Electrical components go circular

Coffee Lectures 2021 I 03.06.2021

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Emmanuel Logakis

Principal Scientist at ABB Research

Biosketch

1998 – 2003 Bachelor in Physics, University of Patras, Greece

2003 – 2005 MSc in Materials Science & Technology, NTUA, Greece

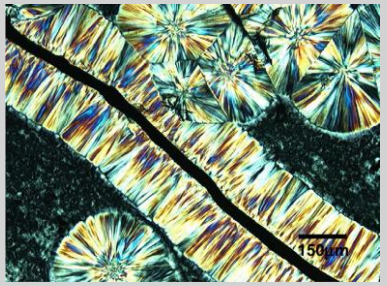
2005 – 2009 PhD in Polymer Physics, NTUA, Greece

2010 – 2011 Research Fellow, Cranfield University, UK

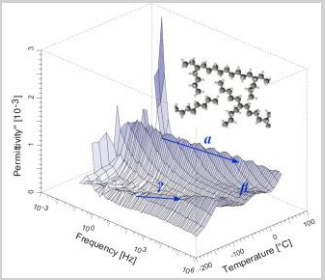
2011 – today Principal Scientist, ABB Corporate Research, Switzerland

Research interests

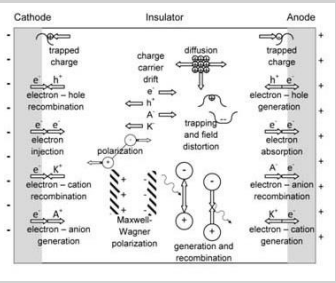
Fundamental



structure-property relationships in polymers and polymer composites



molecular dynamics



charge transport and dielectric breakdown mechanisms

Applied

conductive PC for EMI, ESD, lightning protection and gas sensing

AC/DC insulation

processing

ABB's structure

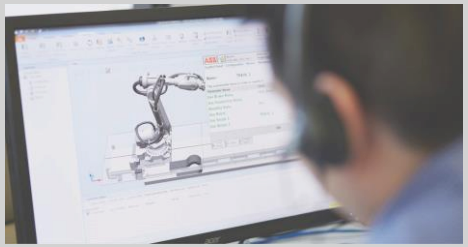
BUSINESS AREAS	Electrification	Motion	Process Automation	Robotics & Discrete Automation
				
DIVISIONS	Distribution Solutions Smart Power Smart Buildings Installation Products Power Conversion E-Mobility	IEC LV Motors Large Motors & Generators NEMA Motors Drive Products Systems Drives Service Traction Mechanical Power Transmission	Energy Industries Process Industries Marine & Ports Turbocharging Measurement & Analytics	Robotics Machine Automation

ABB Research

Footprint

ABB Research

Key figures

- ~ **400** highly qualified scientists and engineers,
- in **7** research centers around the world,

