WASTECOSMART - Increasing regional innovation capacities for resources efficiency and integrated waste management through cooperation, research and technological development

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Abstract

Today, the performance of the European economy relies heavily on the import of raw materials and resources from other parts of the world. Despite this, Europe loses 60% of its 3 billion tonnes of solid waste through landfilling and incineration each year. This current situation has a harmful impact upon both the climate and the environment. From an economic and environmental point of view, it is high time for a paradigm shift for resource efficiency.With its 2011 *Resource Efficient Europe flagship initiative*, the European Union has laid out the political will to promote and implement innovative resource efficiency measures and to accelerate research and innovation in this area. In particular, Europe calls on regional stakeholders to act without delay and invest more and more effectively in sustainable growth with an emphasis on resource efficiency. *Innovative solid waste management* is a key driver for resource efficiency, impacting not only the supply of raw materials and energy, but also the quality of water, soils and ecosystems. The *optimisation of integrated waste management* is a key challenge for many European regions. It requires the formulation of comprehensive waste management strategies, the assessment of research and innovation needs and informed decision-making with regard to the choice of policies, processes and technologies suitable for specific regional circumstances.The WASTECOSMART project aims to contribute solutions to this challenge by increasing regional innovation capacities for resources efficiency and integrated waste management through cooperation, research and technological development. For the project, six research-driven triple helix clusters from science, industry and the public sector have been formed in Paphos (Cyprus), Central Hungary, Piedmont (Italy), Amsterdam (Netherlands), Stockholm (Sweden) and Liverpool City Region (United Kingdom). The project team is supported by waste and communication experts from Belgium and also collaborates with international partners to promote international collaboration and opportunities in waste management.The WASTECOSMART partners joined efforts to move waste management at the regional level up the waste hierarchy pyramid. Knowledge and expertise are shared amongst WASTECOSMART regional clusters,

to define the most efficient solid waste management strategies that can help local and regional authorities to make an informative decision and prevent waste generation.

Keywords

Solid waste management, resource efficiency, innovation, prevention, regional capacities, decision-making

Introduction

Today, the performance of the European economy relies heavily on the import of raw materials and resources from other parts of the world. Despite this, Europe loses 60% of its 3 billion tonnes of solid waste to landfill and incineration each year.The current situation has a harmful impact upon both the climate and the environment. From an economic and environmental point of view, it is high time for a paradigm shift for resource efficiency.

With its 2011 *Resource Efficient Europe flagship initiative*, the European Union has laid out the political will to promote and implement innovative resource efficiency measures and to accelerate research and innovation in this area. In particular, Europe calls on regional stakeholders to act without delay and invest more and more effectively in sustainable growth with an emphasis on resource efficiency [1, 2].

Demand for materials has long exceeded Europe's ability to independently generate what it needs. The continent imports over six times more resources than it exports, and its economy is now threatened by approaching shortages in primary materials [2].

Innovative solid waste management is a key driver for resource efficiency, impacting not only the supply of raw materials and energy, but also the quality of water, soils and ecosystems.

For sustainable waste management to succeed at regional and local levels, a new wave of innovation is required, ensuring "*that residual waste is close to zero and that ecosystems have been restored*" [2]. A number of European regions have already changed the paradigm and can lead the way in innovative waste management. The challenge is now to transfer innovative solid waste management strategies and best practices throughout Europe.

Moving towards a recycling society

In its 2008 Waste Framework Directive[3], the European Commission outlined a *five-step waste hierarchy*, with waste prevention as the best option and landfilling as the worst. In some European countries, recycling and recovery are the predominant waste management options, with the use of landfills being reduced to negligible amounts, whereas other countries still use landfills for the majority of their waste. It will be a crucial task in the future to move these countries up the waste hierarchy to achieve the EU's goal of becoming a recycling society.

