



Appetite for bioenergy ?

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Luuk van der Wielen and Jan van Breugel

Innovation

BioBased

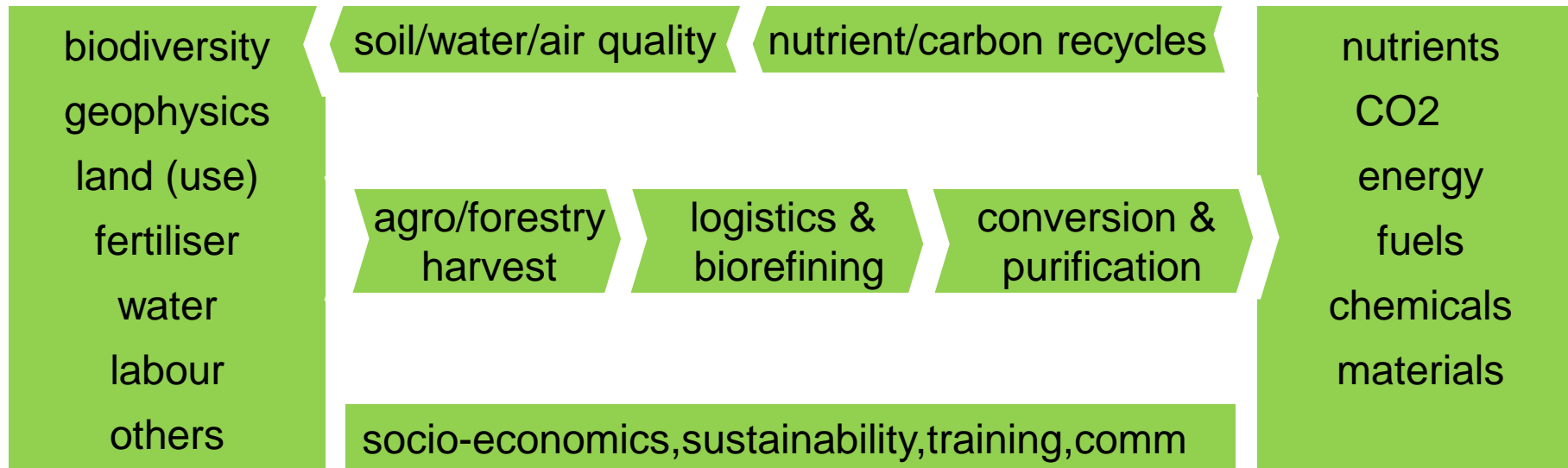
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Corbion


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'Bioenergy' through BE-Basic's eyes

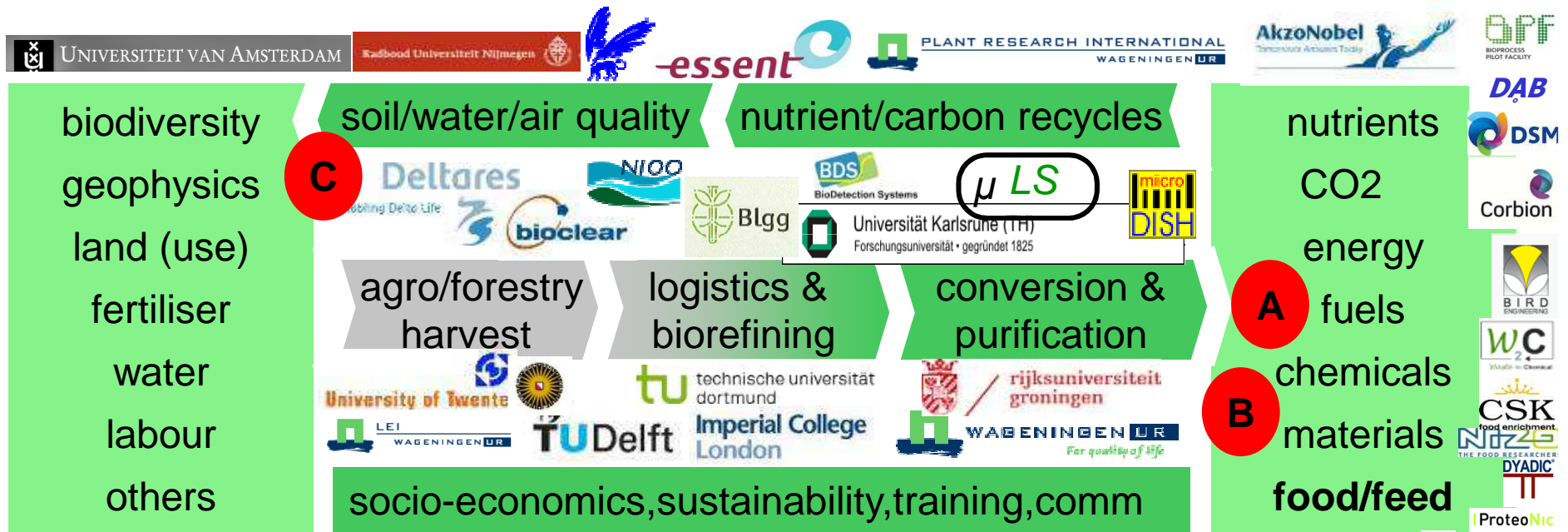
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Appetite for bioenergy

1. Healthy appetite for bioenergy ?
2. Broader diet ?
3. Industry metabolism
4. Can biomass be sustainable resource ...
5. ... for whom ?



