JULY 2021

IMPACT STATEMENT

Cling Systems AB, Organisationsnummer 559254-8332

TABLE OF CONTENTS

Cling Systems - The online mine

MESSAGE FROM OUR CEO

Currently, the transportation industry is responsible for over 60 % of global greenhouse gas(GHG) emissions. In order to dramatically reduce our emissions from transportation by 2030, in line with the Paris agreement, we need to electrify our vehicle fleets. Electrification of our transportation sector also addresses issues such as air-quality and pollution which are also targets included in the United Nations Sustainable Development Goals. So, the automotive industry, and in particular actors producing vehicles for personal mobility such as cars and electric scooters are all betting on electrification to solve the GHG issues of the transportation sector. But, it is not that simple because in order to electrify cars, you need batteries. And there are big problems with today's linear battery supply chains related to human rights, climate change, political instability, irresponsible water consumption and child labor.

Batteries themselves do not capture any carbon nor reduce emissions. Batteries are only as sustainable as the emissions they avoid, meaning emissions avoided from using an electric vehicle compared to using a vehicle with a combustion engine. But, it is important to consider the entire life cycle of the vehicle and this is where the production and disposal of the battery enters the picture. *Today, there are big gaps in battery supply chains making it hard to utilize the battery's full capacity, and in particular recycle the materials after it has reached its end of life. This is the problem that Cling aims to solve.* By closing the loop on battery supply chains, we aim to recycle and re-use all batteries which will not only decrease the need for raw material extraction but also directly target six of the United Nations SDGs. This report is our Impact Statement and will tell you about the positive impact we wish to make across multiple dimensions of sustainability.

"BATTERIES ARE ONLY AS SUSTAINABLE AS THE EMISSIONS THEY AVOID. WE MUST DRASTICALLY MINIMISE EACH BATTERY'S CARBON DEBT"

WILLIAM BERGH, CEO

EXECUTIVE SUMMARY

Lithium-ion batteries enable electrification of our transportation and energy industries. However, they carry heavy social, environmental and geopolitical burdens where circularity plays a critical role.

THE INDUSTRY LACKS THE CAPACITY FOR CIRCULAR VALUE CHAINS

Currently, the battery ecosystem is scattered, fragmented and with limited collaboration between stakeholders. This creates linear supply chains with various issues, such as environmental (high levels of waste and enormous consumption of freshwater and raw materials), economical (few actors dominating the sector) and social (slavery and child labor). The industry lacks the tools to close the loop to ensure efficient recycling and transparency.

THE SOLUTION - AN ONLINE MINE

Simple listing for sellers creates battery stock that can capture used batteries on a global scale and close the loop. Cling's online mine will enable 100% circular battery supply chains, targeting the specific social, environmental and economical challenges related to battery production.

KPI

Kilograms of avoided CO2 equivalent emissions

METHODOLOGY

CO2 equivalent emissions avoided through conveying EOL batteries to recycling or re-manufacturing, calculated as:

Avg CO2 emissions avoided per kWh

X

kWh of battery capacity conveyed

PERFORMANCE

2021: 6 tons of CO2eq- emissions avoided (July) (0.06 MWh)

TARGET 2021

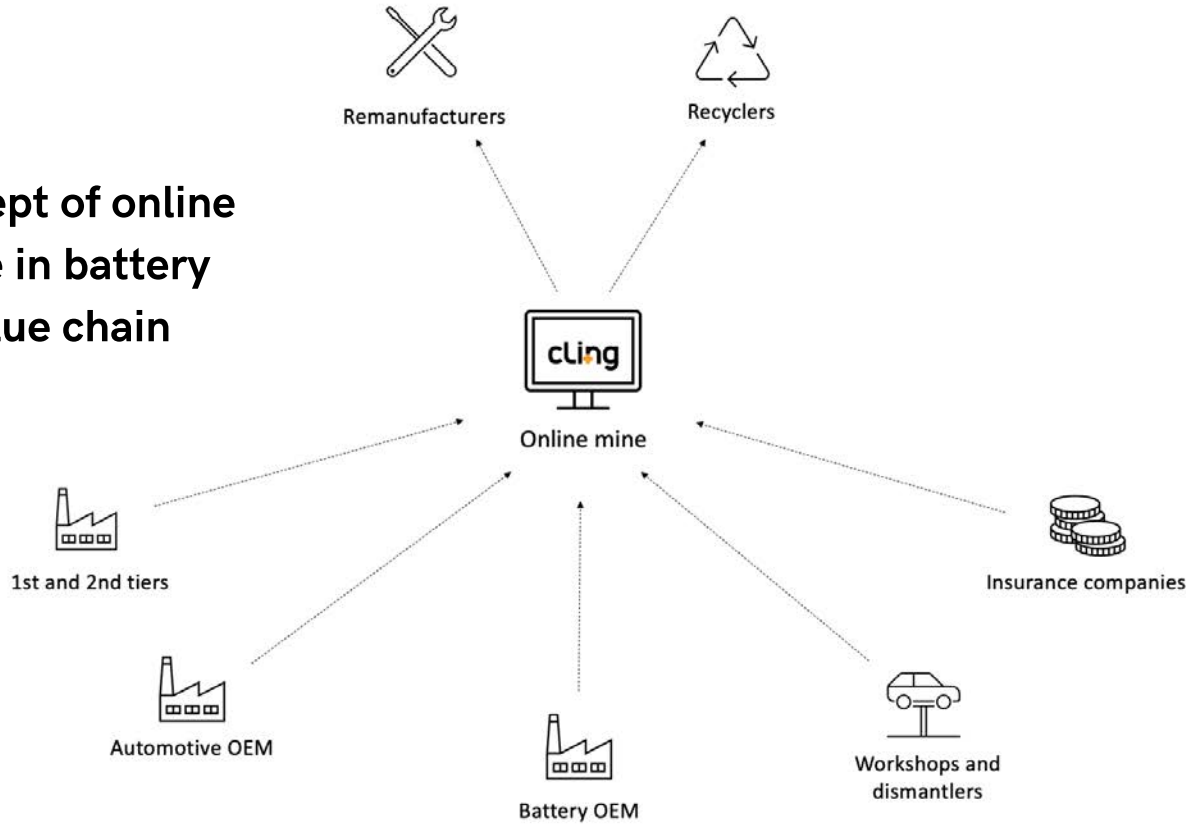
2021: 50 tons of CO2eq-emissions avoided (0.5 MWh)


cling
ABOUT CLING

THE CLING PLATFORM

ABOUT CLING

Concept of online mine in battery value chain



In a circular model, the life cycle of a product is constituted by the sum of multiple smaller life cycles. When a battery has fulfilled its purpose in a vehicle it is repurposed to a new user. The battery's life is extended through recirculation, and we are using the planet's resources in a more efficient way. In theory, it is very simple. The challenge is to apply this in reality which sets high demands on logistics, management and cooperation.

The online mine will work as a platform in order to match battery owners with recyclers/re-manufacturers. A match that is not being made today. Through the online mine, the right battery will find its way to the right new owner along with the right data requested by the buyer. Data such as state, capacity left and chemical composition is crucial for the new owner to have in order to enable efficient recycling/remanufacturing. This data will therefore be provided through the online mine.

