Designing the bio-based economy
Options for Norway?

2 September 2015
Status of the Bioeconomy, Oslo

Michael Carus, Physicist
(Managing Director)
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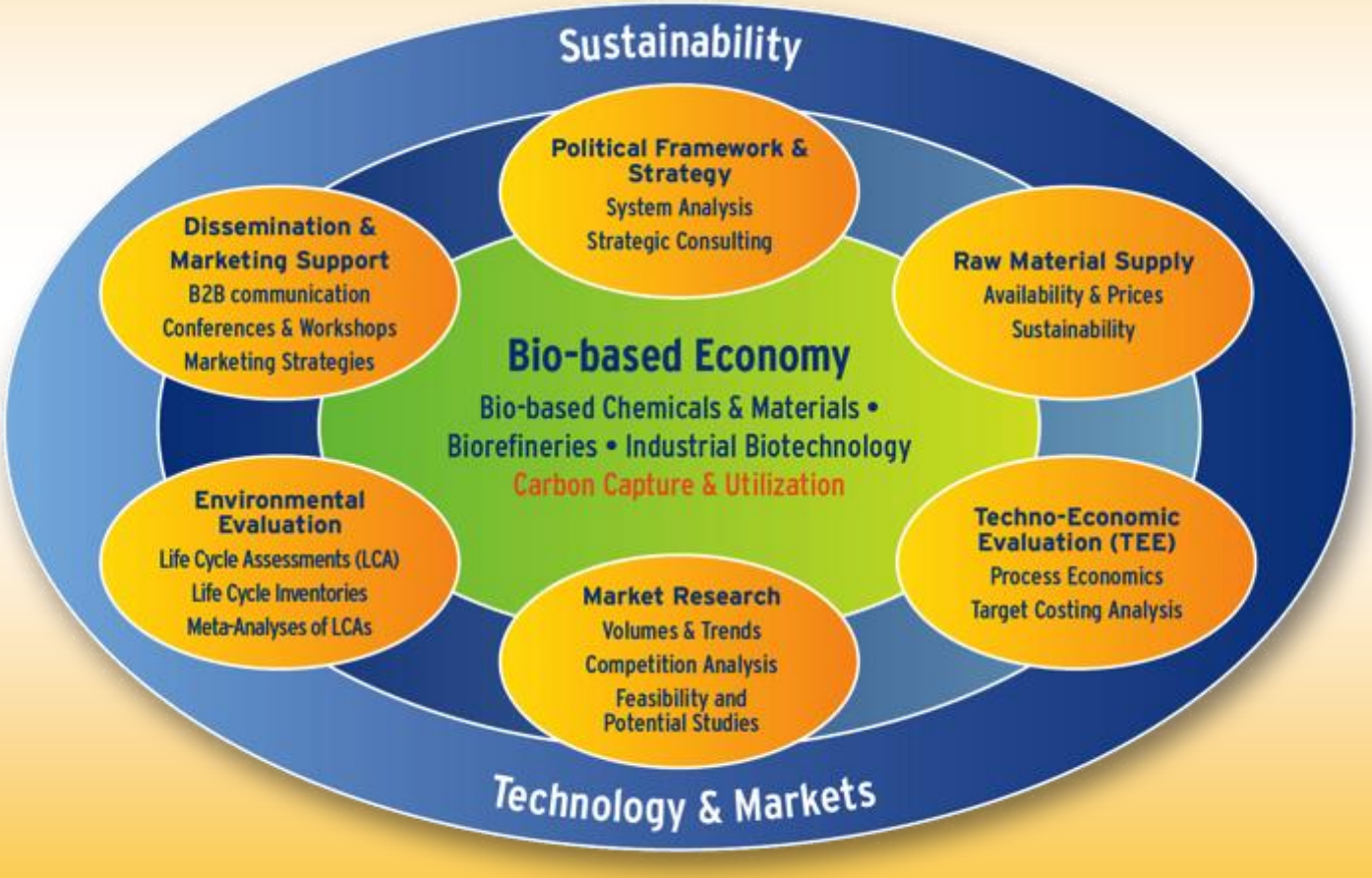
Bio-based Economy – Bio-based Chemistry and Materials

- Raw Material Supply
- Techno-Economic Evaluation
- Market Research
- Environmental Evaluation
- Dissemination
- Political Framework & Strategy

nova-Institut GmbH – SME

Revenue shares

- Research Projects
- Conferences & Dissemination
- Industrial & Political Consultancy



Facts and Figures about nova-Institute

- Founded 1994 as a private and independent research institute
- 25 employees – interdisciplinary, international team
- Turnover of over 2 Mio. € / year
- Member of various associations & committees

  CEN/TC 411, “Bio-based Expert Group” in DG Enterprise & Industry, technical group of the “bio-based panel” and advisory board of CLIB2021

Selected customers from industry, associations and public as well as political institutions

Automotive Industry: Brose, BMW, Mercedes/Daimler, Dräxlmaier, Faurecia, Ford, Johnson Controls, Quadrant, VW

Chemistry, plastics and other materials: Arizona Chemical, BASF, Corbion, ESE Expert, Evonik, FKuR, GreenFuture, Honeywell, IKEA, InfraServ, KOSCHE, LEIFHEIT, LOGOCOS, Teijin

Engineering: Coperion, FERROSTAAL, Reifenhäuser, Uhde-Inventa Fischer

Consulting: AFC Consulting (DE), BLEZAT CONSULTING (FR), Clever Consult (BE), ClouPartners (DE), Ernst & Young (FR/DE), KPMG (MY), meó Consulting (DE)

Associations / Clusters/ NGOs: AVK, CEFIC, CLIB2021, European Bioplastics, EIHA, IAR, VHI, WWF

Ministries & Institutions: BfN (DE), BMELV (DE), DBU (DE), DEFRA (UK), DECC (UK), European Commission, FAO, FNR (DE), GIZ (DE), KfW (DE), NIA (TH), UBA (DE), Netherlands Enterprise Agency (NL), Ministry of Economic Affairs (NL)

Research Institutes: Fraunhofer UMSICHT (DE), HS Bremen (DE), IFEU (DE), INRA (FR), INNVENTIA (SE), Joint Research Centre (EU), London Imperial College (UK), Öko-Institut (DE), RAPRA (UK), VTT (FI), Wageningen UR (NL), Wuppertal Institut (DE)

