European Biofuels Technology Platform – Support for Advanced Biofuels Stakeholders

Report on the 7th Stakeholder Plenary Meeting of the European Biofuels Technology Platform

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FINAL DRAFT

PROJECT PARTNERS

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EXECUTIVE SUMMARY

The European Biofuels Technology Platform (EBTP) aims to contribute to the development of cost-competitive world-class biofuels value chains and the creation of a healthy biofuels industry, and to accelerate the sustainable deployment of biofuels in the European Union, through a process of guidance, prioritisation and promotion of research, technology development and demonstration.

The Stakeholder Plenary Meeting which was organised by the EBTP-SABS project consortium in cooperation with the EBTP Steering Committee brings together the EBTP stakeholders and people interested in the biofuels sector. The 7th SPM Meeting took place on 21st June, and drew interest to around 80 participants from mostly industry including fuel/biofuel producers, consultancy companies, biofuel associations and research institutes/universities. Participants from 20 different countries (mostly European) contributed to the meeting.

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LIST OF ABBREVIATIONS

BtL	Biomass to liquid
CEO	Chief Executive Officer
EBB	European Biodiesel Board
EBTP	European Biofuels Technology Platform
EBTP-SABS	European Biofuels Technology Platform – Support for Advanced Biofuels Stakeholders
e.g.	for example
EU	European Union
EIBI	European Industrial Bioenergy Initiative
iCET	Innovation Center for Energy and Transportation
IEA	International Energy Agency
ILUC	Indirect Land Use Change
ITAKA	Initiative towards Sustainable Kerosene for Aviation
NGO	Non-Governmental Organization
R&D	Research and Development
SPM	Stakeholder Plenary Meeting
UCO	Used Cooking Oil

1 Introduction

The 7th Stakeholder Plenary Meeting (SPM) took place on 21st June 2016, and drew interest to around 80 participants from industry including fuel/biofuel producers, consultancy companies, biofuel associations and research institutes/universities. Participants from 20 different countries (mostly European) contributed to the meeting. The following report will summarize the presentations given in each of the 3 Sessions. Background information of the conference can be found in the Annex. This includes the agenda, speaker information, list of participants and presentations.

2 Summary of the Sessions[1]

2016 is an important year for the implementation of the Energy Union objectives, the 2030 Climate and Energy package as well as to achieve COP 21 ambitions. A series of initiatives are relevant for the future of the biofuel sector:

- The post-2020 effort-sharing decision (how to address non-ETS emissions such as transport) following a Communication on the decarbonisation of transport, accompanied by an Action Plan on second and third generation biofuels (mid 2016)
- Developing a new Renewable Energy Directive post 2020 and a sustainability framework for biomass used for energy

The focus of this event was on the role of biofuels towards 2030 as an essential decarbonisation option. The aim was to discuss with participants the decarbonizing alternatives for the transport sector as well as latest developments in the biofuel research and technology sector.

The programme was organised into 4 sections:

- Introduction to the EBTP (Tomas Kåberger, Chair of the EBTP Steering Committee) and Keynote speech from Piotr Tulej, DG RTD, Unit G3 'Renewable Energy Sources'
- Session 1 Decarbonising transport
- Session 2 Biofuels and the latest research developments
- Session 3 Biofuels technology - The road so far - lessons learnt from different biofuel plants

[1] All presentations can be found in the Annex of this report and online (http://biofuelstp.eu/spm7/spm7.html)

All participants were welcomed by the EBTP Chair Thomas Kåberger who gave an overview of the biofuel sector for the last 10 years. Especially the oil price drop in 2014 and the ILUC debate were major concerns for the biofuels producers.

Keynote address:

The keynote address at SPM7 was presented by **Piotr Tulej, Head of Unit, Renewable Energy Sources, European Commission DG Research & Innovation**, highlighting the role of bioenergy/biofuels in accelerating the European energy system transformation in the European Strategic Energy Technology Plan (SET-Plan) Framework. The SET-Plan aims to accelerate the development and deployment of low-carbon technologies. It seeks to improve new technologies and bring down costs by co-ordinating research and helping to finance projects.

Session 1 Decarbonising transport

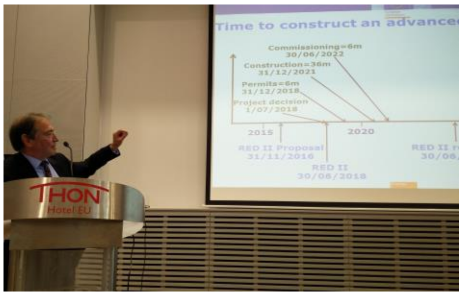
The current changes and outlook in global oil market was presented by **Jérôme Sabathier, Head of the Economics and Environment Evaluation Department at IFP Energies Nouvelles.** Since the end of 2014 the oil price has dropped by 51% due to decisions made by OPEC. Since January 2016 the price is recovering.

Marc Londo, ECN and EBTP Working Group chair Policy and Sustainability' shared the results of the EBTP Transport Vision Group. At the end of 2015 a group of EBTP Working Group chairs have formed the EBTP Transport Vision Group. In December 2015, ECN published a report, based also on the findings and discussions of the EBTP group, on Post-2020 Visions and National Plans for Sustainable Transport. The EBTP has also produced a draft Position Paper on Post-2020 Transport Strategies in Europe, focusing on the pivotal role of advanced biofuels in national and European transport strategy. A key message of the EBTP position paper is that "Next to RD&D and innovation support, a clear EU obligation for advanced biofuels is required. Such an obligation should be gradually increased in the period from 2021 to 2030. The obligation can be defined as an absolute amount e.g. in terms of energy or greenhouse gas reduction, or as a relative share of biofuels in transport energy demand or liquid/gaseous transport fuels demand, and it can be applied to Member States or to fuel blenders."

Links:
http://www.biofuelstp.eu/downloads/ebtpreports/ecn-sustainable-transport-visions-beyond-2020.pdf
http://biofuelstp.eu/downloads/papers/draft-ebtp-position-paper-post-2020-transport-strategies.pdf

Insights in the role of advanced biofuels in future transport options were presented by **Nils-Olof Nylund, VTT Finland, EBTP Working Group Chair 'End use and distribution'.** An overview of different renewable energy options for the transport sector was given with the conclusion that decarbonisation of transport requires a wide range of measures and more than one single energy carrier to meet the needs of the different transport sectors. The results of a national Finnish study analysing the reduction of 40% GHG emissions was presented in regard to their impact on the national economy.

Panel discussion:



Ingvar Landälv was the moderator of the Panel discussion and invited the Panelists each with a short presentation on stage. Panelists were Kyriakos Maniatis, DG Energy; Inmanculada Gomez, ITAKA; Patrik Klintbom, Volvo and William Todts, Transport&Environment. The background of the Panel combined Policy, Environmental and the needs of different transport sectors (Aviation, heavy duty). Kyriakos Maniatis expressed his personal views on the complexity of biofuels value chains and the different requirements of the deployment in regard of the timeframe from construction to production. Investment in the biofuels sector is based on the need of a stable framework up to 2030 as the investment decision and commissioning for biofuels plants might require several years. This view was complemented by the experiences made in the aviation and transport sector from ITAKA and VOLVO. The decarbonisation of the aviation sector is difficult as the sector will strongly depend on liquid fuels for the future. Sustainable drop-in fuels are a priority. The discussion was opened for the conference participants and a lively debate starting from the definition of decarbonisation over to the implementation challenges took place.

Session 2 Biofuels and the latest research developments

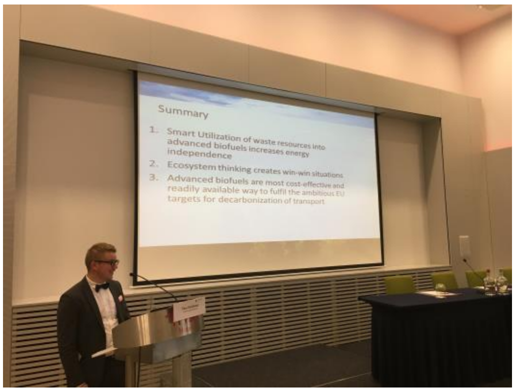
The results from the EBTP Strategic Research Innovation Agenda June 2016 Update were presented by **Britta Müller, Secretariat EBTP.** The SRIA was updated by the EBTP Working Groups to present the recent evolutions and trends in the biofuels sector and to highlight R&D&D priorities. A number of biofuels technologies are mature and ready for the deployment but policies, market regulations and financing are constant issues to bring them to the market. The document can be found online http://biofuelstp.eu/sra.html and partcipants were invited to provide feedback to the EBTP Working Groups.

First results and tools of the on-going S2Biom project for sustainable and resource efficient biomass were presented by **Calliope Panoutsou, EBTP Working Group Chair 'Biomass availability', Imperial College London.** The S2Biom project has the ambition to analyse the complete biomass value chain from primary biomass to end-use incl. logistics, pre-treatment, conversion technologies and have respective datasets and approaches online in the toolset. Results of the project can be found online http://www.s2biom.eu/en/publications-reports/s2biom.html

The integration of advanced biofuels in the circular economy was presented by **René van Ree, WUR**, also representing the IEA Bioenergy Task 42. Advanced biofuels based biorefineries – co-producing fuels and added value biobased products will be major foundation for and initiators of a Circular Economy. To allow an efficient use of the sustainable biomass the biocascading and biorefining approach should be persued. The related IEA Bioenergy Task 42 report is available online (www.iea.bioenergy.task42-biorefineries.com)

Session 3: Biofuels technology - The road so far: lessons learnt from different biofuel plants

Within Session 3 different biofuels plants from Germany, Sweden and Canada have been presented. These plants are using different technologies and synergies. Detailed information can be found in the attached presentation at the end of this document.



Nicolaus Dahmen, KIT, presented the status and outlook for the German bioliq-Project. The bioliq process is being developed to convert lignocellulosic, residual biomass into synthetic fuels and chemicals.

The Etanolix® unit in Gothenburg was presented by **Timo Huhtisaari, North European Oil Trade Oy.** The used waste-to-ethanol concept is a concept where food industry wastes are collected with and used to create advanced ethanol and animal feed as a by-product.

Eric Zinn, Göteborg Energi AB, presented the technical successes and economic challenges from the GoBiGas plant, producing biomethane from woody biomass.

Experiences are made in Canada with the processing of municipal solid waste into clean fuels and renewable chemicals, such as ethanol and methanol at Enerkem’s first commercial facility in Alberta, Edmonton, Canada. The collaboration between a large city and a waste-to-biofuels producer to address waste disposal challenges was presented by **Rob Vierhout, Enerkem.**

Ingvar Landälv, LTU, presented results and lessons learned ofthe company Chemrec which has developed a process in which the Black Liquor, a sideproduct from pulp mills, is gasified to produce a high quality synthesis gas which can be further converted to fuels and chemicals.

3 Participants feedback

Within the previous Stakeholder Plenary Meetings a questionnaire was distributed to all participants in order to evaluate the conference via various questions with the overall objective for the Secretariat and partly the SC to receive feedback on the organization and the program. The reponse rate from SPM 6 was 43 % in total. This time it was decided to implement the questionare online and send it out to all participants in a follow up mail including the information where to find the presentations. However only 5 of the participants provided their feedback via this questionnaire and unfortunately no detailed analysis of the event can be made. So this approach cannot be recommended The received feedback is displayed in a table on the next page. The received feedback is good regarding the organisation and course of the conference. A desire for more representation from side of the European Commission has been expressed as well as a clearer focus of the EBTP towards industry and not only R&D. Feedback received during the coffee and lunch breaks and during the SC meeting the next day was positive. Some participants would like to see poster sessions which could be an idea for the next meeting.

Taking into account previous recommendations the EBTP-SABS team had decided to move the location of the event closer to the EU institutions towards the center of Brussels to receive a higher representation from EU institutions and representatives. Also, as the original planning was to have the SPM as a back to back event with an EC meeting, the team had decided to have a one-day conference. The last SPM were held on 2 half days, allowing most participants to travel to Brussels on the same day and providing more time for discussions. From 110 registered participants only 73 have participated physically in the conference from which around 1/3 came from Brussels.

1. Please rate the organzation of the event	2. How useful was the provided information materia	3. How relevant/ useful were the presentations to	4. Which presentation/ session was the most intere	5. Was the balance good between the presentations	6. Did you find the event useful for meeting other	7. Did you take part in previous EBTP Stakeholder	7.a.If yes, how do you find the variation of selec	8. Please add comments or suggestions on this event..
good	satisfactory	satisfactory	0	good	good	yes	good	
good	satisfactory	not satisfactory	NEOT-Etanolix to a certain extend, Bioliq, still a pilot scale.	not satisfactory	satisfactory	yes	satisfactory	The platform is still keeping a large focus on R&D. Most of operational projects are happening in Scandinavia. Some are failing, some others not. In a nutshell, the EIBI has some perspectives. The supply chain aspects were not tackled. A pity that you are always quicking out what is the main hurdle for the deployment of the numerous technologies available in EU. When the floor will be open to trigger more operational aspects, especially for SME? With some many billions invested into R&D and a very biorefineries, is that the future, budget wise, of EU? Best regards, Patrick de Jamblinne

good	good	very relevant	Transport Decarbonisation: This was highly relevant due to the urgency of 2030 climate change action and to the preparation of the upcoming Commission Communication on Transport Decarbonisation. Conventional European ethanol is highly sustainable and can easily deliver a third of our 2030 transport decarbonisation goals with absolutely no adverse side effects. But Commission definitions about what is "advanced" will likely block sustainable solutions, prohibiting us reaching the 2030 goals (for electric cars to reach 40% we will need 20 years with new cars sales of EVs at 40% of market.. right now it is 1%). What sense is there in working on	very good	very good	no		Overall very good event thank you, with many authoritative and interesting presenters. Best regards, James Cogan

			sophisticated solutions when the basic effective solutions in front of our noses are to be ignored :)					
good	good	very relevant	Oil markets VTT	good		yes	good	Good job generally on the organization, venue, etc. It would be good if some of the Commission staff would stay for the entire day so there could be better dialogue with them, as the leaders of the policy and programs.
good	good	very relevant	Current Changes and Outlook in Global Oil Market	good	good	yes	satisfactory	Consider participation of other stakeholders in the transport sector like EV developers or strategist in mobiliy

4 Conclusion

All in all the overall satisfaction of the participants concerning organisational and contextual aspects can be considered as “good” with potential further improvement in detailed aspects. It is advised to maintain the questionaire as a handout to receive more detailed feedback. The EBTP-SABS Team will try to further improve the preparation and organisation of meetings and conferences for the European Biofuels Technology Platform.

ATTACHMENTS

#1 AGENDA

#2 LIST OF PARTICIPANTS

#3 SPEAKERS CVS & ABSTRACTS

#4 PRESENTATIONS

European Biofuels
TECHNOLOGY PLATFORM

7th Stakeholder Plenary Meeting Agenda

21st June 2016

Decarbonisation of transport

21st June	
08:30-09:00	**Registration of participants and coffee**
09:00-09:20	**Welcome: 10 years of EBTP 2006 - 2016** *Tomas Kåberger, Chair of EBTP Steering Committee, Chalmers University of Technology*
09:20-09:40	**Towards an Integrated SET-Plan – The role of bioenergy/biofuels in accelerating the European energy system transformation** *Piotr Tulej. European Commission DG Research and Innovation*
09:40-12:15	**Session 1 Decarbonising transport** *Moderator: Tomas Kåberger* **Current Changes and Outlook in Global Oil Market** *Jérôme Sabathier , IFP* **The EBTP Transport Vision Group** *Marc Londo, EBTP Working Group Chair 'Policy and sustainability', ECN* **The role of advanced biofuels in future transport options** *Nils-Olof Nylund, EBTP Working Group Chair 'End use and distribution', VTT* **Panel discussion: Decarbonising transport** *Moderation: Ingvar Landälv, EBTP Vice-Chair, LTU* *Panelists:* Inmaculada Gomez, *IATA* Kyriakos Maniatis, *EC Energy* Patrik Klintbom, *VOLVO* William Todts, *Transport&Environment*
12:15-13:15	**Lunchbreak**
13:15-14:10	**Session 2 Biofuels and the latest research developments** *Moderator:* Markku Karlsson, *EBTP Vice-Chair* **Results from the EBTP Strategic Research Innovation Agenda Update** *Britta Müller, Secretariat EBTP* **Sustainable and resource efficient biomass** *Calliope Panoutsou, EBTP WG Chair 1 'Biomass availability', Imperial College London* **Integration of advanced biofuels in bioeconomy** *René van Ree, WUR, IEA Bioenergy Task 42* Q&A

7th Stakeholder Plenary Meeting Agenda

21st June 2016

Decarbonisation of transport

21st June

14:10- 14:50 Session 3 a Biofuel technologies-The road so far -lessons learnt from different biofuel plants
Moderator: Pierre Porot, Co-Chair EBTP Working Group 'Conversion'

Status and Outlook for bioliq-Project – Syngas Platform for High Performance Fuels
Nicolaus Dahmen Karlsruhe Institute for Technology (KIT)

The Etanolix® unit in Gothenburg
Timo Huhtisaari, North European Oil Trade Oy

14:50-15:10 **Coffee break**

15:10- 17:00 Session 3 b Biofuel technologies-The road so far -lessons learnt from different biofuel plants

GoBiGas: Technical successes and economic challenges
Eric Zinn, Göteborg Energi AB

Experiences made in Canada with the processing of municipal solid waste
Rob Vierhout, Enerkem

Efficient integration of fuel generation with pulp mills
Ingvar Landälv, LTU

Discussion

17:00-17:15 **Closing address**
Tomas Kåberger, Chair of EBTP Steering Committee, Chalmers University of Technology

The European Biofuels Technology Platform

7th Stakeholder Plenary Meeting

List of Participants

21st June 2016, Brussels

Hotel Thon EU, Rue de la Loi 75

Name		**Institution**
Andersen	Marika	Bellona
Borella	Alessandra	ENI
Bacovsky	Dina	Bioenergy 2020+
Bitnere	Kristine	Hart Energy
Buffet	Laura	T&E
Busatto	Catherine Busatto	Total
Canciani	Peter	Central European Initiative
Chini	Nina	Ministry of Energy
Christou	Myrsini	CRES
Cluyts	Ivo	Belgian Federal Ministry
Cobror	Sandro	biochemtex
Cogan	James	EERL
Conrad	Silke	Daimler
Cousin	Julien	Vrije Universiteit Brussel
Dahmen	Nicolaus	KIT
De Maré	Carl	ArcelorMittal
Decker	Eelco	Methanol Institute
Domínguez Pérez	Francisco José	IDAE
Font de Mora	Emilio	INEA - EC
Freire	Cristina	INNOVCAT
Gameson	Thomas	abengoa
Georgiadou	Maria	European Commission
Gómez Jiménez	Inmaculada	SENASA
Gryska	Piotr	PKN ORLEN S.A.
Hayes	Daniel	Celignis Limited
Hermanns	Roy	OWI
Hernández Latorre	Marisa	Ingelia
Huhtisaari	Timo	North European Oil Trade Oy
Hulbek	Torsten	KREAB
Kåberger	Tomas	Chalmers University of Technology
Karlsson	Markku	Finnish Forestry Industries Federation

Kerckow	Birger	FNR
Kiel	Jaap	ECN
Klintbom	Patrick	Volvo
Korbee	Evelien	Dutch Standardization Institute
Kraft	Axel	Fraunhofer UMSICHT
Lahaussois	Dorothee	TOYOTA MOTOR EUROPE
Landälv	Ingvar	LTU
Leahy	Patrick	Department for Transport
Londo	Marc	ECN
Löyttyniemi	Meri	Kaidi Finland / Miltton Brussels
Lundgren	Joakim	Luleå University of Technology
Malache	Jacques	International PRESS Agency
Maniatis	Kyriakos	European Commission
Martinelli	Filippo Giancarlo	PNO Consultants
Martinelli	Gerson	Cefic
Mossberg	Johanna	F3 - fossil free fuels
Müller	Britta	FNR
Nylund	Nils-Olof	VTT Finland
Panoutsou	Calliope	Imperial College London
Paulas Santos	André	EBB
Peixoto	Andreia	INNOVCAT
Porot	Pierre	IFP Energies nouvelles
Rogulska	Magdalena	PIMOT
Röj	Anders	Volvo
Sabathier	Jérôme	IFP
Sandquist	Judit	SINTEF Energi
Schmitz	Norbert	Meo Carbon Solutions GmbH
Schweitzer	Christian	bse Engineering Leipzig GmbH
Seisler	Dr. Jeffrey	Clean Fuels Consulting
Seron	Daniel	S2 Biosolutions
Sevcik	Peter	Enviral, a.s.
Shimura	Tsuneaki	Hitachi Zosen Europe Limited
Simjanovic	Jelena	T&E
Simon	Cliff	Energy Experts Intl
Sporer	Josef	Sporer Consulting
Stausboll	Yvonne	UPEI
Todts	William	T&E
Tulej	Piotr	European Commission
Van Ree	René	WUR
Vierhout	Robert	Enerkem
Westkämper	Moritz	FNR
Zinn	Eric	Göteborg Energi AB

Speakers: CVs & Abstracts

Welcome

Tomas Kåberger,

Chair of EBTP Steering Committee, Chalmers University of Technology

Currently, Tomas Kåberger serves as Professor of Industrial Energy Policy at Chalmers University of Technology where he is also responsible for the collaboration between the university and energy companies, including research on sustainable renewable biofuels with the Preem refinery and collaboration on biomass gasification with Göteborg Energy on the GoBiGas project producing methane. He is a member of the board of directors of Vattenfall and the Swedish Forestry Agency. He is also a visiting expert on biofuels at the College of Mechanical and Energy Engineering at Zhejiang University, 2008-2013 extended until 2018. As executive board chairman of the Japan Renewable Energy Institute, Mr Kåberger also spends 25% of his time in Japan. From 2008-2011, he was Director General of the National Swedish Energy Agency responsible for implementing policies as well as funding energy related research, development and demonstration.

10 years of EBTP 2006 - 2016

Keynote

Piotr Tulej,

European Commission, DG Research and Innovation

Piotr Tulej is Head of Unit 'Renewable Energy Sources' in the Directorate-General for Research and Innovation of the European Commission. In this capacity he formulates policies and contributes to the European Research Area in the field of new and renewable energy sources. He is responsible for research strategy for renewable energy technologies. Previously, in the European Commission, he headed implementation of the European Emission Trading System and the Effort Sharing Decision. He oversaw the Directive for Carbon Capture and Storage and the NER300 Programme for co-financing demonstration of innovative energy projects.

Earlier, he was Head of Renewable Energy Unit of the International Energy Agency (IEA), worked as programme manager at the Netherlands Agency for Innovation and Sustainable Development (SenterNovem) and the International Institute for Energy Conservation and Johnson Controls Inc. He began his professional career in research and development.

He authored or co-authored a number of publications on energy technologies and policies.

Towards an Integrated SET-Plan – The role of bioenergy/biofuels in accelerating the European energy system transformation

SESSION ONE: Decarbonising transport

Moderator: Tomas Kåberger

Speakers:

Jérôme Sabathier,

IFP

Jerome Sabathier is currently Head of the Economics and Environment Evaluation Department at IFP Energies Nouvelles. Jerome is an engineer of the Ecole des Mines and IFP School in France and holds a Master of Sciences in Energy Management & Policy from University of Pennsylvania, USA. As an energy economist, he has been working on various energy related projects for government agencies and private business, mainly in charge of financial analysis of investment projects and analysis of oil and gas pricing and fiscal systems. He joined IFP Energies Nouvelles in 2005 where he is now in charge of the Economics Department which carries out research, technical and economic studies and policy analysis in the field of energy and the environment.

Current Changes and Outlook in Global Oil Market

The 2014 sharp fall in oil price and its recent partial recovery are dividing the views of analysts regarding the oil market outlook: Are we entering into a new oil order with “low” oil price for an extended time period or are we at the beginning of new upwards cycle. These two views, “softer for longer” or “higher sooner” needs to be addressed looking at oil market fundamentals not forgetting economic, financial, monetary and geopolitical factors.

- The context: the 2014 oil price shock – what are the main causes of the sharp drop
- Developments in supply and demand
- 2016 Looking ahead: Global oil market and price outlook

Marc Londo,

EBTP Working Group Chair ‘Policy and sustainability’, ECN

Marc Londo is a senior researcher at ECN Policy Studies, coordinating the unit’s activities on renewables in the EU and beyond. He has vast experience in managing and executing energy scenario and road mapping projects, particularly in biofuels for transport, in techno-economic assessments and policy evaluations (ex ante and ex post). He coordinated ECN’s technical support activities to the negotiations for the National Energy Agreement, and also recently led two innovative strategy consulting projects for private clients of ECN. He is an experienced leader of EU projects, within Intelligent Energy Europe and in several impact assessments for the European Commission. Earlier, he worked as a project manager in sustainable energy and integrated rural development. He holds a PhD in biomass and land use and an MSc in environmental chemistry, both obtained at Utrecht University, to which he is currently liaised as a guest researcher.

The EBTP Transport Vision Group

Nils-Olof Nylund,

EBTP Working Group Chair ‘End use and distribution’, VTT

Nils-Olof Nylund has a Doctor of Technology degree in mechanical engineering (internal combustion engines) from Helsinki University of Technology. He is currently Research Professor for Energy Use in Transport and Engine Technology at VTT Technical Research Centre of Finland Ltd. He is manager of the Finnish research programme TransSmart on smart and sustainable mobility. He has been working with alternative fuels since 1979, and has been the Finnish delegate to IEA Advanced Motor Fuels (AMF) since 1990. Since 1998, he has been either Chairman or Vice Chairman of AMF. In addition, he also was the IEA EUWP Vice Chairman for Transport from 2007 to 2016.

The role of advanced biofuels in future transport options

Greenhouse gas emissions from transport will have to be reduced by 30 – 40 % by 2030 and by 60 – 80 % by 2050. Deep decarbonisation will require a wide range of measures, and it is obvious that one single energy carrier cannot meet all needs. Measures to reduce GHG emissions from transport include improvements on energy efficiency on the vehicle as well as on the transport system level, smarter operations throughout the whole system and introduction of renewable/low carbon fuel, including advanced biofuels. Liquid biofuels are among the most versatile alternatives. Electrification is best suited for light-duty vehicles and urban services, whereas long haul heavy-duty trucks, ships and commercial airplanes will have to rely on biofuels for decarbonisation. In addition to be able to serve all modes of transport, the best of biofuels are fully compatible with existing and future vehicles and infrastructure and can offer a fast track to transport decarbonisation. Mandates can effectively bring biofuels to the market. Several heavy-duty vehicle manufacturers have now certified Euro VI vehicles for 100 % paraffinic renewable diesel. Finland, with its huge biomass resources, has set up an ambitious target of 40 % renewable fuels in transport by 2030. In the case of Finland it has been concluded that from a national economy point of view, advanced biofuels are the most cost effective way to decrease GHG emissions from transport. A recent international study confirms that in the 2030 timeframe, improvements of energy efficiency and biofuels are more cost effective measures for GHG reductions than electric vehicles. However, in road transport, in the long run we will need electric vehicles as well as biofuels, electricity with a focus on urban services and biofuels with a focus on long haul operations.

PANEL: Decarbonising transport

Ingvar Landälv,

Vice Chair of EBTP Steering Committee; Lulea University of Technology

Ingvar Landälv, since 2013, has worked as senior project manager at Lulea University of Technology. Between 1997 and 2012 he was engaged in the development and commercialization of Chemrec's black liquor gasification technology, serving as Chief Technology Officer. In this capacity he took the initiative to convert the pulp mills to biorefineries thus making them producers of syngas-based fuels / chemicals in addition to the base product, paper pulp. He graduated in 1975 with a MSc in Physics & Chemistry. He has more than 35 years' experience of process R&D, design, engineering, construction and operation of gasification based process plants based on oil, coal and biomass as feedstock. He holds a number of patents in the area of energy integration in gasification based processes. Within the EBTP he is Vice-Chair of the Steering Committee and Co-Chair of Working Group 2 on ‘Conversion processes’.

Kyriakos Maniatis

DG Energy

Kyriakos Maniatis is Principal Administrator in the Directorate General for Energy, European Commission. He is responsible for technical issues related to biofuels and bioenergy and manages the DG ENER demonstration component on advanced biofuels in the European Commission's 7th Framework Programme. He contributes accordingly to the legislative actions of the EC and to the European Industrial Bioenergy Initiative of the SET Plan and he is involved in the CEN standardisation work on liquid and gaseous biofuels. In June 2011 he initiated the Biofuels FlightPath for Aviation in close coordination with the aviation and biofuels sectors. Kyriakos also represents the European Commission in the Executive Committee of IEA Bioenergy Implementing Agreement and served as the ExCo Chairman in 2002, 2005-2007. He regularly organizes workshops and conferences on these subjects.

Inmaculada Gómez,

Environmental Expert, SENASA

Inmaculada Gomez is the Project Coordinator of ITAKA. She has a PhD in Environmental Sciences with over 10 years' experience, and has been an environmental expert at the Observatory of Sustainability in Aviation of SENASA, since its creation in 2007. She was involved in the creation of the Spanish Initiative for aviation biofuels (Bioqueroseno.es), is member of the working group for alternative fuels of ACARE and the CAEP Alternative Fuels Task Force. Before working at SENASA she was professor of environmental economics and landscape planning, and worked on several research projects.

Patrik Klintbom,

Director Environment and Energy, Volvo Group

Mr Klintbom acts at expert at the Volvo Group Headquarters in Gothenburg Sweden. His areas of expertise are energy resources, alternative/renewable fuels and environment in general. His responsibility is to analyse and give guidance when it comes to issues related to energy supply and environmental issues in order to set the foundation for the Volvo Group Strategy and Positions within the area. Mr Klintbom has been with Volvo Group since 2001. He holds a bachelor's degree in Energy and Environment from Mälardalen University, Sweden.

Mr Klintbom is since 2011 the Chairman of the Swedish Energy Agency Development Platform for Transport (UP-Transport).

Mr Klintbom is a member of the European Commission Sub-Group on "Advanced Biofuels" giving recommendations on how to accelerate the introduction of such fuels in EU.

William Todts,

Transport&Environment

SESSION TWO: Biofuels and the latest research developments

Moderator:

Markku Karlsson,

Vice Chair of EBTP Steering Committee and Vice-Chair of Working Group 1 – 'Biomass availability and supply' , Finnish Forestry Industries Federation

Before retirement, Markku Karlsson was Senior Vice President, Technology at UPM-Kymmene Corporation in Finland. From 1999-2004 he was Senior Vice President in Corporate Technology at Metso Corporation. From 2004 until 2006 he was Vice Chairman of the Academy of Finland, and a member of the board from 2000 until 2003. He has been also a member of the board of the Finnish Forest Research Institute (Metla), a member of the Steering Committee of the European Biofuels Technology Platform, the Advisory Committee for the Forest Based Sector Technology Platform, and the CTO Committee of the Agenda 2020 Technology Alliance. He received a D.Sc. (Chem.Eng.) from Åbo Akademi University, Turku, Finland in 1987.

Speakers:

Britta Müller

Secretariat EBTP, Agency for Renewable Resources

Britta Müller is Project Manager at the Agency for Renewable Resources in Germany. Since 2013 she supports the coordination and management of the FP7 project European Biofuels Technology Platform- Supporting Advanced Biofuels Stakeholders (EBTP-SABS) and is responsible for all day-to-day administration of the project and the EBTP Steering Committee. She is also responsible for the management of project meetings and events as well as coordination of EBTP stakeholders and Working Groups. She has an academic background in agricultural sciences with a specialisation in agricultural economics.

Results from the EBTP Strategic Research Innovation Agenda Update

In light of new legislation and an ongoing debate on the availability and sustainability of feedstocks, as well as the acceleration of novel feedstocks, advanced conversion technologies, and emerging markets (e.g. aviation, shipping) the current Strategic Research and Innovation Agenda has been produced by the EBTP Working Groups. The aim of this update is to present the most significant recent evolutions of relevance to biofuels and to highlight corresponding R&D&D priorities.

Calliope Panoutsou,

Chair of EBTP Working Group 1 – 'Biomass availability and supply' Imperial College London

Dr Calliope Panoutsou is a member of the Bioenergy Group within the Centre for Environmental Policy (Imperial College London) and is the Chair of the EBTP Working Group on 'Biomass availability and supply' within the European Biofuels Technology Platform. Her work assignments focus on supply, logistics & economic analyses of biomass value chains, market & policy analyses and assessment of sustainability for bioenergy systems. She has coordinated several EU projects involving multi-disciplinary research on bioenergy. She also acts as expert in EU bioenergy, biofuels and agriculture committees. She holds a PhD from Aston University.

Sustainable and resource efficient biomass

Transition towards bio-economy and increasing resource efficiency is an important part of the European policy agenda. Research work in the last years has been much focused on evaluation of biomass availability and supply, driven by the demand in the bioenergy and biofuels sectors. However, the evolving bio-based economy covers a wider range of markets and end products. Therefore, it is important to examine synergies, conflicts and interdependencies among the different feedstocks. Moreover, there is a need for coherent indicators to evaluate quantity, quality and cost associated with the production of feedstock.

This gap has been addressed by EU FP7 funded project **S2Biom (**www.s2biom.eu**)**. The project aims to support sustainable delivery of non-food biomass feedstock at local, regional and pan-European level (EU28, Western Balkans, Moldova, Turkey and Ukraine) through developing strategies and roadmaps, supplied by a computerized and easy to use toolset.

René van Ree,

Theme Leader Biofuels & Bioenergy, Wageningen UR – Food and Biobased Research (DLO), Coordinator IEA Bioenergy Task42 Biorefining

René has been working in the energy sector for about 25 years, with a current main focus on circular economy, bioeconomy, biorefining, bioenergy, advanced biofuels & biobased broducts. He is currently employed at Wageningen UR in the Netherlands @ the research institute Food and Biobased Research (part of the DLO Foundation). Before he has worked at the Energy Research Centre of the Netherlands for about 15 years within the fields of clean fossil fuel use for energy purposes and thermal conversion & refinery of biomass for both energy and non-energetic applications. The development and deployment of sustainable biobased value chains as part of a bircular economy in which biomass is optimally and synergistically used for food and non-food applications is his major driver. His main responsibilities are: set-up of large bilateral and private-public projects at national, European and global scale; RTD strategy development; national and European policy support; project management; Dutch/Wageningen UR representative in various (inter)national platforms. His related positions are: Coordinator IEA Bioenergy Task42 Biorefining, Member Steering Committee European Biofuel Technology Platform (EBTP), Member European Energy Research Alliance (EERA) Bioenergy, Member Energy Advisory Group Dutch Ministry of Economic Affairs.

Integration of advanced biofuels in bioeconomy

- Circular economy
- Bioeconomy
- Biofuel based biorefineries

SESSION THREE: Biofuels technology-The road so far - lessons learnt from different biofuel plants

Moderator:

Pierre Porot,

Co-Chair EBTP Working Group 2 – ‘Conversion processes’; IFP

As Deputy Director of the IFP Energies Nuvelles Process Business Unit in charge of the Biofuels program, Hydrogen program and GtL program, he works on the IFPEN Biomass conversion strategy and projects follow-up: ligno-cellulose conversion to fuels through different paths (biological with the FUTUROL project, thermochemical with the BioTfueL project,...), resources availability, co-products management. In 2008, he became vice-chair of the WG2 of the European Biofuels Technology Platform. From 2001 until 2004, he was working as process engineer in the Process Department. He dealt with petroleum heavy ends conversion processes. At the same time, he also managed a project, which aimed to build linear programming refinery models. These simulators are designed for refining economic studies.

Speakers:

Nicolaus Dahmen,

Karlsruhe Institute for Technology (KIT)

Prof. Nicolaus Dahmen studied chemistry at the University of Bochum, finishing his PhD in 1992. He worked on application of high pressure to chemical reactions and separation processes as a group leader and, since 2000, as head of the High Pressure Process Technology division at the Research Centre Karlsruhe (today Karlsruhe Institute of Technology (KIT). In 2005, he joined the bioliq project management to build up a pilot plant to convert residual biomass into synthetic fuels and chemicals. Also, he took over the Thermochemical Biomass Refining division in the Institute for Catalysis Research and Technology (IKFT) at KIT. After habilitation in 2010 at Heidelberg University, he now is professor at the Faculty of Chemical Engineering at KIT. In the bioliq project he is responsible for R&D coordination.

Status and Outlook for bioliq-Project – Syngas Platform for High Performance Fuels

The bioliq process is being developed to convert lignocellulosic, residual biomass into synthetic fuels and chemicals. After erection of the pilot plant first operation along the full process chain from fast pyrolysis for de-centralized energy densification, high pressure entrained flow gasification for clean syngas production, hot gas cleaning, and gasoline synthesis via methanol and dimethyl ether as intermediates was achieved in 2014. The focus is now on optimization of the individual process steps and the overall process chain as well as on the further development in regard to commercialization.

Timo Huhtisaari,

North European Oil Trade Oy

Timo Huhtisaari is the Sustainability and Biofuels Expert at North European Oil Trade Oy, a Finnish fuel procurement company which is operating in Nordic countries. Through his Bachelor in Environmental Engineering and later on Masters of Corporate Environmental Management he developed a deeper interest in environmental topics, renewable energy and specifically biofuels. Currently at NEOT in his position for 3,5 years, Timo focuses on the regulatory affairs on Finnish and European level. Also he looks after advanced biofuels production projects at NEOT and how these fuels could be brought to market in fuels that go beyond blend wall.

The Etanolix® unit in Gothenburg

Advanced biofuels technologies are essential in increasing the sustainable biofuels volumes. Waste-to-biofuel are great way to utilize raw-materials that do not have real use. These concepts can create business ecosystems that create win-win-situations both for business as well as climate. Etanolix ® waste-to-ethanol is a concept where food industry wastes are collected with "bread-circles" and used to create advanced ethanol and animal feed as a by-product. This is possible through collaboration with food retailers, bakeries and waste collecting companies. The feedstock is used in refinery integrated ethanol production facility at the St1 Gothenburg refinery. This gives a variety of benefits in shared utilities, personnel as well as with blending infrastructure to ready fuels. Ethanol production technologies are not the main issue, there are a variety of technologies available around the world. However, the focus should be in how to increase the biofuels usage that truly replaces crude oil refining. The consumption pattern in Europe seems to be trending towards dieselization of fleet. In order to supply the amount diesel needed, the refineries will also need to produce petrol and other fractions as well. Therefore, it is essential to keep energy consumption balanced and replace all refinery process fractions with renewable ones. Waste based ethanol can be a substitute for the diesel used in fleets through ED95, pure ethanol added with ignition improver. This is especially good fuel to replace diesel used in distribution trucks and municipal buses. The most sustainable solutions are created when local production is combined with local consumption. This increases energy independence and truly reduces the crude oil consumption.

Eric Zinn,

Göteborg Energi AB

Eric Zinn has been involved in Göteborg Energi's ambitious investments in biomethane for transportation since 2007, which have transformed the company from one of Sweden's largest suppliers of natural gas to Sweden's leading biomethane developer. He has been responsible for project development (including Europe's first functioning plant for liquefied biomethane), biomethane logistics and business coordination. He is currently involved in business development at the GoBiGas plant and an active contributor to the Swedish Knowledge Centre for Renewable Fuels. Previously, Mr. Zinn has worked as a consultant in waste management and international development (primarily South Africa).

GoBiGas: Technical successes and economic challenges

The GoBiGas plant has the potential of producing one of the most efficient and inexpensive biofuels possible from woody biomass. The state supported demonstration facility was constructed in 2013 and was recently announced to be in full operation. Several initial difficulties have been overcome with the assistance of the growing knowledge base at nearby Chalmers University of Technology, but the economic outlook for the plant has never been bleaker. Will Sweden continue to lead the way for biomethane for transportation?

Rob Vierhout,

Enerkem

A graduate in Political Science and European Law, for 14 years Rob was the voice of European ethanol producers providing political and strategic insight to the membership of the various associations he led. He first was the principal advisor to AFTA (Association for Fair Trade in Alcohol) then the Secretary- General of eBIO (European Bioethanol Fuel Association) later to be appointed the first Secretary-General of ePURE (European Renewable Ethanol Association) in 2010. He stepped down from this position in September 2014. Since early 2015 he is Enerkem’s principal adviser on EU affairs.

Rob began his professional career as an academic researcher followed by 8 years in the European Parliament. He then moved on to private industry and became a public affairs consultant at Deloitte & Touche. Before Rob started working for the ethanol sector he was the managing director of the consulting firm European Affairs Management (EAM), which he founded, now called team. Since the end of 2014, Rob is providing consultancy services to a number of companies, inside and outside Europe, operating in the bioenergy sector. He is member of the European Commission’s advisory group on Advanced Biofuels.

Experiences made in Canada with the processing of municipal solid waste

Enerkem’s first commercial facility in Alberta, Edmonton, Canada, is the world’s first major collaboration between a large city and a waste-to-biofuels producer to address waste disposal challenges and turn municipal solid waste into clean fuels and renewable chemicals, such as ethanol and methanol. This facility can become a model for communities around the world that are looking for a sustainable way to manage waste and produce advanced biofuels. The speaker will discuss the Edmonton experience and address the challenges faced by Enerkem along the way.

Ingvar Landälv,

Lulea University of Technology

For CV please see Session 1

Efficient integration of fuel generation with pulp mills

Pulp mills are large consumers of renewable raw materials when converting wood to pulp. More than 50% of the energy in the feedstock ends up in an energy rich liquid by product, black liquor (BL). In today’s pulping process this stream is burnt in the so called recovery boiler to generate heat and power to run the overall process and to recover the cooking chemicals used to separate the wood fibers from the rest of the feedstock material. The company Chemrec has developed a process in which the BL is gasified to produce a high quality synthesis gas which can be further converted to fuels and chemicals. To compensate the pulp mill for taking its energy supply to other usage the concept also contains an efficient biomass fed boiler which generates the necessary steam and power to run the new pulp mill bio refinery. Since the mid 1990-ies Chemrec has operated its BL gasifiers for about 75 000 hours. The pressurized oxygen-blown gasifier in Piteå, Sweden has run more than 27 000h and the downstream located BioDME plant for more than 10 000 h. The operations result 2005 to 2016 will be summarized under the following key topics:

- Overall concept
- Availability consideration and Syngas quality
- Increasing syngas generation via addition of pyrolysis liquid to the BL flow
- Increasing syngas generation via utilizing renewable power
- Potential for renewable fuels generation from pulp mills in Europe

European Commission

Towards an Integrated SET-Plan – The role of bioenergy/biofuels in accelerating the European energy system transformation

Piotr TULEJ
European Commission, DG Research and Innovation
HoU Unit G3, Renewable Energy Sources

Research and Innovation

Outline

- Energy Policy
- Energy transformation & SET Plan
- Bioenergy & Advanced Biofuels
- EC support

Energy Policy

- EU commitment to a clean energy transition
- *'Resilient Energy Union with a forward-looking climate change policy*' one of the 10 top priorities of the Junker Commission
- Research, Innovation and Competitiveness one of the five pillars of the Energy Union vision

ENERGY UNION – VISION

- True **solidarity and trust**; speaking with **one voice** in global affairs
- An **integrated** continent-wide energy system
- Sustainable, low-carbon and climate-friendly **economy**
- Strong, innovative and **competitive** European economy
- **Citizens** taking ownership of the energy transition

Towards a European Energy Union

Five Pillars

- Energy security, solidarity and trust
- A fully integrated European energy market
- Energy efficiency supporting moderation of demand
- Decarbonising the economy
- Research, Innovation and Competitiveness

2030 Climate and Energy Framework

2020

20 % GHG

20% RES

10 % RES in transport

20 % EE

2030

40 % GHG

27 % RES

No target in transport

27 % EE

New Key Indicators

New governance system

The SET-Plan: coordinating research and innovation across Europe

The Strategic Energy Technology (SET) Plan is the technology pillar of the EU's energy and climate policy

The SET Plan Actors

- European Commission
- Member States (EU28+CH,IS,NO,TR)
- Stakeholder Platforms

New Governance SET PLAN

- Results oriented
- Involving a wide range of stakeholders
- Ensuring transparency, accountability, monitoring of progress and knowledge sharing (via SETIS)
- Stakeholder Platforms to provide strategic input and recommendations to the Set Plan Steering group and mobilize implementation
    - European Technology and Innovation Platforms (ETIPs): structures gathering all relevant stakeholders
    - The European Energy Research Alliance (EERA)
    - Other EU Stakeholder platforms relevant in the energy sector

The Integrated SET Plan

Main Actions

European Commission

1. Number one in RES: technology leadership by developing high performant, integrated and cost efficient renewable technologies
2. Consumer at the center of the future energy system: smart homes and cities, resilient, secure and smart energy system
3. Efficient energy systems: new materials and technologies, less energy intensive EU industry
4. Sustainable transport: leadership in batteries, renewable fuels for sustainable transport
5. A forward looking approach to CCS and CCU
6. Nuclear energy safety

European Technology and Innovation Platforms (ETIPs)

- Continuation of existing ETPs and EIIs in unified Platforms per technology
- Recognized interlocutors about specific R&I needs
- Cover the whole innovation chain, industrial stakeholders (incl. SMEs), research organizations and academic stakeholders, representatives of business, civil society and NGOs, representatives of MS

Freedom to organize as see fit

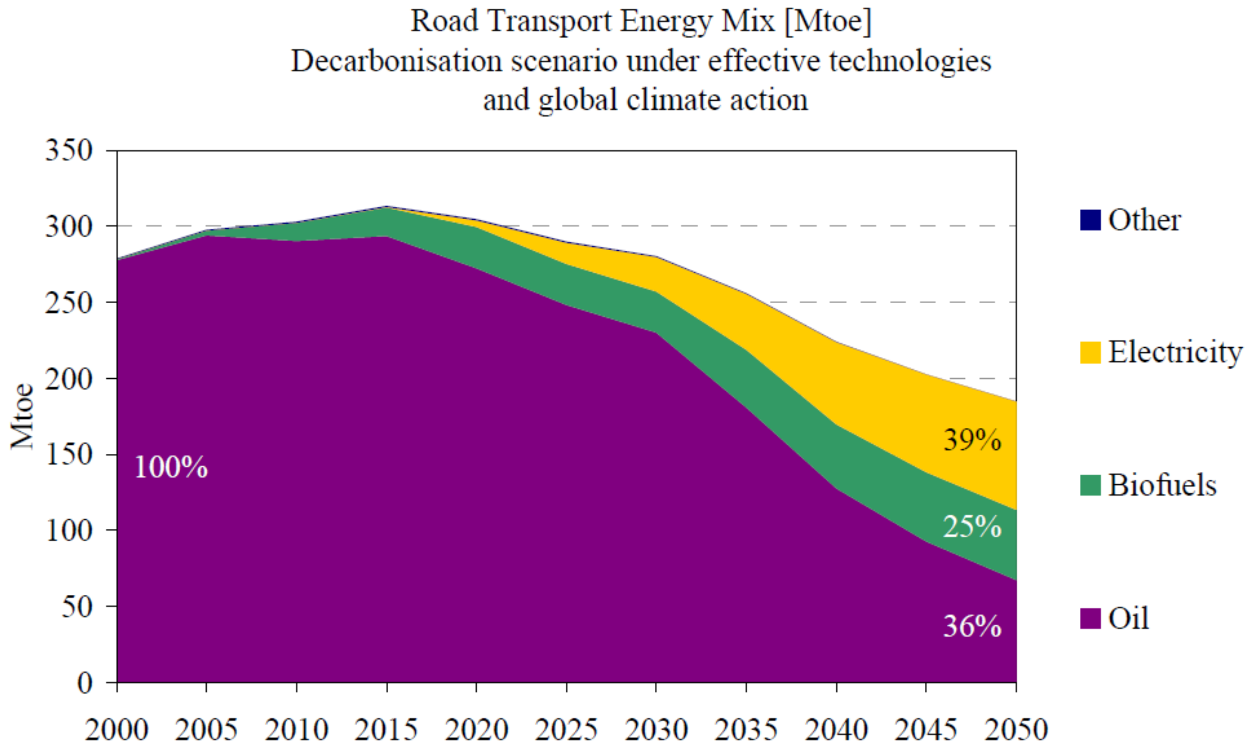
Bioenergy and Advanced Biofuels

Bioenergy in the future energy mix

(EUBCE 2016)

- Biomass crucial to achieve the 2° C target of climate change following the COP 21 agreement
- Already used 730 Gt out of 1000 Gt CO_2 budget for the 2°C
- Bioenergy can provide 10%-30% of all total CO_2 emission reductions needed
- A number of large scale demonstration plants are a reality, showing that biomass can be effectively converted into energy and advanced biofuels

A Roadmap for moving to a competitive low carbon economy in 2050



COM(2011) 112 final

Opportunities for Bioenergy and Advanced Biofuels

- Growing market for advanced biofuels
- Goal of reaching competitiveness to conventional biofuels by lowering production costs of advanced biofuels and addressing feedstock constraints
- Advanced biofuels and intermediates can play an essential role for both energy storage and use (grid balancing, use in electricity, heat and transportation)
- European leadership in advanced biofuels technologies

Bioenergy in Horizon 2020

WP 2014/2016

- EU contribution to bioenergy and advanced biofuels under the Energy calls (incl. SME instrument) reached **€100 Mio**
- Full R&I value chain covered from TRL 2 to 7 and market uptake actions

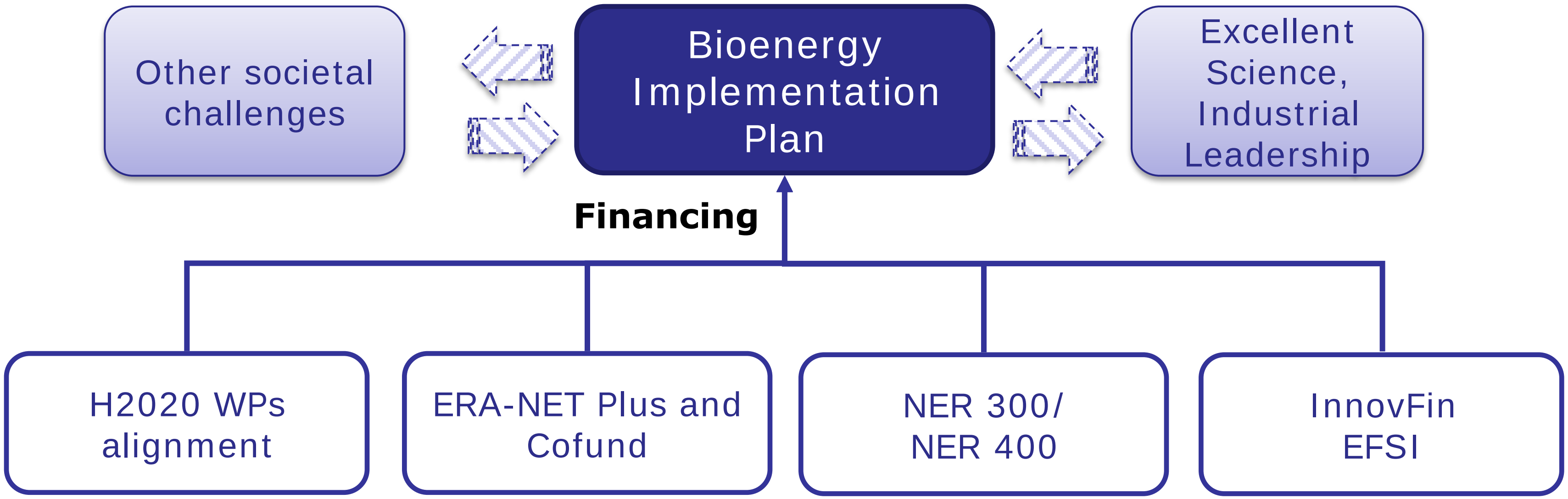
WP 2016/2017

- Evaluations on-going
- **€ 80 Mio** earmarked for advanced biofuels covering from TRL 3 to 7 and **~ € 100 Mio** for bioenergy including biofuels for TRL 2 to 3 and market uptake measures
- Loans for investments for innovation actions (FoK), notably through the EDP facility

Bioenergy in Horizon 2020 Draft WP 2018/2020

- Low TRL (2-3): Bottom-up approach to long-term research and technology development
- Medium TRL research (4-6): Advance and demonstrate the technology, reduce its costs, improve its performance and prove its reliability
- High TRL (7-8): technology-specific demonstration activities and support mechanisms for first-of-a-kind plants with a higher leverage than 'standard grants' (e.g. through the EDP facility)
- Market up-take measures

EC support to Bioenergy



InnovFin for first-of a kind projects

- Access to risk finance for R&I projects
- Promotes first-of-a-kind, commercial-scale industrial demonstration projects
- Loans and guarantees from EUR 25m to 300m
- Information: www.eib.org

Thank you
for your attention!

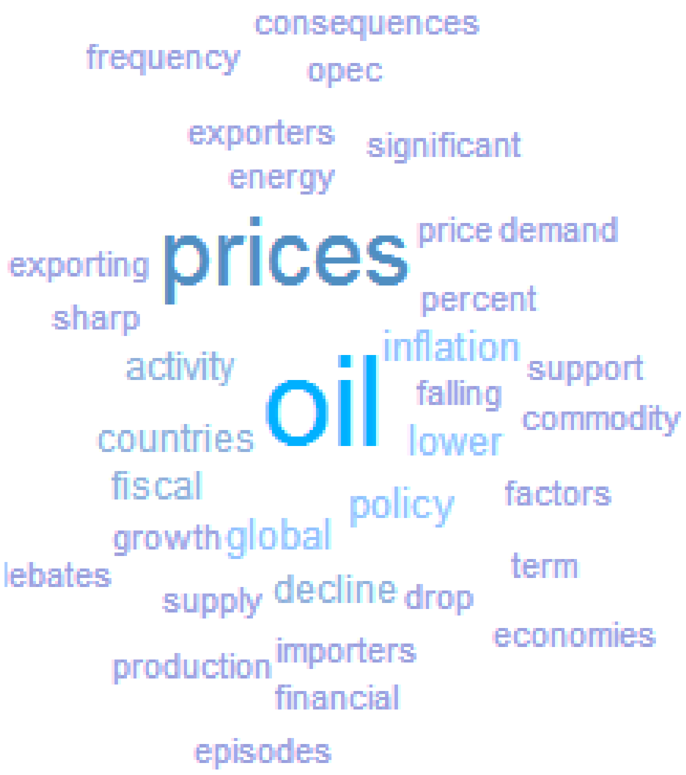
Find out more:
http://ec.europa.eu/programmes/horizon2020/en/

CURRENT CHANGES AND OUTLOOK IN GLOBAL OIL MARKET

JEROME SABATHIER - IFPEN

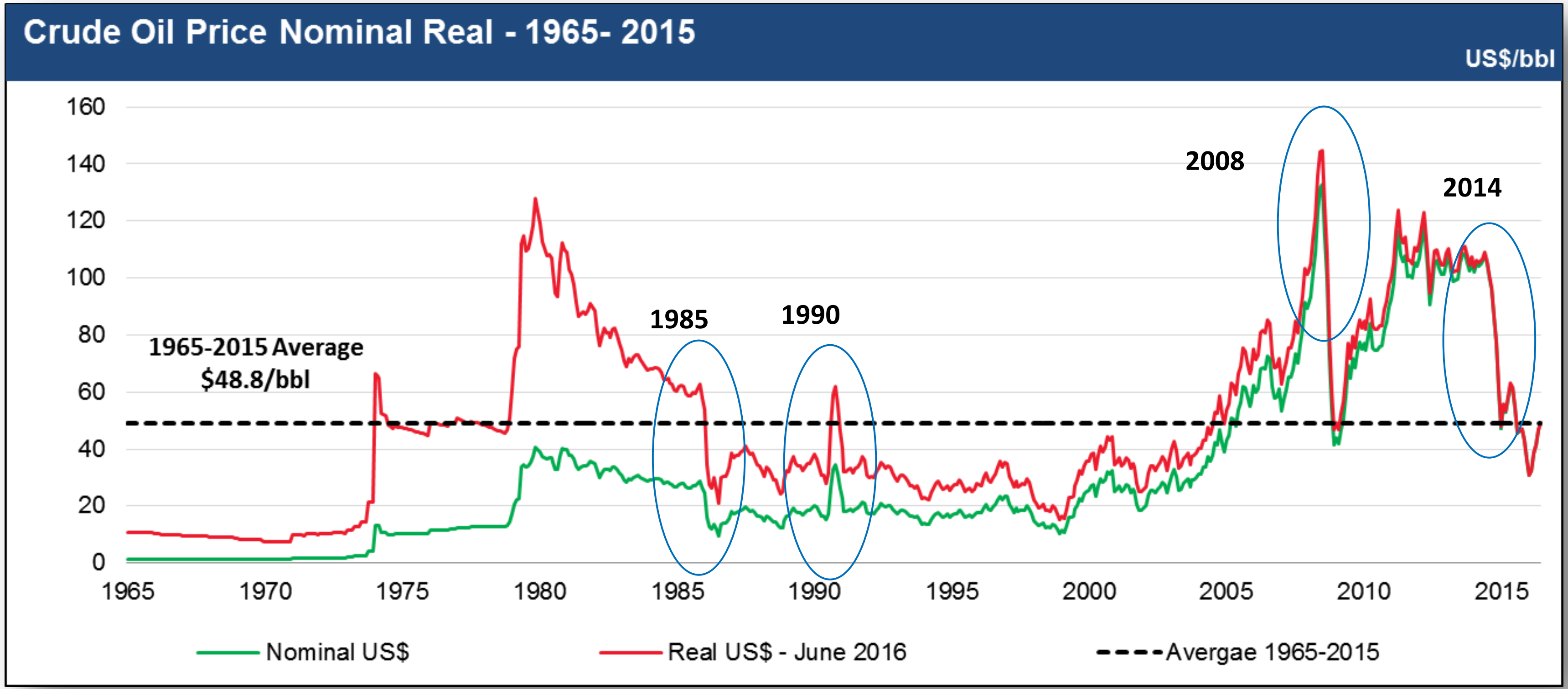
EUROPEAN BIOFUELS TECHNOLOGY PLATFORM

21 JUNE 2016 - BRUSSELS



HISTORY OF OIL PRICE : 1965-2016

RESPONSIBLE
OIL AND GAS



- The 4 biggest drop in crude oil price
  1. 1985-86 OPEC End of regulated prices (-66%)
  2. 1990-91 Gulf War (-48%)
  3. 2008-09 Financial Crises (-77%)
  4. 2014-2015 OPEC Decision (-51%)

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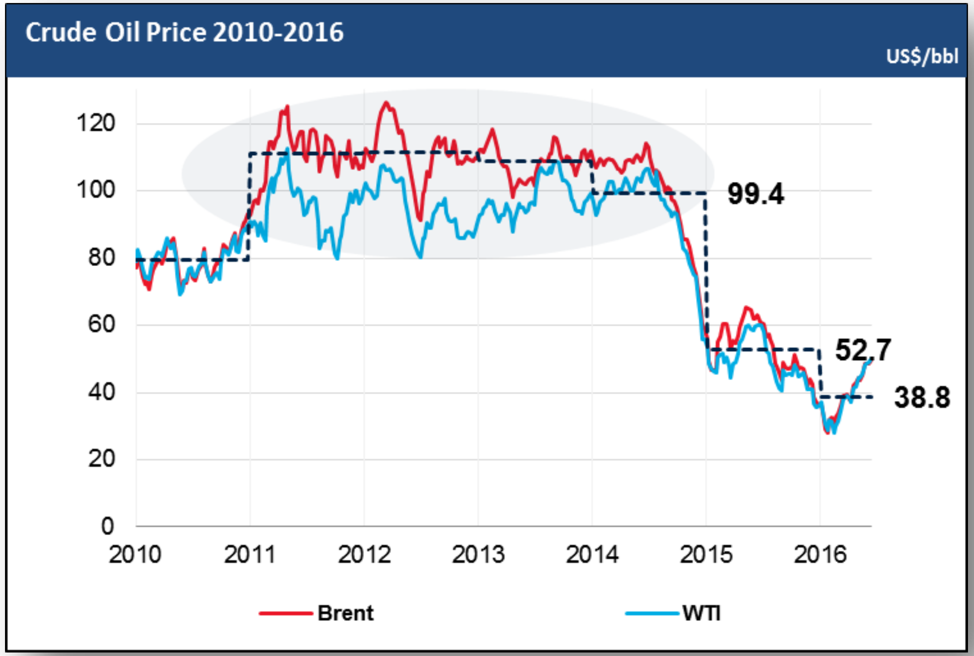
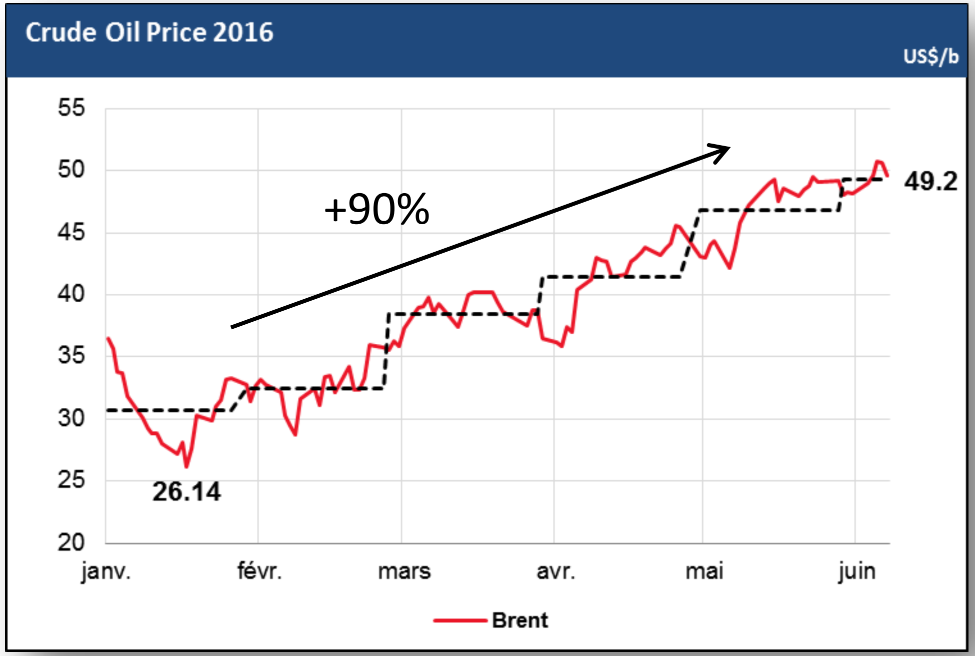
2014 – THE GREAT PLUNGE
2016 – THE GREAT RECOVERY ?





- Following four years of relative stability at around $105/b
- Crude oil sharply decline
  - Divided by 2 in 2015
  - Bottomed out in 2016 at 26$/b

- Since january 2016 price are recovering
  - +90% since end january 2016

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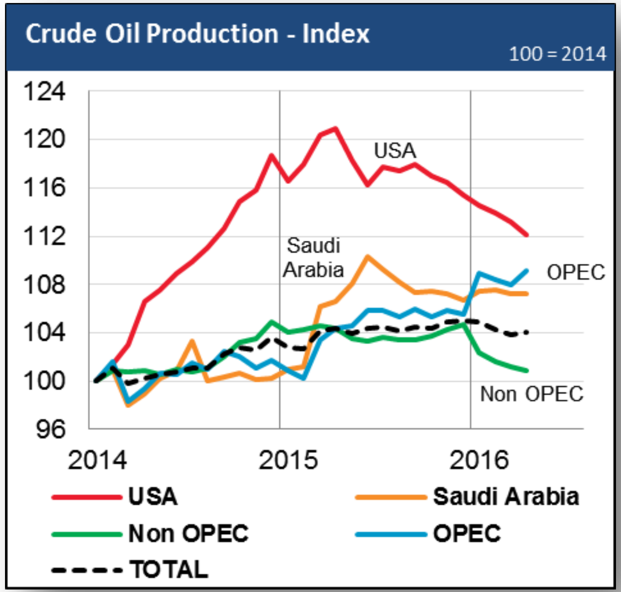
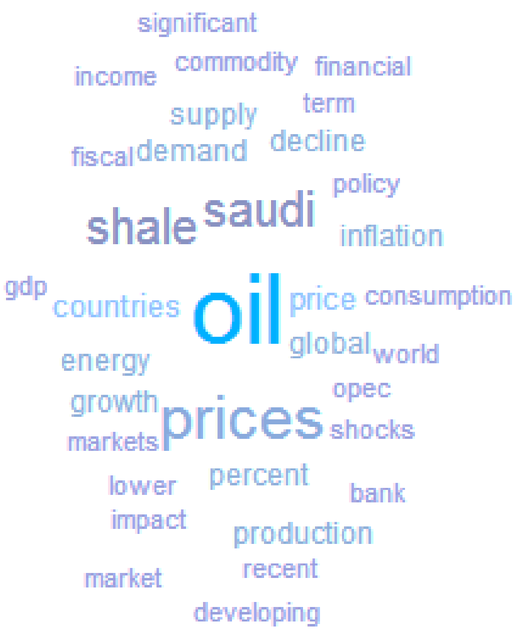
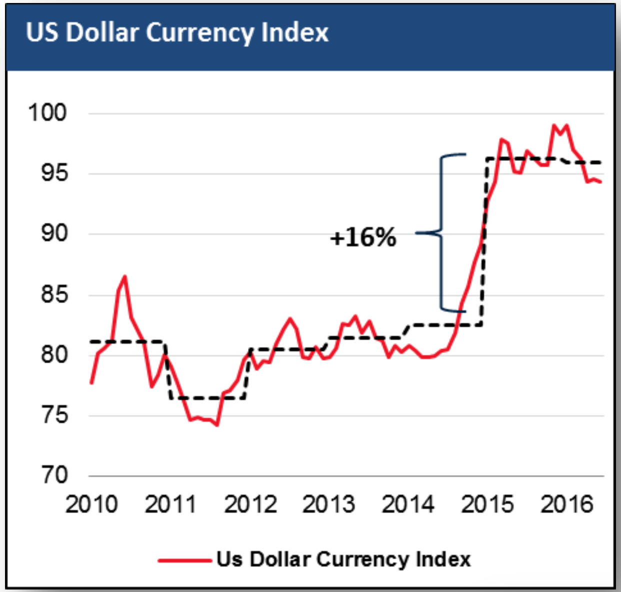
THE CAUSES: MULTIPLES - DIVERSIFIED







Oil Sector

- Surprising production of unconventional oil
- Significant shift in OPEC policy
- Disequilibrium of the oil supply/demand balance
- High level of stocks
- Leading to oil price plugging

Economy

- Weakening world commerce
- Unwinding of some geopolitical risks
- Appreciation of the U.S. dollar.

