To be or not to be a biobased commodity. On the need for developing real lignocellulosic biomass commodities

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Message:

- We need to define and develop a limited number of lignocellulosic intermediate commodities to link the biomass souces worldwide to markets
- This will lower the cost of biomass and increase the security of supply and it will make efficient use of the available biomass

We have two types of biobased feedstocks:

- **Feedstocks for first generation technologies** = sugars, starch and oils
  → issues and solutions

- **Feedstocks for second generation technologies** = Lignocellulose
  → issues and solutions

First generation: sugar, starch, oils

Advantages:

Relatively easy to convert: with first generation technologies

Readily available feedstock

GHG balance positive (in the chain) > 50% better than fossil equivalent

Issues

Variable availability and price

Competition with food and feed

Indirect land use change risk: iLUC

Varying the demand of biofuels may be a solution

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Lignocellulose feedstocks for the biobased economy = wood, crop and processing residues for heat, electricity, fuels, chemicals and materials

Advantages:

Plentiful - many residues underutilised

Large crop potential on released and abandoned land / forest

Low cost feedstock(?)

Issues

Costly to convert into products

Mobilisation takes time

More energy needed to convert than for first generation feedstocks

Purification for chemical conversion difficult

Much (herbaceous) biomass is underutilized – Often causing pollution problems – how much can be used for biobased applications?

Top 10 crops in the world		Total field	Total mill
	Million hectares	Million ton DM crop residue per year	
Maize	185	1,038	
Rice, paddy	163	816	
Wheat			
Sugar cane			
Oil Palm			
Barley			
Sorghum			
Sunflower seed	25	66	8
Millet	31	43	
Seed cotton	35	35	
Sum:	**800**	**3,459**	**316**
All crops worldwide:	1,414		

What part can we mobilize?
Can we recycle the nutrients?
What part is needed for the soil?

