

Annex 9 Priority areas for investment pipeline activities in the waste sector transition to circular economy

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1 Strengthening waste prevention

For successful implementation of waste prevention measures, a combination of regulatory, economic, technical and communication mechanisms is required. The measures have to cover all life-cycle stages – design, sourcing of raw materials, production, distribution, consumption, waste generation and end of waste. The following table contains a list of most widely implemented waste prevention instruments and the life-cycle stage at which the relevant instrument can be applied.

Table 1 - List of most widely implemented waste prevention instruments and the life-cycle stage at which the relevant instrument can be applied

	Design	Extraction	Production	Distribution	Consumption	Waste	End-of-waste
Legal instruments	Product standards Prevention targets Green public procurement	Technology standards Product standards Prevention targets	Technology standards Product standards Prevention targets	Prevention targets Market entries	Prevention targets	Prevention targets Technology standards	Product standards (end-of-waste criteria)
Economic instruments	Positive/negative financial stimuli Extended producer responsibility	Positive/negative financial stimuli	Positive/negative financial stimuli	Extended producer responsibility Positive/negative financial stimuli	Positive/negative financial stimuli	Extended producer responsibility Positive/negative financial stimuli	
Communication / other	Labelling Awareness raising/education Voluntary agreements	Awareness raising/education Voluntary agreements	Awareness raising/education Voluntary agreements	Awareness raising/education Voluntary agreements	Labelling Awareness raising/education Marketing Voluntary agreements Green public procurement	Awareness raising/education Voluntary agreements	Awareness raising/education Green public procurement Marketing Voluntary agreements
Technical instruments	Ecodesign	Technology standards	Reuse (through remanufacturing) Technology standards	Reuse (of packaging)	Reuse (reuse shops etc)	Reuse (reuse of parts)	

1.1 Regulatory and technical instruments

Existing situation

When it comes to measures affecting design, production and product distribution, a positive movement has been noted in regards with the ISO 14001 waste management system, which has been recognised as important for conducting business efficiently by a growing number of companies, but this measure is still not sufficiently applied to be able to result in waste prevention.

A national action plan for green public procurement for the period from 2015 to 2017 was adopted, with a view to 2020, whose focus was introducing basic green measures in public procurement for priority product and service groups

Regulations on conditions and environmental permit issuing, with a goal to prevent and control pollution from industrial and agricultural activities. This permit directs the so called “large polluters” to use the best available techniques (BAT), such as, among others, using technologies producing small quantities of waste and promoting recovery and recycling of matter produced and used in the process, and, where it is applicable, waste

Numbers of essential requirements for products are introduced into the legislation like market bans on non RoHS compliant electrical and electronic equipment as well as on non Essential Requirements compliant packaging. Several EU Eco-design Regulations are directly applicable (without the need of transposing) into Croatian legislation. However, the enforcement of essential requirements and eco-design is lagging behind.

Ordinance on the European Union Environmental Sign - EU Ecolabel is adopted, which regulates the procedure and fees for awarding the EU Ecolabel, the composition and operation of the Advisory Expert Committee, as well as the participation of individuals, associations and organizations in the EU Ecolabel award process. This Ordinance regulates the framework for the implementation of Regulation (EC) No. 66/2010 on the EU Ecolabel. Ministry of Economy and Sustainable Development also operates a national eco-label “Friends of environment “

Is there necessity for investments in regulatory instruments for waste prevention?

Waste prevention is identified by EU legislation as the top priority measure for addressing waste management problems. A series of EU legal documents require sustainable design, production and use of products and services. Although usually voluntary, a multitude of harmonised standards on the EU-level through CEN (European Committee for Standardisation) should apply equally across EU common market. The following non-exhaustive list describes the obligatory and regulated voluntary (standards, eco-label) instruments that EU member states should apply to improve waste prevention:

1. *Replacing virgin materials with more sustainable materials*

- sourcing of renewable and sustainable raw materials (e.g. bioplastics):
 - quality standards to boost market uptake and consumer confidence (e.g. for bioplastics - EN 16640, EN 16785-1, EN 16785-2, EN 17228, EN 16760, biodegradable plastics - EN 13432, EN 14995
 - labelling schemes and green claims to indicate that quality standards are met (e.g. bio-based products: EN 16848 and EN 16935)
- sourcing of recyclates
 - quality standards to boost market uptake and consumer confidence
 - labelling schemes to indicate that quality standards are met
 - database and standardised tools and formats to track substances of concern throughout the supply chain developed by European Chemical Agency (ECHA)

2. Design and manufacturing of products optimised for sustainable resource use (curbing unnecessary raw material use)

- Requirements for encouraging usage of sustainable alternatives
 - bans (e.g. bans on a number of single-use plastics required by Single Use Plastics Directive)
 - marketing restrictions, fees on and taxes to be paid by consumers or producers (e.g. plastic bags and other single-use plastics)
- Requirements for reducing the amount of raw materials used in products
 - Essential requirements (e.g. Packaging Directive, WEEE Directive)
 - eco-design regulations
 - ecomodulated fees of EPR schemes (Waste Framework Directive)
 - Ecolabel (e.g. the criteria in Ecolabel for rinse off cosmetics)
- Requirements for encouraging the use of recycled plastic material
 - standards and end-of-waste criteria –to ensure that recyclates are safe and to create legal certainty and a level playing field compared to virgin materials (e.g. Regulation (EU) N° 333/2011 on iron, steel and aluminium scrap ; Regulation (EU) N° 1179/2012 on glass cullet; Regulation (EU) N° 715/2013 on copper scrap)
 - eco-design regulations
 - eco-label (e.g. EU Regulations on rinse off cosmetics, furniture, textile products)

3. Ensuring sustainable use

- design that aims at environmental sound and safe use phase of life-cycle (to reuse, refurbish or recycle products, we must be able to rely on their safety)
 - obligation to improve the traceability of chemicals (database and formats for tracking substances of concern developed by ECHA)
 - restriction of hazardous substances (a number of heavy metals in packaging, WEEE, ELV, batteries, phthalates, PFOA, cadmium in plastics, etc.)
 - requirements for food-contact materials (Regulation (EC) No 1935/2004 , Regulation (EC) No 2023/2006 , Regulation (EU) No 10/2011)
- requirements to design with the aim of prolonged product use
 - design of products containing more reusable parts
 - targets for reuse (e.g. WEEE, ELV Directives)
 - closed-loop take-back systems like in EU Ecodesign and Energy Labelling of rechargeable electrochemical batteries
 - design of products containing more repairable parts
 - eco-design (EU Eco-design Regulations on washing machines, refrigeration appliances, electronic displays)
 - ecolabel (EU Eco-label Regulations on furniture, televisions)
 - design of durable and upgradable products
 - ecomodulation of EPR fees (Waste Framework Directive)
 - Ecodesign Regulation on vacuum cleaners
 - Ecolabel for textile products regulations

4. Design for enhancing collection, dismantling and recycling

- Encourage design of products **easily collectable and sortable**

- Marking requirements - symbols for identification of material (packaging legislation, Medical devices directive, Ecodesign for electronic displays, Ecodesign for rechargeable electrochemical batteries, Ecolabel for furniture, Ecolabel for televisions but could be extended to other products like construction materials, ELV, WEEE, all battery types, some single use plastics)
- Another material shall not cover or hinder the symbol
- Encourage design for **easy dismantling**
 - easy dismantling requirements (EU Waste Framework Directive Construction products regulation, End-of-life vehicles directive, Waste electrical and electronic equipment directive. Examples of more practical EU requirements for ensuring are specified in Ecodesign for household washing machines, Ecodesign for refrigeration appliances, Ecodesign for electronic displays, Ecodesign for rechargeable electric batteries, Ecolabel for furniture, Ecolabel for televisions regulations)
 - ecomodulation of EPR fees
- Encourage design for use of polymer types currently collectable sortable and recyclable (design for recyclability, dismantlability, sortability)
 - Requirements for design for enhanced use of recyclates - EU Waste Framework Directive (including ecomodulation of EPR fees), Packaging Directive (essential requirements), Construction products regulation, WEEE Directive, Ecodesign for rechargeable electric batteries, Ecolabel for rinse off cosmetics, Ecolabel for furniture, Ecolabel for televisions

5. *Creating markets for recycled waste*

- Launching of pledging campaign - inviting suppliers and buyers of recycled plastic materials to submit voluntary pledges to supply or respectively to buy amount of recycled plastics (voluntary instrument announced in Annex III to the EU 'Plastics Strategy')
- quality standards for recycled plastic materials (different grade qualities) or end-of-waste criteria
- Ecolabel criteria to provide guidelines for companies to improve their environmental performance
- Green Public Procurement

Priority investment measures for awareness raising

The approach for implementation of quality standards, labelling schemes to indicate standards are met, essential requirements, requirement on the presence of hazardous substances, marking requirements (for identification of material), eco-design follow similar approach and the therefore funding of their implementation is similar. Basically funding is required for regulatory costs:

- Appointing and funding of authority for enforcing the requirements on products (usually metrology authorities) or alternatively outsourcing the control and quality assurance to private sector, which will require a mechanism for cost recovery and accreditation of conformity control organizations.
- Funding of inspection and verification procedure - physical inspection, taking samples, test representative sample of units (usually more than one unit) of the model of the product to be verified.
- Laboratory costs and equipment for testing. The usual way to inspect the heavy metal content of packaging is to collect packaging samples and to send them to a specialised laboratory that can perform atomic absorption spectroscopy or other analytical techniques. The analyses are often rather expensive and time consuming and only a limited set of samples is examined. Another

option is to use an X-ray fluorescence gun, which is less reliable but which can serve for a first selection of samples that need to be examined more in detail in the laboratory.

