

Country Report The Netherlands

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### 1. Introduction

Key drivers for the adoption of biorefineries in different market sectors

Chemical Industry	Energy industry	Agro (food/feed) industry
Legislative and consumer requirements for end-products		
Reducing the use of non-renewable fossil resources		
Cleaner and safer chemical manufacturing	Improve economics of biofuels by co-producing value-added products from residues	Improve economics of the full food product lifecycle by producing added-value products from wastes
<i>What is waste in the agro-industry is a renewable raw material for the chemical and the energy industry !</i>		

## 2. Biomass-related national policy goals (1)

- 9% renewable power in 2010
- 10% renewable energy in 2020 (5% in 2010)
- EU (2007): 20% renewable energy in 2020 – NL 20%?
- EU: 5.75% biofuels for transport in 2010 – NL the same
- EU: 10% biofuels for transport in 2020 – NL the same
- 25% biofuels for transport in 2030 (Vision EU TP Biofuels)

### 2. Biomass-related national policy goals (2)

***LT-Vision (Dutch Platform Biobased Raw Materials\*)***

30% of the fossil fuel resources used as both raw materials and fuels should be replaced by bio-based alternatives in 2030

Application	Fossil fuel substitution [%]	Fossil fuel substitution [PJ <sub>th, affu</sub> ] <sup>1</sup>	CO <sub>2</sub> -emission reduction [Mt/a]
Biofuels for transport	60	324	24
Chemicals & materials	25	140	11
Power	25 <sup>2</sup>	203	14
Heat	17 <sup>3</sup>	185	10
Sum		About 850	59

\*Advisory Committee Dutch Government; <sup>1</sup>avoided fossil fuel use; <sup>2</sup>Full plant substitution necessary; <sup>3</sup>Mainly SNG  
Assumption is that the overall energy consumption in 2030 = 2000 = 3000 PJ<sub>th</sub>

### 2. Biomass-related national policy goals (3)

- 850 PJ<sub>th,affu</sub> will require about 1200 PJ<sub>th</sub> raw biomass materials or about 80 Mt dry base per year
- Gross Dutch biomass production = ((import-export) + production): 42.3 Mt or 742 PJ<sub>th</sub> in 2000; only a small amount was available for non-food applications
- Projection Dutch biomass availability for non-food applications in 2030:
  - 6 Mt db primary by-products (100 PJ<sub>th</sub>)
  - 12 Mt db secondary by-products (200 PJ<sub>th</sub>)
  - 0-9 Mt db energy crops (0-150 PJ<sub>th</sub>)totally: 18-27 Mt db or 300-450 PJ<sub>th</sub> (excl. aquatic biomass)
- 60-80% of the required biomass in 2030 has to be imported !!!

### 2. Biomass-related national policy goals (4)

For the Netherlands the development and implementation of high efficiency biorefinery processes is an absolute necessity to meet the LT (2030) Vision Goal(s), i.e. to use the relatively cheap but low volume domestic biomass and the more expensive imported biomass (intermediates) as efficient as possible, and with the lowest overall environmental impact

### 3. Current national biomass use for energy (2006) (1)

Technology	PJ <sub>th, affu</sub>	Action Plan
Large-scale		
Direct / indirect cofiring – power	28	34
Domestic waste combustion facilities – CHP	12.1	20
Cement furnaces – heat	1.7	0
Small-scale		
Combustion CHP	2.7	8 – 18
Wood burners (houses) – heat	5.5	7
Wood burners (industry) – heat	1.85	
Landfills - CHP	1.5	2
Digestion (“GFT” and manure) CHP	0.38	4 – 6
Digestion (rioolwater) CHP	2.2	
Digestion (waste water) CHP	0.8	
Total	56.4	75 - 87

1.7% total primary Dutch energy use; all renewables: 2.5%

65 – 75% of 2010 Action Plan Goals

Country Report “Identification Current Processing Potential and Mapping Existing Biorefineries”

### 3. Current national biomass use for energy (2006) (2)

- Co-firing: mid-2006 MEP-grant 7 -> 2.5 €/kWh<sub>e</sub>, sustainability discussion (a.o. palm oil), criteria sustainable biomass production -> biomass-derived power 2<sup>nd</sup> half 2006 50% of 1<sup>st</sup> half

