生物燃料标准研讨会

Bio-fuel Standard Workshop

主办单位：

中国循环经济协会可再生能源专业委员会、美国贸易发展署、中美能源合作项目
美国国家标准化机构、眉山加州智慧城市研究院、能源创新网络

Host:
Chinese Renewable Energy Industries Association (CREIA)， U.S. Trade and Development Agency (USTDA)
U.S.-China Energy Cooperation Program (ECP)， American National Standards Institute (ANSI)
Meishan California Smart City Institute (MCSCI)，Energy Innovation Network (EIN)

2021年2月2日 北京
Feb. 2, 2021 BEIJING

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Agenda

会议议程

Meeting Agenda

February 2 (Tuesday), 2021
Water Room, 3F, The Westing Beijing Chaoyang

Meeting Host: Fang XU, China Chief Representative, ANSI

Time	Topics	Speaker
09:00am-09:15am	Opening Remarks	CREIA USTDA ECP MCSCI
09:15am-09:35am	Transportation fuels from biomass in California and the USA	Dr. Stephen Kaffka Director of California Biomass Collaborative and extension specialist in the Department of Plant Sciences at the University of California, Davis
09:35am-09:55am	Development overview and standard work sharing of low carbon biofuel in China	Mr. Dingjie LI Senior Engineer, Deputy Director of China Petroleum and Chemical Industry Association (CPCIA)
09:55am-10:10am	Overview of ASTM International's Support of Standards for Aviation Biofuels	Ms. Alyson Fick Manager of International Technical Committee D02 on Petroleum Products, Liquid Fuels and Lubricants, ASTM
10:10am-10:25am	Boeing's Sustainable Aviation Fuel Footprint	Mr. Mark AUGUSTYNIEWICZ Principle Strategist Environmental Sustainability, Boeing
10:25am-10:40am	Technology review of Bio-fuel industry in China	Prof. Dehua Liu Department of Chemical Engineering, Tsinghua University
10:40am-10:55am	Energy Efficiency of Biofuel with Zero Emission	Mr. Kam Mahdi CEO, Clean Energy Technology Inc. (CETY)
10:55am-11:10am	Biomass Energy and Carbon Neutrality	Associate Prof. Shiyan Chang, Institute of Energy, Environment and Economy,Tsinghua University
11:10am-11:25am	Global outlook for (advanced) biofuels	Ms. Praveen Bains Clean Energy Modeller, Energy Technology and Policy division, International Energy Agency (IEA)

11:25am-11:40am	The role of RNG and advanced biofuels in decarbonization (with a California case study)	Dr. Yuri Freedman Senior Director of Business Development Southern California Gas Company
11:40am-11:55am	The overview for China and International biofuel standard development	Dr. Bingsheng XU Director of Ecological Civilization Construction Research Office, Resources and environment branch of China National Institute of Standardization (CNIS)
11:55am-12:30pm	Discussion & Conclusion	Hosted by Mr. Weiquan Wang, Deputy Secretary General (CREIA) • Dr. Stephen Kaffka (UC Davis) • Ms. Alyson Fick (ASTM) • Mr. Mark AUGUSTYNIEWICZ (Boeing) • Prof. Dehua Liu (Tsinghua U) • Prof. Shiyan Chang (Tsinghua U) • Mr. Dingjie Li (CPCIA) • Ms. Praveen Bains (IEA) • Dr. Yuri Freedman (SoCalGas) • Dr. Bingsheng XU (CNIS)

会议日程

2021 年 2 月 2 日 星期二
金茂北京威斯汀大饭店，3 层，水厅

会议主持：美国国家标准机构 中国首席代表 许方 先生

时间	内容	讲演人
9:00am-9:15am	致辞	中国循环经济协会可再生能源专委会 美国贸易发展署 中美能源合作项目 眉山加州智慧城市研究院
9:15am-9:35am	美国加州生物质运输燃料	Stephen Kaffka 博士 加州生物质能源合作中心主任 加州大学戴维斯分校植物科学系推广专家
9:35am-9:55am	中国生物燃料产业发展现状及相关标准工作分享	李顶杰 先生 中国石化联合会产业部能源处副处长 高级工程师
9:55am-10:10am	ASTM 在生物航煤领域的工作分享	Alyson Fick 女士 ASTM/D02（石油化工、液体燃料和润滑剂） 国际技术委员会经理
10:10am-10:25am	波音的可持续发展航煤工作分享	Mark AUGUSTYNIEWICZ 先生 波音环境战略首席专家
10:25am-10:40am	生物燃料技术现状与进展	刘德华 教授 清华大学化工系
10:40am-10:55am	零排放高效生物燃料	Kam Mahdi 先生 美国清洁能源技术公司（CETY）首席执行官
10:55am-11:10am	生物质能源和碳中和	常世彦 副研究员 清华大学环境经济研究所
11:10am-11:25am	全球先进生物燃料展望	Praveen Bains 女士 国际能源署（IEA）能源技术和政策部门 清洁能源建模师
11:25am-11:40am	可再生天然气和生物燃料在未来绿色经济的作用	Yuri Freedman 博士 南加州天然气公司业务发展高级总监

11:40am-11:55am	生物燃料国内外标准化相关工作与进展	徐秉生博士 中国标准化研究院资环分院 生态文明建设研究室主任
11:55am-12:30pm	讨论对话&会议结束	中国循环经济协会可再生能源专委会 副秘书长 王卫权 先生 • Stephen Kaffka 博士 • Alyson Fick 女士 • Mark AUGUSTYNIEWICZ 先生 • 刘德华 教授 • 常世彦 教授 • 李顶杰 先生 • Praveen Bains 女士 • Yuri Freedman 博士 • 徐秉生 博士

Hosts and Supporting Agencies Overview

主办单位介绍

Chinese Renewable Energy Industry Association (CREIA)

Establishment of CREIA

China's 10th Five-Year-Plan guidelines for national economic and social development indicate that energy development should apply the following principles: 1) take advantage of local resources, 2) optimize the energy mix, 3) use energy efficiency applications extensively, 4) enforce environmental protection, 5) actively develop wind, solar, biomass, and other new and renewable energy resources, and 6) promote energy conservation and comprehensive utilization technologies. For the purpose of addressing the environmental problems caused by our country's energy structure, which predominantly relies on the coal, the Government places a priority on promoting the development and utilization of renewable energy resources and using the principle of sustainable economic and social development. In order to assist in promoting these objectives, the Chinese Renewable Energy Industries Association (CREIA) was established in 2000 with the support of the United Nations Development Programme (UNDP), the Global Environment Facility (GEF) and the State Economic and Trade Commission (SETC). CREIA obtained legal registration as the Renewable Energy Professional Division of the China Comprehensive Resource Utilization Association from the Ministry of Civil Affairs on March 25, 2002. CREIA has attracted distinguished membership of more than 200 from industry, academics, organizations and individual experts.

Mission of CREIA

CREIA promotes the adoption of renewable energy advanced technologiesand actively advances the commercialization of the Chinese renewable energy.

Functions of CREIA

During its operation, CREIA established the following priority functions in order to maximize its services to members:

CREIA serves as a bridge between regulatory authorities, research institutes, and industry professionals, in order to provide a forum to discuss renewable energy development at the national level and subsequently advise the Government of China on strategic policy formulation.

CREIA acts as a window to bring together national and international project developers and investors. It promotes technology transfer and raises awareness of renewable energy investment opportunities through an online Investment Opportunity Facility and regional networking and training activities.

CREIA provides a network for its members from the Chinese renewable energy business community without access to communication within their sub-sectors, and provides a platform to voice their concerns collectively.

CREIA

中国循环经济学会可再生能源专业委员会
中国能源研究会可再生能源专业委员会

专委会成立背景

- 2000 年，中国循环经济协会可再生能源专业委员会在原国家经济贸易委员会/联合国开发计划署/全球环境基金“加速中国可再生能源商业化能力建设项目”的支持下组建，并于 2002 年 3 月 25 日获得了国家民政部的正式批准。目前专委会的会员单位已经超过 200 家，汇集了可再生能源行业的优秀企事业单位、行业组织机构、科研设计院所、金融机构、高等院校等。
- 2017 年 7 月，中国能源研究会可再生能源专业委员会经换届更名成立，以“提升学术研究水平，扩大政策影响力，强化产学研的沟通，增强可再生能源的社会认可度”为目标开展相关课题研究及传播活动，旨在促进可再生能源产业良性健康发展。目前专委会拥有专家委员 30 余人，汇集了来自可再生能源行业重点研究机构、设计院所、高等院校、行业组织机构和企事业单位的优秀人才。

专委会宗旨

致力于推动可再生能源领域的技术进步和先进技术的推广应用，积极促进中国可再生能源产业的商业化发展。

专委会职能

- 作为与政府部门、行业组织机构、科研单位和企事业单位沟通的桥梁，加强可再生能源行业与政府部门的沟通与联系，反映产业发展中的问题，为政府部门制定技术经济政策服务。接受各级政府部门和企事业单位的委托，开展能源政策、规划、法规和科技项目的研究咨询评估服务；
- 作为国内可再生能源领域与国外联系和交流的窗口，促进国内可再生能源领域与国际间的联系合作与交流，及时获取信息，寻求国际机构的支持和各种投资机会。开展国内外学术交流、能源科学知识与技术普及；
- 作为可再生能源领域企业间及企业与科研单位联系的纽带，加强产、学、研界的沟通与协作，反映行业发展中出现的问题和企业的集体呼声，形成合力并着力消除行业发展障碍。开展社团标准制定，提供能源管理技术服务和培训等。

U. S. Trade and Development Agency (USTDA)

The U.S. Trade and Development Agency (USTDA) helps to promote U.S. technologies and expertise for priority development projects in emerging economies. USTDA links U.S. businesses to export opportunities by funding project planning activities, pilot projects, and reverse trade missions while creating sustainable infrastructure and economic growth in partner countries.

USTDA promotes economic growth in emerging economies by facilitating the participation of U.S. businesses in the planning and execution of priority development projects in host countries. The Agency's objectives are to help build the infrastructure for trade, match U.S. technological expertise with host country development needs, and help create lasting business partnerships between the United States and emerging economies.

USTDA's Program Activities

Project Development

Project identification and investment analysis generally involves technical assistance, feasibility studies and pilot projects that support large investments in infrastructure that contribute to host country development. Key sectors in China include the transportation, energy, and healthcare sectors.

Trade Capacity Building and Sector Development

Trade capacity building and sector development assistance supports the establishment of industry standards, rules and regulations, market liberalization and other policy reform. In China, USTDA has supported activities to support increased protection of intellectual property rights, fair and transparent government procurement practices, science-based agricultural biotechnology regulations, and standards across a wide range of industry sectors.

International Business Partnership Program

Under the Agency's International Business Partnership Program, USTDA has increased its support for programs designed to bring procurement officials to the United States to witness U.S. technology and ingenuity firsthand and develop the relationships with U.S. companies necessary to spur increased commercial cooperation with emerging economies. These investments include reverse trade missions, technology demonstrations, training and specialized sector-specific workshops and conferences.

Cooperation Programs

The Agency's success in China is due in part to the public-private cooperative programs that USTDA supports in country. These programs provide a forum wherein government agencies and private companies from both the U.S. and China can share technical, policy, and commercial knowledge relevant to a specific field. USTDA has successfully established programs based on this model in the aviation, standards and conformity assessment, energy, and healthcare sectors.

By adapting to the evolving needs of China's market and closely coordinating with Chinese decision makers, these public-private partnerships have enjoyed long-term success, providing continued trade opportunities and enhancing the development of China's key industries.

美国贸易发展署 (USTDA)

美国贸易发展署(USTDA) 致力于在新兴经济体推动经济发展和美国的商业利益。美国贸易发展署通过对项目前期，试点项目以及反向代表团赴美考察等形式的资金资助, 达到在合作伙伴国家推动可持续性基础设施和经济增长的同时帮助美国企业寻找出口机会。

美国贸易发展署鼓励美国公司积极参与新兴经济体项目所在国重点发展领域里的项目规划和实施过程中的机会。目的是帮助美国有技术优势的公司配合项目所在国的发展寻求契机，并建立长期持久合作关系。

美国贸易发展署的项目活动

项目开发

美国贸易发展署支持的项目确认和投资分析通常为了支持项目所在国大型基础设施项目投资决策前以所需要的技术援助，可行性研究分析和试点项目等。在中国的项目集中在交通，能源和医疗卫生领域。

能力建设和行业发展

能力建设和行业发展是为了帮助推动建立行业标准，法规等相关政策需求的活动。在中国，美国贸易发展署支持过的项目内容涉及知识产权，公平透明政府采购，以科学为基础的农业生物技术规范，以及涉及其他更宽泛领域涉及行业标准的内容。

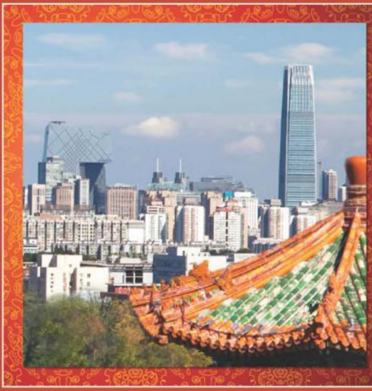
国际商业伙伴关系项目

通过国际商业伙伴关系项目，美国贸易发展署加大资金投入力度，组织更多灵活多样的赴美考察团，技术交流/研讨会和培训等，选择特定的一些行业，帮助中方人员了解美国技术，掌握第一手资料，加深对美国企业的了解并能推动潜在的商务合作。

政府企业合作平台

美国贸易发展署在中国取得成功的部分原因是与其他相关机构共同支持了政府企业合作项目的平台。在这个平台上，美国和中国的政府机构和私营企业均可以共享在特定领域的技术、政策和商业知识。美国贸易发展署已经成功地在航空、标准合格评定、能源和医疗保健等行业推动了该模式。

通过适应中国市场变化的需求，和中国决策者的密切配合，这些公私伙伴关系企业积累了一些长期合作的成功经验，提供持续的贸易机会，并推动中国支柱产业的发展。



U.S.-China Standards and Conformance Cooperation Program

Sponsored by the U.S. Trade Development Agency (USTDA) and coordinated by the American National Standards Institute (ANSI), the **U.S.-China Standards and Conformance Cooperation Program** (SCCP) provides a forum through which U.S. and Chinese industry and government representatives can:

- Cooperate on issues relating to standards, conformity assessment, and technical regulations;
- Foster the relationships necessary to facilitate U.S.-China technical exchange on standards, conformity assessment, and technical regulations; and
- Exchange up-to-date information on the latest issues and developments relating to standards, conformity assessment, and technical regulations.

Beginning in 2013, ANSI will coordinate 20 workshops over a 3-year period in China under the SCCP. The workshops will cover a wide range of sectors, as proposed by interested U.S. private-sector organizations. Workshop topics will be chosen in coordination with relevant industry associations, ANSI, and USTDA.

To learn more about the U.S.-China SCCP or to express interest in sponsoring or participating in a workshop, please visit our website at:

www.standardsportal.org/us-chinasccp

FOR MORE INFORMATION

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美中标准与合格评定合作项目

由美国贸易发展署 (USTDA) 提供资助、 美国国家标准协会 (ANSI) 负责协调的美中标准与合格评定合作项目 (SCCP) 在以下几个方面为美国和中国相关行业和政府代表提供了一个论坛:

- 在标准、合格评定以及技术法规等领域的合作;
- 为促进美中在标准、合格评定以及技术法规等领域的技术交流建立必要的联系;
- 及时交流关于标准、合格评定以及技术法规等领域的 最新议题和发展情况的相关信息

根据 SCCP 项目规定，从 2013 年开始的三年内，ANSI 将在中国协调举办20场研讨会。根据美国私营业界相关组织的建议，研讨会内容将覆盖不同的行业和领域。研讨会的主题将由相关行业组织、ANSI 以及 USTDA 协调选定。

欲了解该项目的更多情况或有意赞助或参与该项目，请访问下列网站:

www.standardsportal.org/us-chinasccp

了解其他信息，请联系

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American National Standards Institute (ANSI)

As the voice of the U.S. standards and conformity assessment system, the American National Standards Institute (ANSI) empowers its members and constituents to strengthen the U.S. marketplace position in the global economy while helping to assure the safety and health of consumers and the protection of the environment.

The Institute oversees the creation, promulgation and use of thousands of norms and guidelines that directly impact businesses in nearly every sector: from acoustical devices to construction equipment, from dairy and livestock production to energy distribution, and many more. ANSI is also actively engaged in accrediting programs that assess conformance to standards – including globally-recognized cross-sector programs such as the ISO 9000 (quality) and ISO 14000 (environmental) management systems.

ANSI has served in its capacity as administrator and coordinator of the United States private sector voluntary standardization system for the past hundred years. Founded in 1918 by five engineering societies and three government agencies, the Institute remains a private, nonprofit membership organization supported by a diverse constituency of private and public sector organizations.

Throughout its history, ANSI has maintained as its primary goal the enhancement of global competitiveness of U.S. business and the American quality of life by promoting and facilitating voluntary consensus standards and conformity assessment systems and promoting their integrity. The Institute represents the interests of more than 270,000 companies and organizations and 30 million professionals worldwide through its office in New York City, and its headquarters in Washington, D.C.

美国国家标准化机构（ANSI）

作为美国标准和合格评定体系的发言人，美国国家标准化机构授权其会员强化美国市场在全球经济中的地位，同时协助保障消费者的安全和健康以及环境保护事宜。

机构对数以千计的标准和指导方针的制定、颁布、实施进行监督，而这些标准和指导方针几乎直接影响商业的每个领域：从声呐设备到建筑设备，从乳制品及家禽产品到能源分配等等。美国国家标准化机构也积极参与评估合格到标准的委托项目——包括诸如 ISO9000（质量）和 ISO14000（环境的）管理系统等全球认可的跨领域项目。

在过去的一个世纪中，美国国家标准化机构担任美国私营部门自愿性标准化体系的管理者及协调者。自 1918 年由五家工程师协会和三个政府部门成立以来，本机构一直是一个民间、非营利性质的会员制组织，得到来自私营和公共部门的多元化支持。

纵观历史，美国国家标准化机构的首要目标一直是强化美国商业的全球竞争力，通过推进自愿性标准及合格评定体系并对它们进行完善从而提高美国人民的生活质量。机构总部设在华盛顿特区，并在纽约设有办公地点，代表全球超过 27 万家公司及组织和三千万专家的利益。

US-China Energy Cooperation Program (ECP)

Founded in September of 2009 by 24 US energy companies, US-China Energy Cooperation Program (ECP) was underscored by US President Barack Obama and China President Hu Jintao in the official joint statements during Obama's visit to China in 2009. US government agencies including Department of Commerce, Department of Energy and US Trade and Development Agency together with Chinese government agencies including National Energy Administration and Ministry of Commerce signed bilateral Memorandums of Understanding to serve as official government advisors to support ECP.

US-China Energy Cooperation Program (ECP)'s mission is to create a bilateral business platform with US and Chinese companies to pursue private sector-based business opportunities, advance sustainable development in the energy industry and combat climate change. Members join ECP through working groups to form industry value chains. Within each working group, members establish a sector development road map according to the national strategies, local demand and potential local partners for both short and long terms. Through this process, each working group identifies annual business development objectives and concrete initiatives for implementation.

ECP currently has the following working groups:

Oil and Gas,
Coal,
Nuclear Energy,
Renewable Energy,
Grid,
Storage,
Building,
Industry,
Transport,
Urban Infrastructure,
Resource Utilization

Learn more about the US-China Energy Cooperation Program by visiting: www.uschinaecp.org

中美能源合作项目（ECP）简介

中美能源合作项目（ECP）肩负着中美两国间清洁能源领域广泛合作的商业执行使命。作为由企业出资运营并管理的非盈利、非政府机构，ECP 于 2009 年 9 月由 24 家美国企业发起成立，致力于在中美两国推动清洁能源领域相关的产业开发、市场开拓、境外直接投资以及创造就业机会等相关工作。通过两国政府对 ECP 的正式承认和支持，ECP 作为一个政府和企业间的伙伴关系平台，为成员公司及其商业伙伴提供动力，通过全方位解决方案产业联盟的组建和运行，推动必须经由集体性的和协调性的努力才能实现的商业发展成果的落实。成员公司通过参与有关工作组来组成不同的产业价值链。在每个工作组之下，各成员公司共同为工作组的相关产业设立短期、中期以及长期的产业开发路线图。在这一工作的过程中每个工作组就每年的相关工作，确立年度商业发展目标，并辅以切实的工作计划，推动实施。

经过六年多的工作，ECP 已经发展成为了包括中国企业在内的三十几家家企业的共同平台。通过同各种各样的合作伙伴关系，致力于在以下诸多工作上有所建树：

•推进新的行业以及市场的形成；
•协助相关行业政策以及法规的制定；
•为中美两国的政府间对话提供企业角度的支持；
•搭建促进商业成果达成的管道。

中美能源合作项目(ECP)CP 行业工作组
ECP 目前有以下行业工作组：
油气、煤炭、核能、可再生能源、电网、储能、建筑、工业、交通、城市基础设施、资源利用

ECP 项目:
为促进交流与合作，ECP 设计并提供相关培训，技术支持，研究及试点项目。ECP 成员公司有机会和中国能源界专家一起参与合作项目，这些项目都得到了国家级或省级的政府官员的认可。每年，ECP 在中国参与并支持诸多与清洁能源领域相关的重要议题、技术讨论及研讨会。
2013 年中美能源合作对话会议
ECP 使命: 通过提高清洁能源解决方案的发展和部署，为中美政府和企业间的合作创建一个坚实的平台。

ECP 在中美两国的能源合作中发挥着重要作用，并通过努力推动以下方面的工作，促进和支持两国清洁能源产业的发展：
•创造就业机会
•知识产权保护
•市场准入和行业发展
•中美相互间的境外直接投资

MCSC INSTITUTE
眉山加州智慧城研究所

MCSC Institute, established in 2020, grew out of extraordinary enthusiasm and support worldwide for the mission and goals of Meishan California Smart City (MCSC) in Sichuan Province. Leading the way for future smart cities with clean energy, new technologies, a fully integrated infrastructure, and data-driven iterative improvement, the concept and intention of MCSC has always been about much more than creating a single development. It is also about sharing information and knowledge globally to advance progress in all facets of smart city development. MCSC Institute was created to provide a comprehensive platform for sharing of best practices, research, and experience gained through designing, building, and inhabiting a forward-focused smart city. Both MCSC development and MCSC Institute are guided by long-standing relationships between world government and business leaders, educators, NGOs, investors, and entrepreneurs. MCSC Institute ushers in a new era that comprehends the global nature of the challenges we face and the need for global collaboration to identify effective solutions.

MCSC Institute will bring together thought leadership, subject matter experts, researchers, educators, entrepreneurs, and innovators to create a dynamic platform where ideas become actions, actions become transformations, and transformations are disseminated, to the benefit of smart development everywhere.

四川天府眉山加州智慧城项目启动后，收获了来自世界各地的殷切支持，为了更好地实现其宏大使命，眉山加州智慧城研究所应运而生，于2020年在万众瞩目之下正式成立。借助清洁能源、新技术、全面整合的基础设施以及由数据驱动的迭代改进，眉山加州智慧城一马当先地驰骋在通往未来智慧城市的发展之路。眉山加州智慧城一直以来不仅仅专注于这单一项目，更致力于智慧城市领域在全球范围内的信息与知识共享。眉山加州智慧城研究所的成立，提供了一个综合性的平台，在这里可以充分展示和分享前瞻智慧城市设计、建造以及栖居在全球的最佳实践、研究成果和经验。眉山加州智慧城的发展及其研究所都受到了来自世界各地的政府和商界领袖、教育界人士、非政府组织、投资者和企业家的关注，也从他们的长期指导中获益匪浅。眉山加州智慧城研究所业充分理解我们将面对的全球性挑战以及寻求有效解决方案的全球合作的需求，它的成立将会引领一个新的时代。

眉山加州智慧城研究所将汇聚起杰出的思想领袖、主题专家、研究人员、教育家、企业家和创新者们，打造一个充满活力的平台，在这里，理念将变成行动，行动将引发变革，变革将传播开来，让世界各地的智能发展从中得益。

Energy Innovation Network (EIN)
能源创新网络

Founded in 2015 in Silicon Valley, Energy Innovation Network (EIN) is a global nonprofit powered by volunteers from the United States, China, India, Africa with a growing presence working in the intersection of high-tech industry and the energy industry.

Through event series, conferences, and special projects, EIN brings together worldwide industry professionals, experts, scholars, and business elites in the energy, environment, and transportation industry to build a global network, promote energy education and innovation and advance a more sustainable future.

能源创新网络(Energy Innovation Network)前身为硅谷中国能源协会(Silicon Valley China-US Energy Association)，我们于2015年初创建于斯坦福大学，成立于高科技产业与能源产业共同飞速发展的美国硅谷，旨在加强能源行业的科技、商业与政策交流，成为能源行业资源对接、信息共享和人才交流的平台。协会涉及的领域包括智能电网，能源大数据，能源物联网，节能技术，太阳能与储能，电动车，石油与天然气，节能环保政策等能源相关领域的方方面面。协会汇聚了能源行业各个领域的专家学者和商业精英，希望通过跨领域、跨国界的交流，促进能源领域未来的共同发展和行业进步。我们作为一个全志愿者运营的NGO，面向年轻一代，渴望创建绿色地球，欢迎更多来自各领域志愿者的加入。

Speaker Biographies

演讲人介绍

Stephen R. Kaffka

Director, California Biomass Collaorative
Extension Specialist, Depatment of Plant Sciences
University of California, Davis

Stephen Kaffka is Director of the California Biomass Collaborative and extension specialist in the Department of Plant Sciences at the University of California, Davis. He is chair of the BioEnergy Work Group for the University of California's Division of Agriculture and Natural Resources. He participates on several advisory committees for the California Energy Commission and California Air Resources Board, including ex officio member of the Bioenergy Interagency Work Group. From 2003 to 2007 he was director of the Long Term Research on Agricultural Systems Project. As director he led the development of current and new projects focusing on sustainable agriculture. His commodity assignments include sugar and oilseed crops. Since coming to U.C. Davis in 1992, he has also carried out research on water quality and agriculture in the Upper Klamath Basin, and the reuse of saline drainage water for crop, forage, energy biomass feed stocks and livestock production in salt affected areas of the San Joaquin Valley. He has received meritorious service awards form the American Society of Sugar Beet Technologists and the Soil and Water Conservation Society, is past president of the California chapter of the American Society of Agronomy, and past section leader for American Society of Agronomy's division on environmental quality. He has Ms and Ph.D. degrees from Cornell University in agronomy and a B.S. from the University of California at Santa Cruz in biology.

斯蒂芬•卡夫卡

加州生物质能源合作中心主任
加州大学戴维斯分校植物科学系推广专家

斯蒂芬•卡夫卡是加州生物质能源合作中心主任以及加州大学戴维斯分校植物科学系推广专家。他是加州大学农业和自然资源部生物能源工作组的主席。他参加了加州能源委员会和加州空气资源委员会的几个咨询委员会，包括生物能源跨部门工作组的当然成员。2003 年至 2007 年，他担任农业系统长期研究项目主任。作为主任，他领导了以可持续农业为重点的当前和新项目的开发。他的商品任务包括糖和油料作物。自 1992 年来到加州大学戴维斯分校以来，他还对上克拉马斯盆地的水质和农业进行了研究，并对圣华金河谷受盐碱影响地区的作物、饲料、能源生物质饲料和牲畜生产进行盐水排水的再利用进行了研究。他曾获得美国甜菜技术专家协会和水土保持协会颁发的功勋服务奖，曾任美国农学学会加利福尼亚分会会长，曾任美国农学学会环境质量分会主任。他拥有康奈尔大学农学硕士和博士学位，以及加州大学圣克鲁斯分校生物学学士学位。

Dingjie LI
Senior engineer,
Deputy Director of China Petroleum and Chemical Industry Federation currently

He has 18 years of working experience in oil,NG and petrochemical fields, and has engaged in production, production management, product R & D, industrial research and other related work in PetroChina and China Petroleum and Chemical Industry Federation.

He has undertaken and participated in more than 20 research projects commissioned by national ministries and relevant enterprises, and obtained 5 provincial and ministerial awards for relevant achievements. He has participated in more than 10 books and published 28 articles. In terms of liquid renewable fuels, he participated in the first aviation biofuels demonstration flight of China, and international cooperation of cellulosic ethanol research projects, etc.

李顶杰
中国石油和化学工业联合会产业部能源处副处长，高级工程师

有 18 年的油气和石化领域工作经历，先后在中国石油、中国石油和化学工业联合会从事过生产、生产管理、产品研发、产业研究等相关工作。

承担和参加 20 余项国家部委和相关企业委托开展的研究项目，相关成果获得省部级奖励 5 项。参编专著 10 余部，发表文章 28 篇。在液体可再生燃料方面，曾参与我国首次航空生物燃料试飞、纤维素乙醇国际合作等研究项目。

Alyson Fick

Manager of International's Technical Committee Operations (TCO)
ASTM

ASTM International is a globally recognized leader in the development and delivery of international voluntary consensus standards. As an ASTM manager, Alyson is responsible for the management of ASTM Committees made up of volunteer member-experts from various industry sectors, such as Petroleum and Plastic. Alyson is responsible for assisting these members as they develop ASTM standards for use around the world to improve product quality, enhance safety, facilitate market access and trade, and build consumer confidence.

She holds a Bachelor of the Arts degree in International Area Studies and Modern Languages from Drexel University and a Masters in Public Administration from Villanova University.

Alyson Fick
ASTM 国际技术委员会运营（TCO）部门的经理
ASTM 国际是全球公认的国际自愿共识标准制定和实施的领导者。作为一名 ASTM 经理，Alyson 负责管理由来自石油和塑料等不同行业部门的志愿成员专家组成的 ASTM 委员会。Alyson 负责协助这些成员制定 ASTM 标准，供全球使用，以提高产品质量、增强安全性、促进市场准入和贸易以及建立消费者信心。
她拥有德雷塞尔大学国际区域研究和现代语言文学学士学位和维拉诺瓦大学公共管理硕士学位。

Mark AUGUSTYNIEWICZ

Principle Strategist
Environmental Sustainability
The Boeing Company

Mark is a Principle Strategist working for the newly created organization supporting the first Chief Sustainability Officer at The Boeing Company. He is focused on developing business opportunities that leverage current and emerging technology solutions to improve the environmental performance of commercial airplanes.

Previously Mark has worked in a variety of engineering and strategy roles at Boeing for over 20 years spanning domains from commercial spaceflight to sustainability reporting and governance. He holds a bachelors of science in mechanical engineering from the University of California, and a master's degree in business administration from Seattle University where he was also an adjunct professor for six years teaching graduate level courses in Competitive Intelligence, Disruptive Innovation, and Sustainability.

A Seattle area native, Mark embraces all forms of human-powered adventure including cross country skiing, mountain biking, ultra trail running, and backpacking the alpine wilderness.

Mark Augustyniewicz
波音环境可持续发展部首席战略专家

Mark 在新成立的部门任首席战略专家，为波音公司首任首席可持续发展官提供支持。 他专注于开发利用当前和新兴技术解决方案改善商用飞机环境性能的商业机会。

此前，Mark 曾在波音公司担任过多个工程和战略职务超过 20 年，涵盖从商业航天到可持续性报告和治理等各个领域。 他拥有加州大学机械工程理学学士学位和西雅图大学工商管理硕士学位，并在西雅图大学担任了六年的兼职教授，教授竞争情报、颠覆性创新和可持续发展方面的研究生课程。

Mark 是西雅图人，喜欢各种形式的冒险活动，包括越野滑雪、山地自行车、超跑和荒野背包旅行。

Dehua Liu

Professor and Director, Institute of Applied Chemistry
Department of Chemical Engineering, Tsinghua University

Education

1986-1991	Ph.D., Chemical Engineering, Tsinghua University, Beijing, China
1981-1986	B.S., Applied Chemistry, Tsinghua University, Beijing, China

Appointments

1999-present	Professor and Director, Institute of Applied Chemistry, Department of Chemical Engineering, Tsinghua University, Beijing, China
2010-present	Director, China-Brazil Center for Climate Change and Energy Technology Innovation
2015-present	Director, China-Latin America Joint Laboratory for Clean Energy and Climate Change
2014-2015	Member, PlantBottle Technical Advisory Board (TAB) of Coca Cola
2008-2011	Consultant, DuPont R&D Center in China
1997-1999	Professor, Institute of Process Engineering, Chinese Academy of Sciences, Beijing, China
1993-1997	Associate Professor, Institute of Process Engineering, Chinese Academy of Sciences, Beijing, China
1994-1995	Visiting Scholar, Laboratory of Renewable Resources Engineering, Purdue University, West Lafayette, IN, USA
1991-1993	Post-Doctoral Research Assistant, Institute of Process Engineering, Chinese Academy of Sciences, Beijing, China

Research Field

Dr. Dehua Liu has expertise in the field of biochemical engineering with specific focus on renewable resources, bio-energy engineering, fermentation technology, bioreaction engineering, and metabolic engineering. He has published more than 200 papers and filed more than 60 patents.

刘德华 教授
清华大学化工系应用化学研究所所长

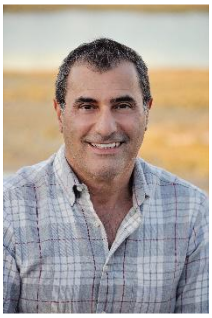
1986 年毕业于清华大学化学系获应用化学学士学位，1991 年毕业于清华大学化工系获化学工程博士学位。

曾任中科院化工冶金研究所生化工程研究部副主任、国家生化工程技术研究中心（北京）常务副主任。1999 年 5 月调任清华大学化工系应用化学研究所所长。2010 年协助创建中国-巴西气候变

化与能源技术创新中心并担任主任，2015 年获科技部批准成立中国-拉美清洁能源与气候变化联合实验室，任实验室主任。

刘德华主要研究领域为生物质综合利用的生物炼制技术，侧重于微生物发酵、酶催化转化及产品纯化工艺优化、设备研发及过程集成。

刘德华团队已申请 60 多项发明专利，获中国专利授权 50 多项，并有多项核心专利已获美国、欧盟、加拿大、澳大利亚、日本、俄罗斯、新加坡、巴西、印度等二十多国授权，发表 SCI 收录论文 200 余篇。主持完成的“生物法耦合生产生物柴油与 1,3-丙二醇”项目先后荣获中国石油化工联合会科技进步一等奖(2006)、中国技术市场金桥奖(2007)、日内瓦国际发明博览会金奖(2015)、联合国工业发展组织（UNIDO）全球可再生能源领域最具投资价值领先技术“蓝天奖”(2016)、中国石油化工联合会“技术发明一等奖”（2016)、UNIDO 全球绿色低碳领域最具投资价值领先技术蓝天奖（2018)。刘德华还荣获“全国化工优秀科技工作者”(2010)、享受国务院政府特殊津贴专家（2016)。



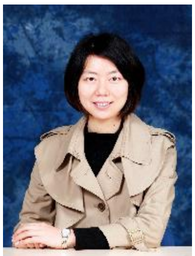
Kam Mahdi

CEO, Clean Energy Technology Inc. (CETY)

Kam Mahdi is an accomplished public company CEO with domestic and international experience in operations, P&L oversight, multi-channel product distributions, licensing, joint ventures, and marketing involving both start-ups and growth organizations.
A passionate leader and entrepreneur at heart , Kam has successfully built his own companies for the past 20 years.
Taking the position of CEO in October of 2015, Mr. Mahdi’s vision of creating a product development accelerator led to the acquisition of the General Electric Heat Recovery Solutions, and he has been instrumental in making CETY a major player in the renewable and energy efficiency markets.

Kam Mahdi
美国清洁能源技术公司（CETY）首席执行官

Kam Mahdi 是一位有成就的上市公司 CEO，在运营、损益监管、多渠道产品分销、许可、合资企业以及涉及初创企业和成长型企业的营销方面拥有国内外经验。
作为一名充满激情的领导者和企业家，Kam 在过去 20 年里成功地建立了自己的公司。
Mahdi 先生于 2015 年 10 月就任首席执行官，其创建产品开发加速器的愿景促成了对通用电气热回收解决方案的收购，并在使 CETY 成为可再生能源和能效市场的主要参与者方面发挥了重要作用。



Shiyan CHANG
Associate Professor
Institute of Energy, Environment and Economy
Tsinghua University

Her research areas are energy transition and its economic and environmental impact. She was involved, as a key contributor, in the building of the China Regional Energy-Emissions-Air Quality-Climate-Health Model (REACH) and China's Regional Energy System Model (C-RESM) to explore possible pathways for sustainable energy transition. As the Principal Investigator or major participant, she has undertaken a number of national projects in this field.

常世彦
清华大学能源环境经济研究所副研究员

主要研究领域为能源系统转型及其经济环境影响评估。作为主要成员，参与构建了中国分区能源-排放-空气质量-气候-健康综合评估模型（REACH）和中国分区能源模型（C-REM），对中国分区域可持续转型路径及社会经济影响开展了研究。作为项目负责人或骨干成员参与多项国家自然科学基金项目和国家重点研发计划项目。

Praveen BAINSA

Clean Energy Modeller, Energy Technology and Policy division,
International Energy Agency (IEA)

She works within the supply-side team, modelling the global fuel transformation and power generation that supply the energy required by the demand sectors. Her works focuses on biofuel production, including sustainable aviation fuel. Prior to the IEA, Ms. Bains worked as a research assistant at Imperial College London in the United Kingdom, modelling the United Kingdom's electricity system with high spatial as well as temporal resolution. She has also spent a year as an ORISE Fellow working for the Office of Fossil Energy at the U.S. Department of Energy (DOE) in Washington, D.C.

Ms. Bains has a Master's degree from the Department of Energy Resources Engineering at Stanford University, and a Bachelors of Engineering in Chemical and Biomolecular Engineering from the University of Pennsylvania.

Praveen Bains
国际能源署（IEA）能源技术和政策部门的清洁能源建模师

她在供应方团队中工作，为供应需求部门所需能源的全球燃料转换和发电建模。她的工作专注于生物燃料生产，包括可持续航空燃料。在国际能源署之前，Bains 女士曾在英国伦敦帝国理工学院担任研究助理，以高空间和时间分辨率为英国的电力系统建模。她还曾在位于华盛顿特区的美国能源部（DOE）的化石能源办公室做过一年的 ORISE 研究员。

Bains 女士拥有斯坦福大学能源资源工程系的硕士学位和宾夕法尼亚大学化学和生物分子工程学士学位。

Yuri FREEDMAN

Senior Director, Business Development
Southern California Gas Company (SoCalGas)

Yuri has broad experience in development and acquisitions of energy infrastructure assets. In his current role of Senior Director of Business Development, he manages the portfolio of growth initiatives and R&D activities of Southern California Gas Company (SoCalGas), the largest North American gas utility. Prior to his current role he held the position of Director of Commercial Development for Sempra LNG, and previously held the positions of Director of Infrastructure Investments and Director of Corporate Mergers & Acquisitions at Sempra Energy. Prior to joining Sempra Energy, Yuri held the positions of Managing Director at Fortress Investment Group and Vice President at GE Energy Financial Services. He began his career as a geologist working in Arctic regions of Western Siberia on the development and construction of natural gas pipelines.
Yuri serves on the board of CALSTART. He holds an MBA from the Yale School of Management and a PhD in Environmental Science and Energy Research from the Weizmann Institute of Science in Israel.

Yuri Freedman
南加州天然气公司业务发展高级总监

Yuri 在能源基础设施资产开发和收购方面拥有丰富的经验。他目前担任业务发展高级总监，负责管理北美最大的天然气公司南加州天然气公司 （SoCalGas） 的增长计划及研发活动。在担任现任职务之前，他曾担任 Sempra LNG 的商业开发总监，并曾担任 Sempra Energy 的基础设施投资总监和企业并购总监。

在加入 Sempra 能源之前，Yuri 曾担任 Fortress 投资集团董事总经理和 GE 能源金融服务副总裁。他的职业生涯始于西西伯利亚北极地区，从事天然气管道的开发和建设的地质学家。

Yuri 是 CALSTART 的董事会成员。他拥有耶鲁大学管理学院的工商管理硕士学位和以色列魏茨曼科学研究所的环境科学与能源研究博士学位。

Bingsheng XU

Associate Researcher.
China National Institute of Standardization

Xu Bingsheng graduated from Peking University Institute of Technology, majoring in energy, power and resource engineering, and obtained his Ph.D. as an associate researcher.

Research field: Engaged in standardization research in ecological civilization, biomass new energy, third-party treatment of environmental pollution, solid waste treatment and disposal, etc.

Research achievements:
He presided over the study of ecological environment standard system and pilot demonstration project. Responsible for the establishment of Huzhou Ecological Environment Standardization Demonstration Zone, Zhangjiakou Ecological Civilization Standardization Planning Research, National Ecological Civilization Experimental Zone (Jiangxi) Standard System Research, National Ecological Civilization Experimental Zone (Guizhou) Standard System Research, Hainan Province Green Standard System Research Project. He presided over the national key R&D plan "Application Research of Integrated Solutions for Optimization and Control of Environmental Protection Equipment and System Facilities in Typical Industries", and presided over the research project of supporting the third-party treatment standard system and evaluation method of environmental pollution. Participate in 863 science and technology plan, national science and technology support and national natural science foundation, such as the construction of green design platform for high-performance lead batteries, the theoretical research on the revision of atmospheric non-point source emission control standards, the research on key technologies and integrated application of monitoring and control of energy conservation and emission reduction in key industries, the research on key technologies of deep dust removal and flue gas purification in metallurgical industry, the research on green production technology of efficient utilization of magnesite, and the research on mass-energy conversion and slag wetting mechanism of CO2 slag splashing. He published 21 papers in SCI, EI and Chinese core journals, participated in drafting and formulating 7 series standards of technical specifications for green product evaluation, and participated in the compilation of "Typical Model Cases of Circular Economy Standardization".

徐秉声

中国标准化研究院 资源环境研究分院 副研究员

徐秉声毕业于北京大学工学院能源动力与资源工程专业，获得博士学位，副研究员。

研究领域：从事生态文明、生物质新能源、环境污染第三方治理、固废处理处置等领域标准化研究工作。

科研成果：

主持完成生态文明标准体系研究及试点示范项目研究。负责湖州市生态文明标准化示范区创建、张家口市生态文明标准化规划研究、国家生态文明试验区（江西）标准体系研究、国家生态文明试验区（贵州）标准体系研究、海南省绿色标准体系研究项目。主持国家重点研发计划“典型行业污水处理和固废处理处置环保装备及系统设施优化控制集成解决方案应用研究”课题，主持完成支撑环境污染第三方治理标准体系及评价方法研究项目，参与高性能铅蓄电池绿色设计平台建设、大气面源排放控制标准制修订技术方法的理论研究、重点行业节能减排监测控制关键技术及集成应用研究、冶金行业烟气深度除尘及烟气净化关键技术研究、菱镁矿高效利用绿色生产技术研究、CO_2溅渣护炉质能转换和炉渣润湿机理的研究等 863 科技计划、国家科技支撑及国家自然科学基金等重大课题研究。发表 SCI、EI 及中文核心期刊论文等 21 篇，参与起草制定绿色产品评价技术规范系列标准 7 项，参编《循环经济标准化典型模式案例》论著。

Weiquan WANG

Registered Consulting Engineer
Deputy Secretary General
Chinese Renewable Energy Industries Association (CREIA)

Mr. WANG is Registered Consulting Engineer. He has been working on renewable energy over 15 years in Chinese Renewable Energy Industries Association (CREIA). He is focusing on the industry and policy analysis of renewable energy, including biomass energy, solar energy, wind energy, geothermal, etc. Mr. WANG has participated in many research and study about renewable energy such as renewable energy planning, roadmap for distributed energy, market and policy of power sector, renewable energy heating in the north of China, financing mechanism for renewable energy, cooperation and technology transfer on renewable energy between China and Africa etc. Mr. WANG has a good network in renewable energy field and particularly in clean heating area.

