

Water Technology Markets – Key Opportunities and Emerging Trends

Exec Summary

In 2008 there was a total of \$8.4Bn of Venture Capital invested in the CleanTech sector, however less than 2% of the total amount invested went into water technologies. The feedback from the Venture Capital world is that while they are interested in the water sector, they appear to be unsure as to where the game changing opportunities are and if there are enough of these types of opportunities. There has however been a significant increase in the amount of Venture Capital flowing into the water sector. Between 1998 and 2008, a total of 109 individual water companies received VC funding representing a total amount invested of \$1.12Billion. What is quite remarkable is that 59% of the total dollar amount invested was invested since 2007.

There is a general feeling that the water sector is conservative and slow to adopt new technologies and adopt new ways of solving old problems. The same could have been said of the energy sector for the past one hundred years. However we are witnessing the beginning of an energy revolution. There are strong signs that there will be similarly dramatic changes in how we manage water in the coming years and decades.

This report was prepared to provide a perspective on where the opportunities are today and will be in the coming years in the water technology market and to profile some of the technologies which are well positioned to take advantage of the direction in which the market is going. The focus is on emerging and disruptive¹ technologies and also on disruptive changes in how water is managed which will create new opportunities for existing technologies.

There were three key stages in the preparation of this report:

1. Identification of Key Drivers for the Water Sector
2. Determination of the overall direction of the water technology sector based on these drivers
3. Identification of the water technology opportunities arising out of the current drivers and general direction of the water industry.

We began by studying the drivers affecting the water sector. From this, a picture emerged of the direction in which the industry is heading and what the trends are likely to be for the water technology market. We then focused on the technologies which were going to be part of an emerging, smarter, more efficient water system. In some cases this included new technologies, in others it was an opportunity for an existing technology in a new application. The emphasis is on generating a macro understanding of the overall direction of the technology market and identifying the technologies which will potentially be disruptive or ‘take-off’ in the next 3-5 years in terms of serious purchasing.

¹ To aid the reader, three classifications have been developed to group technologies, there are ‘not disruptive’, ‘moderately disruptive’ and ‘highly disruptive’. These are defined in the introduction.

1. Identification of Key Drivers for the Water Sector

We identified seven key drivers which are shaping and creating new water technology market opportunities:

1. Energy
2. Water Scarcity
3. Sludge Disposal
4. Nutrient Removal
5. Infrastructure Gap
6. Ageing Infrastructure
7. Emerging Contaminants

Some of the issues in relation to each driver are summarized in Table 1 below.

Table 1 Summary of Key Issues and Drivers

1. Energy
1.1. Rising Energy Costs will increase costs of water services.
1.2. The provision of water services will become more energy intensive due to urbanization and water scarcity
1.3. A drive to reduce Green House Gas Emissions will promote energy efficiency and energy recovery in the provision of water services
1.4. There is potential for net energy generation from wastewater treatment
1.5. There are significant opportunities for improvements in energy efficiencies of distribution systems
2. Water Scarcity
2.1. Climate Change will have negative effects on water availability
2.2. Non-renewable Groundwater Resources are being depleted
2.3. Increasing World Population is increasing the demand for freshwater resources
2.4. Water Resources are not distributed evenly
2.5. Increasing Water Use per Capita as Countries become wealthier
2.6. Population Migration to Water Scarce Areas
2.7. Potential Conflicts due to water scarcity
3. Sludge Disposal
3.1. Large quantities of sludge have to be disposed of annually

3.2. Sludge Treatment and Disposal Costs represent a significant portion of overall treatment costs
3.3. Tighter regulatory limits will increase treatment costs and put pressure on existing disposal routes
3.4. Waste sludge represents a potential source of energy
3.5. Sewage sludge represents a source for resource recovery

4. Nutrient Removal
4.1. Nutrient Limits are at the forefront of new discharge limits for wastewater treatment plants
4.2. Nutrient Trading may provide additional financial incentives to reduce nutrient discharges
4.3. Increasing interest in Resource Recovery will promote technologies which can recover nutrients from wastewater in a re-usable form

5. Infrastructure Gap
The Millennium Development Goals to be accomplished by 2015 include: <ul style="list-style-type: none">• The number of people served by water supply to be increased by 1.6 billion or 32%.• The number of people served by sanitation to be increase by 2.2 billion (59%).

