

Low Carbon Fuel Conference 10 & 11 April 2018 in Brussels, updated in Nov. 2018

# Key position of liquid alternative fuels for climate protection

ProcessNet is a joint initiative of DECHEMA and VDI-GVC

**PROCESSNET**  
EINE INITIATIVE VON DECHEMA UND VDI-GVC



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# Key questions:

- What is the significance of liquid alternative fuels for climate protection?
- Which routes lead to such fuels?
- What is the current state of technology?
- What kind of action is needed?



**Position paper “Advanced alternative liquid fuels: For climate protection in the global raw materials change”, Frankfurt/Main, March 2018**

[https://processnet.org/process\\_net/en/Publications/Topics+of+Strategic+Relevance/\\_/PP\\_Alt.Brennstoffe%202018\\_engl\\_ezl.pdf](https://processnet.org/process_net/en/Publications/Topics+of+Strategic+Relevance/_/PP_Alt.Brennstoffe%202018_engl_ezl.pdf)

# Contributors to the position paper from the ProcessNet Working Group “Alternative Liquid and Gaseous Fuels”

## Industry

## Associations

## Science



Verband der  
Automobilindustrie



THÜNEN



Technische Universität München



# CLIMATE PROTECTION: TIME IS RUNNING

**Target: Limitation of global warming of 1.5 °C**

- **Global CO<sub>2</sub> emission budget from 2018 onwards: 420 Gt CO<sub>2</sub>**

Source: IPCC Special Report on Global Warming of 1.5 °C, Oct. 2018

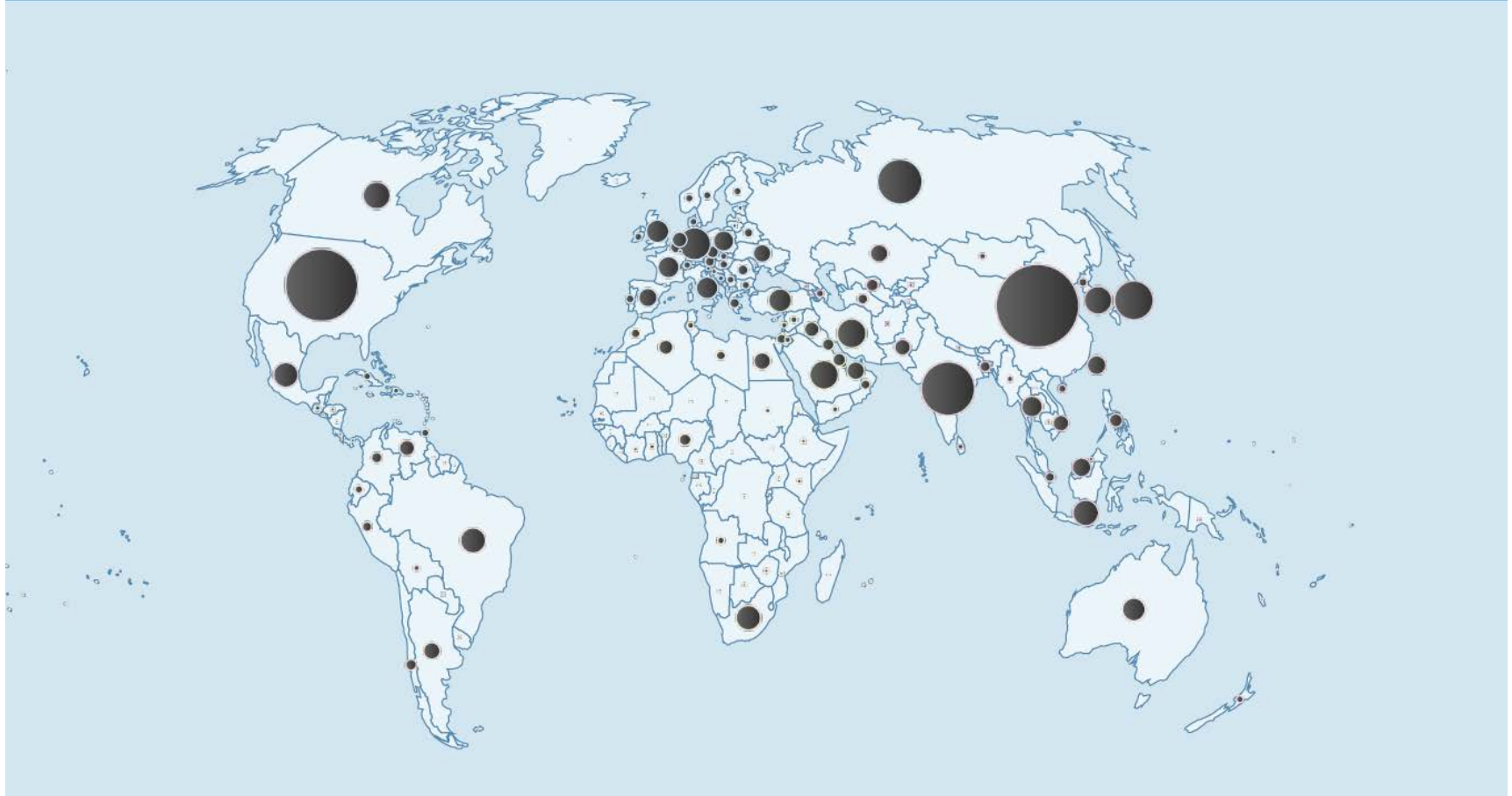
- **Annual net global CO<sub>2</sub> emission (2017): 40 Gt CO<sub>2</sub>**

