Netherlands Enterprise Agency

Sustainable Biomass for Industry

By:

Kees Kwant

Content

- Biomass: a sustainable renewable resource
- Optimal use of biomass in biorefineries
- Implementation in the Netherlands, Refineries and Renewable Heat
- Conclusion

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Biomass a Sustainable and Renewable Resource

Global Biomass Resources [EJ/year]

- Photosynthesis

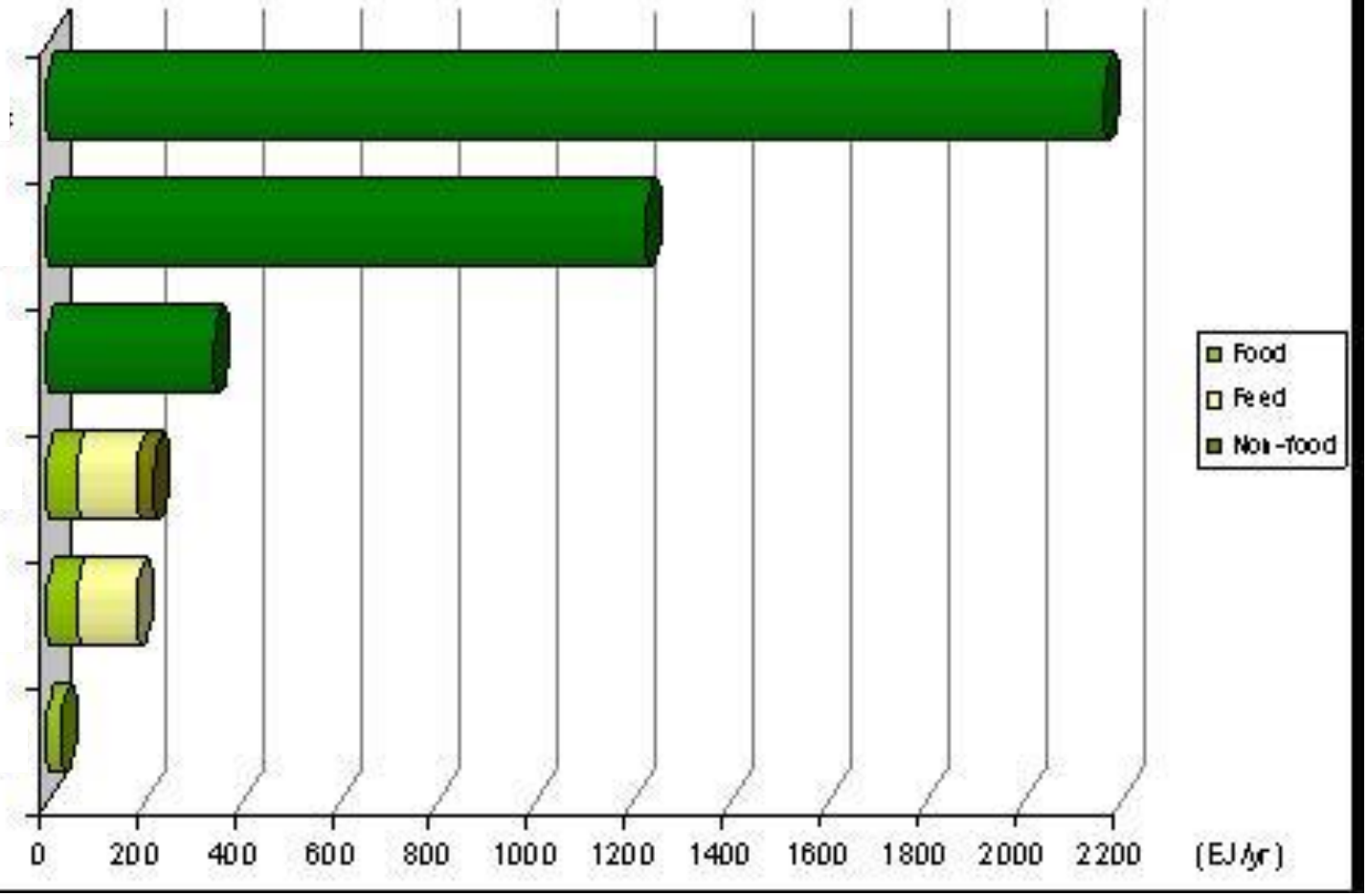
Above Ground

Total Extracted
For human use

Total Deployed

Edible Crop Harvest

Nutritianal Need



World Carbon based Resources (2010) [EJ]

[EJ]	Fossil		Biobased	
	Primary use	End Use	Primary use	End Use
Extracted	432		342	
Deployed	426		222	
Harvest			187	30
Feed			*124*	
El.&Heat	152	57	30	na
Fuels/others	275	235	6	na
non-energy	*33*		*na*	*na*

Ref: van Beeck, N., Moerkerken, A., Kwant, K.W., Stuij B. (2014).
"**An innovative perspective: Transition towards a bio-based economy**". In: Bundschuh, J. and Chen, G. (Editors). Sustainable Energy Solutions in Agriculture, Taylor & Francis Books, UK

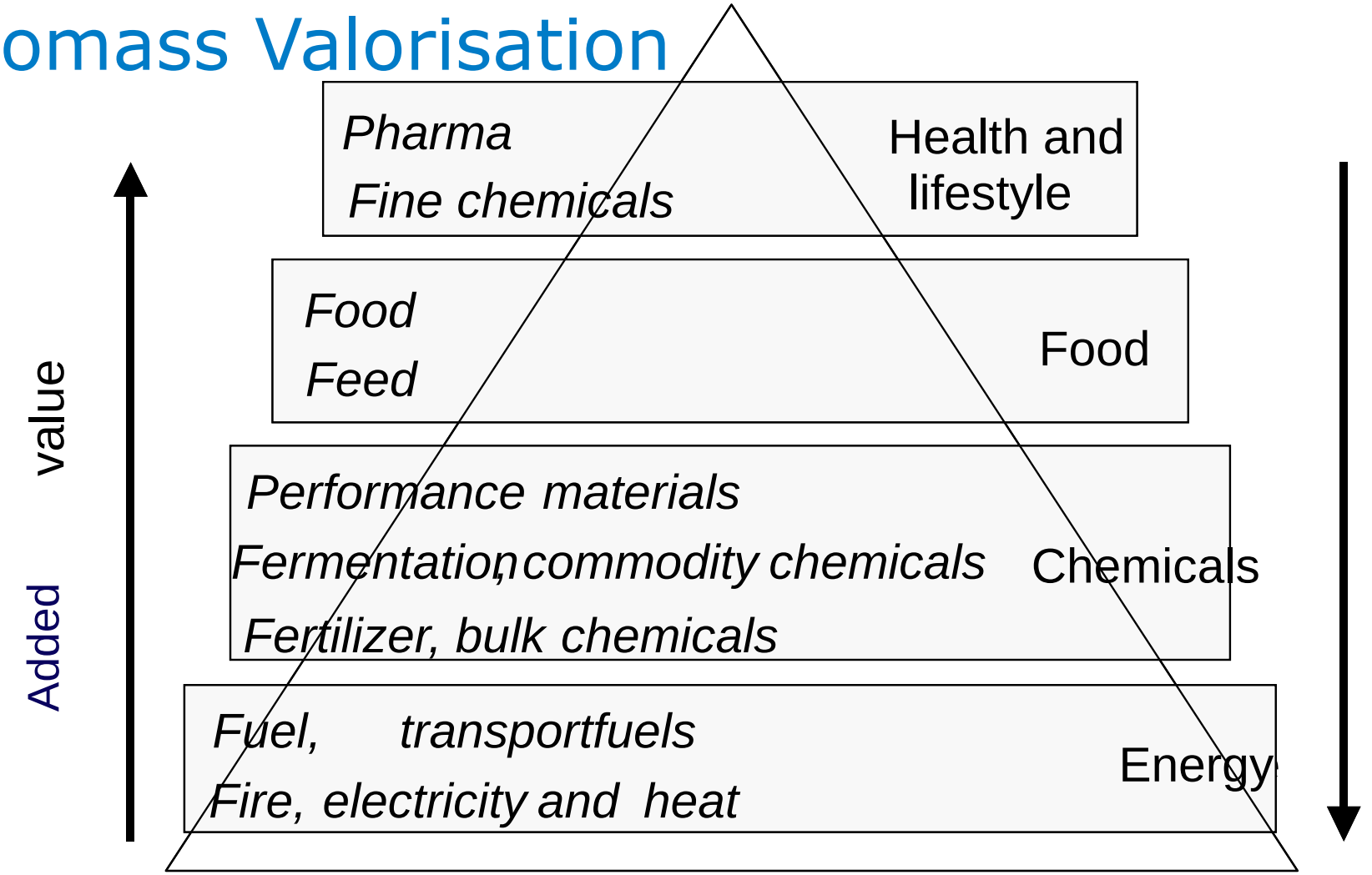
Vision Biobased Economy

Sustainable Production and Use of Biomass:

- *People*: food security, land rights, prosperity
- *Planet*: soil, water, air, GHG, biodiversity
- *Profit:* businesscases

Proven Sustainable Biomass does not come automatically

Biomass Valorisation



Sustainable Biobased Strategy

Integrated Food & Materials production

- Smart agriculture
- Increased production

Sustainable and Rural Development

- Local Resources and local use
- Tapping unused or abandoned land

Smart use of biomass

- Circular Economy, Cascading
- Biorefinery

Ref: http://www.sahyog-europa-india.eu/images/D2_3_Strategic_Advise_on_Biobased_Research_based_on_Sahyog_inventory_V3.pdf

