

Pure Business: Filter Markets to Watch

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Significant Filtration Industry Trends

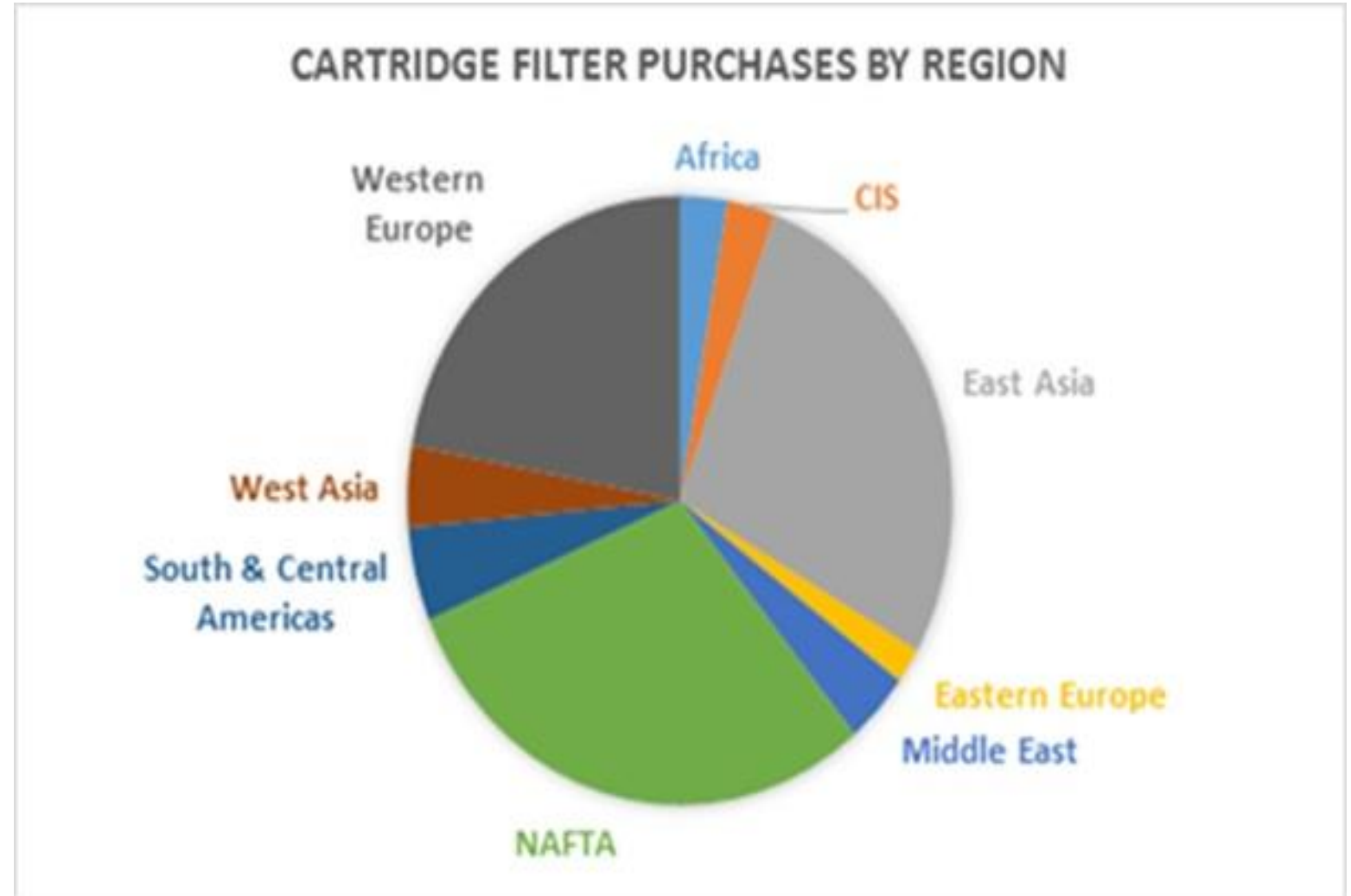
- Information overload: the amount of relevant filtration information being generated doubles every several years while our systems to efficiently use this information are improving at a snail's pace.
- Growing use of filters to remove gases as well as particles: carbon combined with nonwoven media for odor control was the original use of media for gas capture. Direct sorbent injection with catalytic filtration for SO₂, NO_x, HCl, and mercury will be a multi billion dollar per year market.
- Accelerating demand for high efficiency filter media: the switch from medium efficiency filters to high efficiency filters for gas turbine intakes could double this market segment.
- Larger and fewer end user customers: chemical, food, oil and gas, and power providers are expanding with both domestic and offshore acquisitions.
- Larger and fewer OEM customers: mergers of filtration companies are creating larger OEM customers but also larger competitors e.g. GE is buying Baker Hughes.
- Continual market shift to Asia.
- Trend toward global sourcing and the ability to conduct thorough cost of ownership studies: e.g. Arcelor Mittal

