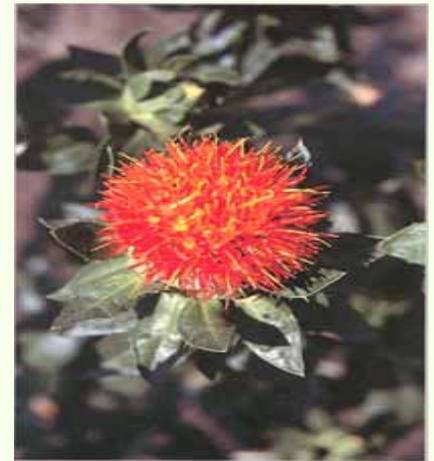
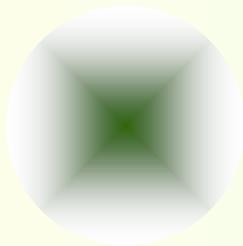


Opportunity and Challenge for the Evolution of Biofuels in the Asia and Pacific Region

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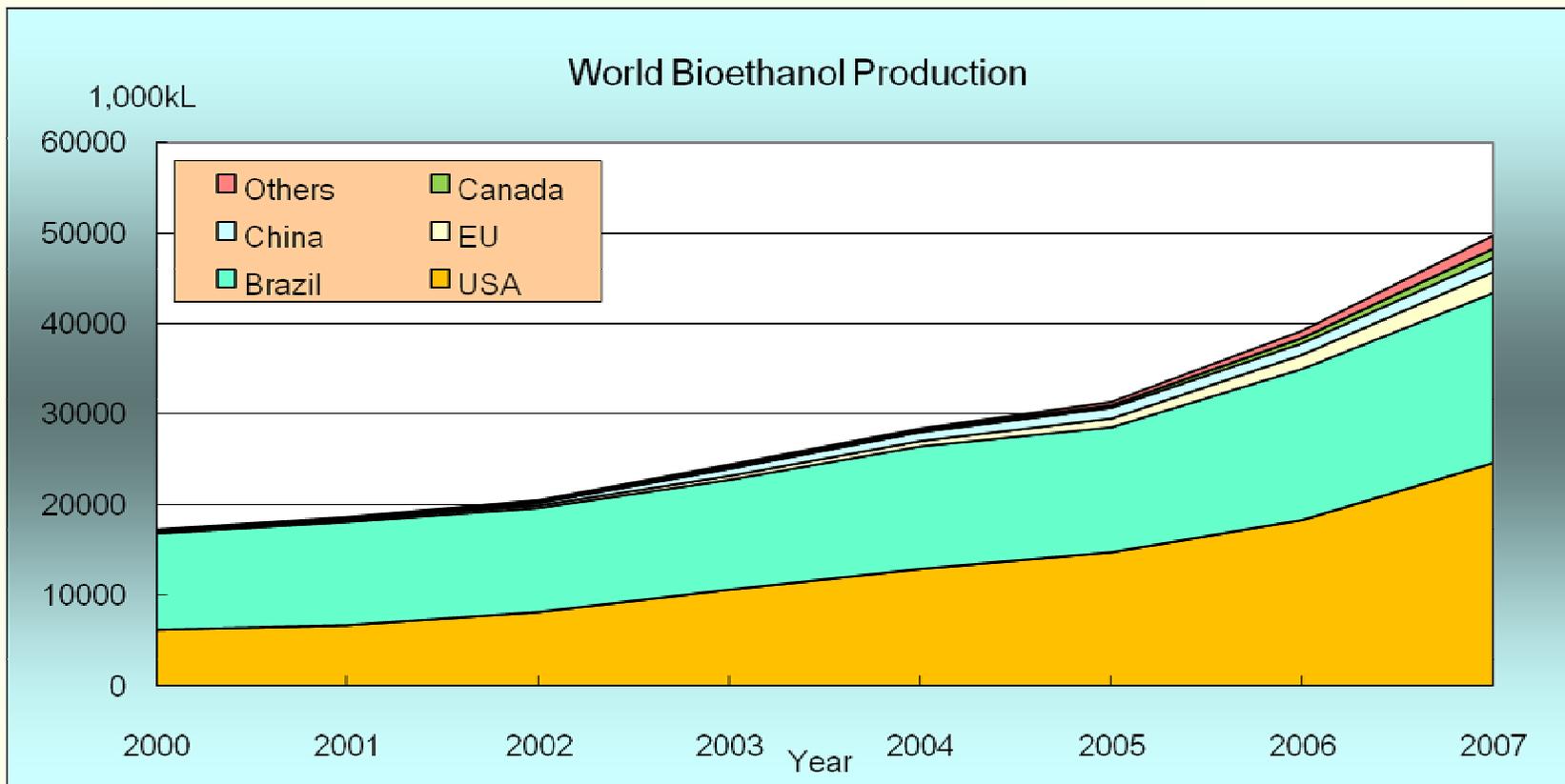
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World Bioethanol Production

