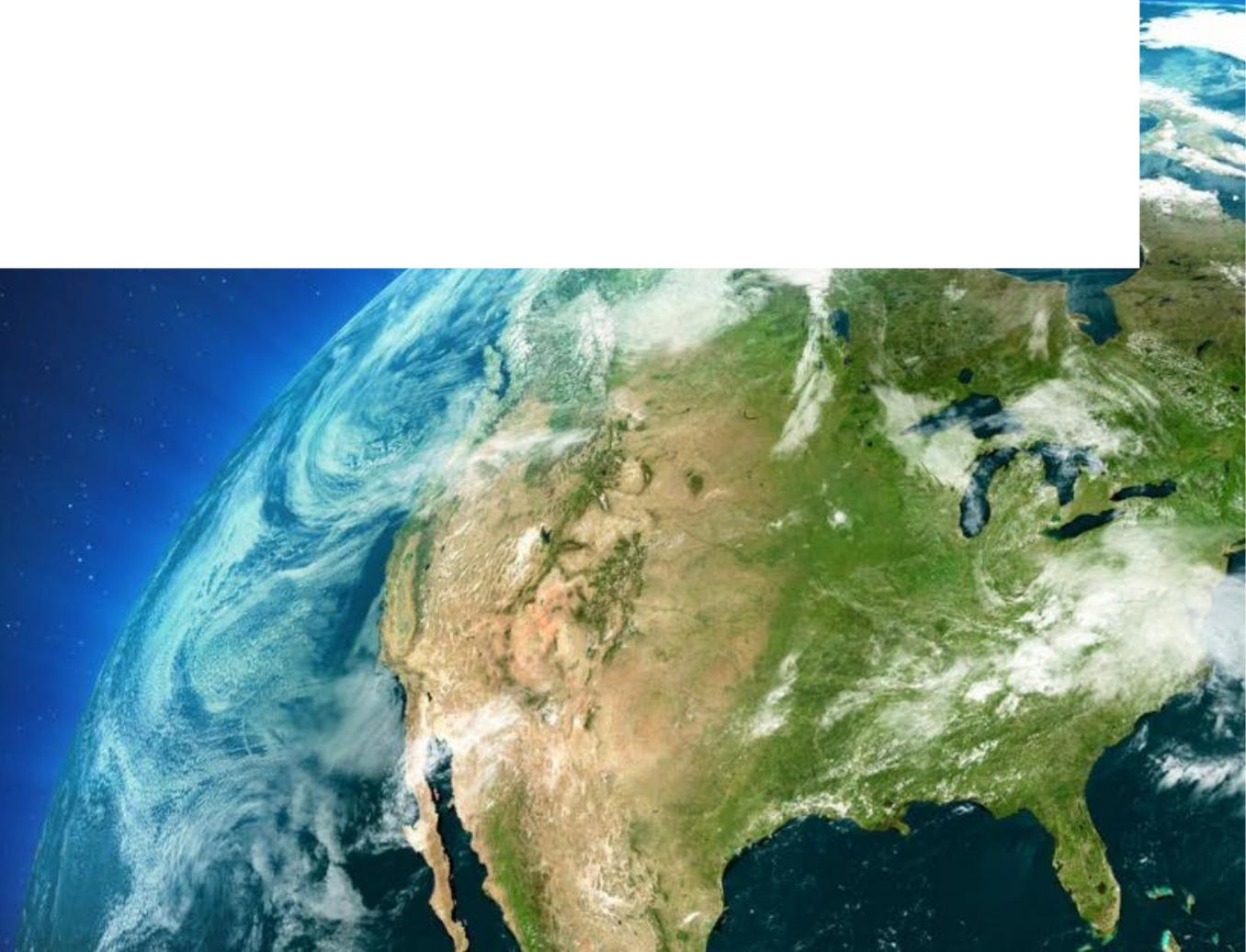


Alternative Powertrains

Options for Africa



About the VDA and the partnership with AAAM

The **German Association of the Automotive Industry e.V. (VDA)** represents automotive manufacturers, suppliers, and trailer and body manufacturers under one roof.

The VDA has more than 600 member companies, which employ over 800,000 people in Germany and have more than 2,500 plants abroad.

With the support of the German Federal Ministry for Economic Cooperation and Development (BMZ), the VDA is strengthening its cooperation with Africa:

The association partnership with the first pan-African automotive association the *African Association of Automotive Manufacturers (AAAM)* serves to establish a

- pan-African automotive policy,
- improve framework conditions,
- knowledge transfer
- and supports members in their commitment in Africa and promotes multilateral trade.

Timeframe The project started on June 1st 2020 and has a duration of 3.5 years. Through the project, the VDA has a project office in Johannesburg/South Africa and a Project Manager in Accra/Ghana.



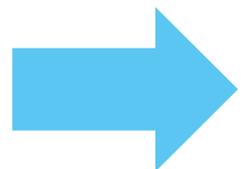
AAAM

African Association of
Automotive Manufacturers

Situation today

A young growing population and rapid rates of urbanisation point to numerous opportunities for growth

- Poor motorisation
 - <1% paved roads
 - Old vehicle fleet (80-150Mio), poor fuel quality, mostly no emission standard
 - 42 vehicles / 1000 inhabitant (Comparison: Worldwide 182)
- Young population (50% <30years)
- Growing middle class in Africa (500Million expected by 2030)
- Growing demand for individual mobility
- Steady market growth
 - African car market reaches almost 1 Million vehicles/year
 - Forecast 1,8Million in 2027