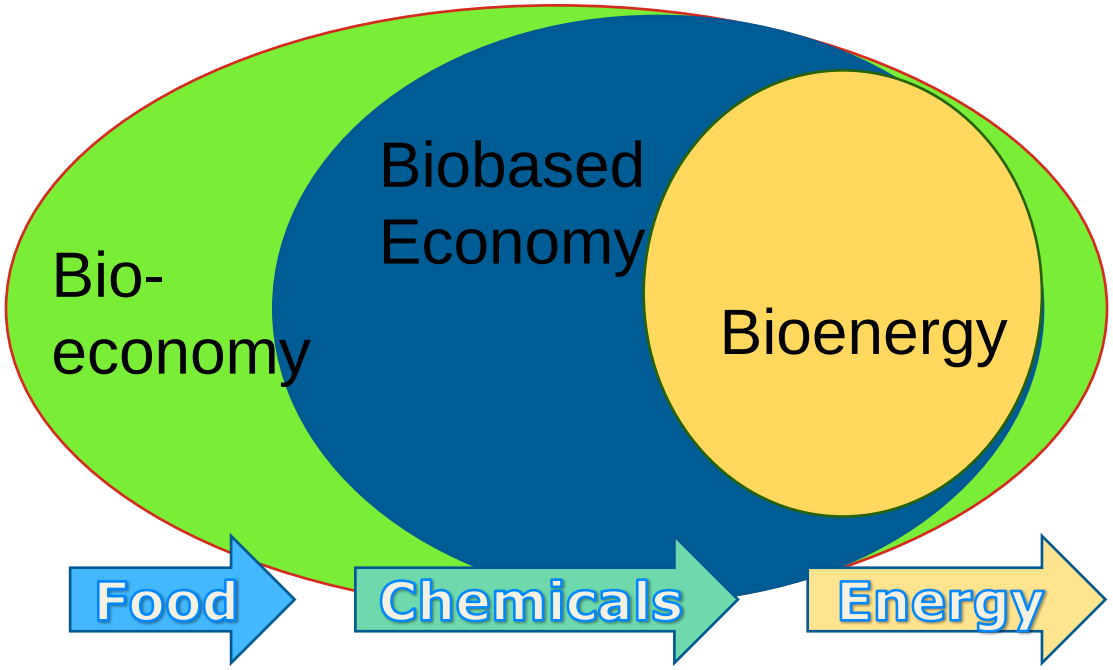
Biobased Economy part of Bioeconomy

A Biobased Economy

is a sustainable
Economy,

optimising
Economic value and
Natural value of biomass

by
Replacing Fossil
Resources



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Trias Biologica

Principles to improve the use of Energy

Trias Energetica

- Energy Savings
- Renewable Energy
- Efficient Use

Principles to improve the use of Energy and Biomass

Trias Energetica

- Energy Savings
- Renewable Energy
- Efficient Use

Translation to Biomass

- Energy -> resources
- Renewable Resources
- Recycle/ Reuse

Principles to improve the use of Energy and Biomass leads to the Trias biologica

Trias Energetica

- Energy Savings
- Renewable Energy
- Efficient Use

Trias Biologica

- Decarbonise resources
- Substituion fossil with Biobased
- Cascading, Circular chains

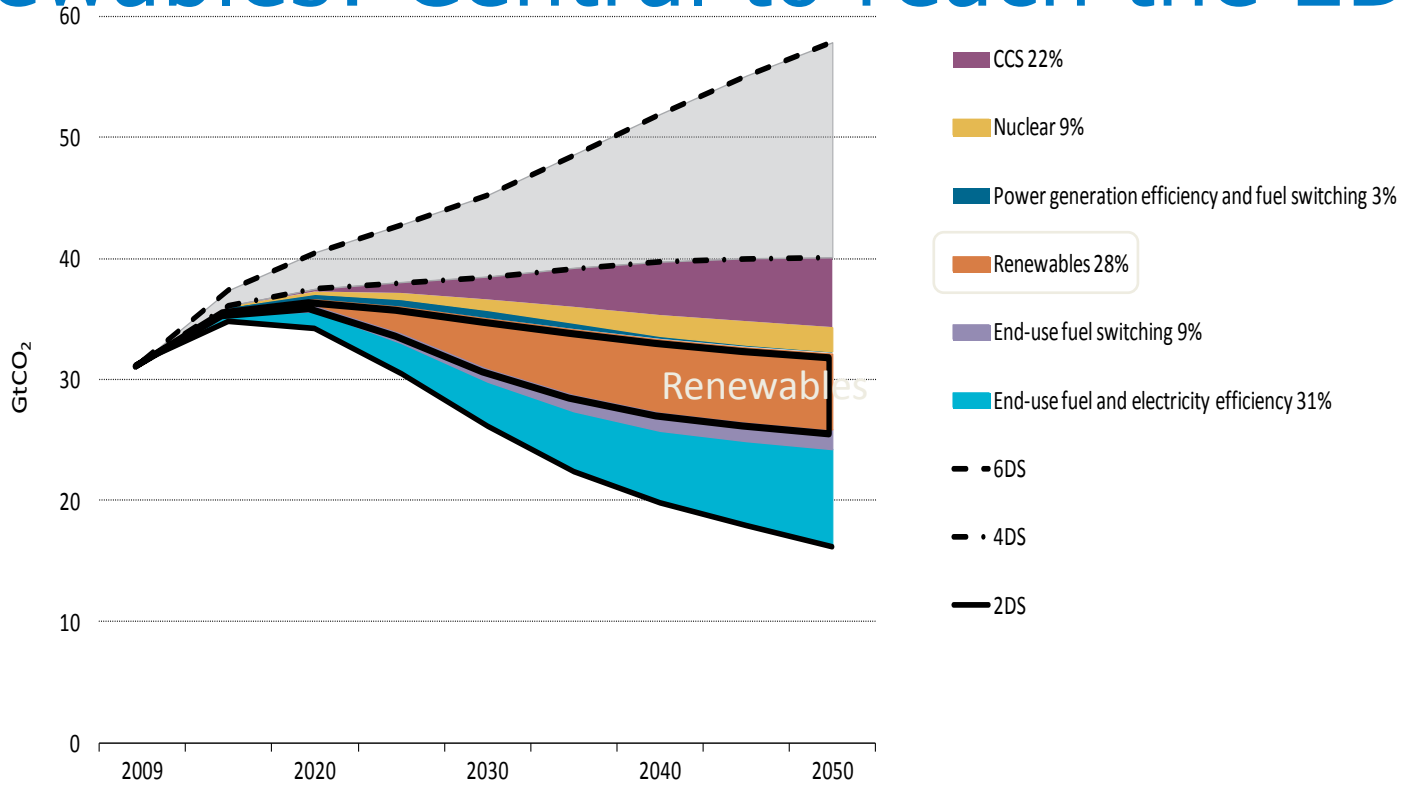
Biomass Contribution to Global Energy and Materials supply

- Business as Usual: 500 -> 800 EJ in 2050

- 1. Decarbonising

- IEA: 2DS:
  - Energy savings
  - Carbon Capture
  - Renewable Electricity from Solar / Wind

Renewables: Central to reach the 2DS



Renewables provide almost 30% of the cumulative reductions needed to reach the 2DS.

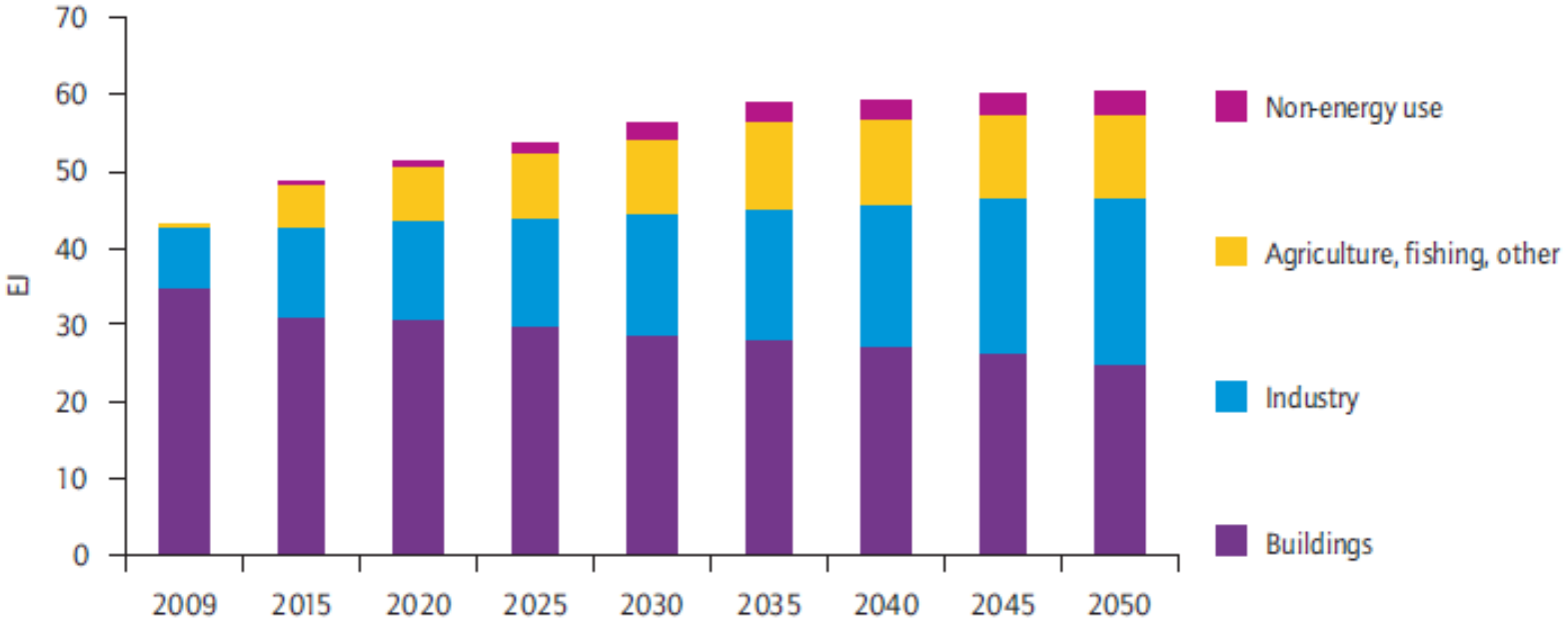
Biomass Contribution to Global Energy and Materials supply