- Development and adoption of designated standards for measurements and calculations
- Training of the personnel of the control authority

For implementation of bans and fees for placing on the market of certain non-sustainable products, funding of another set of regulatory measures is required.

- Appointing and funding of authority for enforcing the bans and fees for placing on the market. In order to ensure that producers, importers observe the ban and pay the fees, an active identification of producers/importers and checking of actual volumes, they put on the market would be needed. This will require audit procedures with checking of accounting systems of producers/ importers to compare volume of products for which they paid fees with the volumes of products they bought, sold or produced. Comparison with documentation issued by other institutions (e.g. Customs) and crosschecks with the accounting systems of their partners (e.g. suppliers of raw materials for manufacturing of the products, distributors) would also be needed.
- Funding of inspection at retailers - physical inspections of points of sale to verify that banned products or cheaper products (for which fee is not paid) are not offered to end users.
- Establishment of a fund (or expansion the activities of existing fund) for accumulation of fees and rules and procedures for spending the fees.
- Funding of Information system for registering the producers/ importers, the quantities they put on the market, degree of consumption reduction, etc.
- Training of the personnel of the market surveillance authority.

1.2 Education and awareness raising for all stakeholders

Existing situation

Globally, there is a tendency for providing more and more convenience for consumers and more frequent replacement of products with newer and more modern ones. This in turn leads to an increase in the use of disposable products and the generation of large amounts of waste. With the development of the economy, these global trends are intensifying in Croatia as well. One of the most important mechanisms for ensuring sustainable consumption is raising public awareness and motivating more sustainable purchases. At present, there is a **lack of targeted action** to radically alter patterns of consumption and production through information tools and incentives.

Is there necessity for investments in awareness raising?

Transition to a circular economy and its associated behavioural change will require action from all sectors of society. Positive practices and behaviours will need to be promoted while 'bad habits' - built up over many years- will need to be discouraged and even prohibited. Improved economic conditions can lead to a seemingly endless pursuit of material goods. This needs to be offset by a return to traditional consumption patterns to include reuse, repair, reduce, exchange and recycle remains once at the end of a usable lifecycle. A working mix of incentivisation and enforcement may be required to increase good behaviour, and the benefits of changed behaviour must be emphasised.

Priority investment measures for awareness raising

There are three necessary elements to effectively shift individuals toward sustainable consumption and encourage separate waste collection behaviour:

- 1) **Informing consumers** - providing consumers with accessible and comparable information about the sustainability of products/ harmful impact of waste is essential to influencing individual decisions and

enabling sustainable consumption and participation in separate collection schemes. **Funding will be needed in:**

- (a) launching information/ awareness raising campaigns;
 - (b) on-product or on-package communications like labels, standards, claims – this includes funding the development of legal requirements, instructions, standards, implementation of the requirements through market surveillance;
 - (c) Development of a Guideline on providing effective product sustainability information to consumers.
- 2) **Motivating the consumers** – simply being aware usually is not enough to make consumers choose more sustainable products or separate their waste. Financing would be needed for behavioral change initiatives like:
- (a) development and implementation of sustainable waste management aligned with circular economy principles linked Communication Strategy to change public attitudes and create public intolerance towards unsustainable products and waste pollution. Funding will be needed for i) establishment of partnerships with key media; ii) improving educational programs with a view of building a lasting and correct behavioral culture; iii) dialogue and partnership with all stakeholders (supporters and opponents); iv) identifying potential natural opinion influencers to be attracted as partners; v) precise targeted work with dissatisfied residents and NGOs, identification of informal leaders and preventive work with them;
 - (b) launching campaigns for influencing individual choice and behavior that may be executed through one or more communications channels, including TV, radio, print media, social media, events, face-to-face, websites, apps, print mailings or email.
 - (c) Positive (encouraging) and negative (discouraging) financial and non-financial incentives
- 3) **Providing alternative sustainable options to consumers** - individuals cannot shift toward sustainable consumption if sustainable alternatives (products and services) and separate collection schemes are not available. To enable consumers to make sustainable choices financing would be needed:
- (a) By companies – to apply eco-design measures aiming to: eliminate problematic or unnecessary plastic packaging; move from single use toward reuse models; highest percentage of materials to be reusable, recyclable or compostable; set recycled content target, etc.
 - (b) By the competent authorities - ban, restrict, or place a tax/fee on unsustainable products; implement incentives; legal requirements for reusability, recyclability or compostability; suitable procurement policies; establishment of separate collection schemes

Priority investment measures for education and training

For the implementation of the new EU circular Economy concept and transition from linear to circular economy economic model in waste management sector in Croatia comprehensive capacity building actions need to be implemented. **Assessment on training needs and as well as training plans need to be developed.**

A **needs assessment** is a systematic process for identifying needs or gaps in the participating stakeholders' current knowledge, skills, or abilities.

There are different **assessment instruments** including direct interviews with experts from administrations, business and other stakeholders, questionnaire sent to the selected stakeholders and focused live meetings with stakeholders once available.

Stages of training assessment of different stakeholders and methodology of training and implementation are presented on the following scheme:

- a. Stakeholder's analyses: define the main stakeholders and their functions

- b. Defining training needs through training needs assessment
- c. Method of trainings customised for different stakeholders
- d. Implementation of trainings
- e. Evaluation of trainings - evaluation tools, and readjustment of trainings if necessary

Most important stakeholders with significant role(s) for design and operation of waste management system in Croatia are the following:

- State administrations
- Economic operators who carry out collection and treatment of waste
- Producers of products which are in the scope of EPR
- Municipalities
- Citizens and NGOs

In order to facilitate communication amongst the various actors, the training must be targeted at a multidisciplinary group and provided using different methods - organized workshops, distant training using WEBINAR platform, practical 'in-situ' modular delivery, etc.

2 Improvement of preparation for re-use and recycling

2.1 Infrastructure for separate collection: biowaste, plastic, paper, metal, C&D waste, textile etc.);

The legislative-regulatory framework for waste management in the RC seeks to establish a higher quality waste management system based on waste prevention and an efficient system of separate collection of waste which is adequately recovered.

Higher recycling rates will require highly efficient collection systems operating in all LSGUs of Republic of Croatia as they move towards capturing greater quantities of material.

2.1.1 Bio-waste

Existing situation

Separate collection of bio-waste is a prerequisite for using bio-waste as a resource in a circular way. Collecting bio-waste separately from other municipal waste keeps the levels of pollutants and contamination at low level as far as possible and make possible its use as valuable secondary resources such as soil improvers, organic fertilisers and biogas. Introducing separate bio-waste collection will require a significant investment by the public sector.

Currently on the territory of Croatia separate collection of biowaste is built in a limited number of municipalities. Data for 2019 show that in only 31% of LSGUs, separate collection of biowaste is conducted¹. It is mostly biodegradable waste from gardens and parks on public surfaces. The quantities of separately collected bio-waste from households are negligible. 14 composting facilities are in operation with total capacity of 135.696 t/year and 29 biogas installation with total capacity 1,264,763 t/year. Biogas installation treat mainly waste from agriculture origin. Quantity of separately collected municipal biowaste for 2019 is 97. 518 t/year which represents 19 % of generated biowaste.

Home composting is also presented as good practices for biowaste treatment. This decreases the need for separate bio-waste collection and thus reduce the waste transport and management costs and the associated environmental impacts. This is especially relevant in sparsely populated areas. "The goal is to achieve that household's separate bio-waste from other household (municipal) waste by putting them in bio-waste containers, and by composting in personal composters or their garden, decrease the total quantities of produced waste. This measure will encompass rural areas, i.e. suburbia to urban centres with a larger number of households with yards. According to NWMP in the Republic of Croatia, the implementation of this measure could deduct 90,000 t of bio-waste annually."²

Current system of separate collection is still not sufficient to deliver enough biowaste for composting to the existing 14 composting plant. Collected quantity is still less than build composting capacities of 135.696 t/year. Separate collection for biowaste need to be more efficient at this stage and it is necessary to secure equipment and vehicles for separate collection of biowaste and the facilities for treatment (composting and biogas producing) of separately collected bio-waste.

