



Methanol: Emerging Markets and Safe Handling

甲醇：新兴市场和处置

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关于甲醇协会
ABOUT MI

历史 HISTORY

- 甲醇协会成立于1989年，最早位于美国首都华盛顿代表美国甲醇生产企业
- *The Methanol Institute (MI) formed in 1989 to represent US methanol producers in Washington*

新加坡 | 华盛顿 | 布鲁塞尔 | 北京
Singapore | Washington | Brussels | Beijing



会员 MEMBERS

 methanex the power of agility			 MHTL METHANOL HYDROTREATING TECHNOLOGY LTD.		 سابك sabc	
 ATLANTIC METHANOL	 Mitsubishi Gas Chemical America, Inc	 MITSUI & CO.	 OCI	 QAFAC QAFAC QAFAC	 PETRONAS	 QAFAC
 bp	 Sulabh Methanol Company U.S.C. (SFC)	 GX G2XENERGY	 JM Johnson Matthey Inspiring science. enhancing life.	 سبكيم Sipchem	 Eni Ecofuel	
 Mitsubishi International Corporation				 METAFRAX		
 CARBON RECYCLING INTERNATIONAL	 MOL Mitsui O.S.K. Lines	 FiTech	 HELM	 United Chemical Company	 IMTT	 منتجات Muntajat
 SCC SOUTHERN CHEMICAL CORPORATION		 VITUSA PRODUCTS INCORPORATED	 NW INNOVATION WORKS	 azelis	 NAKHODKA FERTILIZER PLANT	 TRICON ENERGY
 Enerkem	 Raschemiles	 HALDOR TOPSØE	 CoogeeEnergy	 CLARIANT	 solvadis	 FUEL FREEDOM FOUNDATION

02

什么是甲醇

What is Methanol?

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

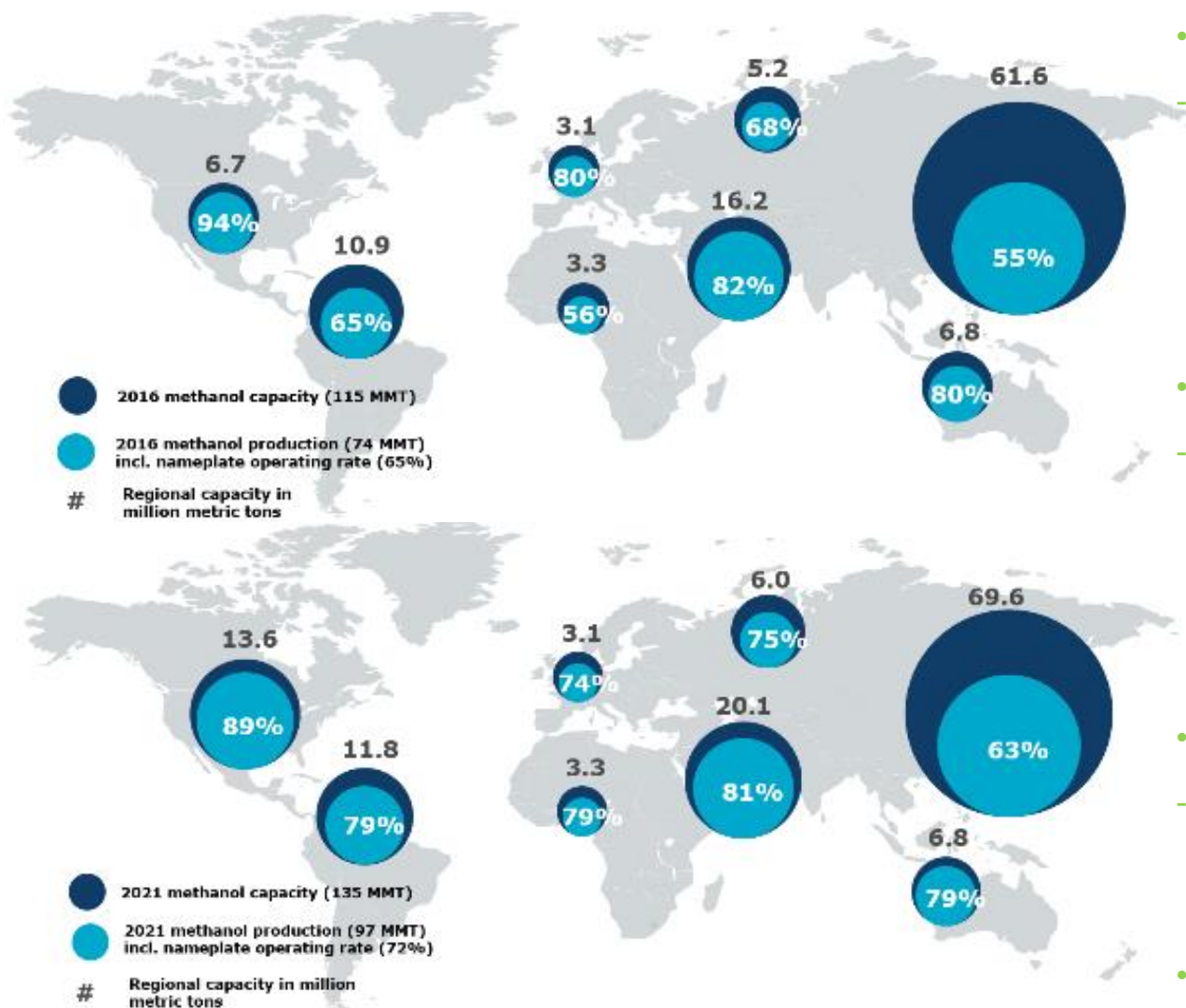
- SI & CI engines 点燃和压燃发动机
- Turbines 燃气轮机
- Fuel cells 燃料电池
- Industrial boilers 工业锅炉
- Cook Stoves 民用灶具



