Technology Trend of Fuels in the Future

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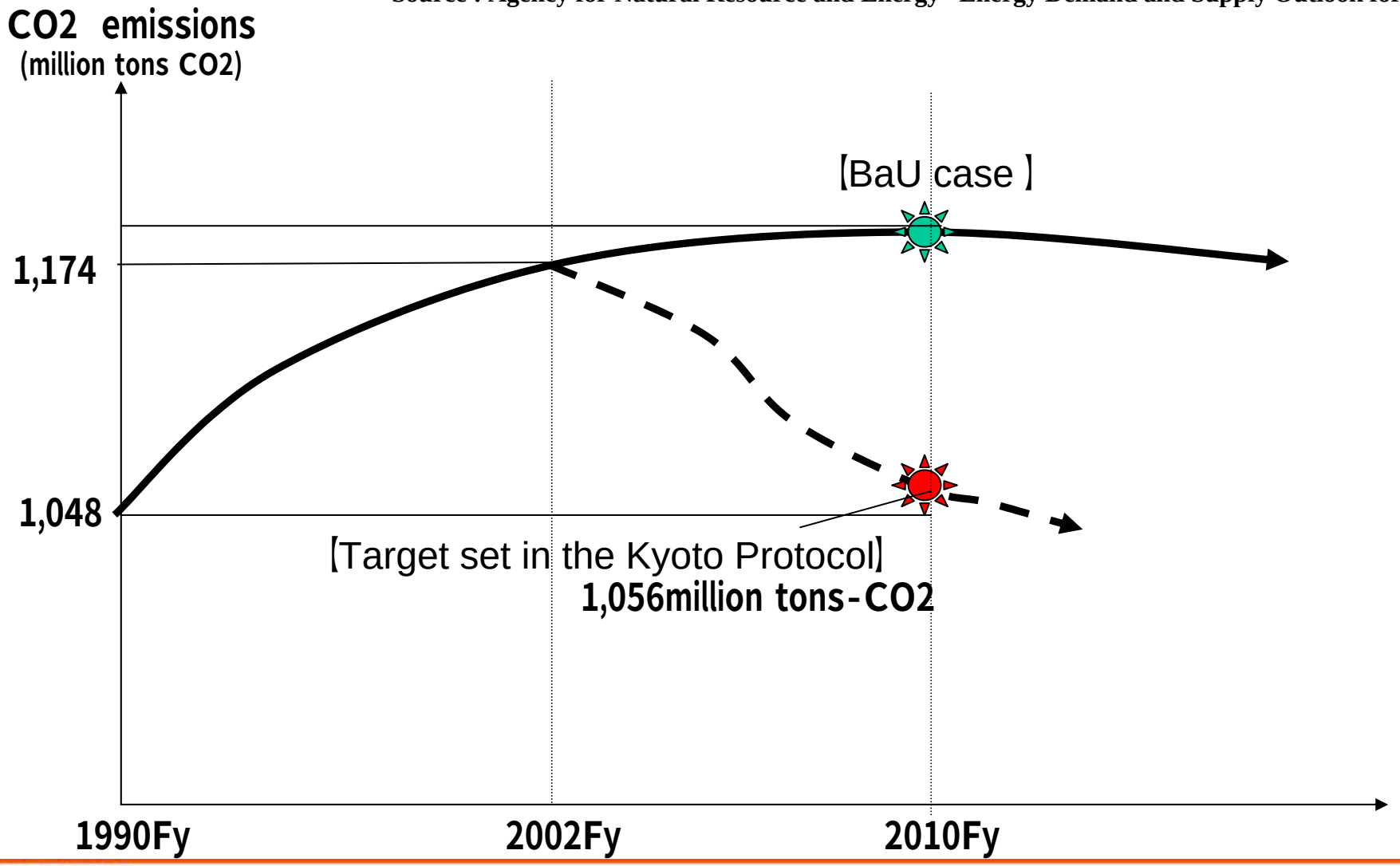
Your Choice of Energy

Contents

CO2 - Reduction goal in Japan

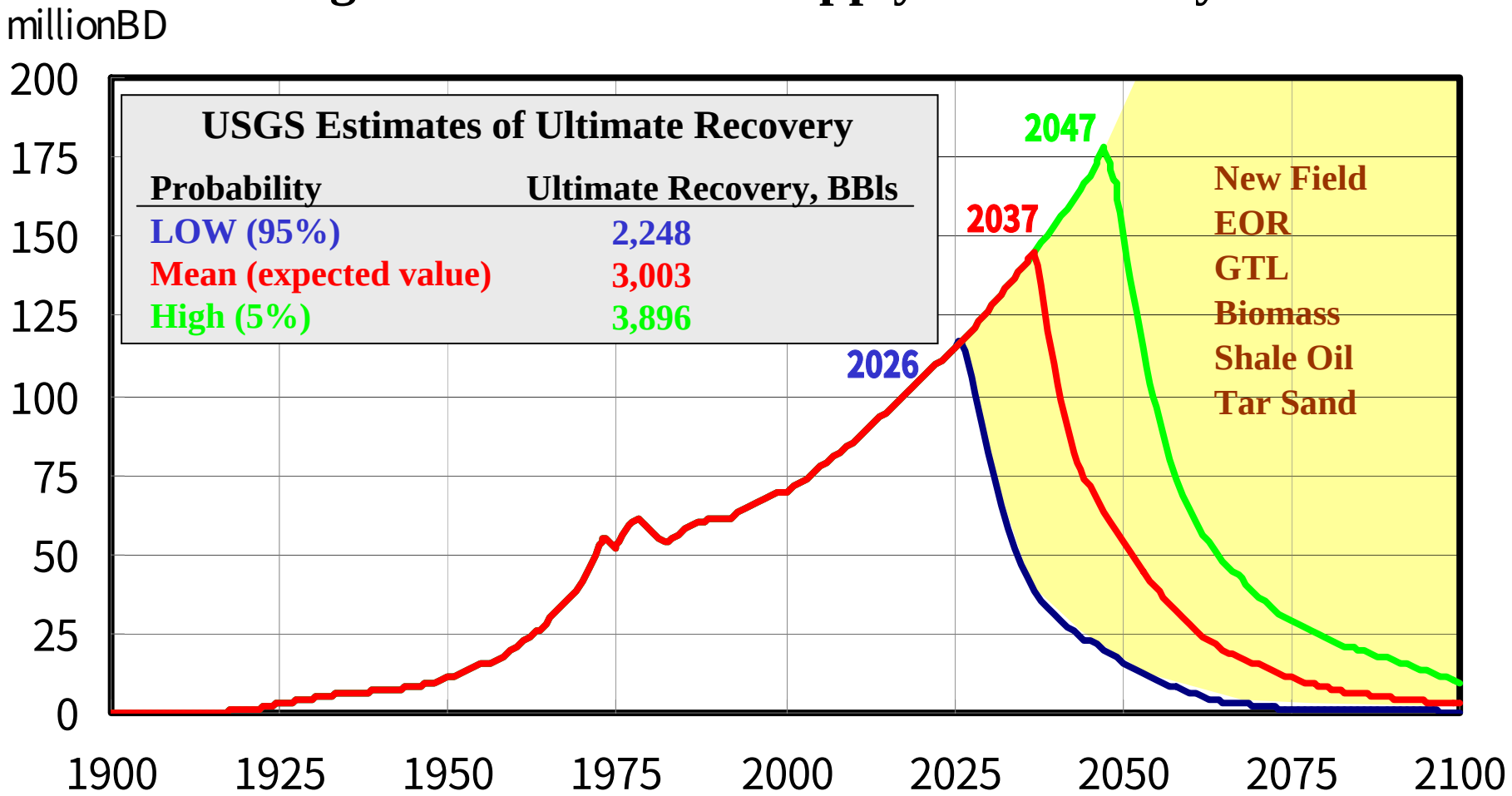
Reduction goal of CO2 emissions generated by energy consumption in Japan