Projects funded by the European Commission

Projects within the FP7 funding programme

- **BIO-TIC** – The Industrial Biotech Research and Innovation Platforms Centre – towards Technological Innovation and solid foundations for a growing industrial biotech sector in Europe: Roadmapping for a bio-based economy, identification of hurdles and network management. (08/2012 – 07/2015)
- **KBBPPS** – Knowledge Based Bio-based Products' Pre-Standardization: Development of a standardization of bio-based products, network management and dissemination. (08/2012 – 07/2015)
- **FIBRA** – EU-China Partnering on fibre crops: Network management, socio-economic and ecological assessment for the development of the natural fibre industry in China. (09/2012 – 11/2015)
- **MultiHemp** – Multipurpose Hemp: Techno-economic evaluation, life-cycle assessment (LCA) and dissemination for the development of a multipurpose hemp. (09/2012 – 02/2017)
- **SPLASH** – Sustainable Polymers from Algae Sugars and Hydrocarbons: Dissemination for a multinational project on algae biotechnology and product development. (09/2012-08/2016)
- **MIRACLES** – Multi-product Integrated bioRefinery of Algae: from Carbon dioxide and Light Energy to high-value Specialties. (11/2013 – 10/2017)
- **Open-Bio** – Opening bio-based markets via standards, labelling and procurement. (2013 – 10/2016)
- **IB2Market** – Bringing innovative industrial biotechnology research to the market. (12/2013 – 11/2015)
- **BIO-QED** – Quod Erat Demonstrandum: Large scale demonstration for the bio-based bulk chemicals BDO and IA aiming at cost reduction and improved sustainability. (01/2014 – 12/2017)

Projects within the Horizon 2020 Programme

- **COSMOS** – Camelina & crambe Oil crops as Sources for Medium-chain Oils for Specialty oleochemicals. (03/2015 – 08/2019)
- **InnProBio** – Forum for Bio-Based Innovation in Public Procurement. (03/2015 – 02/2018)

Projects within the WoodWisdom-Net Research Programme and ERA-NET Bioenergy

- **HEMICELL** – Wood based chemicals, in particular chemical modified hemicellulose, used as functional additives to enhance the material properties of cellulose esters. (04/2014 - 03/2017)

Service contracts for the European Commission

- **Cascades** – Study on Optimised Cascading Use of Wood. (03/2015 – 12/2015)

National projects

- **More resource efficiency through cascading use of biomass – from theory to practice**: Best practice analysis of existing cascades and development of recommendations for political and industrial stakeholders. (Funded by the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB), 07/2013 – 10/2016)

Bio-based Economy – Services of nova-Institute

www.bio-based.eu

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- **iBIB**
  International Business Directory for Bio-based Materials
- **About nova**
  Institute for ecology and innovation
- **Press releases**
  News from nova

CONFERENCES

- **8th International Conference on Bio-based Materials ("Biowerkstoff-Kongress")**
  Maternushaus, Cologne, 13 - 15 April 2015
- **Open-Bio Workshop on Instruments for the Public Procurement of Bio-based Products (Side event to the 8th International Conference on Bio-based Materials)**
  Maternushaus, Cologne, Germany, 14 April 2015
- **12th International Conference of the European Industrial Hemp Association**
  Rheinforum, Wesseling, 20 - 21 May 2015
- **Open-Bio Mid-term Advisory Workshop**
  CEN-CENELEC, Brussels, Belgium, 26 May 2015
- **KBBPPS Final Advisory Workshop**
  The King's Manor, University of York, York, UK, 2 June 2015

The most important service of nova-Institute:

Bio-based News

- Daily news on Bio-based economy world wide
- Free access!
- 2.000 readers every day

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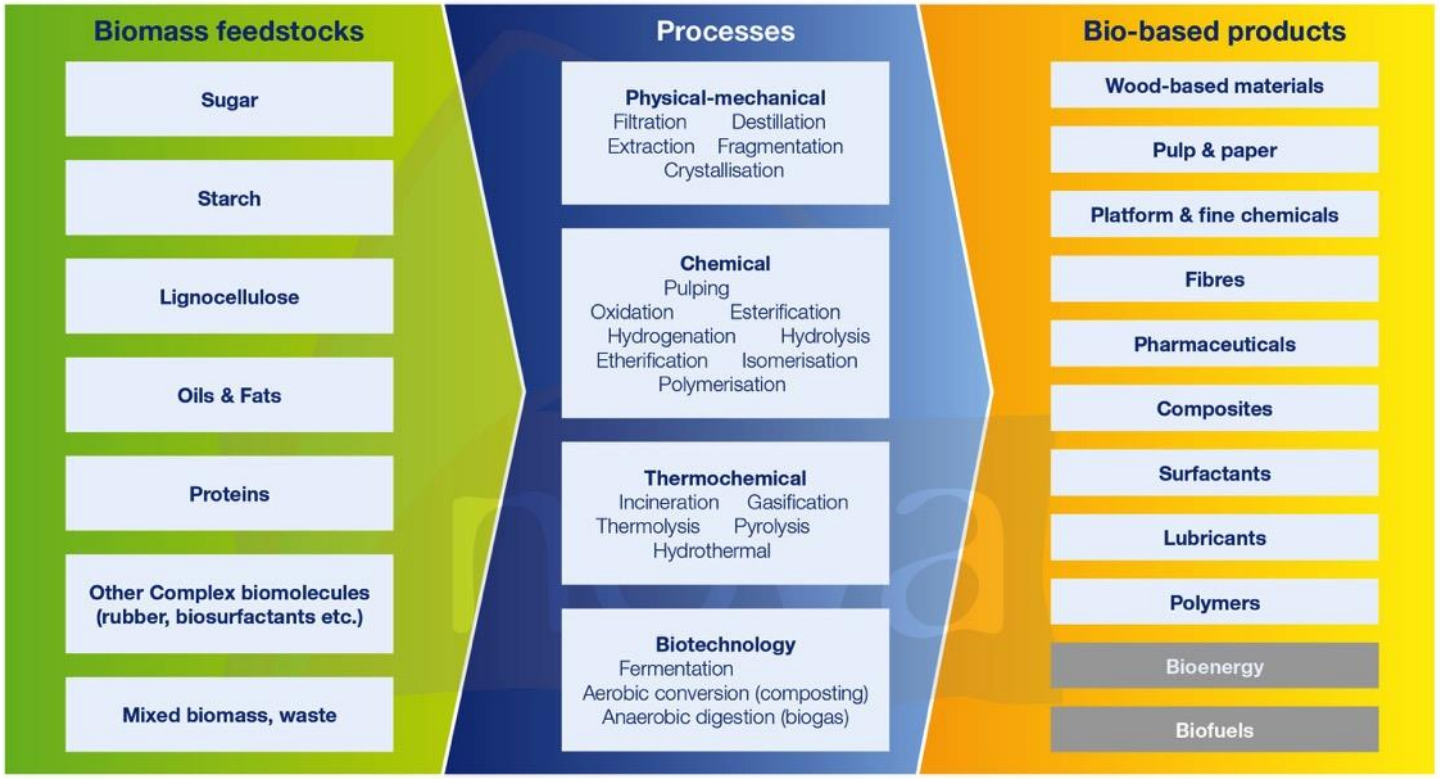
nova paper #6 on bio-based economy 2015-06