Vision: 5Mio Vehicles produced for Africa and in Africa

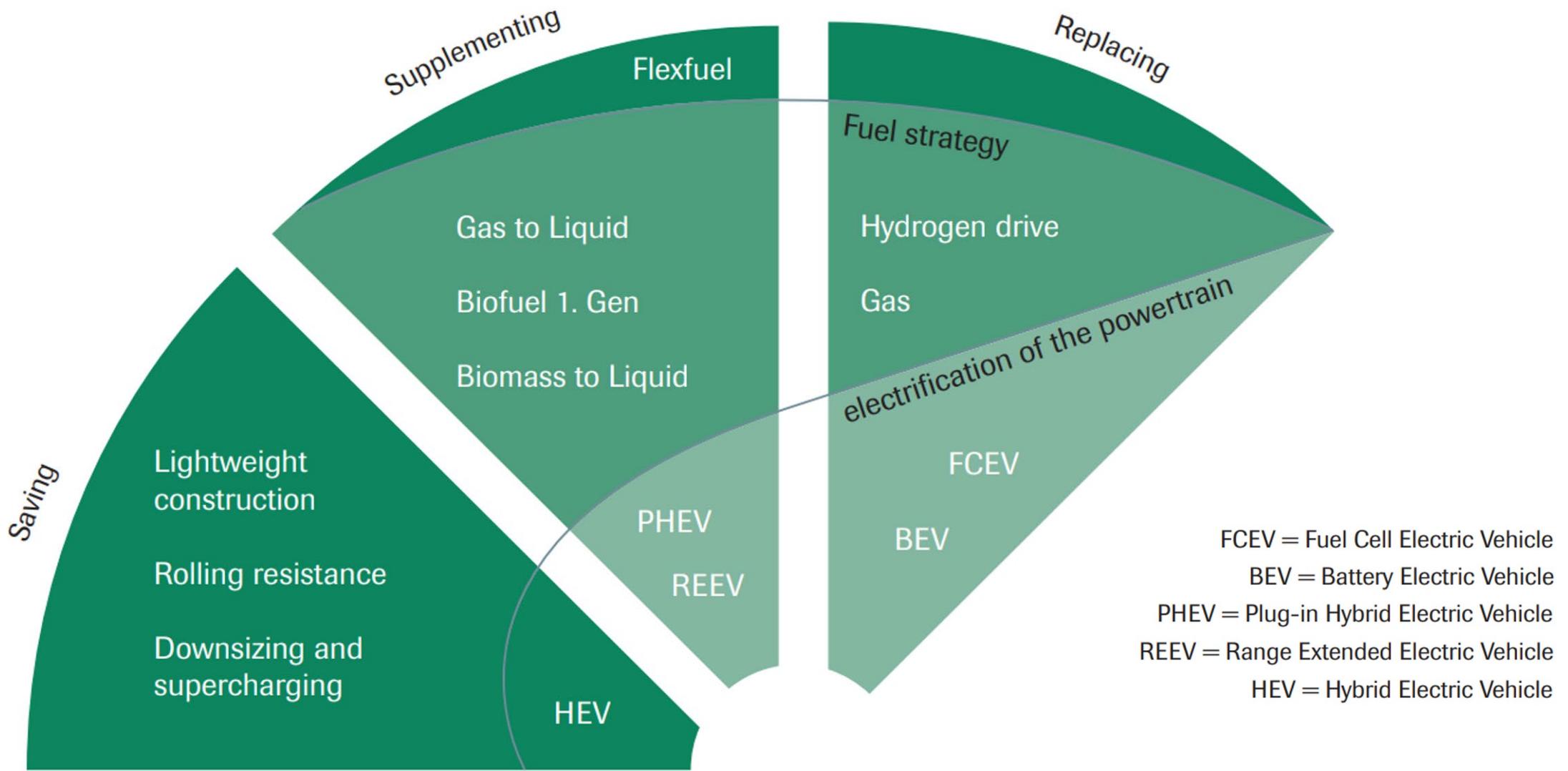
What's the future of vehicles produced in Africa for Africa?

Which technological option is best for Africa?
How shall the technological transition look like?

Multiple future powertrain/energy-options!



The VDA fan strategy for a path towards sustainable transport

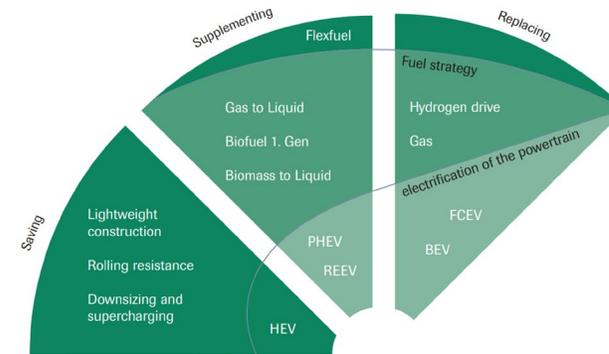
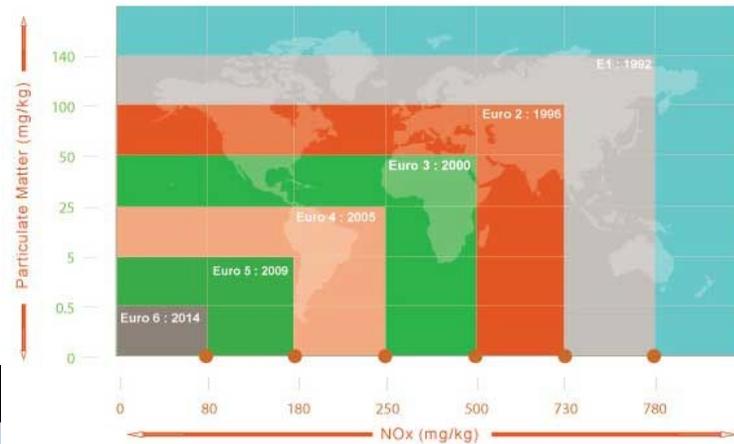


1st Pillar of our Fan-Strategy: Save

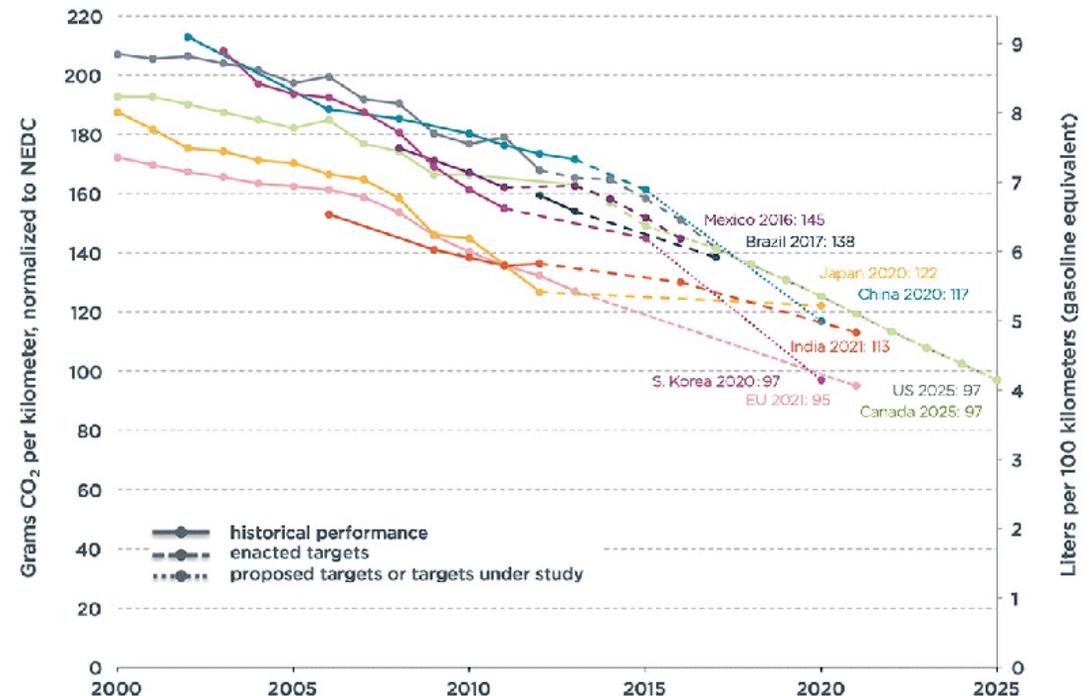
Continuous evolution and optimisation of the powertrains

Fleet renewal with clean and efficient vehicles remains essential

HISTORY OF EURO EMISSIONS STANDARDS
DIESEL PASSENGER CARS



- Euro 6 : 2014
- Euro 5 : 2009
- Euro 4 : 2005
- Euro 3 : 2000
- Euro 2 : 1996
- Euro 1 : 1992

