

American Water Works Association  
**New York Section**

**EDWIN C. TIFFT JR.**

**WATER SUPPLY SYMPOSIUM**

**SEPTEMBER 19 - 20, 2018**

**WEST HARRISON, NEW YORK**

# Current Trends in the Disinfection of Drinking Water

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Hazen and Sawyer

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# AWWA's 2017 Water Utility Disinfection Survey

SurveyMonkey® used for 180 questions characterizing the following:

- General system information
- Free chlorine usage
- Chloramine usage
- Chlorine dioxide usage
- Ozone usage
- Ultraviolet (UV) light usage
- Additional general disinfection parameters



## 2017 WATER UTILITY DISINFECTION SURVEY REPORT

The 2017 Water Utility Disinfection Survey project was commissioned by the American Water Works Association (AWWA) Disinfection Committee Project Team and funded by the AWWA Technical & Educational Council.

Report prepared by Cornwell Engineering Group  
April 2018

 American Water Works Association

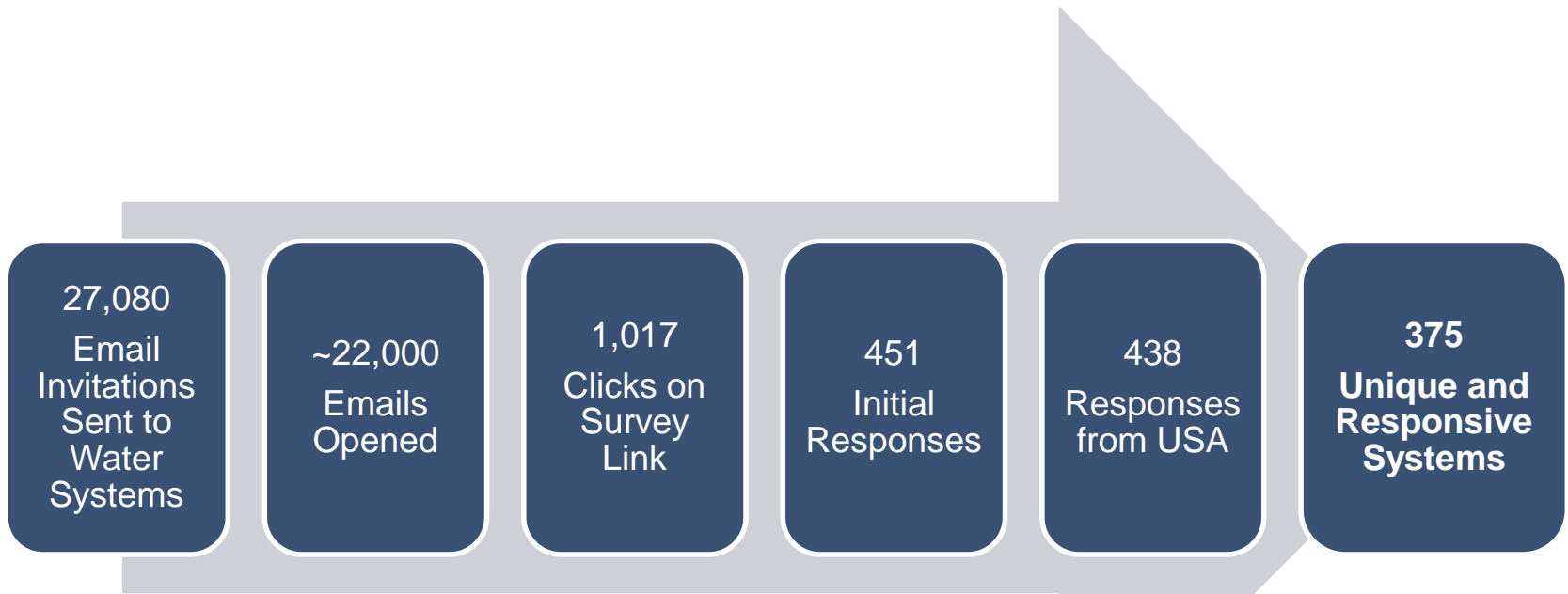
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# 2017 Survey Response

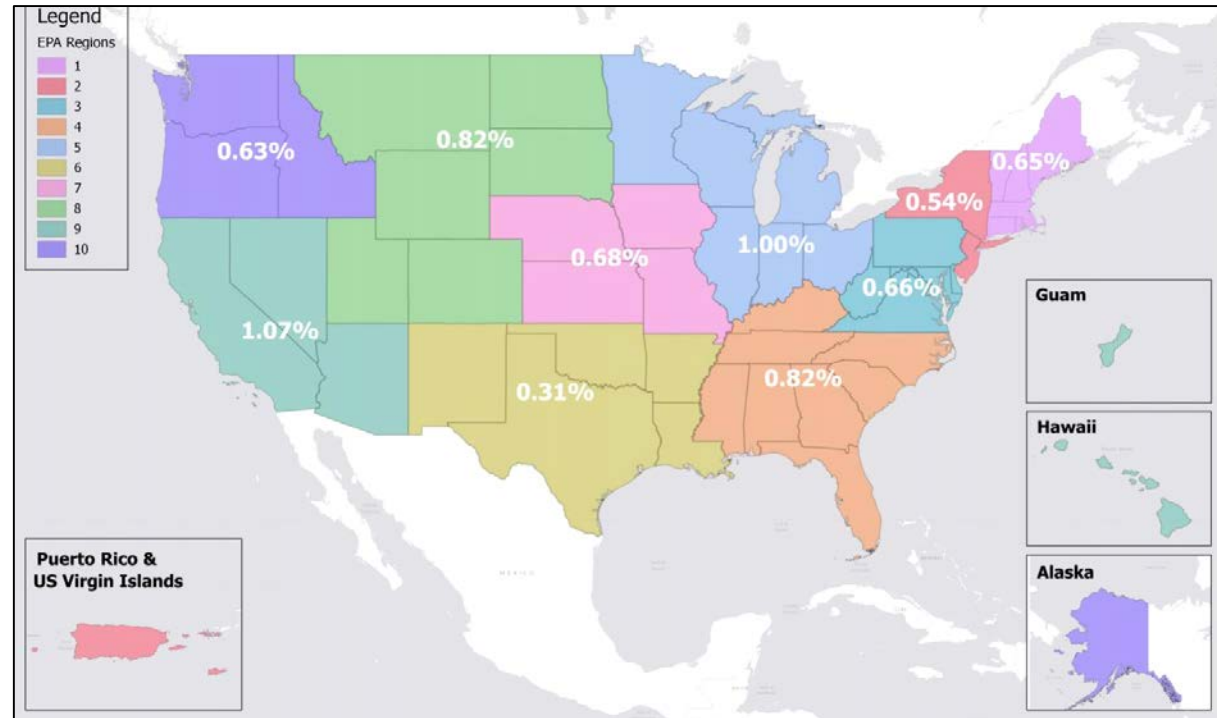


## Similar to Previous Years:

- 1978 – 332 responses (paper survey)
- 1989 – 280 responses (paper survey)
- 1998 – 509 responses (paper survey)
- 2007 – 312 responses (first online-available survey)