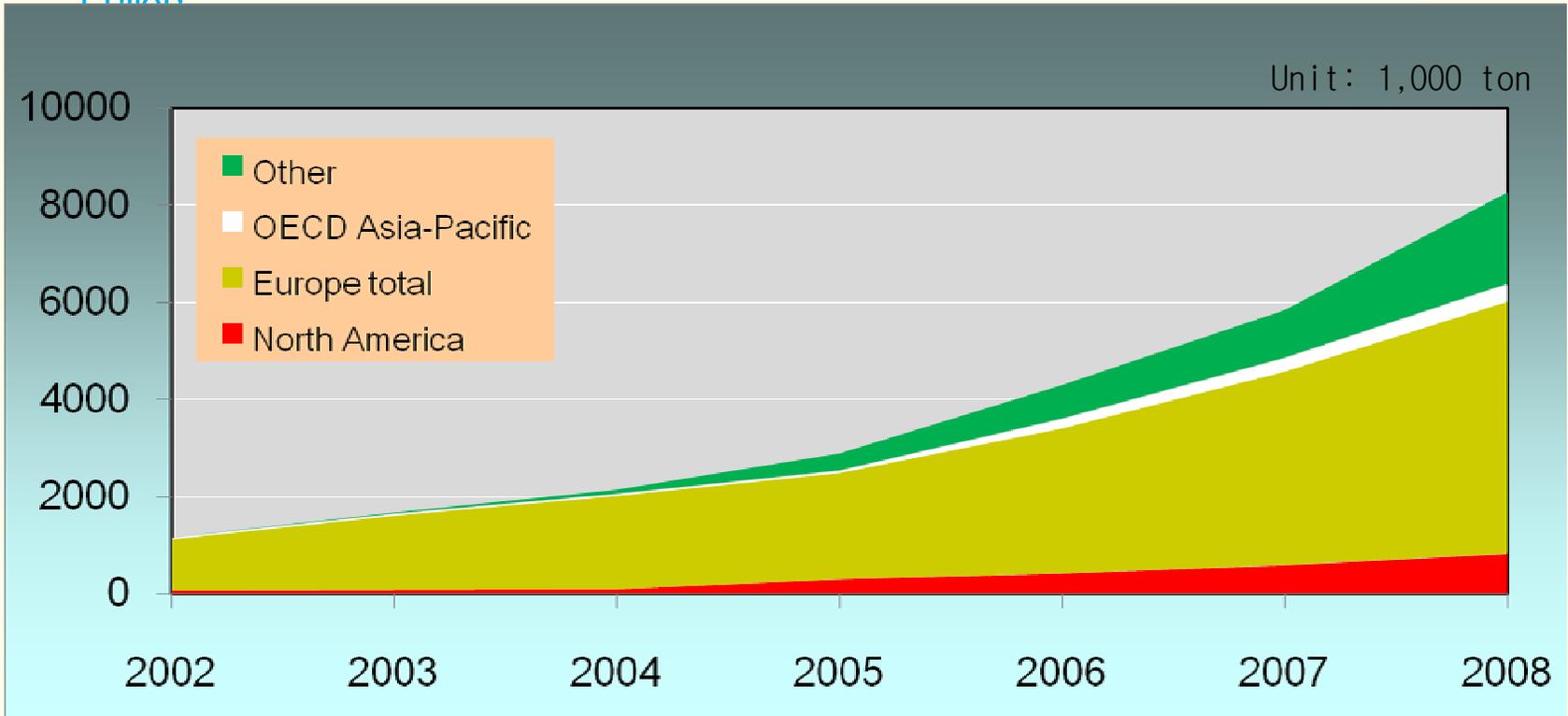
- ❖ World production increases by 3 times bet. 2000 and 2007 (about 2% of world gasoline consumption)
- ❖ About 50 million kL produced in 2007
- ❖ U.S.A. production increases by 4 times for the same period



Source: F.O.Licht, 2007, 'World Ethanol & Biofuels Report

World Biodiesel Production

- ❖ 5.8MT of BD would be produced in 2007 (0.2% of world diesel consumption)
- ❖ Bet. 2002 and 2007, world BD production increases by 5 times
- ❖ EU prod. increases by 3.7 times, OECD Asia prod. increases by 9.5 times



Source: OECD Trade Policy Studies, 2006), *2005: Estimated, **2006~2008: Projected

Biofuel Promotion Policy in EU

- ❖ Subsidy on biofuel promotion as a part of agricultural policy
 - Unilaterally €45/ha supported by Common Agricultural Policy from 2003
 - Fuel Tax exemption as well as Environmental tax exemption also applied
- ❖ 5.38 million TOE of biofuel produced in EU (2006)
 - Share of Germany production: 52.4%
 - Share of entire EU diesel market: 1.6%
- ❖ Promotion goal of BD in EU
 - 2% of total diesel consumption in 2005
 - 5.75% in 2010, minimum 10% in 2020
- ❖ Achievement of BD promotion goal was not promising
 - Germany(3.8%) and Sweden(2.2%) only accomplished the 2005 goal

