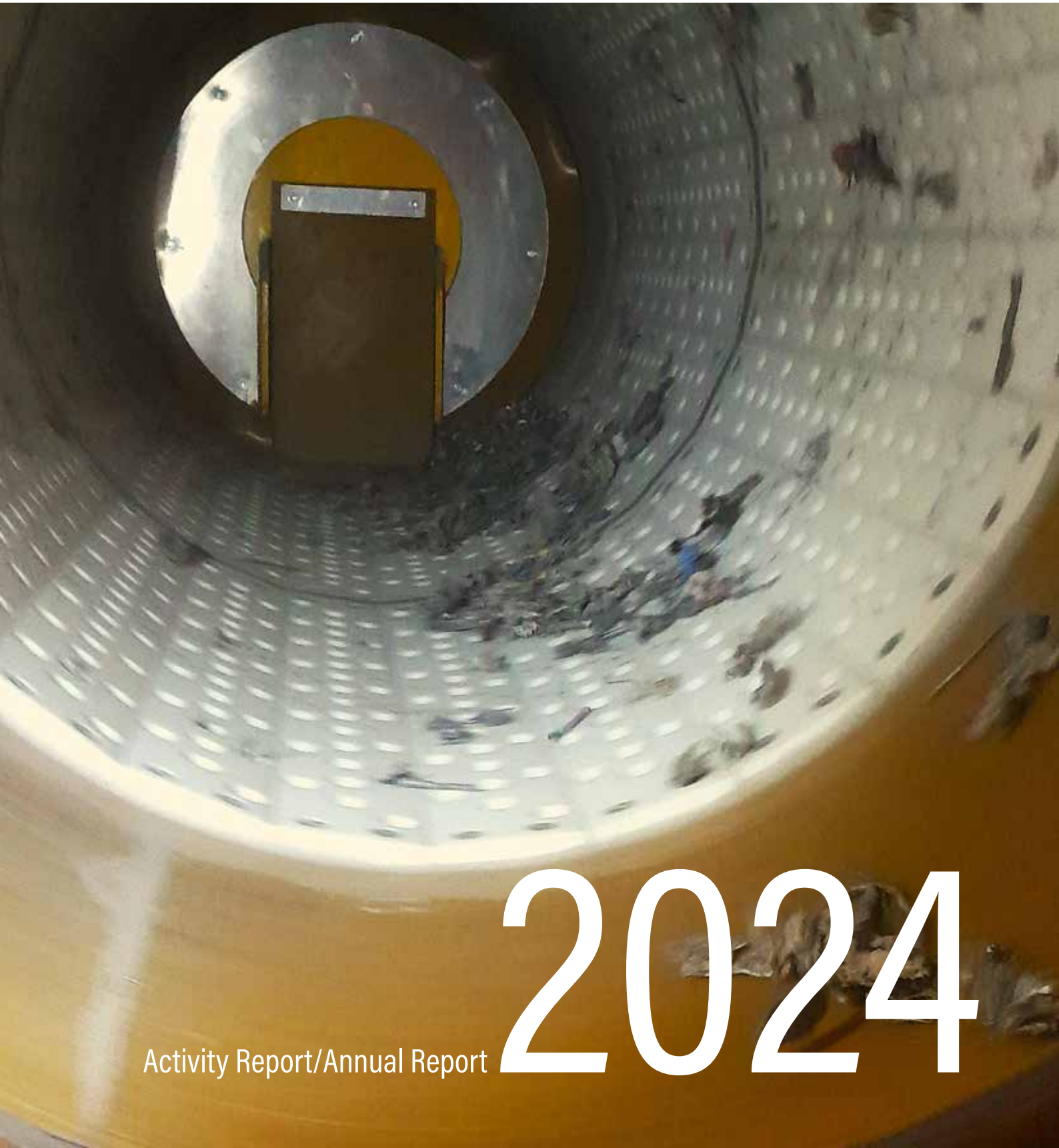
ZAR

STIFTUNG ZENTRUM FÜR NACHHALTIGE ABFALL- UND RESSOURCENNUTZUNG



Activity Report/Annual Report

2024

Content

Foreword by the President

Commitment to sustainable materials policy

As a non-governmental organisation, the foundation 'Center for Sustainable Use of Waste and Resources', ZAR, is committed to *'promoting a sustainable materials policy in the treatment and recycling of waste, ensuring the further development of the state of the art and supporting corresponding development activities. With a broad Swiss sponsorship and co-operation with interested parties, it ensures that the knowledge gained is incorporated into plant development and plant construction in Switzerland or abroad'*. This is the wording of the purpose article in our foundation charter of 21 January 2010.

Thanks to partners, employees and incineration plant sites

As a foundation, we are able to carry out these activities thanks to the support of our loyal donors and project partners, who contribute to our work and co-finance ongoing projects. This support is invaluable, as financing development work is always risky.

Secondly, our foundation's work is only possible and successful because we have outstanding, committed employees at our three development sites.

Thirdly, our approach of sending employees to work at one of our three sites in Hinwil, Niederurnen or Zuchwil, where they join a team operating a waste incineration plant (WIP), has proved very successful. These three waste incineration plants have one thing in common: their decision-makers are characterised by a great willingness to continuously develop their plants in order to create environmental benefits.

I would therefore like to thank all donors, project partners, employees and the people responsible at KEZO, KVA Linth and Kenova for their 'hospitality'.

From development to implementation in practice

If you look at the impact of the ZAR Foundation's activities from a distance, you could summarise them as follows: 'Development is silver – implementation is golden'.

Even if the development of new solutions for recovering recyclable materials or separating pollutants from waste that cannot be directly utilised is an indispensable first step, the greatest challenge ultimately lies in implementation. This is because measures for the treatment and utilisation of waste are usually associated with additional costs. The prerequisite for implementing these measures in this case is, on the one hand, broad social acceptance so that binding legal regulations can be issued. On the other hand, plant owners and the responsible authorities need committed individuals to take on the task of implementation.

If there is no clear legal framework, there can be no planning certainty. Without certainty in planning, there is a lack of appropriate organisations and money – and if there is no money, the implementation of new solutions for a more sustainable approach to waste comes to a standstill.

