METHANOL INSTITUTE

Methanol Fuel Cells: Powering the Future

Tim Chan

Manager, Government Relations and Business Development
Asia & Middle East

MI History

- The Methanol Institute (MI) was established in 1989
- Three decades later, MI is recognized as the trade association for the global methanol industry
- Facilitating methanol's expansion from our Singapore headquarters and regional offices in Washington DC, Brussels, and Beijing

Members

METHANOL INSTITUTE

Tier 1

MHTL · methanex the power of agility · سابك sabic · OCI

Tier 2

Qatar Fuel Additives Company Limited · MITSUBISHI GAS CHEMICAL · ATLANTIC METHANOL · MITSUI & CO., LTD. · PETRONAS · Oman Methanol Company S.A.O.C.

Tier 3

eni ecofuel · Sipchem EXCELLENCE everywhere · G2X ENERGY · OQ · Mitsubishi International Corporation · JM Johnson Matthey Inspiring science, enhancing life

Tier 4

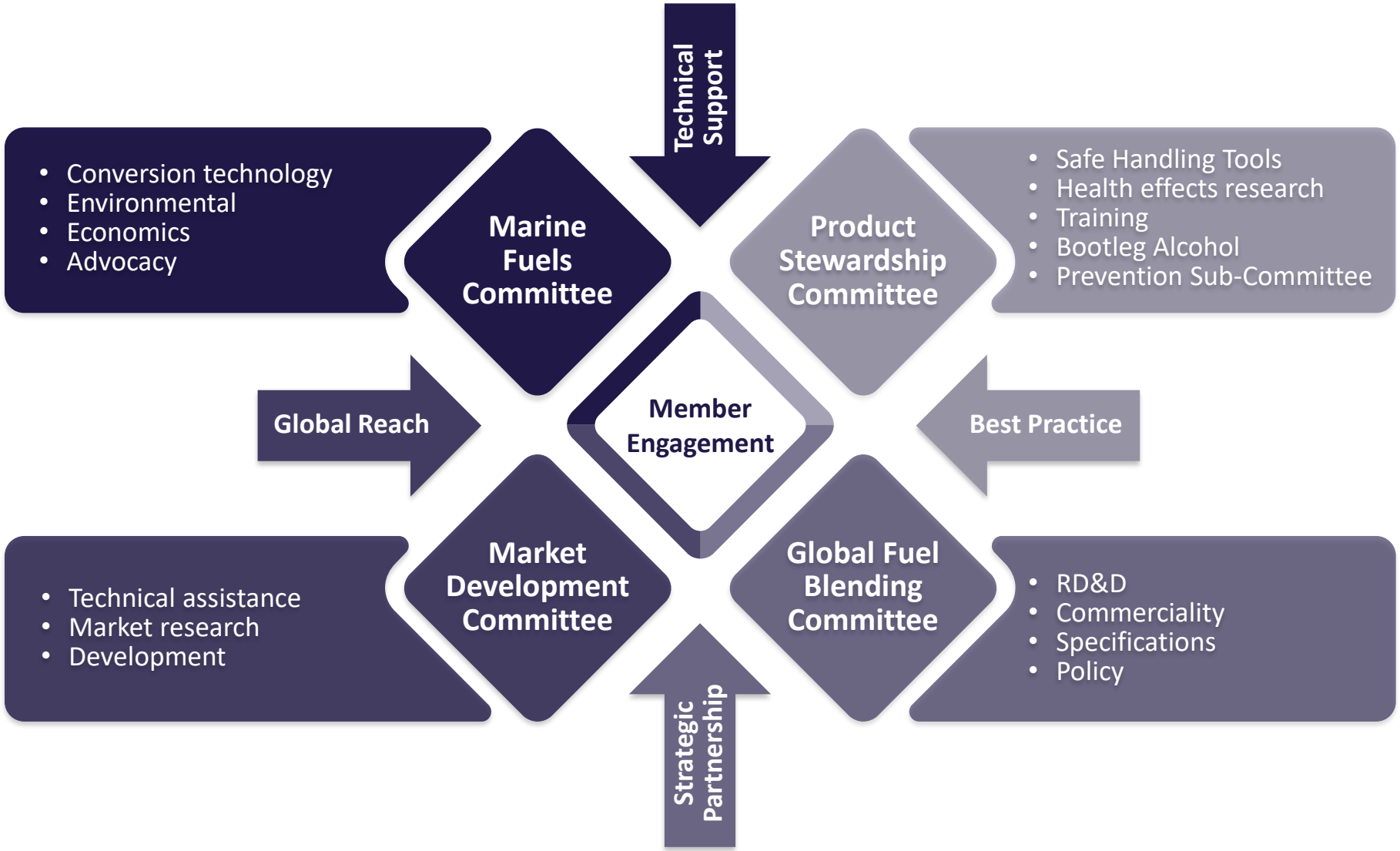
FiTech · Advent · HELM PROMAN METHANOL · OMAN TRADING INTERNATIONAL · MOL Mitsui O.S.K. Lines · Blue World Technologies · CARBON RECYCLING INTERNATIONAL

Element 1 Powering Innovation · SCC Southern Chemical Corporation · bse engineering · YCI METHANOL ONE · FUELSAVE GREEN TECHNOLOGY · GasTechno ENERGY AND FUELS · mmsa · neo-H2

IMTT · Palcan · NW Innovation Works · IGPMethanol · TRICON ENERGY · GANE ENERGY

OLAHMOTORS · CLARIANT · HALDOR TOPSOE · solvadis we do chemistry · Nebraska Public Power District

Committee Structure



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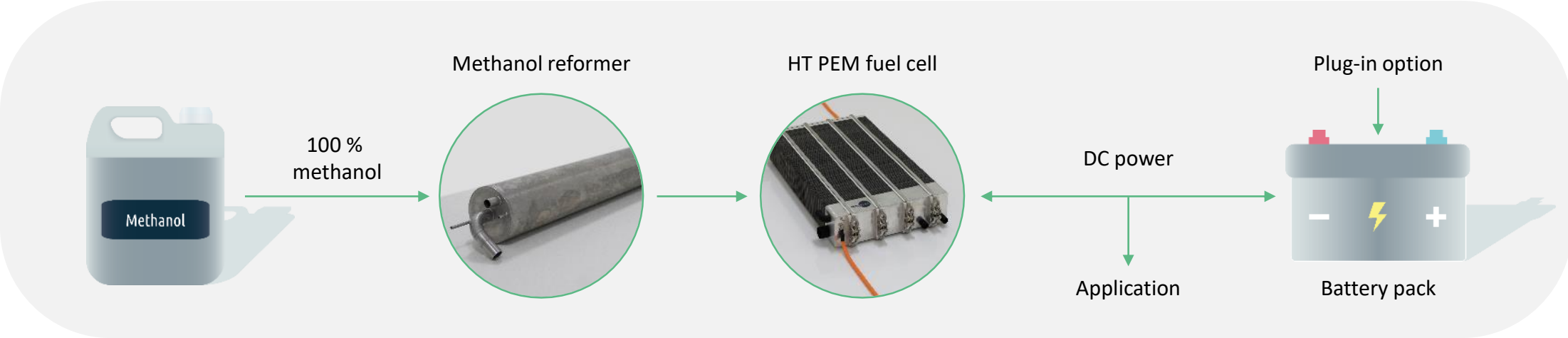
Methanol fuel cell

Powering the future

Webinar 30 June 2020

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

Methanol fuel cells - a **green** alternative



Markets

APU

Automotive

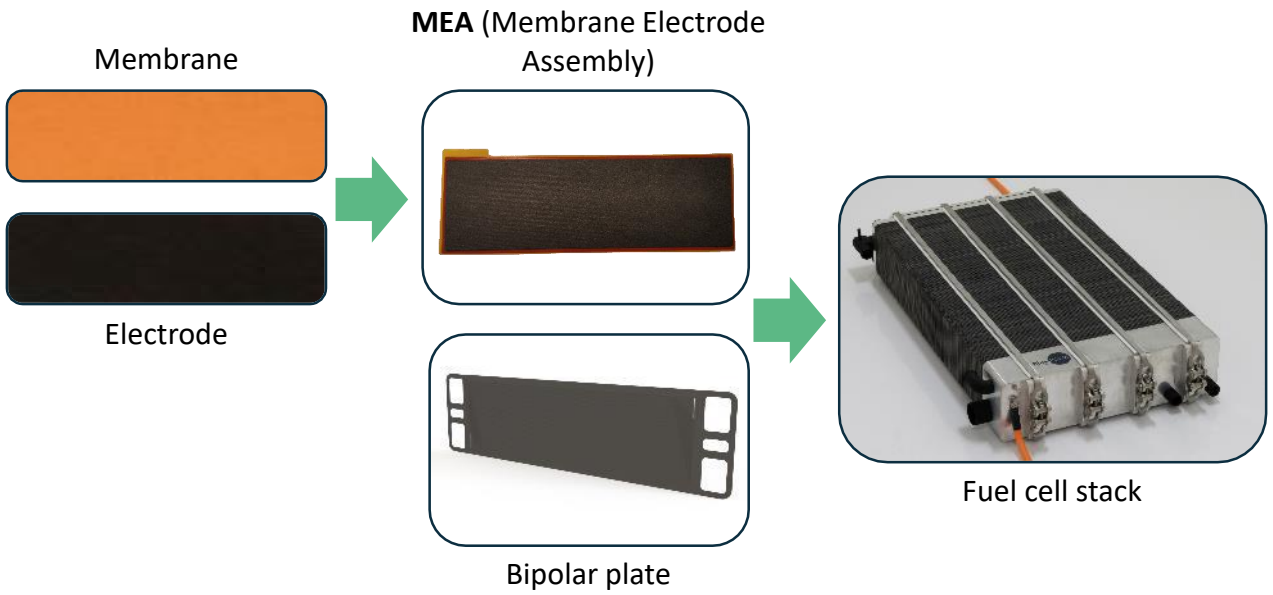
Heavy duty

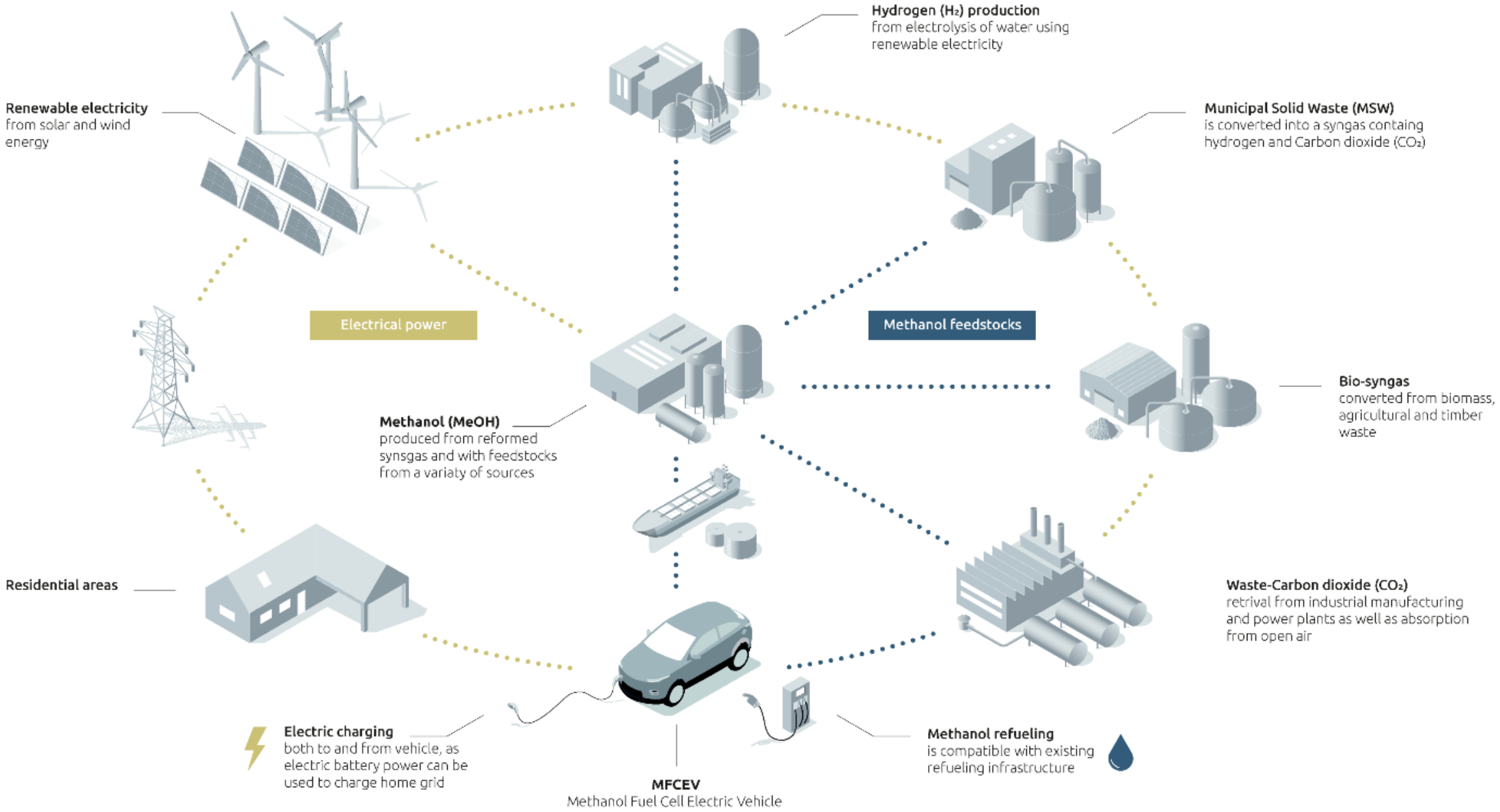
General USPs

- ✓ CO_2 reduction
- ✓ Cost savings
- ✓ Zero harmful emissions

Making the technology competitive

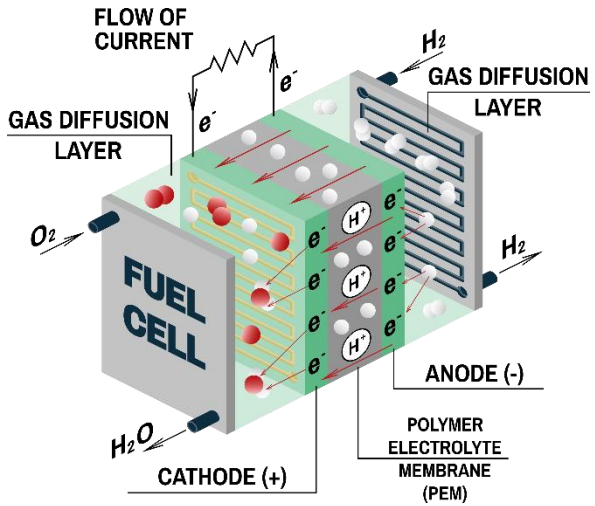
- Production of core materials, key components, fuel cell stack
- Pilot production set up in progress (~1,000 per year)
- 750 MW capacity (50,000 units per year) to be set up in 2022/23

