



# **Policies, Innovations and Networks for enhancing Opportunities for China Europe Water Cooperation**

Project supported by the European Commission within the Horizon 2020  
Programme Grant Number 642433

## **LNEC PROGRESS REPORT (August 2016)**

SHARING OF TECHNOLOGICAL SOLUTIONS: KEY LESSONS LEARNED FROM THE  
PORTUGUESE PARTICIPATION IN H2020 PIANO PROJECT

# LNEC PROGRESS REPORT (August 2016): Sharing of technological solutions. Key lessons learned from the Portuguese participation in H2020 Piano project

Work package	WP 2 Technological Water Innovations
Progress Report title	LNEC Progress Report (August 2016) Sharing of technological solutions: key lessons learned from the Portuguese participation in H2020 Piano project
Due date	Month 18
Actual submission date	Month 17
Start date of project	01.03.2015
Participants (Partner short names)	LNEC
Authors	Dr-Ing. Habil JP Lobo Ferreira (Task 1d and 1e coordinator, LNEC), Dr. Luís Lamas (Task 1e, LNEC), Dr. Teresa Leitão (Task 1a, LNEC) and Dr. José Falcão de Melo (Task 1d, LNEC) Eng. João Pádua (Task 1e, EDP/Labelec)
Dissemination level: ( <b>P</b> ublic, Restricted to other <b>P</b> rogrammes Participants, <b>R</b> estricted to a group specified by the consortium, <b>C</b> onfidential- only for members of the consortium)	RE
Deliverable Status:	Version 1.0

## Table of contents

<b>I. ABSTRACT .....</b>	<b>5</b>
<b>II. PROJECT OBJECTIVES .....</b>	<b>9</b>
<b>III. TASKS OF PIANO PROJECT .....</b>	<b>9</b>
1. BRIEF INTRODUCTION .....	9
2. WP 1 NETWORKING E COMMUNICATION [MONTHS 1-36] .....	9
3. WP 2 TECHNOLOGICAL WATER INNOVATIONS [MONTHS 1-15] .....	10
4. WP3 DRIVERS, BARRIERS AND STRATEGIES [MONTHS 7-24] .....	11
5. WP 4 POLICY UPTAKE AND STRATEGIC RESEARCH AND INNOVATION AGENDA (SRIA) [MONTHS 12-36] .....	11
<b>IV. INNOVATION IN THE WATER SECTOR .....</b>	<b>11</b>
6. TECHNOLOGIC WATER INNOVATIONS (TWI) AND SELECTED THEMATIC AREAS .....	11
7. THEMATIC “AGRICULTURAL WATER MANAGEMENT” .....	12
8. THEMATIC “MUNICIPAL WATER MANAGEMENT” .....	12
9. THEMATIC “INDUSTRIAL WATER MANAGEMENT” .....	12
10. THEMATIC “RIVER BASIN MANAGEMENT AND FLOOD CONTROL” .....	13
11. THEMATIC “WATER FOR ENERGY” .....	13
<b>V. PORTUGUESE CONTRIBUTION TO PIANO PROJECT .....</b>	<b>15</b>
12. INTRODUCTION .....	15
13. REVISED SUB-THEMATIC AREAS AND TWIS SELECTED FOR AUGUST 2015 DEADLINE .....	16
14. PRELIMINARY RANKING OF “RIVER BASIN MANAGEMENT AND FLOOD CONTROL” TWIS .....	17
15. PT CONTRIBUTION FOR “RIVER BASIN MANAGEMENT AND FLOOD CONTROL” TWIS .....	20
16. PRELIMINARY SELECTION OF SUB-THEMATIC AREAS “WATER FOR ENERGY” .....	22
17. CONTRIBUTION FROM PT EDP/LABELEC .....	23
18. REVISED SUB-THEMATIC AREAS AND TWIS SELECTED FOR AUGUST 2015 DEADLINE .....	25
19. PRELIMINARY RANKING OF “WATER FOR ENERGY” TWIS .....	27
20. PT CONTRIBUTION FOR “WATER FOR ENERGY” TWIS .....	29
21. PT CONTRIBUTION FOR “AGRICULTURAL WATER MANAGEMENT” TWIS .....	31
<b>VI. FINAL COMMENTS .....</b>	<b>32</b>
<b>VII. ACKNOWLEDGMENTS .....</b>	<b>32</b>
<b>VIII. GENERAL INFORMATION .....</b>	<b>33</b>
22. DONOR .....	33
23. PROJECT LEADER AND PARTNERS .....	33
<b>IX. APPENDIXES .....</b>	<b>35</b>
24. FINAL SELECTED WP 2 TASK 1D “RIVER BASIN MANAGEMENT AND FLOOD CONTROL” TWIS .....	35
25. FINAL SELECTED WP 2 TASK 1E “WATER FOR ENERGY” TWIS .....	41
26. PAPERS PRESENTED BY LNEC ON WP 2 TASK 1D AND TASK 1E TWIS .....	48
27. PARTICIPATION IN EIP EUROPEAN INNOVATION PARTNERSHIP ON WATER ON 10 FEBRUARY 2016 IN LEEUWARDEN .....	50

**Keywords:** China-Europe policy, innovation, networks, flood management, water for energy.

**Theme:** Public policies, governance and regulation.

# **LNEC PROGRESS REPORT (August 2016): sharing of technological solutions. Key lessons learned from the Portuguese participation in H2020 Piano project**

## **I. ABSTRACT**

This document presents the developments in the first 18 months of activity of LNEC in PIANO project (Policies, Innovation, and Network for Enhancing Opportunities for China-Europe Water Cooperation) financed by the European Union (Horizon 2020) and the Chinese Secretariat of China Water Platform - Europe (China-Europe Water Platform, CEWP, <http://cewp.org/>), as key lessons learned from the Portuguese participation, led by Laboratório Nacional de Engenharia Civil (LNEC). PIANO project aims to strengthen cooperation in the field of water between Europe and China, promoting the creation of networks of enterprises (including SMEs), entrepreneurs, NGOs, policy makers, regulators and funding agencies to create social opportunities and business. The PIANO project objectives are (1) strengthening and expanding the existing network of the China Europe Water Platform (CEWP) to cover all relevant actors for water research and innovation relevant for China Europe water cooperation; (2) identification of European technological water innovations and areas for joint development of technological solutions that have a potential for implementation in China; (3) identification of drivers and barriers and elaborating strategies for overcoming such barriers and taking advantage of drivers for implementation and replication of technological water innovations; (4) promotion of knowledge exchange and policy dialogue to build an enabling environment for the uptake of technological water innovations with a great potential for implementation, further replication and market uptake in China; (5) consolidation of a shared strategic research and innovation agenda between Europe and China in the water domain; and, (6) effective dissemination and mainstreaming of the project results within China, Europe and worldwide to various target audiences. The priority research areas focus on societal challenges related to Agricultural water management (WP2\_1.a), to Municipal water management (WP2\_1.b), to Industrial water management (WP2\_1.c), to river basin management highlighting the problem of floods (WP2\_1.d) and to the Water for energy nexus (WP2\_1.e). The project consortium is composed of nine partners of which eight are located in eight different EU Member States and one is based in China. The consortium encompasses partners from high level academic institutions and experienced research institutes to non for profit organizations, from European umbrella associations to a commercial SME and a large international company. The PIANO partners are supported in their activities by many Chinese institutes and research centres. LNEC leads the development of tasks (WP2\_1d) and (WP2\_1.e). In the case of the task "Water for Energy" LNEC has the support of EDP / Labelec.

Within the activities led by LNEC an inventory of about 50 technological water innovative solutions (TWI) was developed in the thematic areas WP2\_1.d and WP2\_1.e. Later, following several prioritization criteria, 20 TWIs of each of both thematic areas were ranked in descending order of suitability and potential deployment opportunities in China. They are presented for discussion.

## 1. EXECUTIVE SUMMARY

The document addresses the developments in the first 18 months of activity of LNEC in PIANO project (Policies, Innovation, and Network for Enhancing Opportunities for China-Europe Water Cooperation) financed by the European Union (Horizon 2020) and the Chinese Secretariat of China Water Platform - Europe (China-Europe Water Platform, CEWP, <http://cewp.org/>), as key lessons learned from the Portuguese participation, led by Laboratório Nacional de Engenharia Civil (LNEC). PIANO project aims to strengthen cooperation in the field of water between Europe and China, promoting the creation of networks of enterprises (including SMEs), entrepreneurs, NGOs, policy makers, regulators and funding agencies to create social opportunities and business. The PIANO project objectives are (1) strengthening and expanding the existing network of the China Europe Water Platform (CEWP) to cover all relevant actors for water research and innovation relevant for China Europe water cooperation; (2) identification of European technological water innovations and areas for joint development of technological solutions that have a potential for implementation in China; (3) identification of drivers and barriers and elaborating strategies for overcoming such barriers and taking advantage of drivers for implementation and replication of technological water innovations; (4) promotion of knowledge exchange and policy dialogue to build an enabling environment for the uptake of technological water innovations with a great potential for implementation, further replication and market uptake in China; (5) consolidation of a shared strategic research and innovation agenda between Europe and China in the water domain; and, (6) effective dissemination and mainstreaming of the project results within China, Europe and worldwide to various target audiences. The priority research areas focus on societal challenges related to Agricultural water management (WP2\_1.a), to Municipal water management (WP2\_1.b), to Industrial water management (WP2\_1.c), to river basin management highlighting the problem of floods (WP2\_1.d) and to the Water for energy nexus (WP2\_1.e). The project consortium is composed of nine partners of which eight are located in eight different EU Member States and one is based in China. The consortium encompasses partners from high level academic institutions and experienced research institutes to non for profit organizations, from European umbrella associations to a commercial SME and a large international company. The PIANO partners are supported in their activities by many Chinese institutes and research centres. LNEC leads the development of tasks (WP2\_1d) and (WP2\_1.e). In the case of the task "Water for Energy" LNEC has the support of EDP / Labelec.

Within the activities led by LNEC an inventory of about 50 technological water innovative solutions (TWI) was developed in the thematic areas WP2\_1.d and WP2\_1.e. Later, following several prioritization criteria, 20 TWIs of each of both thematic areas were ranked in descending order of suitability and potential deployment opportunities in China. PIANO project is being developed within the planned framework.

### **Technological innovations to address challenges in river basin management**

To increase flood security, this will focus on integrated river basin management tools to support the change from hazard to risk management. These include tools that are reactive, e.g. flood (early) warning systems, flood proofing (e.g. engineered and eco-engineered flood abatement technologies; application

of sustainable urban drainage systems (SUDS), or preventative tools, e.g. river training, canal construction, dykes – including sensors to model dyke performance (both in situ and real time), hydraulic infrastructure (pumping stations, etc.). River basin management will focus on methods, decision support systems (DSS) and monitoring tools for assessing chemical and ecological water quality, encompassing land-use aspects, urbanization issues, industrial priority pollutants, technologies to promote natural processes in the river basin for storage of water and delay of run-off.

PIANO project WP2 Task1.d researched outstanding European Technological Water Innovations (TWIs) on river basin management and flood control highlighting and thematising (1) flood control technologies, e.g. (a) improved river basin management including flood risk management using space-based technology (SBT) and information and communication technology (ICT), (b) smart dikes and sand engines (sensors that relay real-time status reports on the condition of the dike), (c) optimised flood control pumping solutions, and (d) floating technology for water retention and flood resilience in the urban fabric; (2) flood surveillance and risk reduction, e.g. (a) SNIRH, the Portuguese Flood Surveillance and Warning System and (b) Natural Water Retention Measures (NWRM), Natural Engineering techniques used to improve the provision of ecosystem services and prevent environmental degradation in river catchments affected by human activity. (3) Water monitoring has also been addressed, highlighting (a) autonomous platforms for surface water monitoring, (b) Web Mobile Application to report river water bodies status for citizens participation and, (c) smart buoy performing in-situ water quality monitoring and web platform receiving the information provided by the buoy, besides (4) ecosystem degradation management, e.g. highlighting Sustainable Ecosystem Restoration in Semi-Arid Regions by using bio-inspired dams for ecosystem degradation management.



### Technological innovations to address challenges in water for energy

Technological innovations to address challenges in water for energy research primarily focused on the direct use of water in the energy production sector, where priority is on the promotion of renewable energy sources. This includes tools to predict and map resource flows and assessing trade-offs between resource uses, and small scale hydropower technologies including their development, electricity efficiency, optimisation of hydropower generation including retrofitting of small-scale schemes,

construction of fish bypass facilities, maintenance of ecological flows and other mitigation measures to reduce adverse impacts to the riverine environment.

PIANO project WP2 Task1.e researched outstanding European Technological Water Innovations (TWIs) on water for energy highlighting and thematising (1) the use of existing structures to enable customers to tap into the unused hydropower potential of intake towers, unused ship locks, canal weirs and navigation and irrigation dams by using these existing structures as a profitable and renewable energy resource (including an Austrian State Prize for Environmental and Energy Technology), (2) technologies appropriated for extremely low head (below 10m), by using (a) a screw type small hydro unit applicable to existing channel or weir, designed to protect fish (the structure of the screw-shaped waterwheel is sturdy and simple, designed to remove suspended sediment from the water column), (b) a very low head turbine generator Kaplan wheel designed specifically for very low head sites (1.4 to 3.2 meters and up to 4.5 with reinforced structure), and, (c) a vertical micro Pelton turbine with composite runner buckets in package type generating unit for small rivers with relatively low discharge and high head, and (3) highlighting the use of micro-hydro power is the small-scale harnessing of energy from falling water, such as steep mountain rivers. Also (4) the use of behavioural fish barrier, using a strobe light, sound and a bubble curtain as stimuli, product consists in a behavioural barrier developed for freshwater fish using, which allow diverting and/or guiding species, and (5) the use of water lubricated bearings technology to guarantee the non-pollution of the river that can happen with oil lubricated installations, was addressed. Safety and risk analysis have not been forgotten by (6) promoting earthquake safety assessment for concrete dams foundation failure involves application of the existing and the development of new integrated numerical tools to assess the safety of dam foundations in rock masses considering extreme actions, such as those imposed by high intensity seismic events, and by (7) integrating assessment and structural modelling of swelling processes in concrete dams (measurement of concrete stress) using flat jacks and over-coring techniques. As a matter of fact, small to moderate swelling strains do not cause, in general, adverse consequences in concrete dams. However, more intense strains can compromise, initially, the serviceability conditions, namely related with gate operation, and after can introduce damage that affect the durability of the concrete and the structural safety. Finally (8) geothermal energy was highlighted, as heat stored in the ground can be tapped to provide a renewable and inexhaustible energy supply.





