



PYRUM



Pyrum Innovations AG

General Presentation
Pyrum Innovations AG
2023



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

... as tightening regulatory environment forces countries and corporates to take action

Global ELTs in 2019



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

Tightening regulatory environment

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


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


- 

Extended Producer Responsibility (EPR)
Recycling becomes a corporate concern as well as recycling percentages in new products


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OEM Audits are requiring circularity grades
The market is pushing for new raw materials


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Increasing cost of CO₂
Burning tires becomes more and more expensive

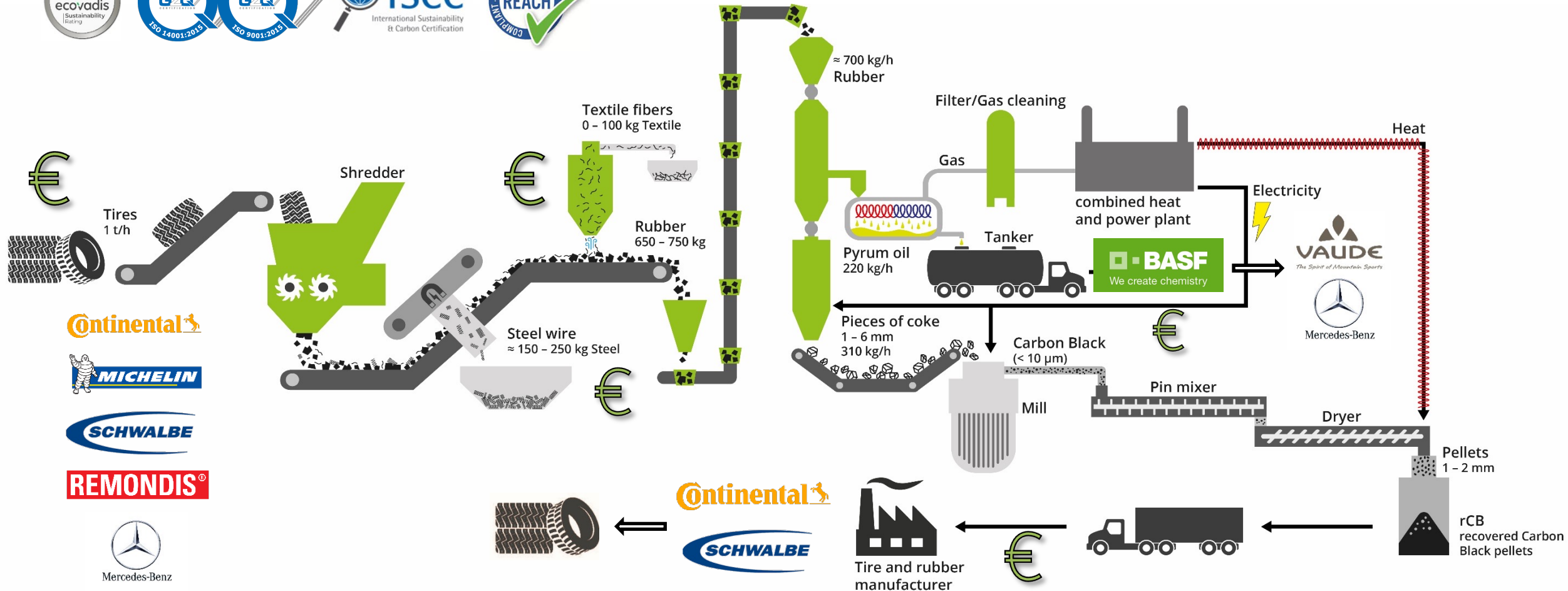




Pyrum offers patented technology with strong value proposition...