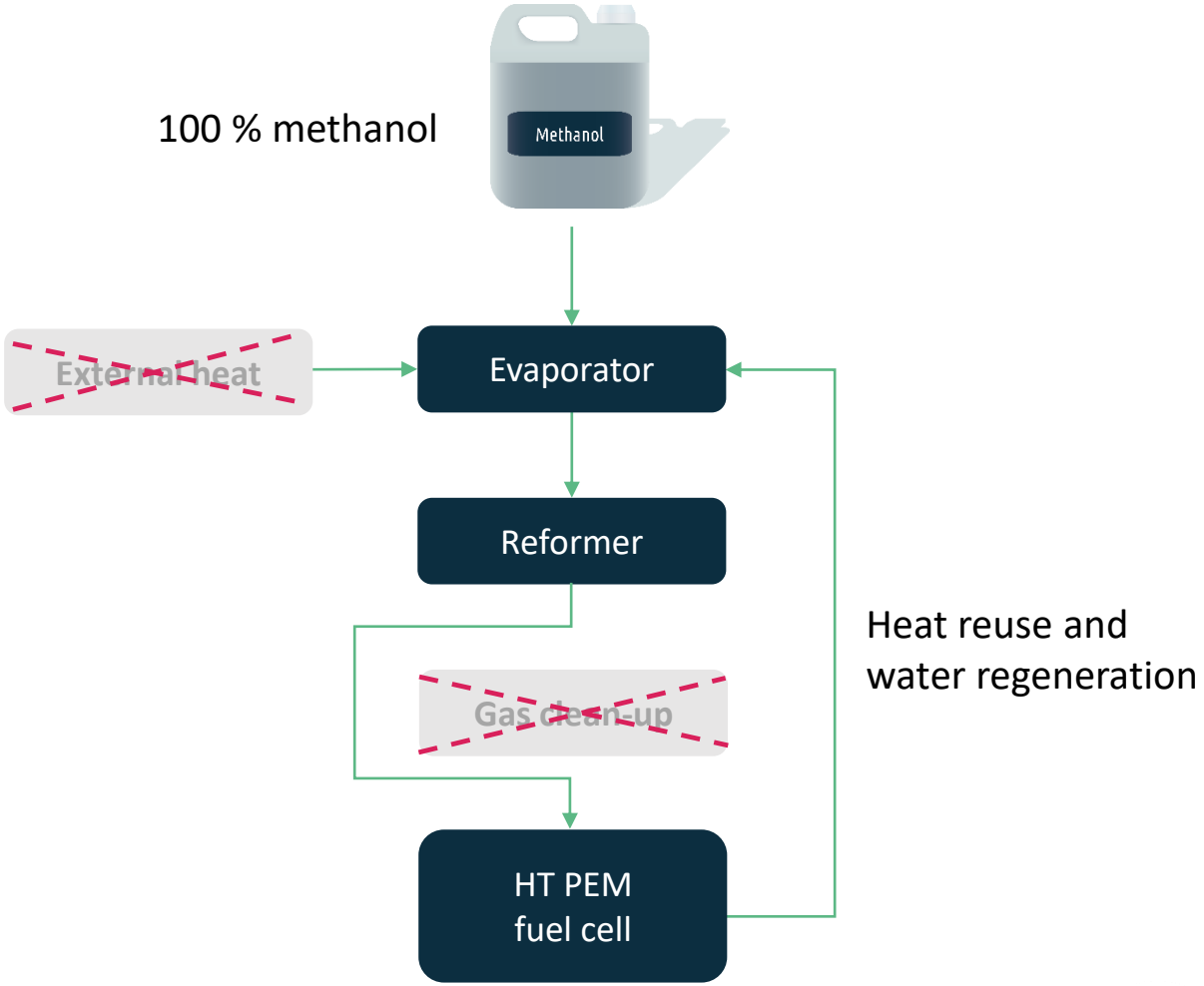



Hydrogen (H₂) production
from electrolysis of water using renewable electricity
Renewable electricity
from solar and wind energy
Municipal Solid Waste (MSW)
is converted into a syngas containg hydrogen and Carbon dioxide (CO₂)
Electrical power
Methanol feedstocks
Methanol (MeOH)
produced from reformed synsgas and with feedstocks from a variaty of sources
Bio-syngas
converted from biomass, agricultural and timber waste
Residential areas
Waste-Carbon dioxide (CO₂)
retrival from industrial manufacturing and power plants as well as absorption from open air
Electric charging
both to and from vehicle, as electric battery power can be used to charge home grid
Methanol refueling
is compatible with existing refueling infrastructure
MFCEV
Methanol Fuel Cell Electric Vehicle

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

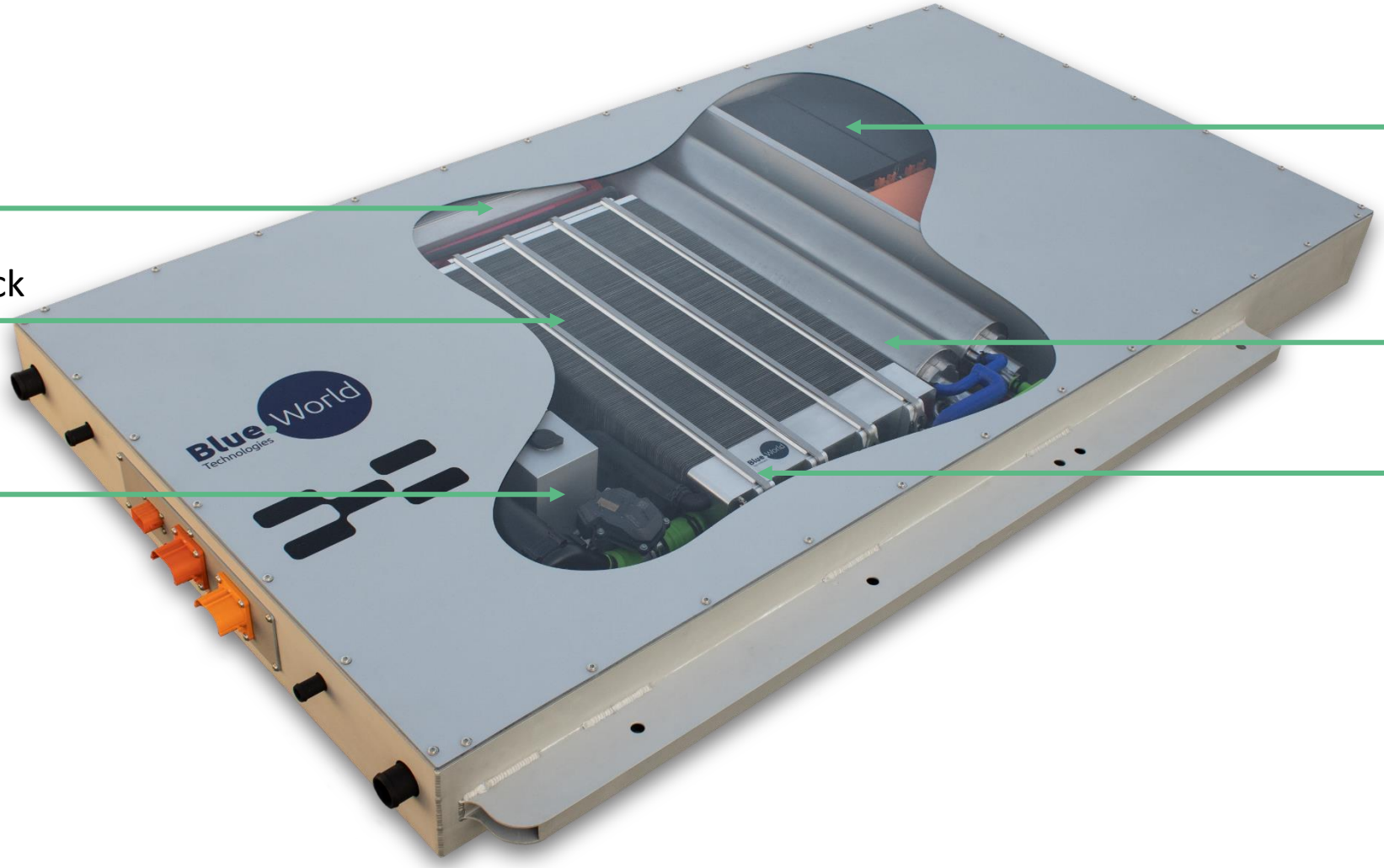




Methanol fuel cell product platform

- Operation on pure methanol (M100)
- Output power range: 7-25 kW
- System efficiency: 40-50 %
- Fuel consumption: 0,5 L/kWh
- Start-up time: 10 minutes
- Operation temperature: 160 ºC

The methanol fuel cell hybrid system



Methanol fuel cell vehicle – a hybrid set-up

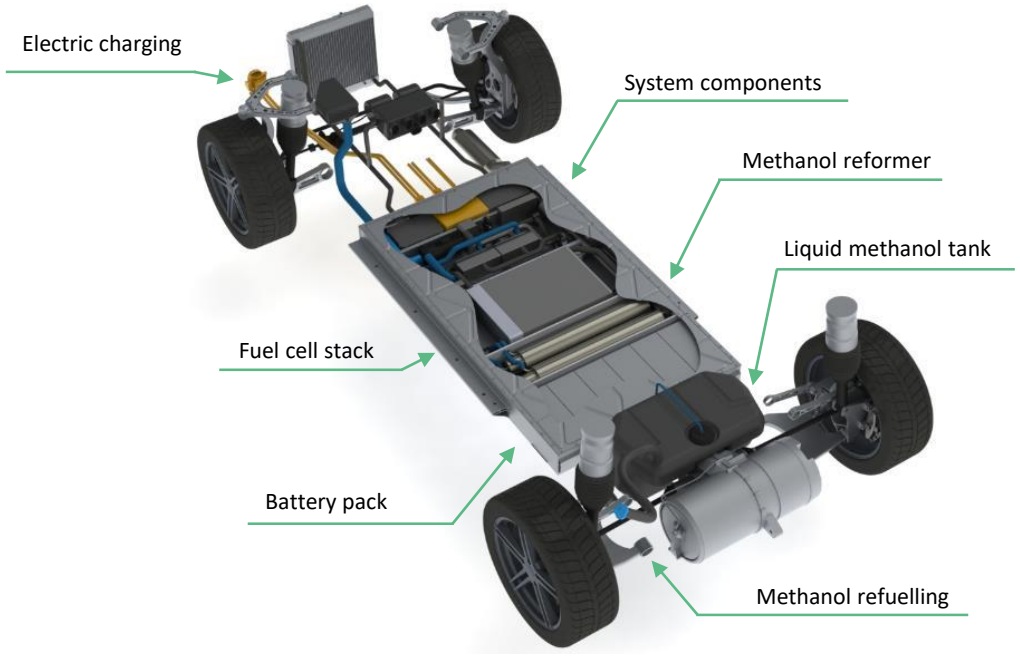
Key value proposition:

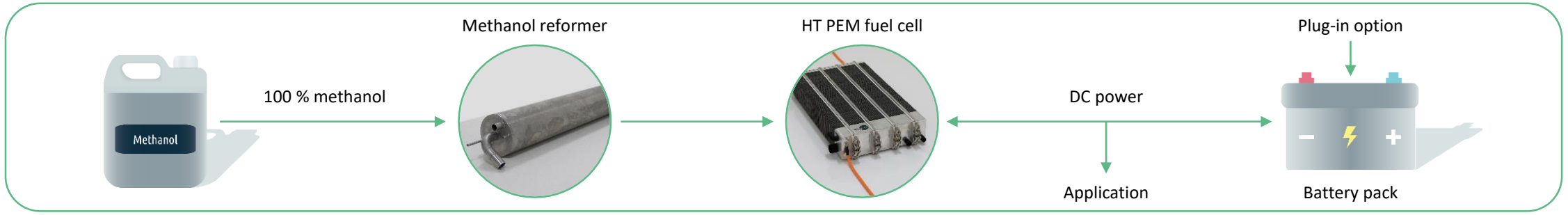
End user

- ✓ 1,000 km range
- ✓ 3 min refuelling time OR plug-in
- ✓ Significant fuel cost savings (typically 30-60%)
- ✓ Zero harmful emissions
- ✓ No noise or vibrations