Source : Agency for Natural Resource and Energy “Energy Demand and Supply Outlook for 2030”



Production Scenarios of Crude

Long-Term World Oil Supply Scenarios by EIA



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1.Background

- ✓CO2-reduction goal
- ✓Forecast of Oil supply

2.Efforts being made by oil industry to reduce CO2 emissions

- **✓Efforts to meet the Voluntary action program made by NIPPON KEIDANREN**
- **✓Additional efforts by the industry**

3.Development of alternative energy sources

- ✓GTL
- ✓Biomass Fuels (ETBE, BDF)

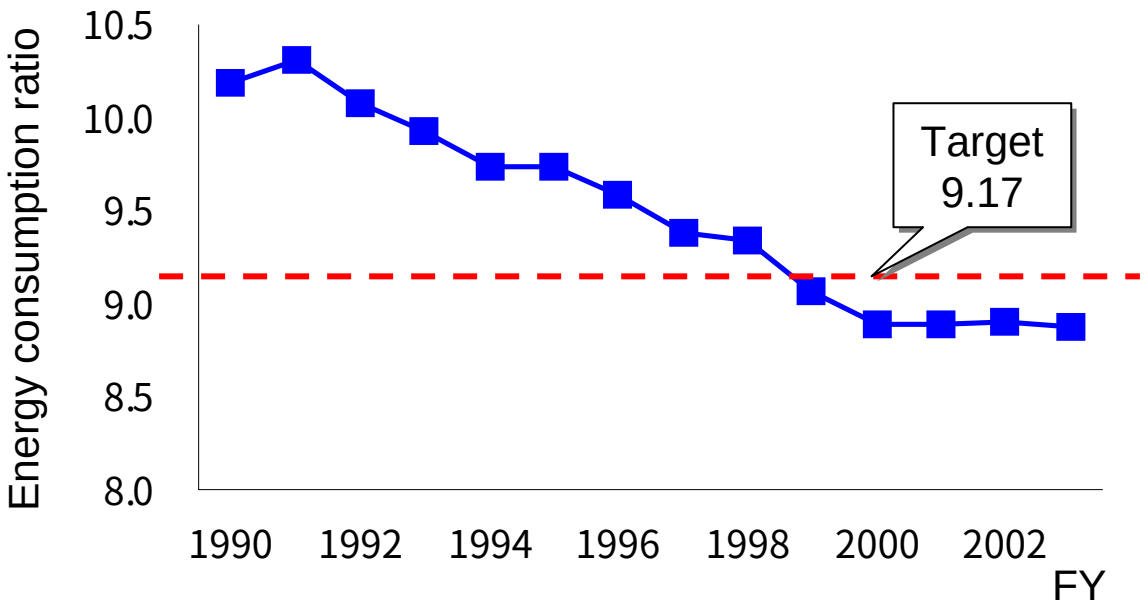
CO2 Reduction --- Voluntary Actions by PAJ (1)

Energy- saving at Refineries

<TARGET>
Energy consumption ratio -10%

	FY 1990 Base Year	FY 2010 Target Year	FY 2003 Achieved
Energy Consumption Ratio*	10.19	9.17	8.87

* Energy consumption in KL (crude oil equivalent) /Crude oil processed in thousand KL



<Countermeasures>

Promotion of heat recovery
- ✓Heat exchangers
- ✓Flare gas recovery

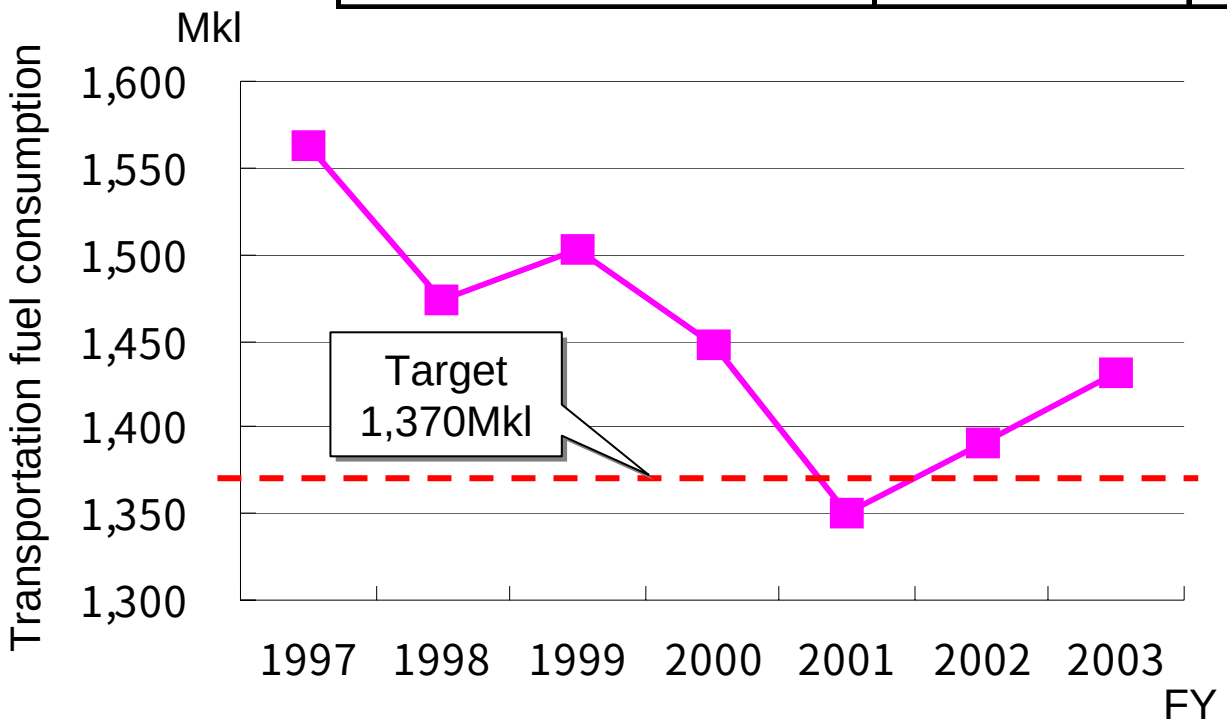
Optimization of equipments
- ✓Heat management among equipments
- ✓Promotion of computerization