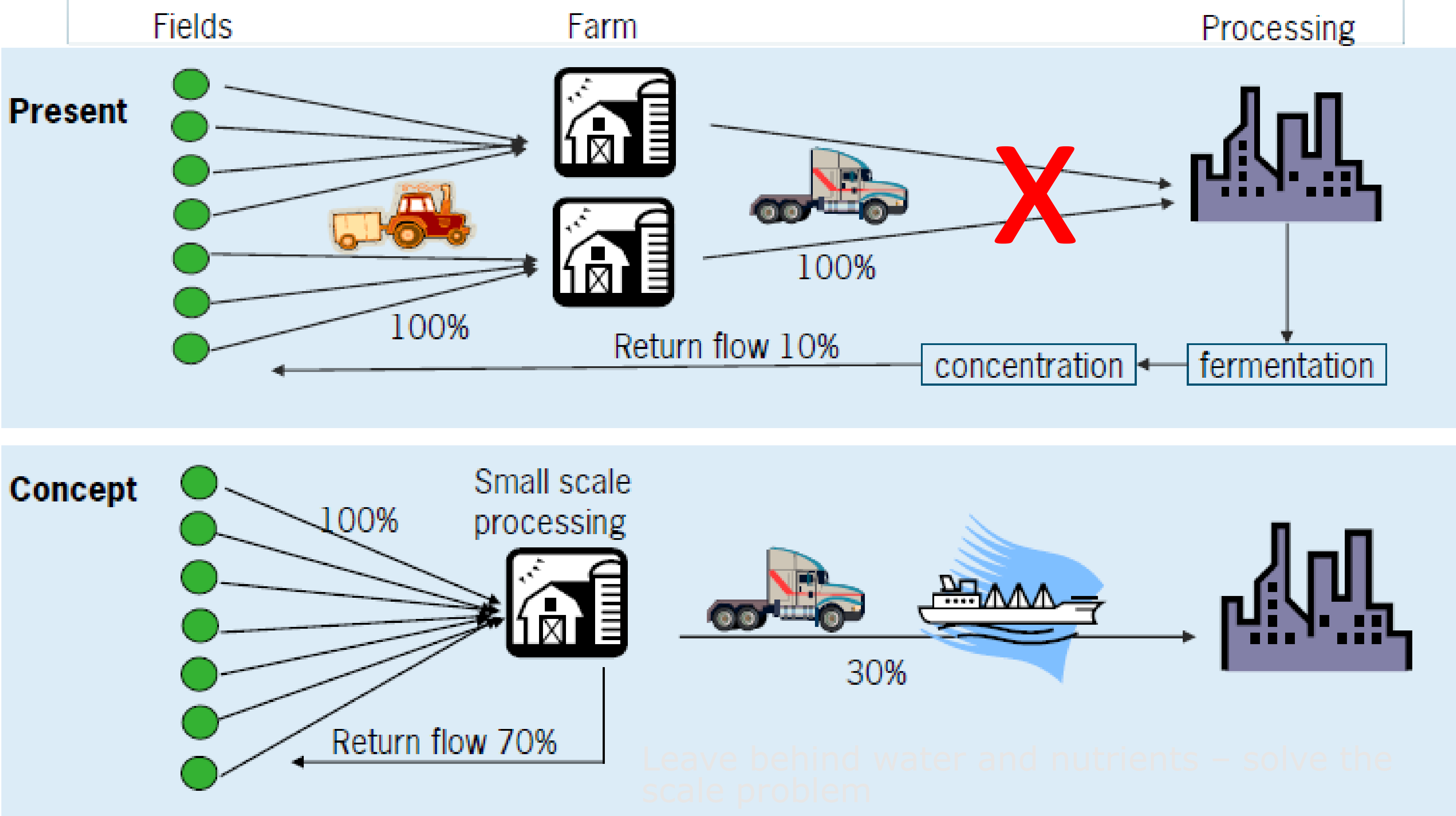



Biomass vision - where should a lignocellulose conversion plant / biorefinery be located?

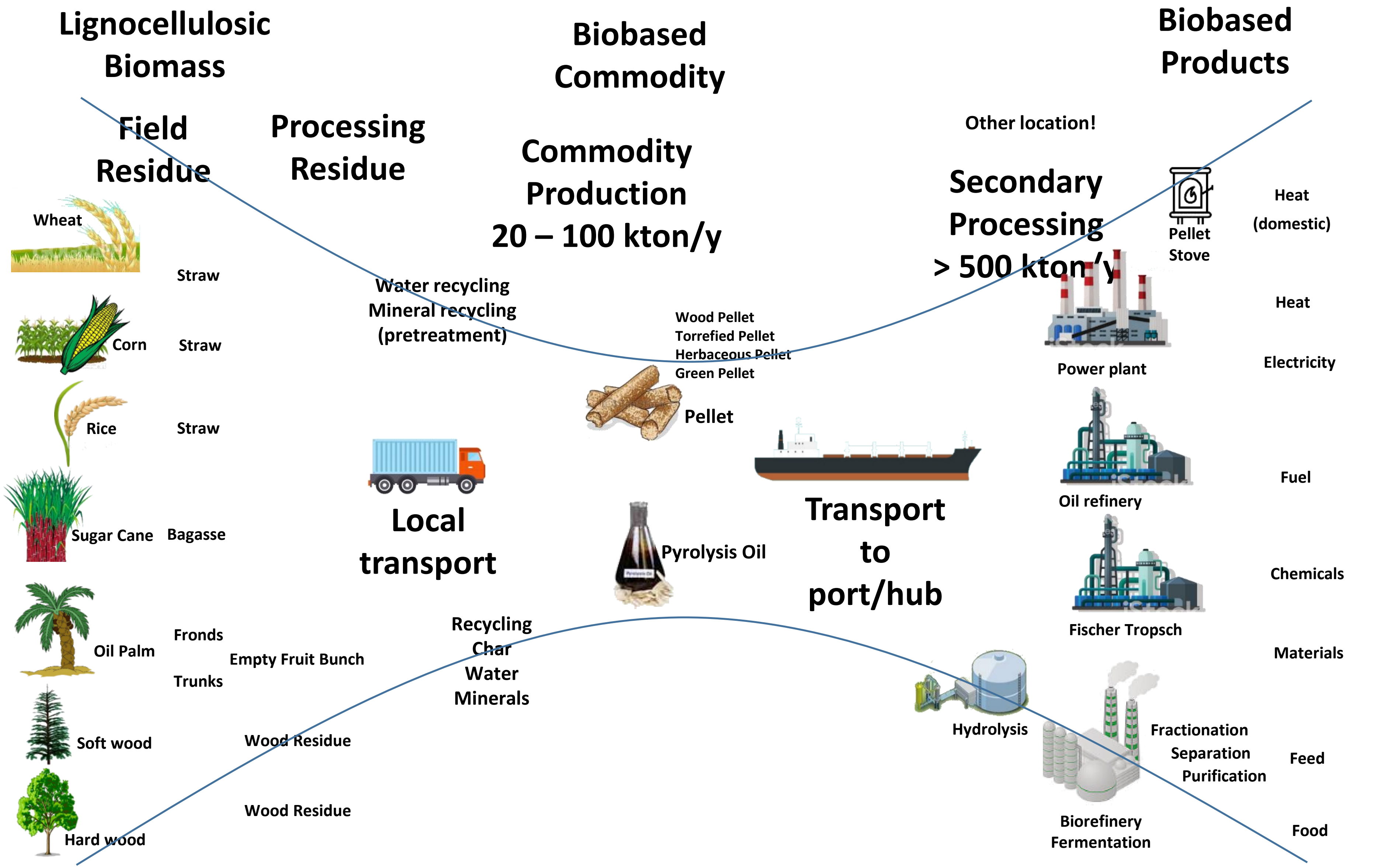
Location: Factor	Near the biomass	At a large logistical hub (harbour)
Cost of biomass	+	-
Biomass security of supply	-	+
Availability of Infrastructure	-	+
Maximum scale	-	+
Availability of personnel / expertise	-	+
Value or residues	-	+
Sum	1+	5+

