Case study NE-Germany + NW-Poland: 2nd gen. Biofuel production

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Instytut Uprawy Nawożenia i Gleboznawstwa

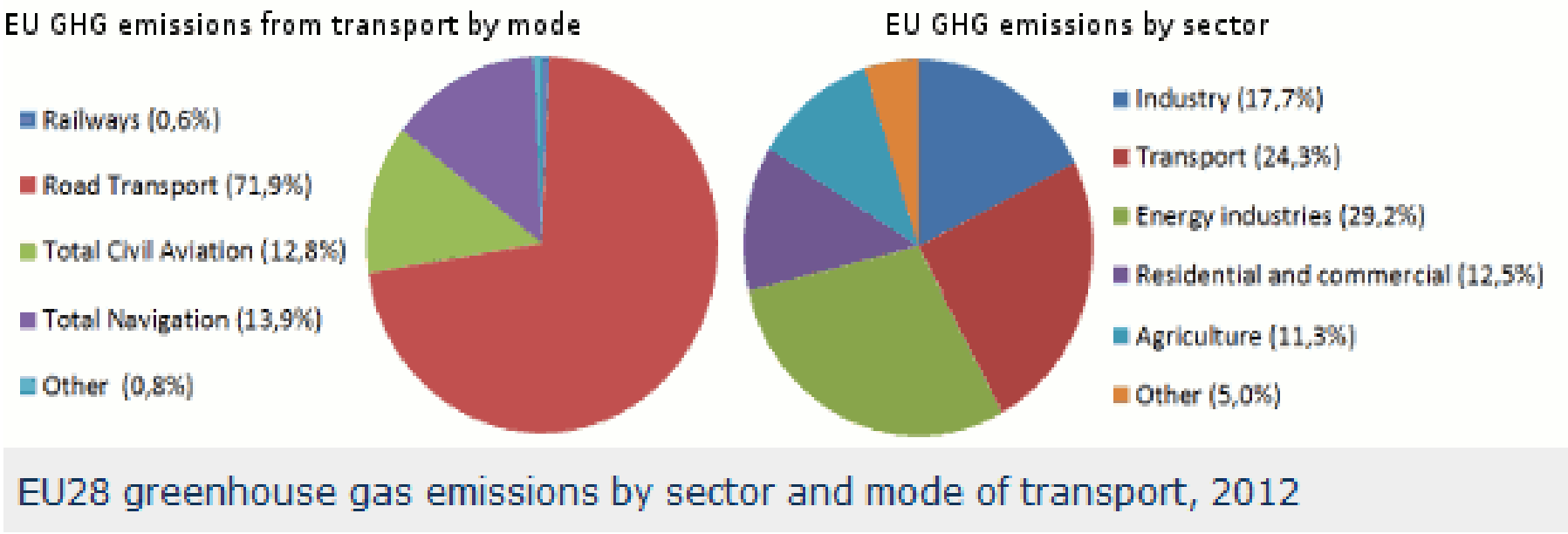

SEVENTH FRAMEWORK PROGRAMME


This project is co-funded by the European Union within the 7th Frame Programme. Grant Agreement n°608622.

The S2Biom-project

- Objective: To support the sustainable delivery of non-food biomass feedstock at local, regional and pan European level
- Coordinator: Fachagentur Nachwachsende Rohstoffe (FNR)
- www.S2Biom.eu
- Funded by the European Union under contract 608622