2017 Liquid Cartridge Market

Sales of cartridges to industrial, commercial and residential customers not including mobile sources will exceed \$17 billion next year. This is the latest forecast in *Cartridge Filter World Market*. NAFTA will be the leading regional purchaser followed by East Asia.

Ranking by Cartridge Type

1. Carbon
2. Nonwoven
3. Membrane
4. String wound
5. metal



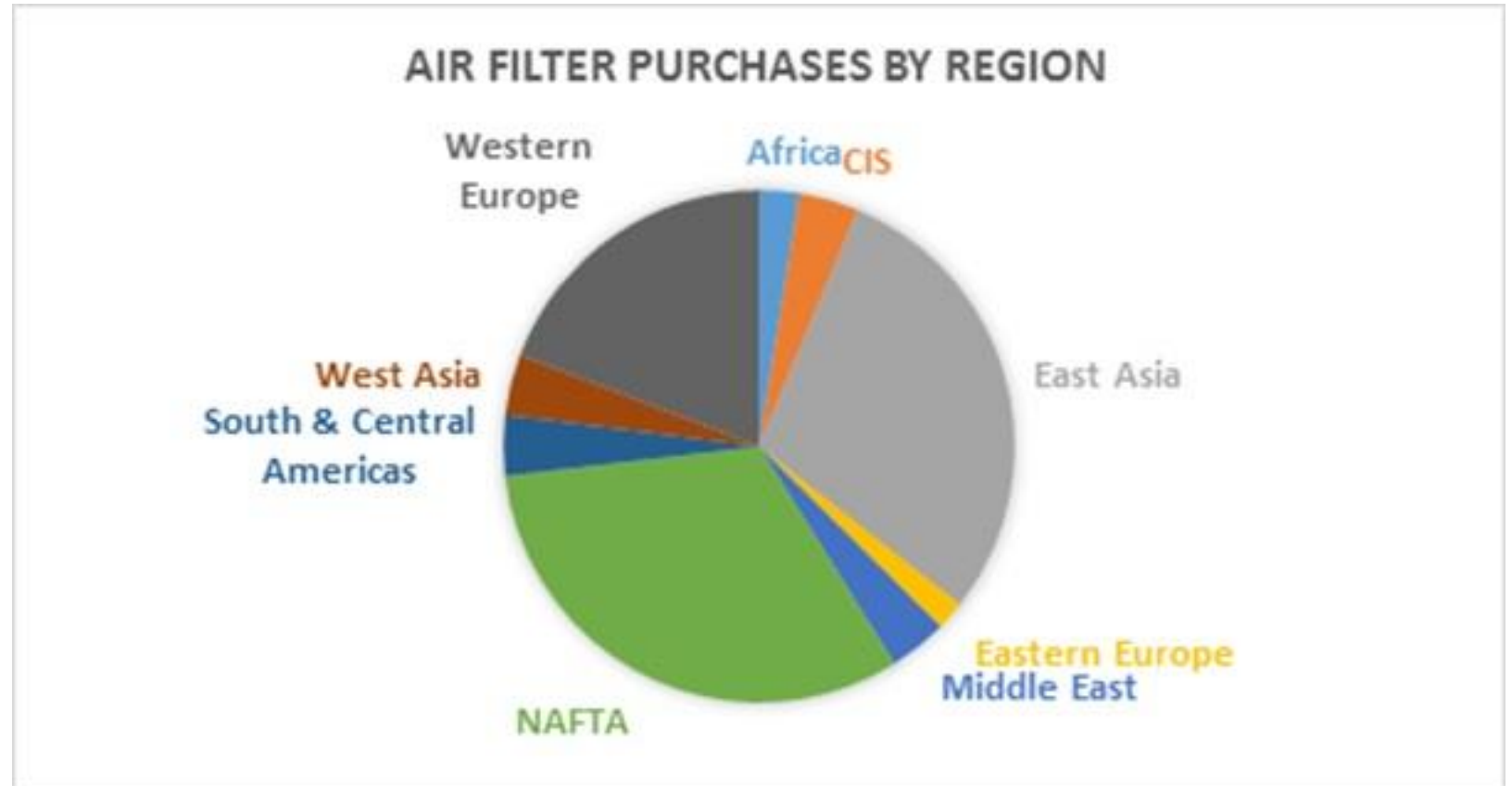
World Market for Air Filters Will Reach \$7.6 billion Next Year

