



VOC Emission Standards and Turpentine Oil Production (Creating additional profit with amortization well under 2 years)

Surfaces Eurasia
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CLASSEN Group

Floors For A Better Tomorrow.

www.classengroup.com

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Fiberboard GmbH, Classen Group
Baruth, Germany

CLASSEN Facts



CLASSEN Facts

- Established 1962; Producer since **1994**
- CLASSEN is one of the **500 largest family-owned companies** in Germany.
 - At present, the first, second and third generation is active
- **550 Mio. € Turnover, approx. 2.000 Employees**
- Production and distribution of laminate and polymer-based flooring
- CLASSEN is one of the innovation leaders in the industry and owns an extensive patent portfolio, especially in the field of surface and installation technology.



Locations



Other sales locations:

| | |
|-----------------------|----------------------|
| Latin America | Miami (Florida), USA |
| North America | Vancouver, Canada |
| Eastern Europe | Rybnik, Poland |
| | Kiew, Ukraine |
| | Gagarin, Russia |
| Western Europe | Izegem, Belgium |
| Middle East | Istanbul, Turkey |
| Far East | Beijing, RP China |

CLASSEN Headquarter



| | |
|-------------|---------------------------|
| Location: | Kaisersesch |
| Production: | Polymer based flooring |
| Opening: | 1994 |
| Employees: | 500 |
| Capacity: | 10 Mio. m ² /a |
| Hall space: | 82.000 m ² |

CLASSEN Industries / Fiberboard



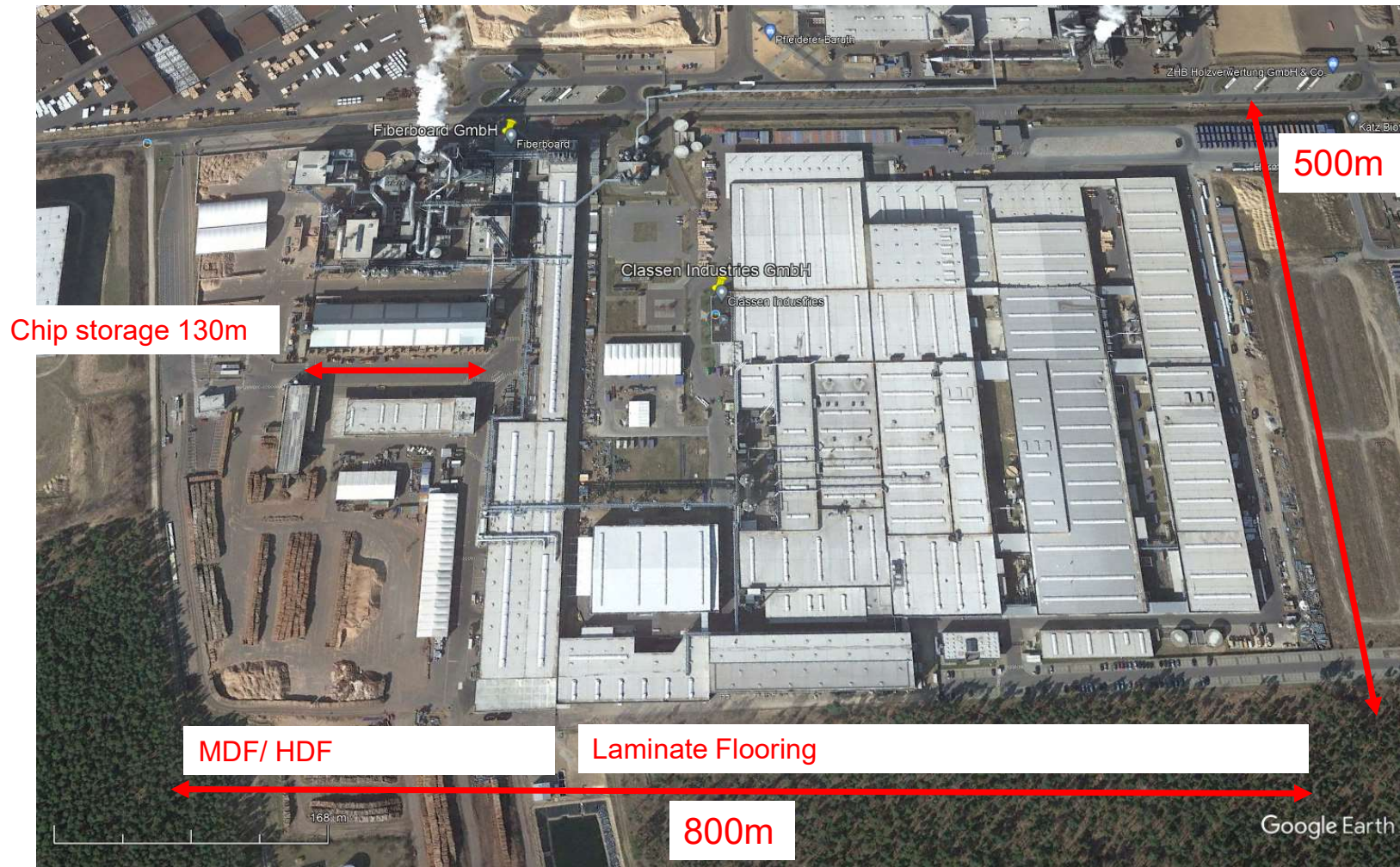
| | |
|-------------|--------------------------------|
| Location: | Baruth |
| Production: | Laminate flooring & HDF-Boards |
| Opening: | 2001 / 2007 |
| Employees: | 830 |
| Capacity: | 80 Mio. m ² /a |
| Hall space: | 113.000 m ² |

