Comparison: how much does our research emit?

Carbon footprint of NMR instruments

Assuming you run 3 NMR magnets, including cryoprobe and solids, 600, 700, 800 MHz, which serve 20 people:

Country: Austria

CO_2 equivalents: 96 g/kWh

Spectrometer setup			CO_2 equivalents	Boil off		Power consumption			
Magnet	Liquefier	Console		Helium	Nitrogen	Spectrometer	He liq	N liq	
800 (4K)	☐	Solids & liquids w/cryo	8907 kg/year	7.9 L/week	100 L/week	8.8 kW	0.29 kW	0.30 kW	details
700 (4K)	☐	Solid state	4090 kg/year	4.4 L/week	80 L/week	3.8 kW	0.16 kW	0.24 kW	details
600 (4K)	☐	Solids & liquids	3076 kg/year	2.7 L/week	50 L/week	3 kW	0.10 kW	0.15 kW	details

Add spectrometer

→ 16 tons CO_{2eq} per year, i.e. 0.8 tons per person

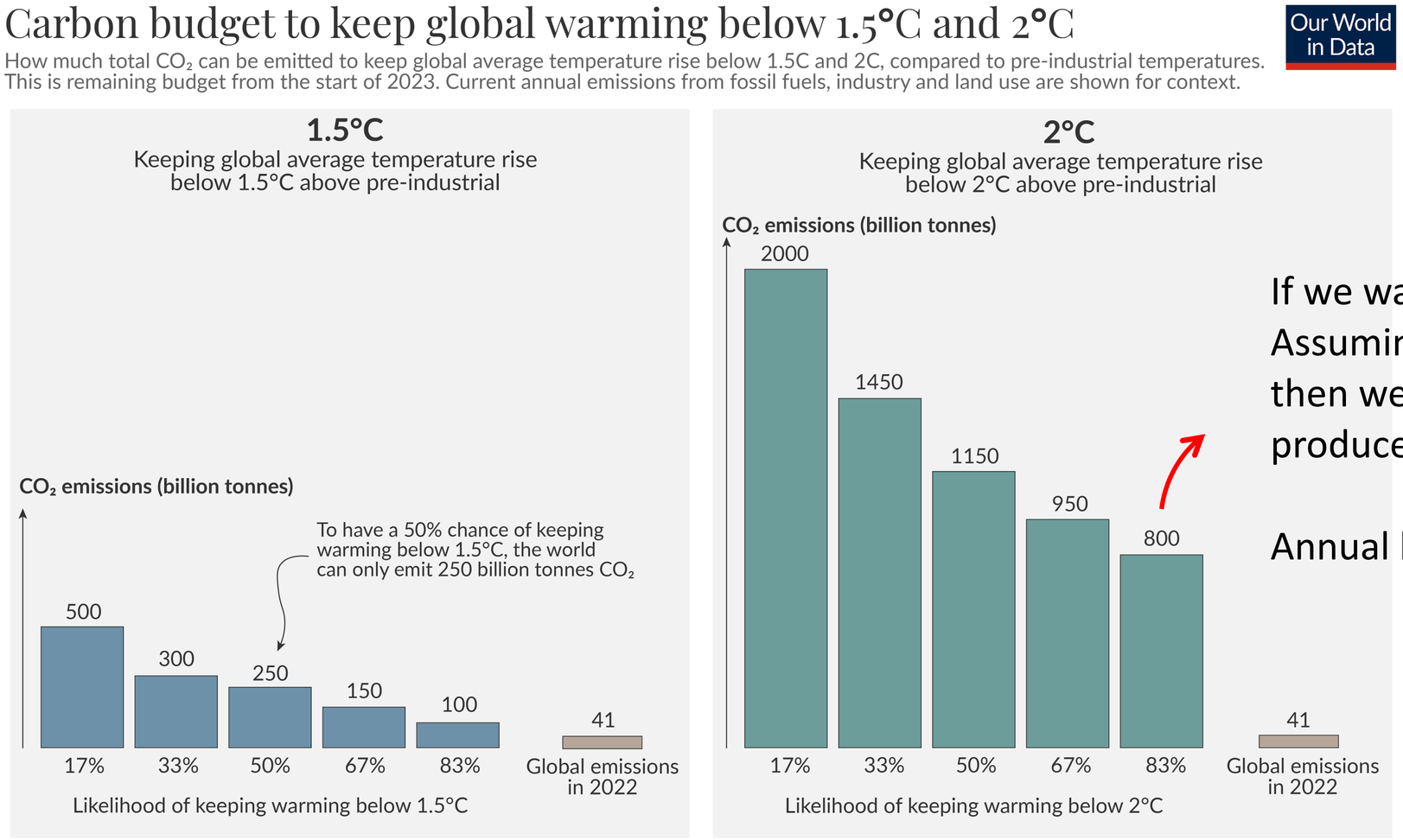
Calculation details

Item	Consumption	Conversion	Energy	CO_2 equiv
He boil off (800 MHz)	7.9 L/week	6.25 kWh/L 486 gCO_2/kWh (World)	2575 kWh/year	1251 kg/year
N boil off (800 MHz)	100.0 L/week	500 Wh/L 96 gCO_2/kWh (Austria)	2609 kWh/year	250 kg/year
Console (Solids & liquids w/cryo)	8.8 kW	96 gCO_2/kWh (Austria)	77141 kWh/year	7406 kg/year
Total			82325 kWh/year	8907 kg/year

Nice tool: https://csdm.dk/rnmr/consumption.html

The 5-day trip to ENC 2025 produced on average 2.9 tons CO_2, which is about 3.5 times more than running the NMR machines all year long (in this example).

Estimating the carbon budget per person to stay within warming limit



If we want to have a 83% chance to stay within 2 °C: Assuming that we have 30 years time (and that by then we found some magic trick to allows us to not produce CO2 any more):

$$\text{Annual budget} = \frac{800 \text{ billion tons } CO_2}{8.1 \text{ billion people} \cdot 30 \text{ years}}$$

$$= 3.3 \text{ tons } CO_{2eq} \text{ per capita/year}$$

Note that this number must ramp down to zero over 30 years.