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REGIONAL STRATEGY – ITALY

Project Title: REEF2W Increased renewable energy and energy efficiency by integrating, combining and empowering urban wastewater and organic waste management systems

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1. PURPOSE AND SCOPE

1.1. Purpose (REEF 2W)

The purpose of REEF 2W project is to enhance the energy recovery from different source of waste in urban areas. This scope was stimulated by two main drivers. The first is an environmental aspect the second is to reduce the energetic costs of the treatments.

Both aspects are strictly correlated due to the effect of the energetic aspects to the increase of greenhouses gas emissions (GHG). Furthermore, with a stricter view of the treatments of waste and wastewater the possibility to decrease the energetic costs of their treatments can free up resources to improve treatments applied.

Furthermore, according to the potential solutions that could be applied using the suggestion provided by the results of the project it could be possible to have a reduction of the GHG even outside of the treatment plants, in the nearby urban areas, thanks to the recovery of heat and gas from waste.

Energy strategies that are in place for the region Emilia Romagna pursue similar objectives for the next ten years.

The Regional Energetic Plan (Piano Energetico Regionale PER) was approved last March 2017 and is valid till next 2030 to push all stakeholders to reduce GHG emission at any level and try to recover renewable energy sources (RES) from any potential source.

Obiettivo europeo	Monitoraggio		Medio periodo (2020)			Lungo periodo (2030)		
	Dato PER (2014)	Stato attuale (2016)	Target UE 2020	Scenario tendenziale	Scenario obiettivo	Target UE 2030	Scenario tendenziale	Scenario obiettivo
Riduzione delle emissioni serra	-12%	**-4%**	**-20%**	-17%	-22%	**-40%**	-22%	-40%
Risparmio energetico	-23%	**-22%**	**-20%**	-31%	-36%	**-27%**	-36%	-47%
Copertura dei consumi finali con fonti rinnovabili	12%	**12%**	**20%**	15%	16%	**27%**	18%	27%

Figure 1: Achievement of climate-energy targets for Emilia-Romagna in 2020 and 2030 (Source: Il Piano Energetico Regionale 2030: policy attuate e monitoraggio dei risultati raggiunti, 2018)

Fig. 1 shows that the only aspect that did not reach target values is the GHG reduction, considering all the economic sectors, energy saving and RES coverage are reached or almost reached.

1.2. Problem Statement

If the regional target for 2020 for electricity production from renewable energies is already reached, the situation for biomethane production (including the production of compressed natural gas for transport) and district heating networks will be completely different.

For the production of biomethane, a lack in the Italian legislation determines a regrettable situation: several economic operators are available to invest in this sector, but there is no clear legal framework for the use of this important energy vector. This situation determines a slowdown of the investments in this sector. Only recently, the Italian legislator has provided to regulate this field. The authors hope that it will be soon possible to move from the existing pilot applications to the full-scale application with a larger diffusion of this technology.

At the moment, the Emilia Romagna region is the second region in Italy that uses the production of bioenergy. Regarding the renewable energy production, biogas is the main RES, but it is important to notice that the majority of these plants does not regard waste and wastewater sector but the agricultural sector. This means that most of the potential in waste and wastewater sector is not used. The reason of this is connected with the legislative aspects already mentioned but in the meantime, also a resistance of the managing companies to change technologies and practices already consolidated.

Only recently, the major regional operators of the waste and wastewater sectors are analysing the possibility to recover the energy content in waste and sludge.

Very often, these companies are only focussed on the treatment technologies, even because the cost recovery for the treatments are calculated mainly on the treatment performances and not on the base of the energetic efficiency.

For these reasons, companies do not focus on improving energy efficiency. They only act when strong subsidies are available that could greatly reduce costs for the companies.

1.3. Target Group

Currently, renewable energy production is an important topic in most countries in the world. The reason for this in the past was the reduction of pollution associated with oil extraction and refining. Nowadays, the increase at the RES is mainly related at the reduction of the effects on climate that the fossil fuels economy is generating. For these reasons target groups of the project and of course the strategies applied at regional levels are several. From the point of view of the project, the first target group is represented by policy makers and regional authorities. This is the most important because political decisions can determine energetic and economic strategies for all the regional actors. It is important to say that there is a strong link between the regional decisions and the decisions made at the central government level. These decisions are bi-directional. The national legislation provide a first frame where the local authorities can act and where they are allowed to modify only slightly. On the other side, regional authorities, especially when they are in coalition with other regions, can urge the central government to make decisions depending on the general advantage.