BBE : full economic bio-mASS-utilisation



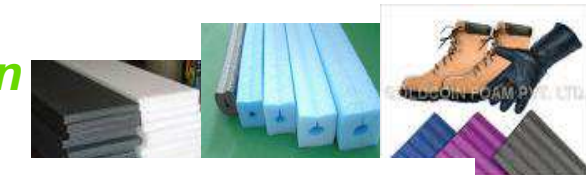
"CO₂"

1^e generation

2^e generation

agro-emissions
(run-offs, N₂O)

nutrients



bioplastics

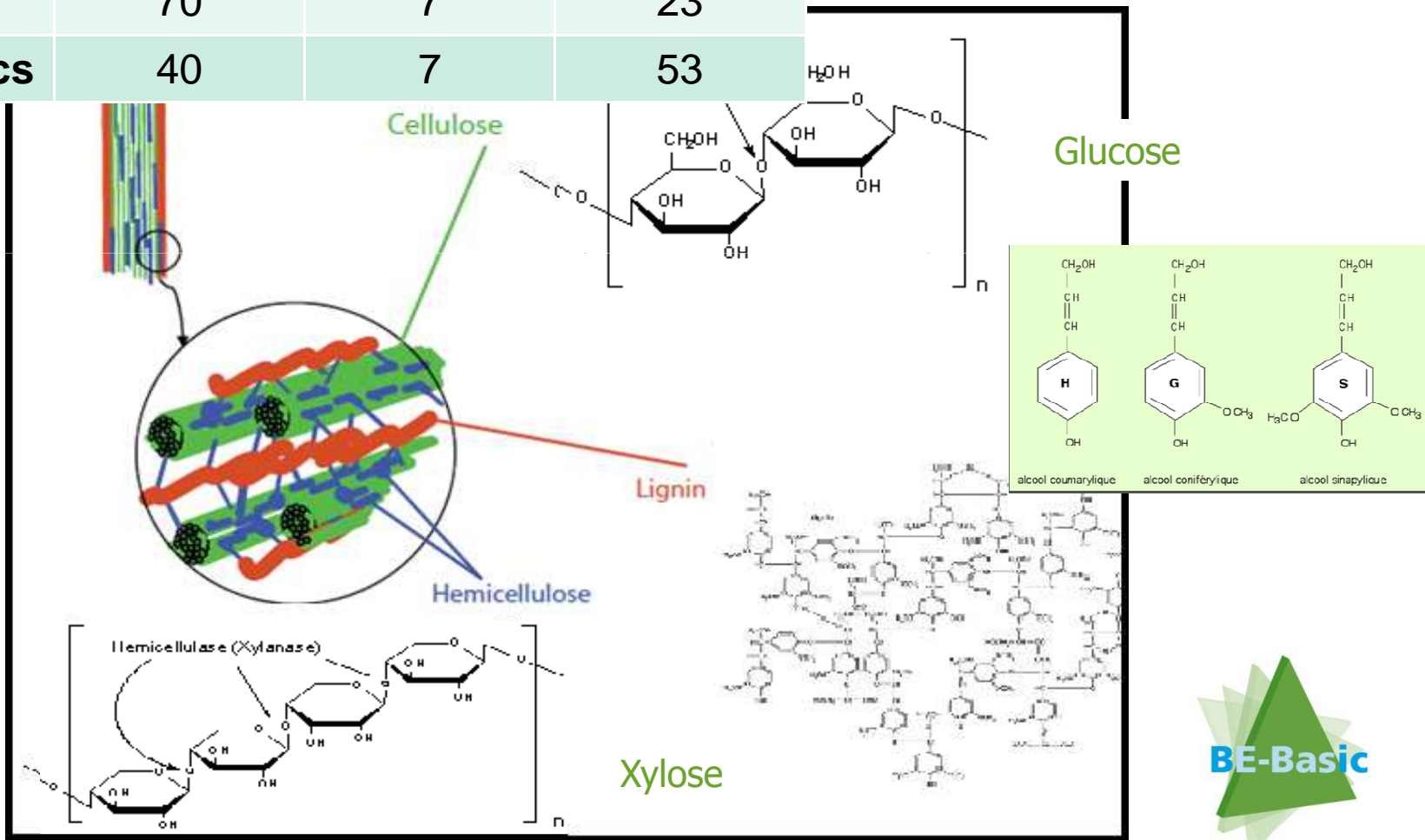


bioconstruction

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Generalised challenge – use oxygen

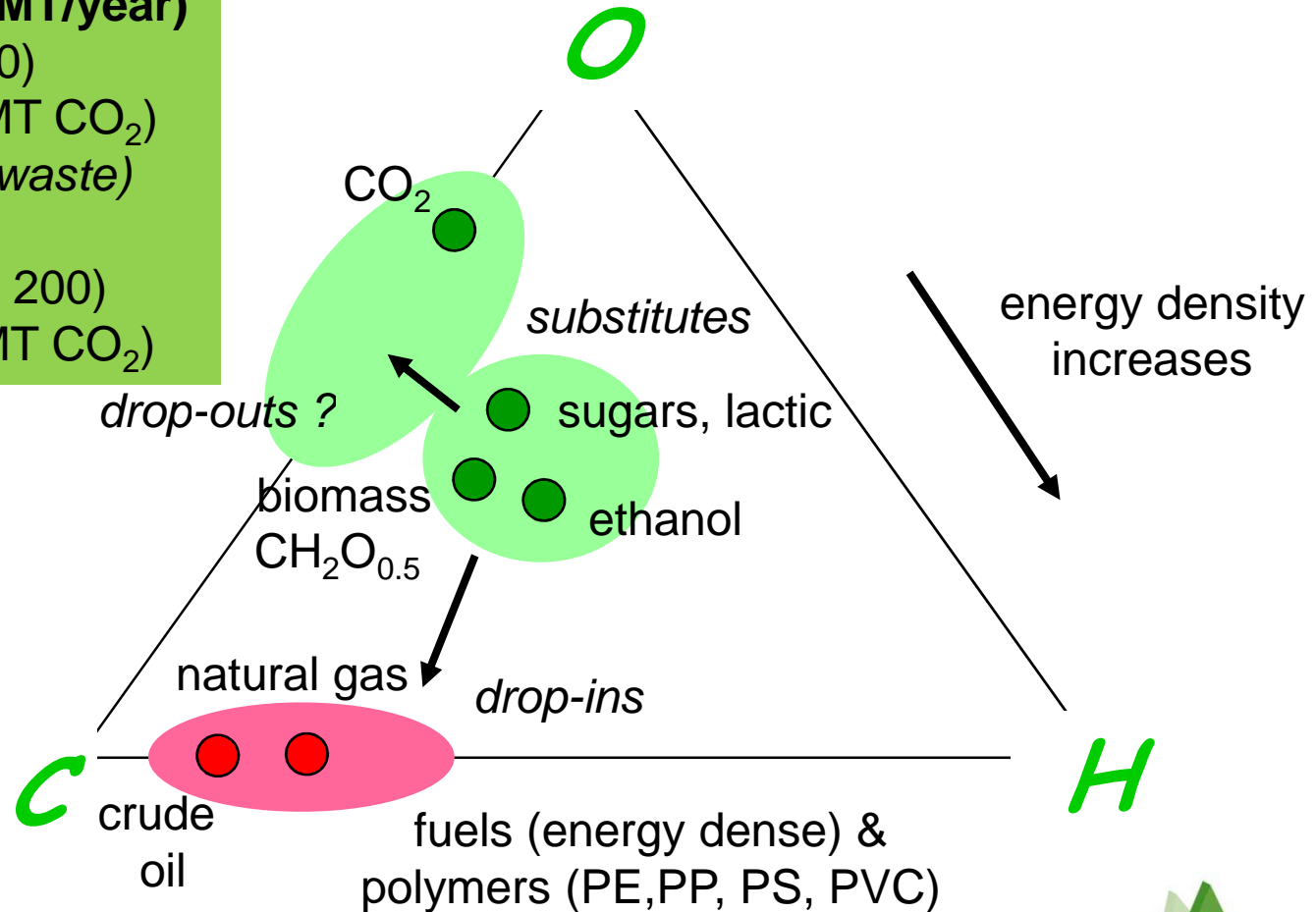
[wt%]	C	H	O
biomass	51	6	43
lignin	70	7	23
cellulosics	40	7	53