ABOUT CLING

ABOUT CLING

Cling was founded on the fundamental promise to contribute to creating a more sustainable world. In order to achieve this, Cling's vision is to make sustainable energy sustainable by closing the loop on today's linear battery supply chains. This will be achieved by developing the world's first online mine to supply battery recyclers with circular and sustainable raw materials. By solving the issue of unstable battery production, Cling will impact the world not only on environmental issues but on social and economic issues as well. When we succeed, we visualize a world where the entire value chain regarding batteries is circular, meaning that all new batteries are produced with materials retrieved from old ones.

In order to reduce GHG emissions from the transport sector, there is a need to introduce more electric vehicles since they emit significantly less CO2 while being used. However, problems occur when one looks at the entire life cycle of an electric vehicle, where the battery plays a considerable role. Today, the production of EV batteries consumes unsustainable amounts of energy while emitting considerable amounts of GHG gases. In addition to this, there are ethical and social dilemmas connected to the extraction of raw materials. In order to deal with these issues, stakeholders agree that more batteries need to be recycled at a higher efficiency rate. This is where Cling enters the picture.

Issues that make repurposing hard and why batteries end up in landfills:

- Insufficient infrastructure for return flows of electric vehicle batteries
- A lack of knowledge regarding how to take care of EOL LiB batteries
- Limited ways for recyclers and re-manufacturers to connect with battery owners, creating gaps in the supply chain

Purpose

To accelerate the transition to a sustainable future through circular energy storage

Vision

A future where the resources for a sustainable society are circular, used efficiently and fairly. Where mining is replaced by recycling. A future where waste is an accessible and valuable resource.

Mission

To develop the global solution that enables circular value chains of lithium-ion batteries. To challenge the material extraction industry by consolidating and giving access to critical raw materials. To be the first online mine.

WHO WE ARE

ABOUT CLING

By combining unique expert competence within battery technology and experience from the automotive, recycling and venture capital industry, we are a diverse team who want to make an impact on our planet. In only one year, we have grown from a single founder to a team who are all working towards a common goal: to revolutionize the battery industry.

Our platform and services are niched towards the automotive and electromobility-industry, allowing us to get to know our customers' preferences and provide unique services specifically designed for our customers.

We are a young and entrepreneurial company with a lot of drive and engagement which permeates the entire organization. People that join Cling are smart individuals from all disciplines that are strong and truly want to make a positive impact on our planet. We share a mutual passion for sustainability, and we believe that the road to get there is creativity and innovation. As a team, we're dedicated to thinking new, working hard and having fun.

In order to achieve our goals and make an impact, it is crucial to be reliable and compliant, which is why we are focusing on building trust towards our stakeholders as well as getting the right certifications.

IMPORTANT MILESTONES SO FAR

ABOUT CLING

FIRST TRANSACTION AND ESTABLISHED PARTNERSHIP WITH VOLTFANG

In January 2021, we made our first transaction where we successfully sold and transported a battery from Uppsala, Sweden to Aachen, Germany. The buyer, Voltfang, is now an established partner that we have made further transactions with. Voltfang is a german-based startup that specializes in re-building EOL EV batteries to ESS to back up the electricity grid.

VOLTFANG

Sting

<norrsken>

STING ACCELERATE CLIMATE ACTION PROGRAM

In February 2021, Cling Systems was accepted to the Climate Action Accelerator program at Sting - Stockholm Innovation and Growth. Cling was one of six carefully selected climate startups to get support from Sting in order to turn our vision into reality and increase our chances of success. Sting offers one of the most extensive startup support ecosystem in the Nordics.

NORRSKEN IMPACT ACCELERATOR

In July 2021, Cling was accepted to be a part of the Norrsken Impact Accelerator, a dedicated 8 week sprint at Norrsken House Stockholm with mentorship from world-class founders including unicorn founders, and an upfront 100K dollar pre-seed investment.

+IMPACT ACCELERATOR

In May 2021, Cling was accepted to the +Impact Accelerator hosted by Danske Bank, WeWork Labs and RISE. +Impact Accelerator is a program specifically designed to bridge the gap between entrepreneurial visions and profitable companies.

+impact accelerator

VINNOVA INNOVATIVA STARTUPS STEP 1

In the spring of 2021, Cling received grant money from the Swedish innovation authority Vinnova from the fund Innovativa startups. Innovativa startups is a grant aimed at young companies targeting sustainable development.

LU INNOVATION

In the fall of 2020, Cling recieved grant money from the Lund University innovation department, LU Innovation. LU innovation supports researchers and entrepreneurs connected to Lund University that want to improve our world and the lives of people.

EAST STREAM 1

Since early 2020, Cling has been a part of the EAST project, a feasibility study with the aim of developing collaboration between trading partners in the automotive supply chain with new technologies. The purpose is to explore the potentials of utilizing Blockchain in the automotive supply chain by gathering OEMs, suppliers, transport companies, researchers, specialists and other stakeholders. The project streams that have been outlined are i) EV Battery Life Cycle Management and ii) Improvements of the Automotive Supply Chain. The project is funded by the Swedish Innovation Authority Vinnova. Participating actors can be seen below.


cling
SUSTAINABILITY
STRATEGY

STRATEGIC ALIGNMENT

SUSTAINABILITY STRATEGY

Since our business idea is based on circular economy, sustainability is integrated into our core business activities. Our business idea and strategies are all part of our goal of being an accelerating force towards re-using and recycling batteries. We believe that the right way to achieve this is by cooperation, which is why we are working hard on building trust and becoming a reliable stakeholder within the industry.

Sustainability to us is not restricted to our solutions aimed at climate change. It is also the way we run our business, connect with people and how we will measure our performance.

Ebba Bratt, Head of Sustainability

MESSAGE FROM OUR HEAD OF SUSTAINABILITY

I started working at Cling because it was this kind of idea that made me feel positive about the future. I believe that in order to reach the targets set in the Paris agreement in 2015, we need to bet on innovations just like Cling. It is by being bold and creative that we will reach the goal of being carbon-neutral.

To me, sustainability has always not only been about the climate but about people. The big issues related to human rights across battery supply chains is heartbreaking and the automotive industry needs to do more to combat these issues because we will never be able to call ourselves sustainable without having a 100% sustainable supply chain. Journalists have been reporting about child labour in Congo for years, but the EU is still very much reliant on Cobalt extracted in Congo and refined in China in order to electrify our vehicle fleets and call ourselves sustainable.

But, things are about to change, the EU and the Swedish government has presented a new battery directive where circularity, recycling and transparency will be key points for battery manufacturers. This makes us at Cling not only strategically positioned from a business point of view but also from a sustainability perspective defined by legislators.

SUSTAINABILITY MANAGEMENT

SUSTAINABILITY STRATEGY

At Cling, management is the key responsible for the organization, and, thus, also that we work actively with sustainability in all decisions. This includes sustainability strategy, goals and policies.

Our head of sustainability is responsible for setting the strategies, implementing them and following up. As mentioned earlier, sustainability is a part of our core business and implemented across all business activities. As a basis for our active sustainability work, we have the following: Stakeholder dialogues, Risk analysis, Climate Impact, UN Global SDGs, ISO-standards.

STAKEHOLDER DIALOGUE
We work closely with our stakeholders and keep continuous dialogues regarding how to increase our positive impact, across the entire battery supply chain, see section 2.5.

RISK ANALYSIS
Sustainability risks are continuously being identified, evaluated and managed.

CLIMATE IMPACT
We continuously measure our environmental footprint and handprint, see section 3.1.

