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A Glance at the World

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This column comprises notes and info not subjected to peer-review focusing on waste management issues in different corners of the world. Its aim is to open a window onto the solid waste management situation in any given country, major city or significant geographic area that may be of interest to the scientific and technical community.

East European recycling societies: The first steps of rural communities in Neamt County, Romania

Romania is still facing major disparities between urban and rural areas regarding the proper waste management (WM) services (Ciuta et al., 2015; Mihai, 2015). This gap suggests that the rural WM sector needs to be a priority in current environmental policy. This paper provides a an overview regarding the recycling prospects in the case of rural communities in Neamt County.

Neamt County includes 5 cities and 78 communes (rural municipalities). Since 2011, separate collection of recyclables (paper/cardboard, plastics, and organics) was implemented only in Piatra Soimului, Borlesti and Rediu localities. After the closure of rural dumpsites under the EU regulations in 2009, municipalities were required to seek licensed waste operators through direct or delegated management. The separate collection is done by setting up the special collection containers in some points within densely populated areas. There are private operators to provide the mixed waste collection services once per week in rural areas of Neamt County (in the case of collection points) and once per month, or when containers reach the filling degree viable for transportation, in the case of dry recyclables.

Between 2011 and 2012 the collection of recyclables from commercial sectors and households was performed across several communes (Fig. 1). The share of separate collection (SC) reflects the approximate value of reuse and recycling, if it is taken into consideration the fact that all these recyclable fractions are marketed by waste operators to specialized companies. The mixed collection prevails in rural areas, separate collection and recovery of recyclables are still at an early stage in most of the communes with values below 6%.

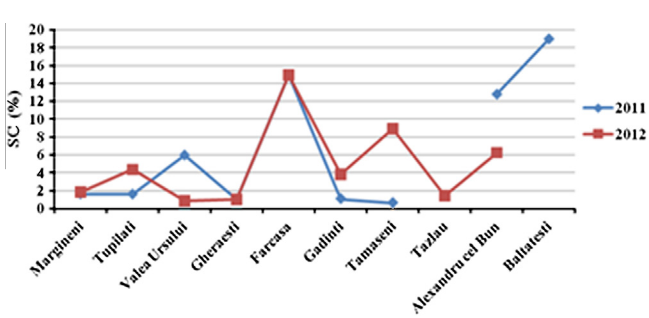

Fig. 1. Share of separate collection (SC %) of total collected household waste.

The threshold of 10% SC is exceeded only by Farcaşa, Bălţăteşti and Alexandru cel Bun communes. The recyclables collected from commercial sectors are more likely to be recovered than those derived from households, because residents do not properly segregate these fractions. Therefore, household waste is mainly disposed in landfills. In some cases, the collected mixed waste is transported to a sorting station where recyclables are extracted (metal, plastic, paper/cardboard, wood, glass) and, thereafter, marketed to specialized units from cities.

Recovery of waste may experience a significant growth in the coming years with the expansion of separate waste collection facilities in most of the rural communities within the County. The correct separate collection is a key issue of urban and rural areas in order to increase the efficiency of the WM system. Environmental education is crucial in rural areas in order to diminish the effects of waste dumping and to develop an optimal separate collection system which encourages the recycling and reuse of household waste.

Nowadays, traditional WM systems still prevail in most of rural municipalities in the study area, but new separate waste collection facilities are already operational in some of them.

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Waste management needs and opportunities in Riyadh

Riyadh, the capital of the Kingdom of Saudi Arabia (KSA), is one of the fastest developing and most affluent cities in the Middle East

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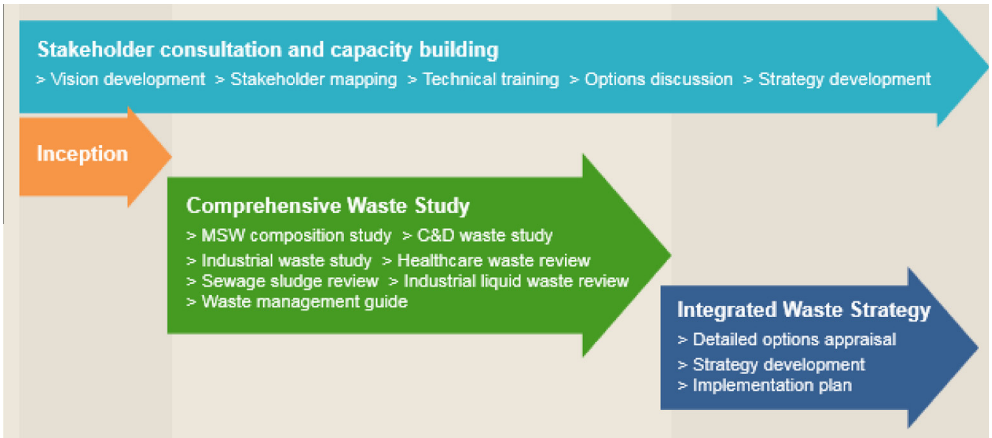

