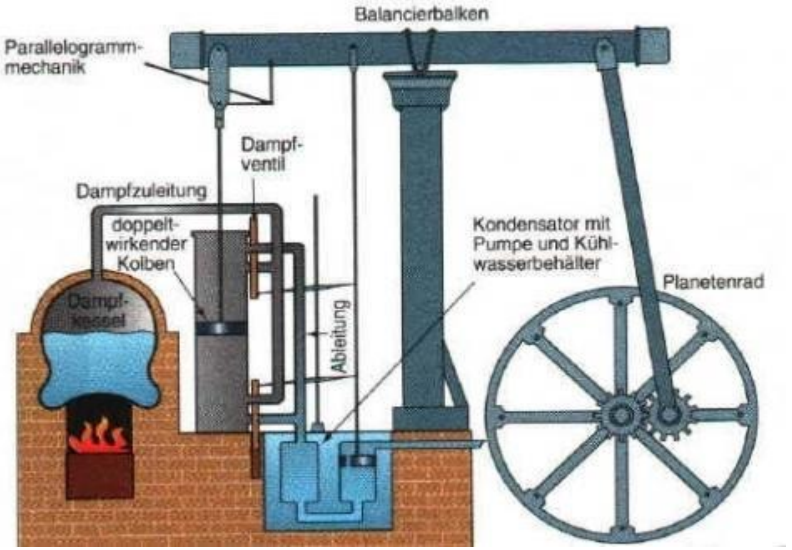
Alternative Fuels – best practices and possible outlook

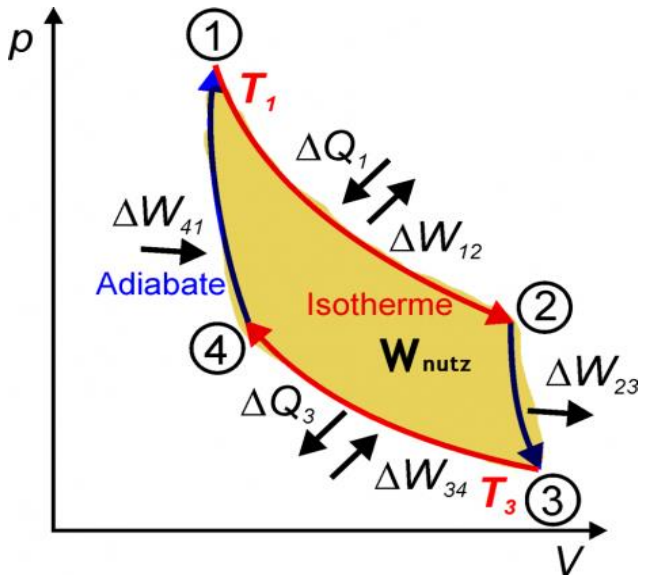
Sebastian Dörr Lubtrading GmbH Know How Trabnsfer Danube 29.9.2020

Society
Cost for infrastructure at harbour's
Space requirements at harbour's
Safety requirements at harbour's
Cost and availability of goods
International Legislation Harmonisation
Fleet Operator
Ship Owner
Type
Size
Performance
Price
Fuel Consumption
Total Cost of Ownership
Experience with Technology
Durability, Service, Lifetime
Logistics at Harbour
Safety
Environment
Limited Emissions
GHG Emissions
Noise
Energy Efficiency
Resources
Sustainable Materials
LCA cradle to grave
Recycling
Waste managment

The world goes electric?

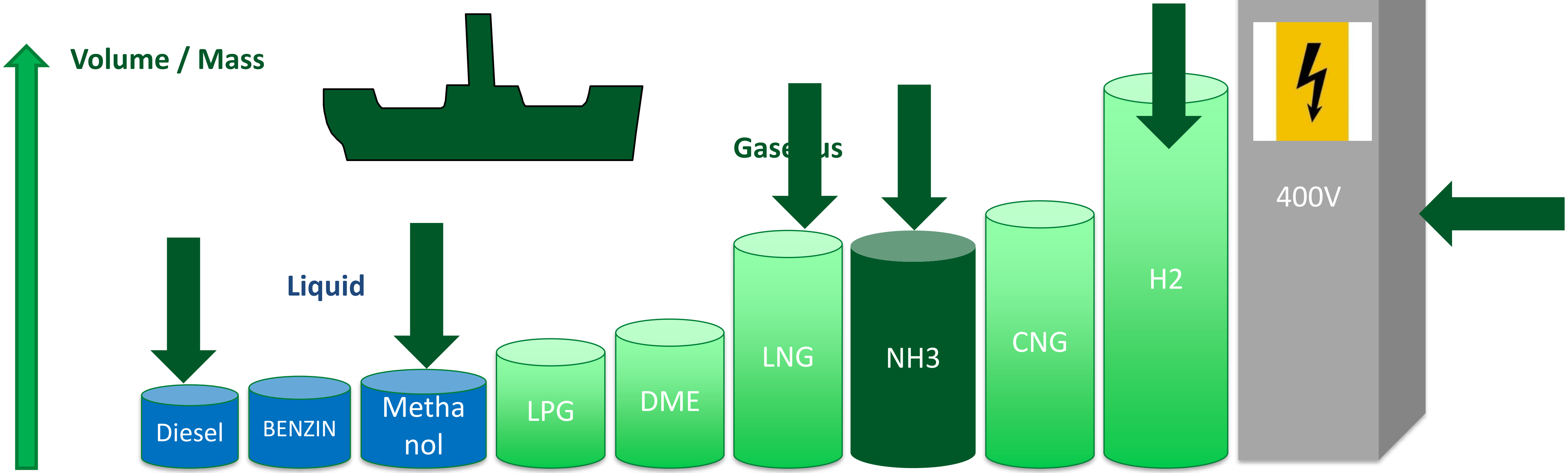
Learning From History…





Steam Engines with Efficiency about 3% have been replaced by diesel engines with efficiency > 25% in the beginning – the success of diesel started
Still today Diesel Engine is most efficient thermodynamic maschine – closed to Carnot process – emissions can be handled (Euro 6d onwards – but how sustainable is the fuel?

