

COOPERATION ROADMAP

D.T4.3.2

Version 1
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D.T4.3.2: Collaboration Roadmap

A.T4.3 Develop a transnational CE strategy

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1. Introduction

Moving towards a circular system is an opportunity for rethinking production and consumption patterns; improving environmental quality and resource efficiency; creating new business models; promoting citizens and business acceptance and awareness on the circular economy through awareness change; and boosting innovation, as has been identified by cities and regions surveyed as part of OECD research on The Circular Economy in Cities and Regions (OECD, 2020).

This transition is not just about optimising the present linear system, using green and clean techniques for production. It is about changing relations across value chains, identifying synergies across sectors, and designing policies that support whole systems change. Such systemic and strategic changes will only be achieved through multi-level collaborations, manifesting in for example common circularity values, a shared market culture and language for circular value development, bridging of regulatory, market and sectorial silos, and increased investment in circular and sustainable solutions.

Game theory has shown everyone can be better off by cooperating. A big challenge to achieving cooperation is information asymmetry, that is, not every actor has the same information, and our decisions are constrained by it. This highlights the importance of building a collective knowledge base and transparent organizational processes in order to ease collaboration between actors. This is especially important in circular economy due to the wide heterogeneity of stakeholders.

Building such new, shared knowledge base and trustworthy collaborative processes often requires experimenting and testing on smaller scale in the first instance.

Hence circular economy strategies and bigger projects in cities and regions are often based on experimentation and pilots. Pilots, contrary to long-term strategies and infrastructure, can be a quick source of learning from success and failures that can stimulate circular economy practices now and in the future. This is both an opportunity for creating new knowledge and information, but also a challenge in terms of the human and technical capital needed to design and implement sustainable, efficient, and effective circular economy policies. The objective is to scale up the experiences and enable them to be financially sustainable after the pilots are over.

CITYCIRCLE project has focused its efforts on piloting several potential solutions for the acceleration of circular economy in cities across central Europe. All of those are showcased in this cooperation roadmap.

1. Purpose and structure of cooperation roadmap

The cooperation roadmap is designed as a knowledgebase dedicated to showcasing circular economy solutions that were piloted locally as part of the Interreg Central Europe CITYCIRCLE project. Its aim is to inspire, inform and enable the upscale of tested solutions in other cities and regions.

It presents the intelligence on each one of the pilot projects implemented. It is comprising learnings and knowledge generated through practical implementation and testing in 5 Central European Cities and



Regions, each one with different thematic focus, to demonstrate the potentials benefits of the Circular Economy for the sustainable development of local and regional economies. Pilots implemented reflect the needs and policy priorities of respective target environment, implementing new approaches on technological, societal or economic levels to form new value chains and to initiate the change towards higher circularity.

The core purpose of this cooperation roadmap is to enable upscaling by disseminating in a structured way, evidence-based tested pilot practices to other cities and places in central Europe and beyond.

In the target regions/cities thematic pilot focuses are as follows:

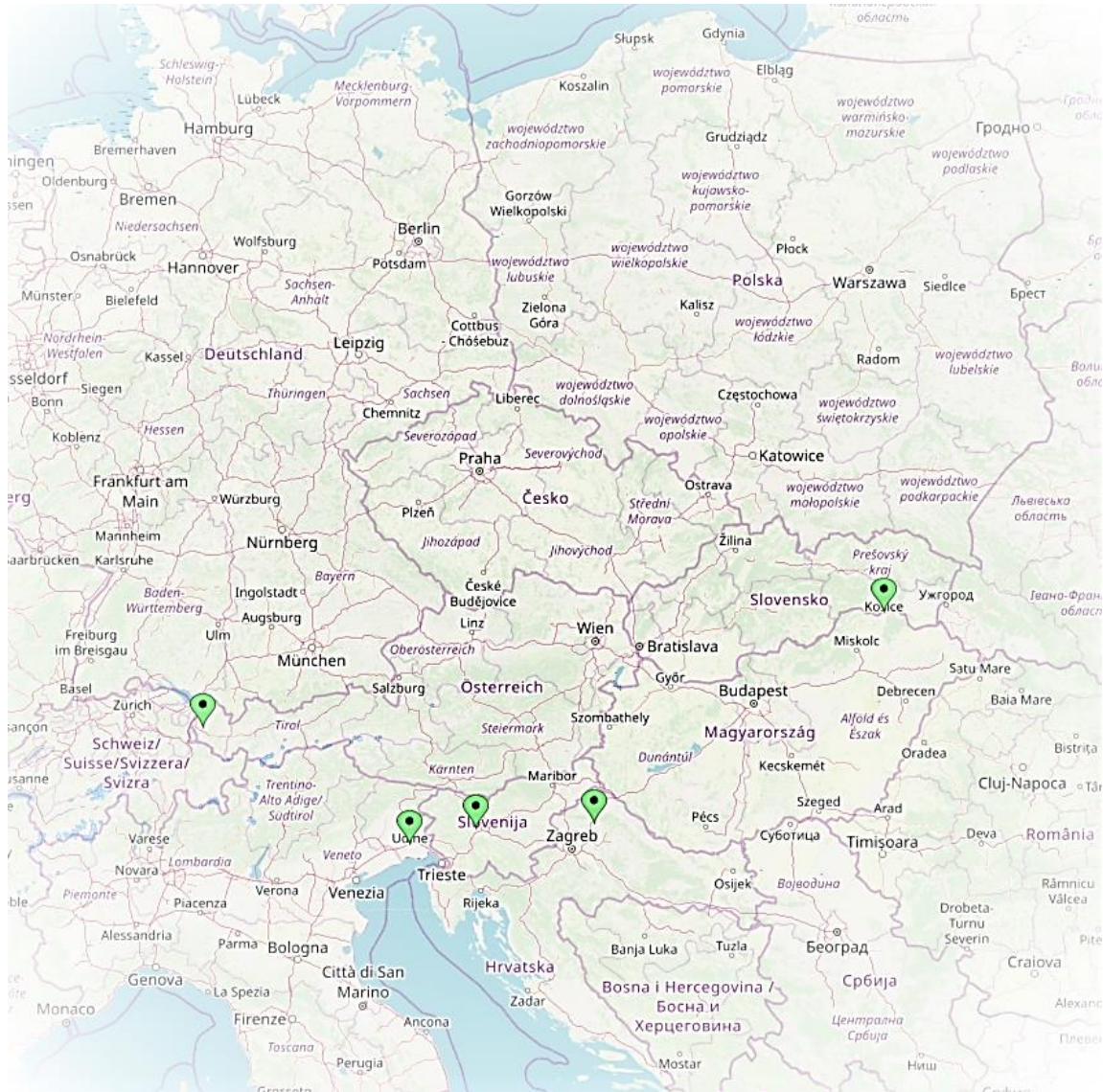
Košice, Slovakia - setting-up value chains in agriculture and forestry industry on circular economy principles. New value chains (farmers, enterprises) supported by ICT tools to provide business model for organic cycle.

Varaždin, Croatia - boosting local economy through innovative approach to waste management and reuse. Innovating new business opportunities originating from waste recycling through public-private co-creation.

Udine, Italy - setting-up value chain in waste-waste water-waste energy field on the principles of CE. Integrating different flows and companies into single solution supported by business model and business plan.

Kranj, Slovenia - management of land (industrial sites, public spaces) on the principles of circular economy. Setting-up the network of land-owners and users to develop joint urban regeneration process.

Dornbirn, Austria - advanced manufacturing and ICT on the principles of circular economy. Developed holistic concept for covering the whole chain from manufacturing over compiling the right product data to recycling.



Location of CITYCIRCLE pilots in Central European area (created by TUKE)

Information and data on pilots have been collected in a structured questionnaire format. The questionnaire covers general information about the project, including its location, size, and implementation timeline. Other aspects covered by the questionnaire focus on the pilot project objectives; sustainability and circularity challenges that the pilot aimed to address; implemented activities; key achievements; governance and financing details; an indication of impacts achieved or expected; monitoring of activities



undertaken or in progress; indication of innovation areas that should be further addressed and key resources needed for designing and delivering the respective interventions.

In the following sections (3-7) of the document each of the 5 pilot is presented according to this structure.

2. Pilot in Košice, Slovakia

Pilot Project Summary

The main aim of the pilot in Slovakia is to map and analyse the generation of waste in primary and secondary schools in the Košice region. Based on the survey among schools within the Košice region a total of 3 schools were selected for this activity.

The pilot activities included:

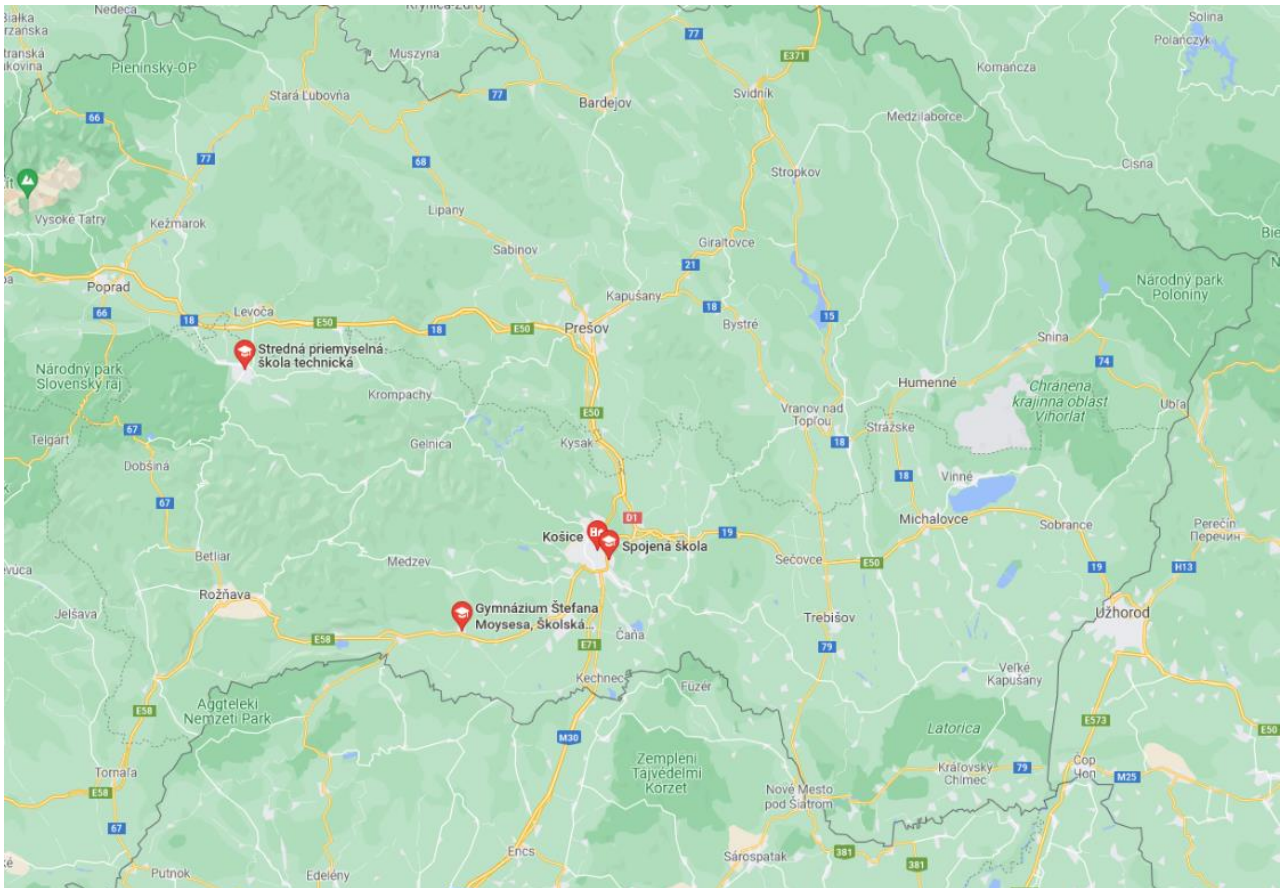
- measurement and analysis of individual types of biological waste that is generated in school canteens
- measurement and analysis of individual types of waste generated in school classrooms
- measurement and analysis of the amount of compost that is generated by the electric composter
- elaboration recommendations and guidelines for schools in the field of waste management at schools

For the effective implementation of the pilot activity in schools, a Methodological Manual for measuring kitchen waste was elaborated and kitchen staff took part in training on the practical application of the measurement methodology. The schools were also provided with bins for separate waste collection and an electric composter.