Ranking by media type

1. Medium efficiency (F5-9)
2. Low efficiency (G1-4)
3. High efficiency (H10-17)
4. Gas phase
5. Metal

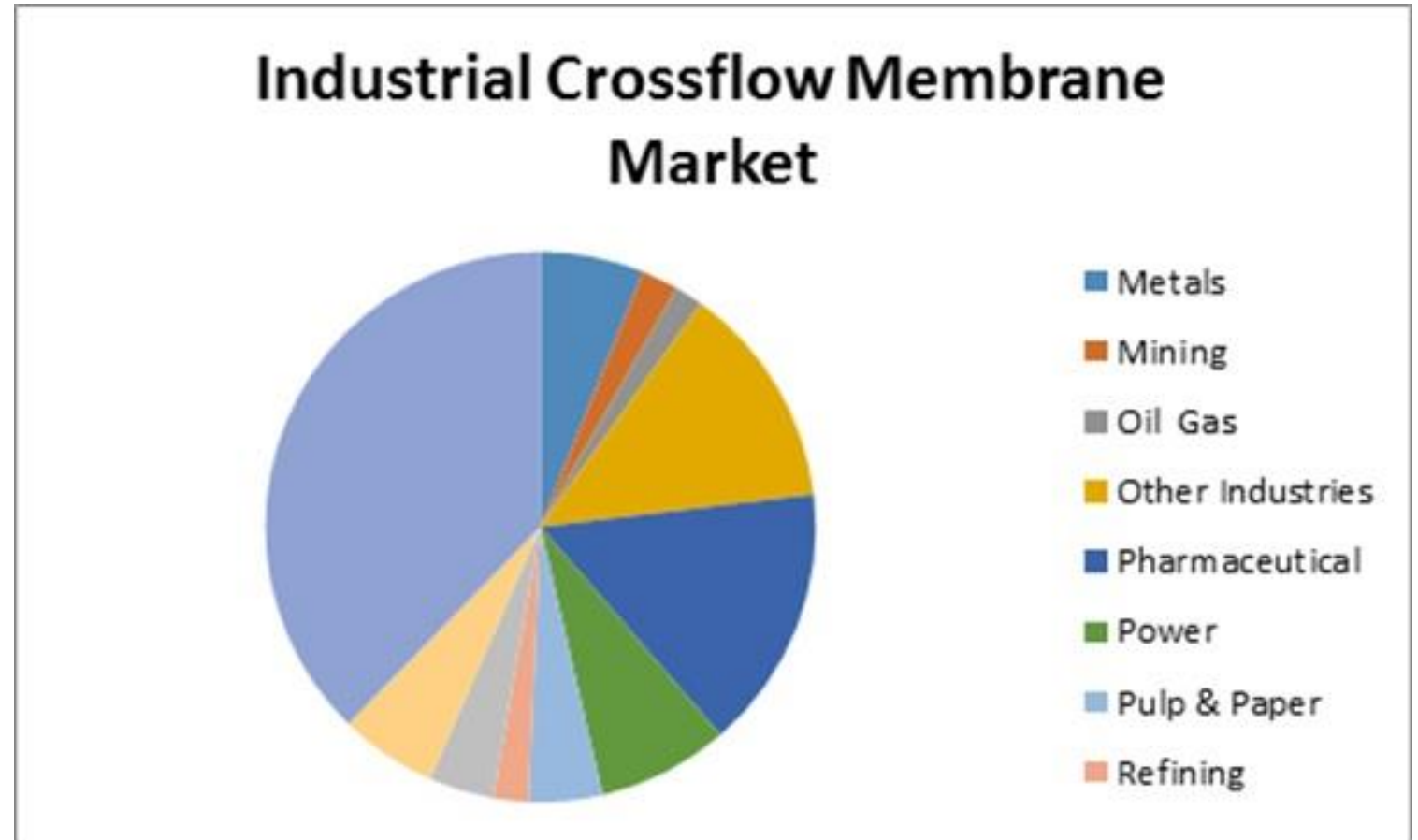
Ranking by use

1. Commercial
2. Residential
3. Industrial HVAC
4. Electronics
5. Power (turbine inlet)



Cross Flow Membrane Market to Exceed \$10 billion in 2017

Industrial facilities will spend over \$10 billion in 2017 for reverse osmosis (RO), nanofiltration, ultrafiltration and microfiltration. This includes the equipment and the replacement membranes. This does not include the residential or commercial market for the small filters.



Indoor Agriculture is a Big Growth Market for Filtration

- The world is growing greener due to increased CO₂ in the atmosphere.
- Greenhouses increase CO₂ in the air by 50% to 600 ppm. This results in 40% faster plant growth.
- The CO₂ from engines which provide power, heat, light, and CO₂ has to be very clean.
