

E²STORMED Strategic Action Plan for Zagreb

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E²STORMED PROJECT
Improvement of energy efficiency in the
water cycle by the use of innovative
storm water management in smart
Mediterranean cities
www.e2stormed.eu



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1. INTRODUCTION

Water and wastewater facilities are often the largest and most energy-intensive loads owned and operated by local governments, representing up to 35% of municipal energy use (NRDC, 2009). In this sense, international recommendations (EC, 2012; USEPA, 2014b) have been elaborated to encourage the implementation of more sustainable, flexible and efficient drainage systems. SuDS benefits can reduce energy consumption in cities by (USEPA, 2014a):

- Reducing use of potable water, hence, energy consumed by acquisition - frequently by pumping - and treatment of drinking water, even higher where desalination is used and/or water imported.
- Reducing stormwater inflow into sewer systems, hence, energy consumed by treatment of wastewater and pumping of surface and foul water.
- Reducing local temperatures and shading building surfaces, hence lessen the cooling and heating demand for buildings, reducing energy needs and decreasing emissions from power plants.

This Strategic Action Plan has been elaborated to improve energy efficiency in the urban water cycle including buildings over the following years by promoting the use of innovative storm water solutions such as Sustainable Drainage Systems (SuDS) in City of Zagreb. In this document, different actions and strategies are described to meet this objective, following the city's vision to achieve a more sustainable urban water management.

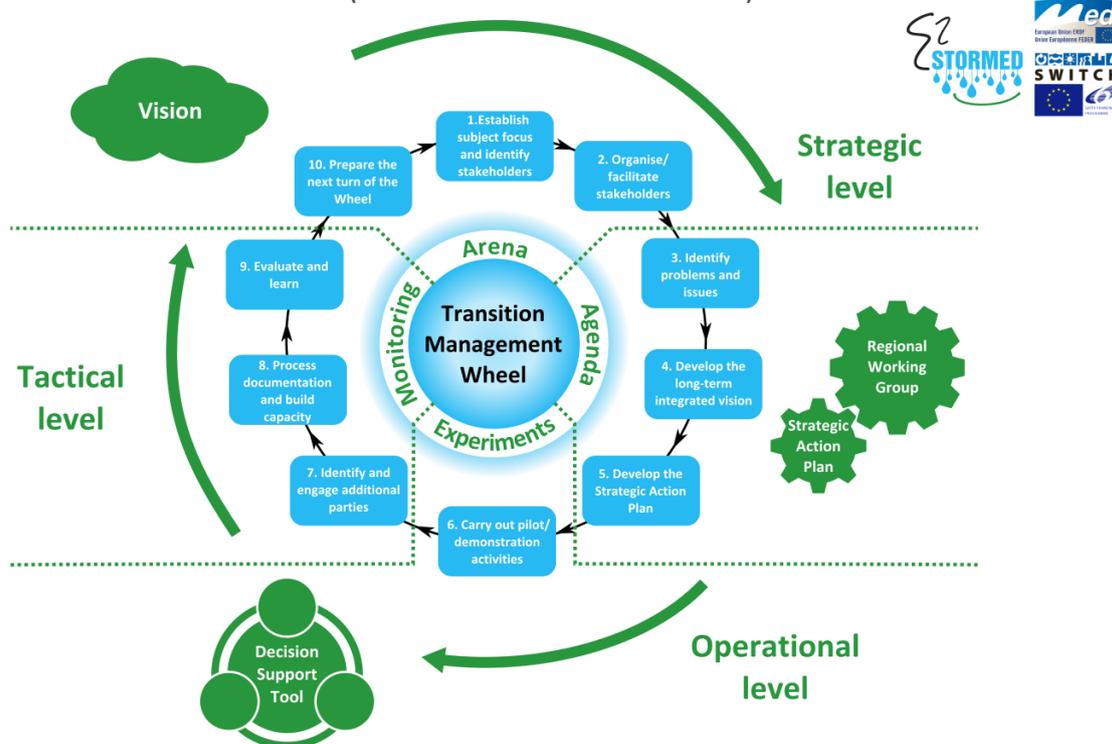
This Strategic Action Plan has been developed within the E²STORMED project (www.e2stormed.eu): Improvement of energy efficiency in the water cycle by the use of innovative stormwater management in smart Mediterranean city. This project is funded by the MED Programme of the European Union.

The central theme of this project - saving energy through better control of stormwater - may seem a strange idea for some people. Many Mediterranean countries are not rich in energy, nor water, so combining stormwater and energy efficient practices should not be thought of as strange, just a different way of thinking. This is known a Paradigm Shift, a different way of thinking and working.

In order to encourage this change, the E²STORMED project partners have developed the E²STORMED Transition Framework, which is summarized in the following figure. Transition Management provides an opportunity for engaging multiple stakeholders and bringing together diverse perspectives on a 'wicked' problem, potential solutions, and enabling new ways of working to emerge.

