METHANOL INSTITUTE

METHANOL AS A FUEL FOR TRANSPORTATION- GLOBAL PERSPECTIVE
全球视角下甲醇作为交通燃料进展

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2019 METHANOL FUEL AND VEHICLE APPLICATION ANS SYSTEM FORUM

甲醇燃料及甲醇汽车应用体系建设论坛

XI AN, CHINA 中国西安

September 5-6th, 2019

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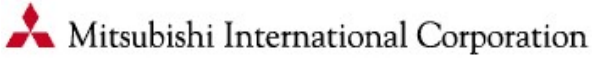

Tier 4

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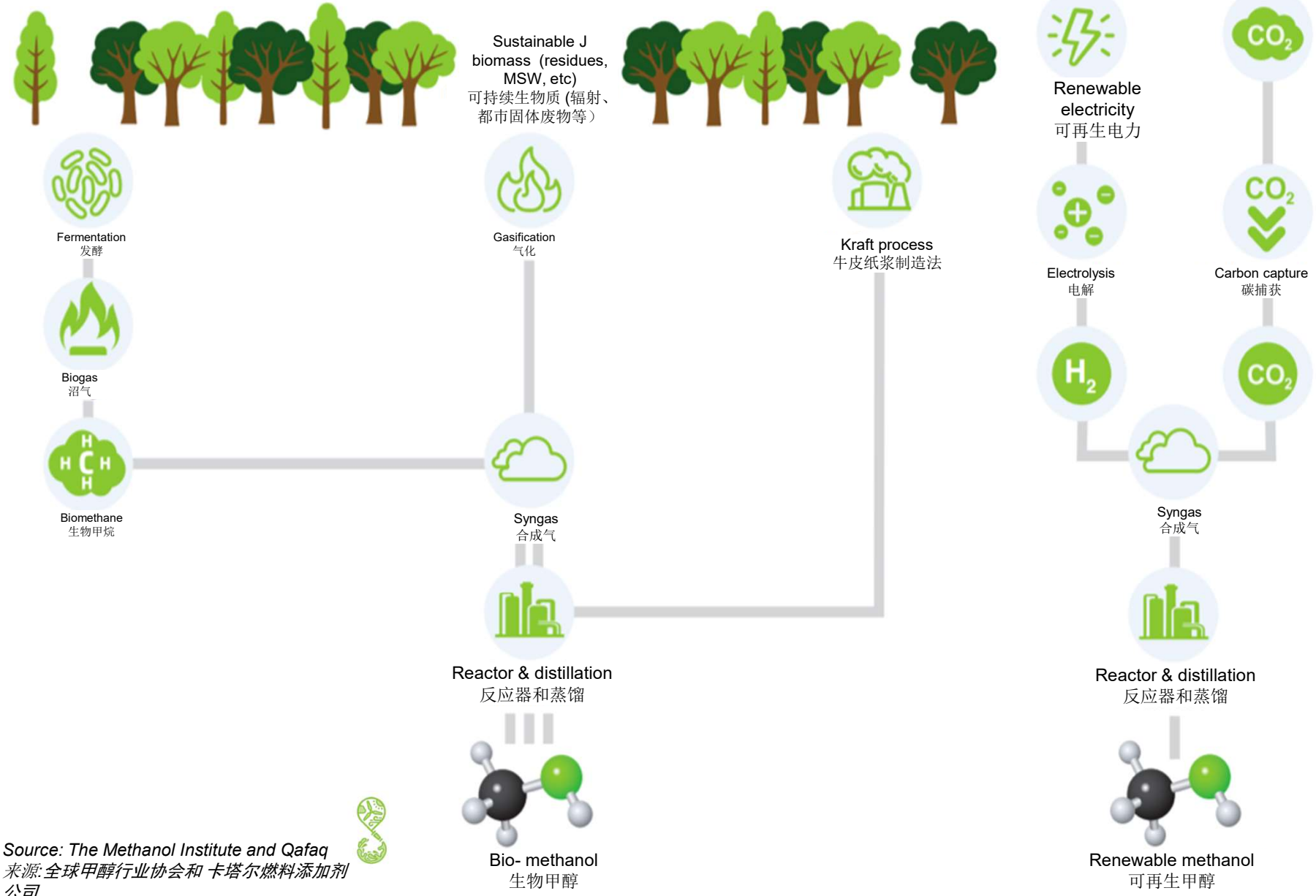
02

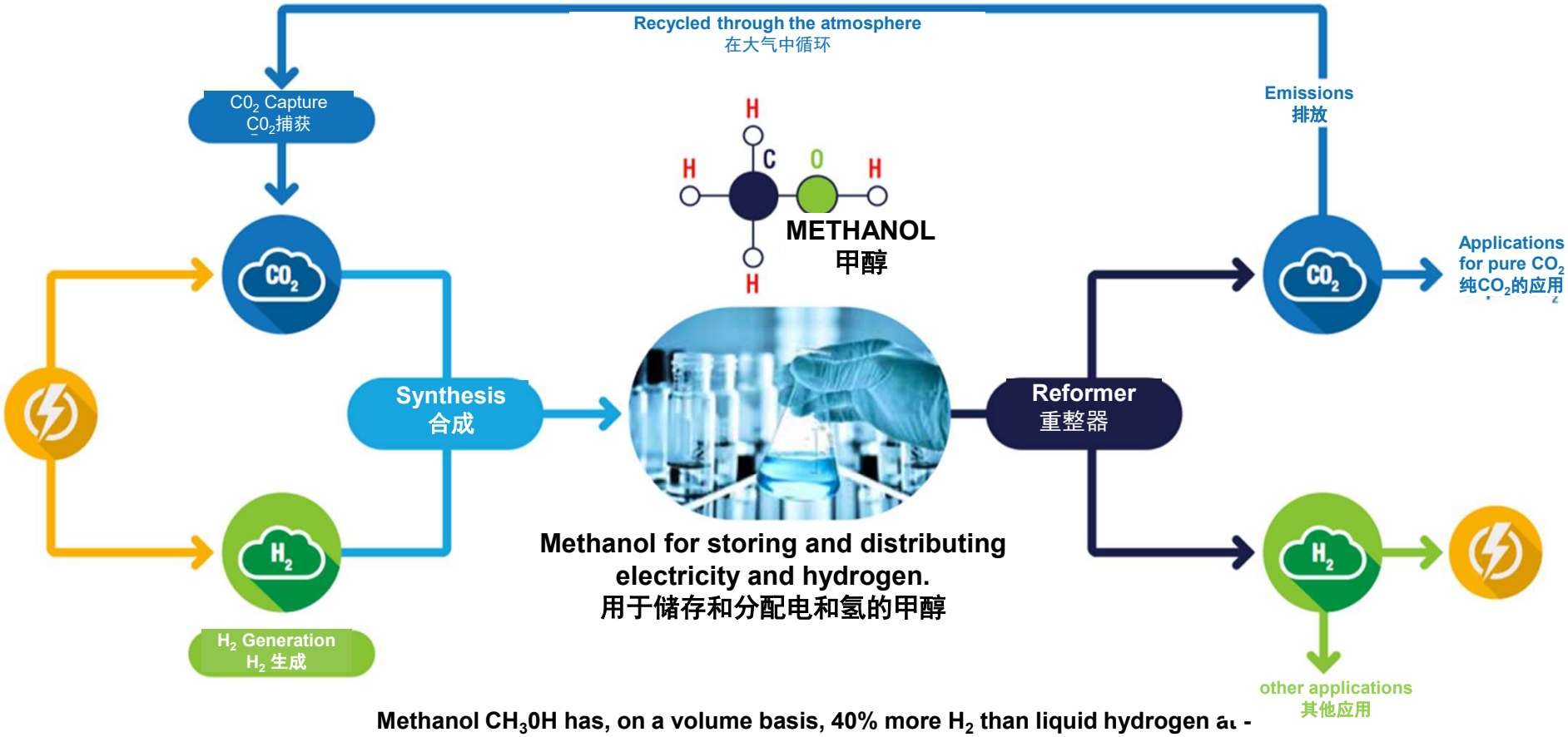
LOW CARBON AND RENEWABLE METHANOL CAPACITY
低碳绿色甲醇