6. Ageing Infrastructure
6.1 Much of the water and wastewater infrastructure in the developed world is over 50 years old and requires replacement to reduce lost water and safeguard public health.
6.2 Significant increases in public spending on infrastructure are required over the next 20 years to maintain current levels of water services.

7. Emerging Contaminants
7.1 Potential regulatory Limits for emerging contaminants
7.2 Concerns regarding Long Term Impact of emerging contaminants on the Environment
7.3 Human Health Concerns such as microbial resistance to antibiotics and endocrine disrupting effects

2. Determination the overall direction of the water technology sector

The picture which emerged has from an analysis of the key drivers can be summarized in three key points:

1. *Our current water system is very inefficient and wasteful.*
2. *Due to mounting global pressures we can no longer afford an inefficient and wasteful system.*
3. *This is driving real change in how we manage water, which is, in turn, creating opportunities for technology development.*

The first thing to note about our current water system is that is inefficient and wasteful. We have a ‘**use once**’ approach to water. We take fresh water, filter it, chlorinate it distribute it, lose anywhere from 30%-60% in that process due to leaking pipes. We use it once, add human wastes, food waste, detergents, pharmaceutical and personal care products, transport it all to a centralized treatment plant where we try and take everything out again; take out the nutrients, take out the organics, produce a treated water which we don’t re-use but discharge into the environment.

It turns out this is very costly in terms of capital and operational costs. Approximately half of the energy bill of any Municipality is associated with providing water services. Half of that is associated with moving water from one place to another (distribution), and the other half is taken up with water and wastewater treatment. In fact, energy represents the single largest controllable cost of providing water services.

Now this system wasn’t designed with efficiency in mind. In fact it wasn’t really designed at all. It just happened over time. Sewers were constructed in the 1850’s to take wastes ‘seaward’ that’s where the word sewer comes from. Then we started to build large treatment plants at the end of these large pipes, and that’s how we got to where we are today, with an inefficient system which consumes significant amounts of energy.

There is a growing consensus among industry experts and thought leaders that a convergence of different pressures are bringing us closer to a tipping point and forcing us to re-think how we manage water.

There is an emerging vision of a smarter, more efficient water system and creating the technologies to make this alternative system a reality are where the opportunities lie in the water sector.

3. Identify the water technology market opportunities arising out of the current trends

To help provide a link between issues, drivers and emerging technology market opportunities, we have created maps to link the drivers to areas of technology development, or emerging areas of application in the water sector. The following four figures (Figures 1 -4), provide maps for the issues of Energy, Water Scarcity, Nutrient Recovery and Recycling and Sludge Management.

In some cases a technology or area of application had more than one driver. For example, sludge to energy technologies are driven by a desire to generate renewable energy and also to come up with a sustainable sludge management solution.

