



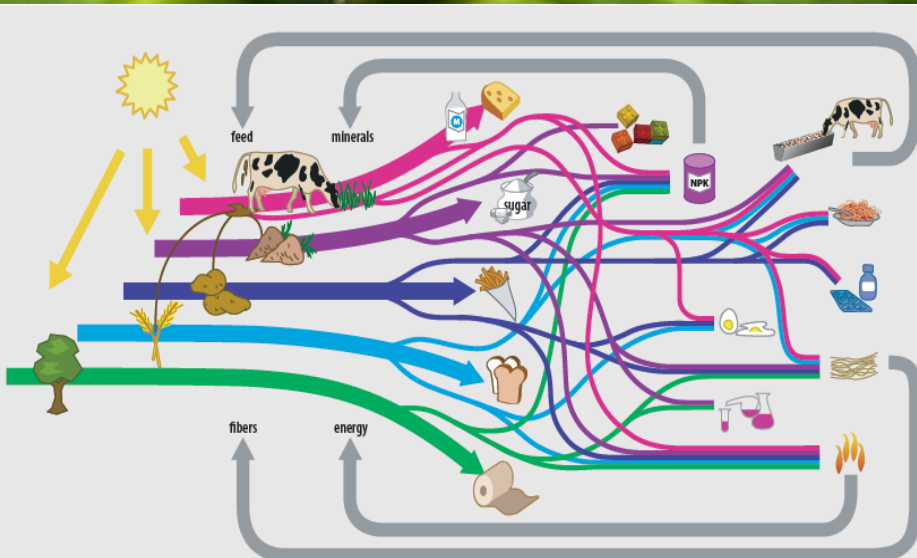
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Biobased Economy in the Netherlands and the regions

Opportunities & Challenges

Ir. Kees W. Kwant



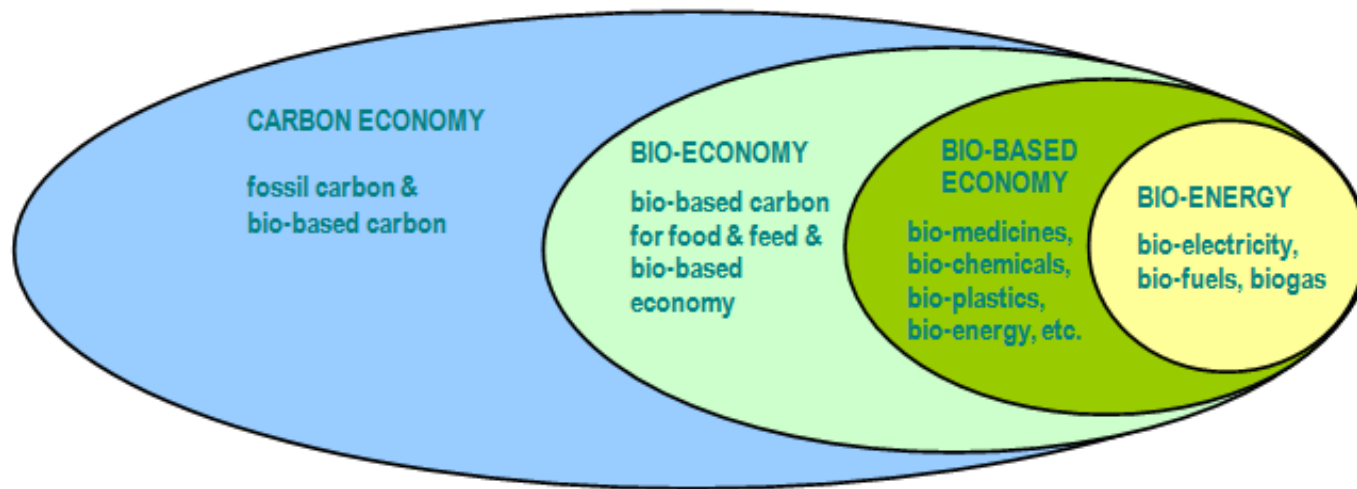


Contents

- Sustainable Resources for a Low Carbon Economy
- Bioeconomy supported by the Circular Economy
- Examples of Biorefineries in the bioeconomy
- Role of Regions
- Results and Conclusion



Integrated Approach for Bioenergy:– The bio-based economy in context



- The bio-energy arena is a subset of the bio-based arena (non-food use of biological resources), itself a subset of the bio economy, and ultimately of the 'carbon economy'.
- Our society is to a significant extent based on the 'carbon economy', fed both by fossil and renewable (or biological) carbon.



Principles of the sustainable bio-based economy

First: Sustainable biomass growth

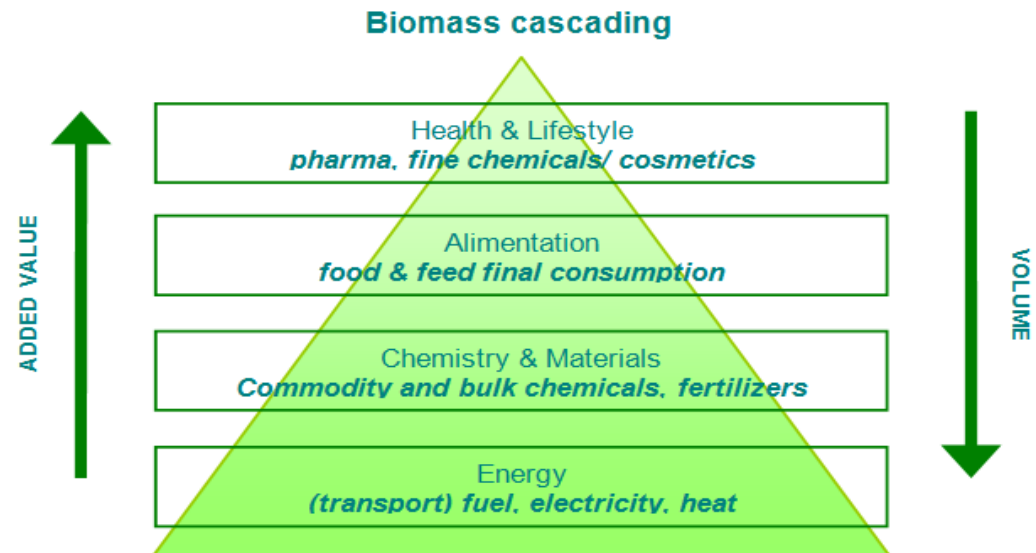
(GBEP) –sustainability indicators for bioenergy:

- Improving yields in agriculture (with better crops, cultures, nursing, care)
- Nutrient recycling
- Optimal use of water (e.g. drip irrigation)
- Minimal pesticide (organic pest control)
- Minimal energy use in production chains

These elements are in line with the Good Agricultural Practices (GAP) codes, standards and regulations promoted by the FAO (2013).



Second: Resource Efficiency



Optimum use of bio-resources implies 'cascading'

- Cascading in time: expanding the utilization of harvested biomass by re-using (or even upgrading) waste streams
- Cascading in value: maximizing and optimizing the economic benefit of the bio resource life cycle.
- Cascading in function: benefiting from all potential functions, e.g. through bio-refinery



Third: Principles: 'trias biologica'

The 'Trias Biologica' is a popularized expansion of the 'Trias Energetica' – (1) reduce energy demand, (2) meet the demand as far as possible with renewable resources, and (3) minimize emissions and ecological impact from the remaining (fossil) supply.

