CAN BIOBANKS BE GREENER?

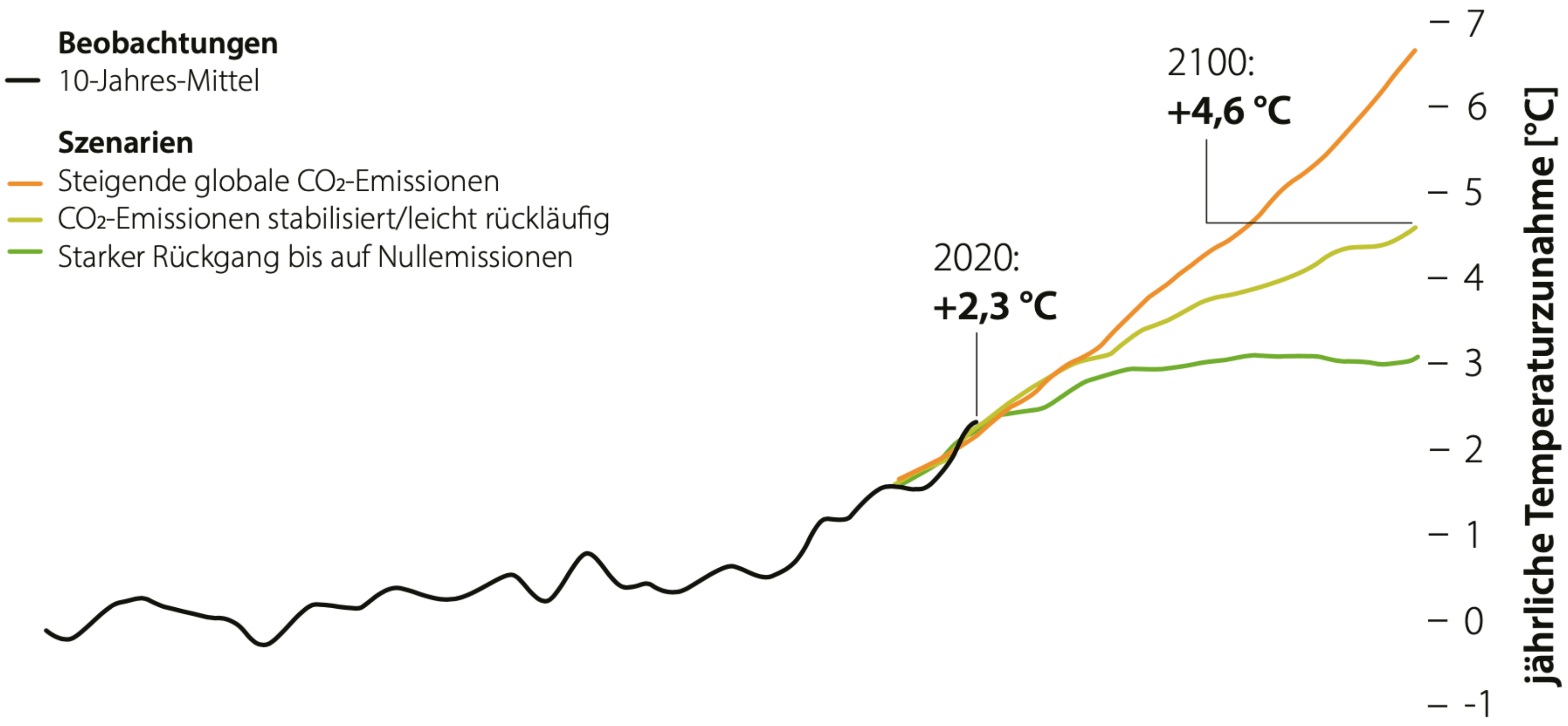
Monika Valjan, Veronika Perz, Sabrina Kral

The Urgency for Change

https://climate.ec.europa.eu/climate-change/consequences-climate-change_en

- Greenhouse gas emissions are increasing Earth's temperature
- Frequency and intensity of extreme weather events are rising (floods, droughts, wildfires, extreme storms, etc.)
- Low-lying coastal regions become uninhabitable due to rising sea levels (more than 700 Mio people affected)
- Large parts of the world might get inhabitable due to alarmingly high temperature until 2100 (1/3 of worlds population affected)

