Pyrum Innovations AG

Pyrum Innovations AG
General Assembly 2023

13.07.2023 / Start 10:00 o'clock

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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

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

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

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

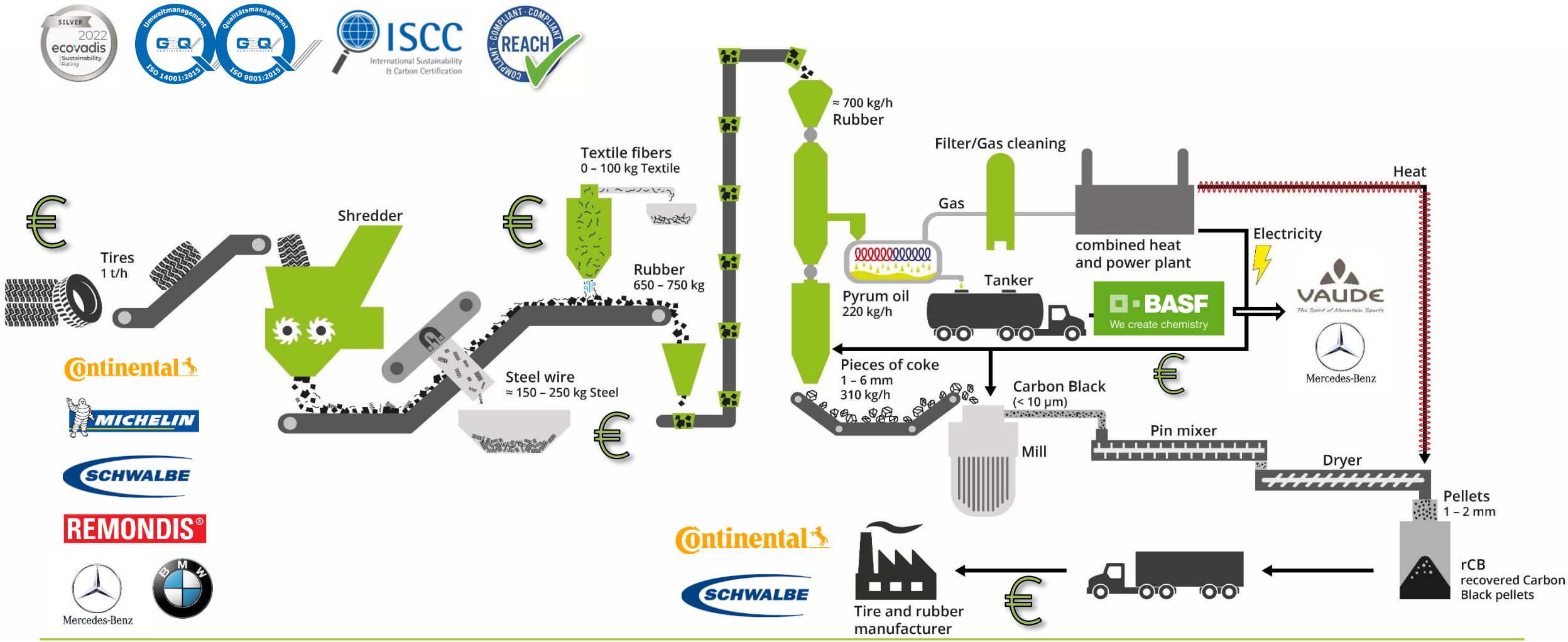
Increasing cost of CO_2
Burning tires becomes more and more expensive

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…

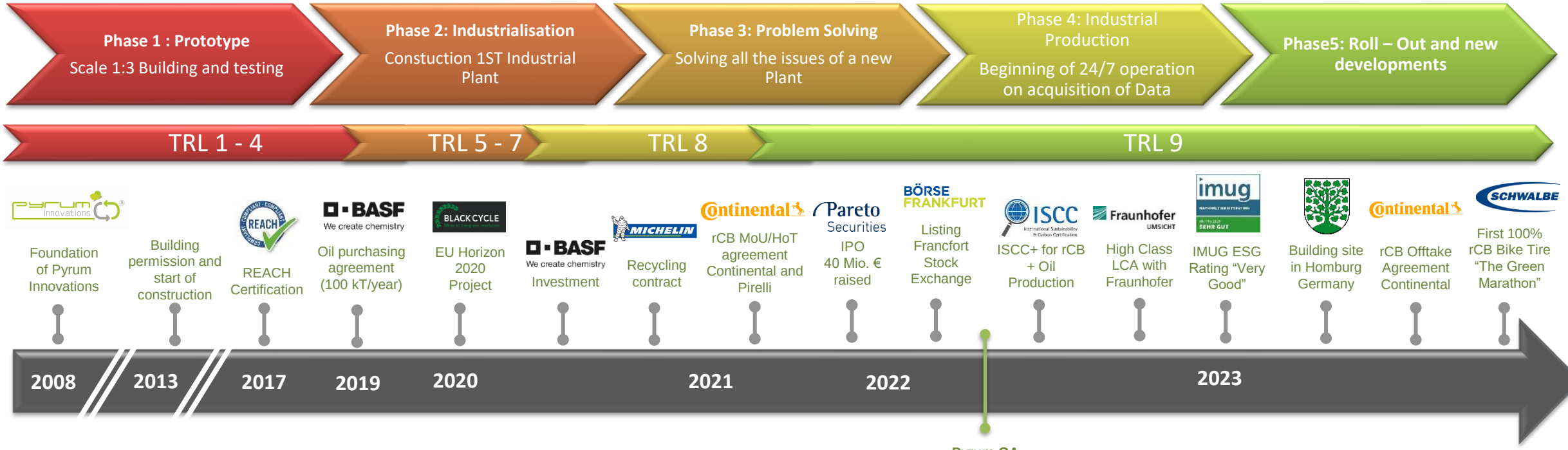
… converting rubber into several high value chemical products – thermolysis oil, carbon and gas

How Pyrum creates value



Our history in short

Key milestones



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
- **Comments:**
  - First VDA 6.3 Audit with Continental took 8 Months
  - Audit two, with Pirelli, took 3 months.
  - Pyrum had to build up new structures in the company

Carbon
0,5 - 5 mm

Milled rCB
10 - 14 µm

Recovered Carbon Black (rCB)
0,8 - 2 mm

The last important Milestone to close the loop: rCB

What happened in the last 12 months to get rCB to the market

Critical issues solved, some little points left

What has been achieved	Last issues
Since April 2023 : Stable 2 shift production	Production runs at 250 kg/h output. Planned was 650 kg/h
Since June 2023: No „off-spec“ production; 100% of output can be sold	Improvements at the Pin mixer and dust return are planned: New conveyor, Wolfram pins (Aug 23)
Pyrum has received all required certificates and permits	Delivery times for spare parts are still long. Improvements take very long
We finally have all products from A-Z in industrial production and sold	Stable production < 10 µm needs to be proven

Jan - Apr 2022: Construction by NEA

Apr – Sep 2022: ramp up and improvements by NEA

Sep 2022 : First in Spec output (unstabel)

