Pyrum Innovations AG

Pareto Securities' 30th annual Energy Conference 2023, Oslo

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Global End-of-Life-Tire (ELT) market accounts for approx. 30.9 mt p.a.

… as the tightening of the regulatory environment forces countries and corporates to take action

Global ELTs in 2019

Tightening regulatory environment

Landfill Ban

The landfill of End-of-Life-Tires and shredded tires is prohibited

Ban on incineration

Prohibition of burning rubber products
Prohibited the use of shredded tire granulate outdoors

Ban of Rubber granulates

Summer 2023: EU has decided to forbid the use of rubber granulates for certain uses (Grace Period of 8 Years)

NEW

OEM Audits are requiring circularity grades

The market is pushing for new raw materials

Increasing cost of CO_2

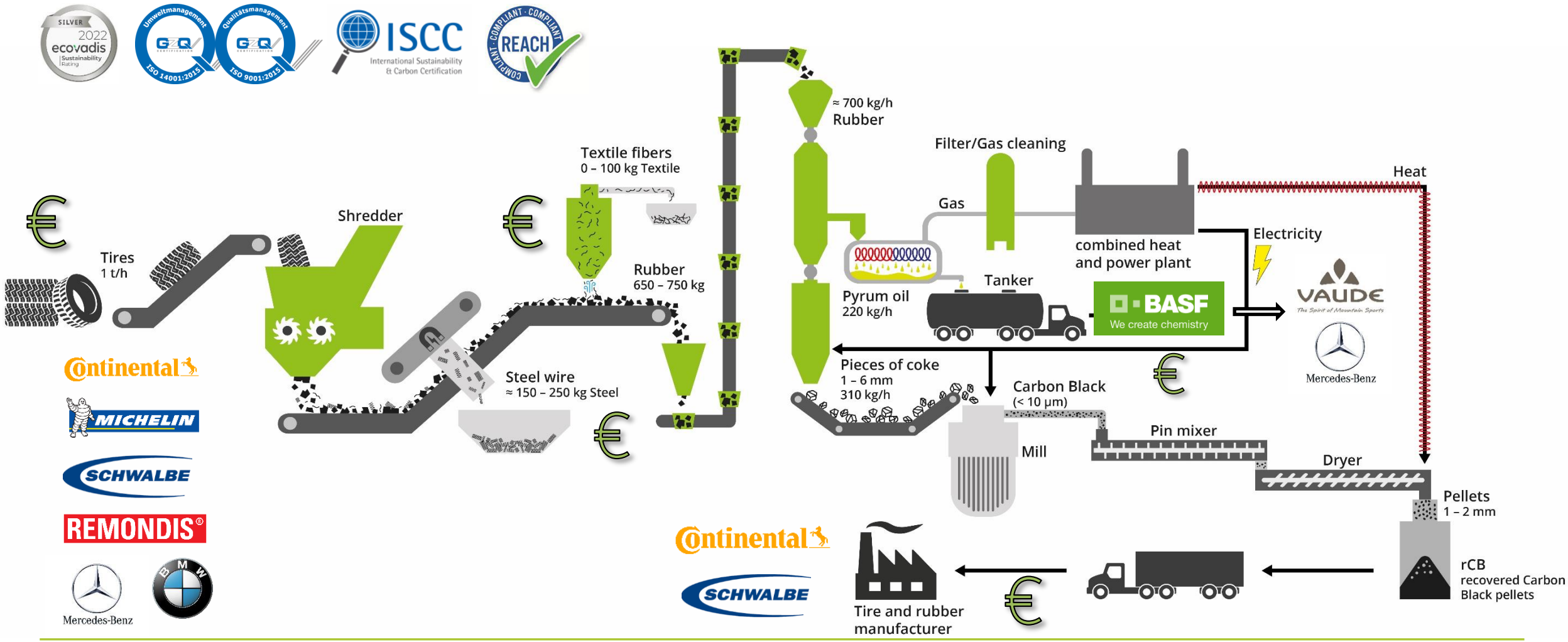
Burning tires becomes more and more expensive

Sources: World Business Council for Sustainable Development (WBCSD): Global ELT Management (2019) + TU Leipzig (Azur Studie 2021)

Pyrum offers patented technology with strong value proposition…

… converting rubber into several high value chemical products – thermolysis oil, carbon and gas

How Pyrum creates value



Our history in short

Key milestones

Phase 1 : Prototype
Scale 1:3 Building and testing

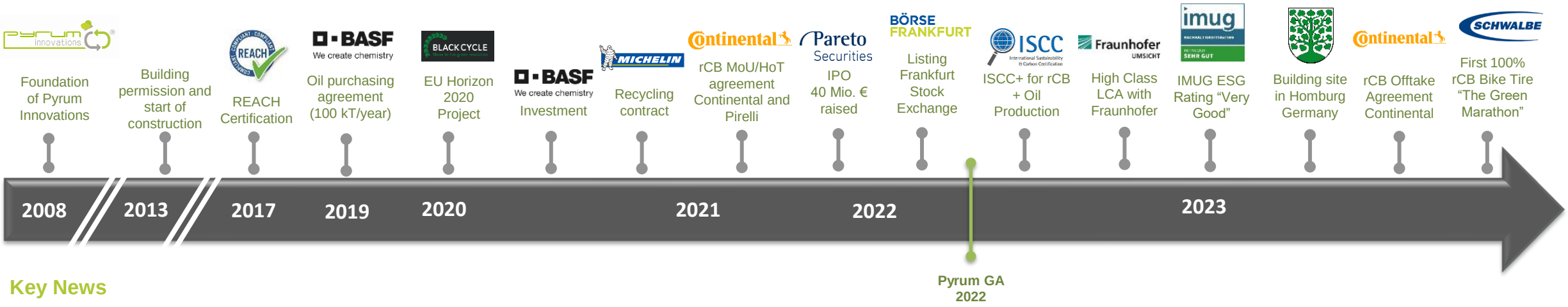
Phase 2: Industrialisation
Constuction 1ST Industrial Plant