CO2 Reduction --- Voluntary Actions by PAJ (2)

Optimization of Transportation

<TARGET>
Fuel consumption -9%

	FY 1990 Base Year	FY 2010 Target Year	FY 2003 Achieved
Fuel Saving <Fuel Consumption>	- <1,510Mkl>	-140Mkl <1,370Mkl>	-80Mkl <1,430Mkl>



<Countermeasures>

Lorry, Tanker
- ✓Large scale freight
- ✓Efficient loading
- ✓Product exchange

Oil terminal
- ✓Joint management

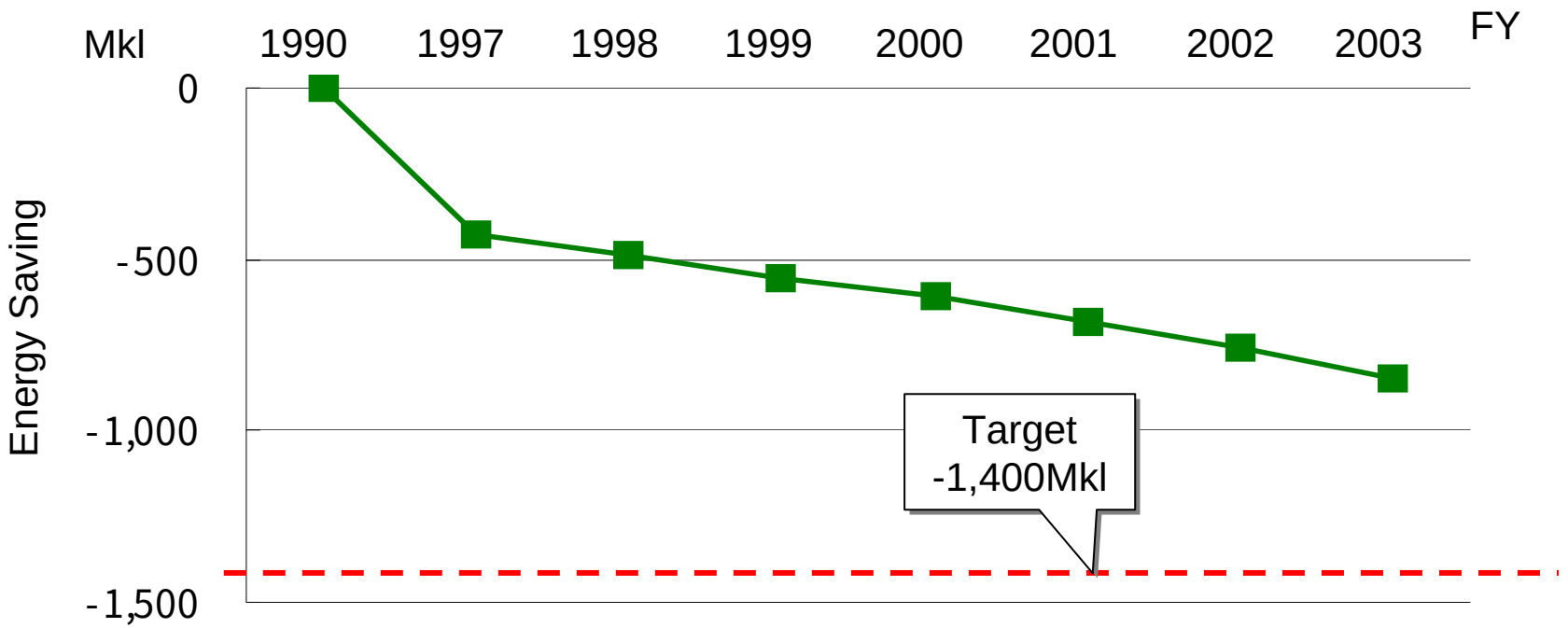
Fueling station
- ✓Large scale storage
- ✓Joint transportation,
- ✓Night/Holiday delivery

CO2 Reduction --- Voluntary Actions by PAJ (3)