UN GLOBAL SDGS
The United Nations sustainable development goals are integrated into our core business activities, see section 2.6.

ISO 14001
Cling is aiming towards becoming certified according to the international standard for environmental management, ISO 14001. The system includes environmental, quality and work-environment related topics. We aim to become certified by having structured routines for dealing with deviation management and tools for change management.

VALUE CREATION

SUSTAINABILITY STRATEGY

Our fundamental goal is to contribute with value to the planet across the entire supply chain. That is why we are aiming to work closely with all our stakeholders to create a positive impact, socially, environmentally and economically.

Commerical

Our economic growth is directly correlated with positive climate impact. We unite sustainability with profitability.

Social

We aim to provide a safe, equal and inclusive work environment where we encourage diversity and respect human rights across the entire battery supply chain.

Environmental

We minimize waste through recycling and re-using. By circulating batteries, we prevent the extraction of virgin raw materials. We contribute to the avoidance of CO2 emissions. We are implementing the circular economy, for real.

EXTERNAL MONITORING

SUSTAINABILITY STRATEGY

2020 is a year we will all remember due to the coronavirus pandemic. However, Cling will remember it as the year we were founded. While other companies had to adjust to the restrictions and lock-downs, the disrupted supply chains and the health emergencies, Cling saw this as the perfect opportunity to decarbonize the battery industry towards becoming green. We chose to see the pandemic as the perfect opportunity to restart the automotive and transportation industry, with sustainability as a core business goal, and it looks like we are not alone.

EUROPEAN EV MARKET 2020

In 2020, Norway became the first country in the world where the share of electric vehicles out of the total newly registered cars exceeded 50% (in fact 54%), reaching the majority, which makes electric vehicle sales in Norway 10% of the total in the EU where the share across the entire union is at 4% (Teknikens värld 2020). 2020 in Sweden was a strong year for the electric vehicle market where 9.6% of all newly registered cars were electric and 22.6% plug-in hybrids, compared to 4.4% and 7% in 2019. This ranked Sweden among the top countries in the EU when it comes to share of electric vehicles of total newly registered vehicles (Elbilen 2021).

The European market for 2021 is projected to heavily increase by three times compared to 2020. One often mentioned reason for this is the increasingly tough emissions regulations set by the EU, where car producers have to ensure that their cars emit less than 95 g of CO2 per kilometer driven. This is difficult to reach with ICE vehicles (GP 2020).

NORTHVOLT AND THE NEW SWEDISH BATTERY INDUSTRY

In late 2016, Northvolt was founded in order to revolutionize the European battery industry by creating the world's greenest battery. Since its foundation, Northvolt has started the production of (to date) one Gigafactory in northern Sweden as well as pack production facilities in Poland and Germany. Previously, Northvolt had announced partnerships with OEMs like Volkswagen, Scania and BMW. On June 21 2021, they announced further partnerships with Volvo Cars which makes all of the largest OEMs within the Swedish automotive industry engaged in developing the world's greenest batteries (Northvolt 2021).

There is no doubt that the entry of Northvolt has created synergies within the Swedish (and European) automotive industry, and has accelerated the road towards a fully electric vehicle fleet. Their target is to produce a battery that has a life cycle impact of 10 kg CO2eq per kWh of battery capacity (Northvolt 2020).

EU BATTERY DIRECTIVE

In December 2020, the European Commission proposed a new Batteries Regulation that aims to ensure that batteries placed in the EU market are sustainable and safe throughout their entire life cycle. This means batteries that are produced with the lowest possible environmental impact, using materials obtained in full respect of human rights as well as social and ecological standards. This also includes that at the end of their life, they should be repurposed, remanufactured or recycled, feeding valuable materials back into the economy (European Commission 2020).

SWEDISH GOVERNMENT INITIATIVES

In December 2020, the government in collaboration with Fossilfritt Sverige presented a strategy for obtaining a sustainable battery value chain for Sweden. The strategy includes recommendations to stimulate the extraction and recycling of secondary raw materials for increased circular material flows. It will also be used to develop criteria for sustainable and traceable batteries through impact and collaboration (Fossilfritt Sverige 2020).

STAKEHOLDER DIALOGUE

SUSTAINABILITY STRATEGY

As a part of the materiality analysis, we continuously analyze and keep dialogues with our different stakeholders in order to be better aware of their expectations. Our customers represent the entire ecosystem of the automotive and electromobility industry with one common in goal: To capture the value in used batteries. The customers include car dismantlers, OEMs, battery recyclers, battery manufacturers, battery re-manufacturers. From established industrial enterprises to small workshops and growing startups, we work with all professionals who wants to circulate batteries.

In the future, keeping a dialogue with our stakeholders will be a part of the materiality analysis to make sure that we are working with the right issues and meeting our customers demands. So far, we have been able to ask questions regarding what stakeholders believe is missing in the battery ecosystem today and we have used this information to prioritize different topics. We will continue to investigate what topics are of which importance to different stakeholders and plan to include other ways of measuring, such as surveys, in our dialogues with stakeholders.

STAKEHOLDERS

Car dismantlers
Workshops
Battery recyclers
Battery remanufacturers
Insurance companies
Fleet owners
Authorities
Coworkers
Shareholders

IMPORTANT TOPICS

Sustainable and smart packaging
Innovation in circular economy
Increased rate of reuse
Efficient material handling
Better waste disposal
Transparency
Traceability
Sustainability reporting

WHERE ARE WE TODAY?

Today, batteries from crashed vehicles are being stored in container fields.

- In an internal investigation performed in June 2020, car dismantlers expressed strong irritation regarding the EV batteries that were coming in with scrapped vehicles. They did not have the processes nor knowledge to deal with this since the batteries couldn't be handled in the same way as traditional spare parts.This resulted in landfilling of batteries in the backyards of car dismantlers. There is a strong demand for an actor who can take care of their batteries, and preferably get rid of them for a profit.

- Recyclers and remanufacturers have expressed concerns regarding the the difficulties of getting their hands on EOL batteriers, and wish for easier sourcing.

WHAT DO OUR CUSTOMERS WANT IN 2030?

Sales of electric vehicles are skyrocketing, and we predict that our customers will demand processes and efficient return-logistics for dealing with large volumes, and preferably with standardized systems.

- To have solid demands on our suppliers regarding sustainability
- To have built up strong relationships that rely on transparency and traceability
- Common standardised method and tool used to measure and reduce emissions in the supply chain

UNITED NATIONS SDGS

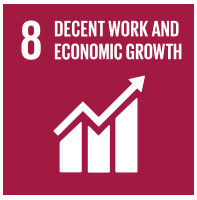
SUSTAINABILITY STRATEGY

Since our mission is to dissolve linear battery supply chains and implement a circular economy, the United Nations goals for sustainable development is a crucial part of our core business and are therefore integrated into our business strategy. Out of the 17 we have chosen six where we make the most difference.

THE GLOBAL GOALS + cling

Target 7.a
By 2030, enhance international cooperation to facilitate access to clean energy research and technology, including renewable energy, energy efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology.

Cling Impact
The Cling platform will enable cleaner energy storage through recycling and making energy storage for intermittent power sources more sustainable.



Target 8.7
Take immediate and effective measures to eradicate forced labor, end modern slavery and human trafficking and secure the prohibition and elimination of the worst forms of child labor, including recruitment and use of child soldiers.