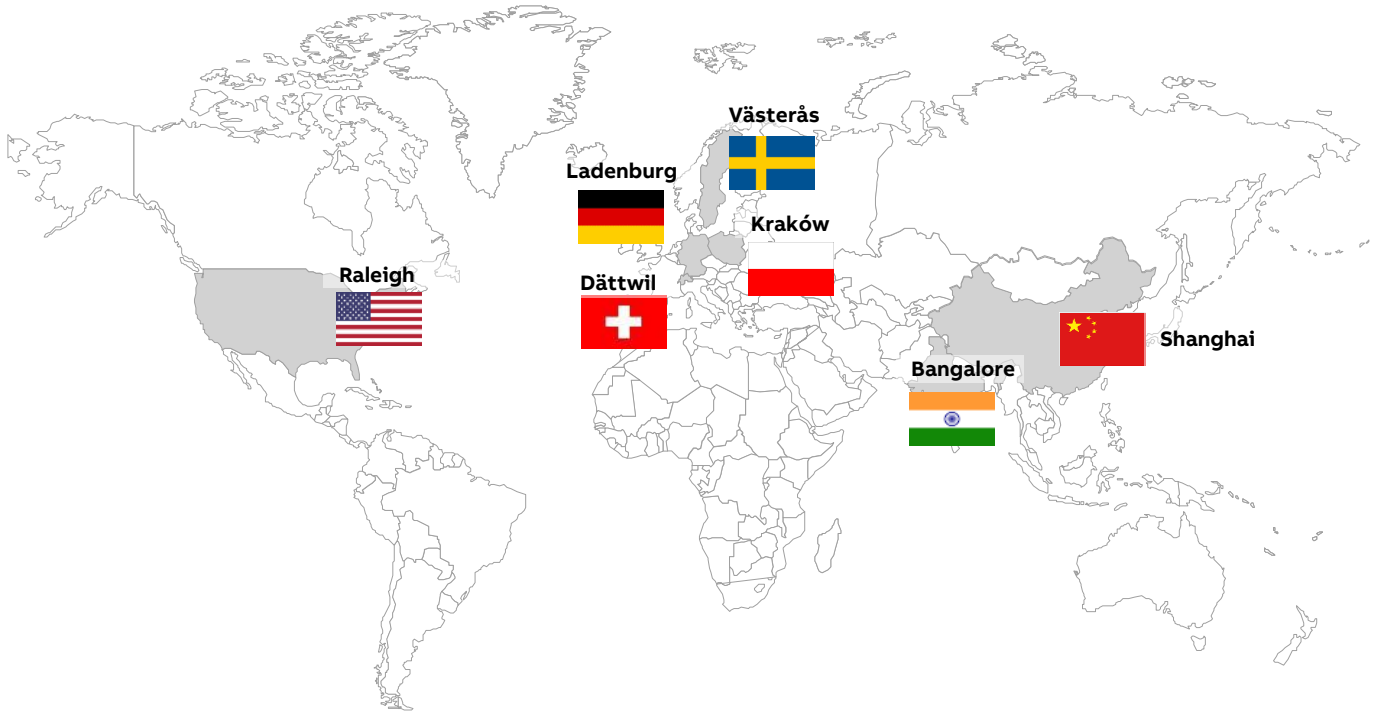


ABB Research Center Switzerland

Location

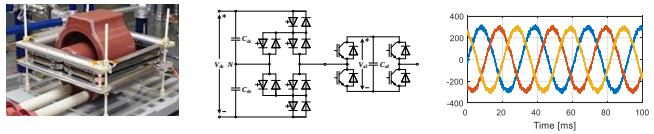
ABB Research Center Switzerland

Research from Switzerland that is changing the world

100 Employees (**75** PhDs)
30 nationalities
50 students
67 internal transfers ‘14-’20
17 full-time professors ‘14-’20

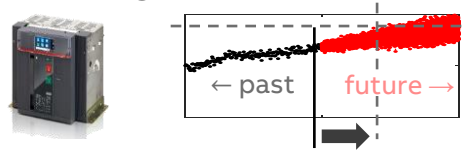
50 labs:
MV/LV Switching
Power Electronics
Sensing, Materials, Analytics

Power Electronics



Energy Storage

Digitalization



Switchgear & Breakers

Outline

Introduction

- ABB's sustainability strategy
- GHG emissions & significance of plastics

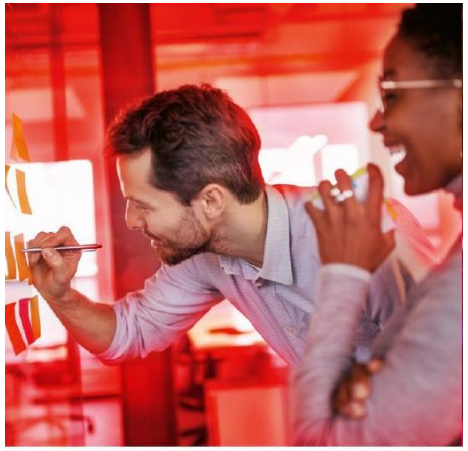
Sustainable plastics

- Overview
- Market drivers & development
- Comparisons

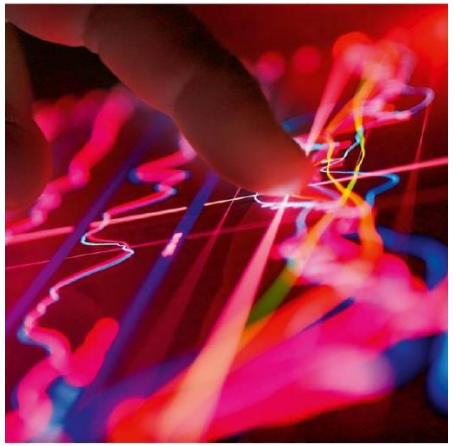
Application case on box covers

Further research directions

- The circular vision
- Circular supplies: expansion to other products



We succeed by creating superior value.

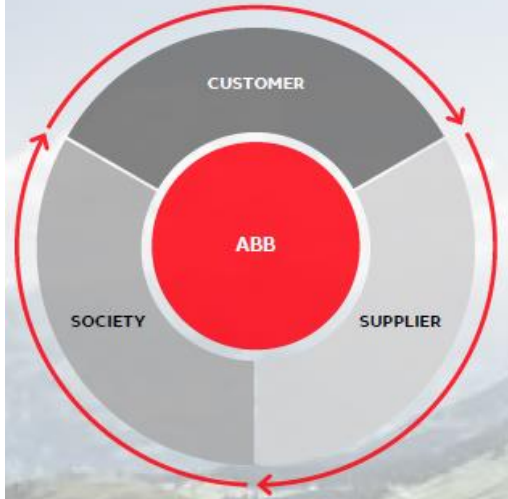


We push the boundaries of technology to drive performance to new levels.