CLASSEN-Pol



| | |
|-------------|-----------------------------------------------|
| Location: | Rybnik / Kattowitz |
| Production: | Interior doors, mouldings & frames |
| Opening: | 1990 |
| Employees: | 655 |
| Capacity: | 600.000 Stk./a Doors 580.000 Stk./a Frames |
| Hall space: | 20.000 m ² |

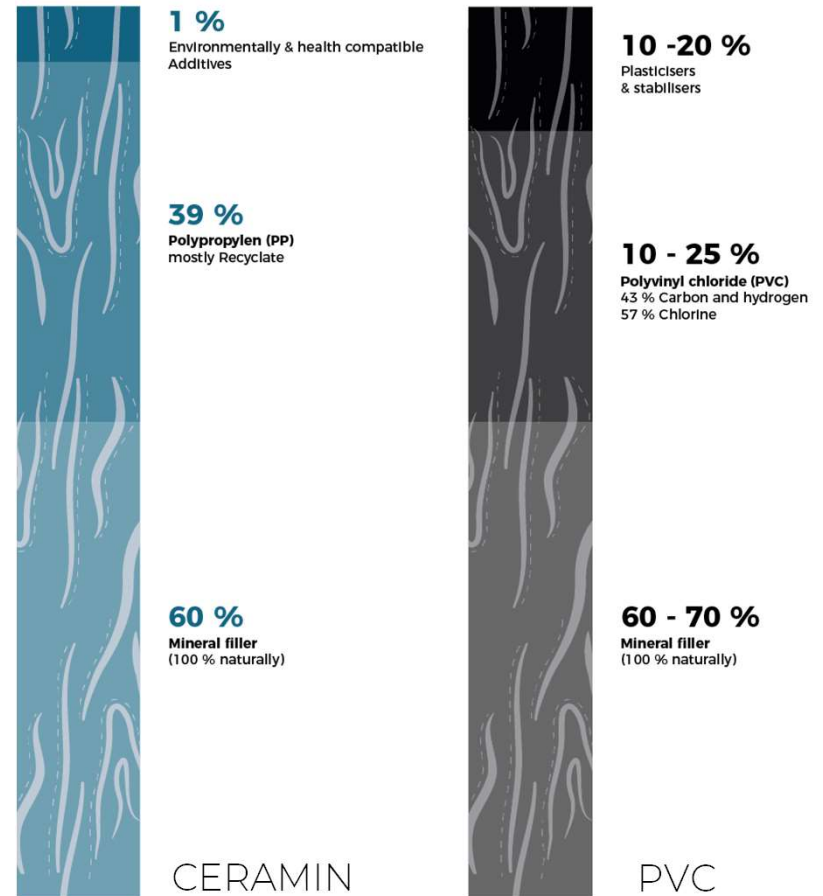
Baruth: integrated MDF/ HDF production facility



- Fully integrated: from tree to laminate flooring
- Capacity MDF: 500.000 m³
- Capacity Laminate: 80 million m², of which 25 million m² digital printing
- State-of-the-art logistics concept
- € 550 million total investment

CERAMINE vs. PVC - here's how the components differ

- CERAMIN is odourless and does not contain any substances that can evaporate and are harmful to health.
 - One quarter consists of already recycled PP material.
- In the case of PVC, harmful plasticisers and chlorine can be emitted over many years.



