



CIRCULAR TURKU

A BLUEPRINT FOR LOCAL
GOVERNMENTS TO KICK
START THE CIRCULAR
ECONOMY TRANSITION



This publication is a product of the “Circular Turku: Regional collaboration for resource wisdom” (2019-2021) project, which aims to design a regional roadmap to operationalize circularity in the Turku region with the support of local stakeholders and ICLEI - Local Governments for Sustainability. The report captures the results and learnings of the inception phase of the project and the existing endeavors and good practices of Turku.

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DISCLAIMER

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ABOUT THE CONSORTIUM

CITY OF TURKU

Located in Southwest Finland, Turku is the regional capital of the third largest urban area in Finland. Turku is the country's oldest city and a global frontrunner for climate action. With its surrounding municipalities, Turku is an energetic centre of growth in the Baltic Sea area. The city is an important business and cultural centre, and a hub for learning and research.



SITRA

Finnish innovation Fund Sitra focuses on improving the well-being of Finnish residents towards a fair and sustainable future. Sitra conducts practical experiments and research, compiles cross-boundary networks and develops and finances business operations. Sitra is an independent public foundation, operating directly under the supervision of the Finnish Parliament.



ICLEI - LOCAL GOVERNMENTS FOR SUSTAINABILITY

is a global network of more than 1,750 local and regional governments committed to sustainable urban development. Active in 100+ countries, ICLEI influences sustainability policy and drives local action for low emission, nature-based, equitable, resilient and circular development. ICLEI's members and team of experts work together through peer exchange, partnerships and capacity building to create systemic change for urban sustainability.



FOREWORD

In Turku we are committed to a circular, resource wise future with zero emissions, zero waste, a low ecological footprint and the sustainable use of natural resources. Turku is on a good path towards carbon neutrality by 2029, and thereafter towards a climate positive area with negative net emissions. We are determined to implement the principles of resource wisdom and aspire to host a socially sustainable circular transition.

Our ambitious goals can be achieved with strong climate mitigation and adaptation measures combined with circular solutions. A successful climate policy must include an element of circularity and address both direct and indirect emissions such as those embedded in material and product life cycles.

A recent study recognized about 700 circular economy operators in the Turku region, 270 of them being businesses visibly engaged in circular economy. Cities have a crucial role as enablers of circularity and in creating a good operating environment for new solutions. Through visible solutions, residents can see the benefits of circulating resources, with positive impacts on our environment, economy and wellbeing.

The roadmap for a Circular Turku is well underway as a collaborative effort by the City of Turku, ICLEI, Finnish Innovation Fund Sitra and regional partners. Our work with ICLEI and the Green Circular Cities Coalition brings new elements to the roadmap process and helps scale our solutions for other cities' and municipalities' use.

A Circular Turku can be achieved through active collaboration, and we are excited to continue this joint work!

MINNA ARVE
MAYOR, CITY OF TURKU



EXECUTIVE SUMMARY

The circular economy offers a relevant practice-oriented framework to rethink the way resources are managed at the local level and shift away from extractive production practices. Through urban planning, policies, investments and their ability to convene different stakeholders, local governments are well positioned to turn the ambitions of the circular economy into an everyday reality.

Yet because the circular economy doesn't have sectoral or geographical boundaries it can quickly feel overwhelming. As a result, the circular economy often ends up being marginally implemented.

Experiences in Turku show the value of regional and multi-stakeholder collaboration in operationalizing the circular economy in a systemic way. This report offers a deep-dive into front-running circular economy practices from the Turku region and provides insights into the governance model and participation mechanisms needed to make them happen. Finally, it showcases how the circular economy can support ambitious climate action through concrete pathways other local governments can replicate.

Moving forward, the city of Turku is designing an action plan to comprehensively implement the circular economy in the surrounding region in an inclusive and participatory manner. These efforts are undertaken as part of the Circular Turku project, co-funded by Sitra and implemented in close partnership with ICLEI – Local Governments for Sustainability. The aim of this cooperation is to draw learnings from international best practices and design needs-based tools and collaborative methodologies for other local governments to use around the world.

Circular Turku is shaped by the inputs of committed stakeholders from a wide variety of fields. Their voices and vision for a Circular Turku as represented throughout this report are foundational to the work that the city plans to undertake.

Together with the city of Turku, a vibrant community of circular economy actors will ensure Turku fulfills the objectives laid out in its city strategy: Becoming carbon neutral, zero waste and respecting ecological boundaries by 2040.



“
Cities have a central role in operationalizing circular economy, and multi-stakeholder collaboration is a key factor in this transition. The Turku region holds a significant amount of expertise in circular economy, and we need to utilize that knowhow together. A roadmap that is designed in broad collaboration from regional to international level has true scaling potential to other local governments around the world. Turku has succeeded in combining economic growth with emission reductions, and we are on a very promising path to carbon neutrality by 2029. Resource wisdom is an important next step towards carbon neutrality!

PEKKA SUNDMAN, CITY OF TURKU



“
ICLEI's Circular Development program guides local governments in embracing circular and sustainable development and shifting away from resource-intense models. We are thrilled to be working with the city of Turku on designing a blueprint for operationalizing the circular economy at the local level. Experiences from Turku demonstrate the key role of cross-sectoral and multi-level collaboration in turning the circular economy into a reality and offer replicable tools to implement similar practices across the ICLEI network.

GINO VAN BEGIN, ICLEI - LOCAL GOVERNMENTS FOR SUSTAINABILITY





MEET CIRCULAR TURKU

ABOUT CIRCULAR TURKU

Supported by The Finnish Innovation Fund Sitra, the Circular Turku project aims to collaboratively design a regional roadmap that will operationalize circularity in the Turku region. The project involves all relevant stakeholders - from municipal companies to regional bodies, businesses, universities and community groups - in the design of an inclusive and systemic circular economy action plan, to be released in 2021.

To ensure these efforts are informed by worldwide best practices and top-notch knowledge on localizing circularity, the city of Turku is partnering with ICLEI - Local Governments for Sustainability, the world's largest city network. Turku has been a committed ICLEI Member since 1995.

Through this partnership, Turku also hopes to facilitate the replication of successful initiatives and methodologies initiated in the Turku region around the world and in particular in East Asia as part of ICLEI's Green Circular Cities Coalition.

This report offers a blueprint for local governments eager to kick-start their circular economy transition in a collaborative and systemic way.



Our collaboration with the city of Turku and ICLEI has been very fruitful! Cities and municipalities enable the important moves to circular economy and Finland has such great examples on how to excel in circular economy with inspiring local solutions and collaboration. ICLEI's global network offers an amazing opportunity to scale up the Finnish model of Circular Economy globally.

MARLEENA AHONEN, SITRA



ABOUT ICLEI'S GREEN CIRCULAR CITIES COALITION

The Green Circular Cities Coalition, managed by the ICLEI — Local Governments for Sustainability East Asia Secretariat, presents an opportunity for cities across the world to become global leaders in fostering transitions towards a circular future and synergize with the Sustainable Development Goals. As an international city-focused platform, the Coalition connects cities, experts, businesses and relevant stakeholders to shift their mindset from “waste management” towards “integrating city-region resource management and sustainable transition”, and increase circularity via experience exchange and mutual learning.



THE CITY OF TURKU

The Boldest city in Finland.



FINLAND'S OLDEST CITY

Located on the Southwest coast of Finland where the Aura river meets the Baltic sea, Turku is the oldest city in the country. It was founded in the 13th century, when Finland was still part of the Kingdom of Sweden. The Turku region comprises eleven municipalities and is home to over 300,000 inhabitants, making it the third largest urban area in Finland after Helsinki and Tampere.

As a port city and a central trade point in Europe, the history of Turku is rooted into the development and growth of its manufacturing and maritime industry, which have been pivotal in the economic development of the country. Traffic routes from all over the country crossed Turku. Nowadays, the Turku harbour remains one of the most important shipment points in the country and an efficient route to serve the Baltic sea.

Having existed for centuries, Turku's foundational industries – manufacturing, maritime and creativity – continue to grow and still form the basis of the economy. These industries thrive on exports, products and services originating from the Turku region. The historical trade route formed by Stockholm, Turku, Helsinki and St. Petersburg remains significant even today, above all as a corridor of expertise-based growth and development and as a concrete logistical passage between East and West.

MAKING HISTORY WITH CARBON NEUTRALITY

While Turku might be old, it is also very bold! As per a unanimous decision of the city council in 2018, the city aims to become carbon neutral by the year 2029, on time for its 800th anniversary.

In practice, this means the greenhouse gas emissions in Turku will be cut by at least 80 percent compared to the 1990 level and the city will compensate for any remaining emissions.

To achieve these ambitious goals, the city is focusing on:

- Transitioning to carbon neutral energy systems
- Increasing low carbon sustainable mobility
- Steering an urban structure conducive to sustainability
- Embedding climate and environmental impacts into investments and procurement decisions
- Strengthening carbon sinks

Turku's climate goals build on strong collaboration with communities, businesses and academia. The city is a hub for innovation and clean tech. Turku Business Region is a dynamic cluster of business and innovation activities, with spearhead fields like bio and circular economies, cleantech, maritime industry, manufacturing and technology industries and health and well-being.

Home to Finland's first university, Turku is also historically an academic city which now welcomes over 40,000 students and hosts six universities. The strong links between academia and the city have been a success factor for innovation activities that foster sustainability and climate action in the region.

Finally, the climate plan emphasizes the need for residents to be part of the change and involved in the climate decisions that will affect their lives. The city's spearhead projects on carbon neutrality also include social inclusion goals to ensure climate action benefits all.

REGIONAL COLLABORATION TOWARDS CIRCULARITY

Turku acknowledges the need for a systemic approach to climate action that looks beyond territorial greenhouse gas (GHG) emissions. Hence the city included the goal to become resource wise by 2040 in its overall strategy.

Resource wisdom is an operating model developed by Sitra to support cities and municipalities in making their activities carbon neutral and waste free, while bringing their use of natural resources within ecosystems boundaries by 2050 at the latest.

The ambitions of resource wisdom are best operationalized through the framework of the circular economy, providing an alternative model to current (linear) economic models. Such linear models rely on intensive resource extraction to fuel an economy in which the vast majority of materials are wasted after a single use.

By preserving materials that are already available, using waste as a resource or developing alternative business models that shift away from ownership, the circular economy aims to decrease the demand for new resources and designs waste out of production systems.

Transitioning away from the linear economy is a massive challenge that a single city cannot achieve on its own. This is why Turku is committed to collaborating with local, regional, national and international partners through the Circular Turku project to accelerate change.

An aerial photograph of Turku, Finland, at dusk. The sky is filled with dramatic, orange and yellow clouds. In the center, a prominent church spire with a cross on top stands out against the cityscape. The city is illuminated with warm lights, and the foreground shows a large building with a blue roof. The overall scene is a mix of urban architecture and natural elements like trees.

SETTING THE SCENE: CIRCULARITY IN TURKU

The city of Turku recognizes that designing a roadmap for operationalizing the circular economy should not reinvent the wheel but rather build on existing motivation, knowledge and initiatives of committed local stakeholders. In addition, it is critical to link local circular economy action to national and transnational endeavors to inform a multi-level governance on the topic.

Finally, a circular economy action plan should be embedded within the city's broader sustainability plan. In the case of Turku, a focal point is to connect circular economy with the city's carbon neutrality targets and related goals.

BUILDING ON LOCAL KNOWLEDGE AND INITIATIVES

The Circular Turku project builds on existing roadmaps designed at the local and regional level, a systemic assessment of circular economy stakeholders and regional material flow assessments. Circular Turku aims to turn this knowledge into concrete action steps for implementation over the next few years.

LOCAL AND REGIONAL CIRCULAR ECONOMY AMBITIONS

To start the operationalization of resource wisdom in Turku, previously roadmap processes including 1) a Resource Wisdom Roadmap for Turku and 2) a Circular Economy Roadmap for Southwest Finland have been carried out.

A preliminary resource wisdom roadmap was designed in 2015, as a collaboration between the City of Turku and the Finnish Innovation Fund Sitra, after resource wisdom was approved as a priority objective in the city's strategy.

Finland's first regional circular economy roadmap was designed for Southwest Finland in 2016-2017. The roadmap was a collaboration by the regional council of Southwest Finland, the service centre Valonia, the City of Turku and Sitra. The roadmap presents the needed steps for a diverse and circular economy based Southwest Finland and functions as a basis for development projects and the collaboration around them. The roadmap focuses on three categories: 1) Sustainable food system 2) Technical loops 3) Transport and logistics. Furthermore, the roadmap includes three cross-cutting themes: 1) Servicizing 2) Public Procurement 3) Know-how in chemistry.

Regional stakeholders identified the need to make these roadmaps less descriptive and more action oriented. The Circular Turku project is building on these two roadmaps to design a circular economy action plan for the Turku region.

CIRCULAR ECONOMY STAKEHOLDERS MAPPING

To gain an understanding of the current state of circular economy actors in the Turku region, the city of Turku commissioned a feasibility study from Finland Futures Research Centre, which was published in 2019. The study also aimed at informing Turku's membership in the ICLEI Green Circular Cities Coalition.

The study identified more than [700 circular economy actors](#). 270 of these are companies engaged in circular economy and 150 are focused on research and training. The study recognized great potential to advance the circular economy significantly in all of Turku's main industrial fields. These include the bioeconomy, ICT, marine and metal industries, construction industry, logistics and creative industries.