Phase 3: Problem Solving
Solving all the issues of a new Plant

Phase 4: Industrial Production
Beginning of 24/7 operation on acquisition of Data

Phase5: Roll – Out and new developments

TRL 1 - 4 | TRL 5 - 7 | TRL 8 | TRL 9



Key News

JDA and rCB Offtake signed with Continental

Materialica Award with BASF and Mercedes-Benz

Schwalbe "The Green Marathon" first 100% rCB Tire

Imug ESG Rating finalized: "Very Good"

Source: Company info

The last important Milestone to close the loop: rCB

No rCB can be sold to the market without those certificates

Usually it takes years to get all these certificates

- **Received certificates in the last 12 months:**
  - Ecovadis: Silver Status
  - VDA 6.3: Continental, Pirelli, Hankook, Mercedes, BMW
  - ISCC+ for Oil and rCB
  - ISO 9001
  - ISO 14001
  - IMUG ESG Certificate
- **Milestone:**
  - First official rCB delivery in April 2023
  - 100% „in Spec“ production since July 2023
  - Stable „in Spec“ production since August 2023

milling

pelletizing

Carbon
0,5 - 5 mm

Milled rCB
10 - 14 µm

rCB
0,8 - 2 mm

LCA: Life Cycle Assessment

Results better than expected

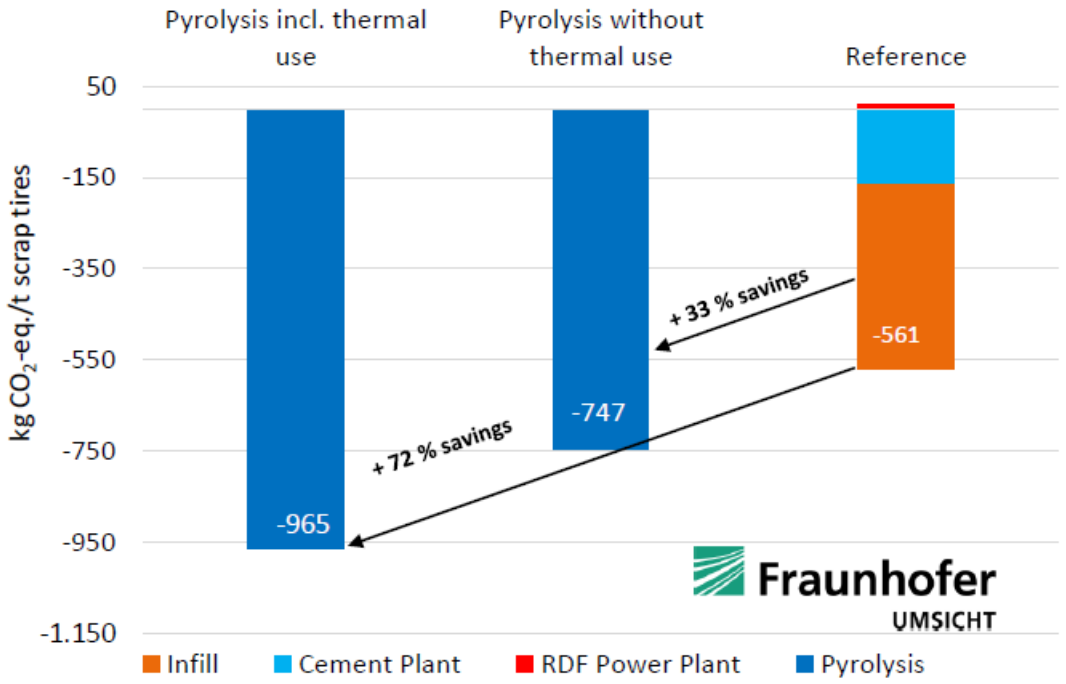
Explanation

- The LCA has been made by Fraunhofer Institute between **May and September 2022**
- The results come from the Pyrum pyrolysis process only and cannot be compared to other pyrolysis processes
- Comparison of the CO_2 Eq. savings depending on different recycling processes. This means: **„How much CO_2 is saved by the recycling process instead of using fossil fuels or raw materials?“** :
  - **EBSPower Plant**: + 164 kg / to used tires
  - **Cement plant:** - 395 kg / to used tires
  - **Material recovery:** - 778 kg / to used tires
  - **Pyrum:** - 965 kg / to used tires

244% CO_2 savings

- From a CO_2 saving perspective, only material recovery is approaching the results of the Pyrum process and represents a good combination.
- Combination of material recovery and Pyrum pyrolysis technology is the best solution.

