GREEN BUSINESS
DEVELOPMENT

# The Big Picture:

# The coupling of mobility- and energytransition

Facts & figures for a
real zero-emission mobility

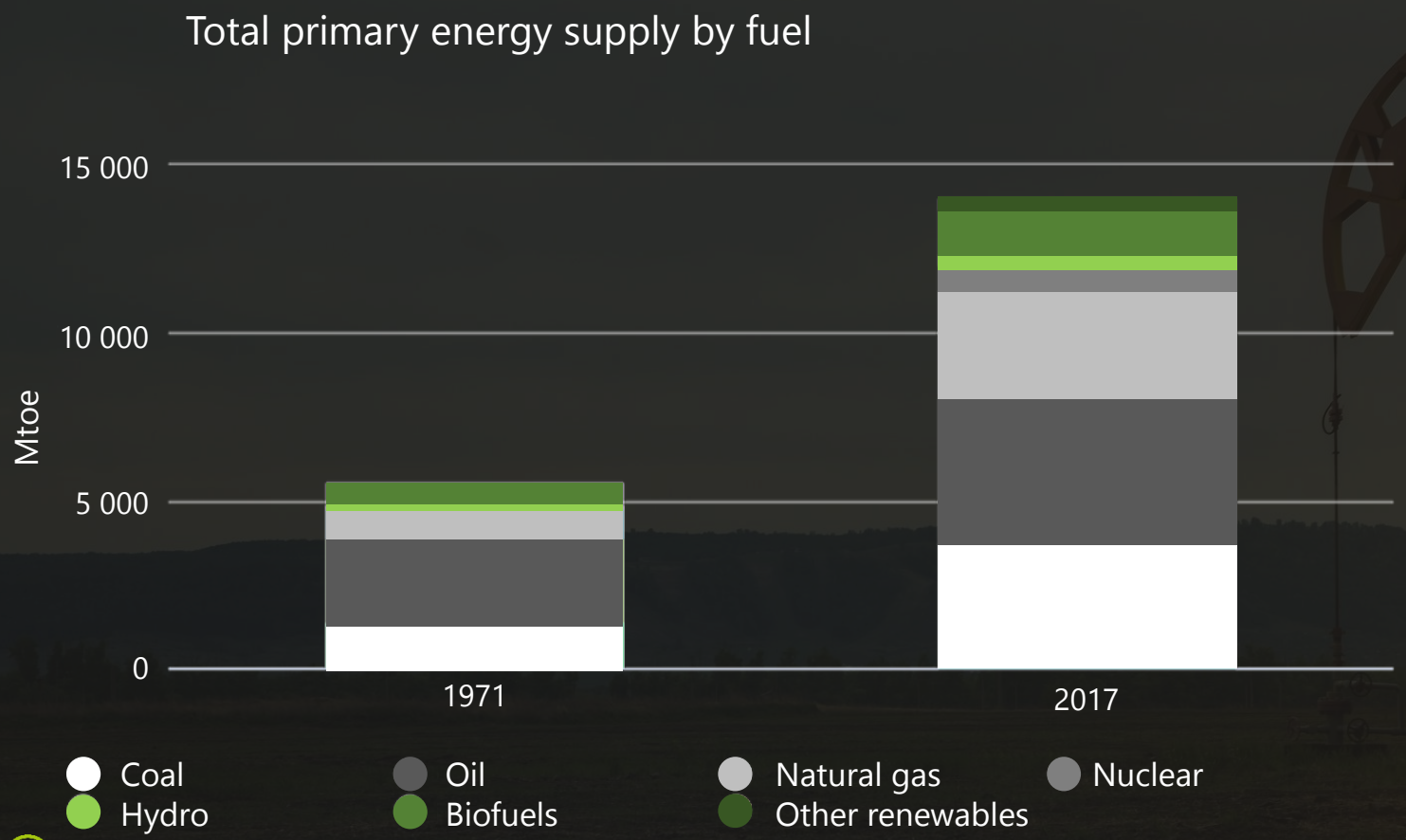
*Egbert Hünewaldt*
*Managing Director GBD*
*huenewaldt@gbd.green*

