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Availability of biomass and biomass supply systems for co-firing purposes

FUEL FLEXIBILITY IN BIOMASS COMBUSTION - THE KEY TO LOW BIO-ENERGY COSTS? Workshop organised by International Energy Agency (IEA) Bioenergy Task 32: Biomass Combustion and Co-firing, Jönköping, 31.5.2006

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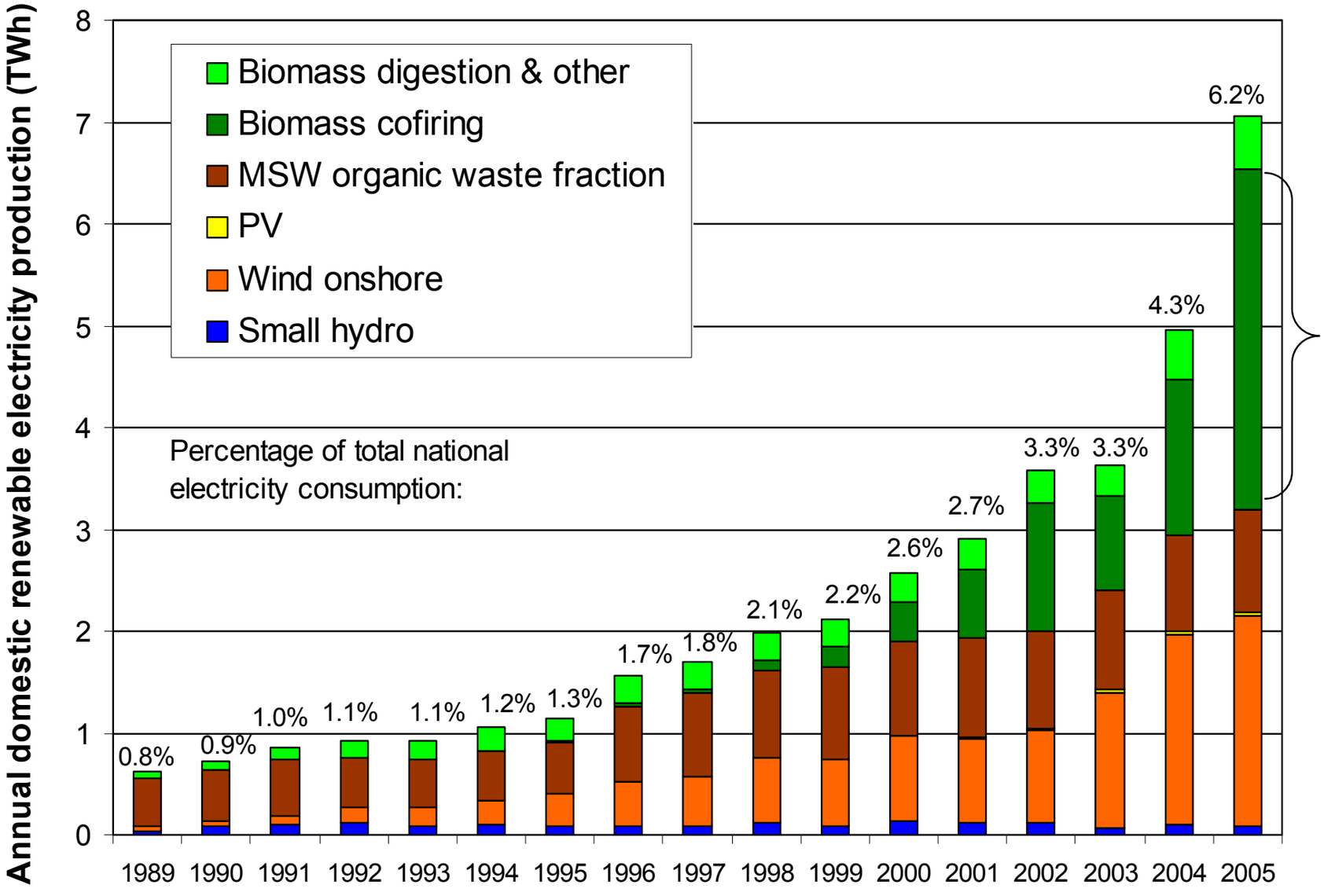
Copernicus Institute
Sustainable Development and Innovation Management

Overview

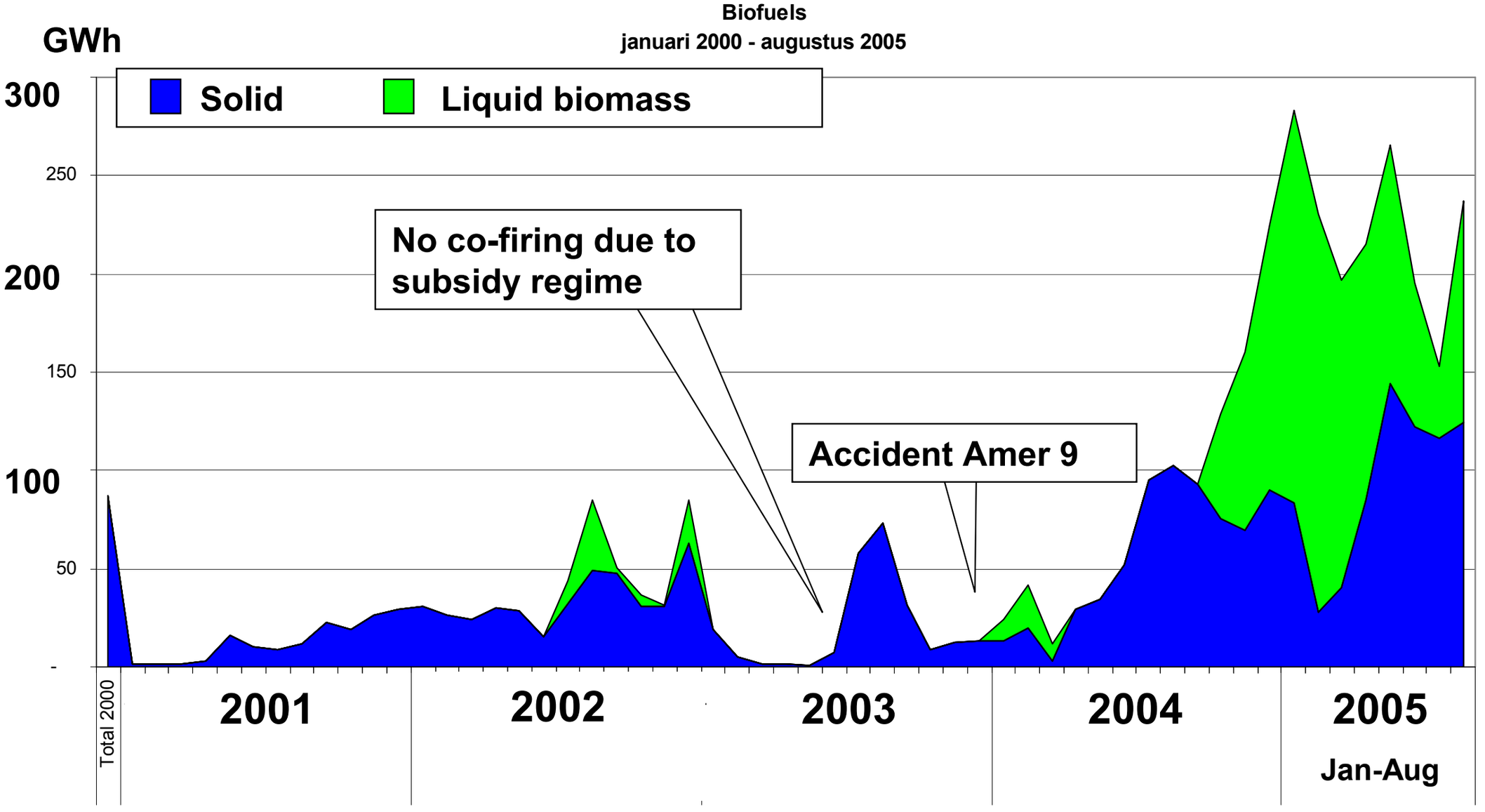
1. Current developments of biomass co-firing in the Netherlands.
2. Future supply chains – resources and pretreatment technologies (for biomass co-firing)
3. Some work of IEA bioenergy Task 40