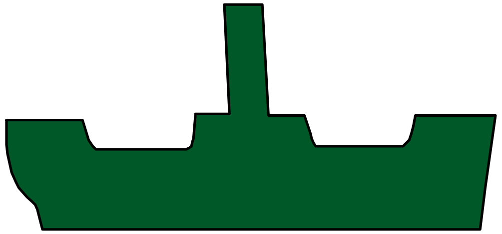
What can be used for marine?



Criteria for Use in Marine Applications:
Experience and Robustness of Technology
Economy and Environmental Aspects
Availability and Logistics

A Ship has Life Time > 50 years!
Technologies need long term proof
Rules to ensure level playing field
Selected Energy available at harbour

What can be used for marine till 2030?



Liquid

Diesel

ULSD Diesel

+ ??

- + Existing and well approved technology
- + Sourcing between several suppliers
- + Global service and maintenance
- + Secured supply and availability
- + Global established logistic
- + Established competitive economy
- + Energy density – space + weight
- + Relatively safe handling

- Emissions of NOx and SOx with Diesel
- Efficient after treatment systems need clean low sulphur diesel
- No Renewable Energy / GHG saving
- High environmental impact at accidents or leackages

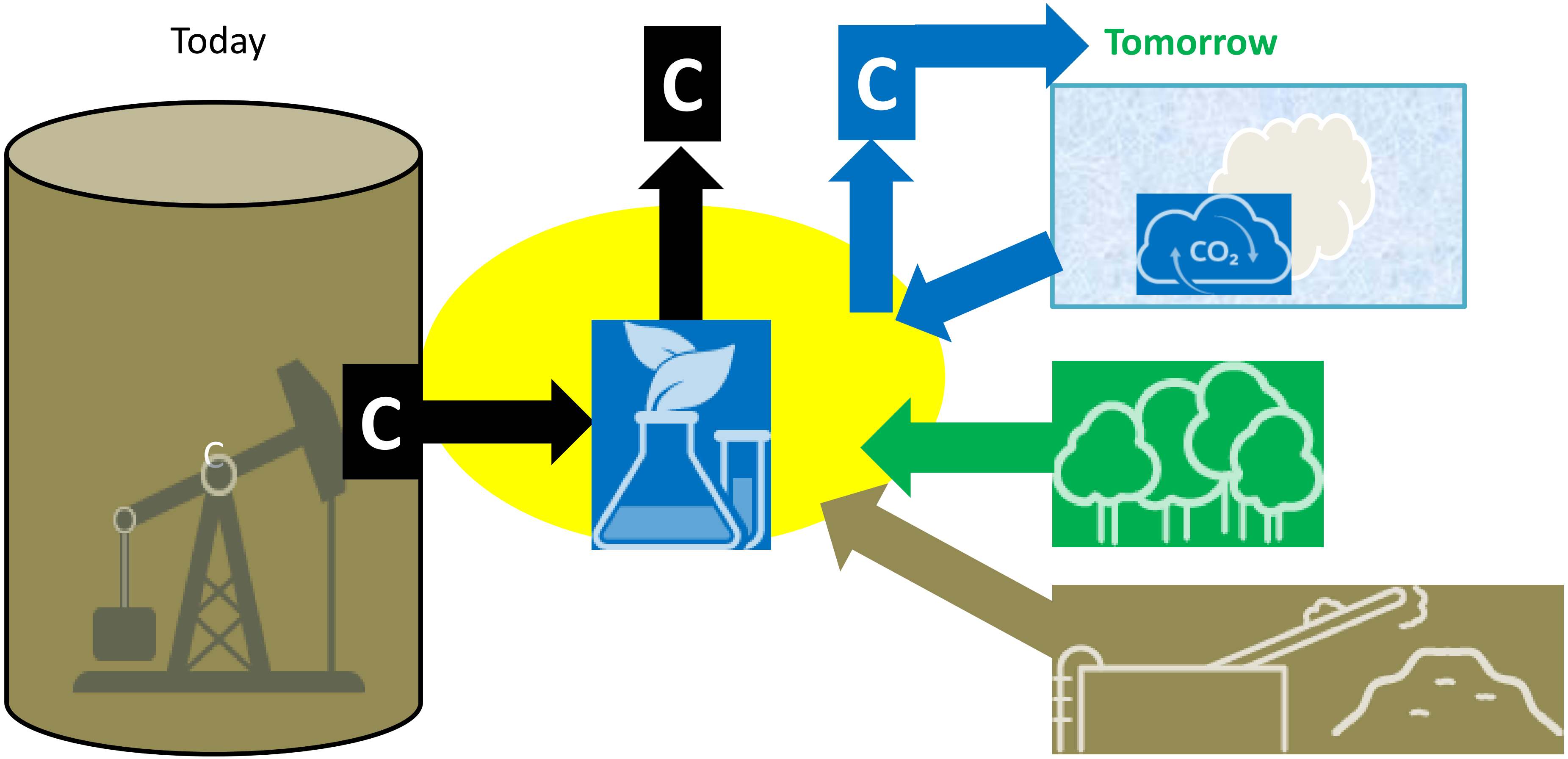
Gaseous

LNG + ?

