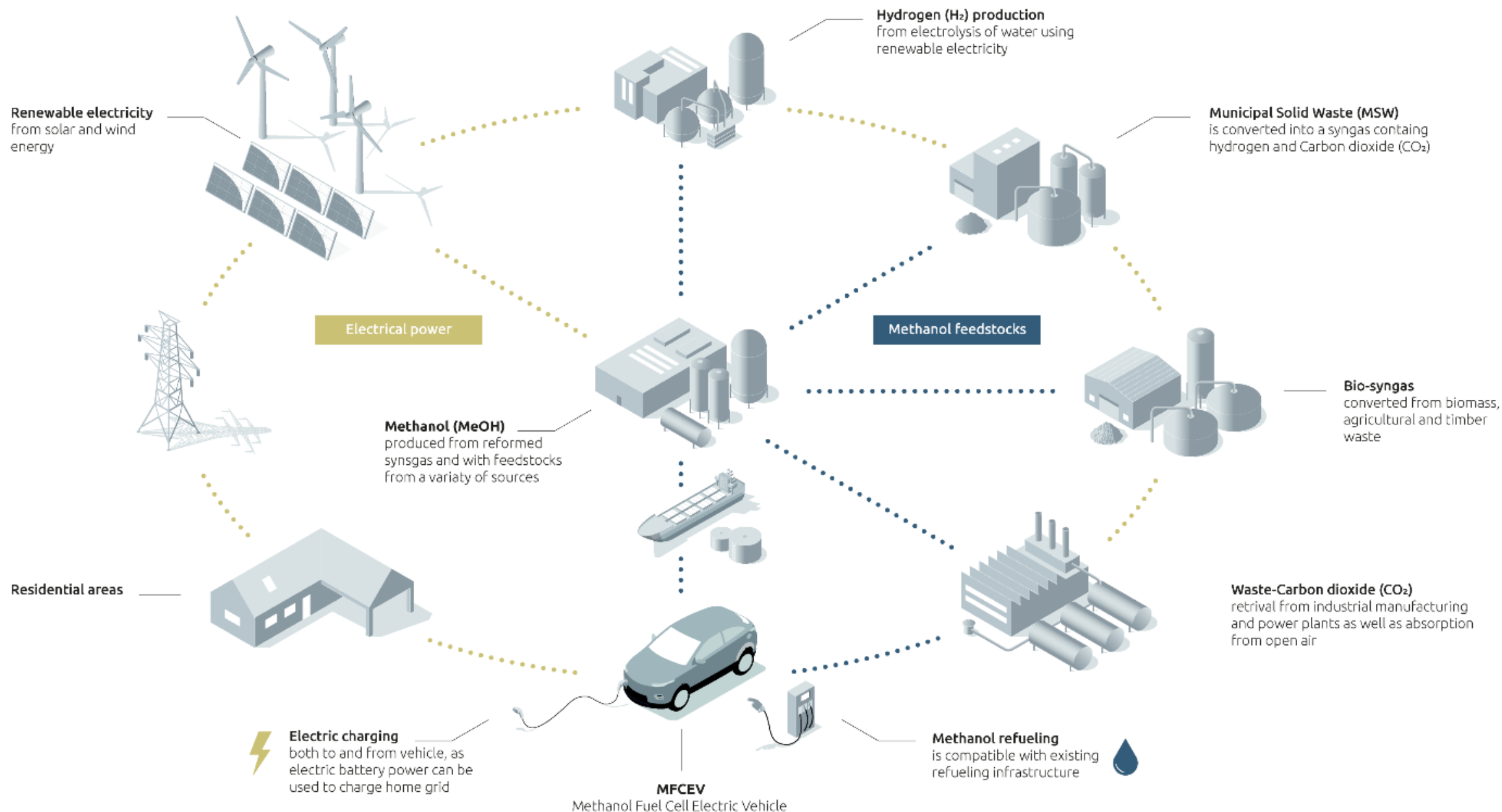


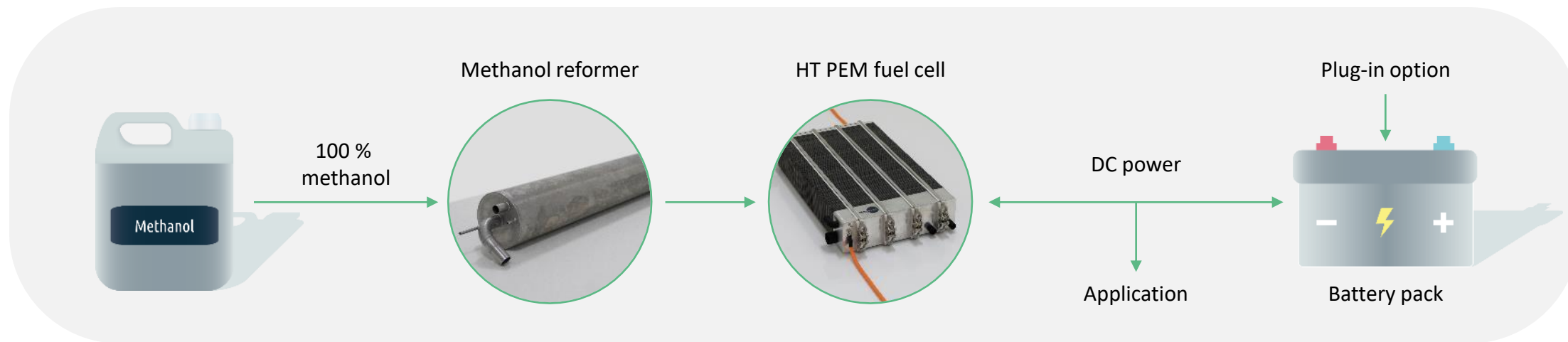
Methanol Fuel Cell

The key to decarbonizing

By Mads Friis Jensen, CCO and Co-founder of Blue World Technologies



