E²STORMED Transition Manual
Municipality of Pisa

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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Date: June 2015
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1. INTRODUCTION

Cities around the world are facing a range of pressures including rapid urbanisation and urban sprawl, industrialisation and climate change. The ecological ‘footprints’ of cities are ever expanding through continued exploitation of available resources – land, water, energy, food, building materials, finance – while also producing large volumes of waste (solid, gaseous, liquid) which contaminate soils, air and water. Conventional water and energy management meanwhile, struggles to manage ever scarcer water and energy resources, to deliver services without adversely impacting the quality of life of urban populations and the environment.

The central theme of E²STORMED (www.e2stormed.eu) - 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.

On the other hand, local governments frequently have fragmented sectors (urban planning, water supply, wastewater, waste, energy, etc.), with parallel planning and implementation processes that are not always aligned with strategies at regional, national and European level. In addition, innovation and research outcomes are rarely consolidated into policy and practical applications. The challenge to finding sustainable solutions - economic, environmental, social and institutional - is beyond the realm of conventional research approaches, and requires a new paradigm.

Transition Management provides an opportunity to engage multiple stakeholders and bring together diverse perspectives on a ‘wicked’ problem, potential solutions, and enabling new ways of working to emerge. E²STORMED project partnership allows the combination of research outputs with practical implementation at local level in six pilot urban areas: Benaguasil (Spain), Cetinje (Montenegro), Pisa (Italy), Hersonissos (Greece), Zagreb (Croatia) and Ħaż-Żabbar (Malta).

This Transition Manual presents a coherent and holistic methodology to guide the desired paradigm shift. It is intended for decision makers at the local level (in areas of urban water, energy, urban planning, etc.), water utilities and practitioners. It contains three main sections: a summary on the concept of sustainable stormwater management; an explanation of the E²STORMED Transition Management Wheel and key activities to successfully manage a paradigm shift; and the case study of Pisa, illustrating how they progressed during the E²STORMED project. Hence, this Manual is intended to enlighten Pisa as it continues its journey towards a more sustainable future, but also serves as an inspirational guide for other Mediterranean regions that aspire for a better future.

The authors acknowledge that the Transition Framework and the explanation contained herein are based on outputs from the EU Funded SWITCH research project. Several concepts have been re-worked to better fit E²STORMED and the pilot partners’ local situation. SWITCH was predominantly concerned with the water cycle and its inputs and outputs. What is new in E²STORMED is that it links sustainable drainage and energy, thus a more energy efficient environment is gained.
2. SUSTAINABLE STORMWATER MANAGEMENT

WHY SUSTAINABLE STORMWATER MANAGEMENT?

When land is developed, the natural cycle of water is altered. In general, urban development removes vegetation and increases impervious surfaces (roofs, roads). These changes produce less evapotranspiration, less infiltration and more runoff.

Conventional drainage systems (drains, pipelines, drainage channels, etc.) are the most common approach to managing stormwater in urban areas. These systems have generally been designed to remove rainfall from the urban environment as rapidly as possible. This results in the following problems (Philip, 2011):

- Combined sewer overflows: Heavy rainfall causes combined sewers to exceed capacity, resulting in overflow of untreated wastewater being released to the environment.
- Diffuse pollution: Non-point source pollutants in the form of heavy metals, oils, nutrients and pesticides are dispersed by runoff into receiving water bodies.
- Decreased base flow in rivers and streams: Increases in impervious surfaces decreases groundwater recharge.
- Downstream flooding: The rapid collection and disposal of stormwater into receiving water bodies increases the risk of downstream flooding.

Furthermore, these problems may worsen due to climate change and larger urban developments. In order to solve these problems, urban drainage should move towards more flexible and adaptive approaches.

In comparison to conventional stormwater management, a sustainable approach focuses on both managing the risks resulting from urban runoff and its contribution to environmental and landscape improvement. Sustainable Drainage Systems (SuDS) objectives are to minimize the impacts from urban developments with regards to stormwater quantity (flooding) and quality (pollution) and maximize amenity and biodiversity opportunities (Woods-Ballard et al., 2007). SuDS can help to solve the problems associated with conventional drainage by contributing to flood control, pollution control and can also provide an alternative source of water for non-potable uses.
### Key differences between a conventional and a sustainable approach to stormwater management.

Adapted from *(Philip, 2011).*

<table>
<thead>
<tr>
<th>Stormwater quantity</th>
<th>Conventional approach: Stormwater as a 'nuisance'</th>
<th>Sustainable approach: Stormwater as a 'resource'</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stormwater is conveyed away from urban areas as rapidly as possible</td>
<td>Stormwater is attenuated and retained at source</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Stormwater quality</th>
<th>Conventional approach: Stormwater as a 'nuisance'</th>
<th>Sustainable approach: Stormwater as a 'resource'</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stormwater is treated together with human waste at centralised wastewater treatment plants or discharged untreated in receiving water bodies</td>
<td>Stormwater is treated as close to the source as possible using decentralised natural systems that may combine soils, vegetation and permanent water bodies</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Recreation and amenity value</th>
<th>Conventional approach: Stormwater as a 'nuisance'</th>
<th>Sustainable approach: Stormwater as a 'resource'</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not considered</td>
<td>Infrastructures are designed to enhance the landscape and provide recreational opportunities</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Biodiversity</th>
<th>Conventional approach: Stormwater as a 'nuisance'</th>
<th>Sustainable approach: Stormwater as a 'resource'</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not considered</td>
<td>Urban ecosystems are restored and protected</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Potential resource</th>
<th>Conventional approach: Stormwater as a 'nuisance'</th>
<th>Sustainable approach: Stormwater as a 'resource'</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eventually considered for reuse from wastewater treatment plants</td>
<td>Stormwater is harvested for non-potable water supply uses and infiltrated to aquifers</td>
<td></td>
</tr>
</tbody>
</table>

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**SUSTAINABLE DRAINAGE SYSTEMS**

Sustainable Drainage Systems (SuDS), also known as Best Management Practices (BMPs), Low Impact Developments (LIDs), Water Sensitive Urban Design (WSUD) or Green Infrastructure (GI), are designed to manage stormwater following natural hydrologic processes. The basic principle is to decentralize retention: to infiltrate and reuse at source as much rainwater as possible both in public and private spaces.