This stakeholder mapping is a core asset for the Circular Turku project which will build upon engagement with all relevant actors in the region.

The study also pinpointed the areas where the region needs to invest heavily in the coming years. The construction sector was highlighted as a key challenge. As such, buildings and construction has been selected as a priority topic of the Circular Turku roadmap.

AN ANALYSIS OF MATERIAL FLOWS IN SOUTHWEST FINLAND

The analysis "Material flow potential in Southwest Finland from a circular economy perspective"¹ was conducted in 2017 by the regional council of Southwest Finland, the city of Turku and Southwest Finland Waste Management Ltd. as a support for the regional roadmap and other regional development endeavors.

The study explored and analyzed eight material streams in the region: manure, straw, other organic side streams, ash, construction and demolition waste, municipal separately collected biowaste and municipal separately collected textile waste.

¹ Southwest Finland, Valonia, City of Turku and Southwest Finland Waste Management Ltd. (2017) "Varsinais-suomen materiaalivirtojen potentiaali kiertotalouden näkökulmasta" Accessible via: <https://www.varsinais-suomi.fi/images/tiedostot/Maankaytto/2017/LAVMK/Varsinais-Suomen-materiaalivirtojen-potentiaali-kiertotalouden-nkkulmasta.pdf>

Furthermore, three entities, where the use of material flows in the province could be significantly enhanced from an environmental and economic point of view, were identified: 1) biogas from organic side streams 2) productizing nutrient-rich streams into recycled nutrients 3) bio-coal and pyrolysis oil as power plant fuels.

The two first priorities were included as part of the priority topic selection process for Circular Turku (see chapter 3).

This solid knowledge base will allow the Circular Turku project to focus on concrete action steps for the Turku region to take in the next years to make the circular economy a reality in the city and neighboring municipalities.



Regional studies show that there are good possibilities in Southwest Finland to move towards a circular economy. For example, over 40,000 cars could use biogas that is produced locally from agricultural manure and biogas residuals could cover 34 percent of the region's demand for phosphorus fertilizer.

ALEKSIS KLAP, SOUTHWEST FINLAND REGIONAL COUNCIL



REGULATORY FRAMEWORKS INFORMING CIRCULAR ECONOMY WORK IN TURKU

The Circular Turku project is grounded into existing regulatory frameworks and circular economy action plans and aims at contributing to goals set at the European and national levels, in pursuit of multi-level collaboration.

EUROPEAN WIDE CIRCULAR ECONOMY FRAMEWORKS

At the European Union level, the Circular Turku project is informed by three main frameworks:

- The **European Green Deal** (2019) supports and accelerates the EU's industry transition to a sustainable model of inclusive growth. In March 2020, the Commission will adopt an EU industrial strategy to address the twin challenge of the green and the digital transformation. In addition, a new circular economy action plan will help modernize the EU's economy and benefit from the opportunities of the circular economy domestically and globally. A key aim of the new policy framework will be to stimulate the development of lead markets for climate neutral and circular products, in the EU and beyond and to ensure sustainable transitions are fair and benefit all. Among the seven policy areas outlined in the European Green Deal, five relate directly to at least one of the priority topics identified for Circular Turku (see chapter 3).

- The **EU action plan for the circular economy** contains an extensive action plan and proposals for legislative amendments to be implemented in nation states, with a key focus on municipal waste. The action plan also includes a monitoring framework for progress on the circular economy. It is composed of a set of ten key indicators which cover each phase – i.e. production, consumption, waste management and secondary raw materials – as well as economic aspects – investments and jobs - and innovation. This monitoring framework will inform the development of performance indicators to be used in the action plan developed through the Circular Turku project.

- The **European plastics strategy**, published in 2018, aims to reduce the challenges posed by plastic waste and litter, enhance the recovery and recycling of plastics, ensure product design that promotes the reuse, reparability and recycling of plastic products and create conditions for new circular economy innovations and investments. According to the strategy, all plastics packaging should be recyclable by 2030. The strategy outlines actions to improve the economics and quality of plastic recycling, to curb plastic waste and littering, to drive investments and innovation and to harness global action. Regional actors in Turku are demonstrating leadership in plastics recycling and bio-alternatives and actively engaging within European networks on the topic. Circular Turku will build on these existing links in the next stages of the project.

NATIONAL LEVEL FRAMEWORKS

A strategic program for advancing the circular economy is being developed in Finland, with the aim of changing the basis of the economy towards circularity. Prepared during the year 2020, the programme will define objectives and indicators and the necessary actions and resources to promote the circular economy and achieve systemic change. This programme builds on Finland's updated circular economy roadmap for the period 2016 - 2025, which was led by Sitra. The starting point of the roadmap is that competitiveness and economic vitality are to be renewed so that circular economy solutions are raised to the centre of the growth strategy of economic competitiveness. The updated version of the roadmap also places a strong focus on decoupling well-being from resource consumption and linking circular economy goals to everyday choices and lifestyles. It also underlines the necessity to acknowledge the challenge of resource scarcity and to incorporate indicators that map resource consumption systemically. The Mayor of Turku is the Chair of the thematic group on "Municipalities and Regions" within the national roadmap process. As such, the city of Turku plays a pivotal role in informing national endeavors from a city perspective.



We have a strong base for collaboration in the region towards circular economy. However, since we are aiming for systemic change we need to push forward and aim for real, holistic change, not just separate activities. I look forward to identifying concrete steps both in a local and global context to strengthen our impact.

RIIKKA LESKINEN, VALONIA - SERVICE CENTER FOR SUSTAINABLE DEVELOPMENT



The circular transition in the Turku region is well underway. We have successful examples of functioning circular solutions which motivate new stakeholders to join the development. Still, we acknowledge that we have major scaling up ahead of us, which will be advanced through the Circular Turku roadmap.

ESSI SILVONEN, FINLAND FUTURES RESEARCH CENTER

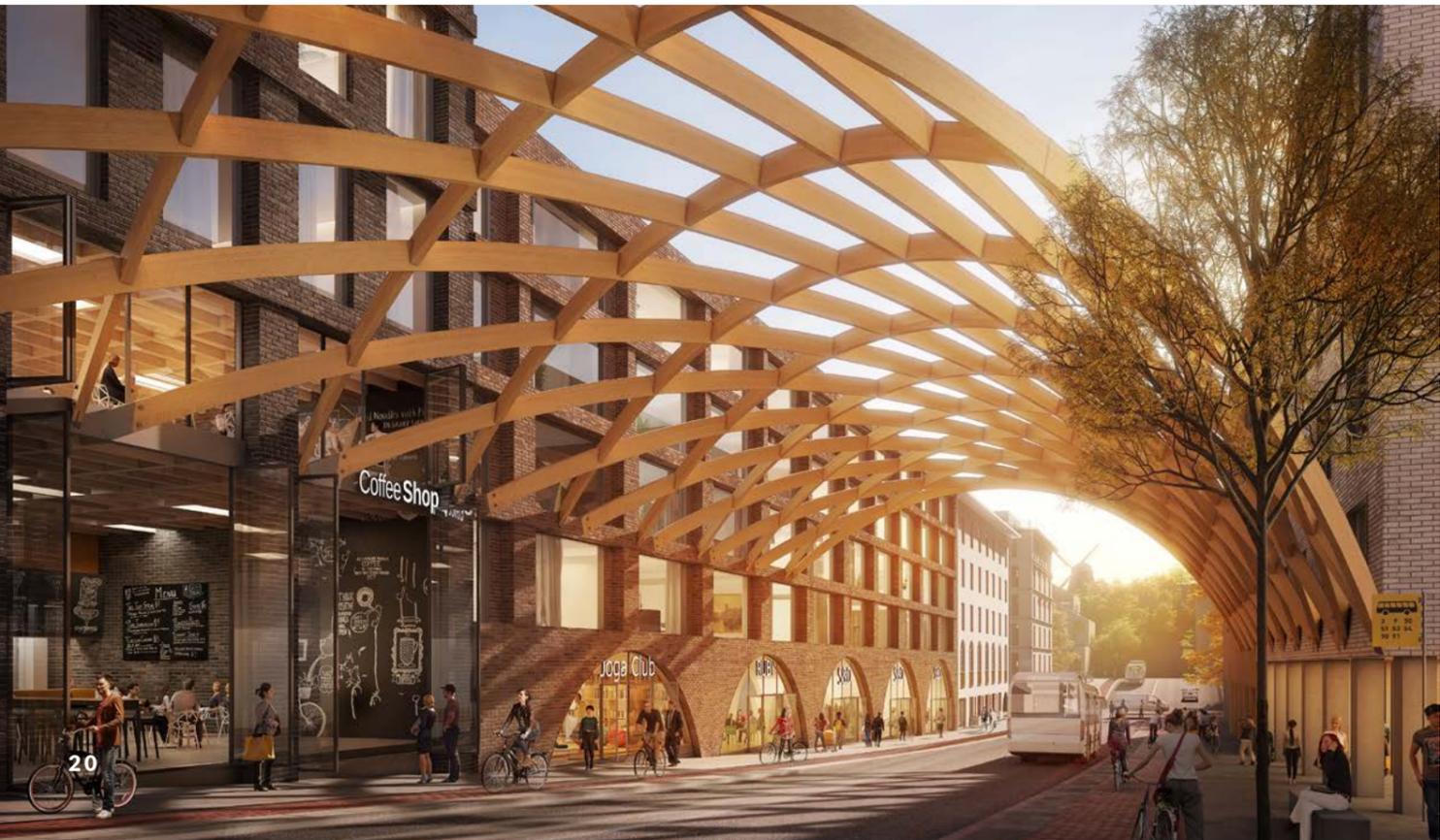


POLICY PROVISIONS SHAPING CIRCULAR ECONOMY WORK IN THE TURKU REGION

For any local government starting its circularity journey, it is pivotal to get a thorough understanding of existing regulations and development frameworks that will inform and shape city-led action on the circular economy. This mapping was conducted in Turku as part of the Circular Turku project and identified the following policy provisions that will contribute to shaping future work on the topic:

- The **city strategy** where carbon neutrality is framed as a goal to be reached by 2029, and resource wisdom, including the principles of zero waste, zero emissions and a sustainable use of natural resources are framed as key targets to attain by 2040. The city strategy is supported by two strategic programmes: “Wellbeing and Activity” and “Competitiveness and Sustainable Growth”, where circular economy is promoted. The programme aims among others at reinforcing the material utilization of municipal waste and the complementary use of local energy. The program also plans for an improved usage of stormwater in all planning and construction.

- The City Council unanimously approved the **Turku Climate Plan 2029 (EU Sustainable Energy and Climate Action Plan, SECAP)** on 11 June 2018 and systematically follows its implementation. The main target of climate policy in accordance with the city strategy is a carbon neutral city area by the year 2029.
- The **Turku Master Plan 2029** provides an overview of the development and planning of the urban environment and transport systems in general
- The **energy efficiency agreement** for municipalities, which took effect in the beginning of 2017, is an agreement between the Ministry of Economic Affairs and Employment, the Energy Authority and the Association of Finnish Local and Regional Authorities on the more efficient use of energy in the municipal sector.
- The **Land use transport and housing agreement (MAL)** outlines the common goals and future endeavors of the municipalities and the state of the Turku City region with regards to land use. The agreement involves 14 municipalities and aims at promoting the development of a growth zone in the Turku region.



- The **Southwest Finland waste management policy programme** defines how the waste management is organized among the 17 municipalities that own the Southwest Finland waste management company, with targets for 2017 – 2022.

As part of the Circular Turku project, the policy provisions outlined above were used to identify opportunities to support circular economy work and gaps that need to be addressed. The mapping was conducted using the thematic framework of ICLEI’s Green Circular Cities Coalition (see next chapter for more information). As a connection to the wider sustainability context of the city, the links to the Sustainable Development Goals were also indicated in the analyses. The analyses revealed the following:

OPPORTUNITIES:

- The links between policy provisions and the GCCC themes were strongest for ‘industrial symbiosis’, ‘buildings and construction’, and ‘urban spatial planning’. There were several policy provisions that directly related to these. For instance, provisions for infill construction, cooperation agreements between municipalities, balanced urban development, improving the provisions for companies to cooperate and share resources beyond physical boundaries but also in virtual platforms were included. Interactions between activities and institutions are strongly embedded in local policy provisions, especially in relation to making information and data open and available to promote cross-silo innovation. In particular, the role of the Turku Science Park Ltd. and its wider network of companies offers great potential for such synergistic endeavors.



I am proud to work for one of the forerunners of the circular economy, Lounais-Suomen Jätehuolto Oy, and thrilled to work with challenges which are at the same time important to myself and which matter globally. I believe that with transition from linear to circular economy we can achieve a sustainable future. The change needs to start from designing and manufacturing and should cover usage, reuse and recycling. The biggest change needs to happen in our way of thinking and consuming.

