燃料乙醇——清洁可持续能源

美国的经验分享交流会

Fuel Ethanol, a Clean and Sustainable Energy

Sharing of the U.S. Experience

U.S. GRAINS COUNCIL

美国谷物协会北京办事处

13th，October，2016
Beijing

2016 年 1 0 月 13 日
北京

Content 目录

日程 Agenda

08:30-09:00　会议报到 Registration

09:00-09:10　开幕式致辞 Opening remark by

发言人：Bryan Lohmar 博士，美国谷物协会主任北京办事处

Speaker: Bryan Lohmar, Director of US Grains Council BJ office

09:10-09:45　清洁空气的选择®改善我们呼吸的空气

Clean Air Choice®Improvingthe Air We Breathe

发言人: Angela Tin 安吉拉·Tin 美国肺协会环境健康副总裁

Speaker:Angel Tin, Vice President

09:45-10:20　机动车燃料增氧剂问题

Automotive Fuel Oxygenate Issues

发言人：James Patrick O’Brien 詹姆斯·帕特里克·奥布莱恩

D&E 科技公司顾问私营咨询机构专家

Speaker:James Patrick O’Brien,Consultant, D & E Technical Inc.

10:20-10:40　茶歇 Tea Break

10:40-11:15　美国玉米乙醇的气候效益

Climate Benefits of US Produced Corn Ethanol

发言人：　Steffen Mueller　史蒂芬·穆勒博士

美国伊利诺伊大学能源资源中心首席经济学家

Speaker:Steffen Mueller, Principal Economist at Energy Resources Center University of Illinois at Chicago

11:15-11:50　有利于农村发展和低碳未来的可持续乙醇燃料

Sustainable Ethanol Fuel for Rural Development and a Low Carbon Future

发言人：Gerry Ostheimer 格林·奥斯特海默博士，

联合国可持续能源倡议小组专家

Speaker: Gerry Ostheimer, UN Global Lead for Sustainable Bioenergy

11:50-12:15　讨论与提问 Q& A session

12:15-12:25　会议总结致辞 Conclusion Remark by Bryan Lohmar

12:30　午餐　Lunch

会议报告 Conference Program


HISTORY 历史
▪ 1904
✓National Tuberculosis Association
全国肺结核协会
✓Christmas Seals
圣诞节封口纸
▪ 1906 - Lorraine Cross
1906 - 洛林双十字
✓Crusaders 十字军
✓French Cross of Lorraine
法国洛林十字架
✓Crusade against the White Plague
十字军遭遇白色瘟疫
Stamp out Tuberculosis
Buy Christmas Seals
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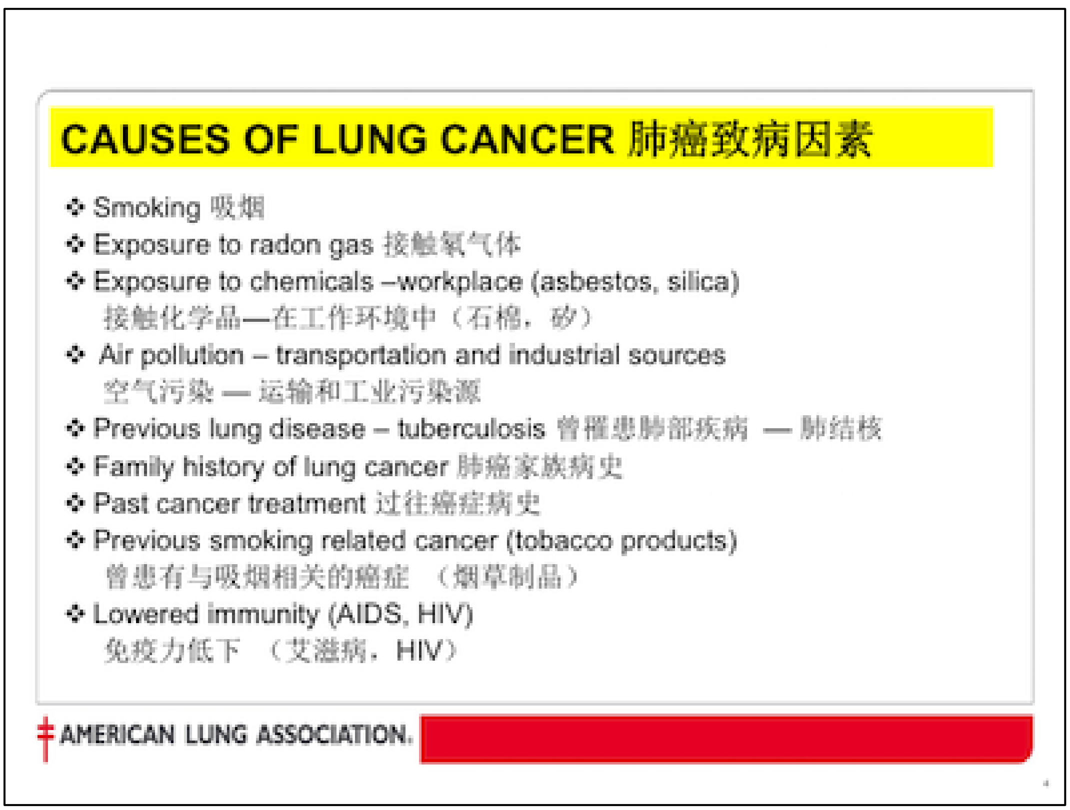
CAUSES OF LUNG CANCER 肺癌致病因素
Smoking 吸烟
Exposure to radon gas 接触氡气体
Exposure to chemicals –workplace (asbestos, silica)
接触化学品—在工作环境中（石棉，矽）
Air pollution – transportation and industrial sources
空气污染 — 运输和工业污染源
Previous lung disease – tuberculosis 曾罹患肺部疾病 — 肺结核
Family history of lung cancer 肺癌家族病史
Past cancer treatment 过往癌症病史
Previous smoking related cancer (tobacco products)
曾患有与吸烟相关的癌症 （烟草制品）
Lowered immunity (AIDS, HIV)
免疫力低下 （艾滋病，HIV）
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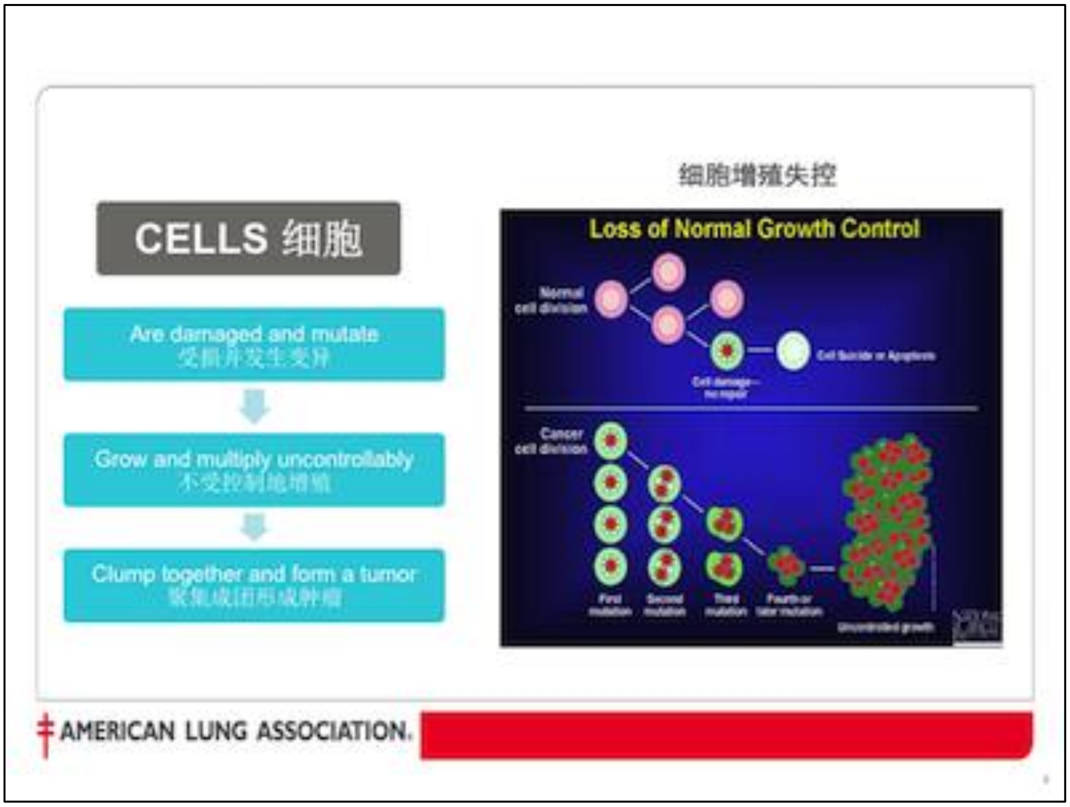
CELLS 细胞
Are damaged and mutate
受损并发生变异
Grow and multiply uncontrollably
不受控制地增殖
Clump together and form a tumor
聚集成团形成肿瘤
细胞增殖失控
Loss of Normal Growth Control
Normal cell division
Cell Suicide or Apoptosis
Cancer cell division
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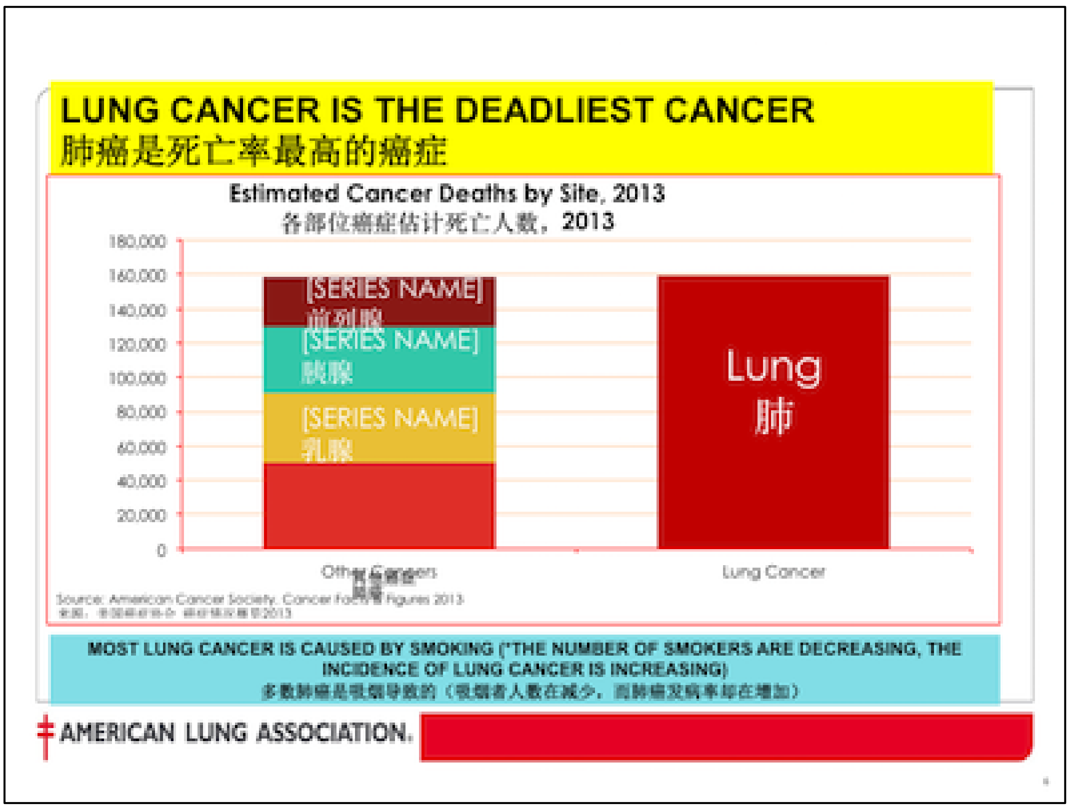
LUNG CANCER IS THE DEADLIEST CANCER
肺癌是死亡率最高的癌症
Estimated Cancer Deaths by Site, 2013
各部位癌症估计死亡人数，2013
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
[SERIES NAME]
前列腺
[SERIES NAME]
胰腺
[SERIES NAME]
乳腺
Lung
肺
Other Cancers
Lung Cancer
Source: American Cancer Society, Cancer Facts & Figures 2013
MOST LUNG CANCER IS CAUSED BY SMOKING (*THE NUMBER OF SMOKERS ARE DECREASING, THE INCIDENCE OF LUNG CANCER IS INCREASING)
多数肺癌是吸烟导致的（吸烟者人数在减少，而肺癌发病率却在增加）
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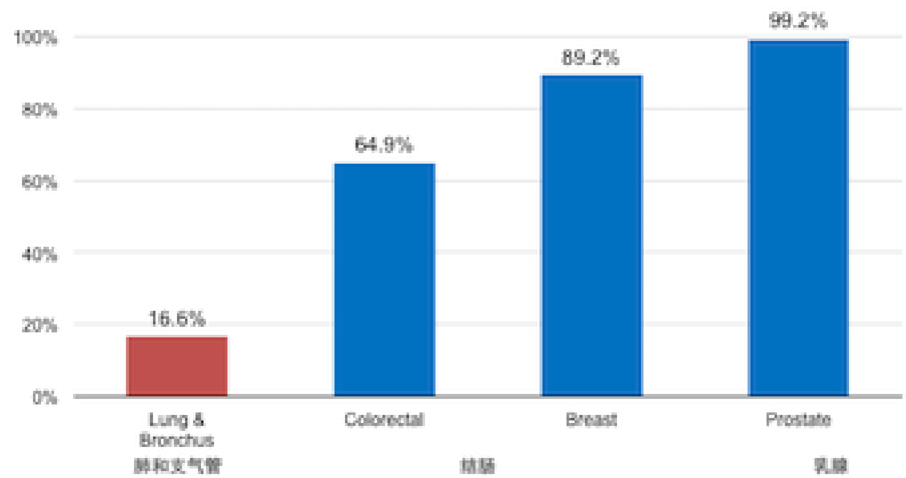
5 YEAR SURVIVAL RATES 五年生存率



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AIR POLLUTION & CLEAN AIR ACT 1970
1970年空气污染及清洁空气法案

- Created Environmental Protection Agency
  设立环保署
- EPA required to establish air quality standards
  要求环保署制订空气质量标准
  - ✓ 6 Criteria pollutants 六种主要污染物 (ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide, particulate matter, and lead臭氧，一氧化碳，二氧化氮，二氧化硫，颗粒物和铅)
  - ✓ Climate change pollutants (CO_2) 气候变化污染物 （二氧化碳）
  - ✓ Toxic air pollutants (carcinogens) 有毒气体污染物（致癌物）
- Time lines to comply
  遵循时间表

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WHO MUST COMPLY?
谁必须遵循法案？
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▪ Mobile Sources 移动污染源 (manufacturers制造商)
✓On road 道路行驶车辆
✓Off road 非路面行驶车辆
✓Planes 飞机
✓Trains 火车
✓Small engines 小型发动机
▪ Chemical Products
化学制剂

NOT HOMES OR PEOPLE (DIRECTLY)!
不直接约束家庭和个人！

No federal laws mandating联邦法律并无强制规定的:
Recycling, reuse, energy, chemical, vehicle choice or fuel usage
资源回收、再利用、能源、化学品，车辆购置选择和燃油使用

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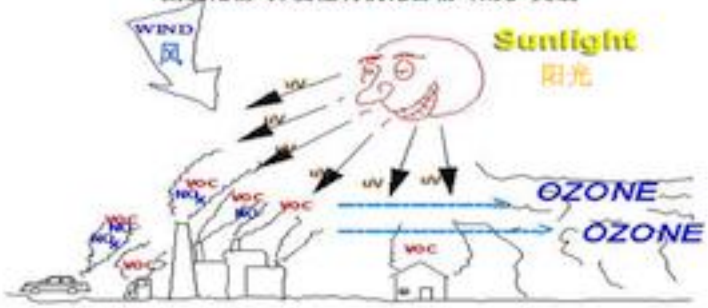
WHERE DOES OZONE COME FROM?
臭氧从何而来？

Primordial Ozone Soup
原始臭氧汤

NOx + VOC = Ozone

氮氧化物+挥发性有机化合物=臭氧

HOW VOCs AND NOx FORM GROUNDLEVEL OZONE
挥发性有机化合物和氮氧化物是如何形成地表臭氧层的
VOC + NOx + SUNLIGHT = OZONE
氮氧化物+挥发性有机化合物+阳光=臭氧



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PARTICULATE MATTER 颗粒物

- Natural & industrial
  自然及工业来源
- PM 10 – PM 2.5 micron 微米
- Health effects 对健康的影响
  - ✓ Bronchioles 1-5 m 细支气管
  - ✓ Lung & heart 肺和心脏
- Environmental effects 环境影响
  - ✓ Haze & smog 雾霾和烟尘
  - ✓ Water acidity 水体酸化
  - ✓ Damage to crops 破坏作物
  - ✓ Effects on ecosystems
    影响生态系统

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Health and Environmental Effects - National Data
健康和环境影响 — 全国数据

- Population = 313,914,040
- 人口 = 313,914,040
- Pediatric Asthma = 6,562,142
- 小儿哮喘 = 6,562,142例
- Adult Asthma = 21,272,415
- 成人哮喘 = 21,272,415例
- COPD = 15,340,484
- 慢性阻塞性肺病 = 15,340,484例
- Lung Cancer = 196,818
- 肺癌 = 196,818例

Carbon Monoxide一氧化碳
74% from Mobile Sources
74%来源于移动源

Nitrogen oxides氮氧化物
59% from Mobile Sources
59%来源于移动源
25% from Fuel Combustion
25%来源于燃料燃烧

Sulfur Dioxide二氧化硫
87% from Mobile Sources
87%来源于移动源

Lead铅
60% from Mobile Sources
60%来源于移动源
28% from Industrial processes
28%来源于工业生产过程

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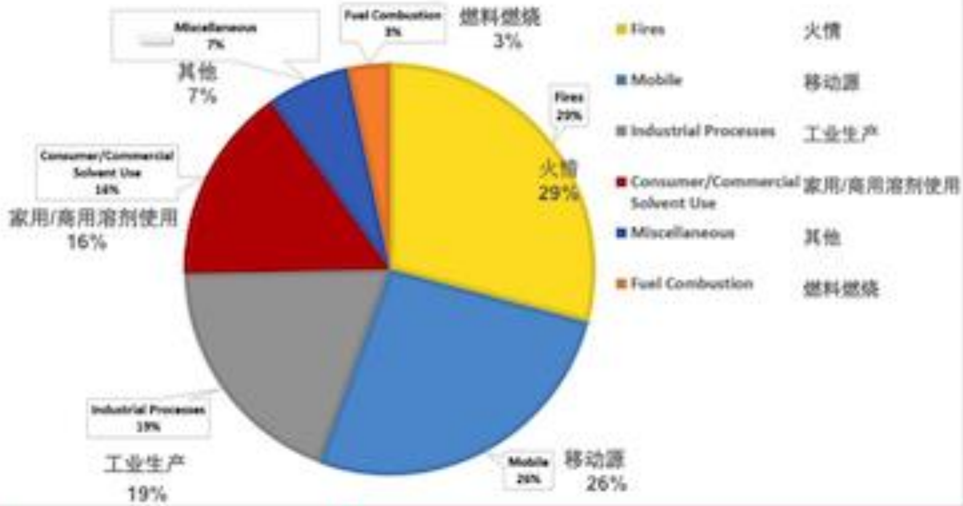
U.S. HYDROCARBONS EMISSIONS BY SECTOR
美国各领域碳氢化合物排放情况



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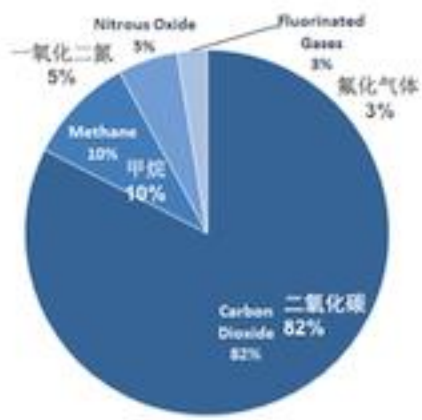
CLIMATE CHANGE & GREENHOUSE GASES
气候变化和温室气体