E²STORMED Transition Management Wheel

(based on SWITCH Transition Framework)



E²STORMED Transition Management Wheel.

This Strategic Action Plan is the fifth step of this Transition Management Wheel and it is the main tool to achieve the long-term vision developed within this framework. This transition process is explained in detail in the E²STORMED Transition Manual of City of Zagreb.

The present document has been elaborated with the participation of the Zagreb Regional Working Groups on Energy Efficiency created within this transition process. This group allows the participation of the main regional actors related to energy, water and urban development, public as well as private, which enables to plan joined actions with other entities and to identify new opportunities.

2. URBAN WATER MANAGEMENT IN ZAGREB

MUNICIPALITY AND WATER CYCLE DESCRIPTION

Zagreb is the largest city of the Republic of Croatia and also its capital. It is located in the northwest of the country, along the Sava River, at the southern slopes of the Medvednica mountain.

Zagreb is covering an area of 640 square kilometers and lies at an elevation of approximately 122 m above sea level. It is situated 170 km from the Adriatic Sea. In the last official census of 2011 the population of the City of Zagreb was slightly over 790.000.

The wider Zagreb metropolitan area includes the City of Zagreb and the separate Zagreb County bringing the total population up to 1.110.000. It is the only metropolitan area in Croatia with a population of over one million.

Zagreb has a continental climate with warm and dry summers and cold winters. The city has the typical spring, summer, autumn, and winter climate variations, with little seasonal deviation. It is very hot during the summer, freezing in the winter and quite pleasant in late spring and early autumn. The wettest time of the year here is in the summer, between late June and October.

Zagreb fetches an average of 1.060 mm of rainfall per year, or 88,3 mm per month. The driest month is February with 48 mm. Most precipitation falls in June, with an average of 101 mm. Snowfall is very common during the winter months. On average there are 96 days per year with more than 0,1 mm of rainfall or 8 days with a quantity of rain, sleet, snow etc. per month.

The city of Zagreb lies on the alluvium of the Sava River which is the main and largest water source for the city. The Sava River Basin is a major drainage basin of the South Eastern Europe covering the total area of approximately 98.000 km².

Water supply is based on groundwater abstraction. Aquifers of the Zagreb area are found along both the left and the right bank of the Sava River. The thickness of the water-bearing sand and gravel stratum is from several to a hundred meters. Above it, a surface layer (mud, loam, clay), 1 to 8 m thick, is found. The aquifer is recharged to a small extent by vertical percolation through the soil, but predominantly by horizontal infiltration from the Sava.

Water supply in the studied area is carried out through the water supply system of the city of Zagreb which serves the city, but also gravitating parts of Zagreb County with total area of over 800 km². Water supply system consists of six water intakes with a total of 30 water wells. The total nominal capacity of wells is 5.500 l/s of which the City of Zagreb uses about 4.950 l/s. Maximum water production of the system is more than 430.000 m³ per day. Some wells are located within the construction area of Zagreb, in residential areas or in close proximity to industrial zones and other potential pollutants. In these wells unacceptable levels of pollution have been identified and they are excluded from the regular water supply system.



The length of the public water supply network at the end of 2012 was 2.707 km of which 2.358 km is accounted for the City of Zagreb with a total of 93.810 connections (of which 81.742 in the City) thus securing the supply for approximately 897,000 residents. The average annual consumption of drinking water is about 70,3 m³ per capita. The households water consumption account for 75,58%, and other users with 24,42%.

Zagreb City sewage system consists of two independent sewage systems, each of which is located on one side of the Sava River. Both were built as a combined sewerage system. The area covered by the public sewage system is 23.500 ha and approximately 750.000 inhabitants are connected to sewage system. Wastewater is treated at a central wastewater treatment plant (WWTP) and effluent is discharged into the Sava River. WWTP is located on the left bank of the Sava. At WWTP wastewater is treated with primary and biological treatment processes. The capacity of the WWTP is 1,2 million population equivalent.

The largest part of the city located on the left bank of the Sava River is connected to the WWTP via the main drainage canal. The connection of the city area on the right bank of the Sava River to WWTP was realized in 2011 and until then wastewater of this area was diverted through collectors in the Sava River.

The total length of sewage network is 1.550 km of which 10 km are open canals. Sewerage network covers approximately 88% area of the City of Zagreb, while about 12% of the area with about 120.000 inhabitants has no connection to the sewage system. Only 20 of the 68 settlements that gravitate towards Zagreb have public sewerage network.

Integral part of wastewater is the rain water from many streams flowing down from the Medvednica mountain. These streams, via open canals, are flowing into the sewage system causing significant amounts of highly diluted wastewater in wet periods, creating additional hydraulic load to the sewage system. Due to heavy precipitation additional quantities of sediment is entering the sewage system.

