HF MIXING GROUP

Environmental Report

2021 – 2023

Ansonia, USA | Dubnica, Slovakia | Freudenberg, Germany
Rescaldina, Italy | Rochdale, UK

Environmental Report 2021-2023

Foreword:

The Corporate Sustainability Reporting Directive (CSRD), which has been resolved by the European Union in 2022, obliges successively more companies to report detailed about their approaches and solutions to reduce their negative impacts on climate change as its consequences are already becoming progressively more visible and will even accumulate in the upcoming years.

As HF Mixing Group is a company highly aware of its responsibilities, we have started many years ago to scrutinise and improve several company processes in the sense of ensuring a reduction of our ecological foot-print through several projects across all of our entities. Thus, over the past years, we have continuously searched for ways to adapt to the 17 goals of sustainability, which have been implemented by the United Nations in 2015.

This report shall give an overview of some of the major projects the HF Mixing Group has started during the period of 2021 – 2023 which are environmentally friendly, energy efficient or improve general safety, for employees or other interested parties – thus such projects which will support at least one of the Sustainable Development Goals – which are described on the next page.

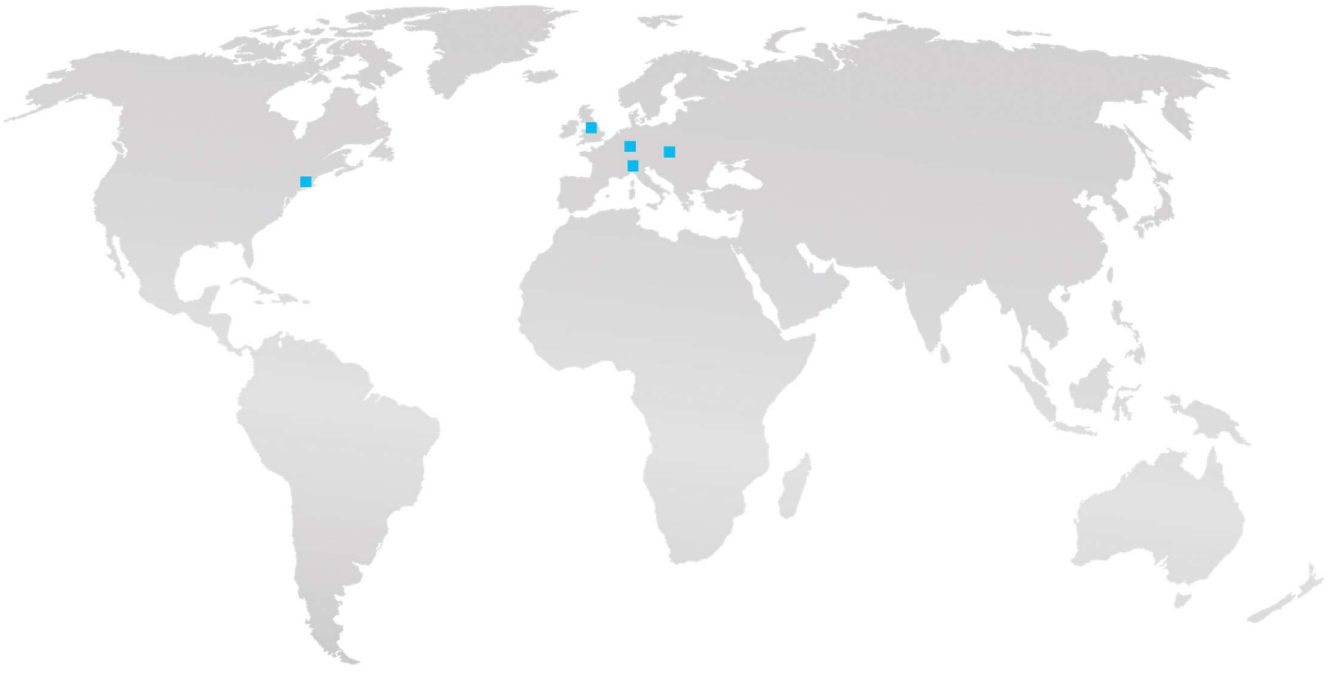


Figure 1: Main Entities: Ansonia, USA | Rochdale, UK | Freudenberg, Germany | Rescaldina, Italy | Dubnica, Slovakia

Sustainable Development Goals:

1. **No poverty:** End poverty in all its forms everywhere.
2. **Zero hunger:** End hunger, achieve food security and improved nutrition and promote sustainable agriculture.
3. **Good health and well-being:** Ensure healthy lives and promote well-being for all at all ages.
4. **Quality education:** Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.
5. **Gender equality:** Achieve gender equality and empower all women and girls.
6. **Clean water and sanitation:** Achieve availability and sustainable management of water and sanitation for all.
7. **Affordable and clean energy:** Ensure access to affordable, reliable, sustainable and modern energy for all.
8. **Decent work and economic growth:** Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.
9. **Industry, innovation and infrastructure:** Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.
10. **Reduced inequalities:** Reduce inequality within and among countries.
11. **Sustainable cities and communities:** Make cities and human settlements inclusive, safe, resilient and sustainable.
12. **Responsible consumption and production:** Ensure sustainable consumption and production patterns.
13. **Climate action:** Take urgent action to combat climate change and its impacts.
14. **Life below water:** Conserve and sustainably use the oceans, seas and marine resources for sustainable development.
15. **Life on land:** Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.
16. **Peace and justice strong institutions:** Promote peaceful and inclusive societies for sustainable development, provide access for justice for all and build effective, accountable and inclusive institutions at all levels.
17. **Partnerships for the goals:** Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development.

Figure 2: The sustainable development goals of the United Nations Organisation

Project Overview:

1. Photovoltaic Systems
[SK, USA]

General benefits:

- Photovoltaic energy is produced without causing emissions
- Photovoltaic enables an independent energy supply
- Photovoltaic energy is produced silently

Figure 3: Photovoltaic System in Dubnica [SK]

In our entity in Dubnica, Slovakia, we were able to generate over **250.000 kWh** of solar energy in the year of installation in **2022** which equals planting over 2.900 trees. In **2023**, the self-generated power rose to over **550.000 kWh** which equals planting nearly 6.400 trees.

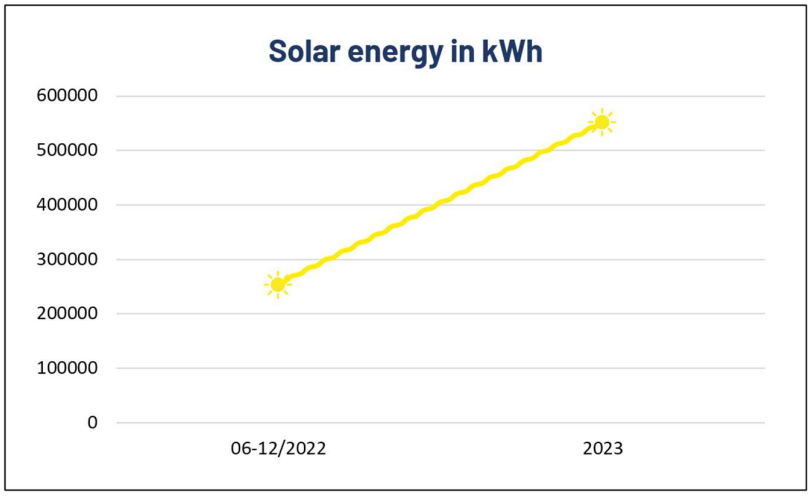


Figure 4: Solar energy production beginning June 2022 [SK]

In Ansonia, in the US, a photovoltaic system with **1.056 individual 370-watt solar panels** has been installed which put out nearly **450.000 kWh in 2021** which equal the planting of about 5,200 trees, over **460.000 kWh in 2022** which equal about planting 5,300 trees and over **412.000 kWh in 2023** which equals planting about 4.750 trees.