Oct 22 – Mar 23 : Improvements by NEA first test deliveries and Audits

LCA: Life Cycle Assessment

Results better than expected

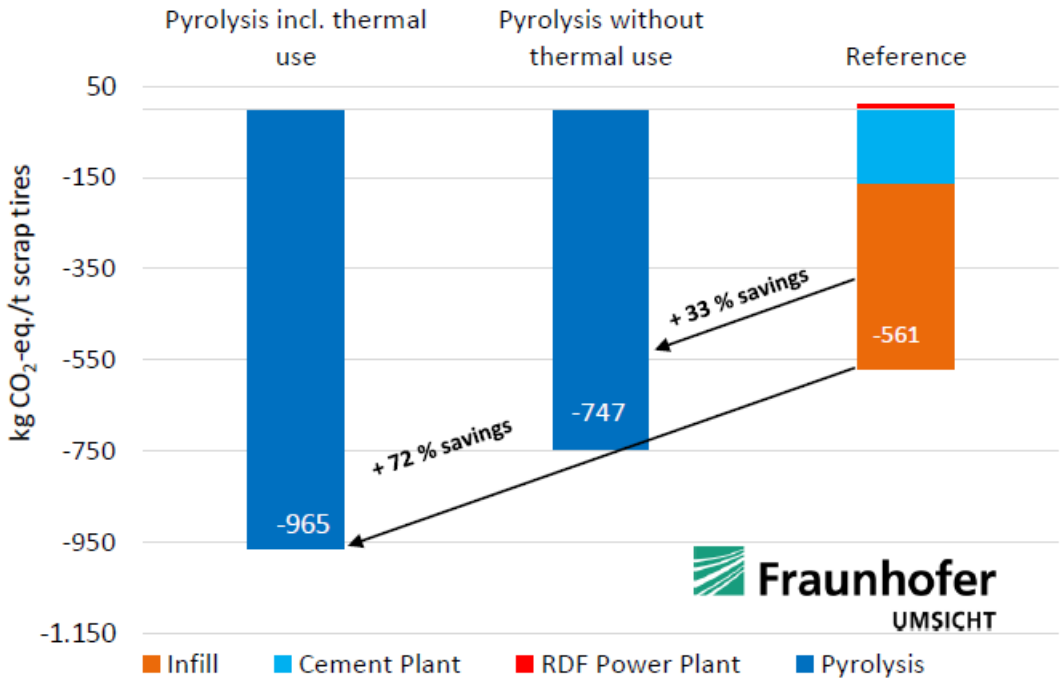
Explanation

- 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 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 approching 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

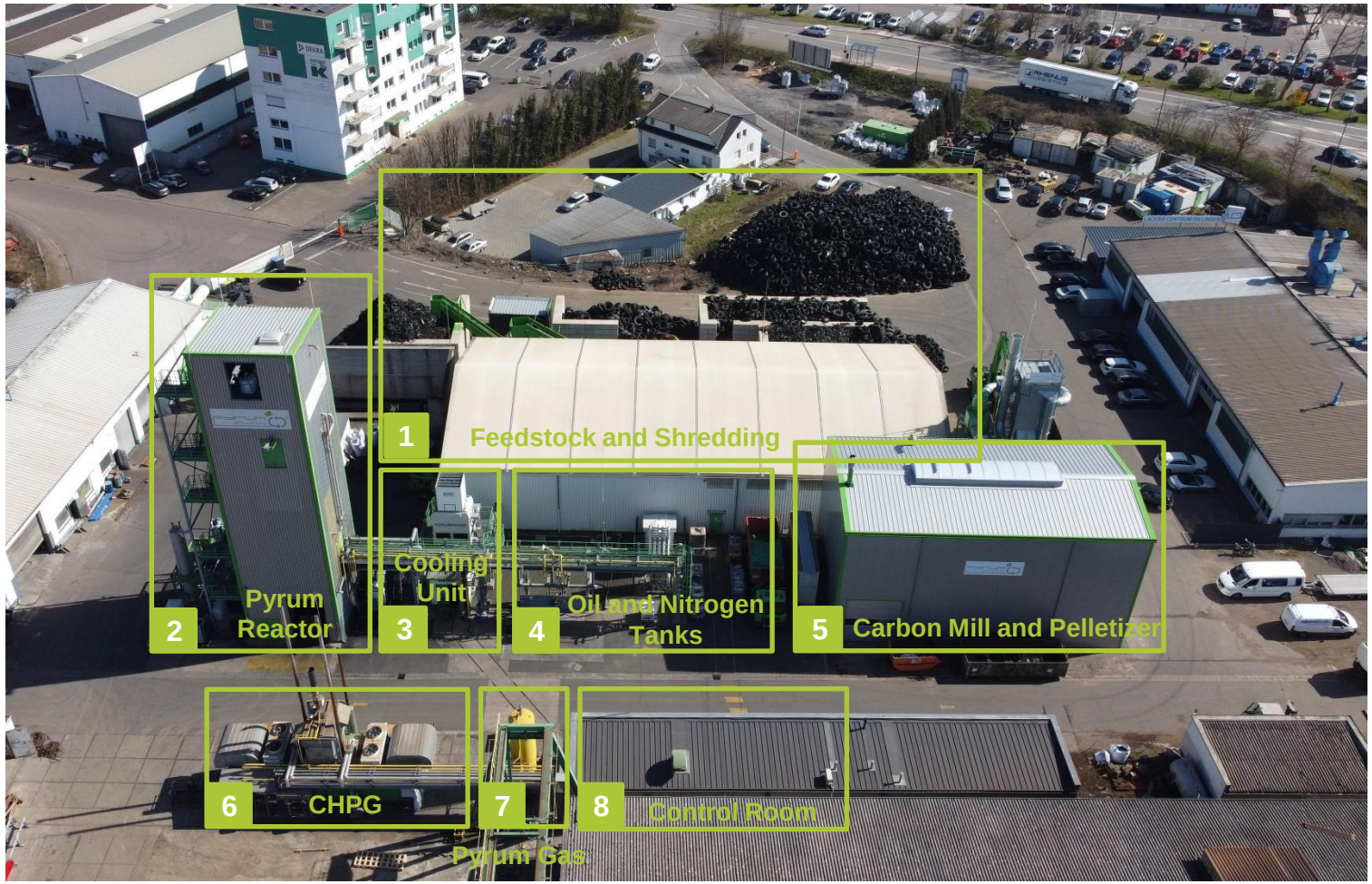


Source: Maga, D.; Aryan, V.; Blömer, J. (2022): Comparative Life Cycle Assessment of End-of-Life Options for Used Tires; Fraunhofer Institute for Environmental, Safety, and Energy Technology UMSICHT

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 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 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

