經濟部能源局
Bureau of Energy

42nd APEC EGNRET Meeting

The Promotion of Biofuels in Transportation Sector in Chinese Taipei

Bureau of Energy
Ministry of Economic Affairs
Chinese Taipei

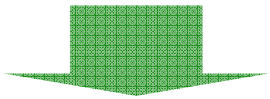
April 7, 2014

Outline

- Low Carbon Policy in Chinese Taipei
- Biofuels Developments in Chinese Taipei
- Biofuels Utilization in Chinese Taipei
- Concluding Remarks

Low Carbon Policy in Chinese Taipei

Jun. 5, 2008	Framework of Sustainable Energy Policy
Apr. 14-15, 2009	3rd National Energy Conference
Apr., 2009	Green Energy Industry Program
Jul. 8, 2009	Renewable Energy Development Act
	Amendment of Energy Management Law
Nov. 20, 2009	Special Report on Energy Conservation and Emission Reduction
Dec., 2009	Establishment of the Committee on Energy Conservation and Emission Reduction
May, 2010	Approval of the Master Plan on Energy Conservation and Emission Reduction



***Developing a Low Carbon Energy Structure by 2025**
***10% Biofuels Applied in Transportation Sector**

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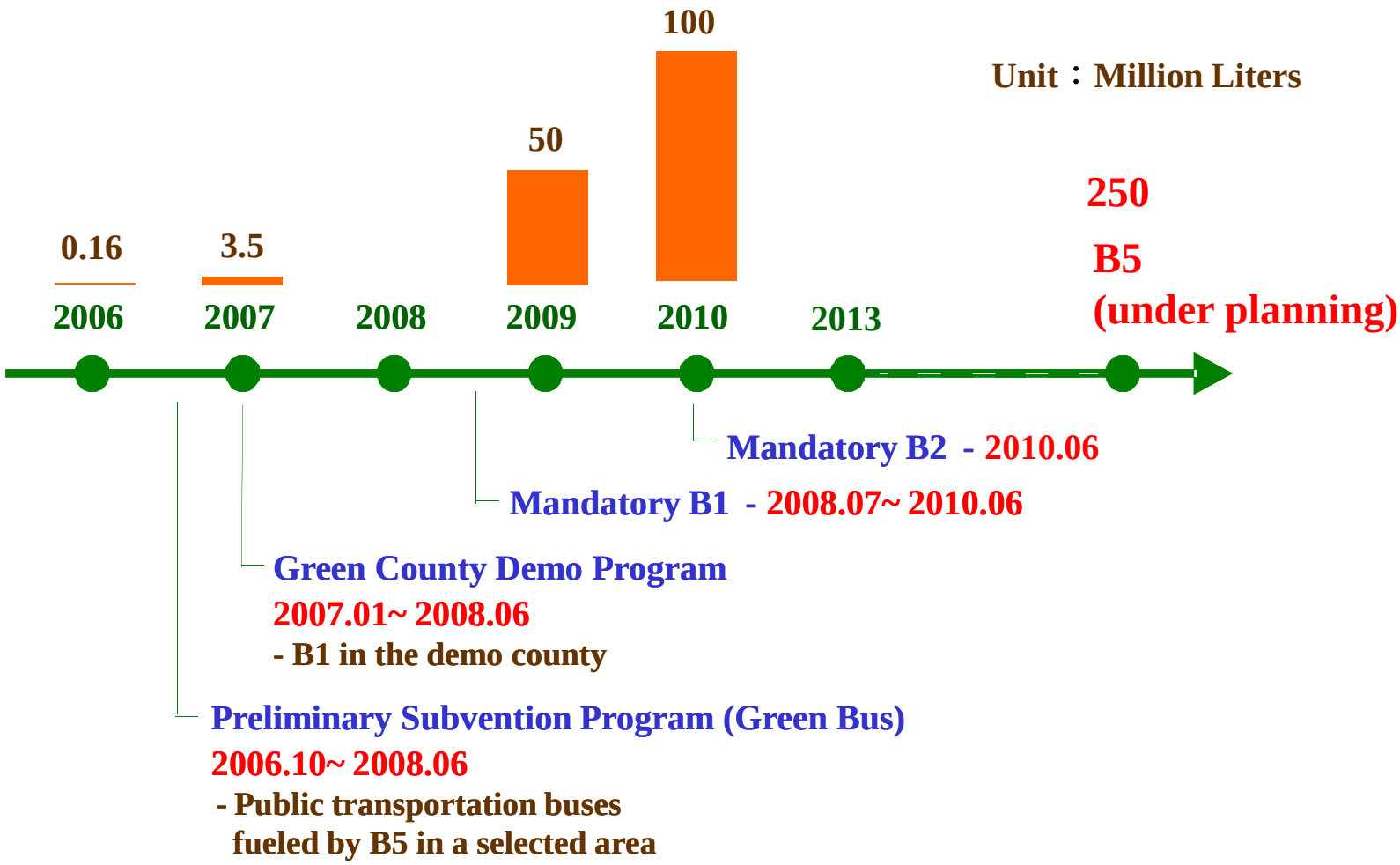
Promoting Biodiesel in Chinese Taipei