Biomass scale does not fit processing scale

Forward integration reduces tranport cost and seasonality and will give more income to the farmer



Ref. Sanders



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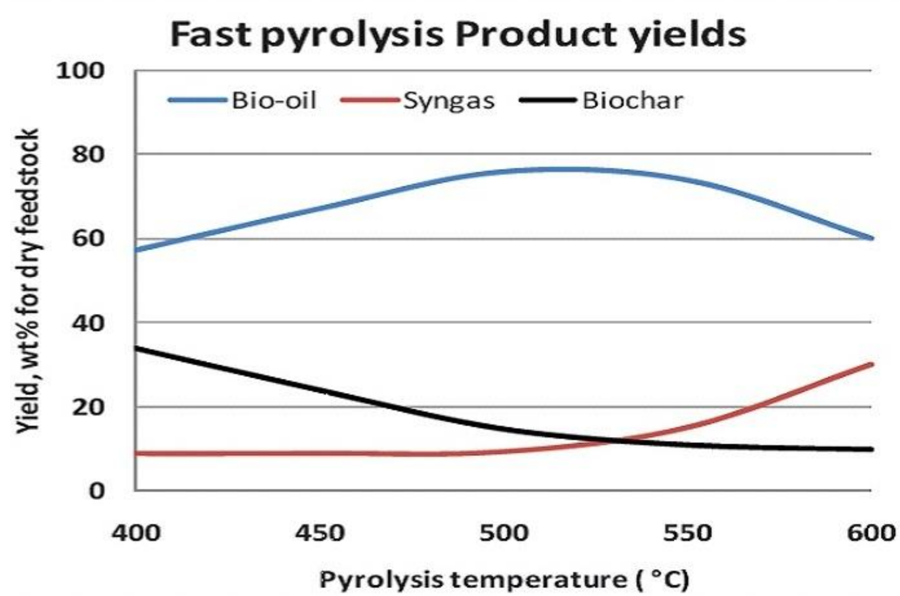
What is a real biomass commodity?

Real commodity	Not a commodity
Easy to store and transport → high energy density, dry, low volume, low ash, nutrient depleted	**Not easy to transport**
Fungible → "exchangeable" = standard quality	**Not fungible**
Standardised transport, contracting, standard insurance, etc.	**No broad standards**
Standard conversion systems	**No functioning markets or trade**
Functioning markets:	**Trust needed between producer and buyer**
Trade systems, Financial instruments (futures, etc.)	**One on one relations between producer and buyer**
High tradability	**Vertical integration**
Sustainability	**Less security of supply**
Standard certification systems	**High transaction costs**
	Inefficient

Pyrolysis oil as Biocommodity?