# Current Situation

# Energy- & Mobilitytransition

# Worldwide primary energy supply by fuel

## Our energy supply is still dominated by fossil fuels by 80% +

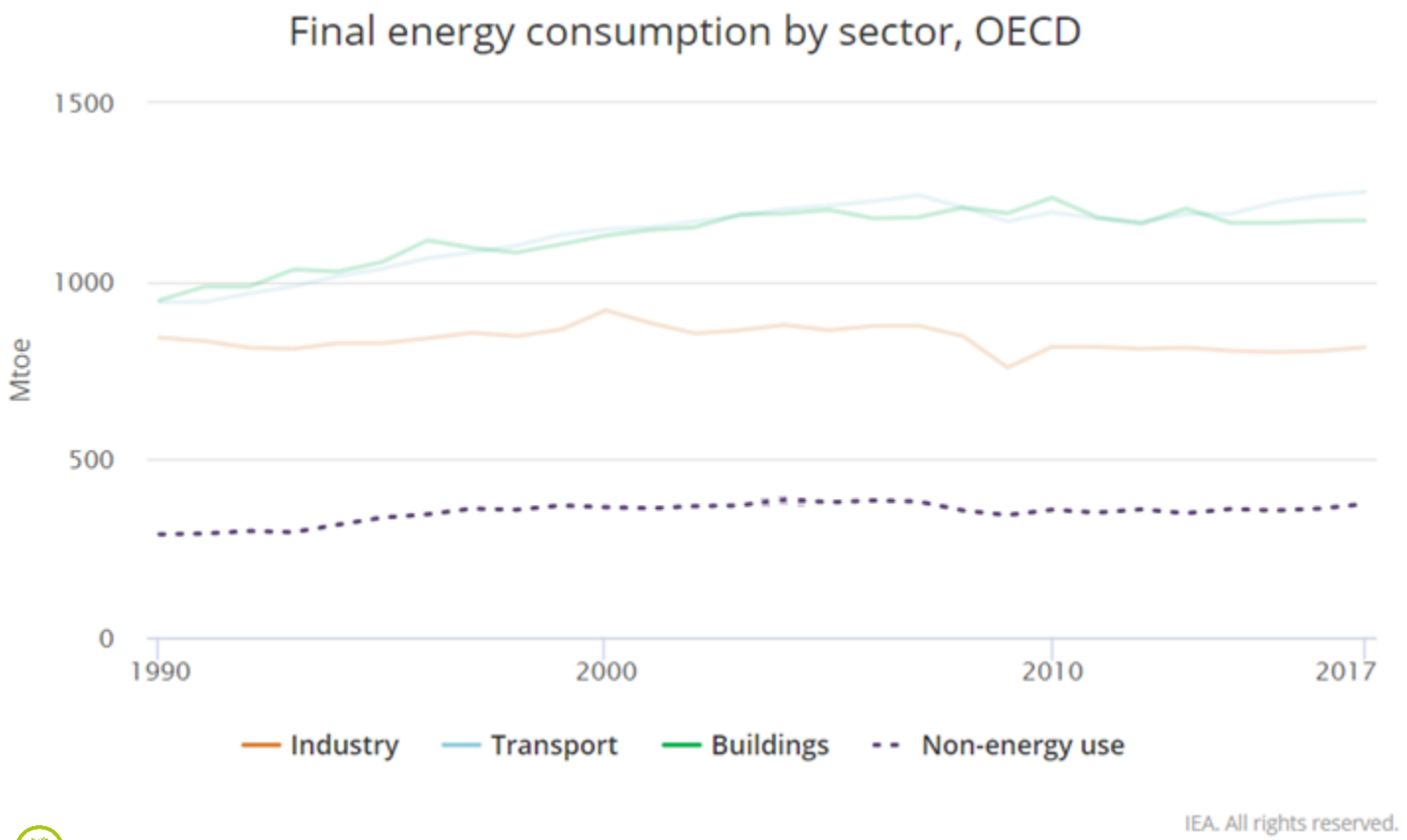



- Increased 2,5x
- Fossil fuels 81%
- Oil 44/32%
- Coal: 26/27
- Natural Gas 16/22
- Biofuels 9/11%
- Nuclear 0,5/ 4,9%
- Hydro 2% / 3%

*Source: : Figures IEA International Energy Agency/ Graph GBD*

# Total Final Energy Consumption (TFC) by sector / OECD countries only

## Transport consumes 1/3 of total energy




- 33% Transport

- Transport 1241 Mtoe
- Buildings 1170Mtoe
- Industry 805 Mtoe
- Non-energy use 362 Mtoe

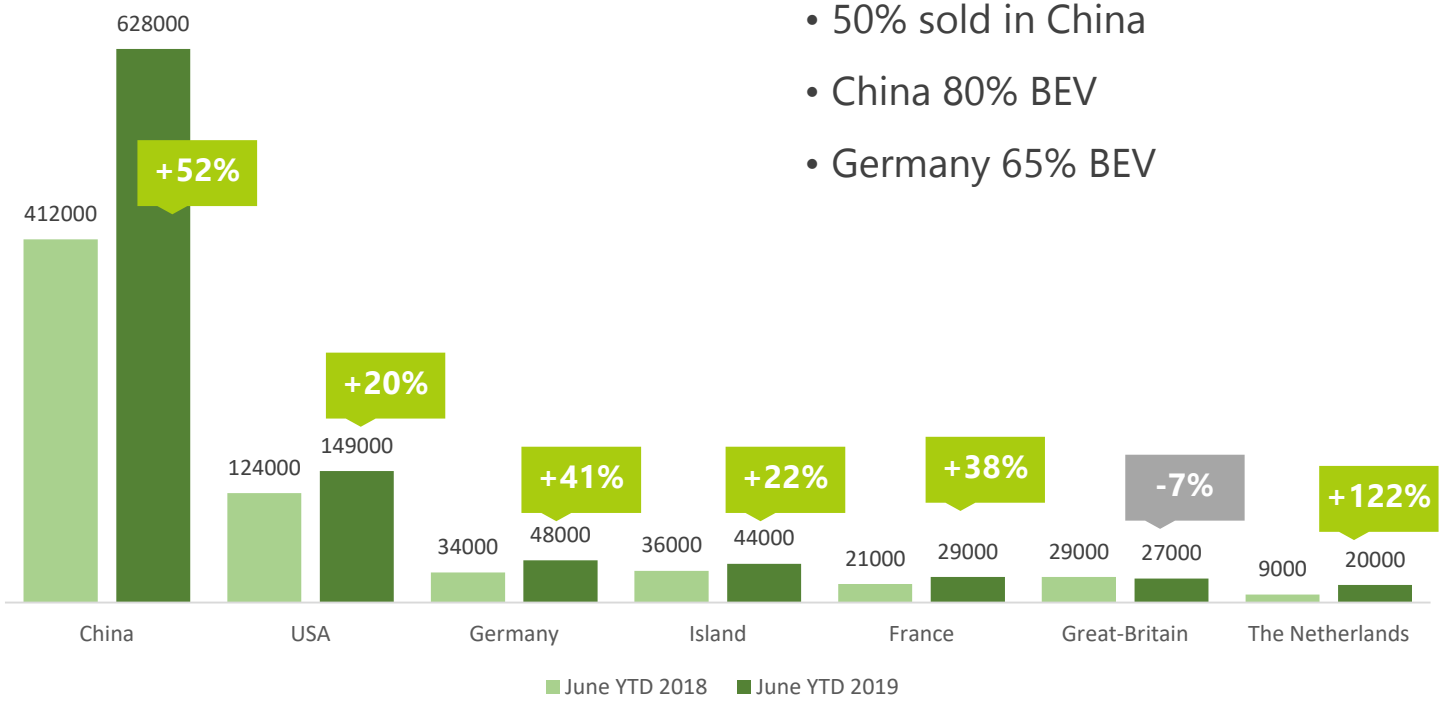
*Source: IEA International Energy Agency*