SINI ILMONEN, LOUNAI-SUOMEN JÄTEHUOLTO OY



GAPS:

- Innovation and expertise in procurements are addressed in policy provisions but circularity is not explicit. Despite being a significant tool for localizing the circular economy, there is limited information on provisions for 'greening' public procurements using circular criteria. Addressing this gap will be a focus of the Circular Turku project.
- Circular economy work is strongly linked to the SDGs that address energy, water, food, innovation and industry, sustainable cities, production and consumption patterns, work and economic growth, climate action, terrestrial ecosystems and partnerships for the goals. The links to the SDGs with a more social perspective (health and well-being; reducing inequality; gender equity and, quality education) are less evident and require further thought and development.

Playing on these synergies and addressing gaps will be a core component of the Circular Turku project, along with streamlining local circular economy with national and European ambitions. This will provide a base for the implementation of resource wisdom goals and the city strategy update in 2021. Developing a shared understanding also facilitates communication and implementation for all relevant stakeholders.



Carbon neutrality and climate change mitigation are Turku Business Regions common motivating goals and several companies in the region have already set ambitious targets to achieve them. Circular economy requires a systemic change in society, where regulation and business play together. Circular economy will be realized through business and new innovations. Turku actors have a competitive edge in fields like electrification and battery recycling, developing the carbon cycle from fossils to new chemicals, waste heat recovery and utilization, as well as biobased production in textiles and plastics. I see that we have both the ambition and the competence to deliver solutions to circular economy.

LINDA FRÖBERG-NIEMI, TURKU SCIENCE PARK LTD



LINKING CIRCULARITY TO CARBON NEUTRALITY IN TURKU

In 2018 Turku tightened its carbon neutrality targets significantly. The Turku City Council approved an ambitious Sustainable Energy and Climate Action Plan with a goal to reach carbon neutrality by the year 2029. This means an emissions reduction of 80 % from the level of 1990 and compensating for the remaining emissions. The goal is also for Turku to become a climate positive area with negative net emissions from 2029 onwards. The decision of a carbon neutral Turku by 2029 was made unanimously by the city council.

According to the 2017 emissions calculations, Turku has reduced its emissions by approximately one third from the 1990 level. The total emission reductions are continuously approaching the target track, and rapid cuts have been achieved particularly in district heating.

To meet the 2029 carbon neutrality target, the city is placing a strong focus on the circular economy. This section explores pathways to cut GHG emissions through circular economy measures at the regional level based on experiences in Turku and explores three reasons why climate action must be paired with circularity.



Our societies are changing very quickly, perhaps more rapidly than ever before. The need to use our resources more wisely, efficiently and sustainably is evident.

Cities are working to identify resource wise solutions are facing tough challenges, and they must work together and learn and adapt quickly if they are to be successful. To achieve good, broad results in shifting processes from linear to circular, we need resource wisdom goals that are ambitious enough to raise interest among both private and public sector actors!

BJÖRN GRÖNHOLM, UBC SUSTAINABLE CITIES COMMISSION



INDIRECT EMISSIONS: THE BLIND SPOT OF CURRENT MITIGATION EFFORTS

To date, most of the policy discussions and investments around climate action have focused on decarbonizing production systems and increasing energy efficiency. These efforts are crucial to meet the goals of the Paris Agreement but do not sufficiently address emissions deeply embedded in the materials and products flowing within the economy. It is estimated that about 50 percent of total greenhouse gas emissions are caused by resource extraction and processing (International Resource Panel, 2019).

From extraction to manufacturing, transport, distribution and disposal, materials and products produce substantial emissions all along their lifecycle. These emissions are called indirect emissions, as they are a consequence of the activities of a specific entity, but are not owned or managed by this entity. Indirect emissions arise across different geographical boundaries and actors, which makes them particularly **difficult to calculate and manage.**

HOW THE CIRCULAR ECONOMY CAN HELP

Currently **only nine percent of the materials flowing through the global economy are revalorized** (Circle Economy, 2019). This means that all the energy and resources that went into producing the other 91 percent are wasted after a single use.

By prioritizing regenerative resources, preserving what is already made, using waste as a resource or generating new business models (e.g. as-a-service models, sharing platforms), the circular economy allows operationalizing action on emissions across direct and indirect sources and helps achieve carbon neutrality targets. A recent study by Sitra concluded that improving the use of key materials that already exist in the economy can take the EU industries of steel, plastics, aluminium and cement halfway towards net-zero emissions (Sitra, 2018).

CITIES HAVE A CRUCIAL ROLE TO PLAY IN ADDRESSING INDIRECT EMISSIONS

Home to over 50 percent of the global population and economic and industrial hotspots, cities are responsible for 70 percent of greenhouse gas emissions (UNFCCC, 2017) and 75 percent of natural resource consumption worldwide (UNEP, 2017). From impacting supply chains through **public procurement to integrating sustainable resource management and planning into their policies**, cities play a crucial role in implementing circular economy measures that mitigate embedded emissions.

Experiences from the City of Turku demonstrate how circular economy measures can help operationalize systemic climate action.

REGIONAL CIRCULAR ECONOMY TOOLS THAT SUPPORT CARBON NEUTRALITY

The circular economy offers an implementation-oriented framework to mitigate climate change through three main pathways. When implemented in combination, these pathways have the potential to cut carbon emissions in a systemic way. In Turku, they directly contribute and are interlinked with the five mitigation measures planned in the city's Climate Plan 2029.

 **PATHWAY 1 - CLOSING RESOURCE LOOPS ACROSS VALUE CHAINS**

Re-circulating materials, building efficiency in the design of products and infrastructures or generating business models that build on pooling or cascading resources represent different means through which the circular economy reduces new production needs as well as related energy demand and carbon emissions (Sitra, 2018).

 **PATHWAY 2 - NEW CLEAN SOURCES OF ENERGY**

Climate mitigation and adaptation require energy systems powered by low carbon sources that are resilient enough to face supply shocks. Energy recovery from organic waste and wastewater is a cost-efficient way to generate energy through under-utilized waste resources.

 **PATHWAY 3 - PROTECTING CARBON SINKS**

Powered by regenerative resources and aimed at protecting the long-term ability of ecosystems to provide key services, the circular economy is an effective tool to protect natural carbon sinks such as oceans, forests and soils. For instance, allowing nutrients to be cycled back into soil through composting practices ensures that soil retains as much of the carbon trapped in the ground as possible.

CARBON NEUTRAL ENERGY SYSTEM

The heat, cold, steam and electricity used in the Turku area will be produced in a carbon neutral manner at the latest in 2029. Smart solutions and energy efficiency will be leveraged in the development of energy systems in the Turku region.

LOW CARBON MOBILITY

The city is promoting active mobility and developing public transport and cycling infrastructure. The city is also investing in electric mobility, in mobility as a service solutions and in low emission logistics.

SUSTAINABLE URBAN STRUCTURE

The City of Turku is steering an urban structure conducive to sustainability through zoning, land use, traffic planning and related development projects. Sustainable construction is developed and promoted.

CITY'S CLIMATE RESPONSIBILITY

Turku City Group's subsidiaries are obliged to focus on the lifecycle climate and environmental impacts of their investments. Subsidiaries also participate in the implementation of an assessment model in collaboration with the City of Turku.

STRENGTHENING CARBON SINKS

The City of Turku increases the carbon absorption capacity of vegetation and soil through various measures: increasing the number of green areas, maintaining forests, fields and the amount of vegetation in various areas of the city.



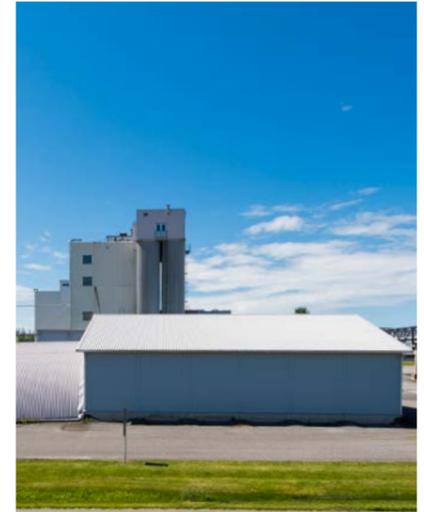
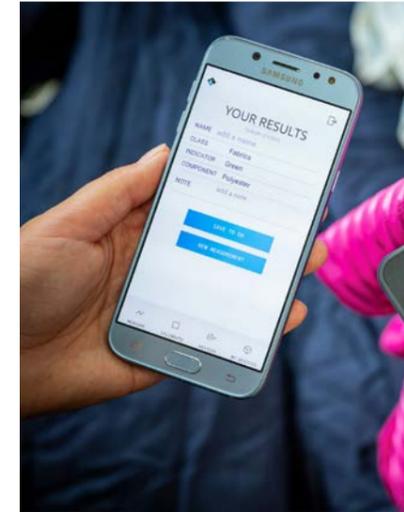
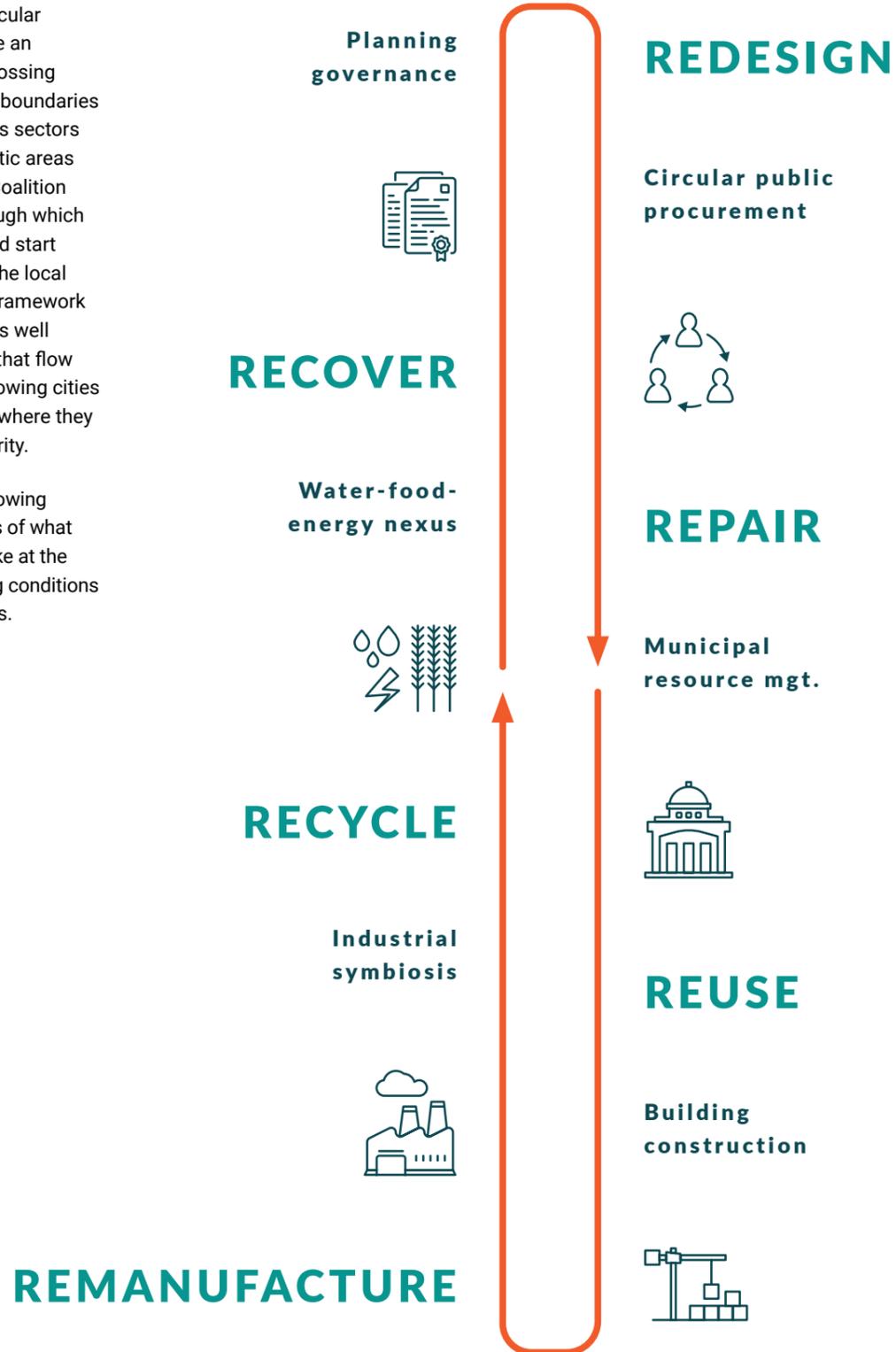


**OPERATIONALIZING
REGIONAL
CIRCULARITY:
BEST PRACTICES
FROM TURKU**

THE GREEN CIRCULAR CITIES COALITION THEMATIC FRAMEWORK

While action-oriented, the circular economy can quickly feel like an overwhelming framework, crossing territorial and administrative boundaries and encompassing numerous sectors and many actors. The thematic areas of the Green Circular Cities Coalition led by ICLEI offer a lens through which to map existing initiatives and start thinking about circularity at the local level in systemic ways. The framework spans governance aspects as well as the diversity of materials that flow through local economies, allowing cities and regions to take stock of where they stand with regards to circularity.

The cases outlined in the following pages offer real-life examples of what the circular economy looks like at the local level and which enabling conditions allow for successful initiatives.