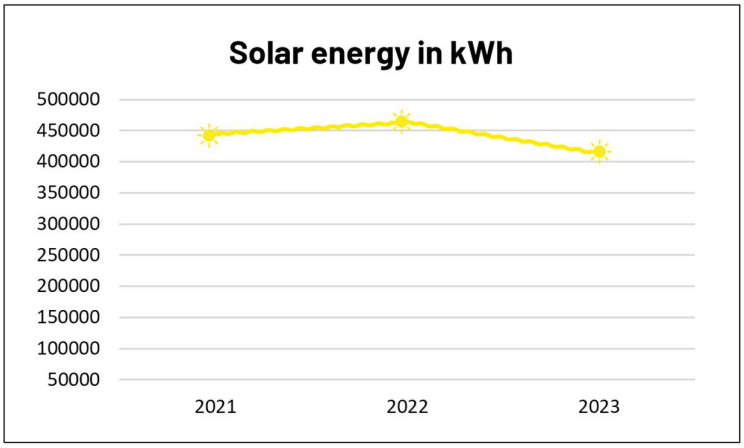


Figure 5: Solar energy production beginning January 2021 [USA]

Figure 6: Photovoltaic System in Ansonia [USA]

2. Electric Charging Stations for E-Cars
[UK, GER]

6 charging stations are currently installed in Freudenberg. With the count from the beginning of June 2022, the six installed charging stations already spent **9.436 kWh**, which can be translated into 4.966 kg of CO_2 emissions if you assume an average car consumption. If you compare this number to the emissions produced from an average non-electrical car, we have been able to save nearly **8.900 kg** of CO_2 emissions.

Additional charging stations, which will provide even more energy, are planned to be installed in the car park in Freudenberg 2024.
Also, the entities in Slovakia and USA have the intention to install several charging stations in the near future.

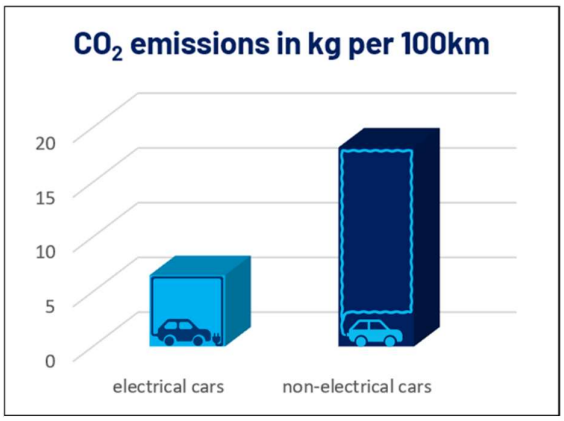


Figure 7: Comparison of average CO_2 emissions for electrical and non-electrical cars

Figure 8: E-Charging stations for visitors in Freudenberg [GER]

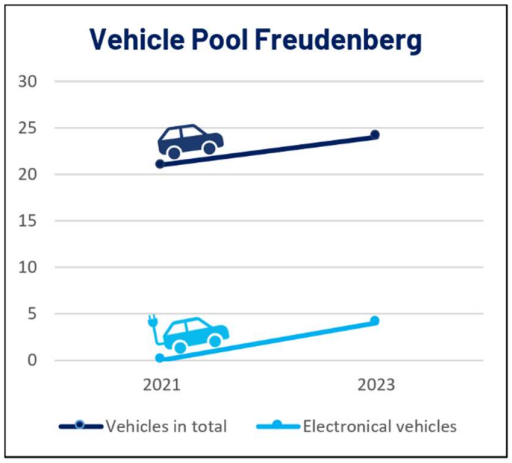


Figure 9: Number of company cars [GER]

Figure 10: Electric Charging Stations in Rochdale [UK]

Figure 11: Charging Station in operation [UK]

Electric Charging Stations in Rochdale

In Rochdale, there are about 10 cars from the workforce, which are currently using the charging stations with the numbers expected to rise in the future. The high amount of charging stations not only allows the employees to charge their cars, but also the customers are welcome to use the systems.

3. Switch to LED lighting

[SK, UK, USA, GER]

Due to the progress within the lighting industry, non-LED lighting has become very inefficient which is why we mostly installed LED lighting in the production areas in our entities in England, Germany, Slovakia and the United States. The benefits of this form of lighting are profound. The lamps last longer (up to 50.000 hours) which makes them the most efficient way to produce good lighting. Also, employee´s safety is improved as the risks of burns are lower because the lamps only become hand-warm and as the LED´s consume lower amounts of energy and are recyclable, the CO_2-emissions are being reduced as well.

Figure 10: LED Lighting in Assembly Area in Ansonia [USA]

4. Installation of water dispensers in Rescaldina and Freudenberg
[IT, GER]

In 2022, two water dispensers had been installed in our entity in Rescaldina, Italy, with steel thermal bottles being distributed to the employees. In Freudenberg, water dispensers had been installed in the new building with glass bottles being provided near the dispensers which can be reused after cleaning.

Ultra-filtered, sterilised and bacteriologically pure, natural, carbonated, cold and hot water is thus provided for all employees. Regular maintaining and sanitising guarantee a high level of health and hygiene safety. These projects help in the matter of healthy and satisfied employees and with a view to environmental sustainability, the disposal of plastic bottles is being reduced as well (as can be seen by looking at the figure below).

Figure 11: Steel bottles for employees in Rescaldina [IT]

Figure 12: Water dispenser in Freudenberg [GER]

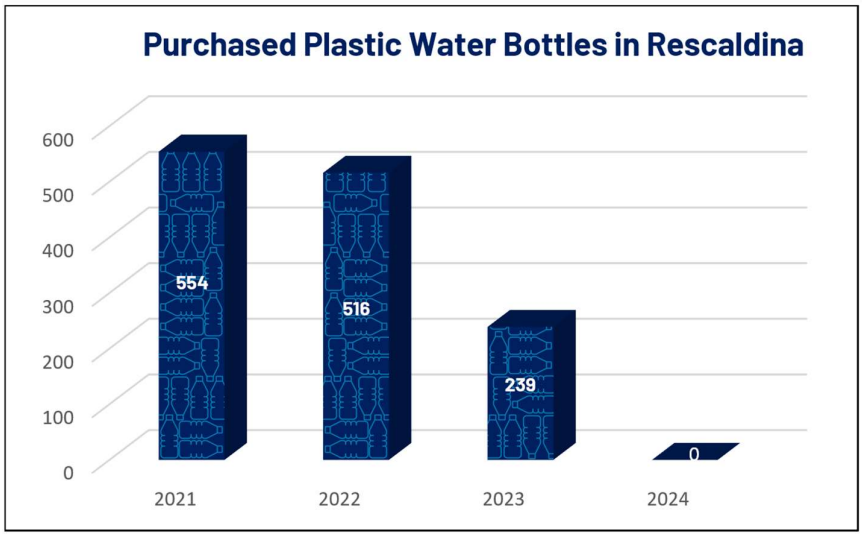


Figure 13: Plastic water bottles purchased by the company from 2021 to 2024 [IT]

5. Heating System Change in Welding in Freudenberg [GER]

General advantages:

- reducing CO_2 emissions
- reducing energy costs

Figure 15: Old Oven in Freudenberg [GER]

The gas oven in the Welding Area has been exchanged with an electric driven oven in September 2023. Through this change, we are able to improve our energy efficiency a lot, as the CO_2-emissions that has been produced by the gas oven will be cut off. The target is to produce **zero CO_2-emissions** through the new oven in our Welding Department, as we are using renewable energy for our electricity supply.