The capacity of the WWTP is limited and in order to provide undisturbed operation of the plant during severe rainfall events excess of the water overflows to Sava River prior to entering the plant.

The water supply system is characterized with high water losses. It is estimated that the difference between the amount of water entering the system and the amount of water that is consumed is between 40 and 50 [%]. This practically means that approximately 135.000 m³ of potable water leaks every day in Zagreb. The economic value of these losses is estimated to be 200.000 €/d. Such losses in water supply system are due to several reasons, some of which include outdated parts of the water supply system, high pressure and non-economic water price. Another issue is the lack of a complete register of water installations, as well as the rehabilitation of the network in the old parts of the city.

The main sewage system problem is the disposal of the sludge from WWTP. The issue of final disposal of sludge still remains unsolved, which poses a significant problem in the operation

and maintenance of this plant. Current solution includes anaerobic sludge stabilization with energetic use of biogas at WWTP and the temporary sludge storage at the treatment plant. The City of Zagreb is in the planning process for a combined solid waste and strained sludge incinerator, as the final solution for the disposal of sludge from the Central Wastewater Treatment Plant of Zagreb.

As it was previously mentioned, City of Zagreb is covered with a combined sewage network. Therefore, a mixture of both sanitary wastewater and rainwater enters the sewage system and is being treated at the WWTP.

Sewage system consists of several wastewater pumping stations so in addition to wastewater treatment energy costs, energy is being consumed for the process of wastewater conveyance as well.

A solution which could reduce the inflow of rainwater into the system would reduce both the wastewater pumping costs as well as the wastewater treatment costs. Additionally, technical solutions which provide on-site rainwater treatment options can also reduce the financial and energy costs of water treatment.

SuDS infrastructure provides both a reduction in rainwater inflow into the sewage system and some initial rainwater treatment prior to its inflow into the system.

MANAGEMENT AND REGULATORY FRAMEWORK

Water and wastewater systems are owned by a local government and managed through water and wastewater utility companies. Stormwater drainage system that is a part of residential, commercial or other building is maintained by the owner of the building. Stormwater drainage related to the roads, railways, ports or airports is maintained by the specialized official institution or company that manages the traffic infrastructure. Only torrent control structures and systems are maintained by Croatian Waters company, a legal entity for professional water management financed from water fees determined by the Water Law.

At present there is no legislation addressing the problem of stormwater management in more detail. Stormwater is only recognized as a wastewater but any other related aspects are not covered. The existing legislation is primarily engaged in wastewater treatment at wastewater treatment plants (WWTP) and effluent quality requirements from WWTP. Since combined sewage systems are mainly present in Croatia, waters overflowing from the relief structures during rain events represent a source of uncontrolled environmental pollution that is not covered by any regulations.

Current practice of urban planning favours conventional sewage and drainage solutions while SuDS are not recognized as a possible alternative. Also the possibilities for energy savings by collecting and using stormwater are not covered by any document at the national level.



Main water regulations have been adjusted with the regulations at European level, but as well as European regulations, still do not provide direct guidelines, actions or at least principle solutions for stormwater management.

Energy Management & Regulatory Framework

Current legislation recognizes the need for energy efficiency and clearly emphasizes that effective energy use is in the interests of the Republic of Croatia. The energy management at national level is based on Energy Development Strategy which is, as the rest of the legislation, based on energy management obligations taken from the EU goals including 20 % gross immediate consumption from the renewable energy sources (RES), 10 % share of RES used in all forms of transport, 20 % reduction of total energy consumption and 20 % reduction of greenhouse gasses emissions by the year 2020. The legislation also provides the responsibility for determining and conducting the policies for stimulating energy production from RES, the conditions and means of production and use of energy from RES at the energy market as well as the financial incentives for the use of energy from RES and energy efficiency measures.

At local level Zagreb is the leading city in Croatia in terms of recognizing the importance of sustainable energy development. As a member of the Covenant of Mayors initiative the City of Zagreb developed a Sustainable Energy Efficiency Action Plan (SEAP) that identifies and gives precise and clear guidelines for the implementation of projects for energy saving, application of energy efficiency measures, RES use and ecologically acceptable fuels at the city level, thus covering buildings, traffic and public lighting sector. The possibility of the energy efficiency through effective storm water management is not included in the municipal SEAP.

3. LONG TERM VISION AND ROADMAP

Water demand is continuously increasing throughout the years and, consequently, the energy consumption associated to it. In this document, a roadmap is presented to achieve city of Zagreb long term vision for enhancing the responsible use of water in the urban water cycle to maintain a sustainable urban development. As explained in the E²STORMED Transition Manual, this long-term vision has been elaborated in collaboration with the Regional Working Groups on Energy Efficiency, which involve the local and regional stakeholders related with water, energy and urban planning.