“
 The transition to a circular economy presents vast opportunities for cities and regions all over the globe to drive economic growth, embrace technological innovation and create a more livable urban environment. Turku has been a pioneer of circular development policies and practices. With their ambition and commitment, Turku and local governments from Europe, China and Japan are aligning on circular economy via the ICLEI supported Green Circular Cities Coalition, to join hands in the transition towards more sustainable and circular systems that benefit both the people and the environment. I believe that Turku’s new resource wisdom strategy will set a model for similar cities and regions who want to boost their circular transition and contribute to the global paradigm shift.

SHU ZHU - ICLEI EAST ASIA, GREEN CIRCULAR CITIES COALITION

MULTI-STAKEHOLDER COLLABORATION FOR A CIRCULAR TURKU



Local and regional governments can act as enablers and platforms for new circular economy solutions and can accelerate their adoption by effectively connecting businesses, universities and residents. The city of Turku aims to speed up the circular transition in the region through continuously strengthening multi-stakeholder collaboration.

CONTEXT

The city of Turku and its surrounding region host a vibrant ecosystem of circular economy actors and front-runner initiatives contributing to sustainable resource management. Although much remains to be done in each sector to adopt the circular economy as primary model of production and operation, there are clear existing strengths and a significant amount of circular activities and stakeholders in the region.

Since 2015 when the city set the target of implementing the principles of resource wisdom by 2040, the priority has been to acknowledge and build on these existing strengths through direct collaboration with regional, national and international stakeholders.

KEY ACTORS

The city of Turku is actively collaborating with regional and national actors to operationalize the circular economy. On the regional level, public collaborators include for example the Service Centre for Sustainable Development and Energy of Southwest Finland (Valonia), the Regional Council of Southwest Finland and the Centre for Economic Development, Transport and the Environment of Southwest Finland (ELY Centre).²

In addition, Turku is involving local businesses as well as regional and local waste, energy and water companies in its circular economy strategy by collecting their inputs and incentivizing them to include circular economy principles into their work.

On the national level, Turku engages with stakeholders such as the Ministry of Environment. Exchanges with research institutions that develop tools for operationalizing circular economy, such as the Finnish Environment Institute, are also central partners for Turku in widening the knowledge base and outlining key actions.

Frontrunner municipality networks in Finland, such as the Finnish Sustainable Communities (FISU) network, are an important source of inspiration and peer-to-peer knowledge exchange.

² The regional council is responsible for the regional strategy and the regional land use plan, and promotes regional and other co-operation between municipalities with key stakeholders in the development of the province, and co-operation between the different provinces. The ELY Centres promote regional development by carrying out the executive and development tasks of the state administration in the regions.



ACTION

The aim of the city of Turku is to design a collaborative action plan for operationalizing the circular economy from the bottom up. To ensure needs-based policymaking, full clarity over who is active on the topic regionally and what challenges and opportunities they identify, is a key requirement.

Upon joining ICLEI's Green Circular Cities Coalition in 2018 and in order to get a clear picture of all actors involved in the circular economy, the city of Turku commissioned a comprehensive stakeholder mapping study to the Turku based Finland Futures Research Centre (FFRC). The study used the Green Circular Cities Coalition's thematic framing to map all actors involved in 1) planning and governance actions linked to the circular economy, 2) water, energy and food systems, 3) buildings and constructions, 4) resource management, 5) public procurement and 6) industrial symbiosis projects.

The mapping identified over 700 different circular economy actors in the Turku region, which were compiled in a living database. The most notable group consists of 270 businesses visibly implementing circular activities or being partners of public operators. Approximately 150 focused on research and training. 90 circular economy projects were identified within the Turku region as well as 20 different circular economy networks.

To strengthen information flow on circular economy between public actors, a circular economy working group has been created in 2018. The informal group gathers regularly to discuss thematic issues, identify common challenges and find synergies.

The group includes representatives from the Turku City Group, local government officials, businesses, universities and regional institutions. Platforms like this provide a low threshold for public actors to directly receive feedback and inputs.

A core element in the multi-stakeholder collaboration for Turku is engaging in active discussion with residents, communities and businesses.

The city of Turku is an active partner and initiator of local business networks, such as the Bastu business enabler and circular economy hub Topinpuisto. Another example is the CleanTurku cluster, conducted by Turku Science Park Ltd., a strategic entity of the city of Turku. The CleanTurku cluster focuses on bio and circular economy and cleantech, including more than 100 innovative companies with technologies, services, processes and products decreasing environmental impacts.

Resident engagement is also continuously strengthened. The city of Turku makes an effort to keep residents updated on how the work towards carbon neutrality is proceeding, by communicating actively, organising events and engaging residents in discussion on social media.

In addition to local and regional platforms, the city of Turku is also engaging nationally on the topic of the circular economy. Turku has a role in the preparation process of the national strategic programme for the advancement of the circular economy, through a thematic group on "Municipalities and Regions".

SUCCESS FACTORS

- The **informal and collaborative approach to multi-stakeholder consultations** has allowed clarifying roles and responsibilities and to gain a realistic understanding of the regional situation on circular economy.
- Turku's **ambitious climate and resource protection goals**, which are enshrined in the city's strategy, have created a momentum for regional actors to collaborate and act on the topic.
- Turku is home to **numerous innovative businesses and universities of excellence** - all situated within a small geographical area which allows for direct cooperation.

IMPACTS

- **Increasing circular activities and stakeholders:** Public actors and contractors have the responsibility to create an attractive platform for developing businesses to try their new solutions and create success stories for the whole region. Enabling measures from the public sector include incorporating circular principles for example in procurements, infrastructure, land use planning and business collaboration.

- **Replication:** The bottom-up approach undertaken by Turku to kick start its work on the circular economy has inspired several other local governments of the ICLEI network to conduct similar multi-stakeholder screenings within their jurisdiction.
- **Collaboration into practice:** The best practices outlined in the following case studies are all well connected to one another. There is a high awareness from regional circular economy actors of who is doing what and which synergies can be played on. This offers an ideal ground for further action on the circular economy.
- **Engaging with national-level stakeholders and processes:** Active collaboration and exchanges with national-level processes, such as the preparation of the Finnish strategic programme of the advancement of circular economy, allow Turku to learn from simultaneous processes and strengthen the city's profiling on circularity.

NEXT STEPS

Moving forward, Turku aims at strengthening the enabling role of public sector actors and to better reflect regional stakeholders' inputs in future city-led endeavors. As part of the Circular Turku project, a collaborative roadmap will be designed and operationalized through an online platform that will facilitate information flows and direct cooperation. One of the main priorities of the project is also to better include residents into the roadmap and collaboration platform.

INCREASING THE CIRCULARITY AMBITIONS OF REGIONAL WASTE MANAGEMENT WITH LOUNAI-SUOMEN JÄTEHUOLTO OY



At the European level, municipalities are asked to comply with increasingly ambitious recycling rates. However, there is a growing recognition that recycling won't suffice to address current resource challenges if recycled materials are not used in primary production. On average, recycled materials constitute less than 12 percent of the European Union (EU) demand for materials³. Moving to high-value recycling and circular economy practices that address waste challenges at their source has become a priority in the EU. This case study highlights how a public waste company owned by several municipalities in the Turku region became a hub and innovation center for the circular economy.

CONTEXT

The birth of the Lounais-Suomen Jätehuolto Oy was a continuation of the close waste management cooperation among municipalities in the Turku region. Until 2015, waste management in the region was operated by two companies co-owned by several municipalities. However, the costs of operations were rising along with recycling requirements and increasingly complex waste management practices. In order to avoid raising customer fees, wider cooperation became necessary. The

municipalities pooled the resources of the two companies into a single entity, Lounais-Suomen Jätehuolto Oy (LSJH), with the aim of providing high-quality waste management services with a focus on circular economy innovations.

KEY ACTORS

LSJH is owned by seventeen municipalities in the Turku region, with the city of Turku owning the largest share (23 percent). LSJH is responsible for organizing municipal waste management and waste prevention on behalf of all seventeen municipalities.

The municipalities do not provide funding for company operations. The waste management services are funded mainly by waste treatment and service fees.

Lounais-Suomen Jätehuolto owns four waste treatment centers and eight sorting stations in the areas surrounding Turku, serving 417,000 inhabitants. In the waste treatment centers, waste can be sorted in thirty different fractions, including recyclable, hazardous and electronic waste, depending on the sorting station.

ACTION

LSJH has developed into more than a municipal waste management company. Its activities have expanded to support circular economy businesses, develop innovative, high-value recycling innovations and raise awareness on sustainable consumption.

In 2015, LSJH created the circular economy center Topinpuisto around one of its waste treatment centers, Topinoja. The objective of Topinpuisto is to develop innovations and business solutions based on the circular economy. The center organizes regular trainings to help companies solve key challenges such as waste material handling, finding demand for reused materials, service development or communication. These trainings bring together experts from different sectors, including local universities, to develop concrete tools and methods that will support companies' circular economy efforts.

Topinpuisto is also developing a material library to map all the materials flowing through the treatment center. The library is developed in cooperation with Turku University of Applied Sciences. The aim is to include features that help companies to receive guidance on product design from a circular economy perspective.

Another strong focus of LSJH is textiles recycling. In alignment with the European Union waste framework directive, a separate collection for textiles must be arranged by 2025. Systematic collection and sorting of textile waste began in early 2016 within LSJH waste treatment and sorting centers. However, for textile waste to be used as raw material by the textile industry, the processors must be able to know exactly what materials the fibers offered to them are made of. This process usually relies on care labels but some textiles might be missing a readable label or the information on the label may be unreliable.

To address this challenge, LSJH has been partnering with universities, business networks and national ministries to develop a processing facility with a mechanical fiber opening line and infrared technology to identify the type of fibers present in textile waste.

Finally, LSJH manages the Kahmari Visitor Center, which functions as a learning environment and showroom for businesses of the Topinpuisto network. All grade 8 (lower secondary) students in Turku and surrounding municipalities visit the center annually. The exhibition changes focus regularly to cover different types of waste and prevention methods and emphasize the value of natural resources and materials. Business partners of the Topinpuisto network also have the opportunity to display their services, competences and ideas.

³ EUROSTAT (2017) Circular material use rate. Accessible via: https://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=cei_srm030&plugin=1



SUCCESS FACTORS

- **Understanding companies' needs:** Through the material library and regular exchanges with business and academic partners, LSJH is investing in understanding companies' operations and needs with regards to materials. This helps to address obstacles early in the supply chain and to raise awareness on the necessity to design products for reuse and recycling.
- **Multi-actor collaboration:** Cooperation between private, public and academic partners has created a fruitful learning environment. The regional sorting and treatment centers offer an appropriate scale for piloting innovative solutions.
- **Addressing waste from a systemic perspective:** Municipalities in the Turku region pooling resources to create a larger public waste management company has enabled waste to be addressed from a systemic perspective.

IMPACTS

- **High recovery rates:** In 2018, LSJH received a total of approximately 144,000 tonnes of municipal waste, out of which 98.5 percent was recovered. Only 1.5 percent of the total amount of waste received went to landfill.
- **Front-running innovation:** Textile recycling innovations developed by LSJH have gathered national and international interest.
- **Circular economy education:** LSJH offers learning opportunities for local students and direct exposure to real-life businesses cases, thereby offering a training environment for future circular economy experts in the region.

NEXT STEPS

The Topinoja sorting station is being renewed to make it easier for residents to leave different materials for reuse and recycling. In parallel, the aim is to build the Topinpuisto Circular Economy Visitor Center and to further increase collaboration with companies and universities.

Topinpuisto also aims at putting the material library into practice and to link it to national efforts to develop material banks as part of the Materiaalitori program. Under this program, from 2020 onwards, waste holders in Finland will have to seek a market-based waste management service for their waste through the national material bank.

Finally, in 2020 LSJH will start building a pilot textile processing plant using the mechanical fiber opening line and further develop the use of infrared sorting technology in the Turku region.

OPERATIONALIZING REGIONAL CIRCULARITY:
BEST PRACTICES FROM TURKU

FROM EXTRACTION TO RESOURCE RECOVERY, A SYSTEMIC WATER CONCEPT IN TURKU



Led by Turku's City Council, municipalities in the Turku region collaborated to design a systemic solution to water management in the area. From groundwater protection to energy positive treatment and nutrients recovery, the water concept developed in the Turku region offers a systemic circular economy solution to efficiently manage water, nutrients and energy at the local level.

CONTEXT

Until 2009, wastewater was collected separately by fourteen municipalities in the Turku region. Nutrients capture wasn't maximized which was causing the Turku marine area to be substantially polluted with phosphorus and nitrogen.

As for drinking water, it used to be produced by separate water production facilities using either groundwater or surface water obtained from small rivers nearby Turku. The quality and quantity of the river water was not sufficient. As a result, drinking water in the Turku area suffered from a bad reputation.

Turku acknowledged the need to reinvent water management in the region to both improve the water quality and protect local ecosystems.

KEY ACTORS

Two main actors are responsible for water management in the Turku region.

Turun Seudun Vesi Oy (Turku Region Water Ltd.) is a wholesale water company owned by seven municipalities in the Turku region. The company is responsible for planning and developing water production and distribution in the Turku region.

Turun seudun puhdistamo Oy (Turku Region Wastewater Treatment Plant Ltd.) is a wastewater treatment service provider that is owned by fourteen municipalities and a subsidiary of the city of Turku. The company is responsible for the operation and treatment of the Kakolanmäki wastewater treatment plant (WWTP), where most of the wastewater produced in the Turku region is directed.