Source: IPCC Special Report on Global Warming of 1.5 °C, Oct. 2018

- **Time horizon for climate protection: may be just until 2033**

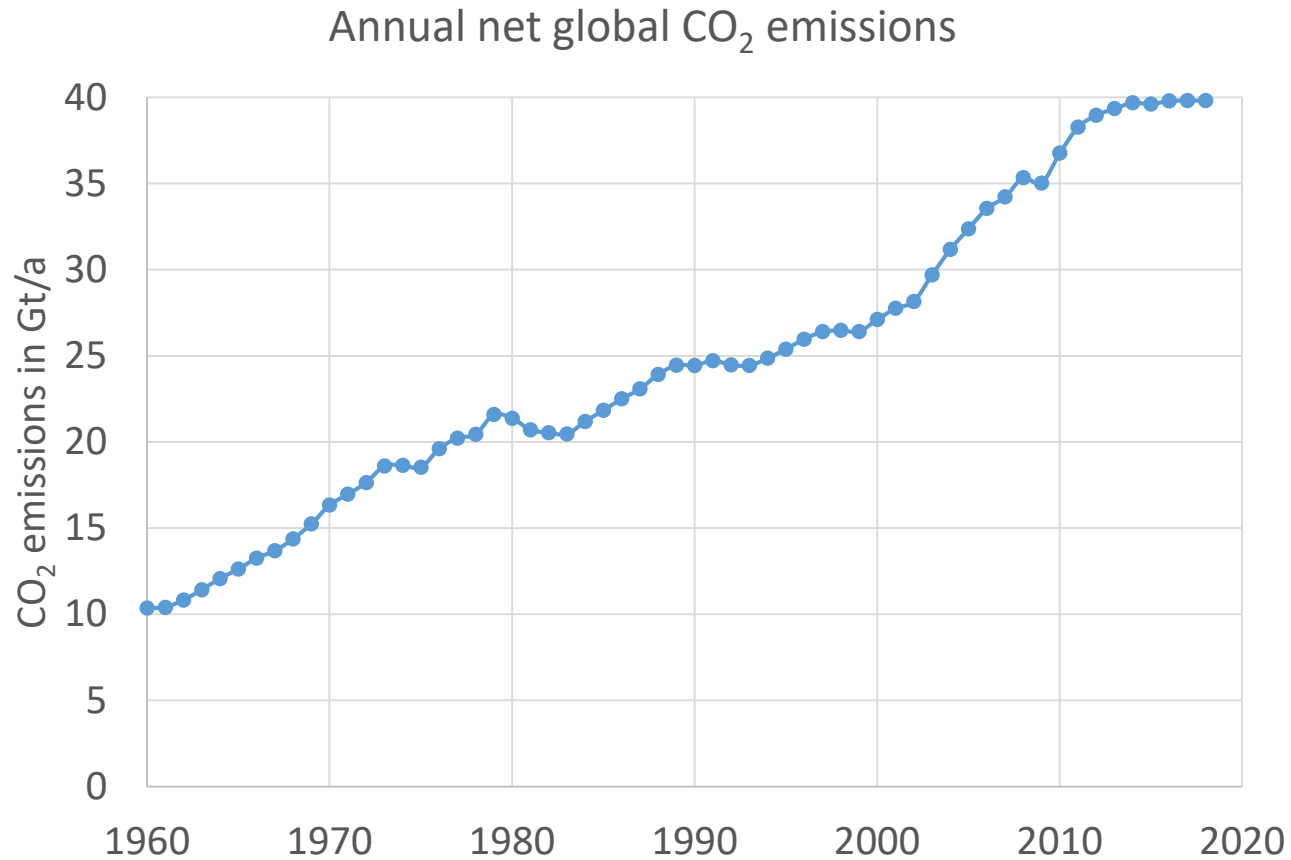
See following 4 slides.

# CLIMATE PROTECTION: TIME IS RUNNING



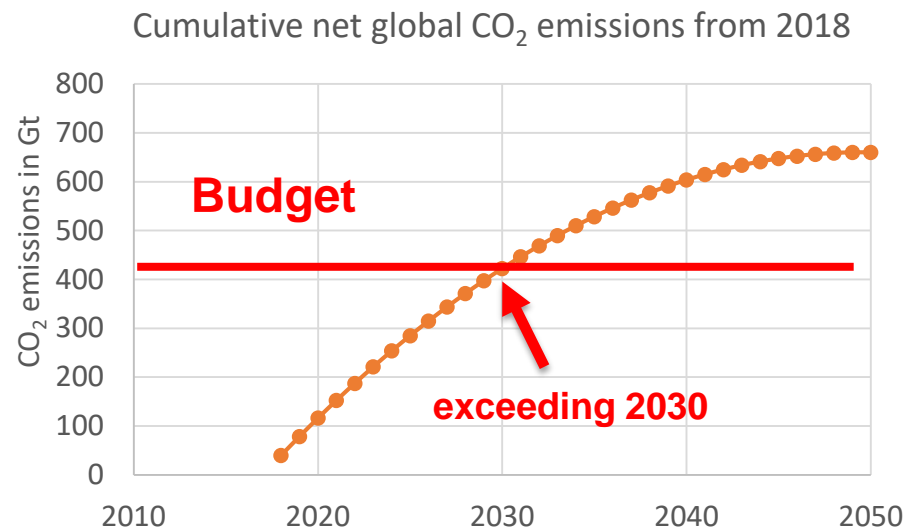
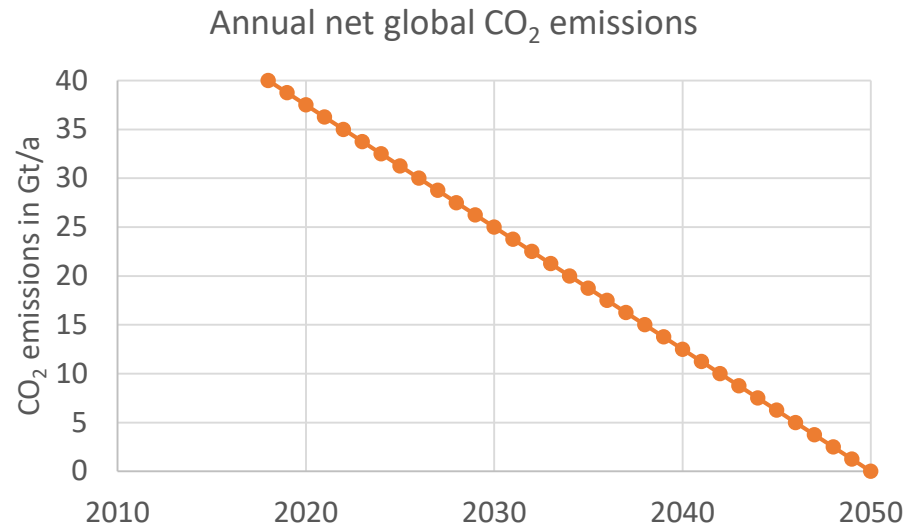
Source: Global Carbon Atlas: <http://www.globalcarbonatlas.org/en/CO2-emissions>