# Good Geographic Distribution of Responses

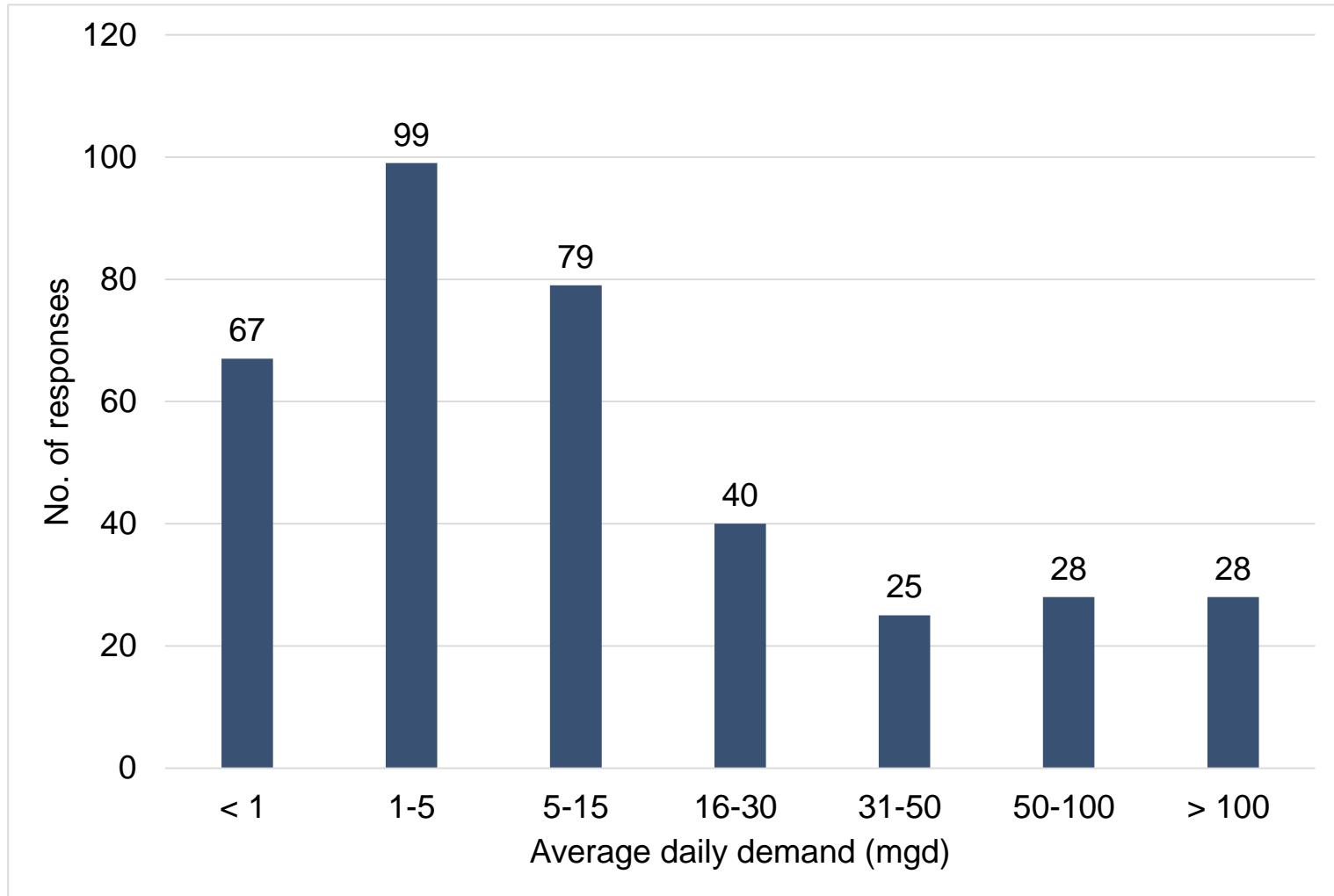
EPA Region	Number of Respondents from Region
1	18
2	21
3	30
4	73
5	74
6	27
7	28
8	27
9	49
10	28