- New plants (> 2010)?:

- Maasvlakte (Electrabel): 700 MWe
- Maasvlakte (E.ON) : 1100 MWe
- Eemshaven (NUON): 1200 MWe
- Eemshaven (RWE): 1600 Mwe

All 10 -20% biomass co-firing; IGCCs and advanced combustion

- Domestic waste combustion facilities (MEP if eff. > 22%), import waste from Germany, increased capacity



### 3. Current national biomass use for energy (2006) (3)

- Small-scale CHP: 56 plants (56 MW<sub>e</sub>) in operation in 2006
  - 2 gasification plants
  - 14 combustion plants (4 new in 2006)
  - 40 digestion plants (14 new in 2006)

Mid 2006: MEP to 0, not for digestion (< 2 MW<sub>th</sub>);  
new alternative?

### 4. Mapping of Existing Biorefineries (1)

*Primary agricultural sector (small-scale initiatives)*

*Food industry (sugar, starch, oleochemistry, bioethanol, biodiesel, ...)*

*Non-food Industry (materials, products, ...)*

*Feed Industry*

*Pulp/paper Industry*

*Petrochemical Industry, incl. Conventional Oil Refineries*

*Power Production Industry*

*Others*

No data available yet, will be filled  
in asap

### 4. Mapping of Existing Biorefineries (2)

Goal of providing this data is getting an indication of the existing infrastructures already available in the partner countries.

This infrastructure could be the starting point for the short-term introduction of biorefineries into the market by upgrading of these existing conventional processes.

Maybe the title of these chapter should be “Mapping of existing industrial infrastructures”?

### *National Programmes*

## 5. RTD-activities (1)

- BBASIC (TUD, ...): Bio-Based Sustainable Industrial Chemistry – Large programmatic consortium of knowledge infrastructure and industry – process development for biomass conversion into chemicals using biocatalysts as micro-organisms and enzymes – biotech focus (NWO-ACTS)
- CATCHBIO (NIOK, ...): CATalysis for Sustainable CHEmicals from BIOmass – Large programmatic consortium of knowledge infrastructure and industry – Fuels, chemicals and pharmaceuticals from biomass – 12 out of 15 subprogrammes are biorefinery-related – catalysis focus (SmartMix, 28.4 M€, 2007 - 2015)

### *National Projects (EOS-LT)*

Max. grant: 1.2 M€

## 5. RTD-activities (2)

- Biobutanol (WUR, ...): ABE production, 2005-2008
- Coraf (TU, ...): Co-refining of biomass in existing refineries, 2006-2010
- LignoValue (WUR, ...): High Grade Valorisation of Lignin for Optimal Biorefinery of Lignocellulose to Energy Carriers and Products, 2007 – 2010
- N-Ergy (WUR, ...): Micro-biological co-production of N-chemicals and ethanol from biomass fractions, 2006-2009
- Optimal Lignocellulose Hydrolysis (WUR, ...): Maximising the bioenergy potential of lignocellulose biomass by mitigating the effect of hydrolysis inhibitors (humic and fulvic acids), 2006 – 2010
- Pectin Challenge (Nedalco, ...): bioethanol from sugarbeet pulp (2007-2010)  
Country Report “Identification Current Processing Potential and Mapping Existing Biorefineries”

