



Methanol: Emerging Global Energy Markets

***Gregory Dolan, CEO
Methanol Institute***

**16th Annual State of the Energy Industry Forum
23 January 2020 – Washington, DC**

Singapore | Washington | Brussels | Beijing

Agenda

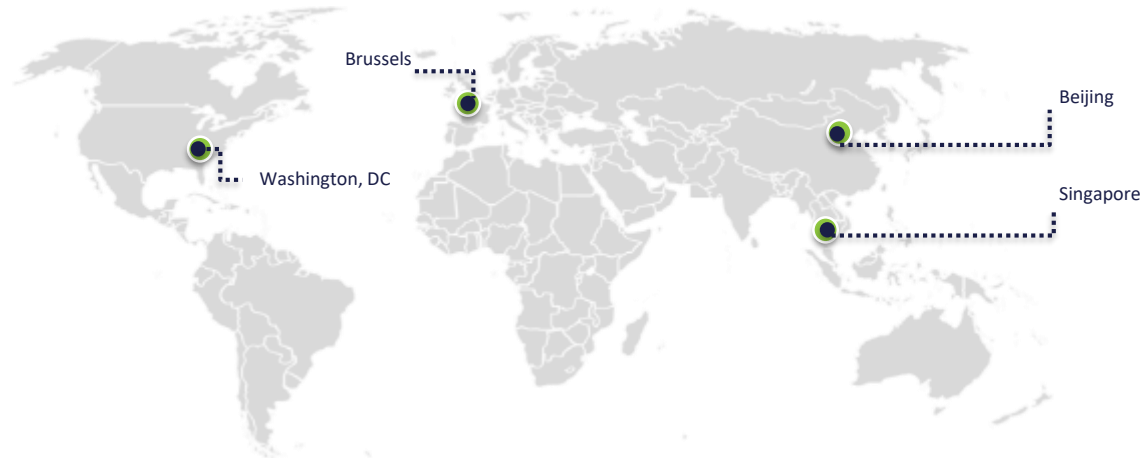


- About the Methanol Institute
- Methanol Overview
- Road Transport
- Marine Fuels
- China Heat Markets
- Hydrogen Carrier