Options for Designing the Political Framework of the European Bio-based Economy

Including statement on the recent ILUC reform proposal and a list of market pull measures for bio-based products

Bio-based Economy: feedstocks, processes and products (without food & feed)



Which raw materials can be used in Norway? First ideas

- **Wood – spruce, pine and birch into cellulose fibres and bio-based chemicals and polymers**
- **Algae such as Kelp into fish feed, bio-based chemicals & polymers and more**
- **Chitin from shrimps and crabs into bio-based chemicals and polymers**
- **Fish waste via insects into fish feed (proteins) and protein-based chemicals and polymers**
- **Cheap hydro electricity to convert CO_2 into aviation fuels**

nova-Institute's Recommendation

Ligno-cellulosic biorefineries – which way to go?

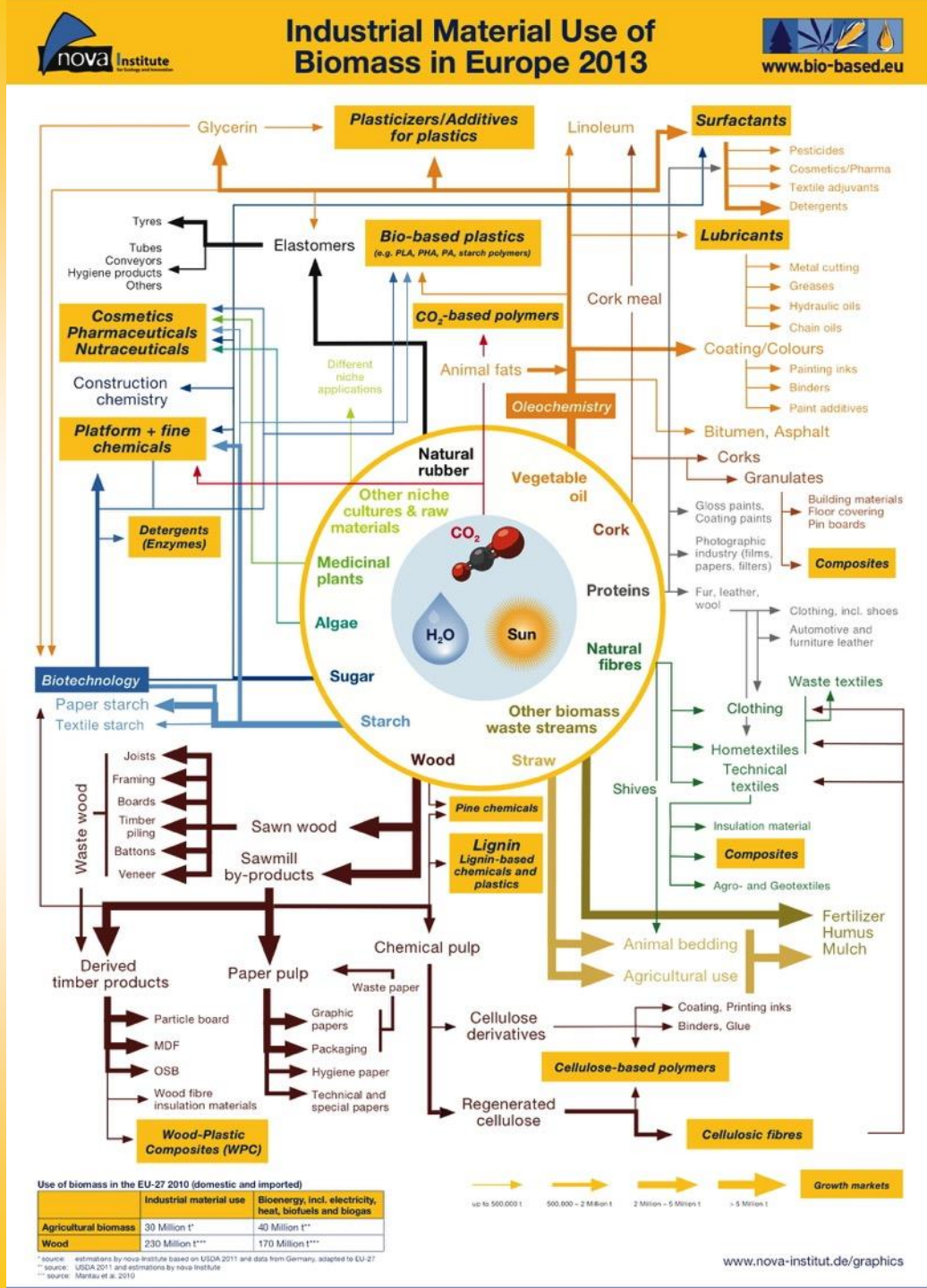
- EU commission and the EU member states have focussed mainly on those kind of ligno-cellulosic biorefineries which produce from woody biomass C5/C6 sugars for fermentation and Lignin. Is this the right way?
  - These biorefineries produce high-priced sugars compared to sugar beet and try to level this by lignin utilization, which did not work so far.
  - Depending on long time subsidies especially if bioethanol is the target product.
  - High volumes > 2 Million t of woody biomass seems to be necessary for economy of scale, which cannot locally covered.