Kaisersesch: Polymer-based flooring

Wear layer with
Soft-touch surface

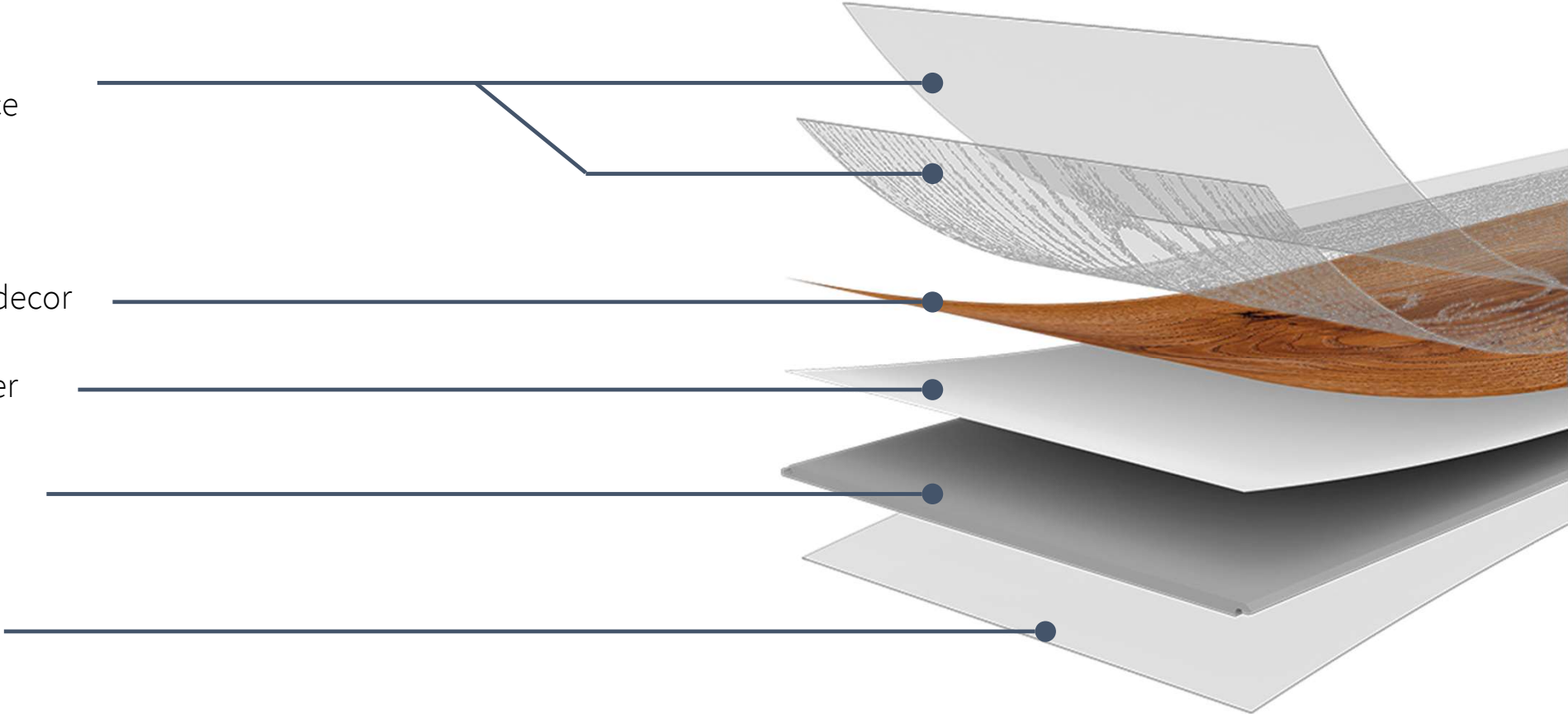
Digitally printed decor

White primer layer

CERAMIN Board

Stabilising
protective layer

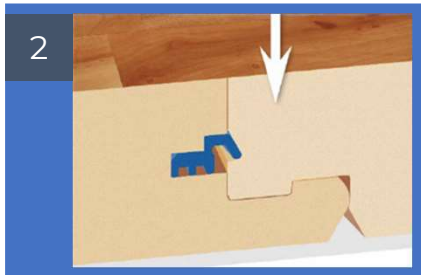
(+ optional impact sound)



Numerous innovations and patents

megaloc

CLASSEN megaloc as a worldwide patented quick laying system with high safety comfort



LLT

CLASSEN's patented Liquid Laminate Technology

The HDF core board is bonded with untreated decor paper and backing. The impregnation takes place in a continuous processing process by **liquid** application. Finally, the structure is created under heat and high pressure.

Advantages :

- Energy-saving production Highly transparent surfaces
- Realistic decor designs
- Individually developed gloss levels
- Optimum look and feel of the laminate surface
- Logistical advantages

Industrial digital printing

Conventional :

Analogue printed papers are purchased from external service providers and glued (laminated) to the board

- High minimum purchase
- Little flexibility
- High storage costs

Digital printing

- Exclusive designs with smaller batch sizes
- Own decor development (design centre)
- High-quality surfaces with synchronous pores become even more precise
- **Baruth prints 25 % digital**
- **Kaisersesch prints 100 % digitally**

...

New technology: essential oil from pine trees (wood oil/ turpentine)

...

MDF-Turpentine

Conventional:

Essential oils are released to the atmosphere with dryer off gases

New:

Production and sale of essential oil

- 1200 t/year = one tank truck per week
- Additional profit generation of € 3 ... € 8 / m³ MDF
- Energy neutral
- Amortization well under two years