Germany and France Policy

❖ 100% fuel tax exemption applied in Germany until 2006

- The largest EU biofuel consumer in 2006: 2.8Mton of BD, 0.48Mton of BE
- Total biofuel quota: 6.75% in 2010 and 8.0% in 2015
- €0.63/liter exempted, but began to convert into partial exemption policy
- In 2007, partial tax is €0.09/liter, and it increases as €0.45/liter in 2012
- Full tax exemption allowed for 2nd generation tech.(BTL, Bioethanol from cellulose)

❖ Partial tax exemption policy in France

- Second largest EU biofuel consumer in 2006:0.62Mton of BD, 0.23Mton of BE
- Consumption target: 5.75% in 2008, 7% in 2010, 10% in 2015
- Partial excise tax exemption: €0.26/liter for BE, €0.167 for BD

Biofuel Policy in Austria, Spain, and Sweden

❖ Austria

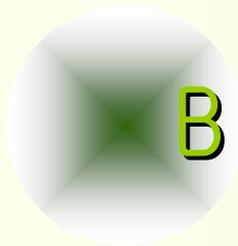
- BD consumption: 0.32Mton in 2006
- Obligation (5.75% in 2008) and full tax exemption

❖ Spain

- 6,000ton of BD was produced from waste oil in 2003
- Production of BD in 2005 was 150,000ton (capacity: 250,000t)
- Starting ETBE in 1995 producing 260,000ton in 2005
- Biofuel is responsible for 1.1% of total petrol and diesel use!
- By 2010, 500,000ton (1.7% of total trans. fuel use) of biofuels are their goal!
- 10 year guarantee of fiscal support for commercial biofuel plants

❖ Sweden

- 270 stations providing E85 will be constructed during 2007
- 13.5% of newly registered cars are FFV(Flex Fuel Vehicle) in 2007



Biofuel Policy in USA

❖ The largest BE consumption country in 2006

- 16.6million kL of BE was produced in 2005
- 3%(17MT) of transportation fuel in 2006 → 15%(130MT) in 2017

❖ Volumetric excise ethanol tax credit

- \$0.51/gallon of tax exemption for BE by 2010
- Federal tax incentives: income tax deduction and production tax deduction

❖ Production and Incentives for biodiesel

- 0.29million kL of BD was produced in 2005
- Tax credit for BD: \$1.0/gallon for virgin oil, \$0.5 for waste oil (2004)

❖ RFS(Renewable Fuel Standard)

- US EPA is responsible for promulgating minimum volume of renewable fuel required to be blended into gasoline
- 4billion gallons in 2006 and 7.5billion gallons in 2012

Biofuel Policy in Brazil and Japan

❖ Current production and goal of biofuels in Brazil

- 15.6million kL of BE was produced in 2005
- Blending ratio for mixing BE with gasoline is 20–25%
- BD consumption: 2% in 2007, 5% in 2013

❖ Measures to promote biofuels in Brazil

- Obligation for the biofuel consumption
- Capital loan (\$41.9M) for the installation of BD plants
- FFV represents more than 90% of LDV (light duty vehicle)

❖ Production and Incentives for biofuel in Japan

- 1,500kL of BD (BD100, BD20)
- E3 tested in 2008 (20,000 of cars in Miyako Island) and E10 blending by 2012
- Import 0.21MT of ethanol in private sector by 2010 to convert into ETBE
- Partial tax exemption for gasohol

Biofuel Profile in Asian Countries

- ❖ Total production of ethanol is estimated as 5,954ML(Dufey, 2006)
- ❖ China and India are major biofuel production countries in Asia

Country	Bioethanol			Biodiesel		
	Production (ML)	Blending Ratio	Crop	Production (ML)	Blending Ratio	Crop
China	3,649	E10	Corn, Casava, Sugarcane, rice, sweet potato	68 (installation, 2004)		Jatropha
India	1,749	E5	sugarcane		B20(2011)	Jatropha
Tailand	280	E10	sugarcane, Tapioca, Casava	90(2005) 722(2010)		palm, soybean, soya, coconut, Jatropha
Indonesia	167		Sugarcane			Palm
Pakistan	26		Sugarcane			
Philipine	83		Sugarcane			Coconut

Source: MOFAT, 2007, Guidebook for Bioenergy Market

Prospect of Biofuels in Asian Countries

- ❖ Until 2030, several Asian countries hope to increase production of biofuels as 153MT
- ❖ Recently, more investment on biodiesel production is made in Malaysia and Indonesia

Country	Ethanol		Gasoline equivalent
	ML	MT	MT
Indonesia	55,995	44.2	27.7
Malaysia	16,157	12.8	8.0
Philippine	21,617	17.1	10.7
Thailand	13,968	11.0	6.9
Vietnam	11,138	8.8	5.5

