

NORSK OMBRUK

THE BENEFITS CASE FOR
REMANUFACTURING



“WHAT’S NO LONGER GOOD ENOUGH FOR SOME, CAN BE MORE THAN GOOD ENOUGH FOR OTHERS.”

ABOUT NORSK OMBRUK

Norsk Ombruk is a dynamic and ambitious remanufacturing company. Established in Norway in 2013, we focus on extending the life of household electrical goods.

In essence our business model delivers the triple bottom line: We extend the life of useful products – save resources – prevent waste – reduce carbon & energy – and, we save people money.

We are gearing up for an ambitious growth plan – working in partnership with market leading brands and retailers – to maximise the benefits of our remanufacturing model for people, planet and economy.

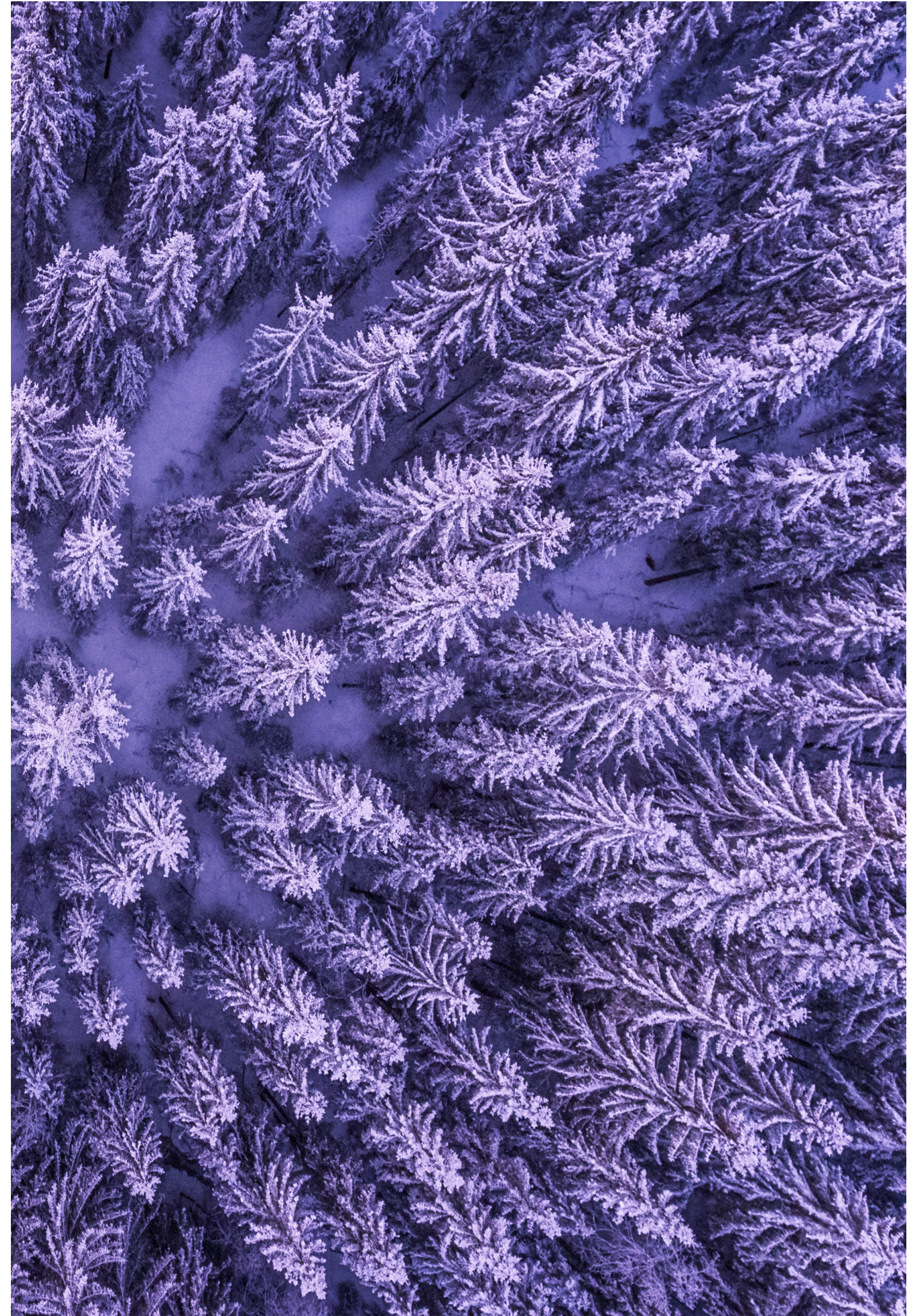
ABOUT EARTHSHINE

Earthshine is an international business consultancy/think-tank focused on business and economic transformation, toward a sustainable and low carbon economy.

Earthshine was founded in 2006 by Mike Townsend, business and economic transformation leader, author, teacher, advisory board member and inspirational keynote speaker.

We focus on progress in four key dimensions: Sustainable business models & strategies, sustainable business leadership, systemic change, and business education. We are passionate about making a real difference – always with a strong focus on the holistic business case.

We have worked with a wide range of businesses, large and small, in all sectors of the economy, mainly in Europe, Scandinavia and North America, including: Aviva, Bloom Centre for Sustainability (Ontario), Copenhagen Business School, EY, IKEA, LoyaltyOne, Lund University, Malmö University, Myrtha Pools, Norsk Ombruk, Triodos Bank, and many others – including Paul Polman at Unilever.



NORSK OMBRUK AS: THE BENEFITS CASE FOR REMANUFACTURING

A report on how the Norsk Ombruk regenerative business model extends product life & customer value through sustainable innovation.

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EXECUTIVE SUMMARY:

All over the world, governments and businesses are struggling to find new ways to create lasting economic success and shared prosperity. The circular economy offers a potential way forward to help policy makers and business leaders deal with key sustainability challenges, while concurrently enabling economic growth within planetary boundaries.

Remanufacturing is a key element within the transition toward a circular economy – enabling products, components and valuable resources to be kept at their highest use for a greater period of time. Remanufacturing can help realise significant savings in resources, energy, emissions, water, and waste – while offering significant potential for creating jobs and generating sustainable economic activity.

In terms of the business case for circular economic transitions, there is a growing body of work promoting macro-level business and economic benefits – often pitched at the scale of larger corporations, countries, or economic regions – to help stimulate policy debate and strategic business interest towards a more sustainable paradigm.

Given the growing urgency for more radical business shifts in sustainability performance, there is a growing need to demonstrate the triple-bottom-line benefits arising – at a more granular level – for individual businesses adopting circular and remanufacturing business models. This White Paper takes us on a journey through developing a detailed insight into how the Norsk Ombruk remanufacturing model works, how the resulting benefits may be modelled and quantified, along with insights and recommendations on the future for remanufacturing.

MIND SHIFT: WASTE AS A RESOURCE

In taking the circular economic opportunity forward, we need to start thinking about waste as a resource – rather than something that we discard and need to dispose of. Globally, we are sitting on a mountain of underutilised, valuable resources, trapped within old and discarded products. The amount of discarded electrical and electronic equipment (e-waste) reached 41.8 million tonnes in 2014, with the vast majority neither re-used nor disposed of in an environmentally friendly way.

More than half our global e-waste (60%) constitutes discarded kitchen, laundry and bathroom equipment – with washing machines, clothes dryers, dishwashers, and electric stoves generating 11.8 million tonnes of waste. Waste is money: the value of global e-waste represents around \$52 billion worth of potentially reusable resources.

In Europe, we see a similar picture. EU countries alone have discarded around 9.45 million tonnes of used electrical

products, including many potentially reusable appliances. Only 35% of these end up in official collection and recycling systems. Many of these assets are ripe for remanufacturing and re-use – if we could develop the infrastructure and capabilities required to realise this potential. It is estimated that remanufacturing in Europe could be worth around €90 billion by the year 2030 – employing up to 600,000 people.

While the potential is huge, the general remanufacturing sector is still in its infancy within the EU – currently worth around €30 billion, involving more than 7,200 companies, and employing around 192,000 people. For the remanufacturing of Electronics and Electrical Equipment (EEE), this sub-sector is worth around €3.1 billion, engaging 2,500 companies, 28,000 employees. The overall intensity of remanufacturing in Europe – represented as a proportion of new manufacturing activity – is still only 1.9%. The opportunity for remanufacturing is wide open.



A NEW BREED OF ENTREPRENEURS

To realise this potential we need a new breed of entrepreneurs – ready to develop new and disruptive business models, in a sector that might not be perceived as attractive as the bright shiny world of conventional manufacturing. Thankfully, new players are emerging with impressive new and disruptive business models.

Norsk Ombruk AS is a dynamic and ambitious remanufacturing company – established in Norway in 2013 – laser focused on extending the useful and productive life of household electrical goods, including refrigerators, washing machines, stoves, dishwashers, and dryers.

Through its unique processes the company is able to produce high-quality remanufactured products, which deliver a further five years of peak product performance, and may be purchased through reputable big-brand stores at half-the-price of new machines.

Norsk Ombruk is growing, having remanufactured over 12,300 electrical products in 2016 – delivering annual sales of €1.8 million. Following a successful start-up phase, the company is now expanding its operations into other countries in Europe and Scandinavia.

Norsk Ombruk AS is a dynamic and ambitious remanufacturing company – established in Norway in 2013

The success of Norsk Ombruk’s approach is supported by a range of collaborations, right through the value chain. By working in partnership with incumbents like Electrolux – Norsk Ombruk is able to source an increasing volume of old products, through which it can produce its range of remanufactured products.

Furthermore, working in partnership with retailers like Elkjøp and IKEA, Norsk Ombruk has access to mainstream sales channels – maximising the opportunity for customers to see and purchase high-quality remanufactured products, as a viable alternative to new products.

Through these collaborations, Norsk Ombruk is able to help bend the value chain away from a linear model, towards a much more circular shape. This could not be achieved in isolation, or without the enlightened cooperation of value chain incumbents.

BIG NUMBERS: THE BENEFITS OF REMANUFACTURING

Through business model innovation, the company is able to deliver positive social, environmental and economic impacts. By extending the life of useful products, the business helps to save resources, prevent waste, reduce carbon and energy, and saves people money. Families on lower incomes can now afford higher quality, energy-efficient products.

This remanufacturing business model not only extends product life, it also extends brand life, too. For example, the Electrolux brand, represented by a high quality remanufactured machine – keeps serving you, the customer, for longer – in a way that does not keep enticing you to throw-away and buy more.

When developing our appraisal of the Norsk Ombruk remanufacturing model, we have drawn on extensive methodologies – developed and refined by Earthshine over the last decade – to help identify and capture a granular approach to modelling the range of financial and other benefits that impact on the economy, businesses, society, people, and the environment.

For a fairly modest company, Norsk Ombruk is able to deliver an impressive range of benefits, which aggregate to be worth around €9.4 million in 2016. Key benefits are derived from the following value streams:

- 1. Customer & Societal Value: € 4,476k.** Greater access and affordability, in particular for households that may be struggling on lower income.
- 2. Brand Value: €441k.** Direct income for end-of-first-life machines, reduced cost of inventory & logistics, enhanced reputation, brand loyalty, and future-proofing the business model.
- 3. Resource Conservation: €2,131k.** Resource extraction avoidance by keeping thousands of products active for a further five years.
- 4. Energy: €1,568k.** Embedded energy saved through avoiding manufacture of new products, along with lifecycle energy savings from enhanced energy rating performance.
- 5. Carbon Price Savings: €12k.** Notional carbon pricing savings – in readiness for future carbon pricing and natural capital policies.
- 6. Reduced Economic Leakage: €768k.** A range of national economic benefits through developing remanufacturing jobs in the real economy.

NEW METRICS

Reflecting on the total range of accumulated benefits for 2016, we have also explored some new business metrics – to help establish the amount of value added, in holistic terms, delivered by Norsk Ombruk's remanufacturing activity:

Level of 'circularity' delivered:

The proportion of products/resources remanufactured for re-use (the highest level of resource use): 48%.
The proportion of resources that are recycled (representing a lower level of utilisation): 52%.

Net value added:

Ratio of benefits delivered in proportion with the manufacturing firm's business operating costs: 11:1.
In simple terms, for every €1 million of operating costs, the company delivers €11 million of benefits to people, the environment, business and the economy.

Value to society:

> Remanufacturing clearly has a major role to play in adding value. It is also worth noting that 56% of the benefits delivered by Norsk Ombruk flow to society.

IN SUPPORT OF THE UN SDGS:

Progressive business leaders are engaging with the SDGs to identify where and how their businesses could make an active contribution. Exploring this vital question also drives us towards finding, or re-finding, our real purpose in business.