LCA graph Fraunhofer

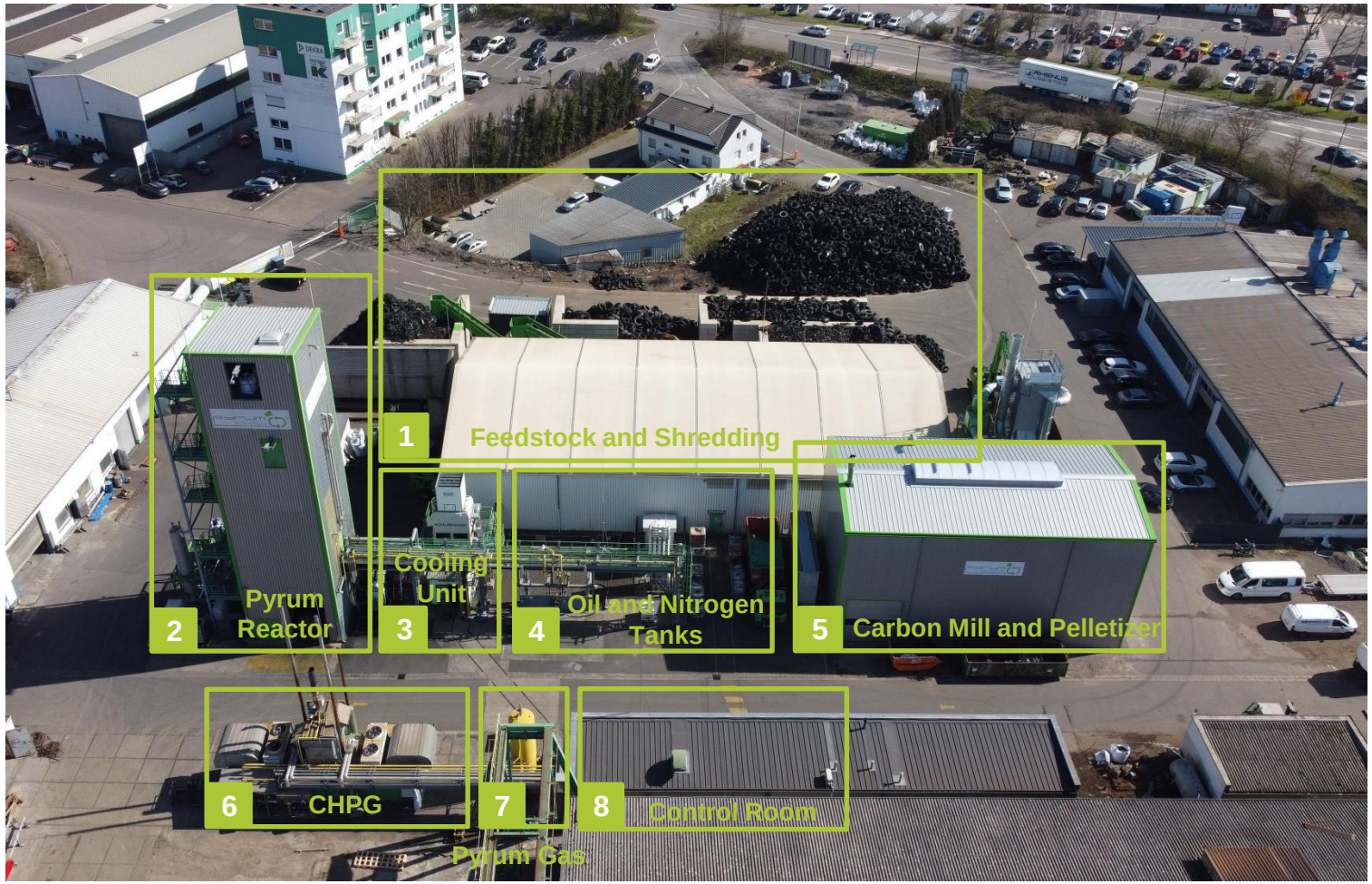


Source: Maga, D.; Aryan, V.; Blömer, J. (2022): Comparative Life Cycle Assessment of End-of-Life Options for Used Tires; Fraunhofer Institute for Environmental, Safety, and Energy Technology UMSICHT

Dillingen plant was one industrial production line for end-of-life-tires…

… and has been running on industrial scale since May 2020 with commercial sales

Overview of the operational unit[1]



Comments

1. **Feedstock (end-of-life-tires) and shredding unit**: granulating whole tires and separating rubber from steel and textile fibers
2. **Pyrum reactor:** patented[2] main part of the Pyrum process. 25-meter-high tower transforming rubber granulates into pyrolysis oil, carbon and gas
3. **Standardized cooling unit** to cool the whole process and all end-products
4. **Oil tanks (40,000 liters underground) and pumping station:** to fill trucks with Pyrum oil + nitrogen
5. **Carbon mill and pelletizer:** to transform raw carbon to commercially recovered Carbon Black (rCB)[3]
6. **Gas generator:** generation of power for the Pyrum plant thanks to the produced gas from the process
7. **Storage and cleaning of pyrolysis gas:** before it enters the gas generator
8. **Control room:** controlling the entire plant with 2-3 persons only

Notes: (1) Current capacity of 5,600 tons p.a.; (2) Patents are owned by Pyrum Innovations International S.A.; (3) In Full operation since April 2023

Dillingen plant consists today of 3 industrial production lines for end-of-life-tires…

… and here we have the two new lines at the Headquarter in Dillingen/Saar called TAD 2+3

Overview of the new operational unit[1]

