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Competitiveness of Biofuels with Other Alternative Fuels

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ASIA PACIFIC ENERGY RESEARCH CENTRE (APERC)
Annual Conference 2015

9-10 June 2015
Hotel New Otani, Toyko/Japan

Outline

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- Transportation fuel/energy around the world
  - Compressed natural gas (CNG)
  - Electricity: HEV, PHEV, BEV, FCEV
  - Biofuel: ethanol, biodiesel
- Fuel pricing
  - oil vs biofuel vs other alternative fuels
- Status of biofuel
  - 1st (conventional) biofuel: bioethanol & biodiesel
    - ✓ Blending level vs part modification
- Reduction of CO_2 emission in transportation
  - Economics: biofuel or CNG or other alternative fuels
- Policy incentives/frameworks for more biofuel in transportation
- Feedback on APERC's Scenario: High Renewable Energy

Global natural gas vehicles (NGV)

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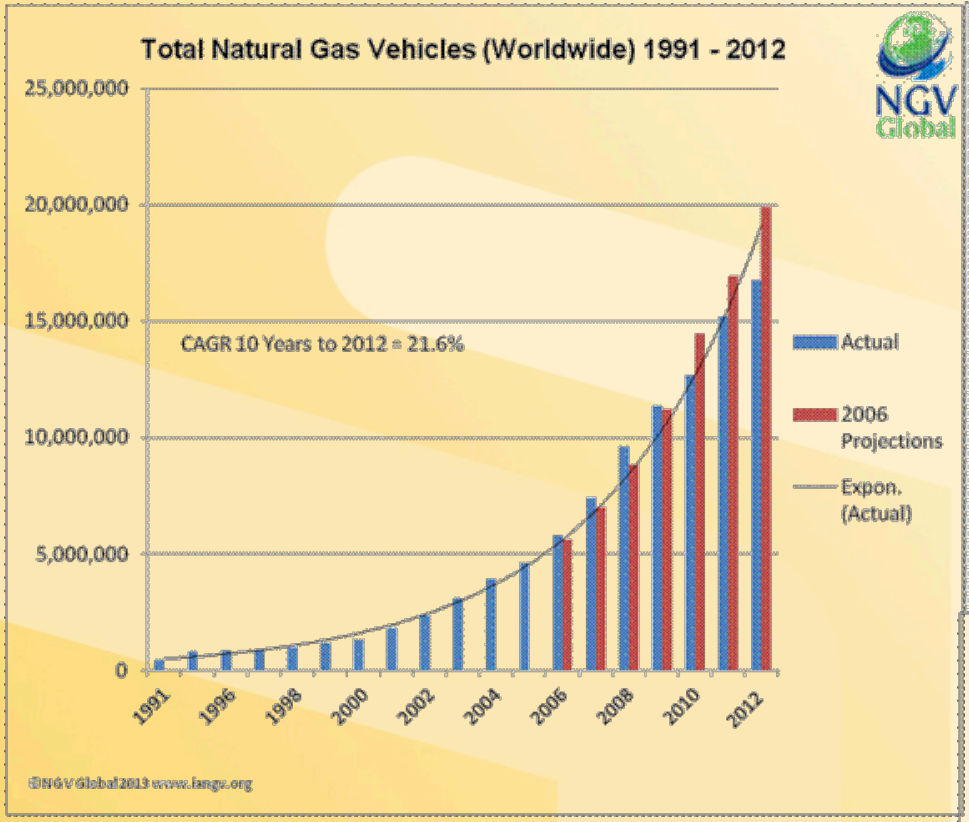

