

The Endeavor Towards a Resource-Efficient and Effective Circular Economy is Continuous – Join us!

“ The evident need for a transition to a circular economy is matched by the business opportunity. This won't happen as quickly as it might unless a solid bottom-up approach is manifested, not just to resource efficiency but in thinking through the whole products, components and materials cycle. Mistra REES is one of the few programmes able to use a developing knowledge base to take the next steps and articulating the potential in these bigger, effective systems. ”

Ken Webster

Circular Economy Pioneer, formerly Head of
Innovation EllenMacArthur Foundation

“ We support Phase 2 of Mistra REES because we can see that Mistra REES research results actually benefit companies in their operational activities. ”

Elinor Kruse

Responsible for Environmental Issues,
Teknikföretagen (the Association of
Swedish Engineering Industries)



MISTRA

Resource-Efficient and
Effective Solutions

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Mistra REES creates value for the entire community

The focus on sustainability challenges is greater than ever, but the counteractions are yet insufficient. Right now, most actors still operate in a linear economy model that is clearly not sustainable. Virgin materials are extracted at high environmental costs, manufactured products are not designed to last, and products become waste in epic proportions.

However, it is gratifying that many organizations and government entities are currently taking action to promote alternative approaches. When searching for models that can work in the long run, the concept of the circular economy is attractive and is now starting to be applied by an increasing number of companies. The decisions to apply the circular economy are based on an understanding of the opportunities with this thinking, which has the potential to develop the companies' business positively at the same time as sustainability challenges are addressed.

In an environment where companies are intensifying their sustainability engagement and are increasingly inclined to promote the circular economy, Mistra REES is a crucial actor by creating knowledge and collaboration. Through purposeful work and together with industrial partners, Mistra REES has developed knowledge of methods, tools and policies that are required when integrating sustainability into the companies' value creation processes. A Mistra REES partner will be better equipped to be successful and profitable beyond the present economic challenges.

The past four years in Mistra REES has produced many highlights to be proud of. As the programme now moves on to Phase 2, Mistra REES is taking a step to the next level of knowledge creation. Based on learnings from Phase 1, the ambition is to close the gap between ideas and implementation and to further spread the knowledge to a broader spectrum of stakeholders and industries that could join in the creation of a circular economy. This year's annual report is devoted to summarizing the upcoming activities in Phase 2.

When assuming my new role as Chairman of the Board of Mistra REES in December, I did so with great expectations over the coming four years. Mistra REES has the potential to make a difference and is well-positioned to execute on its vision of resource-efficient and effective solutions. The board, with its broad expertise, is fully committed to supporting the success of the programme.



Ola Alterå, Chairman of the Board

A New Phase!

Within the Mistra REES programme, we focus on turning environmental challenges into business opportunities. Our starting point is to identify what is effective – that is, “do the right things”; then, we focus on spending resources to do these effectively, or rather, “do things right”. It is encouraging that an increasing number of actors around the world begins to understand this logic in order to act, rather than always focusing on trying to make ineffective systems more efficient.

First, in 2018’s annual report, I stated that more and more people are beginning to understand the urgent environmental challenges and take action. It was 2019 when our program’s focus became mainstream, on almost everyone’s lips and minds, and reached into the executive levels of companies, organizations and governments, due to, e.g., Greta Thunberg’s “Skolstrejk för klimatet”, and the European Green Deal for the European Union (EU).

In parallel, an increasing number of companies officially ramped up their ambitions and activities during the year concerning the topic – and went into action. The 50th World Economic Forum in Davos, Switzerland, with representatives from 117 countries and 121 nationalities, can, in a way, illustrate this. The theme this year was sustainable development under the slogan “Stakeholders for a Cohesive and Sustainable World”. An important message is that even the financial sector now understands the investment risk of global heating and unsustainable business models and is starting to adjust its behavior accordingly.

Second, during 2019 we closed the first phase of the Mistra REES program and had the honor to continue with Phase 2, which runs from 2019 until 2023. The aim of Phase 2 is to reinforce support to our manufacturing industry partners in their transition towards a more circular and sustainable economy. This will be accomplished by providing scientifically founded support for how to achieve this. While

REES Phase 1 set the scene by exploring business models, product strategies and policies for REES, Mistra REES Phase 2 focuses on closing the “idea-implementation gap”. Our consortium will serve as a platform to co-create knowledge on the design of products/services and business models as well as policy measures for resource-efficient and effective solutions (REES) and implementing and testing these in practice.

With the intention to move from interest to action, we will continue to develop principles, methods and guidelines for how manufacturing companies can best be assisted in their implementation of REES and what changes in public policy and legislative measures are needed to enable and support the efforts.