Comments

1. **Feedstock (end-of-life-tires) and shredding unit**: granulating whole tires and separating rubber from steel and textile fibers
2. **Pyrum reactor 2+3:** patented[2] main part of the Pyrum process. 25-meter-high tower transforming rubber granulates into pyrolysis oil, carbon and gas
3. **Standardized cooling unit** to cool the whole process and all end products
4. **Oil tanks (160,000 liters underground) and pumping station:** to fill trucks with Pyrum oil + nitrogen
5. **Carbon mill and pelletizer:** to transform raw carbon to commercial recovered Carbon Black (rCB)
6. **Gas generator:** creation the power for the Pyrum plant thanks to the produced gas from the process
7. **Storage of rCB in all forms:** 4 Silos of 100 m³ each for crude, milled and pelletized rCB
8. **Control room:** controlling the entire plant with 2-3 persons only

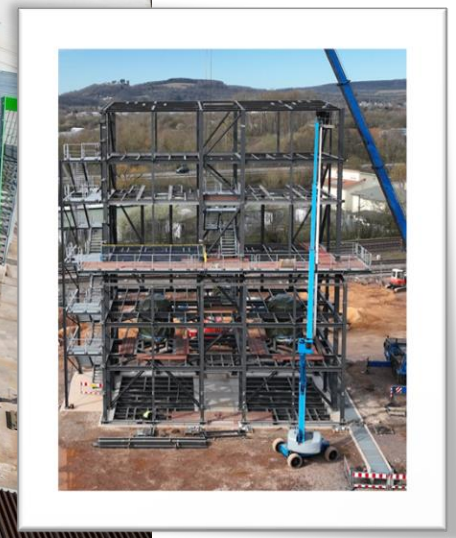
Notes: (1) Future additional capacity of 13,200 tons p.a.; (2) Patents are owned by Pyrum Innovations International S.A.

Building Site of Pyrum Unit 2 and 3 in Dillingen

Sky view impressions

Status quo lines 2 + 3 (10.07.2023)

1 year ago



Building Site of Pyrum Unit 2 and 3

Impressions

New Power Plant and Pyrolysis Unit

Details about Pyrum Unit 2 and 3

- **Start of Building :** November 2021
- **Size of Building site:** 8.000 m²
- **Production Capacity:** up to 6 Tons of used tires per hour (10.000 tires per day)
- **Finished Parts of the Consturction**:
  - Buildings: Finished since 11.2022
  - Power, Water and Energy Supply: Finished since 01.2023
  - Control Room and Social Building: Finished since 04.2023
  - Shredding Plant for 6 to/hour: Finished since 04.2023
  - Construction of Pyrolysis Unit 2+3: Finished since 04.2023
  - End product Storage: Finished since 04.2023
  - Cabling and controls Unit 2+3 Finished since 05.2023
  - Power Plant (Gas to Energy): Finished since 09.2023
  - Start of cold ramp up: Started in June 2023
  - Start of warm ramp up: Start October 2023
  - New Mill and Pelletizer 2024
- **Complete Building time:** 21 months (Planned 18 months)
- **Delay:** 3 months (under the current supply chain conditions)

Pyrum roll out plan for the next years…

… many projects are far advanced or have already been started

Pyrum's roadmap

	Project Nr.	Country	Partner/Site	General Terms agreed	Contract / Pre-Contract signed	Building site secured	20% Capital secured	Authorisation in process	Operative Company created	
SPV	1	Deutschland	Bayern	✓	✓		✓	✓	✓	
SPV	2	Deutschland	Bade-Württemberg	✓		✓	✓			
SPV	3	Deutschland	Hessen	✓						UNITANK
100 %	4	Deutschland	Homburg	✓	✓	✓	✓	✓	✓	pyrum innovations
SPV	5	Deutschland	Emleben	✓		✓	✓		✓	UNITANK
SPV	6	Deutschland	Bremen NEW	✓		✓	✓			?
SPV	7	UK	SUEZ UK NEW	✓	✓		✓	✓		SUEZ
SPV	8	Irland	Waterford	✓						
SPV	9	Greece	Athen „Pyro Lysi SA" NEW	✓	✓	✓	✓	✓	✓	
SPV	10	Belgien	Antwerpen	✓	✓				✓	
SPV	11	Czech Republic	Prag NEW	✓		✓	✓		✓	

Attractive plant economics is the enabler for the rapid roll-out

Estimated plant economics – operating at 20,000 tonnes p.a. capacity

1	**Total revenues, end-products and gate fee**				**EUR ~ 11.5 m**
	Gate fee	*EUR 110/ton*	x	*20,000 tons*	*EUR ~ 2.2 m*
	Steel **(+100%,2021)**	*EUR 300/ton*	x	*4,000 tons*	*EUR ~ 1.2 m*
	Oil **(+60%, 2021)**	*EUR 400/ton*	x	*4,650 tons*	*EUR ~ 1.9 m*
	rCB **(+31%, 2021)**	*EUR 850/ton*	x	*7,350 tons*	*EUR ~ 6.2 m*
	Gas	*used*	x		
	Heat / Energy	*used*	x		
	Direct costs				**EUR ~ 1.6 m**
2	**OPEX**				**EUR ~ 3.1 m**
3	**EBITDA**				**EUR ~ 6.8 m**
4	Investment				EUR ~ 40 m
4 / 3	**Payback EBITDA basis**				**~ 5,9 years**