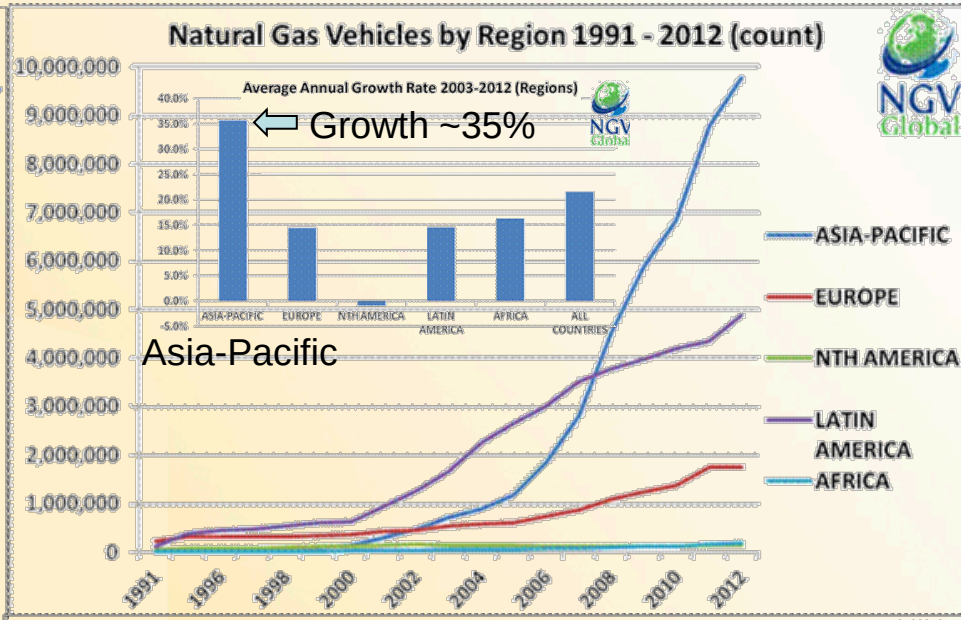

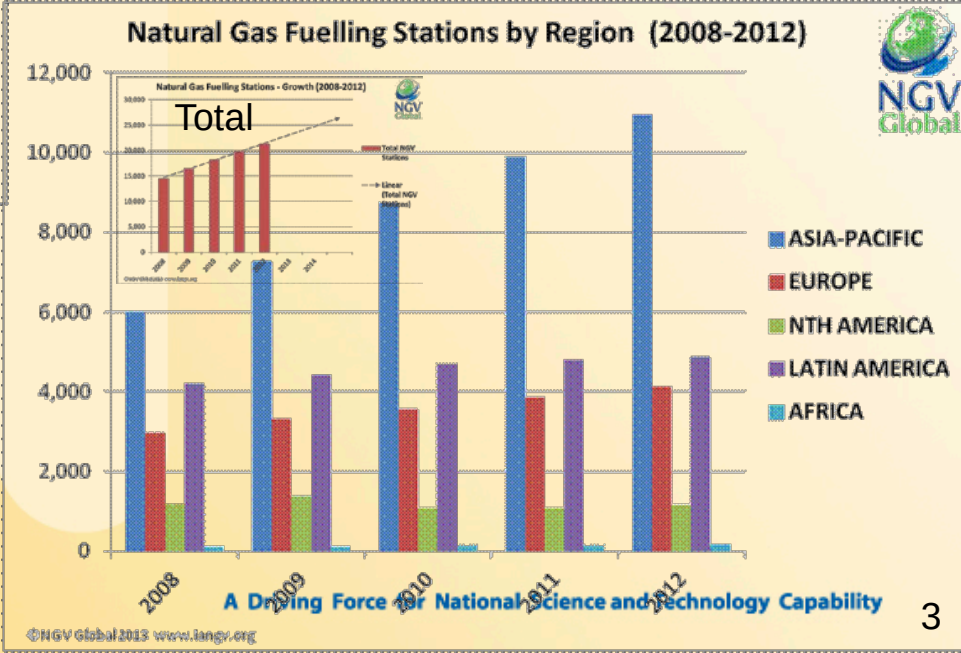

- NGVs rising sharply esp. Asia-Pacific region (35% growth)
- At the end of 2012, 16.7 million NGVs & 21,292 NGV stations

IANGV, http://www.iangv.org/current-ngv-stats/

Global EV

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Global EV Outlook 2015 — 16 EVI members

For more information and for other reports go to: http://www.iea.org/evi

key takeaways

Electric Vehicles Initiative

The Global EV Outlook represents the collective effort of seven years of primary data gathering and analysis from the Electric Vehicle Initiative's 16 member governments. Below are key takeaways and insights from this work. Overall, EV and charging infrastructure deployment has continued growing since the 2013 Global EV Outlook. Battery costs have come down while energy density has climbed; vehicle electrification has gone multi-modal with 46,000 electric buses and 235 million electric two-wheelers deployed; and total EV spending by EVI governments equalled 16 billion USD between 2008-2014.

global EV stock

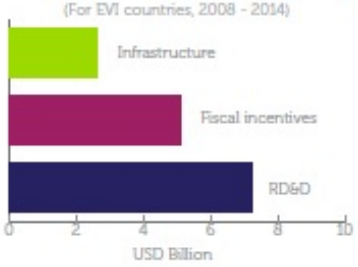
(through end of 2014)

represents 0.08% of total passenger cars

665,000+

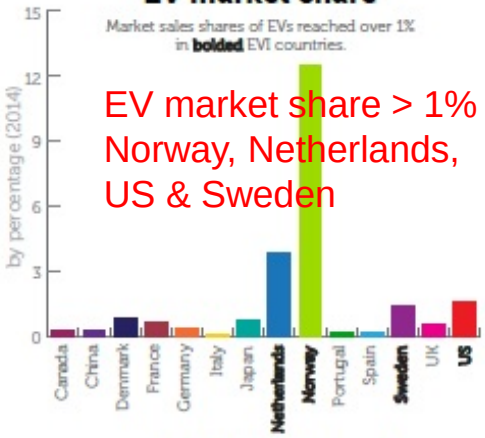
EV spending by category

(For EVI countries, 2008 - 2014)



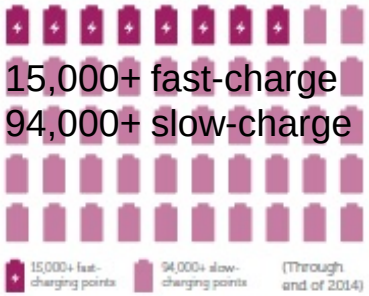
EV market share

Market sales shares of EVs reached over 1% in **bolded** EVI countries.



EV market share > 1%
Norway, Netherlands, US & Sweden

global EVSE stock

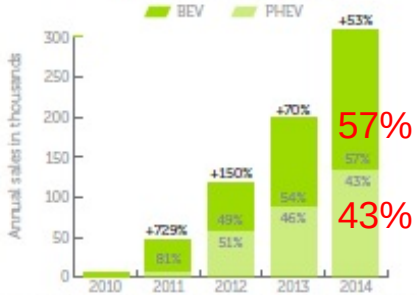


15,000+ fast-charge
94,000+ slow-charge

15,000+ fast-charging points | 94,000+ slow-charging points | (Through end of 2014)

EVSE stock more than doubled for slow charging points between the end of 2012 and 2014, and increased eightfold for fast charging points.

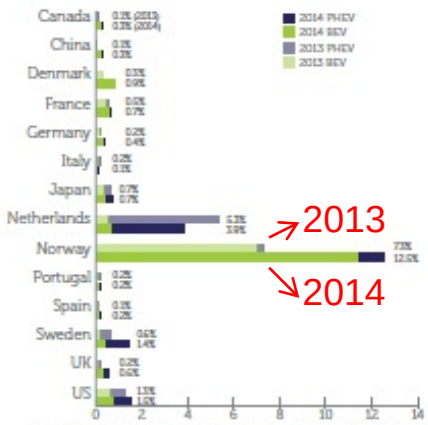
global EV sales



95%+ Percentage of 2014 Global EV Stock in EVI Countries

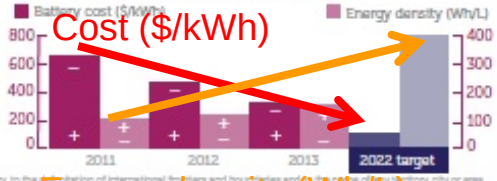
market share growth (%)

Market sales shares of EVs for 2013 (lighter colors) and 2014 (darker colors).