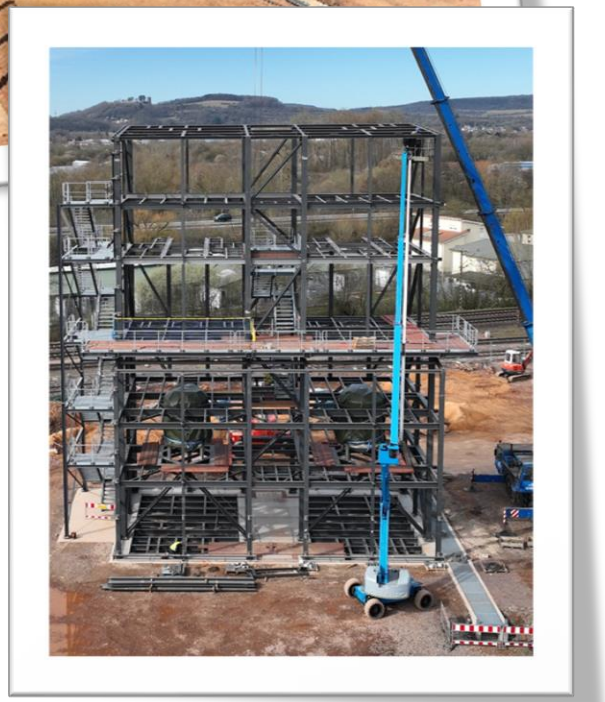
1. **Feedstock (end-of-life-tires) and shredding unit**: granulating whole tires and separating rubber from steel and textile fibers
2. **Pyrum reactor 2+3:** patented[2] main part of the Pyrum process. 25-meter-high tower transforming rubber granulates into pyrolysis oil, carbon and gas
3. **Standardized 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

Sky view impressions

Panorama view of TAD 1 + 2 + 3 from 30 Meter high over Dieselstrasse

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 Stoage:	Finished since 04.2023
– Cabling and controls Unit 2+3	Finished since 05.2023
– Power Plant (Gas to Energy):	Planned for 07.2023
– Start of cold ramp up:	Started in Juni 2023
– Start of warm ramp up:	End of August 2023
– New Mill and Pelletizer	2024

- **Complete Building time:** 21 Months (Planned 18 months)
- **Delay:** 3 months (under the actuall supply Chain conditions)

Pyrum roll out plan for the next years…

… many projects are far advanced or have already been strated

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	Baden Württemberg	✓		✓	✓	✓	
SPV	3	Deutschland	Hessen	✓		✓	✓		
100%	4	Deutschland	Homburg	✓	✓	✓	✓	✓	✓
SPV	5	Deutschland	Niedersachsen	✓		✓	✓		
SPV	6	Belgien	Antwerpen	✓		✓		✓	✓
SPV	7	UK	SUEZ UK	✓	✓	✓	✓	✓	
SPV	8	Irland	Waterford	✓	✓	✓		✓	✓
SPV	9	Greece	Athen	✓	✓	✓	✓	✓	✓

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*
	Heat	*used*	x	*9.6 GWh*	*EUR 0.0 m*
	Energy	*used*	x	*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 / 3	**Payback EBITDA basis**				**~ 5,1 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 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:

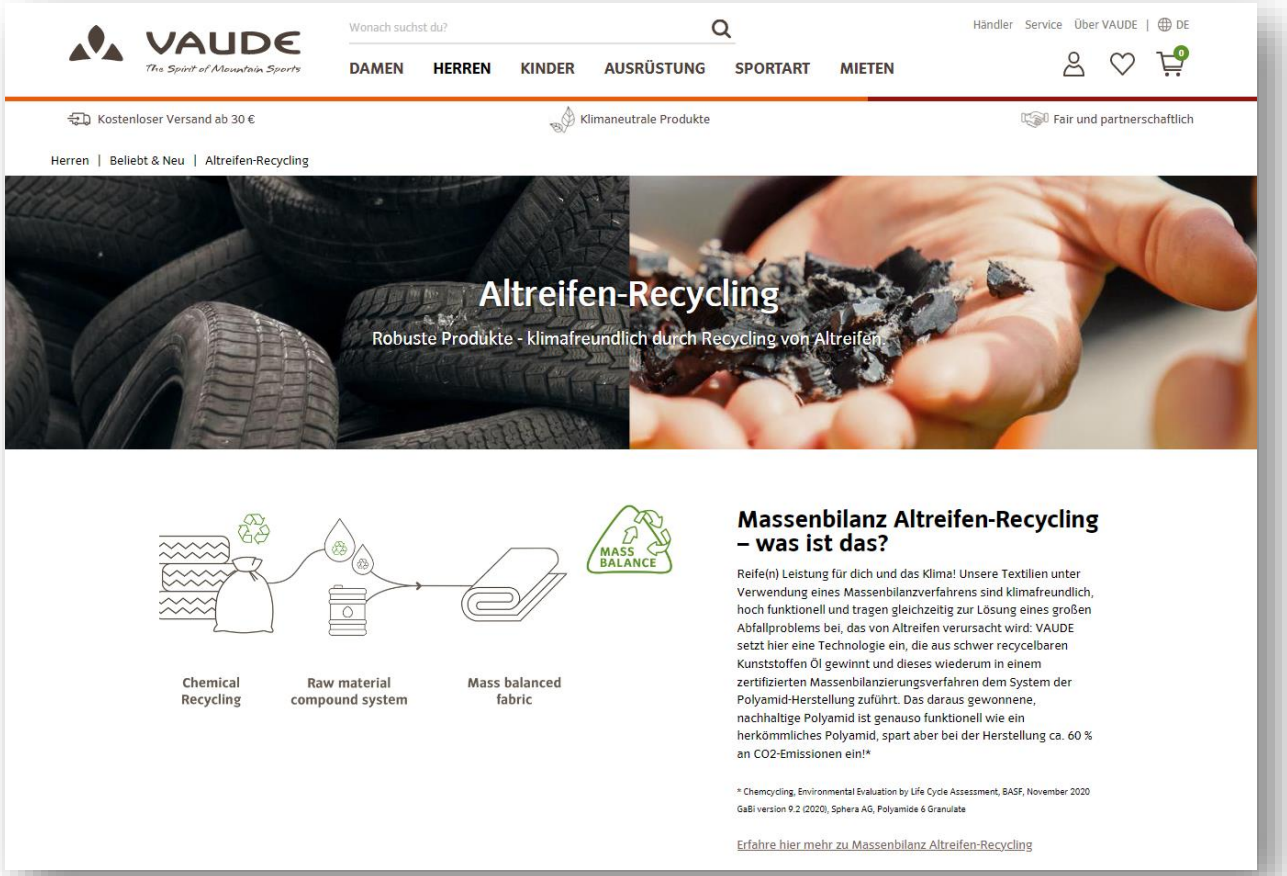
- **17 Plants until 2030**
- **14 of these plants are already in planning, permitting or negotiation phase**
- **Total investment volume of about EUR 600 million**
- **Planned sales > EUR 100 million/year by 2030**

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. .

