Agrifood Cold Chains: Reducing food losses, waste and methane emissions

COP28 side event

OZONE
COOL
ZONE

30 Nov–12 Dec
COP28 UAE

Implemented by

german cooperation
DEUTSCHE ZUSAMMENARBEIT

The Federal Government

IKI INTERNATIONAL CLIMATE INITIATIVE

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Saturday, 9th December 2023, 09:30 am – 10:30 am (GST/UTC+4)
Ozone to Cool Zone (Montreal Protocol Pavilion)

Agrifood Cold Chains: Reducing food losses, waste and methane emissions

Saturday, 9th December 2023, 9:30 am – 10:30 am (GST/UTC+4) | Ozone to Cool Zone (Montreal Protocol Pavilion)

Welcome Remarks (5')	Vassilios Karavezyris, Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection (BMUV), Germany
Challenges of food waste and methane mitigation – and how to tackle them (10')	Anja Schwetje, German Environment Agency (UBA)
The role of refrigeration in worldwide nutrition, the carbon footprint of the cold chain (10')	Didier Coulomb, IIR
Best practice examples of sustainable cold chain technology solutions using natural refrigerants (10')	Philipp Denzinger, GIZ Proklima
Q & A	Everyone
Conclusion an Closing Remarks	Balaji Natarajan, Multilateral Fund Secretariat

Our Speakers

Moderator: Philipp Denzinger, GIZ Proklima

Vassilios Karavezyris

German Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection

Anja Schwetje

German Environment Agency (UBA)

Didier Coulomb

International Institute of Refrigeration (IIR)

Philipp Denzinger

GIZ Proklima International

Balaji Natarajan

Multilateral Fund for the Implementation of the Montreal Protocol

OZONE
COOL
ZONE

30 Nov–12 Dec
COP28 UAE

Welcome Remarks

Vassilios Karavezyris

German Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection (BMUV)

OZONE
COOL
ZONE
30 Nov–12 Dec
COP28 UAE

Challenges of food waste and methane mitigation – and how to tackle them

Anja Schwetje, German Environment Agency

Challenges of food waste and methane mitigation - and how to tackle them from a waste sector perspective

**By disposing un-consumed food and other organic waste,
methane is formed and emitted from dump site and landfills over decades,
harming our livelihoods, environment and economies while accelerating global warming**

CCAC, UNEP: **More than half of global methane emissions** stem **from human activities in three sectors:** fossil fuels (35%), **waste (20%),** agriculture (40%)
Global Methane Pledge: **Reduce global methane emissions by 30% by 2030** from 2020 levels

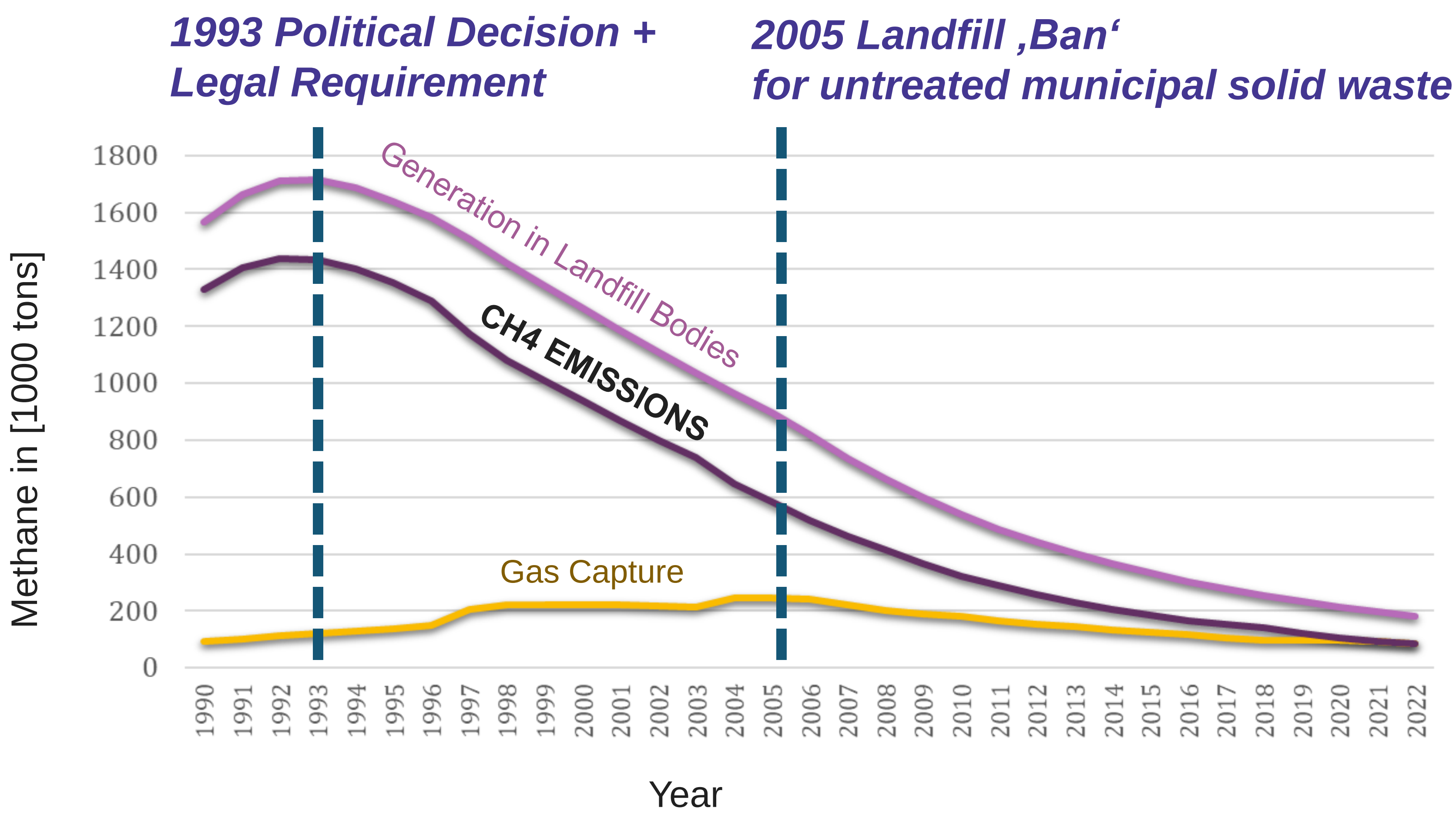
World Bank: **Waste generation** could increase to **3.40 billion tons in 2050**
On average globally **44%** of that **is food and green waste**