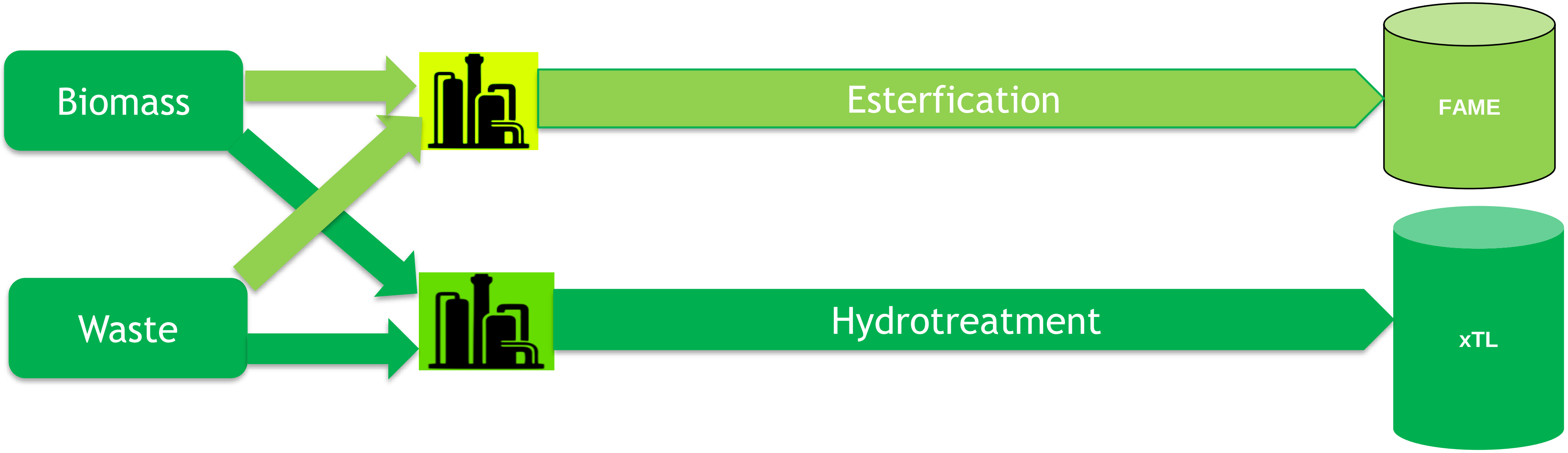
- + Existing and approved technology
- + Sourcing between different suppliers
- + Global service and maintenance
- + Secured supply and availability
- + Established competitive economy
- + low NOx and SOx emissions
- + low environmental impact at leackage

- Higher safety standards for tank
- Higher space demand for tank
- Methan slip needs to be adressed
- Global standard for methan slip needed
- Logistic at main hubs to be established
- Energy demand at logistic (cooling, pressure)
- Risks at accidents