RENEWABLE PATHWAYS 可再生途径



Source: The Methanol Institute and Qafaq
来源:全球甲醇行业协会和 卡塔尔燃料添加剂公司

AN EFFICIENT ENERGY CARRIER高效能源载体



Methanol CH_30H has, on a volume basis, 40% more H_2 than liquid hydrogen at -253° C, and 140% more H_2 than compressed hydrogen at 700 bars.
在-253° C时，甲醇CH_3OH中的H_2体积比液氢高40%，
在700 bar时的H_2含量比压缩氢高140%。

VARIOUS STAGES OF DEVELOPMENT发展的不同阶段

Methanol category 甲醇的类别	Commercial 商业化	Feasibility and R&D 可行性及研发	Stopped or On-hold 停止或暂停
Bio-methanol 生物甲醇	• BioMCN (NL) • BioMCN（荷兰） • Enerkem (CAN) • Enerkem（加拿大） • New Fuel (DEN) • New Fuel（丹麦） • Oberon (USA) • Oberon（美国）	• Biogo (GER) • Biogo（德国） • Enerkem (NL) • Enerkem（荷兰） • LowLands Methanol (NL) • LowLands Methanol（荷兰） • Södra (SE) • Södra（瑞典） • NREL (USA) • NREL（美国） • Heveskes Energy (NL) • Heveskes Energy（荷兰）	• BioMCN (glycerine) (NL) • BioMCN（丙三醇）（荷兰） • Chemrec (SE) • Chemrec（瑞典） • Range Fuels (USA) • Range Fuels（美国） • Schwarze Pumpe (GER) • Schwarze Pumpe（德国） • Värmlands Metanol (SE) • Värmlands Metanol（瑞典） • Woodspirit (NL) • Woodspirit（荷兰）
Renewable methanol 可再生甲醇	• CRI (IC) • CRI（冰岛） • Innogy (GER) • Innogy（德国）	• bse Engineering (GER) • bse Engineering（德国） • Blue Fuel Energy (CAN) • Blue Fuel Energy（加拿大） • CRI (CN/GER) • CRI（中国/德国） • MefCO2 (GER) • MefCO2（德国） • Infraserv (GER) • Infraserv（德国） • Liquid Wind (SE) • Liquid Wind（瑞典） • Port of Antwerp (BE) • Port of Antwerp（比利时） • STEAG (GER) • STEAG（德国） • Swiss Liquid Future (CH) • Swiss Liquid Future（中国） • ZASt (GER) • ZASt（德国） • USC (USA) • USC（美国） • Gensoric (GER) • Gensoric（德国） • Neo-H2 (USA) • Neo-H2（美国）	
Hybrid methanol 混合甲醇		• Haldor Topsoe (DEN) • Haldor Topsoe（丹麦） • OPTIMeoH (GER) • OPTIMeoH（德国）	
Low carbon methanol 低碳甲醇	• GPIC (BAH) • GPIC（巴哈马） • Methanex (CAN) • Methanex（加拿大） • QAFAC (QAT) • QAFAC（卡塔尔） • SABIC (KSA) • SABIC（沙特阿拉伯）	• Carbon2Chem (GER) • Carbon2Chem（德国） • FRESME (SE) • FRESME（瑞典） • NCF (CN) • NCF（中国） • GasTechno (USA) • GasTechno（美国） • Maverick Synfuels (USA) • Maverick Synfuels（美国）	

03

METHANOL FUEL FOR ROAD TRANSPORTATION
道路交通用甲醇燃料

甲醇是多用途的燃料资源
Methanol is a versatile fuel source

- 2017年全球7500万吨甲醇消费中，能源和燃料应用占比40% Out of the ~75 million metric tons of methanol sold globally in 2017, energy and fuel uses represent 40% of total demand
- 从2009-2017，直接甲醇燃料掺混年均增速约23% From 2009-2017, direct methanol fuel blending has increased at an annual rate of nearly 23%