On the other side, policy makers, although assisted by specialized technicians, often do not have the overview of the possible solutions and can therefore only partially correct decisions.

For this reason, the second target group of the project will be the multi-utilities involved in the treatment of waste and wastewater. These stakeholders are of particular relevance because their acceptance of new technologies can determine the success of one

technological approach. Often, they focus on their main work that is the treatment of water and wastewater. The energetic aspects of the treatment are only a side aspect of the treatments. This is also because the increase of energy efficiency of the treatment does not directly show economic benefits.

The last target group is represented by the citizens living in larger cities who can due to emissions of vehicles or the buildings heating systems, be affected by the quality of the air. The strategies suggested by the project can have an effect locally decreasing the access at fossil fuels, and in general at combustion technologies to provide heat for buildings and sanitary water.

1.4. Scope

Scope of the strategy adopted in the project is to implement in each region a potential solution to reduce the energetic costs for the waste treatments without decreasing the quality of the service, and to provide an advantage for the nearby community.

The solution that will be suggested in Italy is a solution to be able to cover all the energetic costs for the treatment of organic solid wastes collected in the area involved and further analyse the possibility to collect other organic substances available in the territory to increase the production. According to the feasibility study conducted, the available biomass could be largely sufficient to cover the energetic costs of the treatment plant. Nevertheless, as the treatment plant is property of seven municipalities and the Italian legislation allow public entities to produce energy in any part of the country and use it in any other part without paying the delivery costs. This opportunity makes it possible to provide energy to the public buildings of the municipalities and to give an example for improving energy efficiency, also for small-scale plants like Montefeltro Valley.

This could also be a good example for other small plants that do not consider the possibility of energy recovery from waste due to lack of specific competencies or wrong assessments.

1.5. Time frame/horizon

The timeframe for implementing this strategy will be the period 2020-2030 according to the Regional Energetic Plan. As already mentioned before the plan defines the regional strategies to improve the energetic efficiency of the region in accordance with the environmental aspects, and in particular at the climate changes acting in this period. Regarding the pilot suggested solutions and the strategies; the local industrial partner has to implement in the future to ameliorate its logistic situation and costs. The timeframe period to implement these technologies will be the next three years.

2. BACKGROUND

2.1. General facts

2.1.1. Wastewater sector

Wastewater treatment in Italy is a large sector that includes around 18786 treatment plants (ISTAT, 2014). About 55% of these plants have at least a primary treatment (removal of organic matter) instead the other 45% are represented by small treatment plants using more simple technologies (Imhoff tank, constructed wetlands).

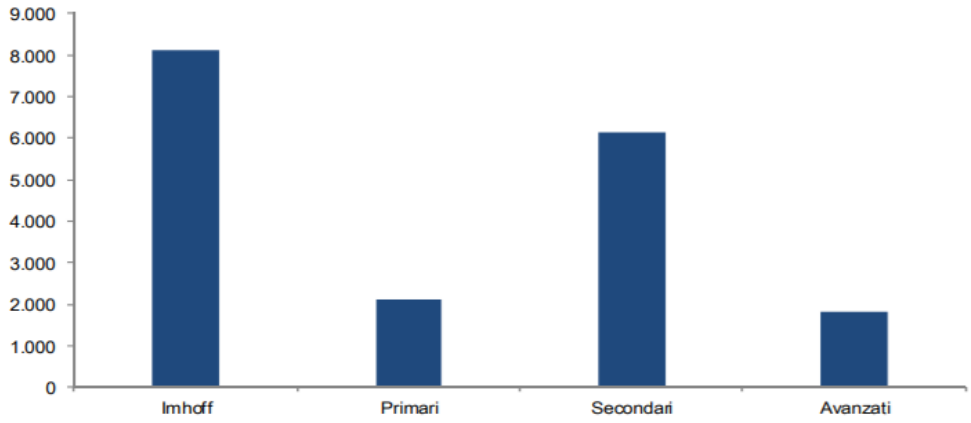

Figure 2: Urban wastewater treatment plants by type of treatment.(ISTAT 2012)

From the total wastewater collected, more than the 60% of the wastewater is treated with an advanced treatment.

In Fig. 1 and 2, it is possible to see the number of treatment plants per type of treatment and the organic load treated for the same categories.