Source: BOE (2010)

Promoting Biodiesel in Chinese Taipei

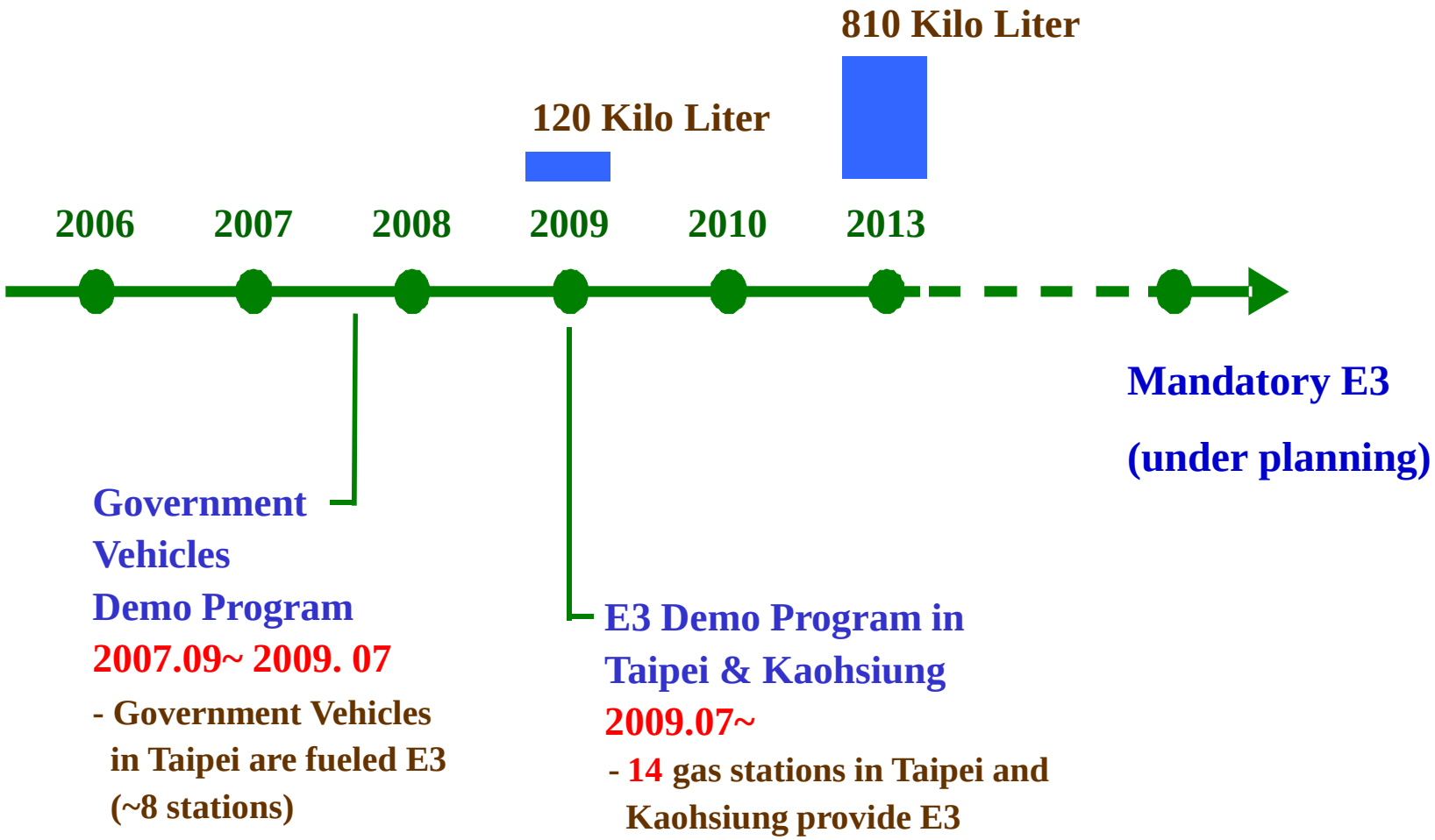
- Mandatory B2 diesel starting from June 2010, which could reduce 0.26 million ton CO_2 emission annually.
- Spent cooking oil is the main feedstock for domestic production, and looking for oversea plantation and microalgae as future feedstocks.
- Higher blend ratio in the future depends on the supply of feedstock.
- Non-food, environmentally and ecologically friendly, cost competitive, positive energy balance

