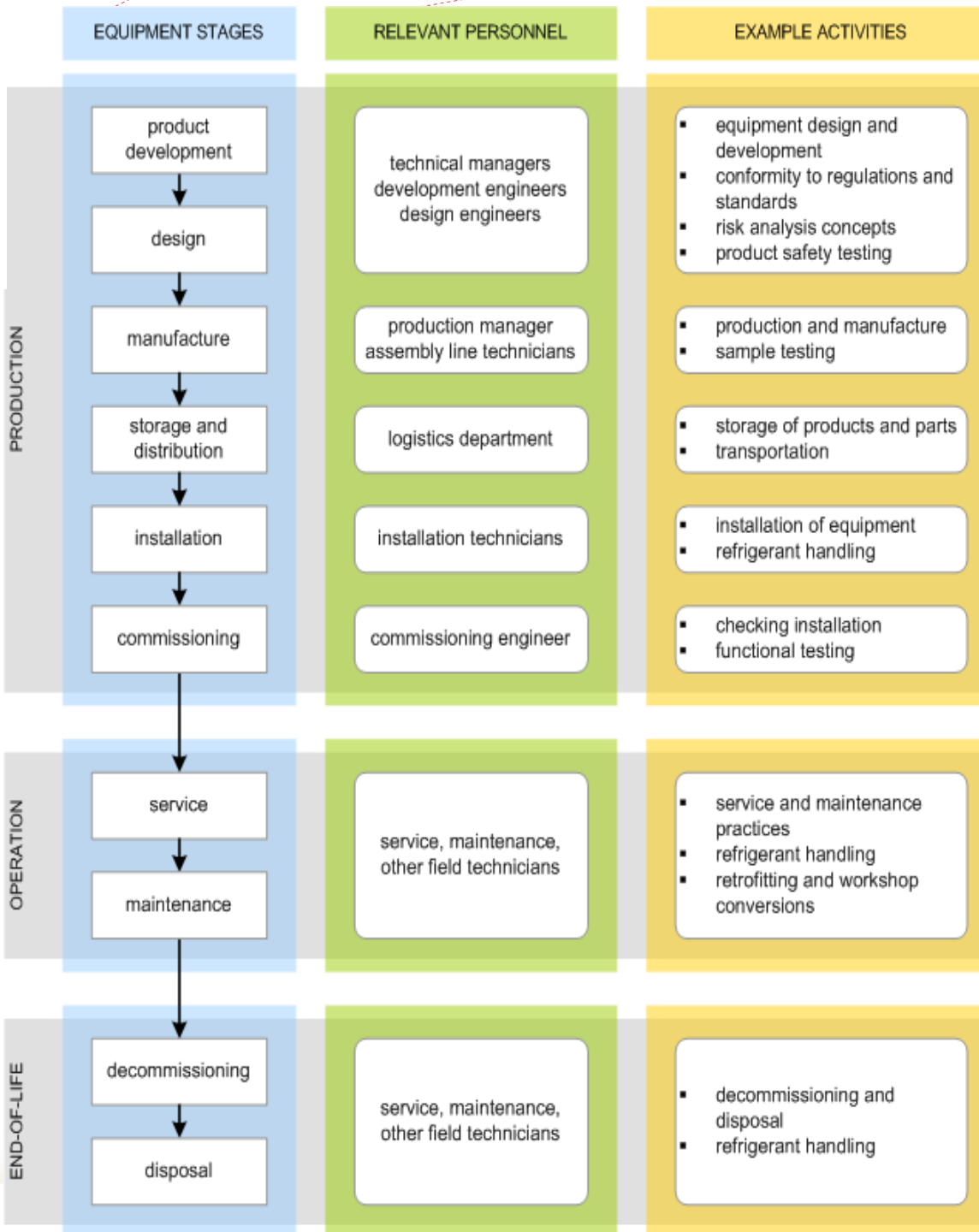
Building capacity throughout the value chain

Transformational Education:

Know what? → Informal

Know how ! → Formal

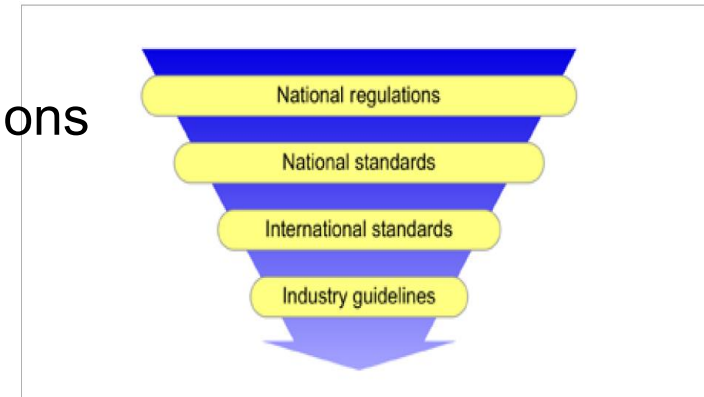
Know why ... → Competent Person



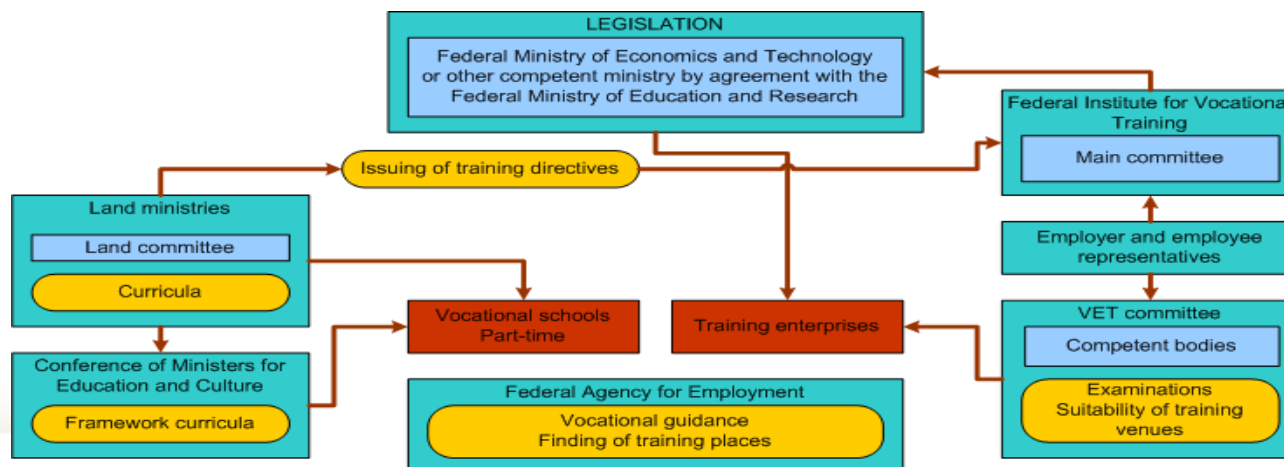


Building capacity throughout organisations

- Industry associations
- Technical/vocational institutes and associations
- Development and funding agents
- National authorities
- Standardisation bodies
- Accreditation bodies /quality assurance
- Research institutions and others



Integration with national stakeholder processes is essential for sustainability of activities