SuDS make use of common sense and simple technologies, embracing a broad range of typologies such as rain gardens, rain barrels, green roofs, swales and porous surfaces for car parking and roads *(USEPA, 2014), (Woods-Ballard et al., 2007).* Some examples are shown in the following pictures.

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*Sustainable Drainage Systems in the urban water cycle. Adapted from *(Perales-Momparler and Valls-Benavides, 2013).*
Examples of Sustainable Drainage Systems.

1. Water butt
2. Filter strip to a swale
3. Detention basins (3)
4. Green roof
5. Pervious pavement
6. Infiltration basin
7. Constructed wetland
8. Filter drain
Sustainable Drainage Systems are now broadly accepted in many countries particularly the US, Australia and northern Europe. Evidence is now available that SuDS are a viable option in Mediterranean regions as well (Perales-Momparler et al., 2014). However, understanding of the concept is still developing, with implementation limited due to lack of knowledge and expertise throughout the region.

**STORMWATER MANAGEMENT AND ENERGY**

Water and wastewater facilities frequently represent the largest and most energy-intensive burden for water utilities, representing up to 35% of municipal energy use (NRDC, 2009). Using a sustainable approach for stormwater management can potentially reduce energy consumption in the urban water cycle, as follows:

- Reducing potable water use reduces energy consumed in acquiring and treating drinking water.
- Reducing stormwater inflows to sewer systems reduces energy consumed in pumping and treating wastewater.
- Improving stormwater quality results in less treatment required before release into the environment.
- Reducing local temperatures and improving buildings’ insulation (with green roofs) reduces cooling and heating demand for buildings, reducing energy needs and decreasing emissions from power plants.

*Left: Wastewater treatment in Zagreb (Croatia). Right: Reverse Osmosis Plant in Ghar Lapsi (Malta).*
3. **Transition Management Wheel**

A radical change is required in culture as well as institutions towards sustainable urban built environments (clean local watercourses for citizens to enjoy, pleasant greener streets, flood resilient properties and infrastructure, etc.). Transition management has emerged as a sound governance approach that can accelerate progress for implementing innovative urban water technologies and practices such as sustainable drainage systems and improve energy efficiencies in the water cycle. Transition management does not aim to control the future; it attempts to influence ongoing processes of changes in society by systematically reflecting on the future and developing shared notions for desired sustainable urban environments.

The E2STORMED Transition Management Wheel as shown below, is a simple cyclical road map illustrating the pathways and tools available to manage the change from traditional types of drainage infrastructure such as stormwater sewers to more sustainable practices such as green roofs and basins, with a holistic view focussed on the local situation, in accordance with the well-known slogan “think global, act local”.

![E2STORMED Transition Management Wheel](image_url)

**E2STORMED Transition Management Wheel. Adapted from the SWITCH Transition Framework (Duffy and Jefferies, 2011).**

Transitioning is a cyclical process; the desired change will not happen overnight and it is expected that multiple cycles will have to be completed, repeating the above group of activities again and again. Completion of each cycle is referred herein as one “turn” of the
Wheel. Not all transition activities need to be undertaken in one cycle to consider that one “turn” has occurred.

The Wheel consists of ten activities that take place at three management levels:

- **Strategic Level (envisaging the desired future):** The focus is on the long-term aspirations and goals towards sustainable urban built environments, requiring strategic thinkers open to innovation and not afraid of change.

- **Tactical Level (working together for the future):** The focus is on development of strategies, networks, coalitions that bring attention to sustainability objectives and gain societal support to achieve short/mid-term goals, overcoming socio-institutional barriers to innovation/change.

- **Operational Level (innovating for the future):** The focus is on short-term actions, experimenting with innovations that have the potential to materialize the vision.

Different types of actors are involved in each level, requiring a range of diverse skills and competencies. All are important; hence the levels do not represent any hierarchy.

For a clearer understanding of the process at first sight, the ten activities are grouped into four clusters in the inner circle (Arena, Agenda, Experiments and Monitoring), while the icons in the outer circle highlight the core Wheel activities, which can be customized for each city depending on their local situation.

In the context of E²STORMED, “steering” the Wheel is initiated by each Municipality through the organization of a Regional Working Group focused on issues of Energy Efficiency (RWGEE) in the Urban Water Cycle, engaging people who can influence, guide and structure governance activities, and who are able to sustain and develop the process over time. The starting point for each pilot urban area was different as it was subject to historical, cultural and political backgrounds. E²STORMED helped guide partners through the process to develop their weaker strengths during the project which will prepare them for continuing beyond the project and into the next round of transition (or “turn” of the Wheel).

### 3.1 Establish Subject Focus and Identify Stakeholders

The term stakeholders refers to individuals, groups or organisations, who have an interest in, influence over, or may be affected by the issues in question and the desire to address the issues. The involvement of all stakeholders ensures that the particular needs, goals, limitations, etc. are considered, defended and negotiated.

In the frame of E²STORMED, each pilot partner is in charge of identifying and engaging relevant stakeholders. As with any group activity, momentum for a new enterprise is often provided by one or two key
individuals, with backing from their superiors and/or organisation/s. To set up a RWGEE a coordinator to champion the alliance and a team of enthusiastic co-workers is required.

Saving energy through better management of stormwater at the local level is the subject focus of E$^2$STORMED; hence, each RWGEE should include a good mix of relevant key stakeholders that make decisions or can effect changes in policy and practice in urban water practices, energy supply, urban planning, service-providers and other stakeholders who can directly influence decisions in related sectors at all levels (industry, regulatory bodies, universities, volunteers, etc.).

Some RWGEE groups may also include, at the appropriate time: water and energy user groups; local champions working to address environment issues; training and research organisations; financial organisations and the press/media, which provides a means by which the RWGEE can reach the public.