Norsk Ombruk recognises the potential impact and contribution – associated with its remanufacturing model – in support of the greater movement towards achieving the SDGs:

- > SDG 1: End poverty. Lower-cost remanufactured appliances provide a benefit to lower income families – freeing up valuable money for other important life costs.
- > SDG7: Affordable, reliable, sustainable and modern energy. Remanufacturing contributes to energy efficiency, reducing both embedded and lifecycle energy – aiding a more achievable and rapid energy transition.
- > SDG 8: Sustained, inclusive and sustainable economic growth. Circular, remanufacturing models enable further economic growth within planetary boundaries – and generate new skilled & resilient jobs and tax receipts within the real economy.
- > SDG 9: Resilient infrastructure. Norsk Ombruk's model acts as a catalyst to generate a circular economy eco-system – through joining up supply and demand networks between retailers, manufacturers, municipalities & waste management authorities.

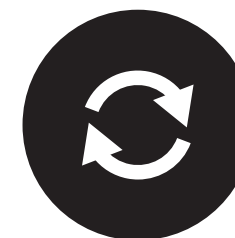
> SDG 11: Resilient cities. Remanufacturing helps to generate 21st century jobs within local economies, developing a more resilient urban economic future.

> SDG 12: Sustainable consumption and production. By its very nature, remanufacturing provides an essential element in bringing together more sustainable production and consumption practices.

> SDG 13: Climate change. Remanufacturing enables a reduced embedded carbon footprint plus reduced lifecycle emissions – by keeping existing products and resources in use for an extra five years.

> SDG 16: Peaceful and inclusive societies for sustainable development. Remanufacturing provides a catalyst for local economic re-generation that can provide greater economic opportunity for the many, which could contribute towards a more cohesive and peaceful society.

If we are serious about generating sustainable prosperity – and this is what the SDGs are about – we should seriously consider aligning the SDGs with our business goals. In taking the first step, we might commit to the #Businessworthy mission. Norsk Ombruk has recently signed-up to support this important initiative.



BEYOND THE TRIPLE-BOTTOM-LINE.

As we reflect on the holistic range of benefits delivered, we can see they tend to take us beyond the triple-bottom-line: we can start to appreciate the true bottom-line for a purpose driven business, operating within planetary and societal boundaries.

KEY INSIGHTS AND THE FUTURE OF REMANUFACTURING

Norsk Ombruk shows us what is possible – and, how remanufacturing can become a practical reality, delivering a broad range of significant benefits for people, planet, and businesses – as well as the economy, as a whole.

There are many insights and lessons arising to help support and advance the spread of remanufacturing within a circular economy.

Scale is Everything: The benefits model is highly sensitive to changes in volume. The scale of the operation, in terms of the volume of products remanufactured, drives everything. Financial and other benefits rapidly accumulate, as the volume of remanufactured products increases, from year-to-year.

Systems Thinking Applies: There are strong inter-relationships between different categories of benefits – as many practices tend to reinforce the impacts in other benefit streams. A fairly small betterment in any aspect of the business model leads to major savings in a range of other areas – including energy, carbon, and resource costs.

Remanufacturing as a Catalyst: Remanufacturing business models can provide a catalyst within markets to generate a more sustainable circular economic ecosystem; forging new links, dependencies relationships, and partnerships – all geared towards the circular flow of products, resources, components and materials – maintaining their highest use. This model can help to drive changes right through the entire value chain, and can help rejuvenate local economies – ultimately, towards a new, more sustainable economic ecosystem.

Collaboration is Essential: Realising the potential of remanufacturing within a circular economy transition requires collaboration right through the value chain. To make this work we need an enlightened view from

incumbent players, including retailers and OEMs (Original Equipment Manufacturers) – not the singular and protective view of old – rather, recognising that remanufactured products are not necessarily a threat to their respective business models, but something which can enhance their position and reputation within a vibrant circular economy.

Further Enablers for Collaborative Success:

Drawing from Norsk Ombruk's successes to date, further collaboration between value chain partners is needed to develop even greater performance and realisation of circular economy and remanufacturing benefits:

1. Greater design for remanufacturing by OEM.
2. Access to old stock of returned and damaged goods from OEMs and retailers.
3. Easy access to quality spare parts at reasonable prices by OEMs.
4. Access to OEM product manuals, knowledge, & repair information.
5. Common standards for remanufacturing quality – approved by OEMs.
6. Collaborative business models – between remanufacturers, retailers, and OEMs – involving sharing of data and systems, to provide visibility of information and data right through the value chain.
7. A supportive policy environment – encouraging sustainable consumption: future policy incentives might include a reduction in the level of VAT on professionally remanufactured goods.



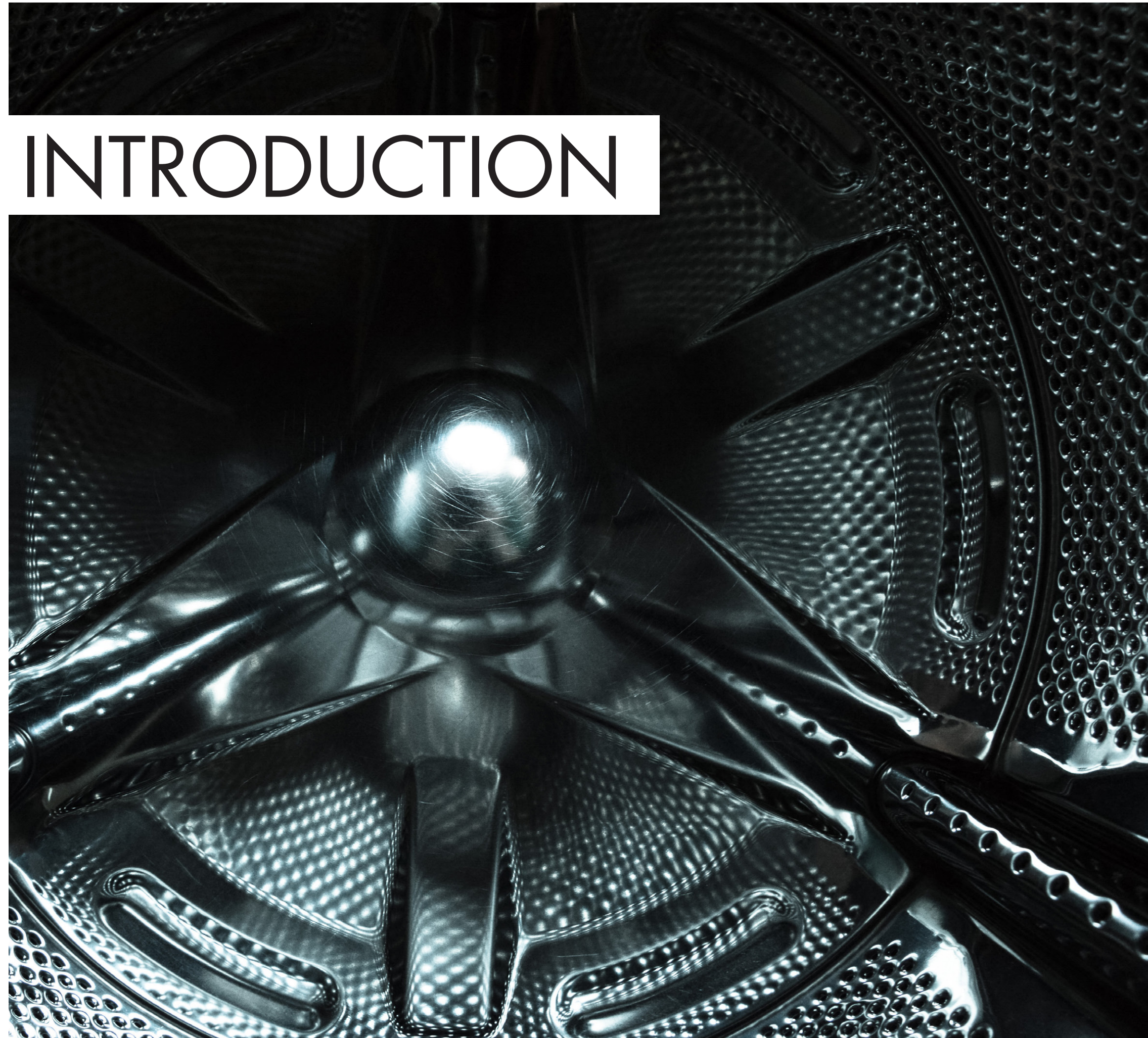
THE FUTURE RESEARCH AGENDA

Further research work is also needed to help develop further visibility and transparency of product costs and performance – to help develop even more robust benefits models, analysis, and insights:

A. Technical Perspectives: Including a scientific appraisal of the performance of remanufactured products in use – and also, the key factors that are leading to so many products being discarded, so early in their technical lifecycles.

B. Customer/Societal Perspectives: A further study on how funds saved through the purchase of remanufactured products are utilised by end-user beneficiaries – to validate how customers' product savings flow through to benefit the rest of the economy.

C. Brand Value Perspectives: More research on impact of quality remanufacturing on brand loyalty – along with the impact of reputational benefits on share price performance, over time.



INTRODUCTION

This White Paper takes us on a journey through developing a detailed insight into how the Norsk Ombruk remanufacturing model works – how the resulting benefits may be modelled and quantified – and how the triple-bottom-line comes into focus.

"REMANUFACTURING IS A KEY ELEMENT WITHIN THE TRANSITION TOWARD A CIRCULAR ECONOMY"

INTRODUCTION

There is much talk about the potential offered by the Circular Economy. Perhaps, more than any other business innovation at this time, the Circular Economy stands out – offering a potential way forward to help businesses deal with key sustainability challenges, through delivering radical resource efficiencies and financial benefits – while providing a viable means to continue economic growth within planetary boundaries.

Remanufacturing is a key element within the transition toward a circular economy – enabling products, components and valuable resources to be kept at their highest use for a greater period of time. Further, by remanufacturing products it is possible to make significant savings in resources, energy, emissions, water, and waste. This sub-sector also has massive potential for creating jobs and generating sustainable economic activity.

In terms of the business case for circular economic transitions, there is a growing body of work promoting macro-level business and economic benefits. The narrative tends to be pitched at the scale of larger corporations – and, even at the level of countries, or economic regions – to help generate major policy and strategic business shifts towards a more sustainable paradigm. For example, recent reports

promote the potential for the circular economy in saving millions of Euros in resource costs, along with the ability to create many thousands of new jobs.

Thus far, there is little in-depth analysis of the business, economic and sustainability benefits arising at the micro and individual business level. But, there is a growing need to demonstrate the more granular level of benefits developed as a result of individual businesses adopting circular and remanufacturing models.

The true test for the circular economy has to be in proving the real impact we can deliver on the ground. We, therefore, need to get more visibility and granularity on the range of impacts where this change actually occurs.

Looking through a more holistic lens, at this level, we can visualise and capture the full range of benefits arising, including societal benefits – for people and communities – as well as the commercial benefits generated for participating businesses.

In demonstrating tangible value to all stakeholders involved – to customers, businesses, and investors alike – on how a real shift in product performance and business results can be achieved, we are much more likely to get real traction in delivering further positive shifts towards a circular economy.

We also need to be mindful of the need to fully explore the myriad of benefits that occur at this level – many of which are interlinked – and, which may otherwise be lost through simplified, high-level macro studies. The devil really is in the detail.

This level of analysis also helps us to understand the level of progress that is possible within individual businesses, and where further support might be needed in order to fully capitalise on the potential in this space.

This White Paper takes us on a journey through developing a detailed insight into how the Norsk Ombruk remanufacturing model works – how the resulting benefits may be modelled and quantified – and how the triple-bottom-line might come into focus.

With over a decade of experience in building detailed business case models, the Earthshine team is delighted to work with Norsk Ombruk in developing this important work – to help capture and articulate the full range of impacts and benefits delivered by the company's remanufacturing model – to demonstrate where further work is needed – and, to help inspire others in this market, and also other businesses that are thinking of engaging with circular economy transitions.

First of all, we create some important context. Not every reader will be fully familiar with the Circular Economy, so we open the main text with some background information, summarising the macro-level potential: in particular, the latent potential of the European Remanufacturing sector – before we dig deeper into the Norsk Ombruk remanufacturing model and how their approach works.

We then highlight a summary of benefit streams, before developing a detailed appraisal of the range of impacts and benefits arising from the Norsk Ombruk model. Finally, we share a range of insights and conclusions, some opportunities for further work, and recommendations for the future of remanufacturing.

Business model innovation is vital to overcome barriers to realising the circular economy transition at scale. This paper demonstrates what can be achieved through developing new business models – going beyond current boundaries – and by being bold, to help reshape the value chain to work fully within the circular economy.