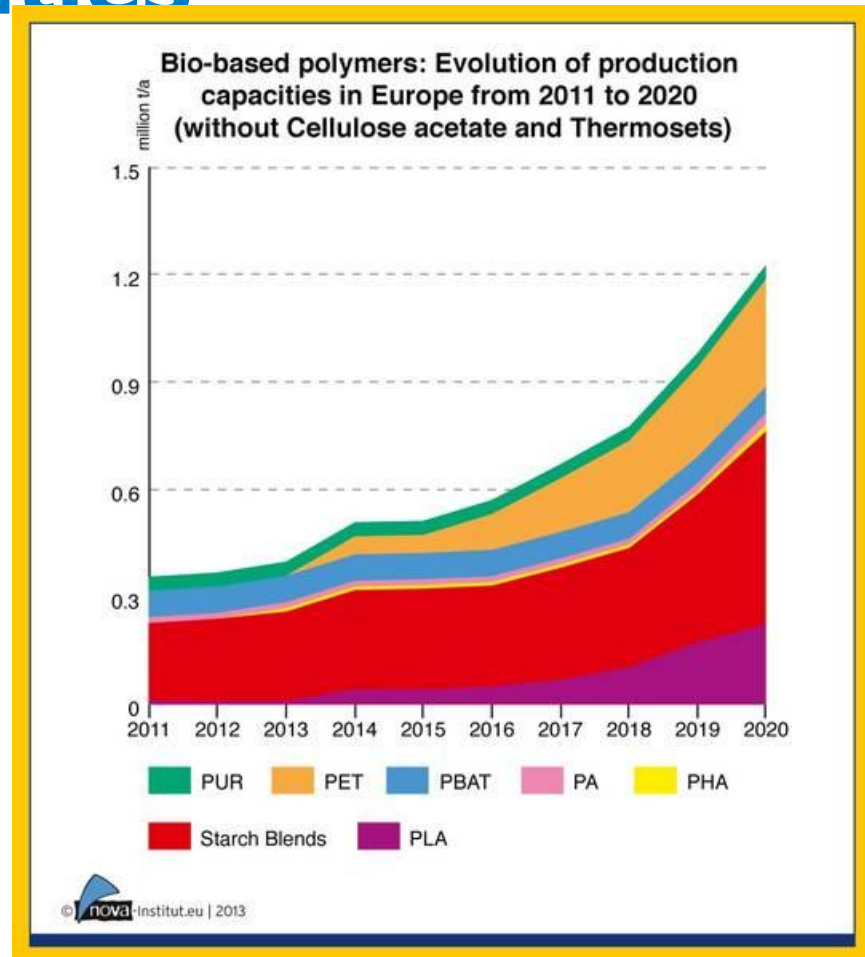
Trias Biologica:

1. De carbonize the economy – i.e. minimize the 'carbon need and footprint'
2. Supply the remaining carbon need from sustainably produced bio-resources
3. Minimize impact and maximize efficiency: use 'cascading' for all carbon resources and avoid all harmful emissions.



Economic opportunities

- Hardly any alternative renewable sources for
 - long distance shipping/aviation
 - chemicals and plastics
 - industrial heat
- Huge growth market for biochemicals and biomaterials



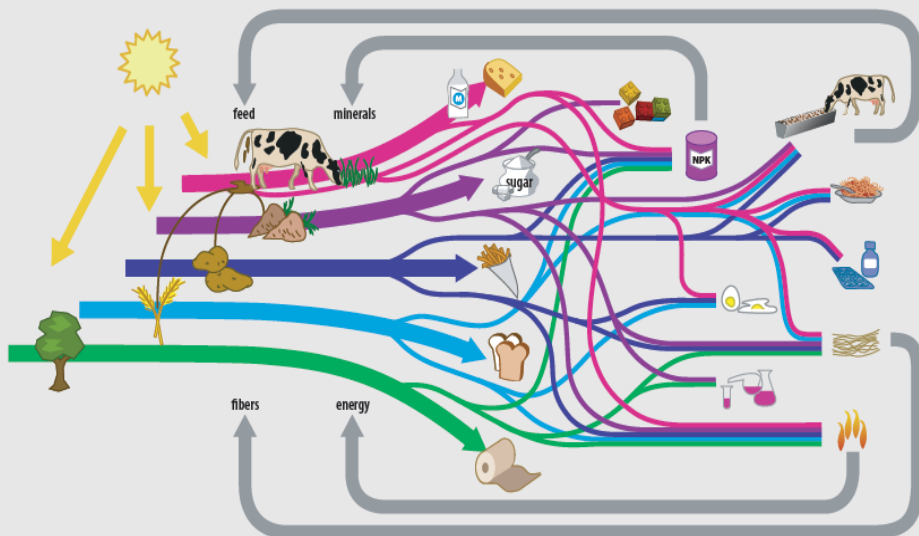


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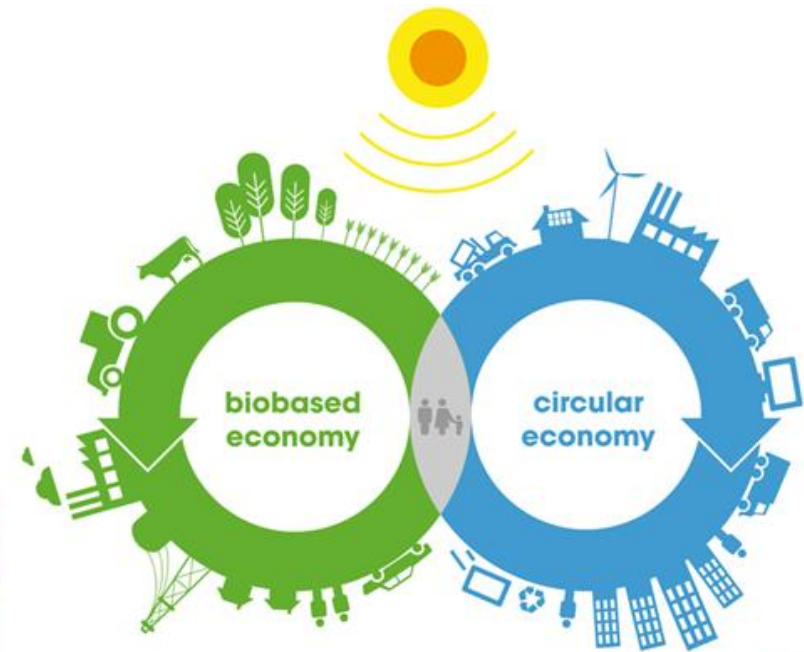
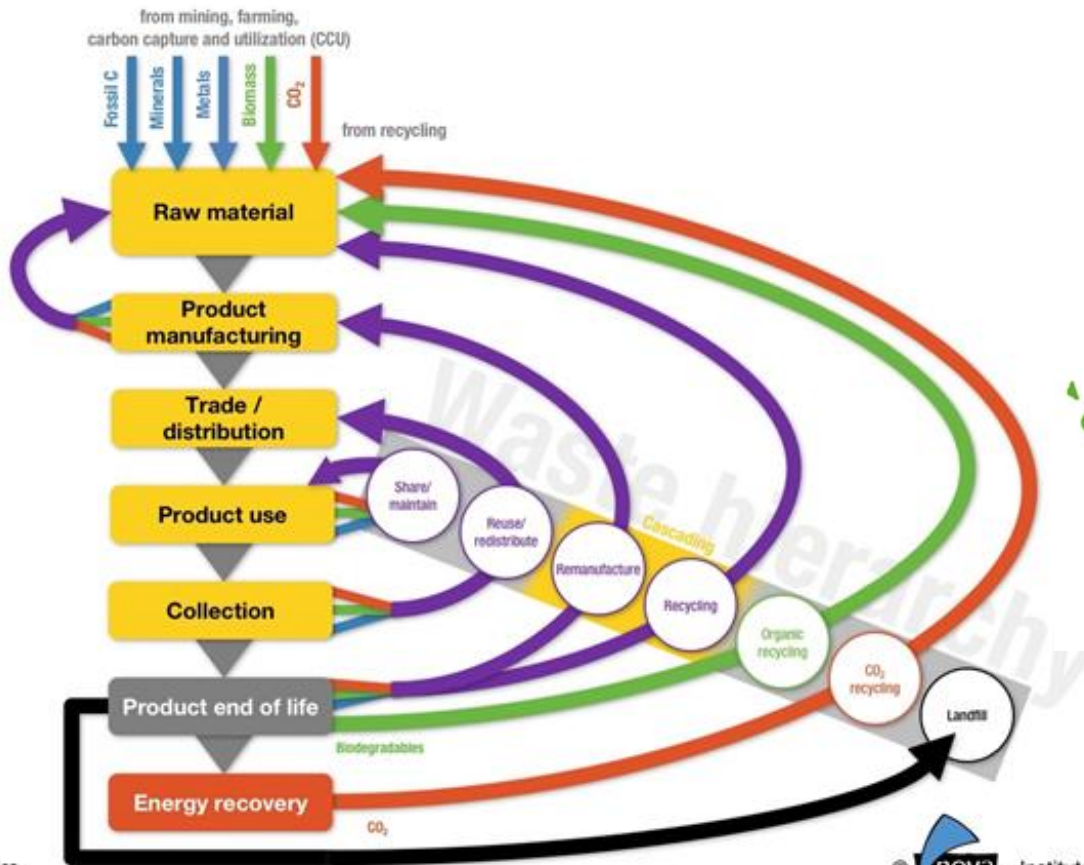
Circular Economy