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THE CONSEQUENCES: WIDE RANGING

Significant real income shift from oil exporters to oil importers

+0.7-0.8 percent increase in global GDP

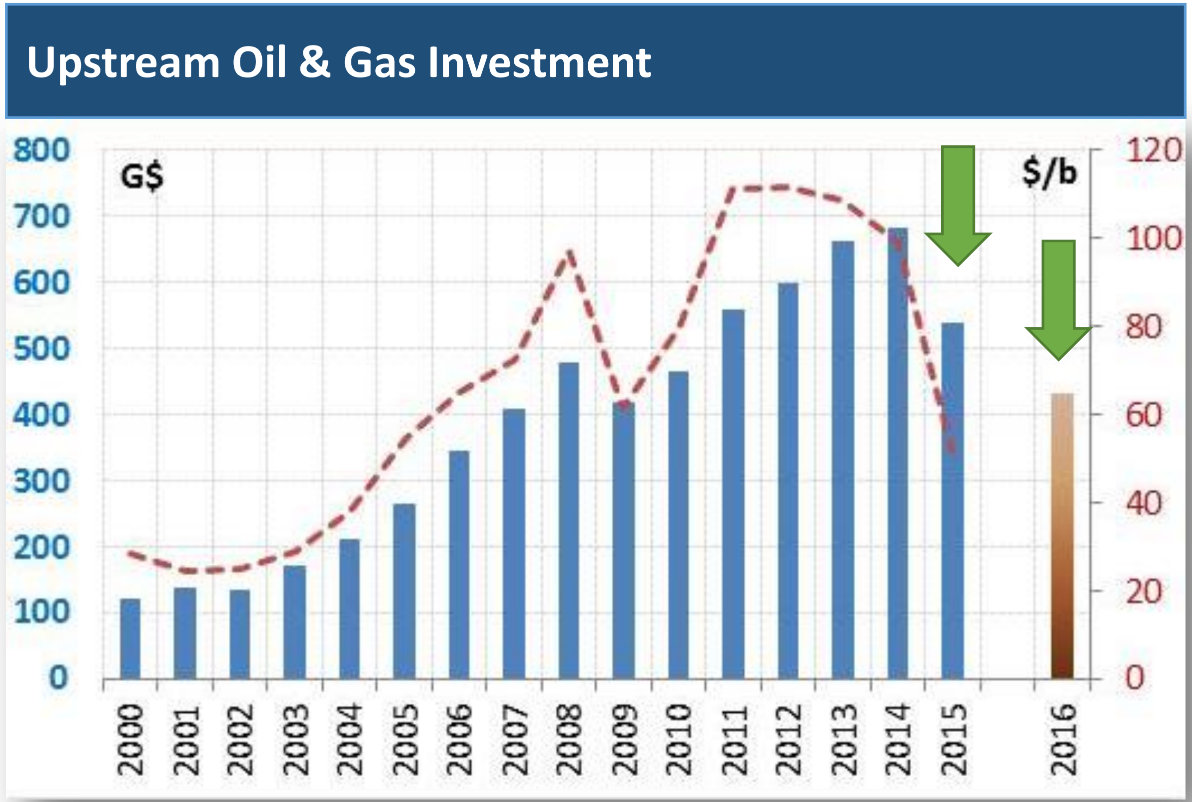
Decline in global inflation of around 1 percentage point

Some oil-exporting countries under stress

Weak global growth environment

Deflation risks

Drastic reduction in oil & gas budgets



2015/2014 : -21%

2016/2015 : -15/20%

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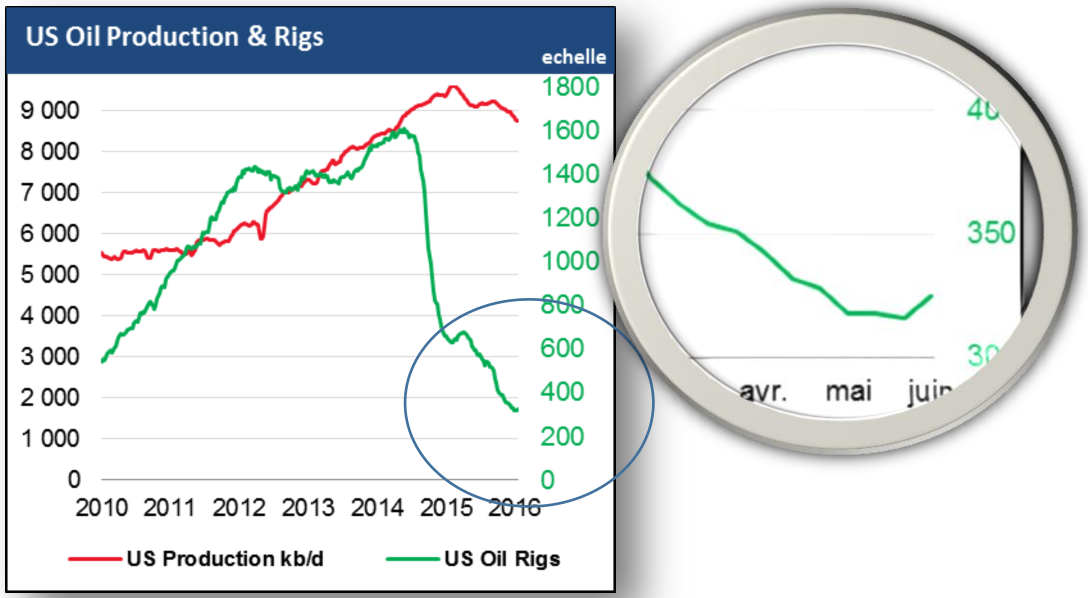
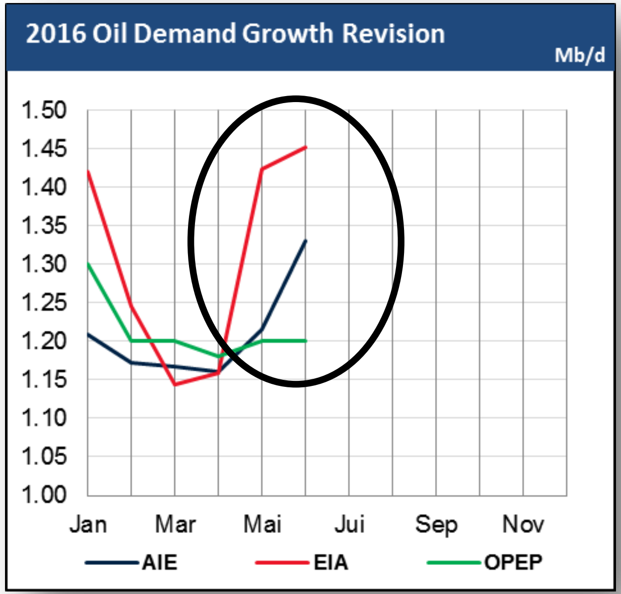
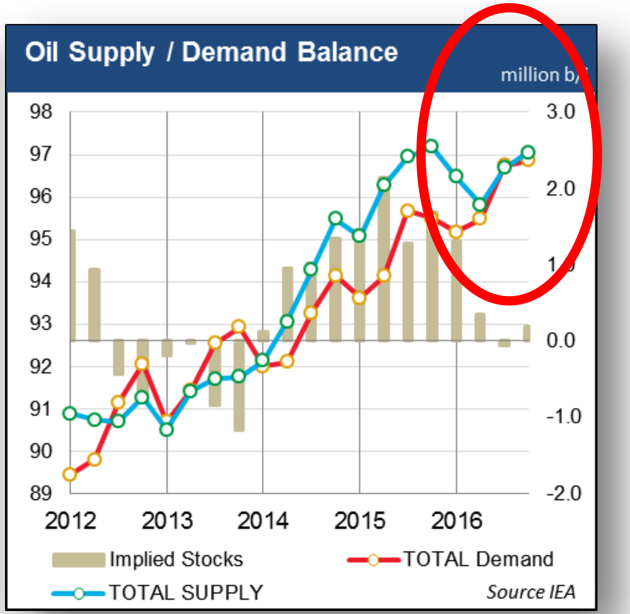
TURNING POINT ?







- US production resilience
- US Oil rigs: -80% since max. 2014
- US Oil production: -10% since max. 2015
- Since 2 weeks, US oil rigs count seems to have bottomed

- AIE & EIA have revised upwards their scenarios of oil demand growth for 2016 & 2017
- Oil Supply / Demand Scenario to be balanced by the end of 2016 (AIE)

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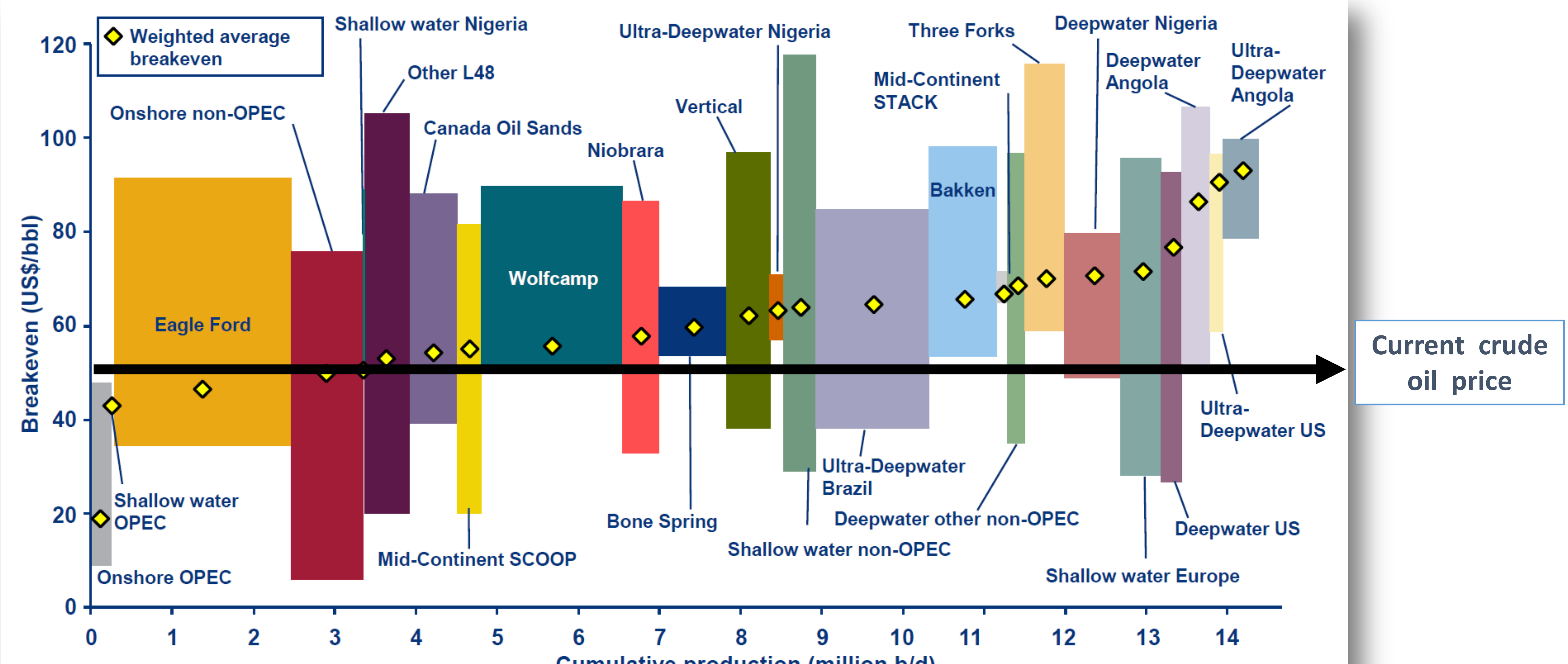
CRUDE COST OF PRODUCTION - OIL'S ACHILLES HEEL

RESPONSIBLE
OIL AND GAS



Source: Wood Mackenzie

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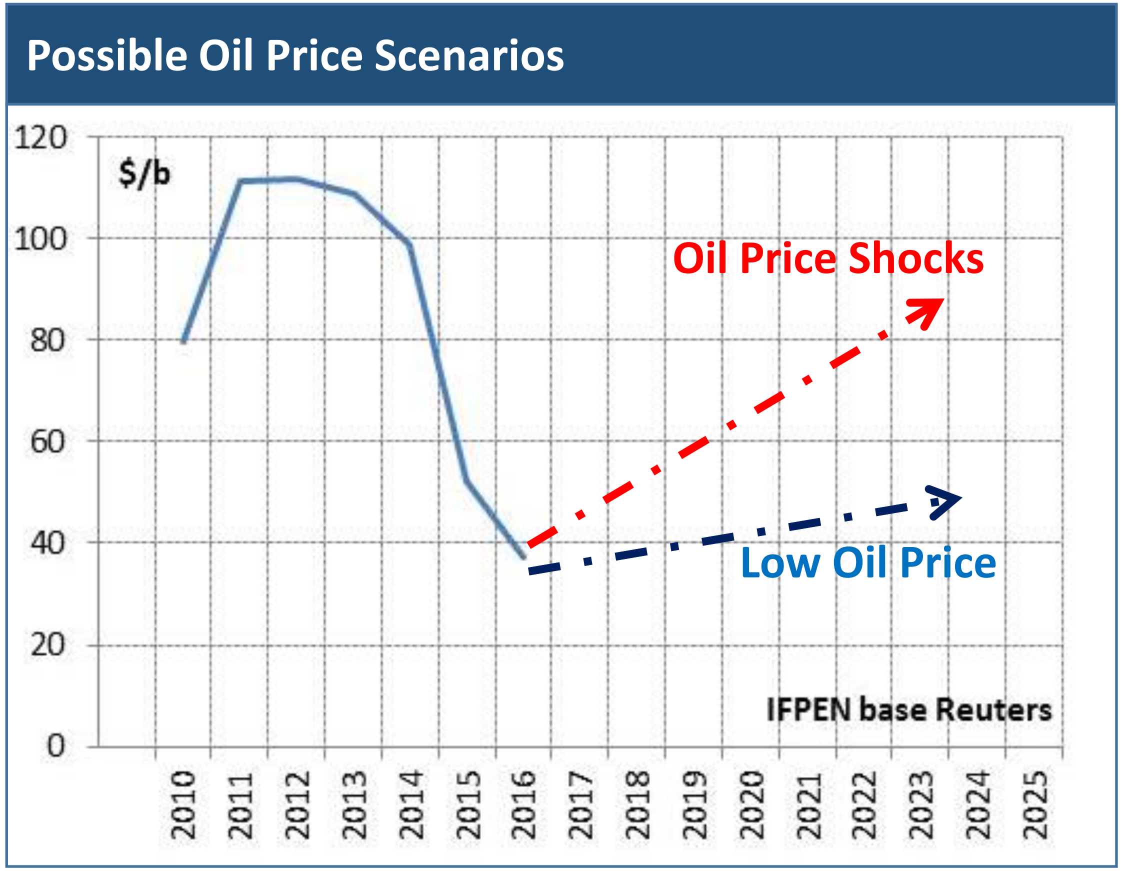
OIL PRICE SCENARIOS



- ***Low Oil Price = Lower Investment = Increasing oil shock risk***
- ***Scenario « Oil Price shocks»***
  - *Strong demand*
  - *Depletion of existing fields*
  - *High cost oil development at risk (offshore, oil sands,...)*
  - *Destabilization of some oil producers*
- ***Scenario « low oil price »***
  - *Important role of Middle East and Oil shales*
  - *Cost reduction*

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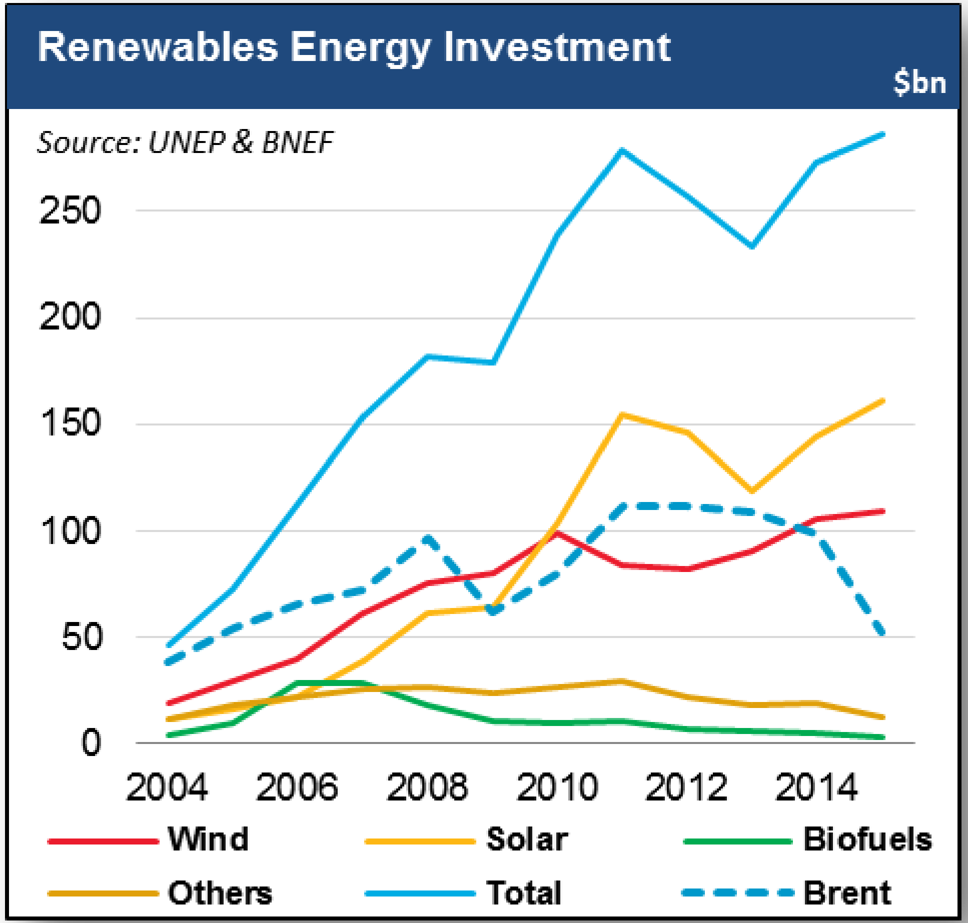
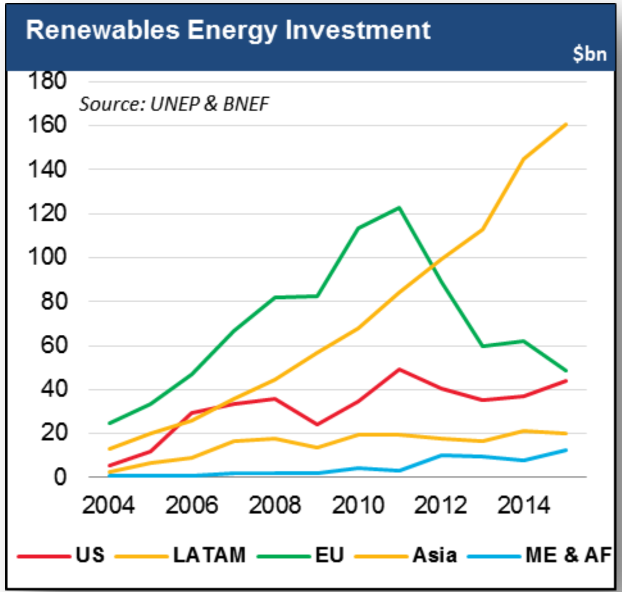
WORLD INVESTMENT IN RENEWABLES

ÉNERGIES NOUVELLES



- In 2015 global investment in renewables rise 5% to $286 billion
- Represents about 53 % of investment in oil & gas (30% in 2005)
- Disconnected from oil price swings



- record-breaking investment in developing countries
- China: about 36% of global total

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Post-2020 Visions and National Plans for Sustainable Transport

Indicative review

Recommendations

EBTP working group 'transport visions'
Marc Londo, ECN Policy Studies

Introduction

Context:

- Post-2020 RES framework under development
- Perspective for biofuels as part of sustainable transport
- What is the status in various member states?

Approach

- Review of MS state of affairs in the debate on sustainable transport
- Sample of 10 MS
- Reflection and discussion
- Position paper endorsed by SC

Key messages of the position paper

For the decarbonisation of transport, biofuels are an essential element

For healthy biofuels development after 2020, clear and stimulating EU policy framework for advanced biofuels and for decarbonisation of transport towards 2030 is essential.

Clear direction at EU level will be needed so that Member States can establish well-elaborated and coherent national decarbonisation strategies for the transport sector.

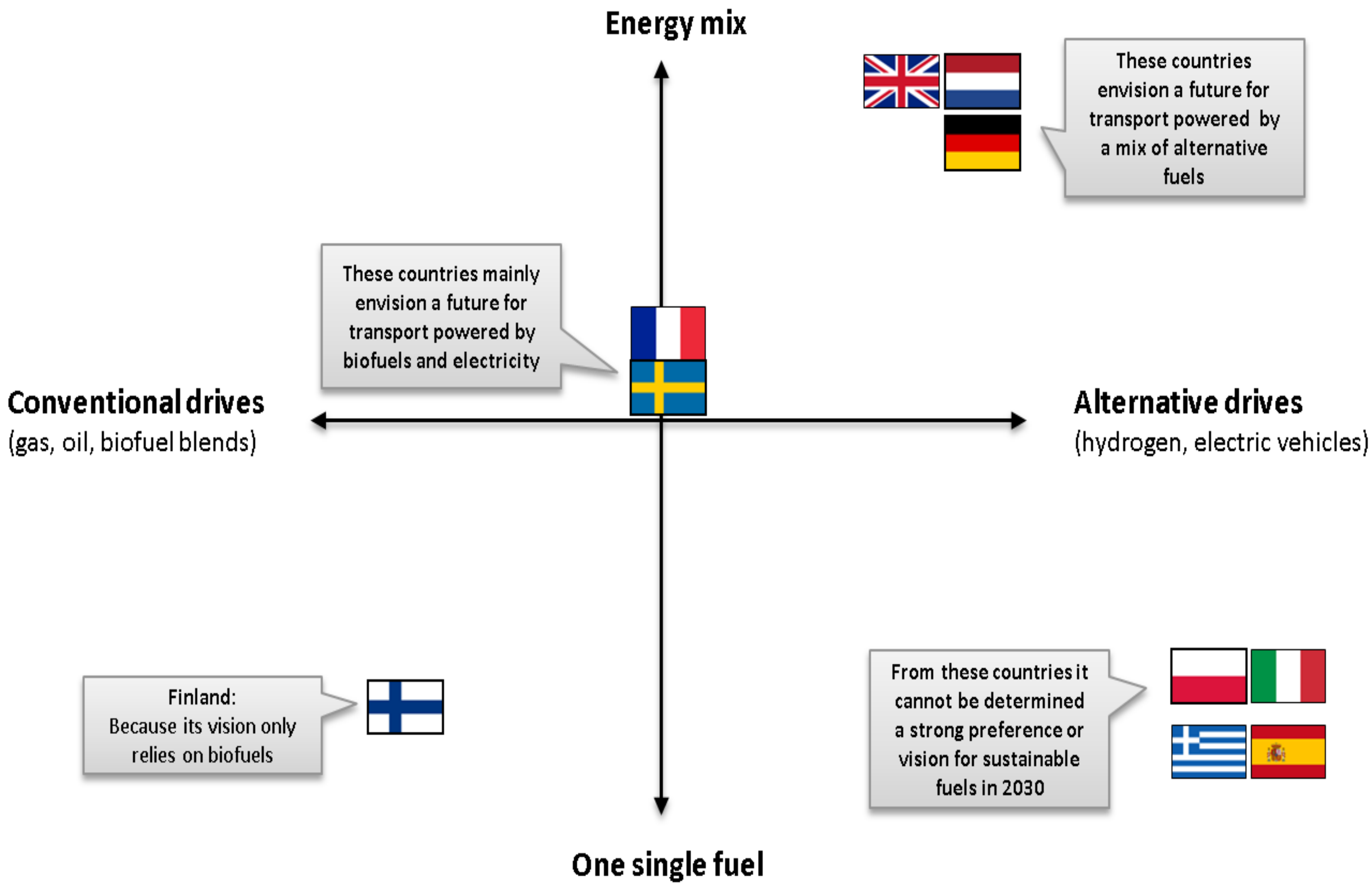
Such EU direction should:

- Aim at providing a sufficiently stable and predictable climate for the development and introduction of advanced biofuels, as an essential element for decarbonising transport. A clear EU obligation for advanced biofuels, which can be defined in several ways, is the most effective policy option for this.
- Provide clear rules and regulations for a healthy R&D climate, as innovation will be essential, creating new economic opportunities, job creation and other co-benefits.
- Maintain a fully working EU internal fuel market, also for biofuels.
- Keep accounting rules simple and straightforward, and deal with sustainability in a responsible manner.

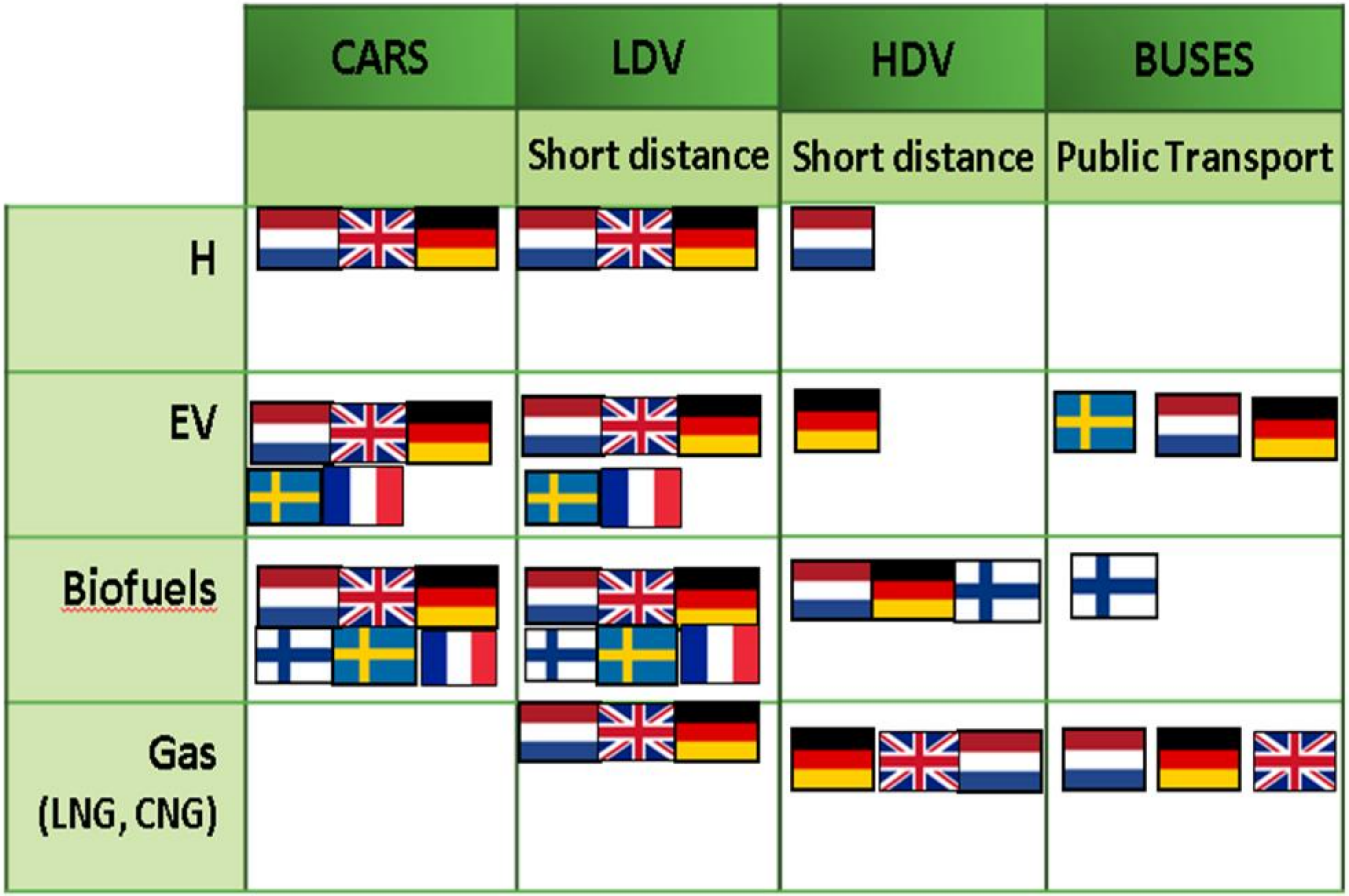
Key outcomes of the review

- Not all the Member States have issued national plans beyond 2020, and the national plans already issued vary in terms of the horizons for further developments between the timeframes 2030 or 2050
- There is a major difference in the availability of data among the national plans reviewed, which diverges between qualitative and quantitative data, and the aim of the policy documents varies from one Member States to another, according to their national preferences.
- The fuel mix and technology strategies also vary considerably, with as key ingredients the ‘usual suspects:
  - Electricification
  - Biofuels
  - Efficiency
  - Demand reduction and modal shift
- Air quality is another major driver for actions in transport

Diversity in technology focus



Diversity in sector focus



Thank you

www.biofueltp.eu

http://www.biofuelstp.eu/downloads/papers/draft-ebtp-position-paper-post-2020-transport-strategies.pdf

londo@ecn.nl

Decarbonising transport: The role of advanced biofuels in future transport options

European Biofuels Technology Platform (EBTP)
7th Stakeholder Plenary Meeting (SMP7)
Brussels June 21st, 2016

Dr. Nils-Olof Nylund, Research Professor
VTT Technical Research Centre of Finland Ltd
Chairman EBTP WG3

Main conclusions

- Deep decarbonisation of transport will require a wide range of measures
- One single energy carrier cannot meet all needs
- It is not electric vehicles vs. biofuels, it is both electric vehicles and biofuels!
- Liquid biofuels are among the most versatile energy carriers
- Revolution gets more attention than evolution
  - e.g. the hype regarding electric vehicles
  - evolution of engines and fuels has brought us tremendous improvements in performance and emission reduction
  - now we have to focus on energy efficiency and CO_2 emissions
  - advanced biofuels offer a fast track to decarbonisation

Outline

- Emission and energy targets in transport
- Ways of reducing transport greenhouse gas emissions
- Definition of advanced biofuels
- Performance of biofuels
- Cost effectiveness of various measures to reduce greenhouse gas emissions
- Summary

The 2011 EU White Paper on Transport

- A vision for a competitive and sustainable transport system
- Growing transport and supporting mobility while reaching a 60% GHG emission reduction target
- Ten goals grouped in three main groups:
  - Developing and deploying new and sustainable fuels and propulsion systems
  - Optimising the performance of multimodal logistic chains, including by making greater use of more energy-efficient modes
  - Increasing the efficiency of transport and of infrastructure use with information systems and market-based incentives

http://ec.europa.eu/transport/strategies/2011_white_paper_en.htm

EU climate and energy packages 2020/2030

2020 climate & energy package

Policy | Documentation | Studies | FAQ | Links

The 2020 package is a set of binding legislation to ensure the EU meets its climate and energy targets for the year 2020.

The package sets three key targets:

- 20% cut in **greenhouse gas** emissions (from 1990 levels)
- 20% of EU energy from **renewables**
- 20% improvement in **energy efficiency**

The targets were set by EU leaders in 2007 and enacted in legislation in 2009. They are also headline targets of the Europe 2020 strategy for smart, sustainable and inclusive growth.

10 % renewable energy in transport by 2020

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European Commission

CLIMATE ACTION

European Commission > Climate Action > Newsroom > Articles

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EU leaders agree 2030 climate and energy goals

24/10/2014

EU Heads of State and Government have agreed the headline targets and the architecture for the EU framework on climate and energy for 2030. The agreed targets include a cut in greenhouse gas emissions by at least 40% by 2030 compared to 1990 levels, an EU-wide binding target for renewable energy of at least 27% and an indicative energy efficiency target of at least 27%. The decision underlines the European Union's position as a world leader in the fight against climate change. The agreed greenhouse gas target will be the EU's contribution to the global climate change agreement due to be concluded in Paris next year. The renewables and energy efficiency targets will increase the security of the EU's energy supplies and help reduce its dependency on imported fossil fuels.

Greenhouse emissions – a cut of at least 40%

The framework contains a **binding target** to cut emissions in EU territory by **at least 40%** below 1990 levels by 2030.

This will enable the EU to:

- take cost-effective steps towards its long-term objective of cutting emissions by 80-95% by 2050 in the context of necessary reductions by developed countries as a group,
- make a fair and ambitious contribution to the new international climate agreement, to take effect in 2020.

To achieve the at least 40% target:

- EU emissions trading system (ETS) sectors would have to cut emissions by **43%** (compared to 2005) – to this end, the ETS is to be reformed and strengthened
- non-ETS sectors would need to cut emissions by **30%** (compared to 2005) – this needs to be translated into individual binding targets for Member States.

Non-ETS GHG -30 %

No target for renewable energy in transport 2030!

Finland, a land of solutions

Strategic Programme of
Prime Minister Juha Sipilä's Government
29 May 2015

Ten-year objective:

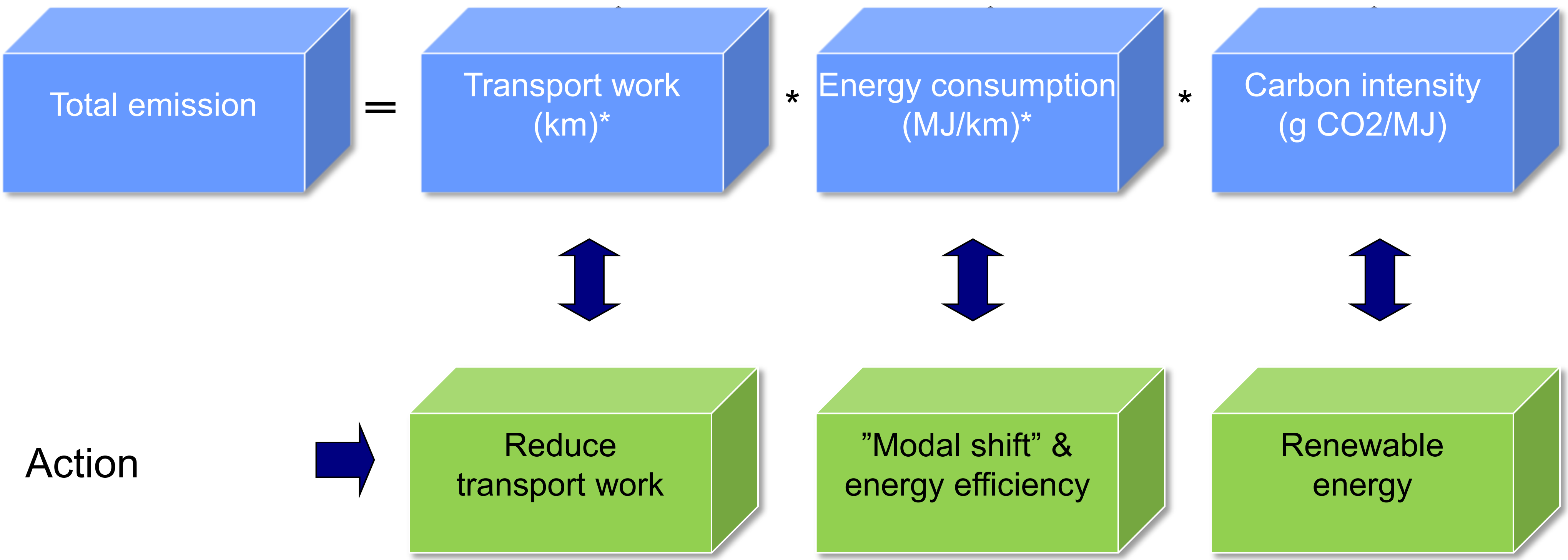
- Finland is a pioneer in the bioeconomy, circular economy and cleantech. By developing, introducing and exporting sustainable solutions we have improved the balance of current accounts, increased our self-sufficiency, created new jobs, and achieved our climate objectives and a good ecological status for the Baltic Sea.

Transport:

- The use of imported oil will be cut in half during the 2020s
- The share of renewable transport fuels will be raised to 40 per cent by 2030

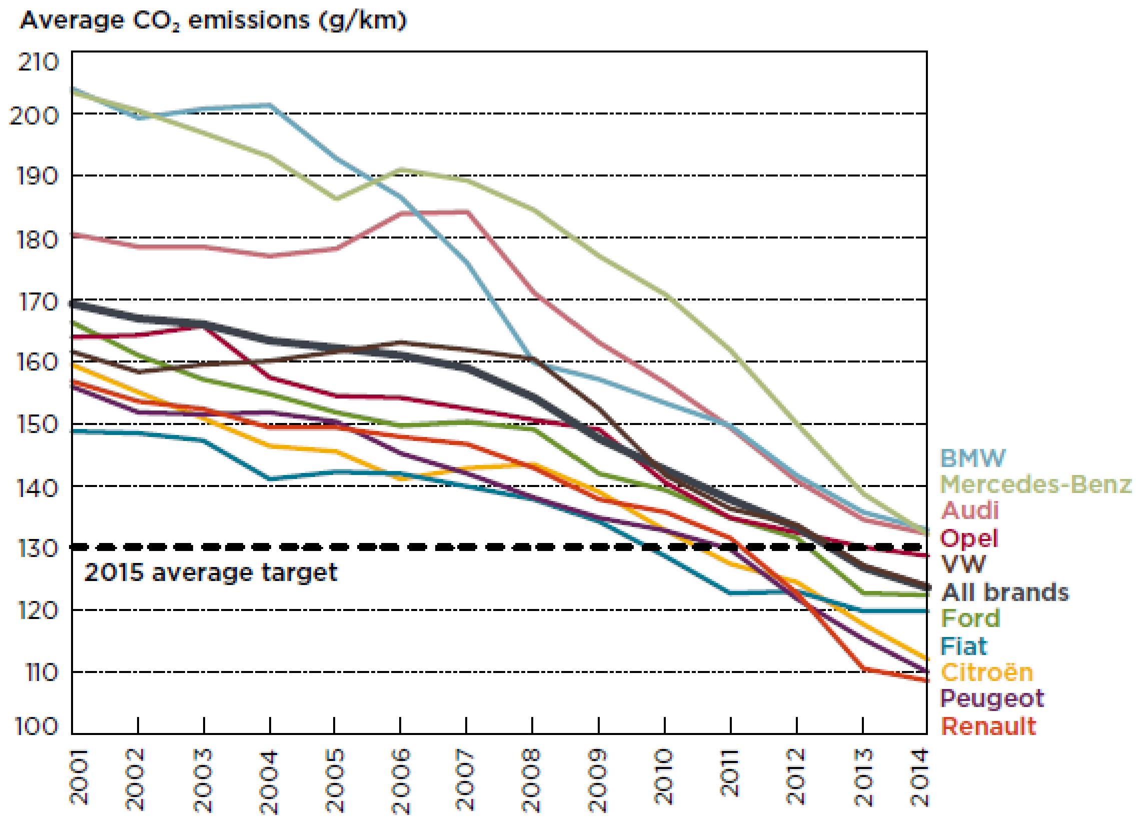
http://valtioneuvosto.fi/en/sipila/government-programme

Reducing CO_2 emissions



*passenger km/ton km

The power of vehicle regulations



ICCT European Vehicle Market Statistics 2015/2016

Renewable energy for transport

- The options are:
  - Liquid and gaseous biofuels
  - Renewable electricity
  - Renewable hydrogen
  - Electrofuels
    - Power-to-gas
    - Power-to-liquids

European Commission

Clean Power for Transport Package

Alternative Fuels for Transport

	Road						Air	Rail	Water		
Range	*Urban*	*Medium*	*Long*	*Short*	*Medium*	*Long*			*Inland*	*Short sea*	*Maritime*
Natural gas					**LNG**	**LNG**	✗		**LNG**	**LNG**	**LNG**
Electricity		✗	✗		✗	✗	✗			✗	
Biofuels											
Hydrogen						✗	✗			✗	

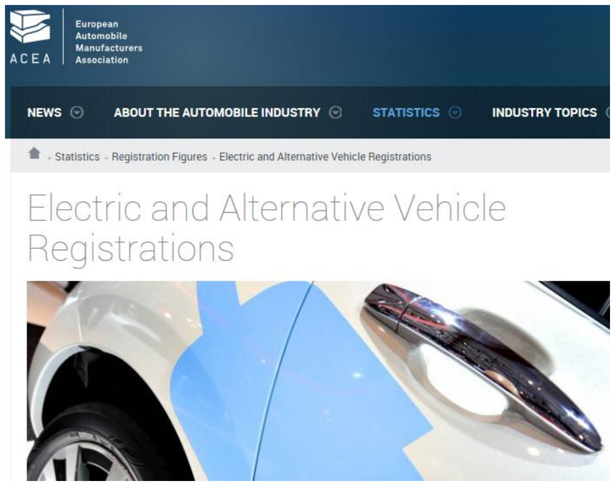
Liquid biofuels and methane are the most versatile alternatives!

Marc Steen/JRC 2014

Alternative fuel vehicle registrations within EU

	EVs BEV + PHEV	HEVs	Gaseous fuels
2014	69 996	176 525	238 666
2015	146 161	217 261	218 713
Change	+109 %	+23 %	-8 %
Total share	1.0	1.5	1.5

Total EU 28 registrations 14.4 million units
http://www.acea.be/statistics



Biofuels in the EU

BIOFUELS BAROMETER

A study carried out by EurObserv'ER.

Biofuel consumption for transport picked up in Europe after a year of uncertainty and decline, increasing by 6.1% over 2013, to 14 million toe (Mtoe) according to EurObserv'ER's first estimates. However it is still below its 2012 level when 14.5 Mtoe of biofuel was incorporated. Consumption of biofuel that meets the European Renewable Energy directive's sustainability criteria rose to 12.5 Mtoe, its highest level so far.

4.9%

the biofuel incorporation rate in European Union transport in 2014 (in energy content)

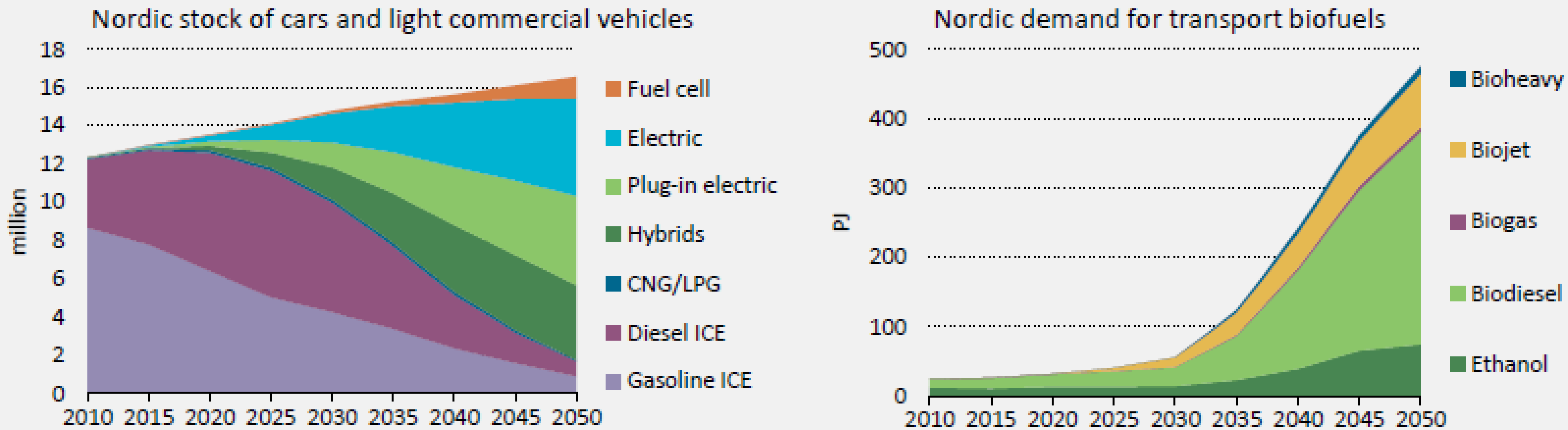
14 Mtoe

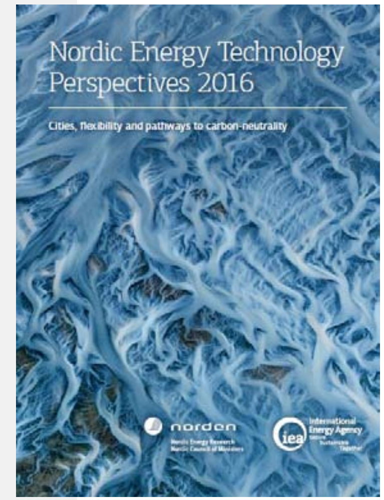
total biofuel consumption in European Union transport in 2014

http://www.eurobserv-er.org/biofuels-barometer-2015/

Towards carbon free transport in the Nordic countries

Figure ES.7 Transformation of Nordic vehicle stocks and biofuel demand in the CNS





Figures and data in this report can be downloaded at www.iea.org/etp/nordic.

Key point *The CNS requires an almost complete phase-out of fossil-fuelled cars and a rapid roll-out of EVs, especially in urban areas. Biofuel imports are needed to decarbonise long-distance transport modes.*

“Long-distance transport is less suited to electrification than urban transport and will require biofuels or significant advances in competing low-carbon technologies”

http://www.iea.org/etp/nordic/

Benefits of biofuels

- Biofuels can serve all modes of transport
- The best of biofuels are fully compatible with existing and future vehicles and infrastructure
- Biofuels offer a fast track to transport decarbonisation
- Mandates can effectively bring biofuels to the market

Renewable Fuel Standard Program

EPA United States Environmental Protection Agency

Proposed 2017 Percentage Standards

Cellulosic biofuel	0.173%
Biomass-based diesel	1.67%
Advanced biofuel	2.22%
Renewable fuel	10.44%

https://www.epa.gov/renewable-fuel-standard-program/proposed-renewable-fuel-standards-2017-and-biomass-based-diesel

Definition of advanced biofuels

- Should not be based on food crops
- Should not raise environmental concern in any way
- Should have high processing efficiency
- Should be cost effective
- **Should not cause any problems in distribution and end use**
- **Should be compatible with existing and future vehicles**

- No one has yet presented an unambiguous definition of advanced biofuels!

No fuss alternative for diesel vehicles: Paraffinic diesel

- Many alternative feedstocks
- Alternative processing routes
- A true drop-in alternative, up to 100 %
- No modifications to infrastructure or vehicles
- No storage issues
- “By-pass lane” to decarbonisation

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

FINAL DRAFT
FprEN 15940

January 2016

ICS 75.160.20

Will supersede CEN/TS 15940:2012

English Version

Automotive fuels - Paraffinic diesel fuel from synthesis or hydrotreatment - Requirements and test methods

Standard to be finalised June 2016

22/06/2015

Volvo city buses and intercity buses ready for HVO

by Press release

Volvo Buses' Euro 6 engines for city buses and intercity buses have now been certified to run on HVO, a renewable fuel that replaces regular diesel. The fuel copes with storage and low temperatures in the same way as regular diesel, and reduces CO2 emissions by up to 90 per cent.

The engines that have been certified to use Hydrogenated Vegetable Oils (HVO) are the 5-litre and 8-litre Euro 6 engines *. Volvo Buses also approves HVO as a fuel for all buses with Euro 5 engines, with no reduction in service interval. This means that the majority of newer Volvo buses can now run on renewable fuel with very low environmental impact.

"This is an important step that gives customers who have access to HVO the opportunity to greatly reduce their climate impact while keeping the same high level of reliability and availability," says Edward Jobson, Environmental Director for Volvo Buses.

Mercedes-Benz

From February 2016: approval for Hydrotreated Vegetable Oil (HVO)

Press Information

22 February, 2016

Mercedes-Benz truck models approved for alternative fuel HVO

- Approval for trucks with heavy-duty OM 470, OM 471 engines as well as medium-duty OM 936 and OM 934 variants
- Use of HVO validated by extensive testing; maintenance intervals unchanged
- The HVO raw material is sourced from controlled and certified cultivation facilities and as such does not compete with foodstuff production
- Clean, economical and powerful: engines from Mercedes-Benz

Green light for HVO-use in Scania Euro 6 range

8 OCTOBER 2015

Press releases | Press room

Scania has given the green light to hydrotreated vegetable oil (HVO) being used to power its Euro 6 range, provided the fuel used meets technical specification TS15940. Vehicles using HVO – which chemically mimics fossil-fuel-based diesel – can under optimal condition achieve up to a 90-percent reduction in CO2 emissions. HVO does not affect a vehicle's characteristics or its maintenance

Renewable paraffinic diesel brings about GHG reductions as well as reductions in local emissions

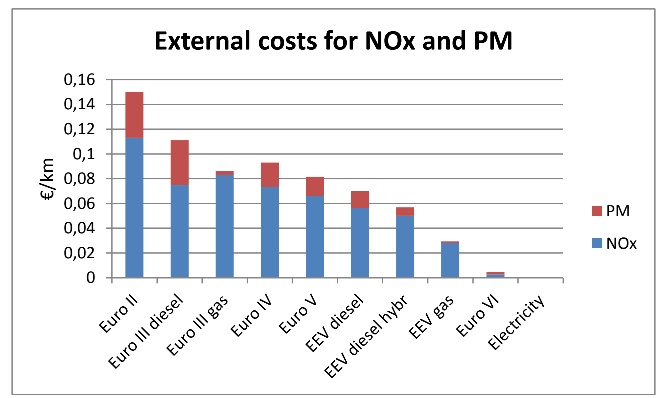
- In older vehicles (Euro I…III) and mobile machinery, paraffinic diesel typically delivers:
  - 10 % reduction in NO_x emissions
  - 30 % reduction in PM emissions
  - 80 % reduction in PAH emissions


Emission performance of paraffinic HVO diesel fuel in heavy duty vehicles

Kimmo Erkkilä & Nils-Olof Nylund, VTT
Tuomo Hulkkonen & Aki Tilli, Aalto University
Seppo Mikkonen, Pirjo Saikkonen, Neste Oil
Reijo Mäkinen, Helsinki Region Transport
Arno Amberla, Proventia Emission Control

SAE International

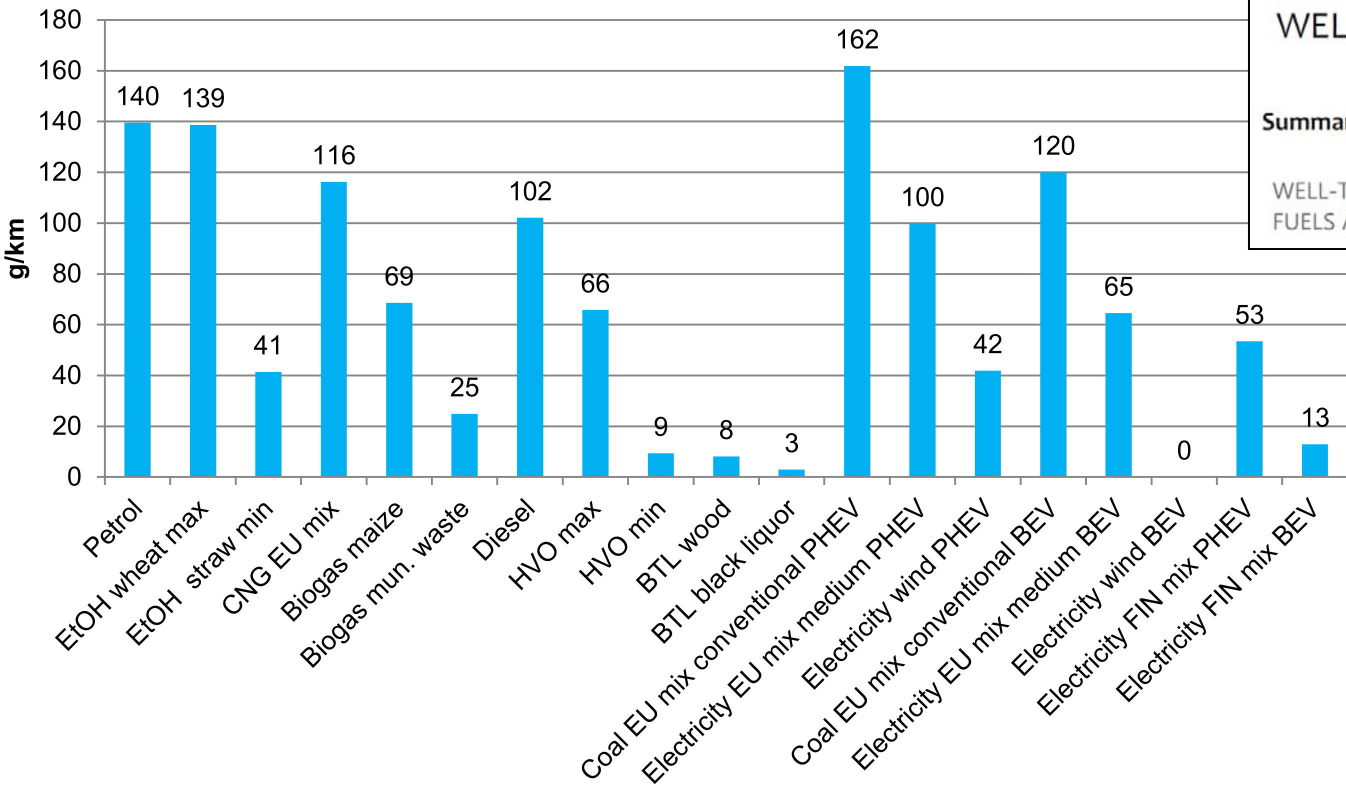
- Euro VI heavy-duty vehicles are extremely clean
  - Emission control technology determines emissions, not fuel composition
  - However, high quality fuels are needed to sustain very low emission levels
  - Paraffinic diesel puts less burden on the exhaust clean-up system than regular diesel



VTT data & Directive 2009/33/EC

Well-to-wheel CO_2 emissions

Passenger car WTW CO_2 emissions
C-category vehicle, performance values by the manufacturer,
fuel data JEC Well-To-Wheels Analysis 2014




European Commission

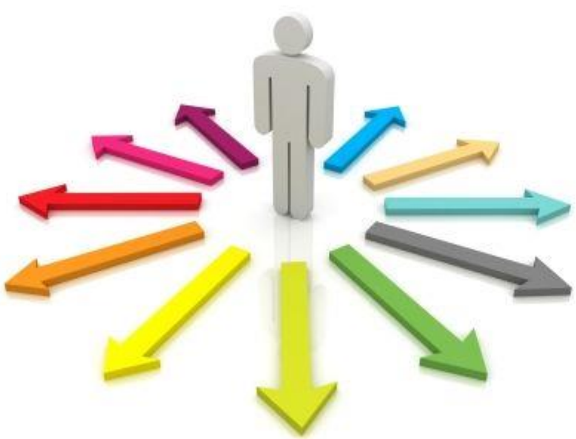
JRC TECHNICAL REPORTS

WELL-TO-TANK Appendix 2 - Version 4a

Summary of energy and GHG balance of individual pathways

WELL-TO-WHEELS ANALYSIS OF FUTURE AUTOMOTIVE FUELS AND POWERTRAINS IN THE EUROPEAN CONTEXT

VTT TECHNICAL RESEARCH CENTRE OF FINLAND LTD



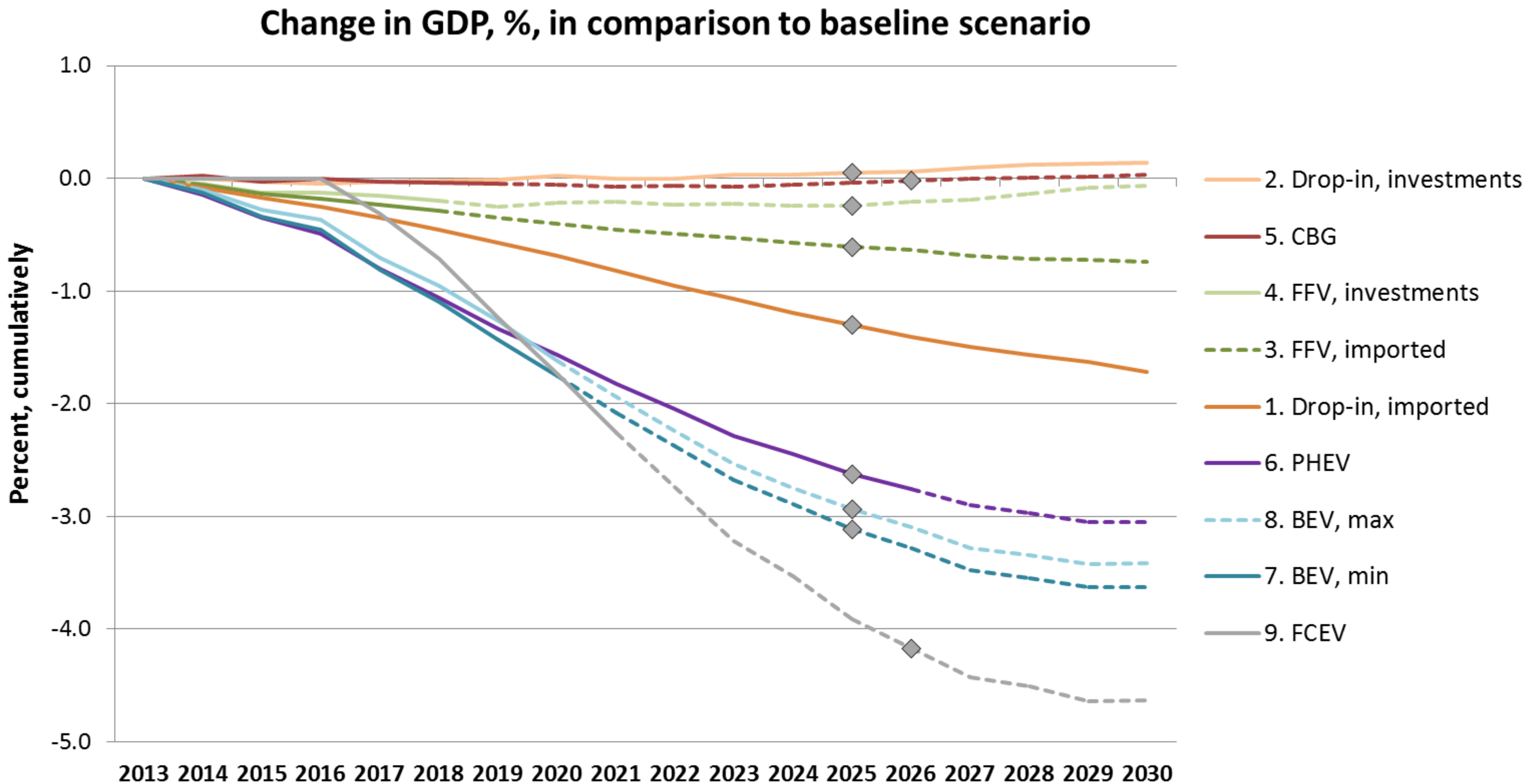
40% Reduction of Carbon Dioxide Emissions from Transport by 2030: Propulsion Options and Their Impacts on National Economy

A joint study by VTT and VATT, the Government Institute for Economic Research

VATT
VALTION TALOUDELLINEN TUTKIMUSKESKUS
STATENS EKONOMISKA FORSKNINGSCENTRAL
GOVERNMENT INSTITUTE FOR ECONOMIC RESEARCH

Impact on GDP

The outcome is specific for Finland but the methodology used is universal



Please observe:

- General increase in GDP from 2005 to 2030 predicted at 30 %
- Curves for EVs and FCVs sensitive to price

Roland Berger

BMW
DAIMLER
HONDA
NEOT North European Oil Trade
neste
OMV
TOYOTA
VOLKSWAGEN AKTIENGESELLSCHAFT
st1

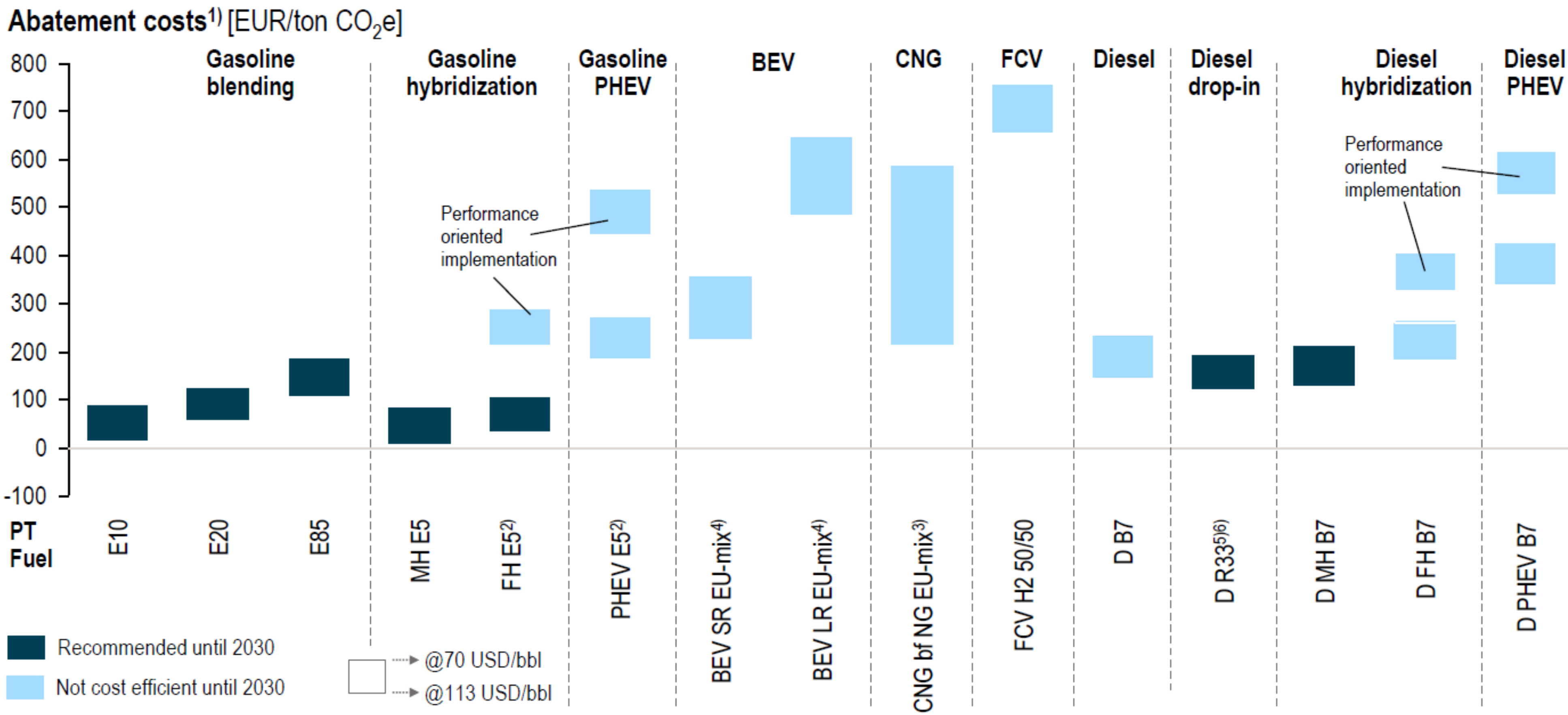
Integrated Fuels and Vehicles Roadmap to 2030+

Study results

http://www.rolandberger.com/media/pdf/Roland_Berger_Study_Integrated_Fuels_and_Vehicles_Roadmap_to_2030_v2_20160615.pdf

Brussels, April 27, 2016

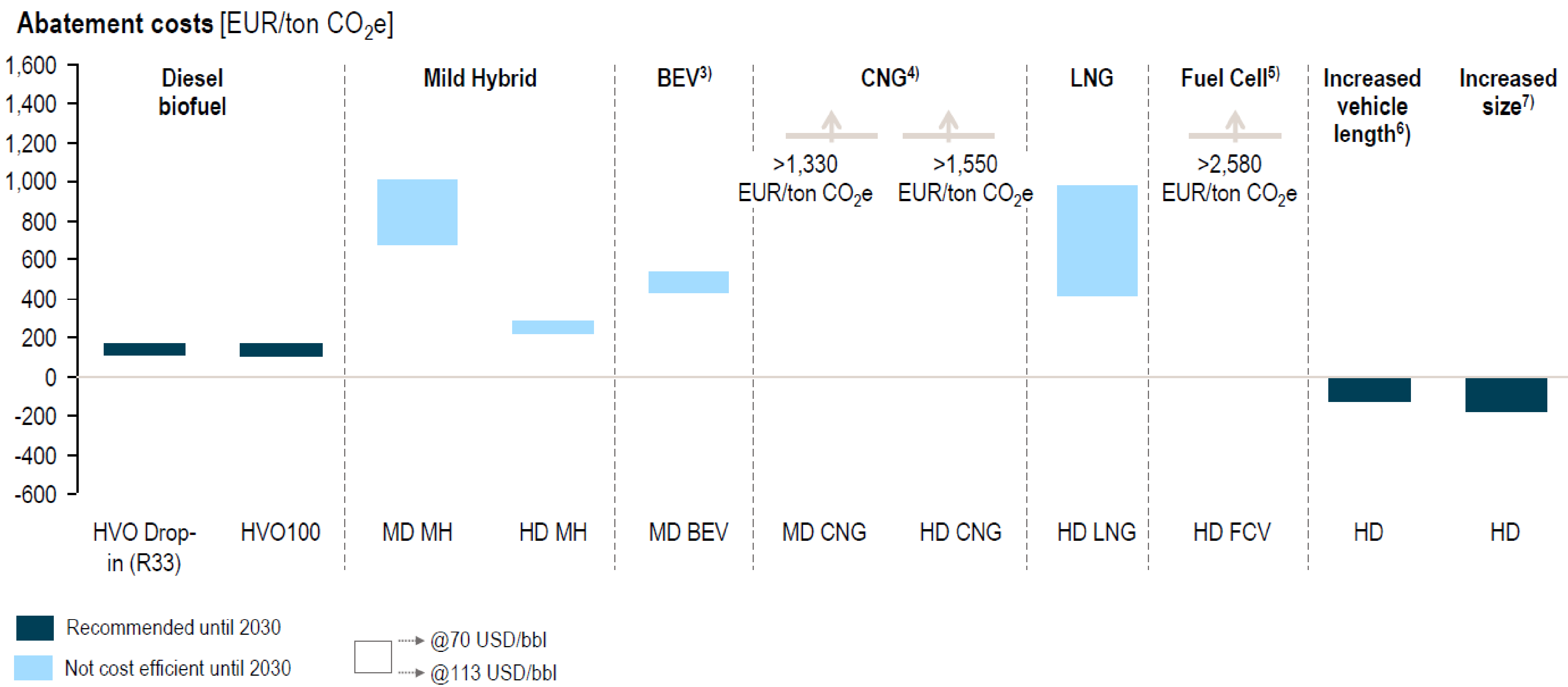
Figure 5: WTW GHG abatement costs pathways, C-segment PCs 2030 [EUR/ton CO_2e]



1) Compared to optimized Gasoline powertrain 2030 using E5, all technologies with 250,000 km lifetime mileage 2) 30% e-driving, higher e-driving share reduces abatement costs 3) Large range between scenarios driven by decoupling effect of natural gas price 4) Risk of higher abatement costs due to need of second battery over lifetime, SR – short range with 35 kWh battery capacity, LR – long range with 65 kWh battery capacity, both using 2030 EU mix electricity, 5) Diesel fuel with 7% FAME and 26% HVO 6) Abatement cost in existing vehicle: -67 EUR/ton CO_2 (high oil price), 7 EUR/ton CO_2 (low oil price)

Source: Roland Berger

Figure 6: WTW GHG abatement costs pathways of medium- and heavy duty vehicle 2030 [EUR/ton CO_2e]



1) Medium duty 2) Heavy duty 3) Exclusion of HD BEV due to incompatibility of BEV range with long haul requirements 4) High CO_2 abatement costs for CNG and LNG within MD/HD/City Bus s result from low quantities of vehicles (missing economies of scale) and CO_2 abatement potential compared to Diesel is small (<5% savings/km) 5) High system cost and low lifetime mileage in medium duty trucks causes very high abatement cost , therefore incompatibility 6) Increased efficiency due to aerodynamic measures to reduce drag 7) Length and gross vehicle weight increase, increased transport efficiency by 10%

Source: Roland Berger

Summary

- Deep decarbonisation of transport will require a wide range of measures
- One single energy carrier cannot meet all needs
  - It is not electric vehicles vs. biofuels
  - It is both electric vehicles and biofuels!
- Biofuels can serve all modes of transport, road, rail, marine and air
- The automotive manufacturers are now starting to see the value of high quality fungible biofuels
- At least until 2030, biofuels seem to be more cost effective than electrification in reducing GHG emissions
- Advanced biofuels can offer a fast track to decarbonisation

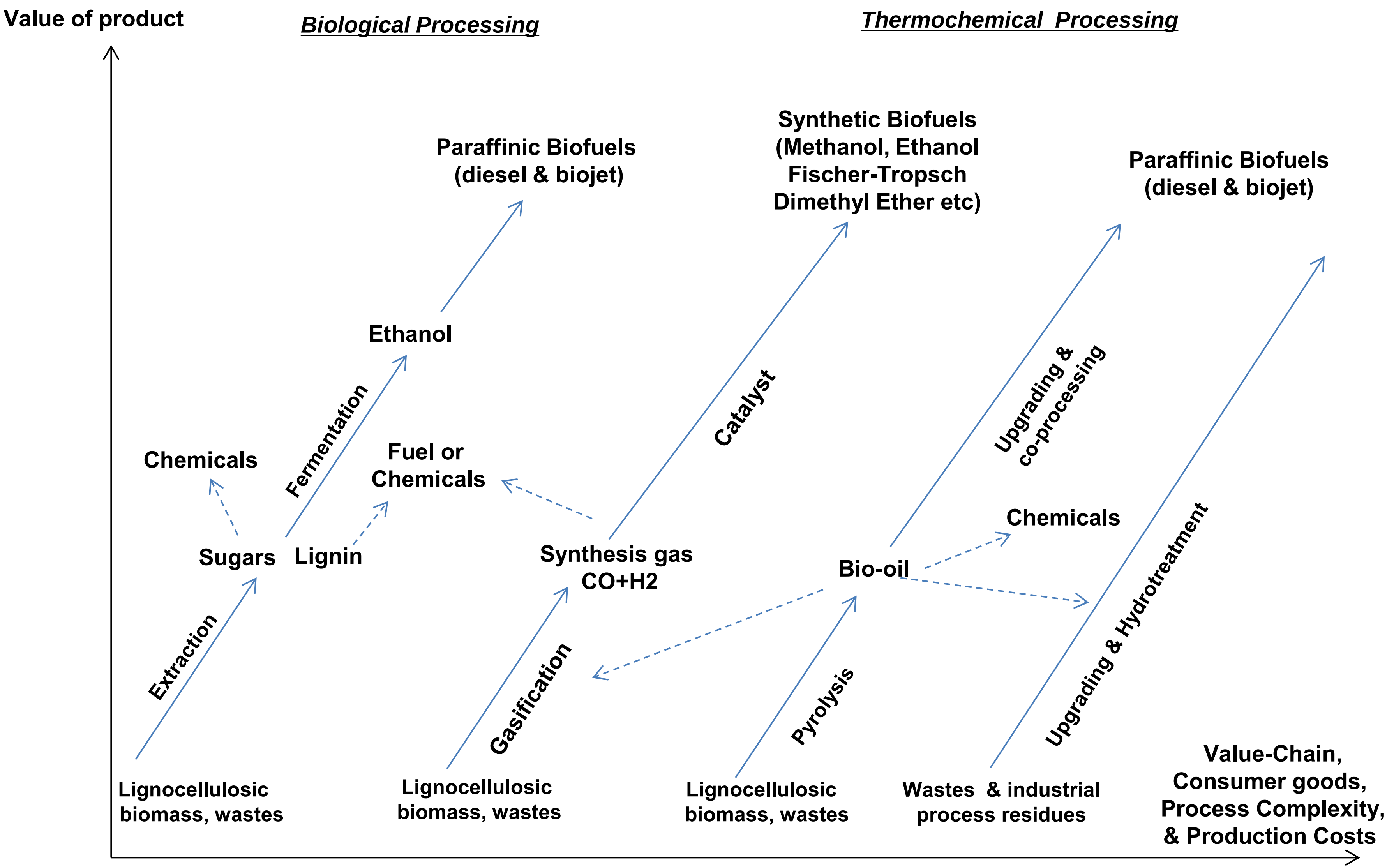

VTT
TECHNOLOGY FOR BUSINESS

Decarbonising transport with Advanced Biofuels

What does it take?