# ECV-Car Sales/ worldwide

( HJI 2018/2019, change over the previous halfyear)

## E-Car Sales are increasing but still strongly dominated by China and US

E-car sells in key markets in the first half of 2019

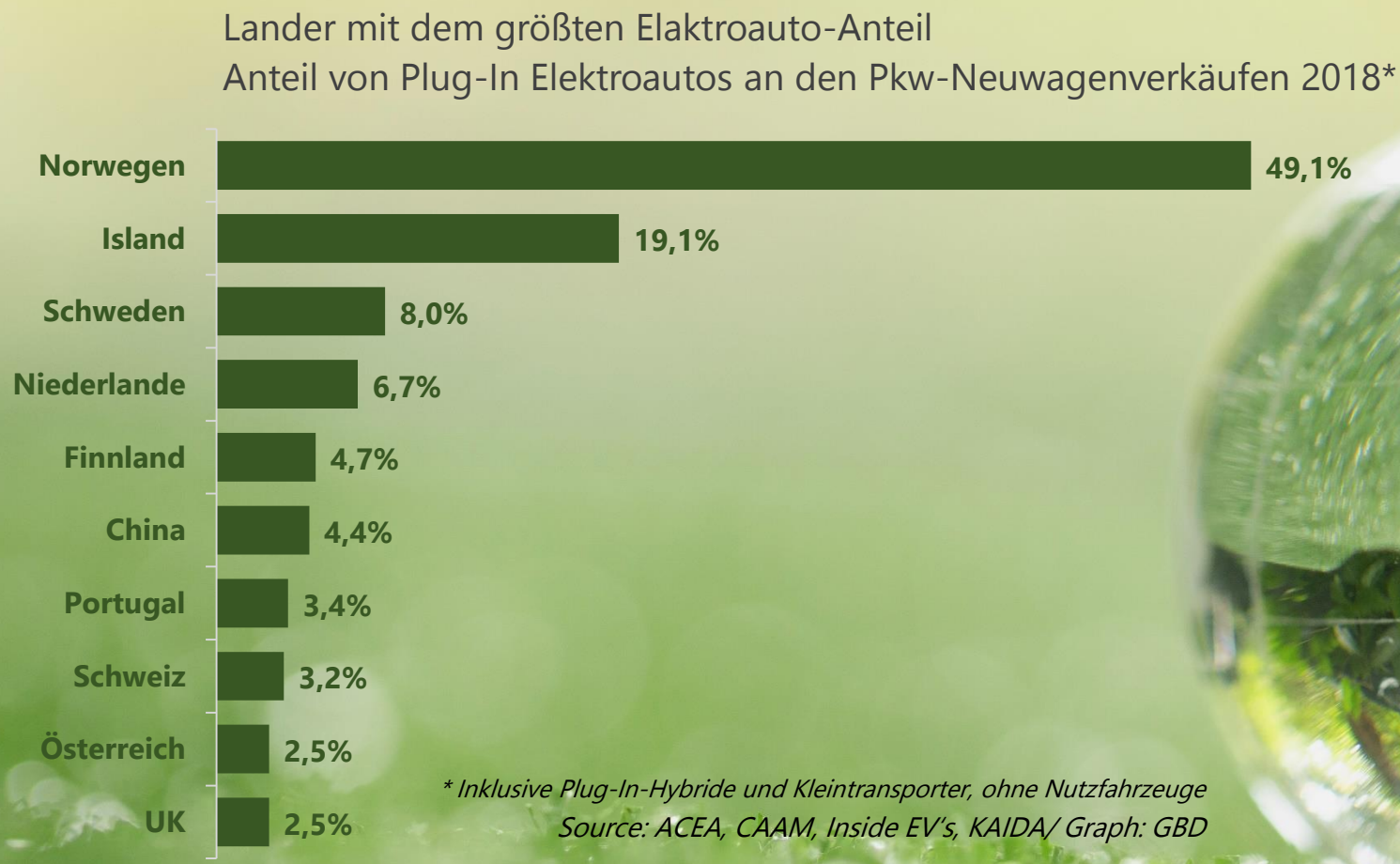



- 50% sold in China
- China 80% BEV
- Germany 65% BEV

*Source: Figures Center of Automotive Management, 07/2019/ Graph GBD*

# ECV share of new registrations / worldwide/ 2018

## New registrations worldwide under 5%



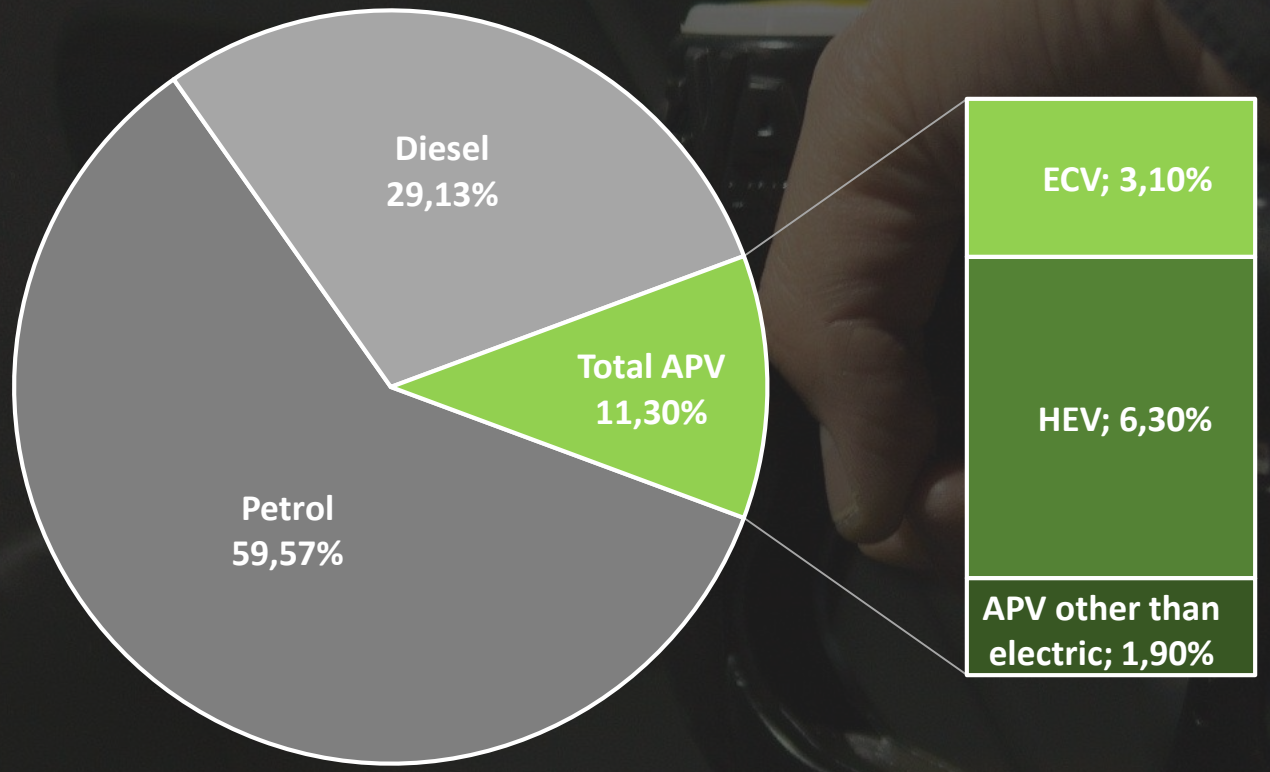

** Inklusive Plug-In-Hybride und Kleintransporter, ohne Nutzfahrzeuge*

*Source: ACEA, CAAM, Inside EV's, KAIDA/ Graph: GBD*

# New Car Registration by fuel type/ EU – Including Hybrid EV

( QIII19, change over the previous quarter)

## Hybrids declining – BEV and LPG/NGV strongly raising at a low level




**Fuel types of new cars:**
- petrol +6,1%
- diesel -14,1%
- electric +51,8%

*(In third quarter of 2019)*

**Diesel -14%**
- -35% Spain
- -20% UK
- -13% France
- +5% Germany

**ECV +51,8%**
- BEV + 126%
- PHEV -8%
- FCEV n.v.

**LPG / NGV +36%**

*Source: ACEA European Automobile Manufacturers Association/ Graph: GBD*

# Current Situation Summary: Any data missing ?

- Strong increase for BEV