Domestic renewable electricity production in the Netherlands



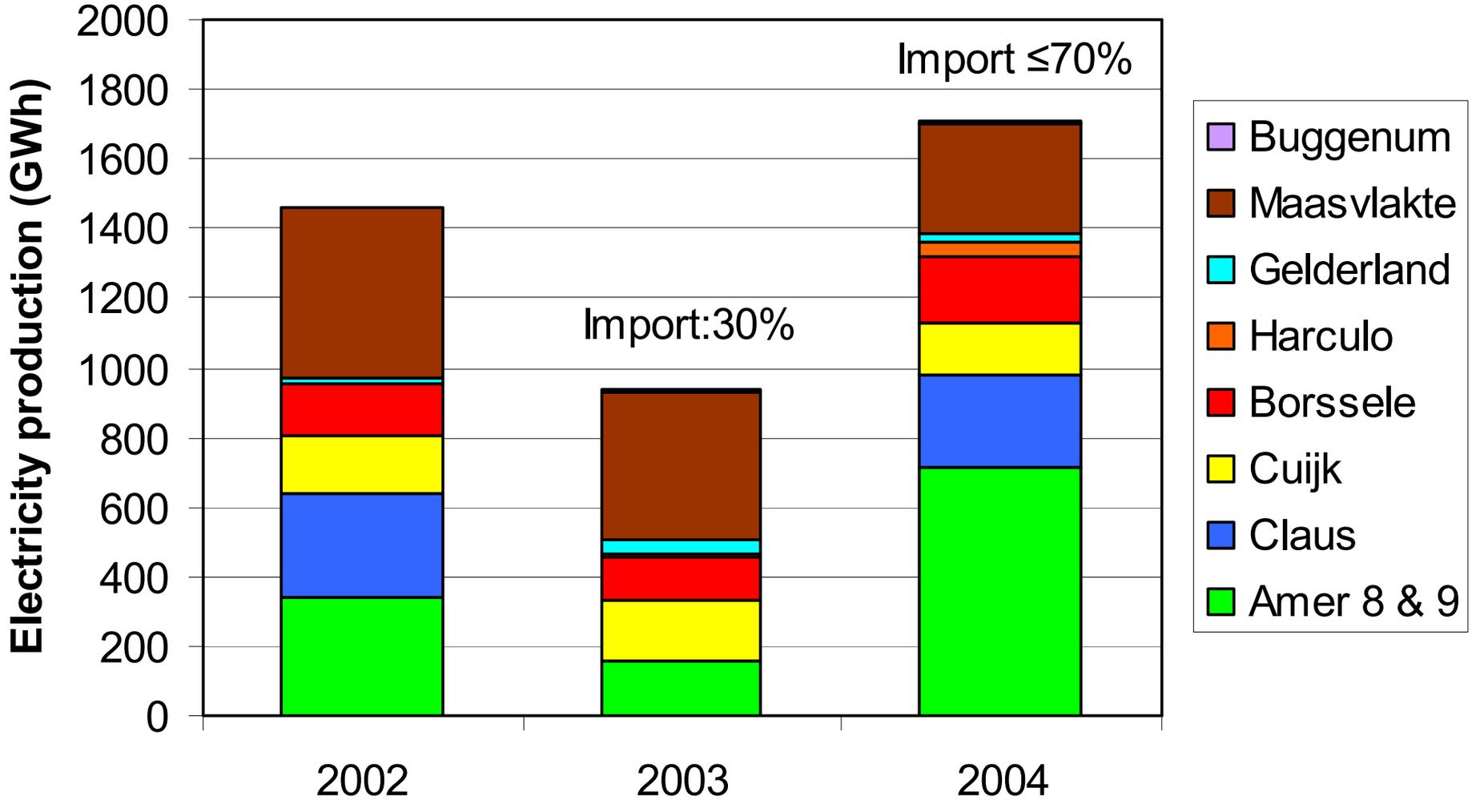
From <1% in 1995 to almost 50% of renewable electricity production in 2005

Co-firing of solid and liquid biomass in Essent power plants



Source: P.P. Schouwenberg, Essent Sustainable Energy

Electricity production from biomass co-firing in power plants



Imported fuels used:

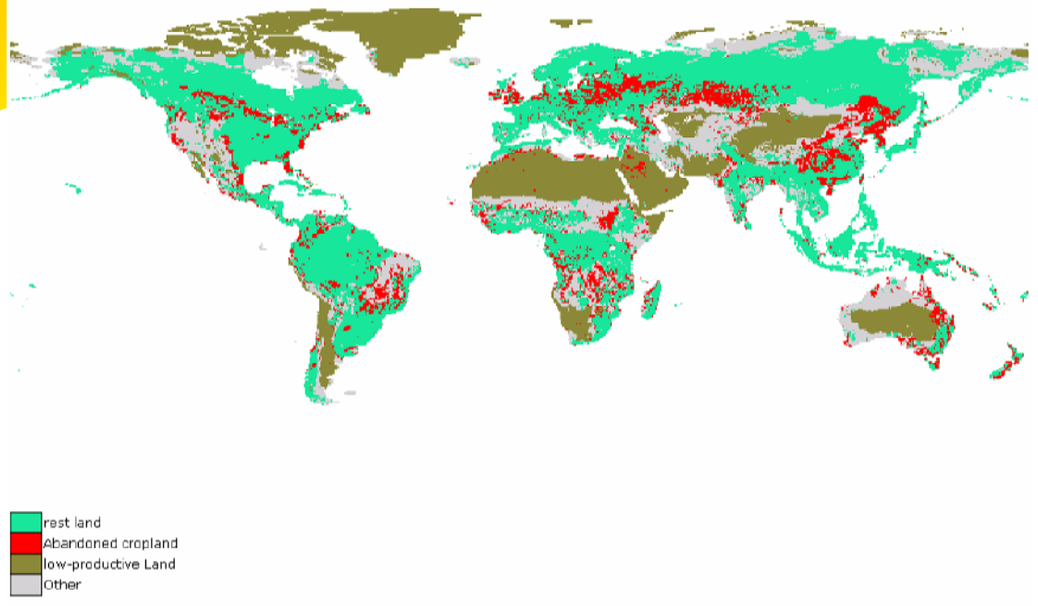
- Wood pellets (mainly from Canada)
- Agro-residues (palm kernel shells, olive nuts, nut shells, cocoa husks, soy and sun flower residues)
- Palm Oil (Malaysia and Indonesia)
- Bone Meal and other waste streams

Current (policy) trends

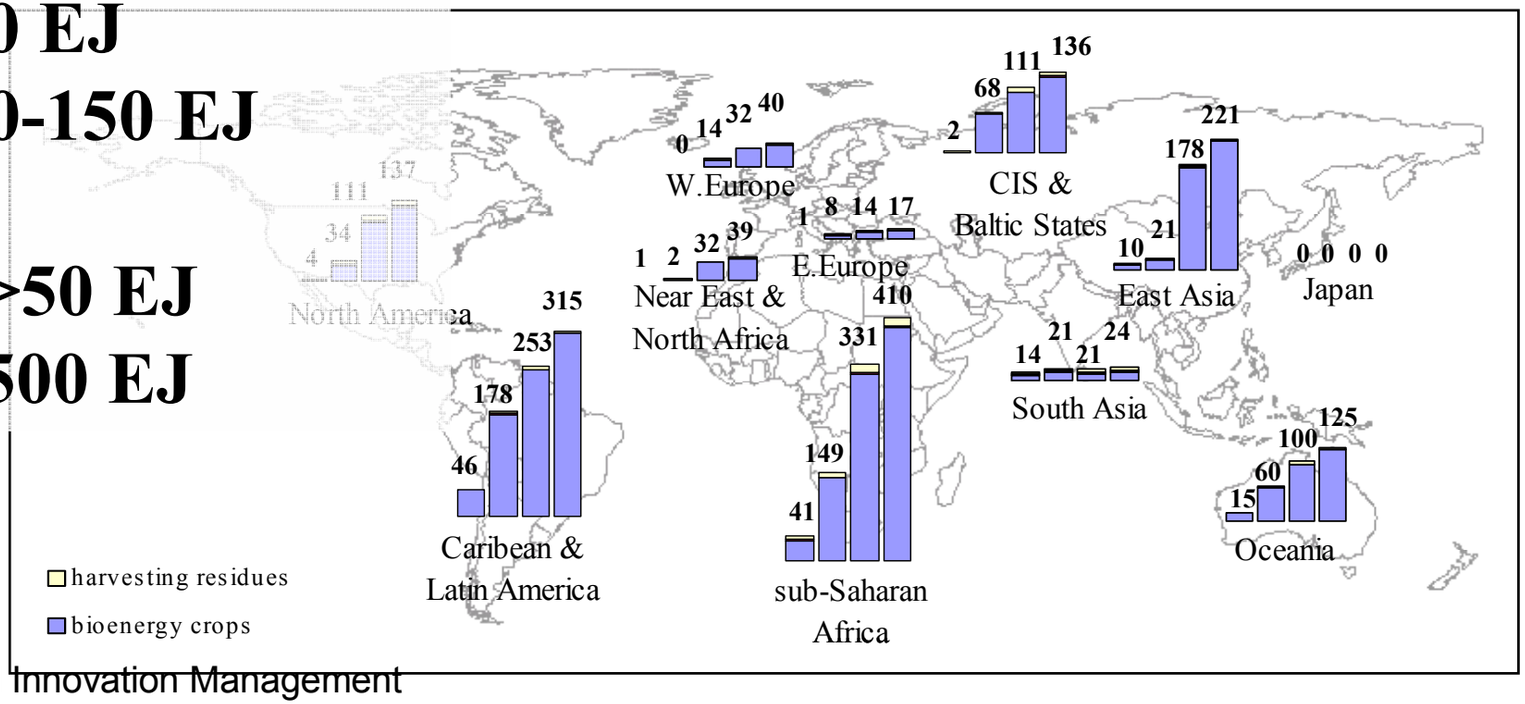
- Palm oil deemed unsustainable, feed-in tariff cut from 7 €ct/kWh to <3 €ct/kWh
- Pellet market very volatile, present shortage of pellets
- Development of sustainability criteria for biomass, likely including CO2/energy balance, food security and nature& biodiversity criteria