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

How Pyrum creates value



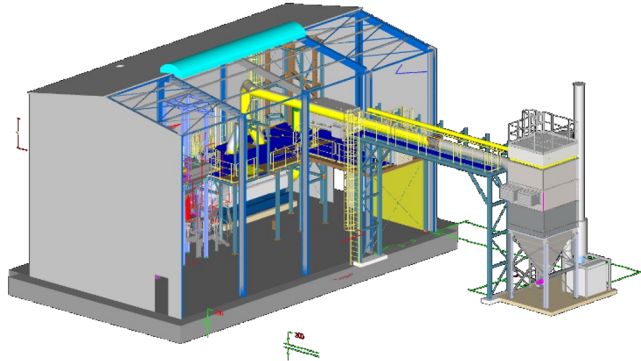
Advancement of rCB development and certification

Milling and Pelletizing

Building, ramp up, fine tuning and certification

Milestones of rCB development:

- **Building of the plant:** 14.02.22 – 19.03.22 ✓
- **First test runs:** 21.03.22 – 25.03.22 ✓
- **Test runs and training:** 28.03.22 – 31.03.22 ✓
- **Quality improvement:** 01.04.22 – 16.09.22 ✓
- **Quality reached:** 16.09.22 ✓
- **Capacity reached:** November 2022 ✓



Once the quality was reached the certification process could start

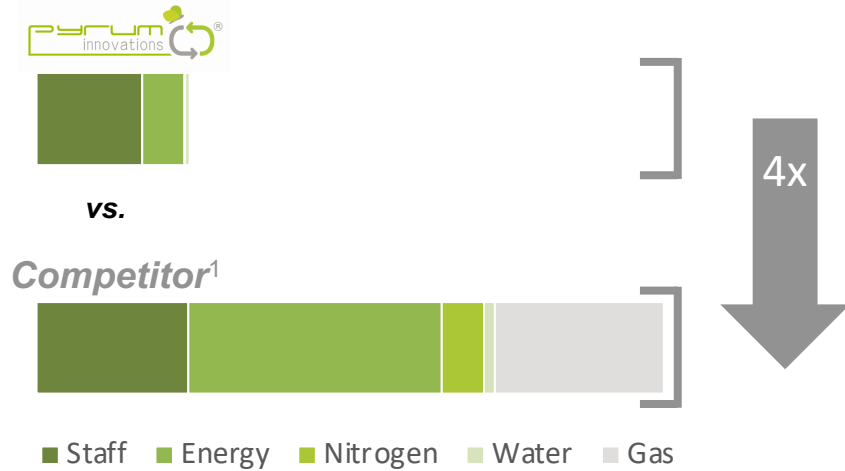
Certificates passed 2nd half 2022 and 1st half 2023



What makes Pyrum so unique?

Pyrum is well ahead of its competitors in terms of technology, timing and economics

Key costs comparison (illustration)



Key criteria comparison

Technology	Process	Economics	Environmental
<p>Technology</p> <p>Controlled process with Siemens NEO as first industrial plant worldwide</p>	<p>Process</p> <p>Continuous process. Elapsed time between entry and exit of waste max. 40 minutes</p>	<p>Staff</p> <p>2-3 workers / shift to run 1 Pyrum line (shredder and mill not included)</p>	<p>REACH</p> <p>REACH certificate for oil from ELT (Lead registrant)</p>
<p>Reliability</p> <p>Dillingen plant is running 24/7 since May 2020. Test operation since May 2015</p>	<p>Lifespan of main reactor</p> <p>10 years guaranteed by Pyrum as the reactor has no moving parts</p>	<p>Market value oil</p> <p>Guaranteed offtake agreements with BASF for 100.000 tons per year = sales of EUR 40 million per year³</p>	<p>Emissions</p> <p>72% CO₂ savings compared to actual recycling mix. Saves 965 kg CO₂ per ton of used tires⁴</p>
<p>Energy</p> <p>Only fully self-sufficient pyrolysis process needing no external energy or heat</p>	<p>Maintenance</p> <p>Stops only 2 times per year for about 3 weeks²</p>	<p>Market value carbon</p> <p>Offtake agreements for pelletized rCB with Continental and Schwalbe</p>	<p>Limited PAHs</p> <p>Just several seconds tires are exposed to temperatures between 450 and 550 °C</p>

