becleantech

Cleantech Innovation for Nutrient Recovery

Dynamics within the Nexus | Business Models | Capital Attraction

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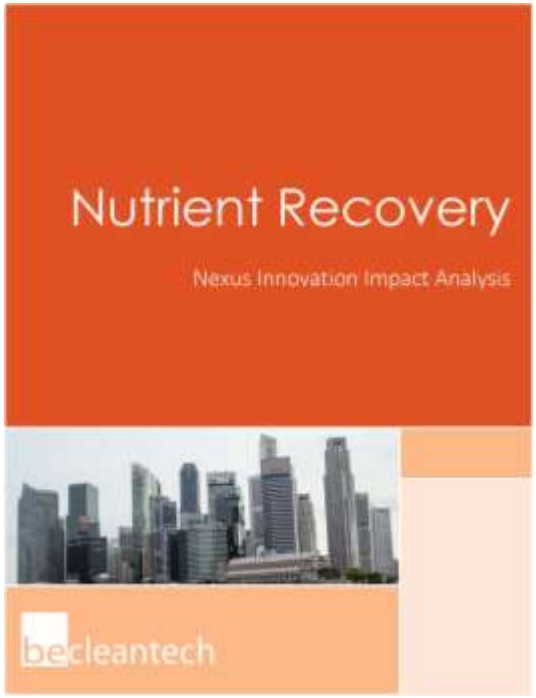
IWA AND CLEANTECH

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



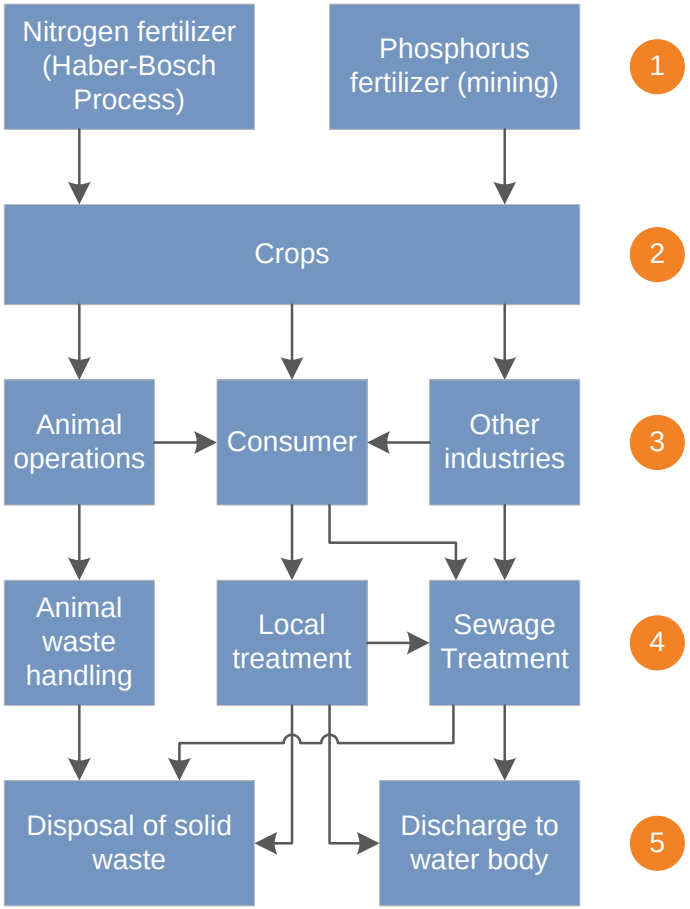
Nexus Innovation Impact Analysis on Nutrient Recovery Technologies