- Carbon dioxide –burning of fossil fuels (coal, natural gas, and petroleum fuels)
- 二氧化碳-化石燃料燃烧产生（煤炭，天然气和石油）
- Result of chemical reactions (mfg of cement)
- 化学反应的结果（水泥制造）
- Usually removed by plants as a part of biological carbon cycle
- 通常可被植物通过生态碳循环吸收
  - ✓ except when an excess
  - ✓ 二氧化碳过量的情形除外



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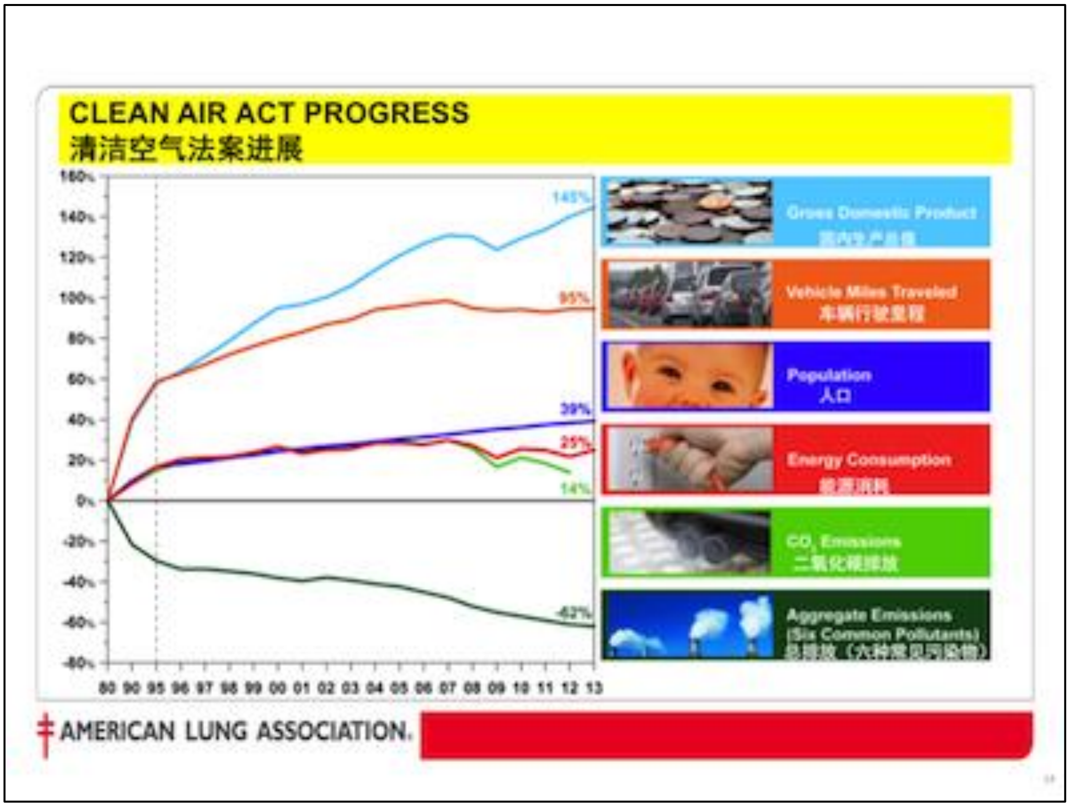
CLEAN AIR ACT PROGRESS
清洁空气法案进展
145%
95%
39%
25%
14%
-62%
Gross Domestic Product
Vehicle Miles Traveled
车辆行驶里程
Population
人口
Energy Consumption
能源消耗
CO_2 Emissions
二氧化碳排放
Aggregate Emissions
(Six Common Pollutants)
总排放（六种常见污染物）
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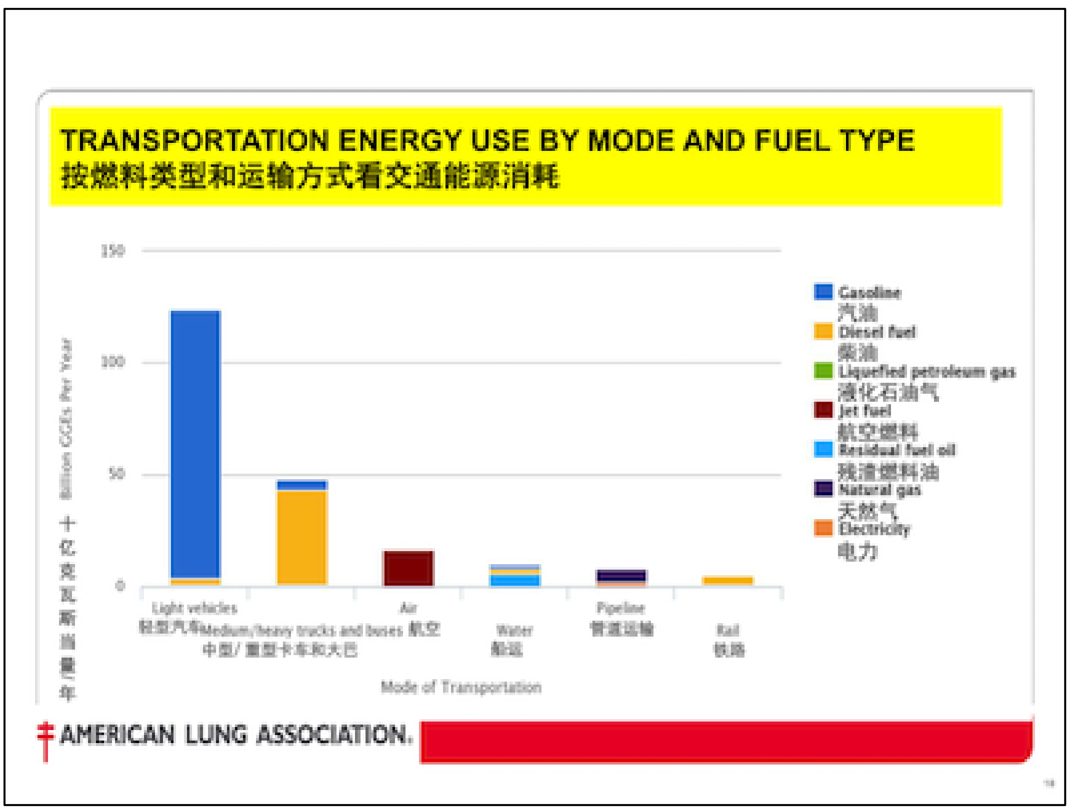
TRANSPORTATION ENERGY USE BY MODE AND FUEL TYPE
按燃料类型和运输方式看交通能源消耗
Billion GGEs Per Year
十亿克瓦斯当量/年
150
100
50
0
Light vehicles
轻型汽车
Medium/heavy trucks and buses
中型/重型卡车和大巴
Air
航空
Water
船运
Pipeline
管道运输
Rail
铁路
Mode of Transportation
Gasoline
汽油
Diesel fuel
柴油
Liquefied petroleum gas
液化石油气
Jet fuel
航空燃料
Residual fuel oil
残渣燃料油
Natural gas
天然气
Electricity
电力
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MOBILE SOURCE EMISSIONS
移动源排放

- Exhaust emissions
  尾气排放
- Evaporative emissions
  (hot days>cold days)
- 蒸发排放（炎热天气>寒冷天气）
- Trip emissions
- 行驶排放
  (average trip = 7 miles X 7 times day)
- （平均每次行驶 = 7英里 X 每天7次）
  - ✓ Variable emissions – speed
  - ✓ 排放量可变因素 – 车速
  - ✓ Variable emissions - age
  - ✓ 排放量可变因素 – 车龄
- Refueling emissions (area source)
  加油时的排放 （局部区域）




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MOBILE SOURCE CLEAN AIR RULES
移动源清洁空气规定

- Clean Cars and Passenger Trucks –Tier 3
  清洁汽车和载人卡车 – 三级
- Clean Heavy-Duty Trucks and Buses 清洁重载卡车和大巴
- Mobile Source Air Toxics Rule 移动源空气污染规定
- Clean Non-road Diesel Engines and Equipment
  清洁非道路柴油机和设备
- Locomotive and Marine Diesel Standards 机车和船用柴油标准
- Ocean-going Vessels 远洋船舶
- Small Gasoline and Recreational Marine Standards
  小型汽油船和游艇标准
- Ultra-low Sulfur Fuel Requirements 超低硫燃料要求
- Renewable Fuel Standards 可再生燃料标准

A new vehicle today is up to 95% percent cleaner than a new vehicle in 1970. Still, by 2020, mobile sources are projected to account for up to 50% of the NOx emissions, and substantial hydrocarbon and PM emissions.

如今一辆新车比1970年的新车清洁度高达95%。可是，到2020年，移动源仍占氮氧化物排放的50%，碳氢化合物和颗粒物的排放量也很可观。

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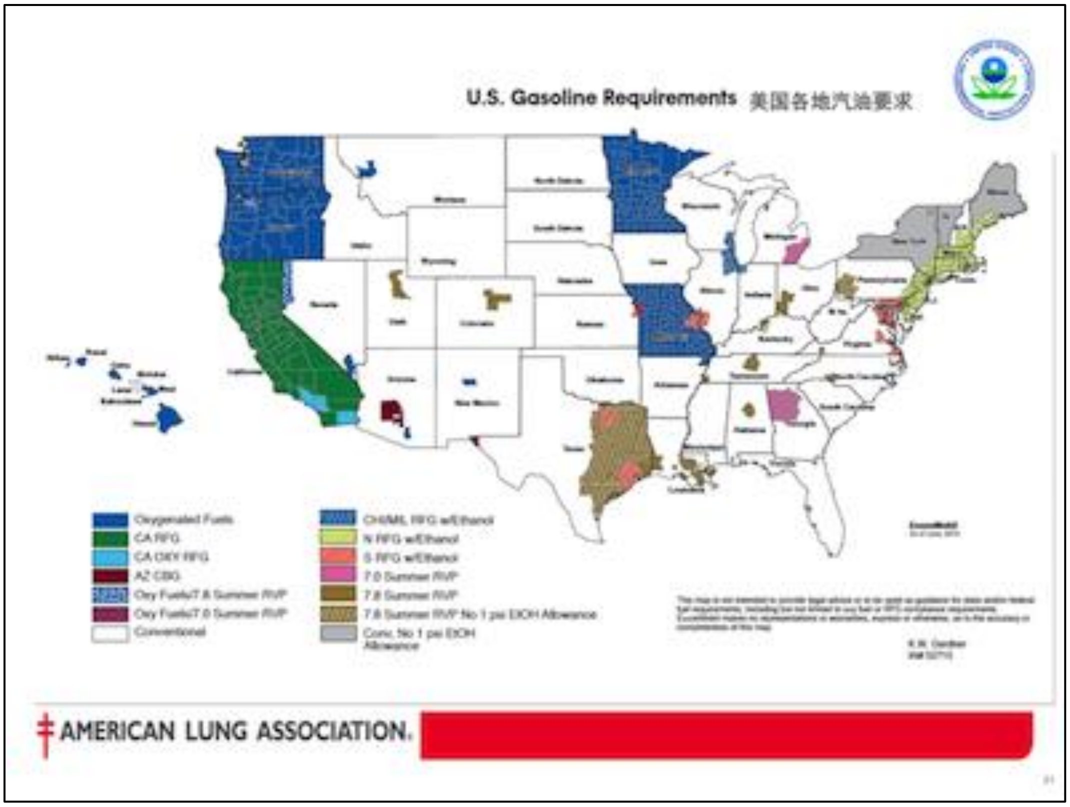
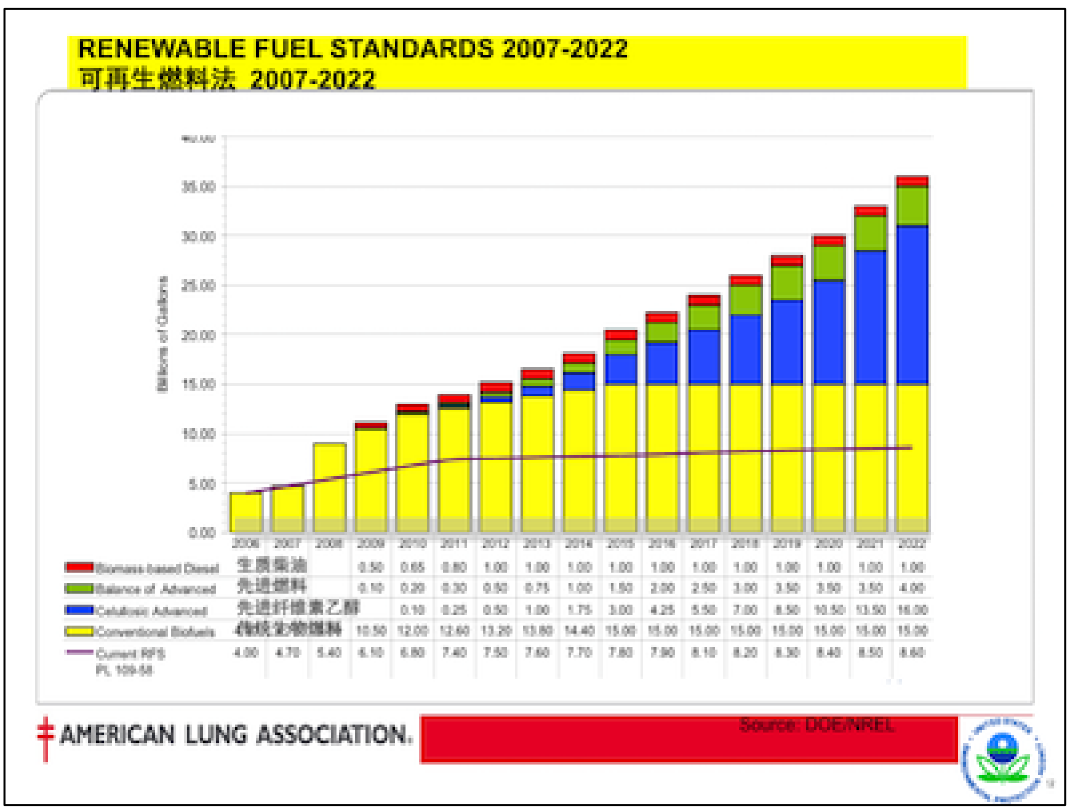
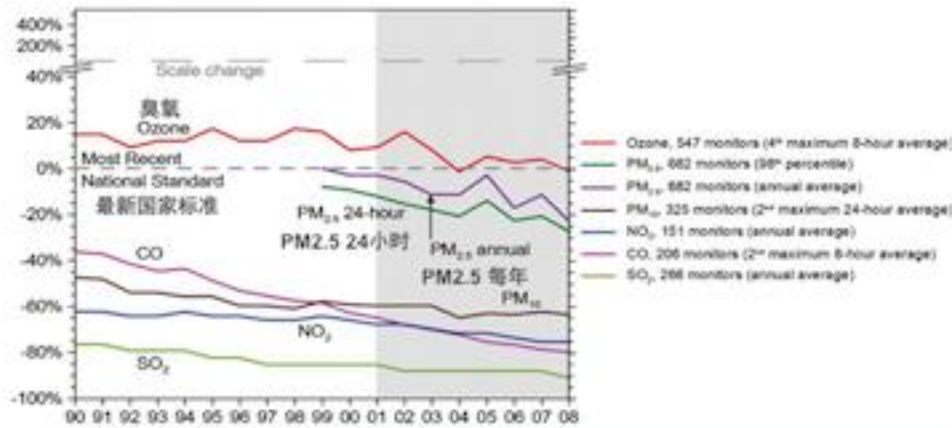




	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Biomass-based Diesel 生质柴油				0.50	0.65	0.80	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Balance of Advanced 先进燃料				0.10	0.20	0.30	0.50	0.75	1.00	1.50	2.00	2.50	3.00	3.50	3.50	3.50	4.00
Cellulosic Advanced 先进纤维素乙醇					0.10	0.25	0.50	1.00	1.75	3.00	4.25	5.50	7.00	8.50	10.50	13.50	16.00
Conventional Biofuels 传统生物燃料				10.50	12.00	12.60	13.20	13.80	14.40	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00
Current RFS PL 109-58	4.00	4.70	5.40	6.10	6.80	7.40	7.50	7.60	7.70	7.80	7.90	8.10	8.20	8.30	8.40	8.50	8.60

COMPARISON OF CRITERIA POLLUTANT LEVELS TO AIR QUALITY STANDARDS (1990-2008)
空气质量标准，污染物指标的比较（1990 – 2008）



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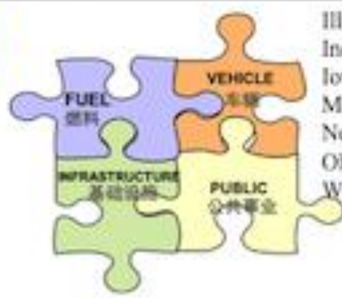
PROGRAM EFFORTS
项目举措

1. Infrastructure Grants
   基础设施补贴
2. GIS Station Mapping
   地理信息系统地图
3. Environmental & Health
   环境与健康
4. Benefits 福利
5. Website 网站
6. Auto manufacturers
   汽车制造
7. IL E85 Coupon Program
   伊利诺伊E85优惠项目
8. FFV Dealership Coupon
   灵活燃料汽车经销店优惠券



Illinois 伊利诺伊
Indiana 印第安纳
Iowa 艾奥瓦
Minnesota 明尼苏达
Nebraska 内布拉斯加
Ohio 俄亥俄
Wisconsin 威斯康星

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2016 USDA BIOFUELS INFRASTRUCTURE GRANTS
2016年美国农业部生物燃料基础设施补贴

- Government provided $100 M in grants
  政府提供一亿美元补贴款
- 1:1 matching dollars 1:1配套投资
  - ✓Stations 加油站
  - ✓Partners (state and private) 合作伙伴（州和私营）
- $200 M in ethanol infrastructure
  乙醇基础设施投入两亿美元
- 5000 Additional pumps providing ethanol
  增加5000台乙醇加油泵
- 1400 Fueling stations
  1400间加油站

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REFORMULATED GAS SUBSTANTIALLY REDUCES HARMFUL GASOLINE EMISSIONS
新配方汽油有效地降低了汽油的有害气体排放

The Health Benefits of Ethanol: C. Boyden Gray 乙醇对健康的益处：C. Boyden Gray	
Air Toxics 毒性空气污染物	-28%
Volatile Organic Compounds 挥发性有机化合物	-17%
Nitrogen Oxides 氧化氮	-3%
Carbon Monoxide 一氧化碳	-13%
Sulfur Oxides 硫氧化物	-11%
Carbon Dioxide 二氧化碳	-4% (-30%)
Particulate Matter 颗粒物	-9% (-50% for fine PM)
Reduced Cancer Risk **降低癌症风险**	**-20 – 30%**

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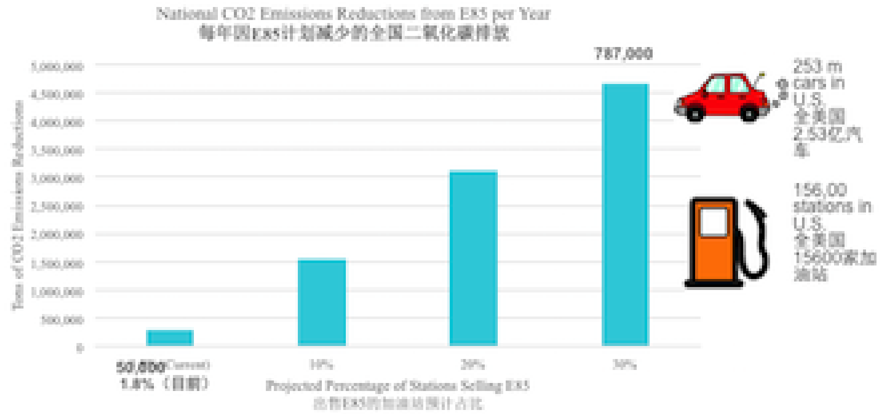
NATIONAL CO2 EMISSIONS REDUCTIONS FROM E85
因E85计划减少的全国二氧化碳排放