Awarded and Government supported technology

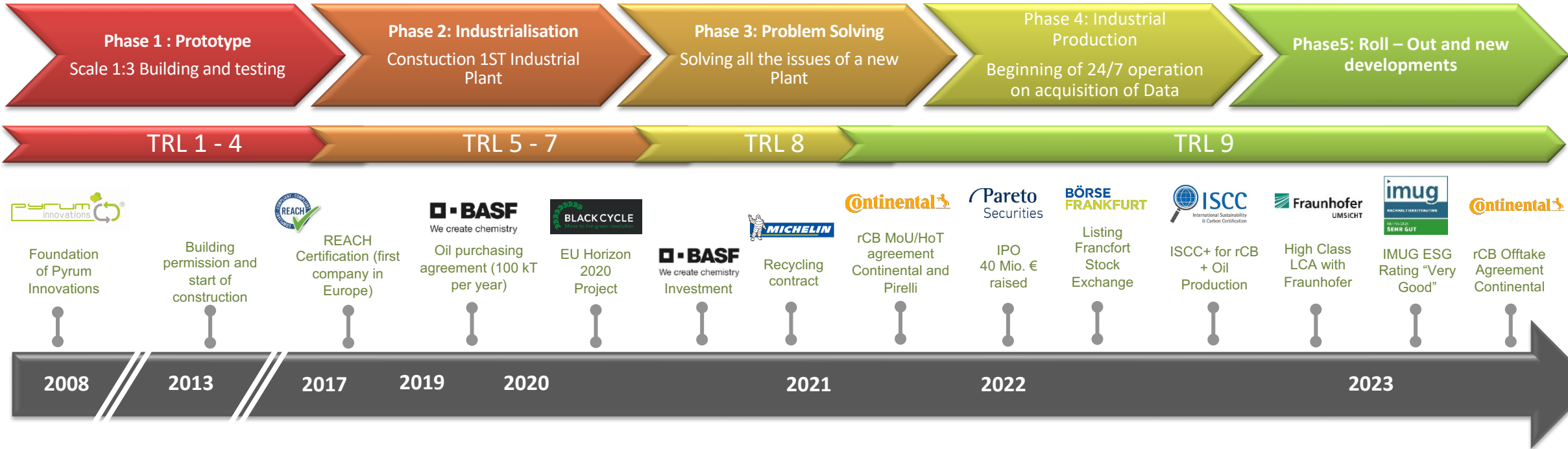


Source: Company info | Notes: (1) Compared to the average competitor using Batch or turning oven (Pyrum is the only company currently having its own patented technology. Patents are owned by Pyrum Innovations International S.A.); (2) Compared to competitors which need to stop process every day. Each of the 150 heating sources can be replaced while the reactor is running; (3) According to terms & conditions of the BASF agreement; (4) Fraunhofer / Pyrum LCA Study made 2022



Our history in short

Key milestones



Key News

JDA and rCB Offtake signed with Continental

Materialica Award with BASF and Mercedes-Benz

Recycling System with Schwalbe + rCB Offtake

Imug ESG Rating finalized: "Very Good"