## II. PROJECT OBJECTIVES

The overall objective of PIANO is to create a strategic cooperation partnership for water research and innovation between Europe and China, promoting the creation of networks of companies (including SMEs), entrepreneurs, not for profit organisations, policy makers, regulators and funding bodies to create business and social opportunities for China Europe Water Cooperation. During the first year of the project European technological innovations were identified in the water sector, with the potential for implementation and replication in China. PIANO project will identify, then the drivers and barriers to implementation and strategies for overcoming obstacles, facilitating the creation of business opportunities. The project aims to promote the exchange of knowledge and a political dialogue leading to the creation of an enabling environment for the absorption of technological innovations in the water sector. Another objective is to develop a strategic research innovation agenda (SRIA) to be shared between Europe and China in the water sector. PIANO project originates from the objectives set at EU level for China-Europe Water Platform (CEWP), which has the participation of 10 Member States: Austria, Denmark (leader), France, Hungary, Netherlands, Italy, Portugal (who co-leader), Spain, Sweden and the UK. To ensure success and achieve the desired impact, the PIANO project consortium consists of 9 European partners, both public and private sector. The Chinese side of the project has 13 partners, including the Ministries of Water Resources and Environmental Protection.

## III. TASKS OF PIANO PROJECT

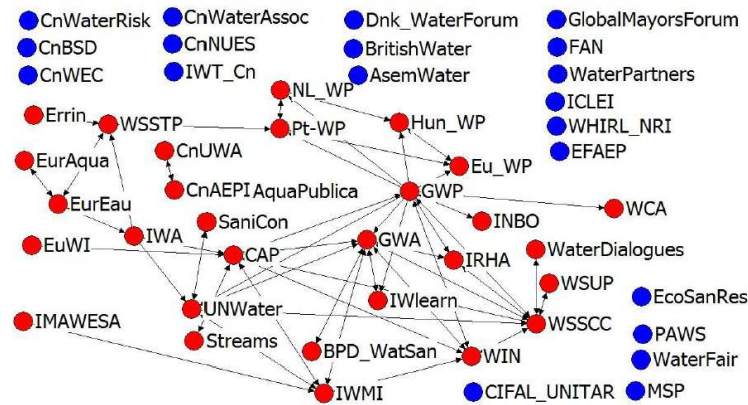
### 1. Brief introduction

The objectives of the project, led by the *University of Natural Resources and Life Sciences (BOKU) Vienna, Austria*, are intended to ensure the sharing of a clear and consistent message to the European entrepreneur community, active in the water sector, and, interested in improving their relationship with China. The overall objective of the Dissemination and Exploitation Work Package (WP5) is to increase the general awareness and interest in the results of the project, namely the innovation applied to the integrated management of water resources with social and economic implications in both geographical areas of the project, Europe and China. In addition to reading this communication to COWM 2016, we suggest reading PIANO project site <http://project-piano.net/> and December 2015 Newsletter <http://project-piano.net/project-piano-1st-newsletter-december-2015/> . The goals of the project, reflected in their Work Packages, are presented hereinafter.

### 2. WP 1 Networking e Communication [Months 1-36]

Preparation, in the first year of the project, of a survey of networks that wish to increase cooperation between Europe and China. The focus is on identifying appropriate networks to strengthen the activities of the CEWP.

The involvement of these networks will be achieved, it is expected, following the signing of Memoranda of Understanding whose contents include the dissemination of articles and publications, as well as co-organized events and participation in networking conferences, for example the following entities:



Globally operating water networks (circles) are linked (arrows), if they share key knowledge and interests (link in the web pages). Colours identify two factions (where within factions there are more links, than between factions). Node sizes measure the centrality of actors in the network (i.e. here: importance for sharing of knowledge).

### 3. WP 2 Technological Water Innovations [Months 1-15]

PIANO will identify and prioritize European technological water innovations (TWIs) that have potential for application in China and identify water challenges where neither Europe nor China have suitable technologies to offer and hence opportunities exist for joint development of technological solutions. Outcome: A report on European technological water innovations.

A report on European technological water innovations with potential for application in China and a list of water challenges which offers opportunities for joint development of technological solutions. In this project we intend to stay in technological innovation in the water sector. The term "technology" can be defined in various ways. For the PIANO project objectives we mean essentially products and processes that modify optimize, support, are parts of or constitute entirely new water treatment technologies, water use, water production, water management and flood protection or energy production. These products and processes may be innovative in their selves, or be part of an innovative process.

PIANO has outlined five thematic areas in which technological water innovations shall be identified, building on the previous activities of the CEWP, in particular the inception workshops that were held in Beijing on 5-6 March 2014 with participation of over 150 experts and stakeholders from EU and China. Based on these activities, Work Package WP2, led by the *Technical University of Denmark (DTU) Kgs. Lyngby, Denmark*, focused on the identification and characterization technologies with potential application in China in the following five thematic areas:

- Agricultural water management;
- Municipal water management;
- Industrial water management;

- River basin management and flood control;
- Water for energy.

#### **4. WP3 Drivers, Barriers and Strategies [Months 7-24]**

We expected that the market for innovative solutions in the water sector, grow in the coming years in China, driven by strong pressure from Chinese society and strategies and decisions made in recent years, for example in relation to the price of water.

It is known that there are barriers that may hinder the implementation and replication of innovative technologies in the water sector, e.g. in the institutional, social and economic areas.

#### **5. WP 4 Policy uptake and Strategic Research and Innovation Agenda (SRIA) [Months 12-36]**

Work Package WP4 aims to facilitate the alignment of actions in promoting innovation in the water sector (between Europe and China) and promote the groundwork for the introduction of recommendations from the activity developed in WP 2 and WP 3 .

The main activities include:

- Writing a summary report on the most appropriate technological innovations to implementation, replication and marketing in China and explanations on how to overcome political and barriers to their successful development.
- Production of recommendations addressed to political and policy dialogue with key European actors and important Chinese for technological development and incorporation both in Europe and in China.
- Exchange of knowledge on research and innovation systems in Europe and China, and analysis of gaps and opportunities to promote cooperation.
- Consultations and recommendations made to the Strategic Research and Innovation Agenda (SRIA) between Europe and China in the water sector.

### **IV. INNOVATION IN THE WATER SECTOR**

#### **6. Technologic Water Innovations (TWI) and selected thematic areas**

Technologic Water Innovations (TWI) will be ranked according to their technological development level (Technology Readiness Level) and its adaptation to the challenges of the water sector in China, as identified by CWEP, completed with the developments of PIANO project. This ranking will be confirmed by an expert judgment of specialists. After prioritization, an inventory will be developed of up to 20 Technologic Water Innovations for each of the five thematic areas selected in the application, mentioned before.

The ranking of the five thematic areas will assess the degree of European technological leadership for this TWI compared to China as well as other non-European competing countries: (1) the technology is obsolete and out-of-date in its area globally, compared with similar technologies from China as well as other non-European competing countries; (2) the technology is nearly obsolete in its area globally and far less used than similar technologies from China as well as other non-European competing countries; (3) the technology is somewhat used in its area globally, but less used than similar technologies from China as well as other non-European competing countries; (4) the technology is commonly used in its area globally, compared with similar technologies from China as well as other non-European competing countries; (5) the technology is very popular used in its area globally, compared with similar technologies from China as well as other non-European competing countries; (6) the technology is a leading technology in its area, compared with similar technology from China as well as other non-European competing countries. In either case a special attention to technological development level will be given.

The results of Work Package WP2 will be presented in a report which will describe the European TWIs with potential for application in China, identifying opportunities for joint developments between TWIs. The end result will be an inventory of up to 10 TWIs with potential for joint developments in each of the five selected thematic areas.

### **7. Thematic “Agricultural water management”**

Agricultural water management will cover aspects of water use efficiency through application of innovative irrigation technologies, and production of fit-for-use waters. It will further cover all aspects of groundwater management and pollution, both by point and non-point sources: innovative approaches to detect, mitigate, contain and remedy groundwater pollution will be addressed, as well as methods for managed aquifer recharge and reduction of groundwater mining practices. LNEC is partner of this thematic area, led by the *Italian National Institute for Environmental Protection and Research (ISPRA) Rome, Italy*.

### **8. Thematic “Municipal water management”**

Municipal water management deal with water supply and wastewater management / sanitation in large urban areas, peri-urban areas (also called rurban space, outskirts or the hinterland), and includes concepts of integrated urban water management. Innovative technologies in the field of water use efficiency have been focused (e.g. water savings in domestic appliances), the supply of non-conventional waters (e.g. desalination and artificial aquifer recharge), new treatment techniques and production of water, detection and mitigation unbilled water, effluent treatment / rehabilitation (e.g. sewage treatment, sludge treatment, the management decentralized wastewater, wastewater reuse, recovery of advanced features) and new technological concepts of eco-cities.

### **9. Thematic “Industrial water management”**

The issue of wastewater management in the industry is for the analysis of efficiency in water use by applying technologies and water-saving processes, and control of water pollution through wastewater treatment and advanced reuse, technology / recycling.

## 10. Thematic “River basin management and flood control”

To increase flood security, this will focus on integrated river basin management tools to support the change from hazard to risk management. These include tools that are reactive, e.g. flood (early) warning systems, flood proofing (e.g. engineered and eco-engineered flood abatement technologies; application of sustainable urban drainage systems (SUDS), or preventative tools, e.g. river training, canal construction, dykes – including sensors to model dyke performance (both in situ and real time), hydraulic infrastructure (pumping stations, etc.). River basin management will focus on methods, decision support systems (DSS) and monitoring tools for assessing chemical and ecological water quality, encompassing land-use aspects, urbanization issues, industrial priority pollutants, technologies to promote natural processes in the river basin for storage of water and delay of run-off. LNEC is the leader of this thematic area, with the contribution of ISPRA, DTU and the *European Water Association (EWA) Hennef, Germany*.

## 11. Thematic “Water for Energy”

This will primarily focus on the direct use of water in the energy production sector, where priority is on the promotion of renewable energy sources. This includes tools to predict and map resource flows and assessing trade-offs between resource uses, and small scale hydropower technologies including their development, electricity efficiency, optimisation of hydropower generation including retrofitting of small-scale schemes, construction of fish bypass facilities, maintenance of ecological flows and other mitigation measures to reduce adverse impacts to the riverine environment. LNEC is the leader of this thematic area, with the contribution of EDP/Labellec, DTU and the EWA.

<b>Activities programed for the first year of the project in Task “River basin management and flood control”</b>		
<b>Programed activities for the first year of the project (starting March 1, 2015):</b>		
Define and delimit your domain, add possible sub-categories.  Send note (ca. ½ page) to DTU.	LNEC	15May
Identify core data sources for TWIs in your domain:  - Provide 6-8 reports/analyses of TWI  - Check EC water innovation project specific databases (e.g. ECOWEB, EUREKA).  - Suggest possible other sources  - Send a note to DTU (full references).	LNEC with ISPRA	5 June
Make a gross list of at least 20 as far as possible TWIs in your domain,  -Describe each TWI according to List Template defined by DTU.	LNEC	5 August
Score the TWI based on Scoring Template provided by DTU	LNEC	10 Sept.
Verify and comment on Inventory 1 sent by DTU	LNEC	5 Oct
Milestone 5 “Inventory of European technological water innovations” for this domain	DTU, EWA (CEWP)	30 Nov

## V. PORTUGUESE CONTRIBUTION TO PIANO PROJECT

### 12. Introduction

Work Package WP 2 was divided into the five thematic areas previously presented. As mentioned, LNEC leads the development of Task WP2\_1d "River basin management and flood control" and of Task WP2\_1e "Water for Energy", besides participating in Task WP2\_1a "Agricultural water management." LNEC had the support, respectively, in the case of Task WP2\_1d "River basin management and flood control" of ISPRA, Italy, and in the case of Task WP2\_1e "Water for Energy" of EDP / Labelec, Portugal.

LNEC inventoried and analysed about 50 Technology Water Innovations (TWIs) in the thematic areas WP2\_1.d and WP2\_1.e. Later, applying various prioritization criteria, 20 TWIs of both thematic areas were ranked in descending order of suitability and potential for deployment opportunities in China. They are hereinafter presented for discussion, responsibility only of LNEC. Preliminary selection of sub-thematic areas

**LNEC considered relevant for analysis the following ten sub-thematic areas:**

1. research on flash flood forecasting and early warning based on enhanced precipitation flow models
2. landscape-scale sediment management and control / Loess plateau watershed rehabilitation project
3. prediction and management of drought and water scarcity situations and environmental impacts on wetlands / ecological restoration / rebuilding natural capital
4. climate change impact assessment on China water resources /water scarcity, drought indicators, forecasting and contingency planning
5. technologies for efficient distribution and higher water use efficiency
6. ecological minimum flow and migration of fish population
7. exchange of experiences on the implementation of measures preventing pollution
8. trans-boundary water management and related challenges in the field of pollution prevention, operation of early-warning systems, abstraction management and conflict management
9. management of groundwater, including groundwater monitoring and trends' analysis in urban and agricultural areas / North China Plain aquifer at Risk Due to Groundwater Depletion
10. groundwater allocation arrangements to adequately regulate groundwater quantity and use / development of non-conventional water resources including managed aquifer recharge

### **13. Revised sub-thematic areas and TWIs selected for August 2015 deadline**

The result of LNEC analysis was the following:

TWIs Task 1d River basin management and flood control (05 Aug 2015)

According to LNEC work classification:

#### **Flood protection technologies/reactive/flood warning devices:**

1. Task 1d TWI 1: Improved river basin management including flood risk management using Space-based technology (SBT) and information and communication technology (ICT)

#### **Flood protection technologies/preventive/ dikes, dams, ... control:**

2. Task 1d TWI 2: Smart Dikes and Sand Engines - sensors that relay real-time status reports on the condition of the dike
3. Task 1d TWI 3: Geophysical surveys with Electrical Resistivity Tomography (ERT) in a timelapse mode

#### **Flood control/Hydraulic structures/adaptation measures:**

4. Task 1d TWI 4: Grundfos Optimised flood control solutions

#### **Water management technologies/ land-use aspects:**

5. Task 1d TWI 5: Floating technology for water retention and flood resilience in the urban fabric (FLOATEC )

#### **Water management technologies/ chemical/ecological water quality**

6. Task 1d TWI 6: EUROENVIRON IX-ELIMINATE Standard nitrate treatment
7. Task 1d TWI 7: The AquaGIS-Mon catamaran lightweight pontoon / innovative autonomous robotic vessel platform
8. Task 1d TWI 8: mO4Rivers (Web Mobile Application to report river water bodies status)
9. Task 1d TWI 9: Microalgae dual-head biosensors for selective detection of herbicides with fiberopticluminescentO<sub>2</sub> transduction (microalgae on-line sensor & AQUATIK Integrative sampler developer and commercialised by Labaqua).