spotlight on China

PHEV battery progress



IEA (2015), http://www.iea.org/evi/Global-EV-Outlook-2015-Update_1page.pdf

Global biofuel

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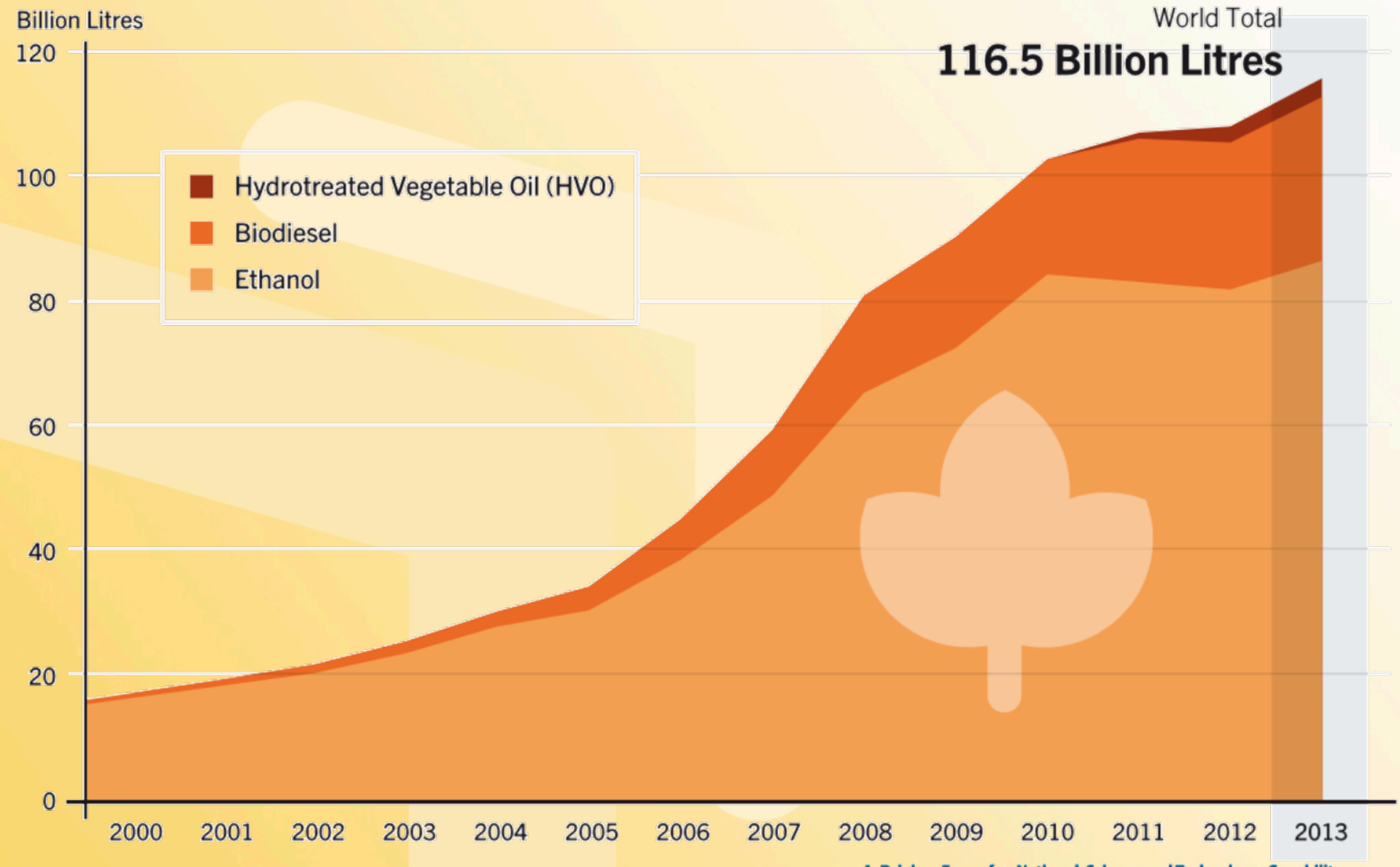

A Driving Force for National Science and Technology Capability

REN21 (2014), http://www.ren21.net/portals/0/documents/resources/gsr/2014/gsr2014_full%20report_low%20res.pdf