- Indoor agriculture requires filtered water.
- More than 10% of capital investment in the agriculture sector is devoted to indoor agriculture.
- If the Empire State building were converted to indoor agriculture it could grow more wheat than is consumed in Manhattan.
- Plant waste can be gasified and used in the power generators to improve the economics.
- Aquaculture with RAS (recirculating aquaculture systems) is indoor fish farming. It is also growing rapidly and requires purification of the recirculating water and removal of the waste.

SCR for NO_x Reduction in the CO₂ Exhaust for Tomatoes or Marijuana

The Currant Creek plant of BHE delivers clean CO₂, power and heat to a tomato processor located on the site. High efficiency catalytic reduction is needed to remove NO_x.



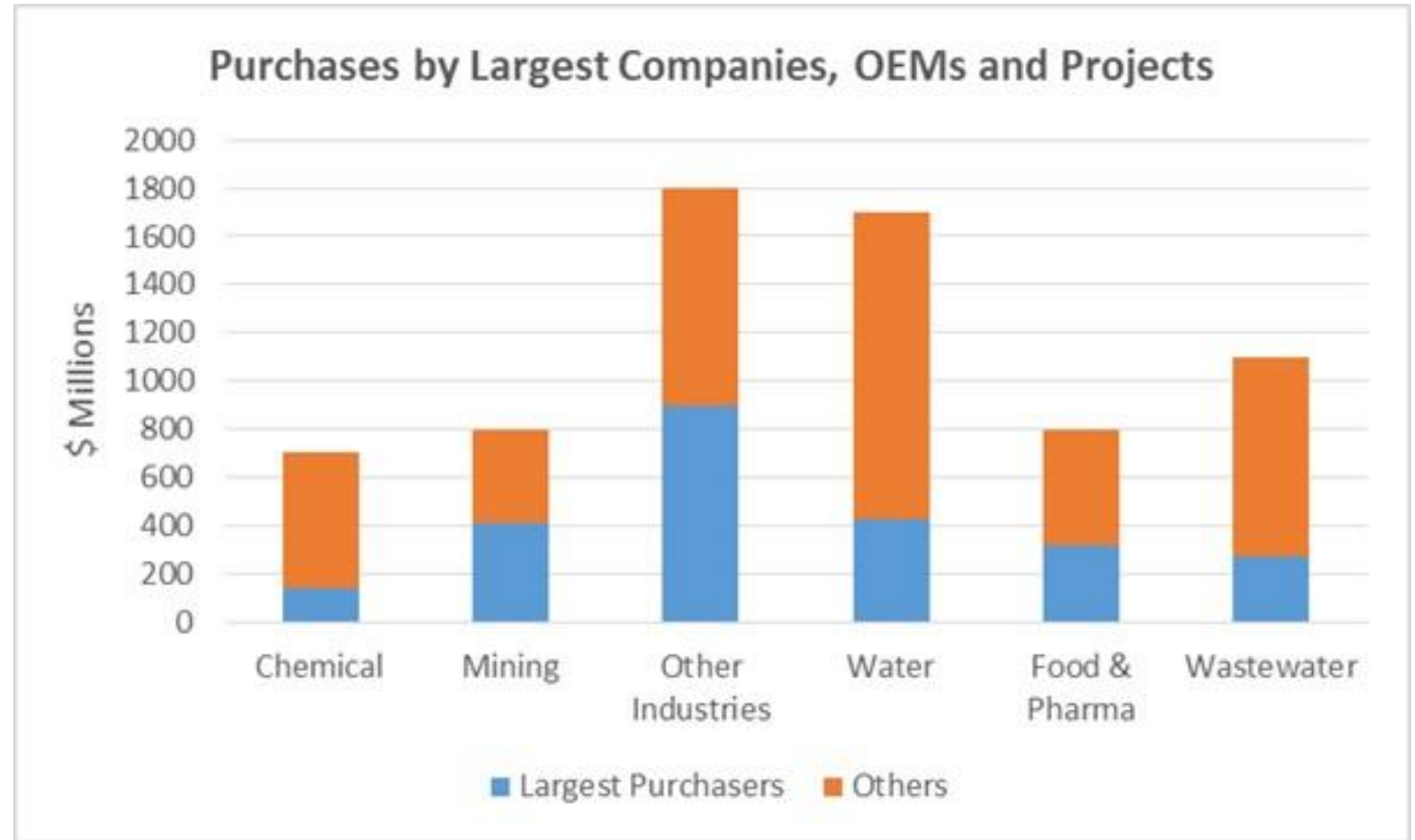
The closet marijuana grower can use a canister of CO₂ from Praxair, but a large grower can efficiently use power plant CO₂