We energize the transformation of society and industry to achieve a more productive, sustainable future.

Introduction

ABB's 2030 sustainability targets



Sustainable Value Chain

We enable a **low-carbon society**

- **Carbon neutrality** in own operations
- Support our customers in reducing annual CO_2 emissions by **>100 Mt**[1]
- Supply chain emission reduction

We preserve **resources**

- **80%** of ABB products & solutions covered by circularity approach
- **Zero waste** to landfill[2]
- Supplier Sustainability Framework

We promote **social progress**

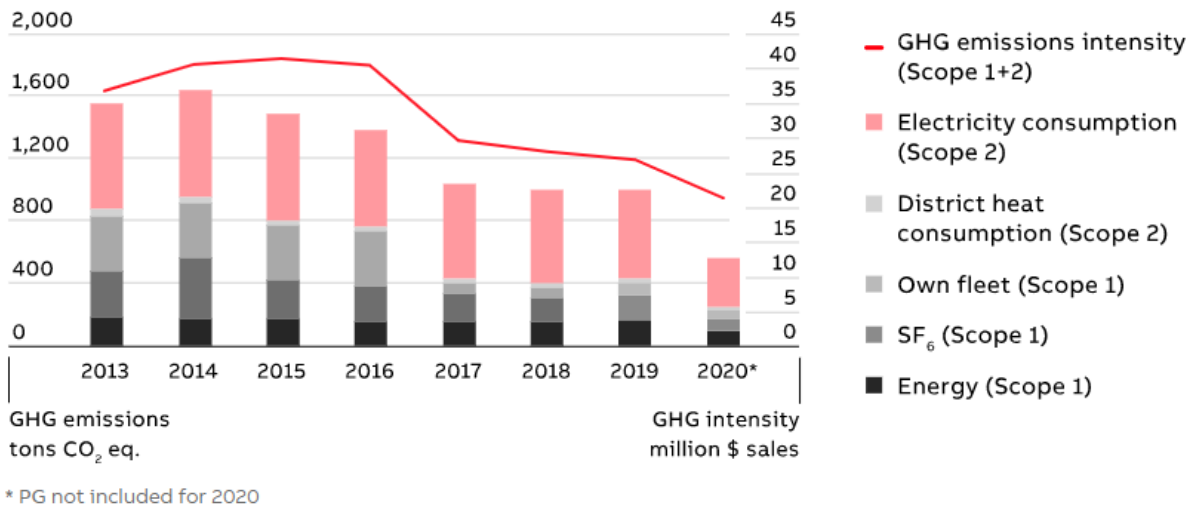
- **Zero harm** to our people and contractors
- Comprehensive D&I framework[3]; **25% women** among ABB leaders
- **Top-tier** employee engagement score in our industry
- Impactful support for community-building initiatives

INTEGRITY AND TRANSPARENCY ACROSS OUR VALUE CHAIN

[1] Savings in the year 2030 from solutions provided to customers 2021-30.
[2] Wherever local conditions allow.
[3] Diversity & Inclusion framework.

Our progress to mitigate climate change

Scope 1 & 2 GHG emissions and GHG intensity[1]