Cling Impact
Cling aims to prevent ethical and social issues such as child labor related to the extraction of virgin raw materials as well as improve working conditions across the entire battery supply chains.

Target 9.2
Promote inclusive and sustainable industrialization and significantly raise industry's share of employment and gross domestic product, in line with national circumstances

Cling Impact
Cling aims to disrupt the traditional mining industry, making it sustainable and ethical.

Target 12.2
Sustainable management and use of natural resources
Target 12.4
Responsible management of chemicals and waste throughout their lifecycle
Target 12.5
Substantially reduce waste generation

Cling Impact
Cling aims to decrease the consumption of natural resources through eased recycling of raw materials. Cling aims to enable transparent battery lifecycles. Furthermore, Cling aims to facilitate the reduction of hazardous waste.

Target 13.1
Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries

Cling Impact
Cling aims to reduce the extraction of virgin raw materials as well as contribute to the reduction of GHG emissions.

Target 17.6
Enhance the global partnership for sustainable development

Cling Impact
Through increased transparency and decentralization, Cling aims to lower the thresholds for small actors and increase collaboration throughout the entire battery supply chain.

A SUSTAINABLE WORKPLACE

SUSTAINABILITY STRATEGY

Cling is an entrepreneurial driven company with clear and strong values. Since the core business is based on circular economy and sustainability, this is what defines the entire organization. We strive to be a workplace where people with vision and drive get the opportunity to excel and truly make an impact on our planet. In order to make this happen, we will not tolerate any kind of discrimination, harassment or hate. We implement all aspects of sustainability into our organization and strongly encourage all types of diversity. Cling encourages people of all colours, religious beliefs, ethnic background, sexual orientation and gender to be a part of the team and will work hard to include people that may stand far away from the labour market.

10

ENGAGE PEOPLE JULY 2021

2

DIFFERENT NATIONALITIES REPRESENTED

20%

FEMALE PEOPLE IN TOTAL

0%

WOMEN IN MANAGEMENT POSITIONS*

*We are not pleased with this distribution and are actively encouraging both men and women to join our team. Today our management team only consists of 2 people.

WORK ENVIRONMENT (SYSTEMATISKT ARBETSMILJÖARBETE)

Cling will work with a systematic work environment (Systematiskt arbetsmiljöarbete) improvements according to guidelines provided by the Swedish Work Environment Authority (Arbetsmiljöverket) including

- Evaluation of the organization
- Risk assessment
- Measure for risk mitigation
- Control and follow-up

WHO WE ARE

THE CLING TEAM TODAY

William Bergh
Founder and CEO

William is the founder of Cling. He is a huge battery nerd and you can ask him anything. He is also the one with the biggest knowledge on practical stuff like roadmap, funding and administration.

Mauro Avellaneda
Full Stack developer

Mauro is our king of software! He develops the platform, and works closely together with William. Ask him if you have questions on product development or other technical stuff.

Gunnar Magnusson
COO

If you are looking for someone with hands-on experience, Gunnar is your man. He started as one of the advisors at Cling, after leaving his position at Volvo Cars, but is now our COO. Ask him if you have questions about different stakeholders or actors at the market.

OUR ADVISORS

ABOUT CLING

All of our advisors are super nice and competent. Always reach out to them if you have a question that you believe they might have the answer to.

Axel Elmqvist: Axel is working as a Sustainability Lead at Verdane, and has previously worked at Material Economics. He knows a lot about sustainability, so feel free to ask him about impact!

David Schelin: David is the previous CEO of Ragnsells, one of the biggest recycling companies in Sweden. Now, he is a board member of re:newcell. Just like Axel, he knows a lot about sustainability and reycling in particular.

Ebba Lilliehöök: Ebba just started working with M&A at Klarna. She is a true business woman, and she knows a lot about M&A, investments and venture capital.

Claes Bidemar: Claes is a former CEO of Telia Ventures. He knows, just like Ebba, a lot about business. His speciality is building strong businesses. Therefore, you can ask him about financial models and business plans.

Gunilla Bergh: Not only is she the mother of William Bergh, she is also a really good marketer! She has been teaching at Berghs and is very helpful.

WORDS FROM OUR INTERNS

ABOUT CLING

All of our advisors are super nice and competent. Always reach out to them if you have a question that you believe they might have the answer to.

What is sustainability to Cling?
"It's everything. Cling was founded on the notion that batteries need to be sustainable in order to enable a global mobility transformation. Sustainability thus means that the full capacity of the battery is utilized in terms of energy, but also in terms of materials. And that is precisely what Cling is working towards."

Maximilian Mangelus, Battery Data Intern

What do you like about batteries?
"I like the thought of green technology as a solution to the climate crisis. I believe that people are unwilling to change their lifestyles even if the environment depends on it. Therefore, li-ion batteries are an important part of improving the environmental situation without forcing people to downgrade their standard of living."

Kajsa Jernetz, Business Development Intern

How do you work with sustainability in your daily work?
"I am searching for ways of how to make people interested and involved in making the supply chains of batteries more sustainable. While this starts with awareness, sometimes it might seem very hard to get the message across. This is where the internal team is super important, to remind each other of why we do what we do."

Helena Paic, Marketing Intern

What do you think characterizes Cling as a company?
"Problem solving, boldness, hard-working, selflessness, passion."

Johanna Sellin, Marketing Intern

Why did you start at Cling?
I started working at Cling because it was this kind of idea that made me feel positive about the future. I believe that in order to reach the targets set in the Paris agreement in 2015, we need to bet on innovations just like Cling. It is by being bold and creative that we will reach the goal of being carbon-neutral.
Ebba Bratt, Sustainability intern


cling
ENVIRONMENTAL
IMPACT

CLIMATE IMPACT

ENVIRONMENTAL IMPACT

Traditionally, a business cannot be run without leaving an ecological footprint. On the other hand, it is possible to decrease this footprint by using resources more efficiently, taking action for waste minimization and using renewable energy to power business activities. Additionally, it is possible to increase the organization's handprint, the positive environmental impact. Having in mind Cling's business idea, it is evident that the handprint is more relevant than the footprint. Cling strives to be climate positive, meaning that we reduce more CO2 emissions than we generate. One of our core business goals is to increase our positive handprint.

It is estimated that between 2021 and 2030, about 12.85 million tons of EV lithium ion batteries will reach their end-of-life worldwide, and over 10 million tons of lithium, cobalt, nickel and manganese will be mined for new batteries (Institute for energy research 2020).

By repurposing a battery to a new second life, we are indirectly preventing that customer from buying a brand new battery. If the customer is a recycler, the raw materials are taken care of and put into a new battery which in turn avoids the extraction of virgin raw materials. These environmental savings are hard to calculate but since this is our core business, Cling is putting a lot of resources to make sure that this is done right.

Figure 1 presents the material share of a cell available for recycling and figure 2+3 presents the share of GHG emissions generated in the different steps of the manufacturing process.