## ... And Source Water Types

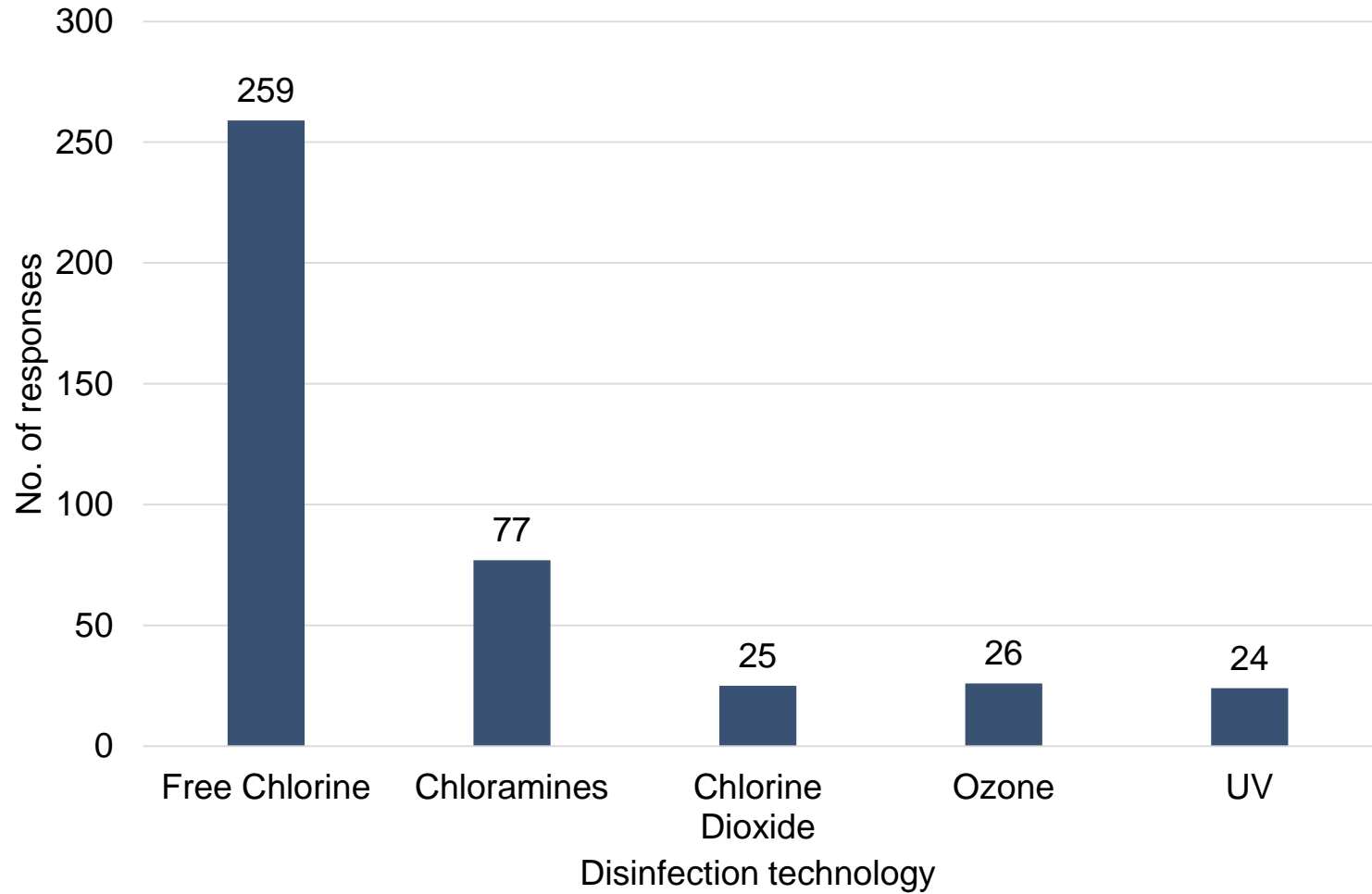
Type	No. of Responding Systems
Surface Water (SW)	166
Ground Water (GW)	106
Ground Water Under the Direct Influence (GWUDI)	7
Potable Reuse	1
SW + GW	63
SW + GWUDI	4
SW + PR	3
SW + GW + GWUDI	11
SW + GW + PR	3
SW + GW + GWUDI + PR	1
GW + GWUDI	5

# Total Average Day Demand of Respondents



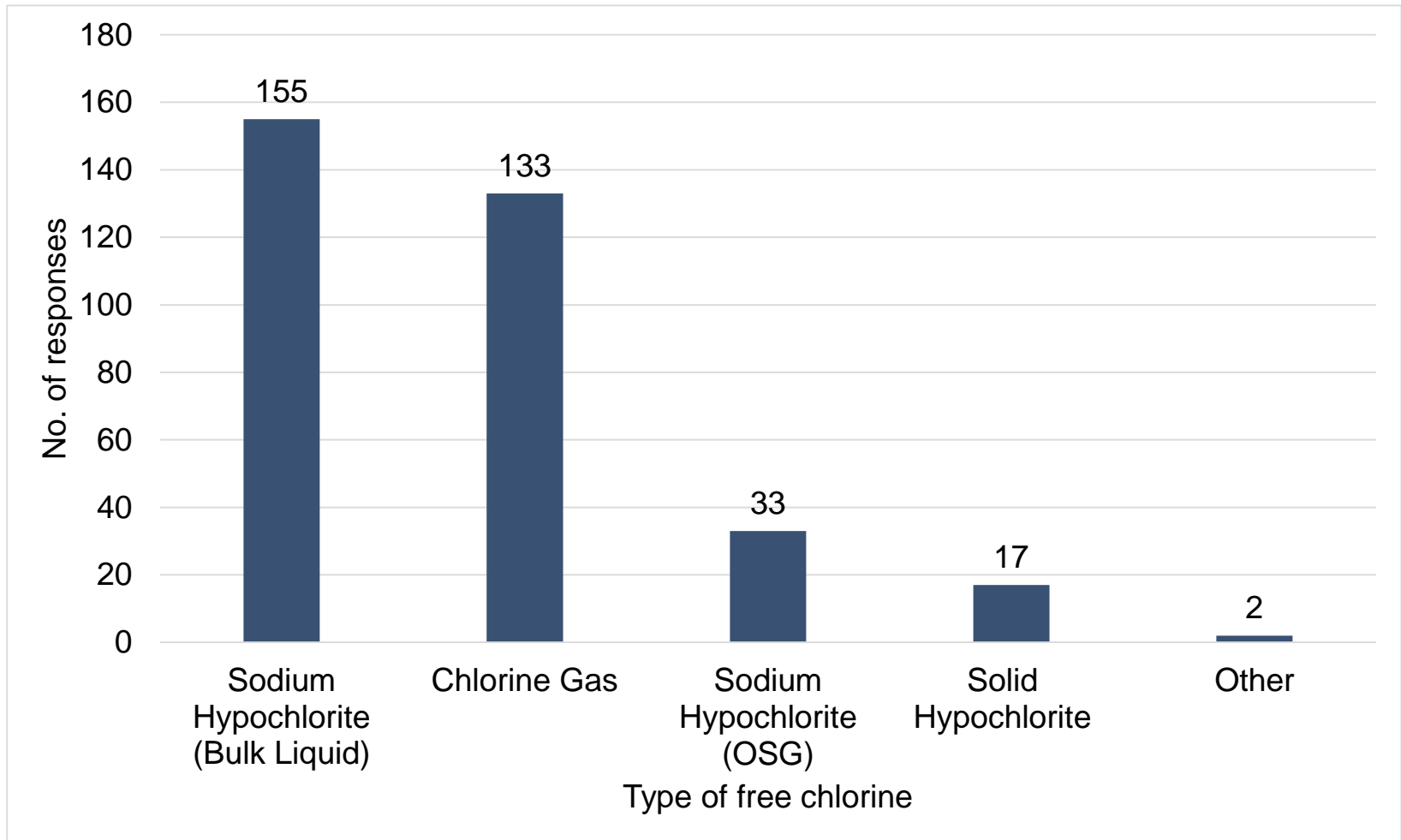
# Disinfection Technologies by Respondents:

Free chlorine is still the most widely used disinfectant!