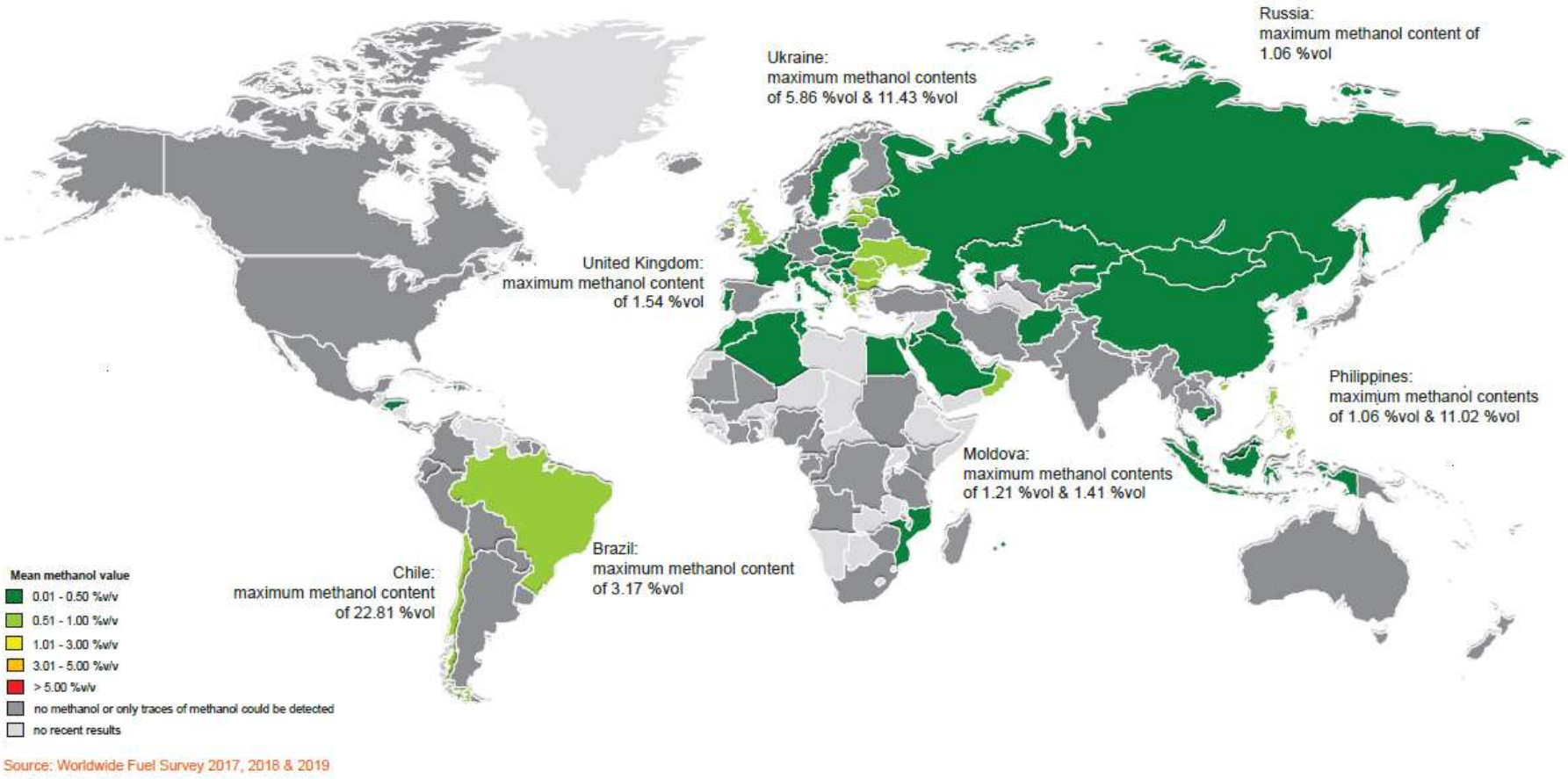
燃料FUELS
- Neat fuel 纯甲醇
- Low blends 低比例混合
- High blends 高比例混合
- GEM 汽油乙醇甲醇三混合
- MTBE 甲基叔丁基醚
- Biodiesel 生物柴油
- DME & OME 二甲醚和聚甲氧基二甲醚
- MTG 甲醇制汽油

技术TECHNOLOGIES
- SI & CI engines 点燃和压燃发动机
- Turbines 燃气轮机
- Fuel cells 燃料电池
- Industrial boilers 工业锅炉
- Cook Stoves 民用灶具




市场细分 SEGMENTS
- Road & non-road transportation 道路和非道路应用
- Power & heat generation 发电和供热
- Marine 船舶

全球汽油中甲醇含量
Global Methanol Content in Gasoline



Source: Worldwide Fuel Survey 2017, 2018 & 2019

综合过去三年世界油品质量调查，截止到 2019年1月

Source 数据来源: SGS INSPIRE

Fuel Blending Initiatives
甲醇燃料掺混

- **3% 甲醇掺掍汽油 M3 Methanol Fuel Blending in Regular Gasoline in Europe**
- 欧洲标准汽油标准（EN228）允许添加最高3%的甲醇