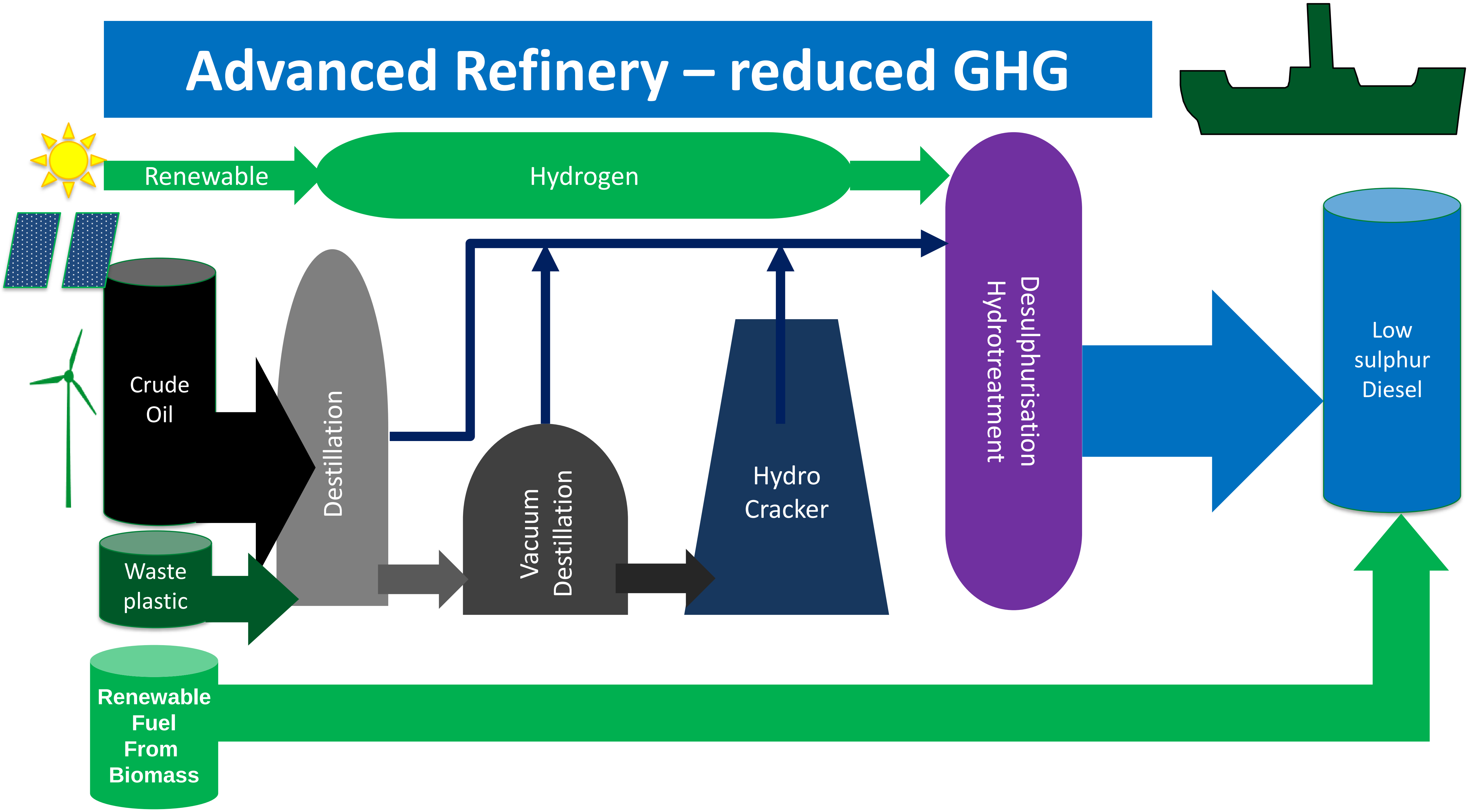
„The Carbon Journey“ How to reduce GHG



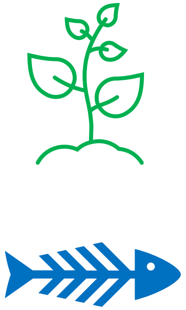
Biofuels from crops and waste are available

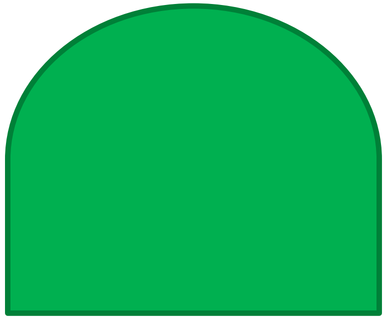


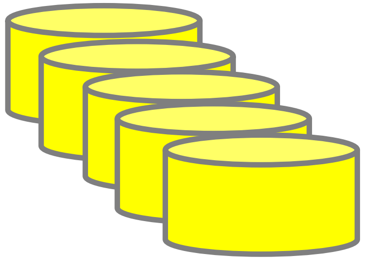
Advanced Refinery – reduced GHG



Liquified Natural Gas from biomass





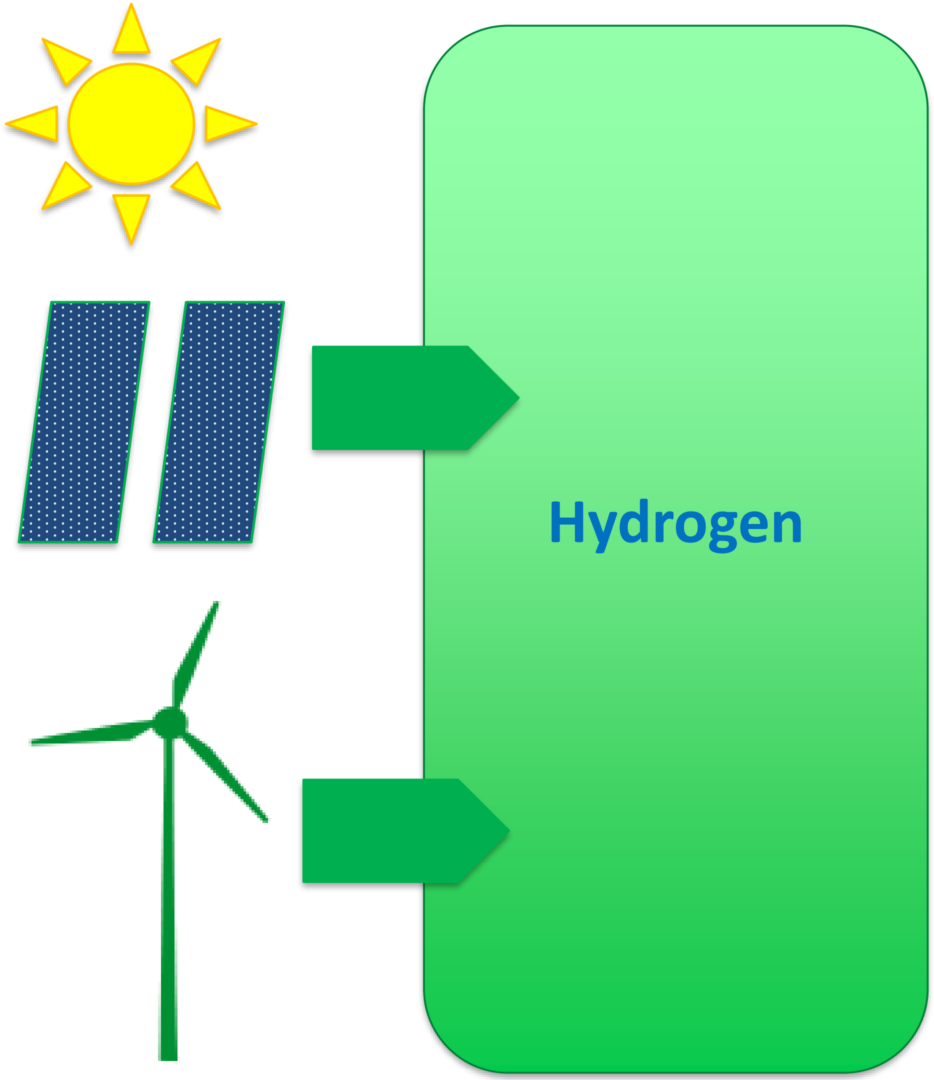


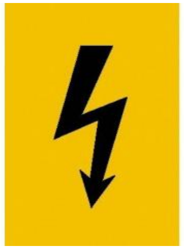
Biomass
Organic
waste

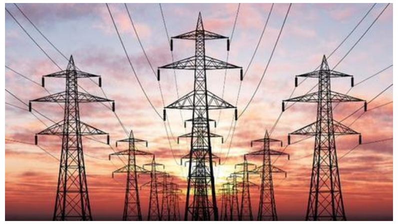
Bio gas
production

Cleaned and conditioned bio gas can be mixed into natural gas in any ratio

Renewable Hydrogen







- Renewable hydrogen from electrolysis can be produced with sufficient electrical energy in almost any amount and can be used as a chemical storage.
- The potential of solar energy on Earth is about 100 times higher than the total primary energy demand
- Not only efficiency, but also cost, storage capability, handling and transport conditions decide what energy carrier is preferred