# CLIMATE PROTECTION: GLOBAL ANNUAL CO<sub>2</sub> EMISSIONS SINCE 1960



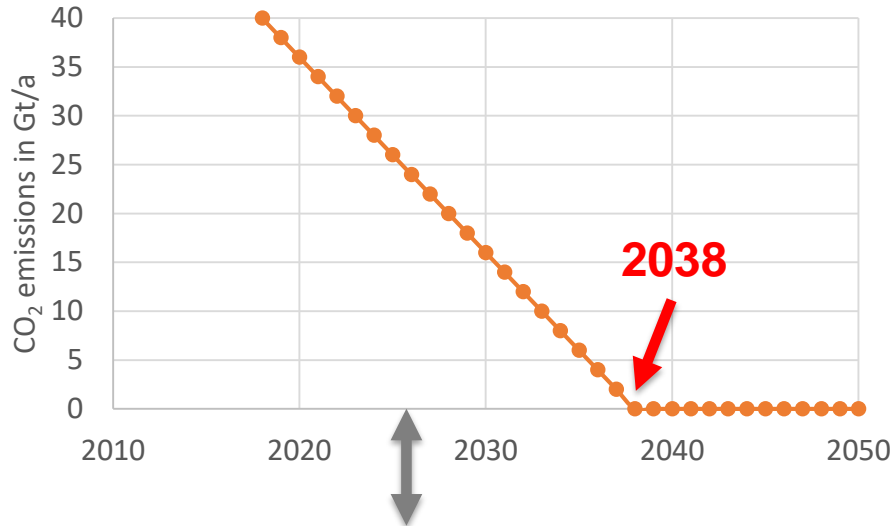
Sources: IPCC Special Report on Global Warming of 1.5 °C, Oct. 2018  
and Global Carbon Atlas: <http://www.globalcarbonatlas.org/en/CO2-emissions>

# CLIMATE PROTECTION: TIME IS RUNNING: 2050 SCENARIO EXCEEDS THE BUDGET

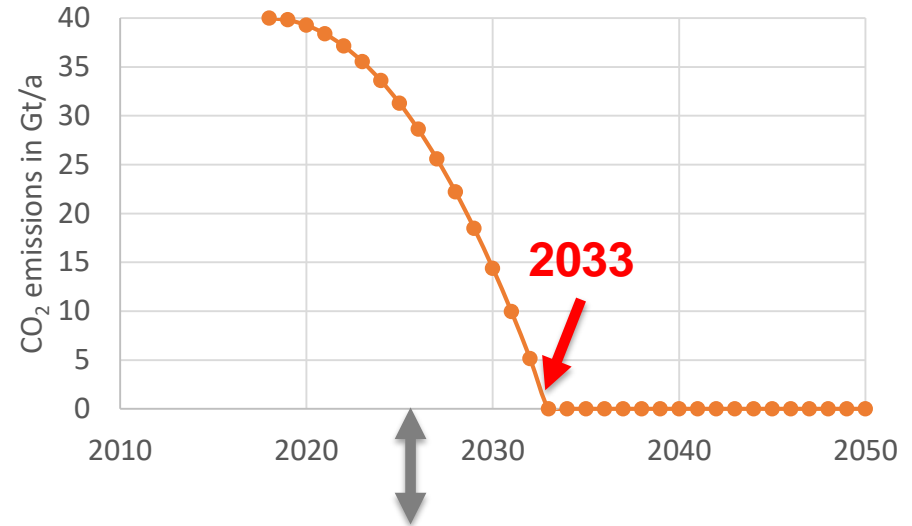


# CLIMATE PROTECTION: TIME IS RUNNING: 2038/2033 SCENARIOS MEET THE BUDGET

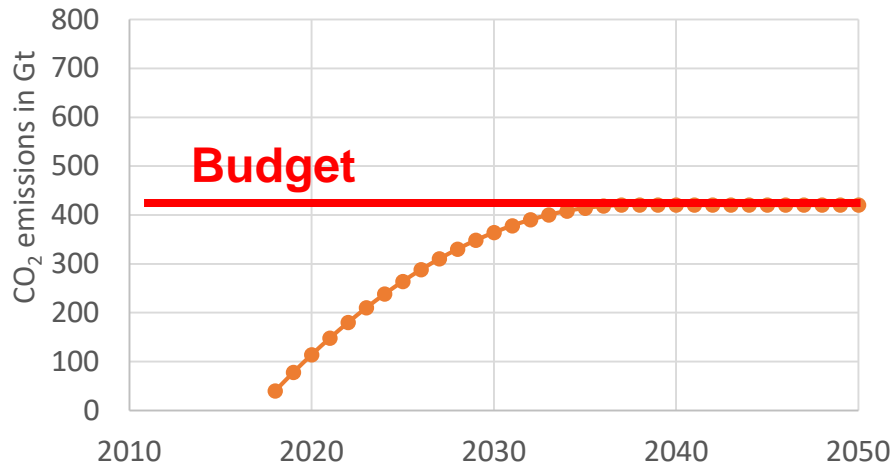
Annual net global CO<sub>2</sub> emissions



