

# **Wind, Marine and Hydrokinetic Energy Plans Proposed for Hartford, Rome and Shanghai**

by

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A Thesis Submitted to the Graduate

Faculty of Rensselaer Polytechnic Institute

in Partial Fulfillment of the

Requirements for the degree of

MASTER OF SCIENCE

Major Subject: ENVIRONMENTAL ENGINEERING

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Troy, New York

December, 2011  
(For Graduation Dec. 2011)

## **ABSTRACT**

The areas around Hartford, Rome and Shanghai have abundant marine, river, and wind energy resources which can be used to generate usable energy. These three cities were chosen because of their similar resource availability including rivers that run through the city centers and a close proximity to a major coastline. The available resources were quantified using an annual variance analysis which was used to design renewable energy plan for each city.

A plan was created for each city individually to harness the renewable resources using the most advanced wind and water technologies. In Hartford 16.2 MW can be generated through a combination of small wind turbines, hydrokinetic turbines and wave energy converters. The plan proposed for Rome will harness wave and off-shore wind energy in the Tyrrhenian Sea as well as hydrokinetic energy from dams along the Tiber River. These two energy sources will produce over 280 MW of renewable power. Finally, the Shanghai plan incorporates the resources available in the East China Sea to produce over 1000 MW of wave and tidal power. Each of these power plans meets around 2% of the cities' energy needs.

Environmental impact analyses were done for each proposal to evaluate both positive and negative impacts of the installation of the proposed technologies. General effects of both wind and water-based energy generation were observed including wildlife, local ecosystems and aesthetics. In addition to the general impacts the individual plans were analyzed for any site-specific environmental impacts that may occur. Because water-based renewable energy remains at low levels of development the environmental effects are uncertain. Quantifying the exact impact of the installation of these power plans will require continuous monitoring.

As part of the environmental impact analysis a life cycle analysis (LCA) was done for the PowerBuoy 150 device, which is proposed for use in the Hartford power plan. The analysis observed the associated greenhouse gas (GHG) emissions through the development, operation and disposal of the product. The analysis concluded that the pollutant emissions off-set by the device are far greater than the emissions produced in the production, installation, and disposal stages.