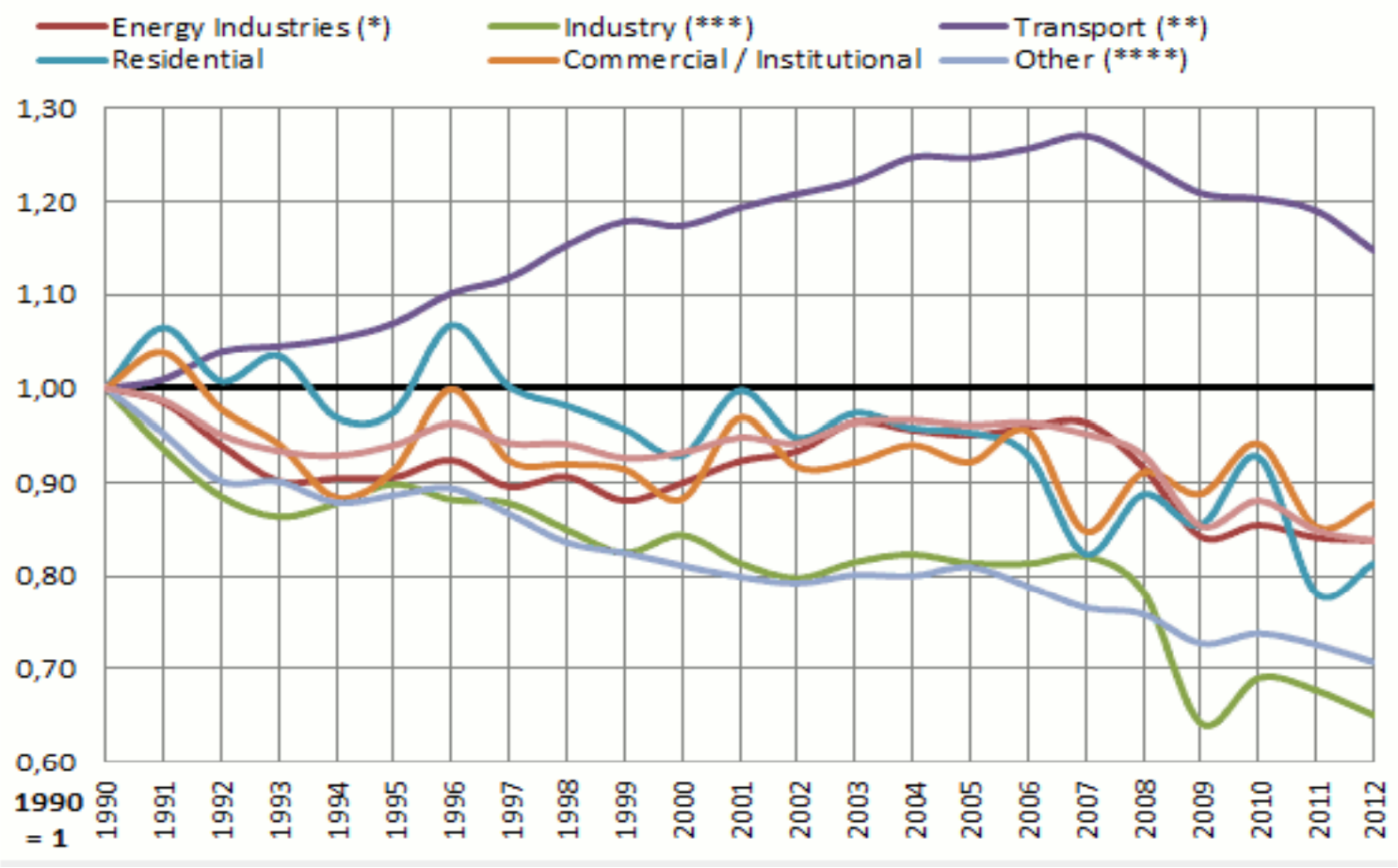
Motivation:
GHG emissions by sector



EU28 greenhouse gas emissions by sector and mode of transport, 2012

~ 25 % of European GHG emissions are from transport

Motivation:
GHG emissions since 1990

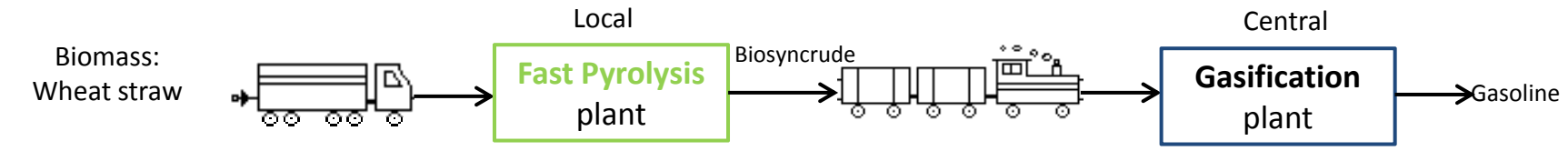


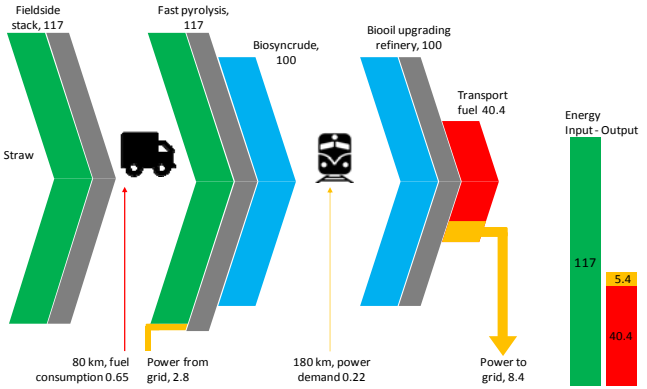
GHG emissions from transport have been increasing from 1990 to 2007

Objectives case study

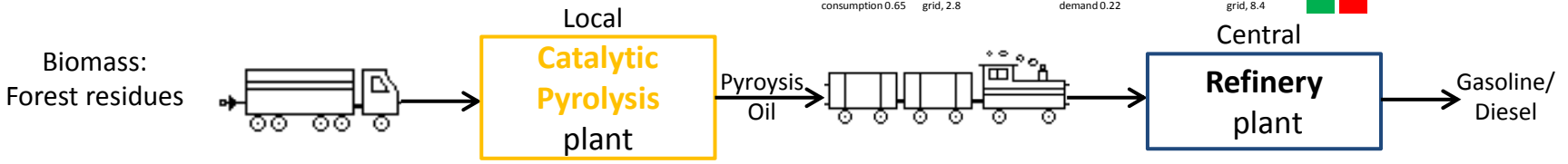
- To model biofuel production to drop-in transportation fuels in North East Germany – West Poland
- Use two split production chains
- Optimizing cost of sustainable biofuel production