- IEA: 2DS 2050

- 2. Substitution
  - Replacing Fossil Carbon with Biobased Carbon

  -> IEA Roadmap:
  - Bioenergy
  - Bioelectricity
  - Biofuels

IEA Roadmap Vision World Final Bioenergy Consumption



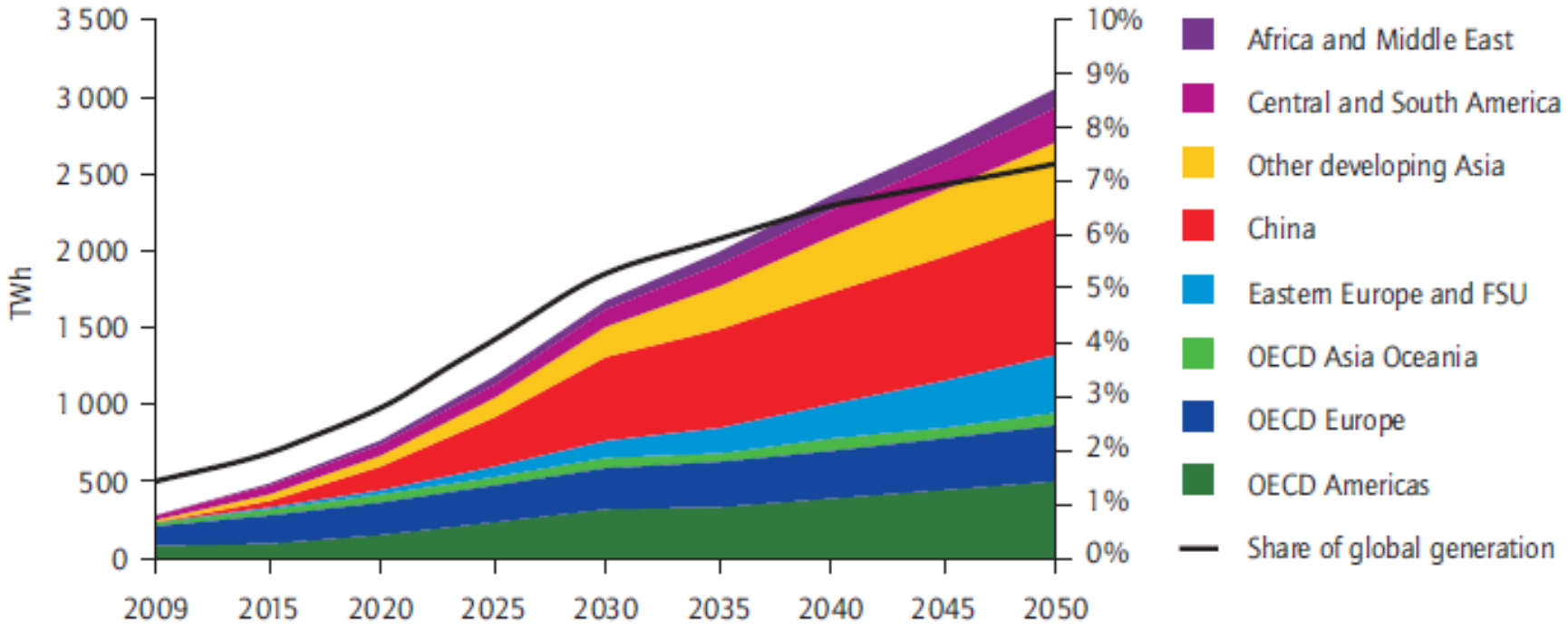
Note: Bioenergy use in the buildings sector is for both heating and cooking. Demand for transport fuels is not shown here since this has been discussed in a previous roadmap (IEA, 2011b).

The above figure includes traditional use of biomass and the transition towards efficient cook stoves.

Increasing bioenergy for productive use (not transport)

IEA, Technology Roadmap Bioenergy for Heat & Power

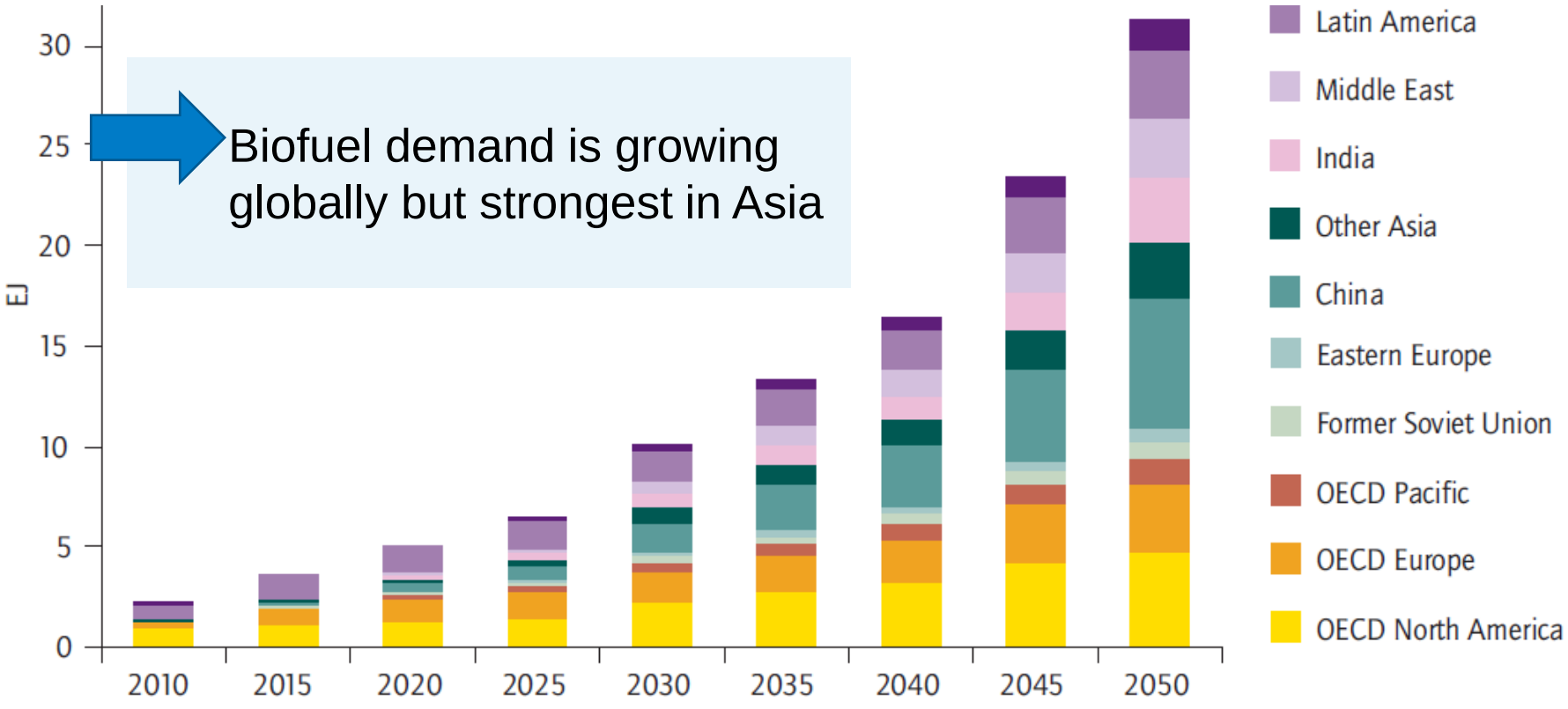
IEA Roadmap vision of Bio Electricity



Very strong growth of global bioelectricity generation, especially Eastern Europe/FSU, China and other developing Asia

IEA, Technology Roadmap Bioenergy for Heat & Power

IEA Biofuel Demand 2010 - 2050



Note: FSU= Former Soviet Union.

IEA 2011, Technology Roadmaps: Biofuels for Transport

Biomass Contribution to Global Energy and Materials supply

- IEA: 2DS 2050

- 2. Substituion
  - Replacing Fossil Carbon with Biobased Carbon

  -> IEA Roadmap:
  - Bioenergy: 40 -> 60 EJ, (cooking -> CHP)
  - Bioelectricity: 500 -> 3000 TWh (< 7%)
  - Biofuels: 3 -> 30 EJ

  3. Cascading to make sufficient supply possible

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Industrial Approach

Sector Integration

Biorefinery

Biorefineries in the Netherlands

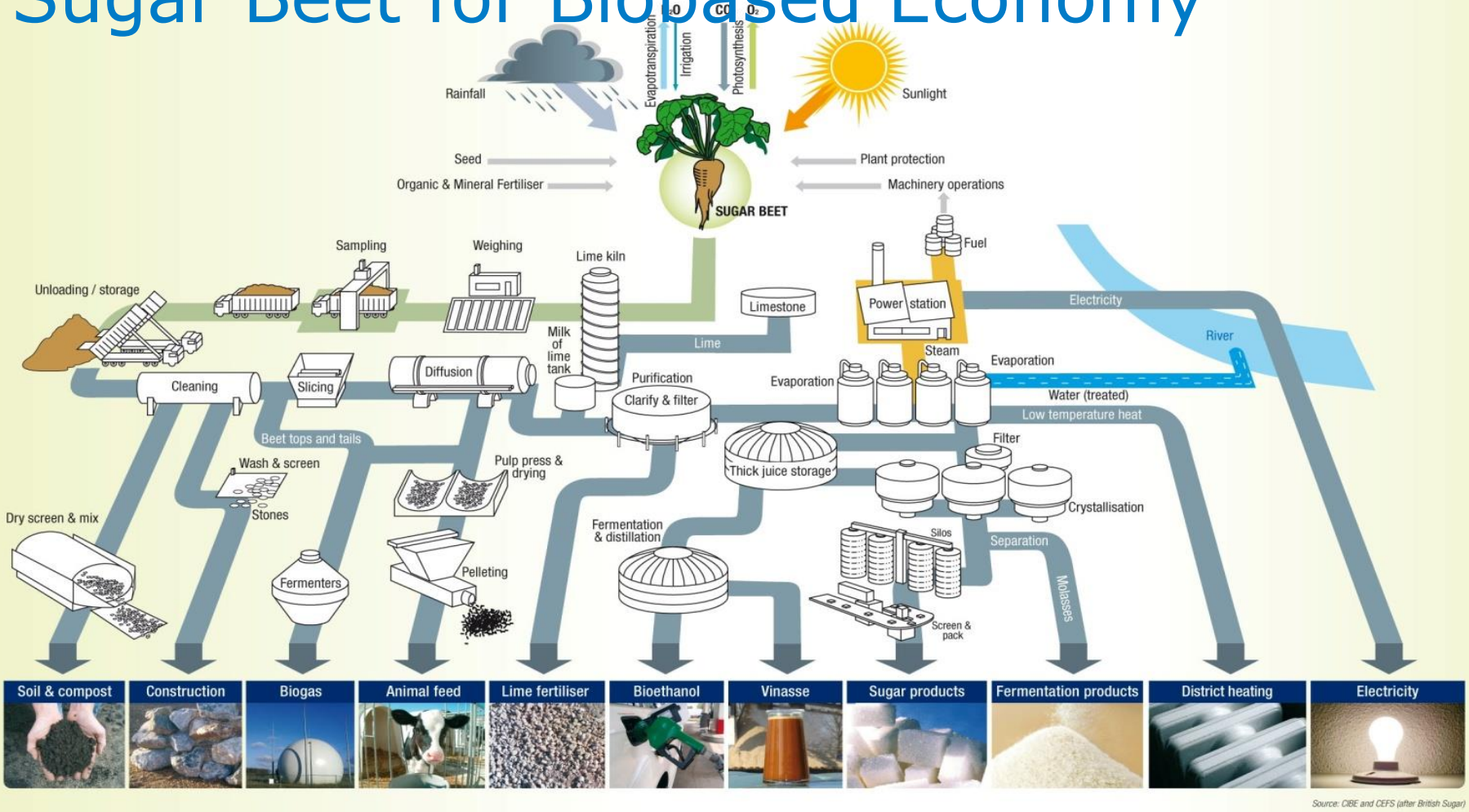
Unbeatable beat

Biorefinery

- Create value for farmer
-
22 – 25 ton/ha
-
Use beat, leaf, root

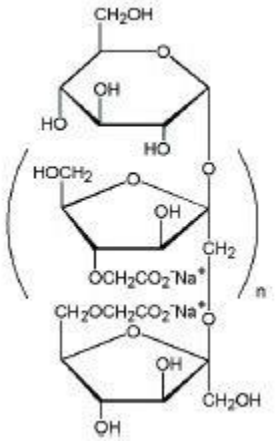
-Pilot products for chemical industry

Sugar Beet for Biobased Economy



Source: CIBE and CEFS (after British Sugar)

