



SIRCLES POLICY TOOLKIT FOR CIRCULAR ECONOMY EMPLOYMENT AND TRAINING

SEPTEMBER 2023



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This toolkit has been elaborated by ARCO/ PIN S.c.r.l., partner of SIRCLES project. The working group was led by Leonardo Borsacchi (PhD), with the contribution of Daniela Tacconi (PhD), Gabriele Feligioni, and Camilla Guasti.

ARCO – Action Research for CO-Development is a university centre founded in 2008 at PIN s.c.r.l., Prato (Italy). It offers research, qualified consulting, and training services in social economy, local development, inclusive development, M&E and impact evaluation and circular innovation and sustainable commodities. ARCO relies on the expertise of a multidisciplinary team and operates both at national and international level. To know more about ARCO visit www.arcolab.org.

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ABOUT **SIRCLES** PROJECT:

SIRCLES—Supporting Circular Economy Opportunities for Employment and Social Inclusion - is a project funded by the European Union under the ENI CBC Med Sea Basin Programme. The project was implemented in Spain, Greece, Palestine, Jordan, Lebanon, Tunisia, Italy between 2021-2023 by the Waste Agency of Catalonia and nine partners, namely Formació I Treball Empresa d'Inserció S.L.U (Training and Employment Labour Insertion Company, Catalonia), National Technical University of Athens (Greece), Organization Earth (Greece), House of Water and Environment (Palestine), EDAMA Association for Energy, Water and Environment (Jordan), Rene Moawad Foundation (Lebanon), Tunisia ECOTOURISM (Tunisia), Italian Composting and Biogas Association (Italy) and PIN S.c.r.l. Scientific and Educational Services for the University of Florence (Italy).

SIRCLES overall objective was to contribute to the alleviation of **poverty** and the **social inclusion** of **NEET** and **women**, through the creation of **green jobs**. New employment opportunities were promoted by applying the **circular economy** model in the **biowaste** sector. A total of **7 pilot composting plants** were set up in each partner country engaging the local hotel, food retail, household, and farming sectors in green and circular economy practices. The pilots served as **training hubs** for NEETs and women to develop new skills and capacities in separation, collection, composting and agriculture practices as well as business development.

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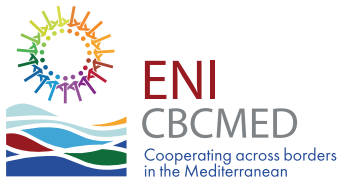


SIRCLES

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SUMMARY

The implementation of the **SIRCLES** model to address challenges related to composting organic waste in Mediterranean countries has provided valuable insights into sustainable waste management. This model encompasses technological, regulatory, and awareness aspects to establish effective collection and composting practices, adapting to varying legal frameworks and citizen awareness levels. The lessons learned from executing seven pilot plants underscore the significance of **involving local institutions, fostering stakeholder collaboration, engaging the private sector** for financial viability, **conducting public awareness campaigns**, and **ensuring continuous education** to create informed societies.

These lessons have led to policy recommendations for local authorities seeking to enhance biowaste collection and composting practices. Prioritizing awareness and education among community members, understanding local contexts and supply chains comprehensively, fostering community engagement, and implementing incentive systems are among the key suggestions. These insights highlight the value of citizen involvement, industry participation, and educational collaboration in achieving a circular economy model at the city level.

By implementing these recommendations, local authorities can create an environment conducive to efficient biowaste collection and composting. This not only reduces landfill waste but also contributes to the development of a circular economy, transforming biowaste into valuable compost for agricultural use. The active participation and awareness of citizens, along with industry engagement, play pivotal roles in affirming circular economy models within cities. Integrating sustainability education and promoting collaboration across academia, industries, and local authorities build a strong foundation for sustainable and resource-efficient urban environments. This holistic approach ensures a better future by equipping generations to come with the knowledge and skills needed to construct environmentally responsible communities.

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INTRODUCTION AND AIM OF THE TOOLKIT

Circular economy is a wide concept, applicable to all sectors. It is basically a systems solution framework that tackles global challenges like climate change, biodiversity loss, waste, and pollution (Ellen MacArthur Foundation, no date). It involves, among others, new production and consumption models, as well as new forms of distribution or business models. Circular economy affects indeed all the dimensions of sustainability: **economic, social, cultural, and environmental**. By the adoption of a circularity approach, it is possible to **close the loop of materials flow**. Thus, life cycle extension strategies are pursued, extending the useful life of products acting at the designing stage, or carrying out actions at the end of the pipe, to prevent the disposal of the product's component. These can be productively used again and again, thereby creating further value.

Accelerating the transition towards a circular economy is an important challenge for institutions, cities, production clusters, organizations and citizens. At the urban level, circular economy principles need to be managed in an integrated manner by policy makers and relevant stakeholders. Thus, at the urban level and where economic activities operate, many different by-products are generated. Embracing a circular production approach, companies have the opportunity to ingeniously convert these by-products into valuable resources, further driving the sustainable evolution of our communities. This way of thinking, called **Life Cycle Thinking**, allows one to think about the environmental, economic and social consequences of a product during its entire life cycle (Shahjadi, Parvez, Nazmul, 2021). Therefore, an industrial ecosystem represents a group of enterprises that utilize each other's materials and by-products, reducing the generation of new waste and favouring potential initiatives of industrial symbiosis (Borsacchi and Pinelli, 2020).

By adopting this framework, SIRCLES project willing to develop skills and favour new job opportunities in the circular economy sector, in the biowaste one, providing marketable opportunities especially for NEET & Women in the involved target areas. In these countries, to NEET & Women have been offered tailor-made trainings on biowaste management, entrepreneurial and soft skills, as well as job opportunities within the sector. The planned pilots for biowaste processing have been implemented according to the Life Cycle Thinking approach and breaking down the process into different phases. The development of capacities along with job insertion and the engagement of local entities aimed to ensure sustainability beyond the project duration.

This toolkit is organised into four chapters. After this introduction, it begins with an overview of the SIRCLES approach, explaining its principles and objectives. Specifically, the chapter 1 delves into the SIRCLES model for biowaste, highlighting its importance and potential in achieving circularity. The work context and methodology are then discussed in chapter 2, providing insights into the research environment and the methods employed in the study. This section outlines the framework and approach used to analyse and evaluate the SIRCLES model. Chapter 3 includes a section on the pilots conducted by SIRCLES, presenting the lessons learned from these practical implementations. This section provides valuable insights and observations from real-world applications of the SIRCLES model, highlighting its strengths, challenges, and areas for improvement. Furthermore, chapter 4 offers potential future scenarios and proposes policy measures that can support and enhance the implementation of the SIRCLES model in various contexts.

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1. THE SIRCLES MODEL WITHIN THE FRAMEWORK OF CIRCULAR ECONOMY

1.1 ADOPTING A "SIRCLES APPROACH"

The introduction of the circular city as a concept and practice in sustainable urban development is a response to the challenges of urbanization. A circular city promotes the transition from a linear to a circular economy across all functions, in collaboration with citizens, businesses, and the research community. This transition involves decoupling resource use from economic activity, maintaining the value and utility of products, components, materials, and nutrients for as long as possible. By closing material loops and minimizing harmful resource use and waste generation, cities aim to improve human well-being, reduce emissions, protect biodiversity, and promote social justice in alignment with the Sustainable Development Goals (European Circular Cities Declaration, 2020).