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

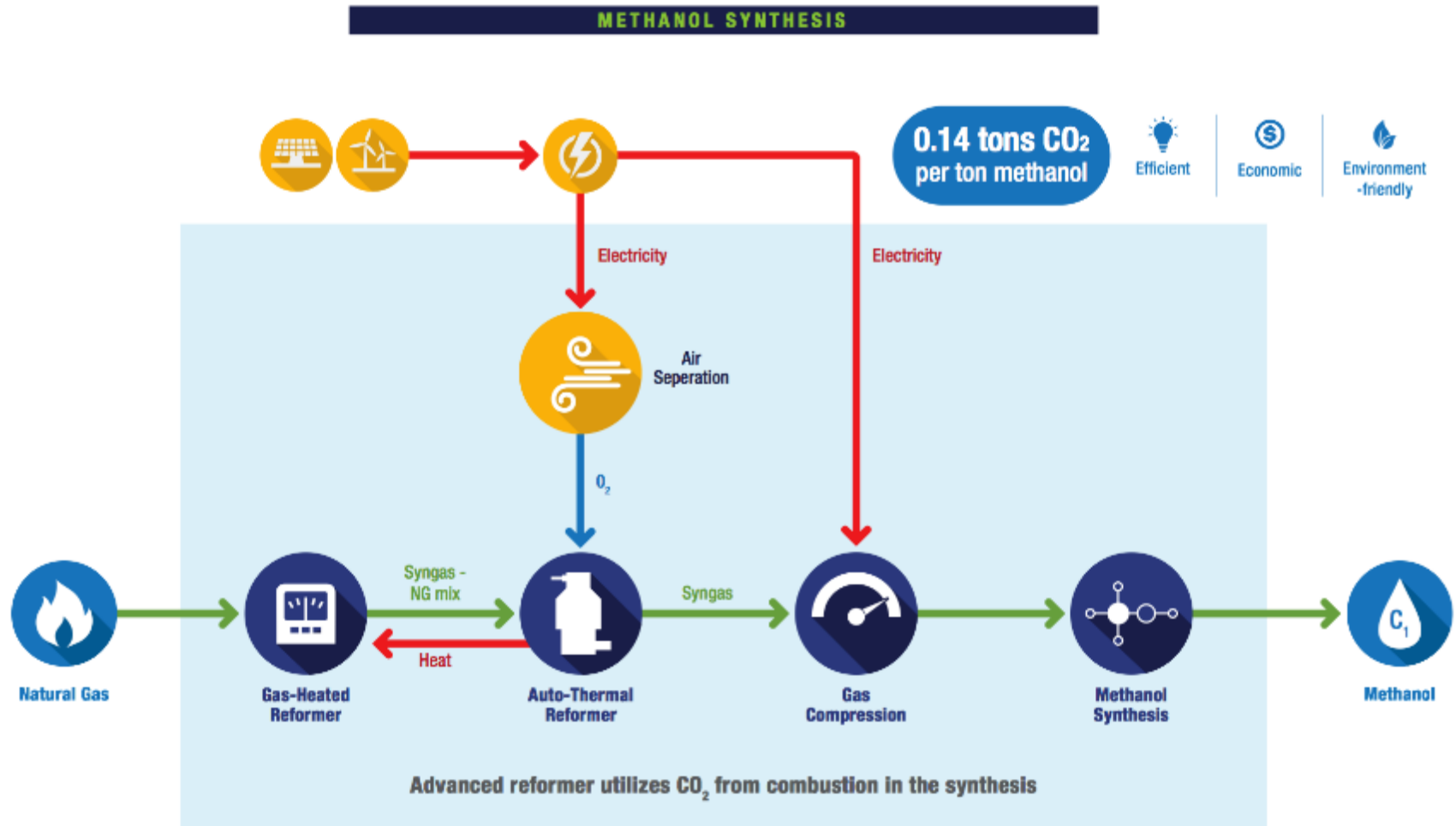
全球甲醇生产概况 2016 vs 2021



数据来源/ Source: IHS Markit, 2016

- 全球 Global
 - 甲醇产业仍将持续增长，2016年世界产能1.15亿吨，产量约7400万吨，2021年世界产能约1.35亿吨，产量约9700万吨
Methanol Industry keep growing
- 中国 CHINA
 - 最大的生产和消费国，未来5年的产能和产量增加放缓但开工率提升
Largest producer & consumer and slowed capacity increase but increased operating rate
- 中东 ME
 - 重要的甲醇生产地未来产能增长
Important methanol producer and future growth
- 美国 US
 - 远期产能增加
Long term capability increase

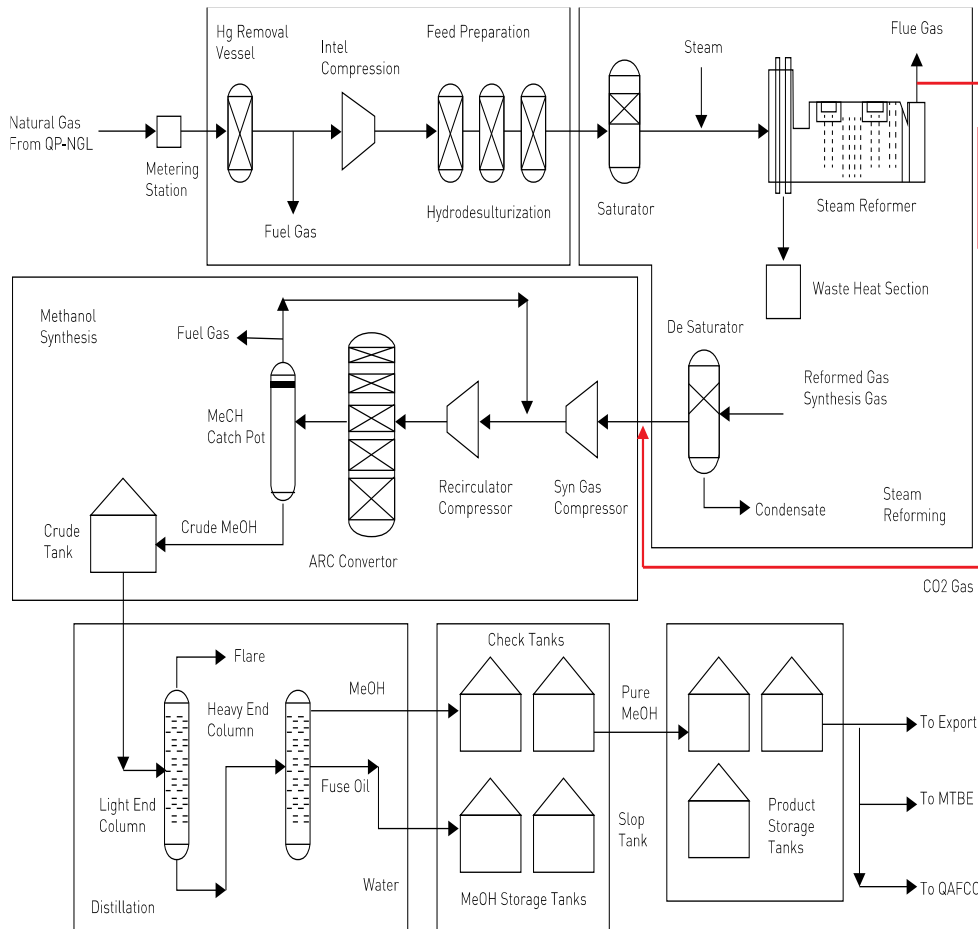
降低碳排放 REDUCED CARBON INITIATIVES



CO₂ Recovery & Utilization

CO₂ 回收和利用技术

QAFAC Utilization of Recovered CO₂



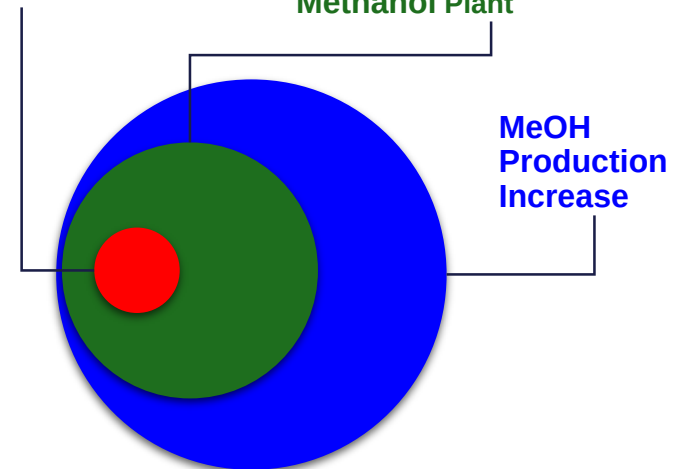
- 500 MTPD of CO₂ is recovered from the flue gas using MHI's proprietary KS-1™ solvent and injected in synthesis loop for boosting Methanol production. 每天500吨二氧化碳回注到甲醇合成中

The capacity of Methanol Plant has increased by 300 MTPD with addition of CO₂ in synthesis gas mixture as excess H₂ is available for the methanol reaction. 工艺中多余的H₂跟回注CO₂反应，每天多生产300吨甲醇