Source: MOFAT, 2007, Guidebook for Bioenergy Market



Prospect of Biofuels by APEC BF T/F

- ❖ Supply potential of biofuel is estimated as 1/3 of total transport fuel demand
 - About 10% of the supply potential can be provided by food crops
 - 90% of the potential will be provided by non-food crops in the long run
 - BD consumption: 2% in 2007, 5% in 2013
- ❖ Sugar cane and corn are the most cost-effective for producing bioethanol
 - Palm is the most productive feedstock for producing biodiesel
 - Second generation technology is not cost-effective for now
- ❖ Application of bio-refinery technology to lower production cost of biofuels
 - Utilization of oil cake and crop residuals: wood pellet, fertilizer
 - Glycerin or pitch can be used as fuels, costumes or bio plastics

Prospect of Biofuels in APEC BF T/F

❖ Expansion of non-food feedstock

- Exploitation of set-aside land or marginal land
- Less requirement on the cultivation of non-food crops
- Jatropha can grow well even in low-graded land

❖ Encouraging free-trading of biofuels among Asian countries

- Low production costs in Southern Asian countries: Malaysia, Indonesia
- High production costs in Northern Asian countries: Korea, Japan

❖ Emerging carbon market in APEC can help economic growth in developing Asian countries

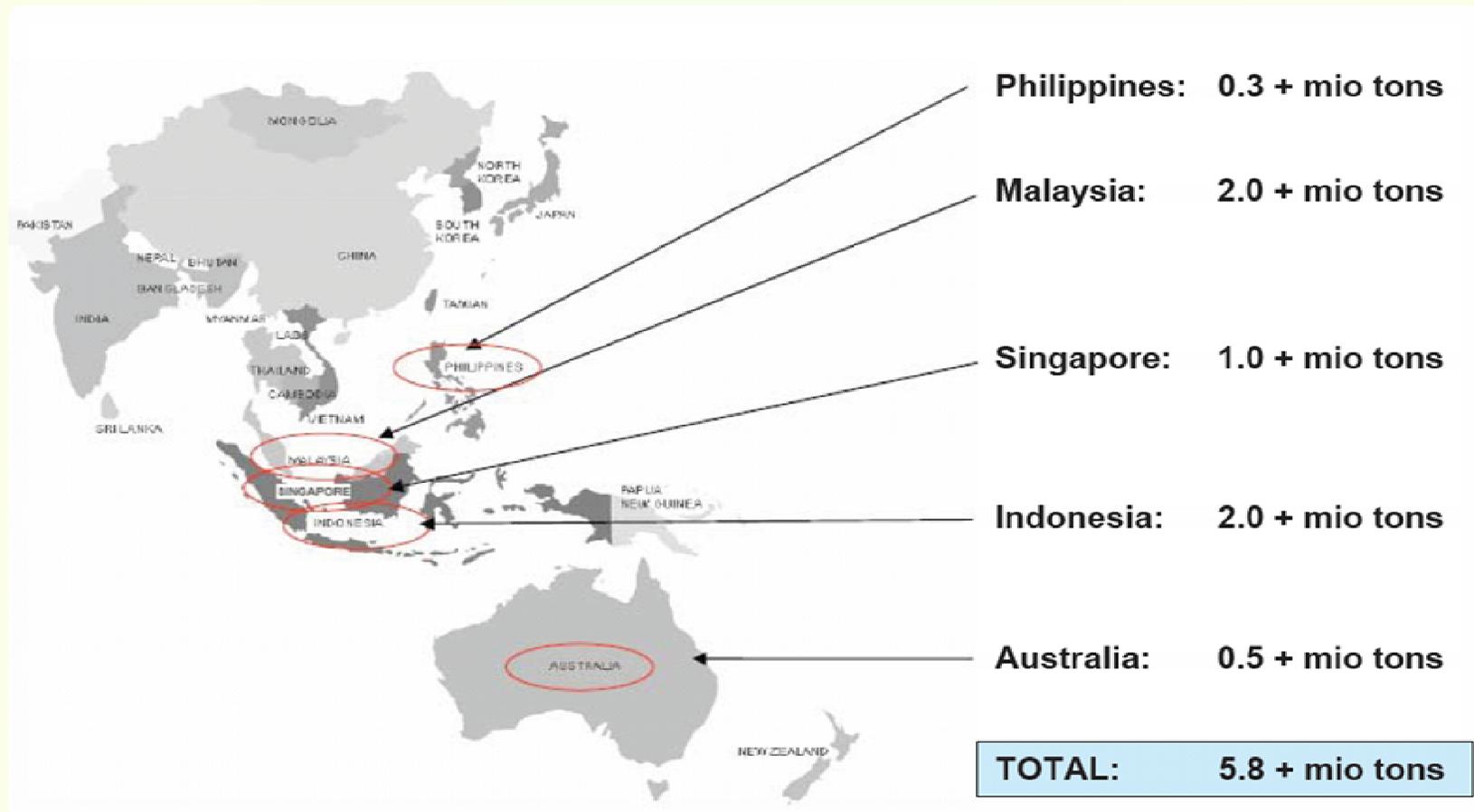
- Non-annex countries in Kyoto protocol: can obtain CER (Certified Emission Reduction) through CDM
- Annex countries: can obtain ERU (Emission Reduction Unit) through JI