- Lignocellulose to pyrolysis oil:
  - Input is (dry) lignocellulose:
  - Low oxygen + 500 °C
  - Also small scale: 20.000 tons per year
  - Pyrolysis oil (70%) + char (20%?)
  - Pyrolysis oil can be used for heat, electricity, refinery of transport fuel (diesel)
  - Not a commodity yet



Bio-oil (~22 GJ m^{-3}) **Bio-char** (~21 MJ kg^{-1}) **Syngas** (~6 MJ kg^{-1})

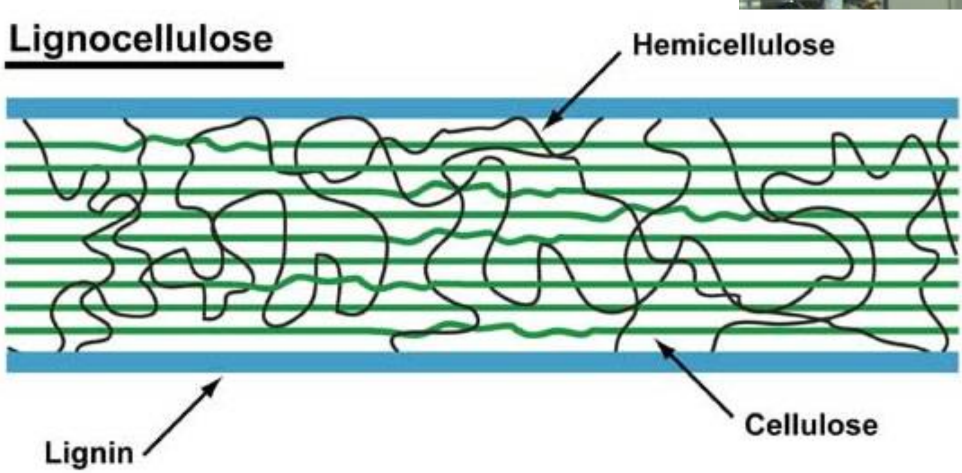
Pellets as Biocommodity?

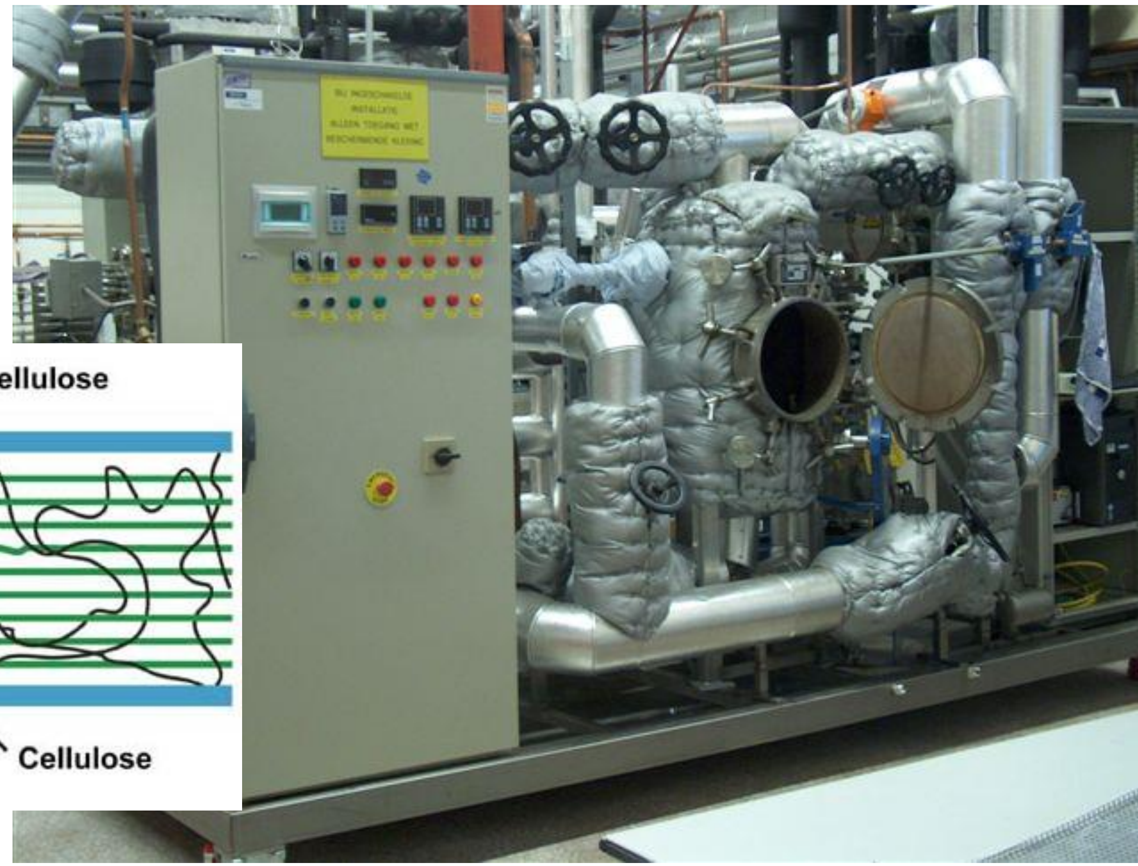
- "Simple" production process
- Min 25.000 ton per year
- Easy transport
- Easy storage
- Pellet production should costs € 35 to €55,-/ton