#### **Water management technologies/ urbanization issues**

10. Task 1d TWI 10: The AZ100 Radio Data Logger - data-logging system that detects leakages in water pipelines by analysing sound waves



11. Task 1d TWI 11: WONE - Water Optimization for Network Efficiency
12. Task 1d TWI 12: RISURSIM - Sewer network management a more proactive business
13. Task 1d TWI 13: Aquasafe - Smart tool for smart wastewater management operation

#### **Water management technologies/ dam reservoir management/storage and delay run-off at the basin scale**

14. Task 1d TWI 14: Laser disdrometer (device for measurement of all precipitation types) (River basin management)
15. Task 1d TWI 15: Natural Water Retention Measures (NWRM )
16. Task 1d TWI 16: Bio-inspired dams for ecosystem degradation management (Sustainable Ecosystem Restoration in Semi-Arid Regions)

#### **Water management technologies/ Groundwater / surface water pollution assessment tools and indicators / Groundwater mitigation and remediation measures:**

17. Task 1d TWI 17: Permeable Reactive Barrier
18. Task 1d TWI 18: Air Sparging System
19. Task 1d TWI 19: Well regeneration
20. Task 1d TWI 20: IDRAIM System for stream hydromorphological assessment

#### **Additional Water management technologies contributions received from DHI-WASY (only in pdf format):**

21. Task 1d TWI 21: Aqua Republica
22. Task 1d TWI 22: Integrated Water Resources Management (IWRM) tool (surface – groundwater interaction) as decision support system (DSS)
23. Task 1d TWI 23: Stochastic method of long-term water management planning

### **14. Preliminary ranking of “River basin management and flood control” TWIs**

The result of LNEC analysis was the following:

#### **TWIs ranking Task 1d River basin management and flood control (10 Sept 2015)**

Criteria used for Ranking Task 1d TWIs:

1. Select from the first of the below mentioned categories the TWI considered the most appropriate to fulfil PIANO aims;

2. Step to the next category and proceed in a similar way;
3. Sequentially step to the next category until all categories have been considered;
4. When all categories have been considered, return to the first category and carry on the above mentioned procedure until all 24 Task 1d TWIs have been ranked;
5. Consider the following indicators relevant for the selection criteria: TRL / Stage of development; Time to market / maturity; Availability (number of individual EU companies); Number of interested EU Member States and other H2020 cooperating countries.
6. Consider the final suggested **Ranking Task 1d TWIs Table** as a draft for discussion with DTU and WP 2 Task 1d partners.

Categories to be considered according to LNEC work classification:

**Flood protection technologies/reactive/flood warning devices:**

1. Task 1d TWI 1: Improved river basin management including flood risk management using Space-based technology (SBT) and information and communication technology (ICT) – Ranking 1

**Flood protection technologies/preventive/ dikes, dams, ... control:**

2. Task 1d TWI 2: Smart Dikes and Sand Engines - sensors that relay real-time status reports on the condition of the dike – Ranking 2
3. Task 1d TWI 3: Geophysical surveys with Electrical Resistivity Tomography (ERT) in a timelapse mode – Ranking 9

**Flood control/Hydraulic structures/adaptation measures:**

4. Task 1d TWI 4: Grundfos Optimised flood control solutions – Ranking 3
5. Flood control and mitigation Watergate barrier (ISPRA extra) – Ranking 10

**Water management technologies/ land-use aspects:**

6. Task 1d TWI 5: Floating technology for water retention and flood resilience in the urban fabric (FLOATEC ) – Ranking 4

**Additional Water management technologies contributions received from DHI-WASY (only in pdf format):**

7. Task 1d TWI 21: Aqua Republica (DHI extra) – Ranking 24

8. Task 1d TWI 22: Integrated Water Resources Management (IWRM) tool (surface – groundwater interaction) as decision support system (DSS, DHI extra) – Ranking 15
9. Task 1d TWI 23: Stochastic method of long-term water management planning (DHI extra) – Ranking 21

#### **Water management technologies/ chemical/ecological water quality**

10. Task 1d TWI 6: EUROENVIRON IX-ELIMINATE Standard nitrate treatment – Ranking 16
11. Task 1d TWI 7: The AquaGIS-Mon catamaran lightweight pontoon / innovative autonomous robotic vessel platform – Ranking 5
12. Task 1d TWI 8: mO4Rivers (Web Mobile Application to report river water bodies status) – Ranking 22
13. Task 1d TWI 9: Microalgae dual-head biosensors for selective detection of herbicides with fiberopticluminescentO<sub>2</sub> transduction (microalgae on-line sensor & AQUATIK Integrative sampler developer and commercialised by Labaqua) – Ranking 11

#### **Water management technologies/ urbanization issues**

14. Task 1d TWI 10: The AZ100 Radio Data Logger - data-logging system that detects leakages in water pipelines by analysing sound waves – Ranking 12
15. Task 1d TWI 11: WONE - Water Optimization for Network Efficiency – Ranking 17
16. Task 1d TWI 12: RISURSIM - Sewer network management a more proactive business – Ranking 20
17. Task 1d TWI 13: Aquasafe - Smart tool for smart wastewater management operation – Ranking 6

#### **Water management technologies/ dam reservoir management/storage and delay run-off at the basin scale**

18. Task 1d TWI 14: Laser disdrometer (device for measurement of all precipitation types) (River basin management) – Ranking 18
19. Task 1d TWI 15: Natural Water Retention Measures (NWRM ) – Ranking 7
20. Task 1d TWI 16: Bio-inspired dams for ecosystem degradation management (Sustainable Ecosystem Restoration in Semi-Arid Regions) – Ranking 13

#### **Water management technologies/ Groundwater / surface water pollution assessment tools and indicators / Groundwater mitigation and remediation measures:**

21. Task 1d TWI 17: Permeable Reactive Barrier – Ranking 8

22. Task 1d TWI 18: Air Sparging System – Ranking 14

23. Task 1d TWI 19: Well regeneration – Ranking 19

24. Task 1d TWI 20: IDRAIM System for stream hydromorphological assessment – Ranking 23

## 15. PT contribution for “River basin management and flood control” TWIs

The Portuguese contribution was the following:

### **Aquasafe - Smart tool for smart wastewater management operation**

1. Name and affiliation of person writing the note: **Pedro Póvoa - AdP**
2. Water domain (one of the 5 approved domains): **Task 1d River basin management and flood control** (cross cutting with Task1e Water for Energy)
3. Name and origin (if known, e.g. inventor, owner, provider) of potential Technological Water Innovation (TWI):

### **Aquasafe - Smart tool for smart wastewater management operation**

<http://aquasafeonline.net/en/principal.asp>

- **WONE - Water Optimization for Network Efficiency**

1. Name and affiliation of person writing the note: **Cláudio de Jesus - AdP**
2. Water domain (one of the 5 approved domains): **Task 1d River basin management and flood control** (cross cutting with Task1e Water for Energy Task 1e)
3. Name and origin (if known, e.g. inventor, owner, provider) of potential Technological Water Innovation (TWI):

### **WONE - Water Optimization for Network Efficiency**

<http://www.epal.pt/EPAL/en/menu/products-and-services/wone>

- **The AquaGIS-Robotic autonomous platform for surface water monitoring**

1. Name and affiliation of person writing the note: **JP Lobo-Ferreira - LNEC**
2. Water domain (one of the 5 approved domains):

### **Task 1d River basin management and flood control**

Name and origin (if known, e.g. inventor, owner, provider) of potential Technological Water Innovation (TWI):

**The AquaGIS-Robotic autonomous platform for surface water monitoring** (catamaran lightweight pontoon / innovative autonomous robotic vessel platform)

The AquaGIS web service register is reachable at HIS Central ([http://hiscentral.cuahsi.org/pub\\_network.aspx?n=3569](http://hiscentral.cuahsi.org/pub_network.aspx?n=3569))

<http://goo.gl/mBDtIV>

<https://drive.google.com/open?id=0B3y00-2-Wrc0TTRNc2lYUVVhMHc&authuser=0>

AquaGIS AmbiSIG, Portugal ([http://hiscentral.cuahsi.org/pub\\_network.aspx?n=3569](http://hiscentral.cuahsi.org/pub_network.aspx?n=3569))

- **m04Rivers (Web Mobile Application to report river water bodies status) for citizens participation)**

1. Name and affiliation of person writing the note: **Nuno Charneca - LNEC**
2. Water domain (one of the 5 approved domains): **Task 1d River basin management and flood control**
3. Name and origin (if known, e.g. inventor, owner, provider) of potential Technological Water Innovation (TWI):

**m04Rivers (Web Mobile Application to report river water bodies status) for citizens participation**

<https://webh2o.net/mo4rivers/frontend/index.php?d=live>

**Geophysical surveys with Electrical Resistivity Tomography (ERT) in a time-lapse mode, for flood risk assessment and prevention**

1. Name and affiliation of person writing the note: **Rogério Mota - LNEC**
2. Water domain (one of the 5 approved domains): Task 1d River basin management and flood control
3. Name and origin (if known, e.g. inventor, owner, provider) of potential Technological Water Innovation (TWI):

Geophysical surveys with Electrical Resistivity Tomography (ERT) in a time-lapse mode, for flood risk assessment and prevention

Resistivity meter (e.g.: ABEM Terrameter LS – [www.abem.se](http://www.abem.se) or Lippman Geophysikalische Messgeräte – [www.L-GM.de](http://www.L-GM.de))

<b>Activities programed for the first year of the project in Task “Water for Energy”</b>		
<b>Programed activities for the first year of the project (starting March 1, 2015):</b>		
Define and delimit your domain, add possible sub-categories. Send note (ca. ½ page) to DTU.	LNEC (with EDP/Labelec expertise)	15 May
Identify core data sources for TWIs in your domain: - Provide 6-8 reports/analyses of TWI - Check EC water innovation project specific databases (e.g. ECOWEB, EUREKA). - Suggest possible other sources - Send a note to DTU (full references).	LNEC (with EDP/Labelec expertise)	5 June
Make a gross list of at least 20 as far as possible TWIs in your domain, -Describe each TWI according to List Template defined by DTU.	LNEC	5 August
Score the TWI based on Scoring Template provided by DTU	LNEC	10 Sept.
Verify and comment on Inventory 1 sent by DTU	LNEC	5 Oct
Milestone 5 “Inventory of European technological water innovations” for this domain	DTU, EWA (CEWP)	30 Nov

## **16. Preliminary selection of sub-thematic areas “Water for Energy”**

LNEC and EDP/Labelec considered relevant for analysis the following six sub-thematic areas:

### **Foreword regarding categories, technology definition and Water for energy PIANO focus:**

Categories:

“Initial delimitation of domain for TWIs of Task 1e” categories and subcategories, primarily focusing on the direct use of water in the energy production sector, where priority is on the promotion of renewable energy sources, namely to:

1. Predict and map resource flows,
2. Assess trade-offs between resource uses,
3. Develop small scale hydropower technologies including their development, electricity efficiency, optimisation of hydropower generation including retrofitting of small-scale schemes, construction of fish bypass facilities, maintenance of ecological flows and other mitigation measures to reduce adverse impacts to the riverine environment.

**Technology:**

For the purpose of PIANO we mean essentially products and processes that modify, optimize, support, are part of, or constitute entirely new treatment technologies, water use technologies, water production technologies, water management technologies, technologies for flood protection or energy production.

**Water for energy PIANO focus:**

Primarily focus on the direct use of water in the energy production sector, where priority is on the promotion of renewable energy sources. This includes tools to predict and map resource flows and assessing trade-offs between resource uses, and small scale hydropower technologies including their development, electricity efficiency, optimisation of hydropower generation, including retrofitting of small-scale schemes, construction of fish bypass facilities, maintenance of ecological flows and other mitigation measures to reduce adverse impacts to the riverine environment.

Based on initial delimitation of domain for TWIs of Task 1e categories, on EDP/Labelec framework suggestions and also on other suggestions, e.g. <http://www.small-hydro.com/Programs/innovative-technologies.aspx> the six categories selected for Task 1e TWIs are the following:

1. Energy production technologies (Electrical & Mechanical Equipment)
2. Water management technologies (Operation & Maintenance)
3. Mitigation measures (Environment)
4. Safety and efficiency of the existing dams and reservoirs
5. Construction
6. New production technologies

**17. Contribution from PT EDP/Labelec**

One of the most significant contributions received from EDP / Labelec was the following:

*According to 2013 Technology Map of the European Strategic Energy Technology Plan, for hydroelectricity we highlight the following reasoning:*

“Technological drivers include increasing the efficiency of generation equipment above the current 85–95%, and enhancing the control capacity of pumps for pumped hydropower storage (PHS) through variable speed. Three main drivers are pushing developments in this field: erection of new large hydropower plants abroad; rehabilitation and refurbishment of existing hydropower facilities in Europe; and the need for the storage capability that would allow the electricity system to accommodate additional renewable power from wind and other variable sources. Average efficiency improvements that can be expected from refurbishment are of the order of 5 %.”

“The EU hydropower potential is already relatively well exploited and expected future growth is rather limited, to between 470 TWh (EC, 2009) and 610 TWh (Eurelectric, 2013) of total annual generation, although it was actually expected to increase only modestly to 341 TWh in 2020 and up to 358 TWh by 20306 (EC, 2009). The largest remaining potential in Europe lies in low-head plants (< 15 m) and in the refurbishment of existing facilities.”

“PHS is currently the only commercially proven, large-scale energy storage technology with over 300 plants installed worldwide with a total installed capacity of over 138 GW, of which about 3 GW was added in 2012 (Ren21, 2013). The EU has an installed PHS capacity of around 43 GW, of which 675 MW was added in 2012. Interest in PHS is again high in the EU, and at least 6 GW of new capacity is expected to be added before 2020, although a significant part of this will correspond to repowering or enhancing existing facilities or to building pump- back plants. While PHS was previously used to enable an electricity mix with a high base-load share, there is now renewed interest driven by an increasing wind and solar energy share.”

“Three large European companies are leading the large- to medium-scale hydropower market worldwide — Alstom, Voith and Andritz Hydro — along with IMPSA from Argentina, and Harbin and Dongfang from China. The market for small hydropower plants (SHP) is more accessible to small companies, with several European manufactures among the 60+ existing ones that hold a recognized industrial position worldwide, leading to significant exports (SHERPA, 2008).”

“R&d efforts address: load and fatigue analysis of turbine and generator components, in particular in a context of variable-speed and frequent stop–start operations; the integration of HP with other renewable energies, for example through speed-adjustable generators; the development of hybrid systems, for example with wind, and minimizing environmental impacts, for example turbine design with fewer blades and less clearance between the runner and housing to reduce injuries to and stress factors for fish, or oil-free Kaplan turbines to eliminate leak-related risks (Andritz, 2013).