A major transition towards the biobased resources required





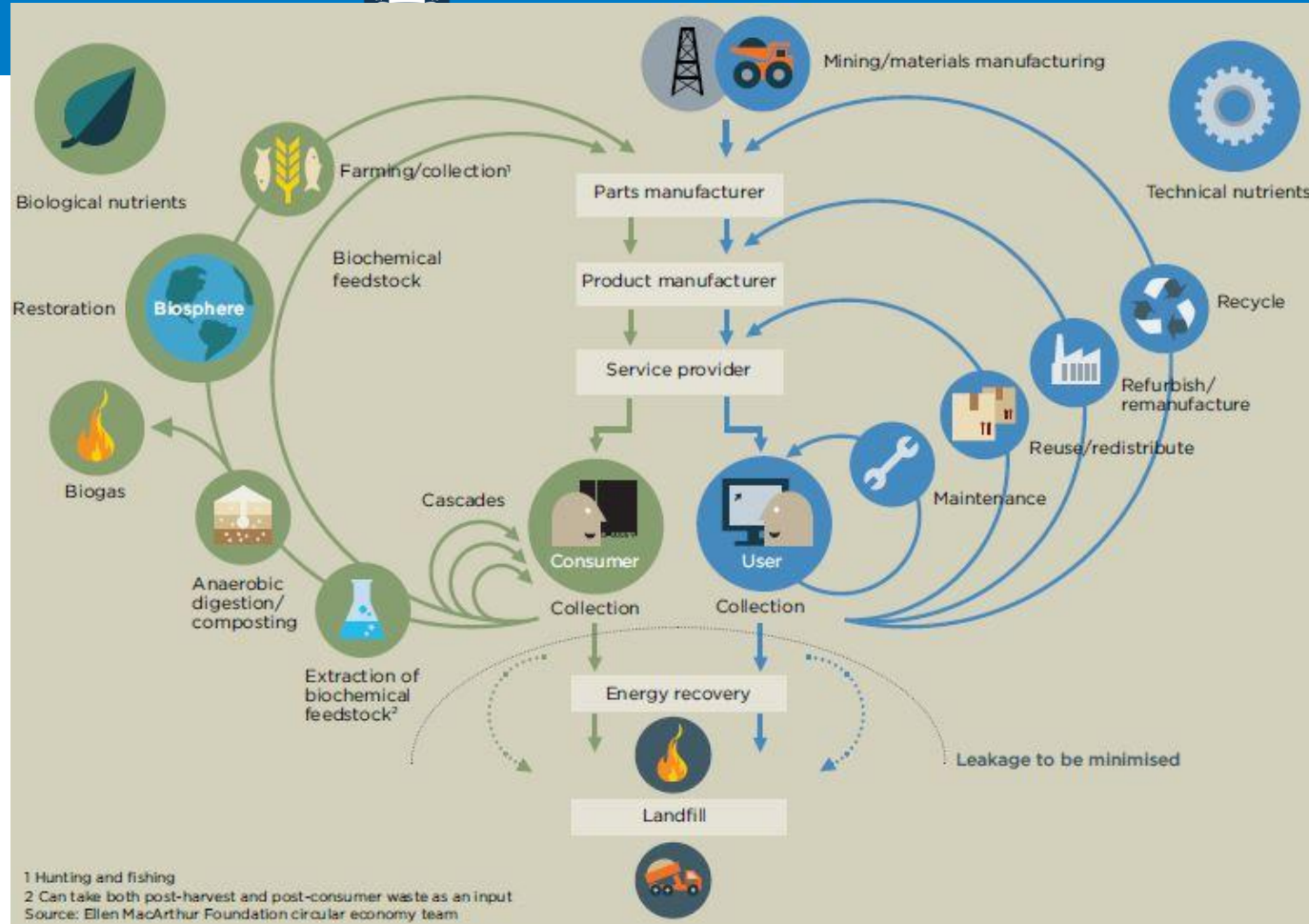
Circular & Biobased Economy





Circular Economy

Reference:
Ellen MacArthur
Foundation (2012)



A Circular Economy is **an industrial system** that is restorative or regenerative by design. It replaces the 'end-of-life' concept with restoration, shifts towards the **use of renewable energy**, eliminates use of toxic chemicals, which impair reuse, and aims for **the elimination of waste** through the **superior design** of materials, products, systems, and, within this, business models.



NL Governmental plan Circular Economy

September 2016

- efficient use of resources
- optimal reuse of resources
- sustainable mining of resources
- less resources used, circular design
- efficient products and services
- intermediate ambition in 2030: realize 50% less consumption of primary resources (mineral, fossil and metal)



5 value chains/ Priority Areas

	European Commission	The Netherlands
1	plastics	Sustainable Biomass and Food Supply
2	biomass and bio-based products	Plastics
3	food waste	Consumer Goods
4	critical raw materials	Industrial production (EU:RMI)
5	construction and demolition waste	Built environment



Instruments

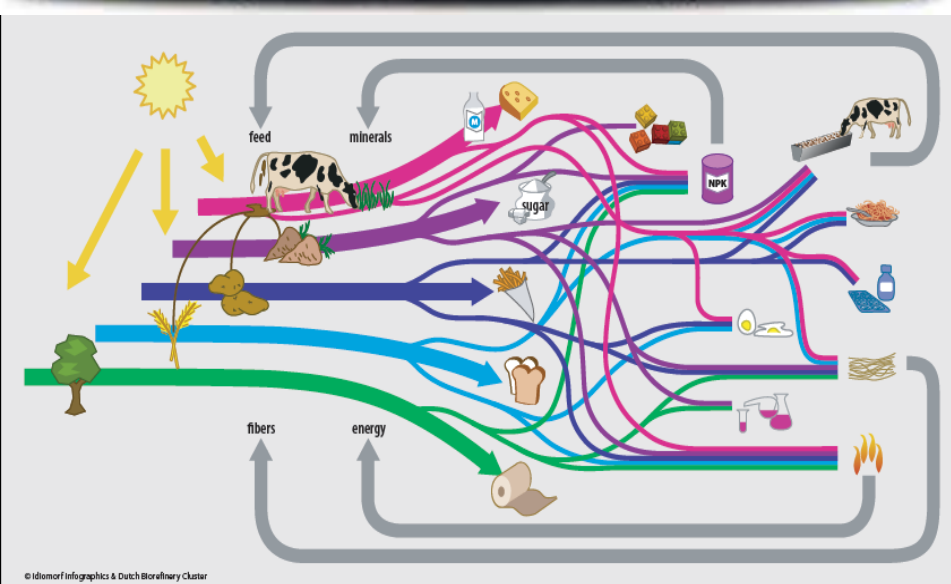
- Green Deals
- stimulating laws & regulations
- smart market stimuli
- financing
- knowledge & innovation
- international cooperation