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

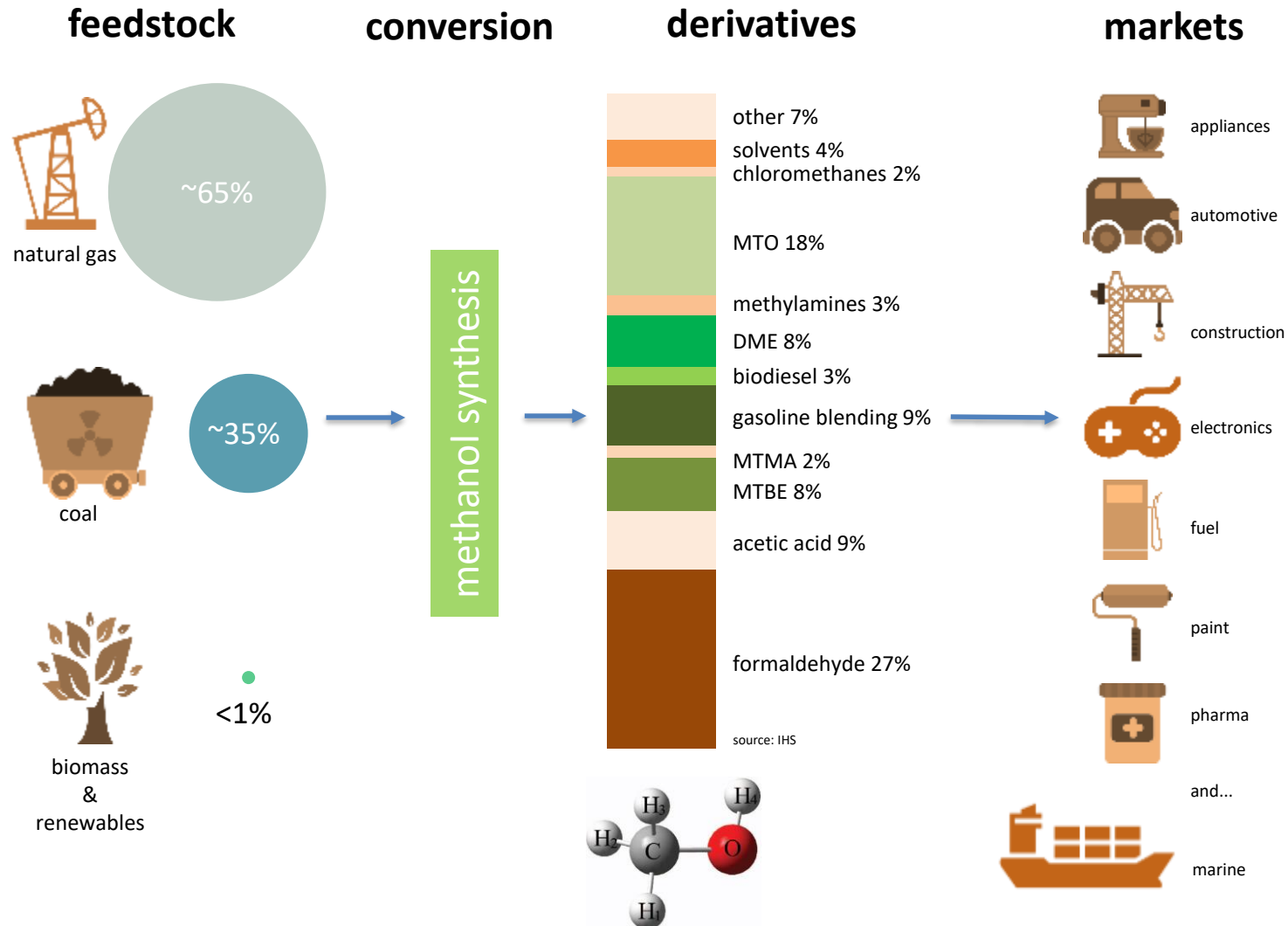


MEMBERS



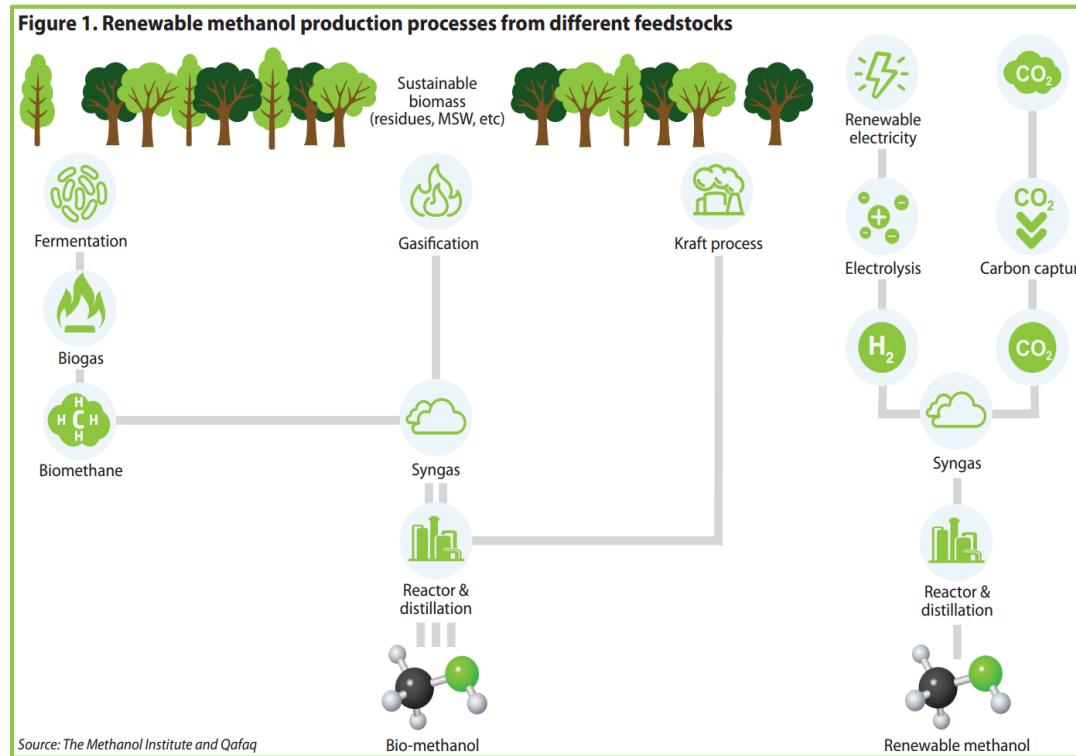
<https://www.methanol.org/join-us/>

Feedstocks and Markets



2019: Global Methanol Demand = 83 Million Metric Tons or 27.6 billion gallons

Methanol: Net Carbon-Neutral Pathways



Renewable methanol is an ultra-low carbon chemical produced from sustainable biomass, often called bio-methanol, or from carbon dioxide and hydrogen produced from renewable electricity.

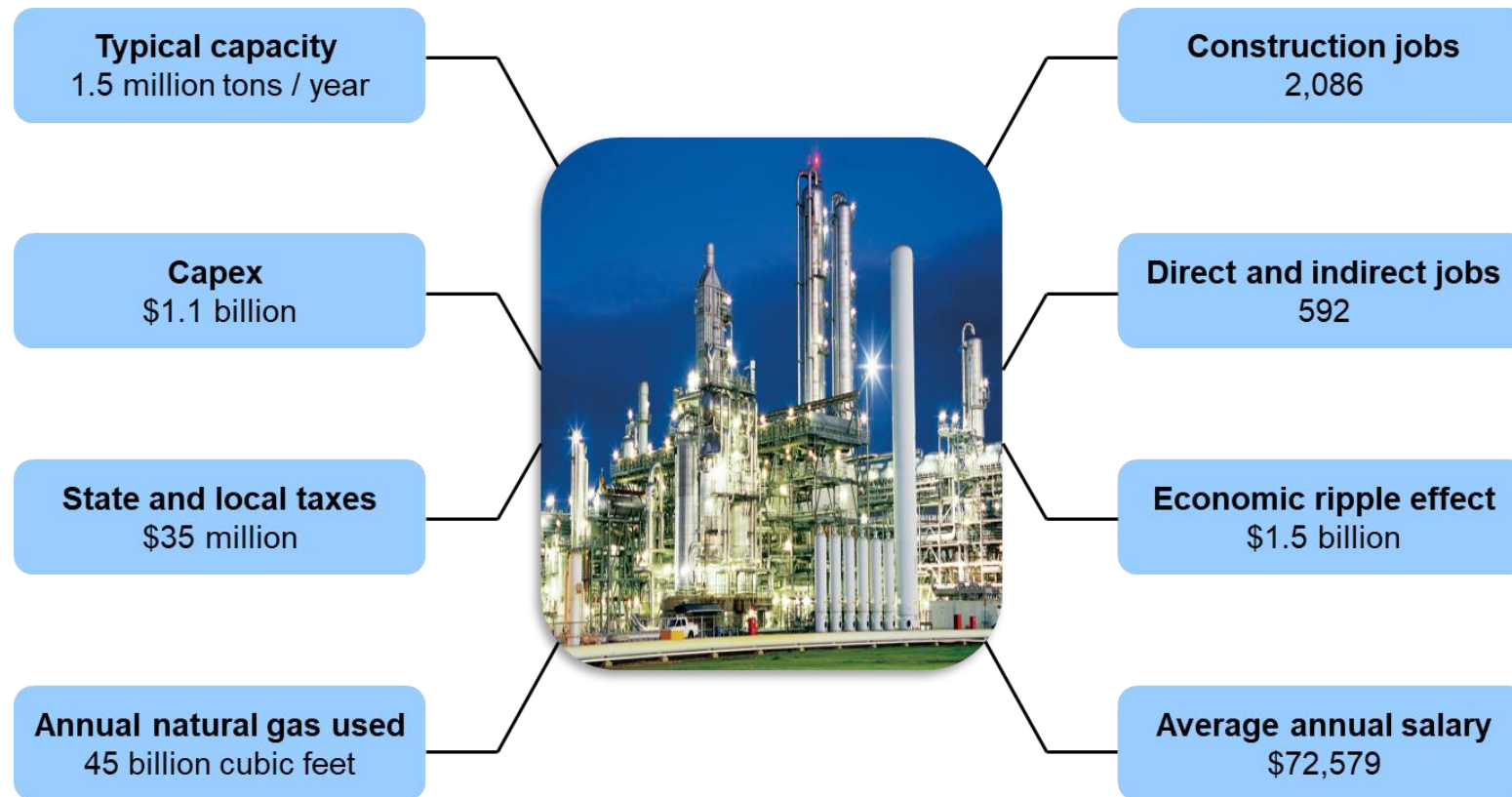
Renewable Methanol Emission Reductions: CO₂ by up to 95%; NO_x by 80%; virtually eliminating SO_x and Particulate Matter (PM)