Research in materials is focusing on cheaper alternatives to steel in some components and applications, such as fiberglass and special plastics. Developing more resistant materials to extend the lifetime of some components is also essential, for example steel alloys that are more resistant to turbine cavitation or high-voltage insulation systems able to sustain short-period operations to 180 °C. Improvements in power electronics would also help the sector: for example increase voltage range of converters from 6.6 kilovolts (kV) today to 20 kV, reduce size from 2–3 m<sup>3</sup> per megavolt-amperes (MVA) to 1.5 m<sup>3</sup> /MVA, and increase efficiency by 1% from 98 to 99% — all at affordable costs by 2020 (Hea, 2013).”

According to Eurelectric (2013), the main innovations have been developed in the following areas:

Integrated and site-specific solutions - Hydropower stations are built and upgraded to combine intelligent turbine and generator elements, multipurpose capabilities, (e.g. flood control devices and locks), river basin management and environmental enhancement measures.

Turbine technology - The pumped storage technology has evolved greatly in the past few years to absorb volatile electricity surpluses and meet the new grid requirements. With fixed speed reversible units, variable speed pump turbine or ternary pump turbine units, pumped storage technology can



change from pumping to generating mode and vice versa in up to 25 to 30 seconds and less. It is the fastest large-scale electricity storage technology

Efficiency development - In order to eliminate the risk of oil spills, the industry has developed oil-free solutions for blade runner hubs, which also allow easier maintenance, lower friction without lowering the bearing performance. Modern turbine design using three-dimensional flow simulation tools (Computational fluid dynamics) allows not only better efficiencies in energy conversion by improved shape of turbine runners and guide/stay vanes but also results in a decrease in cavitation damages.

Utilizing small differences in height - A new challenge for hydropower is to capture the energy potential of water flows and sites with a very low height difference between the upper and lower water level (head). New technologies that can be installed at existing structures include irrigation dams, low head weirs, and ship locks. These newly available technologies open an important potential for future renewable and clean power generation.

Regarding small hydro power plants we highlight the link (<http://www.small-hydro.com/About/Annex-II-Task-Force.aspx>) for working group Hydropower Implementing Agreement da International Energy Agency. In this context a New State-of-the-Art on Innovatives Technologies related to Small Scale Hydropower is available.

Regarding medium and large power plants information is available in the sites of Alstom (<http://www.alstom.com/microsites/power/products-services/renewables/hydro-power/>), Voith (<http://voith.com/en/products-services/hydro-power-377.html>) and Andritz Hydro (<http://www.andritz.com/hydro>). We highlight that those companies are working in China for a long time, also addressing small power plants in their business area.

Relevant information is also available in [http://www.hydroworld.com/technology\\_and\\_equipment/research\\_and\\_development.html](http://www.hydroworld.com/technology_and_equipment/research_and_development.html).

Several documents that we consider relevant are available clicking to link [https://www.dropbox.com/sh/vf353cif7nczc50/AACUUqMI-TNC00cqsibqY\\_6\\_a?dl=0](https://www.dropbox.com/sh/vf353cif7nczc50/AACUUqMI-TNC00cqsibqY_6_a?dl=0).

The next pages contain a revised version of Table LNEC + EDP/Labelec, June 5, 2015 (forwarded on time to PIANO coordination), including the comments received from DTU. June 5, 2015, table has been upgraded with *mitigation measures*.

## **18. Revised sub-thematic areas and TWIs selected for August 2015 deadline**

The result of the analysis was the following:

### **TWIs Task 1e in template format (LNEC Version 5 August 2015)**

#### **Energy production technologies (Electrical & Mechanical Equipment)**

1. Task 1e TWI 1: Hooped Pelton Turbine (Electrical & Mechanical Equipment)

2. Task 1e TWI 2: Sheet Metal Turbine (Electrical & Mechanical Equipment)
3. Task 1e TWI 3: Screw Turbine Generating System
4. Task 1e TWI 4: Vertical Micro Pelton Turbine (Electrical & Mechanical Equipment)
5. Task 1e TWI 5: Very Low Head Turbine Generator (Electrical & Mechanical Equipment)
6. Task 1e TWI 6: HYDROMATRIX
7. Task 1e TWI 7: TWI Hydroelectric power FLINDT II

#### **Water management technologies (Operation & Maintenance)**

8. Task 1e TWI 8: Resource Mapping by GIS (Electrical & Mechanical Equipment)
9. Task 1e TWI 9 Assessment Meth. - Rehab. & Safety (Operation & Maintenance)
10. Task 1e TWI 10: Integrated Approach for Water resources management at river basin scale (cross cutting with Task 1d River basin management and flood control)
11. Task 1e TWI 11: Information on dam operation: SNIRH Portuguese Flood Surveillance and Warning System (cross cutting with Task 1d River basin management and flood control)

#### **Mitigation measures:**

12. Task 1e TWI 12: Behavioural fish barrier (using a strobe light, sound and a bubble curtain as stimuli)
13. Task 1e TWI 13: Water Lubricated Bearings (Environment)
14. Task 1e TWI 14: AQUALITAS (smart buoy performing in-situ water quality monitoring and web platform receiving the information provided by the buoy)

#### **Safety and efficiency of the existing dams and reservoirs:**

15. Task 1e TWI 15: Earthquake safety assessment for concrete dams foundation failure (Safety and efficiency of the existing dams and reservoirs)
16. Task 1e TWI 16: Automated continuous vibration monitoring systems for continuous monitoring the seismic behaviour of large dams (HYDROPOWER DEVELOPMENT / Safety and efficiency of the existing dams and reservoirs)
17. Task 1e TWI 17: Integrated assessment and structural modelling of swelling processes in concrete dams: measurement of concrete stress, using flat jacks and over-coring techniques (HYDROPOWER DEVELOPMENT / Safety and efficiency of the existing dams and reservoirs)

**Construction:**

18. Task 1e TWI 18: Penstock Drilling Technology (Construction)

**New production technologies:**

19. Task 1e TWI 19: Geothermal energy HTH PUMP
20. Task 1e TWI 20: Wave power WWEC

**Task 1d TWIs Water management technologies/ dam reservoir management/storage and delay run-off at the basin scale cross cutting with Task 1e Water for Energy:**

21. Task 1d TWI 15: Natural Water Retention Measures (NWRM )
22. Task 1d TWI 16: Bio-inspired dams for ecosystem degradation management (Sustainable Ecosystem Restoration in Semi-Arid Regions)

## 19. Preliminary ranking of “Water for Energy” TWIs

The result of the analysis was the following:

**TWIs ranking Task 1e Water for Energy (10 Sept 2015)****Criteria used for Ranking Task 1e TWIs:**

1. Select from the first of the below mentioned categories the TWI considered the most appropriate to fulfil PIANO aims;
2. Step to the next category and proceed in a similar way;
3. Sequentially step to the next category until all categories have been considered;
4. When all categories have been considered, return to the first category and carry on the above mentioned procedure until all 22 Task 1e TWIs have been ranked;
5. Consider the following indicators relevant for the selection criteria: TRL / Stage of development; Time to market / maturity; Availability (number of individual EU companies); Number of interested EU Member States and other H2020 cooperating countries.
6. Consider the final suggested **Ranking Task 1e TWIs Table** as a draft for discussion with DTU and WP 2 Task 1e partners.

**Categories to be considered according to LNEC work classification:****Energy production technologies (Electrical & Mechanical Equipment)**

1. Task 1e TWI 1: Hooped Pelton Turbine (Electrical & Mechanical Equipment) – Ranking 19
2. Task 1e TWI 2: Sheet Metal Turbine (Electrical & Mechanical Equipment) – Ranking 18

3. Task 1e TWI 3: Screw Turbine Generating System – Ranking 16
4. Task 1e TWI 4: Vertical Micro Pelton Turbine (Electrical & Mechanical Equipment) Ranking 12
5. Task 1e TWI 5: Very Low Head Turbine Generator (Electrical & Mechanical Equipment) – Ranking 7
6. Task 1e TWI 6: HYDROMATRIX – Ranking 1
7. Task 1e TWI 7: TWI Hydroelectric power FLINDT II – Ranking 20

#### **Water management technologies (Operation & Maintenance)**

8. Task 1e TWI 8: Resource Mapping by GIS (Electrical & Mechanical Equipment) – Ranking 8
9. Task 1e TWI 9 Assessment Meth. - Rehab. & Safety (Operation & Maintenance) – Ranking 2
10. Task 1e TWI 10: Integrated Approach for Water resources management at river basin scale(cross cutting with Task 1d River basin management and flood control) – Ranking 17
11. Task 1e TWI 11: Information on dam operation: SNIRH Portuguese Flood Surveillance and Warning System (cross cutting with Task 1d River basin management and flood control) – Ranking 13

#### **Mitigation measures:**

12. Task 1e TWI 12: Behavioural fish barrier (using a strobe light, sound and a bubble curtain as stimuli) – Ranking 3
13. Task 1e TWI 13: Water Lubricated Bearings (Environment) – Ranking 14
14. Task 1e TWI 14: AQUALITAS (smart buoy performing in-situ water quality monitoring and web platform receiving the information provided by the buoy) – Ranking 9

#### **Safety and efficiency of the existing dams and reservoirs:**

15. Task 1e TWI 15: Earthquake safety assessment for concrete dams foundation failure (Safety and efficiency of the existing dams and reservoirs) – Ranking 15
16. Task 1e TWI 16: Automated continuous vibration monitoring systems for continuous monitoring the seismic behaviour of large dams (HYDROPOWER DEVELOPMENT / Safety and efficiency of the existing dams and reservoirs) – Ranking 4
17. Task 1e TWI 17: Integrated assessment and structural modelling of swelling processes in concrete dams: measurement of concrete stress, using flat jacks and over-coring techniques (HYDROPOWER DEVELOPMENT / Safety and efficiency of the existing dams and reservoirs) – Ranking 10

**Construction:**

18. Task 1e TWI 18: Penstock Drilling Technology (Construction) – Ranking 5

**New production technologies:**

19. Task 1e TWI 19: Geothermal energy HTH PUMP – Ranking 6
20. Task 1e TWI 20: Wave power WWEC – Ranking 11

**Additional Electrical & Mechanical Equipment technologies for hydropower plants contributions received from ISPRA:**

21. Task 1e TWI 21: “Tailor made” Hydrogenerators – Ranking 21
22. Task 1e TWI 22: ATB Riva Calzoni technologies for hydropower plants – Ranking 22

**20. PT contribution for “Water for Energy” TWIs**

The Portuguese contribution was the following:

- **Earthquake safety assessment for concrete dams foundation failure**

1. Name and affiliation of person writing the note: **Luís Lamas - LNEC**
  - a. Water domain (one of the 5 approved domains): Water for energy Task 1e (HYDROPOWER DEVELOPMENT / Safety and efficiency of the existing dams and reservoirs)
2. Name and origin (if known, e.g. inventor, owner, provider) of potential Technological Water Innovation (TWI):

**Earthquake safety assessment for concrete dams foundation failure**

<https://drive.google.com/file/d/0Bzk4EuaNUsx5VI9QWnc2Q3BSVUE/view?usp=sharing>

- **Integrated assessment and structural modelling of swelling processes in concrete dams: measurement of concrete stress, using flat jacks and over-coring techniques**

1. Name and affiliation of person writing the note: **Luís Lamas, LNEC**
2. Water domain (one of the 5 approved domains): Water for energy Task 1e (HYDROPOWER DEVELOPMENT / Safety and efficiency of the existing dams and reservoirs)
3. Name and origin (if known, e.g. inventor, owner, provider) of potential Technological Water Innovation (TWI):

**Integrated assessment and structural modelling of swelling processes in concrete dams: measurement of concrete stress, using flat jacks and over-coring techniques**

<https://drive.google.com/file/d/0Bzk4EuaNUsx5eGIUTkVHQUMwcFk/view?usp=sharing>

- **Automated continuous vibration monitoring systems for continuous monitoring the seismic behaviour of large dams.**

1. Name and affiliation of person writing the note: **Luís Lamas, LNEC**
2. Water domain (one of the 5 approved domains): Water for energy Task 1e (HYDROPOWER DEVELOPMENT /

Safety and efficiency of the existing dams and reservoirs)

3. Name and origin (if known, e.g. inventor, owner, provider) of potential Technological Water Innovation (TWI):

**Automated continuous vibration monitoring systems for continuous monitoring the seismic behaviour of large dams.**

<http://www.riskeng.bg/files/Publication/RISK-OF-LARGE-DAMS-15WCEE.pdf>

- **Behavioral fish barrier**

1. Name and affiliation of person writing the note: **Joaquim de Jesus – Original Solutions**
2. Water domain (one of the 5 approved domains):
3. Name and origin (if known, e.g. inventor, owner, provider) of potential Technological Water Innovation (TWI):

**Behavioral fish barrier (using a strobe light, sound and a bubble curtain as stimuli)**

<http://originalsolutions.wix.com/originalsolutions#!projects/c243u>

- **AQUALITAS**

1. Name and affiliation of person writing the note: **Joaquim de Jesus – Freshwater / Original Solutions**
2. Water domain (one of the 5 approved domains): Water for energy Task 1e (cross cutting with Task 1d River basin management and flood control)
3. Name and origin (if known, e.g. inventor, owner, provider) of potential Technological Water Innovation (TWI):

**AQUALITAS (smart buoy performing *in-situ* water quality monitoring and web platform receiving the information provided by the buoy).**

<http://freshwater.pt/>

<http://originalsolutions.wix.com/originalsolutions#!aqualitas/c1f6h>

- **Information on dam operation (SNIRH, developed by INAG/APA Ambiente)**

1. Name And Affiliation Of Person Writing The Note: **Rui Rodrigues – LNEC**
2. Water domain (one of the 5 approved domains): Water for energy Task 1e (cross cutting with Task 1d River basin management and flood control)
3. Name and origin (if known, e.g. inventor, owner, provider) of potential Technological Water Innovation (TWI):

**Information on dam operation, SNIRH (Portuguese Flood Surveillance and Warning System)**

<http://snirh.pt/>

## **21. PT contribution for “Agricultural water management” TWIs**

LNEC is partner of WP2 Task 1.a “Agriculture water management” led by ISPRA, Rome. One of PT contributions was the following TWI:

- **Technical Support Service for Irrigation Management (SATR)**

1. Name and affiliation of person writing the note: **Teresa E. Leitão, LNEC**
2. Water domain (one of the 5 approved domains): 1a – Agriculture Water Management
3. Name and origin (if known, e.g. inventor, owner, provider) of potential Technological Water Innovation (TWI):

**Technical Support Service for Irrigation Management (SATR); Operational and Technological Irrigation Centre (COTR)** [http://www.cotr.pt/cotr/cotr\\_uk.asp](http://www.cotr.pt/cotr/cotr_uk.asp)

## VI. FINAL COMMENTS

This document presents the developments in the first 18 months of activity of LNEC in PIANO project (Policies, Innovation, and Network for Enhancing Opportunities for China-Europe Water Cooperation) financed by the European Union (Horizon 2020) and the Chinese Secretariat of China Water Platform - Europe (China-Europe Water Platform, CEWP, <http://cewp.org/>), as key lessons learned from the Portuguese participation, led by Laboratório Nacional de Engenharia Civil (LNEC).