The RWGEE size depends on each city and the stakeholders involved in each case; as guidance, an appropriate size may be between 8 and 15 members.

Whether the RWGEE is sustained after the end of E$^2$STORMED is an important question. 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.

### 3.2 ORGANISE/FACILITATE STAKEHOLDERS

To kick off the RWGEE, the coordinator and co-workers should identify the different stakeholder interests in water and energy management, and make initial contact with them. Stakeholders should understand why their participation is relevant also for their own organisation.

It is important at the early stage that local buy-in and ownership of the process is. Caution should be taken to avoid ‘hijacking’ of the process by an elite group resulting in the establishment of a cartel. The RWGEE should be all inclusive if it is to be successful.

Meetings should take place on a regular basis so that momentum is not lost. It is recommended that stakeholders are informed in advance of issues to be discussed during each meeting to allow for them to properly prepare it.
The main tasks for the RWGEE during E²STORMED were (but not restricted to):

- Compiling local (Mediterranean based) data for development of the Decision Support Tool (DST).
- Evaluating and commenting on the application of the DST in the Pilot City and the E²STORMED Transition Manual.
  - Developing a Strategic Action Plan.
  - Learning and disseminating results and conclusions from E²STORMED within their organisations and to external stakeholders about using SuDS to deliver energy efficiency gains that mitigate and adapt to climate change impacts.

Additional/complementary activities can include: bilateral meetings focused on developing trust and gaining understanding; workshops and training sessions on energy efficient stormwater management; organizing joint activities (i.e. school art competitions); etc.

3.3 IDENTIFY PROBLEMS AND ISSUES

RWGEEs provide a means to jointly solve difficult problems. Based on local knowledge, studies and analysis, stakeholders can identify stormwater and energy issues, at technical and management levels, including governance and regulatory aspects.

Each stakeholder will have their own issues and potential solutions and there will be reasons (e.g. responsibilities, mandates, potential benefits) for each to want to seek resolution to the problem(s). It is only through the process of working together that an understanding of each other’s long-term ambitions and aspirations can be appreciated and shared solutions negotiated.

**TIP:** This activity offers a good point in time to assess RWGEE composition and decide whether to invite additional stakeholders or if an existing stakeholder’s contribution is no longer required.
3.4 **DEVELOP THE LONG-TERM INTEGRATED VISION**

A vision is a concise description of the desired future state. RWGEE members are a diverse group of stakeholders with different visions of what future urban water services and the environment should be. What are RWGEE long-term aspirations? The aim is to develop a consensus amongst the group and a commitment to work towards achieving a shared vision.

This activity might start from scratch or build upon an existing vision for the urban area that is set by EU, national or local legislation. The vision for a city must be exciting to inspire organisations and the public, using a mixture of descriptive narrative and numerical targets if appropriate (inspiration can also be gained by reviewing other cities’ visions). Consistency with visions at different spatial and temporal scales is required so as to secure political support and increase the probability of funding for strategies and plans aimed at achieving the vision. It is recommended that wording includes “sustainable drainage” and “energy efficiency”, key objectives of the project.

**Hersonissos long-term integrated vision**

“A vital urban environment and tourist destination where water resources are managed in a sustainable manner, thus rainwater is collected and reused to cover irrigation needs while localised flooding is essentially reduced, and, in which there is space and provision for new developments through the implementation of energy efficient solutions, such as SUDS. In a city like this professionals, stakeholders and citizens, are welcome to be informed, educated and involved in decision making regarding sustainable water management and conservation planning.”

Long-term integrated vision for Hersonissos (Greece).
3.5 Develop the Strategic Action Plan

A strategy is a medium to long-term planning framework within which specific activities are described and plans implemented. Over time, an effective strategy should lead to the realisation of a vision.

This activity could start by brainstorming and listing practical options and opportunities that could become components of an overall strategy, then assessing the social, technical, political, economic and environmental viability and acceptability of each item. Grouping strategy components to relevant parts of the vision will help to identify whether anything is missing to achieve the vision. Although relative costs, benefits, merits and trade-offs of the strategies need to be considered, it is important not to get drawn into too much detail.

Based on a literature review, the academic partners of E²STORMED have compiled a set of actions that pilot partners can use as a starting point for the preparation of Strategic Action Plans. They include communication, legal and technical actions that could be used to improve energy efficiency in stormwater management at the local level. Caution should be used when assessing strategy components for a particular urban area, as there is not “one size fits all” Plan.

3.6 Carry out Pilot/Demonstration Activities

This activity provides a ‘protected’ space for experimenting with activities that are aligned with the vision so that they can mature and become embedded into the existing culture. Pilot/demonstrations activities (also referred to as transition experiments) come in all shapes and sizes and by their very nature, open doors to new options.

E²STORMED transition experiments consisted of application of the Decision Support Tool (DST) to local sites. The DST compares and evaluates different
scenarios of conventional drainage solutions and SuDS in both, developed and undeveloped parts of each pilot urban area. To assist the process of informed decision making, different options are compared in terms of CO₂ emissions, energy consumption and financial savings (amongst other parameters) using a multi-criteria analysis. Application of the DST was undertaken by specialists, with the RWGEE providing local datasets, multi-criteria weightings and constructive recommendations on how to improve the DST so that it is a useful tool. This activity increased RWGEE knowledge on SuDS and their relation to energy efficiency by providing examples of different end uses and how they compared with conventional systems.

A unique demonstration activity amongst the E²STORMED partners has taken place in Benaguasil. This demonstration has been constructed and was monitored within the timeframe of the project: a green roof retrofitted at the Benaguasil Social Centre that was monitored over 20 months. This type of experiment is important as it proves the value of innovative methodologies by providing exemplars to practitioners and the public and as the saying goes: “seeing is believing”.

