



Bio-based polymers and their sustainability

Meeting on the “Cradle-to-Cradle” concept

*Organized by the Vereniging van Milieuprofessionals,
Sectie Innovatie en Managementsystemen*

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Types of bio-based polymers

1.) Natural polymers/chemicals, e.g.

- Starch plastics (pure and chemically treated)
- Cellulose
- Chitin/Chitosane

≤ 100 – 200 kt (≤ 0.1%)

3 000 – 4 000 kt (1.5-2%)

2.) Polymers via thermochem. conversion of biomass, e.g.

- Pyrolysis
- Syngas → methanol → MTO
- Syngas → Fischer-Tropsch → steam cracking

~0 kt

3.) Green Biotechnology polymers

- e.g., PHAs

very small

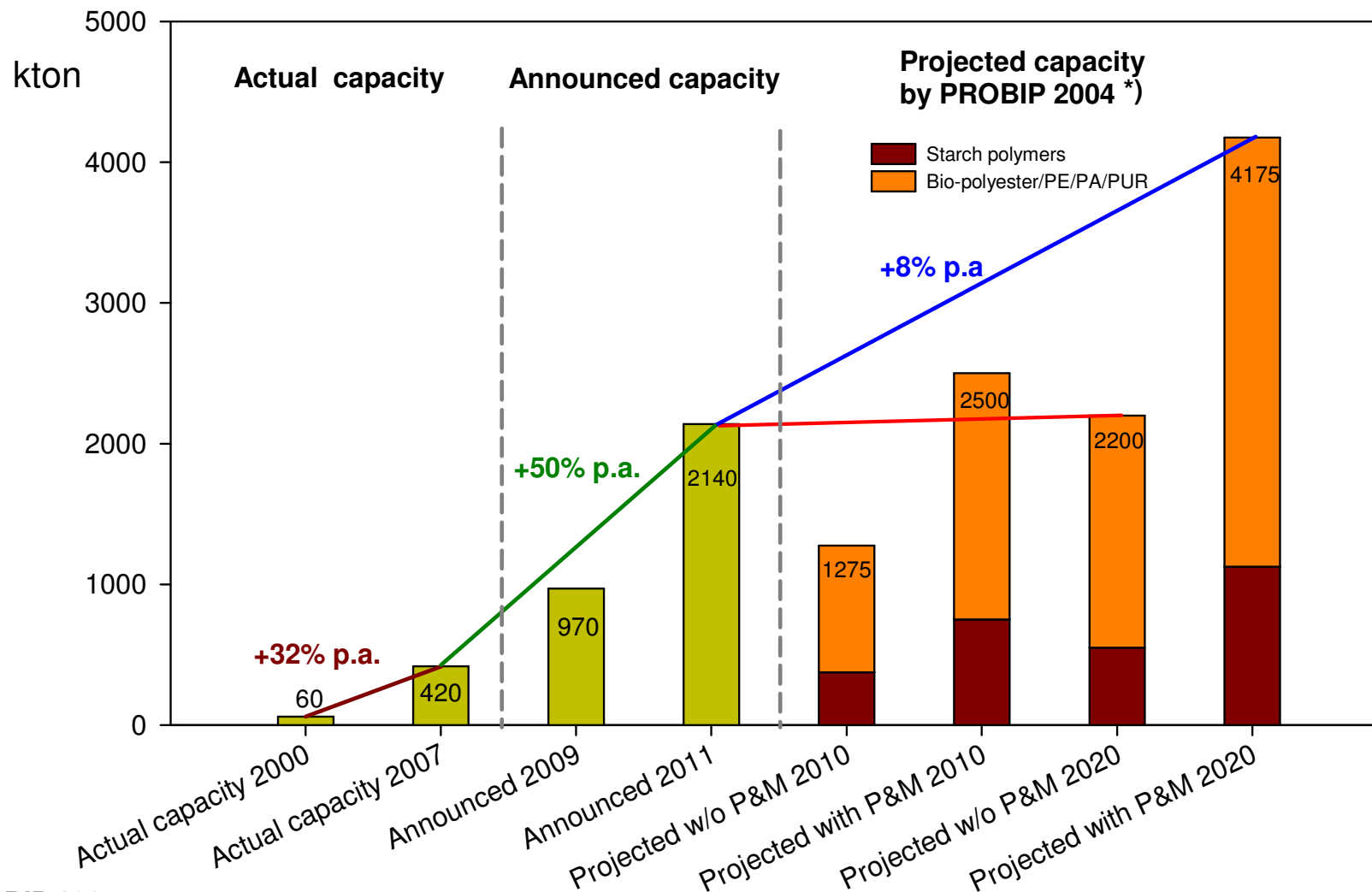
4.) White Biotechnology polymers

~800 kt*) (~0.4%)



Worldwide capacity growth, compared to previous projections

Preliminary compilation, to be released as PROBIP-2008 study



*) PROBIP 2004:
<http://www.biomatnet.org/secure/Ec/S1944.htm>

P&M = Policy and measures



PaperFoam project

Energy and GHG emissions in perspective



Jewelcase

(polystyrene tray
+ polystyrene cover)



PaperFoam

(PaperFoam tray
+ cardboard cover)



DigiPack

(polystyrene tray
+ cardboard cover)





Products studied in BREW project

(Medium and long-term opportunities and risks of the biotechnological production of bulk chemicals from renewable resources)

- | | |
|----------------------------|--|
| 1. Acetic acid | → PVAc and other acetic acid esters |
| 2. Acetone/Butanol/Ethanol | → Acetone + Phenol → Bisphenol A → PC, Epoxy |
| 3. Acrylamide | → Polyacrylamide |
| 4. Acrylic acid | → Polyacrylates |
| 5. Adipic acid | → Adipic acid + HMDA → Nylon 6,6 |
| 6. Caprolactam | → Nylon 6 |
| 7. Citric acid | → - |
| 8. Ethanol | → Ethylene → PE, PS, PVAc, PET, EPDM etc. |
| 9. Lactic acid | → PLA |
| 10. Lysine | → } Lysine polymers |
| 11. Mono-/Diglycerides | → } Plasticizers (various fatty acid esters) |
| 12. Oleyl oleate | → } Plasticizers (various fatty acid esters) |
| 13. Polyglycerol monoester | → |
| 14. Polyhydroxyalkanoates | → Polyhydroxyalkanoates |
| 15. 1,3-Propanediol | → Polytrimethyleneterephthalate (PTT) |
| 16. Succinic acid | → Polybutylene succinate (PBS) |





Conclusions

- Savings of Non-renewable energy use (NREU, in GJ/t):
30 - 70% and beyond
- Bio-based polymers are in their infancy (production and conversion)
→ **Big step changes**
- **Land use** considerations clearly favour bio-based chemicals/polymers over biofuels
- Polymers and fibres represent (potentially) **very large markets** (cellulose, bio-based PE, PLA, PHA)
- Bio-based chemicals/polymers offer important potentials for **innovation and competitiveness**
- Useful results for **marketing**
- The bio-based polymer community should take the lead in **transparent reporting.**
- An active scene in **NL and in Europe**