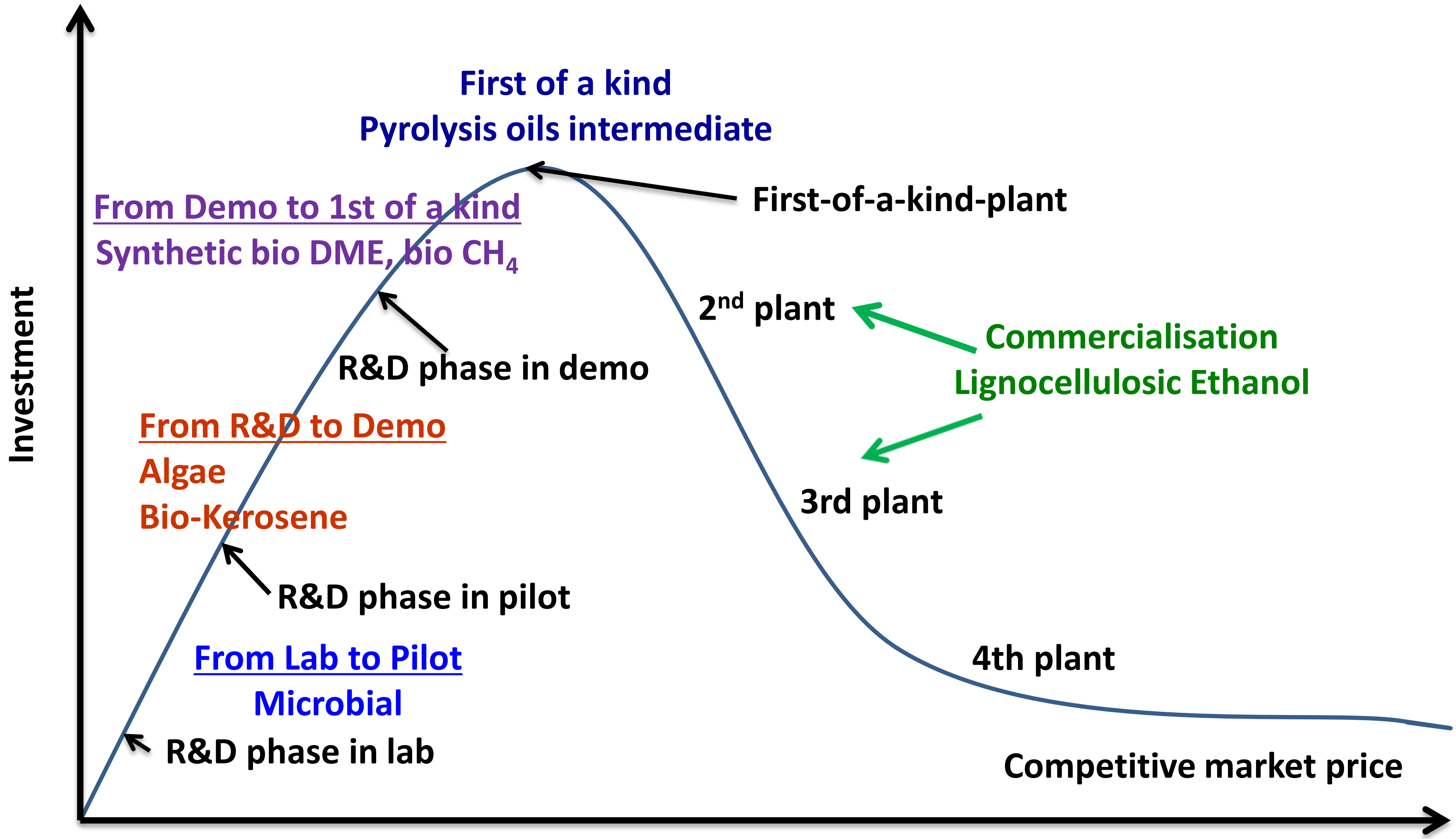
Kyriakos Maniatis

Energy Technologies Innovation & Clean Coal
DG ENER, European Commission



Adding value to biomass by processing to advanced biofuels and to biochemicals

Technology Valley of death: Positioning of FP7 supported technologies



Project specification to construction completion 3-4 yrs

Commissioning: 4 months

Life time: 25 yrs

Approximate pay back:7-10 yrs

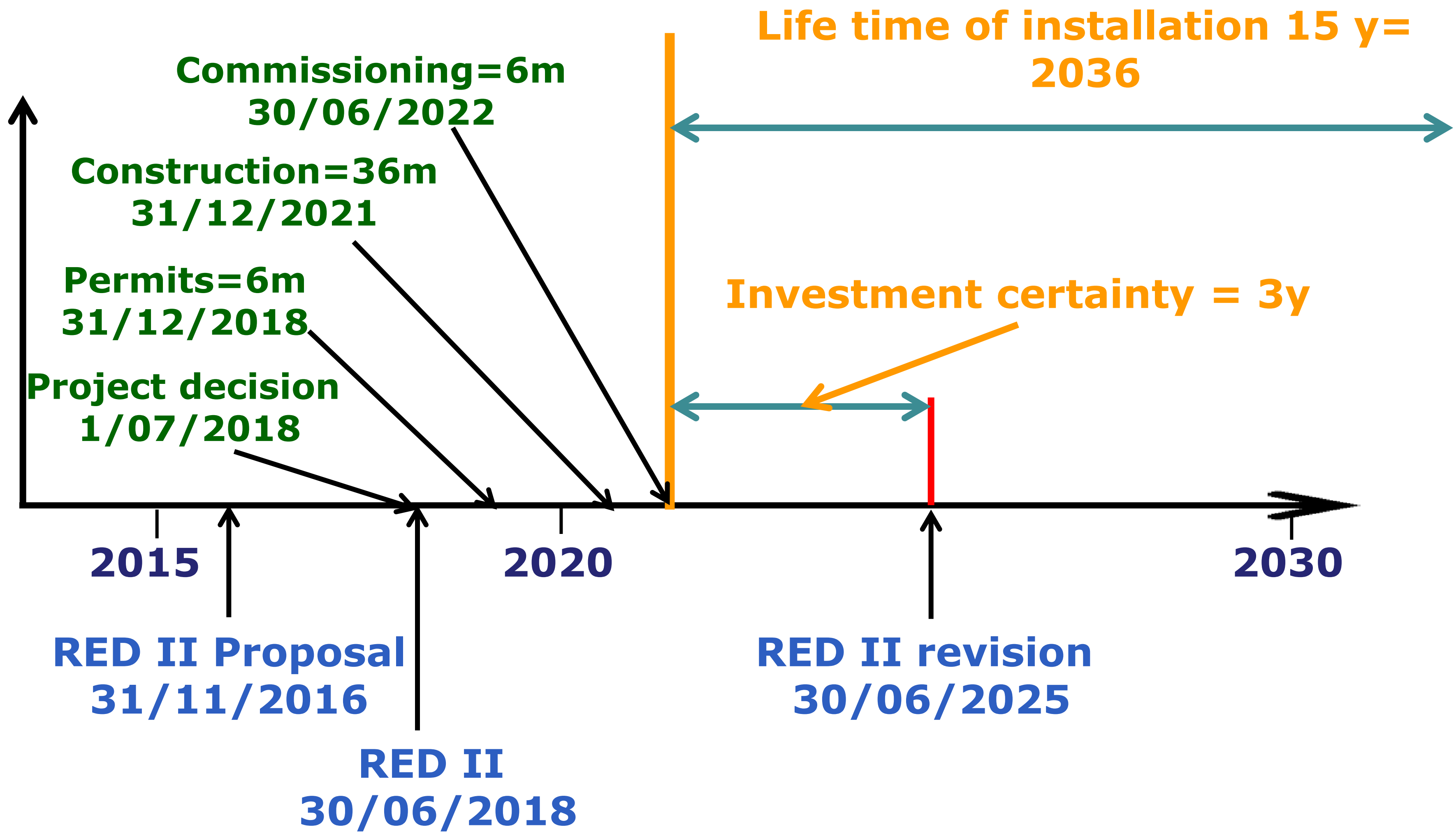
Project specification to construction completion 4 yrs

Commissioning: 3-6 months

Life time: 15-20 yrs

Approximate pay back: 15 yrs

Time to construct an advanced biofuel plant



Do advanced biofuels have a significant role to play in decarbonising transport up to 2030?

Yes or NO ??

If YES,

then any new policy initiative for advanced biofuels must provide a stable framework up to 2030.

Initiative Towards sustAinable Kerosene for Aviation

Decarbonisation of transport. Aviation

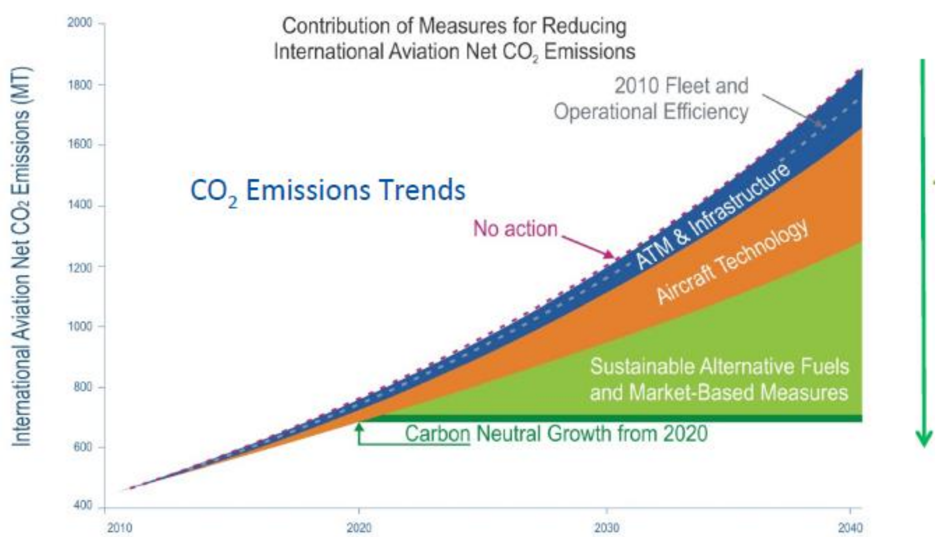
Inmaculada Gomez, ITAKA coordinator (SENASA)

EBTP SPM7 - Brussels, 21 June 2016

Decarbonisation of air transport

- today 2% but growth trends would ↑CO_2 emissions **3x by 2050** [~ 600 Mt CO_2]
- Strong **global goal**
  - neutral growth from 2020
  - halving emissions for 2050
- **Energy efficiency** gain could allow to reach 2x instead, **additional measures** are needed to the 1x and below.

ICAO global aspirational goals



- MBM
- Low carbon drop-in fuels

The way forward

Vision

- Aviation **will continue to depend on liquid fuels for a very long time** □sustainable drop-in fuels are a priority for aviation
- **New alternative energy carriers**. R&D to ↑use of electricity, it is on the roadmap.
- Sustainable bioenergy is a resource demanded by other sectors. **A clear strategy is needed**.

Particularities

- Drop-in is needed because of:
  - Longer time to develop new aircrafts and reach the operation
  - Fleet replacement cannot be 100% at once, so 'old' A/C needs to use same airports / fuel infrastructures than 'new' ones
  - Conditions at fuel supply all over the world need to be equivalent and compatible.

Summary

- Sustainability
- Technology
- The price gap
- Scarce resources
- Deployment
- Cooperation

Initiative Towards sustAinable Kerosene for Aviation

Decarbonization is about much more than only CO_2!

www.itaka-project.eu

info@itaka-project.eu

Decarbonisation of transport

Patrik Klintbom

Director, Environment and Energy

Volvo Group

The Volvo Group is one of the world's leading manufacturers of trucks, buses, construction equipment and marine and industrial engines. The Volvo Group also provides complete solutions for financing and service.

The Volvo Group, which employs about 100,000 people, has production facilities in 18 countries and sales of products in more than 190 markets.

Prosperity through transport solutions

- The Volvo Group's vision is to be the most successful transport solution provider
- Sustainability is an important part to drive prosperity
- The use of renewable fuels is an essential part in order to realize sustainable transport solutions

Roads towards sustainable transports

Commercial vehicles are used in commercial conditions

- A move to non-fossil fuels will come when profitability levels are viable
- Political decisions will be needed
  - Long term vision
  - Short term incentives
- Important principles
  - Energy efficiency and GHG
  - “Work done” principle
  - An international perspective
  - Stable and predictable measures
  - Specification of new fuels

To consider before deployment of new alternative fuels infrastructure - DAFI

- A viable business case for the end customer
  - Important factors to evaluate are:
    - Fuel quality and standardisation
    - Fuel production cost and potential volumes
    - Fuel taxes
    - Additional vehicle cost (tanks, batteries, maintenance etc.)
- Low carbon fuels
  - Focus on fuels that contribute to decarbonisation and enhance the environmental performance
- An expanded fuel infrastructure will not guarantee the use of the fuel

Improvement of conventional fuel

- Conventional diesel fuel, with increasing renewable or synthetic content, will remain the dominant fuel for all types of transport for many years
- A gradual shift to new energy carriers (DME, Methanol, methane, ethanol etc.) is likely as backward compatible fuels are limited in potential and generally more costly and energy consuming to produce

Volvo's position on alternative fuels

Trucks and buses



Long distance applications

- Liquid methane and DME are the main prioritized alternatives. Dynamic electric charging is an additional alternative long term.

Medium distance applications

- Compressed methane and DME are the main prioritized alternatives. Dynamic electric charging is an additional alternative long term.

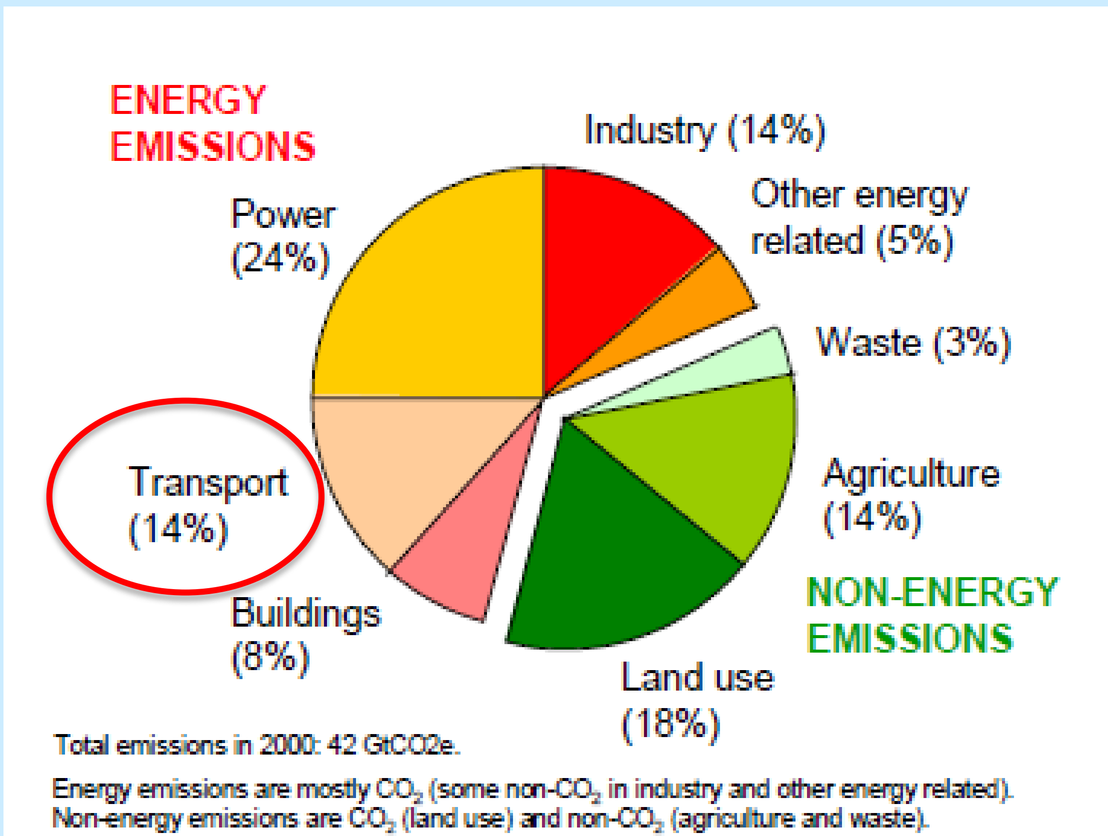
Urban applications

- Electricity and compressed methane are prioritized

Sources of Green House Gases in the Atmosphere

Source: Stern Review

Figure 1 Greenhouse-gas emissions in 2000, by source



Source: Prepared by Stern Review, from data drawn from World Resources Institute Climate Analysis Indicators Tool (CAIT) on-line database version 3.0.

From Minutes of the first meeting with SFT in June 2015

*Commissioner for Transport **Violeta Bulc** explained in her welcome address the importance of this first meeting, as the STF contributes to one of the key objectives of the European Union: to decarbonise our economy and to make Europe a world leader in renewable energies.*

- *Decarbonisation of transport is one objective of the Commission and supports Growth, Jobs, Democratic Change and Fairness.*
- *Decarbonisation is also one of the four core content drivers of the EU together with Digitalization, Internationalization and People.*
- *Decarbonisation must be empowered by Innovation and Investment.*

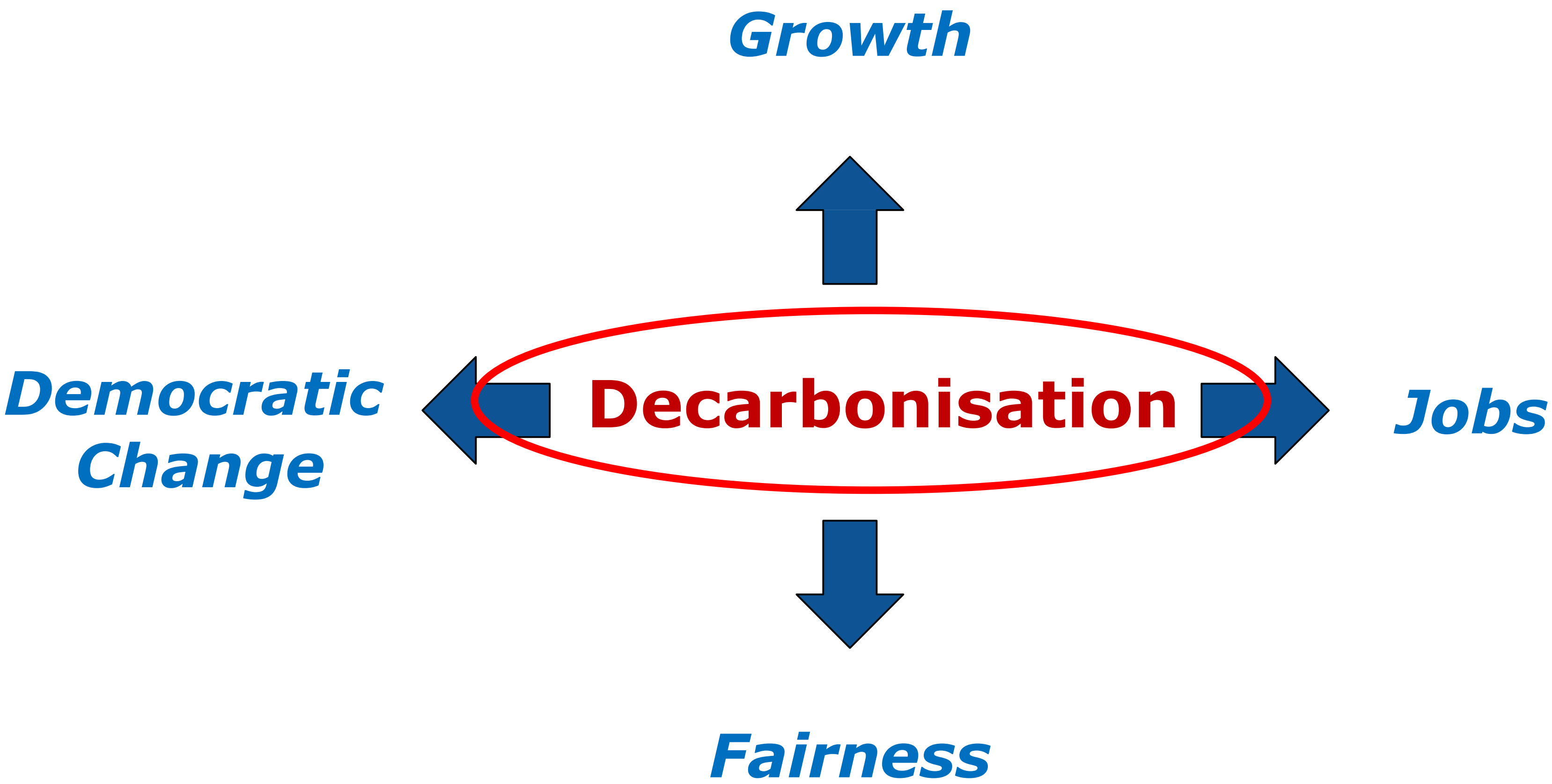
LULEÅ UNIVERSITY OF TECHNOLOGY

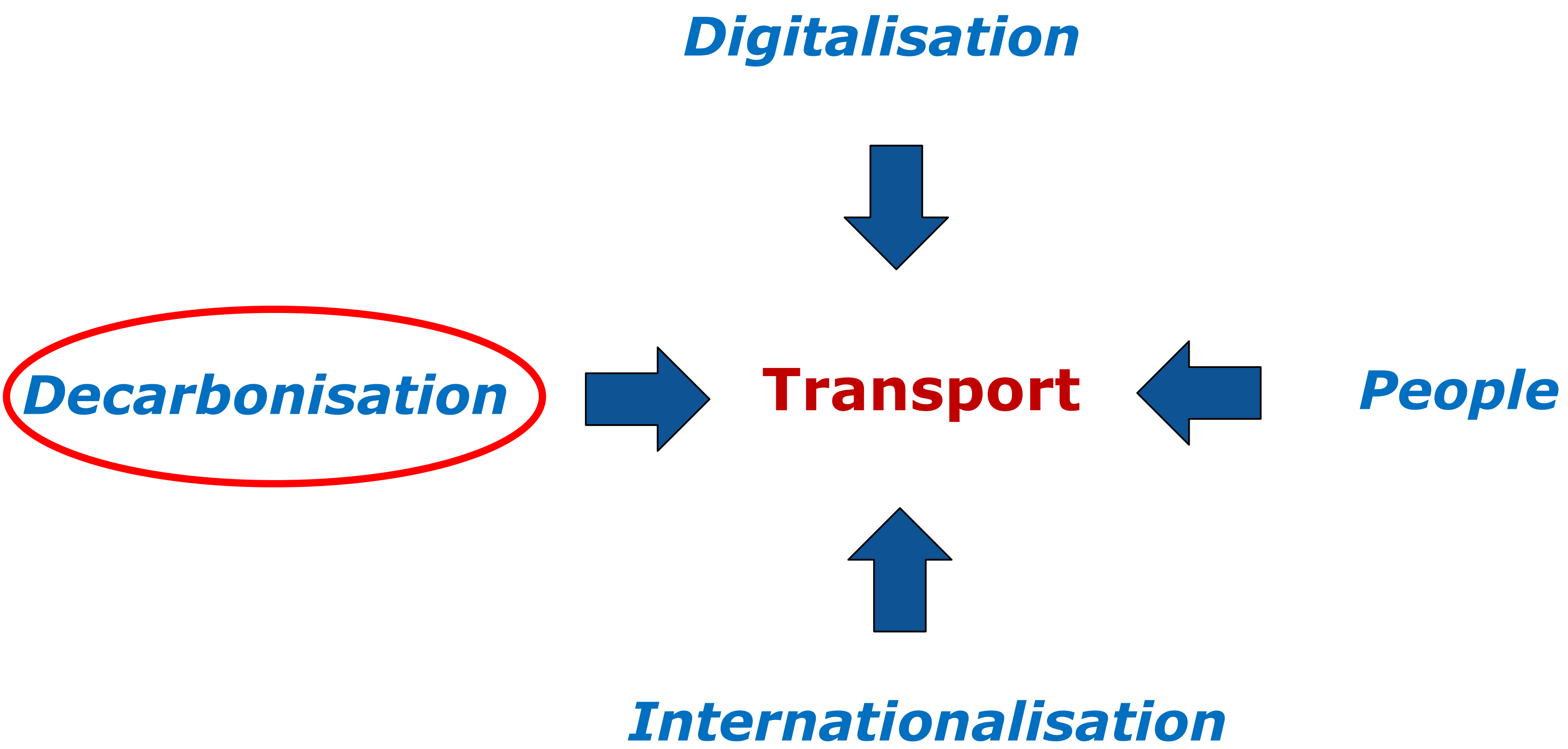
Sustainable Transport Forum
1st Meeting

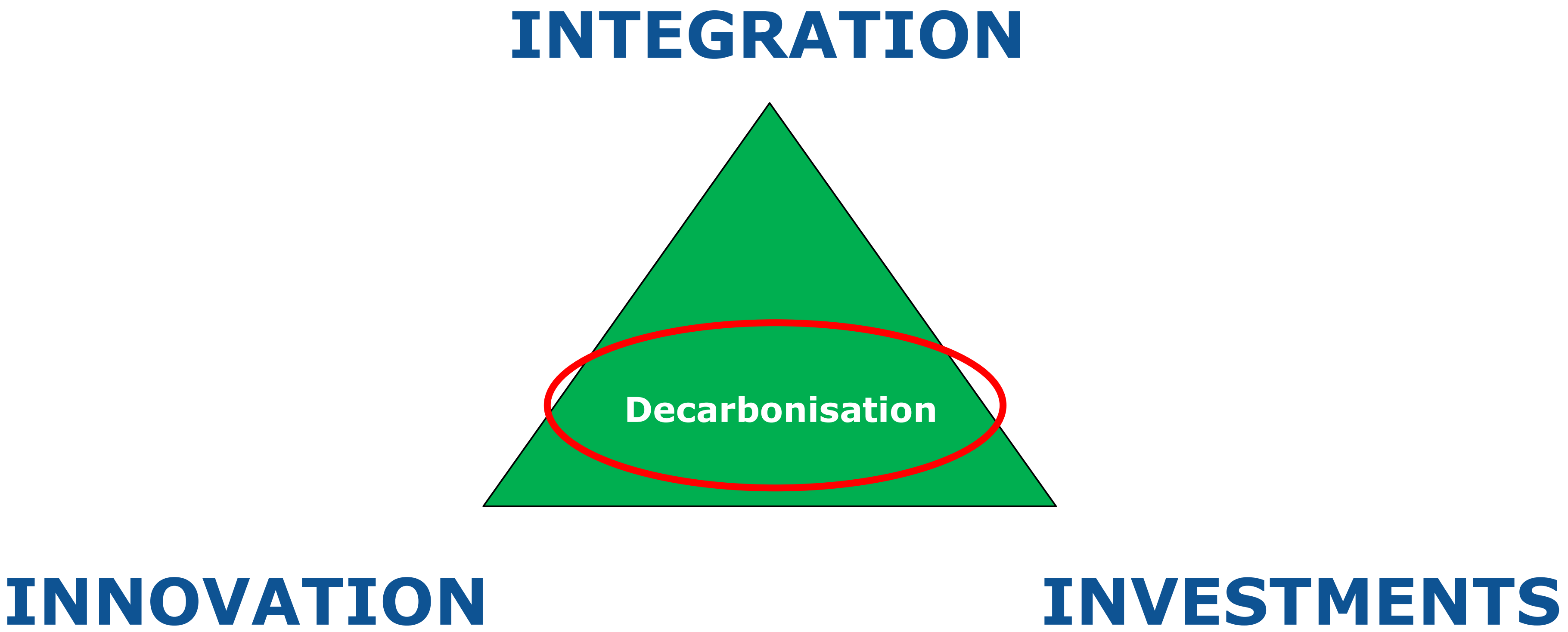
Opening address

Transport Commissioner Violeta Bulc

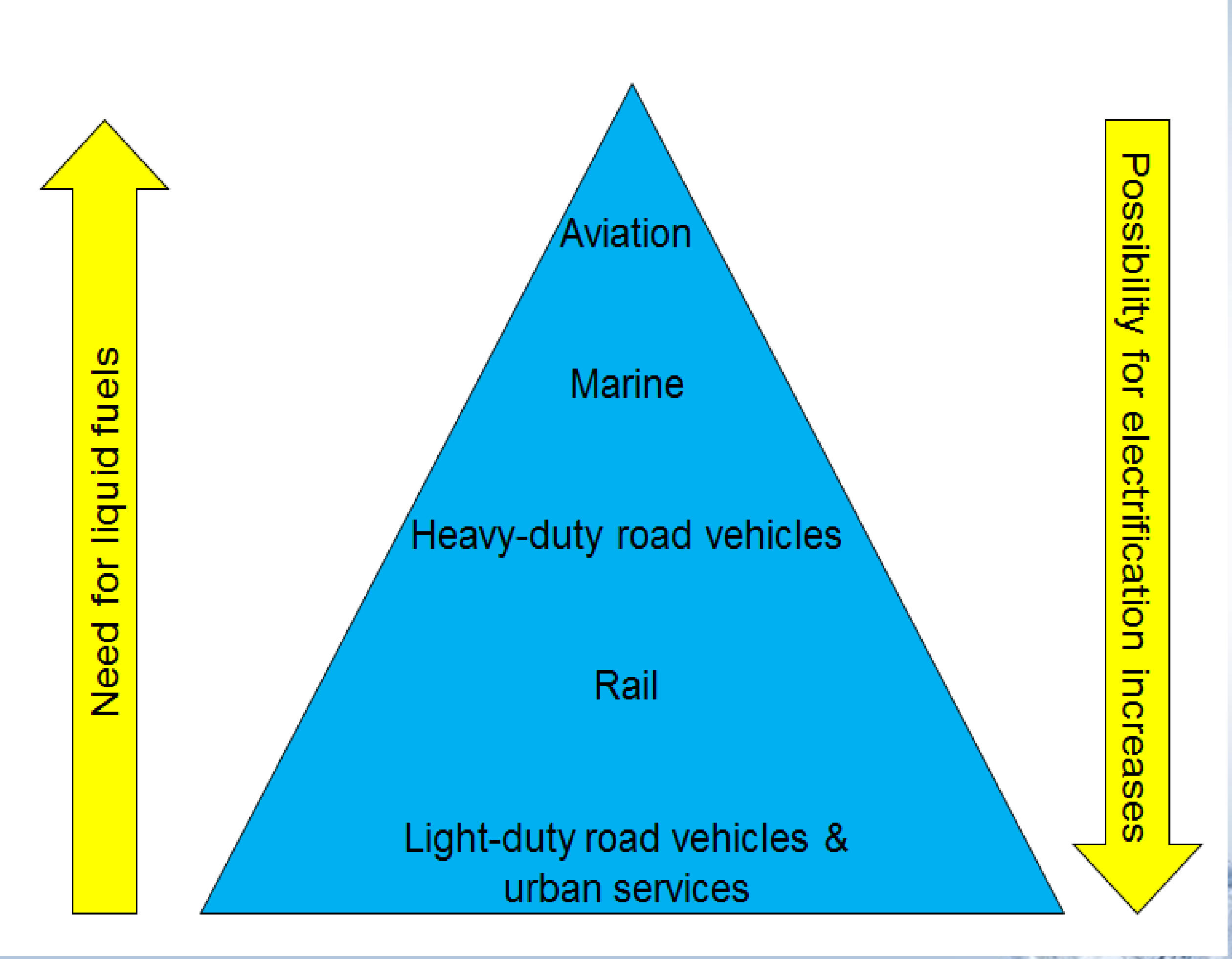
Bruxelles 29 June 2015


Growth
Democratic Change
Decarbonisation
Jobs
Fairness


Digitalisation
Decarbonisation
Transport
People
Internationalisation


INTEGRATION
Decarbonisation
INNOVATION
INVESTMENTS

WG 3: End Use



Source: Ministry of Transport and Communications, Finland 2013

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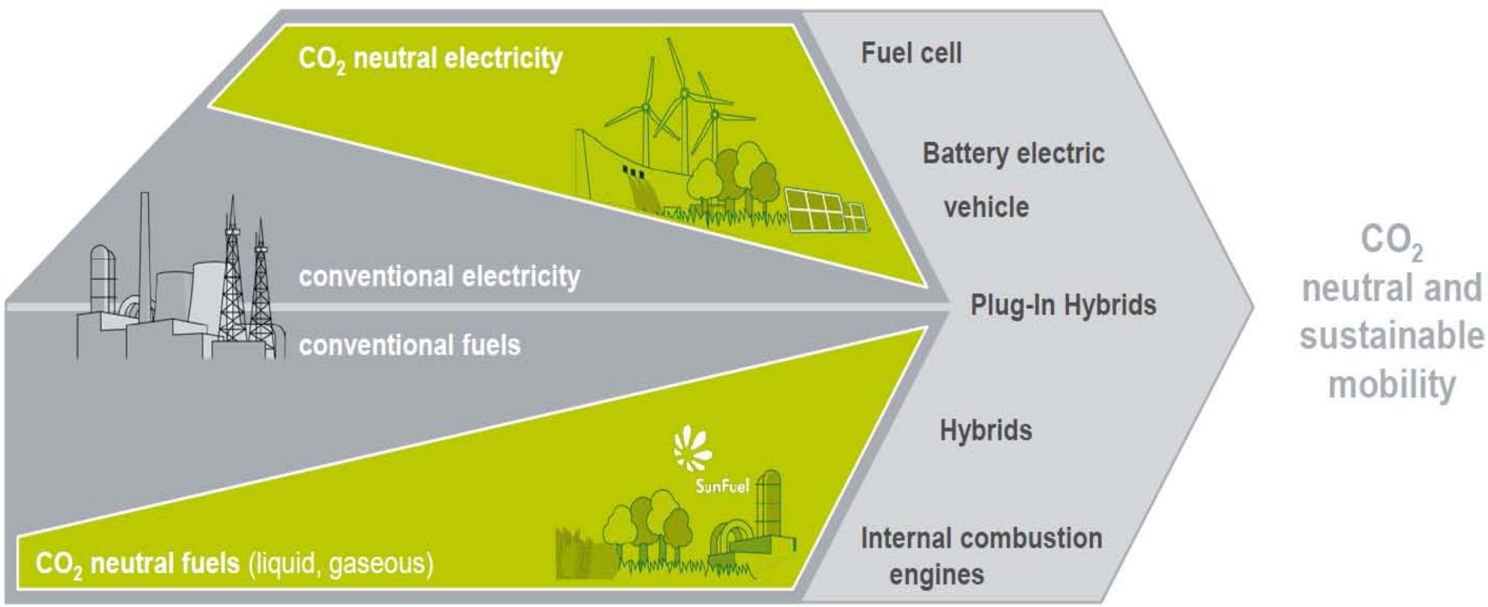
WG 3: End Use

Volkswagen Powertrain and Fuels Strategy
Coexistence of propulsion systems



- ⇨ Coexistence of conventional powertrains and electrified mobility
- ⇨ Decarbonisation of the energy carrier and higher powertrain efficiency
- ⇨ A portfolio of various drivetrains will fulfil the customer expectations

Source: VW, S. Schmerbeck 2014

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EBTP Strategic Research and Innovation Agenda
Results from the 2016 Update

7th Stakeholder Plenary Meeting

Britta Müller, EBTP Secretariat
Agency for Renewable Resources

European Biofuels
TECHNOLOGY PLATFORM

Outline

- Background to EBTP SRIA
- Key Messages
- Biofuels deployment
- Where to find the SRIA
- How to participate?

European Biofuels TECHNOLOGY PLATFORM

Background to EBTP SRIA 2016

- Two earlier EBTP Strategic Research Agendas (2008 and 2010)
- Assessment of update need (EBTP-SABS, Sep 2014)
- a number of biofuel challenges are rather fundamental- and remain unchanged over 6 years
- Process involving EBTP-SABS, WG and SC
- Key input from Working Groups
  - Biomass availability
  - Conversion Process
  - End-Use
  - Policy& Sustainability
- Public consultation March-May 2016

Background to EBTP SRIA 2016

- uncertainties and fragmentation of policies
- volatile prices – mineral oil and biomass
- policy shift from biofuels to decarbonisation of transport sector
- a number of mature technologies for advanced biofuels - move from R&D to deployment
- holistic view required – value chains, transport systems, sustainability, end markets

2010

2016

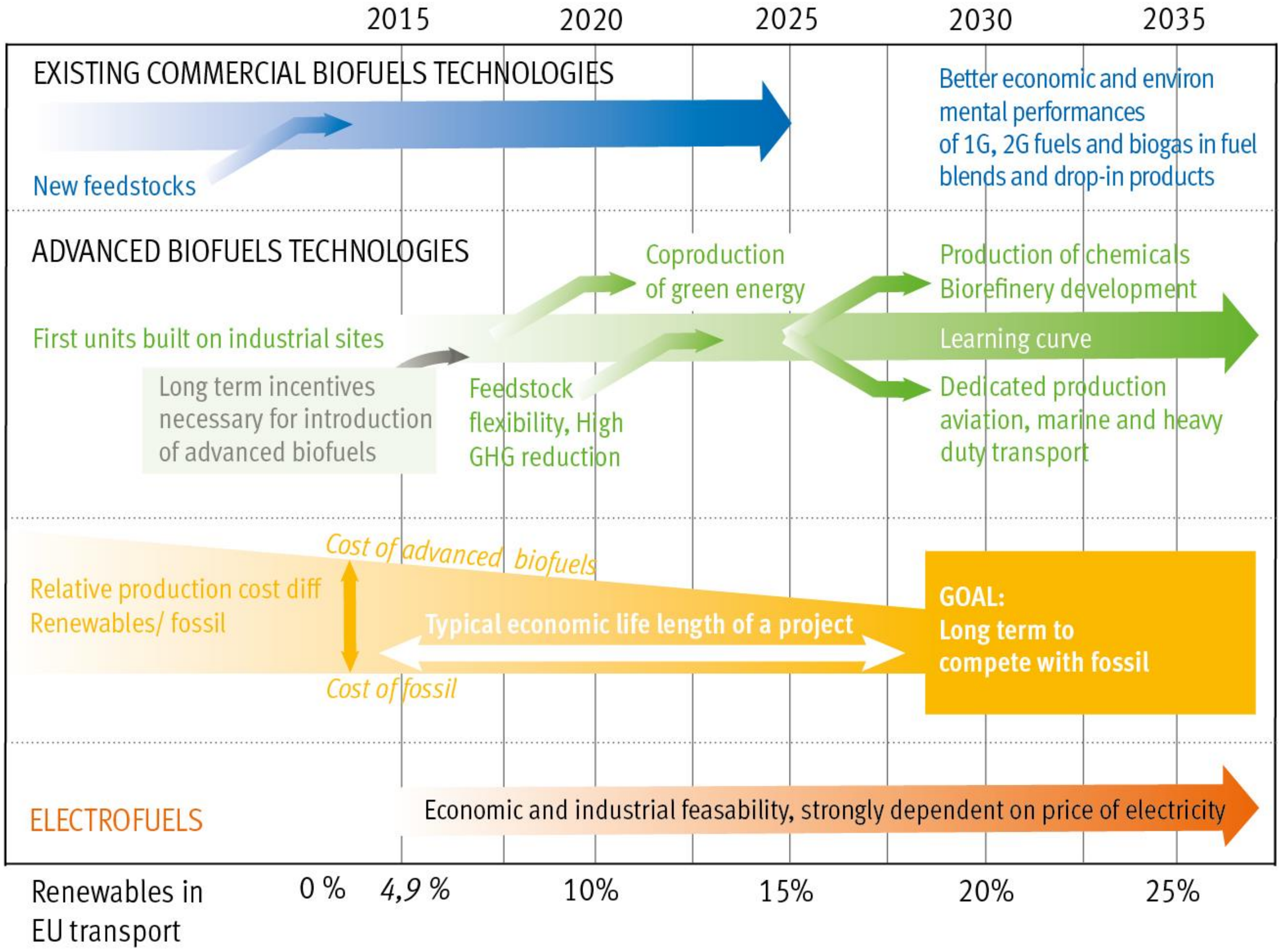
Key messages

- policies, market regulations and financing are constant issues to bring advanced biofuels to the market
- Challenge of societal acceptance
- key criteria for economic viability: ideal locations / infrastructure, secure market for products and long-term raw material supply
- biomass supply and mobilisation is of paramount importance for biofuels to succeed at larger scale
- there is no one-fits all situation as each biofuel plant requires its own specific plant design
- synergies with existing industrial production facilities derserve priority R&D attention

Key messages

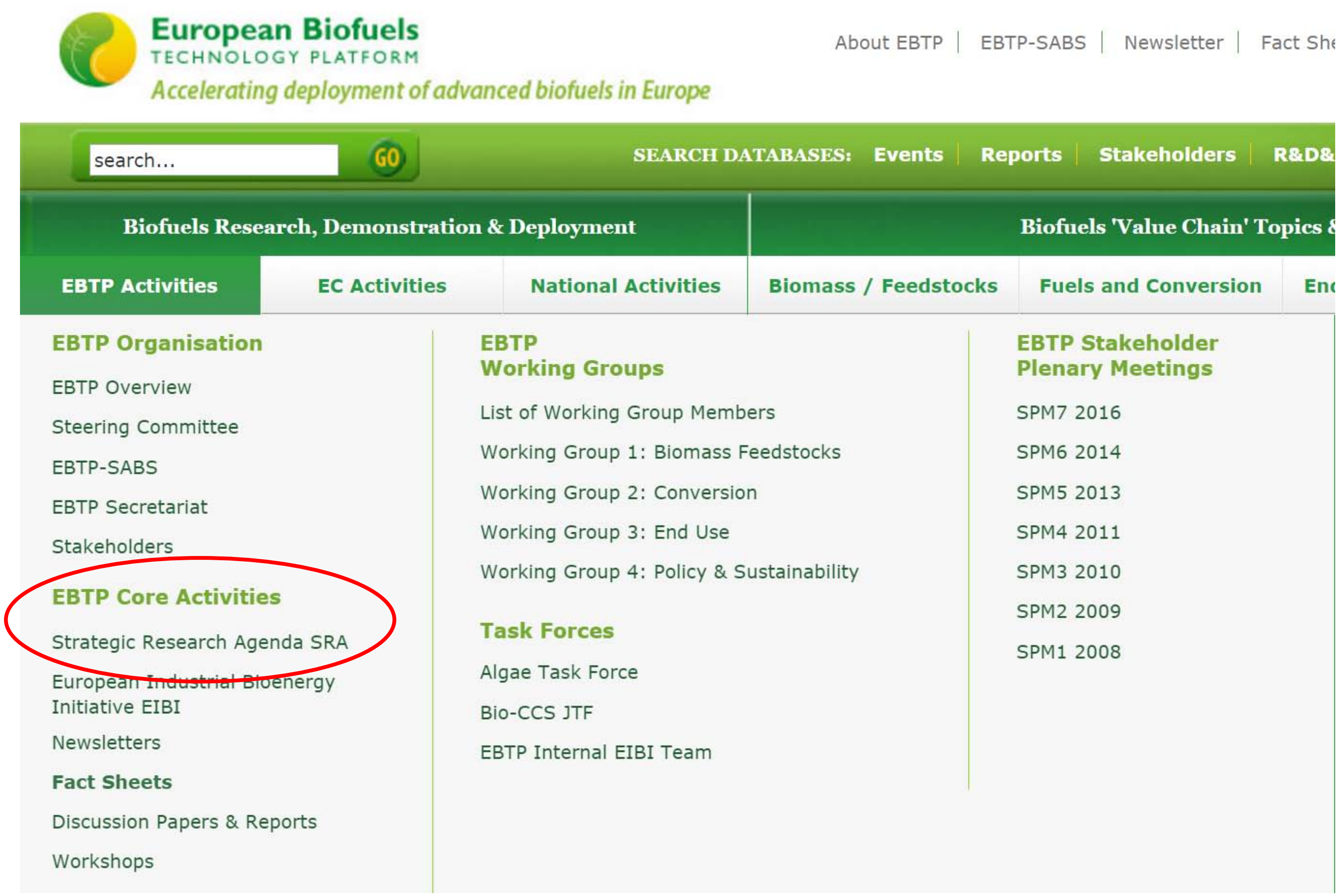
- the key priorities for biofuel technologies are to improve environmental (GHG, energy balance, water, inputs…) and economic performance and bring flexibility as integrated biorefinery
- conversion technologies targeting fuels for heavy duty road, air, and marine transport deserve priority attention because of lack of alternatives and their increasing demand
- work to ensure a fair appreciation of CO2 emissions of vehicles running on biofuels (well-to-wheel approach, electric vehicles and vehicles running on renewable fuel should be treated using equal criteria)
- Understanding the ‘best fit’ of alternatives in the various sectors of transport

Biofuels deployment



Where to find the SRIA

http://biofuelstp.eu/sra.html



How to participate?

- become a member of the Stakeholder Plenary
  - by signing up to the Newsletter, e-mails shots, Stakeholder Plenary Meeting - keeping up to date with the biofuels world.
- by active participation in the Working Groups
  - input to position papers, input to the Strategic Research and Innovation Agenda, input to different other publications – assist in shaping the public opinion on biofuels.

Participation in the EBTP/ETIP Bioenergy is free of charge!

For more information

www.biofuelstp.eu

secretariat@biofuelstp.eu

Sustainable Biomass for the Bioeconomy – S2BIOM project: first results and tools

Calliope Panoutsou (Imperial College London, UK); c.panoutsou@imperial.ac.uk

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Contents

- S2Biom
- Work Plan
- What we have accomplished so far
- Validity & accuracy of data for supply, demand & market projections
- Case study example: Burgundy
- What will S2Biom deliver at the end of the project
- Exploitation plans

- Annex
  - Project partners
  - S2Biom collaborates with
  - Progress
  - Key S2Biom outputs
  - Vision for 1 billion tonnes lignocellulosic biomass in Europe by 2030

S2Biom

Structure

- FP7 Programme
- 4 Mio € EC co-funding
- 36 months (9/2013 – 8/2016)
- 31 Partners
- Geographic scope: EU28 & Energy Community (Western Balkans, Moldova, Ukraine, Turkey)
- www.s2biom.eu

Aims

- To provide consistent & scientific evidence on sustainable supply of non-food biomass to support a resource-efficient bioeconomy in Europe
- To analyse the complete biomass value chain from primary biomass to end-use incl. logistics, pre-treatment, conversion technologies and have respective datasets and approaches online in the toolset
- To disaggregate data and information from NUTS1 to NUTS3

Work plan

S2Biom

Coordination & Management

Theme 1: Data & Tools (WPs 1-4)

- Current and future sustainable lignocellulosic biomass cost supply (domestic and from imports) in EU28; Western Balkans, Moldova, Ukraine and Turkey (37 countries).
- Common operating data, models, and tools representing the entire biomass supply chain
- Incorporation of models and tools for technical, environmental, economic and social impact analysis.

Theme 2: Strategies & Roadmaps (WPs 5-8)

- Policy and regulations for supplying the future bioeconomy
- Support for future industrial investments
- Clarity on cross sector sustainability
- Strategies & Roadmap
- Ex ante impact assessment

Theme 3: Validation & project outreach (WPs 9-10)

- Support for policymaking at local, national, regional and EU28/ Energy Community level by visualizing the outcomes of proposed policies
- Case Studies
- Stakeholder engagement
- Information Campaign/ Consultations/ Webinars
- Improvement of public awareness, education, and outreach

What we have accomplished so far

Large datasets in databases

- Sustainable cost supply of solid lignocellulosic biomass (forestry, biomass crops, agricultural residues, and secondary residues from wood and food industry, wastes) at **NUTS3 level for 37 countries in Europe**.
- Characteristics of biomass for thermochemical and biochemical conversion pathways- **beyond energy & fuels, with selected Product to Market combinations (PMCs)**
- Pre-treatment technologies and logistics components
- Market techno-economic data for biobased product to market combinations
- Policies and support mechanisms for energy, agriculture, waste, environment, etc. (**overall more than 700 measures up to date; work continues**).

What we have accomplished so far

Harmonised methodologies to asses biobased economy

- Biomass cost supply assessment: building on BEE; EUWood, Biomass Futures, Biomass Policies- **in collaboration with JRC, BISO and in discussions with BeO**
- Standardized biomass characterisation and quality requirement for each biomass conversion technology
- Characterization of main logistical components, i.e. storage, pre-treatment and transportation technologies & application to selected case studies
- Life-cycle based environmental sustainability assessment with sustainability criteria and indicators.
- Policy analysis

Validity & accuracy of data/ (i) Supply

S2Biom

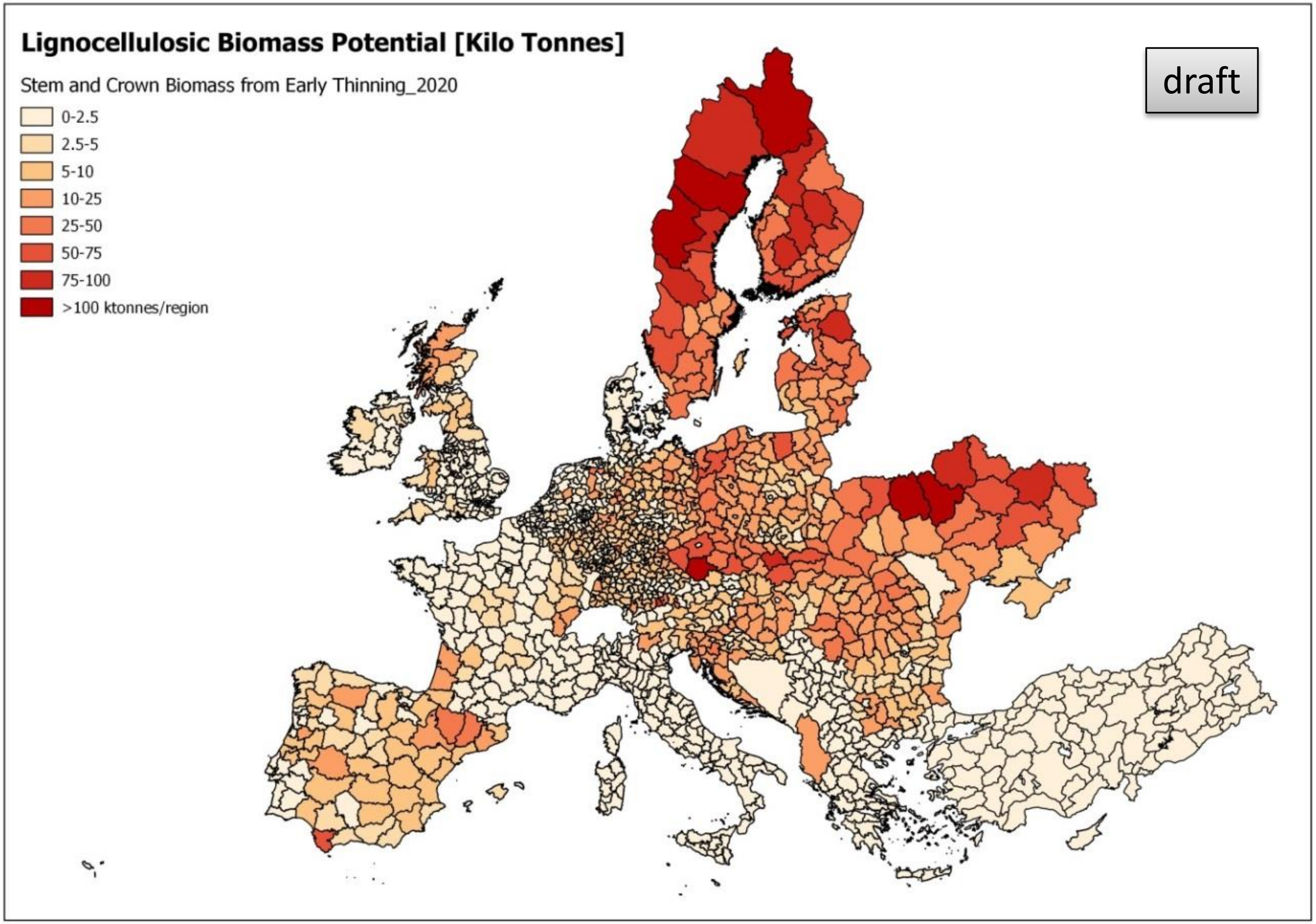
Types of potentials

- **Technical potential**
  - Technical constraints &
  - Current uses for food, feed, biobased products, energy & fuels
- **Base potential**
  - Sustainable potential – RED criteria
  - Considering agreed and established sustainability standards at EU & intl level
- **User-defined potentials**
  - **Vary in terms of type and number of considerations per biomass type**
  - **Options to choose & combine**

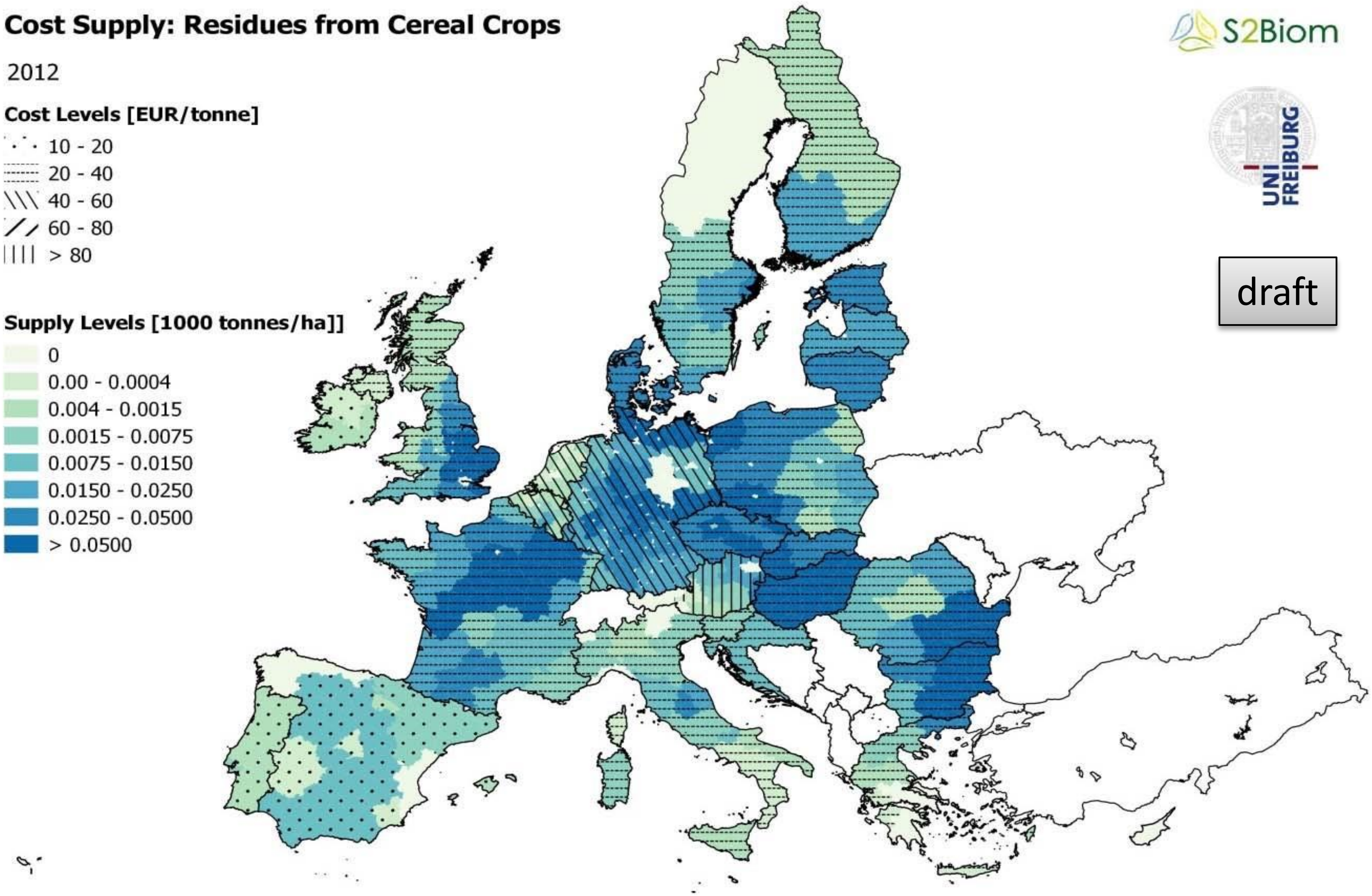
Types of feedstocks

- **Primary production of biomass crops (lignocellulosic and woody crops)**
  - Miscanthus, giant reed, cardoon, sorghum, etc.
- **Agricultural residues**
  - From arable crops cereals, rape, sunflower, grain maize and sugarbeet (leaves).
  - Secondary from agro indusrties
- **Grassland**
- **Forestry**
  - Stemwood, thinnings, etc
  - Secondary- wood processing industries
- **Road verge grass**
- **Landscape care management biomass**
- **Waste/ tertiary residues**

Display of results in the toolset/ atlas: Stem and Crown Biomass from Early Thinnings 2020



Display of results in the toolset/ atlas: Cost-supply potential for residues from cereal crops



draft

Validity & accuracy of data (ii) Demand, Market projections

S2Biom

- **Key question S2Biom modelling focuses: To what extent the additional biomass demand for chemicals and materials could be sufficiently significant to:**
  - influence lignocellulosic biomass prices and
  - induce scarcity and competition issues with
  - energy applications?