The pilot also included educational activities in schools and raising awareness campaign in the region.



Pilot location: The pilot was implemented in the Košice region. A total of 3 schools were included in the pilot. Involved schools are marked on the map below.



Pilot Duration:

6.9.2021 - 31.10.2022

Scale: The pilot was implemented at regional level.



Pilot overview

SOLUTION(S) TESTED/IMPLEMENTED

Describe shortly in bullet point style

- The process of implementation of the pilot was agreed and planned
- The Concept of the pilot has been selected
- Identification of relevant stakeholders involved in the pilot implementation
- Meetings with representatives of selected schools were organized
- The detailed process of implementation of the pilot was agreed
- Explanation and training of school kitchen staff regarding the practical application of the developed methodology
- Educational activities in schools were organized
- A raising awareness campaign was run in the region
- Obtained data from the measurement was collected and evaluated
- recommendations and guideline for schools in the field of waste management were elaborated

CHALLENGES ADDRESSED

You can for example refer to SDG's

- The waste management process in schools was mapped in detail and understood
- All relevant aspects of circular economy were understood
- The current situation of waste flow in the region was mapped
- The possibilities of waste management in the region were analyzed
- The interest of schools, students and the general public in the topic of the circular economy a waste management increased in the Košice region
- Waste generation in schools in the Košice region was mapped and analyzed
- Recommendations and guidelines for schools in the field of waste management at schools were elaborated
- All relevant stakeholders in the field of the circular economy were identified



Pilot core objective:

The Slovak pilot core objective was to map and analyze in detail the generation of different kinds of waste in primary and secondary schools in the Košice region.

Activities implemented:

- Planning of the process of implementation of the pilot. Based on the results of discussions and surveys organized in the previous period, TUKE and EGTC Via Carpatia agreed on the final process of the pilot implementation.
- Selection concept of the pilot
- Identification of relevant stakeholders involved in the pilot implementation
- Meetings with representatives of selected schools were organized
- The detailed process of implementation of the pilot was agreed
- Explanation and training of school kitchen staff regarding the practical application of the developed methodology was organized
- Educational activities in schools were organized
- Official handover of bins for separate waste collection and electric composter to schools was held in Košice
- Measurements of waste produced in schools were run
- Data from the measurement of waste in school was collected
- Results of the pilot implementation were concluded

Key Achievements:

- Increased interest in the circular economy by schools, students and the general public in the Košice region
- We managed to equip schools with bins for separate waste collection and an electric computer
- Creation of good cooperation and partnerships with schools and regional stakeholders
- Obtaining data on waste production in schools
- Organization educational “Enviro days” in schools
- Mapping of circular economy value chains in the Košice region
- The manifest supporting circular economy was signed by representatives of:



- Košice self-governing region
- EGTC Via Carpatia
- Technical University of Košice
- organisation Priatel'ia Zeme
- 3 schools involved in the pilot

Main beneficiaries:

- Citizens
- Public authorities
- Primary and secondary schools
- Students and teachers
- Universities



Governance

MANAGEMENT SET-UP

Who was it led by?

Main collaborators

Management structure

- All activities related to the pilot in Slovakia were led by EGTC and TUKE
- The collaborations included:
- Cooperation with regional public authorities
- cooperation with schools in the region
- cooperation with organization Priatelia Zeme, that contribute to the education activities held in schools.

PAITICIPATORY APPROACHES USED

Co-design

Crowdsourcing

Citizen's engagement

Etc.

- Approaches used:
- Schools' engagement
- Students' engagement

INITIATING ORGANISTAION (TYPE)

Municipality

Private sectors-company

- The whole process of pilot implementation was initiated by EGTC and TUKE



Description of roles of organisations involved:

Roles of EGTC Via Carpatia:

- Study the topic and all relevant aspects of circular economy
- A survey among schools in the Košice region in the topic of waste management and motivation participate on the pilot
- Identification of relevant stakeholders
- Acquaintance with food legal framework
- Study methodologies of waste management
- Regular communication with representatives of schools involved in the pilot
- Meetings with representatives of selected schools
- Purchase of bins for separate waste collection and electric composter for schools
- Organization educational event in schools
- Organization
- Organization of official handover of bins for separate waste collection and electric composter to schools

Roles of TUKE:

- Study the topic and all relevant aspects of circular economy
- Identification of research and methodologies that can be used within our pilot
- Elaboration of the methodology of waste measurement for school staff
- Organization of explanation and training of school kitchen staff regarding the practical application of the methodology
- Elaboration of manifest supporting circular economy
- Coordination of particular steps of measurement of waste that is generated in schools
- Communication with managers of schools' canteens and staff dealing with measurement of waste
- Collecting data from measurements
- Elaboration the methodology of evaluation of abstained data

Roles of schools involved in the pilot:



- Cooperation with pilot activities
- Secure measurement of waste generated in school according to the provided methodology
- Collecting and providing data from measurements
- Proving premises for the organization of educational activities and official handover ceremony

Related policies

The implementation of the pilot in Slovakia responds following policies:

- The European Green Deal
- European Environmental Policy
- Environmental Policy Strategy of the Slovak Republic until 2030 - Greener Slovakia
- Departmental concept of environmental education, training and enlightenment until 2025
- Common strategic goal in the field of circular economy (elaborated within the CITYCIRCLE)
- Program of economic and social development of the Košice self-governing region for the years 2016 to 2022.

Financing

Total cost: approximately 12 000€

Sources of funding: project partners' budget

Type of funding: public budget

Revenues: There were no revenues with the pilot



Impacts and Monitoring

ENVIRONMENTAL IMPACTS

- The percentage of separated waste in schools involved in the pilot increased

SOCIO-CULTURAL IMPACTS

- Raising awareness about the importance the topic among students, schools and general public

ECONOMIC IMPACTS

Availability of monitoring/evaluation reports: *YES/NO*

Link: *if available*

Formal monitoring system implemented: *YES/NO, brief description if yes*

Recommendations for followers

During the previous process of preparation of the pilot, several important pieces of knowledge have been gained:

- analysis of possibilities and options to measure waste at schools need to be evaluated
- national legislation dealing with the topic must be understood



- personal contact and good relationships with representatives of all relevant stakeholders need to be built
- activities and interest from schools is important
- cooperation with professionals in the field of environmental education is very important

Identification of innovation areas that should be addressed

Innovation areas that should be addressed:

- economic impact of good waste management at the level of schools in whole country
- waste management approached implemented at the level of public organizations

Key Resources

- national law dealing with this topic (Waste legal framework)
- the survey among all relevant stakeholders (high schools) in the region (questionnaire survey)
- National Agricultural and Food Centre
- Quantification of food waste in the sector of public catering - school canteens (Polovka M. et al., 2019)
- The MIRO platform

3. Pilot in Varaždin, Croatia

Pilot Project Summary

Through this pilot project, the City of Varaždin has tested how the concept of circular economy works on the model of the city company Gradska tržnica d.o.o. The aim of the project was to raise awareness among city market users about the need for waste sorting, which has resulted in reducing of the amount of municipal waste generated at the market. Separately collected organic waste is treated in a biogas plant where digestate is produced to be used as fertilizer for hazelnut plantations owned by the City Market. This pilot project, in which stakeholders from the city of Varaždin has participate, was demonstrated how the circle in the circular economy can be closed.



Pilot location:



Pilot Duration: *24 months*

Scale: *City scale*



Pilot overview

SOLUTION(S) TESTED/IMPLEMENTED

- *Quadruple helix collaboration*
- *Circular bioeconomy innovation model/framework*
- *Education and engaging of stakeholders*
- *Monitoring and separate waste collection system implemented at City Market*
- *Biowaste treatment in the biogas plant*
- *Digestate produced in biogas plant used as fertilizer for hazelnut plantation*

CHALLENGES ADDRESSED

- *Waste management*
- *Sustainable cities and communities*
- *Climate action*
- *Partnership for the goals*



Pilot core objective:

Boosting local economy through innovative approach to waste management and reuse. Innovating new business opportunities originating from waste recycling through public-private co-creation.

Once successfully implemented, the pilot project will represent a valuable blueprint for policymakers who want to stimulate the progression from a linear towards circular economy.

Activities implemented:

- *Morphological analysis of mixed municipal waste*
- Determination of quantity and composition of city market waste
- Educational activity and design of educational materials on proper waste separation
- Procurement of waste bins in different colours for easier and appropriate separation of waste
- Proper and timely disposal of waste in accordance with needs
- Soil and digestate sampling and analysis and application of digestate on farmland
- Treatment of biodegradable waste in the biogas plant
- Closing the circle using the obtained digestate as fertilizer on a hazelnut farm owned by Gradska tržnica d.o.o.

Key Achievements:

- Established waste monitoring system on the City market Varaždin
- Reduced share of mixed municipal waste in landfills
- Public-private cooperation established
- Improved soil quality

Main beneficiaries (list):

- Public authorities
- Tenants on the Open market
- Private companies
- citizens



Governance

MANAGEMENT SET-UP

*Led by Development
Agency North – DAN ltd*

*Main collaborators:
Municipality of Varaždin
City market Varaždin –
Čistoća ltd - Waste
management company
Vrček Family Farm*

INITIATING ORGANISATION (TYPE)

*Municipality of Varaždin
Developmental Agency
North – DAN ltd.*

PARTICIPATORY APPROACHES USED

*Co-design
Crowdsourcing
Citizen's engagement*

Description of roles of organisations involved:

Development Agency North - DAN ltd and Municipality of Varaždin are initiators of pilot and organizers of cooperation.

Open market Varaždin - The majority of pilot activity is implemented on the Open market premise. Waste sorting bins were purchased and distributed to the users of the business premises of City market. The monitoring and separate waste collection system is established. Responsible for taking soil samples from the hazelnut farm and their analysis. Produced digestate was used as fertilizer for hazelnut plantation owned by Open market.

Čistoća ltd - Waste management company - responsible for establishment monitoring and separate waste collection system and transportation of waste to biogas plantation.

Family farm Vrček - Biogas plantation was responsible for digestate production in biogas plant used as fertilizer and placement on hazelnut plantation as well conducting analysis of and digestate from the biogas plant.

Croteh ltd - They conducted expert supervision and guidance.



Related policies

On the base on the Europe 2020 Strategy - a strategy for smart, sustainable and inclusive growth, the EU has adopted a joint European Commission Energy and Climate Communication: Clean Planet for All - European Strategic Long-Term Vision for a Prosperous, Modern, Competitive and Climate Neutral Economy 2018 (COM (2018) 773) whose purpose is to set the direction for EU climate and energy policy and to set the framework for the EU's long-term contribution to achieving the objectives of the Paris Agreement. In achieving the goals, priorities are set such as employment, research and development, energy efficiency and nature and environmental conservation, education and social inclusion and poverty reduction - priorities that also coincide with the principles of the circular economy. By joining the EU in July 2013, the Republic of Croatia, among other things, committed itself to meeting the set goals. The following legal frameworks and planning and program documents used as source documents in pilot implementation.