Figure 1 Energy related drivers and emerging technology opportunities

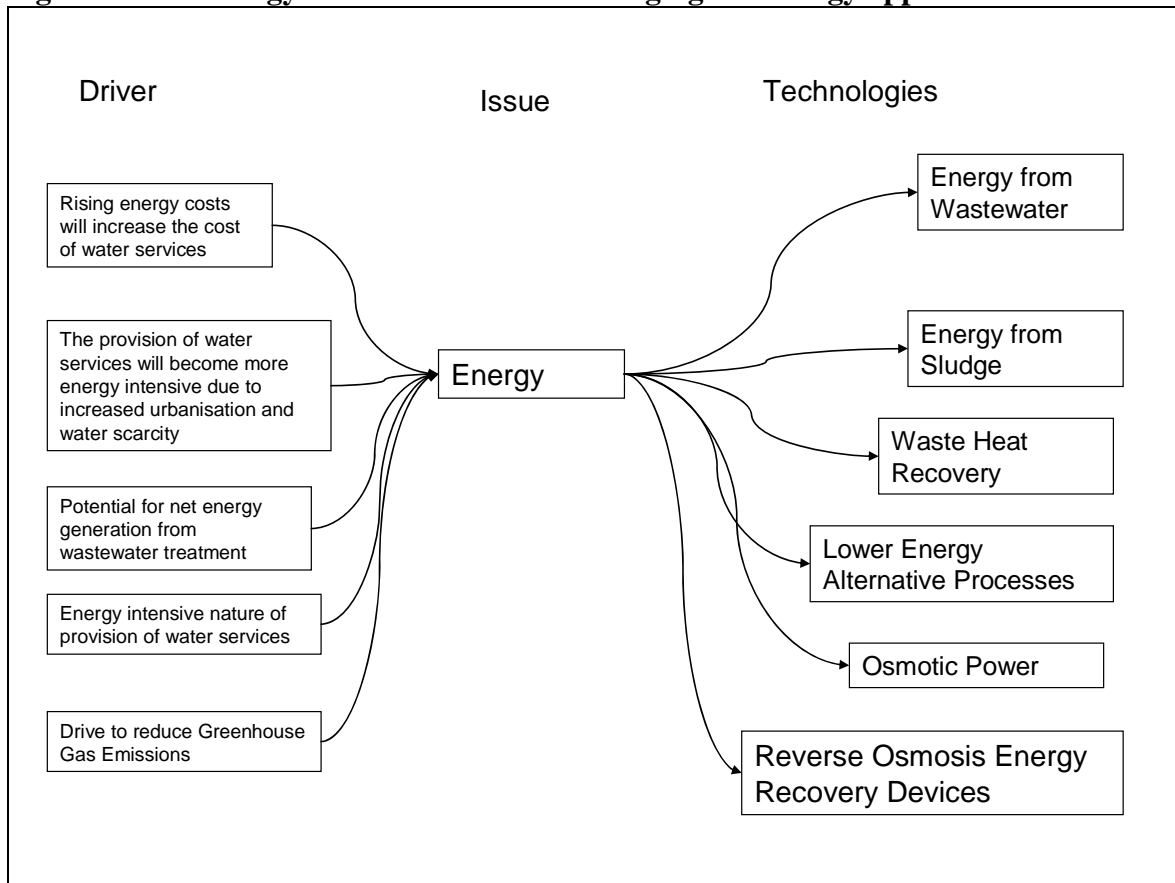