PIANO project is being developed within the planned framework. Besides the work described before, January 2016 a public consultation for additional TWIs was launched. The questionnaire is/was available in [https://dtumanagement.eu.qualtrics.com/SE/?SID=SV\\_9MtDBKhNgSGRTV3](https://dtumanagement.eu.qualtrics.com/SE/?SID=SV_9MtDBKhNgSGRTV3).

It was very enriching to be able to do the analysis described in the first 18 months of the project. The above mentioned work, fulfil the requirements of Dow, and concludes LNEC participation in WP 2, highlighting the work developed for Tasks 1d and 1e, both coordinated by LNEC, and for Task 1a.

During the first semester of 2016 the final ranking of all TWIs was accomplished by DTU.

The Final Selected WP 2 Task 1d and Task 1e TWIs are shown in the 1<sup>st</sup> and 2<sup>nd</sup> Appendixes.

LNEC papers presented on WP 2 Task 1d and Task 1e TWIs and LNEC participation in EIP European Innovation Partnership on Water on 10 February 2016 in Leeuwarden are presented in the 3<sup>rd</sup> and 4<sup>th</sup> Appendixes.

## VII. ACKNOWLEDGMENTS

- LNEC acknowledges the financial support of PIANO project by the European Commission under Grant Agreement No. 642433 of Horizon 2020 Framework Programme for Research.
- Acknowledgments are due to LBELEC, the Technological Centre of the EDP Group, on behalf of Eng.º Carlos Madeira, leading to the collaboration with LNEC of Dr. João Pádua for the large number of discussions held, besides those held with EDP Oporto Eng.º Alexandre Ferreira Silva, Eng.º Mário Silva, Eng.º João Miguel Oliveira, Eng.º José Dias Silva, Eng.º Fernando Barbosa Teixeira and Eng.º Miguel Patena, within the development of Task 1e "Water for Energy" conceptual ideas.
- Acknowledgments are due to the Portuguese Water Partnership (PPA), on behalf of its Executive Director João Simão Pires, that supported the dissemination of the PIANO project and the request to members of PPA for supplying TWIs for Tasks 1d and 1e.
- Acknowledgments are due to LNEC colleagues Doutora Teresa Leitão, Doutor Luis Lamas, Doutor José Falcão de Melo, Doutor Rogério Mota, Doutor Rui Rodrigues and Doutor Nuno Charneca, and to PPA members Eng.º Joaquim de Jesus, Freshwater / Original Solutions, Eng.º Cláudio de Jesus and Eng.º Pedro Póvoa, AdP, for their contributions to conceptual ideas and TWIs for Tasks 1d and 1e.



## VIII. GENERAL INFORMATION

### 22. Donor

The PIANO project is granted by DG Research and Innovation of the European Commission within the programme Horizon 2020 (Grant Agreement no 642433).

### 23. Project leader and partners

The PIANO project is coordinated by the Austrian University of Natural Resources and Life Science of Vienna (BOKU) which is responsible of implementation of the Grant agreement.

#### Coordinator

Dr. Markus STARKL  
Kompetenzzentrum für methodische Umweltbewertung (DIBB)  
Universität für Bodenkultur, Wien  
Gregor Mendel Strasse 33  
1180 Vienna Austria  
E-Mail: [markus.starkl@boku.at](mailto:markus.starkl@boku.at)

#### Project Partners:



[University of Natural Resources and Life Sciences \(BOKU\) Vienna](#)



[Technical University of Denmark \(DTU\) Copenhagen](#)



[International Office for Water \(OIEAU\) Paris](#)



[Italian National Institute for Environmental Protection and Research \(ISPRA\) Rome](#)



[National Laboratory for Civil Engineering \(LNEC\) Lisbon](#)



[Stockholm International Water Institute \(SIWI\) Stockholm](#)



[W.S. Atkins International Limited \(ATKINS\) London](#)



[European Water Association \(EWA\) Hennef \(Germany\)](#)



[European Union Chamber of Commerce in China Beijing](#)

## IX. APPENDIXES

### 24. Final Selected WP 2 Task 1d “River Basin Management and Flood Control” TWIs



#### RIVER BASIN MANAGEMENT AND FLOOD CONTROL TECHNOLOGICAL WATER INNOVATIONS

**Task 1d: River basin management**  
**Task leader: LNEC; Involved partners EU: ISPRA, DTU, EWA**

\*\*\*João Paulo Lobo Ferreira (lferreira@lneec.pt)



<b>WATER DOMAIN</b>	<b>RIVER BASIN MANAGEMENT AND FLOOD CONTROL</b>
<b>WATER CHALLENGE</b>	<b>RIVER BASIN FLOODING ABATEMENT / URBAN FLOODING ABATEMENT</b>
<b>TYPE OF TWI</b>	<b>PREVENTATIVE TECHNOLOGIES</b>
<b>TECHNOLOGY</b>	<b>TWIEU, D2. Smart and sand engines (sensors that relay real-time status reports on the condition of the dike). Use of new natural materials (flexible concrete, durable grass) to bolster flood defenses</b>
<b>CATEGORY</b>	<b>INTEGRATED RIVER BASIN MANAGEMENT TOOLS (FLOOD PROTECTION)</b>
<b>DESCRIPTION</b>	<p>To give nature a helping hand, Dutch researchers are working on new dike materials like flexible cement to attach energy-absorbing stones, geotextiles that prevent internal erosion — a major cause of breaches — and super-strong grass that dampens wave action. One intriguing process strengthens dikes with “bio grout” produced by bacteria fed a substance that makes them excrete calcium. So far, it only works on a small scale. The new designs provide a longer-term solution than barriers.</p> <p>One new dike is protected by a widened beach and concealed beneath a pedestrian-friendly esplanade which combine ecological, recreational, and economic functions with flood control. Devices like Smart Dikes are expensive, and haven’t yet proven their worth.</p>

source: <https://www.deltares.nl/en/projects/smart-dike-reinforcement-using-smooth-block-revetments/>

source:

[http://e360.yale.edu/feature/to\\_control\\_floods\\_the\\_dutch\\_turn\\_to\\_nature\\_for\\_inspiration/2621/](http://e360.yale.edu/feature/to_control_floods_the_dutch_turn_to_nature_for_inspiration/2621/)

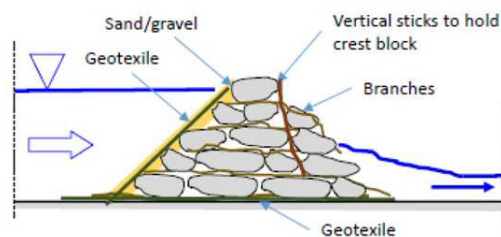


<b>WATER DOMAIN</b>	<b>RIVER BASIN MANAGEMENT AND FLOOD CONTROL</b>
<b>WATER CHALLENGE</b>	<b>RIVER BASIN MONITORING TECHNOLOGY</b>
<b>TYPE OF TWI</b>	<b>INTEGRATED SYSTEMS (MONITORING TOOLS + DSS)</b>
<b>TECHNOLOGY</b>	<b>TWIEU, E14. Smart buoy performing in-situ water quality monitoring and web platform receiving the information provided by the buoy</b>
<b>CATEGORY</b>	<b>WATER MANAGEMENT TECHNOLOGIES</b>
<b>DESCRIPTION</b>	<p>Smart buoy to monitor in-situ water quality (like dissolved oxygen, pH, conductivity, temperature, redox potential, total dissolved solids and turbidity) and web platform to receive the information provided by the buoy.</p> <p>the main and global objective of the AQUALITAS product: to provide qualified and preventive information about water quality to entities managing hydric resources (for hydroelectric production, irrigation or human consumption).</p> <p>Such information is related to two phenomena with high environmental and public health impacts: Thermal Stratification and Eutrophication. The latter promotes, on dams with water for human consumption, hydroelectric or irrigation, the large scale production of biotoxins, produced by cyanobacteria. These toxins can cause severe problems, not only to human health but also to the surrounding aquatic ecosystems.</p>

Source: <http://freshwater.pt/>  
<http://originalsolutions.wix.com/originalsolutions#aqualitas/c1f6h/>



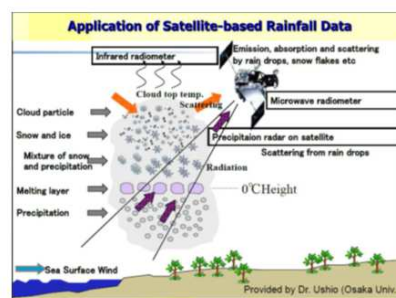
<b>WATER DOMAIN</b>	<b>RIVER BASIN MANAGEMENT AND FLOOD CONTROL</b>
<b>WATER CHALLENGE</b>	<b>RIVER BASIN MONITORING TECHNOLOGY</b>
<b>TYPE OF TWI</b>	<b>PREVENTIVE TECHNOLOGIES</b>
<b>TECHNOLOGY</b>	<b>TWIEU, D16. Bio-inspired dams for ecosystem degradation management (sustainable ecosystem restoration in semi-arid regions)</b>
<b>CATEGORY</b>	<b>INTEGRATED RIVER BASIN MANAGEMENT TOOLS (FLOOD PROTECTION)</b>
<b>DESCRIPTION</b>	<p>Bio-inspired dams built from stones, with branches in layers in between which add tensile resistance. A sealing layer made from impermeable geotextiles seals the upstream, so that a head difference can be maintained. Sticks are added on the downstream side to keep the crown blocks in position. This maintains dam integrity during flood events. The bio-inspired dams are built from local material, and constitute non-permanent structures so that financing and planning issues are minimized. Initial model tests indicate that the stability of rock dams is substantially enhanced by (a) the impermeable layer, which increases the vertical forces acting in the dam, and (b) the reinforcement provided by sticks and branches.</p> <p>Dams based on such construction techniques, using local rocks as main construction material, will provide for the retention of water / the reduction of the hydraulic gradient in restoration projects. Such dams and ponds constitute a sustainable and ecological solution to break through the downward spiral of ecosystem degradation observed in seasonal streams;</p>



source: <http://www.southampton.ac.uk/engineering/>  
<https://www.baufachinformation.de/zeitschrift/Ingenieurtechnische-Aspekte-der-Biberd%C3%A4mme/2014039014144>

**. Bio-inspired dam**

<b>WATER DOMAIN</b>	<b>RIVER BASIN MANAGEMENT AND FLOOD CONTROL</b>
<b>WATER CHALLENGE</b>	<b>RIVER BASIN FLOODING ABATEMENT / / URBAN FLOODING ABATEMENT</b>
<b>TYPE OF TWI</b>	<b>REACTIVE TECHNOLOGIES / INTEGRATED SYSTEMS (MONITORING TOOLS + DSS)</b>
<b>TECHNOLOGY</b>	<b>TWIEU, D1. Improved river basin management including flood risk management using Space-based technology (SBT) and information and communication technology (ICT)</b>
<b>CATEGORY</b>	<b>WATER MANAGEMENT TECHNOLOGIES</b>
<b>DESCRIPTION</b>	<p>Space-based technology (SBT) and information and communication technology (ICT) have spread dramatically. For example, hourly global rainfall maps observed from satellites are provided via the internet about 4 hours after observation, and cellular phones have rapidly spread in the region. These technologies have the potential to improve the monitoring and warning system because (i) satellites can cover a wider area than existing ground observation systems, and (ii) messages can be conveyed directly and simultaneously to citizens in hazardous areas.</p> <p>Powerful non-structural measures to guard against water-related disasters, monitoring and warning systems have been implemented by combining ground observations (rain gauge, water-level gauge) and remote observations (radar rain gauge); improving prediction accuracy of extreme weather events; and strengthening capacities of both governments and communities for pre- and post-disaster actions, including effective utilization of mass media for early warning and evacuation;</p>



source: <http://www.sensors.co.uk/>

<b>WATER DOMAIN</b>	<b>RIVER BASIN MANAGEMENT AND FLOOD CONTROL</b>
<b>WATER CHALLENGE</b>	<b>RIVER TRAINING BASIN SCALE</b>
<b>TYPE OF TWI</b>	<b>PREVENTATIVE TECHNOLOGIES / STAND-ALONE DSS</b>
<b>TECHNOLOGY</b>	<b>TWIEU, D8. mO4Rivers (Web Mobile Application to report river water bodies status) for citizens participation</b>
<b>CATEGORY</b>	<b>WATER MANAGEMENT TECHNOLOGIES</b>
<b>DESCRIPTION</b>	<p>The web mobile application (App) allows common citizens, including students, scout groups or sport associations to characterise and report rivers water bodies and shores to a centralised database. The App supports the "Project Rivers". This project aims to raise awareness and involve the citizens for the importance and relevance of the ecoservices provided by the river network on the entire ecosystem. The project and the web mobile app are based on 500 m river stretches that can be given for adoption and be visited 2 times per year. The project was created in 2007 and since then involved more than 40.000 people in Portugal.</p> <p>The river network was edited for the all country to unically identify each river stretch. This work is executed by volunteers using GIS tools, including the OpenStreetMap project online (<a href="http://www.openstreetmap.org">www.openstreetmap.org</a>). This methodology allows the volunteers to understand both the geographic information production tools and obtain the skills to manage the base information needed for the project.</p>

Source:

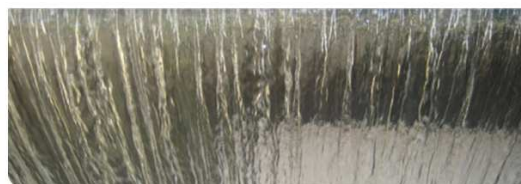
<https://webh2o.net/mo4rivers/frontend/index.php?d=live>