1. A New EU Action Plan for the Circular Economy - For a cleaner and more competitive Europe
2. Green Public Procurement and the EU Circular Action Plan
3. Priorities of the European Union for the period 2014-2020
4. National Environmental Protection Strategy (OG 46/2002)
5. Strategy for Sustainable Development of the Republic of Croatia (OG 30/2009)
6. Entrepreneurship Development Strategy of the Republic of Croatia 2013 - 2020 (OG 136/2013)
7. Waste Management Strategy of the Republic of Croatia (OG 130/2005)
8. Waste Management Plan of the Republic of Croatia for the period 2017-2022

Financing

Total cost: 5.000,00 €

Sources of funding: *European Regional Development Fund (ERDF - Citycircle)*

Type of funding: *non-financial contributions*

Revenues: *no*



Impacts and Monitoring

ENVIRONMENTAL IMPACTS

Reduced amount of mixed municipal waste generated at the City Market
Reduced amounts of biowaste waste disposed of in landfills
Reducing greenhouse gas emissions
Production of renewable energy source, reduction of fossil fuel use

ECONOMIC IMPACTS

Costs savings:
The beginning of hazelnut plantation remediation without cost.
Due to small quantities, it is hard to determine, however, a reduction of costs in biogas plant operation

SOCIO-CULTURAL IMPACTS

Education
Stakeholders participation
The beginning of environmental education amongst market users,
Information on separate collection and resource recovery is presented to people, market users as well as visitors and broader public.

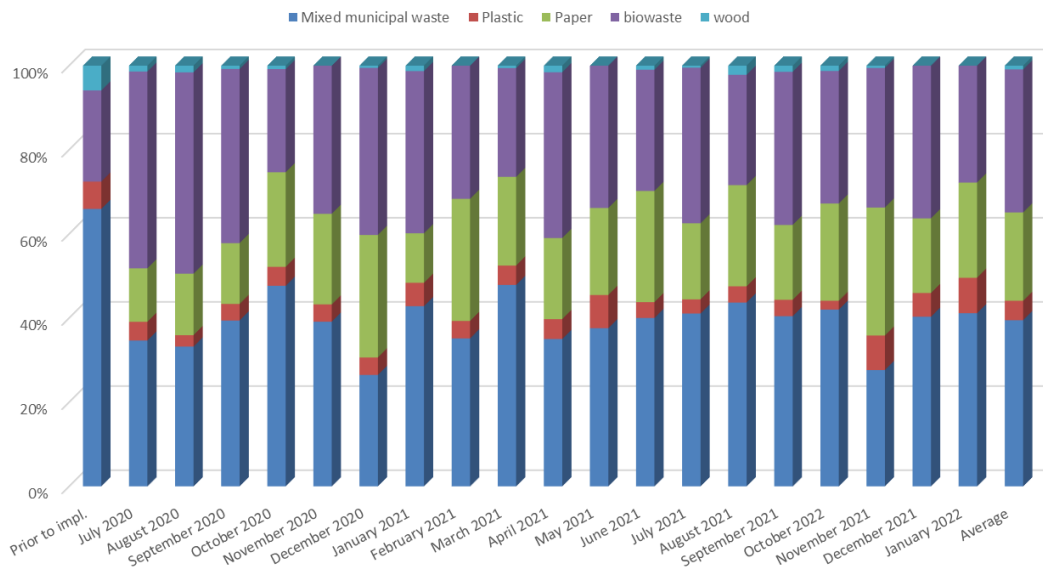


Availability of monitoring/evaluation reports: **YES**

The results of waste collection are shown in Table 1, and the results of monitoring of collected waste during the duration of the pilot project in the City market, are shown in a graph in Figure 1.

Table 1. Records on reported disposal, by type of waste

RECORDS ON REPORTED DISPOSAL, BY TYPE OF WASTE, FOR THE MONTH OF JANUARY																																
DAY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	
MIXED MUNICIPAL WASTE						X							X								X								X			
STYROFOAM														X								X								X		
PLASTIC		X				X			X				X	X							X				X			X	X			
PLASTIC BOXES			X										X																			
WOOD																																
PAPER										X												X										
BIOWASTE						X								X															X			
PLEASE ENTER X IN THE CORRESPONDING FIELD ON THE DAY WHEN THE COLLECTION OF A CERTAIN WASTE IS REPORTED																																



• Figure 1. Fractions of separately collected waste throughout the pilot

Formal monitoring system implemented: **YES**



Due to the encouraging results, the city market will continue to implement separate waste collection after the implementation of the pilot project. Also, monthly reports on separately collected waste will further be prepared and the waste quantity monitored.

Recommendations for followers

- It is necessary to find a way to improve the waste separation and collection by market users
- Additional education and constant encouragement of the importance of waste separation are needed
- Educate market users as well as other visitors about problems due to biowaste disposal on landfills
- Introducing positive/negative incentives for waste separation
- In all steps of the project market users' cooperation was of utmost importance and had crucial effect on successful implementation.
- The use of organic waste for energy/fertiliser in hazelnut farming is a viable option.
- The difference between fertilised and unfertilised plantation is small however visible - it is necessary to regularly implement a plan for a longer period of time in order to achieve more visible results and a full potential of the harvest.

Identification of innovation areas that should be addressed

The example of collecting and monitoring the amount of waste collected at the city market can be applied to any public institution in the City of Varaždin or beyond.

Although most public institutions have waste bins for waste separation, in order to improve and enhance the existing waste collection system, it is necessary to educate the users about the importance of waste separation and the negative impact of biowaste disposal.

In addition, it is very important to educate the population of the basic principles of sustainable waste management, which are: R - reduce - R - reuse -R - recycle.

Given that the pilot project showed a positive effect of digestate on hazelnut plantations, in the form of increased yields, digestate could be used as an alternative for soil cover, for example in city parks with poor soil quality. One of the ways in which the population could be encouraged to properly collect waste, and thus biowaste, is a reward system in which each household would receive a certain amount of digestate in exchange for properly separated biowaste that could be used to cultivate herbs and plants in urban gardens.

Other possible areas of innovation are visible in the current situation in Varaždin and wider region which is such that not many biogas plants are equipped to receive organic waste due to missing necessary pre-treatment and hygienisation unit. Currently only one biogas plant has the appropriate capacity to receive



such waste. Therefore, the capacity is limited, and waste has to be either transported long distances or is treated in unsustainable way. The fact that the capacity of biogas plants currently is not sufficient, because many do not have the permit to treat the food waste, such treatment can be highlighted as a challenge, which is one of the limiting factors in this type of disposal.

Key Resources

<https://www.interreg-central.eu/Content.Node/CITYCIRCLE/CITYCIRCLE-WPT2-Basic-material-HR.pdf>

<https://www.europarl.europa.eu/news/hr/headlines/economy/20151201ST005603/kruzno-gospodarstvo-definicija-vrijednosti-i-korist>



4. Pilot in Udine, Italy

Pilot Project Summary

Industrial symbiosis in the City of Udine

Short description:

The pilot's aim is to develop a technical, economic and environmental feasibility study for a potential project of industrial symbiosis, promoting the development of innovative infrastructures to take advantage of available waste heat in one industrial area and supply it to other companies (industrial and civil) in the surroundings, within a circular economy perspective. This will also allow to promote the development of the so-called “ecologically equipped production areas also known as Eco-Industrial Parks (EIP)” by promoting the transformation of current industrial districts in order to combine competitiveness, planning and environmental protection. The opportunity identified in the Municipality of Udine aims to create territorial synergies between two existing waste-treatment plants (water and organic waste) to obtain products with higher added value (bio-methane for transport) and to optimize energy use (recovering available waste heat) by means of technological processes with low environmental impact taking advantage from a cascade of territorial wastes.

Pilot location:

The pilot is located in the southern industrial area of the City of Udine, as illustrated below in the red circle, where there are two nearby plants with available waste heat, one user/supplier depending from the season and one industrial final user.

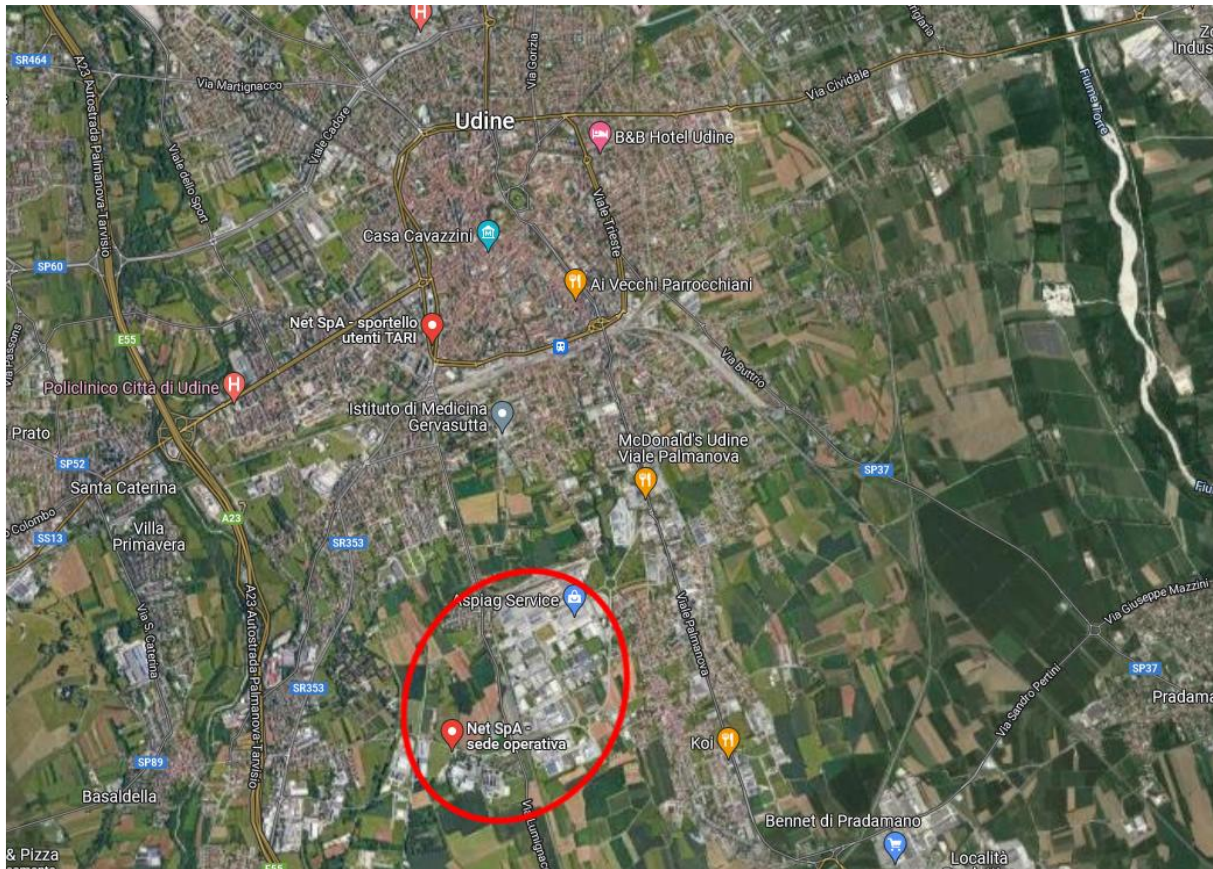


Figure 1: the area interested by the pilot is that one in the red circle



Figure 2: enlargement of the area interested by the pilot, showing locations of potential participants to the industrial symbiosis



Figure 3: the area interested by the pilot, 3D viewpoint



Figure 4: CAFC S.p.A. (waste-water treatment plant)



Figure 5: NET S.p.A. (organic-waste treatment plant), existing (left) and rendering after foreseen enlargement (right)