Figure 2 Water Scarcity Issues and Key Technology Opportunities

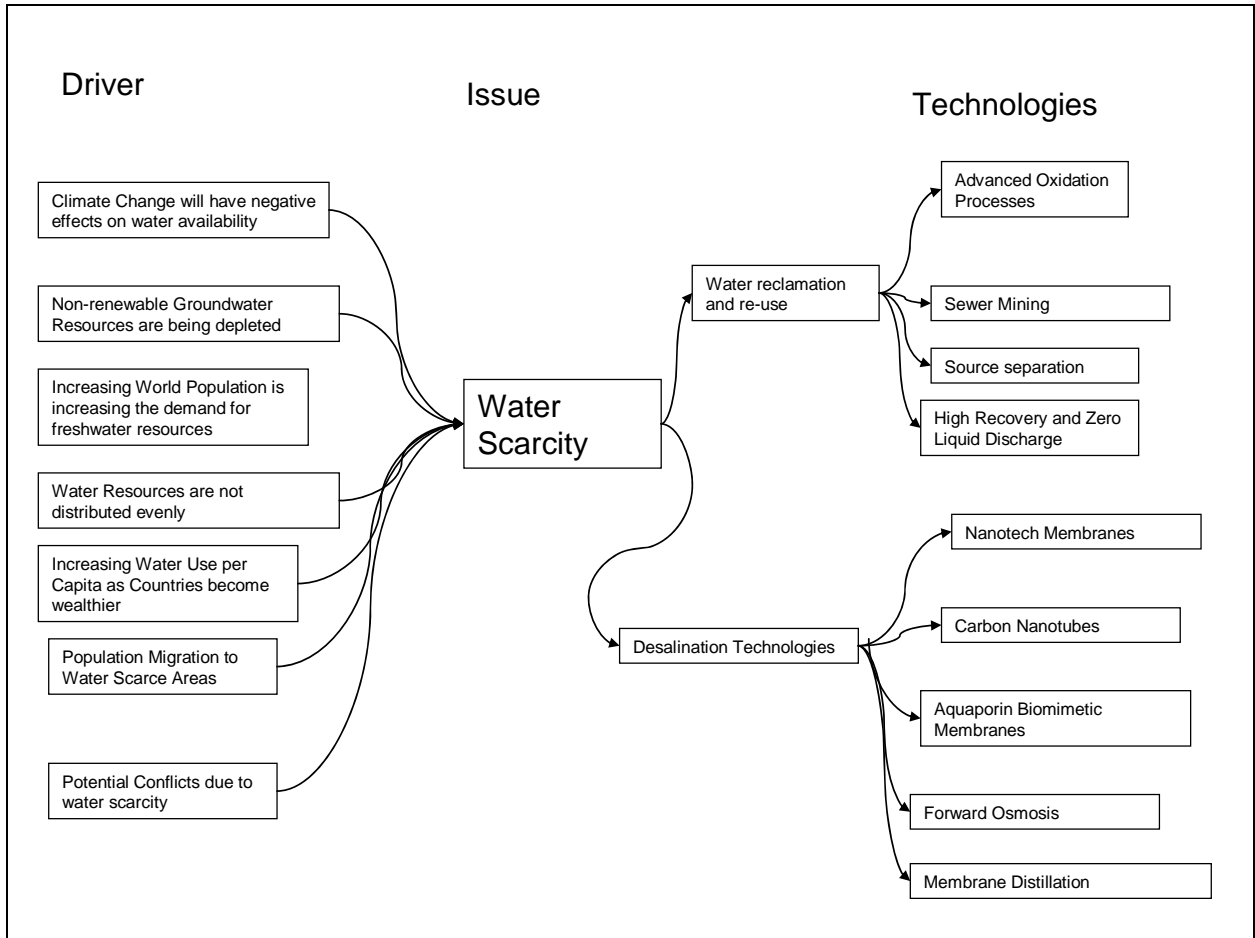


Figure 3 Sludge Management