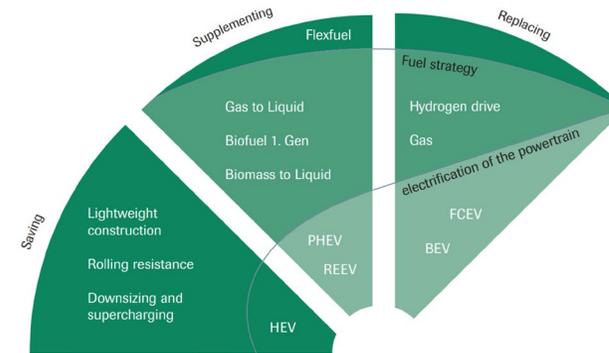
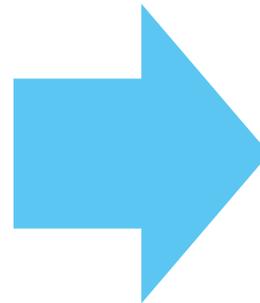


2nd Pillar of our Fan-Strategy: Supplement

Renewable energies can reduce carbon footprint

Regenerative (Bio)Fuels as Drop-In-Quality:

- Ethanol → Gasoline
- Biodiesel → Diesel
- Biogas → CNG
- Regenerative Electricity → fossil electricity
- efuels



- Continuous increase of renewable energies
- Support local agriculture
- Low scale production possible (Biodiesel, Biogas)
- Drop-In-Quality is a key
 - Existing infrastructure can be used
 - Existing vehicles fleet can benefit from de-fossilisation

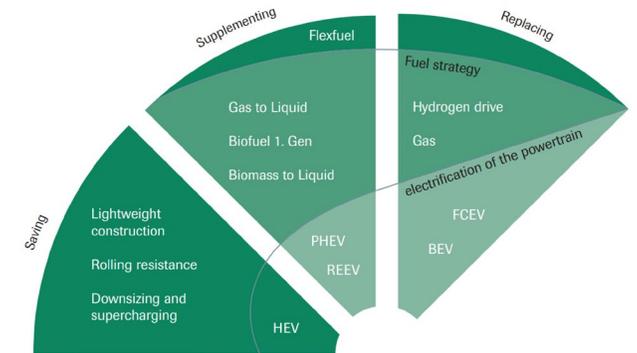
3rd Pillar of our Fan-Strategy: Replace

Electric drivetrains will become part of the powertrain strategy

First lighthouse projects can show a path towards future

Challenges:

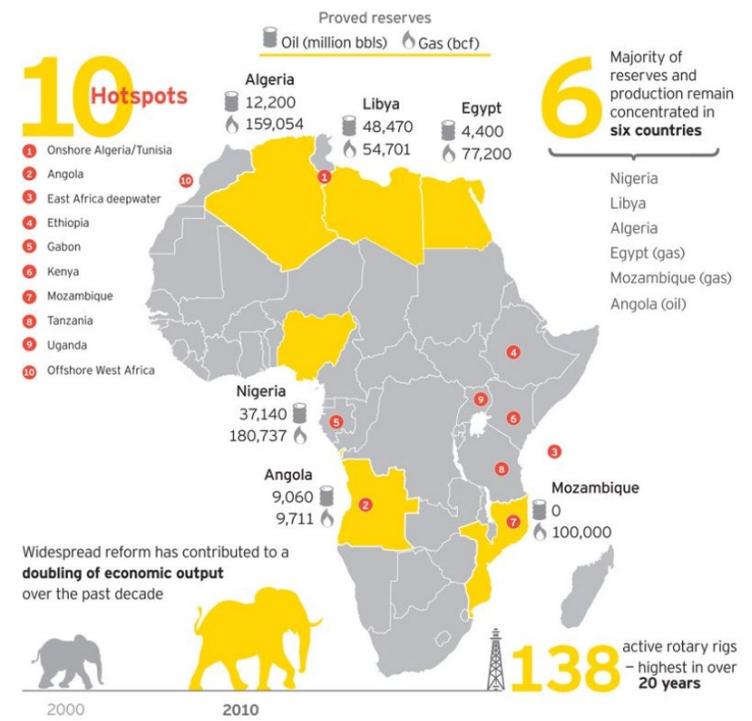
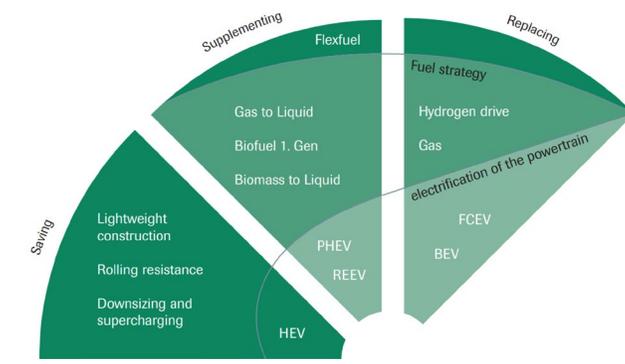
- New production skills
- Local charging infrastructure necessary
- Electric Grid empowerment
- New workshop skills (High voltage)



3rd Pillar of our Fan-Strategy: Replace

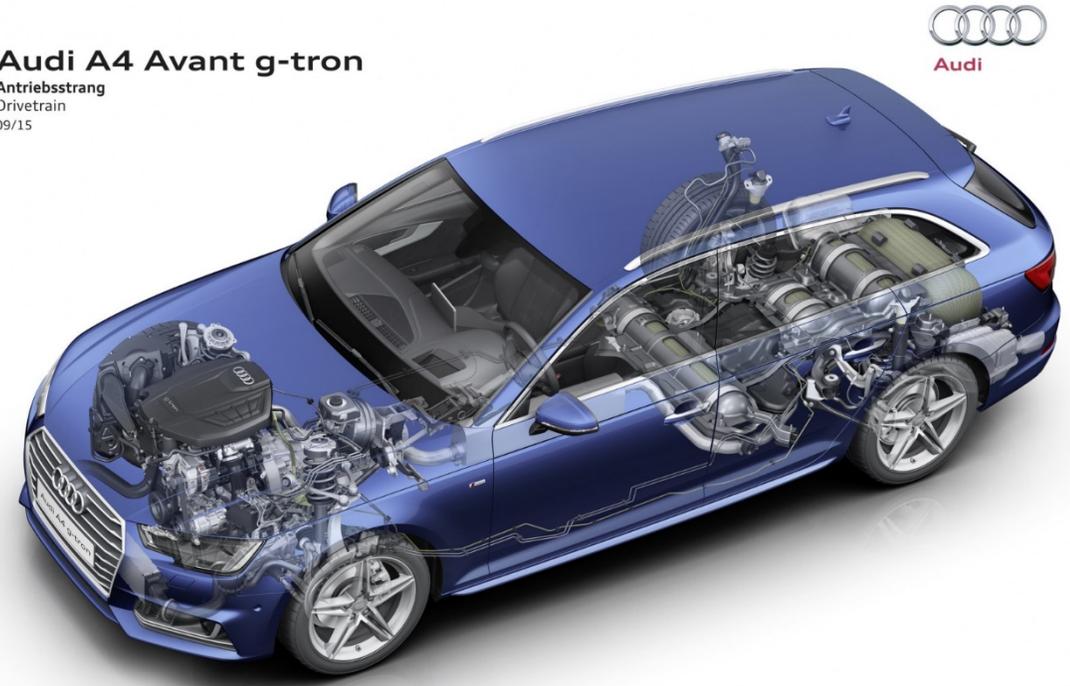
CNG as a realistic option for a cleaner transport

