Import, Improvement, and Export of Technology

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Let’s Begin by Reviewing the Global Water Picture
Globally Agricultural Water Demand is Greatest, and Growing

The grey band represents the difference between the amount of water extracted and that actually consumed. Water may be extracted, used, recycled (or returned to rivers or aquifers) and reused several times over. Consumption is final use of water, after which it can no longer be reused. That extractions have increased at a much faster rate is an indication of how much more intensively we can now exploit water. Only a fraction of water extracted is lost through evaporation.

Water Demand Projections Illustrate Growing Importance of Domestic and Industrial Demands

Maximum Available Water Supply

OECD 2012 - The Environmental Outlook Baseline
Water Use Varies Significantly Across the Planet
Water Stress has been Growing Progressively Across the Planet
Water Issues are Present in the African, Asian, and European Continents Today
But Will Spread Rapidly in the Near Future

3.9 B People Projected to Live Under Severe Water Stress by 2050
Water Availability Does Not Guarantee That the Water is Safe!
USA Illustrates that Efficiency can Satisfy Increased Water Demands

Total freshwater withdrawals in the United States, 2005

- Public supply: 44,200
- Domestic: 128,000
- Irrigation: 143,000
- Livestock: 8,780
- Aquaculture: 17,000
- Industrial: 2,310
- Mining: 

Trends in total water withdrawals and population, 1950-2005

- Total water withdrawals
- Population, in millions

Water withdrawals, in million gallons per day

0 25,000 50,000 75,000 100,000 125,000 150,000 175,000 200,000 225,000
Water Stress is an Issue for More Than the Western US
How Big is the Global Water Market?
Estimated Size of the Global Water Market Depends on What is Counted!

- Municipal
  - Capital
    - Facilities
      - Construction
      - Equipment and Technology
      - Structures, etc.
    - Professional Services
  - Conveyance
    - Construction
      - Pipes
      - Pumps
      - Structures
    - Professional Services
  - O&M
    - Chemicals
    - Energy
    - Labor
    - Other
  - Residential

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    - Chemicals
    - Energy
    - Labor
    - Other
  - Residential
Consider Two Estimates of the Global Market: Global Water Intelligence

Water and wastewater treatment: $177B
Growth rate of 3.9%

65% municipal supply and wastewater treatment.
20% industrial water management.
Consider Two Estimates of the Global Market: Frost & Sullivan

**Global Water Market $425 Billion**
- W & WW Utilities 58%
- W & WW Solutions & Services 42%

**Water & Wastewater Solutions and Services $180 Billion**
- Build & Service $115 Billion 64%
- Design / Consulting 8%
- Build / Infrastructure 21%
- Operation Services 22%
- Maintenance & Monitoring Services 14%

Source: Frost & Sullivan
Developed Countries and China Represent Largest Municipal Water and Wastewater Treatment Markets

GWI, 2014
Let’s Look at Some New Water Technology Development “Hot Spot”
Four Locations will be Highlighted to Contrast with the Tradition North American and European Centers

- Singapore
- Korea
- China
- Israel
Singapore is Building a Global Water Hub

• Built on Successfully Addressing National Water Security:
  • DTSS
  • NeWater
  • Active, Beautiful and Clean (ABC)

• Environment and Water Industry Programme Initiated June, 2006
  • Collaborative Effort of PUB and Economic Development Board (EDB)
  • National Research Foundation R&D Funding of $S 470M
  • Grow Water Sector from $S 0.5B (0.3 % GDP) in 2003 to $S 1.7B (0.6 % GDP) by 2015
  • Double Jobs to 11,000 in 2015

• Singapore International Water Week (SIWW)
Korea is Building a Global Water Business “Under the Radar”

- Four Rivers Restoration Project
- R&D Investments in Excess of $US 500M:
  - RO
  - Smart Grid
  - Reuse
- K-Water Water Resources Management and System Operator
- Doosan is Major Global (Asia, Middle East) EPC Contractor
- Repurposing Manufacturing Capacity to Water Sector:
  - Hyundai
  - Samsung
  - LG
  - Others
- Daegu Water Cluster
China is the “Sleeping Dragon” That is Sleeping No Longer

- Now the Largest Water Market in the World
- Large-Scale Concessionaires Soon Capable of Competing Internationally
- Yixing Industrial Park for Environmental Science & Technology
  - 35,000 Employees
  - 5 Miles Square
- Membrane Companies Abound
  - R&D and Investment Supported by Chinese Government
Having Solved Their Own Water Problems, Israel is Looking to Export Its Expertise and Technology