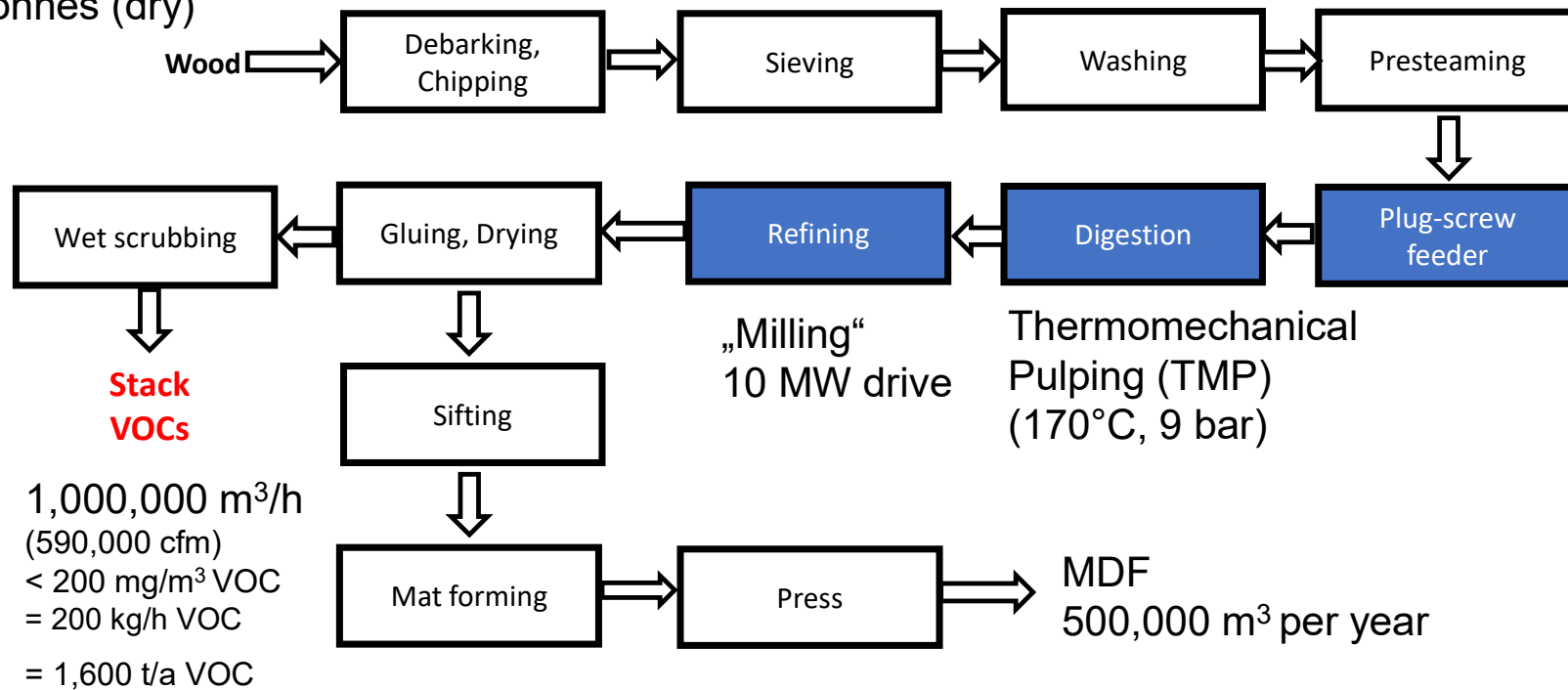
Fiberboard in Baruth/Mark



VOC: Volatile Organic Components

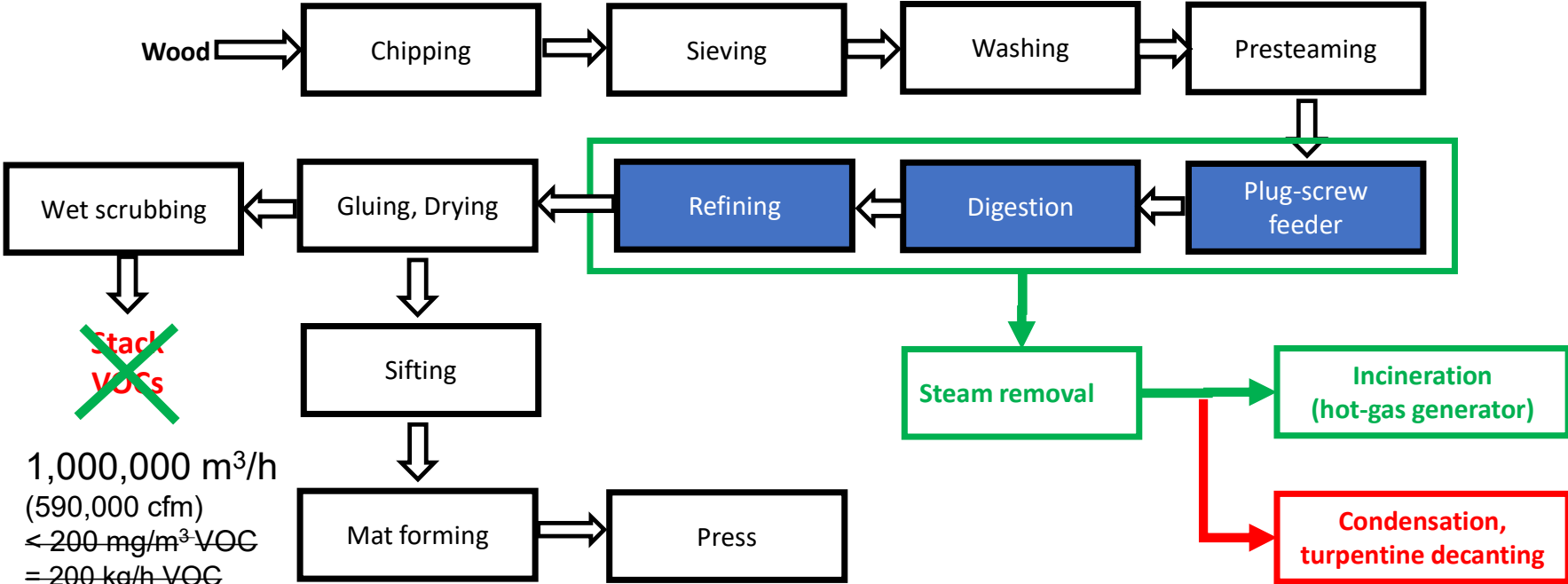
MDF Process

400,000 tonnes (dry)
per year



MDF-process

with VOC reduction
with turpentine production

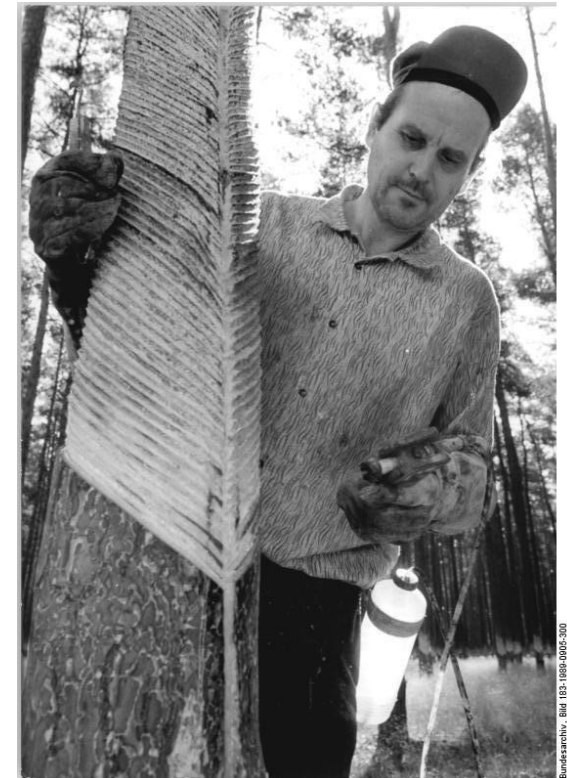


~~Stack VOCs~~
1,000,000 m³/h
(590,000 cfm)
< 200 mg/m³ VOC
= 200 kg/h VOC
= 1,600 t/a VOC
< 50 mg/m³ VOC
< 50 kg/h

150 kg/h
1,200 t/a

Terpenes – only the smell of resin and forest?