Rijksdienst voor Ondernemend
Nederland



Research and Development



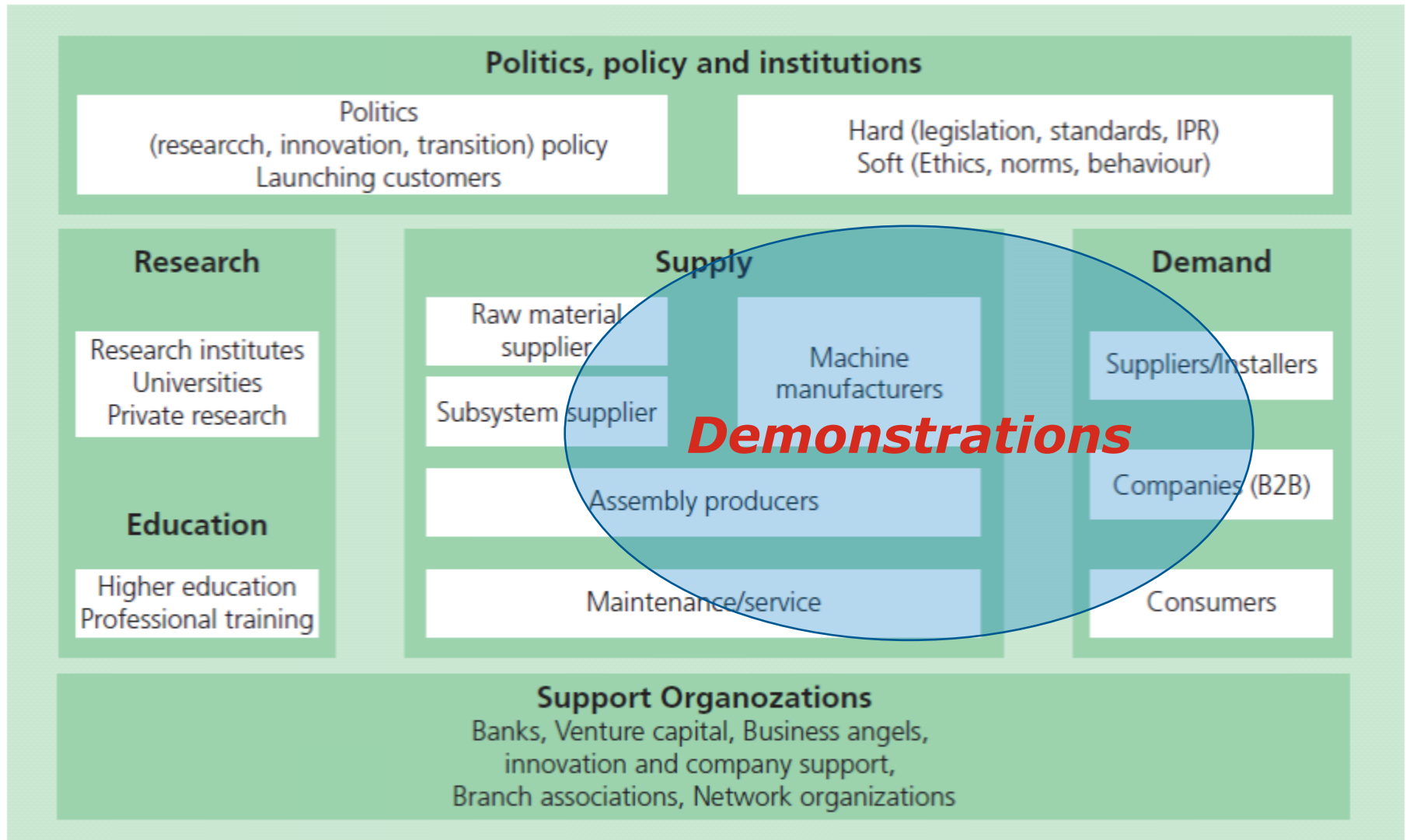


Figure 2 Structure of the innovation system (based on (Kuhlmann and Arnold, 2001))



Research & Development

- Support through topsector approach
 - Market driven Research in topsectors
 - Regional Support for specific strength
- Budget about 240 M€/year
 - Support from government $\sim\sim$ 70 M€/year (subsidies, fiscal, loans etc.)



Research and Development

From lab to Market

- Biorefinery Program
 - 2010 - 2014
- Topsector Approach
 - www.tki-bbe.nl
- Upscaling:
 - www.bpf.eu
- Demonstration
- Flagships / Financing

Bio Proces Facility Delft

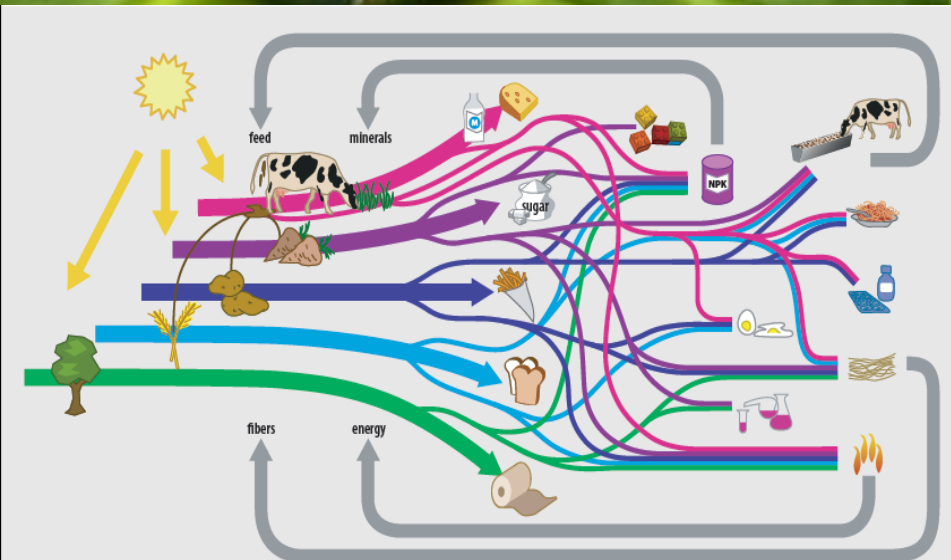




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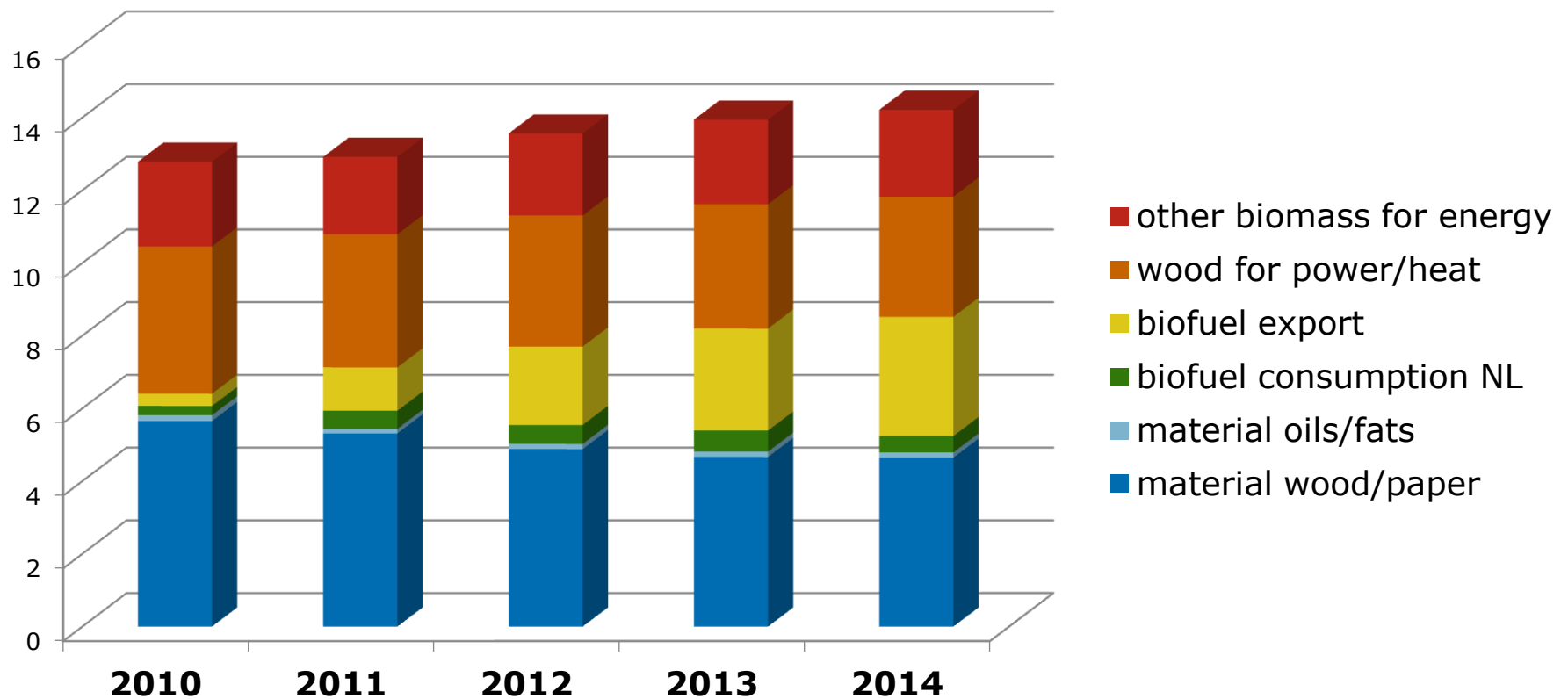