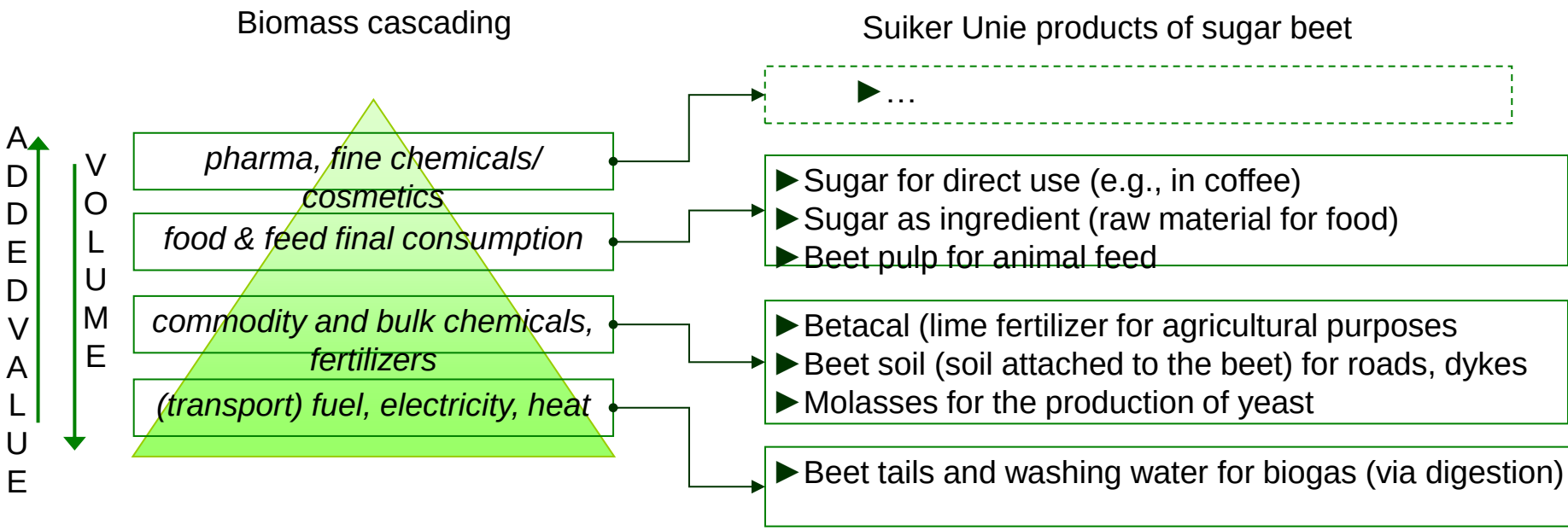
Cosun Biobased Products



->Carboxy*line* ® CMI (Carboxy Methyl Inulin), a green antiscalant for various industries;
->Beta*fib* ® MCF, natural fibers used in many different industrial products;
->CATIN ® (Cationic Inulin);
->Beta*well* ® special sugars, for application in cosmetic and personal care products;
->Biobased chemical building blocks, e.g. furane di-carboxylic acid;
Biobased plasticizers

http://cosunbiobased.com

Biomass Cascading and Valorisation



http://cosunbiobased.com

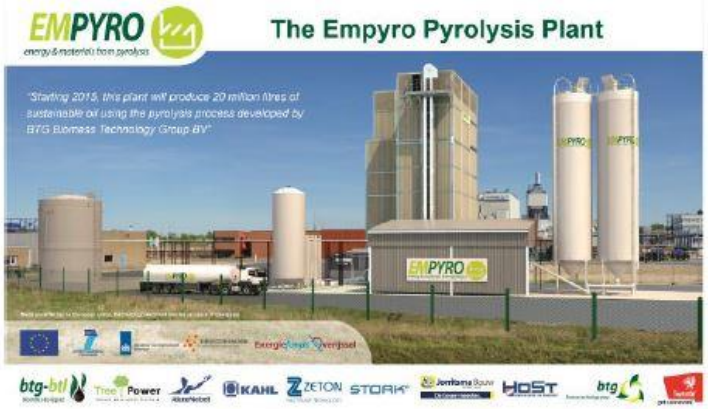
VION Ecoson (2013)

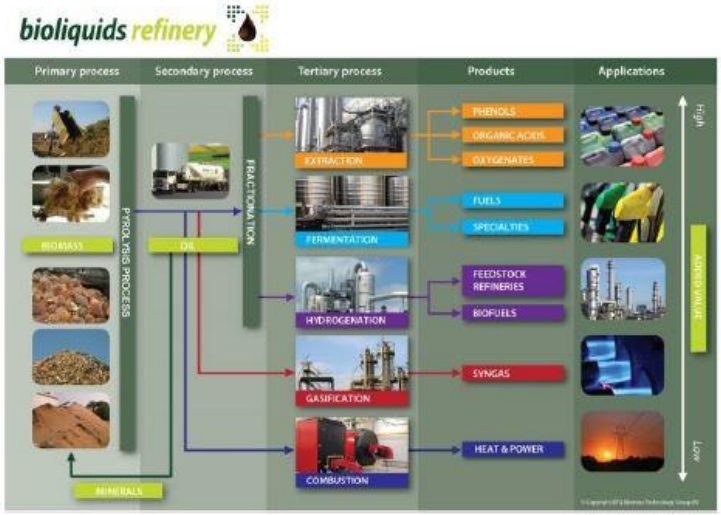
- Integrated production of biogas, CHP and biodiesel from animal waste
- Production capacity per year:
  - 9,000 MWh from biogas
  - 50,000 ton refined fat
  - 5,000 ton biodiesel
- Biophosphate plant opened officially on 6th October 2014

http://www.ecoson.nl

Empyro pyrolysis plant (2014)

- Construction of pyrolysis plant started in February 2014
- Modules
- Feedstock e.g. wood chips
- Production of 20 million litres of pyrolysis oil per year
- Pyrolysis oil used for bioenergy (ST) and chemicals (LT)

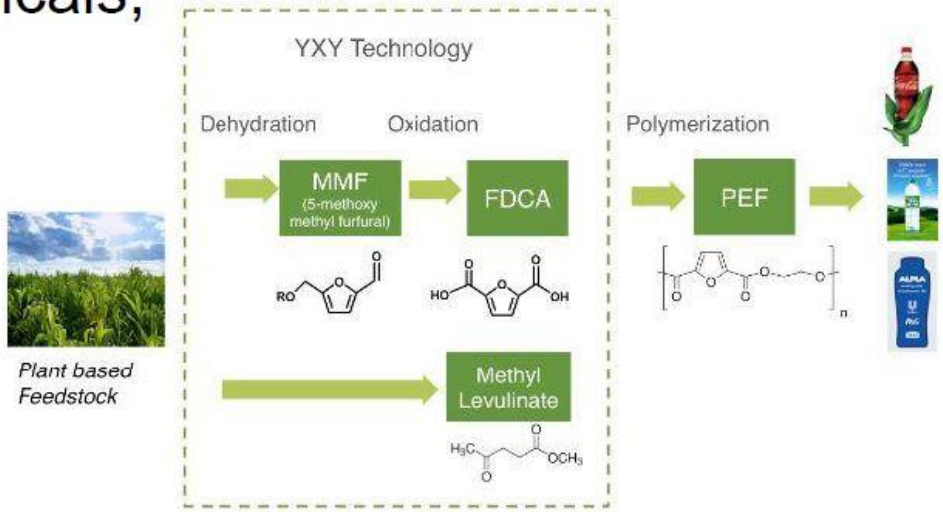




http://www.empyroproject.eu

Avantium YXY Technology

- 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



http://www.avantium.com

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Other Biorefineries

Running commercial biorefineries (6)

Pöls- Biorefinery in Austria

State-of-the-art: Commercial Scale

Type of biorefinery: 3-platform biorefinery producing pulp, paper, tall oil, turpentine, bark and electricity & heat from wood