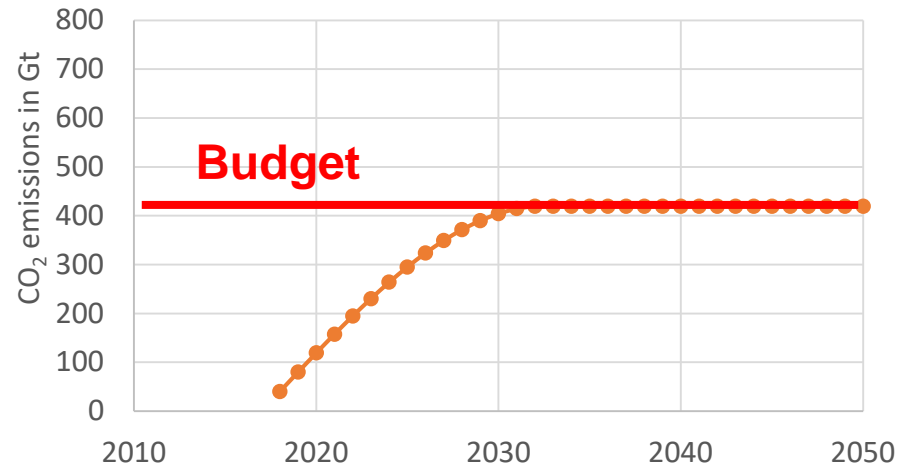
Annual net global CO<sub>2</sub> emissions



Cumulative net global CO<sub>2</sub> emissions from 2018

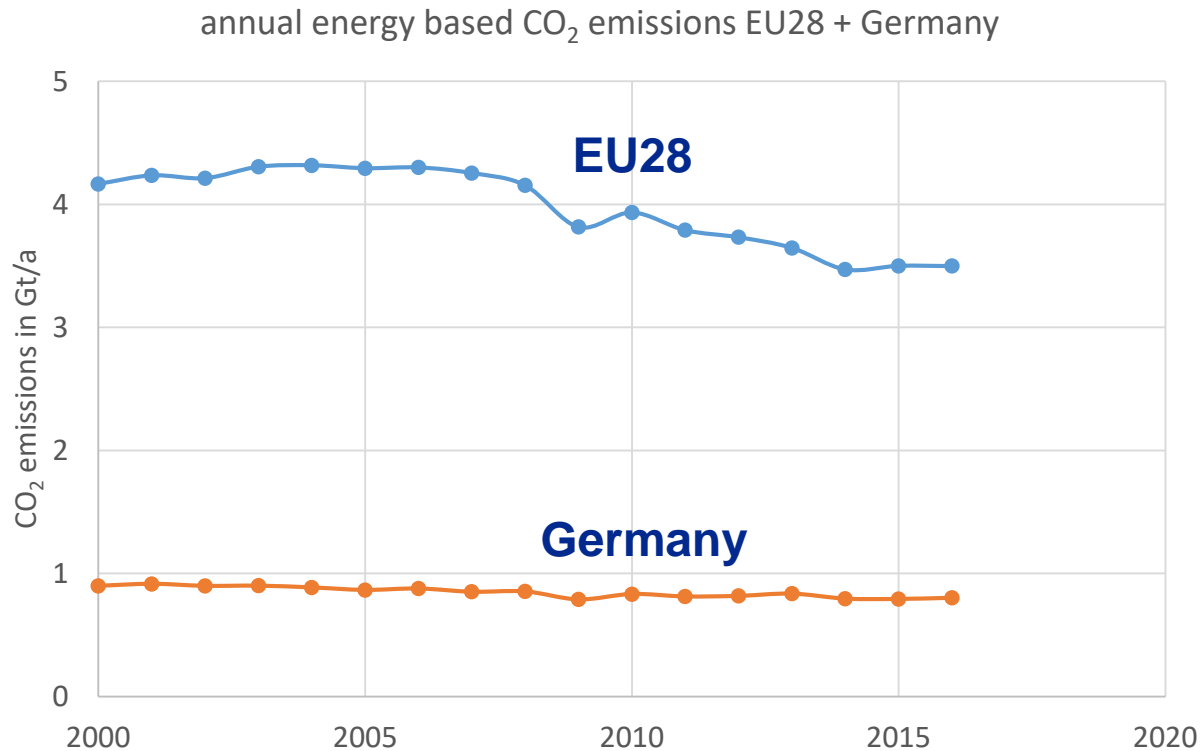


Cumulative net global CO<sub>2</sub> emissions from 2018





# CLIMATE PROTECTION: TIME IS RUNNING: EU28 + GERMANY



**In Germany and Europe CO<sub>2</sub> reduction has been stagnating for years**

Note: **EU28** is emitting **6.9 t CO<sub>2</sub>/a per capita**, Germany **9.8 t**, USA **16.6 t**, China **7.3 t**, global **4.9 t** (2016)

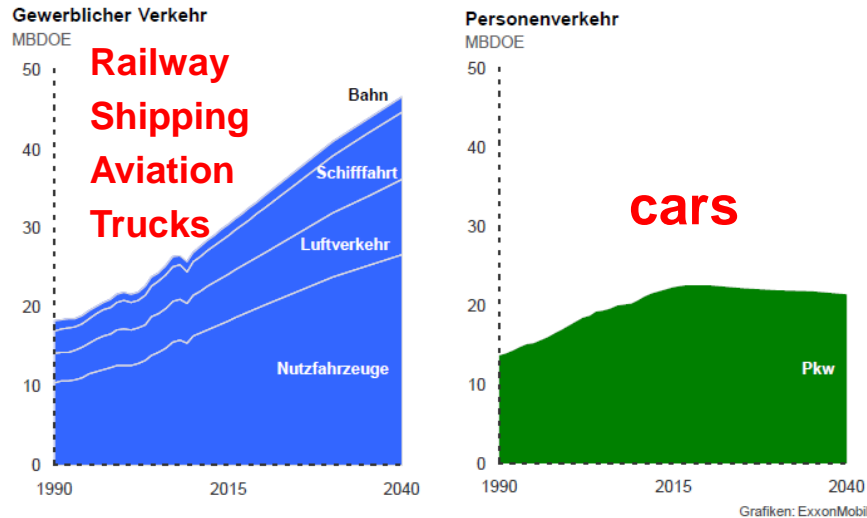
Source: Global Carbon Atlas: <http://www.globalcarbonatlas.org/en/CO2-emissions>