mass yield matters: products are sold per tonne

global production (MT/year)

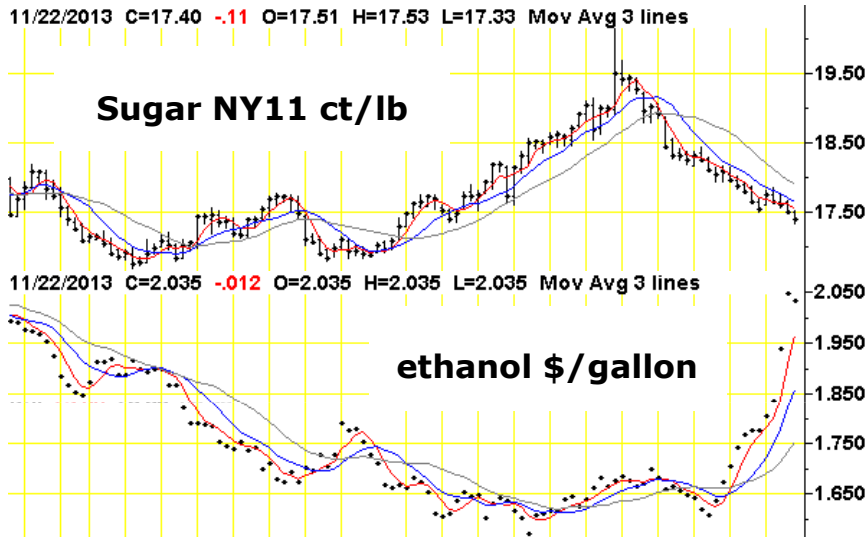
fuels	2000 (jet 300)
cement	3000 (600 MT CO ₂)
food	4000 (50% waste)
glass	120
plastics	280 (big 5: 200)
steel	120 (200 MT CO ₂)



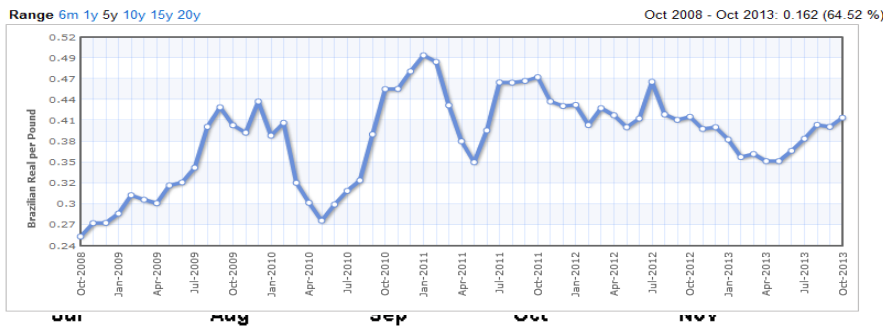
mass composition biobased and fossil feedstocks and products