Location: Pöls, Austria

Owner: Zellstoff Pöls AG, Heinzel Holding GmbH, EMACS Foundation

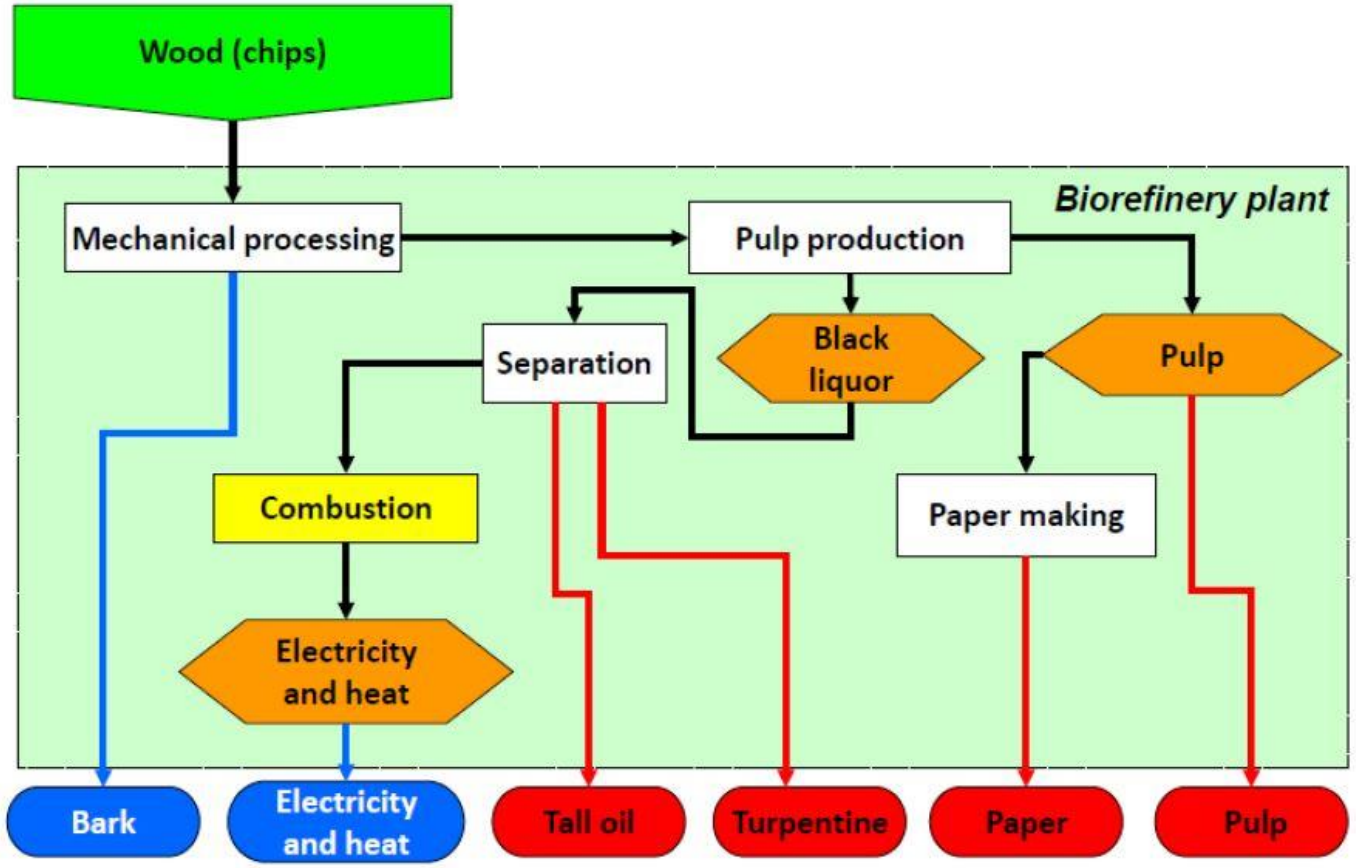
Feedstocks: Wood

Outputs: Pulp, paper, tall oil, turpentine, bark and electricity & heat

Source: Agrana, 2013

Running commercial biorefineries (7)

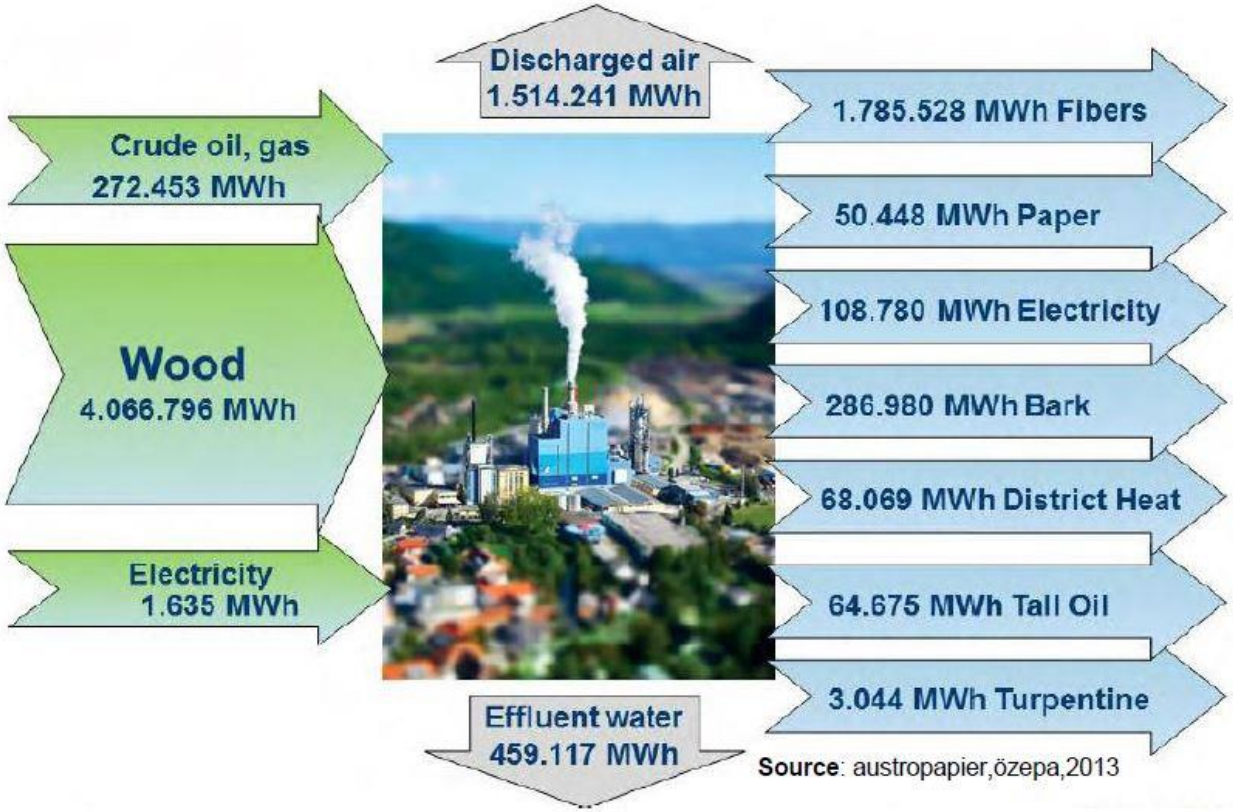
The Concept of the Biorefinery Pöls



Source: Agrana, 2013

Running commercial biorefineries (8)

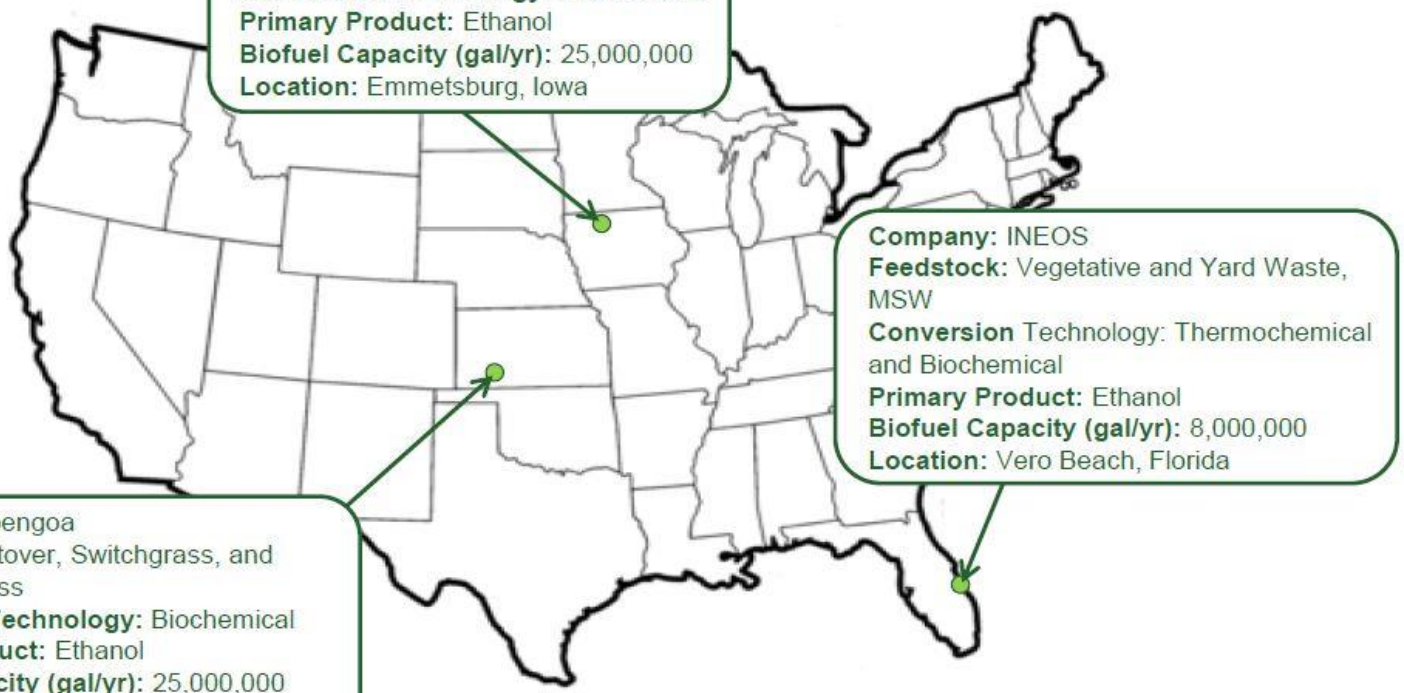
Input- Output ratio of the Biorefinery Pöls



Source: austropapier,özepa,2013

→ Pöls supplies **15000 households with heat** in the local area and is able to supply **35000 households with electricity**