A **circular economy model** applied to a city involves a comprehensive approach to **waste management** and **resource utilization**. It begins with the understanding that waste generation is inevitable, both from households and production activities. However, instead of treating waste as a burden, it is seen as a valuable resource that can be utilized in a sustainable manner.

Following the approach developed and tested within the framework of the project **SIRCLES**, the proposed general model starts with waste collection systems that ensure **proper separation** and **sorting of waste at the source**. This allows for the effective identification of recyclable materials, organic waste, and other valuable resources. The collected waste is then processed using processes and technologies (i.e., a "circular plant" based in the city or in its neighbourhood) that promote recycling, composting, and other forms of waste treatment.

Through these processes, the waste could be transformed into new added value products. For example, recyclable materials can be converted into raw materials for manufacturing, organic waste can be processed into compost for agricultural use, and energy can be extracted from non-recyclable waste through waste-to-energy technologies.

The newly processed products could be then reintroduced into the local economy, closing the circle. For instance, the recycled materials can be used by local industries for production, the compost can be utilized by local farmers, and the energy can be supplied to households and production activities.

To support a circular economy model, a **legal framework** is essential. This framework includes regulations and policies that encourage **waste reduction, recycling**, and the **use of sustainable materials**. It also promotes responsible waste management practices and sets targets for waste diversion and resource recovery.

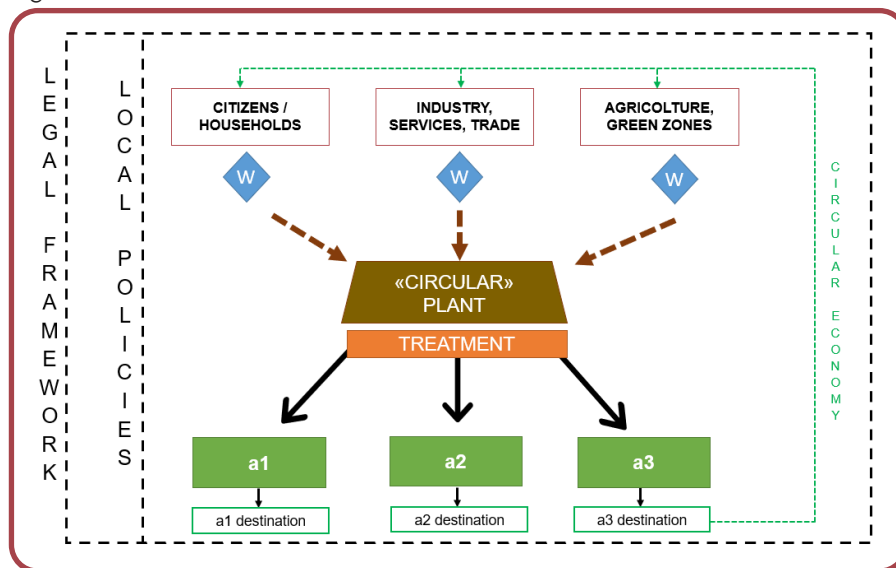
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Furthermore, the success of the circular economy model relies on the active involvement and awareness of all main stakeholders at the urban level. This includes **citizens**, who are encouraged to practice waste segregation and adopt sustainable consumption habits. It also involves **academia**, which can contribute research and innovation to enhance waste management practices. **Local institutions** also play a crucial role in implementing and enforcing waste management policies, while **industries** are encouraged to adopt ecofriendly production practices and utilize recycled materials.

By implementing effective waste collection, processing, and utilization systems, waste is transformed into valuable products that are reintroduced into the local economy. This model is further strengthened by a supportive legal framework and a widespread awareness among all key stakeholders, fostering a more sustainable and resource-efficient urban environment.

Figure 1 shows, in general terms, a model based on the SIRCLES approach, applicable to different scenarios and with different technologies and solutions depending on the waste considered.

Figure 1. **SIRCLES** model Source: Authors' elaboration



1.2 THE SIRCLES MODEL FOR BIOWASTE

The collection and composting of organic waste play a crucial role in sustainable waste management practices.

In general terms, start-up of an organic waste fraction collection and composting activity must consider technological, regulatory and awareness elements, with the aim of making the intervention sustainable. In particular:

1. Identify a suitable area for the installation of the pilot plant, preferably in a sparsely populated area away from dwellings, to avoid possible disturbance to the population. An environmental impact assessment study should be developed and approved by the local authority.

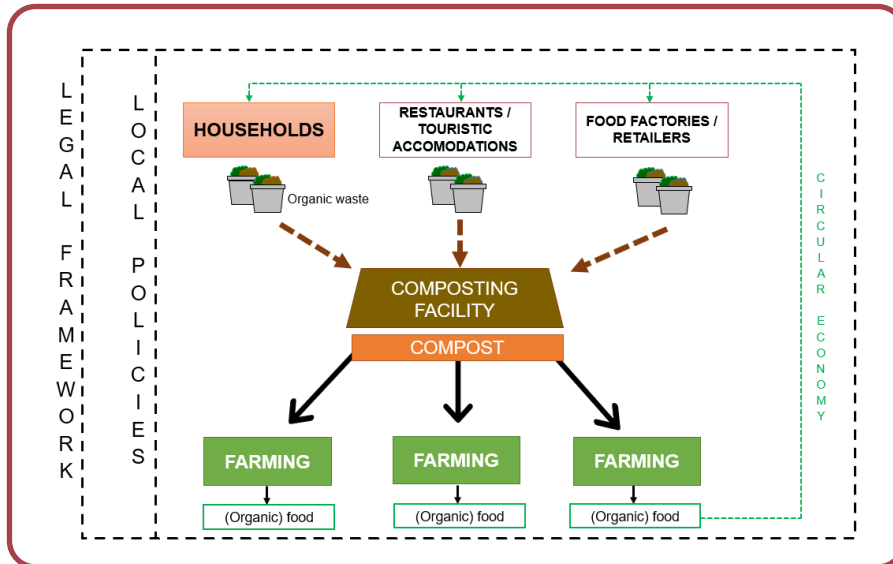
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2. Raise awareness in the local community of the importance of composting and involve residents in the process. Organise information meetings and provide educational material to explain the benefits and practices of home composting.
3. Acquire the materials needed to start up the pilot plant, such as containers for collecting organic waste, equipment for mixing and aerating the compost, and soil or organic material to be used as a starter to accelerate the decomposition process.
4. Start collecting organic waste from residents, providing them with special containers and detailed instructions on what can and cannot be composted. Organise a regular collection calendar and ensure the proper handling of the collected waste.
5. Constantly monitor the pilot plant to ensure that composting is carried out correctly and without problems. Carry out regular checks of the temperature, humidity, and oxygenation within the plant to ensure optimal conditions for the decomposition of organic waste.

