



## 2011 JOHN R. FREEMAN LECTURE



**Vladimir Novotny**  
PhD, PE, DEE

PROFESSOR, NORTHEASTERN UNIVERSITY  
CIVIL AND ENVIRONMENTAL ENGINEERING  
BOSTON, MA

PROFESSOR EMERITUS, MARQUETTE UNIVERSITY  
MILWAUKEE, WI

PARTNER, AQUANOVA, LLC

**Monday**  
**April 11, 2011**  
Reception: 6 p.m.  
Lecture: 7 p.m.

MIT's Tang Center (E51)  
70 Memorial Drive  
Cambridge, MA 02139  
[whereis.mit.edu/?go=E51](http://whereis.mit.edu/?go=E51)



# CLOSING THE WATER CYCLE, RECOVERING ENERGY AND RESOURCES IN FUTURE SUSTAINABLE COMMUNITIES

This lecture will present an up-to-date, integrated and interdisciplinary perspective on the role of urban water design and management in advancing urban sustainability goals. In the context of a city as a system, the flow, use and transformation of water result in polluting effluents and overflows that are inseparable from flows of other materials and energy. The entire process of mass and energy flows constitutes urban metabolism. Current urban metabolism is linear, characterized by long distance underground transfers of water to the communities, underground conveyance of used water and stormwater, high energy use for transport, treatment and disposal of used water and solids. Current urban metabolism concepts and footprints will be introduced documenting that the paradigm of linear urban water infrastructure design and management is not sustainable leading to excessive use of water and resources and high greenhouse gas (GHG) emissions.

Introducing the worldwide Cities of the Future initiative, the presentation will highlight current developments and concepts of the new (fifth) paradigm leading towards water centric sustainable communities whereby stormwater conveyance is mostly by surface and urban water bodies, the core part of the system. They are being rehabilitated and protected, including daylighting those buried in the past. Urban surface and ground waters and landscape are integral parts of the entire water cycle system which is also linked to energy. The backbone of the new approach to building new cities and retrofitting the old to become sustainable is distributed water and energy reclamation from used water and stormwater also its reuse to partially or fully close the hydrologic cycle and reduce GHGs. In addition, integrated resource recovery facilities could reclaim nutrients (struvite), biofuel, electricity, and organic solids. Co-digestion of concentrated used water with organic solids (sludge, solid waste and algae produced from waste nutrients) to produce energy is being investigated and already being implemented in some countries. This could bring the GHG emissions from water systems to net zero and significantly cut down the energy use and GHGs by the city. Current and near future developments of sustainable water centric "ecocities" in Canada, China, Singapore, Sweden, Australia and other countries will be presented and research needs including barriers to implementation will be outlined.

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