36 Percent of Liquid Macrofiltration Equipment Purchased by 448 Companies

Sales of liquid macrofiltration equipment will be \$7 billion in 2017.

Suppliers who focus on 448 purchasers, engineering firms and large projects will be addressing 36 percent of the total potential.



Organizing Filtration Efforts around Large Purchasers

- With the trend toward global sourcing and total cost of ownership analysis it will be advantageous to structure sales around the large purchasers.
- This is more difficult for media suppliers but equally important.
- Media suppliers can be endorsed by the end user and then use that leverage with the suppliers.
- McIlvaine has created a program for Berkshire Hathaway Energy and its suppliers with the goal of better filtration decisions.
- Berkshire Hathaway generates 7% of the power in the U.S. and moves, stores and compresses 7% of the U.S. natural gas.



Berkshire Hathaway Energy Annual Purchases of Liquid/Solid Separation Equipment Totaling \$146 million

Application	U.S. Total Liquid/Solid & Water Treatment \$ Millions	Direct BHE Market \$ Million
7% of the U.S. gas transmission, and storage with 71 compressor stations and more in planning (cooling and lubrication as well as dehydration).	90	7
41 coal-fired units with environmental upgrades and retirements including upgrades to meet CCR and ELG regulations.	1500	105
125 gas turbines and more in planning with inlet water, cooling, steam generation and wastewater.	400	28
190 wind turbines including those providing electricity to BHE. More than 3000 MW of additional turbines in planning (lubrication and hydraulic filtration).	15	1
111 geothermal plants in served states.	70	2
21 hydro plants with environmental upgrades and expansion into Philippines.	30	0
45 biomass plants in served states.	30	1
40 methane fueled generators at landfill and other sources in served states.	20	0
111 solar plants in served states and more being planned by BHE Renewables as IPP.	2	0
Energy recovery at compressor stations and Currant Creek (tomato production) with more planned	40	2
Total		146

Berkshire Hathaway Energy Annual Purchases of Air Filtration and Air Pollution Control Products Totaling \$184 million