According to the purpose of our foundation, it is also our task 'to ensure' that the knowledge gained flows into plant development and plant construction in Switzerland or abroad. The activities of the ZAR Foundation must therefore not be limited 'only' to the development of technologies. Good communication within the industry and society as well as influencing political decision-making processes are also important.

With the recovery of metals from incineration residues, bottom ash and filter dust or the extraction of phosphoric acid from sewage sludge ash, valuable elements have been developed in terms of the circular economy. Ensuring that these findings are put into practice as comprehensively as possible is a major challenge and will only succeed if all stakeholders are on board.

If waste that cannot be directly recycled (including sewage sludge) is thermally recycled in Switzerland, around 85 kilograms of mineral residues are produced per inhabitant per year after the recovery of metallic raw materials, which are currently sent to landfill.

The challenge of mineral residues

The majority of waste deposited in landfills in Switzerland today is non-recyclable waste from the demolition of buildings and infrastructure facilities as well as contaminated excavated material. In total, around 600 kilograms of solid waste per inhabitant and year are deposited in landfills in Switzerland. Finding sufficient landfill space in Switzerland often fails due to the 'not in my backyard' principle. In some regions of Switzerland, there is talk of a landfill crisis.

CO_2 emissions: Invisible landfill space

Another landfill emergency should actually worry us even more: Every year, we in Switzerland dump 4.7 tonnes of CO_2 [in CO_2 equivalents] per capita into the atmosphere as gaseous waste, contributing to the increase in CO_2 pollution in the atmosphere, with the known consequences. In addition, at least twice as much CO_2 is emitted per capita outside Switzerland in the provision of raw materials, goods and commodities for import into our country.

Gaseous waste is neither visible nor tangible. Moreover, it is evenly distributed in the atmosphere over time. This means that our atmosphere is used as a landfill in the sense of a 'commons' and CO_2 emissions lead to a steady increase in CO_2 concentrations.

The thermal utilisation of waste in Switzerland produces around 4 million tonnes of CO_2 emissions every year. Half of these come from fossil and half from biogenic materials. The share of fossil CO_2 emissions from thermal waste utilisation amounts to approx. 2 million tonnes [in CO_2 equivalents] and is therefore currently responsible for approx. 5% of the climate-relevant emissions reported in the statistics on greenhouse gas emissions in Switzerland. It is important that we address these emissions because they will not cease as long as our consumer behaviour or our gigantic stockpile of goods continues to generate waste that needs to be thermally recycled.

This is why the work at the CO_2 Competence Centre in Niederurnen is so important, where the Federal Office for the Environment FOEN, the Swiss Association of Waste-to-Energy Operators VBSA and other project partners are looking for technical ways of separating CO_2 from the exhaust gas stream of a thermal waste utilisation plant and processing it so that this gaseous waste can be transported. If the CO_2 from thermal treatment can be separated and one day converted back into a solid state in suitable minerals or otherwise safely stored, CO_2 emissions from waste utilisation can be eliminated. The fact that biogenic CO_2 can also be captured and stored at the same time means that these 'negative emissions' can contribute to the Federal Councils 'net zero' plan.

As you can probably imagine, a great deal is still required before CO_2 can be captured from a point source and safely mineralised or reused in a rock formation, for example.

Circular economy requires realism

Back to the circular economy: The adoption of the amendments to the Environmental Protection Act in March 2024, which was triggered by the parliamentary initiative 'Strengthening the Swiss circular economy' has shown that the circular economy is not only an ingenious concept for the sustainable use of goods, but also meets with political acceptance. In the further development of measures for the circular economy, it is important that we are not only guided by elegant 'circle diagrams' This harbours the risk of self-delusion by losing sight of reality. There are shortcomings in the cherished cycle graphics:

1. They often lack a reference to the stockpile that we have built up over the last 50 years with an almost exponential development and whose waste will catch up with us in the future.

2. The actual orders of magnitude of the mass flows can only be depicted poorly, so that it is hardly recognisable that we consume five to six times more materials or goods per year and add them to our stockpile than we return to the cycle through reuse or recycling.
3. The element carbon [C], which leads to the largest emissions from our system, is often simply left out.

The purpose article in our foundation charter has lost none of its relevance. On the contrary, the need to engage in the development and implementation of processes for recovering valuable materials from waste that cannot be directly recycled and destroying or eliminating harmful substances from the system is more necessary than ever.

We remain committed and thank you very much for your support – in the development and implementation.

Franz Adam

President of the Board of Trustees

Technical Development

KEZO Hinwil (ZH)

COMPETENCE CENTER DRY BOTTOM ASH PROCESSING

Strategy and Optimisation

The ZAR Foundation consistently follows the guiding principle of 'quality before quantity.' Our aim is to obtain high-quality products from 'waste' for which there is a strong demand. Once quality is assured, it is much easier to increase production volumes - the reverse is much more challenging. The 2024 financial year once again impressively confirmed that this strategic approach is proving its worth.

Targeted optimisations were made to numerous parts of ZAV Recycling AG's plant in the reporting year. These not only helped to simplify plant operation, but also led to a significant increase in the efficiency of metal separation. As many of the improvements were made in parallel, the increase in efficiency cannot be clearly attributed to a single measure.

The realisation that even the smallest optimisation of production conditions has a noticeable impact on maintenance costs and the recovery of metals was particularly valuable. This once again emphasises the importance of continuous further development in line with our quality strategy.

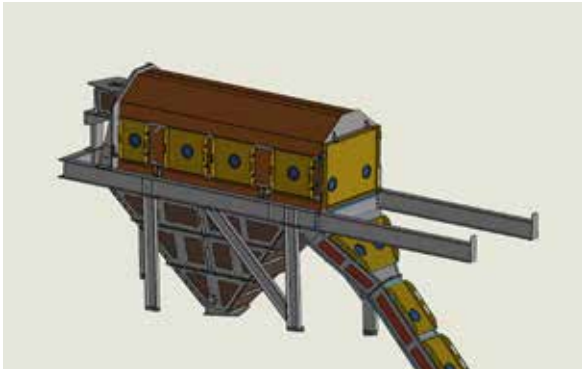
Trommel Screen

In the past, trommel screens were rarely used in bottom ash processing plants due to their size and the comparatively high cleaning effort required. Instead, circular and linear vibrating screens in various designs have become the standard for fractionating bottom ash.