Average **CO_2 emissions per year** through the use if the **gas** oven between 2020 and 2022**:** 27 tons

➔ **Target: save 27 tons of CO2 per year!**

Figure 15: New Oven in Freudenberg [GER]

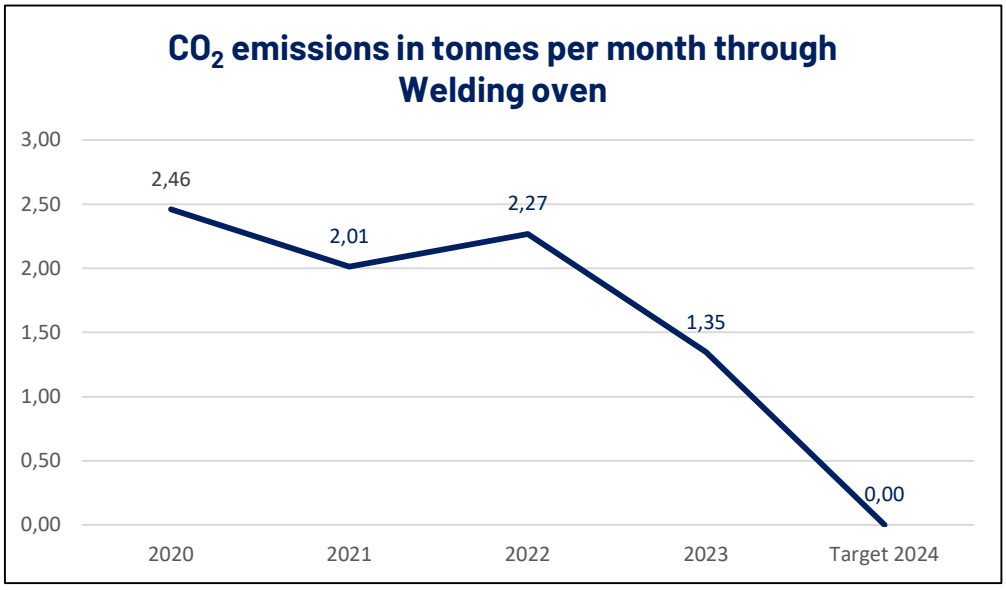


Figure 16: Tonnes of CO_2 emissions per month due to oven operation [GER]

6. New office devices in Freudenberg
[GER]

General advantages:

Use of Kyocera-Original-Toner	→ Climate protection through support of several projects
Use of recycling paper	→ reducing CO_2 emission, reducing the consumption of wood, water and energy

Process:

In our latest report published in 2021, we presented the optimization of our printer system which we started in 2016. Since then we have been searching for further ways to improve it. We continued using the carbon dioxide neutral Kyocera toner but also reduced and exchanged our printers in 2022 which enabled us to begin using recycled paper, which even more increased the CO_2-savings but also needs less water, wood and energy consumption during the manufacturing process of recycling paper.

Figure 17: We have been using recycled Steinbeis paper since 2022 [GER]

Also, the implementation of the new mulit-functional office devices led to print cancellations of the amount of **153kg CO_2** between April 2022 and January 2023, as print orders have now to be confirmed at the device. In the process of finding the best recycled paper for our purposes, we tested several paper types. The Steinbeis Paper #2 was too dark for colored prints so we had to try out Steinbeis Paper #3 which had been successfully tested. When we received the first delivery of the paper in November 2023, we faced problems with many devices but after their rolls had been exchanged and the devices were cleaned up, we have been able to use the recycled paper ever since. In October we also took an agreement with our toner supplier in which we are now collecting the empty toner cartridges in return boxes, which are then picked up for free by our supplier instead of disposing them into residual waste. This way the toner cartridges can be recycled, which has positive ecological impact and also saves disposal costs for us.

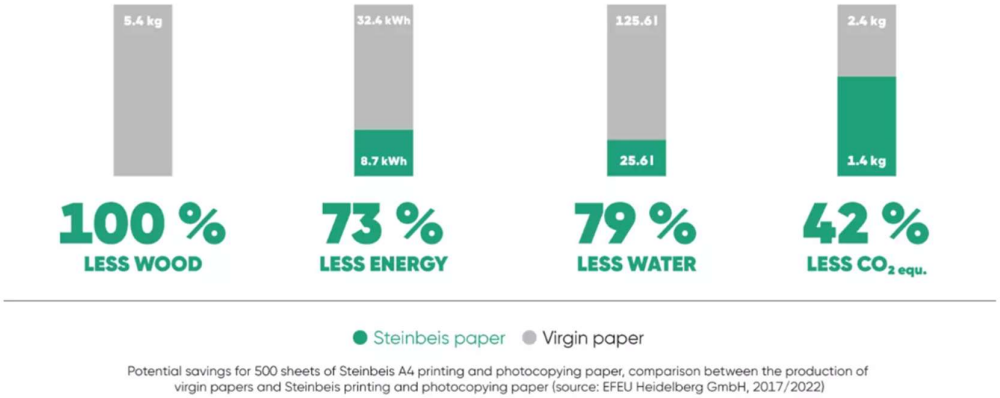


Figure 18: These are the savings that Steinbeis has calculated for the paper [GER]

Trend of paper sheet purchases:

As these are the amounts of purchased paper sheets, they don´t portray the exact amounts of prints.

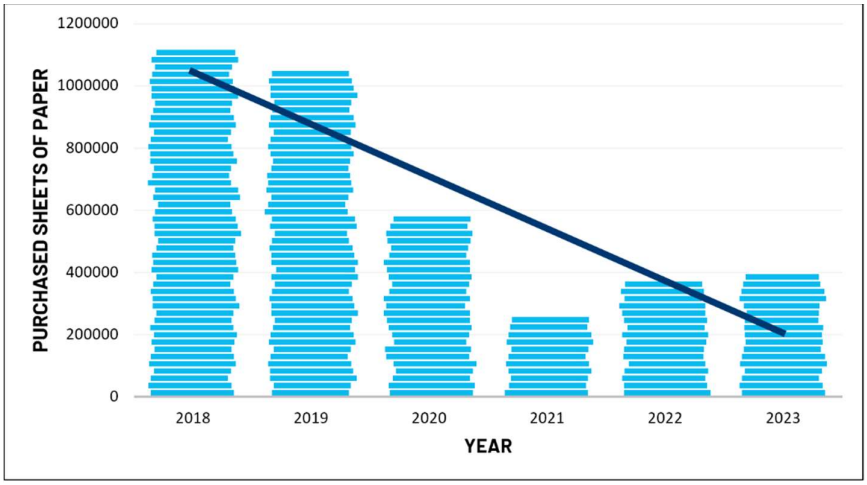


Figure 19: This is a representation of paper purchases over the years [GER]

CO_2-Compensations:

Through the usage of Kyocera **toner**, HF Mixing Group supported the projects **"efficient cookers for Kenya"** and **"biogas plants in Nepal"** between the years of 2021 and 2023 which results in a total of **1,54 tons of CO_2-compensations!**

Figure 20: These are the CO_2 equivalents resulting from the use of Kyocera Printers [GER]

Amount of printers/office devices:

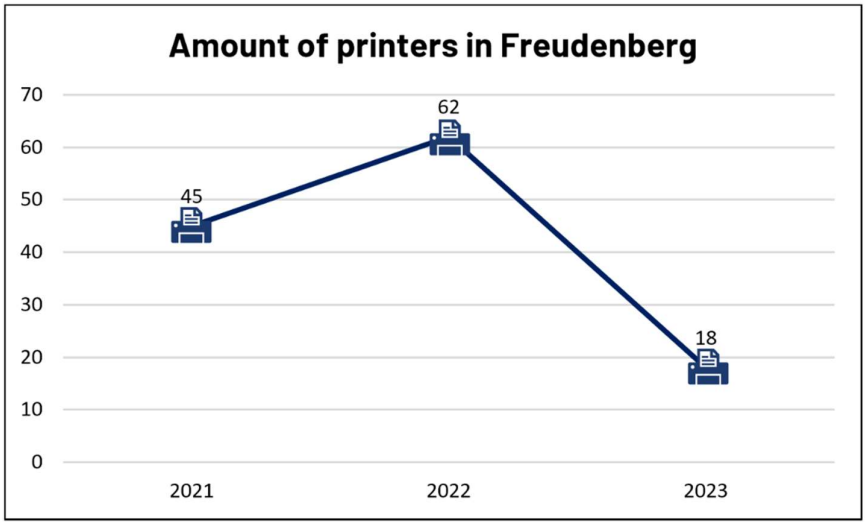


Figure 21: Number of printers in use over the years [GER]

Figure 22: New multi-functional office devices [GER]

7. Energy Monitoring System for Mixing Room and Beyond

[GER]

This project is about offering our customers an Energy Monitoring System for the mixing room. To be able to do so, we are cooperating with an external strategic partner.

Through this project, it is possible to link batch data from the mixing room with associated energy data, i.e. to display and analyse batch-specific energy data. Our cooperation partner is also able to extend energy monitoring to the entire plant or site.

Energy costs can make up **~37-45%** of **specific mixing costs**, so the mixing room's energy consumption can play a major role in the overall energy consumption of a production site. The aim is to **track the energy consumption** and **CO_2 emissions of the production site**. This is to be achieved through a cooperation between HFMG, the global market leader for mixing room equipment, automation and process technology in the tire and technical rubber goods industry, and a market leader in the field of energy management software and services for industrial companies in all sectors.