Pyrum targets more than 20 plants in the long-term

- **Roll out partners and investors:**
  - **Unitank**
    - Plan: Building 10 Plants of 20.000 tons each until 2030
    - Start of first plant: 2023 in Germany
    - Financing secured through Unitank and its shareholders (Aberdeen)
    - Common Pyrum/Unitank company owning the 10 plants. Pyrum will be co-shareholder and owner. (share: 20-40%)
  - **BASF:**
    - Strategic partnership with BASF to build 17 plants until 2030
    - To finance these plants Pyrum has access to a loan package of EUR 50 million from BASF with very good conditions.
    - Guaranteed offtake agreement with BASF of a value of EUR 40 million per year just for the oil offtake
  - **Next 100% Pyrum owned plant in Homburg, Germany, announced in 02.2023:**
    - Building site has been accepted by the city of Homburg (100% City Council decision from 09.02.2023)
    - Pre-contract for the acquisition of the site signed 10.05.2023
    - Start of authorisation process in 06.2023.

Summary:

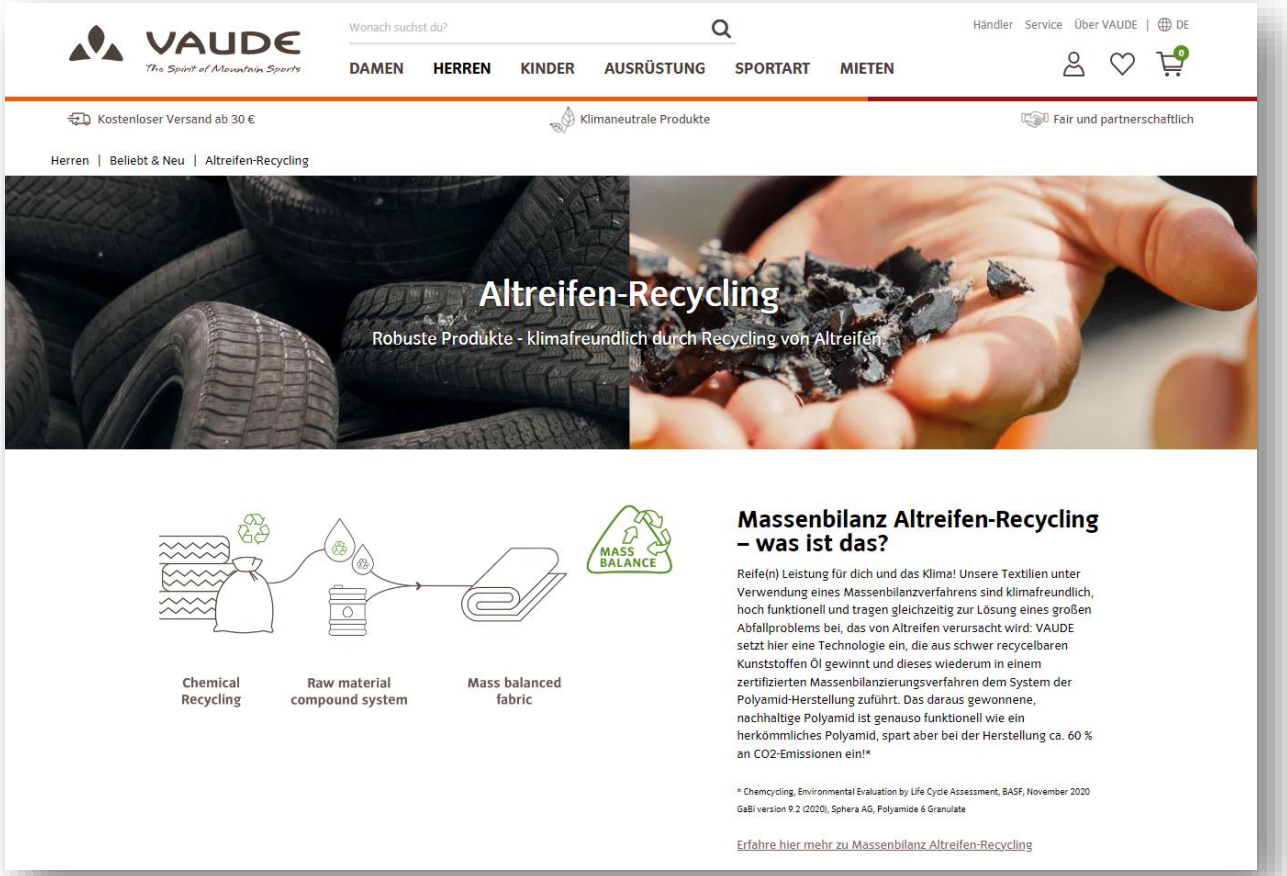
- **17 Plants until 2030**
- **14 of these plants are already in planning, permitting or negotiation phase**
- **Total investment volume of about EUR 600 million**
- **Planned sales > EUR 100 million/year by 2030**

The forward-based information on this slide is shown as an example of a possible future development and is therefore solely for illustrative purposes. Such figures are based on multiple assumptions and there are no agreements entered into to support development illustrated. Such figures are not estimates or forecast and should therefore not be relied upon. Actual figures may therefore deviate materially.