- **2,816** stations selling E85, which makes up only (**1.8%** of the total active stations in U.S.)
- 2,816家加油站出售E85，仅占全美国营业加油站的1.8%。
- **285,627** tons of CO2 emissions reductions per year (less **50,000** cars off the road each year)
- 每年减少285，627吨二氧化碳排放 （等于每年路面上减少五万辆汽车）
- **4,500,000 tons per year** (less **787,000 cars**) If **30%** of stations sell E85
- 如果30%的加油站出售E85，每年将减少4,500,000吨排放（等于减少787,000辆汽车）。

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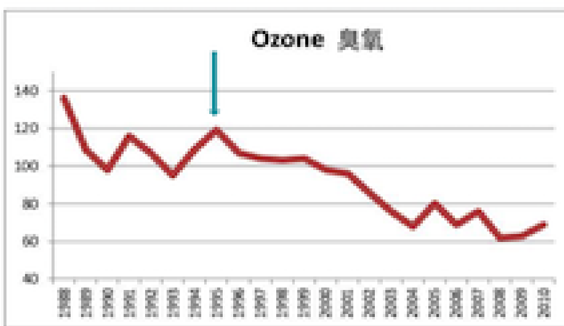
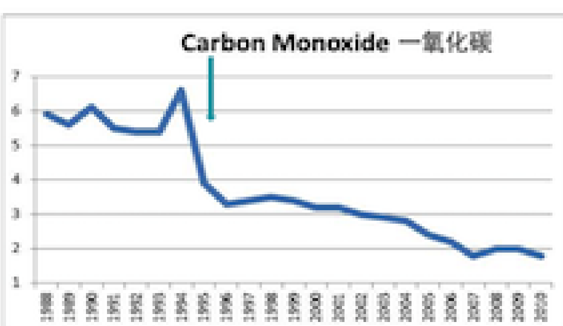
CONTINUOUS AIR QUALITY MONITORING IN ILLINOIS
伊利诺伊州空气质量连续监测

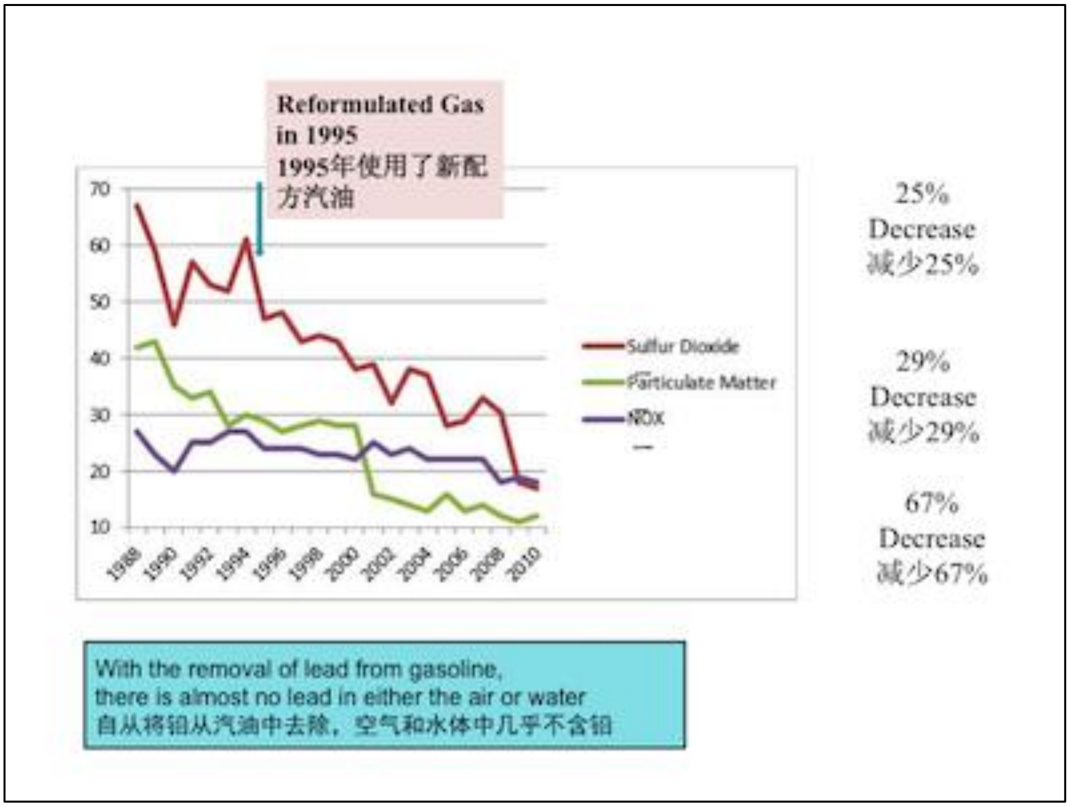




Reformulated Gas in 1995
1995年开始使用新配方汽油

31% Decrease in Carbon Monoxide
一氧化碳减少了31%

Continuous monitoring at 80 monitoring sites with more than 200 instruments
在80个监测站点使用超过200件仪器进行持续监测



SUMMARY 摘要

- The Clean Air Act has been successful in dramatically reducing air pollution in the United States.
- 清洁空气法案成效显著，大幅减少了美国的空气污染。
- Reduction in pollution from all types of motor vehicles has been critical to meeting air quality goals.
- 各种机动车污染排放减少对空气质量目标的达成起关键作用。
- Regulation of motor vehicle fuels at the national level, combined with local fuel requirements, has brought many areas to within health-based air quality standards.
- 有关机动车燃料的国家级法规与地方燃料要求结合，使很多地区的空气质量达到了健康标准。
- Use of oxygenates in fuels, primarily ethanol, has been an important component of fuels programs in the U.S.
- 在燃料中添加增氧剂，主要是乙醇，是美国燃料计划的重要组成部分。
- Ethanol will provide a strong role in national fuels programs in the future, including efforts to address GHG emissions.
- 乙醇在未来国家燃料计划中的作用至关重要，包括温室气体排放治理。

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WHY WE ARE INVOLVED? 我们为何参与？

- To work in area of most harm (mobile sources)
- 在危害最大的领域方面开展工作（移动源污染）
- To reduce air emissions & promote good lung health
- 减少空气排放并促进肺部健康
- Ethanol blended fuel 添加乙醇的燃料
  - ✓ Renewable – sustainable fuel
  - ✓ 可再生 – 可持续燃料
  - ✓ Non toxic, water soluble & biodegradable (all media)
  - ✓ 无毒性，可溶于水并且能够生物降解 （所有媒介）
  - ✓ Positive environmental benefits
  - ✓ 良性的环境效益
  - ✓ No environmental harm from accidental releases
  - ✓ 意外泄漏时对环境无害
  - ✓ No environmental harm compared to oil exploration or natural gas drilling
  - ✓ 与石油开采和天然气钻探相比不会损害环境

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..\VIDEOS\CLEARING THE AIR ON THE ETHANOL VS. GASOLINE DEBATE - YOUTUBE [720P].MP4

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Angela Tin
Vice President Environmental Health
American Lung Association of the Upper Midwest
Angela.Tin@Lung.org
217.787.5864

安吉拉 曾
环境健康副主席
上中西部美国肺协会
Angela.Tin@Lung.org
217.787.5864

* www.CleanAirChoice.org *
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Automotive Fuel Oxygenate Issues
机动车燃料增氧剂问题

U.S. Grains Council
美国谷物协会

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James Patrick O'Brien 詹姆斯·帕特里克·奥布雷恩

- 1983-2003 Manager, Office of Chemical Safety
  1983 – 2003 经理, 化学品安全办公室
  Office of Emergency Management
  紧急情况处理办公室
  Illinois Environmental Protection Agency
  伊利诺伊州环境保护署
  State of Illinois
  伊利诺伊州
- 2003-now Consultant, D & E Technical Inc.
  2003 – 至今 顾问, D & E 技术有限公司

  Clients/Grantor:
  客户/出资人:
  -American Petroleum Institute
  - 美国石油学会
  –Chemical Materials Activity, US Army
  -美国陆军化学材料项目组
  -Federal Emergency Management Agency
  - 联邦紧急事务管理署
  -National Institute of Environmental Health Sciences
  -国家环境健康科学研究所

Why Use Oxygenates ?
为何使用增氧剂？

- More complete combustion to CO2 and water because oxygen is part of the fuel.
  氧气助燃使燃烧更加充分，产生二氧化碳和水
- Complete combustion reduces carbon monoxide (CO) and ground-level ozone (O3)
  充分燃烧减少了一氧化碳（CO）和地表臭氧（O3）的产生
- Examples of oxygenates are:
  增氧剂包括：
  - Ethanol 乙醇
  - Methyl tert-Butyl Ether (MTBE)
    甲基叔丁基醚(MTBE)
    Ethyl tert-Butyl ether (ETBE)
    乙基叔丁醚(ETBE)
  - Tertiary Amyl Methyl Ether (TAME)
    三戊甲基醚(TAME)
  - Tertiary Butyl Alcohol (TBA)
    叔丁醇(TBA)

Oxygenate Mandate in the United States
氧化添加剂在美国的强制使用

- Since 1992 fuel with 2.7% oxygen required during cold months in cities with high carbon monoxide.
  1992年以来，一氧化碳排放较高的城市被要求寒冷月份应在燃油中添加2.7%的增氧剂。
- From 1995 to 2005 Reformulated Gasoline with at least 2% oxygen required in cities with high ground-level ozone.
  从1995年到2005年，地表臭氧浓度较高的城市被要求使用至少添加了2%增氧剂的新配方汽油。
- Ethanol was the oxygenate of choice in the Midwest, but MTBE was used in most other areas for economic reasons and its blending characteristics.
  中西部地区选择乙醇作为增氧剂，但多数其他地区使用甲基叔丁基醚(MTBE)，主要是出于经济原因以及其良好混配性的考虑。

Renewable Fuels Standard in the US
美国可再生燃料标准

- A volume requirement for renewable fuels established.
  确立了可再生燃料使用量的要求
- Automobile engine technology improved combustion efficiency.
  汽车发动机技术发展提高了燃烧效率
- Oxygenate requirements removed for reformulated gasoline in 2006.
  2006年去除了新配方汽油的增氧剂要求
- However, MTBE producers denied liability protection for any harm done by MTBE use in fuel.
  不过，甲基叔丁基醚(MTBE)生产商拒绝为在燃油中使用MTBE产生的任何危害承担责任。

MTBE Problems
MTBE的问题

- Vapor has a sharp and disagreeable odor when fuelling vehicles.
  为车辆加油时散发的汽体有刺鼻的异味。
  - Many consumer complaints.
    许多消费者对此有所抱怨。
- Spills of MTBE persist in groundwater.
  MTBE泼洒后会在地下水中持续存在
  - Not easily treated.
    不易处理
  - More persistent than other gasoline components like BETX.
    与其他汽油成分如BETX（苯系物）相比更不易清除
  - Disagreeable taste at very low concentrations.
    即使浓度极低亦有难闻气味

Use of MTBE in the U.S. has been replaced by Ethanol
在美国MTBE在使用中已被乙醇替代

- USEPA (Environmental Protection Agency) policy since 2000 to phase out MTBE use entirely.
  美国环境保护署的政策从2000年开始分阶段完全淘汰MTBE的使用。
- State of California and New York banned MTBE in 2004, which was 40% of prior MYBE consumption. 25 States had banned it by 2005.
  2004年加利福尼亚州和纽约州禁用了MTBE，这两个州此前占总消费量的40%。到2005年25个州禁用了MTBE。

- Almost no MTBE is now used in the United States.
  现在MTBE几乎已在全美国停用。

Oxygenate Anti-knock and Octane Properties
增氧剂的抗爆性和辛烷特性

- In gasoline engines the spark plug ignites the fuel-air mixtures at the ideal time.
  在汽油发动机中火花塞在恰当的时间点燃油气混合物
- Engine knock occurs when some of the fuel explodes early due to temperature, pressure and fuel properties.
  当燃料因为温度、压力和燃料特性提前点燃，就会发生发动机爆震
- Knock causes locally high pressure in the engine cylinder and may damage the engine.
  爆震会导致发动机汽缸局部高压，可能会损坏发动机。
- Octane rating is a measure of the performance of a fuel in high compression gasoline engines.
  辛烷值是衡量燃料在高压缩比汽油发动机中性能的一个指标

Alkyl Lead 烷基铅

- From the 1920s to the mid-1970s alkyl lead compounds like tetraethyl lead were used to prevent knock and increase octane ratings.
  从20世纪20年代到70年代中期，烷基铅，如四乙基铅，被用于防止爆燃和提高辛烷值。
- USEPA policy win 1979 was to phase out lead in fuel due to its neurotoxicity.
  美国环境保护署在1979年争取到将燃油中的铅逐步淘汰，因为铅具有神经毒性。
- Lead was banned in fuel in the U.S. in 1995.
  美国于1995年禁止在燃料中添加铅。
- Alkyl lead in fuel also damaged catalytic converters required on U.S. cars in 1975, resulting a phase out before the 1995 ban.
  燃油中的烷基铅还会损害美国汽车按1975年规定安装的催化转化器，因此在1995年禁令之前已开始被逐步淘汰。

MTBE as Anti-Knock
作为抗爆剂的MTBE

- Used in fuels starting in 1979 at 3-7% by volume.
  从1979年开始用于燃料，添加量为3 -7%。
- Cost less than ethanol and has good fuel blending properties.
  成本低于乙醇，混配性较好。
- In the U.S., tax incentives for renewable fuels have made grain-based ethanol less expensive than MTBE, ETBE, TAME or TBA
  在美国，可再生燃料的税收激励使谷物乙醇比MTBE，ETBE，TAME或TBA更经济。

Octane Rating 辛烷值

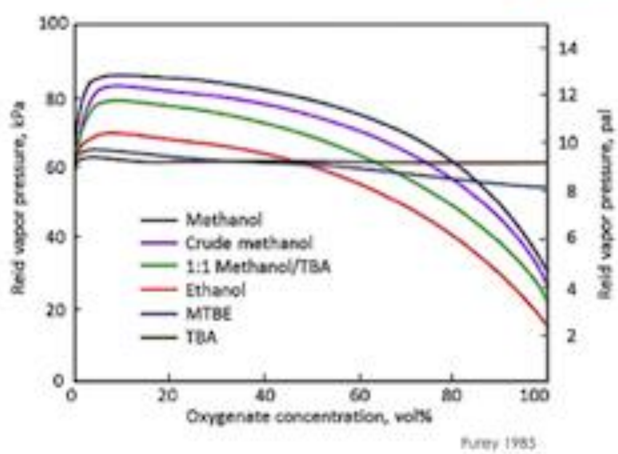
- Engines designed for higher octane fuels are more efficient in using energy.
  设计使用高辛烷值燃料的发动机能源利用的效率更高。
- Adding either Ethanol or MTBE raises the octane rating of regular gasoline.
  添加乙醇或MTBE能提高普通汽油的辛烷值。

	Gasoline 汽油	Ethanol 乙醇	MTBE
Blending RON 混合研究法辛烷值	90-100	108-115	116-120
Blending MON 混合马达法辛烷值	81-90	90-112	100-104

Other Properties of Fuel Additives
燃料添加剂的其他特性

Volatility 挥发性

- Lower volatiles mean less air pollution.
  挥发性低意味着更少空气污染
- Ethanol and MTBE form azeotropes with gasoline resulting in higher volatility fuel blend at lower concentrations.
  乙醇和MTBE与汽油生成共沸，导致在低浓度情况下混合燃料挥发性提高
- Gasoline for blending must have lower volatility to compensate.
  作为补偿，用于混配的汽油必须具有低挥发性。



Oxygen content
含氧量

- Ethanol 35%
  乙醇35%。
- MTBE 18%
  MTBE18%。

Water Solubility
水溶性

- MTBE has negligible bulk water solubility and can be blended into fuels at existing refineries and moved through existing bare metal piping.
  MTBE在大容量水中溶解度较低，可忽略不计，可在现有的精炼厂与燃油混合，并可在现用裸金属管中流动。
- Ethanol will dissolve any water it contacts which can lead to corrosion problems in bare metal tanks and piping.
  乙醇会溶于其接触到的任何水体，因此在裸金属罐和管道中会产生腐蚀问题。
- Ethanol is usually splash blended at the final fuel terminal into the delivery trucks which have lined tanks. Retail tanks are usually have fiberglass liners and non-metal hoses not susceptible to corrosion.
  乙醇通常以在销售终端向有内胆的油罐车内倾倒的方式掺入燃油。零售油罐通常配有玻璃纤维内胆和非金属软管，不易产生腐蚀问题。

Comparative Toxicity of MTBE and Ethanol
MTBE和乙醇的毒性对比

- Acute toxicity is low for both
  两种物质的急性毒性均较低
  - Ethanol LD50 8300 mg/kg bw/day
    乙醇 LD50（致死剂量）8300 mg/公斤体重/每天
  - MTBE LD50 4000 mg/kg bw/day
    MTBE LD50（致死剂量）4000 mg/公斤体重/每天
  - Ethanol NOAEL 2400 mg/kg bw/day
    乙醇 无可见有害作用水平 2400mg/公斤体重/每天
  - MTBE NOAEL 714 mg/kg bw/day
    MTBE 无可见有害作用水平 714mg/公斤体重/每天
  - LD50 = mean lethal dose LD 50 = 平均致死剂量
  - NOAEL = no observed adverse effect level
    NOAEL= 无可见有害作用水平

Occurrence
自然生成

- Ethanol is produced by the human body due to metabolism by intestinal microflora resulting in typical blood alcohol levels of 0.062 to 0.73 mg/L.
  乙醇可能作为肠道菌群代谢的产物在人体中生成，因此人的血液酒精浓度一般为0.062到0.73毫克/升。
- MTBE is not known to occur naturally.
  未发现自然生成MTBE的情形。

Carcinogenicity
致癌性

- Ethanol
  乙醇
- Not directly a carcinogen but its metabolite acetaldehyde is.
  并非直接致癌物，但其代谢产物乙醛是致癌物。
- IARC carcinogen rating based on human (epidemiologic) studies of high concentration exposures.
  国际癌症研究机构的致癌物评级是基于暴露在高浓度环境下的人体(流行病学)研究

- MTBE
- Multiple organ cancers at high concentrations in some animal species but not others.
  对于某些动物种类高浓度MTBE可导致多种器官的癌症，而对其他动物并无此作用。
- No human studies.
  无相关人体研究。

Taste and Odor Thresholds
味觉和气味阈值

	Ethanol 乙醇	Benzene 苯	TBA 叔丁醇	MTBE 甲基叔丁基醚	TAME 甲基叔戊醚	ETBE 乙基叔丁醚
Taste threshold in water (μg/L) 水中味觉阈(μg/L)	--	500	--	20-40	128	47
Odor threshold (ppm) 气味阈 (ppm)	49	0.5	21	0.053	0.027	0.013


Rise and Fall of MTBE Production in the U.S.
MTBE生产在美国的兴衰
Before 1979 minimal
1979年之前 极少
By Jan 1992 3,038,000 bbl/month
到1992年为止 3,038,000 桶/月
By Jun 2000 7,260,000 bbl/month
This was peak production.
到2000年6月为止 7,260,000桶/月
此为产量峰值
By Feb 2015 520,000 bbl/month
到2015年2月为止 520,000 桶/月