王卫权

中国循环经济协会可再生能源专业委员会 副秘书长
注册咨询工程师（投资方向）

王卫权现任中国循环经济协会可再生能源专业委员会副秘书长等职务，主要从事可再生能源行业研究和市场分析，研究领域包括太阳能光伏发电、太阳能热利用、风力发电、生物质供热、秸秆发电、沼气、地热能等。曾参与可再生能源发展规划、分布式发电技术路线图、电力市场与政策、可再生能源投融资机制、中非可再生能源合作、中非可再生能源技术转移等多个研究课题。

Presentations

演讲材料

Transportation Fuels from Biomass in California and the USA

International Biofuel Standard Workshop
Beijing, China
February 2, 2021




Stephen Kaffka*
University of California, Davis &
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http://biomass.ucdavis.edu/

Summary:

1. Policies stimulate biofuel use and are needed to support biofuel adoption and innovation.
2. Optimal feedstocks and fuel types vary locally (one size does not fit all).
3. Feedstock quality, cost and abundance have favored crop-based feedstocks, but first generation technologies based on crops can be the pathway to adoption of advanced technologies and the use of lower quality feedstocks.
4. In California, optimal feedstock-biofuel systems should provide multiple public goods. Biofuel production and use can help achieve important environmental public goods like healthy forests, landscape restoration and pollution reduction, while providing petroleum substitutes.

Transportation Fuels from Biomass in California and the USA: OUTLINE

1. **Policies drive biofuel use at both the national and state level (Federal: RFS, State: LCFS)**
2. **Biomass used for biofuels at the national and state levels (crops, livestock wastes, urban residuals, forest biomass)**
3. **The optimal role of biomass for biofuels in California: helping to achieve public environmental goods**

There are differing biofuel regulations at the federal and state level

- **The Federal EISA (2007) and the RFS2 mandate the use of biofuels, mandate minimum *Carbon Intensities*, and mandate the amounts of fuels to use. But mandates are subject to review (and politics).**
- **California's LCFS mandates reductions in the *Carbon Intensity* of Fuels but does not specify which types of fuels or how much must be used.**
- **These laws are not harmonized and fuel providers must meet both.**
- **Credits from the RFS and LCFS can be combined and enhance profitability in the California market.**

RFS2 Requirements (billion gals)

Type	2009	2022
Cellulosic	---	16.0
Biomass diesel	0.5	1.0
Advanced	0.6	(4.0) 21.0
Corn starch	10.0	15.0
Total	11.1	36.0

Advanced: renewable fuel (from qualifying feed stocks like Brazilian sugarcane*, grain sorghum*,…) anything other than EtOH derived from corn starch, at lest 50% less GHG than petroleum. (Older corn starch facilities are largely exempt from GHG requirements).
Cellulosic: 1. Crop residues such as corn stover, wheat straw, rice straw, citrus residue, sugarcane bagasse. 2. Forest material including eligible forest thinnings and solid residue remaining from forest product production. 3. Annual cover crops planted on existing crop land such as winter cover crops. 4. Separated food and yard waste including biogenic waste from food processing. 5. Perennial grasses including switchgrass and *Miscanthus*.

Biodiesel (> 1 bgy) can substitute for advanced ethanol. *arbitrary classifications

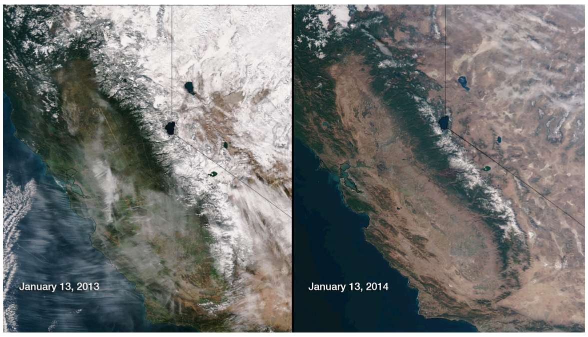
The implementation of the federal RFS has been mired in political controversy and the subject of unending disagreement among biofuel producers, the oil industry, and organized environmental organizations. It is beset with lawsuits and policy uncertainty.

"…the contours of the debate haven't changed. **Environmental groups such as the National Wildlife Federation maintain that conventional ethanol isn't the beneficial fuel alternative** they'd hoped for when the renewable fuel standard was adopted in the mid-2000s and is doing more harm than good. **The conflict among biofuel groups, environmental organizations and the petroleum industry will weigh on the Biden administration** as it reviews pending regulations under the renewable fuel standard. Proposed regulations on minimum biofuel volumes for this year are behind schedule, and EPA has withdrawn regulations on the RFS and other policies that were under review at the end of the Trump administration." **Jan 27, 2021**

https://www.eenews.net/greenwire/2021/01/27/stories/1063723681?utm_campaign=edition&utm_medium=email&utm_source=eenews%3Agreenwire

Signing AB 32: The Global Warming Solutions Act

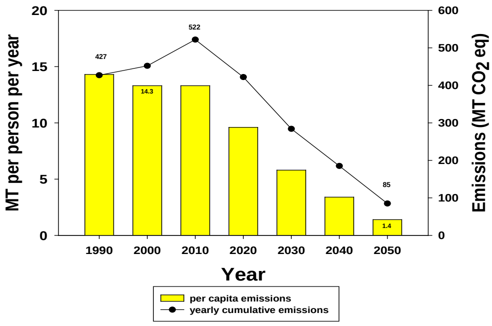
Drought effects on winter snowpack and water storage in California.



Important California Regulations

- Global Warming Solutions Act (AB 32),
- Low Carbon Fuel Standard
- Alternative and Renewable Fuel, Vehicle Technology, Clean Air, and Carbon Reduction Act (AB 118)
- Cap and Trade

: Emission Trajectory Towards 2050

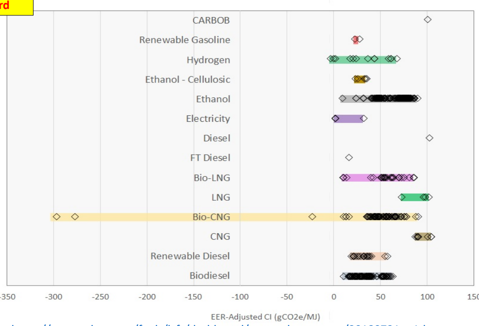


Low Carbon Fuel Standard: a performance based standard

- Creates a framework for transition to low carbon fuels. Described as a performance standard.
- Establishes a regulatory precedent or model for others, and is only effective if others participate.
- Encourages technology innovation. Putatively technology neutral, (but now favors electrification and H2)
- Allows for biofuel providers and others to assert alternative Carbon Intensities, but these are subject to CARBS' review and approval. (CA-GREET, GTAP used for LCA)

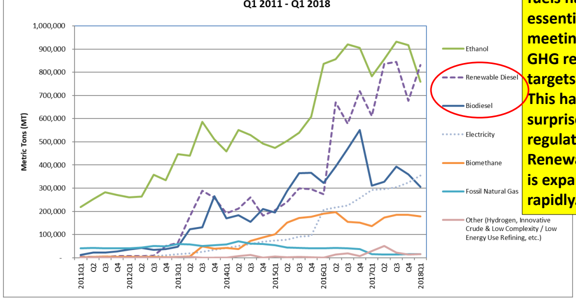
CA Low Carbon Fuel Standard

Carbon Intensity Values of Current Certified Pathways (2018)



https://www.arb.ca.gov/fuels/lcfs/dashboard/quarterlysummary/20180731_q1datasummary.pdf

CA Low Carbon Fuel Standard



Alternative diesel fuels have been essential to meeting the LCFS' GHG reduction targets for fuels. This has been a surprise to the regulators. Renewable diesel is expanding rapidly.

https://www.arb.ca.gov/fuels/lcfs/dashboard/quarterlysummary/20180731_q1datasummary.pdf

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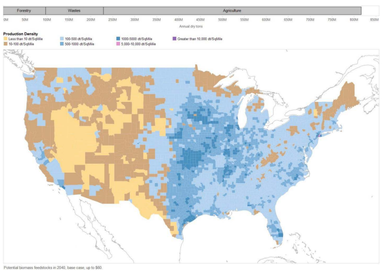
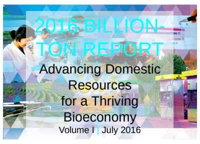
UC DAVIS PLANT SCIENCES — UC ANR MAKING A DIFFERENCE — CALIFORNIA BIOMASS COLLABORATIVE

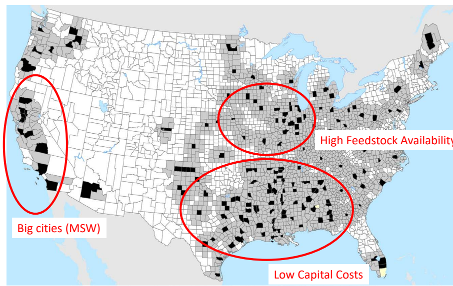




Estimated biomass amounts from forests, farms and urban areas suitable for bioenergy in the USA

U.S. DEPARTMENT OF ENERGY

USEPA predictions (Siting Tool), J. Brown 2010



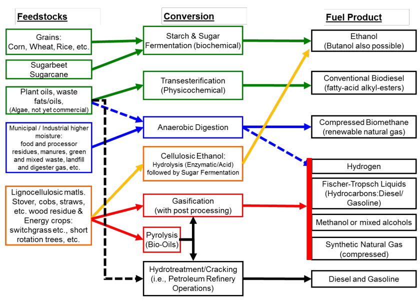
EPA - ASD Division Meeting 16 27 January 2021

Table SK-1. Constructed or proposed advanced ligno-cellulosic or algal biofuel facilites in the United States										
Company			mg/y							
year	2009	2010	2011	2012	2013	2014	State	Region	Fuel	Technology
Cobalt	0.01	0.01	2.01	102.01	102.01	102.01	California	California-irrigated	Biobutanol	Fermentation
Gevo	1	1	50	150	300	300	Missouri	Lower Mississippi River	Biobutanol	Fermentation
Aurora Biofuels	0.01	0.01	0.01	0.01	0.01	0.01	Florida		Biodiesel	Algae transesterification
Solix	0.01	0.01	0.01	0.01	0.01	0.01	Colorado	western great plains and irrigated	Biodiesel	Algae transesterification
Abengoa	0	0	15	15	15	15	Kansas	western great plains and irrigated	Ethanol	Enzymatic hydrolysis
ADM	0	0	0	1	1	1	Illinois	corn-belt	Ethanol	Enzymatic hydrolysis
AE Biofuels	0.01	10.01	10.01	10.01	10.01	10.01	Montana	northern plains	Ethanol	Enzymatic hydrolysis
American Process	0	0	0.89	0.89	0.89	0.89	Wisconsin	easternand central farming and forest	Ethanol	Enzymatic hydrolysis
BlueFire Ethanol	0.01	0.01	3.91	3.91	22.91	22.91	California	California irrigated	Ethanol	Acid hydrolysis
Coskata	0.05	0.05	0.05	55.05	55.05	55.05	Southeast US	southern Altlantic and gulf slope	Ethanol	Gasification
DDCE	0	0.25	0.25	0.25	0.25	0.25	Tennessee	eastern and cnetral farming and forest	Ethanol	Enzymatic hydrolysis
Fulcrum	0.01	0.01	0.01	10.51	10.51	10.51	California	California irrigated	Ethanol	Gasification
IneosBIO	0	0	8	8	8	8	Florida		Ethanol	Gasification-Fermentation
KL Energy	1.3	1.3	1.3	1.3	1.3	1.3	Wyoming	western great plains and irrigated	Ethanol	Enzymatic hydrolysis
Mascoma	0.2	0.2	0.2	20.2	20.2	20.2	New York	Northesast forage and forest	Ethanol	Consolidated bioprocessing
POET	0.02	0.02	25.02	25.02	25.02	25.02	Iowa	corn-belt	Ethanol	Enzymatic hydrolysis
Range Fuels	0	4	4	4	4	4	Georgia	southern Atlantic and gulf slope	Ethanol	Gasification
Verenium	1.4	1.4	1.4	37.4	37.4	37.4	Louisiana	Mississippi valley and delta	Ethanol	Enzymatic hydrolysis
AltAir	0	0	0	100	100	100	Washington	Pacific northwest interior	RDIF	Hydroprocessing
Amyris	0.01	0.01	0.02	1.02	27.02	27.02	California	California irrigated	RDIF	Consolidated bioprocessing
Clearfuels	0	0.1	0.1	0.1	0.1	16.1	California	California irrigated	RDIF	Steam reform
Dynamic Fuels	0	75	75	75	75	75	Louisiana	Mississippi valley and delta	RDIF	Fischer-Tropfs
LS9	0.01	0.1	10.1	10.1	10.1	10.1	Florida		RDIF	Consolidated bioprocessing
PetroAlgae	0.12	0.12	0.12	70.12	140.12	210.12	Florida		RDIF	Coking
Sapphire Energy	0.01	0.2	0.02	0.02	0.02	0.02	New Mexico	Southwestern range and irrigated	RDIF	Hydroprocessing
Solazyme	0.1	0.1	0.1	100.1	100.1	100.1	California	California irrigated	RDIF	Hydroprocessing
Virent	0	0	0.01	0.01	0.01	0.01	Wisconsin	Lake states forest and cropped	RDIF	Bioforming
Kent BioEnergy	0.01	0.01	0.01	0.01	0.01	0.01	California	California irrigated	Renewable oils	Lipid extraction
US Biofuels	0.12	3.8	5.9	10.5	25.3	25.3	California	California irrigated		
total	4.41	97.72	213.45	811.55	1091.35	1177.35				

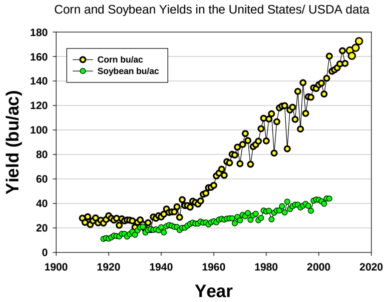
Idled POET corn stover to ethanol facility, Emmetsburg, Iowa

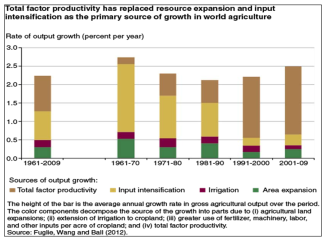
It has been difficult to develop successful businesses in the US based on cellulosic materials. Previously proposed, partially developed or built cellulosic bioernergy facilities/companies (2011). Only Amyris and Fulcrum are operating or about to operate facilities currently. POET, DuPont, and Abengoa constructed facilities but either abandoned or sold them (DuPont, Abengoa) them or idled them. Amyris has shifted to production of high value bio-products and uses sugar as a feedstock.

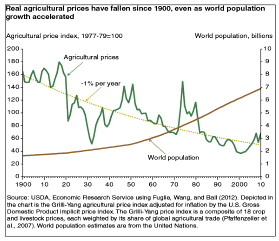
There are many types of biofuel feedstocks and many possible conversion pathways, but those relying primarily on crops and biochemical conversion processes dominate biofuel production. This is due to feedstock quality (ease of conversion), abundance and price.



Crop based feed stocks have dominated biofuel production in the US (and Brazil) because yields steadily increase while resource use efficiency increases simultaneously. This generates a condition of chronic surplus in the USA. Bioenergy use helps sustain the farm economy by clearing that surplus and sustaining prices. This is expected to continue.







Total factor productivity in agriculture in the USA has increased, leading to steady surpluses and declining food prices, while input use has declined. This leads to industrial uses for crops.

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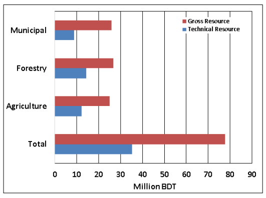
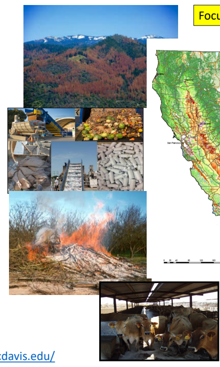
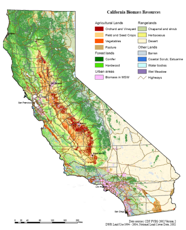
3. **The optimal role of biomass for biofuels in California: helping to achieve public environmental goods_some examples**





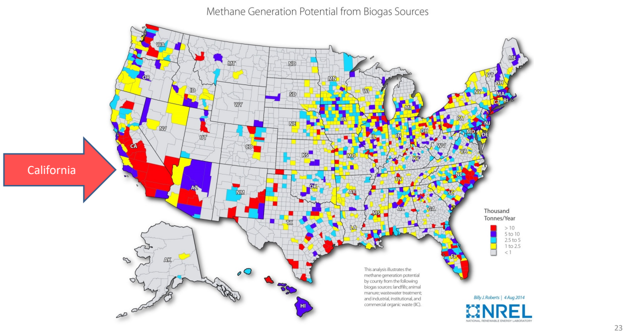
Focus on California



California has a large and diverse amount of biomass, approximately equally divided among urban, forest, and agricultural sources. There are multiple co-benefits and accepted public goods that can be supported by prudent and sustainable biomass use for energy, including for alternative fuel production. This is much less the case for the ZEV program.

https://biomass.ucdavis.edu/

Biogas Potential - Overall



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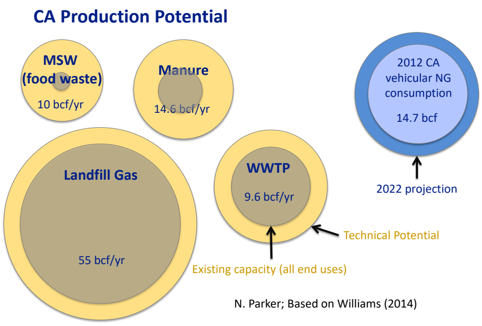
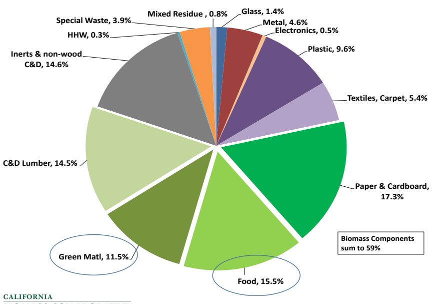
Renewable natural gas potential in California

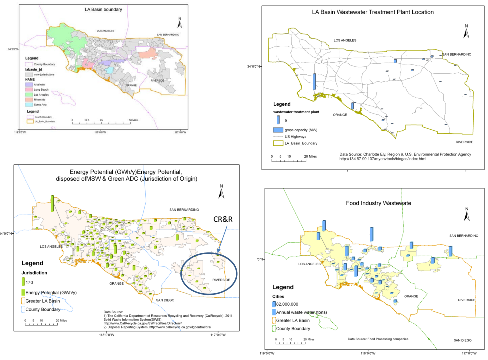


N. Parker; Based on Williams (2014)

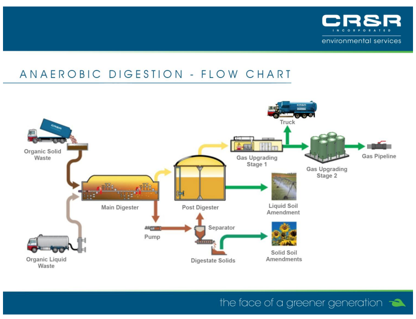
California landfilled waste stream by material type



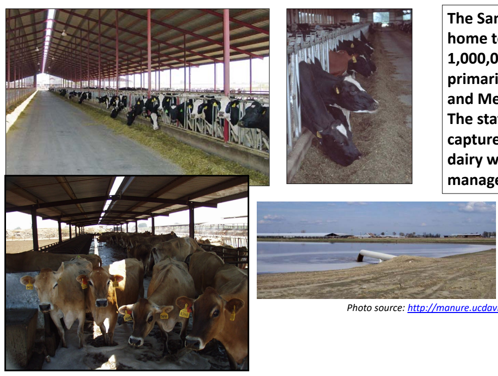
(adapted from 2008 characterization: (Cascadia 2009))



There are large amounts of potentially usable biomass in urban areas of California. Example: the Los Angeles region



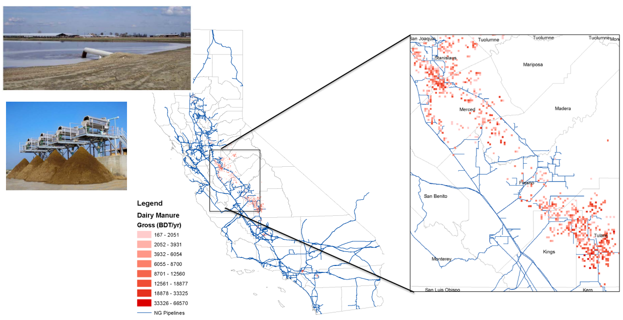
Courtesy of CR&R Environmental Services

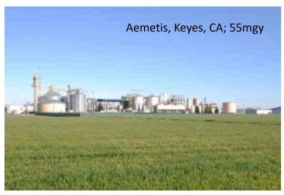


The San Joaquin Valley is home to more than 1,000,000 dairy cows, primarily in Tulare, Kern and Merced Counties. The state subsidizes the capture of CH4 from dairy waste management systems.

Photo source: http://manure.ucdavis.edu/Illustrations/Dairy_Lagoons/

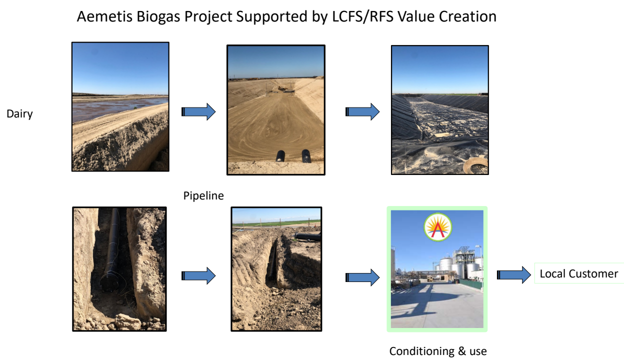
Spatial distribution of dairy manure and the NG transmission network

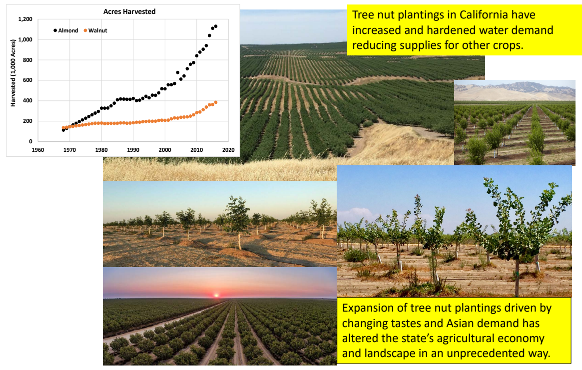


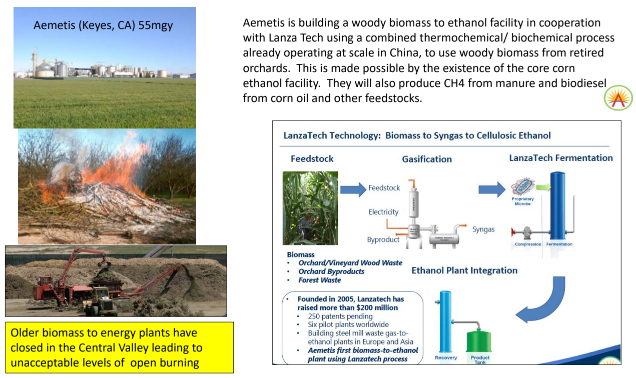


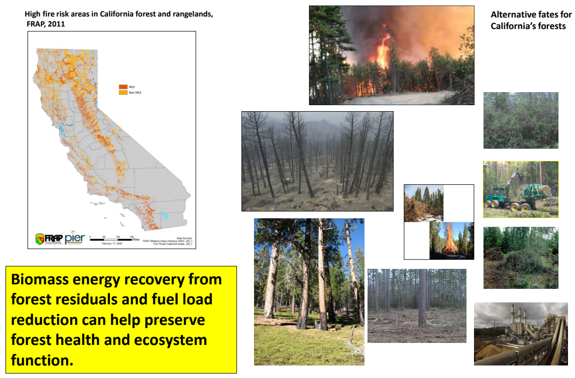
Each of these current ethanol refineries in California are evolving into integrated biorefineries. The LCFS and RFS support investments in innovative technologies and alternative feedstock uses. First generation technologies support and are a necessary step to the development of later generation technologies.

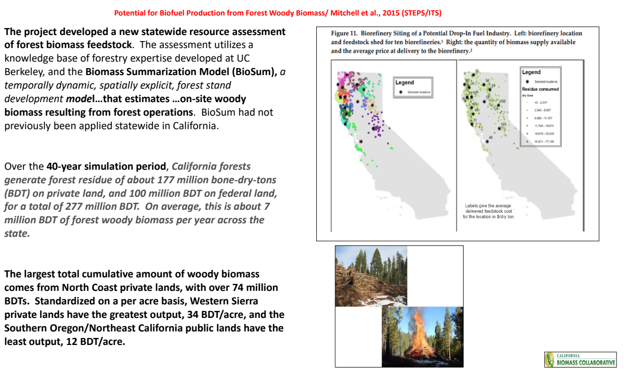
Calgren, Pixley CA; 60 mgy











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4. In California, optimal feedstock-biofuel systems should provide multiple public goods. Biofuel production and use can help achieve important environmental public goods like healthy forests, landscape restoration and pollution reduction, while providing petroleum substitutes.

Supplemental Slides

California has adopted the most aggressive climate focused policy within the USA and perhaps the world. This policy is justified as necessary based on projections of severe, future climate-related harms and a judgement that the higher costs of climate policies are necessary and ethically justified.

"CA is particularly vulnerable to the costs associated with unmitigated climate change. A warming climate would generate more smoggy days, ozone, and foster more large brush and forest fires… by late century, CA will loose 90% of the Sierra snow pack, sea level will rise by more than 20 inches, and there will be a 3x to 4X increase in heat wave days. This will lead to increased flood damage, diverse economic losses and substantial public health costs." Assembly Bill 32 Scoping Plan (Executive Summary).

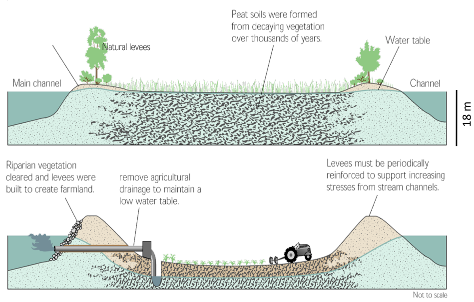
Annual Damage Estimates in 2006 USD (billions)			
	LOW	HIGH	ASSETS AT RISK
Water	N/A	0.6	5
Energy	2.7	7.5	21
Tourism and Recreation	0.2	7.5	98
Real Estate	0.3	3.9	2500
Agriculture, Forestry, Fisheries	0.3	4.3	113
Transportation	N/A	N/A	500
Public health	3.8	24.0	N/A
TOTAL	7.3	46.6	

Fredrich and Roland-Holst (2008)

The Delta region: Before and after: 100 years

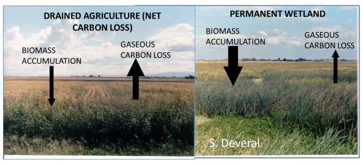


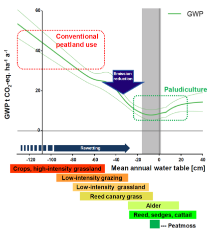

Land subsidence and dissolved organic matter




Subsidence = 1 to 3 cm/y

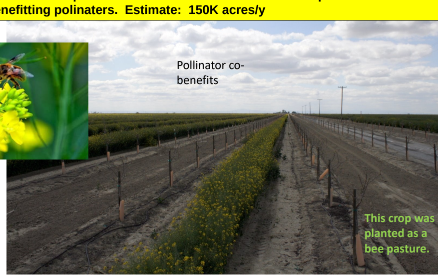
LIFE CYCLE ASSESSMENT, CARBON ACCOUNTING, STATE AND FEDERAL CARBON AND ENERGY POLICY





Tannenberger

Canola intercropped with newly-planted pistachios in Kern County. Pistachios emerge late. There is a large amount of land potentially available in new or re-planted orchards and vineyards in California on a yearly basis that might produce oilseed crops in winter, largely on rainfall or with limited irrigation. There may be opportunities in young orchards throughout California for both Canola and Camelina winter inter-crops. These oils can be used for biodiesel production without using new land while benefitting polinaters. Estimate: 150K acres/y

CALIFORNIA'S LOW CARBON FUEL STANDARD AGGREGATED CERTIFIED PATHWAYS

Data Source: https://www.arb.ca.gov/fuels/lcfs/fuelpathways/pathwaytable.htm

Fuel	Producers	Facility Locations	Feedstock	Average Carbon Intensity Value (gCO2e/MJ)
Diesel	ULSD - based on the average crude oil supplied to CA refineries and average CA refinery efficiencies	California	Crude Oil	102.01
Bio-diesel	BIOX Canada, American Biodiesel, ADM, REG Grays Harbor, Western Iowa Energy	CAN, CA, IA, ND, WA	Canola Oil	55.13
	BIOX Canada, Duonix Beatrice, American Biodiesel, Crimson Renewable Energy, FutureFuel Chemical Company, Western Iowa Energy, Imperial Western Products, REG Mason City/Newton/Albert Lea/Seneca/Danville, High Plains Bioenergy, Adkins Energy	CAN, AR, CA, IA, IL, KS, MN, NE	Corn Oil	34.43
	BIOX, American Biodiesel, ADM, Western Iowa Energy, Ag Processing, REG Mason City, Clinton Biodiesel, Delek Renewables, FutureFuel Chemical, Global Alternative Fuels, Lakeview Biodiesel, Solfuels, W2Fuels	CAN, AR, CA, IA, MO, MI, TX	Soybean Oil	54.62
	Universal Biofuels Private, BIOX Canada, Duonix Beatrice, High Plains Bioenergy, American Biodiesel, FutureFuel Chemical Company, Crimson Renewable Energy, Rothsay Biodiesel, REG Mason City/Newton/New Boston/Albert Lea/Seneca/Danville, Western Iowa Energy, High Plains Bioenergy, Delek Renewables, Imperial Western Products	CAN, India, AR, CA, IA, IL, MN, NE, OK, TX	Tallow	35.01
	Universal Biofuels, Consolidated Biofuels, Duonix Beatrice, Crimson Renewable Energy, FutureFuel Chemical Company, Biocom Energia, American Biodiesel, New Leaf Biofuel, Rothsay, Scott Petroleum, REG Grays Harbor/Mason City/Newton/New Boston/Albert Lea/Seneca/Danville, Western Iowa Energy, Crimson Renewable Energy, Imperial Western Products, BIOX Canada, SeQuential, GeoGreen Biofuels, Global Alternative Fuels, Buster Biofuels, Biodico Westside, Delek Renewables, JC Chemical, General Biodiesel, Dansuk Industrial, ASB Biodiesel, Thumb Bioenergy	CAN, Hong Kong, India, South Korea, Spain, CA, AR, IA, IL, MI, MN, MS, NE, OR, TX, WA	Used Cooking Oil	20.67
Renew-able Diesel	Neste, Diamond Green Diesel, REG Geismar	Singapore & LA	US Corn Oil	34.33
	Diamond Green Diesel & REG Geismar	LA	Soybean Oil	55.22
	Neste	Singapore	South East Asian Fish Oil	33.08
	Neste, Diamond Green Diesel, REG Geismar	Singapore & LA	Tallow	34.48
	Neste, Diamond Green Diesel, REG Geismar	Singapore & LA	Used Cooking Oil	20.98
	Ensyn Technologies	Ontario, CAN	Pyrolysis Oil from Forest Residue	27.33
Fischer-Tropsch Diesel	Fulcrum Sierra BioFuels (Commerical production scheduled for early 2020)	NV	Municipal Solid Waste (MSW)	14.78

The lowest carbon intensity (CI) values are for corn oil (derived from ethanol production) and renewable diesel, (from FOG), and urban residuals.

There is room to lower the CI of soy and canola derived biodiesel, and other innovative crop-based SVO feedstocks.

Calgren: integrated biorefinery based on imported corn grain now (or soon) will produce biodiesel and CNG, based on biogas from 14 nearby dairies and sale of DDGS to those dairies.

Calgren is processing its own corn oil into biodiesel (with brown grease), otherwise exported to China and burned. This is a robust pathway for new biodiesel production in CA. It will integrate biogas from 14 nearby dairies to produce RNG.

中国石油和化学工业联合会
China Petroleum and Chemical Industry Federation (CPCIF)

China's biofuel industry development status and related specification system

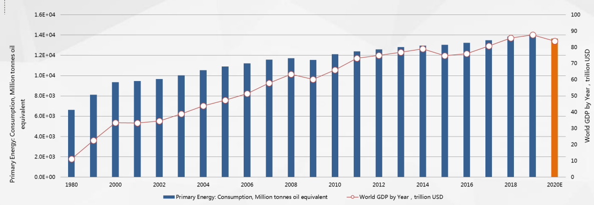
Feb. 2021 • Beijing

CONTENTS

01 Energy and renewable energy consumption of China

- China's energy consumption is growing rapidly
- China is vigorously developing renewable energy

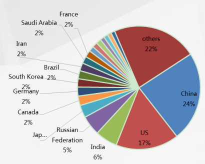
World energy consumption is growing steadily



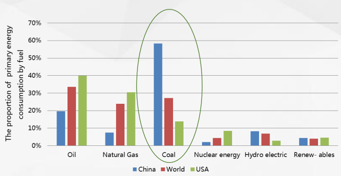
- With the continuous development of the world economy and the improvement of people's living standards, global energy consumption has grown rapidly. From 1980 to 2018, the world GDP increased by 7.6 times, accordingly, world energy consumption increased by 2 folds.

Source: IMF, BP Statistical Review of World Energy

China has become the world's largest energy consumer



Share of Primary Energy Consumption by Country

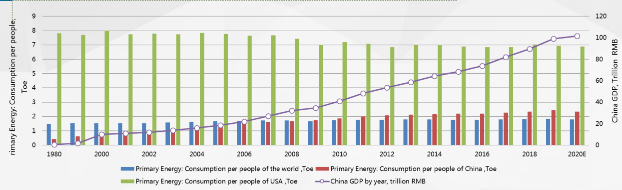


Primary Energy Consumption by Fuel Type in 2018

- The primary energy consumption of China surpassed the United States in 2009, becoming the largest energy consumer in the world.
- Constrained by nature resources, coal accounts for more than 55% of China's primary energy consumption, much higher than that of the world and developed countries.

Source: World bank, BP Statistical Review of World Energy

China's energy consumption is growing fast



- Chinese Energy consumption is closely correlated with economic growth. In the past 40 years, the primary energy consumption per people of China has increased by 5.5 folds. As China is the largest developing country with the population of 1.4 billion.
- Although the energy consumption per people has been slightly higher than the average value of the world, however, there is still a big gap between developed countries (only about 1/3 of USA) .

Source: World Bank, IMF, BP Statistical Review of World Energy, Bureau of Statistics of China

China has attached great importance to develop and utilize of renewable energy for a long time

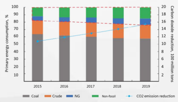
- **In order to fulfill the rapid growth of energy consumption , optimize the energy structures and reduce GHG emission, developing and utilization of renewable energy is one of the important aspects in China's energy policy.**

Time	Achievements
1900-1970s	Developed Small-scale hydropower, Bio methane and firewood forest in rural area
1980s	Government set up renewable energy office to research renewable energy development issues
1997	Issued a ***national renewable energy development plan*** for the first time. To support renewable energy demonstration projects
2002	Signing the ***Kyoto Protocol***, to improve energy efficiency. To develop renewable energy and plant trees to mitigate climate change
Jan. 2006	Issued the ***renewable energy act*****.** Renewable energy has entered a period of rapid development. The act include Hydropower, wind power, solar power, geothermal, biomass energy etc.
2013	Issued ***Action Plan of Air Pollution Prevention and Control***, Adjusting energy structure, reducing coal consumption and increasing clean energy supply are important measures to control air pollution
2015	Signed the ***Paris agreement***, China has pledged to reduce carbon dioxide emissions per unit of GDP by 60-65% of 2005 levels by 2030, and increase the share of non-fossil fuels in primary energy consumption to around 20%.
2020	**Chairman Xi made the statement of "China will take effort to be peak CO2 emissions by 2030 and to be carbon neutral by 2060."**

China is the world's largest consumer of renewable energy

- **Since the implementation of the *Renewable Energy Law* in 2006, renewable energy has become an important part of China's energy supply.**
- **By the end of 2019, China has became the largest renewable energy consumer in the world.** The total consumption of commercialized renewable energy is about 430 million tons of oil equivalent, accounting for 12.6% of China's primary energy consumption.
- Renewable energy consumption is 2.5 times that of the United States of America, 3.8 times that of Brazil, and 8 times that of Germany.

Item	Value
Renewable power generation	2 trillion kilowatt·hours
Biomass energy utilization	12 million tons of oil equivalent
Liquid Biofuel	3 million tons of oil equivalent
Bio-nature gas	1.3 billion cubic meter (1 million tons of oil equivalent)



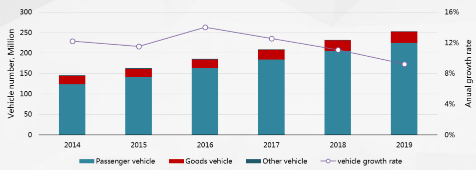
Target: The share of non-fossil fuels in primary energy consumption will be to around 20% by 2030.

Source: 《China Renewable Energy Development Report 2019》

02 Current status of transportation energy and liquid biofuels of China

- Road traffic development in China
- China oil market
- Development of liquid biofuels in China

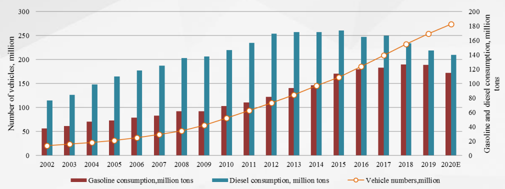
Road traffic of China grown very fast



- By 2019, China's vehicle number has reached 250 million, which is not including agriculture vehicle and motorcycle, and the growth rate of passenger vehicle is the fastest segment.

Source: Statistical bureau of China , CPCIF

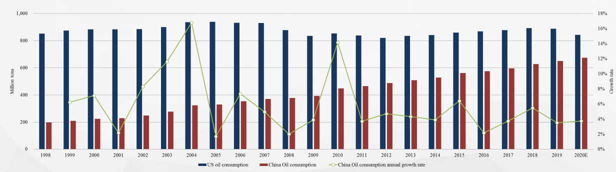
Transport fuel consumption is growing rapidly



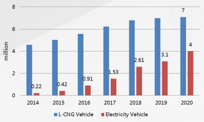
- With the rapid increase of the number of vehicles, the consumption of transportation fuel has also increased significantly, correspondingly.
- In 2020, the Gasoline and Diesel consumption is about 115 million tons and 140 million tons respectively.

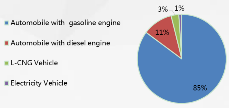
China has already become the second largest oil consumer in the world

- **In 2020, China consumed 620 million tons crude oil, which is the second largest crude consumer in the world, and China has already become the world largest crude importer.**



Actively promotes transportation energy diversification





- In response to the rapid growth of transportation energy, China is actively promoting the diversification of transportation. The number of natural gas and electric vehicles increased significantly.
- In 2020, there were 7 million natural gas vehicles in China, accounting for 25% of global natural gas vehicles. EV number has reached 4 millions, growing very fast. Although the growth rate is fast, the share is still pretty low.

- **By 2050, There will be a large number of vehicles with gasoline and diesel engine are still in service.**
- **Developing and utilization of liquid low-carbon renewable fuels (biofuels) is always an effective way to solve transportation energy problems (supplement, GHG emission, sustainable development, etc.). The Chinese government has done so.**

China's main policy for supporting liquid biofuels

Jan. 2006, *Renewable Energy Law*.

- Definition: Liquid biofuels refer to liquid fuels such as methanol, ethanol and biodiesel produced from biomass resources.
- The state encourages the production and use of liquid biofuels. Oil enterprises should incorporate the liquid biofuels into its fuel blending system conforming to the fuels specification of national level.

Aug. 2007, *Medium and Long-term Development Plan for Renewable Energy*.

- By 2020, 10 million tons of bio-ethanol and 2 million tons of biodiesel will be used annually.

Mar. 2008*, The Eleventh Five-year Plan for the Development of Renewable Energy*.

- By the end of 2010, fuel ethanol consumption would be 2 million tons per year, and biodiesel consumption would be 200 thousand tons per year.

China's main policy for supporting liquid biofuels

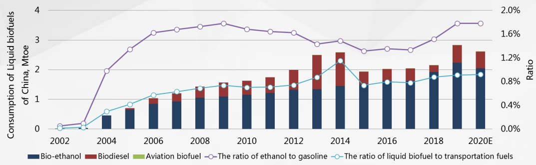
Aug. 2012*, The Twelve Five-year Plan for the Development of Renewable Energy*.

- Steady development of bio-liquid fuels. Constantly support the construction of cassava ethanol, sweet sorghum ethanol, cellulosic ethanol and other projects where conditions allow.
- Continue promoting the demonstration of the industrialization of biodiesel from woody oil plants represented by *jatropha*
- Scientifically guide and regulate the development of biodiesel industry based on catering and waste animal and vegetable oils.

Dec. 2016*, The Thirteen Five-year Plan for the Development of Renewable Energy*.

- Steady expansion of fuel ethanol production and consumption.
- The total amount of grain fuel ethanol should be controlled in combination with the consumption of old grain and heavy metal contaminated grain. Moderate development of cassava, sweet sorghum and other fuel ethanol projects.
- Promoting the industrialization and demonstration application of biomass conversion and synthesis of biofuel and bio-aviation fuel.

Development status of liquid biofuels in China

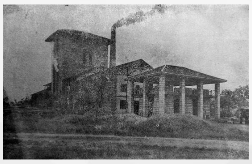


- Supported by the policy, production and consumption of fuel ethanol have risen steadily since 2002.
- In 2020, the total consumption of liquid biofuels was round 2.6 million tons of oil equivalent, which accounting for 1 percent of transportation fuel consumption in 2020.
- Currently, liquid biofuels capacity of China is about 9 million tons, including 6 million tons of biofuel ethanol, 2.5 million tons of biodiesel and 100 Ktons of aviation biofuel.