We hope this holistic and granular study of remanufacturing benefits helps to inspire further interest in the uptake of authentic remanufacturing activity within all sectors, and in all parts of the world. We also hope it helps to stimulate further development and debate concerning the development of robust business cases in this important space.

We welcome further engagement and dialogue.

IN CONTEXT: ON THE VITAL IMPORTANCE OF THE CIRCULAR ECONOMY



All over the world, governments and businesses are struggling to find new ways to create lasting economic success and shared prosperity. Economic growth remains elusive, corporations are struggling to deliver attractive returns², and wages are stagnating. In the developed world, we seem to have run out of wholesome ideas on how to break out of our inexorable decline.

IN CONTEXT: ON THE VITAL IMPORTANCE OF THE CIRCULAR ECONOMY

All over the world, governments and businesses are struggling to find new ways to create lasting economic success and shared prosperity. Economic growth remains elusive, corporations are struggling to deliver attractive returns¹, and wages are stagnating. In the developed world, we seem to have run out of wholesome ideas on how to break out of our inexorable decline.

Meanwhile, we are headed towards a perfect storm, at the intersection of climate change, a looming energy crisis, increasing resource scarcity, and with continued debt challenges acting to constrain public and private sector investment.

Global greenhouse gas emissions have grown at nearly twice the rate, over the past decade, when compared with the previous thirty years.² While there are some encouraging signs of decoupling in the global energy sector – we still have much to be concerned about with emissions arising from industry, agriculture, forestry, transport, from our buildings, and so on – all of which combine to generate around 74% of our total global greenhouse gas emissions.³ We also need to be mindful of our responsibility for outsourcing production and the generation of emissions to lower cost economies – in support of our consumer lifestyles in the West. There is little room for complacency.

Meanwhile, we are extracting 50% more natural resources than was the case only thirty years ago – currently amounting to around 60 billion tonnes of raw materials each year.⁴ Within our linear economy, economic growth still requires the unsustainable consumption of non-renewable resources.

So, it is not surprising that we are crossing planetary boundaries – the thresholds for safe operating conditions for the planet – as a direct result of human activity. We have already crossed four out of nine such boundaries, and we are in the danger zone, when it comes to climate change, loss of biosphere integrity, land system change, and altered biogeochemical flows – our phosphorus and nitrogen cycles.⁵

This all means that we are living beyond our physical means. On average, we already need 1.5 planets of carrying capacity, set to rise toward two planets by 2030, so that we may continue to with our current consumer-oriented lifestyles.⁶ The position is much worse in the West – where unsustainable consumption has become a way of life for many – requiring 3 planets in Europe, and 5 planets in the USA.

But, that's not all: we have to think about societal boundaries, too – as these also impact on our ability to deliver shared prosperity: rising economic inequality, long-term unemployment and under-employment, affordable access to sustainable food, housing, and water, all affect the ability of many people to live decent lives, and to participate fully within their communities.

“Going ‘circular’ is not just a case of minor tweaks to business-as-usual, but means embracing real innovation, and real change in our business models – towards sustainable consumption, as well as production: making a fair return, within planetary and societal boundaries.”⁴⁵



Coming to terms with all these interconnected challenges is mission critical. Our ability to generate long-term value and continued prosperity will require all business leaders and politicians – indeed, all us consumers, too – to think and act in much more progressive ways to avoid the downside risks.

The global economic impact of climate change alone is predicted to result in asset value losses in the range of \$2.5 to \$24 trillion – completely wrecking the global economy, in the worst-case scenario.⁷ If we translate this situation into business impacts, as we should, then each of our businesses could experience a reduction in income by up to 30% – effectively wiping out our profits and reserves. This is clearly not an acceptable trajectory for anybody.

This situation can no longer be considered as a far-off and remote experience, either. Our businesses are already vulnerable. None of the world's top industries are currently profitable if they were to pay for the natural capital (externalities) they currently exploit.⁸ This is a dangerous place to be; reality will bite, as carbon pricing and other natural capital policies come into effect, and we face the true costs of doing business. Investments that do not perform will quickly become stranded assets – their value tending towards zero: worthless.⁹

We are slowly, but surely, undermining our ability to survive and thrive on our wonderful, yet finite planet. Our aspirations for long-term growth and prosperity have little chance of being realised, unless we start to manage within planetary and societal boundaries. Further, the old ways of commerce appear redundant in the face of growing economic, environmental and societal challenges.

Thankfully, the world of business is increasingly recognised as being a part of the solution, as well as part of the problem – with its capacity for innovation, and the ability to mobilise people, investment and resources.

Yet, the overall business response to date, barring a few exceptions, is not as robust as it needs to be. For sure, there are plenty of attractive CSR reports and interesting eco-efficiency initiatives out there, delivering incremental improvements – yet, despite a few good signs, we are not reaching the extent and depth of real change that is required.¹⁰

The painful reality is that we are still nowhere near appreciating our planetary boundaries, let alone managing within them. Less than 5% of businesses even recognising planetary or ecological limits, even fewer are science-based performance targets and strategies to help inspire changes in their product portfolios or business models.¹¹

We must go much deeper and much faster. We badly need a more radical shift in performance, rather than the relatively modest incremental improvements we experience within our current take-make-waste linear economy. And, this shift has to engage with all businesses, in all territories – including all our SMEs (small & medium-sized enterprises) that account for 99% of businesses in any economy, and around 50% of economic value – and, by proxy, responsibility for 50% of all environmental and societal impacts. SMEs have to be included within the necessary economic transformation.

In order to make a more radical shift, we need to challenge our world-view of nature as an unlimited resource, and as providing us with an unlimited dustbin for our waste and outputs. We badly need a new economic model that links sustainable production with sustainable consumption.

The mainstream business conversation, going forward, will have to engage with how we can really deliver responsible growth within planetary limits, while tuning into the real needs and aspirations of the 21st century customer – delivered through new business models; based on real purpose, adding real value to real people, their communities and the planet. Business-as-usual is over.

Thankfully, there is some good news of a more radical response. The rapidly developing field of Circular Economy appears to offer a more meaningful way forward – providing an opportunity for transformation, going way beyond the simplicity of recycling, which might be more realistically described as downcycling, due to the resulting downgrade in material quality and utility experienced.

In practical terms, circular economic activities can include maintenance, re-use, refurbishment, and remanufacturing – all applied before the last resort of recycling. The Circular Economy demands that natural resources are managed efficiently and sustainably throughout their lifecycles.

By adopting a ‘closed loop’ model, the Circular Economy provides a restorative and regenerative model for business and economy that keeps products, components and materials at their highest utility and value, at all times.¹² This enables radical efficiency gains, and means we can minimise the need for new inputs of virgin materials and

energy, while reducing environmental pressures linked to resource extraction, emissions and waste. We can, therefore, continue to grow our businesses and economies, while reducing the stresses we place on our planet.

Going ‘circular’ is not just about producing more stuff, more efficiently. It is also about improving how we consume goods and services, creating a necessary link with more sustainable consumption.¹³ This is important; no matter how good we think we are, in terms of resource efficient production, if we don’t address our unsustainable consumption patterns – we will still deliver net degradation, and we will fail to deliver ‘one planet prosperity’.

If we take the circular economy forward towards its full potential, by integrating sustainable production with consumption, this could mean we achieve absolute decoupling of economic growth from environmental impacts: continuous growth within planetary boundaries.

The real potential goes even further. A circular economy also provides opportunities to create greater wellbeing, economic growth and jobs, as well as reducing environmental pressures. If properly applied, this model approach really appears to hit the sweet spot for the triple-bottom-line.

The EU has recognised the enormous potential of the circular economy. Each year circular economy activity could save over €600 billion, which represents around 8% of annual GDP in EU – while reducing CO₂ emissions by 450 million tonnes/year. Furthermore, the circular economy could create 580,000 new jobs. This really does hit the sweet spot.

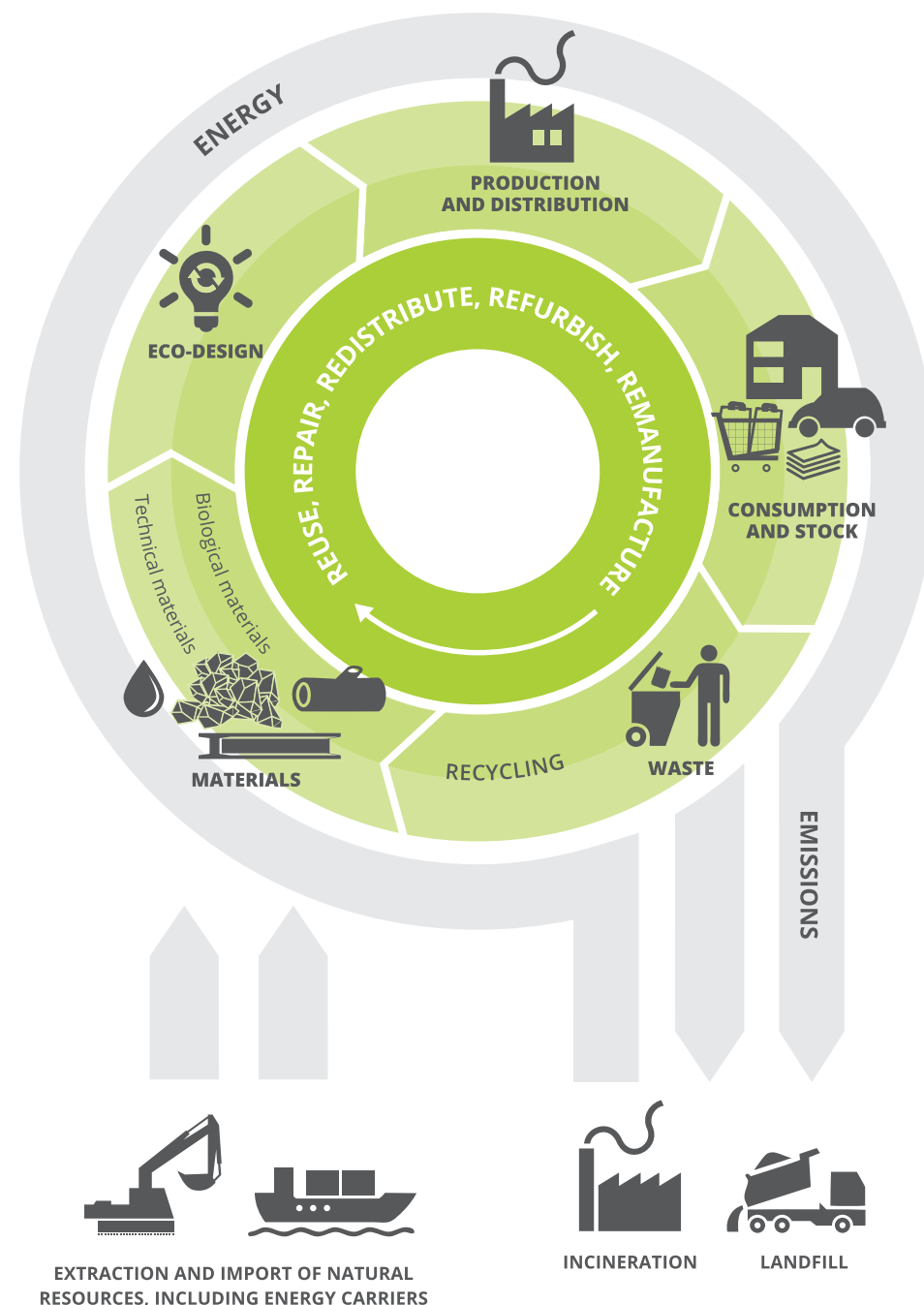


Figure 1: A simplified model of the circular economy (Source EEA, 2016).

The EU launched its Circular Economy Package in 2015 – involving commitments on eco-design, focused on target areas, such as plastics, food, waste, construction, critical raw materials, industrial & mining waste, consumption, and public procurement. A range of horizontal ‘enabling’ measures are also included, providing for innovation and investment, and support for each step in the value chain.

Extending the lifetime of products is a central enabler of the circular economy, and re-using products and their components, as well as remanufacturing, is one of its key strategies.¹⁴ This is where the circular economy gets real traction – although, there are currently few good roadmaps to hand; this is all new territory we have to navigate.

REMANUFACTURING: THE NORSK OMBRUK MODEL



Remanufacturing is an important subset of the Circular Economy, focused on using existing products and components to create new products, with similar properties to the original items.

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It can also be possible to return “a product to at least its original performance with a warranty that is equivalent or better than that of the newly manufactured product.”¹⁵ Although, in reality, we might not realistically aim to surpass original product performance in all respects, but certainly – as we see with the Norsk Ombruk model – it can be possible to enhance some dimensions through a quality re-manufacturing approach; for example, by enhancing the energy rating of the remanufactured product: more of this, later on.