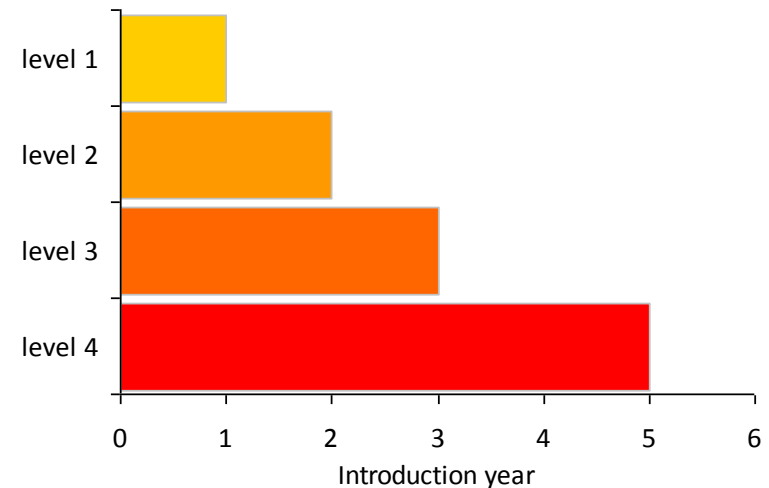




Time frame needs to be adjusted

System categories	Risk rating (Low, Medium, High)					Overall risk level
	charge size	number of SOIs	Similarity	external	other items	
Domestic refrigeration	L	H	L	H	L	level 2
Retail refrigeration						
▪ Integral (stand-alone)	L	M	M	H	L	level 2
▪ Split (condensing unit)	M	M	H	M	H	level 4
▪ [Central direct expansion]	H	H	H	M	H	[level 4]
▪ Central indirect	M	L	L	L	M	level 2
Air conditioning						
▪ Integral (window/portable)	L	L	L	H	L	level 1
▪ Split	L	L	L	M	L	level 1
▪ Close control	M	H	M	M	M	level 3
▪ Rooftop unit	M	M	M	M	M	level 3
▪ [Ducted direct expansion]	H	H	H	M	H	[level 4]
▪ [Multi-split]	H	M	H	M	H	[level 4]
▪ Chiller	H	L	L	L	M	level 2
Transport						
▪ Car air conditioning	L	L	L	L	L	level 1
▪ Transport a/c	M	M	H	M	L	level 3
▪ Truck refrigeration	M	M	M	L	M	level 2
▪ Fishing vessels	M	M	H	M	M	level 3
Food processing, bespoke	H	M	H	M	H	level 4

Capacity building activities need to start as early as possible. Suggested timescale for the staged introduction of HC refrigerants according to risk level





Example: Brazil best practice

Challenges

- Target 30,000 - 26,000 officially certified during NPP
- 80% of workshops „informal“ or „selfemployed“
- huge geographical area, remote areas with low or no access to qualification
- culture of training on the job, formal education low
- RAC vocational training concentrated in large centres
- national standards not developed
- High leakage, low carbon intensity of electricity



Approaches

- registration and certification system
- mobile training for decentral course system
- integrating with national training agents
- preference to practical training
- integrate contents in formal education
- adapted materials (visualized manuals)

Contd.: Brazil HPMP phase out

- First step: emphasis on leak control before putting any new refrigerants in the market
- National standards and regulations for recycling and take back of equipment adopted
- More integration with the private sector, workshops on training and design
- Integration of national research institutions, vocational and industry associations
- Introduction of documentation systems for servicing
- Pilot introduction e-learning, online documentation and info systems
- Modular training on soldering & leak control and best practice
- End user consultation (commercial) for replacement
- Stakeholder consultations on national framework
- Focus on certification of best practices principals



Conclusions

- Training has to be seen in the context of ongoing transformation of global economies; this takes time, better start early as possible
- Despite the “burning” issues of introducing new refrigerants, a culture of continued education and knowledge sharing in RAC sector is necessary
- In many countries formalization of education and certification to take place
- Capacity building not restricted to servicing personnel, integration with value chain and public stakeholders essential
- Public support insufficient, initiative and cooperation from private sector stakeholders required. Transnational technology cooperation specifically beneficial.



- Newly acquired competences develop multiple benefits:
 - higher energy efficiency from better practice (15 % +, EU)
 - less wastes and operational failure - better economy
 - customers understand value and pay for it
 - local supplies of natural refrigerants, no dependence on imports
 - enhances local know how and production options
 - longer term application of framework and know how
- High safety standards may generally improve services & performance
- Cash saved during operation could be used to pay qualified workers

Sustainable practice provides sustainable income!



Thank you for your attention!