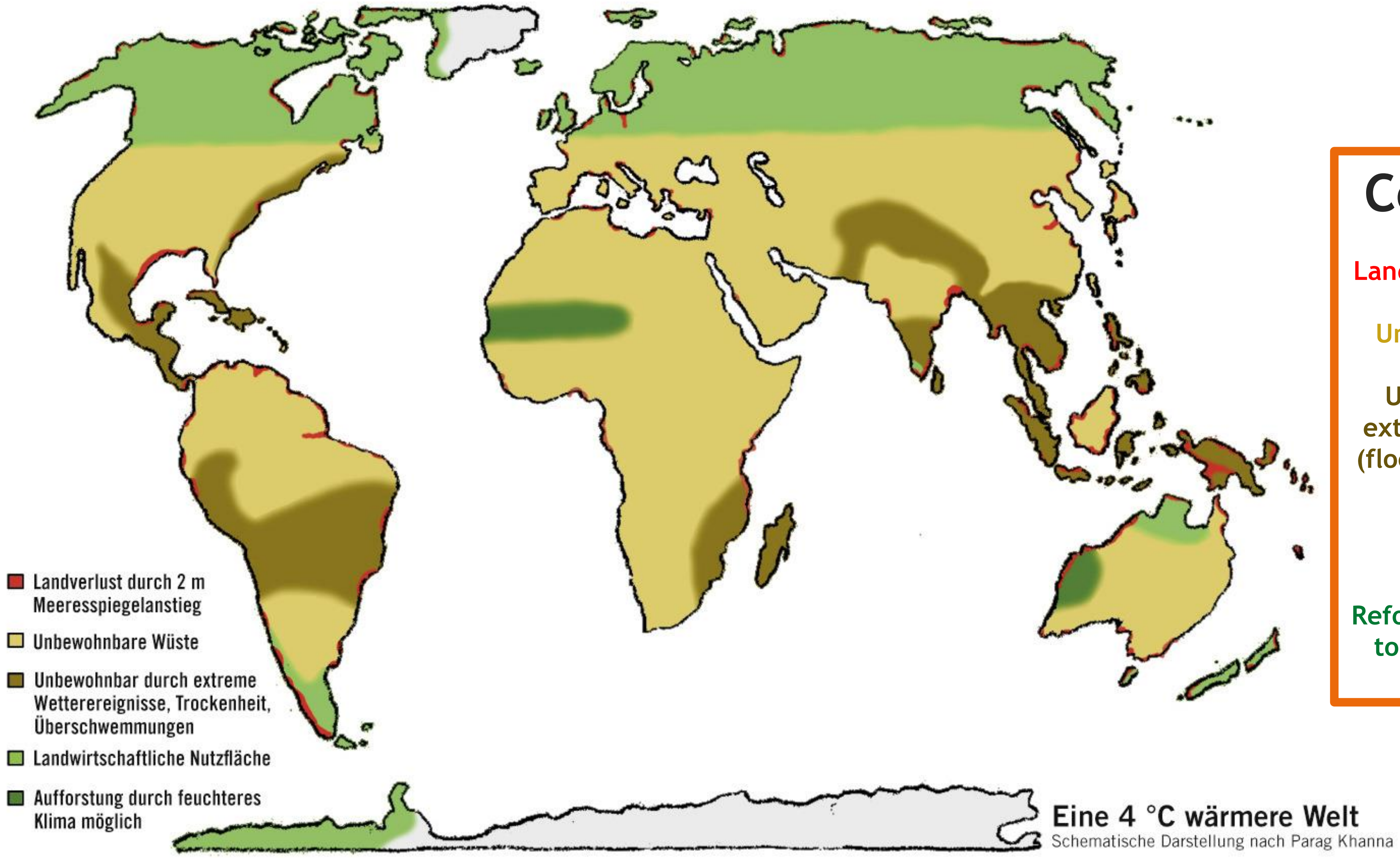
Effects of 4°C Temperature Increase



- Temperature profile of *Germany* and trend until 2100
- Forecasts with constant CO_2 emissions assume a temperature increase of more than +4°C

Source: https://www.oekom.de/beitrag/eine-erde-wie-wir-sie-nicht-kennen-wollen-351

Effects of 4°C Temperature Increase



Color Index:

Land loss due to rising sea

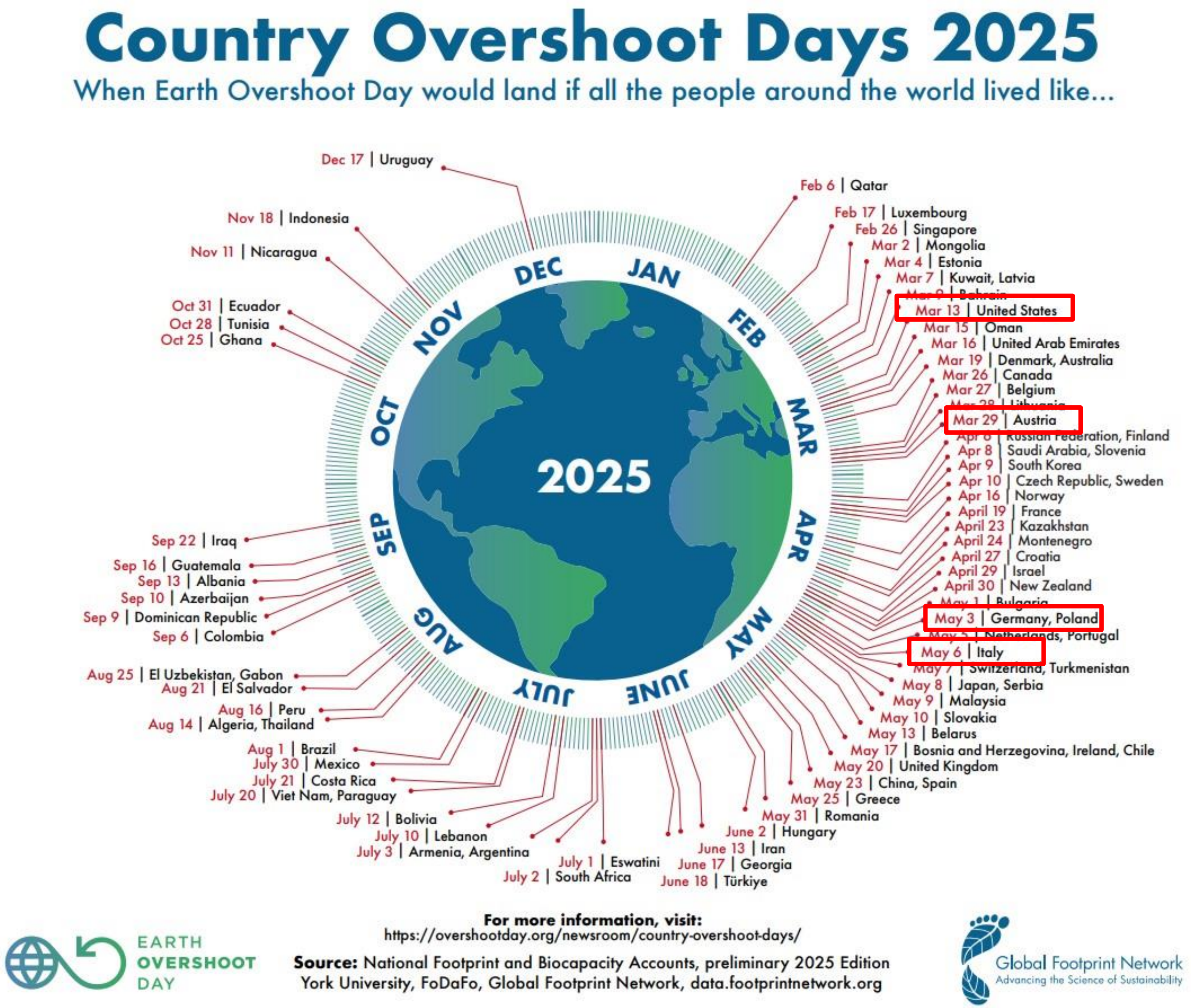
Uninhabitable (desert)