The application of the **SIRCLES** model for biowaste (figure 2) faced opportunities and threats in its application in different Mediterranean countries, each with unique legislation, waste management policies, and levels of citizen awareness. The aim was to explore the challenges faced by the 7 pilots, particularly in terms of starting from scratch, and the potential for producing compost for local agricultural use.

Figure 2. **SIRCLES** model for biowaste

Source. Authors' elaboration



The pilot facilities in the Mediterranean region faced varying circumstances. In Italy, for example, the plant was already in place, while in **Catalonia**, the pilot was new but operated in an environment already prepared for waste management. However, other countries encountered significant challenges, with the entire waste management process being new, from separate collection to waste management protocols. In fact, legislation related to waste management was found to be absent or lacking in many countries, including Lebanon, Tunisia, Palestine, Greece, and Jordan.

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The replicability of the pilot projects in other contexts is a crucial question and remains up to the agenda until the end of the project. The support of regional or national authorities was seen as essential for their success. Thus, their involvement, together with local authorities in promoting the project was seen as crucial.

Municipalities could also play a role in ensuring sustainability by creating job opportunities in the green sector. Consequently, one of the main objectives of the project was to train **NEET and women**, with the composting plant serving as a valuable training tool.

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2. WORK CONTEXT AND METHODOLOGY

Within the framework of SIRCLES project, to map the benefits and potential impacts of the project composting plant pilots, ARCO/PIN S.c.r.l. elaborated the overall methodology, the data collection tools and work plan. ARCO/PIN S.c.r.l. first identified the following key dimensions of analysis undergoing the assessment:

| DIMENSION | BENEFITS/ POTENTIAL IMPACTS |
|------------------------------|--|
| ENVIRONMENTAL | 1. Environmental benefits of the composting plant pilots |
| CULTURAL | 2. Individual and community acceptance of the composting plant pilots 3. Increased environmental awareness |
| SOCIAL & ECONOMIC | 4. Job insertion & social inclusion potential of the composting plant pilots 5. Poverty alleviation potential of the composting plant pilots 6. Benefit for the local economy (i.e., job creation potential) |

Source. Authors' elaboration

The assessment methodology included following activities and methods:

| METHOD | ACTIVITY | TARGET GROUP |
|---|---|---|
| 0. Literature & desk review | N/A | N/A |
| A. QUESTIONNAIRE FOR PILOT COMPOSTING PLANTS IN-JOB TRAINEES | The questionnaire was administered in 5 different languages (English, Italian, French, Arabic, and Greek). It was completed by a total of 112 respondents across partner countries out of 121 project total in-job trainees (92,6% completion rate). | SIRCLES pilot composting plants in-job trainees (N= 112) |
| B. Questionnaire for pilot composting plants stakeholders | Potential project benefits and impacts for the wider group of stakeholders were assessed indirectly via targeted respondents' perceptions and opinions. The questionnaire was completed by a total of 71 respondents across partner countries. | SIRCLES pilot composting plants stakeholders (N=71) |
| C. Semi-structured interview | In parallel to the surveys administration, ARCO/PIN S.c.r.l. conducted a round of 9 semi-structured interviews with pilot managers in all partner countries. | SIRCLES pilot managers from project partner organisations (N=9) |
| D. Focus-group discussion | ARCO/PIN S.c.r.l. facilitated a Structured Focus Group Discussion with pilot managers from partner countries. Participants were invited to exchange and discuss on what practices and behaviours key local stakeholders should adopt for the sustainability of the composting pilots across countries, ranging from citizens, local industries and economic activities, universities and local authorities, among others. | SIRCLES pilot managers from project partner organisations (1 FGD) |

Source. Authors' elaboration

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3. SIRCLES PILOTS: LESSONS LEARNED

Within the framework of the **SIRCLES** project, seven pilot composting plants have been developed, aiming to enhance (or introduce) waste management practices at the local level and promote a circular economy approach. These facilities have implemented separate organic waste collection and utilized composting methods to enhance their waste management practices, reduce waste generation, and contribute to a sustainable future. The pilots are located in:

The following map shows the **location of the pilots.**

1. Aqaba, Jordan
2. Andros, Greece
3. Beitello, Palestine
4. Byblos, Lebanon
5. Bizerte, Tunisia
6. Valle d'Itria, Italy
7. Vila Seca, Catalonia

Figure 3. Location of **SIRCLES** pilots

Source: Authors' elaboration



This chapter explores the experiences and outcomes of these pilot composting plants, highlighting their significance as models for sustainable waste management. The collaboration between government authorities and local stakeholders has been instrumental in achieving environmental and social benefits through these initiatives.

One key aspect of the pilot plants is the engagement of **NEETs and women**, whose involvement not only supports the project's objectives but also provides employment opportunities and contributes to the socioeconomic development of the local communities. By empowering these individuals and addressing social and economic challenges, the project creates a more inclusive and prosperous society.

The production of compost by these pilot plants serves as a **valuable resource** for **soil enhancement** and **sustainable agricultural practices**. This not only reduces the reliance on chemical fertilizers but also promotes a more environmentally friendly approach to farming.

Through awareness campaigns and citizen engagement, the pilot plants encourage active participation and foster a culture of responsible waste management. By educating the public about

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the benefits of composting and encouraging their involvement, these initiatives aim to create a collective effort towards **producing highquality compost** and **reducing waste**.

Overall, the experiences of these pilot composting plants highlight the potential for collaboration between municipalities, businesses, and local communities in achieving sustainable waste management. Their experiences serve as an inspiration for other regions seeking to adopt similar approaches, ultimately contributing to a more environmentally sustainable and socially inclusive future.

3.1 PILOT PLANT IN AQABA, JORDAN

| INDICATORS | PLANNED | STATUS (July 2023) |
|-----------------------------------|---------|--|
| Composting plant | 1 | <i>In operation since January 2023</i> |
| NEETs and women contracted | 8 | 10 |

In **Aqaba, Jordan**, a waste management initiative was launched at the end of **January 2023**, focusing on separate waste collection. The initial phase of the project involved the participation of five hotels in the area. To facilitate the composting process, the facility in Aqaba utilizes a combination of **modular composting boxes** and turned windrows. These methods ensure efficient transformation of organic waste into compost. The successful implementation of this project is the result of a collaborative effort between the local government authority, **ASEZA**. An agreement has been signed with ASEZA, granting approval and support for the project's initiation.

The composting plant in **Aqaba is capable of processing up to 728 tons of various types of waste**, including food waste, garden waste and agricultural waste, on an annual basis, for an output of 100/120 tons/year. Jordanian pilot faced a complicated situation, as the amount of waste they aimed to manage exceeded the capacity of the plant. During the pilot phase of the project, eight individuals, including NEETs and women, have been actively engaged in its implementation and operation.

MAIN CHALLENGE

- Choose the location of the pilot location took time and caused delays.
- Transportation issues.
- Issue of legislation in Jordan. Not allowed to use food waste as compost.
- Small scale pilot not able to manage all collected biowaste.