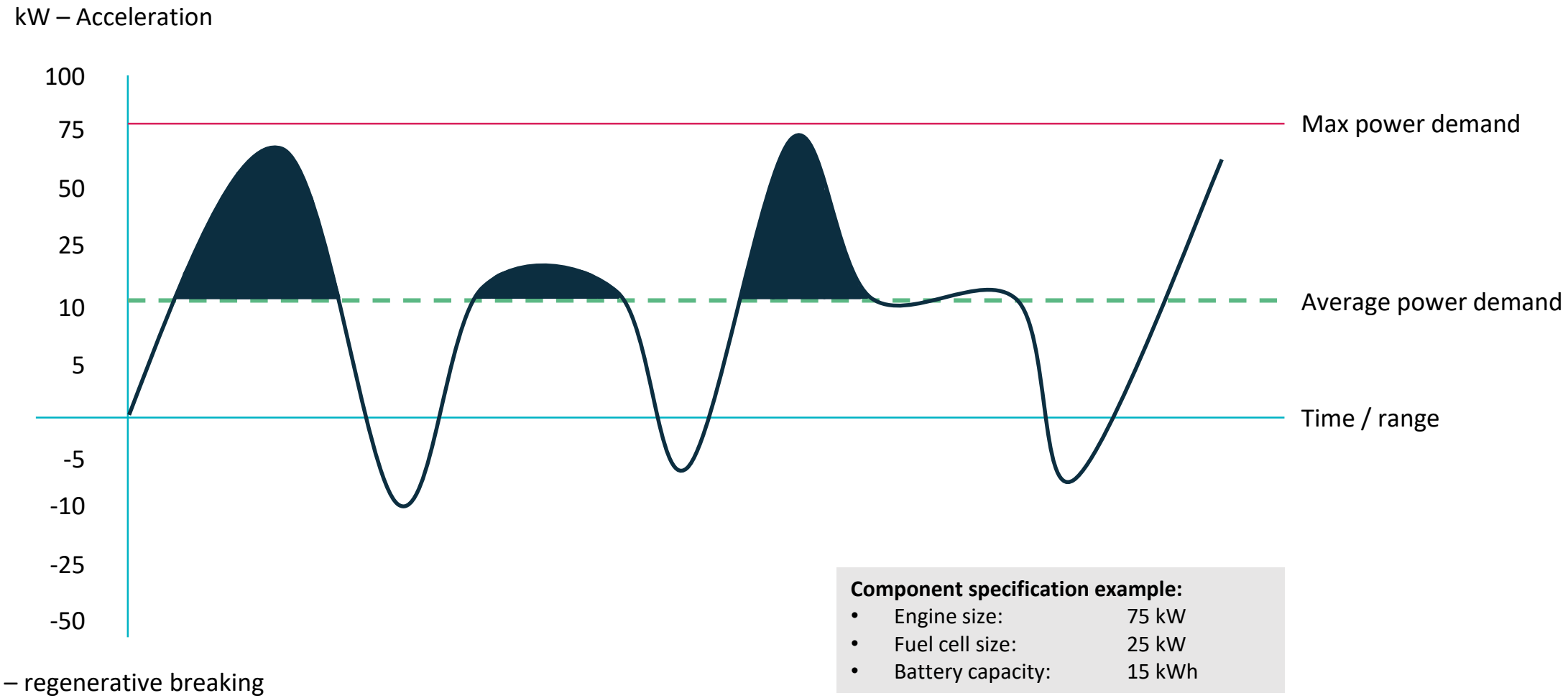
OEM

- ✓ Same form factor and platform as battery pack (flatpack)
- ✓ CO_2 neutral and significant tailpipe CO_2 reduction
- ✓ Higher power density (than battery → light vehicle)





Methanol FC as hybrid range extender



Component specification example:

- Engine size: 75 kW
- Fuel cell size: 25 kW
- Battery capacity: 15 kWh

Efficiency VS effectiveness

Battery electric

75%

Total system efficiency

REFUELLING TIME

VEHICLE RANGE

CABIN HEATING

WEIGHT

INFRASTRUCTURE

ENERGY STORAGE

FUEL COST

GLOBAL / LOCAL EMISSIONS

Methanol fuel cell

25%

Total system efficiency

HYBRID

A optimal solution combination

Air pollution and CO_2 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

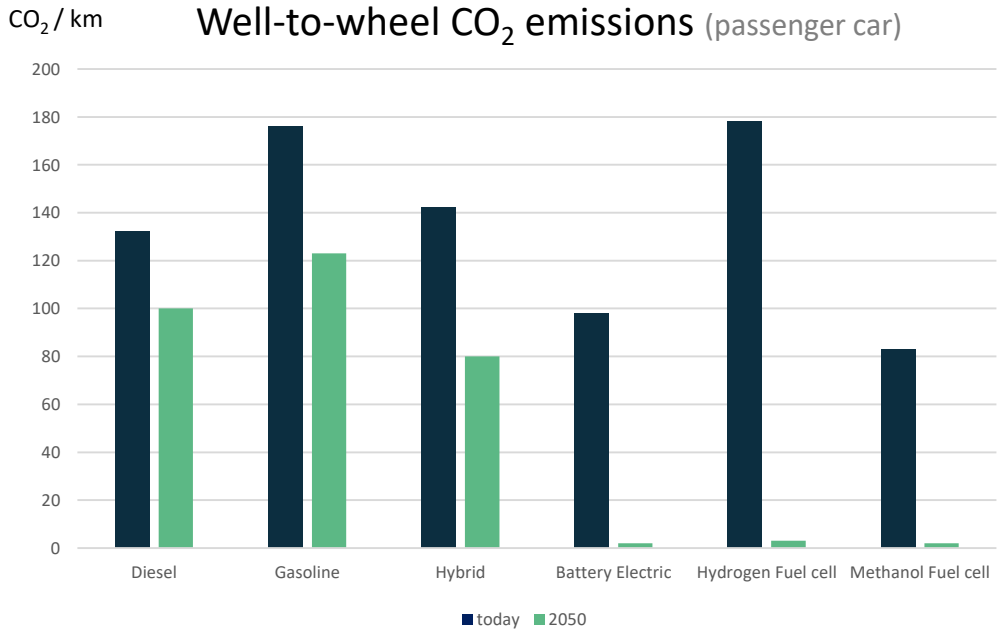
Zero harmful emission:
- No particle emission
- CO_2 tail-pipe reduced by 50-60%
- CO_2 well-to-wheel as hydrogen/electric

Neutrality = decarbonisation

Tank to wheel - methanol fuel cell:
- ~500 g CO_2/kWh
- 30-50 g CO_2/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

Powertrain comparison

	Nissan Qashqai	Hyundai NEXO	Hyundai Kona	Passenger car with Blue World MFC
Cases				
	140 kW gasoline ICE	95 kW hydrogen FC and 120 kW electric motor	150 kW electric motor	25 kW methanol FC and 140 kW electric motor
	55 L gasoline	1.56 kWh battery + 6.3 kg H_2	64 kWh battery	18 kWh battery + 75 L methanol
	800 km range	666 km range	290 - 450 km range	900 km range
	1.9 tonne vehicle weight	2.3 tonne vehicle weight	1.7 tonne vehicle weight	1.7 tonne vehicle weight
	3 minute refuel time	5 minute refuel time	+ 60 minute recharge time	3 minute refuel time
	CO_2 and particle emissions	Zero emissions	Zero emissions	Zero harmful emissions
Economics	1.33 €/liter	5 – 10 €/kg	Fast charge: 0.7 €/kWh Slow charge: 0.1 €/kWh	0.24 – 0.52 €/liter
	0.08 €/km	0.05 - 0.09 €/km	Fast charge: 0.1 €/km Slow charge: 0.016 €/km	0.02 – 0.05 €/km
	28,500 – 41,600 €	80,000 € → ???	33,000 – 41,300 €	25.000 - 50,000 €

Other suitable applications

Public transport

Electric version

243 kWh li-ion battery

Methanol FC version

- 30 kWh battery
- 35 kW FC
- 500 L methanol

Benefits

- ✓ 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

Light commercial vehicles

Electric version

100 kWh li-ion battery

Methanol FC version

- 20 kWh battery
- 25 kW FC
- 100 L methanol

Benefits

- ✓ 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

Heavy duty trucks

Electric version

700 kWh li-ion battery

Methanol FC version

- 60 kWh battery
- 100 kW FC
- 900 L methanol

Benefits

- ✓ 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

Maritime applications

Electric version

4.3 MWh li-ion battery

Methanol FC version

- 400 kWh battery
- 1200 kW FC
- 6500 L methanol

Benefits

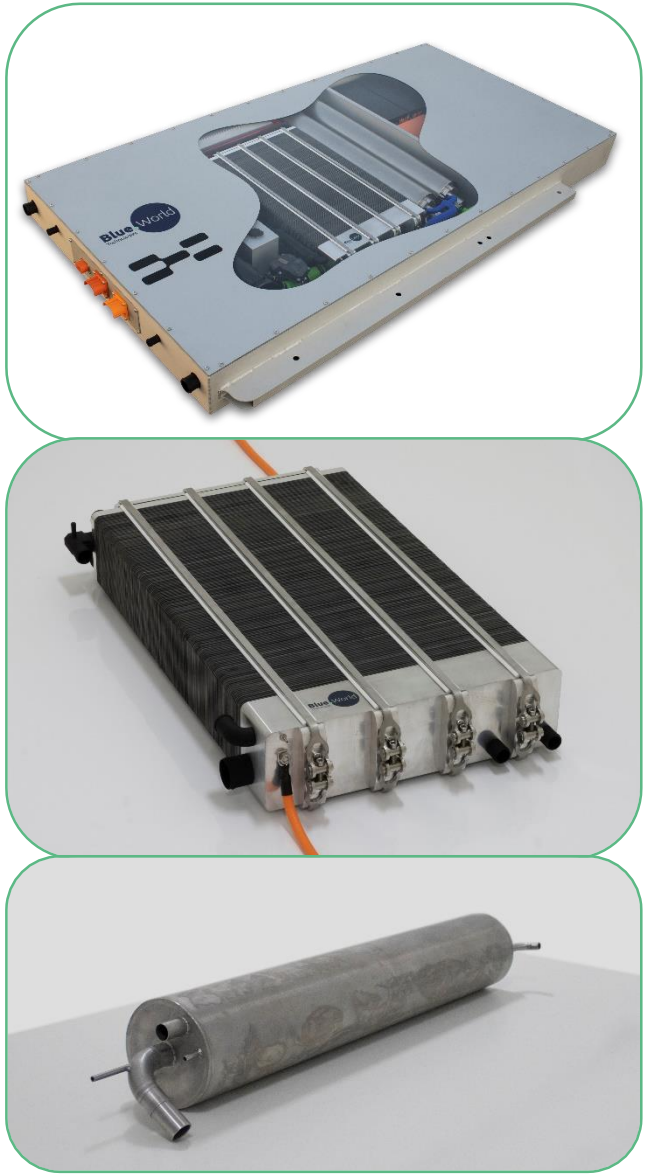
- ✓ Unlimited availability of the E-ferry
- ✓ 190% reduction in power pack costs
- ✓ 250% weight reduction
- ✓ Free heat for operator and traveller comfort
- ✓ 30 min refuelling instead of overnight charge

Ready to make a difference

Commercialisation through large-scale production of methanol fuel cell stacks and reformers

Solid orderbook with customers from different markets - great worldwide interest for the technology

We believe in close partnerships with our customers for development of solutions for integration



For further information please contact

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Element 1
Powering Innovation

Element 1 Corp

Methanol to H_2 Generation (M-Series)

For Low Carbon / Zero Emission Fuel Cell HD Trucks

Methanol Institute

Methanol Fuel Cell: Powering the Future Webinar

Tuesday, June 30th, 2020

Scalable.
Reliable.
Affordable.

www.e1na.com

Element 1 Corp

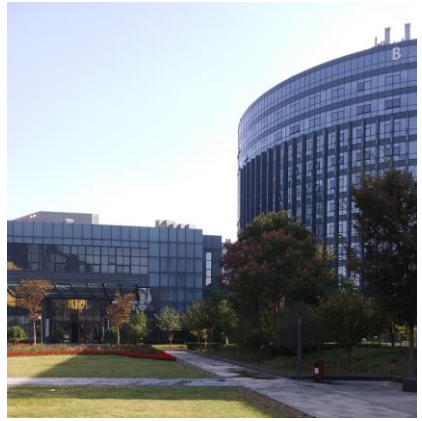
Overview

Scalable, Reliable, and Affordable H_2 Generation

- e1 is the global leader in developing small-scale advanced H_2 generation systems supporting the fuel cell industry
- e1 offers solutions for both stationary and mobile fuel cell systems
  - Extensive IP portfolio
  - Track record of commercial success
- **Business model is licensing and Joint Venture**
- The company maintains world-class product development and testing facilities in Bend, Oregon, with a subsidiary in Jiaxing, China

Scalable.
Reliable.
Affordable.

e1 N.A. Bend, Oregon USA



e1 China, Jiaxing

Solving "The H_2 Challenge"

The Case for on vehicle *Methanol to H_2 Generation*

- Fuel cell solutions are being commercialized in the HD transportation industry
- Fuel cell systems require new H_2 solutions to "Crack the H_2 Challenge"
- Lowering H_2's total cost per kilogram at the point of use is key to adoption of fuel cell power solutions
  - Compressed H_2 is >$12 kg
- Compressed H_2 occupies too much volume to be practical for heavy vehicles requiring extended ranges
  - Limited space is available for H_2 storage which reduces range

On the vehicle H_2 supply technology using e1's Methanol to H_2 Generator ***Solves*** "The H_2 Challenge"

Break-through Solution for HD Fuel Cell Trucks

Onboard Methanol to H_2 Generation

Problem

- Heavy-duty fuel-cell vehicles cannot store enough compressed H_2 to achieve target distance between fueling
- H_2 fueling infrastructure is lacking, expensive to build
- High-pressure compressed H_2 presents safety risk

Solution

- Convert methanol/water mix to high-purity H_2 onboard heavy-duty vehicles with a methanol to H_2 generator

What is a H_2 Generator?