The heat pump station located in the plant tunnels is operated by Turku Energia Oy (Turku Energy Ltd.), which is also owned by the city of Turku. Support services such as sludge treatment and maintenance services are outsourced to regional companies, with carbon neutral criteria integrated in tenders.

ACTION

Turku Region Water Ltd. and Turku Region Wastewater Treatment Plant Ltd. have developed innovative water management techniques to improve the sustainability of water networks in the Turku region, from water extraction to resource recovery at the other end of the pipe. Throughout the chain, the focus is placed on resource efficient and energy neutral processes and continuous improvement through research and development.

Groundwater protection

To protect the condition of groundwater aquifers and water availability, municipalities in the Turku region have been collaborating through Turku Region Water Ltd. to implement innovative managed aquifer recharge techniques. River water is sustainably collected, pre-treated and pumped to Virttaankangas Esker, one of the largest groundwater areas in Southern Finland. There, natural infiltration processes are used to convert pretreated river water to artificially infiltrated groundwater. This technique offers a natural means of producing high quality water and increases the yields of the aquifer. The artificially infiltrated groundwater is then piped gravitationally to underground reservoirs where an electric turbine slows down the water movement at the end of the pipe and generates most of the energy required for water pumping, making it an energy-efficient process. The water is distributed to the 300.000 inhabitants, businesses and industrial sites of the Turku region.

Efficient wastewater management

Located in the solid rock of Kakolanmäki hill in the middle of Turku city, the Kakolanmäki WWTP processes the wastewater of residents in the Turku region.

The wastewater treatment plant uses mechanical, chemical and biological treatment processes. This combination makes the purification process very efficient: the plant removes up to 99 percent of organic matter and phosphorous and over 80 percent of nitrogen from the wastewater, far above the regulatory requirements.

Energy recovery

The Kakolanmäki WWTP also features a heat pumping station. Turku Energy Ltd. uses the station to extract some of the thermal energy from the wastewater to produce heat for district heating purposes (160 GWh / year) of 15.000 households. The water that is cooled down by the pumping station is also used for district cooling (30 GWh / year, or almost all of the need in Turku city).

Investments in research and development have allowed making the heat recovery system particularly efficient: one unit of electrical energy used at the station produces three units of district heating and two units of district cooling.

Sludge treatment

Sludge treatment has been outsourced to the state-own company Gasum Oy, which owns a biogas plant at the Topinoja waste treatment center in Turku. There, the sludge transported from Kakolanmäki is processed using anaerobic digestion. The plant processes 50.000 tons of sludge from Kakolanmäki WWTP per year, producing 30 GWh / year used in various regional transport needs.

One third of the nutrients from the digestate are used as fertilizers in agriculture and two thirds in landscaping. Nitrogen products produced from the sludge and sold to chemical industries.



SUCCESS FACTORS

- **Regional collaboration** between municipalities allowed them to pool resources to face the upfront costs of a very innovative wastewater treatment plant.
- **Focusing on continuous improvement and innovation** through collaboration with local universities and researchers has allowed the WWTP to continuously optimize its processes.
- **Incorporating circular criteria in the procurement of outsourced services**, such as sludge treatment and energy recovery services, which had to demonstrate carbon neutral processes, enabled the WWTP to focus on its core activities while ensuring circular economy side-activities were sustainable.

IMPACTS

Biodiversity protection: Centralizing all municipal wastewater treatment plants in one location at Kakolanmäki has decreased nutrient pollution in the surrounding marine area. Nutrients recovery practices have led to an 83 percent decrease in phosphorus load in the Turku marine area, which has had a positive effect on the water quality of the Baltic Sea.

Carbon savings: The various wastewater activities linked to Kakolanmäki produce 10 times more energy than they consume. It is estimated that carbon emissions in the Turku region are 80.000 tons lower per year because of the use of the heat pump station. As for the sludge treatment process, it is CO2 negative and energy positive.

Water security: The quality and supply of water has become extremely stable thanks to the use of managed aquifer recharge techniques and efficient wastewater treatment. Today, water in Turku benefits from a very good reputation.

NEXT STEPS

Looking into the future, Turku Region WWTP Ltd. is investing into adaptation to climate change. The period 2018-2023 will see the construction of a new wastewater removal channel at the Kakolanmäki WWTP. The new channel will separate the wastewater and stormwater discharge systems, enabling the WWTP to utilize its full wastewater treatment capacity during extreme weather conditions, which are expected to increase substantially in the future as a result of climate change.

Protecting the Archipelago and the surrounding marine area is a key concern for the city of Turku. Regional actors are working together to ensure the innovative water solutions already developed are continuously improved and adapted to changing weather patterns.

OPERATIONALIZING REGIONAL CIRCULARITY:
BEST PRACTICES FROM TURKU

SMART CHEMISTRY PARK: AN INDUSTRIAL SYMBIOSIS PROJECT TO REDESIGN THE CHEMISTRY SECTOR



The chemical sector plays a central role in modern economies. It allows turning raw materials into high-value products that will be used in our everyday life. Yet there is a growing recognition that raw materials extraction is fueling climate change, pollution and ecosystems degradation. Chemistry will be critical to rethink the way waste streams can be used to decrease pressure on raw materials as well as the impacts of industries as diverse as the plastic, construction, energy or electronics industries.

Yet circulating molecules is linked to many challenges, from achieving the required performance properties to complying with safety standards and finding demand for secondary uses. Small and medium enterprises play a pivotal role in developing and testing innovative solutions that can then be implemented at a bigger scale.

Smart Chemistry Park offers a relevant example of how local public actors can support innovative circular economy solutions for high-value materials through industrial symbiosis.

CONTEXT

Like in most regions, the vast majority of waste production in Southwest Finland is a result of the manufacturing industry. Recognizing the need for cleaner production processes and the key role that small and medium size businesses could play in renewing the industries, the city of Turku created the non-profit company Turku Science Park Ltd.. Through the city-owned company, Turku has been supporting a number of circular economy initiatives in the region, including Smart Chemistry Park (SCP). SCP was created to support SMEs to grow by offering a unified infrastructure for piloting innovative circular economy solutions aimed at recycling industrial side-streams into high-value chemical products.

KEY ACTORS

Smart Chemistry Park was established in 2015 as a platform for regional companies in chemistry and chemical engineering to collaborate and identify synergies. The development of SCP was financially supported by Sitra and the cities of Turku and Raisio.

SCP supports small businesses whose solutions are based on material technology, process chemistry and refining technologies. The center also works with business networks at the regional and national level and with municipal energy and waste companies such as Turku Energia Oy and Lounais Suomen Jätehuolto Oy.

SCP continues to work directly with both Turku and Raisio on a strategic level. SCP also collaborates with public sector actors such as Business Finland, Sitra and the Chemical Industry Federation of Finland to support the growth of bio- and circular economy solutions in the chemistry sector.

Finally, SCP cooperates with both national universities and regional research and education institutes, such as Åbo Akademi University, the University of Turku and the Turku University of Applied Sciences, which play a crucial role in supporting companies involved in the SCP on research, development and innovation issues.

ACTION

Smart Chemistry Park is located in the industrial area of the municipality of Raisio, a few kilometers away from Turku. Within the park, companies have access to shared laboratory spaces and the possibility to pilot and expand production to an industrial scale.

The competences of the companies working at SCP lie in different fields of chemistry. They deliver products or technical expertise to a wide variety of industrial sectors, such as metal, energy, paper and packaging, building, and life science industries. At the core of SCP's business model is the reuse of industrial waste streams, which companies can access from the surrounding industrial zone.

For example, CH-Bioforce develops fractionation technologies for wood chips from industrial side-streams to extract bio-materials such as cellulose and lignin. CrisolteQ is a company specializing in recovering metal resources like nickel, chromium and iron from industrial processes. As for Renotech R&D Inc, the company developed the 'Ash to cash' concept, which turns ashes produced through different combustion processes into reusable insulating material for infrastructure construction.

The SCP companies work independently, developing their own technologies and businesses, but in close collaboration with each other, testing and reusing side-streams from one another in the shared laboratory. In addition, companies exchange their infrastructures, equipment and know-how. SCP also includes consulting companies with expertise to complement the value chain with services such as chemical safety and patent engineering.

At the moment, 14 companies operate in the Smart Chemistry Park. The SCP network is broader, with 60 companies working together on cross-cutting issues such as raw material supply or research and development.

SCP also facilitates access to accelerator programs and funding networks to ease the operationalization of innovative and sustainable business models.

Finally, the Smart Chemistry Park offers international cooperation opportunities through programs at the European Union level and with non-EU countries such as Malaysia and China.



SUCCESS FACTORS

- **Access to multiple networks** from universities to business has supported the development of an attractive cluster of expertise. These networks offer regional visibility for SCP companies and strengthen access to relevant markets.
- **A strong focus on SMEs**, with services targeted to their specific needs and facilities allowing to share operational costs, enables the development of innovative solutions in cost-efficient ways.
- **Collaboration with public sector actors** has facilitated access to financing and helped anchor the work of the SCP within national circular economy priorities.

IMPACTS

- **Industrial renewal:** Innovations at SCP are transferred into large branches of industry in Finland. For example, the SCP based Crisolteq was acquired in January 2020 by the Finnish state-owned energy company Fortum to scale an innovative method for recycling of electric vehicle batteries. This technology enables a recycling rate of 80 percent of lithium-ion batteries compared to the current recycling rate of around 50 percent.
- **Employment opportunities:** The SCP has created training and employment opportunities for jobs in the circular economy. An estimated 40 new jobs have been created in SCP companies between 2015-2019.

NEXT STEPS

The SCP aims to continue supporting the growth of sustainable startups that deliver chemistry solutions that advance climate action. Thematic issues that will continue to be important include the battery industry, construction materials and bio-based products, especially for use in textiles.

SUPPORTING CIRCULAR FOOD SYSTEMS THROUGH PUBLIC PROCUREMENT



City-owned assets and public procurement are powerful levers to influence a market-shift towards a more circular management of resources. Through its strategic procurement department, the city of Turku is currently working on decreasing the lifecycle carbon impacts of its food contracts. Along with a tool to track GHG emissions that is applied to contractors, the city is also setting goals for food waste reduction and vegetarian meals.

CONTEXT

As part of Turku's Carbon Neutrality Plan, the city must address the environmental impacts of its investments and acquisitions and promote the use of circular economy solutions to reduce demand for natural resources.

The city of Turku procures goods and services for both residents' needs and the service sector of the city group. The city issues public tenders for all procurements for goods and services with a value exceeding the national threshold value, therefore being subject

to competitive tendering in accordance with the Finnish Procurement Act. In total, the annual value of contracts starting in 2020 in Turku is 420 million euro, making public tenders a key lever for circularity in the region.

KEY ACTORS

In Turku, tenders are managed by the strategic procurement department, which collaborates with the climate department in order to implement the carbon neutrality plan. A special working group is responsible for coordinating the city's food service areas.

In total, the city awards thirteen food contracts to three different service providers. Turku's nearly 140 different types of kitchen facilities cater to a wide range of customers. Meals are provided in various educational and care institutions and facilities, such as kindergartens, schools, elderly homes, care services for disabled, child protection units etc. In total, 3,4 million meals are delivered to care facilities and 5,4 million to the educational sector.

ACTION

To contribute to the city's carbon neutrality goal and decrease the lifecycle emissions of food services in the city group, the strategic procurement department set the following objectives, which would allow of 25 percent reduction of GHG emissions of food services by 2029:

- Reducing food loss from 12 percent to 6 percent
- Doubling the proportion of vegetarian meals from 24 percent to 48 percent

In order to understand what drives the carbon emissions of Turku's food services, how they can be reduced and how progress can be tracked, the strategic procurement department has been involved in a project implemented by the Finnish Environment Institute (SYKE) and funded by Sitra. To determine the factors affecting the carbon load of food services in Turku, the project analyzed two food service areas in the education sector.

The project mapped out all the major factors influencing the carbon footprint of Turku's food services, such as heating the buildings, kitchen equipment, electricity consumption, transportation, the share of vegetarian food and food loss. The impact of foodstuff and raw materials was studied by reviewing the service providers' menus for basic and vegetarian diets throughout a week.

According to the project, the main sources of greenhouse gas emissions in the food service industry in Turku are the production of ordinary mixed food (84 percent of the total emissions) and food waste (10 percent of the total emissions). After food, the next biggest share of emission is caused by the energy consumption of kitchens (6 percent).

The GHG monitoring tool has been applied to all 13 food service contracts of the city. It is estimated that each meal generates on average 1424 gCO₂-eq throughout its lifecycle, from food production to disposal.



The calculator identifies different aspects of food services that would help to reduce their carbon footprint. In the future, the calculator can be used to align the provision of various meal options and plan the kitchen network, as well as for the setting and monitoring of emission reduction targets.

As one immediate measure for doubling the proportion of vegetarian meals, from 2020 onwards, the amount of vegetarian meals within the educational division will increase from one vegetarian meal per week to eight vegetarian meals in a six-week period. Measures also include a gradual reduction of beef in meals in favor of menus including plant-based proteins. Planned measures also include energy and water efficiency criteria within food service contracts.

In care institutions, vegetarian foods suitable for the elderly are being developed to achieve a similar change as in the education division.