Realisation of Biorefineries in the Circular Economy





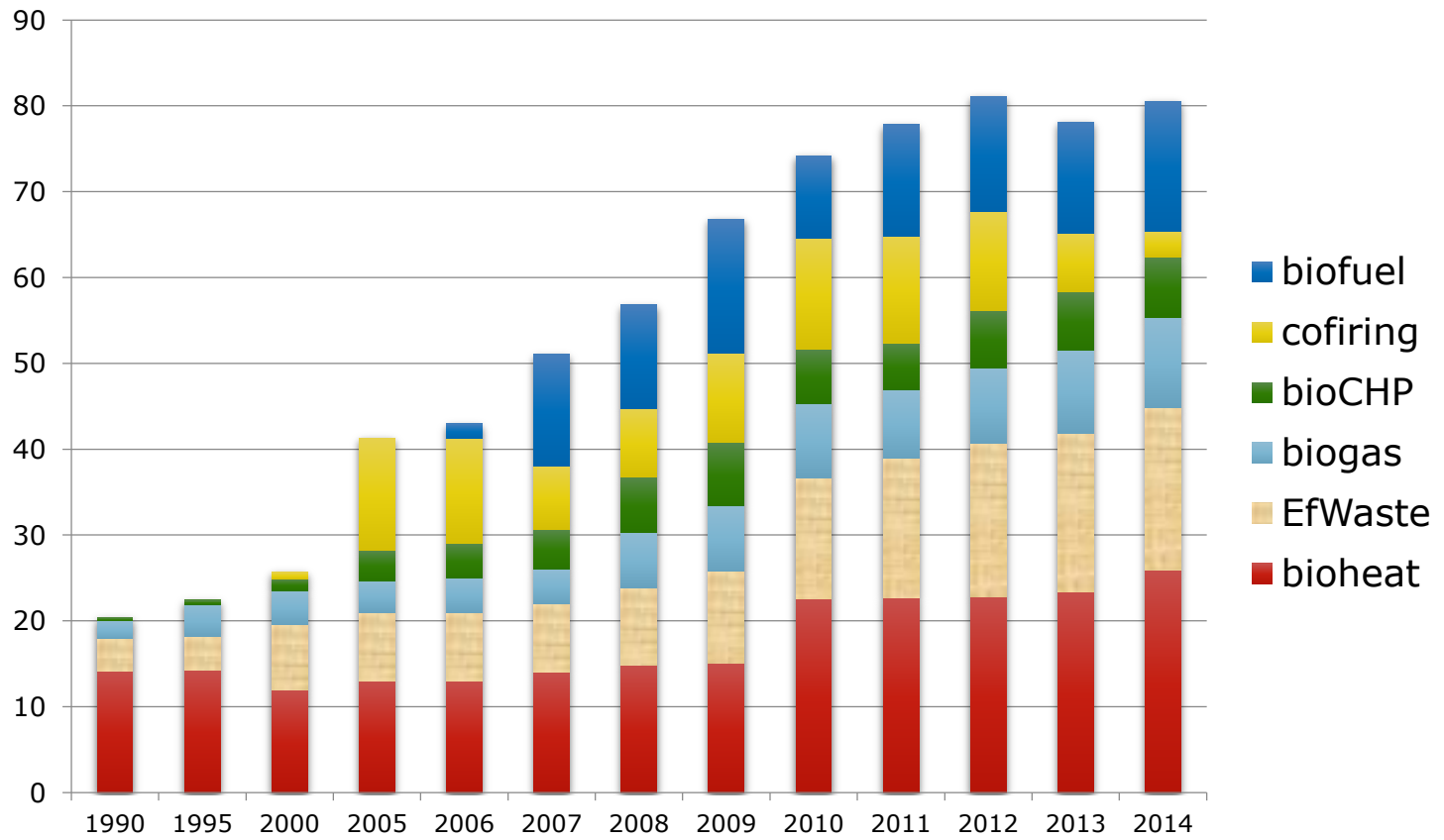
Biomass use increase by 3%/year





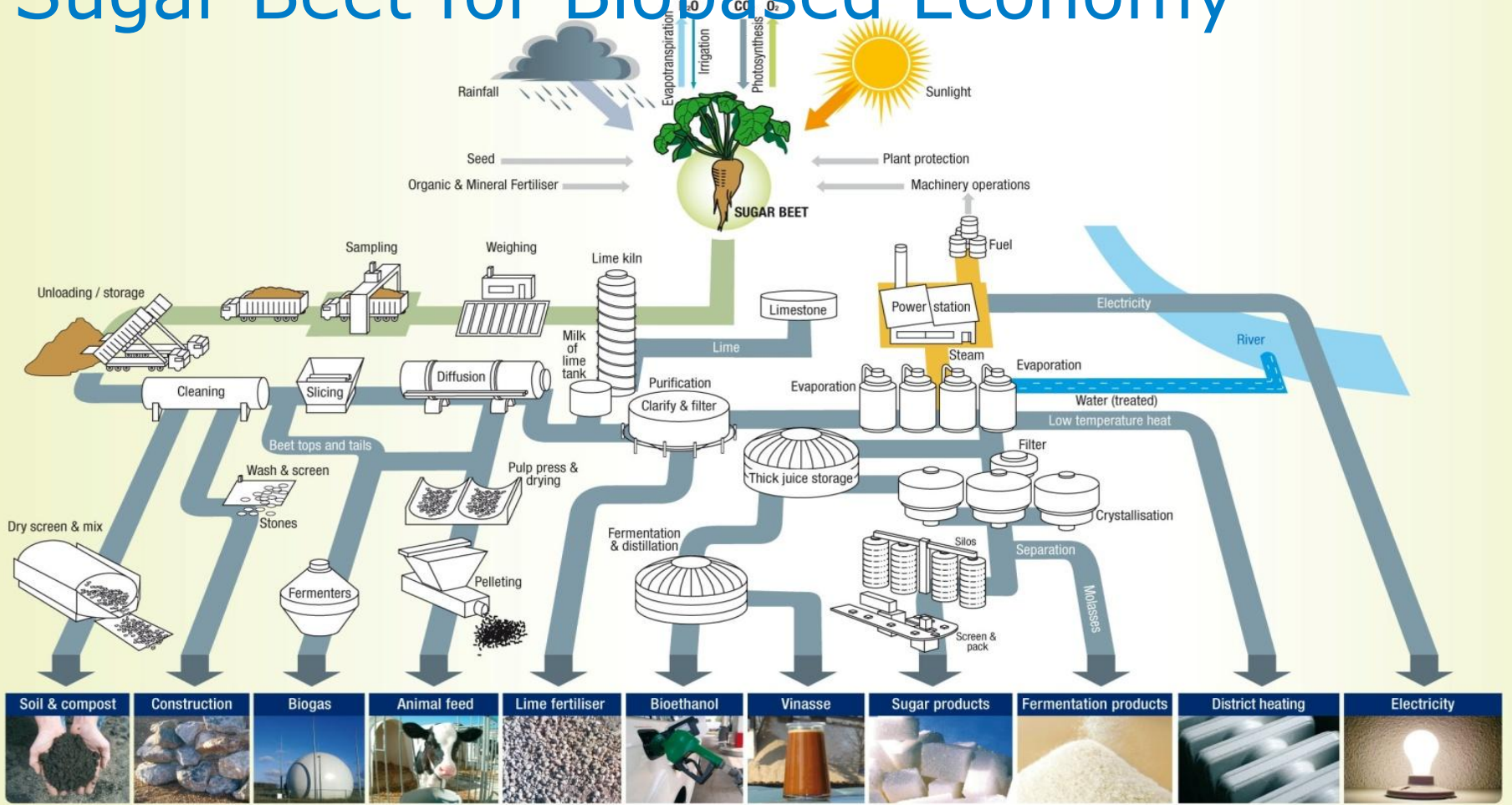
Biomass for Bioenergy use in Netherlands