MTBE is produced from
合成MTBE的原料
C4 olefins (one double bond) from refined crude oil
源自精炼原油的C4烯烃（一个双键）
Too volatile to use all that is produced in gasoline blending
在汽油混合中产生，挥发性过强无法使用全部
Readily available
容易获得
Methane or Methanol
甲烷或甲醇
From natural gas or petroleum
源自天然气或石油

Ethanol can be produced from 合成乙醇的原料

- Petroleum – via ethylene and steam
  石油 – 通过乙烯和水蒸汽
- Natural Gas – via syngas (CO and H2) reforming
  天然气 – 通过合成气(一氧化碳和氢)转化
- Grain-based starch – conventional fermentation and distillation
  谷物淀粉 – 传统的发酵和蒸馏法
- Cellulosic conversion – enzyme modulated conversion to fermentables
  纤维素转化 – 通过酶的调节转化为可发酵物

Ethanol Production in the U.S. bbl/month 美国乙醇产量 桶/月

1981	168,000
1990	1,512,000
1995	3,000,000
2000	3,500,000
2005	8,000,000
2010	28,000,000
2015	29,500,000

Peak MTBE vs. Ethanol in US
MTBE和乙醇的产量峰值 美国

- MTBE 7,260,000 bbl/month (2000)
  MTBE 7,260,000 桶/月 (2000)
- Ethanol 29,585,000 bbl/month (2016)
  乙醇 29,585,000 桶/月 (2016)

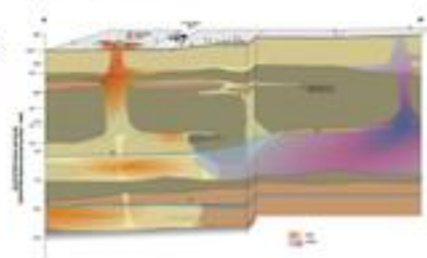
What happened to U.S. MTBE production capacity?
美国MTBE的产量现状如何？

- Units at refineries were put into mothballs, sold overseas, or converted to other products.
  精炼厂的相关设施被闲置起来，出卖给海外企业，或转产成他产品。
- Several merchant (stand alone) facilities still operate for export production. Most are located on the U. S. gulf coast.
  少数商户(独立的)的设备仍在运营，主要用于出口。多数位于美国墨西哥湾沿岸。
- U. S. MTBE production is now only 7% of the peak in 2000.
  如今美国MTBE产量只是2000年峰值时的7%。

MTBE in the Environment
MTBE与环境

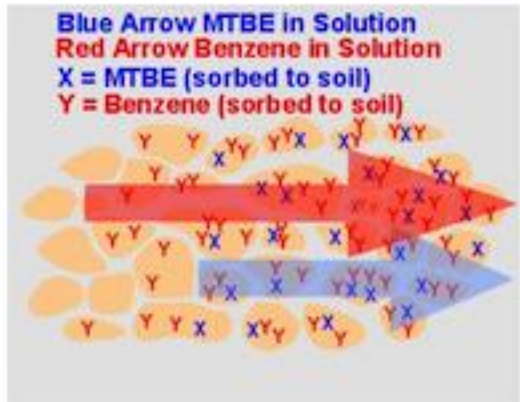
MTBE Fate
MTBE的归宿

- Short half-life in air of 2.4 days
  在空气中的半衰期短，为2.4天。
- Spills on surface soils quickly evaporate
  泼洒到土壤表面会迅速蒸发。
- Large spills or underground tank leaks soak into soil and persist.
  大量泼洒或地下储藏罐泄漏，浸入土壤后会持续存在。

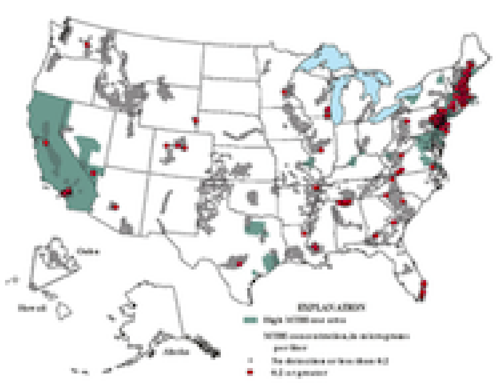


MTBE in Groundwater
MTBE与地下水

- Moves readily from soil to groundwater.
  会迅速从土壤进入到地下水中
- Vapors do not readily escape from deep soil or groundwater.
  不易从深层土壤或地下水中蒸发
- Moves with groundwater flow but only 4.3% soluble in water.
  随地下水流动，但水溶率只有4.3%。
- Very low and disagreeable odor/taste threshold.
  不良气味/味觉阈值很低。



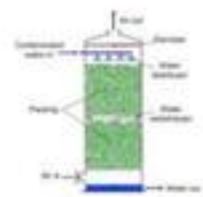
U.S. MTBE in Groundwater
美国地下水中的MTBE



- Numerous studies have shown that MTBE contamination in public and private drinking water wells is widespread in the U.S.
  多项研究显示，全美国MTBE对公共或私有饮水井造成的污染很普遍
- More likely to occur in urban areas.
  常见于城市地区

MTBE in Groundwater Difficult to Remediate
地下水中的MTBE治理很难

- Activated carbon filtration is not cost effective. A two cubic foot bed lasts a month or less in residential usage.
活性炭过滤成本较高。在住宅中二立方英尺的吸附层只能使用不到一个月。
- Air stripping is possible, but only with high air flow to water ratios, which is energy intensive.
空气脱吸法虽然可行，但只有在高汽液比的条件下才能实现，能耗很高。
- Biodegradation may occur, but only very slowly.
可以生物降解，但速度十分缓慢。

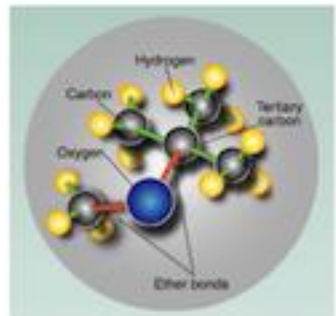


Ethanol Easier to Remediate
乙醇影响较易修复

- Biodegradation occurs quickly.
生物降解发生迅速
- Because it is 100% soluble in water it is diluted quickly.
因其100%溶于水，稀释速度快
- Nutrient (NPK) and pH management may be helpful in some soils.
对于某些土壤养分(氮磷钾)和pH值调节可能有益。

Why doesn't MTBE biodegrade? MTBE为何不能生物降解？

- Soil microorganisms put energy into breaking bonds and get more energy out when the bond breaks. They prefer substrates with the higher net energy gain.
土壤微生物耗费能量使分子断键，键断时能得到更多能量。它们更喜欢净能收益高的基底物。
- MTBE has a tertiary carbon to which three other carbons are attached. More energy is needed to break those tertiary carbon-carbon bonds, so the net energy gain is less.
MTBE带有叔碳原子，与三个其他碳原子相连。叔碳原子断键需要更多能量，因此净能收益较低。
- Microbe enzymes work in 2-carbon bites. Ethanol is ideal. The geometry of MTBE prevents the enzyme from accessing a 2-carbon portion.
微生物酶擅长切割双碳，因此乙醇是更为理想的选择。MTBE的几何结构不利于酶接触双碳部分。



Summary 小结

- Ethanol can be produced from grain using readily available and mature technology. It reduces dependence on petroleum. It is renewable and does not contribute to greenhouse gas increases.
乙醇可以利用现有成熟技术从谷物中提取。它降低了对石油的依赖性。乙醇是可再生资源，且不会导致温室气体增加。
- MTBE poses a risk to groundwater due to its disagreeable taste and odor at vey low concentrations. It must be produced from petroleum and natural gas. It contributes to greenhouse gas accumulation.
低浓度的MTBE即具有异味，对地下水有威胁。它必须从石油和天然气中提取，会增加温室气体的累积。

Climate Benefits of US Produced Corn Ethanol
美国玉米乙醇的气候效益

Steffen Mueller, PhD, University of Illinois at Chicago
Energy Resources Center
斯特芬·穆勒博士，芝加哥伊利诺伊大学
能源资源中心

Stefan Unnasch, Managing Director, Life Cycle Associates
斯特凡·乌纳什，总经理，生命周期伙伴

October 2016
2016年10月

THE UNIVERSITY OF ILLINOIS AT CHICAGO

Life Cycle Associates

Biofuels and Climate: United States Efforts
生物燃料和气候：美国的举措

- Many policy and regulatory structures around the globe recognize biofuels' potential to reduce global warming.
  世界各国多项政策和监管架构认可生物燃料具有减轻全球变暖的潜能。
- In the US the Low Carbon Fuel Standards (LCFS) in California and Oregon as well as the expanded Renewable Fuels Standard (RFS2) have successfully reduced carbon emissions from transportation fuels.
  在美国，加利福尼亚和俄勒冈州的低碳燃料标准（LCFS）及相关的可再生燃料标准（RFS2）已成功地减少了交通燃料的碳排放。
- While both programs replace gasoline with lower carbon fuels, the RFS2 specifically provides volumetric blending requirements for biofuels whereas fuel suppliers under the LCFS need to meet performance based GHG reduction targets from a fuel mix of their choice.
  两个项目都用低碳燃料代替汽油，RFS2特别提出了生物燃料混合配比量的要求，而按照LCFS的要求燃料供应商自行选择燃料成分配比但需要满足基于实际结果的减少温室气体排放的目标。
  - The RFS2 creates GHG reduction categories for four types of fuels: biomass-based diesel, cellulosic biofuel, advanced biofuel, and renewable/conventional fuel. For example, corn ethanol must meet a 20% lifecycle GHG reduction threshold, while advanced biofuels produced from qualifying biomass must meet a 50% reduction in GHG emissions.
    RFS2为四种类型的燃料创建了温室气体排放类别：生物质柴油，纤维素生物燃料，先进生物燃料和可再生/传统燃料。例如，玉米乙醇必须满足20%全周期温室气体减排的门槛，而用符合要求的生物质生产的先进生物燃料必须实现温室气体减排50%。
  - The LCFS in California requires a 10% reduction in the carbon intensity of transportation fuels by 2020.
    加利福尼亚州的LCFS要求2020年之前交通燃料的碳浓度减少10%。
  - Both RFS2 and LCFS consider emissions from land use change
    RFS2和LCFS均考量了土地利用变更的排放。

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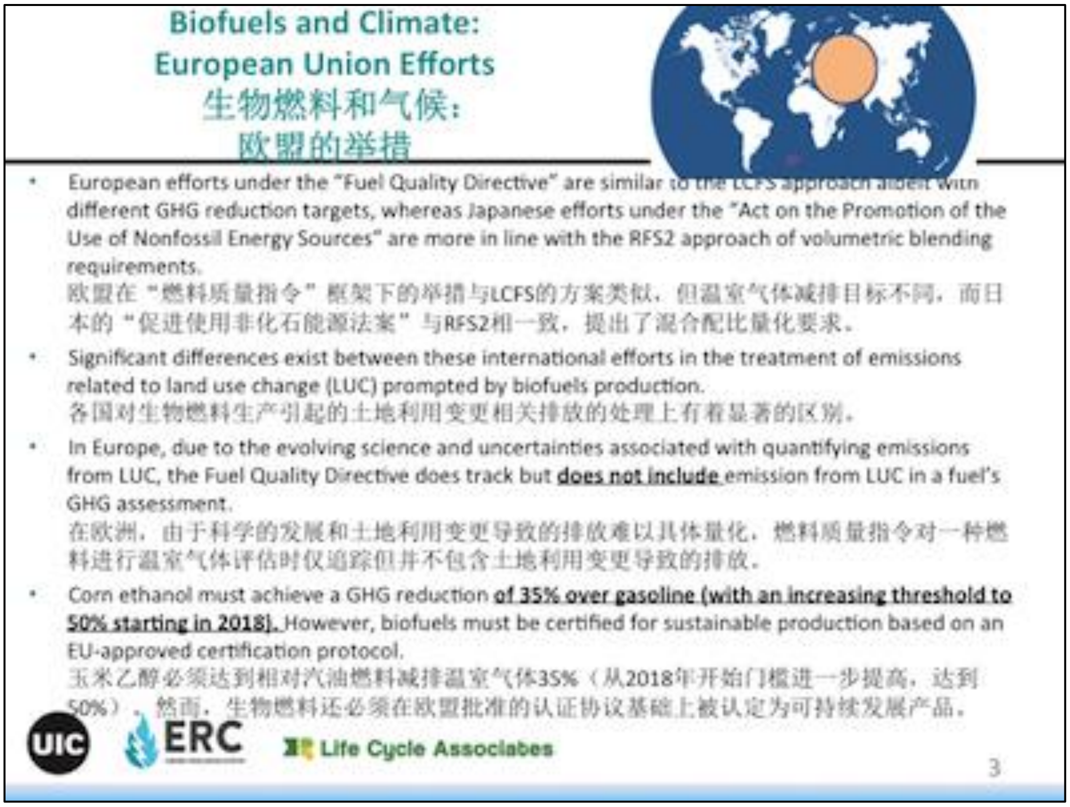
Biofuels and Climate:
European Union Efforts
生物燃料和气候：
欧盟的举措
European efforts under the "Fuel Quality Directive" are similar to the LCFS approach albeit with different GHG reduction targets, whereas Japanese efforts under the "Act on the Promotion of the Use of Nonfossil Energy Sources" are more in line with the RFS2 approach of volumetric blending requirements.
欧盟在"燃料质量指令"框架下的举措与LCFS的方案类似，但温室气体减排目标不同，而日本的"促进使用非化石能源法案"与RFS2相一致，提出了混合配比量化要求。
Significant differences exist between these international efforts in the treatment of emissions related to land use change (LUC) prompted by biofuels production.
各国对生物燃料生产引起的土地利用变更相关排放的处理上有着显著的区别。
In Europe, due to the evolving science and uncertainties associated with quantifying emissions from LUC, the Fuel Quality Directive does track but does not include emission from LUC in a fuel's GHG assessment.
在欧洲，由于科学的发展和土地利用变更导致的排放难以具体量化，燃料质量指令对一种燃料进行温室气体评估时仅追踪但并不包含土地利用变更导致的排放。
Corn ethanol must achieve a GHG reduction of 35% over gasoline (with an increasing threshold to 50% starting in 2018). However, biofuels must be certified for sustainable production based on an EU-approved certification protocol.
玉米乙醇必须达到相对汽油燃料减排温室气体35%（从2018年开始门槛进一步提高，达到50%）。然而，生物燃料还必须在欧盟批准的认证协议基础上被认定为可持续发展产品。
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Biofuels and Climate:
European Union Efforts
生物燃料和气候：
欧盟举措
During the 2010-2011 time frame many US-based ethanol plants exported ethanol to the EU which also required a third party certification (e.g by International Sustainability and Carbon Certification – ISCC or RSB) of the greenhouse gas reductions and additional sustainability criteria such as feedstock sourcing from non-deforested land.
在2010-2011的时间框架内，多家基于美国的乙醇生产者将乙醇出口到欧盟，欧盟要求具有温室气体减排和其他可持续性标准如从非滥砍滥伐地区采购原料等第三方认证（如国际可持续发展和碳认证—ISCC或RSB）。
23 plants in the US were ISCC certified. The certified plants span a wide range of technologies, owner entities, and geographic locations.
23家美国企业得到了ISCC认证。这些认证企业广泛分布于各技术领域、实体形式和地理位置。
Note that several other US-based plants would have possibly met the EU GHG reduction threshold but may have chosen not to participate in the export markets to Europe
要注意有些基于美国的厂家可能符合欧盟温室气体减排的门槛，但选择不进入向欧洲出口的市场。
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Biofuels and Climate: Asia Region
生物燃料和气候：亚洲地区

- Japan is increasing its biofuels blending volumes for gasoline over the next years.
  日本此后会逐年增加生物燃料在汽油中的混合比例。
- Imported ethanol and ETBE additives **must meet a 50% reduction threshold of biofuels over gasoline** set by the "Act on special accounts and the measures for the enhancement of the energy supply-demand structure."
  进口的乙醇和ETBE添加剂必须满足"能源供求结构改善措施和特别会计法"规定的生物燃料比汽油减排50%的门槛。
- Emissions from LUC are considered but only those associated with direct LUC have to be included in the life cycle modeling effort.
  土地利用变更的排放给予考量，但只有与直接的土地利用变更相关的排放才包括在全周期建模中。

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US Ethanol Volume Meeting 50% GHG Reduction
美国乙醇量产满足50%温室气体减排的要求

- We showcase the volume of US produced ethanol that, for example, can also meet the stringent 50% GHG reduction requirements set by Japan
  我们证明了美产乙醇的量产能够满足以日本为例严苛的50%温室气体减排的要求。
- The "Judgment Criteria for Oil Refiners on the Use of Non-Fossil Energy Sources (Ministry of Economy, Trade and Industry Public Notice No. 242 of 2010) regulations" detail the life cycle modeling (LCA) requirements including the ultimate **emissions reduction threshold for ethanol of 50%** (41 gCO2eq/MJ) compared with LCA-based GHG emissions from gasoline (81.7 gCO2eq/MJ)."
  "炼油厂使用非化石能源的判定标准"（经济、贸易和工业部2010年第242号公告）详细规定了全周期建模（LCA）的要求，包括乙醇比石油基于全周期模型的温室气体排放最终减少达50%的门槛。(41 gCO2eq/MJ)
- Many of the LCA guidelines from that document are closely in line with the European Union's Renewable Energy Directive (RED)
  该文件中多项全周期模型指导原则与欧盟的可再生能源指令（RED）相似性很高。
- For past exports of US ethanol to the EU the achieved greenhouse gas reductions were often assessed using the Argonne GREET life cycle model funded by the US Department of Energy.
  过去美国对欧盟出口的乙醇通常运用美国能源部资助的阿贡实验室GREET全周期模型对起温室气体减排效益进行评估。
- Therefore, GREET is used in this analysis
  因此，GREET被用于此分析。

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Employed Life Cycle Model
使用的全周期模型

Argonne GREET LIFE-CYCLE MODEL

- The Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation Model by Argonne National Laboratory (a US Department of Energy laboratory) is the gold standard for life cycle analysis in the US and it contains the most up to date databases on US production methods and the efficiency of the US agriculture and energy sectors.
  阿贡国家实验室（美国能源部实验室）创建的交通领域温室气体、排放控制和能源利用模型是美国全周期分析的金标准，包含了美国生产方法和美国农业和能源领域效益的最新数据库。
- GREET is a flexible LCA model that can be and has been adapted to fit regulation-specific guidelines including those set by the California Low Carbon Fuel Standard, the EPA RFS2 and the RED.
  GREET是有灵活性的全周期评估模型，能够适应有具体规定的指导方针，包括加利福尼亚低碳燃料标准，EPA RFS2和RED。
- In light of the Japanese alignment with the RED we assumed that GREET based modeling would be accepted by Japanese regulators.
  考虑到日本相关法规与RED的一致性，我们推定基于GREET的模型也会被日本监管机构所接受。
- As with modifications for LCFS, RFS2, and RED type pathway modeling GREET can be adjusted to fit the Japanese "Judgement Criteria."
  而通过对LCFS、RFS2和RED类型的路径模型的调整，GREET经过调整亦可适应日本的“判定标准”。