Any New Fuel Needs A Defined Standard, Availability in Large Scale

Low Sulpher Diesel
+
Bio

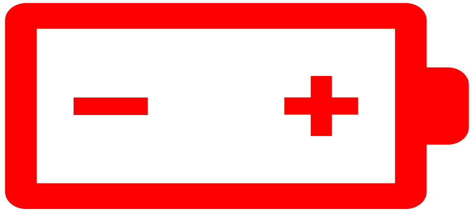
xtl

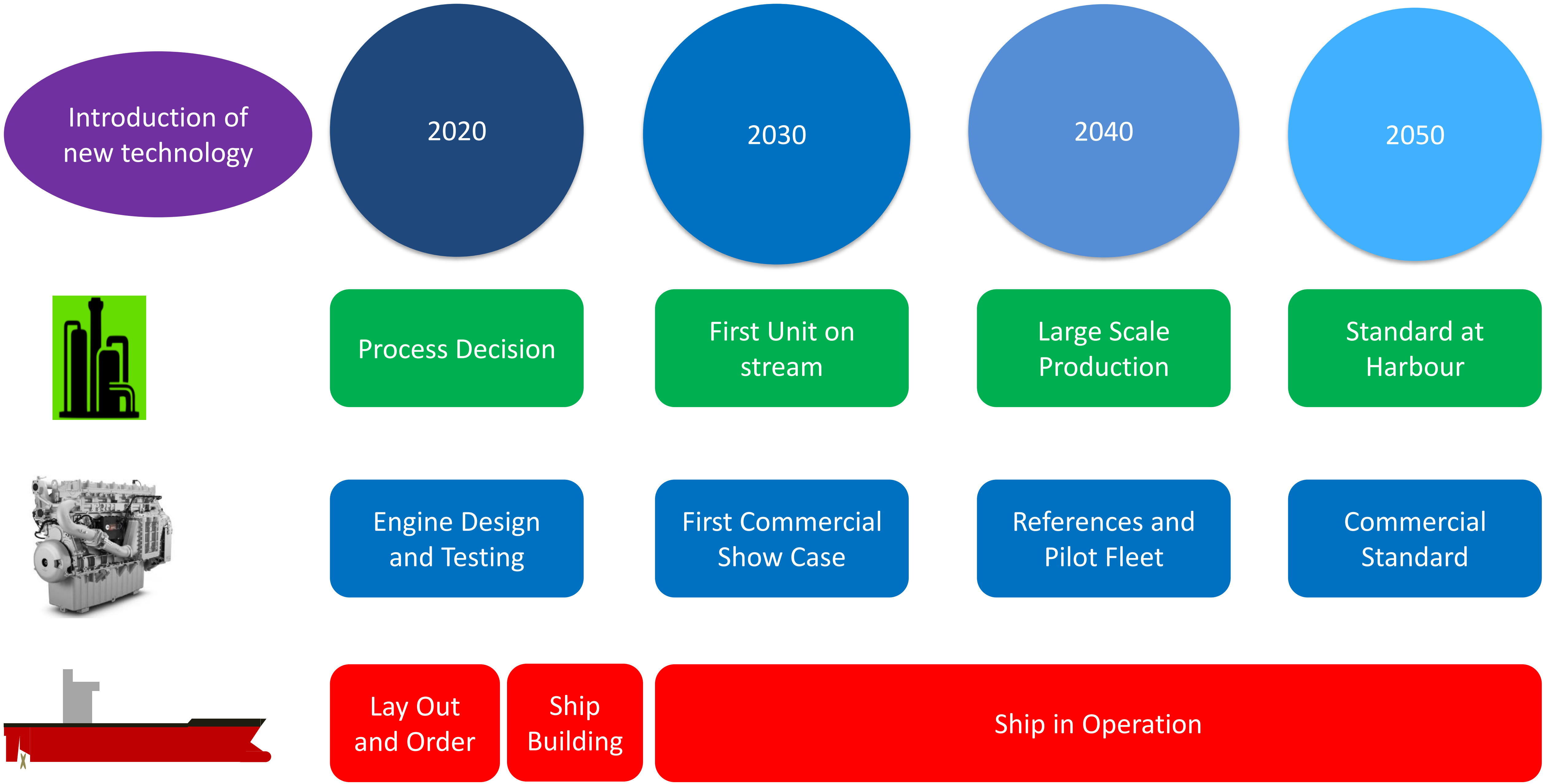
Methanol

LNG
+ BIO

H2

NH3




Introduction of new technology
2020
2030
2040
2050
Process Decision
First Unit on stream
Large Scale Production
Standard at Harbour
Engine Design and Testing
First Commercial Show Case
References and Pilot Fleet
Commercial Standard
Lay Out and Order
Ship Building
Ship in Operation