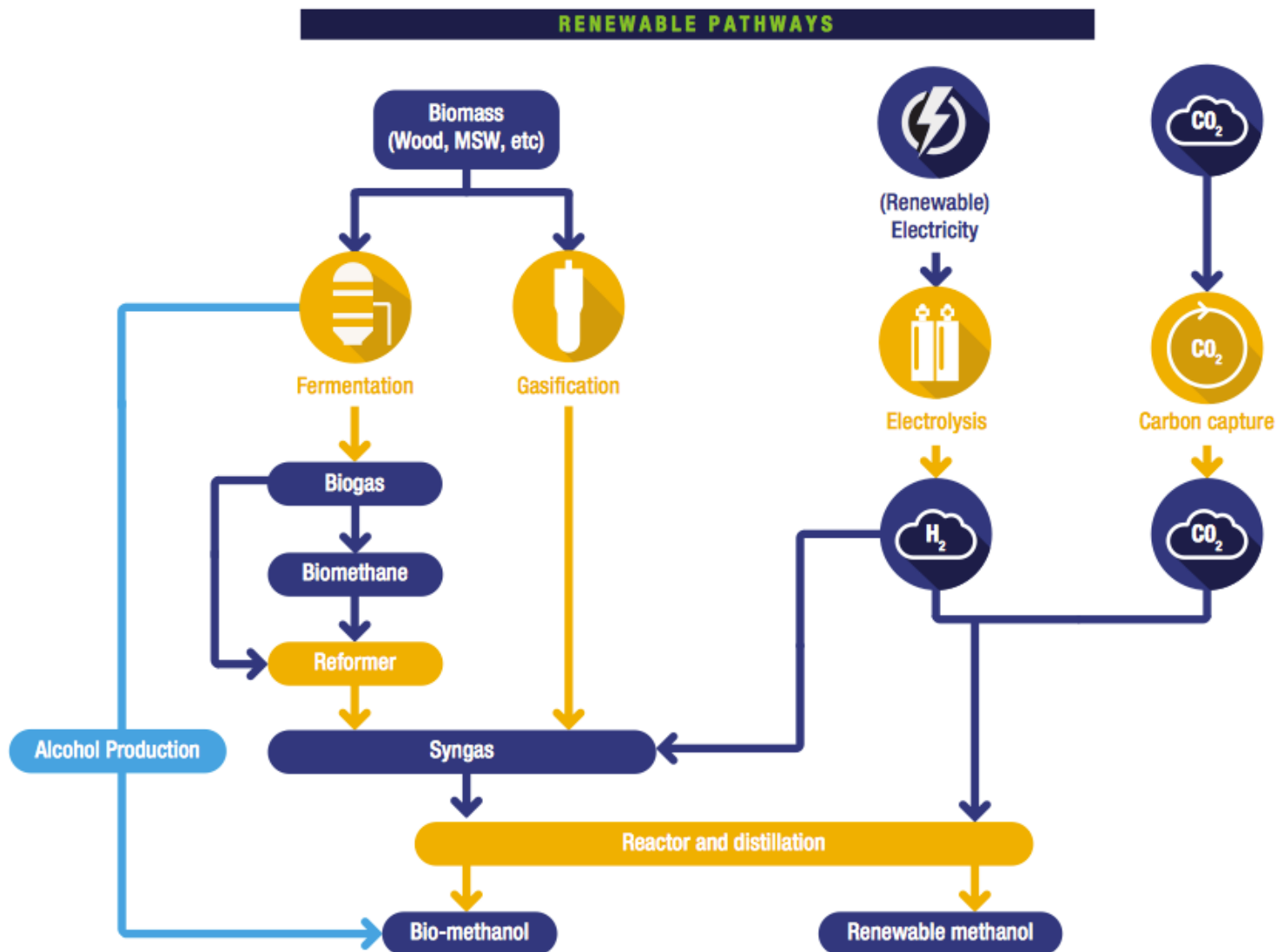
Thus, QAFAC's Methanol Plant became Self-sufficient for raw material (CO₂). 卡塔尔燃料添加剂公司实现二氧化碳原料自给自足。

Excess H₂ in Reformed Gas

CO₂ extraction from Flue Gas by CDR route & Injection in Methanol Plant



可再生路径 RENEWABLE PATHWAYS



可再生甲醇不同的发展阶段

Renewable methanol projects different stages of development

Methanol category种类	Commercial商业化	Feasibility and R&D可行性和研发	Stopped or On-hold停止或暂停
Bio-methanol 生物甲醇	- BioMCN (NL) - Enerkem (CAN) - New Fuel (DEN) - Oberon (USA)	- Biogo (GER) - Enerkem (NL) - LowLands Methanol (NL) - Södra (SE)	- BioMCN (glycerine) (NL) - Chemrec (SE) - Range Fuels (USA) - Schwarze Pumpe (GER) - Värmlands Metanol (SE) - Woodspirit (NL)
Renewable methanol 可再生甲醇	- CRI (IC) - Innogy (GER)	- Blue Fuel Energy (CAN) - CRI (CN) - Infraserv (GER) - Liquid Wind (SE) - Port of Antwerp (BE) - STEAG (GER) - Swiss Liquid Future (CH) - ZASSt (GER)	
Low carbon methanol 低碳甲醇	- GPIC (BAH) - Methanex (CAN) - QAFAC (QAT) - SABIC (KSA)	- Carbon2Chem (GER) - FRESME (SE) - NCF (CN)	

