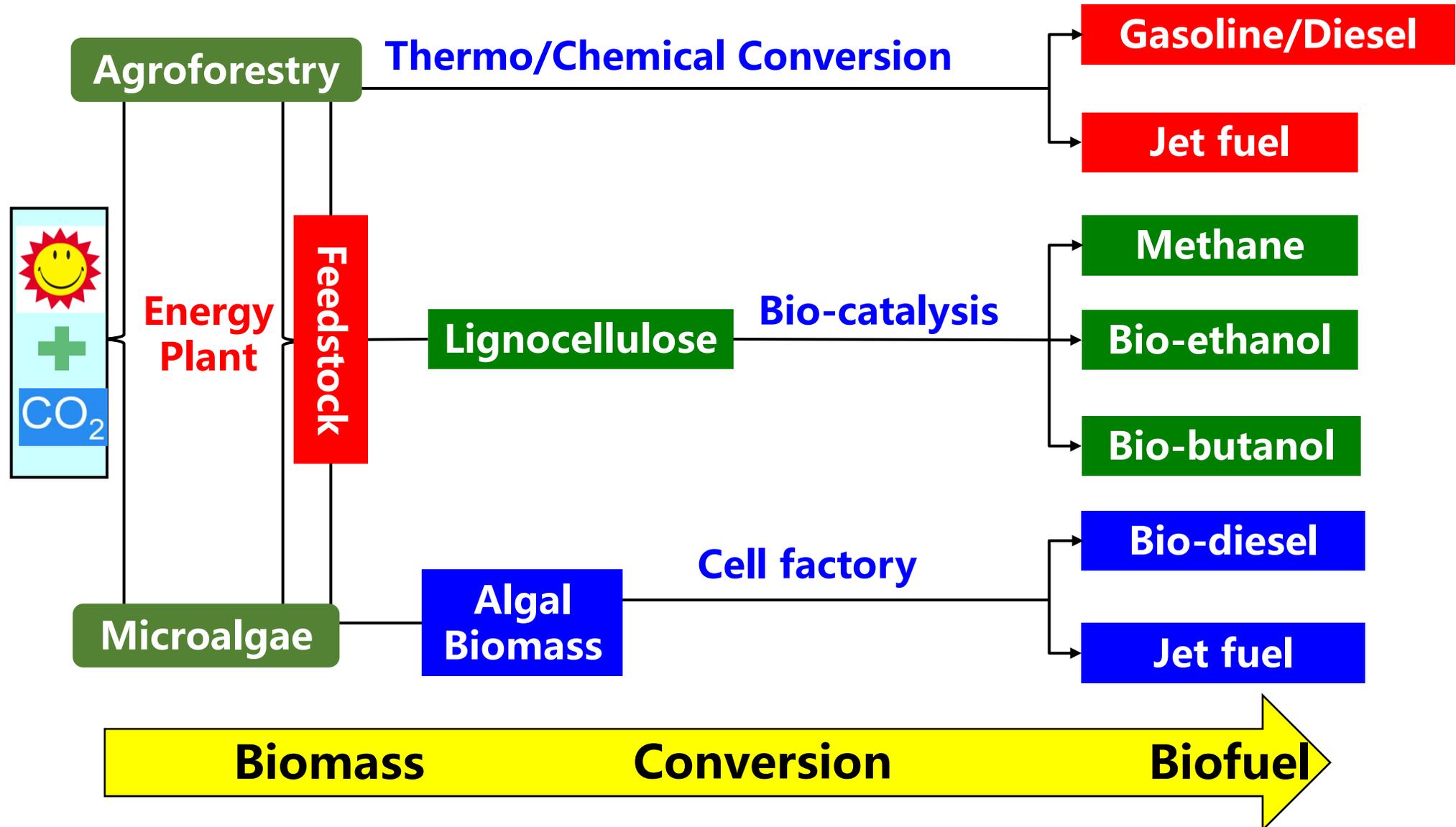


Qingdao Institute of Bioenergy and Bioprocess Technology, Chinese Academy of Sciences



Current Commercialization Status

- Syngas to ethanol: 90 billion m³ steel industry, coal chemical 45000 t/a (Shougang Lanza Tech, Caofeidian, Shizuishan)
- Biomass to ethanol: Guotou Biotech, 25000 ton/a (test)
Hebei Yigao, 25000 ton/a (corn cob residue after furfural production)
- E10 gasoline in China (10 million ton needed)

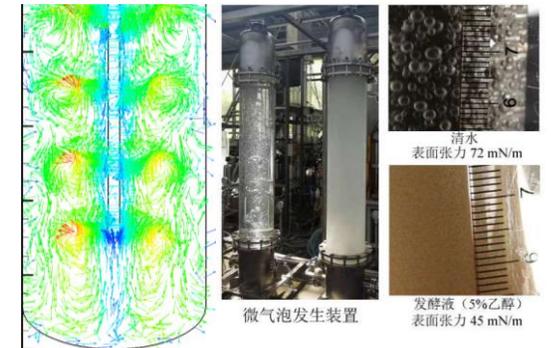


Technical Challenges

- STE: Gas-Liquid Mass Transfer, Metabolic Efficiency, Feedback Inhibition
- BTE: Transformation and genome editing efficiency; Feedstock collection, lignocellulose saccharification