03 Ethanol, Bio-Diesel, Aviation biofuel development in China

The application of ethanol gasoline in China has long history

- The utilization of fuel ethanol in China began during the War II, due to the lack of fuel supply, ethanol partly replaced gasoline as cars and the military vehicles fuels for the war.
- By 1942, China had hundreds of distilleries and consumed 8 million gallons of fuel ethanol at that time.
- With the steady supply of gasoline after 1945, the demand of fuel ethanol had declined rapidly.



Zi Zhong Distiller, Sichuan province, 1940

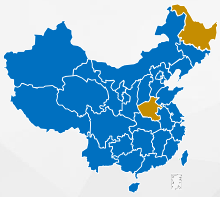
Distiller	Site
Fang lin Distiller	Henan, Nanyang
The first Sichuan Distiller	Sichuan, Neijiang
The Second Sichuan Distiller	Sichuan, Zizhong
The Thrid Sichuan Distiller	Sichuan, Jianyang
Yunnan Distiller	Yunnan, Kunming
Guizhou Distiller	Guizhou, Zunyi
Gansu Distiller	Gansu, Lanzhou

The application of ethanol gasoline in China began at the beginning of this century

Time	Policy	Content
2002	***E10 gasoline tenth five year special development plan***	Zhengzhou, Luoyang, Nanyang, Harbin and Zhaodong were the first batch of pilots, stop sale of unlead gasoline
2004	***E10 Gasoline Pilot expansion program and Implementation rules***	Heilongjiang, Jilin, Liaoning, Henan, Anhui, nine cities in Hubei, Seven cities in Shandong, five cities in Jiangsu, six cities in Hebei are new pilots
2007	***Medium and Long-term Development Plan for Renewable Energy***	By 2020, 10 million tons of bio-ethanol and 2 million tons of biodiesel will be used annually.
2016	***The Thirteen Five-year Plan for the Development of Renewable Energy***	By2020, the utilization amount of bioethanol should be 4 million tons.
2017	***Implementation Plan for Expanding Biofuel Ethanol and Promotion of the Use of Ethanol Gasoline***	Utilization of fuel ethanol will be expanded nationwide, and primary market operation mechanism should be established by 2020.

The Scale Promotion of Ethanol Gasoline Began in the Beginning of 21 Century

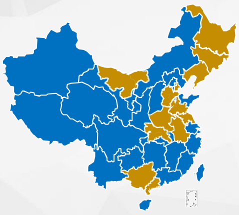
- **In 2001,** China launched the Tenth Five-Year renewable energy substitute Plan to promote the use of fuel ethanol. The promotion of fuel ethanol in China was divided into two main stages.
- **The first stage (2002-2004) :** Began to pilot the promotion of ethanol gasoline (E10) in Henan, Heilongjiang province.



- During the tenth five-year plan period (2000-2005), the government approved four fuel ethanol enterprises, with a capacity of 1.02 million tons/year, using expired grain as feedstock.
- In 2002, lunched ***Ethanol-gasoline Promotion Pilot Program,*** and began to promote E10 gasoline in three cities in Henan province (Zhengzhou, Luoyang, Nanyang) and two cities in Heilongjiang province (Haerbin, Zhaodong).
- The pilot had got desire results. E10 gasoline is applicable in China, and could be expand across the country.

The Scale Promotion of Ethanol Gasoline Began in the Beginning of 21 Century

- **The second stage (2004-2017) :** Expanded E10 gasoline to 36 cities in 12 provinces.



- In 2004, Issued the ***E10 Gasoline Pilot expansion program.***
- Expand the pilot experiences of Henan and Heilongjiang to other 12 provinces, which including Jilin, Liaoning, Anhui and Guangxi etc.
- 6 provinces completely and only have E10 gasoline for sale, 6 provinces have both E10 gasoline and conventional gasoline for sales.
- Fuel ethanol consumption in 2018 was about 280 million tons (930 million gallons), and E10 gasoline accounted for one-fifth of the nation's gasoline consumption.
- China now is the world's third largest consumer of fuel ethanol after the United States and Brazil.
- Bioethanol and E10 gasoline has played an important role in agricultural development, environmental protection and energy diversification.

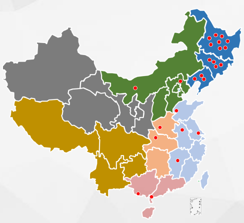
E10 will be expanded nationwide

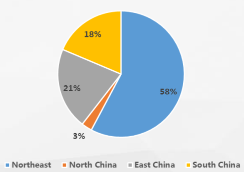
2017, ***Implementation Plan for Expanding Biofuel Ethanol and Promotion of the Use of Ethanol Gasoline,***

E10 will be expanded nationwide, and primary market operation mechanism should be established by 2020.

China is the world Third largest fuel ethanol consumer

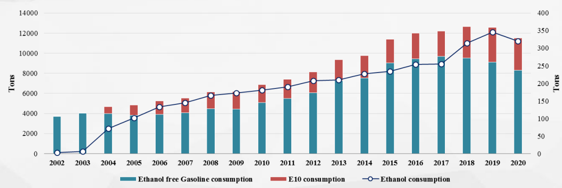
- **By the end of 2020. Ethanol capacity of China is round 6 million tons. Mainly distributed in Northeast China, North China, East China, South China.**





China is the world Third largest fuel ethanol consumer

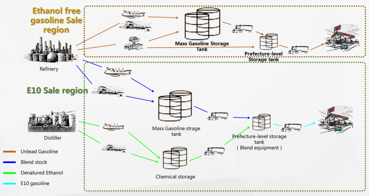
- **By 2020 , China is the world third largest fuel ethanol consumer in the world. About one-fourth of gasoline consumed in China is E10.**



Standard for ethanol and E-gasoline

Standard :

- Blenderstocks of ethanol gasoline for motor vehicles, GB22030
- Denatured fuel ethanol, GB18350)
- Ethanol gasoline for motor vehicles (E10), GB18351
- GB17930 Gasoline for motor vehicles



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Biodiesel is one of most important low-carbon liquid fuel in China

Jan. 2006, *Renewable Energy Law*.

- **Definition: Liquid biofuels refer to liquid fuels such as methanol, ethanol and biodiesel produced from biomass resources.** The state encourages the production and use of liquid biofuels.

Time	Policy	Release Department
2007	《GB/T20828-2007/2014/2015》, Biodiesel blend stock (BD 100) for diesel engine fuels	National standard committee
2009	Renewable Energy Law（Revised edition）	National People's Congress
2010	《GB/T 25199-2010/2014/2015》 Biodiesel fuel blend (B5)	National standard committee
2012	Bioproduct Industry Development Plan	State Council
2014	Biodiesel industry development policy	National Energy Administration
2016	The Thirteen Five-year Plan for the Development of Renewable Energy	National Development and Reform Commission
2017	《GB25199-2017 》 B5 diesel fuels	National standard committee
2018	Production of biodiesel using waste animal and plant oils as raw materials is subject to a Value Added Tax refund of 70%	State Administration of Taxation

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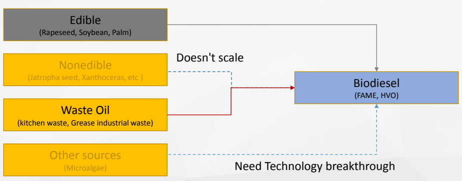
Waste oil is the main raw material of Biodiesel in China

- **Unlike other regions and countries around the world where biodiesel is being massively promoted, for the supply of oil is not sufficient. China can not use Edible oil as feedstock to produce biodiesel.**



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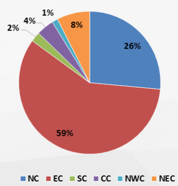
Biodiesel capacity is more than 2.5 million tons

- **There are more than 30 biodiesel enterprises in China, and the capacity is more than 2.5 million tons. These plants almost use waste oil feedstock.**



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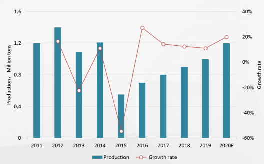
Biodiesel

- **There is no national level mandate for biodiesel in China. Some cities use B5 biodiesel according to their own regulation.**
- EU market is more attractive to Chinese waste-oil-biodiesel. In 2019, China export 660Kt biodiesel. It is estimated that biodiesel production is about 1.2 million tons, and exportation is about 900kt.

Time	Province or City application B5 biodiesel
2009	Qing mai, Hai nan
2011	Kun Ming, Yun Nan
2013	Shang Hai



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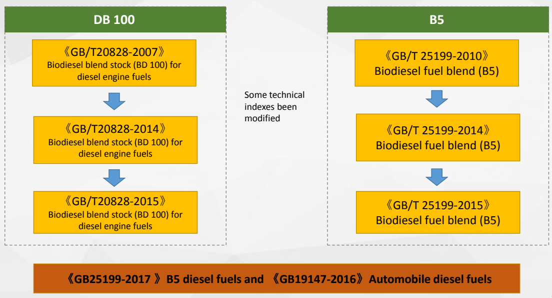
Standard for Biodiesel



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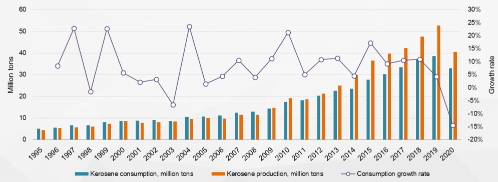
China's aviation industry is developing rapidly

- **China's aviation industry is developing rapidly, Jet fuel consumption is increasing rapidly.**
- In accordance with the requirements of the International Civil Aviation Organization, aviation industry emission reduction has been put on the agenda.



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Aviation biofuel start from 2010

- China-U.S. Advanced Biofuels Forum was held on May 26th 2010 to officially launch the relevant cooperation of the "China-U.S. Renewable Energy Partnership,

- The two sides have signed eight cooperation agreements, including aviation biofuels, natural gas distributed energy, smart electricity meters and cellulosic ethanol

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China's first aviation sustainable biofuel demonstration flight

- NEA
- CAAC
- Petrochina
- China Aviation Oil
- Air China
- capital airport
- Air Traffic Management Bureau
- Aviation Fuel/oil and aerochemicals Airworthiness certification center of CAAC
- Boeing
- Honeywell/UOP
- Pratt & Whitney

- On October 28, 2011, based on the energy cooperation between China and the United States, Air China, PetroChina, Boeing and Honeywell UOP jointly conducted China's first aviation sustainable biofuel demonstration flight at Beijing Capital International Airport.

33

Chinese No. 1 Bio-jet was issued CTSOA in 2014

- On March 24th 2013, the Civil Aviation Administration of China (CAAC) issued the No. 1 Bio-jet special flight permit to China Eastern Airlines. China Eastern Airlines took off on its A320 aircraft after it was filled with Bio-jet No. 1.
- On February 12 2014, Civil Aviation Administration of China (CAAC) officially issued CTSOA to Sinopec No. 1 Bio-jet, and has been officially approved for airworthiness and can be put into commercial use.

34

Aviation Biofuel commercial use in China

- On March 21 2015, the First commercial passenger flight of China, Hainan Airlines Flight HU7604 (Boeing 737-800) with 156 passengers and eight crew on board, took off from Shanghai Hongqiao Airport with Sinopec No.1 Bio-aviation kerosene (Hydorprocessed esters and fatty acids) , Landed at Beijing International Airport.

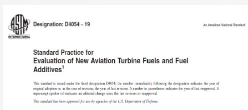
- On Nov 21 2017, HNA flight HU497 left Beijing Capital International Airport for Chicago, marking the first Sino-US green pilot flight with bio-aviation fuel.

- In 2019, China South airline completed over sea flight from Airbus delivery center in Toulouse to Guangzhou. (Hydroprocessed fermented sugars)

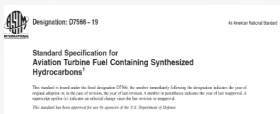
35

Standard for Aviation Biofuel

ASTM D4054， Standard practice for Evaluation of New Aviation Turbine Fuels and fuel additives



ASTM D7566， Standard specification for Aviation Turbine Fuel Contain synthesized Hydrocarbons

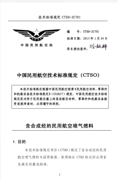


ASTM D1655， Standard Specification for Aviation Turbine Fuels

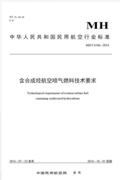
36

Standard for Aviation Biofuel

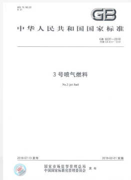
CTS0-2C701
Aviation jet fuels containing synthetic hydrocarbons



MH/T 6106-2014
Technological requirements of aviation turbine fuel containing synthesized hydrocarbons



GB 6537
No.3 Jet fuel



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Summary

- China has long attached great importance to the development and utilization of renewable energy.
- Developing and utilization of liquid biofuels is always an effective way to solve transportation GHG emission.
- In 2020, the total consumption of liquid biofuels was 2.6 million tons of oil equivalent.
- Currently, China is the world third largest fuel ethanol consumer in the world. About a quarter of gasoline consumed in China is E10.
- China is one of the world's leading producers of biodiesel, which is mainly made from recycling oil.
- China already has the technology for the production of aviation biofuel, which is also being in commercial use.

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中国石油和化学工业联合会
China Petroleum and Chemical Industry Federation (CPCIF)

Thank you !

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Tel : +8613718056593, +861084885411

Background

ASTM International's Context

- ASTM's experience offers a robust, time-tested development process delivering globally accepted and respected standards
  - Established 1898
  - 30,000+ members in 155+ nations
  - 145+ Technical Committees meeting market needs of 90+ industry sectors
- Success based on responsiveness to the market – to both member and customer needs
  - In addition to standards, we offer training, proficiency testing, certification and an electronic platform that facilitates collaboration

What Is a Standard?

- Much more than technical documents…
- Documents established by consensus, and approved by a recognized body, that provide for common and repeated use, offer rules, guidelines or characteristics
- Standards fuel global trade, promote health and general welfare, advance innovation
- Wide range of valuable uses

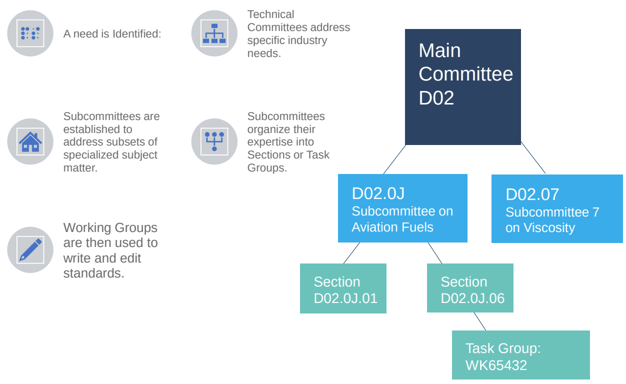
ASTM International Committee D02

Scope: Petroleum products, liquid fuels, and Lubricants

- Largest ASTM Committee, organized in 1904
- Includes over 2,700 members from more than 65 countries
- Developer of over 800 petroleum, liquid fuels, and lubricant standards that have helped to provide heat for homes, fuel for automobiles and airplanes, and lubricants for machinery
- Sponsor of numerous technical publications, laboratory quality assurance programs and technical and professional training courses, workshops, and symposia.

- ASTM Standards come in many forms:
  - Product specifications
  - Test methods
  - Manufacturing practices
  - Operational and purchasing guidelines
  - Classifications
  - Standardized terminology
  - And more….

Technical Committee Organization



Let's Look at Two Examples…

Designation: D1655 – 17

Standard Specification for Aviation Turbine Fuels[1]

6. Materials and Manufacture

6.1.1 Aviation turbine fuel, except as otherwise specified in this specification, shall consist predominantly of refined hydrocarbons (see Note 1) derived from conventional sources including crude oil, natural gas liquid condensates, heavy oil, shale oil, and oil sands. The use of jet fuel blends containing components from other sources is permitted only in accordance with Annex A1.

TABLE 1
Detailed Requirements of Aviation Turbine Fuels
Jet A or Jet A-1

Designation: D7566 – 17a

Standard Specification for Aviation Turbine Fuel Containing Synthesized Hydrocarbons[1]

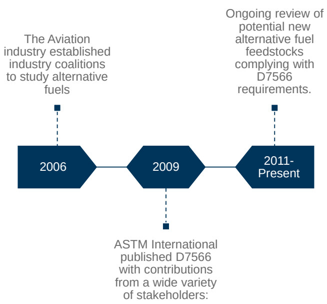
6. Materials and Manufacture

6.1 Aviation turbine fuel, except as otherwise defined in this specification, shall consist of the following blends of components or fuels:

6.1.1 Conventional blending components or Jet A or Jet A-1 fuel certified to Specification D1655; with up to 50 % by volume of the synthetic blending component defined in Annex A1.

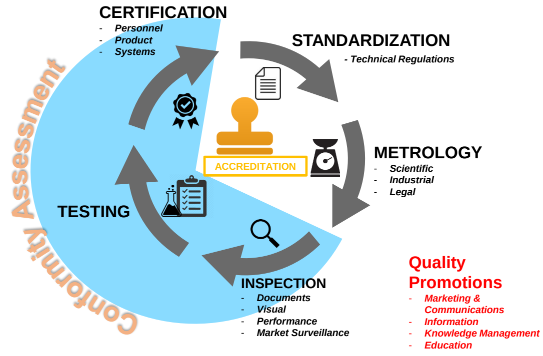
TABLE 1
Detailed Requirements of Aviation Turbine Fuels Containing Synthesized Hydrocarbons
Jet A or Jet A-1

Alternative Jet Fuel: A Need Identified



- ASTM Subcommittee D02.J on Aviation Fuels provides the forum for discussion and consensus building.
  - It is Not a Regulatory body.
  - Uses the process of D4054 Practice for the Evaluation of New Aviation Turbine Fuels and Fuel Additives to review data for new options.
  - Fit-for-purpose in existing engines and aircraft is the desired outcome
- Key Stakeholders Involved:
- Fuel and Feedstock producers
- Additive manufacturers
- Airlines
- Original Equipment Manufacturers
- Laboratories
- Regulatory and Government

Quality Infrastructure



Attributes of Standards Systems that Produce International Standards

Open and Transparent Process
- Direct and equal participation to ASTM for all people and organizations
- Information on ASTM International standards are transparent and readily available online

Impartial, Consensus-Based Model of Engagement
- Balanced system where producer votes are equal to those of users
- Impartial, inclusive, and fair to all, with appeals and protections to avoid abuses

Effective and Relevant Standards
- Constantly responding to market needs, keeping pace with industry and innovation
- Relevant to the global marketplace and performance-based in application

Driven by Research, Data, and Science-Based Decisions
- Focus on science and technical quality, and specifically addressing risks and needs

Collaboration with Other Standards Bodies to Avoid Duplications
- Collaborate with other standards organizations to avoid duplication and to pursue international standards work in a smart way

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Sustainable Aviation Fuels

Mark Augustyniewicz
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Environmental Sustainability
The Boeing Company

February 2021

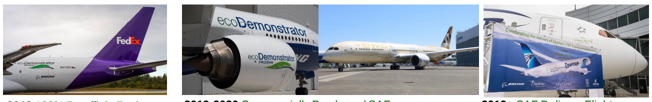
The path to 2050: bigger solutions for a smaller footprint

Airline Fleet Replacement | **Network Operational Efficiency** | **Renewable Energy Transition** | **Future Airplane Technology**

2

Sustainable Aviation Fuel on every ecoDemonstrator Program

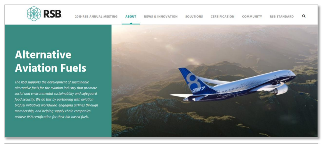
2012 HEFA Blend
2014 & 2015 Green Diesel /HEFA+ Blend
2016 Sugarcane Waste



2018 100% Paraffinic Fuel
2019-2020 Commercially Purchased SAF
2019+ SAF Delivery Flights
- Alaska launch airline; EgyptAir first delivery in new program

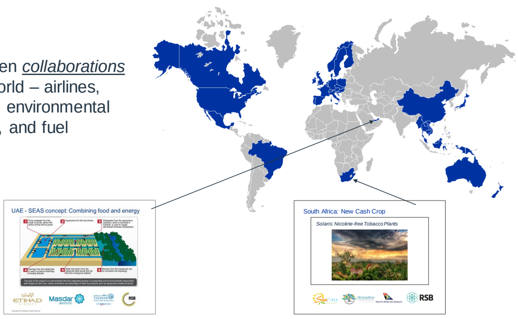
Incentives and investment needed to scale production

- New ways to make the same fuel – blends with Jet-A
- Requires no change to airplanes, engines or fueling infrastructure
- Reduces lifecycle CO2 emissions by 50% to 80%
- No negative impact to food security, fresh water supplies or land-use – strong, credible sustainability certification

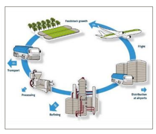


Sustainable aviation fuels and local economic development

Over two dozen *collaborations* around the world – airlines, governments, environmental organizations, and fuel producers



Examples of Boeing Collaborations in China

FLIGHT TEST
Air China conducted China's first aviation biofuel test flight in a Boeing 747-400 using China-grown, jatropha-based biofuel.

PRODUCTION
Supported NEA supervised, PetroChina led, comprehensive analysis on potential of energy crops for biofuel use.

PASSENGER FLIGHT
Boeing, Hainan Airlines and Sinopec partnered for China's first passenger flight with sustainable aviation biofuel.

FUEL PATHWAYS
MOU between Boeing and NDRC announced a new initiative to turn agricultural waste in China into sustainable aviation biofuel

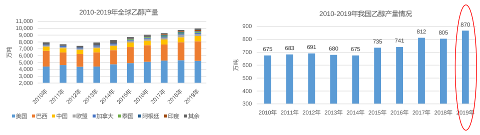
BOEING

生物燃料技术现状与进展

刘　德　华
清华大学化学工程系 教授
中拉清洁能源与气候变化联合实验室 主任

报 告 内 容

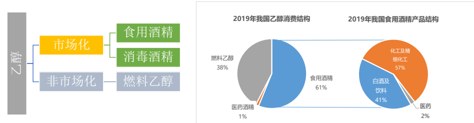
- ➢先进燃料乙醇技术
- ➢酶法生物柴油技术及其产业化
- ➢适应混合生物燃料的先进车辆燃烧技术



- 2019年全球生物乙醇产量9868万吨，美国（5243万吨）、巴西（2860万吨）、中国（870万吨）位列前三。
- 近十年，我国乙醇产量总体呈现稳中增长趋势；受国家扩大生物燃料乙醇消费拉动，2017年后产量快速增长。

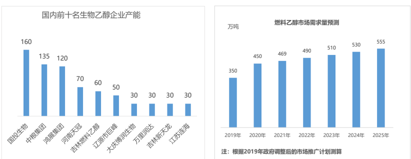
资料来源：世界可再生燃料协会、中国酒业协会

生物乙醇是最基本的化学中间体，广泛用于车用燃料、食品、化工、医疗等领域。



- 2019年中国乙醇870万吨，其中食用酒精529万吨、燃料乙醇330万吨、医药酒精11万吨。
- 食用酒精按市场需求可分为酒及饮料类用、化工及精细化工用、医药用等。

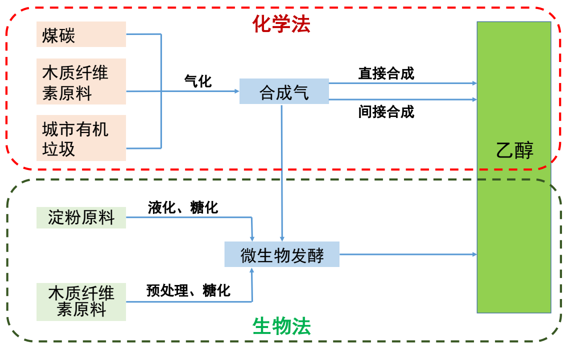
中国燃料乙醇产能与市场需求



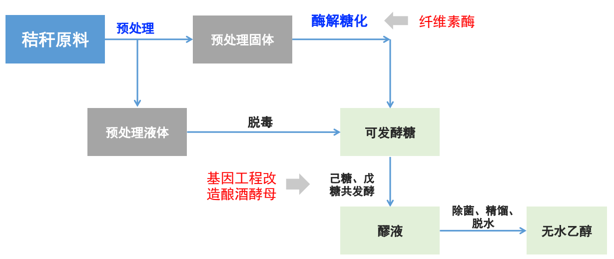
区域	省份		需求量（万吨）
已推广区域	全境	黑龙江	40
		吉林	35
		辽宁	60
		天津	26
		河南	50
		安徽	45
	部分区域	河北	20
		江苏	20
		山东	18
		湖北	30
		广西	6
	小计		**350**

- ➢ 目前，我国乙醇汽油销量约占当年汽油消费总量的25%，已批复11个生物燃料乙醇项目，其中粮食乙醇项目4个、木薯乙醇项目5个，累计生产和消费生物燃料乙醇1725万吨。
- ➢ 自2007年以来，受国家扩大生物燃料乙醇消费拉动，我国汽油消费量平均年增速4.3%，2019年汽油消费量约为1.31亿吨。生物燃料乙醇现有市场需求量350万吨/年。

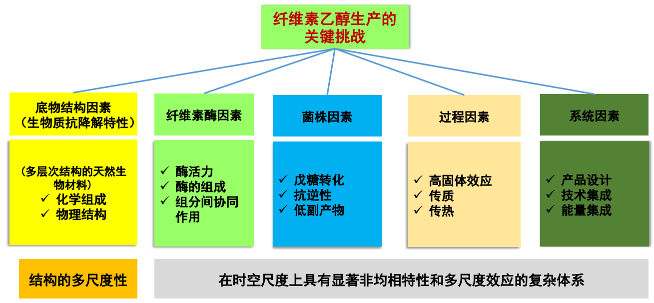
乙醇生产技术



纤维素乙醇的主要生产流程

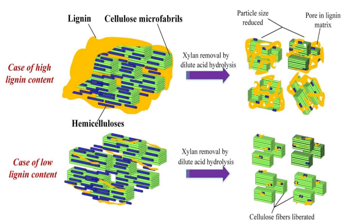


纤维素乙醇的关键挑战



我们的工作: (1)细胞壁的抗降解特性的多尺度效应解析

半纤维素和木质素对纤维素酶解性能影响的机理



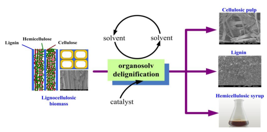
- 半纤维素的脱除有利于"造孔"，使得底物的纤维素酶可及孔（>5.1nm）容积和表面积明显增加；
- 半纤维素脱除可使底物表面更加粗糙，细胞壁出现扭曲，甚至断裂，但细胞壁结构仍然清晰可见，细胞壁仍然粘结在一块；
- 木质素的脱除使得胞间层消失，纤维素解离，细胞壁表面显著蚀刻、片层断裂、破碎、溶解和消失。

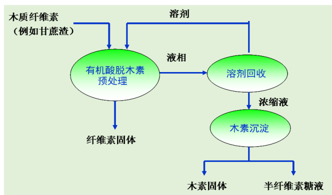
指导意义：半纤维素和木质素的耦合脱除可以有效提高纤维素的可及度

Chen et al., ACS Sust Chem Eng, 2016，4(12), 6668-6679

我们的工作: (2)高效清洁预处理技术开发

有机酸为溶剂的木质纤维素"一锅法"分级预处理技术：Formiline、Acetoline 技术

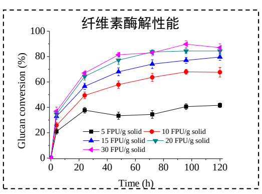


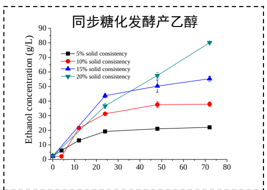


采用有机酸分级预处理的优点
- ✓ 有机酸可通过蒸馏回收使用
- ✓ 有机酸是木质素的良好溶剂
- ✓ 有机酸具有酸性，可同时水解半纤维素
- ✓ 木质素产品具有较高纯度和附加值
- ✓ 有机酸（甲酸和乙酸）可由木质纤维素组分降解产生
- ✓ ……

我们的工作: (2)高效清洁预处理技术开发

Formiline预处理甘蔗渣的酶解和乙醇发酵性能

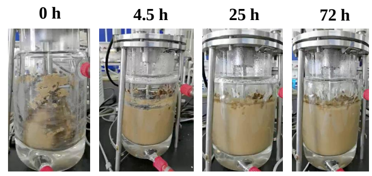




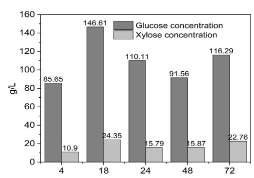
- ✓ 预处理后的纤维素固体具有很好的酶解性能，补料批式糖化可获得高达200g/L的葡萄浓度
- ✓ 预处理后的纤维素固体具有很好的同步糖化发酵性，乙醇浓度可达80g/L

我们的工作: (3)高固体酶解糖化

开发新型高固体酶解反应器，促进高固体系下的纤维素酶解糖化



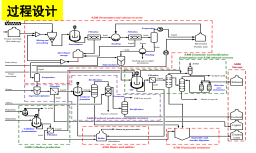
碱处理玉米秸秆高固体糖化（30%固体含量）



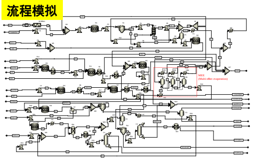
总糖浓度大于100g/L

我们的工作: (4)系统集成、放大示范与经济性评估

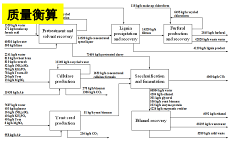
过程设计



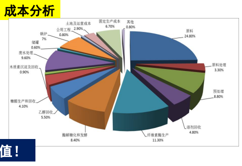
流程模拟



质量衡算



成本分析



多产品联产可显著提高过程经济性和生物质转化的附加值！

我们的工作: (4)系统集成、放大示范与经济性评估

基于甲酸分级预处理（Formiline预处理）年产3万吨纤维素乙醇生产新技术的生产成本及与稀酸预处理技术比较

	Formiline技术	稀酸预处理技术
原料处理量	201,992 干吨/年	133,264干吨/年
全年生产时间	8000 小时/年	8000 hours/year
乙醇得率	0.162吨/吨 干原料 (基于原料中聚糖的乙醇得率：49.4%; 基于原料中纤维素的乙醇得率：82.7%)	0.250吨/吨 干原料 (基于原料中聚糖的乙醇得率：74%)
乙醇产量	32,720吨/年	33,320吨/年
总设备投资（百万美元）	96	68
总资本投资 (TCI，百万美元)	176	125
投资成本 (美元/吨乙醇)	538	363
原材料成本(美元/吨乙醇)	596	453
能耗成本 (美元/吨乙醇)	320	156
废物处理成本 (美元/吨乙醇)	15	13
固定生产成本 (美元/吨乙醇)	105	103
总生产成本 (美元/吨乙醇)	1574	1088
副产物利润 (美元/吨乙醇)	-1440	0
折算副产物利润后的乙醇生产成本 (美元/吨乙醇)	134	1088
每吨秸秆的转化成本 (美元/吨干秸秆)	255	272
每吨秸秆转化后的附加值 (美元/吨干秸秆)*	364	220
附加值增加值 (美元/吨干秸秆)	+109	-52

我们的工作: (4)系统集成、放大示范与经济性评估

连续预处理、酶解设备

连续预处理、酶解设备

膜脱水设备

2.5 m³ 发酵罐

目前正与BP公司合作进行产业化推广前的评估！

由合成气制备乙醇

1、化学合成法有两种技术路线：

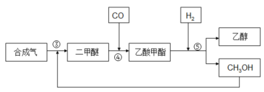
（1）直接合成法

①$2CO_2(g) + 6H_2(g) \longrightarrow CH_3CH_2OH(g) + 3H_2O(g)$ $\triangle H_1$

②$2CO(g) + 4H_2(g) \longrightarrow CH_3CH_2OH(g) + H_2O(g)$ $\triangle H_2 = -253.6kJ\cdot mol^{-1}$

（2）间接合成法

合成气反应生成二甲醚（CH3OCH 3），二甲醚羰基化合生成乙酸甲酯，乙酸甲酯加氢得到乙醇。其生产流程如下图所示：



③ $3CO(g) + 3H_2(g) \longrightarrow CH_3OCH_3(g) + CO_2$ $\triangle H3 = -260.2kJ\cdot mol^{-1}$

④ $CH_3OCH_3(g) + CO(g) \longrightarrow CH_3COOCH_3(g)$

代表性公司如中科院大连化物所与延长石油公司采用合成气经二甲醚羰基化技术

全球首套50万吨/年合成气制乙醇（DMTE）装置技术

2017-12-16 16:22

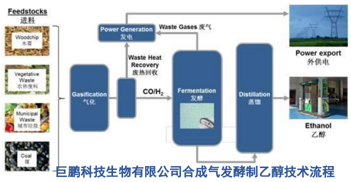
12月15日，陕西延长石油(集团)有限责任公司全资子公司陕西兴化集团有限责任公司与延长中科(大连)能源科技股份有限公司在西安共同签署"50万吨/年合成气制乙醇(DMTE)装置技术许可合同"，标志着中国合成气制乙醇技术正式迈入大规模工业化时代。陕西省人民政府领导、中科院科技促进发展局、陕西延长石油集团和中科院大连化物所领导出席了签字仪式。

由合成气制备乙醇

2、微生物发酵法主要由Coskata 、LanzaTech公司、INEOS Bio（后被巨鹏生物科技有限公司收购）、北京首钢郎泽新能源科技有限公司在推广产业化

Coskata开发了利用合成气发酵制乙醇的技术，2009年该公司在美国宾西法尼亚州建成4万加仑/年的工业示范装置，截至目前，该装置运转了2年，其气化1吨生物质原料可生产0.3吨燃料乙醇。

LanzaTech公司开发了利用钢厂废气（CO）发酵生产乙醇的技术，在新西兰建立了1m3的中试装置，并与宝钢合资建成了300吨/年示范装置，目前与首钢合作产业化。



巨鹏科技生物有限公司合成气发酵制乙醇技术流程

1989 ： 最初发现 – 通过细菌产生乙醇
1994 ： 在美国阿肯色州的费耶特维尔进行了发酵制乙醇的放大试验
2003 ： 示范工厂整合了气化、发酵和精馏的全工艺过程
2011 ： 英力士生物联合其他投资方，在美国佛罗里达州建立了首套商业化规模的废弃物转化生产乙醇的工厂。
2013 ： 工厂开始商业规模生产纤维素乙醇
2017 ： 巨鹏生物收购英力士生物

由合成气制备乙醇

工业尾气生物发酵制乙醇项目

● 行业资讯

潞安集团CO2重整利用工业尾气生产20万吨乙醇项目预计9月试车

作者：CCIIN 来源：煤化工信息网 浏览次数：1215次 更新时间：2020-03-26

近日，潞安集团煤基合成油公司CO2重整利用工业废气生物发酵法生产20万吨/年燃料乙醇项目一期工程建设现场已经一扫疫情阴霾，全面复工复建！

2018年，潞安集团与巨鹏生物签署了战略合作协议，投资2.5亿元，建设CO2重整利用工业尾气生产20万吨/年燃料乙醇（一期2万吨/年示范项目）。该项目采用巨鹏生物专有知识产权的细菌发酵生产燃料乙醇技术，利用潞安煤基合成油有限公司尾废气，在常温条件下，高效、高选择性和快速合成乙醇，再通过精馏、脱水工艺生产燃料乙醇，有效实现二氧化碳减排、尾气综合利用和清洁燃料生产。

项目于2018年4月1日，潞安集团煤基合成油公司隆重举行2万吨合成气生物发酵制乙醇项目示范工程奠基仪式，标志着该项目正式进行实施阶段。2018年9月开始动工建设。

截至目前，该项目一期工程土建工程已完成总工程量的80%，机电安装完成总工程量的50%，现已转入设备和管道安装阶段，预计到今年8月底9月初将具备投料试车条件。据了解，一期项目建成投产后，年产值将达到1.5亿元，实现利税0.3亿元，可提供就业岗位200余个。目前，二期项目也在积极推进中，项目全部建成投用后，潞安集团将率先在省内完成清洁生物乙醇燃料的示范，成为多效并举的应用范例。

据了解，一期项目建成投产后，年产值将达到1.5亿元，实现利税0.3亿元，可提供就业岗位200余个。目前，二期项目也在积极推进中，项目全部建成投用后，潞安集团将率先在省内完成清洁生物乙醇燃料的示范，成为多效并举的应用范例。

http://www.meihuake.net/detail-2-4001-c.html

2018年，山西潞安集团与巨鹏生物签署了战略合作协议，投资2.5亿元，建设CO2重整利用工业尾气生产20万吨/年燃料乙醇（一期2万吨/年示范项目），2018年9月开始动工建设。

第一财经

宁夏首条燃料乙醇生产线预计年底建成投产

第一财经 • 2020-05-07 20:53

责编：陈君君

5月7日，记者从宁夏工业和信息化厅获悉，总投资4.1亿元人民币、宁夏首条以一氧化碳工业尾气为原料的燃料乙醇生产线项目土建基础全部完成，已进入工程主体建设阶段，预计年底建成投产。（中国新闻网）

2020年月7日，宁夏首条以一氧化碳工业尾气为原料，通过生物发酵技术生产燃料乙醇生产线，项目土建基础全部完成，已进入工程主体建设阶段，预计年底建成投产。总投资4.1亿元人民币。生产线采用北京首钢郎泽新能源科技有限公司独有的气体发酵技术，将铁合金矿热炉尾气回收处理，通过生物发酵吸收尾气中的一氧化碳，直接转化为燃料乙醇。项目建成后可年产燃料乙醇4.5万吨，副产动物蛋白饲料5000吨

由合成气制备乙醇

工业尾气生物发酵制乙醇项目

投资5.7亿元 6万吨冶金工业尾气生物发酵制燃料乙醇项目签约

炼油化工动态
2020-09-06

8月31日，由国家电投集团贵州金元绥阳产业有限公司（简称：绥阳公司）、北京首钢朗泽新能源科技有限公司、日本三井物产株式会社共同合作的年产6万吨冶金工业尾气生物发酵制燃料乙醇项目签约仪式在北京举行。国家电投集团贵州金元股份有限公司火电总监兼火电部主任葛斌峰、北京首钢朗泽新能源科技有限公司总裁董燕、日本三井物产株式会社能源解决方案本部长松井先生以云签约方式出席签约仪式，绥阳公司董事长顾庆怀、副总经理王杰及三方各相关负责人见证签约。

2020年8月31日，由国家电投集团贵州金元绥阳产业有限公司（简称：绥阳公司）、北京首钢朗泽新能源科技有限公司、日本三井物产株式会社共同合作的年产6万吨冶金工业尾气生物发酵制燃料乙醇项目签约仪式在北京举行。该项目是贵州省首个工业尾气生物发酵制燃料乙醇项目，计划投资约5.7亿元，投产后可年产燃料乙醇6万吨，菌体蛋白0.66万吨，减少二氧化碳排放约20万吨、氮氧化物640吨、颗粒物175吨，预计可实现销售收入约3.8亿元

石嘴山市与北京首钢朗泽新能源公司签订战略合作协议

宁夏快讯 | 2020-12-18 | 投诉 阅读数：442

12月16日，市政府与北京首钢朗泽新能源科技有限公司举行年产30万吨工业尾气生物发酵制燃料乙醇产业集群项目战略合作协议签约仪式。双方此次战略合作，将有效盘活我市工业尾气资源、提升综合利用率，对促进清洁能源产业发展、加快形成绿色化循环化产业体系、打造宁夏北部绿色发展区产生积极的带动作用。

市委书记王文宇，市长张利，北京首钢朗泽新能源科技有限公司总裁董燕参加了签约仪式。

据了解，北京首钢朗泽新能源科技有限公司是一家科研实力雄厚，拥有全球领先气体生物发酵制燃料乙醇技术的高科技公司。我市与首钢朗泽新能源科技有限公司有着良好的合作基础，2019年5月，首钢朗泽新能源科技有限公司与吉元冶金集团合作在平罗县率先建设全球首套年产4.5万吨铁合金工业尾气制燃料乙醇大工业装置。目前正进行单机调试，预计2021年5月投产。今年11月，首钢朗泽新能源科技有限公司再次与滨河碳化硅、宁源冶金和吉元集团合资成立宁夏滨泽新能源科技有限公司，筹建年产6万吨燃料乙醇项目。本次签约的燃料乙醇产业集群项目总投资26.5亿元，建成后每年可生产燃料乙醇30万吨，蛋白饲料3万吨，实现销售收入25亿元，上缴税收1.5亿元，增加就业岗位1000余人。

2020年12月16日，**石嘴山市政府与北京首钢朗泽新能源科技有限公司举行年产30万吨工业尾气生物发酵制燃料乙醇产业集群项目战略合作协议签约仪式**

报 告 内 容

- 先进燃料乙醇技术
- 酶法生物柴油技术及其产业化
- 适应混合生物燃料的先进车辆燃烧技术

中国石化承诺有序推进能源替代

张玉卓在《石油和化学工业"十四五"发展指南》发布会上发表视频讲话，签署《中国石油和化学工业碳达峰与碳中和宣言》

本报讯 1月15日，在中国石油和化学工业联合会主办的《石油和化学工业"十四五"发展指南》发布会上，中国石化董事长、党组书记张玉卓视频签署《中国石油和化学工业碳达峰与碳中和宣言》并讲话，郑重承诺深入贯彻新发展理念，大力实施绿色洁净发展战略，以碳的净零排放为终极目标，坚持减碳进程与转型升级相统筹，奋力打造世界领先洁净能源化工公司，在中国迈向碳中和的征途中贡献方案和智慧。

《宣言》从推进能源结构清洁低碳化、大力提高能效、提升高端石化产品供给水平、加快部署二氧化碳捕集利用、加大科技研发力度、大幅增加绿色低碳投资强度等6个方面提出倡议并作出承诺，诚挚地接受社会和公众监督，号召全行业共同行动起来，在中国迈向碳中和国家的征途中书写灿烂篇章。

张玉卓表示，中国石化将持续推进能效提升计划和绿色企业行动计划，努力奉献洁净能源，提高洁净能源和非化石能源消费比重，有序推进能源替代，大幅降低二氧化碳排放强度。试点开展碳达峰、碳中和行动，实施CCUS（二氧化碳捕集、利用与封存）全产业链示范项目建设，强化甲烷控排管理，不断提升绿色低碳竞争力。

中国石化已于去年11月启动碳达峰、碳中和战略路径课题研究，制定中国石化碳达峰和碳中和战略、目标、路线图及保障措施。

"十三五"以来，中国石化认真贯彻新发展理念，落实生态文明建设要求，将绿色低碳上升到公司发展战略，积极控制温室气体排放，碳减排工作取得明显成效。

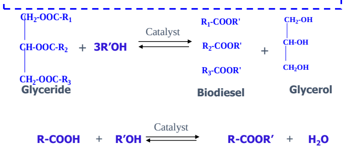
在开发洁净能源方面，在加强常规天然气产能建设的同时，加大页岩气、煤层气勘探开发力度；地热供暖能力达5700万平方米；实现生物航煤在跨洋商业飞行航班上使用，让生物柴油常态化应用于车辆；加快布局氢能产业，建成国内首座油氢合建站。

在强化节能管理方面，加快产业结构调整，淘汰落后产能；推进能效提升计划，已累计实施3406个项目，实现节能548万吨标煤，减少温室气体排放1348万吨。

在温室气体回收利用方面，推进炼化企业高浓度二氧化碳尾气回收利用，开展油田企业二氧化碳驱油矿场试验和甲烷放空气回收；对航煤、润滑油、聚乙烯等产品开展全生命周期产品碳足迹核算评价。

在参与碳交易方面，试点地区企业交易量1110万吨、交易额2.38亿元。（**本报记者**）

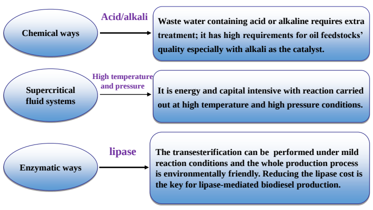
Biodiesel : defined as "a substitute for, or an additive to diesel fuel that is derived from oils and fats of plants, animals and microbes"

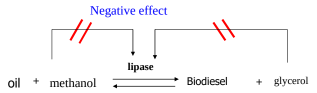


Chemical approaches (alkali, acid)

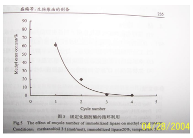
Transesterification at supercritical condition

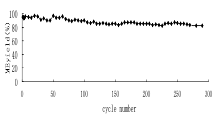
Enzymatic approaches (lipase)



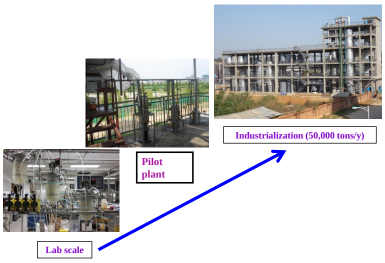


Poor stability and activity of the lipase should be due to the negative effect of methanol and glycerol. With TU's novel technology, the negative effect of both methanol and glycerol on enzyme activity could be greatly eliminated





Demonstration from lab scale to commercial scale



Cooperation of Biodiesel project between Tsinghua and COPPE

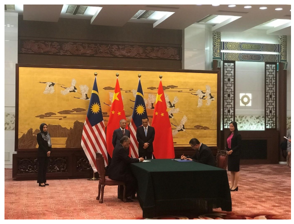
- Coordinated by CCBCE, Tsinghua's enzymatic technology was successfully demonstrated at the pilot plant in COPPE, Brazil (2011)

Projects 合作项目 – Biodiesel 生物柴油

启迪清洁能源、巴中贸促会与Biopar三方签署的MOU

技术团队和投资商拜访Biopar

启迪清洁能源、巴中贸促会与Biopar三方签署合作协议



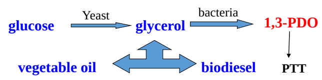
Signature Celebration on Cooperative Agreement between Tsinghua University and MPOB（2018-8-20）

✓Stability and activity of lipase have been improved significantly
✓Some cheap oil sources could be used for biodiesel production

How to deal with the by-product glycerol?

