Most Climate-Friendly Propulsion with Renewable Fuel - Biofuel, Electricity, Hydrogen or e-Fuels

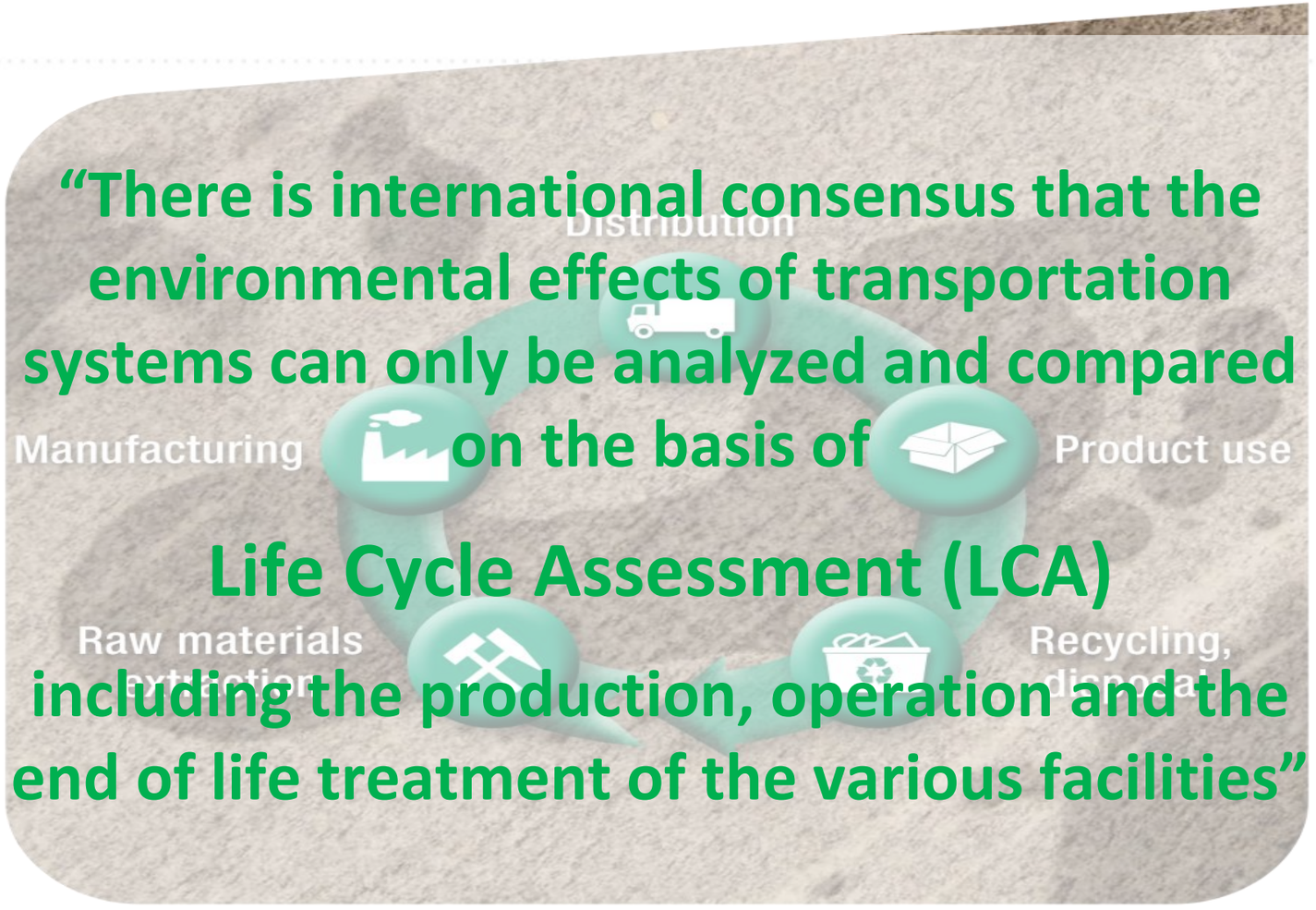
Gerfried JUNGMEIER

ECO-Mobility 2020

19. November 2020

JOANNEUM RESEARCH LIFE

Statement on the Methodology for An Environmental Assessment



“There is international consensus that the environmental effects of transportation systems can only be analyzed and compared on the basis of