MAIN LESSON LEARNED

- Engage local NGOs and social groups to reach the NEET and women in the local society that could benefit from this opportunity.
- Good to encourage bigger communities in this business.
- Having a pilot provides evidence to demonstrate the government that composting from food waste is fine and safe.

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Figure 4. Pilot plant in Aqaba

Source: SIRCLES



3.2 PILOT PLANT IN ANDROS, GREECE

| INDICATORS | PLANNED | STATUS (July 2023) |
|-----------------------------------|---------|---|
| Composting plant | 1 | <i>In operation since November 2022</i> |
| NEETs and women contracted | 20 | 18 |

In the **village of Korthi**, in the southern part of **Andros island**, the separation and collection of food waste is implemented. This initiative started in **November 2022**, coinciding with the opening of the composting site. Modular composting bins with a volume of 1 m³ are used for this purpose. The collection of food waste from restaurants, cafés, supermarkets, and households occurs three times a week, **resulting in approximately 400 kg – 750 kg of organic waste** (depending on the time of the year) being collected.

The responsibility of collecting and transporting the food waste to the pilot unit lies with NEETs and women. At the pilot unit, the food waste is mixed with pruning in a 2:1 ratio. It is then transferred to the compost bins to initiate the composting process. The required energy for this process is generated by **photovoltaics**, while the necessary water is supplied by **treated wastewater**.

In order to encourage residents to participate in the initiative, information materials and a key to access collection bin have been distributed to them. Residents also received **small portable bins** and **compostable bags** to further facilitate and promote this environmentally and economically sound approach. The target for compost production per year is 50 tons. **The project has employed a total of 19 NEETs and women**. The compost produced is packaged and returned to the citizens for their use.

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MAIN CHALLENGE

- Political disagreements.
- Last minute exit of the recycling company.
- Stakeholders affiliated with local political parties initially show interest but, due to political reasons, distance themselves from the project later.
- Installing a composting plant on an island is more challenging.

MAIN LESSON LEARNED

- Need to involve local institutions from the beginning of the project.
- The presence of experienced technicians to manage the composting plant made it possible to solve all operational problems.
- Use of collection bins at family level increase awareness and participation in the waste separation.

Figure 5. Pilot plant in Andros

Source: SIRCLES



3.3 PILOT PLANT IN BEITELLO, PALESTINE

| INDICATORS | PLANNED | STATUS (July 2023) |
|-----------------------------------|----------------------------|--------------------|
| Composting plant | 0 (1 existing, renewed) | Operational |
| NEETs and women contracted | 13 | 23 |

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In October 2022, a group of NEETs and women began to train the staff in 12 enterprises (including hotels, restaurants, and fruit and vegetable markets) on proper organic waste separation techniques. To facilitate the collection of organic waste, **240-litre and 60-litre bins were distributed to the involved enterprises. In January 2023**, after signing agreements with **the Ramallah Municipality and Beitello Village Council regarding the composting plant's gate fees**, the separated biowaste began to be delivered to **the Beitello composting facility**.

This marked the start of the plant's operation, which included the processing of biowaste. The composting method employed in the pilot project is open windrows, providing an efficient and effective means of decomposition and transformation of organic waste.

The maximum capacity of the composting plant is 750 tons/year of biowaste, 90 tons/year of poultry manure and 480 tons/year of shredded wood from trees pruning. The project aims to produce approximately **450 tons of compost per year**, utilizing the collected biowaste. This compost will contribute to soil enrichment and support sustainable agriculture practices in the region. To support the successful implementation and operation of the pilot project, **23 NEETs and women have been engaged.**



MAIN CHALLENGE

- Choose the location of the pilot location took time and caused delays.
- Transportation issues.
- Issue of legislation in Jordan. Not allowed to use food waste as compost.
- Small scale pilot not able to manage all collected biowaste.

MAIN LESSON LEARNED

- Engage local NGOs and social groups to reach the NEET and women in the local society that could benefit from this opportunity.
- Good to encourage bigger communities in this business.
- Having a pilot provides evidence to demonstrate the government that composting from food waste is fine and safe.

Figure 6. Bins distributed to food producers in Palestine

Source: SIRCLES

Spain | Greece | Palestine | Jordan | Lebanon | Tunisia | Italy

3.4 PILOT PLANT IN BYBLOS, LEBANON

| INDICATORS | PLANNED | STATUS (July 2023) |
|----------------------------|---------|--------------------|
| Composting plant | 1 | Operational |
| NEETs and women contracted | 12 | 23 |

The inauguration of the composting plant took place in **November 2022**, after overcoming some licensing issues related to the transportation of biowaste. The plant utilizes **in-vessel composting tunnels with forced aeration**, along with an **outdoor curing stage**, to effectively process organic waste. To support the project's objectives, **a total of 30 agreements have been signed**, including one hotel, eight restaurants, three vegetable markets, one coffee shop, and two resto-café. This collaboration showcases the commitment of various sectors to sustainable waste management practices.

The composting plant has a maximum capacity of **978 tons per year, combining both food waste and garden/agricultural waste**. With this capacity, the plant aims to **produce approximately 456 tons of compost per year**, contributing to soil enrichment and supporting sustainable agricultural practices.

To ensure the successful operation of the pilot project, individuals, including NEETs and women, are currently working at the composting plant. Despite the initial challenges with separate collection, the successful establishment of the composting plant and the signing of multiple agreements demonstrate the engagement of stakeholders towards the introduction of these waste management practices within their business.

MAIN CHALLENGE

- Transportation issues (due to licensing: Truck registration problem due to governmental agencies shut down).
- High cost of fuel hindered waste collection efforts.
- Available area around the tunnels not very wide due to site restrictions.
- Storage space may become an issue. The solution is to use a space nearby that belongs to the union of municipalities.
- Impurities may be high or rise if sensitization is not kept constant over time.

MAIN LESSON LEARNED

- Multiple agreements signed and engagement of the stakeholders.
- Lebanese pilot, despite the difficult situation in the country, showcased a positive approach.

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Figure 7. Pilot plant in Byblos

Source: SIRCLES

3.5 PILOT PLANT IN BIZERTE, TUNISIA

| INDICATORS | PLANNED | STATUS (July 2023) |
|----------------------------|---------|--------------------|
| Composting plant | 1 | Operational |
| NEETs and women contracted | 16 | 80 |

The pilot project in **Bizerte, Tunisia**, commenced operations in **March 2022**, focusing on the utilization of agricultural waste and manure. The process of waste separation began a month earlier, in February, coinciding with the introduction of new machinery, specifically **open windrows**. Organic waste is collected from various sources, including three hotels, **the municipalities of Menzel Jemil, Bizerte, Menzel Bourguiba, and Mateur, the Sciences University of Bizerte, five coffee shops, and a wholesale vegetables market**, as well as other local markets.

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The maximum capacity of the **composting plant is 350 tons/year of biowaste, 150 tons/year of cattle manure and 150 tons/year of wood waste and green waste.** The project aims to produce **approximately 75 tons of compost per year,** contributing to the sustainable management and utilization of organic waste in the region.