Increasing the scope of system for separate collection at this stage does not make sense as long as capacity for biological treatment are not build to cover all LSGUs.

¹ Report on municipal waste 2019 (http://www.haop.hr/sites/default/files/uploads/inline-files/OTP_lzvjec%20C5%A1%C4%87e%20o%20komunalnom%20otpadu%20za%202019_2.pdf)

² Chapter 3.1.1.2 "Home composting" of the NWMP

Is there necessity for investments in bio-waste collection?

Legally binding targets for collection are set out in the legislation. **National Waste Management plan** sets the targets for biowaste in:

- 1) Target 1.3, “Separately collect 40% of mass of produced bio-waste constituent in municipal waste”, must be met, along with
- 2) Target 1.4, “Landfill less than 25% of mass of produced municipal waste”.

Additionally, Target 1.2, calls for separate collection of 60% (by mass) of produced municipal waste (primarily paper, glass, plastic, metal, bio-waste etc.).

Several EU legal documents address the issue of treatment of bio-waste including general waste management requirements, during waste treatment. Priority for waste recycling, are laid down in the revised Waste Framework Directive which also contains specific bio-waste related elements (new recycling targets for municipal waste, which includes bio-waste) and a mechanism allowing setting quality criteria for compost (end-of-waste criteria). Landfilling of bio-waste is addressed in the Landfill Directive which requires the diversion of biodegradable municipal waste from landfills.

At this stage, the NWMP targets for biowaste collection of 40% are not achieved, as well reduction of landfilling to less than 25% of mass of municipal waste produced.

In accordance with NWMP the municipal waste management system will be based on a system for separate collection of municipal waste, through:

- Collection at the source of waste generation,
- recycling yards, on containers on public surfaces and
- implementing the regulations for special categories of waste (packaging waste, waste tyres, waste EE equipment, etc.)

The NWMP do not give priority or specify the percentages of the waste that will be collected through each of the above listed methods. The final results that have to be achieved are presented in Table 1.

Table 2 - Overview of target values for 2022

Total produced Municipal waste <1.571.222 t		
Separately collected municipal waste >942.733 t		Mixed municipal waste <628.489 t
Separately collected municipal waste (paper, glass, plastic and others) >741.617 t	Separately collected bio-waste >201.116 t	

SOURCE - NWMP ID

Priority investment measures for bio-waste collection

It is obvious that it is not within the power of individual LSGU to finance initial investments for containers and trucks for bio-waste collection through the municipal waste fee. Financial support to municipalities through national and European funding would be needed. To this end, a **financial aid mechanism** should be implemented to ensure that the financial resources will achieve the maximum result at the lowest cost, the investments are affordable for the population, monitoring of the achieved results and financial penalties in case the expected results are not achieved. Therefore, funding will be needed for:

1. Feasibility studies for selecting the best option. There are variety of technical approaches for biowaste collection (e.g. collection of food and green waste in common container; collection in 2 separate containers; door-to-door systems, bring systems, etc.) and depending on the local conditions some of them are more suitable in rural areas others are more appropriate for highly populated residential areas. Moreover, when biowaste collection starts it will allow reducing the

frequency of residual waste collection and prolonging the useful life of landfill cells, which should be evaluated in the feasibility studies. **Financing will be needed for development of feasibility studies, their technical assessment and financial evaluation and their final approval for funding.**

2. Supply of equipment for separate collection of biowaste (trucks, containers, etc) – in accordance with the investments for the best option identified in the respective feasibility study. National wide coverage of system for collection and treatment of biowaste need to be build trough gradually increasing the number of municipalities with biowaste collection and in a parallel with the progress of investment and construction process of biowaste treatment installations.
3. Incentives for achievement of the bio-waste collection target. LSGU have to be incentivised to make efforts for achievement of the targets. Economic instruments like landfill tax increase the price of landfilling making it less attractive option than separate collection and recycling. **Financing will be needed for establishment of mechanism and rules for collection of the landfill tax, binding the landfill tax with the achievement of the targets for biowaste collection and reduction of biodegradable waste landfilling, spending the accumulated funds, etc.**
4. Promotion of home composting – investment support for providing citizens with home composters and support to the local self-government in awareness and encouragement of the local population to compost in their households.

2.1.2 Infrastructure for separate collection of dry recyclables - plastic, paper, metal, glass

Croatia met targets for recycling and recovery of ELV and WEEE and assessment showed that waste management system does not require special significant investment for further improvement of those special waste categories. Therefore, this subsection presents the financial needs for separate collection of dry recyclables relevant for achieving the re-use and recycling targets for municipal waste under the WFD and packaging waste under the PPWD.

Existing situation

Dry recyclable waste is collected through:

- Door-to door collection
- municipal recycling yards - separate collection systems for households financed and organized by LSGUs
- through containers on public places(financed by LSGUs).
- established national schemes for special categories of waste whose funding is based on extended producers responsibility principle (Environmental Protection and Energy Efficiency Fund) – packaging waste, WEEE, ELV, etc.
- Depositing refund system – beverage bottles (plastic, glass) and metal cans
- Separate collection of valuable waste based on entirely market principles private collection companies (paper, metals, PET, PP) -

Regarding packaging waste In 2019, a total of 49% of packaging waste was recovered. Individual target for recycling of plastic achieved was 36%. Individual target for recycling of paper achieved was 74%³. Paper is 23% in the composition of MSW. Big portion of the paper is coming from packaging which is in the scope of EPR but printed paper is also significant quantity. For example in Austria printed paper generated is 10 time more than paper from packaging origin.

According to the data from Waste Management Plan system for collection of **Ferrous and Non-ferrous metals** and their subsequent treatment is well functioning. Ferrous and Non-ferrous metals from different sources after pre-treatment operations are delivered for recycling in Croatian metallurgical enterprises. Big quantity of metals is exported for recycling abroad.

³ Report on packaging and packaging waste 2019 (http://www.haop.hr/sites/default/files/uploads/dokumenti/021_otpad/lzjesca/ostalo/OTP_privremeno_amb.PDF)

Regarding **WEEE** in 2019, the minimal prescribed goals were met for recovery and recycling applied per category of EE devices and equipment, ranging from 76,8 to 99,5% for recovery and 76,8 to 99,5% for recycling, depending on the EE equipment category according to Annex I of the Ordinance⁴.

Targets for EoLVs in 2019 are 99,98% recycling and 99,61% recovery by the weight of generated EoLVs on the territory of RC⁵.

Is there necessity for investments in Infrastructure for separate collection of dry recyclables?

The assessment of the current situation shows that the targets for the collection of specific waste streams have been met except for packaging waste. In the case of packaging waste this is done mainly through the collection of recyclable waste from large generators (where the waste is large and homogeneous) and less through separate collection from households. Although the targets have been met, most of the primary packaging remains in mixed municipal waste. Therefore, the contribution of packaging waste collection from households to the fulfillment of the general target for recycling of municipal waste need to be increased. NWMP sets a target for separate collection of 60% (by mass) of the municipal waste generated (primarily paper, glass, plastic, metal, bio-waste etc.).

Another factor determining the need to strengthen separate collection by households is the upcoming new targets of Directive (EU) 2018/852 amending Directive 94/62/EC on packaging and packaging waste:

- 65% of total packaging waste by December 31st 2025.
- 70% of total packaging waste by December 31st 2030.

The increased targets will require an increase in separate collection from households as the opportunities for collection from large generators have already been exploited. Compared to door-to-door collection, other collection methods would not lead to a significant increase in household waste collected as they are more inconvenient for the households (recycling yards) or has already reached its limit (DRS; market-based collection of wastes with high price such as metals, paper, some plastics).

Priority investment measures for dry recyclables collection

Investments in separate collection from households would be needed by both producers (Environmental Fund) and LSGU. However, the main burden for the achievement of the target for municipal waste recycling will be on LSGU as the producers (Environmental Fund) is responsible only for collection targets for specific waste streams (but still contributing for achievement of municipal waste recycling target). Therefore, LSGU would need financial support for the initial investments under the same aid mechanism described in the biowaste collection section – financing of: 1) feasibility studies 2) supply of equipment 3) monitoring 4) economic incentives (e.g. landfill tax).

The density of separate collection containers per number of households achieved in some EU countries with traditions in separate collection from households could be used as a reference criterion for the **amount of investment required** in separate collection systems – at least one container (or set of containers for different materials) per two households.

Although the financing of the separate collection of dry recyclables comes from two sources (producers and municipalities), it is recommended to build a common infrastructure for separate collection of EPR and non-EPR waste. A mechanism for sharing investment and operating costs will be needed.