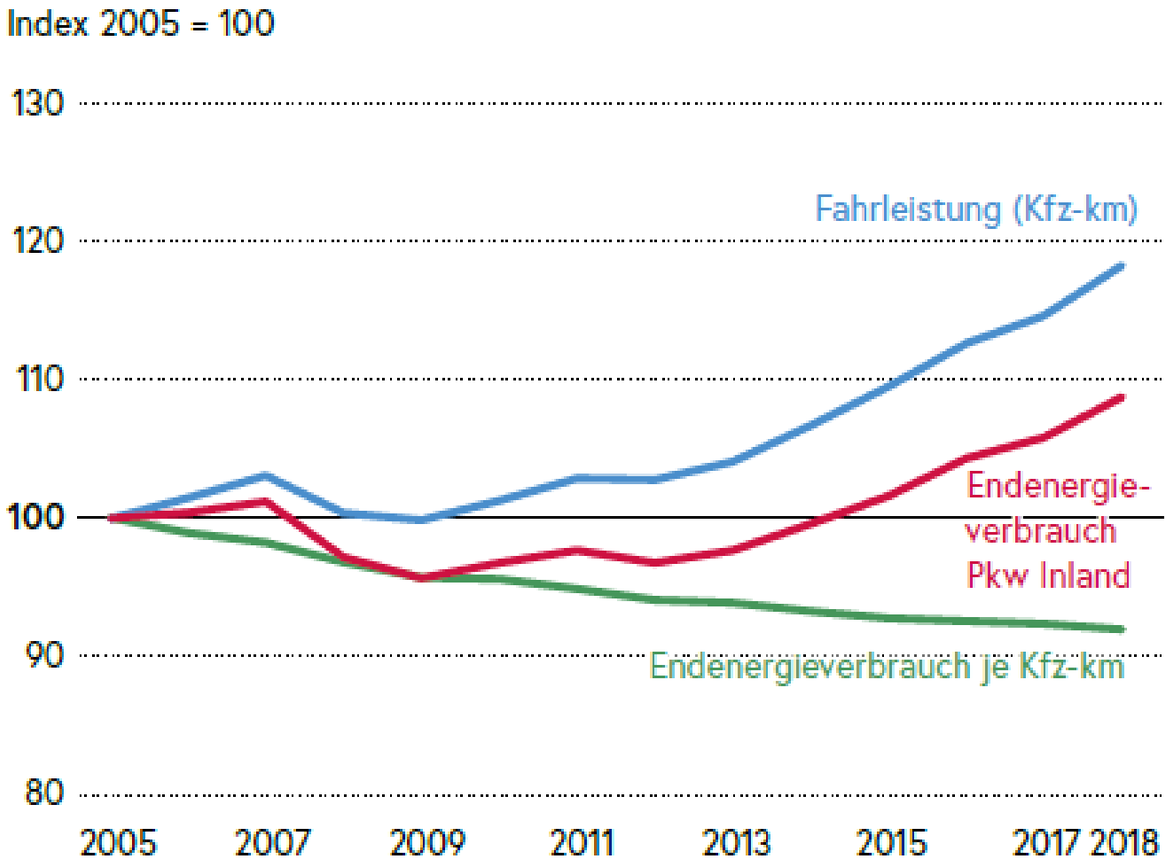
Life Cycle Assessment (LCA)

including the production, operation and the end of life treatment of the various facilities”

prm alg 14 028

Technologie-Development and Energy Demand

Energy intensity of passenger vehicles



Quelle: Österreichische Energieagentur

$$\frac{MJ}{a} = \frac{MJ}{vehicle - km} * \frac{vehicle - km}{a}$$

+ 18

+ 9

- 7

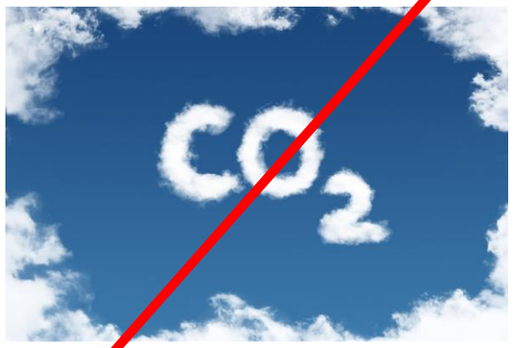
Future GHG reduction targets can be reached anyway:

- 2030: - 55%
- 2040: - 100% in AT
- 2050: - 100% in EU 27

Increasing energy efficiency: Technology development & implementation

Developmnet of E-Fuels: The Two Equations

+



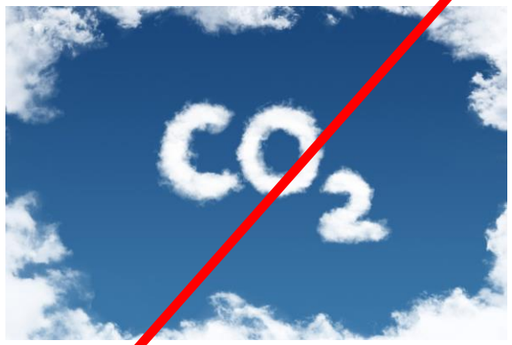
+

=

E-Fuel
- **Gasoline**
- **Diesel**
- **Methanol**
- **Methan**
- **….**

=

+

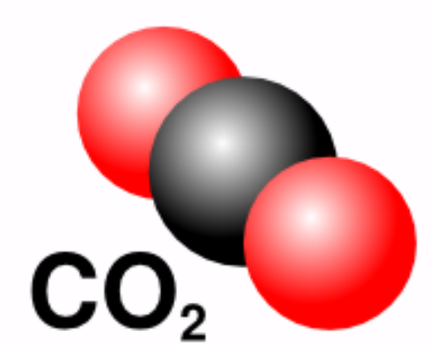


+

E-Fuel-Systems and Climate Effects

Necessary characteristic of e–fuel system

- **Type of primary energy for H_2-production**: hydro, wind, solar
- **CO_2-source**: air, biomass, fossil fuel
- **Products of CO_2-source:** steel, power, cement



CO_2 –Balance of E-Fuels

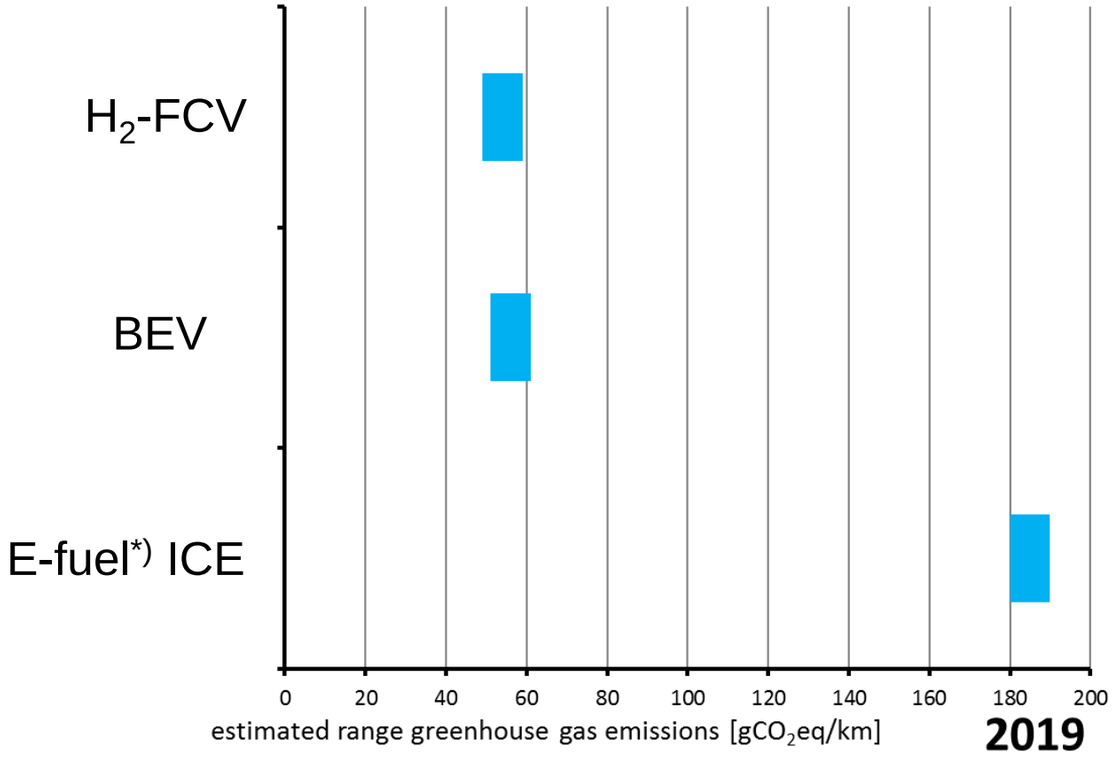
- **Climate neutral only with** CO_2 from
  - air
  - Sustainable & certified biomasse (like in current reporting incl. Land Use Change in LULUCF)
- **CO_2 from fossil** energy or ressources for products
  - **Annual balance:** E-Fuel & Products (e.g. electricity, steel)
  - **Physical flow**: E-Fuel at vehicle (products: CO_2=0)
  - **Allokation** necessary of double used C to e-fuel & products
    - 100% : 0%: CO_2-emissions e-fuel only
    - 50% : 50%: half of CO_2-emissions to e-fuel and products
    - 0% : 100%: CO_2-emissions products only

