

RENEWABLE ENERGY IN TRANSPORT

Case Germany – Focus on Biodiesel – Lessons Learned

Axel Munack

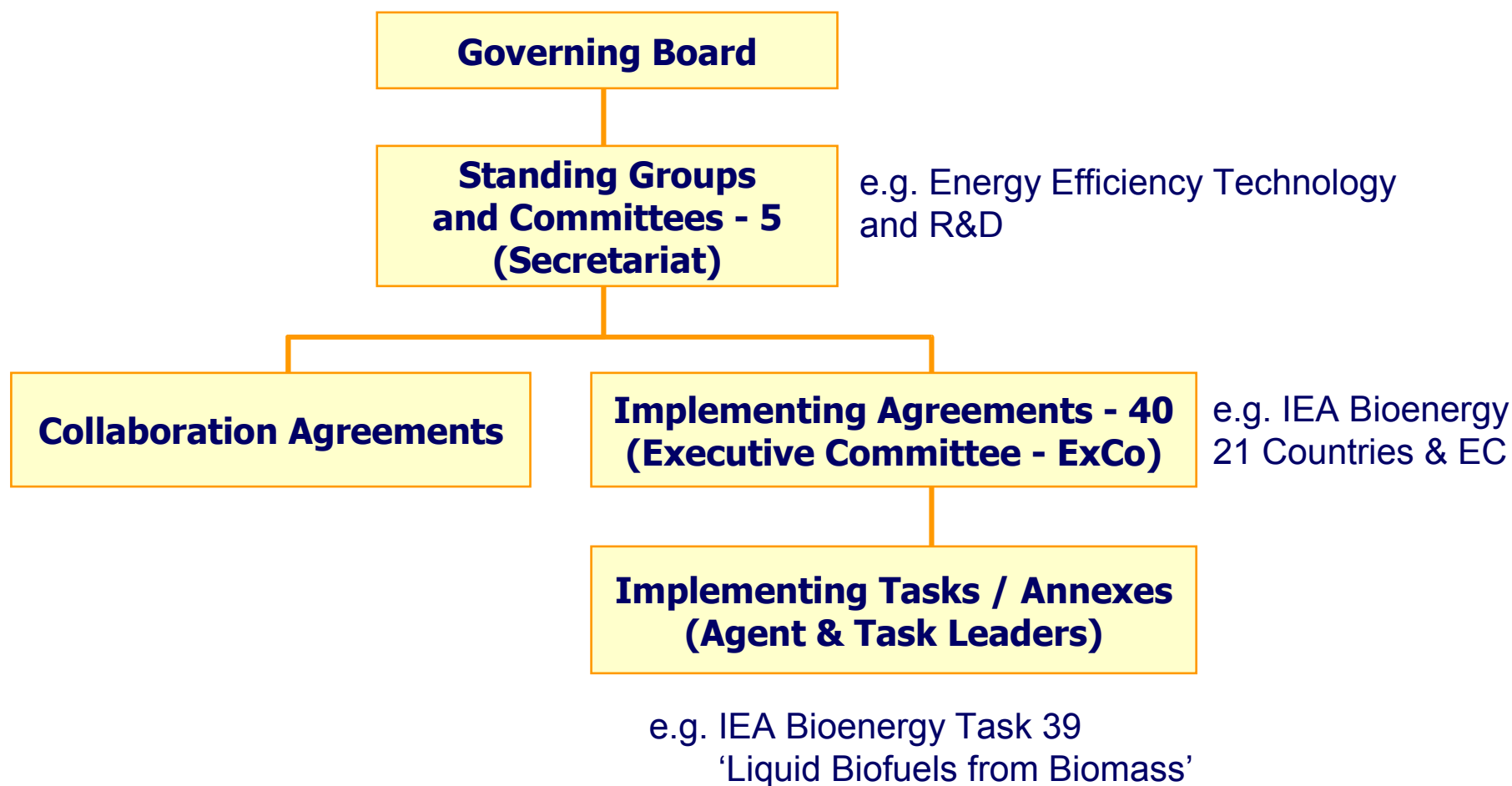
Jürgen Krahl

- **IEA Bioenergy, in particular Task 39**
- **Framework and Actual Situation**
- **Emissions and Health Effects**
- **Conclusions**

International Energy Agency (IEA)

- Founded 1974
- Autonomous agency linked to Organisation for Economic Co-operation and Development (OECD)
- Forum for energy co-operation among 26 Member countries
- Interacts with non-OECD countries to:
 - enhance security of supply
 - advise on energy policy and regulatory reform
 - promote energy efficiency and technology
- Headquartered in Paris

IEA Structure



IEA Bioenergy

www.ieabioenergy.com

IEA Bioenergy

- Objective
 - Realising the use of environmentally sound and cost-competitive bioenergy on a sustainable basis to make a substantial contribution to meeting future energy demands

- Wide-ranging topics
 - Production, processing and utilisation of biomass resources for energy purposes

- Tasks
 - Implementing agreement work is conducted through a series of tasks with a designated work programme
 - Implementing Agent & Task Leader

IEA Bioenergy Members

- Australia
- Austria
- Belgium
- Brazil
- Canada
- Croatia
- Denmark
- Finland
- France
- Germany
- Ireland
- Italy
- Japan
- The Netherlands
- New Zealand
- Norway
- South Africa
- Sweden
- Switzerland
- United Kingdom
- United States
- European Commission

22 members

IEA Bioenergy - Tasks 2007-2009

- Task 29 - Socio-economic drivers in implementing bioenergy projects
- Task 30 - Short rotation crops for bioenergy systems
- Task 31 - Biomass production for energy from sustainable forestry
- Task 32 - Biomass combustion and co-firing
- Task 33 - Thermal gasification of biomass
- Task 34 - Pyrolysis of biomass
- Task 36 - Energy recovery from municipal solid waste
- Task 37 - Energy from biogas and landfill gas
- Task 38 - Greenhouse gas balance of biomass and bioenergy systems