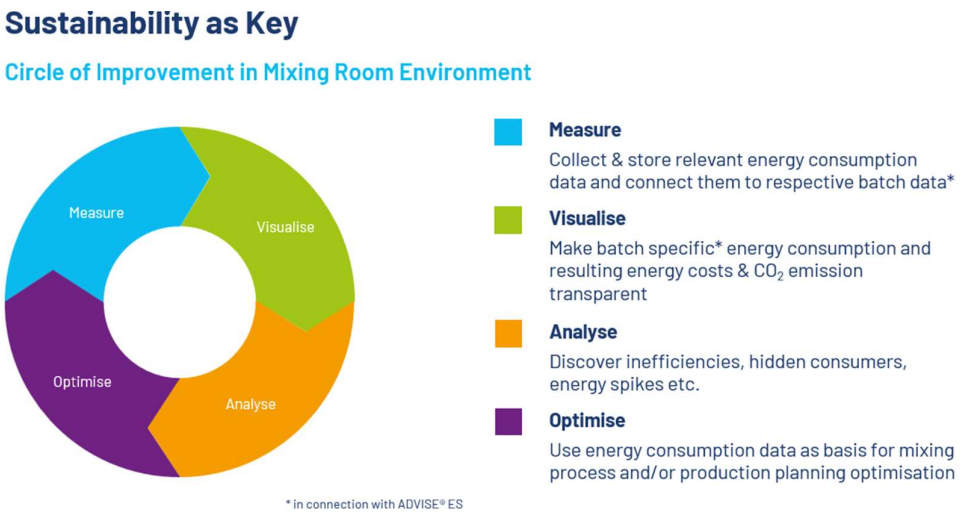


Figure 23: Shown is an extract from the mixing room development process [GER]

Potential of an Energy Management System:

With the Energy Monitoring System as a foundation, an Energy Management System could use the measured data to monitor values with regard to certain criteria and, if necessary, trigger alarms or recommendations for action. Examples for that are the following:

Benefits of energy monitoring:

- Reducing energy costs through transparency
- Record energy consumption online
- Evaluate energy consumption statistically
- Billing energy consumption by client
- Check energy consumption for implausibilities
- Correlate energy consumption with process data and create KPIs
- Convenient creation of energy reports
- Electricity load management
- Electricity consumption monitoring
- Complete solution for the delimitation of third-party electricity volumes in accordance with the EEG

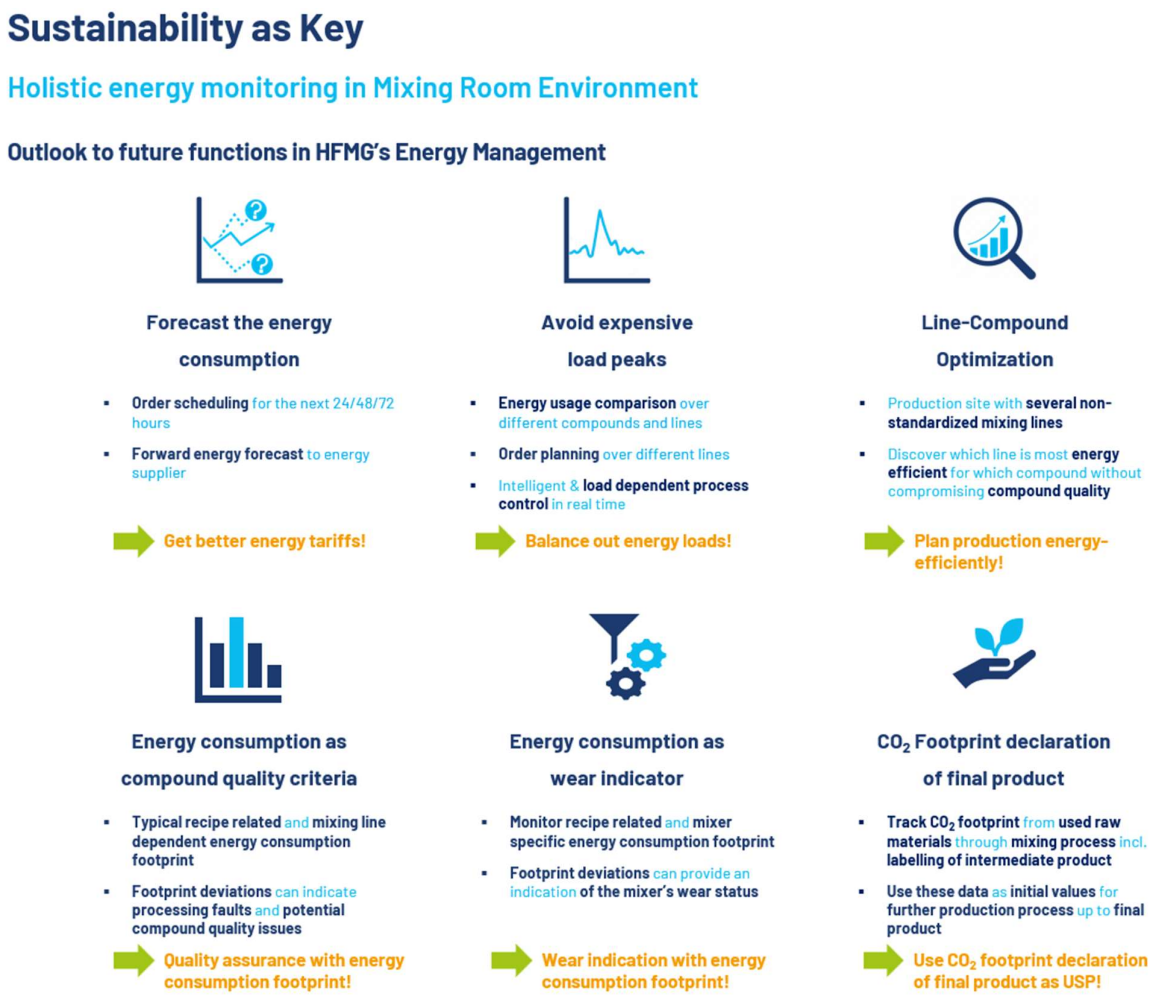


Figure 24: Key points of energy flow monitoring of the mixer room environment [GER]

8. Smart-Final-Mix
[GER]

Figure 25: This is a visualisation showing some areas of potential improvement [GER]

General advantages:

- Lowering of CO_2 emissions
- Increasing of competitiveness
- Reduction of batch production costs

Introduction into this project:

This project is a good example on how impactful process optimizations actually can be. One way to save energy in the rubber industry is to consider, analyse and optimize mixing processes. To optimize one part of the mixing process – the final mixing processes – the HF Mixing Group has developed a new tool called "Smart-Final-Mix", which analyses and optimizes existing final mixing processes based on mathematical models and artificial intelligence. Within the algorithm, the batch temperature, the energy consumption, and the mixing quality are linked to each other and then optimized. From linking the different parameters, optimal process parameter settings, for example for the rotor speed, can be calculated that apply to the final mixing process. The new tool has already been used at several pilot customers since the beginning of this year with great success.