xTL EN 15940 - Standard from several processes

GTL process Natural Gas Fischer Tropsch

Renewable
Feedstock
Crop
Biowaste
Residues

Hydrotreatment — **HVO Biomass or Residues + H_2**

Gasification — **BTL process**
Fischer Tropsch

Electrolyses renewable power + H_2O — **pTL process**
Energy + CO_2

xTL

Short-term

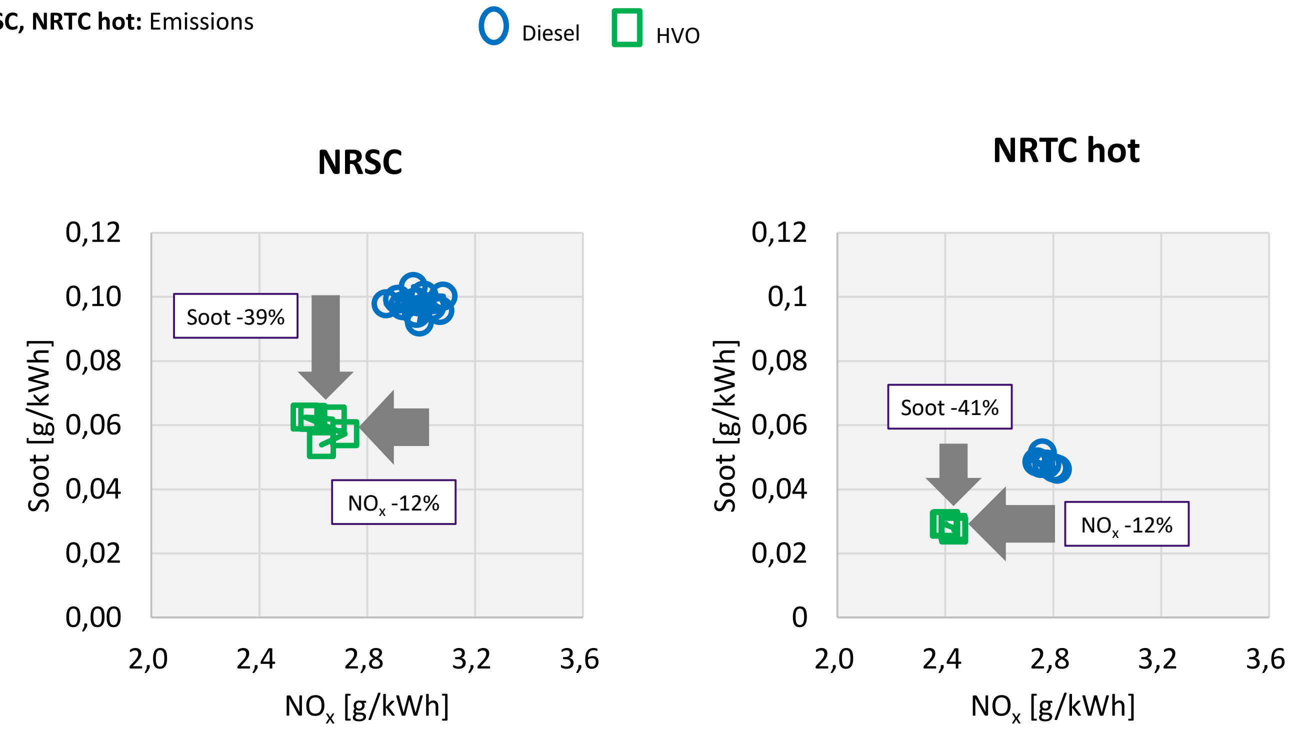
Long-term

Engine Results at a Glance: Example Small OHW Engine

Engine, Engine Dyno
- Stage V / Tier 4f with DPF
- Displacement ca. 2,5 l, 4 cylinder
- Ca. 50 kW
- CRI 2-16 OHW

Test Program
- NRTC (hot)
- NRSC
- Engine map
- Full load curve
- EGR sweeps
- Assessment without DOC/DPF
- Diesel vs. 100% HVO