IEA Bioenergy Task 39

***Commercializing 1st- and 2nd-generation
liquid biofuels from biomass***



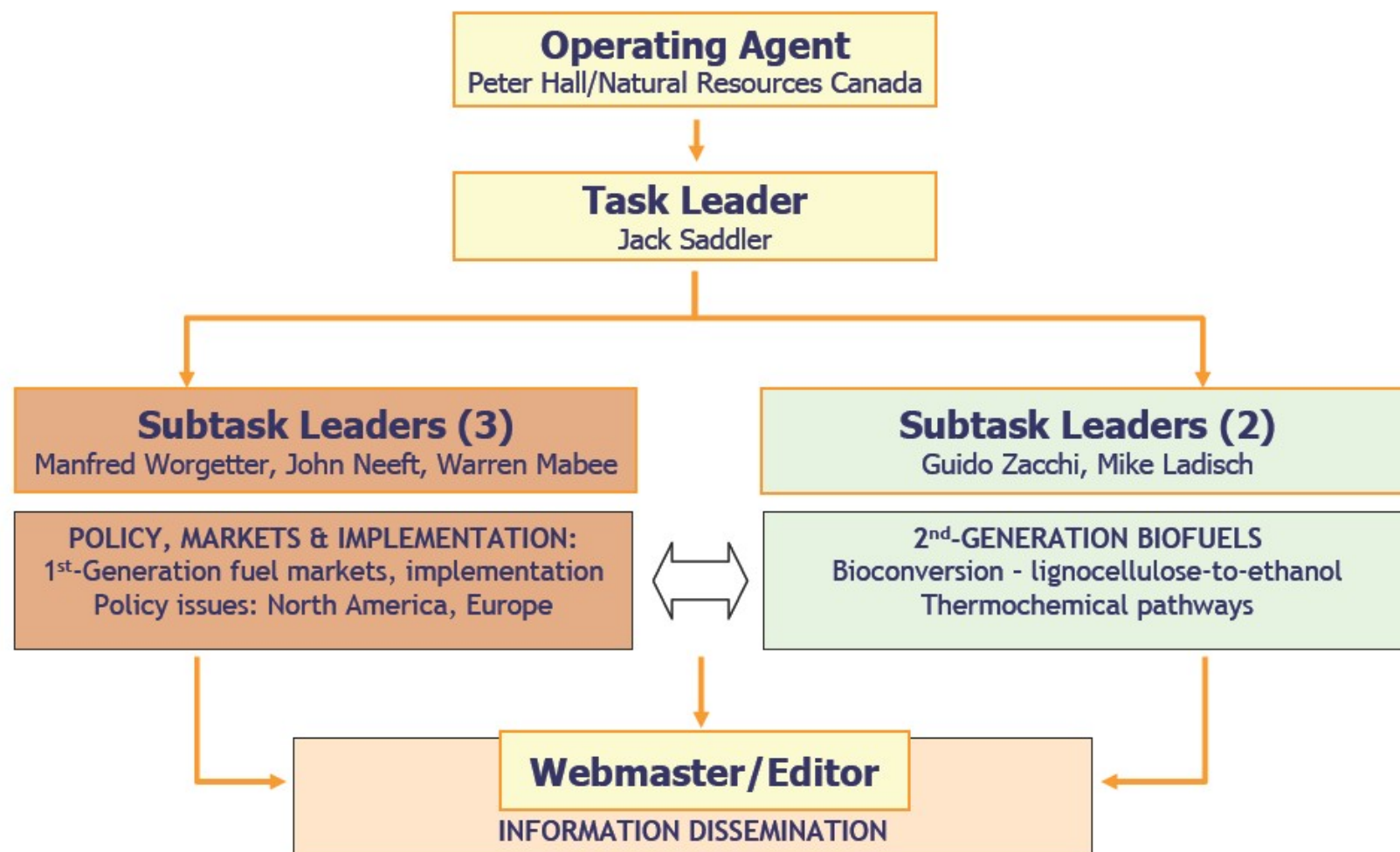
Overall Goal

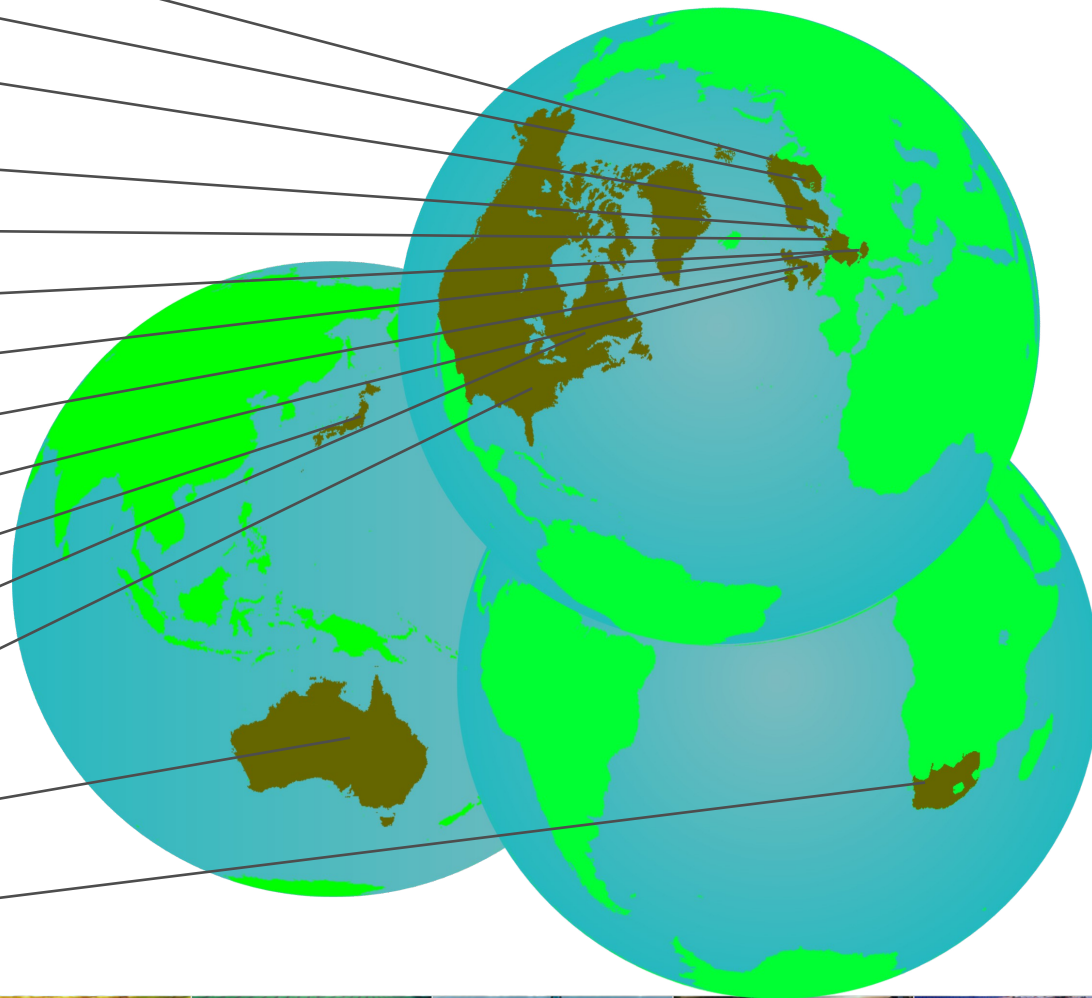
- Provide participants with comprehensive information that will assist them with deployment of biomass derived liquid fuels for use in the transportation sector, including data on the development of 2nd-generation liquid fuels derived from lignocellulosic feedstocks

Objectives

- Catalyze cooperative research and development projects for converting lignocellulosic biomass to liquid fuels, with a particular focus on bioconversion to ethanol. Other liquid fuels such as biodiesel, methanol, DME, biomass derived hydrogen will also be included within the Task, with appropriate linkages to other IEA Bioenergy Tasks.
- Provide information and analyses on policy, regulatory and infrastructure issues required to commercialize renewable liquid biofuels as a replacement for fossil-based fuels.
- Collect and collate relevant information on bioethanol and other liquid fuels, provide for information dissemination, outreach to stakeholders, and coordination with other related groups.

New Task Structure



European Commission*Kyriakos Maniatis***Norway***Lars Sorum, Karin Oyaas, Roger Khalil***Finland***Tuula Makinen, Niklas von Weymarn***Sweden***Guido Zacchi, Bärbel Hahn-Hägerdal**Alice Kempe***Denmark***Birgitte K. Ahring, Lisbeth Olsson***Germany***Axel Munack***Austria***Manfred Wörgetter***The Netherlands***John Neeft, René Wismeijer***United Kingdom***Tony Sidwell***Ireland***Jerry Murphy***Japan***Shiro Saka, Yukinori Kude***Canada***Jack Saddler, Warren Mabee***United States***Jim McMillan, Mike Himmel***Australia***Les Edye***South Africa***Xolile Mtwa*

Deliverables

- Reports required by the Executive Committee
- Annual Meetings/Workshops
 - Planning, Technical, Policy, Joint Technical-Policy
- 3 Newsletters/year (April, Aug, Dec)
- Reports (2-3 Case Studies)
- Website
- Facilitating Exchanges (Personnel, Models, Info from other Tasks)

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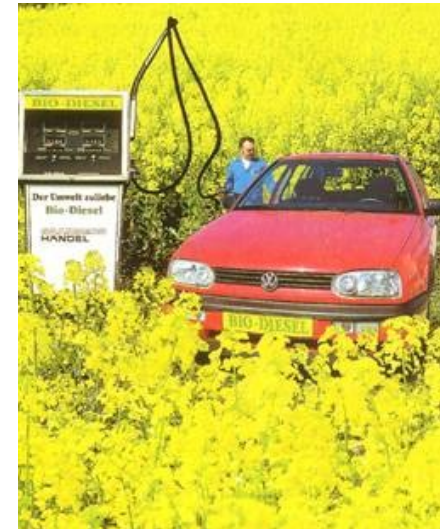
Goals of the European Union

“Indicative goals” for the share of sold biogenic fuels* in the total sold Otto and Diesel fuels (with respect to the energy content) acc. to Information Note 6795/03 of the Council of the EU dated 2003/02/25

year	share [%]
2005	2
2010	5.75

Proposal of the European Commission, Jan 23, 2008:

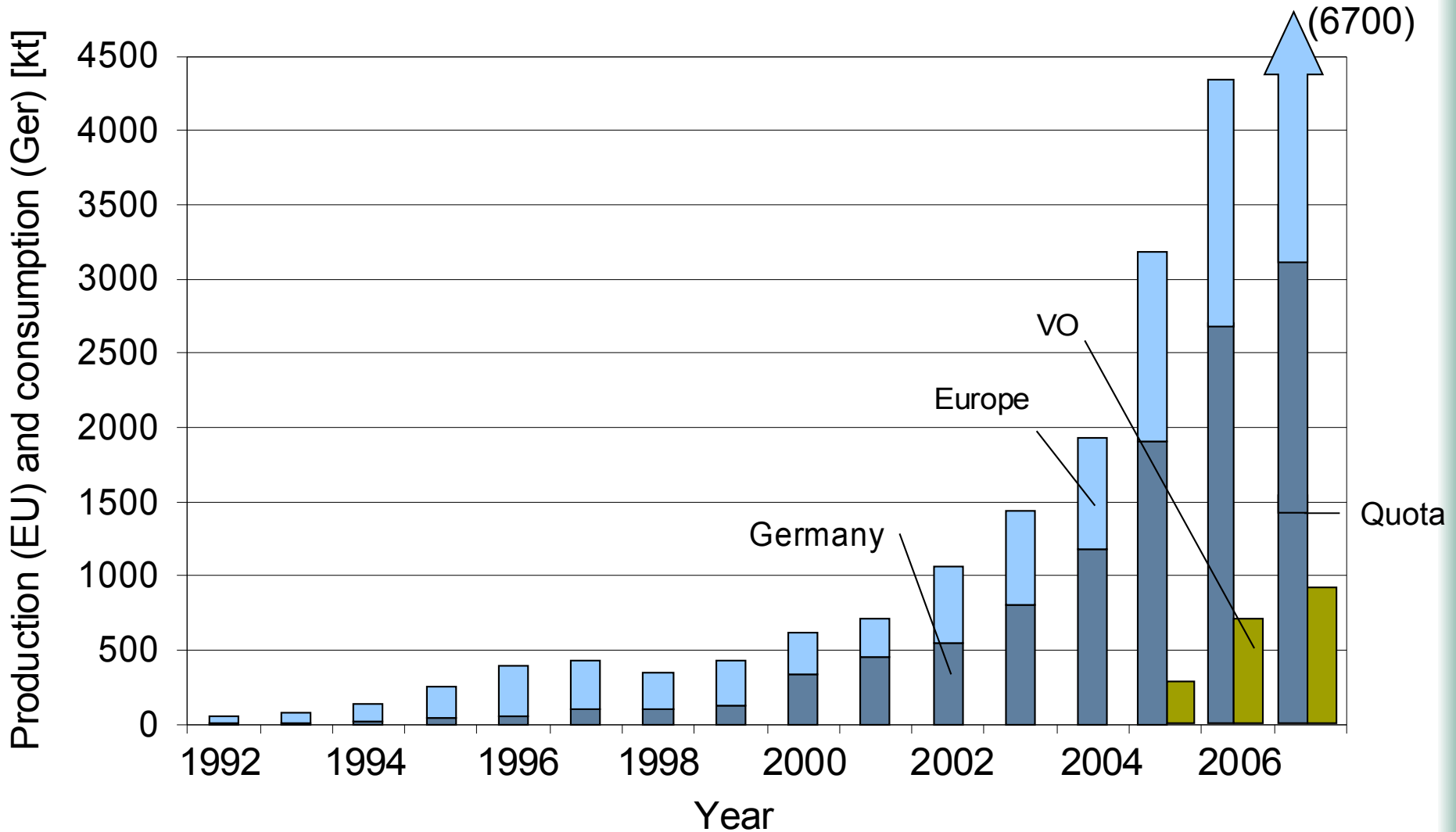
2020	10.00
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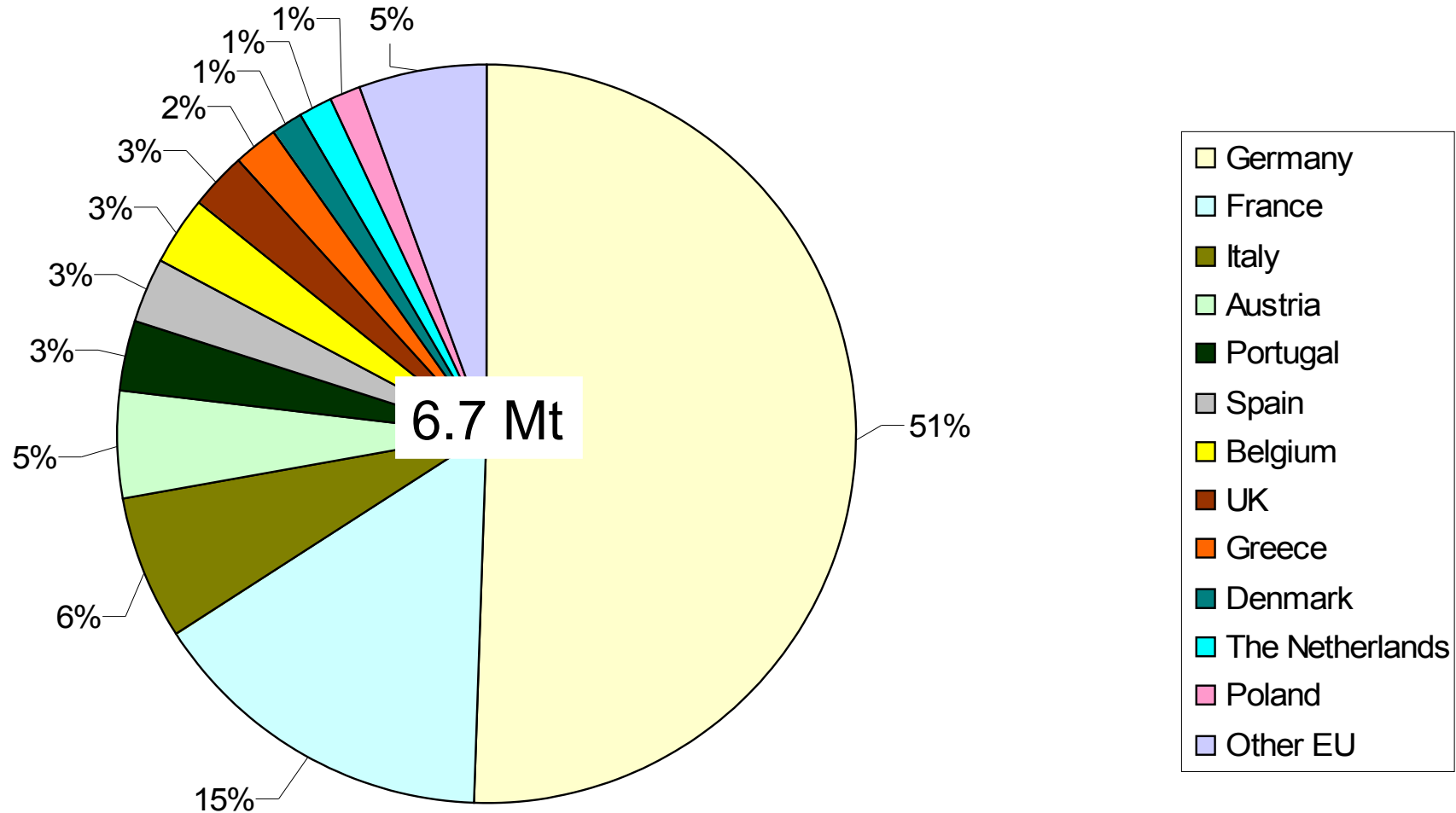
Including the sustainability criterion:

Biofuels must exhibit a reduction of at least 35% in the GHG emissions

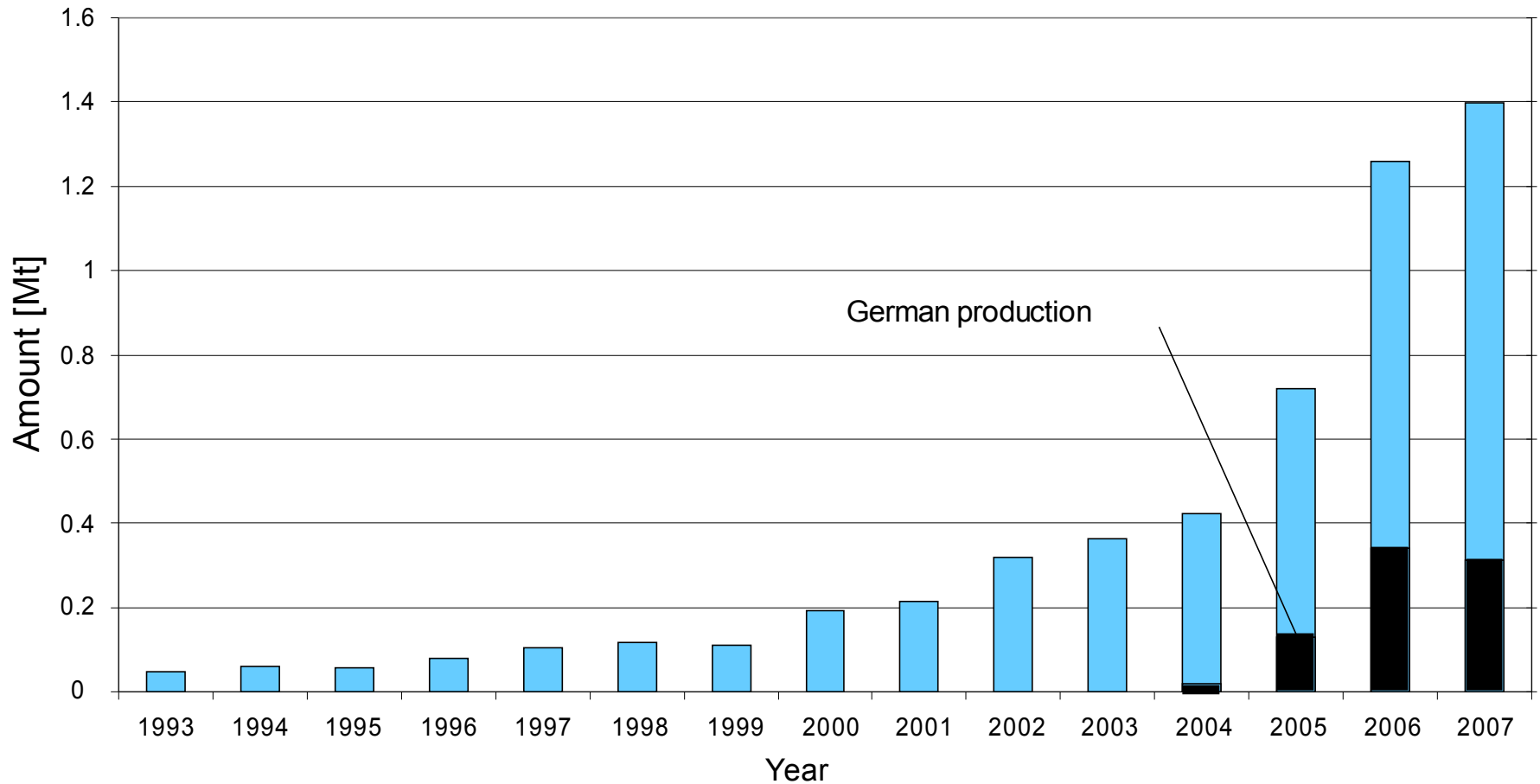
Production of Biodiesel in Europe and German Consumption of Biodiesel and Vegetable Oil



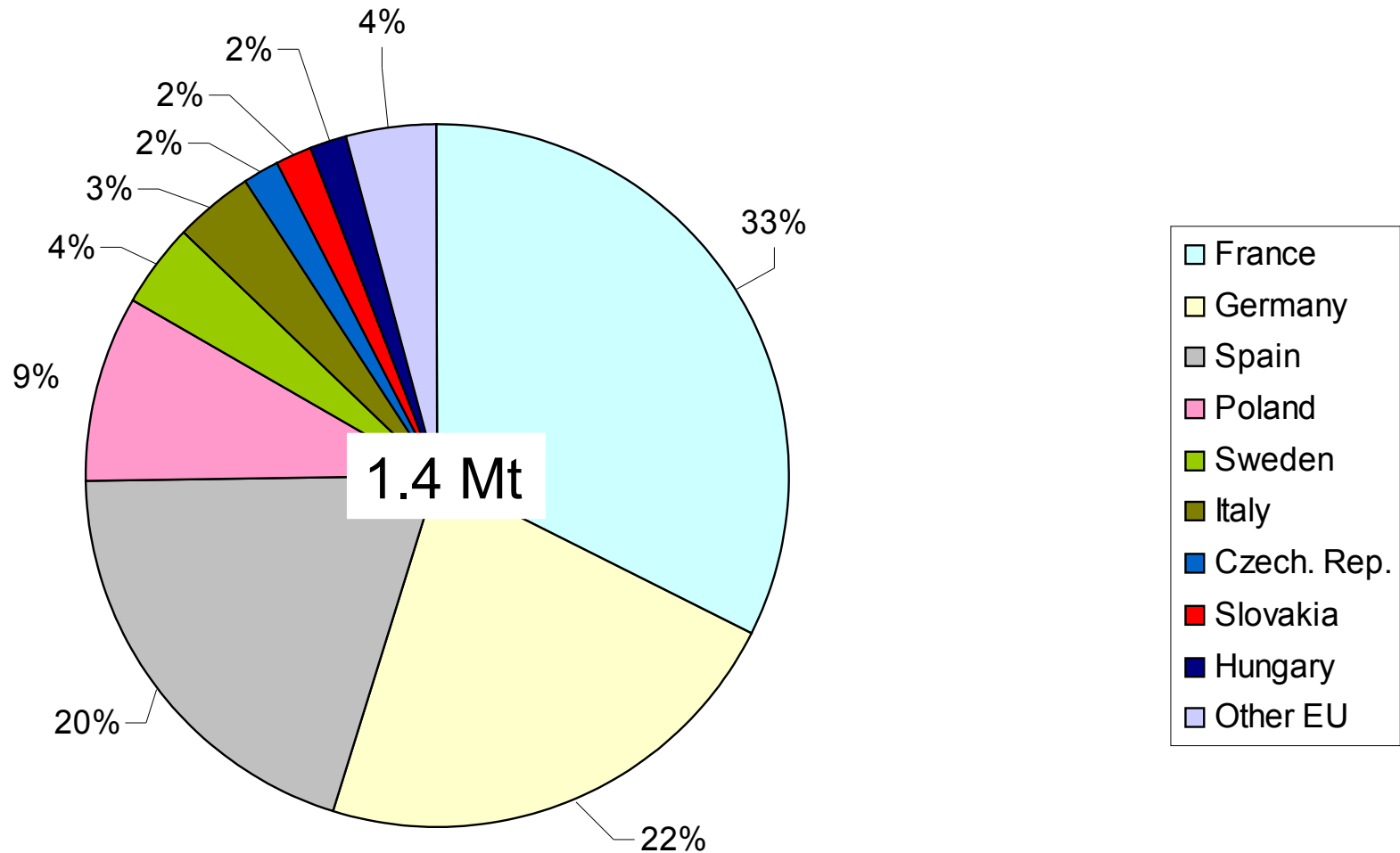
Production of Biodiesel in Europe (EU-27) during the Year 2007