As with the circular economy, the aim is to keep products, components and critical resources at their highest use, for as long as practicable, and thus provide a way of minimising the aggregate environmental impacts of production.¹⁶ By following this ideal it is possible to make significant savings in resources, energy, emissions, water, and waste.

There are further, important social and economic advantages, too. Remanufacturing businesses are able to generate new, medium-to-high skilled jobs – an important dimension in any economy. Remanufactured products, themselves, can also deliver new forms of sustainable customer value – for example, by providing affordable alternatives to brand new products, we can reach under-served markets and customers; particularly those on lower incomes. We’ll explore this valuable dimension within our benefits analysis work, later on.

But, the primary focus, and where the opportunity for big wins lies, concerns the opportunity to capitalise on a global stockpile of underutilised resources.

Collectively we are sitting on a mountain of underutilised, valuable resources, trapped within old and discarded products. Globally, the amount of discarded electrical and electronic equipment (e-waste) reached 41.8 million tonnes in 2014, with the vast majority neither re-used nor disposed of in an environmentally friendly way. Currently, less

than one sixth of global e-waste is recycled properly, or made available for re-use – most of it ends up in the bin, according to UNU.¹⁷

More than half our global e-waste (60%) constitutes discarded kitchen, laundry and bathroom equipment – with washing machines, clothes dryers, dishwashers, and electric stoves creating 11.8 million tonnes of waste. Waste is money, of course. The value of global e-waste represents around \$52 billion worth of potentially reusable resources.

If we zoom in on Europe, we see a similar picture. EU countries alone have discarded around 9.45 million tonnes of used electrical products, including many potentially reusable appliances.¹⁸ Only 35% of these end up in official collection and recycling systems. The remaining 6.2 million tonnes of discarded electronics have been exported, recycled under non-compliant conditions, or simply thrown into waste bins. If we were to try and visualise this level of waste, we might do so by imaging a 10m high wall stretching from the toe of Oslo, all the way to Italy.¹⁹ All in all, globally and within the EU, the volume and value of e-waste is staggering.

Further, when we reflect on where our e-waste ends up, we should also be mindful of a thriving black market – involving the theft of valuable components, such as circuit boards and precious metals. The black market for e-waste is estimated to result in an annual economic loss of between €800 million and €1.7 billion in Europe. But, this is not just a case of losing the economic value of resources: there is also the problem that huge amounts of potential public income are lost through this unregulated activity – along with the potentially serious health and safety issues related to defective and poorly managed old products.

While the potential is huge, the general remanufacturing sector is still in its infancy within the EU – currently worth around €30 billion, involving more than 7,200 companies, and employing around 192,000 people.²⁰ For the remanufacturing of Electronics and Electrical Equipment (EEE), this sub-sector is worth around €3.1 billion, engaging 2,500 companies, 28,000 employees. While these represent significant numbers, the overall intensity of remanufacturing in Europe – represented as a proportion of new manufacturing activity – is still only 1.9%. The opportunity for remanufacturing is wide open.

It is estimated that remanufacturing in Europe could be worth around €90 billion by the year 2030 – employing



Figure 2: White goods: before and after remanufacturing.

up to 600,000 people. By way of comparison, that’s more people than are currently employed within the major US automotive manufacturing companies.²¹ Closer to home, Europe’s high-fashion footwear industry employs around 280,000 people, and its well-established steel sector accounts for around 328,000 jobs. Given our need to prosper within planetary boundaries, remanufacturing has so much to offer.

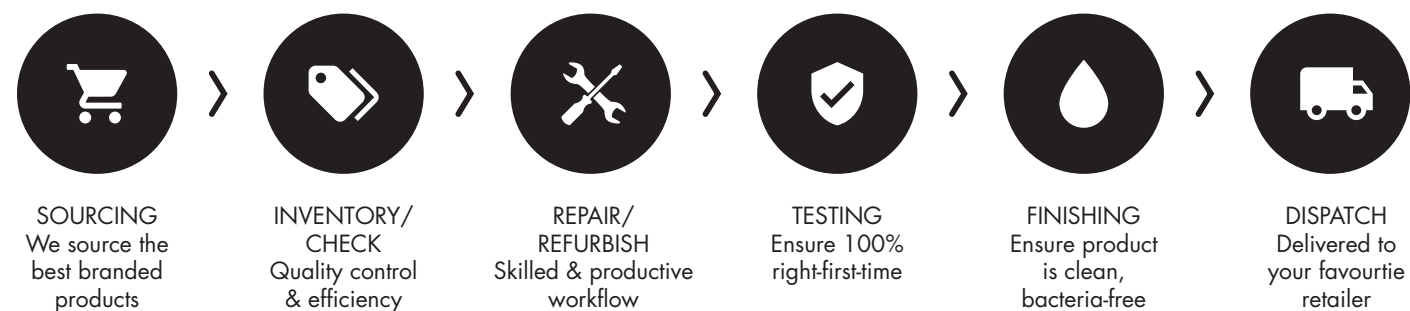
For this potential to be realised we need a new breed of entrepreneurs – ready to develop new and disruptive business models, in a sector that might not be perceived as attractive as the bright shiny world of conventional manufacturing. Thankfully, new players are emerging with impressive new and disruptive business models.

Norsk Ombruk AS is a dynamic and ambitious remanufacturing company – established in Norway in 2013 – laser focused on extending the useful and productive life of household electrical goods.

The company’s value proposition is all about taking products that have come to the end of their first, useful phase of life – usually after five years²² – and, through its unique remanufacturing processes, performed by a team of skilled operatives, the company is able to produce high-quality remanufactured products, which deliver a further useful five years of peak-performance, and which may be purchased through reputable big-brand stores at half-the-price of new machines.

Not only does this business model enhance product life and value for the end-user customer, it also extends the life and reputation of the original brand. The model delivers an affordable alternative, to the brand new product, while preserving valuable resources, and saving energy and associated carbon dioxide emissions. If positioned rightly, as we explore later on, this situation can also work out to the advantage of the Original Equipment Manufacturer (please refer to section on Brand Value Benefits).

Norsk Ombruk currently has a focus on White Goods, a category that includes refrigerators, washing machines, stoves, dishwashers, and dryers. Table 1 (below) includes a summary of the company’s remanufacturing product mix. The relative proportions of products are received are fairly similar, each year, and are purely down to whatever the company receives from its various channels of supply – most usually products returned to retailers at the end of their first useful life. The top-two items are refrigerators and washing machines, accounting for 65-70% of throughput each year.



Title, Figure 3: Norsk Ombruk remanufacturing process flow.

TABLE 1: REMANUFACTURING PRODUCT MIX

Products	2016	2015
Refrigerators	40%	40%
Washing-machines	25%	30%
Stoves	17%	12%
Dishwasher	10%	10%
Dryer	8%	8%

Norsk Ombruk is growing at a rapid pace, having invested heavily in scalable production processes, excellent quality control systems, and in developing a high-skilled workforce. In 2016 the company remanufactured over 12,300 electrical products – representing 50% more throughput than the previous year – delivering annual sales of €1.8 million. Following a successful start-up phase, the company is now expanding its operations into other countries in Europe and Scandinavia. Table 1 (below) summarises the key dimensions of product throughput in the business for 2016 and 2015.

TABLE 2: PRODUCT THROUGHPUT

Product Throughput	2016	2015
1. Number of products received	25,800	15,724
2. Products suitable for potential re-use	14,224	10,636
3. Products failing initial inspection: unsuitable for re-use	11,576	5,088
4. Repairable products	12,331	8,180
5. Quality-checked – un-repairable; discarded for parts recovery & recycling	1,893	2,456

The company receives products from a wide range of sources – including Elkjøp and other electrical retail stores – from OEMs including Electrolux, and some products from municipalities, too.

Through its quality inspection process, the focus is on sourcing higher-quality branded used products, which offer the greatest potential for remanufacturing. It makes good sense to focus on those products that offer the best platform for an effective and efficient remanufacturing process. Typically, this will involve brands like Electrolux, AEG, Zanussi, Miele, Siemens, Bosch, Ariston, Hotpoint, Hotpoint Ariston, LG, Samsung, Whirlpool and others.

When receiving in-bound product deliveries, all inventory is checked, bar-coded, and all details entered onto the quality control system. The age and quality of incoming products is variable – anything from 1-10 years old, although the average product tends to be around 4-5 years old. The specific contract with Electrolux is rather different, focused on un-sold broken items, meaning that products received directly from Electrolux tend to be much newer, with an average age of 1-2 years. Electrolux products received from other channels, of course, do tend to be much older.

A full range of diagnostics are undertaken to check on product performance and determine remanufacturing potential. A good proportion of products are repairable – around 48%, based on current performance. Discarded products are those deemed unsuitable for quality remanufacturing – in which case the key value-add parts are recovered, with remaining materials sent to Revac AS for recycling. The aim is to keep as many parts and materials at their highest level of use, for the longest time possible.

Suitable products are then fully and hygienically cleaned and made-ready for efficient repair. A work schedule for each item is produced – based on the initial diagnostics report – then workflow and productivity are managed through Norsk Ombruk’s bespoke quality management system. Specific refurbishment and repair activities are undertaken by skilled operatives – fully trained in house.

Through the remanufacturing process, it is possible to upgrade key components and deliver enhanced performance, beyond that of the original product – for example with a an average shift in energy performance from ‘C’ to ‘B’ rating is routinely the case.²³

When each product work schedule is complete, each product is tested to ensure the desired level of quality has been achieved. As might be expected, Norsk Ombruk aims for perfection, towards 100% right first time. In practice, the company achieves 95-100% right first time – with any minor issues rectified. Finally, products undergo a finishing process, where they are fully cleaned, again, to ensure they are bacteria-free, before being dispatched to quality big-brand retailers, including Elkjøp and IKEA.

Beyond its own remanufacturing process, the success of Norsk Ombruk’s approach depends on a range of collaborations, right through the value chain. The beneficial interconnections between key players become evident as we start to visualise the emerging value chain, illustrated in Figure 4 (below).

By working in partnership with incumbents like Electrolux – along other OEMs that are less interested in direct ownership of remanufacturing solutions – Norsk Ombruk is able to source an increasing volume of old products, through which it can produce its range of remanufactured products. Furthermore, working in partnership with retailers like Elkjøp and IKEA, Norsk Ombruk has access to mainstream sales channels – maximising the opportunity for customers to see and purchase high-quality remanufactured products, as a viable alternative to new products.

These important collaborations also help to maximise the effectiveness of Norsk Ombruk’s processes, offering increasing economies of scale, which also help to maximise the delivery of triple-bottom-line benefits arising from its remanufacturing model.