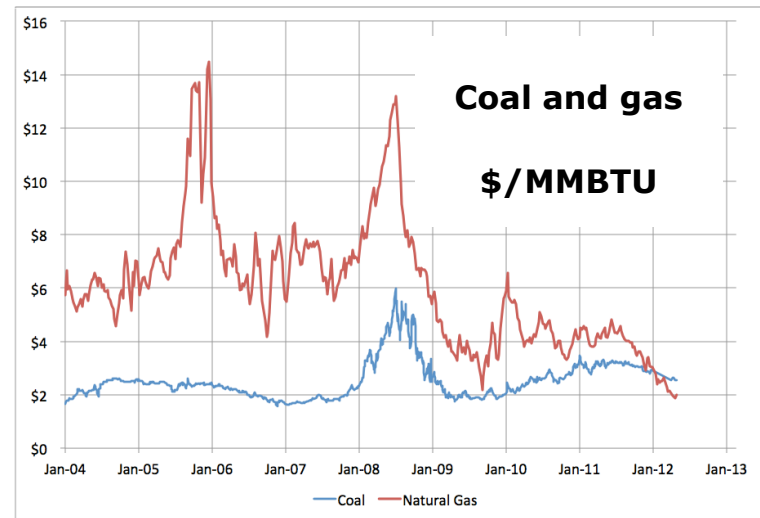
price dynamics



Sugar Monthly Price - Brazilian Real per Pound

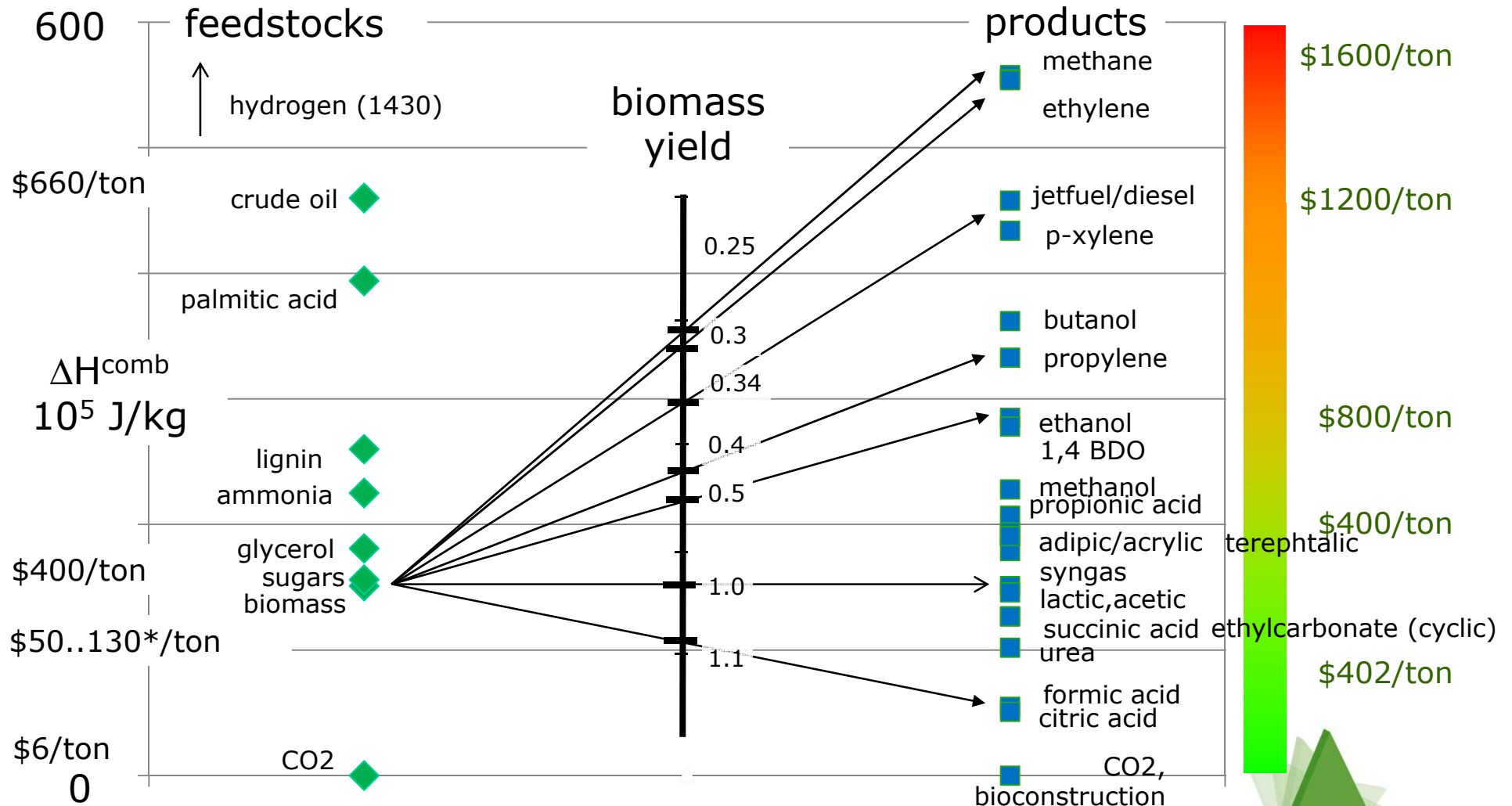


1. sugar \$400...440/ton
2. ethanol \$550...670/ton
3. lignin \$80...100/ton
4. power 10 ... 20 ct /kWh
5. heat only for industry/domestic use