Examples

A completely self-contained machine that converts feedstock to purified H_2

- → **Electrolyzer** (water split by electricity into H_2 and oxygen)
  - High CapEx and OpEx
  - 55 kWhrs electricity → 1 kg H_2 (US$8.25 at $0.15/kWhr)
- → **Natural gas reformer** (methane plus water reacted to make H_2)
  - High CapEx, only possible where there is good NG pipeline infrastructure
- → **Methanol Reformer** (methanol plus water reacted to make H_2)
  - ***Lowest*** CapEx, ***no supporting*** infrastructure required
  - 8.3 kg methanol → 1 kg H_2
- → **Methanol mixed with water** is feedstock for **e1 H_2 generators**
  - 33% of product H_2 is derived from water
  - $CH_3OH + H_2O \rightarrow CO_2 + 3H_2$
  - Cost of produced H_2 about US$4

e1's methanol to H_2 generator has the *lowest* CapEx, produces the *lowest* total cost of H_2, and requires *no supporting* H_2 infrastructure

Methanol

Superior, H_2-Dense Transportation Fuel

A high-volume commodity liquid hydrocarbon fuel (methanol) allows for:

- → ***High-energy*** fuel density onboard the vehicle
- → ***Low-cost*** of fuel (with the right technology)
- → ***Low-cost*** of liquid fuel storage onboard the vehicle (same tanks as diesel)
- → ***Low-carbon*** fuel, with a ***renewable future*** – Just like H_2 and RNG
- → ***Reduces*** Safety Risk – ***No*** onboard HP H_2 storage required
- → ***Clean*** exhaust emissions: **NO NO_x** | **NO SO_x** | **NO Particulate Matter**

Requires technology onboard the Truck to unlock the H_2 in methanol

Why On-board H_2 Generation?

Think in Terms of kW-hours

<1 kWhr — Hundreds of kWhrs — >1 MWhr

kW-hours = kW x hours = power x distance (time between refueling)

Battery EV

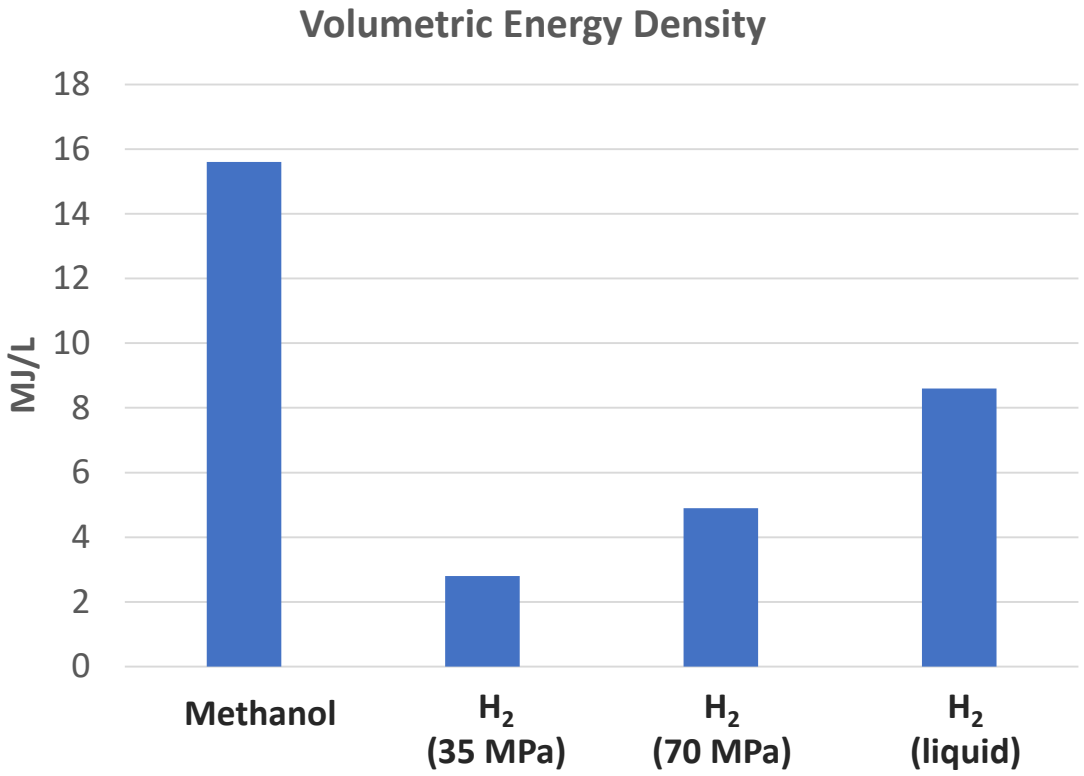
Fuel Cell EV

e1's methanol to H_2 generator

Methanol

Methanol Energy Density ***Exceeds*** Gaseous H_2 Energy Density

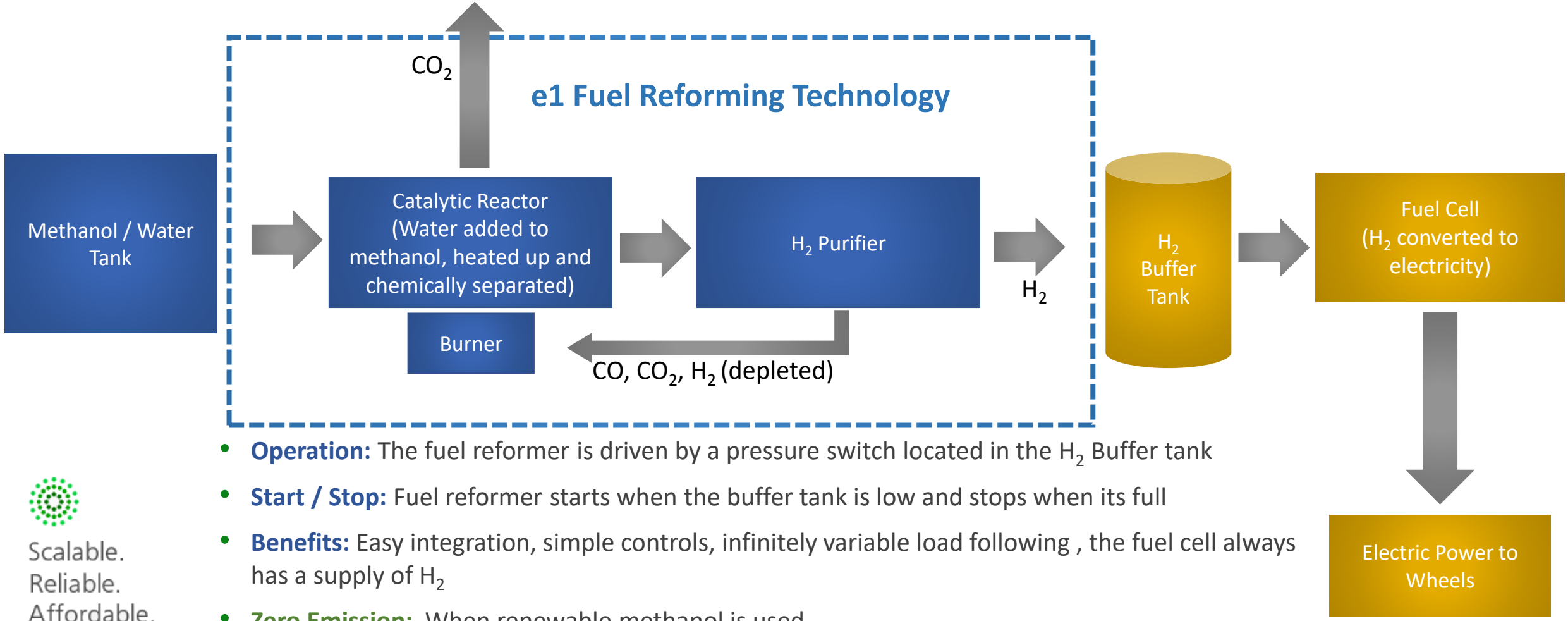
- High density H_2 storage remains a ***significant*** challenge for ***transportation solutions***
- Storage options typically require large-volume systems that store H_2 in gaseous form
- On a volume basis, methanol has almost ***six times*** the energy density of compressed H_2 (350 bar or 35 MPa)



Source: Energy.gov. Comparison of specific energy and energy density (energy per volume or volumetric density) for several fuels based on lower heating values.

e1 Methanol to H_2 Generator

Vehicle Architecture



- **Operation:** The fuel reformer is driven by a pressure switch located in the H_2 Buffer tank
- **Start / Stop:** Fuel reformer starts when the buffer tank is low and stops when its full
- **Benefits:** Easy integration, simple controls, infinitely variable load following , the fuel cell always has a supply of H_2
- **Zero Emission:** When renewable methanol is used

Scalable.
Reliable.
Affordable.

M-Series Methanol to H_2 Generator (Mobile)

On-Board H_2 Generation for ***HD Transportation***

Overview

- **M-Series:** Designed to replace compressed H_2 to support HD mobile fuel cell solutions
- **Feedstock:** Methanol & DI water feedstock
- **H_2 Production:** Can scale to support from 30 kW to 300 kW
- **Product H_2:** ≈ 99.99% with <0.2 ppm CO and <0.2 ppm CO_2
- **Target Uses:** HD trucks, buses, trains and marine vessels

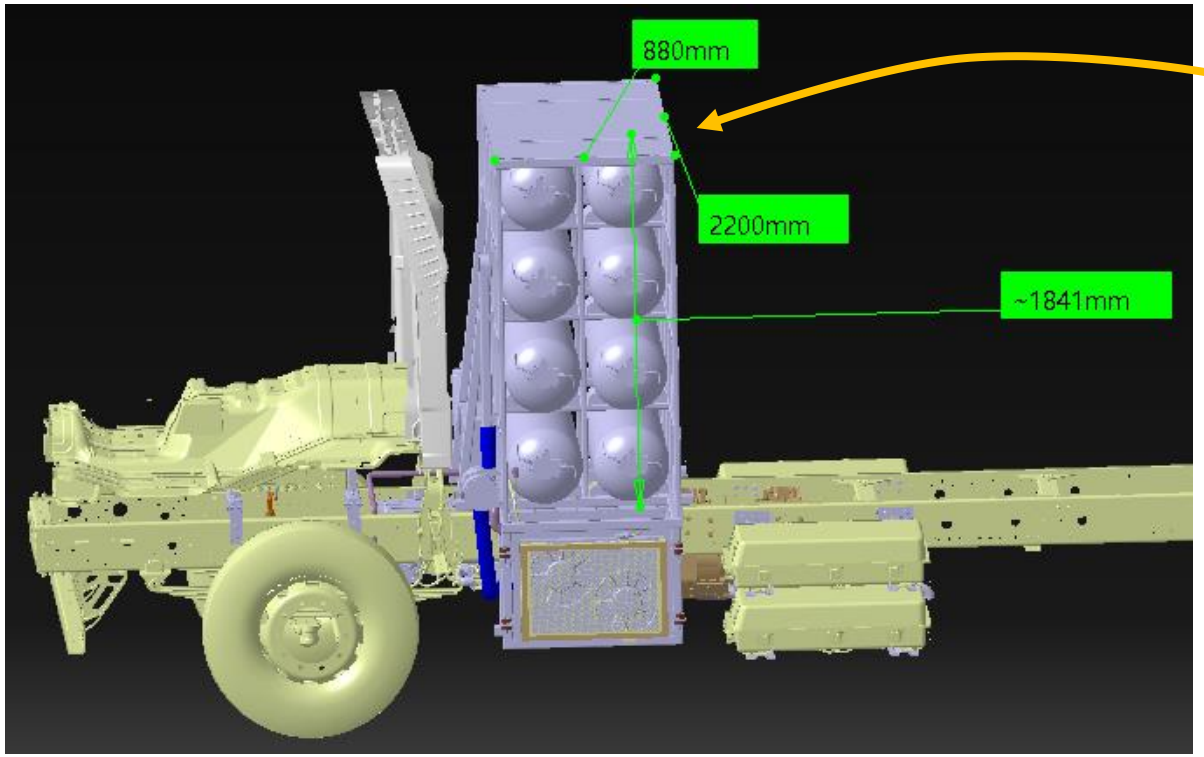
Key Advantages

- **Vibration Resistant:** Designed for transportation applications
- **Operation:** Designed for cyclic and variable operation
- **Compact Design:** Occupies significantly less space than compressed H_2 storage solutions
- **Lifetime:** Designed for 20,000-hour lifetime (H_2 production)
- **Manufacturing:** Under e1 manufacturing license

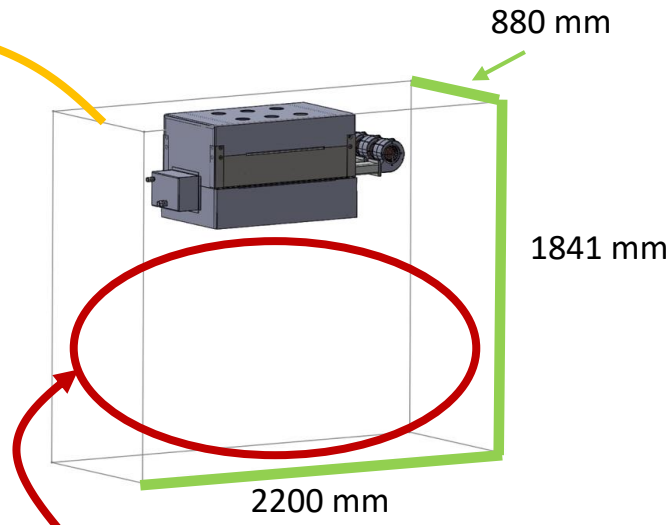
M-Series is Small in Size

Fits in Location Previously Used for Cylinders of H_2

M-Series + methanol/water gives *5x range* of compressed H_2 in same space on vehicle



Light-Duty Delivery Truck, 40 kW FCM



Space for 2,200 L methanol/water tank (equiv. to 190 kg H_2)

Sufficient for **67 hours operation** **at full power (40 kW)**

(only **13 hours operation** using compressed H_2)