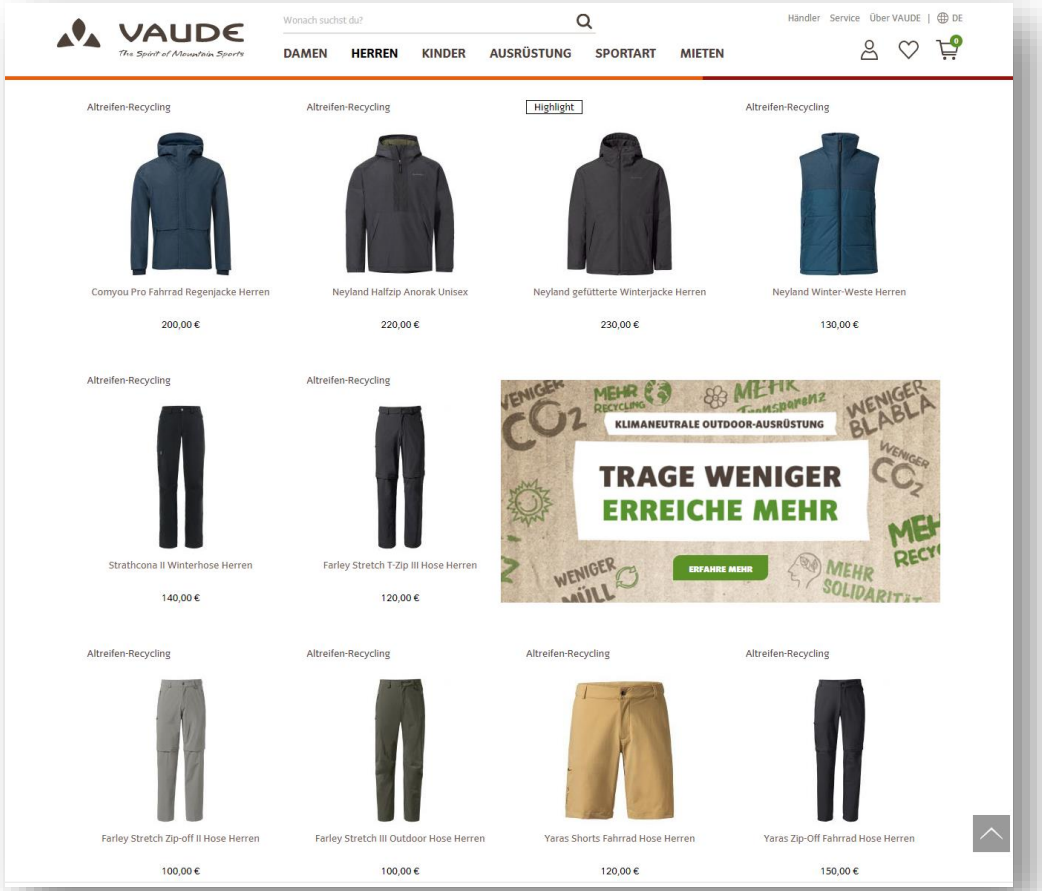
Real applications of circularity

… 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/



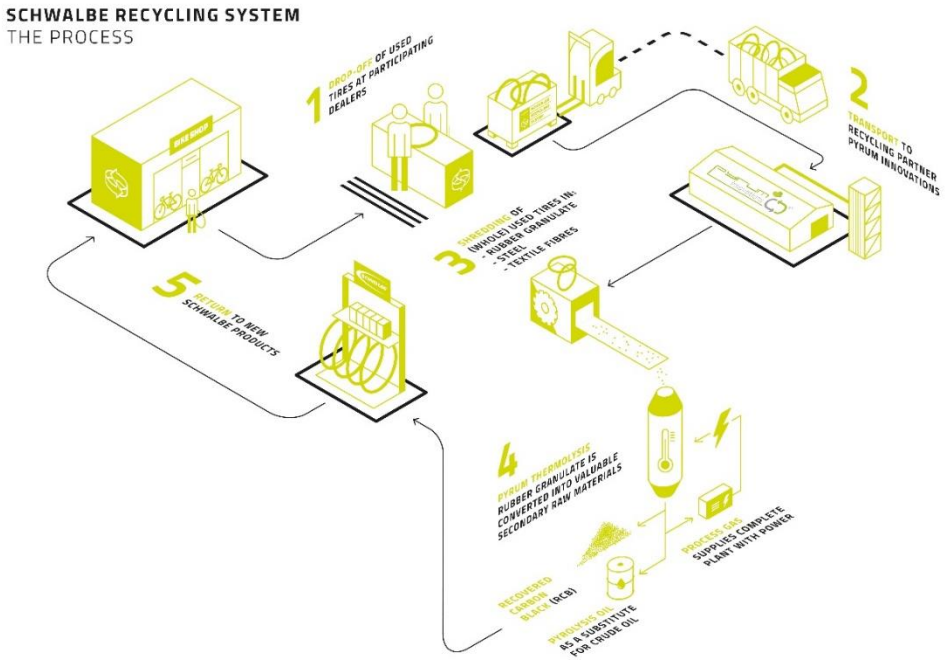
Source: https://www.vaude.com/de-DE/Herren/Beliebt-Neu/Altreifen-Recycling/

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 EUROBIKE in June 2023**



Real applications of circularity

… areas of use that are already in operation

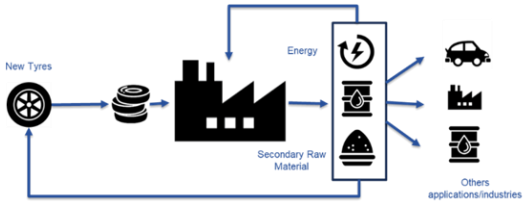
Mercedes-Banz door handles

Source: Mercedes Benz Group AG

Research & Development

Result overview from ongoing projects

BLACK CYCLE
Move to the green revolution



Funded by Horizon2020 European Union Funding for Research & Innovation

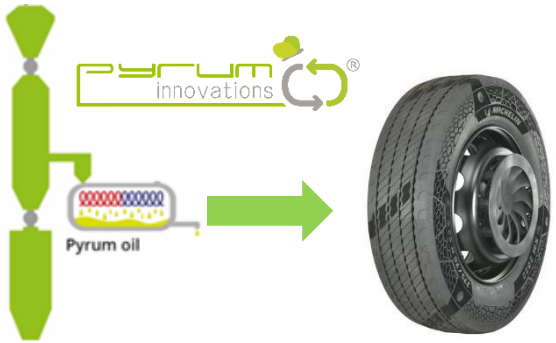
The BlackCycle project aims at creating, developing, and optimising a full value chain:

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**

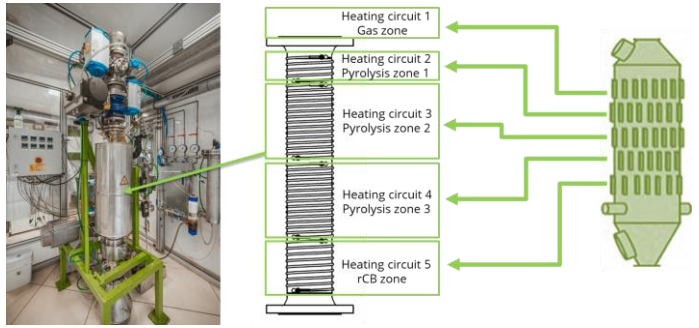
The first tire made from pyrolysis oil



Major milestones since July 2022:

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

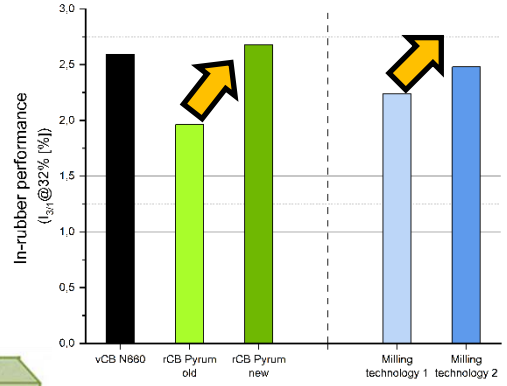
Reproducible scale down of the industrial plant



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

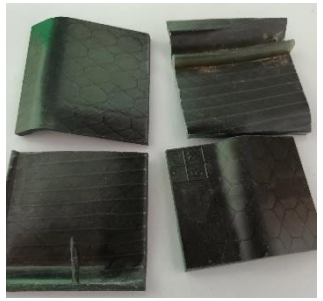
Project: **Infinity**

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

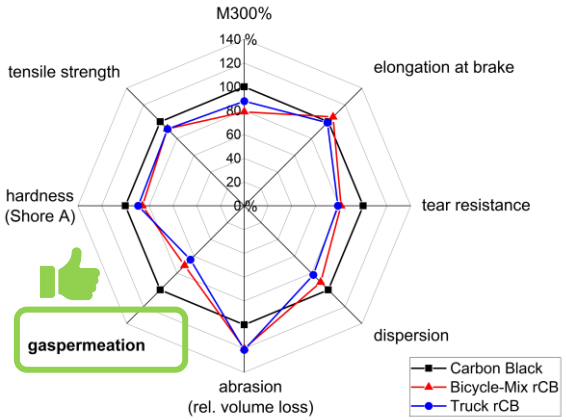
Funded by AiF Projekt GmbH

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 fossile ressources**
- ✓ **More sustainable**

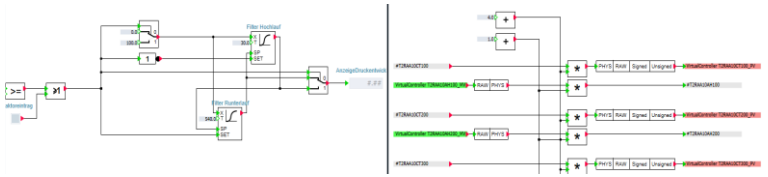
Instrumentation & Process Control Technology

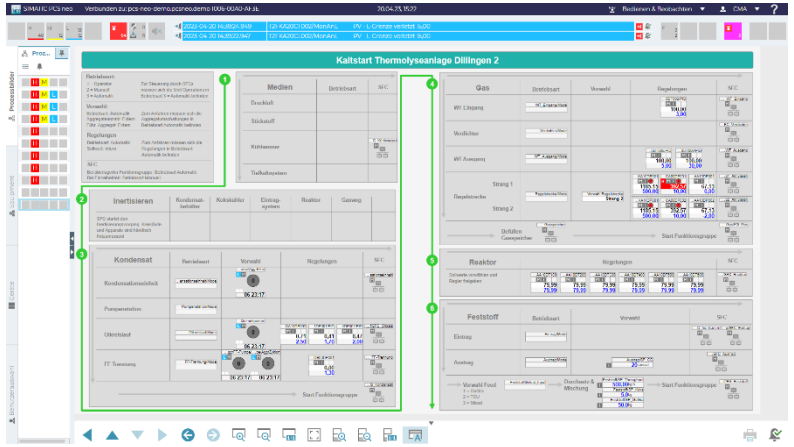
… Process Control Technology and Digitalization made by Pyrum

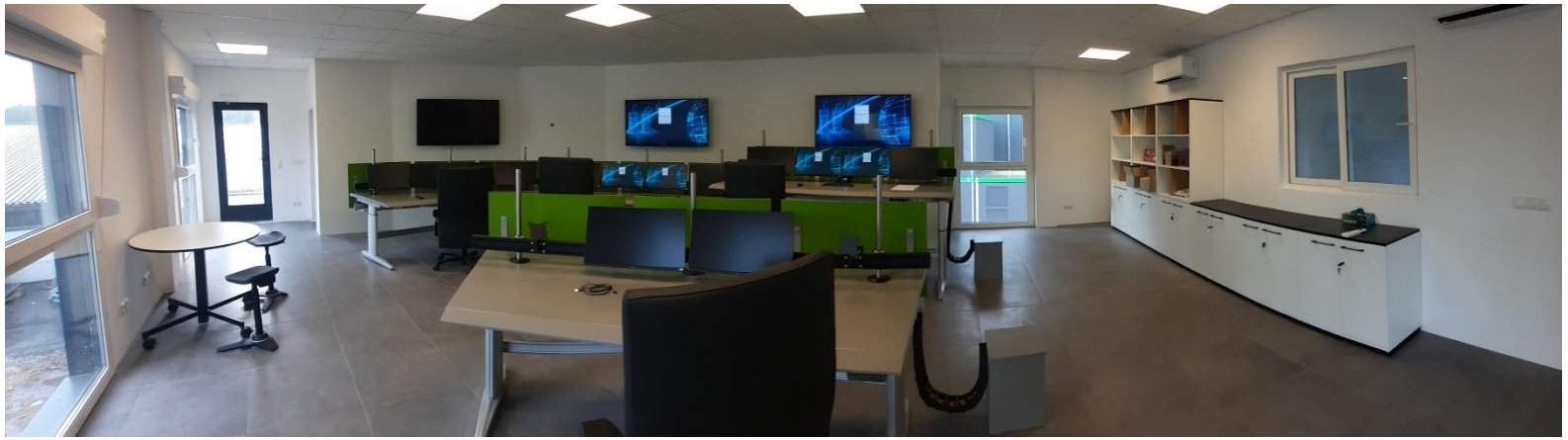
2nd half year 2022

Plant expansion TAD 2&3

- Detail Engineering Instrumentation & Control System
  - >500 Measuring Points
  - ~350 Control Loops
- Completion of HAZOP-Study
  - Consideration of over 250 cases in the field of process safety
- Expansion and commissioning of grid connection to 5.5MW
- Planning and construction of a new control room
- Development of a digital plant model for
  - Operator Training
  - Virtual comissioning
  - Reduction of commissioning time at site
  - Validation of plant and process modifications
- Software development Process Control System PCS-Neo







Thermolysis Plant Dillingen 1

- Introduction Process Measurement Calibration within the scope of the IATF-Certification