- We think other types of biorefineries would be more suitable to Norway
  - Extraction of high value components
  - Producing cellulose fibre for the textile and other markets
  - And high-value chemicals which different kind of processes (not only biotechnology)
  - With Borregard Norway has the world leading company for getting value from a wood-based biorefinery!

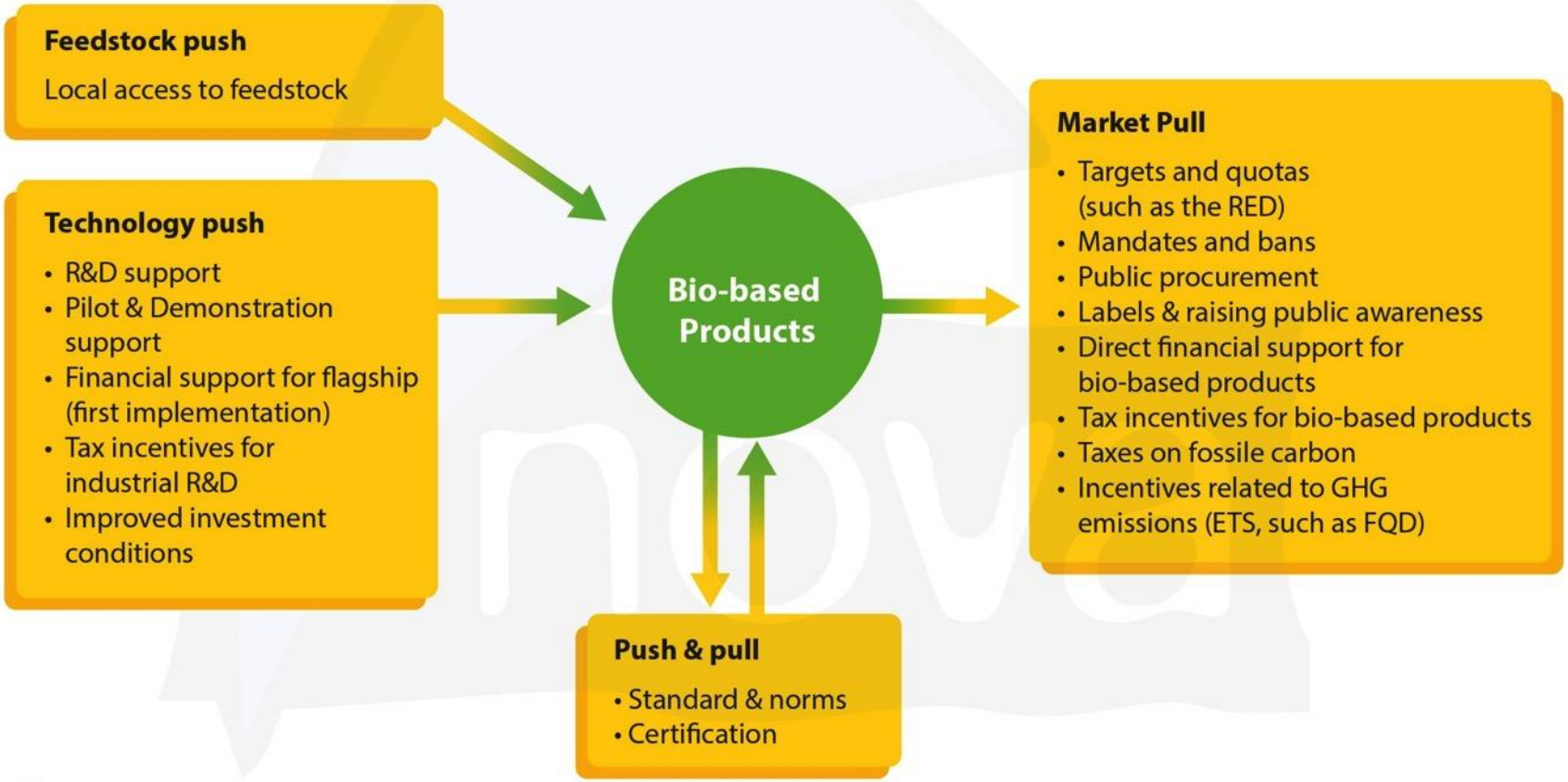
Bio-based Products = Industrial material use covers a range of industries

In 'material use' biomass serves as a raw material for the production of all kinds of goods, as well as their direct use in products. This distinguishes it from energy use, where biomass serves purely as an energy source, and the use for food and feed purposes.

(Carus et al. 2010)



Instruments to strengthen innovation implementation by technology push and market pull (nova 2014)



Note: **RED** Renewable Energy Directive | **GHG** Greenhouse gas | **ETS** Emission Trading System | **FQD** Fuel Quality Directive

Creation of a positive environment

As long as bio-based products are more expensive than petrochemical products – because of lower volumes and higher raw material costs – **there is a need for market pull as created by incentives and mandates, or at least a positive image is needed**. A positive environment is necessary to achieve GreenPremium prices for bio-based products (Carus, Eder & Beckmann 2014).

Both options need a **real political commitment to the bio-based economy, to the transformation from a fossil to a bio-based raw material supply**. This requires more than another roadmap and an additional research agenda. Surveys show that consumers have positive connotations with bio-based products – this should be supported and not undermined.

The **framework of the European Union** and its member states was not very suitable for developing a bio-based economy (CAP, RED, FQD).

Creation of a positive environment

A market pull from the political framework is more important than a complex Bioeconomy Roadmap – see for example Italy! No roadmap but implementation!