- **resin** = sticky liquid from **softwood** like pine, larch and to some extent spruce
- **resin** = resin acids (rosin, „amber“) + **terpenes**
- **terpenes** = **essential oils**
(α -Pinen, β -Pinen, Δ -3-Caren, **Limonene**, ...)
- Composition and amount depends on pine species
- Mixture of terpenes is called turpentine („genuine turpentine“)
- Smell like freshly cut wood or **perfume?**



Terpenes – only the smell of resin and forest? **No and Yes!**

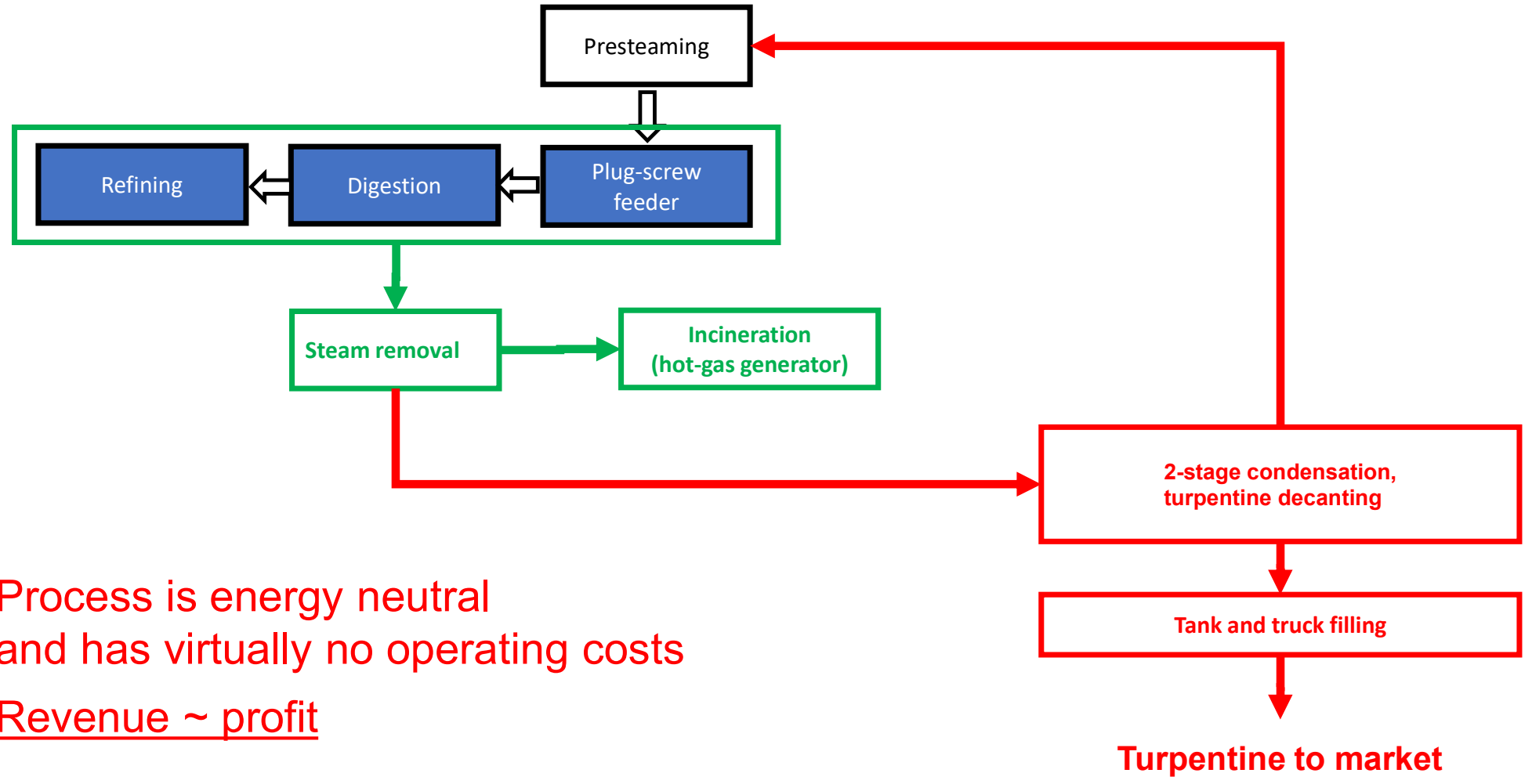
No!