Linked to this, we will develop knowledge and methods for assessing the environmental and financial impacts of REES on all levels, how to simulate and test different solutions and identify policy mixes both generic and for specific sectors. Finally, we will further develop our understanding of the interrelations when providing REES between product and service design, business models, and policies and explore opportunities for the effective interplay between them.

We hope you will join us in this endeavor!



Mattias Lindahl,
Mistra REES Programme Director



Highlights from 2019

Below are some selected highlights, results and activities from 2019. Enjoy!

- During 2019, we have been honored to have Ken Webster serve as the Mistra REES programme's fellow. He was formerly responsible for innovations at the Ellen MacArthur Foundation and is one of the world's foremost experts in the field of circular economics. Yes, it is actually he who popularized and defined the concept around 2012 so that it came into general use. During 2019, he divided his time between the University of Exeter, UK and Mistra REES. The task has been to teach and meet students, researchers, politicians and entrepreneurs – to talk and inspire! Regarding his stay, he has stated:

“In addition, I want to be inspired and learn more myself as well. The Nordic countries are examples of environmental issues and Mistra REES are doing a really interesting job. I would not have accepted the invitation otherwise”.

Below are some examples of events we have had with Ken Webster in April:

- ABB – On the 9th of April, he gave a presentation at ABB Corporate Research about “Circular Economy – What is it and why is everyone talking about it?” in Västerås.
- Public lecture – On the 11th of April, Ken gave a one-hour public lecture at the main conference venue Linköping Konsert & Kongress, about “A Circular Economy – Closing Loops and Opening Minds – how digital is revolutionising how we meet resource challenges”.
- Seminar at the Ministry of Business Development – On the 15th of April, he gave a presentation about “Circular Economy – the past and the future”.
- On the 16th of April, we had a brown bag lunch at VINNOVA and a seminar at the Swedish Climate Policy Council.
- Seminar at Sitra in Helsinki, Finland – On the 17th of April, Ken and the program director Mattias Lindahl from Mistra REES gave presentations at a seminar about the circular economy.



“When end-of-life goods become raw materials for new products, not only does the waste itself disappear. Waste as a concept also disappears,” says Ken Webster. Photo: Mikael Sönne

- Thanks to the Mistra REES program, Linköping University was invited and became a Circular Economy 100 (CE100) Network partner in November. The Ellen MacArthur Foundation CE 100 Network provides an interdisciplinary and pre-competitive space to learn, share knowledge, and initiate and develop collaborative approaches and circular economy activities together with business, government, and academia.
- The International Organization for Standardization (ISO) has started a new Technical Committee for the Circular Economy, something several of us from Mistra REES have been heavily lobbying to make them do. Mistra REES will be able to significantly contribute to this new series of standards and aim to do so. Our program director Mattias Lindahl has been elected to become the chairman of the Swedish mirror committee for the Technical Committee for the Circular Economy.
- The European Committee for Standardization (CEN) and the European Committee for Electrotechnical Standardization (CENELEC) are, on request from the European Commission, developing several standards about assessing energy-related products to facilitate, e.g., service and remanufacturing and material reuse. Erik Sundin from Mistra REES has been quite heavily involved in this process and has had an especially huge influence on the one that is focused on remanufacturing.

- 11th CIRP IPS² Conference took place in Zhuhai and Hong Kong, China, from the 29th to the 31st of May. The program director Mattias Lindahl gave the conference’s first keynote speech, titled “Fit for a Sustainable Future – A Reflection on and Research Agenda for How to Design and Achieve Resource-Efficient and Effective Solutions”. Our Ph.D. Student, Raphael Wasserbaur, won the best paper award.



Photo: Mattias Lindahl

- Almedalen 2019 – This became a very intensive week, and the Mistra REES program director Mattias Lindahl participated in several activities, e.g., a roundtable conversation about the circular economy, “How do we solve waste management’s Gordian knot?”, and the SOI Breakfast Meeting. In total, this week was a success, and we received much positive feedback from our comments during the activities, e.g., by people approaching after presentations. Mattias Lindahl was also involved in two debate articles during that week. For more info, see public debate articles, newspaper articles, etc.