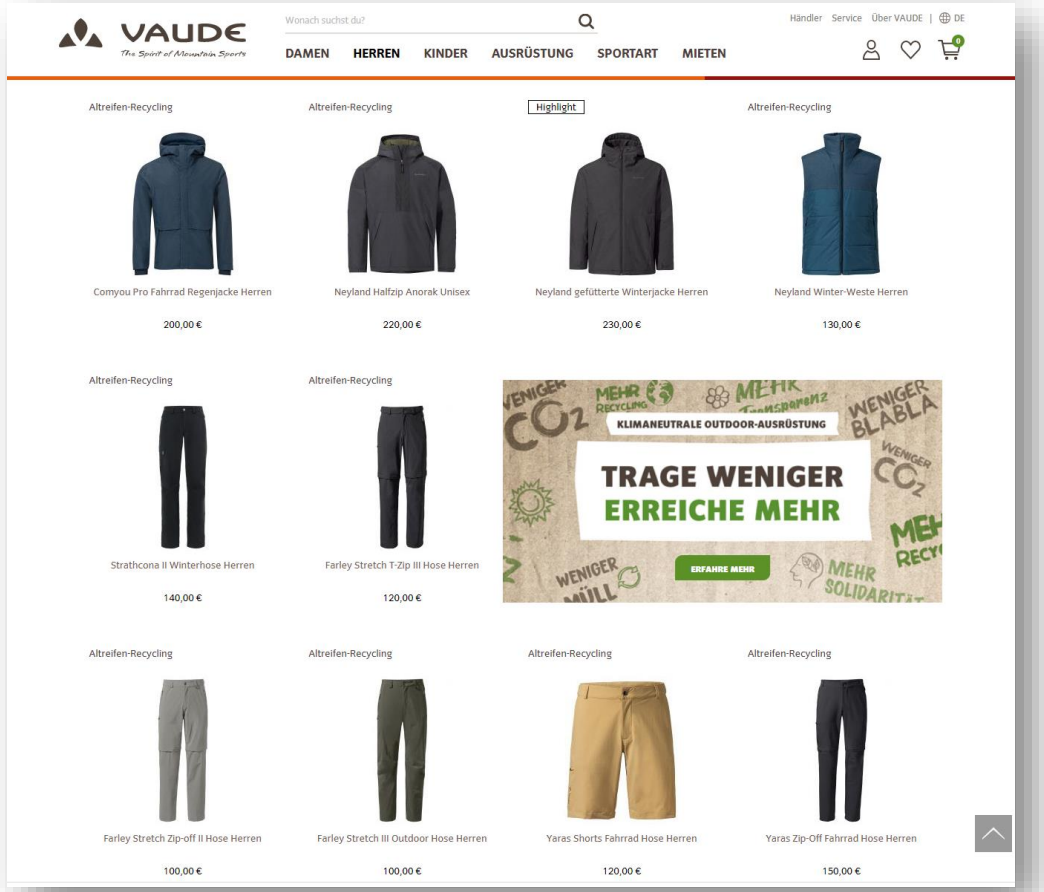
Real applications of circularity

… areas of use that are already in operation

VAUDE Outdoor Equipment and Clothing



Source: https://www.vaude.com/de-DE/Herren/Beliebt-Neu/Altreifen-Recycling/

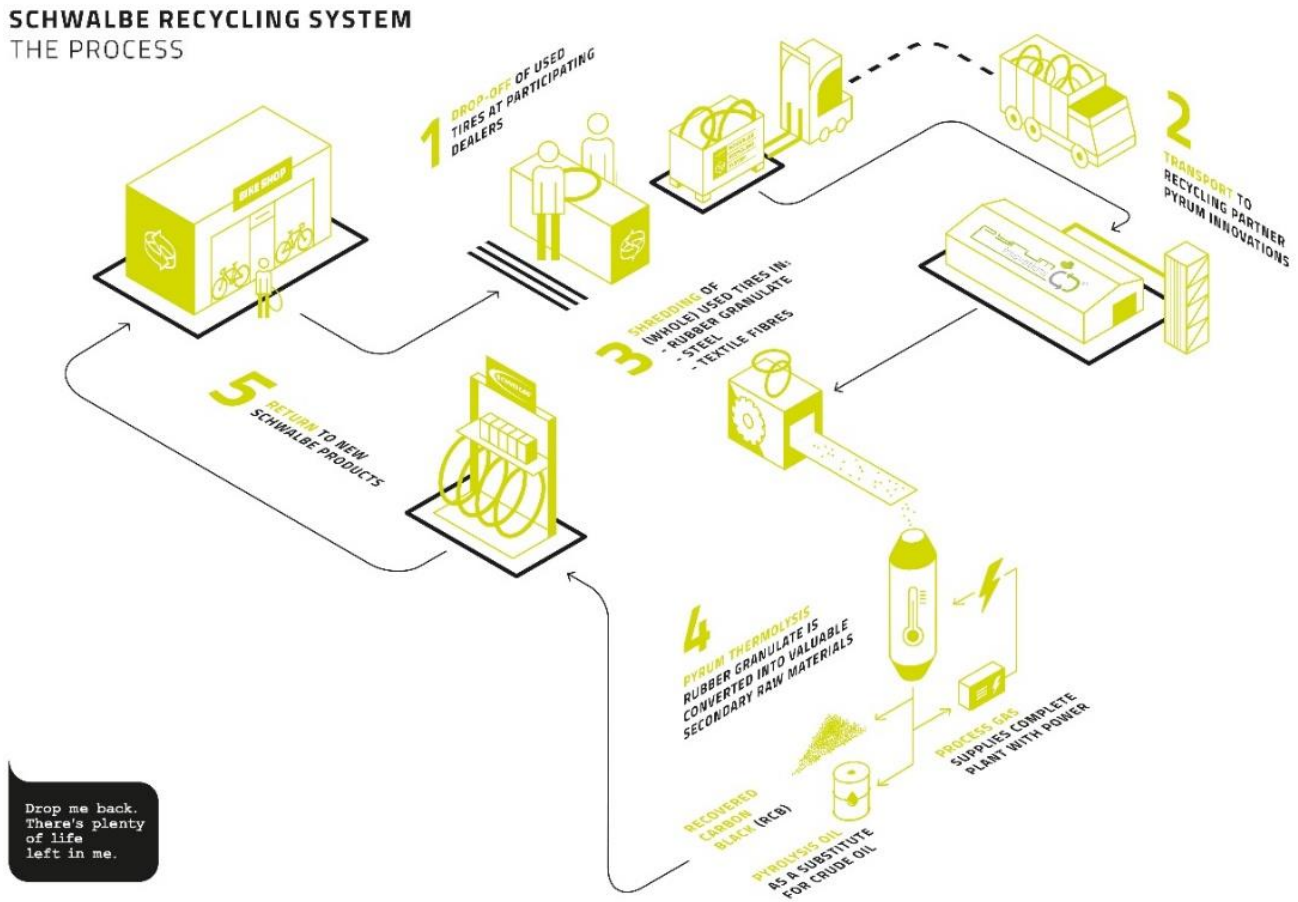


Source: https://www.vaude.com/de-DE/Herren/Beliebt-Neu/Altreifen-Recycling/

Real applications of circularity

… areas of use that are already in operation

Schwalbe Recycing System and „THE GREEN MARATHON“



- **Already 2.100 bike stores in Germany are participating = almost 1/3 of German market.**
- **The first 100% Pyrum rCB tire was released at the EUROBIKE in June 2023**

Real applications of circularity

… areas of use that are already in operation

Mercedes-Banz door handles

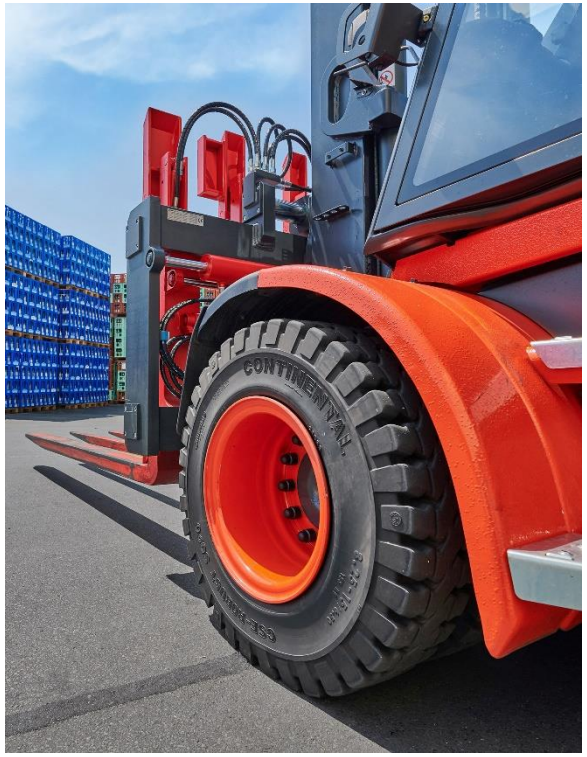
Source: Mercedes Benz Group AG

Real applications of circularity

… areas of use that are already in operation

Continental Tires since September 2023