ZAV Recycling AG has impressively demonstrated in practical use that the trommel screen offers several decisive advantages over conventional circular and linear vibrating screens - especially when processing dry bottom ash:

- No vibrations entering the building or steel structure
- No need to swing out - therefore less effort required for expansion joints
- Around 50 % lower energy consumption
- Significantly better monitoring of the screen linings compared to multi-deck screens
- Easier cleaning of the screen linings

The illustrations below show a latest-generation trommel screen for use in a dry bottom ash processing plant with one screen cut (two fractions). The housing cover can be manually removed from the screen area for cleaning, which enables simple and efficient cleaning. The plastic screen surface has 3D perforations and can be easily cleaned from the outside by lightly tapping it.



VA separation - targeted separation through optimised plant configuration

Experience from operation clearly shows that after crushing and screening the bottom ash, it is mainly non-ferrous and ferrous metals and small amounts of mineral components of a defined particle size that remain in the material flow. An optimised plant configuration was derived from this:
Crusher → 1st trommel screen → Non-ferrous separator → 2nd trommel screen for VA separation → Return of the bottom ash

This arrangement offers several decisive advantages:

- The crushing process exposes finer non-ferrous and non-ferrous metals that were previously trapped in bottom ash agglomerates. Together with the crushed bottom ash, they are separated in the first trommel screen and transferred to the corresponding fine fraction for further processing.
- The screen overflow from the first trommel screen reaches the non-ferrous separator, which separates the non-ferrous metals from the material flow with significantly less adhering bottom ash.
- The remaining material - especially VA metals with minimal bottom ash adhesion - is fed to a second, significantly smaller trommel screen, which efficiently separates the remaining bottom ash from the VA parts.

This means that VA metal can be cleanly separated and efficiently returned to the metal cycle with low energy and capital input.

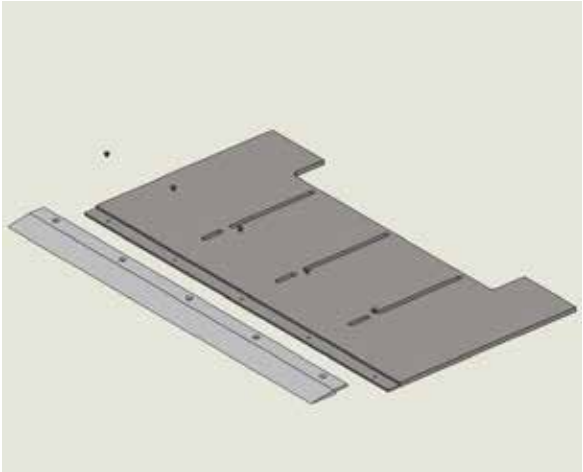
At the same time, this configuration significantly reduces the proportion of non-ferrous metals in the subsequent bottom ash fraction - while at the same time increasing material quality and improving melting yields.

Ceramic apex plate - precise separation of the finest non-ferrous metals

The exact positioning of the apex plate - the separating edge that separates the non-ferrous metals from the mineral bottom ash - is crucial for separating the finest non-ferrous metals in the eddy current separator. This must be as close as possible to the magnetic trommel of the separator in order to ensure clean separation.

However, metal apex plates would heat up quickly in the strong induction field of the eddy current separator and are therefore unsuitable. Plexiglas apex plates have usually been used as an alternative. However, these had a significant disadvantage: the geometry of the separator edge changed during operation due to abrasion, which led to minimal, often barely visible deviations in the distance to the magnetic trommel - with noticeable losses in the quality and yield of the separated non-ferrous metals.

By using a ceramic apex plate with an apex thickness of just 0.3 mm, this problem could be solved sustainably. The highly wear-resistant ceramic ensures a consistently sharp separating edge over a significantly longer operating time and thus enables precise and stable separation of the non-ferrous metals - even in the finest grain range.



Aluminium cleaning - a milestone for quality assurance and metal recovery

Expectations for the new plant section for cleaning the 1-15 mm aluminium fraction were high. However, delays in the delivery of important components and challenges in material transport delayed reliable, fully automated operation until the second half of 2024.

Despite these teething troubles, it soon became clear that this plant expansion is one of the most significant optimisations in bottom ash processing in the last five years. The melting yield of the aluminium fraction was increased by around 10%. At the same time, the residual metal content in the processed bottom ash was significantly reduced.

Non-ferrous scrap metal content in the processed bottom ash	**2024**	2023	2022
NE-Metals > 2 mm (BAFU) [%]	**0.17**	0.38	0.46
NE-Metals > 1 mm (AWEL) [%]	**0.24**	0.55	0.59

Why does cleaning the aluminium fraction affect the residual metal content?

Previously, the non-ferrous separator had to be adjusted so that the aluminium granulate content met the quality requirements of the smelting plant - i.e. as little adhering bottom ash as possible. In practice, this meant that the separation was not geared towards maximum metal yield, but towards purity.

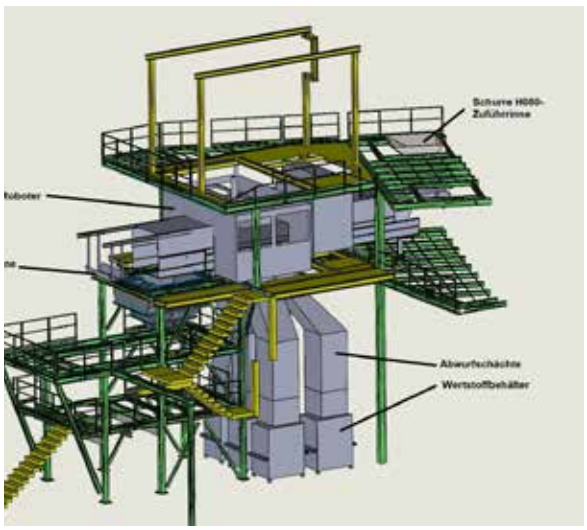
With the new aluminium cleaning system, the quality can now be ensured downstream. This allows the non-ferrous separator to be specifically adjusted to maximise metal extraction, regardless of the bottom ash content in the separated material. The result: a higher proportion of heavy non-ferrous metals and a significantly reduced residual metal content in the final bottom ash fraction.