- The Swedish Circular Economy Delegation – Tomohiko Sakao and Mattias Lindahl from Mistra REES have been appointed as members to their reference group and have participated in several related events. Their comments, mainly based on findings from Mistra REES, have had quite an impact since several other members of the reference group have agreed and referred to quite a few of our inputs. It is also a very good opportunity to make our program well known.
- Our Ph.D. student Katherine Whalen, at Lund University, has taken initiatives to make the circular economy fun and understandable for many people. At her website, she offers circular games that can be used in, e.g., workshops. She also hosts a weekly podcast dedicated to exploring how to transform into a more circular society and features interviews with circular economy experts about what they're doing and learning. In one episode, she interviewed another one of our Mistra REES Ph.D. students, Leonidas Milios, focusing on policies that can support product repair and reuse, two key parts of the circular economy. Listen to the full episode [here](#).
- Tomohiko Sakao and Carl Dalhammar from Mistra REES organized three sessions in an international conference, EcoDesign 2019, in Japan in November 2019 to make the Mistra REES program more known. Tomohiko Sakao also served as chair for the Best Paper Award Committee in this conference, contributing to the community.
- Mistra REES got an innovation to the European Commission/JRC workshop on public procurement criteria for ICT products. Our Ph.D. Student Leonidas Milios and one student alumni (a procurer in a Swedish municipality) were at the event and presented Swedish experiences from procuring remanufactured ICT.
- Carl Dalhammar presented research from Mistra REES, and how the circular economy and agendas relate to each other, at an event arranged by MISTRA at the European Parliament.

Dissertations

- On the 8th of May, Johannes Matschewsky defended his Ph.D. thesis “Effective and efficient design and provision of product-service systems: challenges, opportunities, and solutions” at Linköping University. The thesis addresses the fact that designing and providing a REES is fundamentally different from traditional product sales. Expanding to become a REES provider is, therefore, challenging for companies with a history of designing and selling products.

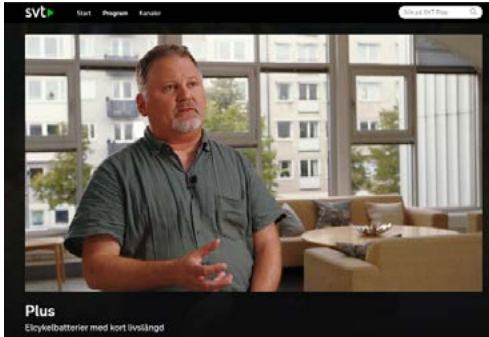
Departing from this, it is the aim of this thesis to support manufacturing companies in their expansion to effective and efficient design and provision of REESs. The research reported has both descriptive and prescriptive properties, reflecting the goals of understanding the status quo in manufacturing companies' practice and providing support based on this. A particular challenge for manufacturing companies expanding to become a REES provider is the change in how value is captured: Resulting from the extensive involvement throughout the lifecycle, a need for a broader, multi-dimensional understanding of value capture is identified.

However, the manufacturing companies investigated have been found to experience challenges in grasping this change, with a focus on a product sales-centric understanding of value capture remaining prevalent. To support companies towards reaping the benefits of the expansion to REES design and provision, methods to explore how value is currently created and captured in the use phase and how to enhance the future value capture based on that information in the design phase have been developed and applied. As a result, broadly relevant value dimensions were attained, aiming to facilitate a lifecycle-focused, effective, and efficient design and provision of a REES. To read the whole thesis, click [here](#).

Public debate articles, newspaper articles, etc.

Below are some examples of public debate articles, newspaper articles and other types of media where Mistra REES has been present during 2019.

- SVT Plus “Elcykelbatterier med kort livslängd” – [Watch the program here!](#)



- SVT Nyheter “Företag måste bli bättre på att redovisa produkters hållbarhet” – [Watch the program here!](#)
- Hållbarhet – ett komplext begrepp – [Read the article here!](#)
- In June, the Mistra REES Program Director was invited to write a post in Hagabloggen. With the title “Circular Business Models – A Key to Coping with the Climate Challenge”, Mattias Lindahl addresses topics such as resource-wasting, the importance of starting to question inherent thought patterns around consumption, and investing more in sharing resources through job creation and feature sales. [Read the article here!](#)
- At the end of May, a first meeting was held in Paris to work on an upcoming ISO standard in circular economics. The purpose of the standard is, among other things, to clarify concepts and perspectives that are linked to the circular economy. The Swedish newspaper Dagens Industri wrote an article on the topic, “ISO standards should work out circular concepts”, where Mattias Lindahl was cited. [Read the article here!](#)



- Debate article in Dagens Samhälle “Det är en konst att upphandla – lär ut hur” – [Read the article here!](#)
- Debate article in Altinget ”Sverige måste bli bättre på sopsortering” – [Read the article here!](#)
- Debate article in Altinget “Återvinn när alla andra alternativ är uttömda” – [Read the article here!](#)
- Article at SvD Debatt “Dags att fasa ut billiga undermåliga prylar” – [Read the article here!](#)
- SR Prynarnas pris “Allt som säljs går sönder” – [Listen to the program here!](#)
- Klotet i vetenskapsradion “Svårt få gammal plast bli till ny plast” – [Listen to the program here!](#)