<b>WATER DOMAIN</b>	<b>RIVER BASIN MANAGEMENT AND FLOOD CONTROL</b>
<b>WATER CHALLENGE</b>	<b>RIVER BASIN MONITORING TECHNOLOGY</b>
<b>TYPE OF TWI</b>	<b>SENSORS AND OTHER DEVICES</b>
<b>TECHNOLOGY</b>	<b>TWIEU, D9. Microalgae dual-head biosensors for selective detection of herbicides with fibre-optic luminescent oxygen transduction.</b>
<b>CATEGORY</b>	<b>WATER MANGEMENT TECHNOLOGIES</b>
<b>DESCRIPTION</b>	<p>AQUATIK tackles the issue of surface water contamination by priority pollutants which have been identified in the Water Framework Directive (WFD) 2000/60/EC. For these priority pollutants the WFD established concentration thresholds which should not be overlapped in the surface water bodies of the EU.</p> <p>AQUATIK aims to design a new monitoring tool of priority pollutants, using the technology of biosensors, able to quantify automatically and at real time their concentrations in order to ensure that the concentration thresholds are not overlapped. Since urban wastewater and a major part of industrial wastewater are transferred to wastewater plants, the monitoring tool is going to be placed at the outlet of wastewater treatment plant (WWTP).</p> <p>The monitoring system is developed for the quantification of seven target priority pollutants selected for their abundance in rivers and particularly in the Llobregat river basin (Catalonia, Spain) where the system is going to be implemented. Four of these compounds belong to the pesticides family (atrazine, diuron, isoproturon and simazine) and the other three are organic substances widely spread in rivers (octylphenol, nonylphenol and DEHP).</p> <p>This project investigates an innovative and promising system for the protection of our surface waters and explores new possibilities offered by biosensor technologies in real time .</p>

Source:

[http://www.life-aquatik.eu/wp-content/uploads/2015/03/newsletter4\\_eng.pdf](http://www.life-aquatik.eu/wp-content/uploads/2015/03/newsletter4_eng.pdf)



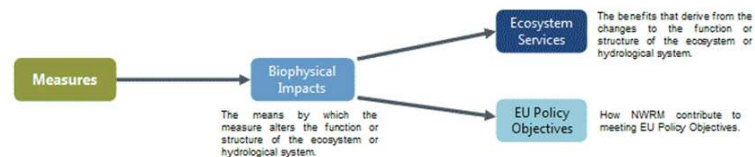


<b>WATER DOMAIN</b>	<b>RIVER BASIN MANAGEMENT AND FLOOD CONTROL</b>
<b>WATER CHALLENGE</b>	<b>URBAN FLOODING ABATEMENT</b>
<b>TYPE OF TWI</b>	<b>REACTIVE TECHNOLOGIES</b>
<b>TECHNOLOGY</b>	<b>TWIEU, D5. Floating technology for water retention and flood resilience in the urban fabric, based on modular composite technology which consists of fiber reinforced EPS structural panels for floating systems.</b>
<b>CATEGORY</b>	<b>INTEGRATED RIVER BASIN MANAGEMENT TOOLS (FLOOD PROTECTION)</b>
<b>DESCRIPTION</b>	The FLOATEC project aims to develop a floating structure that enables multiple use of space, combining e.g. water retention with housing or infrastructure. FLOATEC is developed for multiple applications; large scale pontoons, multi-functional storage basins, amphibious flood proof buildings, multi-functional (semi) floating structures, floating infrastructure and floating greenhouses. The principle of FLOATEC is based on modular composite technology which consists of fiber reinforced EPS structural panels for floating systems. One of the most important prerequisites is to reduce the cost of a floating structure from 150 euro/m2 to 75 euros/m2. Only with such a significant cost reduction will FLOATEC (financially) enable multiple use of space combining water retention with other functions to reduce flood risk and improve fresh water supply. The cost reduction and broad market applicability of the basic module are not only a market risk, but require multiple technological innovations with related technological risks such as: stiffness, durability, peak load resistance, flexibility of shape for specified applications and flexibility for production processes (modular, detachable).

source: <http://www.eurekanetwork.org/content/e-4446-eurekbuild-floatec>  
<http://www.eurekanetwork.org/project/id/4446/>  
 source  
<http://www.eurekanetwork.org/sites/default/files/success-story-pdf/4446.pdf>



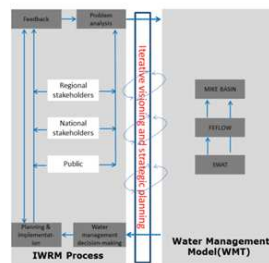
<b>WATER DOMAIN</b>	<b>RIVER BASIN MANAGEMENT AND FLOOD CONTROL</b>
<b>WATER CHALLENGE</b>	<b>RIVER TRAINING ( PREVENTIVE TECHNOLOGIES) AT BASIN SCALE</b>
<b>TYPE OF TWI</b>	<b>PREVENTATIVE TECHNOLOGIES / STAND-ALONE DSS</b>
<b>TECHNOLOGY</b>	<b>TWIEU, D15. Natural Water Retention Measures (NWRM) and DSS to provide multiple benefits, including flood risk reduction</b>
<b>CATEGORY</b>	<b>WATER MANAGEMENT TECHNOLOGIES</b>
<b>DESCRIPTION</b>	Retention basins are used to manage storm-water runoff to prevent flooding, downstream erosion, and improve water quality in an adjacent river, stream, lake or bay. In practice a retention basin differs from an infiltration one, commonly named MAR (Managed Aquifer Recharge), used for groundwater recharge.  Natural water retention measures aim to safeguard and enhance the water storage potential of landscape, soil, and aquifers, by restoring ecosystems, natural features and characteristics of water courses and using natural processes.  Natural Water Retention Measures (NWRM) innovative technological solutions including hydrological-hydraulic (including groundwater) models able to optimally assimilate data from different data sources with varying information value such as standard monitoring networks, remote sensing and citizens through mobile applications (crowdsourcing), promoting a new water quality and turbidity monitoring.



Source: (AF-Consult Switzerland Ltd (<http://www.afconsult.com/fr/worldwide/europe/switzerland/>)  
 Hafren Water Ltd., UK (<http://www.hafrenwater.com/>)  
 SMHI International Consulting Services, Sweden (<http://www.smhi.se/en/services/professional-services/environment>))

<b>WATER DOMAIN</b>	<b>RIVER BASIN MANAGEMENT AND FLOOD CONTROL</b>
<b>WATER CHALLENGE</b>	<b>RIVER TRAINING ( PREVENTIVE TECHNOLOGIES) AT BASIN SCALE</b>
<b>TYPE OF TWI</b>	<b>INTEGRATED SYSTEMS (MONITORING TOOLS + DSS)</b>
<b>TECHNOLOGY</b>	<b>TWIEU, D23. Integrated water resources management (IWRM) tool that combines a hydrological (SWAT), a river basin management (MIKE Hydro Basin) and a groundwater</b>
<b>CATEGORY</b>	<b>WATER MANAGEMENT TECHNOLOGIES</b>
<b>DESCRIPTION</b>	<p>The TWI is being developed as part of the “Integrated Water Resources Management Zayandeh Rud” project, funded by the German Federal Ministry of Education and Research (BMBF) - <a href="http://www.iwrm-isfahan.com/en/home/home.php">http://www.iwrm-isfahan.com/en/home/home.php</a>. To counteract the decline in fresh water resources in a region with difficult climatic conditions, high water demand and salinization of the groundwater, a water management tool (WMT) is being developed which combines soil and water assessment (SWAT), river basin management (MIKE Hydro Basin) with groundwater processes (FEFLOW). The acquired information from the WMT will provide information to the water management decision-making and to the planning and implementation process, while involving stakeholders and the public. The resulting feedback and problem analysis is again transferred to the WMT, allowing a continuous IWRM process through an iterative visioning and strategic planning</p>

source:  
<http://www.inter3.de/>  
<http://www.dhigroup.com/>  
<http://www.iwrm-isfahan.com/en/home/home.php>



<b>WATER DOMAIN</b>	<b>RIVER BASIN MANAGEMENT AND FLOOD CONTROL</b>
<b>WATER CHALLENGE</b>	<b>RIVER TRAINING ( PREVENTIVE TECHNOLOGIES) AT BASIN SCALE</b>
<b>TYPE OF TWI</b>	<b>Integrated systems (monitoring tools + DSS)</b>
<b>TECHNOLOGY</b>	<b>TWIEU, D22.</b>
<b>CATEGORY</b>	<b>WATER MANAGEMENT TECHNOLOGIES</b>
<b>DESCRIPTION</b>	<p>The work has been developed for the Guanting-Yongding basin in Northeast of Beijing, as part of the project “Sustainable water and agricultural land use in the Guanting watershed under limited water resources”, funded by the German BMBF. The method is based on stochastic analysis to provide information for long-term water management planning, in areas where no or little data is available, under consideration of different climatic conditions. It contains:</p> <ul style="list-style-type: none"> <li>- deterministic simulation of water uses in the catchment, including consideration of ranking,</li> <li>- registration of relevant systems states (water levels in reservoirs / filling of reservoirs, discharges at particular river profiles in comparison to minimum flows, deficits in water supply, etc.),</li> <li>- statistical analysis of the registered systems states as a basis for assessment of each examined management variant.</li> </ul> <p>The resulting water resources planning model created with WBalMo is an abstraction of the real-world catchment area Guanting. Severe conflicts of water scarcity could be illustrated and measures of water transfer could be studied with this technology.</p>

source: <http://www.bmbf.wasserressourcen-management.de/en/606.php>





## 25. Final Selected WP 2 Task 1e “Water for Energy” TWIs



### WATER FOR ENERGY TECHNOLOGICAL WATER INNOVATIONS

#### Task 1e: Water for energy

Task leader: LNEC; Involved partners EU: DTU, EWA, EDP/Labelec

\*\*\*João Paulo Lobo Ferreira (lferreira@lneec.pt)



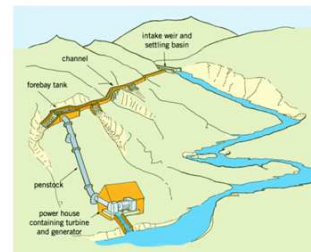
<b>WATER DOMAIN</b>	<b>WATER FOR ENERGY</b>
<b>WATER CHALLENGE</b>	<b>NOVEL ENERGY PRODUCTION TECHNOLOGIES</b>
<b>TYPE OF TWI</b>	<b>OTHER SOURCES / GEOTHERMAL ENERGY</b>
<b>TECHNOLOGY</b>	<b>TWIEU, E19. Geothermal energy pump to harvest geothermal energy</b>
<b>CATEGORY</b>	<b>ENERGY PRODUCTION TECHNOLOGIES</b>
<b>DESCRIPTION</b>	<p>Across Europe, there are plentiful sources of geothermal energy: heat stored in the ground which can be tapped to provide a renewable and inexhaustible energy supply. Using the right technology to access this power at varying depths and temperatures, we can use this heat to reduce our dependence on imported and climate-damaging fossil fuels.</p> <p>Until recently, the technology to exploit geothermal energy in a cost-effective way has remained under-developed. However, in response to the growing economic and policy pressures to cut CO2 emissions and improve energy security, one company set out to change this state of affairs, with remarkable results.</p> <p>Klima and its parent company Mayekawa in Belgium designed the compressor, with unexpectedly good results: for each kW of energy consumed, the pump delivers 6.4kW of heat. The project had delivered a world-class result.</p>

Source:  
<http://www.eurekanetwork.org/content/e-4117-hth-pump>



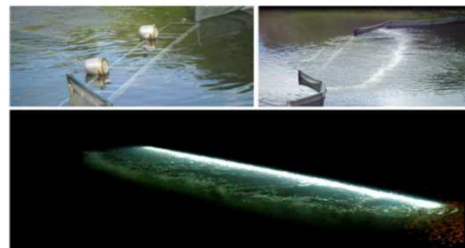
<b>WATER DOMAIN</b>	<b>WATER FOR ENERGY</b>
<b>WATER CHALLENGE</b>	<b>NOVEL ENERGY PRODUCTION TECHNOLOGIES</b>
<b>TYPE OF TWI</b>	<b>SMALL SCALE HYDROPOWER</b>
<b>TECHNOLOGY</b>	<b>TWIEU, E23. Micro-hydro generators: system that do not require a dam or storage facility to be constructed</b>
<b>CATEGORY</b>	<b>ENERGY PRODUCTION TECHNOLOGIES</b>
<b>DESCRIPTION</b>	<p>Micro-hydro power is the small-scale harnessing of energy from falling water, such as steep mountain rivers. Using this renewable, indigenous, non-polluting resource, micro-hydro plants can generate power for homes, hospitals, schools and workshops.</p> <p>Small-scale hydro schemes generate up to 500 kilowatts of power. The microhydro station, which converts the energy of flowing water into electricity, provides poor communities in rural areas with an affordable, easy to maintain and long-term solution to their energy needs.</p> <p>These systems, which are designed to operate for a minimum of 20 years, are usually "Run of the river" systems do not require a dam or storage facility to be constructed. Instead they divert water from the stream or river, channel it in to a valley and drop it in to a turbine via a pipeline called a penstock.</p> <p>The turbine drives a generator that provides the electricity to the local community. By not requiring an expensive dam for water storage, run-of-the-river systems are a low-cost way to produce power. They also avoid the damaging environmental and social effects that larger hydroelectric schemes cause, including a risk of flooding.</p>

Source: <http://practicalaction.org/small-scale-hydro-power-2>  
[http://practicalaction.org/energy/micro\\_hydro\\_expertise?utm\\_source=S000&utm\\_medium=PPC&utm\\_campaign=C10105&s\\_src=Grant\\_PPC&s\\_subsrc=sub\\_source&gclid=CjwKEAjwvbyxBRCS74T049iEp0wSJAC](http://practicalaction.org/energy/micro_hydro_expertise?utm_source=S000&utm_medium=PPC&utm_campaign=C10105&s_src=Grant_PPC&s_subsrc=sub_source&gclid=CjwKEAjwvbyxBRCS74T049iEp0wSJAC)  
 KO5v1WFcuUkp8ajc6gLNRCS0FXEXGunq\_LTEvc8j0GBgfxcC2pDw\_wcB