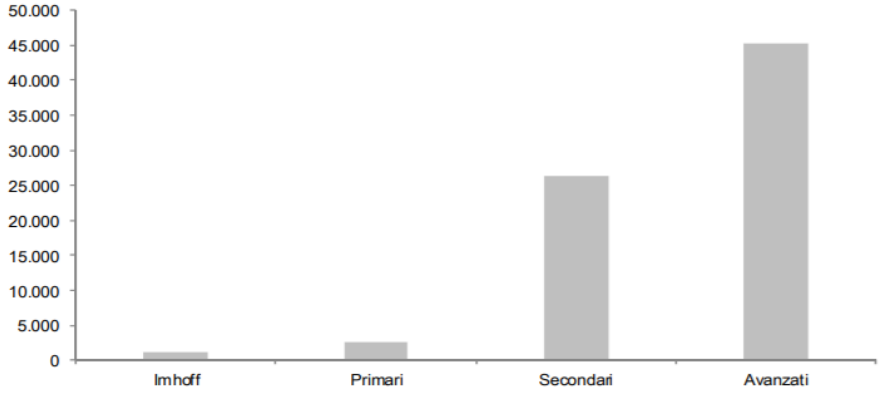

Figure 3: Organic load collected in wastewater treatment plants (ISTAT, 2012) 1000xPE

The improvement of the quality and quantity of the wastewater treatment has been strongly stimulated after the implementation at national level of the European directive on

urban wastewater 91/271 /CEE and subsequently the water framework directive 2000/60/CE. In this moment, almost the entire urban wastewater generated from the big cities are collected and sent to a treatment system.

There are only a few cases (a few small cities or parts of larger cities where wastewater is not collected and treated properly). At these sites, the facilities are not yet in place and part of the wastewater is not treated. Most of these cases relate to small municipalities where the urban wastewater is treated mainly at building level.

More in detail Emilia Romagna Region with a population of 4.395.569 and a surface of 22 452 km^2 represent about the 7% or the total Italian population.

In Emilia Romagna 12 utilities are operating. There are some cases where the water service is managed in house by the municipalities, but the regular case is that the service is managed by some large utility. In particular, two big companies are managing directly or indirectly most of the wastewater treated in the region.

The tariff that each citizen has to pay the service is decided at local level by a local authority named Agenzia Territoriale Emilia-Romagna Servizi Idrici e Rifiuti (ATERSIR, Emilia Romagna Territorial Agency for Water Services and Wastes).

ATERSIR has the task to analyse the costs of each utility and define the tariffs to be used for the billing service.

Regarding the energetic aspects of the treatment plants in several plants to facilitate the secondary treatment is not present the primary sedimentation. This aspect influences also the possibility to recover of biogas from primary and secondary sludge. In Emilia Romagna region, among the 2162 (Bardasi, 2012) treatment plants present in the region, only 23 have implemented the anaerobic digestion process. The reason for this limited number of anaerobic digestors is due to the small size of these plants. About 2072 treatment plants of the 2162 mentioned before have a size smaller than 10.000PE.For these plants is quite difficult to implement an anaerobic digestion process. Sludge produced by these plants are treated mainly in composting facilities. Regarding the other 92 treatment plants with a size bigger than 10000 PE the number of anaerobic digestors is also limited and in an optic of energy recovery could be increased, nevertheless in the 23 existing anaerobic digestors have been treated 261.737 tons of sludge equal at the 69% of the total sludge produced in the region. From this amount of sludge about 6.5 MSCM of biogas (Manuele Gatti, 2019) are produced. Almost all the biogas is used in CHP units to produce electricity instead the heated generated is used mainly for the temperature control of the digestor and in some cases to heat buildings and sanitary water in the plant.

Currently, the production of biogas in Italy is taking a new force especially for the urban and industrial sector. This is due at the interest at biomethane production related to a change in the Italian legislation that, because of the already reached targets for the production of electricity from renewable sources for 2020, is pushing more on the gas and biofuel production.

If to date, the biogas production comes mainly from the agricultural sector and it is transformed in electricity delivered at the grid, this kind of approach is generally more difficult for most of the biogas plants because very often farms are not connected at the gas net because it is not so distributed as the electrical. Urban and industrial plants are usually already connected or very close to the gas grid, and the possibility to inject the biomethane in the grid is a more feasible opportunity.

2.1.2. Waste sector

In Italy, waste management is a very big issue in continuously improvement. If the collection of waste is well done in most of the Italian territory, it is still necessary to increase the capacity of differentiate the collection. According to the last available data of 2017 (ISTAT, 2019) the waste collection per inhabitant, in urban areas correspond at 488.7kg per year, with a small reduction of 1.6% compared at the year 2016. In this amount, the different metrological components are not changed. Only 55.5% of the collected waste are collected sorting the different components.

