



# Environmental performance of mass balanced polycarbonate

LCA Study

LCM Conference 2021 – September 6<sup>th</sup>, 2021

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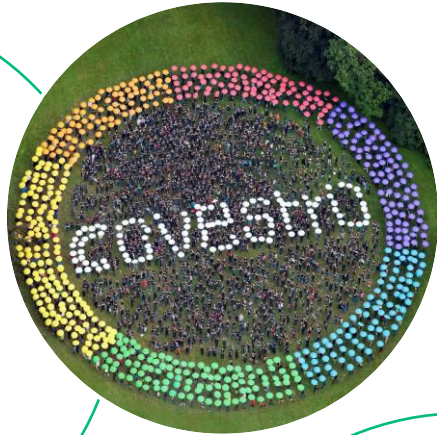
[covestro.com](https://www.covestro.com)



# Covestro – leading in the world of plastics

## Strong

- €10.7 bn in sales
- ~17,700 employees<sup>1</sup>



## Useful

- Plastics, pre-products and solutions
- For many industries



## Global

- ~50 production sites globally
- Close to customers and partners



## Innovative

- 1,400+ employees in research and development
- 80 years of ideas and inventions



Information is based on financial results for 2020, except amount of employees and amount of global production sites. Those are as of June 30, 2021. <sup>1</sup>calculated as full-time equivalent (FTE)

# Our vision – promote circular economy



## Circular economy enables a climate neutral future

- Circular economy is the key to resource conservation, climate and environmental protection
- Plastics are a driving force for implementing circular economy



## We want to become fully circular

- We want to contribute to make circular economy the global guiding principle ...
- ... and anchor it across the whole company

# Transition to alternative raw materials in a circular economy

Use of **alternative raw materials**  
in our value chain...



Bio-based



based on waste streams



Carbon dioxide

...with the **aim of**  
**reducing impacts...**



fossil resources consumption



waste



environmental impact

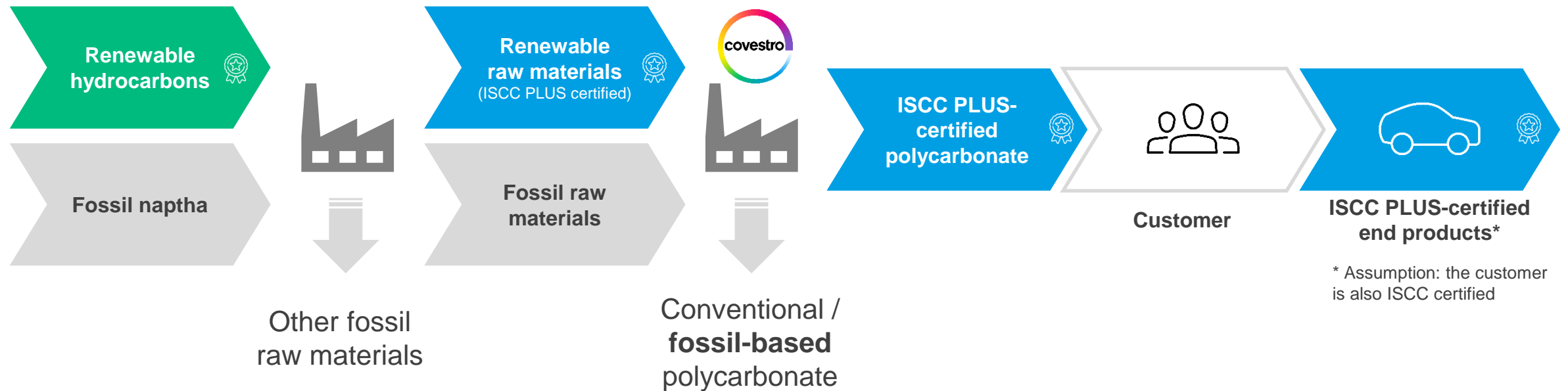
...needs **framework conditions.**

**Mass balance approach** offers a chain of custody:

- ⇒ To **allocate** renewable raw materials to final products
- ⇒ Where **existing plants** can be used to shorten time-to-market
- ⇒ With internationally recognized **certification system**

# Mass balance approach

Enabler of drop in solutions for circular raw materials into chemical processes.