Examples of published scientific papers

For a list of publications, see www.mistrarees.se

Design Support for REES

While Mistra REES Phase 1 spent substantial effort on developing and applying design methods and supports (e.g., models, frameworks, procedures, and tools), Mistra REES Phase 2 aims to design supports at a company level to advance the knowledge about design for REES. This implies an emphasis on evaluating design supports in terms of users' learning outcomes and organizational exploitability at Swedish manufacturing companies, on top of the performance of the supports as such. In addition, a significant focus lies in the integration of design supports for products/services and business models.

However, what to design, first of all? The design object to be addressed involves several elements from a holistic perspective but in an integrated manner – not only the product or service but also the business model. This integration is critical because it has the potential to improve many practices in industry in terms of resource efficiency and effectiveness. Just to name a couple of examples, car sharing (e.g., Sunfleet, Zip car, Blabla Car) and car subscription schemes (e.g., Care by Volvo) represent business mod-

els that have the potential to contribute to sustainability, but the cars as such are designed in a virtually identical manner as for traditional sales models. If the design of the cars would be adjusted to the particular business models by which they are provided, e.g., designed for intense use, reuse, and remanufacturing, then the sustainability performance can be enhanced and negative externalities reduced.

Practitioners in industry often lack the appropriate mindsets and miss such opportunities, being limited not only by structural and market barriers but also internal factors such as company strategy, organizational structure, limited strategic vision, and lack of internal capacities, or, simply, a lack of knowledge to design products/services and configure the business model for sustainability. An integrated insight with a more holistic perspective is also missing in the scientific literature. Developing and providing industry with integrated design supports facilitating designers is urgently needed to accelerate the transition towards a circular economy beyond piecemeal marginal improvements.





We will integrate existing design supports (e.g., models, frameworks, procedures, and tools) and partly those supports based on emerging new technologies such as AI (artificial intelligence), and evaluate the design supports through their application to the partner companies in terms of users' learning outcomes enhanced and organizational changes introduced. Importantly, the supports cannot merely be passed from academia to industry.

The integration of the supports needs to be carried out together with companies in order to adapt to specific needs and build internal capacities accordingly. Only then can design supports be institutionalised within organisations so that they are less susceptible to the individuals, and the potential of REES solutions can be fully exploited and sustained in the long run within organisations. Therefore, action research is adopted so that the researchers and practitioners can work together in a more committed manner.

The major areas of knowledge utilized lie in engineering design, management, and busi-

ness; however, this research is conducted as trans-disciplinary research to create knowledge beyond existing disciplines and together with industry. We will focus on a certain type of company, i.e., large original equipment manufacturers (OEMs) from different sectors based in Sweden, aiming to create synergies between case companies and to increase the productivity within the program. The researchers participating in this research are from Linköping University (the manager) and Lund University.

Development of a design support for REES applying big data analytics (a kind of AI) based on systematic literature review was initiated toward a journal paper publication: we see a high potential to apply big data analytics to design for REES in terms of theory development and industrial application. Also, a foundational work using protocol analysis for design sessions with REES partners was documented to evaluate users' learning of a design support. This work is also showing a scientifically validated result that will contribute to enhancing our knowledge of design for REES.