Research& Development

- STE: Strain Modification, Medium Optimization, Bioreactor Improvement (SinoPec, RongXin Coal Chemical Co.).
- BTE: Genetic improvement of agronomic traits of energy plants (switchgrass); Novel whole cell enzymatic hydrolysis; Coupling of pretreatment, saccharification and fermentation; Lignin-derived value-added byproducts



Current Commercialization Status

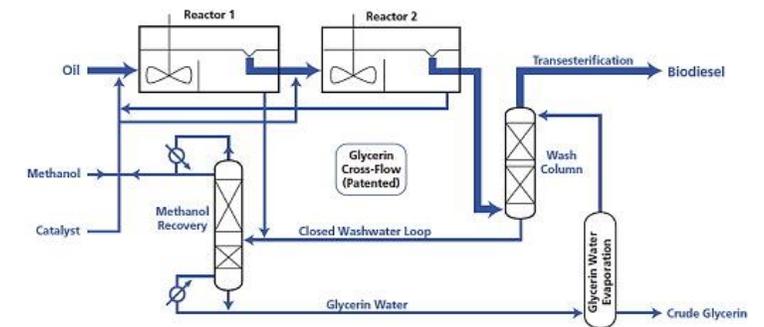
- 1st generation (fatty acid methyl ester) and 2nd generation (paraffins) commercialized, particular in Europe and America. In 2020, global production of first and second generation biodiesel were **39.3** and **7.5 billion liters**, respectively^[1].
- Shandong (1 million t/a), Fujian (100000 t/a) 2nd G

Technical Challenges

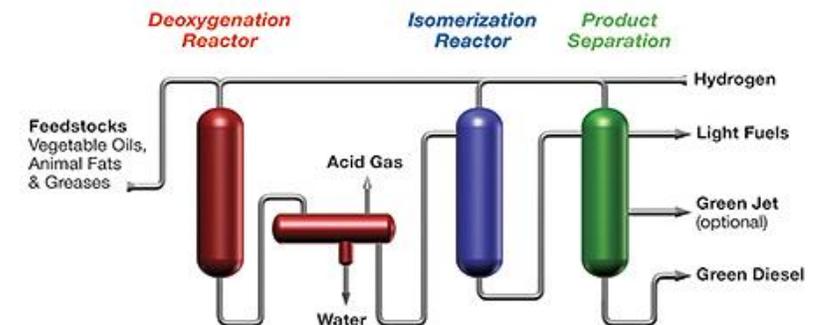
- Corrosivity of Feedstocks and Catalysts
- Impurities in Feedstocks
- Catalyst Life

Research & Development

- Catalyst Exploration (**Solid acid/base catalysts**)
- Process Optimization (**Slurry-bed hydrogenation**)
- Bioreactor Improvement



1st Generation Biodiesel -- Lurgi Process



2st Generation Biodiesel -- Eco-fining Process

[1] REN21, Renewables 2021 Global Status Repot.

Biomass to High Quality Jet Fuels (B2HQJF)

Current Commercialization Status

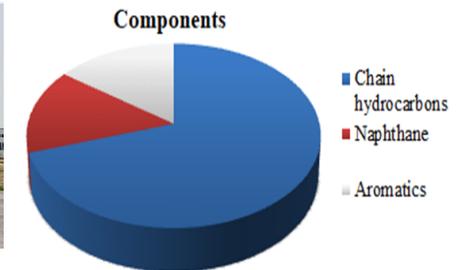
- Hydroprocessing of triglyceride (Sinopec, 2022, 100,000 t/a);
- Biomass to jet fuel: pilot test or industrial demonstration stage;
- Sugar to jet fuel, alcohol to jet fuel...

Technical Challenges

- Raw materials limitation: Fat, Oil, collected difficultly and expensive;
- Composition deficiency: Oil molecules are most chain hydrocarbons;
- Maximum addition limitation: Less than 50% in practical applications

Research& Development

- B2HQJF: biomass gasification and syngas synthesis to jet fuel developed at QIBEBT;
- A 100 t/a pilot scale system will be operated by the end of 2022;
- The obtained oil contained all the components that fits jet fuel standard



Biomass to High Quality Jet Fuel via Gasification-Synthesis Route

Pilot scale system

Components of crude oil



Extended Energy Big Data (EEBD)

Innovation Conception

Extended Energy Big Data (EEBD) is a new conception put forward by QIBEBT, it believes that energy is an essential factor of modern society, so with **energy as a common core**, diverse dimensions such as **economy, society, ecology, environment, engineering, science and technology, climate, energy security etc. can be associated**, and any disturbance from any dimension can be conducted to others through energy. By digging the big data based on EEBD principle, much new knowledge can be revealed, it will be helpful for smart development.

Current Status

- ✦ Conception of EEBD principle has been developed and issued;
- ✦ A big data based on EEBD principle has been constructed;
- ✦ A platform used to manage and dig EEBD has been developed

Research& Development

- ✦ A model used for government intelligent decision developed;
- ✦ A new methodology of GIS-LCA proposed;
- ✦ Some cases of smart plants built up