This challenge presents a real economic opportunity. Solid waste management and recycling industries currently have a turnover of around €137 billion which is just over 1.1% of the EU's Gross Domestic Product. Together, these areas create over 2 million jobs. Overall, municipal waste recycling increased from 19% to 38% between 1998 and 2007. If European countries recycled 70% of their waste, it could create at least half a million new jobs across Europe[4].

However, many regions struggle to move up the waste pyramid, and *optimisation of integrated waste management* is a key challenge. It requires the formulation of comprehensive waste management strategies, the assessment of research and innovation needs and informed decision-making with regard to the choice of policies, processes and technologies suitable for specific regional circumstances.

Key focus is given to the implementation of *waste prevention* through modern manufacturing, eco-design, the reduction of packaging, and collaboration with industry and consumers for greener products.

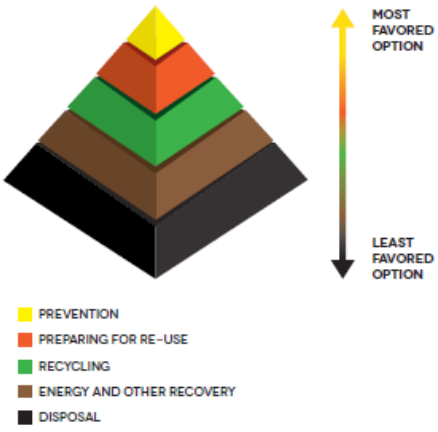

Fig 1 Waste management hierarchy [5]

Six research-driven triple helix clusters from science, industry and public sector have been formedin Paphos (Cyprus), Central Hungary, Piedmont (Italy), Amsterdam (Netherlands), Stockholm (Sweden) and Liverpool City Region (United Kingdom) within the European Union's Seventh Framework Programme for research, technological development and demonstration. Cluster partnersjoined up efforts to move waste management at the regional level up the waste hierarchy pyramid. Their aim was to contribute solutions to this challenge by increasing regional innovation capacities for resources efficiency and integrated waste management through cooperation, research and technological development. Knowledge and expertise were shared amongst WASTECOSMART regional clusters, to define the most efficient solid waste management strategies that can help local and regional authorities to prevent waste generation. The cluster regions are supported by waste and communication experts from

Belgium and also collaborate with international partners to promote international collaboration and opportunities in waste management.

Materials and Methods

The six cluster regions are working together to define a *Joint Action Plan (JAP)* for resource efficiency in waste management by 2016 (Figure 2). In the process of developing this, detailed analysis of each of the regions was carried out to identify the current situation from socio-political, legal and regulatory point of view and future needs of each region. This was achieved using a range of *questionnaires* and *face-to-face interviews.*

