BECCU polycarbonate polyol LCA results

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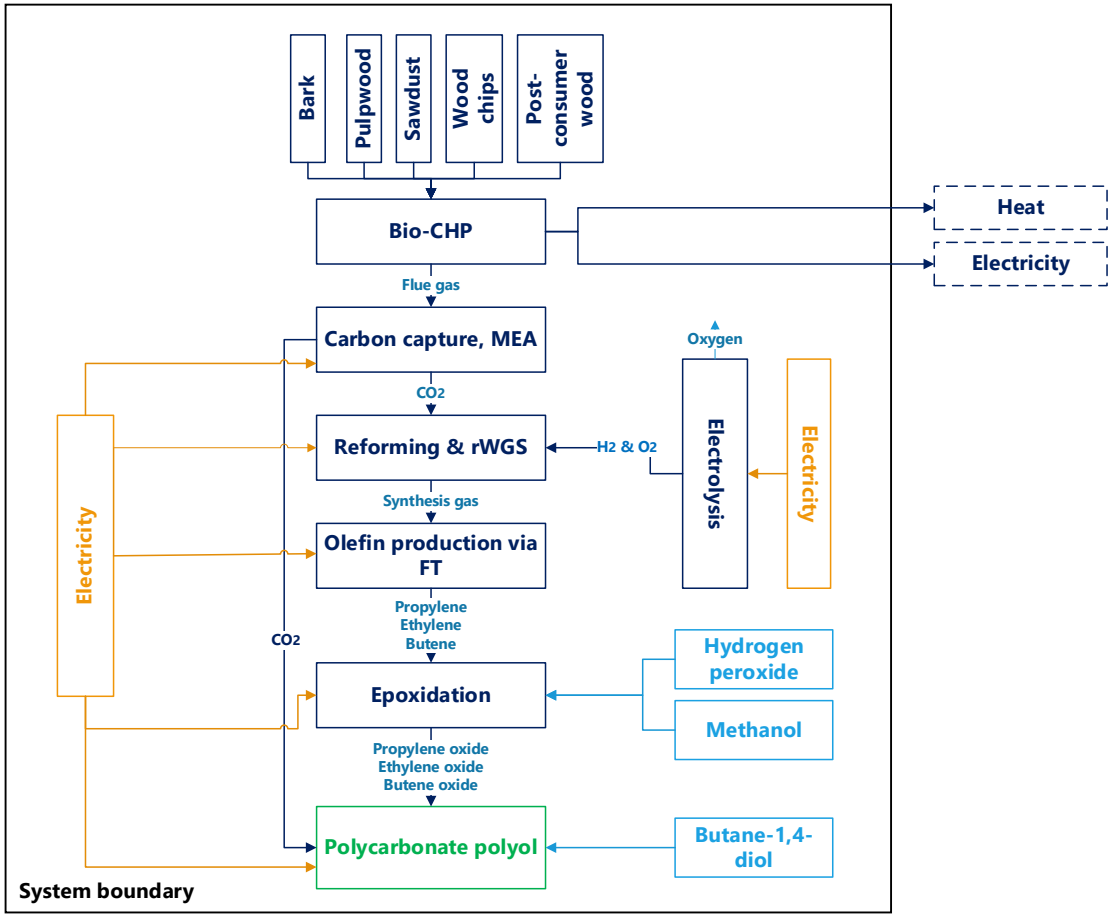
BECCU Final Workshop 24.08.2022

Goal and the scope of the assessment

- To quantify the carbon footprint and other relevant environmental impact categories to evaluate the environmental sustainability of the BECCU polyols in comparison to traditional polyol production

BECCU polyols, System boundary, Cradle-to-Gate



Scenario descriptions and functional unit (FU)

Scenario	Description	FU
Scenario Fossils (SceFF)	Hydrogen production with SMR. All process units use grid electricity (FI). CO_2 feedstock from peat CHP.	1kg polycarbonate polyol, 44.5% carbon content The structure of polycarbonate polyol not specified
Scenario 1 (Sce1)	Hydrogen production and other PUs use grid electricity (FI). CO_2 feedstock from bio-CHP.	
Scenario 2 (Sce2)	Hydrogen production with 100% wind electricity (FI). Other PUs use grid electricity (FI). CO_2 feedstock from bio-CHP.	
Scenario 3 (Sce3)	Hydrogen production and other PUs use 100% wind electricity (FI). CO_2 feedstock from bio-CHP.	