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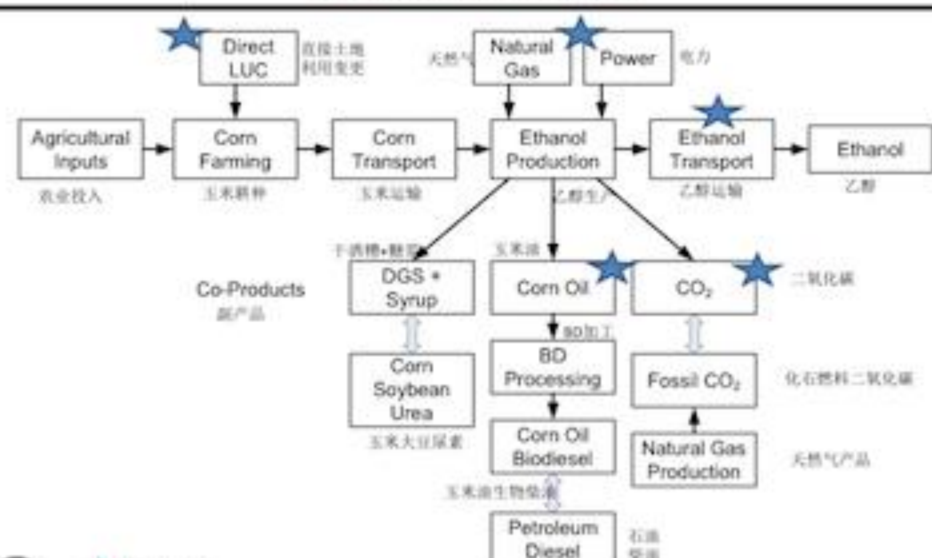
Introduction to Life Cycle Modeling: System Boundary for Selected Corn Ethanol Pathway
全周期模型介绍：部分玉米乙醇路径系统边界



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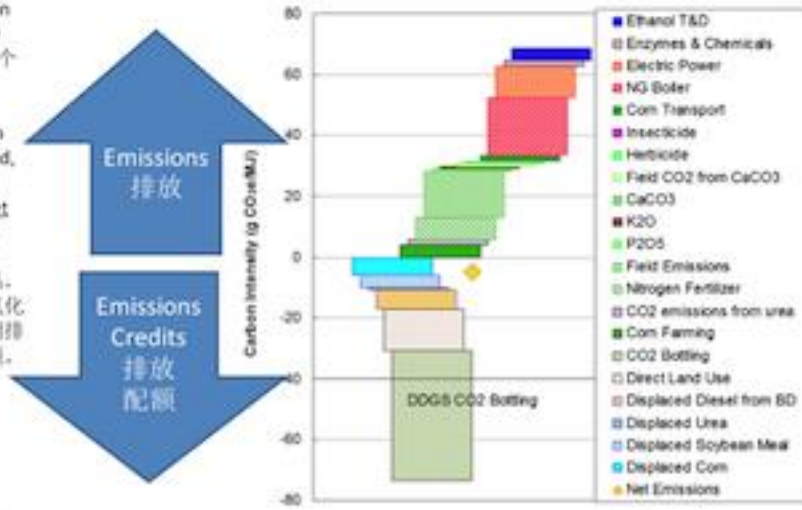
Illustrative Example:
GREET LCA Emission Steps and Life Cycle Stages
图示：GREET LCA排放步骤和全周期阶段

GREET has detailed emission profiles for each production input along a fuel pathway
GREET详述了燃料路径每个生产输入环节的排放量

Products co-produced with ethanol such as animal feed, beverage CO_2, soil carbon sequestration provide a net emissions credit to the life cycle emissions
乙醇生产过程中的副产品，如动物饲料、饮料用二氧化碳、土壤碳固定在全周期排放量中提供了净排放配额。



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Leading-Edge US Ethanol Plant Technologies that Provide CO_2 Reductions
美国乙醇生产商用前沿技术实现了二氧化碳减排

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Qualifying Technologies that Provide CO_2 Reductions
实现二氧化碳减排的合格技术

- Corn Oil Separation at Ethanol Plant going into Biodiesel Production
  乙醇厂家对玉米油脂进行分离，投入生物柴油生产
- Enogen and Energy Efficiency Improvements
  伊诺根品种和能源效率的提高
- CO_2 Recovery for Food Industry or Enhanced Oil Recovery
  二氧化碳回收用于食品业或提高油脂提取率
- Wet DDG 湿酒糟
- Anaerobic Digesters 厌氧消化器
- Direct Land Use Change 直接土地利用变更

Technologies will be detailed in the following slides
下面的幻灯片将进行技术方面的详述

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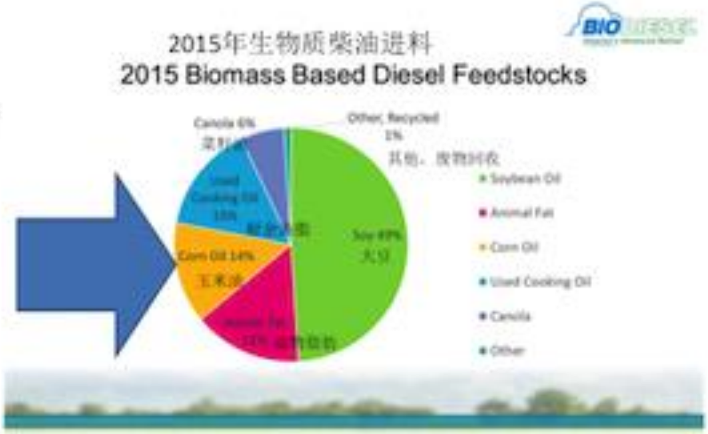
Corn Oil to Biodiesel
玉米油到生物柴油

- Corn oil separated at ethanol plants provides feedstock for biodiesel production
  乙醇厂家对玉米油进行分离，成为生物柴油进料
- Two Uses:
  两种用途：
  - Sale into Animal Feed Markets
    销往动物饲料市场
  - Substitution for petroleum based diesel fuel
    成为石油基柴油的替代物



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Enogen伊诺根品种

- Syngenta's Enogen product has directly incorporated enzymes into its corn traits.
  先正达公司的伊诺根产品直接将酶添加到玉米性状中。
- The technology is now used by 18 plants producing 1.3 billion gallon of corn ethanol (EPM 12/2015).
  此项技术如今在18家厂家应用，生产了13亿加仑玉米乙醇。（EPM 12/2015）。
- According to Syngenta Enogen raises ethanol yield per bushel by up to 3%, reduces electricity use up to 3%, and lowers natural gas use up to 10%.
  根据先正达公司的说法，伊诺根将每蒲式耳玉米的乙醇产量提高了3%，节省了3%的电力，减少天然气使用达10%。
- Example: Western Plains Energy
  实例：西部平原能源公司

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CO_2 Recovery at Ethanol Plants for Food Industry Use and Enhanced Oil Recovery
乙醇生产厂二氧化碳回收用于食品产业和油采收率提升

- About 40 percent of the North American merchant market for CO_2 is sourced from ethanol plants.
  北美商品二氧化碳市场约40%的份额从乙醇生产厂采购。
- Each bushel of corn produces 17 lbs of CO_2 during fermentation
  每蒲式耳玉米在发酵过程中产出17磅二氧化碳。
- Ethanol plants produce CO_2 for both:
  乙醇生产厂出产的二氧化碳用于以下目的：
  - Food/Beverage Industry as well as for
    食品/饮料产业以及
  - Enhanced Oil Recovery
    油采收率提升
- If not recovered as a by-product CO_2 must be produced in conventional CO_2 and Dry Ice Production Plants:
  如果没有作为副产品回收，二氧化碳必需在传统二氧化碳和干冰厂家生产：
  - Fuel source: low Sulphur content diesel, kerosene or natural gas.
    燃料来源：低硫柴油，煤油和天然气。

Conventional CO2 plant fired by fossil fuels
传统二氧化碳工厂用化石燃料作为动力

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Wet DDG and Anaerobic Digesters
湿酒糟和厌氧分解

Wet DDG 湿酒糟

- Nebraska Plants collocated with feed lots
  内布拉斯加工厂和饲养场设在一处
- Skip the drying step of Distillers Dried Grains and ship feed wet to feedlots
  省略了干酒糟的干燥步骤直接将湿酒糟运送到饲养场
- Significant energy savings
  大幅节省了能源

Anaerobic Digesters 厌氧分解

- Anaerobic digestion of syrup, DGS, and manure
  用于糖浆、干酒糟和肥料的厌氧分解
- Digester produces biogas for energy production offsetting onsite energy use
  分解池出产能源产品沼气，抵消了现场能源消耗
- Example: Western Plains Energy LLC in Kansas (also uses Enogen)
  实例：堪萨斯西部平原能源有限公司（也使用伊诺根品种）

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Direct Land Use Change
直接土地利用变更

- Direct land use change to high corn on corn rotations around plants provide annual carbon sequestration
  直接土地利用变更是在工厂周边进行高效玉米连种从而每年进行碳固化
- Derive state-specific carbon sequestration factors based on the GREET CCLUB database
  基于GREET CCLUB数据库提取特定州的碳固化因子
- Soil carbon changes for mixed cropland going into corn on corn rotations under convectional tillage; 100 cm soil depth; CCLUB Version 2015; C-Database Tab Column "CH")
  在传统耕作方式下混合农田进行玉米连种引起的土壤碳变化；100cm土壤深度；CCLUB2015版；C-数据库“CH”列选项）
- Recommendation: Credit under Japanese Direct Land Use Provisions could be applied if transitions to high corn on corn transitions around the plant are verified
  建议：如工厂周边土地向高效玉米连种农田的转换经过验证，则适用于日本直接土地利用变更条例项下的配额。

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Transport from United States
美国对外运输

Rail Shipment of Ethanol to US Port (1750 miles) followed by Vessel to Korea
乙醇通过铁路运往美国港口（1750英里），然后船运到韩国

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Model Inputs and Results
模型输入和结果

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Technology Combinations
技术组合

- Base Case: Corn Ethanol Dry Mill 基础案例：玉米乙醇干磨加工
  - Dry DGS production 干酒糟生产
  - Corn oil extracted for biodiesel and biodiesel displaces diesel
    提取玉米油用于生物柴油,生物柴油替代柴油
- Wet DGS with Efficiency Improvements 效率提升的湿酒糟
  - Corn Ethanol Dry Mill with Primary wet DGS production, Located near cattle feeding (Nebraska)
    湿酒糟的主要出产者玉米乙醇干磨厂，位于牛饲养场附近（内布拉斯加州）
  - Corn oil extracted for biodiesel (1 lb/bu corn) and Biodiesel displaces diesel
    用于生物柴油的玉米油（每蒲式耳玉米出产一磅）和生物柴油替代柴油
  - Enogen and efficiency improvements (+3% yield, -10% NG, -3% power)
    伊诺根和效率提升（单产+3%，天然气-10%，电力-3%）
- Corn Ethanol Dry Mill with CO_2 collected for dry ice and beverage
  在玉米乙醇干磨厂，收集二氧化碳用于干冰和饮料生产
- Wet DGS with Enhanced Oil Recovery 湿酒糟和油脂回收效率提升
  - Corn Ethanol Dry Mill with Primary wet DGS production 湿酒糟的主要出产者玉米乙醇干磨厂
  - Located near oil production (Kansas) 位于产油厂家附近（堪萨斯）
  - Corn oil extracted for biodiesel and Biodiesel displaces diesel提取玉米油用于生物柴油或生物柴油替代柴油
- Wet DGS with Anaerobic Digestion 湿酒糟和厌氧消化池
  - Corn Ethanol Dry Mill with Primary wet DGS production 玉米乙醇干磨厂
  - Located near cattle feeding (Nebraska) 位于养牛场附近 （内布拉斯加）
  - Corn oil extracted for biodiesel and Biodiesel displaces diesel提取玉米油用于生物柴油或生物柴油替代柴油
  - Anaerobic digestion of syrup, DGS, and manure 使用糖浆、酒糟和肥料的厌氧消化池

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Energy Inputs (SI Units)
能源输入（SI 单位）

Case Name 案例名称		Base Case 基础案例	High Efficiency Case 高效能案例	CO_2 Bottling Case 二氧化碳罐装案例	CO_2 EOR Case 二氧化碳气驱强化采油案例	Digester Case 消化池案例
Scenario 场景		Dry DGS 干酒糟	Wet DGS 湿酒糟	Mixed DGS 混合酒糟	Wet DGS 湿酒糟	Less DGS 酒糟较少
		Corn Oil BD 玉米油生物柴油	Corn Oil BD 玉米油生物柴油	Corn Oil BD 玉米油生物柴油	Corn Oil BD 玉米油生物柴油	Corn Oil BD 玉米油生物柴油
			Enogen 伊诺根	CO_2 Bottle 二氧化碳灌装	CO_2 EOR 二氧化碳气驱强化采油	Anaerobic 厌氧
			Membrane薄膜			Digester消化池
Natural Gas 天然气	MJ/L	6.83	4.55	5.85	4.55	0.84
Electric Power 电力	kWh/L	0.20	0.15	0.36	0.53	0.26
DGS 酒糟	kg/L	0.65	0.58	0.60	0.60	0.30
Corn Oil BD 玉米油生物柴油	kg/L	0.34	0.36	0.34	0.34	0.34
CO_2 二氧化碳	kg/L	0	0	-0.61	-0.61	0
Yield 单产	L/kg	0.029	0.031	0.029	0.029	0.029

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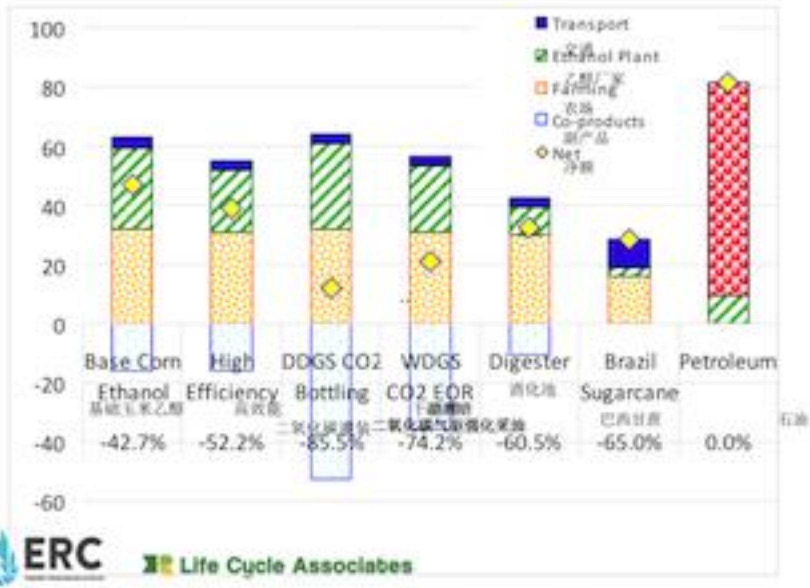
81.7 g/MJ Petroleum Basecase
Without Land Use Credit
81.7 g/MJ石油基础案例
无土地利用配额



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81.7 g/MJ Petroleum Basecase
***With* Land Use Credit**
81.7 g/MJ石油基础案例
有土地利用配额

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Total Ethanol Volume that Meets Japanese Criteria
符合日本标准的乙醇总量

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Ethanol Production in the US
美国乙醇产量

Renewable Fuels Association: Ethanol Biorefinery Locations
可再生能源协会：乙醇生物炼厂分布
http://www.ethanolrfa.org/resources/biorefinery-locations/

Simple Average of Plant Capacity: 74 million gallons per year
*Excludes multiple feedstock plants
工厂产能的简单平均数：每年7400万加仑
*不包括使用多种原料的工厂

State	Sum of PRODUCTION (MGY) 产量总额	Number of Plants
IA	3937	42
NE	2081	26
MN	1169	21
IL	1597	15
SD	1032	15
IN	1163	14
KS	447	11
WI	537	9
OH	528	7
MO	256	6
MI	273	5
ND	465	5
CA	215	4
TX	390	4
CO	122	3
NY	169	2
OR	40	2
TN	225	2
AZ	50	1
GA	120	1
ID	60	1
KY	33	1
MS	54	1
NC	0	1
NM	0	1
PA	110	1
VA	0	1
WY	10	1
Grand Total 共计	15083	201

Renewable Fuels Association Data (reanalyzed)

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Volume that Meets Japanese GHG Reduction Criteria
符合日本温室气体减排标准的总量

			Plants Meeting 50% GHG Reduction With Direct Land Use Credit	Plants Meeting 50% GHG Reduction Without Direct Land Use Credit
Base Plant: Dry DGS 基本工厂：干酒糟	Corn Oil to Biodiesel 玉米油到生物柴油		符合50%温室气体减排并具有直接土地利用配额的工厂 30	符合50%温室气体减排并不具有直接土地利用配额的工厂 0
湿酒糟 Wet DGS	Corn Oil to Biodiesel 玉米油到生物柴油	Enogen / Efficiency Improvements 伊诺粗/效益提升	10	10
混合酒糟 Mixed DGS	Corn Oil to Biodiesel 玉米油到生物柴油	二氧化碳食品市场 CO_2 Food Markets	35	35
湿酒糟 Wet DGS	Corn Oil to Biodiesel 玉米油到生物柴油	二氧化碳气驱强化采油 CO_2 EOR	5	5
酒糟较少 Less DGS	Corn Oil to Biodiesel 玉米油到生物柴油	Anaerobic Digester 厌氧消化池	2	2
		Total # of Plants 工厂总数	**82**	**52**
		Volume (gallons) 产量（加仑）	**6,068,000,000**	**3,848,000,000**

+22.8 Billion Liters

+14.4 Billion Liters

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Sustainability
可持续性

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New Software for Sustainability Assessment: Global Risk Assessment Services Tool (GRAS) for United States Domestic LUC Analysis
可持续性评估的新软件：用于美国国内土地利用变更的全球风险评估服务工具(GRAS)

- Feedstocks are not grown on deforested lands; Verify use of large, mature crop areas
  原料并非来自滥砍滥伐地区。确认利用大面积的成熟的农耕土地
- Applicable for US corn/soy feedstocks 适用于美国玉米／大豆原料
- Use of NAIP Imagery (1-2 m resolution) 利用NAIP图像（1-2 m分辨率）
- Side by side viewer of pre 2008 and current image for direct comparison
  2008年之前和当前图像逐张对比
- Overlay protected areas, carbon masks, LUC risk masks
  覆盖了保护地区。碳掩护和土地利用变更风险掩护地区。

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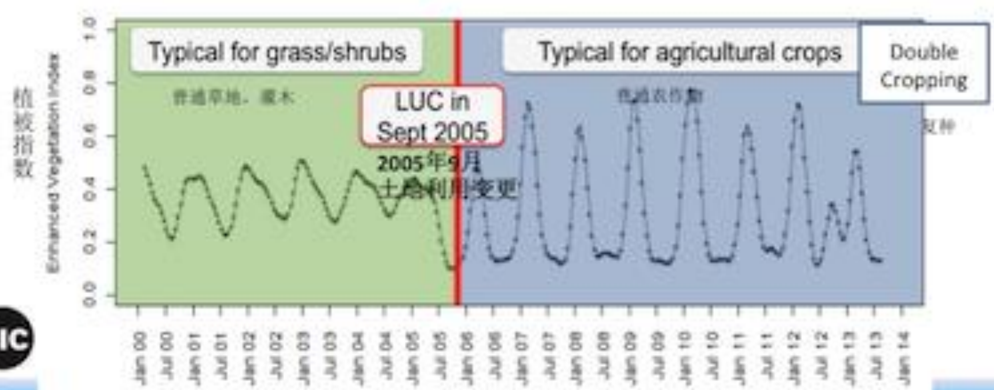
New Software: GRAS Tool for Global Land Use Analysis – Ensure Biofuels Feedstocks Do not come from Deforested Lands
新软件：全球土地利用分析GRAS工具-确保生物燃料原料来自非乱砍乱伐地区

- Particularly applicable for South American Feedstocks (sugarcane, corn soy) and S/E Asia (Palm, etc.)
  尤其适用于南美原料（甘蔗，玉米，大豆）和东南亚（棕榈树等）
- Use of MODIS Enhanced Vegetation Index (300 images) going back to 2000
  利用MODIS植被指数（300张图片），回溯到2000年。
- Differentiate among the types of green cover, see the history of the land, assess double cropping and detect LUC.
  区分出植被的各种类型，了解土地历史，评估复种，发现土地利用变更。
- Grassland has EVI value of 0.3-0.4. The same would apply for perennial trees such as rain forests but on a higher EVI value of about 0.6. Conversion would appear as a clear change in those with a drop of EVI to a value below 0.2.
  草地的植被指数值为0.3-0.4。同样适用于多年生树木如雨林，但植被指数值较高，约为0.6。如数值变化较明显，植被指数降至0.2以下，将会显示为转换。