- **Solid tires from Continental's tire plant in Korbach now contain recovered carbon black from end-of-life-tires**
- **By 2050 at the latest, Continental aims to use <u>100 percent sustainable materials</u> in its tire products**
- **Solid Tires produced since Calendar week 23 2023 contain Pyrum rCB**

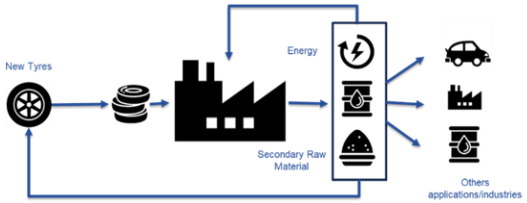


Source: Continental Press Release 12.09.2023

Research & Development

Result overview from ongoing projects

BLACK CYCLE
Move to the green revolution



Funded by Horizon2020 European Union Funding for Research & Innovation

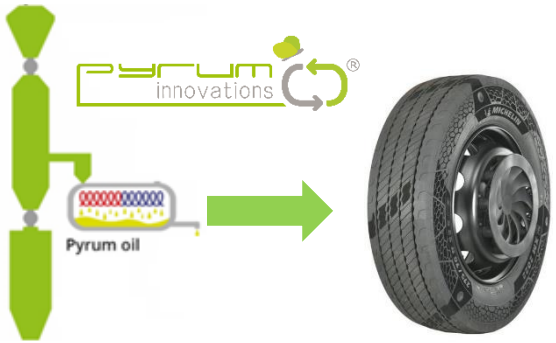
The BlackCycle project aims at creating, developing, and optimising a full value chain:

To valorize **100%** ELTs selected
To increase up to **10 times** SRMs rate into a new tire
To decrease **CO2** emission at least **50%**

Major milestones since July 2022:

Process chain evaluation at **industrial scale**
Production of the **first SRM tires**
LCA studies for the value chain
Scenario deployment and **roll out**