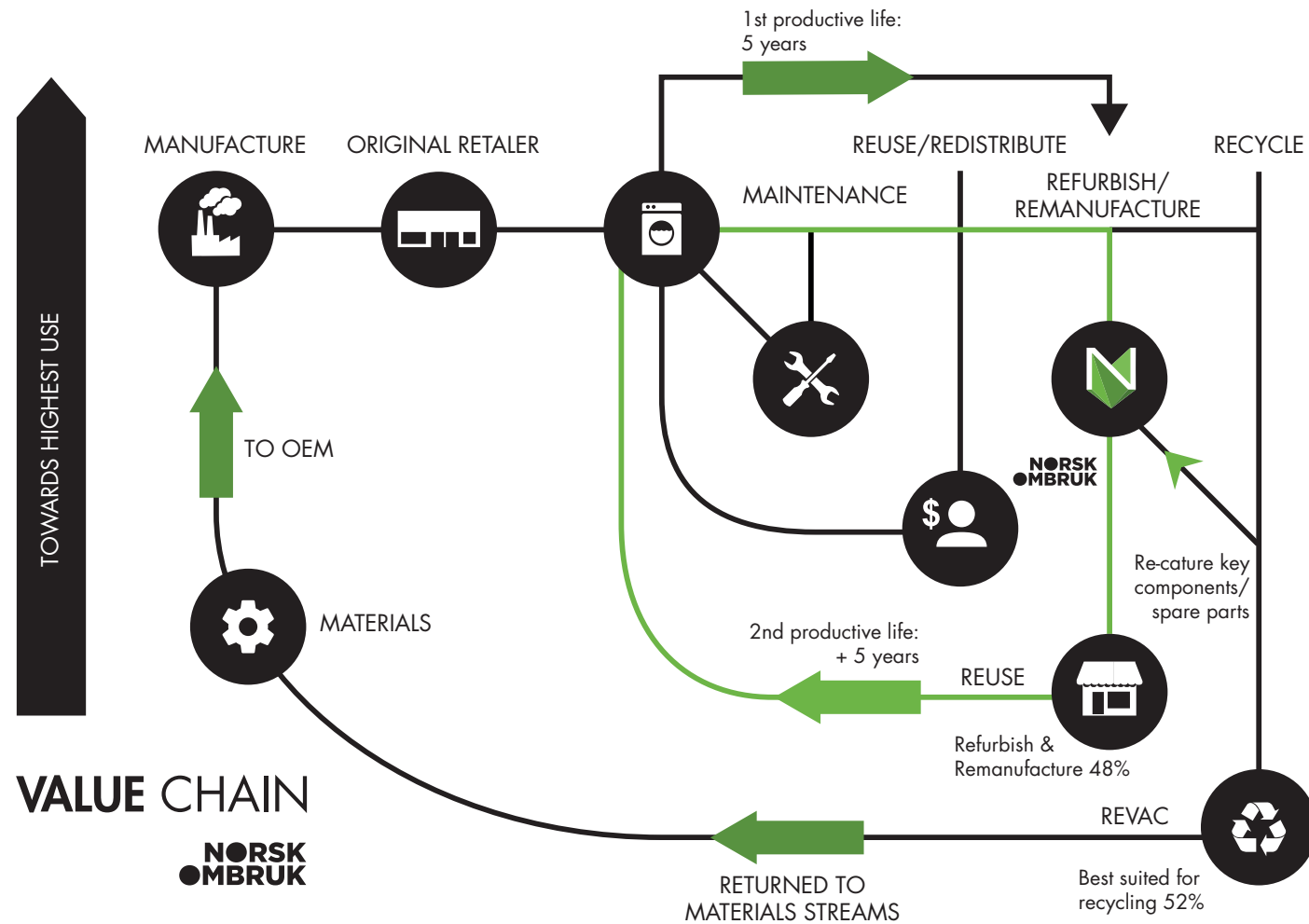


Figure 4: Norsk Ombruk remanufacturing value chain.

“A COMPANY THAT DOES NOT ADD VALUE TO SOCIETY SHOULD NOT EXIST.” - JOE KASSER, CHIEF EXECUTIVE OF SIEMENS.

Through these collaborations, Norsk Ombruk is able to help bend the value chain away from a linear model, towards a much more circular shape. This could not be achieved in isolation, or without the enlightened cooperation of value chain incumbents. ‘Enlightened’ is the operative word, as such players are able to see past present day conditions, and notions of trying to protect their current positions, to seek a deeper range of commercial benefits – for longer-term, sustainable business success.

This remanufacturing business model not only extends product life, it also extends brand life, too. For example, the Electrolux brand, represented by a high quality remanufactured machine – keeps serving you, the customer, for longer – in a way that does not keep enticing you to throw-away and buy more. This also generates longer-term loyalty, as purchasers of quality re-manufactured products can tend to trade-up, later on. Meeting the business model challenge is a real game-changer for all concerned.

Remanufactured products are high-quality, designed to last a further five years. Norsk Ombruk’s remanufactured

products are sold retailers with a six-month re-manufacturing warranty. The stores offer customers a two-year warranty, although the customer can also buy further extended warranties, if desired.

The likelihood of problems is very low – Norsk Ombruk records 97% pass rate through the warranty period and beyond; an enviable track record. Any defects usually tend to show within the first few weeks of use. If there is a problem within the first six months, Norsk Ombruk will remedy any defects at their own expense. If there are faults between six and twelve months, if it is an easy fix, Norsk Ombruk will undertake the repair for free, out of goodwill. If the repair is more difficult, the repair will be at the expense of the electrical store. For problems after the two-year store warranty period, the customer pays. The average cost of these repairs is only round 600 NOK (around €65).

In the next section, we start to explore, in more granular detail, the holistic range of benefits delivered by the Norsk Ombruk remanufacturing model.

BENEFITS & IMPACTS STUDY – AN OVERVIEW

By optimising the closed loop – and keeping products at their highest level of use, for longer – Norsk Ombruk is able to realise a significant and diverse range of benefits.

Through business model innovation, the company is able to deliver positive social, environmental and economic impacts. By extending the life of useful products, the business helps to save resources, prevent waste, reduce carbon and energy, and saves people money. Families on lower incomes can now afford higher quality, energy-efficient products.

For a fairly modest company, Norsk Ombruk is able to deliver an impressive range of benefits, which aggregate to be worth around €9.4 million in 2016. A summary of key benefits is given in Table 3 – with a short description of each benefit category, below.



Figure 5: An array of holistic benefits.

Benefit Streams	2016 (€k)	2015 (€k)
1. Customer & Societal Value	4,476	2,969
2. Brand Value (OEM)	441	292
3. Resource Conservation	2,131	1,413
4. Energy: Embedded & Lifecycle	1,568	1,041
5. Carbon Savings	12	8
6. Reduced Economic Leakage	768	586
Total	9,396	6,309

TABLE 3: SUMMARY OF KEY BENEFITS

- 1. Customer & Societal Value:** This is all about the end-user, you and I, and the combined societal benefit achieved by offering a high-quality remanufactured product at half the price we might pay for a new product. This provides greater access and affordability, in particular for households that may be struggling on lower income.
- 2. Brand Value:** A range of benefits available to the Original Equipment Manufacturer (OEM) – some tangible, some not (yet) fully monetised, including: Direct income for end-of-first-life machines, reduced cost of inventory & logistics, Product R&D (performance), Enhanced reputation, Brand loyalty (future trading up), and Future proofing the business (operating with an enhanced circular business model – ready for future legislation).
- 3. Resource Conservation:** Resource extraction avoidance by keeping thousands of products active for a further five years, and Recycling income from components not directly suitable for remanufacturing.

- 4. Energy:** Embedded energy saved through avoiding manufacture of new products, along with energy saved through extended lifecycle of remanufactured products, with enhanced energy rating performance.
- 5. Carbon Price Savings:** Costs avoided by OEM and customers – based on notional carbon pricing applied to embedded and lifecycle energy used. A fairly modest benefit, with today's low carbon prices, and the extremely low carbon intensity achieved in Norway, but an important one to keep on the map – especially in view of future policy shifts, and also with many jurisdictions having much higher carbon intensive energy.
- 6. Reduced Economic Leakage:** A range of national economic benefits through keeping products in use, avoiding the black market, and developing remanufacturing jobs. These include: Reduced cost of unemployment, Greater income tax, Value added tax on re-selling, and through Up-skilling the workforce.

DETAILED REVIEW OF IMPACTS AND BENEFITS

There is a growing body of work exploring the benefits of the circular economy – particularly from a macro-perspective, concerning the strategic business and economic benefits available. For example, recent reports promote the potential for saving millions of Euros in resource costs, along with the ability to create many thousands of new jobs.

Much of the general narrative tends to be pitched at the scale of larger corporations, and even at the level of countries, and economic regions – aiming to influence key policy shifts towards a more sustainable, circular economy paradigm. The macro business and economic case looks quite attractive – although many businesses will be more interested in the micro-level case; it has more immediate meaning and impact.

There is also an increasing knowledge base of circular economy and remanufacturing case studies, although many cases tend to be in the form of high-level summaries, and are mostly qualitative in nature. Some cases offer headline numbers, but provide little evidence of in-depth analysis concerning the full range of business, economic and sustainability benefits arising at the micro and individual business level.

Given the growing urgency for more radical business shifts in sustainability performance, allied to an increasingly compelling macro-level case for circular economic and remanufacturing models, there is a real need to demonstrate the triple-bottom-line benefits arising, at a more granular level, for individual businesses adopting circular and remanufacturing business models.

This is important – not only to demonstrate the value and business case, in real terms – but, also to help inspire customers, businesses, and investors to go further and realise

the full range of opportunities available within their own markets. This is particularly important when we consider the case for engaging SMEs in the necessary transition towards a circular economy; they are the lifeblood of our economies and represent a large proportion of manufacturing activities. Without visibility of the business case at this level, it is unlikely we will get much traction.

When developing our appraisal of the Norsk Ombruk remanufacturing model, we have drawn on extensive methodologies – developed and refined by Earthshine over the last decade – to help identify and capture a granular approach to modelling the range of financial and other benefits that impact on the economy, businesses, society, people, and the environment.

Our approach involves the evaluation of the Norsk Ombruk remanufacturing model versus a business-as-usual, linear economic approach. The baseline for all benefit streams is the position that would otherwise exist should the Norsk Ombruk approach not be deployed on the volume of products concerned. The key difference, as we might see in the earlier value chain comparison, concerns the range of opportunities available by keeping a greater number of existing electrical household products at their highest use for a further five years.

This work represents the start of a journey – towards greater visibility of performance and benefits throughout the whole value chain. Currently, some elements of cost and performance are more visible and transparent than others. Within the scope of this exercise, we have attempted to create a good, initial sketch of the benefit streams arising, although further work is needed to generate further visibility in key areas.

We have also had to simplify our model, and extrapolate from an initial focus on washing machines – as there are greater levels of detailed data and information available within this category. Going forward, there is an opportunity

for more detailed product lifecycle analysis on other items, including Refrigerators, Stoves, and Dishwashers. More work is also needed to make visible the resource utilisation and performance during the manufacture of original products. As such, this analysis provides a starting point, which can be further developed, going forward.

We explore fully detailed and granular benefits models, including explanations, assumptions, and data sources, for each of the following benefit streams, within Appendix 1.

1. Customer & Societal Value
2. Brand Value (OEM)
3. Resource Conservation
4. Energy: Embedded & Lifecycle
5. Carbon Savings
6. Reduced Economic Leakage

Further beneficial impacts are also possible, in terms of the level of circularity enabled by remanufacturing – along with, the contribution of Norsk Ombruk's approach towards achieving the United Nations' Sustainable Development Goals (the Global Goals).



REMANUFACTURING VALUE: NEW METRICS

Reflecting on the total range of accumulated benefits for 2016, it can be worth exploring some new business metrics – in addition to more conventional Economic Value Add (EVA) measures – to establish the amount of value added, in holistic terms, through remanufacturing activity.

Firstly, we consider a high-level metric to give an indication of the level of ‘circularity’ being delivered. We are able to develop this theme on two levels for Norsk Ombruk; firstly, the mass of products/resources remanufactured for re-use (the highest level of resource use), and also the level of resources that are recycled (representing a lower level of utilisation).

Level of ‘circularity’ delivered:

For 2016, Norsk Ombruk records a total mass of incoming products = 1,393,200 kg (a function of total recorded mass less mass of cages): representing 25,800 electrical products. The total mass of products remanufactured = 665,874 kg. This represents a remanufacturing performance of 48%.

Meanwhile, the total mass of resources broken down for recycling = 727,326 kg: representing 52% recycling performance.

Almost half of incoming products turn out to be in good enough condition to enable high-quality remanufacturing, while the remainder are only suitable for recycling. Perhaps, in the future, there could be an opportunity to shift the balance towards a greater proportion of products that can be remanufactured – it all depends on the level of quality of incoming products, and the ability to effect productive remanufacturing activities.

Net value added:

We have also developed a ratio of benefits delivered in proportion with the manufacturing firm’s business operating costs. In the case of Norsk Ombruk the ratio of benefits to business operating costs = 11:1.

In simple terms, for every €1 million of operating costs, the company delivers €11 million of benefits to people, the environment, business and the economy.

We might compare this with the work of the New Economic Foundation, which evaluated that conventional banks destroy £7 of value for every £1 they earn.⁴²

Value to society:

Remanufacturing clearly has a major role to play in adding value. It is also worth noting that 56% of the benefits delivered by Norsk Ombruk flow to society.





CONTRIBUTION TO UN SDGs

The UN Sustainable Development Goals (SDGs) could provide the greatest opportunity and catalyst for business and economic transformation, this generation will see.



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The UN Sustainable Development Goals (SDGs) could provide the greatest opportunity and catalyst for business and economic transformation, this generation will see.

For many progressive companies, the SDGs are also seen as a positive driver for sound business, rather than an obligation. It is possible for businesses to pivot off the SDGs for a number of business advantages – unlocking a wealth of opportunities, as we seek worthy, new income streams from contributing towards the great challenges of our time.

Progressive business leaders are already engaging with the SDGs to identify where and how their businesses could make an active contribution. Exploring this vital question also drives us towards finding, or re-finding, our real purpose in business, too.

Norsk Ombruk also recognises the potential impact and contribution – associated with its remanufacturing model – in support of the greater movement towards achieving the SDGs. Their key impacts may be summarised as:

If we are serious about generating sustainable prosperity – and this is what the SDGs are about – we should seriously consider aligning the SDGs with our business goals. In taking the first step, we might commit to the #Businessworthy mission.⁴³ Norsk Ombruk has recently signed up to support this important initiative.