- Terpenes = most important group of **VOC** that form **photooxidants**
- NO_x (car exhaust gases) + VOC + oxygen = photooxidants (ozone)

Yes!

- Terpenes are a valuable and **sought after chemical**
- Market value creates **profit of 3 – 8 € / m³ MDF**

Turpentine production with 2-stage condensation = energy neutral

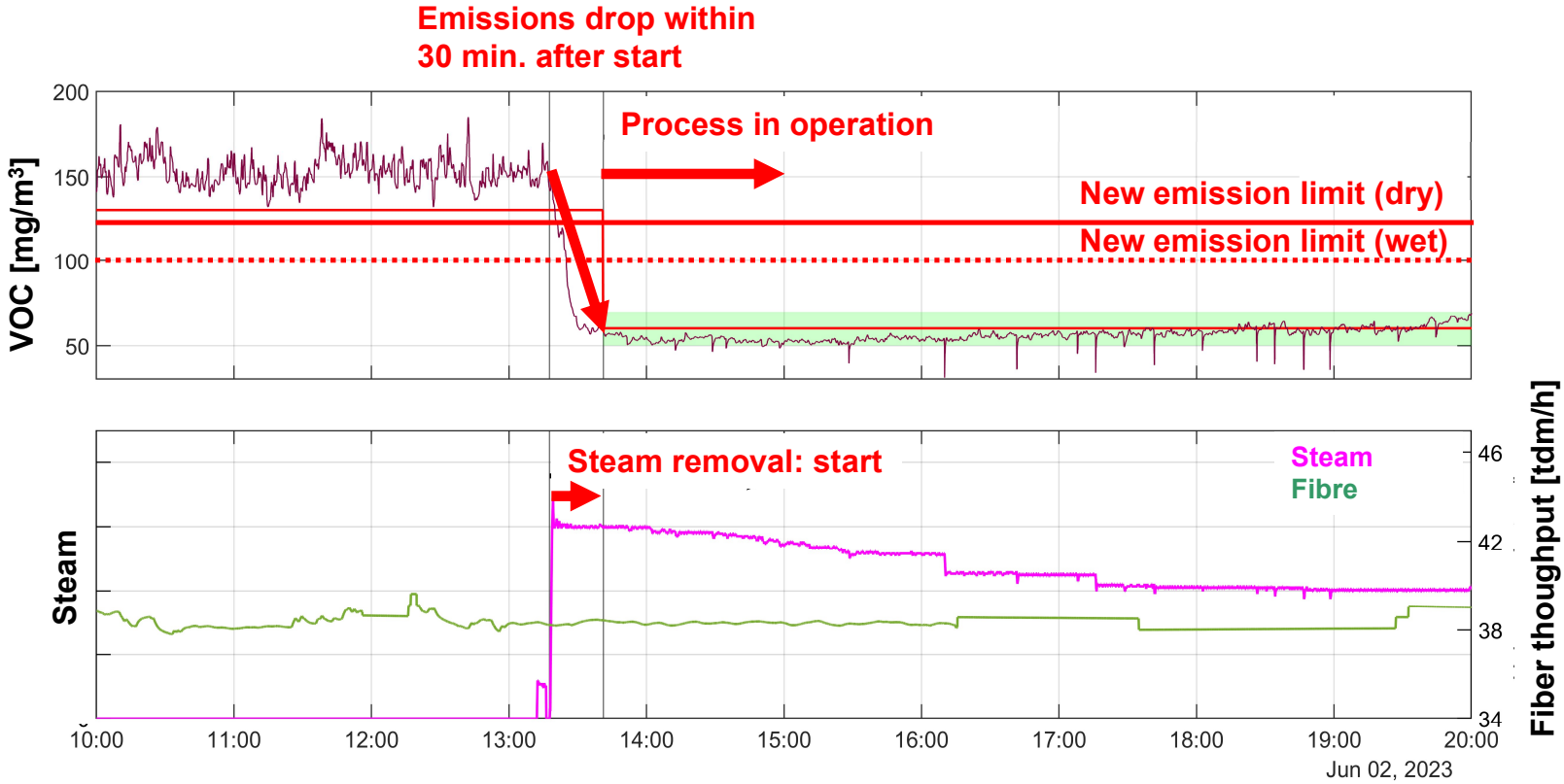


- Process is energy neutral and has virtually no operating costs
- Revenue ~ profit

Benefits

- 1) Compliance with **EU environmental legislation on VOCs**
 - ✓ EU-BAT: 120 mg/m³ (dry) ~ 100 mg/m³ (wet, old basis)
- 2) Reduction of *operating costs* by replacing **Regenerative Thermal Oxidization (RTO, USA)** **Savings of € 10 / m³ MDF**
- 3) **Additional profit** generation by terpene production (turpentine) **€ 3...8/m³ MDF**
- 4) **No influence on product performance**
- 5) **Low investment costs, almost no operating costs**
- 6) Application for OSB, Particle Board: development under way
- 7) **Reduction of indoor emissions of boards**