Magnetic bottom ash as a corrective material - an important raw material for the cement industry

Thanks to the optimisations carried out, magnetic bottom ash now meets the requirements of cement manufacturers as well as the legal requirements for use as a corrective material in cement production. With the commissioning of the return of the processed bottom ash in containers, it will be possible to provide large quantities of magnetic bottom ash for the cement industry. The first large-scale trials are scheduled to take place in the first half of 2025 to test the suitability of magnetic bottom ash under real production conditions.

Manual sorting - robot-assisted coarse parts separation

As part of the capacity expansion of ZAV Recycling AG from 100,000 tonnes to 200,000 tonnes of bottom ash, the manual sorting of large metal parts by the employees of the disability organisation 'Züriwerk' also had to be redesigned. Due to the high demands on operating hours, the decision was made in favour of robot-assisted coarse parts separation, which will be in operation around the clock, seven days a week. When planning the system, the existing layouts of the manual sorting system were taken into account as framework conditions.



Innovative dry bottom ash discharge - focus on air exclusion and operational safety

More and more plants in Germany and abroad are recognising the benefits of dry bottom ash discharge. While the ZAR Foundation has primarily concentrated on optimising metal recovery from bottom ash in recent years, less attention has been paid to the area of bottom ash discharge directly after the furnace. In practice, a wide variety of systems have been used to optimise the process transition between the furnace and discharge. It became apparent that a permanently reliable air seal was difficult to realise.

With the new objective of significantly reducing the oxygen content (O_2) in modern furnace systems, the airtight closure came back into focus. In collaboration with the company Magaldi (donor of the ZAR Foundation), KEZO and the ZAR Foundation, it was decided in autumn 2024 to install a new dry bottom ash discharge system on KEZO's furnace line 2 for test purposes. On the one hand, this should ensure 100 % air exclusion and, on the other hand, enable uncomplicated handling of coarse particles in the bottom ash.

The specifications for the new discharge include the following requirements:

- Reliable air exclusion from the furnace
- Continuous bottom ash discharge without lifting
- Optimum conditions for cooling the bottom ash
- Possibility of complete, automatic emptying of the bottom ash discharge
- Safe access in the event of blockages

The installation and commissioning took place at the beginning of December 2024. Initial operating experience and any necessary modifications will be evaluated and documented in the course of 2025.

Team KEZO/ZAR, Hinwil

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KEBAG, Zuchwil (SO)

HYDROMETALLURGY COMPETENCE CENTER

In order for circular economy projects to be successfully implemented in practice, many other important gears need to mesh seamlessly in addition to technical maturity: a clear legal framework, political will, stakeholders who are committed to the projects and financing solutions, as in many cases the ecological benefits are associated with higher costs. The two projects SwissZinc and Phos4life also operate in this field of conflicting interests.

SwissZinc

Due to the existing regulatory hurdles, SwissZinc AG suspended the project in May 2024. At the end of 2024, the political initiative with motion 24.3475 'Remove the regulatory blockade in zinc recycling' pointed the way to a solution. The Federal Council's statement stated that the amendment to the Waste Ordinance would create legal certainty and that residues from the incineration of municipal waste would also qualify as municipal waste and thus be subject to the municipal waste monopoly. As a result, SwissZinc AG resumed work at the end of 2024 and hopes to be able to bring the project to a positive conclusion in 2025.

Phosphorus recovery

With the implementation of the parliamentary initiative to strengthen the Swiss circular economy and the anchoring of the phosphorus recovery obligation at the legislative level (Environmental Protection Act, EPA, Art. 30d), important framework conditions have been created for needs-based phosphorus recovery and its polluter-pays financing. The newly introduced partial recovery obligation requires the recovery of a quantity of phosphorus to be determined by the Federal Council, which in a first step is based on domestic mineral fertiliser requirements. Not all sewage sludge or the sewage sludge ashes used for phosphorus recovery must be treated for this purpose, so that a portion of the sewage sludge can continue to be used for energy recovery without phosphorus recovery. However, partial recovery does not exempt those sewage treatment plants that do not feed their sewage sludge to phosphorus recovery from the obligation to co-finance phosphorus recovery. This means that a small number of plants with efficient processes can recover the necessary amount of phosphorus, while the associated additional costs will be borne by all those who produce the sewage sludge.

To ensure that the first stage of practical implementation does not fail due to excessive hurdles, it is expedient to base the amount of phosphorus to be recovered on the existing infrastructure and, in particular, on the amount of sewage sludge ash available. In this way, costs can be limited and important operating experience can be gained with the new technologies. In a later step, based on the findings to date, the quantity target for phosphorus recovery can then be adjusted and the requirements for other customer groups included.

With the tailwind of the parliamentary initiative, the formation of the organising body for the implementation of the Phos4life process in Emmenspitz also took the momentum into the new year. The aim is to establish Phos4Swiss AG to implement the Phos4life process towards the end of 2025. The necessary articles of association and shareholders' agreements are currently being drawn up, and the definitive commitment of the current partners to finance and implement the project planning until the building permit is obtained (SIA phases 31 - 33) is expected by summer 2025. The concretisation of the construction project in Emmenspitz for the production of technically pure phosphoric acid from sewage sludge ash is therefore within reach. Planning work is scheduled to begin in early 2026 and be completed by around mid-2029 with the receipt of the building permit. Once a project is ready for approval, Phos4Swiss AG can then decide to implement it and realise the plant in Emmenspitz by around 2032.

FLUWA platform and 'filter ash' activities

The exchange of experience as part of the 'FLUWA platform' was successfully continued at two events in 2024. Most plants are well on the way to being able to fulfil the metal recovery requirements set out in the Waste Ordinance VVEA from the beginning of 2026. Corresponding adjustments are currently being implemented in the plants.