CRI ETL 冰岛绿色甲醇工厂

CRI ETL Green MeOH Plant

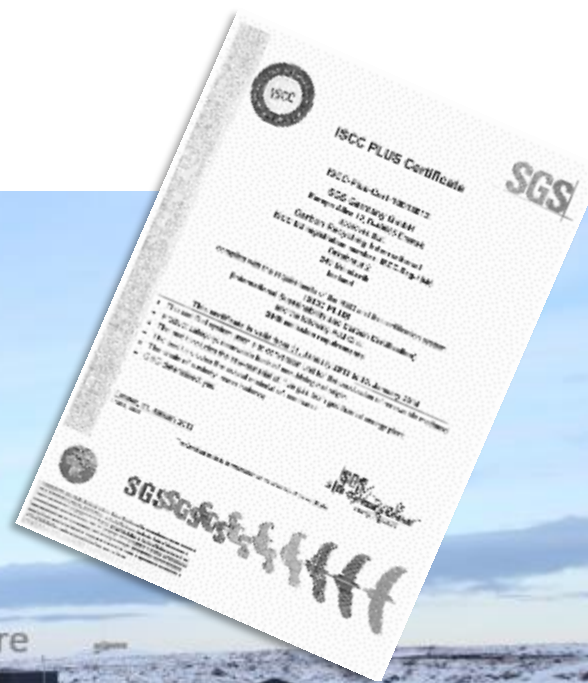


Synthesis



CO₂ capture

H₂ generation



工业规模工厂
电制甲醇工厂: 全球首创
碳循环量: 6000 吨/年
甲醇产量: 4000 吨/年
可再生电能: 6 兆瓦

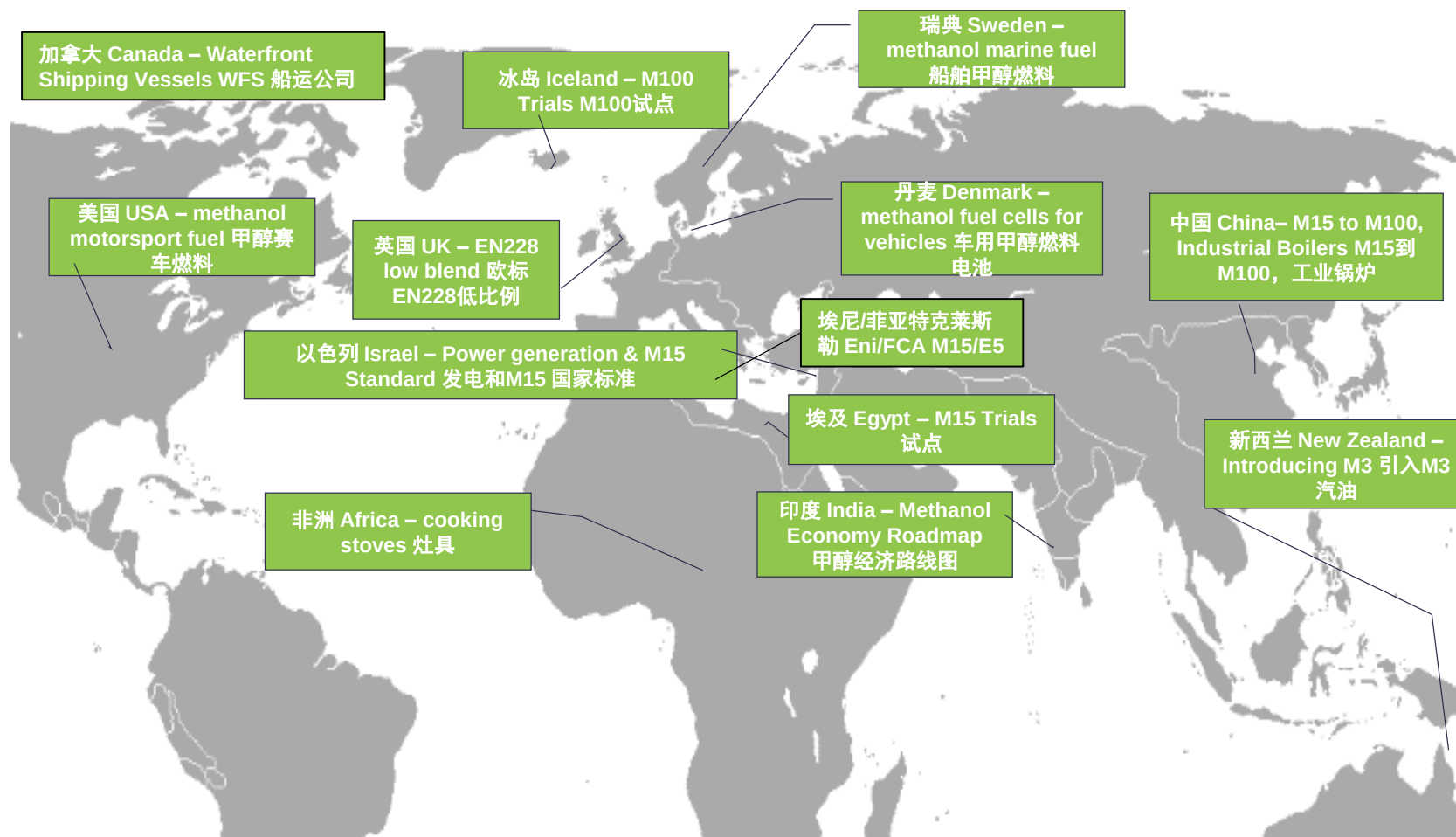
注册: ISCC Plus
证书: SGS
原料: CO₂
能源: 非生物质可再生能源
产品: Vulcanol, 甲醇每MJ减排90%CO₂

03

Global Methanol Fuel Blending
全球甲醇燃料发展

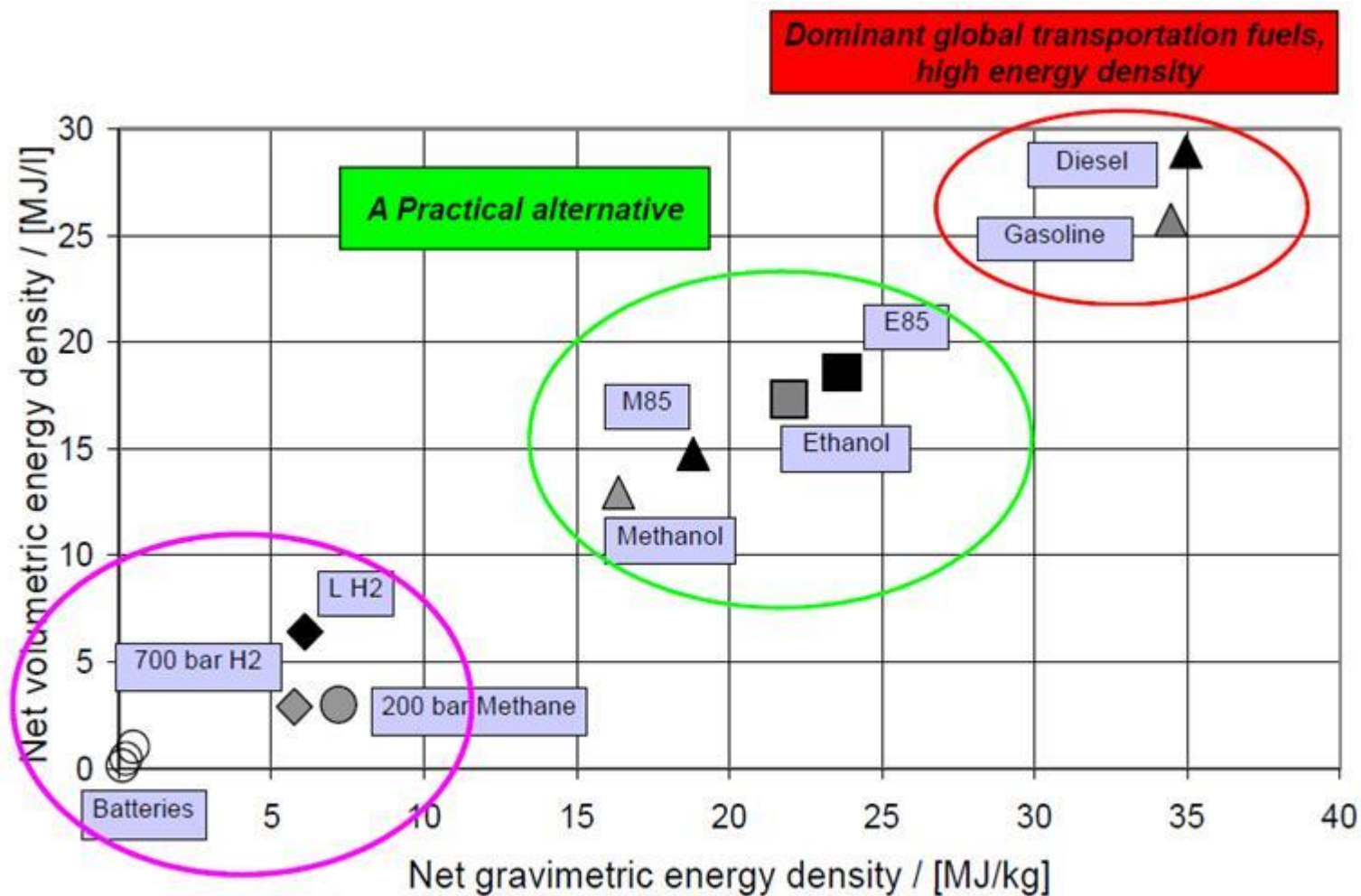
全球甲醇燃料应用案例

Methanol Fuel Examples Around the World



可行的液体燃料

PRACTICAL LIQUID FUEL



Methanol Fuel Buckets 甲醇燃料三只桶

Bucket #1: M3-M15 第一只桶: M3-M15

EU allows M3 欧盟允许M3燃料

China using M15 中国使用M15燃料



Bucket #2: Mixed Mid-Level Alcohol High Octane Fuels: A20-A30

第二只桶: 混合中等比例醇类的高辛烷值燃料: A20-A30

Automakers calling for more octane to facilitate greater engine efficiency 汽车制造商呼吁提高辛烷值以增强发动机效率

Bucket #3: M51-M100 第三只桶: M51-M100

Light- and Heavy-Duty markets 轻型-重型机动车市场

Mid-Level Mixed Alcohol High Octane Fuels 混合中等比例醇类的高辛烷值燃料

- Methanol and ethanol have high blending octane (anti-knocking).