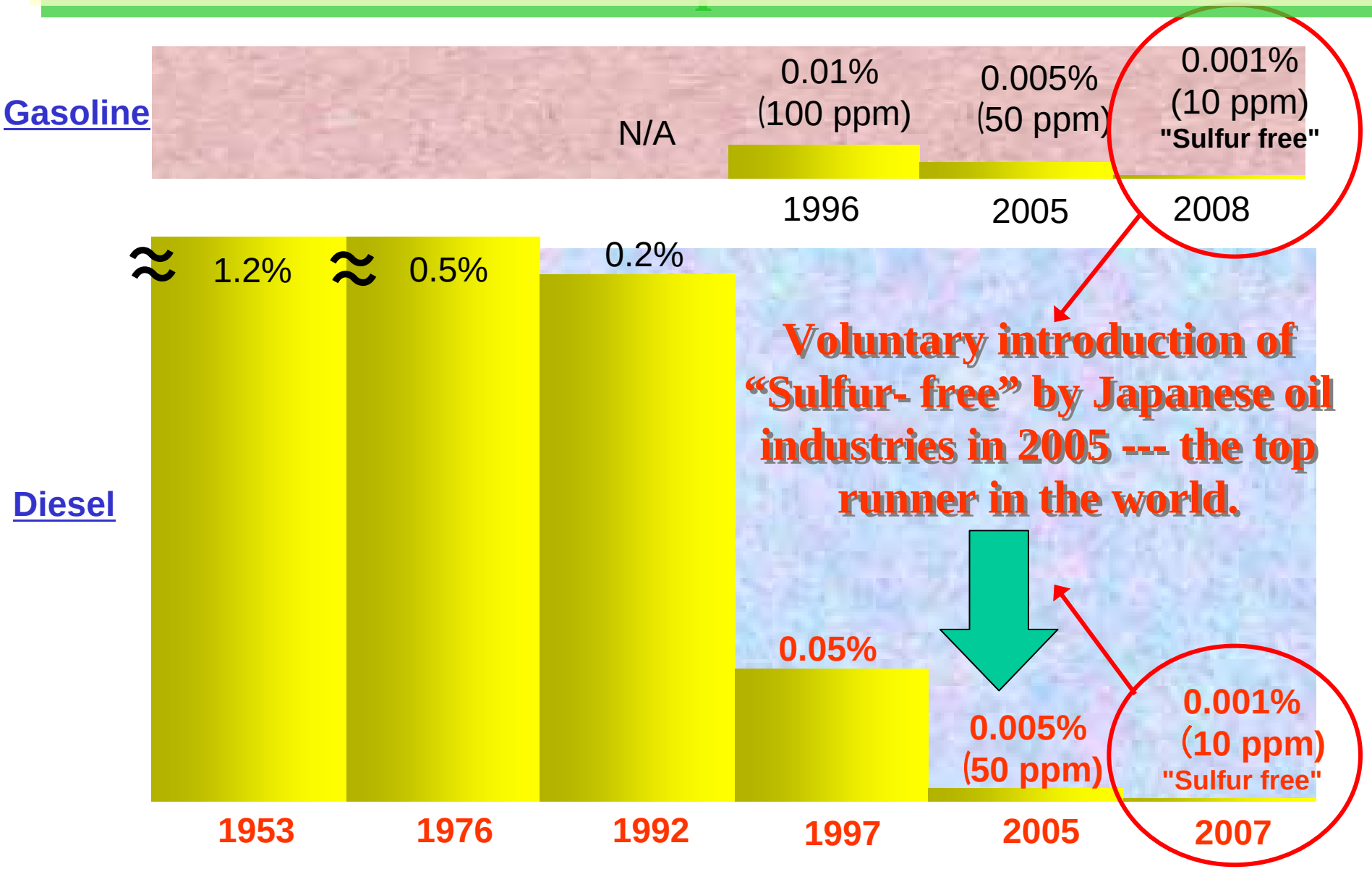
Consumers ----- diffusion of co-generation

<TARGET>
Energy saving -1,400Mkl

	FY1990 Base Year	FY2010 Target Year	FY2003 Achieved
Energy Saving <Co-generation diffusion>	- <1,140MkW>	-1,400Mkl <5,000MkW>	-850Mkl <3,250MkW>



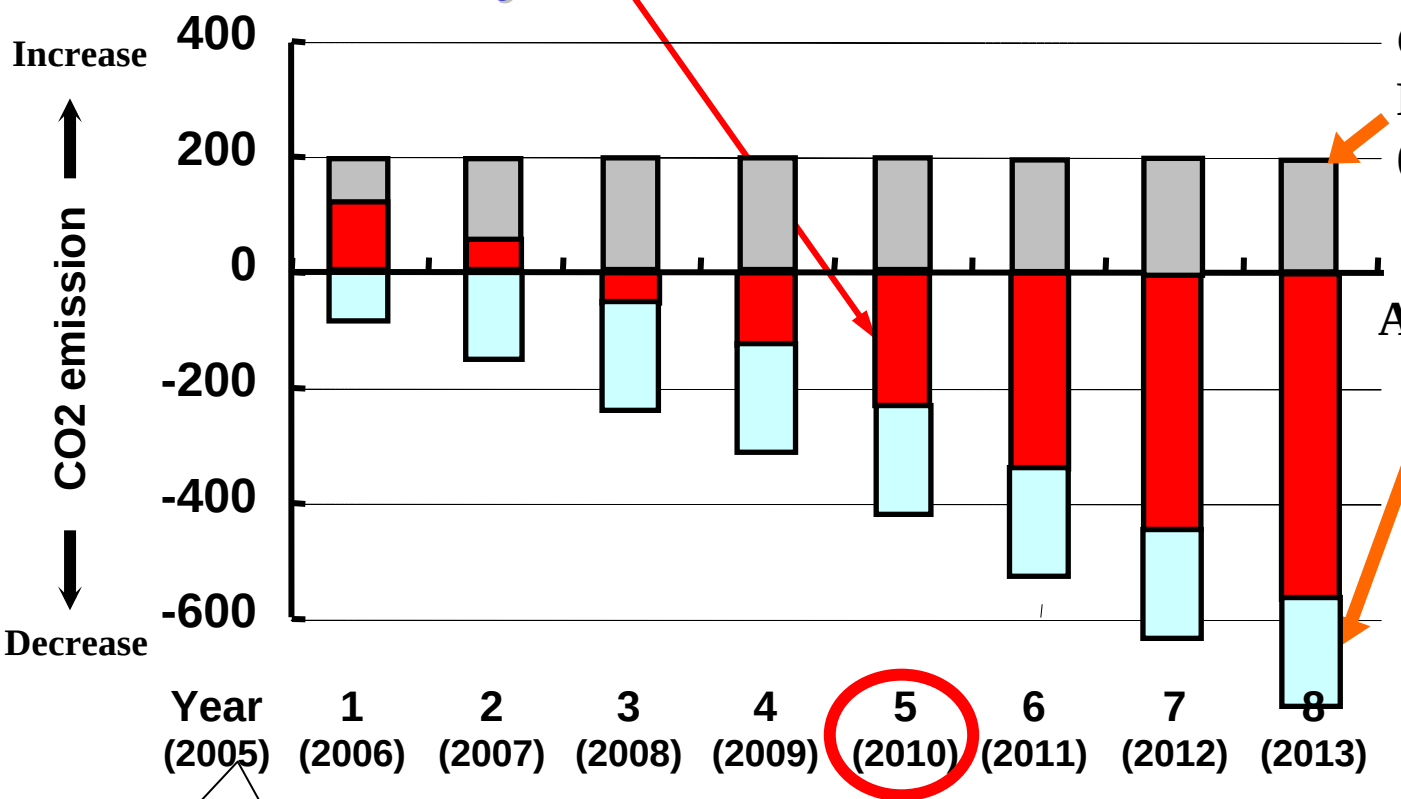
Sulfur Standards in Japan "The road to Sulfur-free"



CO2 Reduction --- Additional efforts by the industry

Introduction of Sulfur-free gasoline and diesel

2 million ton of CO2 reduction is achievable in five years after the introduction of sulfur-free fuel.