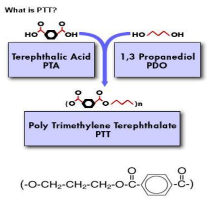
Integrated production of Biodiesel and 1,3-PDO

Tsinghua University has proposed a novel flexible process for 1,3-PDO production from glycerol or glucose.



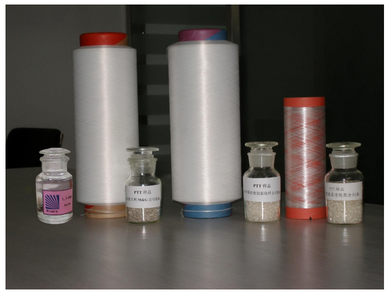
More than 50 patents were filed, among which more than 40 have been granted.

What is PTT ?



PTT- A Novel Polyester Made from PDO

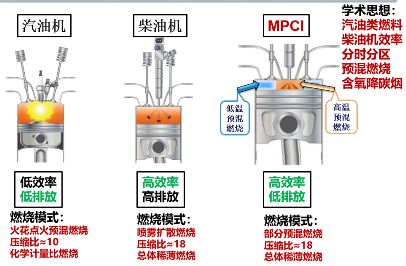
The industrial scale production of PDO with capacity of 20,000 tons /year is running in Jiangsu province, China .



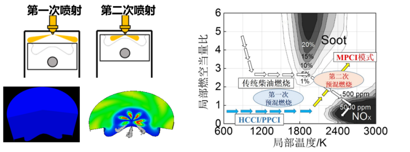
报 告 内 容

- ➢先进燃料乙醇技术
- ➢酶法生物柴油技术及其产业化
- ➢适应混合生物燃料的先进车辆燃烧技术

清华大学提出了多次预混压燃（MPCI）燃烧概念



多次预混压燃（MPCI）燃烧方法

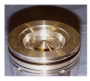


思想：**分时分区预混燃烧**

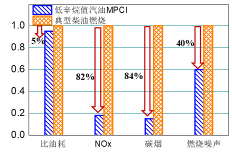
- 分时燃烧：燃油二次喷射，多次放热，降低燃烧噪声；
- 分区燃烧：第一次喷在燃烧室周围，形成稀预混压燃；第二次喷入的燃油避开第一次预混压燃之后的"活性热氛围"，降低了碳烟和NOx排放。

Wang Z, Wang B et al. Energy Conversion and Management, 2014, 88: 79-87

多次预混压燃（MPCI）燃烧效果



MPCI发动机燃烧室



通过多次预混压燃，避免扩散燃烧，大幅度降低了碳烟、NOx排放和燃烧噪声

Acknowledgements

Ministry of Science and Technology
National Development and Reform Commission
Ministry of Education
National Natural Science Foundation of China (NSFC)
My colleagues and students
……………

CETY
CLEAN ENERGY TECHNOLOGIES

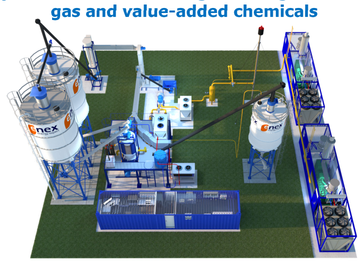
ENEX energy expert

A better cleaner and environmentally sustainable future

Energy Efficiency of Biomass with Zero Emission

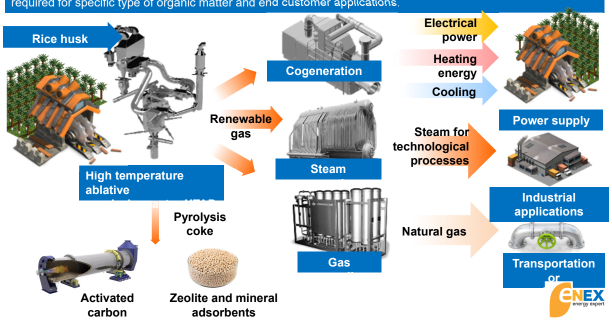
Pyrolysis Technology

Processing of industrial and municipal organic waste in high temperature ablative pyrolysis system for renewable high heating value fuel gas and value-added chemicals



ENEX energy expert

High temperature ablative pyrolysis process is the thermic destruction of organic matter without oxygen at a temperature range of 900-970 deg.C.
ENEX can provide integrated turnkey solutions for production of synthetic (renewable) fuel gas for onsite power generation and heat energy production in the form of hot water, thermo-oil or steam, including all equipment required for specific type of organic matter and end customer applications.



Applications

Industrial solid waste (plastic, paper, textile, wood, processed food)

Municipal solid waste non-recyclables

Industrial wastewater sludge

Agricultural farming waste (straw, stem, biomass, mulch, drip watering, fumigation materials, manure, substrates)

APPLICATIONS

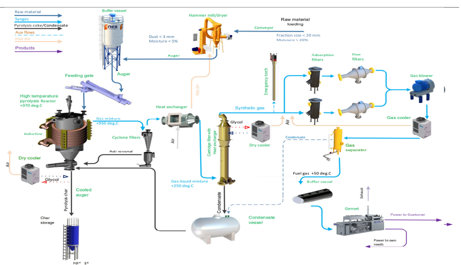
Refused derived fuel/solid refused fuel (RDF/SRF)

Agricultural processing waste (husks, hulls, sludges)

Municipal wastewater sludge

Forestry waste

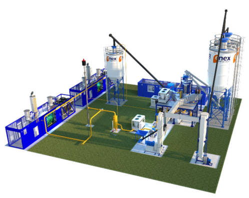
Process flow diagram



- Organic waste matter is fed into a course shredder
- After shredder it comes to the drying module.
- The waste powder has moisture content 2-4% and fraction size 1-3 mm.
- Waste organic is decomposed into syngas and pyrolysis char at temperature above 900deg.C.
- Syngas vapor passes through imbedded overheating chamber to decompose condensable polycyclic aromatic hydrocarbons into hydrogen, carbon monoxide and methane.
- The discharged syngas is supplied for electric and heat power production in ICE gensets, gas turbines or gas boilers.
- Pyrolysis char is cooled and stored in the buffer vessel for production of value-added chemicals or solid fuel briquettes.
- Operating mode of the system is continuous 8600 hours per year with scheduled maintenance stops every 4000 hours.

High Temperature Ablative Pyrolysis (HTAP)

- **ENEX HTAP technology Equipment assembly HTAP**



Confidential 7

TECHNICAL SPECIFICATION

Description	HTAP5	HTAP10
Capacity, tons per day (dry mass basis)	15	30
Annual capacity, tons (dry mass basis)	5250	10500
Waste to energy application: Installed electric generation power, kW	1300	2400
Waste to energy application: Net electric power supply to the grid, kW	1000	1800
Annual operating hours	8400 … 8600	
Operating personnel (qty per shift)	2	

Zero Emission

No combustion in the ENEX HTAP process. Induction heating is used for cold start. No exhaust from reactor. TARs breaks down into simpler hydrocarbons because of hot cracking of gas vapor.

Parameter	ENEX HTAP	Direct incineration in a solid fuel boiler
NOx emission	No	Yes
CO emission	No	Yes
Soot and tar emission	No	Yes
Water consumption	No	Yes
Power Generation Efficiency	High	Low
Activated Carbon Production	Yes	No
Zeolite Production	Yes	Yes

Chemical process of high temperature pyrolysis is exothermic reaction by nature. Excess of heating energy is recuperated for drying of raw organic matter. HTAP process has at least 30% higher efficiency compare to direct incineration.

KEY FEATURES

- Zero emissions (no added oxidizing agent, exothermic reaction does not require external heat supply)
- Waste sourcing and mixing flexibility
- Designed for maximizing of high heating value synthetic fuel gas production
- Zero liquid residue discharge
- Zero solid residue waste
- (used for production of fuel briquettes, adsorbents, soil amendments, carbon black, construction materials, etc.)
- Options for conversion of produced synthetic gas into liquid hydrocarbons (dimethyl ether, methanol)
- Options for conversion of produced synthetic gas into renewable hydrogen
- Modular design for projects implementation time reduction

Poultry farm manure

Waste source: mixture of cage and bedding poultry farming manure.

This manure has moisture content 50%, ash content 10%, volatiles level 84%.

Required manure flow for one HTAP10 unit is 58 tpd or 20780 tons annually.

Gross electric power generation from this manure is 2400 kW.
Heat from HTAP5 and gensets is used for waste drying.

Plywood and fiberboard production waste

Waste source: mixture of wood chips, sawdust, bark from sawmill and plywood production factory.

Waste has moisture content 40%, ash content 2% and volatiles level 87%.

Waste required for HTAP5 unit is 24 tpd or 8600 tons annually.
Gross electric power generation from this waste is 1340 kW.

Heat from HTAP5 and gensets is partially used for waste drying.

Rice husk

Waste source: rice processing and packaging factory.

Rice husk has moisture content 8%, ash content 20% and volatiles 68%.

Waste flow for one HTAP5 unit is 15 tpd or 5375 tons annually.

Gross electric Power production from this waste is 1000 kW.

Recuperated heat from HTAP5 is used for waste drying.

For additional question please contact:

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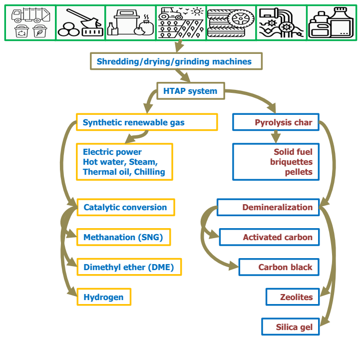
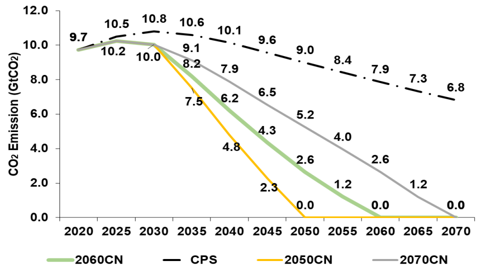
HTAP MODULAR ECO-SYSTEM



生物质能与“碳中和”的几点思考

常世彦
2021年2月2日

“碳中和”情景

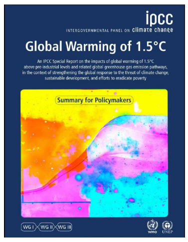


数据来源：张希良.2020.

- 生物质能碳捕集与封存BECCS
- 生物质能可持续标准

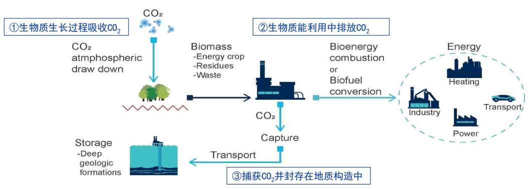
IPCC 1.5℃特别评估报告的主要结论（2018年）

- **气候变化已经不是未来的挑战，而是眼前的威胁**：全球气温2017—2018年已比工业化前高出1℃，按照这一排放速度，2040年左右将比工业化前高出1.5℃，2065年左右可能达到甚至超过2℃。
- **实现1.5℃温升控制目标要求从现在起就采取大规模的减排措施**：到2030年实现全球净人为CO_2排放量在2010年水平上减少约45%，到2050年左右达到净零排放，同时要求非CO_2温室气体排放大幅下降。
- **依靠常规的减排措施可能不足以实现温升控制目标**，还需要发展碳移除技术以更为快速地实现温室气体减排。
- **生物质能结合碳捕集与封存（BECCS）**是当前最受关注的一项碳移除技术，也是一项具有负排放特征的可再生能源技术，有必要对其技术路径、影响因素和可能潜力进行评估。



生物质能结合碳捕集与封存技术（BECCS）

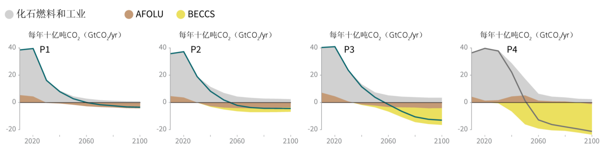
- BECCS是通过捕获生物质能利用过程中的CO_2，并将CO_2永久封存在地质构造中的一项负排放技术。生物质能结合碳捕集与封存（BECCS）技术包括生物质能利用和碳捕集与封存（CCS）两个阶段。
- 在负排放技术中，BECCS是唯一能够在移除大气中的CO_2的同时提供持续的能源供应的技术



BECCS示意图（GCCSI，2019）

全球升温1.5℃特别报告中的BECCS技术

四个说明性路径中对全球CO_2净排放量的贡献的细分



P1： 在社会、商业和技术创新导致2050年能源需求下降的情景下，但生活水平提高，特别是南方国家。一个小型能源系统可以实现能源供应的快速脱碳。造林是唯一考虑的CDR方案；化石燃料与CCS和BECCS都不使用。

P2： 广泛关注可持续发展包括能源强度、人类发展、经济一体化和国际合作、以及向可持续和健康的消费模式、低碳技术创新以及管理良好的土地系统转变的情景，社会接受BECCS程度不高。

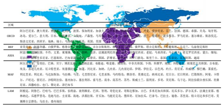
P3： 一个中间路线的情景，其中社会和技术发展遵循历史模式。减排主要是通过改变能源和产品的生产方式来实现的，其次是减少需求程度。

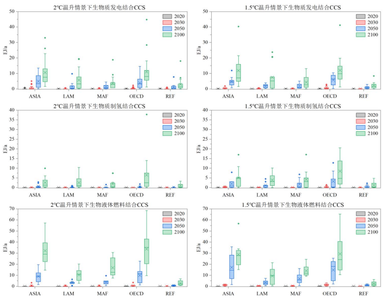
P4： 在资源和能源密集型情景下，经济增长和全球化导致广泛采用温室气体密集型生活方式，包括对运输燃料和畜产品的高需求。减排主要通过技术手段实现，通过部署BECCS大力推广使用CDR。

路径分类	P1: No or limited overshoot	P2: No or limited overshoot	P3: No or limited overshoot	P4: Higher overshoot
2030年生物质能相对于2010年的%	-11	0	36	-1
2050年生物质能相对于2010年的%	-16	49	121	418
到2100年累积的BECCS	**0 $GtCO_2$**	**151 $GtCO_2$**	**414 $GtCO_2$**	**1191 $GtCO_2$**
2050年能源作物的土地面积	0.2 million km^2	0.9 million km^2	2.8 million km^2	7.2 million km^2

全球主要区域BECCS发展潜力

- SSP数据库中BECCS的技术路线包括生物质发电、生物质制氢以及生物质液体燃料
- 生物质发电和生物质液体燃料结合BECCS的发展潜力占比较大，而生物质制氢的占比较小
- 但是当提高温升目标到1.5℃时，生物质制氢的增加量相对较大



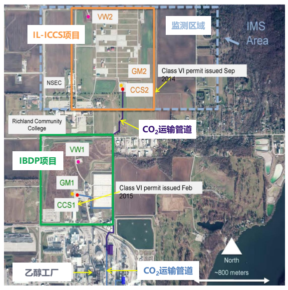


典型案例：乙醇工厂+CCS

项目名称	伊利诺伊州工业二氧化碳捕集与封存项目（IL-ICCS）
地点	美国伊利诺伊州迪凯特（Decatur）
时间	2017年开始注入
捕集量	1百万tCO_2/年
CO_2源	ADM公司的玉米乙醇工厂
运输方式	管道运输
封存地点	西蒙山大约2.1km深的砂岩层中
投资	总投资2.08亿美元，其中美国能源部负担1.415亿美元，占总投资的68%

IL-ICCS项目是另一个BECCS项目IBDP（Illinois Basin –Decatur Project）的延续，IBDP项目开始于2011年，并在2014年结束，同样从乙醇工厂中捕获CO2，经管道运输至西蒙山的砂岩层中永久封存，目前处于监测阶段。IBDP项目每天捕获1千吨的CO_2，在运行的3年期间共捕获1百万吨CO_2。

https://www.energy.gov/fe/articles/doe-announces-major-milestone-reached-illinois-industrial-ccs-project



IL-ICCS项目

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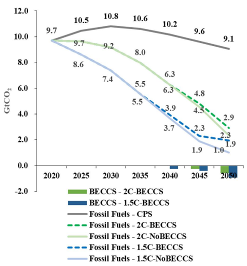
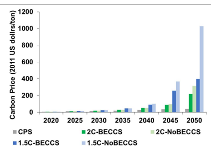
BECCS在中国深度减排中的作用

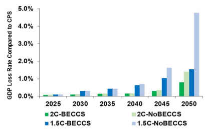


Possible ⟶ Feasible

Source: Huang, X., et al., 2020



不同情境下的碳价



不同情境下的GDP损失

9

对中国研究和发展BECCS的初步思考与政策建议

考虑中国自身的能源结构和经济发展阶段，较高的碳排放总量和人均排放量将长期存在，未来中国将面临更大的减排压力。从全球层面看，我们对BECCS应该持何种态度？中国是否需要发展BECCS？如果要发展，如何合理部署相关战略？这些问题的回答，都有赖进一步深入的科学研究、技术创新和产业实践。

第一，需要增强对BECCS对实现“碳中和”目标的作用的科学认识。减排目标相同的情况下，近中期越是沿着高排放的路径前进，未来大规模采用BECCS的可能性就越大，起始时间点也越靠前。大规模实施BECCS相关的负减排技术，能够降低减排成本，有助于实现控制全球升温的目标，但还需要通过进一步的研究以加强科学理性的认识，并采取适当的措施降低BECCS发展中的潜在风险。

第二，将BECCS技术纳入中国应对气候变化战略框架。BECCS是一种长期减排技术，其未来的发展和应用情况还有很大不确定性，但是按照现有的发展路径，实现2 ℃/1.5 ℃温升控制极有可能需要大规模应用BECCS技术。这就需要将BECCS技术作为减缓气候变化的可能选项，正视BECCS技术的潜在风险，对其应用保持客观理性和相对开放的态度。

第四，推进BECCS研究示范，增加相关的科学认识和公众接受度。目前已有不少国家进行了BECCS相关的示范工程，预计下一步将有更多的国家投入到这一领域，中国在该领域稍显滞后。应通过增强BECCS示范研究，增强技术储备。目前，中国在先进生物质能和CCS两方面已有商业化示范，如何结合这两者实现负排放是未来的主要方向。

第四，进一步推进生物质能可持续认证体系的构建，引导生物质能产业可持续发展。

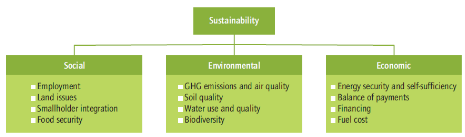
第五，BECCS的技术研发示范应用和推广要具有国际视野，将发展BECC纳入“一带一路”战略框架下。

10

- 生物质能碳捕集与封存BECCS
- 生物质能可持续标准

11

生物质能可持续标准的基本原则



社会、环境和经济是可持续发展的三大支柱。

Source：IEA, 2011. Technology Roadmap Biofuels for Transport. OECD/IEA, Paris.

国际生物质能可持续政策和标准

政策和标准名称 Initiative	名称缩写 Abbreviations	发布单位 Organization	发布时间 Year	适用的地域范围 Geographical coverage	适用的原料 Feedstock (s) covered	适用的生物质能 Bioenergy covered	类型 Types
可再生能源指令	RED	欧盟	2009	欧盟（包括进口）	所有类型	交通用生物燃料和其他生物液体燃料	政策法规
可再生燃料标准II	RFSII	美国环境保护署	2010	美国（包括进口）	所有类型	所有类型生物燃料	政策法规
加州低碳燃料标准	LCFS	加州环保署	2010	美国加州	所有类型	所有类型生物燃料	政策法规
生物燃料全生命周期评价条例	BLCAO	瑞士联邦环境、交通、能源与通讯部	2009	瑞士联邦（包括进口）	所有类型	所有类型生物燃料	政策法规
英国可再生运输燃料义务法	RTFO	英国可再生燃料署	2008	英国	所有类型	所有类型生物燃料	政策法规
社会燃料标识	SFS	巴西土地发展部	2009	巴西	所有类型	生物柴油	政策法规
FFSC森林管理原则和标准	FSC-PCFS	FSC	1993	全球	以森林产品为主	所有类型生物燃料	认证标准
Bonsucro 欧盟生产标准	Bonsucro	Bonsucro	2010	全球	甘蔗	燃料乙醇	认证标准
国际可持续碳认证	ISCC	ISCC	2010	全球	所有类型	所有类型	认证标准
北欧生态标签	NEF	北欧国家	2008	北欧国家	所有类型	所有类型生物燃料	认证标准
可持续生物质圆桌倡议组织全球/欧盟RED认证标准	RSB Global / RSB EU RED	RSB	2010	全球/欧盟	所有类型	生物液体燃料	认证标准
可持续棕榈油生产原则和标准	RSPO-PCSPOP	RSPO	2007	全球	棕榈油	生物柴油	认证标准
负责任大豆圆桌协会原则和标准	RTRS-PC	RTRS	2010	全球	大豆	生物柴油	认证标准
乙醇可持续验证倡议	SEKAB-VSEI	SEKAB（一家瑞士企业）	2008	巴西圣保罗地区（生产）/瑞典（分销）	甘蔗	燃料乙醇	认证标准
生物质能可持续性标准	ISO-SCB	ISO	2015	全球	所有类型	所有类型	指导性标准
GBEP生物质能可持续指标	GBEP-SIB	GBEP	2011	全球	所有类型	所有类型	指导性标准

来源：常世彦与康利平 (2017). "国际生物质能可持续发展政策及对中国的启示." 农业工程学报(11): 1-10.

中国生物质能可持续性认证要求

ISO 13065:2015 Preview

Sustainability criteria for bioenergy

ISO 13065:2015 specifies principles, criteria and indicators for the bioenergy supply chain to facilitate assessment of environmental, social and economic aspects of sustainability.

ISO 13065:2015 is applicable to the whole supply chain, parts of a supply chain or a single process in the supply chain. ISO 13065:2015 applies to all forms of bioenergy, irrespective of raw material, geographical location, technology or end use.

ISO 13065:2015 does not establish thresholds or limits and does not describe specific bioenergy processes and production methods. Compliance with ISO 13065:2015 does not determine the sustainability of processes or products.

ISO 13065:2015 is intended to facilitate comparability of various bioenergy processes or products. It can also be used to facilitate comparability of bioenergy and other energy options.

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中华人民共和国认证认可行业标准

RB/T 175—2018

生物质能可持续性认证要求

Requirements for bioenergy sustainability certification

2018-03-23 发布 2018-10-01 实施

中国国家认证认可监督管理委员会 发布

1. 范围
2. 规范性引用文件
3. 术语和定义
4. 一般原则
5. 认证指标
   5.1 社会: 土地使用, 社会发展
   5.2 环境:
      - 生态系统保护
      - 水资源节约和保护
      - 土壤质量和生产力保护
      - 空气质量保护
      - 温室气体排放
      - 废弃物管理
   5.3 经济: 经济可持续
6.追溯要求

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如何确保生物质能生命周期温室气体减排?

表 4 可持续生物质能政策和标准中 GHG 的相关内容[13,15]

Table 4 GHG requirement in bioenergy sustainability initiatives and criteria

政策/标准 Initiatives	GHG 排放核算方法 GHG emission calculation method	副产品分摊方法 Co-product treatment	是否考虑直接土地利用变化 Land use change considered	直接土地利用变化的基期 Baseline for LUC	是否考虑间接土地利用变化 Indirect land use change considered	土地利用排放均摊年限 Annualized land use emissions	最低 GHG 减排要求 GHG reduction requirement
LCFS	CA-GREET 模型	替代法	是	-	是	30 a	10%（到 2020 年平均交通燃料碳强度降低 10%）
ISCC	ISCC 全生命周期排放方法	能量分摊法	是	2008-01-01	否	20 a	与 RED 相同
RED	在附录中给出 GHG 排放核算的一般方法	能量分摊法	是	2008-01	是	20 a	35%（2017 年以前）；50%（2017 年 1 月以后）；60%（2018 年 1 月后新建项目）
RFSII	土地利用变化用森林和农业部门优化模型和粮食与农业政策研究所的模型系统	替代法	是	2007	是	100 a（2%折扣）30 a（无折扣）	20%（常规可再生燃料）；50%（生物柴油）；50%（先进燃料）；60%（纤维素燃料）
RSB	GHG 全生命周期计算器	替代法	是	2009-01-01	否	20 a	RSB Global: 50%; RSB EU RED Certification: 与 RED 相同
RTFO	与 RED 相同	替代法	是	2005-11-30	否	10 a（碳回收期）	与 RED 相同

资料来源：常世彦等，2017

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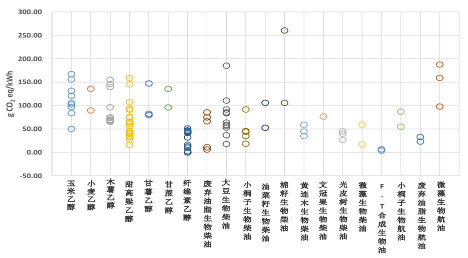
国际生物质能可持续标准中GHG的相关内容

政策/标准 Initiative	最低GHG减排要求 GHG reduction requirement	GHG排放核算方法 GHG emission calculation method	副产品分摊方法 Co-product treatment	是否考虑直接土地利用变化 Land use change considered	直接土地利用变化的基期 Baseline for LUC	是否考虑间接土地利用变化 Indirect land use change considered	土地利用排放均摊年限 Annualized land use emissions
RED	35%（2017年以前）；50%（2017年1月以后）；60%（2018年1月后新建项目）	在附录中给出GHG排放核算的一般方法	能量分摊法	是	2008-01	是	20 a
LCFS	10%（到2020年平均交通燃料碳强度降低10%）	CA-GREET模型	替代法	是	-	是	30 a
ISCC	与RED相同	ISCC全生命周期排放方法	能量分摊法	是	2008-01-01	否	20 a
RFS II	20%（常规可再生燃料）；50%（生物柴油）；60%（纤维素燃料）	土地利用变化用森林和农业部门优化模型和粮食与农业政策研究所的模型系统	替代法	是	2007	是	00 a（2%折扣）0 a（无折扣）
RSB	RSB Global: 50%; RSB EU RED Certification: 与RED相同	GHG全生命周期计算器	替代法	是	2009-01-01	否	20 a
RTFO	与RED相同	与RED相同	替代法	是	2005-11-30	否	0 a（碳回收期）

来源：常世彦与康利平 (2017). "国际生物质能可持续发展政策及对中国的启示." 农业工程学报(11): 1-10.

不同生物燃料路线的全生命周期能耗和GHG排放



生物质能可持续标准在产业政策中的应用的支持

- 欧盟《可再生能源指令》（RED）的目标是实现生物燃料在交通部门能源消费中的比例达10%。为了保证预期减排效果的实现，只有符合可持续性要求的生物液体燃料才**可计入RED目标量**
- 欧盟委员会要求各成员国出台财税政策来扶持本国生物燃料的发展，包括价格扶持、消费税减免、进口关税减免、贷款优惠等，虽然各成员国实施的政策不一，但基本理念和整体思路一致，只有**满足可持续发展要求的生物燃料才可以获得优惠**。
- 在生物质能贸易方面，为了不与世界贸易组织的要求相抵触，欧盟并没有禁止不符合可持续标准的生物燃料的流通，但特别强调欧盟委员会必须审视生物燃料生产与原料供应国是否采取任何更广泛的措施来遵守并维护可持续原则，**只有通过认证的生物燃料量才能获得政策扶持和被计入规划指标**。

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主要建议

- （1）在《可再生能源法》或以及《生物质能“十四五“”发展规划》中明确提出可持续性要求
- 可持续性既是最低要求，也是激励方向，其核心理念是引导生产要素的重新配置。中国的生物质能发展一直秉承“不与人争粮，不与粮争地”等可持续原则，但是缺乏用以支撑这些原则的具体准则和评价指标，对技术研发和产业发展方向缺乏明确的指引。因此，中国应尽快在《可再生能源法》或以及《生物质能“十四五“”发展规划》等政策法规中明确提出可持续性要求，将可持续生物质能准则和评价指标作为一项重要的内容，明确只有符合可持续准则和评价指标的生物质能利用量才可计入规划量。
- （2）生物质能产业政策要与可持续性要求挂钩
- 生物质能市场准入机制要以可持续生物质能标准为支撑。补贴和税收优惠等激励政策的实施，要与生物质能可持续要求挂钩，即只有符合可持续标准的生物质能技术才能获得补贴和税收优惠。同时，可对生物质能进行分类管理，补贴与税收优惠的额度要与可持续绩效效益(如全生命周期GHG减排量)相挂钩。生物质能进出口政策的实施，也要以可持续生物质能要求为支撑。
- （3）优先在航空生物燃料等领域构建更为具体的可持续标准与GHG排放计算方法学
- 中国生物质能可持续标准的建立要考虑如何综合考虑国内情况以及保持与国际已有标准的衔接，但是由于生物质能原料、生产工艺和燃料产品多样，需要在特定领域，就生物质能可持续标准与相应的GHG生命周期排放计算方法学进行更为深入的而研究。建议优先在以下两个领域开展进一步工作:
- (1)航空生物燃料。航空生物燃料的使用是民航部门的一项重要减排措施，构建航空生物燃料可持续标准具有重要现实意义。国际民航组织推出了基于市场的减排措施——全球民航碳抵消与减少计划(CORSIA),旨在实现2020后全球国际航空的碳中和增长。航空业将面临严峻的碳减排压力。所以，航空生物燃料的可持续要求将成为各方关注热点，中国应及早准备。
- (2)以生物质废弃物为原料的生物质能。一般而言，生物质废弃物及不当处理方式会带来负面环境影响。例如，屡禁不止的秸秆焚烧是中国很多地区秋季气溶胶颗粒物的重要来源；畜禽粪便所产生的氨排放是大气中氨的主要来源，而氨排放在二次颗粒物形成中的作用也日益受到重视。因此，生物质废弃物资源的能源化利用具有迫切的现实需求。而且，相对于原料为能源植物的生物质能，原料为农林业剩余物和废弃物的生物质能在生物多样性和间接土地利用变化等方面的争议较小，比较容易达成具有共识的可持续标准，因此建议对以生物质废弃物为原料的生物质能优先开展生命周期GHG排放核算与可持续认证。

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谢 谢!

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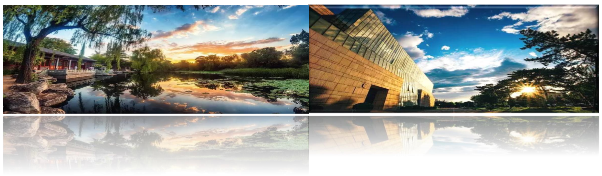

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International Energy Agency

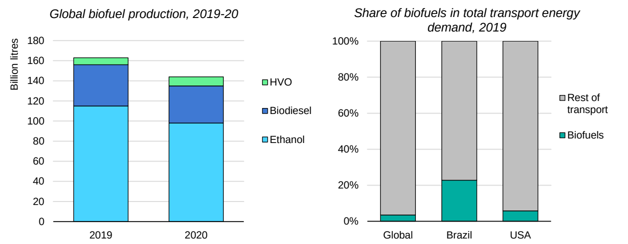
Global Outlook for Advanced Biofuels

Praveen Bains

US-China Energy Cooperation Program: Biofuels Standards Workshop

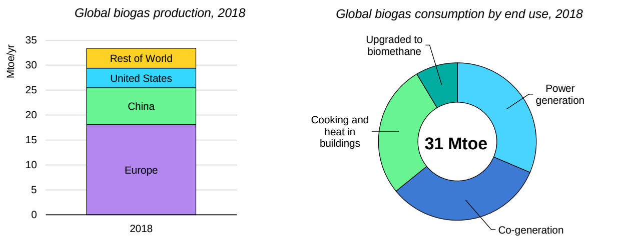
2 February 2021

Biofuels: how much and where are they used today?



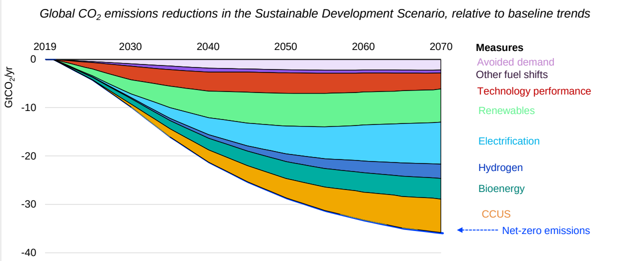
Today, biofuels account for small portions of global energy use in key sectors: 5% of road transport, 1% of residential cooking, and <1% of power and heat generation

Biofuels: how much and where are they used today?



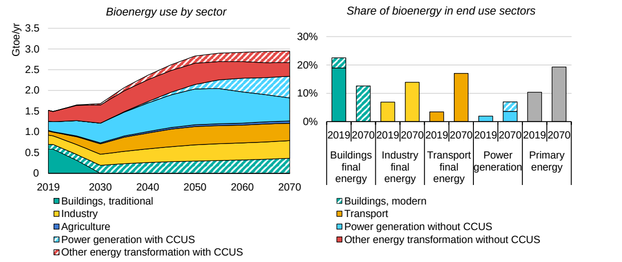
Today, biofuels account for small portions of global energy use in key sectors: 5% of road transport, 1% of residential cooking, and <1% of power and heat generation

Bioenergy has a key part to play in reaching net zero emissions



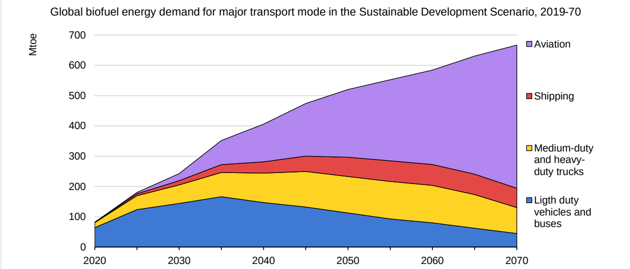
Bioenergy directly provides 12% of the cumulative emissions reductions needed to reach net zero in the Sustainable Development Scenario, with biofuels accounting for one-third of this.

Bioenergy is a versatile resource



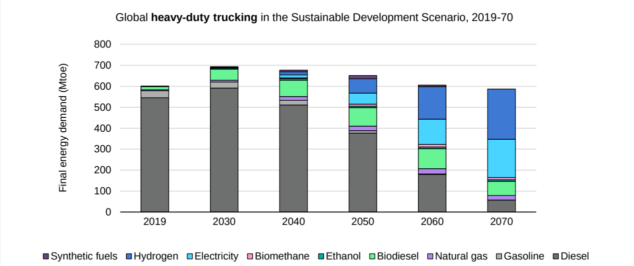
Modern bioenergy can be used as drop-in solutions to existing infrastructure, decarbonise hard-to-abate sectors and provide negative emissions when coupled with CCS

The role of biofuels evolves over time to net zero emissions



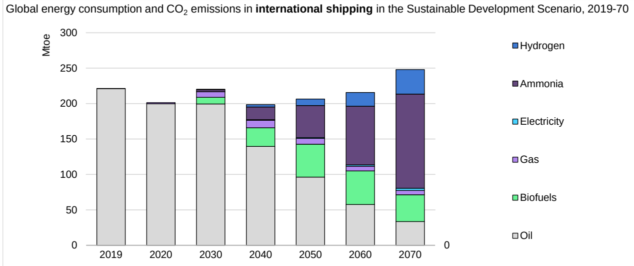
Advanced biofuels are first adopted by passenger transport before shifting to freight trucking and finally shipping and aviation

Advanced biofuels lead the way in decarbonising long-distance transport



In particular, advanced biofuels help to decarbonise long-distance transport, account for 14%, 20% and 35% of heavy-duty trucking, shipping and aviation in 2070.

Advanced biofuels lead the way in decarbonising long-distance transport



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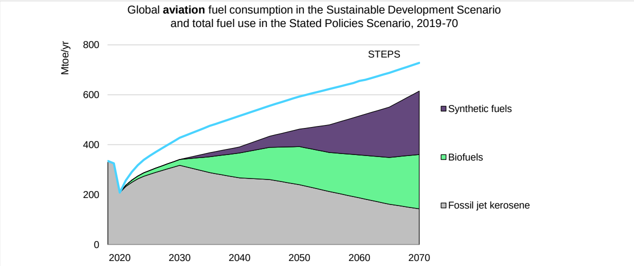
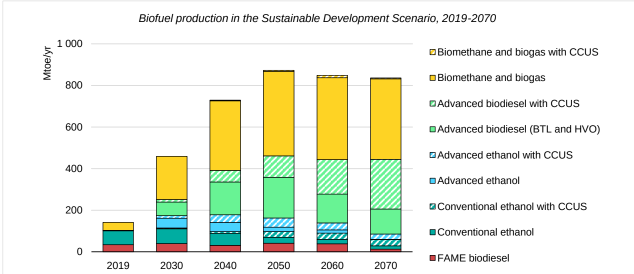


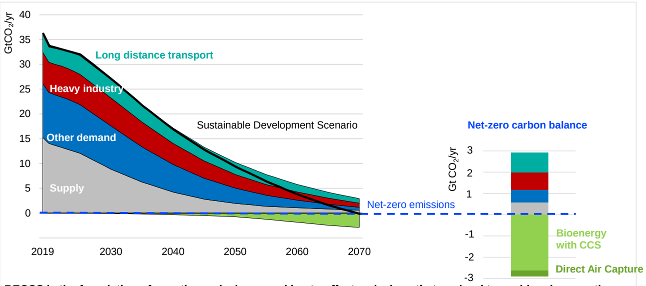
In particular, advanced biofuels help to decarbonise long-distance transport, account for 14%, 20% and 35% of heavy-duty trucking, shipping and aviation in 2070.

Advanced biofuel production ramps up significantly



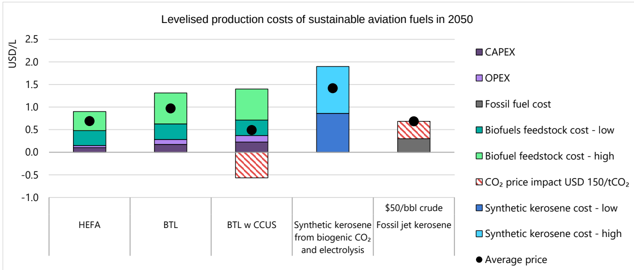
Advanced biofuels, biogas and biomethane grow more than 20 times from today to 2070, underpinned by biomass-to-liquid routes and anaerobic digestion with upgrading

BECCS helps bring the entire energy system to net-zero emissions



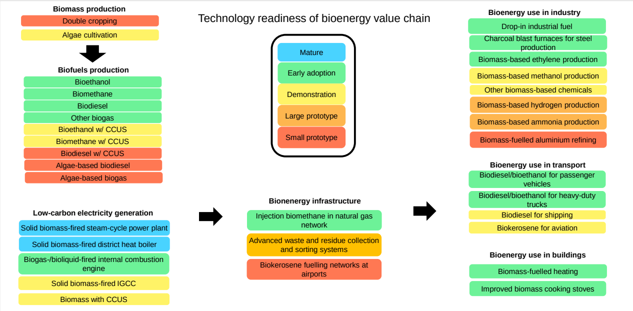
BECCS is the foundation of negative emissions, working to offset emissions that are hard to avoid and supporting a faster transition to net –zero. Biofuel production with CCS provides around half of these negative emissions.

The cost of advanced biofuels are high – policy must close the gap



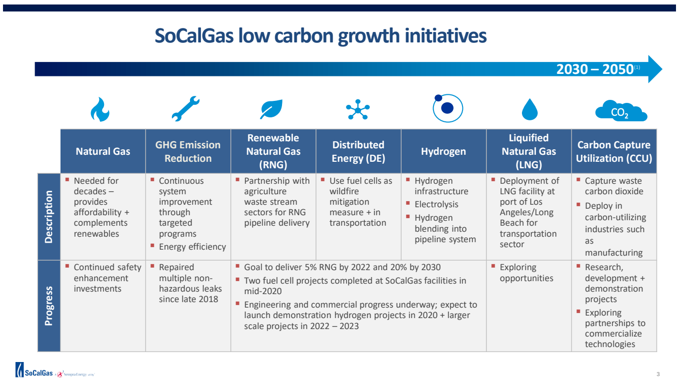
Even with deployment, the costs of advanced biofuels remain high. Policy measures must be used to close the cost gap between clean fuels and their fossil fuel counterparts.