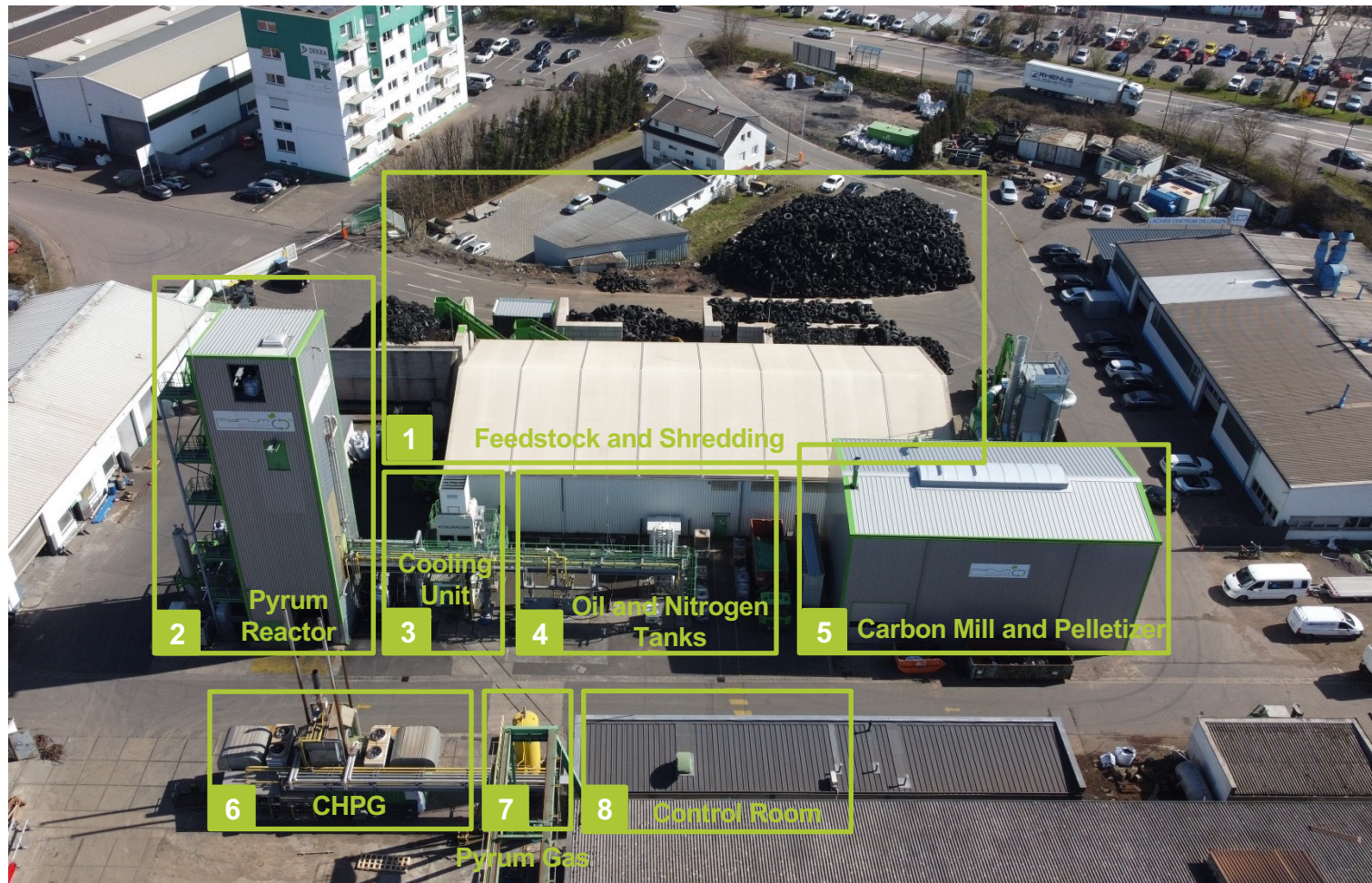
Source: Company info



Dillingen plant consists of 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 unit¹



Comments

- 1 ▶ **Feedstock (end-of-life-tires) and shredding unit:** granulating whole tires and separating rubber from steel and textile fibers
- 2 ▶ **Pyrum reactor:** patented² 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 commercial recovered Carbon Black (rCB)³
- 6 ▶ **Gas generator:** creation the 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 6,600 tons p.a.; (2) Patents are owned by Pyrum Innovations International S.A.; (3) In Full operation since April 2023



Building Site of Pyrum Unit 2 and 3

Sky view impressions

Status quo lines 2 + 3 (17.05.2023)