⁴ Report on WEEE 1019 (http://www.haop.hr/sites/default/files/uploads/dokumenti/021_otpad/lzjesca/ostalo/lzje%C5%A1%C4%87e%20EE%20otpad_2019_final_WEB.PDF)

⁵ Report on ELV 2019 (http://www.haop.hr/sites/default/files/uploads/dokumenti/021_otpad/lzjesca/OTP_Otpadna%20vozila%20%20otpadne%20gume_preliminarni%20podaci%20za%202019_FINAL.pdf)

2.1.3 Single use plastic

Existing situation

In Croatia already exists well established legal base for single use plastic carrier bags and deposit refund system for plastic beverage bottles. However, the transposition and implementation of the Single Use Plastics Directive (Directive (EU) 2019/904) has not been completed yet.

Is there necessity for investments in single use plastic management?

The Single Use Plastics Directive requires that the following measures shall be taken in order to reduce the harmful impact of single use plastic products:

- Bans on placing on the market – Straws, Stirrers, Cutlery, Plates, EPS Beverage containers (incl. caps and lids), EPS Food containers, EPS Cups, Balloon Sticks, Cotton bud sticks, Oxo-degradable plastic;
- Consumption reduction through 1) Fees paid by producers/ importers, or 2) fees paid by consumers; 3) legal obligations such as SUP not to be provided for free and/or obligations to provide sustainable alternatives at the point of sale - Non-EPS cups, their covers and lids and Non-EPS Food containers, Lightweight plastic carrier bags (>15µm and <50µm)
- product requirement caps and lids to be firmly attached to the bottle - non-EPS beverage containers and their caps and lids
- minimum content of recycled plastics (target to incorporate 25% of recycled plastic in PET bottles as from 2025 and 30% in all plastic bottles as from 2030) - Plastic bottles
- marking on each item to indicate it is made from plastic - Sanitary towels, Wet wipes, Tobacco filters, Cups for beverages
- EPR schemes with full cost coverage and subject to plastic recycling targets - Packets and wrappers, Very lightweight plastic carrier bags (<15µm) and Other plastic carrier bags (>50µm)
- EPR schemes with partial cost coverage (for clean up and residual waste collection/treatment) and not subject to plastic recycling targets - Wet wipes, Balloons, Tobacco products
- Consumption reduction target for Lightweight plastic carrier bags (>15µm and <50µm)– consumption does not exceed 40 lightweight plastic carrier bags per person by 31 December 2025
- Targets for separate collection for recycling equal to: 77 % (weight) of products placed on the market by 2025 and 90% by 2029 - Beverage bottles
- Legally binding labels - biodegradable and compostable plastic carrier bags

Priority investment measures for single use plastics

For the SUP management measures described above the financial resources for the following **regulatory and enforcement costs** would be needed:

- Bans on placing on the market – identification of companies producing/importing single-use plastics, appointing competent authority for market surveillance, inspection producers/ importers and points of sale;
- Fees paid by producers/ importers - identification and registration of companies producing/importing single-use plastics, appointing competent authority for market surveillance, inspecting producers/ importers and points of sale, information system for monitoring the reduction, procedures and rules for collection and spending the fees

- fees paid by consumers - identification and registration of companies selling single-use plastics, appointing competent authority for market surveillance, inspecting points of sale (make test purchases, question staff and inspect records), information system for monitoring the reduction, procedures and rules for collection and spending the fees
- legal obligations such as SUP not to be provided for free and/or obligations to provide sustainable alternatives at the point of sale - identification and registration of companies selling single-use plastics, appointing competent authority for market surveillance, inspecting points of sale (make test purchases, question staff and inspect records), information system for monitoring the reduction
- product requirement caps and lids to be firmly attached to the bottle, minimum content of recycled plastics, marking on each item to indicate it is made from plastic, Legally binding labels - quality standards, harmonized test methods, quality assurance schemes, market surveillance, inspection
- EPR schemes with full cost coverage and subject to plastic recycling targets - subsidizing innovation and introduction of new technologies for recycling of packets and wrappers (by producers/ Environmental Fund)
- EPR schemes with partial cost coverage (for clean up and residual waste collection/treatment) and not subject to plastic recycling targets – rules and procedures for collecting fees from producers and spending of the funds by waste collection/ treatment companies
- Targets for separate collection for recycling – new investments by the Deposit Refund System in vending machines, collection and counting centers with the increase of the targets

2.1.4 C&D waste

Existing situation

According to NWMP the total quantities of construction and demolition waste produced in the period 2016 - 2022 are estimated at 32.2 million tonnes. The quantities of C&D will increase in the following period as Croatia was in 2020 affected by two major earthquakes (one in the City of Zagreb and the other in Petrinja). The construction and demolition activities will intensify as there are large number of buildings that must be recovered/repaired/demolished and this will cause as well the figure demonstrated the necessity of recognizing this waste as the priority categories of waste in RC and that, in the following period, groundwork is prepared for the efficient management of this type of waste. Valuable properties of C&D waste are still not utilized and probably the main part is landfilled.

In 2019, 24 crushers for construction waste with total capacity of 2,97 mil tones/year were registered. Currently construction and demolition waste are treated in mobile units, asphalt bases and at certain landfills where it is used as cover for landfilled waste or simply disposed. Still, it is estimated that about 13% of generated construction waste isn't evidenced through waste management information system. It is presumed that these are unreported data in the case of export, temporary storage, implementation of procedures for which no permit has been obtained or waste disposed of at wild dumps⁶.

It is planned an **Action Plan for separate collection and recycling of construction and demolition waste** to be developed that will include:

- assessment of the quantities of produced construction and demolition waste;
- the availability of current capacities and available technologies for recycling

⁶ Report on construction waste 2019

(http://www.hoop.hr/sites/default/files/uploads/dokumenti/021_otpad/izvjesca/ostalo/OTP_Gradjevni_izvjesce_2019.pdf)

- an estimation of the need for new capacities and possible adaptations or modernisation of current facilities
- Supply of equipment for recycling yards for construction and demolition waste and improving the technology of existing recycling yards
- constructing and equipping new and increasing the capacities of existing mobile units for recycling construction and demolition waste;

Is there necessity for investments in C&D waste management?

Directive 2008/98/EC on waste and repealing certain Directives sets a target for 70% material recovery of C&D waste by 2020.

NWMP of RC sets target for 75% separate collection of C&D waste by 2022.

Currently, these targets are not achieved, and this waste category takes a large volume at landfills.

Priority investment measures for C&D waste

The necessary facilities for final treatment of C&D waste are already available in Croatia but in order to increase the quantities for recycling more organizational measures and investments will be needed for improving selective deconstruction, separation at source and collection of C&D waste from small generators (especially C&D waste from repairs in households):

- funding of regulatory and enforcement costs – imposing stricter obligations on investors (e.g. construction permit is issued if the investors presents a C&D management plan and commissioning permit is issued in case the plan is fulfilled), training of permitting authorities; strengthening the inspection and control; the stricter control will boost the market for C&D treatment services and private investments in mobile and stationary treatment facilities
- provision of services for small C&D generators – funding will be needed for **completion of the nationwide network of recycling yards** where households and other small scale generators bring their C&D waste; additional regulatory costs may arise if waste acceptance rules and procedures are applied to ensure that only pre-sorted and selectively deconstructed C&D waste are accepted at the recycling yards (e.g. visual check, sampling, testing, measuring, registering of the quantities, differentiated tariff policy for different material types and materials of different quality)
- upgrade of existing recycling yards – in case the focus is shifted to selective deconstruction and sorting of C&D waste at source some existing recycling yards may need upgrade to provide enough space for acceptance and storage of different types of C&D waste instead of accepting mixed waste in common storage; with the development of separate collection schemes there will be more free space in recycling yards as some waste types (paper, glass, plastics, bio-waste) currently collected at the yards will be diverted to separate collection schemes;
- recycling yards could be made eligible for the financial aid schemes through the state budget or international financial institutions (like bio-waste and dry recyclable waste)

2.1.5 Textile waste

Existing situation

According to the data on estimated composition and quantities of municipal waste in the RC the portion of textile waste in mixed municipal waste is 3.7%. The quantities of waste textile footwear waste that is separately collected or separated from municipal waste are relatively small. Special regulation has been introduced, regulating the management of this type of waste in 2015. (Ordinance on textile and footwear waste (OG 99/15)). It is estimated that a high percentage of textile waste is still disposed via landfilling in the RC, especially if it is contained in mixed municipal waste. Separately collected textile waste is exported or recycled. In 2019 the waste management permit for final process of recovery of waste textiles and waste footwear had 16 companies in Croatia, while others are mainly performing sorting or preparation for final

treatment⁷. One of the the biggest is factory in Zabok, with capacity of around 8,000 t/year. The waste management system for textile and footwear waste is insufficiently developed.