Member	Name of Strategy	Main Actors	Key Funding Areas
Canada	Growing Forward	Ministry of Agriculture	R&D on renewable resources and biobased materials, Bioenergy
EU	Innovating for Sustainable Growth	DG Science, Research, Innovation	Research & Innovation (Horizon 2020), Public-Private-Partnerships
France	bundle of BE-relevant policies	Ministry for Ecology, Ministry for Research	Bionergy, green chemicals, clusters, circular economy
Germany	1. Research Strategy BE 2. Policy Strategy BE	1. Ministry for Research 2.Ministry for Agriculture	R&D on food security, sustainable agriculture, healthy nutrition, industrial processes, bioenergy
Great Britain	bundle of BE-relevant policies	Parliament, Depts: Energy & Climate, Environment, Transport, Business	Bioenergy, agri-science and -technology
Italy	no specific BE policy	–	Participation in EU programmes
Japan	Biomass Utilization and Ind. Strategies	Cabinet, National Biomass Policy Council	Research & innovation, circular economy, regional development
United States	1. Bioeconomy Blueprint 2. Farm Bill	1. White House 2. USDA	1. Life Sciences (Biomedicine) 2. Agriculture (multiple areas)

Latest news on investments in Europe

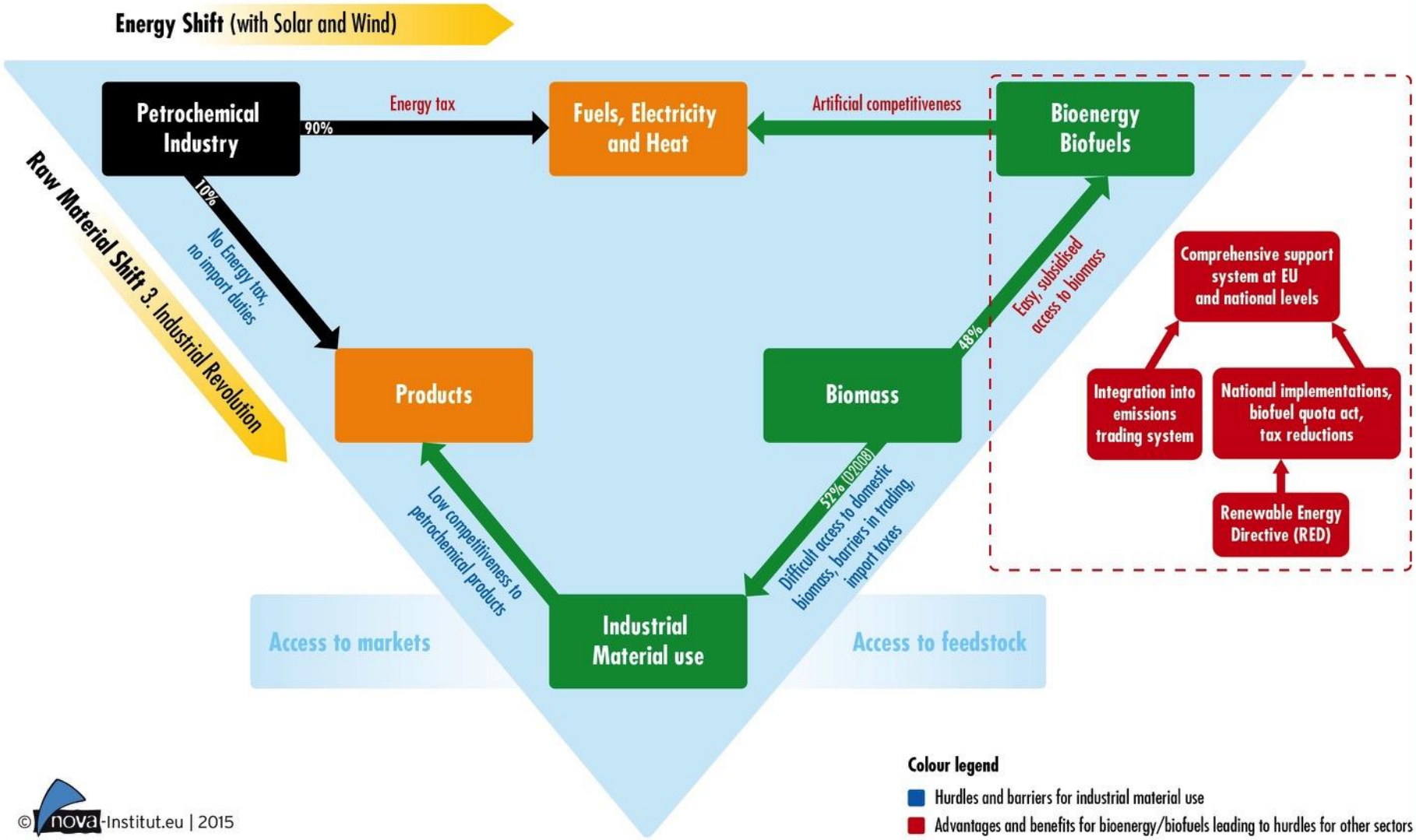
- In 2014 and 2015 most of the bio-based investment in Europe went into smaller plants which produce high value bio-based chemicals – and NOT in biofuels/bioenergy and also NOT in large plants.

- With one exception: Metsä Group in Finland with 1.2 billion investment. The bioproduct mill's annual pulp production will be approximately 1.3 million tonnes, of which 800,000 tonnes will be softwood pulp and 500,000 tonnes hardwood pulp. The softwood pulp will be exported mainly to Europe and Asia. In addition to premium pulp, the mill will produce much more electricity than it will need, as well as tall oil and turpentine, among other bioproducts. All side streams from the bioproduct mill are planned to be utilised in the ecosystem that will be formed by various companies around the mill. (http://globenewswire.com/news-release/2015/04/21/726366/0/en/Metsä-Group-to-build-next-generation-bioproduct-mill-in-Äänekoski.html)

- Most investments took place in France, Italy and Finland.

The competition triangle:

No level playing field for bio-based chemicals and products



“Wastes and residues” – Annex IX ILUC Proposal

Examples market distortion by the RED

- **Animal fats for Biodiesel – too expensive for oleochemistry**
- **Bark from trees for incineration / green electricity – too expensive for the top soil / humus industry**
- **Glycerin for biofuels – too expensive for Solvay’s epichlorhydrin production**
- **Tall oil (from the pulp industry) for biofuels – too expensive for Arizona Chemicals production**
- **Wood for incineration (pellets) – Shortage and high prices for other sectors like particle boards and OSB (Pfleiderer, Sonae), Lyocell (Lenzing)**
- **In the latest RED reform paper a lot of agricultural raw materials and by-products are covered as “wastes and residues”, which can be worthwhile for the chemical industry!**

All these material application have much higher added-value and need much less or even no support – only level playing field

The impacts

- Increasing prices for biomass
- Increasing land prices
- Insecure availability for other sectors
- The battle for biomass is lost for the material sector: If a raw material is covered by the bioenergy/biofuel support, it is lost for the material sector. The energy sector can just pay more for the raw material - due to subsidies only.
- Bioenergy/biofuel incentives leads to a price support up to 80% of the revenues between 2009 and 2013 (in Germany)
- Hundreds of potential biomass applications in the industrial material sector – like bio-based chemicals and materials are – are not realised!