甲醇和乙醇燃料具有高辛烷值（抗爆震性能）

- Increasing octane allows automakers to use:
提高辛烷值可以让汽车制造商使用：

- Higher compression ratio engines

压缩比更高的发动机

- Greater turbocharging

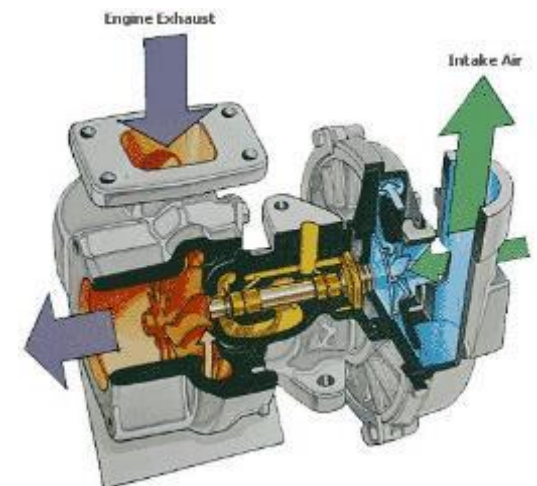
更大的涡轮增压

- More direct fuel injection

更直接的燃油喷射

- Engine downsizing

小型化的发动机

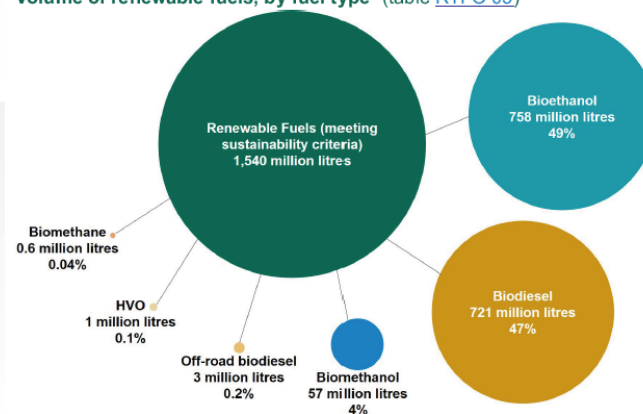


英国的生物甲醇掺混

UK BioMethanol Blending

- 英国交通部：可再生交通燃料责任报告-2018年2月1日 UK Department of Transport: Renewable Transport Fuel Obligation Report – 1 February 2018
- 5700万升生物甲醇，约占英国总可再生燃料总量的4% Biomethanol 57 Million liters, or 4% of UK total renewable fuel use
- “近几年生物甲醇供应持续增加，2016/2017年度全年保持高位” “The supply of biomethanol has been increasing in recent years to an all-time high in 2016/2017”

Volume of renewable fuels, by fuel type* (table RTFO 05)



* Figures may not add up to 100% due to rounding

丹麦：甲醇燃料电池电动车增程器

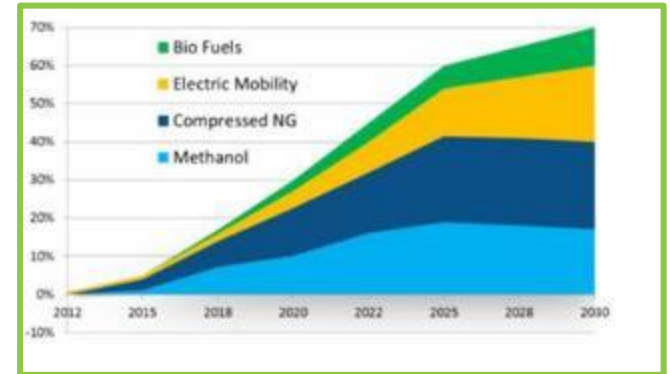
Denmark: Methanol Fuel Cell EV Range Extender



- 丹麦绿色甲醇基础设施联合体
（ Serenergy, OK and Hamag ） 开放了
欧洲首座甲醇燃料加注站 In Denmark the
Green Methanol Infrastructure
consortium (Serenergy, OK and Hamag)
opened the first methanol fuel pump in
Europe
- 轿车/货车 使用Serenergy RMFC 重整甲
醇燃料电池技术按作为增程器和冰岛碳循
环公司甲醇作为燃料 Cars/vans use
Serenergy RMFC technology as range
extender and CRI methanol as fuel
- 增加纯电动汽车里程 从200公里至800公
里 Increasing range of battery powered
vehicles from 200 to 800 kilometers

以色列 甲醇燃料示范 Israel Methanol Fuels Demonstrations

- 总理内塔尼亚胡建立了燃料选择计划 Prime Minister Netanyahu established Fuel Choices Initiative.
- M15 已使用100万公里并改善了功率和扭矩 Driven 1,000,000 kms on M15 fuels with improved power and torque.
- 2016年以色列正式采用了M15国标 In 2016, Israel adopted national standard for M15 fuels.
- 菲亚特汽车公司在以色列推广M15轿车, Dor 化学公司推出M15零售加注 Fiat marketing M15 car in Israel, and Dor Chemicals has introduced M15 retails pumps



意大利M15/E5掺混燃料 Italy M15/E5 Blending

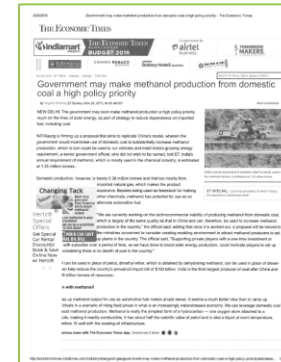
- 2017年11月21日：在意大利总理见证下，埃尼公司和菲亚特克莱斯勒公司的首席执行官签署合作备忘录共同发展道路交通车辆减碳技术
21 November 2017: With Italian Prime Minister, the CEOs of Eni and Fiat Chrysler Automobile sign MOU for joint development of technology reducing CO₂ of road transport vehicles
- 埃尼公司已经开发出15%甲醇和5%生物乙醇的混合燃料 Eni had developed a 15% methanol and 5% bioethanol fuel blend
- 新混合燃料将被使用在5辆菲亚特500型驾车用于埃尼公司“Enjoy”汽车共享车队 New blend will be used in 5 FCA Fiat 500 vehicles in Eni's Enjoy car-sharing fleet



印度：甲醇经济路线图

India: Roadmap to Methanol Economy

- 2015年9月，印度改革研究院成立甲醇经济专家组 September 2015, NITI Aayog formed Methanol Economy Expert Group.
- 2016年9月，MI在首都德里共同举办了甲醇经济国际研讨会 September 2016, MI jointly organized Methanol Economy International Seminar held in Delhi.
- 正在制定M15、M100和MD95 燃料掺混标准，并在灶用、船舶、铁路燃料领域开展试点 Working towards standard for M15, M100 and MD95 fuel blending, demonstrations for cook stoves, marine fuels, railways, methanol production.