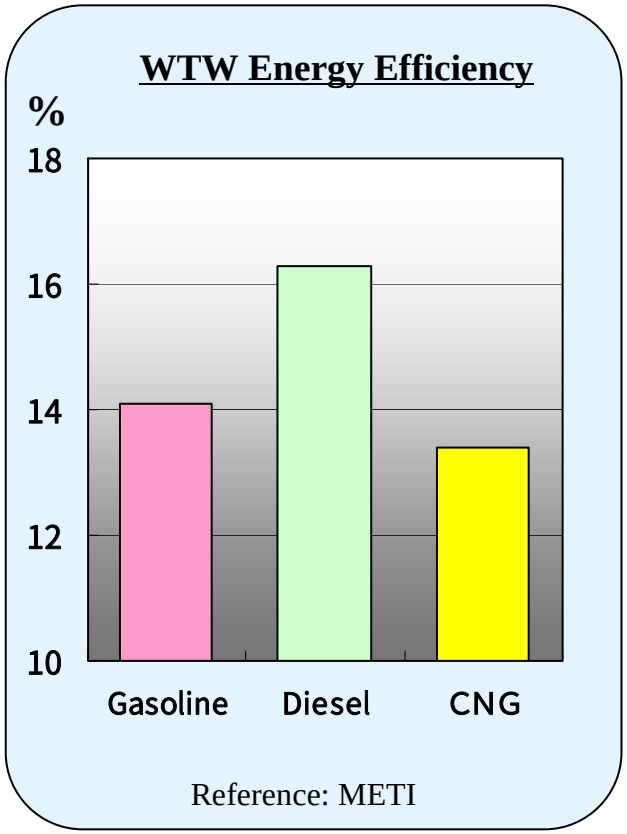
CO2 Increase at Refinery (2 million ton per year)

Automotive CO2 reduction

The rate of reduction will increase year by year along with the introduction of high performance vehicles.
Sulfur-free is necessary for high performance vehicles.

Reference:JCAP2

“Sulfur-free” to “Diesel Shift”

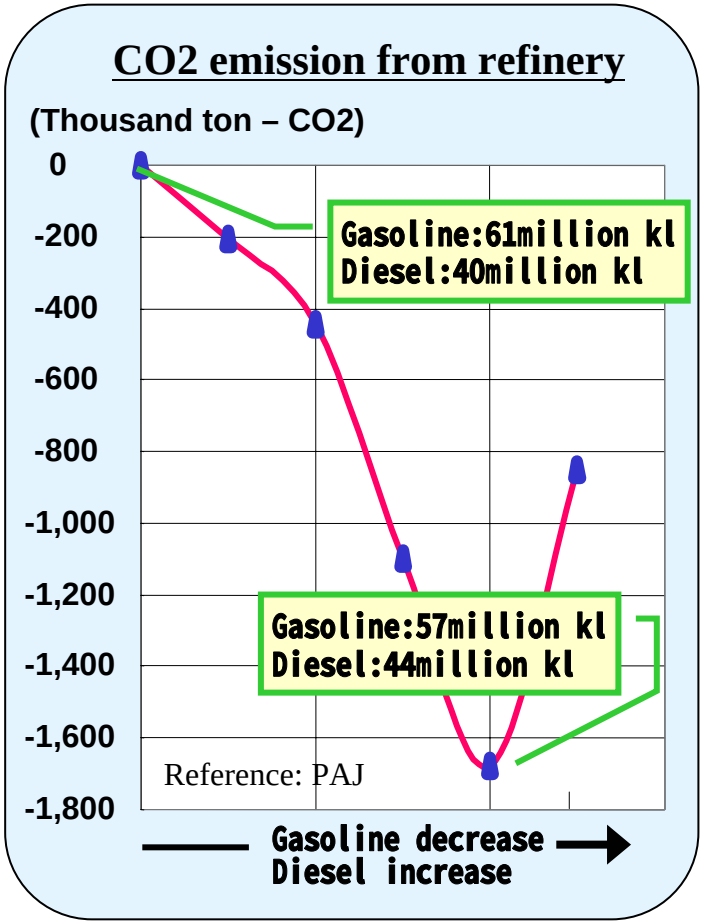


Introduction of
“Sulfur-free” diesel fuel

Development of **“Clean Diesel”** with advanced technology

Clean up the image
“Diesel is dirty”

The popularization of diesel vehicle with excellent fuel economy
“Diesel Shift”



CO2 Reduction estimation by JARI and PAJ

Vehicle: 2 million ton reduction with 10% enhancement of diesel passenger vehicle ratio

Refinery: 1.7 million ton reduction with 10% increase of diesel fuel production to replace gasoline

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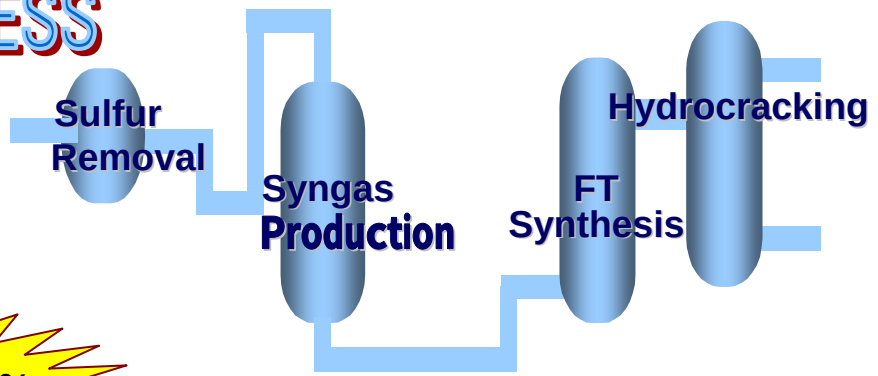
- **✓Biomass Fuels (ETBE, BDF)**

Development of New GTL Technology

OUR GTL PROCESS

Natural Gas
(CO_2 20%)



CO2 Reduction: 5%
(Syngas section)

Syngas Production

CO2/Steam Reforming
No need for :
- -CO2 Removal
- -O2 Generator
- -Syngas Conditioning