Insecure environment and political framework for the industry:
Low investment in bio-based economy in Europe.

The best framework would allow for the highest resource efficiency, the most innovation capacity, the highest value added, the most employment and the greatest climate protection.

Employment in biofuels and bio-based chemicals

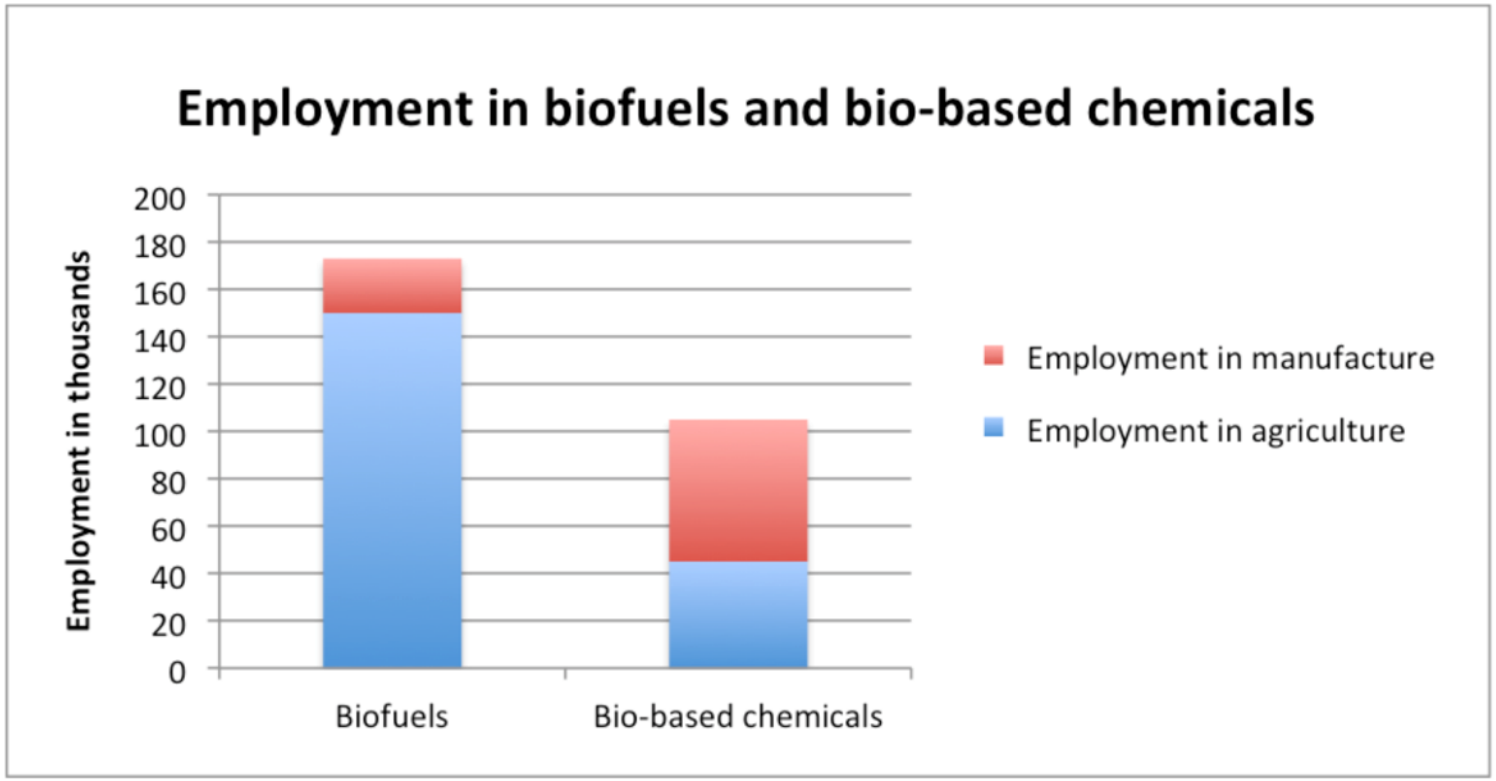


Figure 4a: Total employment (agricultural and manufacture) in biofuels and bio-based chemicals in EU-28, year 2011 (source: nova 2015)

Twice times employment in bio-based chemicals per tonnes of biomass – and more high level jobs