- Robust gasolinetechnology
- Cleanfuel
- High Efficiency
- Sufficient energydensity
- Low carbon fuel
- Large Gasressources



Audi A4 Avant g-tron

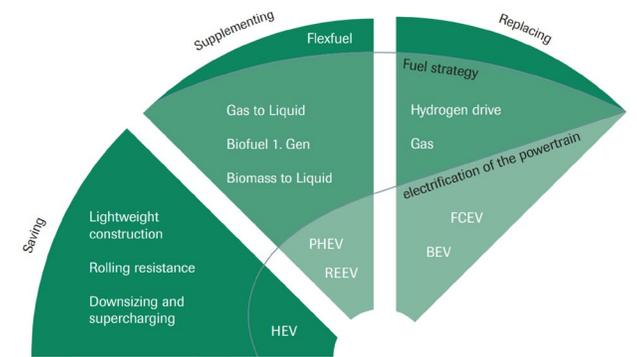
Antriebsstrang
Drivetrain
09/15



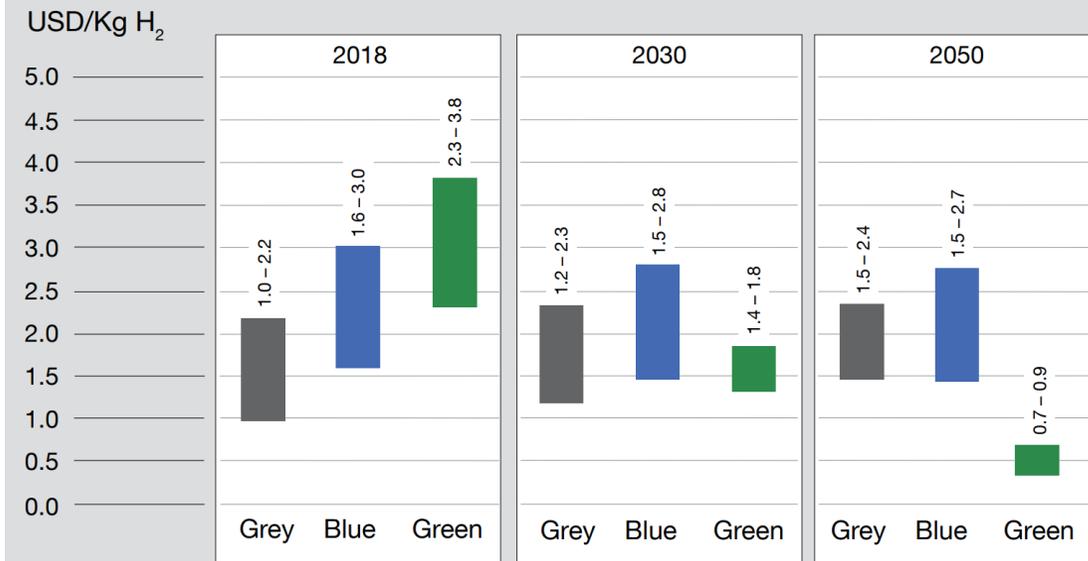
Source: EY, Audi

3rd Pillar of our Fan-Strategy: Replace

Hydrogen as energy carrier: low production and storage costs



Hydrogen cost development by production type



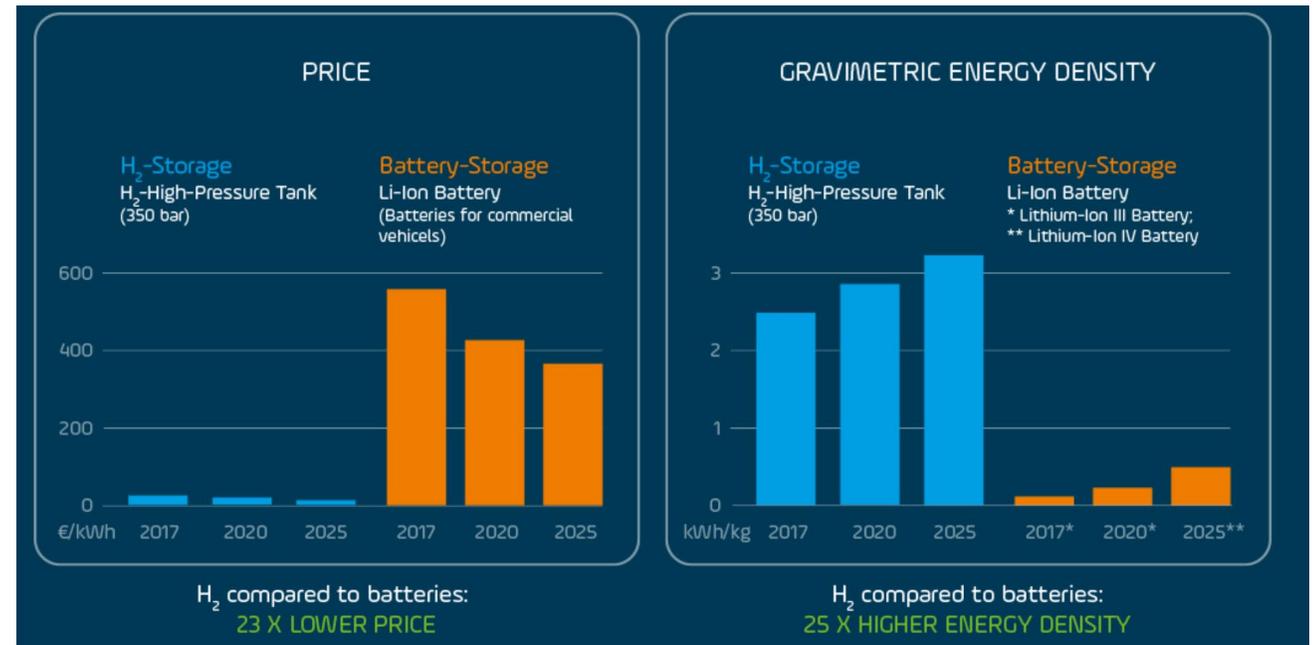
Renewable LCOE (USD/MWh)