# CLIMATE PROTECTION: KEY MESSAGE

**The reduction of CO<sub>2</sub> / GHG emissions must be achieved**  
**quickly und simultaneously**  
**in all sectors**  
**by any means available**

# CLIMATE PROTECTION: MOBILITY SECTOR

- **Global share of mobility in CO<sub>2</sub> emissions 2012:** **20 %**  
Sources: IEA Key World Energy Statistics 2017, BMWi Erneuerbare Energien in Zahlen, Shell New Lens Scenarios 2013
- **Global share of liquid fuels in the mobility sector 2015:** **95 %**  
Source: IEA Key World Energy Statistics 2017
- **Global share of biofuels in the mobility sector 2015:** **3-4 %**  
Source: IEA Key World Energy Statistics 2017, BMWi Erneuerbare Energien in Zahlen 2015



**EU28 & Germany:**  
**similar situation and perspective**

Source:  
Rainer Wiek (EID/Energie Informationsdienst), MKS Workshop 19.4.2012

1 MBDOE = 1 million barrels per day of oil equivalent = 2,19 EJ/a

# CLIMATE PROTECTION – MOBILITY SECTOR: KEY MESSAGE

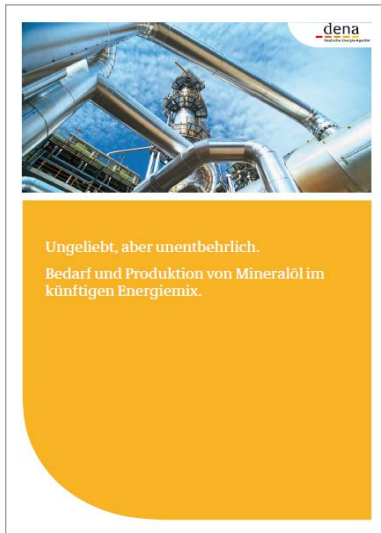
## World, EU28 and Germany:

- **no significant increase expected for cars**
- **continuous increase expected for trucks, aviation and shipping**

**(note: especially these increasing areas are difficult to electrify)**

# CLIMATE PROTECTION: GERMAN MOBILITY SECTOR

## Long-term high demand for liquid fuels in transport



**2030: 87 %**  
(total transport)

DENA study (2011)



**2040: 85 %**  
(road transport)

DLR study (2013)



**2050: 80 %**  
(total transport)

UBA study (2013)

Sources: DENA-Studie 2011 „Bedarf und Produktion von Mineralöl im künftigen Energiemix“

DLR-Studie 2013 „Der PKW-Markt bis 2040“

UBA-Studie 2013 „Treibhausgasneutrales Deutschland im Jahr 2050“

# CLIMATE PROTECTION: MOBILITY SECTOR

## Reasons for long-term high demand of liquid fuels

- Maximum energy density
- A number of traffic areas are difficult to electrify  
(e. g. **heavy duty transport, aviation, shipping**)
- Long average operating time of cars (stock of cars 45,8 Mio in 2017)  
(in Germany appr. **12 years**) Source: BMVI 2015 „Verkehr in Zahlen 2015/2016“
- Slow startup of electromobility due to disadvantages and problems  
(e. g. **high price**, low range due to **low energy density** of batteries, **ethical problems with cobalt production in Africa** for battery needs, **high precious metal demand** for fuel cells)
- No realistic scenario to electrify all sectors  
(in Germany we would need at least **7 times more renewable electricity** than today)  
Source: Volker Quaschnig 2016 „Sektorenkopplung durch die Energiewende“