US Methanol Production Resurgence

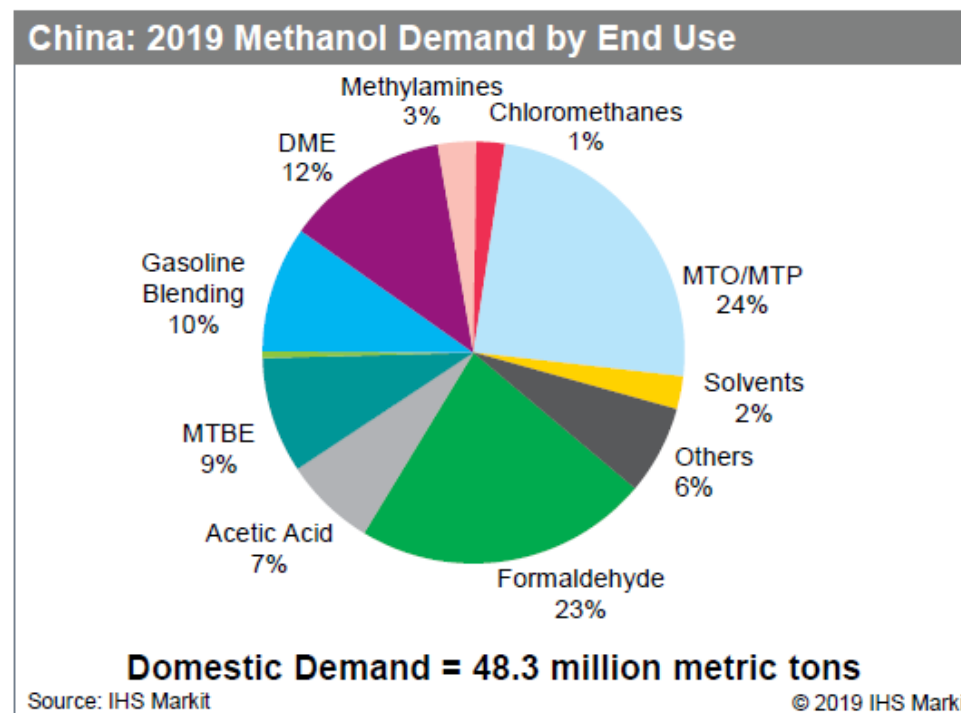
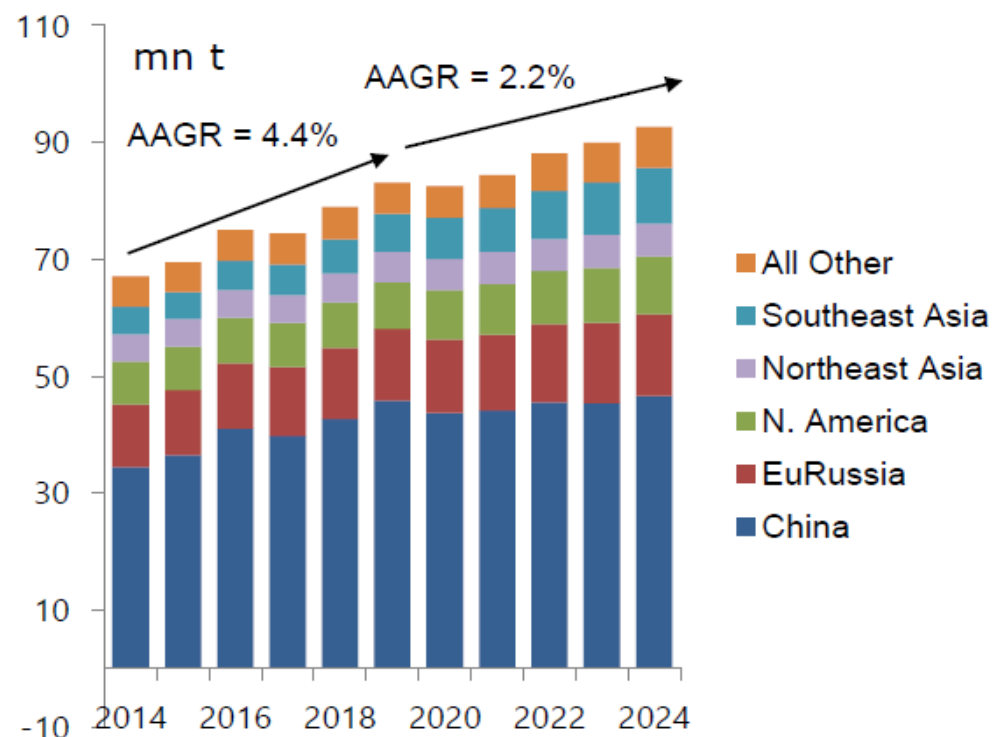
Timing	Name	Location	Ownership	Capacity '000t	Status
In Operation					
2010	Eastman, LYB, Praxair	Various	Various	860	
'11-'15	LYB, OCI, Methanex, Fairway	Various	Various	5,060	
2018	Natgasoline	Beaumont, TX	OCI/G2X	1,800	
2019	Alpont LLC	Toledo, OH	Interstate Chemical	85	
				7,805	
Under/Pending Construction					
2020	US Methanol - Liberty ONE	Institute, WVA	US Methanol	200	Under Re-assembly
	Koch - Methanol 1	St. James, LA	Koch/Yuhuang	1,650	Under Construction
2022	Methanex Geismar 3	Geismar, LA	Methanex	1,650	Approved
2023	South Louisiana Methanol	St. James, LA	Todd Energy/SABIC	2,000	FID 2019
2024	Theoretical			2,800	From List Below?
				8,300	
In Development					
TBD	Lake Charles Clean Energy	Lake Charles, LA	Lake Charles Clean Energy	1,600	Planning Stages
TBD	Sandpiper	Texas City, TX	EAI	1,600	Under Study
TBD	Primus Green Energy	Marcellus Region	Primus	56	Under Study
TBD	Northwest Innovation Works	Kalama, WA	NW Innovation	3,600	Challenges
TBD	IGP	Plaquemines Parish, LA	IGP	7,200	Under Study
TBD	Nauticol Energy	Alberta, Canada	Nauticol Energy	3,000	Under Study
TBD	Nauticol Energy	Quebec, Canada	Nauticol Energy	1,500	Under Study
TBD	Big Lake Fuels/G2X Energy	Lake Charles, LA	G2X Energy/Proman	1,400	Under Study
TBD	Celanese/Partner TBD	Bishop, TX	Celanese/JV	1,300	Under Study
TBD	Zeogas	Lake Charles, LA	Zeogas	1,600	Under Study
				22,856	
Total existing, under construction, probable and in development				38,961	