30-45

18-26

14-18

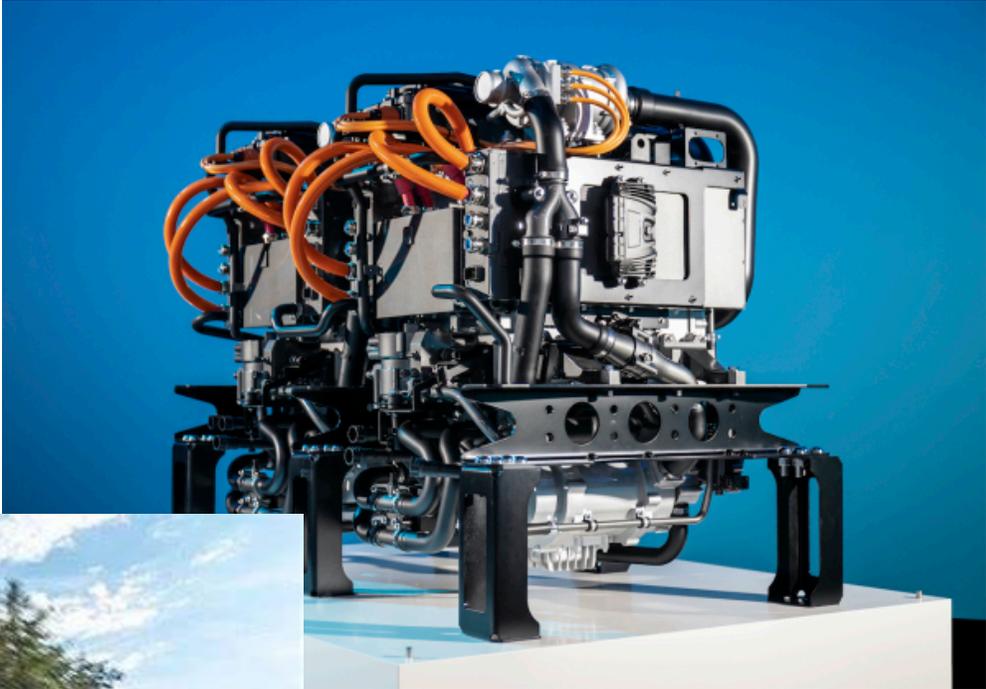
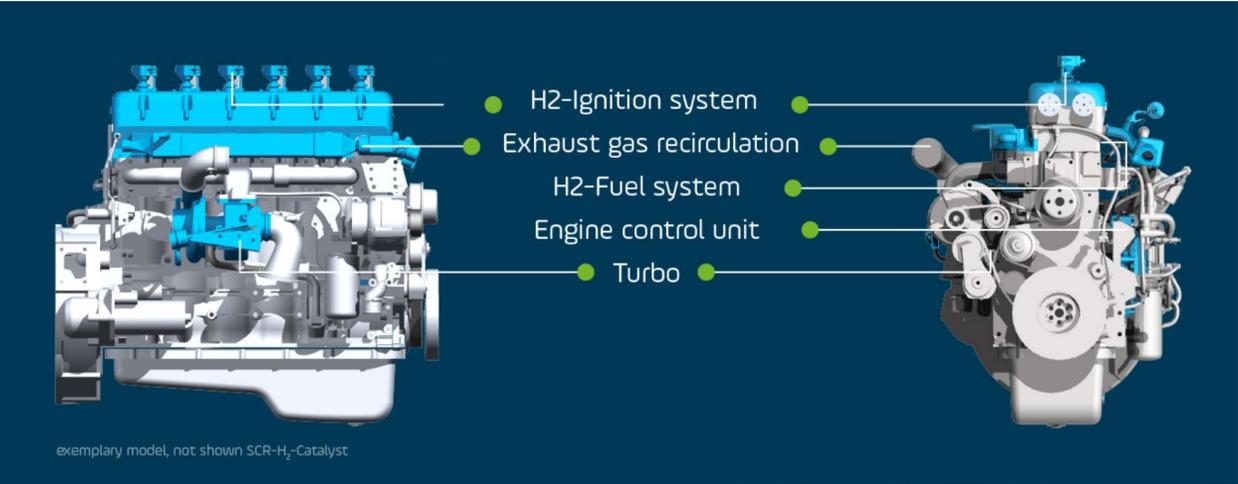
Note: Cost assumptions based on greenfield projects, excluding cost for buildings and cost for building cooling requirements.



Source: KEYOU, IEA

3rd Pillar of our Fan-Strategy: Replace

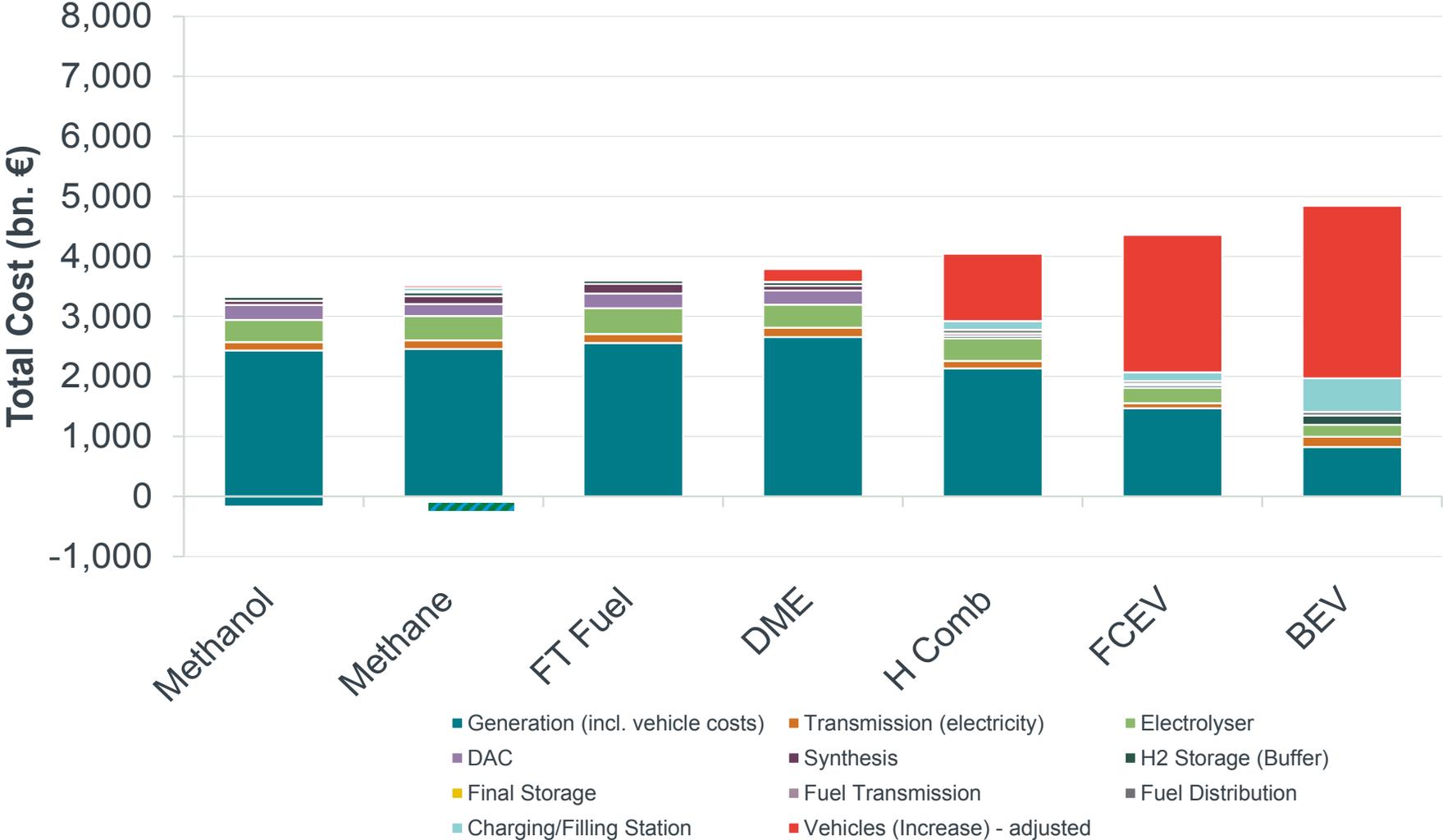
Two powertrain options: Hydrogen Combustion Engine or Fuel Cell /electric powertrain:



Source:
KEYOU, Daimler, Anglo American

Technology Cost Comparison

The FVV Study for climate neutral mobility



Source: FVV, Nov 2021

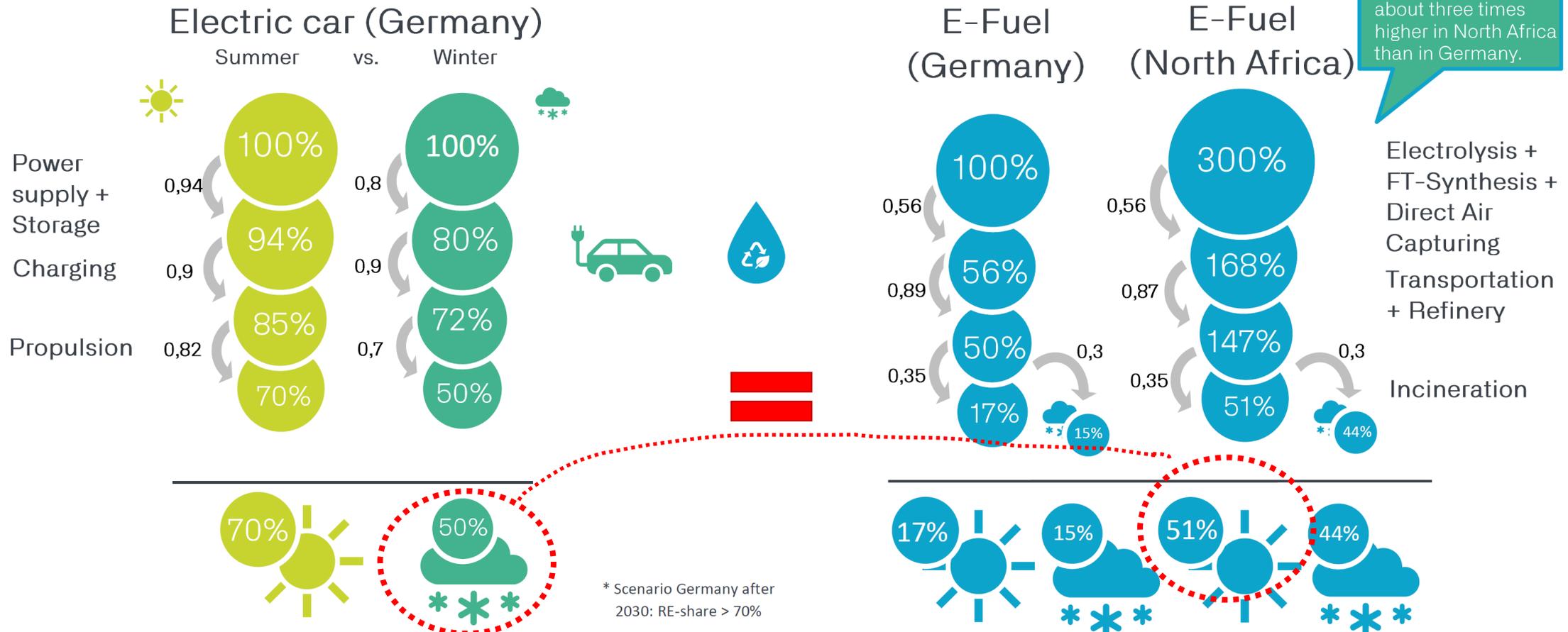
Cost Comparison



Use efficiency of sun and wind in Germany* and favourable locations (e.g. North Africa)

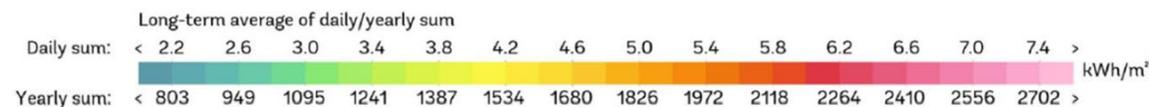
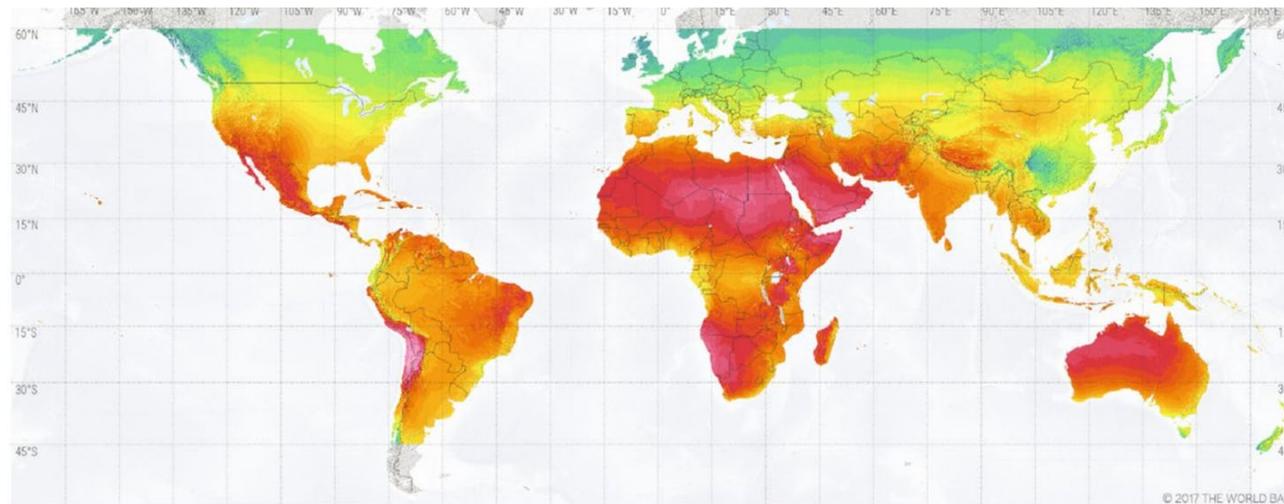
The RE use efficiency depends on the location of RE production, the season & the type of drive

The use efficiency of PV and wind power is about three times higher in North Africa than in Germany.



Lookout: Energy Partnerships, Fuels and possible opportunities for Africa

- To become part of a win-win-EnergyPartnership between Europe and Africa
- To become exporter of fuels and energy
- To create jobs within the energy sector
- To have an positive impact on climate protection for the already existing car fleet within Africa
- Production possibilities:



Thankyou very much for your attention!