1 NO POVERTY



> **SDG 1:** End poverty. By providing access to lower-cost remanufactured appliances, Norsk Ombruk enables a benefit to lower income families – freeing up valuable money for other important life costs. While absolute poverty is the key challenge in many parts of the world, we should also be mindful of the growing levels of relative poverty in the developed world.

7 AFFORDABLE AND CLEAN ENERGY



> **SDG 7:** Access to affordable, reliable, sustainable and modern energy for all. While availability of renewable energy is key, energy efficiency is just as important; we need to reduce our demand for energy, to help enable a more achievable and rapid energy transition. Remanufacturing reduces both embedded and lifecycle energy.

8 DECENT WORK AND ECONOMIC GROWTH



> **SDG 8:** Sustained, inclusive and sustainable economic growth. Circular, remanufacturing models enable further economic growth within planetary boundaries, and generate new skilled & resilient jobs and tax receipts within the real economy.

9 INDUSTRY, INNOVATION AND INFRASTRUCTURE



> **SDG 9:** Resilient infrastructure. Norsk Ombruk's model acts as a catalyst to generate a circular economy eco-system – through joining up supply and demand networks between retailers, manufacturers, municipalities & waste management authorities: helping to bend the wasteful linear economic model into a more circular shape. Through its expansion strategy, the company is also able to influence developing circular economic infrastructure within other EU countries.

11 SUSTAINABLE CITIES AND COMMUNITIES



> **SDG 11:** Resilient cities. Norsk Ombruk is helping to generate 21st century jobs: remanufacturing skills within local economies has a big part to play in developing a more resilient urban economic future.

12 RESPONSIBLE CONSUMPTION AND PRODUCTION



> **SDG 12:** Sustainable Consumption and Production. By its very nature, remanufacturing provides an essential element in bringing more sustainable production and consumption practices together.

13 CLIMATE ACTION



> **SDG 13:** Climate change. Remanufacturing enables a reduced embedded carbon footprint plus reduced lifecycle emissions – by keeping existing products and resources in use for an extra five years.

16 PEACE, JUSTICE AND STRONG INSTITUTIONS



> **SDG 16:** Peaceful and inclusive societies for sustainable development. Norsk Ombruk's model provides a catalyst for local economic re-generation that can provide greater economic opportunity for the many and – if followed with interventions towards greater economic equality – could contribute towards a more cohesive and peaceful society.

KEY INSIGHTS AND THE FUTURE OF REMANUFACTURING

The Norsk Ombruk remanufacturing model is all about product life management; away from the wasteful linear value chains, with old products simply discarded, or broken down for recycling. The Norsk Ombruk model is all about keeping assets at their highest use for as long as economically and practically possible.

Norsk Ombruk shows us what is possible – and how remanufacturing can become a practical reality, delivering a broad range of significant benefits for people, planet, businesses, and the economy as a whole.

Major financial benefits are possible in terms of value generated for customers, OEMs, and retailers – as a result of keeping products at their highest use for a longer period; in this case, by generating an extra five years of useful product and brand life.

A total economic benefit of €9.4 million during 2016 is impressive – given the fairly modest scale of operation within a single SME business in one territory – accumulating from a range of practices within the following categories:

1. Customer & Societal Value
2. Brand Value (OEM)
3. Resource Conservation
4. Energy: Embedded & Lifecycle
5. Carbon Savings
6. Reduced Economic Leakage

In terms of net value added by Norsk Ombruk, we can think about the ratio of benefits delivered in proportion with the manufacturing firm's business operating costs: 11:1. In simple terms, for every €1 million of operating costs, the company delivers €10 million of benefits to people, the environment, business and the economy.

Norsk Ombruk also delivers an impressive degree of circular economic performance:

The proportion of products/resources remanufactured for re-use (the highest level of resource use): 48%.
The proportion of resources that are recycled (representing a lower level of utilisation): 52%.

Societal as well as business benefits:

Quite significantly, there are also benefits to people and society, through the access to affordable, high-quality branded white goods – available at half the price of their newly manufactured counterparts. 56% of the benefits delivered by Norsk Ombruk flow to society. This makes for a genuinely attractive proposition to encourage customer participation within the circular economy.

Contribution towards UN SDGs:

The holistic range of remanufacturing benefits can also provide a great contribution towards the achievement of the Global Goals (UN Sustainable Development Goals).

Thinking more widely, it is stimulating to reflect on what might be possible within a number of remanufacturing companies and value chains, and across a range of economic territories.

Beyond the triple-bottom-line:

While the notion of the triple-bottom-line is a helpful concept – in getting us to think about a wider perspective of business impacts – when we analyse and reflect on the full range of benefits here, we tend to notice, in practice, that many positive benefits seem to transcend the simple boundaries of thinking around environmental, social and economic benefits. It can prove difficult to try and categorise benefits within these simple, single silos – and, we might question the real value in doing so. In practice, the benefits explored tend to take us beyond the triple-bottom-line – towards thinking about the holistic performance of all players in the value chain, as they concurrently add a range of 'goods' to society, while reducing their adverse

environmental impacts. For Norsk Ombruk, we can start to appreciate the true bottom-line for a purpose driven business, operating within planetary and societal boundaries.

There are many further insights and lessons arising to help support and advance the spread of remanufacturing within a circular economy.

Scale is everything:

When quantifying the impacts of remanufacturing, scale is everything. The benefits model is highly sensitive to changes in volume. The scale of the operation, in terms of the volume of products remanufactured, drives everything. Financial and other benefits rapidly accumulate, as the volume of remanufactured products increases, from year-to-year.

Systems' thinking applies:

There are strong inter-relationships between different categories of benefits – involving positive feedback loops – as many practices tend to reinforce the impacts in other benefit streams. For example, a fairly small betterment in any aspect of the business model leads to major savings in a range of other areas – including energy, carbon, and resource costs.

Remanufacturing as a catalyst:

Remanufacturing business models can provide a catalyst within markets to generate a more sustainable circular economic ecosystem – forging new links, dependencies relationships, and partnerships – all geared towards the circular flow of products, resources, components and materials – maintaining their highest use. This model can help to drive changes right through the entire value chain, and can help rejuvenate local economies – ultimately, towards a new, more sustainable economic ecosystem.

Collaboration is essential:

Realising the potential of remanufacturing within a circular economy transition requires collaboration right through the value chain. To make this work we need an enlightened view from incumbent players including retailers and OEMs – not the singular and protective view of old – recognising that remanufactured products are not necessarily a threat to their respective business models, but rather something that can enhance their position and reputation within a vibrant circular economy.

Barriers to further progress:

Other studies have found there can be numerous barriers obstructing the potential that extensive remanufacturing offers, including: Customer recognition; Availability of 'core' (used components for remanufacturing); Quality of core; High labour costs; Legal ambiguity (especially across different jurisdictions); Lack of sales channels; Lack of product information; Lack of technology; Low cost competition from new products; Skills shortages; and, Poor design for remanufacturing of original products.⁴⁴ More work is needed in dealing with these issues, to help ensure that the beneficial spread of high-quality remanufacture can continue.

Further enablers for collaborative success:

Drawing from Norsk Ombruk's successes to date, further collaboration between value chain partners is needed to develop even greater performance and realisation of circular economy and remanufacturing benefits:

- > 1. Greater design for remanufacturing by OEM: To aid more productive working, OEMs could adopt greater levels of design for future disassembly and remanufacturing – perhaps adopting 'design for remanufacturing' as a specific discipline within their processes

- > 2. Access to old stock of returned and damaged goods from OEMs and retailers: This enables a continuous flow of products to work on, leading to more efficient remanufacturing and lower production costs.
- > 3. Easy access to quality spare parts at reasonable prices by OEMs: to further enable efficient, timely, and cost effective remanufacturing activity.
- > 4. Access to OEM product manuals, knowledge, & repair information – enables greater efficiency in the remanufacturing process. Greater levels of collaboration – building on the relationship model currently established with Electrolux – will enable greater access to product information and technology support, enabling the remanufacturer's daily work schedule to be even more productive.
- > 5. Common standards for remanufacturing quality – approved by OEMs. Potentially leading to a quality mark/certification of remanufactured products by OEM – to provide further credibility, beyond warranties.
- > 6. Collaborative business model – between remanufacturers, retailers, and OEMs – involving sharing of data and systems, to provide visibility of information and data right through the value chain: a shared value ecosystem.
- > 7. A supportive policy environment – taking the lesson from Sweden's approach to encouraging sustainable consumption – future policy incentives might be introduced in terms of a reduction in the level of NOMS/VAT applied to professionally remanufactured goods; making them cheaper to buy and further stimulating both demand and supply.

The future research agenda:

Further research work is also needed to help develop further visibility and transparency of product costs and performance – to help develop even more robust benefits models, analysis, and insights:

- > A. Technical Perspectives: Including a scientific appraisal of the performance of remanufactured products in use – to establish a robust view of trouble-free performance for the five years of extra machine life – and also, in terms of enhanced energy rating performance. This study could also include identifying the key factors that are leading to so many products being discarded, so early in their technical lifecycles.
- > B. Customer/Societal Perspectives: A further study on how funds saved through the purchase of remanufactured products are utilised by end-user beneficiaries – is this saving used on other essentials, like food and utilities, put into savings, or used for leisure? This will help to validate how customers' product savings flow through to benefit the rest of the economy.
- > C. Brand Value Perspectives: More research on impact of quality remanufacturing on brand loyalty – and to establish whether the potential for trading-up in future years is realised. In addition, a further measurement study on the specific dynamics and impact of reputational benefits on share price performance, over time.

We hope this holistic and granular study of remanufacturing benefits helps to inspire further interest in the uptake of authentic remanufacturing activity within all sectors, and in all parts of the world. We also hope it helps to stimulate further development and debate concerning the development of robust business cases in this important space. We welcome further engagement and dialogue.



APPENDIX: DETAILED BENEFIT CALCULATIONS



No longer operating with a singular emphasis on short-term profit maximisation and shareholder value, enlightened business leaders are re-focusing on what really creates business value – emphasising a renewed focus on customer value.²⁴ Norsk Ombruk carries this insight forward with great entrepreneurial energy; the primary purpose for its business is extending product life and customer value through sustainable innovation.

BENEFIT 1: CUSTOMER & SOCIETAL VALUE

No longer operating with a singular emphasis on short-term profit maximisation and shareholder value, enlightened business leaders are re-focusing on what really creates business value – emphasising a renewed focus on customer value.²⁴ Norsk Ombruk carries this insight forward with great entrepreneurial energy; the primary purpose for its business is extending product life and customer value through sustainable innovation.

Norsk Ombruk's focus on customer value provides high quality products that last a further five years, beyond the usual five-year lifespan, and at half the price of new machines. This means that the company is able to deliver a positive social impact. Families on lower incomes can now afford higher quality, energy-efficient products.

Societal Benefit: A refurbished product offers an affordable alternative for the increasing number of less well-off in society.

We need to differentiate between two customer types: the end-user and the original manufacturer (OEM).

**In 2016:
4.5 million in customer
and societal value.**

1.1 END-USER:

The average price for a brand new machine (incl. tax) = 5,500 NOK

The average price for a remanufactured machine (incl. tax) = 2,200 NOK

Saving for customer = 3,300 NOK per machine. This is equivalent to three weeks worth of food for the average family.

1.2 SOCIETAL VALUE:

Scaling this up, by 12,331 machines remanufactured and sold in 2016:
Total saving to society = 40,692,300 NOK
= €4,476,153

The money saved is not lost to the economy – it is most likely put to other good purposes; paying for other essentials, like food, utilities, and so on – or, perhaps, put into savings accounts. The key point is not to have so much limited family budget tied up in new and resource-intensive capital purchases. This is an important aspect of the benefits profile not just a case of shared value, this actually means shared wealth – as more people have access to affordable high quality goods, at half the price, while doing so within planetary limits.

BENEFIT 2: BRAND VALUE BENEFITS FOR ORIGINAL EQUIPMENT MANUFACTURER (OEM) & RETAILERS

In 2016: €0.44 million of monetised benefits, plus further intangible business value benefits.

A range of benefits for the Original Equipment Manufacturer (OEM)/Retailers:

- > Direct income from selling end-of-first-life products to the remanufacturer.
 - > Reduced cost of managing inventory and logistics. Enhanced 'circular economy' reputation: if partner with high-quality remanufacturer.
 - > Enhanced business reputation – especially, the societal benefit, helping less well-off families to benefit from having a super product.
 - > Extended brand life – product credentials and reputation enhanced for a further five years.
- Generate a new segment of customers, developing brand loyalty, perhaps trading up later on.
- > Product performance data to enable further product lifecycle R&D.
 - > Future-proofing: helps OEM's meet new EU targets for recycling/re-use.