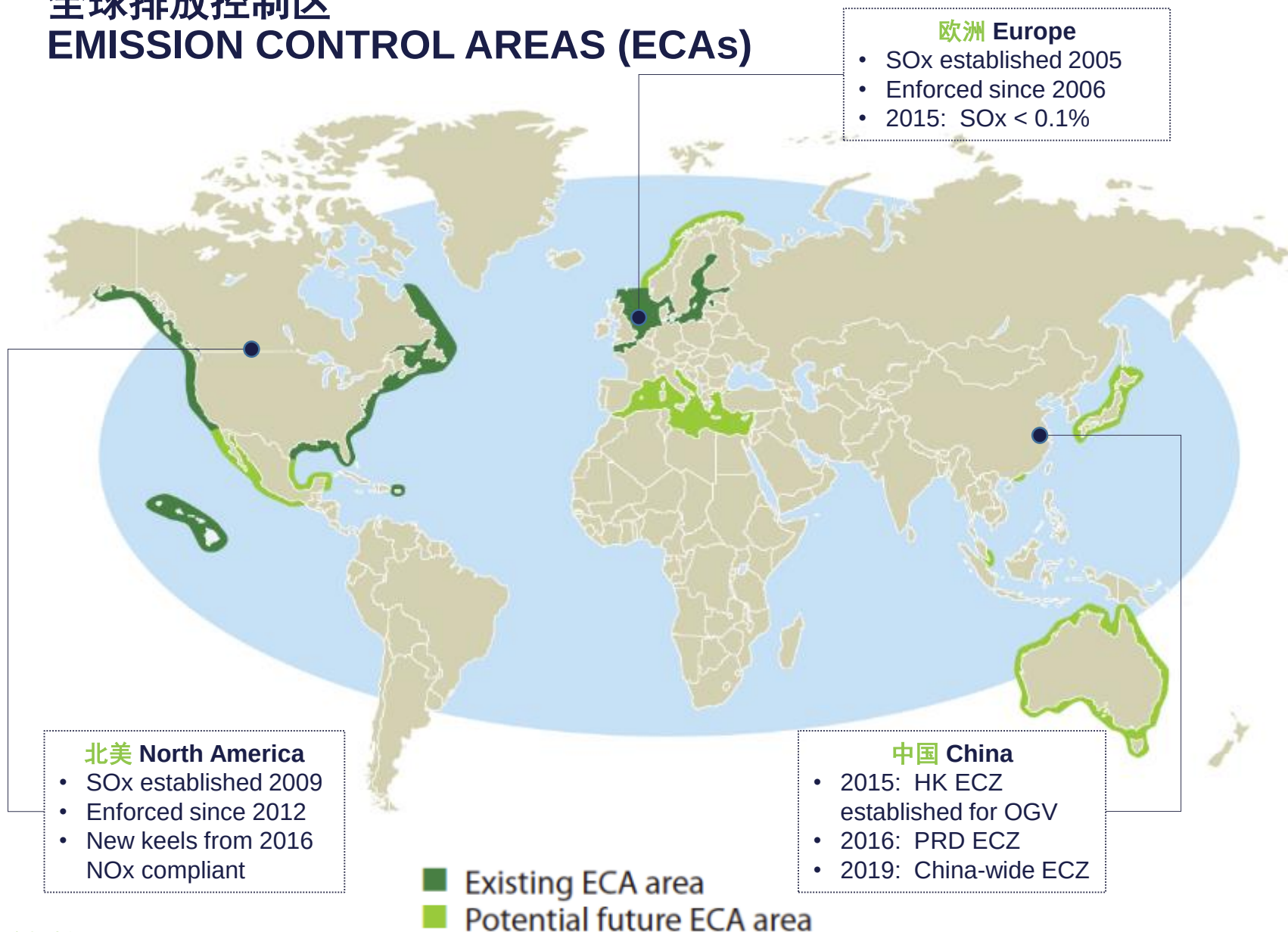
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甲醇船舶燃料
METHANOL MARINE FUEL



- 船舶行业主要使用重油
 - *Bunker fuel mainly used in the shipping industry*
- 全球约10万艘船舶，3.7亿吨燃料消费（重油和中质油）
 - *~100,000 vessels consuming 372 mln mtpa of fuel (HFO / MGO) globally*
- 高度污染的燃料
 - *Bunker fuel is highly polluting*

全球排放控制区 EMISSION CONTROL AREAS (ECAs)



资料来源 Sources: IMO

没有完美的解决方案

NO SILVER BULLET

1. 重质油和中质油+后处理:
 - a. 可以燃烧低硫中质油, 增加成本
 - b. 增加后处理技术
2. 硫氧化物减排:
 - a. 选择性催化还原 (SCR)
 - b. 尾气再循环技术 (EGR)
3. 氮氧化物减排:
 - a. 现阶段没有任何柴油能够满足氮氧化物排放要求
4. 替代燃料:
 - a. 生物燃料, 甲醇, LPG
 - b. 柴油/LNG 双燃料或者 柴油/甲醇双燃料

1. **HFO / MDO + After Treatment:**
 - a. *Burn low-sulfur MDO at cost premium*
 - b. *Add after treatment technology*
2. **SOx reduction:**
 - a. *Selective catalytic reduction (SCR)*
 - b. *Exhaust gas recirculation (EGR)*
3. **NOx reduction:**
 - a. *Currently, no diesel fuels will meet NOx regulations on their own*
4. **Alternative Fuels:**
 - a. *Biofuels, methanol, LPG*
 - b. *Dual-fuel with diesel/LNG or diesel/methanol*

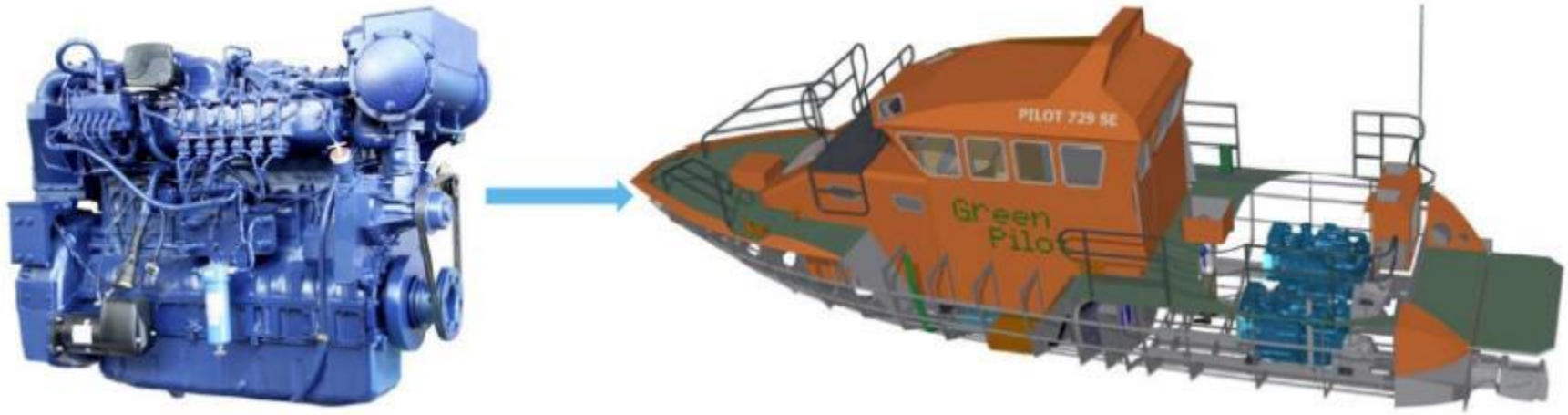


船舶应用经验 MARINE EXPERIENCE

- 2015年3月: Stena Germanica 船运公司– Wärtsilä 瓦锡兰甲醇发动机
 - Mar 2015: Stena Germanica – Wärtsilä methanol-fueled marine engine
- 2016年4月: Methanex 梅塞尼斯公司的甲醇船公司– 曼恩 MAN– 甲醇/柴油双燃料船
 - Apr 2016: Methanex's Waterfront Shipping – dual-fuel MAN methanol/diesel engines
- 英国劳氏船级社 MethaShip 项目
 - Lloyd's Register MethaShip project
- LeanShips 双燃料示范
 - LeanShips dual-fuel demo
- 2015 年10月: 新加坡 Billion Miles 公司开发小型船舶应用
 - Oct 2015: Billion Miles Singapore develops small-marine applications
- 2016 年6月: 瑞典ScandiNAOS, 绿色试点项目改造
 - Jun 2016: ScandiNAOS Green Pilot Boat conversion