Contacts			
<p>Dr. Jakob Seiler</p> <p>Head of Coordination Unit for Drives of the Future and Electric Mobility</p> <p>German Association of the Automotive Industry (VDA) Tel: +49 30 897 842 303 jakob.seiler@vda.de</p>	<p>Marius Ochel</p> <p>Head of Cluster International Association Partnerships Africa and India</p> <p>German Association of the Automotive Industry (VDA) Tel: +49 30 897 842 355 marius.ochel@vda.de</p>	<p>Victoria BackhausJerling</p> <p>Head of Project Office Africa VDA-AAAM Project (South Africa)</p> <p>German Association of the Automotive Industry (VDA) Mobile: +26775968413 victoria.jerling.extern@vda.de jerling@aaamafrica.com</p>	<p>Issaka L. Tetteh</p> <p>Project Manager, ECOWAS Region VDA-AAAM Partner Africa Project</p> <p>African Association of the Automotive Industry (AAAM) Mobile: +233550009965 iltetteh@aaamafrica.com</p>

BACKUP

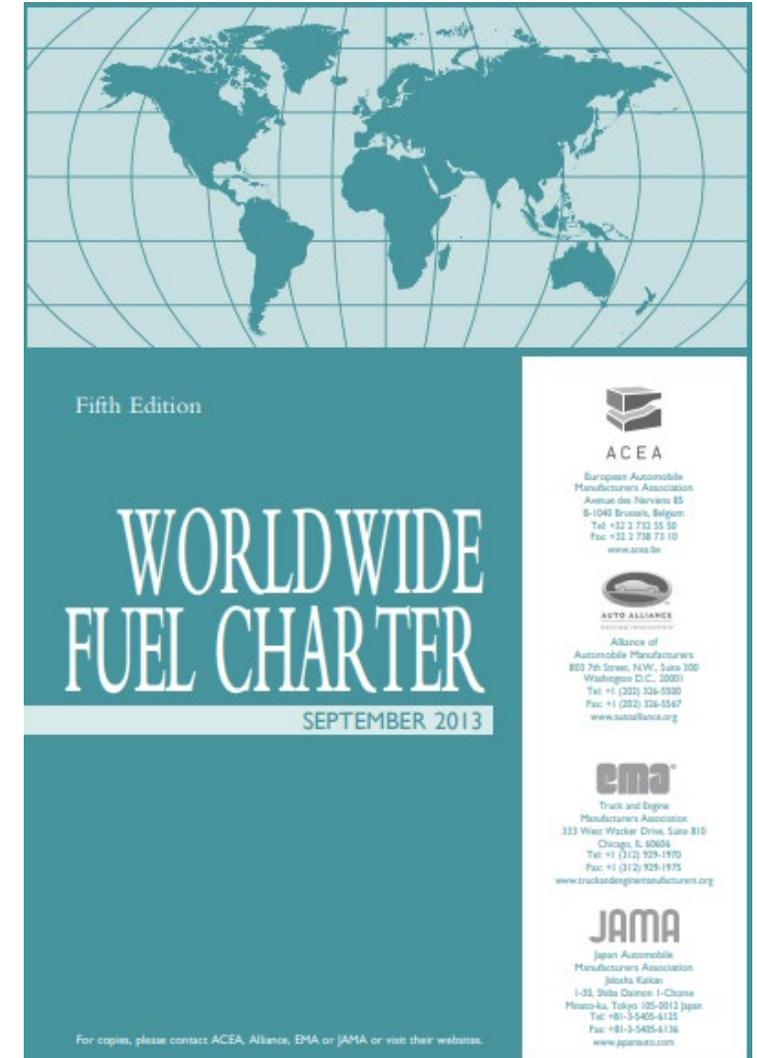
1st Pillar of our Fan-Strategy: Save

58- and 98 agreement of UNECE /United Nations has proven to be successful

- Emission Legislation from Euro 0 to Euro 6
- Worldwide harmonised test- and certification procedures for passenger cars and heavy duty vehicles
- International Type Approval System
- World Wide Fuel Charta
 - Matching Emission Standards and required fuel quality
 - Recommendations for Diesel, Gasoline and Ethanol
 - Different stringency levels to be appropriate for different markets worldwide



Source: UNECE, OICA



Possible Opportunities for Africa

- To become part of a win-win-Energy-Partnership between Europe and Africa
- To become exporter of fuels and energy
- To create jobs within the energy sector
- To have an positive impact on climate protection for the already existing car fleet within Africa

What is needed?

- Governments who want to use this opportunity with i.e. pilot projects supported by industry stakeholders

What's the future of vehicles produced in Africa for Africa? **VDA**

The african cars of the future have to tackle the challenges of the future!