Team KEBAG/ZAR, Zuchwil

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Fine Gozdzik
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KVA Linth, Niederurnen (GL)

CO2-COMPETENCE CENTRE

The nationwide use of Carbon Capture and Storage (CCS) in the WTE plant sector is part of Switzerland's long-term climate strategy and has the potential to reduce Switzerland's hard-to-avoid residual emissions by around 4 million tonnes of CO_2eq per year. The ZAR CO_2 Competence Centre at KVA Linth is developing the technical and regulatory basis for the implementation of CCS and making it available to the industry. The table below shows the processing status of the work packages that have been contractually agreed between the FOEN and the ZAR Foundation in this regard (as at November 2024).

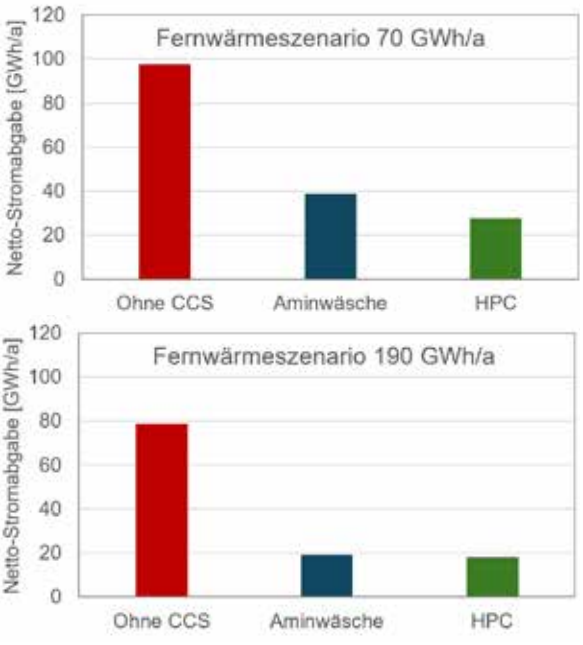
Work Packages	Progess
WP1: Establishment of the Competence Center	100%
WP2.1: Risk Analyses	80%
WP2.2: Environmental Monitoring	60%
WP2.3: Process Monitoring	80%
WP3: Optimization of Flue Gas Cleaning	80%
WP4.1: Heat Integration	90%
WP4.2: CO_2-Utilization	100%
WP4.3: CO_2-Storage	50%
WP5: Preliminary Project	90%
WP6: International Logistics	60%
WP7: Legal Framework and Permitting	60%
WP8: Financing	50%
WP9: Communication	60%

Preliminary project

In 2024, the main focus was on work package 5, the implementation of the preliminary project for the planned CCS plant at KVA Linth. The preliminary project focussed in depth on the two separation processes that have the required level of technical maturity for use in waste-to-energy plants (WTE plants) in the near future: amine scrubbing and the hot potassium carbonate (HPC) process. The subject of the investigation was not only the separation process. The subsequent process steps of compression and drying at the Linth waste incineration plant site, pipeline transport to the Weesen railway station site and the subsequent liquefaction and loading of the CO_2 onto rail tank wagons were also considered. One aim was to draw up reliable statements on the energy integration, space requirements and costs of the two processes. The project team commissioned several process suppliers to plan and design the plant technology.

Energy integration

The aim is to operate the CCS plant at full load all year round and cover the district heating requirements at the same time. For KVA Linth, this is possible with both amine scrubbing and the HPC process - the necessary energy can be provided from waste incineration. However, the amount of electricity fed into the grid falls by 70-80 %. The two graphs show this reduction in net electricity output for both separation technologies for two variants of district heating network expansion. Amine scrubbing has slight advantages with lower district heating output; with high district heating extraction, both processes are equivalent in terms of energy.



(Fernwärme-Szenario=Scenario for District Heating Expansion, Netto-Stromabgabe=Net electricity output)

Space requirements

The preliminary project confirms the spatial feasibility for both separation technologies. At the Linth waste incineration plant site, it is necessary to arrange the process technology within one building for both processes in order to accommodate the process technology on the planned area of approx. 1100 m^2. In the 3D visualisation above, the planned CCS building at the Linth WTE plant site is highlighted in dark red. The variant with the HPC process is shown. Its space requirement is higher than for amine scrubbing due to the large flue gas compressor. The height of the building can therefore be reduced by one storey for amine scrubbing. The building houses the separation, compression, drying and waste heat utilisation, including heat pumps. The large columns for separation are located behind the building. Additional space is required for the liquefaction and intermediate storage of the CO_2. In the case of the Linth waste incineration plant, these process steps are planned at Weesen railway station. The space required there, with a horizontal arrangement of the intermediate storage tanks, is around 1,400 m^2.

International transport and storage

The options for transporting and storing CO_2 from Swiss waste incineration plants were examined in parallel with the work on the preliminary project. The analyses in the area of international logistics and storage are based on discussions and initial indicative price offers from various providers. They will be updated and continued on an ongoing basis and several transport routes and storage destinations will be considered for the time being.

In general, it is clear that the international transport and storage of CO_2 is a market that is still in the development phase. As the various links in the CCS value chain are being established simultaneously, it is difficult to predict how the market will develop over the next few years. Even though

the construction of a Europe-wide CO_2 pipeline infrastructure is under discussion, it must be assumed that no pipeline network will be available in the near future. Transport by road using lorries may be appropriate for small quantities of CO_2, but is not suitable for larger quantities of CO_2 in combination with the long transport distances. For the planned CCS plant at the Linth waste incineration plant, the use of rail tank wagons was therefore chosen as the technically available means of transport for international CO_2 transport that is suitable for the quantities involved.

Environment

Another focus was on investigations into air pollution control during amine scrubbing. In order to deepen our understanding of the resulting emissions, the CO_2 Competence Centre took part in a project at the Amager Bakke incineration plant in Copenhagen, Denmark. An amine-based pilot plant was operated there for a period of one year. In all measurement campaigns, the emissions of the amines used were in a range that would be too high for a commercial plant. In order to achieve tolerable emission values, it appears to be essential to avoid the formation of aerosols during the separation process, as these are difficult to remove afterwards. The findings from Copenhagen and other pilot plants show that fine aerosols/particles in the WTE plant waste gas stream can lead to high amine emissions, even if otherwise optimum operating parameters are maintained and neutral and acidic scrubbing stages and droplet separators are used for the waste gas after separation. As WTE plant waste gases are insufficiently characterised in this respect, the CO_2 Competence Centre plans to carry out measurements at various WTE plants in Switzerland.