To support the implementation and operation of the pilot project, a team **of 20 NEETs and women** have been engaged. Integrating waste management practices in **Bizerte is crucial for promoting environmental sustainability and reducing waste sent to landfills.** The experience of Tunisian pilot is remarkable because it was able to achieve commendable results despite lacking the necessary tools and infrastructure.

MAIN CHALLENGE

- Waste separation at the source is a critical step.
- Transportation cost can be a significant challenge in the operation of a composting plant, especially if the site is located far from the waste generators.
- High labour costs can impact the economic viability of the operation, especially if labourintensive tasks are not optimized or automated.
- Keep NEETs and women engaged.

MAIN LESSON LEARNED

- Where waste materials are available, process should be achieved in the same area to take local advantage of the organic residues collected.
- Active role of the pilot in providing education on environmental management, organic waste treatment, agricultural practices.
- Cooperate with the Ministry of Agriculture to promote new opportunities in the field of organic waste recovery.
- Encourage more people in adopting circular practice in their homes and communities.



Figure 8. Pilot plant in Bizerte

Source: **SIRCLES**

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3.6 PILOT PLANT IN VILA SECA, CATALONIA

| INDICATORS | PLANNED | STATUS (July 2023) |
|----------------------------|---------|--------------------|
| Composting plant | 1 | Operational |
| NEETs and women contracted | 12 | 12 |

In **Catalonia** the pilot project began its operations **in May 2022**. However, the collection of green waste had already commenced in February of the same year. A total of twelve hotels participates in providing green waste for the project, contributing to the organic material available for composting. **The technology chosen is composed by 20 Modular composters 1m3 each and 4 for yard trimmings. The maximum capacity of the composting plant is 120 tones/year of food waste and minimum 80 and until a maximum of 400 tones/year of garden waste.**

The project aims to produce **approximately 18 tons of compost per year**, utilizing the collected biowaste. To support the implementation and success of the pilot project, **eleven NEETs and women** have been engaged. Their involvement not only contributes to the operational aspects of the project but also provides employment opportunities and promotes social inclusion.

The participation of twelve hotels demonstrates the commitment of the hospitality industry to environmental stewardship and sustainable practices. This collaboration showcases the potential for various sectors to work together towards a common goal of waste reduction and resource conservation. By promoting composting and sustainable waste management practices, Catalonia is taking proactive measures to protect the environment, enhance soil health, and contribute to a more sustainable future for the region.

MAIN CHALLENGE

- No economic support by the Municipality
- Constant management by Master Composters
- NEETs to be kept motivated
- After project sustainability

MAIN LESSON LEARNED

- Organisation and promotion of awareness campaign about compost production and use of quality compost in agriculture.

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Figure 9. Pilot plant in Vila Seca

Source: SIRCLES

3.7 PLANT IN VILLA D'ITRIA, ITALY

| INDICATORS | PLANNED | STATUS (July 2023) |
|-----------------------------------|---------------------------------------|--------------------|
| Composting plant | 0 (1 existing, 1 new demo site) | Operational |
| NEETs and women contracted | 8 | 7 |

When the project SIRCLES started, there was already an existing pilot in place. The pilot focused on raising awareness among citizens through information campaigns, aiming to improve the quality of the compost produced. The objective of SIRCLES in Italy was the sensitization of the stakeholders involved in the bio-waste management: municipalities, citizens, commercial activities, Ho.Re.Ca sector. As part of the sensitization to citizens the project made some special attention to students by creating a small modular composting site in **the Agronomic institute to be managed by them after capacity building and awareness raising**. To ensure the successful implementation and operation of the project, **seven NEETs and women** have been engaged. Their involvement not only supports the project's objectives but also provides opportunities for skill development and empowers individuals in the community.

The integration of the existing pilot into the project allows for the utilization of valuable insights and lessons learned. Through the combination of the existing pilot, information campaigns, and the engagement of NEETs and women, the project aims to create a sustainable and inclusive waste management system.

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MAIN CHALLENGE

- Unemployed young people with little interest in doing this kind of work.
- Improving biowaste quality and habits of citizens by means of NEETs will be challenging.
- Keep restaurants engaged after the Green Label Campaign.

MAIN LESSON LEARNED

- Pilot focused on public awareness to improve quality of final compost.
- Young people not aware on compost production from organic fraction: do not assume that messages conveyed 10 years ago when recycling started are still in people's minds.

Figure 10. Final event of pilot plant in Valle d'Itria

Source: Authors' elaboration



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3.8 EVIDENCE FROM SIRCLES PILOTS: THE VOICE OF IN-JOB TRAINEES AND LOCAL STAKEHOLDERS

During the SIRCLES project, Arco/PIN S.c.r.l. administered two questionnaires, one for in-job trainees and one for local stakeholders. The results are summarised in the following lines.

The questionnaire for **in-job trainees** was completed by **a total of 112 respondents** from the partner countries, out of a total of 121 project in-job trainees, with a completion rate of 92.6%. In general, in the target countries, women appear to be more involved. The most represented age group is between 25 and 54.

Educational background of respondents shows significant differences from country to country. For example, in Greece, the majority of those involved have at least a high school diploma, and some also have a master's degree. In Italy, the training of trainees ranges from secondary school to high school, with the majority having attained at least high school. In Jordan, training ranges from secondary school to a bachelor's degree, with 70 per cent of trainees in this range. In Lebanon, the majority of subjects have completed high school or have a bachelor's degree. In Palestine, education ranges from secondary school to a bachelor's degree, with an almost even distribution. In Spain, a large percentage of subjects (57%) have only completed secondary school. In Tunisia, although all levels of education are represented, most respondents have an elementary (42%) or middle school education (35%). By analysing this data according to gender, it can be seen that women are in the majority among those who have a higher education or a bachelor's degree, while men are in the majority among those who have an elementary, middle or bachelor's degree.

The majority of those involved per country (**83% and above**) are currently not enrolled in training, educational or vocational programmes. As regards current employment, **the majority of people never had a stable job (23%)**, but there are also significant cases of people who have been unemployed for more than two years (15%), unemployed for six months to one year (17%), casual workers (15%) and part-time workers (19%). A small percentage (5%) work full-time.

In response to the question "Do you feel you are facing a socially and/or economically disadvantaged situation?", **most respondents (54%)** stated that they **have difficulty providing for their own and their family's needs**. This difficulty emerges in all age groups considered. **However, a 20% did not reported difficulties**. In relation to the issue of social and economic disadvantage, **the majority of respondents (78%) have never received any form of social support or assistance**.

The feedback from in-job trainees regarding their experience with the SIRCLES project has been overwhelmingly positive. Many trainees reported that their perception of waste has completely changed since their involvement. They expressed that the project has significantly increased their awareness of environmental sustainability and the importance of proper waste management practices. The training led the trainees to tangible changes and improvements in their daily waste management habits. Moreover, the acquisition of technical skills and know-how through the project has greatly enhanced their employability prospects. The remuneration the trainees received during their involvement within the project has alleviated their financial insecurity, providing a sense of stability. Additionally, the project has facilitated the development of valuable contacts for future job opportunities. Trainees now feel equipped with the necessary skills, fostering independence and reducing their dependence on family financial support. Furthermore, the project has had a transformative effect on their personal growth, enhancing their self-perception and improving their relationships with others. Overall, the trainees view the SIRCLES project as a **positive and life-changing opportunity**.

