IUVA Vision:

…to advance the science, engineering and applications of ultraviolet technologies to enhance the quality of human life and to protect the environment.

- A not-for-profit, educational association
- ~500 members; 27 countries represented
- Members: leading utilities, regulators, academicians, consulting engineers, manufacturers, end users
- Traditional focus on water--new task groups to address health care; food & beverage safety
- Publish quarterly journal; sponsor annual conferences
- Celebrating 20th Anniversary
- http://iuva.org/

INTERNATIONAL IUVA ULTRAVIOLET ASSOCIATION


INTERNATIONAL
IUVA
ULTRAVIOLET ASSOCIATION
2020 AMERICAS CONFERENCE
March 8-11, 2020
Disney Coronado Springs
Orlando, Florida USA
Conference & Exhibition with the Latest In:
• UV Applications in Drinking Water
• UV Validation Methods
• UV in Food, Air and Medicine
• UV Industry Equipment Showcase
• UV LEDs
• UV in Public Health
• UV Technology Advances
• UV-AOP
• Food Safety Panel
• Municipal Application Workshop
• IUVA Young Professionals AMA
www.IUVA.org

UV Technology
143 Years and Counting

Oliver Lawal

14th January 2020

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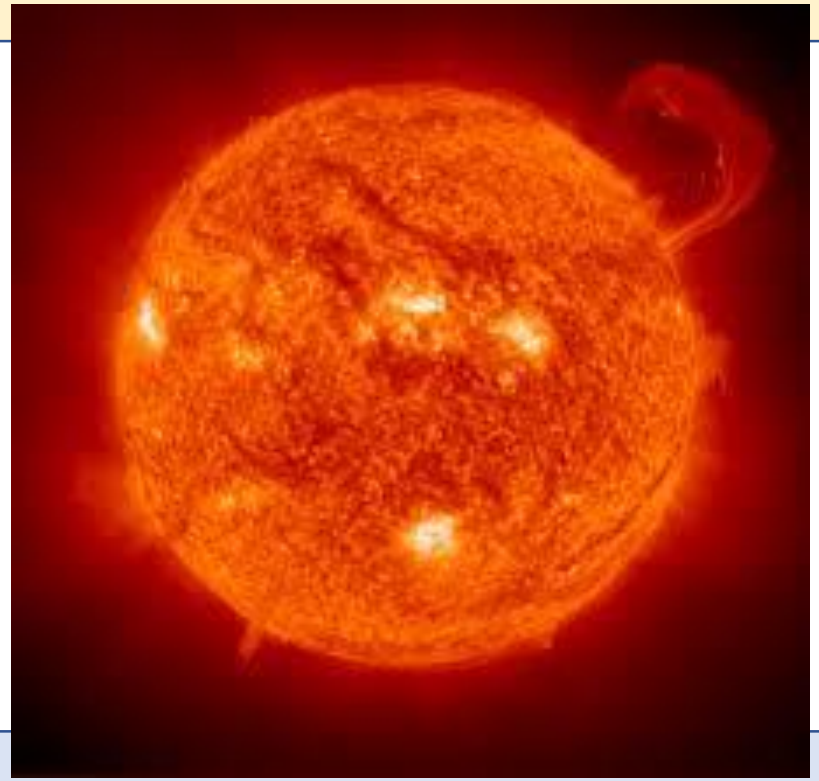
A new technology came into being….



……around 4.5 billion years ago

Technology

Then not much progress recorded for the next few billion years!

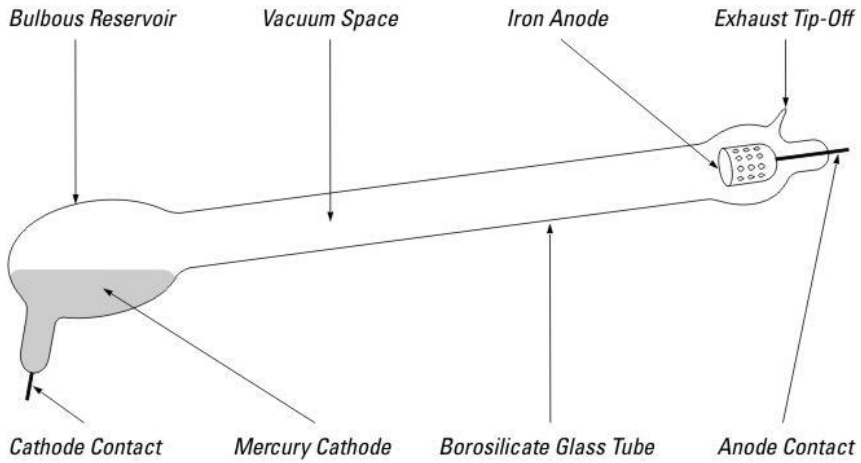
Science and Regulation

Blunt & Downes prove the bactericidal action of light

1877

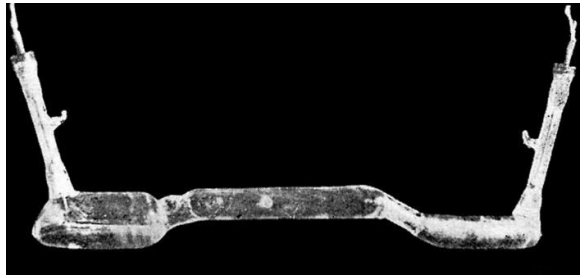
1901

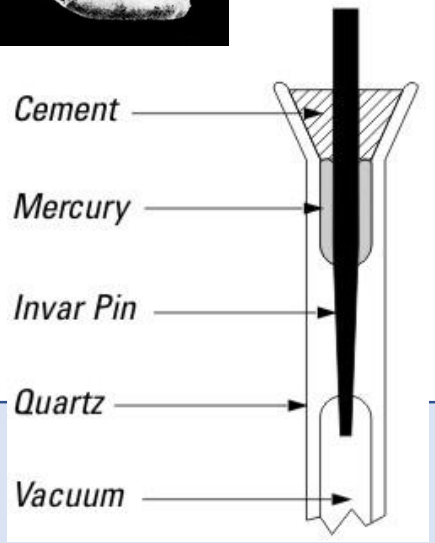
Invention of mercury arc lamp by Cooper-Hewitt