\* Assumption: the customer is also ISCC certified

E.g. Bio-Circular Fossil Mass balance

# Tailored and standard polycarbonates

## Products

Polycarbonate is a high-tech material – very robust, break-proof and light-weight. It can be flexibly shaped and is available in all colors.

Covestro develops and produces the granules for polycarbonate parts.

It is an excellent substitute for traditional material such as glass or metal.

This allows for a wide variety of application possibilities ranging from vehicles to electronic devices as well as medical applications.

## Sample applications



For future mobility



For modern notebooks



For safer medical products



For trendy design

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# Environmental impacts for mass balanced products



## Goal:

Environmental impact assessment of polycarbonate in EMEA considering different feedstocks and electricity source for intermediate production



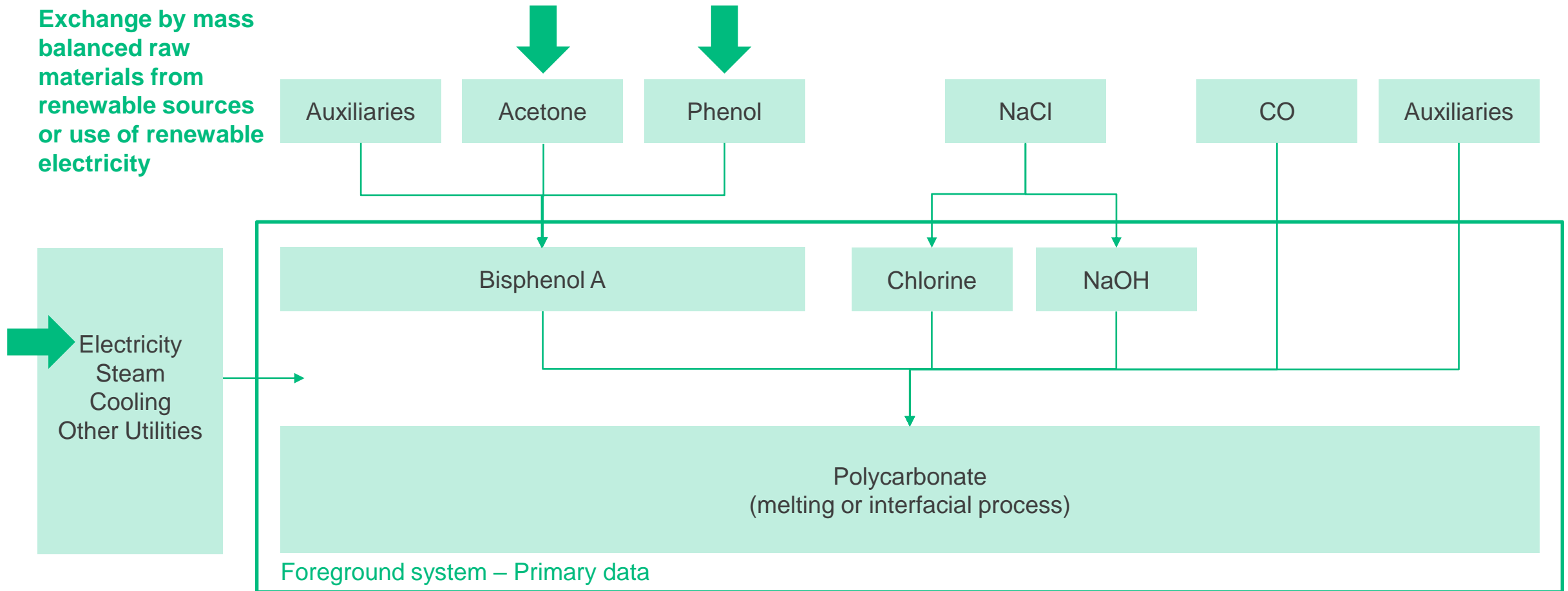
## Scope:

Cradle-to-Gate Life Cycle Assessment of the production of 1 kg polycarbonate in EMEA

Critical review by TÜV Rheinland.