Capex: 85% of ATR

FT Synthesis

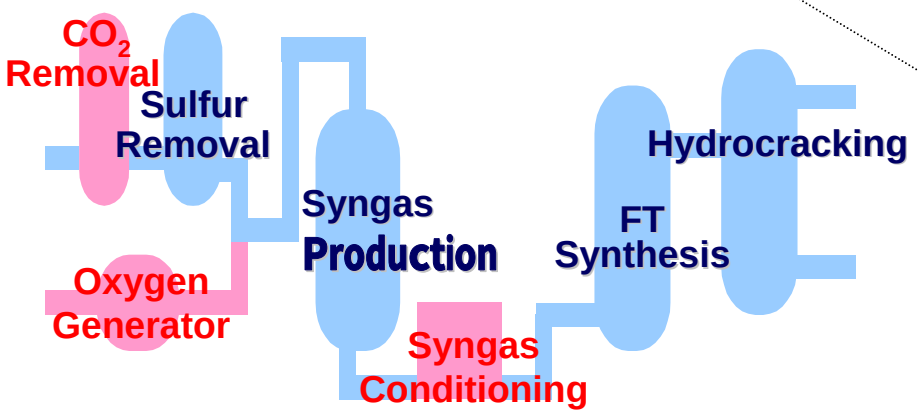
Own Technology

Hydrocracking

Own Technology

Existing Process

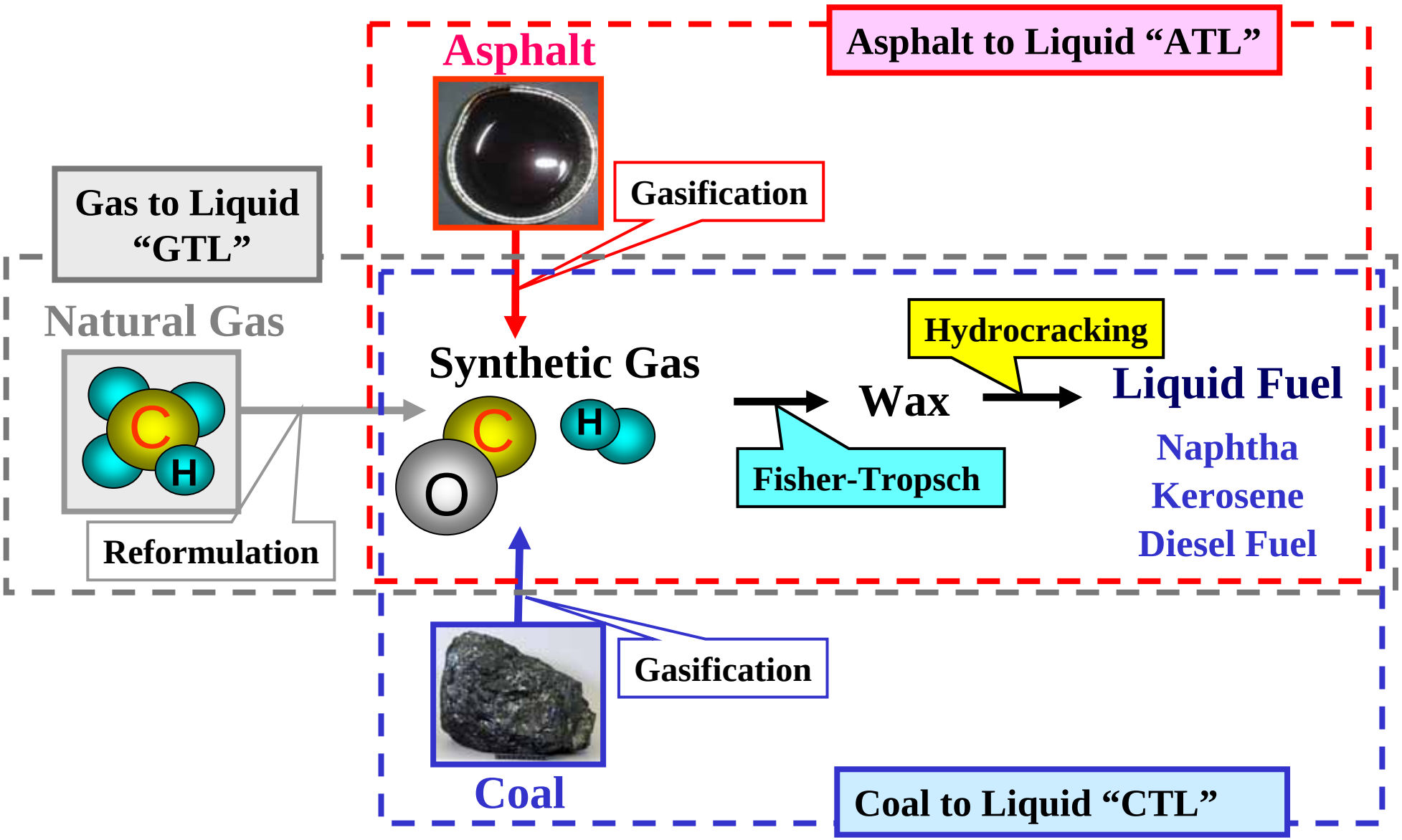
Natural Gas
(containing CO_2)



Syngas Production

ATR (Autothermal Reforming)
Partial Oxydation

GTL, ATL and CTL "Liquefaction"



GTL Plant Construction Plans

"GTL Plant Construction and Operation Plans"

2004	2005	2006	2007	2008	2009	2010	2011
Shell - Malaysia 12.5MBD Sasol – South Africa 105MBD PetroSA - South Africa 30.2MBD		Sasol - Qatar 34MBD	Sasol - Nigeria 34MBD		Sasol - Qatar 66MBD Shell – Qatar 70MBD Conoco – Qatar 80MBD		

Blue: Constructed
Red: Plan

The capacity in total will reach 450MBD in 2010,
equivalent to 18 million kl as diesel fuel--- only 3% of OECD demand.
Products will be supplied to EU ---- very small amount of products left for Asia?

Automotive fuels are "Sulfur-Free" in Japan.
GTL has little advantage in view of low sulfur property.

GTL is the candidate of automotive fuel diversity in a long-term.

---Meaningless as the countermeasure for environmental concerns in near-term

Biomass, Why?

For agriculture industries
Economic revitalization

Own energy supply source

Why in the US, EU and Brazil

CO2 reduction

For agriculture industries ?
Economic revitalization?

Own energy supply source?

Why in Japan?

CO2 reduction?

The reason in the US, EU and Brazil etc.

≠

Why in Japan?