There still exists innovation gaps along the bioenergy value chain

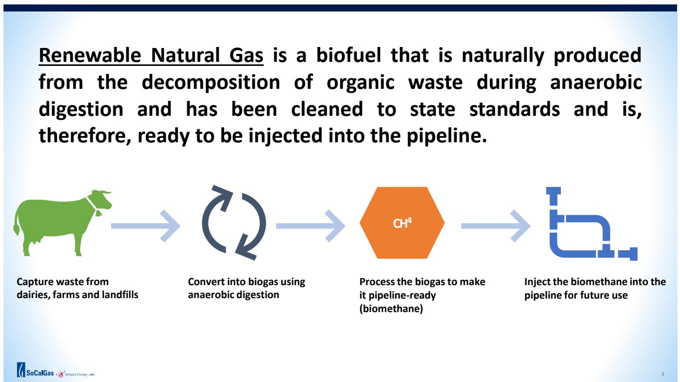


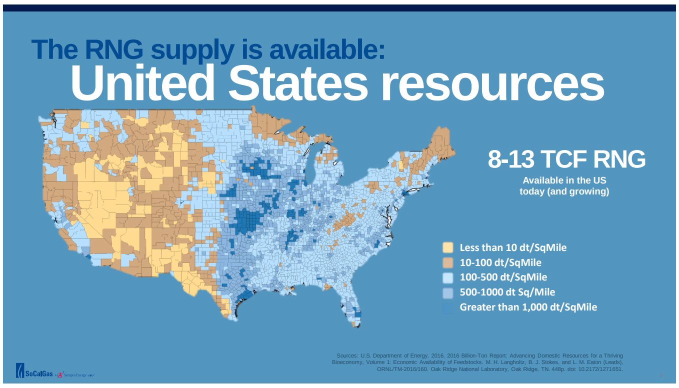
Policy must close the cost and innovation gaps in biofuels

Technology Readiness	Goal	Policy Mechanisms	Biofuel example
Mature	Deal with existing assets	• Blending mandates • Low-carbon fuel standards • CO_2 performance standards	• Blending biomethane into gas grids • Converting petroleum refineries to biorefineries
Early adoption	Strengthen markets for tech at early stage of adoption	• CO_2 prices and subsidies • Mandated phase-outs • Public funding for R&D	• Feed-in tariffs for clean power and heat • SAF offtake agreements
Demonstration, Early adoption	Develop and upgrade enabling infrastructure	• Loan guarantees • Public-private partnerships	• Large-scale waste and residue collection and sorting systems • CO_2 transport and storage sites
Small prototype, Large prototype, Demonstration	Continued support for RD&D	• Public funding for RD&D with knowledge-sharing • Prioritise tech with spillover potential	• International test centers for testing biofuel blends in engines • Biotech spillover: genetic engineering of algae



	Natural Gas	GHG Emission Reduction	Renewable Natural Gas (RNG)	Distributed Energy (DE)	Hydrogen	Liquified Natural Gas (LNG)	Carbon Capture Utilization (CCU)
Description	▪ Needed for decades – provides affordability + complements renewables	▪ Continuous system improvement through targeted programs ▪ Energy efficiency	▪ Partnership with agriculture waste stream sectors for RNG pipeline delivery	▪ Use fuel cells as wildfire mitigation measure + in transportation	▪ Hydrogen infrastructure ▪ Electrolysis ▪ Hydrogen blending into pipeline system	▪ Deployment of LNG facility at port of Los Angeles/Long Beach for transportation sector	▪ Capture waste carbon dioxide ▪ Deploy in carbon-utilizing industries such as manufacturing
Progress	▪ Continued safety enhancement investments	▪ Repaired multiple non-hazardous leaks since late 2018	▪ Goal to deliver 5% RNG by 2022 and 20% by 2030 ▪ Two fuel cell projects completed at SoCalGas facilities in mid-2020 ▪ Engineering and commercial progress underway; expect to launch demonstration hydrogen projects in 2020 + larger scale projects in 2022 – 2023			▪ Exploring opportunities	▪ Research, development + demonstration projects ▪ Exploring partnerships to commercialize technologies





California policy is driving RNG project development

Current

CA Senate Bill 1383 (2016)

Includes a requirement to reduce methane emissions by 40% by 2030. Two subparts of the bill are significantly driving RNG projects:

- *Requires the CPUC to direct gas corporations to implement not less than 5 dairy RNG injection pilot projects. **SoCalGas to commission interconnection facilities for four large dairy pilot projects in 2021***
- *A 75% reduction in statewide disposal of organic waste by 2025. CalRecycle estimates ~50 to 100 new anaerobic digestion and/or compost facilities are needed to meet the requirement*

Pending

CA Senate Bill 1440 (2017)

Requires the CA Public Utilities Commission (CPUC), in consultation with the State Air Resources Board, to consider adopting specific biomethane procurement targets or goals for each California gas corporation

- *A procedural schedule for implementation of SB 1440 has yet to be established by the CPUC*
- *A utility procurement program can significantly accelerate the RNG market*

SoCalGas

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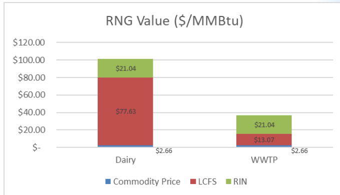
RNG used for transportation fuel is helping drive project development

When RNG is used as a transportation fuel from a qualified feedstock, credits can be generated and sold which increases the market value of RNG

- **California Air Resources Board Low Carbon Fuel Standard (LCFS)** – program to reduce the carbon intensity of California's transportation fuels by at least 20 percent by 2030
- **EPA Renewable Fuel Standard (RFS)** – federal program that requires petroleum refiners and importers of gasoline to demonstrate that a portion of the fuel they sell is renewable. Fuel volume requirements currently go through 2022. The trading credit is called a RIN.



Assumptions
* Average LCFS price the week of January 18, 2021 ($200/metric ton) - Weekly LCFS Credit Trading Activity Reports (ca.gov) –
** D3 RIN price on 12/21/20 ($1.62) - RIN Trades and Price Information | Fuels Registration, Reporting, and Compliance Help | US EPA
** Assumes:
1) carbon intensity for WWTP biogas of 30 gCO2e/MJ, and Dairy biogas of -276 gCO2e/MJ
2) approximate Henry Hub Natural Gas future Price – $2.66 for February of 2021 - https://www.cmegroup.com/trading/energy/natural-gas/natural-gas_quotes_settlements_futures.html

SoCalGas

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Examples of projects currently injecting RNG into a CA utility pipeline

With many more under development

1. **Point Loma Wastewater Treatment Plant (Point Loma CA)**
   - Capturing more than 1.3 MMcfd of digester gas
   - Injecting since 2012 into utility pipeline
   - Total project cost of $45 million, **75% was subsidized** through incentives and tax credit

2. **CR&R Waste and Recycling Services (Perris CA)**
   - Two of the four phases are complete with each phase capable of handling ~83K tons/year of organic waste (~1M DGE/yr of vehicle fuel)
   - Green/food waste (previously sent to a landfill) is converted to produce fertilizer, soil amendment and RNG
     - 100% of the RNG produced is used to fuel CR&R trucks
   - Injecting since mid-2018, into SoCalGas pipeline
   - Cost: Over $100 million at full buildout
   - First RNG-to-pipeline project in SoCalGas' service territory

SoCalGas

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Examples of projects currently injecting RNG into a CA utility pipeline

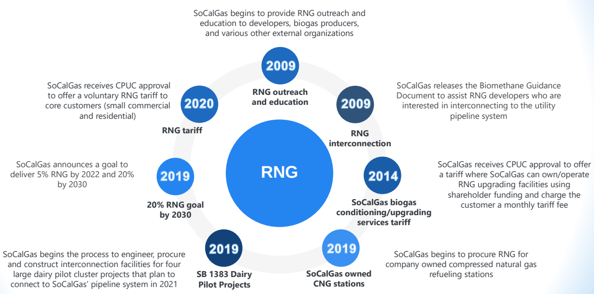
With many more under development

3. **Calgren Dairy Fuels (Pixley CA)**
   - First dairy digester pipeline cluster project in California and started injecting RNG into SoCalGas' pipeline in February of 2019
   - Plan to collect biogas from anaerobic digesters at 12 Tulare County dairies by the end of 2019
   - The facility will capture the methane produced from more than 75,000 cows
   - SoCalGas will be capable of adding up to 2.26 billion cubic feet of RNG each year to its pipeline system
   - Enough to fuel more than 1,200 Class 8 heavy duty trucks.

SoCalGas

10

SoCalGas has been very supportive of RNG for over a decade



SoCalGas

11

Thank You

SoCalGas

12

生物燃料国内外标准化相关工作与进展

中国标准化研究院资源环境研究分院

生态文明建设研究室 徐秉声

2021年2月

目录

CONTENTS

- 中国标准化研究院始建于1963年，隶属于国家市场监督管理总局。
- 国家级社会公益类综合性标准化科研机构。
- **宗旨**：科研为本 服务社会 面向市场 走向国际。
- **使命**：开展标准化战略和规划研究，研制综合性基础标准，为社会提供权威标准信息和技术服务，为政府的标准化决策和行政管理提供科学依据及技术支撑。

资源环境研究分院

基本情况

现有科研人员：68

国务院政府津贴专家	2
国家百千万人才工程人员	1
研究员	9
副研究员	17
博士	18
亚太经合组织（APEC）能效和节能专家组（EGEE&C）主席	1
ISO能源管理和能源节约（ISO/TC 301）技术委员会副主席	1
ISO技术委员会秘书	3
国际标准项目负责人	11
国际标准化注册专家	20

重点业务

1. 节能：能效、能耗；系统优化、节能监测；能源管理、绩效评估
2. 节水：水效、取水定额；水系统优化；水回用与再生水节水评价
3. 生态文明建设：城乡建设；区域生态文明标准化建设；地方实践
4. 循环经济：清洁生产；综合利用；固废处理、循环化改造
5. 应对气候变化：核算方法学；碳排放与碳资产管理；低碳技术、低碳评价；低碳城市
6. 环保产业：水、气、声渣污染防治；环保技术、环保设备；环保服务
7. 新能源：太阳能、氢能；生物质、智慧能源
8. 绿色发展：体系顶层设计、标准化建设；指南、地方实践应用、绿色金融

2. 国内生物质相关标准化工作进展-标准化技术委员会

1. 全国林业生物质材料标准化技术委员会（SAC/TC416）

- 负责专业范围为以林业植物原料为主制造加工的材料以及生物质原料经化学、生物加工制成的材料等。

- 由国家林业和草原局筹建及进行业务指导。
- 秘书处所在单位：中国林业科学研究院木材工业研究所

2. 全国能源基础与管理标准化技术委员会新能源与可再生能源分会（SAC/TC20/SC6）

- 负责专业范围为新能源和可再生能源等专业领域标准化工作。

- 由国家标准化管理委员会筹建及进行业务指导。
- 秘书处所在单位：中国标准化研究院

3. 能源行业农村能源标准化技术委员会（行业NB）

- 主管部门为国家能源局。

4.其他：国家标准、行业标准

- 农业农村部（GB、NY）
- 国家林业和草原局（GB、LY）
- 国家能源局（NB）

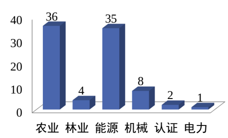
2. 国内生物质相关标准化工作进展

现有标准分布情况

国家标准30项：试验类26项、术语类2项、规范类1项、产品类1项

行业标准86项：试验类33项、产品类9项、分类3项、规程类1项、规范类17项、术语类2项、通用类2项、要求类19项

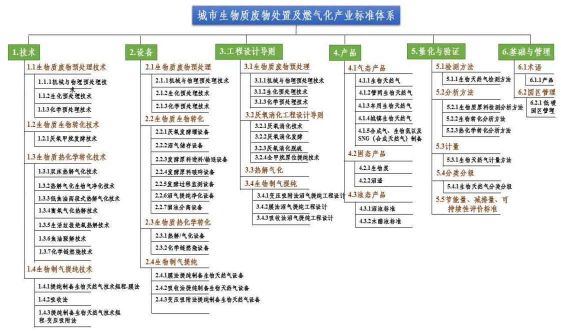
目前国家标准及行业标准中多以试验方法类标准为主，占国家标准的86.7%，占行业标准的38.3%。



2. 国内生物质相关标准化工作进展- SAC/TC20/SC6重点关注领域

术语 | 分类 | 试验 | 规范 | 规程 | 指南 | 要求

2. 国内生物质相关标准化工作进展-标准体系



2. 国内生物质相关标准化工作进展- SAC/TC20/SC6

目前我院承担的全国能源基础与管理标委会新能源和可再生能源分技术委员会(SAC/TC20/SC6)是国内负责生物质领域国家标准制修订的技术委员会，目前有委员16人，制定标准13项。其中8项已发布，5项已形成报批稿。

国家标准计划号	国家标准名称	阶段
20154064-T-303	生物质热解炭气油多联产工程技术规范 第1部分：工艺设计	已报批
20173915-T-303	农林生物质原料收储运通用技术规范	已报批
20173637-T-303	生物质燃气中焦油含量测定的方法	已报批
20173914-T-303	车用生物天然气	已报批
20173636-T-303	生物天然气 术语	已报批

2. 国内生物质相关标准化工作进展-国家标准

- 《生物天然气 术语》

规定了用于生物天然气相关标准起草的基础术语及专业术语，适用于生物天然气行业规划、设计、施工、管理、科研、教学等领域。术语标准是行业规范化的基础，运用标准化的手段，对生物天然气行业概念进行严格定义，选择或确立最恰当的术语，减少多义和同义现象，避免信息交流过程中的歧义和误解，对于促进生物天然气行业规范发展具有重要的意义。

欧盟及其成员国、澳大利亚、日本等为了大力推动可再生生物质能源的利用，促进配套能源补贴优惠政策的切实有效施行，出台了相关的生物质能源认证方法体系和组织架构，如欧盟的国际可持续和碳认证（ISCC）、法国的生物质生物燃料可持续性自愿认证计划（2BSvs）、日本的上网电价补贴方案（Feed-in Tariff Scheme），关于生物质废物源的生物天然气产生或认证有所涉及，为本项目的编制实施提供参考素材和模式范本，有助于本项目成为具备国际先进性的国家标准，与国际接轨。

2. 国内生物质相关标准化工作进展-国家标准

②《车用生物天然气》

规定了车用生物天然气的技术要求，适用于来源为沼气、填埋气等生物气提纯产品，压力不大于25MPa，作为车用燃料的生物天然气。车用生物天然气可以缓解化石资源带来的能源短缺的压力。从环境角度看它能有效地减少环境污染和温室效应，促进低碳经济发展，其排放不仅优于汽柴油燃料，也优于化石天然气燃料。

◆ 优化天然气供给结构
- 常规天然气的重要补充
- 有利于降低天然气供需短板，降低进口依存度

◆ 构建分布式可再生清洁燃气生产消费体系
- 增加天然气气源保障
- 有效替代农村散煤
- 助力解决农村煤改气气源

✓ **生物天然气的发展**

◆ 走“工业化”、“商业化”可持续发展道路
- 以工业化、市场化推进发展
- 加快专业化、市场化、规模化发展
- 融入大能源，纳入国家能源体系

2. 国内生物质相关标准化工作进展-重点标准

③《生物质燃气中焦油含量测定的方法》

给出了生物质燃气中焦油含量的测定方法，适用于生物质燃气焦油含量测定。本标准提出的生物质燃气中焦油含量的测定方法可有效缓解国内大多借鉴的国标GB/T 12208-2008所存在的焦油与灰尘不能分开测量、生物质燃气中水分含量高而导致的分析结果误差大以及滤膜不能完全捕获生物质燃气中部分低沸点物质而导致测量结果偏小等顽疾，可实现生物质燃气中焦油含量的精确测量，促进生物质利用技术的优化升级和发展。

✓ 国内尚未建立生物质燃气中焦油含量测定的标准，已极大阻碍了我国生物质能源产业的健康发展，亟待建立与生物质热解气化科学研究及产业发展紧密相关的焦油检测中国标准。

■ 国内尚未建立生物质燃气中焦油和灰尘含量测定的标准，多参考国标**GB/T 12208-2008《人工煤气组分与杂质含量测定方法》**来测定生物质燃气中的焦油和灰尘含量。

■ **欧洲标准化委员会建立了生物质燃气中焦油和颗粒物含量测定的方法CEN/TS 15439:2006 《Biomass gasification-Tar and Particles in product gases-Sampling and analysis》。**

2. 国内生物质相关标准化工作进展-重点标准

④《农林生物质原料收储运通用技术规范》

规定了农林生物质原料收储运通用技术规范的术语和定义、总则、原料收集、原料储存和加工预计原料运输，适用于农林生物质资源化利用中所使用原料的收集、储存和运输活动。标准的提出引领农林生物质原料科学化的收储运模式，是提高秸秆资源利用的根本，也是保证秸秆利用的最基本的环节。以最经济的模式实现秸秆处理，降低环境污染，促进新能源和可再生能源发展。

- 解决政府头疼的秸秆废弃燃烧问题，保护大气环境, 改善农村生产生活环境
- 将丰富的农林废弃物变废为宝，转换为优质燃料，保护生态环境和促进农业可持续发展
- 解决生物质企业原料收集难的瓶颈问题，用标准规范收集过程问题

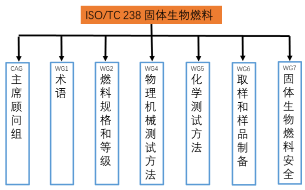
2. 国内生物质相关标准化工作进展-重点标准

表 生物质联合工作组团体标准

编号	团体标准编号	团体标准名称	领域
1	T/BGLM 0004.02-2017	车用生物天然气	新能源
2	T/BGLM 0002.03-2017	生物天然气 术语	新能源
3	T/BGLM 0003.03-2017	提纯制备生物天然气技术规程-膜法	新能源
4	T/BGLM 0003.02-2017	提纯制备生物天然气技术规程-水吸收法	新能源
5	T/BGLM 0003.01-2017	提纯制备生物天然气技术规程-变压吸附法	新能源
6	T/BGLM 0002.05-2017	生物天然气检测方法	新能源
7	TB-20160005	生物质热解气	新能源

3. ISO/TC238生物固体燃料标委会介绍

- 国际标准化组织于2007年成立了生物质固体燃料技术委员会(ISO/TC 238)，秘书处由瑞典标协承担。下设7个工作组。25个正式成员国，21个观察员国。研究方向为树木种植业、农业、水产养殖、园艺和林业的原材料和加工材料领域的术语、规范和等级、质量保证、取样和样品制备及试验方法的标准化，不包括液体生物燃料和天然气领域。
- 目前已发布44项标准，在研14项标准。



4. ISO/TC238标准化工作进展

目前中国标准化研究院资环分院承担对口ISO/TC 238投票工作，2020年共计完成28项投票。

票数 投票种类	全年收到数	当年应投票数	实投票数	占百分比
新工作项目提案(NP)	1	1	1	100%
国际标准草案DIS(ISO)、委员会投票草案CDV(IEC)	10	10	10	100%
国际标准最终草案(FDIS)	5	4	4	100%
国际标准复审(SR)	12	6	6	100%
其他委员会内部投票(CIB)	6	6	6	100%
技术规范草案(DTS)	1	1	1	100%

4. ISO/TC238标准化工作进展

序号	标准号	标准名称
1	ISO/AWI 5370	固体生物燃料—颗粒中细粒含量的测定
2	ISO/DIS 16559	固体生物燃料—术语，定义和描述
3	ISO/DIS 17225-1	固体生物燃料—燃料规范和等级—第1部分：一般要求
4	ISO/DIS 17225-2	固体生物燃料—燃料规范和等级—第2部分：分级木质颗粒
5	ISO/DIS 17225-3	固体生物燃料—燃料规范和等级—第3部分：分级木块
6	ISO/DIS 17225-4	固体生物燃料—燃料规范和等级—第4部分：分级木屑
7	ISO/CD 17225-5	固体生物燃料—燃料规范和等级—第5部分：分级木柴
8	ISO/CD 17225-6	固体生物燃料—燃料规范和等级—第6部分：分级非木质颗粒
9	ISO/CD 17225-7	固体生物燃料—燃料规范和等级—第7部分：分级非木质型煤
10	ISO/DIS 17225-9	固体生物燃料—燃料规范和等级—第9部分：工业用分级粉状燃料和木屑
11	ISO 18135:2017/AWI Amd 1	固体生物燃料 —取样 —修改单1
12	ISO/CD 20048-2	固体生物燃料—脱气和耗氧特性的测定—第2部分：一氧化碳脱气筛选的操作方法

5. 2021年生物质领域拟开展重点工作

国际标准提案走出去

凝练一批生物质清洁供热、生物天然气（沼气）、生物质热解气化、生物质液体燃料先进技术和核心检测方法，推出国际生物质领域的中国提案。

国际标准转化引进来

加快转化一批代表世界先进水平、适合我国产业现状的生物质领域标准，促进我国生物质领域与国际接轨。

完善专家队伍支撑

继续完善现有专家团队，提高技术支撑水平，为我国参与和主导国际生物质领域标准化工作提供坚实后盾。

《商业和工业应用中固体生物燃料颗粒的安全处理和储存》

敬请批评指正

谢谢！

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Transportation Fuels from Biomass in California and the USA

International Biofuel Standard Workshop
Beijing, China
February 2, 2021

Stephen Kaffka*
University of California, Davis &
California Biomass Collaborative
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http://biomass.ucdavis.edu/

Summary:

1. Policies stimulate biofuel use and are needed to support biofuel adoption and innovation.
2. Optimal feedstocks and fuel types vary locally (one size does not fit all).
3. Feedstock quality, cost and abundance have favored crop-based feedstocks, but first generation technologies based on crops can be the pathway to adoption of advanced technologies and the use of lower quality feedstocks.
4. In California, optimal feedstock-biofuel systems should provide multiple public goods. Biofuel production and use can help achieve important environmental public goods like healthy forests, landscape restoration and pollution reduction, while providing petroleum substitutes.

Transportation Fuels from Biomass in California and the USA: OUTLINE

1. **Policies drive biofuel use at both the national and state level (Federal: RFS, State: LCFS)**
2. **Biomass used for biofuels at the national and state levels (crops, livestock wastes, urban residuals, forest biomass)**
3. **The optimal role of biomass for biofuels in California: helping to achieve public environmental goods**

There are differing biofuel regulations at the federal and state level

- **The Federal EISA (2007) and the RFS2 mandate the use of biofuels, mandate minimum *Carbon Intensities*, and mandate the amounts of fuels to use. But mandates are subject to review (and politics).**
- **California's LCFS mandates reductions in the *Carbon Intensity* of Fuels but does not specify which types of fuels or how much must be used.**
- **These laws are not harmonized and fuel providers must meet both.**
- **Credits from the RFS and LCFS can be combined and enhance profitability in the California market.**

RFS2 Requirements (billion gals)

Type	2009	2022
Cellulosic	---	16.0 ←
Biomass diesel	0.5	1.0
Advanced	0.6	(4.0) 21.0
Corn starch	10.0	15.0
Total	11.1	36.0

Advanced: renewable fuel (from qualifying feed stocks like Brazilian sugarcane*, grain sorghum*,…) anything other than EtOH derived from corn starch, at lest 50% less GHG than petroleum. (Older corn starch facilities are largely exempt from GHG requirements).
Cellulosic: 1. Crop residues such as corn stover, wheat straw, rice straw, citrus residue, sugarcane bagasse. 2. Forest material including eligible forest thinnings and solid residue remaining from forest product production. 3. Annual cover crops planted on existing crop land such as winter cover crops. 4. Separated food and yard waste including biogenic waste from food processing. 5. Perennial grasses including switchgrass and *Miscanthus*.

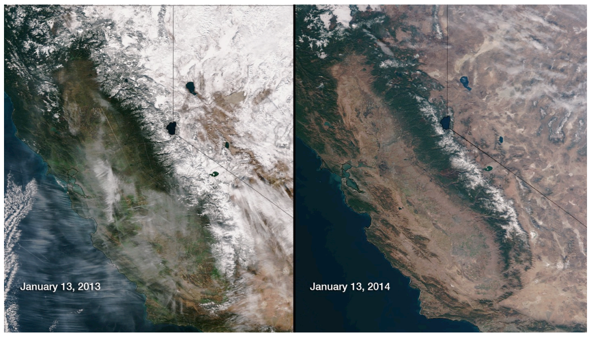
Biodiesel (> 1 bgy) can substitute for advanced ethanol. *arbitrary classifications

The implementation of the federal RFS has been mired in political controversy and the subject of unending disagreement among biofuel producers, the oil industry, and organized environmental organizations. It is beset with lawsuits and policy uncertainty.

"…the contours of the debate haven't changed. **Environmental groups such as the National Wildlife Federation maintain that conventional ethanol isn't the beneficial fuel alternative** they'd hoped for when the renewable fuel standard was adopted in the mid-2000s and is doing more harm than good. **The conflict among biofuel groups, environmental organizations and the petroleum industry will weigh on the Biden administration** as it reviews pending regulations under the renewable fuel standard. Proposed regulations on minimum biofuel volumes for this year are behind schedule, and EPA has withdrawn regulations on the RFS and other policies that were under review at the end of the Trump administration." **Jan 27, 2021**

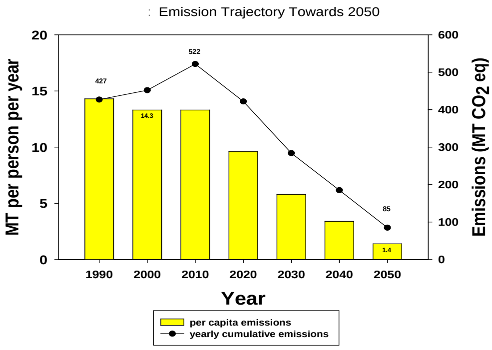
https://www.eenews.net/greenwire/2021/01/27/stories/1063723681?utm_campaign=edition&utm_medium=email&utm_source=eenews%3Agreenwire

Drought effects on winter snowpack and water storage in California.



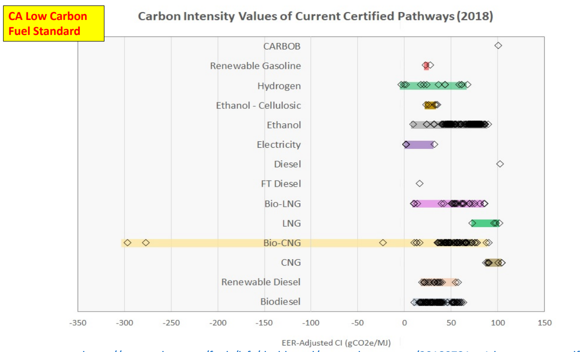
Important California Regulations

- Global Warming Solutions Act (AB 32),
- Low Carbon Fuel Standard
- Alternative and Renewable Fuel, Vehicle Technology, Clean Air, and Carbon Reduction Act (AB 118)
- Cap and Trade



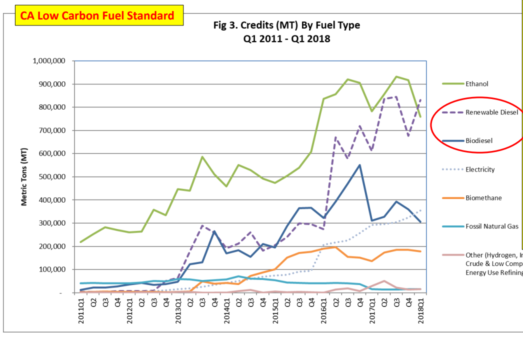
Low Carbon Fuel Standard: a performance based standard

- Creates a framework for transition to low carbon fuels. Described as a performance standard.
- Establishes a regulatory precedent or model for others, and is only effective if others participate.
- Encourages technology innovation. Putatively technology neutral, (but now favors electrification and H2)
- Allows for biofuel providers and others to assert alternative Carbon Intensities, but these are subject to CARBS' review and approval. (CA-GREET, GTAP used for LCA)



https://www.arb.ca.gov/fuels/lcfs/dashboard/quarterlysummary/20180731_q1datasummary.pdf

CA Low Carbon Fuel Standard

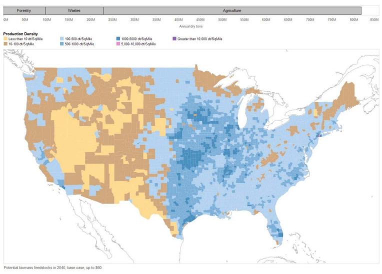


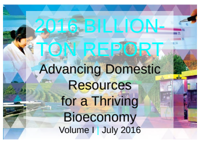
Alternative diesel fuels have been essential to meeting the LCFS' GHG reduction targets for fuels. This has been a surprise to the regulators. Renewable diesel is expanding rapidly.

https://www.arb.ca.gov/fuels/lcfs/dashboard/quarterlysummary/20180731_q1datasummary.pdf

Transportation Fuels from Biomass in California and the USA: OUTLINE

1. **Policies drive biofuel use at both the national and state level (Federal: RFS, State: LCFS)**
2. **Biomass used for biofuels at the national and state levels (crops, livestock wastes, urban residuals, forest biomass)**
3. **The optimal role of biomass for biofuels in California: helping to achieve public environmental goods**

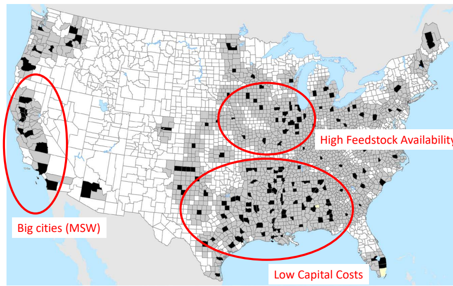




Estimated biomass amounts from forests, farms and urban areas suitable for bioenergy in the USA

U.S. DEPARTMENT OF ENERGY

USEPA predictions (Siting Tool), J. Brown 2010



EPA - ASD Division Meeting 16 27 January 2021

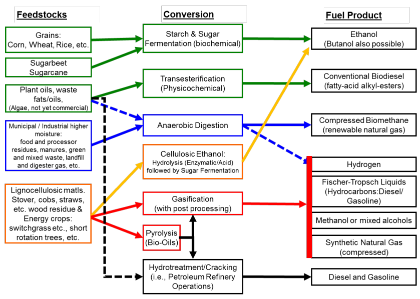
Table SK-1. Constructed or proposed advanced ligno-cellulosic or algal biofuel facilites in the United States

Company	mg/y									
year	2009	2010	2011	2012	2013	2014	State	Region	Fuel	Technology
Cobalt	0.01	0.01	2.01	102.01	102.01	102.01	California	California-irrigated	Biobutanol	Fermentation
Gevo	1	1	50	150	300	300	Missouri	Lower Mississippi River	Biobutanol	Fermentation
Aurora Biofuels	0.01	0.01	0.01	0.01	0.01	0.01	Florida		Biodiesel	Algae transesterification
Solix	0.01	0.01	0.01	0.01	0.01	0.01	Colorado	western great plains and irrigated	Biodiesel	Algae transesterification
Abengoa	0	0	15	15	15	15	Kansas	western great plains and irrigated	Ethanol	Enzymatic hydrolysis
ADM	0	0	0	1	1	1	Illinois	corn-belt	Ethanol	Enzymatic hydrolysis
AE Biofuels	0.01	10.01	10.01	10.01	10.01	10.01	Montana	northern plains	Ethanol	Enzymatic hydrolysis
American Process	0	0	0.89	0.89	0.89	0.89	Wisconsin	easternand central farming and forest	Ethanol	Enzymatic hydrolysis
BlueFire Ethanol	0.01	0.01	3.91	3.91	22.91	22.91	California	California irrigated	Ethanol	Acid hydrolysis
Coskata	0.05	0.05	0.05	55.05	55.05	55.05	Southeast US	southern Altlantic and gulf slope	Ethanol	Gasification
DDCE	0	0.25	0.25	0.25	0.25	0.25	Tennessee	eastern and cnetral farming and forest	Ethanol	Enzymatic hydrolysis
Fulcrum	0.01	0.01	0.01	10.51	10.51	10.51	California	California irrigated	Ethanol	Gasification
IneosBIO	0	0	8	8	8	8	Florida		Ethanol	Gasification-Fermentation
KL Energy	1.3	1.3	1.3	1.3	1.3	1.3	Wyoming	western great plains and irrigated	Ethanol	Enzymatic hydrolysis
Mascoma	0.2	0.2	0.2	20.2	20.2	20.2	New York	Northesast forage and forest	Ethanol	Consolidated bioprocessing
POET	0.02	0.02	25.02	25.02	25.02	25.02	Iowa	corn-belt	Ethanol	Enzymatic hydrolysis
Range Fuels	0	4	4	4	4	4	Georgia	southern Atlantic and gulf slope	Ethanol	Gasification
Verenium	1.4	1.4	1.4	37.4	37.4	37.4	Louisiana	Mississippi valley and delta	Ethanol	Enzymatic hydrolysis
AltAir	0	0	0	100	100	100	Washington	Pacific northwest interior	RDIF	Hydroprocessing
Amyris	0.01	0.01	0.02	1.02	27.02	27.02	California	California irrigated	RDIF	Consolidated bioprocessing
Clearfuels	0	0.1	0.1	0.1	0.1	16.1	California	California irrigated	RDIF	Steam reform
Dynamic Fuels	0	75	75	75	75	75	Louisiana	Mississippi valley and delta	RDIF	Fischer-Tropfs
LS9	0.01	0.1	10.1	10.1	10.1	10.1	Florida		RDIF	Consolidated bioprocessing
PetroAlgae	0.12	0.12	0.12	70.12	140.12	210.12	Florida		RDIF	Coking
Sapphire Energy	0.01	0.2	0.02	0.02	0.02	0.02	New Mexico	Southwestern range and irrigated	RDIF	Hydroprocessing
Solazyme	0.1	0.1	0.1	100.1	100.1	100.1	California	California irrigated	RDIF	Hydroprocessing
Virent	0	0	0.01	0.01	0.01	0.01	Wisconsin	Lake states forest and cropped	RDIF	Bioforming
Kent BioEnergy	0.01	0.01	0.01	0.01	0.01	0.01	California	California irrigated	Renewable oils	Lipid extraction
US Biofuels	0.12	3.8	5.9	10.5	25.3	25.3	California	California irrigated		
total	4.41	97.72	213.45	811.55	1091.35	1177.35				

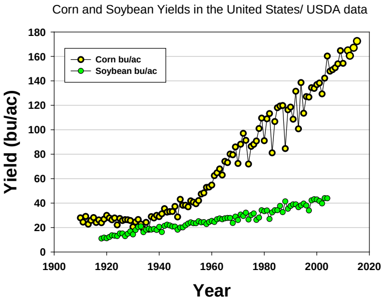
Idled POET corn stover to ethanol facility, Emmetsburg, Iowa

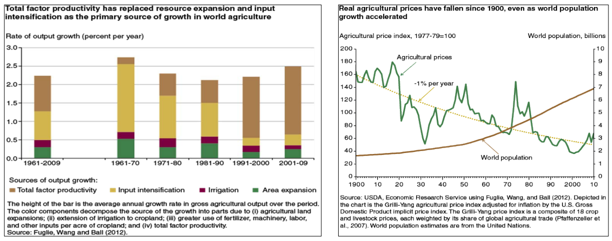
It has been difficult to develop successful businesses in the US based on cellulosic materials. Previously proposed, partially developed or built cellulosic bioernergy facilities/companies (2011). Only Amyris and Fulcrum are operating or about to operate facilities currently. POET, DuPont, and Abengoa constructed facilities but either abandoned or sold them (DuPont, Abengoa) them or idled them. Amyris has shifted to production of high value bio-products and uses sugar as a feedstock.

There are many types of biofuel feedstocks and many possible conversion pathways, but those relying primarily on crops and biochemical conversion processes dominate biofuel production. This is due to feedstock quality (ease of conversion), abundance and price.



Crop based feed stocks have dominated biofuel production in the US (and Brazil) because yields steadily increase while resource use efficiency increases simultaneously. This generates a condition of chronic surplus in the USA. Bioenergy use helps sustain the farm economy by clearing that surplus and sustaining prices. This is expected to continue.

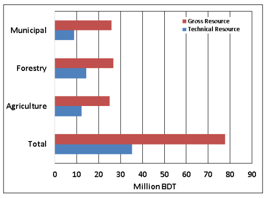




Total factor productivity in agriculture in the USA has increased, leading to steady surpluses and declining food prices, while input use has declined. This leads to industrial uses for crops.

Transportation Fuels from Biomass in California and the USA: OUTLINE

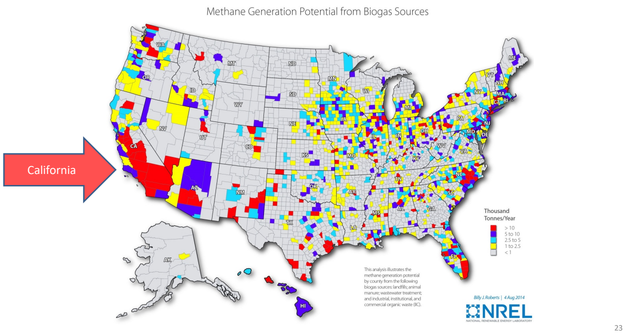
1. Policies drive biofuel use at both the national and state level (Federal: RFS, State: LCFS)
2. Biomass used for biofuels at the national and state levels (crops, livestock wastes, urban residuals, forest biomass)
3. **The optimal role of biomass for biofuels in California: helping to achieve public environmental goods_some examples**



California has a large and diverse amount of biomass, approximately equally divided among urban, forest, and agricultural sources. There are multiple co-benefits and accepted public goods that can be supported by prudent and sustainable biomass use for energy, including for alternative fuel production. This is much less the case for the ZEV program.

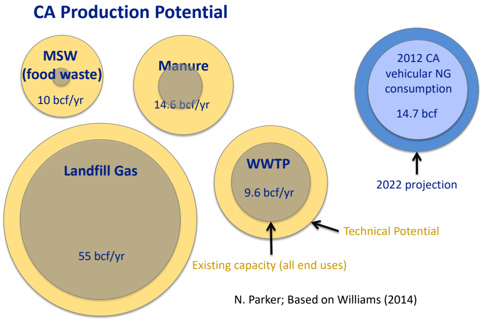
https://biomass.ucdavis.edu/

Biogas Potential - Overall



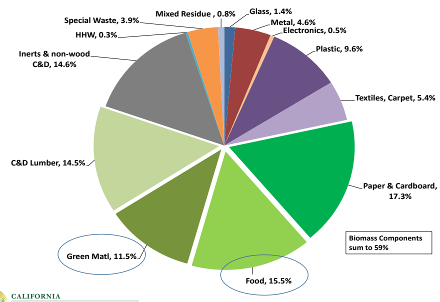
23

Renewable natural gas potential in California



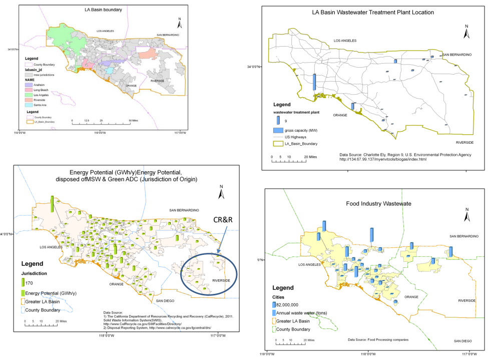
N. Parker; Based on Williams (2014)

California landfilled waste stream by material type



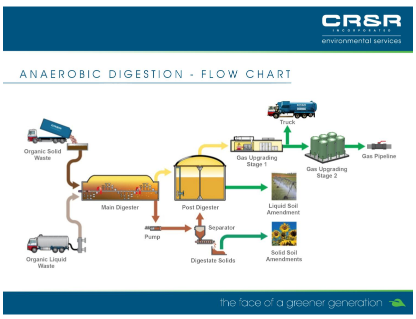
CALIFORNIA BIOMASS COLLABORATIVE

(adapted from 2008 characterization: (Cascadia 2009))

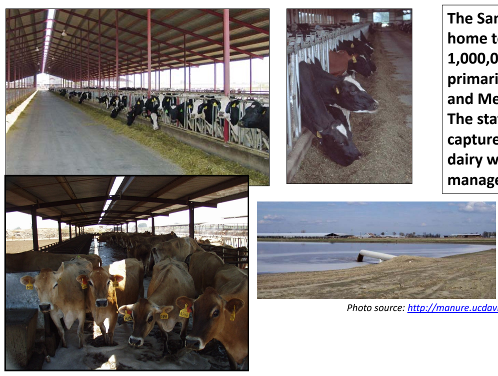


There are large amounts of potentially usable biomass in urban areas of California. Example: the Los Angeles region

CALIFORNIA BIOMASS COLLABORATIVE



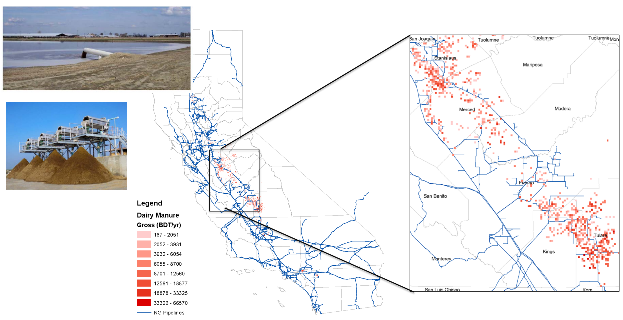
Courtesy of CR&R Environmental Services

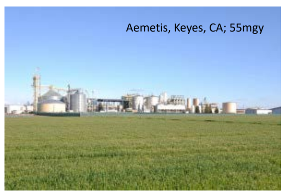


The San Joaquin Valley is home to more than 1,000,000 dairy cows, primarily in Tulare, Kern and Merced Counties. The state subsidizes the capture of CH4 from dairy waste management systems.

Photo source: http://manure.ucdavis.edu/Illustrations/Dairy_Lagoons/

Spatial distribution of dairy manure and the NG transmission network

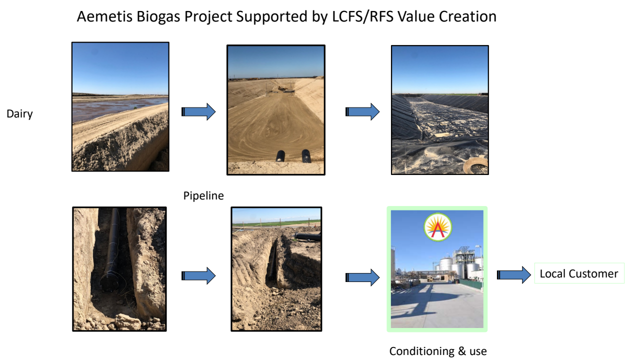


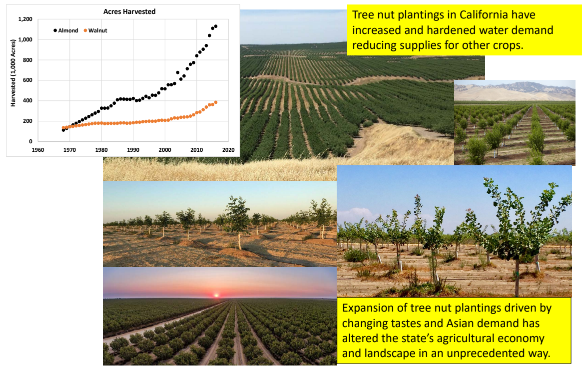


Aemetis, Keyes, CA; 55mgy

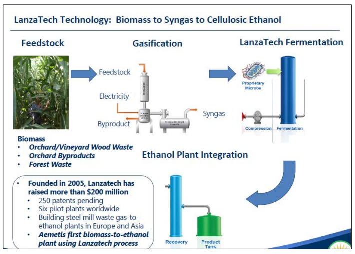
Each of these current ethanol refineries in California are evolving into integrated biorefineries. The LCFS and RFS support investments in innovative technologies and alternative feedstock uses. First generation technologies support and are a necessary step to the development of later generation technologies.