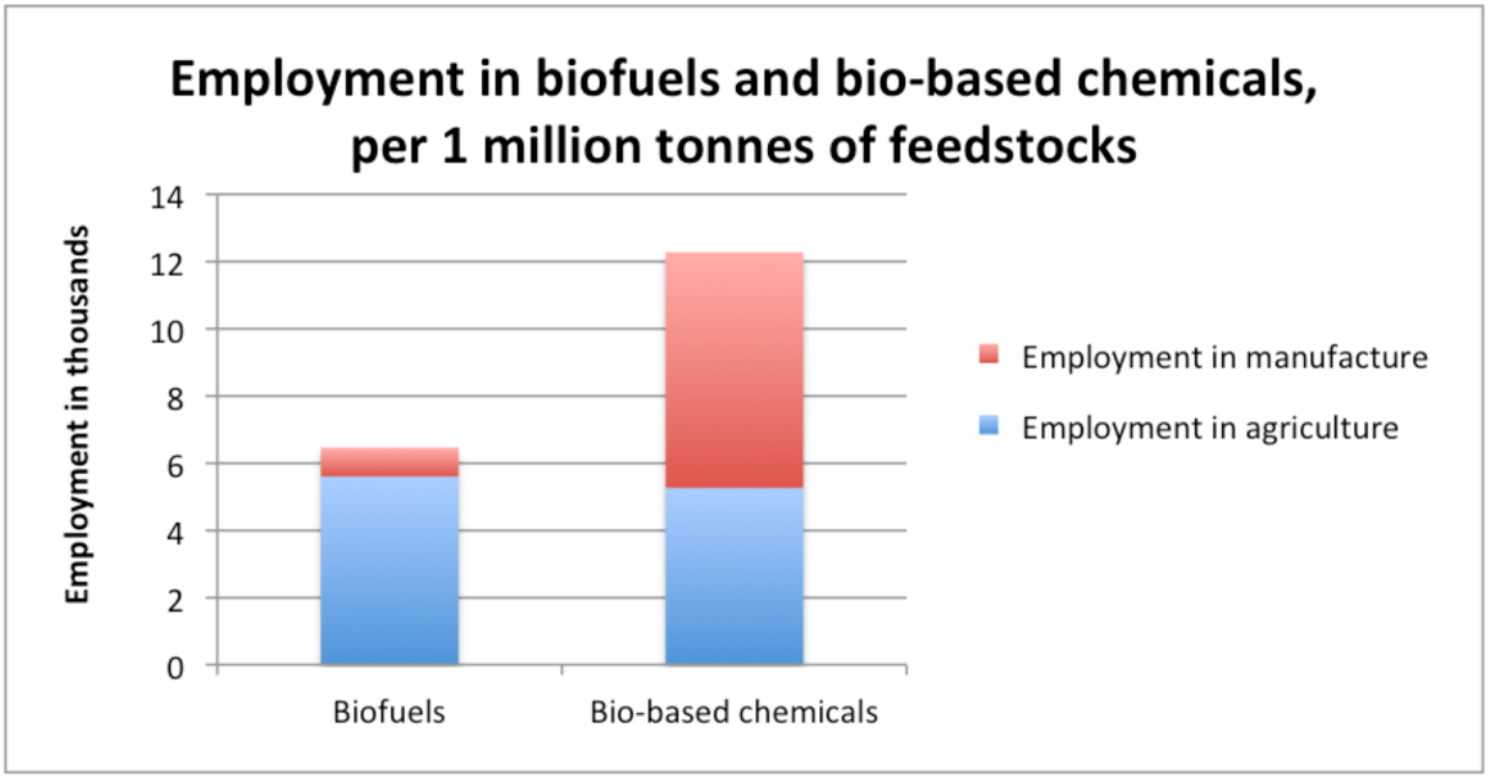


Figure 4b: Total employment (agricultural and manufacture) in biofuels and bio-based chemicals in EU-28, year 2011 per 1 million tonnes of bio-based feedstocks (source: nova 2015) (source: nova 2015)

nova-Institute's Recommendation

Use mandates and bans to create environmentally friendly innovation.

Mandates and bans should be used as strong instruments based on sound environmental and health reasons in order to tap the full positive potential of bio-based products.

These market pull measures should be implemented in close coordination with a technological push in the form of support for R&D, pilot and demonstration plants and flagship investments, in order to get those technologies and products off the ground for which a sufficient market pull and demand exists.

Full three page list with concrete proposals for mandates available:
nova paper #6 on bio-based economy 2015-06: Options for Designing the Political Framework of the European Bio-based Economy
www.bio-based.eu/policy

Poster on biodegradation in different environments available (www.bio-based.eu/graphics)

Examples of applications in which biodegradable plastics would be a suitable solution (nova-Institute 2015)

Ecovio® F Mulching film
BASF 2015

Mulching film
nova 2015

Bio-Fed® Plant clip
Metabolix 2015

BioTAK® Fruit sticker
SAI 2015

Plant pot
nova 2015

Forest sign
nova 2015

Tree protection
nova 2015

Tree protection
nova 2015

Part of tree protection
nova 2015

String for gras trimmer
(oxo-fragmentable) nova 2015

~~Blade~~ for gras trimmer
nova 2015

Dirt eraser
nova 2015

Cable fixer
nova 2015

Fish equipment from PHA – fully biodegradable in cold ocean

MICROPLASTIC IN THE ENVIRONMENT
Sources, Impacts & Solutions

23-24 November 2015
Maternushaus, Cologne, Germany

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K ZEITUNG

Technology Review
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Welcome to the international conference on

MICROPLASTIC IN THE ENVIRONMENT – SOURCES, IMPACTS & SOLUTIONS

23 - 24 November 2015, Maternushaus, Cologne, Germany

++ More than 200 participants expected ++ Free exhibition booths for participants ++

Scientific studies have shown that plastics greatly contribute to the littering of oceans. In marine protection, plastic particles with a diameter smaller than 5 mm are referred to as microplastics. These can be secondary fragments created by the breaking up of larger pieces of plastic such as packaging materials, or fibres that are washed out of textiles. They can also be primary plastic particles produced in microscopic sizes. These include granulates used in cosmetics and in other applications.

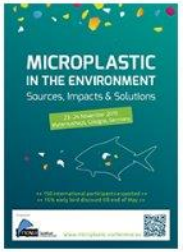
The microplastic conference will:

- Identify **sources** of microplastics and quantify the amount ending up in nature
- Reveal **impacts** on marine ecosystems and human beings
- Propose **solutions** for current problems, such as prevention, recycling and substitution with biodegradable plastics & other materials

The event will provide plenty of scope for discussion between producers, consumers, scientists, environmental organisations, governmental agencies and other interested stakeholders.

If you want to contribute as a speaker or like to become a partner/ media partner of this conference please get in contact with the nova-team!

