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### Introduction

Sewerage networks have been designed as centralized infrastructure, with end of pipe treatment and hence by definition, away from the points of re-use of treated water, making reuse costly (in terms of energy and infrastructure). However, recent advances in both treatment and ICT present a unique opportunity for a solution to this problem: coupling Membrane Bioreactors with advanced nano-filtration and/or reverse osmosis membranes provides superior effluent quality which can meet the most stringent reuse criteria - packaged in a treatment unit of minimal footprint. In DESSIN we demonstrate fully automated, optimally run, packaged treatment plants suitable for arid and semi-arid regions.

### Context

Athens has suffered rapid urbanization resulting in few urban green spaces. Coupled with peri-urban forest fires in the last decade this resulted in severe degradation of its environment and quality of life of its inhabitants. What is seen as priority is the deployment of innovative management options and technologies for reuse needed to irrigate (primarily) green urban areas. The demonstration looks into sewer mining for distributed reuse within the urban environment, exploiting state-of-art ICT solutions for distributed monitoring and management of multiple sites.

### Site description: KEREFYT Athens

At the Athens pilot site (Figure 1), we demonstrate a fully automated packaged treatment plant featuring membrane based, small footprint, sewer mining technologies that allow direct mining of sewage from the network, close to the point-of-use with minimum infrastructure required and low transportation costs for the treated effluent. Distributed low energy sensor networks are coupled with distributed ICT intelligence innovative in terms of data fusion, data communication, interoperability and mobile solutions for remotely controlling and operating the distributed infrastructure (Figure 2). The demo is also used as a testbed for testing reused water characteristics on the soil, through onsite experiments, irrigating onsite peri-urban green.