UNEP Food Waste Index Report 2021: 2019 globally about 931 million tons of **food waste** generated,
61% from households, 26 % from food service and 13 % from retail
Estimates **8-10% of global GHG emissions** are associated with food that is not consumed

Data on global food waste is improving, but **still few and variable**

Example Germany:
Policy Impact on Methane Emission Reduction from Landfill

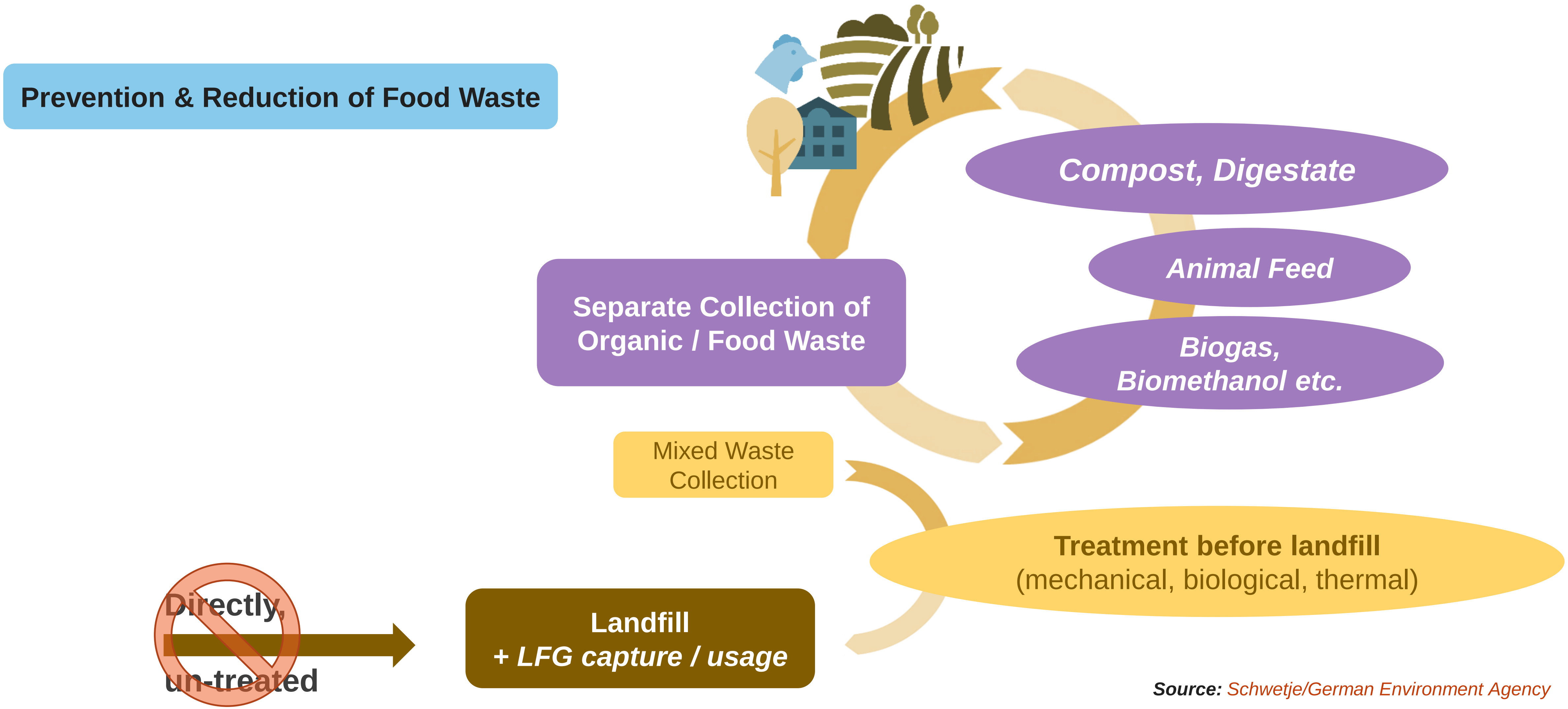
12 years transition for infrastructure development



- **Main methane mitigation effect by diversion of food / organic waste from landfill!**

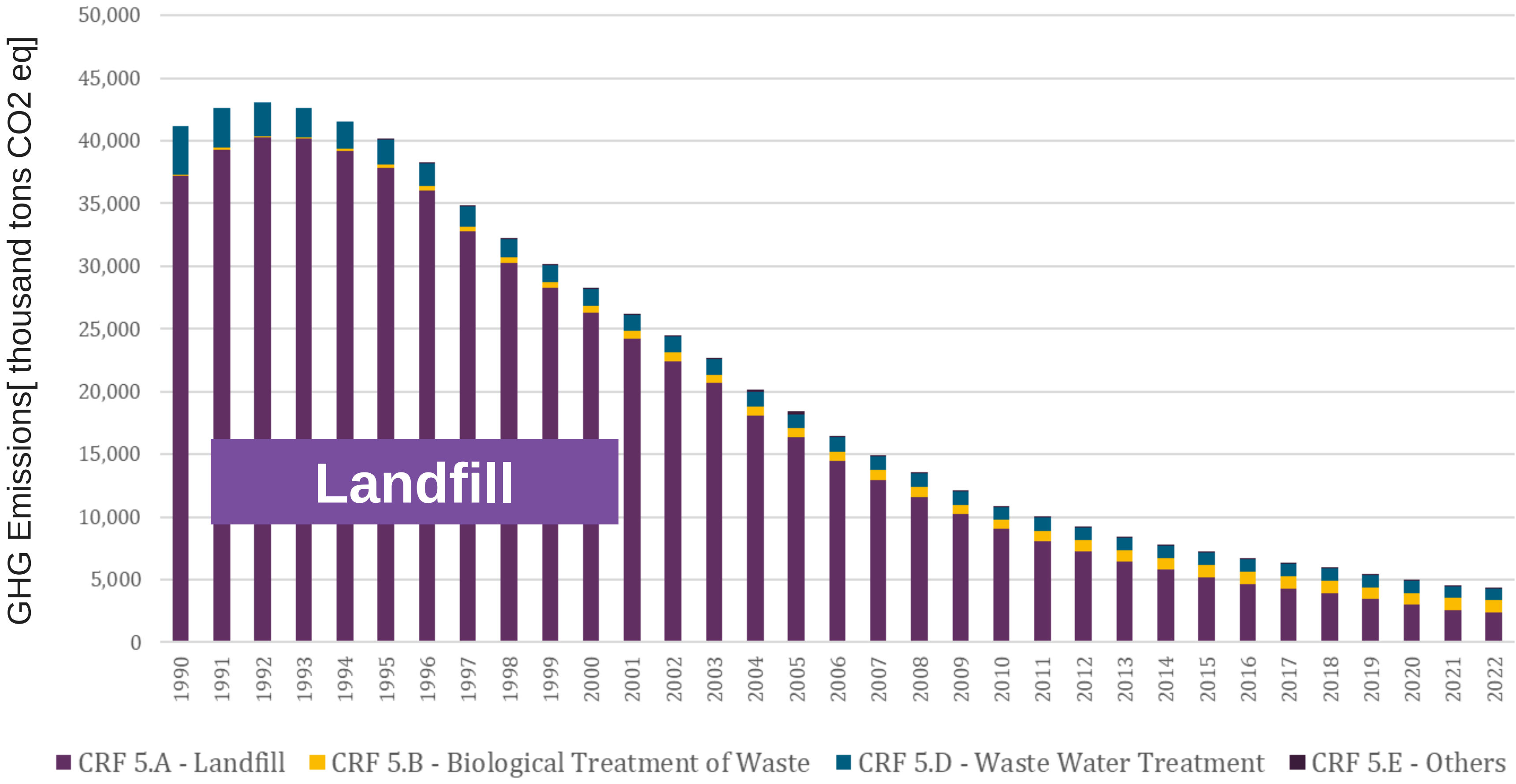
Source: *Butz / German Environment Agency*

