

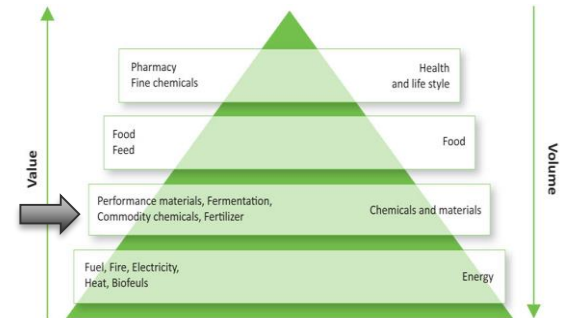
# Green Chemistry (Sino-Dutch opportunities)

Heeres & Heeres, Hanzehogeschool/RUG/Syncom

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**move the world.**

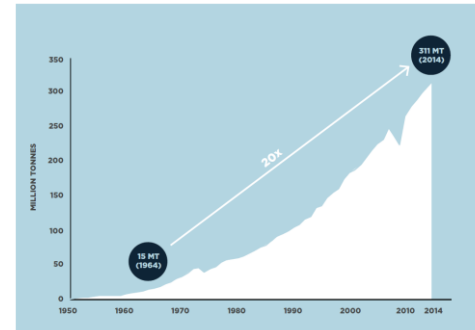
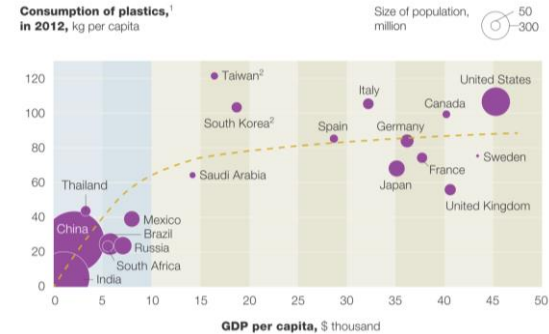
# Content

- Drivers biobased transition
- Green Chemistry in the Northern part of the Netherlands
- A case study (propylene glycol)
- Opportunities and chances for Sino Dutch cooperation's



# Drivers biobased transition

- Environmental aspects
- Exhaustion of oil/decoupling from fossil feedstock
- Demographic trends
  - Growth world population
  - Increasing prosperity (middle class)
- Economic opportunities!



Ellen McArthur foundation, 2016

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# Biomass to chemicals

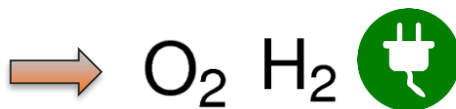


- Northern Part of The Netherlands



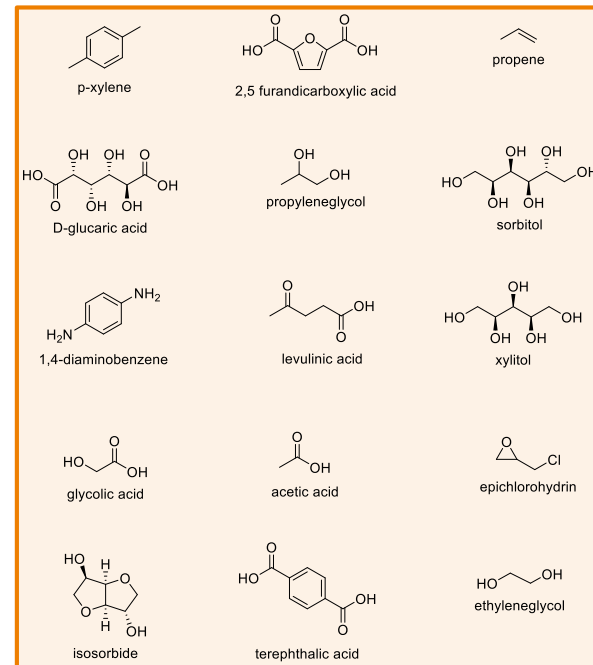
- Knowledge Institutes (4x)
  - University of Groningen
  - Hanze University of Applied Sciences
  - NHL Stenden
  - Van Hall Larenstein
- Chemistry sites (2x)
  - Eemsmondregio/Delfzijl
  - Emmen (plastics)
- Harbour/(Sea)
- Biomass available