Running Commercial Biorefineries



Biorefinery Demonstration and Pilot Plants

Project (State)	Feedstock	Product	Scale	MGY
Algenol (FL)	Carbon Dioxide, Algae, Sunlight	Ethanol	Pilot	0.1
API (MI)	Woody Biomass	Ethanol, Potassium Acetate	Pilot	0.8
Bioprocess Algae (IA)	Carbon Dioxide, Algae, Sunlight	Algae Oil to Jet A	iPilots	TBD
Frontline (IA)	Carbon Dioxide, Algae, Sunlight	Jet Fuel and Diesel Fuel	iPilots	0.02
Haldor Topsoe (IL)	Wood Pellets	Renewable Gasoline	Pilot	0.345
ICM (MO)	Corn Fiber, Switchgrass, Energy Sorghum	Cellulosic Ethanol	Pilot	0.26
Mercurius (WA)	Carbon Dioxide, Algae, Sunlight	Ethyl Levulinate	iPilots	0.25
Myriant (MI)	Non-Food Cellulosic Feedstock	Bio-succinic Acid	Pilot/ Demonstration	30 MM lb/year
Sapphire (NM)	Carbon Dioxide, Algae, Sunlight	Jet Fuel and Diesel Fuel	Demonstration	0.5
Solazyme (IL)	Sucrose (From cane), Municipal Green Waste, and Switchgrass	Biodiesel and Renewable Diesel from Purified Algal Oil	Pilot	0.001
UOP (HI)	Agricultural and forestry residue, wood, energy crops, and algae	Gasoline, Diesel, and Jet Fuels	Pilot	0.01
Zeachem (OR)	Woody Biomass and other Cellulosic Feedstocks	Ethanol and Intermediate Chemicals	Pilot	0.25

IEA Bioenergy

Task 42 Biorefining

Running commercial biorefineries

Kinleith Pulp Mill

Type of biorefinery: A 3-platform (pulp, black liquor, electricity/heat) biorefinery producing pulp/paperboard products, electricity and heat, and chemicals from wood.
Location: Tokoroa, New Zealand
Owner: Carter Holt Harvey (to be purchased by Oji Oceania Management (NZ) Ltd)
Description of the plant: New Zealand's largest pulp and paper mill producing bleached softwood kraft pulp and paperboard products from *Pinus radiata* wood. Black liquor and waste wood are burnt to generate electricity and heat. Chemical by-products including crude tall oil, crude turpentine and terpene extracts.

SCION
forests · products · innovation

IEA Bioenergy

Task 42 Biorefining

Running commercial biorefineries

Edgecumbe Milk Processing Plant

Type of biorefinery: A 2-platform (whey/protein) biorefinery producing food products and bioethanol from milk

Location: Edgecumbe, New Zealand

Owner: Fonterra Cooperative Group Ltd

Description of the plant: Fonterra's Edgecumbe milk processing plant processes 3.2 million litres of milk per day. Anchor Ethanol Limited (a subsidiary of Fonterra) produces ethanol from the whey/permeate by-product from the manufacture of cheese and protein products. The Edgecumbe plant, together with two other plants (Tirau, Reporoa) can produce 15 million litres of ethanol/year.

SCION
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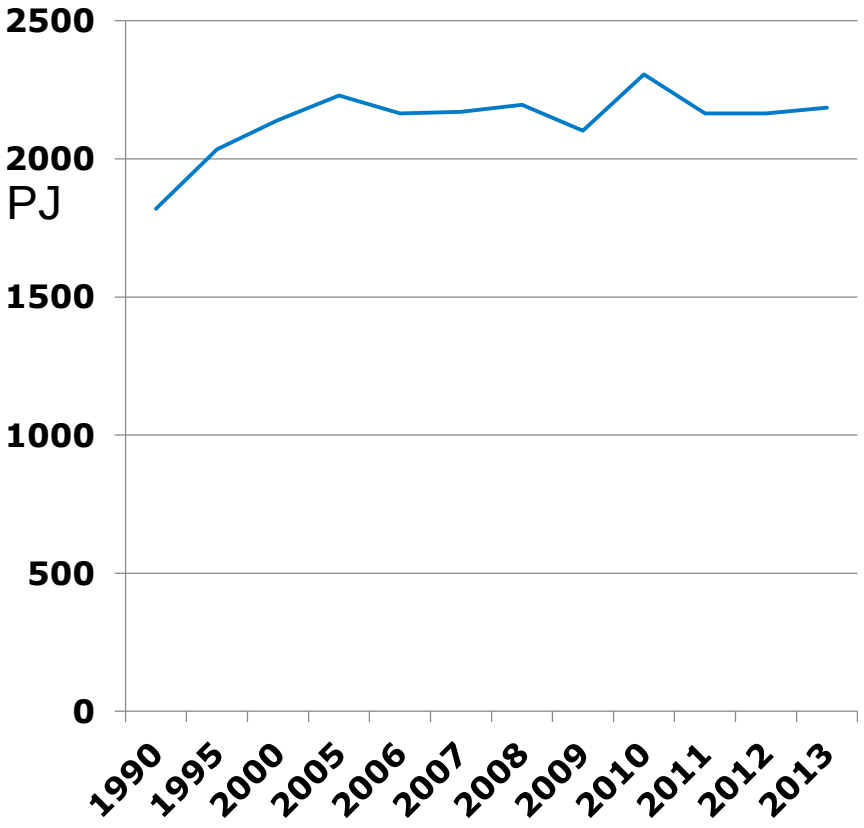
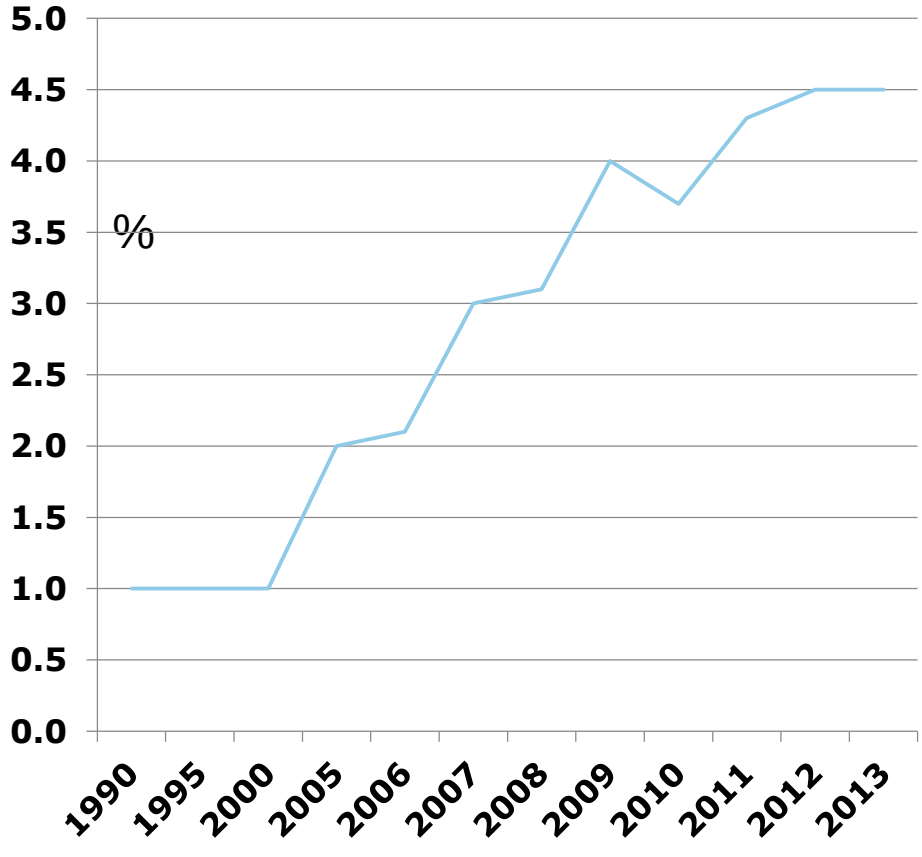
Biomass for Renewable Energy

Final energy end use and % Renewable Energy



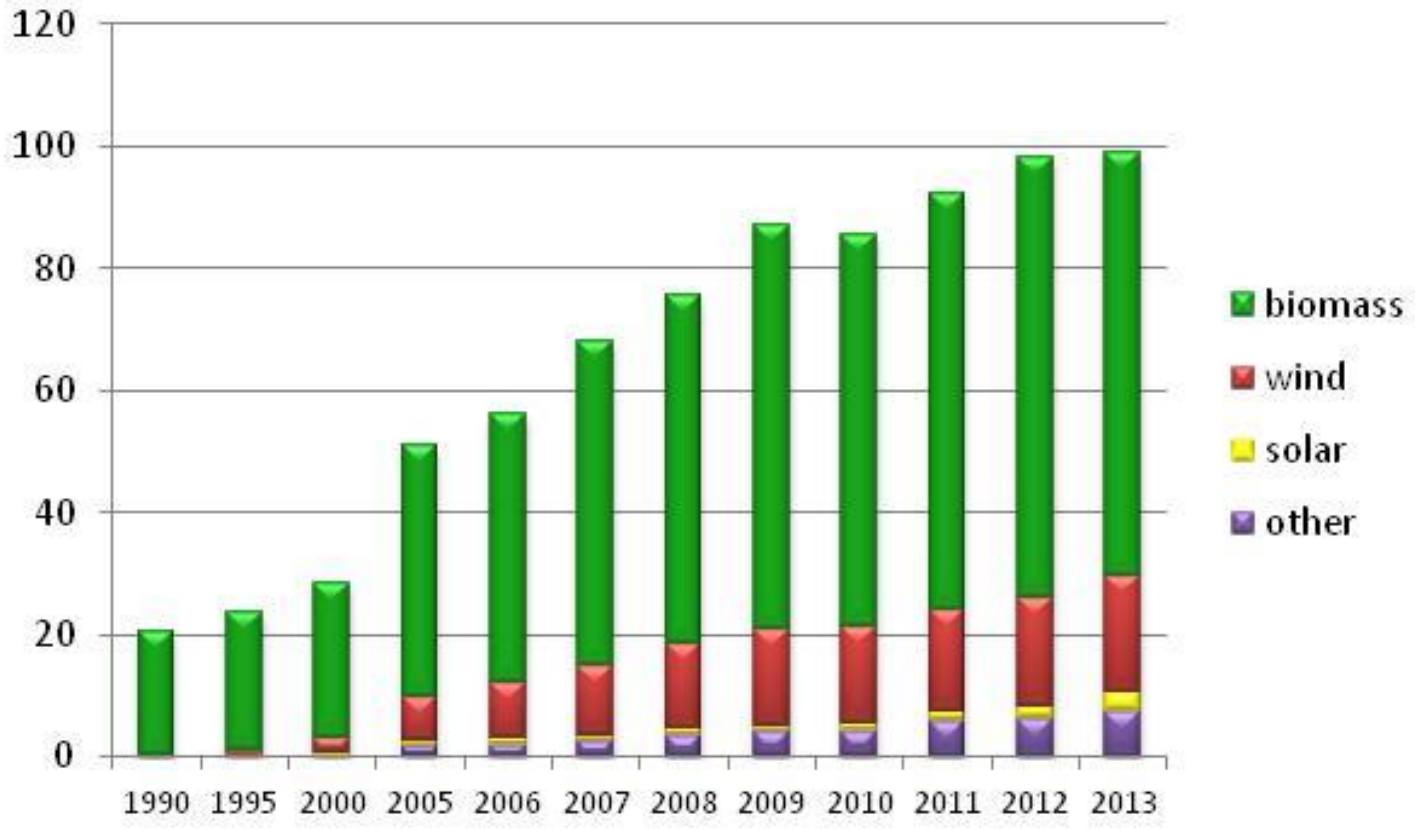


Changing policies, changing instruments

- 1995 – 2002:
- Goal for 2010: 5% Renewable Energy
- by: **Support for Green Electricity**
- 2002 – 2006:
- Goals set by EU directives for 2010:
- electricity: 9%, biofuels 5,75%
- by. **Support by MEP subsidy scheme for Power**
- 2007 – 2010:
- Goals government at 20% Renewable Energy in 2020
- by **Support by SDE for Power**
- obligation for liquid biofuels
- 2011 - :
- Goal defined by RED: 2009/28/EC : 14% RE
- **support by SDE+ for Power and Heat**