- No standards for non-wood?
- No transparent market, cost of transport
- Reliability of transport, contractibility
- Not a real commodity yet

(Superheated) steam pilot plant for pretreatment

Pre-treatment and nutrient removal at small scale.





Counter current extraction

2 to 3 liter of water to extract 1 kg of biomass. To lower K or Cl by 95% we need more water or more stages

Estimate of cost for 40.000 ton (DM) per year of biomass is 6.5 €/ton, = 8 US$/ton

Oil palm residue extraction

EFB		Before	After
Ash (550 ºC)	(% of DW)	4.64	1.85
Ash (815 ºC)	(% of DW)	3.77	1.73
S	(% of DW)	0.063	0.023
Cl	(% of DW)	0.38	0.024
SiO_2	(% of ash 815 ºC)	30.8	33.5
Al_2O_3	(% of ash 815 ºC)	0.53	0.92
TiO_2	(% of ash 815 ºC)	< 0,1	< 0,1
P_2O_5	(% of ash 815 ºC)	4.87	10.1
SO_3	(% of ash 815 ºC)	1.89	9.54
Fe_2O_3	(% of ash 815 ºC)	0.99	1.11
CaO	(% of ash 815 ºC)	4.35	17.9
MgO	(% of ash 815 ºC)	9.51	12.7
Na_2O	(% of ash 815 ºC)	2.93	0.78
K_2O	(% of ash 815 ºC)	37.8	12.7
Mn_3O_4	(% of ash 815 ºC)	0.12	0.26
SST	ºC	990	1080
DT	ºC	1210	1120
HT	ºC	1250	1160

Example: Cost of electricity delivery from straw (25 MWe) compared to large scale electricity and heat production (500 MWe + 375 MWth) via a clean (commodity) pellet.

	€ per kW·hr	
	Local straw to electricity	Large scale clean straw pellets to electricity
Raw materials	0.019	0.061
Transport	0.009	0.013
Electricity prod. costs	0.113	0.042
Heat revenues	0.000	-0.011
Sum	**0.141**	**0.105**

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How to get there?

- Develop local biorefinery systems - relatively small (25.000 ton per year?) - remove nutrients and water and produce a lignocellulosic commodity
- Define only a few biomass commodities that cover
  - All lignocellulosic biomass types (wood, grass, straw, bagasse, etc.)
  - All applications: heat, co-firing, biorefinery, etc.
- Set wide standards and avoid frivolous demands
- Involve all players in the production chain (biomass producers, machine builders, regulators, insurers, bankers, transport, final users)
- **Use current demand for energy to develop commodities for biorefineries of the near future**

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We are looking for

- Examples of lignocellulosic commodities in biobased economy?
- Lignocellulosic biomass trade systems?
- Effect on price of biomass trade systems (wood chips?)
- How to speed up the development of commodities?
- What should we do?
- What should we <u>not</u> do?

END

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