- Primary energy still 81% fossil fuels

- Missing data: percentage of ECV charged with renewables?

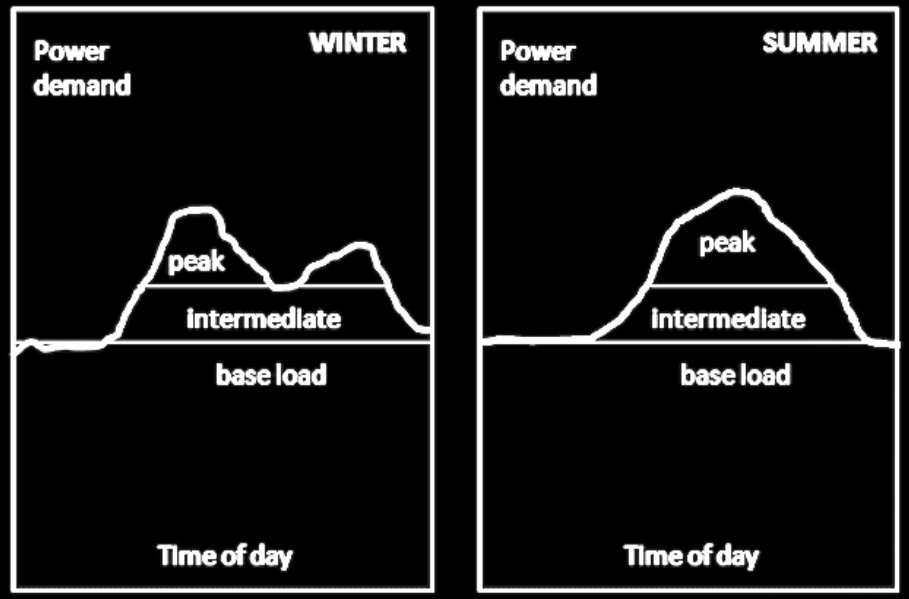
# The Way to Go… consequences of 100% renewable energy

- Thinking about transition should start at its ending

# The Baseload Power Question

## Can the baseload power be entirely provided by renewable energy sources?

Typical daily variation in power demand




*Source: Mark Fedkin*

- **The base load** power plants typically are **coal-fueled or nuclear plants** due to steady state power they can produce.
- The renewable energy systems, such **as solar and wind**, are most suitable for **intermediate load plants.** These are intermittent energy sources, with their output and capacity factor depending on weather conditions, daily, and seasonal variations.
- **The peak power generation** is attributed to the systems that can be **easily stopped and started**. Possibilities are **natural gas and oil plants, hydro-facilities**.
- **Unless there is an effective energy storage system in place**, they cannot be relied upon to meet constant electricity supply needs, nor can they be immediately employed to respond to peak demands.