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The questionnaire for **local stakeholders** was completed by a total of **71 respondents from the partner countries**, with a completion rate of 59,7%. In general, in the target countries, the most represented age group is between 25 and 54, as in the case of in-job trainees.

Professional background of the respondents is varied. Most respondents fall under the categories "**Agri-food business/market/food store**" (26.6%), "**Restaurant**" (20.3%), "**Local authority**" (15.2%).

With regard to the commitment of the organizations to which the respondents belong, most of them take care of the supply of organic waste for the project (55.1%). There is also a good percentage of project collaborators (37.2%), while the percentage of those who receive compost is very small (5.1%).

According to the stakeholders' perception of SIRCLES, the composting pilots are highly regarded for its positive impact. They believe the plants play a crucial role in improving organic waste management, leading to the reduction of municipal waste and contributing to enhanced urban health. Additionally, the plants effectively avoid the creation of new landfills, ensuring sustainable waste disposal practices. Stakeholders also appreciate that the installation of the pilots does not result in an increase in waste truck traffic. Furthermore, the absence of unpleasant odours and minimal visual disruption to the landscape are seen as significant benefits: in this sense, the strategic location of the plant, appropriately distanced from residential areas, further enhances its positive perception. Overall, stakeholders agree that SIRCLES has successfully improved the perception of waste management in various communities, fostering a more sustainable and environmentally conscious approach.

Finally, stakeholders were asked what policy/legislative change was needed to enable and incentivise good waste management practices in their communities; it was felt that **awareness-raising policies were needed, followed by policies to help citizens sort out waste types**. The **introduction of taxes that incentivise the fair division of waste** is also seen as a good way to improve waste management.

3.9 MAIN LESSONS LEARNED

To generalize and summarize what emerged for the pilots, the implementation of the 7 facilities has encountered several **challenges** that have hindered their progress and success.

- One of the primary possible obstacles faced is **disagreements**, which can create divisions and hinder collaboration among stakeholders.
- A **last-minute exit from** a local authority or another relevant stakeholder can disrupt project continuity. This can result in a loss of support and resources, impeding the implementation process, and/or require finding alternative solutions.
- The **logistics** of waste transportation, including the cost and availability, is challenging and timeconsuming. Transportation costs and issues, including licensing requirements, further complicate the implementation of the pilots.
- High **transport costs** can strain project budgets, especially if the composting plant is located far from the waste generators.
- **Licensing issues** can cause delays and administrative challenges.
- The **training** of NEETs and women is crucial for their effective involvement in the project.

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- **Lack of knowledge** and **awareness** about waste management and composting practices could stop their participation and hinder the project's success. The lack of knowledge about waste separation among stakeholders in many countries is another significant challenge. Proper separation at the source is a critical step in effective biowaste management, and without it, the composting process becomes more difficult and less efficient.
- **Identification of suitable sites** for the pilots has proven to be a time-consuming task, causing delays in project timelines. If the site is far from waste generators, the cost of transporting the waste to the facility can be a considerable burden on the project's budget. In addition, in many countries, legislation generates specific challenges and barriers.
- High **labour costs** can also impact the economic viability of the operations, especially if labour-intensive tasks are not optimized or automated. Finding ways to streamline processes and reduce labour costs becomes crucial for the sustainability of the projects. Moreover, without adequate financial backing, the projects may struggle to overcome various obstacles and achieve their intended goals.
- Lastly, **engaging unemployed young people** in this type of work can be challenging due to their lack of interest. Motivating and inspiring them to participate actively requires innovative approaches and incentives.

Implementing the 7 pilot plants has also provided valuable **lessons** in various aspects, including regulation, financial considerations, and awareness. These lessons learned can guide future initiatives and contribute to the success of similar projects.

- In terms of regulation, it is crucial to **involve local institutions** since the beginning of the project. Their support and cooperation can help navigate legal requirements and ensure compliance with regulations. Additionally, **engaging also with upper authorities** (i.e., national and regional level) can foster a supportive policy environment.
- **Multiple agreements with stakeholders** and the engagement of various parties are essential for the success of composting projects. By involving local institutions, NGOs, and social groups, a collaborative approach can be achieved, enhancing the project's impact and reach.
- Financial aspects play a significant role in the implementation of composting projects. The **involvement of the private sector** is suggested, both in providing a steady supply of bio waste and in selling the resulting compost. Moreover, encouraging bigger communities to participate in this business can also contribute to financial viability and sustainability.
- **Creating awareness** and promoting **public participation** is vital for the success of composting initiatives. Using collection bins at the family level can increase awareness and participation in waste separation, encouraging individuals to adopt circular practices in their homes and communities. Engaging local NGOs and social groups could also be an effective way to reach NEETs and women, providing them with opportunities to benefit from the project. Moreover, the active role of the pilot in providing education on environmental management, organic waste treatment, and agricultural practices helps disseminate knowledge and create a culture of responsible waste management.
- **Awareness campaigns** play a significant role in improving the quality of the final compost. Organizing and promoting campaigns on compost production and the use of quality compost in agriculture educates the public and encourages their active participation.
- Lessons learned also highlight the need to update messages and awareness efforts. Young people may not be aware of compost production from organic waste, assuming that messages conveyed years ago when recycling started are still in people's minds. **Continuing education** and awareness initiatives are necessary to ensure a well-informed society.

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4. SCENARIOS AND POLICY RECCOMENDATIONS

The implementation of the seven pilot composting projects faces numerous challenges. From political disagreements and stakeholder disengagement to transportation issues, legislation limitations, and lack of education and training, each obstacle has needed to be addressed strategically. Legislation and financial sustainability are key factors that need to be addressed, along with the involvement of regional or national authorities. Despite the challenges, these pilot facilities have demonstrated the potential for successful organic waste management.

Moreover, the implementation of the pilots has provided also valuable lessons:

Direct involvement of local institutions since the beginning of the project/idea.

Engagement of the private sector by promoting public-private partnerships.

Promotion of public awareness for the success of the initiatives.

| LESSON LEARNT | BENEFITS |
|---|---|
| Direct involvement of local institutions since the beginning of the project/idea | <ul style="list-style-type: none"> Navigate legal requirements. Ensure compliance with regulations. Foster a supportive policy environment. |
| Engagement of the private sector by promoting public-private partnership | <ul style="list-style-type: none"> Provide a constant supply of biowaste. Having compost buyers. Financial sustainability of the project. |
| Promotion of public awareness for the success of the initiatives | <ul style="list-style-type: none"> Encourage individuals to adopt circular practices in their homes and communities. pread knowledge and create a culture of responsible waste management. Improve the quality of the final compost. |

By applying these lessons, future projects can be better prepared to address challenges and achieve sustainable waste management practices.

It should be noted that the implementation of the SIRCLES model for waste management depends on the specific context in which it is applied, as it can be adapted to different countries, regions, and waste types.