Avoiding methane formation in landfills by recycling and treatment of food / organic waste



Source: Schwetje/German Environment Agency

Example Germany: National Inventory Reporting



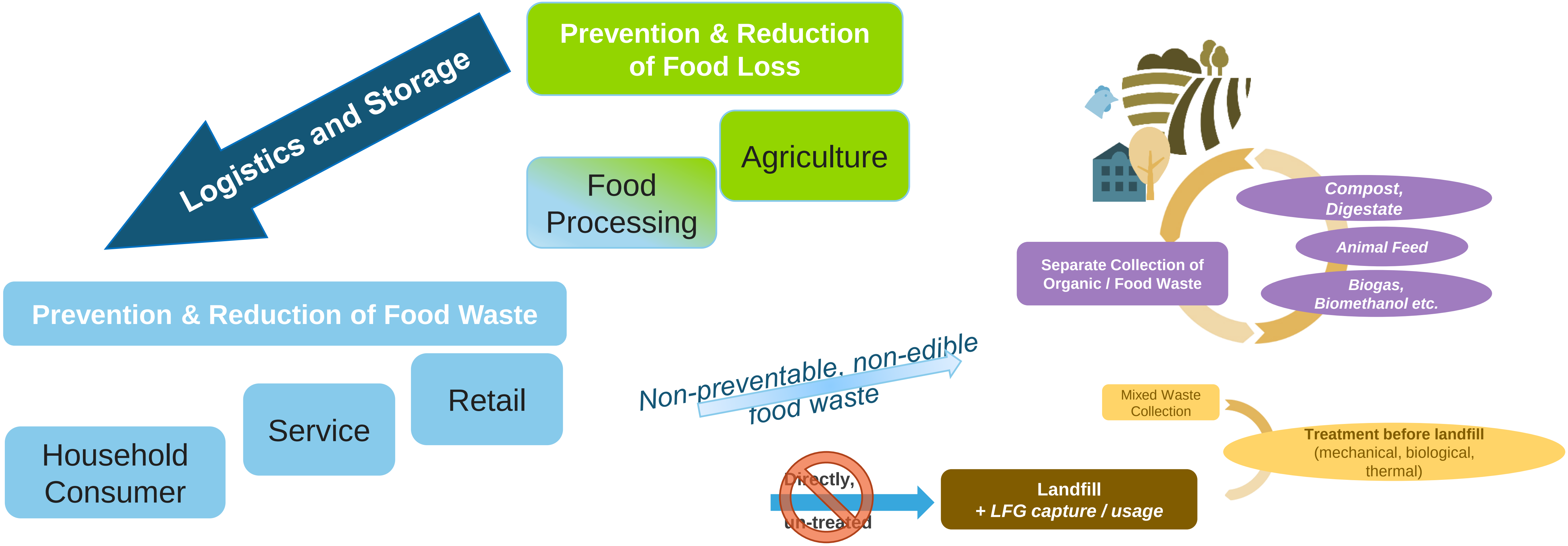
- **Methane formation in landfills continues for decades!**
- **Early / quick decisions to reduce / stop dumping and landfilling of food / organic waste needed!**