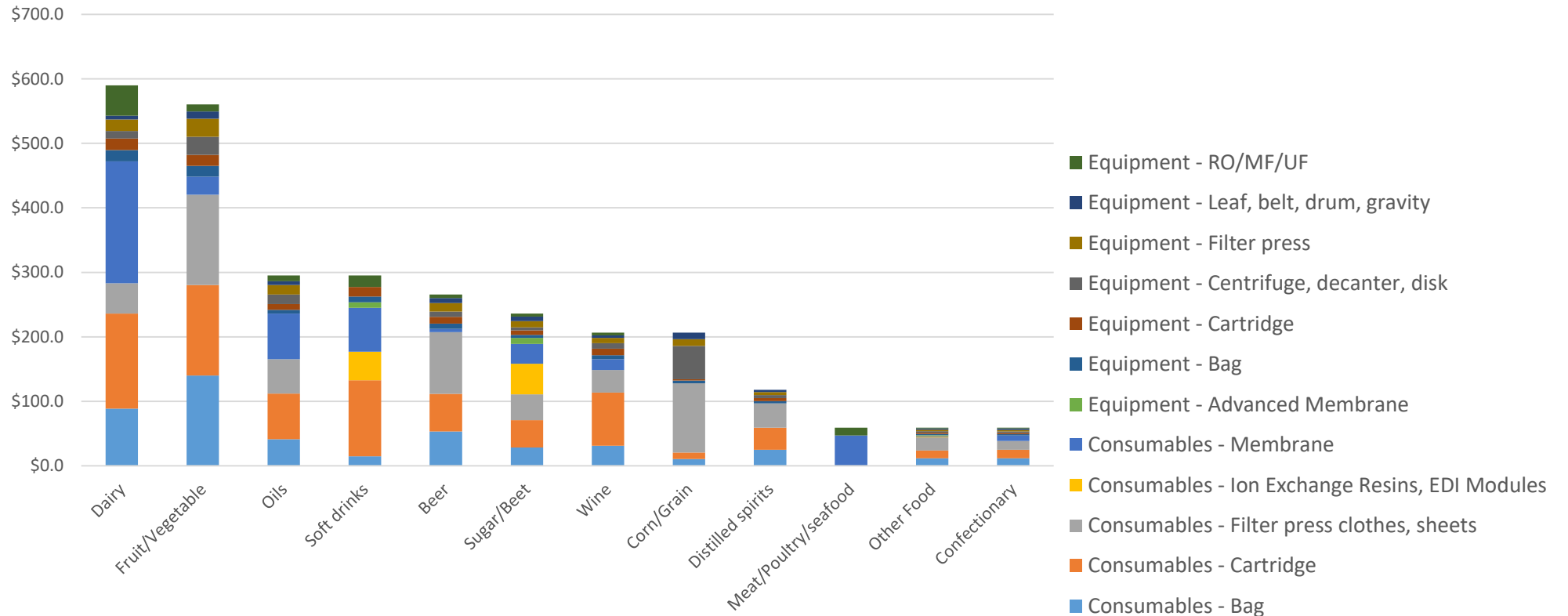
Application	U.S. Total \$ Million	Direct BHE Market \$ Million
7% of the U.S. gas transmission and storage with 71 compressor stations and more in planning with intake filters and emission control on engines and turbines.	100	9
41 coal-fired units with environmental upgrades and retirements including a \$700 million NO _x control program and purchases of urea, lime, limestone, etc.	2,000	140
125 gas turbines and more in planning with inlet filters and emission control.	400	28
190 wind turbines including those providing electricity to BHE. More than 3000 MW of additional turbines in planning (ambient air filters).	20	2
111 geothermal plants in served states- H ₂ S removal.	70	3
21 hydro plants with environmental upgrades and expansion into Philippines-pump driver filters.	10	0
45 biomass plants in served states.	40	1
40 methane fueled generators at land fill and other sources in served states.	20	0
111 solar plants in served states and more being planned by BHE Renewables as IPP.	2	0
Energy recovery at compressor stations and Currant Creek (tomato production) with more planned.	30	1
Total		184

Large Food Producers spend billions of dollars per Year for Filtration

- Starting with the washing of raw produce to the finished product the food industry relies on filtration and separation to create and protect its products.
- There are many different processes depending on whether the end product is beer or cheese.
- It is important that filtration suppliers understand the processes where their product is being used.
- This is more challenging in the food industry because of the many different processes.
- The industry can be segmented into 12 major product groups and then by filtration use within that group.