Fuel prices

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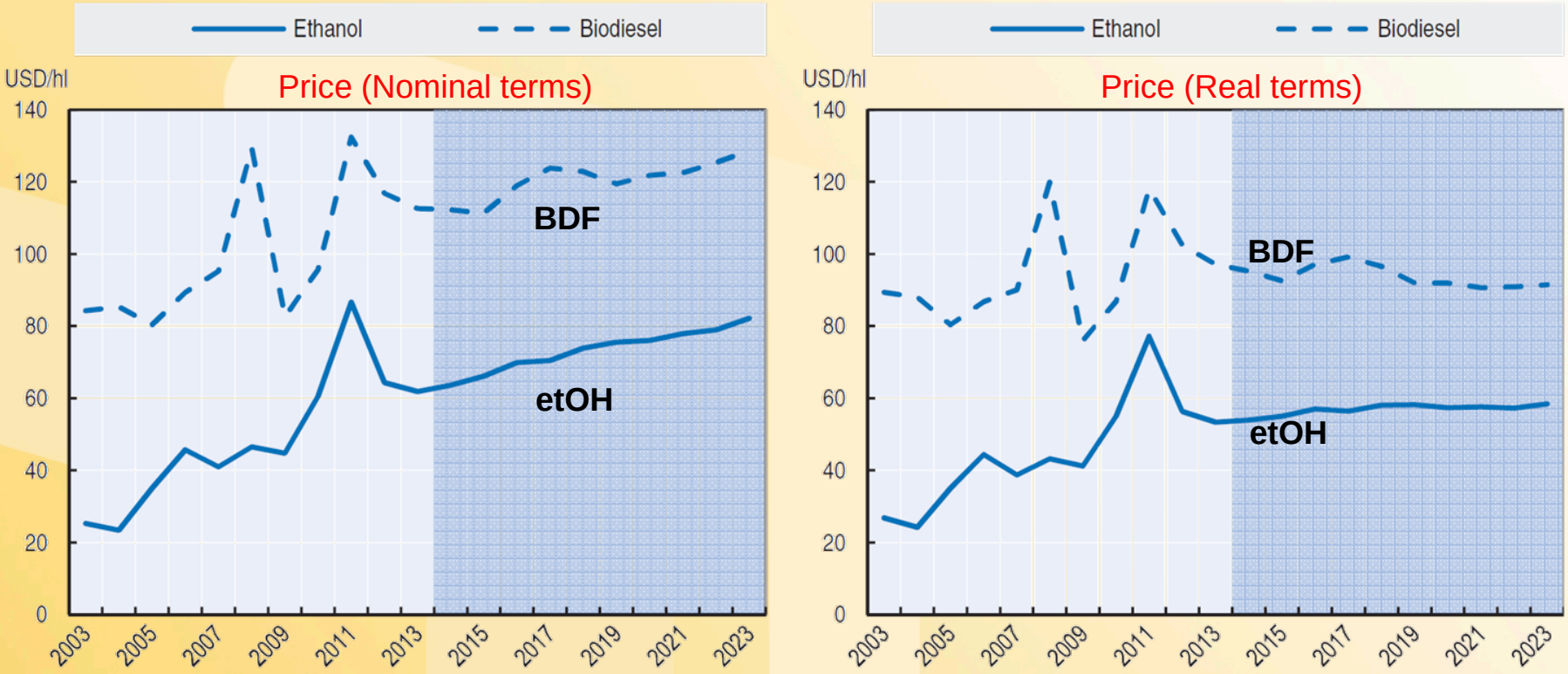
Figure 3.1. **Biofuel prices to remain almost constant in real terms**

Evolution of prices expressed in nominal terms (left) and in real terms (right)



Notes: Ethanol: Brazil, Sao Paulo (anhydrous, ex-distillery), Biodiesel: Producer price, Germany, net of biodiesel tariff and energy tax.
Source: OECD and FAO Secretariats.

StatLink http://dx.doi.org/10.1787/888933099713

- Ethanol price projected to increase with inflation rate & crude oil price while biodiesel growth is slower (due to growth of vegetable oil price)
- Global production of ethanol and biodiesel in 2023 forecasted to 158 and 40 billion L

OECD-FAO Agricultural Outlook 2014-2023 (2014)

Production Costs of Alternative Transportation Fuels

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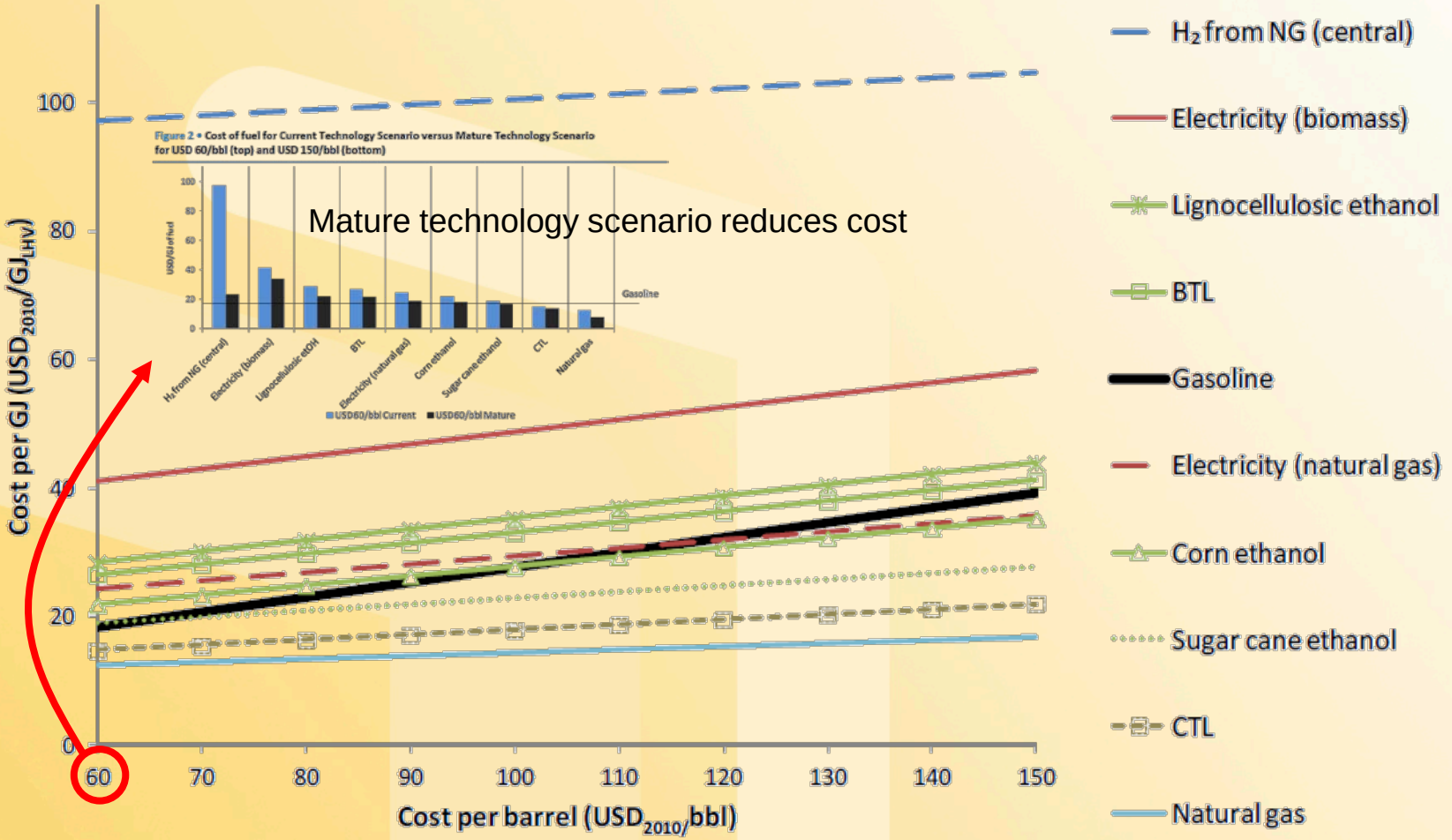
Figure 1 • Cost of fuel production versus oil price for select fuels in Current Technology Scenario