Methanol fuel cells - a **green** alternative



Markets



APU



Automotive

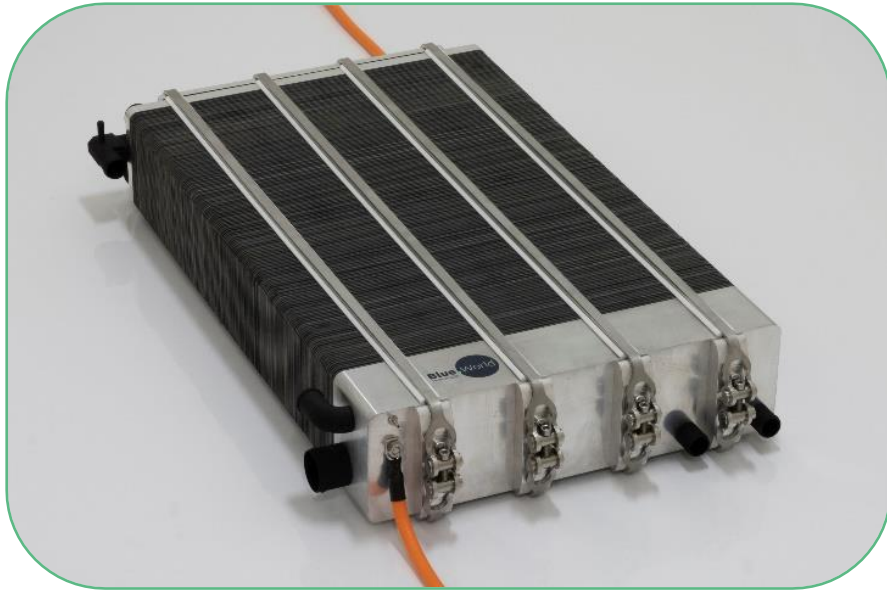


Heavy duty

General USPs

- ✓ CO₂ reduction
- ✓ Cost savings