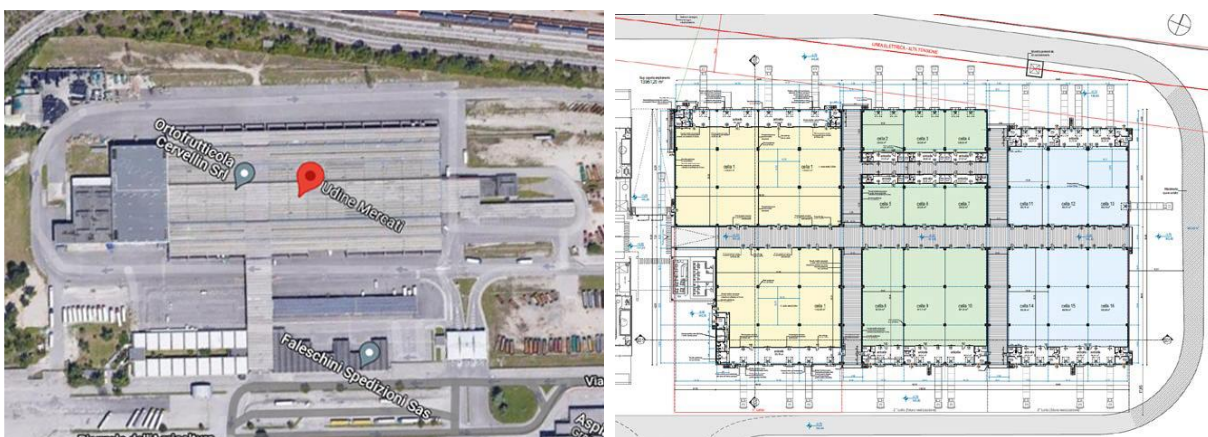


Figure 6: Udine Mercati S.p.A. (agri-food wholesale market), existing (left) and foreseen enlargement (right)

Pilot Duration:

The potential pilot was first investigated during the preparation of the proposal. This means that both Italian partners, i.e. the local energy agency APE FVG and the Municipality of Udine, started to work on it immediately after the approval of the project and its development required around 30 months. A deeper investigation in the form of a technical, economic and environmental feasibility study, was afterwards assigned to the University of Udine - Polytechnic Department of Engineering and Architecture through a



Pilot overview

SOLUTION(S) TESTED/IMPLEMENTED

- Endogenous solutions designed for environmental and energy improvement of the individual production activity by identifying technological solutions within a circular economy perspective applied to individual companies
- Exogenous solutions designed for limited adjoining areas characterized by the presence of different production activities aiming to exploit industrial symbiosis within a circular economy perspective
- Industrial-Urban-Symbiosis solutions designed to integrate industrial areas and neighbouring civil areas within a circular economy perspective to optimize energy use

CHALLENGES ADDRESSED

- Improve waste management
- Recover waste heat
- Transform by-products into higher added value products (bio-methane)
- Identify the best industrial-urban symbiosis solutions by carrying out a cascade energy recovery from the considered plants within a circular economy perspective
- Develop an approach that can be transferred to other areas and countries
- Identify further solutions that can be further extended to the surrounding area
- Assess uncertainty through the analysis of the most critical project variables

Pilot core objective:

The pilot aims to develop a smart energy system that implements a regenerative model of energy use based on the concepts of industrial symbiosis and circular economy. This is made possible by a systemic vision that develops synergies between the organic waste anaerobic digestion plant, the waste water treatment plant and the wholesale market of the city of Udine.

Activities implemented:

- (A1) Development of a collaboration agreement with pilot partners
- (A2) Definition of available powers and systems that can be synergic and definition of the required powers and systems to take advantage of energy recovery within a circular economy perspective



- (A3) Identification of the best technologies for the development of the industrial symbiosis and identification of possible implementation scenarios in the area
- (A4) Definitions of possible plant configurations
- (A5) Preliminary technical, economic and environmental assessment and identification of strengths and weaknesses of the identified solutions
- (A6) Business model structuring
- (A7) Technical, economic and environmental full assessment
- (A8) Multi-objective modelling of the different investment hypotheses (Decision Support System)
- (A9) Scenario simulation
- (A10) Identification of the optimal solution in terms of sustainability

Key Achievements:

Three different circular economy scenarios have been taken in account for investigation.

All of them are possible, but the third one results to be the optimal one, maximising energy and environmental benefits:

1. Connection of NET and CAFC plants (one in front of the other) into a local hub for matter and energy exchange
2. Integration of the CAFC-NET hub with Udine Mercati facilities (agri-food wholesale market, 700m away from the hub)
3. Connection of the CAFC-NET hub with the district heating network serving the southern basin of the city of Udine.

In the first scenario, a surplus of co-generation heat of almost 12.000 MWh/y has been detected. The electric produced by cogeneration is more than enough to cover the electric load of the hub, allowing a recovery of more than 4.000 MWh/y with a surplus of around 13.000 MWh/y.

Around 13.000 MWh/y of electric energy is remaining, justifying the inclusion of UDINE MERCATI in the business plan. Since UDINE MERCATI main request consist in electric energy load deriving from the electric chillers, this remaining energy can be used to cover the overmentioned load. The remaining energy from the cogeneration allows to cover the UDINE MERCATI load entirely, leading to a total electric energy recovery of more than 5.000 MWh/y.

In the third scenario, a further way to utilize the surplus heat is to integrate the NET-CAFC hub with the planned district heating network serving the southern basin of the city of Udine. The basin of the DHN could reach a heat load of 200 MW: consequently, it can be integrated with the hub both as a source of energy when the heat produced by the CHP is not enough to cover the load, or as a user to absorb the remaining 12.000 MWh of heat energy from the NET cogeneration plant. This would lead to a total energy recovery of more than 19.000 MWh/y, 3,309.2 tonnes of CO₂ emission reduction and a primary energy saving of 1,439.5 toe.

Main beneficiaries (list):



- SMEs: n.2 Public Utilities working in the field of organic-waste treatment and in the field of waste-water treatment and n.1 Company working in the field of agri-food wholesale market
- Public authorities: Municipality of Udine
- Citizens belonging to the DHN of the southern basin of the city of Udine.

Governance

MANAGEMENT SET-UP

The Energy Management Agency of Friuli Venezia Giulia led the development of the technical, economic and environmental study for the pilot project.

The study was assigned to the University of Udine – Polytechnic Department of Engineering and Architecture with a team composed by:

1. Prof. Patrizia Simeoni
2. Prof. Giovanni Cortella
3. Dott. Ing. Mattia Cottes
4. Dott. Ing. Matia Mainardis

INITIATING ORGANISATION (TYPE)

The Municipality of Udine is the main stakeholder of the pilot and facilitated the involvement of the two Public Utilities (NET S.p.A. waste-treatment plant and CAFC S.p.A. waste-water treatment plant) and of the agri-food wholesale market (Udine Mercati srl). As well, the city of Udine is interested in the development of the District Heating Network (DHN) that is taken in account in the third scenario of the pilot.

PARTICIPATORY APPROACHES USED

Co-design: before pilot activities started, a Collaboration Agreement was promoted and signed by all the interested parties (APE FVG, Municipality of Udine, University of Udine, NET SpA, CAFC SpA, Udine Mercati s.r.l.) to promote and facilitate a joint development of the pilot.

Description of roles of organisations involved:

Energy Management Agency of Friuli Venezia Giulia > project management, sectoral agency
Team assigned to the pilot:

1. Martina Arteni, project manager
2. Matteo Mazzolini, pilot activities manager



3. Stefano Treu, communication manager

Municipality of Udine > promoter, public authority

Team assigned to the pilot:

1. Bruno Grizzaffi, project manager
2. Agnese Presotto, pilot activities manager

University of Udine - Polytechnic Department of Engineering and Architecture > subcontractor, research institution

Team assigned to the pilot:

1. Patrizia Simeoni, pilot activities developer
2. Giovanni Cortella, pilot assistant
3. Matia Mainardis, pilot assistant
4. Mattia Cottes, communication manager

NET S.p.A. > waste-energy supplier, public utility

Team assigned to the pilot:

1. Davide Bonetto, pilot activities manager
2. Giampiero Zanchetta, pilot activities assistant

CAFC S.p.A. > waste-heat supplier, public utility

Team assigned to the pilot:

1. Michele Mion, pilot activities manager
2. Nicola De Bortoli, pilot activities assistant

UDINE MERCATI S.r.l. > waste-energy user, public company

Team assigned to the pilot:

1. Andrea Sabot, pilot activities manager
2. Giuseppe Pavan, pilot assistant

Related policies

This pilot has been developed in response both to the Renewable Energy Directive (RED II) and to the Energy Efficiency Directive (EED) where it is stated that Member States have to consider waste heat when planning, including early spatial planning, designing, building and renovating urban infrastructure, industrial, commercial or residential areas and energy infrastructure. Furthermore, energy efficiency can result from efficient district heating and cooling, means a district heating or cooling system using at least 50 % renewable energy, 50 % waste heat, 75 % cogenerated heat or 50 % of a combination of such energy and heat. In particular, art. 14 of EED foresees an obligation for MS to perform a comprehensive assessment of the potential for efficient heating and cooling including an overview of the heating and cooling market



demand, policy measures and a cost benefit analysis of the economic potential for efficiency in heating and cooling.

In Friuli Venezia Giulia Autonomous Region, waste-heat utilization is envisaged in the current Regional Energy Plan, in compliance with European and national strategies on energy efficiency and use of renewable energy sources.

Moreover, a Regional Waste Heat Utilization Action Plan was developed by the Energy Management Agency of Friuli Venezia Giulia in April 2018 and will be adopted by the Autonomous Region in the next Regional Energy Plan: waste-heat accounts for 5.500 GWh of primary energy in Friuli Venezia Giulia, being a very significant source of energy for the Region. Waste heat recovery could contribute for 13,7% of emissions reduction to the low carbon transition of the region and for 19,1% of final energy savings.

Financing

Total cost:

To be estimated. This analysis has investigated the potential energy recovery and correspondent cash flows for each participating subject in three different scenarios. The third scenario (waste heat into the DHN of Udine South) appears to be the optimal to maximise cash flows and environmental benefits: however, this scenario requires a much deeper analysis since infrastructure costs are relevant and must be planned with a long-term perspective. Typically, DHN have long payback periods (> 20 years) and this decision requires agreement between the local Authority (the Municipality, who is part of this process and promotes it) and the Regional Authority (the Autonomous Region of Friuli Venezia Giulia, who is the public authority with the financial capacity to overcome present barriers to investment).

Sources of funding:

Public (Regional Authority and Municipality) and private (Utilities and Investors)

Type of funding:

Private Public Partnership through dedicated Project financing. In this way, public finance can be provided to shorten payback periods and to provide a guarantee (“a due diligence”) to the private investment which will be very significant.

Revenues:

Cash flows are calculated below in the “economic impacts” box, but net profit cannot be estimated without a proper assessment on the initial investment required.



Impacts and Monitoring

ENVIRONMENTAL IMPACTS

19.000 MWh of waste energy recovery

3.309,2 ton of CO₂ emissions reduction

1.439,5 toe of primary energy savings

ECONOMIC IMPACTS

Estimated Cash Flow for the waste treatment hub: 236.000€

Estimated Cash Flow for the agrifood wholesale market: 87.000€

Estimated Cash Flow for the DHN: 216.000€

SOCIO-CULTURAL IMPACTS

Implementing circular economy loops in local society

Developing local competences and know-how

Involving different stakeholders in co-design of potential new circular loops

Availability of monitoring/evaluation reports: NO

Link: NO

Formal monitoring system implemented: NO

Recommendations for followers

Strengths = S | Weaknesses = W

- S1 Cultural background supporting concept development: long history in developing local renewable energy systems (first one dated back in 1911, an hydroelectric cooperative in an alpine valley)
- S2 Circular economy loops in urban contexts: this was also considered during project preparation since urban environments offer higher possibilities of matchmaking between demand and offer
- S3 Availability of by-products (here the by-product is waste heat)
- S4 Taking advantage of new circular loops means not only reuse of by-products but also reduction of primary resources (efficiency first)



- S5 Proximity represents an added value, since many exchanges are facilitated by short range logics
- S6 Collaboration agreements have proven to be an effective tool to ensure participation to the feasibility phase (the Municipality of Udine played a significant role in this respect)
- W1 Data availability is not ensured and stakeholders don't support data exchange adequately
- W2 Financing is often a barrier since investors are looking for profitable projects
- W3 Matchmaking requires often a facilitator that is not paid by anyone
- W4 By-products require often characterisation that imply technical and economic evaluations which are demanding
- W5 Technical competences and expertise are key to assess the potential of new circular economy loops (available market channels, potential business models, multi-criteria analysis, etc.)