* PG not included for 2020

Scope 1: Direct GHG Emissions

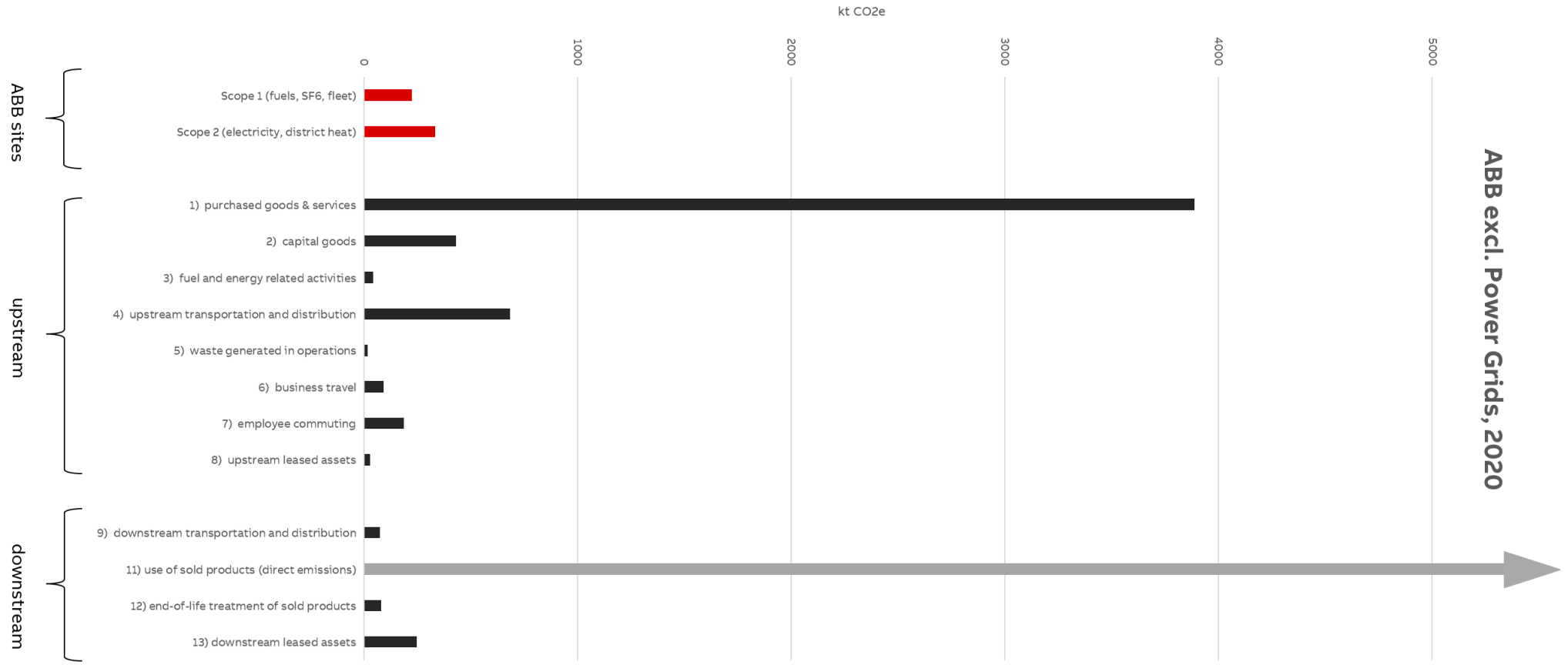
– Emissions from company-owned and controlled resources (stationary and mobile combustion, fugitive and process emissions).

Scope 2: Electricity Indirect GHG Emissions

– Emissions from the generation of purchased energy, from a utility provider.

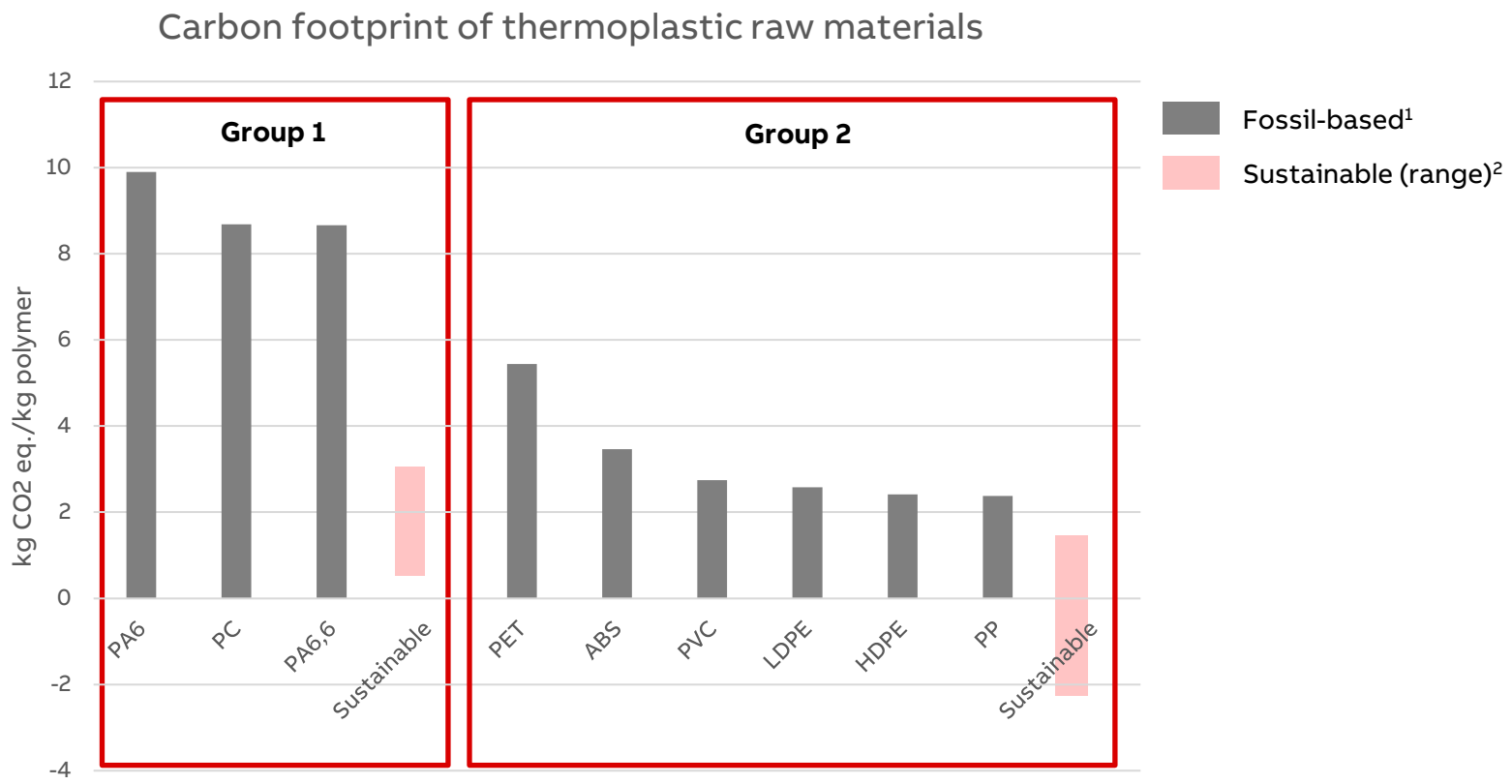
[1] ABB Sustainability Report 2020.