Life Cycle Impact Assessment (LCIA)

Impact category (IC)	Method	Unit	Examples of affecting substances
Climate change	IPCC 2013 GWP 100a	kg CO_2 eq	CO_2, CH_4, N_2O
Resource use, fossils (Abiotic resource depletion, ADP-F)	CML 2002 (Guinée et al., 2002) and van Oers et al. 2002	MJ	Natural gas, oil, coal
Eutrophication, marine	EUTREND model (Struijs et al, 2009) as implemented in ReCiPe	kg N eq	NO, NH_3, NH_4+
Photochemical ozone formation, human health	LOTOS-EUROS model (Van Zelm et al, 2008) as implemented in ReCiPe 2008	kg NMVOC eq	NMVOC, NOx
Acidification	Accumulated Exceedance (Seppälä et al. 2006, Posch et al. 2008)	mol H+ eq	SO_2, NOx

Method: PEF (Product Environmental Footprint) PEF 2021 3.0

Reference LCA results for polyether polyol and polyethercarbonate polyol from literature

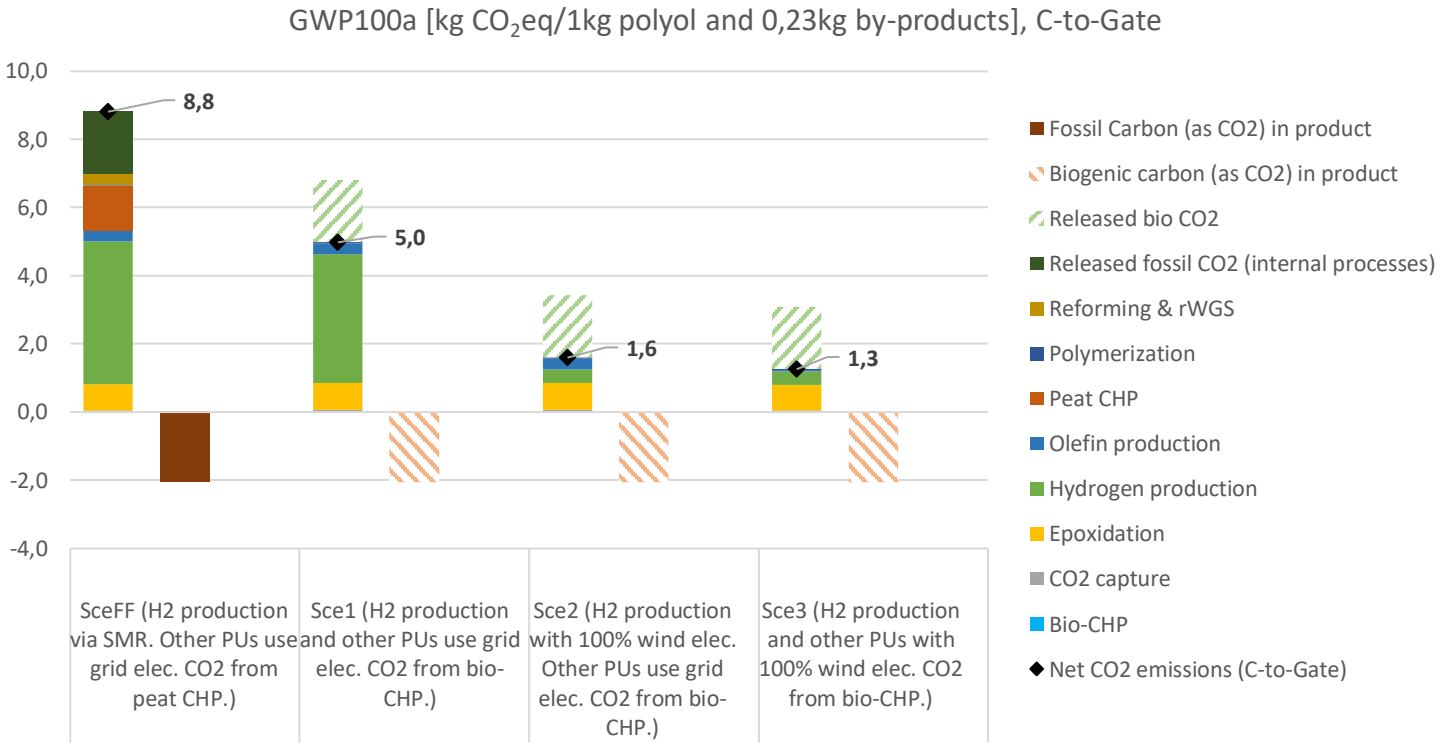
Product	kg CO_2 eq/kg polyol	Source
Polyether polyol	4,0	Ecoinvent
Polyether polyol	2,2-2,9	Plastics Europe (2012). Results for short-chain (MW< 1000 g/mol) and long-chain (MW >1000 g/mol) polyols. CML assessment method applied.
Polyether polyol	3,2	von der Assen (2014)
Polyethercarbonate polyol	2,65-2,89	von der Assen (2014). The results range depending on the allocation method.