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

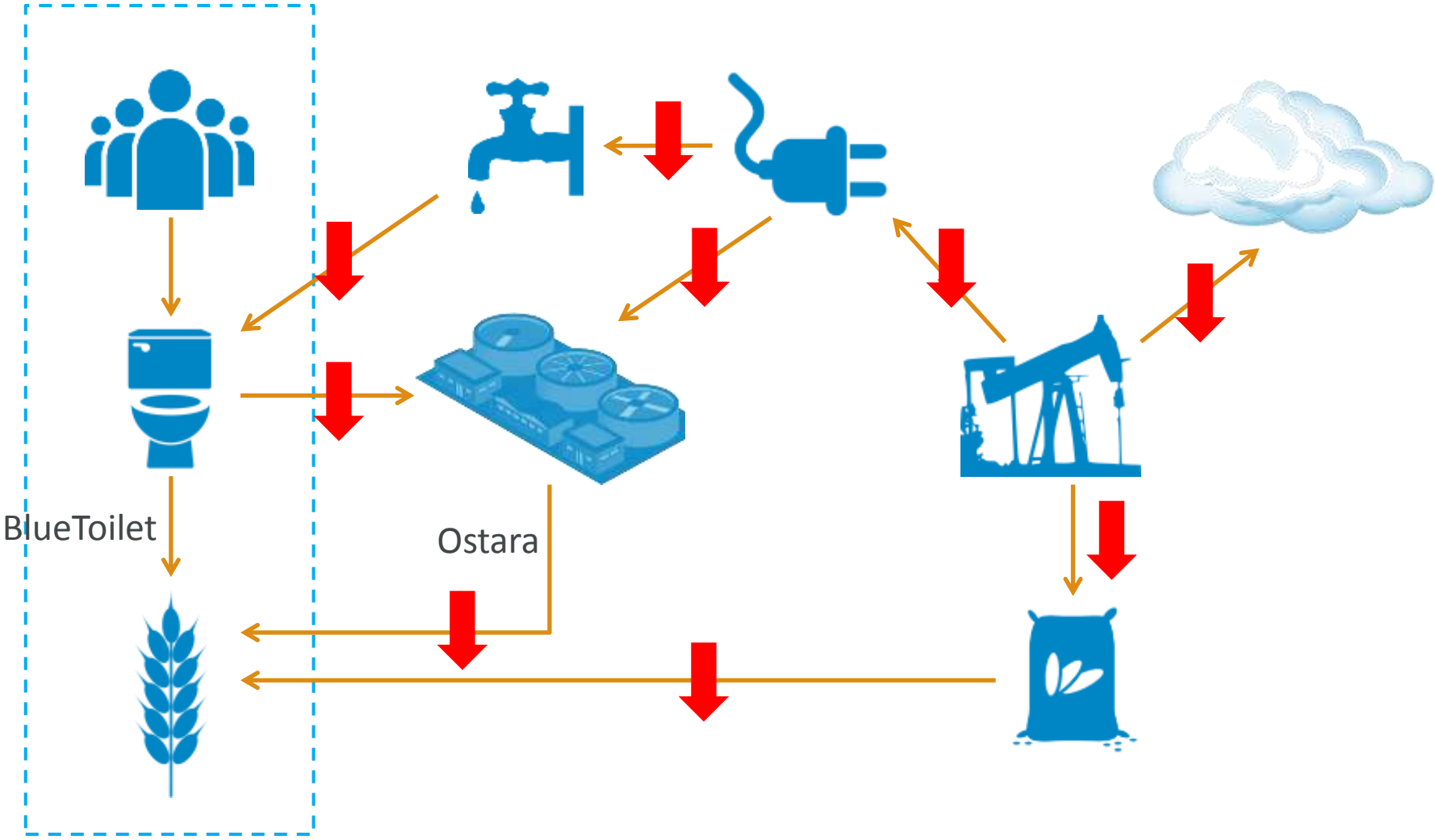


- Fresh animal waste
- Food waste
- Human urine
- Human feces
- Industrial wastewater
- Septic tank effluent
- Septic tank solids
- STP influent
- Activated sewage sludge
- STP internal flows
- Treated animal waste
- Treated sewage sludge
- STP effluent