Identification of innovation areas that should be addressed

- Cooling DHN: the agrifood wholesale market (Udine Mercati s.r.l.) requires more energy for cooling than for heating purposes. Especially in industrial areas, cooling demand can represent a critical aspect that has not taken in due account so far.
- Thermal energy communities can represent an interesting and innovative opportunity as an alternative business model to be implemented where significant amounts of waste heat are available.
- Innovative financial mechanisms can help to go beyond current market barriers where potential investments in these kind of projects are taken in account only if payback periods are short (< 5 years)

Key Resources

- *CE-HEAT toolkit* (<https://www.waste-heat.eu>)
- *HOTMAPS toolkit* (<https://www.hotmaps.eu>)
- *modeFRONTIER® multicriteria modelling and optimization software* (www.esteco.com)
- *Regional web cadastre of waste heat* (<https://www.atlanteenergetico.fvg.it/app/en>)
- *Simeoni P, Ciotti G, Cottas M, Meneghetti A. Integrating industrial waste heat recovery into sustainable smart energy systems. Energy 2019; 175:941-51. <https://doi.org/10.1016/j.energy.2019.03.104>.*
- *Burhenne, S., Jacob, D., Henze, G., 2011. Sampling based on Sobol's sequences for Monte Carlo techniques applied to building simulations. Proceedings of Building Simulation 2011: 12th*



Conference of International Building Performance Simulation Association, Sydney, 14-16 November <https://www.researchgate.net/publication/257139589>

- Zupančič GD, Roš M. Heat and energy requirements in thermophilic anaerobic sludge digestion. *Renewable Energy* 2003; 28:2255-67. [https://doi.org/10.1016/S0960-1481\(03\)00134-4](https://doi.org/10.1016/S0960-1481(03)00134-4).
- Yang X, Wei J, Ye G, Zhao Y, Li Z, Qiu G, et al. The correlations among wastewater internal energy, energy consumption and energy recovery/production potentials in wastewater treatment plant: An assessment of the energy balance. *Science of The Total Environment* 2020; 714:136655. <https://doi.org/10.1016/j.scitotenv.2020.136655>.
- Osservatorio Meteorologico Regionale (Osmer). *Data Archive* 2019.

5. Pilot in Kranj, Slovenia

Pilot Project Summary

Short description:

Through the CITYCIRCLE pilot project the Municipality of Kranj explored, tested and refined its land management approach on the principles of circular economy. The city of Kranj aimed to create an approach that will enable urban regeneration in collaboration with land-owners and users.

The municipality recognised urban space as a key resource for enabling a sustainable, circular and prosperous development of the city. It also recognised that degraded, non-vital areas of the city are a high priority challenge that can be tackled with circular economy approach. Herein the city recognised vital opportunities to regenerate and enhance the value of this crucial resource.

Municipality of Kranj has for this purpose chosen a pilot area, called zone Primskovo. The reason for choosing this area was its current status as low-performing asset at risk of degradation.

Pilot location:



Image 1: Aerial map of Primskovo zone

Pilot Duration: 1.1.2020 do 31.3.2022

Scale: Neighbourhood - Primskovo zone



Pilot overview

SOLUTION(S) TESTED/IMPLEMENTED

Describe shortly in bullet point style

- USE OF CIRCULAR ECONOMY PRINCIPLES ON LAND MANAGEMENT
- PROMOTION OF BEST PRACTICE CASES
- DIGITALISATION

CHALLENGES ADDRESSED

You can for example refer to SDG's

- SUSTAINABLE CITIES AND COMMUNITIES
- CLIMATE ACTION
- PARTNERSHIP FOR THE GOALS
- LAND USE MANAGEMENT
- ENGAGEMENT OF STAKEHOLDERS
- BETTER INFORMATION SYSTEM
- RAISE AWARENESS OF CIRCULAR ECONOMY
- ESTABLISHMENT OF INOVATIVE SOLUTION

Pilot core objective:

The overarching objective of the CITYCIRCLE pilot is to develop an approach on management of land based on the principles of circular economy.



Testing the CE based on land management approach in Primskovo area will help the municipality to explore the strengths and weaknesses of this approach with the aim to refine experiential input of involved stakeholders, so that it becomes a blueprint model for regeneration and activation of under-utilised spaces across municipality. As such the concept is deeply embedded in circular system thinking, where resources such as urban space are seen as key assets, whose value and overall quality can be enhanced with regeneration, optimisation, resource/services sharing and digitalisation.

Activities implemented:

- In-depth analysis of the zone Primskovo area to understand the context, define key challenges and opportunities for revitalisation and land management improvement as seen by users, potential users, landowners, and the municipality,
- Setting-up the network of landowners & users to develop joint established business location.
- Upgrade of city municipality IS system with new relevant data and new potential solutions to support competitiveness of business location,
- Activation of support for implementation of CE activities in the area,
- Monitoring, approach testing and upgrades.

Key Achievements:

- Raised awareness of circular economy,
- Implementation use of CE principles in the area (industrial symbiosis, reuse of degraded space, optimization, replacement...)
- Network of stakeholders,
- Database of Primskovo area,
- Upgrade of information system,
- Joint Circular economy strategy for City of Kranj (in progress).

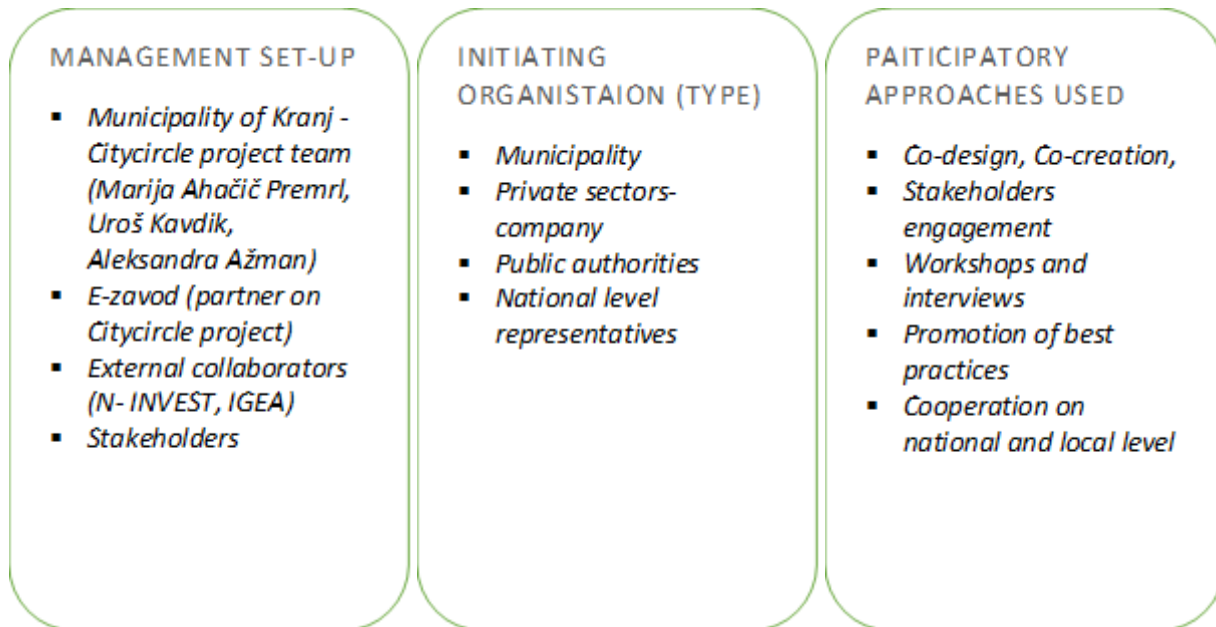
Main beneficiaries (list):

- Public authorities (Municipality, Communal public company)
- SMEs



- Citizens
- Etc.

Governance



Description of roles of organisations involved:

City of Kranj, Citycircle team - project management

Stakeholders - co-creation of application

National level representatives - presentation of guidelines towards circular economy

External collaborators - promotion of best practices

Related policies:

- Circular Economy Action Plan
- European Green Deal
- 2030 Agenda for Sustainable Development in the EU
- Vizija Slovenije 2050
- Strategija razvoja Slovenije 2030
- Strategija prostorskega razvoja Slovenije
- Strategija pametne specializacije



- MOK - Trajnostna urbana strategija 2030

Financing

Total cost: 35.000,00 EUR

Sources of funding: City of Kranj public budget, CITYCIRCLE project

Type of funding: public budget, Interreg CE CITYCIRCLE project budget

Revenues: /

Impacts and Monitoring

ENVIRONMENTAL IMPACTS

*Sustainable resource
management*

Better land management

Space utilization

Greenfield protection

ECONOMIC IMPACTS

*Strengthening the
potential of business
locations*

Economy development

*Transition from linear to
circular economy*

SOCIO-CULTURAL IMPACTS

Wellbeing

Network of stakeholders

*Possible degradation
protection*

Availability of monitoring/evaluation reports: YES

Link: <https://poslovne-lokacije.kranj.si/>

Formal monitoring system implemented: NO

Recommendations for followers

- Land and space are a limited resource



- Principles of the circular economy can be used on land management
- Active role of the City is important to start, promote and lead circular economy
- To establish network of stakeholders involved takes a lot of time and trust needed
- Personal interview is the best to build trust
- Upgrading the information system takes a lot of time and effort
- Best practises promotion and national guidelines is good way to raise awareness about circular economy

Identification of innovation areas that should be addressed

Application developed within the CITYCIRCLE project can be used in other business location in Kranj and also in old city town. Used approach triggered transition to circular economy in City of Kranj.

Key Resources

External collaborators (N-INVEST d.o.o., IGEA d.o.o.)