New U.S. Methanol Plants Offer Many Economic Benefits

Economic Impact of a Typical U.S. Methanol



China = More than Half of Global Methanol Demand – 16 Billion Gallons



US-China Tariffs



MI Opposes Tariffs

- Reciprocal 25% tariffs on methanol in effect
- 23 August 2018 – MI Testified before U.S. Trade Representative
- Urged USTR to remove methanol from List 3 of 6,000 products of Chinese goods
- **Virtually no methanol trade from China to U.S.**
- U.S. net methanol exporter and China the world's largest market for methanol
- Tariffs threaten expansion of U.S. methanol production – risking billions \$\$ in investment and thousands of jobs
- ***SIMPLY PUT, CHINA DOESN'T WANT TO SELL US THEIR METHANOL, THEY WANT TO BUY OUR METHANOL***

China Methanol Taxi Fleet

- China consumes 4.8 MMT or 1.6 billion gallons of methanol for road transport
- Currently over 20,000 methanol-fueled taxis operation for total of 125 million kilometers
- Neat methanol fuel or “M100” consumption for taxi is 13.5 litres/100 km, with energy consumption of 237.8 MJ



Table 2 Taxi Fuel Cost Comparison of Taxi in Jin Zhong City

	Gasoline	CNG	M100
Fuel Price RMB/L	5.51	3.5 RMB/m ³	1.8
Fuel Economy L/100km	8	8.8 m ³ /100km	13.5
Fuel Cost Saving %	37.5	10.6	--

Note: the fuel price is based on the operation in November of 2015;

China M100 Promotion Policy

- Dec 2018: MIIT completes acceptance of all methanol pilot demonstration programs
- *March 2019: MIIT and 7 other ministries announce methanol policy paper for M100*
- MI issues press release and briefing report
 - <https://www.methanol.org/wp-content/uploads/2019/03/A-Brief-Review-of-Chinas-Methanol-Vehicle-Pilot-and-Policy-20-March-2019.pdf>
- “Paper 61” encourages commercial introduction of M100 vehicles
- Approval of 32 product models from 9 methanol vehicle manufacturers



Italy M15/E5 Blending

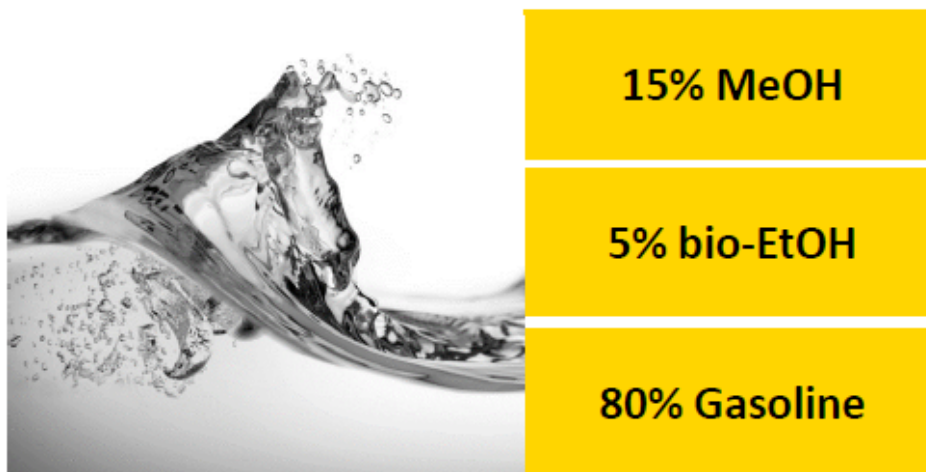
- 21 November 2017: With Italian Prime Minister, the CEOs of Eni and Fiat Chrysler Automobile sign MOU for joint development of technology reducing CO₂ of road transport vehicles
- Eni had developed an “A20” fuel blend of 15% methanol and 5% bioethanol
- New blend demonstrated in 5 FCA Fiat 500 vehicles in Eni’s Enjoy car-sharing fleet



https://www.eni.com/en_IT/media/2017/11/eni-and-fca-sign-research-agreement-for-joint-projects-to-significantly-reduce-co2-emissions-produced-by-road-transport-vehicles