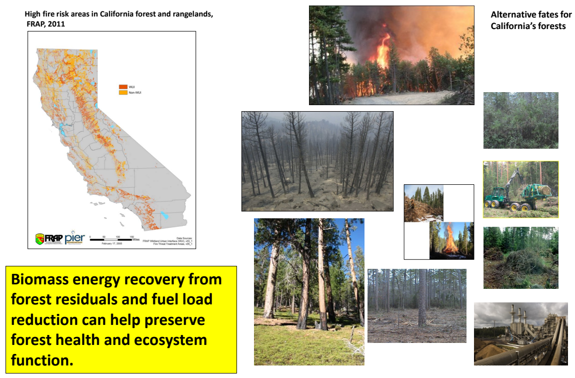
Calgren, Pixley CA; 60 mgy





Aemetis is building a woody biomass to ethanol facility in cooperation with Lanza Tech using a combined thermochemical/ biochemical process already operating at scale in China, to use woody biomass from retired orchards. This is made possible by the existence of the core corn ethanol facility. They will also produce CH4 from manure and biodiesel from corn oil and other feedstocks.





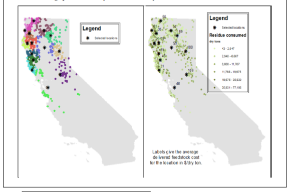
Potential for Biofuel Production from Forest Woody Biomass/ Mitchell et al., 2015 (STEPS/ITS)

The project developed a new statewide resource assessment of forest biomass feedstock. The assessment utilizes a knowledge base of forestry expertise developed at UC Berkeley, and the **Biomass Summarization Model (BioSum),** *a temporally dynamic, spatially explicit, forest stand development* ***model*****...that estimates ...on-site woody biomass resulting from forest operations**. BioSum had not previously been applied statewide in California.

Over the **40-year simulation period**, *California forests generate forest residue of about 177 million bone-dry-tons (BDT) on private land, and 100 million BDT on federal land, for a total of 277 million BDT. On average, this is about 7 million BDT of forest woody biomass per year across the state.*

The largest total cumulative amount of woody biomass comes from North Coast private lands, with over 74 million BDTs. Standardized on a per acre basis, Western Sierra private lands have the greatest output, 34 BDT/acre, and the Southern Oregon/Northeast California public lands have the least output, 12 BDT/acre.

Figure 11. Biorefinery Siting of a Potential Drop-In Fuel Industry. Left: biorefinery location and feedstock shed for ten biorefineries.[1] Right: the quantity of biomass supply available and the average price at delivery to the biorefinery.[2]



CALIFORNIA BIOMASS COLLABORATIVE

Summary:

1. Policies stimulate biofuel use and are needed to support biofuel adoption and innovation.
2. Optimal feedstocks and fuel types vary locally (one size does not fit all).
3. Feedstock quality, cost and abundance have favored crop-based feedstocks, but first generation technologies based on crops can be the key to adoption of advanced technologies and the use of lower quality feedstocks.
4. In California, optimal feedstock-biofuel systems should provide multiple public goods. Biofuel production and use can help achieve important environmental public goods like healthy forests, landscape restoration and pollution reduction, while providing petroleum substitutes.

Supplemental Slides

California has adopted the most aggressive climate focused policy within the USA and perhaps the world. This policy is justified as necessary based on projections of severe, future climate-related harms and a judgement that the higher costs of climate policies are necessary and ethically justified.

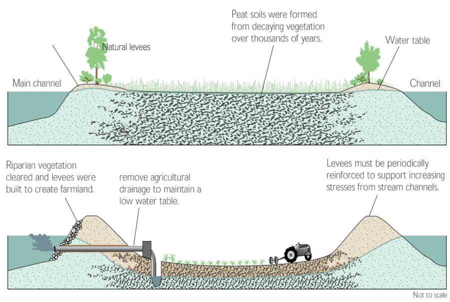
"CA is particularly vulnerable to the costs associated with unmitigated climate change. A warming climate would generate more smoggy days, ozone, and foster more large brush and forest fires… by late century, CA will loose 90% of the Sierra snow pack, sea level will rise by more than 20 inches, and there will be a 3x to 4X increase in heat wave days. This will lead to increased flood damage, diverse economic losses and substantial public health costs." Assembly Bill 32 Scoping Plan (Executive Summary).

Annual Damage Estimates in 2006 USD (billions)			
	LOW	HIGH	ASSETS AT RISK
Water	N/A	0.6	5
Energy	2.7	7.5	21
Tourism and Recreation	0.2	7.5	98
Real Estate	0.3	3.9	2500
Agriculture, Forestry, Fisheries	0.3	4.3	113
Transportation	N/A	N/A	500
Public health	3.8	24.0	N/A
TOTAL	7.3	46.6	

Fredrich and Roland-Holst (2008)

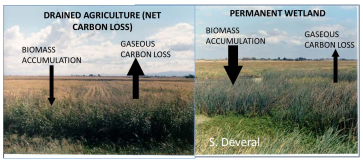
The Delta region: Before and after: 100 years

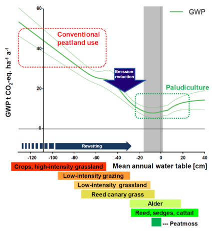
Land subsidence and dissolved organic matter



Subsidence = 1 to 3 cm/y

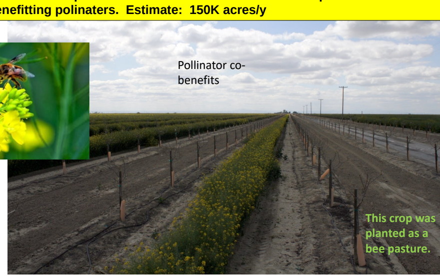
LIFE CYCLE ASSESSMENT, CARBON ACCOUNTING, STATE AND FEDERAL CARBON AND ENERGY POLICY





Tannenberger

Canola intercropped with newly-planted pistachios in Kern County. Pistachios emerge late. There is a large amount of land potentially available in new or re-planted orchards and vineyards in California on a yearly basis that might produce oilseed crops in winter, largely on rainfall or with limited irrigation. There may be opportunities in young orchards throughout California for both Canola and Camelina winter inter-crops. These oils can be used for biodiesel production without using new land while benefitting polinaters. Estimate: 150K acres/y



CALIFORNIA'S LOW CARBON FUEL STANDARD AGGREGATED CERTIFIED PATHWAYS

Data Source: https://www.arb.ca.gov/fuels/lcfs/fuelpathways/pathwaytable.htm

Fuel	Producers	Facility Locations	Feedstock	Average Carbon Intensity Value (gCO2e/MJ)
Diesel	ULSD - based on the average crude oil supplied to CA refineries and average CA refinery efficiencies	California	Crude Oil	102.01
Bio-diesel	BIOX Canada, American Biodiesel, ADM, REG Grays Harbor, Western Iowa Energy	CAN, CA, IA, ND, WA	Canola Oil	55.13
	BIOX Canada, Duonix Beatrice, American Biodiesel, Crimson Renewable Energy, FutureFuel Chemical Company, Western Iowa Energy, Imperial Western Products, REG Mason City/Newton/Albert Lea/Seneca/Danville, High Plains Bioenergy, Adkins Energy	CAN, AR, CA, IA, IL, KS, MN, NE	Corn Oil	34.43
	BIOX, American Biodiesel, ADM, Western Iowa Energy, Ag Processing, REG Mason City, Clinton Biodiesel, Delek Renewables, FutureFuel Chemical, Global Alternative Fuels, Lakeview Biodiesel, Solfuels, W2Fuels	CAN, AR, CA, IA, MO, MI, TX	Soybean Oil	54.62
	Universal Biofuels Private, BIOX Canada, Duonix Beatrice, High Plains Bioenergy, American Biodiesel, FutureFuel Chemical Company, Crimson Renewable Energy, Rothsay Biodiesel, REG Mason City/Newton/New Boston/Albert Lea/Seneca/Danville, Western Iowa Energy, High Plains Bioenergy, Delek Renewables, Imperial Western Products	CAN, India, AR, CA, IA, IL, MN, NE, OK, TX	Tallow	35.01
	Universal Biofuels, Consolidated Biofuels, Duonix Beatrice, Crimson Renewable Energy, FutureFuel Chemical Company, Biocom Energia, American Biodiesel, New Leaf Biofuel, Rothsay, Scott Petroleum, REG Grays Harbor/Mason City/Newton/New Boston/Albert Lea/Seneca/Danville, Western Iowa Energy, Crimson Renewable Energy, Imperial Western Products, BIOX Canada, SeQuential, GeoGreen Biofuels, Global Alternative Fuels, Buster Biofuels, Biodico Westside, Delek Renewables, JC Chemical, General Biodiesel, Dansuk Industrial, ASB Biodiesel, Thumb Bioenergy	CAN, Hong Kong, India, South Korea, Spain, CA, AR, IA, IL, MI, MN, MS, NE, OR, TX, WA	Used Cooking Oil	20.67
Renew-able Diesel	Neste, Diamond Green Diesel, REG Geismar	Singapore & LA	US Corn Oil	34.33
	Diamond Green Diesel & REG Geismar	LA	Soybean Oil	55.22
	Neste	Singapore	South East Asian Fish Oil	33.08
	Neste, Diamond Green Diesel, REG Geismar	Singapore & LA	Tallow	34.48
	Neste, Diamond Green Diesel, REG Geismar	Singapore & LA	Used Cooking Oil	20.98
	Ensyn Technologies	Ontario, CAN	Pyrolysis Oil from Forest Residue	27.33
Fischer-Tropsch Diesel	Fulcrum Sierra BioFuels (Commerical production scheduled for early 2020)	NV	Municipal Solid Waste (MSW)	14.78

The lowest carbon intensity (CI) values are for corn oil (derived from ethanol production) and renewable diesel, (from FOG), and urban residuals.

There is room to lower the CI of soy and canola derived biodiesel, and other innovative crop-based SVO feedstocks.

Calgren: integrated biorefinery based on imported corn grain now (or soon) will produce biodiesel and CNG, based on biogas from 14 nearby dairies and sale of DDGS to those dairies.

Calgren is processing its own corn oil into biodiesel (with brown grease), otherwise exported to China and burned. This is a robust pathway for new biodiesel production in CA. It will integrate biogas from 14 nearby dairies to produce RNG.

中国石油和化学工业联合会
China Petroleum and Chemical Industry Federation (CPCIF)

China's biofuel industry development status and related specification system

Feb. 2021 • Beijing

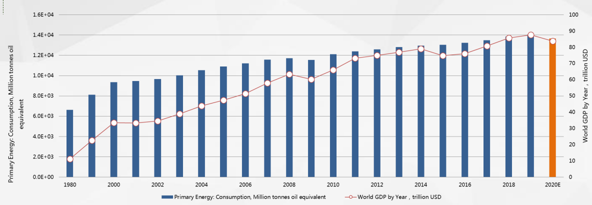
CONTENTS

1. Energy and renewable energy consumption of China
2. Current status of transportation energy and liquid biofuels of China
3. Ethanol, Bio-Diesel, Aviation biofuel development in China
4. Summary

01 Energy and renewable energy consumption of China

- China's energy consumption is growing rapidly
- China is vigorously developing renewable energy

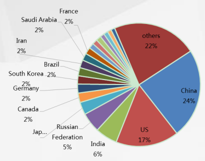
World energy consumption is growing steadily



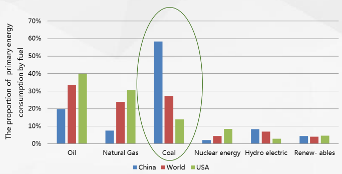
- With the continuous development of the world economy and the improvement of people's living standards, global energy consumption has grown rapidly. From 1980 to 2018, the world GDP increased by 7.6 times, accordingly, world energy consumption increased by 2 folds.

Source: IMF, BP Statistical Review of World Energy

China has become the world's largest energy consumer



Share of Primary Energy Consumption by Country

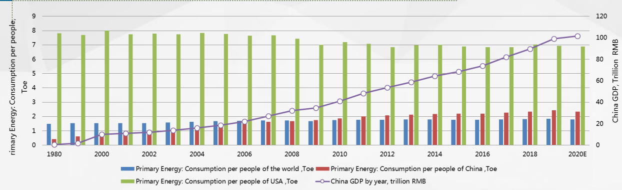


Primary Energy Consumption by Fuel Type in 2018

- The primary energy consumption of China surpassed the United States in 2009, becoming the largest energy consumer in the world.
- Constrained by nature resources, coal accounts for more than 55% of China's primary energy consumption, much higher than that of the world and developed countries.

Source: World bank, BP Statistical Review of World Energy

China's energy consumption is growing fast



- Chinese Energy consumption is closely correlated with economic growth. In the past 40 years, the primary energy consumption per people of China has increased by 5.5 folds. As China is the largest developing country with the population of 1.4 billion.
- Although the energy consumption per people has been slightly higher than the average value of the world, however, there is still a big gap between developed countries (only about 1/3 of USA) .

Source: World Bank, IMF, BP Statistical Review of World Energy, Bureau of Statistics of China

China has attached great importance to develop and utilize of renewable energy for a long time

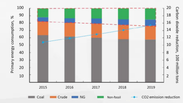
- **In order to fulfill the rapid growth of energy consumption , optimize the energy structures and reduce GHG emission, developing and utilization of renewable energy is one of the important aspects in China' s energy policy.**

Time	Achievements
1900-1970s	Developed Small-scale hydropower, Bio methane and firewood forest in rural area
1980s	Government set up renewable energy office to research renewable energy development issues
1997	Issued a ***national renewable energy development plan*** for the first time. To support renewable energy demonstration projects
2002	Signing the ***Kyoto Protocol***, to improve energy efficiency. To develop renewable energy and plant trees to mitigate climate change
Jan. 2006	Issued the ***renewable energy act*.** Renewable energy has entered a period of rapid development. The act include Hydropower, wind power, solar power, geothermal, biomass energy etc.
2013	Issued ***Action Plan of Air Pollution Prevention and Control***, Adjusting energy structure, reducing coal consumption and increasing clean energy supply are important measures to control air pollution
2015	Signed the ***Paris agreement***, China has pledged to reduce carbon dioxide emissions per unit of GDP by 60-65% of 2005 levels by 2030, and increase the share of non-fossil fuels in primary energy consumption to around 20%.
2020	**Chairman Xi made the statement of "China will take effort to be peak CO2 emissions by 2030 and to be carbon neutral by 2060."**

China is the world's largest consumer of renewable energy

- **Since the implementation of the *Renewable Energy Law* in 2006, renewable energy has become an important part of China's energy supply.**
- **By the end of 2019, China has became the largest renewable energy consumer in the world.** The total consumption of commercialized renewable energy is about 430 million tons of oil equivalent, accounting for 12.6% of China's primary energy consumption.
- Renewable energy consumption is 2.5 times that of the United States of America, 3.8 times that of Brazil, and 8 times that of Germany.

Item	Value
Renewable power generation	2 trillion kilowatt·hours
Biomass energy utilization	12 million tons of oil equivalent
Liquid Biofuel	3 million tons of oil equivalent
Bio-nature gas	1.3 billion cubic meter (1 million tons of oil equivalent)



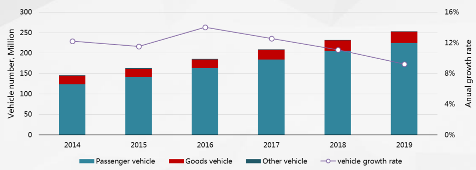
Target: The share of non-fossil fuels in primary energy consumption will be to around 20% by 2030.

Source: 《China Renewable Energy Development Report 2019》

02 Current status of transportation energy and liquid biofuels of China

- Road traffic development in China
- China oil market
- Development of liquid biofuels in China

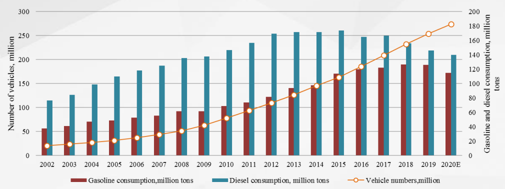
Road traffic of China grown very fast



- By 2019, China' s vehicle number has reached 250 million, which is not including agriculture vehicle and motorcycle, and the growth rate of passenger vehicle is the fastest segment.

Source: Statistical bureau of China , CPCIF

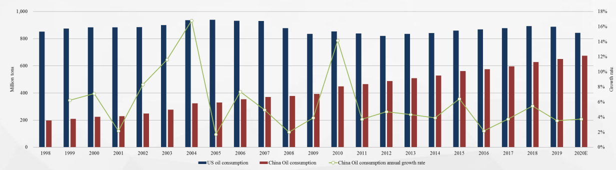
Transport fuel consumption is growing rapidly



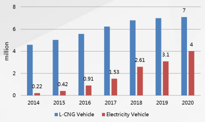
- With the rapid increase of the number of vehicles, the consumption of transportation fuel has also increased significantly, correspondingly.
- In 2020, the Gasoline and Diesel consumption is about 115 million tons and 140 million tons respectively.

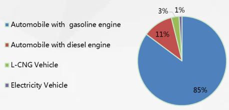
China has already become the second largest oil consumer in the world

- **In 2020, China consumed 620 million tons crude oil, which is the second largest crude consumer in the world, and China has already become the world largest crude importer.**



Actively promotes transportation energy diversification





- In response to the rapid growth of transportation energy, China is actively promoting the diversification of transportation. The number of natural gas and electric vehicles increased significantly.
- In 2020, there were 7 million natural gas vehicles in China, accounting for 25% of global natural gas vehicles. EV number has reached 4 millions, growing very fast. Although the growth rate is fast, the share is still pretty low.

- **By 2050, There will be a large number of vehicles with gasoline and diesel engine are still in service.**
- **Developing and utilization of liquid low-carbon renewable fuels (biofuels) is always an effective way to solve transportation energy problems (supplement, GHG emission, sustainable development, etc.). The Chinese government has done so.**

China's main policy for supporting liquid biofuels

Jan. 2006, *Renewable Energy Law*.

- Definition: Liquid biofuels refer to liquid fuels such as methanol, ethanol and biodiesel produced from biomass resources.
- The state encourages the production and use of liquid biofuels. Oil enterprises should incorporate the liquid biofuels into its fuel blending system conforming to the fuels specification of national level.

Aug. 2007, *Medium and Long-term Development Plan for Renewable Energy*.

- By 2020, 10 million tons of bio-ethanol and 2 million tons of biodiesel will be used annually.

Mar. 2008*, The Eleventh Five-year Plan for the Development of Renewable Energy*.

- By the end of 2010, fuel ethanol consumption would be 2 million tons per year, and biodiesel consumption would be 200 thousand tons per year.

China's main policy for supporting liquid biofuels

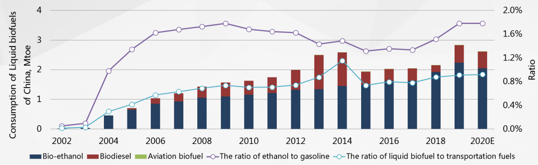
Aug. 2012*, The Twelve Five-year Plan for the Development of Renewable Energy*.

- Steady development of bio-liquid fuels. Constantly support the construction of cassava ethanol, sweet sorghum ethanol, cellulosic ethanol and other projects where conditions allow.
- Continue promoting the demonstration of the industrialization of biodiesel from woody oil plants represented by *jatropha*
- Scientifically guide and regulate the development of biodiesel industry based on catering and waste animal and vegetable oils.

Dec. 2016*, The Thirteen Five-year Plan for the Development of Renewable Energy*.

- Steady expansion of fuel ethanol production and consumption.
- The total amount of grain fuel ethanol should be controlled in combination with the consumption of old grain and heavy metal contaminated grain. Moderate development of cassava, sweet sorghum and other fuel ethanol projects.
- Promoting the industrialization and demonstration application of biomass conversion and synthesis of biofuel and bio-aviation fuel.

Development status of liquid biofuels in China

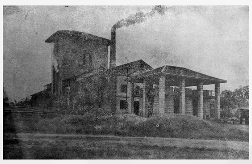


- Supported by the policy, production and consumption of fuel ethanol have risen steadily since 2002.
- In 2020, the total consumption of liquid biofuels was round 2.6 million tons of oil equivalent, which accounting for 1 percent of transportation fuel consumption in 2020.
- Currently, liquid biofuels capacity of China is about 9 million tons, including 6 million tons of biofuel ethanol, 2.5 million tons of biodiesel and 100 Ktons of aviation biofuel.

03 Ethanol, Bio-Diesel, Aviation biofuel development in China

The application of ethanol gasoline in China has long history

- The utilization of fuel ethanol in China began during the War II, due to the lack of fuel supply, ethanol partly replaced gasoline as cars and the military vehicles fuels for the war.
- By 1942, China had hundreds of distilleries and consumed 8 million gallons of fuel ethanol at that time.
- With the steady supply of gasoline after 1945, the demand of fuel ethanol had declined rapidly.



Zi Zhong Distiller, Sichuan province, 1940

Distiller	Site
Fang lin Distiller	Henan, Nanyang
The first Sichuan Distiller	Sichuan, Neijiang
The Second Sichuan Distiller	Sichuan, Zizhong
The Thrid Sichuan Distiller	Sichuan, Jianyang
Yunnan Distiller	Yunnan, Kunming
Guizhou Distiller	Guizhou, Zunyi
Gansu Distiller	Gansu, Lanzhou

The application of ethanol gasoline in China began at the beginning of this century

Time	Policy	Content
2002	***E10 gasoline tenth five year special development plan***	Zhengzhou, Luoyang, Nanyang, Harbin and Zhaodong were the first batch of pilots, stop sale of unlead gasoline
2004	***E10 Gasoline Pilot expansion program and Implementation rules***	Heilongjiang, Jilin, Liaoning, Henan, Anhui, nine cities in Hubei, Seven cities in Shandong, five cities in Jiangsu, six cities in Hebei are new pilots
2007	***Medium and Long-term Development Plan for Renewable Energy***	By 2020, 10 million tons of bio-ethanol and 2 million tons of biodiesel will be used annually.
2016	***The Thirteen Five-year Plan for the Development of Renewable Energy***	By2020, the utilization amount of bioethanol should be 4 million tons.
2017	***Implementation Plan for Expanding Biofuel Ethanol and Promotion of the Use of Ethanol Gasoline***	Utilization of fuel ethanol will be expanded nationwide, and primary market operation mechanism should be established by 2020.

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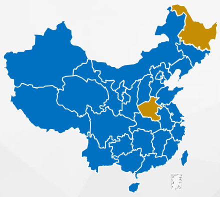
The Scale Promotion of Ethanol Gasoline Began in the Beginning of 21 Century

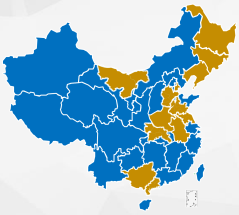
- **In 2001,** China launched the Tenth Five-Year renewable energy substitute Plan to promote the use of fuel ethanol. The promotion of fuel ethanol in China was divided into two main stages.
- **The first stage (2002-2004) :** Began to pilot the promotion of ethanol gasoline (E10) in Henan, Heilongjiang province.



- During the tenth five-year plan period (2000-2005), the government approved four fuel ethanol enterprises, with a capacity of 1.02 million tons/year, using expired grain as feedstock.
- In 2002, lunched ***Ethanol-gasoline Promotion Pilot Program,*** and began to promote E10 gasoline in three cities in Henan province (Zhengzhou, Luoyang, Nanyang) and two cities in Heilongjiang province (Haerbin, Zhaodong).
- The pilot had got desire results. E10 gasoline is applicable in China, and could be expand across the country.

The Scale Promotion of Ethanol Gasoline Began in the Beginning of 21 Century

- **The second stage (2004-2017) :** Expanded E10 gasoline to 36 cities in 12 provinces.



- In 2004, Issued the ***E10 Gasoline Pilot expansion program.***
- Expand the pilot experiences of Henan and Heilongjiang to other 12 provinces, which including Jilin, Liaoning, Anhui and Guangxi etc.
- 6 provinces completely and only have E10 gasoline for sale, 6 provinces have both E10 gasoline and conventional gasoline for sales.
- Fuel ethanol consumption in 2018 was about 280 million tons (930 million gallons), and E10 gasoline accounted for one-fifth of the nation's gasoline consumption.
- China now is the world's third largest consumer of fuel ethanol after the United States and Brazil.
- Bioethanol and E10 gasoline has played an important role in agricultural development, environmental protection and energy diversification.

E10 will be expanded nationwide

2017, ***Implementation Plan for Expanding Biofuel Ethanol and Promotion of the Use of Ethanol Gasoline,***

E10 will be expanded nationwide, and primary market operation mechanism should be established by 2020.

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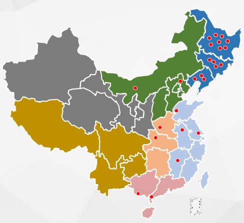
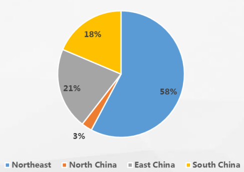
China is the world Third largest fuel ethanol consumer

- **By the end of 2020. Ethanol capacity of China is round 6 million tons. Mainly distributed in Northeast China, North China, East China, South China.**





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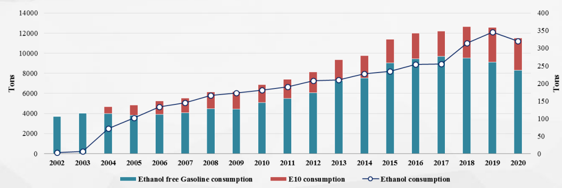
China is the world Third largest fuel ethanol consumer

- **By 2020 , China is the world third largest fuel ethanol consumer in the world. About one-fourth of gasoline consumed in China is E10.**



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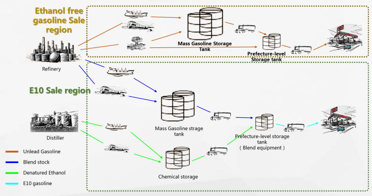
Standard for ethanol and E-gasoline

Standard：

- Blenderstocks of ethanol gasoline for motor vehicles, GB22030
- Denatured fuel ethanol, GB18350)
- Ethanol gasoline for motor vehicles (E10), GB18351
- GB17930 Gasoline for motor vehicles



Biodiesel is one of most important low-carbon liquid fuel in China

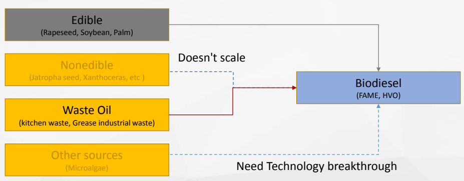
Jan. 2006, *Renewable Energy Law*.

- **Definition: Liquid biofuels refer to liquid fuels such as methanol, ethanol and biodiesel produced from biomass resources.** The state encourages the production and use of liquid biofuels.

Time	Policy	Release Department
2007	《GB/T20828-2007/2014/2015》, Biodiesel blend stock (BD 100) for diesel engine fuels	National standard committee
2009	Renewable Energy Law（Revised edition）	National People's Congress
2010	《GB/T 25199-2010/2014/2015》Biodiesel fuel blend (B5)	National standard committee
2012	Bioproduct Industry Development Plan	State Council
2014	Biodiesel industry development policy	National Energy Administration
2016	The Thirteen Five-year Plan for the Development of Renewable Energy	National Development and Reform Commission
2017	《GB25199-2017 》B5 diesel fuels	National standard committee
2018	Production of biodiesel using waste animal and plant oils as raw materials is subject to a Value Added Tax refund of 70%	State Administration of Taxation

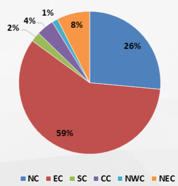
Waste oil is the main raw material of Biodiesel in China

- **Unlike other regions and countries around the world where biodiesel is being massively promoted, for the supply of oil is not sufficient. China can not use Edible oil as feedstock to produce biodiesel.**



Biodiesel capacity is more than 2.5 million tons

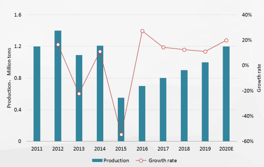
- **There are more than 30 biodiesel enterprises in China, and the capacity is more than 2.5 million tons. These plants almost use waste oil feedstock.**



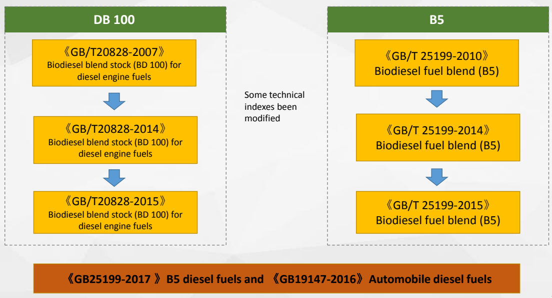
Biodiesel

- **There is no national level mandate for biodiesel in China. Some cities use B5 biodiesel according to their own regulation.**
- EU market is more attractive to Chinese waste-oil-biodiesel. In 2019, China export 660Kt biodiesel. It is estimated that biodiesel production is about 1.2 million tons, and exportation is about 900kt.

Time	Province or City application B5 biodiesel
2009	Qing mai, Hai nan
2011	Kun Ming, Yun Nan
2013	Shang Hai

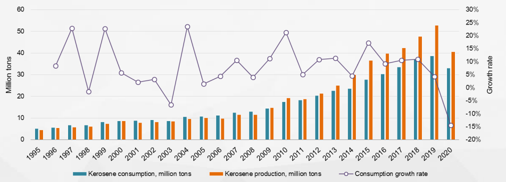


Standard for Biodiesel



China's aviation industry is developing rapidly

- **China's aviation industry is developing rapidly, Jet fuel consumption is increasing rapidly.**
- In accordance with the requirements of the International Civil Aviation Organization, aviation industry emission reduction has been put on the agenda.



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Aviation biofuel start from 2010

- **China-U.S. Advanced Biofuels Forum was held on May 26th 2010 to officially launch the relevant cooperation of the "China-U.S. Renewable Energy Partnership,**

- The two sides have signed eight cooperation agreements, including aviation biofuels, natural gas distributed energy, smart electricity meters and cellulosic ethanol

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China's first aviation sustainable biofuel demonstration flight

- NEA
- CAAC
- Petrochina
- China Aviation Oil
- Air China
- capital airport
- Air Traffic Management Bureau
- Aviation Fuel/oil and aerochemicals Airworthiness certification center of CAAC
- Boeing
- Honeywell/UOP
- Pratt & Whitney

- **On October 28, 2011, based on the energy cooperation between China and the United States, Air China, PetroChina, Boeing and Honeywell UOP jointly conducted China's first aviation sustainable biofuel demonstration flight at Beijing Capital International Airport.**

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Chinese No. 1 Bio-jet was issued CTSOA in 2014

- **On March 24th 2013, the Civil Aviation Administration of China (CAAC) issued the No. 1 Bio-jet special flight permit to China Eastern Airlines. China Eastern Airlines took off on its A320 aircraft after it was filled with Bio-jet No. 1.**
- **On February 12 2014, Civil Aviation Administration of China (CAAC) officially issued CTSOA to Sinopec No. 1 Bio-jet, and has been officially approved for airworthiness and can be put into commercial use.**

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Aviation Biofuel commercial use in China

- **On March 21 2015, the First commercial passenger flight of China, Hainan Airlines Flight HU7604 (Boeing 737-800) with 156 passengers and eight crew on board, took off from Shanghai Hongqiao Airport with Sinopec No.1 Bio-aviation kerosene (Hydorprocessed esters and fatty acids) , Landed at Beijing International Airport.**
- **On Nov 21 2017, HNA flight HU497 left Beijing Capital International Airport for Chicago, marking the first Sino-US green pilot flight with bio-aviation fuel.**
- **In 2019, China South airline completed over sea flight from Airbus delivery center in Toulouse to Guangzhou. (Hydroprocessed fermented sugars)**

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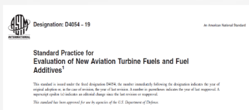
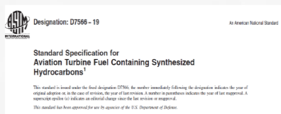
Standard for Aviation Biofuel

ASTM D4054， Standard practice for Evaluation of New Aviation Turbine Fuels and fuel additives



ASTM D7566， Standard specification for Aviation Turbine Fuel Contain synthesized Hydrocarbons



ASTM D1655， Standard Specification for Aviation Turbine Fuels

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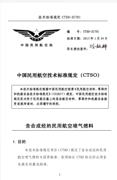
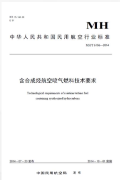
Standard for Aviation Biofuel

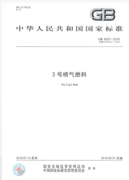
CTS0-2C701
Aviation jet fuels containing synthetic hydrocarbons



MH/T 6106-2014
Technological requirements of aviation turbine fuel containing synthesized hydrocarbons



GB 6537
No.3 Jet fuel



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Summary

- China has long attached great importance to the development and utilization of renewable energy.
- Developing and utilization of liquid biofuels is always an effective way to solve transportation GHG emission.
- In 2020, the total consumption of liquid biofuels was 2.6 million tons of oil equivalent.
- Currently, China is the world third largest fuel ethanol consumer in the world. About a quarter of gasoline consumed in China is E10.
- China is one of the world's leading producers of biodiesel, which is mainly made from recycling oil.
- China already has the technology for the production of aviation biofuel, which is also being in commercial use.

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中国石油和化学工业联合会
China Petroleum and Chemical Industry Federation (CPCIF)

Thank you !

Industrial Development Department

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Background

ASTM International's Context

- ASTM's experience offers a robust, time-tested development process delivering globally accepted and respected standards
  - Established 1898
  - 30,000+ members in 155+ nations
  - 145+ Technical Committees meeting market needs of 90+ industry sectors
- Success based on responsiveness to the market – to both member and customer needs
  - In addition to standards, we offer training, proficiency testing, certification and an electronic platform that facilitates collaboration

What Is a Standard?

- Much more than technical documents…
- Documents established by consensus, and approved by a recognized body, that provide for common and repeated use, offer rules, guidelines or characteristics
- Standards fuel global trade, promote health and general welfare, advance innovation
- Wide range of valuable uses

ASTM International Committee D02

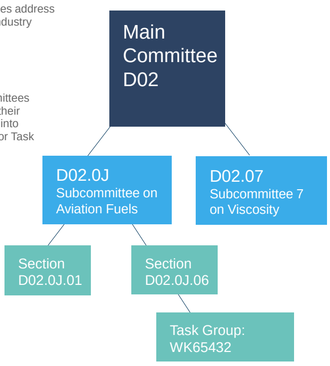
Scope: Petroleum products, liquid fuels, and Lubricants

- Largest ASTM Committee, organized in 1904
- Includes over 2,700 members from more than 65 countries
- Developer of over 800 petroleum, liquid fuels, and lubricant standards that have helped to provide heat for homes, fuel for automobiles and airplanes, and lubricants for machinery
- Sponsor of numerous technical publications, laboratory quality assurance programs and technical and professional training courses, workshops, and symposia.

- ASTM Standards come in many forms:
  - Product specifications
  - Test methods
  - Manufacturing practices
  - Operational and purchasing guidelines
  - Classifications
  - Standardized terminology
  - And more….

Technical Committee Organization

- A need is Identified:
- Technical Committees address specific industry needs.
- Subcommittees are established to address subsets of specialized subject matter.
- Subcommittees organize their expertise into Sections or Task Groups.
- Working Groups are then used to write and edit standards.



Let's Look at Two Examples…

Designation: D1655 – 17

Standard Specification for Aviation Turbine Fuels[1]

6. Materials and Manufacture

6.1.1 Aviation turbine fuel, except as otherwise specified in this specification, shall consist predominantly of refined hydrocarbons (see Note 1) derived from conventional sources including crude oil, natural gas liquid condensates, heavy oil, shale oil, and oil sands. The use of jet fuel blends containing components from other sources is permitted only in accordance with Annex A1.

TABLE 1
Detailed Requirements of Aviation Turbine Fuels
Jet A or Jet A-1

Designation: D7566 – 17a

Standard Specification for Aviation Turbine Fuel Containing Synthesized Hydrocarbons[1]

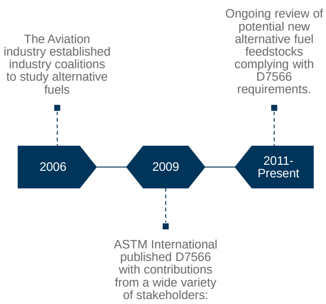
6. Materials and Manufacture

6.1 Aviation turbine fuel, except as otherwise defined in this specification, shall consist of the following blends of components or fuels:

6.1.1 Conventional blending components or Jet A or Jet A-1 fuel certified to Specification D1655; with up to 50 % by volume of the synthetic blending component defined in Annex A1.

TABLE 1
Detailed Requirements of Aviation Turbine Fuels Containing Synthesized Hydrocarbons
Jet A or Jet A-1

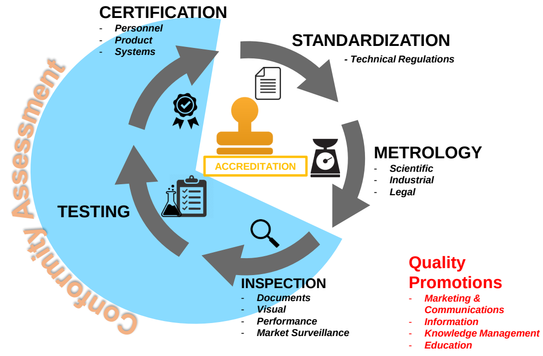
Alternative Jet Fuel: A Need Identified



– ASTM Subcommittee D02.J on Aviation Fuels provides the forum for discussion and consensus building.
  – It is Not a Regulatory body.
  – Uses the process of D4054 Practice for the Evaluation of New Aviation Turbine Fuels and Fuel Additives to review data for new options.
  – Fit-for-purpose in existing engines and aircraft is the desired outcome

– Key Stakeholders Involved:
– Fuel and Feedstock producers
– Additive manufacturers
– Airlines
– Original Equipment Manufacturers
– Laboratories
– Regulatory and Government

Quality Infrastructure



Attributes of Standards Systems that Produce International Standards

Open and Transparent Process
– Direct and equal participation to ASTM for all people and organizations
– Information on ASTM International standards are transparent and readily available online

Impartial, Consensus-Based Model of Engagement
– Balanced system where producer votes are equal to those of users
– Impartial, inclusive, and fair to all, with appeals and protections to avoid abuses

Effective and Relevant Standards
– Constantly responding to market needs, keeping pace with industry and innovation
– Relevant to the global marketplace and performance-based in application

Driven by Research, Data, and Science-Based Decisions
– Focus on science and technical quality, and specifically addressing risks and needs

Collaboration with Other Standards Bodies to Avoid Duplications
– Collaborate with other standards organizations to avoid duplication and to pursue international standards work in a smart way

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Sustainable Aviation Fuels

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February 2021

The path to 2050: bigger solutions for a smaller footprint

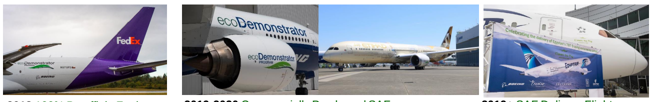
Airline Fleet Replacement | **Network Operational Efficiency** | **Renewable Energy Transition** | **Future Airplane Technology**

Sustainable Aviation Fuel on every ecoDemonstrator Program

2012 HEFA Blend

2014 & 2015 Green Diesel /HEFA+ Blend

2016 Sugarcane Waste



2018 100% Paraffinic Fuel

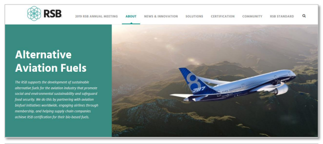
2019-2020 Commercially Purchased SAF

2019+ SAF Delivery Flights

- Alaska launch airline; EgyptAir first delivery in new program

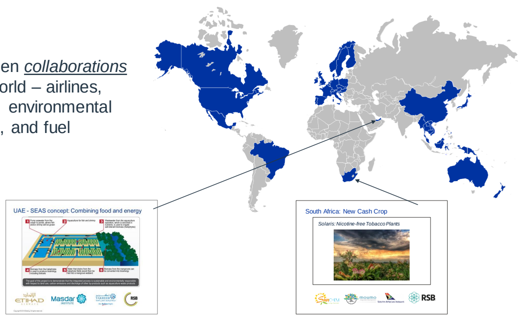
Incentives and investment needed to scale production

- New ways to make the same fuel – blends with Jet-A
- Requires no change to airplanes, engines or fueling infrastructure
- Reduces lifecycle CO2 emissions by 50% to 80%
- No negative impact to food security, fresh water supplies or land-use – strong, credible sustainability certification



Sustainable aviation fuels and local economic development

Over two dozen *collaborations* around the world – airlines, governments, environmental organizations, and fuel producers



Examples of Boeing Collaborations in China

FLIGHT TEST

Air China conducted China's first aviation biofuel test flight in a Boeing 747-400 using China-grown, jatropha-based biofuel.

PRODUCTION

Supported NEA supervised, PetroChina led, comprehensive analysis on potential of energy crops for biofuel use.

PASSENGER FLIGHT

Boeing, Hainan Airlines and Sinopec partnered for China's first passenger flight with sustainable aviation biofuel.