On behalf of



Federal Ministry
for Economic Cooperation
and Development

Federal Ministry for the
Environment, Nature Conservation
and Nuclear Safety





Conclusion:



Reduce HCFC demand in the servicing sector step by step

- Start with training and certification in best practice and leak safe containment
- Normative framework for registration, certification and regulatory control
- Investigate pilot activities for drop in, retrofit and replacement
- Adapt extension based on these experiences and provide advise for investors



Access to information
Working conditions
Guided flexible procedures
Build in safety
System integration
Efficiency
Improve service remote
Reduce hardware
Detailed information
Conceal complexity behind

1000 Technician
21 units installed

Carel Bitzer

New challenges and obstacles

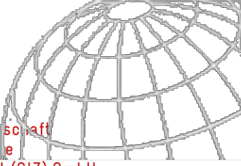


- Modification of existing systems to improve tightness
- Design or re-design of existing or new refrigeration systems
- Installation practices
- Use of new tools
- Identification of HCFCs and of HCFC replacements in form of HFC mixtures in various forms.
- Safety matters using natural refrigerants as direct HCFC replacement
- Best practices for low emission service, maintenance, containment of HCFC and alternatives



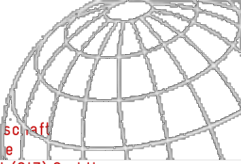
Example: Elements for control of refrigerant emissions in the commercial sector

- secure refrigerant containment,
- documented leak inspection regimes,
- record keeping,
- auditable refrigerant recovery,
- skills training and safe refrigerant handling
- certification of the service and maintenance company and its employees.



Registration & certification of servicing enterprises

- a. Registered as carriers of hazardous waste;
- b. Possess recognized certification competency to handle refrigerants;
- c. Conform with all current legal requirements;
- d. Operate auditable procedures for the proper control of refrigerants;
- e. Use purpose designed refrigerant recovery equipment;
- f. Can account for all refrigerant used and recovered;
- g. Are environmentally aware and perform refrigerant transactions with minimum emissions .



O Kit didático é patrimônio
do ffgffj **Kit C**
nnnnnnnnnnnnffgffggggg
jn,n,,,,,,,,,,,,,,,,,,,,,fgfvSENAI
Departamento Nacional.



É construído em MDF,
revestido com laminado
plástico, perfis de
alumínio, rodízios,
bancada de trabalho e
equipamentos.



Benefits of applying safe & sustainable refrigerants

Environmental protection benefits

- Use of recycled materials
- locally produced natural fluids
- Energy saved,
- increased environmental and work place standards
- Use of renewable energy
- continued services
- higher reliability
- reduced power demand
- Less waste of material resources
- appropriate use of wastes
- Controlled environment maximises quality
- economy and environmental benefit of recycling
- Reduced emissions from pollutants
- safe living environment

Resources

- Initiation of research on using local/recycled materials
- Jobs in refining industries

Manufacturing

- New designs increase competitiveness of local industries
- building innovative know how/capacities

Operation Use

- Operational energy and maintenance savings
- Sustained supply of refrigerated goods
- better hygiene
- productivity
- increased living and working place standards
- Higher income

After Sale Servicing

- Qualified services will be better paid
- material costs reduced
- High qualification raises status of mechanics

Waste

- Formalisation of waste collection provides socially secured jobs
- better work place and health conditions

Disposal, Destruction

- New infrastructure allows for the introduction of polluter pays principle
- work places