A20: a New Methanol-based Alternative Fuel



- Formula Cost Reduction
- “Transparent” to all the E10 car vehicles
- No-chemical corrosion problems
- No-phase separation (in the car tank and gas-station)

CUNA specification (NC 627-02 July 2018)

Property	Units	Limits MIN – MAX	
Research octane number, RON		100	
Motor octane number, MON		86	
Lead content	mg/l		5.0
Density (at 15 °C)	kg/m ³	720.0	775.0
Sulfur content	mg/kg		10.0
Manganese content	mg/l		2.0
Nitrogen content	ppm		100
Oxidation stability	minutes	360	
Existent gum content (solvent washed)	mg/100 ml		5
Water content	% (m/m)		0.2
Oxygen content	%(m/m)		10.0
Methanol	%(V/V)	12.0	16.0
Ethanol + other Alcohols (C3-C4)	%(V/V)	4.0	6.0
Ethers (5 or more C atoms) other oxygenates	Volume blending of these components is restricted to 10.0 % (m/m) maximum oxygen content including methanol oxygen.		

CUNA NC 627-02 include also the evaporative class parameters to prepare A20 grade for summer, winter and transition period

German C3 Mobility

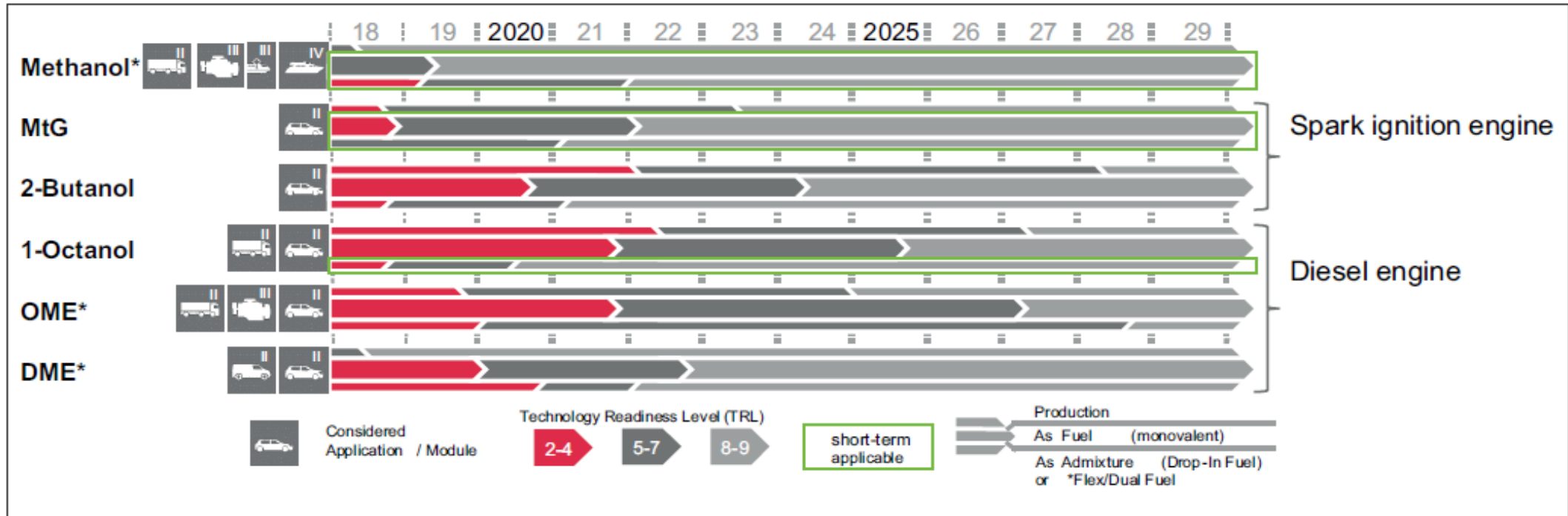
- C3 Mobility for Closed Carbon Cycle
- Joint public/private partnership with German Ministry of the Economy and Energy and German automotive industry
- Two-year, € 24 million program



Assoziierte Partner und im Unterauftrag



German C3 Mobility



- Renewable methanol obtained from CO₂ and hydrogen can be imported to Germany/Europe as an e-fuel/electrofuel/power-to-X
- As much as one-third of Germany's transport sector could be fueled with e-fuels by 2050
- Renewable methanol can be used directly as a fuel or converted to derivative fuels
- Light- and heavy-duty vehicles and vessels will be demonstrated

Emissions Regulations Driving Marine Fuel Market

- The International Maritime Organization has adopted emission regulations transforming the shipping industry
- In 2020, global SO_x reductions took effect
- By 2050, greenhouse gas emissions must be cut in half