- **Focus of specific product to market combinations (PMCs- see next slide): Uncertainties are substantial with respect to:**
  - technologies that are to be further developed
  - supporting policies required
  - the future of (petro)chemical industry in EU
  - the oil price, being a strong factor affecting the
  - prospects for biobased chemicals and
  - materials
- **BIOTIC project**

S2Biom product to market combinations (PMCs)

	Product	Market
1	Heat	District heating
2	Electricity	Power market
3	Advanced Biofuels	Transport fuel
4	C6 sugars	C6 chemistry: polymers & plastics, others
5	C5 sugars	C5 chemistry: polymers & plastics, others
6	Bio-methane	Grid, transport
7	BTX	Petrochemical industry
8	Methanol	Transport, chemical industry
9	Hydrogen	Transport, (petro)chemical industry
10	Ethylene	(petro)chemical industry

What we have accomplished so far

Tool demo for testing; two webinars so far- new update within May – initial tailoring to case studies

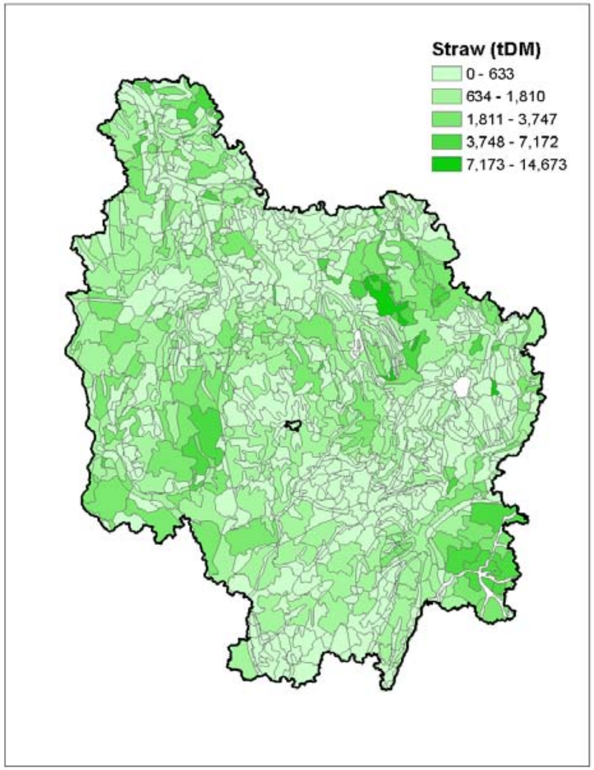
Current state of biomass use for bioenergy, biofuels and bio-based materials & scenarios for modelling future demand in Europe

Strategic and advanced case study work ongoing

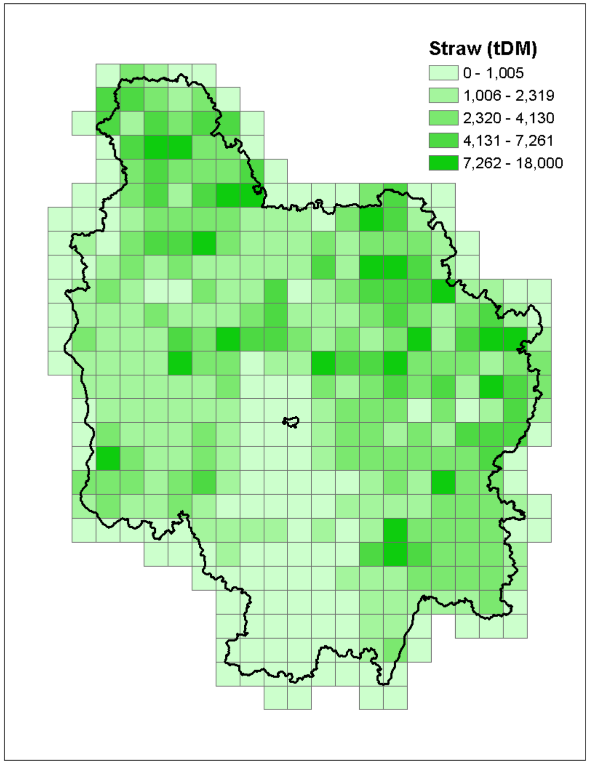
Vision of 1 Billion tonnes lignocellulosic biomass in Europe by 2030- open consultation & ongoing validation (see slides in Annex)

Case study example: Burgundy

Straw availability



Aggregated straw availability



Input: biomass (WP1)

- Biomass
  - Location
  - Availability
  - Collecting cost

BeWhere model; IIASA

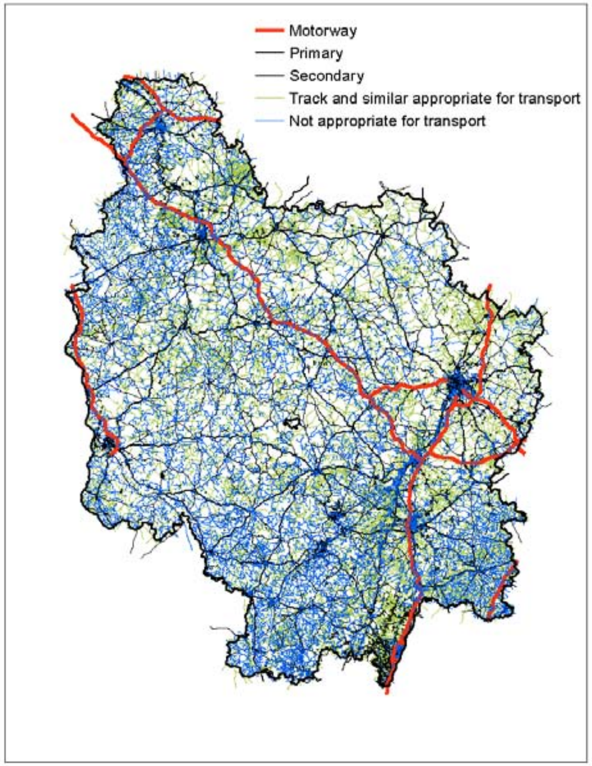
Input: technology

Key parameters	*Unit*	*Methanol* [a, b]	*Ethanol* [c]	*FT diesel* [b]	*CHP* [d]
Feedstock		Wood chips	Wood chips	Wood chips	Straw
Base plant capacity	$t_{biomass}$/hour	357	105	100	3.75
Cost					
Base investment	M€/a	505	143	67	0.63
O&M	M€/$PJ_{biofuel}$	1.2	2.5	2.9	1.75
Efficiencies					
Total	GJ_{in}/GJ_{out}	**0.66**	**0.81**	**0.57**	**0.85**
Biofuel	$GJ_{biofuel}/GJ_{biomass}$	**0.55**	0.30	0.45	–
Electrical	$GJ_{electricity}/GJ_{biomass}$	0	0.11	0.06	**0.25**
District heating	$GJ_{heat}/Gj_{biomass}$	0.11	**0.40**	0.06	**0.60**

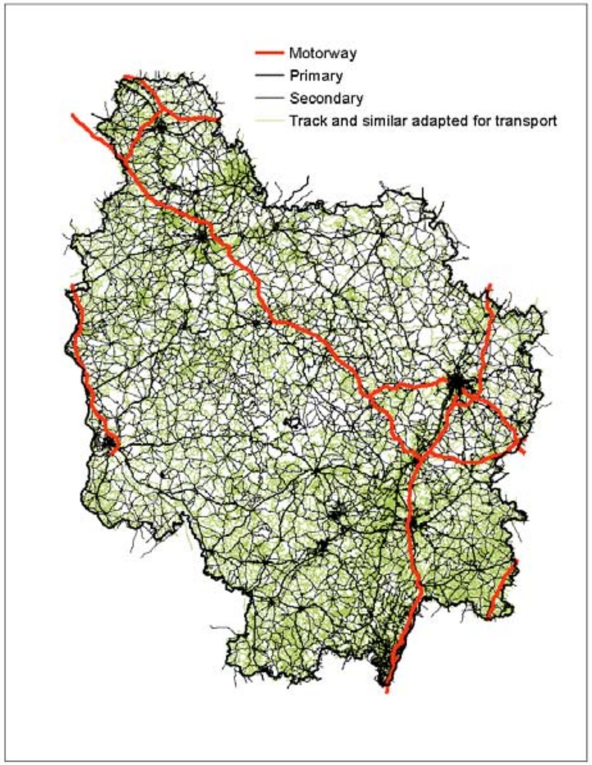
[a] *Hamelinck, et al., 2002.*
[b] *Wahlund, et al., 2004.*
[c] *Barta, et al., 2010.*
[d] *S2Biom*

Input: logistics

Road Network



Used road network



Input

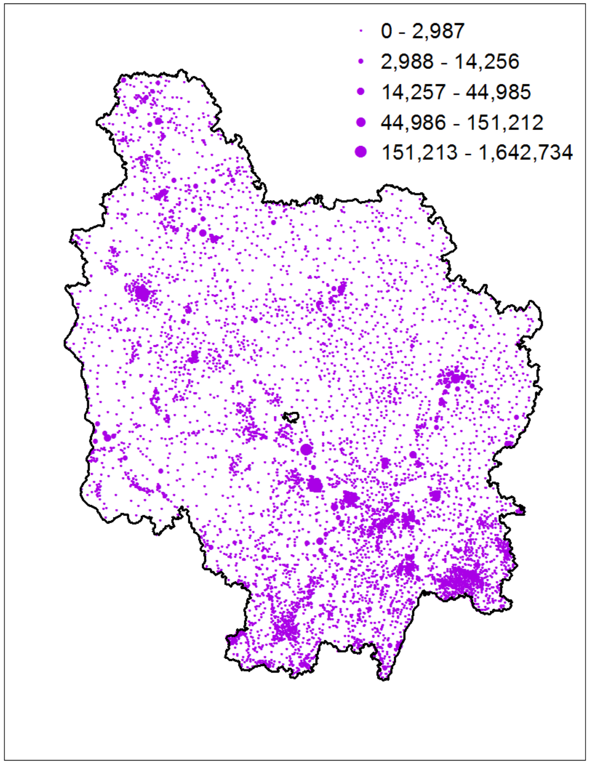
- Transport cost
- Emissions
- Terminals / pretreatment

- Distances from all points to all points based on Min(*t*) or Min(*d*)

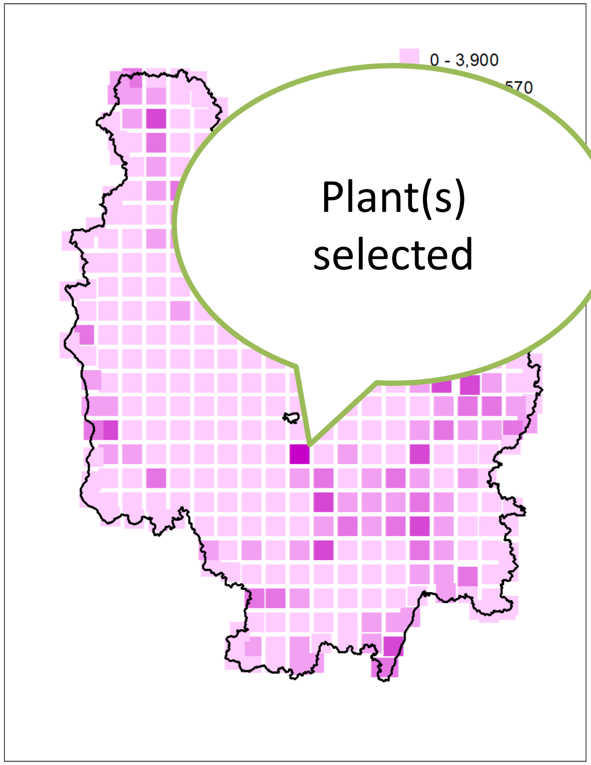
Source: OpenStreetMap.org

Input: demand

Population



Aggregated population



Source: OpenStreetMap.org

- Existing industries

  Location

  Feedstock demand

  Power/heat output

- Production plants

  Type of biomass

  Biomass need

  Economic parameters

  Conversion efficiency

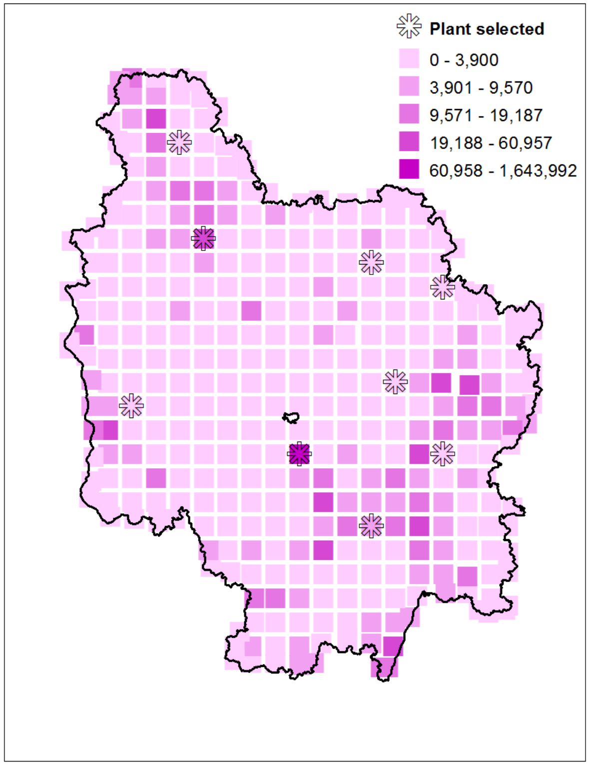
- **Heat** consumption
- **Power** consumption
- **Transport fuel** consumption

Based on statistics and weighted by number of inhabitants.

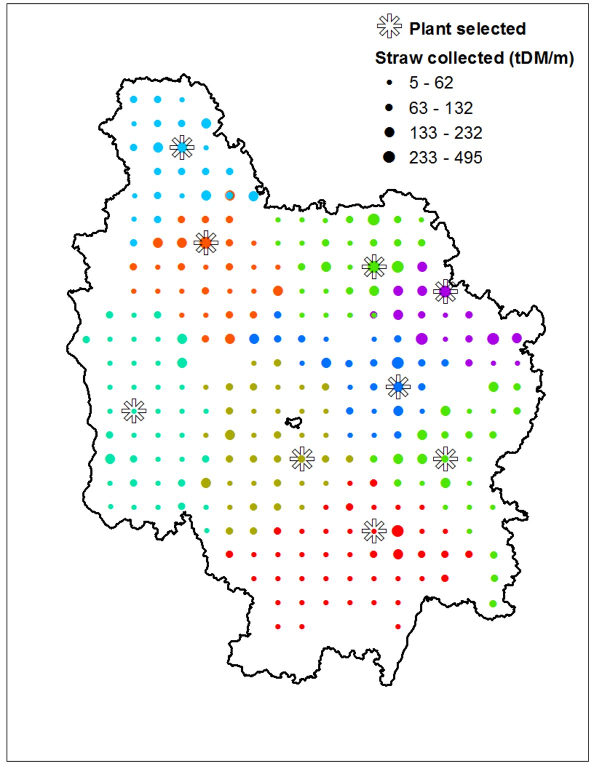
- **Price** of competing fossil fuel based heat / power / transport fuel

Result Example

Plant selected



Biomass allocated



Output

- Biomass used
- Technology allocated
- Heat, power produced

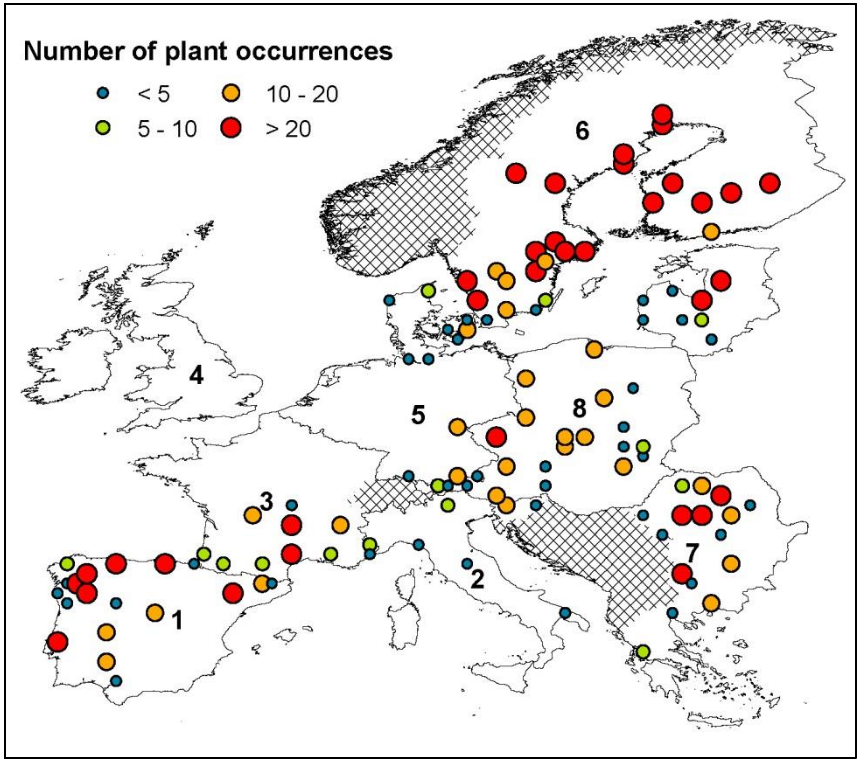
- Costs
- Emissions avoided

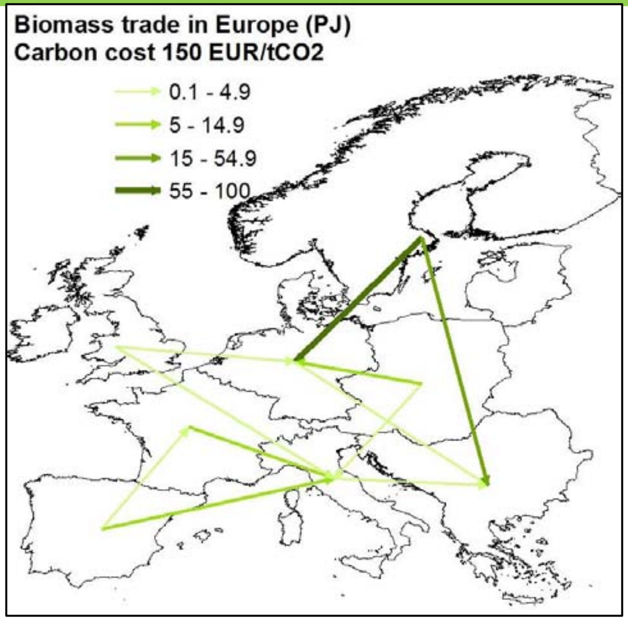
→ LOCAgistics tool

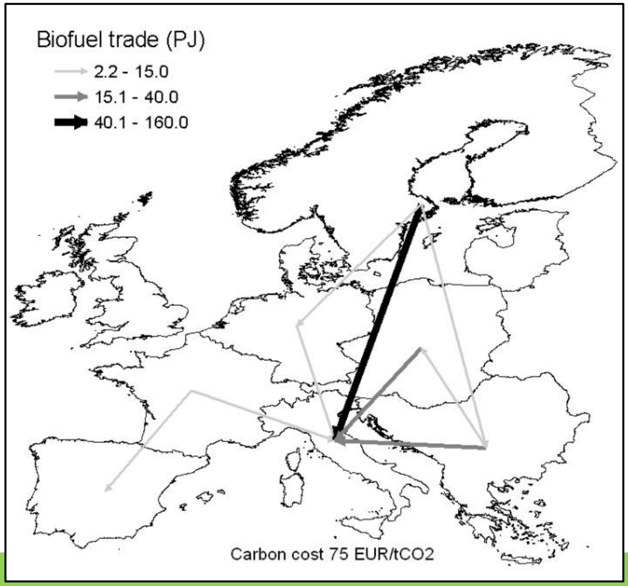
Results

- **Biomass**
  - Site used
  - To which plant
- **Production plants**
  - Number
  - Technologies
  - Capacities
- **Demand**
  - Demand met
  - Import and fossil fuel used
- **Additional information**
  - Quantities
  - Costs
  - Emission

European Model







What will S2Biom deliver at the end of the project

- **Large datasets in databases:**
  - Facilitate the formation and comparability of comprehensive databases populated with consistent datasets on:
    - Lignocellulosic biomass cost supply, conversion technologies, policies/ support mechanisms
- **Harmonised methodologies to asses biobased economy (cross sector)**
  - Transparency in data collection- harmonised protocols
  - Cross sector integrated frameworks addressing all bioeconomy sectors for: Life Cycle Analysis, Sustainability Criteria & Indicators Economic & energy modelling and Policy
- **S2Biom toolset- improve (feedstocks- geography) IT capacity for biomass cost supply & logistics for a wide range of feedstocks in a large geographic area with high resolution**
- **Bridging policy/ regulatory framework with local capacity and investment opportunities to develop action and investment plans in selected cases**
- **Developing a Vision, Strategies, regional implementation plans (EU28 & EnC) & an R&D roadmap**

Thank you for your attention!

www.s2biom.eu

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Annex

Project partners

No.	Institution/Organisation (original language)	Acronym	Country code
1	Agency for Renewable Resources	FNR	DE
2	Imperial College	Imperial	UK
3	Stichting Dienst Landbouwkundig Onderzoek	DLO	NL
4	University of Freiburg	ALU-FR	DE
5	Joanneum Research	JR	AT
6	International Institute for Applied Systems Analysis	IIASA	AT
7	European Forest Institute	EFI	FI
8	Natural Resources Institute Finland	LUKE	FI
9	VTT Technical Research Centre of Finland	VTT	FI
10	University of Bologna	UniBO	IT
11	Energy research Centre of the Netherlands	ECN	NL
12	Flemish Institute for Technological Research	VITO	BR
13	IINAS - International Institute for Sustainability Analysis and -Strategy	IINAS	DE
14	Clever Consult	CC	BE
15	SYNCOM Research and Development Consulting GmbH	SYNCOM	DE
16	WIP Renewable Energies	WIP	DE
17	Biomass technology group BV	BTG	NL
18	Central European Initiative	CEI	IT
19	Institute of Soil Science and Plant Cultivation, State Research Institute	IUNG	PL
20	International Centre for Sustainable Development of Energy, Water and Environment Systems	SDEWES	HR
21	Ege Universtity Solar Energy Institute	EU-SEI	TR
22	National Institute for Agricultural Research	INRA	FR
23	Joint Research Centre	JRC	IT
24	CENER-CIEMAT Foundation	CENER	ES
25	Research Centre for Energy Resources and Consumption	CIRCE	ES
26	Slovenian Forestry Institute	SFI	SI
27	Centre for Research & Technology Hellas	CERTH	EL
28	Renewable Energy Agency	REA	UA
29	University of Belgrade - Faculty of Mechanical Engineering	UBFME	RS
30	Census-Bio	Census-Bio	UK
31	Biomass Research	Biomass Research	NL

S2Biom collaborates with:

- EU projects: BEE, CEUBIOM, Biomass Futures, Biomass Policies, Biomass Trade Centres, CAPRI, Sector, Bioboost, Logistec, INFRES and EuroPruning;

- Biobased industries: close collaboration with key stakeholders from industry and market sectors.

- Energy Community: collaboration with the Secretariat and Contracting Parties at national (ministerial) level (Albania, Bosnia & Herzegovina, Kosovo, Macedonia, Moldova, Montenegro, Serbia, Turkey and Ukraine).

Progress

S2Biom

Knowledge base

Knowledge management

What we know & how we best use the knowledge?

S2Biom work mid term

- Spatial cost supply database & atlas
- Conversion technologies database
- Logistical components database
- GUI; central database; viewing tools
- Environmental Footprint, Criteria & Indicators
- 600 policies in database
- Scenarios, Market analysis
- Current state bioeconomy Vision
- Strategic and Advanced case studies

Planning till end

Deliver scientifically robust and user friendly information

Strategic development

How can the S2Biom outcomes be used to inform the future agendas of policy and industry?

Case studies
Maximise project outreach
PIAC

Key S2Biom outputs

S2Biom

Database, method and atlas of sustainable non-food lignocellulosic biomass feedstocks at NUTS3 level for EU28, western Balkans, Turkey, Moldova and Ukraine.

Database, method and tool with indicators to assist decision makers in matching biomass types with the optimal conversion technologies.

Database, method and tool to evaluate promising logistics supply chains at local, regional level with sustainability and demand criteria

A computerised toolset integrating data and methodologies from biomass cost supply, conversion and logistics which will "facilitate the integrated design and evaluation of optimal biomass delivery chains at European, national, regional and local scale.

Key S2Biom outputs

Harmonized sustainability requirements for bioeconomy value chains, including guidelines for methodologies to determine sustainability performance.

A database on EU and national level, for all 37 counties analysed in this call, and policy guidelines in relation to the mobilization of sustainable non-food biomass for the biobased economy.

Strategies & implementation plans for lignocellulosic biomass supply tailored to a) different levels of governance (i.e. regional and specific local ones linked to case studies) and ii) industrial sectors

Case studies to validate the Strategies, Roadmaps and the Tool from the users' point of view (i.e. Member States, Associates and neighbouring countries, regional authorities, industries)

1 billion tonnes* lignocellulosic biomass for biobased economy by 2030 in Europe

First version- September 2015- under consultation on project website

***** Technical potential of lignocellulosic biomass for all biobased economy sectors***

Purpose of work

- To establish a Vision statement for an expanded role of sustainable non-food biomass supply and delivery in the European **(EU28, Western Balkans, Ukraine, Moldova and Turkey)** bio based economy, including **stretching but realistic goals**.

- Timeframe: **2030** (with analysis for 2020)

This version is a **draft** which will be informed by the S2Biom toolset, against which views will be sought and debated (online consultation on project website), and which will finally form the basis for as a series of strategies, implementation plans (Task 8.3) and an R&D roadmap (Task 8.4).

Vision: general

- How do we see 2030?
  What is the (expected) amount of lignocellulosic biomass to be available in 2030?

- Optimistic & realistic

- This will only be realised under optimal conditions.
  What are the optimal conditions to realise that Vision (yield, costs, logistics, markets, technologies, policy framework, …)?

Current use of lignocellulosic biomass- Forest

Total amount of **<u>forest based lignocellulosic biomass</u>** used for energy and material uses in 2013 (E28 + WB, UKR, MD): **530 million tonnes** (485 in EU28)

An estimated **261 million tonnes** (245 in EU28) of wood used as a "classical" bio-based material primarily used in the woodworking and pulp and paper industry

269 million tonnes (with 240 in EU28) of wood are used for production of energy (mainly heat and power).

Sources: EuropaBio, Nova Institut, DG ENER, EnC

Current use of lignocellulosic biomass- Agriculture

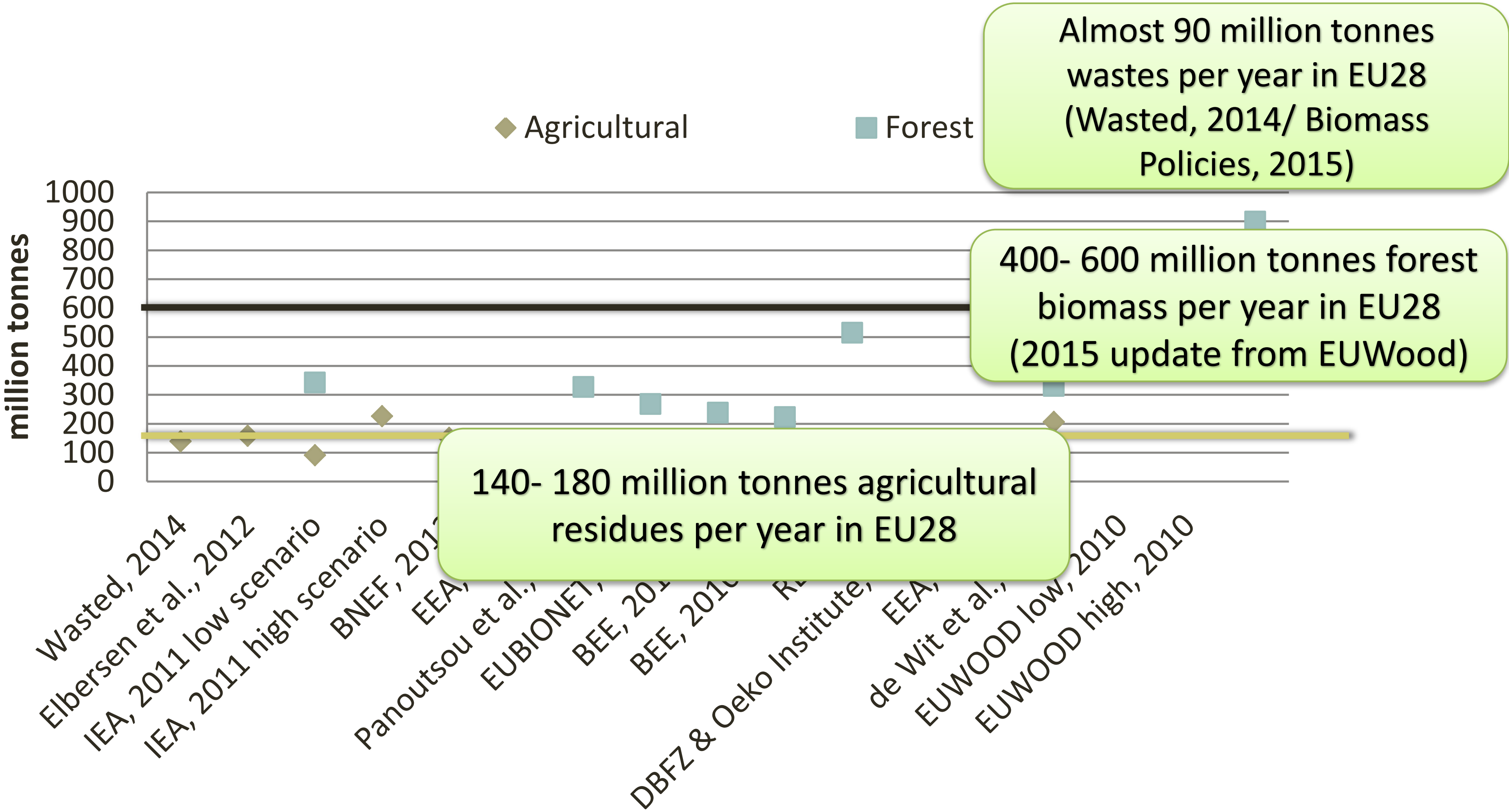
Total amount of **agricultural (non lignocellulosic) biomass** in 2013: almost 10% (8 million tonnes out of 79) of the raw materials base for the chemical industries in the EU was based on renewables:

- sugar and starch: 1.56 mTonnes)
- plant oils (1.26 mTonnes)
- bioethanol ETBE (1 mTonnes)
- natural rubber (1.06 mTonnes)
- pure bioethanol (0.46 mTonnes)
- animal fats (0.43 mTonnes)
- glycerine (0.41 mTonnes)
- …

Total amount of **agriculture based lignocellulosic biomass:**
Estimates from 5-10 million tonnes (dry) but information relies on individual studies without recent harmonisation across EU

Sources: EuropaBio, Nova Institut, Cefic, VDI, EnC

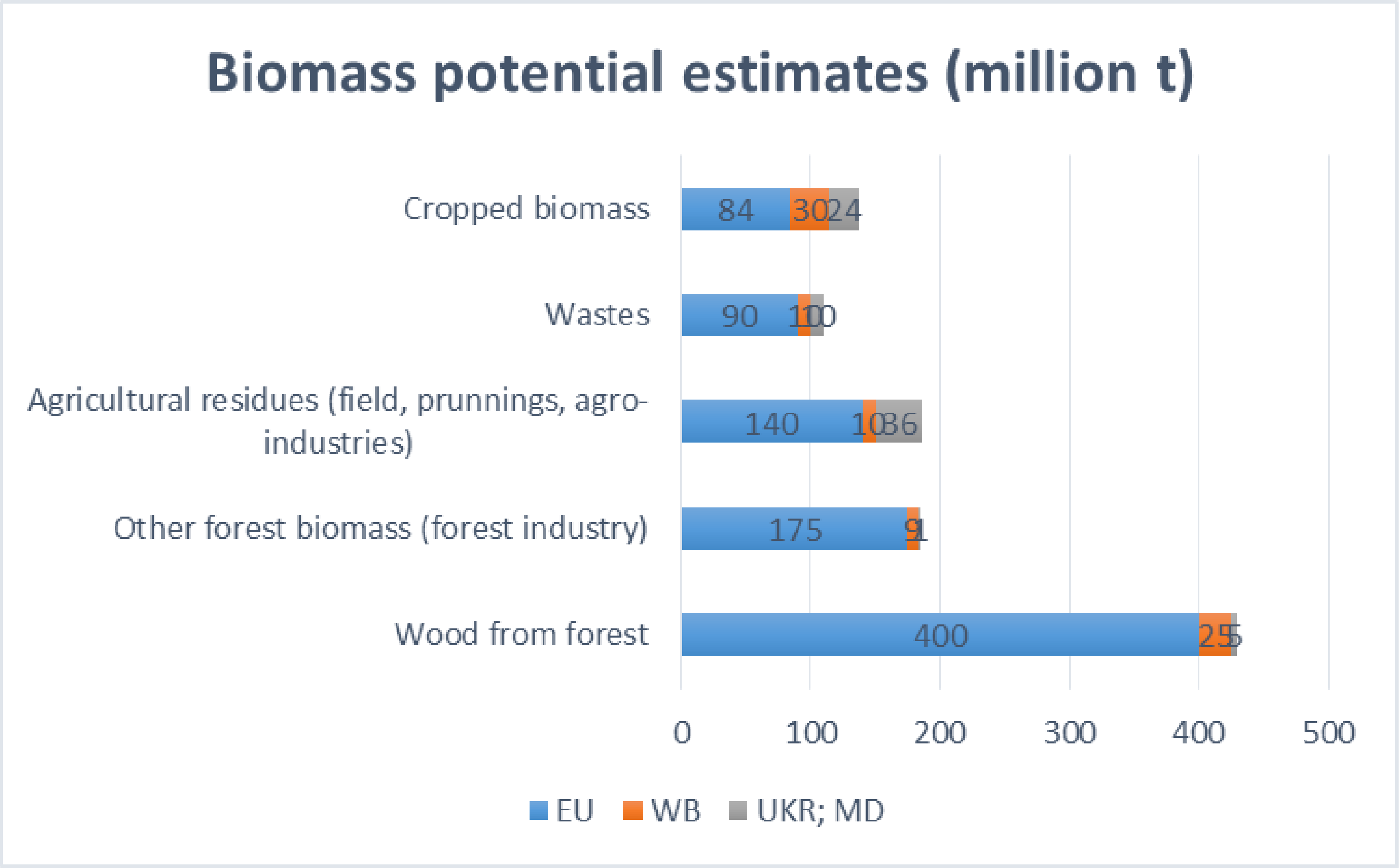
The lignocellulosic biomass base in EU28 in 2030: Forest, Agriculture, Wastes



Cropped biomass and released agricultural land in EU28 in 2030

Study	Cropped Biomass Potential (million tonnes)	Comments
Commission's 2030 impact assessment for BBI JU (2014)	84- 180	The impact assessment estimates **7-12 million ha** being available for biomass crops. We assumed that the low value will result in 84 million tonnes by using an average crop yield of 12t/ha while the high mobilization will result in 180 million tonnes by using an average crop yield of 15t/ha
Biomass Policies (2015)	230	**20 million ha** in 2030, reference scenario - Biomass Policies project
EEA, 2012	217	**16.7 million ha** available in 2020 in Storyline 1 (economy & market first)
Biomass Futures, 2012	234	**18.8 million ha** in 2030, reference scenario - Biomass Futures project
REFUEL, 2010	575	Agricultural land potentially available for growing biofuel feedstocks in 2030: EU27 & Ukraine/ LU-Env scenario: **44.2 million ha**

Total potential baseline EU28 + WB, UKR, MD



1 Billion tonne supply by 2030

Resource costs

- **Local agricultural residues** were estimated to
  - €60-80 per tonne (delivered) for northern/ central Europe
  - €30-40 per tonne for southern and eastern Europe.

- Current market prices for **industrial wood chips** of around €59-65 per tonne.

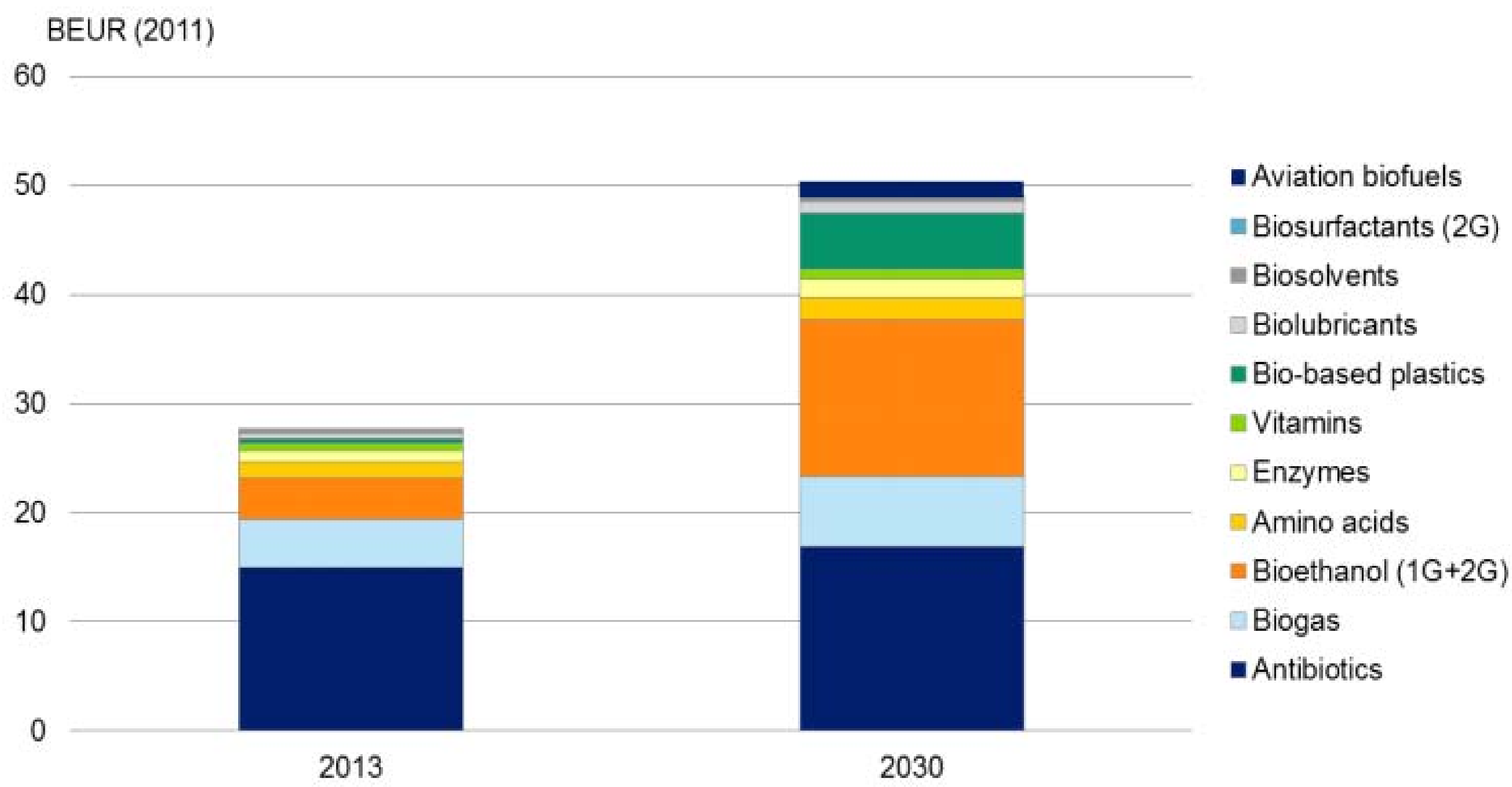
- Biorefinery operations might be able to charge a **gate fee** in the range of €20-40 per tonne for accepting the material.

These are only average representative examples, and one should bear in mind that there will be significant variation in actual feedstock costs, depending on the actual project details

Sources: S2Biom, Biomass Policies, Wasted, EnC

Opportunities for bio-based industries

Estimated biobased products market demand in the EU up to 2030*

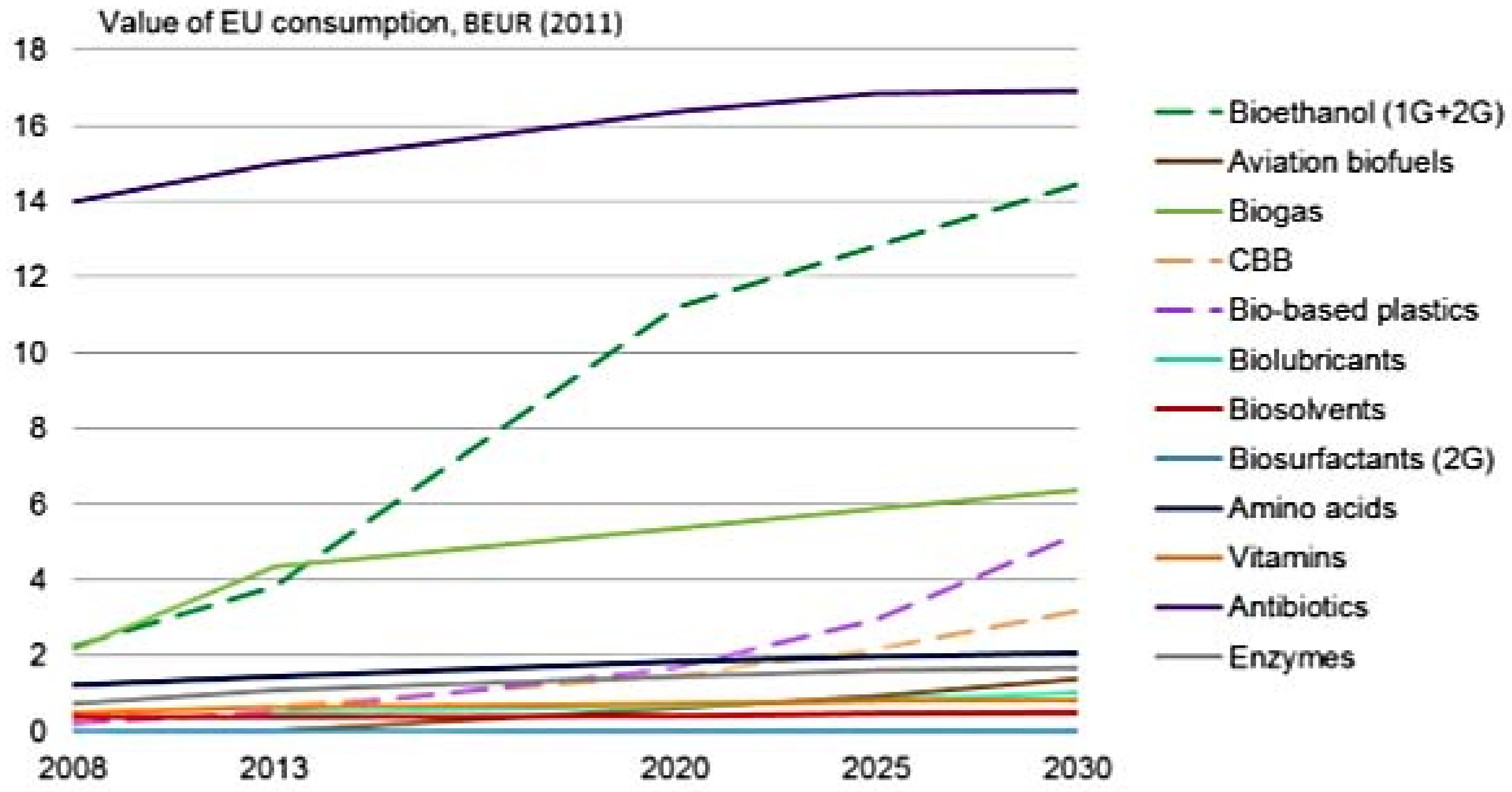


** BIO-TIC project*

Opportunities for bio-based industries

S2Biom

Estimated market demand in the EU up to 2030 – by product segment*



** BIO-TIC project*

Chemicals and materials: existing studies

	Current state	2020	2030
Bioplastics	• European Bioplastics: 280 kT (2013) • BioTic: around 1 B€	• European Bioplastics: 512 kT (2018) • BioTic: around 2 B€	• - • BioTic: around 5,2 B€
Biolubricants	• ERRMA: 137 kT (2008) • BioChem: 150 kT (2008)	• ERRMA: 420 kT (2020) • BioChem: 230 kT (2020)	• -
Biocomposites	• ERRMA: 362 kT (2010) • Nova institute: 315 kT (2010)	• ERRMA: 920 kT (2020) • Nova institute: 830 kT (2020)	• - • -
Biochemicals	• Chemical industry is estimated to use 8-10% renewable raw materials • BioTic: around 1 B€ (Chemical building blocs - 2013)	• The share of biobased chemicals is expected to be 20% • BioTic: around 1,5 B€ (Chemical building.g blocks)	• The share of biobased chemicals is expected to be 30% (BIC Vision) • BioTic: around 3 B€ (Chemical building blocks)
Bioenergy & biofuels	• BioTic: bioethanol around 4 B€ • Nova institute: biofuels (all) around 6 B€ (2011) • DG Agri: bioethanol 3,3 Mtoe (2013)	• BioTic: bioethanol around 11 B€ and 0,5 B€ aviation fuels • DG Agri: bioethanol 6,1 Mtoe (2023)	• BioTic: bioethanol around 14,2 B€ and 1 B€ aviation fuels

IEA Bioenergy

Integration of Advanced Biofuels in the Circular Economy

Identifying major innovation options

European Biofuels Technology Platform
7th Stakeholder Plenary Meeting (SPM7)
Brussels, Tuesday 21 June 2016

FOOD & BIOBASED RESEARCH
WAGENINGEN UR

René van Ree
Coordinator IEA Bioenergy Task42 Biorefining
Theme Leader Bioenergy & Biofuels Wageningen UR, NL

iea Energy Technology Network

IEA Bioenergy, also known as the Implementing Agreement for a Programme of Research, Development and Demonstration on Bioenergy, functions within a Framework created by the International Energy Agency (IEA). Views, findings and publications of IEA Bioenergy do not necessarily represent the views or policies of the IEA Secretariat or of its individual Member countries.

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Sustainable biomass production and valorisation for the BioEconomy by cascading and refining approaches to optimise full chain resource efficiency

€ market pyramid is leading

Pharma
FF ingredients
Chemicals
Materials
Fuels
Energy

Optimal sustainable biomass mobilisation & valorisation to both food and non-food within a market-pull approach should be the main focus of a BioEconomy

GHG-emission reduction policy goals: high vol, low € markets are leading

Production of advanced biofuels & bioenergy is leading and upstream cascading and refinering approaches and downstream residues valorisation strategies are applied to optimise full chain sustainability

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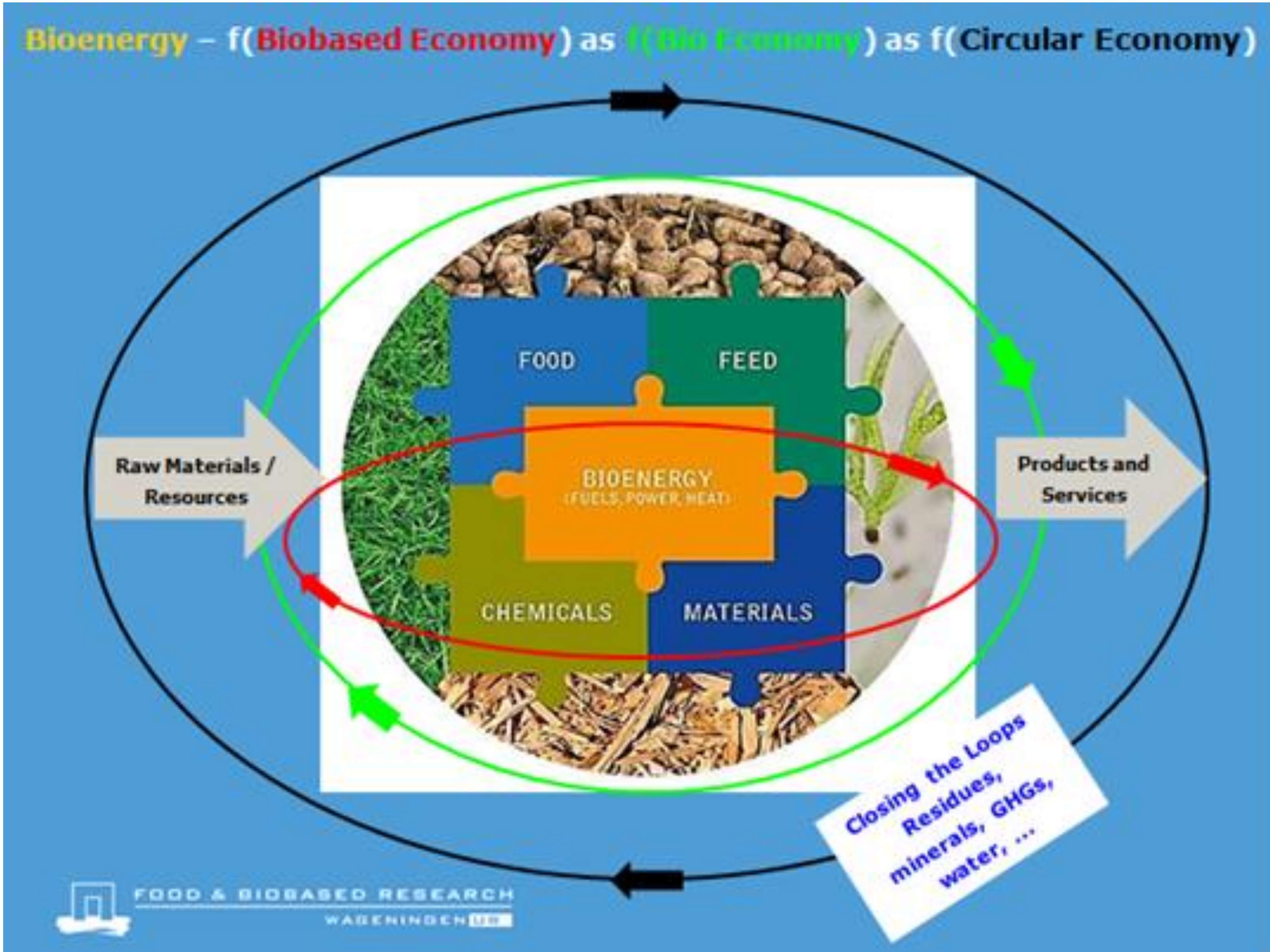
Bioenergy in the Circular Economy



Energy and Biofuel based Biorefineries

Energy based biorefineries		
Main Product	**Biorefining opportunities**	**Main issues**
Power Heat CHP	• Use of 1/2/3 residues • Upsteam ref. raw mat. • Integration existing & new infrastructures	Profitability (low coal €) Sustainability
Biogas (SNG, CHP)	• Upstream ref. raw mat. • Digestate valorisation • Biogas/CO_2 valorisation • Digestion 2 fractionation	Profitability Raw. mat. rel. policies

Advanced biofuel based biorefineries		
Main Product	**Biorefining opportunities**	**Main issues**
Truck fuels Aviation fuels	• Sugar & syngas platforms • Lignin valorisation (c2bbp2>€)	Sustainability Techn SOTA
Shipping fuels	Ligin val. in robust engines	New desulp.reg.

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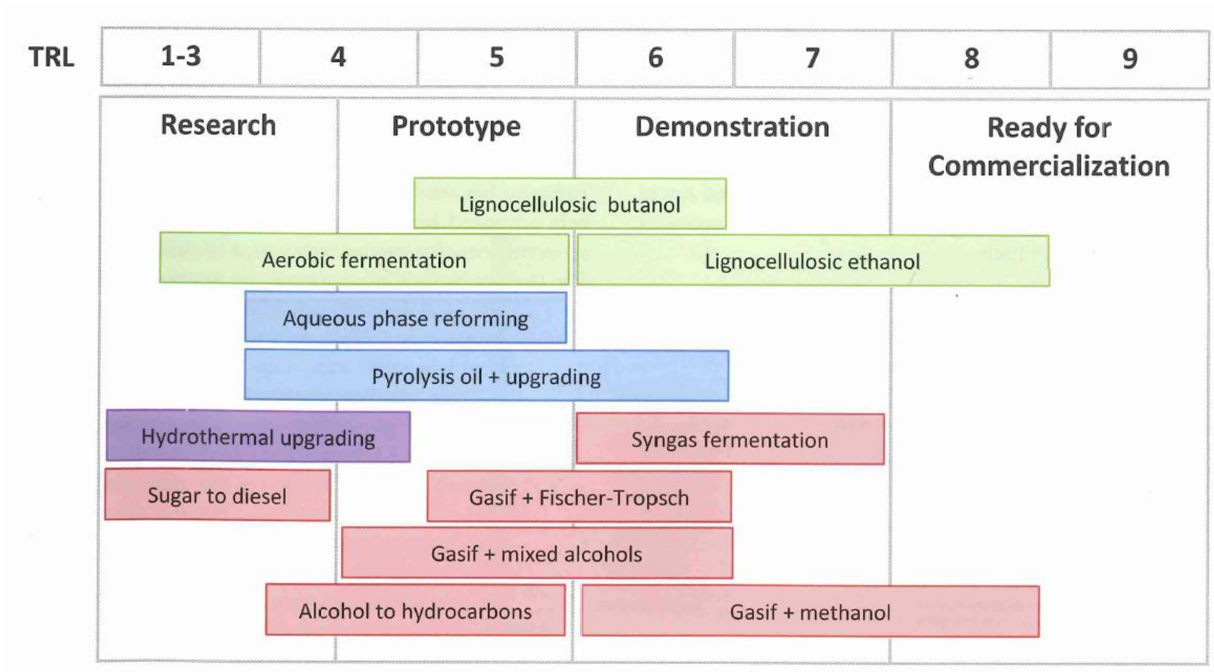
Advanced Biofuel Based Biorefineries

Commercialisation Status (IRENA)

International Renewable Energy Agency, BE Sustainable, 2016



- **Main technological issues will be solved**
- **Multi-product valorisation will be necessary for full market competitiveness and flexibility**
- **Main crucial innovation issues:**
  - Need for sustainable biomass supply: **<u>BIOCOMMODITIES</u>**
  - Efficient use biomass sources: **<u>BIOREFINING</u>**

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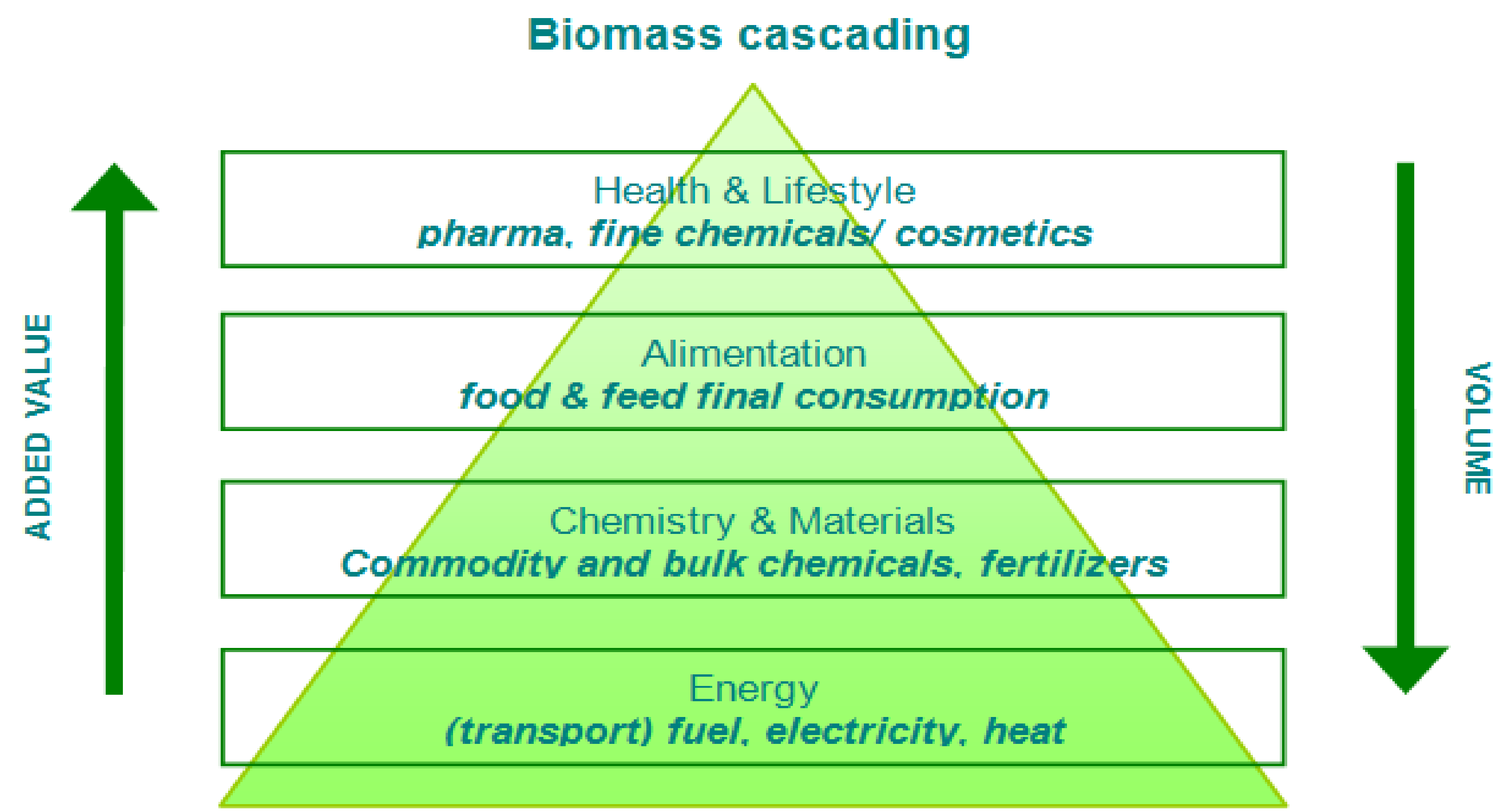
Optimal sustainable use of biomass CASCADING / REFINING



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Cascading in time: optimal use harvested biomass & re-use;

Cascading in function/value: biorefining using the value pyramid

BioEconomy Market Pull
Product Based Biorefineries

Markets	Current sit	Biorefining opportunities
Pharma	Chem & Nat	Extraction from land/aq. crops
Food	Veg & Meat	Ingredients (proteins, CHs, oils, vitams, ...) from biomass (reduced meat cons./neg.em.)
Feed	Crops & Res	
Chemicals	Mainly fossil	Drop-in/better performance new chem/mat (lighter, stronger, ...)
Materials	Mainly fossil	
Fuels	Fossil / 1G bio	Non-food BM to advanced fuels
Energy	Fossil / RE	Use of BR residues
Minerals	Mining	Separation and bring back to the field/process to incr. overall sustainability
Water/CO_2	Use/Em. = -/-	

Main INN Issues: - Standardisation/certification traj. > t
- No level playing field –> artificial market pull
- Sep. "worlds" 1) Food and Non-food (reg./stak./R&D-support) & 2) Upstream (cultivation) and downstr. (processing)

<u>Stakeholder Cooperation</u>

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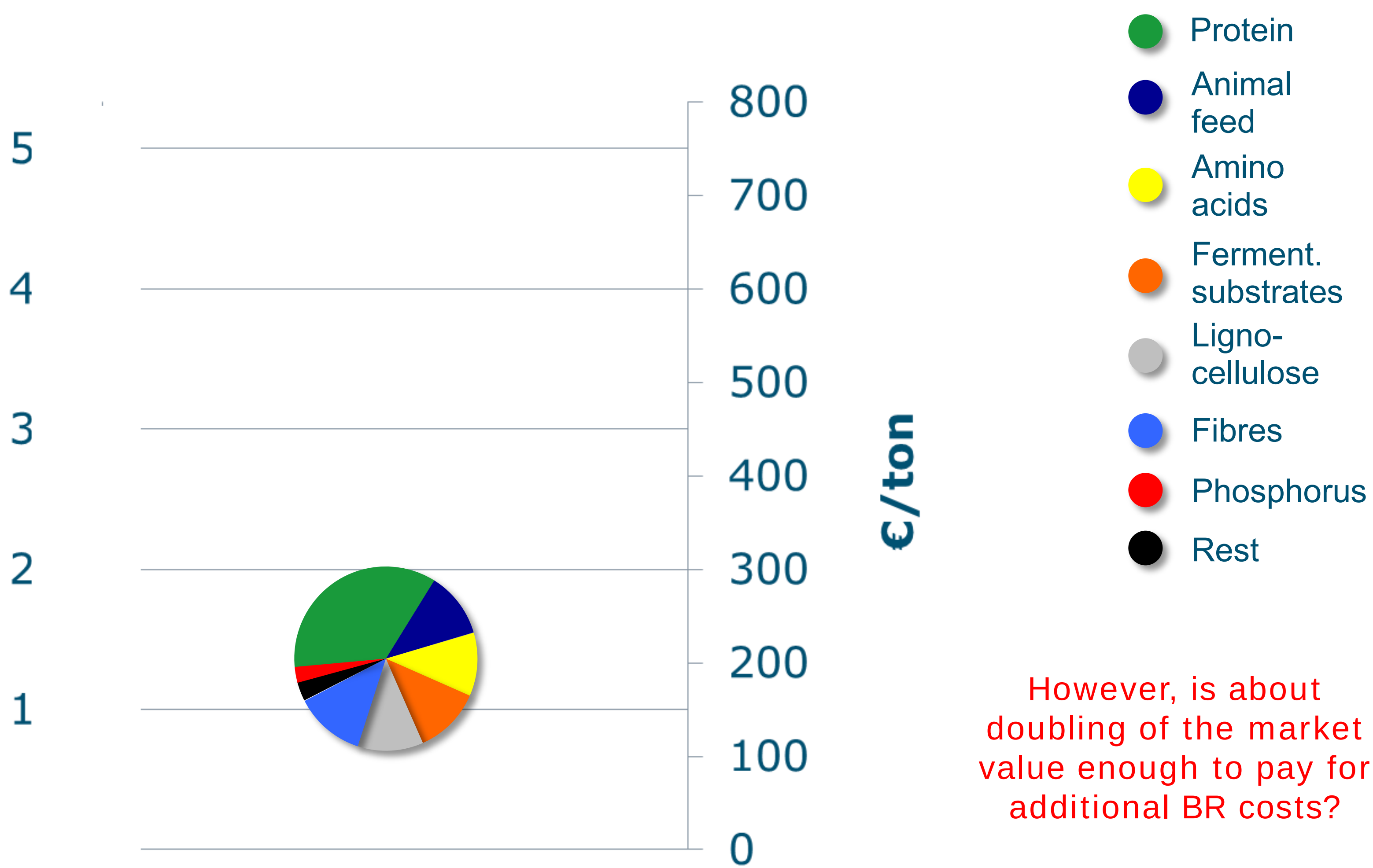
Multi vs single product focussed processes

Biorefining rapemeal increasing its overall value



However, is about doubling of the market value enough to pay for additional BR costs?