Drivers and Emerging Technology Areas

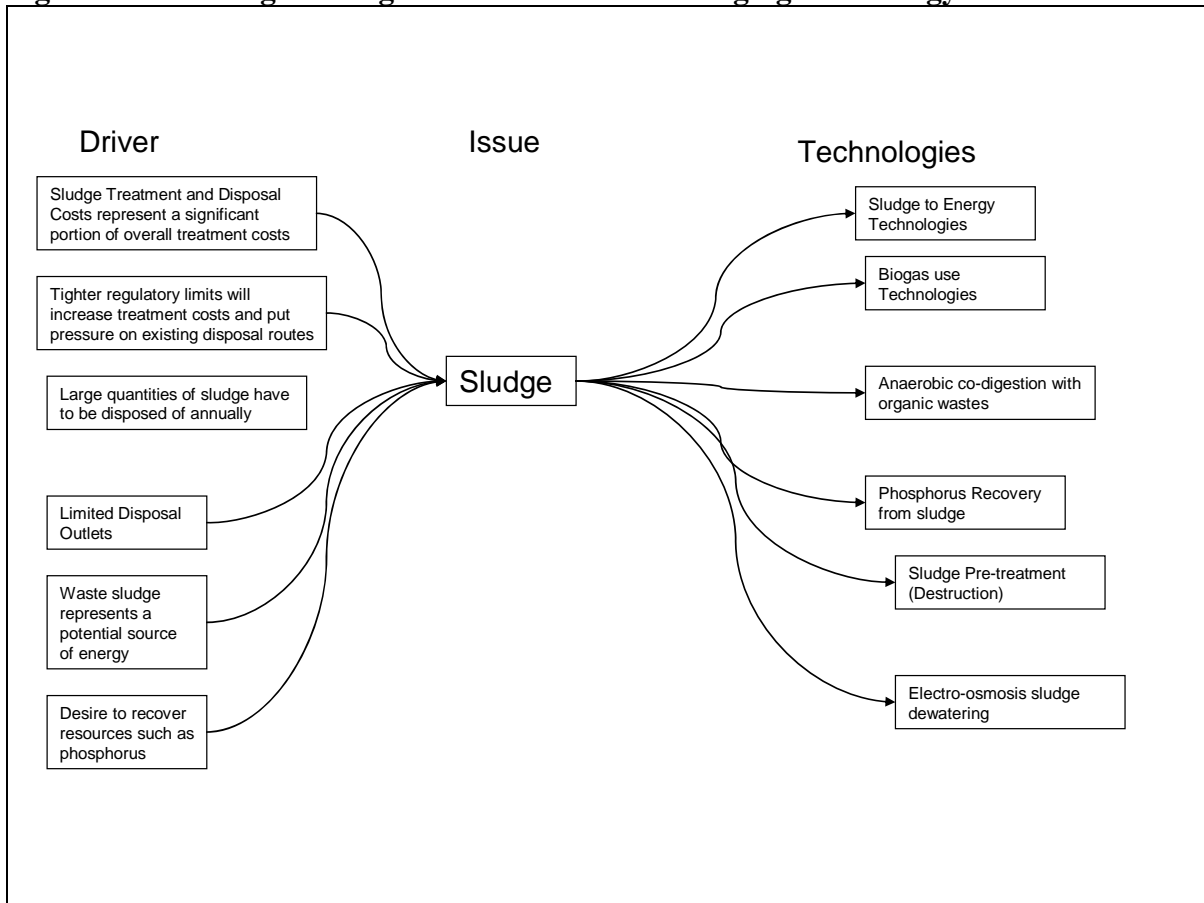
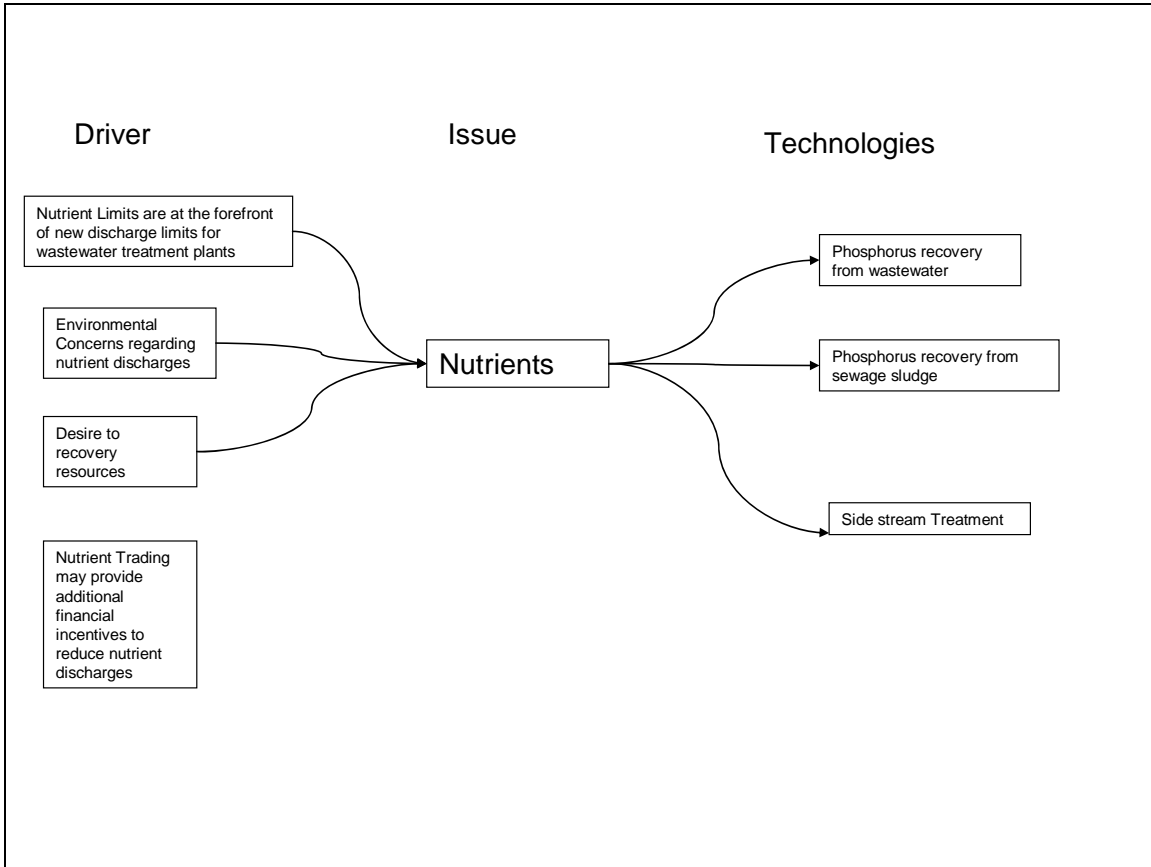