Fig. 1. Scheme of strategy development tasks.

region. The population of approximately 5.4 million in 2014 is estimated to rise to almost 8 million by 2030, an increase of over 40% in 16 years.

The city's rapid urban and industrial growth has increased the volume and types of wastes produced. Riyadh city is, therefore, facing increasingly significant challenges in the management of its wastes and that poor waste management is creating serious environmental damage.

In 2013, Ricardo-AEA was commissioned by the Arriyadh Development Authority (ADA) on behalf of the High Commission for the Development of Riyadh to develop a Waste Management Strategy for the city. The strategy has been developed in partnership with close key stakeholders and draws upon 18 months of data collection, detailed analysis, options appraisals and action planning. The strategy is intended as a framework for developing an integrated solid waste management system for Riyadh which meets international best practice. The development of the strategy considered the current situation, the needs and aspirations for the city's waste management, and the necessary actions that will be needed over time to implement the strategy.

The baseline waste management situation

Riyadh's existing municipal waste management system is funded directly by the government through the general budget. Users of the waste management system make no contribution to the cost of providing the services, either via direct or indirect user charges. Under these arrangements, because users of the service do not incur the costs, there are no incentives on waste producers and transporters to reduce the quantity of waste generated at source or divert waste from illegal dumping to other management options further up the waste hierarchy.

There is a comprehensive regulatory framework for waste management in KSA, however, these regulatory requirements are not stringently enforced in Riyadh as a whole. Illegal tipping and dumping is widespread. Compliance with the waste acceptance, classification and tracking system (a requirement of National Environmental Standards 8, 9 and 12) is poor and, in some cases, fraudulent (e.g. use of a single waste manifest for multiple movements of waste).

The strategy

The strategy comprises five main elements: (1) the *Baseline*, presenting the results of a number of comprehensive waste situational studies; (2) the *Vision and Principles*, that have been developed with stakeholders to underpin and inform the development of the waste management strategy; (3) the *Options appraisal* detailing an assessment of the range of waste management options, focusing on municipal waste but with consideration given to commercial, industrial, healthcare and sewage sludge waste streams; (4) the *Strategy Framework* which sets out specific objectives, targets and actions for each of the key elements of the strategy; and (5) the *Implementation Plan (Short & Long Term)* which outlines a timeline for the actions that will be required to deliver the strategy (Fig. 1).

The key priorities for the next 5 years in terms of the strategy's implementation will be: setting up a new Waste Management Information System, with the data being used to create updated projections and business cases for new services and infrastructure; building new infrastructure for the treatment of MSW, C&I, and medical wastes; phasing out illegal dumping and moving towards engineered landfill sites; implementation of segregated collection services (domestic and commercial); raising public awareness of issues relating to waste, recycling, and consumption; educating and building capacity of the sector/workforce; and developing an investment climate to underpin new services and infrastructure.

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Investigating waste to energy potential in Al-Hasa region, Saudi Arabia

Al-Hasa is located in the Eastern part of Saudi Arabia and has seen a very rapid urbanization in the last ten years. In addition to the tens of villages, Al-Hasa's region has five major cities of Al-Hofuf, Al-Mobarraz, Al-Oyoun, Al-Omran and Al-Jafar. Al Hasa is growing rapidly and so is its waste. The estimated current annual municipal solid waste (MSW) generation is about 0.51 million tons. The MSW consists of organic food, agriculture and garden waste (50%), paper and cardboard (12.5%), plastics (11%), glass (6.3%), metals (3.2%), wood (4.8%) and other types of waste (9.4%). Two landfills (an old dumpsite and a new landfill) in the city of Hofuf are currently open, however, efforts are exerted to reduce the amount of waste sent there in order to increase the lifetime of the landfill. On the other hand, the region is increasingly consuming large amounts of power generated from burning the fossil fuels (heavy oil, diesel, and gas) to meet the demand of the various residential, commercial, industrial and agriculture sectors.