Infrastructure



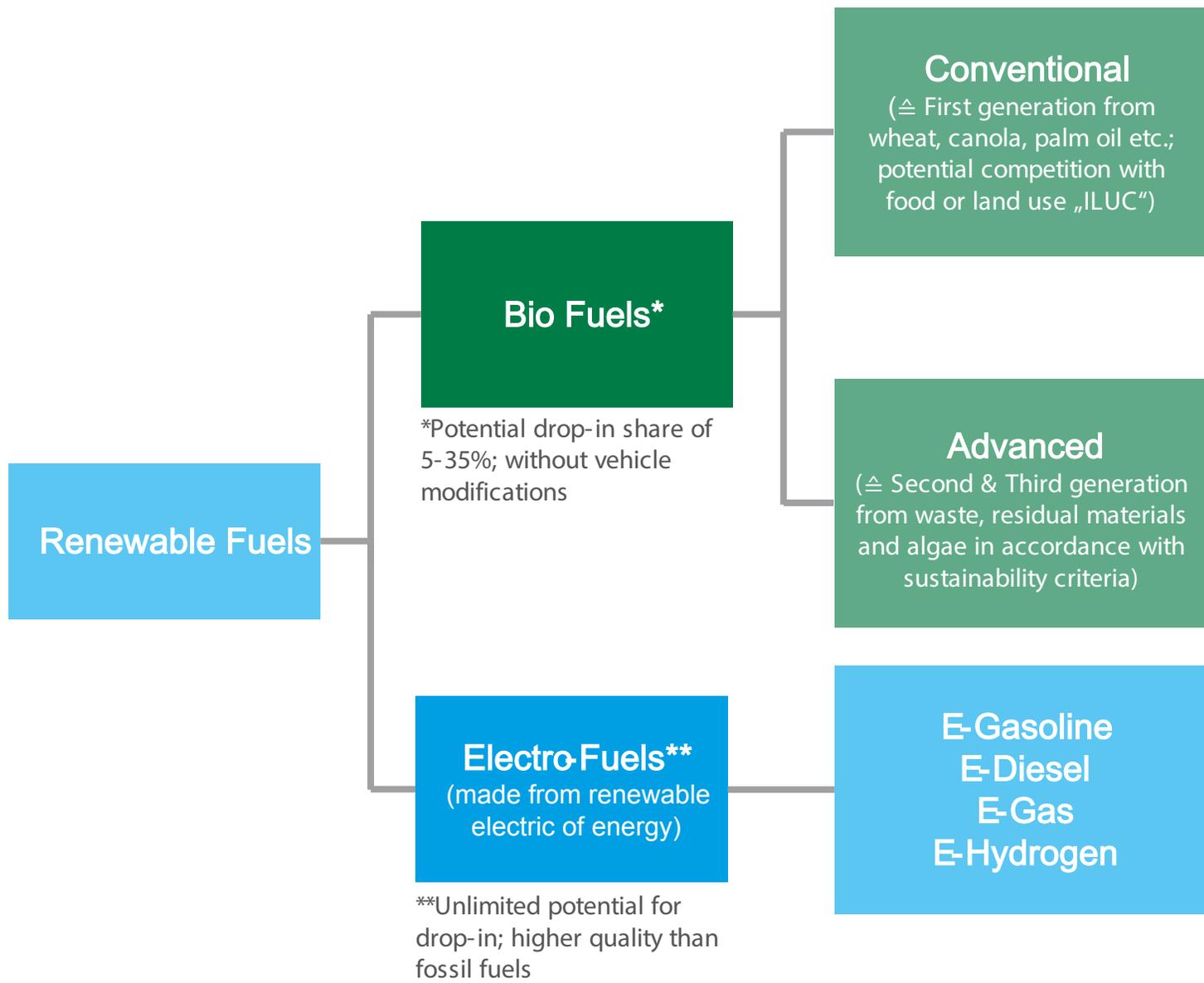
Air Quality



Climate Protection

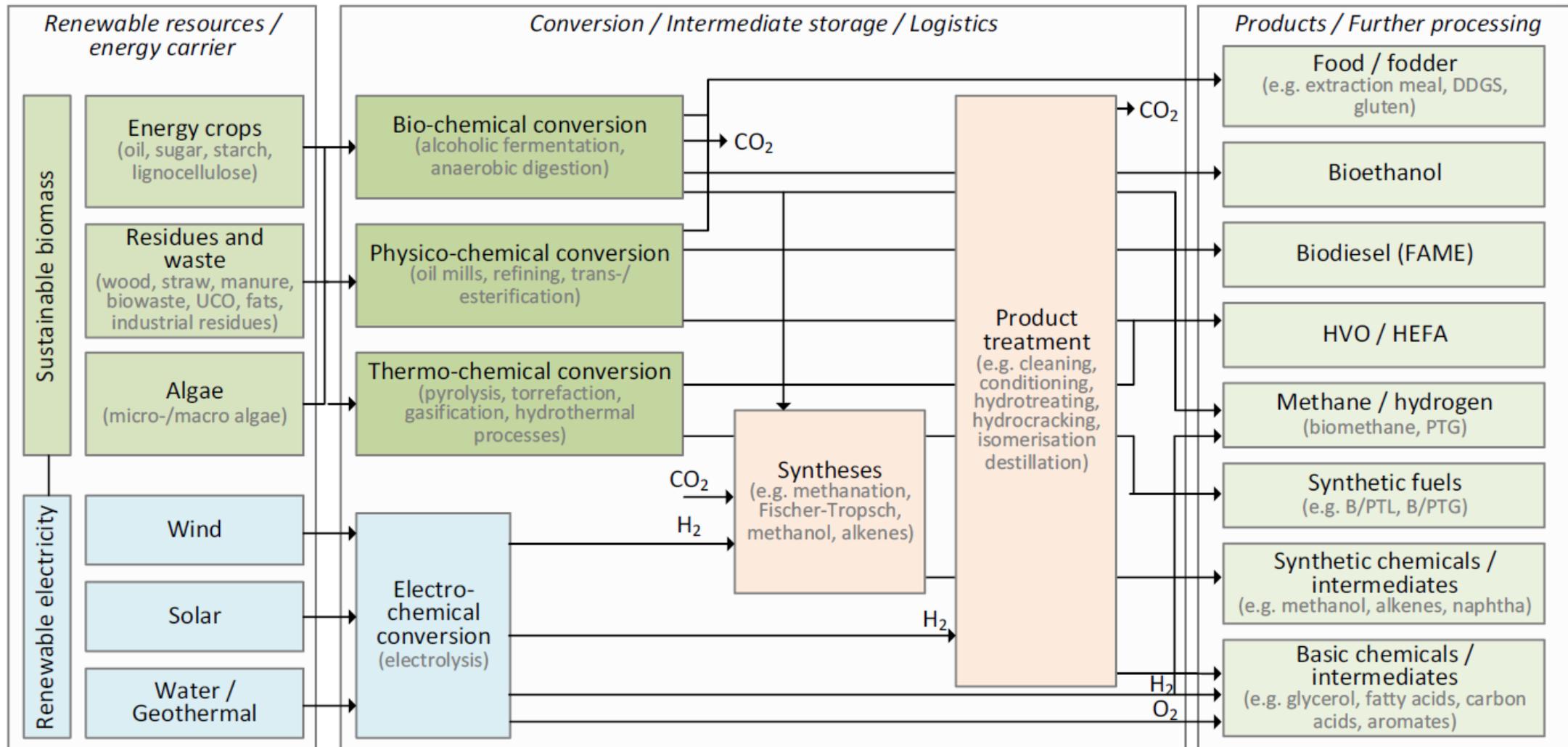


Pathways for renewable energies



Technical routes and synergies

Characteristics of BtX and PtX



SynBioPTx © DBFZ 01/2019 (w/o entitlement of completeness)

B/PTG – Biomass-/Power-to-Gas, B/PTL – Biomass-/Power-to-Liquids, DDGS - Dried Distillers Grains with Solubles, FAME – Fatty acid methyl ester, HVO / HEFA - hydrotreated vegetable oils / esters and fatty acids, UCO – used cooling oil

Identifying the appropriate powertrain/energy-technologies

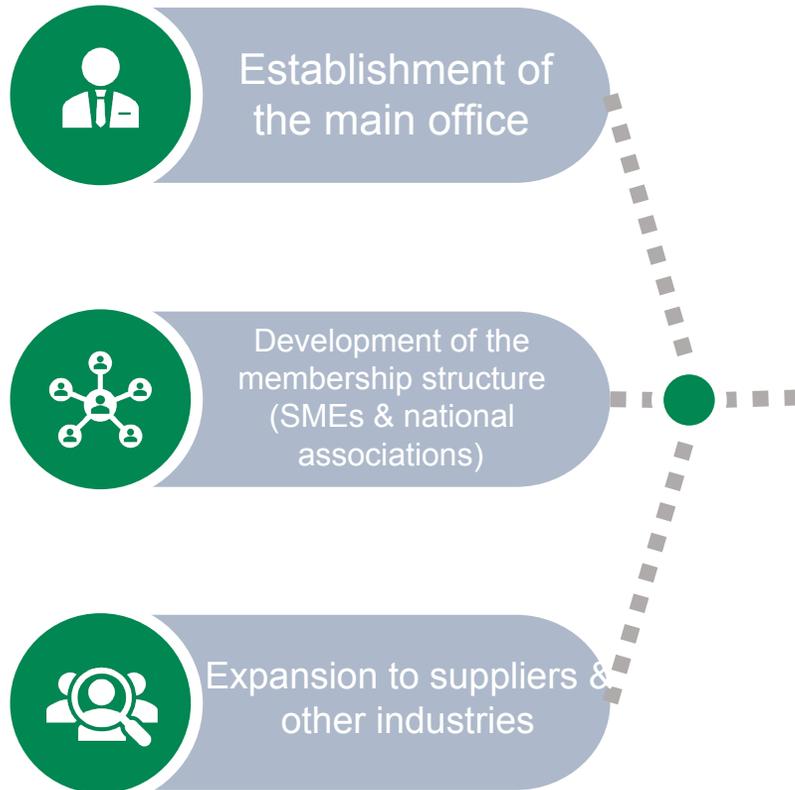
There is no golden bullet

	Powertrain maturity	Powertrain Costs	Efficiency	Energy Supply	Energy Infrastructure	Energy Costs	Eco-Friendly
SI-Engine	++	++	--	+	++	--	--
CI Engine	++	+	-	+	++	--	-
CNG	++	++	-	+	0	-	-
Flex Fuels (Ethanol)	+	++	-	++	++	-	0
H2 Combustion	0	0	-	-	--	0	+
Fuel Cell	--	-	+	0	-	0	+
PHEV	+	-	0	+	++	++	+
BEV	0	-	++	-	-	++	++

Association partnership Germany Africa

Fields of activity

Capacity development and building



Support for the representation function