Note: BTL = biomass-to-liquids; CTL = coal-to-liquids; NG = natural gas; USD_{2010}/bbl = 2010 nominal USD per barrel of oil; USD_{2010}/GJ_{LHV} = 2010 nominal USD per gigajoule using lower heating value. Fuel production costs in this figure are extrapolated from their USD 60/bbl value using an arithmetical average of the two methods (Petroleum Intensity and Historic Trend) are discussed below (see Chapter "Results").

Source: unless otherwise stated, all material in figures and tables derive from IEA data and analysis.

IEA (2013), https://www.iea.org/publications/freepublications/publication/FeaturedInsights_AlternativeFuel_FINAL.pdf

Biofuel blending limit: ethanol

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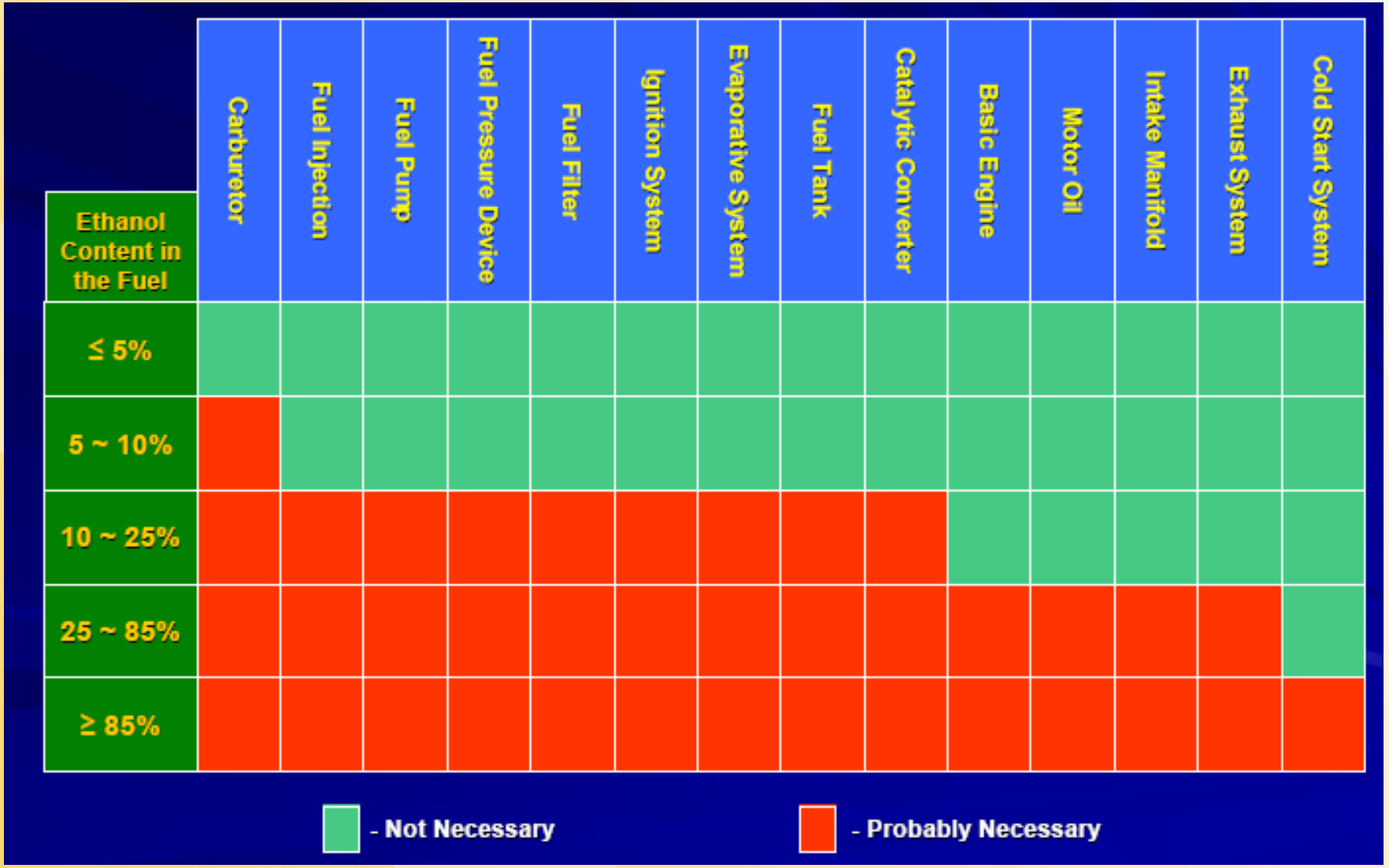
(Otto Engines)



Part modification for ethanol blending in gasoline

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Carburetor

The material of the carburetor body or carburetor cover cannot be aluminum or exposed ; if it is, must be substituted, protect with surface treatment or anodize;

Any component in polyamide 6.6 (Nylon) that has contact with the fuel must be substituted by other material or protected;

The material of buoy, nozzle, metering jet, floating axle, seals, gaskets and o-rings must be appropriated.

Engine

The engine compression ratio should be higher;

Camshaft with new cam profile and new phase;

New surface material of valves (intake and exhaust) and valve seats.

Intake Manifold

With new profile and less internal rugosity, to increase the air flow;

Must provide higher intake air temperature.

Fuel Tank

If the vehicle fuel tank is metallic, the internal surface of tank must be protected (coated);

Any component in polyamide 6.6 (Nylon) that has contact with the fuel must be substituted by other material or protected.

Higher fuel tank capacity, due to the higher fuel consumption.