1906

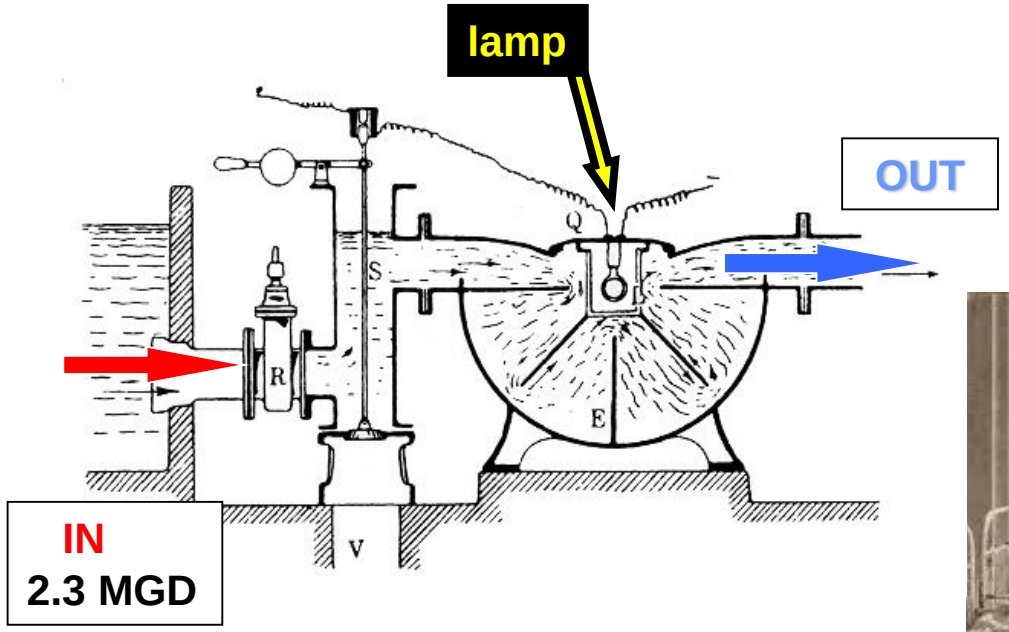
Küch & Retschinsky use quartz as transmitting material





1910

First full-scale UV disinfection apparatus by Henri and coworkers in France



1916

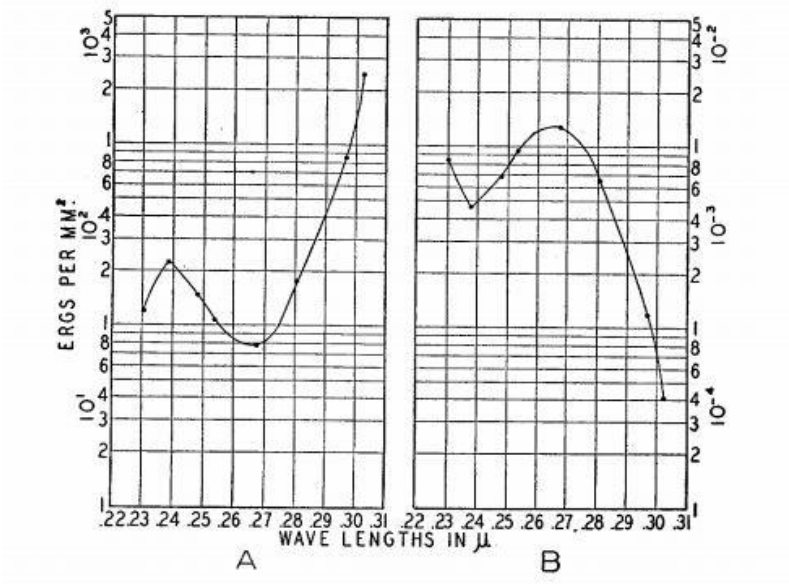
Small scale wastewater treatment

Dr Auguste Rollier, proved tuberculosis cure by the sun's rays.

1911

1929

Hanovia founded

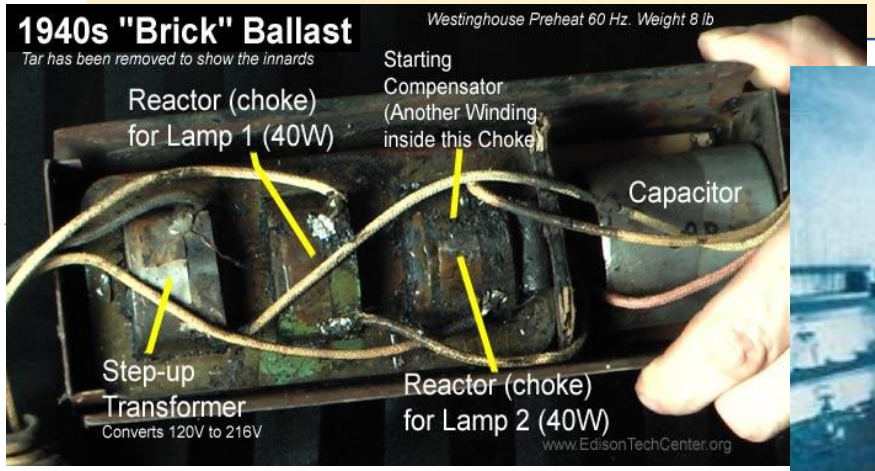


Gates produces action spectra for *Staphylococcus aureus* and *Bacillus coli* .
These action spectra corresponded to the absorption spectrum of nucleic acid

1929

1930’s

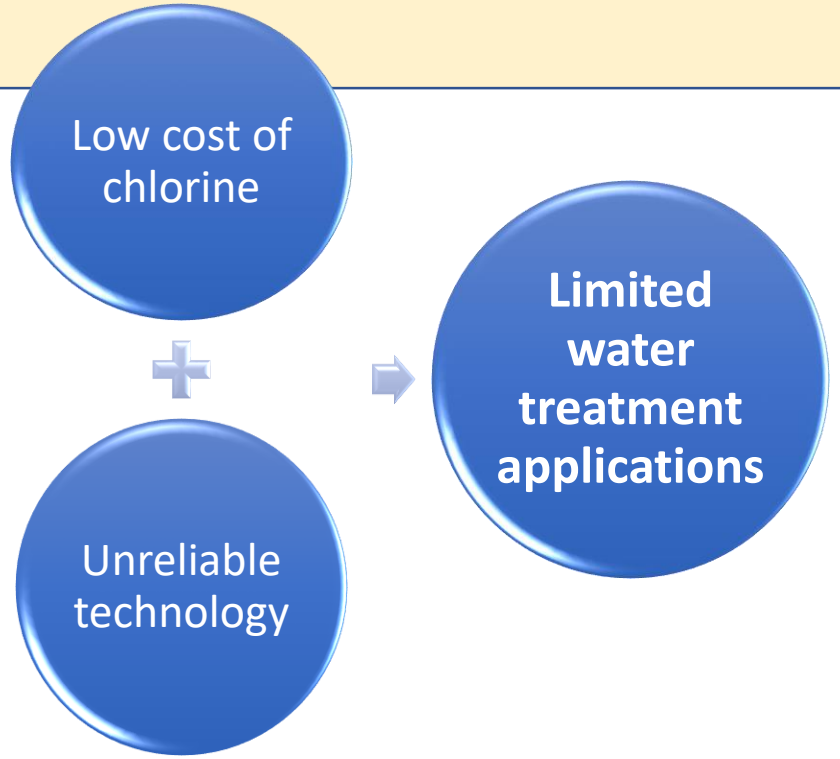
Development of fluorescent lamp technology



