



# Cleantech Innovation for Nutrient Recovery

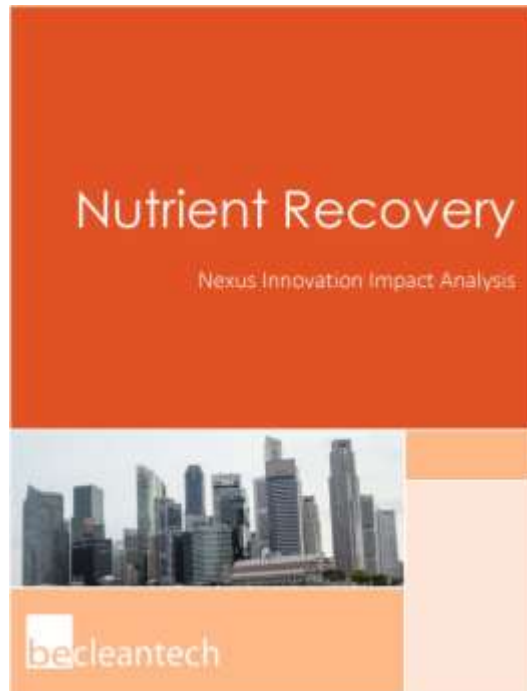
Dynamics within the Nexus | Business Models | Capital Attraction

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# IWA AND CLEANTECH

- BeCleantech Initiative under the auspices of the Specialist Group on Sustainability in the Water Sector



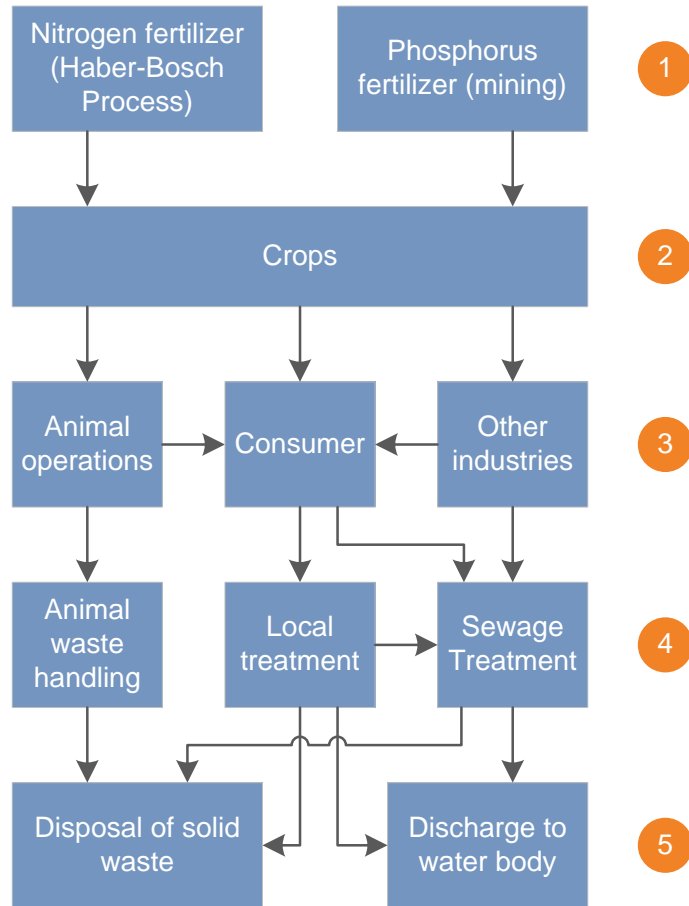
## Nexus Innovation Impact Analysis on Nutrient Recovery Technologies

# IWA AND CLEANTECH

- What is cleantech?

*Economically competitive and socially acceptable technologies and services that use fewer resources (materials and/or energy) while causing less, or even positive, environmental impact.*