Uninhabitable due to extreme weather events (floods, droughts, storms, etc.)

Agricultural land

Reforestation possible due to more humid climate possible

Source: https://mymodernmet.com/parag-khanna-global-warming-map/



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Overshoot day – Living beyond Earth's Limit
Calendar date on which resource consumption exceeds Earth`s capacity to regenerate those resources:

USA : 13th March
Austria: 29th March
Germany: 3rd May
Italy: 6th May

Earth Overshoot Day 2024 fell on August 1st

© *Global Footprint Network 2025*, *www.overshootday.org* and *www.footprintnetwork.org*.

Biobanks and Environmental Responsibility

- Growing awareness of climate change necessitates sustainable practices in all sectors
- How can we ensure that our valuable samples are managed sustainable?
- How can we reduce our carbon footprint?
- How can we transform our practices to become leaders in Green Biobanking?

Source: https://www.aau.at/blog/neuerscheinung-verantwortlich-das-klima-manipulieren/

Legal and Ethical Drivers for Sustainable Biobanking

Legal Framework	Description
European Green Deal	Aim: first climate-neutral continent in the world
EU directive - Corporate Sustainability Reporting Directive (CSRD)	Obligation for SMEs or companies that generate over EUR 150 million on the EU market to publish
	reaching climate neutrality by 2050
F-gas regulation	Aim: significantly reduce emissions of climate-

So far, these directives do not have a direct impact (such as mandatory reporting) on universities and their biobanks. Nevertheless, we believe that:

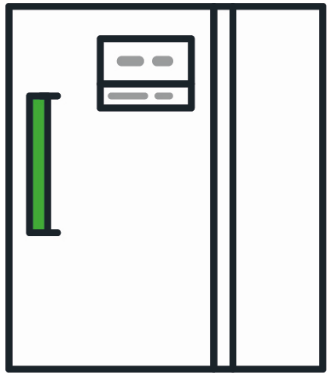
- **Universities should lead by example**
- **Universities and their biobanks should be prepared for the future**
- **These frameworks can guide biobanks in adopting sustainable practices**

Visit our posters:

„Sustainability in Biobanking: Legal Framework and Practical Implementation"

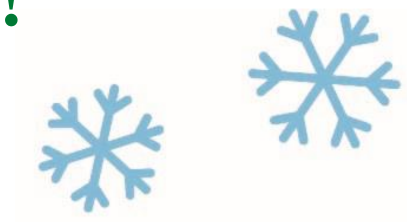
"Effect of fluorinated greenhouse gases regulation on biobanks - a case study using the example of Biobank Graz"

Key Areas of Energy and Resource Consumption of a Biobanks Infrastructure, where does our Energy go? Hotspots!

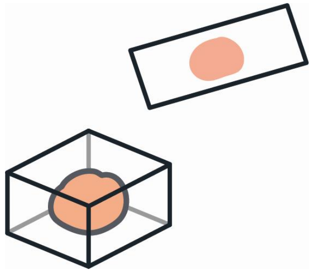


Electricity

(mainly for cooling)

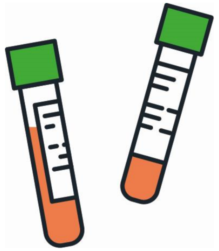


Refrigerants



FFPE tissues consumables

(glas slides, formalin, paraffin)



Labware & consumables

(primary & storage tubes, tips, gloves, paper etc.)