Biological Waste Treatment

- from accidents, operation failures, process or storage

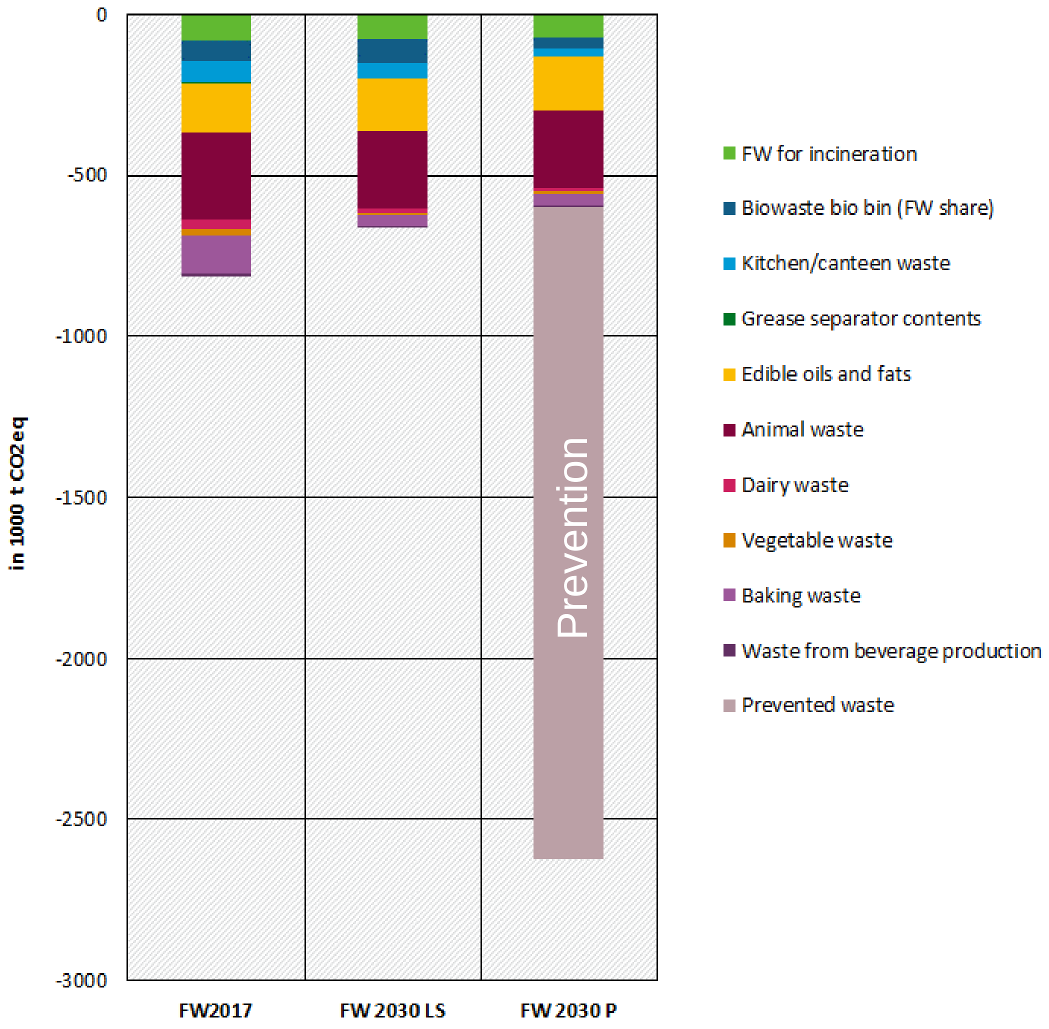
Source: Umweltbundesamt,
https://www.umweltbundesamt.de/sites/default/files/medien/361/dokumente/2023_03_15_em_entwicklung_in_d_ksg-sektoren_pm.xlsx

Methane Mitigation:
Preventing, recycling and treatment of food / organic waste



Source: *Schwetje/German Environment Agency*

Example Germany: Climate Potential of Food Waste Prevention and Treatment



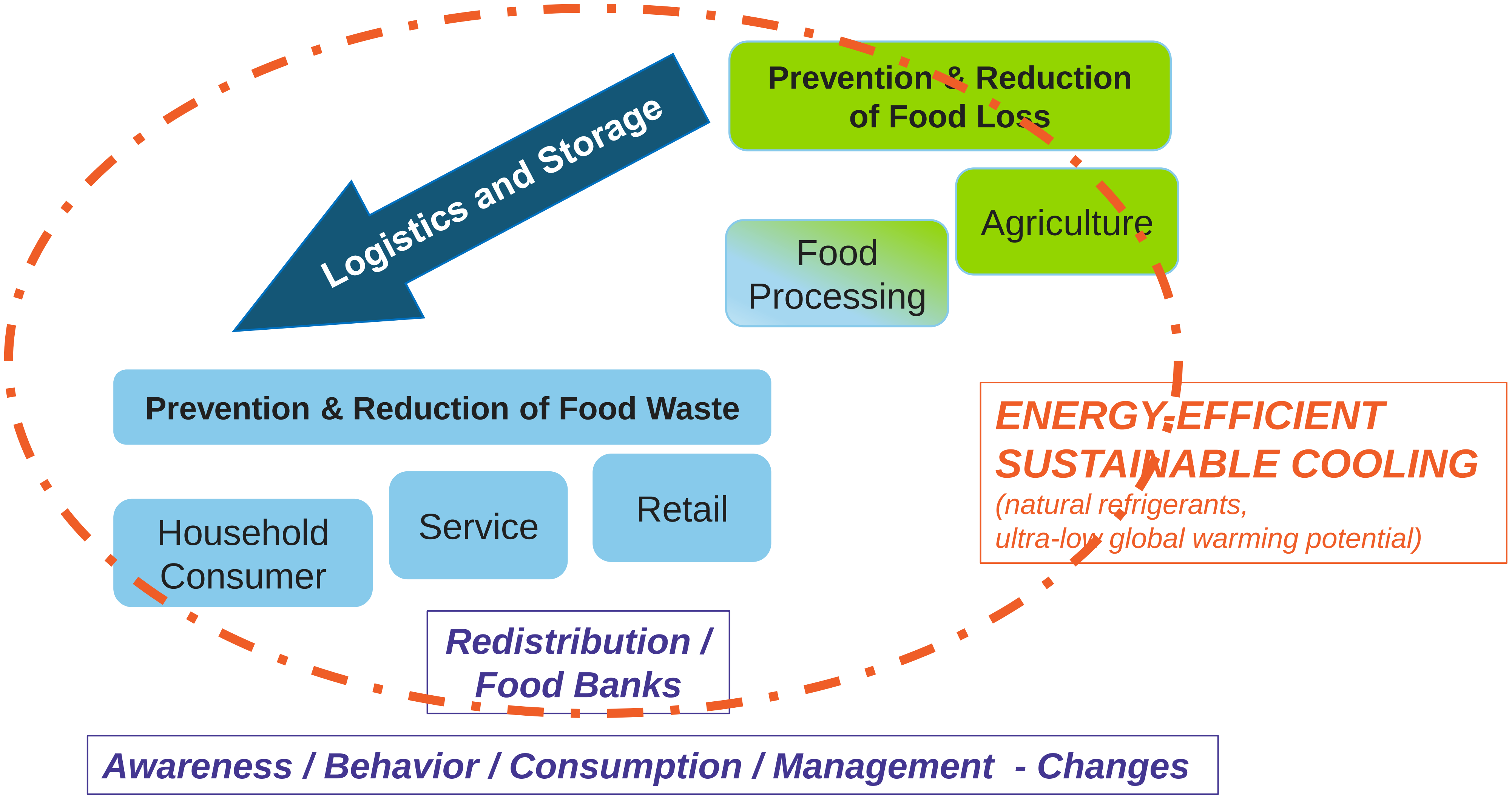
Determining climate protection potentials in the circular economy for Germany and the EU / Partial Report Germany | Umweltbundesamt