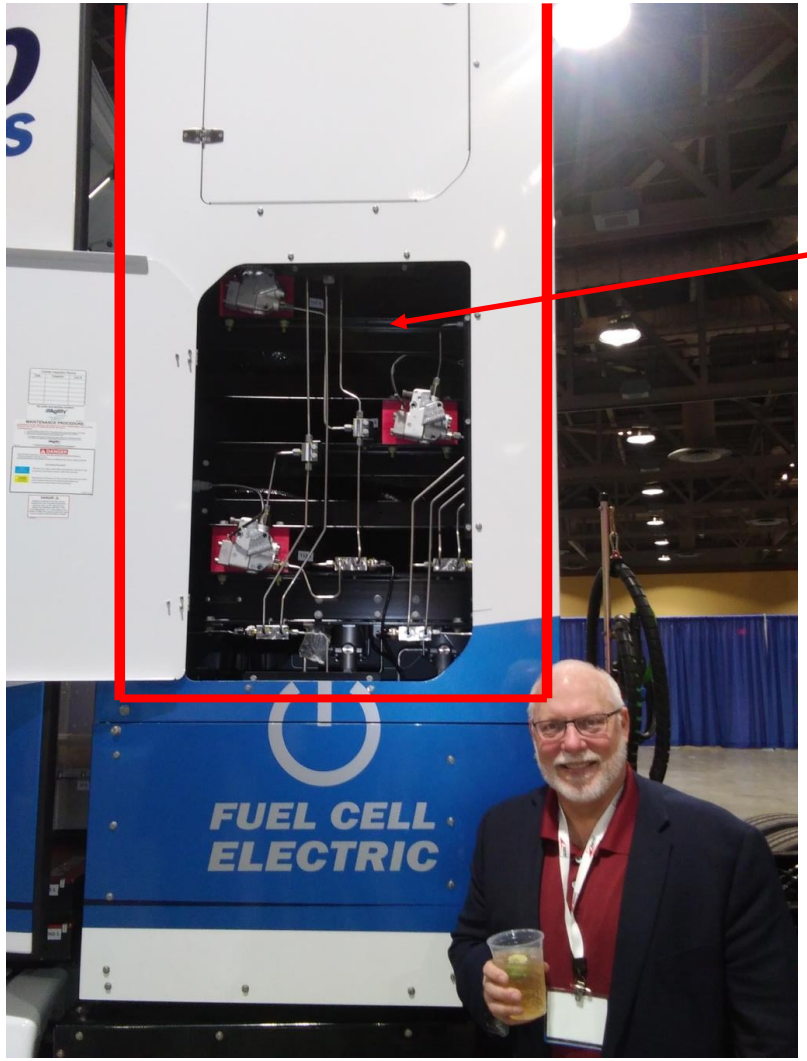
M8 (800 sLm)

Mobile Methanol to H_2 Generator

Example of M-Series sized to support 60 kW FCM (100 kg/d)

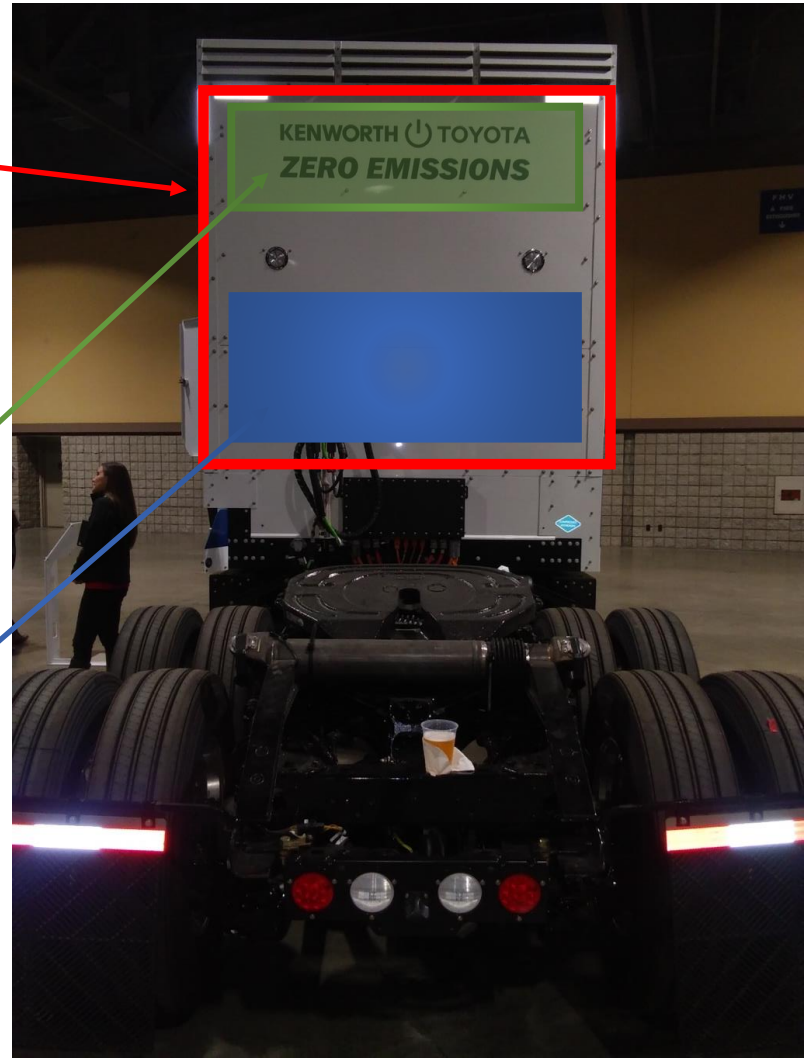
Example of Fuel Cell Class 8 Truck

Toyota Kenworth Partnership



- Space dedicated to high-pressure H_2 storage
- 60 kg H_2
- Range is 300 miles

- Approximate volume occupied by M-Series H_2 generator
- Range is 1,000 miles from 650-gal methanol/water mix



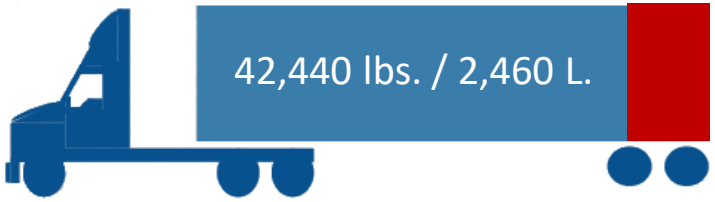
Payload & Energy Density

Class 8 HD Truck Long Haul 1,000 Mi Range

Diesel	
Fuel Amount:	210 gallons
Fuel Wt.:	1,500 lbs
Tank Wt.:	450 lbs
Total Wt.:	**1,950 lbs**
Total Vol.:	**795 Liters**

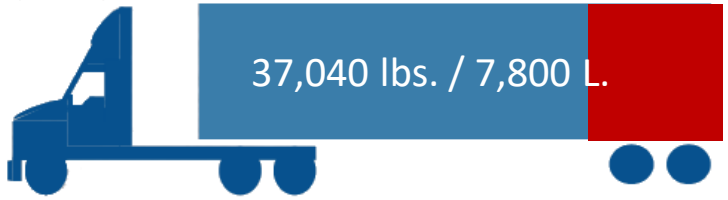
Methanol to H_2 Storage	
Fuel Amount:	650 gallons
Fuel Wt.:	4,710 lbs
Tank Wt.:	1,350 lbs
H_2 Generator Wt.	1,500 lbs
Total Wt.:	**7,560 lbs**
Total Vol.:	**2,460 Liters**

≈ 30% of Volume and 60% of weight of equivalent compressed H_2 solution



Compressed H_2	
Fuel Amount:	165 kg
Fuel Wt.:	360 lbs
Tank Wt.:	12,600 lbs
Total Wt.:	**12,960 lbs**
Total Vol.:	**7,800 Liters**

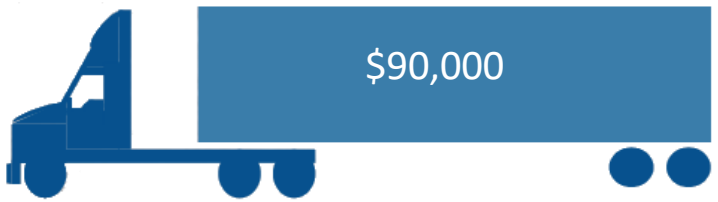
Heavier and reduced space available for transport



Fuel Cost Comparison

Class 8 HD Truck Long Haul 1,000 Mi Range

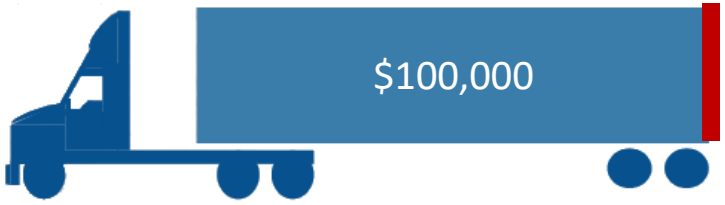
Diesel Fuel	
Fuel Cost	$3.00 Gallon
Miles	500 Miles/D.
Miles per Gallon	5 Miles/G.
Days	300 Days/Yr.
Total Fuel Cost:	**$90,000 Year**



Methanol/Water Feedstock	
H_2 Cost per kg*	$4.00 kg
Miles	500 Miles/D.
Miles per kg	6 miles/kg.
Days	300 Days/Yr.
Total Fuel Cost:	**$100,000 Year**

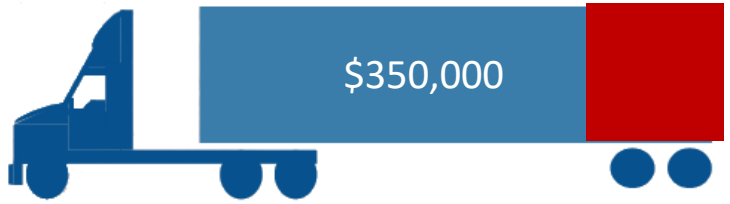
*Methanol Cost $400 MT

≈ Methanol Feedstock mix is near cost parity to diesel fuel solution



Compressed H_2 Fuel	
Fuel Cost	$14.00 kg
Miles	500 Miles/D.
Miles per kg	6 miles/kg.
Days	300 Days/Yr.
Total Fuel Cost:	**$350,000 Year**

≈ Compressed H_2 is four times cost of diesel fuel solution



e1 Fuel Reformers

Easy Integration with the PEM Fuel Cell

e1 fuel reformers have been integrated with PEMFC's from the major global suppliers

- Can work with all PEM fuel cell systems
- Simple controls and easy interface with the fuel cell
- Provides flexibility to the system integrator

Horizon Fuel Cell Technologies

BALLARD®

HYDROGENICS
SHIFT POWER | ENERGIZE YOUR WORLD

Intelligent Energy

Nedstack
PEM FUEL CELLS

Scalable.
Reliable.
Affordable.

altergy
Leading the Fuel Cell Revolution

Top+ energy
Toplus Energy Corporation

Vehicle-Based H_2 Generator

Key Advantages

→ **Occupies smaller space on the HD vehicle compared to compressed H_2**
- Result is greater driving range between fueling

→ **Attractive Economics**
- Very low CapEx and OpEx, produce H_2 for $3 to $5 per kg

→ **Minimal Maintenance**
- Simple, routine servicing every 12 months

→ **Scalable**
- Support 30 kW to MW fuel cells

→ **Simple / Familiar Feedstock Storage**
- No stored high-pressure H_2 required, improved safety
- No requirement to invest in gaseous H_2 fueling infrastructure

Extreme cold weather operation available with methanol

Accelerates the Adoption of Fuel Cell HD Trucks

Element 1
Powering Innovation

The End

For More Information Contact:
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President
Element 1 Corp (e1)
+1 (541) 678-5943
Robert@e1na.com

Scalable.
Reliable.
Affordable.

Renewable Energy Solution

——Methanol Reformed fuel cell

background

Most Asian countries like China，India etc. are facing a major problem-——Air Pollution

The "Global Air Condition 2019" report released by the American Institute for Health Effects recently (based on 2017 data) shows:

In 2017, nearly 5 million people died of stroke, heart disease, lung cancer, diabetes, and chronic lung disease due to long-term exposure to outdoor and indoor air pollution; in China, the number is 1.2 million.

Data from the "Global Air Condition 2019" report shows that in 2017, air pollution in China reduced the average life expectancy by 23 months. Among them, outdoor and indoor air pollution reduced the average life expectancy by 15 months and 8 months, respectively. Among non-communicable diseases, the contribution rate of air pollution to the incidence of lung cancer is 26%, and the contribution rates to heart disease and stroke are 17% and 12%, respectively.

The History of Energy Development

charcoal

Fire/wood
The birth of human civilization
3-8%

coal

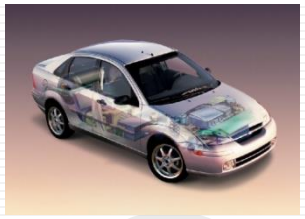
Steam engine
First industrial revolution
10-15%

oil

internal combustion engine
second industrial revolution
25-40%

natural gas

Natural Gas Pipeline
clean energy
35-55%



hydrogen energy

Hydrogen age
fuel cell
40-65%

Multi-carbon → **Carbon free**

Problems in the promotion of hydrogen fuel cells

- H_2 is a gas with the smallest molecular weight and is very active. There is a safety problem in storage (hydrogen embrittlement).
- Hydrogen compression is very difficult.
- Hydrogen storage conditions are harsh.
- Hydrogen transport costs are high.