# CLEANTECH: NUTRIENT RECOVERY



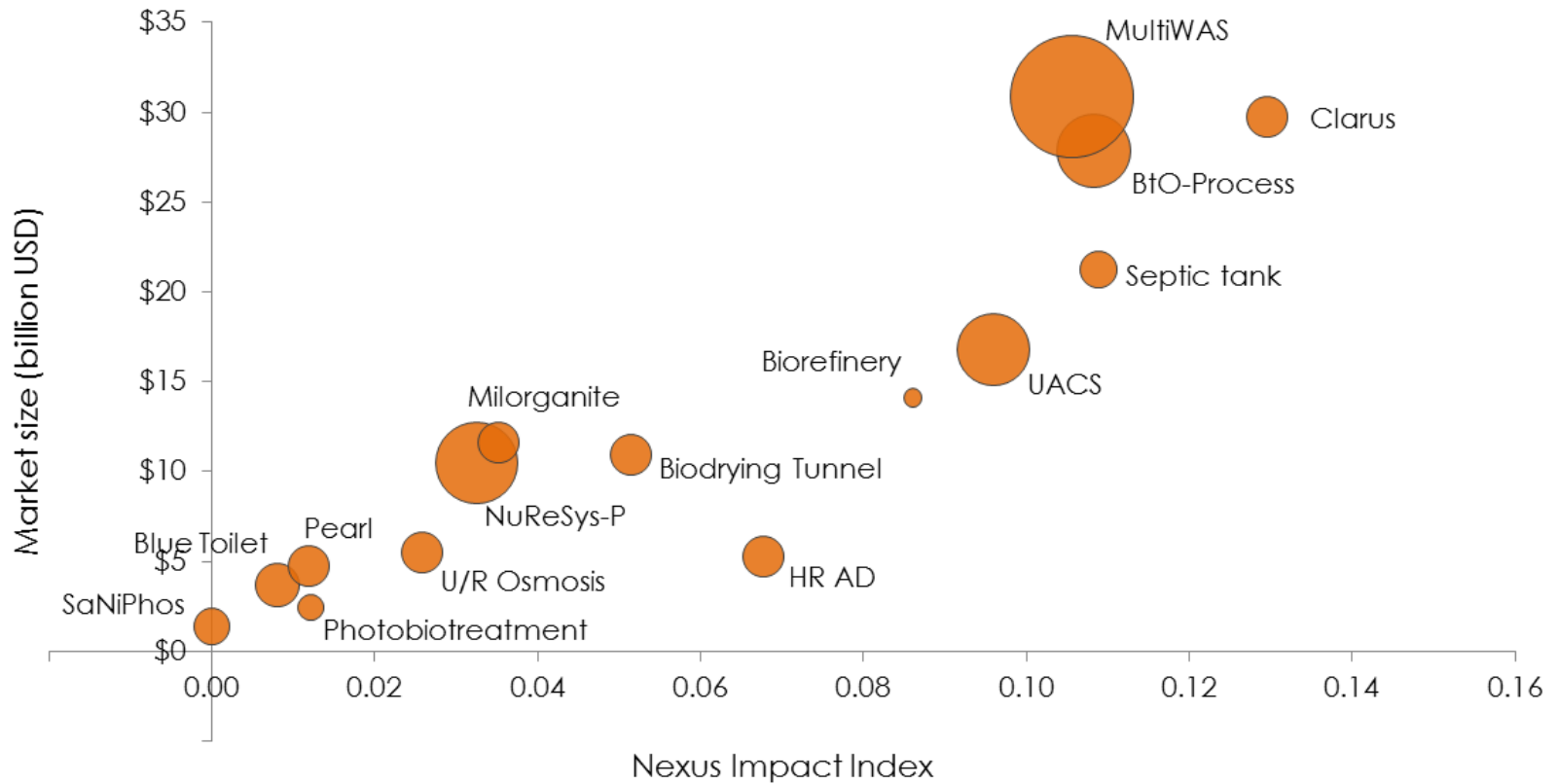
- Fresh animal waste
- Food waste
- Human urine
- Human feces
- Industrial wastewater
- Septic tank effluent
- Septic tank solids
- STP influent
- Activated sewage sludge
- STP internal flows
- Treated animal waste
- Treated sewage sludge
- STP effluent

# CLEANTECH: NUTRIENT RECOVERY

Organization	Technology	Description
<b>Eisenmann</b>	Anaerobic Digestion	Treats organic waste in the absence of oxygen. Technology used primarily for biogas generation but produces liquid and solid streams rich in nutrients.
<b>Eawag</b>	Blue Diversion Toilet.	Toilet station that separates and collects feces and urine for subsequent processing for resource recovery. The used water is treated onsite and recycled.
<b>Ennesys</b>	Urban Algae Culture System	Algae culture and biofuel production using raw wastewater or supernatant flow from municipal sludge digesters.
<b>NuReSys</b>	NuReSys-P	Recovers magnesium ammonium phosphate ( $\text{NH}_4\text{MgPO}_4 \cdot 6\text{H}_2\text{O}$ ) from industrial wastewater (food industry) and supernatant flow from municipal sludge digesters.
<b>Algae Systems</b>	Integrated Biorefinery.	Municipal wastewater treatment using OMEGA algae systems to recover nutrient while producing a biofuel source and soil amendment.
<b>Ostara</b>	Pearl <sup>®</sup> Process	Recovers magnesium ammonium phosphate ( $\text{NH}_4\text{MgPO}_4 \cdot 6\text{H}_2\text{O}$ ) present in the supernatant flow from municipal sludge digesters.
<b>GMB Int'l</b>	GMB Biodrying Tunnel	Dewatered waste activated sludge is thermally treated so that it can be used as a fuel for energy generation. The ammonia generated during the bio-drying process is captured as ammonium sulfate fertilizer.
<b>Universidad de Cádiz</b>	Photobiotreatment	Treatment of wastewater using algae for biofuel production. This could be an alternative for tertiary treatment.