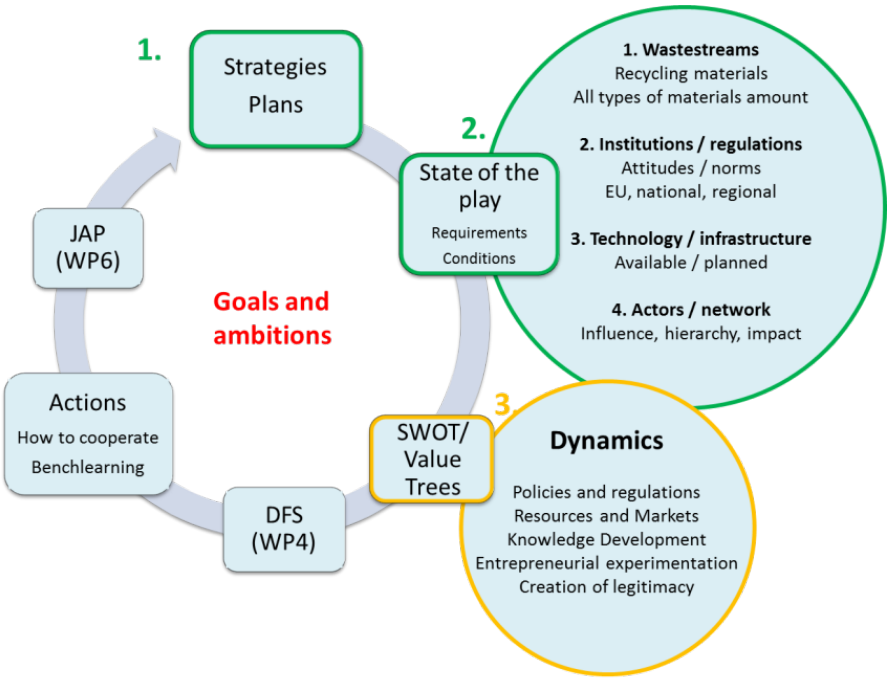

Fig 2 A process of generating a Joint Action Plan (JAP)[6]

To better understand technological innovation, it is not sufficient to focus only on innovation processes within a single organisation. Increasingly, the speed and direction of technological innovation is the result of complex interaction between many actors of various types that are working together in a certain environment. Therefore an analytical framework called *Technological Innovation System (TIS)* has been developed to support policy-making that promotes innovations in a certain area [6].

Specific regional strengths, weaknesses, threats and opportunities were explored around interventions towards a resource-efficient waste management practice based on different concepts and factors illustrated on Figure 3 [7].

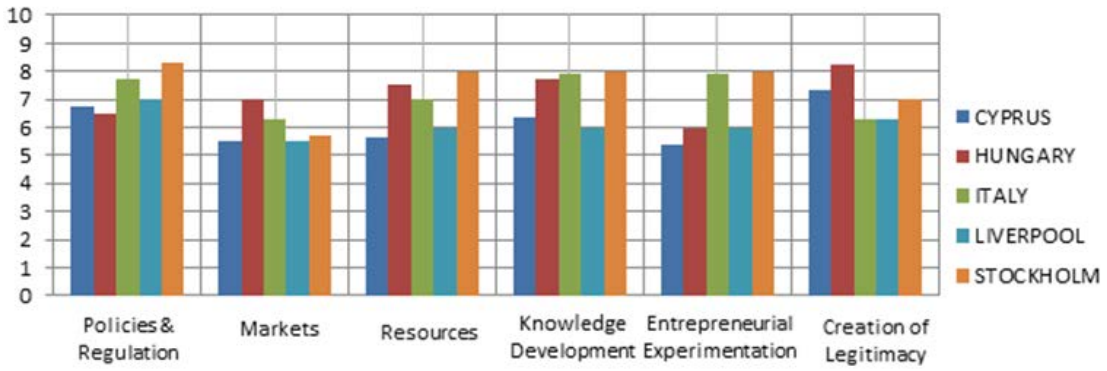

Fig 3 Comparative similarities in the ratings of concepts or factors used to identify, assess needs, research and innovation capacities in each cluster by country color

A *Decision Support Framework (DSF)*was built on the mentoring guide framework, enhancing regional waste management development for politicians and policymakers. The DSF is an optimisation

decision support framework that is translated into a toolfor policymakers and goes beyond the regular life-cycle analysis (LCA).

The DSF toolused by each cluster region is called “Definite”. It isbased on multi-criteria analysis, leading to a more pragmatic approach to waste management. It is a generic tool that could be adapted to different uses [8].

Results and Discussion

Waste treatment

The first analysis has shown that treatment methods for Municipal Solid Waste (MSW) still differ substantially between regions in Europe. Recycling accounts for more than 50% in Liverpool and Piedmont, whilst energy recovery is the main method of waste treatment in Amsterdam and in Stockholm. Although landfilling is considered the least favoured option under EU policy, and should only be used when all other treatment options have been exhausted, we can still find a high share of landfilled MSW in – for example - Cyprus (exceptional high), Liverpool, Piedmont and Budapest. The differences are illustrated in Figure 4 [7].