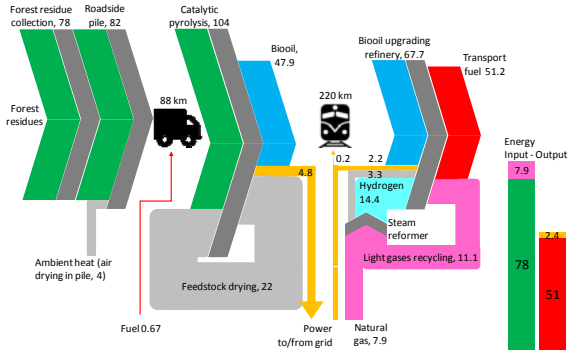
Fuel production pathways





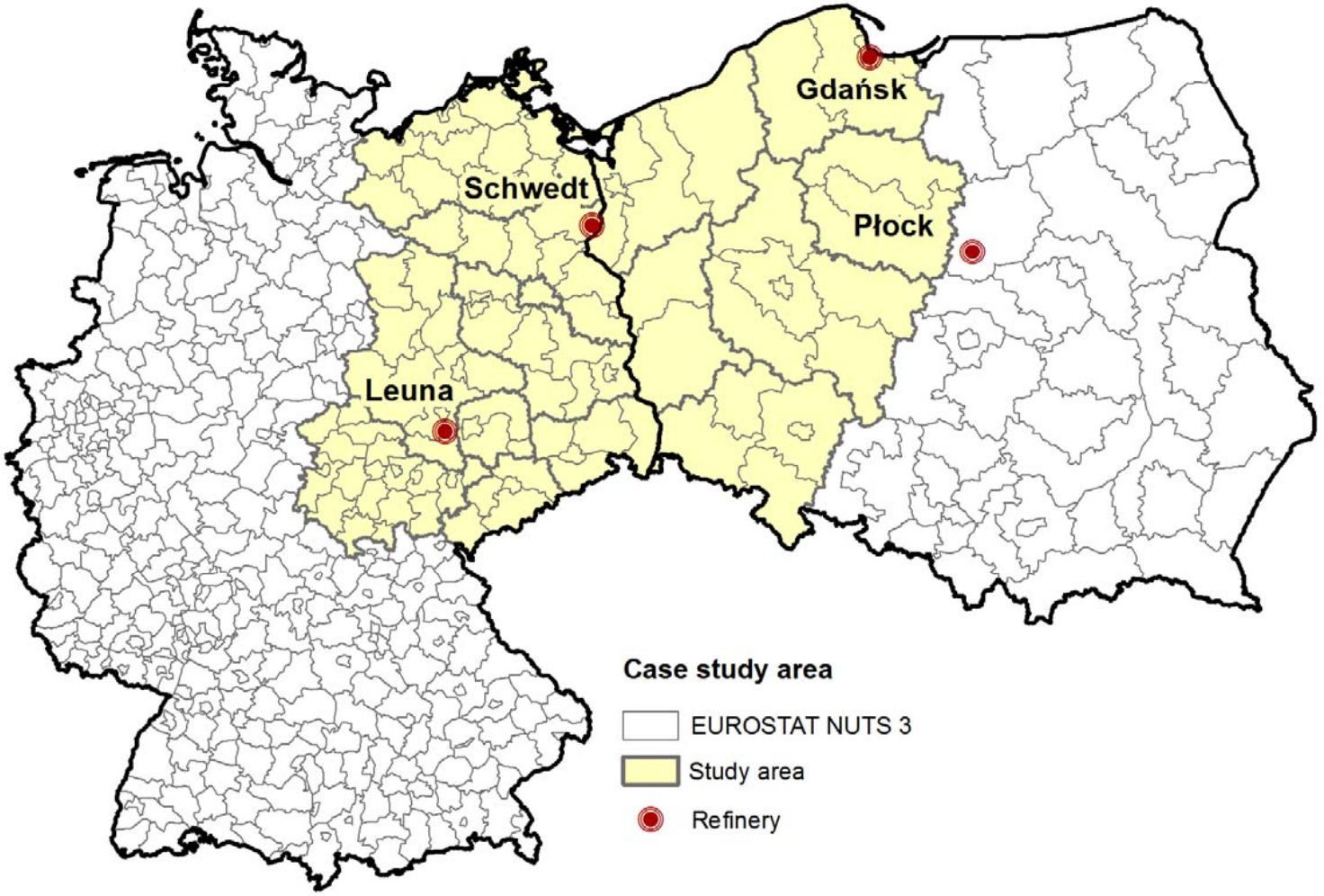
45 % Energy efficiency





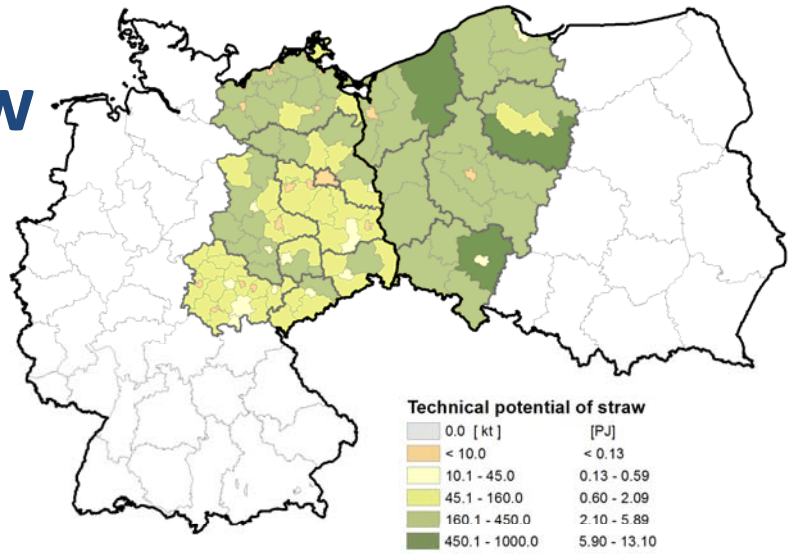
53 % Energy efficiency

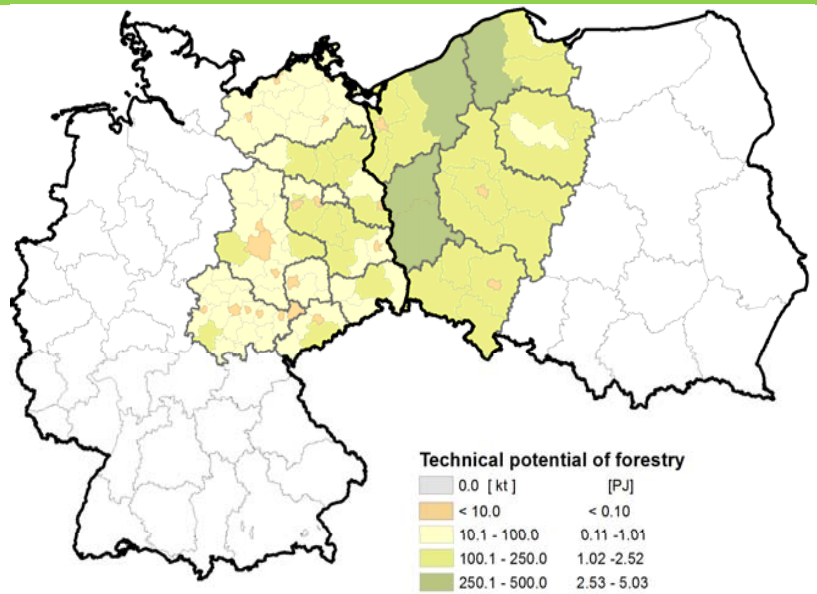
Case study area



Sustainable feedstock potential

Straw





Technical potential	Straw [t/a]	Forest Residues [t/a]
DE4 - Brandenburg	1,773,000	1,625,000
DE8 - Mecklenburg-Vorpommern	2,480,000	706,000
DED - Sachsen	1,737,000	752,000
DEE - Sachsen-Anhalt	2,234,000	735,000