Standardization of Biofuels in APEC

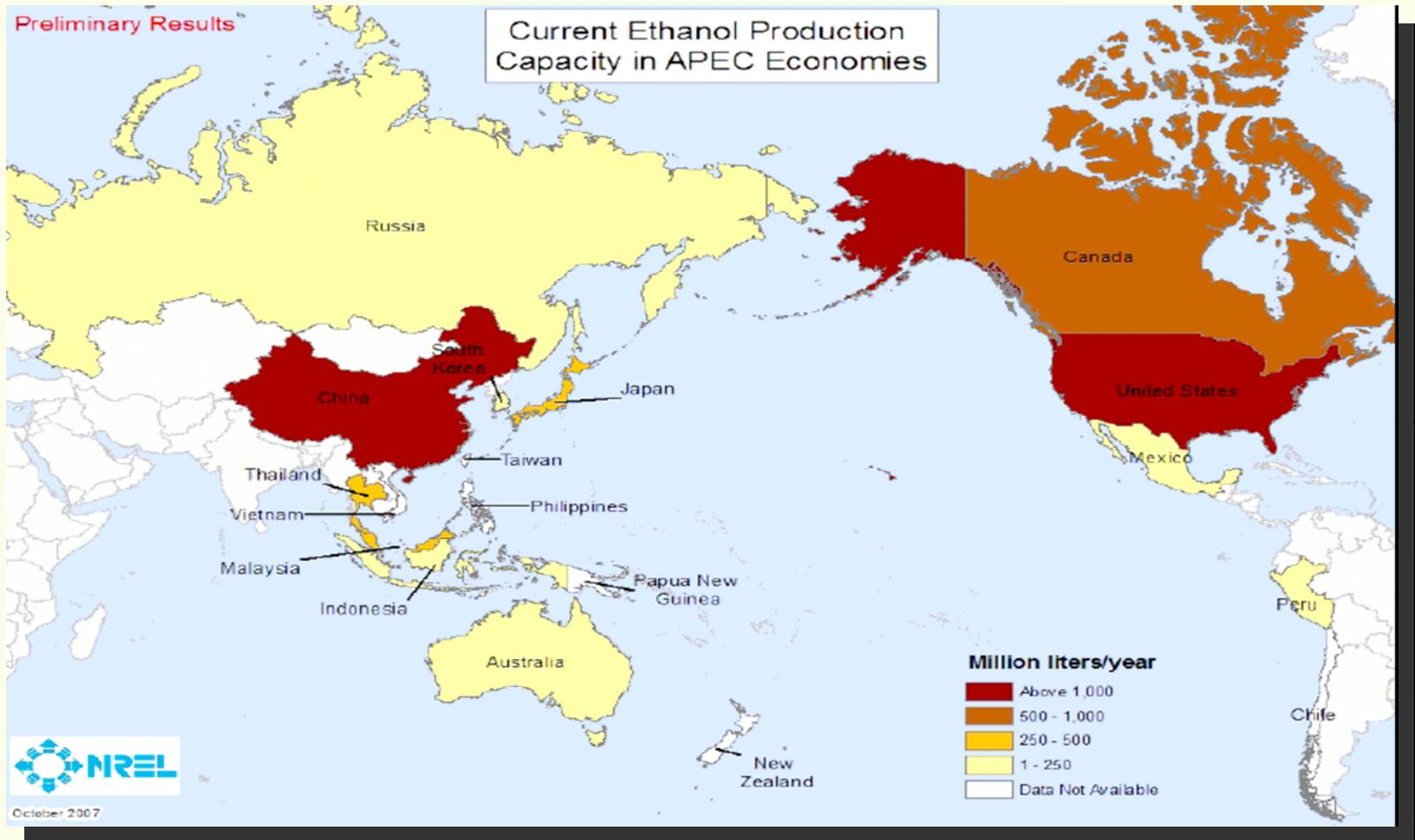
- ❖ Current international standards on BD are EN14214 and ASTM D 6751
 - Feedstock of APEC is quite different from that of EU and USA
 - Without standardization of BD, no free-trading in APEC
- ❖ Conclusion of the 1st workshop on BD standardization in APEC
 - Commodity subject to free-trading is BD 100
 - High-speed as well as low-speed vehicles included
- ❖ Various kinds of feedstock with different physical attributes
 - Major parameters : combustion, engine and after-treatment tech., durability, cetane, CFPP, viscosity, sediment, and water content
 - Standardization will be completed at the end of 2008