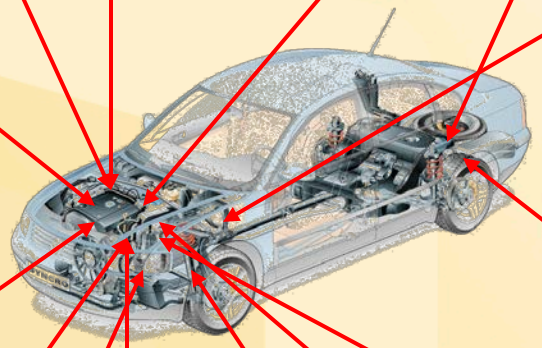
Electronic Fuel Injection

Substitution of fuel injector material by stainless steel;

New fuel injector design to improve the “fuel spray”;

New calibration of air-fuel ratio control and new Lambda Sensor working range;

Any component in polyamide 6.6 (Nylon) that has contact with the fuel must be substituted by other material or protected.



Catalytic Converter

It is possible to change the kind and amount of noble metal present in the loading and wash-coating of catalyst converter;

The catalyst converter must be placed closer to the exhaust manifold, in order to speed up the working temperature achievement (light-off).

Fuel Pump

The internal surface of pump body and winding must be protected and the connectors sealed;

Any component in polyamide 6.6 (Nylon) that has contact with the fuel must be substituted by other material or protected.

The pump working pressure must be increased.

Exhaust Pipe

The internal surface of pipe must be protected (coated);

The exhaust design must be compatible with higher amount vapor.

Fuel Pressure Device

The internal surface of the fuel pressure device must be protected;

Any component in polyamide 6.6 (Nylon) that has contact with the fuel must be substituted by other material or protected.

The fuel pressure must be increased.

Motor Oil

New additive package.

Cold Start System

Auxiliary gasoline assisted start system, with temperature sensor, gasoline reservoir, extra fuel injector and fuel pump;

The vehicle battery must have higher capacity.

Fuel Filter

The internal surface of the filter must be protected;

The adhesive of the filter element must be appropriated;

The filter element porosity must be adjusted.

Ignition System

New calibration of advance control;

Colder heat rating spark plugs.

Evaporative Emission System

Due to the lower fuel vapor pressure, it is not necessary evaporative emission control

(Otto Engines)

Biofuel blending limit: biodiesel

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BIODIESEL.

OEM Support

OEMs Supporting B100	OEMs Supporting B20	OEMs Supporting B5
Case IH (2007)	Arctic Cat (2006)	Audi * (Allow up to B20 in IL and MN in 2009-2015 models)
Deutz AG (2012)	Buhler (2007)	BMW
Fairbanks Morse (2007)	Caterpillar (All model years)	Hustler Turf Equipment
New Holland (2007)	Fiat Chrysler (FCA) – Ram (2007) & Jeep (2013)	Mercedes Benz * (For blends over B5, see MB brochure)
	Cummins (2002)	Mitsubishi Fuso *
	Daimler Trucks - Including: (2012)	PACCAR* - Including:
	- Detroit Diesel * (Series 60 engines only; other models approved for B5)	- Kenworth (Allow up to B20 in models with Cummins engines)
	- Freightliner / " Custom Chassis (models with Cummins engines)	- Peterbilt (Allow up to B20 in models with Cummins engines)
	- Thomas Built Buses	Volkswagen * (Allow up to B20 in IL and MN in 2009-2015 models)
	- Western Star (w/ Cummins engines)	
	Ferris (2011)	* = Actively Researching B20
	Ford (2011)	
	GMC & Chevrolet (2011 all; SEO available since 2007)	
	HDT USA Motorcycles (2008)	
	Hino Trucks (2011)	Biodiesel Position Not Yet Announced:
	Navistar - International / MaxxForce (2007)	JCB
	IC Bus (2007)	Jaguar / Land Rover
	Isuzu Commercial Trucks (2011)	Mahindra
	John Deere (2004)	Mazda
	Kubota (2006)	Porsche
	Mack (EPA 2007 & EPA 2010 models)	Nissan
	Monaco RV (2007)	Toyota
	Perkins (2008)	
	Tomcar (2008)	
	Toro (2008; SEO kits for <2008)	
	Volvo Trucks (EPA 2010 models)	
	Workhorse (2007)	
	Yanmar (2011)	

- Generally, no engine/parts modification needed for B5-7 blending
- For B20, many OEM warranty for B20 according to ASTM D7467

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A Toyota Group Company

For Immediate Release

For More Information:
Glenn Ellis, Vice President
Marketing and Dealer Operations
Hino Motors Sales U.S.A., Inc.
248-699-9300