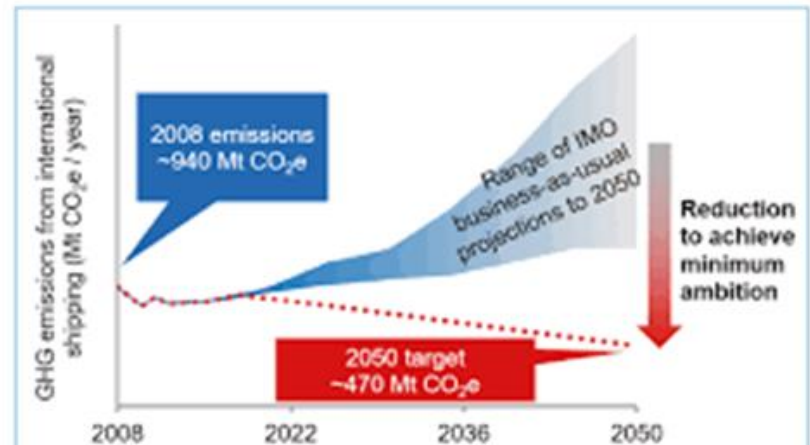
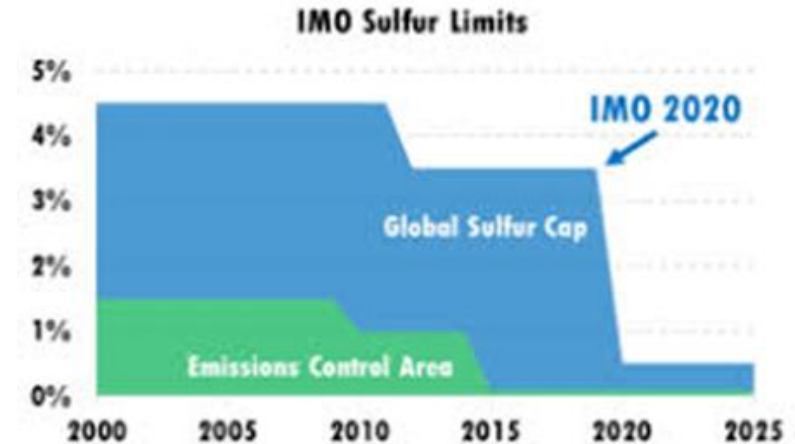


Figure 1 - Zero carbon fuels are required to meet the IMO's 2050 decarbonisation target

Methanol Vessels on the Water

DUAL FUEL



9x - **+2**

1x

1x

1x

chemical
tankers

ROPAX
ferry

Pilot
boat

dry
bulk

MOL, WL,
Marinvest

Stena Line

MI/SMA
ScandiNaos

Jiang
Long

2 stroke
MAN

4 stroke
Wärtsila

high speed
Scania,
Weichai

DMCC
Yuchai

new build

retrofit

retrofit

new build

FUEL CELL



2x

1x

Tourist
Boat
propulsion

Ferry
hotel load

Innogy
HTWG
Konstanz

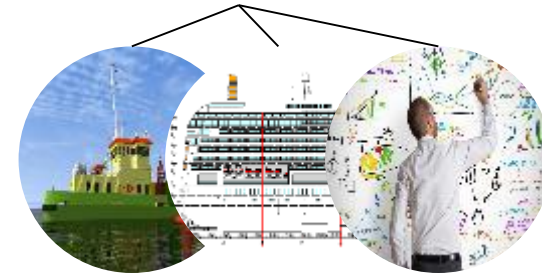
Viking Line

SerEnergy fuel cells

retrofit

retrofit

PROJECT and R&D



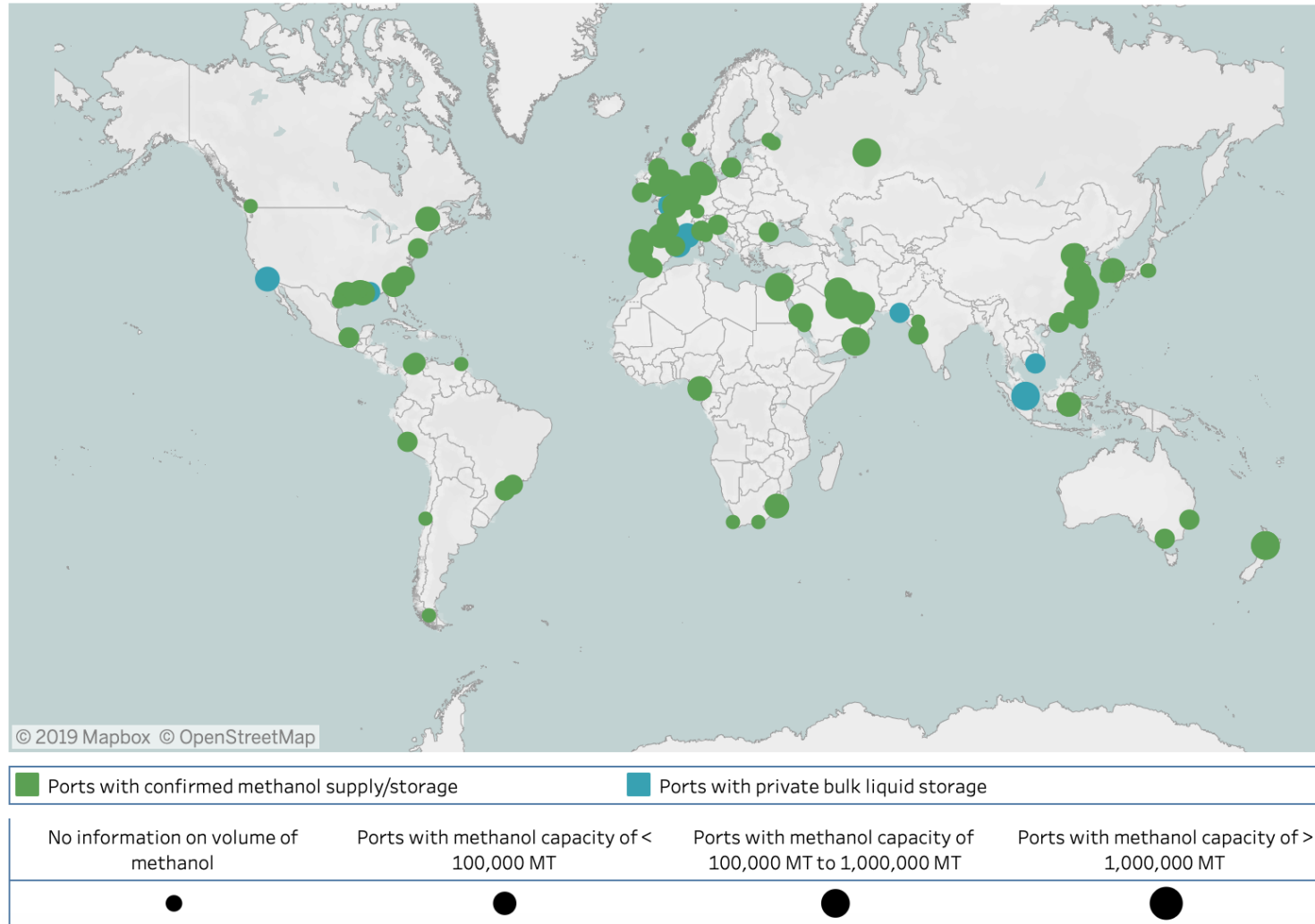
Cruise ships, fishing boat,
barge, dredge, a.o.