Socio-economic benefits



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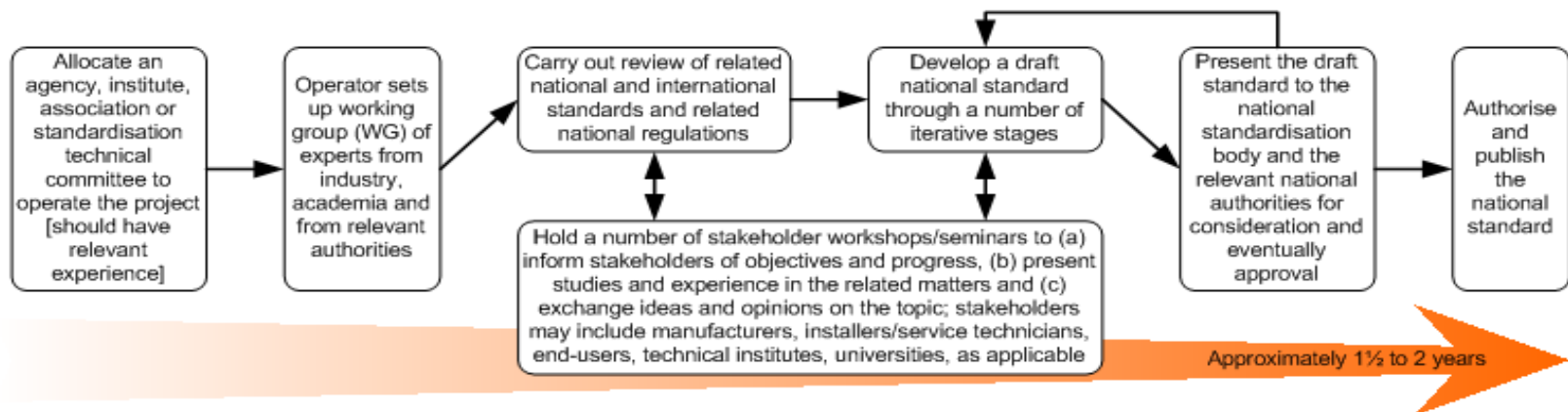




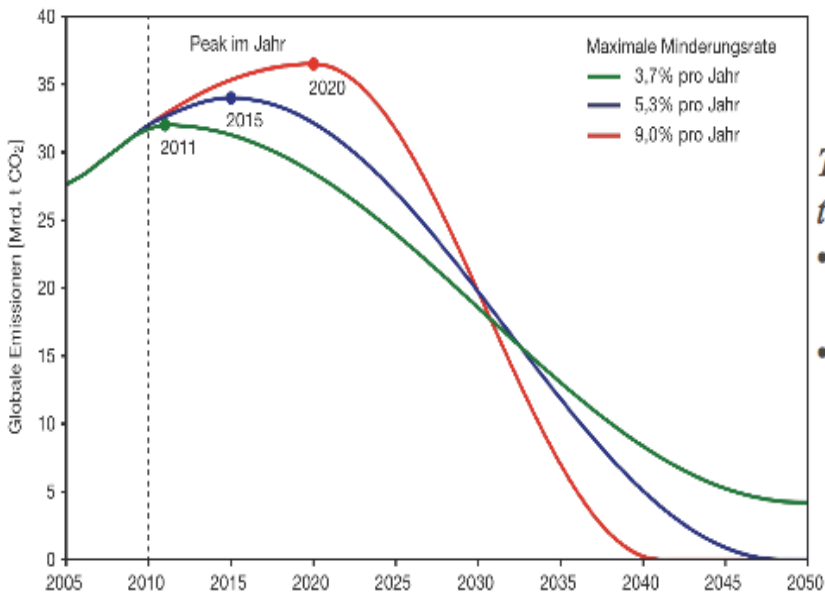
Normative Action

There are a extensive number of regulations, standards and industry guidelines that directly or indirectly impact on the use of HC refrigerants, for example, at the following stages:

- Design of systems and equipment
- Manufacture of components, systems and equipment
- Installation and positioning of systems and equipment
- Service, maintenance and dismantling of systems and equipment



General transformation is a long term challenge!!!



*Transformation needs
to be global:*

- *2,5 t per capita 2010 - 2050*
- *110 countries beyond 2 tons*



Awareness

Training best practices

Leak Control Practices

Monitoring, Documentation

Training on new alternatives

- Training of A/C
- Training Commercial



GIZ assistance in training under the MLF

- 18 training programmes under the NPP
- 12 Training programmes under the HPMP
- Brazil, Liberia, India, Iran, Kenya, Namibia, PNG, Zimbabwe,