Commerical bio-diesel plant
(10,000 kL/yr in Changhua , 2007)

Microalgae Pilot Plant
in Cement Industry

Microalgae Cultivation/Harvest/Dewater

Promoting Bioethanol in Chinese Taipei



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Promoting Bioethanol in Chinese Taipei

- Promote E3 gasoline in Taipei and Kaohsiung cities since July 2009. There are 14 gas stations in Taipei and Kaohsiung supply E3 with an incentive price 2NT$/L cheaper than gasoline.
- Compatibility of old model vehicles and scooters is the major concern for mandatory nationwide E3 gasoline
- No fuel ethanol plant in Chinese Taipei now; cellulosic ethanol technology is under development.
- Cellulosic alcohol (ethanol & butanol) technologies are under development via enzyme/chemical hydrolysis of lignocellulose.

Typical gas station

Rice straw bale

Enzyme / Chemical Cellulosic Hydrolysis

Cellulose hydrolyzed by ionic solution

CT for 42rd EGNRET 8

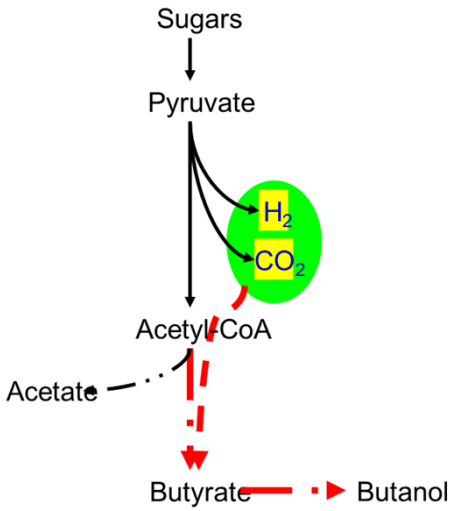
Biofuel Technologies Development

- Development of non-food material sources
  - Key technologies of microalgal biofuel
    - ✓ Bag type PBR for microalgal cultivation
    - ✓ Combination of microalgal cultivation and CCS technologies for CO_2 recovery in cement industry (Pilot scale)
    - ✓ Multi-layer filter for microalgae harvest
    - ✓ Bio-disruption & tunable solvent extraction for microalgal lipid recovery

Microalge culturing system in cement industry including culturing and harvesting system

Biofuel Technologies Development

- Advanced biofuel technology
  - Cellulose hydrolysis for agriculture and forestry materials
    - ✓ Lignocellulosic depolymerization using ionic solution
    - ✓ 1,000-L scale “lignocellulosic depolymerization and sugar production pilot systems”
  - Bio-Butanol production
    - ✓ Unique microbial culture medium and domestication process for biobutanol production with zero carbon release
    - ✓ Novel microorganism for volatile fatty acids production from syngas
    - ✓ One new company established– Green Cellulosity Corporation(鼎唐能源科技公司)