SUCCESS FACTORS

- **Lifecycle assessment:** Tracking drivers of GHG emissions from production to waste has allowed to gain a clear understanding of where mitigation measures can be implemented.
- **Using tenders as a lever:** Engaging contractors on common goals creates incentives for long-term change and a momentum service providers can use to impact the supply chain.
- **Early childhood education** has been recognized in Turku as the most important target group to ensure residents get accustomed to vegetarian meals.

IMPACTS

- The project has **attracted interest nationally** and the meal-specific CO2 calculator has been used by nation-wide food companies.

- Thanks to the calculations the amount of **food waste and the consumption of vegetarian food will be closely monitored** and further plans will be made, in cooperation with the education industry and service providers, to minimize waste and promote vegetarian eating.

- While still at an early stage, the project holds great **GHG emission reduction potential**. In one year, between 2019 and 2020, the GHG emissions produced by the food services have already decreased by 4 % per meal.. Measures planned for 2020 will further accelerate the emission reduction.

NEXT STEPS

The strategic procurement department plans to monitor progress annually, to improve the monitoring of the consumption of vegetarian food. To facilitate monitoring, the department is envisioning to develop an electronic tool for calculating emissions from the different food services in an automatic manner. Currently, data on food consumption from the welfare and educational sector need to be manually collected.

The city is also interested in working further with service providers to systematically assess the carbon footprint of their menus, in close partnerships with the producers they work with.

Looking beyond food contracts, the city's strategic procurement department is also preparing a sustainable procurement guide, with specific guidelines for small-scale procurement, and working towards better integration of lifecycle indicators into the city's tenders.

LAYING THE FOUNDATIONS OF A CIRCULAR CONSTRUCTION INDUSTRY



Buildings and construction consume half of the world's natural resources and about 40 percent of the world's energy. The sector also accounts for about a third of global greenhouse gas emissions. Finland's national government is calling for a reduction in construction emissions by 40 per cent by 2030, and for carbon neutrality by 2050⁴.

The city of Turku is eager to develop circular construction innovations to decrease the lifecycle impacts of buildings and infrastructures and complement its carbon neutrality strategy. An area of importance for the city is the valorization of land masses, such as clean surplus masses, mildly contaminated lands and dredged materials. This case study explores how Turku is piloting a landmasses valorization project for local reuse in new earthworks.

CONTEXT

Rural-urban migration and continued urban growth will require future built environment expansion in Turku. The city of Turku is currently a part of the 6Aika national strategy, which supports cities (Helsinki, Espoo, Vantaa, Tampere, Turku and Oulu) in Finland to advance sustainable development. Within 6Aika, Turku is involved in the CircVol project, which focuses on finding circular solutions for industrial side-streams.

Anticipating the need for future residential construction, Turku is developing a solution that recycles local landmasses and industrial byproducts to create a locally adapted circular earthworks material that could lay the foundation of the envisioned residential district Lauttaranta.

KEY ACTORS

The CircVol project in Turku is led by Turku Science Park Ltd., a subsidiary of the city, with support from Turku University of Applied Sciences and Åbo Akademi University. The project partners also collaborate with local regional actors specifically the city of Turku, the Turku Port Authority as well as industrial companies and local building and construction SMEs, especially earthwork experts. The wider CircVol Project includes several other national partners and is supported by the European Commission.

ACTION

The focus of the CircVol project in Turku is to create an innovative circular solution for unused landmasses, specifically clay from Turku's port that is dredged during maintenance. The dredged clay is stabilized using industrial side-stream materials such as ash and wasted gypsum. The industrial side-stream inputs are sourced from a number of industrial factories in Turku and the surrounding region. Data collection for the project commenced in 2018 with lab and field tests taking place in 2019 and 2020.

This circular clay-based material developed by the CircVol project can be used as an alternative solution for part of the estimated 100 million tonnes of rock materials needed across Finland for construction. Adoption of this solution would limit the need for virgin material extraction as well as increase the use of local materials rather than carbon-intensive imports.

Lab tests conducted by the project's research partners ensured that the fortified material meets strict environmental standards. Results show that the material is not soluble and is considerably cleaner than the separate input components. The re-use of the clay and industrial byproducts also ensures that these materials can be re-valorized to generate economic and material benefits for Turku-based businesses rather than being dumped in landfill sites. An additional circular aspect of this project is that most of the material is sourced within a 50 kilometer radius of the city of Turku – substantially reducing transport costs and related emissions.

The aim would be to use the fortified circular clay material to lay strong foundations for the development of the Lauttaranta district. 500.000 cubic meters of earthwork materials would be needed to raise the area by 2,5 meters to avoid flooding and prepare for sea level rise caused by natural variations and climate change.

SUCCESS FACTORS

- A **systemic approach to the construction value chain**, based on the reuse of multiple, locally sourced side-streams, yields environmental co-benefits and cost savings across different sectors.
- **Multi-stakeholder collaboration across the value chain** is contributing to building an ecosystem of public, research and technical actors working together on circular construction solutions in Finland. The findings of the CircVol pilot are being circulated by the Association of Southwest Finland who are using their network to educate diverse stakeholders on the opportunities of using circular materials rather than virgin resources.
- The CircVol project is being developed with **replicability** in mind. Reusing waste earth materials for construction can also be replicated in other regions, provided pre-feasibility research and testing on the specificities of local materials used is undertaken.

⁴ Finnish Ministry of the Environment (2019) "Climate-friendly construction requires swift action". Press release, 25 September 2019. Accessible via: [https://www.ymp.fi/en-US/Latest_News/Press_Releases/Minister_Mikkonen_appeals_to_the_interna\(51763\)](https://www.ymp.fi/en-US/Latest_News/Press_Releases/Minister_Mikkonen_appeals_to_the_interna(51763))



IMPACTS

- **GHG emission reduction:** The re-valorization of recycled landmasses and industrial materials for construction promises to decrease the need for virgin extracted material for new construction projects in the Turku region, which holds substantial opportunities for GHG emission reduction compared to traditional practices.
- **Biodiversity:** Before finding a circular use, most of the dredged clay material was dumped back into the sea near the city. While the dumped material met environmental standards, the dumping activities increased the murkiness of the water and impacted ecological balances for coastal and marine life in Turku.
- **Cost savings:** If initiative continues to be successful, the stabilized clay material developed in the CircVol project will be used for developing the new residential Lauttaranta district, generating substantial economic opportunities for the building and construction industry in the Turku region. The CircVol project estimates that this circular construction solution would save the city of Turku 7 million euro in overall economic costs. In addition, project stakeholders are confident that the project and earthworks costs could easily be recouped through the sale of land for development in Lauttaranta. Finally, the reuse of side-streams is expected to decrease waste management costs of materials that would normally have been dumped in landfill sites.

NEXT STEPS

The project in Lauttaranta is currently in the pre-construction phase waiting for an environmental permit before land preparation and earthworks can commence. The project has a long development timeline and is currently due to be completed in 2030. CircVol partners also recognize that once the permit has been granted, there will be a need to encourage increased citizen awareness and participation in the district's development.



FIVE PRIORITIES FOR A CIRCULAR TURKU

Having gathered a clear picture of where the region stands with regards to the circular economy, the next step was to prioritize well delineated topics in order to identify concrete action steps.

This section provides an overview of existing challenges and opportunities for the topics that will receive particular attention in the Circular Turku roadmap and outlines the collaborative process through which these topics were selected.

SETTING PRIORITIES FOR FIVE VALUE CHAINS

FOOD VALUE CHAIN AND NUTRIENT CYCLING

Priority topic scoping

The food value chain includes all activities from farm to fork, such as: agriculture, fertilizers production, manufacturing, packaging and storage, wholesale, consumer sales, consumption and nutrients and waste management. A circular economy approach to food systems involves, favoring regenerative and water efficient agricultural practices, preventing and managing food waste and prioritizing food items with a lower environmental and material footprints, such as plant-based options.

Key stakeholders and existing initiatives

Southwest Finland is often called "Finland's breadbasket", having a central position in Finnish food production from agriculture to the food processing industry.

There is a high number of farms in the region, cultivating different plants and cereals with a will to experiment new varieties as well. Ongoing initiatives on farms include for example biogas production from manure of dairy and meat farms.

Food production, manufacturing and distribution are carried out by companies of many sizes, which makes business collaboration a key player in the development of resource wise food systems.



Food distribution in the area is mainly the responsibility of two national central offices, which have significant influence over what is usually distributed. Most grocery stores are owned by local entrepreneurs. Consumer demand is an important factor in these stores' decisions to include, for example, local produce or organic products.

Community-based initiatives facilitating direct purchases between producers and consumers also exist, such as "REKO" which is mainly operated on social media.

Nation-wide chains are strongly represented in the local canteens, with often centralized decision-making on raw materials, operation, and food waste treatment. Smaller canteens have the responsibility for procurement and can influence the value chain and management of food products.

The Finnish government has been working on a climate food program since early 2020 to support the goal of a carbon-neutral Finland by 2035. Under this program, regional research actors (such as the Brahea Center of the University of Turku and the Functional Foods Forum) are actively developing projects on local fish breeding and new plant-based protein sources.

National actors (such as the Finnish Environment Institute, the Natural Resources Institute, the Central Union of Agricultural Producers and Forest Owners and the Centre for Economic Development, Transport and the Environment) are cooperating with regional businesses and public actors to make nutrients management more circular.

A pilot project includes testing the reuse of minerals from side streams to reduce fertilizers inputs and prevent nutrients runoff, such as using limestones or gypsum from wasted building materials as a soil additives and fertilizers.

Challenges and opportunities

While several initiatives exist to make food systems more circular in Turku, many are still in their nascent stage and substantial challenges remain.

The consumption of meat continues to increase in Turku and contributes to high GHG emissions. Agriculture in the region as in other areas in Europe is strongly tied to EU subsidies and their conditions.

Finally, food businesses are operated by a diversity of companies, making it difficult to agree on common goals and measures, such as food waste reduction.

A key opportunity for action lies in the strong food research and innovation capacity in the region. The University of Turku hosts several research teams working with food related topics and a faculty of food chemistry. The University of Turku also hosts a novel food experience center, Flavoria, a living lab for academic research and companies' development needs. Falvorio includes a test restaurant minimizing food loss.

Regional efforts linking academia and practitioners on food topics are also underway, for instance on nutrients recycling, biogas production from food waste, sustainable water management in agriculture and revalorizing low-value fishes.



ENERGY SYSTEMS

Priority topic scoping

In alignment with Turku's carbon neutrality and resource wisdom goals, renewable sources must be used for energy production in the region. A circular economy approach to energy systems (production, storage, distribution and use) includes for instance decreasing overall energy demand, facilitating waste heat capture and ensuring the sustainable recovery of energy from selected waste streams.

Context and key stakeholders

Heat and electricity distribution networks are operated by Turku Energia Oy, which is owned by the city of Turku. The largest share of Turku's district heating is produced by Turun Seudun Energiantuotanto Oy, owned partly by Turku Energia. Turku's energy systems have benefited from substantial investments (approximately 300 million euro) in bioenergy, solar, wind and hydropower over the period 2014-2018 by the Turku City Group and affiliated companies, which has created a structural readiness for carbon neutrality by 2029.

The region's energy system will be supplemented in 2021 by an "eco-power plant" in the neighboring municipality of Salo, where non-recyclable municipal waste will be used for energy generation.

Most of the heat production in the Turku region comes from the Naantali multi-fuel power plant, which has a predominant share of biofuel (forest residues and by-products from industries). District heating sources include wastewater from the Kakolanmäki WWTP and two bioheat plants. Plans have also been made to supply 10 percent of district heat needs through geothermal sources.

New models for circular energy production are being planned. Such plans can be seen at the Turku Student Village Foundation. The new housing project includes a geothermal heat system and wastewater heat recovery from nearly thirty neighboring buildings in the student village. The area has also made significant investments in solar power. 515 solar panels were installed on the roof of a student housing building finished in 2019 and the electricity can be distributed to adjacent properties within the student village area.

Challenges and opportunities

The renewable energy transition in Turku has achieved great strides but challenges remain. Total energy consumption and production are still the largest contributor of emissions in the city. The integration of decentralized, new energy production, storage and distribution to the heat and electricity grid is making progress but further work is needed.

Smart solutions in the district heating network offer great opportunities for circular economy action within Turku's energy systems. Two-way heat trading (allowing generators to sell energy excess), waste heat recovery, thermal storage in soils and heat storage are currently being piloted and applied by Turku Energia and explored especially by academic partners such as the Turku University of Applied Science and businesses.



BUILDINGS AND CONSTRUCTION

Priority topic scoping

The value chain of buildings and construction covers property development and design, materials sourcing and manufacturing of building components, construction, usage and maintenance. A circular economy approach to buildings and construction includes among others designing buildings for modular use and future disassembly, facilitating building materials reuse and using / recycling locally sourced sustainable materials.

Key stakeholders and existing initiatives

Stakeholders in the building and construction field include building owners, housing associations, rental housing companies, real estate investors and companies who own commercial and industry sites. Additional important stakeholders are companies planning and implementing renovation and energy solutions, property management companies and building services companies, demolition and recycling of building materials providers.

For new construction, the city of Turku has a significant steering role in order to implement the city's master plan.