=> New efficient & sustainable biomass supply chains needed

Global potentials are large…; but need to be developed

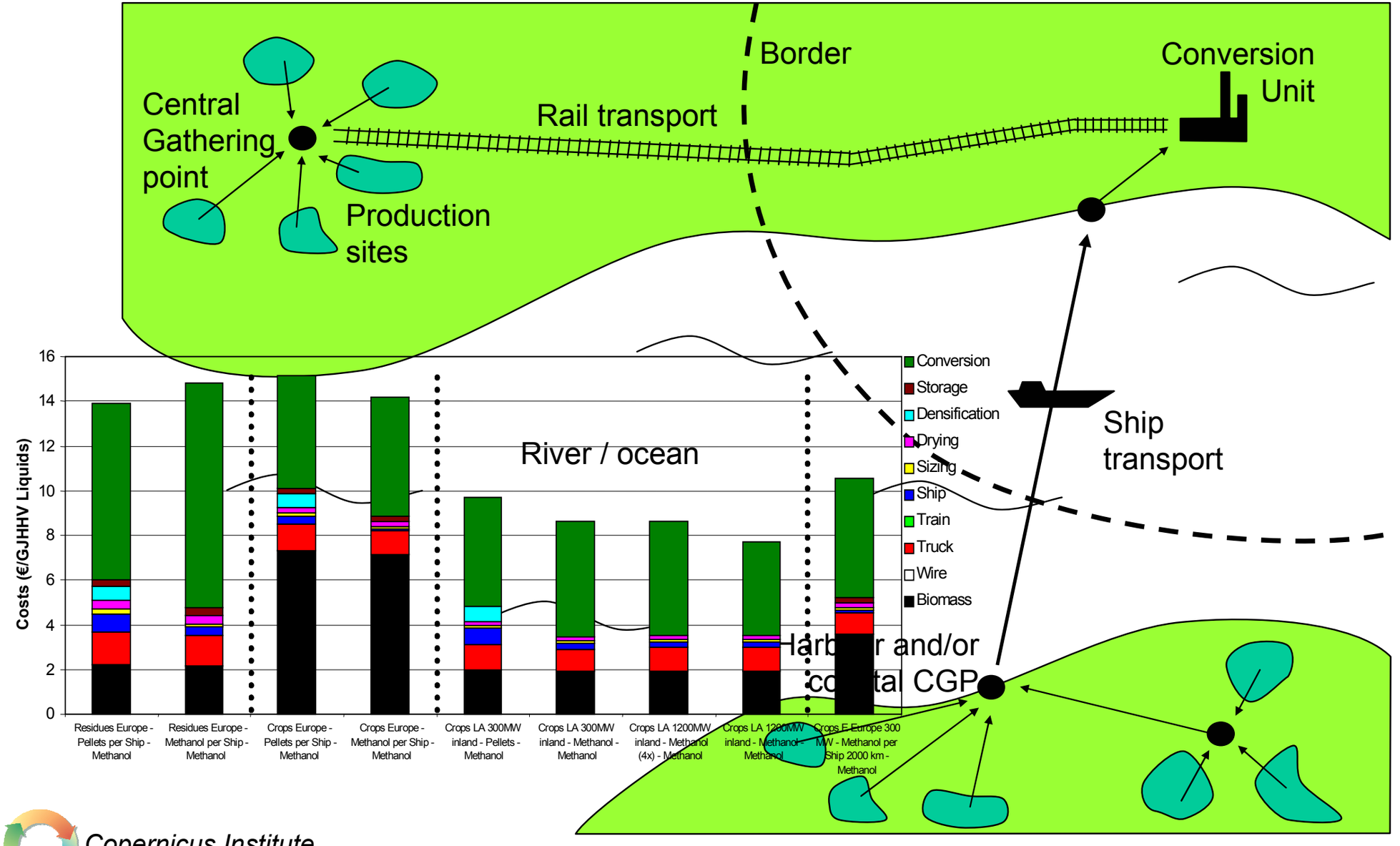


Agricultural land: <100- >300 EJ
Marginal lands: <60- 150 EJ
Agri residues: 15-70 EJ
Forest residues: <30-150 EJ
Dung: 5-55 EJ
Organic waste: 5 - >50 EJ
TOTAL: < 250 - > 500 EJ