  3% methanol allowed in EU EN228 gasoline standard

  目前在英国和北欧国家

  Currently in UK and Nordic Countries

- **可再生甲醇的燃料应用 Renewable Methanol in fuel pool**

- **甲醇用于乙醇汽油中作为助溶剂，如巴西和意大利的A20**

  Methanol in ethanol gasoline as co-solvent, like Brazil and A20 in Italy

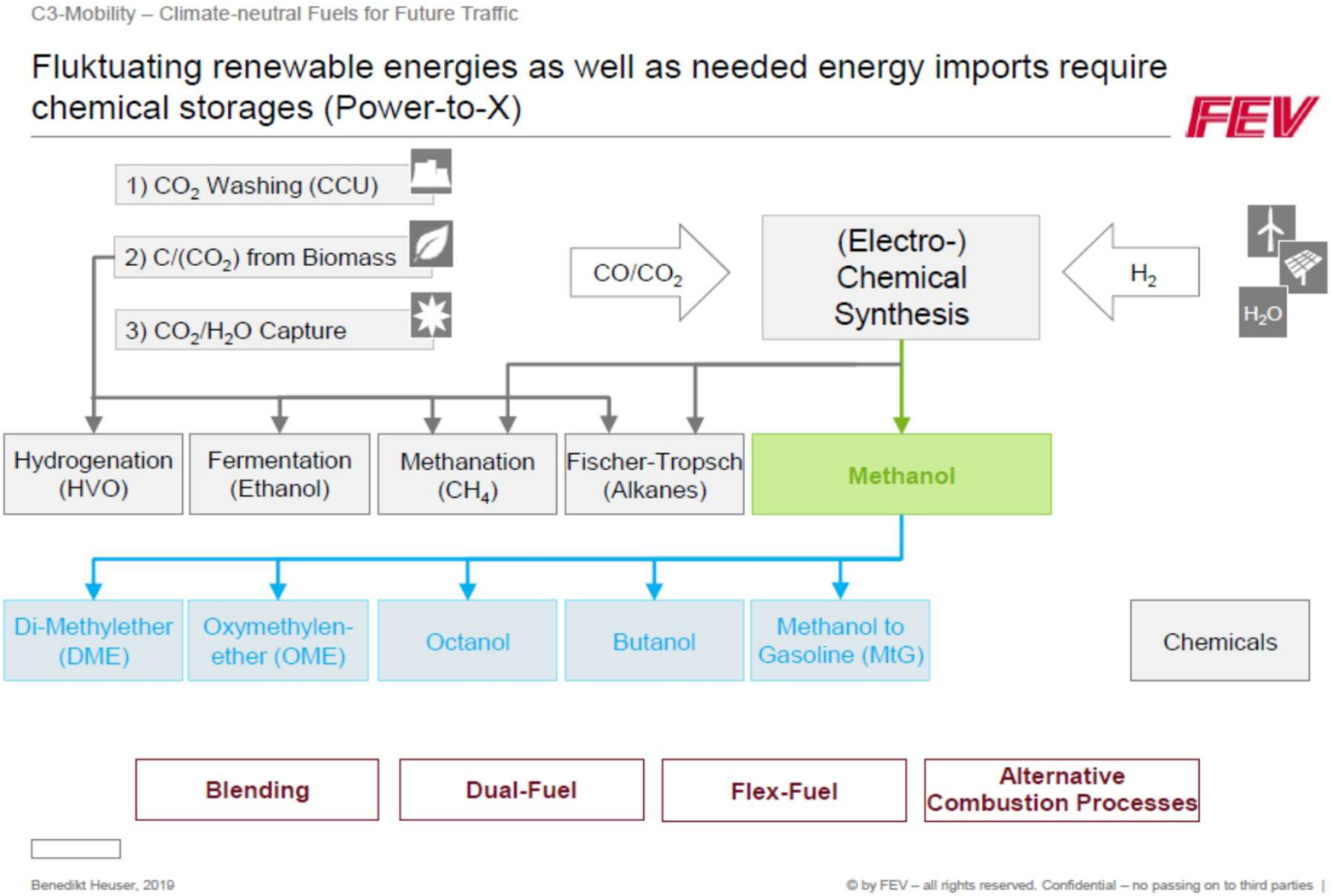
- **在一些国家发现超过汽油允许添加量的甲醇**

  Even higher content than allowed limits found in many countries

德国 C3项目 German C3 Mobility

- C3：闭环碳循环 C3 Mobility for Closed Carbon Cycle
- 德国能源局和汽车工业领导下的公共部门和私有企业合作Joint public/private partnership with German Ministry of the Economy and Energy and German automotive industry
- 2年，2400万欧元 Two-year, € 24 million program

德国 C3项目 German C3 Mobility



India: Roadmap to Methanol Economy
印度：甲醇经济规划蓝图

- September 2015, NITI Aayog formed the Methanol Economy Expert Group
- 2015 年 9 月，NITI Aayog 成立甲醇经济专家组

- 2018 Methanol M15 Guidelines published
- 2018 年发布了《甲醇汽油 M15 指南》

- 2018 IRClass published Guidelines for Methanol Fueled Vessels
- 2018 年 IRClass 发布了《甲醇燃料船舶指南》

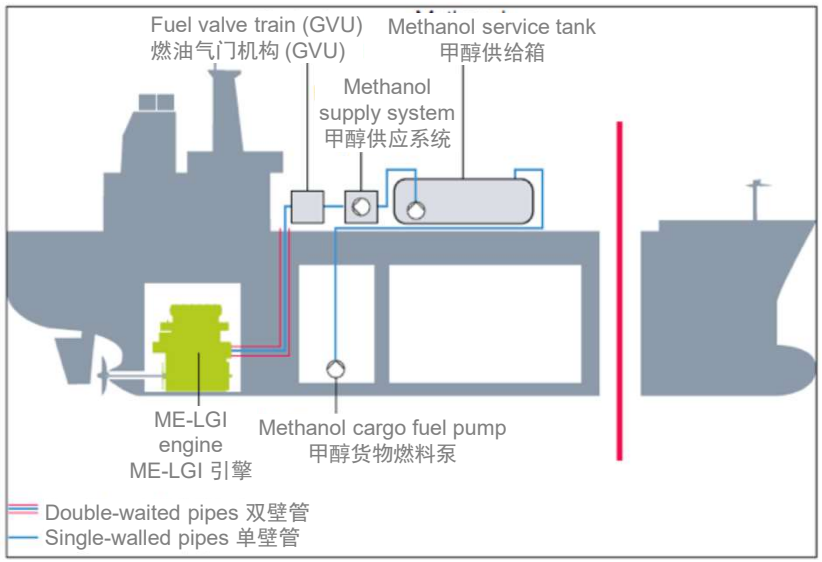
- Launching Projects:
- 启动项目：
  - M15 fuel blending M15
  - 混合燃料
  - Methanol M100 gensets, buses and trucks
  - 甲醇M100发电机，公交车和卡车
  - railway engines 火车头
  - inland waterways 内陆水路
  - cook stoves 烹调用炉
  - industrial boilers 工业锅炉

Union & Road Transport Minister Nitin Gadkari
工会和道路交通部长

04

METHANOL AS MARINE FUEL
船用甲醇燃料

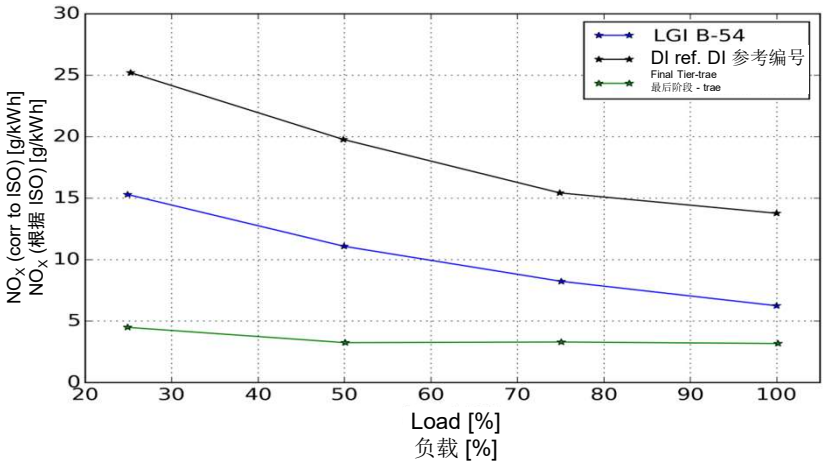
PRACTICAL SOLUTION 实用的解决方案

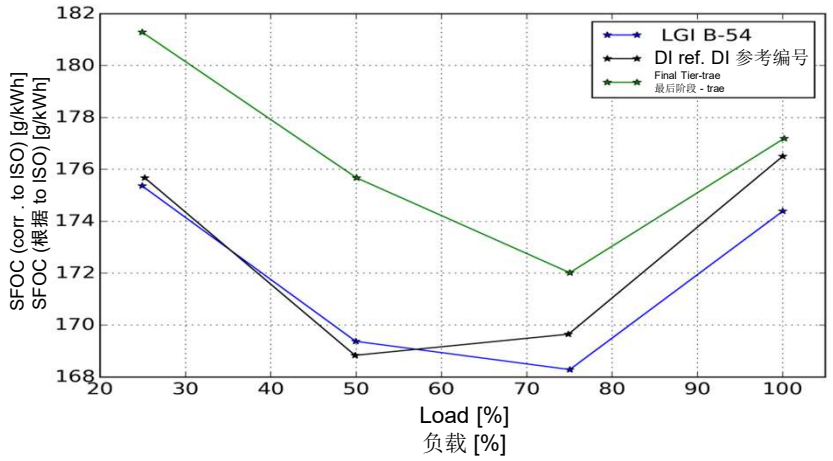


- **Multi – fuel engines will be the norm going forward**
  多燃料发动机将成为未来的主流
- **Methanol can be readily and safely applied in both new build and conversion**
  在建造和改造过程中可以轻松而安全地应用甲醇

- **Methanol can be a practical solution for dual fuel applications, to include other alternative fuels such as LPG and LNG**
  甲醇可带来实用的双燃料组合应用解决方案，搭配的燃料包括替代燃料，如液化石油气和液化天然气