Estimation on food waste prevention: net GHG savings potential **nearly 4 times higher than for treatment only**

- Assumption for 2030: 50% of food waste in MSW prevented
- Data base was weak

- Life Cycle Assessment (LCA) method for waste management (follows ISO 14040/44)
  - 'hidden' climate protection contributions (recycling, recovery) shown
  - All emissions from waste treatment (also future emissions from landfill) are included
  - Inclusion of prevention possible if food products are known → possible for food for consumption → MSW food waste
- Decrease of net savings potential in the lead scenario 2030 mainly due to defossilisation of the energy system

Preventing Food Waste/Loss - Selection of Measures
There is no silver bullet!



OZONE COOL ZONE
30 Nov–12 Dec
COP28 UAE

Anja Schwetje

Unit III 2.4 Waste Technology, Waste Technology Transfer

German Environment Agency

Dessau Rosslau – Germany

anja.schwetje@uba.de

+49 (0)340 2103 3284

Umwelt Bundesamt

The role of refrigeration in worldwide nutrition, the carbon footprint of the cold chain

Didier Coulomb, International Institute of Refrigeration (IIR)

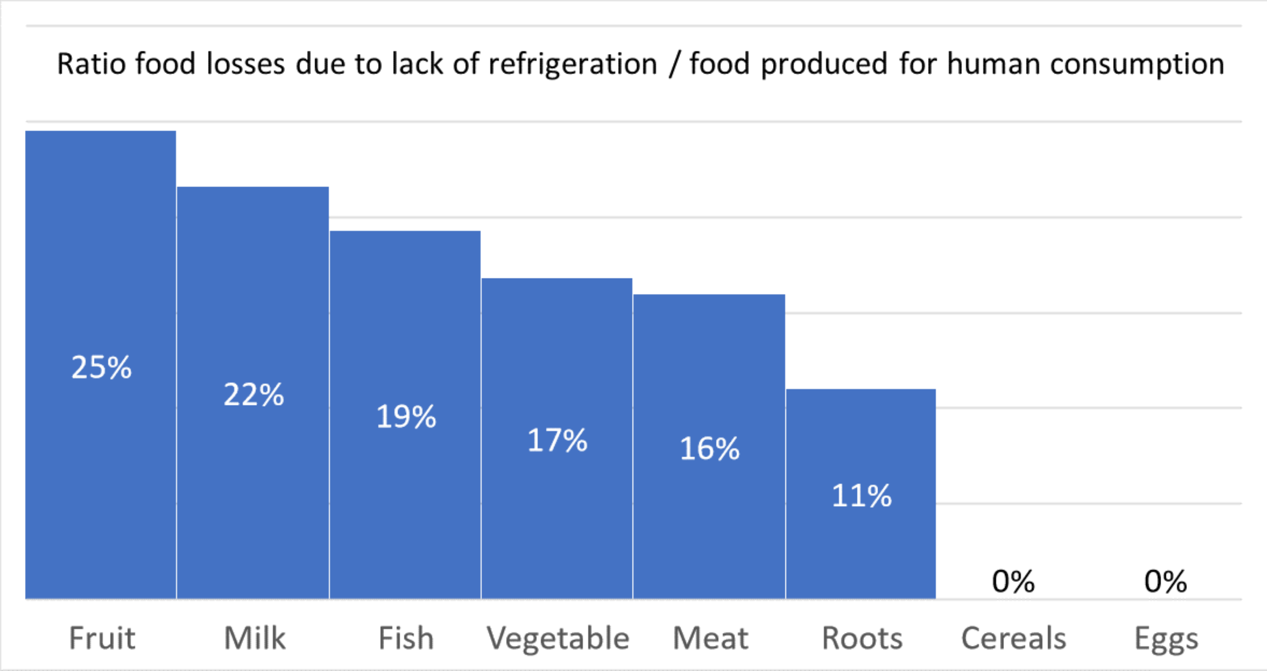
Assessment of the carbon world footprint of the human food production and of the food losses due to lack of refrigeration

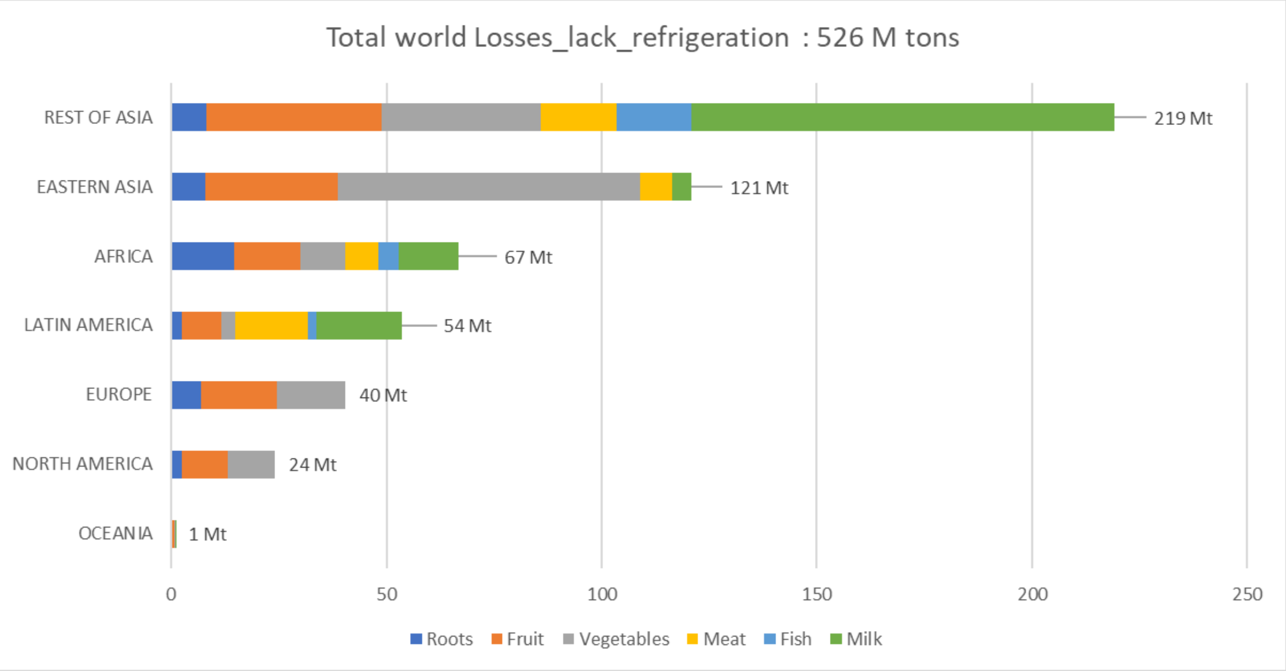
The compilation of FAO data (2017) and IIR expertise leads to following assessments :