US Water Pollution Control Act to protect water quality – Cincinnati Research Facility (now USEPA) authorized

1948

Technology



Considerable research on mechanisms of UV and inactivation of microorganisms
Increasing regulatory concerns with environmental impacts of chemical treatment

1950 & 1960's

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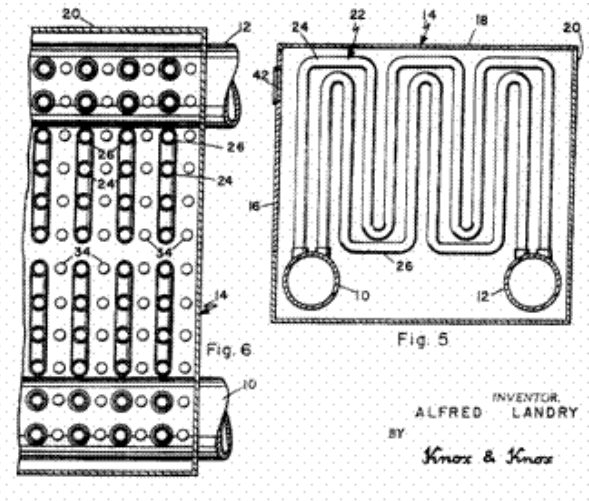
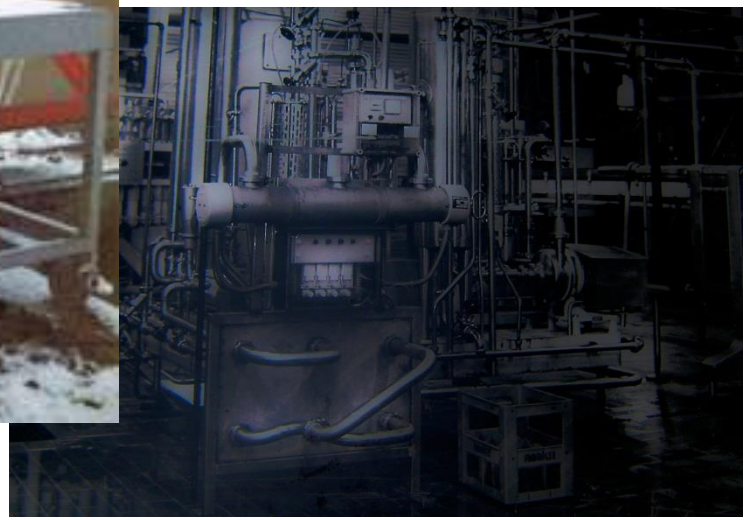
1972

Patent issued to A. Landry for gravity flow ww system using PTFE tubes



1972

Water treatment systems installed by Wedeco and Berson



Regulation to reduce chlorine and by-products in wastewater

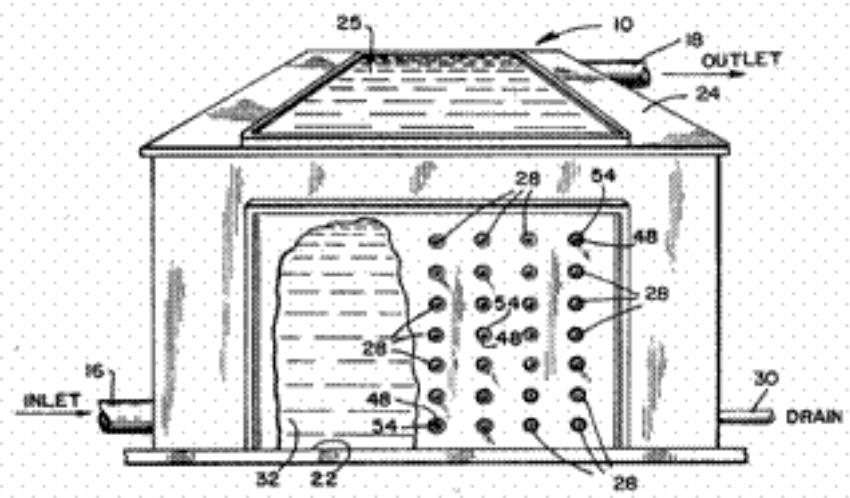
1976

1978

1978

Patent issued to S. Ellner for ww system with lamps perpendicular to flow

UV selectable sensors commercialized



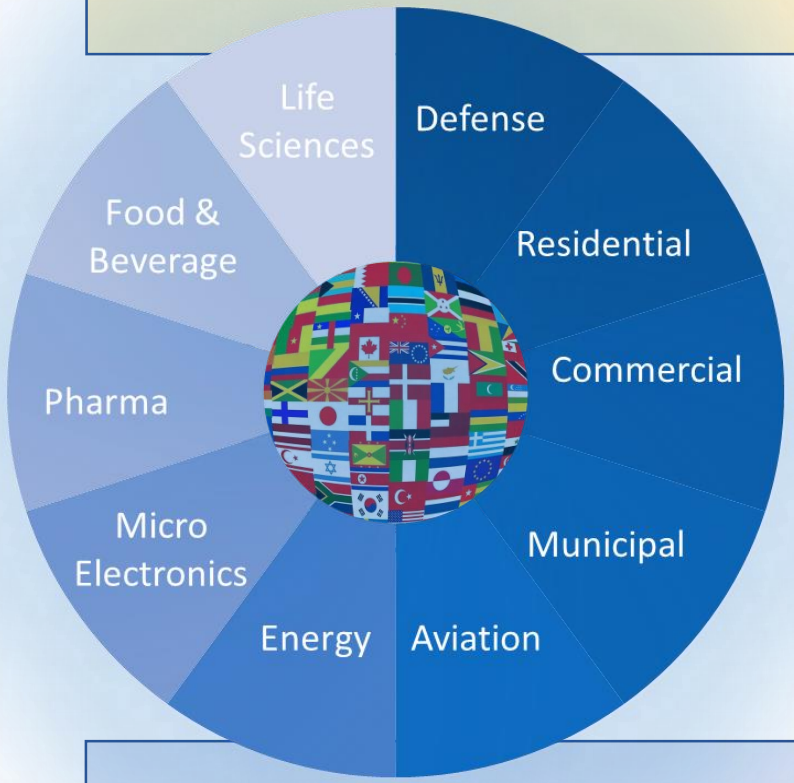
US EPA funds several full scale wastewater systems with positive results