1) Compliance with EU legislation

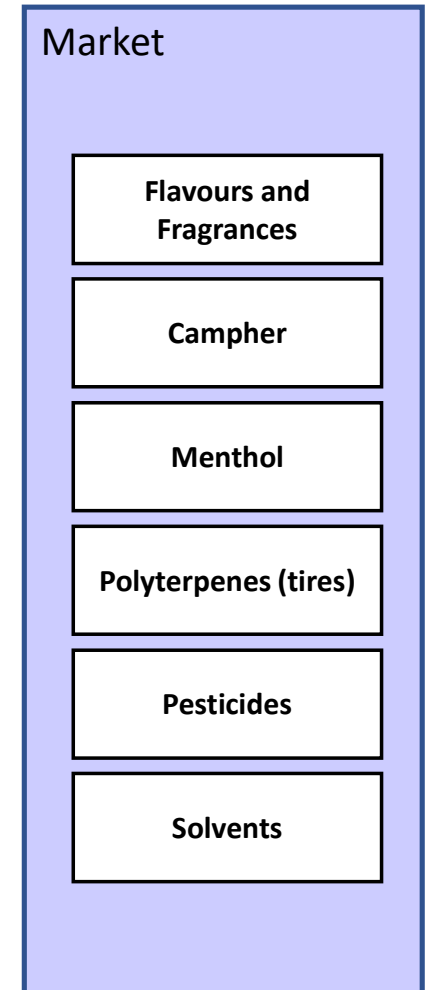


↓ Turpentine production

- ✓ Reliable attainment of emission limits
- ✓ Proven in industrial operation

3) Revenue from Turpentine Production

- ✓ Turpentine = essential oil from pines
- ✓ Price depends on composition (α -pinene, β -pinene content)
- ✓ Turpentine is a sought after renewable raw material:
 - Flavour and fragrance industry
 - Chemical industry: tires, adhesives, ink
 - Sustainable Aviation Fuel (SAF)
- ✓ **Turpentine recovery system (MDF-T) in Baruth will come onstream in 2025 to give 1200 tonnes per year of turpentine (= more than one tank truck per week)**
- ✓ **Amortization time well under 2 years**
- ✓ **Profit: € 3...8/m³ MDF**



System installation



Steam removal



Pipe to hot-gas generator



Combustion-chamber inlet

Business case examples: MDF Turpentine from 6 locations

- For purposes of illustration only
- A price* was calculated from the ($\alpha+\beta$ pinene) content based on
 - 14 year average price index for Brazilian Gum Turpentine
 - Source: Comexstat, Brazilian foreign trade statistics
 - BT = \$ 2300/ ton (€ 2150/ton)
 - Price = ($\alpha+\beta$ pinene) content * BT
 - Further information: https://prof.bht-berlin.de/fileadmin/labor/mvt/SHK/PCA_Bungert_MDF-T_2023-09-19.pdf
- Business cases:

| | |
|---------------------------|-----------------------------------------------------------------------------------------|
| 1) Baruth Germany | (500,000 m ³ /a; Pinus Sylvestris) |
| 2) Brasil | (600,000 m ³ /a; Pinus Eliottii) |
| 3) USA | (300,000 m ³ /a; Pinus Eliottii) (300,000 m ³ /a; Pinus Taeda) |
| 4) Australia, New Zealand | (300,000 m ³ /a; Pinus Radiata) |
| 5) Portugal, Spain | (300,000 m ³ /a; Pinus Pinaster) |
| 6) Turkey | (880,000 m ³ /a; Pinus Sylvestris) |

* No business information, only meant to assess an order of magnitude

Comparison of 6 business cases

| Nr. | Site | pine | MDF m ³ /a | Wood t/a | Turpentine kg/t | Turpentine t/a | (a+b)/ (a+b) e | Turpentine €/t * | Estimated* Revenue [€] | €/m ³ MDF |
|-----|--------------------|---------------------|--------------------------|-------------|--------------------|-------------------|-------------------|---------------------|---------------------------|----------------------|
| 1 | Baruth, Germany | pinus sylvestris | 500.000 | 400.000 | 3 | 1.200 | 0,55 | 1.183 | 1.419.000 | 2,8 |
| 2 | Brasil | pinus elliottii | 600.000 | 480.000 | 4,6 | 2.208 | 1,00 | 2.150 | 4.747.200 | 7,9 |
| 3 | USA | pinus elliottii | 300.000 | 240.000 | 4,6 | 1.104 | 1 | 2.150 | 2.373.600 | 7,9 |
| | | pinus taeda | 300.000 | 240.000 | 3,2 | 768 | 1,02 | 2.193 | 1.684.224 | 5,6 |
| 4 | Aus, NZ | pinus radiata | 300.000 | 240.000 | 1,7 | 408 | 1,09 | 2.344 | 956.148 | 3,2 |
| 5 | Spain, Portugal | pinus pinaster | 300.000 | 240.000 | 4 | 960 | 1,02 | 2.193 | 2.105.280 | 7,0 |
| 6 | Turkey | pinus sylvestris | 880.000 | 704.000 | 3,5 | 2.464 | 0,68 | 1.462 | 3.602.368 | 4,1 |

- All cases are interesting for the MDF industry to start turpentine recovery

* No business information, only meant to assess an order of magnitude

European Green Deal. Sustainability. New Products?