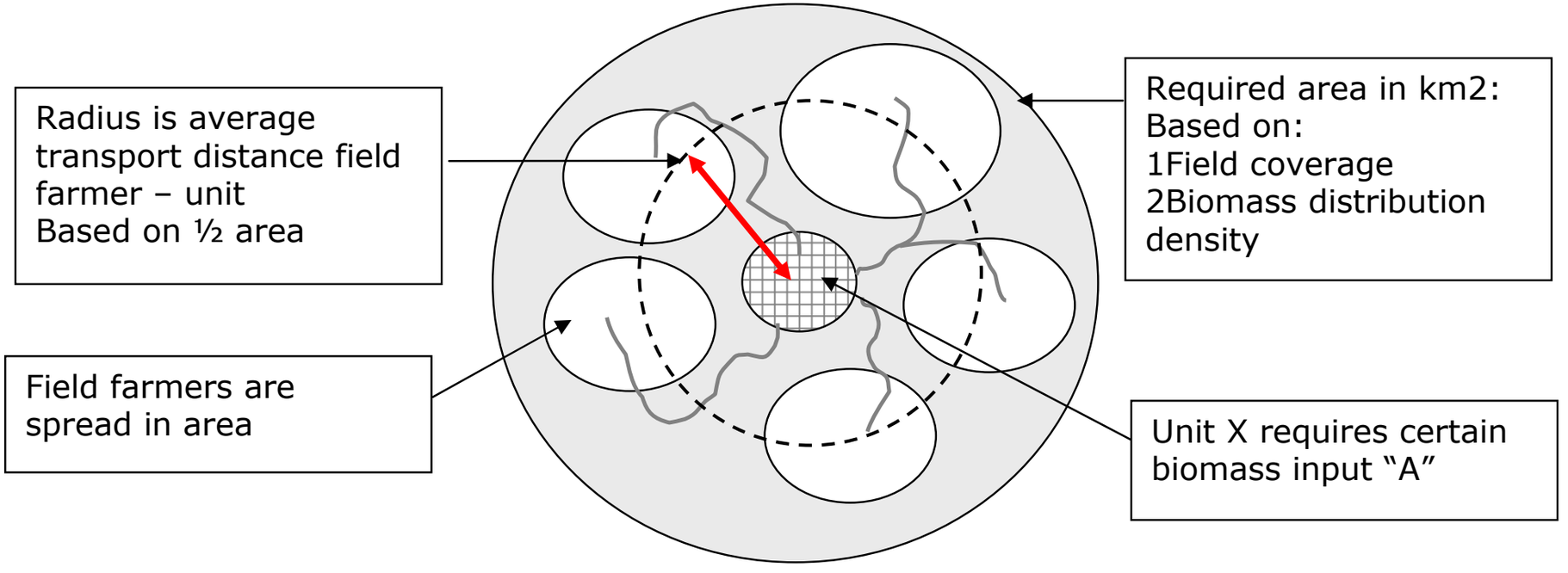


International bio-energy logistics

not a showstopper *when organized rightly*



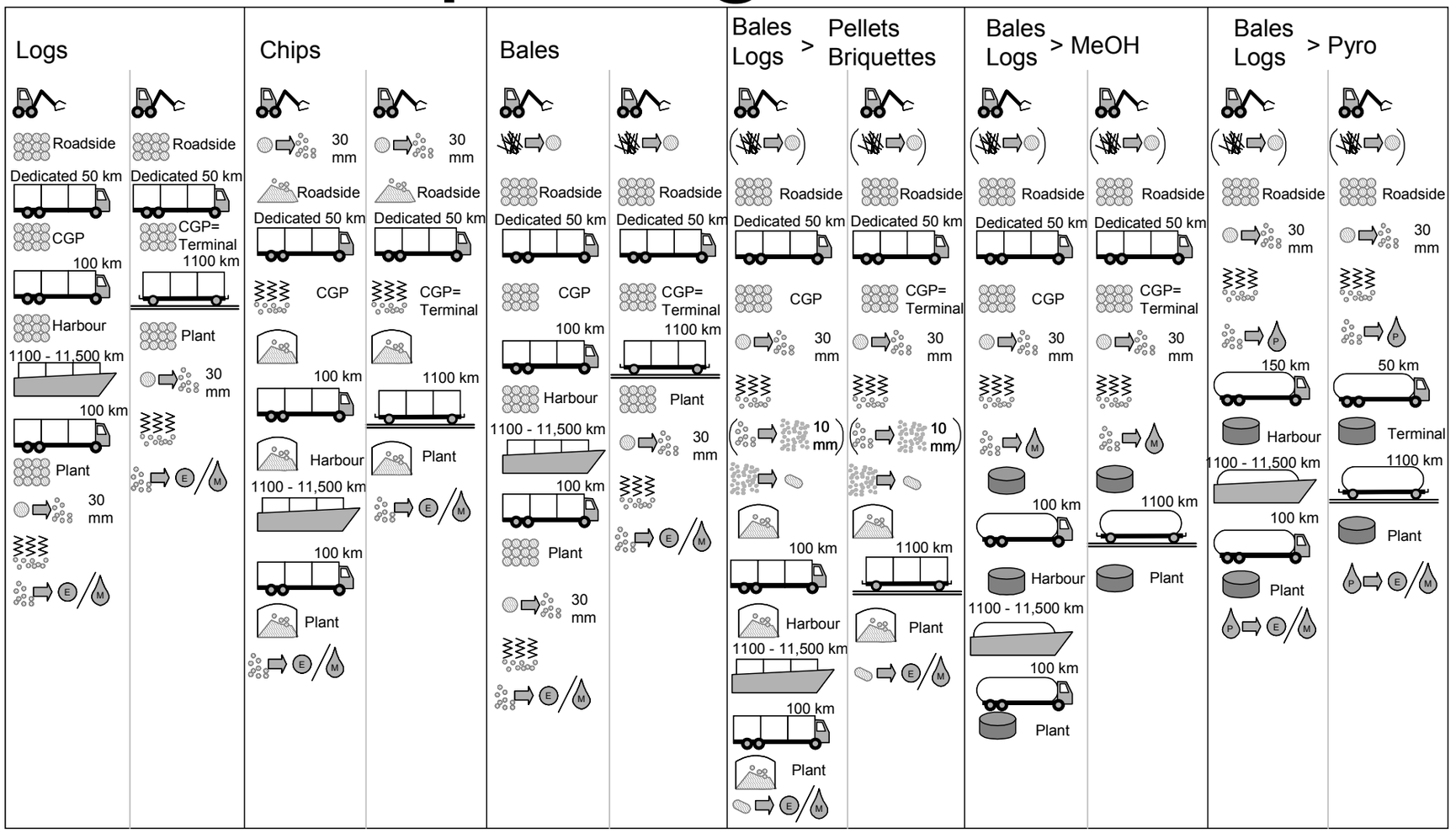
Logistic concept for production regions



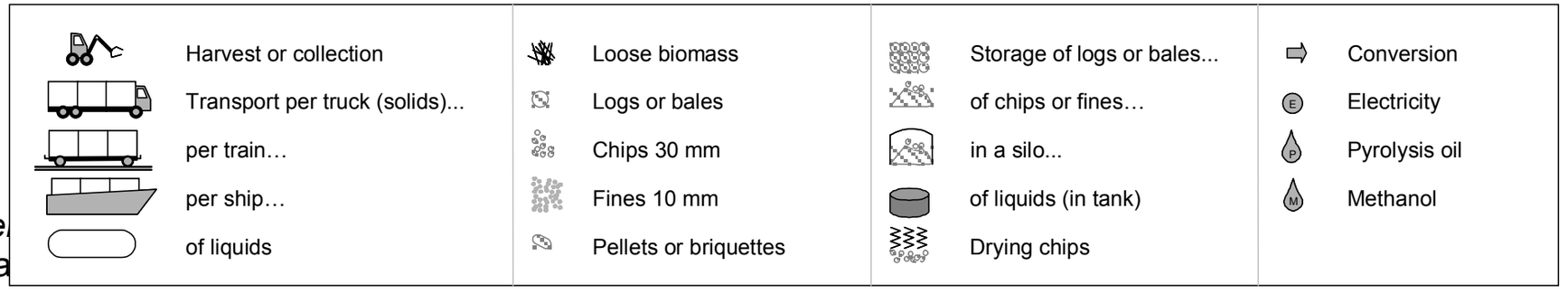
Many possible 'biotrade chains'

Exporter	Transport/transfer/storage	Importer
Biomass production	'raw' biomass	Full conversion
Biomass production & pre-treatment	Pre-treated (pellets, bales, bio-oil) biomass	(partial) conversion
Biomass production & conversion	Fuels (H2, MeOH, EtOH, HC's)	End-use
Production and conversion	Electricity transport	End-use
Biomass production	'conversion along the way'	End-use

Composing chains…



Legend



Source: Hamelinck, Faaij, 2003

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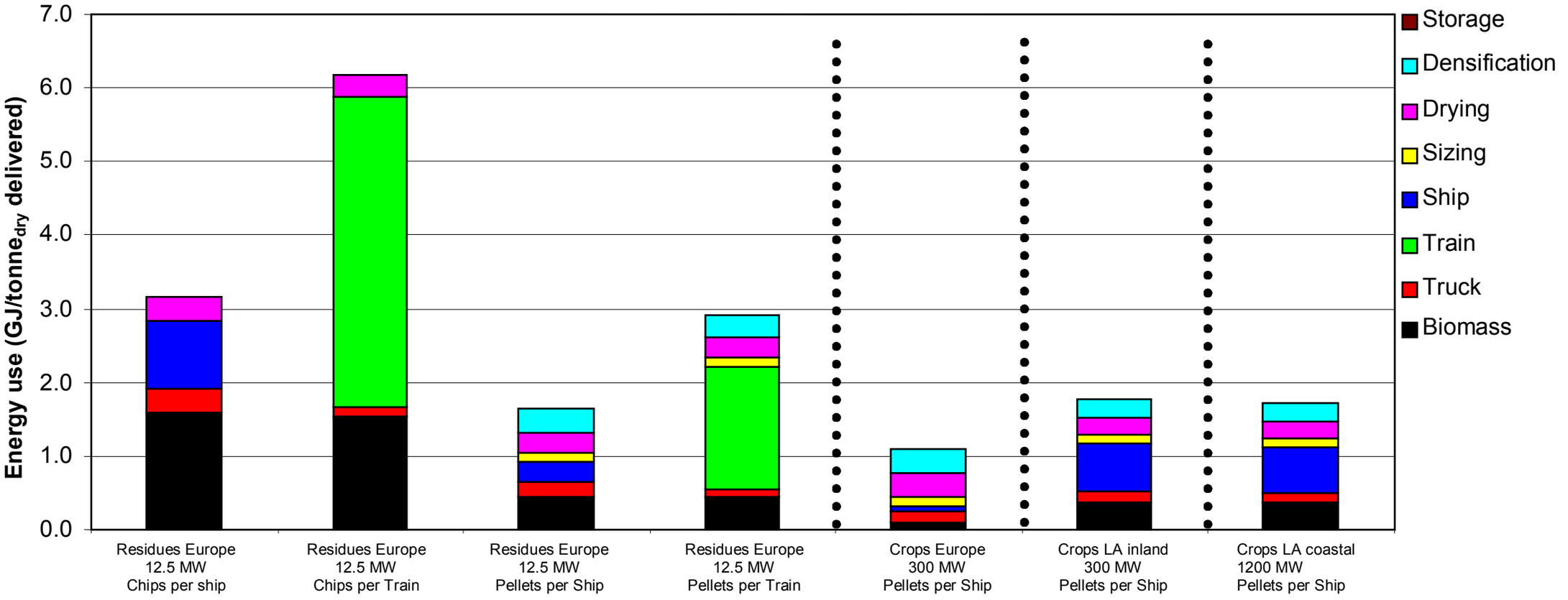
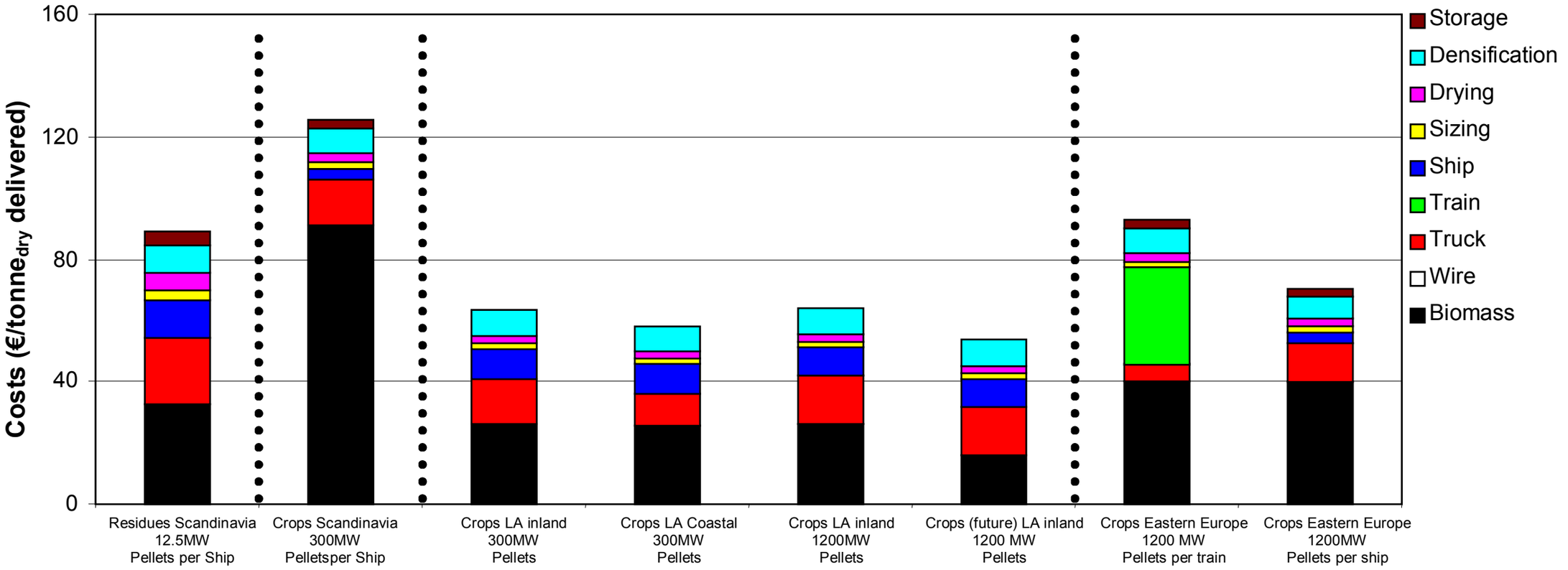
Primary energy use of biomass supply chains to a Dutch power plant