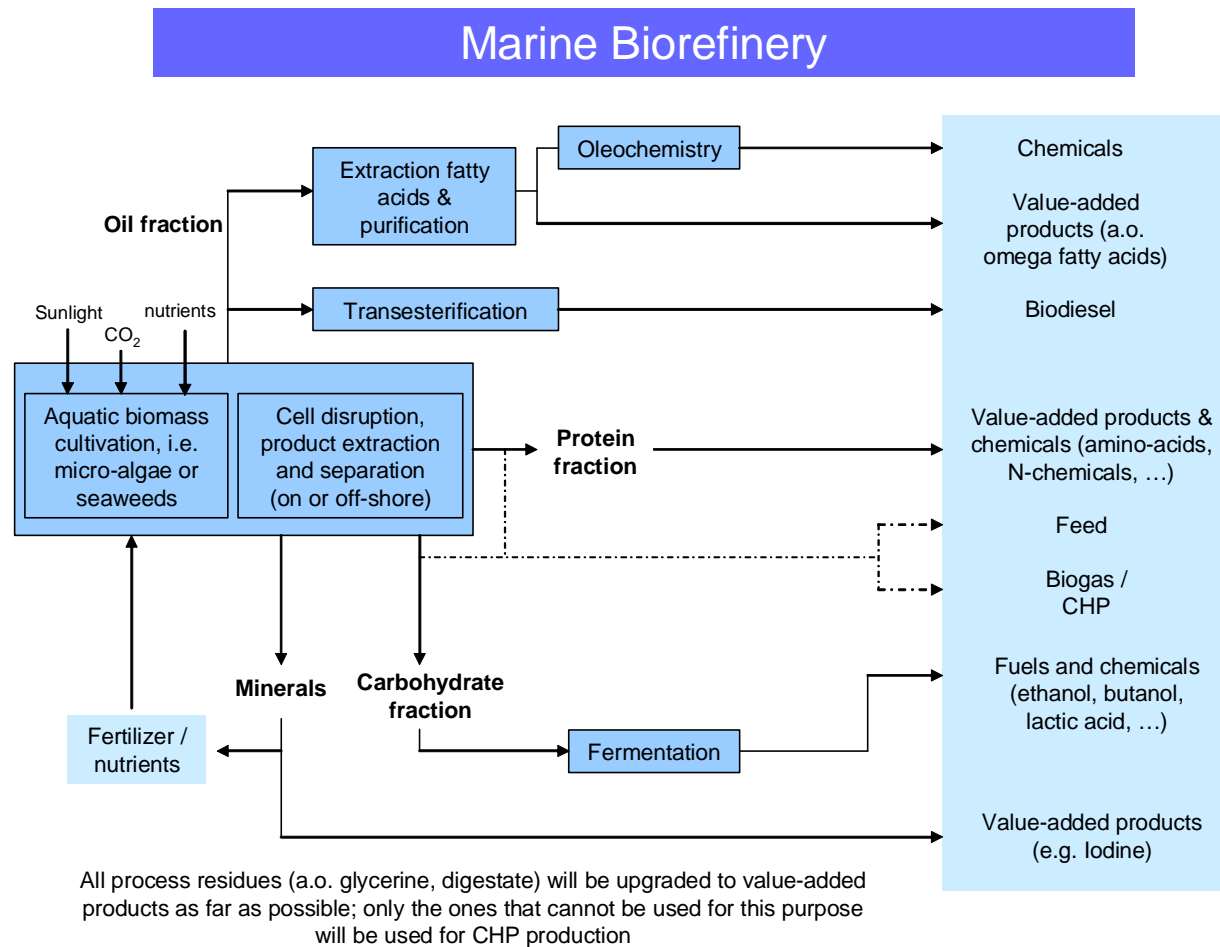
### *National Projects (others)*

## 5. RTD-activities (3)

- Thermo-chemical Biorefinery (ECN, TU)
- Staged (catalytic) biomass degasification (ECN)
- Local primary biorefinery (WUR)
- Advanced fermentation (WUR, TUD)
- Pre-treatment / hydrolysis (ECN, WUR, TNO)
- Functionalised chemicals production (WUR)
- Separation processes (universities, institutes, industry)
- (Catalytic) upgrading processes (universities, institutes, industry)
- New concept development, optimisation (WUR)
- Marine biorefinery (WUR, ECN, industry)
- • Country Report “Identification Current Processing Potential and Mapping Existing Biorefineries”

### *Aquatic Biomass*

## 5. RTD-activities (4)



### *National Problem*

## **5. RTD-activities (5)**

Unfortunately, at the moment no joint Research programme exists yet between the Energy sector and the Agricultural sector, comparable to the joint DOE-USDA initiative in the US.