- 45% of the food that deserves refrigeration is actually refrigerated
- 12% of the agricultural production for human consumption is lost due to lack of refrigeration
- These losses are responsible of an avoidable carbon emission of 1 004 M tons of eq. CO_2

	Mt of food	Mt eq. CO2
Agricultural production	**7 209 Mt**	**5 940**
Agricultural & post harvest losses	- 1 137	
Production used for other purposes than human consumption	- 1 501	
Total agricultural production for human consumption	**4 547**	**4 727**
Quantities deserving refrigeration	**1 800**	
Quantities actually refrigerated	**819**	
Food losses due to lack of refrigeration	**526**	**1 004**

These average values conceal wide disparities between different food commodities and world regions





Reading example :
25% of the world's fruit production is lost due to lack of refrigeration

Assessment of the carbon footprint of the food cold chain

The reduction of the food losses due to lack of refrigeration would require to develop the food cold chain from field to fork, which would mean :

- An increase of the number of refrigeration equipment
- An increase of the direct and of the indirect effect of these equipment

Scenario studied by IIR studies:

☞ *What would be the carbon impact of an "improved" cold chain, for which all the countries in the world would have a food cold chain as developed as the food cold chain in developed countries ?*

	Current cold chain	Improved cold chain	
Food losses due to lack of refrigeration	526	236	Mt of food
Associated carbon emission	1004	76	Mt eq CO2
Increase of the number of equipment used			
Number of refrigerated vehicles	3 400	7 500	Thousand unit
Numbers of refrigerators	1 967	4 640	Million units
Cold storage volume	449	843	Million m3
Linear meters of display cabinets	66	110	Thousand km
Increase of the electricity consumption	281	714	TWh
Increase of the bank of refrigerant	413	914	kt
Increase of CO2 emissions from equipment	261	589	Mt eq CO2
Additonal CO2 emissions	328		Mt eq CO2
Food savings	290		Mt of food
in terms of carbon emissions	928		Mt eq CO2
Carbon emissions savings	600		Mt eq CO2

For the studied scenario,

- Food savings : 290 M tons, but :
- On one hand, an enhanced food cold chain would increase the refrigeration emissions of 328 Mt eq CO_2
- On the other hand, it would permit to reduce the carbon emissions of food losses 928 Mt eq CO_2

<u>It results in a net saving of 600 Mt eq CO2</u>

Conclusion

Even if responsible of direct and indirect CO_2 emissions, the food cold chain saves more carbon than it emits

It is shown that a cold chain brought in all countries to the level of that of developed countries would reduce the carbon footprint associated with the food cold chain by more than 47% while avoiding 55% of food losses.

It also shown that avoiding 55% of food losses thanks to the development of refrigeration would permit to nourish additional 1 billion of people without any change of the present world agricultural production neither than its carbon emission.

In one word : Yes, the food cold chain is definitely sustainable and has to be promoted and encouraged !

OZONE COOL ZONE

30 Nov–12 Dec
COP28 UAE

Didier Coulomb

Director General

International Institute of Refrigeration

IIF IIR
INSTITUT INTERNATIONAL DU FROID
INTERNATIONAL INSTITUTE OF REFRIGERATION

Best practice examples of sustainable cold chain technology solutions using natural refrigerants

OZONE COOL ZONE
30 Nov–12 Dec
COP28 UAE

Philipp Denzinger, GIZ

german cooperation
DEUTSCHE ZUSAMMENARBEIT

The Federal Government

IKI INTERNATIONAL CLIMATE INITIATIVE

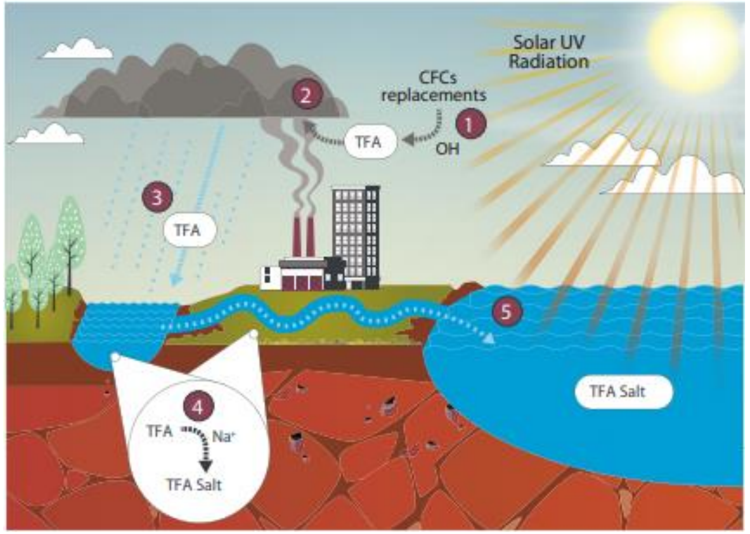
Implemented by

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

A brief on refrigerants

Present and future options for split air conditioning

Refrigerant	Type	GWP 20	GWP 100	PFAS	TFA
R22	HCFC	5690	1960	No	No
R404A	HFC blend	7208	4728	Yes	Up to 20% R134a (4%), up to 10% R143a (52%)
R407A	HFC blend	4944	2262	Yes	Up to 20% R134a (20%)
R410A	HFC blend	4850	2256	Yes (R125)	No
R134a	HFC	4140	1530	Yes	Up to 20%
R32	HFC	2690	771	No	No
R513A	HFC/HFO blend	1823	673	Yes	Up to 20% R134a (44%), up to 100% R1234yf (56%)
R1234ze(E)	HFO	4.94	1.37	Yes	Up to 10%
R1234yf	HFO	1.81	0.501	Yes	Up to 100%
R744	Natural (CO_2)	1	1	No	No
R717	Natural (Ammonia)	<1	<<1	No	No
R600a	Natural (Isobutane)	<<1	<<1	No	No
R290	Natural (Propane)	0.072	0.02	No	No



These substances are not manageable, and all efforts should be undertaken to avoid them as completely as possible.