In North East of Italy there is a higher production of waste that reaches an amount of 541.5 kg pro capita per year. In comparison, in the North West of the country the production pro capita is of 475.3 kg per year. These two areas correspond also at the CEU area.

Together with the higher waste production in these areas, there is also a higher capacity to realize a good separate waste collection system. This system reaches 68.3% in the north-east and 64.5% in the north-west. These values are very close to the national targets.

Regarding more in detail the amount of the organic fraction collected separately in Italy it amounts at 6.516,88 MTons per year (ISPRA, 2017)and it represent the 41% of the total urban waste collected. In the North of Italy this fraction decrease at 39%.

All this amount of waste collected are treated in 326 treatment plants distributed in all the country. Although it is not convenient in terms of energy efficiency, 84% of the plants are aerobically composted. The others combine anaerobic digestion and aerobic stabilization and only 6% use the anaerobic process.

It is interesting to point out that the actual trend towards more energy efficient technologies is increasing in any case and comparing data from 2015 and 2016 (ISPRA, 2017) it is possible to see that treatments involving anaerobic digestion process were increased by 24%. This is due to the new policy developed in Italy during the last years (in particular Italian Ministry Decree of June 2016) and the consequent advantage that utilities can obtain.

In detail, the total amount of biomasses used in anaerobic/aerobic integrated treatment amounts to approx. 2.507.020 Mtons in 2016. Their composition is represented in the Fig. 3. It is possible to see that the organic fraction of municipal solid waste (OFMSW) is the main part or the substrate used. It is interesting to see that almost the 4% of the substrate are represented by the sludge deriving from the wastewater treatments.

Biomasses sent instead only at the anaerobic treatment are quite limited if compared at the other technologies and 19 of the 21 plants are located in North of Italy. In this case, the composition of the biomasses changes considerably compared at the integrated treatment and it is represented in t Fig. 4.

It is possible to see that in this case the amount of sludge increase drastically if compared to the integrated solution, representing more than the 45% of the total amount of biomass used in this process.

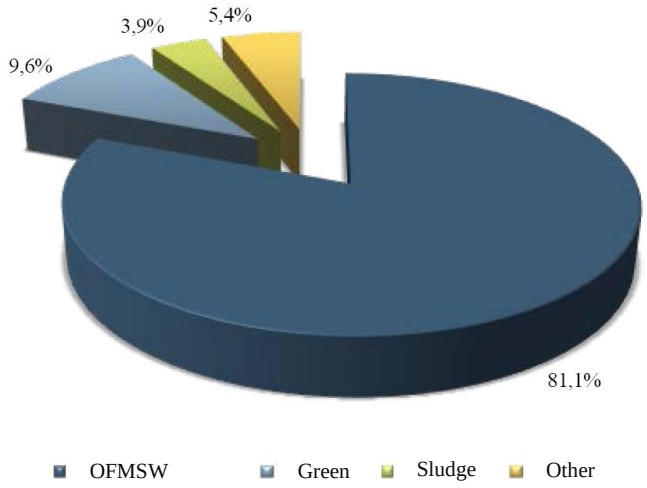

Figure 4: Type of wastes used at the anaerobic/aerobic integrated cycle (2016, (ISPRA, 2017)

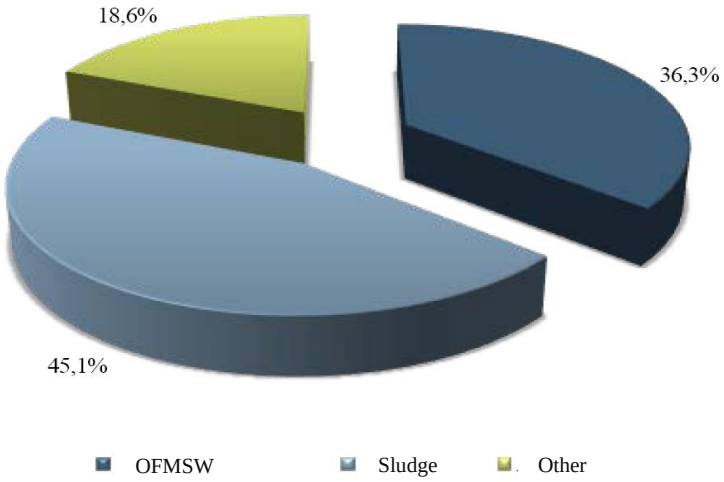

Figure 5: Type of wastes used at the aerobic process only (2016, (ISPRA, 2017)

In detail, regarding the situation in Emilia Romagna region, where the pilot is located, the use of the collected waste, its management and use is very similar than in the north of Italy.