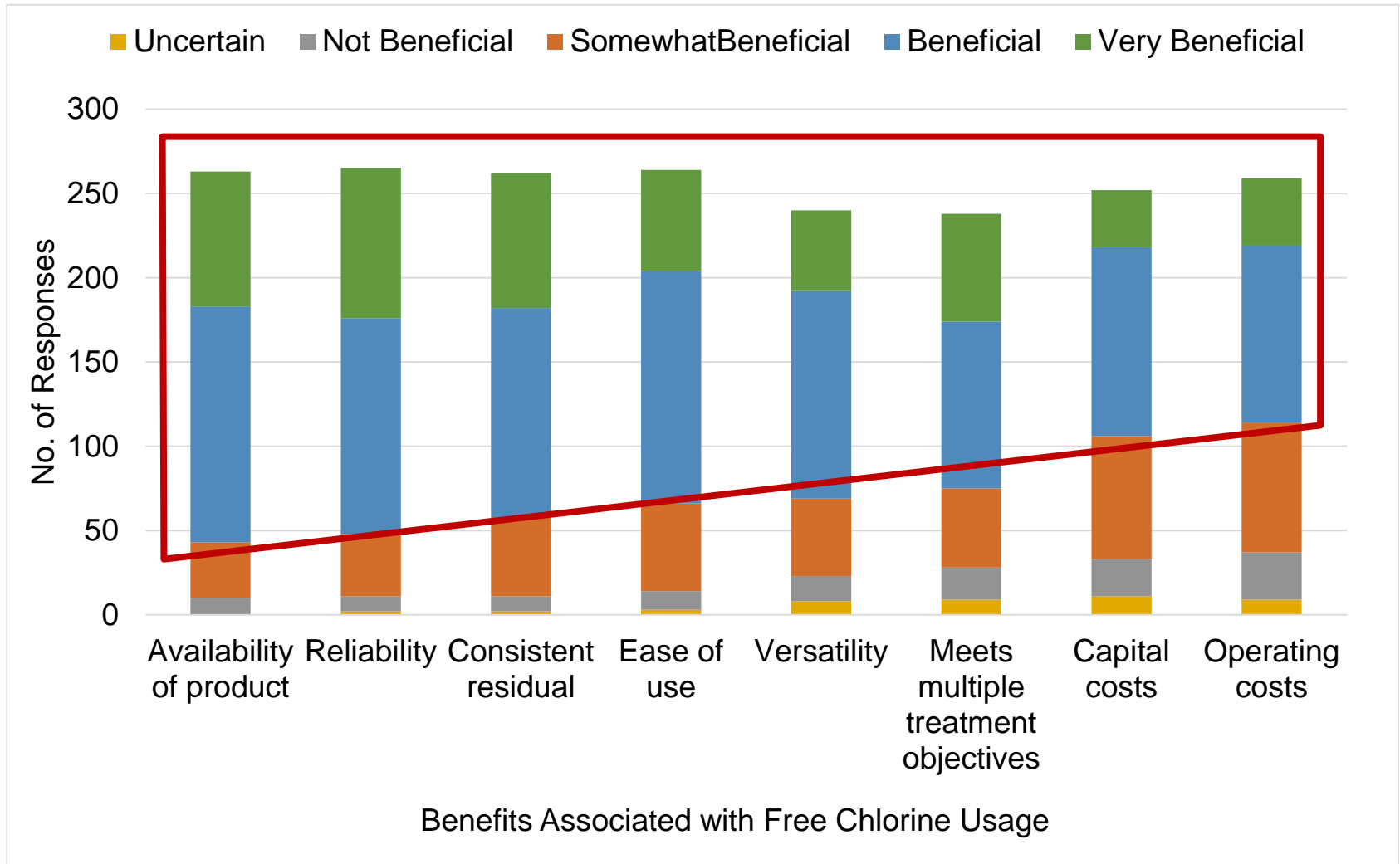




# What Types of Free Chlorine?

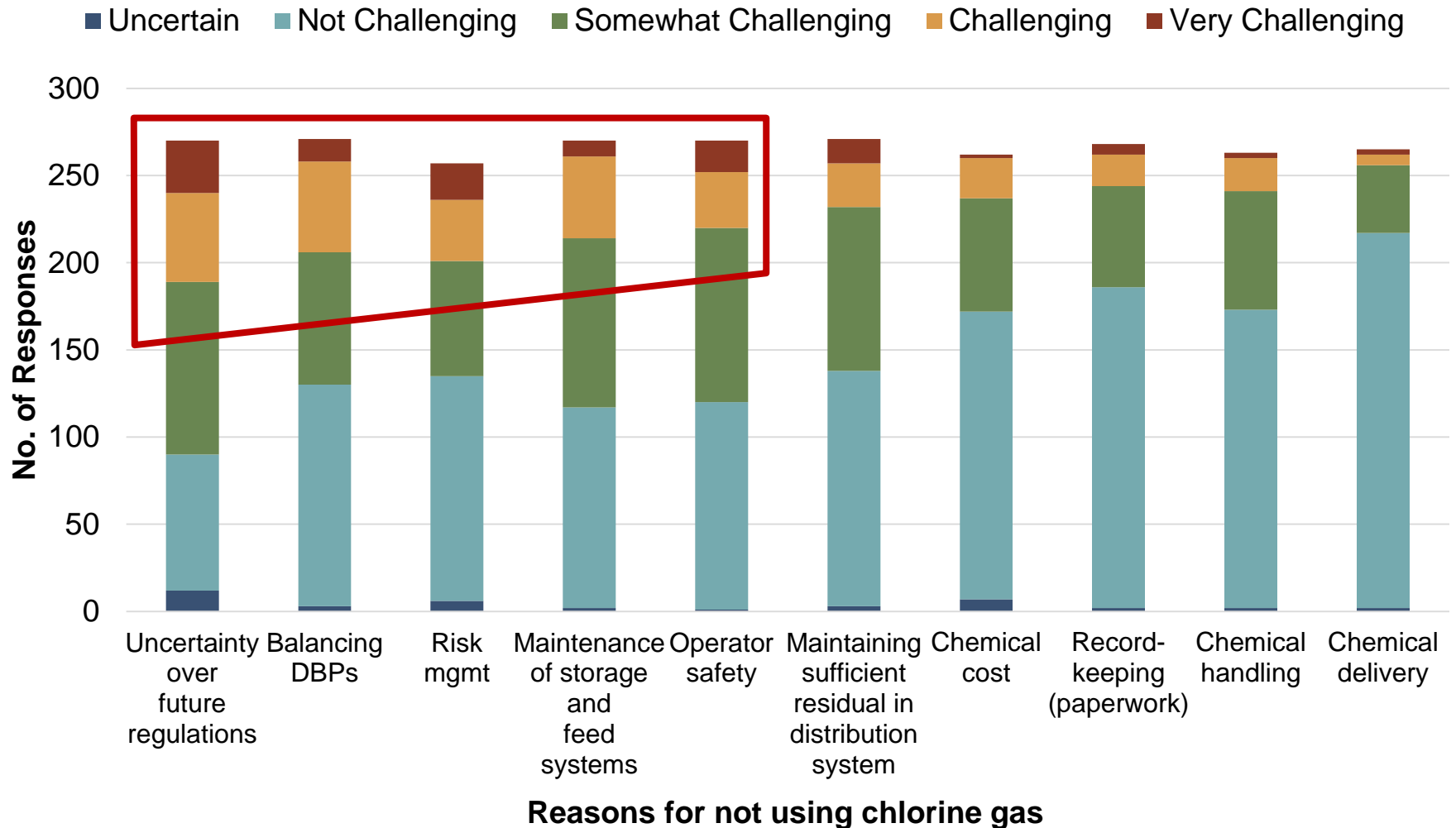


# Benefits of Free Chlorine



# **What are the Challenges of Disinfectants?**

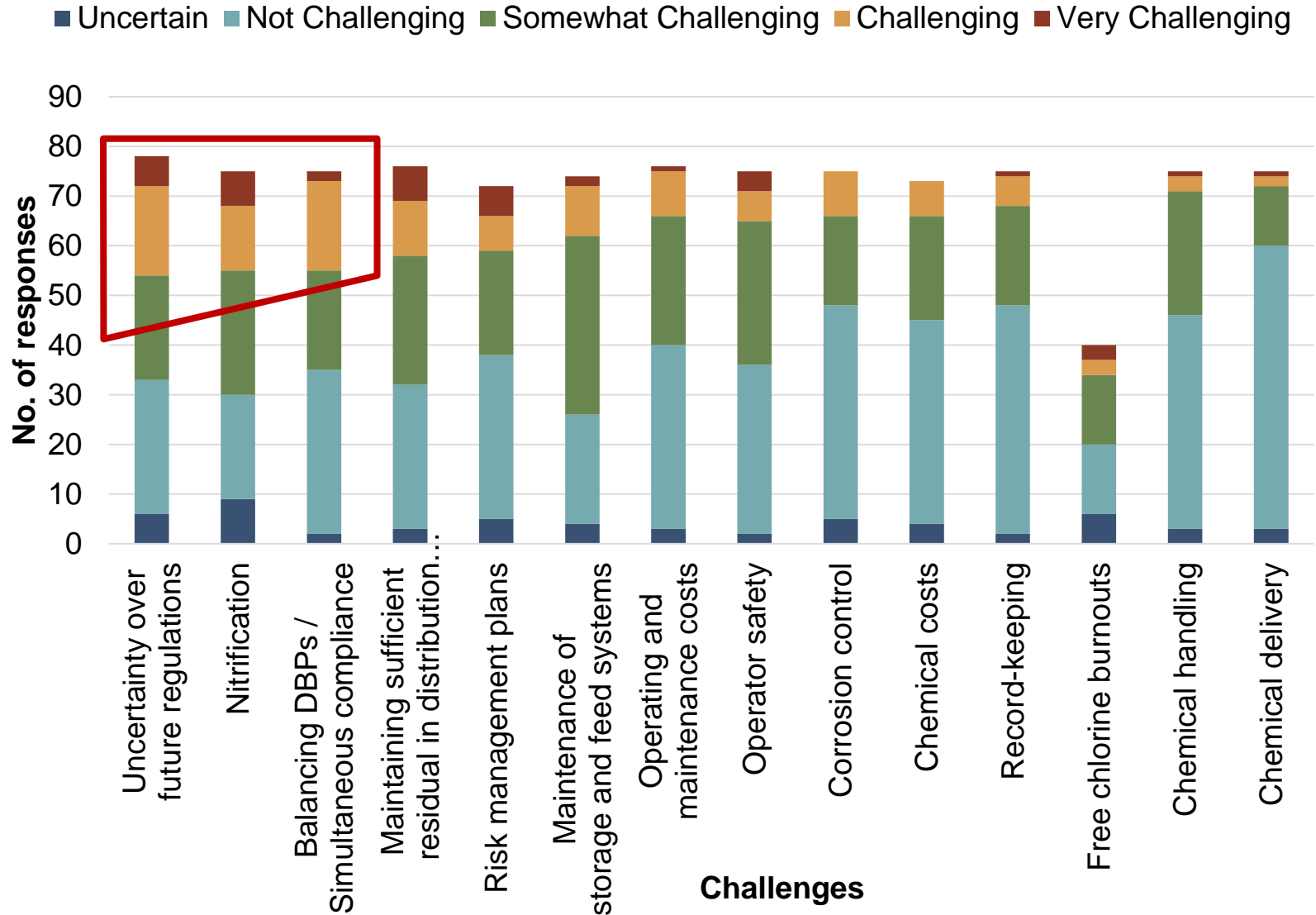
# Challenges of Free Chlorine



# Chloramines

- Relatively common but no significant growth expected in future.
- Most utilities that use chloramines have done so for > 20 years.
- Benefits / Drivers:
  - Lower Chlorinated DBPs
  - More Persistent Residual