This research aims to assess the potential value of Waste-to-Energy (WTE) in alleviating the MSW and electricity demand challenges in Al-Hasa region.

Currently, incineration is the dominant WTE approach. In the current study, two scenarios have been considered: Mass Burn and Mass Burn with Recycling. The Mass Burn scenario caters for full utilization of MSW (general waste stream) while Mass Burn with Recycling assumes removal of recyclable materials from the general waste stream and use of the remaining for WTE production. Forecasting was performed by keeping the year 2013 as a base until year 2035. The MSW production rate was assumed to be 1.4 kg/capita/day. Literature documented a combustion efficiency of 25–30% for operated WTE facilities in different places across the globe. A combustion efficiency of 25% was assumed in WTE calculation for Saudi Arabia.

The energy content of Saudi MSW was calculated based on the calorific content of MSW materials and the MSW composition. Table 1 shows the energy contents in kW per kilograms of MSW for the Mass Burn scenario and Mass Burn with Recycling scenario. The energy content for Mass Burn scenario was estimated at 3.11 kW h/kg. The energy content for Mass Burn with Recycling scenario was estimated at 1.19 kW h/kg.

The big difference between the energy contents of the two scenarios resulted from removing the high energy contents materials (plastic, paper, wood, and textiles) from the Mass Burn scenario and considering them for recycling purposes.

Fig. 1 suggests a WTE Production Forecast for the two scenarios (i.e. with and without recycling) in accordance to the population annual growth rate of 3.4% (Ouda, 2014) in Al-Hasa region. In 2013, through Mass Burn there was a potential of producing approximately 23 MW of electricity which will grow to around 47 MW up to the year 2035. On the other hand, Mass Burn with Recycling had the potential of producing around 4 MW of electricity in 2013 with a forecast of around 7.5 MW by the year 2035. So the Mass Burn scenario can produce about 6 folds higher than the Mass Burn with Recycling scenario.

Table 1
Saudi MSW energy contents in kW h/kg.

Material	Waste composition %	Energy content (Btu/lb)	kW h/kg in material	kW h/kg in waste HHV
Paper	12.5	6800	4.394	0.5492
Plastic	11.0	14000	9.046	0.9950
Glass	6.3	0	0.000	0.0000
Wood	4.8	7300	4.726	0.2268
Textiles	2.8	8100	5.199	0.1456
Organic	50.0	2400	1.551	0.7753
Others	12.6	5200	3.360	0.4234
Total energy contents for Mass Burn with recycling (kW h/kg)				1.1987
Total energy contents for Mass Burn (kW h/kg)				3.1153

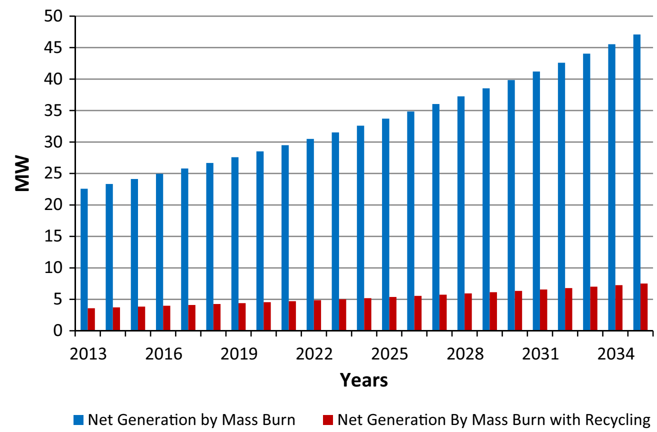

Fig. 1. Electricity generation forecast in Mega Watts (MW) for potential WTE facility in Al-Hasa region for the two scenarios.

Further investigations are recommended to compare the two scenarios also using financial, social, technical and environmental criteria.

The environmental studies should also include carbon credit analysis. The socio-economic studies should consider WTE production costs, recycling value, land saving, job creation, and human capacity-building opportunities. And technical studies should be focused on determining the optimum Waste-to-Energy technology to be implemented in the KSA.

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