METHANOL / WATER BLENDING (EMULSIFICATION)
甲醇/水混合（乳化）





- Approximately 25-40% water is added to the methanol to achieve a new, Tier III solution
  向甲醇中添加大约 25-40% 的水，获得的新溶液可满足欧洲氮氧化物第三阶段排放要求
- NOx decreases almost linearly with water content, to approximately 2 g/kWh at 50% and 75% load
  氮氧化物下降的幅度几乎与含水量同步，在 50% 和 75% 负荷下约为 2 g/kWh
- Similar system is being planned for fuel oil, so the Tier III compliant technology will be available as a dual fuel solution
  目前正计划对燃油使用类似的系统，从而实现满足欧洲氮氧化物第三阶段排放要求的技术，获得双燃料解决方案
- R&D testing completed - service test is under preparation
  研发测试已完成 — 运用测试正在准备中

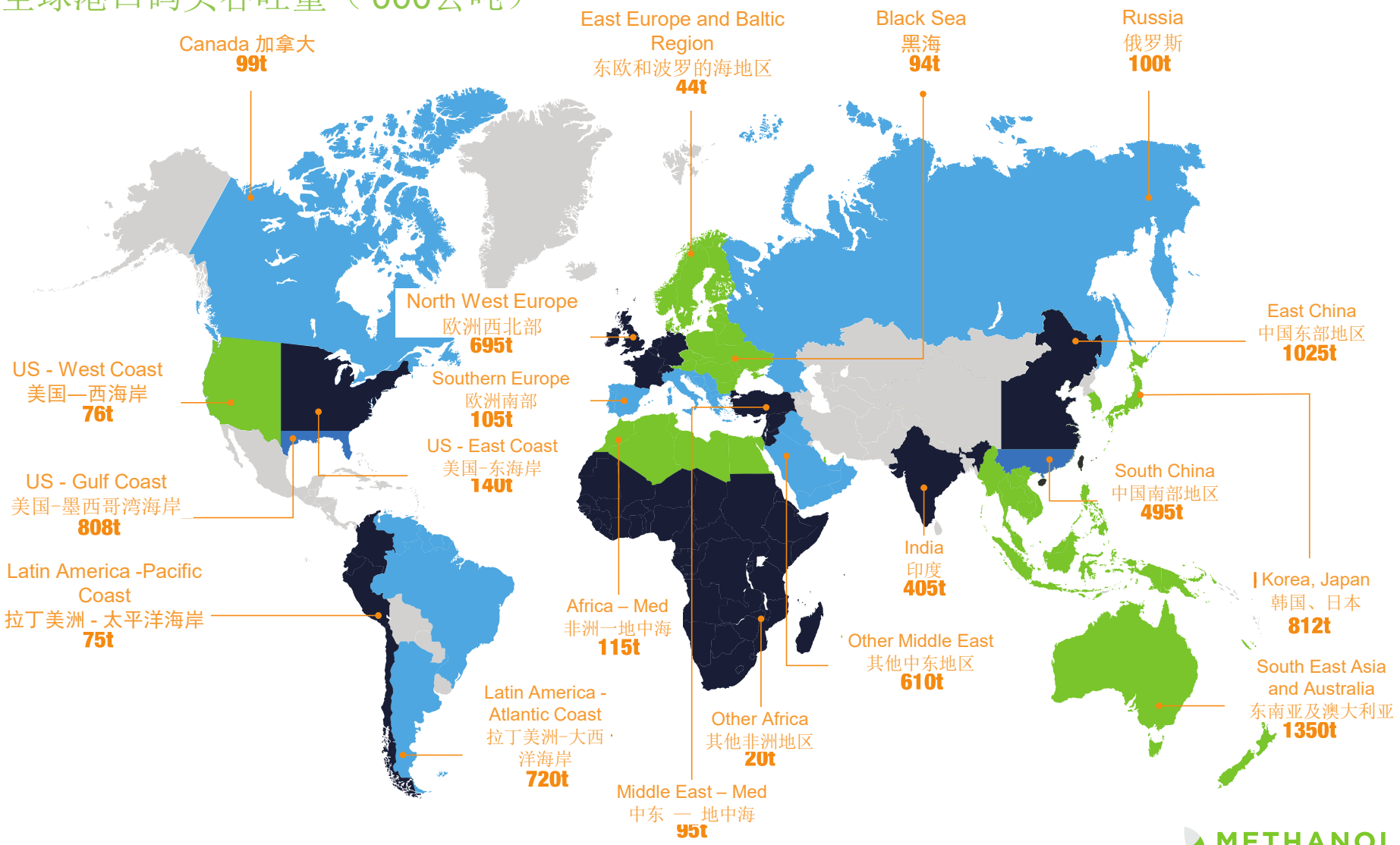
Source: MAN
来源：MAN

CONVENTIONAL MeOH EMISSIONS SCORECARD
传统的甲醇船舶排放评价

Methanol (MeOH) achieves low emissions & acts as a bridge in lowering CO_2 in the future (renewable/bio methanol)