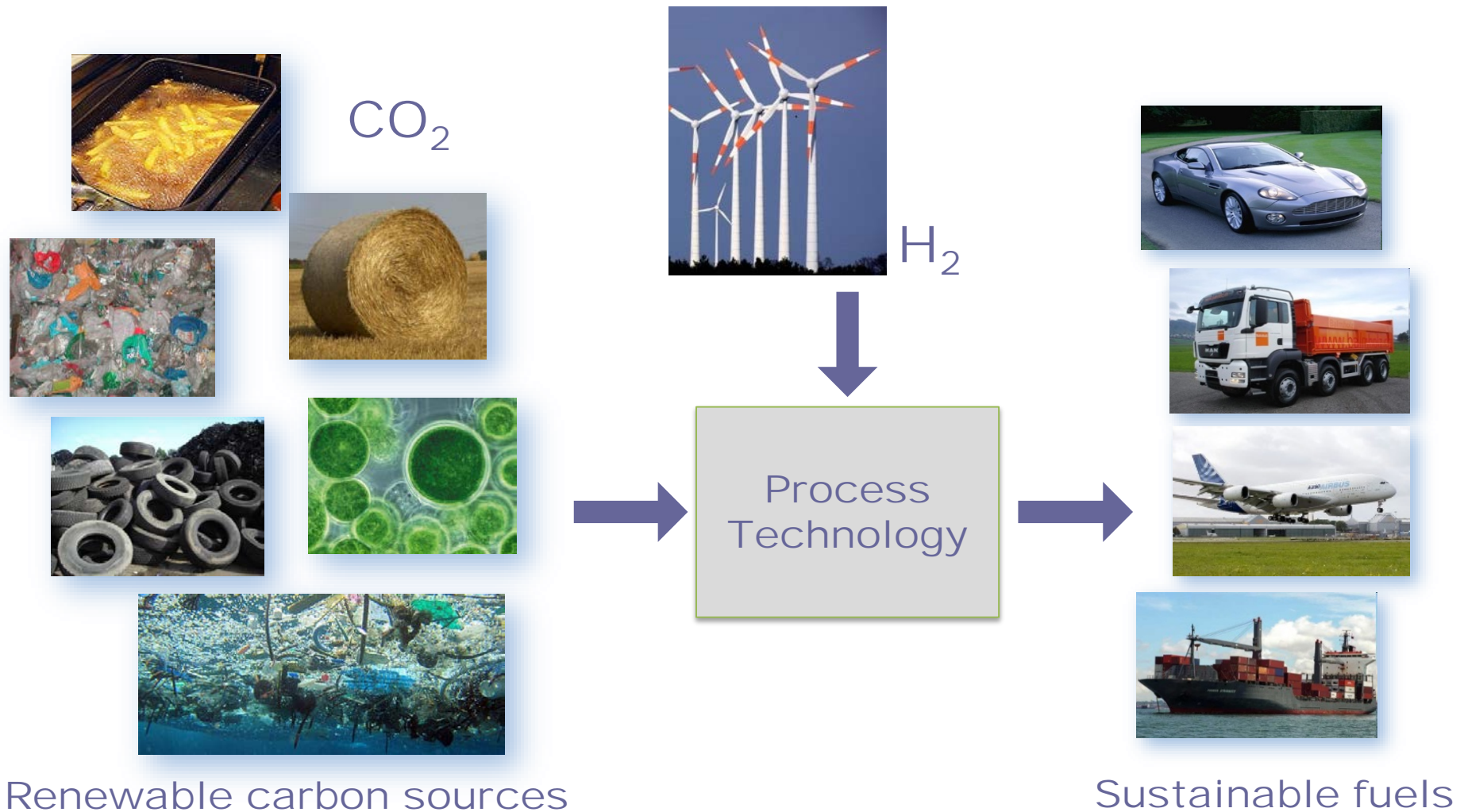
# CLIMATE PROTECTION: MOBILITY SECTOR: KEY MESSAGE

- **Liquid alternative fuels will play the key role for climate protection in the mobility sector**

**note: even by 2050 appr. 80 % of the mobility sector is expected to be based on liquid fuels**

# POSITION PAPER: ROUTES TO NEW FUELS

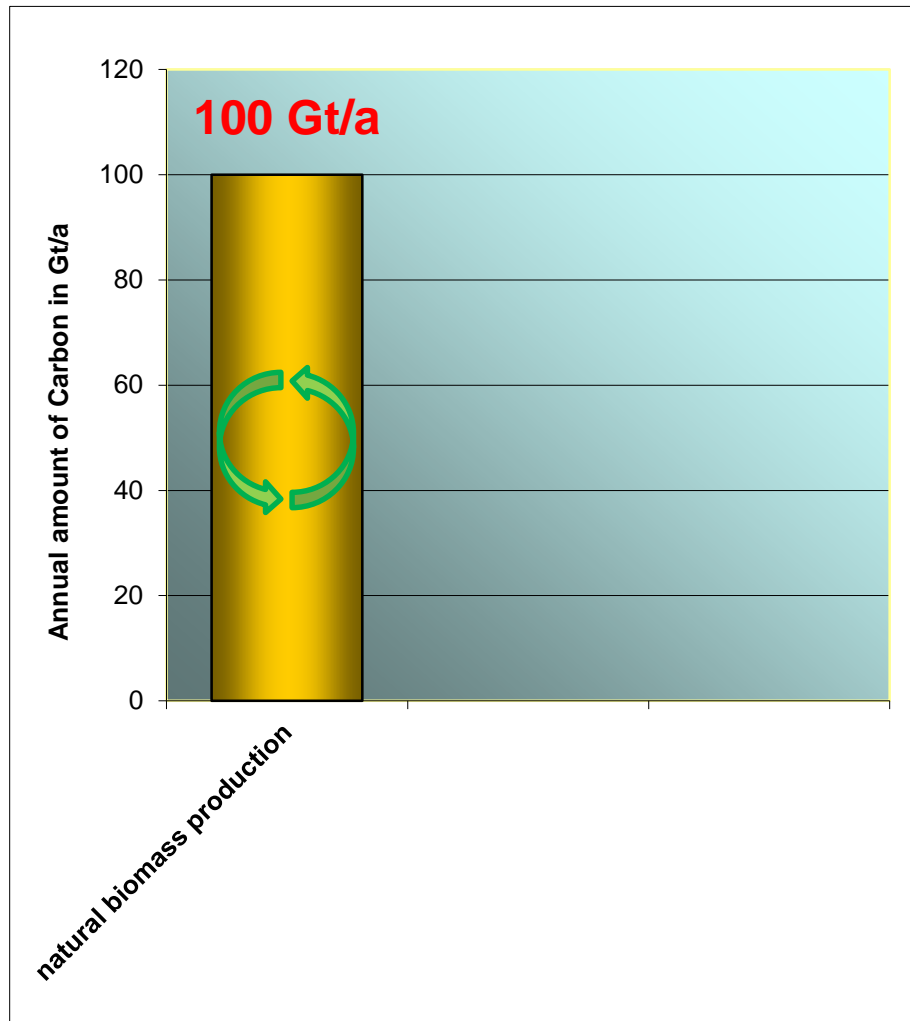
## Routes to advanced liquid alternative fuels