Building Site of Pyrum Unit 2 and 3

Sky view impressions

Back view with Power Plant / Oil Storage and Pyrum Tower



Front view with Shredder Feeding system



Building Site of Pyrum Unit 2 and 3

Impressions

New mobile control room and social building



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: Planned for 05.2023
 - Power Plant (Gas to Energy): Planned for 06.2023
 - Start of cold ramp up: End of May 2023
 - Start of warm ramp up: End of July 2023
- **Complete Building time:** 21 Months (Planned 18 months)
- **Delay:** 3 months (under the actual supply chain conditions)



LCA: Life Cycle Assessment

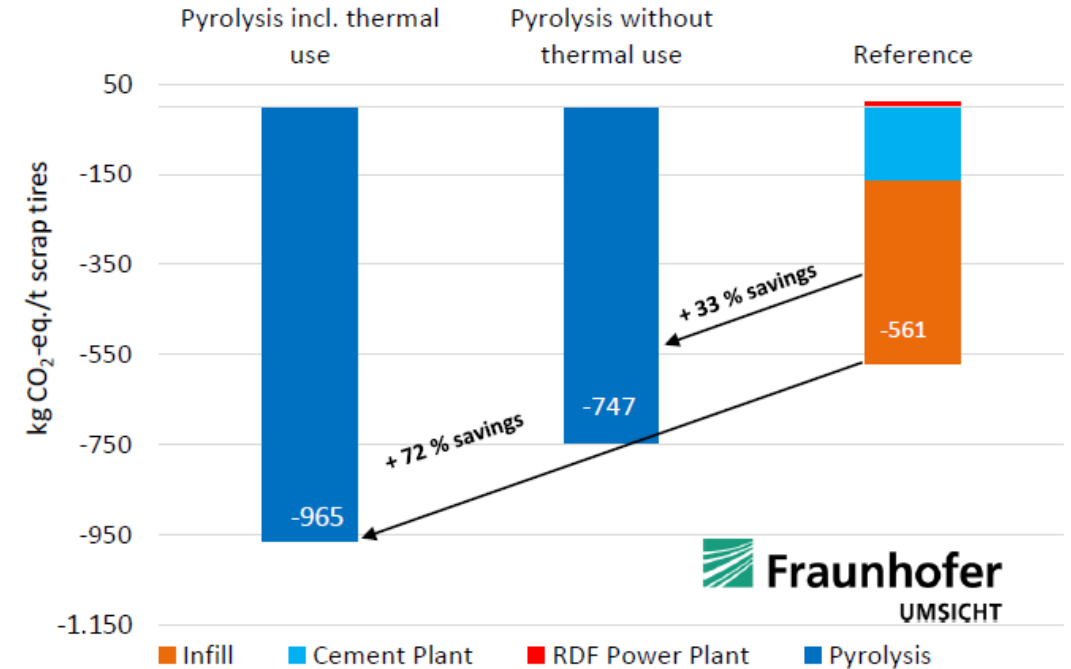
Results better than expected

Explanation

- The LCA has been made by Fraunhofer Institute between **May and September 2022**
- The results are coming only from the Pyrum pyrolysis process and can not be compared to other pyrolysis processes
- Comparison of the CO₂ Eq. savings depending on different recycling processes. This means: „**How much CO₂ is saved by the recycling process instead of using fossil fuels or raw materials?**“ :
 - **EBS Power 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% CO₂ savings

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



Real applications of circularity

... areas of use that are already in operation

VAUDE Outdoor Equipment and Clothing



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Altreifen-Recycling
Robuste Produkte - klimafreundlich durch Recycling von Altreifen

Massenbilanz Altreifen-Recycling – was ist das?