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For quality of life

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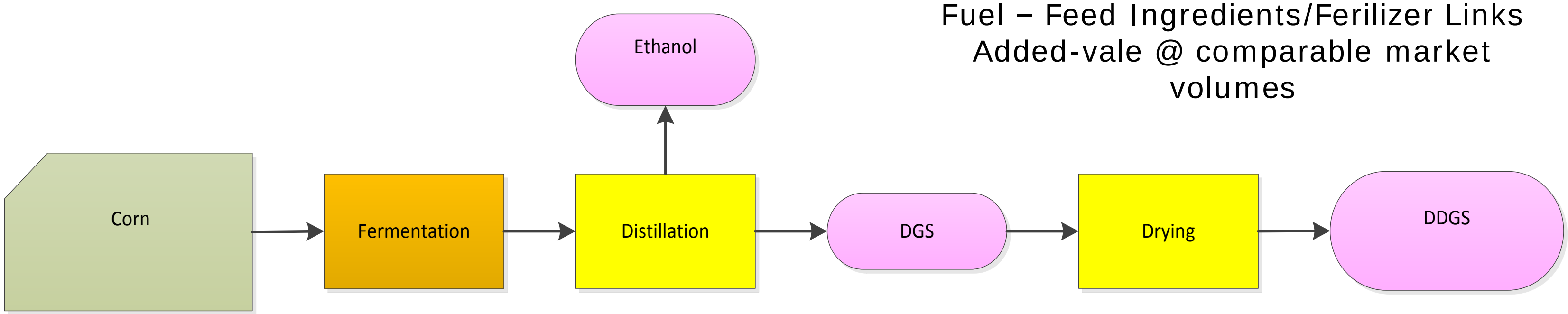
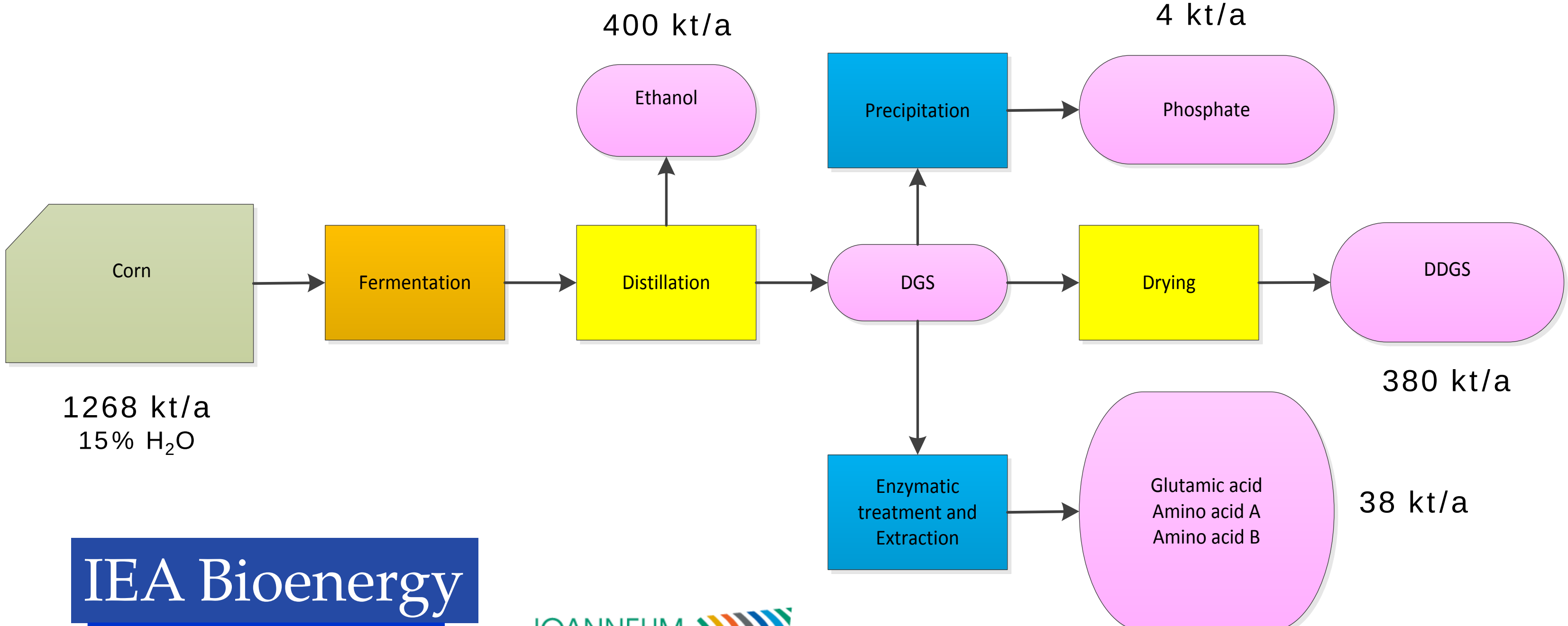
Conventional bioethanol example

Fuel – Feed Ingredients/Ferilizer Links
Added-vale @ comparable market volumes





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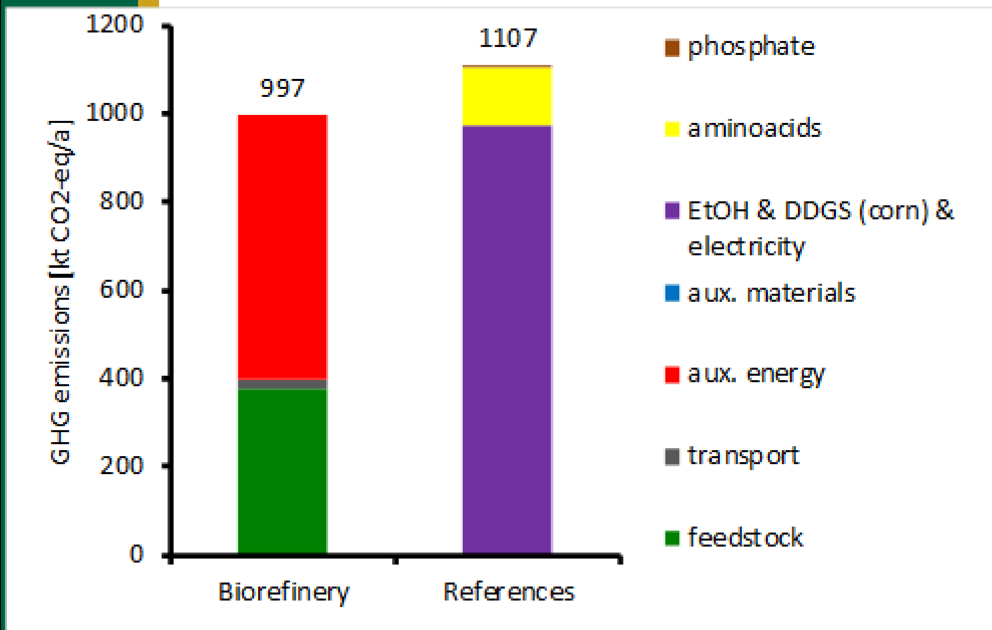
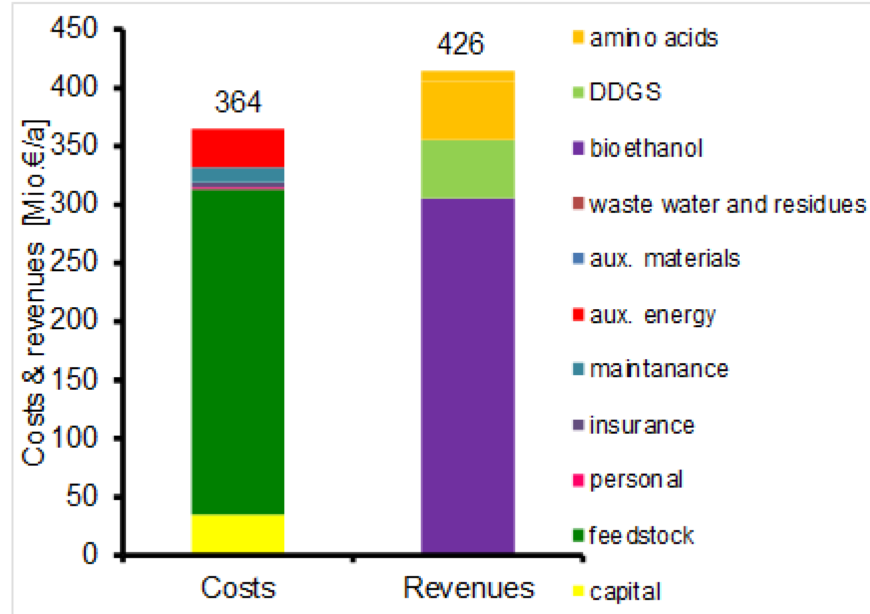
Conventional bioethanol example





Co-producing proteins and phoshpate from DGS before drying to DDGS decrease full overall GHG-emissions processing by about 10%

Net annual revenues (rev – costs) of the full biorefining process are calculated at about 60 M€/a. A significant part of these revenues can be realised by a relative small additional investment (extr./enz. treatment DGS)

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Report available july 2016
@
www.iea-bioenergy.task42-biorefineries.com

Contact:
wim.mulder@wur.nl

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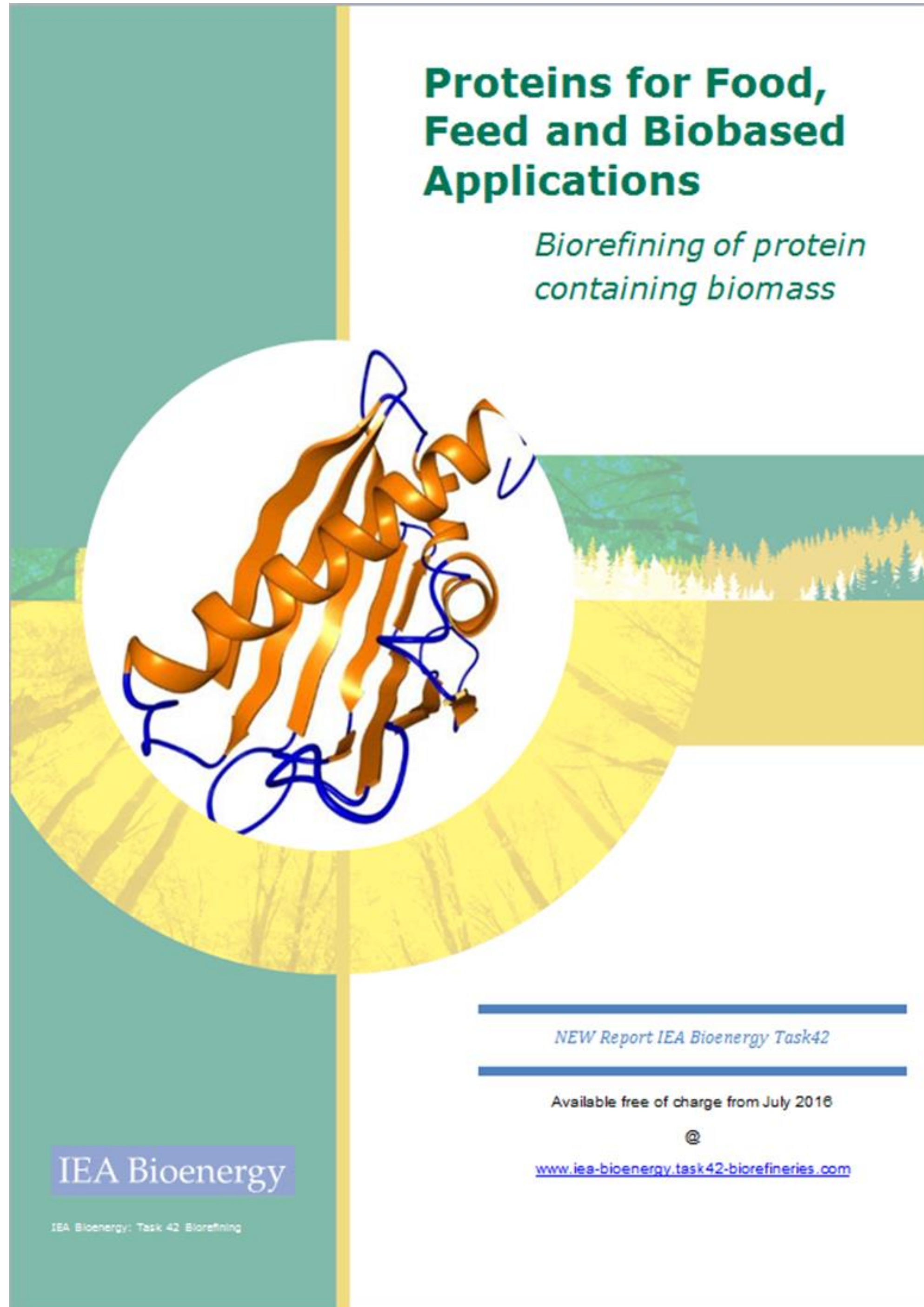

Take Home Messages

1. In a Circular Economy biomass should be sourced sustainably, and synergistically processed to both Food AND Non-food Products
2. The sustainable biomass potential should be used as efficient as possible by the development and deployment of biocommodities to be used in biocascading & biorefining approaches in closed-loop systems
3. Bioenergy is inevitable to meet short and midterm RE policy goals and a critical link in the future Circular (Bio)Economy
4. Advanced biofuel based biorefineries – co-producing fuels and added-value biobased products (i.e. feed ingredients) will be major foundations for and initiators of a Circular (Bio)Economy (use of sustainable supply chains and industrial infrastructures)
5. Proteins extraction and valorisation to both food and feed and non-food (technical) applications is a major potential success factor for optimal sustainable biomass use in the Circular (Bio)Economy AND to increase the market competitiveness of advanced biofuel based BRs
6. Cooperation of stakeholders over the full value chains (biomass production – conversion – end-use) and between different market sectors is a critical success factor for a successfull Circular (Bio)Economy

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More info on biocascading, biorefining, Circular (Bio)Economy:
www.iea-bioenergy.task42-biorefineries.com

Global knowledge dissemination platform including:
AUS, AT, CAN, GER, DEN, IRE, IT, NL, US

Activities 2016-2018 Triennium

1. Biorefinery Systems – Analysis and assessment of biorefining in the whole value chain
2. Product Quality – Reporting on related biobased products/ bioenergy standardisation, certification and policy activities
3. Evolving BioEconomy – Analysing and advising on perspectives biorefining in a Citcular BioEconomy
4. Communication, dissemination & training – Knowledge exchange by stakeholder consultation, reporting and lecturing

Deliverables

Biorefinery Database System – Factsheets – Joint Tasks Projects – **Reports on Chemicals, Materials and Proteins** – **Country Reports** – Task42 Brochure, Thematic Stakeholder Workshops together with IEA IETS, FAO and OECD, conference & training contributions, ...

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Karlsruher Institut für Technologie

bioliq
Biomass to Liquid Karlsruhe

Status and Outlook for bioliq-Project –

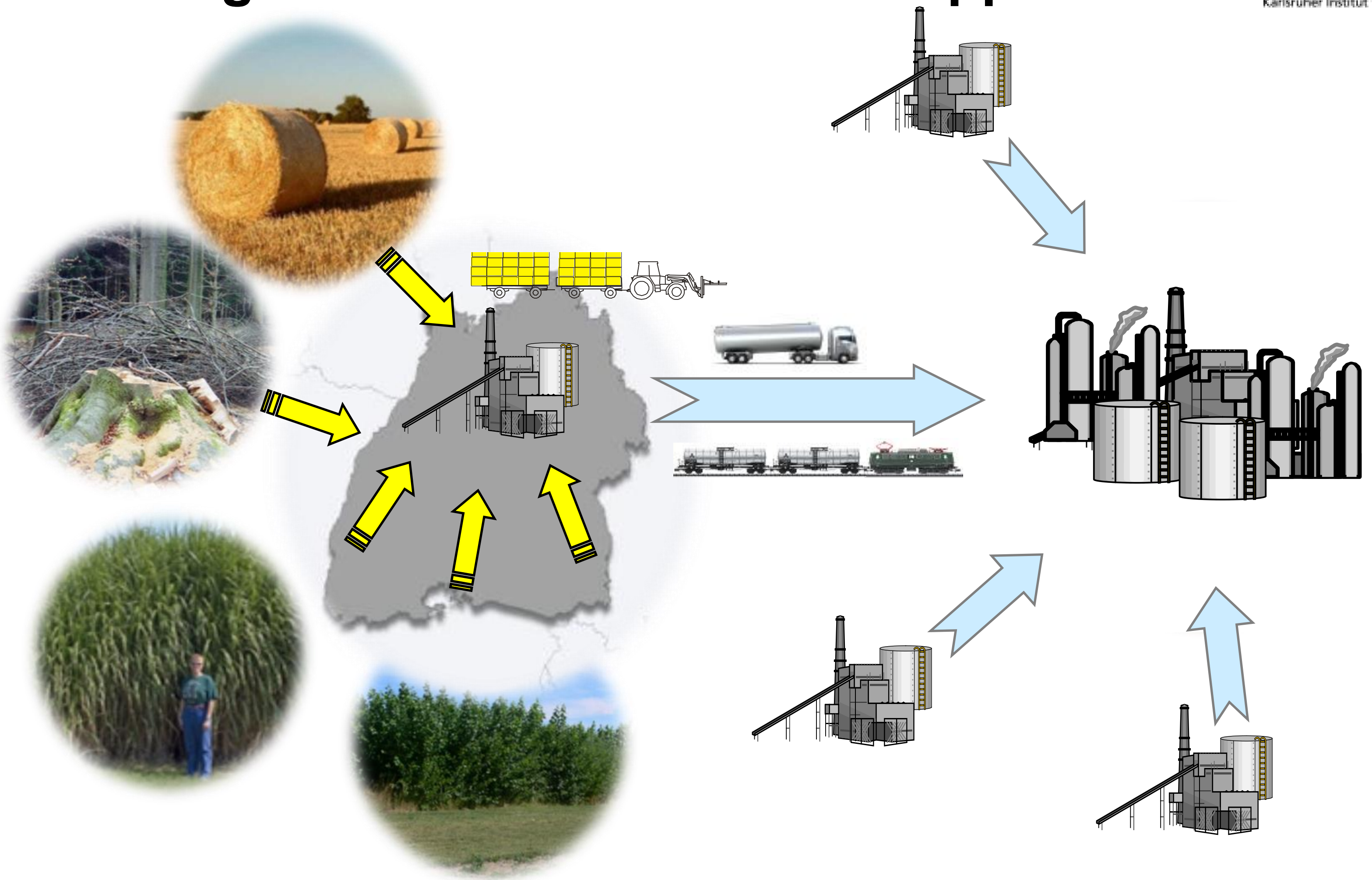
Syngas Platform for High Performance Fuels

Nicolaus Dahmen

EBTP 7th stakeholder Meeting, Brussels, June 21, 2016

Institut für Katalyseforschung und –technologie IKFT
Institut für Technische Chemie, Vergasungstechnologie, ITC vgt
Engler-Bunte-Institut, Chemische Energieträger – Brennstofftechnologie, EBI ceb

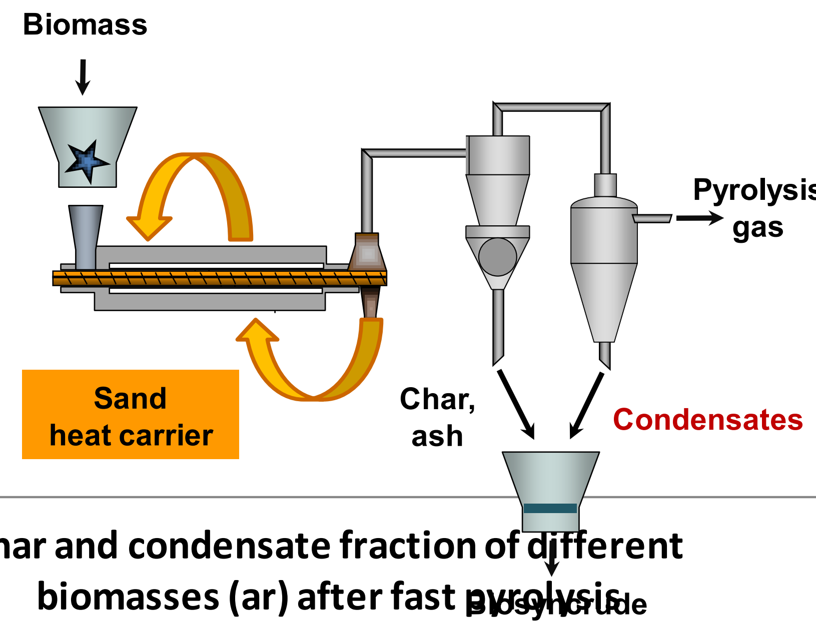
The challenge… …..and solution approach

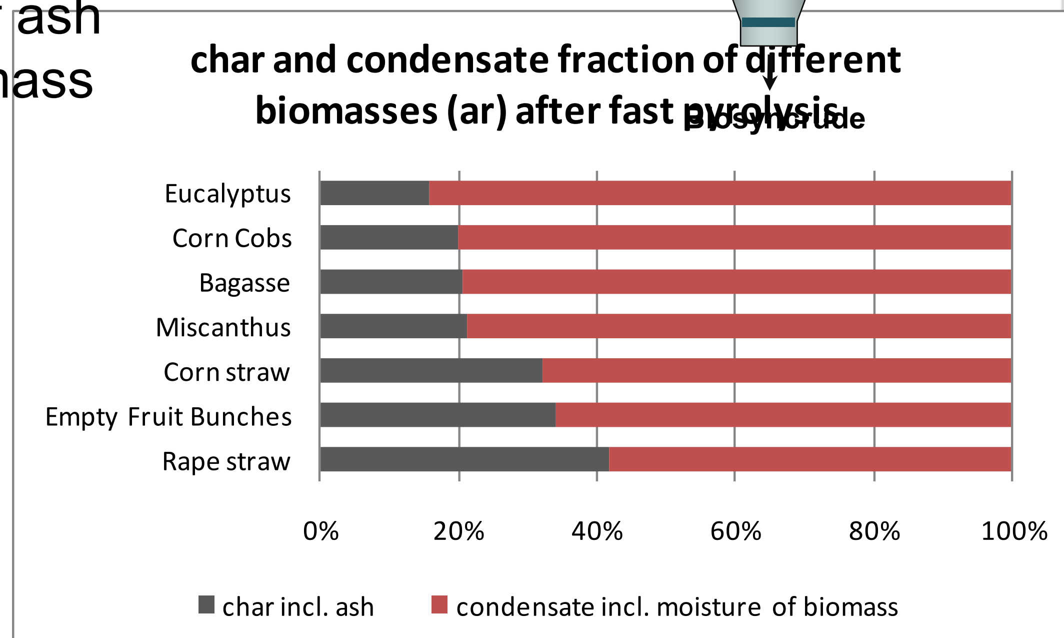


Biomass production and sourcing	Regional energy densification	Trans-port	Large scale, central further conversion

bioliq®fast pyrolysis

- Tasks in the bioliq process:
  - Produce an intermediate bioenergy carrier to maintain as much of the biomass energy as possible
  - Provide a fuel suitable for pressure loaded gasification
  - Make use of a multitude of ash rich, residual types of biomass
- Fast pyrolysis char and condensate(s) are mixed to form a biosyncrude, conserving up to 85 % of the biomass energy

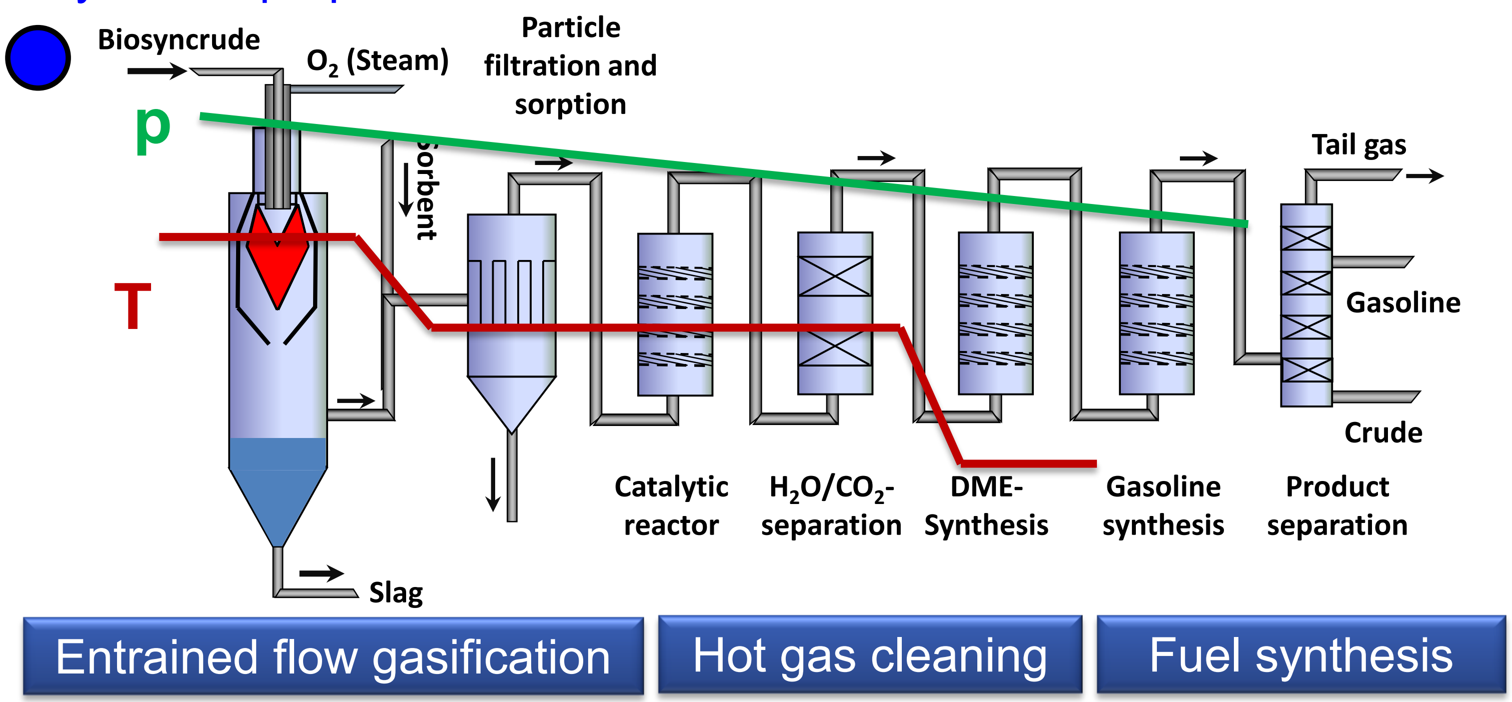




bioliq® central plant

- High pressure gasification – high temperature gas cleaning – methanol/dimethyl ether and gasoline synthesis (MtG)
- Technical innovations: Biosyncrude preparation and conditioning, high pressure gasification, and hot gas cleaning

Biosyncrude preparation



Gasoline
Diesel
Kerosene
Ethylene
Propylene
Methane
Hydrogen
Advanced biofuels!?

bioliq® pilot plant at KIT

Fast pyrolysis Biosyncrude production	Syngas production	Gas leaning and fuel synthesis

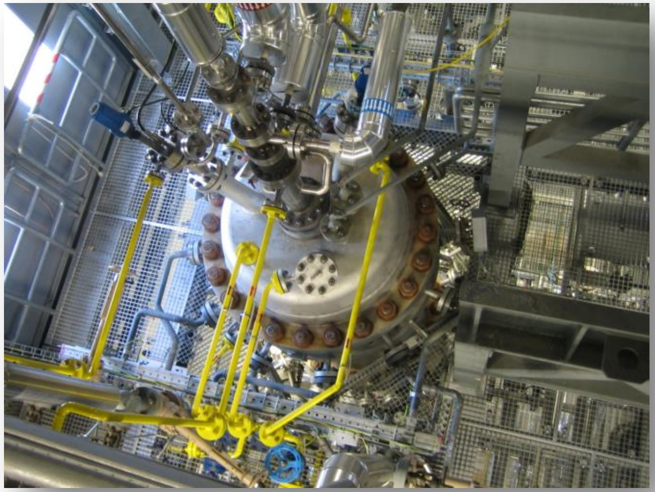
Full commissioning: 2014

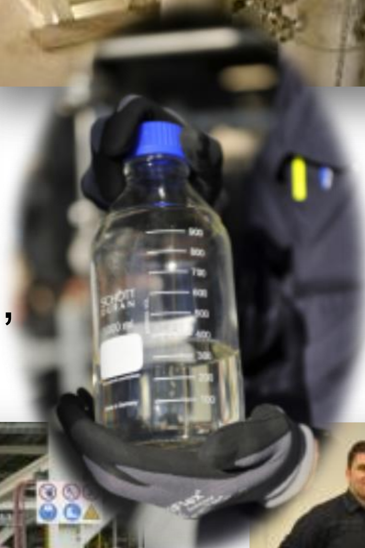
Technical demonstration & **Research platform**

- Mass and energy balances
- Scale-up, practicability
- Production costs

- Further development and optimization
- Diagnostics, modeling, simulation
- New applications

bioliq® impressions



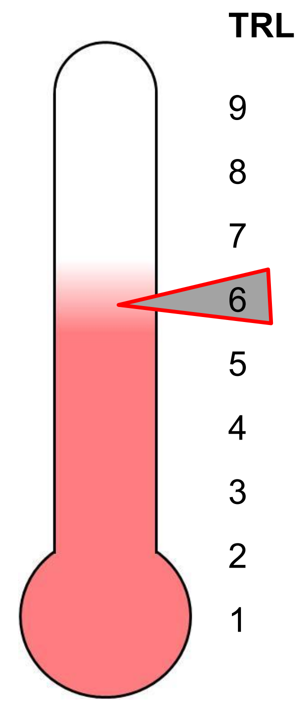


12 km pipelines, 50 km wiring,
250 motors, 1500 t steel,

1200 I/Os, 40 pumps,
100.000 engineering hours

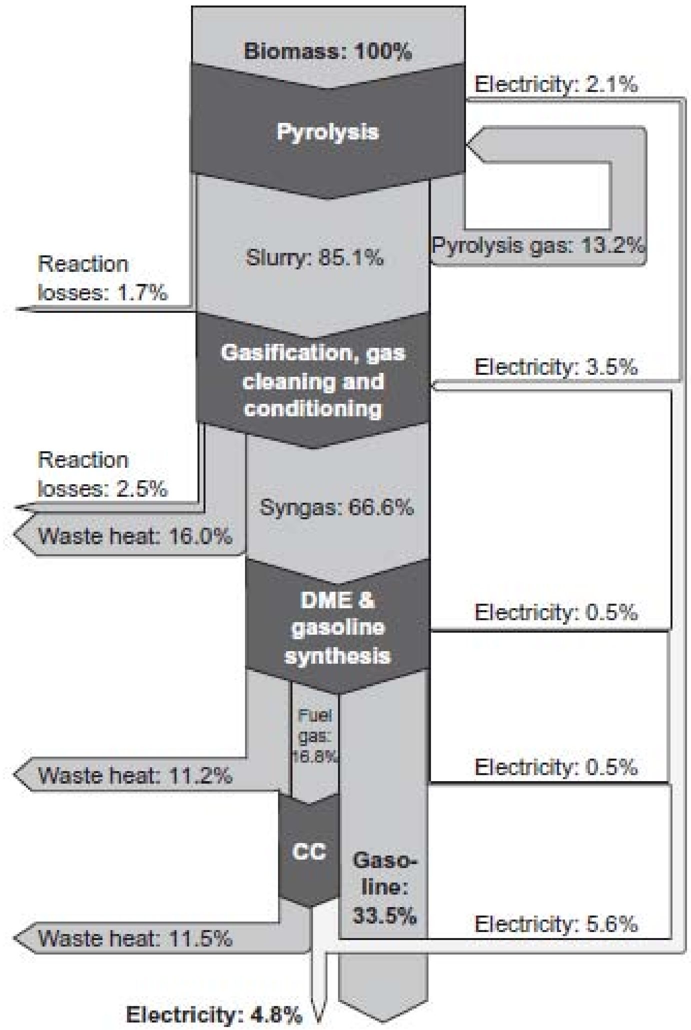
R&D implementation

- Program oriented funding of Helmholtz Association
  - Pilot plant operation and R&D themes addressed in HGF ENERGY program 2015-2020
- bioliq PhD network at KIT
  - Actually 25 students working on fundamental, bioliq technology related aspects at 5 institutes of KIT
- HVIGasTech Network of Young Scientists
  - 12 PhD students with partners for modeling gasification of solid/liquid fuel in an entrained flow reactor (www.hvigastech.org)
- Funded joint projects



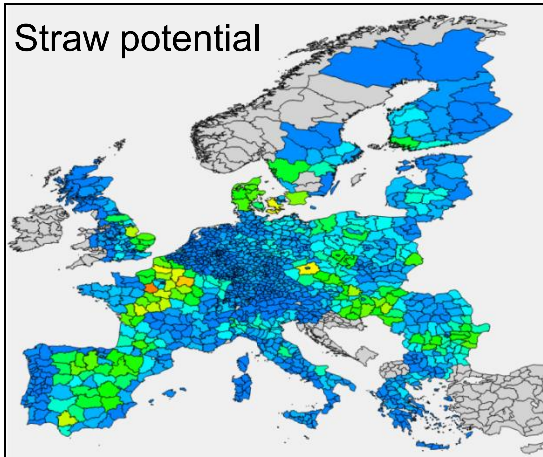
Systems analysis

- Biomass potential studies
  - Regional
  - National
  - EU 27+CH, NUTS 3 level
- Logistic models and simulation
- Life cycle assessment:
  > 82 % CO_2 reduction potential
- Techno-economic assessment
  - Different studies: 1-1.85 EUR/L
  - Target price: 1.0-1.4 EUR/L



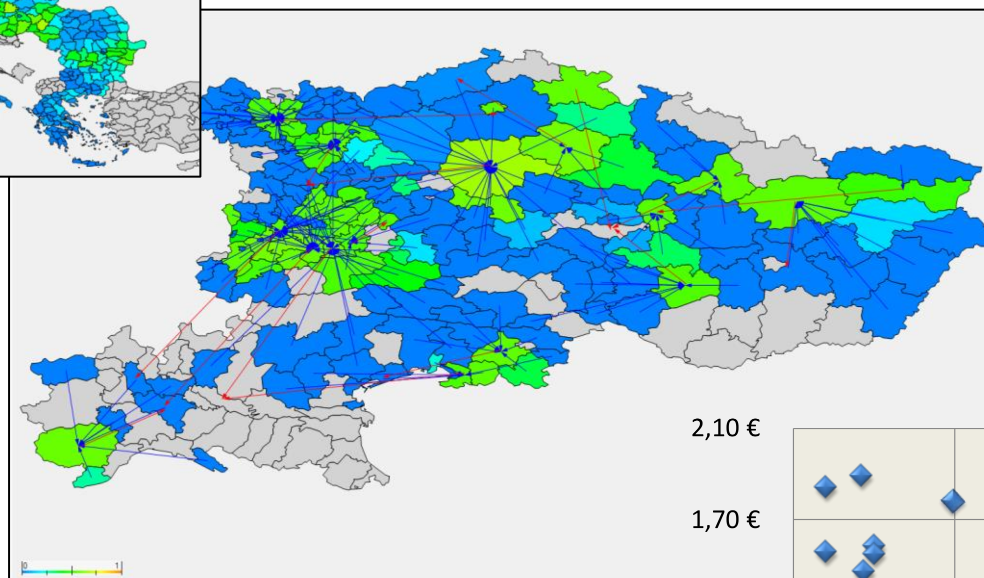
F. Trippe et al., Fuel Processing Technology 106 (2013) 577–586

Systems analysis



Sustainable potential
of biomass residues

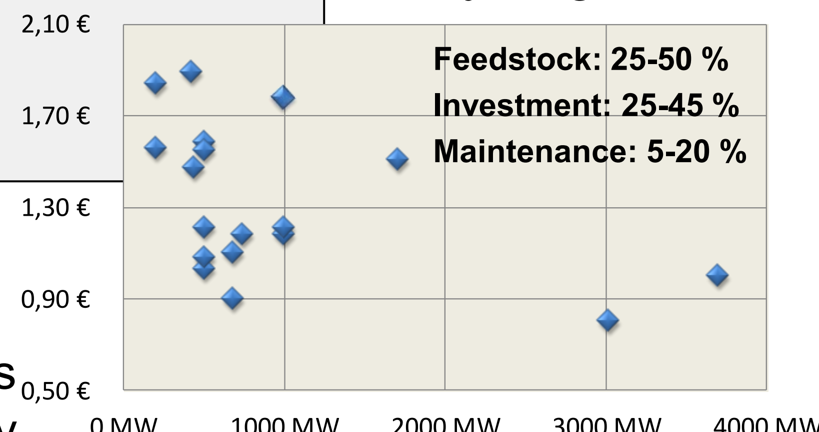
Simulation for cost optimization



[Navigator by www.bioboost.eu](http://www.bioboost.eu)

New cost model

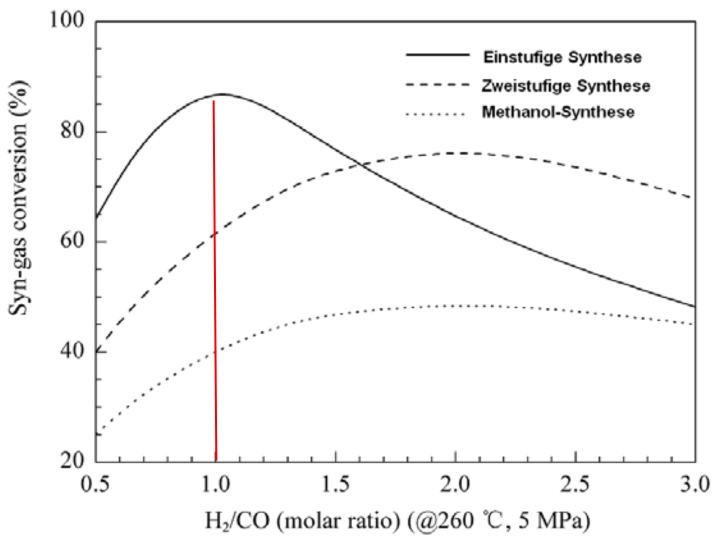
- Reference case
- Conversion costs
- Fossil co-feed
- Hydrogen feed-in



Specific production costs
by bioliq meta-study

The dimethyl ether (DME) issue

- Single step DME production by mixed/bifunctional catalysts
- DME formation is favored at CO/H_2 ratio around 1
- DME principally is an excellent fuel component, but….
- DME as intermediate for high performance fuel additives
  - Full compatible (drop-in)
  - Emission reduction



Ogawa et al., J. Nat. Gas Chem. 2003,12, 219-227

$$3\,CO + 3\,H_2 \leftrightarrows CH_3OCH_3 + CO_2$$

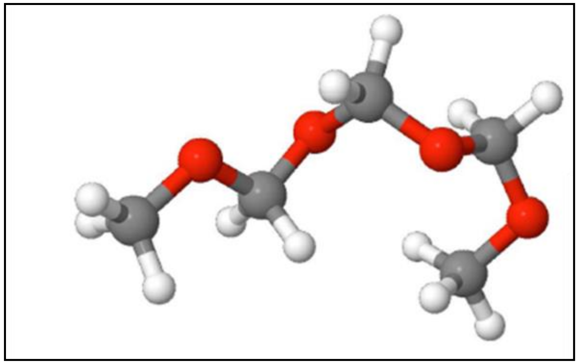
Tailor made fuel (components) via DME

- Reduction of aromatics content in DME to gasoline synthesis
- Improve gasoline quality towards advanced IC engines
- Alkylate based petrol
- Polyoxymethylene ethers (OME) as diesel additives
- …by new and improved catalysts

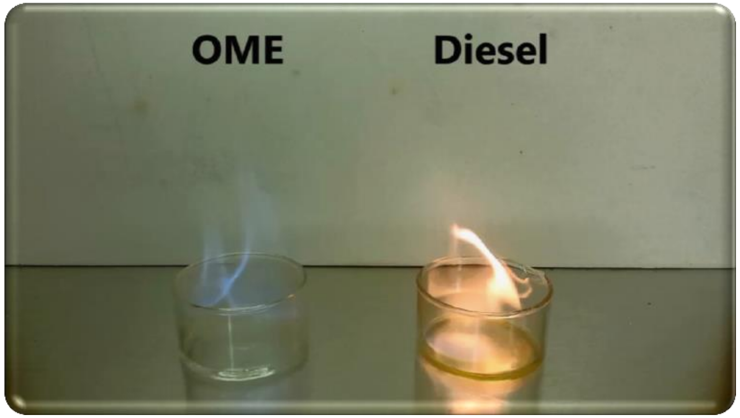
Reduction of..

… toxicity

…emissions



Polyoxymethylene ether (OME 4)



bioliq® essentials

- Energy densification of a **multitude of lignocellulosic biomass** in regionally distributed plants by **biosyncrude production**
- Economic conversion in large scale to syngas and further **refining into synthetic fuels & chemicals**
  - **Network scalability**: combination of local pre-treatment of biomass with centralized synthesis at high feedstock flexibility
- Syngas offers a broad application range for fuels and chemical
  - **High product quality**: Targeted production of drop-in capable fuels with high energy density and improved emission behavior
- bioliq® pilot plant for **process demonstration and research platform** for optimization, further development, and scale-up
  - Critical mass and expertise along the full process chain with aligned R&D program and appropriated partners

Lessons learned

- Trivial: Things take longer than expected
- Biofuels development is a long term task, stable frame conditions for R&D required
- Consider co-utilization of fossil fuels to improve specific production costs
- If applicable, use additional H_2 to increase carbon efficiency and product yield
- Make use of the oxygen contained in biomass
- Care for cost determining biomass supply logistics

Next steps

- Increase pilot plant availability (1000 h/a)
- Perform proof of concept
- Improve and optimize process (steps)
- Establish R&D platform for the development of high performance fuel components
- Establish commercialization platform to prepare business model(s) & market implementation

Gefördert durch:
Bundesministerium für Ernährung und Landwirtschaft
aufgrund eines Beschlusses des Deutschen Bundestages
FNR Fachagentur Nachwachsende Rohstoffe e.V.

Investition in die Zukunft
gefördert durch die Europäische Union Europäischer Fonds für regionale Entwicklung und das Land Baden-Württemberg


NEOT
North European Oil Trade
Etanolix Göteborg -
Why do we need advanced
biofuels
Timo Huhtisaari

North European Oil Trade Oy

- NEOT was established in January 2003 and operations started on the 1st of February 2004.

- NEOT is registered in Finland and is owned by two Finnish companies SOK and St1 Nordic Oy. SOK owns 50,8% of the company and St1 Nordic Oy 49,2%.

- NEOT is a significant independent fuel procurement company in the Baltic Sea region and actively operates on the global trading markets

- We offer high-quality sea transportation, road transportation and terminal services for third parties

- NEOT supply annually (2016 →) approx. 8 billion liters of oil products

- Our market share of Finnish traffic fuel supply is approx. 43%

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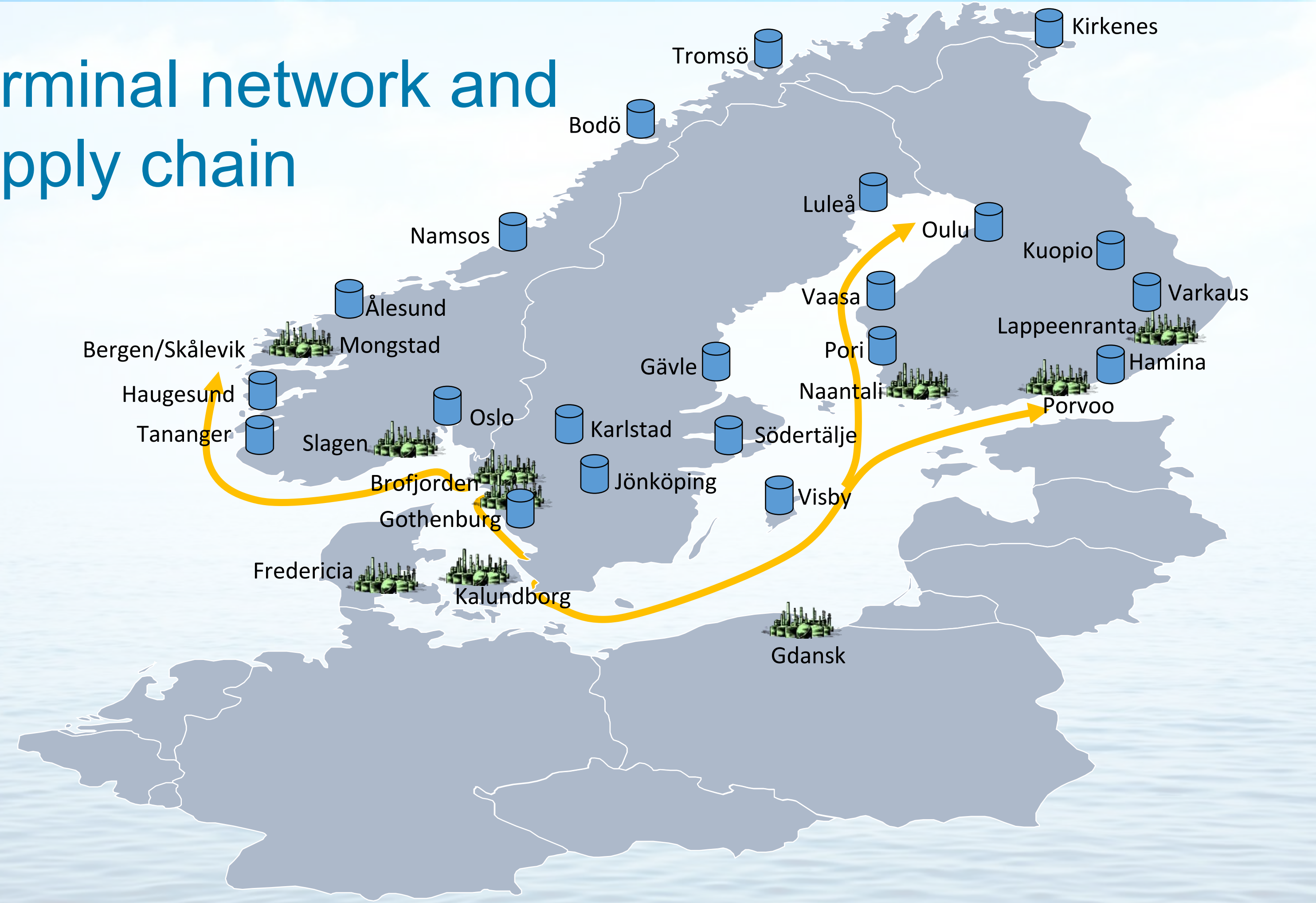
Terminal network and supply chain



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NEOT
North European Oil Trade

Etanolix® - Integration to oil refinery

Production capacity

- Ethanol (as per 100% ETOH) 5.000 m^3/a

Feedstock

- Industrial bakery waste / industrial process residue
- Packed and unpacked out dated waste bread from shops and markets
- Approx 20.000 tn/a feedstock is required (bread)

Products

- Anhydrous fuel grade ethanol
- Liquid animal feed for pig farms / feed for biogas plant (AD)

Etanolix 2.0 LIFE+ project

Etanolix® concept further development & demonstration:

- New raw material handling.
- unique way of integrating the ethanol plant in a conventional refinery:
  - direct ethanol blending to vehicle fuels and in an effective way distribution to the consumers
  - utilize excess energy, cooling systems and wastewater treatment plant
- Refinery personnel's expertise and experience for safe and optimal operation.

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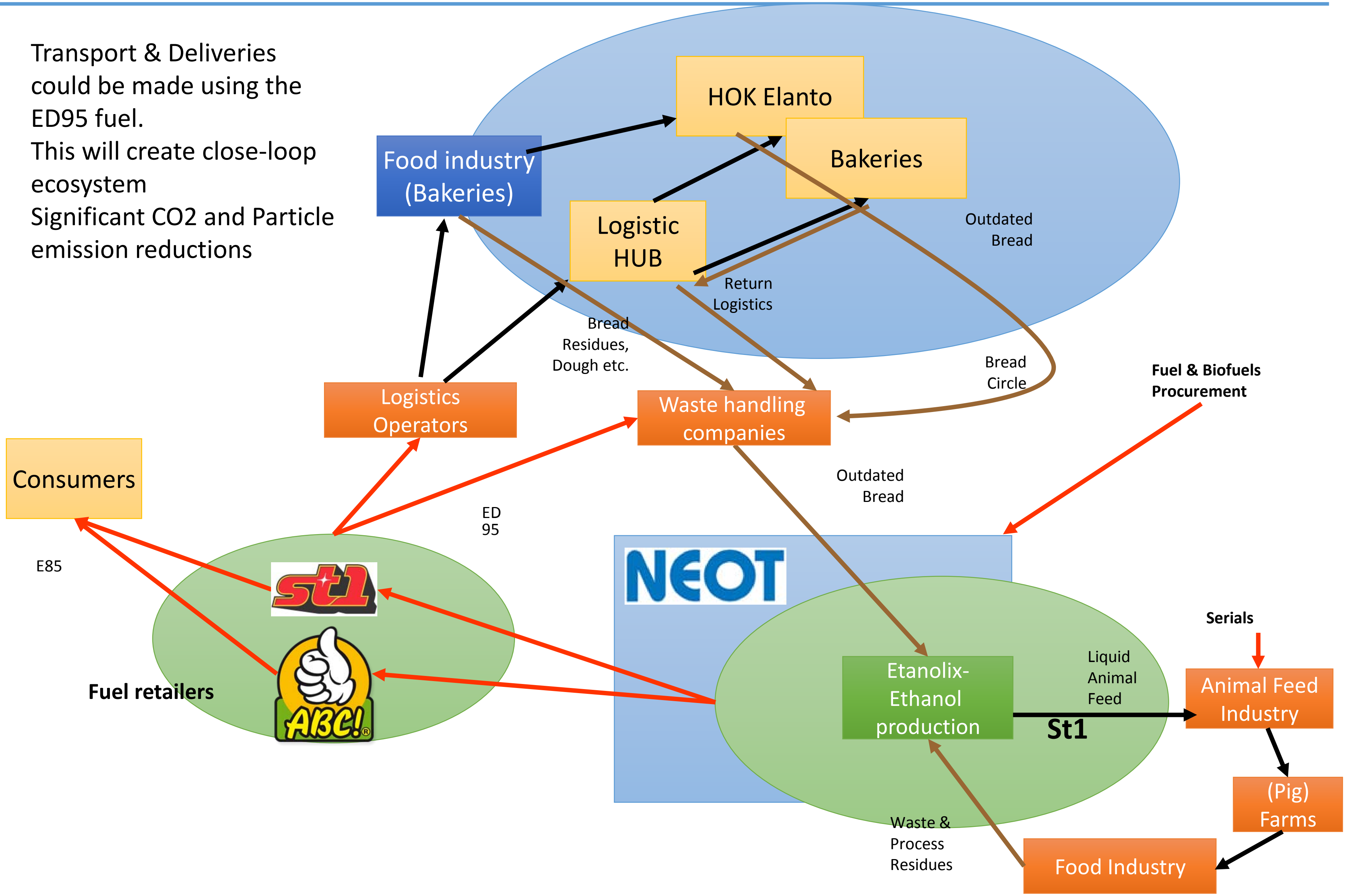
2gen ethanol production & consumption eco-system

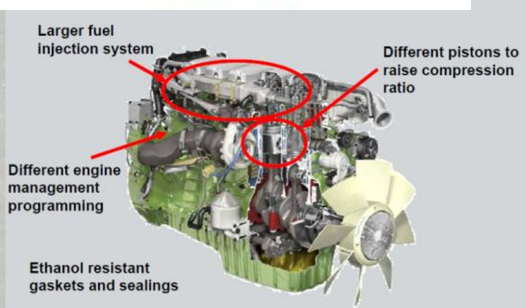
- Transport & Deliveries could be made using the ED95 fuel.
- This will create close-loop ecosystem
- Significant CO2 and Particle emission reductions



ED95 ecosystem in Finland

+ water

+ additive



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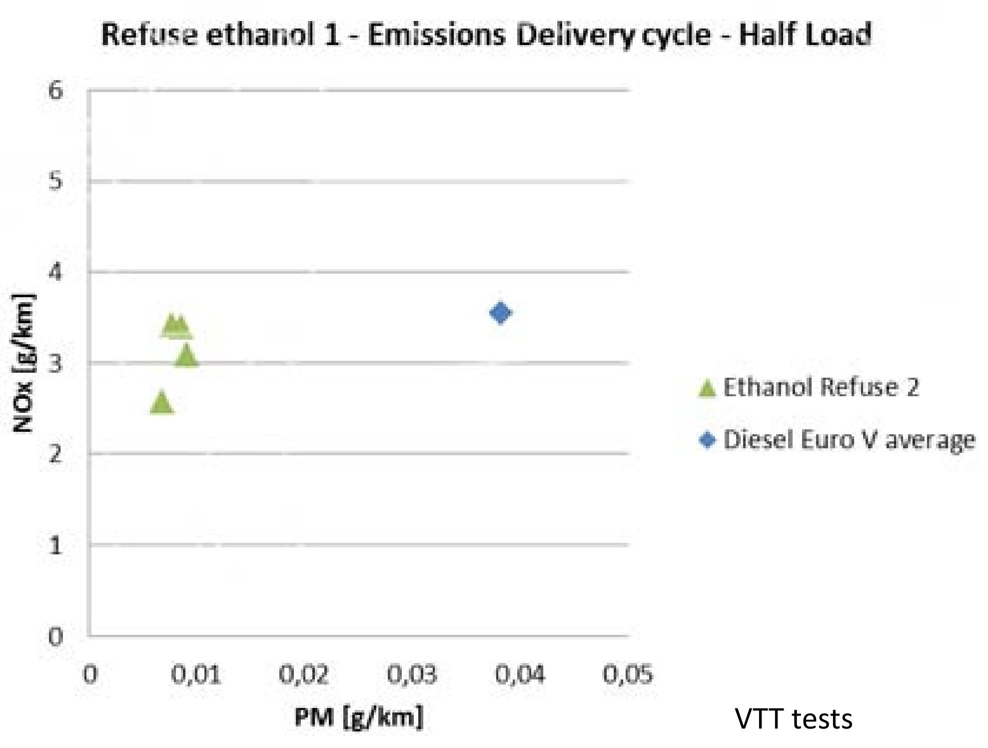
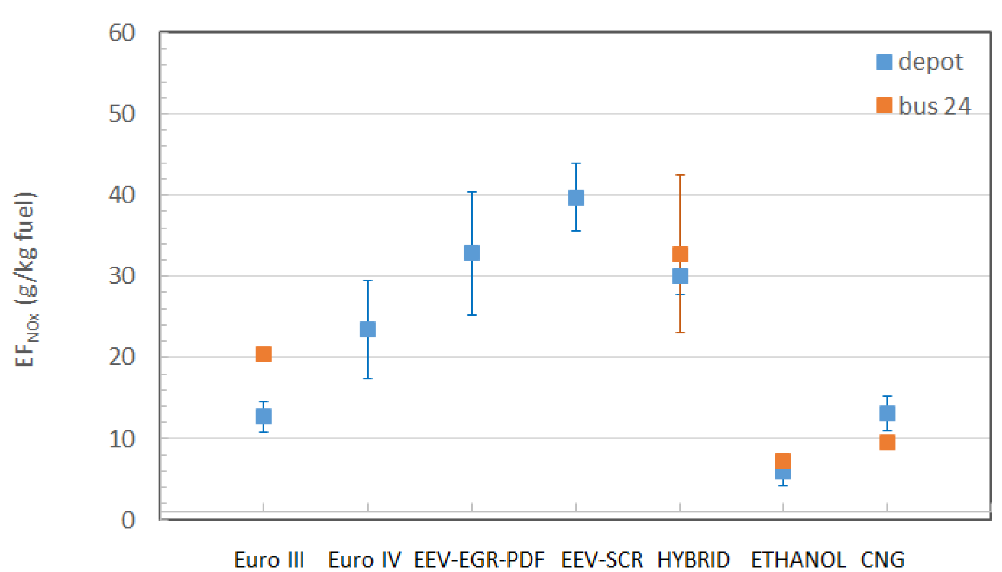
ED 95-proven fuel in Stockholm and Helsinki

1. Usability as good as conventional Diesel Engines
2. Energy consumption is the same as conventional diesel engines. Volume is 1,7 times higher due to ethanol's lower energy intensity.
3. Local emissions are significantly lower
   1. Particle Matter (PM) -80 %.
   2. Very low NO2/NO ratio. NO2 defines the air quality limit
4. ED95-fuel can reduce up to 90 % fossil Greenhouse Gases.



VTT tests

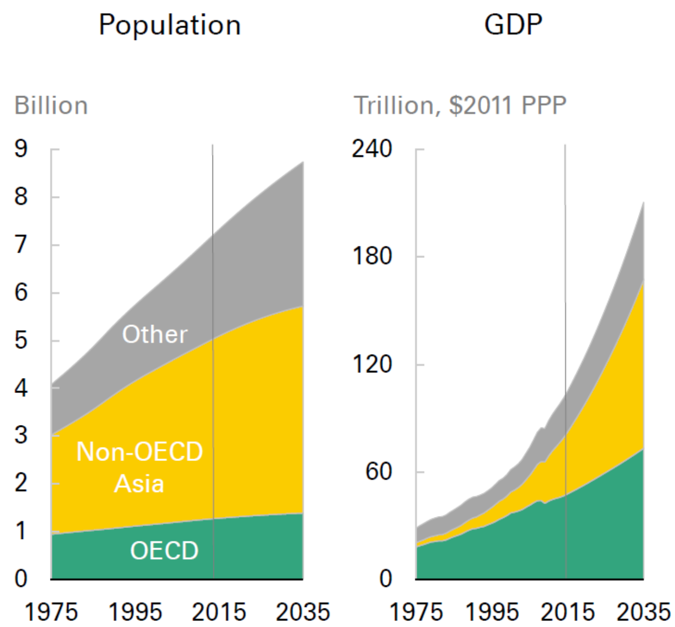


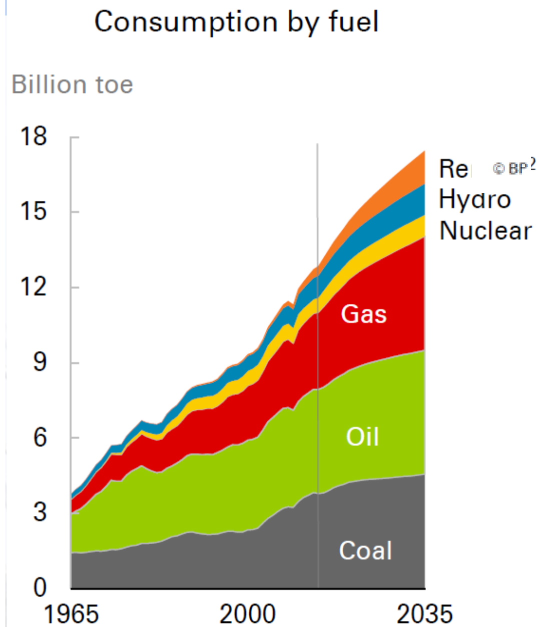
Pirjola:Bussienpäästömittaukset2013 –tulokset MMEA-hanke4. kausi

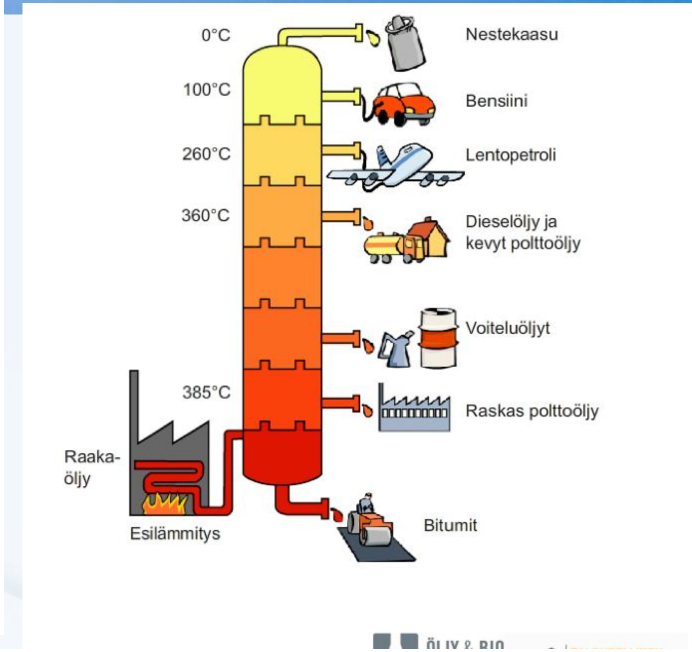
Urho Kekkosen katu 5 C ,
00100 Helsinki Finland

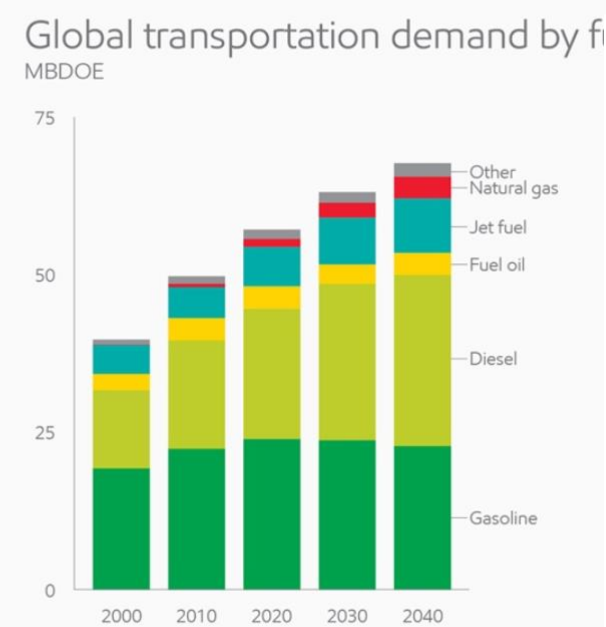
Tel. +358 10 76 809
Fax. +358 10 76 808

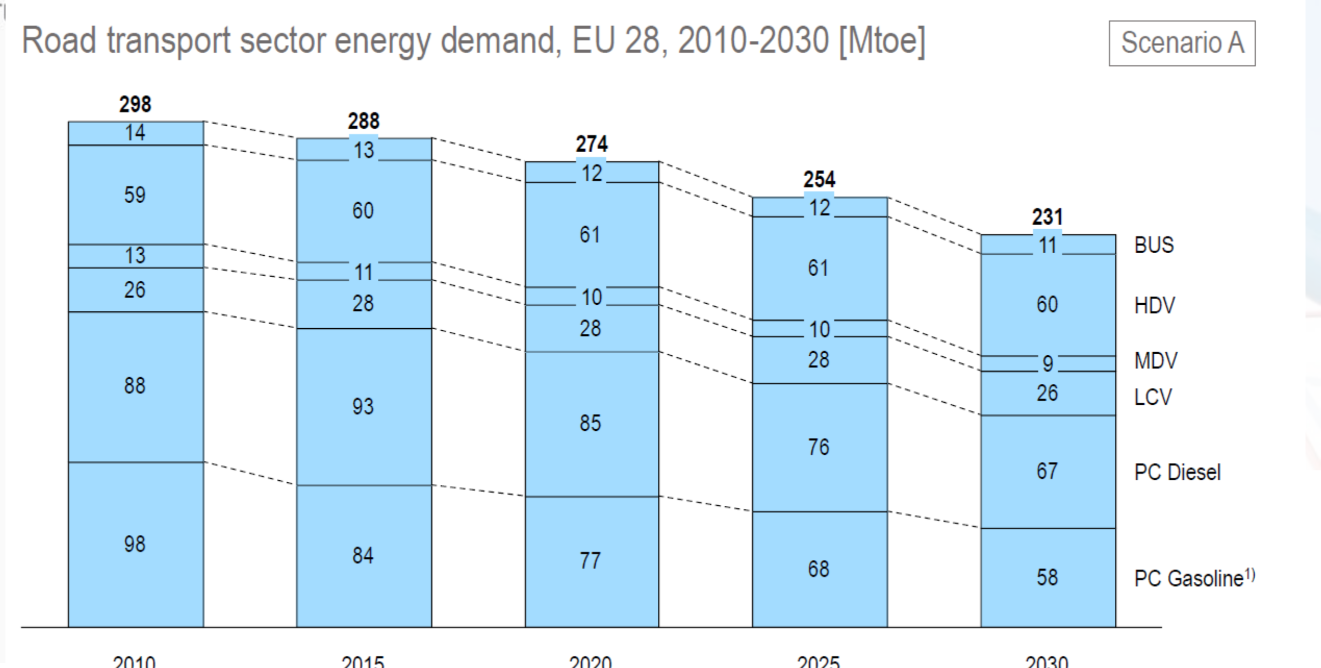
Global Energy trends





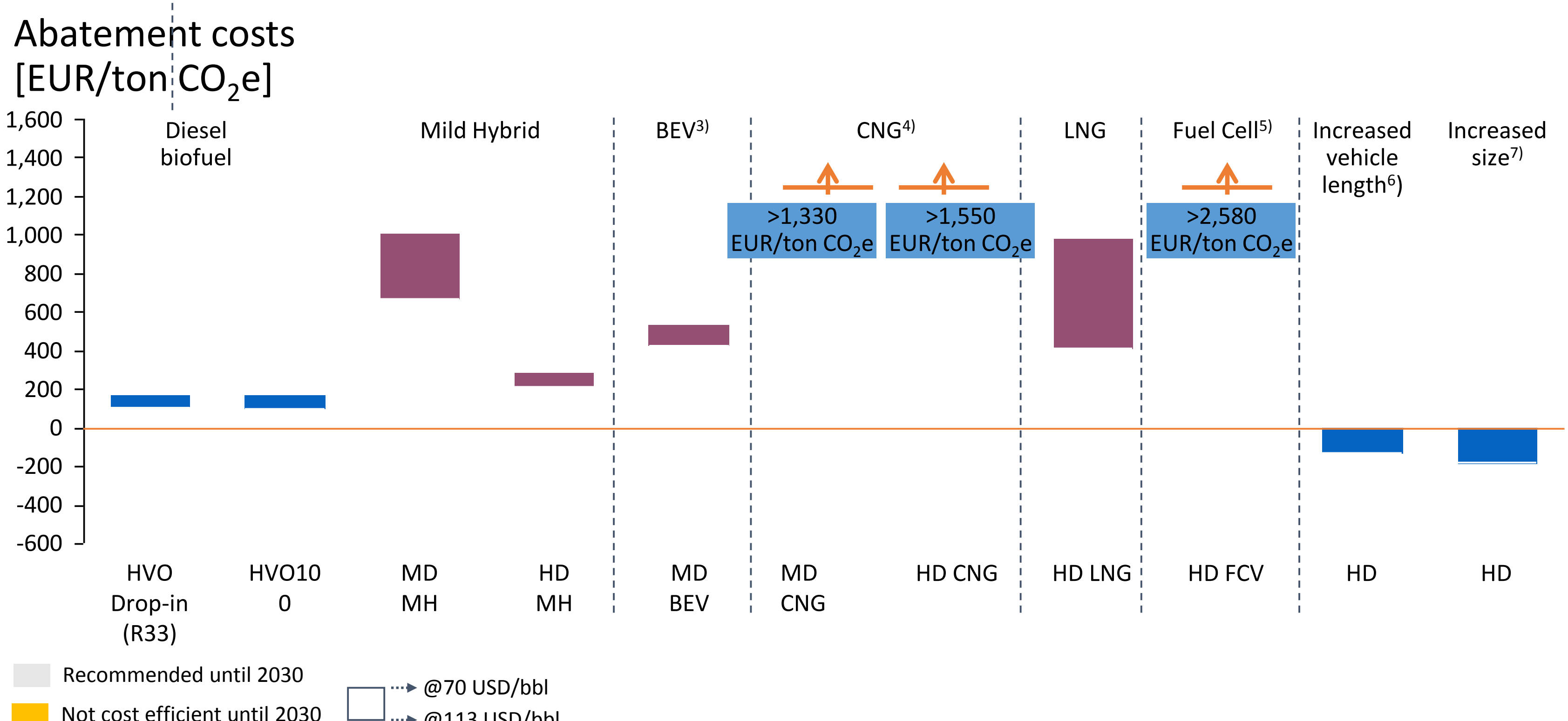






In trucks, pathway technology high biofuel drop-ins is cost efficient – Larger trucks could have negative abatement cost