### 3.7 IDENTIFY AND ENGAGE ADDITIONAL PARTIES

The RWGEE should realise the benefits of involving other parties (community, civil society groups, business, media), and decide who and at what stage of the process they should be invited to join. They can be involved in multiples ways such as participation in meetings, special conferences, guided tours to SuDS sites, etc.

Involving the Media is crucial as they can get the message out to a wider audience. Media can raise awareness of issues and sustainable solutions available by communicating technical, institutional and economic issues using non-technical language.
In addition, frontrunners who are innovative individuals (not necessarily from institutions) could be invited as they are generally powerful actors with strategic capabilities in the business sector, the policy domain, academia or society.

It is also beneficial to identify possible synergies and alignments with other agendas (i.e. the green agenda) as this can increase the likelihood of success through taking advantage of joint funding opportunities.

**3.8 PROCESS DOCUMENTATION AND BUILD CAPACITY**

Process documentation captures and tracks what happens during a process of change and how it happened. Good process documentation enables stakeholders to reflect and analyse why changes happened and to organise and disseminate the findings. Meeting minutes, photographs, voice recordings, videos, etc. are some of the ways that information can be captured, and this should be processed and stored in a way that changes can be tracked.

In terms of capacity building, training sessions and workshops which empower middle management / operatives / community, etc. will encourage a change in mind-set and ensure engagement with new technologies / techniques.

RWGEE meetings are a good platform to conduct training activities (e.g. inform members about the performance of built sustainable drainage infrastructures in Mediterranean cities such those in Benaguasil).

**3.9 EVALUATE AND LEARN**

The starting point for each pilot partner at the beginning of E²STORMED was different and dependant on its own background, with transition strengths already developed in some of the activities. During the project, progress was represented by colour coding transition management activities in accordance with strengths developed as the project advanced. Dark green signifies that an activity is completed;
light green signifies that the activity is underway whilst blue signifies that the activity is still to be considered.

Evaluation of transition strengths in Zagreb (Croatia).

3.10 **Prepare the next turn of the Wheel**

The transition management cycle is almost complete by this stage, but the journey towards the desired future is far from over. In the image of the Transition Management Diagram, the Wheel has turned once during E²STORMED.

Sustainability should be thought of as a journey of discovery rather than a fixed goal that can be worked towards. The quest for sustainable outcomes will generate new knowledge areas as well as identifying gaps where knowledge does not exist. The next round of transitioning will begin after E²STORMED has finished where n gaps will have been identified and the vision readjusted if required. New visions may be required, and new actors may need to be found who are ready to become the champions of the future.

Throughout the process, the RWGEE is seeking more sustainable solutions and this can only be achieved by turning the Wheel again....and again....and again!
4. TRANSITION IN É²STORMED URBAN AREAS

This chapter presents a summary of the transition activities undertaken by the six É²STORMED pilot partners, in order to move towards a more sustainable future for managing its resources.

Strengths developed by each pilot partner are depicted using the following colour code: dark green signifies that an activity had been completed; light green signifies that the activity is underway whilst blue signifies that the activity is still to be considered. For clarity, only numbers are used to refer to each activity; these correlate to the following activities:

- Establish subject focus and identify stakeholders
- Organise/facilitate stakeholders
- Identify problems and issues
- Develop the long-term integrated vision
- Develop the Strategic Action Plan
- Carry out pilot/demonstration activities
- Identify and engage additional parties
- Process documentation and build capacity
- Evaluate and Learn
- Prepare the next turn of the Wheel

Municipality of Benaguasil (Spain)

The most remarkable achievement in Benaguasil during this Turn of the Transition Wheel has been the formation and work undertaken by the Regional Working Group, formed by the main regional actors involved in stormwater management. In addition, É²STORMED project has boosted understanding and dissemination of the benefits that SuDS bring, contributing to enhanced urban environments from the energetic, environmental and social points of view.

Municipality of Pisa (Italy)

Pisa Regional Working Groups on Energy Efficiency (RWGEE) has created an opportunity to bring together the main regional actors related to energy, water and urban development, public as well as private. Transition management has been gradually introduced and explained in all meetings, together with an update on project progress and activities. During the meetings the main problems of storm water management in the city of

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Pisa were identified and a vision for the future of the city has been shared. These are the most relevant results including, a proposed Strategic Action Plan. Through the Italian Municipalities Association (ANCI) the experience developed by the Municipality of Pisa within E2stormed project will be spread at national level.

**Local Government Association (Malta)**

In Malta the transition process in relation to the E2STORMED project was very interesting and engaging both for Local Government Association (LCA) as a partner and for the main stakeholders. Malta is new to SuDS, therefore, one cannot simply implement SuDS straight away. Their transition is aimed at a gradual transition from the solution used today to the implementation of SuDS. Issues and problems were identified and these helped in the development of a long-term strategy which complements the government’s vision for sustainable drainage management in Malta. All main stakeholders agreed that the way forward is by using SuDS and by means of this project LCA also had the opportunity to hold lectures for students attending the University of Malta in order to introduce them to SuDS. The next step is the actual implementation of a pilot project so as to assess the impact of SuDS in Malta and this will be done with the cooperation of the Ministry of Energy and Health.

**Municipality of Hersonissos (Greece)**

The E2STORMED experience in Hersonissos has been particularly interesting. It has proved to be a valuable tool towards improving stormwater management in the region. With the assistance of local stakeholders, who were identified at the very early stages of the project, problems and issues were mapped and scenarios tested. The transition process has been driven and informed at the same time by the vision developed in the early stages of the project, to develop a vital urban environment with sustainability, energy efficiency, and improved stormwater management, while actively involving local stakeholders and the public. This vision has contributed towards developing a concrete Strategic Action Plan and enriching the CoM with future sustainable stormwater management activities, including dissemination of project outcomes to the local society and especially to young students. Overall, the transition process in the Municipality of Hersonissos can be characterised as an important tool, and the experiences gained by its use could be utilised in future applications.
Old Royal Capital Cetinje (Montenegro)

Cetinje is one of the cities with the highest rainfall in Europe. Project E²STORMED brought to Old Royal Capital Cetinje a new philosophy regarding stormwater and its connection with energy efficiency. Old Royal Capital Cetinje has learned that the large quantities of stormwater should be considered as a valuable resource that can benefit it in many ways, and especially to contribute to significant savings in electricity consumption. With SuDS solutions Old Royal Capital Cetinje will be able to have at the same time flood protection, energy savings and new interesting landscapes. Reusing a large quantity of stormwater will provide the opportunity for Old Royal Capital Cetinje to have a potable water during the whole year without the usual restrictions.