In the seven sewage treatment plants in the region, in which 479,809 tonnes of OFMSW are treated anaerobically every year, the biogas obtained is completely converted into electrical energy with a total production of 58,522 kWh. According to the information available, the heat generated by the cogeneration system is not transferred for consumption to urban areas.

Recently, a full-scale plant for the waste treatment was implemented and the biogas transformed to biomethane and injected into the grid. Unfortunately, there is no data available to evaluate the performance of this plant. Other three plants are planned for the next years.

2.2. REEF2W approach and solutions

In the wake of the energy transition, an increased focus is concentrating on the yet unexploited energy-saving potential of the solid waste and wastewater sector. Wastewater treatment plants (WWTPs) are large consumers of energy and make key contributions to the carbon footprint of municipalities and urban governments. Their energy consumption usually accounts for the bulk of operational costs of wastewater utilities, sometimes up to 60 per cent. However, despite being a large source of electricity and heat, sewage is generally not considered. In fact, the amount of energy it contains can be 10 times bigger than what is required to treat it. Lately, an increasing number of utilities have deployed energy-efficiency measures and novel technologies to better harness the energy of sewage. Evaluations of pioneering projects show that utilities are not only capable of becoming energy self-sufficient, but also suppliers of energy thereby diversifying the local mix.

The project's main objective is to drive up energy efficiency and renewable energy production in solid waste and wastewater facilities. It focuses on solutions that integrate organic waste and wastewater streams and the development of new infrastructures. Several are the potential solution analysed in the project. The bigger opportunity is the recovery of biogas from OFMSW, because it is a technology well known and largely applied around the world on several municipal treatment plants. Nevertheless, other technologies as gasification, heat recovery from treated water as well as other renewable energy sources as photovoltaic panels, solar panels, incineration of sludge. This fact, as it is important to identify the best solution for each potential user, aware that the suggested solution in the tool is not able to cover all possibilities for upgrading a treatment plant. A minor scope of the tool is to stimulate utilities or public authorities to rethink about the energetic potential that waste has.

3. METHODOLOGY

3.1. Strategic Framework

The strategic framework of the action that the project is trying to implement are following the main strategies that the region has developed or is still under development.

In particular, the increase of the energy efficiency of buildings, transport and industries is the first aspect where the regional energetic plan focalize the attention. Taking in consideration this point and the necessity to increase the renewable energy production even from wastes to produce biogas biomethane but mainly recovery the available heat present in even in these products, the project activities are absolutely in line with the regional strategies.

3.2. Data inquiry

In the periodic reports published at regional and national level, some of which have already been used in previous sections to describe the actual situation, some interviews were conducted with various regional stakeholders representing regional authorities and private companies active in the field of waste and wastewater management.

From these interviews, it could be concluded that all persons contacted are aware of the relevance of the energetic costs of the treatments. Nevertheless, there is no connection among the different strategies of the water plan, the waste management plan and the regional energetic strategy.

3.3. Stakeholder engagement

Regarding the involvement of regional stakeholder, the strategy adopted in Italy is to contact as much as possible utilities present in the region. The scope of this action is to show them the potential that the tools developed in the project have and to show them how it is possible to increase their energetic efficiency and in particular showing them the potentialities of the heat recovery.

Not all contacted utilities have shown the same interest. Some see the approach as too innovative others think the investment costs may be too high and the payback period considered not in line with the financial capacity of the company.

More or less everybody stresses the necessity to have the possibility to access a public subsidy, so that most of the possible activities could be more easily implemented.

In any case, all the contacted companies are interested in testing the tool for potential future applications.

4. STEP I: VISION, GOAL and OBJECTIVE SETTING - What are we aiming for?

4.1. Vision

Most of the strategies developed at regional level derives from the national and European strategies and legislations. There are precise limits that each country has to respect for the environmental aspects that in this moment are also involving the energetic aspects. In particular, the regional energetic plan vision is focussed on the necessity to reduce the greenhouse gasses emissions and in the meantime reduce the particulate in the air.

Especially the reduction of particulate matter in the air is a rather big problem for the cities in Northern Italy. Regional authorities are focussed to increase the heat distribution networks in the next 10 years. In this sense the activities of the project, even if developed in a small community, could be a demonstration action that it is possible to recover energy even without the availability of large plants.