INCITE



Innovation Centre for Industrial Transformation and Emissions

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European Innovation Centre for Industrial Transformation and Emissions

INCITE promotes the uptake of innovative technologies to achieve decarbonisation, depollution, increased resource efficiency and circular economy in large industrial plants.

- New Technology follows the requirements of the EU Green Deal
- New Technology will be listed at INCITE
- The Classen MDF-Turpentine process is a **truly new and sustainable product**

Summary

- 1) New process reduces emissions dramatically:
 - VOC emissions from dryer
 - Indoor emissions from board (MDF, OSB, Particle Board)
- 2) Profit generation of € 3 – 8 / m³ of MDF
- 3) No influence on product performance
- 4) Low investment costs, almost no operating costs
= amortisation well under 2 years
- 5) Classen will be happy to install the new technology at your plant

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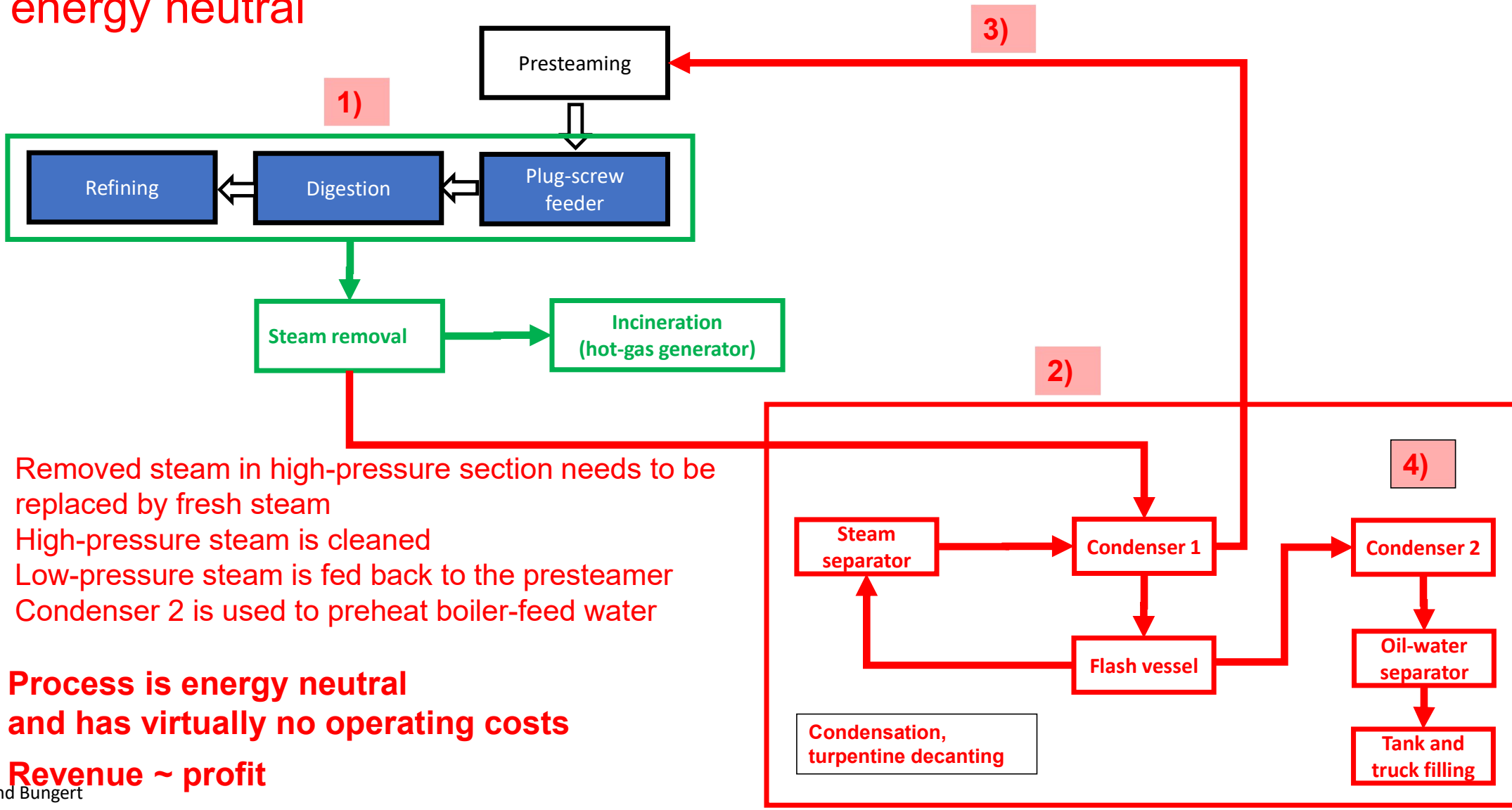
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Turpentine production with 2-stage condensation = energy neutral



- 1) Removed steam in high-pressure section needs to be replaced by fresh steam
- 2) High-pressure steam is cleaned
- 3) Low-pressure steam is fed back to the presteamer
- 4) Condenser 2 is used to preheat boiler-feed water

• **Process is energy neutral and has virtually no operating costs**

• **Revenue ~ profit**