City of Zagreb (Croatia)

City of Zagreb has undertaken most of the transition activities in the transitioning wheel. Subject focus was identified (improvement of stormwater management practices) and most of the relevant stakeholders have attended RGWEE meetings. During the meetings problems and issues were identified and members of the RGWEE agreed on a vision. A Strategic Action Plan was also developed, with regards to the Sustainable energy action plan of the City of Zagreb. Pilot activities have been conducted using the DST software on two areas within the city.

Future transitioning activities (in the next “turn of the wheel”) should involve additional parties, especially ones able to influence the national and local legislature regarding stormwater management.
5. **TRANSITION IN PISA**

In the frame of E²STORMED project six pilot partners, following the transition methodology of the SWITCH manual, had to apply its contents to promote a change in city water system from today’s state in to a sustainability condition also introducing new practices like SUDS. Municipality of Pisa started its activities involving stakeholders and others in sharing a new vision of the future of the city based on structural changes in water management. In order to implement the principles of this strategy have been identified two areas in which pilot was carried out a comparison between traditional and new drainage systems more sustainable systems. Transition management activities were undertaken and will be developed until June 2015.

**Population of the city:** 92,250

**Area of the city:** 185,18 km²

**Climate:** Mediterranean.

Climate of the city of Pisa is influenced by two factors: the proximity of the sea, which mitigates the winter temperatures winter that the summer heat, and the continentality of Valdarno.

**Temperatures:** quite cold in winter (2.9 ° - 11 ° C in January) and hot in summer (17.5 ° - 28 ° C in August).

- maximum temperature average annual: 19,9°
- minimum temperature average annual: 9,8°

**Rainfall:** 900 mm/year, 75mm. monthly average rainfall.

The city of Pisa rises above the banks of Arno River, just before the mouth of it at Marina of Pisa. It is one of the most important cities in Tuscany and it is extremely well-known in the world, because of its famous symbol: the leaning tower, known as Pisa Tower. Pisa is both an ancient and modern city.

It has an old town grew up within the medieval walls and an urban area all round it composed by ancient sub-urban neighborhoods and new urban development especially to the north-east side in the new hospital direction. In the south part of the city is also planned the development of the existing industrial area. Along the coast the summer towns of Marina,
Tirrenia and Calambrone have been developed, starting from the beginning of nineteenth century.

Pisa is a university town with a significant variation during the summer time when student and other non-resident people, like off-site workers, come back home. On the other hand during the summer time people coming from the neighboring municipalities make the population grow, increasing the pressure of tourism.

In the urban area the surface water network is made by the main channel of Arno river, which runs through the heart of the city. There is also a secondary hydraulic system constituted by drainage channels. Flow in the drainage channels can be by gravity or mechanically drivers by needs of land reclamation pumping stations. The Arno River doesn’t interact with the secondary drainage system.

In urban areas there are some drains conveying the waters into the sewer separate or combined; in non-urbanized areas the waters naturally flow into the minor grid. Combined sewers are also equipped with overflow facilities.

The water supply requires a lot of energy cause we use only underground water that must be pumped before the treatment and after the treatment. The water supply network has been optimized controlling the pressure to reduce water leaks and the related energy losses. The wastewater treatment plants have automatic control for energy saving.

There are three areas where are located several boreholes. The underground water is treated to remove metals and disinfected; from the treatment plants the water is pumped to the network. In one plant water is pumped directly into the network using pumps with frequency inverters, otherwise is pumped in reservoirs over the hills that supply the network. In the water supply network the pressure is automatically controlled using an integrated control platform. Total amount of water initially supplied (considering losses) and finally consumed by citizens in the city (m3) 12,207,415 m3/year (the City).
In the frame of the E2STORMED, six Regional Working Groups on Energy Efficiency have been created, allowing the participation of the main regional actors related to energy, water and urban development, public as well as private, which may enable the identification of new opportunities and work niches (green jobs). RWGEE main objective is to set a platform to share knowledge from their own experiences on energy efficiency related to the urban water cycle and storm water management.

The following sections explain how Municipality of Pisa has progressed in each one of the transition activities during E²STORMED.

5.1 Establish Subject Focus and Identify Stakeholders

The starting point of the 1st Turn of the Wheel, have been:

1. the proposal of criteria to consider to select members of the transition “Arena”, elaborated by lead partner (RWGEE guide)
2. The Municipality of Pisa strategic vision shown and described during the second open day in Cetinje, 6th-7th June, 2013.

The identification of the first group of relevant stakeholders (individuals, groups or organizations) has been proposed by the technical staff working in E²STORMED and validate by the political body, in this case by the Alderman to the Environment.

According to the RWGEE guide paper, Municipality of Pisa decide to involve at the beginning people belonging to these categories:

- organizations that make decisions or effect changes in policy and practice in water supply and drainage, energy supply, urban planning and waste water systems;
- energy and water service-providers;
- University and other research institute related to urban water cycle and storm water management.

Being the working group mission “sharing knowledge from the experiences “and contribute to the development of the Decision Support Tool (DST) with evaluations and comments on its
application, 12 institutions were invited to be part of the first RWGEE, and all of them have participated, in greater or less degree, as shown in Annex 2.

### 5.2 Organise/Facilitate Stakeholders

The facilitators of Pisa RWGEE have been the Municipality’s technical assistants within E³STORMED project: a geologist, responsible of the technical activities, an architect as general coordinator of meeting and events, and two groups of technical experts from Sant’ Anna school of advanced studies and from a private society, both with experience in urban water management.