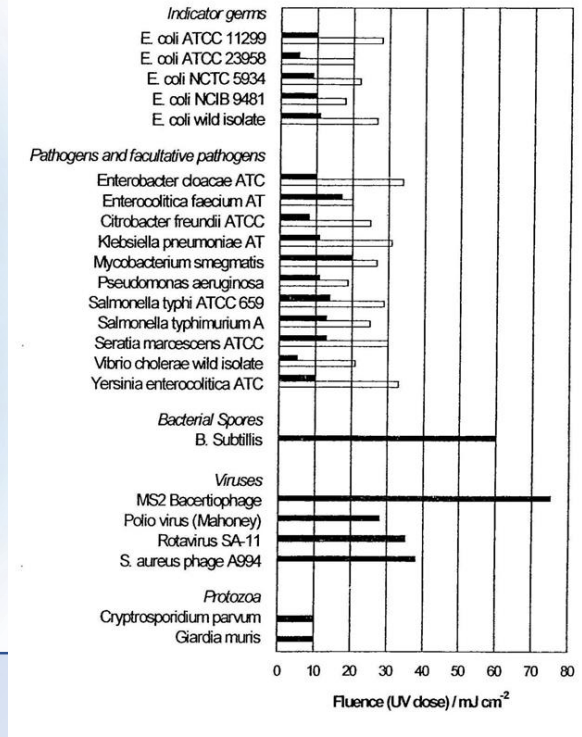
1978

1980's

1989

Large growth in UV suppliers, products and applications





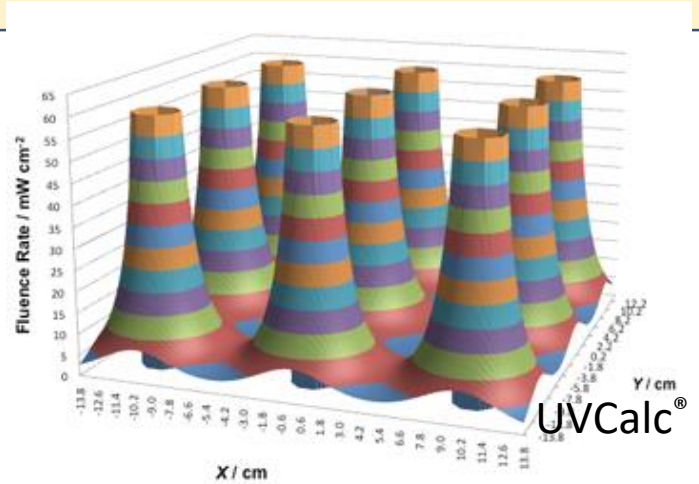
First municipal Drinking Water installation at Fort Benton, IN

UV Dose response characterized for many pathogens

1990's

Huge efficiency improvements through;
LPHO lamps and variable power ballasts and hydraulic design tools

Manufacturing volume and quality increases



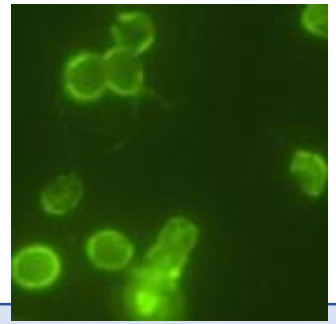
UVCalc®

The term "Reduction Equivalent Dose" (RED) first used

NWRI National Water Research Institute

ÖNORM

DVGW



Key regional regulations published:
NWRI, ÖNorm and DVGW

Clancy et. al. prove *Cryptosporidium* and *Giardia* is inactivated at low UV Doses

1993 1996 1997 1998

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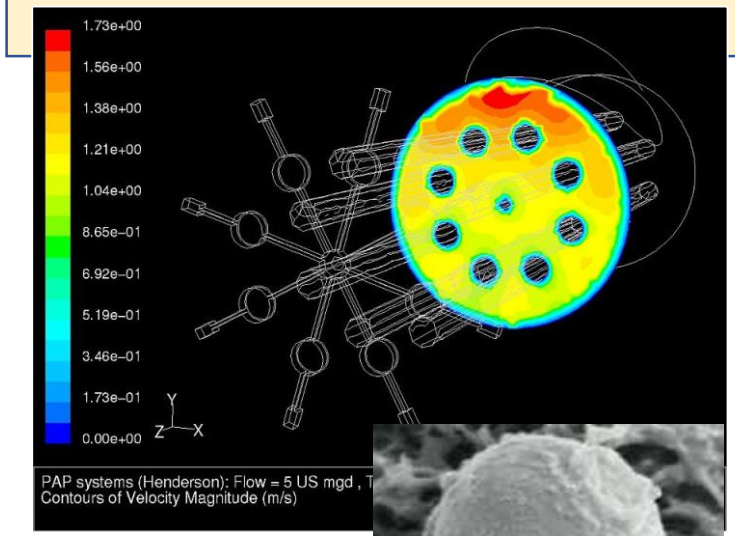
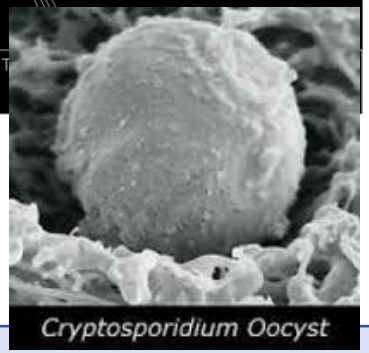
2000's

CFD design tools become common place





Huge water, wastewater and reuse systems installed

Patent issued for controlling cryptosporidium, in drinking water at low doses

2002

Chinese UV wastewater guidelines released

2003

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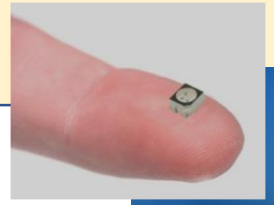
2012