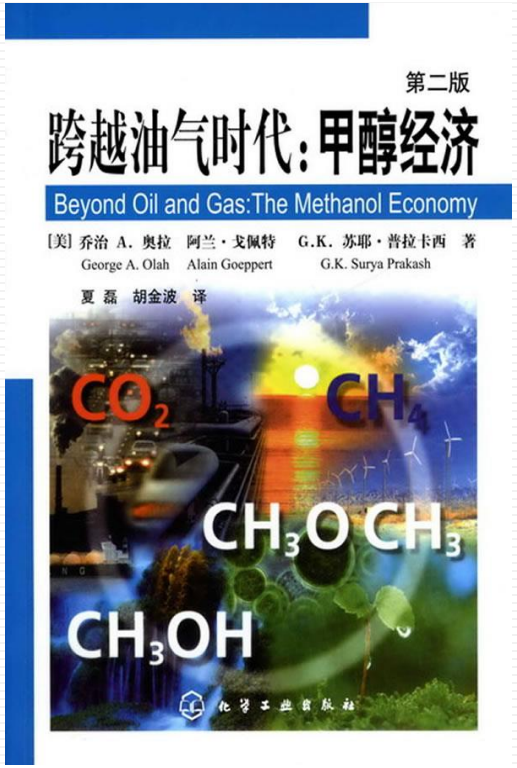
Problems in the promotion of hydrogen fuel cells

- Core equipment depends on import
- High construction cost
- Complex approval
- Site selection is difficult

Methanol Energy

American Nobel Laureate, Dr. George Ola - Methanol Economy: Methanol is the Best Secondary Energy Source.

- It is liquid at room temperature.
- It is easy to store and transport.
- Mature methanol production process.
- Perfect methanol matching chain.



Methanol Energy (taking China as an example)

1

China's coal resources are abundant. Coal-to-methanol can ensure China's century-long energy security.

Future methanol can also be made from biomass, crop stalks, etc.

2

As of 2018, the global methanol production capacity is about 144 million tons per year, and China's methanol production capacity is 86 million tons per year, accounting for more than 60% of world production.

3

China is increasing the construction of the methanol industry, and it is expected that 20 million tons of new production capacity will be added in the future.

4

Methanol production technology is mature, and the cost is lower than petrol and diesel.

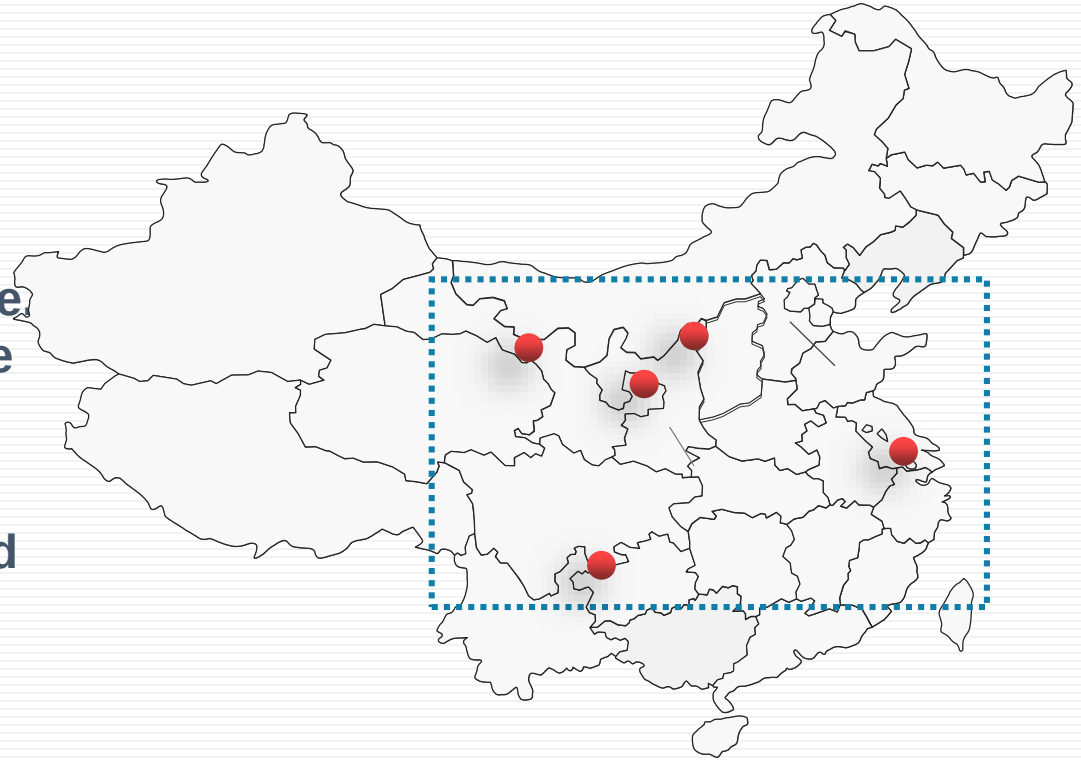
Methanol Energy (taking China as an example)

15 years ago, methanol cars were listed as national key science and technology projects and pilot projects were promoted in multiple cities.

In 2014, the Ministry of Industry and Information Technology expanded the methanol car pilot to China's “four provinces and one city”:

Shanxi Province, Shaanxi Province, Shanghai Municipality, Guizhou Province, and Gansu Province. In the future, we will further expand the scope of the pilot.

The 2017 methanol car pilots have all been accepted by the State Ministry of Industry and Information Technology.



Methanol Energy Specification
(taking China as an example)

In 2015, the General Office of the Ministry of Industry and Information Technology of China issued

Notice on "Code for Construction of Vehicle Methanol Fueling Station" and "Safety Specification for Methanol Fuel Used in Vehicles"

中华人民共和国工业和信息化部
Ministry of Industry and Information Technology of the People's Republic of China

搜索

工业和信息化部 新闻动态 信息公开 在线办事 公众参与 专题专栏 工信数据

首页 > 工业和信息化部 > 机构设置 > 节能与综合利用司 > 工作动态 > 正文

工业和信息化部办公厅关于印发《车用甲醇燃料加注站建设规范》和《车用甲醇燃料作业安全规范》的通知

发布时间：2015-10-27 来源：节能与综合利用司

工信厅节〔2015〕129号

山西省、上海市、贵州省、陕西省、甘肃省工业和信息化主管部门：

为推动甲醇燃料加注站规范化建设，指导和规范甲醇燃料加注作业安全操作，保证甲醇汽车试点工作顺利进行，我部组织编制了《车用甲醇燃料加注站建设规范》和《车用甲醇燃料作业安全规范》。现印发你们，请遵照执行。

工业和信息化部办公厅

2015年10月13日

Methanol Energy (taking China as an example)

On March 19, 2019, China's eight Ministries, such as the Ministry of Industry and Information Technology, signed an agreement of the development of methanol vehicles in some regions in China.

The agreement encourages and supports enterprises to develop methanol hybrid vehicles, methanol extended-range electric vehicles, and methanol fuel cell vehicle products. Promote and accelerate the construction of methanol fuel production and filling systems.

邮箱登录

中华人民共和国工业和信息化部

Ministry of Industry and Information Technology of the People's Republic of China

搜索

工业和信息化部 新闻动态 信息公开 在线办事 公众参与 专题专栏 工信数据

首页 > 信息公开 > 政策文件 > 文件发布 > 综合 > 正文

发文机关：工业和信息化部 国家发展和改革委员会 科学技术部 公安部 生态环境部 交通运输部 国家卫生健康委员会 国家市场监督管理总局

标　　题：工业和信息化部 国家发展和改革委员会 科学技术部 公安部 生态环境部 交通运输部 国家卫生健康委员会 国家市场监督管理总局关于在部分地区开展甲醇汽车应用的指导意见

发文字号：工信部联节〔2019〕61号

成文日期：2019-03-12　　发布日期：2019-03-19

文章来源：节能与综合利用司　　分　　类：节能与综合利用

八部门关于在部分地区开展甲醇汽车应用的指导意见

工业和信息化部 国家发展和改革委员会 科学技术部 公安部 生态环境部 交通运输部 国家卫生健康委员会 国家市场监督管理总局关于在部分地区开展甲醇汽车应用的指导意见

工信部联节〔2019〕61号

各省、自治区、直辖市及计划单列市、新疆生产建设兵团工业和信息化、发展改革、科技、公安、生态环境、交通运输、卫生健康、市场监管主管部门，各有关单位：

为加快推动甲醇汽车应用，实现车用燃料多元化，保障能源安全，现就在部分条件具备地区开展甲醇汽车应用工作提出以下意见：

The use of methanol as an energy source

CH3OH

1 Direct combustion

2 internal combustion engine

3 MFC

Efficient Environmental protection

Methanol - Safer and easier transporting energy

Palcan

US Energy Department - Comparison of Fuel Safety

►**Safer and easier to transport**

Relative risk of several fuels
Divided in seven levels (1=low, 7=high)

DANGER	PETROL	DIESEL	METHANAL	LPG
Leakage	3	1	2	5
Evaporation	3	1	2	4
Released to the atmosphere	5	6	3	4
Released in a closed room	2	5	4	3
Automatic ignition	6	5	4	3
Spark ignition	2	1	-	3
Flame propagation	2	1	5	3
Flash fire	5	6	1	2
Radiation from the flame	6	7	1	5
Health effects	7	5	6	4
Total	41	34	28	36

Analysis of advantages and disadvantages of different energy power systems

Power System	Energy Density	Efficiency	PM2.5	Safety	Initial cost	Operation cost	Lifespan	Environmental adaptability	Promotion of social costs
Disel/petrol iternal combustion engine car	★★★★★	★	★	★★★★	★★★★★	★★	★★★★★	★★★★★	★★★★★
Lithium battery car	★★	★★★★	★★★★★	★★	★★	★★★★★	★	★	★★
Hydrogen fuel cell car	★★★	★★★	★★★★★	★	★	★	★★	★★	★
Methanol hydrogen fuel cell car	★★★★	★★★★	★★★★★	★★★★★	★	★★★★★	★★	★★★	★★★

★ quantity indicates performance superiority

Palcan-A well Established company

1998 Founded

2000 Launched in Shanghai

2004 World 1st portable hydrogen FC
(using cost：100RMB/kwh)

2009 World 1st MFC van

2010 Changzhou subsidiary founded、Shanghai palcan founded

2014 Zhejiang palcan founded (China's largest MFC production base)

2015 World 1st hydrogen bicycle

2016 Suzhou subsidiary founded

2017 China First Photovoltaic Hydrogen Storage Power Station

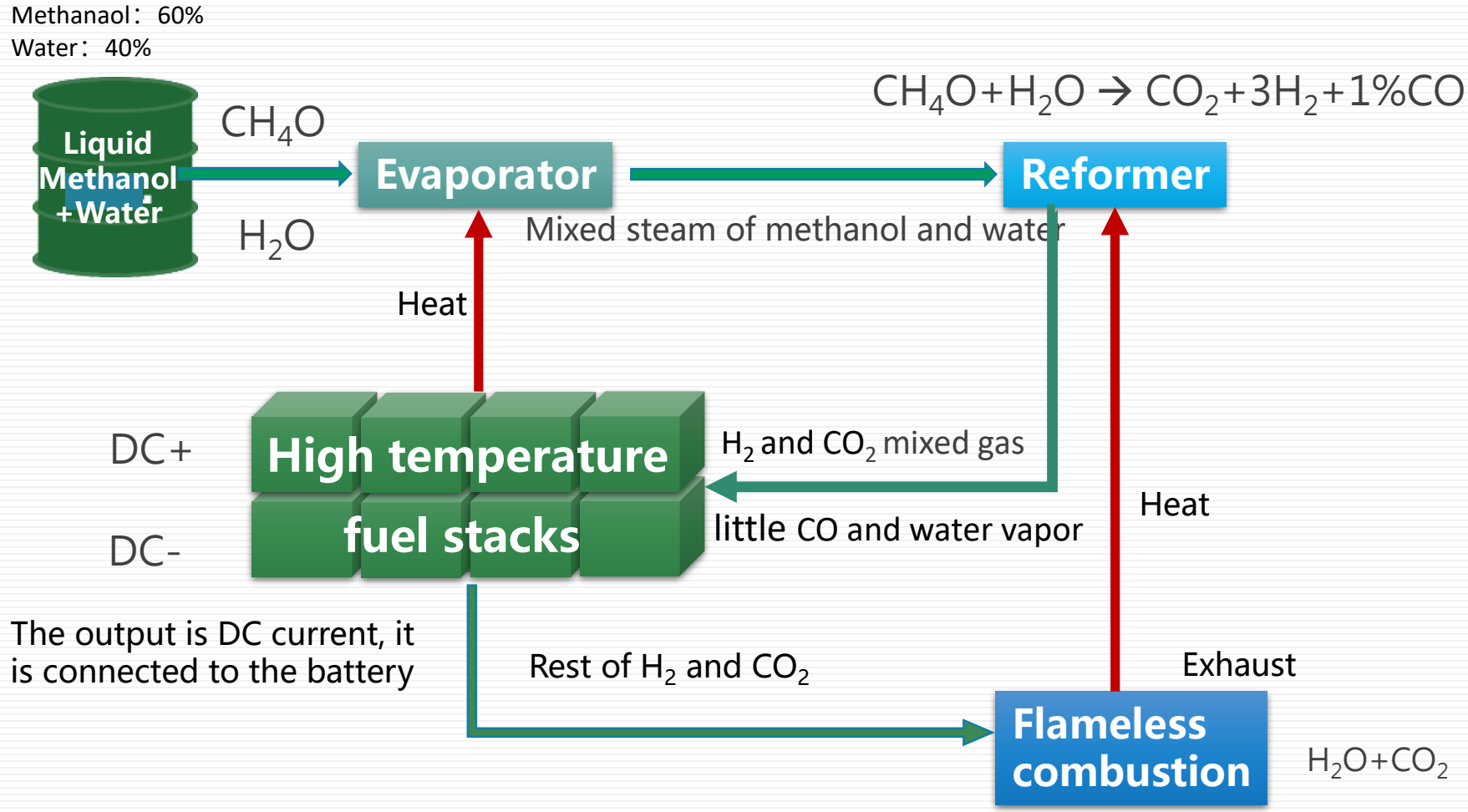
2018 World 1st MFC truck

(using cost：1RMB/wh)

China 1st MFC vehicle announcement by Ministry of Industry and Information Technology

entering new energy vehicle re;ated policy catalogues

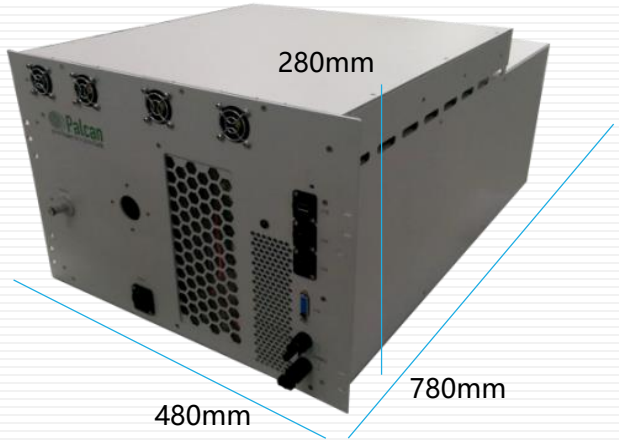
Palcan Technology- Methanol Reformed Fuel cell system



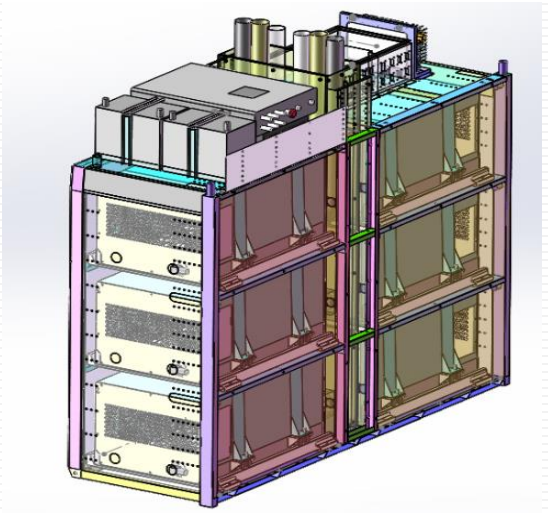
No hydrogen storage, safe and reliable!