R&D 100 Awards- Cellulose hydrolysis & Biobutanol

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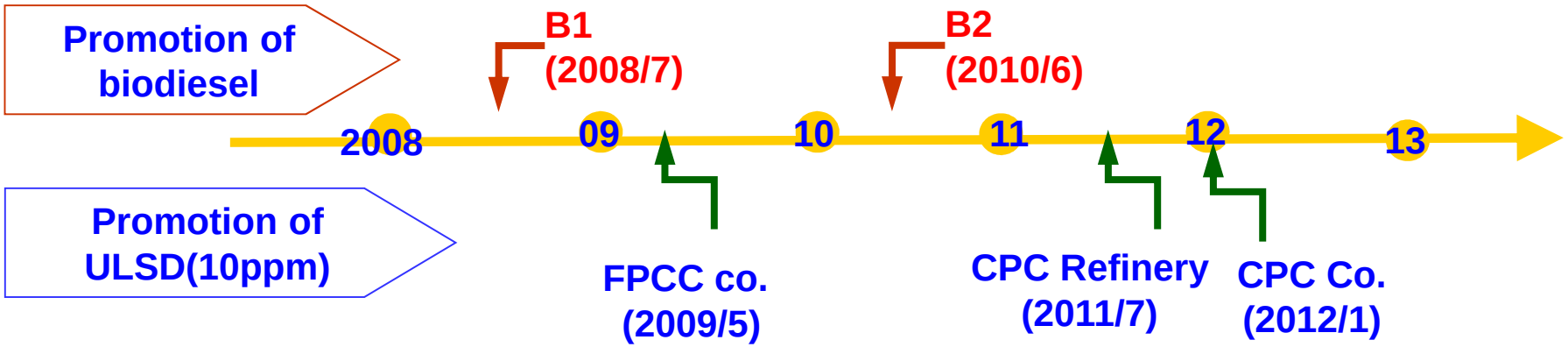
Current Biofuels Utilization in Chinese Taipei

- **Mandatory B1 since July 2008, and B2 from July 2010**
  - Annual consumption of biodiesel (B100) ~ 47,000 kL in 2009 and 100,000 kL in 2013.
  - ~70% domestic production from mostly waste cooking oil
  - 11 licensed biodiesel plants with ~US$ 43 million production
  - Completed biodiesel supply chain including feedstock suppliers, manufacturers, and marketing.

- **E3 demonstration since Sep. 2007**
  - **14** gas stations in Taipei and Kaohsiung Cities

Source: BOE (2010)

Promotion of Biofuels



[NOTE]: ULSD: Ultra-low-sulfur diesel

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Concluding Remarks

- Support from all stakeholders is necessary
- Government subsidy is necessary for the promotion of biofuels
- Blend ratio can be higher if biofuels are cheaper than petro-fuels
- Multi-feedstocks is the trend in the future
- R&D is essential for the adoption of biofuel
  - Cost
  - Quality
  - Supply

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2014 APEC Workshop on Biodiesel Application Experiences

EGNRET self-funded project proposed by Chinese Taipei

Date: September 10, 2014 (*TBC*)
Venue: GIS NTU Convention Center, Taipei (*TBC*)

- **Objective:** To enhance the quality control of the supply chain management and popularize the applications of biodiesel in the APEC region by sharing the international practical experience, especially the high moisture and temperature environment in the APEC region.
- **Workshop Topics**
  - The status and challenges of the clean fuels application, such as ULSD and Biodiesel Blended vehicles fuels, in the APEC Region.
  - Biodiesel Blended quality control and microbial contamination prevention in the supply chain, including the fuel tanks of terminal distributor and gas station dispenser.
  - Key issues on the Biodiesel Blended Standard Management.

Future Perspectives

Issues	Technology Needs
Feedstock availability • Waste Cooking Oil: 60,000 tonnes • Set aside land: 220,000 hectare	**Multiple Feedstocks** • Waste: Agricultural, industrial and municipal wastes • Algae cultivation • New energy crops **Advanced Processing** • Cellulose Ethanol & Bio-butanol • Bio-oil from wastes via pyrolysis process
Vehicle suitability • B5: 35 models in total, 28 of them are suitable, the rest unknown (2001~06) • E3 Vehicle: 96 models in total, 3 of them are NOT suitable (2001~06) • E3 Scooter: ~12 millions scooters in total, most of them are NOT suitable	**New formula biofuel** • Butanol: similar to gasoline in terms of energy content, octane number and combustion parameters • Renewable Alkanes via hydrogenation • Fischer-Tropsch Synthesis **Flex Fuel Vehicle/Scooter** • Engine Management System • Auto sensor for ethanol concentration • Emission Control System

Thank you for your attention.