Taking into consideration the data provided, the estimated quantity of textile and footwear waste which was in 2019 a part of mixed municipal waste is 51.632 tonnes, i.e. 12 kg per capita annually while total quantity produced was 60.190 t. Separately collected types of textile and footwear waste (production and municipal), including textile packaging, constituted 12.060,91 tonnes. Around 13% of separately collected textile waste is recovered in the RC and 7% was exported from country., 64% was landfilled while the remains are temporary stored

Is there necessity for investments in textile waste management?

Textile waste take part in the targets for recycling of MSW and targets for reduction of waste for landfilling. As this waste stream represents 3.7% of the mixed municipal waste quantity, its potential need to be used for increasing recycling and reduction of landilled waste.

Priority investment measures for textile waste

Funding will be needed for:

- investments in recycling yard network - existing separate collection system for textile and footwear waste need to be improved and such system to be built in all municipality in a parallel with building recycling yards and re-use centers. As the source of funding will come from producers (because they are obliged under EPR to cover the costs, which can be performed either directly or if such decision is taken following the experience with other EPR waste streams – through the EPEEF) a mechanism for reimbursement of the costs for recycling yards and re-use centers should be envisaged
- Investments in textile waste treatment - Boosting the sorting, reuse and recycling of textiles including through innovation, encouraging industrial applications and regulatory measures such as EPR.
- Covering the **regulatory and enforcement cost** for implementation of eco-design measures to ensure that textile products are fit for circularity, ensuring the uptake of secondary raw materials, tackling the presence of hazardous chemicals; This will include costs for quality standards, harmonized test methods, quality assurance schemes, market surveillance, inspection.

2.2 Re-use and recycling infrastructure on the state level

Existing situation

- **Recycling yards**

In 2019, there were **221 recycling yards and 121 mobile recycling yards in Croatia**⁸. The ASWM prescribes to LSGUs a minimal number of recycling yards or mobile units, depending on the number of citizens in the LSGU. The execution regulation determines the types of waste that recycling yards are obliged to receive (problematic waste, waste paper, metal, glass, plastic, textile, bulky waste, edible oils and fats, detergents, paints, medicine, EE waste, batteries and accumulators and construction and demolition waste from minor household repairs).

The total number of established recycling yards, including mobile units and the results they achieved is deemed dissatisfactory and in the near future necessitates an increase in their number and capacity. However taking into account that recycling yards are much less convenient for the households another

⁷ Report on waste textiles and footwear 2019

([http://www.hoop.hr/sites/default/files/uploads/dokumenti/021_otpad/izvjesca/OTP_izvje%C5%A1%C4%87e_tekstil_2019%20\(final%20WEB\).pdf](http://www.hoop.hr/sites/default/files/uploads/dokumenti/021_otpad/izvjesca/OTP_izvje%C5%A1%C4%87e_tekstil_2019%20(final%20WEB).pdf))

⁸ Report on municipal waste 2019, MoESD

alternative approach would be for some of the waste streams with bigger contribution for recycling a door-to-door collection schemes to be enhanced (as described in previous sections).

- ***Sorting facilities for separately collected waste***

Available sorting installations (70 000 total capacity) are not sufficient and not all of collected waste can reach recycling facilities

Lack of sufficient sorting facilities results in not achieving the 50% targets for re-use and recycling set-out in the Waste Framework Directive. New methodology counts waste after process of sorting and entering effective recycling process. The sorting capacity is insufficient even taking into account the fact that some of recyclable waste don't need to be sorted in standard sorting installations – waste in the scope of deposit refund system, recyclable waste from big market chains and other big business producers of dry recyclables.

In principle sorting installation are planned at regional level.

After sorting, separately collated waste is taken to certified companies for recycling, or other treatment.

- ***Facilities for biological waste treatment***

Aerobic biological treatment (composting) of bio-waste, in 2019 was conducted in 11 composting plants with a total capacity of around 124.389 t/year, of which all of them had a valid waste management permit. In 2019, of the total 29 biogas facilities, 18 biogas facilities possessed the permit for anaerobic biological treatment of bio-waste, totalling a capacity of 1.064.596 t/year. **The system for separate collection of bio-waste is insufficiently developed in most LSGUs.**

- ***Other facilities for material recovery of specific waste streams (EPR waste)***

According to the data by CAEN, the total capacity for material recovery of special categories of waste was 900,000 t/year in 2012. The available capacities for the treatment of some special categories of waste are sufficient (e.g. packaging waste), and some even significantly overshoot current needs (end-of-life vehicles 250,000 tonnes, EE waste 66,000 tonnes).

Is there necessity for investments in re-use, recycling infrastructure?

It is necessary to be assessed capacity of all existing sorting and pre-treatment installation based on the mass balances and forecasting based on the following assumptions for the calculations in the forecast model for fulfilment of the national waste recycling targets.

1. The Waste Framework Directive (2008/98/EC), that set up the targets for municipal waste and C&D waste
2. The National Waste Management Plan 2017-2022 that sets up the strategic priorities in the management of waste and different targets for different waste streams
3. Lack of enough capacity of the existing infrastructure for collection and treatment of municipal waste, C&D waste, recyclable waste paper, metal, plastic, glass in the scope of EPR and out of the scope of EPR
4. The recycling rate of four fractions of municipal waste - paper, plastic, metal and glass in 2019 was 37% (Calculation according to method 2, Commission Decision 2011/753/EU establishing rules and calculation methods for verifying compliance with the targets set in Article 11 (2) of Directive 2008/98/EC of the European Parliament and of the Council or the Waste Framework Directive.).
5. The COMMISSION IMPLEMENTING DECISION (EU) 2019/1004 introduces methodology for target's calculation for Municipal and C&D waste based on the new definition for Municipal waste:

'municipal waste' means:

- (a) mixed waste and separately collected waste from households, including paper and cardboard, glass, metals, plastics, biowaste, wood, textiles, packaging, waste electrical and electronic equipment, waste batteries and accumulators, and bulky waste, including mattresses and furniture;
- (b) mixed waste and separately collected waste from other sources, where such waste is similar in nature and composition to waste from households;

Municipal waste does not include waste from production, agriculture, forestry, fishing, septic tanks and sewage network and treatment, including sewage sludge, end-of-life vehicles or construction and demolition waste. This definition is without prejudice to the allocation of responsibilities for waste management between public and private sectors

The Decision ensures uniform application of the calculation rules by all Member States for the most common waste types and recycling processes specifying which waste materials should be included in the calculation and the Material Calculation Point.

Priority investments in re-use, recycling infrastructure

Due to the increasingly stringent regulatory requirements and the increasing recycling targets, it is necessary to strengthen the separate collection at the source, which in turn determines the type of facilities for treatment of separately collected waste fractions. Therefore funding will be needed for:

- re-use centres – as the second-hand market of valuable waste (furniture, telecommunication electronic, spare parts, etc.) should have been covered by the private sector, funding will be needed for establishment of re-use centers for non-valuable waste. Re-use centres could be established as social enterprises on the basis of voluntary labour or being subsidized by social programs for unemployed workers or disabled people. In order to save investment and running costs it is recommended that re-use centres are part or combined with recycling yards, regional waste management centers, and dismantling centers for EPR waste (e.g. repair of WEEE, spare parts and components for vehicles)
- recycling yards – As separate collection at source is envisaged, the amount of dry recyclable waste collected at recycling yards will decrease. At the same time, with the increase of the selective demolition and on-site separation of C&D waste from households, it will be necessary to provide storage areas for the different C&D fractions. Bulky waste is another waste stream that contributes for achievement of the targets for municipal waste recycling. Therefore, it makes sense to invest in equipment for pre-treatment of bulky waste at recycling yards. These trends have to be taken into account when planning investments for the completion of the national network of recycling yards.
- Composting/ Anaerobic Digestion facilities – Investments in bio-waste treatment facilities are of highest priority because bio-waste has very high percentage in MSW and respectively significant contribution for achievement of the targets for recycling of municipal waste and reduction of landfilling of biodegradable waste. LSGU are not able to finance the investments for bio-waste treatment through the municipal waste fee, therefore a **financial aid mechanism** should be implemented as described in bio-waste collection section. When planning the completion of national bio-waste treatment network it should be taken into account that there are variety of technical approaches for bio-waste treatment (e.g. centralized, decentralized, different technologies for composting and anaerobic digestion, etc.). Therefore, it is of high importance that **funding for feasibility studies** is secured to avoid taking non-optimal decisions when selecting the best bio-waste treatment option.
- Sorting facilities – Construction of facilities for sorting of separately collected dry recyclables is of highest priority because of the focus on separate collection at source and taking into account that the other options (sorting of mixed MSW at MBT plants and collection at recycling yards) are not effective enough to contribute significantly for achievement of the targets for municipal waste

recycling. State funding will be needed to cover the investment costs through a **financial aid mechanism** and the EPEEF. As it makes sense to collect dry recyclables (for which LSGU are responsible) and packaging waste (for which producers/EPEEF are responsible) through a common system for separate collection, there should be rules and procedures for costs sharing and reimbursement of the costs.