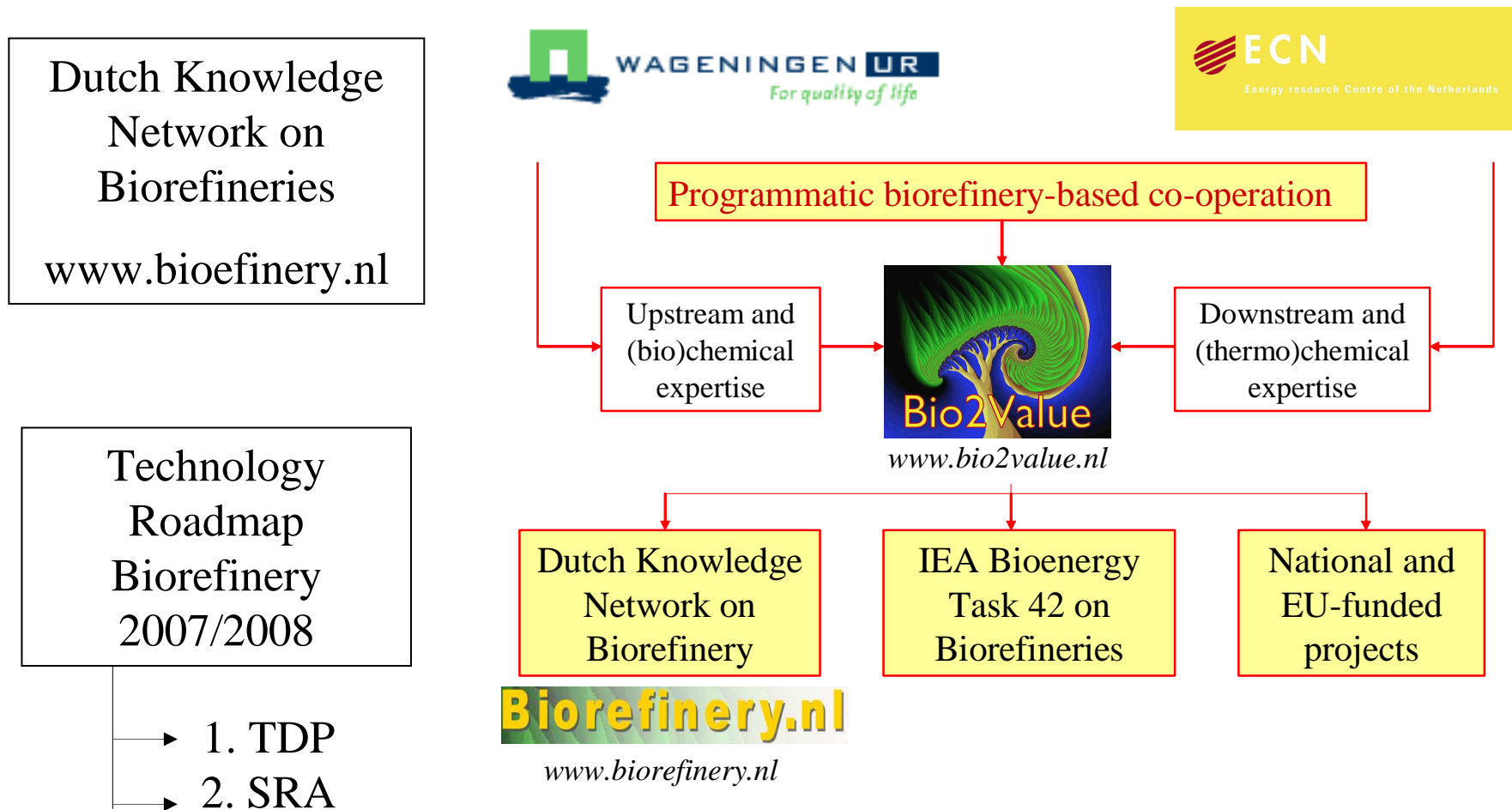
The result is that biorefinery research projects can hardly focus on biomass feedstock issues.

Because of this the development (and implementation) of full biorefinery chains is slowed down significantly.