In order to be able to estimate the resulting emissions, the competence centre commissioned the Tchnical university Graz to develop a dispersion model suitable for Switzerland. This was necessary because atmospheric chemical reactions have to be taken into account, which until now have only been included in models that are not suitable for the uneven topography in Switzerland. The model was developed using the example of the Horgen waste incineration plant (Zimmerberg disposal) and the results are used for the approval process, which is closely monitored by the CO_2 Competence Centre for Air Pollution Control. It has been shown that it is a major challenge to be able to comply with the current immission targets by calculation.

The immission concentrations of the relevant substances should be measured before and after the commissioning of an amine-based CCS plant.

The competence center has therefore conducted test measurements of air and water samples in the vicinity of the Horgen waste-to-energy plant (KVA Horgen). No nitrosamines were detected in these samples. However, the technically achievable detection limits—particularly for air measurements—are significantly higher than the target value thresholds. As a result, compliance with the target ambient concentrations cannot currently be verified using available measurement technology.

The approvability of an amine scrubbing system must therefore be critically assessed under the current conditions and requires further efforts, especially since several conservative assumptions are currently compounding:

- Due to limited operational experience, suppliers are cautious about guaranteeing low emission levels Conservative and simplifying assumptions are necessary in dispersion modeling
- The calculation of the target ambient concentration by FOEN/cantons is based on conservative assumptions
- The valuable collaboration between the CO_2 Competence Center, the cantons, and FOEN on this topic will be continued.

HPC pilot plant at KEZO

The main advantage of the HPC process lies in the fact that no substances harmful to health are used or generated during the process—provided no additives are employed. KEZO is therefore planning the construction and operation of a pilot plant for this process. Work on this project has continued and is being closely supported by the ZAR CO_2 Competence Center. The plant is scheduled to go into operation at the end of 2026 and will supply the captured CO_2 to the surrounding greenhouses

Team KVA Linth/ZAR, Niederurnen

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Public Relation

Competence Center KEZO, Hinwil (ZH)

Interest from Switzerland and abroad was also high in 2025. Numerous delegations were welcomed and informed about the development projects and the 24/7 operation of bottom ash processing at ZAV Recycling AG.

Visitor groups/guided tours

- AWEL (Office for Waste, Water, Energy and Air – Zurich Cantonal Authority)
- BAFU (Federal Office for the Environment FOEN – Switzerland)
- Holcim Switzerland Ltd
- Saudi Investment Recycling Industry
- China Nonferrous Metals Industry Association Recycling Metal Branch (CMRA)
- Mingtai Al Group (China)
- SGM with Spanish clients
- Magaldi with clients
- Reworld
- Kanadevia Inova AG
- Kanadevia Inova England
- Recycling World AG
- Suez France
- Goldkammer Switzerland
- AST-Turbo Ltd
- STAG Ltd
- Wien Energie (Vienna Energy)
- Magaldi-Days
- ClimatePartner Switzerland Ltd
- VCU Linth
- Zurich City Councillor Ms Brander
- Satom SA
- KVA Thurgau (WTE Plant Thurgau)
- Limeco
- KVA Winterthur (WTE Plant Winterthur)
- Industry Hinwil

Conferences

- IBAX-Meeting, Wien, Österreich
- 3-Ländertagung, Neuenburg, CH

Competence Center KEBAG, Zuchwil

Visitor groups/guided tours

- Luc Desender, Renasci Oostende
- Kanadevia Inova AG / Covanta
- Galliker / Vermeille
- TR und Infraserv
- Tobias Schleicher, Atiemo Sampson, Atiemo Nana
- Magaldi S.r.l. / Covanta
- Luc Desender mit AIK und Kanadien
- TR mit KNRN, DWA
- Kanadevia Inova AG

Conferences

- GDMB Zinkausschuss Nordenham

CO2-Kompetenzzentrum, KVA Linth

Präsentations

- Presentation Forum Sector Coupling OST, Rapperswil
- Presentation Sustainability Days, Basel
- Presentation Parliamentary Group Renewable Energies aeesuisse, Bern
- Presentation Wood Energy Symposium, Zurich
- Presentation VBSA Climate Fund Event, Bern
- Participation Greenhouse Gas Control Technologies Conference (GHGT-17), Calgary Canada

Travels abroad

- Pilot plant at WTE plant Amager Bakke, Copenhagen, emission measurement project

Foundation

Excerpt from the foundation certificate

Art. 2 Purpose of the foundation

The purpose of the foundation is to promote a sustainable materials policy for the treatment and recycling of waste. It promotes the further development of state-of-the-art technology and supports the corresponding development activities which are to take place in the immediate vicinity of the waste-to-energy plant of the Zweckverband Kehrichtverwertung Zürcher Oberland KEZO in Hinwil/ZH or its legal successor. The foundation can also support the commercial exploitation of the findings.

With a broad Swiss sponsorship and cooperation with interested parties, it is intended to ensure that the knowledge gained is incorporated into plant development and plant construction in Switzerland or abroad.