The long term vision decided for stormwater management in Zagreb is:

City of Zagreb, a member of the Covenant of Mayors, as one of the first European capitals that recognized the significance of this great initiative for sustainable development of urban areas of European Union, strives towards more efficient energy management in the fight against global warming. By signing the Covenant, City of Zagreb is committed to the implementation of numerous energy efficiency measures which will reduce CO₂ emissions in their cities by 20 % until the year 2020, how obliges a European energy policy Proposal from 2007.

As an important component of a path towards a sustainable future, City of Zagreb also strives towards better stormwater management. Environmentally safe, energy efficient stormwater management solutions with the ability to protect the aquifer and preserve groundwater quality are required to ensure an ecologically friendly and safe surrounding able to provide a high quality of living. Ongoing participation and cooperation of all stakeholders, government and administrative bodies, technical experts and citizens, is necessary to design an efficient and socially and environmentally beneficial system.

In order to ensure substantial changes it is necessary to make a political and strategic decisions that would encourage long-term activities primarily by changing the approach to urban planning through the adjustment of legislation. This Paradigm Shift should envisage a planning and financing of SUDS, a maintenance and training of utilities together with the education of the professional staff and the public. Eventually regulations for urban nonpoint source pollution with the inclusion of SUDS solutions should be considered.

In order to achieve set objectives a complete strategy with some short-term goals must be considered. The purpose of these short-term goals is the preparation of various documentation (economic and technical studies) to provide the evidence base for implementing SUDS pilots.

At the local government level it is necessary develop an energy action plan regarding sustainable use of energy in water sector (supply and sewage) or to add this sector into an existing action plan.

The roadmap presented in this section is a summary of the strategic actions to achieve this long term vision. These actions are described in detail in Section 4. These actions are divided in three groups depending on its nature:

- Short term actions (within 1 year).
- Medium term actions (within 3 year).
- Long term actions (within 5 year).

Roadmap to improve energy efficiency in stormwater management in City of Zagreb		
Time period	Action	Estimated budget
Short term (2015-2017)	Approval of the Strategic Action Plan	5 000 €
	Development of a methodology for data collection and analysis	25 000 €
	Information, awareness and education campaigns for general public	30 000 €
	Development of a study of possible locations for SUDS implementation and possible energy savings at the city level	30 000 €
	Total	90 000 €
Medium term (2015-2020)	The identification of funding sources for the implementation of the Strategic Action Plan	20 000 €
	Preparation of various documentation to provide the evidence base for implementing SUDS pilots	45 000 €
	Pilot SUDS construction and monitoring	1 200 000 €
	Total	1 265 000 €
Long term (2015-2025)	Best practices document for stormwater management	30 000 €
	Influence on Regional and National Regulations	25 000 €
	Creating a strategy for a long term SUDS implementation	40 000 €
	Total	95 000 €
Total		1 450 000 €

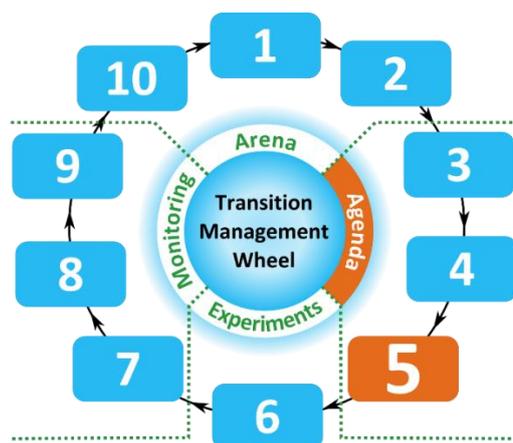
4. SPECIFIC ACTIONS WITHIN THE STRATEGIC ACTION PLAN

APPROVAL OF THE STRATEGIC ACTION PLAN

Description

Before attempting to conduct any of the actions planned by the SAP, it is necessary to acquire approval from the municipality first. Therefore, with the approval of this plan, the municipality commits to use resources to take into action the activities described in this plan.

As explained in Section 1, this Strategic Action Plan is one of the key steps of the E²STORMED Transition Management process. It is the fifth step of the Transition Wheel, naturally following the development of the long-term integrated vision.



Objectives and benefits

- Approval of the Strategic Action Plan by the municipality
- Commitment of municipality's resources towards activities defined by the Plan
- The execution of the objectives envisaged by SAP
- Making SAP official in terms of information and documentation makes the public aware of the actions and decisions taken by the municipality

Required resources

- Staff: 2 - 3 people, familiar with E2Stormed project's goals
- Activity bearer: The City of Zagreb; City Office of Energy, Environment and Sustainable Development
- Material : office space, office supplies
- Sources of funding: City of Zagreb budget
- Time : 6 months

Estimated budget

5 000 €

Time period

Short-term

DEVELOPMENT OF A METHODOLOGY FOR DATA COLLECTION AND ANALYSIS

Description

In order to define the specific steps for energy, thus CO₂ reduction it is essential to gain detail insight of the existing energy consumption in stormwater management. Therefore it is necessary to define a methodology for data collection and analysis of all wastewater management components including: sewerage system type and network data, wastewater volumes and energy consumption at WWTP and pipe network, pumping stations energy consumption (transport and treatment), fuel consumption, related CO₂ emissions, sewage network infiltration and exfiltration (losses).