GHG emissions in the value chain



Carbon footprint of plastic materials

Fossil vs sustainable plastics



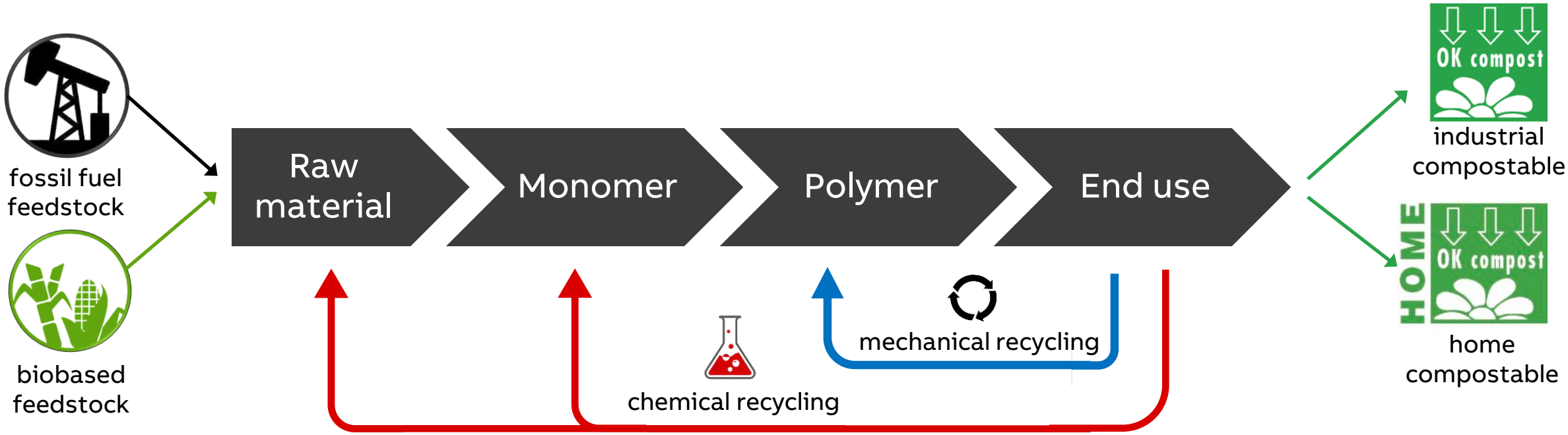
[1] Source: ecoinvent 3.6

[2] Bio-based plastics can even have negative carbon footprint values due to the capture of CO_2 during the growth of the plant-based feedstock. However other environmental impact categories connected to agricultural practices (land use, water use or ecotoxicity related to the usage of fertilizers) and increased transport needs due to spatially distributed biomass collection show unfavorable results for bio-based plastics.