Per- and polyfluoroalkyl substances (PFAS) are a large class of synthetic chemicals that increasingly detected as environmental pollutants and linked to negative effects on human health. **Trifluoroacetic acid (TFA)** is an ultra short chain type of PFAS, commonly found in the breakdown of f-gases.

Sources: IPCC, 2021: 6th Assessment Report of the IPCC (Table 7.SM.7).
Behringer, D. et al. 2021: Persistent degradation products of halogenated refrigerants and blowing agents in the environment, Final report.
UNEP, "Refrigeration, Air conditioning and Heat Pumps Technical Options Committee, 2022 Assessment Report", 2022.
Climate-friendly alternatives to HFCs (europa.eu)

Climate-friendly solutions exist for (almost) all refrigeration applications related to the cold chain

Refrigerators	Commercial refrigeration	Chiller	Industrial refrigeration	Transport refrigeration
				
HC	CO_2 HC NH_3	CO_2 NH_3 HC	NH_3 HC	CO_2 HC

HC: Hydrocarbons (e.g Isobutane, Propane)   CO2: Carbondioxide   NH3: Ammonia

Avoiding emissions by "leapfrogging” to Green Cooling

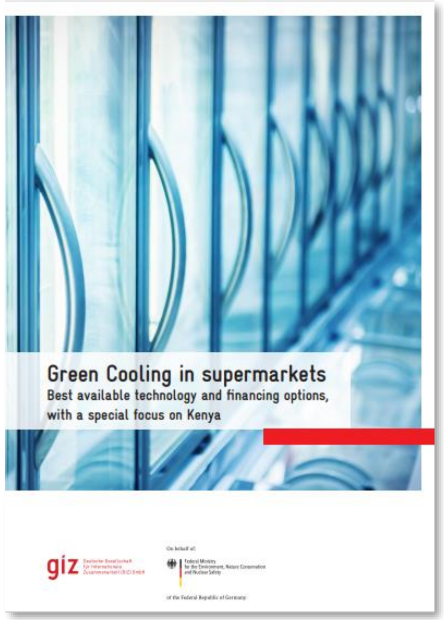
Instant switch to highly **energy-efficient** technologies with **natural refrigerants** without relying on environment- and climate-damaging interim technologies. Use of **natural blowing** agents for insulation materials. Use of **solar powered technologies** combined with **ice storage**.

Domestic and Commercial Refrigeration

- Success Story: Greenfreeze: **Over 70% of domestic refrigerators** worldwide are powered by natural hydrocarbons such as isobutane (R600a)
- Many **commercial refrigerators** are using on propane (R290) which is very energy efficient and can be used in a large range of commercial applications.

Example: Switching Supermarkets to Natural Refrigerants & Energy Efficiency

- ✓ Two Pick n Pay supermarkets switched to combined CO_2 cooling systems in South Africa
- ✓ Reduction of direct emissions of ozone and climate damaging refrigerants of more than 500.000 kg of CO_2 equivalent
- ✓ Approximately 350 supermarkets switched up to date to CO_2 in South Africa
- ✓ Centralized hydrocarbon supermarkets systems are also being installed in Thailand (water loop), South Africa and in Kenya (semi plug-in) in near future and offer another excellent technology solution



Read more: IKI Website

Example: Installation of R-290 Chillers for Industry and Businesses in Indonesia

	HFC Chiller (R-22)	Green Chiller (R-290)	Difference (%)
Unit Price (USD)	37.822 USD	55.886 USD	32%
Energy Efficiency Ratio (EER)	2,7	3,6	+ 25%
Energy Consumption (kWh/year)	783,442	572,238	- 37%
Annual Energy Cost (USD)	61,584	44,982	- 37%
Lifecycle Cost, LCC (USD)	434,686	348,372	- 25%
Direct Emissions (tCO2eq)	451	0,34	
Indirect Emissions (tCO2eq)	12,367	9,033	
Total Emissions (tCO2eq)	12,819	9,034	- 42%
Global Warming Potential (GWP)	1810	3	
Ozone Depletion Potential (ODP)	0.055	0	
Internal Rate of Return (IRR) %	21 %		
Payback Period (years)	1,04 %		

Source: CCAC, 2019

Photo: MEMR 2022


Photo: GIZ 2018

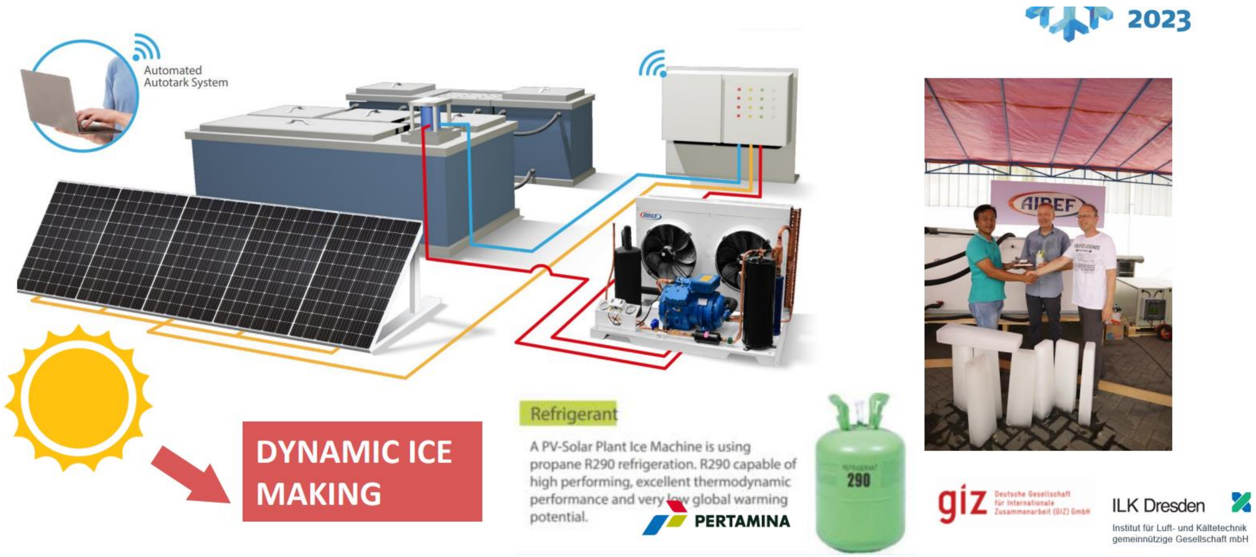
Example: Solar Powered Walk-in Cold Room: Cold Hubs – Nigeria