DEG - Thüringen	1,522,000	942,000
PL21 - Malopolskie	205,000	134,000
PL41 - Wielkopolskie	1,427,000	792,000
PL42 - Zachodniopomorskie	1,141,000	876,000
PL43 - Lubuskie	454,000	792,000
PL51 - Dolnoslaskie	1,588,000	691,000
PL61 - Kujawsko-Pomorskie	976,000	391,000
PL63 - Pomorskie	799,000	593,000
Total	**16,336,000**	**9,057,000**

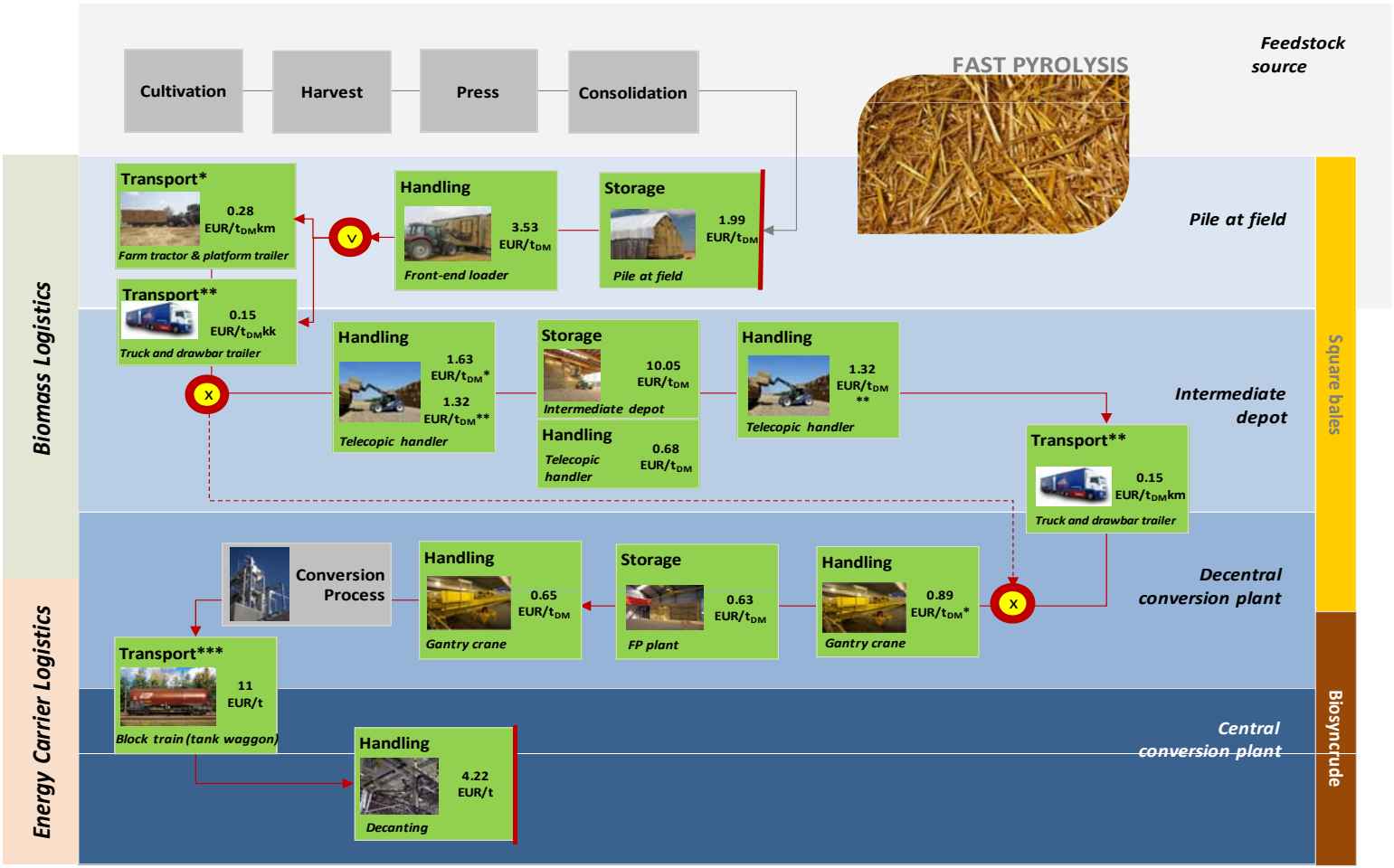
Forest Residues

Pathway modeling

Modeling to determine best sites and sizes for conversion plants and optimisation of production costs