Reife(n) Leistung für dich und das Klima! Unsere Textilien unter Verwendung eines Massenbilanzverfahrens sind klimafreundlich, hoch funktionell und tragen gleichzeitig zur Lösung eines großen Abfallproblems bei, das von Altreifen verursacht wird. VAUDE setzt hier eine Technologie ein, die aus schwer recycelbaren Kunststoffen Öl gewinnt und dieses wiederum in einem zertifizierten Massenbilanzierungsverfahren dem System der Polyamid-Herstellung zuführt. Das daraus gewonnene, nachhaltige Polyamid ist genauso funktionell wie ein herkömmliches Polyamid, spart aber bei der Herstellung ca. 60 % an CO₂-Emissionen ein!*

* Chemcycling, Environmental Evaluation by Life Cycle Assessment, BASF, November 2020
GaBI version 9.2 (2020), Sphera AG, Polyamide 6 Granulate

[Erfahre hier mehr zu Massenbilanz Altreifen-Recycling](#)

Diagram illustrating the process: **Chemical Recycling** (represented by a recycling symbol and a bag) leads to a **Raw material compound system** (represented by a barrel), which then results in **Mass balanced fabric** (represented by a folded fabric). A **MASS BALANCE** icon is also shown.

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

Grid of clothing items with 'Altreifen-Recycling' labels:

- Comyo Pro Fahrrad Regenjacke Herren: 200,00 €
- Neyland Halfzip Anorak Unisex: 220,00 €
- Neyland gefütterte Winterjacke Herren: 230,00 €
- Neyland Winter-Weste Herren: 130,00 €
- Strathcona II Winterhose Herren: 140,00 €
- Farley Stretch T-Zip III Hose Herren: 120,00 €
- Farley Stretch Zip-off II Hose Herren: 100,00 €
- Farley Stretch III Outdoor Hose Herren: 100,00 €
- Yaras Shorts Fahrrad Hose Herren: 120,00 €
- Yaras Zip-Off Fahrrad Hose Herren: 150,00 €

Central banner: **TRAGE WENIGER ERREICHE MEHR** (Wear less, achieve more). Includes text: **KLIMANEUTRALE OUTDOOR-AUSRÜSTUNG**, **WENIGER CO₂**, **MEHR RECYCLING**, **WENIGER BLABLA**, **WENIGER CO₂**, **MEHR SOLIDARITÄT**, **ERFAHRE MEHR**.