- ✓ Zero harmful emissions

Methanol fuel cell system - key components



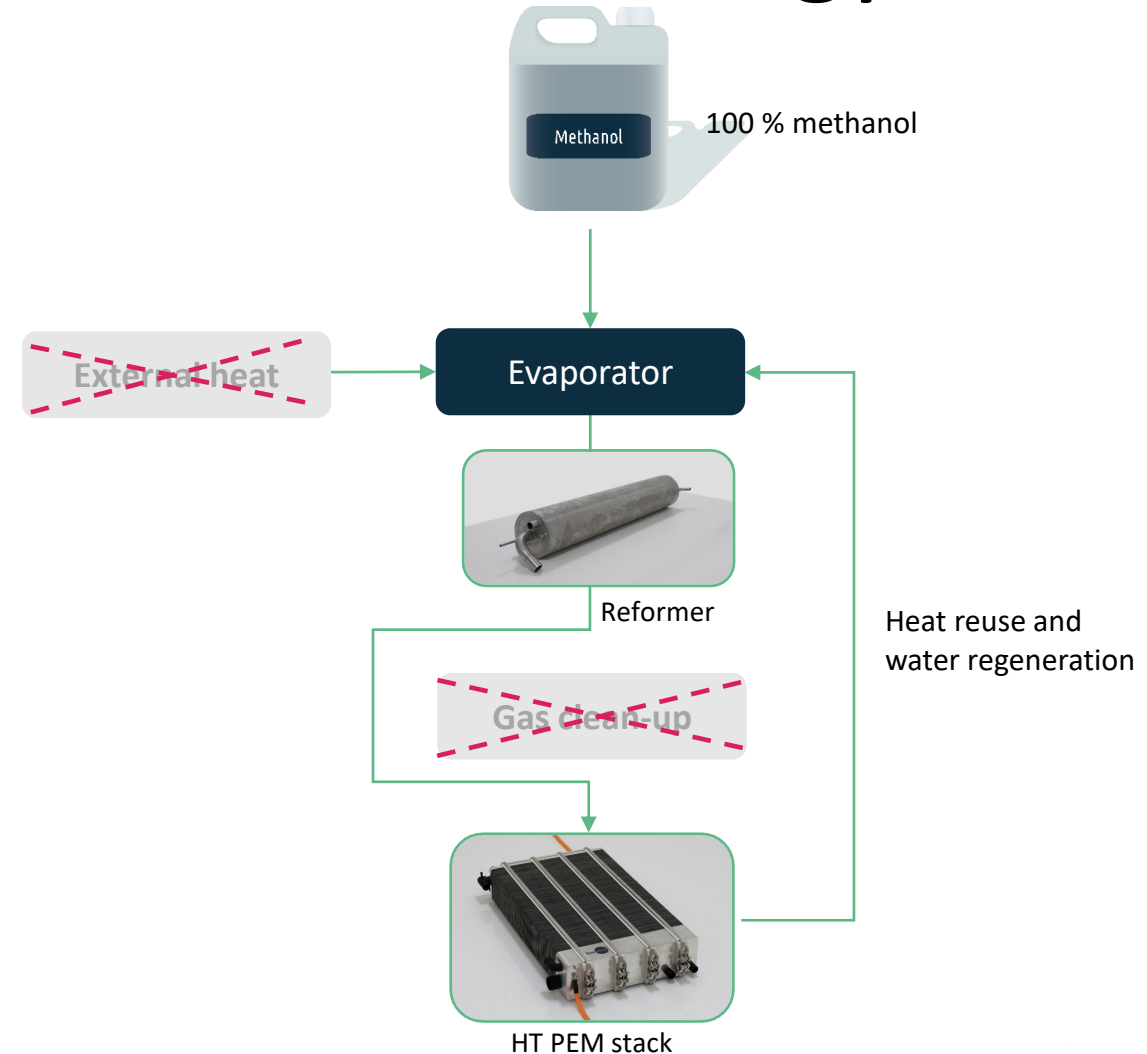
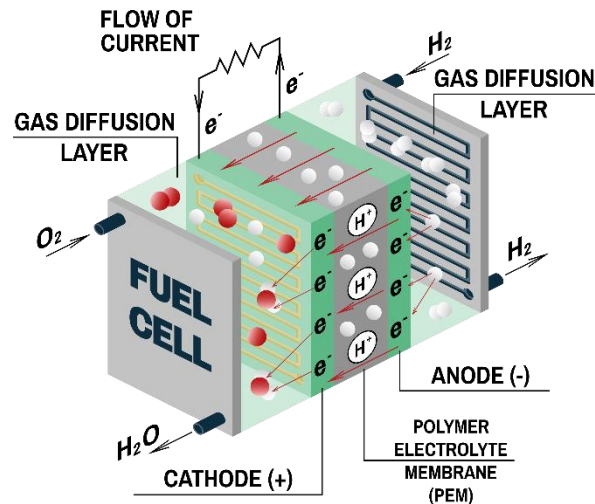
High Temperature PEM Stack