# The Capacity Factor

## „Dunkelflaute“ or are renewables reliable?

**Capacity factors of power plants based on different fuel resources**

| Energy Conversation System | Capacity Factor (%) |
|---|---|
| Nuclear power | 90.3 |
| Coal | 63.8 |
| Natural gas | 42.5 |
| Hydroelectric | 39.8 |
| Concentrating solar | 33 (CA) |
| Wind | 20-40 |
| Photovoltaic solar | 15-19 |

**Definition Capacity Factor:**

In the table above, the lower the capacity factor, the more susceptible the system to potential interruptions or drops in performance. We can see that solar and wind technologies, which are notoriously weather-dependent have the lowest CF numbers. At the same time, nuclear power and coal systems are most advantageous when operated continuously and at full load.

*Source: US Energy Information Administration (EIA)*

# Surplus Energy

## 100% renewable will lead to a significant increase of Surplus Energy due to the low capacity factor


**Definition:**

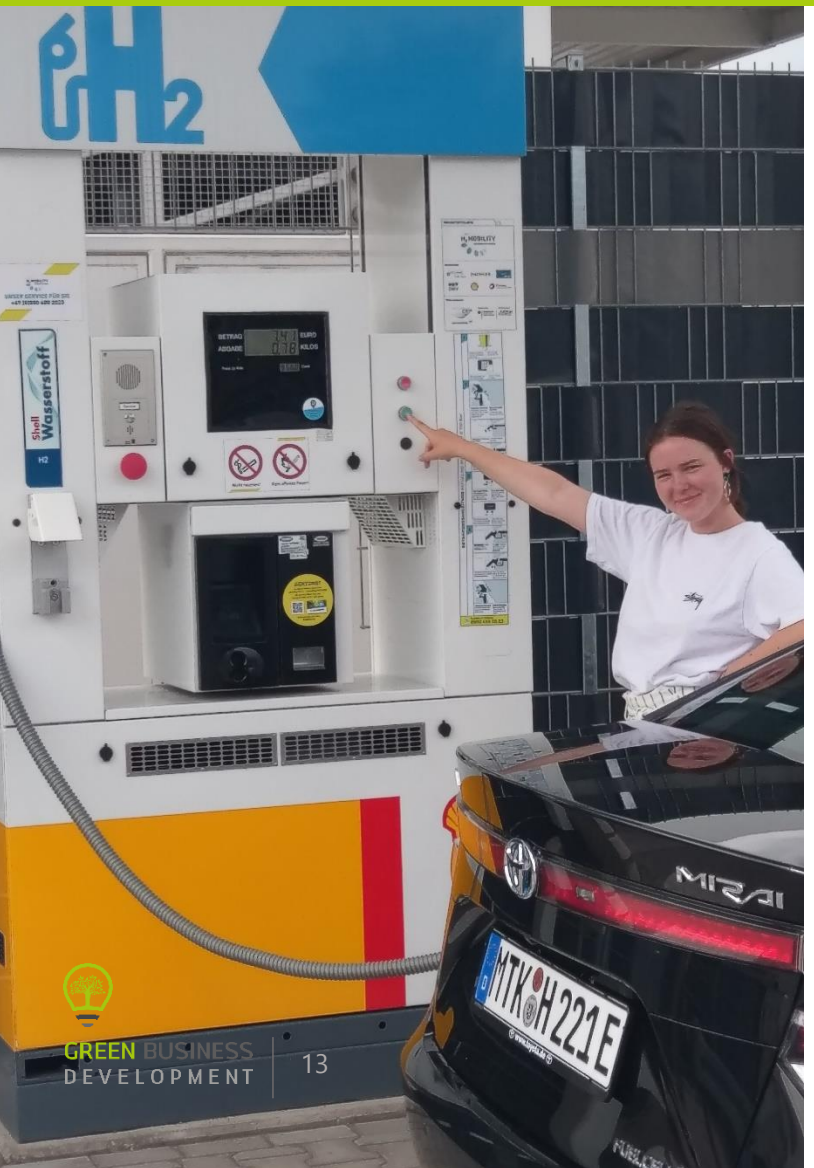
Suprlus Energy: electric energy generated out of renewable resources which would be wasted because of the lack of a market.

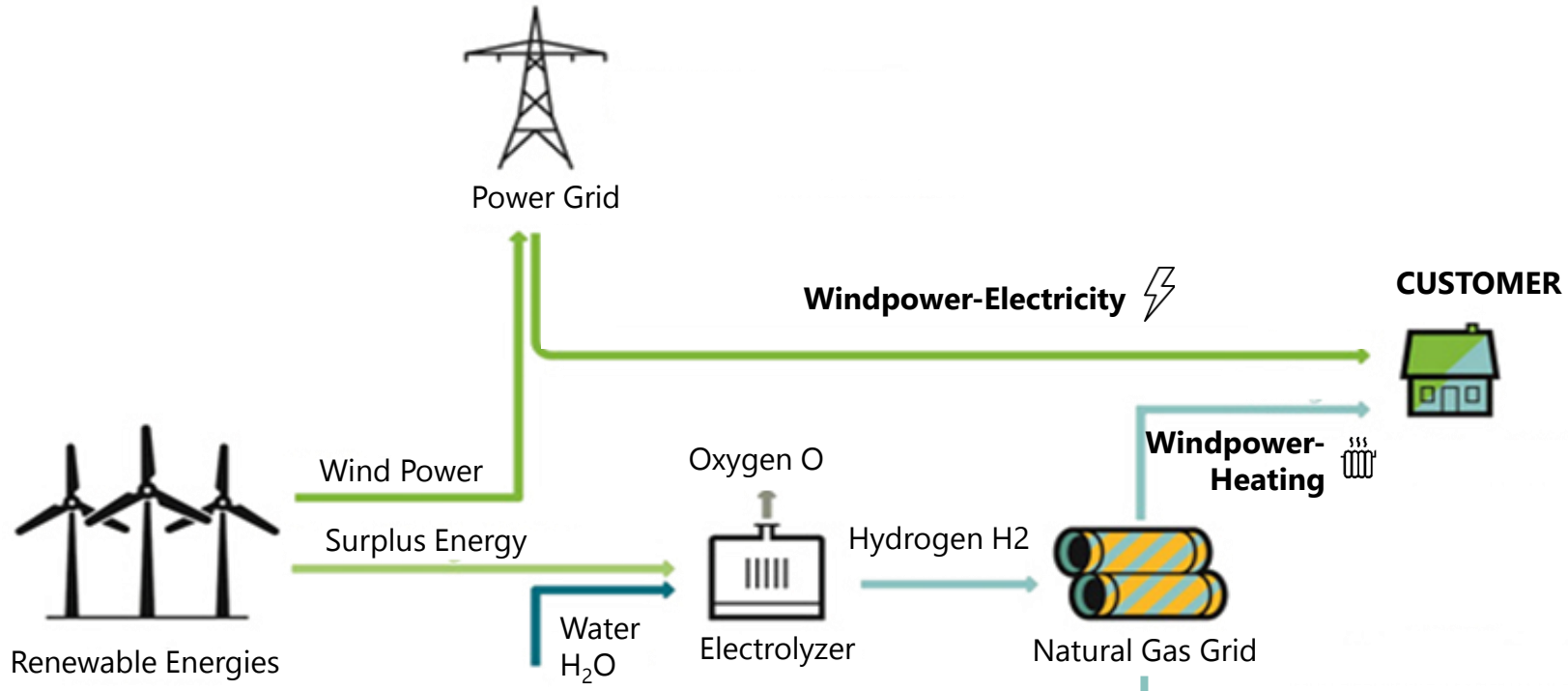
- Baseload line (30-40% of maximum) when produced with renewables must be much higher then when produced withnuclear/ coal
- High percentatge of surplus energy
- Today = no usage of surplus energy
- Solution = storage
- Solution Option = H2