- A holistic logistic approach employing a multi-stage supply network and simulation based optimisation
- Pre-calculated distance matrix between geographic units (NUTS 3 or subregions of max 7500 km²)
- All cost items along the pathway from biomass to fuel
- Variable costs for feedstock and production

Determination of cost



* transports by farm tractor

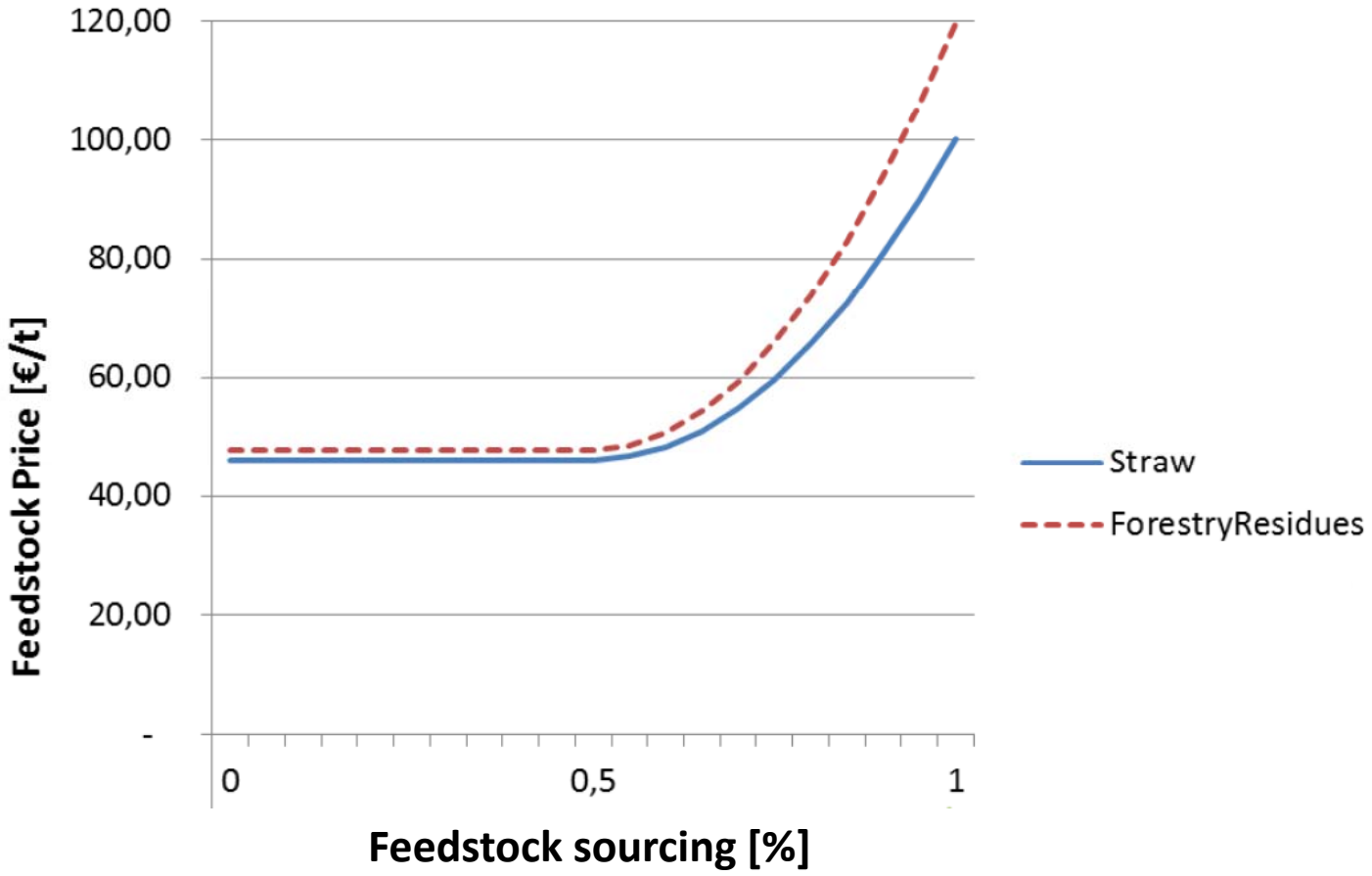
** transports by truck

*** transports by rail

[1] Rail transport costs depend on transport relation (east/west) and distance classes (from 200 km to 2000 km); costs range from 11 to 60 EUR/t