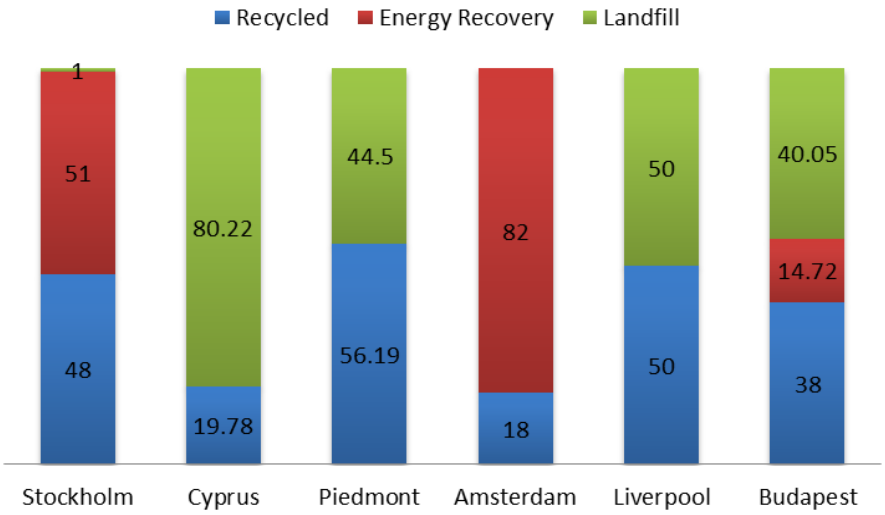

Fig 4 Municipal Solid Waste (MSW) treated - percentages for the six regions

Regions Goals and Visions

A common goal of all regions is the reduction of CO_2 emissions, and all have established infrastructures to collect landfill gas. Waste reduction and increased energy recovery are also common goals, which contribute to minimising landfilling and improving re-use and recycling rates (Figure 5). Typical solutions include incineration, anaerobic digestion and bio-drying for production of compost or Solid Recovered Fuel (SRF). Based on the country reports, it can be concluded that EU directives and policies have been the main driving force behind the waste management planning of the Regions. Thus many similarities are seen with respect to recycling, landfilling and energy recovery.