7/12/11

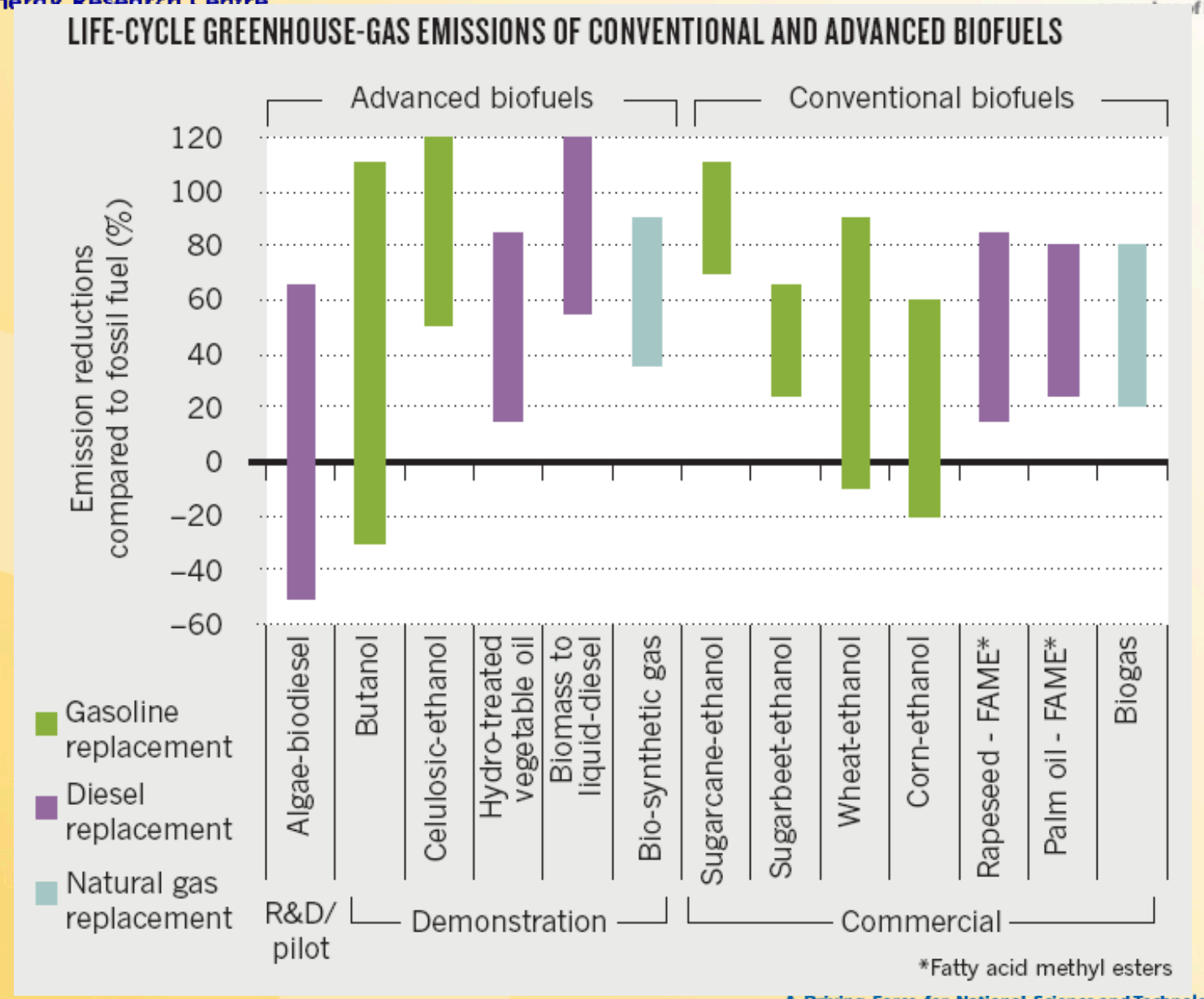
HINO TRUCKS APPROVES THE USE OF B20 BIODIESEL

Novi, Michigan – Hino Trucks' complete product line of class 4 and 5 cab over, and class 6 and 7 conventional trucks are now approved to use up to B20 biodiesel.

All 2011 and 2012 model year cab over and conventional trucks powered exclusively with Hino's proprietary J-Series engines are approved to use biodiesel B20 blends that contain biofuel blend stock (B100) compliant to American Society for Testing and Materials (ASTM) D6751, and blended fuel compliant to ASTM D975. B20 biodiesel meeting these standards is also approved for use in Hino's newly announc ed diesel-electric hybrid cab over due to enter the market late this fall.

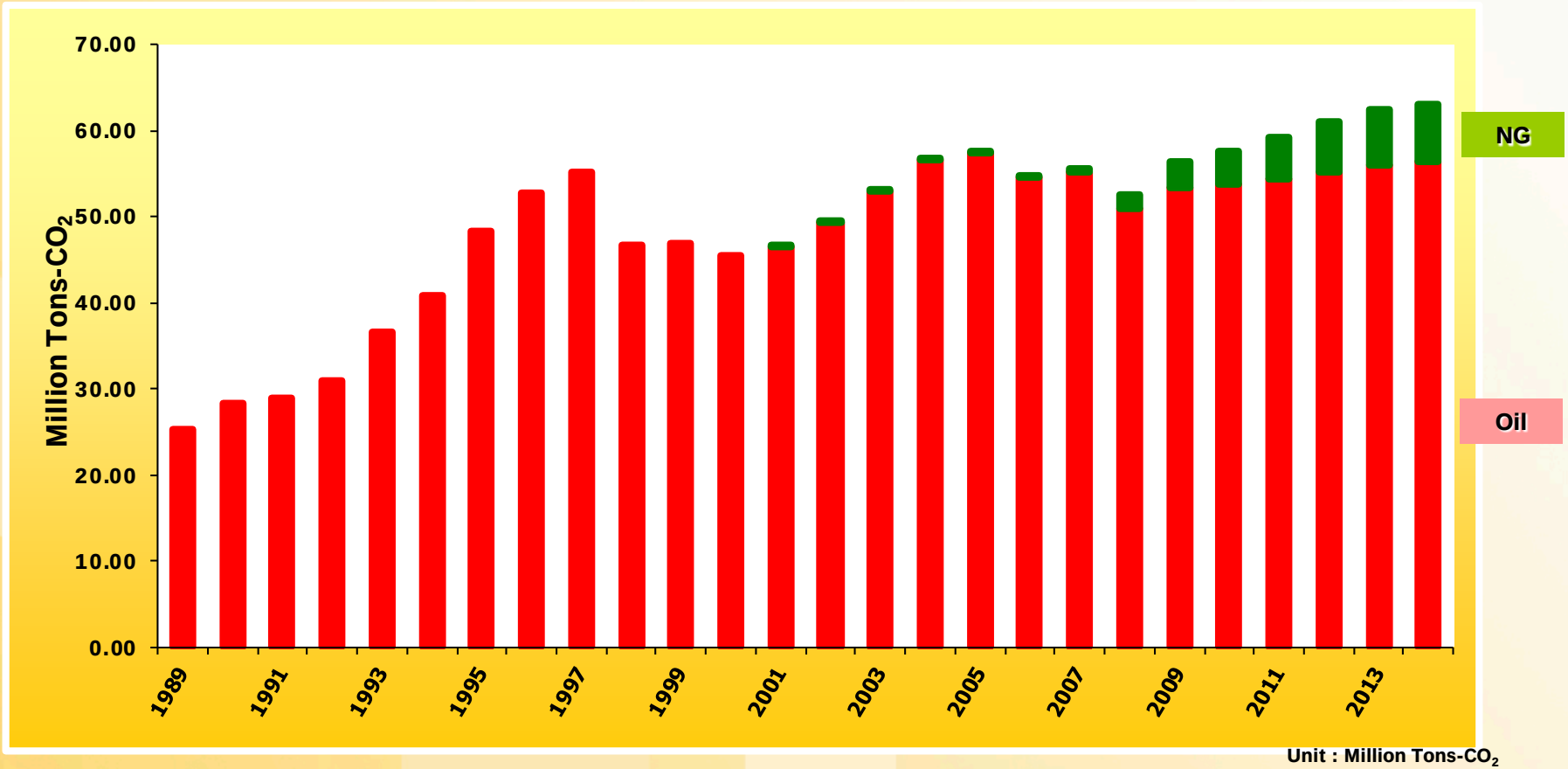
US National biodiesel board (2015), http://www.biodiesel.org/docs/default-source/ffs-engine_manufacturers/oem-support-summary.pdf?sfvrsn=16
Hino (2011), http://www.biodiesel.org/docs/oem-statements/hino-b20_press_release_july12_2011.pdf?sfvrsn=0