### National Networks (1)

## 5. RTD-activities (6)



### 5. RTD-activities (7)

#### *International Projects with Dutch Involvement(EC) (1)*

- **BIOCOOP** (VTT, UT, ...): co-processing of upgraded bio-liquids in standard refinery units (FP6, 2006-2011)
- **BIOPOL** (WUR, ...): Assessment of BIOrefinery concepts and the implications for agricultural and forestry POLicy (FP6, 2007-2009)
- **BIOSYNERGY** (ECN/WUR, ...): BIOmass for the market competitive and environmental friendly SYNthesis of bioproducts and secondary enERGYcarriers through the biorefinery approach (FP6, 2007 – 2010)
- **EPOBIO** (CNAP, WUR, ...): Bioproducts from non-food crops (FP6, 2005-2007)

### 5. RTD-activities (8)

#### *International Projects with Dutch Involvement(EC) (2)*

- BIOREF-INTEG (WUR, ...): Development of advanced BIOREFinery schemes to be INTEGrated into existing industrial (fuel) producing complexes (FP7, 2008-2009)
- SUSTOIL (York, WUR, ...): ,, focus on biodiesel sector (FP7, 2008-2009)
- Green Biorefinery (JR, WUR, Bumaga, ...): Technical, economic and ecological optimisation of value chains by the introduction and efficient use of sustainable raw materials (SUSPRISE, 2008-2009)
- .....