Liquid nitrogen

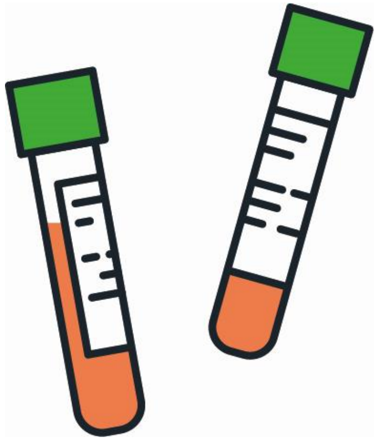
(for cooling)

Temperature & humidity control

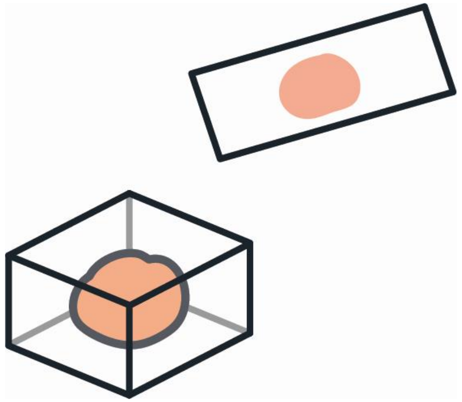
(storage facilities, labs, offices)


27
28
29
30
31

Our Biobank: A Wealth of Resources, a Responsibility to Protect



1.600.000 liquid aliquots



7.000.000 FFPE blocks
14.000.000 FFPE slides

38.000 tubes with cryo samples

These samples represent invaluable research potential, making sustainable storage paramount.

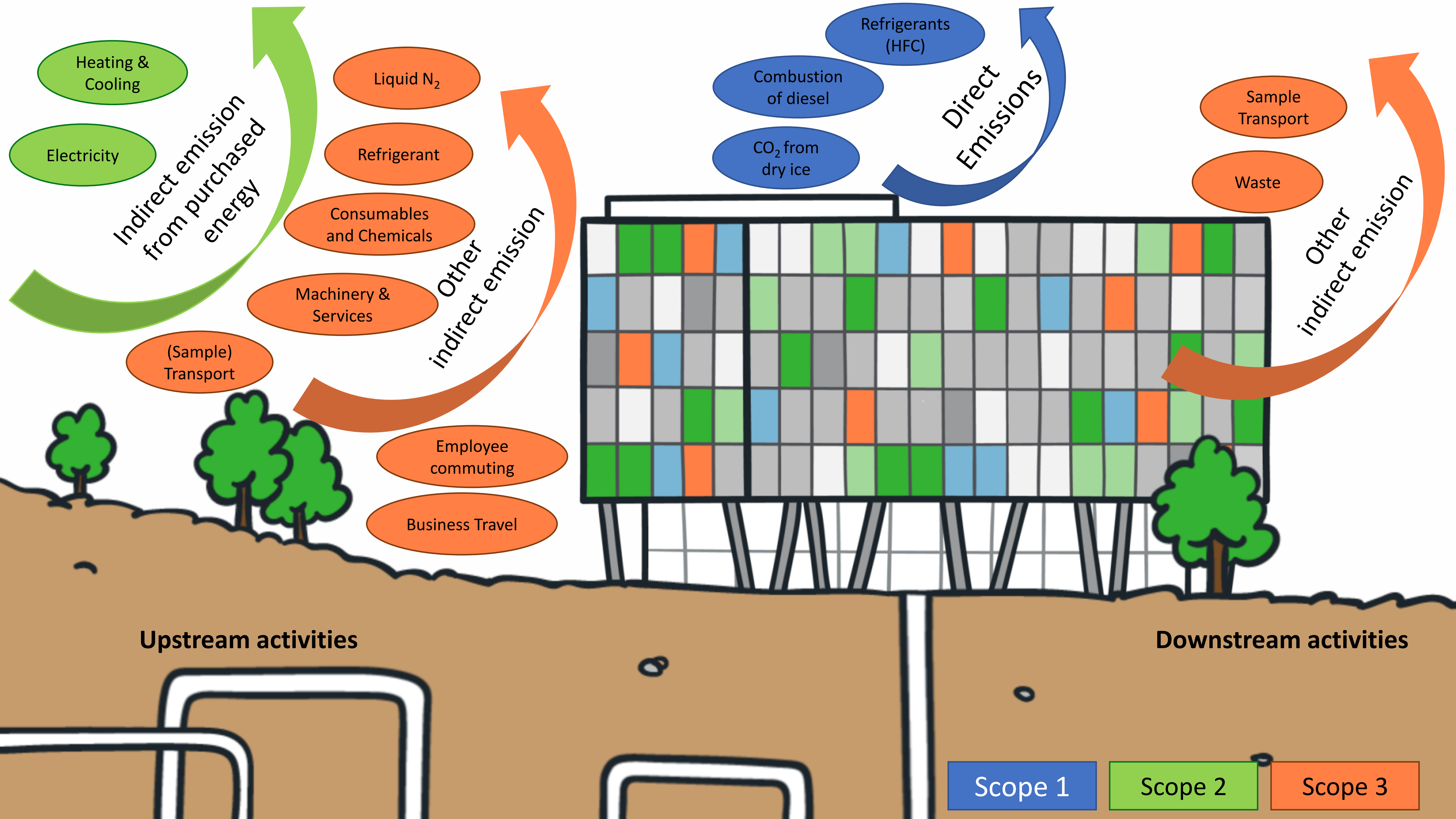
Can Biobanks be greener?

Where to start?

What are the main emission sources in your Biobank?

Which measures are feasible and make a difference?

- Evaluation of status quo (Biobanks emissions)
  - Data collection
  - Determination of carbon footprint
  - Biobank Graz is working on this initiative within the framework or the BBMRI WP
- Action plan based on hard facts
- Annual evaluation of measurements



Heating & Cooling
Electricity
Indirect emission from purchased energy
Liquid N_2
Refrigerant
Consumables and Chemicals
Machinery & Services
(Sample) Transport
Other indirect emission
Employee commuting
Business Travel
Refrigerants (HFC)
Combustion of diesel
CO_2 from dry ice
Direct Emissions
Sample Transport
Waste
Other indirect emission
Upstream activities
Downstream activities
Scope 1
Scope 2
Scope 3

Illustrating the calculation Process

Calculation of CO_2 equivalents. Formula of carbon footprint calculation. Example for daily carbon footprint of a freezer using 10 kWh of electricity per day using electricity generated in Austria.