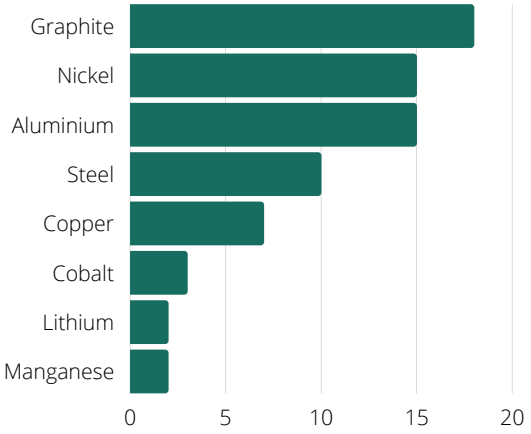


Figure 1: Material share of cell [%]

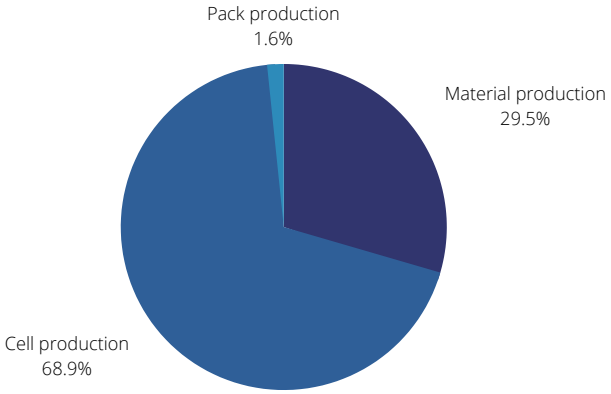


Figure 2: GHG emissions per kWh of battery capacity distributed over the production steps of a battery

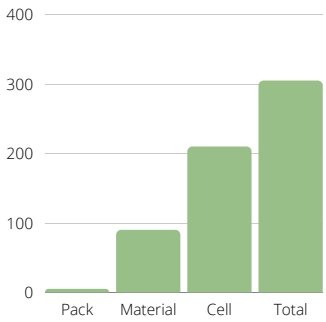


Figure 3: GHG emissions per kWh of battery capacity per production step

When calculating our potential climate impact, it is assumed that the match between buyer and seller would not be made without Cling, since this is the case today and the problem that we aim to solve.

Assuming that the buyer of the battery is a recycler and that the recycling process emits 10kg of CO2eq per kWh of battery capacity(Aichberger and Jungmeier 2020), 20 kg of CO2eq can be saved (per kWh of bc) by substituting primary material for recycled material. Which can be seen in figure 5, the market for batteries is expected to reach 381 611 MWh (accumulative 2021-2030). This makes Cling's potential impact almost 10 million tons of CO2eq when the batteries produced in 2030 reaches their end-of-life and are repurposed or recycled (figure 6).

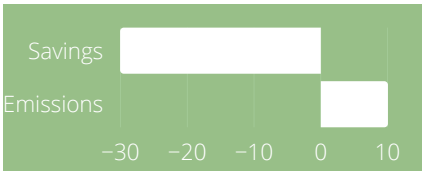


Figure 4: Emissions and savings (by substituting primary material) from recycling [kg of CO2eq/kWh_bc]

The numbers used when calculating emissions from battery production varies a lot. They depend on where the materials are sourced, where the production facilities are located, the energy mix used for the different production steps, the chemical composition in the battery, the battery type, production scale, production energy demand, electricity/heat share and component share, among other factors. It is therefore hard to make an average estimate, and as Christian Aichberger and Gerfried Jungmeier have realized in their investigation regarding the different numbers reported, it can vary as much as 20-210 kg of CO2eq per kWh of battery capacity for cell manufacturing, 1-5 kg for pack manufacturing and 50-90 kg for material production. This makes it hard for us to calculate our climate impact since there are so many different parameters. But, since the dirtiest batteries are the ones that will reach their end-of-life first (and they're the ones where the impact potential is the greatest) we have used the highest span of numbers so far. This will have to be reevaluated as we proceed and carefully considered so that our climate impact will be calculated in the most correct and transparent way.

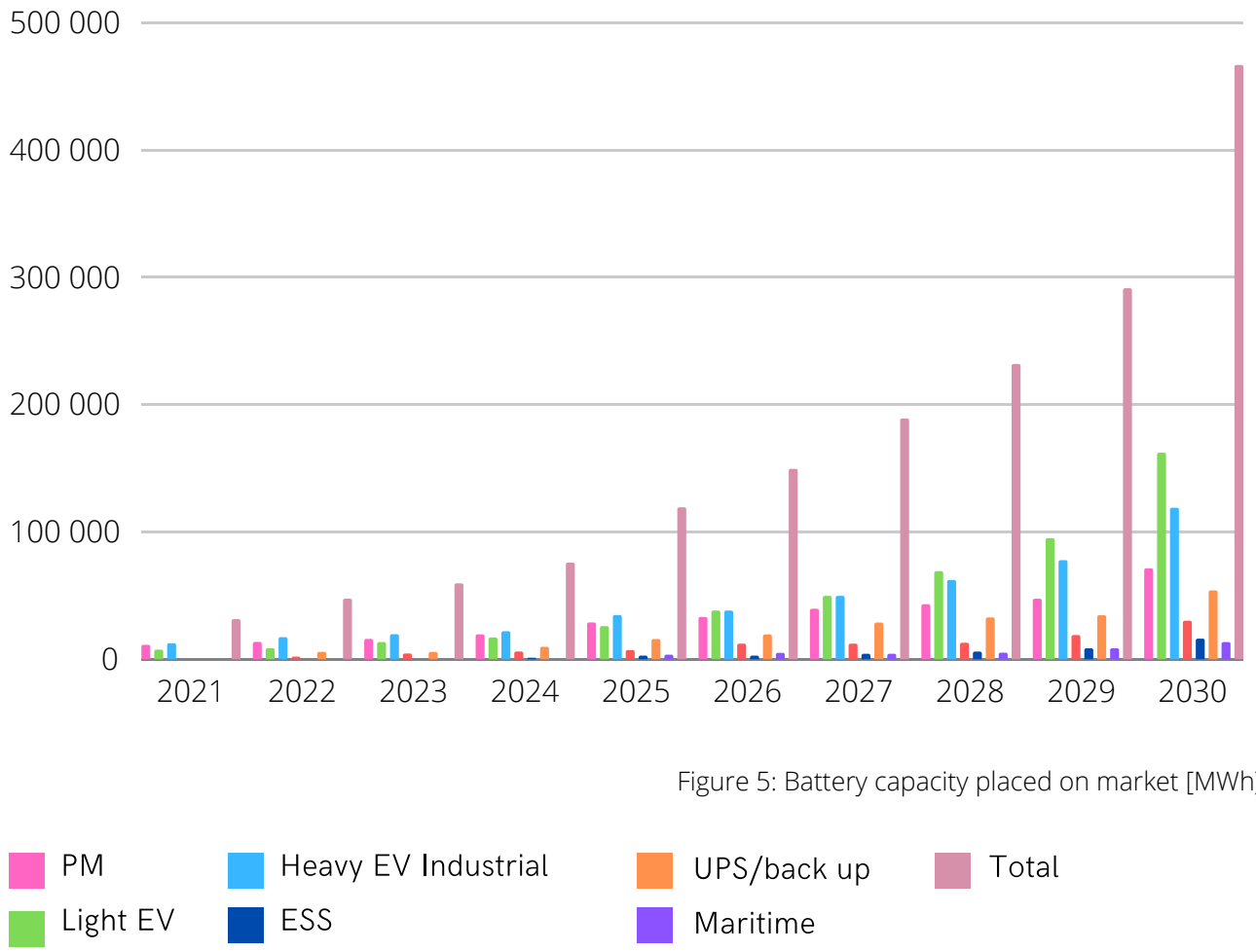


Figure 5: Battery capacity placed on market [MWh]