4.2. Goal

The goal is to influence policy makers, national, regional and local authorities to enable legal and operational framework for implementing REEF 2W solutions and models in order to implement energy efficiency and renewable energy production in waste and wastewater sector.

4.3. Objectives

The main objective for the strategy in Italy is to finalize the pilot plant in 5 years and demonstrate that solution available from the REEF 2W tool could be useful in the three of decision of a municipality.

The second objective is that with the help of the local authorities other utilities using the tool and applying the solution suggested could implement new technologies for the energy recovery from waste.

5. STEP II: STRATEGIC ANALYSIS - What Are The Key Issues Our Strategy Must Address?

The action that the project is implementing are in line with the targets of the national and European legislation.

The challenge will be to keep all the activities performed in the project active and updated after the end of the project. To do this it will be important that the public authorities adopt the methodology and the solution suggested by the project in its policies.

External Analysis

The regional energetic targets established in the Energetic Plans approved in 2017 are:

- the reduction of climate-changing emissions by 20% by 2020 and by 40% by 2030 compared at the 1990 levels;
- the increase to 20% in 2020 and to 27% in 2030 of the share of coverage of the consumption through the use of renewable sources;
- the increase in energy efficiency to 20% in 2020 and 27% in 2030.

In the region in particular the new energy strategies will concern the three main sectors:

- transport,
- electrical,
- thermal.

Interventions will be concentrated to achieve the objectives set by the European Union and implemented by the Energetic Plan.

Internal Analysis

Emilia Romagna Region has already developed the strategy to facilitate the use of RES at local level, in particular simplifying the procedures for their implementation.

Technical partners of the actions could be other bigger utilities or specialized companies having the knowledge for the technological aspects to be faced.

The financing of the action has to be evaluated first by the local agency for waste and water management that, if approved will facilitate the access at the financing.

6. STEP III: STRATEGY FORMULATION – How are we implementing our strategy?

6.1. Strategic area with actions

Strategic Area I: Capacity building

Problem statement:

To ensure the sustainability of research results after the project has ended including their further development and application will be in the hands of the partners in particular the academic partners that will remain in contact for further developments. The application of the solutions suggested instead are in the hands of the auditors trained during the project or in subsequent courses.

Aim of action:

Capacity building measures strengthen the REEF 2W approach by disseminating project results including skills, knowledge and tools. Furthermore, solid waste and wastewater treatment utilities will be enabled to achieve their energy targets.

Strategic Action I.1: Training

Trainings courses are offered to form expert auditors able to evaluate the better solutions for the specific application analysed.

Strategic Action I.2: Register

A register of trained experts within the REEF 2W project will be published on the web project platform. These experts will have qualified technical and financial competences enabling them to consult and coach operators of waste or wastewater treatment plants that are interested in implementing REEF 2W solutions.

The register will be kept updated with the future auditors that will be engaged after the appropriate training.

Strategic Area II: Reaching energy targets

Problem statement:

To ensure clear defined and achievable energy targets both on local and regional level is challenging.

Aim of action:

Encourage local and regional authorities to include REEF 2W solutions for their waste and wastewater utilities in future energy plans.

Strategic Action II.1: Anaerobic digestion that includes bio-waste

Increase the options connected with the anaerobic digestion process and suggested by REEF 2W WWTPs (anaerobic digestion with added bio-waste where there is proven feasibility and applicability).

Strategic Action II.2: Operational framework

Establishing operational framework that includes both making legal preconditions and suitable finance model(s) that will enable implementing REEF 2W solutions.

Strategic Action II.3: Other RES solutions

Stimulate the heat recovery from wastewater and from cogeneration systems to increase the general energetic efficiency not only of the treatment plant but also of the nearby urban areas.

Stimulate the development of heat networks starting from public buildings and sport centre.

7. CONCLUSIONS

The regional strategy focusses on the Emilia Romagna Region. This region tries to decline all the environmental aspects with the necessity to provide energy for the cities and for the industries. The municipality has already conducted several actions, but economic occupational aspects limit these actions.

At the moment, the potential of waste recovery is generally known, not only as energy recovery but also as material recovery. Phosphorus recovery that is a technology that is considered by several countries, could be strongly stimulated by applying one of the technologies proposed by the project.

The REEF 2W approach has a high potential, in case it will be accepted, implemented and sustained, to foster a circular economy approach in the Italian regions considered in this study.

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