First UV-C LED based UV system launched

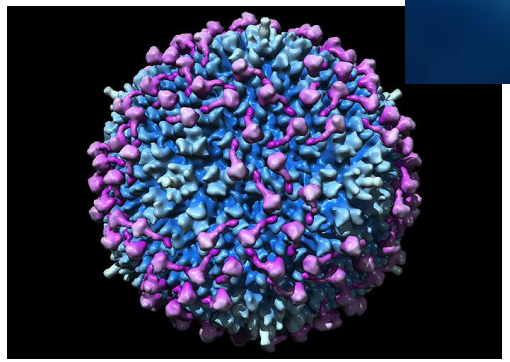


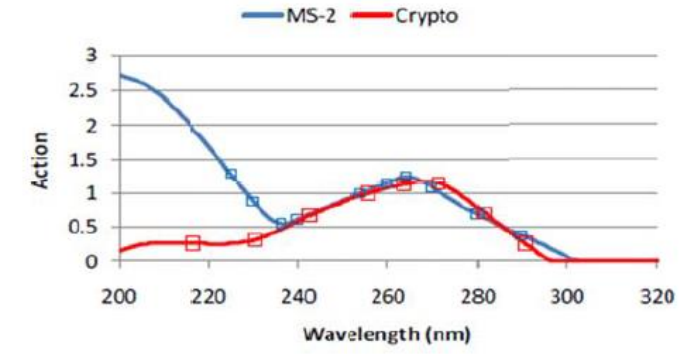
EPA United States Environmental Protection Agency

Table 1.4. UV Dose Requirements – millijoules per centimeter squared (mJ/cm²) [1]

Target Pathogens	Log Inactivation							
	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0
Cryptosporidium	1.6	2.5	3.9	5.8	8.5	12	15	22
Giardia	1.5	2.1	3.0	5.2	7.7	11	15	22
Virus	39	58	79	100	121	143	163	186

[1] 40 CFR 141.720(d)(1)





US EPA release "*UV Disinfection Guidance Manual*"

2006

Linden et. al. show polychromatic effectiveness against Adenovirus

2009

Revised action spectra released for key target and surrogate pathogens

2013

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UV Use in Heathcare

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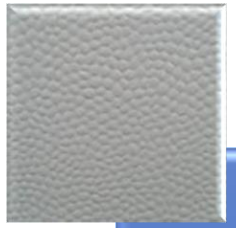
Healthcare UV Applications Overview

Air

- In-duct air disinfection
- In-room wall/ceiling mounted air disinfection
- Mobile air disinfection
- Patient Temp Control



Surface

- In-ceiling room surface disinfection
- Mobile cart room surface disinfection
- Electronic device surface disinfection
- Instrument disinfection

Water

- Dialysis
- Patient Temp Control
- Faucets
- Sink drains
- Showers
- Ice Makers
- Dental
- Waste discharge

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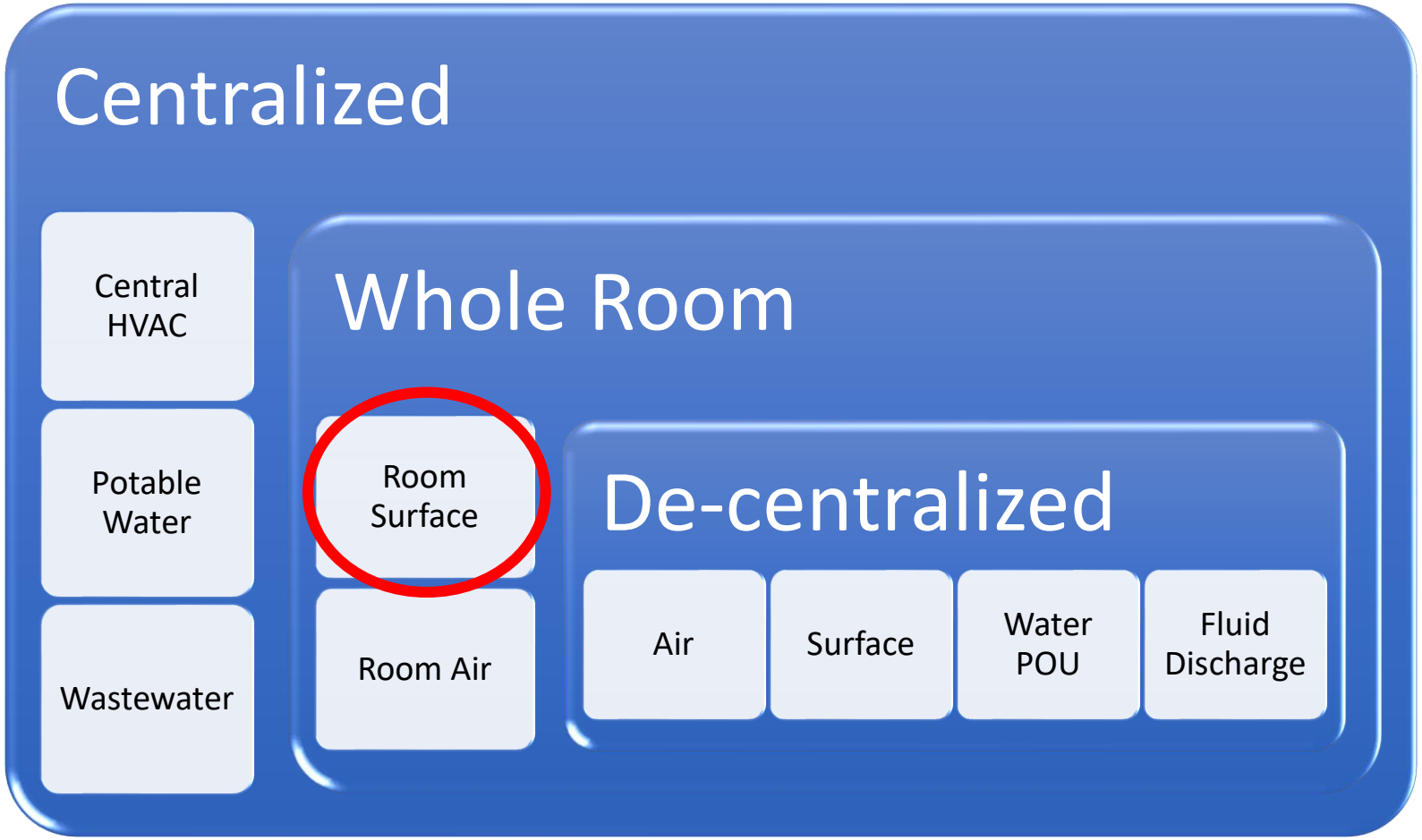
Healthcare Applications Overview