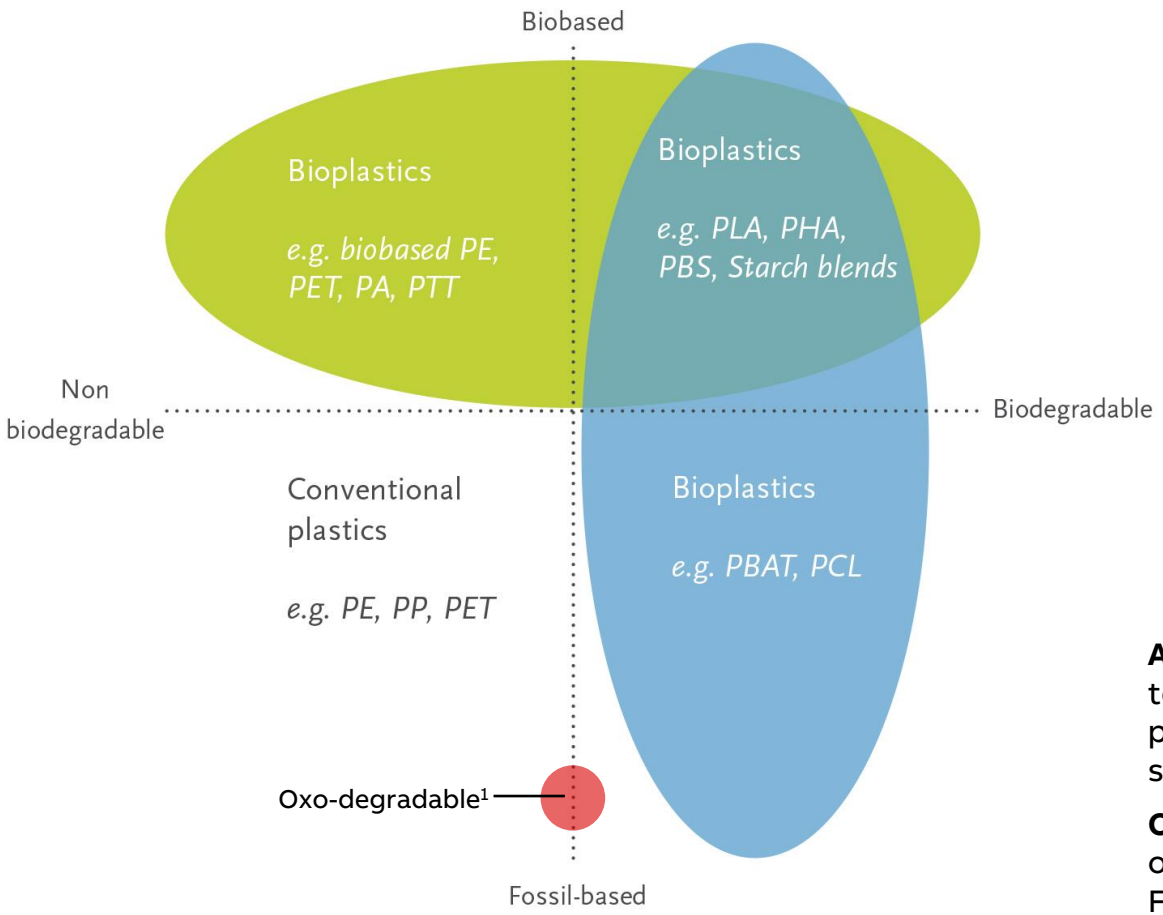
Sustainable plastics

Sustainable plastics

Overview: recycled & bioplastics



Bio-based, bio-degradable & oxo-degradable plastics



Abbreviations – PE: polyethylene, PP: polypropylene, PET: polyethylene terephthalate, PA: polyamide, PCL: polycaprolactone, PLA: polylactic acid, PTT: polytrimethylene terephthalate, PHA: polyhydroxyalkanoates, PBS: polybutylene succinate, PBAT: polybutyrate adipate terephthalate

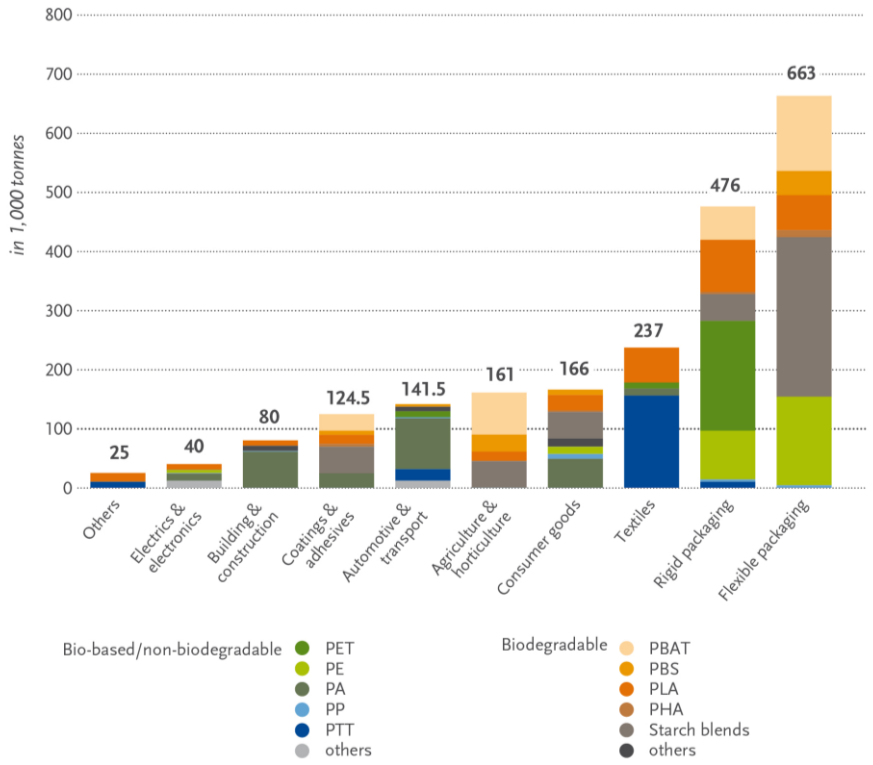
Oxo-degradable – Conventional plastics containing transition metals that foster oxidation and chain scission when exposed to heat, air and/or light. Fragmentation is not a sign of “bio-degradation”.