Palcan MFC system

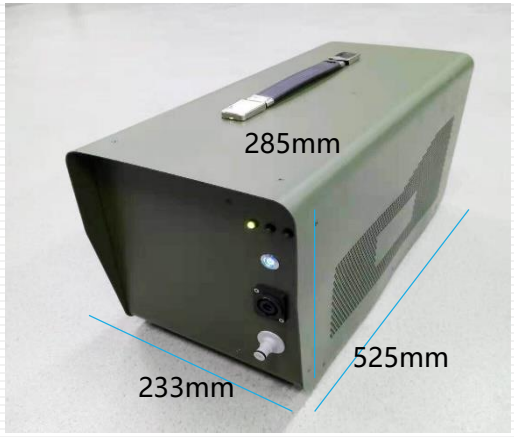
5KW



Power：5KW
Weight：65KG



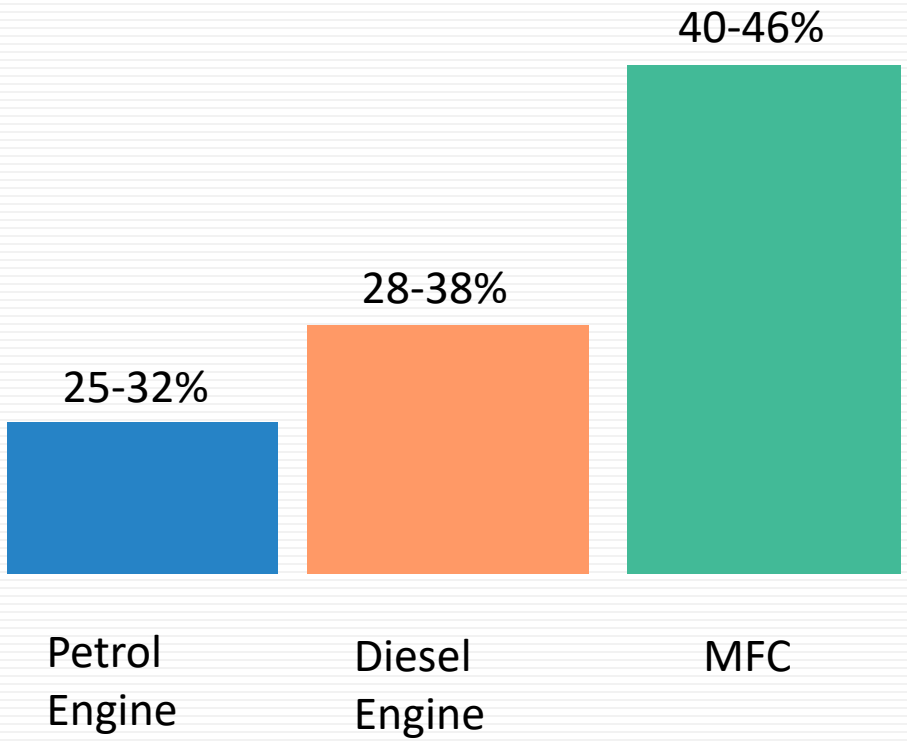
300W



Power：300W
Weight：12KG

Technical Advantages

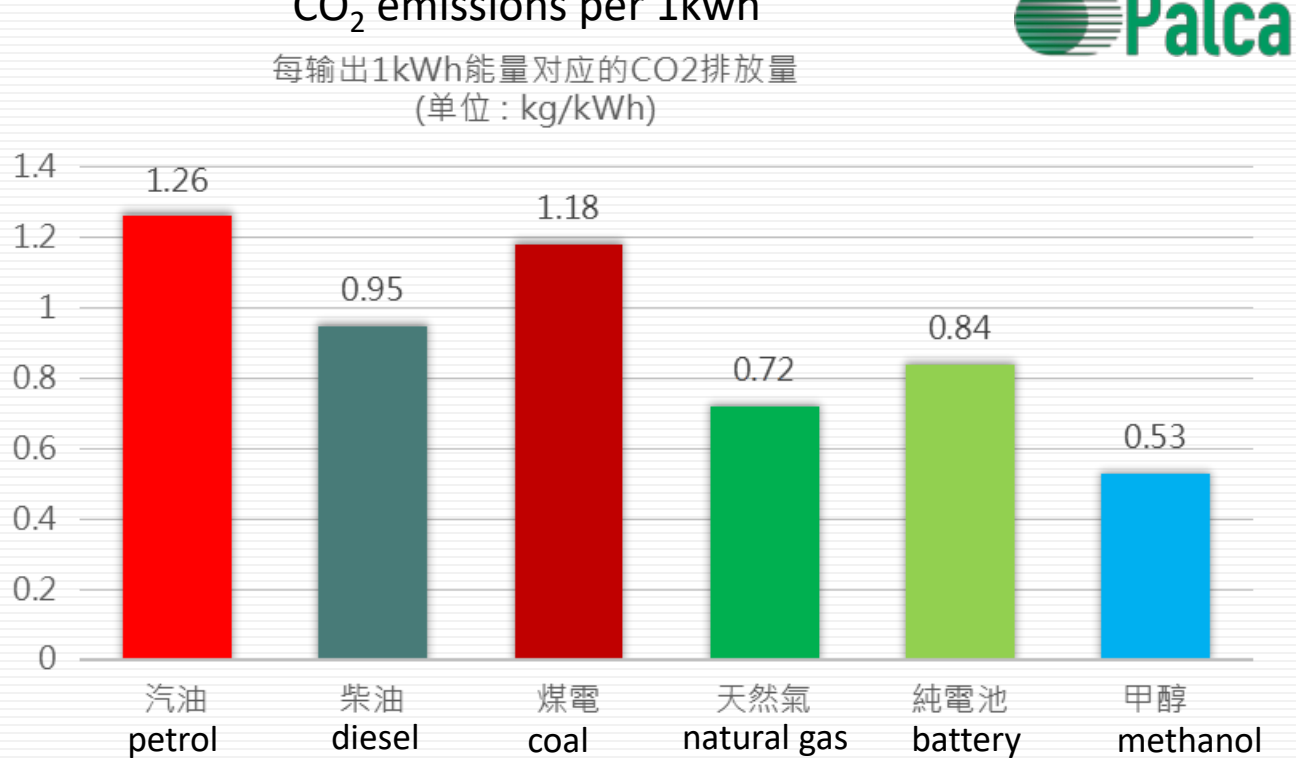
- **Highest energy conversion efficiency**

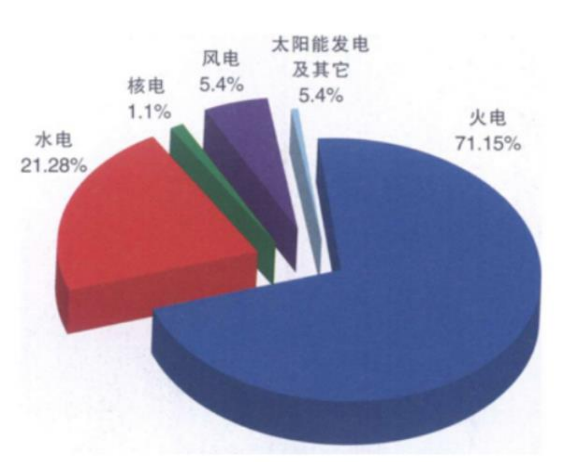


Technical Advantages

►CO_2 emission is lower than current pure electric emission!

To make the current level of electricity average emission reach the level of methanol, it needs to reduce the proportion of coal thermal power generation to below 45%!





Hydropower: 21.28%

Nuclear power: 1.1%

Wind power: 5.4%

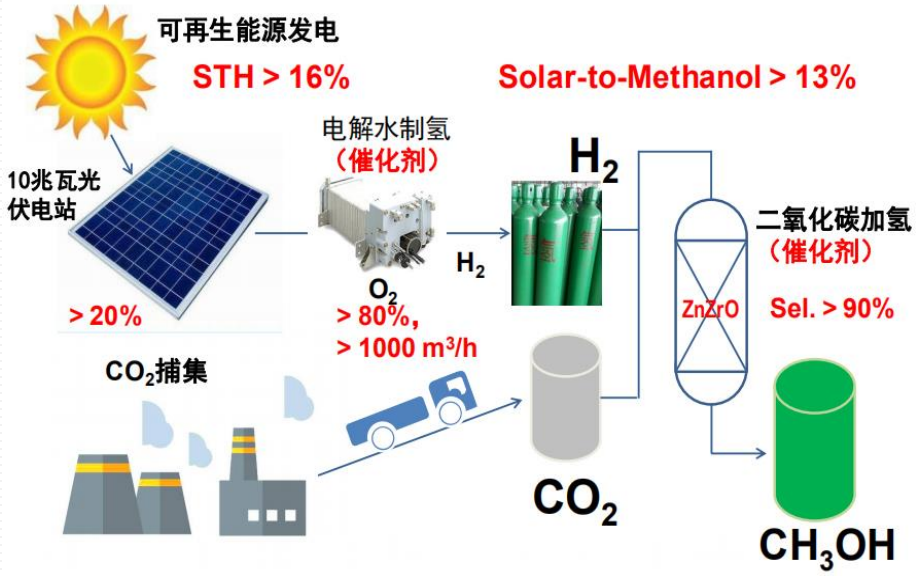
Solar power and other: 5.4%

Thermal power: 71.15%

Technical Advantages

►The National Laboratory of Dalian Institute of Chemical Physics, Chinese Academy of Sciences has completed the preliminary pilot test of the solar fuel synthesis industrialization technology route. In July 2018, a solar fuel thousand-ton methanol industrialization demonstration was launched in Lanzhou.

►The project plans to build a methanol plant with an annual output of 1,000 tons. After the plant is stable, the scale of carbon dioxide hydrogenation to methanol will be expanded to 3000 tons per year.



Technical Advantages

Take Dongfeng T7 for example，the operation costs are lowest!

地区	90号汽油	93号汽油	97号汽油	0号柴油
北京油价	6.75（京89）	7.48（京92）	7.97（京95）	7.17
上海油价	6.62（沪89）	7.45（沪92）	7.92（沪95）	7.1
江苏油价	6.66	7.46	7.93	7.08

Petrol/Diesel:
2.87yuan/kWh
18 L/100KM
135yuan/100KM

MFC:
0.9元/kWh
47kWh/100KM
42.3yuan/100KM

July 2019
Methanol price of China
Average price: 2000 yuan/ton

公共充电桩电价大约是每度电1.0~1.5元,加上0.8元/度服务费,最后价格约为2~2.3元/度。
民电：0.65元/度（只限用于从自家电表接线，物业安装充电桩按工业电价收费，价格为0.8~1.5元/度）

Pure electrical:
1.1 yuan/kWh
47kWh/100KM
51.7yuan/100KM

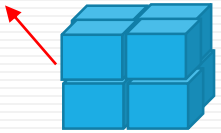
High pressure hydrogen FC:
52yuan/kg
4kg/100KM
200yuan/100KM

Palcan's advantages in traffic pplications

“Extended range - to solve the problem of short mileage”

Take electric bus for example

Lithium battery



540V, 600Ah
324 kWh,
3600 kg

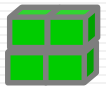
Controller

Electric Machinery

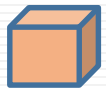
√Save 50% batteries, reduce 1 ton weight of the car
√Eletricity increased from 324 kWh to 492 kWh

Palcan's solution

Fuel Cell



Methanol Tank



About 800 kg,
330kwh Reserve

492 kWh, 2600 kg

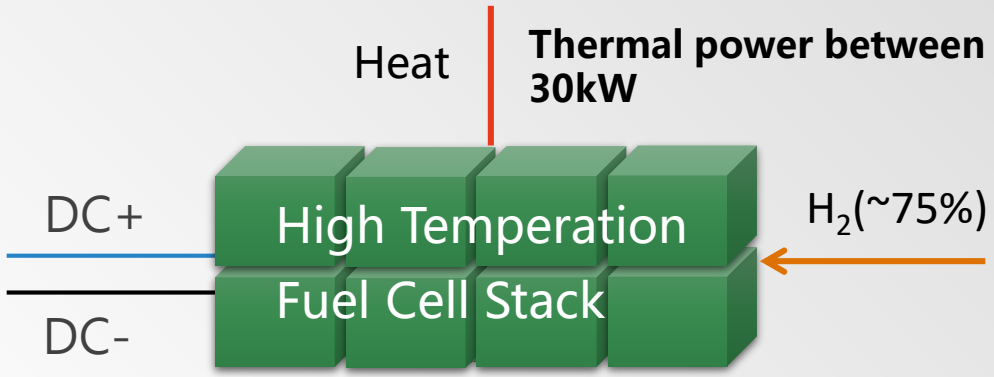
About 1800kg, 162kwh Reserve

Controller

Electric Machinery

Palcan's advantages in traffic applications

“Low-temperature operation - Solving the problem that lithium batteries cannot be charged or discharged at -20°C”



We use “high-temperature fuel cell stack”, the temperature of the heat exchanger is about 140 degrees, the heat energy can be fully utilized to heat the lithium cell and the car.