*Source: figures US Energy Information Administration (EIA), figures & graph GBD,*

# Transformation of Surplus Energy adding P-t-G to the Power Grid System

## Combining Power Grid and Power to Gas System to use Surplus Energy

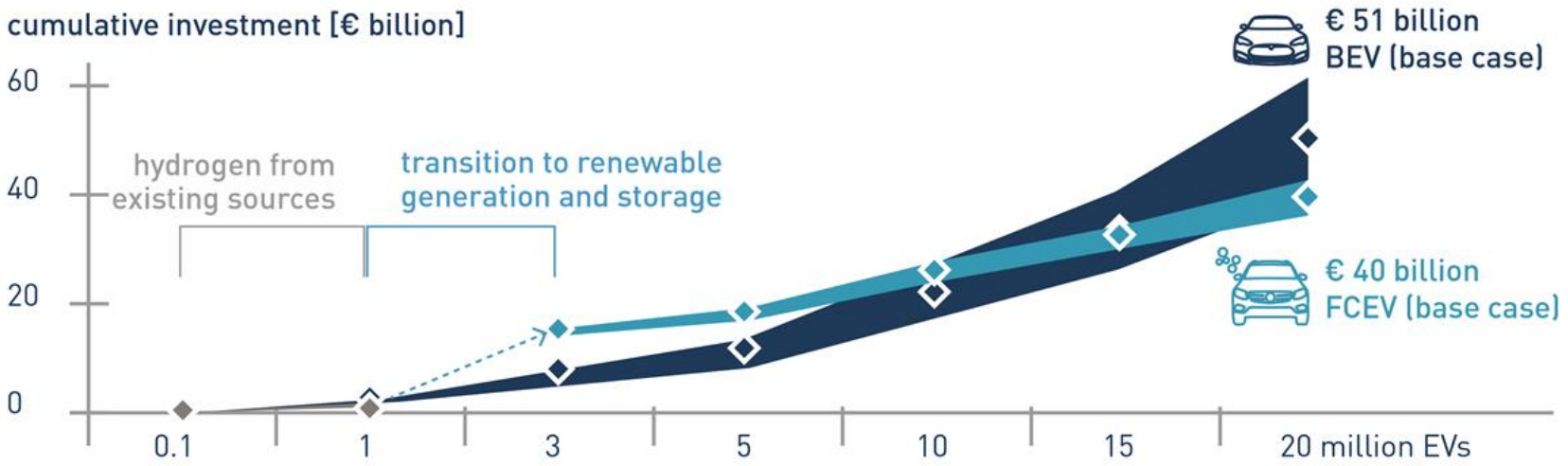



*Source: Green Business Development, 2019;*

# Comparison of the cumulative investment of supply infrastructures for BEV / FCEV (for Germany)

## Infrastructure costs for 20 million vehicles are slightly cheaper at FCEV



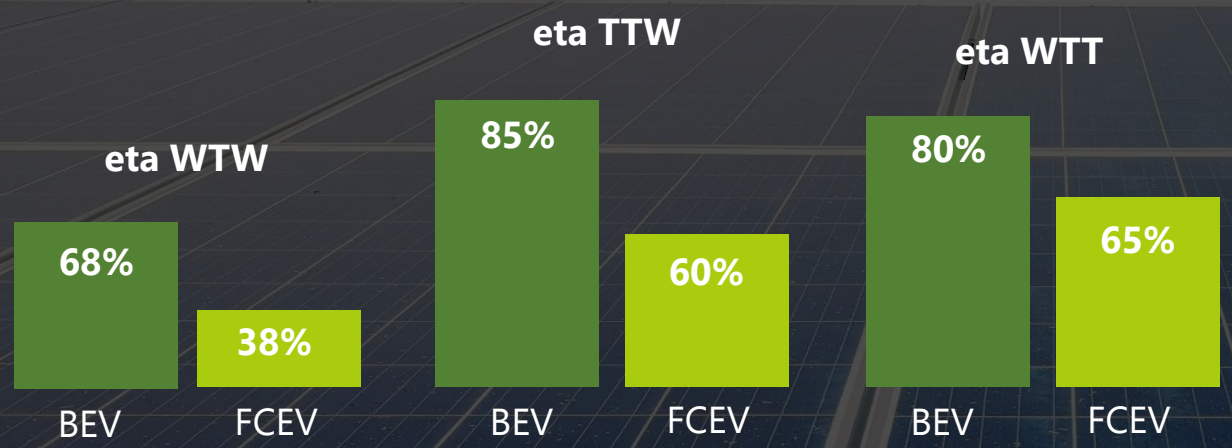

*Source: Forschungszentrum Jülich, Comparative Analysis of Infrastructures: Hydrogen Fueling and Electric Charging of Vehicles, 2019;*