Production of Bio-Ethanol in Europe (EU-15; since 2004: EU-25)



Production of Bio-Ethanol in Europe (EU-27) during the Year 2007



- The former complete tax exemption is ceased; instead, fuel-dependent rising taxes are scheduled (since 8/2006)
- Quotas for admixing biofuels to fossil fuels are introduced; these quota biofuels are fully taxed
- Biofuels for agricultural purposes remain tax-free
- 2nd generation biofuels remain tax-free until 2015

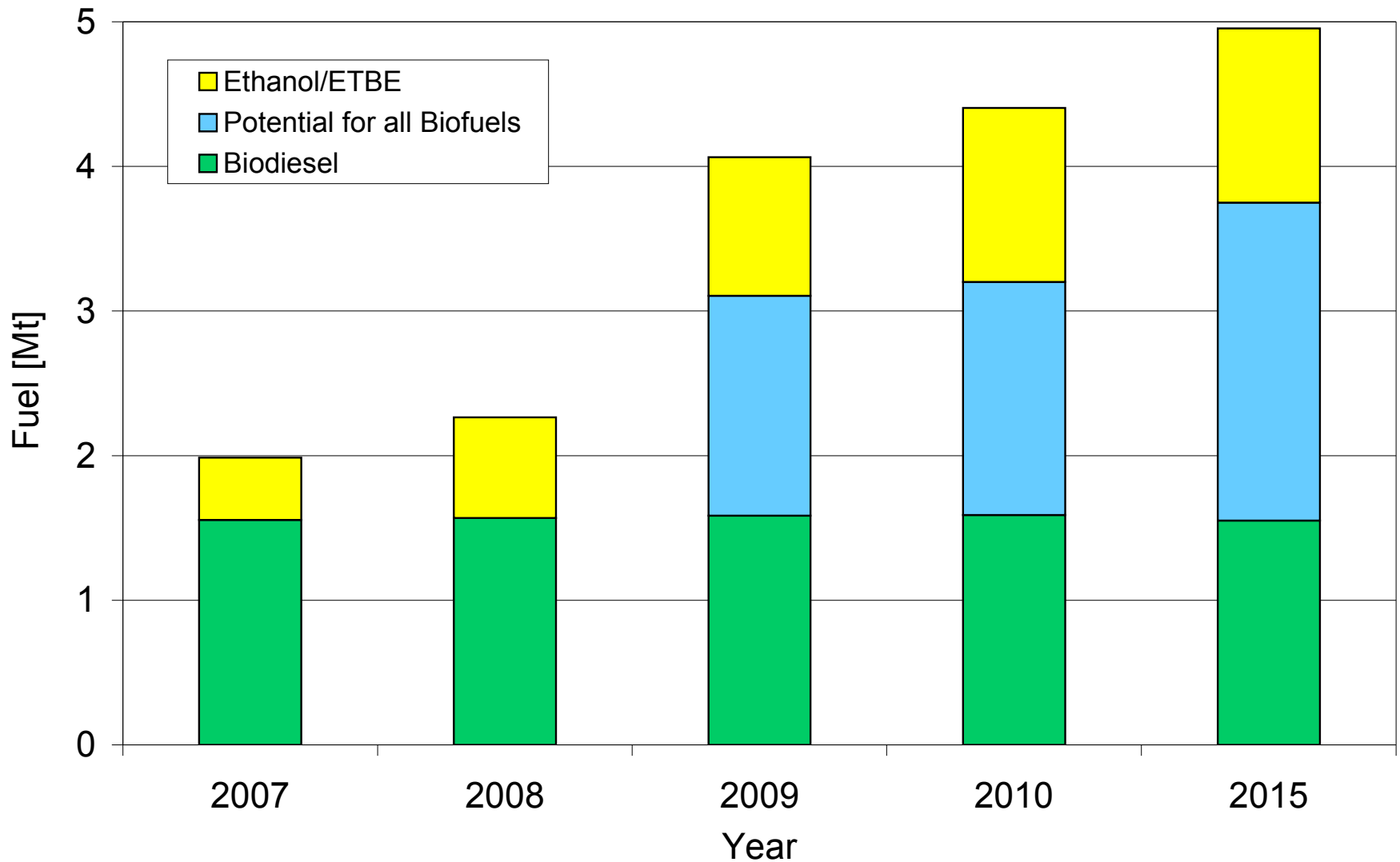
Quotation; the Admixed Biofuels are Fully Taxed

(Quotas Refer to Energy Content)

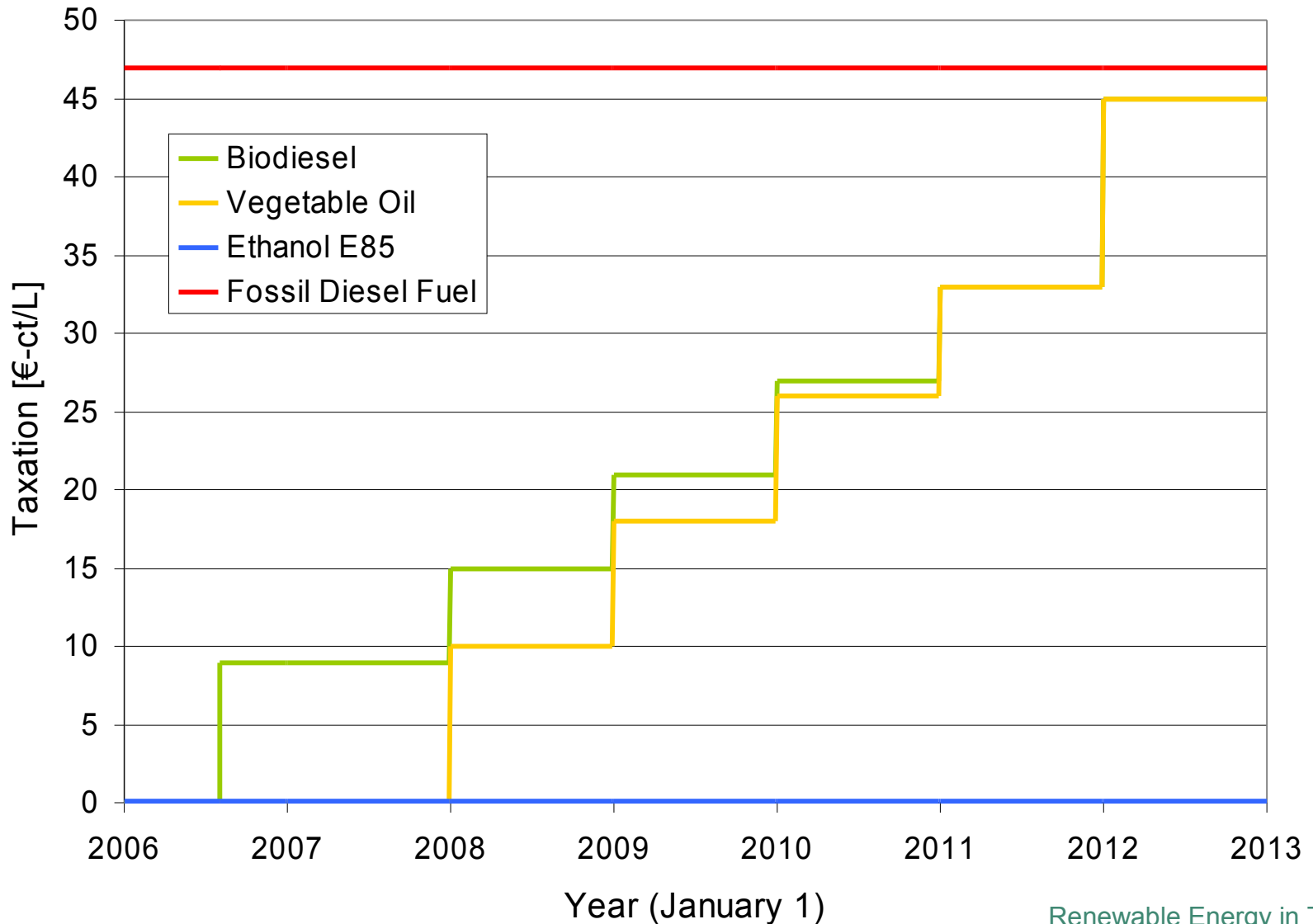
Year	Quota (Total)	Sub-Quota Diesel Fuel	Sub-Quota Gasoline
2007	--	4.4 %	1.2 %
2008	--	4.4 %	2.0 %
2009	6.25 %	4.4 %	2.8 %
2010	6.75 %	4.4 %	3.6 %
2011	7.00 %	4.4 %	3.6 %
2012	7.25 %	4.4 %	3.6 %
2013	7.50 %	4.4 %	3.6 %
2014	7.75 %	4.4 %	3.6 %
2015	8.00 %	4.4 %	3.6 %

Remark: The tax for diesel fuel is 47 €-ct/L and for gasoline 65 €-ct/L.

Effects of the Quota Regulation on the Amounts of Biofuels' Admixtures to Fossil Fuels



Reduced, but Yearly Increasing Taxation for Neat Biofuels



- The ministries for environment and agriculture, the German association of car manufacturers, the German farmers' association and some others agreed upon the formulation of a "Roadmap biofuels" (Nov. 2007)

Cornerstones:

immediately or within a short time: release of E10; release of B7; B7+H3 with proof of the positive ecological balance of the hydrotreating component; FFV with E85; B100 in the utility vehicle area; certification system for check of sustainability and greenhouse gas efficiency (see below)

in the medium term: B20 – where the bio component still needs to be defined; tax exempt for 2nd generation should be extended into the years following 2015

- A certification system is developed which should
 - (a) assess the sustainability of the production of biofuels and
 - (b) be extended afterwards on the assessment of the greenhouse gas efficiency

State: March 2008

- ☹ 85% of the existing biodiesel production capacities of 5 Mt/a are set aside
- ☹ 14% of the filling stations stopped selling biodiesel (B100) and further 36% are planning to do so
- ☹ 70% of the companies stopped production or went bankrupt
- ☹ 2/3 of the admixed quota biodiesel is imported (e.g. as subsidized 99% biodiesel with 1% fossil diesel fuel from U.S. exporters)

Recent Changes in the German Biofuels Policy – Technical Questions to Be Solved

- Due to the regeneration strategy for exhaust gas particle filters a distinct dilution of the engine lubricant is expected for B20. Some engine manufacturers are worried about such behavior for B7, too.
- The biggest German drivers association, the ADAC, claims that at least 2.25 Mill passenger cars (with an uncertainty of 7 Mill more) are not suited for E10.