GHG emission of biofuels



P. Fairley, “Next Generation Biofuelst”, Nature, 474, 23 Jun 2011

CO_2 Emission in Thai Transport



Unit : Million Tons-CO_2

Year	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Oil	25.20	28.35	28.98	30.91	36.53	40.94	48.21	52.71	55.24	46.77	46.92	45.58	46.55
NG	-	-	-	-	-	-	-	-	-	-	-	-	0.01
Year	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Oil	49.25	53.02	56.50	57.41	54.63	55.07	50.90	53.36	53.77	54.37	55.18	55.94	56.33
NG	0.01	0.01	0.06	0.14	0.23	0.50	1.65	3.03	3.85	4.90	5.92	6.52	6.73

EPPO (2014)

Policy incentives/frameworks for more biofuel in transportation

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- Create regulatory arrangements for bioenergy tailored to national resource endowments, which do not upset food and energy supply, but instead enhance agricultural productivity, rural income and worker's skills;
- Deploy strategies to avoid the emergence of a technological gap between land-intensive 1st generation and capital-intensive 2nd generation biofuels. This is especially critical for poorer countries which have a strong incentive to attract pilot plants and commercial demonstrators of 2nd generation biofuels.
- Offer support and training to ensure that the costs of sustainability certification are spread along supply chains in a way that protects small farmers from undue cost burdens;
- Secure a continuous inflow of private investment in production and process technologies for developing countries, especially through predictable business environments;
- Prioritize research and deployment of advanced technologies that can convert non-edible biomass, and specially agricultural residues, into bioenergy products, in cooperation with other countries to reduce costs;
- Facilitate international trade by engaging in consultations, negotiations and adoption of harmonized sustainability requirements that are compatible with sustainability regulations in place in the main international markets.

UNCTAD Policy Brief (2014) http://unctad.org/en/PublicationsLibrary/presspb2014d3_en.pdf

Feedback on APERC's Scenario: High Renewable Energy

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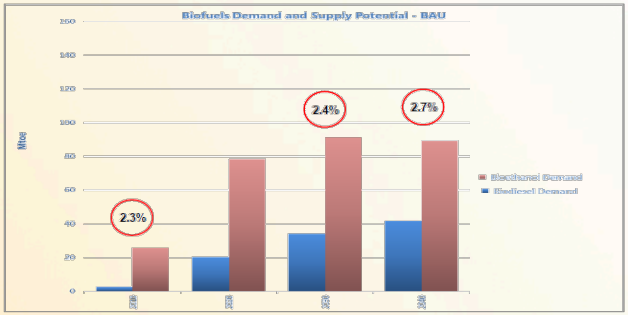
- Key messages on biofuels
  - Biofuel supply (1st gen only) in 2030: 30% higher than BAU → why not 2nd gen?
  - Share of biofuel in transportation: 2.2% (2010) → 4.6 or 6%? (2030)
- Slide 30 → additional economies for potential biofuel supply?
- Slide 31 → biofuel demand (BAU) wrongly plotted?
- Slide 33 → need to list necessary mechanism to achieve doubling of RE transport in 2030
- Slide 34 → Inter-regional balancing between biofuel supply & demand?



Source: APERC Analysis

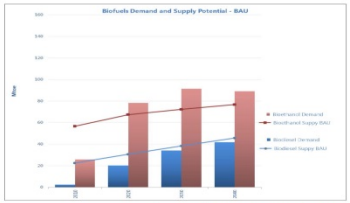
Biofuels Supply Potential (3)

- Other economies with supply potential for bioethanol are: Australia, Vietnam, Canada, Indonesia, Japan, Korea and PNG.
- Other economies with supply potential for biodiesel are: U.S. , Philippines, Australia, New Zealand, Russia and Canada.

Top Economies with Bioethanol Supply Potential	Top Economies with Biodiesel Supply Potential
1) United States	1) Indonesia
2) China	2) Malaysia
3) Russia	3) Mexico
4) Mexico	4) Thailand
5) Thailand	5) Papua New Guinea

Source: APERC Analysis

BAU Biofuels Demand



	2010	2020	2030	2040
BAU Demand, Bioethanol (Mtoe)	26	32	37	41
BAU Demand, Biodiesel (Mtoe)	2	7	10	13
BAU Supply, Bioethanol (Mtoe)	57	67	72	77
BAU Supply ,Biodiesel (Mtoe)	22	31	38	46

- In the BAU scenario, the share of biofuels will remain the same in 2012 and 2030.
- The BAU demand of bioethanol is about 51% of the BAU supply for bioethanol in 2030, and 45% of the high supply.
- The BAU demand of biodiesel is only 26% of the BAU supply for biodiesel in 2030, and 21% of the high supply.

Source: APERC Analysis


本当にありがとう
ขอบคุณ
Thank you