# POSITION PAPER: ROUTES TO NEW FUELS

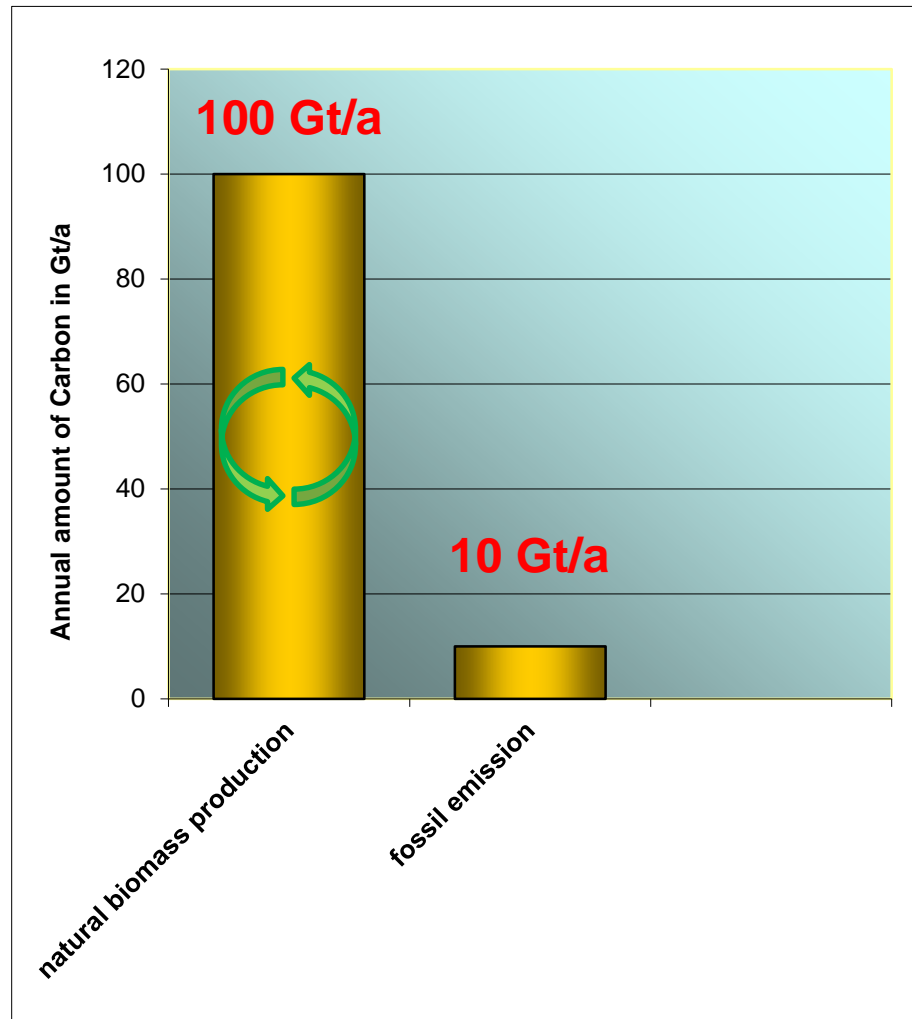
## Huge natural biomass carbon potential



Source: IPCC  
Climate Change 2013,  
The Physical Science  
Basis, Chapter 6  
"Carbon and Other  
Biogeochemical Cycles"

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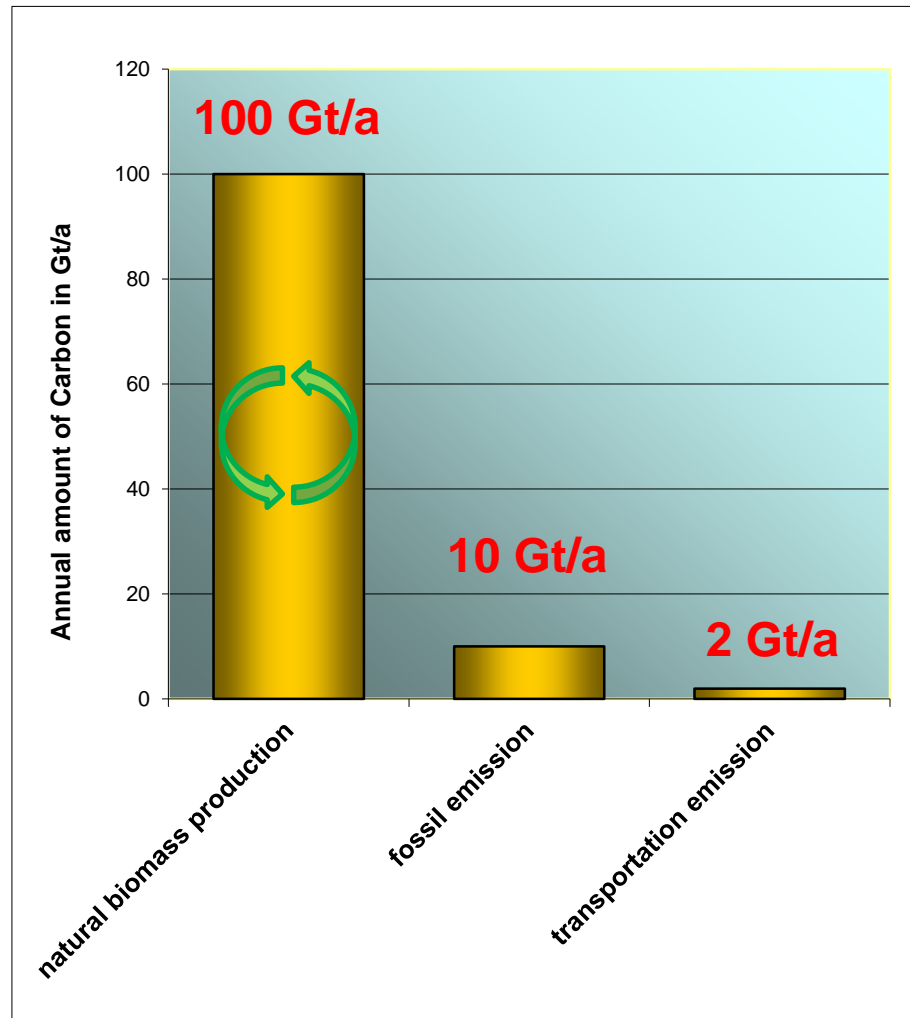
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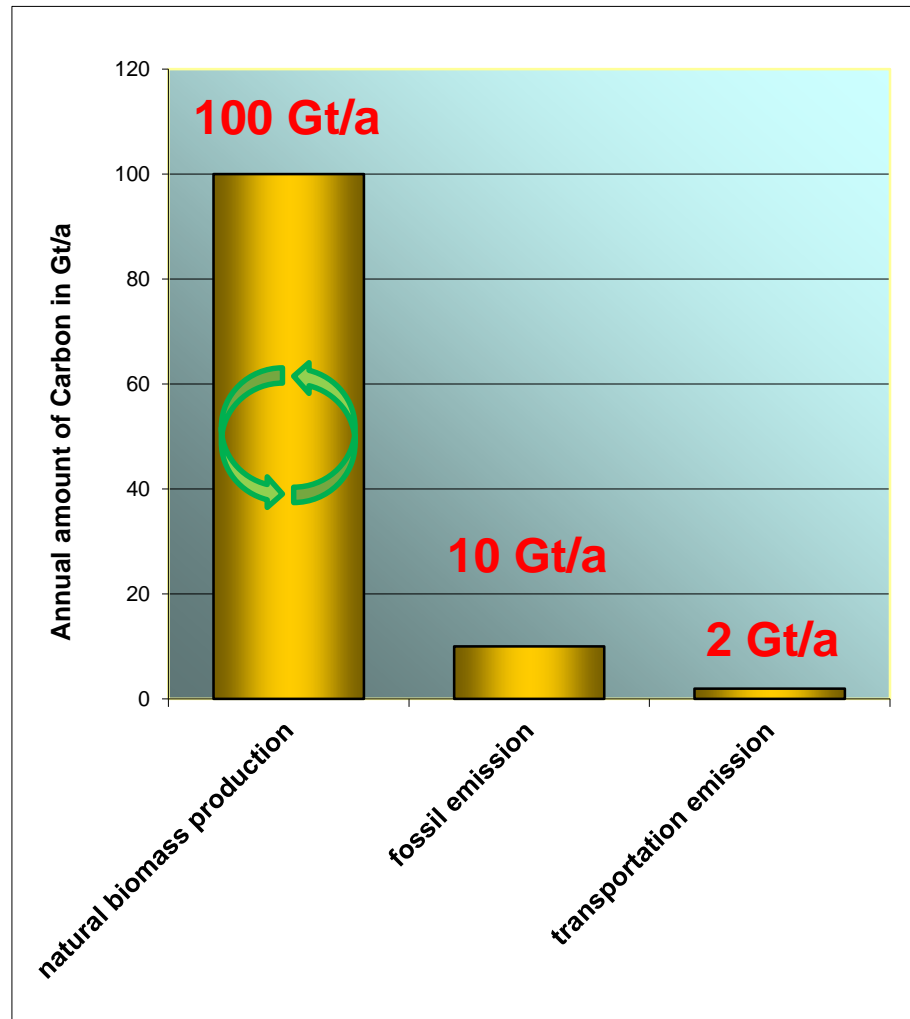
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# POSITION PAPER: ROUTES TO NEW FUELS