BD Production Plan of Asia and Australia bet. 2007-2008



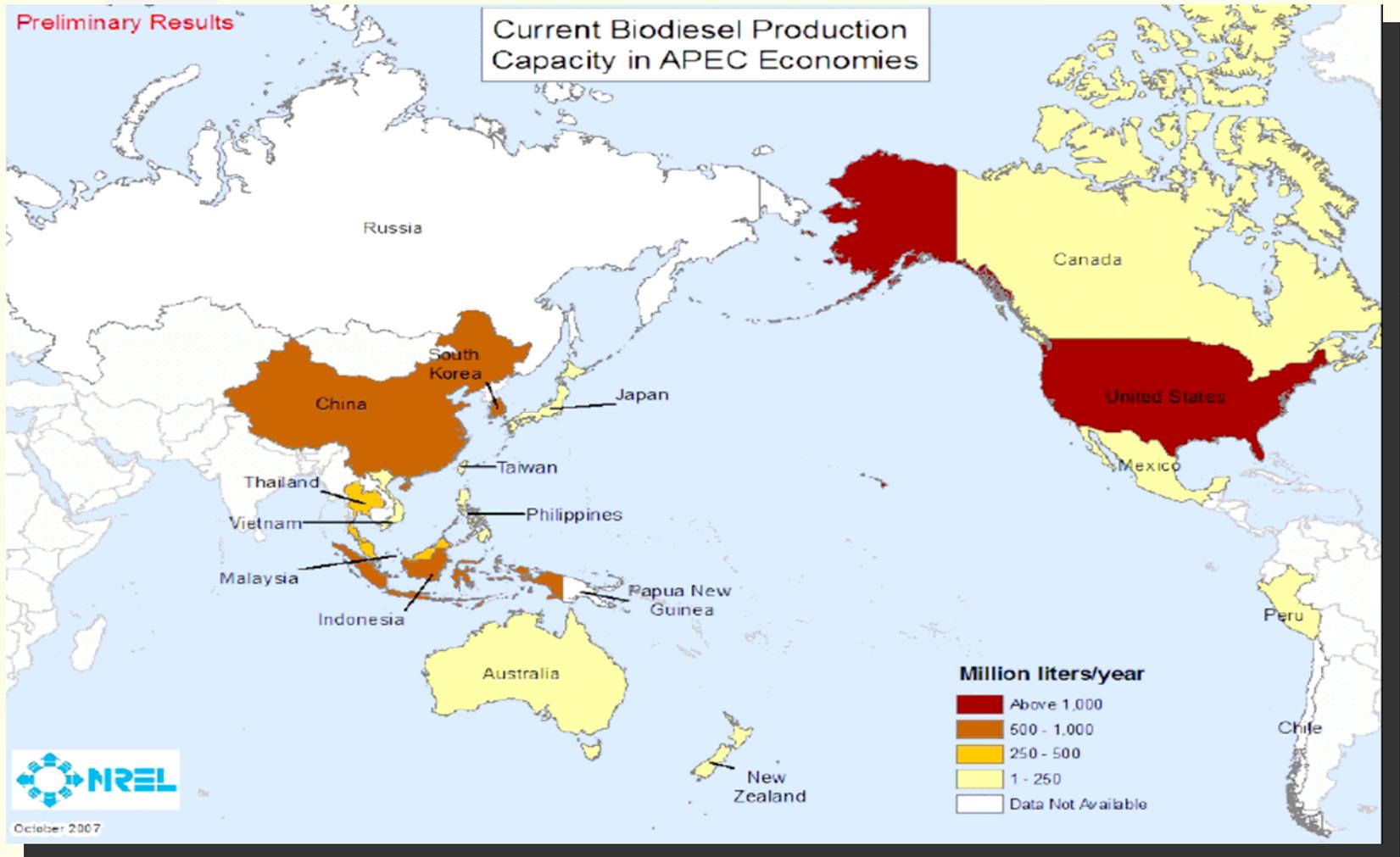
Source: Initium Partners Inc. 2007

Estimation of BE Potential in the APEC



source: NREL's presentation in the APEC BTF workshop (2007)

Estimation of BD Potential in the APEC



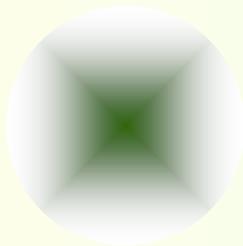
source: NREL' s presentation in the APEC BTF workshop (2007)

BE Potential from ASEAN(2030) (Association of South East Asian Nations)

- ❖ Feedstock: residues of sugarcane (bagasse and filter cake), cassava (crude fiber, stalks and leaves), corn (crude fiber, stalks, leaves, cobs and husks), oil palm (shells and empty fruit bunch), coconut (shells and fiber)