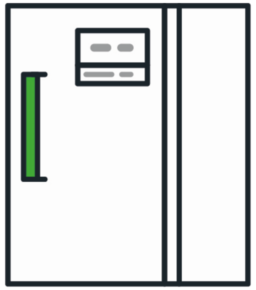
CO_2 relevant data x emission factor = CO_2 equivalents

10 kWh x 0,23 kg/kWh = 2,3 kg CO_2 eq

(online) tools available for calculation of CO_2 equivalents

* secure.umweltbundesamt.at/co2mon/co2mon.html with Austrian electricity mix

Energy Consumption: Biobank Graz Example



Electricity

(mainly for cooling)

kWh per year

400000

Average of
335.000 kWh/year

The Biobank's yearly electricity consumption equals that of 96 average households

or

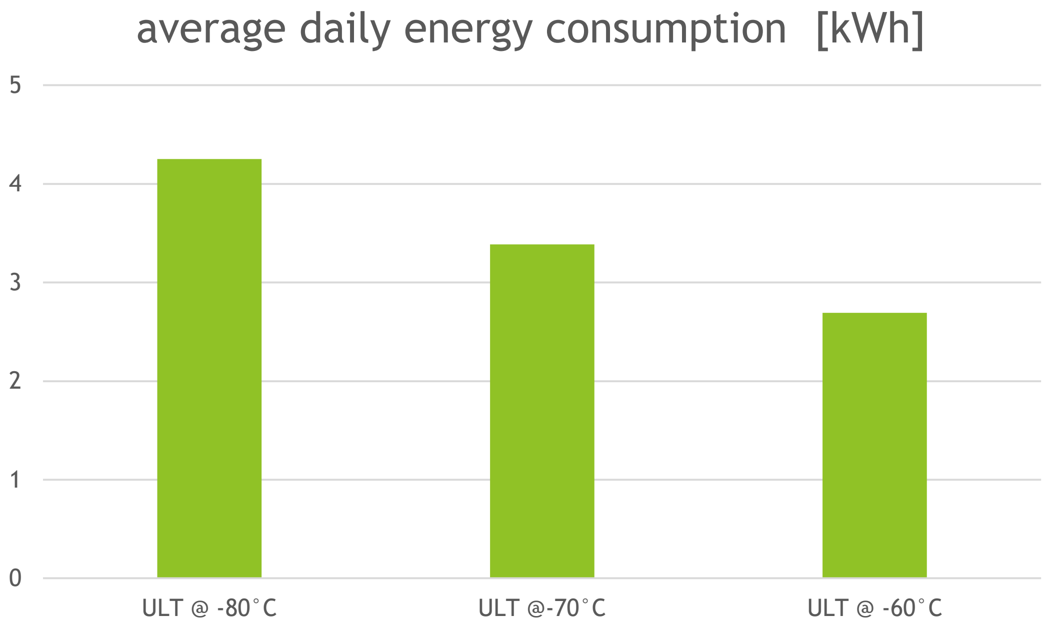
an average car driving 322.580 km (circling the Earth 8 times)