Instrumentation & Process Control Technology

… Process Control Technology and Digitalization made by Pyrum

1st half year 2023 & future outlook

Plant expansion TAD 2&3

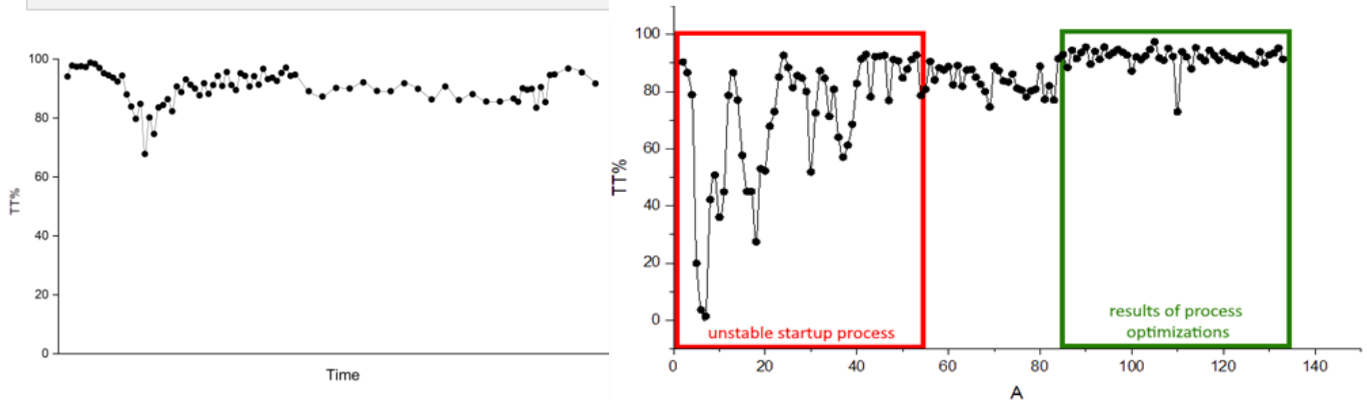
- Extension of the HAZOP-Study by a LOPA (Layer of Protection Analysis)
  - Site-independent fulfillment of all process safety requirements
  - Meeting the highest global standards
- Virtual commissioning thermolysis plant finished in February 2023
- Commissioning Thermolysis plant
  - Loop-Checks completed by 80%
  - Operational-Checks solids handling (Reactor Feed) finished
  - Start of Operational Checks in the oil and gas segments in July 2023
  - First heat up reactor and adjusting the control loops in August 2023
- Implementation of operator training based on the plant model
  - Theoretical training Thermolysis Plant
  - Practical training PCS-Neo
  - Practical training Plant Start-up/Ramp-up process
  - Practical training “Abnormal Situations & Malfunctions”
  - ➢ Already trained operator staff for commissioning & start-up
- Development of a cloud based digitization concept
  - Data collection of all plants
  - Central analysis and optimization at HQ in Dillingen

Participation in research projects

- Software Development Infinity Laboratory Plant
  - Based on Modular Type Package (MTP)

Thermolysis Plant Dillingen 1

- Process Optimization
  - Optimization of gas residence time
  - Optimization of several control loops
  - ➢ increase in process stability
  - ➢ increase of product quality (thermolysis coke) and throughput



Start of own futre research projects

- Development of level measurement technology thermolysis reactor
  - Available systems are unsuitable and not process stable
  - Development of new technology with research partners
- Development of a reactor model including kinetics
  - Optimization of process control
  - Prediction of product qualities

Human Resources

Staff expansion in the last 12 months

Important jobs were filled

- Project management
- Sales
- Accounting
- Industrial employees
- Engineers
- Research Engineers

What we do for our Staff

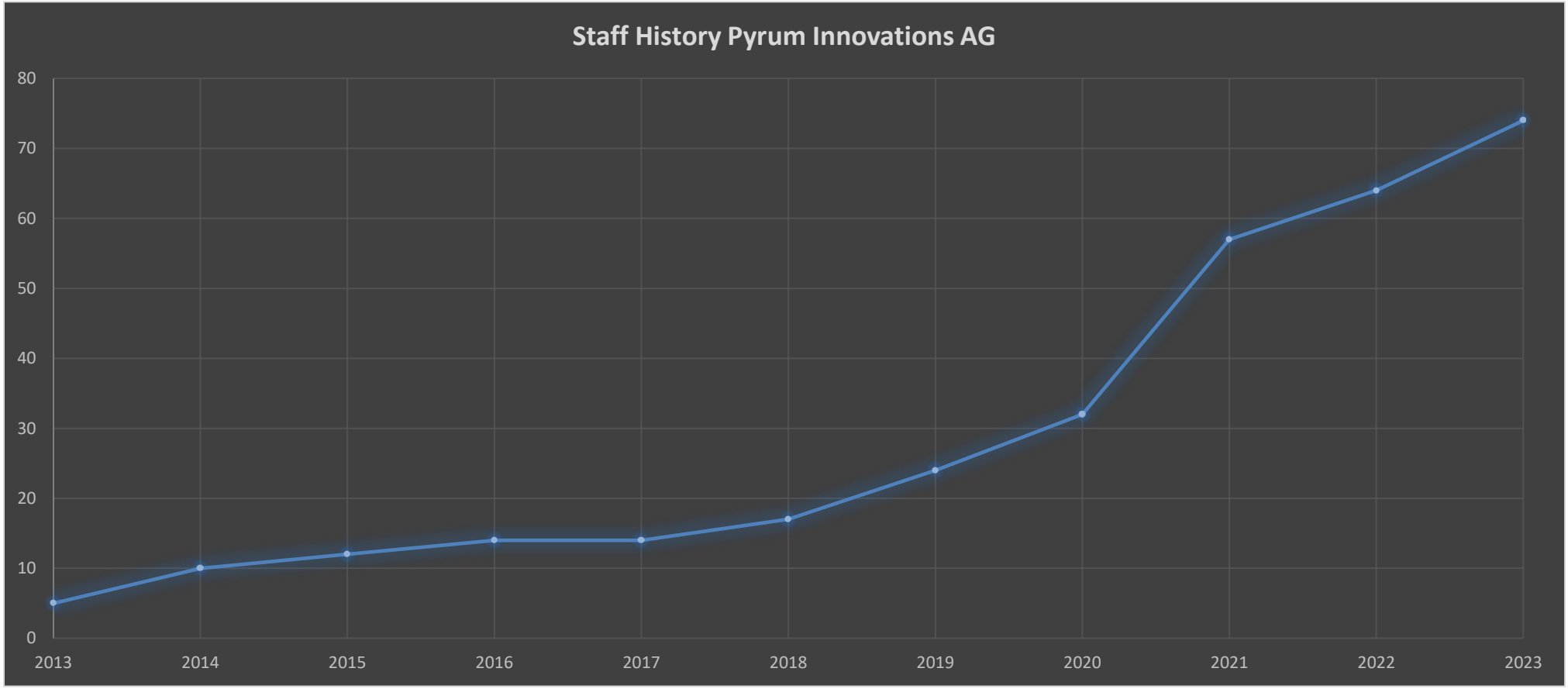
- Company pension plan supported by Pyrum
- Company health insurance
- Gym supported by the company
- “Job Rad”: Company Bicycle
- Shares for Employees
- Flexible work times