SUMMETH/MARTEC,
Lean Ships, Methaship,
Billion Miles, FiTech, India,
PCG Product Vessel, NTU Test
Port of Rotterdam Barge, **Green
Maritime Methanol, FastWater**

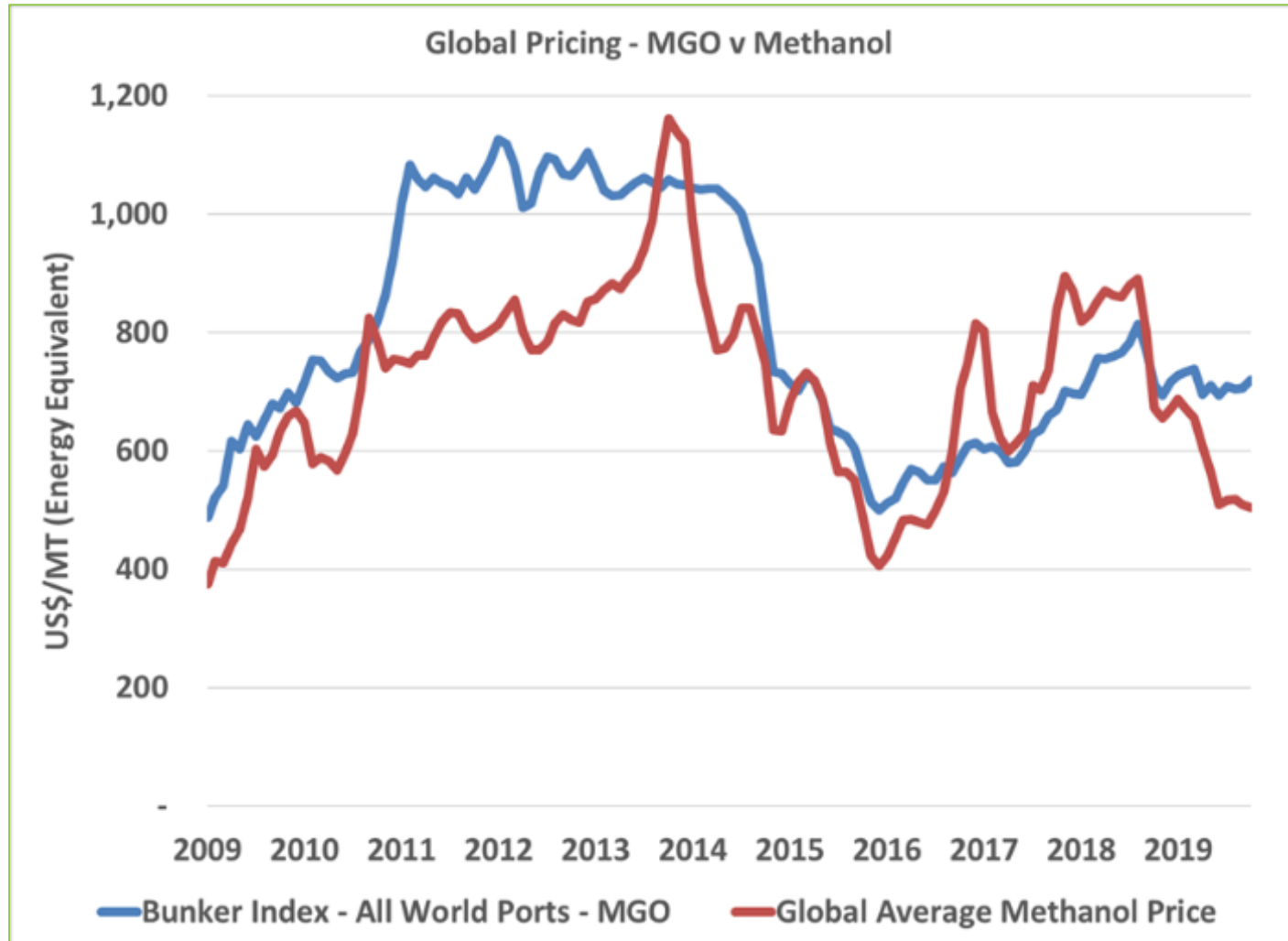
SI hybrid, dual fuel, fuel cells

new build & retrofit

Methanol Available in Over 100 Ports Today



Compliance Cost Comparison



“Methanol is an economically competitive marine fuel over the cycle”

**Paul Hexter, CEO
Waterfront Shipping**

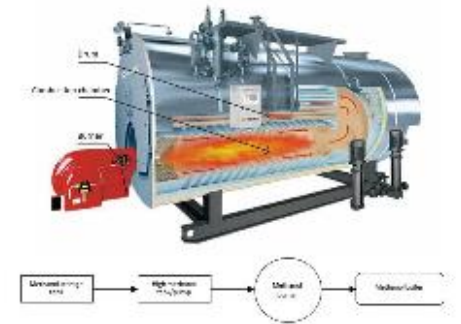
Methanol Bunkering Easy and Clean

- Liquid at atmospheric pressure
- Available in many ports around the world and along rivers
- Low infrastructure cost
- Flexible, modular system
- Environmentally friendly as it's **biodegradable**



China: Methanol Industrial Boilers

- Industrial boilers are widely used for heating and industrial stream
- Many cities in China prohibiting use of coal and diesel fuels
- Capacity ranged from 1 to 20 ton/hour
- One steam ton capacity consumes 110 kg of methanol, and runs 24/7
- Methanol fuel is used neat or as blend with diesel fuel
- Standards developed with MI and Methanex support
- *Estimated more than 1000 units, consuming over 2 MMTs methanol in 2018*
- *Growing to 5 MMT in 5 years*