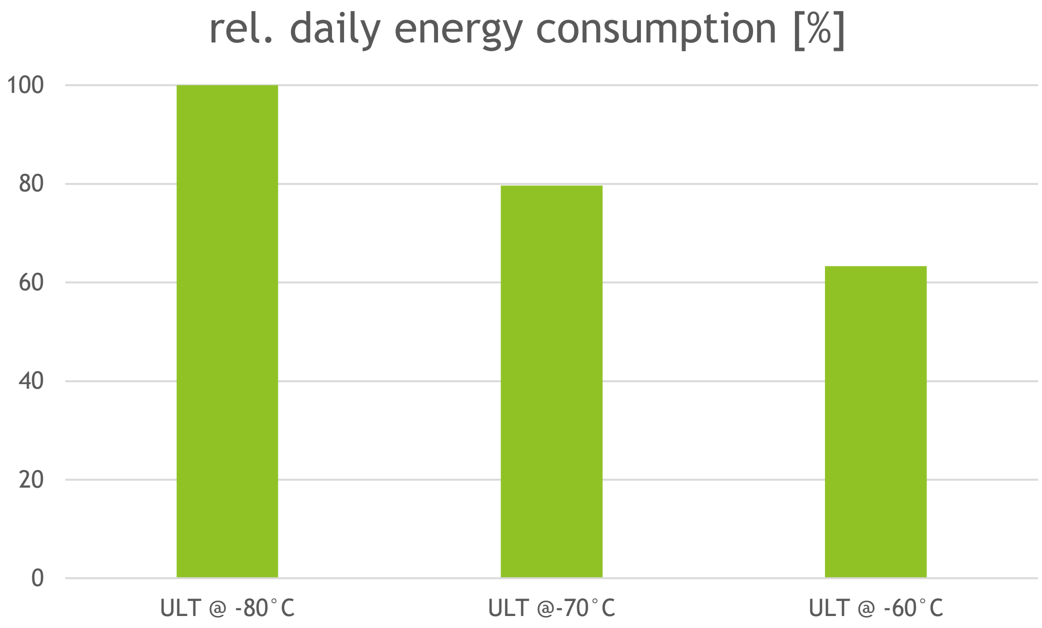
or

70 tons* of CO_2

* secure.umweltbundesamt.at/co2mon/co2mon.html with Austrian electricity mix

ULT Freezer Energy Consumption: -60°C vs -70°C vs -80°C



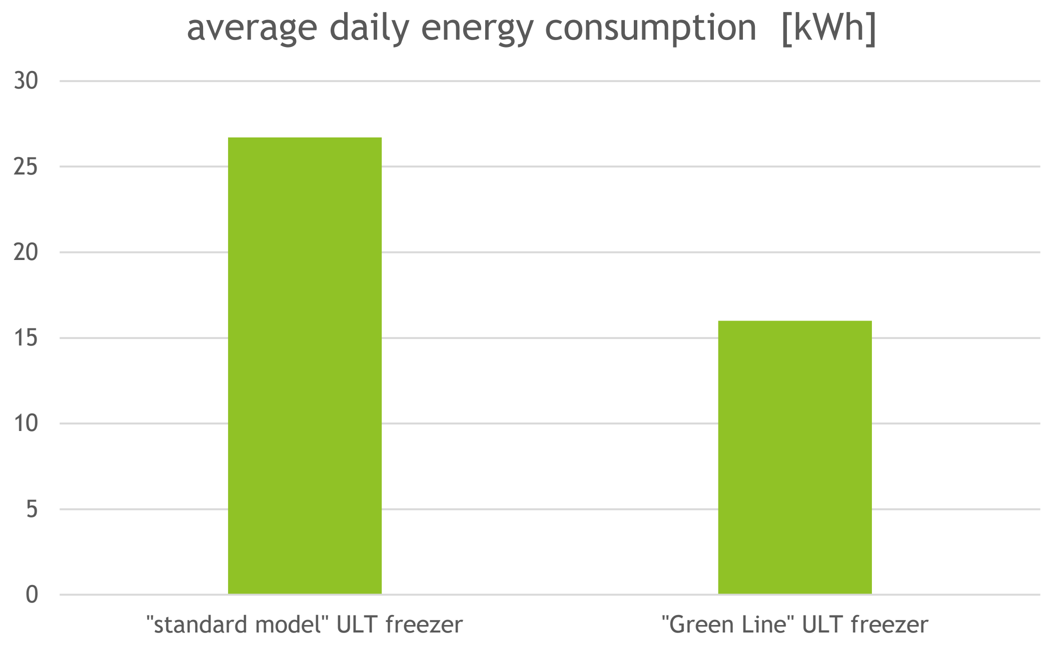


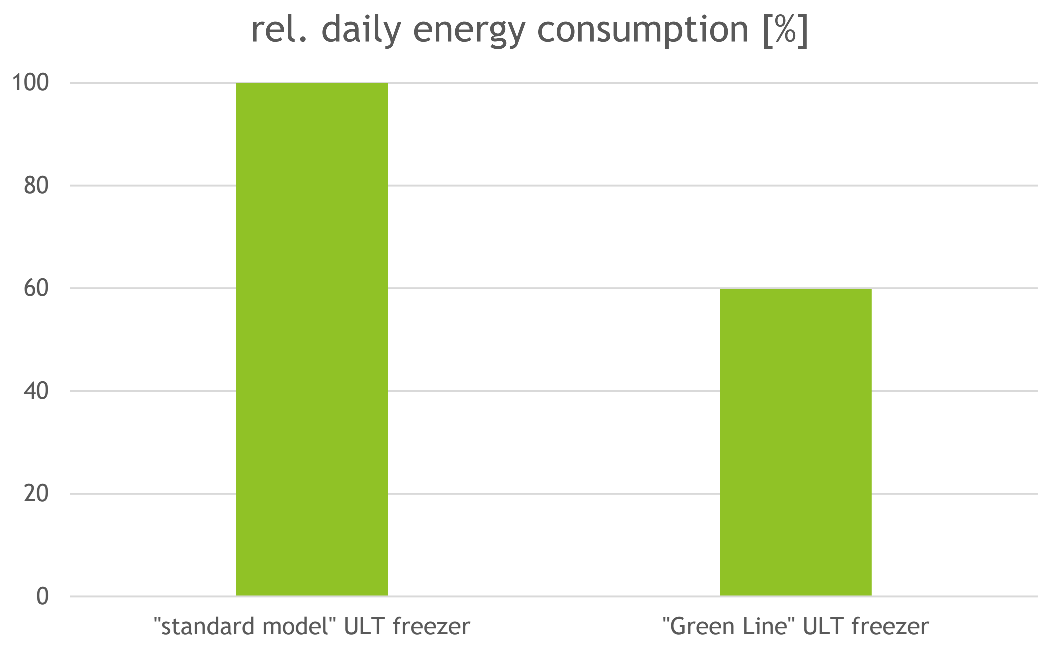
ULT - ultra low temperature freezer

Energy consumption measurements were conducted one after another on the same freezer:

- freezer capacity: 51 L
- compressor type: air-cooled
- Measurements lasted approximately 2 weeks

ULT Freezer Energy Consumption: Green Line versus standard model





ULT - ultra low temperature freezer

Energy consumption measurements were conducted on two different freezers:

- “Standard model” without special energy-saving technologies
- “Green Line” - model with enhanced energy efficiency features
- both freezer types are from the same manufacturer and correspond to the same freezer model
- compressor type: water-cooled
- freezer capacity: 753 L
- measurements lasted approximately 2 weeks