# System boundaries for polycarbonate production.

Exchange by mass  
balanced raw  
materials from  
renewable sources  
or use of renewable  
electricity



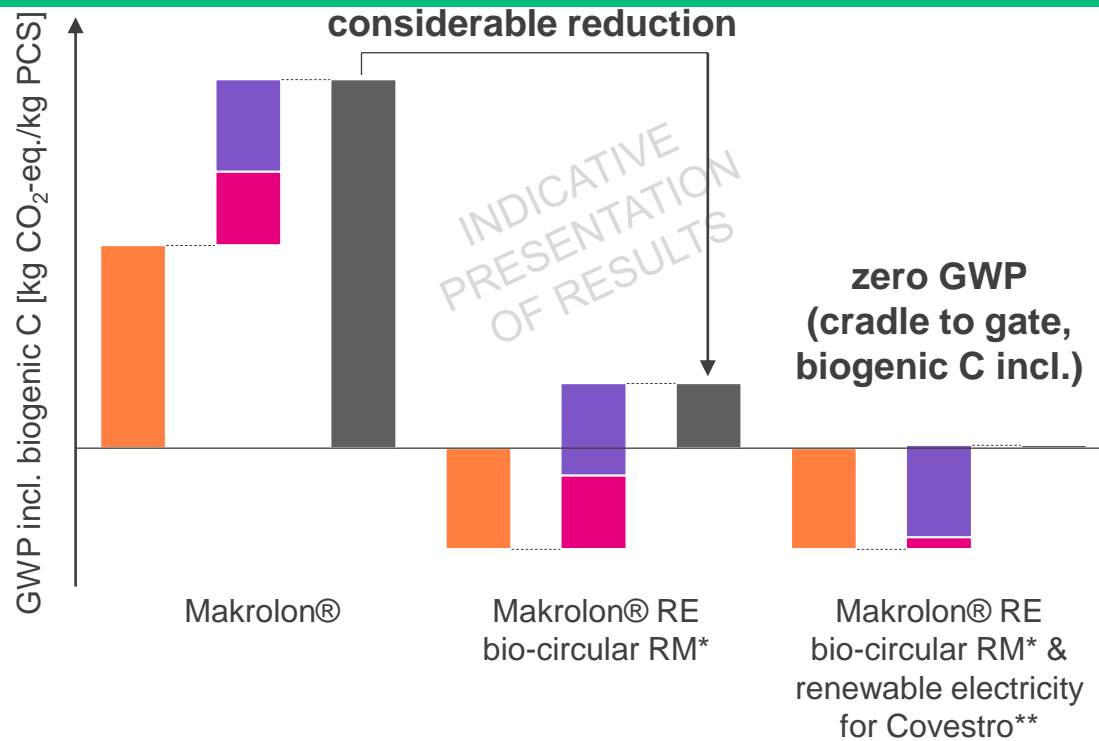


# Mass balanced bio-circular raw materials as possibility to reduce the global warming potential of polycarbonate.



## 1 kg polycarbonate (PCS) – cradle to gate

### GLOBAL WARMING POTENTIAL (GWP)



### RESULTS

- Main raw materials have a high contribution to the global warming potential (GWP).
- The overall impact is considerably reduced if mass balanced bio-circular raw materials are used for the production of polycarbonate due to the biogenic C-content.
- Makrolon® RE can be produced with a GWP of zero if mass balanced bio-circular raw materials and renewable electricity for Covestro production processes are used.
- LCA study was critically reviewed by TÜV Rheinland.