<http://beyondeconomics.org/2013/01/07/the-not-so-promised-land-of-fracking/>

Cost contribution of feedstocks



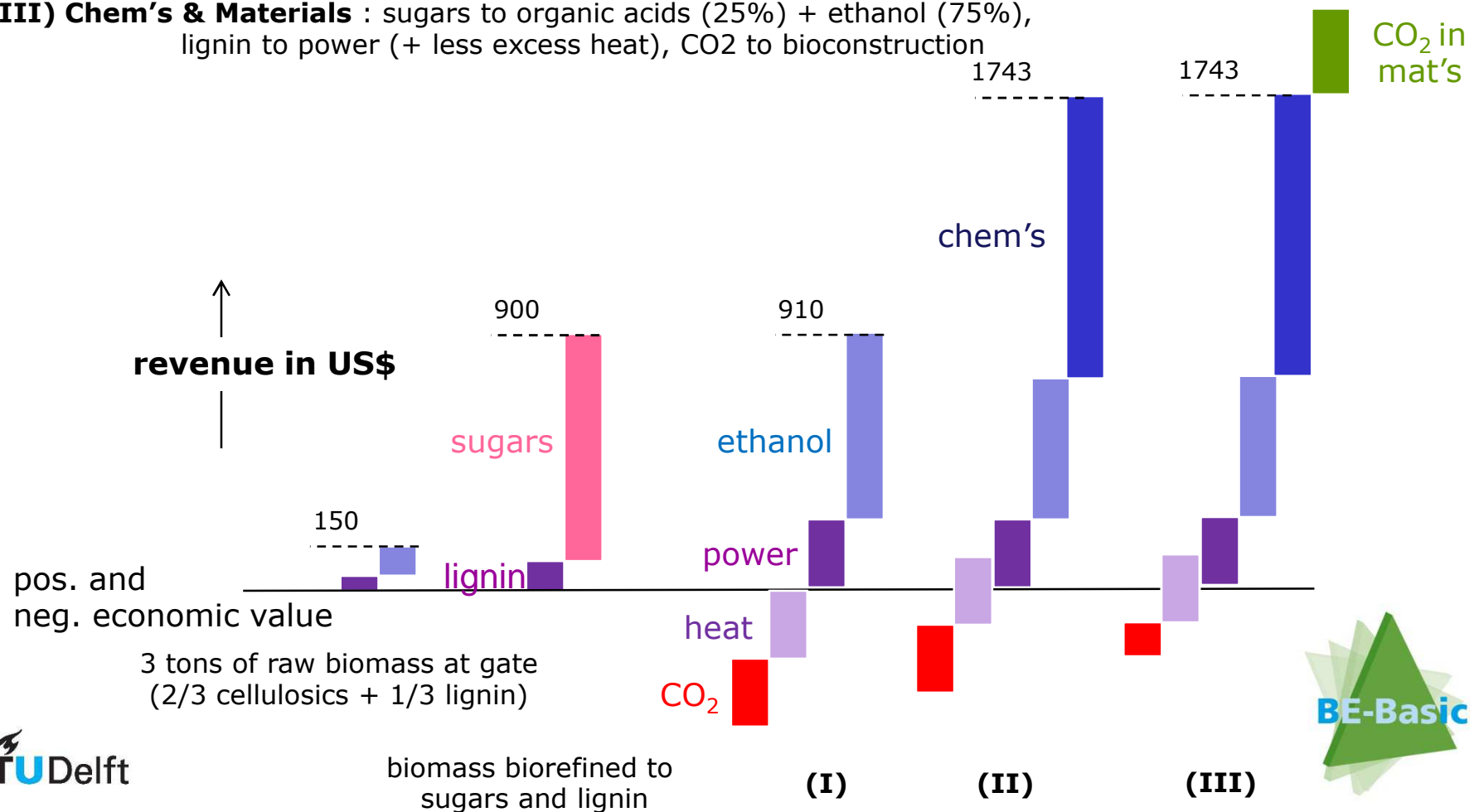
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biorenewables' scenarios

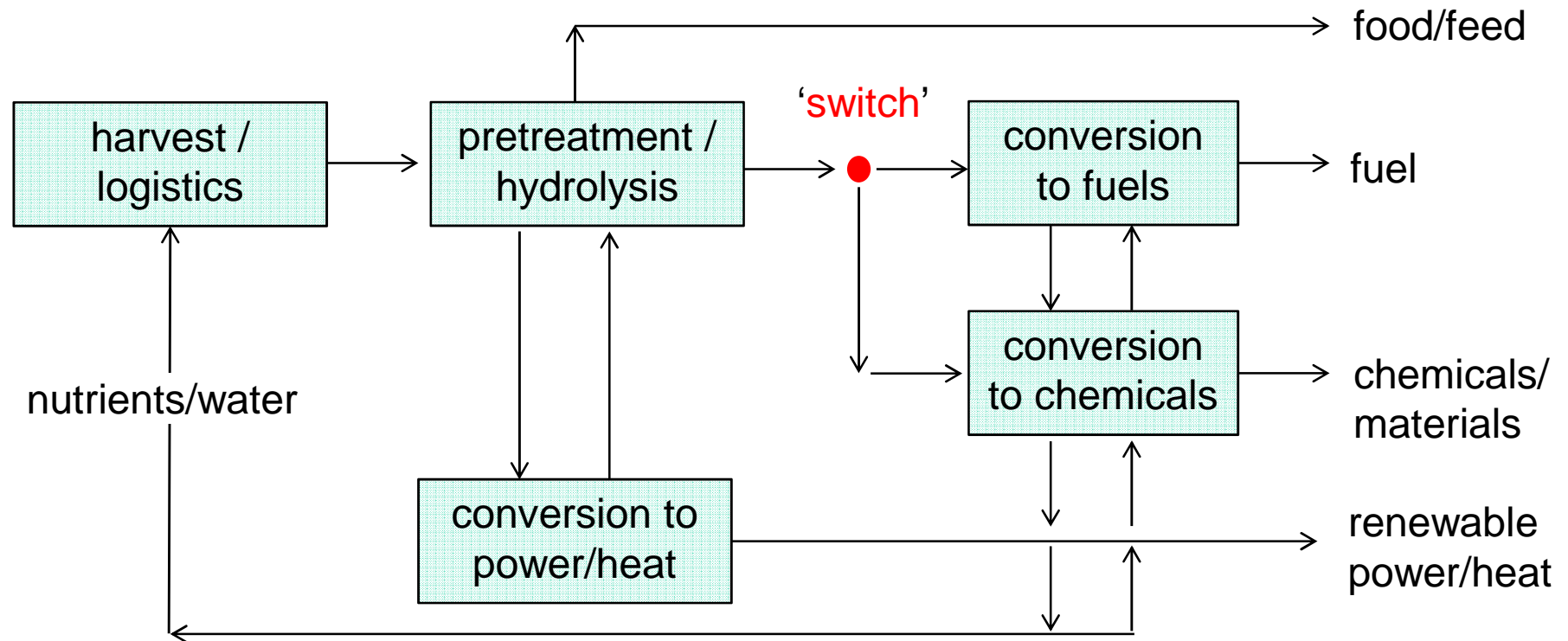
(I) Bioenergy Only: sugars to ethanol (100%) , power (heat)

(II) Chem's : sugars to organic acids (25%) + ethanol (75%),
lignin to power (+ less excess heat), CO₂

(III) Chem's & Materials : sugars to organic acids (25%) + ethanol (75%),
lignin to power (+ less excess heat), CO₂ to bioconstruction