甲醇 (MeOH) 可实现低排放，可作为一种优选方式在未来降低 CO_2 排放 （可再生/生物甲醇）

GLOBAL PORT TERMINAL AVAILABILITY ('000 MT) – ALREADY 97 PORTS CONFIRMED
全球港口码头吞吐量（'000公吨）



Source: IHS 2018

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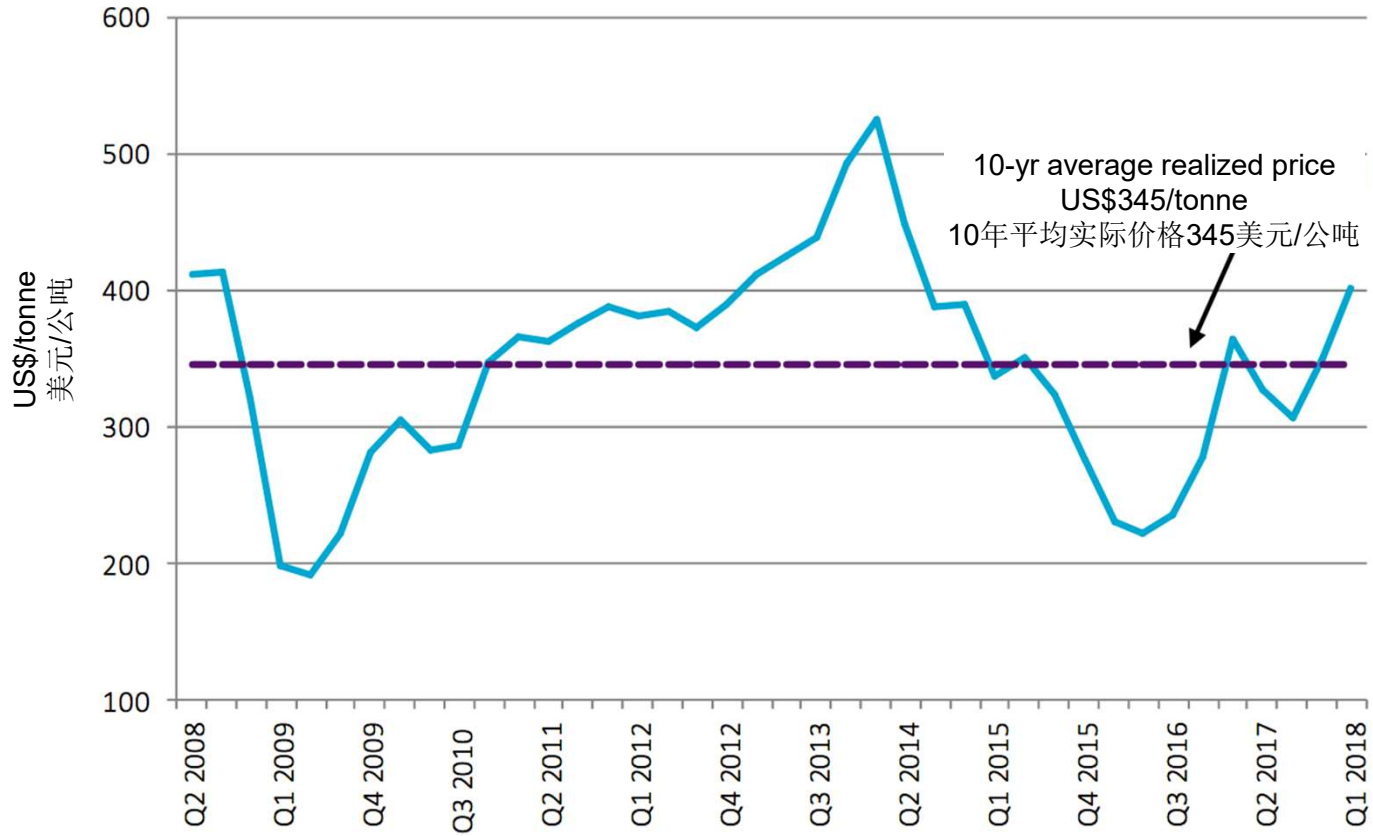
METHANEX 10-YR AVG REALIZED PRICE
梅赛尼斯公司10 年平均实际价格



- Methanex posts reference prices monthly in Asia and North America and quarterly in Europe
  Methanex 在亚洲和北美每月发布参考价格，在欧洲每季度发布参考价格
- Realized pricing is lower than reference prices due to discounts specified in contracts
- 由于合同中会提供一定的折扣，实际价格低于参考价格

Source: Methanex Corporation
来源：梅赛尼斯公司

METHANOL FUELLED VESSELS AND PILOTS
甲醇船舶及试点项目

	DUAL FUEL双燃料			FUEL CELL 燃料电池		PROJECT | R&D 可行性研究
						
Quantity 数量	7 + 4	1	1	2	1	+4
Vessel Type 船型	Chemical tankers	ROPAX ferry	Pilot boat	Tourist boat	Ferry	Cruise ships, fishing boats, barges, dredges, others
Owner 船东	MOL, W-L, Marinvest, Methanex, Mitsui, OIlO, NYK	Stena Line	MI/SMA ScandiNaos	Innogy HTWG Konstanz	Viking Line	SUMMETH/MARTEC, Lean Ships, Methaship, Billion Miles[1], FiTech[2], IWAI[3], PCG Product Vessel[4], NTU[2], GMM, Fastwater, Port of Rotterdam Barge, Jupiter, Paxell, Methanex Fishing[5]
Engine Type 发动机型号	2 stroke MAN	4 stroke Wärtsila	high speed Scania, Weichai	Serenergy fuel cell stacks		SI hybrid, dual fuel, etc.
Design 设计	new build	retrofit	retrofit	retrofit	retrofit	new build & retrofit

All projects are based in the EU unless noted otherwise[1]China/SG, [2]EU/China/SG, [3]India, [4]Malaysia, [5]China

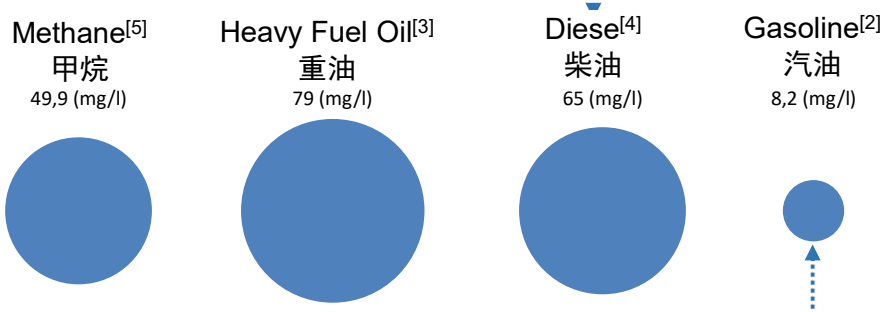
SAFER FOR THE ENVIRONMENT
在环境中更安全

CONCENTRATION （致死浓度）
LC50 半数致死浓度, LC = LETHAL

Concentration in water, at which half the population died within specified test duration
在规定的测试时间内，致半数海洋生物死亡的水中浓度

Methanol[1]
15,400 (mg/l)
甲醇[1]
15,400 (mg/l)