Conference Leaflet



Partner

Bio Biotechnology Industry Organization

CLIB 2021 CLUSTER INDUSTRIELLE BIOTECHNOLOGIE

IBB Netzwerk GmbH

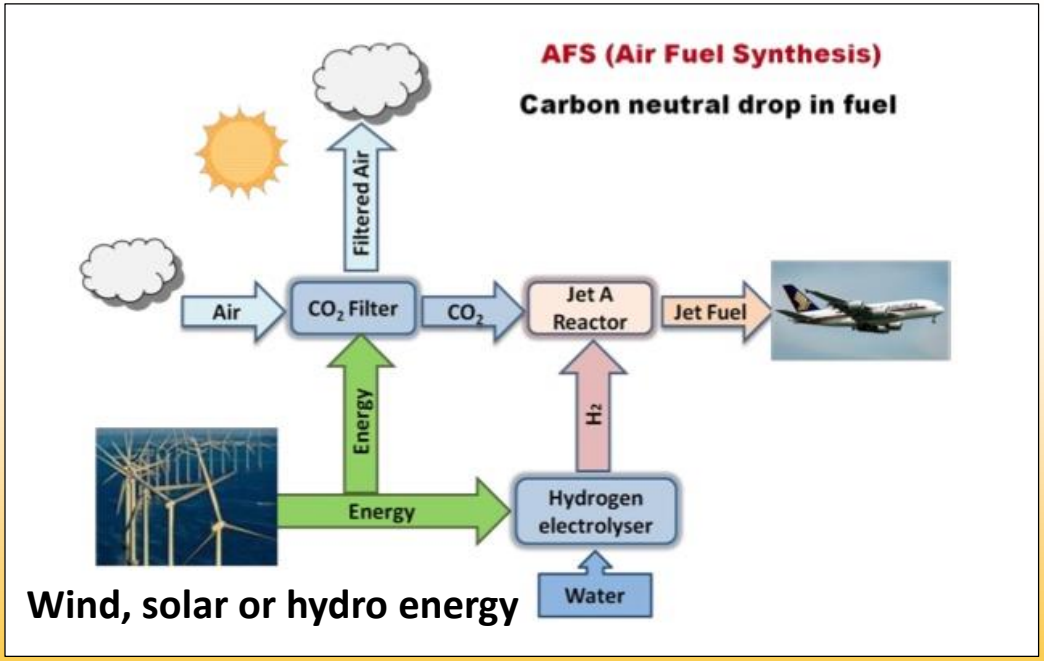
kunststoffland NRW e.V.

polycomply hoechst

nova-Institute‘s Recommendation

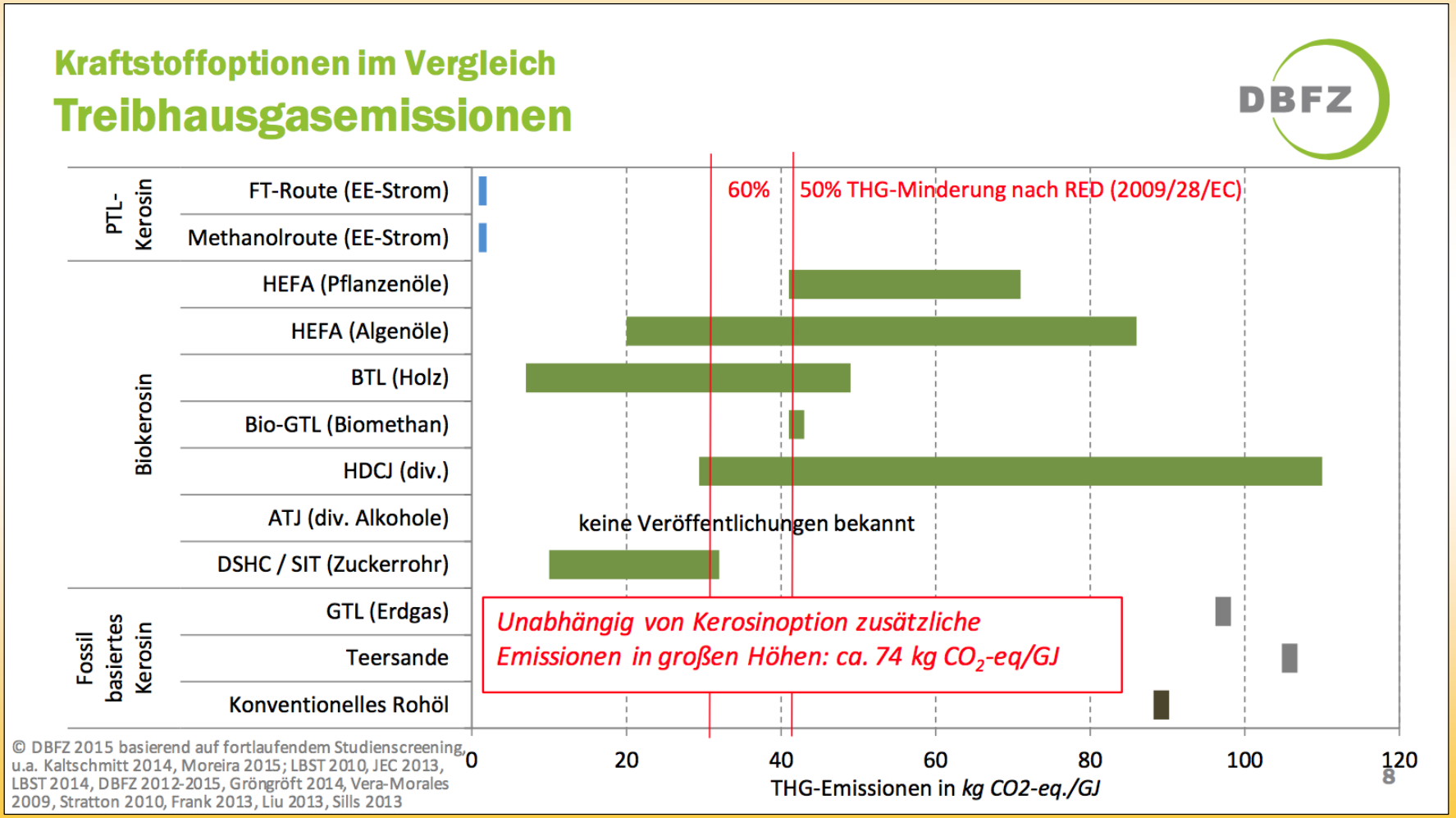
There will be a huge demand for sustainable aviation fuels.

Renewables-to-liquids (Kerosin) is the best option with the lowest carbon footprint. Cheap water electricity is a unique option to produce aviation fuels on high scale.



nova-Institute's Recommendation

Extremely low THG emissions compared to bio-kerosin!



www.co2-chemistry.eu

Thank you for your attention!

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