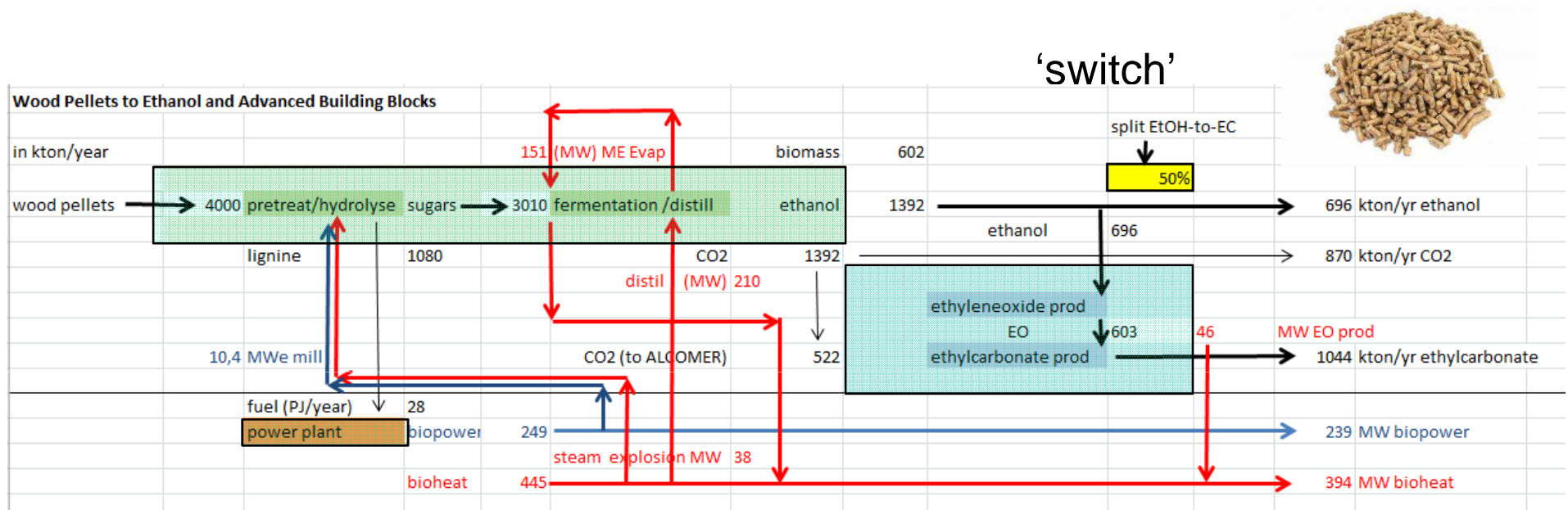


Biorefinery structure - biomass to integral value



- tune portfolio value renewable energy/fuels/chemicals
- counter-acting scale effects of logistics (5-10% for bagasse, 30% for palm oil biomass) and conversion costs
- energy/heat, water, and nutrient integration
- need for cross-industry sector collab's (JVs, trade, co-op's,...)

Worst case: wood pellets to renew. energy & chemicals



Location: Port of Rotterdam. Ethanol and ethylcarbonate.

Investment 1.4 bn EUR, RoI > 25%, payback time < 3 yrs

No subsidy, yet 80+% of RE (relative to cofiring-only, depending on scenario) but with different energy mix.

Production of ethanol and ethylene carbonate from wood pellets
A sustainable business for the Port of Rotterdam