Better than Diesel by a factor of 240 times
比柴油优240倍



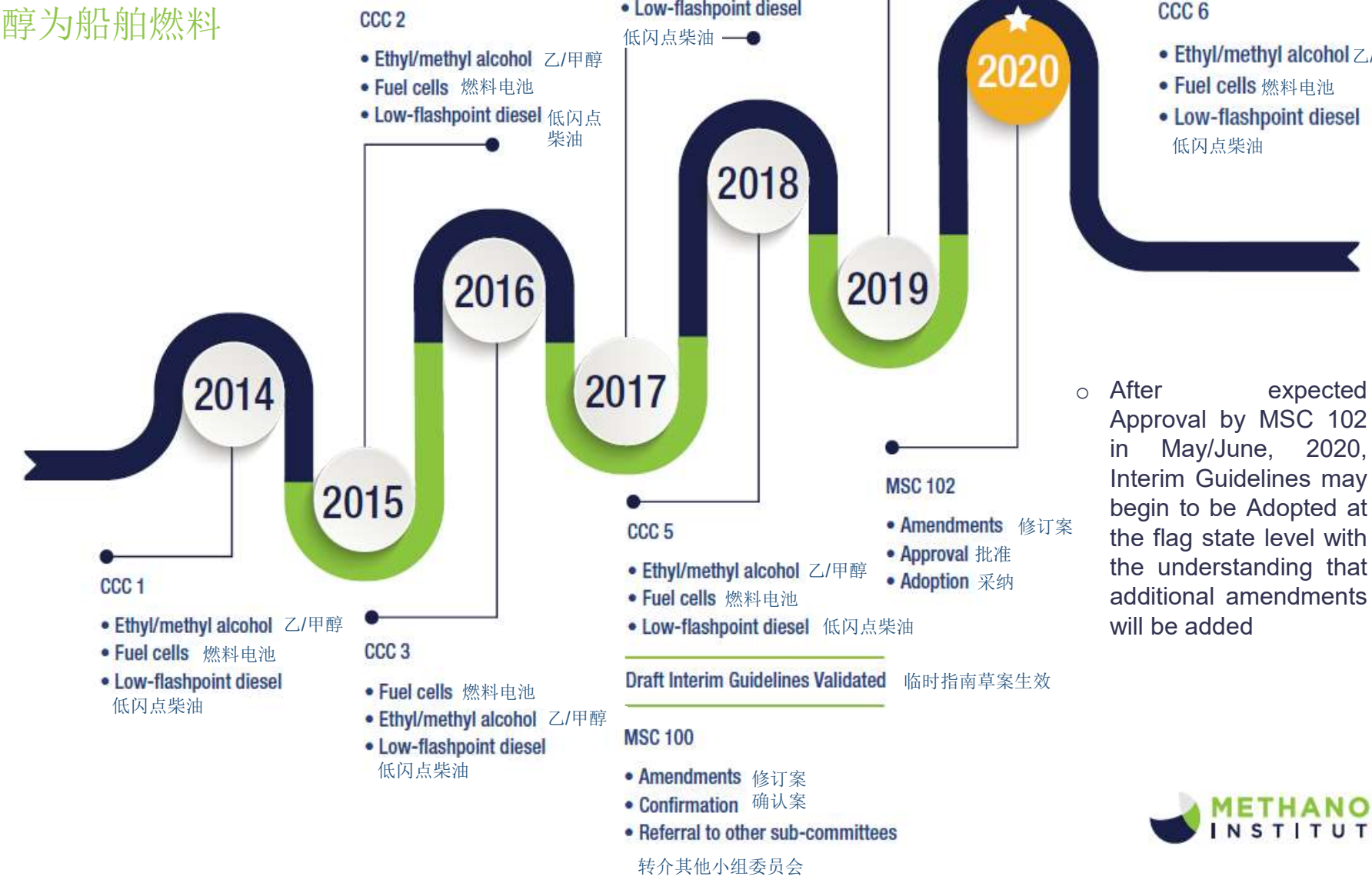
Better than Gasoline by a factor of 1900 times
比汽油优1900倍

[1] ECHA, European Chemicals Agency, registration dossier Methanol
[2] Petrobras/Statoil ASA, Safety Data Sheet, ECHA registration dossier Gasoline
[3] GKG/ A/S Dansk Shell, Safety Data Sheet
[4] ECHA, European Chemicals Agency, registration dossier Diesel
[5] ECHA, European Chemicals Agency, registration dossier Methane

Additional Source: Meyer-Werft
其他来源：Meyer-Werft

IMO CONFIRMATION OF METHANOL AS A MARINE FUEL

国际海事组织确认甲醇为船舶燃料



- After expected Approval by MSC 102 in May/June, 2020, Interim Guidelines may begin to be Adopted at the flag state level with the understanding that additional amendments will be added

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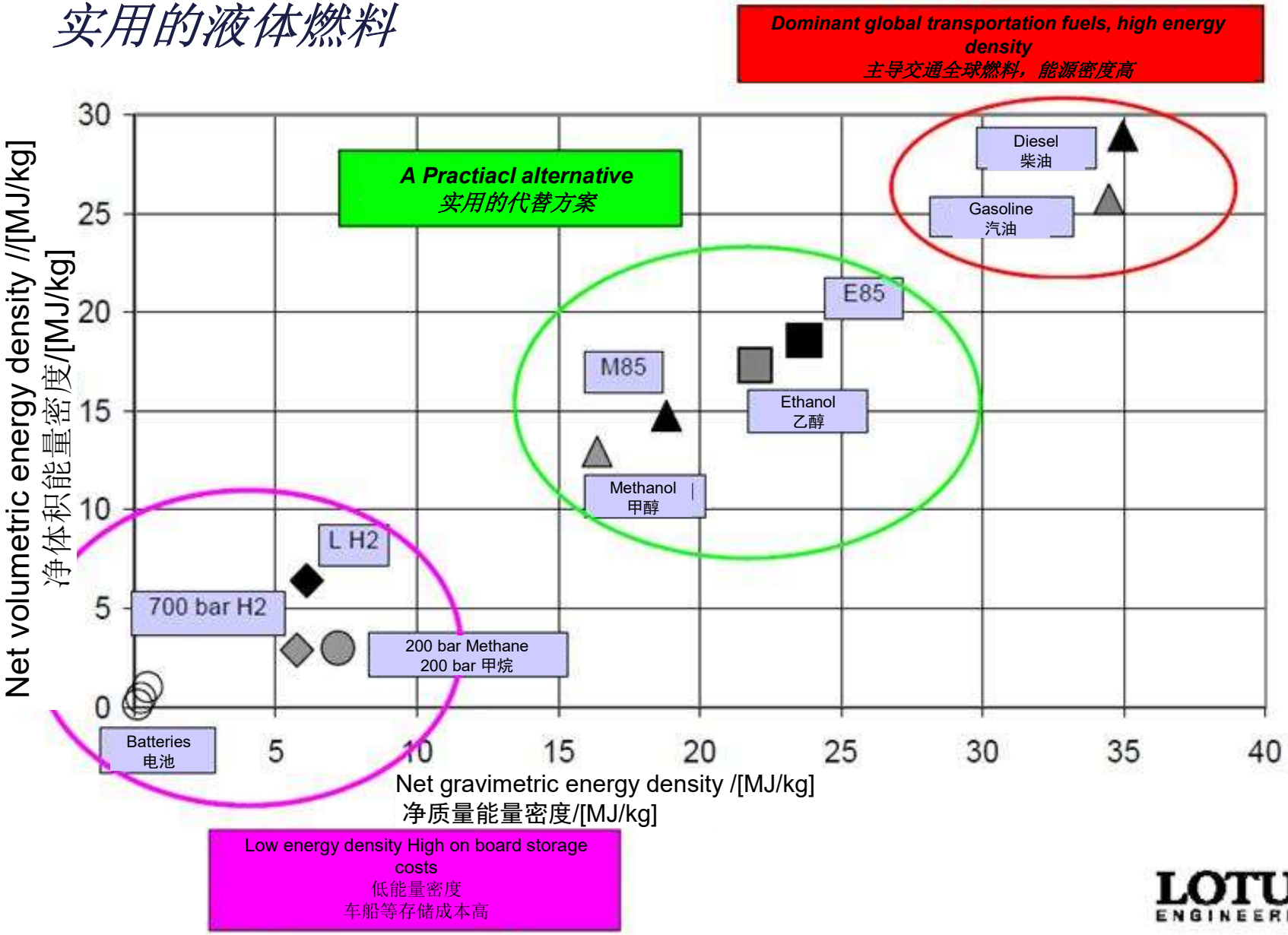
05