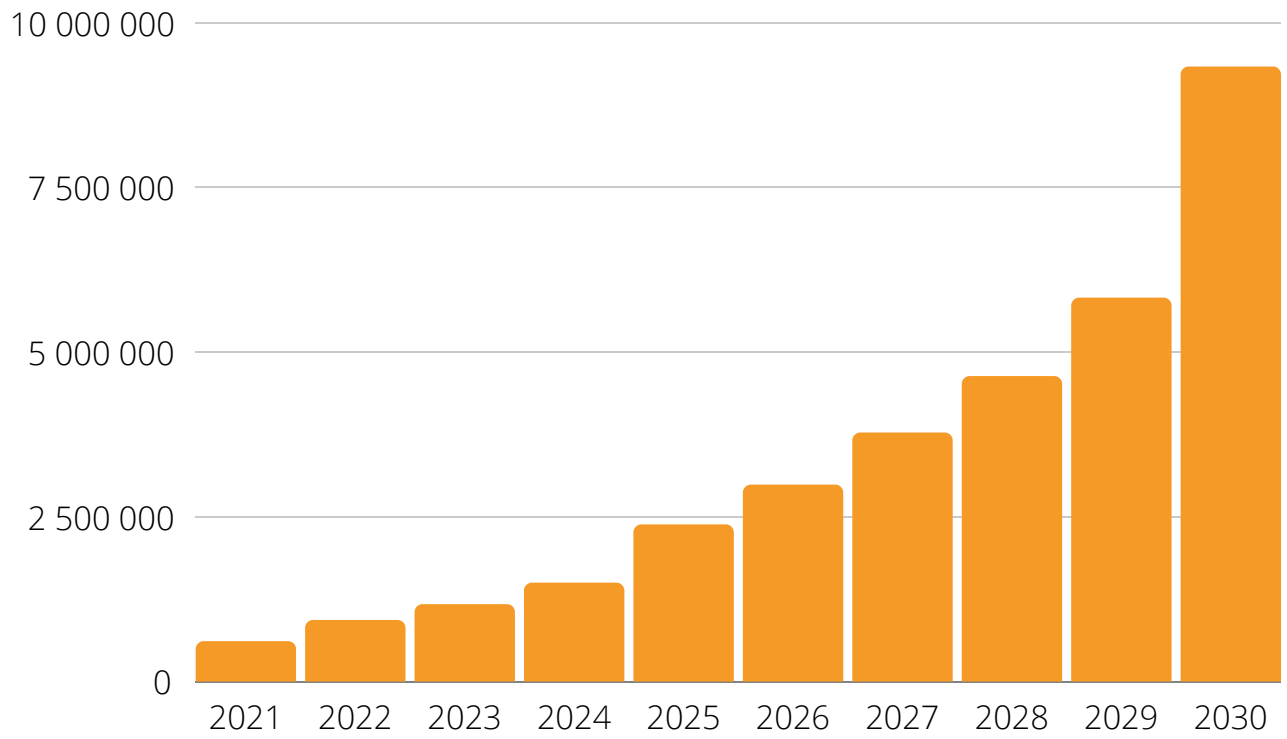


Figure 6: Cling potential impact - avoided CO2 emissions [ton] from recycling

If the customer who purchases a battery via the Cling platform on the other hand is a remanufacturer, the avoided CO2eq emissions are calculated as the emissions avoided from cutting the production stages not needed when reusing, meaning that the emissions from the material extraction process and cell-manufacturing are avoided. It is here assumed that (in the future) the market is saturated thus meaning that the customer avoids buying a new battery and instead buys the old battery through Cling. The emissions from the material extraction process and cell manufacturing are heavily reliant on energy mixes used in the process and where the refining plants and production sites are located as well as chemical composition in the battery, but since the batteries that will reach end of life first will be the 'dirtiest' ones, it is assumed that the material extraction process emits 90 kg of CO2eq per kWh of battery capacity and the cell manufacturing process emits 210 kg(Aichberger and Jungmeier 2020) of CO2eq per kWh of battery capacity, the savings per kWh will be 300 kg of CO2eq. The potential impact if all batteries put on the market in 2030 would be re-used would therefore be over 125 million tons of CO2eq emissions avoided, calculated with today's data regarding emissions, excluding the emissions generated from the remanufacturing process (Note: This number is extremely high and 100% theoretical). The reduction in GHG emissions varies significantly with the intended application of the second life battery, e.g. for stationary energy storage it can be as high as a 70% savings in emissions compared to manufacturing a new battery(Bee Planet 2021).

The other perspective regarding Cling's impact not yet mentioned is the localization of batteries and local sourcing/distributing. Since raw-material, electrodes and other components and batteries are being shipped enormous distances across the world in order to find its way into a vehicle, a significant amount of emissions will be avoided by local recycling and local remanufacturing. Figure 8 presents where material is usually shipped.

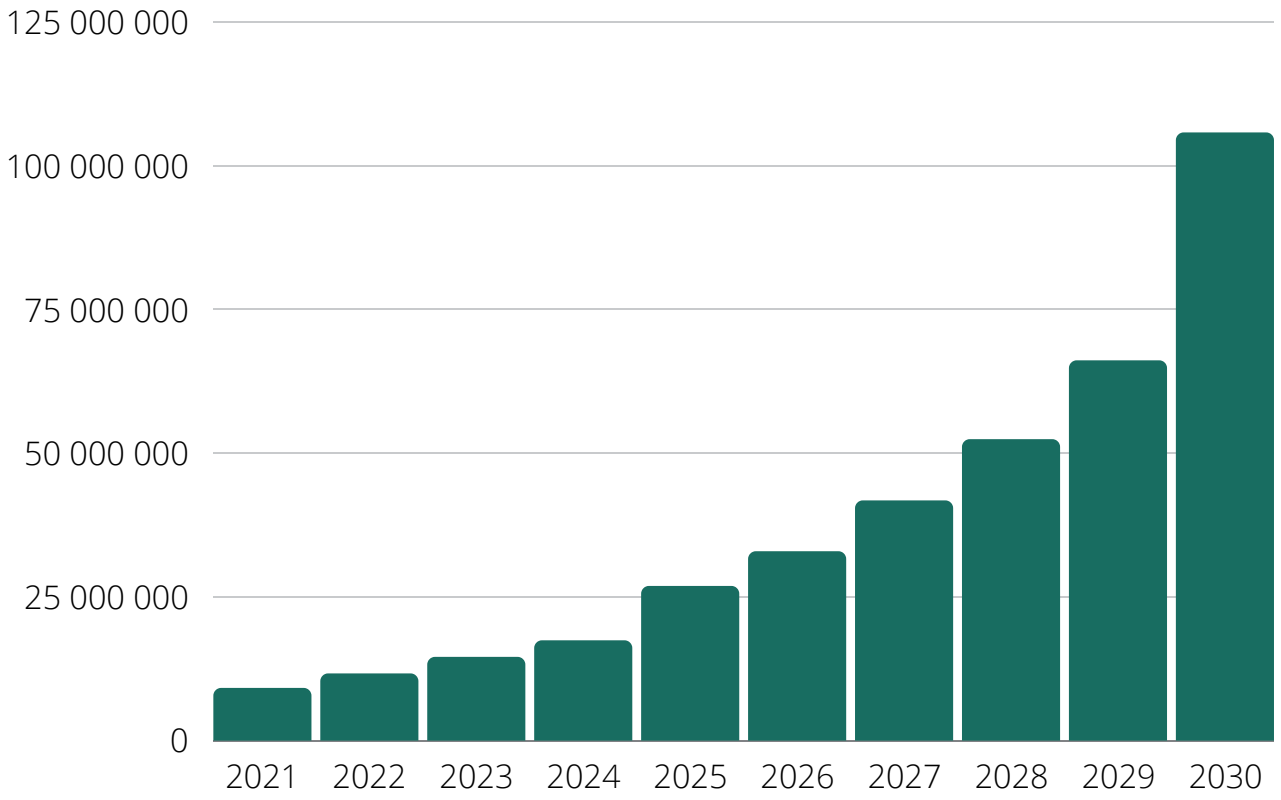


Figure 7: Cling potential impact - avoided CO2 emissions [ton] from remanufacturing (excluding emissions from remanufacturing process)