Source: Ramirez et al 2020: Andrea Ramirez Ramirez, Aïcha El Khamlichi, Georg Markowz, Nils Rettenmaier, Martin Baitz, Gerfried Jungmeier, Tom Bradley: LCA4CCU - Guidelines for Life Cycle Assessment of Carbon Capture and Utilisation; DG ENER, March 2020, Document reference: LCA4CCU001

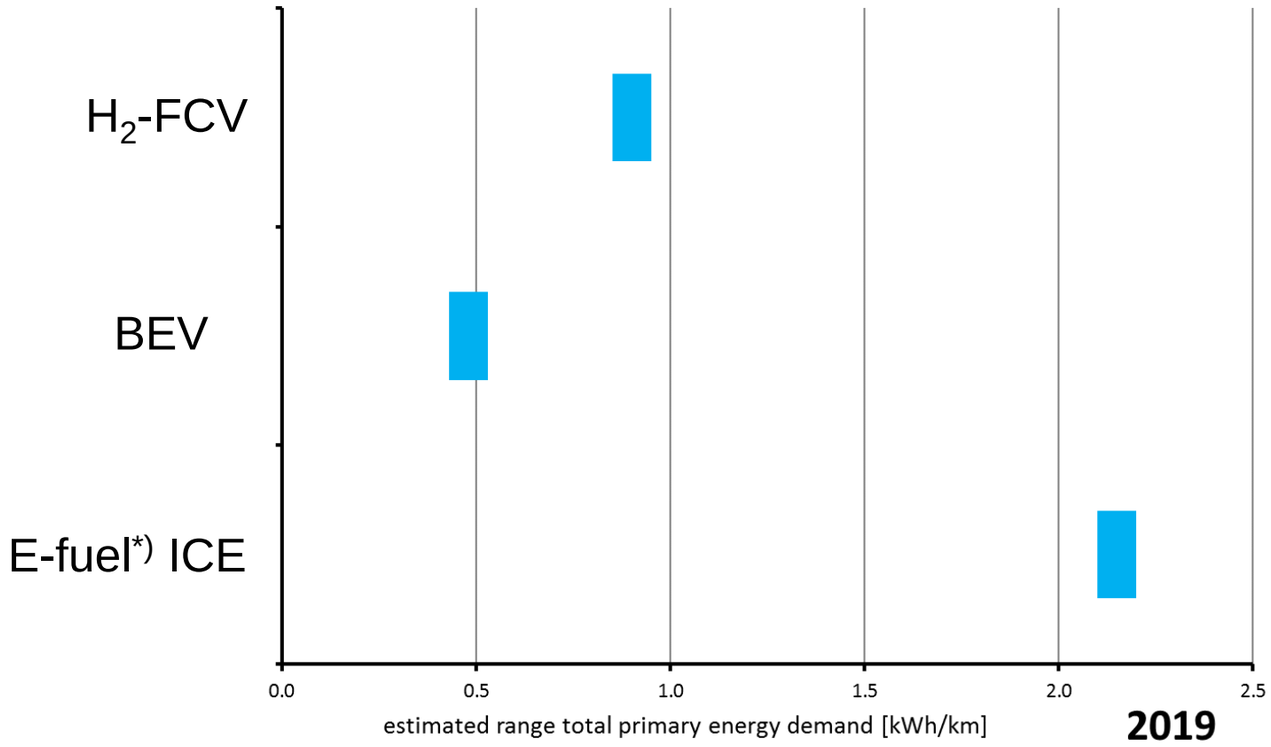
Using Wind Energy for H_2-FCV, E-fuel and BEV