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



Real applications of circularity

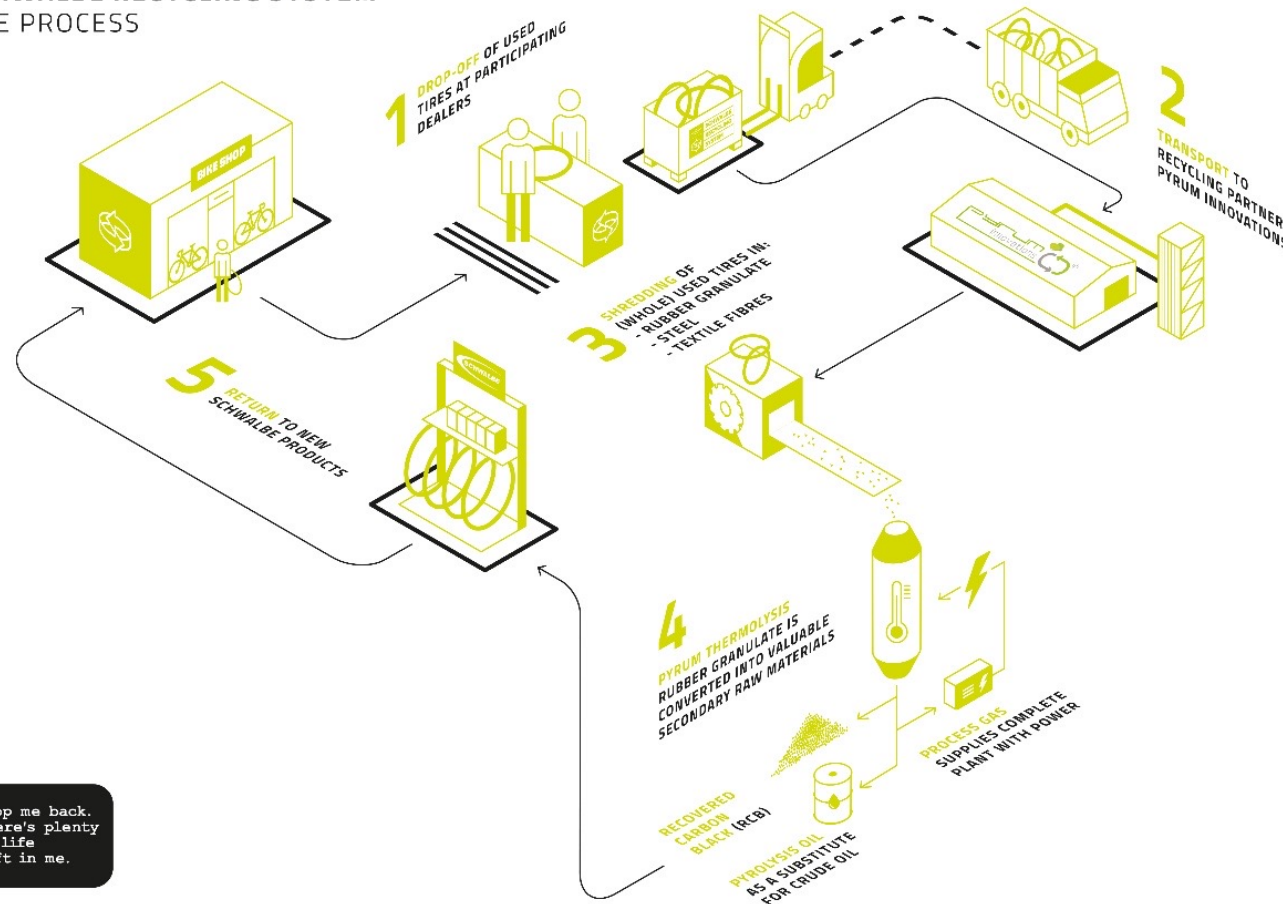
... areas of use that are already in operation

Schwalbe Recycling System



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SCHWALBE RECYCLING SYSTEM THE PROCESS



- Already 1.850 bike stores in Germany are participating = almost 1/3 of German market.
- Schwalbe is already purchasing Pyrum rCB in industrial scale
- The first 100% Pyrum rCB tire will be released at EUROBIKE in June 2023



Source: Ralf Bohle GmbH



Real applications of circularity

... areas of use that are already in operation

Mercedes-Benz door handles







Source: Mercedes Benz Group AG



Pyrum follows several R&D projects ...

... accompanied by renowned research institutes and blue-chip companies

R&D project pipeline

	High priority			Prio 2
Idea				
Why?	<ul style="list-style-type: none"> ▶ CFRP are built into every wind turbine, aircraft or electric vehicle ▶ Blades of wind turbines have to be renewed every 15-25 years, each with a weight up to 25 tons ▶ First semi industrial test unit in operation since Q1 2023 ▶ Member of "Infinity" project³ 	<ul style="list-style-type: none"> ▶ Hydrogen is part of the Pyrum process gas ▶ Filter separates the hydrogen in a pure and clean way ▶ Gas contains up to 40 vol.% of hydrogen ▶ Creates up to 200 tons of hydrogen per plant, per year ▶ Could fuel a fleet of up to 20 - 25 trucks per day 	<ul style="list-style-type: none"> ▶ Development of the "tire of the future"- "BlackCycle-Project" ▶ Made out of (up to) 85% raw materials from end-of-life-tires ▶ Project covering the entire recycling chain together with partner, i.e. Michelin/Orion ▶ Enhancing rCB value 	<ul style="list-style-type: none"> ▶ PUR is an ideal recycling material ▶ Homogeneous waste / little or not mixed with other waste ▶ Pyrum can guarantee a very stable end product quality ▶ Huge market potential facade isolation / mattresses
Status	Start Phase 2 ⁴ : November 2020	Start: September 2020	Start: May 2020	Start: September 2020