2.3 Investment in projects/programs for innovations in production;

Existing situation

NWMP 2017-2022 identifies that the transition to circular economy requires complete change in the existing economic system and innovations, not only in technology, but in organization, society, funding methods and policies. Despite this conclusion, in the WMP there is a lack of targeted eco-innovation policies in the waste management sector. The existing policy measures addressing circular economy and eco-innovations in Croatia are the following:

- Publicly co-funded venture capital funds
 - Croatian Private Equity and Venture Capital Association (CVCA) – facilitates private equity and venture capital investments in Croatia and aims at improving the investment environment.
 - HAMAG-BICRO (Croatian Agency for SMEs, Innovations and Investments) is a government agency that promotes foreign investments in SMEs and publishes a catalogue of private companies looking for equity investments
- Public guarantee funds
 - The Government provides guarantees to the Croatian Bank for Reconstruction and Development that supports SME sector, energy efficiency projects and renewable energy, among other activities.
- Research and Development (R&D) funding
 - HORIZON 2020 - The EU Framework Programme for Research and Innovation
 - European Structural and Investment Funds: Operational Programme Competitiveness and Cohesion
 - Programs that support R&D activities like RAZUM, IRECO, EUREKA
 - HAMAG-BICRO provides funding to public sector through several programs
- Tax incentives for R&D and start-ups
 - profit tax base can be lowered by 150% of the eligibility cost for fundamental research, 125% for industrial research and 100% for development research
 - for SMEs, further 20% for industrial and development research can be applied, and for medium-sized companies additional 10%
- Competence centres, clusters, science-technology parks
 - BIOCentre, is developed in partnership between BICRO, the University of Zagreb and the city of Zagreb
 - Centre for Technology Transfer , Zagreb, supports SMEs
 - Rudjer Innovation, provides services regarding the Intellectual Property Rights
- Regulations and standards
 - The Strategy for Innovation encouragement of Croatia 2014-2020
 - Regulation on EU Ecolabel
 - GPP Strategy

Is there necessity for investments in innovations?

Innovation creates the necessary enabling condition for introduction of circular economy. Without innovation technologies for production of biodegradable plastics there would be no single use sustainable alternatives for many single use plastics or without digital platforms for sharing information and connecting users sharing economy services (e.g., bikes, cars) would not be possible. The tendency is that in the foreseeable future renewable and bio-based materials and energy will replace fossil fuels and materials which cannot be realized without innovation innovations for production of more bio-based products. Innovations are needed also in technologies as well as in organizational and financial measures to boost reuse, sharing, repair, refurbishment, remanufacturing and recycling to create a closed-loop systems.

Priority investments in innovations

In order to identify the priority investments in innovation, a pack⁹ of innovative solutions proposed by projects funded by the EU through the Horizon 2020 programme was analyzed. Innovation areas that were approved for funding by EU give indication about the prioritization of innovations for circularity.

- RESYNTEX is a textile recycling pilot plant in Slovenia - sorted textile waste is chemically treated to extract resources such as protein-based fibres to be used for producing wood panel adhesives and cellulosic fibres for producing bioethanol; new raw materials are obtained for producing biodegradable plastics; terephthalic acid is recovered from PET and used for production of new plastics; new plastics and chemicals are produced from Polyamide (PA)
- BAMB project developed a *Reversible Building Design Protocol* that enables reversible design strategies in construction and refurbishment; *Materials Passports* that acts as a one-stop shop for material information supporting circular decision making; *Circular Building Assessment tool* - methodology for assessing new and existing buildings' resource productivity. These instruments were tested in practice by constructing 'Build Reversible in Conception' building that has been assembled and disassembled for three consecutive years. Each transformation has been accompanied by a change in function: from an office (2018) to a shop (2019) and eventually an acoustic laboratory (2020).
- CABRISS project focused mainly on a Photovoltaic (PV) production value chain, thus demonstrating the cross-sectoral industrial symbiosis with closed-loop processes. Innovative technologies were used for dismantling of PV waste (such as water-based technology that does not break glass, wire-based delamination technology) which enabled increasing yield and quality of recovered materials, including Si, In, Ag, and high-quality undamaged glass. Raw materials were provided as feedstocks for other industries, like Si waste for the metallurgy industry demonstrating the cross-sectoral industrial symbiosis with closed-loop processes.
- URBANREC project aimed at enhancing Bulky waste management across 4 municipalities in 4 countries - Belgium, Spain, Poland and Turkey. Project's most relevant achievements include knowledge transfer and experimentation, collection for the purpose of recycling and educational programmes customised to citizens' needs.
- Waste4Think project demonstrates how different approaches could be used to achieve the same goal of increasing sorted waste in four pilot areas of Halandri (Greece), Zamudio (Spain), Seveso (Italy) and Cascais (Portugal) that have different social, demographic and geographic features and represent different levels of industrialisation..
- CIRC-PACK project developed numerous innovations: biodegradable plastics using alternative bio-based raw materials and eco-friendly packaging designs adapted to these plastics to improve collection and recycling; design of a bio-based and compostable mono-material plastic layer as an attractive alternative to current non-recyclable multilayer films; in the automotive sector, closed-loop recycling and reuse of scrap to produce new car components reduced the use of virgin

⁹ <https://cordis.europa.eu/article/id/411500-circular-economy-innovations-for-industrial-and-urban-waste-management>

polypropylene by about 20 %; diaper recycling yielded plastic for tertiary packaging and cellulose for the biopolymer sector.

- FORCE project aimed at enhancing circularity in the management of plastic waste, WEEE, biowaste and wood waste in 4 European cities.
 - In Copenhagen the plastic collection scheme was simplified and the collection rate increased by 30 %. In addition sorting and recycling tests were also conducted. Results showed that polypropylene (PP) and high-density polyethylene (HDPE) could be collected from residual waste, sorted and reprocessed into secondary raw materials with properties and value similar to raw materials derived from source separated PP and HDPE plastics.
 - In Hamburg, the objective was to raise public awareness on WEEE reduction and avoidance. FORCE introduced an innovative decision support tool, CYCEL, to observe the WEEE market and inform citizens about reselling, repairing, recycling and donation possibilities.
 - In Genoa to improve and integrate existing wood waste management and test new sustainable practices, FORCE redesigned the collection schemes for four types of wood waste.
 - Lisbon undertook a pilot project developing the web app LISBOA ZERO for the reduction of organic waste at its source, in which the food products produced and near the end of their life cycle can be redirected to new channels and platforms.
- DECISIVE is a DECentralized management Scheme for Innovative Valorization of urban biowaste. DECISIVE's microscale digester concept uses little energy and water and is simple enough for a lay person to operate. Decentralised and local urban biowaste valorisation, organised as a network, reduces the impact of waste collection (road traffic and environmental emissions) and promotes local food production using organic fertilisers from biowaste.

From the review of the projects approved for funding under Horizon 2020, it can be concluded that innovation in the following areas is a priority.

- Production of bio-based and biodegradable products – investments in bio-refineries, production of bioplastics (PHA, PLA), biodegradable plastics, compostable plastics, bio-based construction materials, biocatalysts, bio-based chemicals, biofuels, biogas and electricity
- Production of new plastics from waste – chemical recycling instead of currently dominating mechanical recycling (thermoforming). Chemical recycling allows total depolymerisation of plastic waste into its monomers and production of high grade plastics
- New design of buildings and sustainable construction
- Dismantling and recycling of products that are new in the market and respectively waste generated after their use is new thus requiring new technologies for dismantling and recycling
- cross-sectoral Industrial symbiosis
- innovations to facilitate knowledge transfer
- technologies for sorting and reprocessing of mixed waste that will simplify separate collection and reduce the need for behavioral change
- information sharing to connect suppliers and users of waste for reuse and to boost sharing economy
- decentralized waste treatment to enable local communities or even single households to manage their waste reducing the need of large facilities and long distance transportatio

3 Establishment of management system for marine litter

Existing situation

The exact status of marine litter pollution will be determined through survey on marine litter sources, quantities, polluting items. The results of the survey will be used to identify the degree of background pollution for defining policy options for tackling the marine litter.

Is there necessity for investments in marine litter management system?

Marine litter is gaining growing attention at EU level. A range of strategic documents and directives require prompt action to curb marine litter pollution.