## Huge natural biomass carbon potential



Source: IPCC  
Climate Change 2013,  
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Tapping into a tiny portion of less than 2 % of the natural biomass carbon recycled every year would cover all the needs of the transport sector.

# POSITION PAPER: ROUTES TO NEW FUELS

**There is enough renewable carbon potential in the world**

CO<sub>2</sub>

To be replaced:

**Mineral oil: 4.3 Bn t/a (180 EJ/a)**

Global potential of feedstocks:

**Biomass: 8-9 Bn t OE/a (appr. 360 EJ/a)**

**Waste: 1-2 Bn t OE/a (appr. 60 EJ/a)**

**Additional: Algae, Power, H<sub>2</sub> and CO<sub>2</sub>**

1 t OE = 1 t oil equivalent = 41,868 GJ

**FAO study 2011  
appr. 30 % of all food is  
wasted worldwide  
= 1.3 Bn t/a**



Sources: A. Günther: Herausforderungen und Potentiale für den Anlagenbau im erneuerbaren Brenn- und Kraftstoffsektor. Präsentation am ProcessNet Infotag „Alternative Brenn- und Kraftstoffe“, Frankfurt/Main 18.10.2011;  
Felicitas Schneider in „Biotreibstoffe auf dem Prüfstand“. Österreichischer Biomasse-Verband 2012, [www.biomasseverband.at](http://www.biomasseverband.at)

# POSITION PAPER: ROUTES TO NEW FUELS

## Routes to advanced liquid alternative fuels

Process  
Technology

### Described technology routes:

#### 9 XtL routes via synthesis gas

(BtL = Biomass to Liquid, WtL = Waste to Liquid, GtL = Gas to Liquid, PtL = Power to Liquid)

#### 7 DL routes via oils

(DL = Direct Liquefaction)

 new

#### 2 lipid routes

#### 3 algal routes

#### Num. biorefinery routes via pulping of lignocellulosics

Numerous synergy effects  
through **cross-linking** of  
routes to reduce costs

### Current state of technology: max. TRL 8

TRL = Technology Readiness Level

# POSITION PAPER: ROUTES TO NEW FUELS

## Routes to advanced liquid alternative fuels



### Sustainable fuels:

#### Drop in fuels:

- Pure hydrocarbons
- Miscible with conventional fuels

#### Novel fuels:

##### Oxygenates such as

- Oxymethylene ethers (OME)
- Other ethers (e. g. DME, MTBE, ETBE)
- Alcohols (e. g. Methanol, Ethanol, Butanol)

In accordance with the requirements of **RED II**, **EIBI KPI** and **German „Biokraftstoff-Nachhaltigkeitsverordnung“**

Overcoming **blendwalls**

Warranty of **long-term storage stability**

RED = EU Renewable Energy Directive; EIBI KPI = European Industrial Bioenergy Initiative Key Performance Indicators

# KEY MESSAGES

- **We need strong action for climate protection in all sectors.**  
(the target year „2050“ may be already too late!)
- **We need more ambitious new legislation and new policies.**  
(e.g. road map with both short term and long term targets)
- **In the mobility sector liquid alternative fuels, biofuels in particular, will play the key role in CO<sub>2</sub> / GHG reduction.**  
(let`s focus on the „80 %“)
- **We need all kinds of alternative fuels.**  
(e.g. 1<sup>st</sup> generation biofuels phase-down would be a big mistake!)



# Thank you