WTW GHG abatement costs of MD[1] and HD[2] commercial vehicle 2030 [EUR/ton CO_2e]



1) Medium duty 2) Heavy duty 3) Exclusion of HD BEV due to incompatibility of BEV range with long haul requirements 4) High CO_2 abatement costs for CNG and LNG within MD/HD/City Bus s result from low quantities of vehicles (missing economies of scale) and CO_2 abatement potential compared to Diesel is small (<5% savings/km) 5) High system cost and low lifetime mileage in medium duty trucks causes very high abatement cost , therefore incompatibility 6) Increased efficiency due to aerodynamic measures to reduce drag
7) Length and gross vehicle weight increase, increased transport efficiency by 10%

Source: Roland Berger, Expert interviews, IKA CO_2 study

http://www.rolandberger.com/media/publications/2016-04-28-rbsc-pub-Auto_Fuel_Study.html

Summary

1. Smart Utilization of waste resources into advanced biofuels increases energy independence
2. Ecosystem thinking creates win-win situations
3. Advanced biofuels are most cost-effective and readily available way to fulfil the ambitious EU targets for decarbonization of transport

GoBiGas

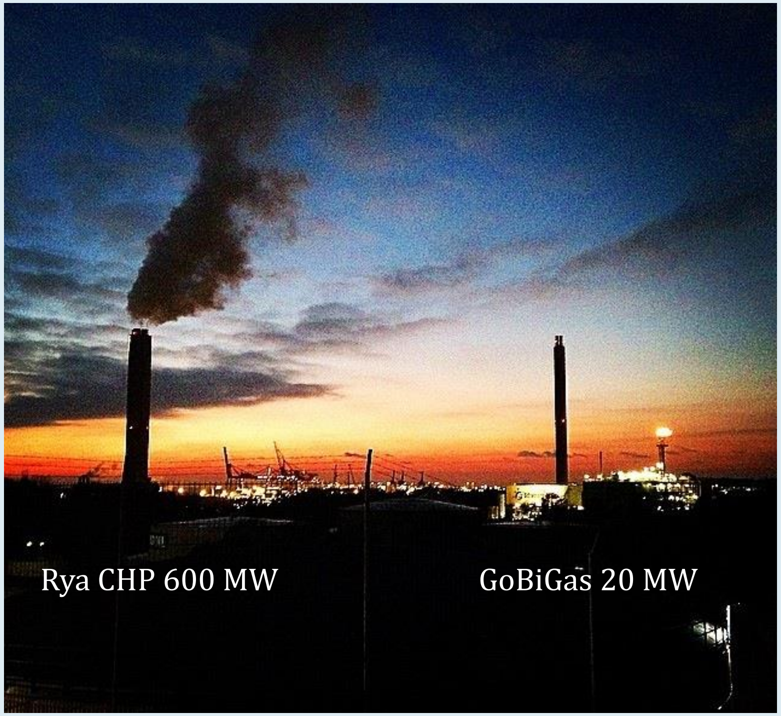
Technical successes and economic challenges

Göteborg Energi

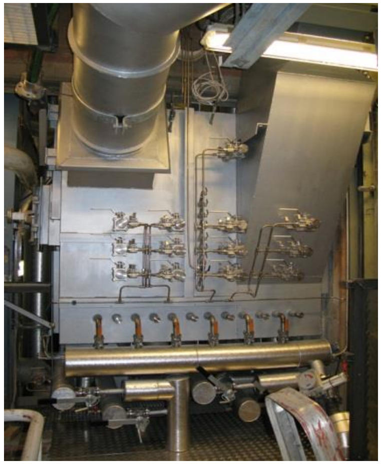
Eric Zinn EPTP 160621

GoBiGas – Pioneering New Technology

- The world's first plant for bio-methane from biomass through gasification
- Injects bio-methane into the transmission grid, potentially reaching all of Europe

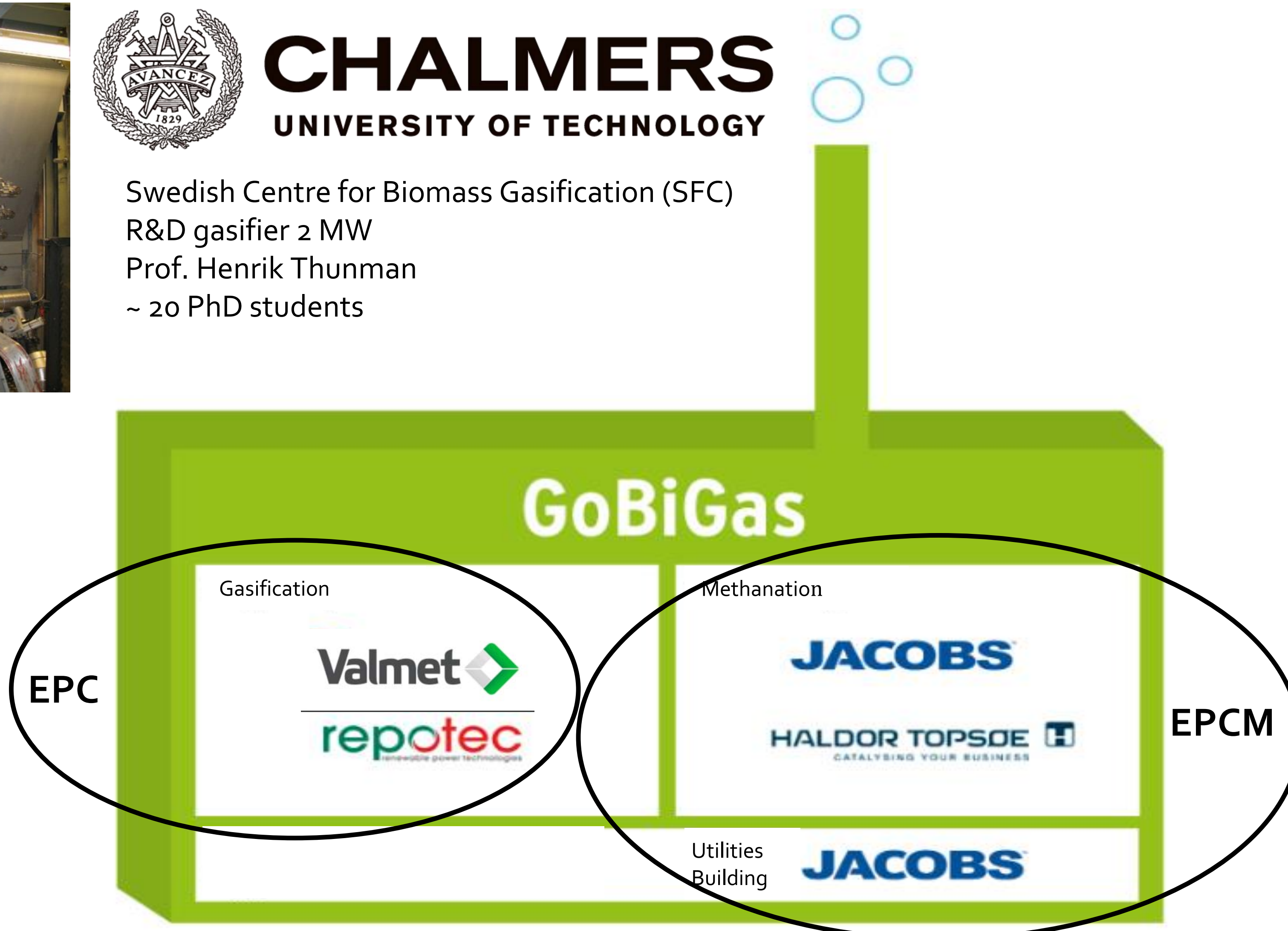


GoBiGas - Partners



CHALMERS UNIVERSITY OF TECHNOLOGY

Swedish Centre for Biomass Gasification (SFC)
R&D gasifier 2 MW
Prof. Henrik Thunman
~ 20 PhD students



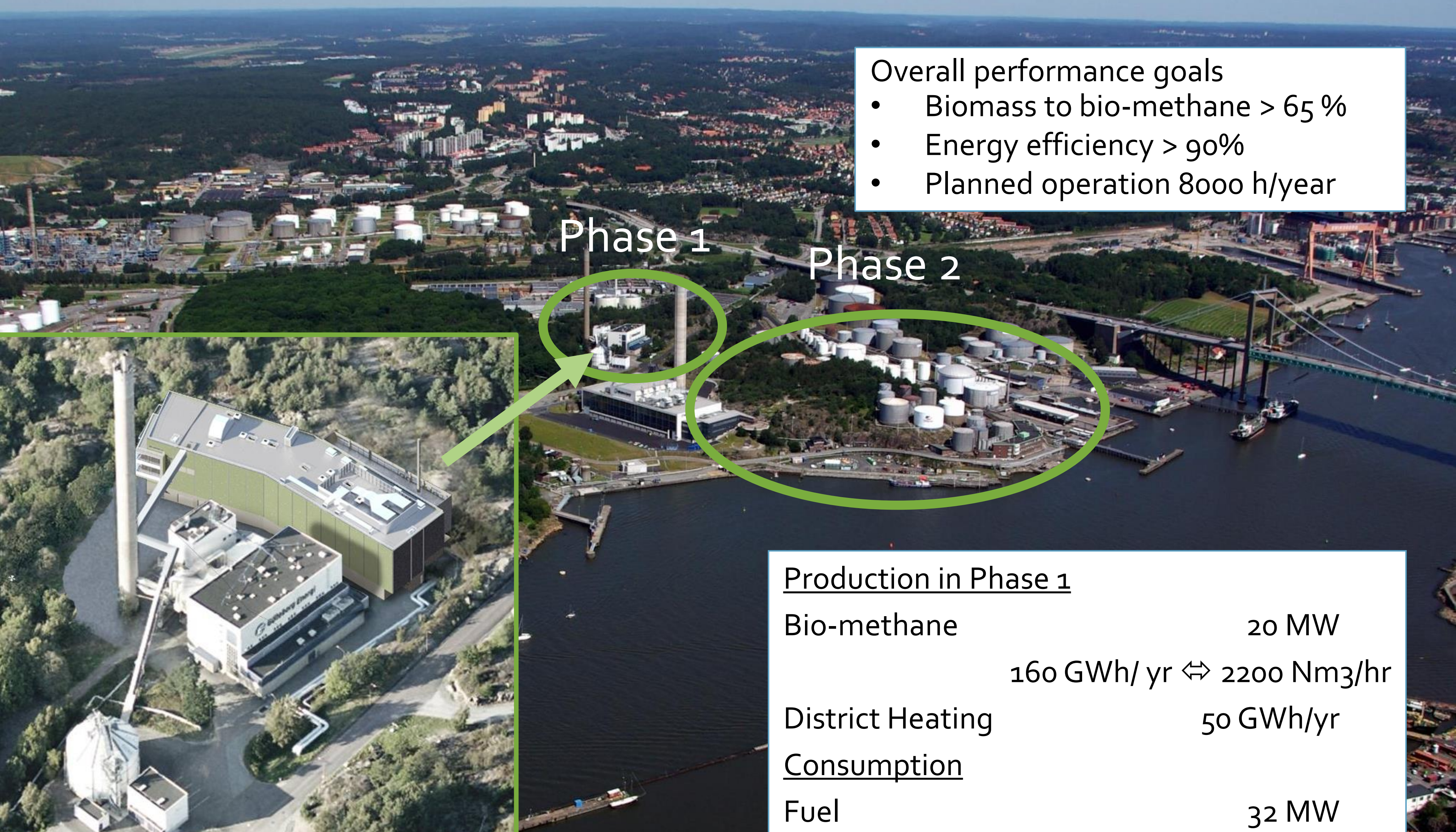
The GoBiGas project

- The first plant in the world to produce bio-methane from biomass continuously through gasification
  - Using forest residues as feed stock
  - Polygeneration – producing fuel and heat

- Injects bio-methane into the transmission grid for:
  - Vehicle fuel
  - Fuel to CHP or heat production
  - Feedstock to process industry

- Commercializing the technology in two phases:
  - Phase 1 - 20 MW demo plant, partly financed by Swedish Energy Agency
  - Phase 2 - 80 – 100 MW commercial plant, when the technology is proven in phase 1 and the market conditions are sufficient
  - Phase 2, a selected project by the EU Commission in NER300 but is currently not being developed.

The GoBiGas sites for Phase 1 & 2

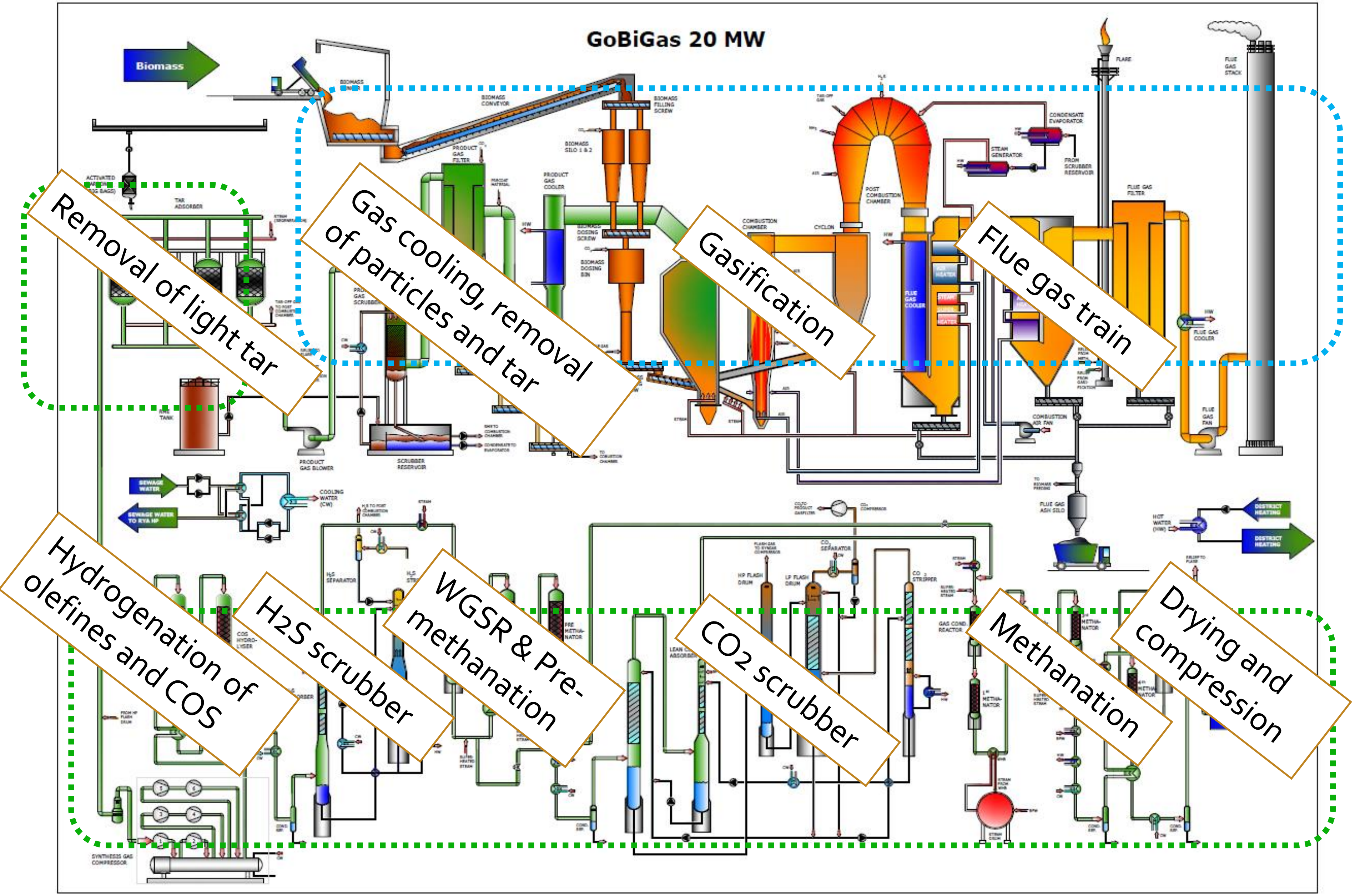


Overall performance goals

- Biomass to bio-methane > 65 %
- Energy efficiency > 90%
- Planned operation 8000 h/year

<u>Production in Phase 1</u>	
Bio-methane	20 MW
	160 GWh/ yr ⇔ 2200 Nm3/hr
District Heating	50 GWh/yr
<u>Consumption</u>	
Fuel	32 MW
Electricity	3 MW
RME (bio-oil)	0,5 MW

Göteborg Energi

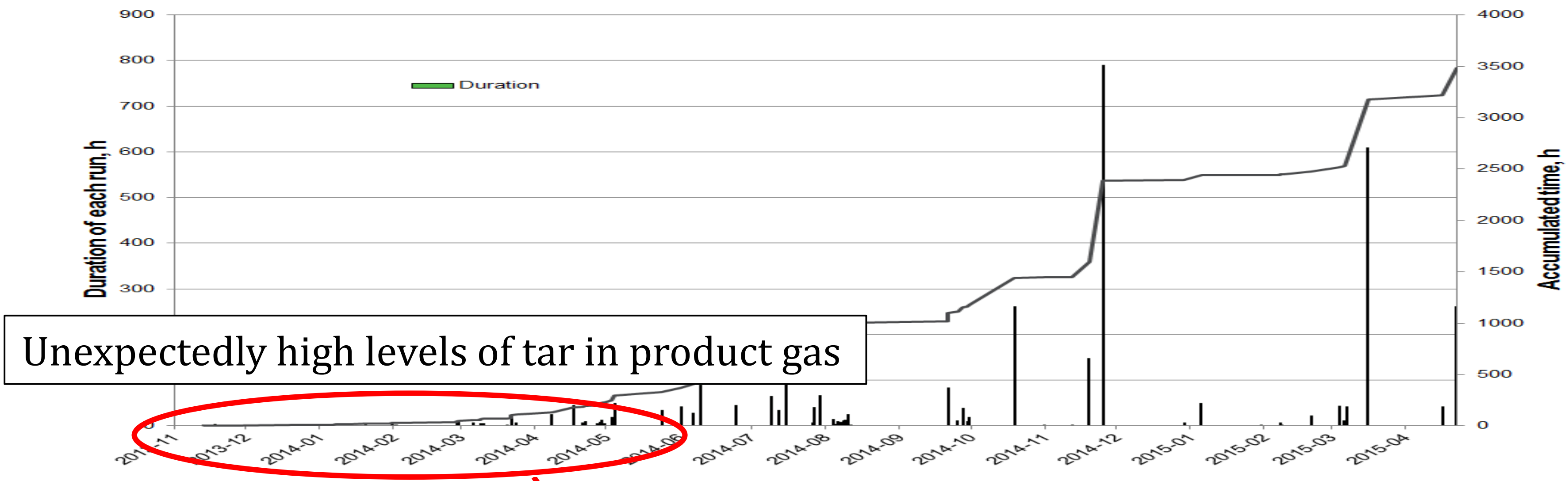


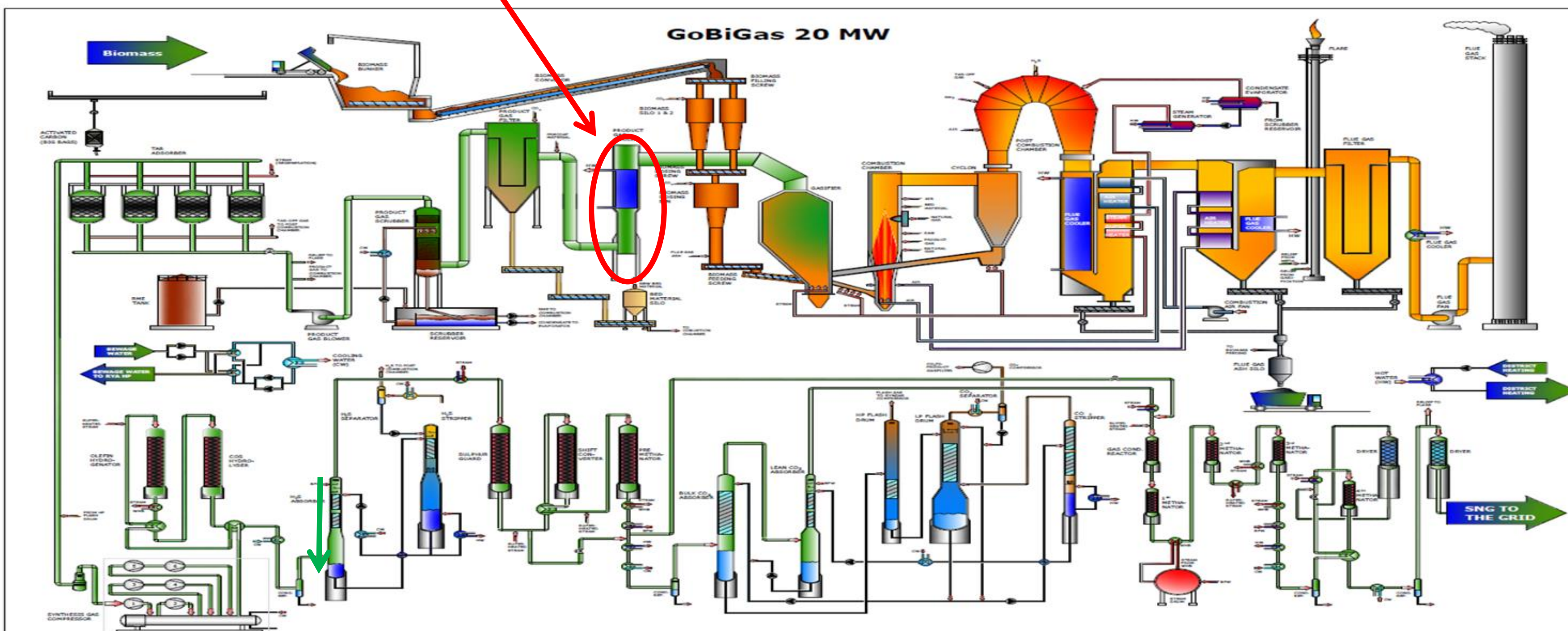
Eric Zinn EPTP 160621

Göteborg Energi

Check out the video! http://goteborgenergi.streamingbolaget.se/video/156153/link

Technical successes





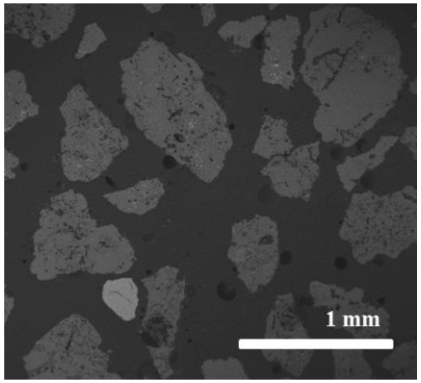
Göteborg Energi

How did we reduce tars?

- Activate the olivine sand (Mg, Si, Fe)!
- What makes the olivine ”active”? How is this activity achieved?
- Addition of K_2CO_3 activates olivine

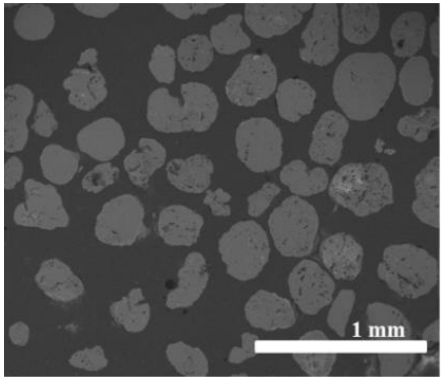
	Before K2CO3	After K2CO3
Total tar* (g/m3)	43,1	13,1
Total tar, excl. BTX (g/m3)**	21,8	4,4

Fresh olivine



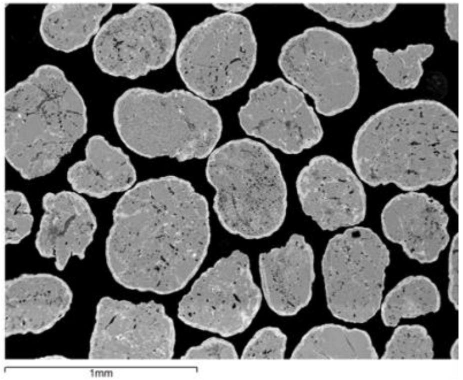
Analysis: Dr. Pavleta Knutsson

Used olivine

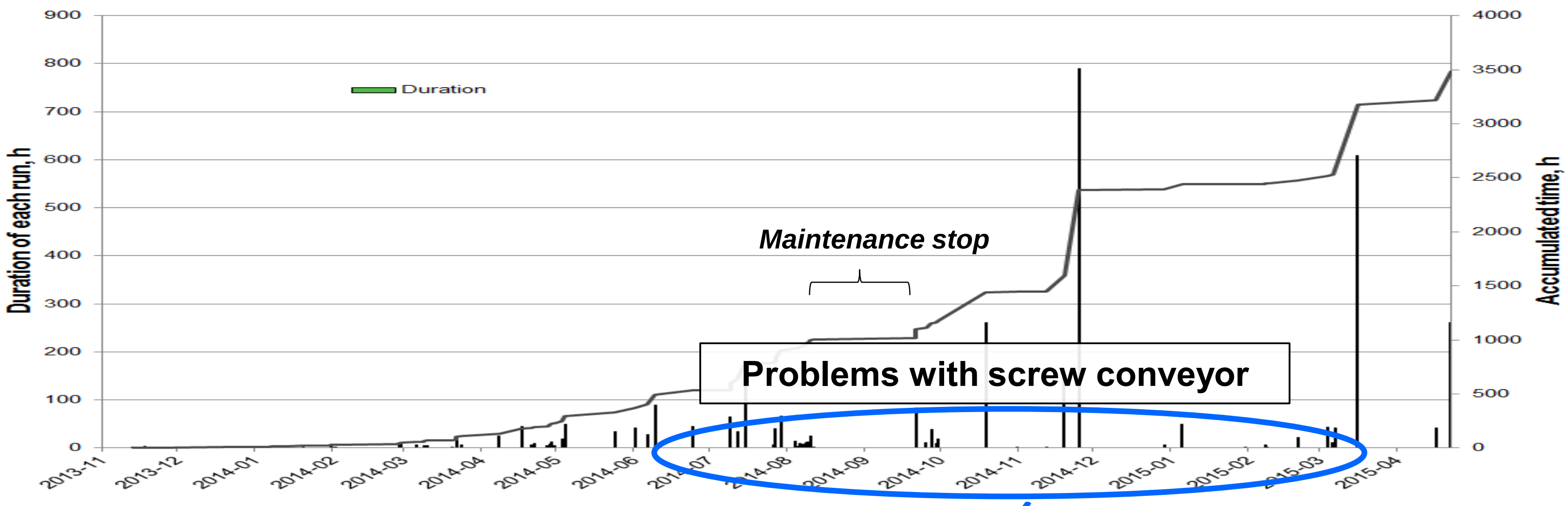


Analysis: Dr. Pavleta Knutsson

Used olivine after K_2CO_3



Analysis: TOP ANALYTIC, BSE-image


Duration
Maintenance stop
Problems with screw conveyor
Duration of each run, h
Accumulated time, h
2013-11
2013-12
2014-01
2014-02
2014-03
2014-04
2014-05
2014-06
2014-07
2014-08
2014-09
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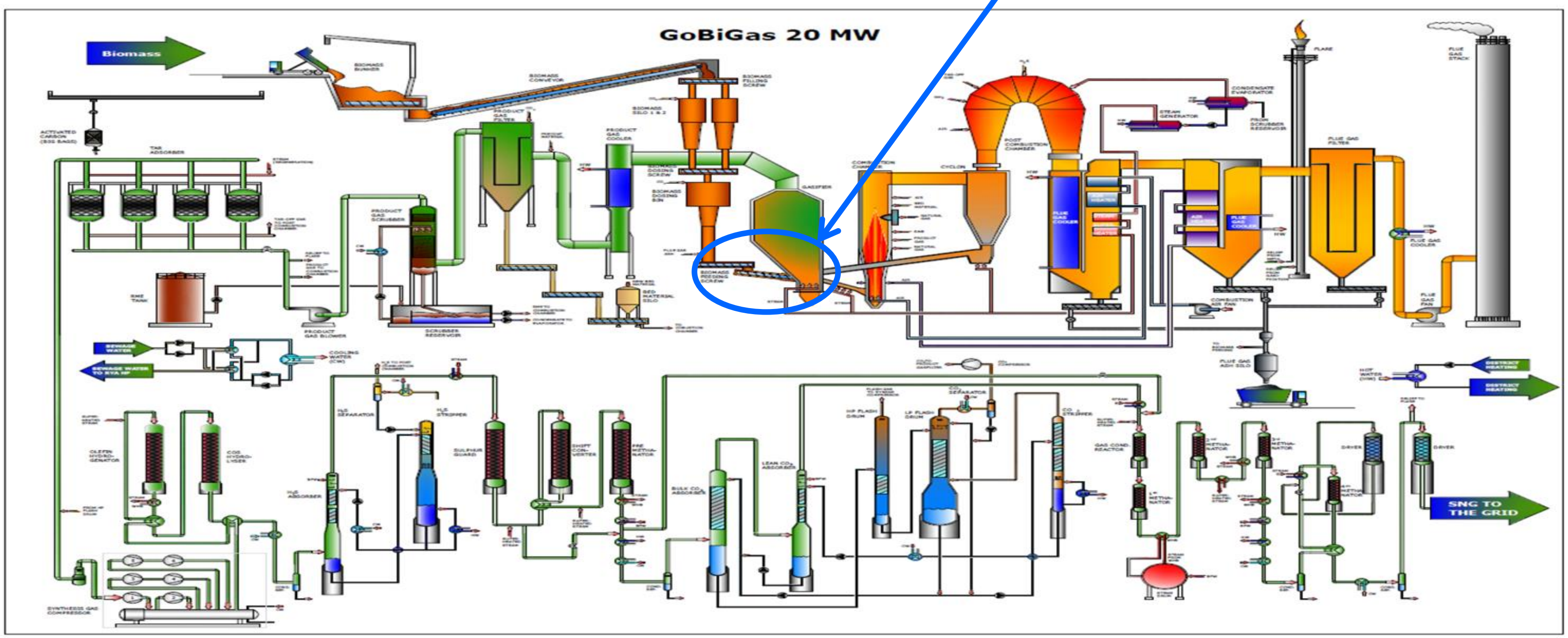
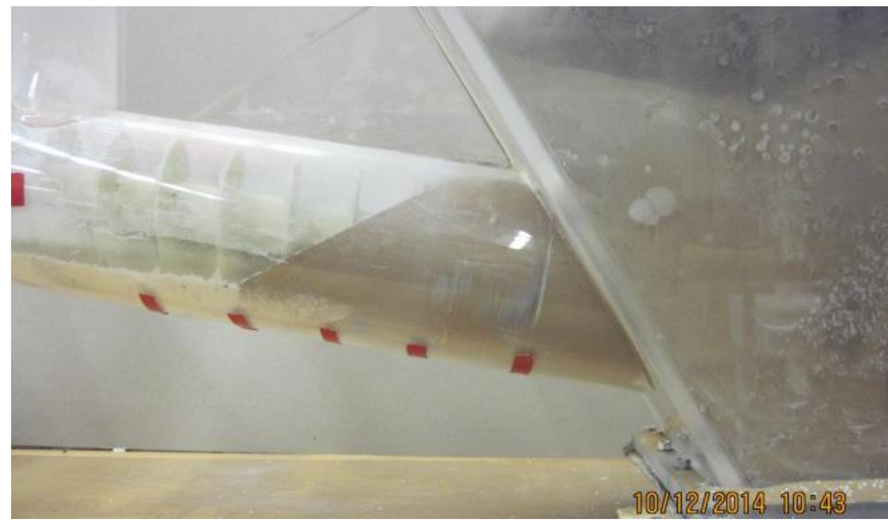
2015-03
2015-04


GoBiGas 20 MW
Biomass
SNG TO THE GRID

Improving the screw conveyor technique



Pictures: Dr. Claes Breitholtz, Valmet Power AB

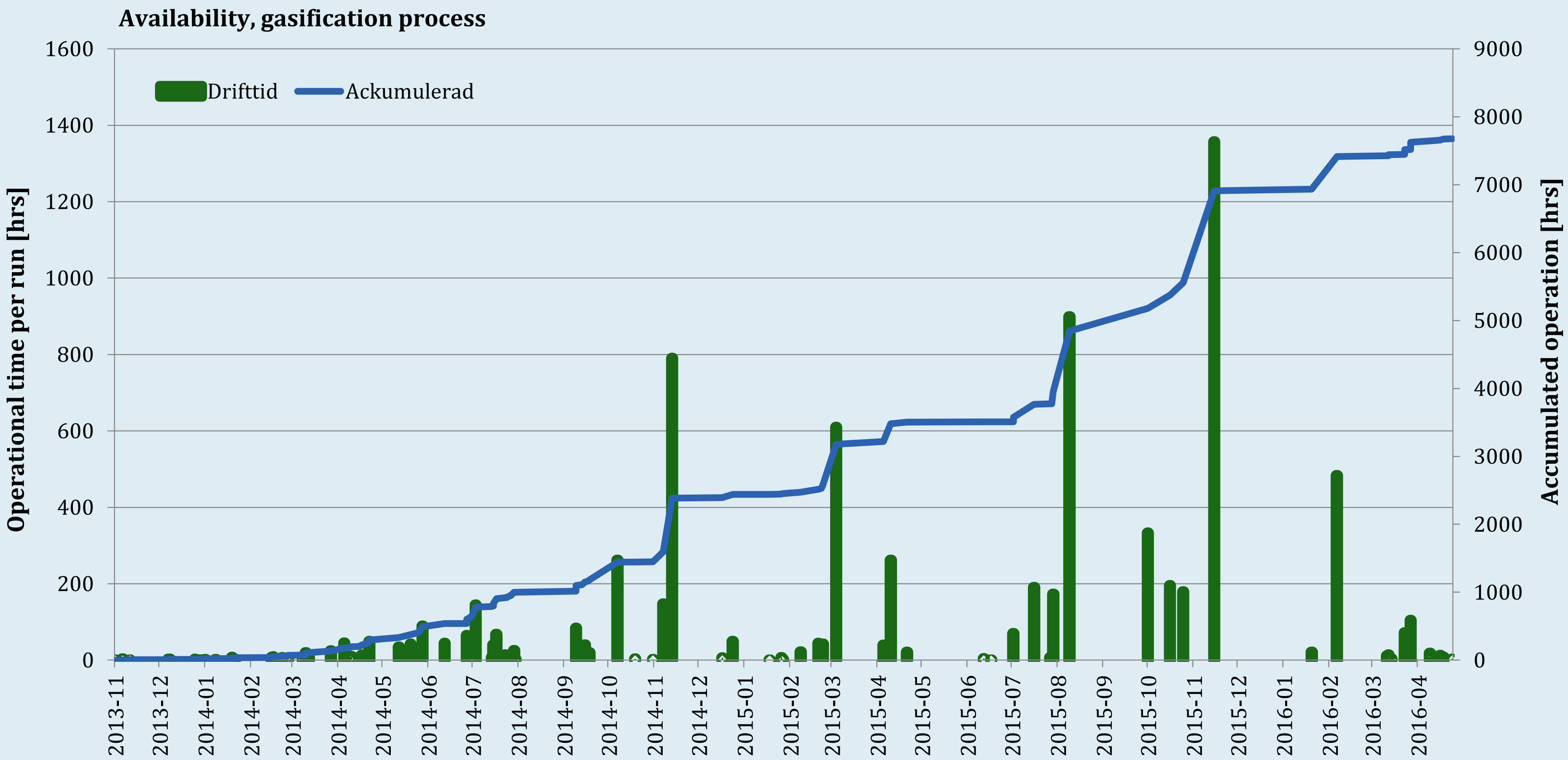
GoBiGas - status

- 29 GWh biogas delivered in total in 2015.
- 26,5 GWh delivered to transportation, 74 % CO2 reduction (RED).
- Record of two months of continuous delivery of bio-SNG.
- 100 % capacity in gasification.
- 80 % capacity in methanation due to high levels of benzene.
- Currently changing feedstock to wood chips.

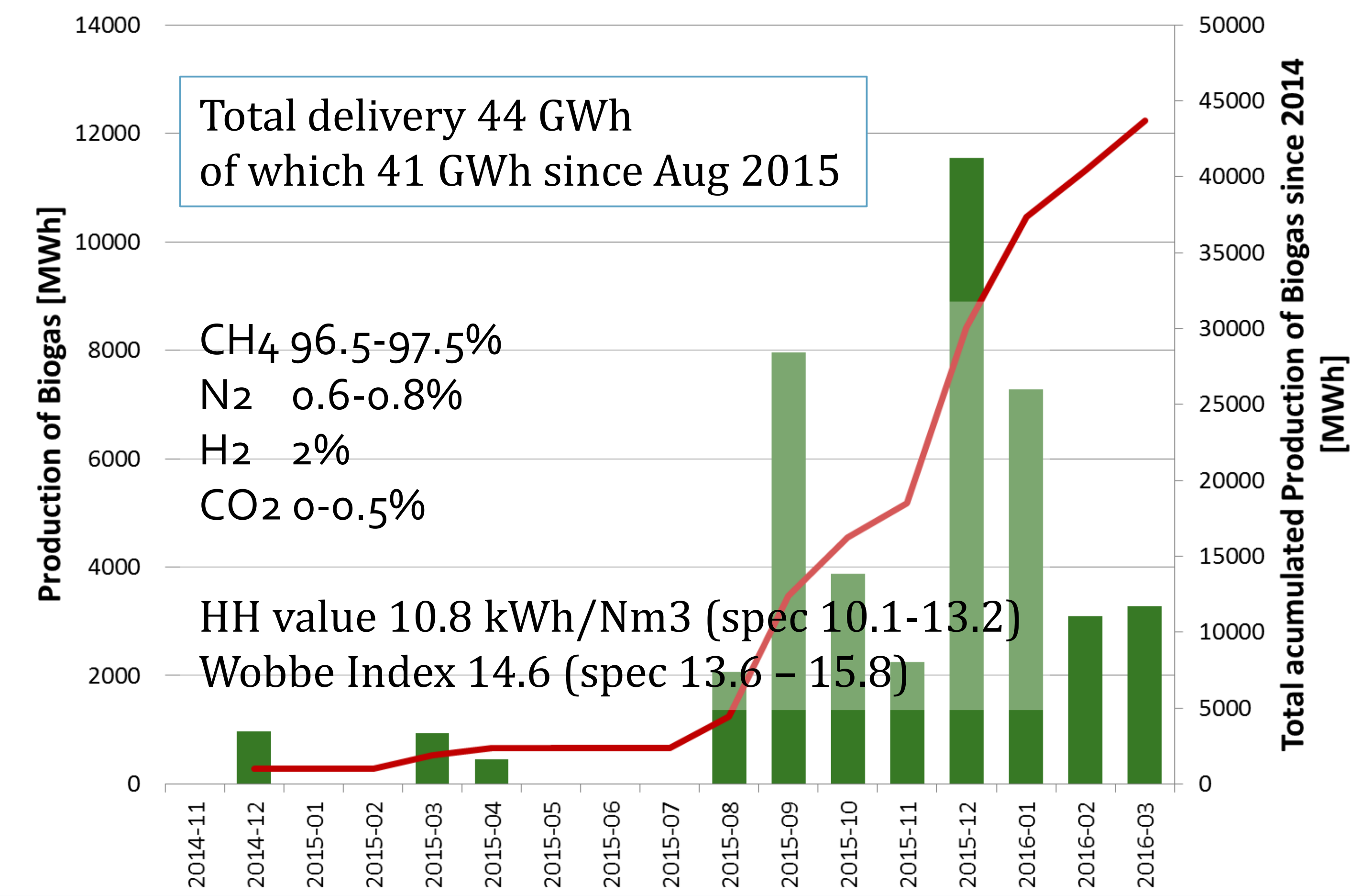
Göteborg Energi

GoBiGas - status

Gasification in operation >7500 hours



GoBiGas - status

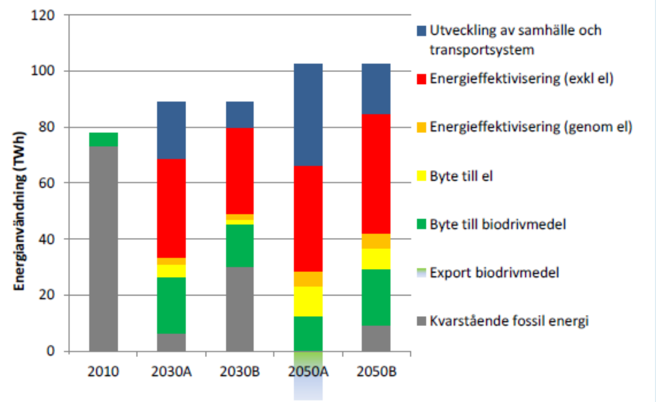


Göteborg Energi

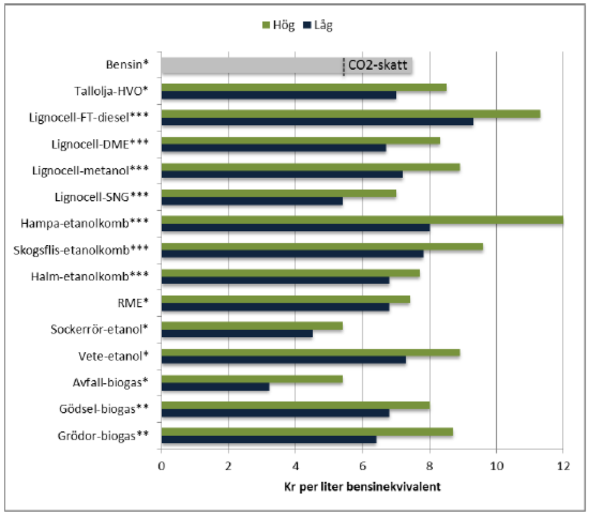
Commercially viable?

- Possibly in DE, NL, FR, IT, UK, DK – which all have ambitious support schemes which include biogas and/or bio-SNG.
- Currently not in SE, where we await long-term regulations and support schemes for biogas.

Figur S.1 **Vägtrafikens användning av fossil energi med och utan åtgärder (TWh). Toppen av staplarna visar utvecklingen utan åtgärder (dvs. hur stor energianvändningen skulle ha blivit om dagens fordonspark och bränslen använts vid de olika årtalen med trafikutveckling enligt Naturvårdsverkets referensscenario). De gråa fälten visar återstående fossil energi efter åtgärder. Negativa värden avser export av bioenergi**



Figur 10.12 **Uppskattade produktionskostnader för olika biodrivmedelssystem, uttryckt som kr per liter bensinekvivalent**



Källa: Börjesson et al (2013). Låg (blå) respektive hög (grön) stapel illustrerar möjliga variationer i råvarukostnader (biogas, RME och etanol från grödor) alternativt processutformning (etanolkombinat och drivmedel via termisk förgasning). Graden av osäkerhet i produktionskostnaderna indikeras med * = liten osäkerhet, ** = viss osäkerhet, respektive *** = stor osäkerhet. Produktionskostnaden för HVO är inkluderad i figuren i efterhand, liksom kostnaden för bensin där koldioxidskatt också är inkluderad.

The Swedish government knows that bio-SNG needs to be a part of its targets.

Conclusions

- GoBiGas is now online
- Major hurdles have been solved in the gasification stage and the gasifier now operates at full load.
  - Alkali needs to be in balance to achieve sufficient reduction and simplification of tars
  - Fuel feeding into the bed needs attention and reconstruction is probably required to enable 8000h/year operation
- Optimization of carbon beds for benzene removal now restricts the unit to go to full load
  - Condensation and heat recovery
- Expecting challenges with chips
  - Moisture, impurities, etc.

Thank you for your attention!

www.goteborgenergi.se
www.gobigas.se

Göteborg Energi

European Biofuels Technology Platform Meeting – Brussels, 21 June 2016

Rob Vierhout

Enerkem

Enerkem biorefineries:
setting a new global standard in biofuels, chemicals and waste management

Enerkem at a glance

- Canadian-based company producing biofuels and renewable chemicals from non-recyclable and non-compostable household garbage (MSW or RDF) as an alternative to landfilling and incineration
- Proprietary clean technology developed in-house
- Private company founded in 2000; 200 employees
- First full-scale commercial biorefinery beginning operations in Edmonton (CND) in 2015
    - Pilot and demonstration facilities in Québec
- Developing similar facilities in North America and abroad
    - MOUs in China and EU

Global '15 Cleantech 100

ICIS INNOVATION AWARDS 2015

GoingGreen Global 200 -WINNER-

FAST COMPANY 50 MOST INNOVATIVE COMPANIES

50 Hottest Companies in the Advanced Bioeconomy 2016

The Enerkem solution

Feedstock

Municipal Solid Waste

Approximately 1.3B MT[1] of trash generated per year at global scale

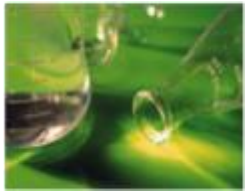
Process

Proprietary Thermochemical Technology

Syngas

10 year history – Largest operating demo plant in cellulosic ethanol

Products



Ethanol / Methanol

Renewable Chemicals

Power Generation

Product cost competitive with those derived from fossil-based feedstocks

Markets

Transportation Fuels

Solvents, Polymers, Coatings, Plastics, Adhesives

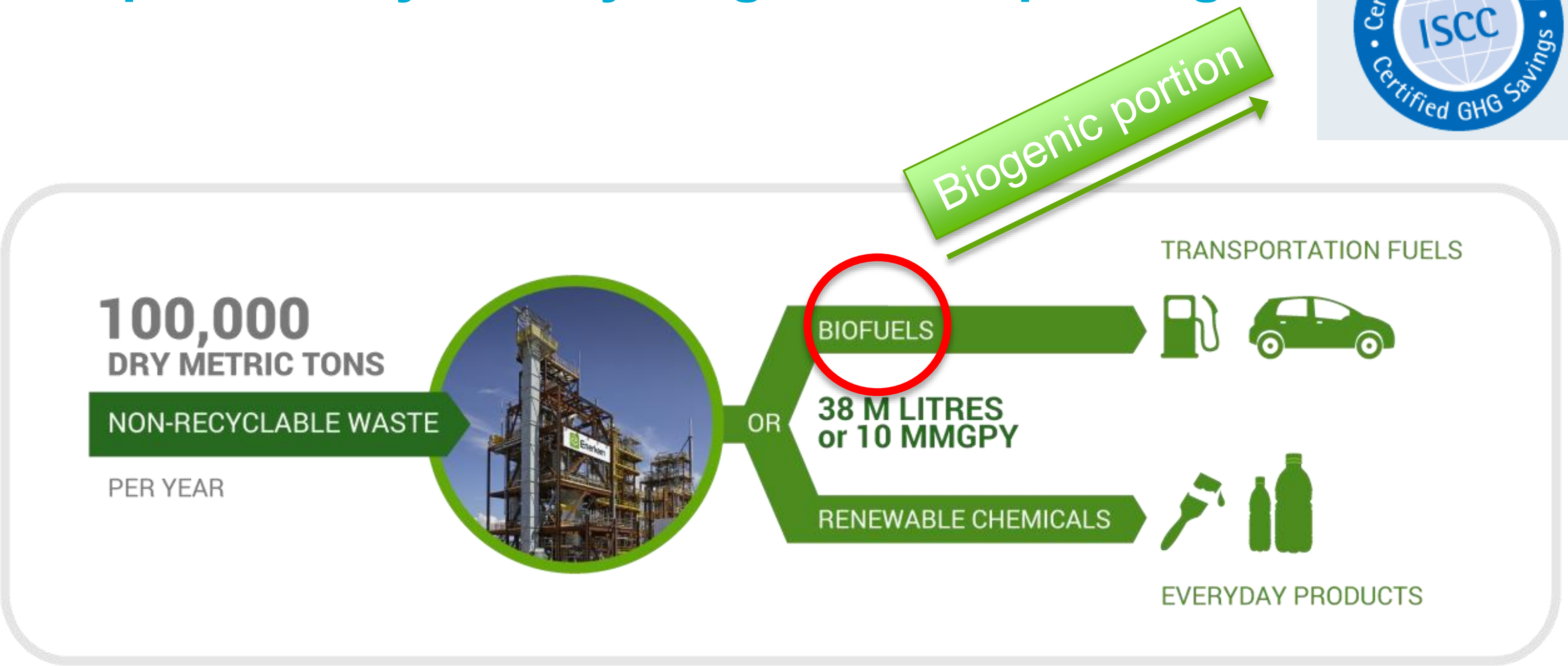
End Products Flexibility

Alternative to landfilling and traditional WTE

Helping increase waste diversion to 90%

Sustainable waste management solution

Complementary to recycling and composting



Enerkem

Key market drivers for waste as feedstock

- Increased scarcity of urban landfill airspace and societal desire for waste diversion
- Circular economy or “cradle-to-cradle” approach
- Low cost unconventional feedstocks
- Renewable fuels mandates around the world
- Consumer pull for renewable and biobased products
- Focus on carbon footprint and GHG emissions reduction

Benefits of using waste as feedstock

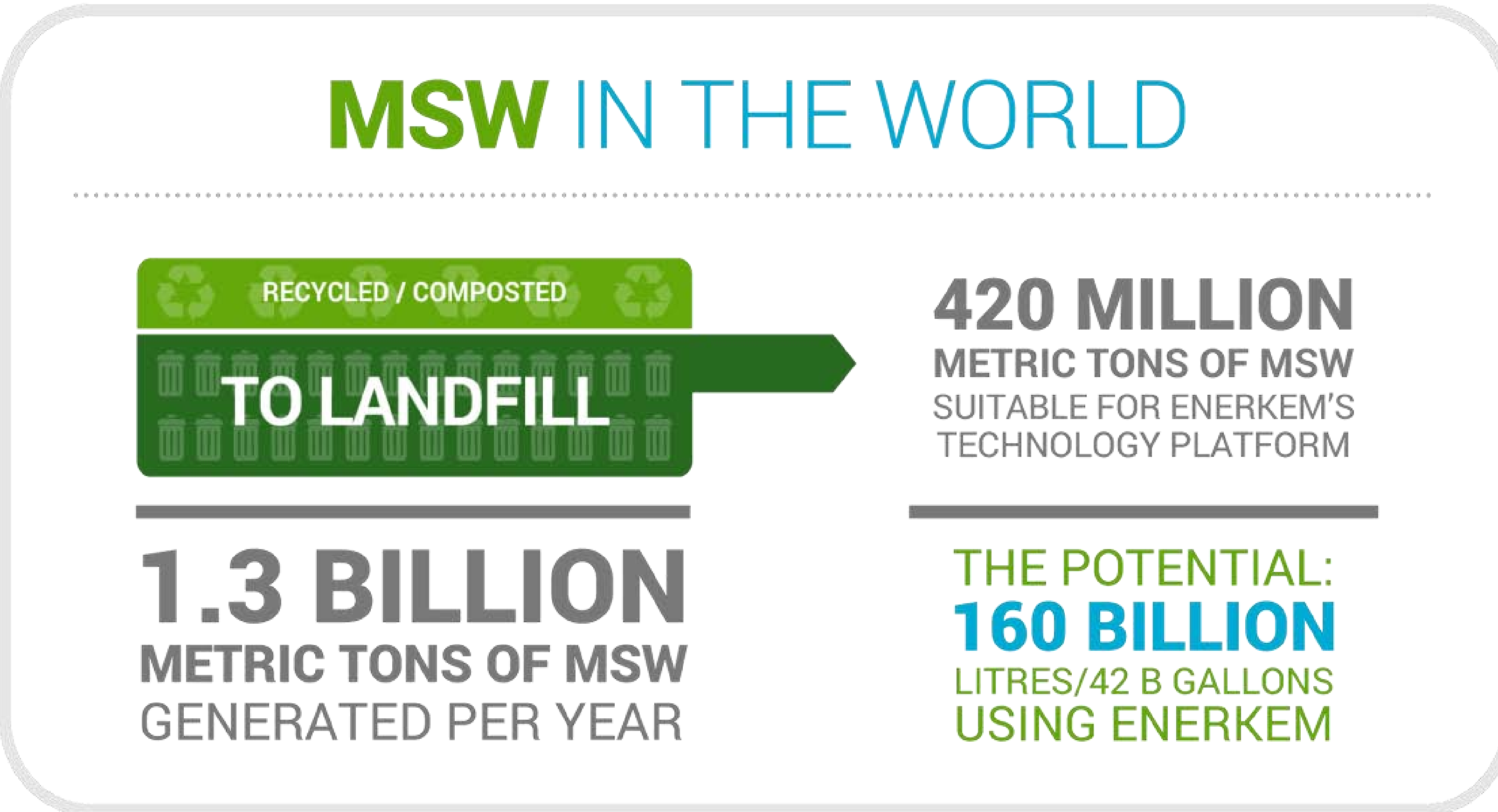
ENVIRONMENTAL

- Reduces GHG emissions
- No land use impact
- Sustainable alternative to landfilling
- Complementary to recycling
- Fuel produced close to point of consumption/feedstock (limited transportation)

ECONOMIC

- Most inexpensive feedstock (typically no cost)
- Abundant resource
- Readily available and collected
- Available in all regions (urban and rural)

Large market potential globally ……



Source: World Bank, 2012

….. but also in Europe

MSW IN THE EU

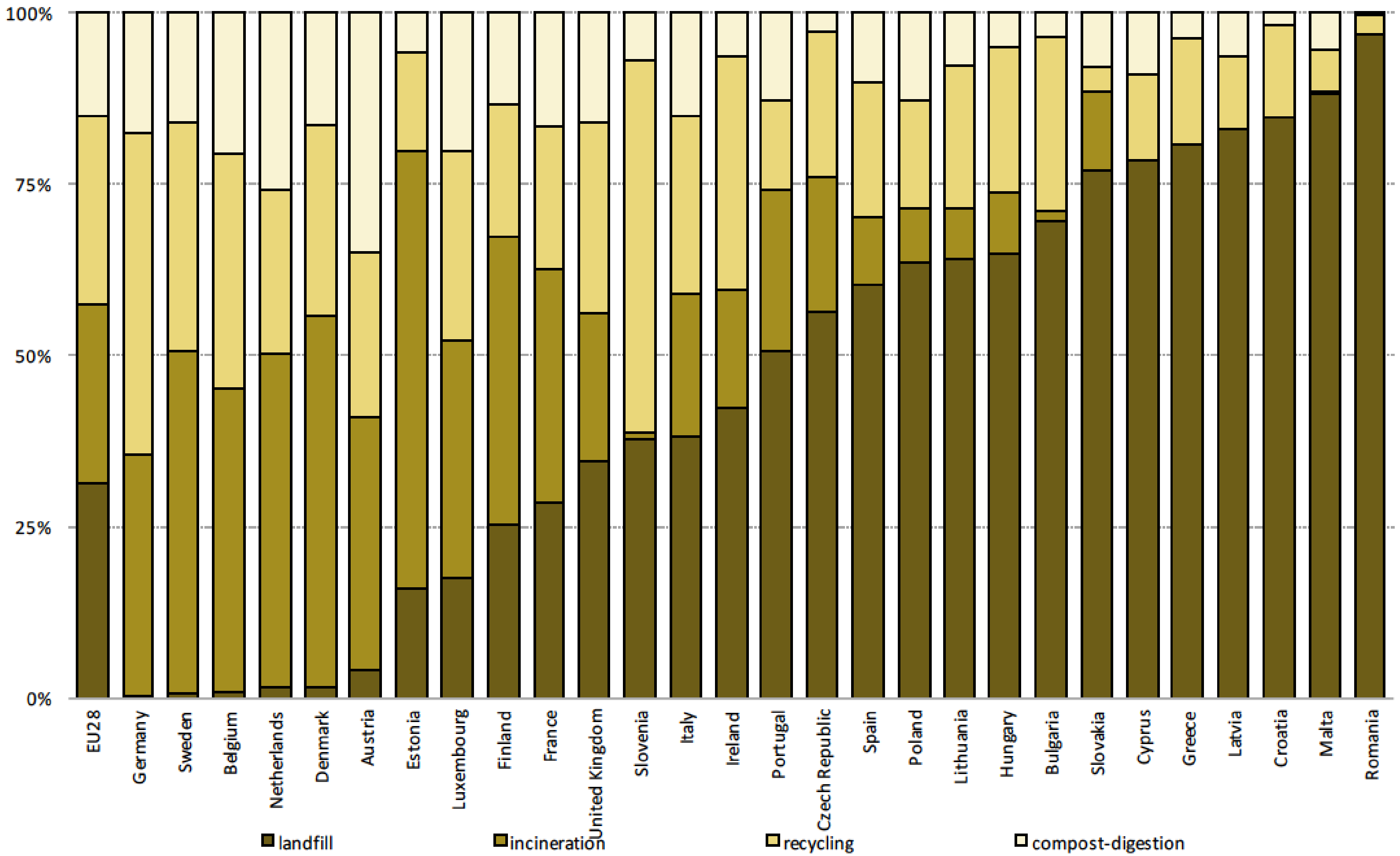
75 MILLION
METRIC TONS OF MSW
SUITABLE FOR ENERKEM'S TECHNOLOGY PLATFORM

254 MILLION
METRIC TONS OF MSW
GENERATED PER YEAR

THE POTENTIAL:
28.3 BILLION
LITRES USING
ENERKEM'S TARGET YIELD[1]

[1] 375 litres of cellulosic ethanol per metric ton
Source: Eurostat (European Commission), 2011

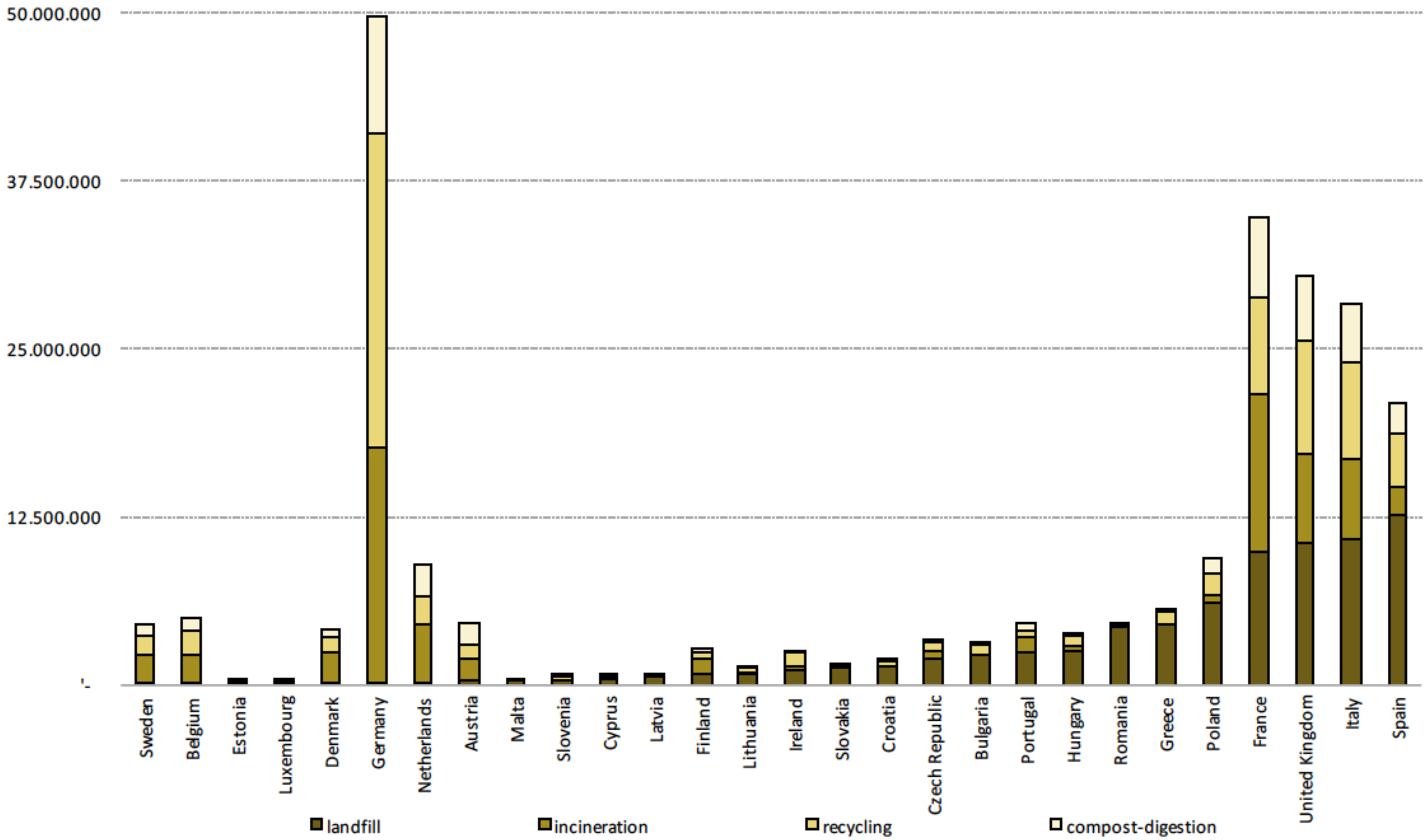
MSW treatment in EU MS in 2013



Source: Eurostat 2016

Enerkem

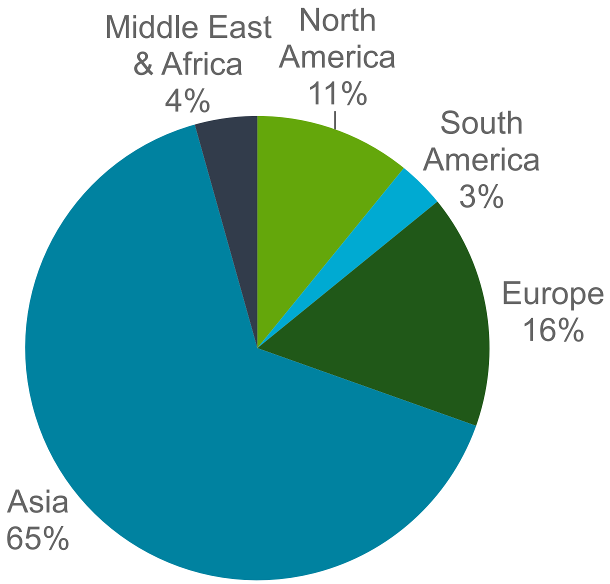
MSW treatment in EU MS in 2013 (in tons)