- Goal: 20 m cars
- Costs: FCEV < BEV
- Surplus Energy > need of energy for car- charging energy, under the condition of a dominant percentage of renewable energy

# η (Eta) :Electrical Efficiency Discussion: WTW / WTT / TTW /

## Coefficient: FCEV x 1,8 = BEV

Efficiency comparison of a BEV and a hydrogen based FCEV that has solar and wind energy as its primary energy sources




Coefficient:
FCEV x 1,8 = BEV

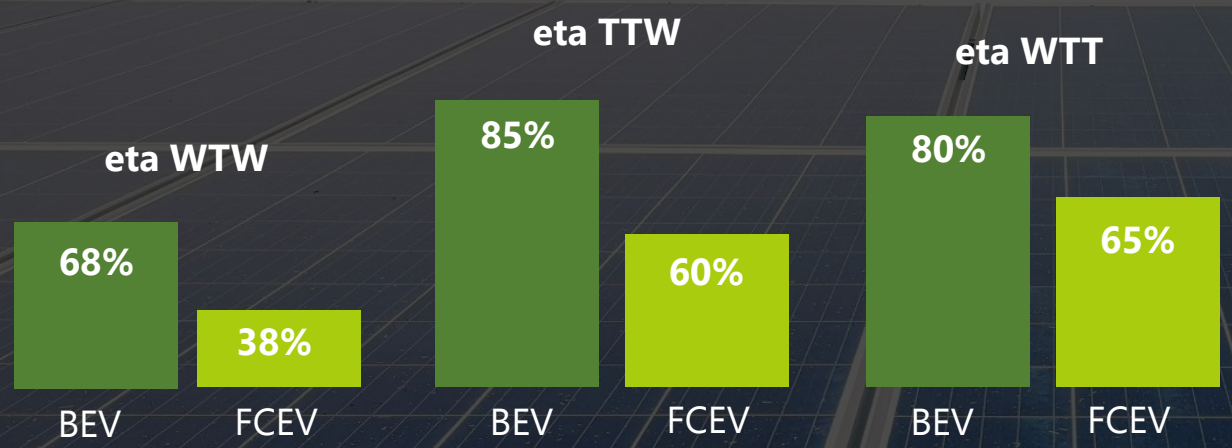
- WTW: Well-to-Wheel
- WTT: Well-to Tank
- TTW: Tank-to Wheel

*Source: Figures Forschungszentrum Jülich/ Graph: GBD*

# η (Eta) :Electrical Efficiency Discussion: WTW / WTT / TTW /

## Coefficient: FCEV x 1,8 = BEV

Efficiency comparison of a BEV and a hydrogen based FCEV that has solar and wind energy as its primary energy sources