The Role of Liquid Nitrogen

Liquid nitrogen

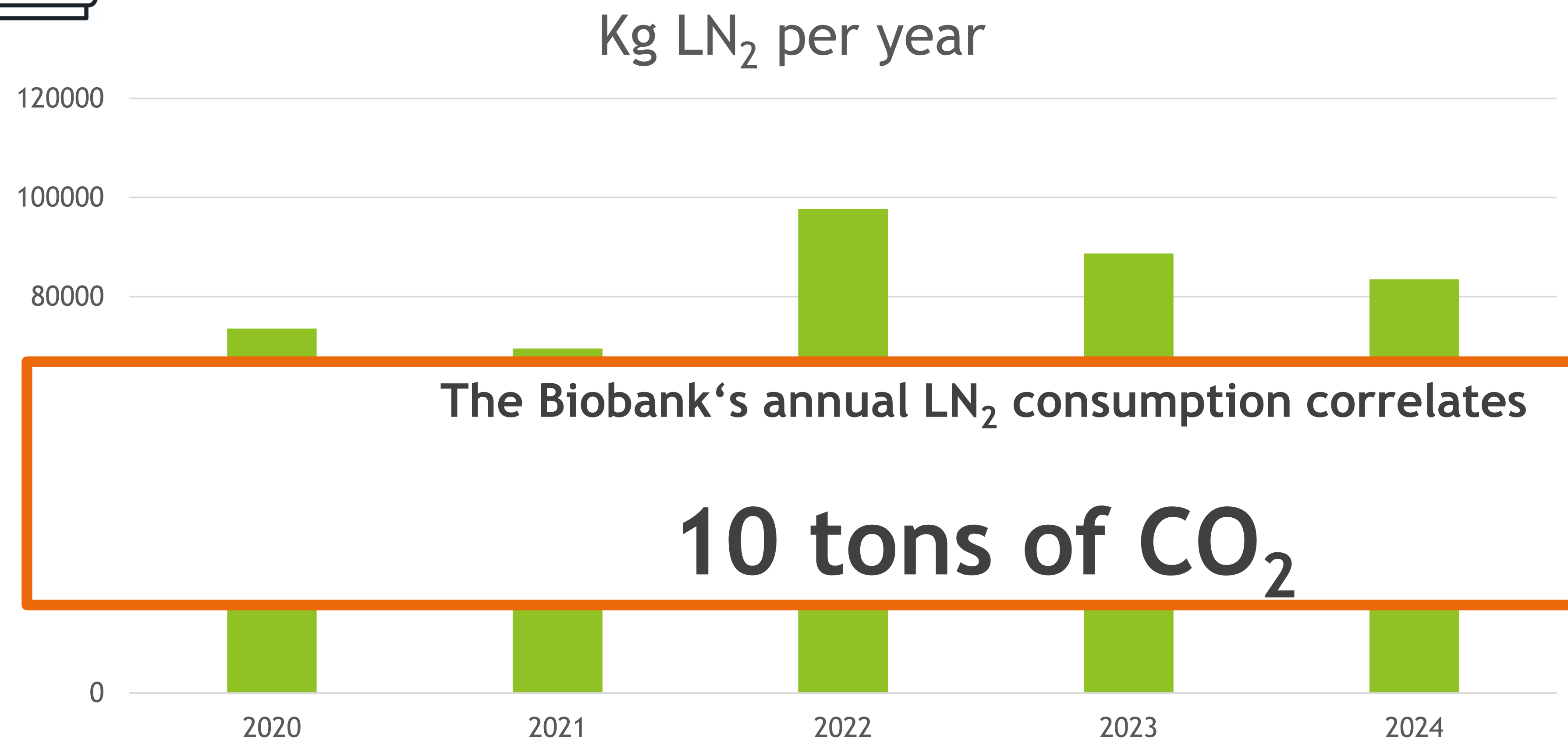
(for cooling)

- Energy-intensive aspect of biobanking
- Use of LN_2 is used to minimize the degradation of biological samples stored in biobanks
- Oxygen is produced primarily through the low-temperature decomposition of air (also called cryogenic air separation)
  - Nitrogen is a by-product of oxygen production
  - Average consumption of energy for $1m^3$ of LN_2 should be provided and communicated by the manufacturers (in our case Air Liquide)
  - Footprint of LN_2 strongly depends on the type of production (green line gases available)

Liquid Nitrogen Usage: Biobank Graz Data

Liquid nitrogen

(for cooling)



Average of 83.000kg/year

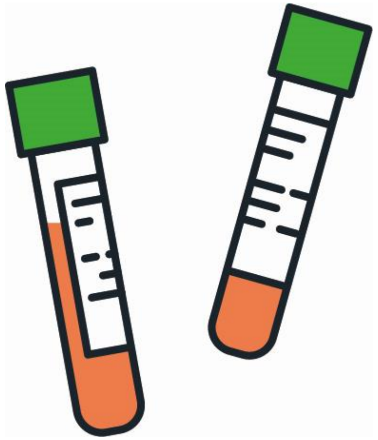
The Biobank's annual LN_2 consumption correlates

10 tons of CO_2

Comparison:
Footprint of Storage Options

Emitted CO_2 equivalents for storage of 1 aliquot per year

-80 storage (70 tons/year at Biobank Graz)



44g

1.600.000
liquid aliquots

1 liquid aliquot

LN_2 storage (10 tons/year at Biobank Graz)