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Summary小结

- Significant volumes of US produced corn ethanol can meet diverse international sustainability standards
  美国出产的玉米乙醇中很可观的一部分能够达到各种国际可持续发展标准。
- However, detailed pathway analysis is required and thorough understanding of international sustainability modeling approaches
  然而，仍需详尽的路径分析和更深入理解国际可持续发展模型方法
- New remote sensing tools are now available to verify and confirm land use and agricultural production practices
  现在已有可用的新的远程监测工具，用以验证和确认土地利用和农业生产实践。

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Appendix 附件
Modeling Inputs in SI Units
SI单元的模型输入

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Energy Inputs (in US Units)
能源输入（美国单位）

Case Name 案例名称		Base Case 基础案例	High Efficiency Case 高效能案例	CO_2 Bottling Case 二氧化碳灌装案例	CO_2 EOR Case 二氧化碳驱强化采油案例	Digester Case 消化池案例
Scenario场景		Dry DGS 干酒糟	Wet DGS 湿酒糟	Mixed DGS 混合酒糟	Wet DGS 湿酒糟	Less DGS 酒糟较少
		Corn Oil BD 玉米油生物柴油	Corn Oil BD 玉米油生物柴油	Corn Oil BD 玉米油生物柴油	Corn Oil BD 玉米油生物柴油	Corn Oil BD 玉米油生物柴油
			Enogen 伊诺根	CO_2 Bottle 二氧化碳灌装	CO_2 EOR 二氧化碳气驱强化采油	Anaerobic 厌氧
			Membrane 薄膜			Digester 消化池
Natural Gas 天然气	Btu/gal	24,500	16,328	21,000	16,328	3,000
Electric Power 电力	kWh/gal	0.742	0.6	1.35	2	1
DGS 酒糟	lb/gal	4.98	4.76	4.98	4.98	2.49
Corn Oil BD 玉米油生物柴油	lb/bu	1.0	1.0	1.0	1.0	1.0
CO_2 二氧化碳	kg/gal	0	0	-2.3	-2.3	0
Yield 单产		2.8	3	2.8	2.8	2.8

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Appendix B: 附件B：
Selected Team Publications
部分团队出版物

32

University of Illinois at Chicago Selected publications
芝加哥的伊利诺伊大学部分出版物

- Qin, Z., Dunn, J. B., Kwon, H., Mueller, S. and Wander, M. M. (2016), Influence of spatially-dependent, modeled soil carbon emission factors on life-cycle greenhouse gas emissions of corn and cellulosic ethanol. GCB Bioenergy. Accepted Author Manuscript. doi:10.1111/gcbb.12333
- Qin, Z., Dunn, J. B., Kwon, H., Mueller, S. and Wander, M. M. (2015), Soil carbon sequestration and land use change associated with biofuel production: empirical evidence. GCB Bioenergy. doi: 10.1111/gcbb.12237
- Elliott, J., Sharma, B., Best N., Glotter., M., Dunn, J., Foster, I., Miguez, F., Mueller, S., Wang, M., A Spatial Modeling Framework to Evaluate Domestic Biofuel-Induced Potential Land Use Changes and Emissions, Environ. Sci. Technol., 2014, 48 (4), pp 2488–2496 DOI: 10.1021/es404546r
- J. B. Dunn, S. Mueller, H. Kwon Land-use change and greenhouse gas emissions from corn and cellulosic, M. Wander, M. Wang. Carbon Calculator for Land Use Change from Biofuels Production (CCLUB) Manual, ANL/ESD/12-5, Rev. 2, May 2014.
- Ho-Young Kwon, Steffen Mueller, Jennifer B. Dunn, Michelle M. Wander; Modeling state-level soil carbon emission factors under various scenarios for direct land use change associated with United States biofuel feedstock production; Biomass and Bioenergy (2013), http://dx.doi.org/10.1016/j.biombioe.2013.02.021
- Jennifer B Dunn, Steffen Mueller, Ho-young Kwon and Michael Q Wang; Land-use change and greenhouse gas emissions from corn and cellulosic ethanol; Biotechnology for Biofuels 2013, 6:51 doi:10.1186/1754-6834-6-51; Published: 10 April 2013
- Dunn, Jennifer and Steffen Mueller, Michael Wang, Jeongwoo Han. Energy consumption and greenhouse gas emissions from enzyme and yeast manufacture for corn and cellulosic ethanol production; Biotechnol Lett DOI 10.1007/s10529-012-1057-6, October 2012.
- Mueller, S. 2008 National dry mill corn ethanol survey; Biotechnol Lett DOI 10.1007/s10529-010-0296-7, May 15, 2010.
- Mueller, S. Research investigation for the potential use of combined heat and power at natural gas and coal fired ethanol plants; US Department of Energy; 2006.

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Life Cycle Associates: Selected Publications
全周期伙伴：部分出版物

Forman, G.S. and S. Unnasch (2015) Integration of Non-Fuel Coproducts into the GREET Model. Environ. Sci. Technol. DOI: 10.1021/es505994w.

Unnasch, S., T. Darlington, J. Dumortier, W. Tyner, J. Pont and A. Broch (2014) CRC Report No. E-88-3. Study of Transportation Fuel Life Cycle Analysis: Review of Economic Models Used to Assess Land Use Effects. Prepared for Coordinating Research Council Project E-88-3.

Boland, S. and S. Unnasch (2014) Carbon Intensity of Marginal Petroleum and Corn Ethanol Fuels. Life Cycle Associates Report LCA.6075.83.2014, prepared for Renewable Fuels Association.

Unnasch, S. et al. (2013) Review of Fuel Programs, Sustainability

Keesom, W. H., J. Blieszner, and S. Unnasch (2012) EU Pathway Study: Life Cycle Assessment of Crude Oils in a European Context. Prepared by Jacobs Engineering and Life Cycle Associates for Alberta Petroleum Marketing Commission (APMC).

Unnasch, S. et al. (2011) CRC Report No. E-88. Review of Transportation Fuel Life Cycle Analysis. Prepared for Coordinating Research Council Project E-88.

McCormick, J. and S. Unnasch (2011) Inventory of Fugitive Emissions from LPG Transfers in California. Life Cycle Associates Report LCA.8026.425.2011, prepared for Western Propane Gas Association.

Brandt, A.R. and S. Unnasch (2010) Energy Intensity and Greenhouse Gas Emissions from Thermal Enhanced Oil Recovery. Energy Fuels, 2010, 24(8), pp 4581–4589.

Unnasch, S. et al. (2009) Assessment of Life Cycle GHG Emissions Associated with Petroleum Fuels. Life Cycle Associates Report LCA-6004-3P, prepared for New Fuels Alliance.

Unnasch, S. (1990) Greenhouse Gas Emissions from Corn-Based Ethanol Production and Vehicle Use. Prepared for National Corn Growers Association.

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Contacts联系方式

Steffen Mueller, PhD
Principal Economist
Energy Resources Center
The University of Illinois at Chicago
1309 South Halsted Street
Chicago, IL 60607
(312) 316-3498
muellers@uic.edu

Stefan Unnasch
Life Cycle Associates, LLC
office: 1.650.461.9048
mobile: 1.650.380.9504
facsimile: 1.484.313.9504
unnasch@LifeCycleAssociates.com

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SUSTAINABLE
ENERGY FOR ALL

Sustainable Ethanol Fuel for Rural Development and a Low Carbon Future
有利于农村发展和低碳未来的可持续乙醇燃料

U.S. Grains Council
October, 2016
美国谷物协会
2016年10

Gerard J. Ostheimer, Ph.D. 杰拉德·J ·奥斯特米尔博士
Global Lead 全球领导力
Sustainable Bioenergy High-Impact Opportunity
可持续生物能源高影响力机遇
Sustainable Energy For All
人人享有可持续能源

NARRATIVE 简述

- Biofuels are necessary to de-carbonize the transportation
  生物燃料对于交通减碳十分重要
- The misunderstanding regarding the relationship between Biofuels and Food Security is a barrier to increased use
  对生物燃料和粮食安全之间关系的误解是影响推广的障碍
- New policy tools create the opportunity to accelerate biofuel deployment
  新的政策工具为加速发展生物燃料创造了机会
- International Agencies are now working to up-scale Sustainable Biofuel Production and Use
  各国际机构都在致力于扩大可持续生物燃料生产和使用的规模

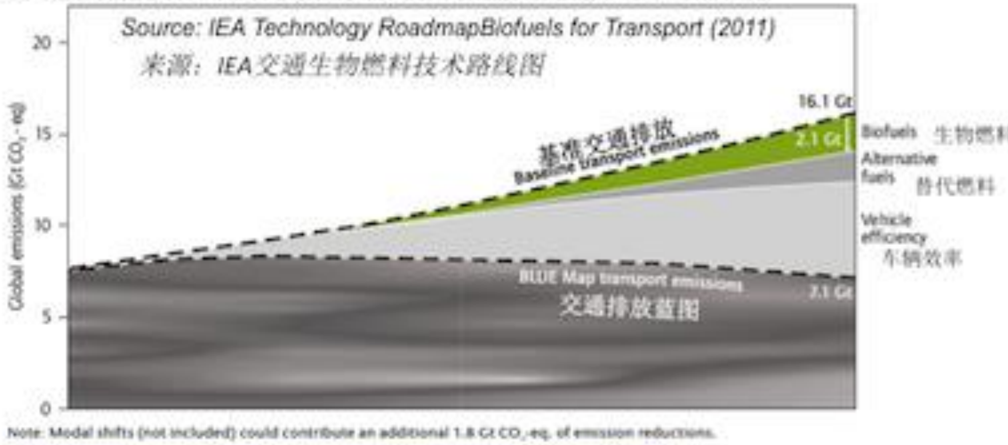
Low carbon fuels are essential to achieving our environmental, social and economic goals

低碳燃料对于实现环境、社会和经济目标至关重要


International Energy Agency: 国际能源组织：

To limit warming below 2° C Sustainable Biofuels are needed to reduce emissions from the Transport Sector

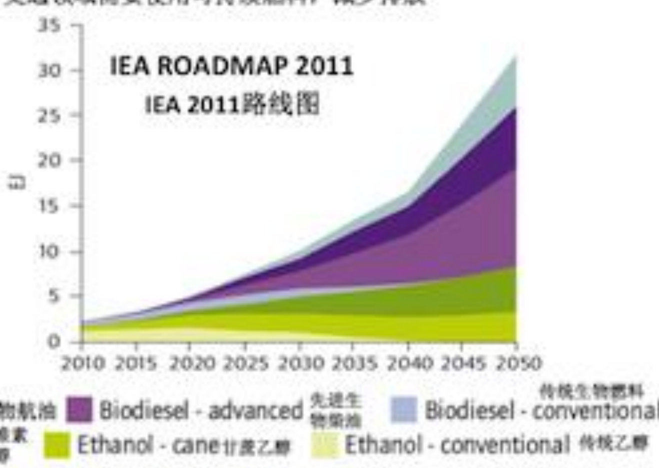
要将气候变暖幅度控制在2°C以内，交通领域需要使用可持续燃料，减少排放



- Efficiency improvements are essential to reduce transport emissions
  提高效率对减少交通排放至关重要。
- Biofuels can reduce global transport emissions by 2.1 Gt CO_2-eq. in 2050
  生物燃料到2050年能使全球交通排放减少相当于2.1 Gt二氧化碳。
- To achieve these reductions, all biofuels must provide considerable life-cycle GHG emission reductions
  要实现减排目标，所有生物燃料都必需能够全周期减少温室气体排放。

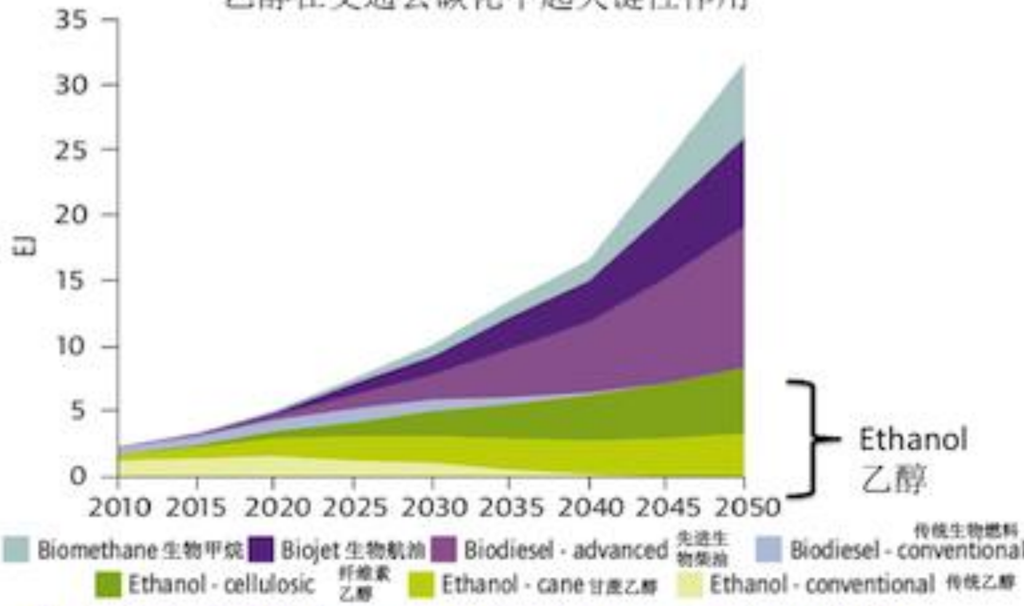
To remain below 2° C of warming, Sustainable Biofuels are needed to reduce GHG emissions from the Transport Sector

要将气候变暖幅度控制在2°C以内，交通领域需要使用可持续燃料，减少排放



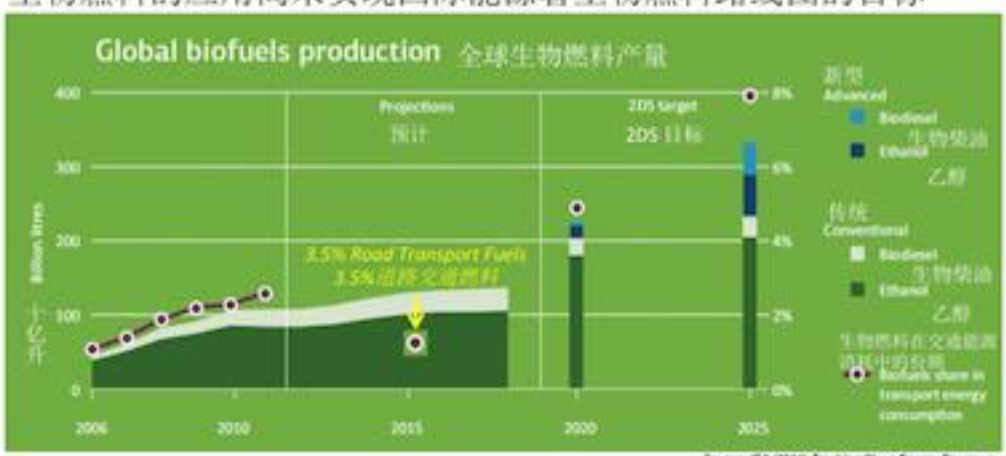
- Global biofuel supply grows from 2.5 EJ today to 32 EJ in 2050
  2050年全球生物燃料的供应从现在的2.5 EJ增长到32 EJ。
- Biofuels share in total transport fuel increases from 2% today, to 27% in 2050
  2050年生物燃料在整个交通燃料中的份额从现在的2%增长到27%
- In the longer-term, diesel/kerosene-type biofuels are particularly important to decarbonise heavy transport modes
  长远来看，柴油/煤油类生物燃料对于重型运输的去碳化尤为重要。
- Large-scale deployment of advanced biofuels vital to meet the roadmap targets
  大规模开发新一代生物燃料对于实现路线图目标起决定性作用。

Ethanol will plays an essential role in de-carbonizing transport
乙醇在交通去碳化中起关键性作用



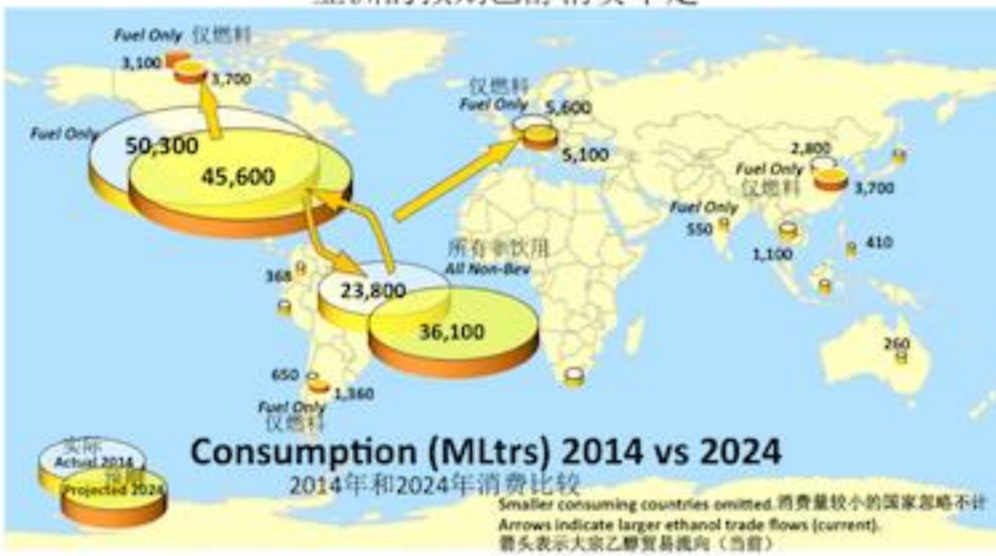
- Due to technological advances corn ethanol is becoming advanced with emissions reductions > 50% relative to gasoline
  得益于技术进步，玉米乙醇与汽油相比，减排超过50%，效果显著。

生物燃料的应用尚未实现国际能源署生物燃料路线图的目标



- Biofuels production affected by policy uncertainties in a number of key markets.
  生物燃料生产在多个主要市场中受到政策不确定性的影响。
- Without significant improvements of the policy framework for advanced biofuels, long-term targets (27% in 2050) will not be met.
  如果与先进生物燃料相关的政策框架没有显著改善，长远目标（2050年占比27%）很难实现。
- Need to create new biofuel markets.
  需要开发新的生物能源市场。

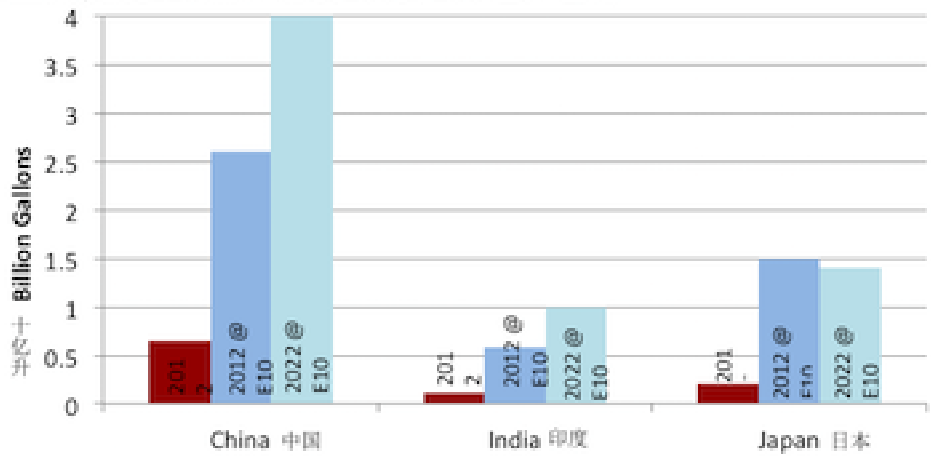
Projected Ethanol Use in Asia is Insufficient
亚洲的预期乙醇消费不足



Failure to use ethanol in Africa and Asia will be a missed opportunity to
非洲和亚洲未能利用乙醇使他们失去了如下机会

- De-carbonize the transportation sector; and 交通领域去碳化和
- Increase regional investment in Agriculture. 增加区域农业投入

E10 in Asia requires 20 - 25 Billion Liters of Ethanol
在亚洲发展E10燃料需要200到250亿升乙醇



Stable ethanol demand in Asia would stimulate investment in Agriculture in Asia; thereby, increasing yields and *increasing* food security.