Fisheries Control Regulation:

Fisheries Control Regulation requires full implementation of the obligation to mark gear to carry retrieval equipment on board, to retrieve lost gear, or to report its loss in case it cannot be retrieved. It introduces daily electronic reporting for all vessels and removes the exemption of small vessels from the obligation to carry retrieval equipment.

Single Use Plastics Directive

The Directive requires Member States shall:

- established extended producer responsibility schemes for fishing gear containing plastic placed on the market of the Member State
- set a national minimum annual collection rate of waste fishing gear containing plastic for recycling.
- monitor fishing gear containing plastic placed on the market of the Member State as well as waste fishing gear containing plastic collected and shall report to the Commission
- take awareness raising measures

For tackling fishing gear pollution collaboration with other institutions is needed. Waste from ships (reception in port facilities) is under the authority of the Ministry of the Sea, Transport and Infrastructure. It is responsible for implementation of EU Port Reception Facilities Directive, which is not covered by waste management legislation in Croatia. However, as the Directive contains important obligations for fishing vessels its implementation is important for tackling fishing gear pollution.

The EU Port Reception Facilities Directive:

- Requires vessels to land the waste they produce during voyages to and between EU ports to port reception facilities.
- Requires ports to develop Waste Handling Plans and provide Port Reception Facilities to the ships using their port. :
- Introduces a 100% indirect fee for waste from ships, as well as waste catch passively during fishing.
- Requires port reception facilities to effectively implement the waste hierarchy in the context of management of waste from ships, including the separate collection of waste from vessels in port given further reuse/recycling.
- Dedicated enforcement regime for fishing vessels over 100 GT (minimum 20% inspection target)
- additional measures for reducing lost or abandoned fishing gear are examined, such as extended producer responsibility and deposit-refund schemes for commonly littered fishing gear

Priority investments in in marine litter management system

Investments should be focused in the following areas:

- Regulatory cost for enforcement the prohibition on abandoning of fishing gear
- Regulatory cost for enforcement the requirements to mark gear
- Regulatory cost for enforcement the obligations for fishers to carry retrieval equipment onboard, to retrieve lost gear or to report its loss in case it cannot be retrieved, introduction of daily electronic reporting
- Establishment of EPR schemes for fishing gear - recycling funds or deposit schemes, including setting recycling targets and minimum annual collection rate
- subsidize marine litter clean up through European Maritime and Fisheries Fund or other national sources of fundin

4 Ensuring economically and environmentally sound management of residual waste

Existing situation

The concept for treatment of residual waste is based on WMC system. NWMP and NWMP ID plan construction of 11 WMC for treatment of residual waste ¹⁰. NWMP and NWMP ID define the need to prepare a feasibility study for each individual centre which will respect the waste management objectives to be achieved by NWMP. These studies should outline all the measures that need to be implemented in the wider WMC coverage area in order to achieve the objectives and justify the planned capacity. For all planned WMC feasibility studies were prepared and mechanical-biological treatment technology was selected, except for WMC of City of Zagreb for which feasibility study is under preparation ¹¹.

MBT describes a series of processes which include the mechanical sorting of waste followed by a phase of biological treatment.

MBT plants can be grouped into the following types based upon the main technology used in the biological stage:

- MBT with a major landfill fraction
- Aerobic processing.
- MBT with dry anaerobic treatment; and
- MBT with wet anaerobic treatment
- MBT (MBS) for solid recovered fuel/refuse-derived fuel (SRF/RDF) production
- Short aerobic drying process (BD) and efficient material separation after drying for use in combustion and recycling

The outputs from the process are recovered recyclables (3-7%¹²), a Refuse Derived Fuel (RDF) and a low quality, stabilised composted output. Recyclables recovered from this process are of much lower quality than those from source segregated waste, due to big levels of mixing and increased potential for contamination with other materials. Stabilised composted output is lower quality than compost produced from segregated biodegradable waste and EU Good practices show that the best options is landfilling the product, requiring less volume and generating fewer methane emissions than landfilling of the original, untreated waste.

Information about German situation with MBT plants that gives outputs ratios of different fractions depending on applied MBT technology is presented in the following study - http://www.wasteconsult.net/files/referenzen/Situation_of_MBT_in_2007.pdf

MBT is contributing to the achievement of goals regarding the decrease of biodegradable waste landfilling and total quantities of landfilled waste, but it is not sufficient in regards to achieving the municipal waste recycling goals.

¹⁰ Also, the NWMP within the WMC envisages the possibility of construction of biowaste treatment plants, sorting plants, recycling yards, bulky waste treatment plants, reuse centers and asbestos disposal cells.

¹¹ Data provided by the MoESD. Evaluation and analysis of feasibility studies, and process of preparation of the WMC projects in general, were not within the scope of this Report.

¹² Towards a circular economy – Waste management in EU, European Parliamentary Research Service, PE 581.913.

Public funding secured the construction of two WMCs: WMC Kaštijun, with a 90,000 t/year capacity (County of Istria) and WMC Marišćina, with a 100,000 t/year capacity (County of Primorje-Gorski Kotar). In addition, private funding secured the MBT facility in the City of Varaždin (95,000 t/year). Long-term solution for RDF in Croatia is not established and existing WMCs currently rely on the capacities of existing cement plants as well as exports. In addition, the existing capacities of cement plants for processing waste in the Croatia are insufficient (total max. 65,000 - 70,000 tons/year). Currently, projects are being conducted for WMC Bikarac, with a capacity of 38 thousand t/year (County of Šibenik-Knin) and WMC Biljane Donje, with a capacity of 80 thousand t/year (County of Zadar), after the Decision on financing from the EU Cohesion Fund.

Is there necessity for investments in residual waste management?

The municipal waste treatment system is based on mechanical biological treatment in order to stabilize the organic part of the waste and subsequent disposal in landfills that meet the requirements of the Landfill Directive.

NWMP and NWMP ID foresaw the construction of 11 waste management centres for treatment of mixed municipal waste and other waste. All foreseen WMCs facilities are already built or in the process of construction or planning and preparation for construction

The current EU waste management legislation does not necessitate change in the concept for treatment of residual waste in Croatia. In accordance with the Landfill Directive by 2035 the amount of municipal waste landfilled shall be reduced to 10 % or less of the total amount of municipal waste generated (by weight). Also, according to the Waste Framework Directive, as of January 1, 2027, Member States will be able to consider municipal bio-waste entering aerobic or anaerobic treatment as recycled only if it is separately collected or separated at the source. This means that the possibility that bio-waste, as a part of mixed municipal waste, will not be included toward the achievement of recycling targets.

When it comes to waste to energy EU legislation provide framework for construction of waste incineration facilities that will ensure energy recovery from waste and push toward better level of energy efficiency. Method of calculating the target defines that the input to incinerators, which carry out the treatment operation D10¹³, shall be reported as landfilled¹⁴ (incinerators that do not ensure adequate level of energy recovery). This calculation method does not apply to facilities that incinerate waste ensuring energy recovery in line with Annex II of Waste Framework Directive. For those facilities waste shall not be considered as landfilled but energy recovered¹⁵ Priority investments in residual waste management system

Investments should be focused in the following areas:

- Completion of the construction of the network of Waste Management Centers
- Waste incineration with energy recovery – Especially for bigger regions Waste-to-Energy facilities have economic benefits over MBTs (high economies of scale; long depreciation period; secure markets for output products (electricity and steam), fuel replacement). Therefore, based on results of implementing NWMP measure M 1.4.6. (energy recovery planning) funding could be provided for feasibility studies for individual project preparation. to determine the long term viability of transitioning to energy recovery of the residual waste

¹³ Defined by Annex I of the Waste Framework Directive. Also see COMMISSION IMPLEMENTING DECISION (EU) 2019/1885 of 6 November 2019 laying down rules for the calculation, verification and reporting of data on landfill of municipal waste in accordance with Council Directive 1999/31/EC and repealing Commission Decision 2000/738/EC

¹⁴ In the case of MBT the output is considered as landfilled (Article 5a of the Landfill Directive).

¹⁵ Method Defined by Annex I of the Waste Framework Directive

5 Improvement of hazardous waste management system

Existing situation

In 2018 hazardous waste amounted to 174.350 tonnes. Hazardous waste from special categories of waste constitutes the largest portion of total quantities of hazardous waste 54% (174.350 tones)¹⁶. This share is probably even higher as special categories of waste that may contain hazardous types of waste include - packaging waste, waste oils, waste batteries and accumulators, end-of-life vehicles, asbestos waste, medical waste, waste electrical and electronic (WEEE), construction and demolition waste, waste polychlorinated biphenyls and terphenyls (hereinafter: PCB)).