In order to check availability of spaces for the 3rd open day in Pisa, the first RWGEE meeting was organized on the premises of the Fiumi e Fossi Office in Pisa. Members were invited directly by the technical coordinator with suggestions by the experts.

Transition management was gradually introduced and explained in all meetings, together with an update on the project progress and activities as summary of the Open Day organized by the different partner, according with the project timetable. In particular the 4th RWGEE meeting, that was combined with a workshop organized by Sant’Anna, developed a technical section about Sustainable Drainage Systems. In this section the design and research in the field of sustainable urban hydraulics have been illustrated and national and international case studies have been shown, with a focus on activities related to phyto-purification in peri-urban areas.

Main particular outcomes of each one of the meetings are shown in Annex 3.
5.3 IDENTIFY PROBLEMS AND ISSUES

The main problems of storm water management in the city of Pisa have been identified by the RWGEE as being:

- Wastewater reaching maximum treatment capacity
- Non-sustainability of new growth forecasts
- Management of the exceptional events of Arno river
- Pisa area is divided in a number of land reclamation basins and pumps are needed operating all days-year to maintain the area free from groundwater and excess surface runoff. So a large amount of energy is needed for maintaining such a system
- Sewer system not adequate to flash storm

5.4 DEVELOP THE LONG-TERM INTEGRATED VISION

During the Open Day at Cetinje (6th-7th June-2013), Pisa partners presented the proposal of long term integrated vision and in the first RWGEE it was discussed, considering its draft level. The vision springs to one side from two outputs, coming out from the project, that the Municipality of Pisa established to realize, to the other side from the territorial, hydraulic, energetic, and of waters management analysis.

The two outputs coming out from the project are:

1) codify the results of the activities of study, search and exchange in operational manuals and orientation documents, revolts to the public authorities, that promote the energetic efficiency in the cycle of the waters both to urban level that house-building
2) to promote the transfer of the operating and managerial indications in to the town-planning tools and other actions of communal programming through the indication of performance requirement, transformability conditions, evaluation indicators.

Bases of the vision

In the Mediterranean areas the meteoric events have irregular and torrential connotations setting difficulty of management in the urban areas in relationship to the sizing / efficiency of the drain network and the waters treatment infrastructures, engraving on the costs of maintenance and management. On the other hand however meteoric waters represent a natural resource that could be carried and used, guaranteeing so a great efficiency in the water provisioning. From here the challenge for the SMART cities to achieve more elevated standards of energetic efficiency in the cycle of the waters. And' is shown in fact that from one side the waters treatment costs are directly proportional to the energetic consumptions, from the other the recycle of the meteoric waters for non drinkable (irrigation, cleanings) uses could guarantee good levels of saving.

new methods and systems to achieve a sustainable significant savings in energy: increase of
The Vision

The water to the origin in Pisa, Pisa to the origin of the change in water management.

Pisa is a city historically linked to the water (city on the river and ancient maritime republic) and it promotes SMART and innovative policies and tools for the sustainable water resource management and reduction in water related energy consumption.

The vision should be implemented as following:

- defining the competences among subjects responsible for the management of the drainage network;
- defining measures to reduce the risks produced by the extreme storm water and consequent floods;
- improving the water reuse for non-potable uses (irrigation, home cleaning, etc);
- introducing tools, methods and good practices (SuDS) in integrated and sectorial policies and plans to reduce maintenance and energy costs;
- using sustainable engineering techniques for structural works able to assure a best efficiency and safety of the drainage network and, in the meantime, to create new landscape qualities.

5.5 Develop the Strategic Action Plan

A 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 Pisa. In this document, different actions and strategies are described to meet this objective, following the city vision to achieve a more sustainable urban water management. The plan is based on the long term vision of Pisa on the theme of water and energy and it set up a strategy for intervention and activities to be implemented in the future (short term to long term). With the contribute of all RWG attendees a detailed list of actions with their relative time and cost has been drafted. 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. It represents an attempt to make a strategic planning considering the coupling of water and energy; it is therefore a flexible tool that can be modified and upgraded with future iterations of the transition process.
### Strategic Action Plan: ACTION 10.1 – TECHNOLOGICAL DEVELOPMENTS

<table>
<thead>
<tr>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improve conventional water cycle infrastructures to reduce energy consumption on piping, pumps.</td>
</tr>
<tr>
<td>Install the necessary monitoring devices and technologies for a “Smart” urban water cycle, aiming to identify “weak points” with high potential for improvement in the water cycle infrastructures.</td>
</tr>
<tr>
<td>Improve energy efficiency in the urban water cycle facilities through motor efficiency upgrades, improved control schemes, and variable speed control. In addition, process optimization and improved system design can also improve energy efficiency.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Objectives and benefits</th>
<th>Required resources</th>
<th>Estimated budget</th>
<th>Time period</th>
</tr>
</thead>
</table>
| - Reduce water consumption  
- Reduce energy consumption  
- Reduce air pollution and GHG emissions  
- Reduce energy costs  
- Use renewable energy  
- Extend the life of infrastructure/equipment  
- Improve energy and water security. | - Design of infrastructures/equipments/plants  
- Equipments, instruments, ...  
- Staff, | 500.000 € | Long term action. |
| - Reduce water consumption  
- Reduce energy consumption  
- Reduce air pollution and GHG emissions  
- Reduce energy costs  
- Extend the life of infrastructure/equipment  
- Improve energy and water security. | - Survey of infrastructures  
- Equipments, instruments, software  
- Staff,  
- Training courses; | 300.000 € | Long term action. |
| - Improve energy efficiency;  
- Reduce energy consumption;  
- Reduce air pollution and GHG emissions;  
- Reduce energy costs;  
- Extend the life of infrastructure/equipment; | - Plan of installation;  
- Equipments; | 50.000 € | Short term action |