Market Center of Gravity



Commercial Examples – Whole room Surface

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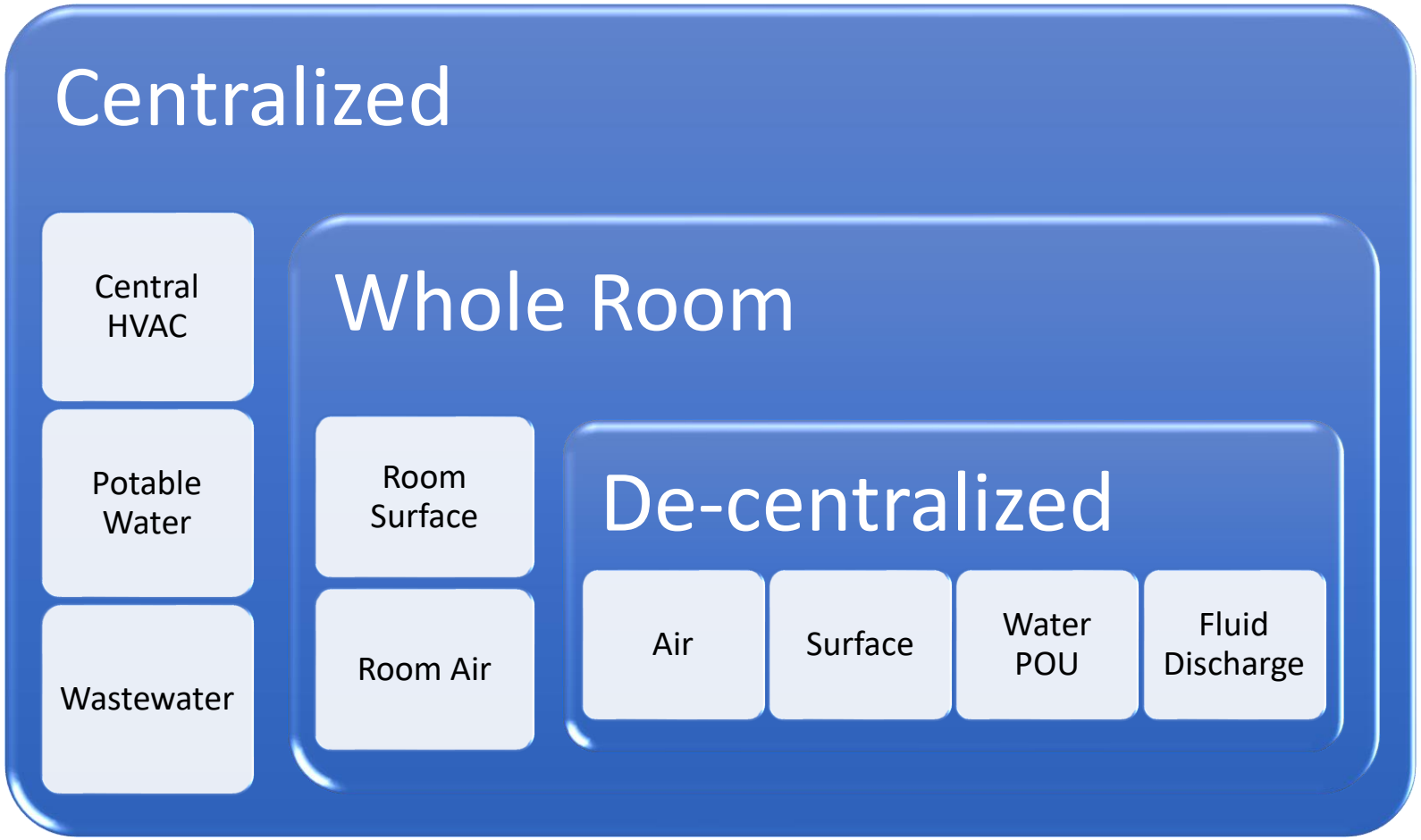
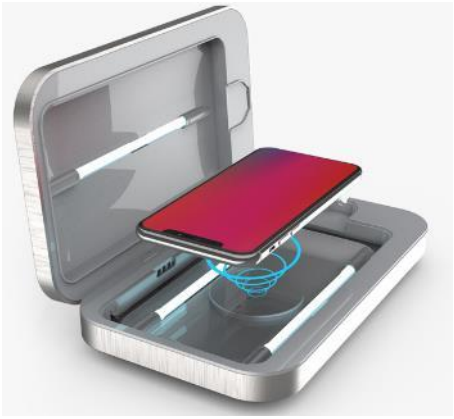
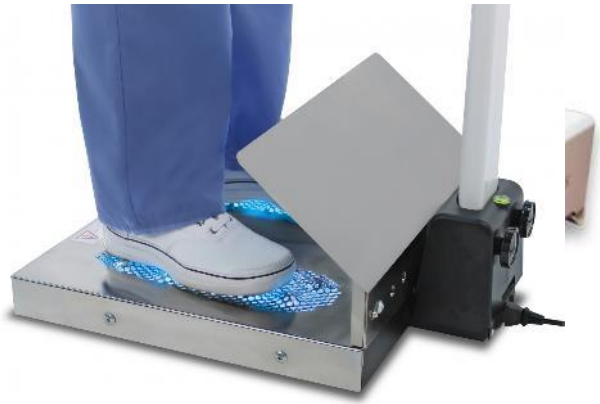
Healthcare Applications Overview



Some Market Movement in this Direction

Commercial Examples – Decentralized Surface





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Claims & Standards

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Claims

Product X eliminates superbugs multiple times a day without the need for human assistance.

INDEPENDENT CLINICAL LAB TEST RESULTS High Efficacy and Kill Rates in Just 8 Seconds!		
Staph aureus (MRSA)	**99.98%**	3.66 log
Clostridium difficile (C-Diff)	**85.3%**	0.83 log
Enterococcus faecalis (VRE)	**99.75%**	2.60 log
Escherichia coli (CRE)	**99.87%**	2.87 log
Streptococcus pyogenes	**99.994%**	4.20 log
Pseudomonas aeruginosa	**99.2%**	2.08 log

CLEANS 99.99%† EVERYTIME

The UV-C lights inside PhoneSoap kill germs without harmful heat, liquids or chemicals.

Our units are portable, making delivery and setup a breeze. We'll show you just how quick and easy it is to roll our system into place, use the remote control, and get 99.999% whole room disinfection. Our patent-pending technology takes the guesswork out of disinfecting with light.