German Consumption of Biofuels in the Years 2007 and 2008

Fuel	2007 [kt]		2008 (est.*) [kt]
Biodiesel (quota)	1,387	↗	1,640
Biodiesel (B100)	1,745	↘	1,129
Biodiesel (sum)	3,132	↘	2,769
Vegetable oil	727	↘	353
Bioethanol (ETBE)	365	→	353
Bioethanol (quota)	89	↗	197
Bioethanol (E85)	6	↗	9

* estimates on the basis of January to September sales

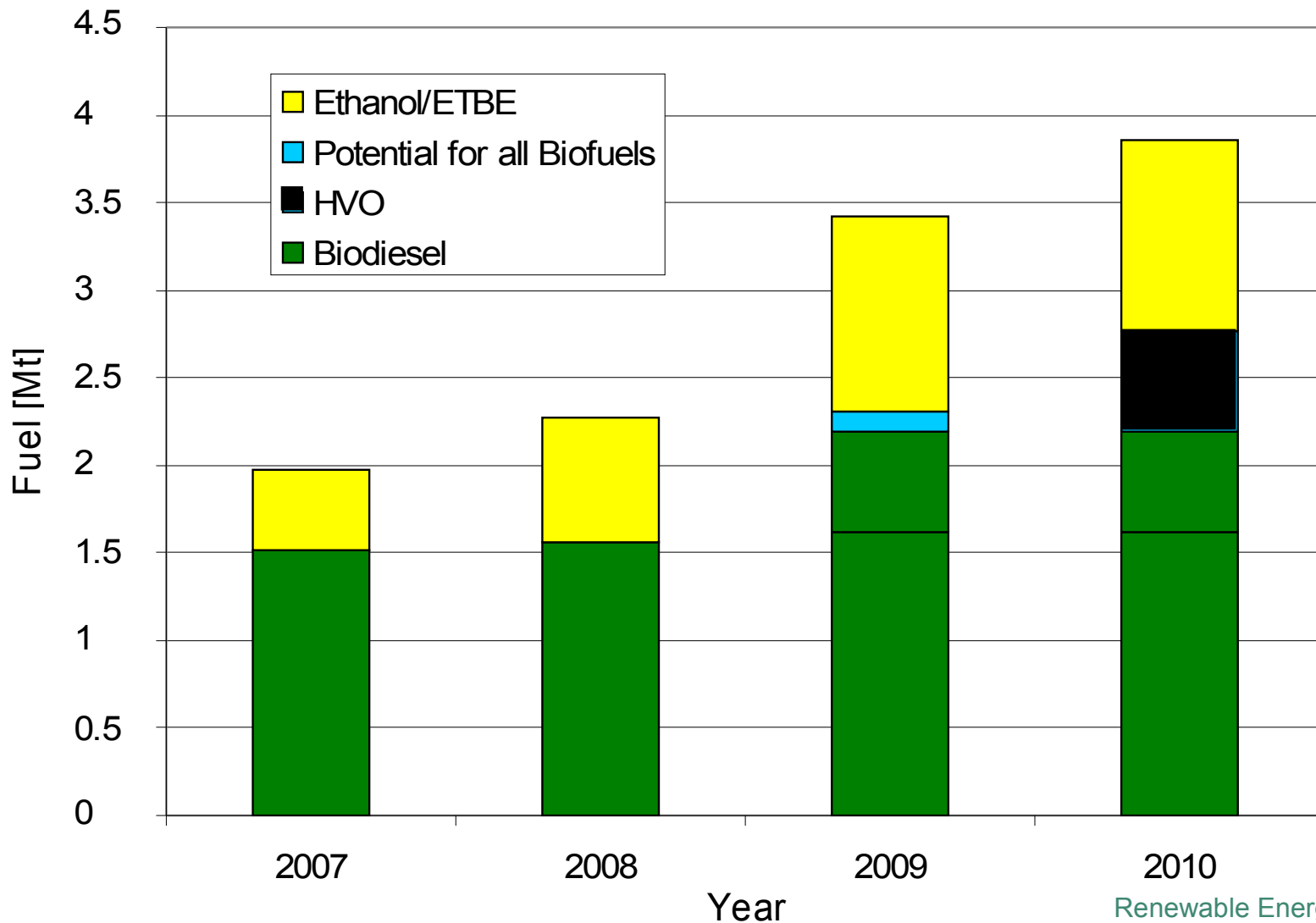
Quotation According to New Legislation Draft 2008; the Admixed Biofuels are Fully Taxed (Quotas Refer to Energy Content)

Year	Quota (Total)	Sub-Quota Diesel Fuel	Sub-Quota Gasoline
2007	--	4.4 %	1.2 %
2008	--	4.4 %	2.0 %
2009	5.25 %	4.4 % *	2.8 %
2010	6.25 %	4.4 % **	2.8 %
2014	6.25 %	4.4 % **	2.8 %
2015	Diminishing of GHG emissions by 3 % required \approx 5.1 %		
2017	Diminishing of GHG emissions by 4.5 % required		
2020	Diminishing of GHG emissions by 7 % required		

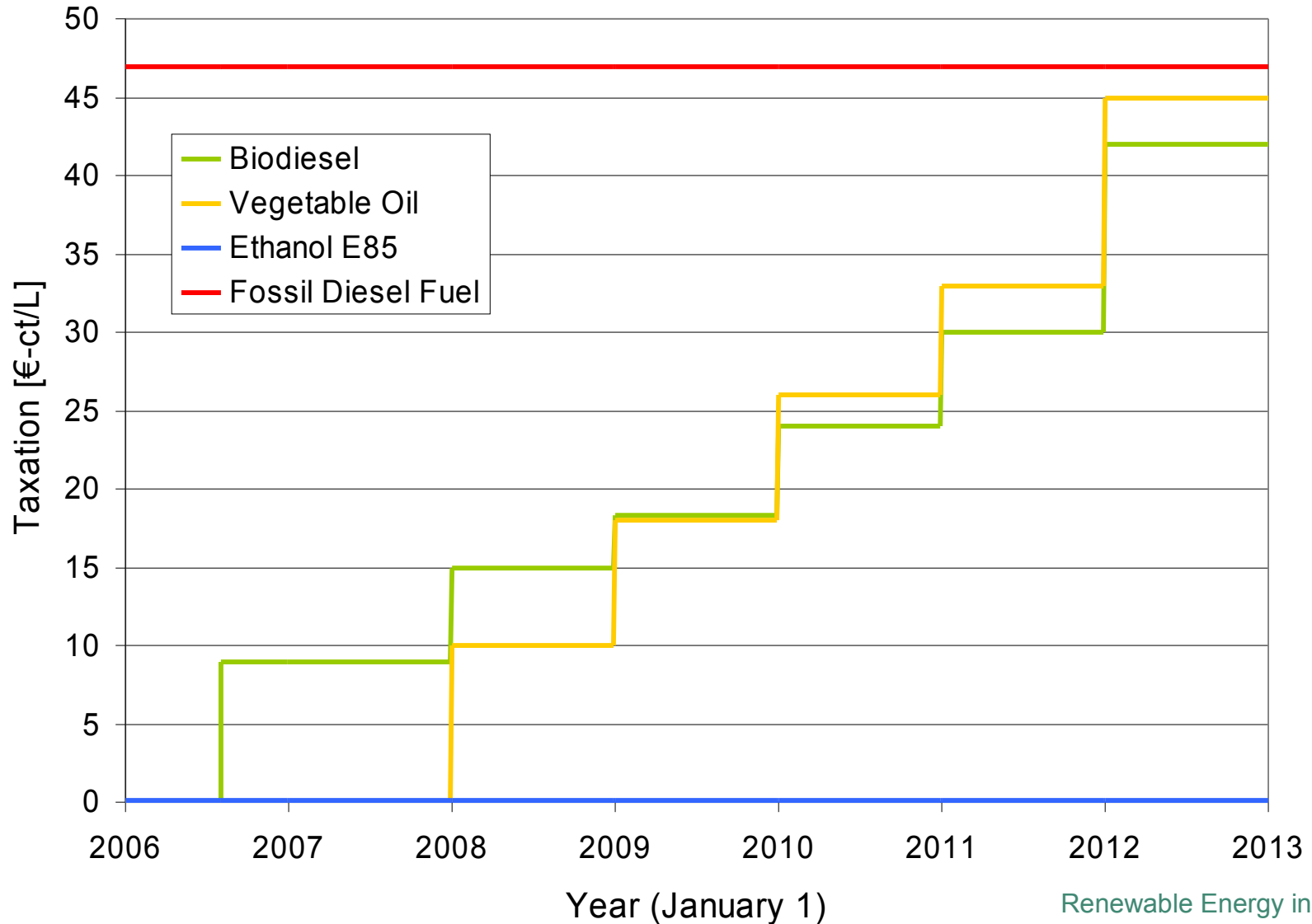
* 6.2 %
possible

** 6.2 % +
2.7 % HVO
possible

Effects of the Quota Regulation on the Amounts of Biofuels' Admixtures to Fossil Fuels (New Legislation Draft of 2008)



Reduced, but Yearly Increasing Taxation for Neat Biofuels, According to New Legislation Draft in 2008



Further Measures, According to New Legislation Draft in 2008

- Methane from upgraded biogas will be eligible to count for the gasoline quota.

- Fuels based on palm oil or soybean oil are considered for quota fulfilment or tax reduction only if the sustainability act is in operation and the sustainability certificates are submitted.

- Fuels that are already subsidized are not considered for quota fulfilment or tax reduction (this mainly affects the import of B99 from the USA).