Palcan's advantages in traffic applications

"Compared with hydrogen FC, MRFC is more economical and feasible"

MRFC Logistics vehicle

►Various ways to add methanol: methanol station, partial refit of gas station, tank truck, etc.

►Same volume, twice the energy of high-pressure hydrogen tank.

Hydrogen FC Logistics vehicle

►Hard to find hydrogen station

►Construction costs and transportation costs are higher

►Two times higher cost than gasoline

►Safety hazard

Applications

- Mobile charging
- Backup power
- Distributed generator
- Portable power
- EV Applications

Silent Mobile power

“Silent Mobile Charging Car”

Backup Power

“Communication base station backup power”

Asia Pacific Style

Domestic style

Project	Parameter
Output Power	2.5~10KW
Output voltage	−48DCV
Operating temperature	−20~50℃
Stack Type	HT-PEMFC
Cooling method	Air cooling
Certified product	CTTL certificate
Fuel Type	Aqueous methanol solution
Water tank capacity	100L*2
Dimensions	900*900*2200mm
Weight	425~500kg
Communication Method	RS485/SNMP
Monitoring method	Wireless remote monitoring

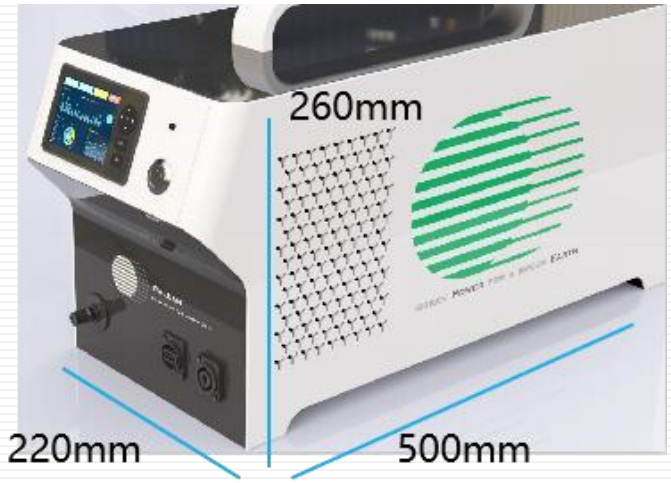
Distributed, island Power

“Island power generator”

size（mm）	1350 *650*1070（except fuel tank）		
quality（kg）	230（except fuel tank）		
output power（kW）	5	Output voltage	220VAC
fuel（Volume ratio）	60%methanol / 40%water	Fuel tank capacity（L）	200-500
Single injection power generation（kWh）	~2200	Sustainable running time	long-term
characteristic	stable energy output , free from weather, sunshine and other conditions; zero emissions without pollution; high energy efficiency; low noise; convenient infrastructure, safe operation; low operating costs.		

Portable power

“300W portable power generator”



Suitable for power sources such as single station power supply, field camping power supply, small drone power supply, and street small sweeper.

Parameters

performance	power range [W]	300~350
	DC Output voltage range [V]	24DC/48DC/220 AC
	System efficiency （%）	33(peak)
Working characteristics	fuel type	60% vol methanol / 40% vol water
	Fuel consumption@300W [KWh/L]	1.015
	Operating power consumption[W]	<77
	Ambient temperature [°C]	-20~50
	Communication methods	485/LAN
Connection characteristics	Fuel interface [mm]	Ø6
	Exhaust port [mm]	Ø60
Physical characteristics	size [mm×mm×mm]	525×233×285
	Volume[L]	34
	Weight [Kg]	~12

“China's first 30kW Methanol Reformed FCV (Co-op with Dofeng)”

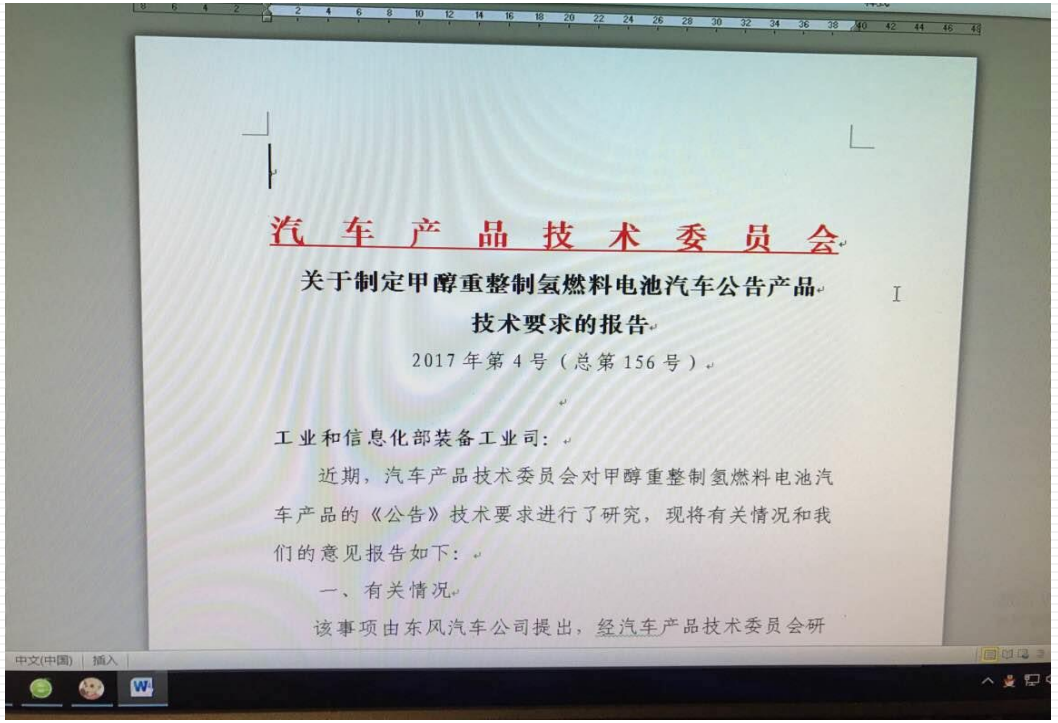
2016.05.24 Chairman of Dongfeng Yanfeng Zhu pays close attention to MRFC car

“China's first 30kW Methanol Reformed FCV (Co-op with Dofeng)”

►Developped the 1st methanol reformed hydrogen FCV in China.

►Fist MRFC issued by the Ministry of Industry and Information Technology in China.

►Developped the technical standard for methanol reformed hydrogen FCV.


汽 车 产 品 技 术 委 员 会

关于制定甲醇重整制氢燃料电池汽车公告产品技术要求的报告

2017 年第 4 号（总第 156 号）

工业和信息化部装备工业司：

近期，汽车产品技术委员会对甲醇重整制氢燃料电池汽车产品的《公告》技术要求进行了研究，现将有关情况和我们的意见报告如下：

一、有关情况

该事项由东风汽车公司提出，经汽车产品技术委员会研

“China's first 30kW Methanol Reformed FCV (Co-op with Dofeng)”

中华人民共和国工业和信息化部
Ministry of Industry and Information Technology of the People's Republic of China

企业申报车型公示详情

产品商标：	东风牌	产品型号：	EQ5080XXYTFCEV2	产品名称：	甲醇重整制氢燃料电池用式运输车
企业名称：	东风汽车公司	注册地址：	湖北省武汉市武汉经济技术开发区东风大道特1号		
目录序号：	3	生产地址：	湖北省十堰市		

查看原图 查看原图 查看原图

右部照片 后部照片 防护装置照片

外形尺寸(mm)：	长：6310 宽：2200 高：2820		
货箱栏板内尺寸(mm)：	长：3150 宽： 2150高： 1920		
排放依据标准：		燃料种类：	
最高车速(km/h)：	80	总质量(kg)：	7600
载质量利用系数：	0.58	额定载质量(kg)：	2605
转向型式：		整备质量(kg)：	4800
轴数：		准拖挂车总质量(kg)：	
轴距(mm)：		轮胎规格：	
钢板弹簧片数（前/后）：		半挂车鞍座最大允许承载质量(kg)：	
轮胎数：		驾驶室准乘人数（人）：	3
额定载客（含驾驶员）（座位数）：			
轮距（前/后)mm：	前轮距: 后轮距:	接近角/离去角（度）：	
反光标识生产企业：	浙江道明光学股份有限公司	反光标识型号：	VCDM-4
反光标识商标：	道明	防抱死制动系统：	有
车辆识别代号（VIN）：		前悬/后悬(mm)：	1180/1530

►Has been issued by the Ministry of Industry and Information Technology "new energy automotive product announcement"（2017/12/29）

►Has entered the "new energy vehicle promotion recommended list" (3rd batch of 2018)

►Has entered the "Exemption Vehicle Purchase Tax New Energy Vehicle Model Catalog" (17th batch of 2018)

►Mass production has started.

“China's first 30kW Methanol Reformed FCV (Co-op with Dofeng)”

2018/10/25, the world's first MRFC logistics vehicles were officially put into commercial operation release ceremony at the Kunshan International Auto Show.

http://www.cvnews.com.cn/portal.php?mod=view&mobile=yes&aid=57786&$page=

“10kW MFC used in MPV”

►The car has been driving in Suzhou-Inner Mongolia of China, which is highly valued by the Inner Mongolian government

►capacity of 800km+

►Meet the special needs of new energy vehicles with low temperature and vast territory in Inner Mongolia.

“High Power Fuel Cell System Module R&D(20kW) ”

► Target market: passenger cars and combined heat and power etc.

►Using micro-inverted technology to improve the energy conversion efficiency and extend the service life while increasing the module power density

“High Power Fuel Cell System Module R&D(60~80kW)”

Targeted market: ships, construction temporary power supply, electricity used during rail transit construction, power stations, collectors and combined heat and power supply, etc.

Our Target

Palcan

“Using Methanol to Replace Traditional fuel by Fuel Cell Technology”

THANK YOU!

Roland Gumpert

for Methanol Matters - June 2020

Methanol Fuel Cell: Powering the Future

Hello,

My name is Roland Gumpert
and I want you invite to show our
revolutionary driving technology
with hydrogen generated
from methanol.

https://www.youtube.com/watch?v=KfJ774jHSkQ

“My idea was to build a car which didn't stop when the battery is empty“

- Batteries only have a range of 100-350km
- The entire charging infrastructure would require a doubling of the existing electricity network and the implementation would take decades
- The waiting times at the charging stations are not technologically acceptable - long waiting times do not have to be with our technology
- For me, driving means freedom. When I get a phone call, I have to be able to get into my car and drive to another city without any planning

Is electric driving the future?

Yes this is undoubtedly the case!

Because:

- No risk of explosion because we do not work with high pressures up to 800 bar, our highest pressure is below 30 bar
- No new petrol stations required (conversion from diesel to methanol approx. 2000 €
- Transporting H2 is extremely energy-intensive and higher hazard classes than methanol
- A hydrogen filling station costs between € 1-3 million and must not be close to other buildings for explosion protection reasons (distance between residential buildings 100 meters; distance filling station 300 meters, German law)

Nathalie
“First Edition“

Key Facts & Parameters

820 km
Range

300 km/h
Top speed

Sports coupé
With two seats

3 min
Refueling

2,5 s
Acceleration 0–100 km/h

Carbon
Chassis

4-wheel drive
4 engines, 4 wheels (4E4W)

400 kW
Power

Grille frame
Made for the race track

Recuperation
Energy recovery

190 kWh
System power capacity

Rear spoiler
Aerodynamic rear

65 l methanol
Tank volume

120 km/h
When battery is empty

Dimensions

Length:	4370 mm
Width:	2076 mm (from mirror to mirror)
Height:	1306 mm
Wheel base:	2648 mm
Weight:	1800 kg

Quantity	500 pcs.	
Lifetime	4 Years	
SOP	2021	
EOP	2024	
Torque	< 1000 Nm	
System Voltage	400 V	
Average Consumption	20 kWh	
Charging Mode	37 (15+22) kW, ~2h	
Refueling	3 min	
Recuperation	0,3 m/s²	
Empty Battery Velocity	80 km/h	
Fuel Cell Capacity	65l Fuel = 118 kWh	
Fuel Cell Power	Up to 15 kW	
HV-Battery Capacity	60 kWh	
HV-Battery Power	450 kW	
Engine Power	4x100 kW	
Rpm	12.000 U/min	
Gearbox	2 Gears	1. 0 - 170 km/h
		2. 170 - 300 km/h

The future of hydrogen from a fuel cell is beyond question!

And methanol is the carrier!

Methanol is the perfect solution

and our vision for all vehicles (small and big) in the future

Here is an example of a small car with a methanol reforming fuel cell (this is a working test vehicle from us)

- From 40 HP car to 40 t truck
- The fuel cell is the size of a medium-sized travel case
- Already installed in an electrically operated Smart, one of our test vehicles
- This is the emission-free future without mineral oil

We already have the car of the future here in Ingolstadt/Bavaria (Germany)

- We manufacture the vehicles here in Ingolstadt
- We have orders from all over Europe
- We expect the first vehicles to be delivered to customers in the first half of 2021

We need support from business and politics to bring this technology to a wider range.

https://youtu.be/uOHzT-gATEc

Imprint

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Q&A