Concerns with Ethanol-contained Gasoline

Energy Security, Cost

Import = Brazil is the only one candidate
---- Lack of confidence in energy security
30-50\/L @CIF --- High cost
Domestic Production = Under development
In the case of production from waste of buildings
= the cheapest way Cost: over 100\/L
Raw material availability: 0.9million kl/Y as ethanol

The effect of CO2 reduction

55-87% "WTW" CO2 reduction
(100% as the Kyoto protocol rule)
CO2 reduction cost : over 10,000\/t-CO2
---CO2 market: 1,300\/t-CO2

Distribution

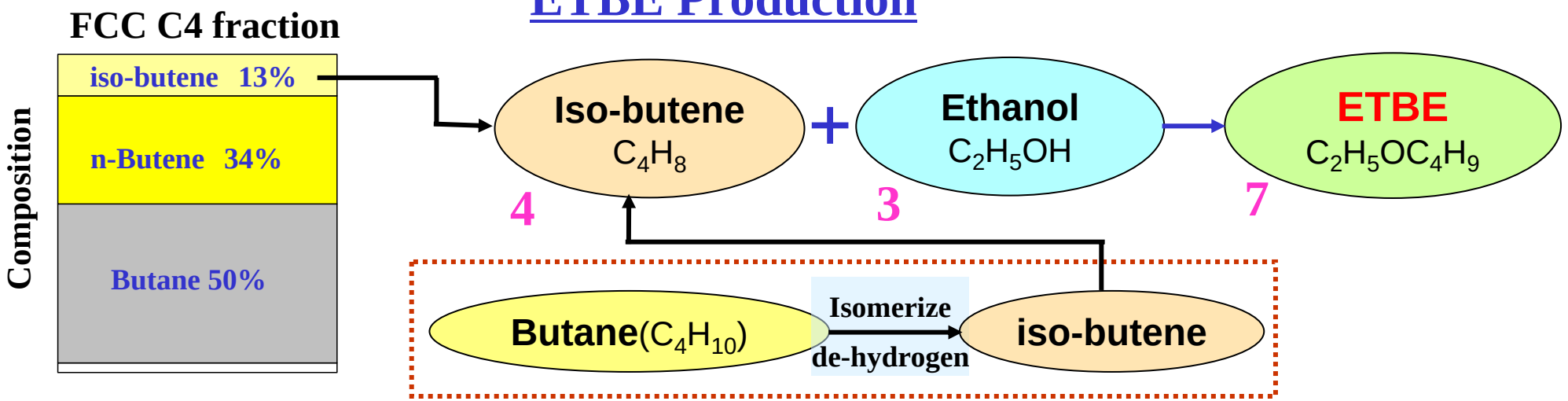
Ethanol must be blended at the very end of distribution
= To prevent water contamination, phase separation
Ethanol corrodes certain kind of materials.
----- Cost of new facility construction: over \330 billion
Very difficult to observe "Fuel quality maintenance low"

Product Quality

Vapor Pressure : 5-7 kPa increase
= Increase of Evaporative emission
Aluminum corrosion with over 3% ethanol blend
Exhaust emission: Increase of NOx and aldehyde

ETBE

ETBE Production

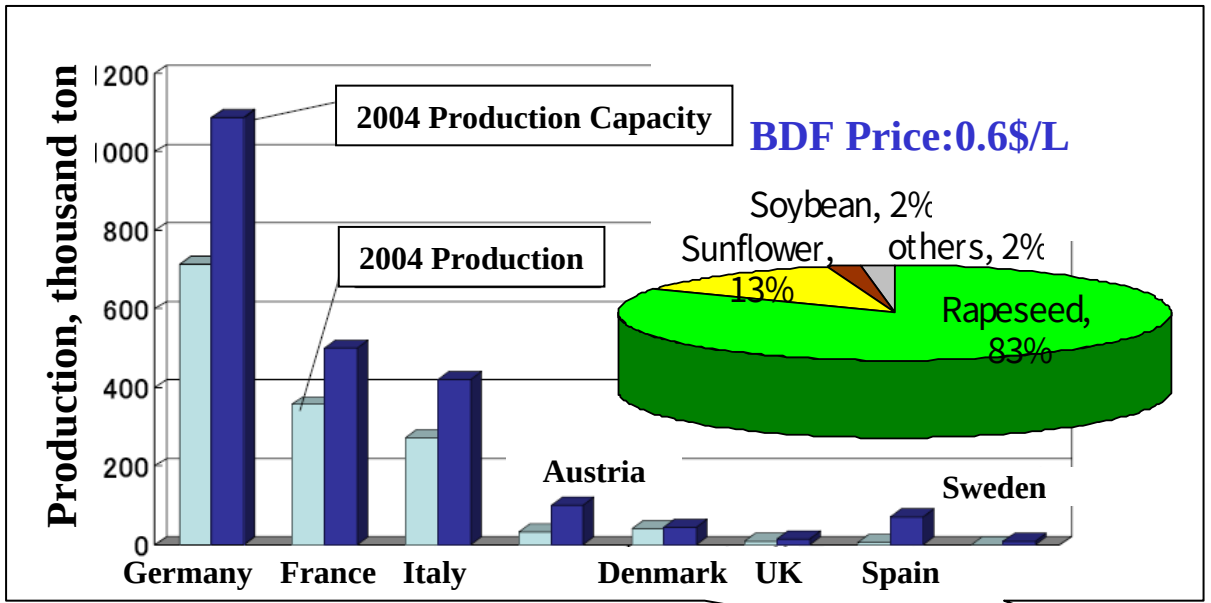


Comparison of ETBE with Ethanol

CO2 Reduction: Almost the same using the same amount of ethanol, ethanol 3% = ETBE 7%
Energy security, cost : Concerns of raw ethanol are the same. ETBE production facilities are necessary.
Distribution: **No problem**
Product quality: **No vapor pressure increase**
The same with the effect on exhaust emission
The influence on ground water has to be proven. (US-problem, EU-No problem)

Bio-diesel Trend in the world

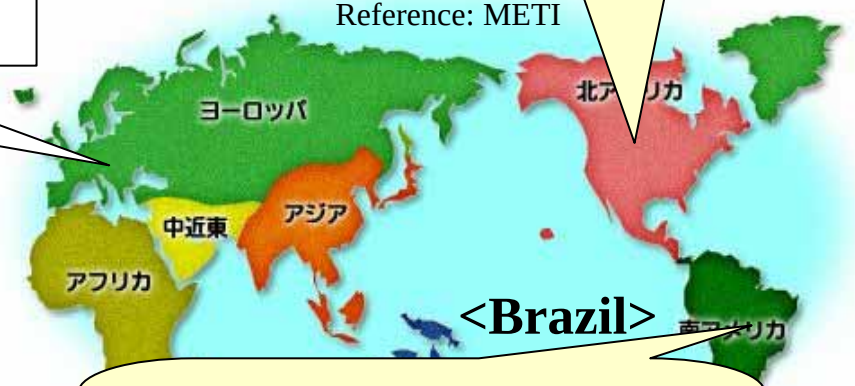
<EU>



<US>

Raw material: Soybean
Production:103 thousand ton (2004)
1,100 thousand ton (2005 estimation)
BDF Price: 0.7$/L