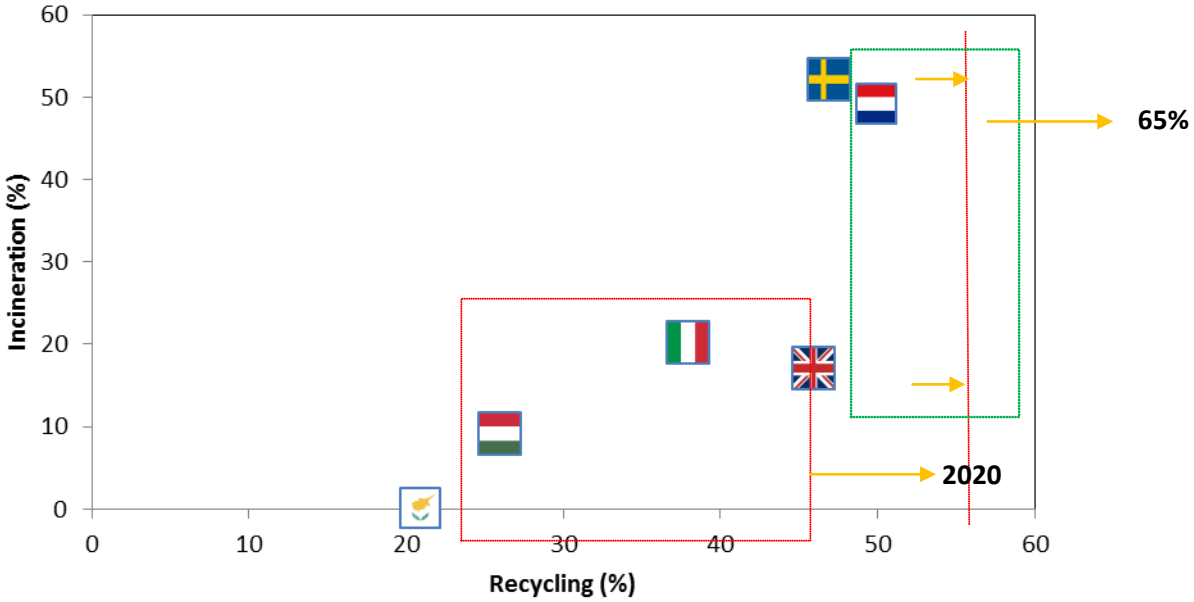

Fig 5 Incineration versus Recycling rates of the six regions

On the other hand, waste prevention and the handling of waste as a resource are having a larger influence in policy making. Waste Management Plans show a growing trend towards resource efficiency goals and integrated Waste Management with Carbon Footprint, social aspects and economic considerations (though to varying degrees in each region). Smart city and Circular Economy considerations are identified in the Waste Management Plans of Stockholm, Amsterdam and Liverpool. In Amsterdam's Smart City vision, for example, the goal of waste treatment facilities is to shift solely to a practice of energy recovery and reuse of materials, to reach a circular economy. Liverpool, through its thirty-year Resource Recovery Contract (RRC), is aiming at a reduction of the amount of landfilled Local Authority Collected Municipal Waste to 10% by 2020 and 2% by 2030, through energy recovery of

residual waste (Figure 6). Stockholm bases recovery of waste on reuse value, giving priority to the recovery of Waste Electrical and Electronic Equipment (WEEE) and textiles.

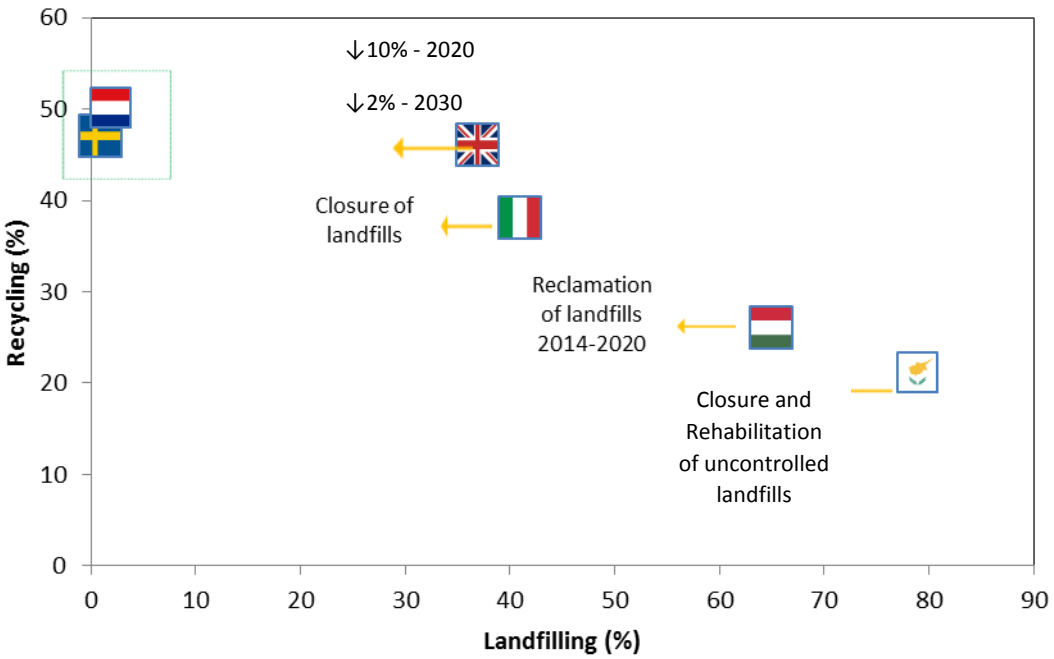

Fig6 Landfilling versus Recycling rates of the six regions

DSF analysis

The DFS tool has a number of objectives that could be clearly defined to facilitate the understanding and the use of the tool such as use of resources, cost-benefit analysis, environmental and social impact. It can handle both qualitative and quantitative data by changing the influence of different objectives. By bringing all the data together it is possible to see where synergy exists but also the challenges for commonality across the European member states. The presentation of the results from the