Economy	Ethanol (Million Liters)	Ethanol (Million Tons)	Gasoline Equivalent (Million Tons)
Indonesia	55,995	44.2	27.7
Malaysia	16,157	12.8	8.0
Philippines	21,617	17.1	10.7
Thailand	13,968	11.0	6.9
Viet Nam	11,138	8.8	5.5
total	118,875	94	59

Source: APEC Biofuel Taskforce report, 2007



BE Potential in APEC

- ❖ Australia: grain crops
- ❖ Canada and USA: grain crops and agricultural residues
- ❖ Thailand: agricultural residues, animal manure, forest residue, new wood plantation, municipal solid waste

Economy	Ethanol (Million Liters)	Ethanol (Million Tons)	Gasoline Equivalent (Million Tons)
Australia	9,804	7.7	4.9
Canada	4,194	3.3	2.1
Thailand	54,831	43.3	27.2
United States	352,565	278.3	174.7
total	421,394	333	209

Source: APEC Biofuel Taskforce report, 2007

BD Potential from Available Resources

- ❖ Australia: oilseed crops, tallow, and waste cooking oil
- ❖ Canada : oilseed crops, animal fats, and other fats and oils
- ❖ Chinese Taipei: waste cooking oil
- ❖ Malaysia: crude palm oil

Economy	Biodiesel (Million Liters)	Biodiesel (Million Tons)	Diesel Equivalent (Million Tons)
Australia	903	0.8	0.8
Canada	473	0.4	0.4
Chinese Taipei	60	0.05	0.05
Malaysia	16,300	13.9	13.9
total	17,736	15	15

Source: APEC Biofuel Taskforce report, 2007

Indonesia's plan for biofuel production

Total biodiesel production capacity: 4.8MT

Item	unit	2006	2007	2008	2009	2010	total
Substitution of diesel in transportation	million KL	11.9	11.0	12.2	12.3	12.4	
biodiesel production capacity	thousand KL	40	240	640	1,536	2,360	4,816
production of palm	thousand ton				440	320	760
production of Jatropha	thousand ton	40	200	400	456	504	1,600
#of plant with 3,000 ton of cap.	number		12	15	15	9	51
#of plant with 30,000 ton of cap.	number		6	10	13	15	44
#of plant with 100,000 ton of cap.	number				2	2	4
area for palm	thousand ha		110	80			190
area for Jatropha	thousand ha	25	125	250	285	315	1,000

Source: Ministry of Energy, Indonesia

Malaysia's plan for biofuel production

Total production capacity: 0.5MT

Name of company	Partner	production capacity(ton)	investment (Million RM)
Loreno Sdn Bhd	Italy	60,000	90
Golden Hope/Rubiotech Sdn Bhd	MPOB	60,000	40
Golden Hope Bioganic	-	30,000	10
Kumpulan Fima	MPOB	60,000	40
Carotino	MPOB	60,000	40
Kulim Bhd/Natoleo	CremerOleo GMBH	100,000	-
Golden Hope	-	150,000	100
Poic Sabah	Ecosolution Co (Korea)	-	180
Bio Energy int. Plc	-	-	200

Source: Garten Rothkopf.

Thailand's plan for bioethanol production

Name of company	Region	Feedstock	Production capacity(100liter/day)
Pawn WiLai International Group Trading Co.ltd	Ayudhdhaya	Molaasses	25,000
Thai Alcohol Plc	Nakorn PaThom	Molaasses	200,000
Thai Agro Energy Co.ltd	Suphanbur i	Molaasses	150,000
Thai Nguan Ethanol Co.Ltd	KhonKhen	Cassava	130,000
KhonKhen Alcohol Co.Ltd	KhonKhen	Sugar Cane/Mol asses	150,000
PetroGreen Co.ltd	Chaiyaphoom	Sugar Cane/Mol asses	200,000
Thai Sugar Ethanol Co.ltd	Kanchanabur i	Sugar Cane/Mol asses	100,000
K I Ethanol Co.ltd	NakornRatchasima	Sugar Cane/Mol asses	100,000
EIC B Business Patners Co.ltd	Rayong	Cassava	150,000
FahKwanThip Co.ltd	Pachinbur i	Cassava	60,000
EkaraPhattana Co.ltd	NakornSawan	Mol asses	200,000
Ratchabur i Ethanol Co.ltd	Ratchabur i	Cassava/Mol asses	150,000
Thai RungRueng Energy Co.ltd	Sarabur i	Sugar Cane/Mol asses	120,000
Petro Green Co.ltd	Kanlaseen	Sugar Cane/Mol asses	200,000
E S Power Co.ltd	SaKeaw	Cassava/Mol asses	150,000
Sima Inter Products Co.ltd	ChaChoengSao	Cassava	150,000
ThrupThip Co.ltd	Lopbur i	Cassava	200,000
P S C Starch Products.Plc	Chonbur i	Cassava	150,000
TPK Ethanol Co.ltd	NakornRatchasima	Cassava	340,000
total			2,925,000

Source:Department of Alternative Energy Development and Efficiency, Ministry of Energy.