- Tested to show >99.9999% reduction of C. difficile & MRSA

Reduce infection rates by 50-100%

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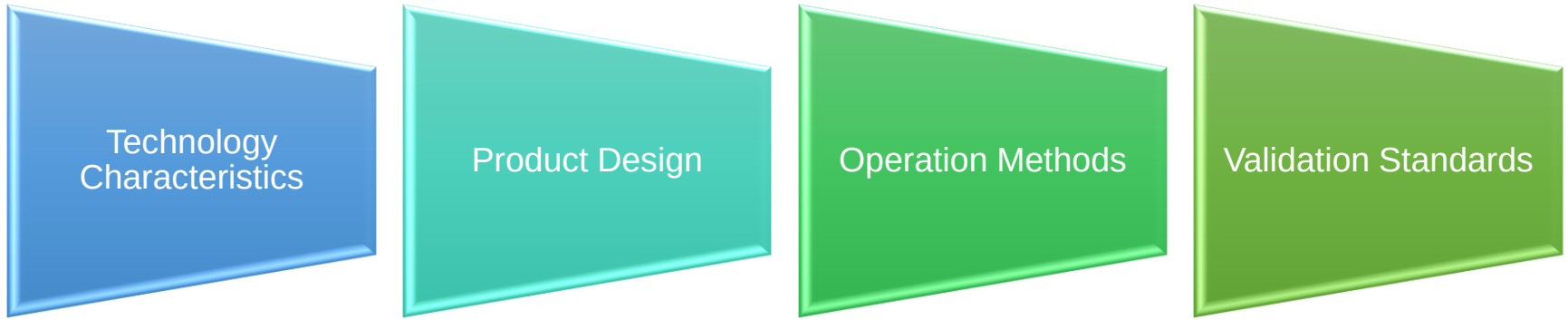
Appropriate Solutions



What is the best technology for the job?

How is the technology deployed?

How is the product used?

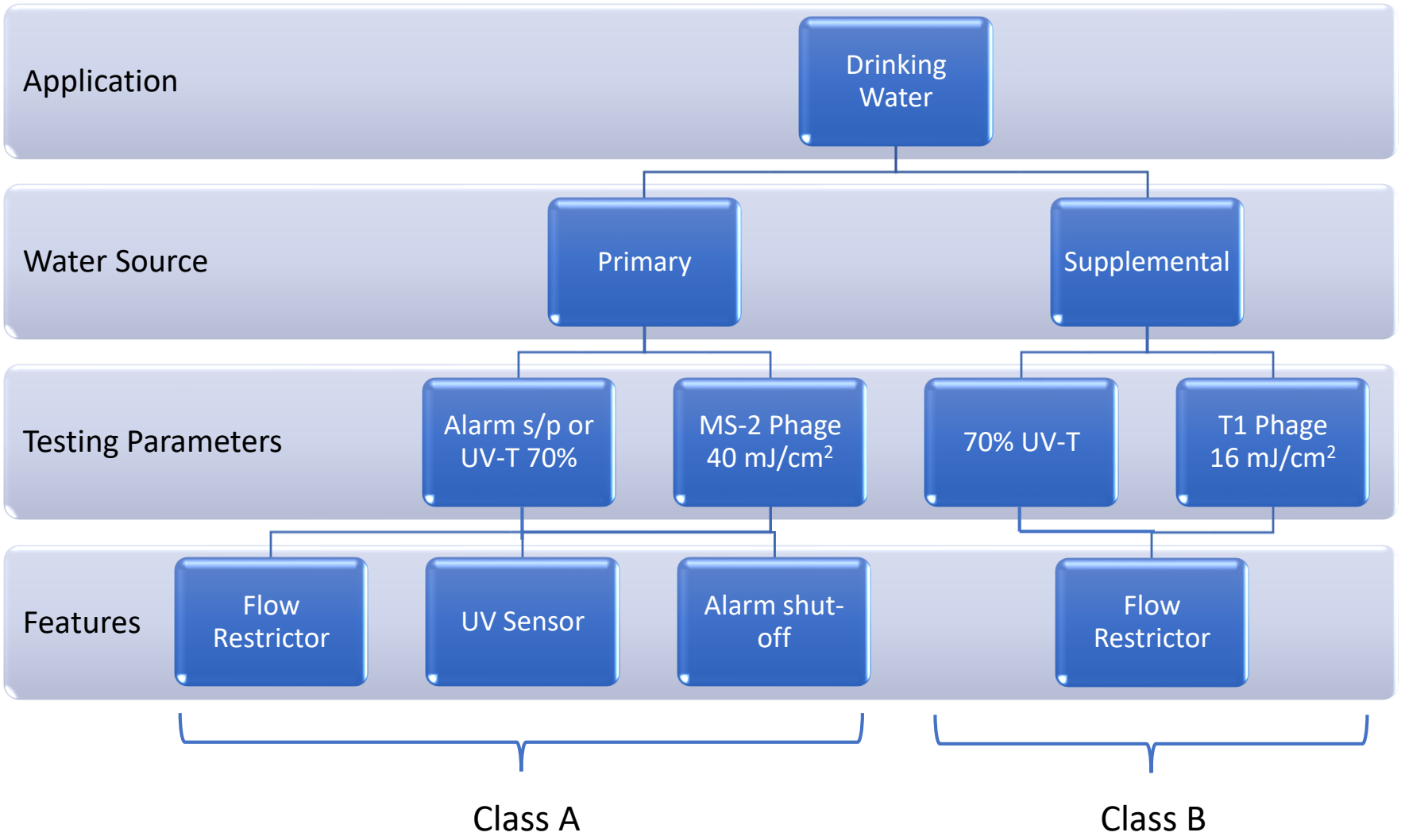
How is the effectiveness quantified?