For the six special categories of waste, “extended producer responsibility” has been introduced by way of fees for placing on the market of products from which after use special categories of waste are generated. All of these six special waste categories, except waste tyres, may contain certain amounts of hazardous waste types. Other wastes considered as hazardous waste are

- chemical waste (14%).
- Sorting residues (8%)
- soils containing hazardous substances (7%)
- acid, alkaline or saline wastes (4%)
- combustion wastes (3%)
- health care and biological wastes (2%)
- and other (8%)

Priority investments in hazardous waste management system

- The existing system for waste mechanical oil management is insufficient in separate collection of waste mechanical oils and needs to be restructured in a way to increase its efficiency.
- End-of-life vehicles - waste management system is insufficiently regulated insofar as repealing waste status and waste prevention.
- System for management of re-usable vehicle parts (spare parts) is not established. System for quality control and certification of spare parts need to be implemented by market surveillance authorities.
- System for collection packaging containing remains of hazardous substances is not well established
- Capacities for treatment of packaging polluted by hazardous substances on a national level is insufficient. These wastes are mostly exported from the RC but some of them ends to the existing landfills.
- System for collection of hazardous waste from household is not well working.

¹⁶ This quantity covers following waste categories: discarded equipment, discarded vehicles, waste batteries and accumulators, used oils and asbestos waste. (Source: <https://ec.europa.eu/eurostat/data/database>).

6 Remediation of waste polluted sites

Existing situation

The process of closure and remediation of non-compliant landfills has started in and certain number of non-compliant landfills were remediated. From 2005, a total of 317 official landfills were identified and monitored, of which on 306 sites municipal waste was disposed, and on 11 exclusively industrial waste.

The Croatia failed to bring all existing landfills into compliance with the Directive 1999/31/EC (Landfill Directive) by 31 December 2018 - a deadline defined by the Treaty concerning the accession of the Croatia to the EU from 2011 (Accession Treaty)

By the end of 2018, a total of 201 official landfills were closed. Out of the total number of closed landfills, remediation was in preparation at 41 landfills, and at 17 landfills it was in progress, while at 142 it was completed.¹⁷

According to the measure 4.1. from NWMP, in 2018 the Plan for closing the landfill for non-hazardous waste was developed. In 2019, Decision on order and dynamics of landfill closure was adopted, too. This Decision determines the order and dynamics of closure of non-hazardous waste landfills by counties, selection of non-hazardous waste landfills where non-hazardous municipal and industrial waste will continue to be disposed of until disposal capacity is filled and selection of non-hazardous landfills where non-hazardous municipal and industrial waste will continue to be disposed of until construction and start of operation of waste management centres in the Republic of Croatia..

NWMP and NWMP ID defined 6 projects for remediation of highly polluted locations in the environment, so called "hot spots". By the end of 2020, no remediation has been implemented for any of 6 "hot spots". As, the identification of new locations polluted by hazardous waste is ongoing process, NWMP foresee identification of new "hot spots".

Is there necessity for investments in remediation of waste polluted sites?

Landfill Directive requires that landfills which have been granted a permit, or which are already in operation, may not continue to operate unless the landfill operators prepare and present to the competent authorities, for their approval conditioning plans. The competent authority shall assess the conditioning plan and shall make a decision concerning the continued operation (or closure) of the site and the implementation of the conditioning plan. Any existing landfill shall comply with the requirements of the Landfill Directive within a deadline fixed in the Directive.

Priority investments in remediation of waste polluted sites

- **Remediation of existing non-compliant landfills;**

Investments should be focused in the following areas:

- Closure and remediation of existing non-compliant landfills. This activity could be started only when the new infrastructure for mixed municipal waste is in operation and waste collection system, including transportation to new facilities, is well established. In many locations dumps are very close one to another. Some small dumps could be closed immediately, and waste used to be dumped in them could be diverted to other existing landfills.

¹⁷ http://www.hoop.hr/sites/default/files/uploads/dokumenti/021_otpad/lzjesca/OTP_lzje%C5%A1%C4%87e_Odlagal%C5%A1ta_2019_web.final.pdf (in Report information is not available for one landfill)

- Improving the conditions of existing non-compliant landfills with deadline of operation until the construction of new compliant landfills.
- **Remediation of dump sides (wild landfills)**

Investments should be focused in the following areas:

- Closure and remediation of existing dumpsites. The LSGU should be supported financially for remediation of bigger dumpsites.
- Regulation and enforcement costs for strengthening the control and monitoring the illegal dumping in order to prevent arising of new dumpsites.
- **Remediation of hot spots**

Investments should be focused in the following areas:

- Assessment of appropriate remediation technologies and the necessary financial resources
- Implementation of the identified remediation measures

7 Improvement of waste management information system

Existing situation

According to the Act on Sustainable Waste Management, MoESD is responsible for the establishment and maintaining the Waste Management Information System. This Act also defines the content of the Information System, which includes the following databases:

1. *Waste Register* - [e-ONTO](#) for the monitoring each waste shipment. Mandatory users are: waste management companies (waste collection companies and treatment companies), waste transporters, recycling yards, redemption stations, municipal waste companies, producers and users of sewage sludge – established and publicly available
2. *Waste Management Activities Register* for the electronic issuing of waste permits, for entering in the managing registers and for issuing other documentation related to waste management activities – under preparation
3. [Emission Pollution Register](#) for reporting annual data on amounts of generated, collected and treated waste - - established and publicly available
4. *Central digital application for transboundary movement of waste* - - under preparation
5. *Application on the management of a special waste categories* for EPR scheme data – under preparation
6. [Application for abandoned waste locations](#) - established and publicly available

In addition to these applications/databases, the MoESD has also established the application [Waste Management Permit Register](#), [Waste Prevention Portal](#) (general information on the waste prevention topics, news from waste prevention area, implementation of waste prevention projects), [Database on Landfills](#) (semi-annual data on landfilling biodegradable municipal reported by each landfill) and the [Waste Categorization Application](#) (provides assistance in waste categorization).

A certain set of data from all established applications is merged and displayed as spatial data at a common platform [ENVI Portal](#).

NWMP envisages measure aimed at integration of existing digital applications on a joint IT waste

management platform in the Republic of Croatia as part of the national environmental protection platform.

Furthermore, except data contained in the applications/databases mentioned above, Waste Management Information System consist of significant range of data which are not digitalized.

Is there necessity for investments in integrated information system on waste?

Monitoring and reporting would be easier if all existing databases are linked. Also, double reporting would be avoided and administrative burden on the economy reduced. All data contained in the Waste Management Information System which are not covered by stipulated databases should be digitalized with aim of ensuring the public access to environment information and thus increase transparency and trust in. Digitalization will also enable more efficient processes in companies, will contribute to the waste prevention and minimization, promote longer life for products etc. and thus in general will promote a green and circular economy.

Digitalization of information contributes for better control and enforcement. It will enable waste inspectors to check (before each inspection) the database to find out what waste quantity should be expected at the inspected site which will make it possible to verify the reported quantities with the actual waste quantity found on the site.

Digitalization and links between waste related databases will help for identification of risky behaviour by waste management operators such as:

- a comparison of the amount of waste that a company accepts with the amount specified in the permit;
- comparing the quantities with the previous period and finding whether there are sharp declines or increases;
- comparing the reports of industrial enterprises that manufacture same or similar products may reveal that one enterprise reports less waste quantity per production output comparing to other enterprises.

Priority investments for development of integrated information system on waste

The necessary investments for upgrade and integration of all existing waste related databases including data from DRS and completion the digitalization of waste reporting could be summarized as follows.

- Elaboration of assessment to identify the needs for upgrade, integration of all waste related databases and completion the digitalization of waste reporting including digital transformation of municipal companies. The assessment might include:
 - Analysis of the functionality and practicability of the existing databases, and their compliance with the current waste reporting requirements and practical needs of the Ministry, inspectorates, EPEEF, LSGU, RSGU to perform their duties
 - Development of concept for improvement and proposing measures for upgrade of the existing waste data management systems with a view of incorporating all legal requirements, all waste streams, ensuring integration and compatibility of the data with other waste management related databases and information systems, completion the digitalization of waste reporting, quality assurance and data validation of the reported data.
 - Preparation of technical specification and complete tender dossier for assignment the proposed upgrade and integration of waste related databases.

- Announcing open tender and selection of contractor that will develop the integrated Waste Information Platform
- Financing Technical assistance to developers to ensure that Waste Information Platform meets all requirements of waste management legislation and the technical specification
- Secure finding and financing the development and putting into operation of the waste information system – software development and supply and putting into operation of necessary hardware
- Funding the development of Inspection plan – not all entities should be inspected but only those that pose higher risk of reporting non-reliable data. Prioritization of inspections based on risk factors.
- Financing regular inspections for verification of reported waste data
- Allocation of funds for auditing - cross-checking the reported data with the information contained in other documents – Contracts, Permits, Consignments, accounting Invoices – information from other databases and cooperation with other competent authorities is needed