总述 GREENPILOT – OVERVIEW



- 全球甲醇协会和瑞典海事局提供资助 Funding from Methanol Institute and Swedish Maritime Administration, June, 2016
- 6缸M100 甲醇发动机改装自天然气发动机用于救生和领航船 6-cyl M100 converted NG engine in rescue/pilot vessel
- 2017年5月起东莞传动/潍柴 发动机海试 Sea trials started on FiT/WeChai engine in May, 2017
- 试点船舶将参加北欧海事展 Both the vessel and a second, converted Scania engine were exhibited at Nor-shipping

Sources: ScandiNAOS, FiT

安装后的甲醇发动机 GREENPILOT – INSTALLED ENGINE



Sources: ScandiNAOS, FiT

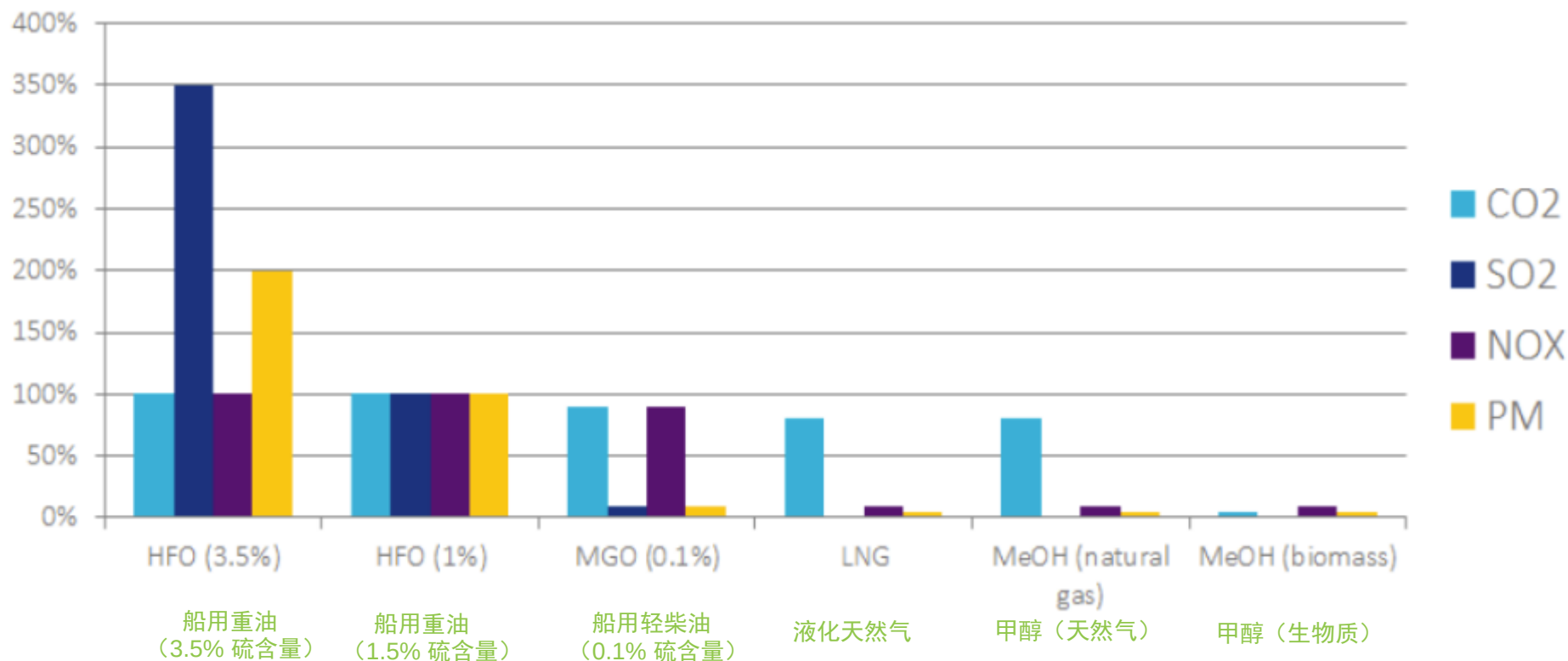
改装前后 共轨 GERMANICA – BEFORE & AFTER (COMMON RAIL)



Source: Stena

环保的解决方案

ENVIRONMENTAL SOLUTION



资料来源: 欧洲相关实验数据 Stena / Effship / example for 4-stroke engines)

加注系统 **BUNKERING THE GERMANICA**

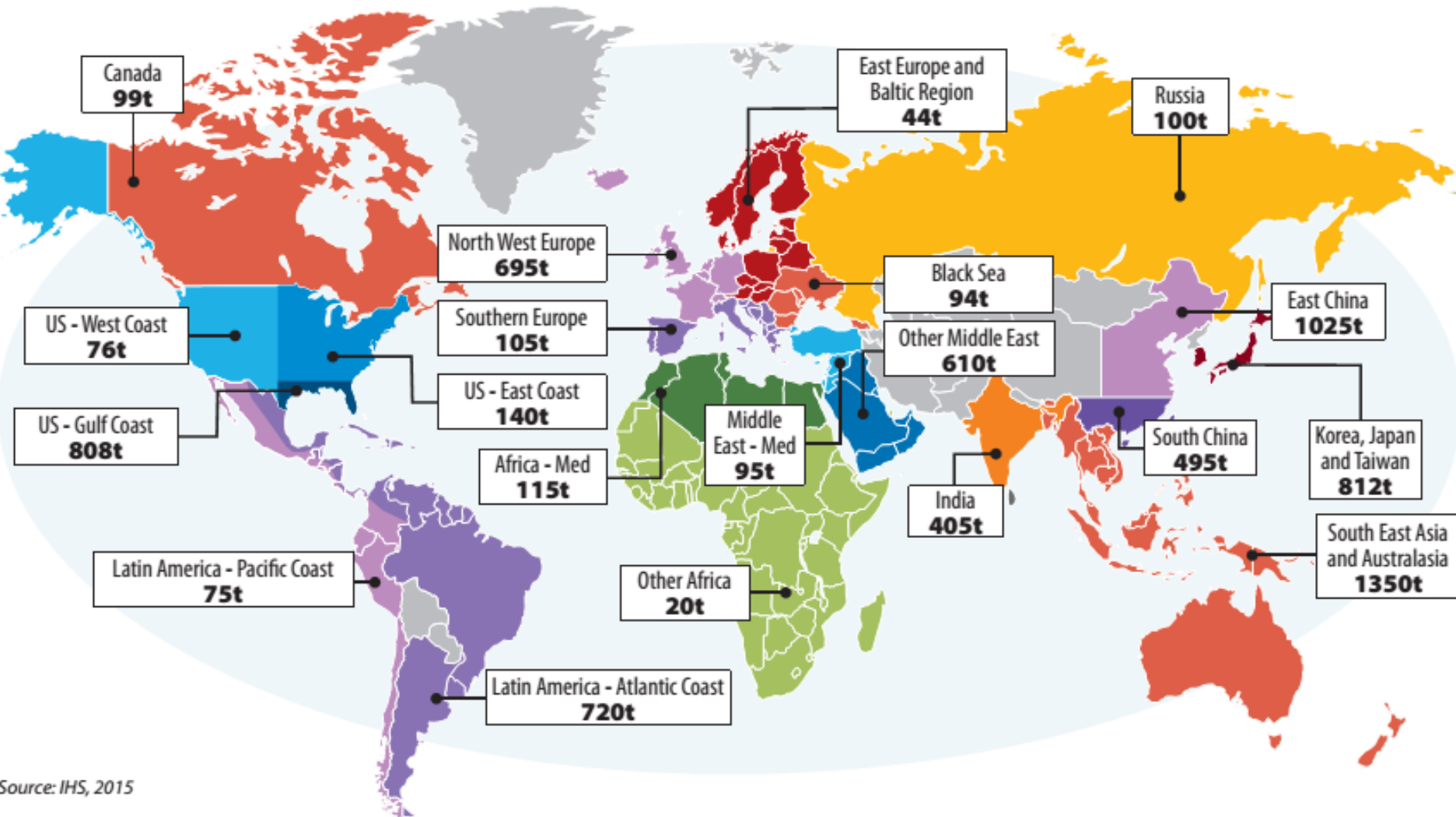


- 自带洗眼喷淋站 Self-contained eye/body wash station
- 气体泄露感应 Gas leak detection
- 火焰传感器 Flame detection
- 泡沫灭火系统 Foam fire extinguishing system
- 围堰 Coffer dam
- 防滴防漏连接 No-drip connections