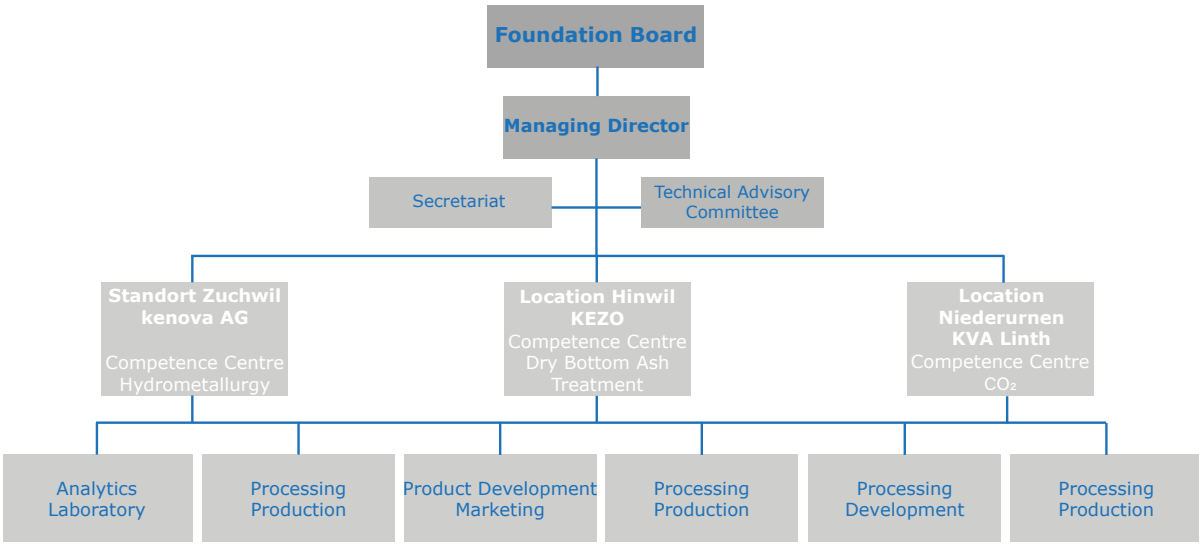
The purpose of the foundation can be extended to activities with similar objectives at a later date.

We reserve the right to change the purpose of the foundation in accordance with Art. 86a ZGB (Swiss Civil Code). The foundation does not pursue any commercial purposes and is not profit-oriented.

Founders

VBSA
Verband der Betreiber Schweizerischer Abfallverwertungsanlagen
(Swiss Association of Waste-processing Plants)
Kanton Zürich
Baudirektion, Amt für Abfall, Wasser, Energie und Luft (AWEL)
Department for Waste, Water, Energy and Air of the Canton of Zurich)
KEZO
Zweckverband Kehrichtverwertung Zürcher Oberland, Hinwil
(Association of Waste Disposal for the Zurich Oberland, Hinwil)

Organisation Chart



Foundation Board

Adam, Franz (President)	Senior Consultant
Brunner, Urs	VfA - Association for Waste Disposal Buchs SG, Managing Directo
Christen, Daniel	SARS Stiftung Auto Recycling Schweiz, Managing Director
Furgler, Walter KVA Linth	Managing Director
Dr. Gablinger, Helen	Kanadevia Inova AG, Director Product & Marketing Energy from Waste
Juchli, Markus	KEBAG AG, Director
Marti, Jakob	Former Head of the Environment, Forestry and Energy Department (Glarus)
Martin, Ulrich	MARTIN GmbH, Owner
Morgan, Kurt	NEROS NEROS Network Mineral Resources Switzerland, Managing Director
Schucan, Christian	KEZO Hinwil, Chairman of the Board of Directors

Technical Advisory Board

Dr. Morf, Leo (Vorsitz)	AWEL, deputy section head, sewage sludge,
Bolliger, Markus	Jura Cement AG, Wildegg
Budde, Ivo	Hitachi Zosen INOVA AG
Prof. Dr. Ing. Deike, Rüdiger	Institute of Metal Technologies, University of Duisberg-Essen
Prof. Dr. Hellweg, Stefanie	ETH Zürich, Institute for Environmental Engineering, Zurich
Dr. Ing. Koralewska, Ralf	MARTIN GmbH, Munich
Lieball, Kai	Kanadevia Inova AG
Dr. Liechti, Jürg	Neosys AG, Gerlafingen
Dr. Ing. Warnecke, Ragnar	GKS - Gemeinschaftskraftwerk Schweinfurt GmbH
Wermeille, Christiane	Fed. Office for the Environment (FOEN), Raw Materials & Waste Division

Donations

AIK Technik AG	Sursee
ERZ Entsorgung + Recycling Zürich	Zürich
Entsorgung Zimmerberg	Horgen
Kanadevia Inova AG	Zürich
kenova AG	Zuchwil
Magaldi Industrie s.r.l.	Salerno (I)
MARTIN AG für Umwelt- und Energietechnik	Wettingen
Renergia Zentralschweiz AG	Perlen
SARS Stiftung Auto Recycling Schweiz	Bern
SATOM AG	Monthey
Verband KVA Thurgau	Weinfelden
ZAV Recycling AG	Hinwil

Project contributions CO_2 Competence Center

Bundesamt für Umwelt BAFU	Bern
VBSA Klimafonds	Bern
KVA Linth	Niederurnen
KEZO Kehrichtverwertung Zürcher Oberland	Hinwil
Stiftung Glarner Kantonalbank	Glarus

Finanzbericht

Financial Report

	2024 [CHF]	Budget 2024 [CHF]	2023 [CHF]
Donations	510 000.00	530 000.00	530 000.00
Other income	1 257.40	0.00	1 130.00
Subsidies / funding contributions FOEN	426 600.00	150 000.00	327 200.00
Service income	596 211.40	500 000.00	579 594.68
Income	**1 534 068.80**	**1 180 000.00**	**1 437 924.68**
Material costs	-1 434.00	-92 000.00	-2 216.82
Analysis costs	-17 909.22	-91 000.00	-3 832.51
Expenses for third-party services	-1 111 955.88	-814 000.00	-461 512.23
Change in project reserves	422 037.49	1 030 000.00	-262 096.21
Expenses for materials, goods & 3-party services	**-709 261.61**	**33 000.00**	**-729 657.77**
Gross profit after cost of materials and goods	**824 807.19**	**1 213 000.00**	**708 266.91**
Labour costs	-555 108.18	-859 000.00	-524 630.10
Social security costs	-119 349.33	-215 000.00	-112 588.82
Training and further education of employees	-2 351.30	0.00	0.00
Other personnel expenses	-10 799.20	0.00	-19 115.05
Personnel expenses	**-687 608.01**	**-1 074 000.00**	**-656 333.97**
Gross profit after personnel expenses	**137 199.18**	**139 000.00**	**51 932.94**
Maintenance and repairs	-1 403.73	-20 000.00	0.00
Administrative expenses	-53 591.82	-65 000.00	-7 894.32
IT	-7 094.80	0.00	-4 947.46
Advertising expenses	0.00	-5 000.00	0.00
Representation expenses	-2 990.93	-2 000.00	-789.89
Foundation Board costs	-4 933.92	-5 000.00	-6 005.20
Technical Advisory Board costs	-159.06	-1 000.00	-171.71
Other operating costs	-88.30	0.00	0.00
Travel expenses	-2 315.36	0.00	-1 803.12
Foundation Board fees	0.00	0.00	0.00
Other operating expenses	0.00	-30 000.00	0.00
VAT expenses Subsidies	-41 059.55	0.00	-14 298.98
VAT expenses Subsidies	**-113 637.47**	**-128 000.00**	**-35 910.68**
Operating result before depreciation & interest	**23 561.71**	**11 000.00**	**16 022.26**
Depreciation and value adjustments	0.00	0.00	0.00
Operating result before interest	**23 561.71**	**11 000.00**	**16 022.26**
Financial expenses	-283.41	0.00	-258.50
Financial income	16 950.00	0.00	15 362.50
PROFIT (+) /LOSS (-) FOR THE YEAR	**40 228.30**	**11 000.00**	**31 126.26**