Further jobs will be created as part of the expansion

Pyrum is an employer of choice

Human Resources

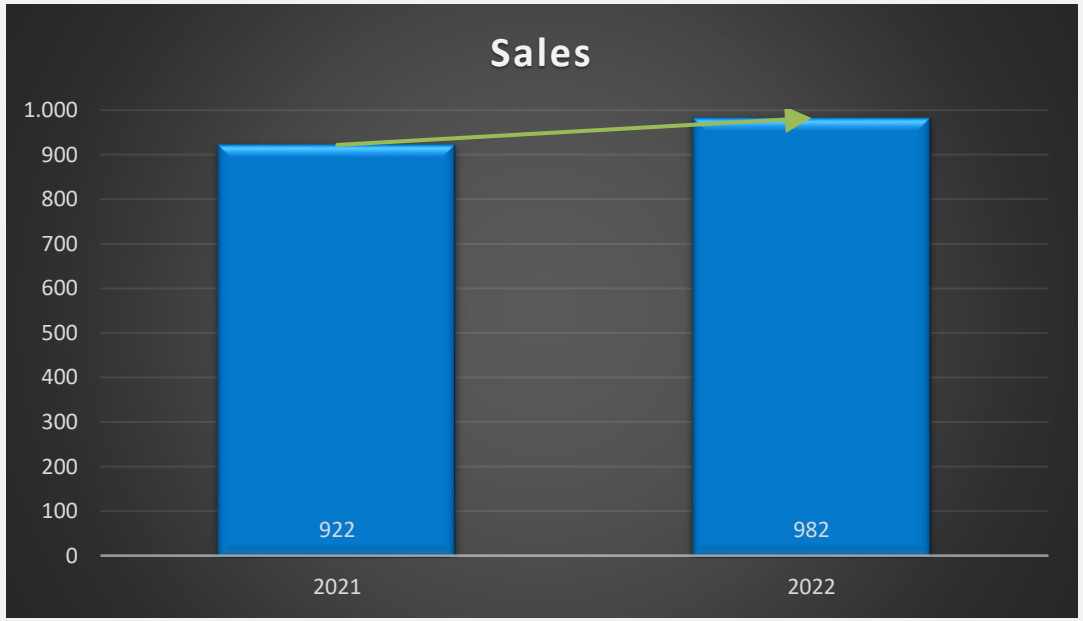
Personnel growth in the last ten years



Pyrum (Consolidated) Income Statement 2022

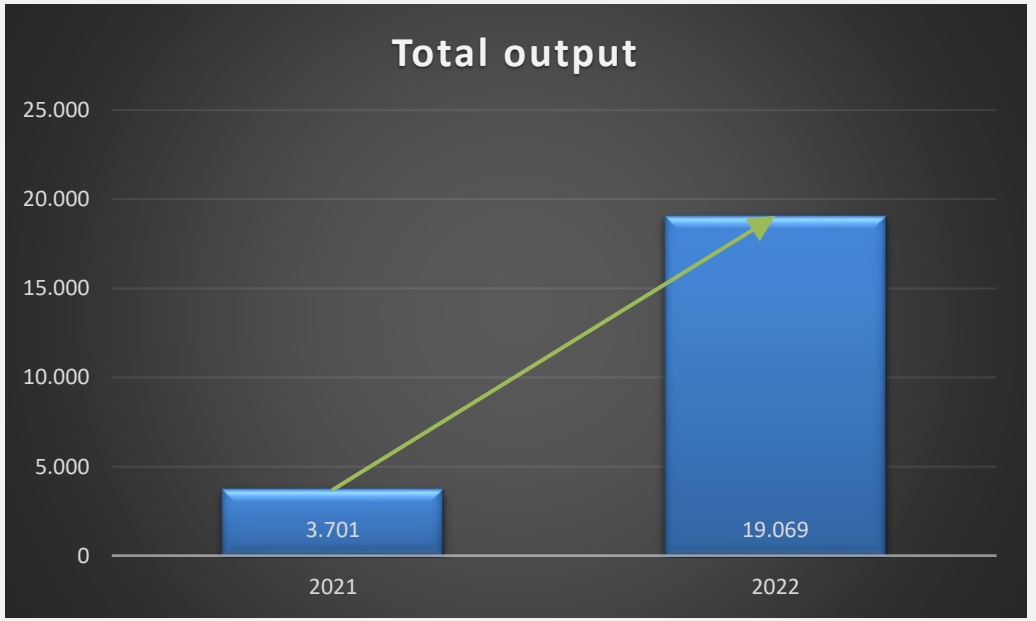
Reconciliation of sales to total output

~ 6%
Increase 2021-2022



~ 415%
Increase 2021-2022

Sales (982)
+/-
Finished/unfinished goods (277)
+
Own work capitalized (17,810)
=
Total output