In general terms, several scenarios can be outlined at the urban level, taking into account the existing level of governance and awareness (see Figure 3):

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1. **Bad governance and poor awareness:** In this scenario, waste management is characterized by ineffective policies and a lack of awareness among both citizens and businesses. This leads to uncontrolled waste production, open dumps, and a lack of ecological practices.
2. **Bad governance and good awareness, or good governance but poor awareness:** In these scenarios, there may be either ineffective policies despite a high level of awareness or good governance but a lack of awareness among citizens. This can result in inconsistent waste management practices and limited progress towards sustainable solutions.
3. **Different levels of quality of governance and awareness:** This scenario encompasses a range of situations where governance and awareness levels vary. Some areas may have relatively effective waste management policies but still struggle with awareness, while others may have high awareness but face challenges in governance.
4. **Ideal situation, with good governance and good awareness:** In this scenario, waste management is characterized by effective policies, well-informed citizens, and businesses that actively participate in ecological practices. This ideal situation enables the implementation of sustainable waste management systems and the promotion of circular economy models.

In addition, the local institutional mapping conducted for the SIRCLES at the early stages of the project revealed stark differences in waste management practices between target countries.

On one hand, some countries have dedicated legislation, well-established collection systems based on sorting, supported by efficient logistics and treatment facilities.

On the other hand, other countries may have immature legislation, low awareness among citizens and businesses, resulting in uncontrolled waste production, open dumps, and a lack of ecological practices.

Understanding these different scenarios and the disparities in waste management practices is crucial for implementing effective strategies for improving waste management and promoting circular economy models. By addressing governance issues and raising awareness, cities can work towards achieving sustainable and efficient waste management systems in their respective contexts.

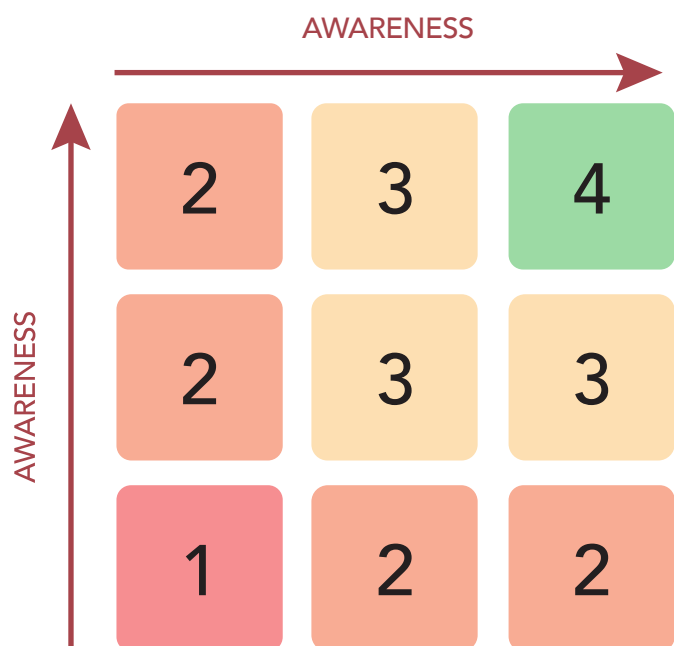


Figure 3. Source: Authors' elaboration

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4.1 POLICIES AND TOOLS FOR CIRCULARITY AT URBAN LEVEL

For the affirmation of a SIRCLES model, local authorities and policymakers have to support, plan, and manage material input flows required. So far, the following points constitute the precondition for the effective implementation of the model.

| | |
|--|---|
| <p>Awareness and knowledge of the material</p> | <ul style="list-style-type: none"> • In order to reuse waste materials safely and efficiently, a thorough understanding of their composition is essential. It is important to have knowledge about the specific waste materials and their potential for reuse or recycling. This understanding enables the identification of appropriate methods and processes for handling and repurposing waste. • When it comes to the development of new products using recycled materials, there may be legal constraints and product standardization requirements that can pose challenges. These constraints and requirements can potentially hinder upcycling activities, making it difficult to trade or sell these products in certain markets. • Compliance with legal regulations and product standards is crucial to ensure the quality and safety of recycled products. It is necessary to consider the specific regulations and standards applicable to the target market or industry to avoid any barriers or limitations in trading recycled products. • To overcome these challenges, collaboration among stakeholders is essential. This includes cooperation between waste management organizations, recycling facilities, manufacturers, and regulatory bodies. In addition, research and development efforts can contribute to finding alternative uses for waste materials and developing new processes or technologies to overcome any limitations. |
| <p>Deep understanding of the supply chain and local context</p> | <ul style="list-style-type: none"> • To effectively implement circular economy principles and address the demand and supply requirements, a comprehensive analysis of the context is crucial. This analysis should focus on various aspects such as the local supply chain, availability of waste materials, by-products, and secondary raw materials, local production and clusters, as well as the local needs and demand. • By conducting a detailed context analysis, it becomes possible to map out and further investigate the specific characteristics and dynamics of the local environment. This includes identifying the sources of waste materials, understanding the availability of by-products and secondary raw materials, and assessing the local production capabilities and clusters. • Moreover, it is essential to gain insights into the local needs and demands. This involves understanding the specific requirements and preferences of the local market, including the industries and consumers that could potentially utilize recycled materials or products. |

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| | |
|--|---|
| <p>Deep understanding of the supply chain and local context</p> | <ul style="list-style-type: none"> • With a deep context analysis in place, it becomes easier to direct the collected waste materials to the appropriate transformation plants. These plants can be selected based on their ability to satisfy the local needs and demands, thus facilitating the matching between the available supply and the existing demand. • By aligning the supply of waste materials with the local requirements, waste recycling efforts can be optimized. This approach enhances the circularity of the local economy by promoting the reuse and transformation of waste materials into valuable resources that cater to the specific needs of the community. |
| <p>Community awareness, with respect to waste collection</p> | <ul style="list-style-type: none"> • To foster community awareness and promote waste recycling, it is crucial to involve the local community in knowledge exchanges, networking activities, and other educational tools such as events and workshops. By engaging the community in these activities, valuable information and experiences can be shared, leading to increased awareness and understanding of the importance of waste recycling. • Communication/information tools, and nowadays social networking, play a vital role in promoting community awareness. These tools enable the dissemination of information about waste recycling initiatives, educational resources, and upcoming events. They provide a platform for community members to connect and stay informed about the latest developments in waste recycling. • By utilizing social networking platforms, communities can build networks and create online communities dedicated to waste recycling. These platforms allow for the exchange of knowledge, experiences, and best practices, fostering collaboration and collective action towards waste recycling goals. • Communication and information tools, such as websites, newsletters, and educational materials, are also essential for raising awareness within the community. These tools provide accessible and easily understandable information about waste recycling processes, benefits, and opportunities for involvement. They serve as educational resources that empower community members to take action and participate in waste recycling initiatives. |
| <p>System of incentives</p> | <ul style="list-style-type: none"> • Regulators and local authorities could play a crucial role in fostering waste recycling. One way they can do this is by implementing a system of incentives that encourages industries to adopt a circular thinking approach. • One potential incentive is to reduce taxation for recycled products. By lowering the tax burden on these products, it becomes more economically viable for businesses to engage in circular practices. This can help create a market demand for circular products and incentivize industries to incorporate materials obtained by waste recycling into their production processes. • By aligning economic incentives with sustainable practices, regulators and local authorities can create a favourable environment for businesses to embrace circular thinking and actively engage in waste recycling efforts. |

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Local authorities should play an important role in piloting the overall cooperation and coordination among citizens, industries, and academia, and addressing them relevant policies. For this reason, the following paragraphs ...