The city of Turku has included circular economy principles in zoning and urban planning. Brownfield revitalization in Ratapiha and Itäharju areas has been prioritized. In the Linnanfältti area and Skanssi area, wood construction is highly promoted as building material. Compact urban structure and complementary construction are also being planned in Turku's city center as measures to promote resource efficient urban planning.

Challenges and opportunities

Incorporating circular principles into the construction industry is linked to many challenges. The building stock is slowly renewed, and both new construction and renovation requires significant investments and capacity building to include circular economy principles. Construction actors and developers also emphasize the lack of access to data on materials and their recyclability. Incorporating circular economy criteria in public procurement in order to incentivize market development remains a major challenge. This is because there is insufficient research and tools to be able to assess the life cycle impacts of buildings.

The Turku region can count on its vibrant research community to help address these challenges. For example, Turku University of Applied Sciences hosts strong research fields in refurbishment and sustainable design and focuses among other topics on energy efficiency in buildings. A number of regional actors are working on the recyclability of building materials and innovation platforms facilitate collaboration between academia and construction industry experts. A number of tools are also in development, for example a method for assessing the carbon footprint of buildings has been developed by the Ministry of Environment and is currently being tested in Turku.



TRANSPORT AND LOGISTICS

Priority topic scoping

Transport and logistics include the movement of people and goods by private and public transport and freight. Developing sustainable, low-carbon mobility is one of the major climate change mitigation measures in the Turku Climate Plan. Adopting a circular economy approach to transport and logistics involves facilitating shared mobility practices, optimizing freight transport, tapping into waste streams to power vehicles, remanufacturing and reconditioning vehicles and ensuring the recyclability of e-vehicle parts.

Context and key stakeholders

As part of its Climate Plan, Turku is investing into redesigning its city center to make it more conducive to soft mobility. The main actor responsible for transport services in Turku is Turku Region Public Transport, also known as Föli, a collaboration between the municipalities of Turku, Kaarina, Raisio, Lieto, Naantali and Rusko. Turku's public transport equipment has already been partially converted to electric alternatives and a well-functioning city-bike sharing system has been implemented in the city.

As part of Smart and Wise Turku, one of the city's spearhead projects that combines the strategic goal of regional carbon neutrality in 2029 with the Smart City concept, Turku is working on ensuring city-logistics is emission free.

Finally, efforts are made to power transport by biogas from regional organic waste. An example is the sludge collected at the Kakolanmäki WWTP which is used to serve the needs of municipal vehicles, among others.

Challenges and opportunities

Freight traffic is constantly increasing to serve the needs of growing industries and logistics remains a cost-oriented, fragmented industry. However, opportunities exist to make freight transport more resource wise. Industrial sites and logistics centers are concentrated in a relatively small geographic area in the Turku region, with efficient linkages to the main roads. Increasing the load factor for freight transport, planning return loads, optimizing the delivery system within the city and maximizing the use of zero-emission delivery vehicles will contribute to the circular economy of freight transport.

Good practices in terms of using biogas as a fuel can be expanded to ensure e-mobility alternatives are powered by sustainable sources.



WATER CYCLES

Priority topic scoping

The water cycle spans resource extraction, treatment, distribution, use and discharge. Turku's water system is comprised of domestic water, sewage and storm water and natural waters.

Applying a circular economy lens to water cycles implies among others looking at aquifer protection, reducing new water needs, managing water in an efficient manner and ensuring heat and nutrients recovery from wastewater.

Key stakeholders and existing initiatives

The production of clean water and wastewater treatment serving 300,000 residents in the Turku region is ensured by Turku Region Water Ltd. and Turku Region Wastewater Treatment Plant Ltd. These two organizations have developed a sustainable and energy-efficient way of managing regional water, from extraction to discharge.

Key stakeholders advancing the circularity of water cycles in the Turku region include the city of Turku, the urban environment division and water supply subsidiaries of the Turku City Group as well as regional institutions, research institutes and universities and the Union of Baltic Cities. The protection of the Baltic sea is a major concern in the Turku region, with efforts underway to address nutrients pollution and eutrophication.

Challenges and opportunities

The Turku region is already a leading example for circular water management. The challenge is to ensure the region is ready to face the increased water risks brought about by climate change. To confront this challenge, the region is building on its strong research and innovation water community and cooperation with Baltic cities.

Areas of research that will inform future circular economy work include stormwater treatment, smart water management, new purification technologies and efficient water usage in agriculture.



TOWARDS AN ACTION-ORIENTED ROADMAP

For each of the priority topics, further consultations with relevant stakeholders will be organized throughout 2020 to map opportunities for action. To ensure action points are identified in a systemic way, the following cross-cutting enablers have been identified. The aim is for regional actors to map opportunities and challenges across all these enablers to inform policy making, investments and collaboration around the circular economy in Turku.

REGULATION AND POLICIES

Circular policy making is about systemically incorporating incentives and enablers for the circular economy in decision-making processes across different sectors and in partnerships with local and national actors. From setting ambitious goals to designing economic incentives, there are many ways local governments can localize the circular economy through policy tools.

PUBLIC PROCUREMENT

Each procurement and investment decision a government makes is an opportunity to push the market towards sustainable alternatives and to set an example. Public procurement is a powerful intervention tool to develop more circular products and infrastructures and influence the supply chain to shift away from the linear model.

Circular procurement is about setting standards and making agreements to the products procured are produced in accordance with the principles of the circular economy and will be further processed after use. Such products are, for example, designed for durability, reparability and recycling and can at the end of their life cycle be broken down into components, materials or raw materials, which can then be used again in the production chain⁵.

REGIONAL COLLABORATION

Implementing circular economy measures implies linking sectors that are usually siloed. These areas may be under the jurisdiction of different departments, municipalities or levels of governments.

Regional collaboration increases the ability of individual municipalities to bring sectors together on circular economy initiatives. Regional collaboration also allows pooling resources to design innovative projects and offers an appropriate scale to effectively manage material use in carbon intensive categories (construction materials, chemicals, textiles, etc...).

Finally, the convergence of a diverse set of actors, such as universities, businesses and community initiatives, within regions offer opportunities for circular innovation and synergy between different actors (e.g. for the purpose of industrial symbiosis).

SUSTAINABLE EVERYDAY LIFE AND COMMUNITY INVOLVEMENT

The circular economy transition has deep implications for how people consume and access resources. As such, it is critical that residents are engaged in the decisions that will affect their lives so that they can help design a more sustainable way of managing resources locally.

The circular economy also offers a unique opportunity to relocalize economic activities and to ensure local knowledge creation on how resources can be preserved. While mapping circular economy intervention points, it is therefore crucial to identify how they can create local opportunities for all residents.

COLLABORATION WITH BUSINESSES AND EXPORT INDUSTRIES

Implementing circularity requires businesses to fundamentally change their product design, production processes and marketing activities. This challenge can represent an opportunity to increase the economic attractiveness of a jurisdiction, through initiatives such as industrial symbiosis, material exchange platforms and supporting incentives for circular businesses. City-business collaboration for circular economy innovation is essential and can take different forms, from tax breaks to early-market engagement activities in the pre-procurement stage.

As a port city, Turku will also have to work closely with export industries to push for circular economy ambitions beyond geographic boundaries.

⁵ ICLEI (2018) Circular Procurement: Best Practice Report.

METHODOLOGY FOR A COLLABORATIVE PRIORITIZATION OF CIRCULAR ECONOMY TOPICS

This section describes the collaborative methodology that was developed as part of Circular Turku to “crowd-source” a prioritization of circular economy topics to be addressed in the roadmap.

A pre-selection of ten priority topics for circularity was compiled based on insights from existing resources on circular economy in the region, the national circular economy priorities identified by Sitra and the learnings collected by Finland Futures Research Council as part of the Green Circular Cities Coalition Feasibility Study. These topics as stated above are: food value chain, recyclables and packaging, consumer goods, buildings and construction, water cycles, transportation and logistics, energy system, chemicals, textiles and the maritime industry.

A set of 20 criteria was developed and used to prioritize the pre-selected topics. The criteria were co-defined with steering group members and organized around five categories. These categories aimed at reflecting both resource wisdom ambitions (zero carbon, zero waste and a low ecological footprint) and key enabling factors and co-benefits that would maximize the impacts of the roadmap. As such, indicators linked to socio-economic and governance aspects were included, as well as the readiness of actors involved in the topics. The graphic on the right provides an overview of these criteria-set.

Environmental impacts

- GHG emission impacts
- Waste volumes
- Biodiversity impacts
- Natural resources intensity
- Adaptation to climate change

Governance

- Influence of major policy or investments decisions by 2040
- Local and regional government agency
- Alignment with regional policy frameworks

Scaling potential

- Replication potential in Finland
- Relevance for Finland’s national priorities
- Relevance for international outreach
- Global positioning of Turku

Socio-economic impacts

- Economic potential and business development
- Job creation and skills development
- Potential for public participation
- Links to health and well-being
- Social inclusion

Level of action and readiness

- Existing initiatives have already started
- Level of action and readiness of actors
- Research and academic resources



Future experts need to be able to combine circular economy expertise with their own experience in their chosen field. Education plays an important role in this. Studies at Turku University of Applied Sciences (TUAS) are designed to combine theoretical studies with professional skills – and you can study circular economy at TUAS. We really want to emphasize the importance of education in Turku’s resource wisdom roadmap and encourage all organizations to work with students and enjoy learning in all its forms!

PIIA NURMI, TURKU UNIVERSITY OF APPLIED SCIENCES



Advancing sustainable development requires versatile measures. Resource wisdom is one central element. Finland Futures Research Centre and the University of Turku want to contribute to this work through research, education and societal interaction. We gladly take part in building the regional roadmap!

JUHA KASKINEN, FINLAND FUTURES RESEARCH CENTER





TAKING CIRCULAR TURKU GLOBAL

FOUR PILLARS OF A CIRCULAR TURKU

Turku's circular economy efforts are built on four pillars, which the city is eager to share on the global stage:

Ambition:

A transition as all-encompassing as the circular economy needs strong leadership. In its city strategy, Turku committed to become carbon neutral by 2029 and resource wise by 2040. These objectives inform the work of city departments and city subsidiaries and are essential in stepping up the sustainability ambitions of all relevant stakeholders.

Integration:

In Turku, the circular economy is seen as an enabler of broader sustainability goals. Resource wisdom is paired with carbon neutrality in the city's strategy to emphasize Turku's ambitions to address climate change in a systemic way. Similarly, the city is exploring how regional circular economy initiatives can support their work on biodiversity protection and localization of the SDGs. Identifying these synergies allows the city to work towards targeted measures that yield multiple benefits.

Collaboration:

Turku prioritizes a bottom up approach to the circular economy and seeks to identify and support all relevant regional actors that will ultimately be the implementing forces of the roadmap. In addition, city partners working together with national government institutions ensures local efforts can reflect and inspire national ambitions. Finally, cooperation with international organizations, such as ICLEI, is fostering replication globally and elevates the level of ambition locally.

Inclusion:

The city places a strong emphasis on social inclusion within its carbon neutrality plan and is determined to embed social equity into the Circular Turku roadmap. Turku is working with ICLEI to ensure the actions identified as part of the roadmap are inclusive, build on community initiatives and create opportunities for all residents.