2.1 DIRECT INCOME:

Income to OEM/Retailer from recovery of old machines – from remanufacturer paying:

100 NOK per machine x 12,331 machines
= 1,233,100 NOK = €135,641

2.2 COST AVOIDANCE:

A range of costs avoided from managing inventory of old products, including: Storage, Transport, and disposal costs.

A. Disposal cost: 2.0 NOK/kg x 54kg per machine (average for all products) x 12,331 machines
= 1,331,748 NOK = €146,492
Reduced inventory of old machines stored while awaiting disposal – avoid costs of storage and transport:

B. Storage: Old products at the end of their first-life will be collected by Retailers. Assuming that each month inventory is collected and disposed of in batches – we therefore only need to find storage for an average of 1/12 of the total volume (Validate further with Store?). Further, assuming 0.72 m² of average storage/access area per machine.²⁵ Warehouse storage area required = 1/12 x 12,331 machines x 0.72 m² = 720m². Rental saving = 720 x €150/m²/year²⁶
= €110,979 /year

C. Transport: 12,331 products X 40% (Fridges only): 170 per truck load = 72.53 journeys x 15,000 NOK per journey (average) x 40% = 435,212 NOK
= €47,873/ year



BENEFIT 2: CONTINUES →

2.3. FURTHER PRODUCT R&D:

There are further benefits available to the OEM through collaborating with a high-quality professional remanufacturing company, such as Norsk Ombruk. The remanufacturer's detailed diagnostics reveal much useful information on the condition and performance of the end-of-first-life products. This new feedback loop of product life knowledge can help OEMs with their future designs, and support materials selection and sourcing with greater emphasis on sustainable lifecycle performance, and in design for remanufacturing. For example, at a strategic level, this can help with development work towards EU requirements for eco-design within the Circular Economy Package. At a more practical level, this could involve a move towards greater standardisation of screws & fittings to enable easier disassembly for repair and/or remanufacture. More collaborative work is required in order to fully quantify the financial impact of Product R&D benefits.

2.4. REPUTATIONAL VALUE

There are a number of reputational benefits, which also flow from taking an enlightened position on remanufacturing within the circular economy – available to OEMs working in partnership with quality remanufacturing partners:

A. Circular Economy Leadership:

Partnering with a quality remanufacturer helps the OEM to meet new EU targets for re-use and for recycling. For the OEM it must be an attractive proposition to be able to meet and match the 87% circular economy metric achieved by Norsk Ombruk (see Conclusions). The greater the number of its original products that are re-manufactured, through high-quality process, the greater the level of circularity achieved by the OEM concerned. Further leadership is possible on individual resources streams, including plastics. There is also an opportunity for reflective glory, where remanufacturing is undertaken to high standards.

B. Social Sustainability Benefit:

Norsk Ombruk's remanufactured products, sold at half the price of new equipment, helps less well-off families to benefit from having affordable access to high quality products. The OEM brand is directly visible, seen as caring about all members of society – and, not seen purely as a profit-maximising corporate machine. The financial benefit for society is quantified within the preceding pages, but there is further value-added to the brand value of both OEMs and Retailers when selling high quality remanufactured items – being seen as enabling this important societal benefit.

C. Enhanced Brand Life & Loyalty:

Norsk Ombruk extends both product and brand life for a further five years, effectively serving a wider range of

customers, for longer – in a way that does not keep enticing customers to throw away and buy more. This enables customers to participate very easily within the circular economy. Of course, conventional business wisdom implies that if products are remanufactured by a third-party, this will result in reduced sales and lost revenue for the OEM. The reality could be quite different, however. At this stage, there is no evidence of cannibalised sales. Further, the more enlightened and realistic view is that 'quality remanufacturing' can generate access to new customer segments and longer-term brand loyalty – as purchasers of quality re-manufactured products can tend towards trading-up, later on. Further research is needed in this field in order to establish the future purchasing behaviours of customers buying remanufactured products.

D. Future Oriented and Future-proof Organisations: New public policies and regulations are evolving, tackling the important challenge of sustainable consumption. Working more fully in the circular economy, with quality remanufacturing partners, allows the OEM to align with new policies and regulations. For example, the new Strategy for Sustainable Consumption launched in Sweden in 2016 incentivises re-use and repair through beneficial tax allowances. There is no doubt that the future business policy landscape will do more to encourage and support

All of the above reputational factors combine to enhance the brand value of participating OEMs and retailers. While more work is needed to quantify the precise impact of enhanced circular economy/remanufacturing reputational impact on specific stock price performance, we do know that recent research from Harvard Business School demonstrates companies that undertake true sustainability efforts outperform competitors who don't – generating up to twice the value of investment performance, over time.²⁷

BENEFIT 3: RESOURCE CONSERVATION

In 2016: €2.13 million resource savings to the economy and recycling income to the remanufacturer.

By keeping high-quality remanufactured products in use – thereby extending the useful life of products for an extra five years – Norsk Ombruk helps to reduce the pressure for extracting and processing virgin resources.

Ideally, it would be possible to model each specific resource stream, and establish the total quantify of key resources that we can avoid using, for a further five years, due to the deployment of remanufactured products, each year. We don't yet have this level of visibility – but can develop a proxy estimate of benefits, in lieu of an exploratory exercise with OEMs.

So, as a starting point we can develop a proxy estimate on resource savings by modelling the approximate value of resources avoided through keeping products in use. For a new machine, we might assume that 50% of retail price is sunk within manufacturing costs – and, 50% of these manufacturing costs might be attributed to resource costs: i.e. resource costs represent 25% of total retail price. Further work is required to build on the assumptions here, and to develop a more granular baseline for resource utilisation and performance of the original manufactured product.

3.1 RESOURCE SAVING:

Avoid the need for discarding valuable resources – that would otherwise go to down-cycling/waste.

For 12,331 machines, with an average retail price of 5,500 NOK x 25% = 16,955,125 NOK = €1,865,064/year

We hope to explore this benefit stream further – and with greater visibility, highlight specific availability and price risks/opportunities associated with scarce materials, over time.

N.B. We can reflect on the timing and compound effect of benefits; with each remanufactured machine we save a specific amount of resources, each year for five years, until each comes to the end of its second useful, remanufactured life.

3.2 RECYCLING VALUE:

Some products are not necessarily suitable for remanufacturing, but they can still be recycled. Valuable resources can be extracted, including the steel casing, and plastics from the top panel of washing machined. Furthermore, certain parts or elements from remanufactured machines that are beyond economic repair can also be recycled.

Total value of resources sent for recycling at REVAG AS = 2,100,000 kg x 1.15 NOK/kg = 2,415,000 NOK = €265,650

BENEFIT 4: ENERGY SAVINGS

In 2016: €1,568k Embedded energy and Lifecycle energy savings.

Energy savings are categorised in terms of: Embedded energy saved, through keeping the product in use for longer, and thereby avoiding the need to expend new energy in primary manufacture of each new product, for a period of a further five years.

Customer life-cycle energy savings, through replacing old appliances with a more efficient remanufactured product.

4.1 EMBEDDED ENERGY:

Typical repairable product is 5 years old: with energy 'A' performance rating.

Remanufactured product is given 5 years further productive life, and is restored to a 'B' energy rating.

For each product remanufactured:

Avoided embedded energy: 1,061.29 kWh.²⁸

Offset by additional energy required in remanufacture: 10.35 kWh.²⁹

Total embedded energy saving per machine 1,050.93 kWh.

For annual remanufacturing:

Total embedded energy for annual remanufactured products (based on 12,331 units): 12,959,043.73 kWh.

This equates to financial savings of 12,959,043.73 NOK ³⁰ = € 1,425,494 ³¹

4.2 CUSTOMER LIFE CYCLE ENERGY:

Further 5 years, with refurbished 'B' rating machine replacing an old 'C' rating machine.³²

Remanufactured 'B' rated product in use for 5 years:

Average 'A' rating, means energy used < 0.23 kWh/kg (std) With 6 kg/load (average in Norway) this means 1.38 kWh/load 175 washes/yr (Average scenario) = 241.5 kWh/yr Total lifecycle energy of B-rated product over 5 years = 1,207.5 kWh

Old 'C' rated product, if it had been able to keep running:

Average C rated machine, means energy used 0.25kWh/kg With 6 kg/load, and 175 washes/year = 262.5 kWh/year Total lifecycle energy of C-rated product over 5 years = 1,312.5 kWh

Total lifecycle energy saved: 105 kWh/product x 12,331 products = 1,294,755 kWh

This equates to financial savings of 1,294,755.00 NOK over 5 years = €142,423.05 or €28,484.61 /year.

NB keeps accumulating, further remanufactured machines added each year, before dropping off the curve, after 5 further years.)

Total annual energy saved (embedded plus in-use) in 2016: €798,150.66

BENEFIT 5: REDUCED CARBON DIOXIDE EMISSIONS

In 2016: €12k savings in Embedded & Lifecycle Carbon Dioxide Emissions.

Naturally, as we keep products and resources in use for longer, and as we consume less energy, so the remanufacturing process results in less carbon dioxide emissions. There are two categories of carbon emissions savings: firstly, the emissions avoided by potentially manufacturing less new products; and, secondly, the life cycle savings.

5.1 EMBEDDED CO₂ SAVING:

220 kg CO₂/machine³³ x 12,331 machines = 2,712,820 kg = 2,712.82 tonnes

Financial saving = 2,712.82 tonnes x €4.50 per tonne³⁴ = €12,207.69

Q where manufactured/carbon intensity there, check?
Q Offset by total carbon footprint of Norsk Ombruk remanufacturing operations.

5.2 LIFE-CYCLE/IN-USE CO₂ SAVING:

Total lifecycle electricity saved for 12,331 remanufactured machines = 1,294,755 kWh

We need to convert this to CO₂ emissions, based on the carbon intensity of electricity in Norway: factor to be applied = 0.002240278 kg CO₂/kWh.³⁵

Total CO₂ emissions saved: 2,900.61 kg = 2.90 tonnes

Based on shadow price for carbon of 4.5 €/tonne = €13.05.

This CO₂ cost saving looks modest, in the extreme: this is a function of a very low carbon intensity of electricity produced in Norway, with around 96% derived from hydro in 2013³⁶ – coupled with a rather low carbon price in Europe. If we reach the more desirable carbon price of \$100/tonne – the level at which many experts argue is needed to drive the right behaviours towards lower carbon investment³⁷ – this benefit will increase by over a factor of 20.

Total cost saving from reduced embedded and lifecycle CO₂ emissions = €12,220.74

BENEFIT 6: REDUCED ECONOMIC LEAKAGE

In 2016: €769k savings in Unemployment costs, Income tax, and Value-added-tax (NOMS).

By keeping products within the circular economy, it means less theft and leakage of resources and value into the black market – thereby allowing more value in the real economy, to create more real jobs and tax revenue.

It is currently estimated that 20% of discarded machines enter the black market³⁸ – while the remaining 80% of discarded machines would end up being broken down and recycled, if quality remanufacturing within the circular economy was not possible.

So, 20% of the products remanufactured by Norsk Ombruk would otherwise be lost into an unregulated and invisible part of the economy – with, expend on conditions....
Machines retained in the legitimate economy = 20% x 12,331 = 2,466 /year.

6.1 OEM BENEFITS:

Direct income to OEM that would otherwise be lost:
2,466 machines x 100 NOK/machine = 246,620 NOK = €27,128

(NB this represents an additional benefit to the OEM that would be lost, if such products were lost into the black market. We will not count this benefit, however, as it is already included within the section on OEM benefits: it is important, however, to highlight that 205 of that income would be at risk.)

6.2 STATE BENEFIT SAVINGS:

Creating good, skilled jobs in the real economy – assumption: we focus only on extra jobs arising from keeping 20% machines in circular use, and assume that the 80% would cover jobs in conventional recycling.

For Norsk Ombruk, by saving the 20% of machines, it is able to generate 20% more jobs = 20% x 13.5 = 3.4 further legitimate jobs, beyond those in purely recycling of the 80% of discarded machines.