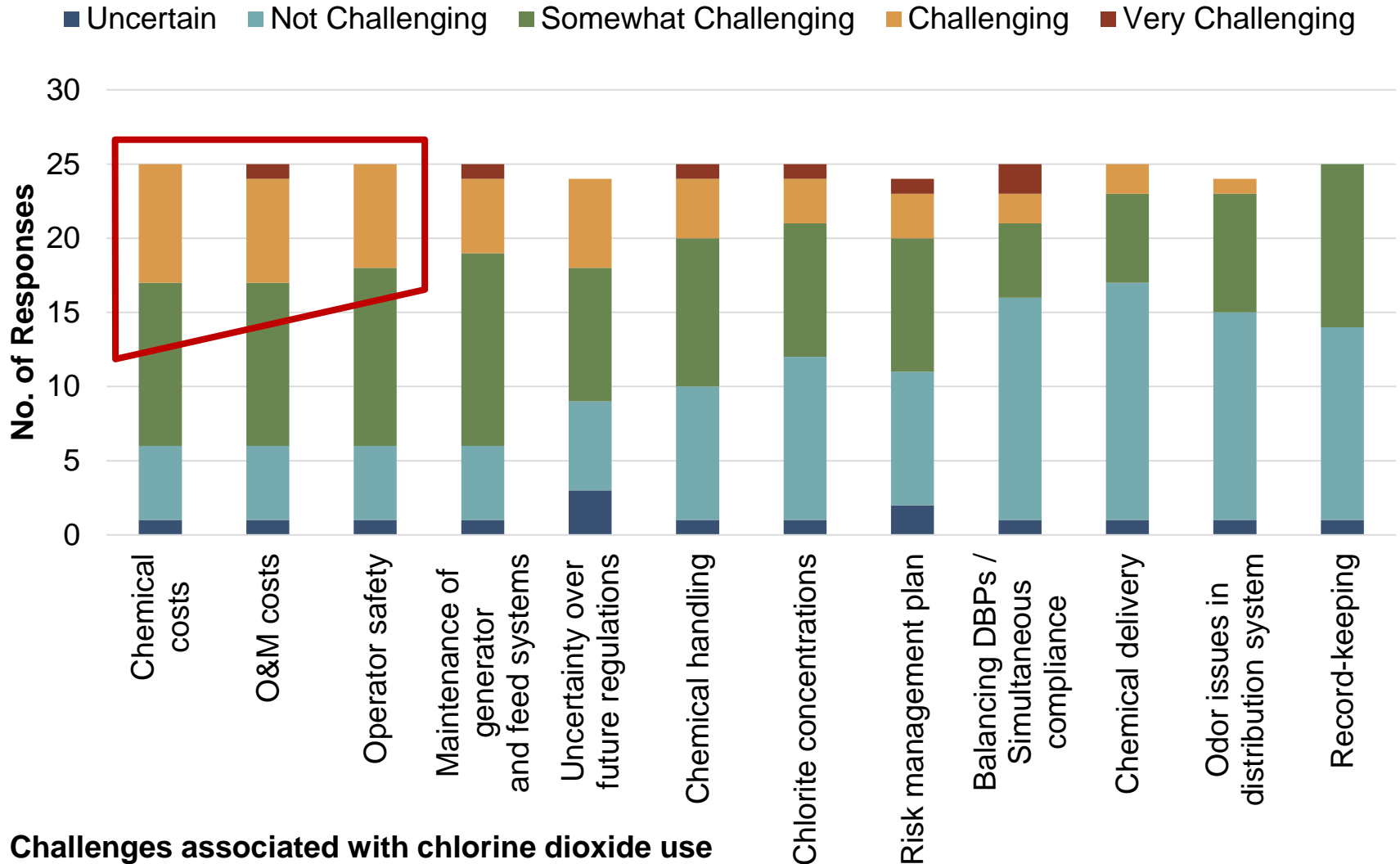
# Challenges of Chloramines



# Chlorine Dioxide

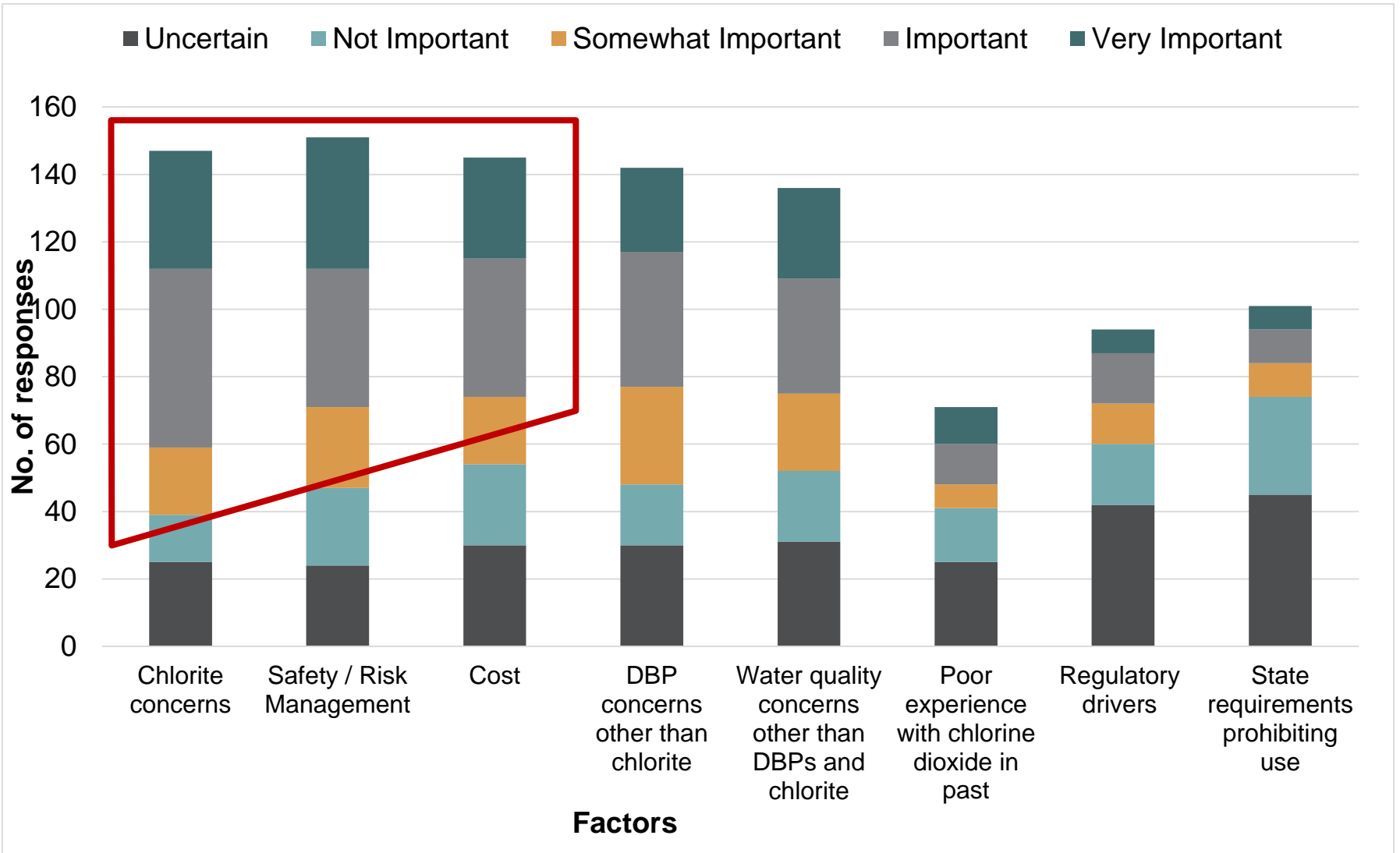
- Limited usage ( $\approx 8\%$ )
- No significant growth expected
- $>70\%$  of installations built over 10 years ago
- Predominantly surface water
- Small, medium, and large systems
- Benefits / Drivers
  - Ability to meet multiple treatment objectives beyond disinfection and act as an oxidant for Fe/Mn and T&O
  - DBP control
  - Reliable and available