263g

1 cryo tube

38.000 cryo
sample tubes

Refrigerants and their Environmental Impact

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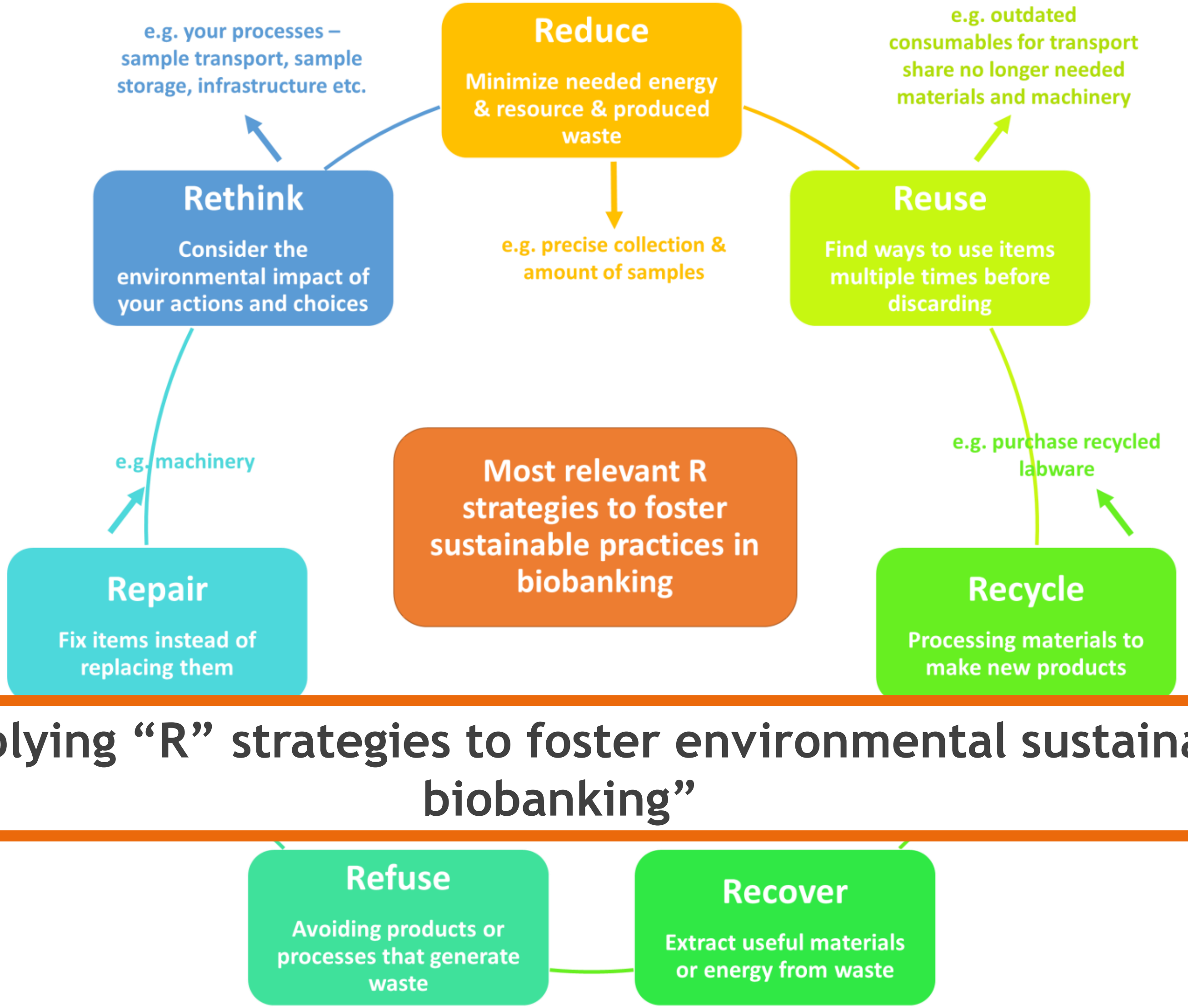
Refrigerants

Examples for GWPs of frequently used refrigerants

Information	Refrigerant	Common Name	GWP
Frequently used in the past **Phasing out**	R404A		3922
	R508B	Freon 95	13214
	R507A		3985
Natural refrigerant options (some still facing technical challenges regarding system design or safety)	R290	Propane	3
	R744	Carbon Dioxide	1
	R717	Ammonia	0

Consider not only the energy demand but also the greenhouse warming potential of the used refrigerant when buying freezers, low-temperature storage systems or air conditioning systems!

“R“ Principles - Implementing Sustainable Practices



See poster → „ Applying “R” strategies to foster environmental sustainable practices in biobanking”

Easy Wins-
Implementing Sustainable Practices

- Transition to green energy
- Investments in energy-efficient equipment (CO_2 cooling)
- Choose freezers/air conditioning with low GWP refrigerants
- Optimize freezer management
- Reduce LN_2 consumption
- Run freezers at -70°C
- Regular inventories
- Engage staff through training programes

Green Biobanking – Invest in the Future of Research

Imagine a world where Biobanks lead the change in sustainability

- By embracing renewable energy, we can power our mission without compromising the earth
- By optimizing our resources, we can preserve invaluable research without leaving a heavy footprint
- By fostering a culture of sustainability, we inspire the next generation of researchers to think differently

Are you ready to join us in this journey to Green Biobanking?

Source: https://www.aau.at/blog/neuerscheinung-verantwortlich-das-klima-manipulieren/

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DI Dr. Veronika Perz
Biobank Graz
Medical University of Graz
BBMRI.at

Sabrina Kral MSc
Biobank Graz
Medical University of Graz
BBMRI.at