Potential New Fuels for Diesel Engines

- BTL – Biomass-to-Liquid; Synfuel, Sunfuel, Artfuel, ...
- Synthetic Biodiesel (Ethanol-to-Diesel Process)
- DME - Dimethylether



Potential New Fuels for Spark Ignition Engines

□ 2nd generation Ethanol

- Abengoa has, at present, a European ethanol production capacity of 725 Mill L/a (572 000 t/a);
2nd generation: a demonstration plant with a production capacity of 5 Mill L/a (3.950 t/a) should be set into operation at the end of 2007

- Iogen / Volkswagen: new results have not been published yet

- further companies: Mascoma, Verenium (was Celunol), Poet (was Broin), DuPont, SunOpta, Xethanol,

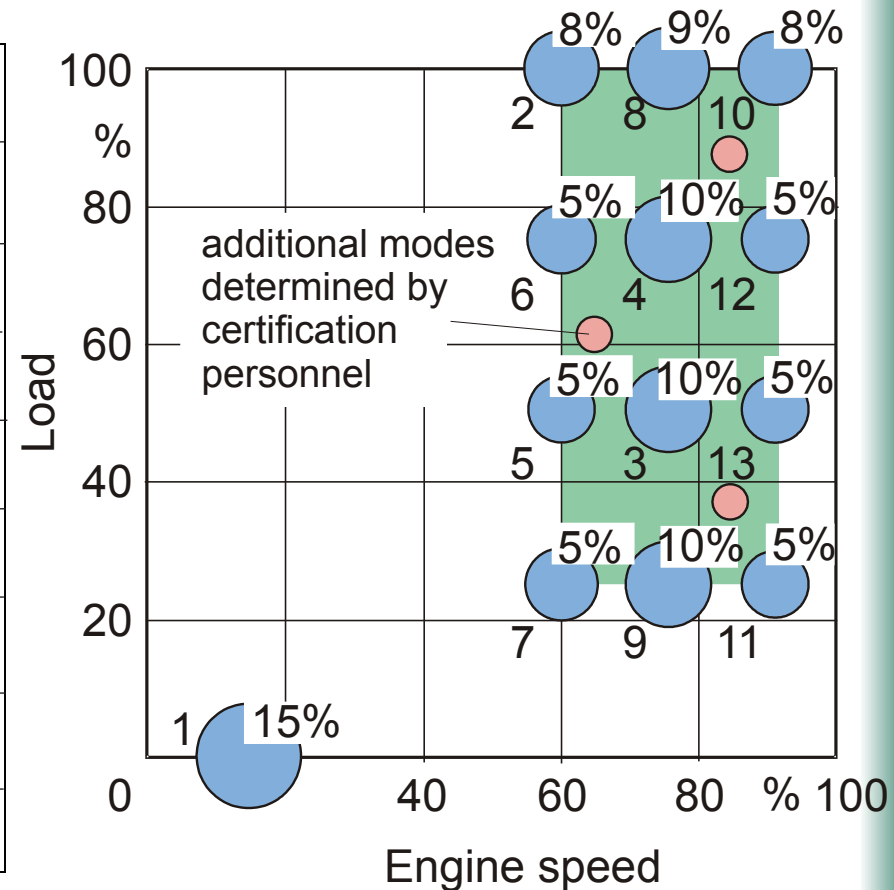


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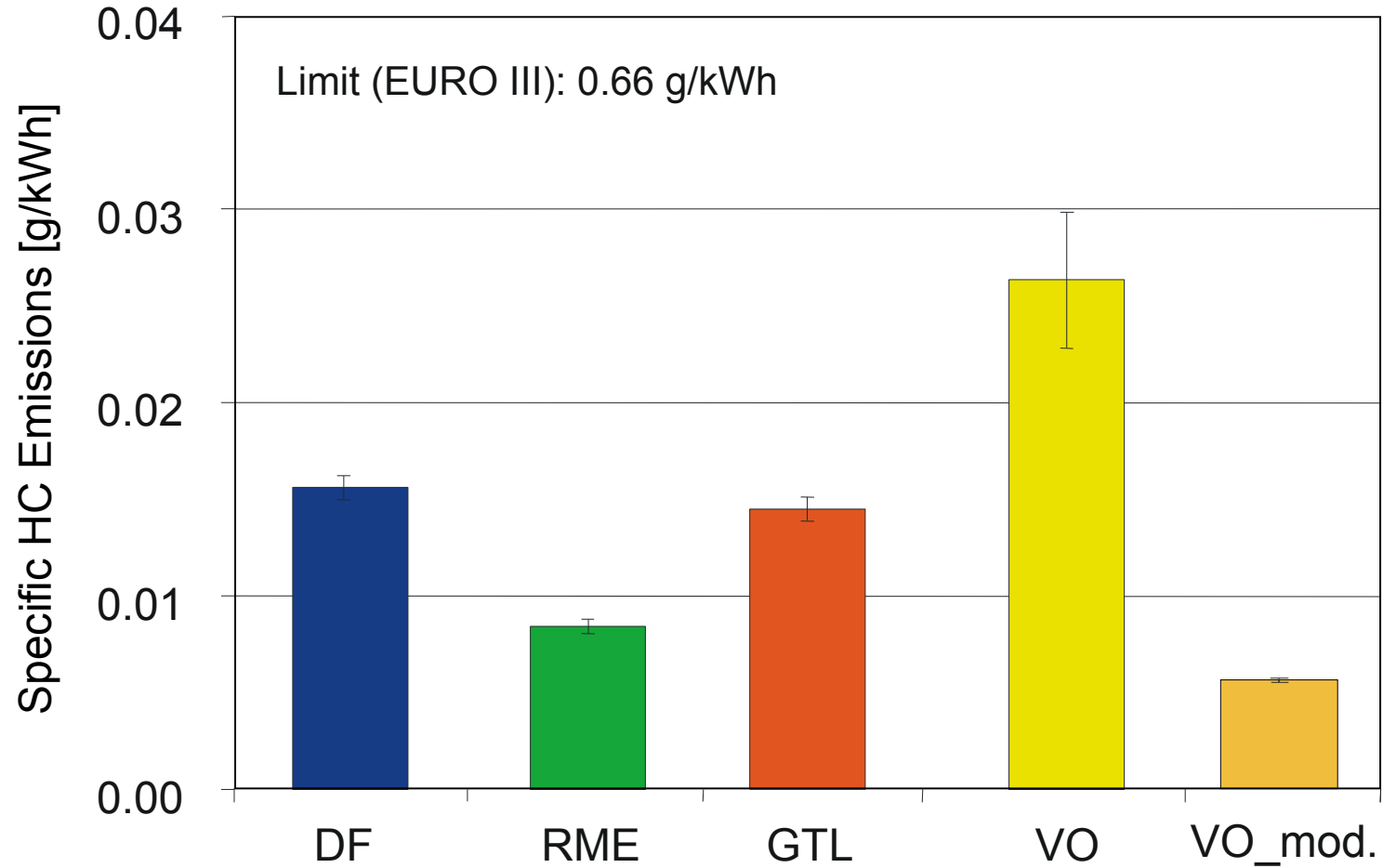
Mercedes Benz OM 906 LA

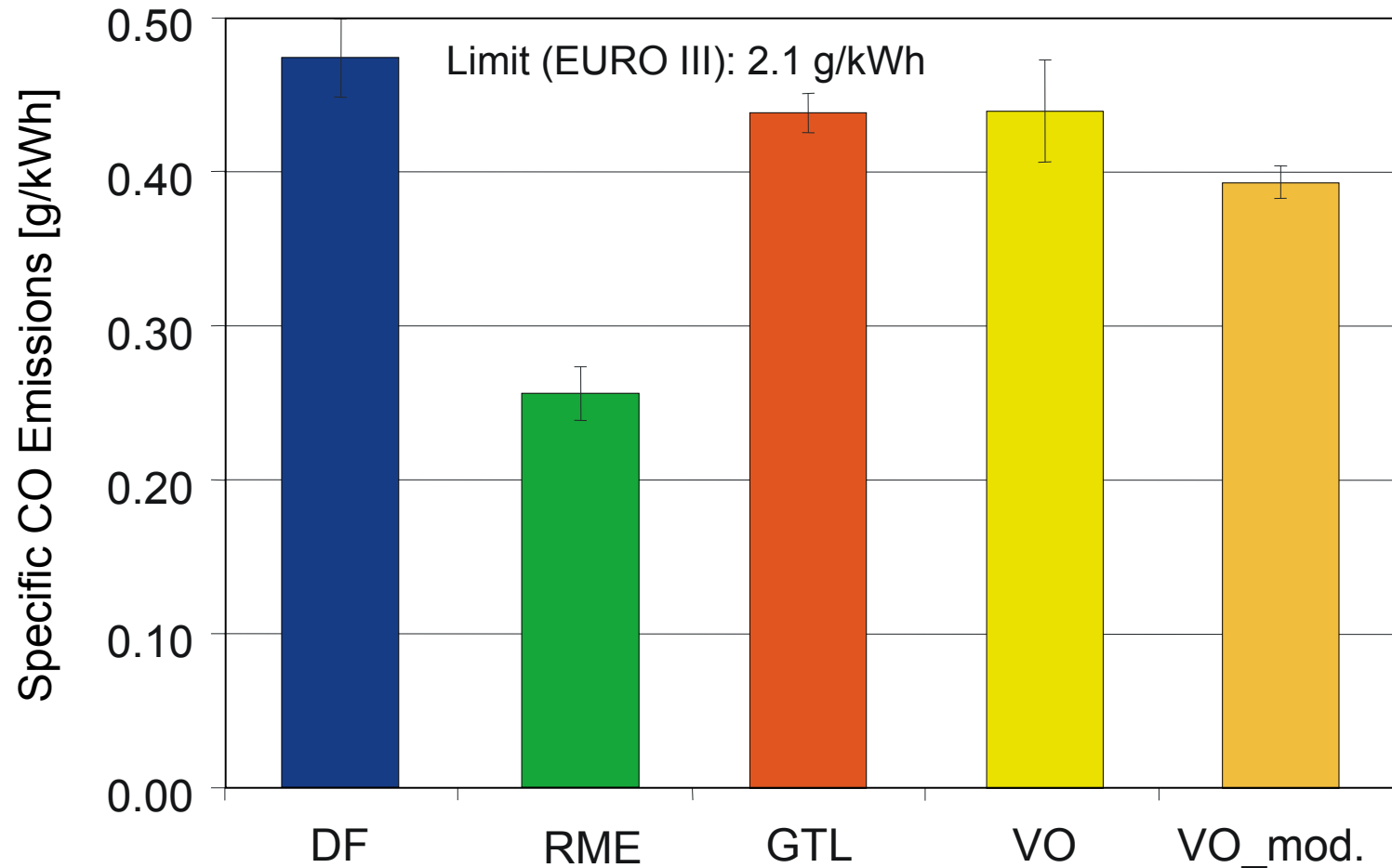
Stroke of cylinder	130 mm
Bore of cylinder	102 mm
Number of cylinders	6
Stroke volume	
Normal rate of revolutions	
Rated power	205 kW
Maximum torque	
Compression ratio	18
Certification	EURO III