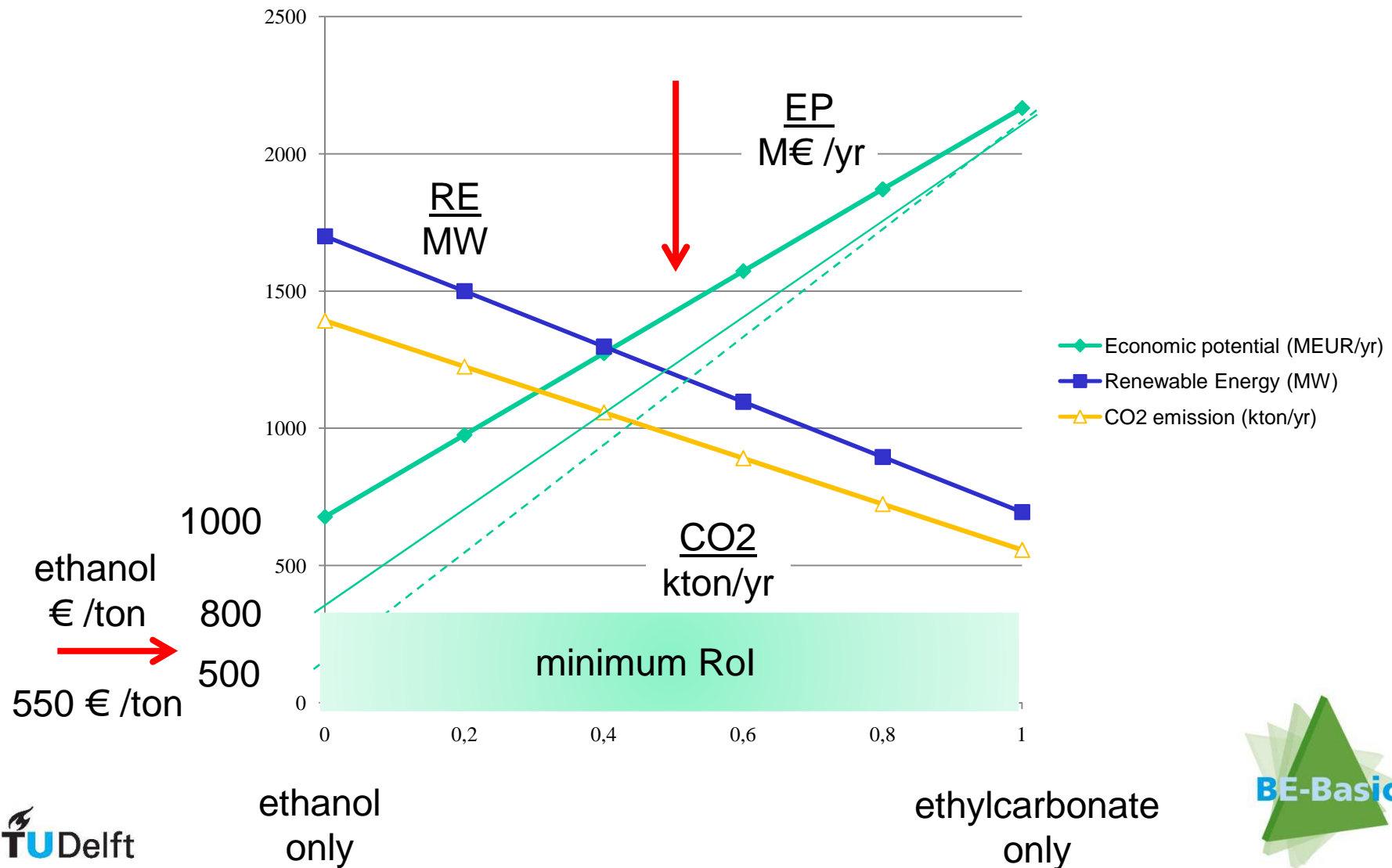


Address:
Wierland 100 (2204AS)
Boulevard Oudehaven (2204AS)
2204AS Rotterdam (2204AS)
T +31 (0)10 412 2222
info@bigport.nl
www.bigport.nl

Contact:
Sander van den Broek
Sander@bigport.nl
+31 (0)10 412 2222
+31 (0)10 412 2222
+31 (0)10 412 2222
+31 (0)10 412 2222

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Economy & Sustainability trade with RE

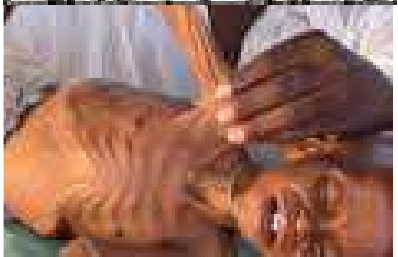


Global drivers for a BBE ?



al landen, mede in het kader van

nergiebesparingen door
n. Door fors overheidsingrijpen
g moet het mogelijk zijn het
2030 te stabiliseren op het niveau



- more people with more wealth
- less **nett** GHG emission (global warming) and/or climate adaptation
- politics (security of oil/gas supply)
- innovation, rural income and economic development
- increasing (*and decreasing*) prices of resources
- in time*, limited fossil reserves
- **add sustainability to food chain**
- **add value to food chain and prevent hunger**

Pick your personal selection !

conclusions

1. Healthy appetite for bioenergy ? but balanced
2. Broader diet to add value and sustainability
3. Industry metabolism requires integrated 'digestion'
4. Biomass can be sustainable resource ...
5. ... for whom ? – when integrated in broader BBE picture



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Foundation

Contact us

B(E)-Basic Foundation

T +31 15 – 2782363

E info@be-basic.org | Brazil@be-basic.org

W www.be-basic.org

or

L.A.M.vanderWielen@tudelft.nl



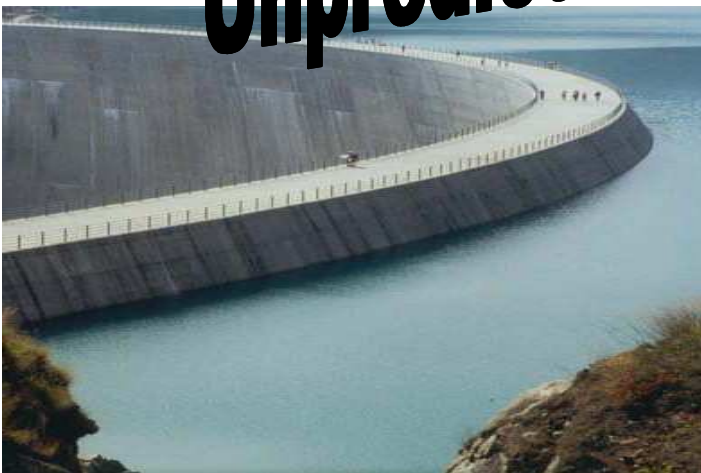
Back-up

Life in a Delta is ...