70% less GHG emissions is generated by remanufacturing a second life battery for stationary storage compared to producing a new one!

Material	Extracted	Refined	Estimated Distanc (km)
Nickel	Philippines	China	2 500
Manganese	South Africa	China	12 000
Cobalt	Democratic Republic of Congo	China	14 000
Lithium	Chile	China	19 000
Aluminium	China	China	2 000
Copper	Philippines	China	2 500
Graphite	China	China	3 000
Steel	China	China	2 000

Figure 8: Shipping distances that Cling has the potential to eliminate through local sourcing.


cling
SOCIAL IMPACT

HUMAN RIGHTS ACROSS THE SUPPLY CHAIN

SOCIAL IMPACT

It is no longer a secret that there are serious issues related to human rights during the production of electric vehicle batteries, especially during the earliest steps of the supply chain: the mining processes.

One of the critical materials used in EV batteries is cobalt. Because of high demand and little supply, cobalt is currently on the EU list of critical raw materials. Cobalt is extracted in nickel and copper-mines where the Democratic republic of Congo is currently supplying around 64% of the total cobalt in the world (Sovacool 2019). The world's most important cobalt-reserves, with over 3 million tons of cobalt, is located there, in what is called the Central-African copper-belt (Sveriges Geologiska undersökning 2019). The biggest portions of the extracted cobalt is shipped to refining plants in China where it is later sold to battery manufacturers within China but also to South Korea and Japan. There have been many reports on child labor, slave labor, dangerous working conditions and corruption related to the extraction of cobalt in DRC. In 2018, 30% of the cobalt extracted in DRC came from Kolwezi where "informal workers" and in particular children, where digging by hand (Financial Times 2019). It has been reported that children as young as seven years old are working in these mines (Aftonbladet 2019). Untraceable metals from these informal miners leak into the global supply chain via refineries in China and end up being sold in cars in Europe and the USA (Financial Times 2019). In a projection by Rawles (2018), the DRC dominance will only grow in the future, anticipating that the country's share of total cobalt production will rise to 75% in 2021. This is extremely worrying since it means that Congolese cobalt is a crucial part of supply chains for emerging low-carbon innovations critical to energy or climate sustainability such as batteries (Sovacool 2019). Some have gone so far as to call Congolese cobalt the "new oil" of our digital economy (Aftonbladet 2019).

Pictures from the article "Bloodbatteries" by Staffan Lindberg and Urban Andersson published in Aftonbladet 2019

Cobalt is not the only material used in batteries that seriously impacts the environment and society. The lithium extraction process uses a lot of water.

South America's Lithium Triangle, which covers parts of Argentina, Bolivia and Chile, holds more than half the world's supply of the metal beneath its salt flats. But it is also one of the driest places on earth, famous for its photogenic salt desert (pictured below). In Chile's Salar de Atacama, mining activities consumed 65% of the region's freshwater which is having a large impact on local farmers and residents. China is one of the top five countries with the most lithium resources and it has been buying stakes in mining operations in Australia and South America. In 2018, China became the second-largest shareholder of the largest lithium producer in Chile (Institute for Green Energy Research 2020). The huge water-consumption related to lithium-extraction is a big problem for the local communities. The water crisis is not only located to the Atacama region but spreads across the entire country, since more than 80% of fresh water is used for industrial production, mining, agriculture and livestock crating a huge shortage of drinking water for Chileans as well as contaminating it with industrial waste (Latin America Bureau 2020).

As presented, the human rights and societal issues related to li-ion battery production is not only concentrated to Congo but spreads across the globe and we need to address this, fast.

GEOPOLITICAL SUSTAINABILITY RISKS

SOCIAL IMPACT

The European Union has realized the importance of domestic battery production and as mentioned earlier, there are gigafactories being built in the EU for future production. But today, the EU lacks self-reliance on cell and material production, making the supply risks high.

As presented earlier, China controls a big part of the global battery supply chain, from mining facilities in Asia, South America, Australia and Africa to processing plants and cell production. In 2019, it was estimated that China produced over 70% of rare minerals (Ny teknik 2019) including those used in batteries. Furthermore, China owns eight of the 14 largest cobalt mines in the DRC and has over 80% control of the cobalt refining industry where raw materials are turned into commercial-grade cobalt metal (Institute for Energy Research). This means that the entire electrification of the European vehicle fleet is dependent on these minerals sourced from distant nations. It is evident that what once was Europe's and the US' reliance on the Middle East for oil, it is now China that dominates. Europe and the US will have to take serious action in order to not be dependent on Chinese materials when electrifying their transportation industry. For the EU to be more independent and less reliant on other nations for materials and cell production, we need circularity.

The EU lacks control of the supply chain, making traceability difficult and allowing actors violating human rights to operate

Europe needs independence and self-reliance when it comes to sourcing of raw materials and components