4.2 LOCAL AUTHORITIES AND CITIZENS

Citizens play a crucial role in the affirmation of circular economy models at the city level. To achieve this, it is necessary to **change citizens' behaviours** and **promote waste separation**. This can be done through the adoption of different bins and containers at home and on the street to enhance waste separation.

Local authorities have a responsibility to **raise awareness among citizens** about the importance of waste collection and separation. They should provide information on waste destinations and educate citizens on the impact of their waste on the environment.

Education at the school level, particularly in primary schools, is essential. It is important for cities to invest in awareness campaigns to ensure a good quality of biowaste, with proper separation and fewer impurities for composting. These campaigns should be refreshed every year through various events and initiatives.

In addition to awareness campaigns, **demonstration composters** can be placed in schools. This allows students to understand the cycle of organic waste and its uses, including composting and energy generation. This hands-on experience helps in reinforcing the importance of waste management and circularity.

Integrating circular economy principles into the education system from an early age can have a long-lasting impact on citizens' behaviour and mindset. By teaching children about waste separation and the value of composting, cities can foster a culture of sustainability.

Furthermore, ongoing engagement with citizens is crucial. **Regular communication** through various channels, such as social media, newsletters, and community events, can help maintain awareness and encourage continued participation in waste separation and circular economy practices.

It is important to note that the success of circular economy models at the city level relies heavily on the active **involvement of citizens**. Their commitment to proper waste separation and participation in recycling programs is essential for the effective implementation of circularity.

4.3 LOCAL AUTHORITIES AND INDUSTRIES

Industries and economic activities, as **big waste generators**, also play a key role in the affirmation of circular economy models at the city level. To achieve this, it is important to **increase awareness** among workers about the importance of proper waste separation. This can be done by including waste separation responsibilities in their job descriptions.

It is essential to establish a frequent and efficient method of waste collection. This requires arranging logistics and **promoting collaboration among municipalities and industries** to support and organize waste management systems. This is extremely challenging in those countries where there is no structured waste management system.

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Taxation can be used as a tool to contribute to the infrastructure and logistics of waste management. One option is to impose a fee based on the quantity of waste generated. Another option is to provide a discount for industries that demonstrate good waste separation practices. The taxation system should be implemented at the municipality level to ensure consistency.

In addition, replicating projects similar to SIRCLES can help introduce circular practices for other waste flows and materials. This expansion of **circular economy initiatives** can be achieved through **partnerships** among stakeholders, including industries, municipalities, and waste management organizations.

Integrating circular economy principles into the operations of industries can lead to resource optimization and reduced waste generation. This can be accomplished through the adoption of sustainable production practices, such as using recycled materials and implementing closed-loop systems.

Furthermore, **industries can collaborate with research institutions and innovation centres** to develop and implement new technologies and processes that promote circularity. This collaboration can lead to the development of innovative solutions for waste management and resource recovery.

It is important for industries to actively participate and engage in circular economy initiatives. This includes sharing best practices, reporting on waste management efforts, and actively seeking opportunities for collaboration and partnerships.

4.3 LOCAL AUTHORITIES AND ACADEMIA

Regarding the role of academia and educational institutions, it should be noted that different levels of schools have different roles to play in promoting sustainability and waste management practices.

Starting at the **primary school level**, it is important to work with children and **introduce thematic subjects on sustainability, ecological practices, and waste separation**. By instilling these values at a young age, children can develop a lifelong commitment to environmental stewardship.

In addition to **primary schools, agronomic schools and technical schools** also have an important role to play. These institutions can focus on **teaching sustainable agricultural practices** and **promoting circular economy principles** in their curriculum.

Effective communication about the environment and sustainability is crucial. It is important to train journalists who can effectively communicate these topics to make them accessible for all. By raising awareness and providing accurate information, journalists can play a significant role in promoting environmental consciousness and circular economy practices.

At the **university level, sustainability should be included in various academic programs**. This integration can be achieved by incorporating **sustainability-related courses** and projects into the curriculum. Universities should also establish **linkages and collaboration with industries and local authorities** to develop **innovative solutions** for waste management and circularity. Furthermore, academia should actively engage in **research and innovation** to advance waste management practices and promote circularity. This can involve conducting studies, developing new technologies, and collaborating with industries and local authorities to implement sustainable solutions.

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CONCLUSIONS AND FINAL REMARKS

The application of the SIRCLES model and the implementation of the project pilots, provided relevant information to outline policy recommendations for local authorities. To summarize, the main recommendations to enhance biowaste collection and composting practices are:

- 1. Awareness and knowledge of the material:** Local authorities should prioritize raising awareness and knowledge about biowaste among community members. This includes educating them about the importance of separating biowaste from other waste streams and understanding its potential as a valuable resource for composting.
- 2. Deep understanding of the supply chain and local context:** To effectively implement biowaste collection and composting practices, local authorities need to map out the sources of biowaste, identifying (or facilitate the installation of) potential composting facilities, assessing the local infrastructure (if available) and resources available for the collection and processing of biowaste.
- 3. Community awareness,** with respect to waste collection: Local authorities should focus on raising community awareness about the benefits of using recycled products. This includes promoting the use of compost produced from biowaste in the agricultural sector at the local level. By highlighting the positive impacts of compost, such as reducing reliance on chemical fertilizers and improving soil health, community members can be encouraged to support and utilize these products.
- 4. System of Incentives:** To further encourage biowaste collection and composting practices, local authorities should consider implementing a system of incentives. This could include measures such as reduced taxes or financial incentives for businesses and individuals engaged in biowaste management and composting. By providing economic benefits, local authorities can stimulate participation in these practices, leading to increased biowaste separation and compost production.

By implementing these policy recommendations, **local authorities** can create an enabling environment for biowaste collection and composting. This not only helps in reducing the amount of waste going to landfills but also contributes to the development of a circular economy, where biowaste is recognized as a valuable resource that can be transformed into compost for agricultural use.

As described, **citizens'** active participation and awareness are key to the affirmation of circular economy models at the city level. Through education, awareness campaigns, demonstration composters, and ongoing engagement, citizens can contribute to a more circular and resource-efficient future.

Industries also play a vital role in the affirmation of circular economy models at the city level. By increasing awareness among workers, establishing efficient waste collection methods and promoting partnerships, industries can contribute to a more sustainable and resource-efficient future.

By integrating sustainability into **education** at all levels and fostering collaboration between academia, industries, and local authorities, cities can create a strong foundation for the affirmation of circular economy models. This holistic approach ensures that future generations are equipped with the knowledge and skills needed to build a more sustainable and resource-efficient urban environment.

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