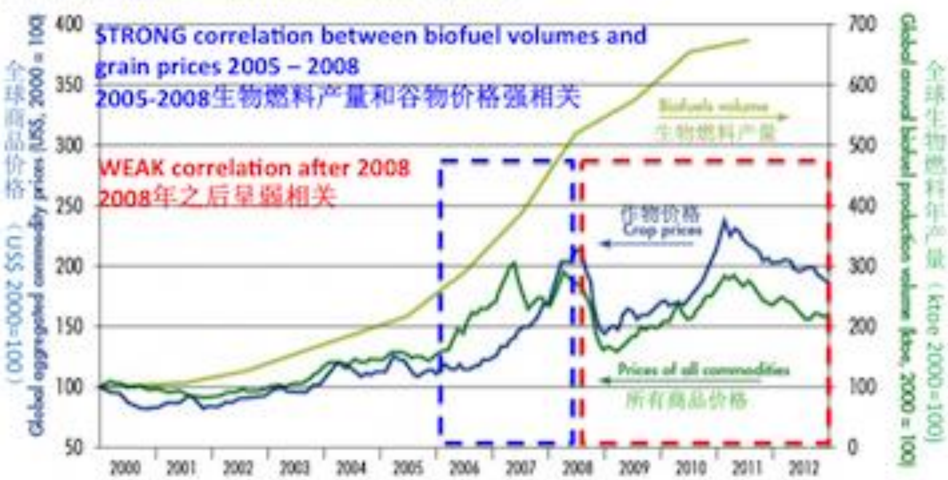
亚洲对乙醇的稳定需求将会刺激亚洲的农业投入，提高单产，提高粮食安全。

Barriers to Bioenergy Deployment
开展生物能源的障碍

- Lack of Awareness and Understanding of Bioenergy
  缺乏对生物能源的理解和相关意识
- Perception that Bioenergy is Unsustainable
  认为生物能源不可持续的观点
- Lack of Policy Stability
  政治稳定性较差
- Lack of Catalytic Finance
  缺乏催化金融
- Lack of Sustainable Supply Chains
  缺乏可持续的供应链
  - Poor yields, Bad roads, etc
    单产低，路况差，等等

Misunderstanding the "Food and Fuel" relationship
对"食品和燃料"关系的误解

- Commodity prices spiked in 2008, including food prices.
  2008年商品价格出现暴涨，包括粮食价格。
- Biofuels were blamed.
  生物燃料被指难辞其咎。
- Since 2008, biofuel production increased but grain prices fell.
  2008年以来，生物燃料产量上涨而谷物价格下跌。
- Despite contrary evidence "Food versus Fuel" story is still propagated.
- 尽管与事实证据相左，"粮食燃料相争"的故事仍然盛行。



Critics *assume* direct competition between Food and Ethanol that harms the Global Poor
批评者推定粮食和乙醇之间存在直接竞争关系，损害了世界贫困人口

For Ethanol to compete with Food
乙醇与粮食竞争的说法声称

1. The amount of food in the world must be limited; and
   全世界粮食的总量是有限的，而且
2. The global price of grain determines local food availability.
   全球谷物价格决定了当地的粮食可获得性。

Hunger is NOT caused by a Global lack of food
饥荒并不是全球粮食不足导致的

WFP
World Food Program

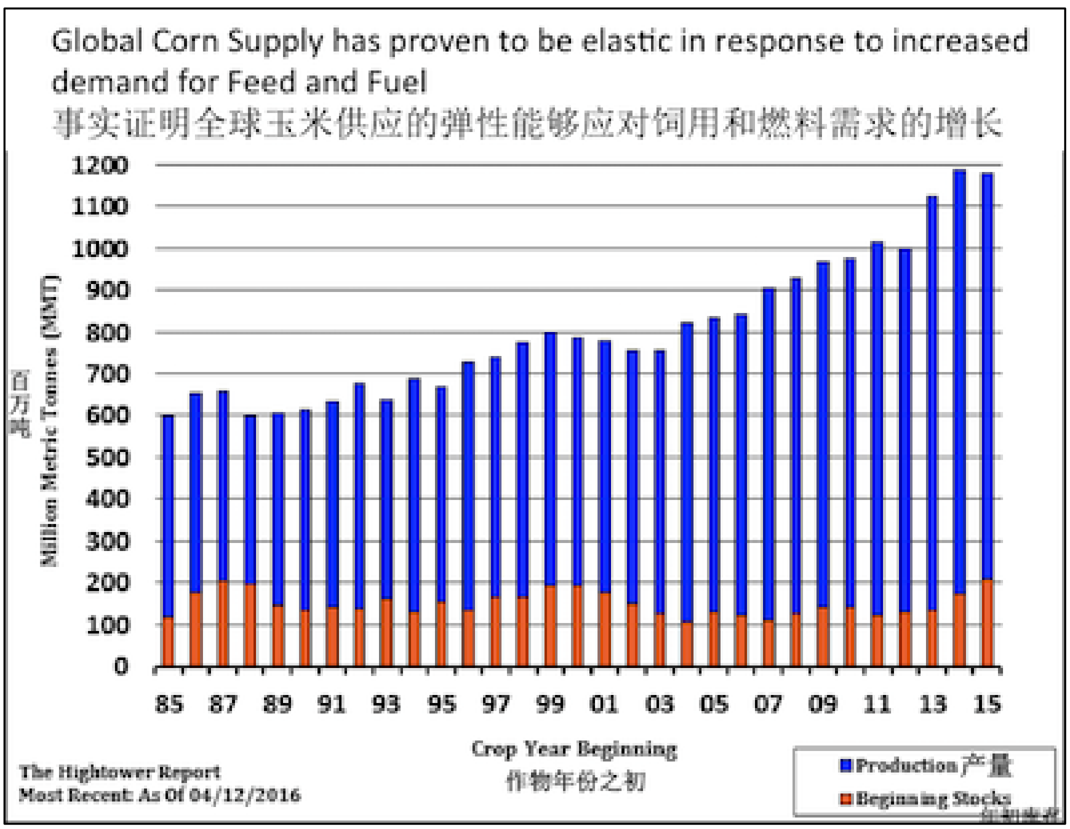
What causes Hunger?
是什么导致了饥荒？
www.wfp.org/hunger/causes

- The world produces enough to feed the entire global population of 7 billion people.
  全球的粮食产量足够满足世界上70亿人口所需。
- And yet, one person in eight on the planet is hungry.
  而在这个星球上，八个人中就有一个人在忍饥挨饿。

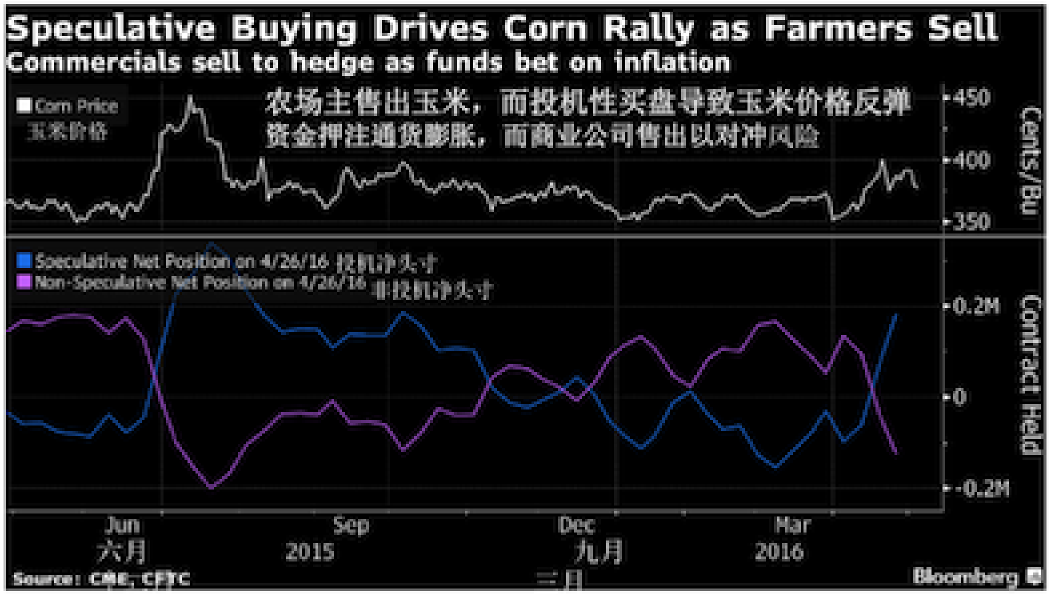
1. **POVERTY TRAP 贫穷困境**
2. **LACK OF INVESTMENT IN AGRICULTURE 农业投入不足**
3. CLIMATE AND WEATHER 气候条件和天气
4. WAR AND DISPLACEMENT 战争和流离失所
5. UNSTABLE MARKETS 市场动荡
6. FOOD WASTAGE 粮食浪费

Hunger is driven by local conditions.
饥荒是当地情势导致的


Corn is getting cheaper: 玉米的价格在走低：
Supply is meeting demand at the global level.
全球的供应均能满足需求。
Long-term price of maize in real terms 1908 – 2024
1908 – 2024玉米长期实际价格（美元/吨）
Real Maize Price
玉米实际价格
Long Term Trend
长期趋势
USD/t
1 200
1 000
800
600
400
200
0
Note: The US yellow #2 Gulf maize price is used as a benchmark for the coarse grain world market price. This price is recorded back to 1960 in World Bank datasets as monthly data. Monthly prices were converted to annual averages using the maize marketing year September-August. For the years 1908-59 the series is extended using the relative changes in "corn price received" from the USDA quickstats. Nominal prices are deflated using the consumer price as reported by the Federal Bank (www.minneapolisfed.org/community_education/teacher/calc/hist1800.cfm).
StatLink http://dx.doi.org/10.1787/888933228870

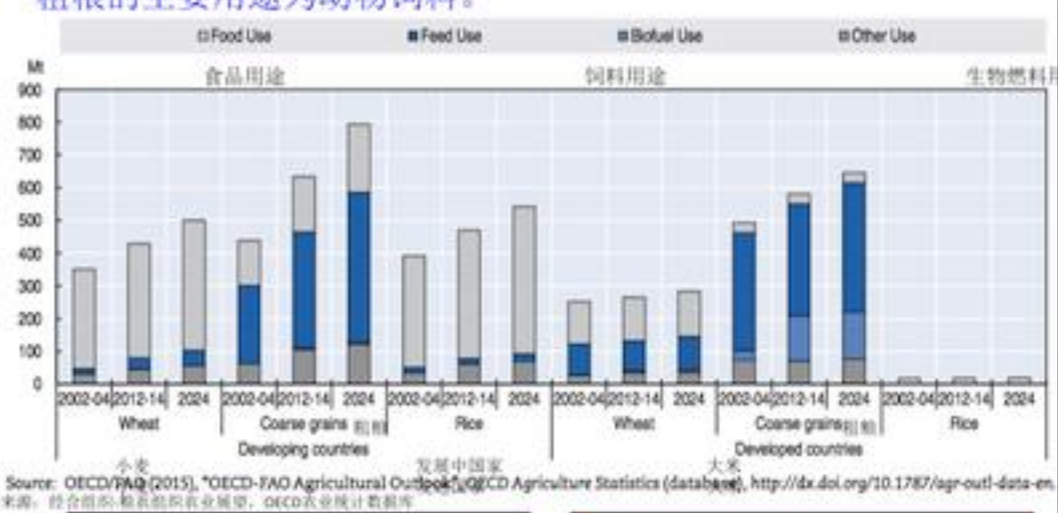

Global Corn Supply has proven to be elastic in response to increased demand for Feed and Fuel
事实证明全球玉米供应的弹性能够应对饲用和燃料需求的增长
Million Metric Tonnes (MMT)
百万吨
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
85
87
89
91
93
95
97
99
01
03
05
07
09
11
13
15
Crop Year Beginning
作物年份之初
The Hightower Report
Most Recent: As Of 04/12/2016
Production 产量
Beginning Stocks

In 2016 corn is selling between $3.50 and $4.00 a bushel, yet ethanol production is as high as ever.
2016年，玉米价格为每蒲式耳$3.50到$4.00，而乙醇产量与以往一样高。



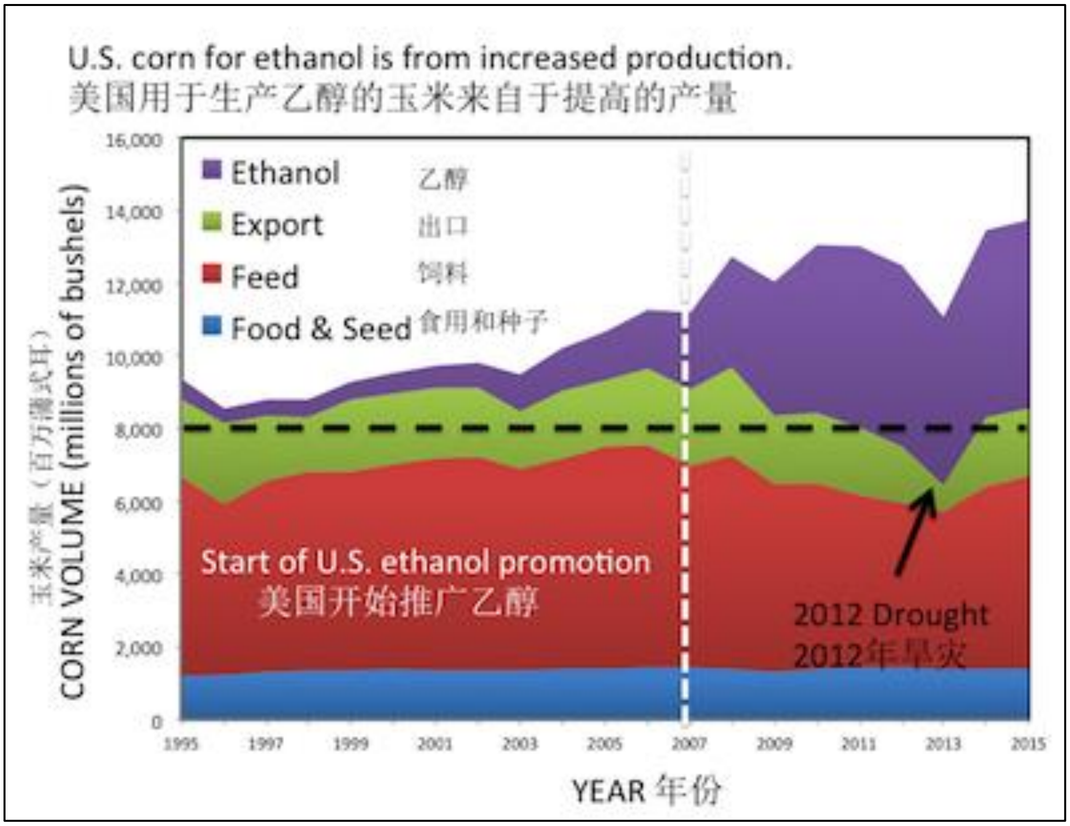
OECD-FAO Outlook: Main uses of cereals in developed and developing countries 2014 – 2024
经合组织-粮农组织展望：2014-2024年发达国家和发展中国家谷物的主要用途

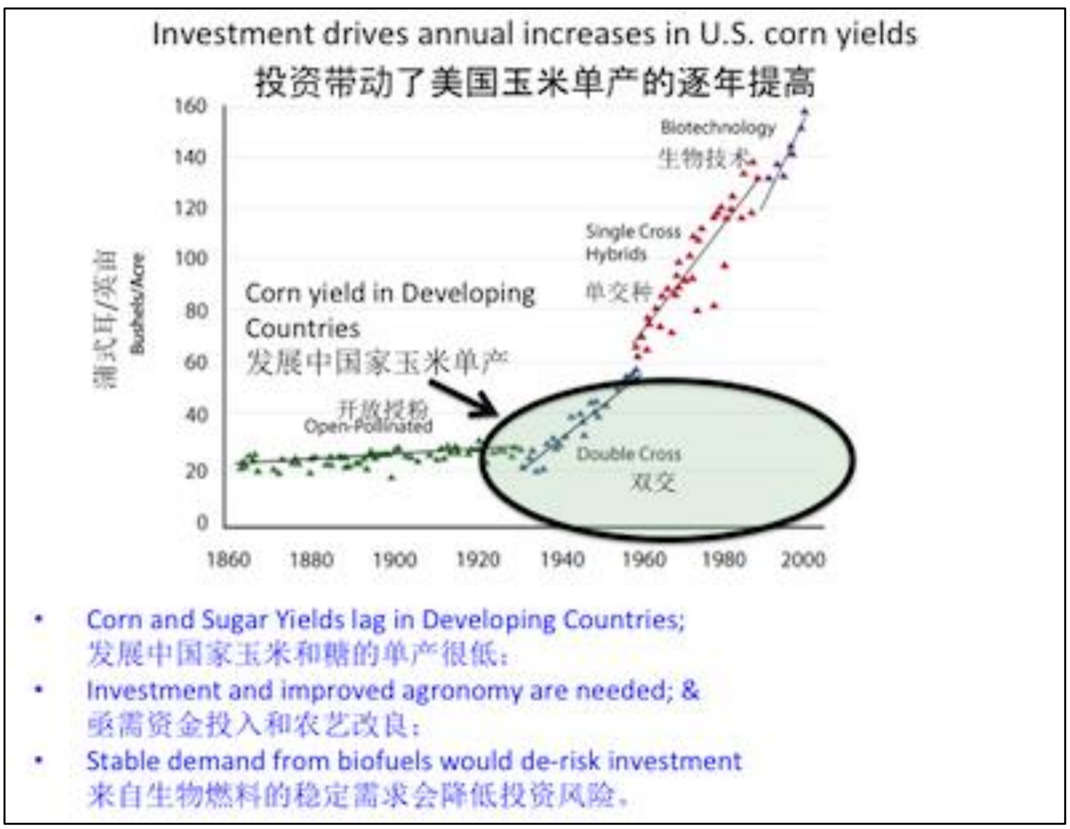
The dominant use of coarse grains is for animal feed.
粗粮的主要用途为动物饲料。



DEVELOPING 发展中国家

DEVELOPED发达国家


U.S. corn for ethanol is from increased production.
美国用于生产乙醇的玉米来自于提高的产量
Ethanol 乙醇
Export 出口
Feed 饲料
Food & Seed 食用和种子
CORN VOLUME (millions of bushels)
玉米产量（百万蒲式耳）
Start of U.S. ethanol promotion
美国开始推广乙醇
2012 Drought
2012年旱灾
YEAR 年份


Investment drives annual increases in U.S. corn yields
投资带动了美国玉米单产的逐年提高
蒲式耳/英亩
Bushels/Acre
Biotechnology
生物技术
Single Cross Hybrids
单交种
Corn yield in Developing Countries
发展中国家玉米单产
开放授粉
Open-Pollinated
Double Cross
双交
• Corn and Sugar Yields lag in Developing Countries;
发展中国家玉米和糖的单产很低；
• Investment and improved agronomy are needed; &
亟需资金投入和农艺改良；
• Stable demand from biofuels would de-risk investment
来自生物燃料的稳定需求会降低投资风险。

The real threat is that grain prices will drop and suppress investment in global agriculture.