A. Saving unemployment costs that would otherwise be borne by the State:

In Norway, and assuming no other gainful employment: unemployment benefit covers up to 87.6% of the average salary (for up to 500 days).³⁹

This means a saving of 3.4 jobs x 390,000 NOK (average salary) x 87.6% = 1,161,576 NOK = €127,773

B. Real jobs paying income tax:

3.4 people x 390,000 NOK (average salary) x average tax of 30% = 397,800 NOK = €43,758

C. Additional NOMS (value added tax) recovered:

12,331 machines x 100% remanufactured⁴⁰ x 440 NOK/machine for VAT = 5,425,640 NOK = €596,820

This looks like a significant additional benefit to the government – which raises the question, whether a future policy incentive might be introduced by way of a reduction in the level of VAT on remanufactured goods; making them cheaper to buy and further stimulating demand and supply. This should be possible, and affordable – as a proportion of value-added tax revenue would still be significant, even

with a concession. It is interesting to see that Sweden – the first nation in the world to develop a National Strategy for Sustainable Consumption – has reduced VAT from 25% to 12% for repairs on items including bicycles, shoes and for white goods that are repaired in the home.⁴¹ To stimulate a greater shift towards remanufacturing within any economy, it might be an option to extend this approach to include all products, wherever they are remanufactured.

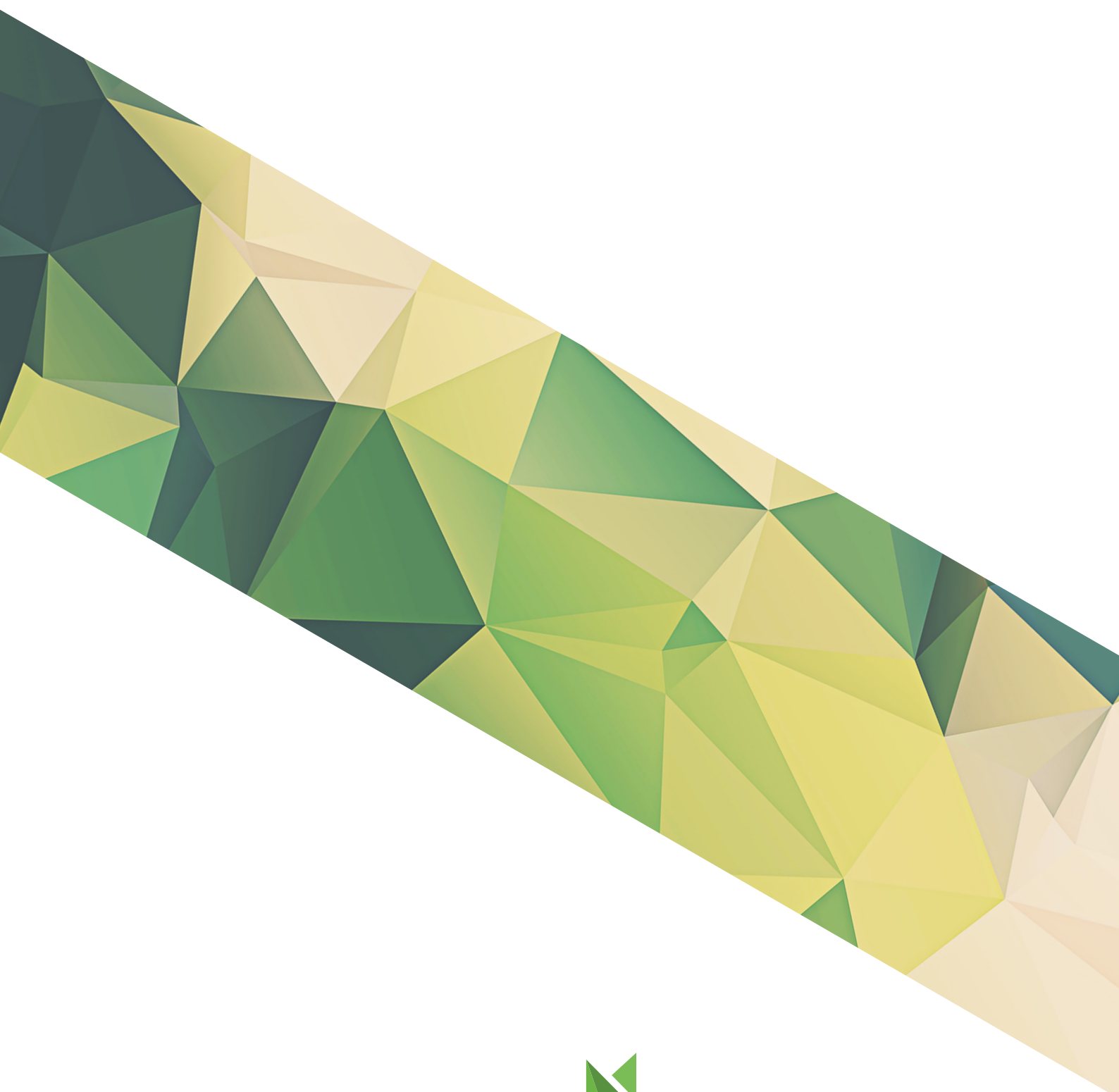
D. Up-skilling the Economy.

There are further economic benefits to be gained, in terms of improved circular economy and remanufacturing skills within any specific economy. This can help with long-term economic competitiveness, as well as in managing a more effective transition toward a sustainable and low carbon economy. Where old industry jobs are in decline, new industrial strategies are hungry for opportunities to create significant numbers of more sustainable, new economy jobs. A greater emphasis on remanufacturing provides a great opportunity to support re-training and re-deployment when transitioning parts of the workforce from old economy jobs towards 'greener' jobs. More work is required in developing the full rationale and economic benefits arising from this opportunity.



REFERENCES

- ¹ Economist (2017) *In retreat: The multinational company is in trouble*. <http://www.economist.com/news/leaders/21715660-global-firms-are-surprisingly-vulnerable-attack-multinational-company-trouble>
- ² Goldenberg (2014) *UN: rate of emissions growth nearly doubled in first decade of 21st century*. <https://www.theguardian.com/environment/2014/apr/11/un-greenhouse-gas-emissions-doubled-decade-ipcc-report>.
- ³ Townsend (2016) *Beyond Carbon Confusion*. <http://www.edie.net/library/Beyond-carbon-confusion--strategies-for-real-business-impact/6703>
- ⁴ Friends of the Earth (2009) *Overconsumption? Our use of the world's natural resources*. <https://www.foe.co.uk/sites/default/files/downloads/overconsumption.pdf>.
- ⁵ Stockholm Resilience Institute (2016): <http://www.stockholmresilience.org/research/research-news/2015-01-15-planetary-boundaries---an-update.html>
- ⁶ WWF (2016) *Living Planet Report 2016*. http://wwf.panda.org/about_our_earth/all_publications/lpr_2016/
- ⁷ Dietz et al (2016) *'Climate value at risk' of global financial assets*, Nature Climate Change Vol. 6.
- ⁸ Trucost (2013) *Natural Capital at Risk: The Top 100 Externalities of Business*. <https://www.trucost.com/publication/natural-capital-risk-top-100-externalities-business/>
- ⁹ Whelan & Fink (2016) *The Comprehensive Business Case for Sustainability*. <https://hbr.org/2016/10/the-comprehensive-business-case-for-sustainability>
- ¹⁰ Trucost (2017) *Sustainability is increasingly core to business strategy, says new report*. <https://www.trucost.com/trucost-news/sustainability-is-increasingly-core-to-business-strategy-says-new-report/>
- ¹¹ Bjorn et al (2015) *Is Earth recognized as a finite system in corporate responsibility reporting?* <http://www.sciencedirect.com/science/article/pii/S0959652615019204>
- ¹² EMF (2015) *Towards a Circular Economy: Business Rationale for an Accelerated Transition*. https://www.ellenmacarthurfoundation.org/assets/downloads/publications/TCE_Ellen-MacArthur-Foundation_26-Nov-2015.pdf
- ¹³ Mont & Heiskanen (2015) *Breaking the stalemate of sustainable consumption with industrial ecology and a circular economy*. https://www.researchgate.net/publication/276918171_Breaking_the_stalemate_of_sustainable_consumption_with_industrial_ecology_and_a_circular_economy
- ¹⁴ EEA (2015) *Circular Economy in Europe: Developing the Knowledge Base*.
- ¹⁵ Centre for Remanufacturing & Reuse (2017): <http://www.remanufacturing.org.uk/what-is-remanufacturing.php>
- ¹⁶ EEA (2015) *Circular Economy in Europe: Developing the Knowledge Base*.
- ¹⁷ Edie Newsroom (2015) *Majority of 40 million tonne global e-waste binned, says UNU*. <http://www.edie.net/news/5/Majority-of-40-million-tonne-global-e-waste-binned--says-UNU/>
- ¹⁸ Huisman et al (2015) *Countering WEEE Illegal Trade (CWIT) Summary Report, Market Assessment, Legal Analysis, Crime Analysis and Recommendations Roadmap*, August 30, 2015, Lyon, France.
- ¹⁹ Edie Newsroom (2015) *Only one third of European e-waste 'properly recycled'*. <http://www.edie.net/news/6/One-third-of-European-e-waste--properly--recycled/>
- ²⁰ European Remanufacturing Network (2015), *Remanufacturing Market Study*: European Commission.
- ²¹ <http://www.takepart.com/article/2014/12/03/not-just-health-and-fitness-cycling-has-created-650000-jobs-europe>
- ²² While higher quality OEMs design for a technical life of 10+ years, the reality of the 'commercial life' of products – in terms of the average age of items received by Norsk Ombruk – is much lower, with an average of 4-5 years. Further work is required to identify the factors that are leading to so many products to be discarded, so early in their technical lifecycles.
- ²³ Anecdotal evidence from Norsk Ombruk: more work is needed, going forward, to establish the specific age, condition, and level of upgrading possible for each product received.
- ²⁴ Denning (2014) *The Financial Times Slams 'The World's Dumbest Idea'*. <https://www.forbes.com/sites/stevedenning/2014/09/02/the-financial-times-slams-the-worlds-dumbest-idea>
- ²⁵ Average storage area: 0.72 m² includes the physical footprint of product (on average 0.6m x 0.6m = 0.36m²) and access area of the same area.
- ²⁶ Source: Statista.com
- ²⁷ Serafeim (2014) *Turning a Profit While Doing Good: Aligning Sustainability with Corporate Performance*, Washington DC: Brookings.
- ²⁸ Data from life cycle analysis: Garcia, Alma L. "Resource efficiency indicators for EU product policy - Embedded energy in washing machines." Master's thesis, University of Aalborg, 2013. Assuming low-mid price machine, HWM1: GER 3820.63 MJ. Converted using 1MJ = 0.277777778 kWh
- ²⁹ An average of 0.8kg of parts are added through re-manufacturing: assumed directly proportional embedded energy used.
- ³⁰ Assumed cost of electricity is 1.00 NOK on average for each kWh in Norway (source: enova.no: <https://www.enova.no/radgivning/privat/rad-om-produkter-og-losninger/styring-og-effektivisering/hvite--og-brunevarer-/energieffektive-hvite--og-brunevarer-/109/132/>)
- ³¹ Exchange rate at 20th September 2016: 1 NOK = 0.11 €
- ³² Anecdotal evidence from Norsk Ombruk: more work is needed, going forward, to establish the specific age, condition, and level of upgrading possible for each product received.
- ³³ Source: Garcia, Alma L. "Resource efficiency indicators for EU product policy - Embedded energy in washing machines." Master's thesis, University of Aalborg, 2013. Data for embedded saving for HWM1 machine.
- ³⁴ Shadow price applied, based on EU ETS mid-point price over 12 months to end September 2016: €4.5/tonne: <https://www.eex.com/en/market-data/emission-allowances/spot-market/european-emission-allowances#!/2016/09/27>
- ³⁵ EcoMetrica: <https://ecometrica.com/assets/Electricity-specific-emission-factors-for-grid-electricity.pdf>
- ³⁶ IEA (2014) Norway Overview.
- ³⁷ Peter Bakker, President of WBCSD, Speech to IARU Sustainability Science Congress in Copenhagen 2014: <https://video.ku.dk/plenary-session-growing-society>
- ³⁸ Estimate from Norsk Ombruk, 2016.
- ³⁹ Source: Woolsey (2008) *World's Best Places For Unemployment Pay*, Forbes: http://www.forbes.com/2008/06/27/unemployment-benefits-world-forbeslife-cx_mw_0627worldunemployment.html
- ⁴⁰ Conventional recycling means all VAT opportunity would be lost.
- ⁴¹ Government Offices of Sweden (2016) *Strategy for Sustainable Consumption*: <http://www.government.se/articles/2016/10/strategy-for-sustainable-consumption/>
- ⁴² NEF (2009) *A Bit Rich*: <http://neweconomics.org/2009/12/a-bit-rich/>
- ⁴³ <http://businessworthy.org/mission>
- ⁴⁴ Ibid.
- ⁴⁵ Townsend (2016) *Coming of age: The heroes and villains of the circular economy*. <http://www.edie.net/library/Coming-of-age-The-heroes-and-villains-of-the-circular-economy/6720>



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