# Challenges of Chlorine Dioxide





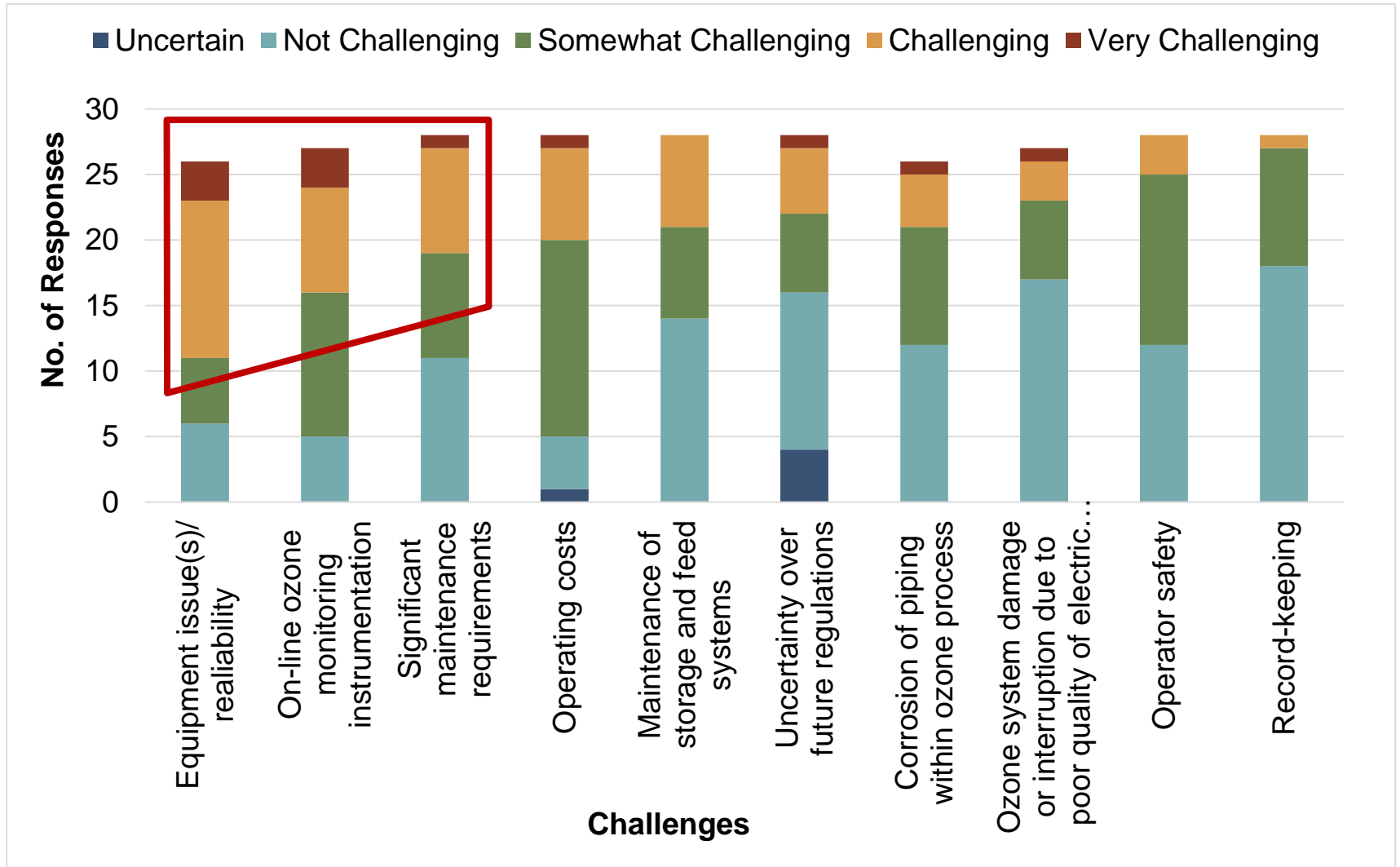
# Barriers to Adoption of Chlorine Dioxide