Methanol Reformer

Superior High Temperature PEM technology

- No external heat needed as waste heat drives fuel evaporation process = **higher** conversion efficiency
- No gas clean-up needed = **simple** and cost effective system
- Water regeneration = **increased** energy storage



Air pollution and CO₂ emission

Blue World Technologies **makes a difference** with zero harmful emission fuel cell technology

7 million

people die every year from exposure to fine particles in polluted air

Out of the 7 million premature deaths

4.2 million

die as a result of exposure to ambient air pollution

91%

of the world's population lives in places where air quality exceeds WHO guideline limits

The transport sector

is responsible for a large proportion of urban air pollution

zero harmful emission:

- No particle emission
- CO₂ tail-pipe reduced by 50-60%
- CO₂ well-to-wheel as hydrogen/electric

Neutrality = decarbonisation

Tank to wheel - methanol fuel cell:

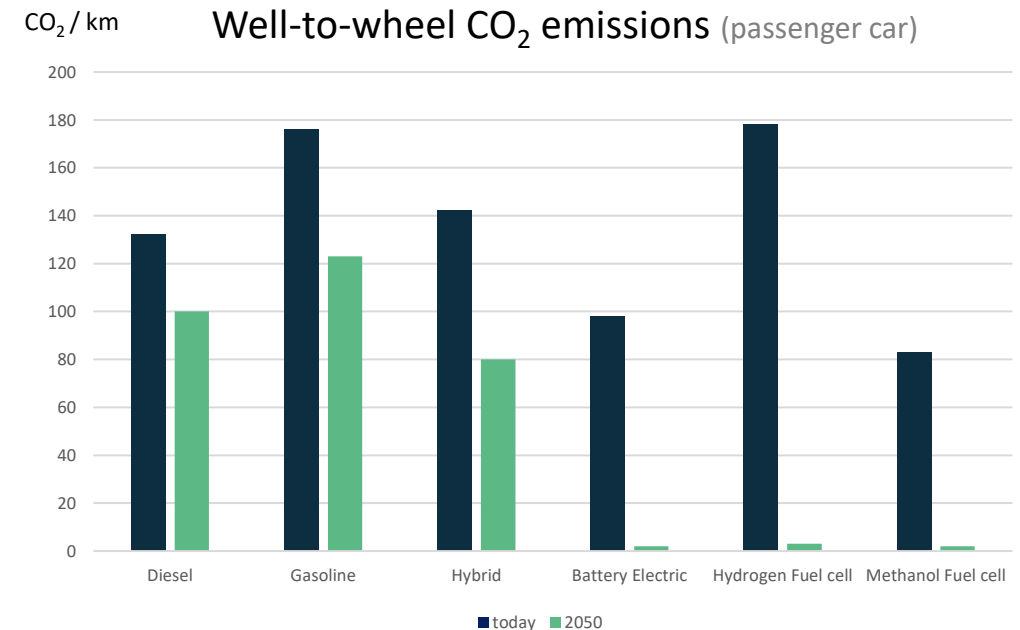
- ~500 g CO₂/kWh
- 30-50 g CO₂/km
- **Zero harmful emissions**

Today:

- Energy mix: oil, coal, natural gas, wind, solar, biomass









2050:

- Renewable energy sources: biomass, solar, wind, biogas



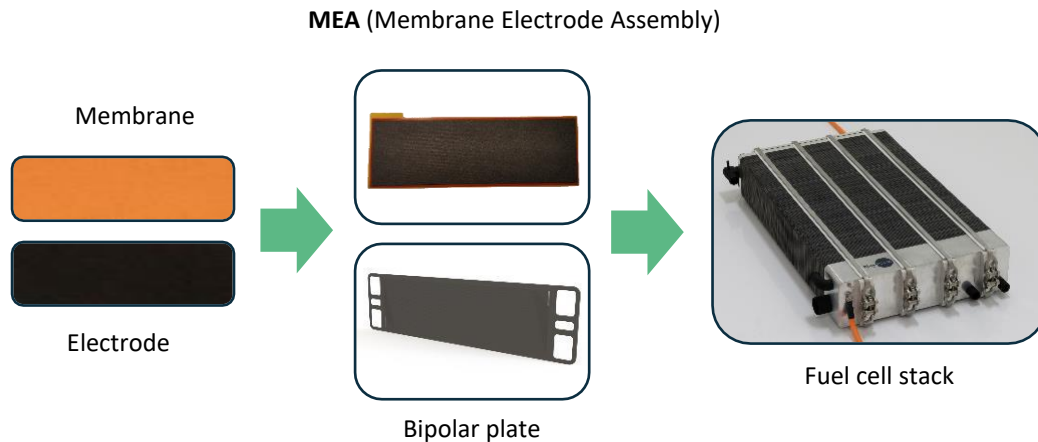
Source: Danish Department of Energy – Alternative drivetrains 2014

Suitable applications

<div>  Public transport </div>  <div> <div> Electric version 243 kWh li-ion battery </div> <div> Methanol FC version <ul style="list-style-type: none"> 30 kWh battery 35 kW FC 500 L methanol </div> </div>	<div>Benefits</div> <ul style="list-style-type: none"> ✓ Increase operation time from 8 to 28 hours ✓ 50% reduction in power pack costs ✓ 65% reduction in power pack weight ✓ Free fuel cell heat for user comfort ✓ 3 min refuelling instead of overnight charge
<div>  Light commercial vehicles </div>  <div> <div> Electric version 100 kWh li-ion battery </div> <div> Methanol FC version <ul style="list-style-type: none"> 20 kWh battery 25 kW FC 100 L methanol </div> </div>	<div>Benefits</div> <ul style="list-style-type: none"> ✓ Increase range from 240 km to 520 km ✓ 20% reduction in power pack costs ✓ 60% power system weight reduction – more payload ✓ Free cabin heat ✓ 3 min refuelling instead of overnight charge
<div>  Heavy duty trucks </div>  <div> <div> Electric version 700 kWh li-ion battery </div> <div> Methanol FC version <ul style="list-style-type: none"> 60 kWh battery 100 kW FC 900 L methanol </div> </div>	<div>Benefits</div> <ul style="list-style-type: none"> ✓ Increase operation time from 8 to 24 hours ✓ 50% reduction in power pack costs ✓ 100% weight reduction ✓ Free cabin heat for operator comfort and clear windows ✓ 3 min refuelling instead of overnight charge
<div>  Maritime applications </div>  <div> <div> Electric version 4.3 MWh li-ion battery </div> <div> Methanol FC version <ul style="list-style-type: none"> 400 kWh battery 1200 kW FC 6500 L methanol </div> </div>	<div>Benefits</div> <ul style="list-style-type: none"> ✓ Unlimited availability of the E-ferry ✓ 190% reduction in power pack costs ✓ 250% weight reduction ✓ Free heat for operator and traveller comfort ✓ 30 min refuelling instead of overnight charge

Industrialising the methanol fuel cell technology

- Production of core materials, key components, and fuel cell stack
- Limited production is ongoing
- Pre-series production and run-in of production equipment in 2021
- Serial production with a production capacity of 5,000 units per year from mid-2022
- Scaling serial production up to 50,000 units per year



For further information please contact

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