Policies for REES

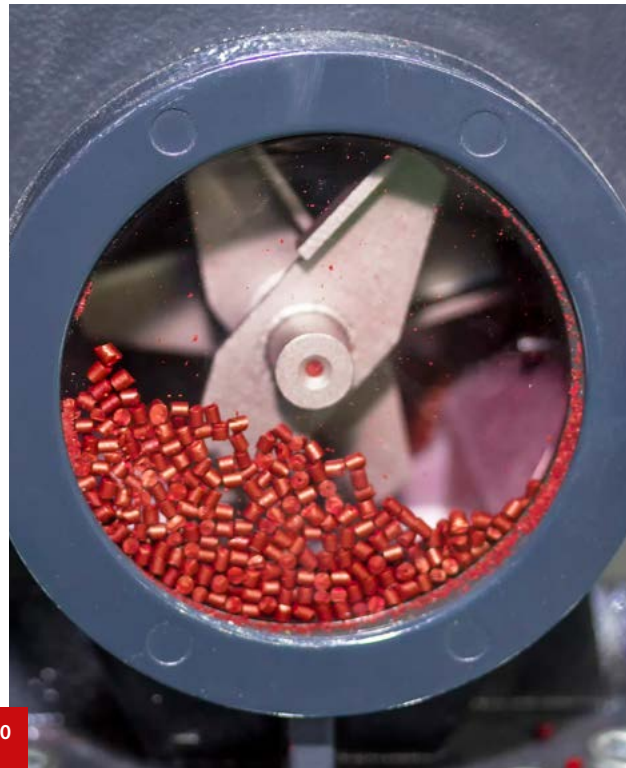
It is very unlikely that we can realize the vision of a circular economy without significant policy interventions. Unless the right policy framework is in place, new businesses with circular business models find it difficult to compete in a “linear” economy. Further, we cannot expect consumers to drive the necessary changes as consumers are constrained by the current circumstances, such as the choices available in the market and limited access to relevant information. Indeed, the European Commission has proposed a large number of policy interventions in their Circular Economy Action Plan. Some of these policies should be adopted by the EU, but we also need policies at the national, regional, and local levels.

Therefore, the aim is to explore REES and the interactions at the policy level. This research integrates knowledge from REES Phase 1, though with a different focus, as well as uses several new approaches, and aims to examine new policies and policy areas. This is done to identify

what policies, policy packages, and laws affect different types of REES, identify interrelations between policies, and gain a deeper understanding of the interrelations between business models, business practice, product and service design, and policy drivers.

It will also provide a deeper understanding of the relations between actors and markets in relation to resource flows, look at potential resources and policies and laws that affect the resource flows, elaborate on new policies, and examine the potential for Swedish industrial policy to examine cases where Sweden could take the lead and prioritize which policy interventions are of highest relevance.

To conclude, the focus will be on several policies issues, e.g., identifying areas where new, progressive policies are necessary, “bottom-up” studies of new companies with circular business models, and an analysis of specific policies and policy issues.



Environmental and Financial Impacts of REES

The aim is to provide knowledge about financial, environmental, and resource use implications of design, policy, and business management for REES. Such knowledge supports companies and policymakers in their activities for transitioning to a more resource-efficient and circular society. This research specifically aims to support actors in the early phases of experimentation on ways of changing designs, management, and policy for REES.

The circular economy is expected to increase resource availability and reduce environmental impacts. Although such potential benefits can be mainly confirmed through available literature, our research in Mistra REES Phase 1, importantly, also points to large variations in benefits and even risks of increased impacts. We identified that any REES does not fit any product, but instead needs to be matched with certain product characteristics to have a high potential to reduce impacts.

For example, there is a clear difference between what solutions fit consumable and durable products, active and passive products, and products that are typically used for their full technical lifetimes and those that are discarded before being worn out. Furthermore, the benefits will depend on the specific real-world conditions in which the solutions are implemented.

There are also risks of trade-offs between different types of environmental impact, such as climate change and resource depletion. Such highly relevant, yet complex conclusions have been drawn using life cycle assessment (LCA) and material flow analysis (MFA) and are crucial for companies and policy makers for selecting REES with high potential and implementing them in ways that realize their benefits. For this purpose, the findings have been brought forward for developing develop and testing a design support tool and exploring circular business models.

The challenge of capturing the benefits and drawbacks of REES is particularly large in the



early phases of product development and policy transitions. Early phases involve significant uncertainties regarding the final solutions and the future conditions in which they will be used. Accounting for uncertainties in the assessments is thus crucial, and even more so in the context of substantially extended lifetimes and multiple-use cascades in a more circular economy, e.g., long-life followed by remanufacturing, repurposing and recycling.

The research in Phase 2 will thus explicitly address such uncertainties in assessments of environmental and resource use impacts of REES considered by manufacturing companies. This also involves estimating future resource potentials for circular loops in terms of quantity, timing, and location. These potentials depend on the supply of products, components, and materials for such solutions and the degree to which they can satisfy market demand and are crucial for companies as well as policy when launching or creating incentives for these solutions.

Mistra REES Phase 2 will also address the financial implications of circular solutions. Methods for assessing the complex financial implications of such solutions, from both a provider and customer perspective, will be developed. Based on life cycle costing and traditional financial capital budgeting and costing techniques, these methods will capture the complexity in these processes and investments' life cycles and will be tested in case studies.

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MISTRA REES – Resource-Efficient and Effective Solutions based on a circular economy thinking is a research program run by a consortium of leading Swedish universities, large and small companies etc.

The vision of the program is to accelerate the transformation of the Swedish manufacturing industry towards a circular and sustainable economy.

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