• With Completion of Fifth Desalination Plant, Israel is Water Secure

• Mekerot
  • National Water Company of Israel
  • Water Supply
    • Surface and Ground Water
    • Desalination
    • Treated Sewage Effluent (TSE) to Agriculture
    • Highest Extent of Reuse in the World

• WaTech
  • Government/Industry Collaboration to Promote “Cleantech” Economic Development, Including Water
  • Booky Orren Global Water Enterprises
Water Clusters Create the “Ecosystem” That Facilitates Technology Development and Commercialization

• Akron (OH) Global Water Alliance
• The BlueTechValley (CA)
• Colorado Water Innovation Cluster
• Confluence Water Technology Innovation Cluster (OH/KY/IN)
• Michigan Water Technology Initiative
• The Water Council (Milwaukee)

• New England Water Innovation Network
• Nevada Center of Excellence in Water
• Pittsburgh Water Economy Network
• Southwest Water Cluster Initiative
• Surge Accelerator (Houston)
• Urban Clean Water Technology Zone (Tacoma, WA)

http://www2.epa.gov/clusters-program
How is Water/Wastewater Treatment Technology Developed?
Adoption of Innovations Follows Classic “S” Curve*

- Innovators
  - Like New Things
  - Fund Research
- Early Adopters
  - Seek Advantage
- Early Majority
  - Copy Leaders
- Late Majority
  - Adopt Out of Necessity
  - Avoid Disadvantage
- Laggards
  - Adopt to Survive

<table>
<thead>
<tr>
<th>Stage</th>
<th>Mechanism</th>
<th>Cost</th>
<th>Market Share</th>
<th>Learning Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Invention</td>
<td>Random Breakthroughs and Basic Research</td>
<td>High</td>
<td>0%</td>
<td>-</td>
</tr>
<tr>
<td>Innovation</td>
<td>Applied Research, Development, and Demonstration (RD&amp;D)</td>
<td>High</td>
<td>0%</td>
<td>-</td>
</tr>
<tr>
<td>Niche Market</td>
<td>Niche Applications; Replace Existing Use; Learning by Doing, Suppliers and Users Close Relationship</td>
<td>High but Declining</td>
<td>0-5%</td>
<td>20-40%</td>
</tr>
<tr>
<td>Pervasive Diffusion</td>
<td>Standardization, Mass Production, Economies of Scale, Network Effects</td>
<td>Rapidly Declining</td>
<td>5-50%</td>
<td>10-30%</td>
</tr>
<tr>
<td>Saturation</td>
<td>Commodity, Intense Competition</td>
<td>Low and Declining</td>
<td>Up to 100%</td>
<td>0-5%</td>
</tr>
<tr>
<td>Senescence</td>
<td>Few Improvements Possible</td>
<td>Low and Declining</td>
<td>Declining</td>
<td>0-5%</td>
</tr>
</tbody>
</table>

Once Introduced, New Technologies Follow Learning Curve*

Technologies Compete While They Evolve*

The Difference Between Sustaining and Disruptive Innovations Must Also be Understood

Functionality

Customers

Performance Gap

Performance

Reliability

Convenience

Price

Undervalued Features

Sustaining Innovation

Disruptive Innovation

Often Coupled with Disruptive Business Model

Source: Christensen, 2000, 2003
Applying to Water Profession, What Are Some Sustaining Innovations?

- Piped Water
- Indoor Plumbing
- Sewers
- Nutrient Recovery
- Potable Reuse
- Sustainability
- Advanced Water Treatment
- Nutrient Removal
- Deep Tunnel Storage
- Sustainability
- Price
- Performance
- Time
- Functionality
- Sustaining Innovation

Customers
Applying to Water Profession, What Are Some Disruptive Innovations?

- Contract Operations
- Design Build
- Alliances
Take Home Messages:

• Water/Wastewater Technology Development More Like in the Housing Sector Than Consumer Electronics

• Municipal Water and Wastewater Treatment Receives Significant Attention Due to its Large Size and Complex Nature

• While No Longer the Largest Water Market, Large Size of US Market Attracts Significant Attention by Technology Developers/Suppliers

• New Entrants are Diversifying the Locus of Water/Wastewater Treatment Technology Development
  • Singapore, Korea, China, Israel

• Europe Will Continue to Develop New Technologies That Will Subsequently be Exported to the US

• But, the “Sleeping Dragon” in China is Awake and Will be (is) Coming to the US
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