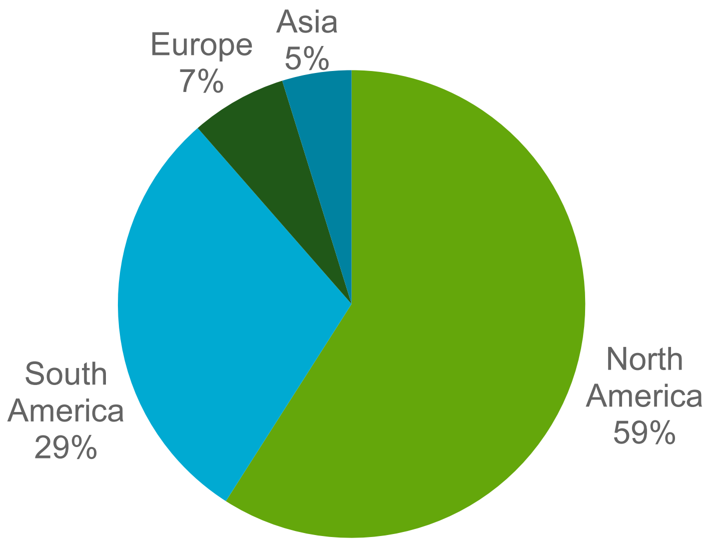
Source: Eurostat 2016

Large Global Market with Regulatory Upside

2014 Global Methanol Demand (84 Bn L)



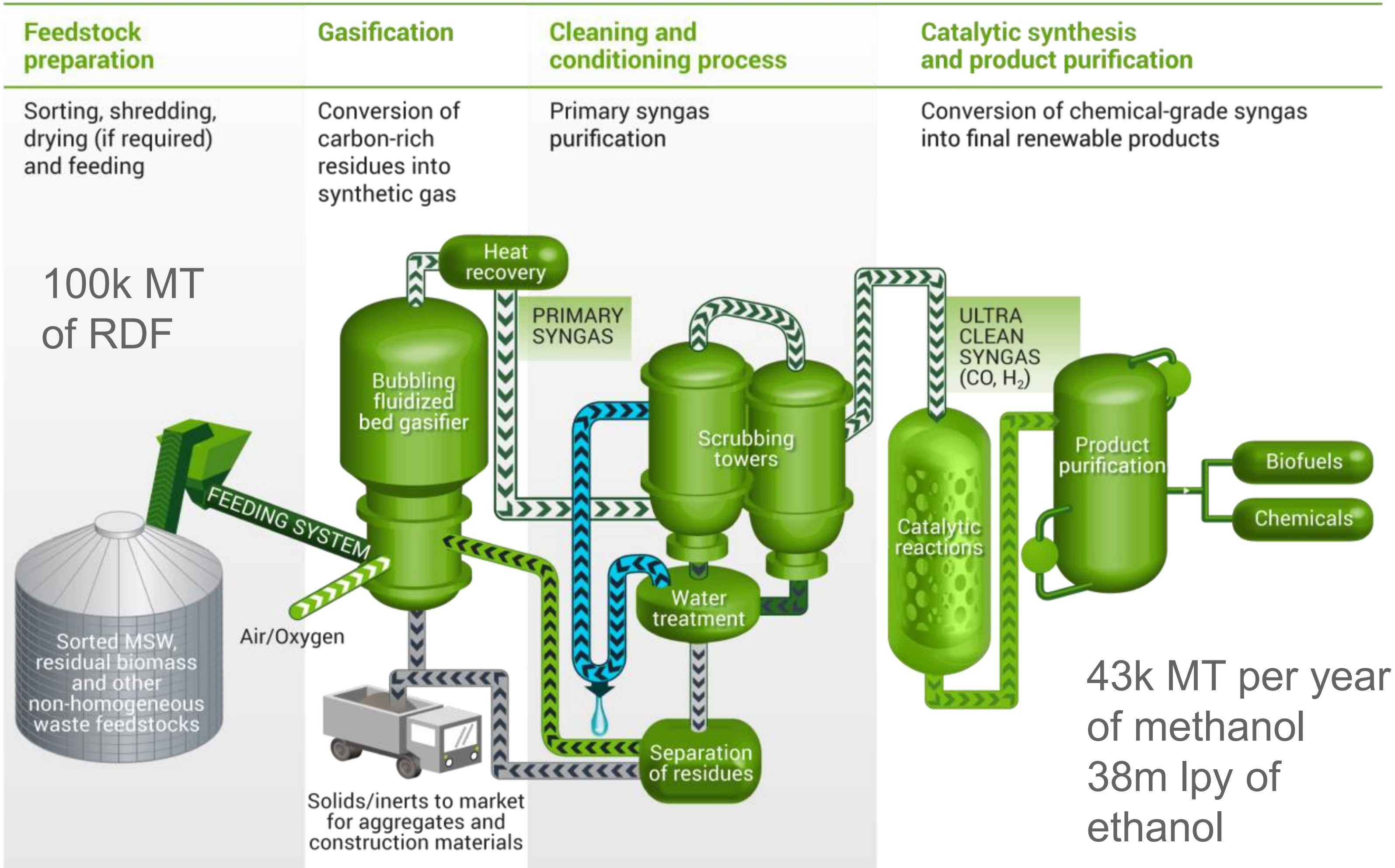
2014 Global Ethanol Demand (102 Bn L)



- North American ethanol market highly incentivized by Canadian and US Renewable Fuel Standard mandates.
- Ethanol and biomethanol are used as a transportation fuel blend in some EU states (RED) and China
- Unique opportunity in EU and China for blending methanol in fuels (instead of selling as chemical intermediate)

Enerkem

An efficient "carbon-recycling" process



* Municipal solid waste

Bringing the model to reality

Rigorous path to commercialization

UNIVERSITY OF SHERBROOKE PILOT

SHERBROOKE

WESTBURY FACILITY

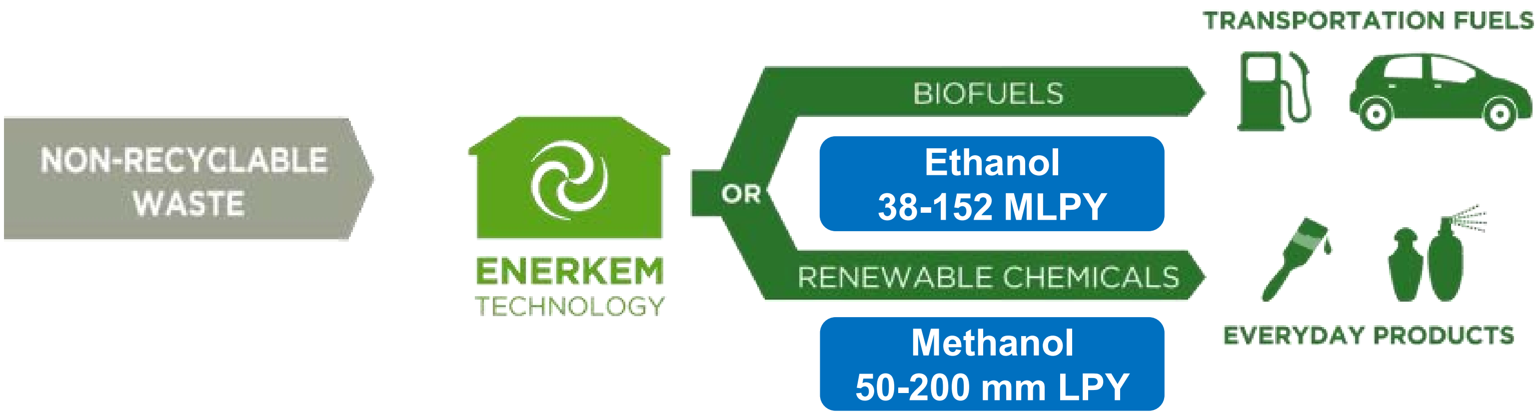
MODULAR COMMERCIAL BIOREFINERIES

Laboratory → Pilot → Syngas Demo → Methanol Demo → Ethanol Demo → **Full-scale commercial production**

We're building the bioeconomy. | © Enerkem, 2016

Enerkem

Cost-competitive and sustainable solution



Municipality:

- Supplies between 100,000 to 400,000 tons of MSW per year (as available)
- Long-term contract
- Pays tipping fee – attractive compared to status quo
- Suggests sites

Enerkem:

- Technology provider and joint venture partner in project
- Converts MSW into biofuels and renewable chemicals up to 4x scale of Edmonton
- Works with the waste and municipal partners to optimize MSW sorting into commodities and for site selection
- Manages business risks incl. sale of final product
- Creates high-quality jobs
- Generates $C65 M/year in net economic benefits in the region (for 1 X standard Enerkem system of 100,000 tons / year)

Modular approach

- Modular manufacturing approach enabling global expansion
- Pre-fabricated modules assembled on site

World’s first commercial MSW-to-biofuels and chemicals facility

ENERKEM ALBERTA BIOFUELS

Capacity:	38 million litres per year (i.e. 1 X standard Enerkem system)
Feedstock:	25-year agreement with City of Edmonton for 100,000 dry tonnes of MSW per year
Products:	Biomethanol, cellulosic ethanol

City of Edmonton's Integrated Waste Management Centre

Edmonton

Recycled	➲	20%
Composted	➲	40%
Biofuels	➲	30%
Landfill	➲	10%

Waste diversion = 90%

1. Integrated Processing and Transfer Facility
2. Recycling center
3. Composting center
4. ENERKEM biorefinery

Alberta Innovates
Energy and Environment Solutions

Edmonton Waste-to-Biofuels Initiative

Integrated Processing and Transfer Facility

- Funded by City of Edmonton
- Owned / operated by City of Edmonton
- Prepares waste materials for composting and biofuels facilities

Enerkem Alberta Biofuels Waste to Biofuels Facility

- Funded by Enerkem Inc.
- Supported by:
  - ✓ AI-EES ($20M – this grant is administered by the City of Edmonton)
  - ✓ Alberta Energy ($3.35M)
- Owned / operated by Enerkem

Advanced Energy Research Facility

- Funded by AI-EES
- Owned / operated by City of Edmonton
- Powered by Enerkem technology
- Hosts a laboratory and other technologies

Edmonton | Enerkem | Alberta Innovates Energy and Environment Solutions

Advanced Energy Research Facility

Edmonton

Alberta Innovates
Energy and Environment Solutions

Delivering new technology (1)

Key challenges Enerkem has overcome

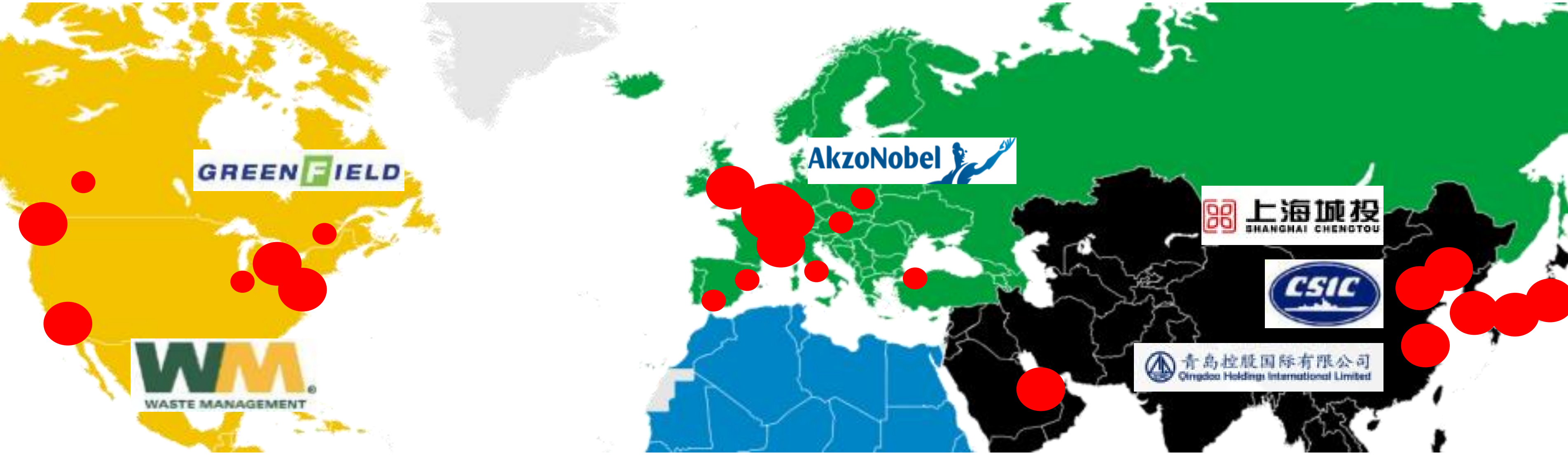
- Scaling-up from pilot to demonstration to commercial plants
    - Iterative design improvements based on operational performance
    - Move from ‘custom’ to modular delivery
- Funding / financing demonstration facility and 1st commercial plant
    - 15 year development programme
    - Capital scarcity during economic downturn
- Project deliver challenges
    - Modularisation and transport of modules to site
    - Building a reliable and costs effective supply chain
    - Construction in the Albertan winter!

Delivering new technology (2)

Ongoing challenges…

- EU market – policy variability and uncertainty
    - 28 sets of member states' biofuels policies – RED vs FQD?
    - Approach to 0.5% advanced sub-target?
    - Lack of clarity over policy post 2020 – all set to change?
    - Where are the highest value markets?

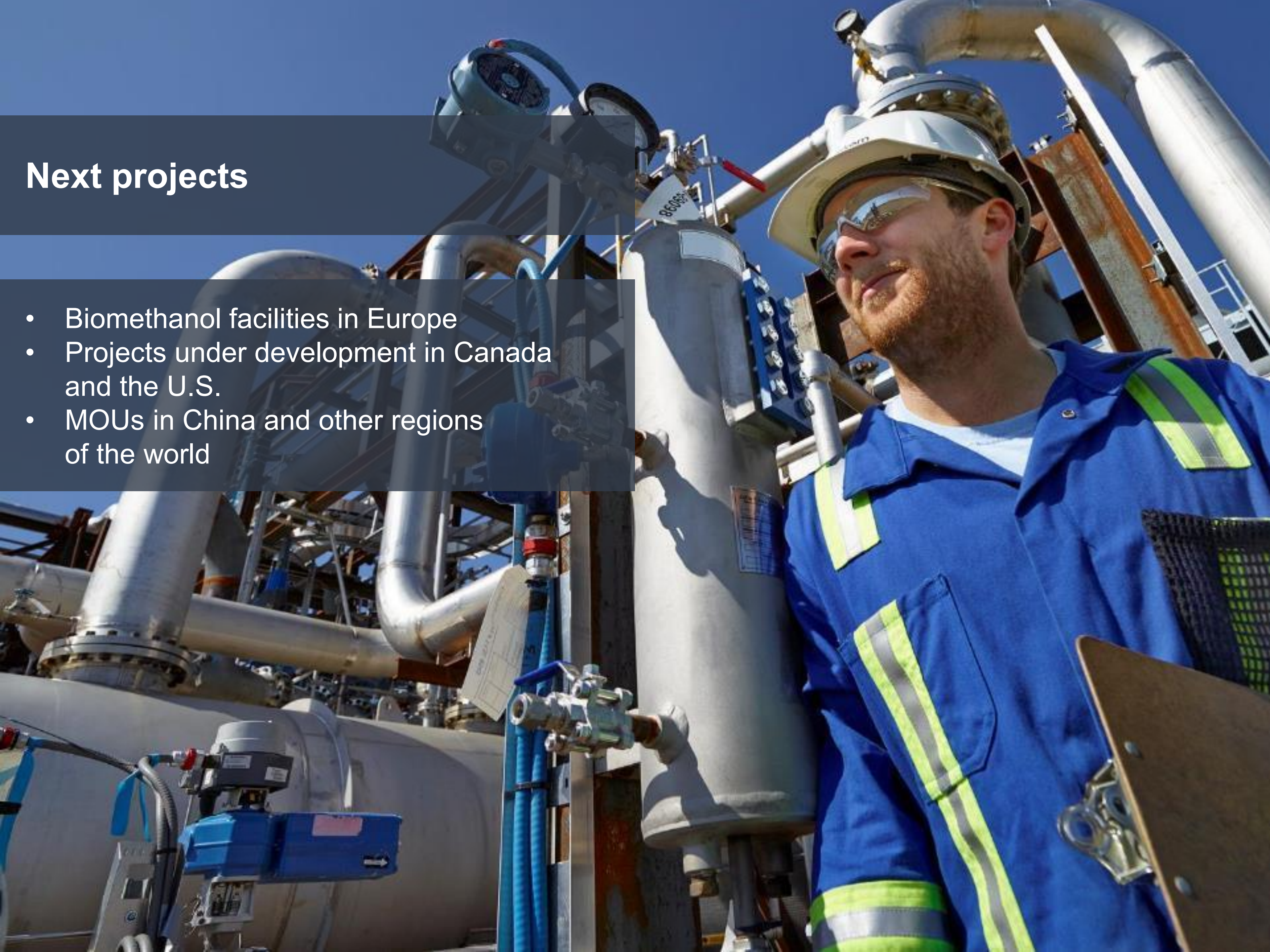
Target growth areas for global partnerships



- Strategic partnerships with leading industrial groups
- Selection based on market attractiveness:
  - public policies
  - tipping fees
  - proximity to petrochemical infrastructure
  - population

Next projects

- Biomethanol facilities in Europe
- Projects under development in Canada and the U.S.
- MOUs in China and other regions of the world



VANERCO

First advanced biofuels facility in Canada to be co-located with a conventional biofuels production facility

Capacity: 38 million litres
Feedstock: Urban waste (industrial, commercial, institutional, construction, etc.)
Status: Pre-construction work started

GREENFIELD Enerkem

Using **waste as feedstock** for the chemical industry

AkzoNobel

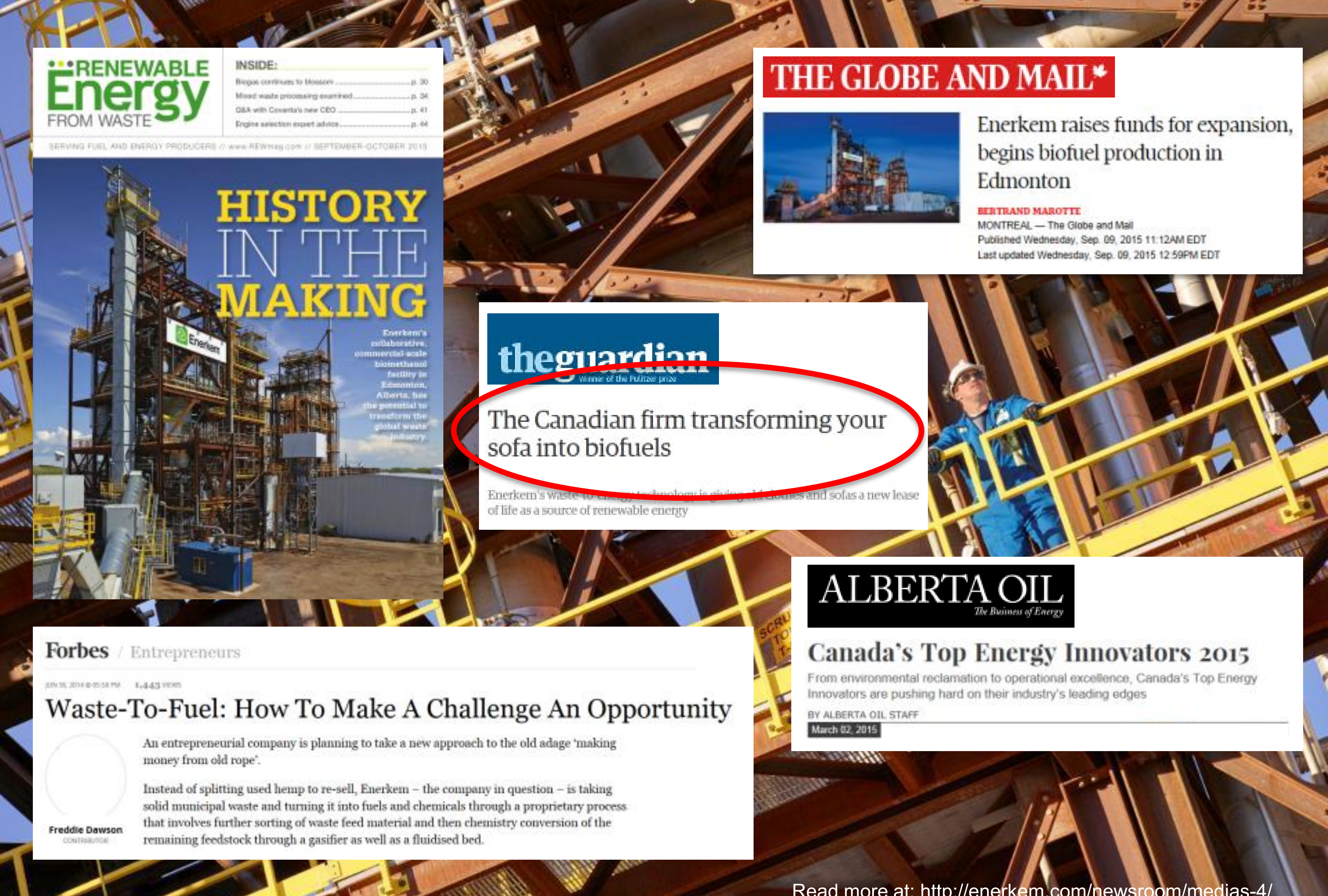
www.akzonobel.com

Fourteen partners have joined forces to assess the use of waste for the production of chemicals in the Netherlands.

The public-private partnership will study the options for setting up Europe's first plant, either in Rotterdam or Delfzijl.

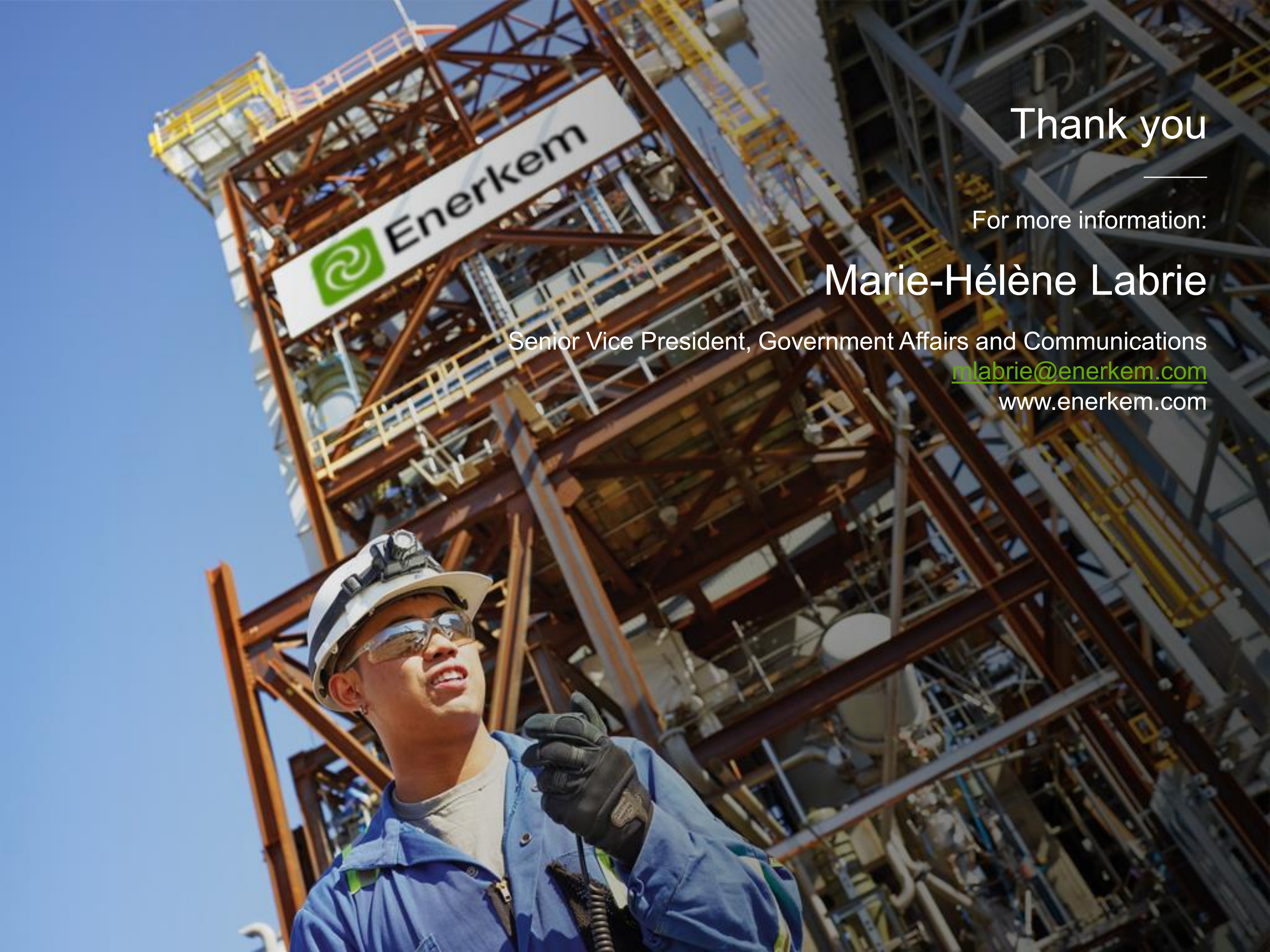
Other partners involved in the initiative:

Air Liquide, BioMCN, Clean Tech Delta, DNV·GL, eew, Enerkem, Groningen Seaports, Innovation Quarter, NOM, Port of Rotterdam, Van Gansewinkel, Veolia, Visser & Smit Hanab



RENEWABLE Energy FROM WASTE
INSIDE:
Biogas continues to blossom ... p. 30
Mixed waste processing examined ... p. 34
Q&A with Covanta's new CEO ... p. 41
Engine selection expert advice ... p. 44
SERVING FUEL AND ENERGY PRODUCERS // www.REWmag.com // SEPTEMBER-OCTOBER 2015
HISTORY IN THE MAKING
Enerkem's collaborative, commercial-scale biomethanol facility in Edmonton, Alberta, has the potential to transform the global waste industry.
THE GLOBE AND MAIL
Enerkem raises funds for expansion, begins biofuel production in Edmonton
BERTRAND MAROTTE
MONTREAL — The Globe and Mail
Published Wednesday, Sep. 09, 2015 11:12AM EDT
Last updated Wednesday, Sep. 09, 2015 12:59PM EDT
theguardian
Winner of the Pulitzer prize
The Canadian firm transforming your sofa into biofuels
Enerkem's waste-to-energy technology is giving old clothes and sofas a new lease of life as a source of renewable energy
ALBERTA OIL
The Business of Energy
Canada's Top Energy Innovators 2015
From environmental reclamation to operational excellence, Canada's Top Energy Innovators are pushing hard on their industry's leading edges
BY ALBERTA OIL STAFF
March 02, 2015
Forbes / Entrepreneurs
1,443 VIEWS
Waste-To-Fuel: How To Make A Challenge An Opportunity
An entrepreneurial company is planning to take a new approach to the old adage 'making money from old rope'.
Instead of splitting used hemp to re-sell, Enerkem – the company in question – is taking solid municipal waste and turning it into fuels and chemicals through a proprietary process that involves further sorting of waste feed material and then chemistry conversion of the remaining feedstock through a gasifier as well as a fluidised bed.
Freddie Dawson
CONTRIBUTOR
Read more at: http://enerkem.com/newsroom/medias-4/

Enerkem



Thank you

For more information:

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www.enerkem.com

Efficient integration of fuel generation with the pulping process

EBTP / ETIP Bioenergy's
7th Stakeholder Plenary Meeting

Brussels
June 21, 2016

Ingvar Landälv
Senior Project Manager
Luleå University of Technology

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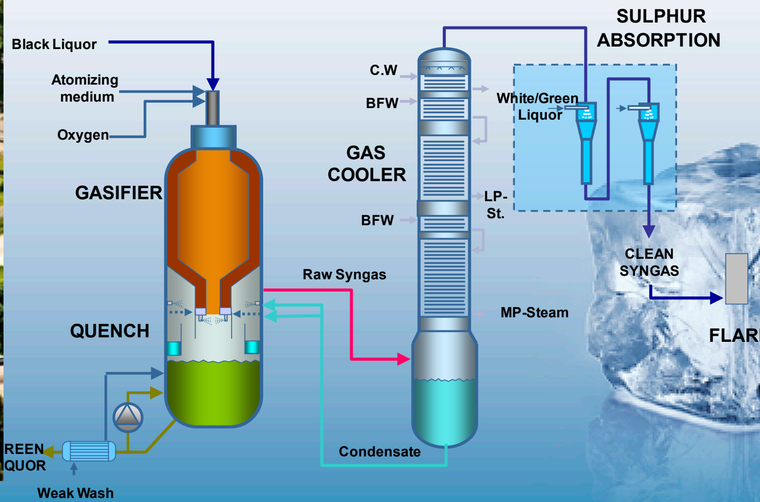
Status Chemrec technology 2013 post 2012

Where do we go from here?

- ***Dec 31, 2012*****:** Chemrec Piteå companies including pilot plants sold by Chemrec AB to LTU Holding AB,
- ***Jan 1, 2013:*** 17 pilot plant staff employed by LTU.
- ***Dec 31, 2012:*** License agreement between licensor Chemrec AB & HaldorTopsøe with LTU and LTU Holding. Technology rights stay with licensors.
- ***Jan 30, 2013:*** Consortium Agreement between parties involved in continued R&D.
- Chemrec has reduced staff awaiting long term stable regulations for advanced biofuels. Two Chemrec Stockholm staff employed by LTU
- ***Jan 2013 – May 2016:*** Continued operation of the plants as part of LTU Biosyngas Program
- **June 2016:** Application filed for mothballing the plant. Alternative: Dismantling



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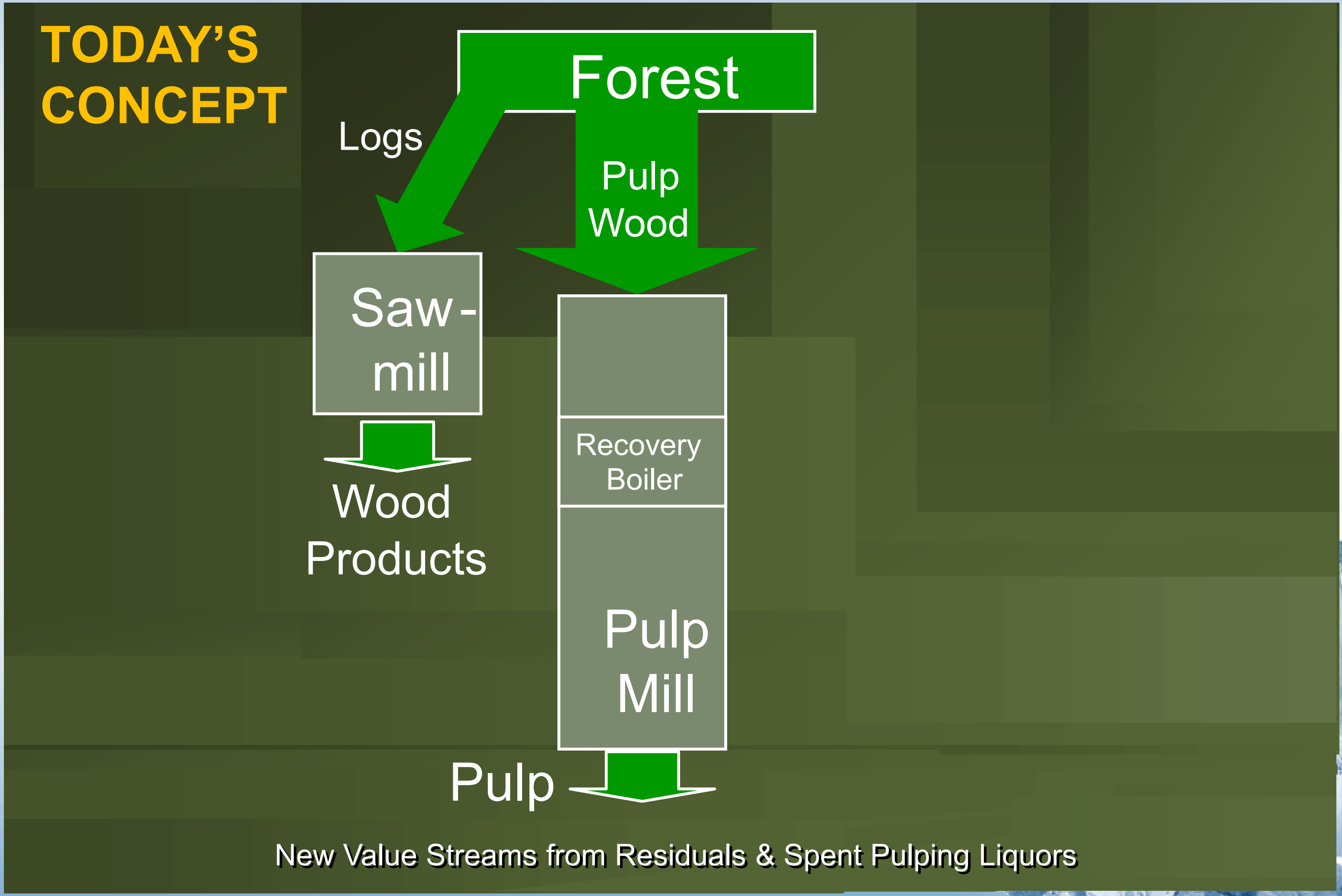
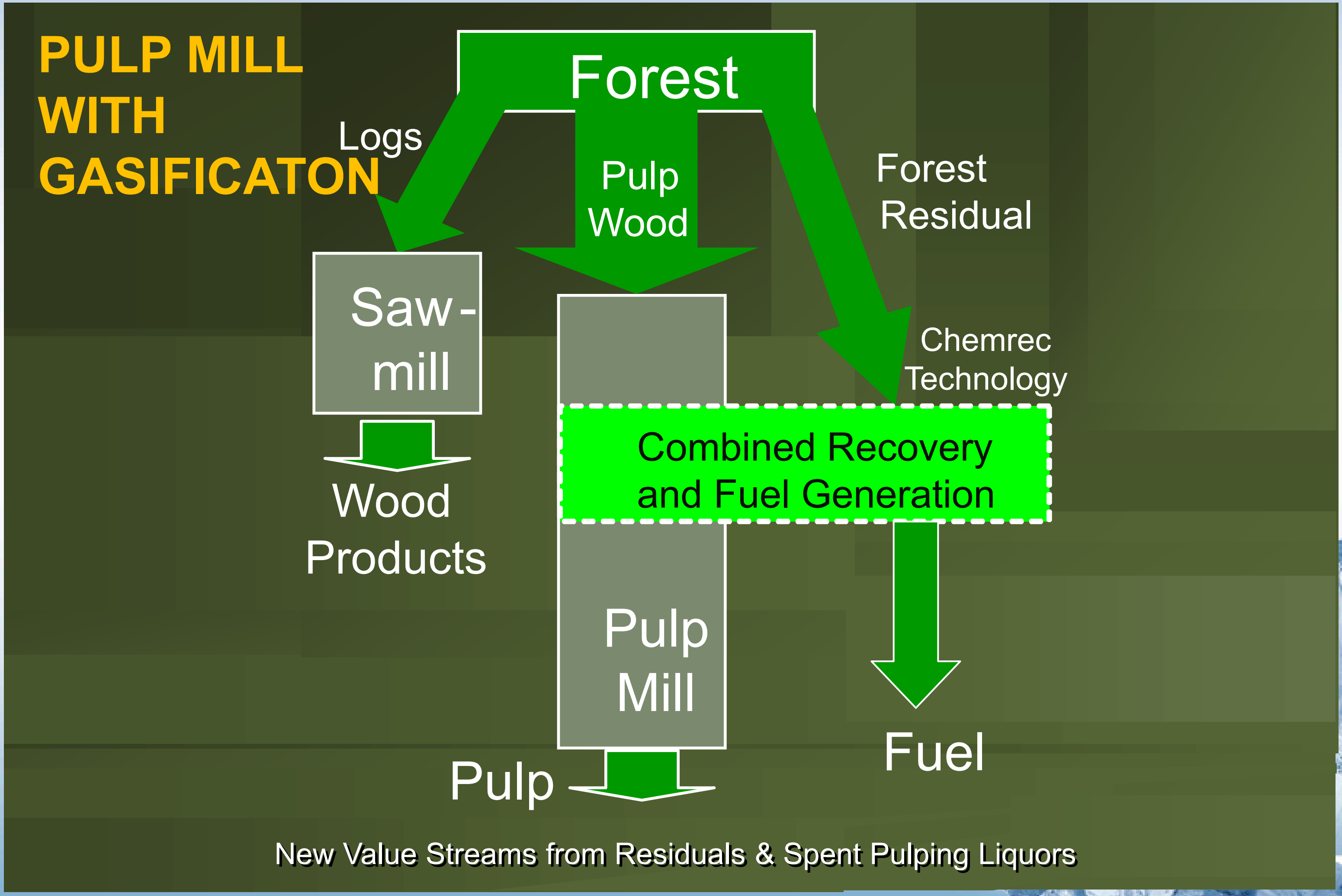
Today's commercial Forrest Industry has two main legs

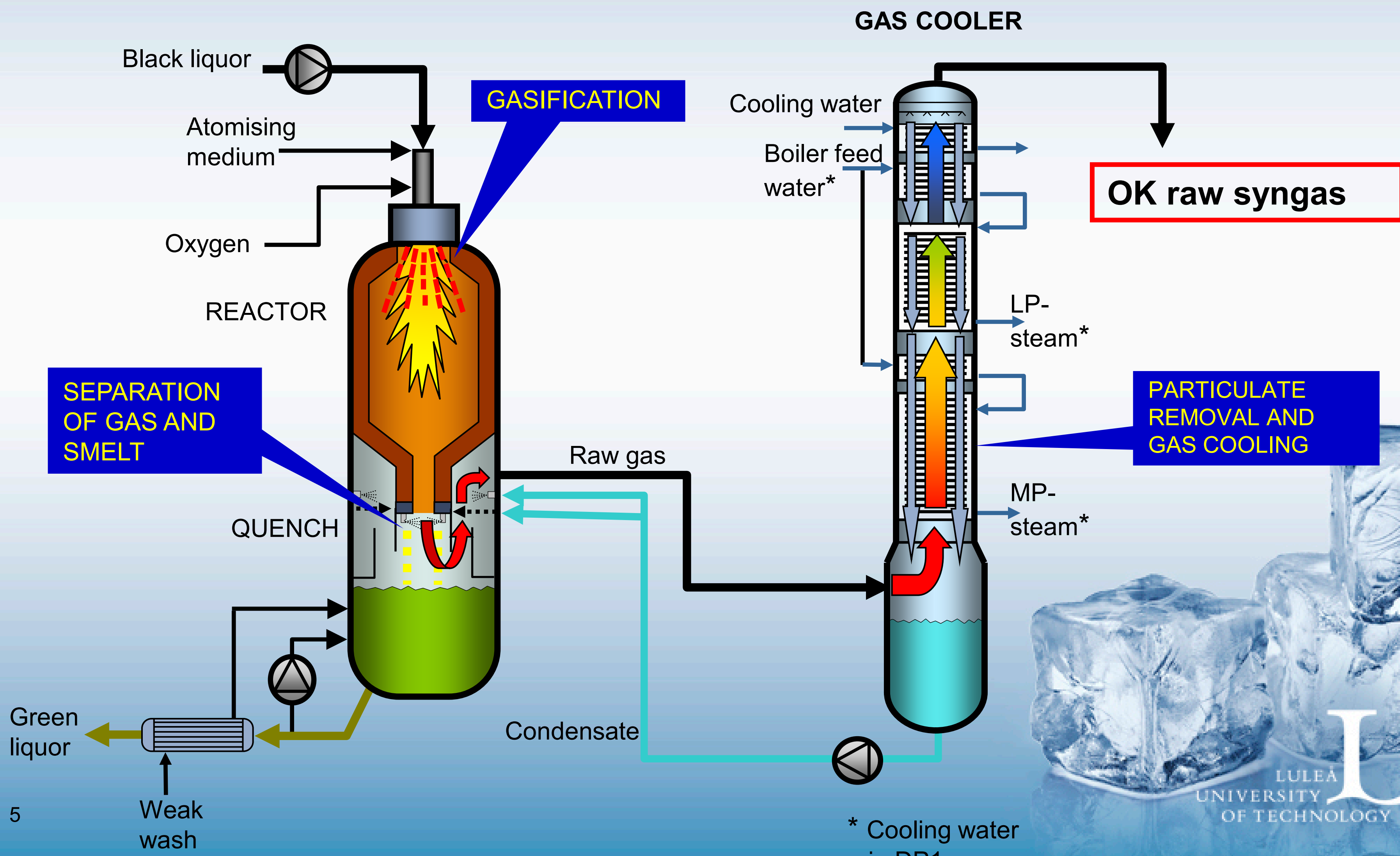


The Vision: Tomorrow's Biomass flow to the Forrest Industry



Chemrec technology generates good quality raw syngas with three main process steps: (1)Gasification, (2)Quenching and (3)Cooling

- Running as a gasification unit only Sep 2005 to June 2011 -



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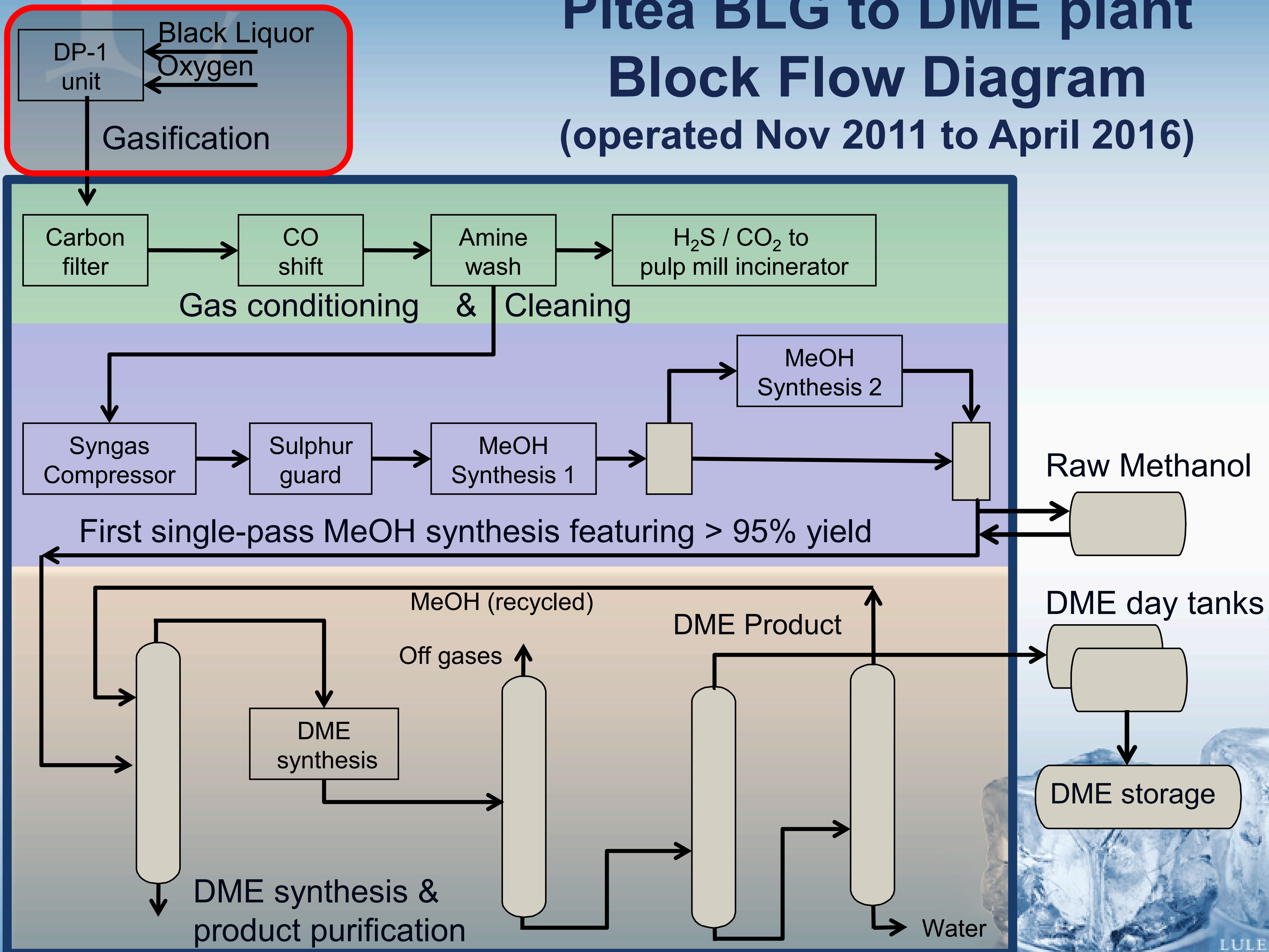
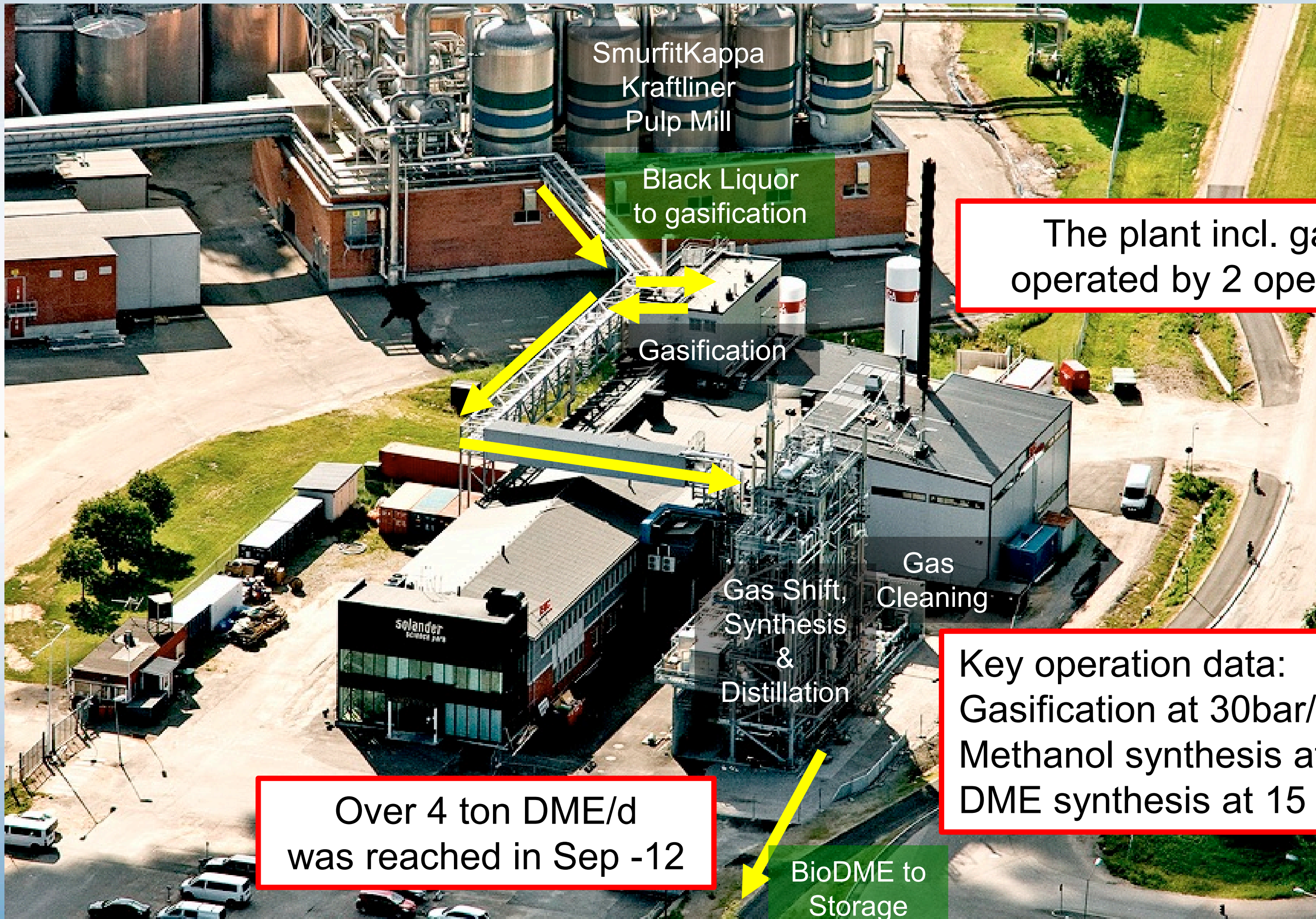
Piteå BLG to DME plant
Block Flow Diagram
(operated Nov 2011 to April 2016)



The integrated Black Liquor to DME plant in Piteå, Sweden



The plant incl. gasification is operated by 2 operators per shift

Key operation data:
Gasification at 30bar/1050˚C
Methanol synthesis at 130 bar
DME synthesis at 15 bar

Over 4 ton DME/d was reached in Sep -12

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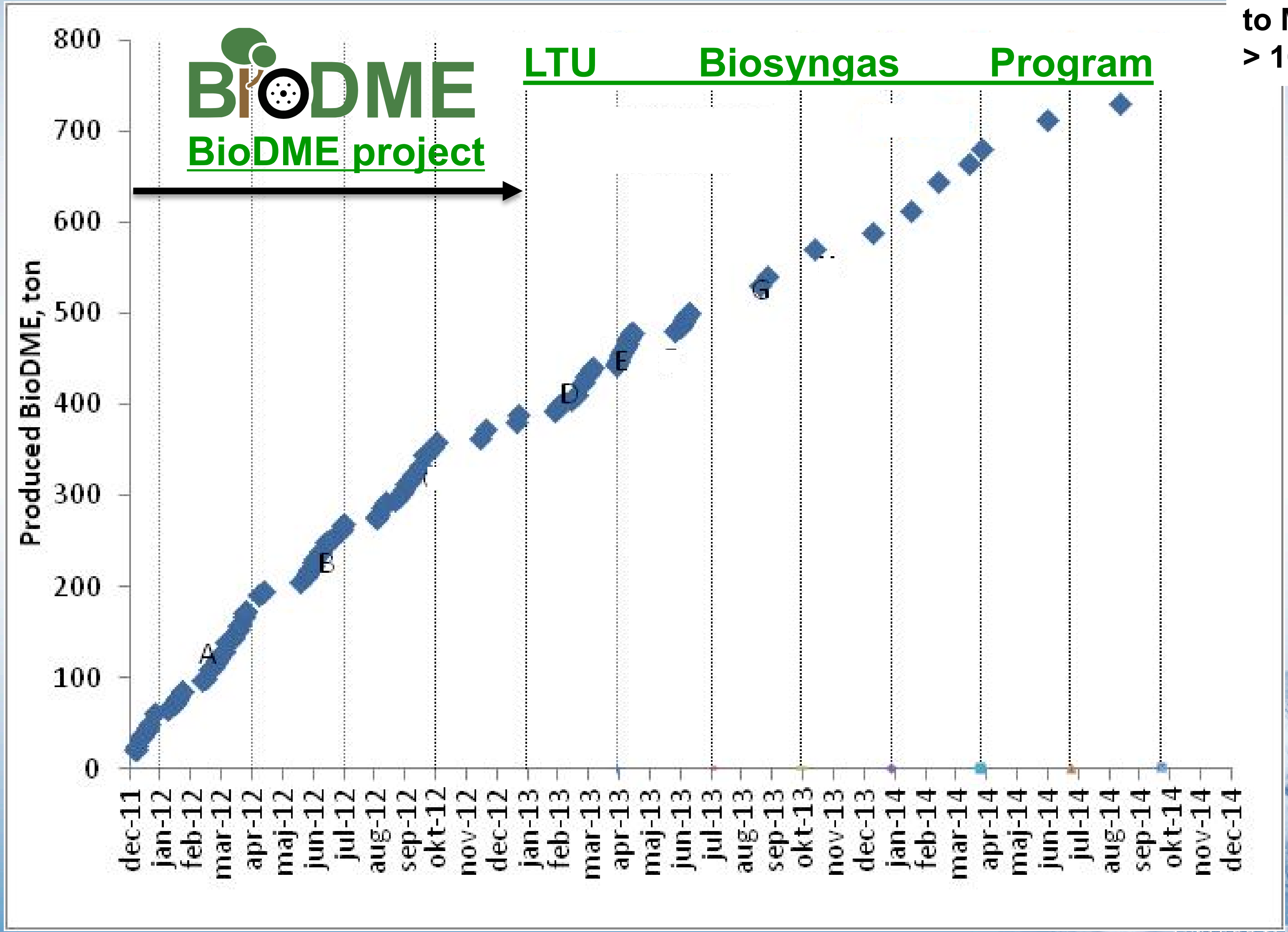
More than 1000 tons of BioDME has been produced since start in Nov 2011

to May 2016
> 1000 ton



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Fuel Distribution

- Available technology modified for DME
- Safety regulations based on LPG
- ~200 k€ per filling station (+33% vs diesel)
- Easy to achieve

200 m^3 storage tank in Piteå

34 m^3 trailer

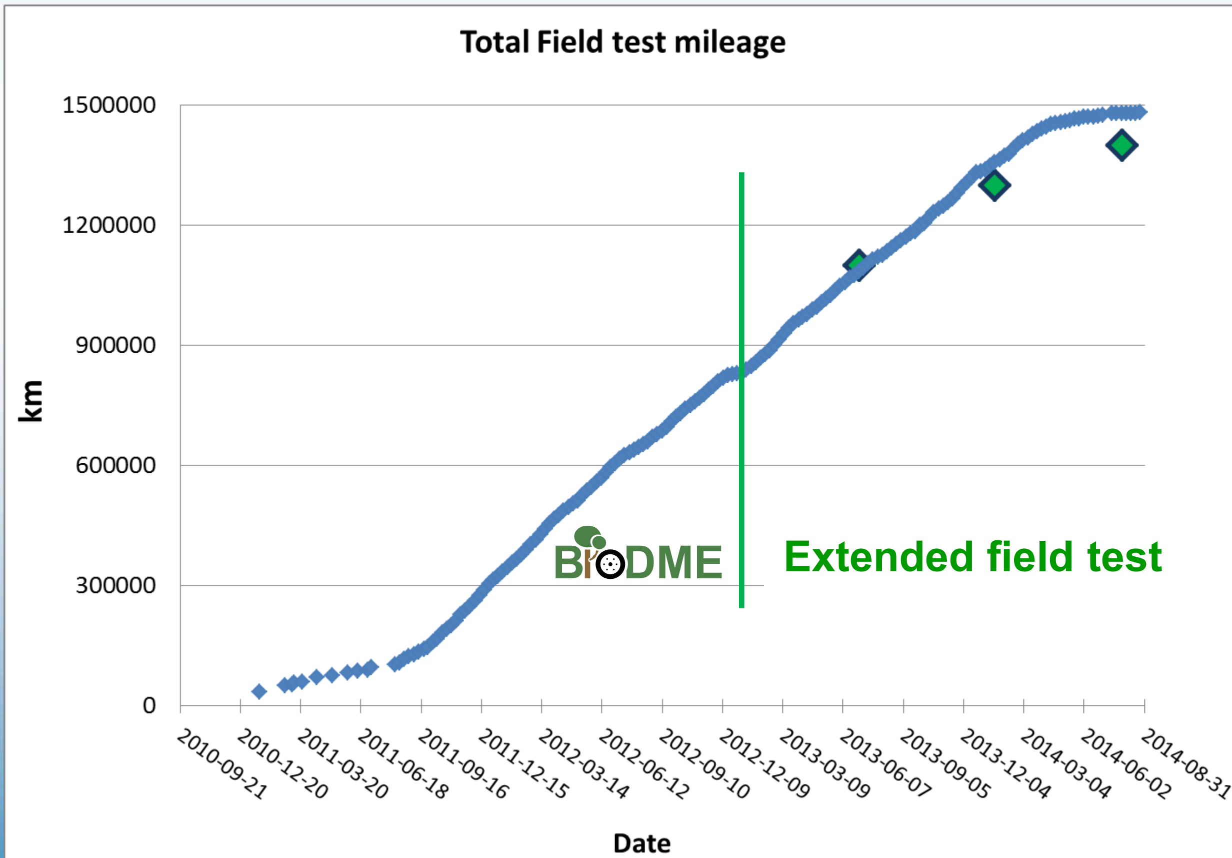
Four filling stations

BioDME

Goals achieved for the Volvo field tests

8 trucks, 2013-01-01 to 2014-06-30

Km / Mile	Status 2014-08-31	Target June 2014
Total mileage	1 485 000 / 933 000	1 400 000 / 870 000
1 truck	296 000 / 184 000	250 000 / 155 000



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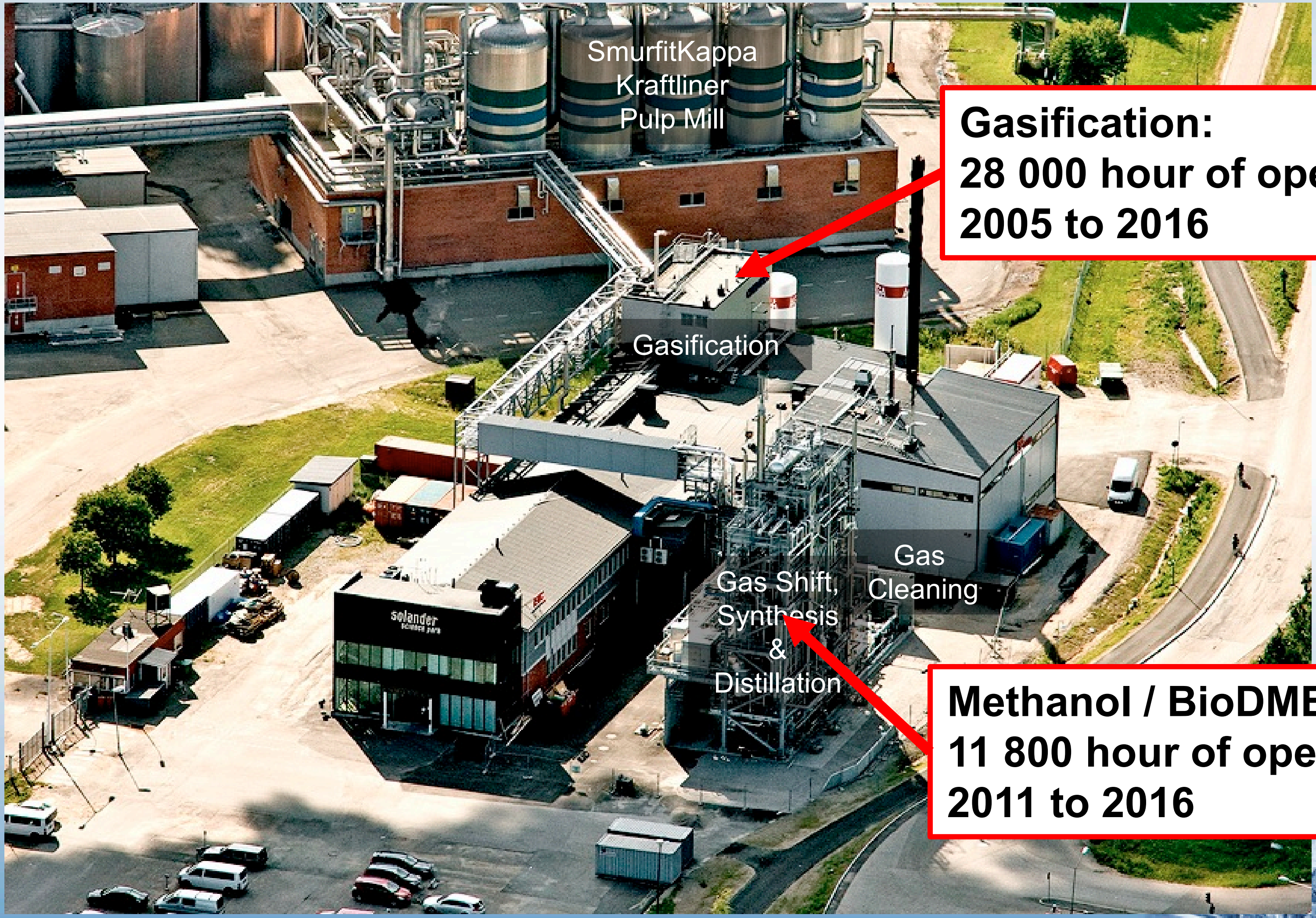
Total operating hours for the Piteå development plant



Gasification:
28 000 hour of operation
2005 to 2016

Methanol / BioDME Plant:
11 800 hour of operation
2011 to 2016

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BioDME Plant Non-availability Jan-June, 2012
(total calendar time: 4368h)

Variable	Total downtime Jan-June 2012	Planned downtime	Unplanned downtime caused by			
			Gasifier unit	BioDME plant	Support system	Mill
Gasifier + BioDME plant not in operation	1527 h	737	252	433	26	80
% of total time (4368 h)	35 %	17	6	10	<1	2
% of total downtime		48	17	28	2	5

On stream factor, PLANNED: 50% of calendar time
On stream factor, ACHIEVED: approx. 65% of calendar time
On stream factor, ACHIEVED: approx. 78% of planned operation time
Longest run: 26 days followed by a planned stop

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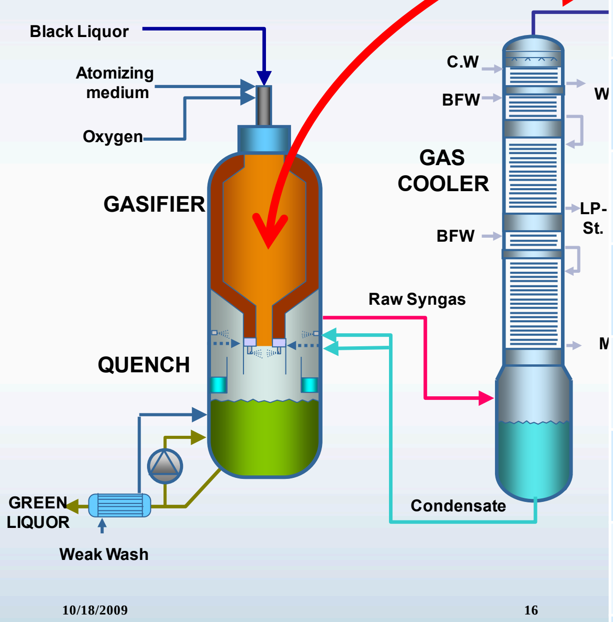
Gas composition for a typical case (p = 27 bar, λ = 0.3, T = 1050 ºC)



	Inside reactor (%)	Cooled syngas (%)
CO_2	33.9 ±0.3	33.6 ±0.2
H_2S	1.65 ±0.04	1.71 ±0.02
CH_4	1.36 ±0.07	1.44 ±0.07
CO	28.7 ±0.2	28.5 ±0.2
H_2	34.3 ±0.2	34.8 ±0.1
COS	468 ±22 ppm	122 ±5 ppm
H_2/CO	1.19 ±0.01	1.22 ±0.01
H_2/CO_2	1.01 ±0.01	1.04 ±0.01
CO/CO_2	0.85 ±0.01	0.85 ±0.01

* Average of ten samples per sample point

Data by the BLG Program,
R. Gebart et al, TCBiomass 2009

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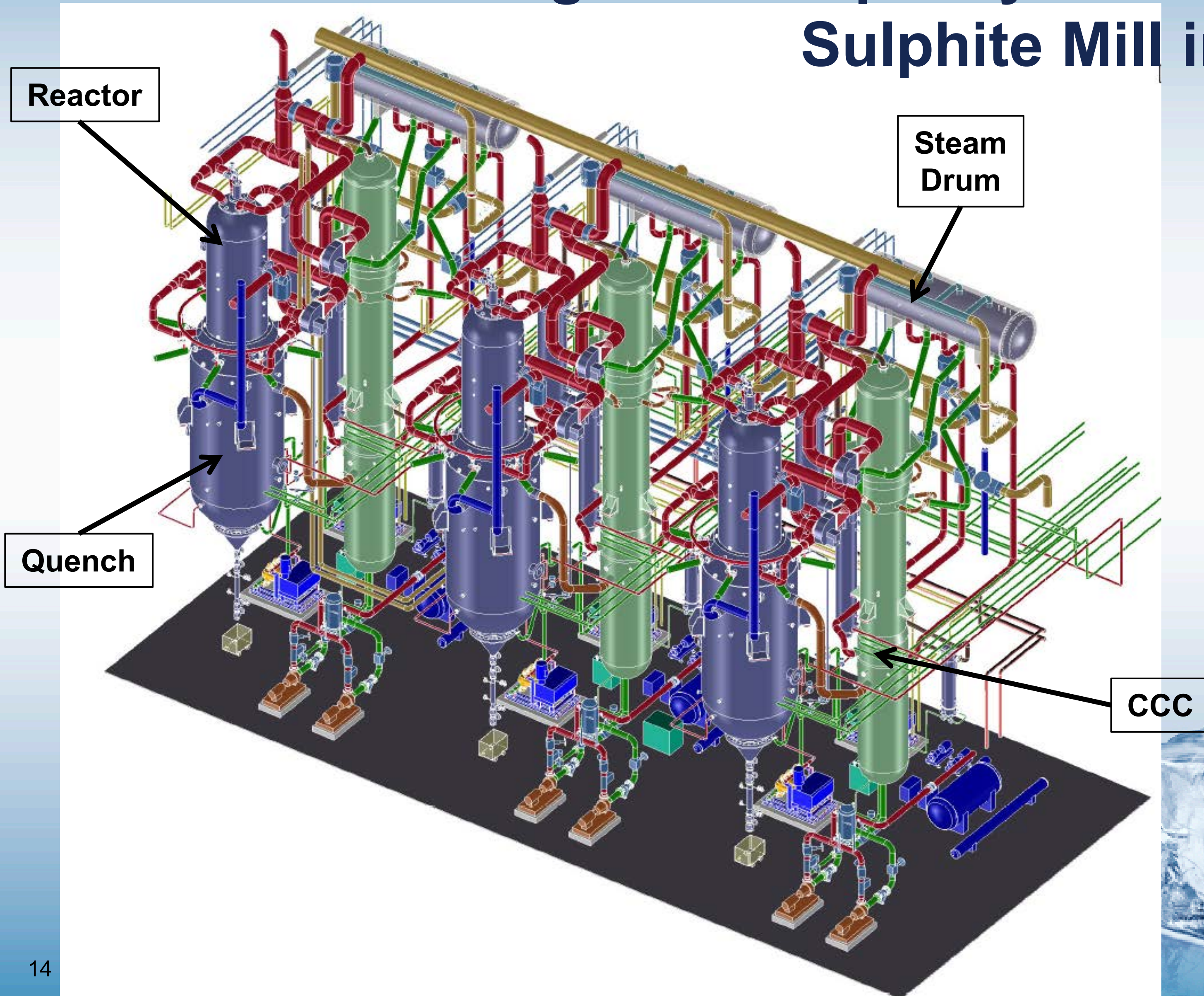
2011: Time for full scale demonstration. 3 x 50% gasifier capacity for the Domsjö Sulphite Mill in Sweden



Approx. 90 MW Feedstock per gasifier

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Why was the Domsjö project not completed?