Variable feedstock costs

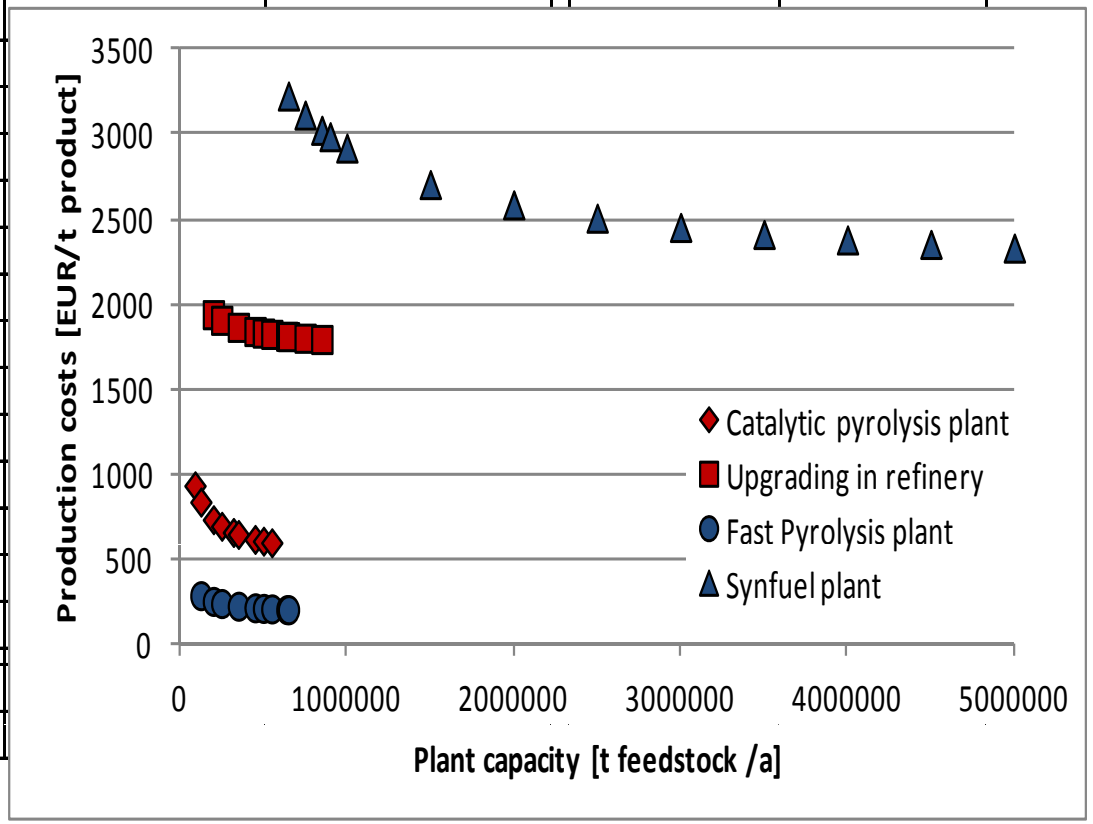
The feedstock price depends on availability: High demand increases the price!



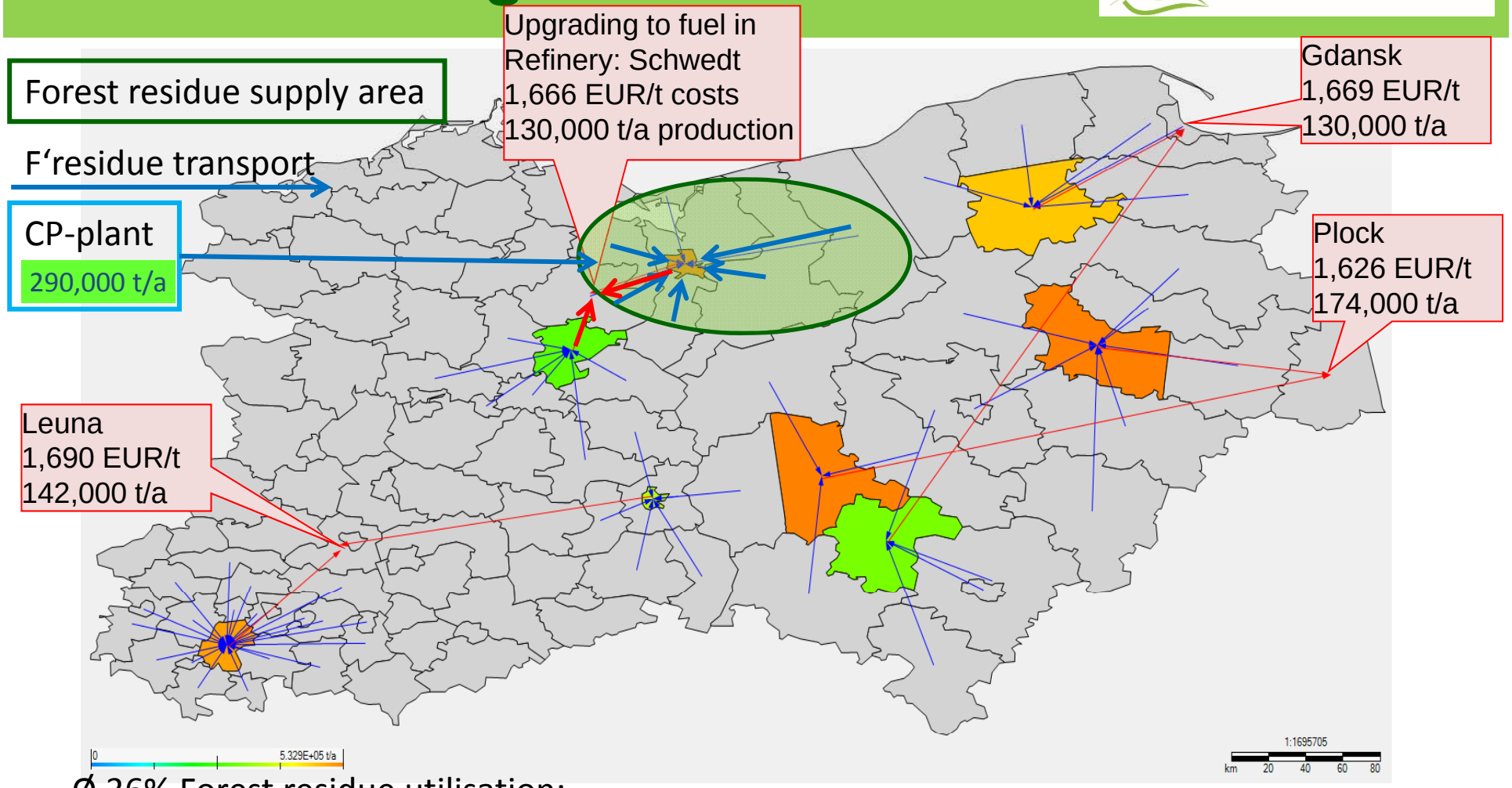
CP-value chain

Production cost items and scale of unit effect: Large plants have lower production costs per unit!