# Chemical landscape “Delfzijl”



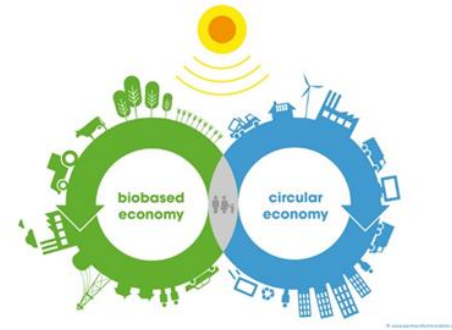
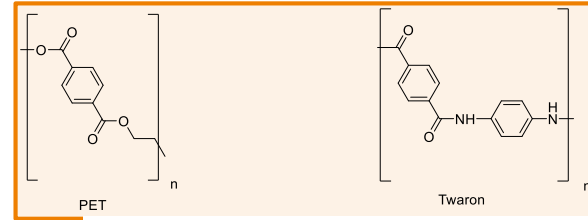
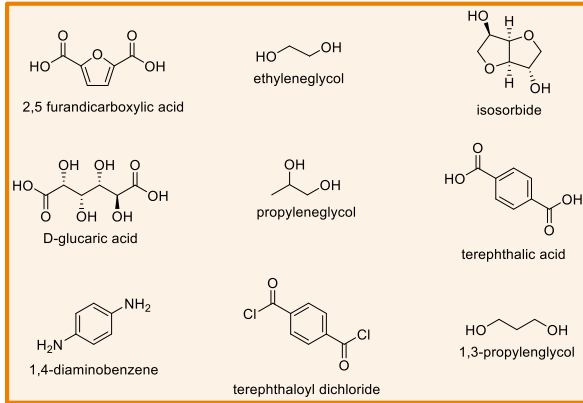
**Chemistry site Delfzijl**

- Chlorine ( $Cl_2$ ,  $NaOCl$ ), hydrogen peroxide ( $H_2O_2$ ) and oxygen ( $O_2$ ) (small amounts)
- Hydrogen ( $H_2$ ) (small amounts)
- Monochloroacetic acid ( $ClCH_2COOH$ )
- Sodium hydroxide ( $NaOH$ ), hydrochloric acid ( $HCl$ ) en sulphuric acid ( $H_2SO_4$ )
- Formaldehyde ( $H_2CO$ )
- Ammonia ( $NH_3$ ), acetic acid ( $CH_3COOH$ )
- Methanol ( $MeOH$ )
- Glucose (pilot), glycerol
- Zeolite catalysts



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# .... and further to Emmen

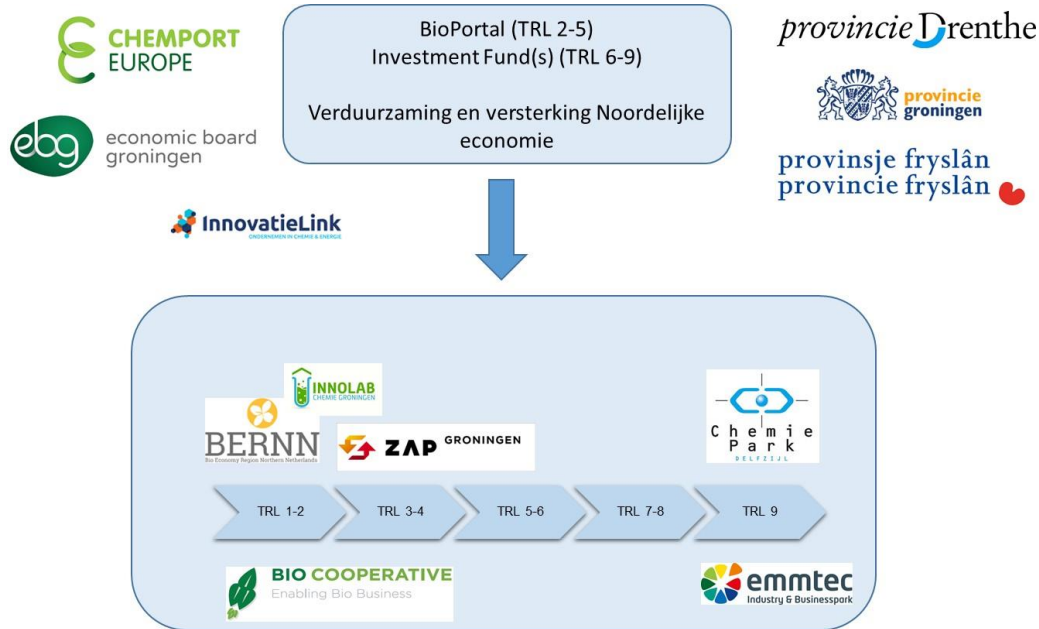


## .....and recycle properly?

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# The “Green development train”

- Bridging the gap
- Infrastructure (Chemport Industry Campus, TRL 6-8)/Organisation



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- Erik, je moet even kijken of hier nu voorbeeld (en moeten).
- Eventueel kan het ook voor slide 7.
- RUG format slides gebruiken
- Conclusies aanvullen (neem jij deze slide voor je rekening?)



# Opportunities for Sino Dutch cooperation's

- Proposition Delfzijl/Emmen for Chinese companies/investment
- Collaboration/investment in earlier stage projects
  - TRL 1-3: Knowledge Institutes (students, PhD, postdoc..., “vice versa”)
  - TRL 4-6: ZAP
  - (TRL 7-8): Chemport Industry Campus)
- Transfer concepts towards China
  - “Logistic concept Delfzijl”
  - “Green development train”
- .....