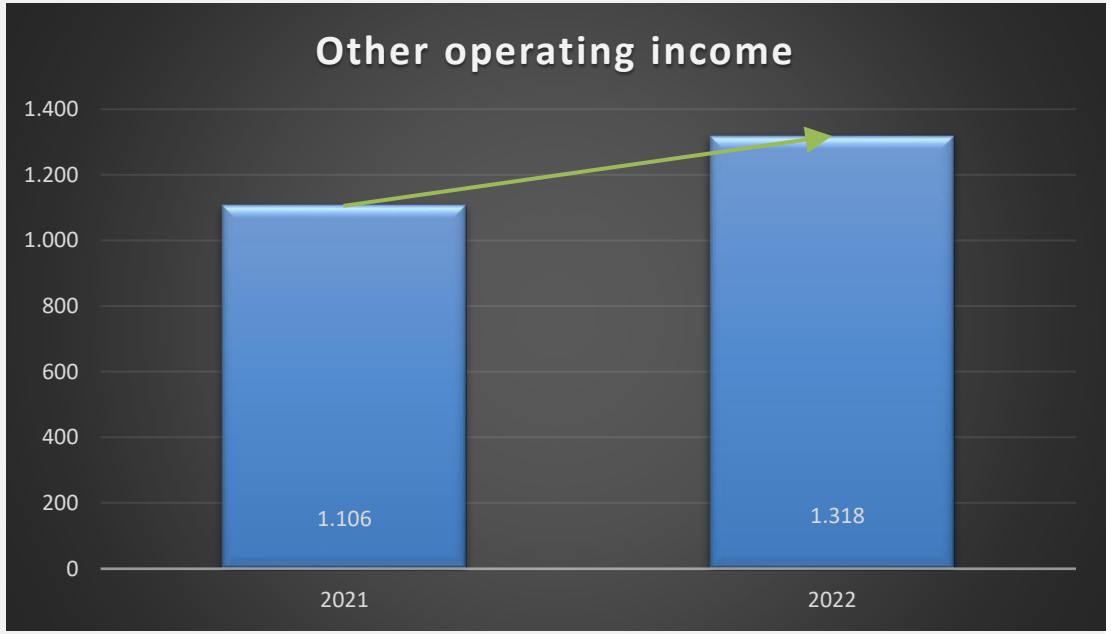
TEUR

Pyrum (Consolidated) Income Statement 2022

Reconciliation of total output to EBITDA

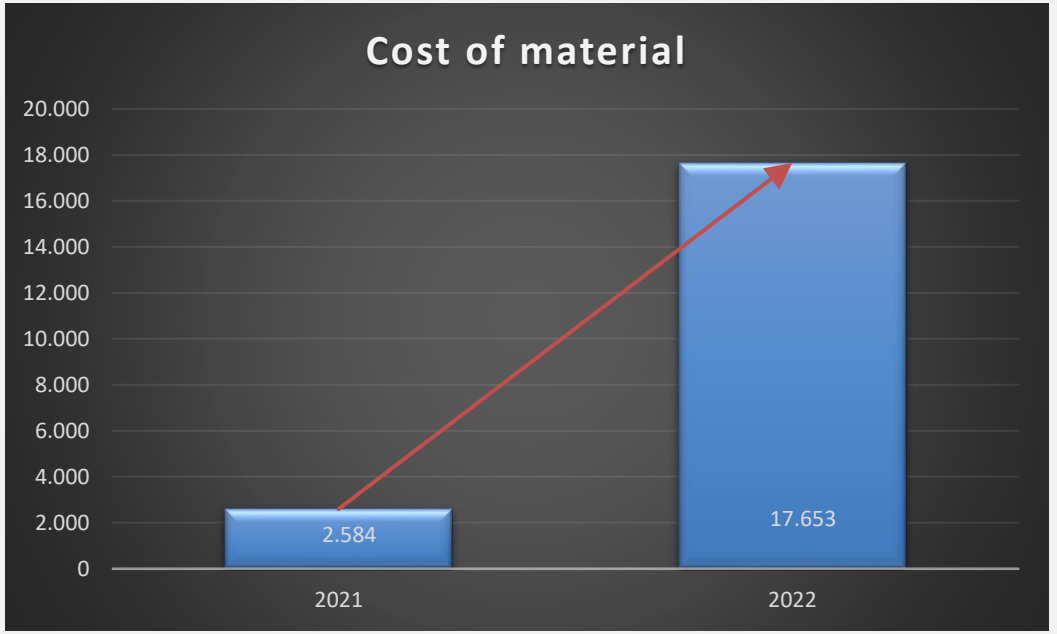
~ 19%
Increase 2021-2022

Income from R&D (993, pre year 510)



~ 583%
Increase 2021-2022

Includes TEUR 15,802 required for the preparation of the own work



TEUR

Pyrum (Consolidated) Income Statement 2022

Reconciliation of total output to EBITDA

~ 21%
Increase 2021-2022

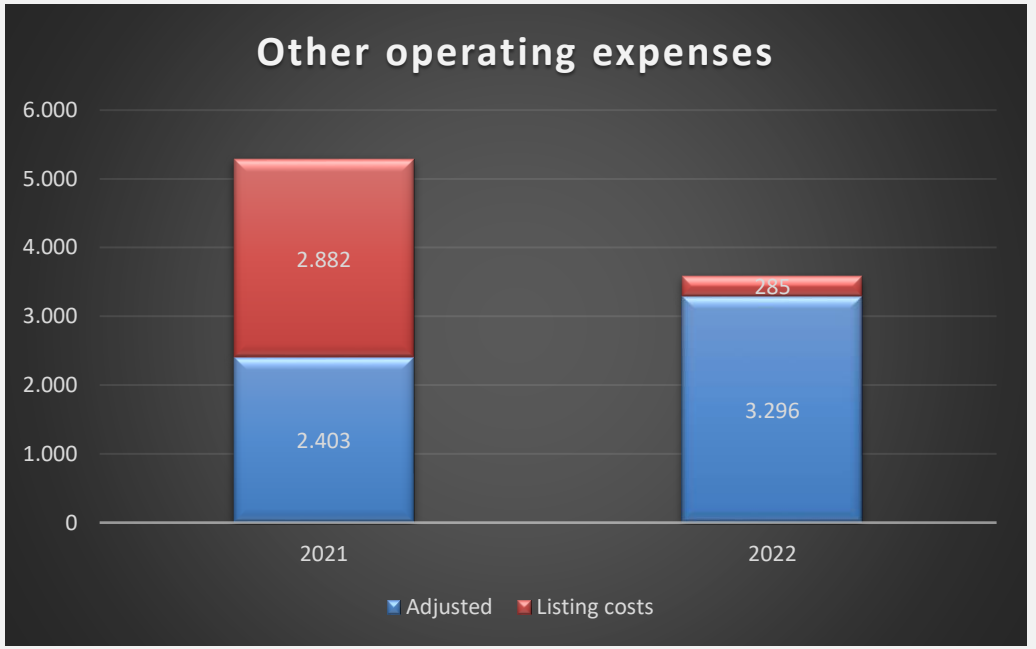
Average number of employees:

2021: 51
2022: 63

~ -32%
Decrease 2021-2022

One off expenses:

costs of listing Frankfurt (285)
pre year listing Oslo (2.882)



TEUR

Pyrum (Consolidated) Income Statement 2022

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%***

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%**	

Explanations:

- Property, plant and equipment:

  EUR 17.8 million for assets under construction alocated to plant extension in Dillingen

  EUR 2.9 million from land purchase in Dillingen

- Available liquidity:

  EUR 12.5 million

- Liabilities: (main effects)

  Increase by 2.5 million for financing land purchase by 3.0 million second tranche of BASF convertible

The Roll Out plan and particular targets

… milestones

Year by year until 2030

2024

- **Plants operating:** 1
- **Project capacity:** 3 p.a.

2025

- **Plants operating :** 3
- **Project capacity:** 5 p.a.

2026

- **Plants operating: 5**
- **Tires: ~ 100.000 to p.a.**
- **Oil: > 20.000 to p.a.**
- **rCB: ~ 35.000 to p.a.**

2027

- **Plants operating:** 7
- **Project capacity:** 6 p.a.

2028

- **Plants operating: 11**
- **Tires: ~ 200.000 to p.a.**
- **Oil: > 50.000 to p.a.**
- **rCB: ~ 75.000 to p.a.**

2029

- **Plants operating:** 15
- **Project capacity:** 7 p.a.
- **one plant per quarter**

2030

- **Plants operating: 17+**
- **Tires: ~ 350.000 to p.a.**
- **Oil ~ 100.000 to p.a.**
- **rCB > ~ 150.000 to pa.**

Main Numbers:

• Value BASF Oil Offtake Agreement at full load:	40 Mio. EUR/Year
• Mid Term Goal to build per Year:	4 units (1/5 Pyrum Owned)
• Profit depending on share in SPVs:	25-49 percent target

Not yet included:

- **Profits from new technologies under development like CFRP Recyling (published 05.2023)**