Source: https://www.european-bioplastics.org/

Bioplastics

Market drivers & development

By market segment (data 2019)



Drivers

- **Political**
  - EU to become climate neutral by 2050
- **Legislative**
  - European Climate Law (transforms political promises into a binding legal obligation)
- **Societal**
  - 80% of European customers want to buy products with a minimal impact on the environment (Eurobarometer Survey)
- **Technological**
  - typically, no compromise in performance
- **Economical**
  - increasing demand leads to lowering production costs closing the price gap with conventional materials

Source (left): https://www.european-bioplastics.org/

Sustainable plastics

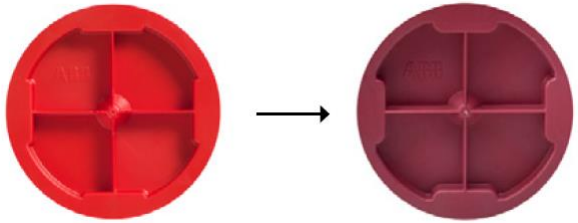
Comparisons

	PROS	CONS
Mechanical recycling	+ Appealing story (e.g. ocean waste) + Variety + Low or no premium in cost (0-30%)	- Usually compromised performance (downcycling), e.g. mechanical, flammability,… - Aesthetics (typically only in dark colors) - Feedstock availability
Chemical recycling	+ Applied also for mixed waste + Performance (opportunity even for upcycling)	- Reduced environmental benefit (usage of high amounts of solvents) - Limited variety - Moderate premium in cost (20-50%)
Biobased (measurable)	+ Performance + The highest CO_2 reduction potential + Variety	- Possible competition with the food chain - Complex LCAs - Moderate premium in cost (20-50%)
Biobased (mass balanced)	+ All advantages mentioned above + Identical performance with fossil grades + No need for re-qualifications	- Cumbersome in explanation/communication concept - Maintenance of certification process (cost 2-3 kUSD/y) - Moderate premium in cost (20-50%)
Biodegradable	+ End-of-life, in principle, addressed + High CO_2 reduction potential	- Long-term performance - Limited variety - High premium in cost (200-500%)

Application case

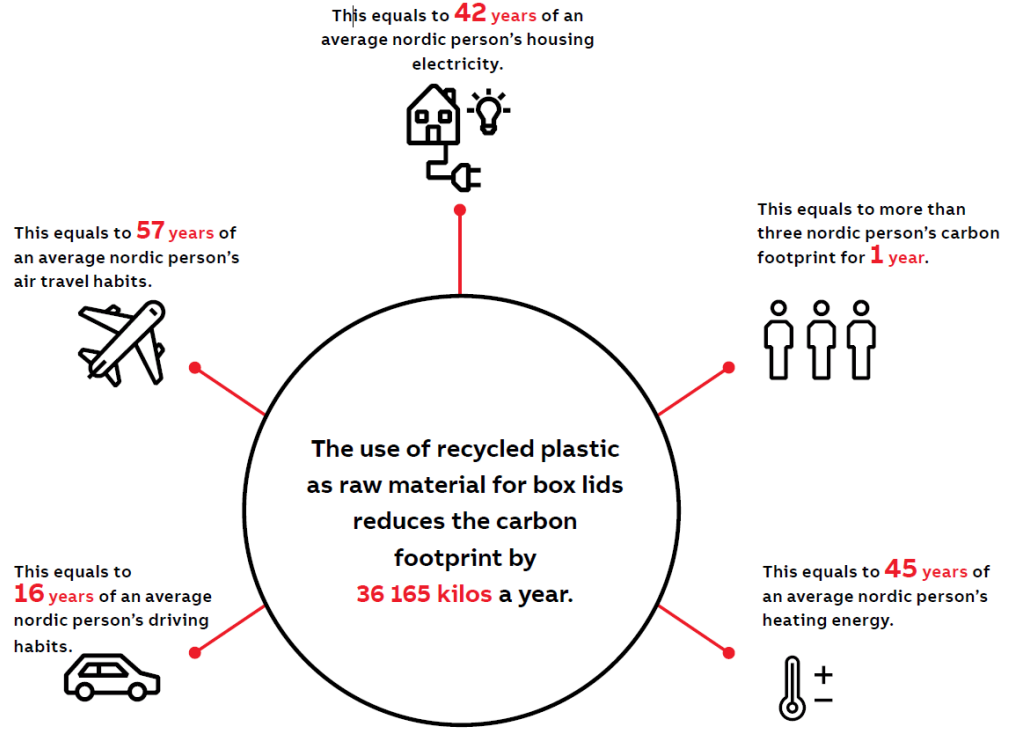
ABB wins award for its use of recycled materials