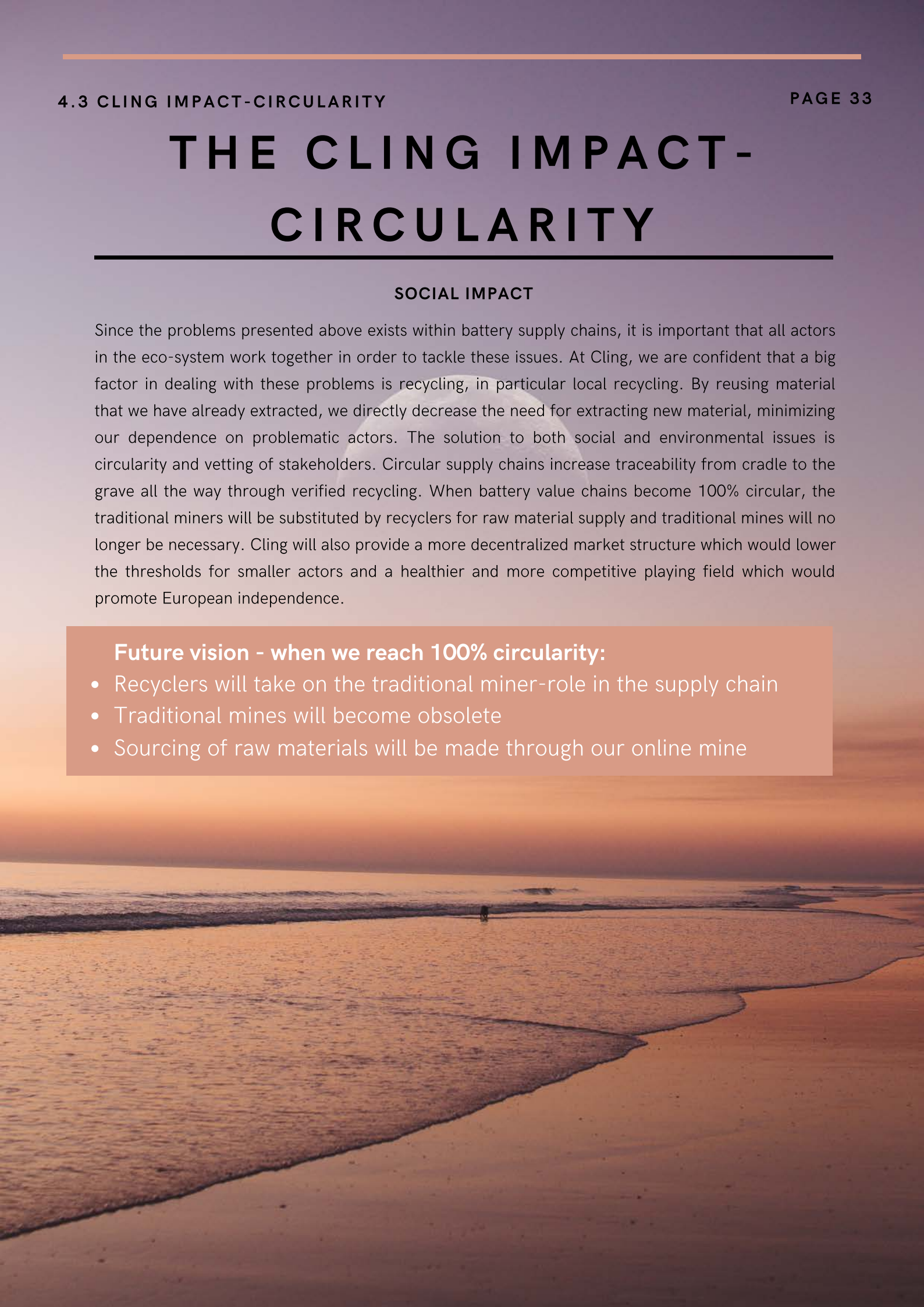
THE CLING IMPACT-CIRCULARITY

SOCIAL IMPACT

Since the problems presented above exists within battery supply chains, it is important that all actors in the eco-system work together in order to tackle these issues. At Cling, we are confident that a big factor in dealing with these problems is recycling, in particular local recycling. By reusing material that we have already extracted, we directly decrease the need for extracting new material, minimizing our dependence on problematic actors. The solution to both social and environmental issues is circularity and vetting of stakeholders. Circular supply chains increase traceability from cradle to the grave all the way through verified recycling. When battery value chains become 100% circular, the traditional miners will be substituted by recyclers for raw material supply and traditional mines will no longer be necessary. Cling will also provide a more decentralized market structure which would lower the thresholds for smaller actors and a healthier and more competitive playing field which would promote European independence.

Future vision - when we reach 100% circularity:

- Recyclers will take on the traditional miner-role in the supply chain
- Traditional mines will become obsolete
- Sourcing of raw materials will be made through our online mine




cling
ECONOMIC
IMPACT

COMMERCIAL IMPACT

COMMERICAL IMPACT

Today, there are only a few companies that are dominating the market, creating thresholds that make it hard for small actors to enter. The supply chain set up today, with centralized mining, refining and cell production located in a few countries and owned by large corporations makes it hard for smaller actors, especially new companies and startups that are trying to change the way we produce batteries to enter the ecosystem. With Cling's online mine, the thresholds will be lower for small actors to source/sell batteries and be a part of the ecosystem, allowing for a decentralized market structure. The decentralized structure will also make it easier to keep the value chains circular and allow for more competition that will promote trade, innovation and industry. Innovation and increased collaboration is needed in order for a new market of remanufacturers and startups to grow and Cling will be an accelerating force to make this happen.

Furthermore, one of the current issues with recycling is that the rates are so low that is is hard for recyclers to make a profit from it and a lot of the handling is done manually. With Cling, the recycling rates are expected to increase due to larger volumes of batteries reaching recycling instead of landfills meaning that recyclers will be able to scale up their facilities to a more automated process and see their profits increase, creating stronger incentives for recycling.


cling
TARGETS AND
PERFORMANCE

TARGETS 2021

0.5 MWH

CAPACITY CONVEYED THROUGH PLATFORM

50 TONS

AVOIDED CO2EQ EMISSIONS

PERFORMANCE

0.06 MWH

CAPACITY CONVEYED THROUGH PLATFORM

6 TONS

AVOIDED CO2EQ EMISSIONS

REFERENCES

- Bee Planet (2020). https://beeplanetfactory.com/en/2021/01/06/second-life-and-emissions-reduction/
- Institute For Energy Research (2020). https://www.instituteforenergyresearch.org/renewable/the-environmental-impact-of-lithium-batteries/
- Teknikens Värld (2021). https://teknikensvarld.se/nyheter/bil-och-trafik/elbil-laddhybrid/norge-forst-i-varlden-med-elbilsmajoritet/
- Elbilen.se (2021). https://elbilen.se/nyheter/nya-rekord-i-elbilsforsaljningen-i-sverige-laddbart-storre-an-bensin-och-diesel-i-december/
- Göteborgsposten (2020). https://www.gp.se/ekonomi/elbilsf%C3%B6rs%C3%A4ljning-tredubblas-i-europa-1.35424493
- Northvolt (2021). https://northvolt.com/environment/
- EU Commission (2021). https://ec.europa.eu/commission/presscorner/detail/en/ip_20_2312
- Fossilfritt Sverige (2020). https://fossilfrittsverige.se/strategier/hallbar-batterivardekedja/
- Sveriges Geologiska Undersökning (2021). https://www.sgu.se/mineralnaring/kritiska-ravaror/kobolt/?acceptCookies=true
- Financial Times (2021). https://www.ft.com/content/c6909812-9ce4-11e9-9c06-a4640c9feebbv
- Aftonbladet (2019). https://special.aftonbladet.se/blodsbatterier/
- BK Sovacool (2019). *When Subterranean Slavery Supports Sustainability Transitions? Powers, Patriarchy and Child Labor in Congolese Cobalt Mining*
- Rawles (2018). *Cobalt & Cathodes: How Are Materials Evolving To Deal With The Cobalt Conundrum*
- Ny Teknik (2019). https://www.nyteknik.se/samhalle/kan-vi-klara-oss-utan-kinas-sallsynta-jordartsmetaller-6959917
- Swedish Energy Agency (2019). *State of the Art in Reuse and Recycling of Lithium Ion Batteries*
- BBC (2019). *Top Tech Firms fined over Congo Cobalt Mining Deaths*
- Circular Energy Storage(2019). *Analysis of the Climate Impact of Lithium-ion batteries and How to Measure it*
- C.Aichberger and G.Jungmeier (2020). *Environmental Life Cycle Impact of Automotive Batteries Based on a Literature Review*
- Latin America Bureau (2020). https://lab.org.uk/chiles-water-crisis/
- Cling Systems (2021). Internal analysis and calculations