The final goal of this step is obtaining detailed information regarding total energy consumption (kWh) and CO₂ emissions (t CO₂) in wastewater sector and its overall participation and relation with other sectors at city level. Gaining detail insight in wastewater/stormwater management energy consumption will indicate the critical components for which priority actions are needed.

Since the evaluation of stormwater management is necessary, defining a specific indicators for environmental, social and economic performance is needed for analysis and reporting.

Objectives and benefits

- Gaining insight in wastewater/stormwater management energy consumption and CO₂ emissions
- Quantifying the amount of energy used and CO₂ emissions in wastewater/stormwater sector
- Pointing out critical and the most inefficient management components
- Defining a specific objectives for energy savings and their execution priority

Required resources

- Staff: 2 to 6 people;
- Activity bearer: The City of Zagreb; City Office of Energy, Environment and Sustainable Development
- Material: office space and supplies, materials for conducting a survey and data gathering
- Sources of funding: City of Zagreb budget
- Time: up to a year

Estimated budget

25 000 €

Time period

Short-term

INFORMATION AND AWARENESS CAMPAIGN FOR GENERAL PUBLIC

Description

Stormwater education programs and awareness campaigns have been shown to have many benefits over 'engineering' solutions, including favourable cost-benefit comparisons. Effective community education projects:

- Involve stakeholders and learners in decisions about the planning, management, content, style and delivery of the project.
- Create a supportive environment for influencing behaviour.
- Educate and create awareness for stormwater management.
- Support and strengthen existing community networks and help create new ones.
- Motivate and encourage ownership.
- Provide opportunities for examining beliefs and values.
- Identify and promote positive actions rather than discourage undesirable ones.
- Are relevant, accessible and affordable, recognising the differing circumstances and constraints in a community.
- Respond to the diverse needs of the community.

Other options are programs and campaigns focused on reducing water and energy consumptions at home or on reducing pollution of wastewater. In these campaigns, dissemination material (flyers, pens, books, etc.) can be very useful to reach the population. Also, these campaigns can be reinforced with communication actions in local media (newspapers, local TV, etc.). Furthermore, developing a website for the campaign (or creating a section in the municipality website) can be very appropriate to support the campaign.

Regional working groups represent a second, equally important aspect of awareness raising activities. In the frame of E²STORMED, each pilot partner has identified and engaged relevant regional and local stakeholders related with urban water and energy management to support the transition process. After this project, these groups are still very valuable to ensure the participation of the main stakeholders and to promote a more sustainable stormwater management at the regional and national levels.

In order to sustain the meetings of these Regional Working Groups after the end of E²STORMED, municipalities and the rest of the stakeholders will have to find ways for the activities to be funded, and agree on how costs and benefits are going to be shared. In conclusion, the continuity of these groups is envisaged to be very useful to continue promoting sustainable policies and actions on urban water management.

Application of the E²STORMED Decision Support Tool characterizes the third aspect of the information and awareness rising campaign. DST quantifies the economic costs, savings, energy consumptions and carbon emissions of different drainage scenarios and they are included in a multi-criteria analysis.

These results are used to develop decision criteria based on energy efficiency, economic costs and water management principles. They can be complemented with social and environmental criteria to support the decision-making process. These criteria are used to choose between different drainage scenarios. Regional and local entities can use the E²STORMED DST to support stormwater

management and to justify the construction of new infrastructures. With this tool, the decision making process for stormwater management is more public, transparent and objective. Furthermore, it includes energy efficiency and environmental criteria in this process.

In the E²STORMED Transition Framework, transition experiments (step 6) consisted mainly on the application of the developed E²STORMED Decision Support Tool (DST) to local sites. The E²STORMED DST has been used to compare and to evaluate different scenarios of conventional drainage solutions and SuDS in both, developed and undeveloped area in Zagreb. The DST tool can be used to facilitate in the decision making process of choosing a suitable location for SuDS pilot construction, which is a projected activity in the Plan.

In the context of promotion it would be beneficial to inform water utility staff and other water professionals about the possibilities of DST tool. This can be accomplished through specialized seminars, workshops and expert meetings.

Although the before mentioned actions are classified as short-term, awareness increasing activities may be reclassified as medium or long term if the need for increased institutional or public awareness or additional sources of funding arises during the implementation of the Strategic action plan.