By using the tool for optimizing industrial processes in the technical rubber goods (TRG) industry as well as at tire customers, **energy savings of up to 29%** could be achieved:

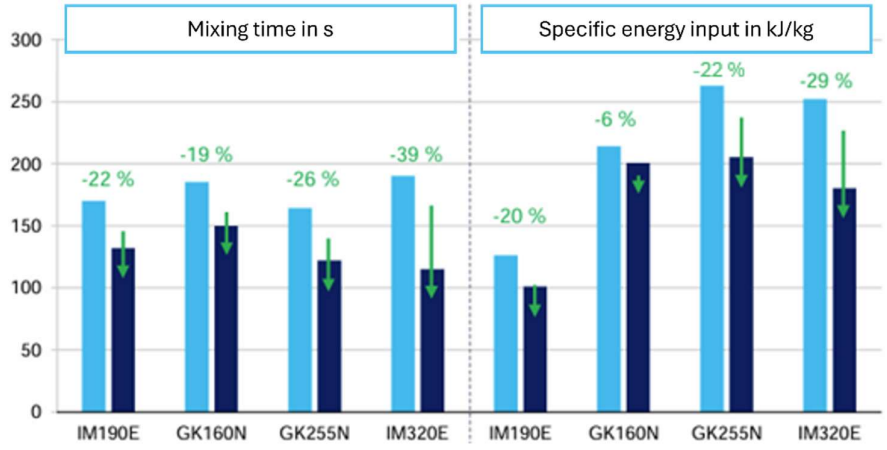


Figure 26: Energy savings with help of the Smart Final Mix [GER]

Besides the energy savings, the potential of CO_2-reductions by using the Smart-Final-Mix is also to be highlighted. This can be shown by two example calculations:

1. With an annual production of 1350 t of the EPDM and Kaolin compound mixed on the **IM190E** mixer, a total of **4.100 kg of CO_2 emissions could be saved** by using the tool (based on German power mix with 434g CO_2/kWh). This corresponds to a round trip flight from Frankfurt to Los Angeles.
2. For a **yearly** production of around 4.000 t of the NR and carbon black compound on the **IM320E** mixer up to **34.000 kg CO_2 emissions could be saved.**

9. Use of tandem mixers in Freudenberg
[GER]

Figure 27: IM320E & IM550E / IM550ET & IM1000ET [GER]

General advantages:

- Energy reduction (while maintaining the same mixing quality)
- Economic efficiency
- Increase in throughput
- Reduction of mixing stages and thus also specific energy input
- Reduction of warehouse and logistic costs

Introduction into this project:

One possibility for increasing energy efficiency is the use of tandem mixing processes. As a result of a cooperation between Kraiburg Austria and the HF Mixing Group, a concept has been developed that makes it possible to analyse and evaluate existing mixing processes, transfer them to tandem mixers and identify potential savings.

Tandem Mixing technology:

The tandem mixing process makes it possible to significantly reduce the number of mixing stages. For this purpose, two internal mixers are arranged in such a way that one internal mixer is located below the other. Due to the spatial arrangement, the first of the two machines is described as the upper mixer and the other as the lower mixer. Different process tasks can be assigned to each of the two mixers, resulting in design differences in the machine. A possible arrangement is shown here:

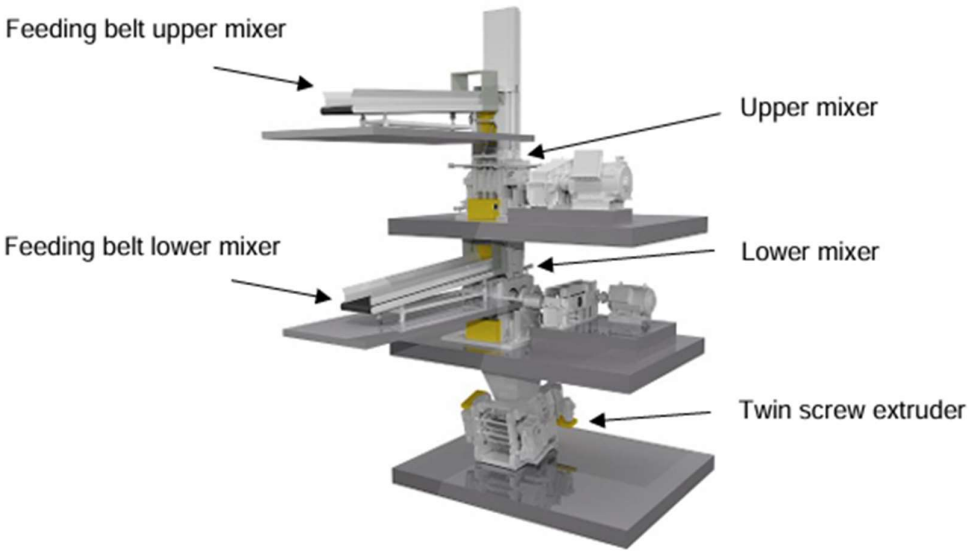


Figure 28: Dual mixing chamber arrangement [GER]

Comparison between the three-stage mixing process and the tandem mixing process:

The following figure demonstrates the potential of time and specific energy input savings that can be reached through the tandem mixing technology in comparison to the usual three stage mixing process. The numbers are referring to an entire line of a 320L mixer:

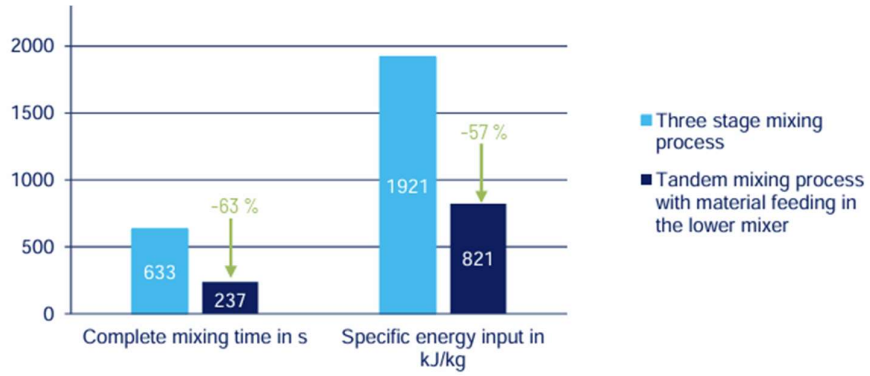


Figure 29: Comparison between mixing processes

➔ The **mixing time** can be **reduced** by up to **63%** and **savings** of specific energy input of up to **57%** can be achieved!

Reduction of energy input and CO_2-emissions on one line:

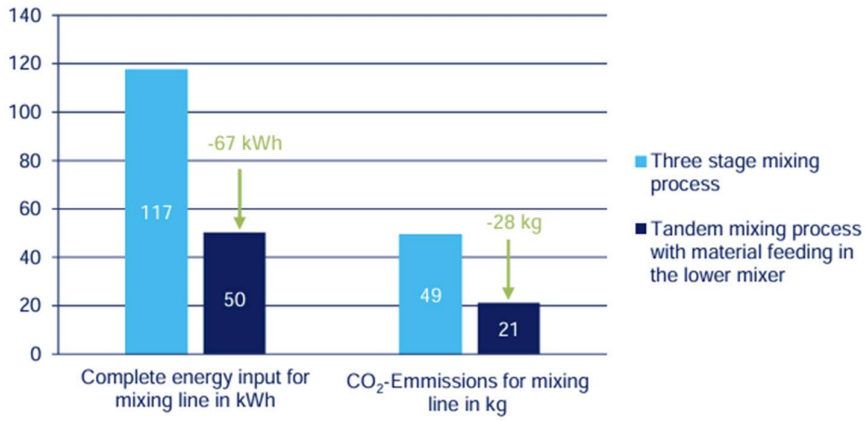


Figure 30: Reduction of the energy input when using a tandem mixer

➔ The graph describes the absolute values of energy savings and CO_2 savings for one entire line. To demonstrate them, the values of the graph above have been multiplied by the batch weight. The reduction of the specific energy input leads to a lower absolute energy input. By comparing the absolute energy inputs per batch between the three-stage mixing process and the tandem mixing process, the absolute savings can be calculated. The **complete energy input for this entire mixing line** considered can be reduced by **67 kWh** and around **28 kg of CO_2 can be saved**. Assuming an **annual production of 6.600 t** of the three-stage batch, the **saving potential** corresponds to around **840.000 kg of carbon dioxide per year** (based on real production days). For a good approximation, this corresponds to around **280 round trip flights from Frankfurt to Los Angeles**.

10. Current research project "PARNES"

[GER]

Target of the research project:

The short-term PARNES stands for the German translation of "Process-integrated exhaust gas treatment in tyre production through the use of feed streams as sorbents". This publicly funded research project started in July 2023 and will run for 36 months in total. The target of the project is no longer to burn the emerging volatile organic components (VOCs) during the production of rubber tyres or technical rubber products, as is currently the case, but to bind them to the soot through adsorption. With the adsorption, a combustion (with fossil fuels) is no longer necessary, thus reducing CO_2 emissions.
Besides not requiring fossil fuels, the newly pursued approach is process-integrated, utilizes material streams already used in the mixing process as adsorbents and avoids the operational problems of previously used technologies.