Balance Sheet

	31.12.2024 [CHF]	31.12.2023 [CHF]
Assets		
Raiffeisenbank Uster, current account	2 391 143.83	2 608 323.00
Cash and cash equivalents	**2 391 143.83**	**2 608 323.00**
Trade receivables from third parties	571 336.40	0.00
FTA receivable	14 230.62	5 376.88
Withholding tax credit	5 932.50	0.00
Trade receivables from goods & services	**591 499.52**	**5 376.88**
Prepaid expenses and deferred charges (TA)	0.00	219 531.45
Prepaid expenses and deferred charges	**0.00**	**219 531.45**
Current Assets	**2 982 643.35**	**2 833 231.33**
iCAP 7600 ICP-OES Duo (analyses equipment)	87 789.84	87 789.84
Spectro Blue 138491	60 217.92	60 217.92
Vibrating disk mill	22 109.83	22 109.83
Value adjustments of tools and equipment	-170 117.59	-170 117.59
Movable assets	**0.00**	**0.00**
Fixed assets	**0.00**	**0.00**
TOTAL ASSETS	**2 982 643.35**	**2 833 231.33**
Liabilities		
Accounts payable to third parties	841 796.07	0.00
Creditor FTA, value added tax	0.00	34 271.65
Liabilities from deliveries & services	**841 796.07**	**34 271.65**
Accrued expenses and deferred income (TP)	233 546.46	509 849.67
Deferred Projects	1 624 127.71	2 046 165.20
Accrued expenses and deferred income	**1 857 674.17**	**2 556 014.87**
Short-term liabilities	**2 699 470.24**	**2 590 286.52**
Foundation Capital	100 000.00	100 000.00
Foundation Capital	**100 000.00**	**100 000.00**
Project reserves	142 944.81	111 818.55
Annual result	40 228.30	31 126.26
Reserves, Retainesd earnings	**183 173.11**	**142 944.81**
Equitiy capital	**283 173.11**	**242 944.81**
TOTAL LIABILITIES	**2 982 643.35**	**2 833 231.33**

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An den Stiftungsrat der

Stiftung Zentrum für nachhaltige Abfall- und Ressourcennutzung ZAR, Hinwil

Brüttisellen, 07.04.2025

Bericht der Revisionsstelle zur eingeschränkten Revision

Als Revisionsstelle haben wir die Jahresrechnung (Bilanz, Erfolgsrechnung und Anhang) der Stiftung Zentrum für nachhaltige Abfall- und Ressourcennutzung ZAR für das am 31.12.2024 abgeschlossene Geschäftsjahr geprüft.

Für die Jahresrechnung ist der Stiftungsrat verantwortlich, während unsere Aufgabe darin besteht, die Jahresrechnung zu prüfen. Wir bestätigen, dass wir die gesetzlichen Anforderungen hinsichtlich Zulassung und Unabhängigkeit erfüllen.

Unsere Revision erfolgte nach dem Schweizer Standard zur Eingeschränkten Revision. Danach ist diese Revision so zu planen und durchzuführen, dass wesentliche Fehlaussagen in der Jahresrechnung erkannt werden. Eine eingeschränkte Revision umfasst hauptsächlich Befragungen und analytische Prüfungshandlungen sowie den Umständen angemessene Detailprüfungen der beim geprüften Unternehmen vorhandenen Unterlagen. Dagegen sind Prüfungen der betrieblichen Abläufe und des internen Kontrollsystems sowie Befragungen und weitere Prüfungshandlungen zur Aufdeckung deliktischer Handlungen oder anderer Gesetzesverstösse nicht Bestandteil dieser Revision.

Bei unserer Revision sind wir nicht auf Sachverhalte gestossen, aus denen wir schliessen müssten, dass die Jahresrechnung nicht dem schweizerischen Gesetz, der Stiftungsurkunde sowie den Reglementen entspricht.

baumgartner & wüst gmbh

Simon Wüst
Zugelassener Revisionsexperte
(Prüfungsleitung)

Kendrim Kadriu
Zugelassener Revisionsexperte

Beilage
Jahresrechnung


AUTOMATIC
START-UP
MACHINE

Image caption

Front page	Trommel screen for separating non-metallic steel
Page 6	Visualisation of Trommel screen closed / open
Page 7	Ceramic apex with support plate
Page 8	View of the warehouse for cleaned ferrous scrap (©ZAV Recycling AG)
Page 9	Visualisation of robot sorting for coarse particle separation
Page 13	Annual electricity output without CCS (red) and with the two separation technologies amine washing (blue) and HPC- process (green) for the two district heating scenarios 70 GWh/a (left) and 190 GWh/a (right) (©KVA Linth)
Page 14	Visualisation of CCS at the Linth site for the HPC process: Separation, compression, drying and waste heat utilisation (© KVA Linth)
Page 15	Stefan Ringmann and Daniel Marxer visiting the pilot plant at the Amager Bakke waste incineration plant in Copenhagen as part of an emissions measurement project. The upper part of the absorber column can be seen in the background.
Page 21	Separated brass metal part
Page 25	Aluminium cleaning plant (©ZAV Recycling AG)

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