Segmentation of Filtration Revenue by Type, within Industry, \$ mil

2014 Filtration Revenue Segmentation by Food Industry, \$Mil



ConAgra is a Major Filtration Purchaser

- ConAgra Foods, Inc. is one of North America's largest packaged food companies with branded and private branded food found in 99 percent of America's households, as well as a strong commercial foods business serving restaurants and foodservice operations globally.
- Consumers can find recognized brands such as Banquet[®], Chef Boyardee[®], Egg Beaters[®], Healthy Choice[®], Hebrew National[®], Hunt's[®], Marie Callender's[®], Orville Redenbacher's[®], PAM[®], Peter Pan[®], Reddi-wip[®], Slim Jim[®], Snack Pack[®], and many other ConAgra Foods brands, along with food sold by ConAgra Foods under private brand labels, in grocery, convenience, mass merchandise, club, and drug stores.
- Additionally, ConAgra Foods supplies frozen potato and sweet potato products, as well as other vegetable, spice, bakery, and grain products, to restaurants, commercial, and foodservice customers.

Useful Filtration Information about ConAgra

- There are air and water permits renewed at each plant on a five year basis.
- The air permit lists each dust collector in the plant and often has details on the filter design and flow.
- ConAgra also operates the municipal wastewater treatment plants in small towns where it is the major generator of wastewater.
- These combined industrial-municipal plants generate more publicly available information than does a solely private establishment.
- Expansions require 1000s of pages of information related to the equipment to be installed.
- Most ConAgra decision makers have created detailed profiles on LinkedIn.
- This availability of information about the companies can be incorporated into programs for effective marketing at the corporate level.

ConAgra Food Plants in the U.S

[CONAGRA BEEF COMPANY](#)

[CONAGRA DAIRY FOODS](#)

[CONAGRA DAIRY FOODS COMPANY](#)

[CONAGRA FLOUR MILLING CO](#)

[CONAGRA FLOUR MILLING COMPANY](#)

[CONAGRA FLOUR MILLING-ALTON](#)

[CONAGRA FLOUR MILLING-CHESTER](#)

[CONAGRA FOODS](#)

[CONAGRA FOODS - HAM UNIT](#)

[CONAGRA FROZEN FOODS](#)

[CONAGRA FROZEN FOODS, INC](#)

[CONAGRA GROCERY PRODUCTS, CO.](#)

[CONAGRA INTERNATIONAL](#)

[CONAGRA POULTRY - FARMERVILLE](#)

[CONAGRA POULTRY CO MAYFIELD FE](#)

[CONAGRA POULTRY CO MAYFIELD PR](#)

[CONAGRA POULTRY CO.](#)

[CONAGRA POULTRY CO.-NATCHITOCH](#)

[CONAGRA POULTRY COMPANY](#)

[CONAGRA SIGNATURE MEATS GROUP](#)

[CONAGRA TURKEY](#)

[CONAGRA-GILCREST](#)

[CONAGRA-KUNER](#)

[DIXIE STORAGE/CONAGRA](#)



ConAgra Milton using Westfalia Centrifuge, Ashbrook Belt Filter Press and Cummins Engines

- New 2.4 MGD Anaerobic Treatment Process (ADI Systems, Inc.)
- New 5 MGD Headworks Facility (IPEC fine screens, Hydro International grit removal)
- Enhanced 0.25 MGD Trucked-In Waste Facilities (Lakeside)
- New 4.25 MGD Verticel Biological Nutrient Removal Facilities (Evoqua)
- New UV Disinfection Facilities (ENAQUA)
- New Odor Control Systems (Evoqua)
- New Direct Heat Sludge Drying (Andritz)
- New 2 MW Cogeneration Equipment (Cummins)
- Secondary Clarification (Evoqua)
- Sludge Thickening and Aerobic Digestion Facilities
- Dewatering Equipment (Westfalia centrifuge, Ashbrook belt filter press)

Summary

- There are important trends such as greater filtration efficiency and the development of indoor agriculture.
- The market is changing due to mergers and the growing markets in developing countries.
- There is the opportunity to structure marketing campaigns around corporations as opposed to specific plants.
- The 500 largest filtration purchasers around the world account for more than 50% of the sales.
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