	Catalytic Pyrolysis	Refinery upgrading	Fast Pyrolysis	Synfuel plant
Design capacity [t/a]	179856	249690	219123	1345493
Conversion efficiency [t product/t feedstock]	0.25974	0.689655	0.675676	0.160256
Construction costs [EUR/t*20a]				
Operation costs [EUR/a]				
Construction scaling exponent				
Operation scaling exponent				
Utilisation factor				
Storage costs [EUR/t]				
Catalyst costs [EUR/t]				
Exemplary feedstock costs [EUR/t]				
Electricity costs [EUR/t feedstock]				
Hydrogen costs [EUR/t feedstock]				
Waste water costs [EUR/t feedstock]				
Cooling water costs [EUR/t feedstock]				
Electricity revenues [EUR/t feedstock]				
Light gases revenues [EUR/t feedstock]				
Linear production costs [EUR/t product]				
Scalable production costs [EUR/t product]				



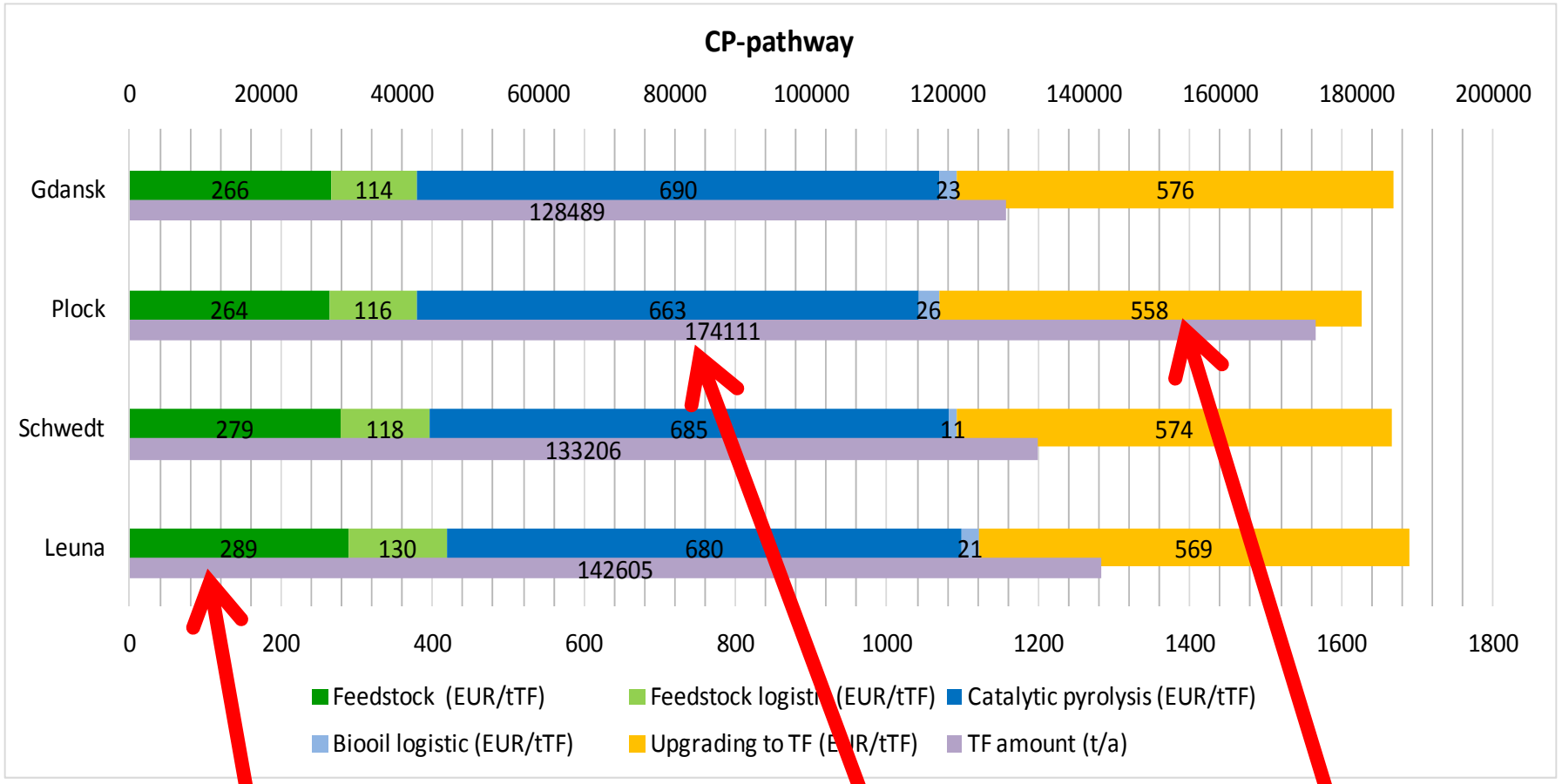
CP- modeling results:



Ø 36% Forest residue utilisation;
530,000 t transport fuel;
Ø 1661 EUR/t fuel production costs;
variation 1626 to 1743 EUR/t in 6 runs