Figure 4 Nutrient Management Drivers and Emerging Technology Opportunities



In the following tables areas of opportunity for water technologies are summarised under their primary driver heading. Individual technologies in each area are discussed in detail within the main document.

Table 2 Energy Management
Generation of energy from wastewater
Technologies associated with the conversion of Biogas to Energy
Sludge to Energy technologies
Waste Heat Recovery Technologies
Lower Energy Alternative Processes
Energy Recovery & Generation in Reverse Osmosis Systems

Table 3 Water Scarcity
Water Re-use
Advanced Oxidation Technologies
Sewer Mining
Source Separation
High Recovery/ Zero Liquid Discharge (ZLD) solutions

Desalination Technologies
Nano Engineered Membranes
Carbon Nanotubes for Desalination
Biomimetic Membranes — Aquaporins
Forward Osmosis Desalination
Deep sea reverse osmosis desalination
Membrane Distillation

Table 4 Sludge Management
Sludge Pre-Treatment / Sludge Destruction Technologies
Anaerobic Co-Digestion of sludge and organic wastes
Electro-Osmosis Sludge Dewatering
Sludge to Energy technologies
Phosphorus Recovery from Sludge

Table 5 Nutrient Removal / Recovery
Side Stream Treatment for nutrient removal
Phosphorus Recovery from Sewage Sludge
Phosphorus & Ammonia Recovery Directly from Wastewater

SUMMARY

Where there is ‘Big Change’, there is ‘Big Opportunity’. The mounting and converging pressures on water resources and on our water management system will be a catalyst for grass roots change in the way we think about and manage water, energy, waste, and resource issues.

To illustrate the requirement for change, Glen T. Daigger, Senior Vice President and Chief Technology Officer of CH2MHill, posed a simple question in a keynote address at WEFTEC 2008:

‘Can a system which was designed for a population of less than 2 Billion, mostly rural dwelling and lacking in modern technology, be the solution for a population which may reach 10 billion, mostly urban and experiencing greater resource constraints’.

To meet the challenges facing the water sector, a smarter, more efficient water system is required. Creating the technologies to make this new, smarter, more efficient water system a reality are where the technology market opportunities lie in the water sector.

For further information please contact:

Paul O’Callaghan

Paul.ocallaghan@o2env.com

CEO, O₂ Environmental Inc.

www.o2env.com

North America: + 1 604 6763581

Europe: + 353 21 240 9133

About the Author:

Paul is CEO of O₂ Environmental Inc., a Director with Ionic Water Technologies, and an industry expert reviewer for both Sustainable Development Canada and the Innovative Clean Energy Fund.

Paul recently completed a cutting edge analysis of BlueTech investment opportunities in the water sector for Global Water Intelligence, “Water Technology Markets – key opportunities and emerging trends”.

Paul has worked with technology start-ups including Ostara Nutrient Recovery Technologies, Microsludge, MicroDynamics UV and Aquacritox to take technologies from proof of concept through to commercialization.

Paul’s comprehensive technical and market expertise gained in both Europe and North America provides a unique international perspective on the emerging technology opportunities.