<b>WATER DOMAIN</b>	<b>WATER FOR ENERGY</b>
<b>WATER CHALLENGE</b>	<b>PRESERVATION OF NATURAL ECOSYSTEMS IN DAMMED RIVERS</b>
<b>TYPE OF TWI</b>	<b>MITIGATION TECHNOLOGIES</b>
<b>TECHNOLOGY</b>	<b>TWIEU, E12. Behavioral fish barrier (using a strobe light, sound and a bubble curtain as stimuli) to e.g. divert fish from turbines blades of hydropower structures</b>
<b>CATEGORY</b>	<b>WATER MANAGEMENT TECHNOLOGIES</b>
<b>DESCRIPTION</b>	<p>The PISCIS product consists in a behavioural barrier developed for freshwater fish using, as stimuli, a strobe light, sound and a curtain of bubbles, which allow to divert and/or guide the potamodromous species. For example, diverting fish from turbine blades of hydroelectric structures and guiding shoals for the fish passages. This allows, in the first case, a substantial reduction in the mortality of species with high conservation interest and, in the second case, to restore the genetic continuous of those species.</p> <p>This behavioural fish barrier represents a new generation of dynamic biodiversity protection systems in altered and fragmented watercourses, where ecological disruptions imposed restrictions on migratory genetic flows and where the existing hydraulic structures do not respond favourably to the migratory and reproductive impulses of this fauna. This innovation can safeguard the ecological integrity of the biota, without interfering with the functional productivity and profitability of the systems of water use (whether they are used for electricity production, irrigation or consumption). Its action is directed at the behaviour of fish species without any physical obstacle or constraint interfere with these structures.</p>

Source: <http://originalsolutions.wix.com/originalsolutions#!projects/c243u>



<b>WATER DOMAIN</b>	<b>WATER FOR ENERGY</b>
<b>WATER CHALLENGE</b>	<b>INCREASE ELECTRICITY EFFICIENCY OF SMALL SCALE HYDROPOWER</b>
<b>TYPE OF TWI</b>	<b>TURBINES AND COMPONENTS</b>
<b>TECHNOLOGY</b>	<b>TWIEU, E5. Very low head turbine generator (Kaplan type) for up to 4.5 m head</b>
<b>CATEGORY</b>	<b>ENERGY PRODUCTION TECHNOLOGIES: SMALLSCALE HYDROPOWER</b>
<b>DESCRIPTION</b>	The Very Low Head Turbine (VLH Turbine) is designed specifically for very low head sites (1.4 to 3.2 meters and up to 4.5 with reinforced structure). The objectives of the designers of the VLH turbine was to develop a unit that requires very few civil work, is easy to install and offers a high degree of reliability at a reasonable cost per installed KW. To achieve these goals, the VLH concept takes a completely different approach from the traditional turbine design, using large runners to practically eliminate the expensive civil structures of the traditional concept. It includes advanced technological characteristics such as Directly driven Permanent Magnet Variable speed Generator. The VLH offers a very good environmental integration, it is noiseless and submersed, and it has a unique fish friendly capacity.



source: <http://www.small-hydro.com/IT-Documents/121-1-Very-Low-Head-Turbine-Generator.aspx>

<b>WATER DOMAIN</b>	<b>WATER FOR ENERGY</b>
<b>WATER CHALLENGE</b>	<b>INCREASE ELECTRICITY EFFICIENCY OF SMALL SCALE HYDROPOWER</b>
<b>TYPE OF TWI</b>	<b>TURBINES AND COMPONENTS</b>
<b>TECHNOLOGY</b>	<b>TWIEU, E1. Hooped Pelton turbine designed based on the separation of function between buckets and hoops</b>
<b>CATEGORY</b>	<b>ENERGY PRODUCTION TECHNOLOGIES: SMALL SCALE HYDROPOWER</b>
<b>DESCRIPTION</b>	The hooped Pelton is an innovative new design based on the separation of function between buckets and hoops. This runner is composed of separate buckets mechanically attached to a hub consisting of 2 flanges. This is a great advantage for maintenance, with in addition improved mechanical characteristics. The Pelton wheel runner of this technology has a structure in which a bucket is fitted in the peripheral ring. Compared to the one-piece casting structure, this structure can reduce the manufacturing cost, as well as other costs, by partial replacement of the bucket. This technology requires no spare runners, and it allows the bucket to be replaced partially, to be installed correctly, and to be replaced quickly, all of which make the maintenance easy. Advantages: Improved behavior of the runner under operation; Controlled and shorter delivery time; Minimized risk of cracking during operation due to improved metallurgical quality and dynamic stresses redistribution; Reduction of cost of ownership due to less stock (optimization of spare parts stock) and due to possibility to replace few buckets instead of an entire runner; Easy maintenance due to removable buckets.



source: <http://www.small-hydro.com/Documents/112-4-Hooped-Pelton-Turbine.aspx>  
<http://www.small-hydro.com/Programs/innovative-technologies.aspx>  
<http://www.small-hydro.com/Documents/112-4-Hooped-Pelton-Turbine.aspx>

<b>WATER DOMAIN</b>	<b>WATER FOR ENERGY</b>
<b>WATER CHALLENGE</b>	<b>INCREASE ELECTRICITY EFFICIENCY OF SMALL SCALE HYDROPOWER</b>
<b>TYPE OF TWI</b>	<b>TURBINES AND COMPONENTS</b>
<b>TECHNOLOGY</b>	<b>TWIEU, E3. Screw Turbine Generating System, a screw type small (up to 300 Kw) hydro unit applicable to existing channel or weir</b>
<b>CATEGORY</b>	<b>ENERGY PRODUCTION TECHNOLOGIES: SMALL SCALE HYDROPOWER</b>
<b>DESCRIPTION</b>	<p>A screw type small hydro unit applicable to existing channel or weir. It is robust, long wearing, no fine screens necessary and fish friendly. Water flow: up to 5,500 L/s, Head: up to 10 m, Power: up to 300 kW.</p> <p>The water turbine is designed to protect fish. Applications of this technology are extended to areas of an extremely low head below 10m. This technology has been widely applied in Europe. The structure of the screw-shaped waterwheel is sturdy and simple. This structure is designed to remove suspended sediment from the water column. These factors contribute to a greatly simplified maintenance regime. Advantages: No control system necessary; The efficiency is greater than with comparable waterwheels and small turbines; Flat, stable efficiency gradient; Robust, long wearing, trouble free, fish friendly.</p>

source:  
<http://www.small-hydro.com/Programs/innovative-technologies.aspx>  
<http://www.small-hydro.com/Documents/311-5-Screw-Turbine-Generating-System.aspx>



<b>WATER DOMAIN</b>	<b>WATER FOR ENERGY</b>
<b>WATER CHALLENGE</b>	<b>INCREASE ELECTRICITY EFFICIENCY OF SMALL SCALE HYDROPOWER</b>
<b>TYPE OF TWI</b>	<b>TURBINES AND COMPONENTS</b>
<b>TECHNOLOGY</b>	<b>TWIEU, E4. Vertical Micro Pelton Turbine with composite runner buckets in package type generating unit for small rivers with relative low discharge and high head</b>
<b>CATEGORY</b>	<b>ENERGY PRODUCTION TECHNOLOGIES: SMALL SCALE HYDROPOWER</b>
<b>DESCRIPTION</b>	<p>Composite runner buckets in package type generating unit for small rivers with relatively low discharge and high head. The system can be provided with remote control and be adapted to customer needs. Advantages:</p> <p>Composite runner buckets have low cost and are easily replaced. Package type generating unit is easy to install at site. Easy maintenance due to simplified structure. Available between 15 kW and 150 kW, Net head &gt;30 meters, 1-5 automatically controlled nozzles with servo engines. Production of electricity in rivers with high head and low run-off. Standard equipment: Automatic closing of nozzles by no run-off or power failure, power meter, control panel.</p>

source:  
<http://www.small-hydro.com/Programs/innovative-technologies.aspx>  
[www.3d-verksted.no](http://www.3d-verksted.no)  
<http://www.small-hydro.com/Documents/112-1-Vertical-Micro-Pelton-Turbine.aspx>





<b>WATER DOMAIN</b>	<b>WATER FOR ENERGY</b>
<b>WATER CHALLENGE</b>	<b>RETROFITTING OF EXISTING SMALL SCALE HYDROPOWER SCHEMES</b>
<b>TYPE OF TWI</b>	<b>TURBINES AND COMPONENTS</b>
<b>TECHNOLOGY</b>	<b>TWIEU, E6. Small turbines to be retrofitted e.g. intake towers, unused ship locks, canal weirs and navigation and irrigation dams</b>
<b>CATEGORY</b>	<b>ENERGY PRODUCTION TECHNOLOGIES: SMALLSCALE HYDROPOWER</b>
<b>DESCRIPTION</b>	<p>Use at existing structures HYDROMATRIX® technology enables customers to tap into the unused hydropower potential of intake towers, unused ship locks, canal weirs and navigation and irrigation dams by using these existing structures as a profitable and renewable energy resource.</p> <p>Flexibility in arranging the small TG-units and associated electromechanical equipment allows integration of HYDROMATRIX® plants in existing structures that fulfil the basic application criteria. High profitability HYDROMATRIX® turbines can operate with only minimal tailrace submergence. Deep excavation and other costly civil work can be avoided, thus leading to significant cost savings. State-of-the-art hydraulic runner design and generator technology guarantee highest possible energy generation through high levels of hydraulic and electrical efficiency.</p> <p>In 2010 ANDRITZ HYDRO received the Austrian State Prize for Environmental and Energy Technology for its HYDROMATRIX® concept .</p>

source  
<http://www.small-hydro.com/Programs/innovative-technologies.aspx>  
<http://www.andritz.com/hy-hydromatrix-en.pdf>



<b>WATER DOMAIN</b>	<b>WATER FOR ENERGY</b>
<b>WATER CHALLENGE</b>	<b>PRESERVATION OF NATURAL ECOSYSTEMS IN DAMMED RIVERS</b>
<b>TYPE OF TWI</b>	<b>TURBINES AND COMPONENTS</b>
<b>TECHNOLOGY</b>	<b>TWIEU, E13. Water Lubricated Bearings guarantee the non-pollution of the river that can happen with the oil lubricated alternatives</b>
<b>CATEGORY</b>	<b>ENERGY PRODUCTION TECHNOLOGIES: SMALL SCALE HYDROPOWER</b>
<b>DESCRIPTION</b>	<p>Water lubricated bearings technology guarantee the non-pollution of the river that can happen with oil lubricated installations. In addition of this great advantage, the technology features improved performances, low maintenance, simplified and compact design.</p> <p>PRO: This technology is environmentally friendly because it uses no oil. Simplified design. Improved performances with better dynamic behaviour and lower losses. Reduction of costs of ownership due to low maintenance. No risk of pollution by oil in the rivers.</p>

Source:  
<http://www.small-hydro.com/Documents/522-1-Water-Lubricated-Bearings.aspx>

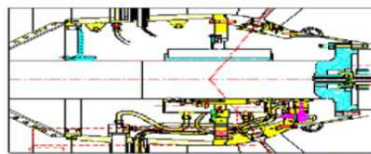


Fig.1 Comparison between Oil Lubrication and Water Lubrication

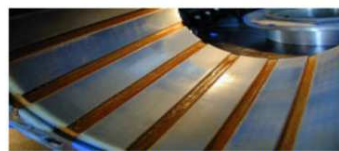


Fig.2 Water Lubricated Bearing

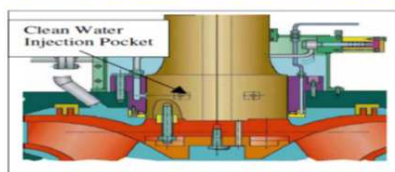


Fig.3 Hydrostatic Water Guide Bearing

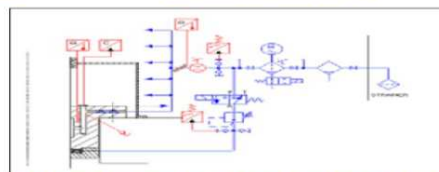
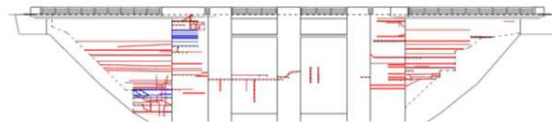


Fig.4 Water Lubricated Bearing/Water Supply System Diagram

<b>WATER DOMAIN</b>	<b>WATER FOR ENERGY</b>
<b>WATER CHALLENGE</b>	<b>RISK ASSESSMENT &amp; PRESERVATION OF NATURAL ECOSYSTEMS IN DAMMED RIVERS</b>
<b>TYPE OF TWI</b>	<b>DECISION SUPPORT SYSTEMS (DSS)</b>
<b>TECHNOLOGY</b>	<b>TWIEU, E15. Earthquake safety assessment for concrete dams foundation failure by application of integrated numerical tools</b>
<b>CATEGORY</b>	<b>ENERGY PRODUCTION TECHNOLOGIES</b>
<b>DESCRIPTION</b>	<p>Earthquake safety assessment for concrete dams foundation failure involves application of the existing and the development of new integrated numerical tools to assess the safety of dam foundations in rock masses considering extreme actions, such as those imposed by high intensity seismic events.</p> <p>Two major roles are anticipated for their use: assess the safety level of existing dams, in order to support decisions regarding the need for rehabilitation works; define and the major potential failure modes allowing a more effective design of new dams, and expediting the interpretation of data collected during or after the seismic events, and thus allowing an adequate support to the definition of emergency decisions.</p>

Source: <http://www.lnec.pt/barragens-betao/en/>  
<https://drive.google.com/file/d/0Bzk4EuaNUsx5VI9QWnc2Q3BSVUE/view?usp=sharing>



<b>WATER DOMAIN</b>	<b>WATER FOR ENERGY</b>
<b>WATER CHALLENGE</b>	<b>RISK ASSESSMENT &amp; PRESERVATION OF NATURAL ECOSYSTEMS IN DAMMED RIVERS</b>
<b>TYPE OF TWI</b>	<b>DECISION SUPPORT SYSTEMS (DSS)</b>
<b>TECHNOLOGY</b>	<b>TWIEU, E17. Integrated assessment and structural modelling of swelling processes in concrete dams</b>
<b>CATEGORY</b>	<b>ENERGY PRODUCTION TECHNOLOGIES</b>
<b>DESCRIPTION</b>	<p>Small to moderate swelling strains do not cause, in general, adverse consequences in concrete dams. However, more intense strains can compromise, initially, the serviceability conditions, namely related with gate operation, and after can introduce damage that affect the durability of the concrete and the structural safety. In concrete dams the structural evidences of AAR development can be dissimulated by the creep response, which causes some difficulties on the AAR phenomena identification.</p> <p>For detection of early AAR signs, the main technological innovations that resulted from recent research are in the following areas: detailed visual inspections; proper interpretation of monitoring results obtained from plumb-lines, geodetic instrumentation, joint meters, rod extensometers, stress meters and strain meters, particularly stress-free strain meters; laboratory testing for AAR evaluation (petrography, chemical and expansion tests); laboratory tests to evaluate the depreciation of the mechanical properties of concrete (compressive and tensile strengths, elasticity modulus and creep); and measurement of concrete stress, using flat jacks and over-coring techniques.</p>

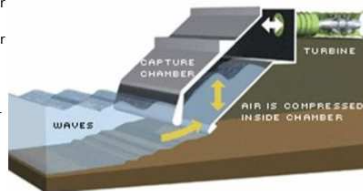
Source: <http://www.lnec.pt/barragens-betao/en/>  
<https://drive.google.com/file/d/0Bzk4EuaNUsx5eGIUTkVHQUMwcfk/view?usp=sharing>



<b>WATER DOMAIN</b>	<b>WATER FOR ENERGY</b>
<b>WATER CHALLENGE</b>	<b>NOVEL ENERGY PRODUCTION TECHNOLOGIES</b>
<b>TYPE OF TWI</b>	<b>OTHER SOURCES / WAVE ENERGY</b>
<b>TECHNOLOGY</b>	<b>TWIEU, E20. Oscillating water columns, device that generates electricity from waves</b>
<b>CATEGORY</b>	<b>ENERGY PRODUCTION TECHNOLOGIES</b>
<b>DESCRIPTION</b>	The fundamental functions of wave power devices are to capture waves and then absorb energy from the captured waves, which then are converted into electricity. Most of these devices are called oscillating water columns. These oscillating water columns consists of a "partially submerged, hollow structure" (as seen in diagram one), which is open to the sea below the water line for waves to pass through. The principle of operation of an oscillating water column is that as waves enter the shell chamber or capture chamber (as noted in diagram 2), the level of water rises, compressing and depressurizing the air in the top of the chamber or air column, which is then forced through a blow-hole into the turbine to generate electricity. When the waves draw back, air returns under pressure into the chamber, keeping the turbine moving at all times. The air that blows in both directions produces enough movement for the turbine to drive a generator. This generator then converts the energy into electricity. Most often the turbines used in an oscillating water column is the Wells Turbine. A Wells Turbine is a low-pressure air turbine developed for use in oscillating-water-column wave power plants.