1. **Secured funding**

   200 million EUR, more than half of 350 million EUR total project funding, arranged as follows:

   55 million EUR Swedish Energy Agency Grant, approved by DG Comp.

   145 million EUR Pledged by mill owner, EPC Contractor and Int. Oil & Gas major

2. **Missing funding**

   Debt financing of the remaining 150 million EUR prevented mainly due to lenders assessment of political risk:

- Swedish CO2 & Energy tax exemption for Biofuels only applicable 1 year at a time. Project finance requires min 3+10=13 year stable legal framework.
- Letter of Comfort required from Swedish Government did not provide clarity on long term regulations.

Summary: Lack of stable regulatory framework stopped the project!!

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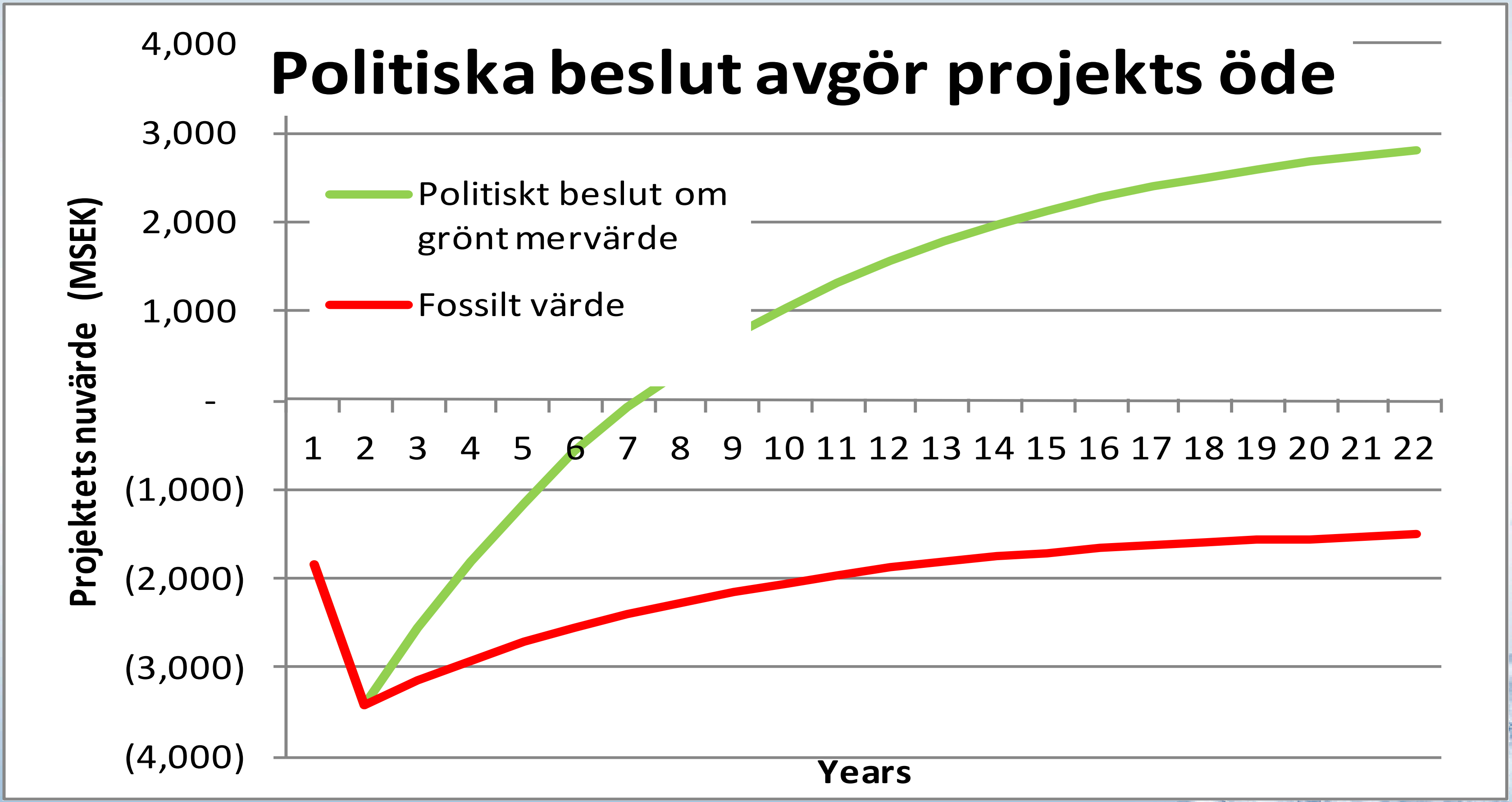
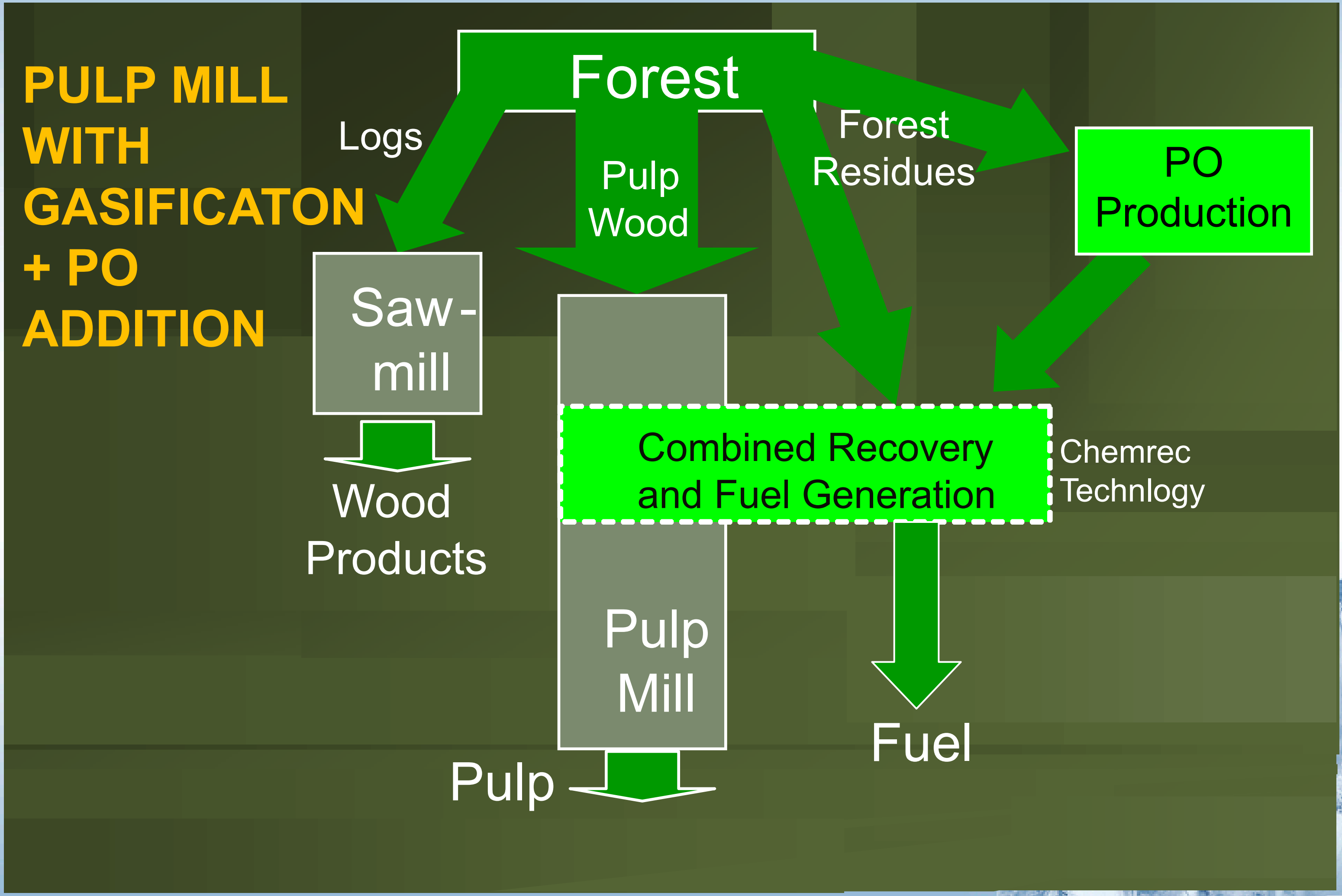
Lawmakers did not understand that political decisions ultimately and irrevocably determine the fate of Biofuel production projects.

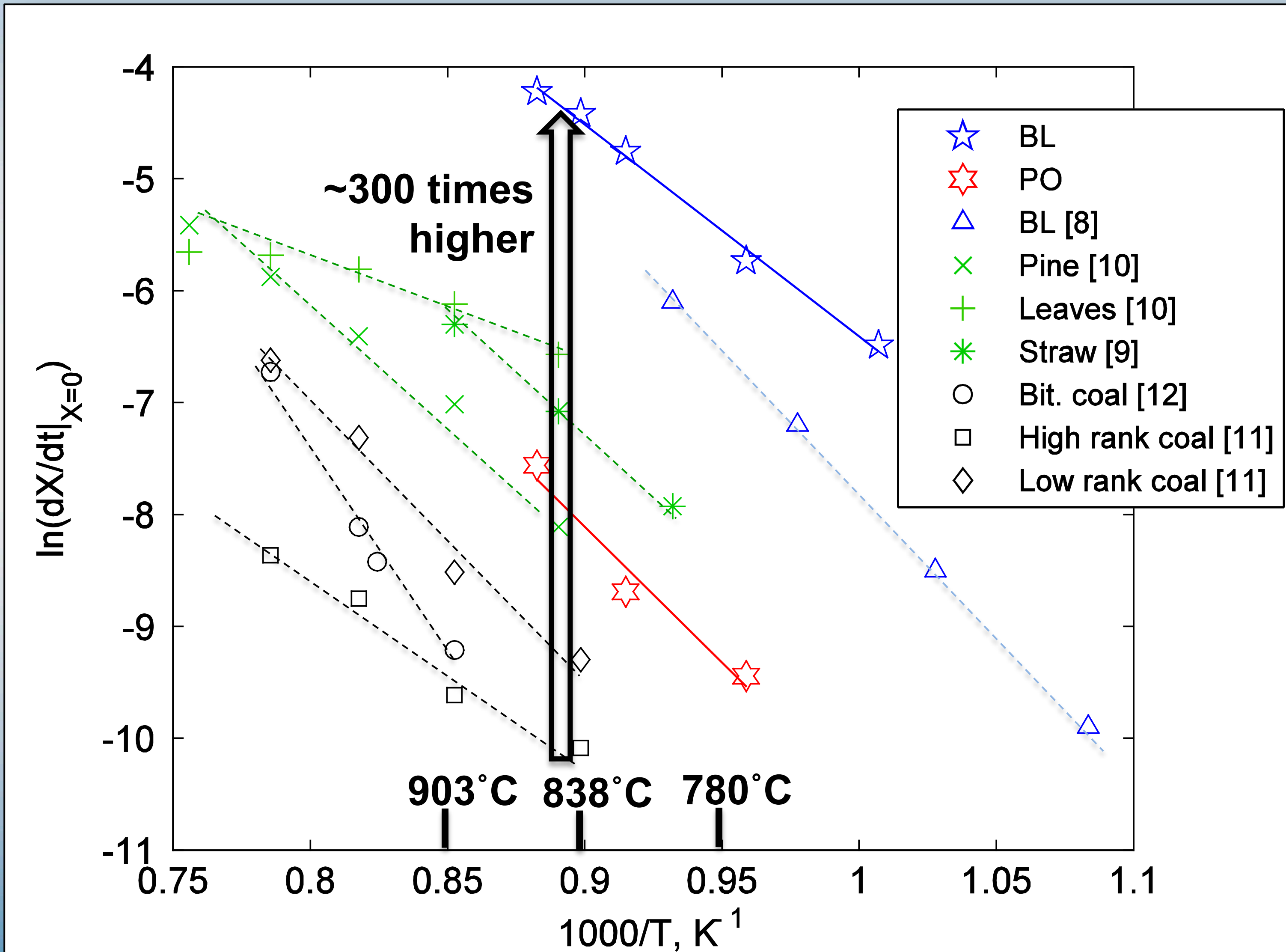


<u>Note:</u> 1st plant NPV (MSEK)
Investment ~ 350 MEUR

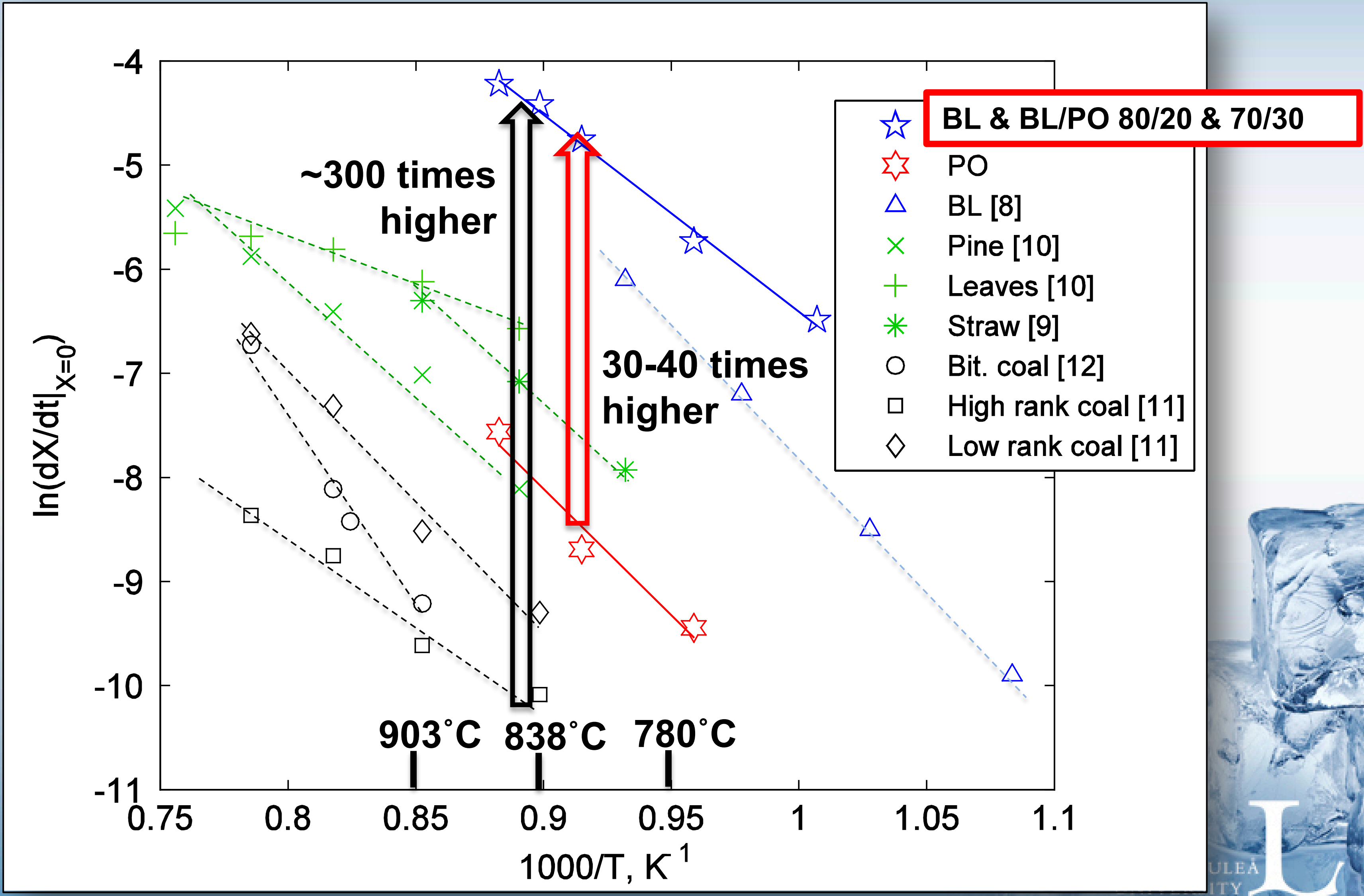
Biomass flow from the forest can be increased adding pyrolysis oil to the black liquor flow



Black liquor char has a very high reactivity compared to chars of other origin



When BL and PO are mixed the char from the mix gets the reactivity of BL



With about 25% of PO in the BL/PO mix syngas production is doubled

Capacity can be increased up to 100% by adding about 25% PO to the BL (by weight)

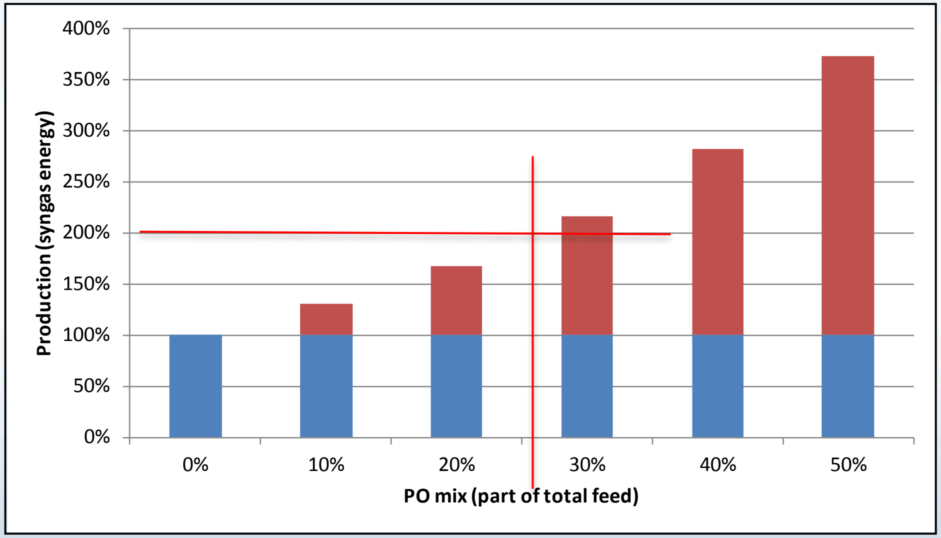


Figure shows simulated increased production of final liquid biofuel product at fixed BL feed (i.e. for specific mill)

Energy efficiency for gasification of added PO is 80-85%

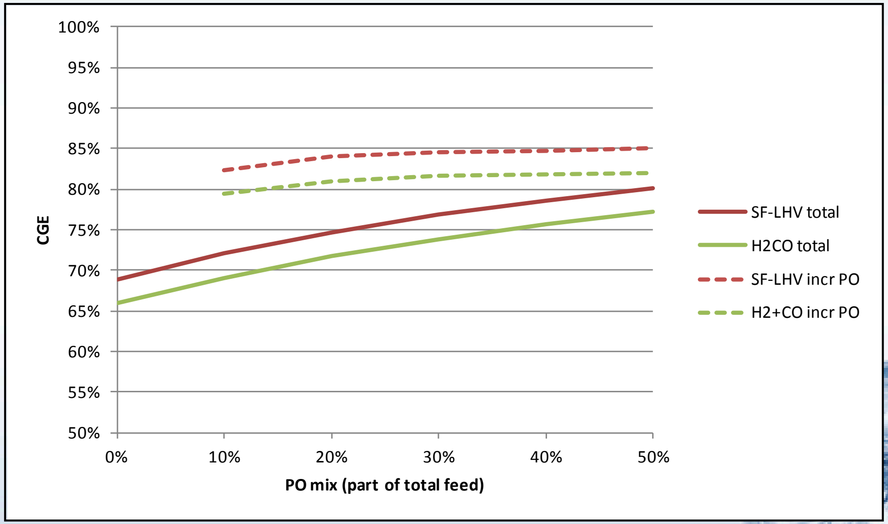


Figure shows simulated gasifier energy efficiency of total mixed feed (solid) and for added PO (dashed)

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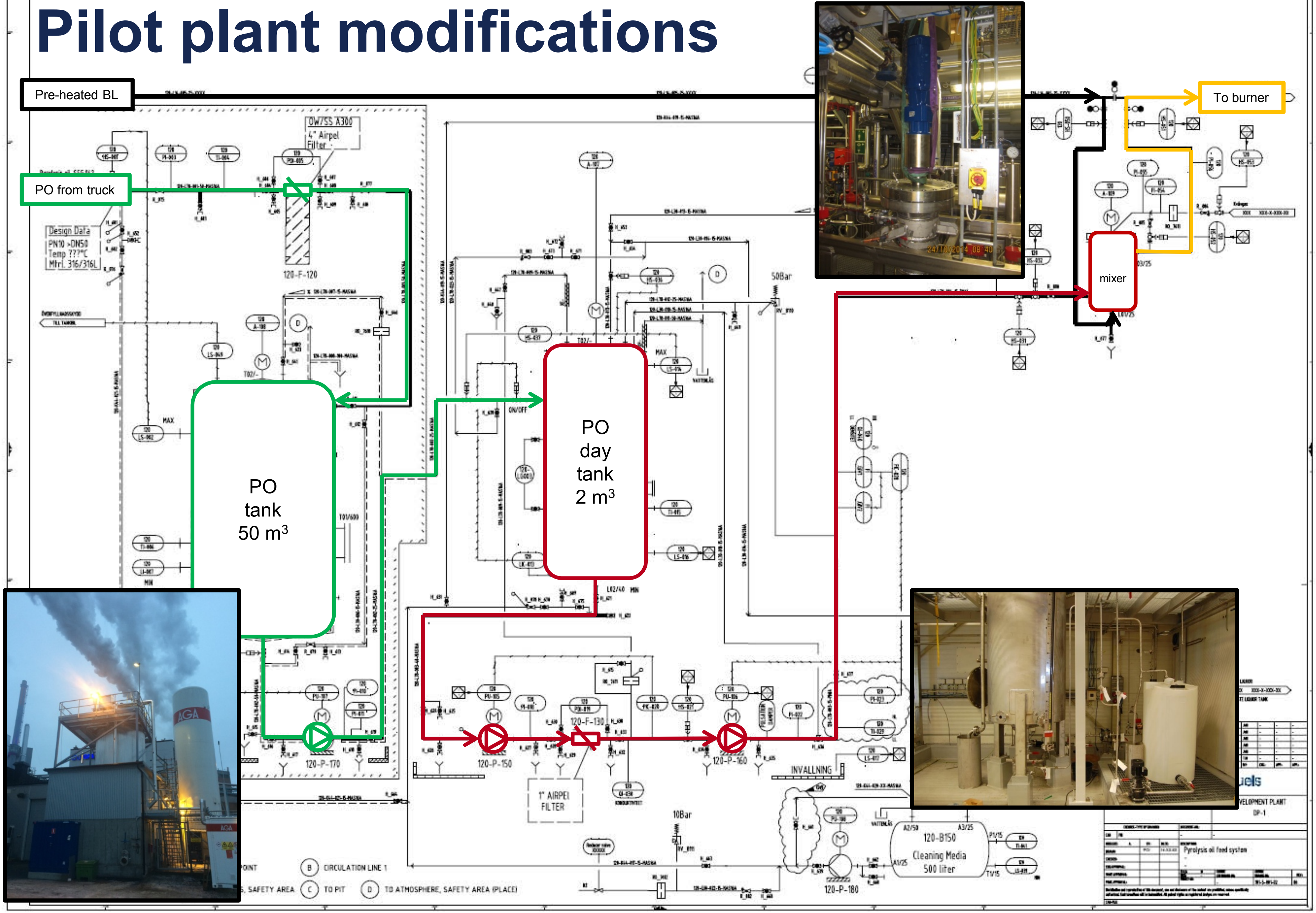
Pilot plant modifications



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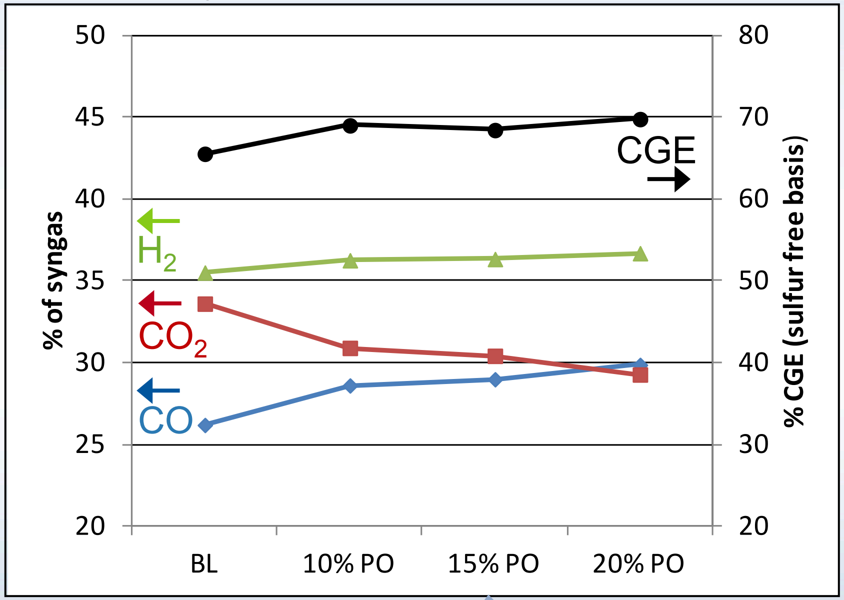
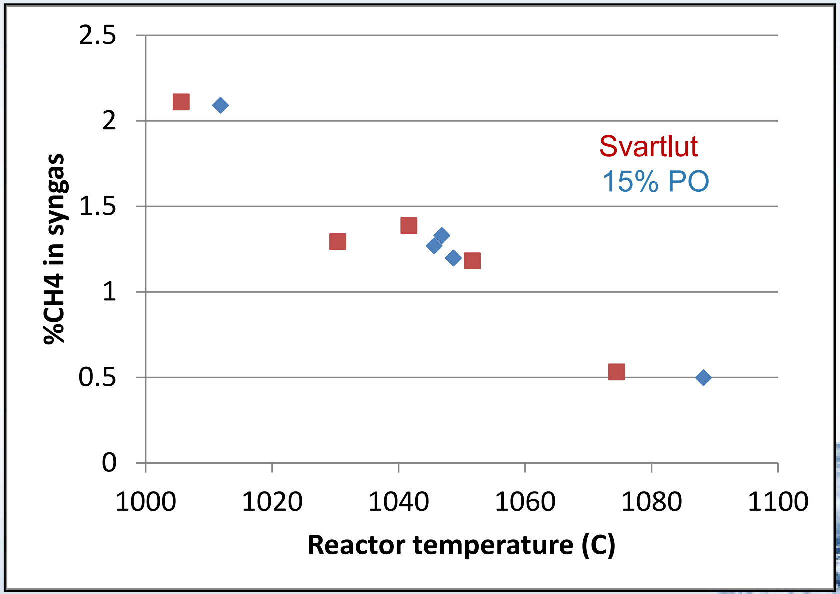
Pilot plant performance

Efficiency increases



1.3% CH_4
1.5% N_2
1.4% H_2S
114 ppm C_6H_6
11 ppm C_2-C_3

Very similar temperature



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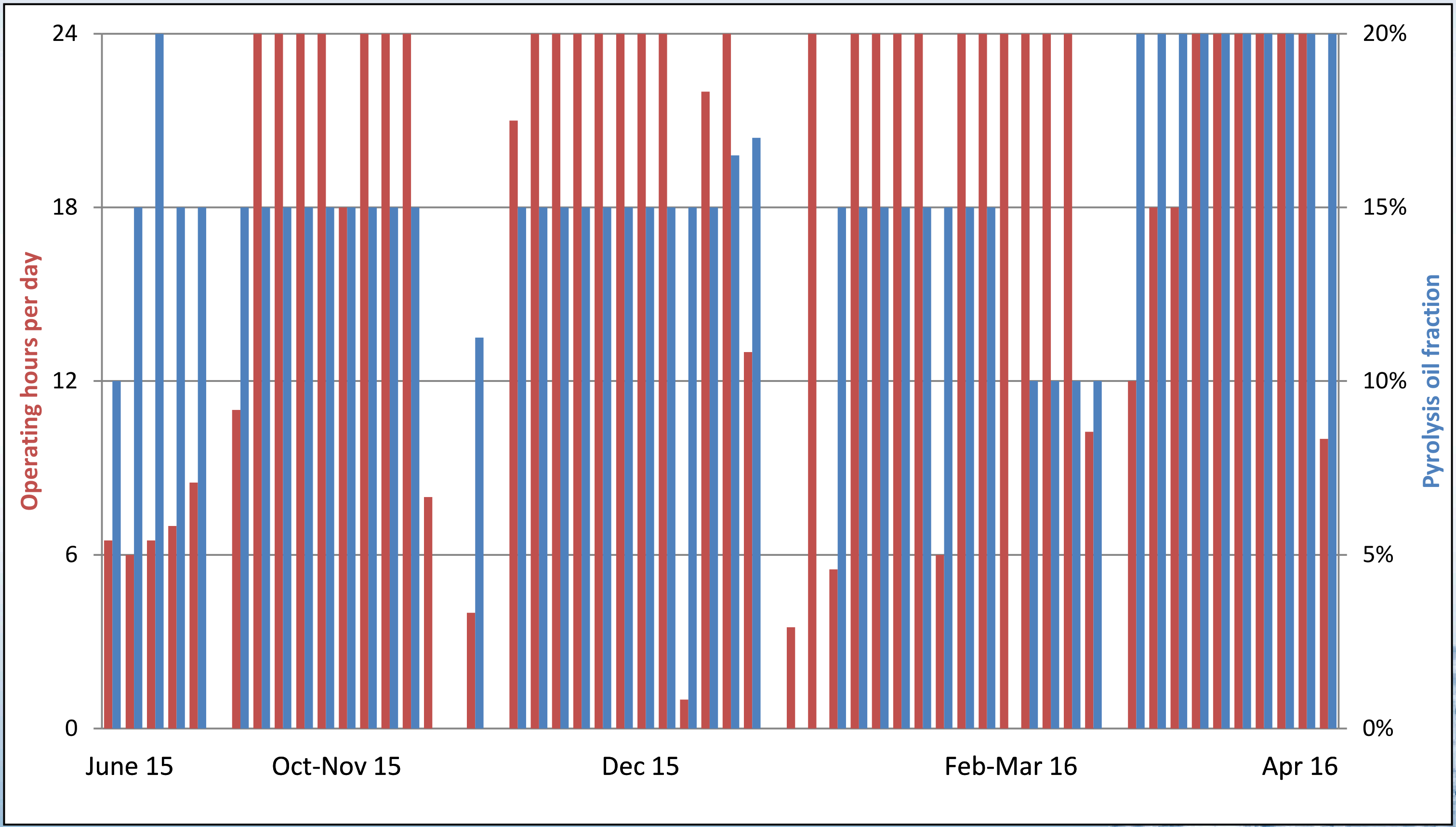
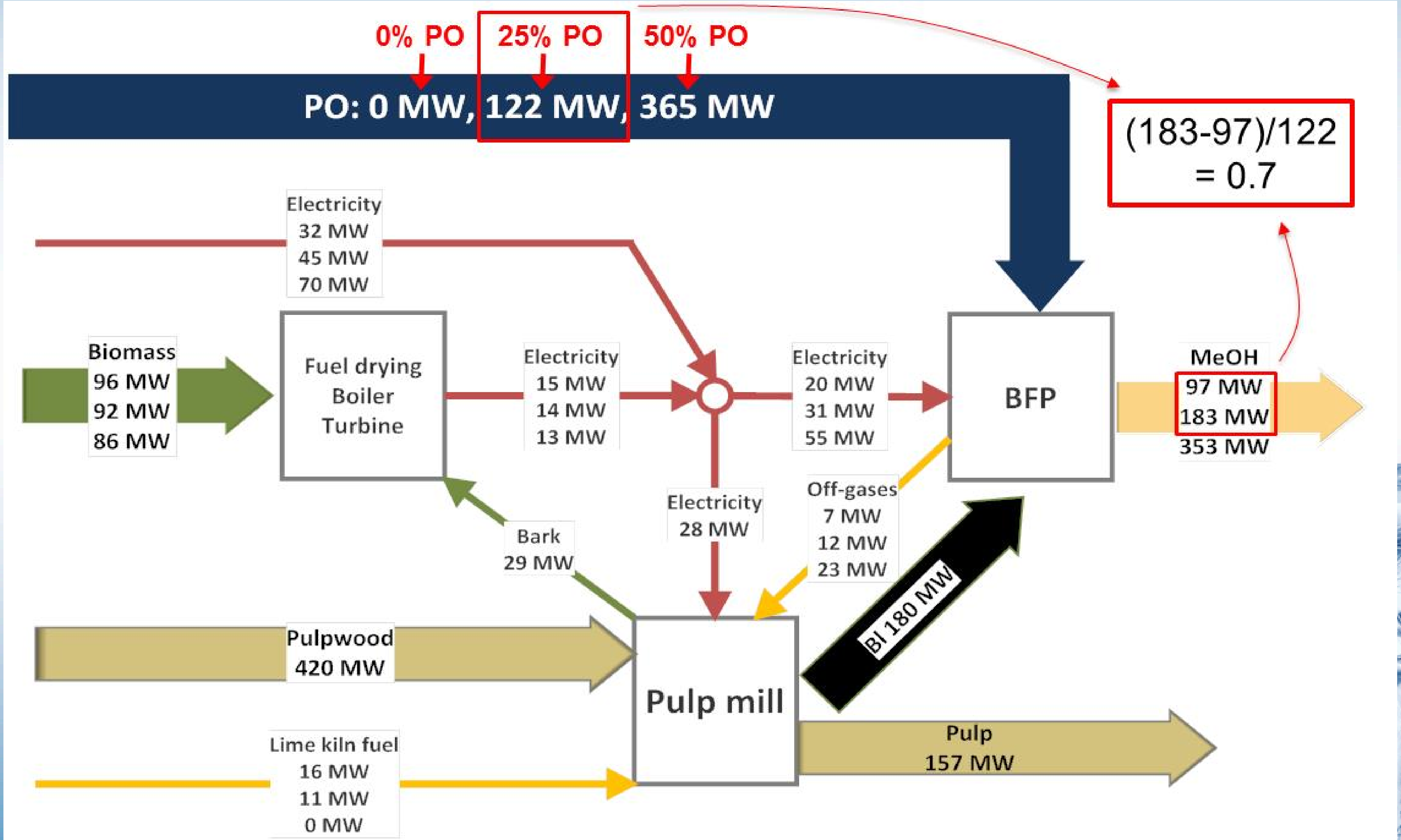
Pilot plant demonstration

Total: ~1100 h (900 h with MeOH/DME), 170 ton PO



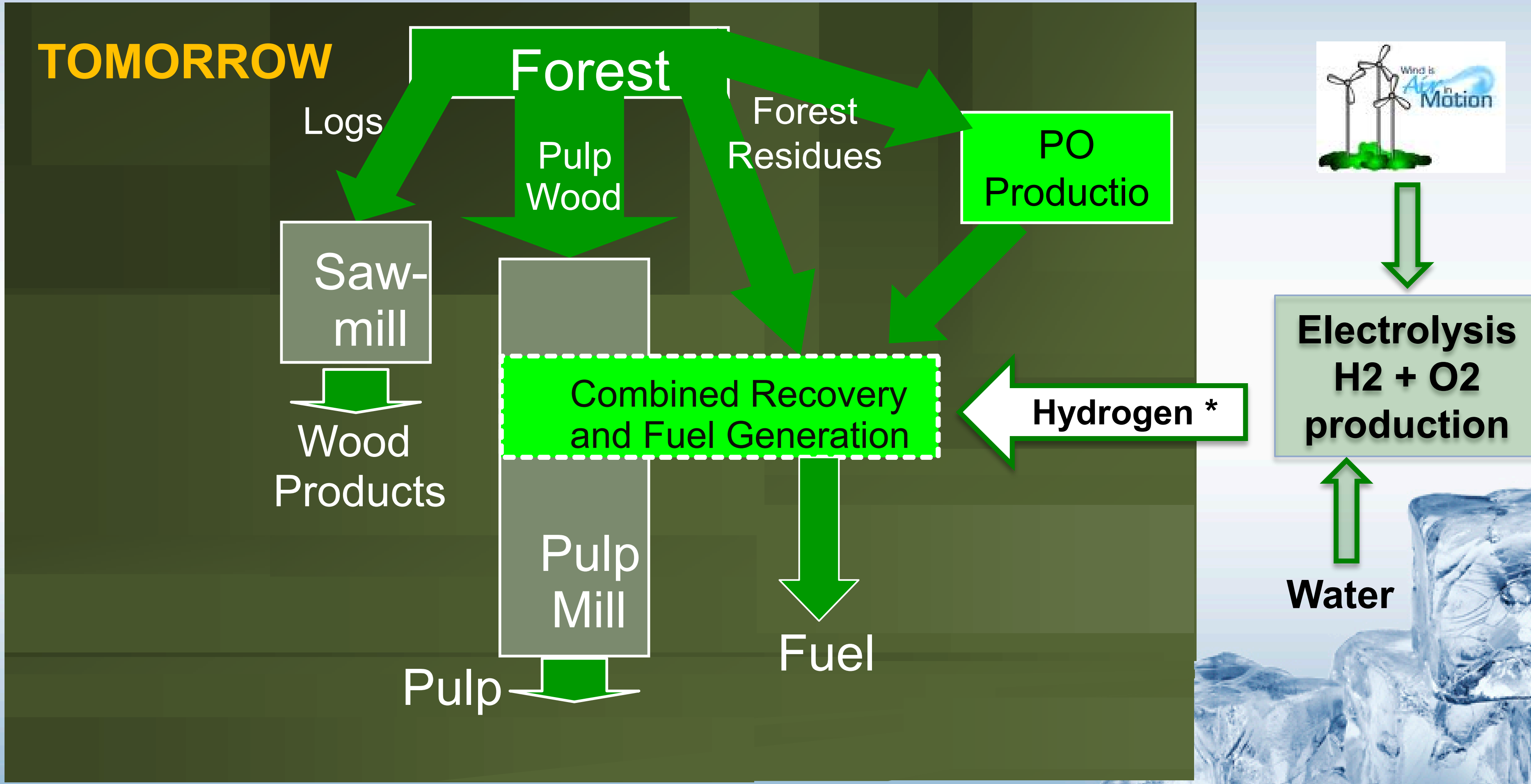
Material and energy balances



OF TECHNOLOGY

Biomass flow from the forest can be increased adding hydrogen from renewable power

(*true for any type of gasification based process*)



* Plus Oxygen for gasification

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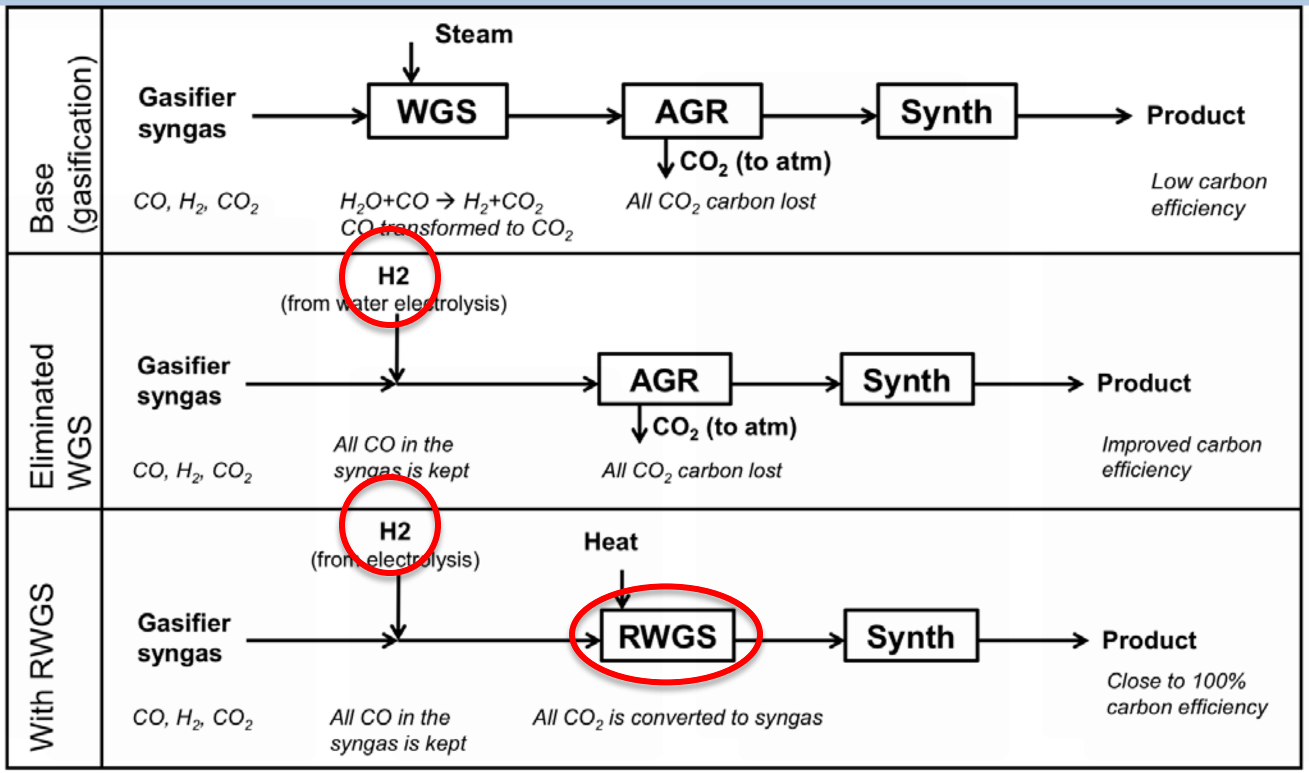
Power-to-liquids in a biorefinery



Base case

Hydrogen addition
60% improvement

Reverse shift
150% improvement

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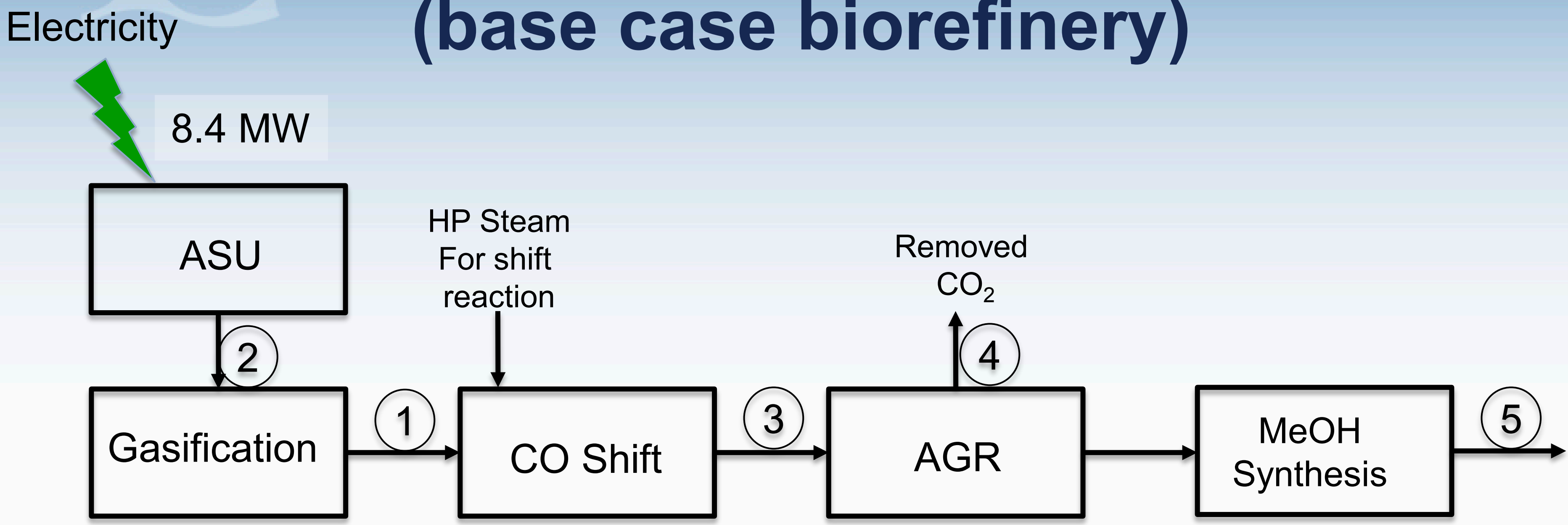
Main Process Blocks (base case biorefinery)



Kompo-nent	(1) Rågas, Nm3/h	(2) Oxygen	(3) Shifted Gas MW	(4)Removed CO_2 Nm3/h	(5) MeOH, MW / Ton/h			
H_2	22351 (67MW)		128,1 MW	CO_2 16819	102.5 / 18.6			
CO	19416 (67,9 MW)							
O_2		12874						

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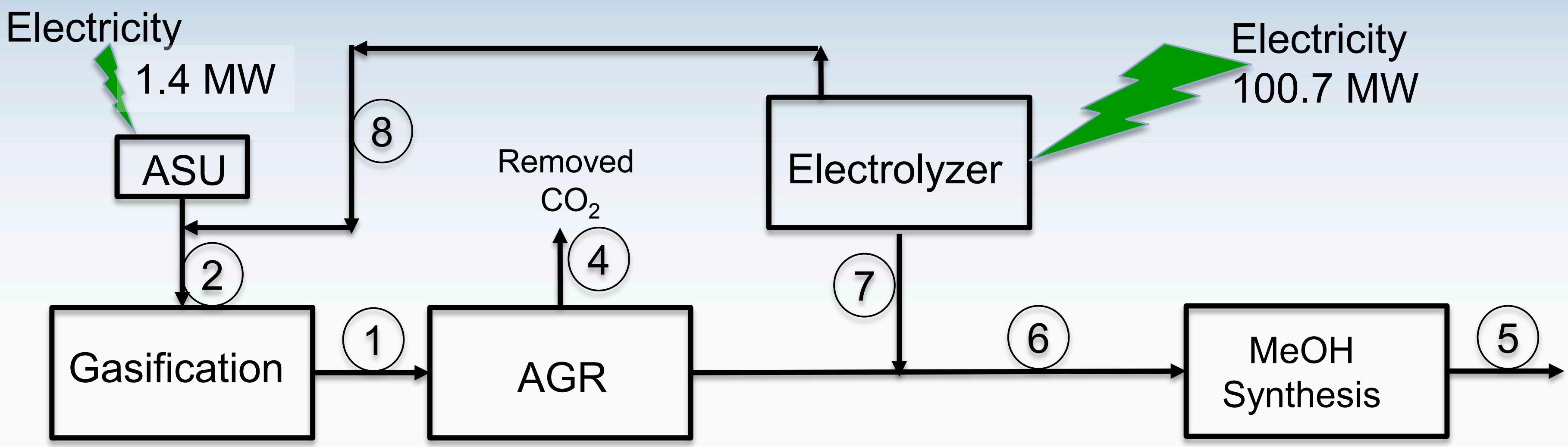
Main Process Blocks (Power to Liquid Case)



Kompo-nent	(1) Rågas, Nm3/h	(2) Oxygen	(3) Shifted Gas MW	(4)Removed CO_2 Nm3/h	(5) MeOH, MW / Ton/h	(6) Gas after H_2 injektion, Nm3/h	(7) Added H_2, Nm3/h	(8) Added O_2, Nm3/h
H_2	22351 (67MW)		----	CO_2 11412	159.3 / 28.9	43775 (131,2 MW)	21424 (64,2 MW)	
CO	19416 (67,9 MW)					19416 (67,9MW)		
O_2		12874						10712

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Key conclusions

- **Increased production** from a given amount of feedstock: 159.3 / 102.5 x 100 = **55%**

- **Conversion efficiency** of hydrogen energy to methanol energy:

  100 x (159.3 – 102,5) / 64,2 = **88%**

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Cost of power in the Hydrogen cost

Power price 60 €/MWh

Cost of power in the hydrogen production cost then becomes 60 / 0.685 = **88€ / MWh ***

Power price 45 €/MWh

If average power price is 45€ / MWh the corresponding cost element is ***66 €/MWh ****

**** Regarding Oxygen***

Hydrogen costs are credited for the oxygen supplied to gasification

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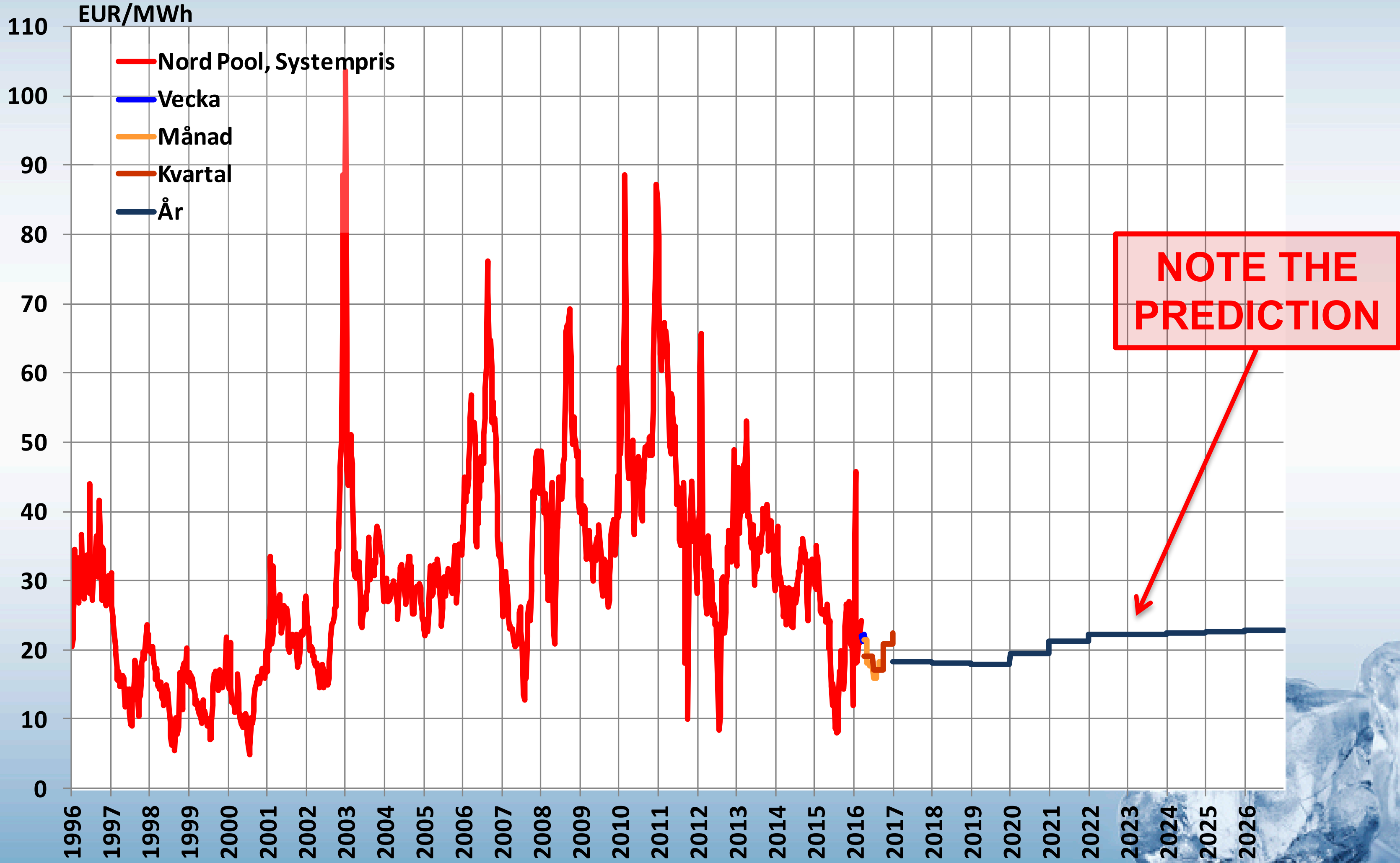
Spot Price Power in Nord Pool

Source: Nord Pool Spot, Nasdaq/OMX Commodities, Svensk Energi



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Cost of power in the methanol production cost

- If Power price average is 45€ / MWh then the cost of power in the methanol production cost is 45 / 0.685 / 0.8 = **82 € / MWh.**
- If Power price average is 25€ / MWh then the cost of power in the methanol production cost is 25 / 0.685 / 0.8 = **46 € / MWh.**

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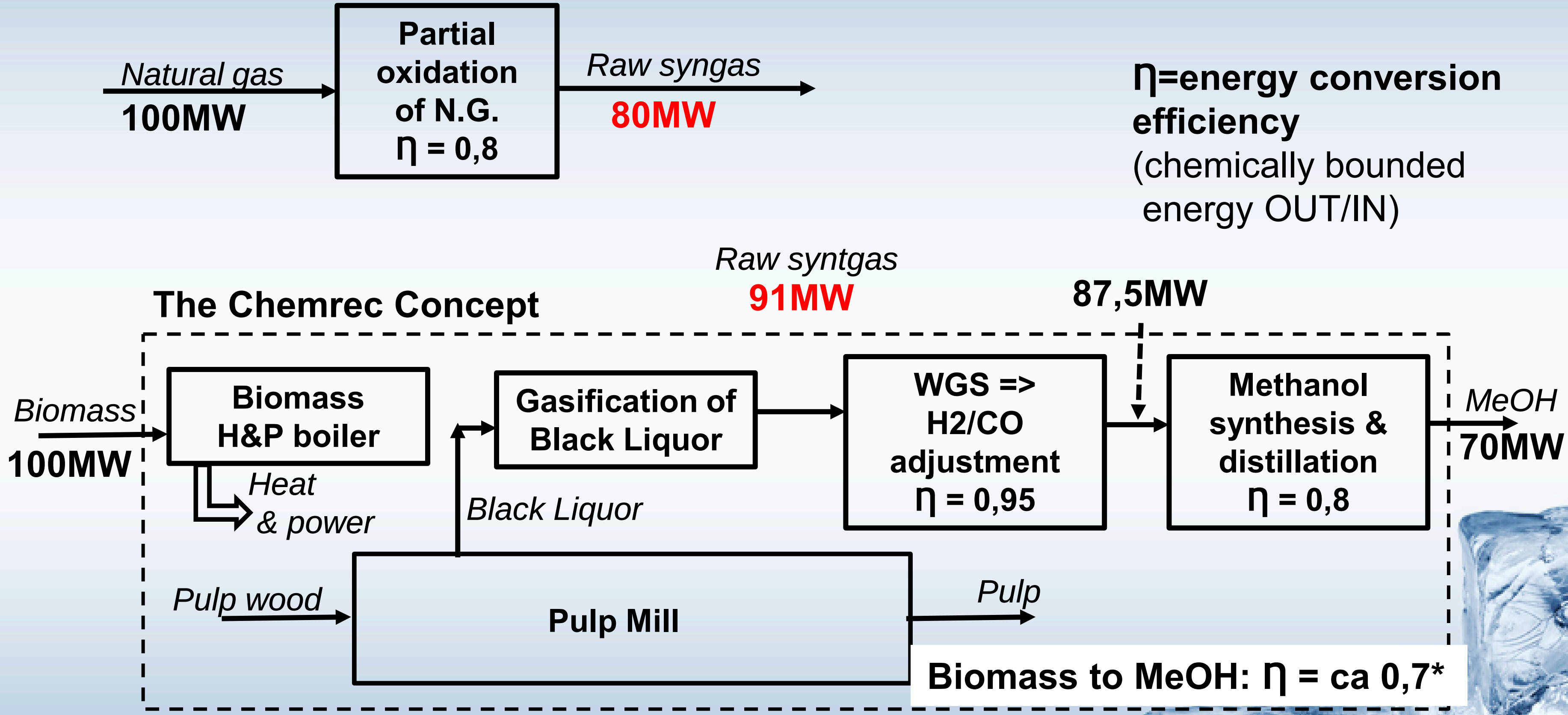
Raw syngas from natural gas and biomass respectively utilizing black liquor in pulp mills (energy balances)



- Se e.g.. http://www.princeton.edu/pei/energy/publications/texts/Princeton-Biorefinery-Study-Final-Report-Vol.-1.pdf p. 56
  - http://www.chemrec.se/admin/UploadFile.aspx?path=/UserUploadFiles/2003 BLGMF report.pdf p 111

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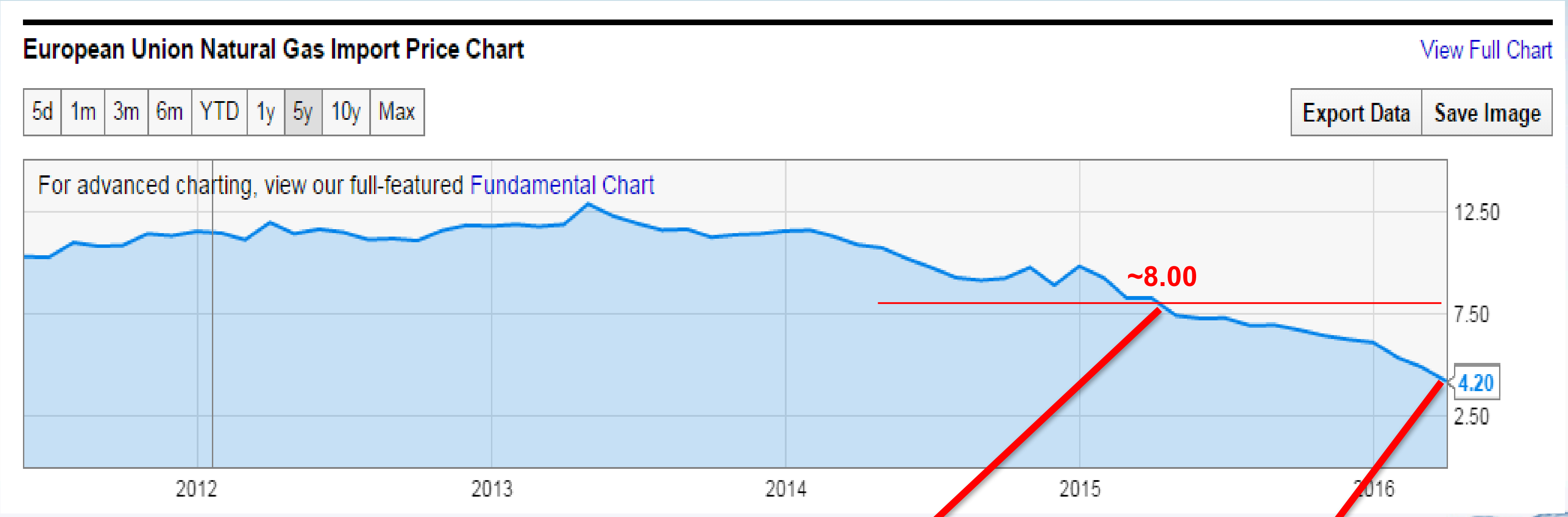
European Union Natural Gas Import Price

(USD/MMBtu)



1 MWh = 3,4095 MMBTU
EUR/USD = 1.12

2.4 €cent/kWh

1.3 €cent/kWh

Source: [*https://ycharts.com/indicators/europe_natural_gas_price*](https://ycharts.com/indicators/europe_natural_gas_price)

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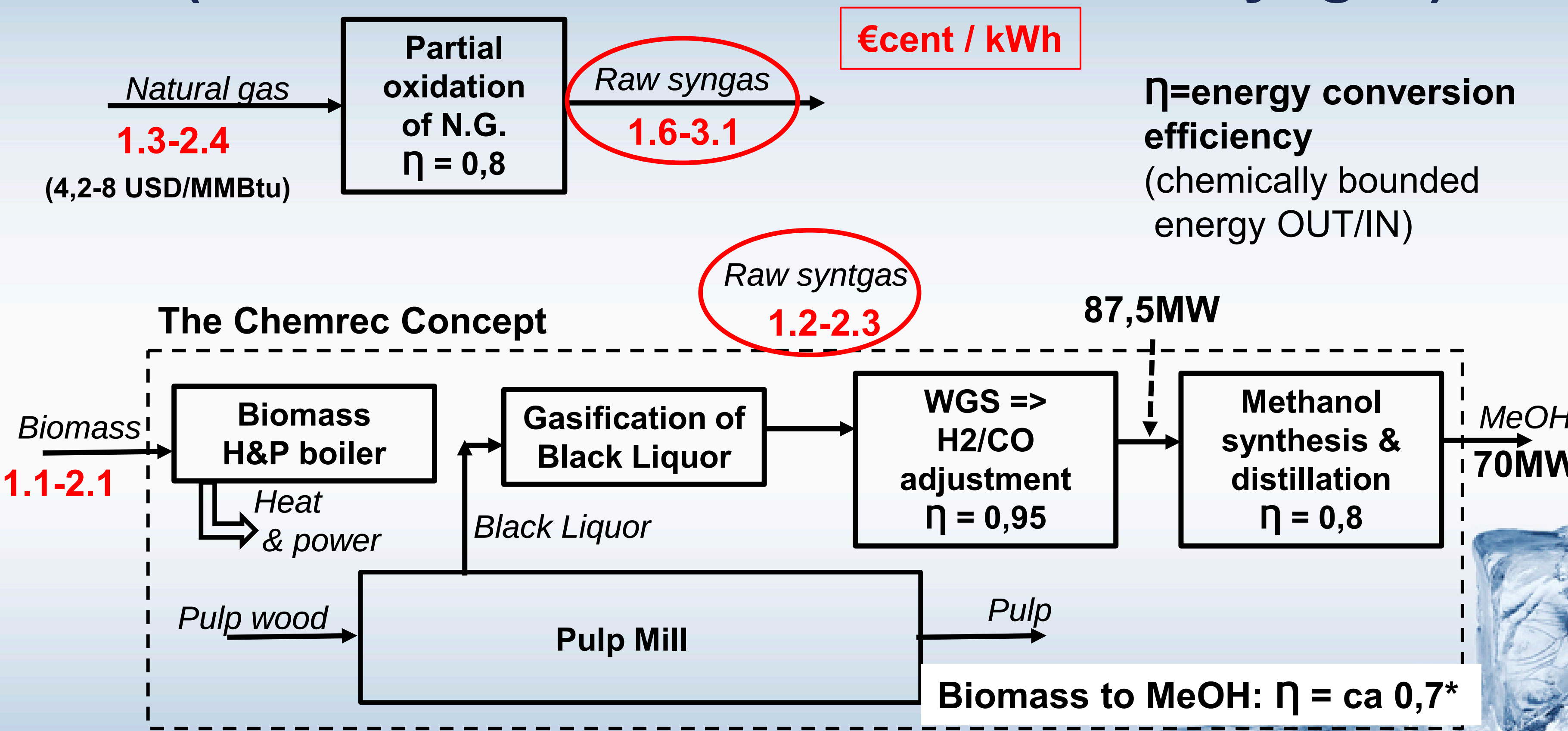
Raw syngas from natural gas and biomass respectively utilizing black liquor in pulp mills (Cost of feedstock vs cost of raw syngas)



- Se e.g.. http://www.princeton.edu/pei/energy/publications/texts/Princeton-Biorefinery-Study-Final-Report-Vol.-1.pdf p. 56
  - http://www.chemrec.se/admin/UploadFile.aspx?path=/UserUploadFiles/2003 BLGMF report.pdf p 111

Methanol production potential from EU Black liquor (BL) capacity combined with addition of Pyrolysis Liquid (PL) and electricity (non-biobased) NOTE: Approximate calculation only

	TWh/y	Toe/y	% of EU estimate* of transport fuel in 2030 (350 Mtoe)	Biomass required TWH/y
BL in Europe	140	--	--	---
MeOH fr BL in Europe	77	6,7	1.9	110
PL part 25% in BL + PL: Production x 2	155	13,4	3.8	240
PL part 50% in BL+PL: Production x 3	230	20	5.7	365
Add H2 instead of WGS shift process	370	32	9.1	365
Add H2 and use reversed WGS	580	50	14.3	365

* https://ec.europa.eu/energy/sites/ener/files/documents/trends_to_2050_update_2013.pdf

The best way to make renewable fuels happen would be to ….
(from Keynote EU BC&E conf. 2013 in Copenhagen)

1. **Accept that renewable fuels cannot be introduced without a <u>long term</u> incentive (> 10 years)**
2. **<u>Agree on support level</u> on an energy basis e.g.**

   - Advanced Biofuels will be priced double cost of fossil (a minimum fossil price level needed) for the first demonstration like 100 €/MWh when fossil price is 50 €/MWh

With these two requirements in place

- there will be plants built.

- The risks associated with new technologies will be carried by the investors.

- Technology barriers will be resolved / removed!

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If nothing happens:

(from Keynote EU BC&E conf. 2013 in Copenhagen)

If the above does not materialize the risk is big that developers and their financers leave the green fuels business for an indefinite time period. This has major consequences like

- **Built up knowledge disappears**
- **Key individuals change work focus**
- **IPR portfolios loose value**
- **Time to get up and running again will be long**
- **Etc**

This scenario is a not unlikely and a real threat to continued R&D efforts.

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Research partners and sponsors from 2005 until today

THANK YOU!