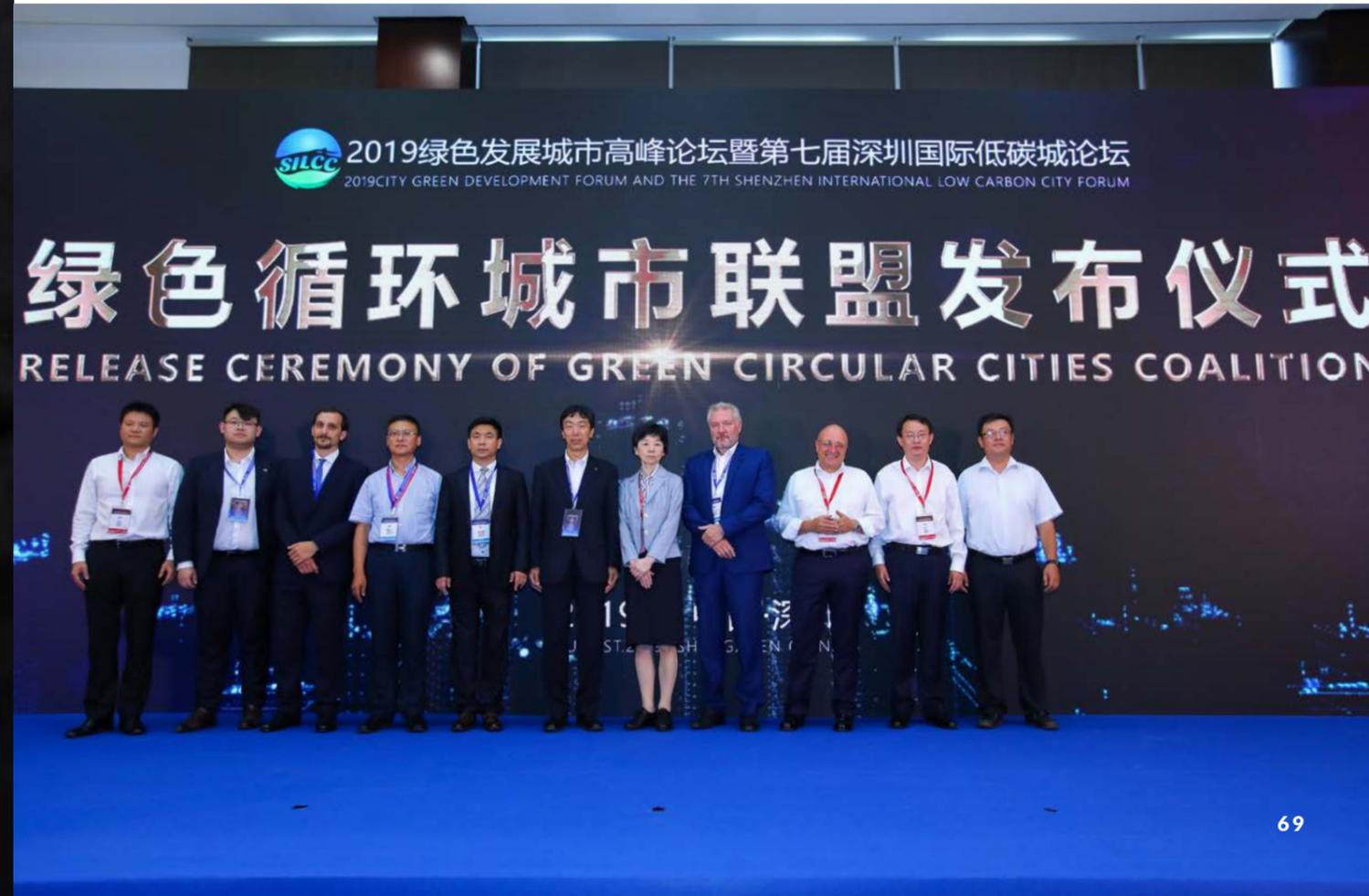
SCALING CIRCULAR TURKU THROUGH THE GREEN CIRCULAR CITIES COALITION

As a founding member of ICLEI's Green Circular Cities Coalition (GCCC), Turku has been collaborating with peer cities from Japan, China and Germany on circular economy related strategies and good practices. Through this network, the learnings and achievements from Turku's unique regional approach can be applied on a global scale. During the strategic GCCC members meeting on 29-30 August 2019 in Shenzhen, China, Turku's collaborative and bottom-up roadmap design received a lot of attention from fellow members.

A key focus of the collaboration in the GCCC is the joint development of a strategic policy agenda on the circular economy and its integration with carbon neutrality and biodiversity efforts in member cities. Coalition members recognize that multilevel governance and multi-stakeholder collaboration are crucial in localizing the circular economy. Emphasizing the need to engage businesses and communities, GCCC members have committed to further explore public-private-community collaboration mechanisms.

However, many cities in the coalition do not yet have a strategic circular economy agenda but rather support individual initiatives. Turku's successful application of the GCCC thematic framework to map existing stakeholders and initiatives thus provides a great inspiration and is expected to accelerate progress in peer cities.

The city of Turku will continue to work closely with peer members of the GCCC to facilitate replication of regional good practices and receive support on specific circular economy challenges. A particular focus will be placed on collaboration with Japanese cities.



COLLABORATION WITH JAPANESE CITIES

National governments in Finland and Japan share a strong interest in paving the way for collaborative circular economy initiatives to face environmental challenges. At the 2018 World Circular Economy Forum, the Memorandum of Environmental Cooperation signed by Finnish and Japanese ministers laid a solid foundation for increased collaboration on the topic.

At the sub-national level, this coincided with Yokohama, Nagano (both Japan) and Turku joining ICLEI's Green Circular Cities Coalition. Through the GCCC, these cities have access to practical experiences and peer-learning to operationalize the circular economy at the local level.

As part of the Circular Turku project, a multi-stakeholder delegation from Turku engaged in a four-day visit organised by ICLEI in January 2020. The delegation received insights on the circular economy work in Tokyo and Yokohama and how it links to local climate action. The political support to collaborate on local circular economy strategies was strengthened through a high-level meeting between the head of the Climate Change Division of the Ministry of Foreign Affairs of Japan, the Ambassador of Finland to Japan and the Institute for Global Environmental Strategies (IGES).

In line with Turku's key messages for circularity ambitions, the following themes will shape further collaboration between Turku and Japanese cities as part of the Circular Turku project:

- **Ambition:** Localizing and operationalizing two pioneering circular economy frameworks
- **Integration:** Linking carbon neutrality goals to the circular economy
- **Collaboration:** Cooperating to make food systems more circular
- **Inclusion:** Promoting the shift to 1.5 degree lifestyles and engaging citizens

LOCALIZING AND OPERATIONALIZING TWO AMBITIOUS CIRCULAR ECONOMY FRAMEWORKS

Recognizing the necessity for a systemic approach to address the environmental crisis, the national government of Japan introduced the vision of "circular and ecological economy" in its Fifth Basic Environment Plan (2018). The concept captures the idea of a decarbonized, resource-efficient, and self-sufficient society in which humans live harmoniously with nature. To transition from the current economic development paradigm to the circular and ecological economy, local and regional governments are exploring concrete actions to ensure environmental impacts are kept within ecological boundaries.

On the subnational level, the so-called regional/local circular and ecological sphere (CES) provides a framework for cities and regions to revitalize urban-rural collaboration and rediscover their resource production potential. Collaborative planning with residents and businesses is a high priority. When it comes to practical implementation, the CES framework is still at an early stage. Tokyo and Yokohama, with high capacity on environmental affairs, have designed systemic plans with engagement of businesses and stakeholders. Smaller cities and towns are rather focusing on pilot projects and feasibility studies.

The CES framework shares numerous similarities with the resource wisdom approach adopted by the city of Turku. Aiming for carbon neutrality, zero waste and a low ecological footprint, the resource wisdom approach focused on collaborative and cross-cutting strategies, much like the CES framework. During the implementation of both concepts, exchange of knowledge and experiences will be of great value. Already, the collaborative approach adopted by Turku could be replicated in Japanese cities, especially in those of smaller sizes which struggle to kickstart a CES action plan.

Continuous exchanges between Japanese cities and Turku will be a strong focus during the further development of the Circular Turku roadmap, allowing mutual learning on how ambitious concepts can be translated into practice and how progress can be monitored and evaluated.

LINKING CARBON NEUTRALITY GOALS TO THE CIRCULAR ECONOMY

Like Turku, the two most populous cities in Japan have also set carbon neutrality goals: Tokyo and Yokohama aim for carbon neutrality by 2050. When defining concrete action steps to achieve this goal, both cities look towards Turku's integrated, cross-sectoral application of the resource wisdom approach.

Tokyo Metropolitan Government (TMG) was the first in Japan to set detailed milestones and action plans on the path to achieve full carbon neutrality, focusing on six key sectors. However, remaining questions are 1) how to translate planning into practical action, 2) how to include opinions from businesses and citizens and 3) how to generate citizen buy-in for sustainable lifestyles. Turku's experiences - particularly in stakeholder engagement from an early stage, in continuously adjusting the action plan during the process, and mobilizing citizens for climate neutrality efforts - would be of great value.

The city of Yokohama, with the zero-carbon target in mind, is taking quick action towards energy decarbonization. Acknowledging the gap between the city's renewable energy generation potential and the energy demand, Yokohama collaborates with twelve municipalities and businesses in the Tohoku region in north-east Japan which have a surplus of renewable energy. This energy collaboration between municipalities with spillover benefits on the local economy could provide valuable insights for city-to-city cooperation in the Turku region.



COOPERATING TO MAKE FOOD SYSTEMS MORE CIRCULAR

To enhance the circulation of resources in Japan and operationalize the circular and ecological economy concept, food waste has been identified as a top priority. Recognizing that food waste from businesses accounts for 55 percent of the total food loss, Tokyo and Yokohama are working with the private sector to prevent food loss and to turn unavoidable food waste into fertilizer and animal feed. Collaboration is seen as the key success factor - collaboration not only with large food manufacturers and wholesalers, but also with smaller retailers and restaurants. Both cities are striving to advance multi-stakeholder partnerships and design campaigns co-led by businesses. In Yokohama, significant efforts are devoted to reach businesses and consumers alike, seeking their buy-in to manage food sustainably and maximize the value of food wisely. Past awareness-raising activities included local food festivals, food movies, food banks, and food storage technique lessons. In Tokyo, a Food Waste Reduction Policy will be developed in 2020 to systematically strengthen the collaborative food systems approach.

In the Turku region, a similar food systems priority has been linked to circular economy principles, again with a strong focus on collaboration. Valonia, the service center on sustainable development and energy in Southwest Finland, has mapped the food system in the region with a resource management lens. By identifying the key actors in the region and the potential of utilizing nutrients and resources, the region goes beyond food waste reduction and pursuits of nutrients cycling. Public authorities and relevant stakeholders also collaborate to identify new sources of protein and self-sufficiency on nutrients.

Both regions would strongly benefit from an exchange of cooperation models around food systems. In addition, Southwest Finland's experience in shifting away from food waste reduction towards nutrients management could be shared with cities in Japan.

PROMOTING THE SHIFT TO 1.5 DEGREE LIFESTYLES AND ENGAGING CITIZENS

The paradigm shift to sustainable development requires not only producers to take actions, but also consumers to change their behavior. While environmental awareness might be high in Finland and Japan, the translation of knowledge into concrete actions remains a challenge. Yet, individual lifestyle choices yield a huge potential to reduce greenhouse gas emissions. In this regard, per capita carbon footprints can be a strong tool to emphasize the gap of current lifestyles from the 1.5-degree threshold.

Turku city practitioners and experts from the Japan-based Institute for Global Environmental Strategies (IGES) are already discussing research insights and policy implications of an international comparison of lifestyles. Two pathways have been identified to increase support from residents: Firstly, a focus on "options for a new lifestyle" instead of "giving up the current one" would increase the potential for change. Micro-scale analyses and scenarios on the local level could help to identify concrete options for different communities and realities. Secondly, strong citizen engagement in the development of these scenarios would be crucial to ensure that these options match their realities. Systematic efforts to include all citizen groups would strengthen these outcomes.

It is worth noting that participatory approaches with a high level of engagement from residents and businesses is relatively new for the Japanese society. Local governments and stakeholders are learning by experiment and value good practice examples from their international peers.

The city of Turku currently participates in a 1.5-degree lifestyle localization trial in Finland in partnership with IGES and Sitra. Such similar pace and interests increase the opportunities for further in-depth collaboration. For example, Turku could utilize co-creation workshop models from the resource wisdom roadmap process to gather more detailed information to support lifestyle changes. Such insights could include the cost or benefit of lifestyle alternatives and market readiness. This would also contribute to similar work in Japan.

KEY LEARNINGS AND OUTLOOK

KEY LEARNINGS

The previous chapters have shown Turku's unique regional collaboration approach to accelerate the circular transition. Across the good practice examples and case studies, key learnings can be drawn for local governments to kick-start their circular economy transitions:

Embedding circularity into climate action

In Turku, the circular economy is seen as an enabler of the city's bold climate neutrality goals. Pairing resource wisdom goals with climate action in the city's strategy has created a political buy-in that facilitates ambitious action from regional actors.

Addressing waste from a systemic perspective

Through close collaboration with businesses and academia, the city has been able to address waste from a value chain perspective, from the design of products to their end-of-life. A particular focus is placed on high-value materials and industrial side-streams to maximize environmental benefits.

Designing an action plan from the bottom up

Circular Turku is informed by the experiences and lessons learnt by circular economy actors in the region. Best practices from Turku demonstrate that local governments are very well positioned to effectively connect different actors, identify synergies and scale successful initiatives.

Understanding businesses' needs

Regional circular economy actors are putting efforts into understanding companies' operations and needs with regards to materials. This helps to address obstacles early in the supply chain. Turku's vibrant research community is also a strong enabler of innovative circular economy solutions.



The inception phase of the Circular Turku project has been interesting and opened our eyes to new opportunities available to us in South-West Finland. Looking at various topics through the lens of circular economy made us consider new partnerships and uncover possibilities that earlier had gone unnoticed, even within our own organization. Systematically working through various themes - from infrastructure to water cycles - with colleagues from different organizations made the exercise meaningful and opened up new possibilities of cooperation.

SANNA TIKANDER AND OLLI HAKALA, CENTRE FOR ECONOMIC DEVELOPMENT, TRANSPORT AND THE ENVIRONMENT OF SOUTHWEST FINLAND

Collaborating across different levels of governance

Regional collaboration around the circular economy has enabled Turku to design innovative projects at an appropriate scale and to mitigate the risks and burden of related upfront investments. In addition, cooperation across different levels of government (regional councils, national bodies, European institutions) has created a national momentum around circular economy efforts in Turku.

OUTLOOK

Building on inclusive stakeholder engagement and the diverse expertise gathered in this report, the Circular Turku roadmap will address 5 priority topics that hold a high potential for change: the food value chain, energy systems, buildings and construction, transport and logistics and water cycles. Within these priorities, tangible circular economy levers and tools will be developed. Consultations with key stakeholders and practitioners will inform policy making in the city to create the enabling conditions to make these key sectors more circular.

The collaborative and innovative community of practice built in Turku is the region's strongest asset to implement rapid and tangible change. As part of Circular Turku, practice-oriented resources will be developed for other local governments around the world to replicate Turku's hands-on and collaborative approach to circularity.



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