- 24/7 off-grid storage and preservation of perishable foods
- “plug and play” modular
- Using natural refrigerant R290 (monobloc)
- 120mm insulating cold room panels retain the cold
- Batteries + inverter (newer generation with ice storage)
- Pay-as-you-store subscription model
- Around 100 units installed in Nigeria
- Newer installations also come with ice storage instead of batteries

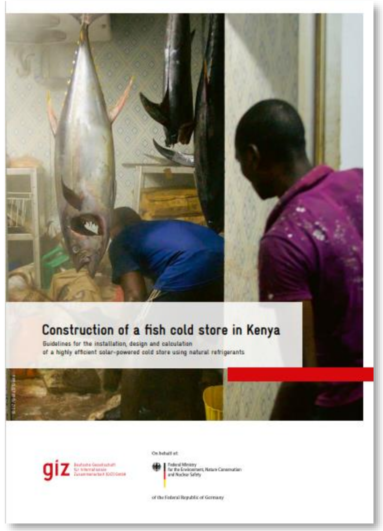
© coldhubs

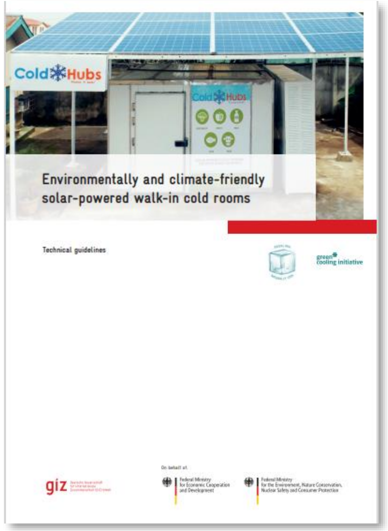
Examples: Solar Powered Solutions with R290

R290 ice production in Indonesia



R290 walk-in fish cold room Kenya





Examples: Transport Refrigeration using Natural Refrigerants in the South Africa, Philippines, Burkina Faso and South Africa

- Demonstration and market induction in South Africa (IKI/BMU/GIZ Transport refrigeration)
- Demonstration in Burkina Faso (EU/BMZ/GIZ ROCA)
- Demonstration in the Philippines (UNIDO/ATMOsphere)

- Natural refrigerant R290 or R600a (or CO2)
- Outstanding efficiency
- Zero planned maintenance
- Reduces carbon footprint of the fleet

- Use of natural blowing (ultra low GWP) agents for foam / insulation materials and improved body design

Picture: Hydrocarbons21.com

Pictures: GIZ Proklkma

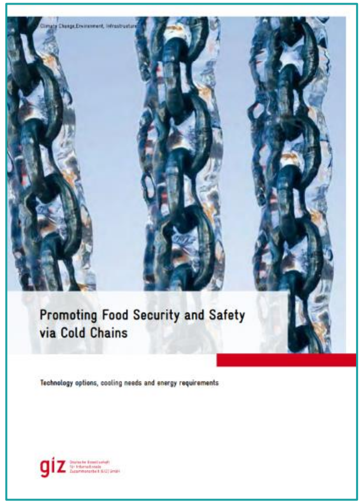
Green Cooling Summit 2022 - Green Cooling in Supermarkets

Highlights: Green Cooling in Supermarkets

Recap Day 1: Policies and Technologies to advance Green Cooling in Supermarkets

Recap Day 2: Planning, Procurement, Operation and Maintenance

Green Cooling Summit 2023 - Green Cooling along the Cold Chain



Highlights: Green Cooling along the cold chain

Recap Day 1: Policies, financing options and innovative business models to advance Green Cooling along the cold chain

Recap Day 2: Technologies for stationary refrigeration and transport refrigeration

OZONE COOL ZONE

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Conclusions and Recommendations

Use of Green Cooling technologies towards a sustainable Cold Chain:

- Fighting food losses, waste and methane emissions can only be sustainable with Green Cooling technologies. Otherwise, we are fighting losses and methane emissions and creating additional emissions within the cold chain!
- **Environmentally and climate friendly** refrigeration technologies that use **ultra-low GWP natural refrigerants** exist and can also be used safely in the Global South
- Consequently, an instant switch to highly **energy-efficient** technologies with **natural refrigerants** without relying on environmentally- and climate-damaging interim technologies is possible
- Apart from the natural refrigerants, **natural blowing** agents shall be used for insulation materials
- There are many **solar powered technologies available that use natural refrigerants** and are combined with **ice storage to avoid batteries**
- Natural refrigerants and blowing agents **avoid the end of life** (recovery and destruction) problems that HFCs and HFOs are coming with
- **Only trained and certified technicians shall be permitted to work with refrigerants**, especially flammable refrigerants and more training and certification is needed
- **Development cooperation and finance** as well as procurement guidelines **shall include sustainability criteria** on cold chain equipment

OZONE
COOL
ZONE
30 Nov–12 Dec
COP28 UAE

Philipp Denzinger

Proklima International
Project Manager

philipp.denzinger@giz.de

www.green-cooling-initiative.org

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

OZONE COOL ZONE
30 Nov–12 Dec
COP28 UAE

Q & A

OZONE
COOL
ZONE

30 Nov–12 Dec
COP28 UAE

Conclusion and Closing Remarks

Balaji Natarajan

Multilateral Fund for the Implementation of the Montreal Protocol

MONTREAL PROTOCOL
ADVANCING
CLIMATE ACTION

COP28 UAE 30 Nov–12 Dec

Thank you for listening!