---

### 5.6 CARRY OUT PILOT/Demonstration Activities

Transition experiments in the context of E²STORMED included the analysis of outputs delivered by the DST at two sites: a retrofit (Porta a Lucca residential area) and a new development situation (Ospedaletto industrial and commercial area). Two storm water management scenarios have been compared for each location, one using conventional storm water systems and one with an appropriate SuDS solution.
Pilot case 1: Porta a Lucca

Being the area densely populated and already developed, a retrofitting solution is needed. In that framework, and given the low cost of pumps, SuDS are economically not convenient. An important issue is also related to the presence of a shallow water table which make SuDS not the best sustainable drainage solution. Moreover, a critical issue is the determination of accurate values for construction and maintenance of the infrastructures. In the selected scenario, the costs of construction and maintenance for the detention basin, greatly overwhelm energy savings attained by raising a lower volume of drained water. Hence, reliable data are needed in order to apply the DST and properly compare the two scenarios.
Pilot case 2: Ospedaletto

SuDS solution, by reducing runoff volumes may play a major role in protecting new urbanization areas from flood risks, while having reasonable costs and contributing in energy saving for stormwater management. However, in the simulations performed appeared that retrofitting highly urbanized areas located within land reclamation works might not be the appropriate solution because of lack of adequate spaces and of a shallow water table. On the other hand, the case of new development, SuDS may constitute a viable solution in order to reduce stormwater runoff, reducing good quality water and energy consumption and increasing the aesthetic values of the urbanized areas.

5.7 IDENTIFY AND ENGAGE ADDITIONAL PARTIES

During the IVth RWGEE meeting, placed Sant’Anna school, a set of qualitative and quantitative decision criteria to be used in a multi-criteria analysis has been shown to the participants. In order to establish a shared decision criteria weight assessment, a questionnaire has been delivered to them and we have got 21 compiled questionnaires back.

Most relevant criteria identified was the Global Outflow water quality (17%), followed by Volume of runoff produced and volume of water reused (14% and 12% respectively). On the other hand, little relevance was given by the participants to Total Construction and Maintenance Costs and Treatment and Conveyance energy consumption. The value obtained by means of the questionnaires were then use as input data in order to apply the multi-criteria analysis in the DST.
5.8 Process Documentation and Build Capacity

Process Documentation: At the end of each meeting minutes delivered where produced to launch the transition process and to inform members about the meetings results, including evaluation made by other partners on our level in comparison to the “wheel” activities. All information gave to the RWGEE member have allowed them to monitor progress and to give suggestions or advices to Pisa staff.

Capacity Building: Pisa partner participated in the special SuDS tour in Scotland in July 2014 to inspect real example of sustainable rain-off solution in different territorial and urban areas (around the highway, in the commercial areas, urban center, suburbs) and to participate in training. In addition Sant’Anna School members together with Municipality of Pisa technical, have contributed to publish the article “toward a more efficient management of the meteoric waters in the Mediterranean cities”.

5.9 Evaluate and Learn

Interim analyses have been carried out during the project, with time to make appropriate changes and adjustments.

Partner evaluations, especially those of Abertay University, have allowed the Pisa working group to deepen some aspects and to correctly address the wheel activities. Of particular importance we signal the contribution furnished on the long-term vision and on the involvement of the stakeholders within the RWGEE meetings.
5.10 Prepare the Next Turn of the Wheel

Pisa Municipality is going to prepare the next turn of the Wheel. The focus will be the dissemination of project results and educational meeting, for secondary school, regarding the ways to reduce energy consumption within the urban water cycle. At the same time an internal evaluation of the process, the organization and the results has been developed.

At the end of the VI RWGEE meeting, presents agreed on the following three points:

> The Municipality of Pisa expresses the will to participate in the future to other projects that address issues similar to those of E2stormed.

> The Municipality of Pisa confirms the role of partner and the will to experiment new methods and tools on its territory, through pilot cases.

> Pisa can offer a good level of structured data as well as methods of analysis and research thanks to the cooperation with local universities and advanced research centre.
6. REFERENCES AND FURTHER INFORMATION


ANNEX 1. INSTITUTIONS PARTICIPATING IN RWGEE
<table>
<thead>
<tr>
<th>Type of Stakeholder</th>
<th>Stakeholders invited to the RWGEE</th>
<th>Participation in Meetings*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Local public authority</td>
<td>Municipality of Pisa/other municipalities and representative associations</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td>Ufficio Fiumi e Fossi (Consorzio di bonifica)</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td>Basin Authority of Arno river</td>
<td>Y</td>
</tr>
<tr>
<td>Public-Private sector</td>
<td>Ingegnerie Toscanne society</td>
<td>Y</td>
</tr>
<tr>
<td>Private sector</td>
<td>Representatives of the productive sectors of Ospedaletto (pilot case)</td>
<td>*</td>
</tr>
<tr>
<td></td>
<td>B.R.A Elettronica</td>
<td>*</td>
</tr>
<tr>
<td>Civil society / community groups</td>
<td>Committees of city share (n. 3 e n. 6)</td>
<td>*</td>
</tr>
<tr>
<td>Academia</td>
<td>Pisa University</td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>Sant’Anna school of advanced studies</td>
<td>*</td>
</tr>
<tr>
<td>The Media</td>
<td>Municipality of Pisa Communication Department/other media</td>
<td>*</td>
</tr>
<tr>
<td></td>
<td>Local network television</td>
<td>*</td>
</tr>
</tbody>
</table>

| Nº of Institutions invited to each meeting | 5 | 8 | 9 | 10 | 7 | 10 |
| Nº of Institutions participating in each meeting | 4 | 5 | 2 | 6 | 7 | 2 |