■ Main raw materials ■ Electricity ■ Other ■ Total

\* Mass balanced bio-circular raw material according to ISCC PLUS (ISCC = international sustainability & carbon certification)

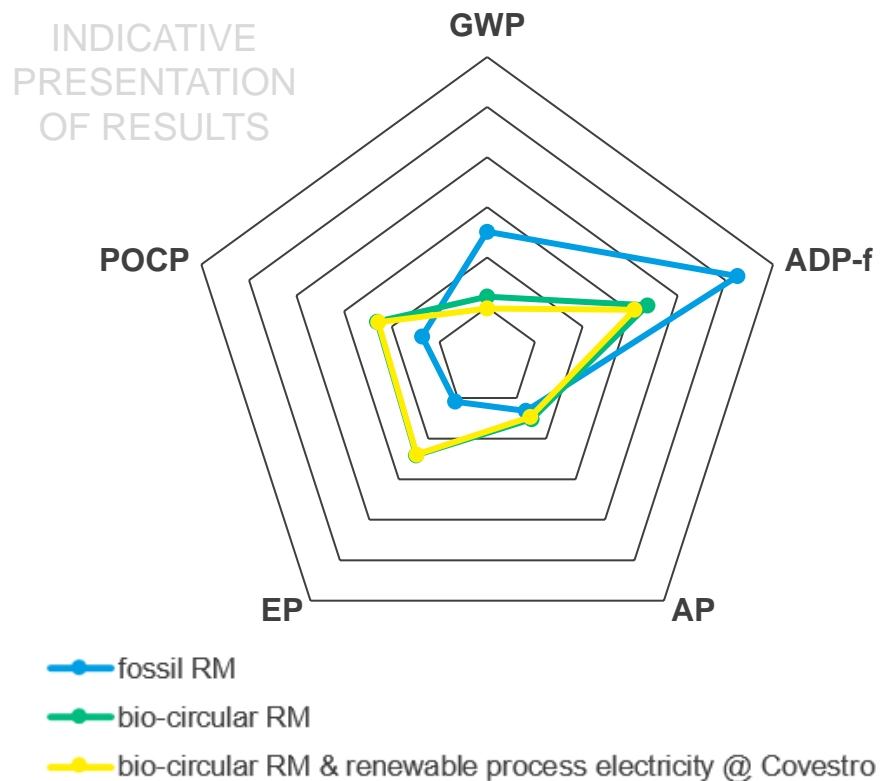
\*\* Use of renewable electricity for Covestro production processes not yet certified

# Global warming potential and abiotic depletion potential of higher relevance for fossil raw materials.



## 1 kg polycarbonate – cradle to gate

### NORMALIZED LCA RESULTS\*



### RESULTS

- For fossil raw materials, GWP and ADP-f have the highest relevance compared to AP, EP and POCP.
- Using mass balanced bio-circular raw materials, impacts of GWP and ADP-f decrease. AP remains on a similar level. Impacts of EP and POCP increase in relevance. As bio-circular feedstock excludes agricultural burden, this increase results probably from different processes to produce phenol and acetone.
- Using renewable electricity in addition to mass balanced bio-circular raw materials mainly affects GWP and ADP-f.
- LCA study was critically reviewed by TÜV Rheinland.

GWP: Global Warming Potential, ADP-f: Abiotic Depletion Potential fossil, AP: Acidification Potential, EP: Eutrophication Potential, POCP: Photochemical Ozone Creation Potential

\* Normalization via CML Normalization (World) in GaBi.



The use of **mass balanced bio-circular raw materials** has the potential to significantly **reduce the global warming potential and the abiotic depletion potential - fossil** of **polycarbonate products** compared to fossil resources.



The acidification potential, eutrophication potential and the photochemical ozone creation potential seem to increase by using mass balanced bio-circular raw materials (for normalized results the acidification potential is similar). Differences might result from different assumptions for process models to phenol and acetone.



A **combination of mass balanced bio-circular raw materials and the use of renewable electricity** in Covestro's production processes can lead to **polycarbonate products with a specific CO<sub>2</sub> footprint of zero** (cradle to gate, biogenic C included).



# Thank you very much for your attention!

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