Contribution to environmental relief:

- No waste material flows are generated because
  - No waste water is produced
  - No solid waste streams are generated
- No fuel is used for the start-up, operating pauses and the operation of regenerative thermal post-combustion plants, therefore direct carbon dioxide emissions are avoided. The consumption of electrical energy by low-temperature plasma (LTP), entrained flow reactor and fabric filter is relatively low according to current knowledge.

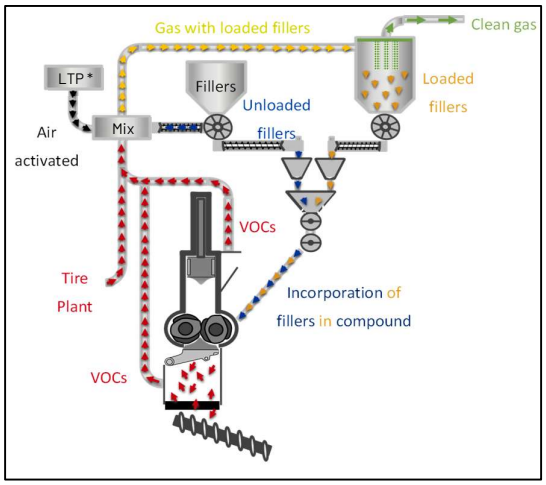


Figure 31: PARNES concept [GER]

- There is no deterioration of the emission values in the clean gas due to
  - Adhesion of the adsorbent in the adsorption wheel
  - Irreversible catalyst deactivation as a result of the oxidation of silicon organic exhaust gas components. In the new, production-integrated process, fresh sorbent is always fed in.
- The electrical power required to extract emissions from the kneader can be significantly be reduced considerably.
- The high compressor output required to transport the exhaust gases through the regenerative-thermal oxidation plants is completely eliminated.

11. Cooperation with WF Recycle-Tech
[USA]

HF is a part owner of WF Recycle-Tech and we have been working with them for **over 10 years** to develop market leading pyrolysis technology that can help recycle end of life tyres and produce new materials. We have developed several ways of using the rCB material, including use by tyre producers, technical rubber goods manufacturers and plastics masterbatch manufacturers, our customers. The oil that is recovered can be used as a sustainable fuel, but more recently work is advancing to use the oil as a feedstock for plastics production and even virgin carbon black production.

Why is an end of life tyre solution required?

➔ Waste tyre problem:

1,8b ELTs p.a.

4,0b ELTs in landfill

26m T Material Resources Lost

➔ Social responsibility

14m T Global CB Production

70% Production CB in Tyres

2m T CO2 saving -10% to rCB

Figure 32: Addressing the downstream problem of recycling [USA]

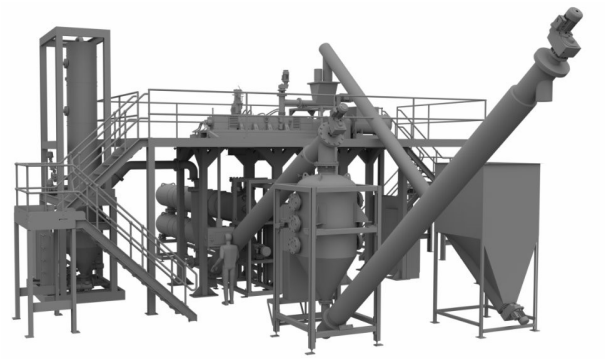


Figure 33: Simplified illustration of a pyrolysis system [USA]

The sustainable solution:
WF RECYCLE-TECH offers an end of life tire pyrolysis system that takes shredded rubber crumb from ELTs and breaks it down using a combination of kinetic energy and heat to produce three end products: Oil, gas and a raw recovered carbon black (rCB) all of which have commercial applications.

Environmental Benefits:

The WF Recycle-Tech solution recovers approximately 10.500 tons per year of end of life tyres and avoids landfill waste. In addition, following processing on the WF Recycle-Tech system, tyre pyrolysis oil (5m Lit p.a.) and rCB (4.000 T p.a.) are produced. These output materials can be returned to the manufacturing cycle as materials and feedstock.

For every ton of rCB that is used as a substitute for virgin carbon black, carbon dioxide emissions are reduced by approximately 2,5 tons.

The use of pyrolysis oil prevents the need for fossil fuel extraction leading to:

- Reduced Carbon Dioxide and Methane emissions
- Reduced wildlife disruption and fragmentation of habitats
- Reduced oil spills and ocean contamination
- Preservation of pristine landscapes

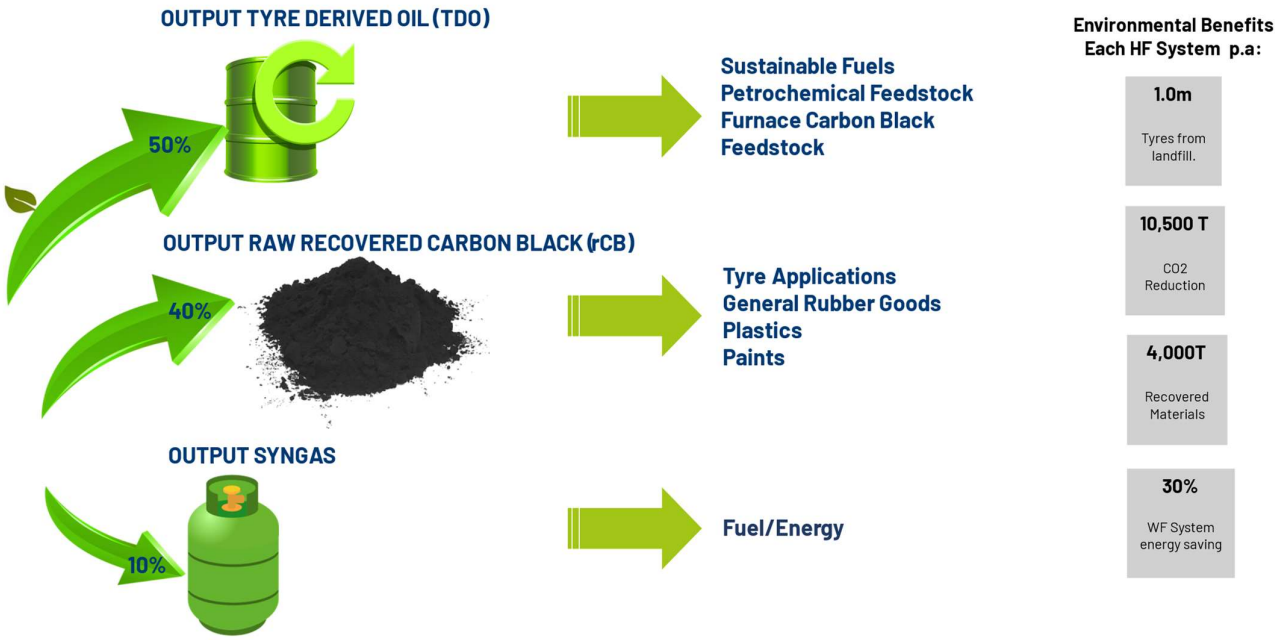


Figure 35: Output & Environmental Benefits

It is clear to see that in today's world more effective and environmentally friendly methods are required to recycle end of life tyres with over 1 billion tyres reaching this stage every year. This coupled with the need for sustainable substitutes to oil and virgin carbon black makes the WF Recycle-Tech system an attractive investment opportunity. It's this premise which has driven the team at WF Recycle-Tech and with the engineering capabilities of HF and Farrel Pomini at our side we look to build on our now over **10 years old** research and development programme and deliver consistently performing production machines to the market.

For more information on WF Recycle-Tech or our cooperation,
please visit their website by using the following QR-Code:

Figure 36: Website Picture of WF Recycle-Tech

12. Project ClearWater in Ansonia
[USA]

Project benefits:

Water is becoming scarcer every day. Droughts, climate change and the merciless exploitation of this valuable, renewable resource mean that water scarcity is becoming an even more pressing issue. This is why water recycling is becoming increasingly popular and important. Water recycling stands for the systematic reuse of water that has already been utilised. This is a process in which the wastewater is reused for another application. Thus, our plant in the USA implemented the project ClearWater. It allows the recycling and reusing of water for the laboratory, to which the cooling tower is connected.
This system brings the benefits of reduced water consumption, reduced energy consumption, eliminated hazardous chemicals and reduced waste discharge.

Figure 37: Water Laboratory in Ansonia [USA]

We are planning on implementing similar systems in our other entities in the near future as well.