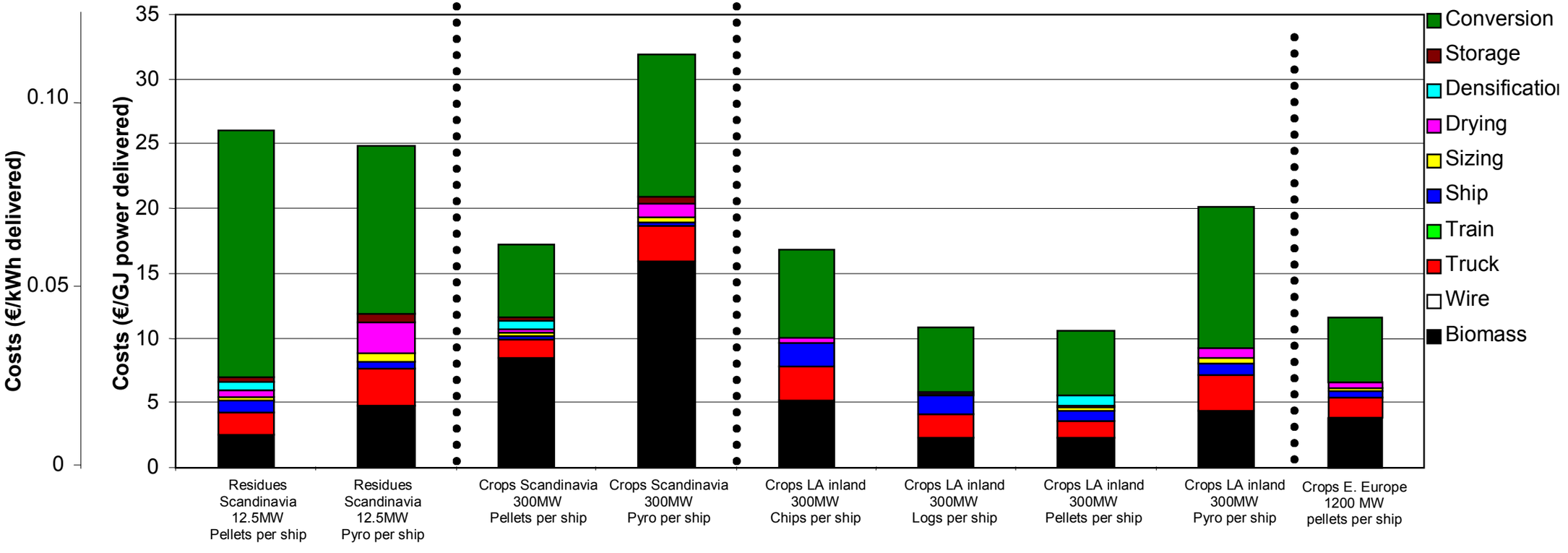
Source: Hamelinck, Faaij, 2003

Cost breakdown of solid biomass delivered to the Netherlands



Source: Hamelinck, Faaij, 2003

Cost breakdown of electricity delivered to the Dutch grid

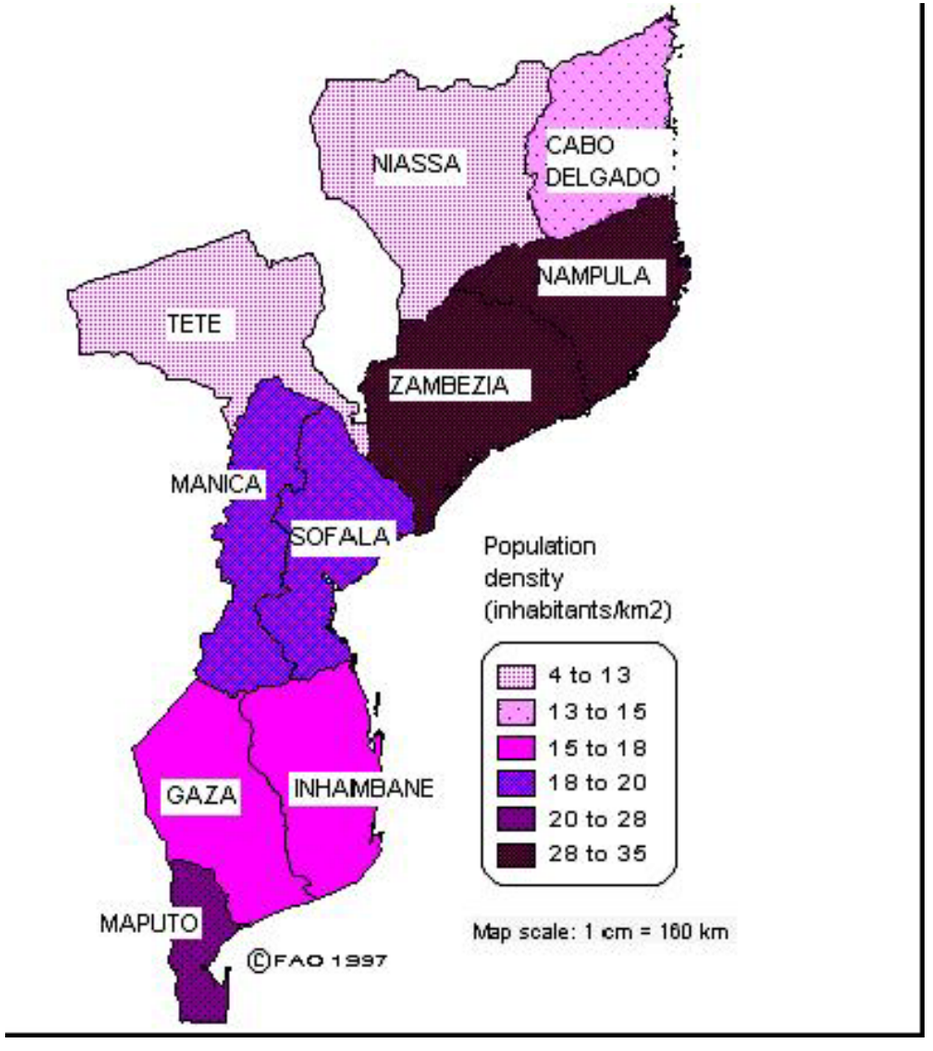


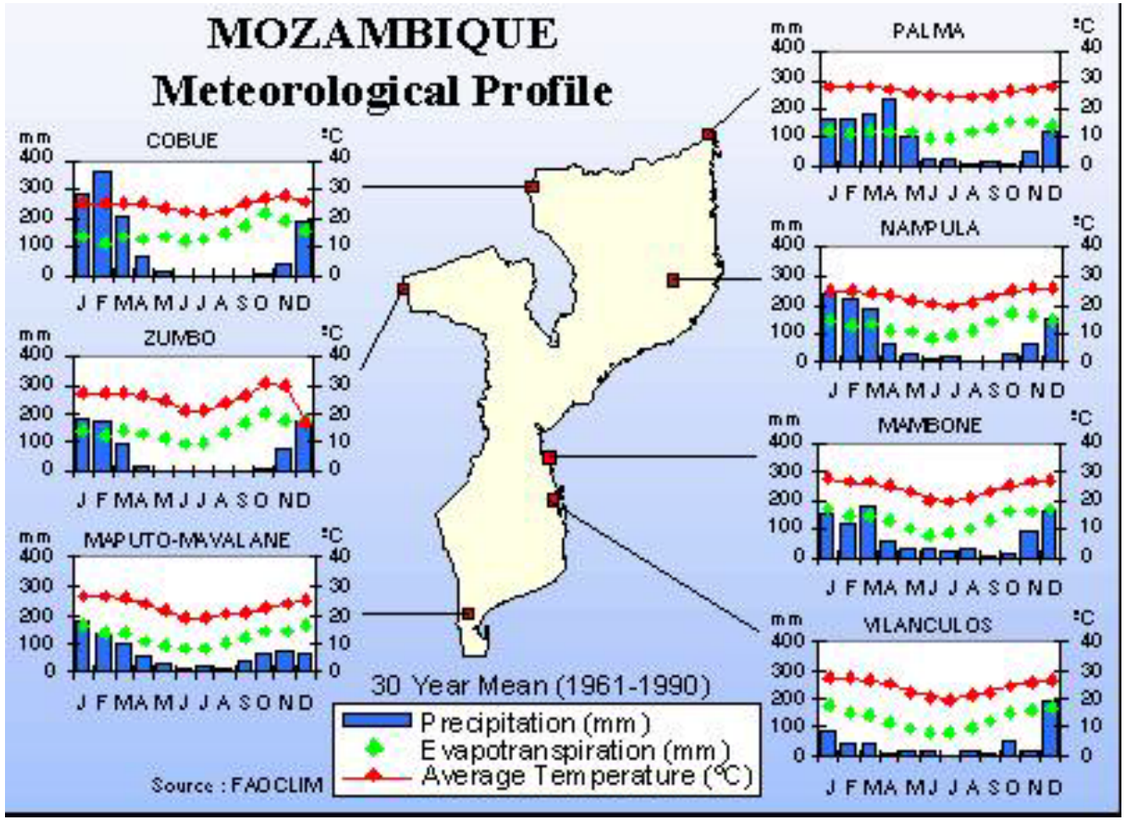
Source: Hamelinck, Faaij, 2003

Some key findings…

- Reference systems importing & exporting country crucial for net GHG impact.
- Economies of scale are crucial.
- Pre-treated biomass or secondary energy carriers preferred for international transport.
- Sea transport limited impact; road transport significant.
- Region specific (biomass distribution density, transport parameters, etc.).

Mozambique…





Batidzirai & Faaij, 2005

Level of advancement of agricultural technology

Level of agricultural technology	Water supply	Description
Low	rain-fed	No use of fertilizers, pesticides or improved seeds or breeds, specialised health care for animals and calf rearing activities, equivalent to subsistence farming as in rural parts of e.g. Africa and Asia.
Intermediate	rain-fed	Some use of fertilizers, pesticides, improved seeds or breeds, animal health care and mechanical tools.
High	rain-fed	Full use of all required inputs and management practices as in advanced commercial farming presently found in the USA and EU.
Very high	rain-fed	Use of a high level of technology on very suitable and suitable soils, medium level of technology on moderately suitable areas and low level on moderately and marginally suitable areas.
Very high	rain-fed/ irrigated	Same as a very high input system, but including the impact on irrigation on yields and areas suitable for crop production.