- PJ





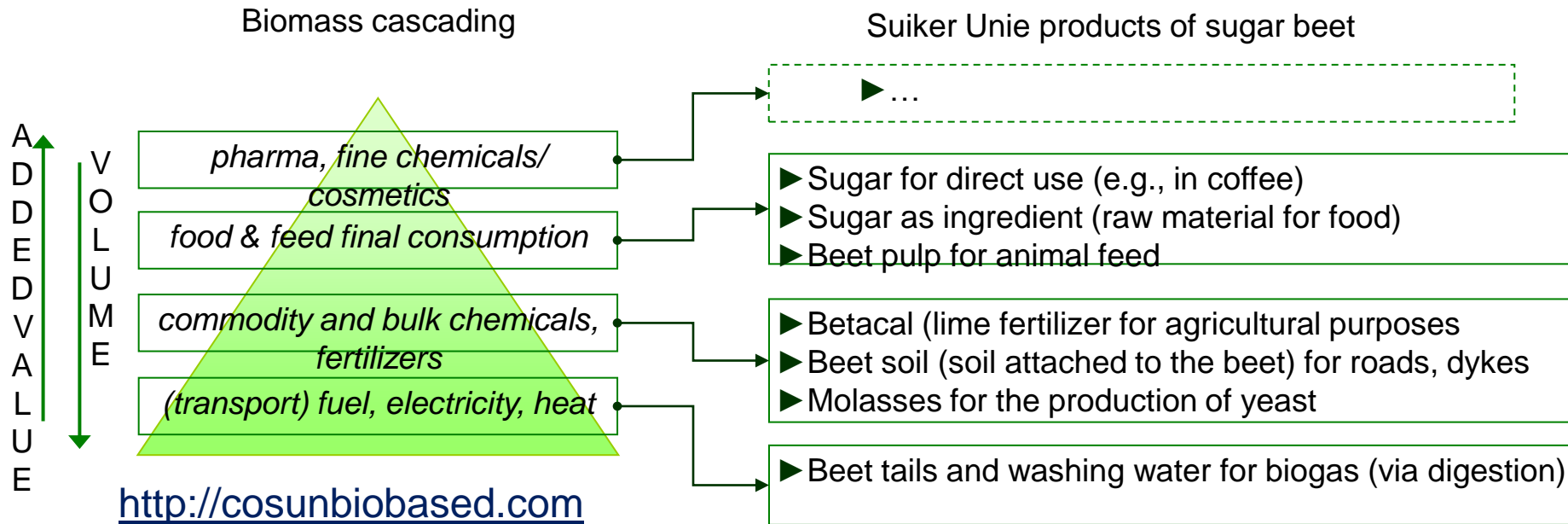
Sugar Beet for Biobased Economy



Source: CIBE and CEFS (after British Sugar)



Biomass Cascading and Valorisation



- Total concept, including a 50% increase in sugar beet yield per hectare, a 50% reduction in fertilizer use, and a 50% efficiency improvement in the sugar plant (all in about 20 years).
- Further optimization includes export of waste heat, and site utilization for renewable energy production (solar and wind).



Pyrolysis Empyro (www.btg-btl.com)

- **First Operational Plant in NL**

- Built in modules in Hengelo,
- operational since 2015

- **Phasing of applications**

- 1: burning ->
- 2: transportfuels ->
- 3: chemicals

- **Take off client:**

- 20 mln. liter/jaar, used by Friesland Campina Borculo for steam (supported by SDE+)





23 Dutch water authorities put wastewater to good use :

- **Increased Output:**
 - energy, biogas to power cars or electricity
 - raw materials ; phosphate, which is used to produce fertilizers.
- **Collaboration**
 - the water boards have set up a collaborative network organization called Energy & Raw Materials Factory (EFGF). <http://www.efgf.nl/english>
 - Joint Research programme with Universities



Products from waste water sludge

- Energy
- Fosphate
- Cellulose
- Bioplastics & Acids
- Alginate
- CO₂

- Movie:

- <https://www.youtube.com/watch?v=CT91VE6wfIc>





Biorefinery of grasses

- Grass Refinery:
 - > Green fibres and juice for digester
- Product: Green Egg box
 - www.huthamaki.com
- Result: 60% less water,
10 % less CO2
- Future: Juice for proteins
- Lesson:
 - Use Market opportunity
 - Work in the chain



- Chemical catalysis biorefinery
- Pilot plant in Geleen
- Feedstocks: cellulose, hemi-cellulose, starch, sucrose
- Outputs: furan based biofuels, monomers for polymers, fine and specialty chemicals, solid fuels



Plant based
Feedstock

PEF
making 100%
plant based
bottles possible



**Lower Footprint
Better Quality**



Green chemicals from solar (www.photanol.com)

- CO₂+light -> chemicals
 - Blue algae -> lactic acid
- Spinn-off Univ. AMS
- Collaboration AKZO
- Labscale -> pilot -> demo in greenhouse

Lessons:

- Partnering for market entry
- Use existing infrastructure

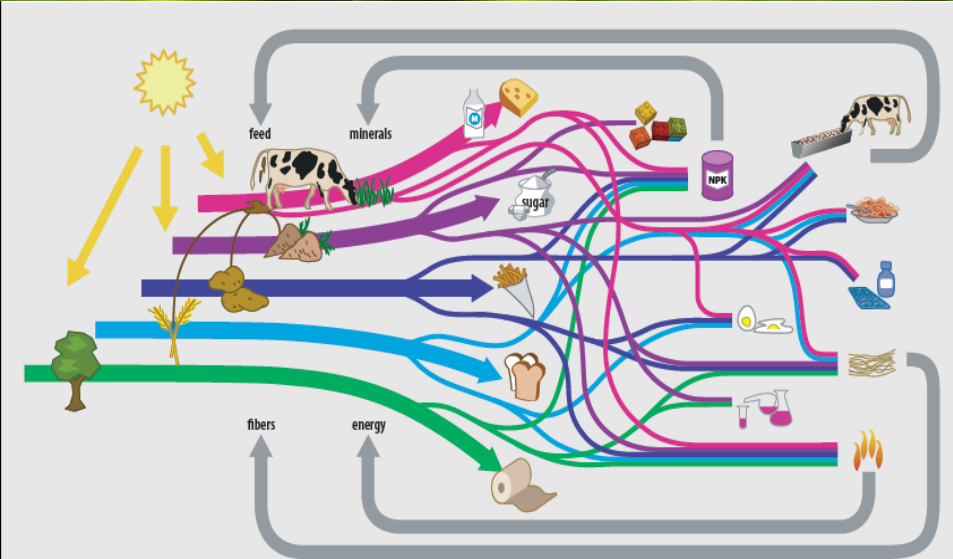




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Role of Regions





Development of Biobased Economy In the REGIONS

Flevoland

WUR/Accres, Prov. Flevoland en Eneco, HarvestaGG, CAH Viltentum, Ringg, OMFL

Focus:

- * Bio-energie
- * Cascadering
- * BBE experimenteren/testen/demonstraties

Biobased Economy Noord Nederland

Avebe, FrieslandCampina, Cosun, Agrifirm, BioMCN, Grassa, DOC, PKI, API, Cumapol, Eemshaven, Stenden PRE, Wetsus, biobRUG, Biocab, Hanze Hogeschool, CCC, HANNN, Prov. Groningen, Drenthe en Friesland, NOM etc.

Focus:

- * Verwaarding organische reststromen
- * Eiwitten & koolhydraten (food/feed/industrie)
- * Fybres en biopolymeren
- * Chemical buildingblocks
- * Biofuels

Biobased Connections

ICL, Cargill, Greenmills, AEB, Haven Amsterdam, Orgaworld, AIM, Schiphol, HvA, UvA, Amsterdam Economic Board Watermet, Aalsmeer, Haarlemmermeer, Amstelveen, NPSP, Photonol, SADC, Ursapaint, Pharmafilter, Jagran, Hempflax etc.

Focus:

- * Inzet organische reststromen voor bio-energie, biofuels en biomaterialen

Biobased Economy Oost Nederland

Bio-energie Cluster Oost Nederland, BTG, Byosis, Ten Cate, AkzoNobel, Van Wijhe, Rolsma, ROVA, GTC, Utwente, WUR, BIC Oost-Nederland, Prov. Gelderland en Overijssel, OostNV etc.

Focus:

- * Bio energie (pyrolyse/fermentatie)
- * biobased coatings
- * Biobased garens, textiel en biopolymeren
- * Verwaarden van cellulose houdende materialen, gebruik van mest en slib als biomassagrondstof en toepassing van nieuwe biomassastromen algen en kroos

Biobased Delta

Green Chemistry Campus, DOW, Cosun, Purac, Sabic, Bio Base Europe, Avans Hogeschool, Prov. Zeeland, Brabant en Zuid-Holland, Haven Rotterdam (BioPort), TUD, Leiden Univ., Plant One, RCI, BE-BASIC, DSM, Pilotplant, Biotechpark Delft Kenniscentrum Plantenstoffen, Growport, Greenport, BOM, REWIN, Impuls, InnovationQuarter etc.