# CLEANTECH: NEXUS IMPACT



# CAPITAL ATTRACTION: TREND

	Visualization: mapping	Internet	Ostara	BlueToilet
Funding	Initial : government  Later: private funds	Initial : government  Later: private funds	Initial: government  Now: private funds	Initial: government  Now: the Bill & Melinda Gates Foundation
Lead time	15-20 years	15-20 years	10 years ...	5-10 years ...
Impact	Initial: business, research, and government  Now: personal use	Initial: connect research centers  Now: commercial and personal use	nutrients from sludge liquids from municipal STP	Decentralized sanitation in places where there is not sanitation
Entrepreneurs	Academia developed early GIS platforms. Later spun off as a private enterprise (e.g. ArcGIS).	University consortium in the US, but later joined by IBM and Verizon	University and later spun off as Ostara	Research institute



# CAPITAL ATTRACTION: GOVERNMENT

## Discoveries funded by NSF under the Research Area of Biology

Year	Discovery title	Funds
2004	RNA Lariat May Tie Up Loose Ends to Decades-Old Mystery of Retrovirus Life Cycle	\$600K
2004	Scientists Use Seals as "Underwater Eyes"	\$260K
2004	Geomagnetic Landmarks Give Turtles Sense of Where They Are	\$145K
2004	Spider Venom Could Yield Eco-Friendly Insecticides	\$300K
2014	Strawberries with a thirst	\$1MM
2014	Converting biomass to fuels	\$52MM
2014	Is white--or green--the new black in cities?	\$1.5MM
2014	How much fertilizer is too much for Earth's climate?	\$4MM

# CAPITAL ATTRACTION: CLEANTECH ROLE

**Clean-Tech Venture Capital Investments in U.S.-Based Companies as Percent of Total 2001-2011**

Year	Total Venture Investments (\$Millions)	Clean-Tech Venture Investments (\$Millions)	Clean-Tech Percentage of Venture Total
2001	\$37,624	\$458	1.2%
2002	\$20,850	\$660	3.2%
2003	\$18,614	\$713	3.8%
2004	\$22,355	\$844	3.8%
2005	\$22,946	\$1,337	5.8%
2006	\$26,594	\$2,814	10.6%
2007	\$30,826	\$3,909	12.7%
2008	\$30,546	\$6,861	22.5%
2009	\$19,746	\$3,814	19.3%
2010	\$23,263	\$5,062	21.8%
2011	\$28,425	\$6,576	23.1%

*Source: Cleantech Group and PricewaterhouseCoopers/NVCA data with Clean Edge analysis, 2012. Clean-tech venture investment includes seed funding and follow-on rounds prior to private equity activity related to stake acquisitions or buyouts. Investment categories include agriculture, air & environment, energy efficiency, energy storage, materials, recycling & waste, smart grid, solar, transportation, water & wastewater, and wind.*

# CAPITAL ATTRACTION: SOURCES

<b>Stage of Venture</b>	<b>R&amp;D</b>	<b>Seed</b>	<b>Launch</b>	<b>High Growth</b>
Company Enterprise Value at Stage	Less than \$1 million	\$1 million–\$5 million	More than \$1 million–\$50 million-plus	More than \$100 million
Sources	Founders High net worth individuals FFF SBIR	FFF* Angel funds Seed funds SBIR	Venture capital series A, B, C . . . Strategic partners Very high net worth individuals Private equity	IPOs Strategic acquires Private equity
Amount of Capital Invested	Less than \$50,000–\$200,000	\$10,000–\$500,000	\$500,000–\$20 million	\$10 million–\$50 million-plus
% Company Owned at IPO	10–25%	5–15%	40–60% by prior investors	15–25% by public
Share Price and Number <sup>†</sup>	\$.01–\$.50 1–5 million	\$.50–\$1.00 1–3 million	\$1.00–\$8.00 +/- 5–10 million	\$12–\$18 + 3–5 million

# CAPITAL ATTRACTION

*A startup is "a company that is confused about what its product is, who its customers are, and how to make money"*

- Innovative technology with market vision
- Technically feasible and scalable
- Realistic cost and revenue projections
- Protection of intellectual property well-protected
- Fit in current infrastructure
- Competitors, synergies, and antagonisms

**Clear value proposition**

# BUSINESS MODEL: OSTARA

- Before 2005, research at the University of British Columbia was funded by the National Research Council in Canada
- 2005, Ostara Nutrient Recovery Technologies Inc. secured a customer in Alberta (global market estimated at least \$1 billion).
- 2008, Ostara completed a US \$10.5 million private equity financing (VantagePoint Venture Partners and Foursome Investments Limited)
- 2012, achieved a US \$14.5 million private equity financing (VantagePoint Capital Partners, Frog Capital, Waste Resources Fund L.P., and FourWinds Capital Management)
- 2013, secured \$13 million (USD) in equity financing (Wheatsheaf Investments, VantagePoint Capital Partners, Frog Capital)

# BUSINESS MODEL: OSTARA

- Capital-based model: Utility covers Capex and Opex.
  - Return of capital in ~5 years (calculated from increased plant capacity, reduced operating and maintenance costs, and revenue from the sale of the fertilizer): Ostara builds facility and markets fertilizer.
- Fee-based model: Ostara covers Capex and Opex (some).
  - Utility pays a fee over 10-15 years (calculated from a share of the wastewater plant's operating and maintenance cost savings). Revenue of fertilizer is shared. Utility's share is used to cover reactor's Opex.

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