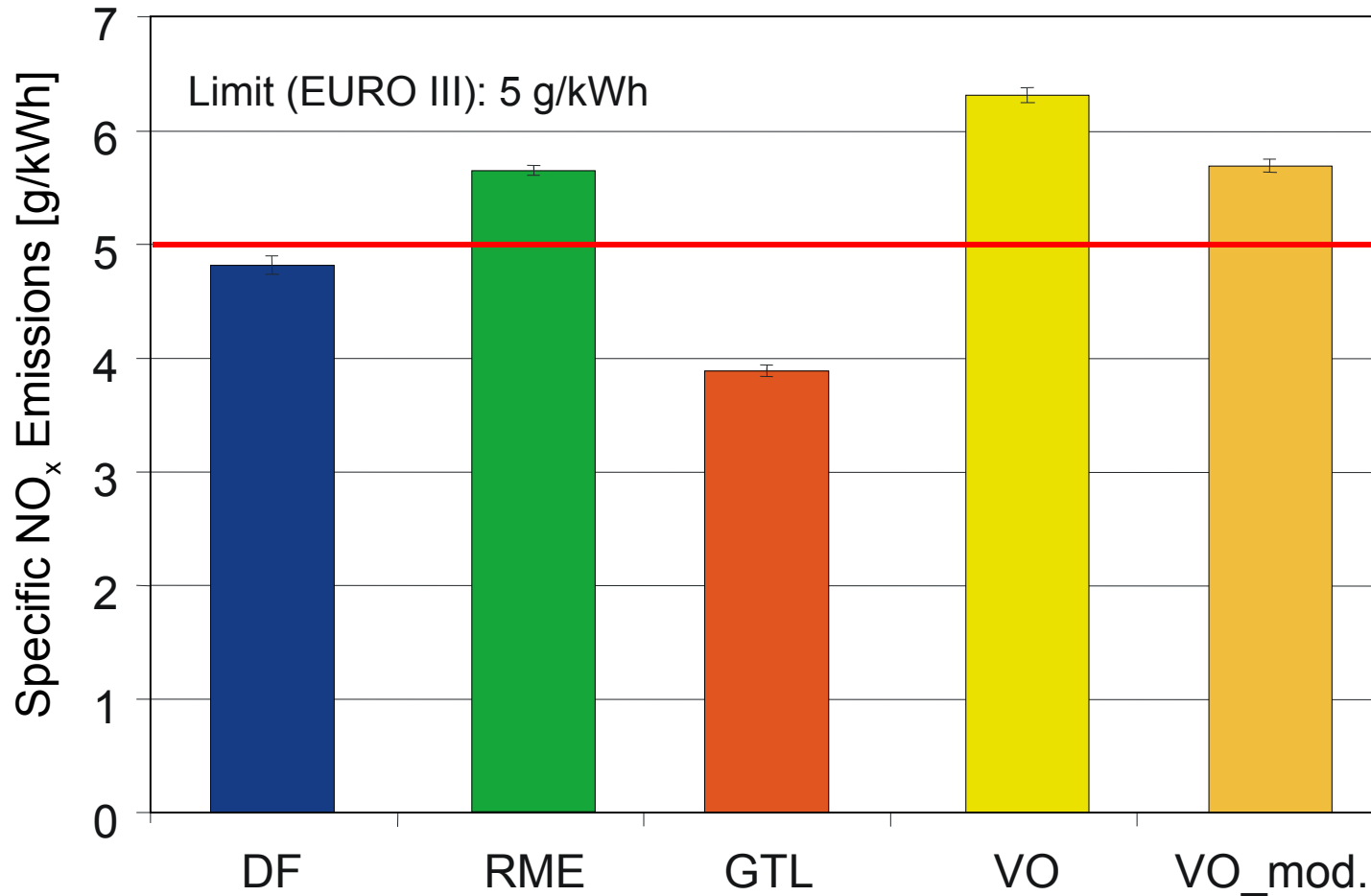
ESC Test

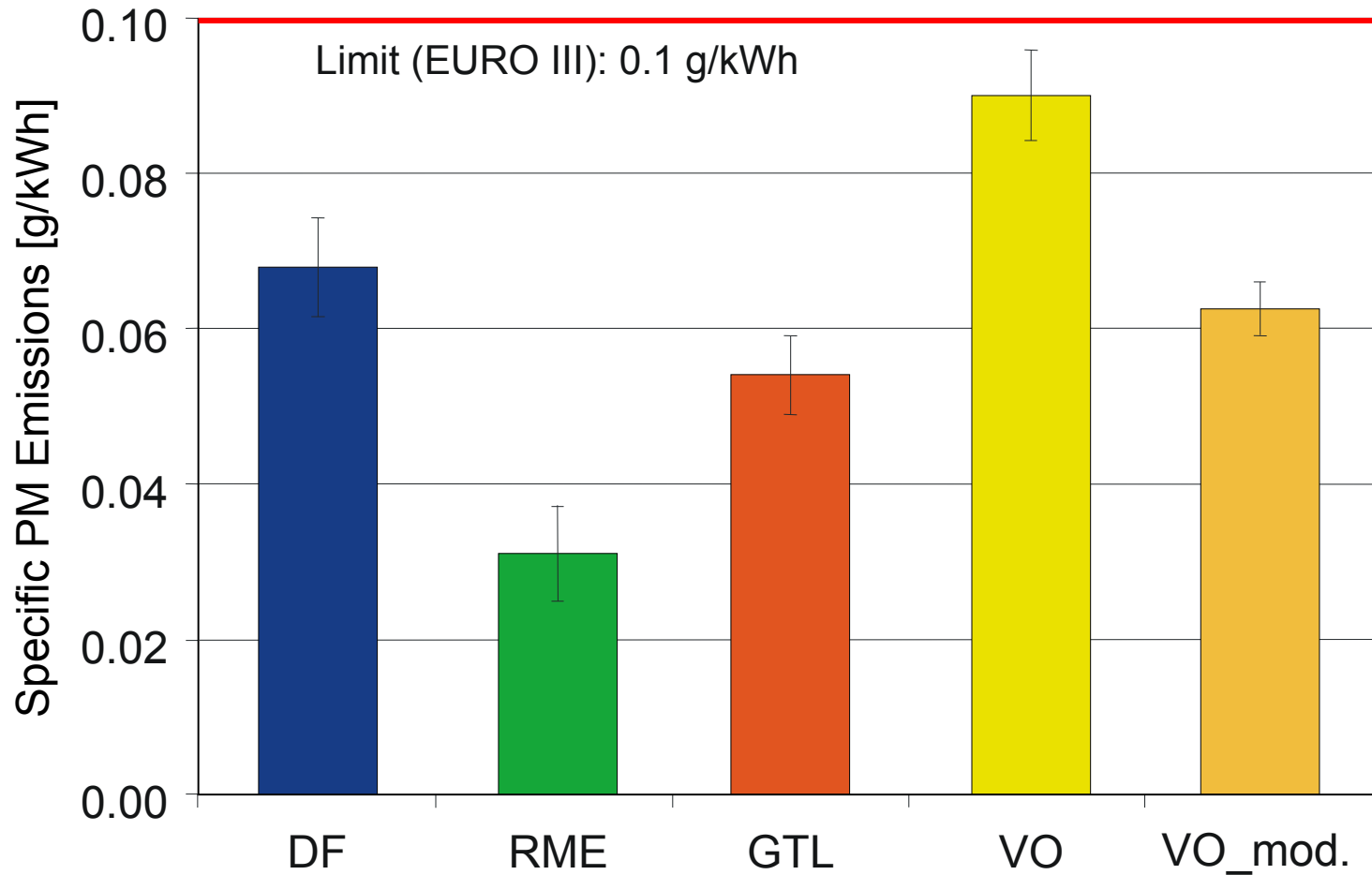


- Reference diesel fuel according to DIN EN 590 (**DF**)
- RME according to DIN EN14214 (**RME**)
- Shell Middle Distillate (**GTL**)
- Cold pressed rape seed oil close to DIN V 51605 (**VO**)
- Refined and flow improved vegetable oil according to DIN V 51605 (**VO_mod.**). For these tests the engine was equipped with brand-new injection nozzles.