NRSC, NRTC hot: Emissions



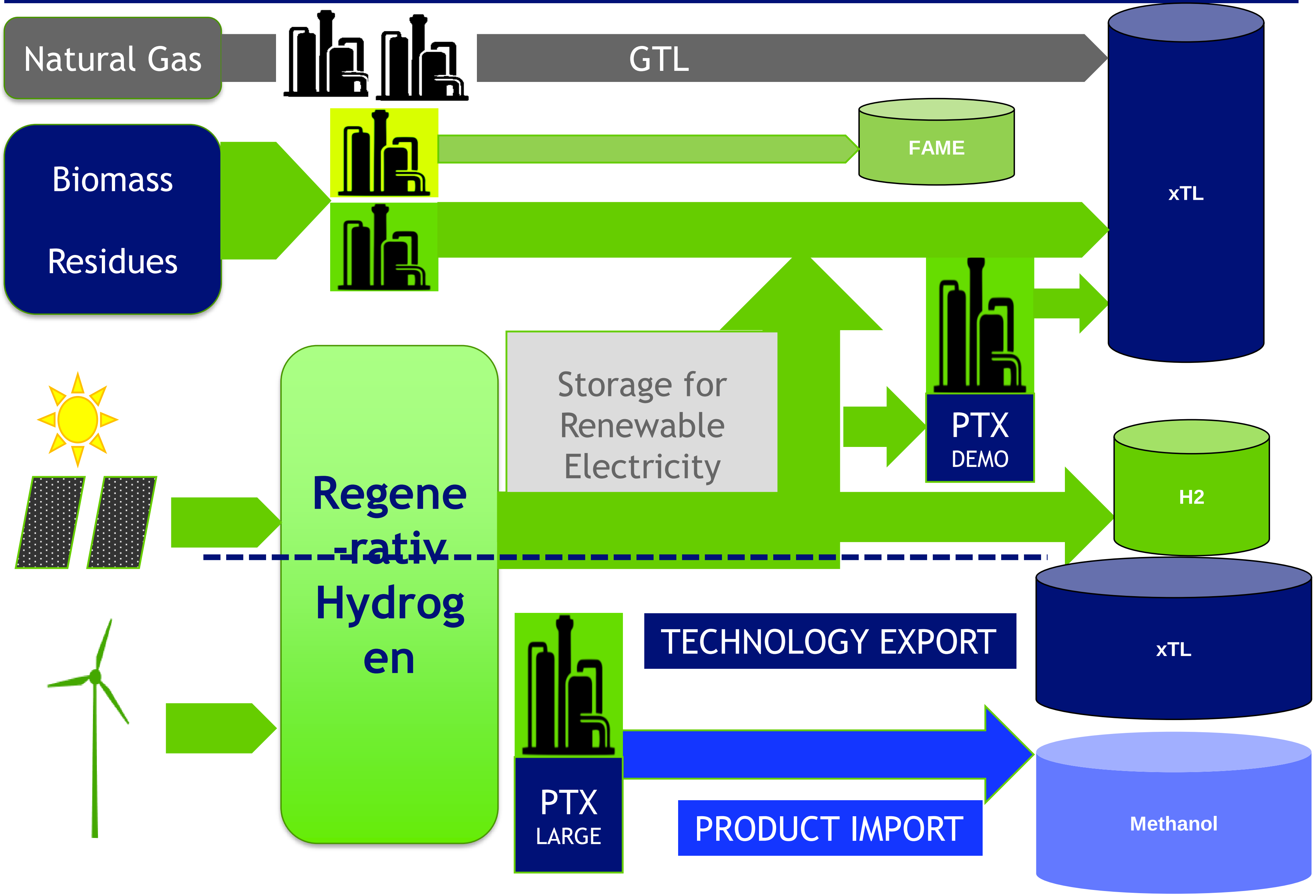
Improved raw emissions → improved tail pipe emissions for strategies without exhaust gas treatment
(e.g. < 56 kW Tier 4f with DOC only)

Source: Robert Bosch GmbH C. Uhr, FEV ZeroCO2Mobility Conference, 2018

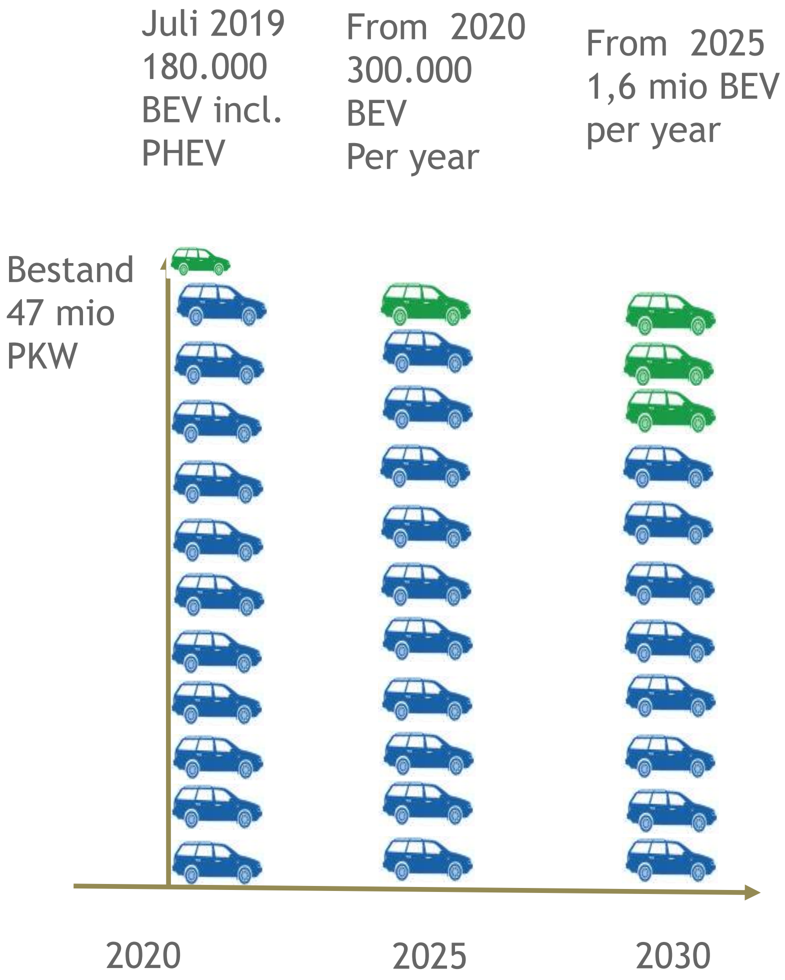
PTL Demand over Time and Application

Time

Strategy for more xtl Fuel



Germany Fleet Till 2030
Target: 10 mio BEV

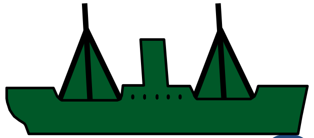


10 mio BEV in 2030 - what is the impact to Climat Targets?

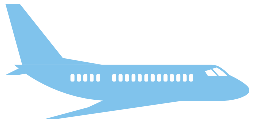
O Battery back pack?
O E mix 2030 - renewable share?
O BEV millage vs all PC?