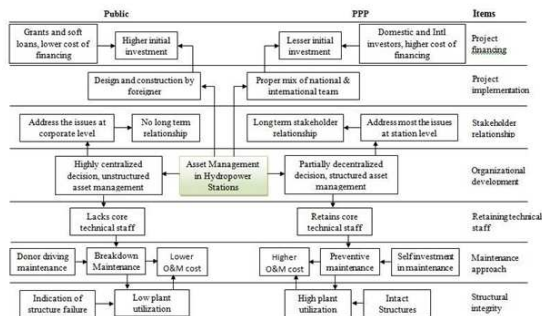
Source:

<http://www.eurekanetwork.org/content/e-2278-wwec>  
<http://www.eurekanetwork.org/sites/default/files/success-story-pdf/2278.pdf>  
<http://www.environmental-expert.com/companies/wave-energy-35805>



<b>WATER DOMAIN</b>	<b>WATER FOR ENERGY</b>
<b>WATER CHALLENGE</b>	<b>INCREASE ELECTRICITY EFFICIENCY OF SMALL HYDROPOWER SCHEMES</b>
<b>TYPE OF TWI</b>	<b>Tool to predict and map resources flows and assessing trade-offs between resources use</b>
<b>TECHNOLOGY</b>	<b>TWIEU, E9. DSS: Hydropower plant simulator (HPPSW) for simulating the refurbishment and maintenance decisions of hydropower plants</b>
<b>CATEGORY</b>	<b>ENERGY PRODUCTION TECHNOLOGIES: SMALL SCALE HYDROPOWER</b>
<b>DESCRIPTION</b>	A new tool for simulating the refurbishment and maintenance decisions of hydropower plant. Presentation of the latest investigations and the results of some simulations. The Simulator is programmed on a Webserver and therefore no additional installation is necessary. The user just needs access to the internet and a commercial internet browser. The rest is done by the administrator and the programme himself. Advantages:  The technological advantage of this feature is the webbased platform. It needs just an administrator and an internet access. The rest is done at the webserver, which is installed here at the University; Can reduce the time and especially the costs by varying different maintenance and operation strategies before any work starts; By training the operators and planners they get an impression about the results of their decisions in this case.

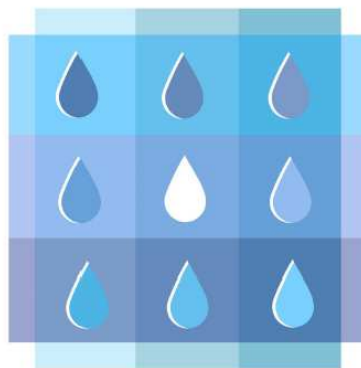
Source:  
<http://www.ite.tuwien.ac.at/>  
<http://www.small-hydro.com/Documents/423-1-Assessment-Methods-for-Rehabilitation-and-Sa.aspx>



## 26. Papers presented by LNEC on WP 2 Task 1d and Task 1e TWIs

13º Congresso da Água, Lisbon, Portugal, March 7 – 9, 2016

13.º Congresso da Água



**13.º Congresso da Água**  
7, 8 e 9 março de 2016  
LNEC | LISBOA  
Como assegurar soluções resilientes e sustentáveis?



### PROGRAMA



**13.º Congresso da Água**  
7, 8 e 9 março de 2016  
LNEC | LISBOA  
Como assegurar soluções resilientes e sustentáveis?



POLÍTICAS, INOVAÇÃO, E REDES PARA MELHORAR AS OPORTUNIDADES DE COOPERAÇÃO CHINA-EUROPA NA ÁGUA: O PROJETO PIANO

João Paulo LOBO FERREIRA

Doutorado em Engenharia Civil (IST), Dr.-Ing. Habil. (TU Berlin), Investigador-Coordenador do LNEC, LNEC/DIR, Av. do Brasil, 101 P-1700-066 Lisboa (Portugal), [lferreira@lnecc.pt](mailto:lferreira@lnecc.pt)

#### RESUMO

Apresentam-se os desenvolvimentos do primeiro ano de atividade do projeto comunitário PIANO (Policies, Innovation, And Network for enhancing Opportunities for China-Europe water cooperation), financiado pela União Europeia (PQ Horizonte 2020) e pelo Secretariado Chinês da Plataforma da Água China-Europa (<http://cewp.org/>), na vertente liderada pelo LNEC. O projeto PIANO visa reforçar a cooperação internacional no domínio da água entre a Europa e a China, promovendo a criação de redes de empresas, PME, empresários, ONGs, decisores políticos, reguladores e agências de financiamento, para criar oportunidades de negócios e sociais.

Os objetivos do projeto PIANO são (WP1) o fortalecimento e expansão da rede existente da Plataforma da Água China-Europa (CEWP) para cobrir todos os atores relevantes para a cooperação entre a China e a Europa em domínios de investigação e inovação da água, (WP2) a identificação de inovações tecnológicas europeias no domínio da Água para o desenvolvimento conjunto de soluções tecnológicas inovadoras (Technology Water Innovations, TWI) com potencial de implementação na China, (WP3) a identificação dos drivers e barreiras relativos a esta cooperação e elaboração de estratégias para superar tais barreiras, aproveitando os drivers para a sua implementação e replicação de inovações tecnológicas de água na China, a promoção do intercâmbio de conhecimento e política de diálogo para construir um ambiente propício para a absorção de inovações tecnológicas de água com um grande potencial para implementação, e também a replicação e penetração no mercado na China, (WP4) a consolidação de uma agenda estratégica partilhada de investigação e inovação (SRIA) entre a Europa e a China no domínio da Água, e (WP5) uma eficaz divulgação e generalização dos resultados do projeto.

As áreas de investigação prioritárias concentram-se nos desafios sociais relacionados com a gestão da água na agricultura (WP2\_1.a), em circuito urbano (WP2\_1.b), em circuito Industrial (WP2\_1.c), por bacias hidrográficas, com realce para a problemática das cheias (WP2\_1.d) e com o Nexus Água-Energia (WP2\_1.e).

O consórcio do projeto é composto por nove parceiros, localizados em oito Estados-membros da UE e um na China. O consórcio engloba parceiros de instituições académicas e institutos de pesquisa e organizações sem fins lucrativos, associações europeias, uma PME comercial e uma grande empresa internacional.

O LNEC lidera o desenvolvimento das tarefas (WP2\_1d) e (WP2\_1e). No caso da tarefa "Nexus Água-Energia" o LNEC com o apoio da EDP/Labeltec.

No âmbito da atividade liderada pelo LNEC foram analisadas e inventariadas cerca de 50 soluções tecnológicas inovadoras (Technology Water Innovations, TWI) nas áreas temáticas

# Policies, Innovation And Networks for enhancing Opportunities for China Europe water cooperation (PIANO)



PIANO project is funded by  
EU Programme, Horizon 2020 Grant Agreement no 642433

<http://project-piano.net/>



### Citizen Observatories for Water Management – COWM 2016

We are pleased to announce that the city of Venice will host an International Conference titled "Citizen Observatories for Water Management – COWM 2016" on 7th, 8th and 9th June 2016.

The conference will focus on the potential of Citizen Science in the European water innovation landscape, and in particular in the fields of Monitoring and Modeling; Flood and Drought Risk management; and Land functions and management. The Conference will be an occasion for all actors in the field of water and innovation to meet and exchange stories and experiences on the use of new technologies to bring water-related issues closer to citizens. We invite you to participate at the Conference and to possibly submit an abstract for a presentation. Please have a look at the first conference announcement.



**EVENT INFORMATION**

---

**Date of event:**

🕒 Tuesday, June 7, 2016  
to Thursday, June 9, 2016

**Website:**

COWM2016

**Other event information:**

- ✘ Event includes lunch
- ✘ Event includes dinner



João Paulo LOBO-FERREIRA  
(LNEC, Portugal)

## Sharing of technological solutions:

### Key lessons learned from the Portuguese participation in H2020 Piano project

#### ACKNOWLEDGMENTS

##### SHARING OF TECHNOLOGICAL SOLUTIONS: KEY LESSONS LEARNED FROM THE PORTUGUESE PARTICIPATION IN H2020 PIANO PROJECT

Dr.-Ing. Hsiki, Principal Research Officer at Laboratório Nacional de Engenharia Civil (LNEC) Board of Directors, Av. do Brasil, 101 P-1700-066 Lisboa (Portugal), [hsiki@lnecc.pt](mailto:hsiki@lnecc.pt)

The talk addresses the developments in the first year of activity of PIANO project (Policies, Innovation, and Network for Enhancing Opportunities for China-Europe Water Cooperation) financed by the European Union (Horizon 2020) and the Chinese Secretariat of China Water Platform - Europe (China-Europe Water Platform, CEWP, <http://cewp.org/>), as key lessons learned from the Portuguese participation, led by Laboratório Nacional de Engenharia Civil (LNEC). PIANO project aims to strengthen cooperation in the field of water between Europe and China, promoting the creation of networks of enterprises (including SMEs), entrepreneurs, NGOs, policy makers, regulators and funding agencies to create social opportunities and business. The PIANO project objectives are (1) strengthening and expanding the existing network of the China Europe Water Platform (CEWP) to cover all relevant actors for water research and innovation relevant for China Europe water cooperation; (2) identification of European technological water innovations and areas for joint development of technological solutions that have a potential for implementation in China; (3) identification of drivers and barriers and elaborating strategies for overcoming such barriers and taking advantage of drivers for implementation and replication of technological water innovations; (4) promotion of knowledge exchange and policy dialogue to build an enabling environment for the uptake of technological water innovations with a great potential for implementation, further replication and market uptake in China; (5) consolidation of a shared strategic research and innovation agenda between Europe and China in the water domain; and, (6) effective dissemination and mainstreaming of the project results within China, Europe and worldwide to various target audiences. The priority research areas focus on societal challenges related to Agricultural water management (WP2\_1.a), to Municipal water management (WP2\_1.b), to Industrial water management (WP2\_1.c), to river basin management highlighting the problem of floods (WP2\_1.d) and to the Water for energy nexus (WP2\_1.e). The project consortium is composed of nine partners of which eight are located in eight different EU Member States and one is based in China. The consortium encompasses partners from high level academic institutions and experienced research institutes to non for profit organizations, from European umbrella associations to a commercial SME and a large international company. The PIANO partners are supported in their activities by many Chinese institutes and research centres. LNEC leads the development of tasks (WP2\_1.d) and (WP2\_1.e). In the case of the task "Water for Energy" LNEC has the support of EDP / Labelec.

Within the activities led by LNEC an inventory of about 50 technological water innovative solutions (TWI) was developed in the thematic areas WP2\_1.d and WP2\_1.e. Later, following several prioritization criteria, 20 TWIs of each of both thematic areas were ranked in descending order of suitability and potential deployment opportunities in China. PIANO project is being developed within the planned framework.



The PIANO project is funded by EU Programme Horizon 2020 Grant Agreement no 642433

- LNEC acknowledges the financial support of PIANO project by the European Commission under Grant Agreement No. 642433 of Horizon 2020 Framework Programme for Research.
- Acknowledgments are due to LABELE C, the Technological Centre of the EDP Group, on behalf of Eng.º Carlos Madeira, leading to the collaboration with LNEC of Dr. João Pádua for the large number of discussions held, besides those held with EDP Oporto Eng.º Alexandre Ferreira Silva, Eng.º Mário Silva, Eng.º João Miguel Oliveira, Eng.º José Dias Silva, Eng.º Fernando Barbosa Teixeira and Eng.º Miguel Patena, within the development of Task 1.e "Water for Energy" conceptual ideas.
- Acknowledgments are due to the Portuguese Water Partnership (PPA), on behalf of its Executive Director João Simão Pires, that supported the dissemination of the PIANO project and the request to members of PPA for supplying TWIs for Tasks 1.d and 1.e.
- Acknowledgments are due to LNEC colleagues Doutora Teresa Leitão, Doutor Luis Lamas, Doutor José Falcão de Melo, Doutor Rogério Mota, Doutor Rui Rodrigues and Doutor Nuno Charneca, and to PPA members Eng.º Joaquim de Jesus, Freshwater / Original Solutions, Eng.º Cláudio de Jesus and Eng.º Pedro Póvoa, AdP, for their contributions to conceptual ideas and TWIs for Tasks 1.d and 1.e.

## 27. Participation in EIP European Innovation Partnership on Water on 10 February 2016 in Leeuwarden

Dr.JP Lobo Ferreira (LNEC) participated in the annual conference of the EIP European Innovation Partnership on Water took place on 10 February 2016 in Dutch Leeuwarden. With more than 550 participants from over 50 countries the conference resulted into the Leeuwarden declaration which summarizes key findings and recommended actions in 8 areas of water sector: circular economy and water innovation (WI), regions and cities and WI, sustainable development goals and WI, regulation and WI, finance for WI, public procurement and WI, partnerships and WI, showcases and demonstration sites and WI. Some representatives of the organizations involved in the PIANO project were invited to disseminate information on the ongoing activities through a roll-up and a stand.