Objectives and benefits

- Increased interest in the E2Stormed project
- Increases awareness resulting from a good marketing campaign could result in a public demand for SuDS implementation
- Building of the knowledge base regarding the E2Stormed project (about potential issues, possible benefactors etc.)
- Stakeholders feedback
- Possible emergence of new stakeholders or important figures interested in the project's further development

Required resources

- Staff: 2 to 6 people
- Activity bearer: The City of Zagreb; City Office of Energy, Environment and Sustainable Development
- Material: pamphlets and booklets containing relevant information, possibly material needed to record a promotional video, office space and supplies
- Sources of funding: City of Zagreb budget
- Time: one year

Estimated budget

30 000 €

Time period

Short-term

DEVELOPMENT OF A STUDY OF POSSIBLE LOCATIONS FOR SuDS IMPLEMENTATION AND POSSIBLE ENERGY SAVINGS AT THE CITY LEVEL

Description

After fully understanding the process of energy consumption in wastewater/stormwater management sector and identifying its critical parts it is necessary to examine in more detail the possibilities for energy savings. Developing a case study at the city level should define the locations and the activities that will result in greatest savings as well as determine the necessary investments for their achievements.

Primary orientation in the making of the study must be related to energy efficiency in stormwater management. This means that at first the study must provide solutions for reducing the amount of stormwater entering the sewage network but still provide adequate stormwater flooding protection. This will reduce the need for further wastewater pumping as well as CSOs and mitigate the amount of pollution entering local water body. The study has to be developed for short and long term priorities with associated locations of the city, necessary drainage infrastructures, implementation costs and return periods, funding proposals, estimates for energy savings as well as the time frame for their achievement.

The study has to take into account different drainage scenarios and must consider all aspects of wastewater/stormwater management. Thus not only technical but organisational and managing aspects should be considered as well as the social impact. In this sense the assistance in the study preparation can be provided by DST tool. This tool can provide the required results and examine the use and the validity of different SuDS infrastructure. The advantage of using the DST tool is also in possible examination of specific infrastructure that can provide energy savings. Thus the installation of solar systems or similar systems for pumping stations can be tested.

Through this study the evidence base for implementing SuDS pilots should be created, thus major goals of the study include: defining the area and specific steps for pilot SuDS installation, estimation of energy savings and estimation of CO₂ emission reduction.

Objectives and benefits

- Defining location for SuDS implementation and possible energy savings evaluation
- Different stormwater drainage scenarios and infrastructure examination
- Defining pilot funding, implementation costs and return periods
- Creating the evidence base for SuDS implementation

Required resources

- Staff: 4 to 5 people
- Activity bearer: The City of Zagreb; City Office of Energy, Environment and Sustainable Development
- Material: office material (computers, office supplies etc.), DST software, previously collected data, various additional information
- Sources of funding: City of Zagreb budget



- Time: several months

Estimated budget
Time period

45 000 €

Short-term

IDENTIFICATION OF FUNDING SOURCES FOR THE IMPLEMENTATION OF THE STRATEGIC ACTION PLAN

Description

Definition of funding sources is necessary to ensure the participation in future projects focused on energy efficiency and water management in order to continue the E²STORMED transition process.

The city of Zagreb should look for funding in their own regulation and economic framework. The funds of the Zagreb city budget should be planned in a timely manner providing the possibility for the implementation of the Strategic Action Plan. It is also possible to exploit funding opportunities from Environmental Protection and Energy Efficiency Fund and Croatian Bank for Reconstruction and Development.

If available funds cannot ensure the implementation of the Plan, the help in the realization can be achieved together with funding from the European Union.

In this sense, funding support from European, National or Regional programs can be identified for improving water cycle infrastructures and promoting sustainable drainage systems, energy efficiency and renewable energy sources. In addition, research programs for pilot/demonstrative/innovative activities at the European and national/regional levels can be very useful to construct and monitor pilot Sustainable Drainage Systems and to promote energy efficient urban water management. Some example of research and capitalization programs at the European level are:

- Horizon 2020:
<http://ec.europa.eu/programmes/horizon2020/en/what-horizon-2020>
- Life+ Programme:
<http://ec.europa.eu/environment/life/funding/lifeplus.htm>
- MED Programme:
<http://www.programmemed.eu/en>
- SEE Programme:
<http://www.southeast-europe.net/hu/>
- Water JPI:
<http://www.waterjpi.eu/>
- Climate KIC
<http://www.climate-kic.org/>

Furthermore, this identification can be complemented providing easily accessible information about these funding options to local and regional entities and private companies related with water and energy management.

Public-private partnerships provide a way to accelerate and finance Sustainable Drainage Systems investments. In general, a public-private partnership is an arrangement between government and the private sector in which the private sector assumes a large share of the risk in terms of financing, constructing, and maintaining the infrastructure. Government repays the private sector over the long term if the infrastructure is built and maintained according to specifications.