Thailand's plan for biodiesel production

Name of company	Region	Production capacity(liter/day)
Bangchak	Bangkok	50,000
Bio Energy Plus	Ayuddhya	100,000
Suntech Palm Oil	PraChinbur i	200,000
Patum Vegetable Oil	PathumThanee	300,000
Bangkok Renewable Energy	ChaChoenSao	200,000
Green Power	Chumporn	200,000
AI Energy	Samut Sakorn	250,000
WeeraSuwan	Samut Sakorn	200,000
SookSomboon Energy	Chuonbur i	50,000
total		1,550,000

Source: Department of Alternative Energy Development and Efficiency, Ministry of Energy.

Issues in the Biofuel Potential and Economics in APEC

- ❖ Figures show great potential exists in the APEC region
 - 283 million tons of petroleum equivalent biofuels are available
 - However most of them are based on 'second generation' lignocellulosic feedstocks
 - Lignocellulosic feedstocks are not cost effective relative to conventional feedstocks
 - More investment on R&D is needed to lower costs of biofuels from lignocellulosic feedstocks

- ❖ Estimation of costs of biofuels in the APEC (2007)

cost item	USA	Malaysia	Chinese Taipei	South Korea
crop	corn	palm	waste oil	rapeseed oil
feedstock cost	0.21	0.26	0.48	1.58
capital plant cost	0.03	0.06	0.02	0.03
O&M	0.12	0.06	0.2	0.2
credit for by-product	0.06	0.005	-	0.44
total	0.42	0.385	0.7	2.25
petroleum equivalent	0.656	0.448	0.814	2.616

Source: APEC Biofuels taskforce, 'APEC biofuels taskforce task group on biofuel resources', **25**
 draft report to APEC energy working group, Mar. 2007



Frontier Issues in the Biofuel Promotion

❖ Zero Sum or Win-Win Game?

- Expansion of biofuel consumption affects agricultural market significantly
 - ✓ OECD' s estimation of impact of biofuels on the agricultural market
 - ✓ Demand for vegetable oil and wheat in the EU market increases by 49% and 26% in 2014
 - ✓ Demand for sugarcane in Brazil increases by 27% in 2014
 - ✓ Along with the sharp increases of demand for crops, world price of vegetable oil and sugar will increase by 15% and 60%
- Development of unused or marginal arable land: about 2 billions of hectare in the world are available
 - ✓ Sub-Saharan(0.9 billion ha), South and Southeast Asian, Latin and Central America(1.0 billion ha)
 - ✓ 6 billions KL of biofuels are enough to provide world fuel demand(4.8billions KL)
 - ✓ Transformation from 'agriculture' to 'ergo-culture' (John Methews) **26**



Frontier Issues in the Biofuel Promotion

❖ Impact on biodiversity and climate change

➤ Desperate threat to endangered species

- ✓ There are between 50,000 and 60,000 of orang-utan on Borneo and 7,000 on Sumatra. But 5,000 ~10,000 are killed each year
- ✓ Forests in Indonesia and Malaysia are being felled so quickly that 98% could be gone by 2022.
- ✓ Yet the orang-utan's lowland forest could disappear much sooner (UN report)

➤ Increase of GHGs from the plantation for biofuels

- ✓ Indonesia emits 600 millions of carbon due to the use of peat or cut-down of timber for plantation of palm
- ✓ Issue a certificate for sustainable cultivation of feedstock for biofuel



Frontier Issues in the Biofuel Promotion

❖ Extension to Niche market

- Conversion of fish oil into biodiesel: substitute petro-diesel for ships
- Self-sufficiency of fuel for rural community
 - ✓ replace petro-diesel used in tractor, combine, and other agricultural machinery
 - ✓ Small scale biodiesel conversion plants
 - ✓ Woodchips or wood pellet from transforming the residuals and oil cake of feedstock and seeds
- Substitute fuels for boilers or power plants
 - ✓ Low requirements for using the biofuels for heating or electricity generation compared to transportation fuels
 - ✓ Next generation Technology
 - ✓ More investment on BTL, Biofuels from marine plants and micro algae
 - ✓ Ex: South Korea, Australia, Chinese Taipei started experimental projects to develop biofuels from macro/micro algae

Special Issue: solution to water pollution

- Conversion of fish oil into biodiesel: substitute petro-diesel for ships
 - ✓ Bio-degradable BD can be a solution to water pollution by petroleum
 - ✓ Exxon-Valdez Accident in 1989 killed 0.6millions of seabirds, salmon and herring
 - ✓ Cordova' s residents began biodiesel business using waste fish oil in 2006
 - ✓ Tae-an province polluted by crude oil in 2007 may lose fishery industry





Biofuels for ships will provide a solution to the destruction of marine ecosystem occurred by leakage of petroleum