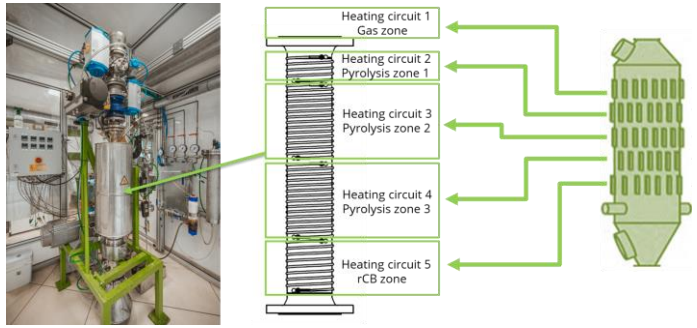
The first tire made from pyrolysis oil



Major milestones since July 2022:

Operation of all **laboratory plants** (shredding, pyrolysis, milling)
Identification of ideal **milling technology**
Scan of **pyrolysis** process conditions completed

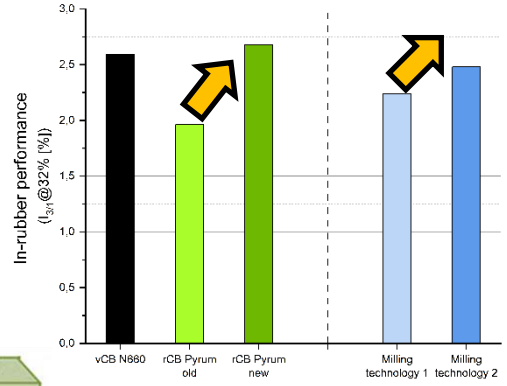
Reproducible scale down of the industrial plant



Creating of a high quality rCB for the implementation into new tires:

Ideal **feedstock** composition
Optimized **pyrolysis** process conditions
Optimized rCB **refining** process conditions
Application and tests in **tire** compounds

Goal: Quality level of N660 and higher



At this early stage we…

…highly increased the quality

…obtained knowledge about impacts

…already surpassed the level of N660

Research & Development

Result overview from completed projects

CFRP Recycling

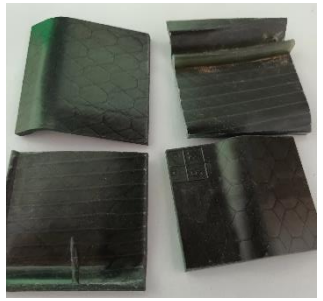
Project: **Infinity**

Project duration: Jan '21 – Jun '23

- Basic & detail engineering of a continuous and automated demonstration plant for recycling of carbon-fiber-reinforced plastic (CFRP)
- Installation of an operating container incl. machine, lock and control room
- Successful commissioning and operation of the demonstration plant

➡ **First time holistic recycling of CFRP**

Funded by Bundesministerium für Wirtschaft und Klimaschutz



CFRP from car

Pyrolysis

recycled carbon fiber (rCF)

- ✓ **Perfect separation of the fiber matrix**
- ✓ **High proportion of recycling**
- ✓ **Sustainable supply of rCF due to substantially lower CO_2 emissions compared to new production**

➡ **Already in this plant size**

Bicycle tire recycling

SCHWALBE

Technology
Arts Sciences
TH Köln

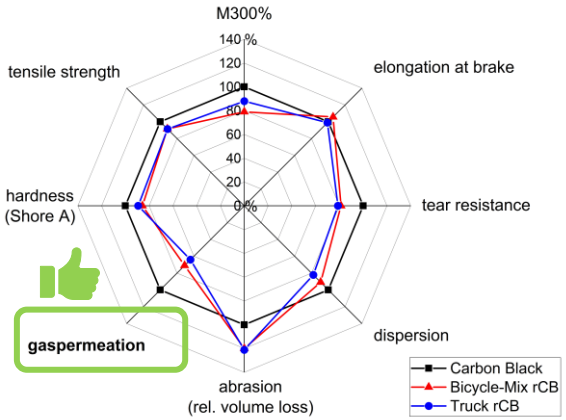
Funded by AiF Projekt GmbH

The project aims at creating, developing, and optimizing a full value chain:

Setup of the **first collection system** for bicycle tires
Optimization of **bicycle tire pyrolysis**
Implementation of bicycle-rCB into **inner tubes**

Major milestones since July 2022:

Optimization of the **pyrolysis** process conditions
Optimization of the **rCB refining process**
Introduction of **new rCB type** in rubber compounds
Performance test of **inner tube** demonstrator



Pyrolysis

- ✓ **Lower gaspermeation**
- ✓ **Less use of fossil resources**
- ✓ **More sustainable**

Outlook for the rest of the year 2023

Pyrum`s shortterm focus

Investment highlights

Pyrum addresses global environmental problems with revolutionary scalable technology

I **Addressing the global tire waste problem with a patented pyrolysis solution, recycling rubber into high value products – oil, carbon, gas**

II **The Dillingen Plant running on an industrial scale since May ´20. Quality of Pyrum`s Oil and Carbon proven with thousands of tons of delivered oil. rCB finally in serial production since July/August 2023**

III **Industrial partnerships with BASF (long-term offtaker of oil and shareholder), Michelin, Continental (Shareholder), Schwalbe, Siemens, UNITANK provide verification and secure basis for rapid growth**

IV **Two-pillar business model. Recurring revenues from plant ownership and revenues from sale of plants to other operations.**

V **Targets to build 4 – 6 plants (3 reactors each) until End of 2026**