Passenger vehicles

GHG emissions



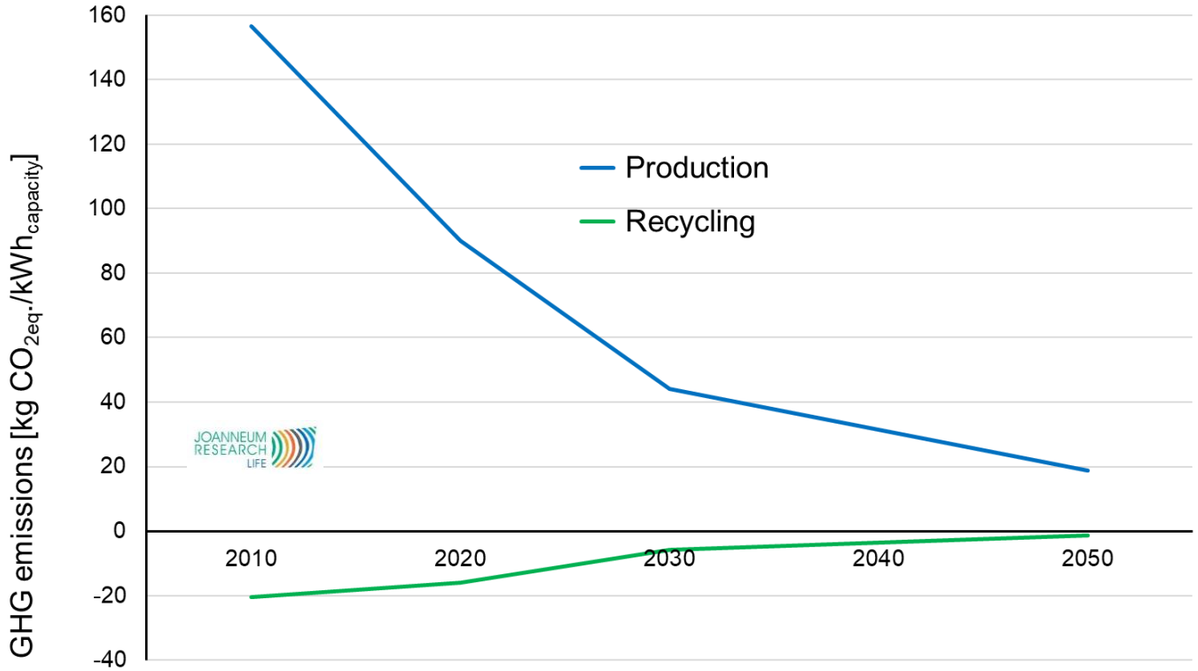
Primary energy demand



*) CO_2 from air

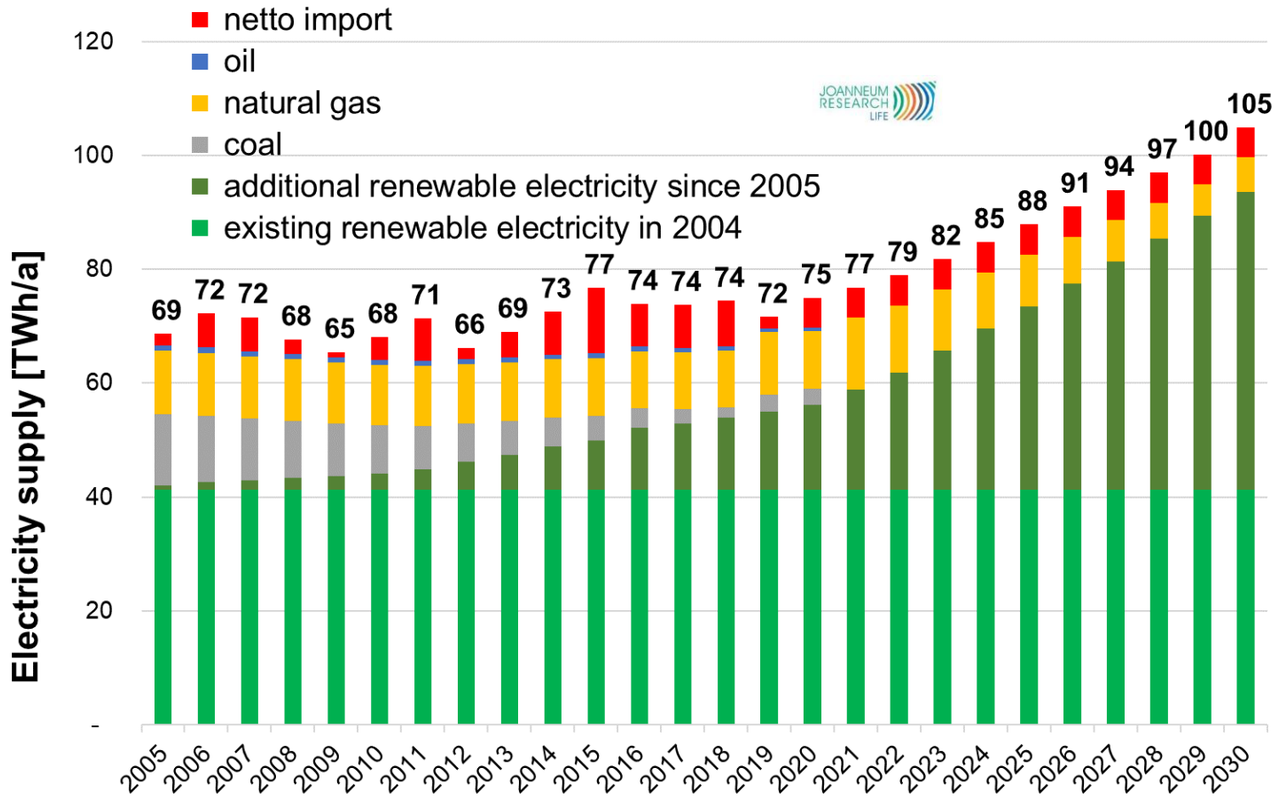
Climate Friendly Batteries and Renewable Electricity for Austria

GHG of automotive batteries



Renewable electricity in Austria: 100% RES in 2030

30 – 35 g CO_2-Äq/kWh



Climate Friendly Lifestyles and Mobility

Why do I have to go somewhere else?

Which possibilities do I have?

How do I decide?

Energy Efficiency in a System`s Perspective for People Mobility

- **Fuel**
  - (vegetarian) food
  - Renewable electricity

Energy Efficiency in a System`s Perspective for People Mobility

- **Fuel**
  - (vegetarian) food
  - Renewable electricity

- **Technology**
  - Shoes
  - Bicycle
  - Bus
  - Train
  - Metro
  - Tram

  - Electric Passenger vehicle with Green Box ≥ 2.0 (presented at A3PS Conference 2017)

Take Home Messages

Bio- , E-Fuels and H_2 only for trucks, ships and planes where electrification is not possible

Technologies for climate friendly mobility: shoes, bicycle, bus, train, tram, metro and (electric) passenger vehicle (G.B. ≥ 2.0)

Future fuels for climate friendly mobility: (vegetarian) food and renewable electricity

Energy efficiency in a system perspective is the key to climate friendly/neutral mobility

GHG-Emissions and **Primary Energy Demand** are minimum requirements from LCA for mobility systems

Environmental effects of transportation services can only be assesed based on **Life Cycle Assessment** (LCA)

Danke für Ihre Aufmerksamkeit!

JOANNEUM RESEARCH
Forschungsgesellschaft mbH

LIFE – Zentrum für Klima,
Energie und Gesellschaft

Science Tower
Waagner-Biro-Straße 100, 8020 Graz
Tel. +43 316 876-7600
life@joanneum.at

www.joanneum.at/life

JOANNEUM RESEARCH
LIFE