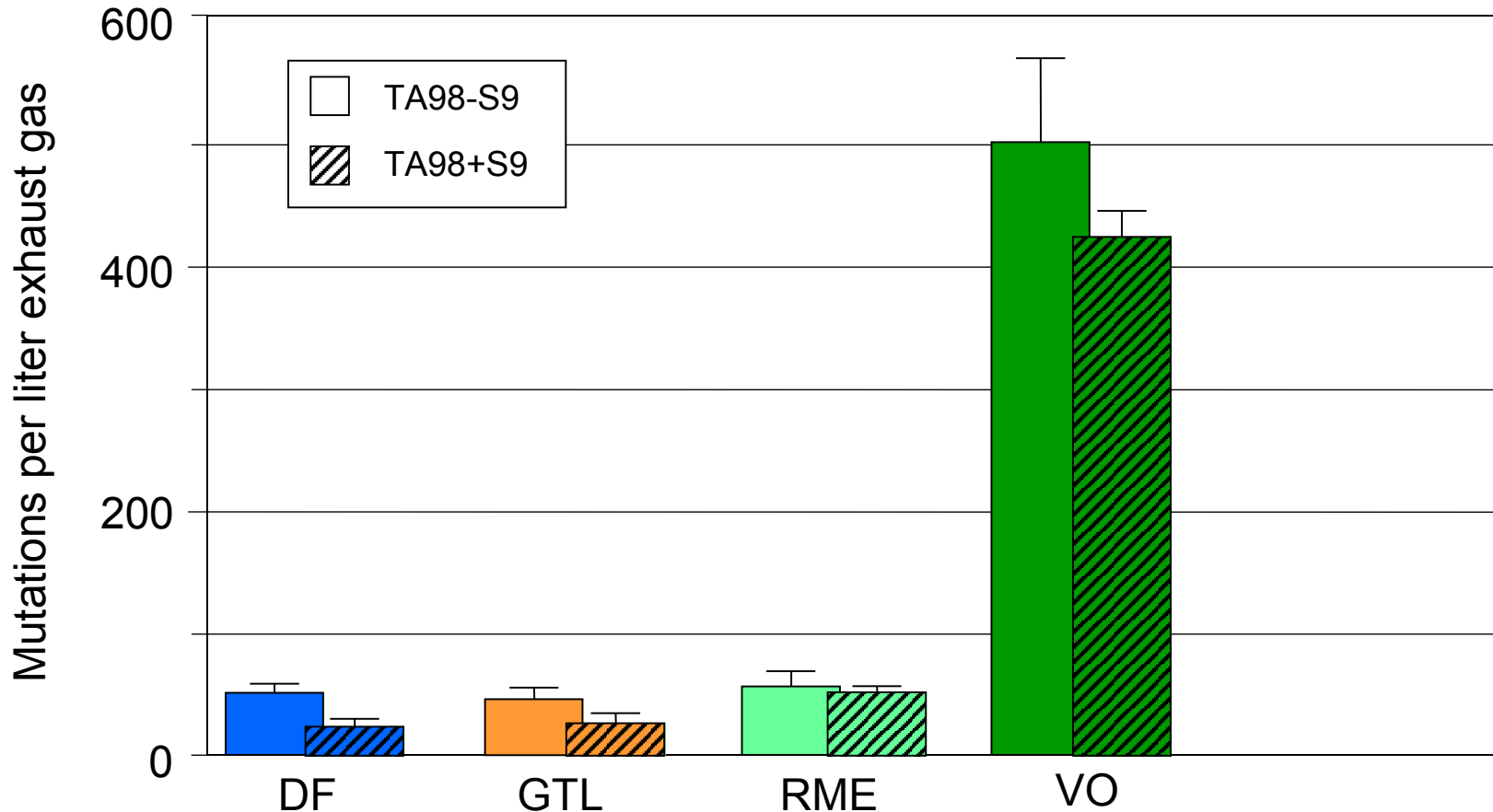




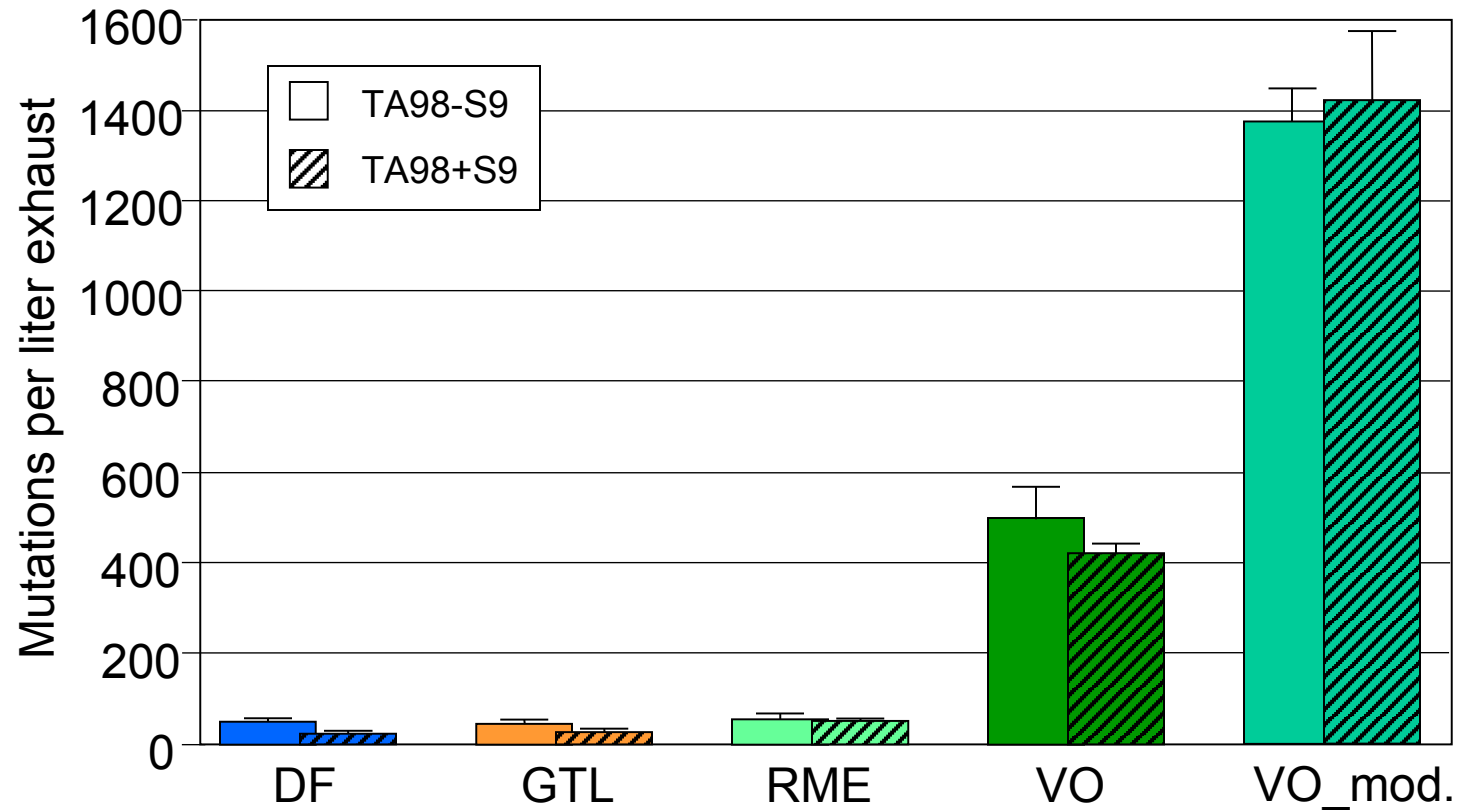




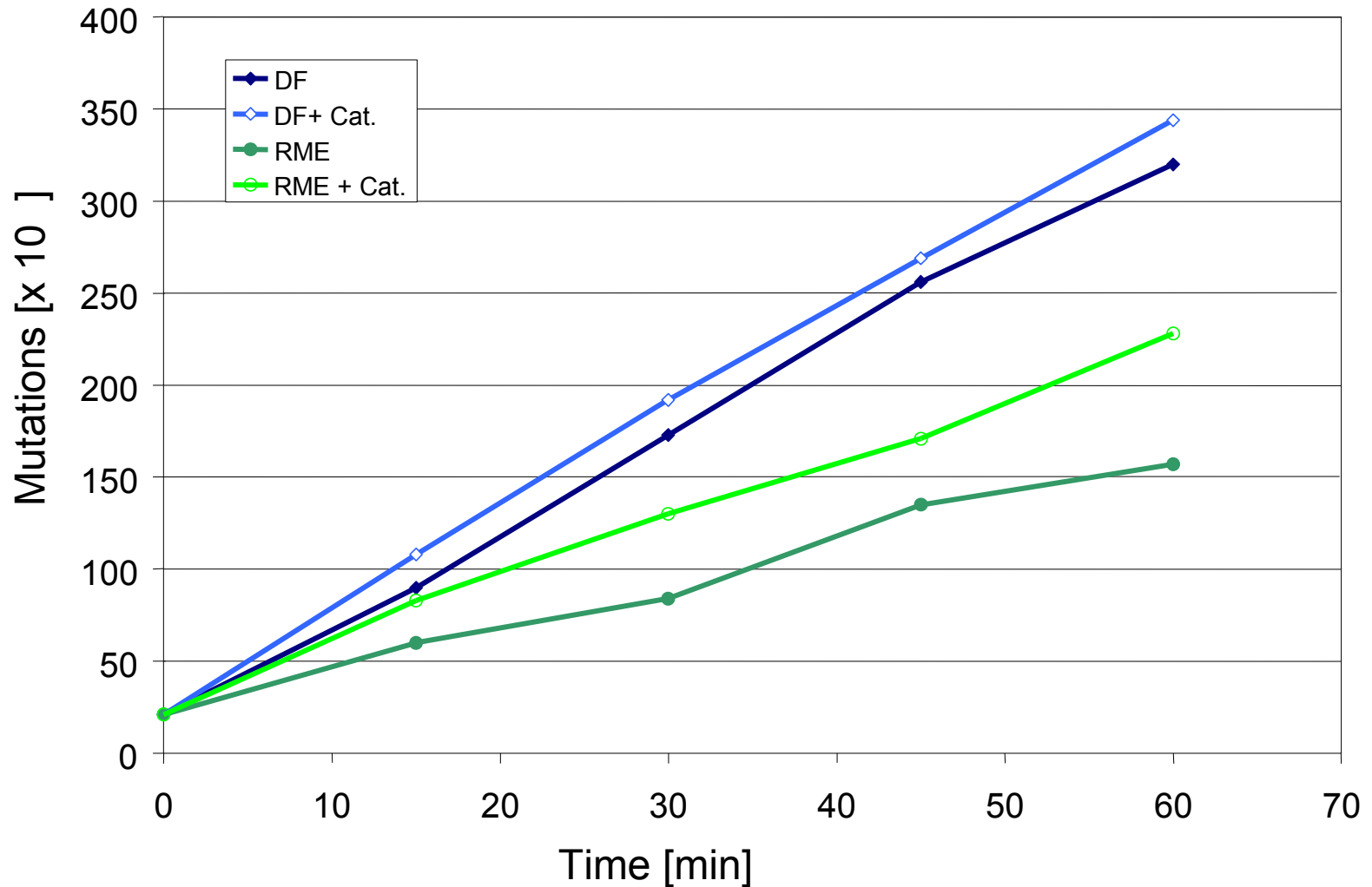
Mercedes Benz OM 906 LA, Euro III, ESC Test



Mercedes Benz OM 906 LA, Euro III, ESC Test



Impact of an Oxidation Catalytic Converter on the Mutagenicity at Rated Power; Tester Strain TA98



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- ❑ Biofuels will become increasingly important (although their increased application lost some momentum during the preceding months)
- ❑ In Europe, diesel based biofuels may predominate
- ❑ Biodiesel may play an important role but should be optimized
- ❑ HVO will certainly become an important fuel component

- ❑ Emissions and health effects of biofuels and blends have to be investigated
- ❑ Cold pressed rapeseed oil led to a 10-fold higher mutagenicity of the exhaust gas particles at the test engine. When preheated and flow improved vegetable oil was used, the mutagenicity increased 30-fold versus DF
- ❑ An oxidation catalytic converter can increase the mutagenicity at rated power