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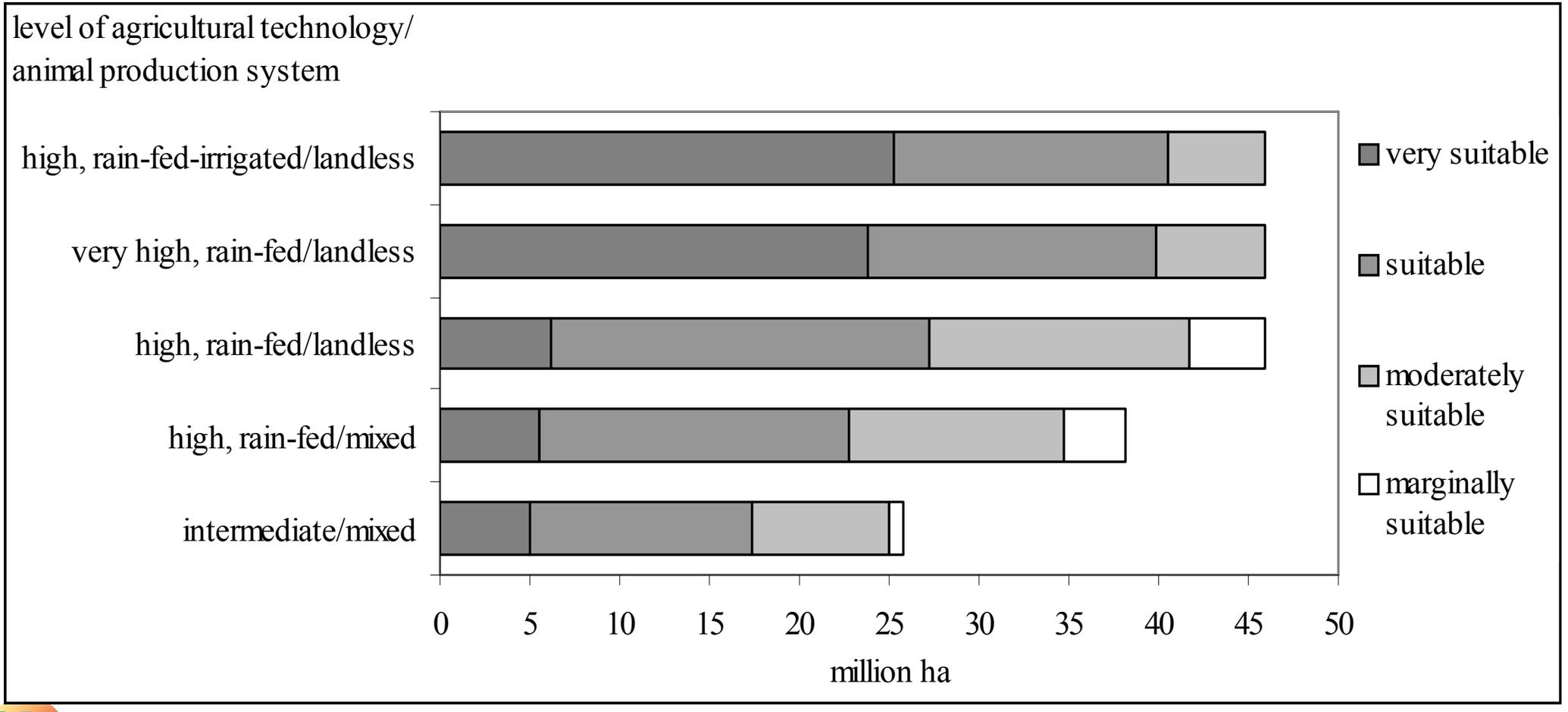
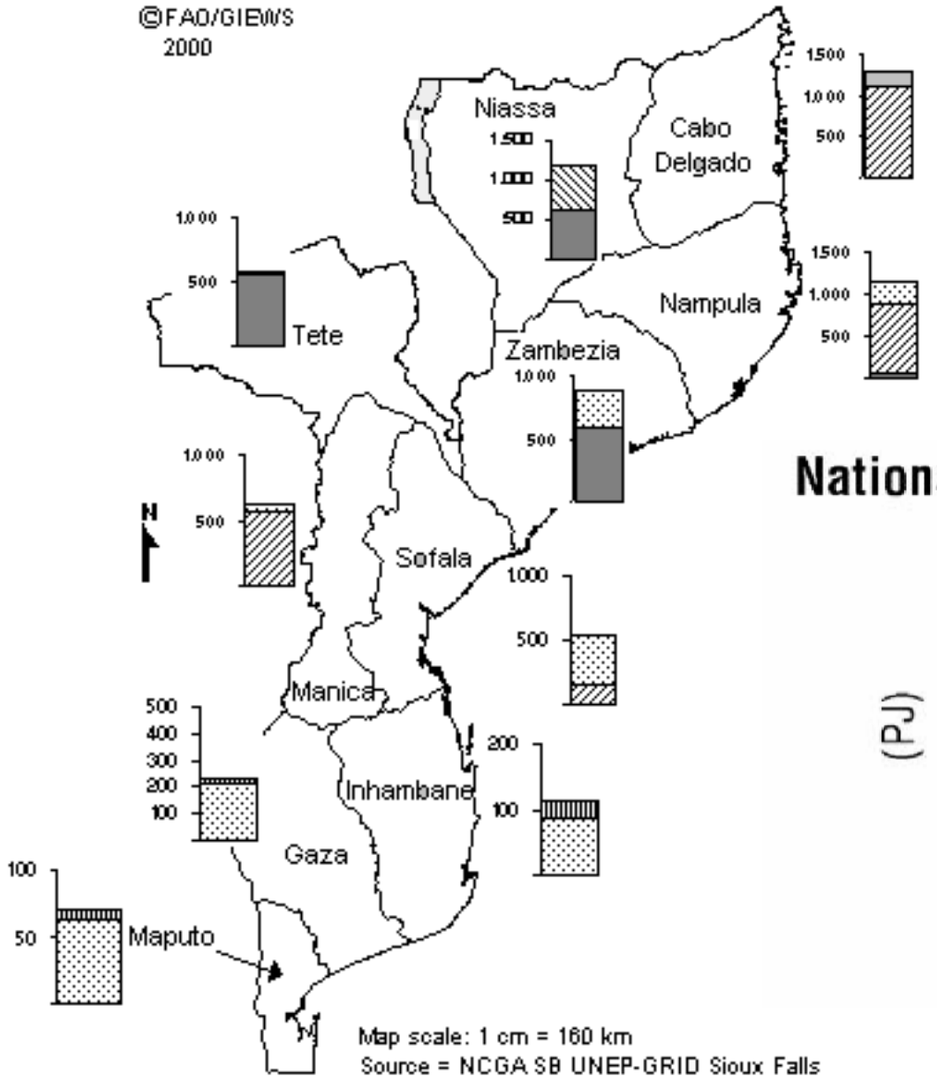
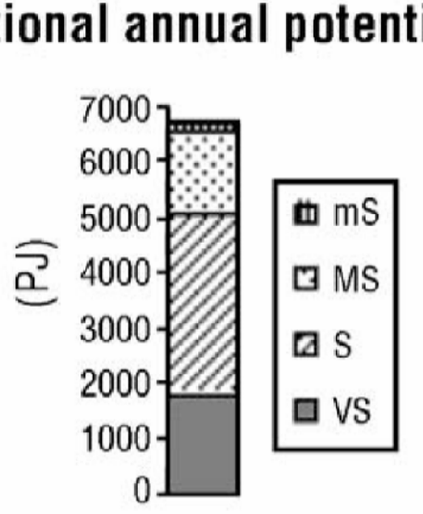
Potential surplus agricultural land in 2015 in Mozambique, dependent on the level of advancement of agricultural technology



Batidzirai & Faaij, 2005

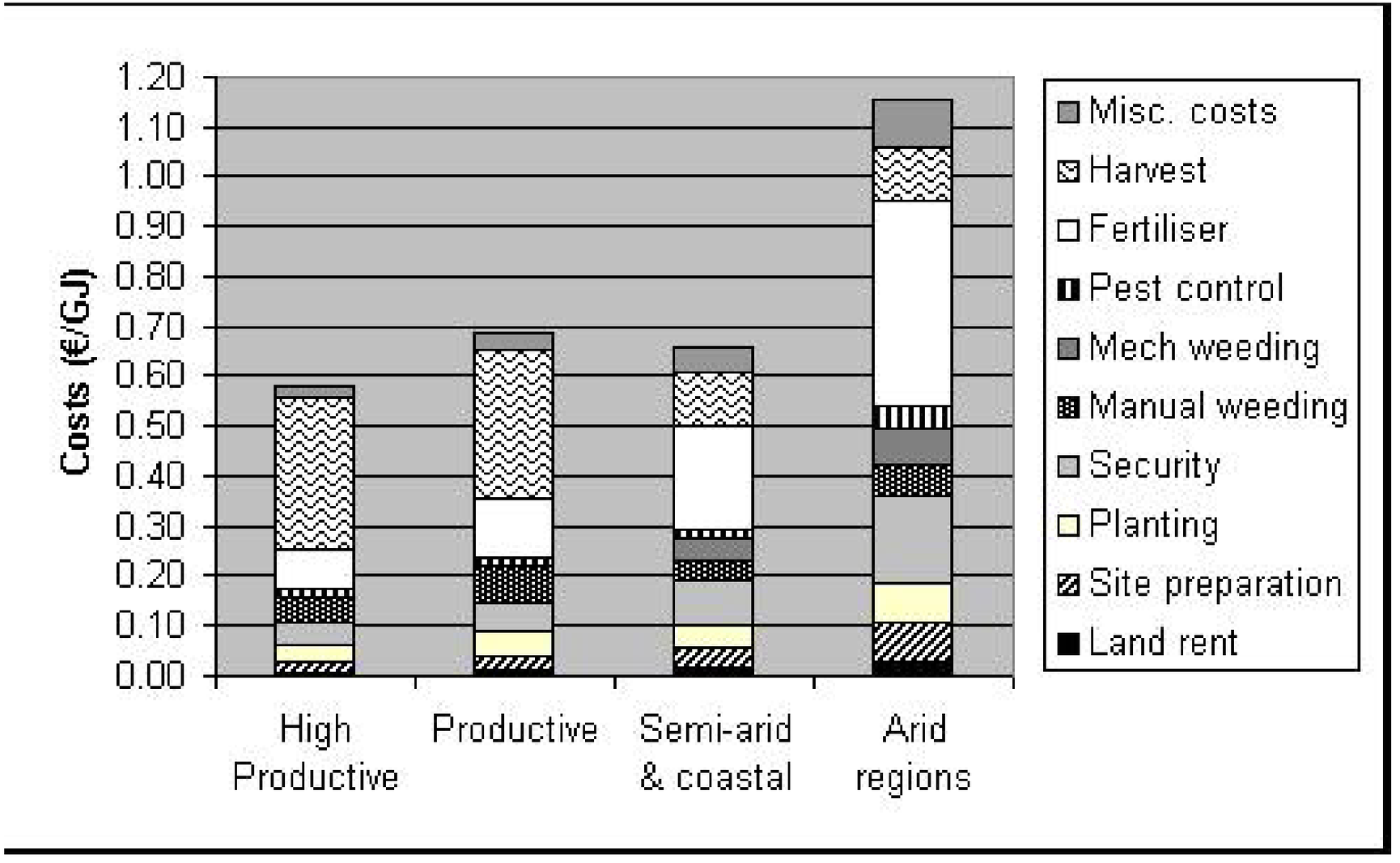
Regional biomass annual production potential in Mozambique/PJ_{HHV} (2015)