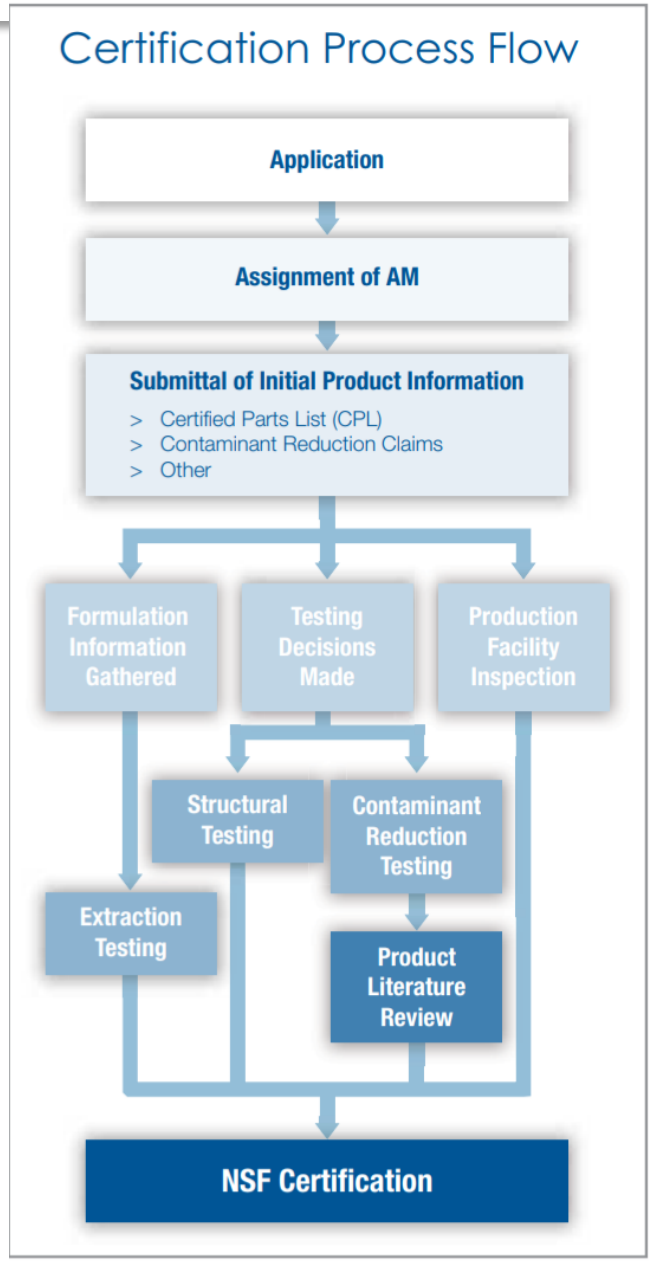
Certification/Validation/Regulation Gaps

- Operational
  - Safety
  - Usage effectiveness
  - Monitoring feedback
- Efficacy
  - Common method of performance testing between product variants
  - Appropriate UV Dose values for target application

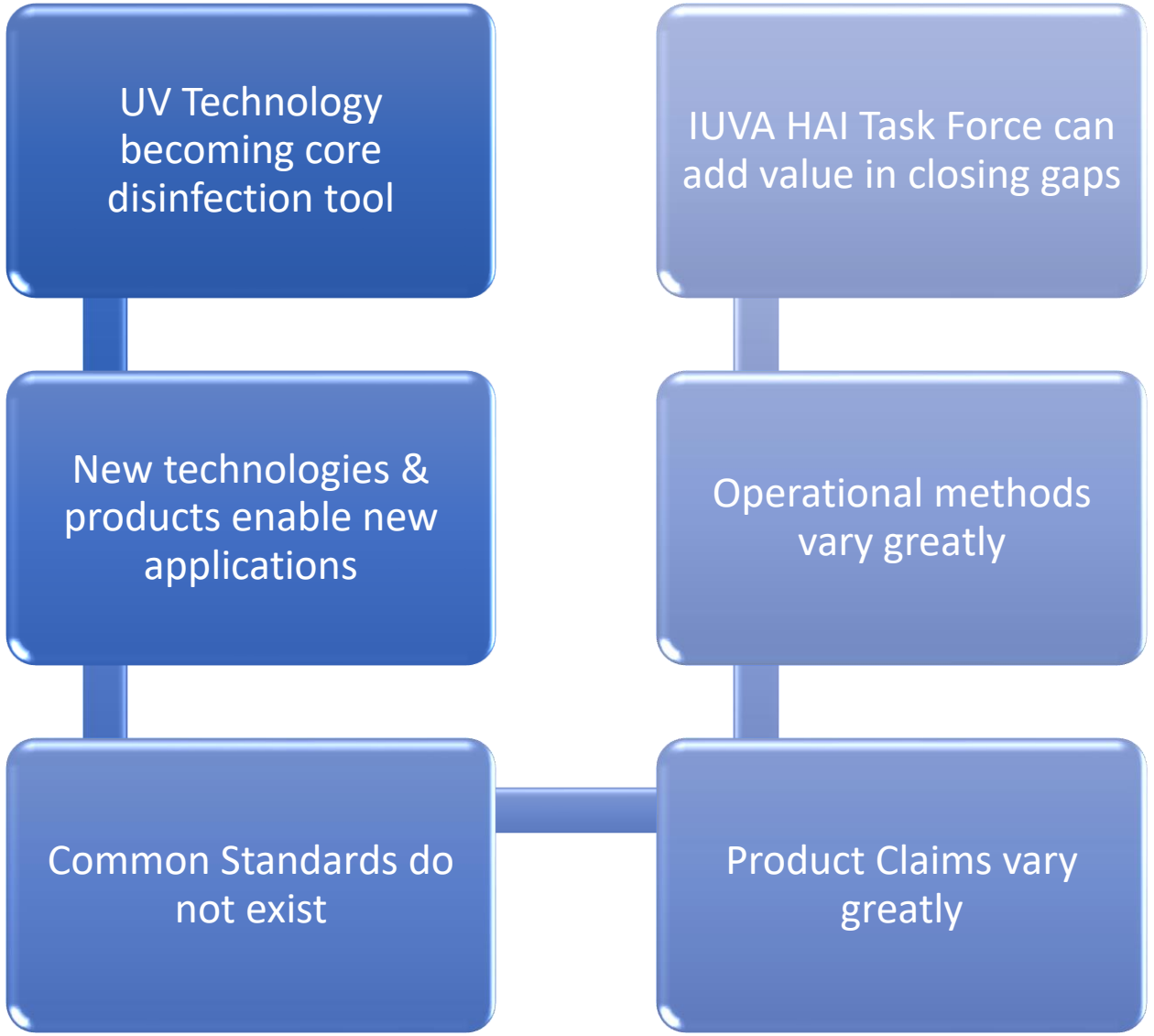
Ideally should avoid regulation of System or Process Design!

Example Standard - NSF 55





Summary



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The Final Word

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The Final Word

Ultraviolet Technology

Distinct from other disinfection methods

- Easy and reliable to apply
- No change of water chemistry
- No by products or residuals
- No effect on odour and taste
- No corrosion
- No hazardous chemicals
- No resistance as with chlorine
- No concentration, no sludge

The Final Final Word