tool is fairly easy to grasp. The tool also allowed to analyse the sensitivity to changes in priorities of the objectives (Figure 7).

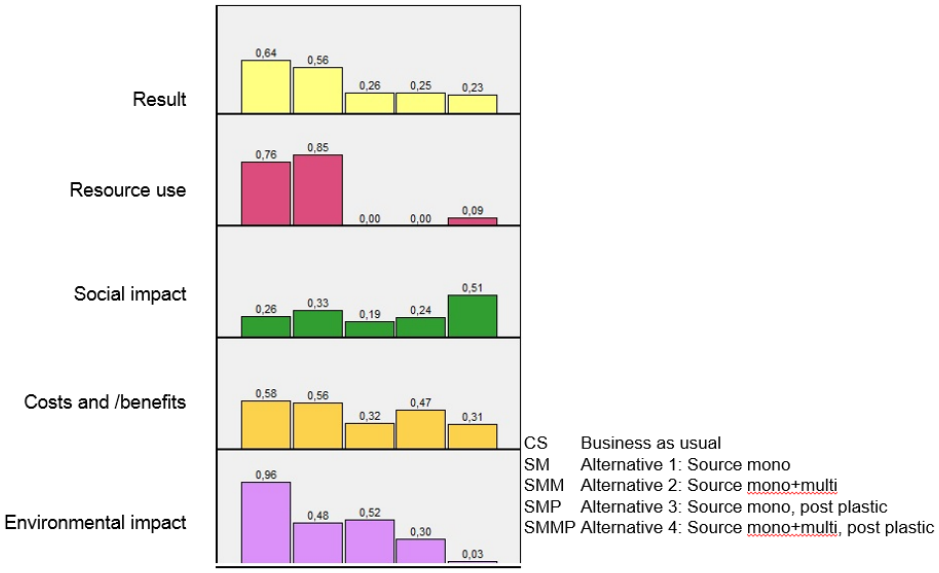

Fig 7 Ranking of pre-defined waste management alternatives [8]

Conclusion

Several similarities between the regions regarding weaknesses and threats have been found. Particular, there were weaknesses in collaboration between different actors. This is important to avoid "reinventing the wheel" again and to share knowledge and learn from each other.

It also turned out that there was a lack of knowledge and awareness of waste management, which can inhibit the development of waste management in the regions. Universities could be an important actor to minimize the lack of knowledge.

The result shows there is a lack of motivation or incentives for citizens and businesses to become more resource efficient. The attitude and the willingness of citizens and businesses to participate in preventive work regarding waste needs to be changed.

It is vital to involve competent authorities and relevant stakeholders at an early stage in the development and definitions of valid and innovative waste strategies and engage them in their implementation.

A solid definition of the alternative strategies that should be evaluated in the DSF is important.

The objectives could be improved for easy understanding and application. In some cases they are more adapted to traditional waste treatment methods rather than waste prevention or innovative waste management.

The main outcomes of DSF analysis concluded that there were particular aspirations for the different regions. All waste management choices within the regions sought to optimize carbon reduction wherever practicable. However, depending on the region, the level at which this was being engaged in varied greatly. It was found that the level of ambition of strategies was a concern for the more established regions such as UK and Sweden. Hungary's very high level of centralisation for waste management meant that there were strict regulations coordinated by the National Waste Management Agency.

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