Figure 39: Cooling Tower in Ansonia [USA]

13. New boiler in HARP mill in Rochdale [UK]

Figure 40: Old boiler in Rochdale [UK]

The old boiler had been manufactured in 1990 and served the HARP office block ever since, providing heating throughout all of its rooms. But the boiler was outdated technology, inefficient and did not comply with current regulations. Although the biggest issue was that due to the age of the boiler, the manufacturer and any aftermarket suppliers no longer manufactured spare parts, meaning all the parts were being obsolete. Over the past 4-5 years before the exchange, a number of issues had arisen causing the boiler to breakdown. We had managed to repair these in house or purchased the last of the spare parts, such as a probe/burner assembly but if the boiler broke down again there would have been no guarantee that it would have been repairable. This would have left the full office block without any heating. For this reason, we took action and replaced the boiler.

There had been installed two new boilers which are more reliable and more efficient than the old one and also have a much **smaller environmental footprint**. With the old boiler consuming about 212.000 kWh in the winter season 2021/2022, the new boilers consumed only about 163.000 kWh in 2022/2023 and 168.000 kWh in 2023/2024, which equals about **22% less energy consumption** despite the latter winters being colder than the winter 2021/2022.

Figure 41: New efficient boiler in Rochdale [UK]

14. New Caltherm Oven in Fab Shop in Rochdale [UK]

Replacement of the old stress relieving oven with a new oven supplied by Caltherm. The old oven was not efficient and caused bottle necks in production and large sub con costs due to no forced cooling, making cycle times extremely long in comparison.

Over 80% of all components manufactured at Farrel Ltd. require at least one stress relieving cycle, some components require multiple making the stress relieving ovens vital to the manufacturing methods. The main stress relieving oven in Rochdale was in dire need of an upgrade. During the last 12 months before the oven exchange, we had spent about 30.000€ on sub con stress relieving because our oven wasn´t capable to fulfil the needs of our requirements.

The installation of a new oven brought a 58% reduction in cycle time (oven capabilities rose from 2 cycles per week to 5). The internal oven volume had been increased by 26% and energy consumption had been reduced by 23%.

Figure 42: New Caltherm oven in Rochdale [UK]

Figure 43: New Caltherm oven in Rochdale [UK]

15. Change of the hard surface on Rochdale´s sealing rings for rotors from Stellite 1 to WP48 [UK]

This initiative produces the following benefits:

- WP 48 is nearly half the price compared to Stellite 1
- Reduction in rework of cracks in hard material, this reduces weld repairs, side grinding and returning
- Reduction in energy consumption for stress relieve – 500 C (WP48) vs. 680 C (Stellite) 1 – claim on ISO 14001

Some Rings are required to stay made with Stellite 1. However, we have recently approved using one layer of weld rather than two. Obviously, this saves material and energy. We have also seen a reduction in cracks so are using less materials and energy on repairs.

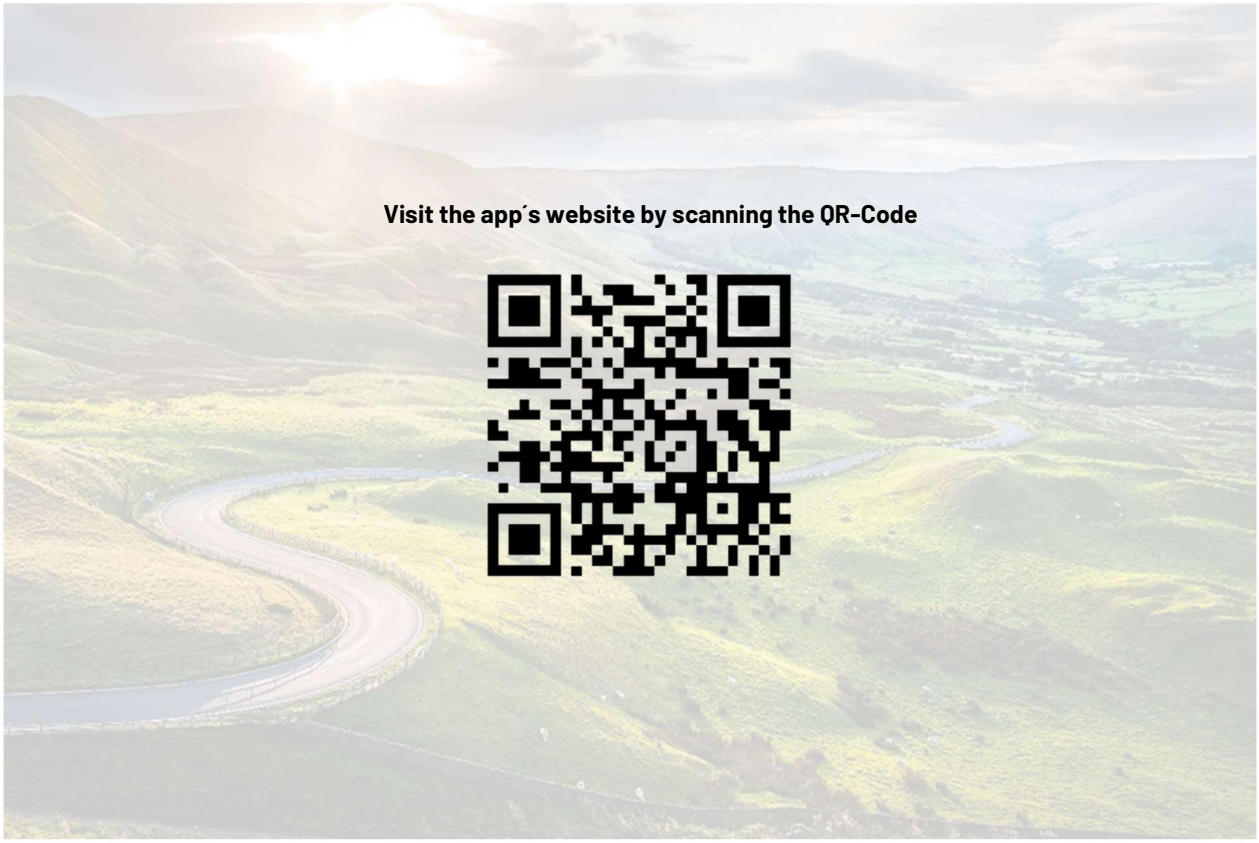
Figure 404: Sealing ring for rotors [UK]

16. Use of CargoSecApp for load securing
[GER]

To optimize the process of load securing, HFF decided in 2019 to start using an App to obtain photographic documentation of the load securing measures taken. Step by step, the shippers have to go through mandatory checkpoints of a loading process and upload photos of the cargo. By using this app, we are able to control and evaluate the load securing measures. We are able to see which shippers must improve their loading measures, what the most occurring problems are and whether recordings are taken (correctly). The documentation helps the shippers to remember all necessary steps to secure a safe loading and it can be used in court to protect the shipper and the company.

It is planned that other entities than Freudenberg begin with using the app as well.

Figure 45: Interface of the CargoSec app [GER]



17. Electrical mixers – coming soon!

Remove all hydraulics and/or pneumatics to produce a more efficient, sustainable and precise machine.

Benefits:

- A much simpler installation using far less components and no required piping.
- Very precise movement with excellent controllability and accurate feedback.
- Lower maintenance needs with predictive maintenance easily observed.
- Very little risk of contamination.
- Reduced noise impact in the work environment.
- Overall smaller CO_2 footprint.
- Far more sustainable with little environmental impact.
- Largely increased efficiency – Energy consumption reduction / sustainability.