Source: Company info Notes: (1) Carbon Fiber Reinforced Polymers; (2) Polyurethane; (3) The aim of the "Infinity" project is to develop, establish and demonstrate a sustainable process cycle for carbon fibre composite materials using novel recycling technologies, materials and processing methods; (4) Phase 1 (feasibility study) started in 2017 and was successfully completed in 2019



Pyrum Consolidated Income Statement 2022 Financial Year

Overview

KPI	2022	2021	Δ EUR PL	Δ % PL
Revenues	982	922	60	6.48%
Increase/decrease of finished goods	277	-28	305	
Other own work capitalised	17,810	2,807	15,003	534.58%
Total output	19,069	3,701	15,368	415.24%
Other operating income	1,318	1,106	212	19.15%
Expenses for materials	17,653	2,584	15,069	583.12%
Personnel expenses	4,184	3,459	725	20.97%
Other operating expenses	3,581	5,285	-1,704	-32.25%
Other taxes	31	10	21	225.26%
EBITDA	-5,061	-6,530	1,469	-22.49%
Depreciation, amortisation and write-downs	2,554	1,626	928	57.10%
EBIT	-7,615	-8,156	541	-6.63%
Income from non-current loans	0	7	-7	
Interest and similar income/expenses	192	202	-10	-4.88%
Result before taxes	-7,808	-8,351	544	-6.51%
Taxes on income and profit	0	0	0	
Result after taxes	-7,808	-8,351	544	-6.51%

Report in TEUR



Pyrum Consolidated Balance Sheet (short) as of 31st December 2022

TEUR	2022	2021	Share in capital 12M 2022
Non-current assets			
Non-current intangible assets	6,492	7,378	13.0%
Property, plant, and equipment	28,759	9,065	57.7%
Non-current financial assets	37	0	0.1%
	35,288	16,443	
Current assets			
Inventories	389	58	0.8%
Receivables and other current assets	1,406	346	2.8%
Cash at hand and in bank	12,726	34,446	25.5%
	14,520	34,850	
Deferred expenses	49	29	0.1%
Equity	31,891	39,699	64.0%
thereof accumulated losses	-23,421	-15,612	
Provisions and Accrued Liabilities	3,114	3,481	6.2%
Liabilities	14,852	8,140	29.8%
Total equity and liabilities	49,857	51,320	
Equity capital ratio	64.0%	77.4%	



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	⊗ 20,000 tons	EUR ~ 2.2 m
	Steel (+100%, 2021)	EUR 300/ton	⊗ 4,000 tons	EUR ~ 1.2 m
	Oil (+60%, 2021)	EUR 400/ton	⊗ 4,650 tons	EUR ~ 1.9 m
	rCB (+31%, 2021)	EUR 850/ton	⊗ 7,350 tons	EUR ~ 6.2 m
	Heat	used	⊗ 9.6 GWh	EUR 0.0 m
	Energy	used	⊗ 5.6 GWh	EUR 0.0 m
	Direct costs			EUR ~ 1.6 m
2	OPEX			EUR ~ 3.1 m
3	EBITDA			EUR ~ 6.8 m
4	Investment			EUR ~ 35.0m
4	Payback EBITDA basis			~ 5,1 years
3				

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 trough 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:

- **More than 17 Plants until 2030**
- **14 of these plants are already in planning, permitting or negotiation phase**
- **Total investment volume of about EUR 600 million**
- **Sales potential p.a. ~ 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. See risk factors section for further information..



The Roll Out plan and particular targets

... milestones

Year by year until 2030



Investment highlights

Pyrum addresses global environmental problems with revolutionary scalable technology