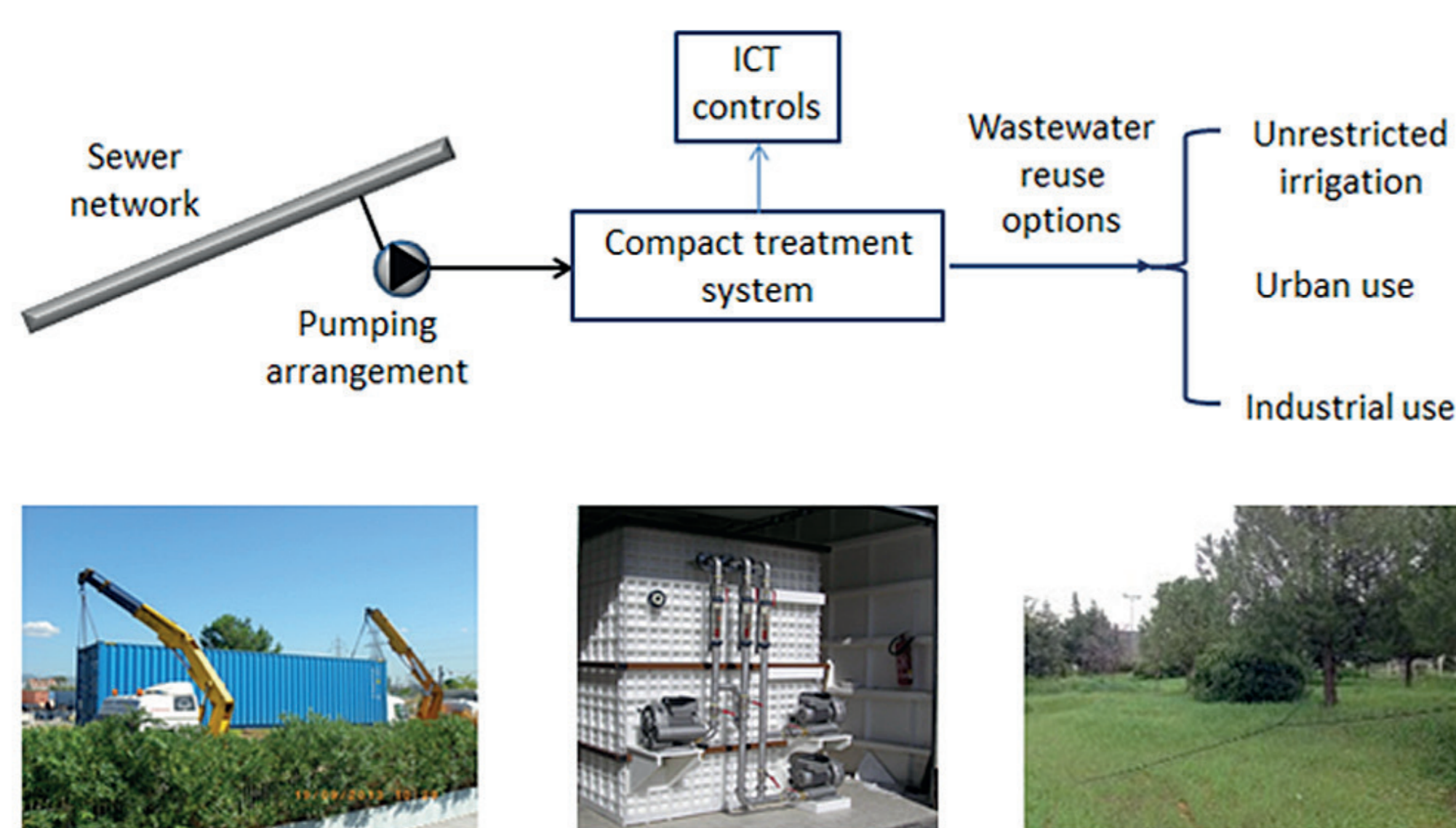


Figure 1: System architecture – main concept

### Methodology

The aim of this study is to optimize and demonstrate a membrane based, small footprint packaged treatment plant combined with distributed ICT intelligence. Specific objectives and corresponding methods are listed in Table 1.

Specific aims	Method
Optimise the configuration of modular packaged treatment solutions focusing on new membrane solutions and technologies	Field study, market research
Develop the sewer-mining software and hardware platform	Field study, modelling
Install and optimise the operation of the small footprint packaged treatment plant	Field study
Develop monitoring and control optimisation algorithms for distributed management of multiple sewer mining sites	Modelling

Table 1: Specific aims and method for the DESSIN Athens demonstration

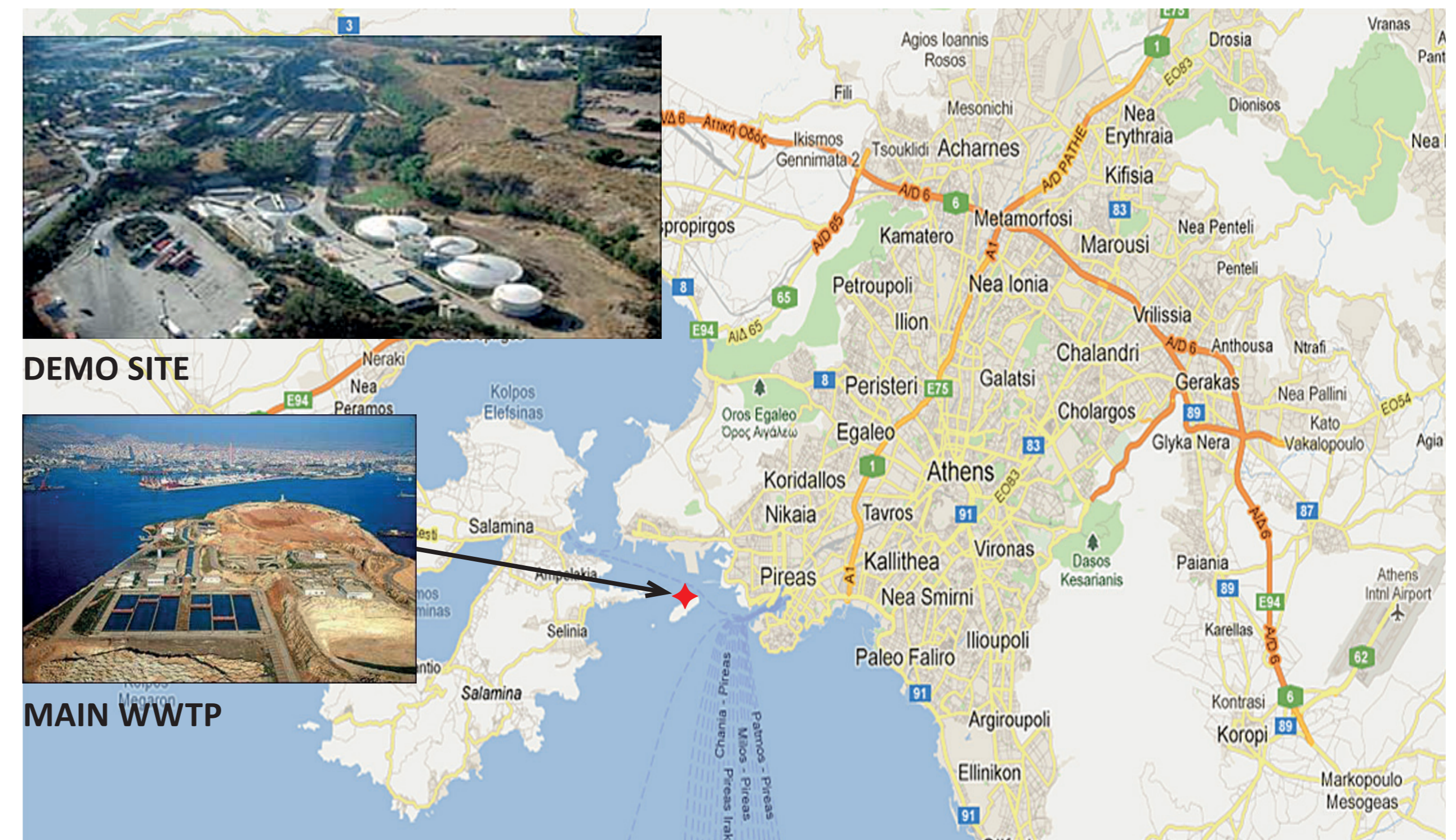


Figure 2: Map of Attica and location of Athens demo site and main WWTP

### Results and Discussion

#### Design of packaged treatment plant

Figure 3 illustrates the packaged treatment plant layout consisting of two units, the MBR unit and the RO unit combined in a new design of one containerised system. Membrane technology removes most viruses and bacteria from treated water as the chosen membrane has a pore size  $\leq 0,030\mu\text{m}$ . Effluent quality makes it appropriate for irrigation, car washing, WC flushing and when extended to use RO as tertiary treatment then Laundry and Household uses are also applicable.