METHANOL FOR FUEL CELLS
燃料电池甲醇燃料

PRACTICAL LIQUID FUEL
实用的液体燃料



LOTUS ENGINEERING

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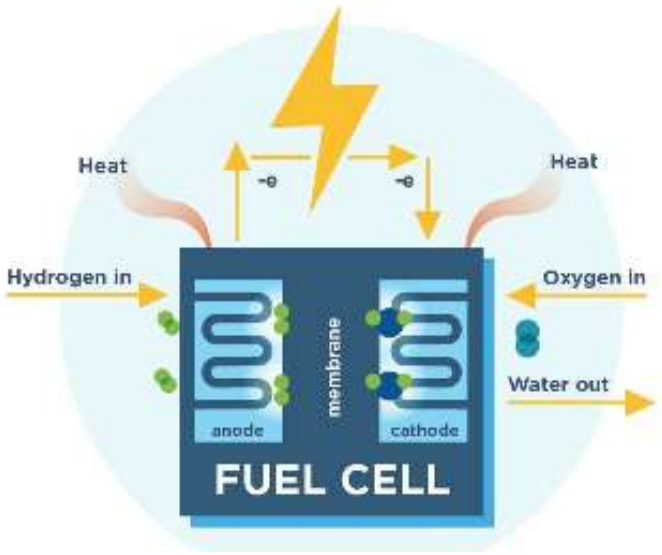
燃料电池如何工作
HOW A FUEL CELL WORKS



任何可被电力驱动的物体都可使用燃料电池 **Anything that can be powered by electricity can run on a fuel cell.**

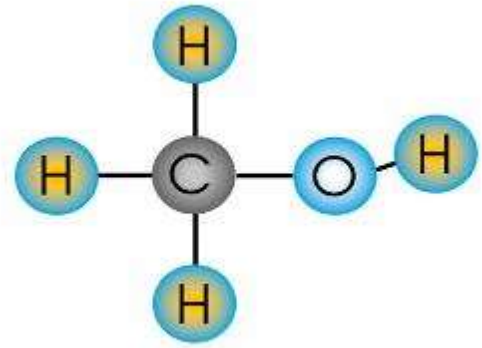
- 能量效率 **Energy Efficiency: 35% – 85%**
- 零 或 接近零 排放 **Zero or Near-Zero Emissions**
- 长期使用经济 **Economical in Long-Term**

氢气的不足 HYDROGEN INCOMPATIBLE

- **作为所有气体物质中最轻的，氢气的物理性质不能满足能源市场的要求 As the lightest of all gases, the physical properties of hydrogen are incompatible with the requirements of the energy market**

- **仅用于制氢需约1.2 单位的电能或1.4 单位的天然气 About 1.2 units of electricity or 1.4 units of natural gas needed just to produce hydrogen**

甲醇能源经济
METHANOL ENERGY ECONOMY



- 富氢的简单分子，没有硫 Simple molecule rich in hydrogen, with no sulfur
- 在室温和常压下是消费者友好型燃料Consumer-friendly liquid at room temperature and ambient pressure
- 能够从可再生资源中获取 Can obtain from renewable sources
- *甲醇含氢量高，体积储氢量显著高于液氢Methanol Volumetric H2 Density higher than LH2*

甲醇 Methanol:100g/L，氢H2:71g/L

甲醇可以成为燃料电池和许多其他应用的通用燃料"Methanol could become a universal fuel for fuel cells and many other applications."

开创性的美国NECAR 5道路测试
NECAR 5 RECORD ROAD TRIP

2002年6月4日：戴姆勒克莱斯勒公司的NECAR 5 项目成为首个完成由旧金山到华盛顿特区的横穿美国里程的燃料电池车辆

June 4, 2002: DaimlerChrysler's NECAR 5 became the first fuel cell vehicle to complete a cross-country trip, from San Francisco to Washington, D.C.

甲醇加注站VS 氢加注站
METHANOL VS HYDROGEN STATION

- **2002年4月：加州燃料电池合作组织开放甲醇加注站 April 24, 2002: California Fuel Cell Partnership opens methanol fueling station**

- **2000加仑（约7.4立方米）的地面储罐，价格仅4.5万美元 2,000-gallon above-ground tank and dispenser just $45,000**

- **需要一个10层（建筑物）高，10米直径的储罐来满足常规加油站的液体加注能力 A 10 story tank with a 10 meter diameter would be needed to match liquid refueling capacity at the average fueling station**

规模化 甲醇加注站与加氢站对比 Station to Station（美国）

基础设施建设成本比较 Comparative Infrastructure CAPEX			
	液体燃料 Liquid Fuels	电 Electricity	氢 Hydrogen
典型站每日实现的英里数 Daily Miles Enabled by Typical Current Station	500,000	4,800	9,000
实现相同能量吞吐能力需要的站数量 Stations Needed to Achieve Energy Equivalent Throughput Capacity	1	104	56
每种站的建设成本 Cost Per Current Station	$200,000	$80,000	$2,500,000
同等能力的站点建设成本 Cost Per Equivalent Station	$200,000	$8,300,000	$139,000,000
10000座站的全国网络 Cost for 10,000 Station National Network	20亿美元 $2bln	830亿美元 $83bln	1.4 万亿美元 $1.4tln

假设条件：
加油站加注能力：600,000加仑/月，平均25 mpg，相当于1000公斤/小时
充电站充电能力：200英里/电动车，需要1.5小时充满，每个站2个充电桩，一天加注24俩车
小型氢气加注站能力：150kg/天，60英里/公斤

Global Transportation Fuel Progress
全球燃料应用进展（燃料电池）

Denmark 丹麦
- Methanol Fuel Cell for EV range extension用于电动汽车续航里程的甲醇燃料电池
- Europe's first methanol filling station in Aalborg, Denmark (Aug. 2015)欧洲首个甲醇加注站 — 丹麦奥尔堡(2015 年 8 月)

China 中国
- Palcan Cooperation with Dongfeng on FC Lorry with product certificate 博能集团同东风商用车合作甲醇燃料点厢式货车获得公告
- Chinese government supporting FC vehicles and max. 500K RMB subsidy 国家财政对燃料电池车支持并给与最高50万元补贴
- Other methanol fuel cell companies cooperating with OEMs in China to development more models其他甲醇燃料电池公司正同国内汽车合作开发多种车型

Germany 德国
- MS Innogy using methanol fuel cell for passenger ship MS Innogy 公司使用甲醇燃料电池作为客运船舶动力
- Green methanol produced from CO2 使用CO2生产的绿色甲醇

甲醇燃料电池超级跑车
SUPER CAR WITH METHANOL FUEL CELLS

THANK YOU
谢谢