6. Pilot in Dornbirn, Austria

Pilot Project Summary

Short description:

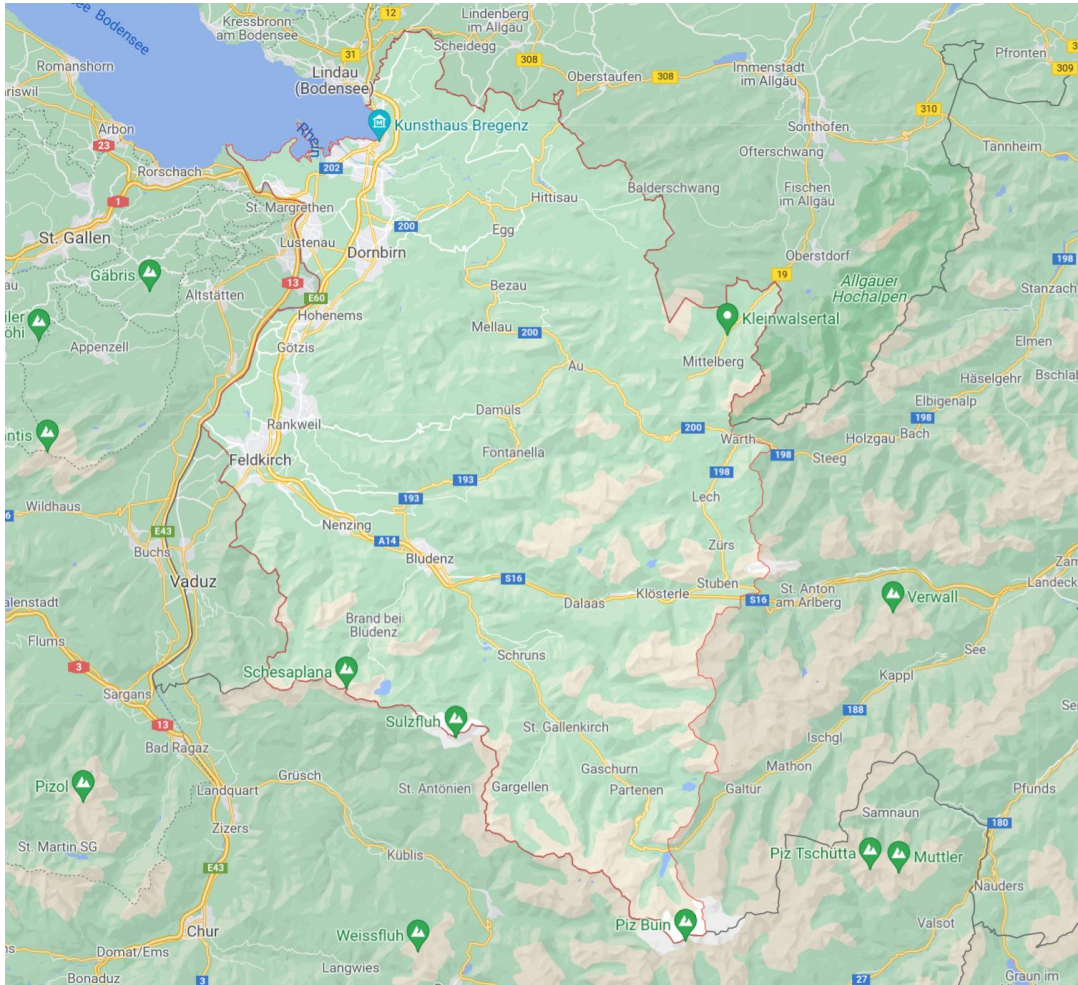
The scope of FHV's pilot is in the field of advanced manufacturing and green innovation. Focusing on Industry 4.0 Smart City setting, FHV tested new methods and business models targeting advanced manufacturing innovation systems that stimulate circular economy expansion within the region. The pilot promotes defined circular economy strategy, both triggering the further growth of regional intelligent production systems in Vorarlberg and simultaneously stimulating regional transition towards circular economy. The Intelligent production system, in the context of defined smart specialization strategy in Vorarlberg, promotes the economic growth through manufacturing, ICT, Information system activities, professional, scientific, and

technical activities. In this regard, the pilot adapts solutions in the field of industrial production and technologies that stir economic efficiency and competitiveness, improve industrial production and technology, as well as ensures general advancement of knowledge. More specifically, the pilot formulates an open circular economy-oriented business model for advanced manufacturing, and further tests the application of key enabling technologies in this context - advanced manufacturing systems in the scope of the circular economy strategy implementation.





Pilot location: Vorarlberg, Austria



Pilot Duration: March 2020 - Dec 2021

Scale: Regional



Pilot overview

SOLUTION(S) TESTED/IMPLEMENTED

- Collaborative business model for circular advanced manufacturing
- Design for Circularity: Materials minimization for minimized energy use and waste
- Circular production planning and optimization of manufacturing processes model – wood and textile industry, food industry, mobility and electric vehicles SMEs
- Digital Skills for CE: Reduction of the set-up time, and the speeding up of human-machine interaction and decision-making
- Lean production technologies: Reduction of the process failure rate, predictive maintenance
- Financial models for circular advanced manufacturing

SOLUTION(S) TESTED/IMPLEMENTED

- Collaborative business model for circular advanced manufacturing
- Design for Circularity: Materials minimization for minimized energy use and waste
- Circular production planning and optimization of manufacturing processes model – wood and textile industry, food industry, mobility and electric vehicles SMEs
- Digital Skills for CE: Reduction of the set-up time, and the speeding up of human-machine interaction and decision-making
- Lean production technologies: Reduction of the process failure rate, predictive maintenance
- Financial models for circular advanced manufacturing



Pilot core objective:

Introduction of the circular economy strategy and assessment of open circular models implemented within the scope of advanced manufacturing system in Vorarlberg - established on the ground of efficient innovation processes and collaborative decision-making activities among regional actors of the quadruple helix innovation system.

Activities implemented:

Activity 1 - Circular Economy, Open Business Models and Advanced Manufacturing: State-of-the-Art

Activity 2 - Best Practice Analysis and Feasibility Study

Activity 3 - Circular Economy Advanced Manufacturing Framework

Activity 4 - Circular Economy Open Business Model for Advanced Manufacturing: Test

Scenarios

Activity 5 - Circular Economy Open Business Model for Advanced Manufacturing:

Evaluation

Activity 6 - Circular Economy Open Business Model for Advanced Manufacturing:

Recommendations and Guidelines

Activity 7 - Communication and Dissemination

Activity 8 - Monitoring and evaluation

Key Achievements:

- Concept design and test of the quadruple helix model for smart circular value creation implemented within the scope of intelligent production - Collaborative Circular Model for Advanced Manufacturing
- Assessment of the financial impact on the further uptake of innovation solutions provided through the implementation of circular models for advanced manufacturing
- Promotion of the defined circular economy strategy that both triggers growth of the intelligent production systems in Vorarlberg, as well as stimulates further regional transition towards circular economy
- Identification of key activities, resources, and key factors of impact for value creation and value capture in smart circular models for advanced manufacturing

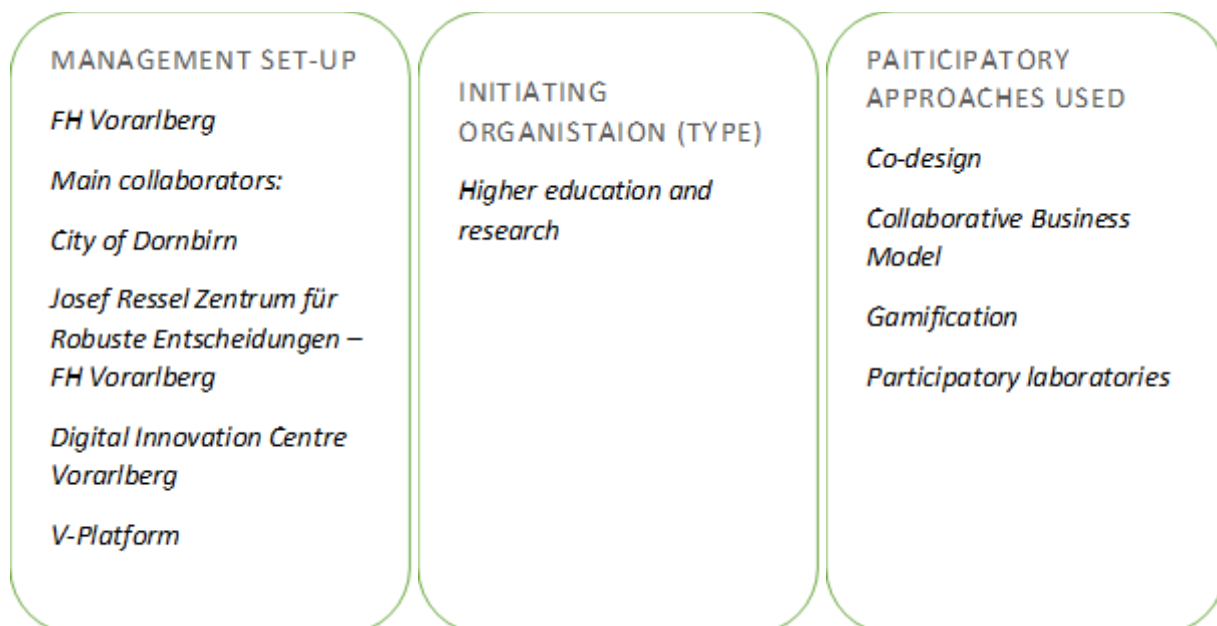


- Development of innovation communities that stimulate further integration of circular models for advanced manufacturing and intelligent production within the current system
- Identification of key actors, roles, and communication channels for smoother transition towards circular economy within the scope of quadruple helix system of innovation
- Recommendations and guidelines for implementing CE principles in advanced manufacturing, studied in context of national & public, industrial, entrepreneurial & start-up, as well as academic relevance.

Main beneficiaries (list):

- Public authorities
- Industry and SMEs representatives
- NGOs and citizens
- Research institutes

Governance





Description of roles of organisations involved:

State Government of Vorarlberg - Regional public authority - Supports the transition towards circular economy system through the implementation of the four main policy instruments: Energy Autonomy Vorarlberg, Waste management Vorarlberg, Building Codes Vorarlberg and Spatial Planning Vorarlberg.

City of Dornbirn - Local authority - offers attractive framework conditions to promote digital innovations in start-ups, companies and administration. By digitizing its services, Smart City Dornbirn enables direct contact with its citizens, going far beyond purely technical digitization with the main goal to improve the quality of life and societal welfare in the long term.

V-Research - Higher education and research - non-university center of excellence for applied research, development and innovation in the technological-industrial sector. The activities performed by the institute aim at meeting the complex challenges of the economy as well as at ensuring the contribution to the further development of society on a non-profit basis.

Josef Ressel Zentrum für Robuste Entscheidungen, FH Vorarlberg - Research and business center - Addresses issues in manufacturing and finance as well as conduct fundamental research in the field of robust decision making

Digital Innovation Hub Vorarlberg - Business support organization- Supports the development and implementation of smart specialization strategies in the region and the implementation of applied research models in close collaboration with industry in Vorarlberg. Focusing closely on small and medium-sized enterprises, the hub examines the opportunities and challenges of Industry 4.0 as a tool for a new, digital transformation in companies, and provides a setting for the experimentation and uptake of co-creative solutions.

Related policies

EU policy initiatives:

- 7th Environmental Action Programme (7EAP) under Priority Objective 8, entitled, Sustainable Cities: "Working together for Common Solutions"
- Closing the loop - An EU action plan for the Circular Economy, COM(2015) 0614
- Roadmap to a Resource Efficient Europe, COM(2011) 571
- A sustainable Bioeconomy for Europe: Strengthening the connection between economy, society, and the environment, COM(2018) 673/2

Austrian policies:

- Energy autonomy Vorarlberg 2050 ("Energieautonomie Vorarlberg 2050")
- e5 Programme



- Waste prevention program (“Bundes-Abfallwirtschaftsplan“)
- Austrian Recycled Construction Materials Regulation

Regional Policies

- Science and Research Strategy Vorarlberg 2020+ (“Wissenschafts- und Forschungsstrategie Vorarlberg 2020+“)
- Smart Specialization Strategy RIS3