Focus:

- * biobuilding blocks
- * biobased aromatics
- * Performance materials & chemicals
- * Agro functionals/hoogwaardige plantinhoudsstoffen
- * Aquatische biomassa
- * Coatings
- * Witte bio-technologie voor fuels en chemicaliën
- * Bioport

Biobased Economy Limburg

Greenport & biotransitiehuis Venlo, Chemelot, DSM, Sabic, Lanxess, Avantium, Papier & Kartonindustrie, Univ. Maastricht, Zuyd Hogeschool, Prov. Limburg, Liof etc.

Focus:

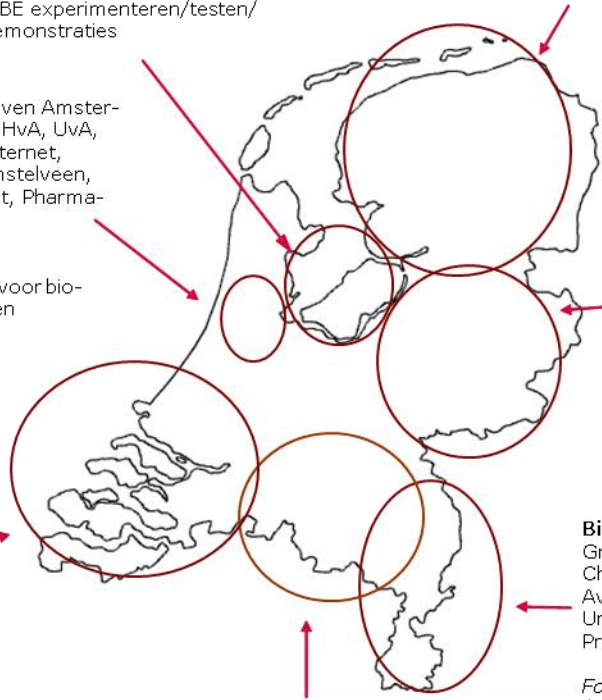
- * Biobased performance materials & chemicals
- * Biomedical materials
- * Processtechnolgy & biobased buildingblocks
- * biobased tuinbouw toepassingen & Agroraffinage
- * Neutraceuticals en cosmetica

Biobased Business Brainport

BOM, SRE etc.

Focus:

- * Verwaarden van mineralen uit dierlijke en plantaardige nevenstromen richting food, feed en pharma





Region 1: Biobased Delta:

Application Centers



Port of Rotterdam



Agri Innovation Center
Bio Innovation Garden



Zeeland Seaports



Biobase Europe



Bio Proces Facility - Natural Fibers



Campus Delft



Knowledge center
Plant Ingredients



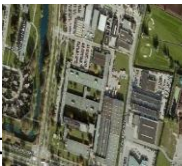
Port of Moerdijk



Nieuw Prinssland



6b – Living Color
6c – Biopolymers



13-Veenweide -Dairy



GCC



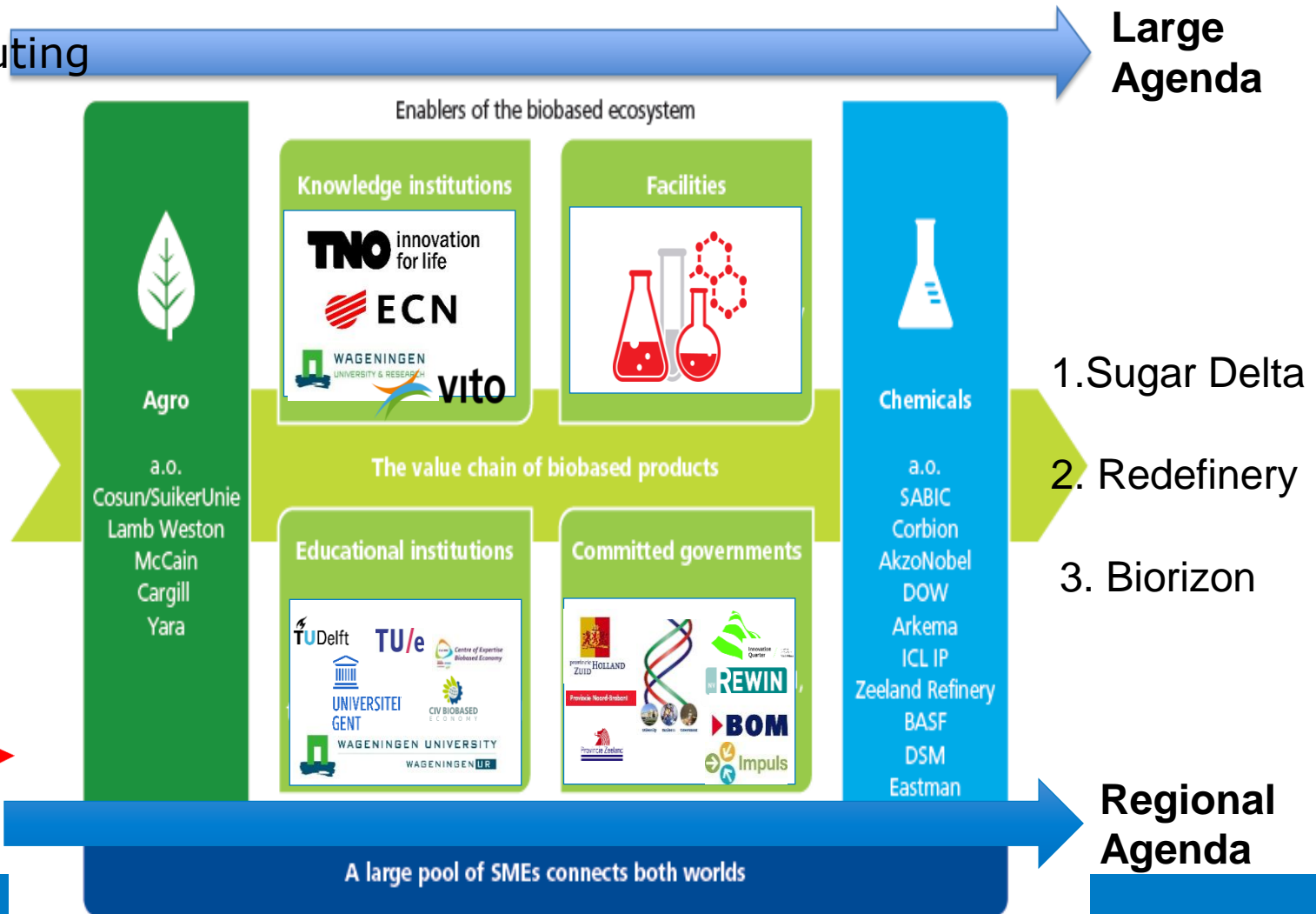
CoE BBE



Agro meets Chemistry :

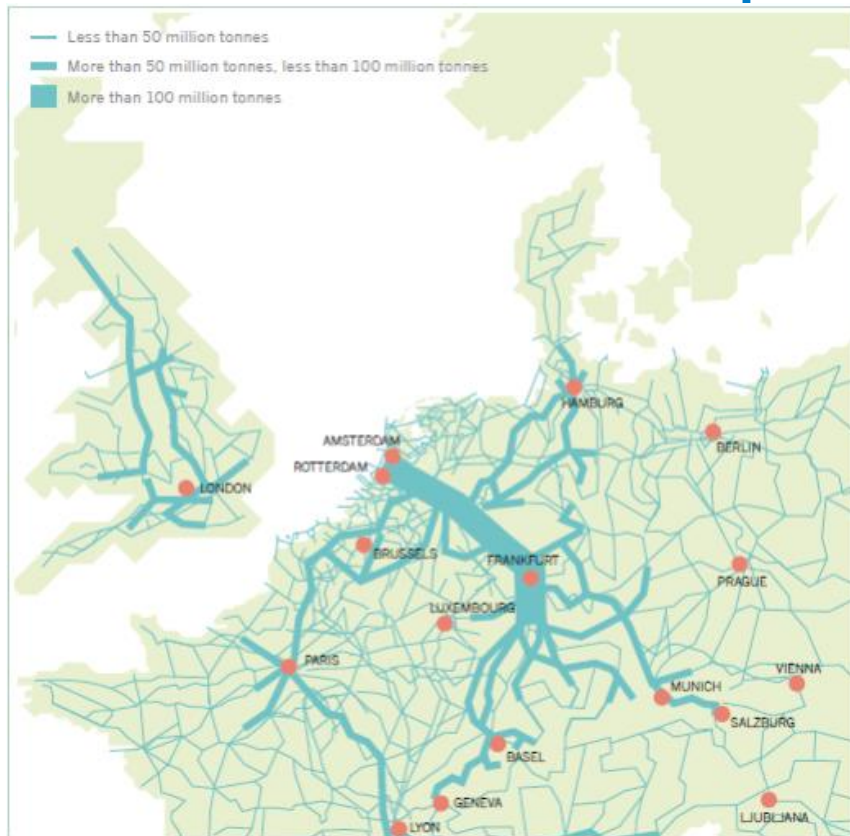
Contributing

Large
Agenda





Region 2: East Netherlands, Flandres, Nord-Rhein Westphalia



- Logistic central
- Strong chemical industry
- Strong agricultural sector
- Big market: 41 M
- 17 + 17 + 7 M people
- Ref:

http://www.era-ib.net/sites/default/files/big_c_innovation_cluster.pdf



Strong Public Private Partnerships



- **BIG-C**
- Creating Synergy:
 - - Human Capital
 - - Joint logistics
 - - Joint Pilots
- Creating Critical Mass
 - - Joint Flagships
- Budget: 3 M€
 - 2/3 industry, 1/3 gov



Knowledge institutes



- Collaboration:
 - Joint Research
 - Human Capital
 - Support SME's

Focus Value Chains:

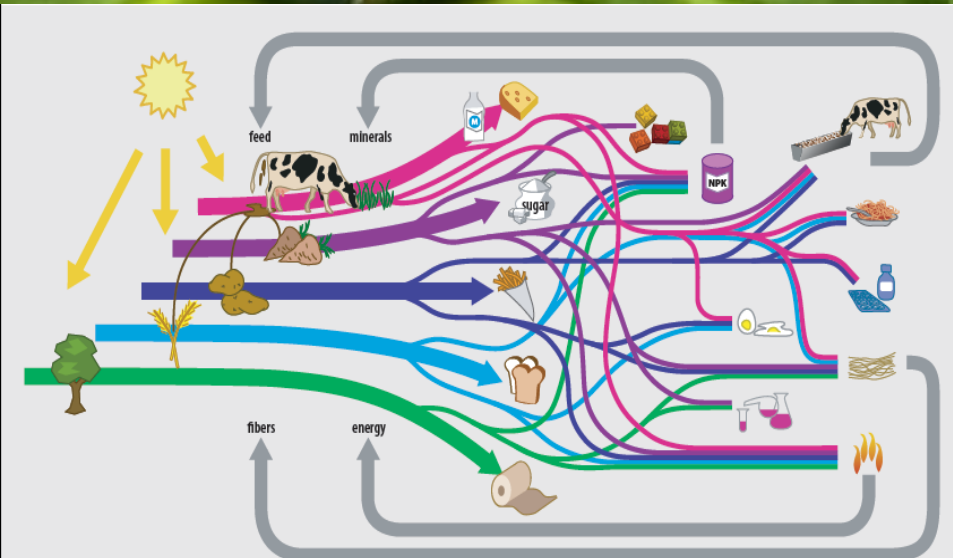
- Cellulosics -> chem
- New crops
- Agro Waste streams
- CO2 based



Results

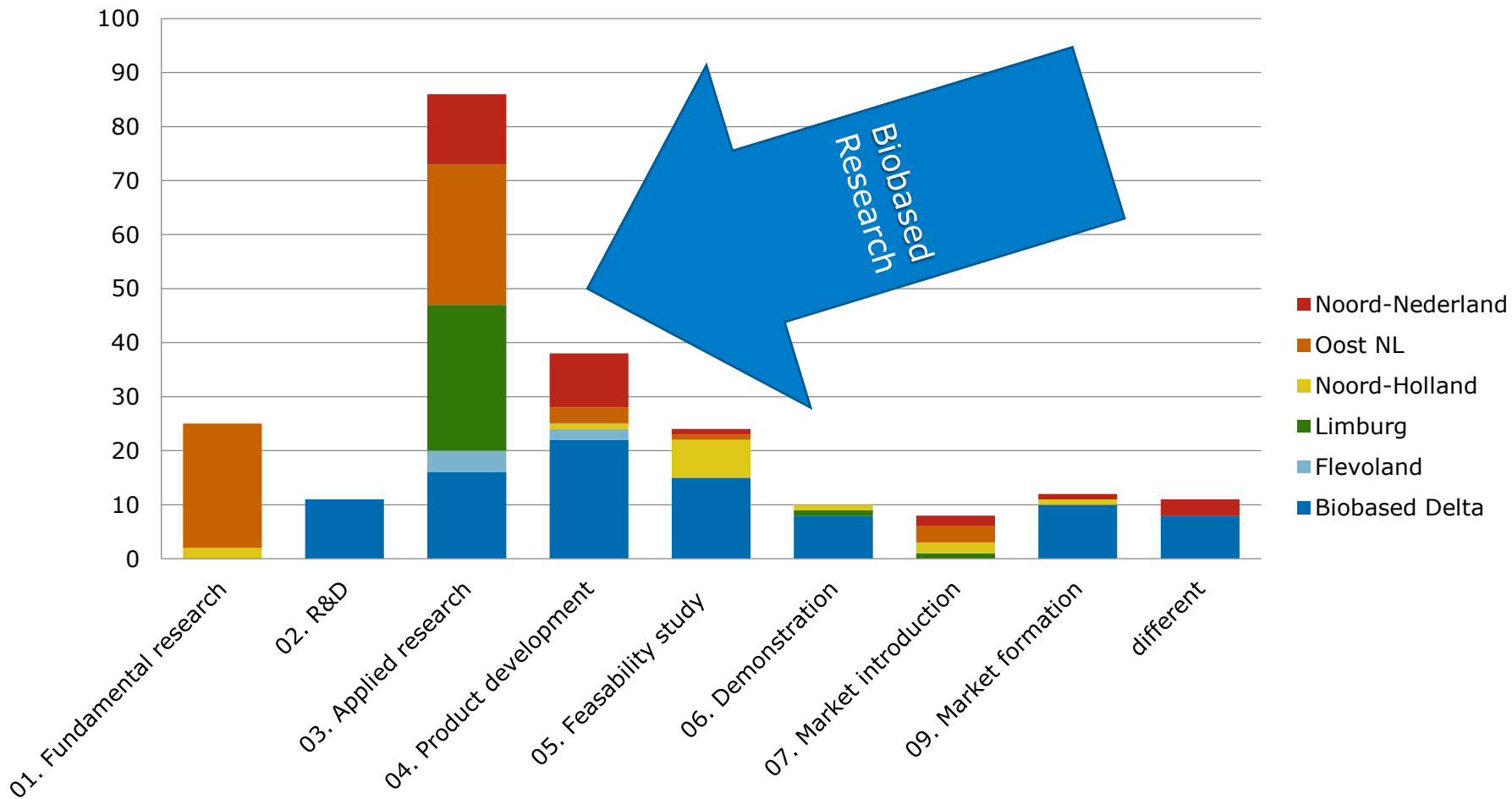
Recommendations

and Conclusion





Projects from regions on the S-curve





Markets Slow: Biobased Procurement

- **Sustainable Procurement**
- Biobased <-> Biodegradable
- Biobased <-> Sustainable
- Complete Chain Evaluation





Required Policies in Society

- Steering on CO2 reduction
 - Polluter pays principle
 - Not only for ETS companies, but society
 - Level playing field for energy and materials

- Innovation; biorefineries for integrated optimised conversion of biomass





Conclusion

1. Steering on CO2 emission reduction
2. Smart low carbon forestry/agri/aqua culture
3. Integrated approach in Biorefineries to valorise the biomass
4. Level playing field between energy and biomass is required
5. Volumes will come from energy
6. Examples of Implementation of biorefineries exist
7. Collaboration opportunities exist and can be expanded
 - I. Collaboration with regions offer additional opportunities
 - II. Saksen -> Tsech? Poland? (EFRO support)



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*Thank you for
your attention*

Questions?

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