Advantage Plock:
-Largest refinery
-Biooil-capacity of 2 large CP-plants

CP- cost composition

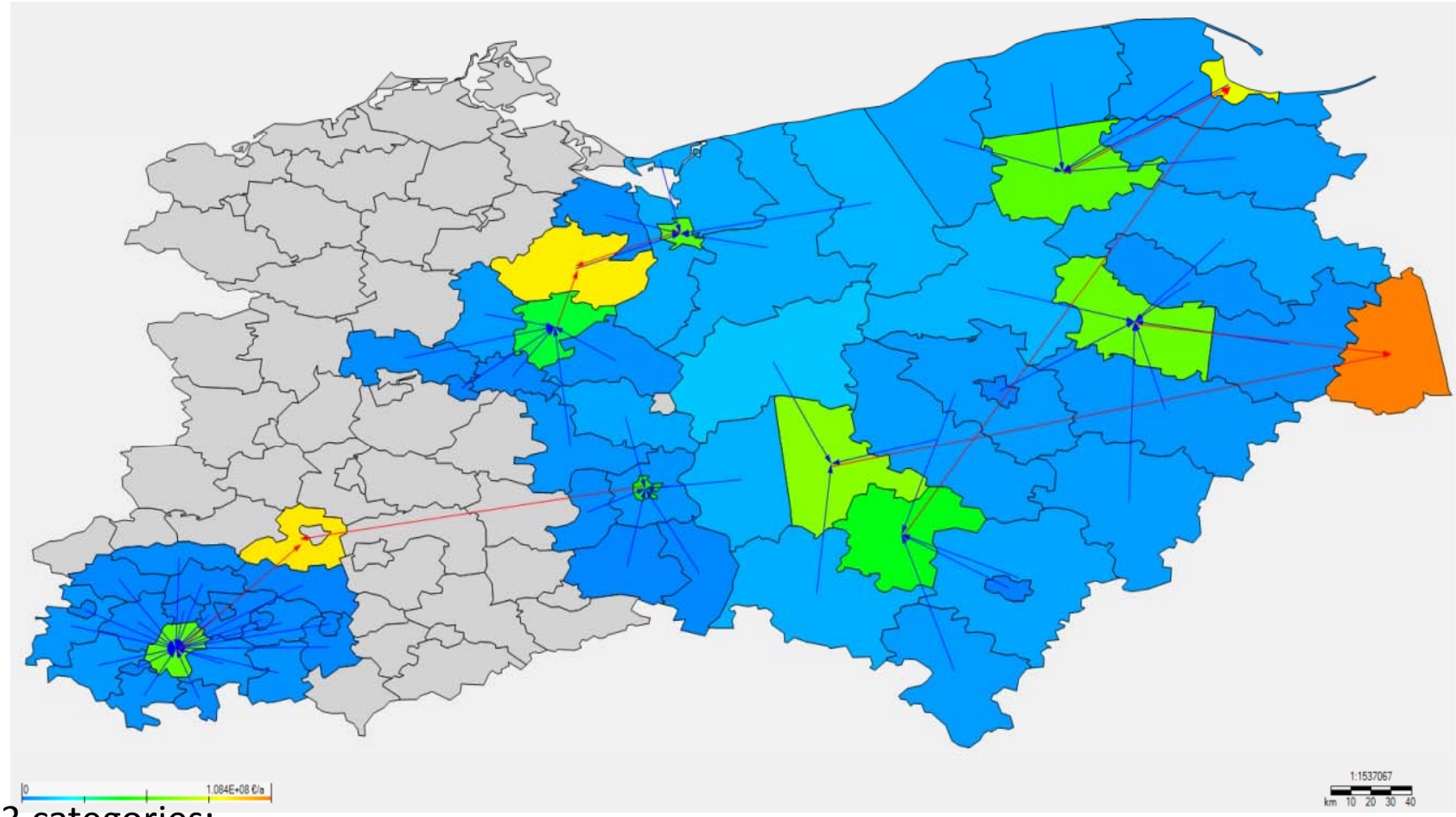


De: Higher feedstock costs

Plock: 2 max-size CP-plants

Plock: Scale-of-unit in upgrading, too

CP – regional added value



3 categories:

- Blue - FR supply, up to 11 mio EUR/a
- Green – 8 CP plants, 40 – 60 MEUR/a
- Yellow/orange – 4 refineries, 80 – 110 MEUR/a

Total added value in study area 960 MEUR/a.

Case study conclusions (1/3) Overall

1. Sustainable straw + forest residue potential 7.1 Mtoe per year
2. Full implementation of CP+FP would convert 50% of available biomass to 1.5 million tonnes per year transport fuel
3. CP+FP biofuel potential would cover 10% of fuel demand in study area
4. FP-synthetic gasoline and CP-biofuel are drop-in fuels, blendable in high share without impact on engines
5. Total 3.500 million EUR per year; 1/3 plant-depreciation, 1/3 plant operation, 1/3 for farmers and foresters
6. Total investment 23 billion EUR.

Case study conclusions (2/3) Production cost

1. Production cost CP fuel (100%) ~ 1,40 €/l
2. Production cost FP fuel (100%) ~ 1,80 €/l
3. With CP- and FP-blends the GHG emission targets could be achieved for cost of + 1 – 6 Cent/l more than RME- or bioethanol within the current fuel specification (no B10, no E11).
4. FP: first 50.000 t plants in Finland and The Netherlands
5. CP: not proven in commercial scale yet

Case study conclusions (3/3) GHG emissions

1. GHG-avoidance of CP fuel is at 80 %,
2. Emission reduction of transport is 7.7%,
3. CO_2 avoidance cost ~ 505 €/t

Acknowledgement

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Thank you for your attention !!

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