Financing

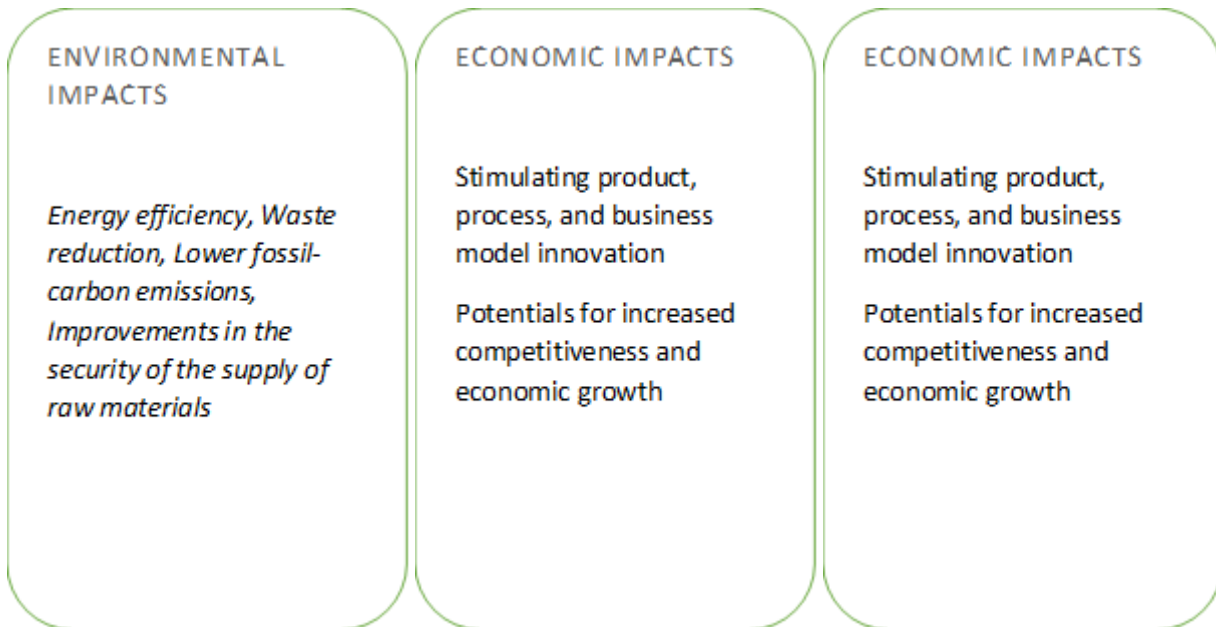
Total cost: 250.000 EUR

Sources of funding: Interreg CE program

Type of funding: European funding program

Revenues: x

Impacts and Monitoring





Availability of monitoring/evaluation reports: *YES*

Link: [D.T3.4.2](#)

Formal monitoring system implemented: *NO*

Recommendations for followers

- Circular economy infrastructure needs to be advanced and developed simultaneously aligned with policy frameworks directly and indirectly impacting circular economy practice in the region.
- Market coupling is beneficial in stimulating circular economy practices and uptake of circular solutions
- Policy framework often stimulate negative behaviour of citizens in terms of indirect effects of circular economy-related policies, i.e. incentivizing wasteful behaviour
- Beneficial: Municipal support to businesses with limited internal capacities and resources for launching/testing circular economy products/services (financial, training, courses etc.)
- Know-how and incentives for repair and reuse needed
- Lack of enablers of cross-cycle and cross-sector performance as a gap to transition
- Advancements in skills and investment into circular design required - more research needed in these areas
- Implementation of circular models require openness of industrial players towards more collaborative business models, as well as decreased reluctance in data sharing - more research needed on effects of standardization and collaboration among multistakeholder innovation co-creation
- Promote the development of circular economy related investments, resource efficiency, recycling, and waste management
- Provide capacity building, training, and exchange of best practices for national and international actors
- Industrial players should lead an active dialogue with financial sector and contribute to the standardization of circularity metrics
- Awareness should be improved in the scope of challenges, gaps, and opportunities for circular economy finance in cross-disciplinary contexts
- Monitor future financial trends based on customer changing needs, while simultaneously managing collaboration with other financial service providers in FinTechs to establish a stable ecosystem



- Introduce citizen science projects which could raise awareness and participation of society in the co-creation of solutions to circular challenges, as well as promote innovation culture within society.

Identification of innovation areas that should be addressed

Areas to explore:

- Sustainable innovation for product-service system
- Design theory and sustainability methodology based on the intelligent production and green innovation
- Cross-sectoral standardization of circularity metrics and ESG regulations at the national level, and exploration of effects of standardization in international context
- Managing quadruple helix innovation models for circular economy (applied in sectoral context) with particular focus on the role and effects of financial institutions

Key Resources

Benner, M. (2020)

Six additional questions about smart specialization: implications for regional innovation policy 4.0.

In: European Planning Studies, 1-18.

<https://www.tandfonline.com/doi/abs/10.1080/09654313.2020.1764506>

Circle Economy and ARA (2019)

The Circularity Gap Report: Closing the Circularity Gap in Austria.

<https://publish.circle-economy.com/circularity-gap-report-austria>

De Wit, M., Hoogzaad, J., Ramkumar, S., Friedl, H., & Douma, A. (2018)

In: The Circularity Gap Report 2018: An analysis of the circular state of the global economy.

Circle Economy: Amsterdam, The Netherlands.

<https://www.legacy.circularity-gap.world/2018-report><https://www.circularity-gap.world/>

European Sustainable Business Federation (2019)

Circular Economy Update: Overview of Circular Economy in

Europe.<https://circulareconomy.europa.eu/platform/sites/default/files/ecopreneur-circular-economy-update-report-2019.pdf>

Rahman, S. M., Perry, N., Müller, J. M., Kim, J., & Laratte, B. (2020)

End-of-Life in industry 4.0: Ignored as before?

In: Resources, Conservation and Recycling, 154, 104539.



https://www.researchgate.net/profile/S_M_Rahman/publication/336318913_End-of-Life_in_Industry_40_Ignored_as_before/links/5de5533aa6fdcc2837005842/End-of-Life-in-Industry-40-Ignored-as-before.pdf

Schmidt, S., Pamminger, R., & Wimmer, W. (2019, March)

Der Circular Economy Analyst. Ein Tool zur Quantifizierung des Umweltnutzens von Kreislaufstrategien. *In: Industrial Life Cycle Management (pp. 145-153). Rainer Hampp Verlag.*

Silvestri, F., Spigarelli, F., & Tassinari, M. (2020)

Regional development of Circular Economy in the European Union: A multidimensional analysis. *In: Journal of Cleaner Production, 255, 120218.*

<https://www.sciencedirect.com/science/article/abs/pii/S0959652620302651>

Su, D., Wu, Y., & Chai, Z. (2019, October)

Advanced Integrated Manufacturing by Application of Sustainable Technology through Product Lifecycle: a Circular Economy Approach.

In: Proceedings of the 2019 International Conference on Artificial Intelligence and Advanced Manufacturing (pp.1-4).

<https://dl.acm.org/doi/abs/10.1145/3358331.3358360>

Suzanne, E., Absi, N., & Borodin, V. (2020, November)

Towards Circular Economy in Production Planning: Challenges and Opportunities.

In: European Journal of Operational Research, 287, 168-

190.<https://www.sciencedirect.com/science/article/abs/pii/S0377221720303969>

Van Eygen, E., Laner, D., & Fellner, J. (2018)

Circular economy of plastic packaging: Current practice and perspectives in Austria.

In: Waste Management, 72, 55-64.

<https://www.sciencedirect.com/science/article/pii/S0956053X17308802>



7. Summary of opportunities for replication and follow up actions

In this last chapter a summary of opportunities for follow up actions based on learning and experiences from CITYCIRCLE pilots is provided. Follow up action ideas for each pilot focus area are summarised with the purpose to support and accelerate further the circular economy initiatives and solutions (locally and transnationally).

These insights were gathered as part of experience exchange journey, that has been conducted under work package 3.

Follow-up ideas around pilot of Košice, where pilot actions aim to support the decision-making processes of the actors of agri-food value chains and food service sector towards implementation of circular economy solutions and models, by providing them with the proper information, tools, and guidelines to implement the change.

Udine

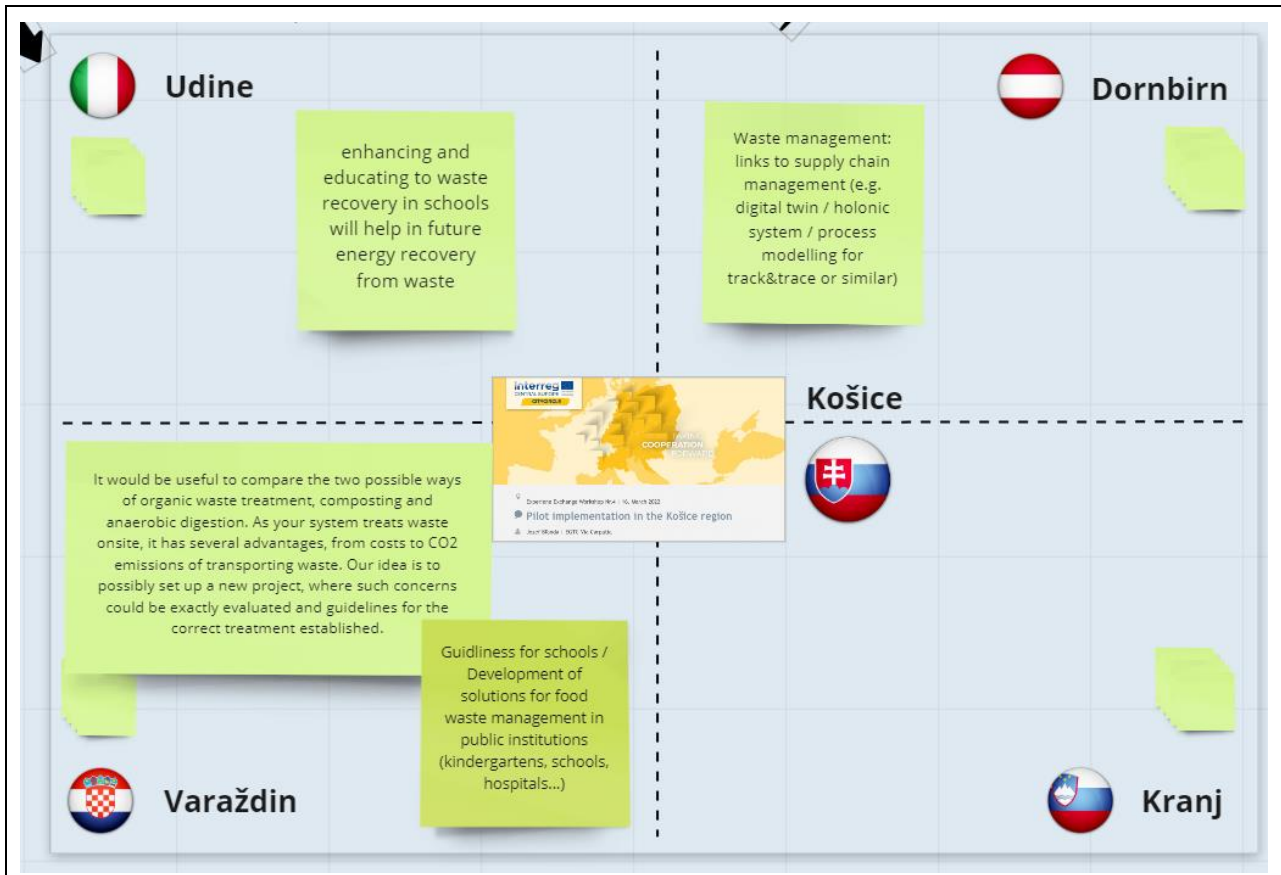
- Enhancing and educating to waste recovery in schools will help in future energy recovery from waste

Dornbirn

- Waste management: links to supply chain management (e.g. digital twin / holonic system / process modelling for track&trace or similar)

Varaždin

- It would be useful to compare the two possible ways of organic waste treatment, composting and anaerobic digestion. As your system treats waste onsite, it has several advantages, from costs to CO2 emissions of transporting waste. Our idea is to possibly set up a new project, where such concerns could be exactly evaluated and guidelines for the correct treatment established.
- Guidlines for schools / Development of solutions for food waste management in public institutions (kindergartens, schools, hospitals...)