Investment banks and financiers may see innovative stormwater management as an emerging market. Such stable regulatory drivers as consent decrees and stormwater permits are attractive to private investors because they create surety for funding. While the municipality will benefit from private-sector financing, the private partner will be paid from stormwater taxes collected by the municipality.

Hence, the municipality can create attractive projects in the water cycle for private investment, for instance involving private stakeholder in the urban water cycle. The E²STORMED Decision Support Tool can be very useful to justify these projects, since life cycle cost and expected benefits of stormwater infrastructures are estimated and presented in a simple way. Estimation of expected benefits and energy savings can attract private investors to invest in Sustainable Drainage Systems.

Furthermore, this private funding can be complemented with public funding from research programs as explained in the previous action, since additional funding could help minimise risks to the investor and facilitate capital investment.

Objectives and benefits

- Search for funding for the improvement of the E2STORMED project and vision according to the Strategic Action Plan
- Proving the cost effectiveness of SuDS
- Enthusiastic benefactors can greatly influence on the outcome of the project

Required resources

- Staff : up to 6 people
- Activity bearer: The City of Zagreb; City Office of Energy, Environment and Sustainable Development
- Material: office material (computers, office supplies etc.)
- Sources of funding: City of Zagreb budget
- Time: up to 3 years

Estimated budget

20 000 €

Time period

medium term action

PREPARATION OF VARIOUS DOCUMENTATION TO PROVIDE EVIDENCE BASE FOR IMPLEMENTATION OF SUDS PILOTS

Description

In order to successfully influence regional and possibly national regulations regarding stormwater management it is essential to have a substantial evidence base regarding SuDS efficiency and its' applicability in local conditions. Representatives from public and national bodies dealing in stormwater management are usually very concerned with the quality of groundwater.

It is very important to present evidence that SuDS infrastructure does not pose any threat to the local underground aquifer.

Additional proof of SuDS efficiency regarding wastewater treatment and flood protection benefits, as well as other ecological, economic and social benefits, should be gathered.

A strong evidence base is the first step towards the lengthy process of influencing regional/national government.

Objectives and benefits

- Creation of a sufficiently large evidence base for SuDS implementation
- Better understanding of the SuDS infrastructure interaction with the local environment
- Better understating of the legal and administrative processes which precede the legislature changes regarding stormwater management

Required resources

- Staff: at least 4 people
- Activity bearer: The City of Zagreb; City Office of Energy, Environment and Sustainable Development
- Material: office space, usual office supplies
- Sources of funding: City of Zagreb budget
- Time: up to 2 years

Estimated budget

45 000 €

Time period

medium term

PILOT SuDS CONSTRUCTION AND MONITORING

Description

Building new Sustainable Drainage Infrastructures is one of the keys to promote an innovative stormwater management in the city. Construction and monitoring of new infrastructures will help to prove the SuDS benefits and will promote them in the entire region. SuDS can be retrofitted in developed areas and they can be broader included as a part of urban planning in new developments. Construction of several SuDS can be included as separated actions within the Strategic Action Plan.

When new typologies of SuDS are built in a region, it is fundamental to monitor its benefits and costs, in order to prove their benefits to other municipalities and to the population. These results will be very useful to spread these infrastructures to other cities.

Informative panels can be placed at these infrastructures' sites to reinforce the 'green' municipal image and to explain their objectives and performance. These panels are really useful to explain new investments to the population.

Objectives and benefits

- Construction of a SuDS infrastructure in local conditions
- Possibility of testing SuDS efficiency and social acceptance in local conditions

Required resources

- Staff: depending on the scale of the pilot, 2 to 6 people
- Activity bearer: The City of Zagreb; City Office of Energy, Environment and Sustainable Development
- Material: depending on the chosen infrastructure
- Sources of funding: City of Zagreb budget
- Time: up to 3 years

Estimated budget

1 200 000 €

Time period

medium term action

BEST PRACTICES DOCUMENT FOR STORMWATER MANAGEMENT

Description

Elaborating a document to define guidelines and recommendations to implement Sustainable Drainage System at a regional and/or national level. These guidelines may include experience gained on construction and maintenance of these infrastructures in the country or in countries with a similar climate.

This document should include an explanation on why a more sustainable stormwater management is needed and the demonstration of the usefulness of this sustainable approach for Mediterranean climates.

In order to widespread these best practice document, it should be preferable to use local languages. Furthermore, contact can be established with universities and local technicians to widespread them amongst engineers and architects.