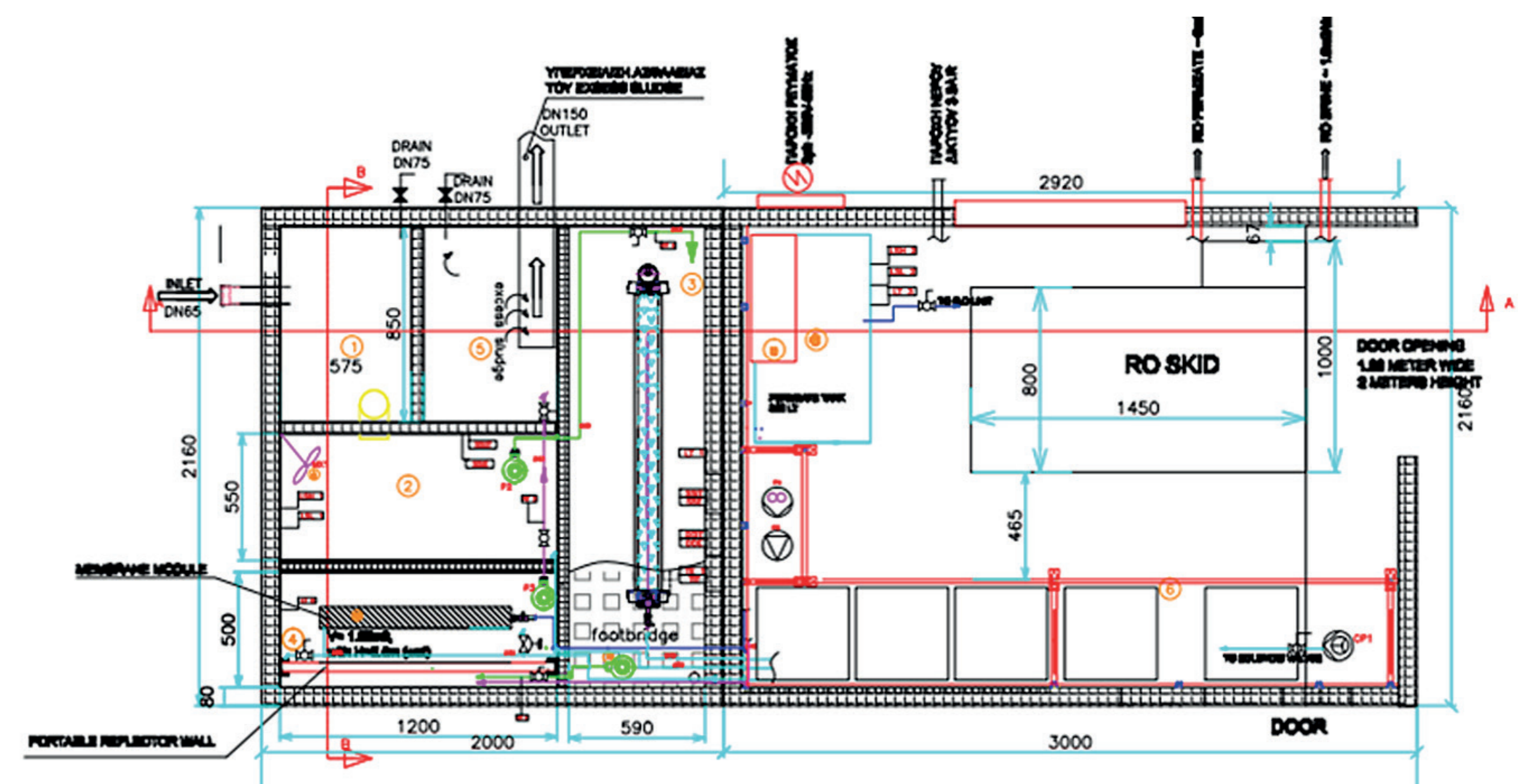


Figure 3: Packaged treatment plant layout for the Athens pilot

#### Development and installation of packaged treatment plant

The packaged treatment plant is under development and it will be connected to the main sewage system within 2015.

### Conclusions

The Athens pilot demonstration shows the potential for distributed reuse in the highly constrained urban environment. Deployment of distributed treatment solutions allows reuse close to the point of use, drastically improving the cost-benefit balance. The project is now focusing on optimising the operation of the packaged units and face the new challenge for remote control and operation under strict health and water quality standards.

### Acknowledgements

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