FUEL PATHWAYS

MOU between Boeing and NDRC announced a new initiative to turn agricultural waste in China into sustainable aviation biofuel

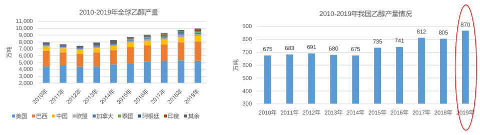
BOEING

生物燃料技术现状与进展

刘　德　华
清华大学化学工程系 教授
中拉清洁能源与气候变化联合实验室 主任

报 告 内 容

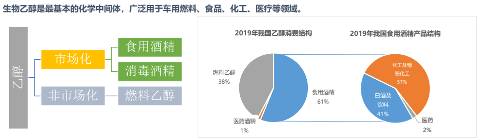
- ➢先进燃料乙醇技术
- ➢酶法生物柴油技术及其产业化
- ➢适应混合生物燃料的先进车辆燃烧技术



- 2019年全球生物乙醇产量9868万吨，美国（5243万吨）、巴西（2860万吨）、中国（870万吨）位列前三。
- 近十年，我国乙醇产量总体呈现稳中增长趋势；受国家扩大生物燃料乙醇消费拉动，2017年后产量快速增长。

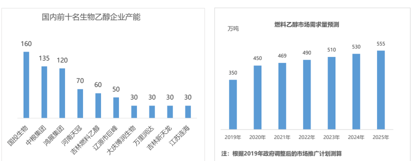
资料来源：世界可再生燃料协会、中国酒业协会

生物乙醇是最基本的化学中间体，广泛用于车用燃料、食品、化工、医疗等领域。



- 2019年中国乙醇870万吨，其中食用酒精529万吨、燃料乙醇330万吨、医药酒精11万吨。
- 食用酒精按市场需求可分为酒及饮料类用、化工及精细化工用、医药用等。

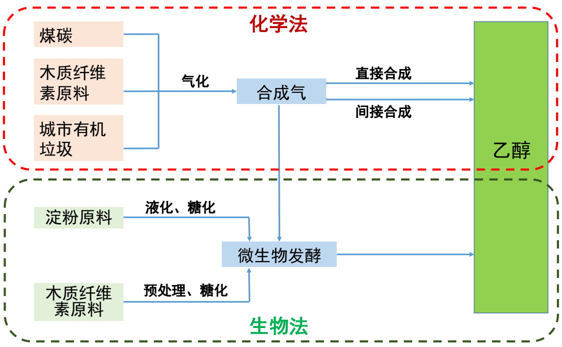
中国燃料乙醇产能与市场需求



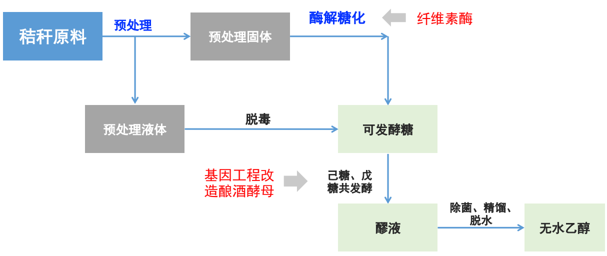
区域		省份	需求量（万吨）
已推广区域	全境	黑龙江	40
		吉林	35
		辽宁	60
		天津	26
		河南	50
		安徽	45
	部分区域	河北	20
		江苏	20
		山东	18
		湖北	30
		广西	6
	小计		**350**

- ➢ 目前，我国乙醇汽油销量约占当年汽油消费总量的25%，已批复11个生物燃料乙醇项目，其中粮食乙醇项目4个、木薯乙醇项目5个，累计生产和消费生物燃料乙醇1725万吨。
- ➢ 自2007年以来，受国家扩大生物燃料乙醇消费拉动，我国汽油消费量平均年增速4.3%，2019年汽油消费量约为1.31亿吨。生物燃料乙醇现有市场需求量350万吨/年。

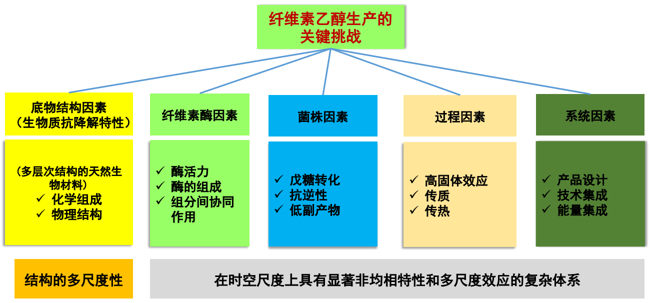
乙醇生产技术



纤维素乙醇的主要生产流程

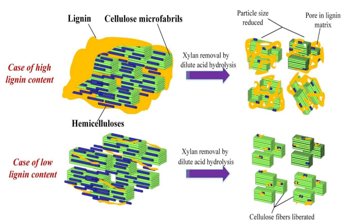


纤维素乙醇的关键挑战



我们的工作: (1)细胞壁的抗降解特性的多尺度效应解析

半纤维素和木质素对纤维素酶解性能影响的机理



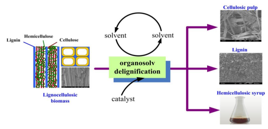
- 半纤维素的脱除有利于“造孔”，使得底物的纤维素酶可及孔（>5.1nm）容积和表面积明显增加；
- 半纤维素脱除可使底物表面更加粗糙，细胞壁出现扭曲，甚至断裂，但细胞壁结构仍然清晰可见，细胞壁仍然粘结在一块；
- 木质素的脱除使得胞间层消失，纤维素解离，细胞壁表面显著蚀刻、片层断裂、破碎、溶解和消失。

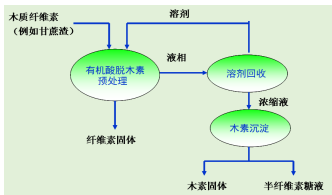
指导意义：半纤维素和木质素的耦合脱除可以有效提高纤维素的可及度

Chen et al., ACS Sust Chem Eng, 2016，4(12), 6668-6679

我们的工作: (2)高效清洁预处理技术开发

有机酸为溶剂的木质纤维素“一锅法”分级预处理技术：Formiline、Acetoline 技术



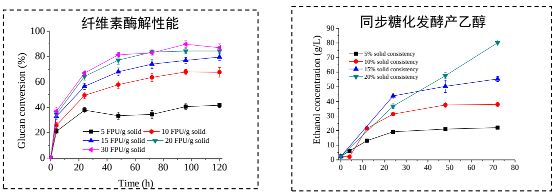


采用有机酸分级预处理的优点

- ✓ 有机酸可通过蒸馏回收使用
- ✓ 有机酸是木质素的良好溶剂
- ✓ 有机酸具有酸性，可同时水解半纤维素
- ✓ 木质素产品具有较高纯度和附加值
- ✓ 有机酸（甲酸和乙酸）可由木质纤维素组分降解产生
- ✓ ……

我们的工作: (2)高效清洁预处理技术开发

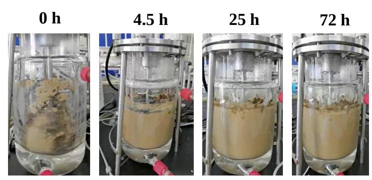
Formiline预处理甘蔗渣的酶解和乙醇发酵性能



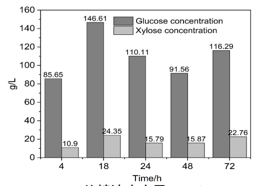
- ✓ 预处理后的纤维素固体具有很好的酶解性能，补料批式糖化可获得高达200g/L的葡萄浓度
- ✓ 预处理后的纤维素固体具有很好的同步糖化发酵性，乙醇浓度可达80g/L

我们的工作: (3)高固体酶解糖化

开发新型高固体酶解反应器，促进高固体系下的纤维素酶解糖化



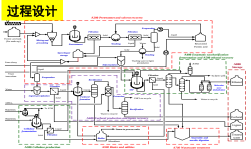
碱处理玉米秸秆高固体糖化（30%固体含量）



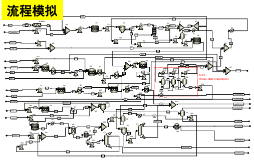
总糖浓度大于100g/L

我们的工作: (4)系统集成、放大示范与经济性评估

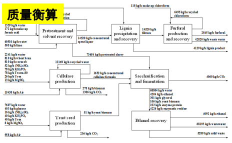
过程设计



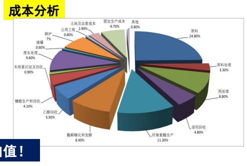
流程模拟



质量衡算



成本分析



多产品联产可显著提高过程经济性和生物质转化的附加值！

我们的工作: (4)系统集成、放大示范与经济性评估

基于甲酸分级预处理（Formiline预处理）年产3万吨纤维素乙醇生产新技术的生产成本及与稀酸预处理技术比较

	Formiline技术	稀酸预处理技术
原料处理量	201,992 干吨/年	133,264干吨/年
全年生产时间	8000 小时/年	8000 hours/year
乙醇得率	0.162吨/吨 干原料 (基于原料中聚糖的乙醇得率：49.4%; 基于原料中纤维素的乙醇得率：82.7%)	0.250吨/吨 干原料 (基于原料中聚糖的乙醇得率：74%)
乙醇产量	32,720吨/年	33,320吨/年
总设备投资（百万美元）	96	68
总资本投资 (TCI，百万美元)	176	125
投资成本 (美元/吨乙醇)	538	363
原材料成本(美元/吨乙醇)	596	453
能耗成本 (美元/吨乙醇)	320	156
废物处理成本 (美元/吨乙醇)	15	13
固定生产成本 (美元/吨乙醇)	105	103
总生产成本 (美元/吨乙醇)	1574	1088
副产物利润 (美元/吨乙醇)	-1440	0
折算副产物利润后的乙醇生产成本 (美元/吨乙醇)	134	1088
每吨秸秆的转化成本 (美元/吨干秸秆)	255	272
每吨秸秆转化后的附加值 (美元/吨干秸秆)*	364	220
附加值增加值 (美元/吨干秸秆)	+109	-52

我们的工作: (4)系统集成、放大示范与经济性评估

连续预处理、酶解设备

连续预处理、酶解设备

膜脱水设备

2.5 m³ 发酵罐

目前正与BP公司合作进行产业化推广前的评估！

由合成气制备乙醇

1、化学合成法有两种技术路线：

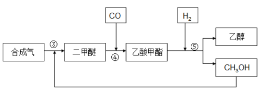
（1）直接合成法

①$2CO_2(g) + 6H_2(g) \longrightarrow CH_3CH_2OH(g) + 3H_2O(g)$ $\triangle H_1$

②$2CO(g) + 4H_2(g) \longrightarrow CH_3CH_2OH(g) + H_2O(g)$ $\triangle H_2 = -253.6 kJ\cdot mol^{-1}$

（2）间接合成法

合成气反应生成二甲醚（CH3OCH 3），二甲醚羰基化合生成乙酸甲酯，乙酸甲酯加氢得到乙醇。其生产流程如下图所示：



③ $3CO(g) + 3H_2(g) \longrightarrow CH_3OCH_3(g) + CO_2$ $\triangle H3 = -260.2 kJ\cdot mol^{-1}$

④ $CH_3OCH_3(g) + CO(g) \longrightarrow CH_3COOCH_3(g)$

代表性公司如中科院大连化物所与延长石油公司采用合成气经二甲醚羰基化技术

全球首套50万吨/年合成气制乙醇（DMTE）装置技术

2017-12-16 16:22

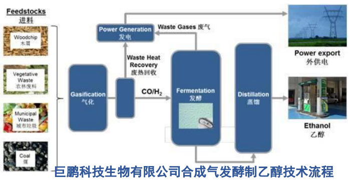
12月15日，陕西延长石油(集团)有限责任公司全资子公司陕西兴化集团有限责任公司与延长中科(大连)能源科技股份有限公司在西安共同签署"50万吨/年合成气制乙醇(DMTE)装置技术许可合同"，标志着中国合成气制乙醇技术正式迈入大规模工业化时代。陕西省人民政府领导、中科院科技促进发展局、陕西延长石油集团和中科院大连化物所领导出席了签字仪式。

由合成气制备乙醇

2、微生物发酵法主要由Coskata 、LanzaTech公司、INEOS Bio（后被巨鹏生物科技有限公司收购）、北京首钢郎泽新能源科技有限公司在推广产业化

Coskata开发了利用合成气发酵制乙醇的技术，2009年该公司在美国宾西法尼亚州建成4万加仑/年的工业示范装置，截至目前，该装置运转了2年，其气化1吨生物质原料可生产0.3吨燃料乙醇。

LanzaTech公司开发了利用钢厂废气（CO）发酵生产乙醇的技术，在新西兰建立了1m3的中试装置，并与宝钢合资建成了300吨/年示范装置，目前与首钢合作产业化。



巨鹏科技生物有限公司合成气发酵制乙醇技术流程

1989 ： 最初发现 – 通过细菌产生乙醇
1994 ： 在美国阿肯色州的费耶特维尔进行了发酵制乙醇的放大试验
2003 ： 示范工厂整合了气化、发酵和精馏的全工艺过程
2011 ： 英力士生物联合其他投资方，在美国佛罗里达州建立了首套商业化规模的废弃物转化生产乙醇的工厂。
2013 ： 工厂开始商业规模生产纤维素乙醇
2017 ： 巨鹏生物收购英力士生物

由合成气制备乙醇

工业尾气生物发酵制乙醇项目

● 行业资讯

潞安集团CO2重整利用工业尾气生产20万吨乙醇项目预计9月试车

作者：CCIIN　来源：煤化工信息网　浏览次数：1215次　更新时间：2020-03-26

近日，潞安集团煤基合成油公司CO2重整利用工业废气生物发酵法生产20万吨/年燃料乙醇项目一期工程建设现场已经一扫疫情阴霾，全面复工复建！

2018年，潞安集团与巨鹏生物签署了战略合作协议，投资2.5亿元，建设CO2重整利用工业尾气生产20万吨/年燃料乙醇（一期2万吨/年示范项目）。该项目采用巨鹏生物专有知识产权的细菌发酵生产燃料乙醇技术，利用潞安煤基合成油有限公司尾废气，在常温条件下，高效、高选择性和快速合成乙醇，再通过精馏、脱水工艺生产燃料乙醇，有效实现二氧化碳减排、尾气综合利用和清洁燃料生产。

项目于2018年4月1日，潞安集团煤基合成油公司隆重举行2万吨合成气生物发酵制乙醇项目示范工程奠基仪式，标志着该项目正式进行实施阶段。2018年9月开始动工建设。

截至目前，该项目一期工程土建工程已完成总工程量的80%，机电安装完成总工程量的50%，现已转入设备和管道安装阶段，预计到今年8月底9月初将具备投料试车条件。据了解，一期项目建成投产后，年产值将达到1.5亿元，实现利税0.3亿元，可提供就业岗位200余个。目前，二期项目也在积极推进中，项目全部建成投用后，潞安集团将率先在省内完成清洁生物乙醇燃料的示范，成为多效并举的应用范例。

据了解，一期项目建成投产后，年产值将达到1.5亿元，实现利税0.3亿元，可提供就业岗位200余个。目前，二期项目也在积极推进中，项目全部建成投用后，潞安集团将率先在省内完成清洁生物乙醇燃料的示范，成为多效并举的应用范例。

http://www.meihuake.net/detail-2-4001-c.html

2018年，山西潞安集团与巨鹏生物签署了战略合作协议，投资2.5亿元，建设CO2重整利用工业尾气生产20万吨/年燃料乙醇（一期2万吨/年示范项目），2018年9月开始动工建设。

第一财经

宁夏首条燃料乙醇生产线预计年底建成投产

第一财经 • 2020-05-07 20:53

责编：陈君君

5月7日，记者从宁夏工业和信息化厅获悉，总投资4.1亿元人民币、宁夏首条以一氧化碳工业尾气为原料的燃料乙醇生产线项目土建基础全部完成，已进入工程主体建设阶段，预计年底建成投产。（中国新闻网）

2020年月7日，宁夏首条以一氧化碳工业尾气为原料，通过生物发酵技术生产燃料乙醇生产线，项目土建基础全部完成，已进入工程主体建设阶段，预计年底建成投产。总投资4.1亿元人民币。生产线采用北京首钢郎泽新能源科技有限公司独有的气体发酵技术，将铁合金矿热炉尾气回收处理，通过生物发酵吸收尾气中的一氧化碳，直接转化为燃料乙醇。项目建成后可年产燃料乙醇4.5万吨，副产动物蛋白饲料5000吨

由合成气制备乙醇

工业尾气生物发酵制乙醇项目

投资5.7亿元 6万吨冶金工业尾气生物发酵制燃料乙醇项目签约

DSL 炼油化工动态
2020-09-06
订阅

8月31日，由国家电投集团贵州金元绥阳产业有限公司（简称：绥阳公司）、北京首钢朗泽新能源科技有限公司、日本三井物产株式会社共同合作的年产6万吨冶金工业尾气生物发酵制燃料乙醇项目签约仪式在北京举行。国家电投集团贵州金元股份有限公司火电总监兼火电部主任葛斌峰、北京首钢朗泽新能源科技有限公司总裁董燕、日本三井物产株式会社能源解决方案本部长松井先生以云签约方式出席签约仪式，绥阳公司董事长顾庆怀、副总经理王杰及三方各相关负责人见证签约。

2020年8月31日，由国家电投集团贵州金元绥阳产业有限公司（简称：绥阳公司）、北京首钢朗泽新能源科技有限公司、日本三井物产株式会社共同合作的年产6万吨冶金工业尾气生物发酵制燃料乙醇项目签约仪式在北京举行。该项目是贵州省首个工业尾气生物发酵制燃料乙醇项目，计划投资约5.7亿元，投产后可年产燃料乙醇6万吨，菌体蛋白0.66万吨，减少二氧化碳排放约20万吨、氮氧化物640吨、颗粒物175吨，预计可实现销售收入约3.8亿元

石嘴山市与北京首钢朗泽新能源公司签订战略合作协议

宁夏快讯 | 2020-12-18 | 投诉　　阅读数：442

12月16日，市政府与北京首钢朗泽新能源科技有限公司举行年产30万吨工业尾气生物发酵制燃料乙醇产业集群项目战略合作协议签约仪式。双方此次战略合作，将有效盘活我市工业尾气资源、提升综合利用率，对促进清洁能源产业发展、加快形成绿色化循环化产业体系、打造宁夏北部绿色发展区产生积极的带动作用。

市委书记王文宇，市长张利，北京首钢朗泽新能源科技有限公司总裁董燕参加了签约仪式。

据了解，北京首钢朗泽新能源科技有限公司是一家科研实力雄厚，拥有全球领先气体生物发酵制燃料乙醇技术的高科技公司。我市与首钢朗泽新能源科技有限公司有着良好的合作基础，2019年5月，首钢朗泽新能源科技有限公司与吉元冶金集团合作在平罗县率先建设全球首套年产4.5万吨铁合金工业尾气制燃料乙醇大工业装置。目前正进行单机调试，预计2021年5月投产。今年11月，首钢朗泽新能源科技有限公司再次与滨河碳化硅、宁源冶金和吉元集团合资成立宁夏滨泽新能源科技有限公司，筹建年产6万吨燃料乙醇项目。本次签约的燃料乙醇产业集群项目总投资26.5亿元，建成后每年可生产燃料乙醇30万吨，蛋白饲料3万吨，实现销售收入25亿元，上缴税收1.5亿元，增加就业岗位1000余人。

2020年12月16日，**石嘴山市政府与北京首钢朗泽新能源科技有限公司举行年产30万吨工业尾气生物发酵制燃料乙醇产业集群项目战略合作协议签约仪式**

报 告 内 容

- ➢先进燃料乙醇技术
- ➢酶法生物柴油技术及其产业化
- ➢适应混合生物燃料的先进车辆燃烧技术

中国石化承诺有序推进能源替代

张玉卓在《石油和化学工业"十四五"发展指南》发布会上发表视频讲话，签署《中国石油和化学工业碳达峰与碳中和宣言》

本报讯 1月15日，在中国石油和化学工业联合会主办的《石油和化学工业"十四五"发展指南》发布会上，中国石化董事长、党组书记张玉卓视频签署《中国石油和化学工业碳达峰与碳中和宣言》并讲话，郑重承诺深入贯彻新发展理念，大力实施绿色洁净发展战略，以碳的净零排放为终极目标，坚持减碳进程与转型升级相统筹，奋力打造世界领先洁净能源化工公司，在中国迈向碳中和的征途中贡献方案和智慧。

《宣言》从推进能源结构清洁低碳化、大力提高能效、提升高端石化产品供给水平、加快部署二氧化碳捕集利用、加大科技研发力度、大幅增加绿色低碳投资强度等6个方面提出倡议并作出承诺，诚挚地接受社会和公众监督，号召全行业共同行动起来，在中国迈向碳中和国家的征途中书写灿烂篇章。

张玉卓表示，中国石化将持续推进能效提升计划和绿色企业行动计划，努力奉献洁净能源，提高洁净能源和非化石能源消费比重，有序推进能源替代，大幅降低二氧化碳排放强度。试点开展碳达峰、碳中和行动，实施CCUS（二氧化碳捕集、利用与封存）全产业链示范项目建设，强化甲烷控排管理，不断提升绿色低碳竞争力。

中国石化已于去年11月启动碳达峰、碳中和战略路径课题研究，制定中国石化碳达峰和碳中和战略、目标、路线图及保障措施。

"十三五"以来，中国石化认真贯彻新发展理念，落实生态文明建设要求，将绿色低碳上升到公司发展战略，积极控制温室气体排放，碳减排工作取得明显成效。

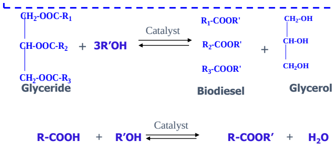
在开发洁净能源方面，在加强常规天然气产能建设的同时，加大页岩气、煤层气勘探开发力度；地热供暖能力达5700万平方米；实现生物航煤在跨洋商业飞行航班上使用，让生物柴油常态化应用于车辆；加快布局氢能产业，建成国内首座油氢合建站。

在强化节能管理方面，加快产业结构调整，淘汰落后产能；推进能效提升计划，已累计实施3406个项目，实现节能548万吨标煤，减少温室气体排放1348万吨。

在温室气体回收利用方面，推进炼化企业高浓度二氧化碳尾气回收利用，开展油田企业二氧化碳驱油矿场试验和甲烷放空气回收；对航煤、润滑油、聚乙烯等产品开展全生命周期产品碳足迹核算评价。

在参与碳交易方面，试点地区企业交易量1110万吨、交易额2.38亿元。（**本报记者**）

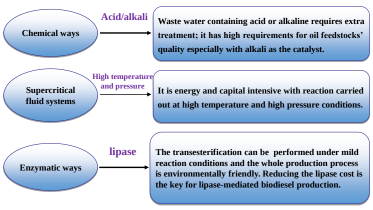
Biodiesel : defined as "a substitute for, or an additive to diesel fuel that is derived from oils and fats of plants, animals and microbes"

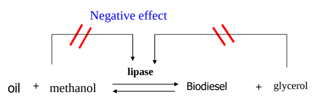


Chemical approaches (alkali, acid)

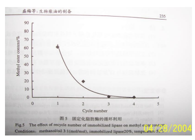
Transesterification at supercritical condition

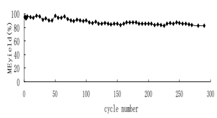
Enzymatic approaches (lipase)



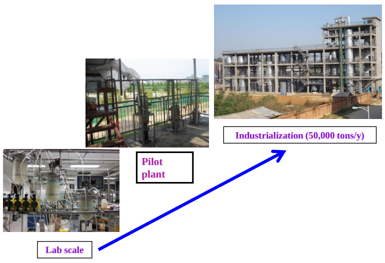


Poor stability and activity of the lipase should be due to the negative effect of methanol and glycerol. With TU's novel technology, the negative effect of both methanol and glycerol on enzyme activity could be greatly eliminated





Demonstration from lab scale to commercial scale

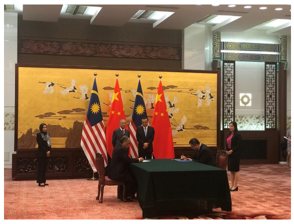


Cooperation of Biodiesel project between Tsinghua and COPPE

- Coordinated by CCBCE, Tsinghua's enzymatic technology was successfully demonstrated at the pilot plant in COPPE, Brazil (2011)

Projects 合作项目 – Biodiesel 生物柴油

启迪清洁能源、巴中贸促会与Biopar三方签署的MOU 技术团队和投资商拜访Biopar 启迪清洁能源、巴中贸促会与Biopar三方签署合作协议



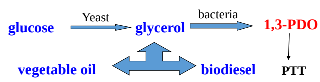
Signature Celebration on Cooperative Agreement between Tsinghua University and MPOB（2018-8-20）

✓Stability and activity of lipase have been improved significantly
✓Some cheap oil sources could be used for biodiesel production

How to deal with the by-product glycerol?

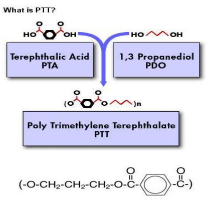
Integrated production of Biodiesel and 1,3-PDO

Tsinghua University has proposed a novel flexible process for 1,3-PDO production from glycerol or glucose.

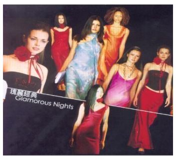


More than 50 patents were filed, among which more than 40 have been granted.

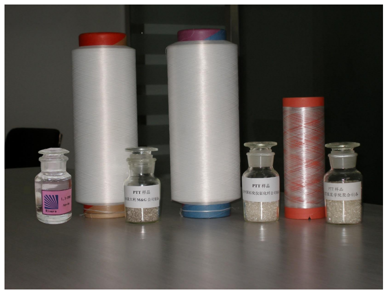
What is PTT ?



PTT- A Novel Polyester
Made from PDO



The industrial scale production of PDO with capacity of 20,000 tons /year is running in Jiangsu province, China .



报 告 内 容

- ➢先进燃料乙醇技术
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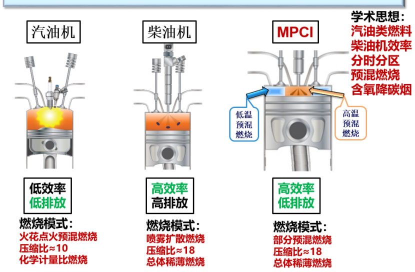
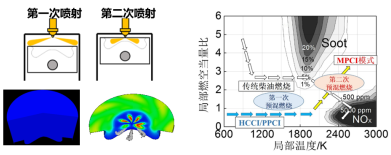
- ➢适应混合生物燃料的先进车辆燃烧技术

清华大学提出了多次预混压燃（MPCI）燃烧概念



多次预混压燃（MPCI）燃烧方法

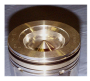


思想：**分时分区预混燃烧**

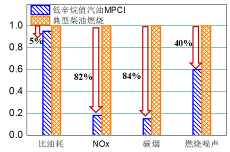
- 分时燃烧：燃油二次喷射，多次放热，降低燃烧噪声；
- 分区燃烧：第一次喷在燃烧室周围，形成稀预混压燃；第二次喷入的燃油避开第一次预混压燃之后的“活性热氛围”，降低了碳烟和NOx排放。

Wang Z, Wang B et al. Energy Conversion and Management, 2014, 88: 79-87

多次预混压燃（MPCI）燃烧效果



MPCI发动机燃烧室



通过多次预混压燃，避免扩散燃烧，大幅度降低了碳烟、NOx排放和燃烧噪声

Acknowledgements

Ministry of Science and Technology
National Development and Reform Commission
Ministry of Education
National Natural Science Foundation of China (NSFC)
My colleagues and students
……………

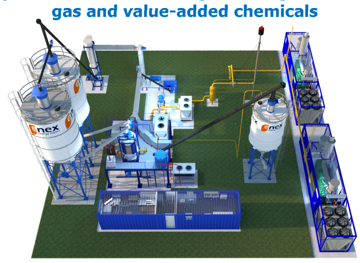
CLEAN ENERGY TECHNOLOGIES

A better cleaner and environmentally sustainable future

Energy Efficiency of Biomass with Zero Emission

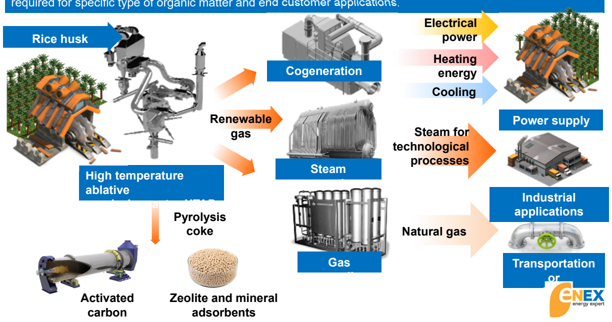
Pyrolysis Technology

Processing of industrial and municipal organic waste in high temperature ablative pyrolysis system for renewable high heating value fuel gas and value-added chemicals



Confidential 2

High temperature ablative pyrolysis process is the thermic destruction of organic matter without oxygen at a temperature range of 900-970 deg.C.
ENEX can provide integrated turnkey solutions for production of synthetic (renewable) fuel gas for onsite power generation and heat energy production in the form of hot water, thermo-oil or steam, including all equipment required for specific type of organic matter and end customer applications.



Applications

Industrial solid waste (plastic, paper, textile, wood, processed food)

Municipal solid waste non-recyclables

Industrial wastewater sludge

Agricultural farming waste (straw, stem, biomass, mulch, drip watering, fumigation materials, manure, substrates)

Confidential 4

APPLICATIONS

Refused derived fuel/solid refused fuel (RDF/SRF)

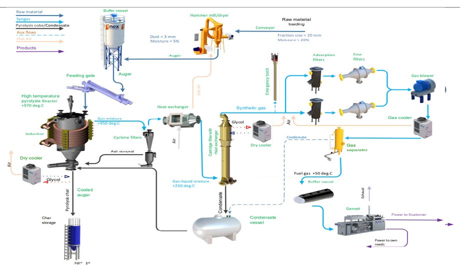
Agricultural processing waste (husks, hulls, sludges)

Municipal wastewater sludge

Forestry waste

Confidential 5

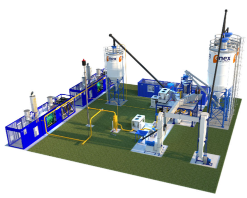
Process flow diagram



- Organic waste matter is fed into a course shredder
- After shredder it comes to the drying module.
- The waste powder has moisture content 2-4% and fraction size 1-3 mm.
- Waste organic is decomposed into syngas and pyrolysis char at temperature above 900deg.C.
- Syngas vapor passes through imbedded overheating chamber to decompose condensable polycyclic aromatic hydrocarbons into hydrogen, carbon monoxide and methane.
- The discharged syngas is supplied for electric and heat power production in ICE gensets, gas turbines or gas boilers.
- Pyrolysis char is cooled and stored in the buffer vessel for production of value-added chemicals or solid fuel briquettes.
- Operating mode of the system is continuous 8600 hours per year with scheduled maintenance stops every 4000 hours.

High Temperature Ablative Pyrolysis (HTAP)

- **ENEX HTAP technology Equipment assembly HTAP**



TECHNICAL SPECIFICATION

Description	HTAP5	HTAP10
Capacity, tons per day (dry mass basis)	15	30
Annual capacity, tons (dry mass basis)	5250	10500
Waste to energy application: Installed electric generation power, kW	1300	2400
Waste to energy application: Net electric power supply to the grid, kW	1000	1800
Annual operating hours	8400 … 8600	
Operating personnel (qty per shift)	2	

Zero Emission

No combustion in the ENEX HTAP process. Induction heating is used for cold start. No exhaust from reactor. TARs breaks down into simpler hydrocarbons because of hot cracking of gas vapor.

Parameter	ENEX HTAP	Direct incineration in a solid fuel boiler
NOx emission	No	Yes
CO emission	No	Yes
Soot and tar emission	No	Yes
Water consumption	No	Yes
Power Generation Efficiency	High	Low
Activated Carbon Production	Yes	No
Zeolite Production	Yes	Yes

Chemical process of high temperature pyrolysis is exothermic reaction by nature. Excess of heating energy is recuperated for drying of raw organic matter. HTAP process has at least 30% higher efficiency compare to direct incineration.

KEY FEATURES

- Zero emissions (no added oxidizing agent, exothermic reaction does not require external heat supply)
- Waste sourcing and mixing flexibility
- Designed for maximizing of high heating value synthetic fuel gas production
- Zero liquid residue discharge
- Zero solid residue waste
- (used for production of fuel briquettes, adsorbents, soil amendments, carbon black, construction materials, etc.)
- Options for conversion of produced synthetic gas into liquid hydrocarbons (dimethyl ether, methanol)
- Options for conversion of produced synthetic gas into renewable hydrogen
- Modular design for projects implementation time reduction

Poultry farm manure

Waste source: mixture of cage and bedding poultry farming manure.

This manure has moisture content 50%, ash content 10%, volatiles level 84%.

Required manure flow for one HTAP10 unit is 58 tpd or 20780 tons annually.

Gross electric power generation from this manure is 2400 kW.
Heat from HTAP5 and gensets is used for waste drying.

Plywood and fiberboard production waste

Waste source: mixture of wood chips, sawdust, bark from sawmill and plywood production factory.

Waste has moisture content 40%, ash content 2% and volatiles level 87%.

Waste required for HTAP5 unit is 24 tpd or 8600 tons annually.
Gross electric power generation from this waste is 1340 kW.

Heat from HTAP5 and gensets is partially used for waste drying.

Rice husk

Waste source: rice processing and packaging factory.

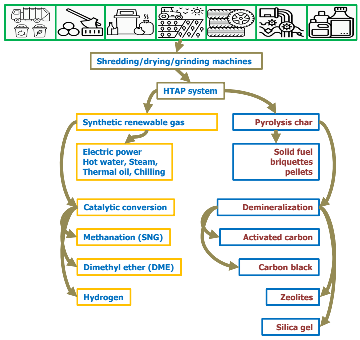
Rice husk has moisture content 8%, ash content 20% and volatiles 68%.

Waste flow for one HTAP5 unit is 15 tpd or 5375 tons annually.

Gross electric Power production from this waste is 1000 kW.

Recuperated heat from HTAP5 is used for waste drying.

HTAP MODULAR ECO-SYSTEM



CLEAN ENERGY TECHNOLOGIES

For additional question please contact:

Kam Mahdi at kmahdi@cetyinc.com

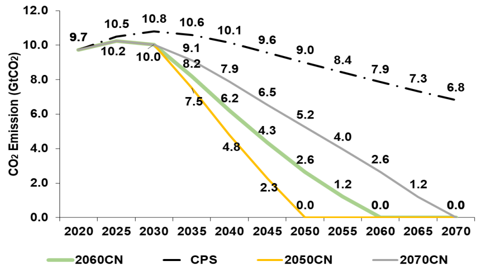
T: 949-273-4990 X 814

www.cetyinc.com

生物质能与“碳中和”的几点思考

常世彦
2021年2月2日

“碳中和”情景

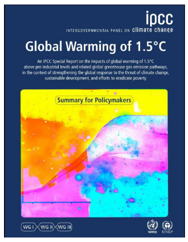


数据来源：张希良.2020.

- 生物质能碳捕集与封存BECCS
- 生物质能可持续标准

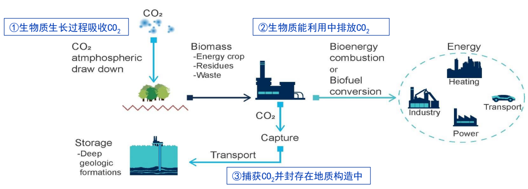
IPCC 1.5℃特别评估报告的主要结论（2018年）

- **气候变化已经不是未来的挑战，而是眼前的威胁**：全球气温2017—2018年已比工业化前高出1℃，按照这一排放速度，2040年左右将比工业化前高出1.5℃，2065年左右可能达到甚至超过2℃。
- **实现1.5℃温升控制目标要求从现在起就采取大规模的减排措施**：到2030年实现全球净人为CO_2排放量在2010年水平上减少约45%，到2050年左右达到净零排放，同时要求非CO_2温室气体排放大幅下降。
- **依靠常规的减排措施可能不足以实现温升控制目标**，还需要发展碳移除技术以更为快速地实现温室气体减排。
- **生物质能结合碳捕集与封存（BECCS）**是当前最受关注的一项碳移除技术，也是一项具有负排放特征的可再生能源技术，有必要对其技术路径、影响因素和可能潜力进行评估。



生物质能结合碳捕集与封存技术（BECCS）

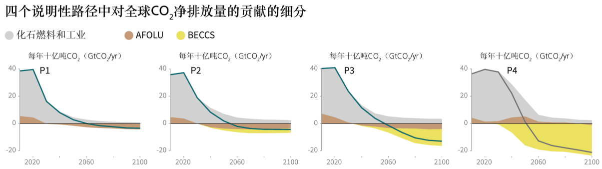
- BECCS是通过捕获生物质能利用过程中的CO_2，并将CO_2永久封存在地质构造中的一项负排放技术。生物质能结合碳捕集与封存（BECCS）技术包括生物质能利用和碳捕集与封存（CCS）两个阶段。
- 在负排放技术中，BECCS是唯一能够在移除大气中的CO_2的同时提供持续的能源供应的技术



BECCS示意图（GCCSI，2019）

全球升温1.5℃特别报告中的BECCS技术

四个说明性路径中对全球CO_2净排放量的贡献的细分



P1： 在社会、商业和技术创新导致2050年能源需求下降的情景下，但生活水平提高，特别是南方国家。一个小型能源系统可以实现能源供应的快速脱碳。造林是唯一考虑的CDR方案；化石燃料与CCS和BECCS都不使用。

P2： 广泛关注可持续发展包括能源强度、人类发展、经济一体化和国际合作、以及向可持续和健康的消费模式、低碳技术创新以及管理良好的土地系统转变的情景，社会接受BECCS程度不高。

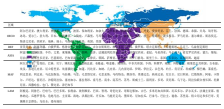
P3： 一个中间路线的情景，其中社会和技术发展遵循历史模式。减排主要是通过改变能源和产品的生产方式来实现的，其次是减少需求程度。

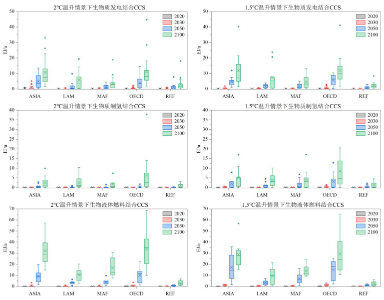
P4： 在资源和能源密集型情景下，经济增长和全球化导致广泛采用温室气体密集型生活方式，包括对运输燃料和畜产品的高需求。减排主要通过技术手段实现，通过部署BECCS大力推广使用CDR。

路径分类	P1: No or limited overshoot	P2: No or limited overshoot	P3: No or limited overshoot	P4: Higher overshoot
2030年生物质能相对于2010年的%	-11	0	36	-1
2050年生物质能相对于2010年的%	-16	49	121	418
到2100年累积的BECCS	**0 $GtCO_2$**	**151 $GtCO_2$**	**414 $GtCO_2$**	**1191 $GtCO_2$**
2050年能源作物的土地面积	0.2 million km^2	0.9 million km^2	2.8 million km^2	7.2 million km^2

全球主要区域BECCS发展潜力

- SSP数据库中BECCS的技术路线包括生物质发电、生物质制氢以及生物质液体燃料
- 生物质发电和生物质液体燃料结合BECCS的发展潜力占比较大，而生物质制氢的占比较小
- 但是当提高温升目标到1.5℃时，生物质制氢的增加量相对较大



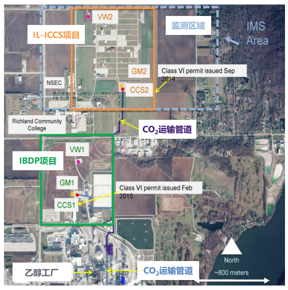


典型案例：乙醇工厂+CCS

项目名称	伊利诺伊州工业二氧化碳捕集与封存项目（IL-ICCS）
地点	美国伊利诺伊州迪凯特（Decatur）
时间	2017年开始注入
捕集量	1百万tCO_2/年
CO_2源	ADM公司的玉米乙醇工厂
运输方式	管道运输
封存地点	西蒙山大约2.1km深的砂岩层中
投资	总投资2.08亿美元，其中美国能源部负担1.415亿美元，占总投资的68%

IL-ICCS项目是另一个BECCS项目IBDP（Illinois Basin –Decatur Project）的延续，IBDP项目开始于2011年，并在2014年结束，同样从乙醇工厂中捕获CO2，经管道运输至西蒙山的砂岩层中永久封存，目前处于监测阶段。IBDP项目每天捕获1千吨的CO_2，在运行的3年期间共捕获1百万吨CO_2。

https://www.energy.gov/fe/articles/doe-announces-major-milestone-reached-illinois-industrial-ccs-project



IL-ICCS项目

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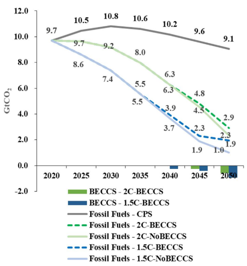
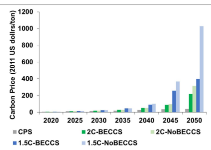
BECCS在中国深度减排中的作用

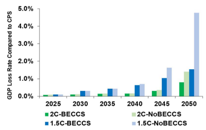


Possible ⟶ Feasible

Source: Huang, X., et al., 2020



不同情境下的碳价



不同情境下的GDP损失

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对中国研究和发展BECCS的初步思考与政策建议

考虑中国自身的能源结构和经济发展阶段，较高的碳排放总量和人均排放量将长期存在，未来中国将面临更大的减排压力。从全球层面看，我们对BECCS应该持何种态度？中国是否需要发展BECCS？如果要发展，如何合理部署相关战略？这些问题的回答，都有赖进一步深入的科学研究、技术创新和产业实践。

第一，需要增强对BECCS对实现“碳中和”目标的作用的科学认识。减排目标相同的情况下，近中期越是沿着高排放的路径前进，未来大规模采用BECCS的可能性就越大，起始时间点也越靠前。大规模实施BECCS相关的负减排技术，能够降低减排成本，有助于实现控制全球升温的目标，但还需要通过进一步的研究以加强科学理性的认识，并采取适当的措施降低BECCS发展中的潜在风险。

第二，将BECCS技术纳入中国应对气候变化战略框架。BECCS是一种长期减排技术，其未来的发展和应用情况还有很大不确定性，但是按照现有的发展路径，实现2 ℃/1.5 ℃温升控制极有可能需要大规模应用BECCS技术。这就需要将BECCS技术作为减缓气候变化的可能选项，正视BECCS技术的潜在风险，对其应用保持客观理性和相对开放的态度。

第四，推进BECCS研究示范，增加相关的科学认识和公众接受度。目前已有不少国家进行了BECCS相关的示范工程，预计下一步将有更多的国家投入到这一领域，中国在该领域稍显滞后。应通过增强BECCS示范研究，增强技术储备。目前，中国在先进生物质能和CCS两方面已有商业化示范，如何结合这两者实现负排放是未来的主要方向。

第四，进一步推进生物质能可持续认证体系的构建，引导生物质能产业可持续发展。

第五，BECCS的技术研发示范应用和推广要具有国际视野，将发展BECC纳入“一带一路”战略框架下。

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- 生物质能碳捕集与封存BECCS
- 生物质能可持续标准

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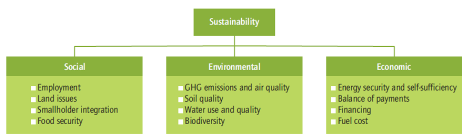
生物质能可持续标准的基本原则



社会、环境和经济是可持续发展的三大支柱。

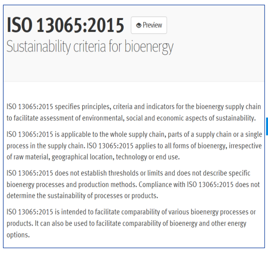
Source：IEA, 2011. Technology Roadmap Biofuels for Transport. OECD/IEA, Paris.