Sources: Haan Paa, Stena

全球港口设施满足供应

GLOBAL PORT TERMINAL AVAILABILITY



Source: IHS, 2015

甲醇船舶燃料优势 BENEFITS OF METHANOL AS A MARINE FUEL

- 初始投成本低于LNG，与后处理成本相当
 - *Capital costs for ship conversion less than LNG and similar to after treatment technologies*
- 甲醇已经能够在世界任何港口简易和经济地加注
 - *Methanol is already easily and cost effectively stored at any port in the world*
- 甲醇是世界前五位的海运大宗化学品，占世界海运化学品总量的35%
 - *Methanol is one of the top 5 seaborne chemical commodities accounting for 35% of the world seaborne chemical and vegoil trade*
- 世界主要发动机公司对发动机能够满足硫氧化物和氮氧化物要求抱有信心
 - *Major engine OEMs confident engines can meet SOx and NOx requirements*

05

甲醇安全
METHANOL SAFETY

Must Knows of Methanol

必须了解的甲醇知识

Flammable 易燃

Burns with a clear, low heat flame 燃烧时发出透明、低温火焰



Difficult to see during daylight 日光下火焰不明显

Impact confined to size of spill 影响限于溢出范围

Biodegrades quickly 快速生物降解

Soluble in water 溶于水

Toxic 有毒

Readily absorbed into the body 容易被身体吸收



Methanol Storage

甲醇储存

Storage of methanol employs same precautions used for gasoline storage.

甲醇储存使用与汽油储存一样的预防措施。

Methanol is routinely stored in tanks farms consisting of above-ground, floating roof tanks.

甲醇通常储存在位于地面之上的浮顶罐组成的油罐区。

Tanks must be grounded to avoid hazards associated with static discharge.

油罐必须妥善接地以避免静电放电带来的危险。

All storage materials, including totes and drums, require berming and adequate ventilation.

所有储存材料，包括手提桶和圆桶，都必须有隔离空间且通风良好。

Use non-sparking type tools and equipment.

须使用不产生火花类型的工具和设备。



甲醇有更低的火灾风险 Methanol has lower fire risk



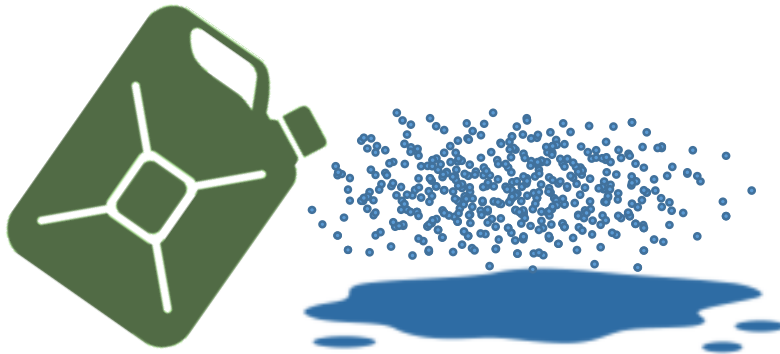
甲醇 Methanol 挥发慢 evaporates slowly



需要大量挥发气体燃烧
needs lots of vapour to burn



有限的火焰区域；火灾可能性低
confined fire zone;
fires less likely



汽油 Gasoline 挥发快 evaporates fast



需要少量挥发气体即可燃烧
needs little vapour to burn



宽的火焰区域；火灾可能性高
broad fire zone;
fires more likely

Managing the Fire Risk 管理火灾风险

Fire Fighting 灭火

- ▶▶ Fixed systems & portable systems 固定装置和便携式装置
- ▶▶ Materials – depending on size of fire & location
材料 – 根据火灾面积和地点确定

CO₂ extinguisher 二氧化碳灭火器

Dry chemical extinguisher 干粉灭火器

Water; fine spray; mist; fog 水; 细雾; 水雾;
喷雾

Foam – Alcohol Resistant-Aqueous Film
Forming Foam (AR-AFFF) 泡沫 – 抗溶水成
膜泡沫灭火剂 (AR-AFFF)

**Thermal imaging cameras can detect
methanol flames. 热成像相机可探测甲醇火焰。**



Fate and Transport

归趋和转移

- “The fate and transport of methanol in the environment is well understood. Methanol spills to the soil, groundwater, and surface water will quickly biodegrade under both aerobic and anaerobic conditions and, consequently, methanol is not expected to persist. Methanol exhibits a lower toxicity to humans and indigenous microbes than conventional gasoline. **Therefore, based on this analysis, methanol appears to be a more environmentally benign fuel compared to conventional gasoline.**”
 - Malcolm Pirnie, Inc., January 1999
- “甲醇在环境中的归趋和转移是十分清楚的. 甲醇泄漏到土壤, 地下水和地上水会在依靠氧气和不依靠氧气条件下迅速为生物分解. 其结果是甲醇没有继续生存的预期. 甲醇展示对人和当地微生物的毒性比传统汽油要低. 因此, 基于这一分析, 甲醇比起传统汽油似乎是一种对环境更为无害的燃料.”
 - -马尔肯姆帕米公司, 一九九九年一月

Half-Lives of Methanol and Benzene in the Environment

甲醇和苯在环境中的半衰期

Environmental Medium 环境中介	Methanol Half-Life (days) 甲醇半衰期(天数)	Benzene Half-Life (days) 苯半衰期(天数)
Soil 土壤	1-7	5-16
Surface Water 地上水	1-7	5-16
Groundwater 地下水	1-7	10-730

在环境中更安全 SAFER FOR THE ENVIRONMENT

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

*Concentration in water, at which half the population
died within specified test duration*

甲醇 Methanol^[1]
15,400 (mg/l)

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

甲烷
Methane^[5]
49,9 (mg/l)

重油
Heavy Fuel Oil^[3]
79 (mg/l)

柴油
Diesel^[4]
65 (mg/l)

汽油
Gasoline^[2]
8,2 (mg/l)

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

US-China Tariffs 美中关税问题



全球甲醇行业协会反对甲醇关税 Methanol Institute Opposes Tariffs

- 8月23日-MI 在美国贸易代表办公室作证 23 August – MI Testified before U.S. Trade Representative
- 要求美国贸易代表办公室取消在6000项中国商品加征25%关税产品列表中的甲醇 Urged USTR to remove methanol from list of 6,000 products of Chinese goods for 25% tariff
- 没有从中国到美国的甲醇贸易流向 No methanol trade flow from China to U.S.
- 美国正在成为净甲醇出口国，中国是甲醇的最大市场 U.S. becoming net methanol exporter and China the world's largest market for methanol
- 关税威胁到美国甲醇生产的扩展 Tariffs threaten expansion of U.S. methanol production
- 希望美中能够解决不同 Hopeful U.S. and China can resolve differences

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非常感谢！
THANK YOU

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