### 5. RTD-activities (9)

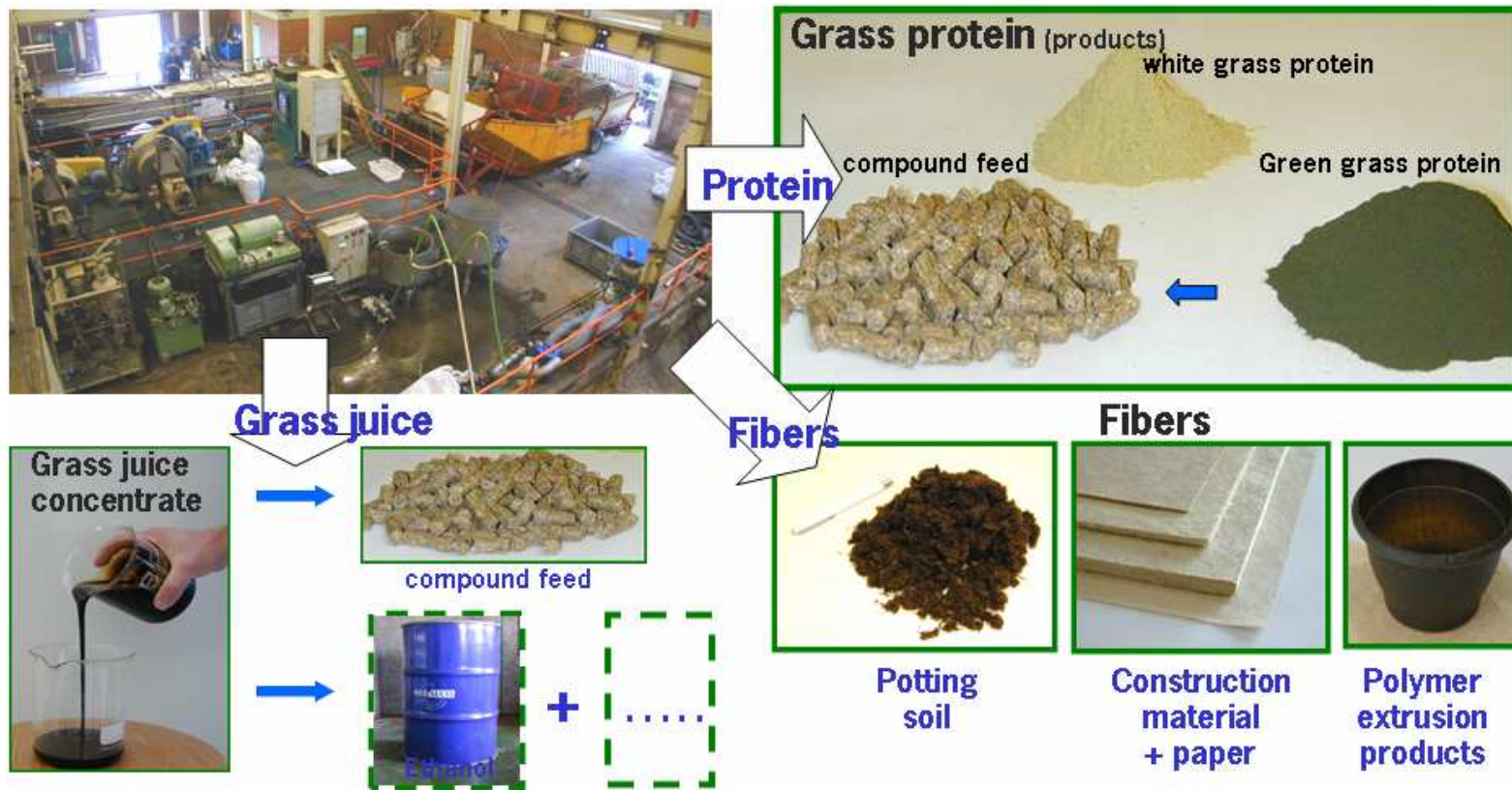
#### *Pilot Plan(t)s (1)*

- Beethanol (Agrologistiek, WUR): small-scale bioethanol production from arable crops (plans)
- Bioport (Harbours, WUR, ...): the Netherlands as Bioport for Europe (plans)
- Dutch Green Biorefinery of Prograss: operated in 2000 – 2002 (see figure), now plans for restart
- Grass Refinery (Courage, WUR): grass refinery to value-added products (see figure), bench-scale done, plan for pilot
- Lignocellulosic Ethanol (Nedalco): integration pilot-plant in existing bioethanol plant running on residues from Cargill (plan)

### 5. RTD-activities (10)

*Pilot Plan(t)s (2)*

*Pilot plant Green Biorefinery Prograss Consortium*



### 5. RTD-activities (11)

#### *Pilot Plan(t)s (3)*

##### *Courage Grass Refinery*



Harvesting



Pressing



Juice collection



Fibre pressing

### 5. RTD-activities (12)

#### *Pilot Plan(t)s (4)*

- Multi Purpose Biorefinery (Costa Due): improved utilisation and energy-efficient processing of forest/plant raw materials and by-streams (plan)
- FT-diesel production at Buggenum (Shell/ECN/...):  
small-scale FT-diesel pilot-plant running on cleaned/conditioned syngas sidestream from coal/biomass fired IGCC for power production
- .....

### *Demonstration Plants*

## 5. RTD-activities (13)

- **Bio Methanol Chemie Nederland (BIO MCN):**  
production of 900 kt/year 100% green biomethanol from glycerin
- **Biovalue:** advanced biodiesel production (a.o. glycerin to fuel additive, pharmaceutical acetates)
- **Multi Fuel Power Plant Eemshaven (NUON):**  
1200 MW<sub>e</sub> natural gas fired CC in the Eemshaven, within 2 year  
upstream coal/biomass gasifier, within x year multiple syngas-  
derived products



### 6. Major National Stakeholders (1)

<i>Industry (involved via biorefinery.nl)</i>		
ADM	DOW Europe	Paques
Akzo Nobel	DSM	Port of Rotterdam
Albemarle Catalysts	Dyadic Ned.	Port of Terneuzen
Avantium Catalysts	ENC	Purac
Avebe	Eneco	Rodenburg Biopolym.
BIOeCON	Essent	Royal Nedalco
BTG	Groningen Seaports	Sabic Europe
CCL	Meneba	Shell
Cosun	NOM	Sonac
Delta	NUON	

### 6. Major National Stakeholders (2)

<i>Institutes (involved via biorefinery.nl)</i>		
ECN	TNO	WUR – A&F
WUR - PRI		
<i>Universities (involved via biorefinery.nl)</i>		
Delft (TUD)	Eindhoven (TUE)	Groningen (RUG)
Leiden (UL)	Twente (TU)	Utrecht (UU)
Wageningen (WUR)	<i>Others</i>	
Energy Valley	EZ / SenterNovem	Greenpeace / WWF
KCPK	LTO-Noord / ZLTO	LNV
MVO	Natuur & Milieu	PGG
PHG	Rabobank	VNPI