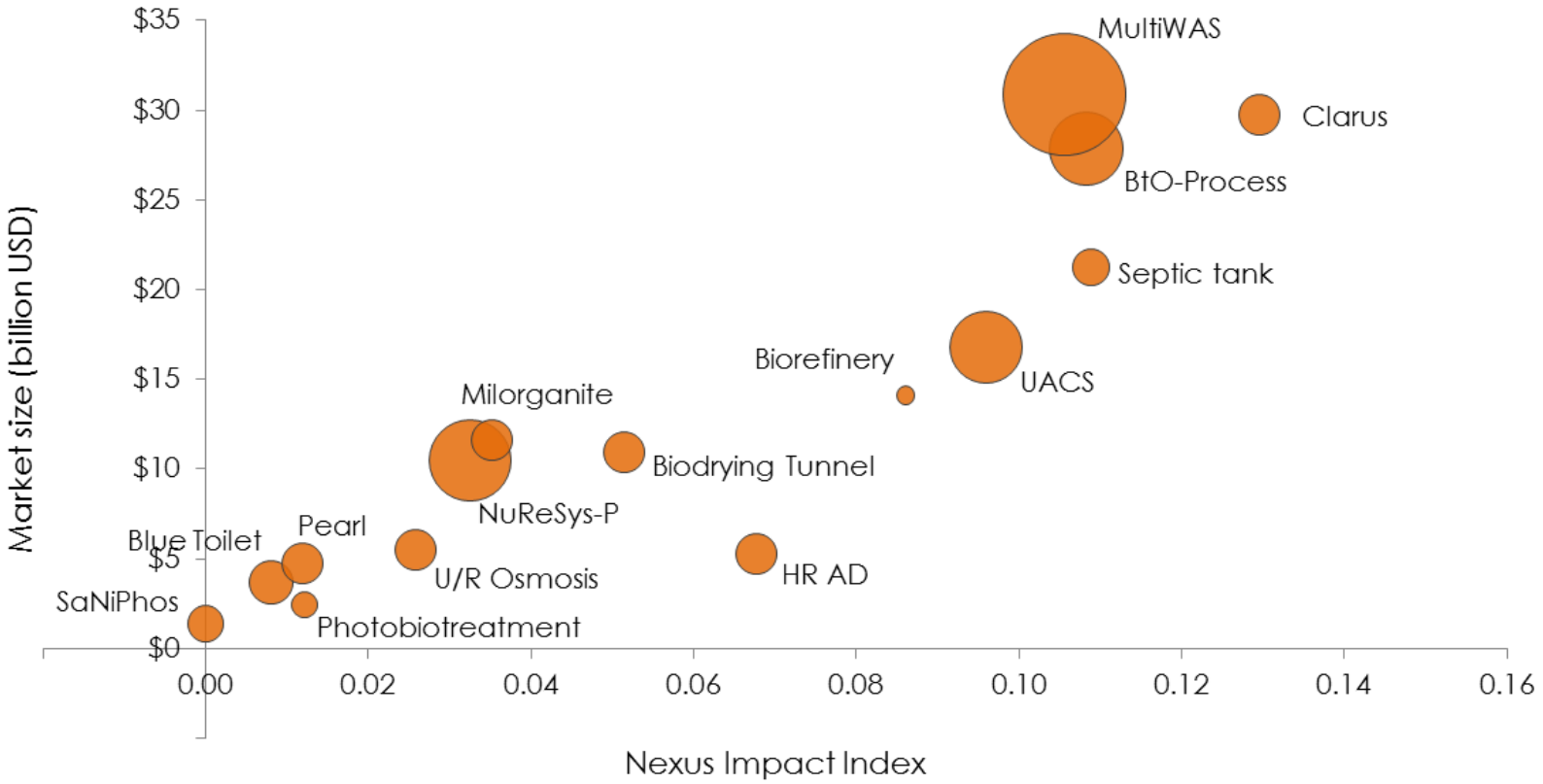
CLEANTECH: NUTRIENT RECOVERY

Organization	Technology	Description
Eisenmann	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.
Eawag	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.
Ennesys	Urban Algae Culture System	Algae culture and biofuel production using raw wastewater or supernatant flow from municipal sludge digesters.
NuReSys	NuReSys-P	Recovers magnesium ammonium phosphate ($NH_4MgPO_4 \cdot 6H_2O$) from industrial wastewater (food industry) and supernatant flow from municipal sludge digesters.
Algae Systems	Integrated Biorefinery.	Municipal wastewater treatment using OMEGA algae systems to recover nutrient while producing a biofuel source and soil amendment.
Ostara	Pearl® Process	Recovers magnesium ammonium phosphate ($NH_4MgPO_4 \cdot 6H_2O$) present in the supernatant flow from municipal sludge digesters.
GMB Int'l	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.
Universidad de Cádiz	Photobiotreatment	Treatment of wastewater using algae for biofuel production. This could be an alternative for tertiary treatment.

CLEANTECH: SYNERGIES AND ANTAGONISMS



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

Stage of Venture	R&D	Seed	Launch	High Growth
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†	$.01–$.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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CFGnet
Cities as forces for good network

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