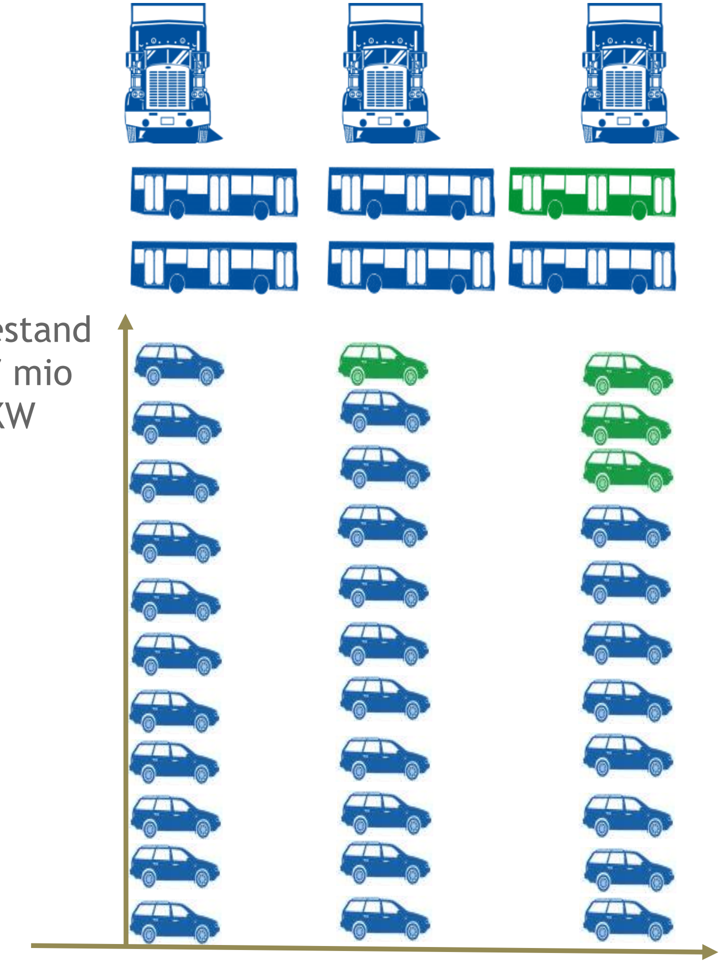
Best case: No Battery back pack
Energy mix 100 % Renewable
BEV Millage equal to average

BEV can reduce GHG of PC about 20% - 25%!



Development Car Fleet Till 2030





10 mio BEV in 2030 - what is the impact to Climat Targets?

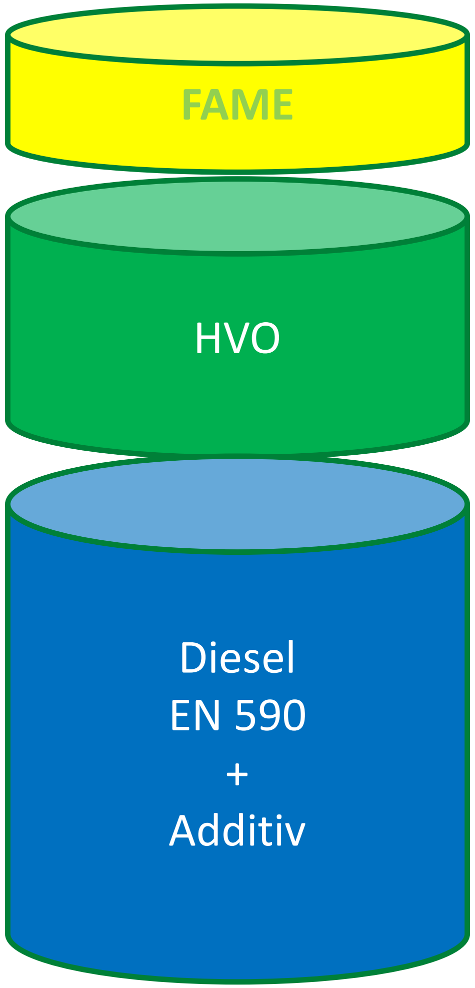
- 75 % of PC are still ICE
- Trucks and Busses are about 80% ICE
- Vessels, Ships and Planes will need liquid fuel for long time

Renewable Liquid Fuels are needed complimentary to pure Electric Drive

Learning from Road Transportation

- Field test with 280 vehicles (PC, truck + buses)
- different manufacturers
- Detailed performance, emission and durability tests
- Project time: August 2012 – August 2014
- Now available at pump stations

Concept of Diesel R33



7 % FAME
From Crop or waste

26 % HVO from crop,
waste, yeast or algae

67 % high quality fossil diesel
+ additiv

Diesel R33 meets **EN 590**

What we can do now – Example Diesel R33

	Fame	Diesel	HVO	R 33
Cetan Zahl	53	53	75-99	> 55
Cloud point (°C)	+15 - -5	0 - -12	-5...-30	< -22
Heizwert (unterer)(MJ/kg)	37	43	44	43
Density at +15 °C (kg/m3)	880	830	780	830
Kin. Viskos. (20°C) in mm²/s	5	5	4	5
Sulfur content (mg/kg)	<10	10	0	< 10
Destillationsberreich°C	> 320	180 - 360	180 - 320	180 - 360

Diesel R 33 fullfills EN 590, save > 20 % GHG
R33 can utilise all biofuels and feedstocks available today and in future and can bridge the time before ptx fuels are available in large scale – without new logistics or combustion technic

New fuels will be blends –fuel Roadmap

2020 **2025** **2030** **2035** **2040**

EN 590
Maingrade

Higher paraffinc share

R33Blue Diesel
regenerative

EN 15940

EN 15940
Maingrade

For specific use
slight adoprions of actual engines
option: „City-Diesel“

paraffinic Diesel

EN 15940 mod.

EN 15940 mod.
Maingrade

For specific use
hardware changes

Paraffin
\+ blend OME

T. Garbe, H. Broeker, L. Kunkel, M. Unglert, J. Krahl

tac
technologietransfer automotive
hochschule coburg

No future for combustion engines?