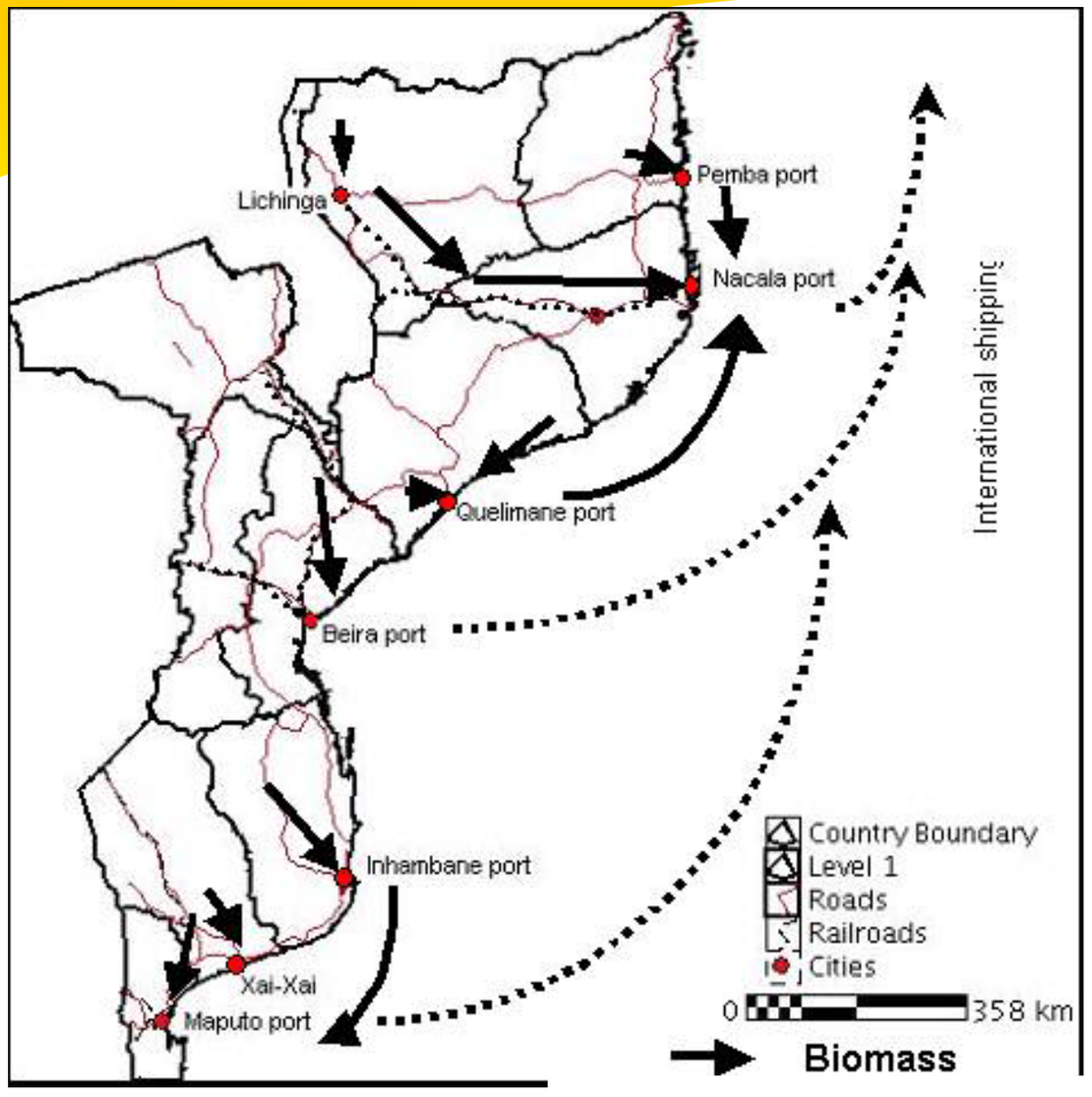
Batidzirai & Faaij, 2005

Comparison of bioenergy growing costs by region type (€/GJ)

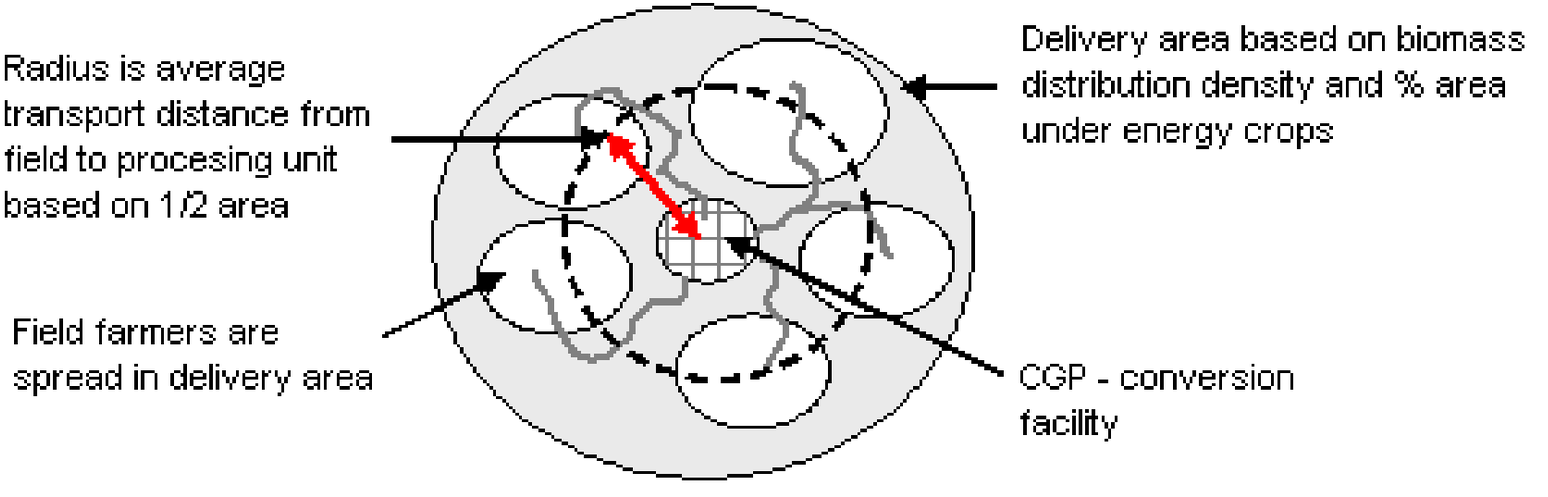


Batidzirai & Faaij, 2005

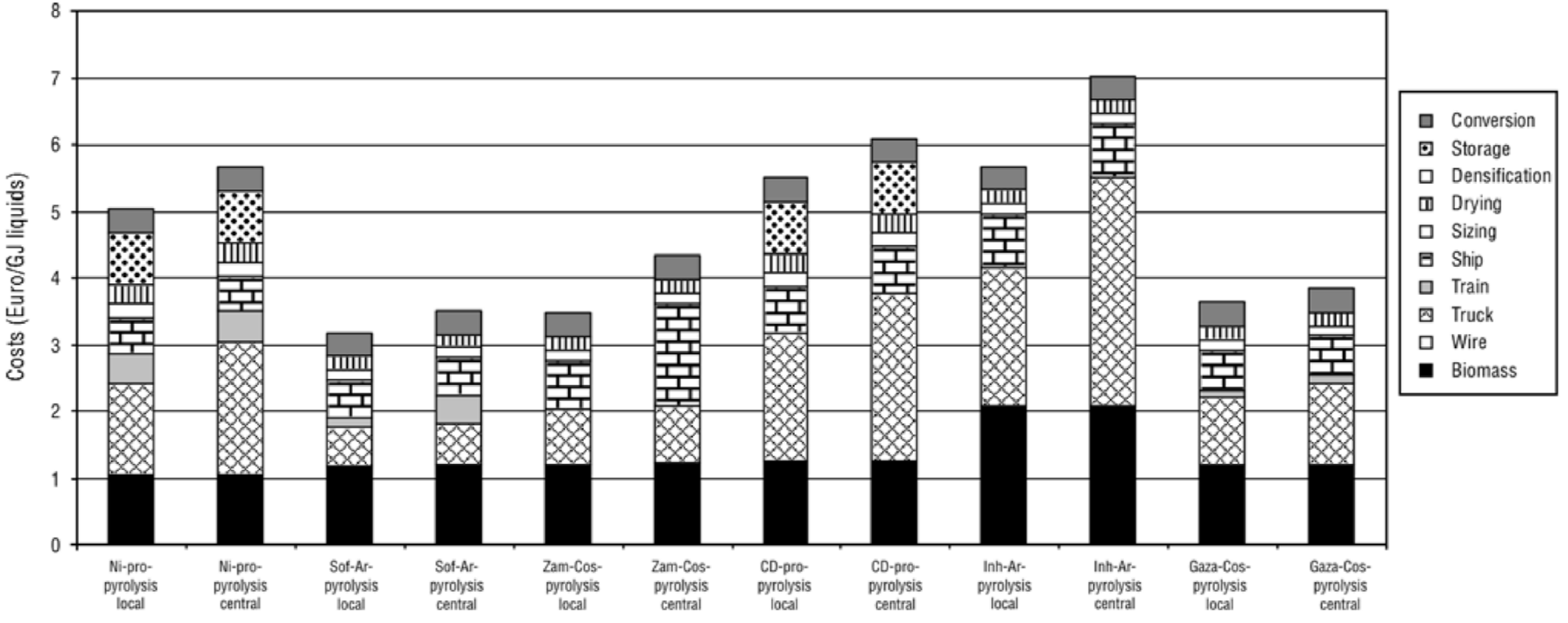
Logistics for export….