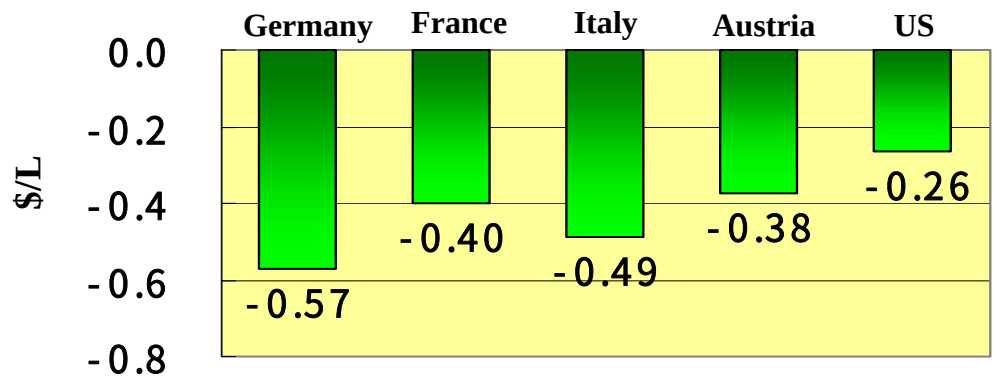
Reference: METI



<Brazil>

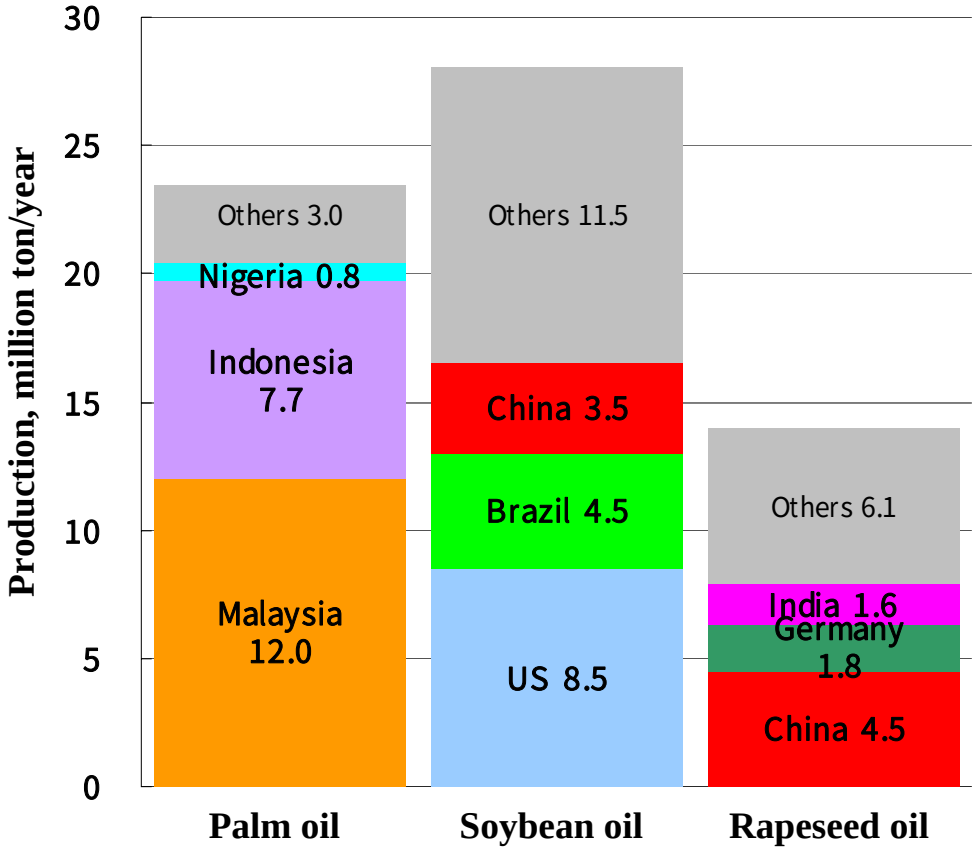
Raw material: Soybean, Palm
Production:
720 thousand ton (2005 estimation)

BDF Tax incentives



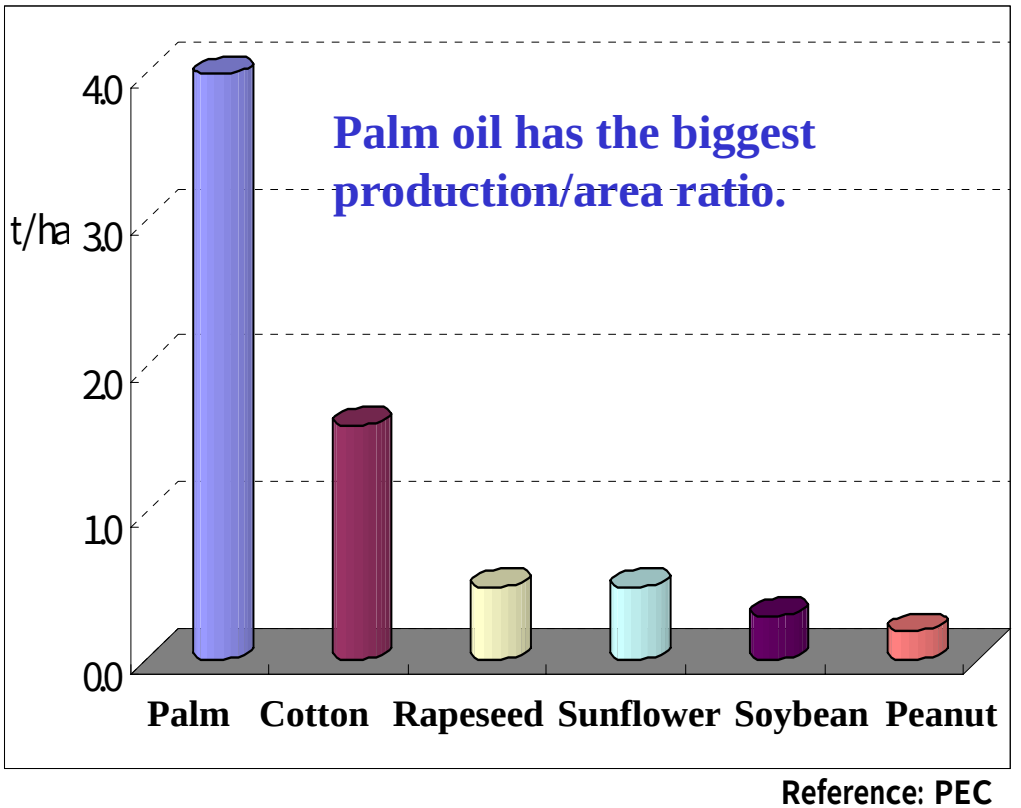
BDF Concerns Raw material availability, Cost

Raw materials production



Reference：Oil World Annual 2002

Production per area



Reference: PEC

Cost of Palm BDF: \60-70/L CIF Japan
（PEC estimation）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