Follow-up ideas around pilot of Varaždin, where innovative business opportunities from waste recycling through public-private co-creation have originated

Košice

- Awareness activities to support the operation of proposed circular solutions
- Scaling the circular projects - larger amounts, organization of network (e.g. for the use of biogas in public transport)
- How to overcome the current legislation barriers

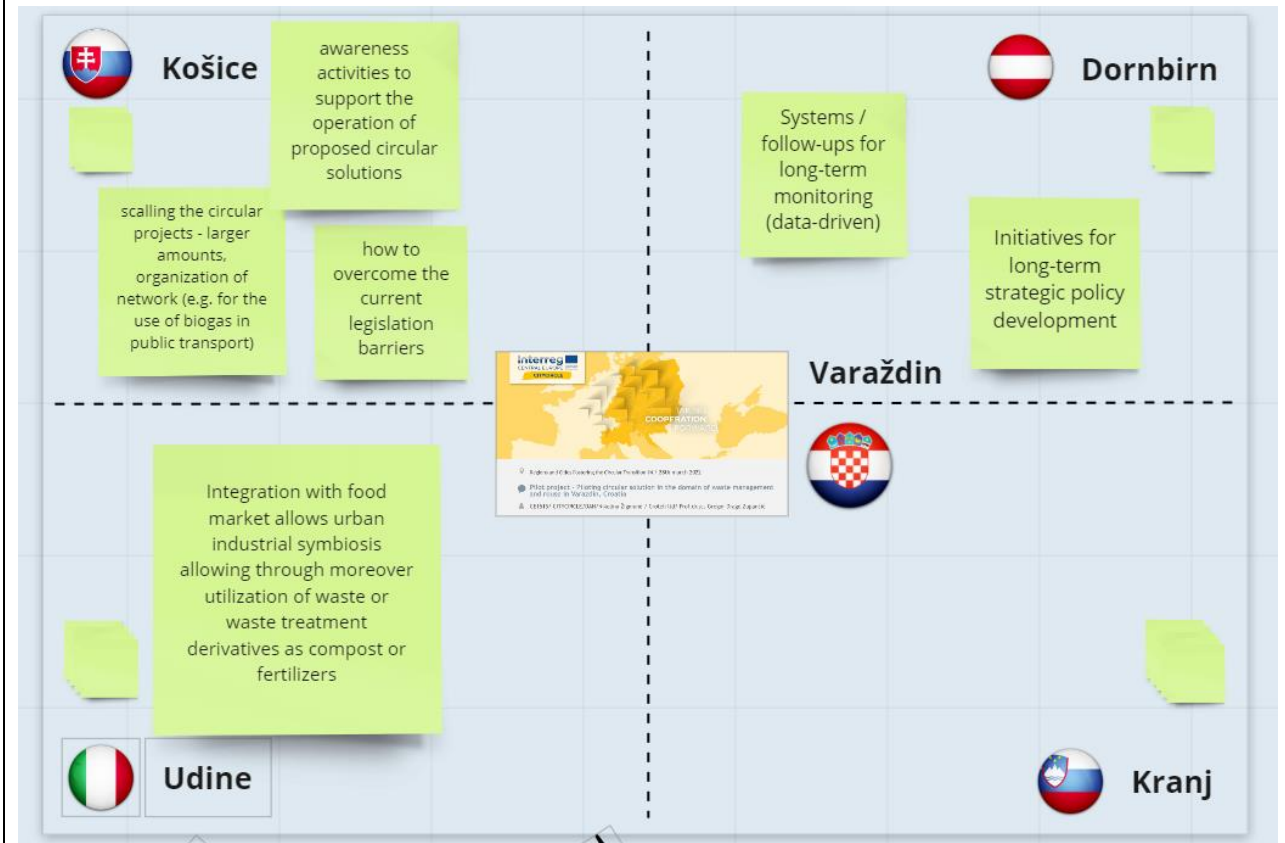
Dornbirn

- Systems / follow-ups for long-term monitoring (data-driven)
- Initiatives for long-term strategic policy development



Udine

- Integration with food market allows urban industrial symbiosis allowing through moreover utilization of waste or waste treatment derivatives as compost or fertilizers



Follow-up ideas around pilot of Udine, where pilot activities elaborated on the potential of industrial symbiosis and circular economy exploiting the thermal waste (heat otherwise dissipated) and fuels deriving from the construction of a waste treatment plant.

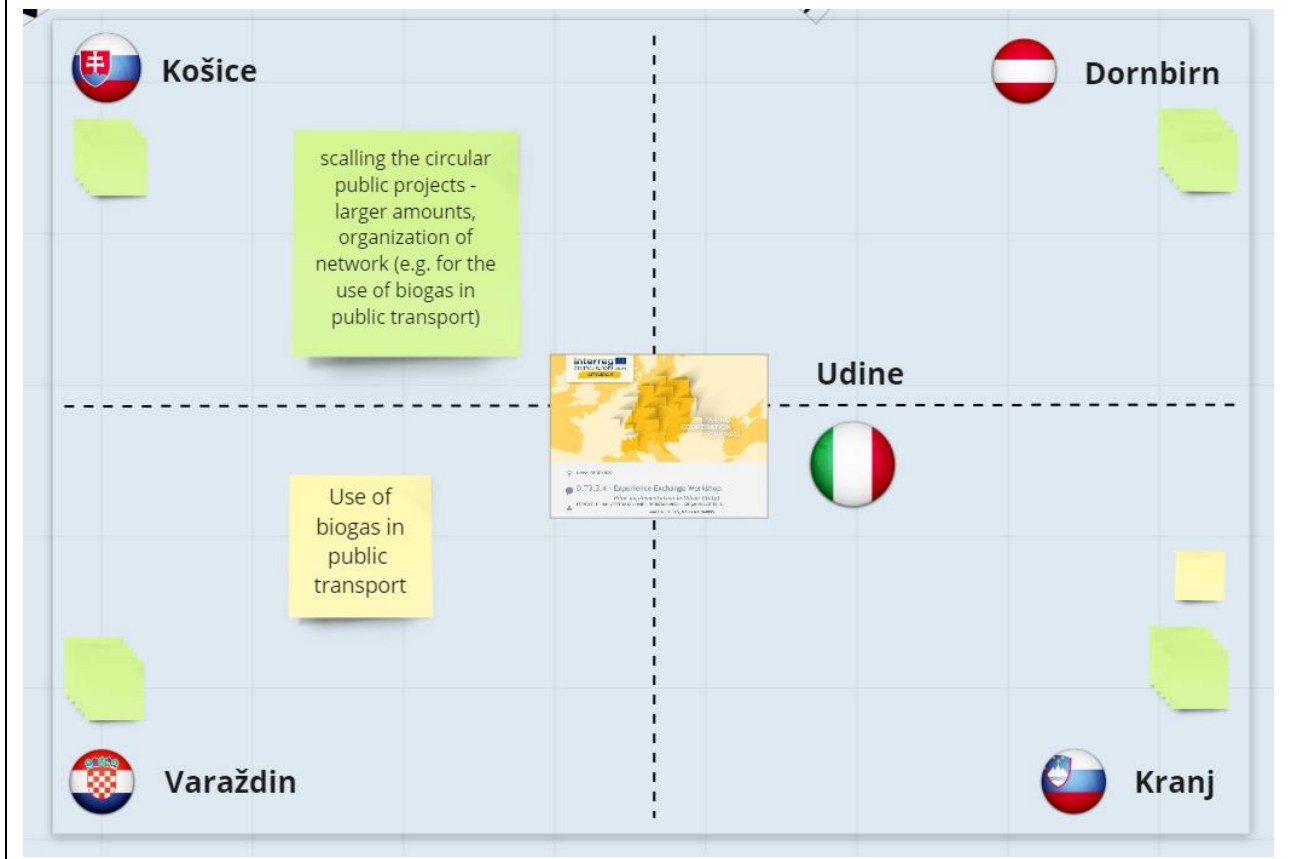
Košice

- scaling the circular public projects - larger amounts, organization of network (e.g. for the use of biogas in public transport)



Varaždin

- Use of biogas in public transport



Follow-up ideas around pilot of Kranj, where pilot actions aimed at exploring, testing and refining approach on management of land on the principles of circular economy, to enable urban regeneration in collaboration with land-owners and users.

Dornbirn

- GIS / policy learning platform for buildings; one-stop shop for CE in buildings / spatial planning or similar

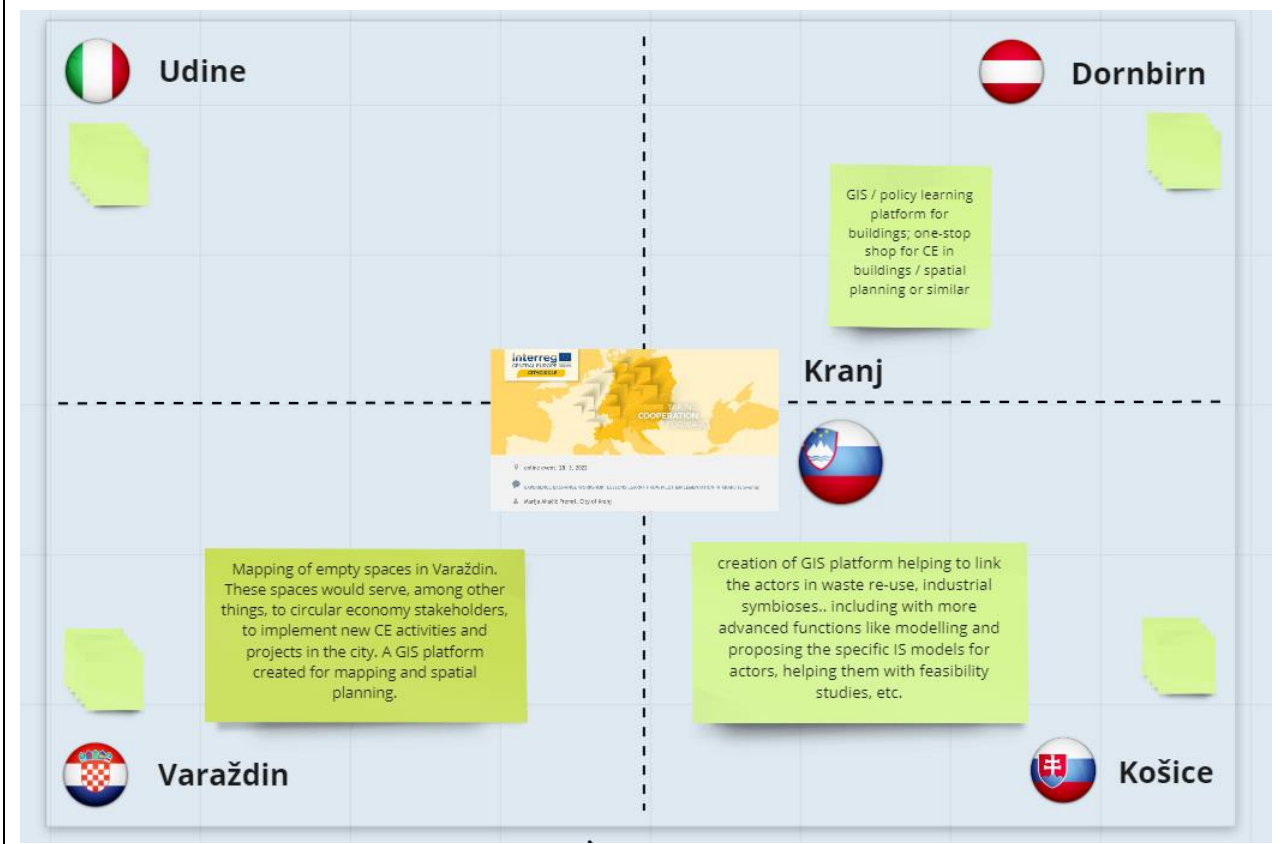
Varaždin



- Mapping of empty spaces in Varaždin. These spaces would serve, among other things, to circular economy stakeholders, to implement new CE activities and projects in the city. A GIS platform created for mapping and spatial planning.

Košice

- Creation of GIS platform helping to link the actors in waste re-use, industrial symbioses, etc., including the more advanced functions like modelling and proposing the specific IS models for actors, helping them with feasibility studies, etc.





Follow-up ideas around pilot of Dornbirn, where pilot actions aim to elaborate on the potentials of circular economy principles in the domain of advanced manufacturing and intelligent production.

Košice

- Financing of circular transition in industrial sector - private funds, relation to new taxonomy

Varaždin

- Development of CE business models for food and textile industry