国际生物质能可持续政策和标准

政策和标准名称 Initiative	名称缩写 Abbreviations	发布单位 Organization	发布时间 Year	适用的地域范围 Geographical coverage	适用的原料 Feedstock (s) covered	适用的生物质能 Bioenergy covered	类型 Types
可再生能源指令	RED	欧盟	2009	欧盟（包括进口）	所有类型	交通用生物燃料和其他生物液体燃料	政策法规
可再生燃料标准II	RFSII	美国环境保护署	2010	美国（包括进口）	所有类型	所有类型生物燃料	政策法规
加州低碳燃料标准	LCFS	加州环保署	2010	美国加州	所有类型	所有类型生物燃料	政策法规
生物燃料全生命周期评价条例	BLCAO	瑞士联邦环境、交通、能源与通讯部	2009	瑞士联邦（包括进口）	所有类型	所有类型生物燃料	政策法规
英国可再生运输燃料义务法	RTFO	英国可再生燃料署	2008	英国	所有类型	所有类型生物燃料	政策法规
社会燃料标识	SFS	巴西土地发展部	2009	巴西	所有类型	生物柴油	政策法规
FFSC森林管理原则和标准	FSC-PCFS	FSC	1993	全球	以森林产品为主	所有类型生物燃料	认证标准
Bonsucro 欧盟生产标准	Bonsucro	Bonsucro	2010	全球	甘蔗	燃料乙醇	认证标准
国际可持续碳认证	ISCC	ISCC	2010	全球	所有类型	所有类型	认证标准
北欧生态标签	NEF	北欧国家	2008	北欧国家	所有类型	所有类型生物燃料	认证标准
可持续生物质圆桌倡议组织全球/欧盟RED认证标准	RSB Global / RSB EU RED	RSB	2010	全球/欧盟	所有类型	生物液体燃料	认证标准
可持续棕榈油生产原则和标准	RSPO-PCSPOP	RSPO	2007	全球	棕榈油	生物柴油	认证标准
负责任大豆圆桌协会原则和标准	RTRS-PC	RTRS	2010	全球	大豆	生物柴油	认证标准
乙醇可持续验证倡议	SEKAB-VSEI	SEKAB（一家瑞士企业）	2008	巴西圣保罗地区（生产）/瑞典（分销）	甘蔗	燃料乙醇	认证标准
生物质能可持续性标准	ISO-SCB	ISO	2015	全球	所有类型	所有类型	指导性标准
GBEP生物质能可持续指标	GBEP-SIB	GBEP	2011	全球	所有类型	所有类型	指导性标准

来源：常世彦与康利平 (2017). "国际生物质能可持续发展政策及对中国的启示." 农业工程学报(11): 1-10.

中国生物质能可持续性认证要求

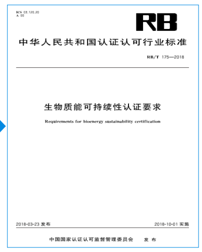

ISO 13065:2015 Preview
Sustainability criteria for bioenergy

ISO 13065:2015 specifies principles, criteria and indicators for the bioenergy supply chain to facilitate assessment of environmental, social and economic aspects of sustainability.

ISO 13065:2015 is applicable to the whole supply chain, parts of a supply chain or a single process in the supply chain. ISO 13065:2015 applies to all forms of bioenergy, irrespective of raw material, geographical location, technology or end use.

ISO 13065:2015 does not establish thresholds or limits and does not describe specific bioenergy processes and production methods. Compliance with ISO 13065:2015 does not determine the sustainability of processes or products.

ISO 13065:2015 is intended to facilitate comparability of various bioenergy processes or products. It can also be used to facilitate comparability of bioenergy and other energy options.


RB
中华人民共和国认证认可行业标准
RB/T 175—2018
生物质能可持续性认证要求
Requirements for bioenergy sustainability certification
2018-03-23 发布
2018-10-01 实施
中国国家认证认可监督管理委员会 发布

1. 范围
2. 规范性引用文件
3. 术语和定义
4. 一般原则
5. 认证指标
   5.1 社会: 土地使用, 社会发展
   5.2 环境:
      - 生态系统保护
      - 水资源节约和保护
      - 土壤质量和生产力保护
      - 空气质量保护
      - 温室气体排放
      - 废弃物管理
   5.3 经济: 经济可持续
6.追溯要求

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如何确保生物质能生命周期温室气体减排?

表 4 可持续生物质能政策和标准中 GHG 的相关内容[13,15]

Table 4 GHG requirement in bioenergy sustainability initiatives and criteria

政策/标准 Initiatives	GHG 排放核算方法 GHG emission calculation method	副产品分摊方法 Co-product treatment	是否考虑直接土地利用变化 Land use change considered	直接土地利用变化的基期 Baseline for LUC	是否考虑间接土地利用变化 Indirect land use change considered	土地利用排放均摊年限 Annualized land use emissions	最低 GHG 减排要求 GHG reduction requirement
LCFS	CA-GREET 模型	替代法	是	-	是	30 a	10%（到 2020 年平均交通燃料碳强度降低 10%）
ISCC	ISCC 全生命周期排放方法	能量分摊法	是	2008-01-01	否	20 a	与 RED 相同
RED	在附录中给出 GHG 排放核算的一般方法	能量分摊法	是	2008-01	是	20 a	35%（2017 年以前）；50%（2017 年 1 月以后）；60%（2018 年 1 月后新建项目）
RFSII	土地利用变化用森林和农业部门优化模型和粮食与农业政策研究所的模型系统	替代法	是	2007	是	100 a（2%折扣）30 a（无折扣）	20%（常规可再生燃料）；50%（生物柴油）；50%（先进燃料）；60%（纤维素燃料）
RSB	GHG 全生命周期计算器	替代法	是	2009-01-01	否	20 a	RSB Global: 50%; RSB EU RED Certification: 与 RED 相同
RTFO	与 RED 相同	替代法	是	2005-11-30	否	10 a（碳回收期）	与 RED 相同

资料来源：常世彦等，2017

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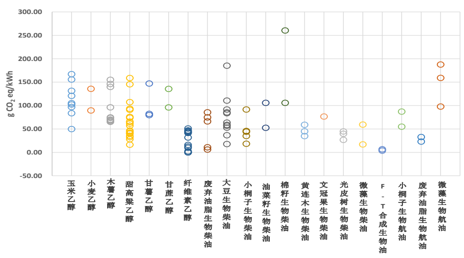
国际生物质能可持续标准中GHG的相关内容

政策/标准 Initiative	最低GHG减排要求 GHG reduction requirement	GHG排放核算方法 GHG emission calculation method	副产品分摊方法 Co-product treatment	是否考虑直接土地利用变化 Land use change considered	直接土地利用变化的基期 Baseline for LUC	是否考虑间接土地利用变化 Indirect land use change considered	土地利用排放均摊年限 Annualized land use emissions
RED	35%（2017年以前）；50%（2017年1月以后）；60%（2018年1月后新建项目）	在附录中给出GHG排放核算的一般方法	能量分摊法	是	2008-01	是	20 a
LCFS	10%（到2020年平均交通燃料碳强度降低10%）	CA-GREET模型	替代法	是	-	是	30 a
ISCC	与RED相同	ISCC全生命周期排放方法	能量分摊法	是	2008-01-01	否	20 a
RFS II	20%（常规可再生燃料）；50%（生物柴油）；50%（先进燃料）；60%（纤维素燃料）	土地利用变化用森林和农业部门优化模型和粮食与农业政策研究所的模型系统	替代法	是	2007	是	00 a（2%折扣）0 a（无折扣）
RSB	RSB Global: 50%; RSB EU RED Certification: 与RED相同	GHG 全生命周期计算器	替代法	是	2009-01-01	否	20 a
RTFO	与RED相同	与RED相同	替代法	是	2005-11-30	否	0 a（碳回收期）

来源：常世彦与康利平 (2017). "国际生物质能可持续发展政策及对中国的启示." 农业工程学报(11): 1-10.

不同生物燃料路线的全生命周期能耗和GHG排放



生物质能可持续标准在产业政策中的应用的支持

- 欧盟《可再生能源指令》（RED）的目标是实现生物燃料在交通部门能源消费中的比例达10%。为了保证预期减排效果的实现，只有符合可持续性要求的生物液体燃料才**可计入RED目标量**
- 欧盟委员会要求各成员国出台财税政策来扶持本国生物燃料的发展，包括价格扶持、消费税减免、进口关税减免、贷款优惠等，虽然各成员国实施的政策不一，但基本理念和整体思路一致，只有**满足可持续发展要求的生物燃料才可以获得优惠**。
- 在生物质能贸易方面，为了不与世界贸易组织的要求相抵触，欧盟并没有禁止不符合可持续标准的生物燃料的流通，但特别强调欧盟委员会必须审视生物燃料生产与原料供应国是否采取任何更广泛的措施来遵守并维护可持续原则，**只有通过认证的生物燃料量才能获得政策扶持和被计入规划指标**。

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主要建议

- （1）在《可再生能源法》或以及《生物质能“十四五“”发展规划》中明确提出可持续性要求
- 可持续性既是最低要求，也是激励方向，其核心理念是引导生产要素的重新配置。中国的生物质能发展一直秉承“不与人争粮，不与粮争地”等可持续原则，但是缺乏用以支撑这些原则的具体准则和评价指标，对技术研发和产业发展方向缺乏明确的指引。因此，中国应尽快在《可再生能源法》或以及《生物质能“十四五“”发展规划》等政策法规中明确提出可持续性要求，将可持续生物质能准则和评价指标作为一项重要的内容，明确只有符合可持续准则和评价指标的生物质能利用量才可计入规划量。
- （2）生物质能产业政策要与可持续性要求挂钩
- 生物质能市场准入机制要以可持续生物质能标准为支撑。补贴和税收优惠等激励政策的实施，要与生物质能可持续要求挂钩，即只有符合可持续标准的生物质能技术才能获得补贴和税收优惠。同时，可对生物质能进行分类管理，补贴与税收优惠的额度要与可持续绩效效益(如全生命周期GHG减排量)相挂钩。生物质能进出口政策的实施，也要以可持续生物质能要求为支撑。
- （3）优先在航空生物燃料等领域构建更为具体的可持续标准与GHG排放计算方法学
- 中国生物质能可持续标准的建立要考虑如何综合考虑国内情况以及保持与国际已有标准的衔接，但是由于生物质能原料、生产工艺和燃料产品多样，需要在特定领域，就生物质能可持续标准与相应的GHG生命周期排放计算方法学进行更为深入的而研究。建议优先在以下两个领域开展进一步工作:
- (1)航空生物燃料。航空生物燃料的使用是民航部门的一项重要减排措施，构建航空生物燃料可持续标准具有重要现实意义。国际民航组织推出了基于市场的减排措施——全球民航碳抵消与减少计划(CORSIA),旨在实现2020后全球国际航空的碳中和增长。航空业将面临严峻的碳减排压力。所以，航空生物燃料的可持续要求将成为各方关注热点，中国应及早准备。
- (2)以生物质废弃物为原料的生物质能。一般而言，生物质废弃物及不当处理方式会带来负面环境影响。例如，屡禁不止的秸秆焚烧是中国很多地区秋季气溶胶颗粒物的重要来源；畜禽粪便所产生的氨排放是大气中氨的主要来源，而氨排放在二次颗粒物形成中的作用也日益受到重视。因此，生物质废弃物资源的能源化利用具有迫切的现实需求。而且，相对于原料为能源植物的生物质能，原料为农林业剩余物和废弃物的生物质能在生物多样性和间接土地利用变化等方面的争议较小，比较容易达成具有共识的可持续标准，因此建议对以生物质废弃物为原料的生物质能优先开展生命周期GHG排放核算与可持续认证。

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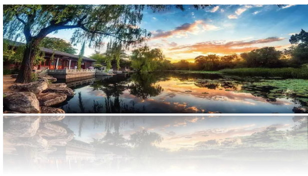
谢 谢!

changshiyan@tsinghua.edu.cn



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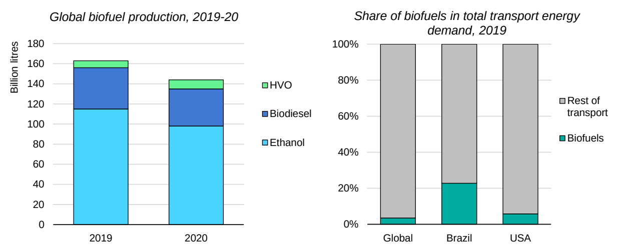
Global Outlook for Advanced Biofuels

Praveen Bains

US-China Energy Cooperation Program: Biofuels Standards Workshop

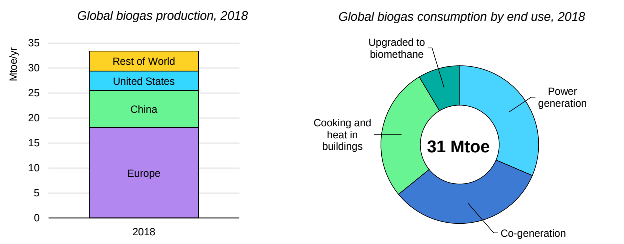
2 February 2021

Biofuels: how much and where are they used today?



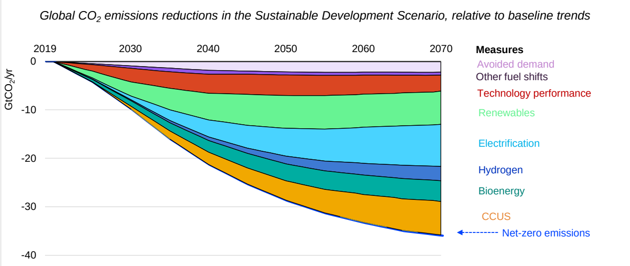
Today, biofuels account for small portions of global energy use in key sectors: 5% of road transport, 1% of residential cooking, and <1% of power and heat generation

Biofuels: how much and where are they used today?



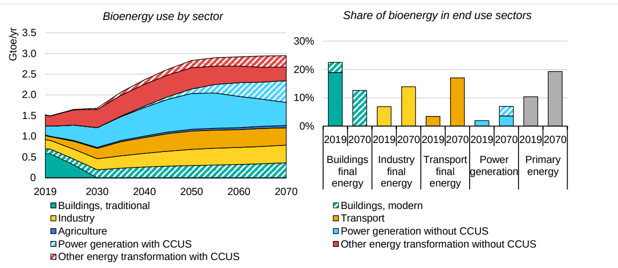
Today, biofuels account for small portions of global energy use in key sectors: 5% of road transport, 1% of residential cooking, and <1% of power and heat generation

Bioenergy has a key part to play in reaching net zero emissions



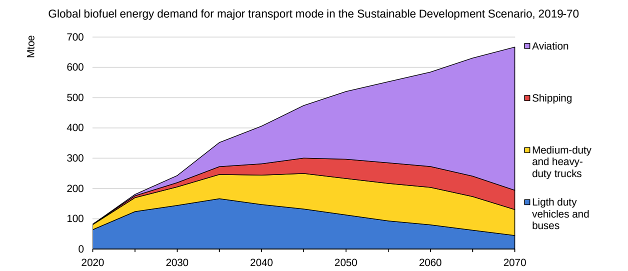
Bioenergy directly provides 12% of the cumulative emissions reductions needed to reach net zero in the Sustainable Development Scenario, with biofuels accounting for one-third of this.

Bioenergy is a versatile resource



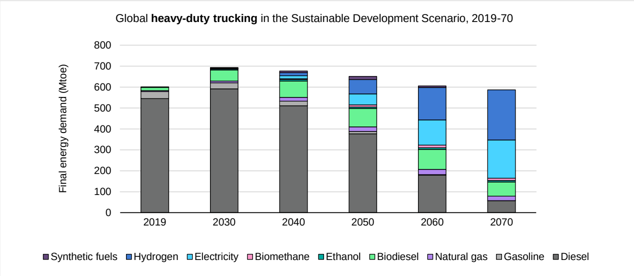
Modern bioenergy can be used as drop-in solutions to existing infrastructure, decarbonise hard-to-abate sectors and provide negative emissions when coupled with CCS

The role of biofuels evolves over time to net zero emissions



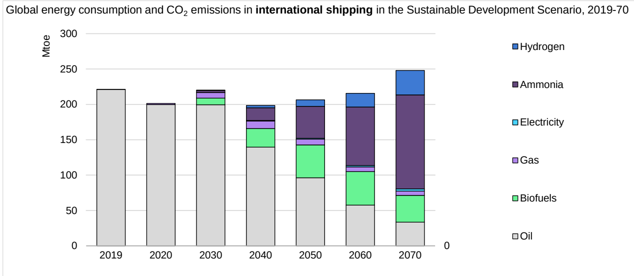
Advanced biofuels are first adopted by passenger transport before shifting to freight trucking and finally shipping and aviation

Advanced biofuels lead the way in decarbonising long-distance transport



In particular, advanced biofuels help to decarbonise long-distance transport, account for 14%, 20% and 35% of heavy-duty trucking, shipping and aviation in 2070.

Advanced biofuels lead the way in decarbonising long-distance transport



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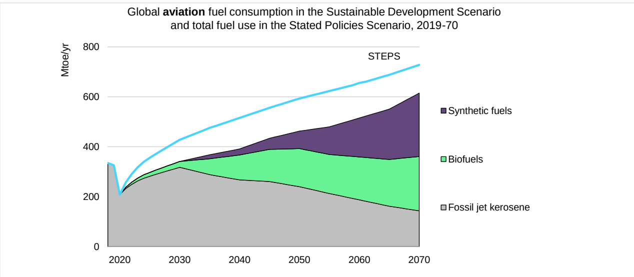
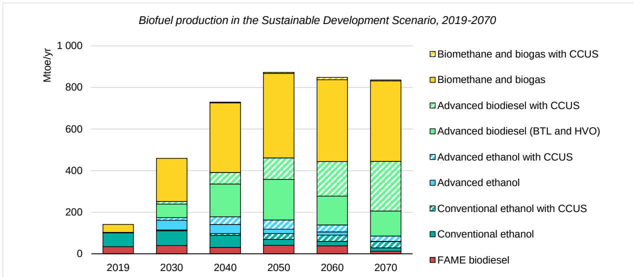


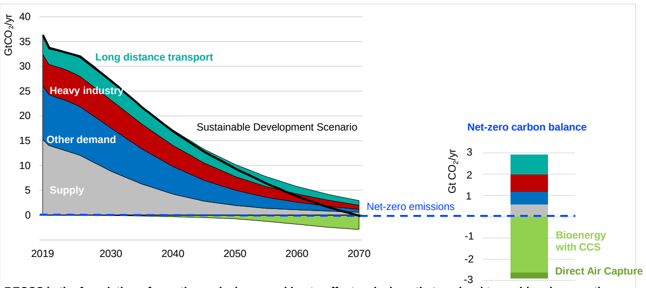
In particular, advanced biofuels help to decarbonise long-distance transport, account for 14%, 20% and 35% of heavy-duty trucking, shipping and aviation in 2070.

Advanced biofuel production ramps up significantly



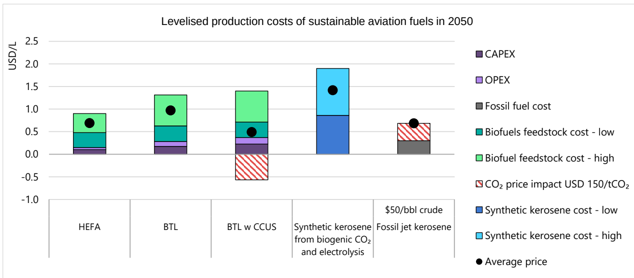
Advanced biofuels, biogas and biomethane grow more than 20 times from today to 2070, underpinned by biomass-to-liquid routes and anaerobic digestion with upgrading

BECCS helps bring the entire energy system to net-zero emissions



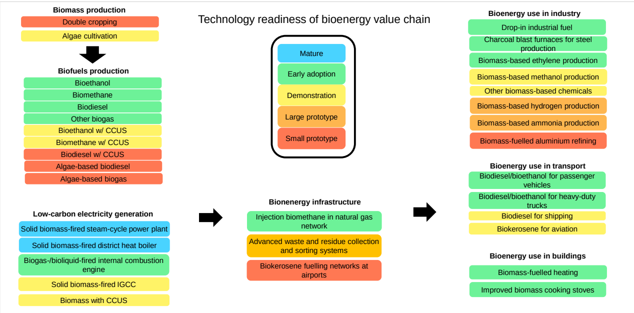
BECCS is the foundation of negative emissions, working to offset emissions that are hard to avoid and supporting a faster transition to net –zero. Biofuel production with CCS provides around half of these negative emissions.

The cost of advanced biofuels are high – policy must close the gap



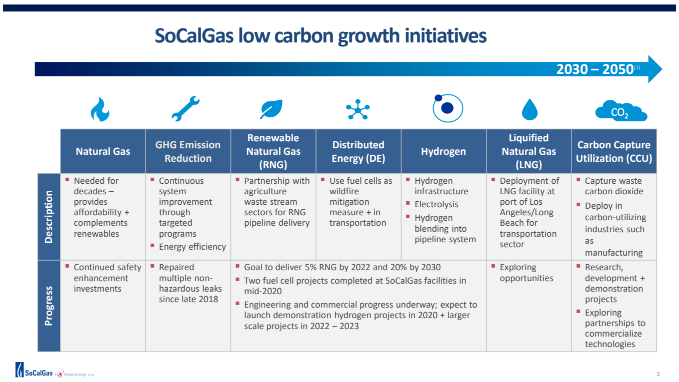
Even with deployment, the costs of advanced biofuels remain high. Policy measures must be used to close the cost gap between clean fuels and their fossil fuel counterparts.

There still exists innovation gaps along the bioenergy value chain

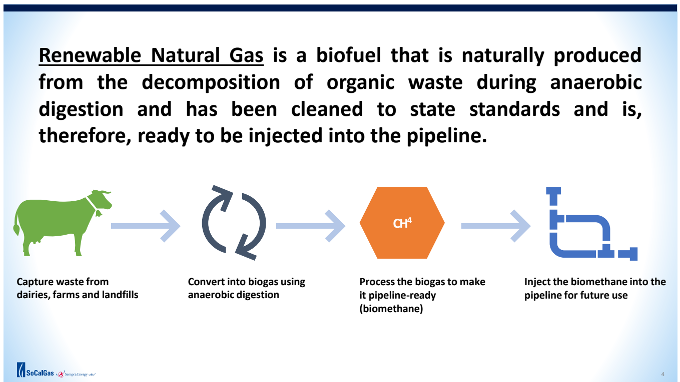


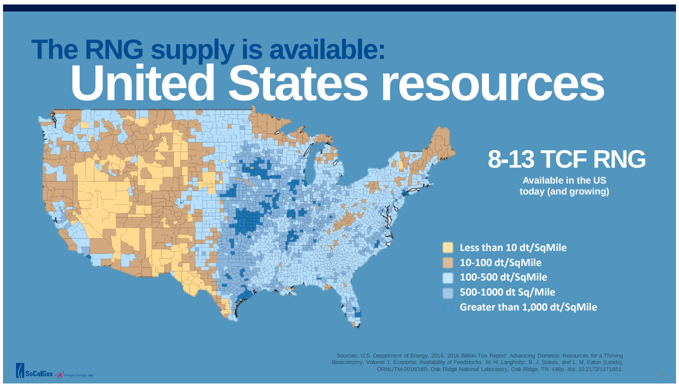
Policy must close the cost and innovation gaps in biofuels

Technology Readiness	Goal	Policy Mechanisms	Biofuel example
Mature	Deal with existing assets	• Blending mandates • Low-carbon fuel standards • CO_2 performance standards	• Blending biomethane into gas grids • Converting petroleum refineries to biorefineries
Early adoption	Strengthen markets for tech at early stage of adoption	• CO_2 prices and subsidies • Mandated phase-outs • Public funding for R&D	• Feed-in tariffs for clean power and heat • SAF offtake agreements
Demonstration, Early adoption	Develop and upgrade enabling infrastructure	• Loan guarantees • Public-private partnerships	• Large-scale waste and residue collection and sorting systems • CO_2 transport and storage sites
Small prototype, Large prototype, Demonstration	Continued support for RD&D	• Public funding for RD&D with knowledge-sharing • Prioritise tech with spillover potential	• International test centers for testing biofuel blends in engines • Biotech spillover: genetic engineering of algae



	Natural Gas	GHG Emission Reduction	Renewable Natural Gas (RNG)	Distributed Energy (DE)	Hydrogen	Liquified Natural Gas (LNG)	Carbon Capture Utilization (CCU)
Description	▪ Needed for decades – provides affordability + complements renewables	▪ Continuous system improvement through targeted programs ▪ Energy efficiency	▪ Partnership with agriculture waste stream sectors for RNG pipeline delivery	▪ Use fuel cells as wildfire mitigation measure + in transportation	▪ Hydrogen infrastructure ▪ Electrolysis ▪ Hydrogen blending into pipeline system	▪ Deployment of LNG facility at port of Los Angeles/Long Beach for transportation sector	▪ Capture waste carbon dioxide ▪ Deploy in carbon-utilizing industries such as manufacturing
Progress	▪ Continued safety enhancement investments	▪ Repaired multiple non-hazardous leaks since late 2018	▪ Goal to deliver 5% RNG by 2022 and 20% by 2030 ▪ Two fuel cell projects completed at SoCalGas facilities in mid-2020 ▪ Engineering and commercial progress underway; expect to launch demonstration hydrogen projects in 2020 + larger scale projects in 2022 – 2023			▪ Exploring opportunities	▪ Research, development + demonstration projects ▪ Exploring partnerships to commercialize technologies





California policy is driving RNG project development

Current — **CA Senate Bill 1383 (2016)**

Includes a requirement to reduce methane emissions by 40% by 2030. Two subparts of the bill are significantly driving RNG projects:

- *Requires the CPUC to direct gas corporations to implement not less than 5 dairy RNG injection pilot projects.* ***SoCalGas to commission interconnection facilities for four large dairy pilot projects in 2021***
- *A 75% reduction in statewide disposal of organic waste by 2025. CalRecycle estimates ~50 to 100 new anaerobic digestion and/or compost facilities are needed to meet the requirement*

Pending — **CA Senate Bill 1440 (2017)**

Requires the CA Public Utilities Commission (CPUC), in consultation with the State Air Resources Board, to consider adopting specific biomethane procurement targets or goals for each California gas corporation

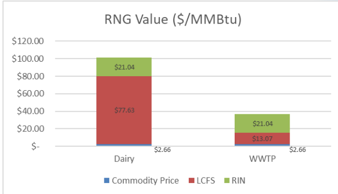
- *A procedural schedule for implementation of SB 1440 has yet to be established by the CPUC*
- *A utility procurement program can significantly accelerate the RNG market*

SoCalGas A Sempra Energy utility 7

RNG used for transportation fuel is helping drive project development

When RNG is used as a transportation fuel from a qualified feedstock, credits can be generated and sold which increases the market value of RNG

- **California Air Resources Board Low Carbon Fuel Standard (LCFS)** – program to reduce the carbon intensity of California's transportation fuels by at least 20 percent by 2030
- **EPA Renewable Fuel Standard (RFS)** – federal program that requires petroleum refiners and importers of gasoline to demonstrate that a portion of the fuel they sell is renewable. Fuel volume requirements currently go through 2022. The trading credit is called a RIN.



Assumptions
* Average LCFS price the week of January 18, 2021 ($200/metric ton) - Weekly LCFS Credit Trading Activity Reports (ca.gov) –
** D3 RIN price on 12/21/20 ($1.62) - RIN Trades and Price Information | Fuels Registration, Reporting, and Compliance Help | US EPA
** Assumes:
1) carbon intensity for WWTP biogas of 30 gCO2e/MJ, and Dairy biogas of -276 gCO2e/MJ
2) approximate Henry Hub Natural Gas future Price – $2.66 for February of 2021 - https://www.cmegroup.com/trading/energy/natural-gas/natural-gas_quotes_settlements_futures.html

SoCalGas 8

Examples of projects currently injecting RNG into a CA utility pipeline
With many more under development

1. **Point Loma Wastewater Treatment Plant (Point Loma CA)**
   - Capturing more than 1.3 MMcfd of digester gas
   - Injecting since 2012 into utility pipeline
   - Total project cost of $45 million, **75% was subsidized** through incentives and tax credit

2. **CR&R Waste and Recycling Services (Perris CA)**
   - Two of the four phases are complete with each phase capable of handling ~83K tons/year of organic waste (~1M DGE/yr of vehicle fuel)
   - Green/food waste (previously sent to a landfill) is converted to produce fertilizer, soil amendment and RNG
     - 100% of the RNG produced is used to fuel CR&R trucks
   - Injecting since mid-2018, into SoCalGas pipeline
   - Cost: Over $100 million at full buildout
   - First RNG-to-pipeline project in SoCalGas' service territory

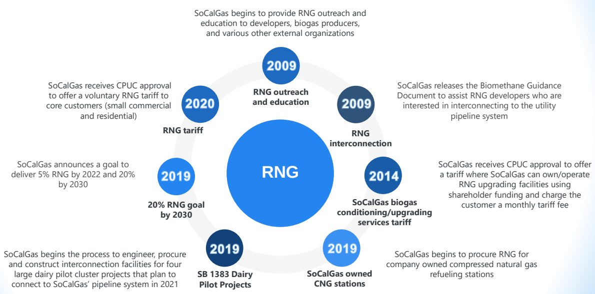
SoCalGas 9

Examples of projects currently injecting RNG into a CA utility pipeline
With many more under development

3. **Calgren Dairy Fuels (Pixley CA)**
   - First dairy digester pipeline cluster project in California and started injecting RNG into SoCalGas' pipeline in February of 2019
   - Plan to collect biogas from anaerobic digesters at 12 Tulare County dairies by the end of 2019
   - The facility will capture the methane produced from more than 75,000 cows
   - SoCalGas will be capable of adding up to 2.26 billion cubic feet of RNG each year to its pipeline system
   - Enough to fuel more than 1,200 Class 8 heavy duty trucks.

SoCalGas 10

SoCalGas has been very supportive of RNG for over a decade



SoCalGas 11

Thank You

SoCalGas 12

生物燃料国内外标准化相关工作与进展

中国标准化研究院资源环境研究分院
生态文明建设研究室 徐秉声

2021年2月

目录
CONTENTS

- 中国标准化研究院始建于1963年，隶属于国家市场监督管理总局。
- 国家级社会公益类综合性标准化科研机构。
- **宗旨**：科研为本 服务社会 面向市场 走向国际。
- **使命**：开展标准化战略和规划研究，研制综合性基础标准，为社会提供权威标准信息和技术服务，为政府的标准化决策和行政管理提供科学依据及技术支撑。

资源环境研究分院

基本情况

现有科研人员：68

国务院政府津贴专家	2
国家百千万人才工程人员	1
研究员	9
副研究员	17
博士	18
亚太经合组织（APEC）能效和节能专家组（EGEE&C）主席	1
ISO能源管理和能源节约（ISO/TC 301）技术委员会副主席	1
ISO技术委员会秘书	3
国际标准项目负责人	11
国际标准化注册专家	20

重点业务

1. 节能：能效、能耗；系统优化、节能监测；能源管理、绩效评估
2. 节水：水效、取水定额；水系统优化；水回用与再生水节水评价
3. 生态文明建设：城乡建设；区域生态文明标准化建设；地方实践
4. 循环经济：清洁生产；综合利用；固废处理、循环化改造
5. 应对气候变化：核算方法学；碳排放与碳资产管理；低碳技术、低碳评价；低碳城市
6. 环保产业：水、气、声渣污染防治；环保技术、环保设备；环保服务
7. 新能源：太阳能、氢能；生物质、智慧能源
8. 绿色发展：体系顶层设计、标准化建设指南、地方实践应用、绿色金融

2. 国内生物质相关标准化工作进展-标准化技术委员会

1. 全国林业生物质材料标准化技术委员会（SAC/TC416）
- 负责专业范围为以林业植物原料为主制造加工的材料以及生物质原料经化学、生物加工制成的材料等。

- 由国家林业和草原局筹建及进行业务指导。
- 秘书处所在单位：中国林业科学研究院木材工业研究所

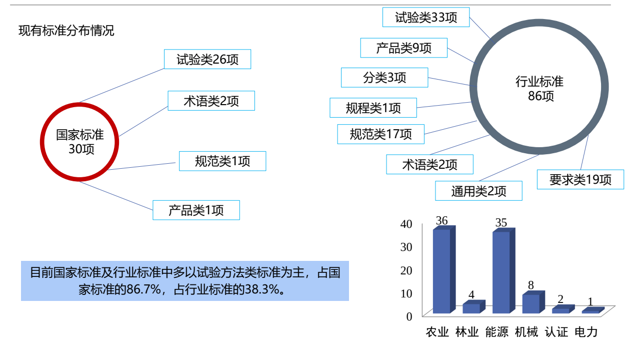
2. 全国能源基础与管理标准化技术委员会新能源与可再生能源分会（SAC/TC20/SC6）
- 负责专业范围为新能源和可再生能源等专业领域标准化工作。

- 由国家标准化管理委员会筹建及进行业务指导。
- 秘书处所在单位：中国标准化研究院

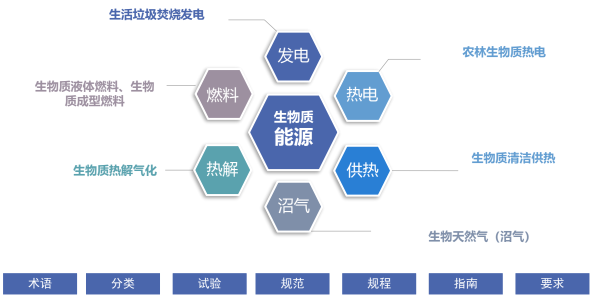
3. 能源行业农村能源标准化技术委员会（行业NB）
- 主管部门为国家能源局。

4.其他：国家标准、行业标准
- 农业农村部（GB、NY）
- 国家林业和草原局（GB、LY）
- 国家能源局（NB）

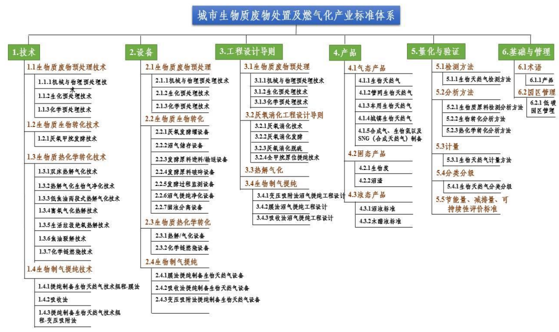
2. 国内生物质相关标准化工作进展



2. 国内生物质相关标准化工作进展- SAC/TC20/SC6重点关注领域



2. 国内生物质相关标准化工作进展-标准体系



2. 国内生物质相关标准化工作进展- SAC/TC20/SC6

目前我院承担的全国能源基础与管理标委会新能源和可再生能源分技术委员会(SAC/TC20/SC6)是国内负责生物质领域国家标准制修订的技术委员会，目前有委员16人，制定标准13项。其中8项已发布，5项已形成报批稿。

国家标准计划号	国家标准名称	阶段
20154064-T-303	生物质热解炭气油多联产工程技术规范 第1部分：工艺设计	已报批
20173915-T-303	农林生物质原料收储运通用技术规范	已报批
20173637-T-303	生物质燃气中焦油含量测定的方法	已报批
20173914-T-303	车用生物天然气	已报批
20173636-T-303	生物天然气 术语	已报批

2. 国内生物质相关标准化工作进展-国家标准

- 《生物天然气 术语》

规定了用于生物天然气相关标准起草的基础术语及专业术语，适用于生物天然气行业规划、设计、施工、管理、科研、教学等领域。术语标准是行业规范化的基础，运用标准化的手段，对生物天然气行业概念进行严格定义，选择或确立最恰当的术语，减少多义和同义现象，避免信息交流过程中的歧义和误解，对于促进生物天然气行业规范发展具有重要的意义。

欧盟及其成员国、澳大利亚、日本等为了大力推动可再生生物质能源的利用，促进配套能源补贴优惠政策的切实有效施行，出台了相关的生物质能源认证方法体系和组织架构，如欧盟的国际可持续和碳认证（ISCC）、法国的生物质生物燃料可持续性自愿认证计划（2BSvs）、日本的上网电价补贴方案（Feed-in Tariff Scheme），关于生物质废物源的生物天然气产生或认证有所涉及，为本项目的编制实施提供参考素材和模式范本，有助于本项目成为具备国际先进性的国家标准，与国际接轨。

2. 国内生物质相关标准化工作进展-国家标准

②《车用生物天然气》

规定了车用生物天然气的技术要求，适用于来源为沼气、填埋气等生物气提纯产品，压力不大于25MPa，作为车用燃料的生物天然气。车用生物天然气可以缓解化石资源带来的能源短缺的压力。从环境角度看它能有效地减少环境污染和温室效应，促进低碳经济发展，其排放不仅优于汽柴油燃料，也优于化石天然气燃料。

◆ 优化天然气供给结构
- 常规天然气的重要补充
- 有利于降低天然气供需短板，降低进口依存度

◆ 构建分布式可再生清洁燃气生产消费体系
- 增加天然气气源保障
- 有效替代农村散煤
- 助力解决农村煤改气气源

✓ **生物天然气的发展**

◆ 走“工业化”、“商业化”可持续发展道路
- 以工业化、市场化推进发展
- 加快专业化、市场化、规模化发展
- 融入大能源，纳入国家能源体系

2. 国内生物质相关标准化工作进展-重点标准

③《生物质燃气中焦油含量测定的方法》

给出了生物质燃气中焦油含量的测定方法，适用于生物质燃气焦油含量测定。本标准提出的生物质燃气中焦油含量的测定方法可有效缓解国内大多借鉴的国标GB/T 12208-2008所存在的焦油与灰尘不能分开测量、生物质燃气中水分含量高而导致的分析结果误差大以及滤膜不能完全捕获生物质燃气中部分低沸点物质而导致测量结果偏小等顽疾，可实现生物质燃气中焦油含量的精确测量，促进生物质利用技术的优化升级和发展。

✓ 国内尚未建立生物质燃气中焦油含量测定的标准，已极大阻碍了我国生物质能源产业的健康发展，亟待建立与生物质热解气化科学研究及产业发展紧密相关的焦油检测中国标准。

■ 国内尚未建立生物质燃气中焦油和灰尘含量测定的标准，多参考国标**GB/T 12208-2008《人工煤气组分与杂质含量测定方法》**来测定生物质燃气中的焦油和灰尘含量。

■ 欧洲标准化委员会建立了生物质燃气中焦油和颗粒物含量测定的方法**CEN/TS 15439:2006 《Biomass gasification-Tar and Particles in product gases-Sampling and analysis》**。

2. 国内生物质相关标准化工作进展-重点标准

④《农林生物质原料收储运通用技术规范》

规定了农林生物质原料收储运通用技术规范的术语和定义、总则、原料收集、原料储存和加工预计原料运输，适用于农林生物质资源化利用中所使用原料的收集、储存和运输活动。标准的提出引领农林生物质原料科学化的收储运模式，是提高秸秆资源利用的根本，也是保证秸秆利用的最基本的环节。以最经济的模式实现秸秆处理，降低环境污染，促进新能源和可再生能源发展。

- 解决政府头疼的秸秆废弃燃烧问题，保护大气环境, 改善农村生产生活环境
- 将丰富的农林废弃物变废为宝，转换为优质燃料，保护生态环境和促进农业可持续发展
- 解决生物质企业原料收集难的瓶颈问题，用标准规范收集过程问题

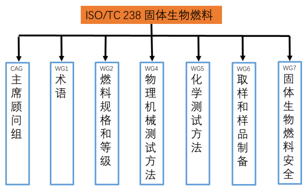
2. 国内生物质相关标准化工作进展-重点标准

表 生物质联合工作组团体标准

编号	团体标准编号	团体标准名称	领域
1	T/BGLM 0004.02-2017	车用生物天然气	新能源
2	T/BGLM 0002.03-2017	生物天然气 术语	新能源
3	T/BGLM 0003.03-2017	提纯制备生物天然气技术规程-膜法	新能源
4	T/BGLM 0003.02-2017	提纯制备生物天然气技术规程-水吸收法	新能源
5	T/BGLM 0003.01-2017	提纯制备生物天然气技术规程-变压吸附法	新能源
6	T/BGLM 0002.05-2017	生物天然气检测方法	新能源
7	TB-20160005	生物质热解气	新能源

3. ISO/TC238生物固体燃料标委会介绍

- 国际标准化组织于2007年成立了生物质固体燃料技术委员会(ISO/TC 238)，秘书处由瑞典标协承担。下设7个工作组。25个正式成员国，21个观察员国。研究方向为树木种植业、农业、水产养殖、园艺和林业的原材料和加工材料领域的术语、规范和等级、质量保证、取样和样品制备及试验方法的标准化，不包括液体生物燃料和天然气领域。
- 目前已发布44项标准，在研14项标准。



4. ISO/TC238标准化工作进展

目前中国标准化研究院资环分院承担对口ISO/TC 238投票工作，2020年共计完成28项投票。

票数 投票种类	全年收到数	当年应投票数	实投票数	占百分比
新工作项目提案(NP)	1	1	1	100%
国际标准草案DIS(ISO)、委员会投票草案CDV(IEC)	10	10	10	100%
国际标准最终草案(FDIS)	5	4	4	100%
国际标准复审(SR)	12	6	6	100%
其他委员会内部投票(CIB)	6	6	6	100%
技术规范草案(DTS)	1	1	1	100%

4. ISO/TC238标准化工作进展

序号	标准号	标准名称
1	ISO/AWI 5370	固体生物燃料—颗粒中细粒含量的测定
2	ISO/DIS 16559	固体生物燃料—术语，定义和描述
3	ISO/DIS 17225-1	固体生物燃料—燃料规范和等级—第1部分：一般要求
4	ISO/DIS 17225-2	固体生物燃料—燃料规范和等级—第2部分：分级木质颗粒
5	ISO/DIS 17225-3	固体生物燃料—燃料规范和等级—第3部分：分级木块
6	ISO/DIS 17225-4	固体生物燃料—燃料规范和等级—第4部分：分级木屑
7	ISO/CD 17225-5	固体生物燃料—燃料规范和等级—第5部分：分级木柴
8	ISO/CD 17225-6	固体生物燃料—燃料规范和等级—第6部分：分级非木质颗粒
9	ISO/CD 17225-7	固体生物燃料—燃料规范和等级—第7部分：分级非木质型煤
10	ISO/CD 17225-9	固体生物燃料—燃料规范和等级—第9部分：工业用分级粉状燃料和木屑
11	ISO 18135:2017/AWI Amd 1	固体生物燃料 —取样 —修改单1
12	ISO/CD 20048-2	固体生物燃料—脱气和耗氧特性的测定—第2部分：一氧化碳脱气筛选的操作方法

5. 2021年生物质领域拟开展重点工作

国际标准提案走出去

凝练一批生物质清洁供热、生物天然气（沼气）、生物质热解气化、生物质液体燃料先进技术和核心检测方法，推出国际生物质领域的中国提案。

国际标准转化引进来

加快转化一批代表世界先进水平、适合我国产业现状的生物质领域标准，促进我国生物质领域与国际接轨。

完善专家队伍支撑

继续完善现有专家团队，提高技术支撑水平，为我国参与和主导国际生物质领域标准化工作提供坚实后盾。

《商业和工业应用中固体生物燃料颗粒的安全处理和储存》

敬请批评指正

谢 谢！

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