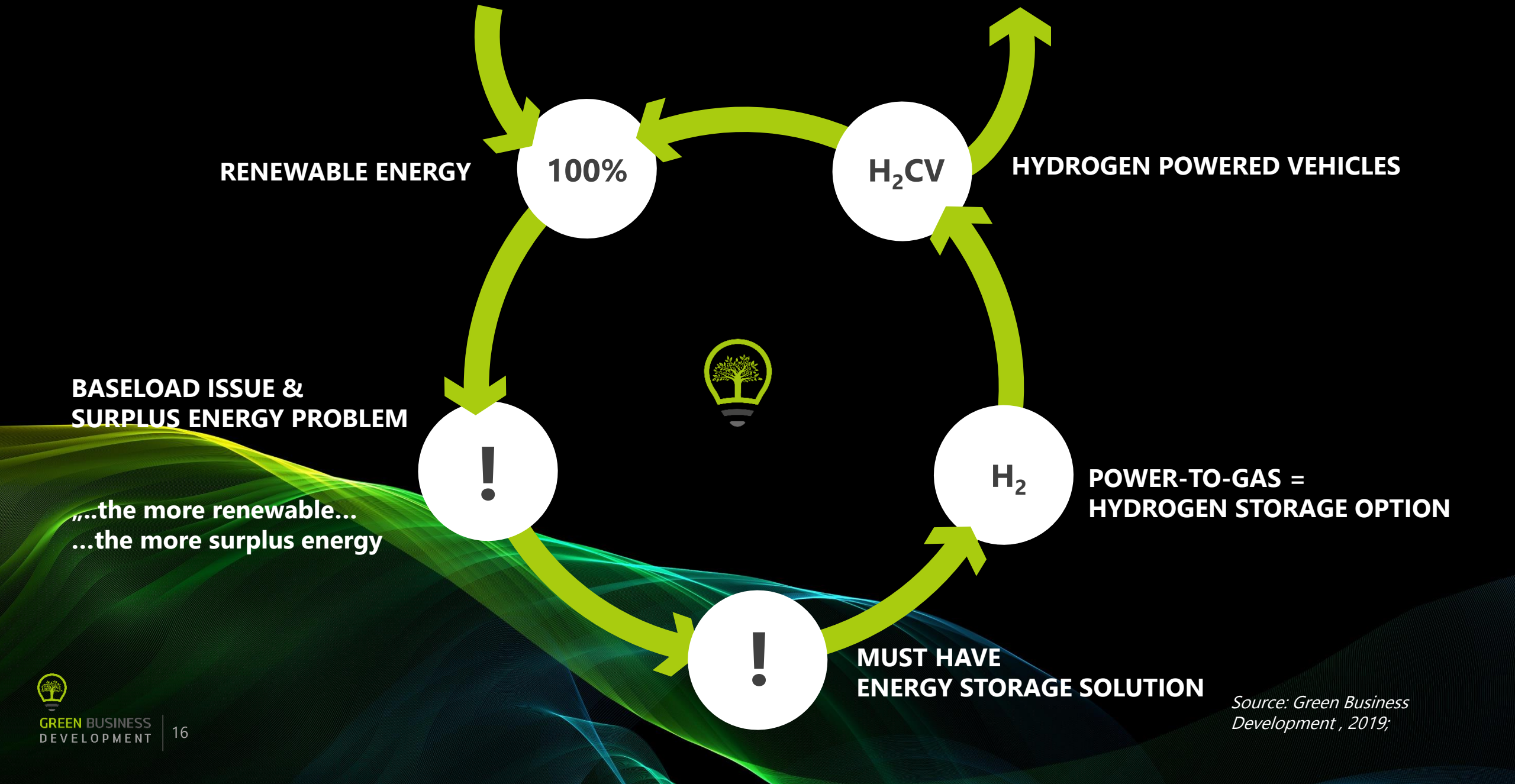



Coefficient:
FCEV x 1,8 = BEV

- WTW: Well-to-Wheel
- WTT: Well-to Tank
- TTW: Tank-to Wheel

*Source: Figures Forschungszentrum Jülich/ Graph: GBD*

# THE LOGICAL CIRCLE FOR ZERO-EMISSION MOBILITY

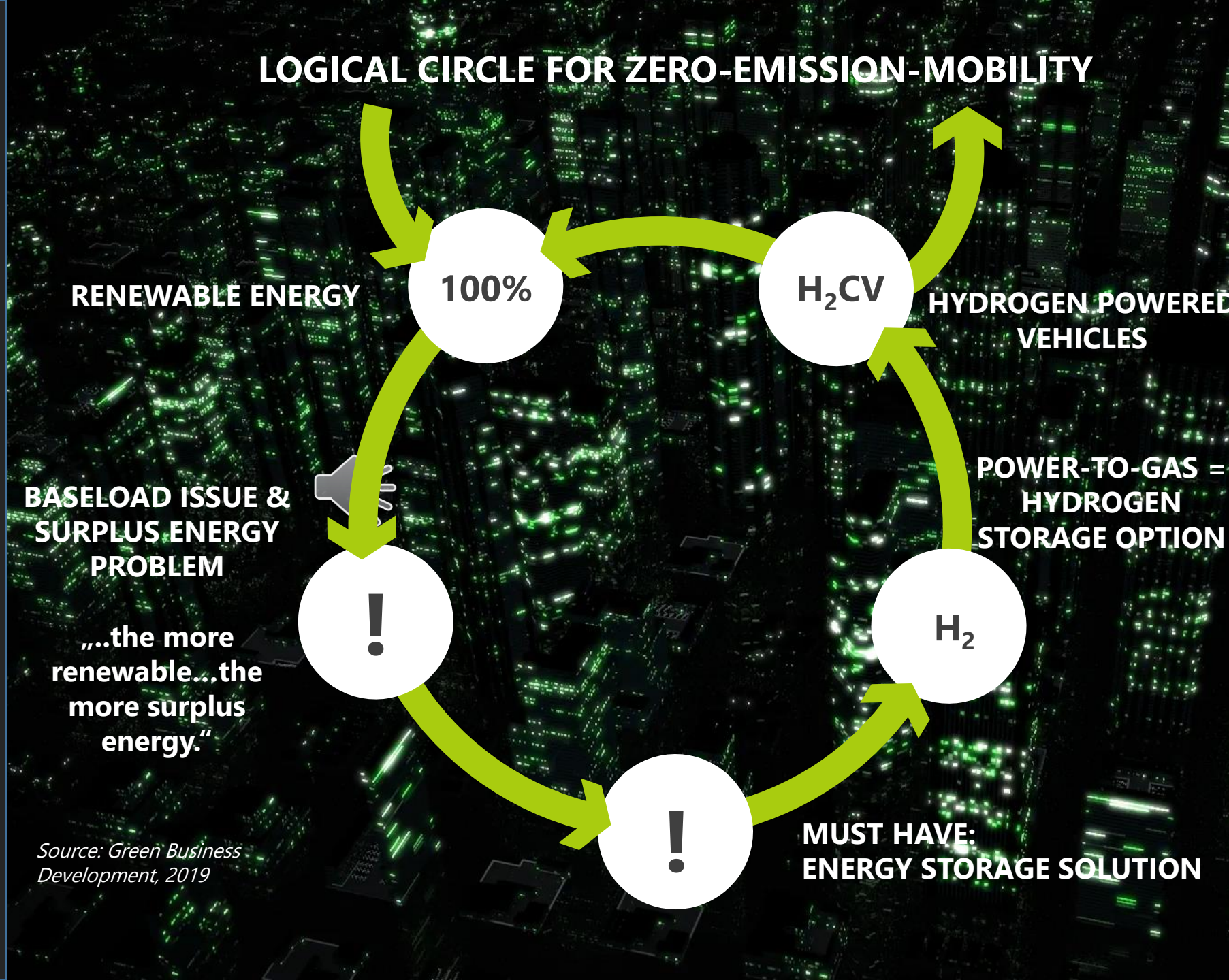



*Source: Green Business Development , 2019;*

GREEN BUSINESS DEVELOPMENT

# The Logical Circle: Zero-Emission-Mobility

*Egbert Hünewaldt*
*Managing Director GBD*
*huenewaldt@gbd.green*



# Thank You!

GREEN BUSINESS DEVELOPMENT

huenewaldt@gbd.green

greenbusinessdevelopment.de

photos: www.freepik.com