LCA results for BECCU polycarbonate polyols

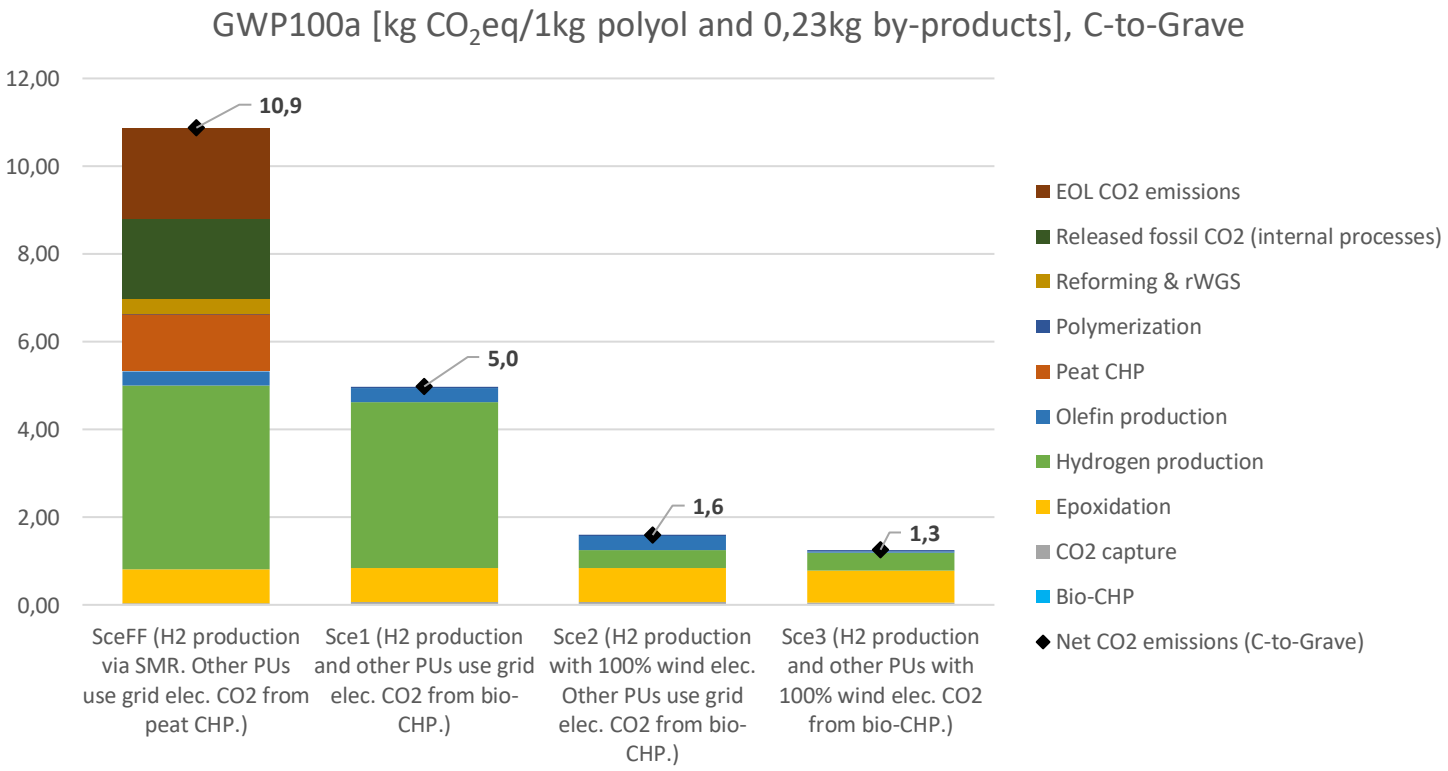
LCIA results of 1kg polycarbonate polyol

Impact category	Unit	SceFF (H_2 production via SMR. Other PUs use grid elec. CO_2 from peat CHP.)	Sce1 (H_2 production and other PUs use grid elec. CO_2 from bio-CHP.)	Sce2 (H_2 production with 100% wind elec. Other PUs use grid elec. CO_2 from bio-CHP.)	Sce3 (H_2 production and other PUs with 100% wind elec. CO_2 from bio-CHP.)
Climate change	kg CO_2 eq	8,8	5,0	1,6	1,3
Resource use, fossils	MJ	132,8	182,5	37,1	22,0
Eutrophication, marine	g N eq	3,2	6,0	2,0	1,6
Photochemical ozone formation, human health	g NMVOC eq	11,7	16,7	6,3	5,2
Acidification	mol H+ eq	0,02	0,03	0,01	0,01

GWP100a C-to-Gate



GWP100a C-to-Crave



Conclusions

- Energy sources used, especially, in the production of the hydrogen as well as in other PUs affect the results of the end product significantly.
- Compared to conventional polyether polyols, worthy environmental benefits are achieved starting from the Sce2 where 100% wind electricity is used to produce the hydrogen.
- In Sce2 and Sce3 the results can be even lower if hydrogen peroxide is produced more sustainably in the future.
  - In these scenarios epoxidation (where hydrogen peroxide is used) is responsible for approx. 49%-59% of the total CO_2 emissions.
- If by-products of the epoxidation and polymerization are allocated out the impacts for the polyol are expected to drop.
- The source of CO_2 (bio or fossil) affects the end results rather heavily. Both cradle-to-gate and especially cradle-to-crave results increase significantly if fossil CO_2 is used as a feedstock.

THANK YOU.

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Q&A