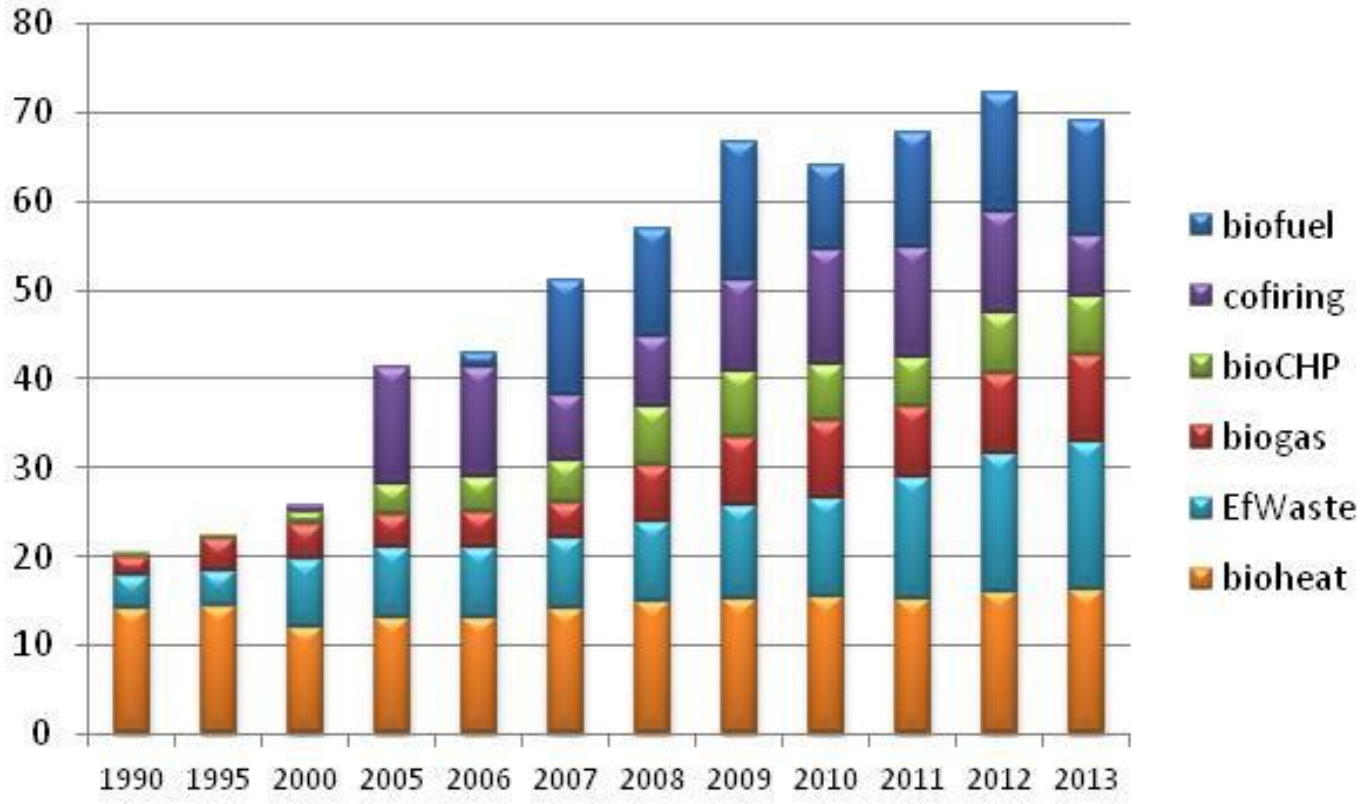
Results: About 70% realised with Bioenergy

- PJ



Bioenergy implementation Netherlands

- PJ



RE targets: RED: 2020: 14%

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Netherlands Energy Agreement , 2013

Agreement between parties:

- NGO
- Energy sector
- Industry
- Government

To realise 2020 targets

http://www.energieakkoordser.nl

Netherlands Energy Agreement in 10 points

1. Energy Savings: 1.5%/year
2. Upscaling Renewable Energy to 14% in 2020 (wind, bio)
   - With a cap of 25 PJ on cofiring
3. Decentral local renewable power/heat by communities
4. Smart Energy Transmission Network
5. ETS well functioning to stimulate CO2 reduction (- 80% in 2050)
6. Closing old coal fired power plants by 2016
7. Mobility and Transport (efficiency, electric, ..)
8. Employment (create 15.000 jobs by 2020
9. Energy Innovation for world first class cleantech solutions
10. Financing by banks

Specific Requests for biomass in Agreement

Sustainability

- Criteria in addition to NTA8080 by 31-12-2014
- For solid biomass for 25PJ cofiring
  - iLUC,
  - Carbon Debt

Cascading

- Intensify cascading for material use and energy
  - Create actions and pilots
  - Integrate in energy covenants
  - Verify EU legislation (EED)
  - Sustainable governmental procurement

Indicative Contribution of R.E. opti

Source	2013	2020	2023
Wind offshore	3,1	27,0	60,0
Wind land based	20,6	54,0	63,0
Solar PV	0,9	11,6	12,4
Cofiring	6,1	25,0	25,0
Waste Incineration	13,3	11,7	12,0
Biomass CHP	3,5	13,6	18,0
Biomass Heat	19,0	31,6	34,1
Biofuels	18,0	35,6	34,6
Renewable Heat	6,1	36,3	46,3
TOTAL	105,5	261,6	335,4
Percentage R.E.	4,4%	14%	16%

For Biomass:
2013: 59,9
2020: 117,5
2023: 123,7

Doubling the amount of biomass in 5 years

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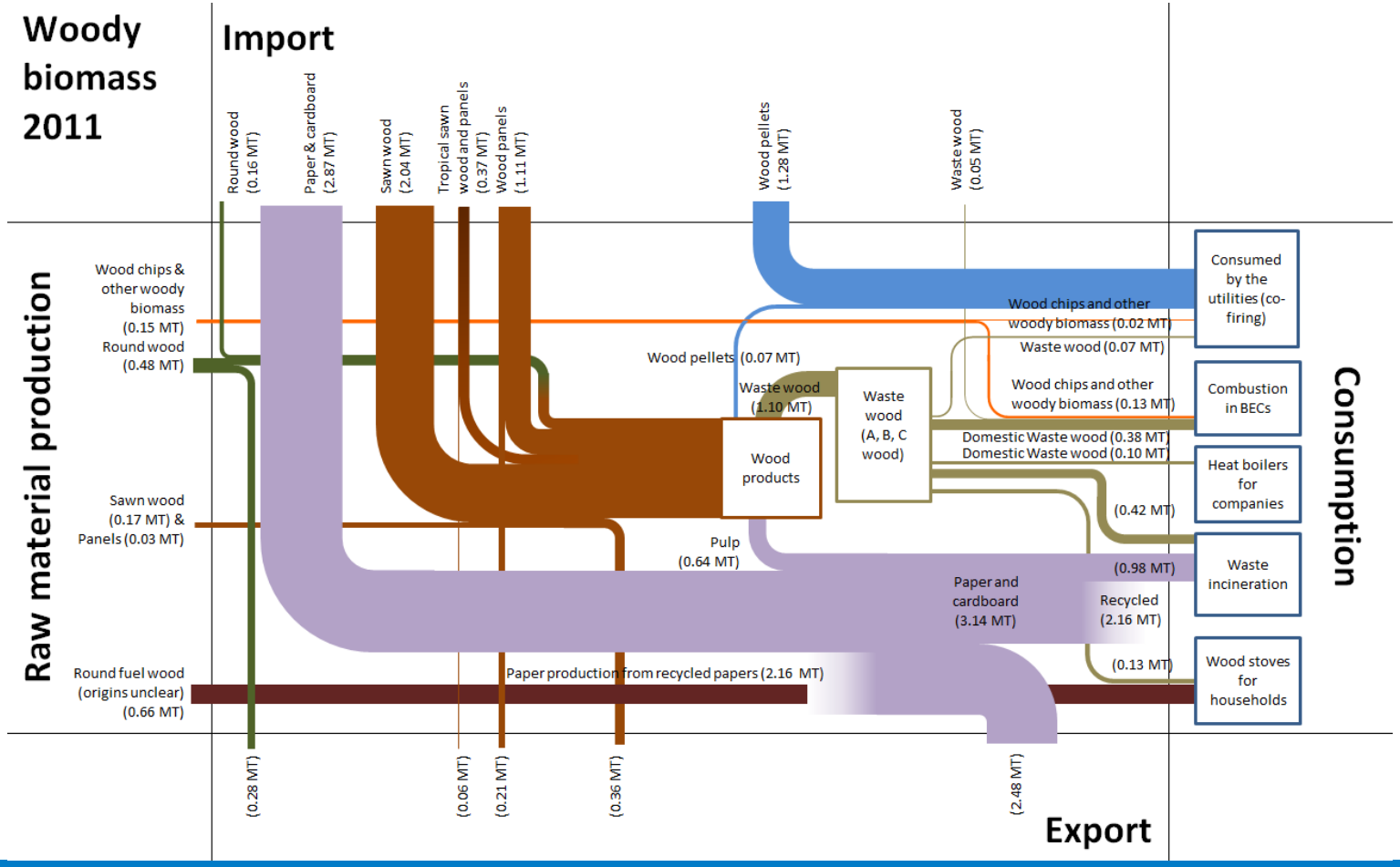
Biomass Supply Flows