真正的风险来自谷物价格下跌从而抑制全球农业投入

Extremely low food prices suppress market entry by developing country farmers forcing them to remain in the **POVERTY TRAP** of subsistence agriculture.
超低的粮食价格会抑制发展中国家农民进入市场的意愿，迫使他们陷入勉强维生的生计农业的**贫穷困境**

World Food Program

1. **POVERTY TRAP 贫穷困境**
2. **LACK OF INVESTMENT IN AGRICULTURE**
   农业投入不足
3. CLIMATE AND WEATHER
   气候条件和天气
4. WAR AND DISPLACEMENT
   战争和流离失所
5. UNSTABLE MARKETS
   市场动荡
6. FOOD WASTAGE 粮食浪费

Hunger is driven by local conditions.
饥荒是当地情势导致的

For Developing Countries to NOT produce ethanol is a lost opportunity to boost global agriculture.
对于发展中国家，不生产乙醇就丧失了一次振兴全球农业的机会

- Bioenergy can ***increase*** food security when investment and technology improve the overall agricultural productivity and food availability.
  当投资和技术改良提高了整体的农业生产率和粮食可获得性，生物能源能够提高粮食安全。
- While higher food prices can reduce food accessibility, bioenergy can ***increase rural family incomes*** and hence improve the ability to purchase food.
  粮食价格增高虽然会增加食物成本，但生物能源能够使农业家庭的收入提高，同时也提高他们购买食物的能力。
- New ***infrastructure*** built to support a developing bioenergy sector, can ***improve access to markets*** in various industry sectors, thereby increasing overall accessibility.
  为支持发展生物能源领域进行的新的基础设施建设会带动各工业领域的市场进入，因此会增加整体可达性。

Bioenergy & Sustainability: Bridging the Gaps
2015 Scientific Committee on Problems of the Environment (SCOPE)
生物能源和可持续性： 消除鸿沟
2015年环境问题科学委员会（SCOPE）

UN Food and Agriculture Organization studied the impact of bioenergy on food security

联合国粮农组织就生物能源对粮食安全的影响进行了多项研究

Result: Bioenergy is neither automatically good, nor automatically bad for food security - it depends on how it is produced.

结果： 生物能源对于粮食安全来说既非天赐福音亦非天降横祸，而取决于如何进行生产。

The Global Bioenergy Partnership promotes the sustainable production and use of bioenergy.

全球生物能源伙伴致力于生物能源的可持续生产和利用

GBEP Timeline: 全球生物能源伙伴时间表

2005 GBEP founded to promote **"the continued development and commercialisation of renewable energy … particularly in developing countries where biomass use is prevalent".**

2005 GBEP成立，致力于"可再生能源不断地发展和商品化，尤其在生物质的利用占绝对优势的发展中国家。"

2007 GBEP creates a ***Task Force on Sustainability*** to develop criteria and indicators of sustainable bioenergy development.

2007 GBEP成立了可持续发展任务组，开发可持续能源发展的标准和指标。

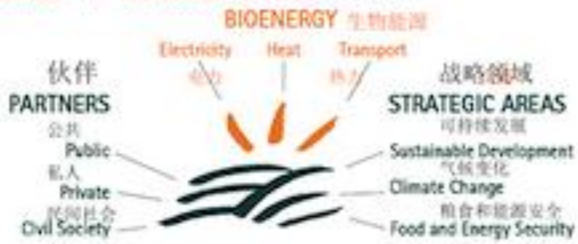
2011 GBEP releases Version 1 of its ***Methodological Framework for GHG Lifecycle Analysis of Bioenergy***

2011年GBEP发布了第一版*生物能源温室气体全周期的分析方法框架*

2012 GBEP publicly releases report on ***24 indicators of sustainable bioenergy production and use***

2012年GBEP公开发布了*可持续能源生产和利用的24项指标*的报告

GBEP
Global Bioenergy Partnership



GBEP developed 24 indicators of sustainable bioenergy production and use
GBEP开发了可持续能源生产和利用的24项指标

1. GBEP is the only initiative seeking to build consensus among a broad range of national governments and international institutions on the sustainability of bioenergy.
   GBEP是唯一一个最先寻求广泛地在各国政府和国际机构之间就生物能源的可持续性建立共识的组织。

2. The GBEP sustainability indicators do not feature directions, thresholds or limits and do not constitute a standard; nor are they legally binding on GBEP Partners.
   GBEP可持续性指标并不规定方向、阈值或限制，也不制定标准，亦对GBEP伙伴成员无法律约束性。

3. Measured over time, the indicators will show progress towards or away from a sustainable development path as determined nationally.
   经过时间验证，这些指标会显示出对各国所确定的可持续发展路径接近和偏离的动向。

GBEP indicators of sustainable production and use of bioenergy provide a framework and a toolkit.

GBEP生物能源可持续性生产和利用指标提供了框架和工具包

ENVIRONMENTAL 环境	SOCIAL 社会	ECONOMIC 经济
1. Life-cycle GHG emissions 全周期温室气体排放	9. Allocation of land 土地配置	17. Productivity 生产率
2. Soil quality 土壤质量	10. Price and supply of a national food basket 全国粮食一揽子价格和供应	18. Net energy balance 净能量平衡
3. Harvest levels of wood resources 森林资源的采伐水平	11. Change in income 收入变化	19. Gross value added 总增值
4. non-GHG air emissions 非温室气体空气排放	12. Jobs in the bioenergy sector 生物能源领域就业	20. Change in consumption of fossil fuels and traditional biomass 化石能源和传统生物量消费的变化
5. Water use and efficiency 水资源利用和效率	13. Unpaid time spent by women and children collecting biomass 妇女儿童无报酬采集生物量所花费时间	21. Training and re-qualification of the workforce 劳动力的培训和转产
6. Water quality 水体质量	14. Access to modern energy services 能否获得现代能源服务	22. Energy diversity 能源多样性
7. Biological diversity 生物多样性	15. Mortality and disease due to indoor smoke 室内吸烟导致的致死和致病数	23. Infrastructure and logistics for distribution of bioenergy 生物能源流通的基础设施和物流
8. Land use and land-use change 土地利用和土地利用变更情况	16. Occupational injury 职业性损伤	24. Capacity and flexibility of use of bioenergy 生物能源利用的容量和灵活性

SUSTAINABILITY SUPPORT TOOLS

可持续性支持工具

- After 2008 international agencies and groups did research and developed tools to support sustainable bioenergy production and use

  2008年国际组织和机构研发了支持可持续生物能源生产和利用的工具

Key messages on bioenergy from FAO's work
粮农组织工作关于生物能源的关键信息

- Tools are now available to help governments and operators reduce risks and enhance opportunities of bioenergy
  帮助政府和经营者在生物能源方面减少风险和增加机遇的工具已就绪。
- *Per se* biofuels are neither good nor bad. What matters is the way they are managed
  从本质上说，生物燃料是好是坏不能一概而论，重要的是管理的方法。
- Small-scale bioenergy is important for rural livelihoods and not very risky
  小规模生物能源对于农村生计很重要，且风险不大

Food and Agriculture Organization of the United Nations

www.fao.org/bioenergy

SE4All Sustainable Bioenergy Group
SE4All可持续生物能源集团

The SBG will promote
SBG将会致力于

- Knowledge enhancement and information sharing 加强知识和信息的分享
- Policy and sustainability support
  政策和可持续性支持
- Deployment support
  部署方面的支持

To drive the deployment of sustainable
推进可持续发展的部署

- Increased Agricultural Productivity
  提高农业生产力
- Energy from Municipal Solid Waste
  从城市固体废弃物中开发能源
- Aviation Biofuels
  航空生物燃料
- Low Carbon Fuels
  低碳燃料

RSB ROUNDTABLE ON SUSTAINABLE BIOFUELS

novozymes Rethink Tomorrow

Bloomberg NEW ENERGY FINANCE

KLM Royal Dutch Airlines

UNITED NATIONS FOUNDATION

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SUSTAINABLE
ENERGY FOR ALL
Leveraging International Institutions to Drive Deployment
借国际机构之力推进部署
IRENA
国际可再生能源署
World Bank
世界银行
Regional Development Banks
区域发展银行
Development Assistance
发展援助
Governments
各国政府
Energy Efficiency Hub 能源效率中心
SE4All GFT Headquarters (Vienna)
SE4All GFR总部（维也纳）
Access Hub 纽约办公室
SE4All GFT - New York Office
Knowledge Management Hub
知识管理中心
Latin America Hub
拉美中心
Africa Hub
Renewable Energy Hub
可再生能源中心
Capacity Building Hub
Asia Hub
亚洲中心
Legend
SE4All GFT Locations SE4All GFT地点
Proposed Regional and Thematic Hub Locations
计划区域或专项中心地点


SUSTAINABLE
ENERGY FOR ALL
PUBLIC SECTOR
公共领域
Governments Donors
政府捐助
Multilateral Organizations
多边组织
Development Banks
发展银行
PRIVATE SECTOR
私有领域
Multinationals – WBCSD
跨国机构·世界持续发展商业理事会
Local Entrepreneurs
当地企业家
Private Capital
私人资本
Sustainable Bioenergy Group connects the Private Sector to SE4All countries and Stakeholders
可持续生物能源将私有领域与SE4All国家和利益相关者连接到一起。

The Low Carbon Fuels LCTP is deploying technologies to mitigate emissions from the transport sector.

低碳燃料**LCTP**开发新技术以减少交通领域的排放

Large-scale deployment of sustainable biofuels will require joint effort between the businesses and governments.

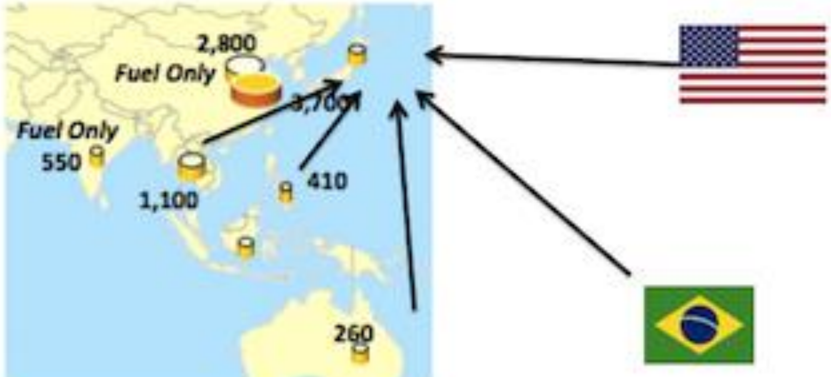
可持续生物能源的大规模部署需要企业和政府的通力合作

Public support for the transition to low carbon fuels should

公共部门支持向低碳燃料转型应该做到

- Increase market demand for low carbon fuels,
  增加低碳燃料的市场需求
- Promote investment and support for innovation and R&D,
  促成对创新和研发的投资和支持
- Provide clear standards for sustainability criteria based and reward emission reduction performance,
  对可持续性的概念制定明确的标准，奖励减排行动
- Provide policy stability, including carbon pricing systems, so as to boost investor confidence.
  保持政策稳定，包括碳定价系统，以提高投资者信心

Biofuels for Sustainable Development in Asia
亚洲可持续发展的生物燃料



Stable policy support for ethanol in Asia will
亚洲对乙醇的稳定政策支持将会

- De-risk regional trade in ethanol; and
  降低乙醇区域贸易的风险；并且
- Increase regional investment in Agriculture.
  增加对农业的区域投入。

U.S. and Brazilian ethanol can jumpstart use in the region.
美国和巴西的乙醇可在该区域的消费中抢跑。

SE4ALL Sustainable Bioenergy Group
SE4ALL 可持续生物能源组织

Gerard J. Ostheimer, Ph.D.
杰拉德·J ·奥斯特米尔博士
Global Lead and Secretariat
全球领导人和秘书长
GEOE@novozymes.com

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Congressional Research Service
美国国会研究局报告

汽油中的 MTBE：清洁空气和饮用水问题

（报告摘要）

http://digitalcommons.unl.edu/crsdocs/26/

2006 年 4 月更新版

詹姆斯·E·麦肯锡

美国国会研究局

玛丽·蒂曼

美国国会研究局

环境政策、资源、科学和工业部专家

随着汽油价格在 2006 年三月和四月的上涨，甲基叔丁基醚（MTBE），一种从国家燃料供应中逐步淘汰的汽油添加剂，引起了人们新的注意。很多人称淘汰甲基叔丁基醚并以乙醇取而代之是导致油价上涨的主要因素。

20 世纪 70 年代后期，炼油厂开始使用甲基叔丁基醚。它在含铅汽油被淘汰后开始广泛应用，因其提高辛烷值的效果和添加铅类似，又不会损害 70 年代中期开始使用的减少排放的催化转换器。甲基叔丁基醚还被用于生产清洁燃烧的新配方汽油（RFG），1995 年后按照清洁空气法案的要求，美国污染最严重的地区必须使用这种汽油。空气清洁法案并不强制使用甲基叔丁基醚（也可以使用乙醇或其他添加物满足其中有关增氧剂的规定），不过甲基叔丁基醚添加剂因为价格低廉且适合混配，使用最为广泛。

根据 2005 年能源政策法案(P.L. 109-58)，新配方汽油（RFG）计划中有关增氧剂的强制要求于 2006 年 5 月 6 日终止。炼油业急不可待地在此日期之前将甲基叔丁基醚从全国的汽油供应中去除。甲基叔丁基醚的淘汰（与其被采用一样）并非联邦法律强制要求，但炼油企业认准了 5 月 6

日这个日期，因为他们担心继续使用甲基叔丁基醚可能会有承担责任的风险。多个州发生了甲基叔丁基醚污染饮用水的问题，半数左右通过立法禁止或者限制其使用。数百起诉讼要求炼油企业和油品经销商负责对受到污染的供水设施进行清洁，相关费用估计可能高达数十亿美元。石油产业坚持认为他们使用甲基叔丁基醚是为了满足新配方汽油（RFG）计划中有关增氧剂的强制要求，因此不该为此承担责任。如果有关增氧剂的强制要求被废除，他们就很难维持这种立场了。

为了替换甲基叔丁基醚，炼油企业都以最快的速度转向乙醇，导致乙醇短期内供应短缺价格上涨。乙醇产业坚持认为乙醇产量足够满足需求，但承认在国内某些地区暂时供应短缺，可能会在六月底之前对价格产生持续影响。供应短缺和价格上涨引得某些被免除了治理甲基叔丁基醚污染责任的炼油企业（一种所谓的“安全港”条款）再次议论纷纷。另一些企业再三呼吁联邦立法鼓励建设新的炼油设备。

除了去除新配方汽油（RFG）计划中的增氧剂要求，国会还在 2005 年的能源政策法案中出台了一项对乙醇生产的关键激励措施。按照可再生能源标准，全国发动机燃料的增量中必须包含可再生燃料，比如乙醇。法律规定 2006 年应达到 40 亿加仑（此目标已经达成），然后到 2011 年每年增加 7 亿加仑，直到 2012 年达到 75 亿加仑。

MTBE in Gasoline: Clean Air and Drinking Water Issues

http://digitalcommons.unl.edu/crsdocs/26/

Updated April 14, 2006

James E. McCarthy and Mary Tiemann

Specialists in Environmental Policy

Resources, Science, and Industry Division

Summary

As gasoline prices have risen in March and April 2006, renewed attention has been given to methyl tertiary butyl ether (MTBE), a gasoline additive being phased out of the nation’s fuel supply. Many argue that the phaseout of MTBE and its replacement by ethanol have been a major factor in driving up prices.

MTBE has been used by refiners since the late 1970s. It came into widespread use when leaded gasoline was phased out — providing an octane boost similar to that of lead, but without fouling the catalytic converters used to reduce auto emissions since the mid-1970s. MTBE has also been used to produce cleaner-burning Reformulated Gasoline (RFG), which the Clean Air Act has required in the nation’s most polluted areas since 1995. The act didn’t mandate the use of MTBE (ethanol or other substances could have been used to meet the act’s oxygenate requirement), but price and handling characteristics of the additive led to its widespread use.

Under the Energy Policy Act of 2005 (P.L. 109-58), the RFG program’s oxygen mandate terminates on May 6, 2006, and refiners are scrambling to remove MTBE from the nation’s gasoline supply by that date. The phaseout of MTBE (like its use) is not required by federal law, but gasoline refiners have focused on the May 6 date because of concerns over their potential liability for its continued presence. MTBE

has contaminated drinking water in a number of states, and about half have passed legislation to ban or restrict its use. Hundreds of suits have been filed to require petroleum refiners and marketers to pay for cleanup of contaminated water supplies, the cost of which has been estimated to be in the billions of dollars. The petroleum industry has maintained that it used MTBE to meet the RFG program’s oxygen mandate and therefore should not be held liable. That position could become more difficult to maintain once the oxygen mandate is removed.

To replace MTBE, refiners are switching to ethanol as swiftly as they can, leading temporarily to supply shortages and higher prices. The ethanol industry maintains that there will be sufficient ethanol to meet demand but concedes that temporary shortages exist in some parts of the country that could affect prices until the end of June. These shortages and higher prices have led to renewed discussion by some of exempting gasoline refiners from liability for MTBE cleanup (a so-called “safe harbor” provision). Others have renewed their call for federal legislation to stimulate the construction of new refining capacity.

Besides removing the RFG program’s oxygen requirement, Congress provided a major incentive to the production of ethanol in the Energy Policy Act of 2005. Under a Renewable Fuels Standard, an increasing amount of the nation’s motor fuels must consist of renewable fuel, such as ethanol. The law requires 4.0 billion gallons in 2006 (a level already being achieved) and an increase of 700 million gallons each year through 2011, before reaching 7.5 billion gallons in 2012.

美国谷物协会简介

U.S. Grains Council

美国谷物协会是一家私立的、非盈利性机构, 自 1960 年成立以来，长期致力于美国玉米、高粱和大麦的市场拓展。通过与美国谷物生产者、农业综合企业及公众部门建立独特的合作伙伴关系，美国谷物协会给国外客户提供服务，来开发国际市场。

美国谷物协会的会员包括美国国内各州的大麦、玉米和高粱商会、其他农户组织及多种农业综合企业。美国谷物协会的总部位于美国华盛顿特区，在世界 10 个国家和地区设有办公室，并在全球 80 余个国家开展项目活动。我们的项目经费由协会会员和美国政府共同提供。

1982 年以来，美国谷物协会一直在北京设有办公室，来管理在中国的项目。美国谷物协会中国办公室开展的项目涵盖了饲料谷物业的所有主要领域---商业饲料生产、养猪、奶牛生产、玉米加工、酿造及燃料酒精业等等。

美国谷物协会开展种类多样的项目活动--技术、贸易服务、贸易政策等等––以期加强美国供应商与中国最终用户的联系。开展技术项目可以在生产过程中帮助最终用户更有效地利用饲料谷物。同时，我们还给顾客提供有关美国饲料谷物质量及特性方面的资料，以证明其使用价值。美国谷物协会在技术及管理方面的培训，提供了两国进行信息交流的宝贵机会。这些培训有助于加强两国间的相互了解，构筑互惠贸易的基础。

美国谷物协会还提供内容广泛的市场信息及客户培训方面的贸易服务。我们提供市场信息给买主、最终用户及政府官员等组成的广泛的社会团体；进行客户培训，使其着重了解美国饲料谷物的质量情况和采购方法。饲料谷物业的新进展，如各种增值谷物等，是我们开展市场培训的新项目。

美国谷物协会同时也参与贸易政策有关的活动，以确保买主可以在市场上获得美国的饲料谷物。美国谷物协会支持贸易自由化和减少贸易壁垒。

美国谷物协会支持依靠饲料谷物的中国工业的进步，并希望它们不断发展兴旺。对于迅速发展的中国经济来讲，美国是优质谷物的可靠来源，我们同时希望两国互惠互利的关系能不断得到加强。

长按图中蓝天，识别图片二维码

关注驱散雾霾

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U.S. GRAINS COUNCIL

美国谷物协会北京办事处

北京市建国门外大街 1 号国贸中心办公楼 1 座 1010 室，邮编：100004

电话：（8610）65051314，65052320　　　传真：（8610）65050236

电子邮箱：grainsbj@grains.org.cn 网址:http://www.grains.org.cn