Objectives and benefits

- Completion of a best practices document as a guide towards a better stormwater management
- Increase in knowledge base regarding stormwater management

Required resources

- Staff: 2 to 4 people
- Activity bearer: The City of Zagreb; City Office of Energy, Environment and Sustainable Development
- Material: usual office material (computers, office supplies etc.)
- Sources of funding: City of Zagreb budget
- Time: up to 5 years

Estimated budget

30 000 €

Time period

long term action

INFLUENCE ON REGIONAL AND NATIONAL REGULATIONS

Description

Influence on regulations and recommendations about stormwater management at local, regional, national and international levels can be really useful to widespread Sustainable Drainage Systems. In this sense, the results of the E²STORMED project in the pilot areas can be very useful to demonstrate the benefits of these systems to other decision makers and technicians. Some examples of documents where these recommendations can be included are:

- Legislation and plans about water management and flood protection.
- Legislation and plans about energy efficiency and carbon emissions.
- Legislation and plans about urban planning.
- Municipal ordinances of other cities.

In this process, it is really important to learn how the institutions work in order to address the right person in the right time to influence policy making. In this influencing process, it is important to:

- Establish stable communication.
- Increase awareness.
- Disseminate obtained results.

In order to influence these regulations and legislations, it can be very useful to participate in working groups at regional and national levels. These groups are usually established to renew regulations and guidelines, therefore, they can be a very interesting forum to present the achieved results with Sustainable Drainage Systems.

Furthermore, demonstration events, where the pilot infrastructures are explained, can be very useful to present the benefits of these infrastructures to decision makers and technicians.

Objectives and benefits

- Changes in local/regional regulations which would allow SuDS implementation as a valid alternative to conventional stormwater sewage system
- Successful change in regulations would provide a significant steps towards sustainable future

Required resources

- Staff: at least 4 people
- Activity bearer: The City of Zagreb; City Office of Energy, Environment and Sustainable Development
- Material: office space and supplies
- Sources of funding: City of Zagreb budget
- Time: at least 5 years



Estimated budget

Time period

30 000 €

long term

CREATING A STRATEGY FOR LONG TERM SUDS IMPLEMENTATION

Description

Based on the achieved results a strategy for a long term SuDS implementation at local and national level should be defined. This strategy must be an integral part of the legislation and set specific goals and objectives regarding establishing SuDS as the preferred drainage practice for all new developments, where appropriate, and to retrofit SuDS on existing drainage systems which have an adverse effect on the environment. Specific goals of the Strategy include ensuring their long term management as well as to allocate responsibility for the maintenance of SUDS and provide the basis for national standards for designing, constructing, operating and maintaining sustainable drainage systems.

It also has to answer how the Strategy will be implemented through national planning policy in order to ensure SuDS implementation.

Also a transparency and a reporting commitments in achieving the objectives of the strategy should be defined. The extent to which objectives are achieved is assessed using indicators generated from continuously collected data. Thus it is necessary for the authorities to continuously collect necessary data and publish indicators regarding energy and CO₂ efficiency as a part of a stormwater management.

Objectives and benefits

- SuDS implementation at local and national level
- Providing the basis for national standards for designing, constructing, operating and maintaining sustainable drainage systems
- Continuous reporting regarding energy and CO₂ efficiency

Required resources

- Staff: 3 to 4 people
- Activity bearer: The City of Zagreb; City Office of Energy, Environment and Sustainable Development
- Material: usual office material (computers, office supplies etc.)
- Sources of funding: City of Zagreb budget
- Time: up to 5 years

Estimated budget

40 000 €

Time period

long term action

5. STRATEGY MONITORING AND EVALUATION

The development of the Strategic Action Plan will be evaluated twice a year in meetings with the participation of local and regional stakeholders. In this evaluation, the progress towards the long term vision and the targets will be reviewed and a document will be elaborated to describe this progress.

Plan monitoring involves collection and analysis of data and information to assist timely decision-making, ensure accountability and provide the basis for assessing progress towards achievement of objectives and targets (City of Boroondara, 2014). It will help identify if adjustments need to be made to strategies, resourcing, and program design. Resources need to be committed for monitoring so that it becomes an integral part of the program and project cycle.

In order to evaluate this process, different monitoring indicators have been defined to evaluate the effectiveness of the Strategic Action Plan and the progress towards the long term vision. They are presented in the in the following table, and should be reviewed to analyse the degree of achievement of each indicator.

Monitoring Indicator	Target value	Achieved
Number of Regional Working Group meetings held	6	
Participation of stakeholders in scheduled Regional Working Group meetings	100 %	
Number of meetings with relevant figures in the field of stormwater management regulations held	6	
Participation of relevant figures in meetings held with the purpose of influencing the local/regional regulations	80 %	
Completion of best practices document for stormwater management	1	
Number of constructed SuDS	1-3	
Change in local/regional regulations regarding implementation of SuDS as a valid stormwater sewage alternative	1	

6. MORE INFORMATION AND REFERENCES

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E²STORMED PROJECT
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www.e2stormed.eu

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