Typical Efficiency Figures:

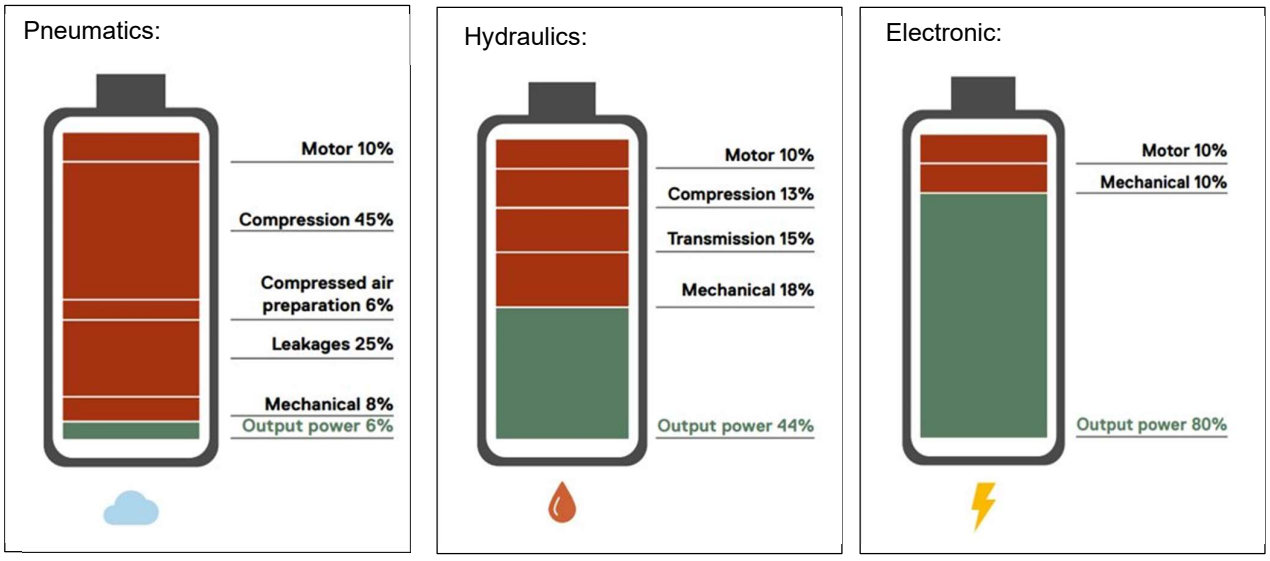


Figure 416: Efficiency figures of our mixers

BR1600E - Electric Lab Mixer

- Electric BR1600 build is mechanically complete. New software currently being finalized including the implementation of the new electronic axis. Expected complete by the end of the first quarter of 2024
- Initial floating weight testing was carried out in week 7 to accelerate technology verification, on existing BR1600 in Farrel Ltd. Lab with good results.
- Full energy saving comparison study to take place on existing BR1600 vs new BR1600E.
- Market launch planned for 2024 following successful testing
- Through switching to electric hopper technology, pressure can be put in the mixing process only when it is needed, thus saving energy

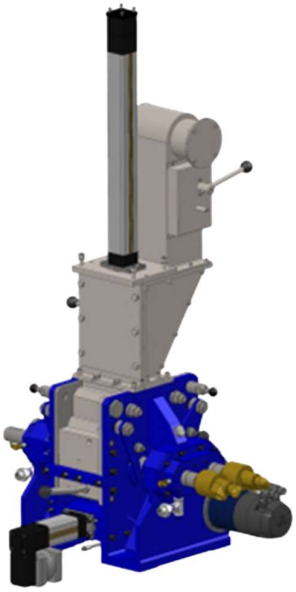


Figure 47: BR1600E

20N Electric Conversion

- 20N was chosen to further test the technology by electrifying the floating weight.
- A new crosshead design allows fitment of either electric or hydraulic cylinders.
- Hydraulic cylinders can also be used to accelerate testing times.
- Force measurement bolts also to be used to verify forces.
- Following successful tests, a full electric specific hopper can be produced for the 20N with a more concise crosshead and an electrical feed door cylinder also.

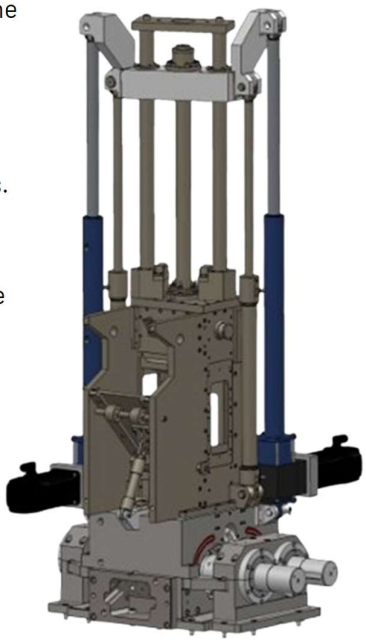


Figure 428: 20N

Production Sized Machine

- Cylinders and drives have been specified for a 305N machine (sizes shown in image).
  Available power from cylinders could cover full machine range.
- Synchronization of the 2 cylinders is not a problem for technology, many working case studies in the field are operating this way, 20N will prove this functionality also.
- Some concerns over self-locking behavior of ball screw and nut, this has been confidently dismissed by several suppliers and considered no issue.
- Hopper feed door solution has already been offered, simple change, should also allow for retrofit.
- Further testing on 20N to prove efficiency and also trial main drive energy regeneration through floating weight cylinders.

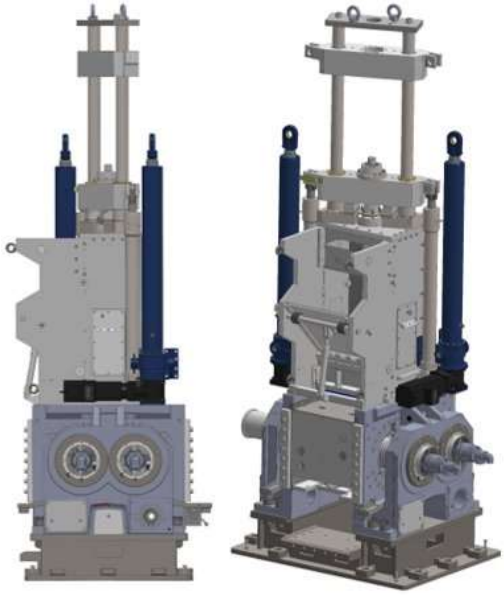


Figure 4943: 305N

Priority 1: Electrical hopper

- The hopper accounts for approximately 70-80% of the energy usage from the hydraulic unit and the complex valve system to control the floating weight also accounts for a lot of the heat losses in the hydraulics. This is the largest factor and therefore the biggest efficiency increase in moving to electrics

Priority 2: Drop Door

- The drop door and latch are only used once every mixing cycle, this intermittent use means they have little effect on the heating of the fluid and the only real losses are in the movement itself.
  Electric solutions will still make this more efficient and further remove a hydraulic unit requirement

Priority 3: Duststops

- Duststops are the final priority and a difficult aspect to solve electronically, this will have further investigation and development following the initial 2 prioritisations

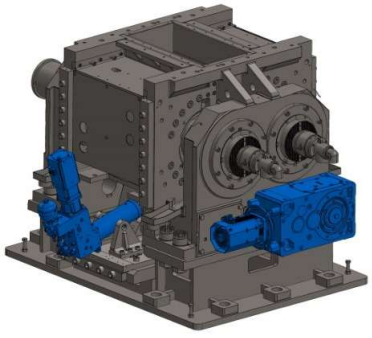


Figure 440: The hopper (blue)

18. Attachment - Important key figures

[IT, SK, UK, USA, GER]

Power consumption

2022	2023
USA: 319.500 kWh	USA: 448.200 kWh
Slovakia: 2.536.890 kWh	Slovakia: 2.335.370 kWh
Germany: 1.683.211 kWh	Germany: 1.733.055 kWh
Italy: 186.130 kWh	Italy: 173.208 kWh
England: 1.944.787 kWh	England: 1.891.788 kWh
Total: 6.670.518 kWh	Total: 6.581.621 kWh

Gas consumption

2022	2023
USA: 25.050 kWh	USA: 25.550 kWh
Slovakia: 1.077.130 kWh	Slovakia: 1.154.450 kWh
Germany: 1.933.456 kWh	Germany: 1.500.243 kWh
England: 3.316.140 kWh	England: 3.331.054 kWh
Total: 6.351.776 kWh	Total: 6.011.297 kWh

Generated solar power

2021	2022
USA: 444.261 kWh	USA: 462.471 kWh
Total: 444.261 kWh	Slovakia: 254.700 kWh
	Total: 717.172 kWh

2023

USA: 412.422 kWh

Slovakia: 552.920 kWh

Total: 965.342 kWh

CO2 emissions in tons (power + gas)

2022	2023
4.172 t	3.709 t

CO2 reductions in tons (solar)

2021	2022
182 t	311 t

2023

367 t