Batidzirai & Faaij, 2005

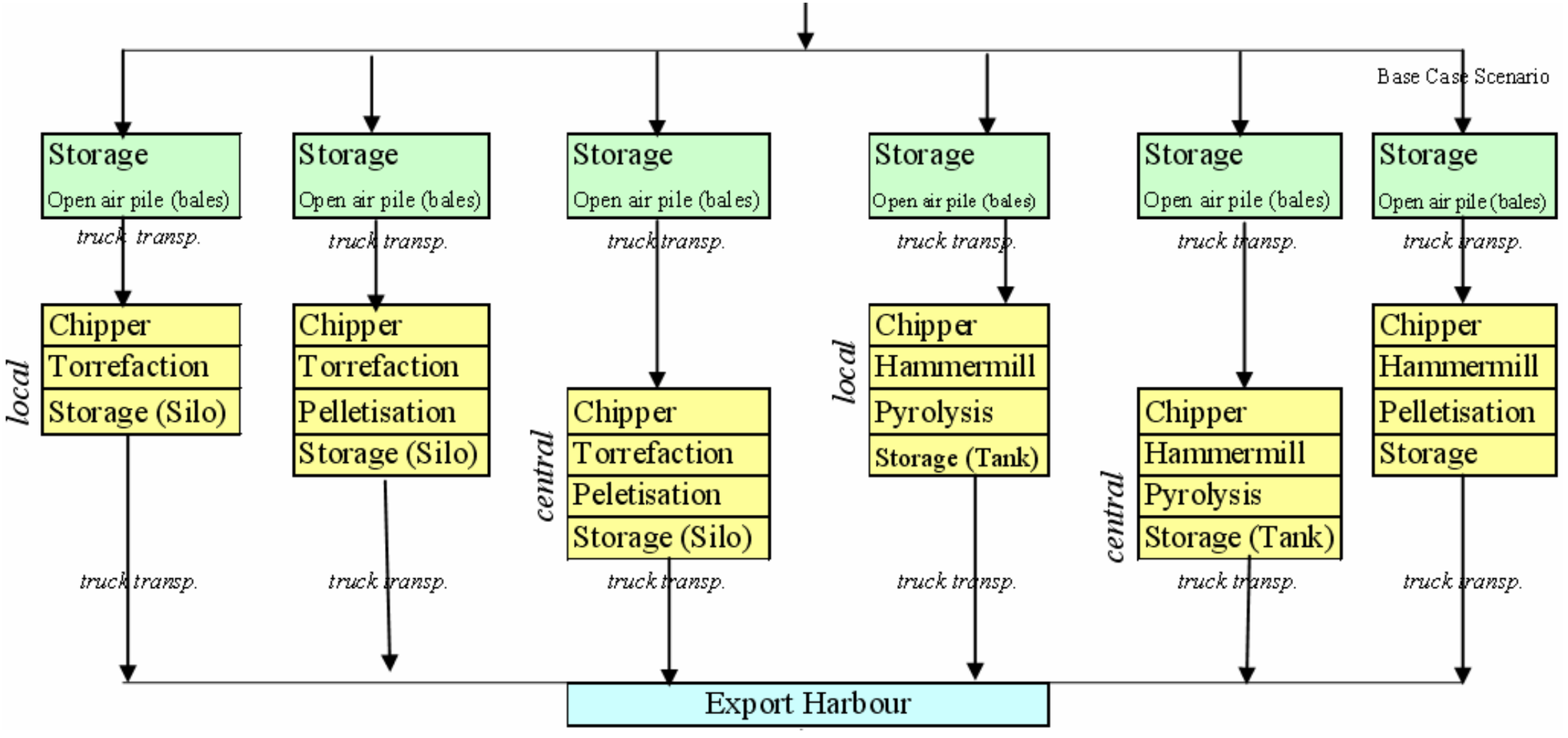


Chains supplying pyrolysis oil from Mozambique to Rotterdam



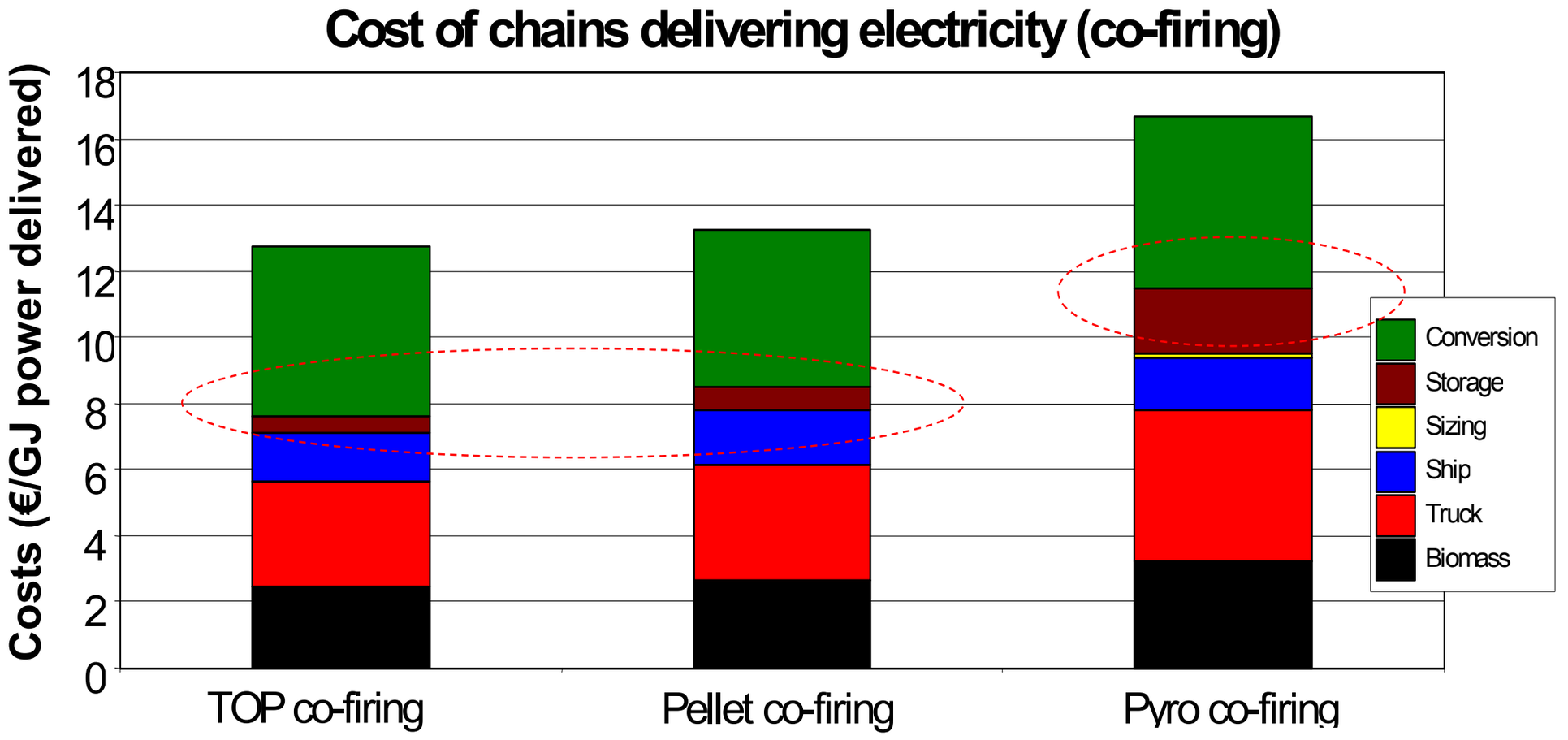
Batidzirai & Faaij, 2005

Comparison of Torrefaction, pellets and Pyrolysis pretreatment



Uslu & Faaij, 2006

Comparison of co-firing wood pellets, torrefied pellets (TOP) and Pyrolysis oil



	TOP co-firing	Pellet co-firing	Pyro co-firing
Energy use (GJ/GJ)	8.5%	11%	8%

Uslu & Faaij, 2006

Relevant work of IEA bioenergy Task 40

Country reports

- on Brasil, Finland, the Netherlands, Norway…
- Updated country reports and synthesis report to be published in autumn 2006

Market studies:

- on ethanol (published)
- on global wood pellet markets and resources (to be published end of 2006)
- On pyrolysis oil (to be published end of 2006)

=> Keep an eye on www.bioenergytrade.org

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Thank you for your attention!

Refs to the studies presented:

Carlo Hamelinck, (C.N.), Outlook for advanced biofuels, Ph.D. thesis, University of Utrecht, 2004, 232 pp. (NWS-E-2004-25)

Batidzirai, Faaij and Smeets, Biomass and bioenergy supply from Mozambique, Energy for Sustainable Development, Volume X (1), March 2006.

Faaij and Uslu, Pretreatment technologies and their effects on international bioenergy supply chain logistics, Techno-economic evaluation of torrefaction, fast pyrolysis and pelletisation. Forthcoming.

Available at www.chem.uu.nl/nws -> publications