Monitoring With:

IEA Bioenergy Task 40

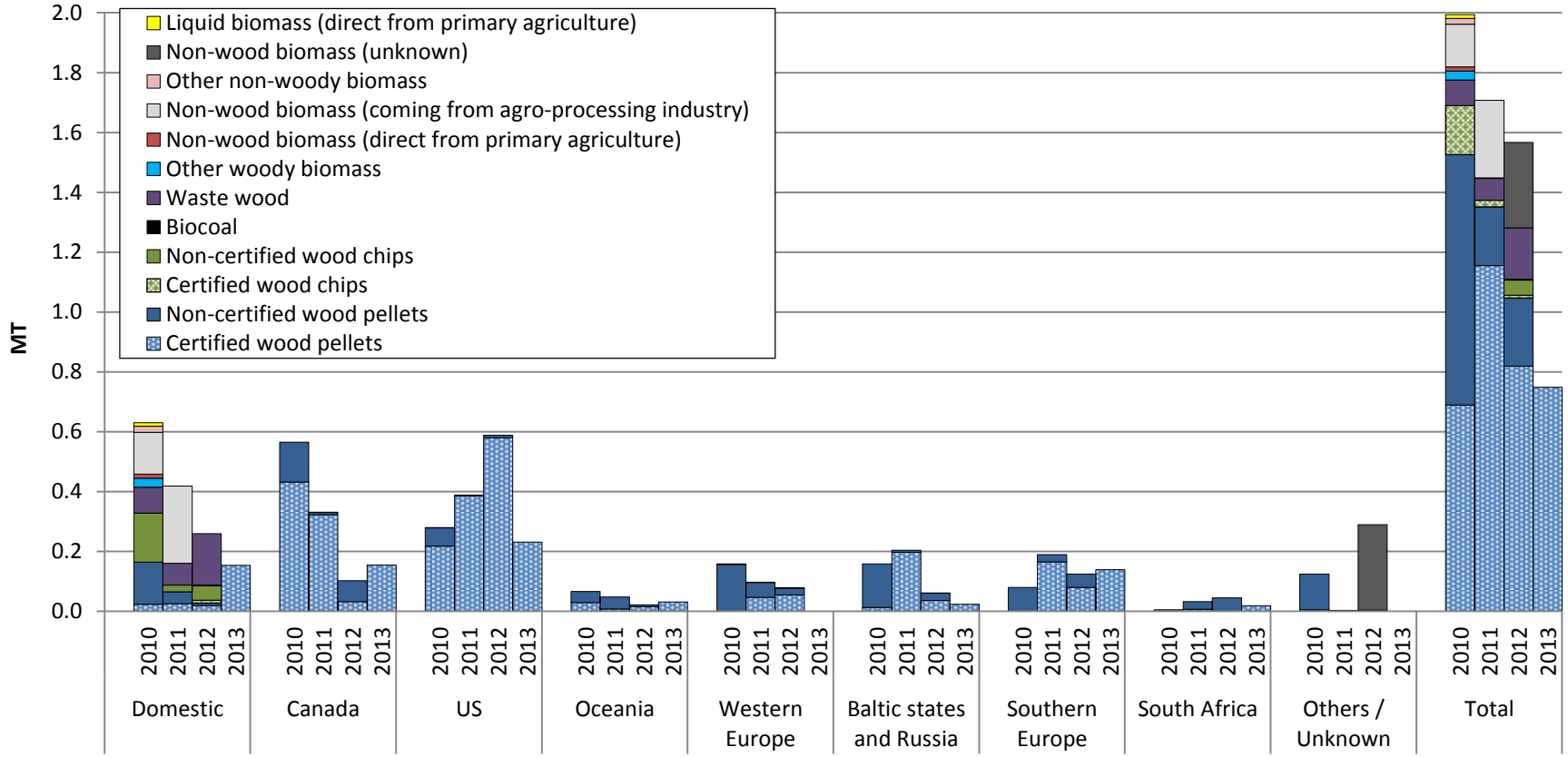
http://www.bioenergytrade.org

Woody Biomass



http://english.rvo.nl/topics/sustainability/sustainable-biomass/publications-results/monitoring

Biomass co-fired by the Dutch utilities in 2010 -2013



http://english.rvo.nl/topics/sustainability/sustainable-biomass/publications-results/monitoring

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Sustainability of biomass import in the Agreement

Energy Agreement for Sustainable Growth

Government and stakeholders agreed on a package to meet 2020 targets

1. An annual maximum of 25 PJ (1,2%) of the 14% Dutch renewable energy target from co-firing

2. Used solid biomass has to comply with sustainability criteria on SFM, GHG emissions, carbon debt and ILUC

Sustainability criteria for categories

Biomass categories	Sustainability criteria						
	SFM criteria	GHG balance	Carbon debt	ILUC	Soil quality	Compliance with legislation	Chain of Custody
1. Woody biomass from large forest management units	X	X[1]	X[1]	X[1,2]	X[1]	X[1]	X[1]
2. Woody biomass from small forest management units	X	X	X	N/A	X	X	X
3. Residual products from multi-functional forests	N/A	X	N/A	N/A	X	X	X
4. Agricultural residual products	N/A	X	N/A	N/A	X	X	X
5. Residual agri-food products and timber industry products	N/A	X	N/A	N/A	N/A	X	X
6. Biogenic waste materials	N/A	X	N/A	N/A	N/A	X	X
7. Residual products from natural site and landscape management	N/A	X	N/A	N/A	N/A	X	X

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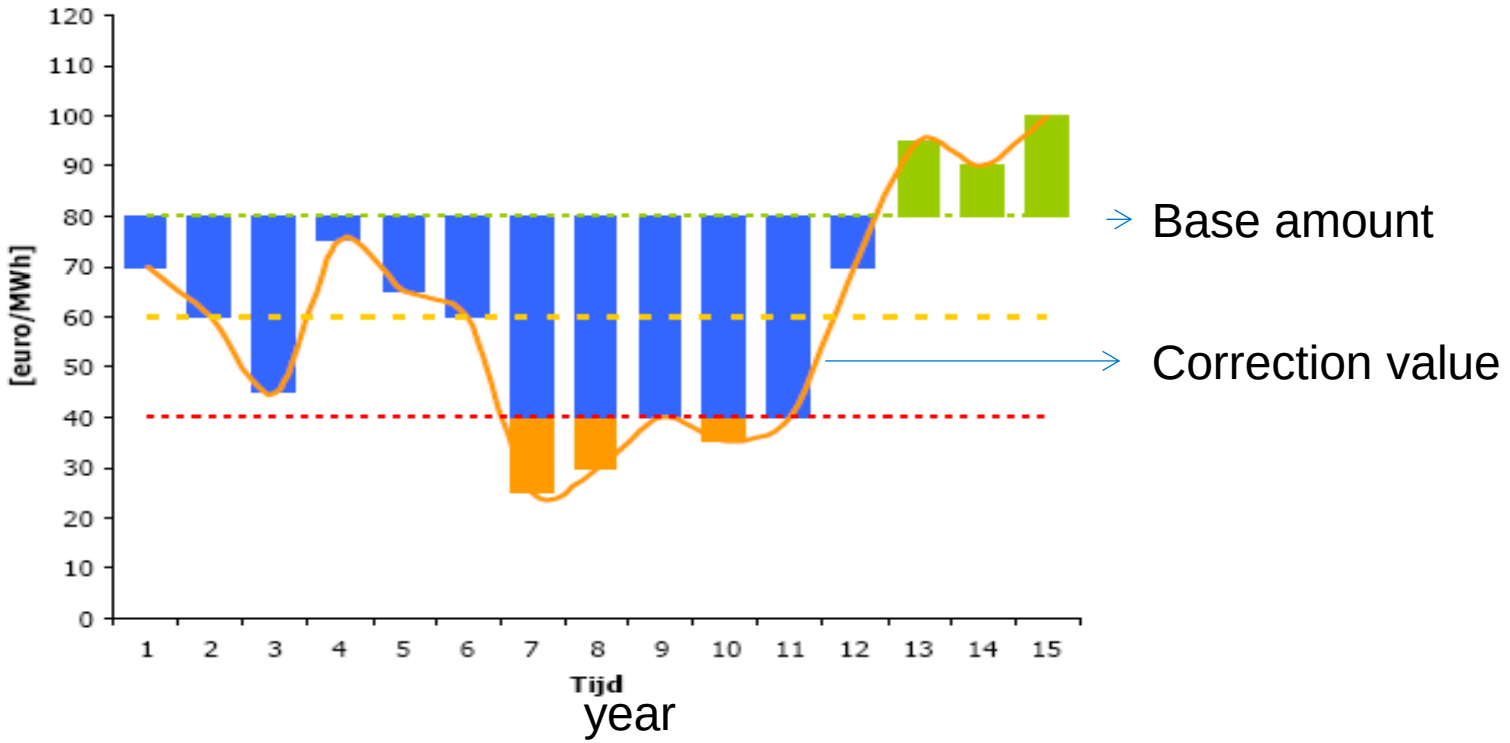
SDE +

Support scheme with feed in tariff Netherlands

How does SDE+ work?

1. Feed in tariff
2. Premium based on average costs for different categories (financial gap, additional cost)
3. Annual update for new applications
4. Compensation for fluctuation energy prices
5. Fixed for the duration of the project (8 – 15 years)
   For Cofiring: 8 years
6. Tenders in phases
7. Budget to be contracted in 2015: 3.5 billion euro
8. Paid by a levy on the energy bill of consumers

Premium Tariff based on additional costs



http://english.rvo.nl/subsidies-programmes/stimulation-sustainable-energy-production-sde

Base Amount SDE+ 2015, budget 3.5 G€

	2015	Base Amount €/MWh					
Phase	**Date**	**extended co-firing**	**wind on land <7m/s**	**CHP co-digestor**	**CHP mono digester**	**Renewable Heat >10MWth**	**Applica-tion G€**
1	31-mrt	70	70	70	70	54	
2	20-apr	80	80	80	80	54	1.05
3	11-mei	90	90	90	90	54	
4	1-jun	100	98	100	100	54	
5	22-jun	108	98	110	110	54	
6	31-aug	108	98	113	120	54	
7	21-sep	108	98	113	130	54	
8	12-okt	108	98	113	140	54	
9	9-nov	108	98	113	150	54	
closed	17-dec						

Conclusion

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Thank you for your attention

Questions?

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