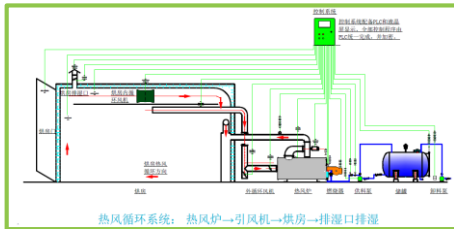
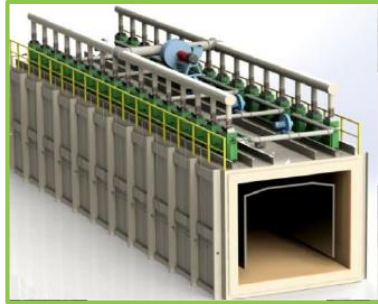


China: Methanol Cook Stoves



- **Different types methanol cook stoves:** Single heating, stir fry, steaming
- Widely used in restaurants, central kitchens, mainly cost-driven
- Simple storage and transportation, filling the gap of pipeline NG supply
- Fuel: 100% methanol to methanol blends usually with water
- ***Market for Cooking Application over 5 MMTs in China in 2018***
- ***Growing to 7-8 MMT in 5 years***

China: Glass/Ceramic Kilns and Tobacco Drying



- **China also developing other new markets for the use of methanol:**
 - **Glass/ceramic kilns** – China produced 60% of world's glass products; methanol uses less air intake and produces cleaner flue gas for superior finish
 - **Tobacco drying** – One in every 3 cigarettes smoked in the world are smoked in China

China: Household Heating



- **Beginning in 2018, China using methanol for home heating**
- Shanxi Province methanol used in 30,000 households in 10 counties, with Jinzong City adding 50,000 households in 2020
- Small heaters for individual families and centralized 2-4 ton steam boilers for larger buildings
- Cities promoting methanol as replacement for coal with government support of 6,000 RMP to furnace providers, free heaters for families and fuel subsidies

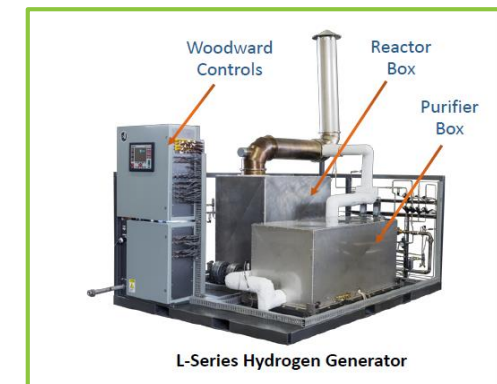
METHANOL A HYDROGEN CARRIER FOR FUEL CELLS

- Blue World Technologies (*Denmark*)
- Palcan (*China*)
- Horizon Energy Systems (*Singapore*)
- Oneberry (*Singapore*)
- Alteryg (*USA*)
- Serenegy (*Denmark*)
- SFC Energy (*Germany*)
- Toshiba (*Japan*)
- Ultracell (*USA*)



Practical Solution for Battery and Fuel Cell Vehicles

- Reformed Methanol Fuels Cells (RMFC) as range extender for battery electric vehicles
- Increasing range of battery powered vehicles from 300 to 1000 kilometers
- If you really need hydrogen, reform methanol at the fueling station



Denmark's Blue World Technologies and China's Palcan

MANUFACTURING PLANTS: 50,000 UNITS/YEAR – 5-15 kw RMFC



Launch Reception: Blue World Technologies presenting plans for large-scale manufacturing facility

Blue World Technologies today presents plans for the world's largest methanol fuel cell factory located at the Port of Aalborg ready for global export of clean energy technology. Methanol fuel cell components will be produced in high volume enabling electric vehicles to have a 1000km range with 3 minutes refuelling time.

Blue World technology is newly founded but has ambitious goals from the start by targeting the most potential markets in form of automotive and electric mobility. The challenge is daunting, but also the possibility to really make a difference in the world.

Today the mayor of Aalborg; Mr. Thomas Karstrup Larsen is attending the launch reception of Blue World Technologies on the Port of Aalborg. Furthermore, plans for the world largest methanol fuel cell manufacturing facility will be presented.



3 - Blue World Technologies - fuel cell factory visualisation

Volume production of methanol fuel cells

Blue World Technologies will establish a state-of-the-art manufacturing plant for a unique fuel cell technology platform utilising methanol as a fuel. The plant will be highly specialised in the production of materials and components for the fuel cell and stack which can be compared to the engine block of a car. The overall effort will require several hundreds of new employees for both development and operations. The factory will be built and have initial manufacturing activity during 2019.

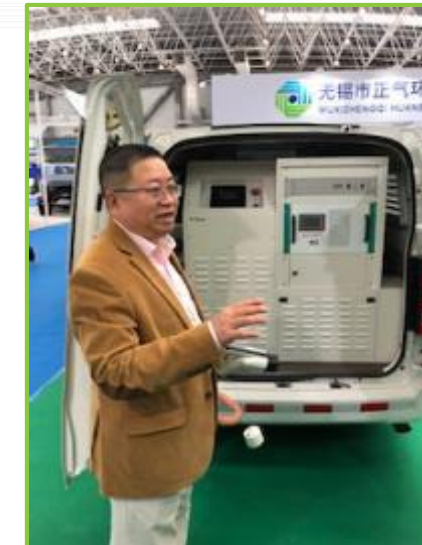


• Our Development Plan II

“Build a 50,000 sets of fuel cell module production base (2018)”

- ▶ Industrial Base: Cixi, Zhejiang province
- ▶ Total investment of 100 million
- ▶ Achieve 50,000 sets of fuel cell module production capacity.

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▶ Market target : Electric logistics vehicle, mobile charging vehicle, communication backup power supply, civil-military integration.



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