Y: The institution was invited to the meeting and attended.
N: The institution was invited to the meeting but did not attend.
*The institution, at that moment, was not invited to the meeting.
ANNEX 2. RWGEE MEETINGS’ ATTENDEES
<table>
<thead>
<tr>
<th>Stakeholders invited to the RWGEE</th>
<th>Members</th>
<th>Nº Attendees per Meeting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ufficio Fiumi e Fossi (Consorzio di bonifica)</td>
<td>Marco Monaco Sandro Borsacchi</td>
<td>1 0 0 0 0 0</td>
</tr>
<tr>
<td>Basin Authority of Arno river</td>
<td>Isabella Bonamini</td>
<td>0 0 *0 0 1 0</td>
</tr>
<tr>
<td>Ingegnerie Toscane society</td>
<td>Simone Lippi Damasco Morelli Roberto Cecchini Oberdan Cei</td>
<td>1 1 0 2 3 0</td>
</tr>
<tr>
<td>Representatives of the productive sectors of Ospedaletto</td>
<td>Alessandro Scarpellini Paolo Carrozzi</td>
<td>0 *0 0 0 0 0</td>
</tr>
<tr>
<td>Committees of city share (n. 3 e n. 6)</td>
<td>Federica Ciardelli Marco Biondi</td>
<td>0 0 0 2 0 0</td>
</tr>
<tr>
<td>Pisa University</td>
<td>Stefano Pagliara</td>
<td>0 0 0 0 0 0</td>
</tr>
<tr>
<td>Sant’ Anna school of advanced studies</td>
<td>Rudy Rossetto Tiziana Sabbatini Chiara Valiebona</td>
<td>0 1 2 1 2 1</td>
</tr>
<tr>
<td>Experts</td>
<td>Tommaso Paceetti Chiara Chiostrini</td>
<td>0 2 2 1 0 2</td>
</tr>
<tr>
<td>Municipality of Pisa Communication Department</td>
<td>Margherita Tennirelli Sergio Plane</td>
<td>0 0 0 0 0 0</td>
</tr>
<tr>
<td>Local network TV</td>
<td>Tele granducato</td>
<td>0 0 0 1 1 0</td>
</tr>
<tr>
<td>Municipality of Pisa</td>
<td>Marco Redini Gabriele Berti Sandro Ciabatti</td>
<td>3 3 3 3 3</td>
</tr>
<tr>
<td>Other Municipalities</td>
<td>Montespertoli Monsummano Bientina Fucecchio</td>
<td>0 0 0 0 4 0</td>
</tr>
<tr>
<td>Local Print</td>
<td>La Nazione Il Tirreno</td>
<td>0 0 0 0 2 0</td>
</tr>
<tr>
<td>Other Public Organizations</td>
<td>ANCI Toscana (Municipalities association)</td>
<td>0 0 0 0 3 0</td>
</tr>
<tr>
<td>Private sector</td>
<td>B.R.E. Elettronica</td>
<td>0 0 0 1 2 0</td>
</tr>
</tbody>
</table>

| Nº of Attendees per Meeting                                          | 5 7 7 12 20 7 |
ANNEX 3. EVALUATION TABLE
### Main outcomes of Pisa RWGEE meetings

*Box to be color-coded as follows: Dark green signifies that an activity had been completed; light green signifies that the activity is underway whilst blue signifies that the activity is still to be considered.

**Those stakeholders which have justified their absence but provide information and show interest in meeting outcomes can be considered to have participated in it.

<table>
<thead>
<tr>
<th>Meeting Nº</th>
<th>Date</th>
<th>Main outcome of the meeting</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>June the 26th 2013</td>
<td>The questionnaire and the Pilot area description has been shared as well as the Switch manual, the skills and competences of the external experts to be selected for the pilot project have been identified.</td>
</tr>
<tr>
<td>2</td>
<td>November the 20th 2013</td>
<td>Involving “Basin Authority of Arno river” and ensuring of the constant presence of the media. The technical experts have started a discussion and reflection about the content of the guidelines (Decision Support Tool).</td>
</tr>
</tbody>
</table>
| 3          | June the 4th 2014 | The external experts have described the processing status of the report relating to the two pilot areas and the draft of the questionnaire responses. External experts show the need that concerning the two areas:  
- one must be a retrofitted one (and the selected area of Porta Lucca fits well);  
- one must be a new development.  
- about Municipal ordinance, members agreed to define a strategic action plan.                                                                                                                                                                                                                                    |
| 4          | January the 29th, 2015 | **Technical and Dissemination section**  
Sustainable Urban Hydraulic: from research to design: Professor Patrizia Piro (Department of Civil Engineering - University of Calabria);  
practical applications of sustainable drainage systems in urban and peri-urban areas: Fabio Masi (Iridra Srl - Firenze);  
**Update project activities**  
E2 stormed project contents and pilot case: Sandro Ciabatti and Marco Redini (Municipality of Pisa);  
Pilot case and DST: activities and results: Rudy Rossetto (Scuola Superiore Sant’Anna) and Tommaso Pacetti (ProGeo Engineering).                                                                                                                                                                                                                     |
| 5          | May the 13th, 2015 | The initial vision proposed in cap. 4 of Transition has been showed, and after a debate a new vision has been defined and shared.                                                                                                                                                                                                                                                                                                                                                       |
| 6          | June, the 23rd 2015 | > Final version of Transition document (cap. 4), integrated taking into account suggestions and advices proposed by University of Abertay University experts.  
> General contents of Strategic action plan and focus on the urban water cycle analysis (water supply system, and drainage), objectives and action and measures for energy efficiency improvement in the urban water cycle facilities.  
> Dissemination and information.  
> Discussion and proposals in order to answer to questions proposed during the last meeting as following.                                                                                                                                                                                                                           |
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

PROJECT PARTNERS

UNIVERSITAT POLITÈCNICA DE VALÈNCIA (E)

GRANA AND MAIRA VALLEYS MOUNTAIN COMMUNITY (I)
Comunità Montana VALLI GRANA E MAIRA

MUNICIPALITY OF BENAGUASIL (E)

MUNICIPALITY OF PISA (I)

LOCAL COUNCILS’ ASSOCIATION (MLT)

MUNICIPALITY OF HERSONISSOS (GRE)

UNIVERSITY OF ABERTAY DUNDEE (UK)

OLD ROYAL CAPITAL CETINJE (MNE)

CITY OF ZAGREB (CRO)