River erosion

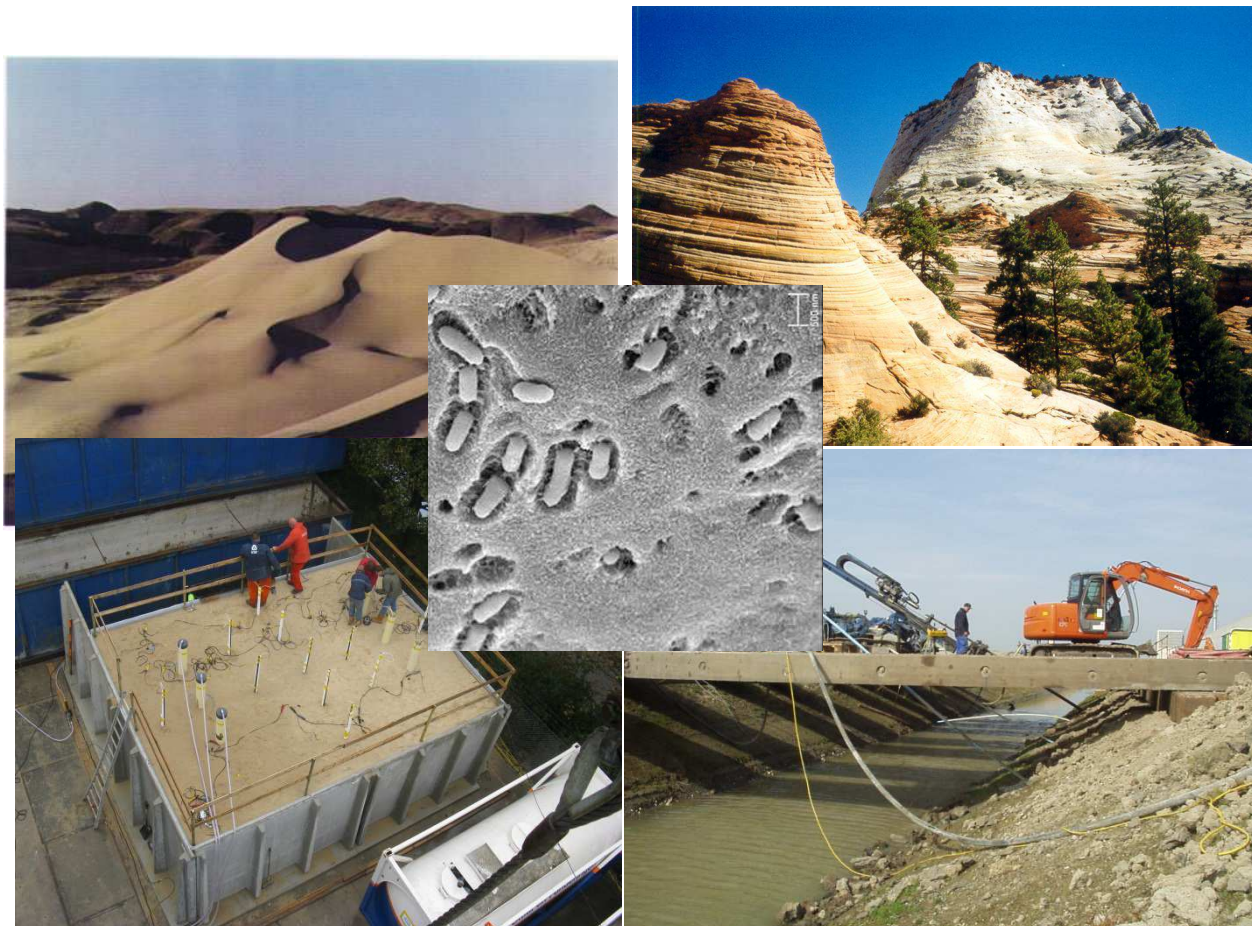


Settlement

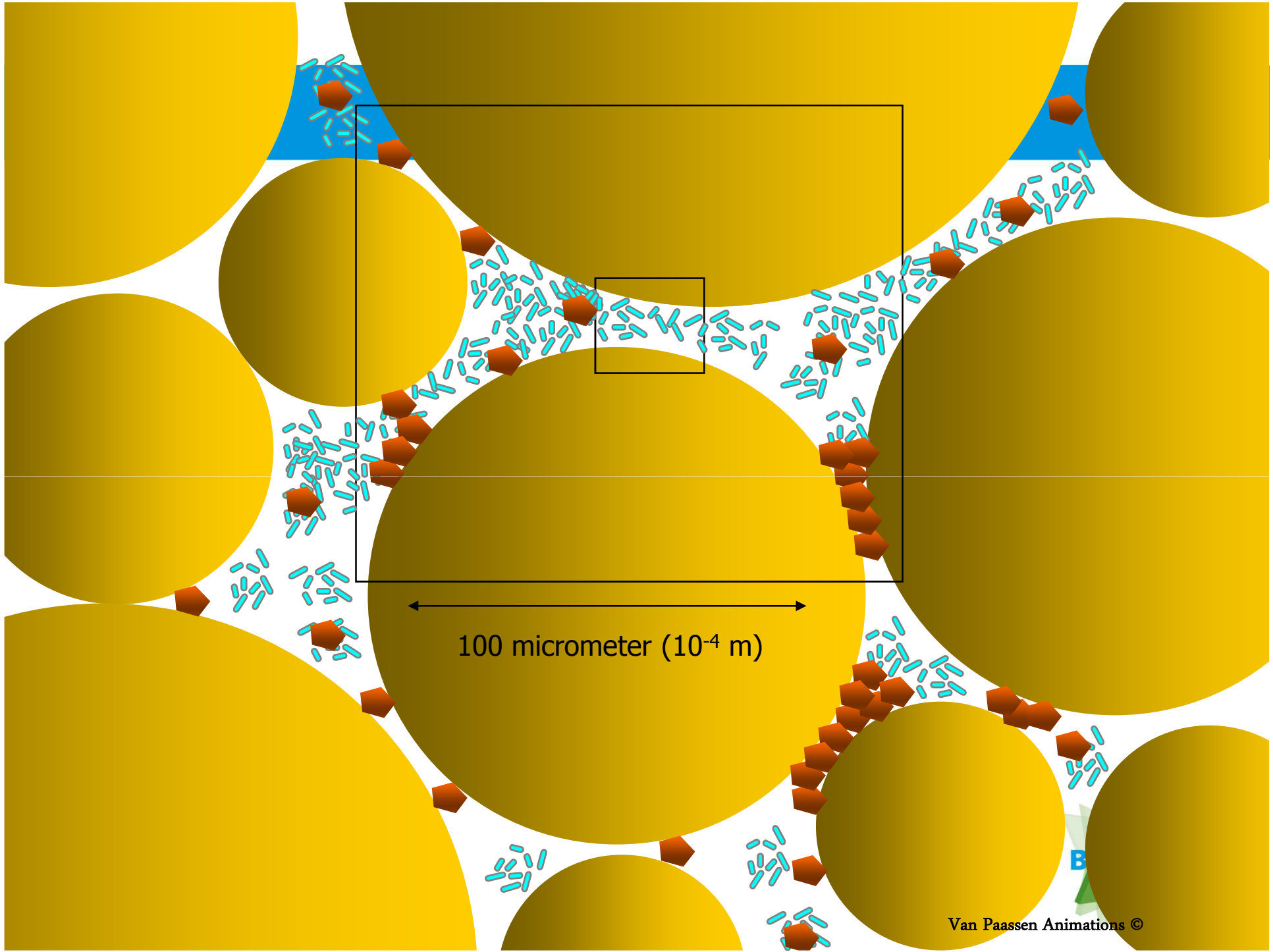


Unpredictable soil behaviour

Biogrout & bioconcrete: from soft soil to rock solid



In-situ concrete by carbonate fixation



100 micrometer (10⁻⁴ m)