Box covers made of PCR plastic



- Plastic waste from households is processed locally to recycled plastic. The recycled plastic granulate is delivered to ABB's Porvoo factory in Finland, where it is made into lids for installation boxes.
- To ensure sustainable in our box covers, we use color pigment as little as possible. This may cause the color to vary depending on the manufacturing batch.
- The product was voted and recognized by the Swedish Elmässan (The Electricity Fair) for its sustainable credentials and contribution to making the electricity industry a more circular economy.

Environmental benefit



Research directions

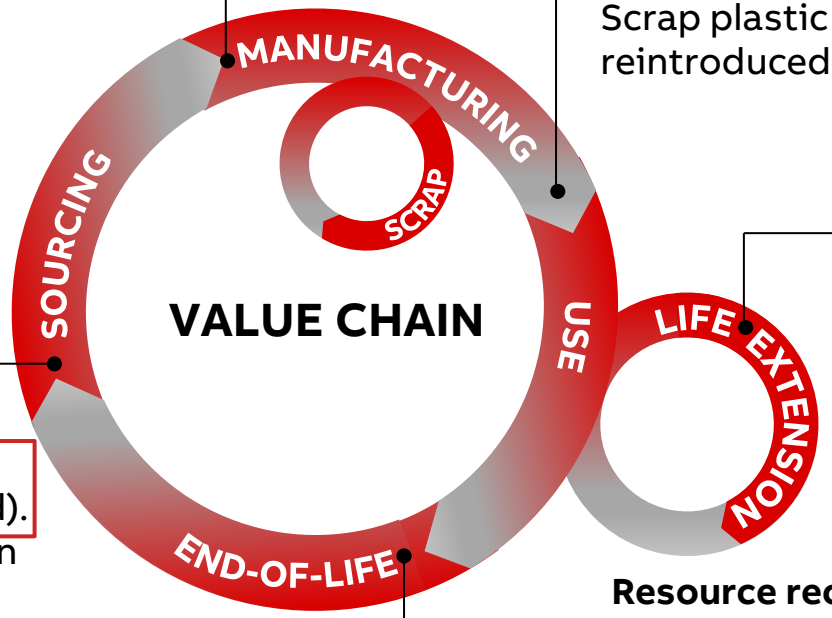
Circular vision for the electrical industry

Design

Products designed for durability, reusability, recyclability and reparability. Substances of concern substituted out.

Circular supplies and resource recapture

Input materials with minimal environmental footprint (bio-based, bio-degradable, recycled).
Policies to encourage recycling and integration of recycled content into new products.



Reintegration of manufacturing scrap

Scrap plastic or metal from manufacturing is reintroduced into new components.

Repair, second life and durability

Products last longer and have second and third lives through repair, aided by advanced maintenance intelligence.

Resource recovery

Maximize the collection of end-of-life products through incentives to customers and recover valuable resources.

Circular/sustainable plastic raw materials

Applications in various products

Products

PA

Up to 80t CO_2 savings

Accessory covers

Up to 700t CO_2 savings

Mech. frames for switches

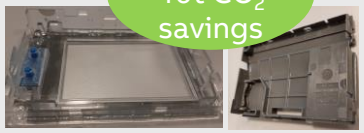
Handles in switches

PP

Flush-mounted installation boxes

PC

EQ meter housing



Up to 40t CO_2 savings

Components for LV air-CB

Pole windows, covers/bottom parts in safety switches

ABS

Aesthetical covers

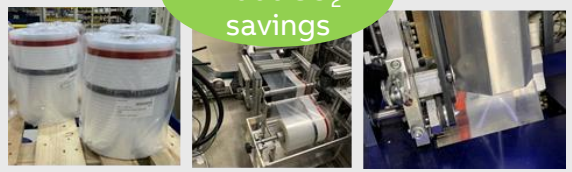
Packaging

PP

Up to 10t CO_2 savings

Accessory boxes (rigid packaging)

LDPE



Up to 400t CO_2 savings

Films/bags (flexible packaging)

2020 **2021**

Supplier contacts | **Identification of applications** | **Proof of concept (prototyping)** | **Generalization/dissemination**


Running the world without polluting the earth.