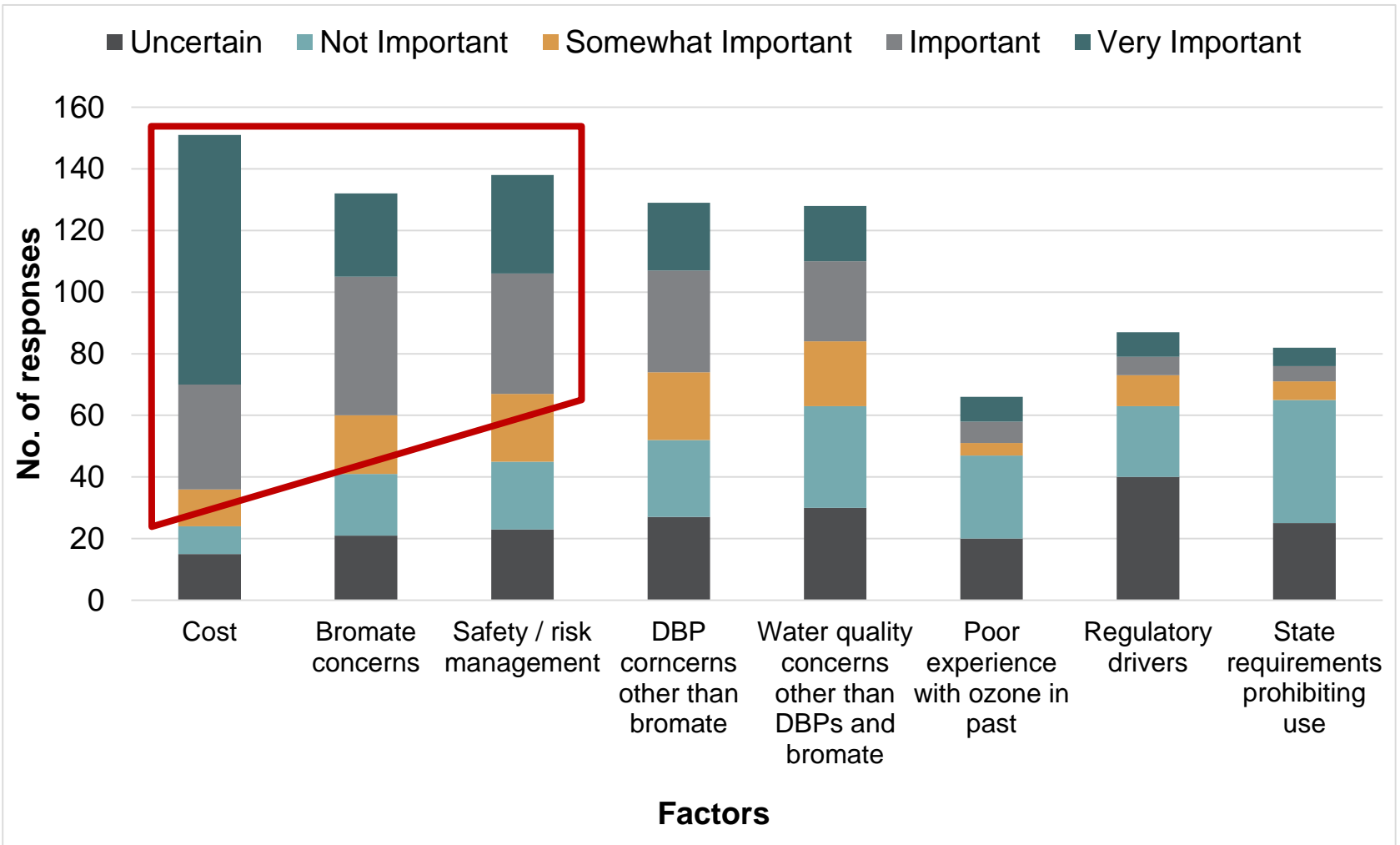
# Ozone

- Limited usage ( $\approx 10\%$ ) but many utilities considering ozone
- Majority of installations built over 10 years ago
- Predominantly surface water
- Medium and large systems
  - No system  $< 1$  MGD : Ozone not cost-competitive
- Benefits / Drivers
  - Taste and Odor Control
  - Control of DBPs
  - Ability to meet multiple treatment objectives beyond disinfection compliance

# Challenges of Ozone



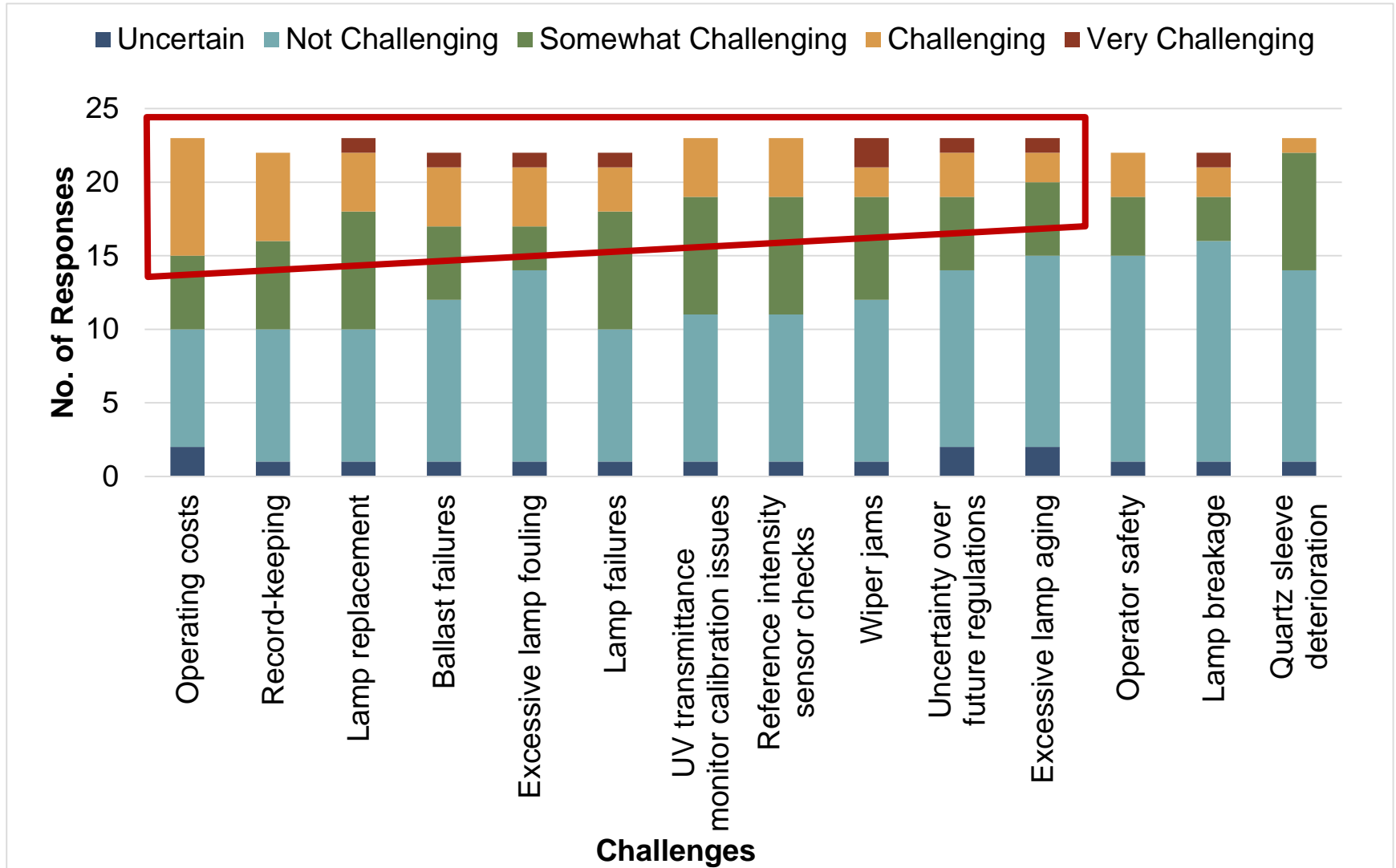
# Barriers to Adoption of Ozone



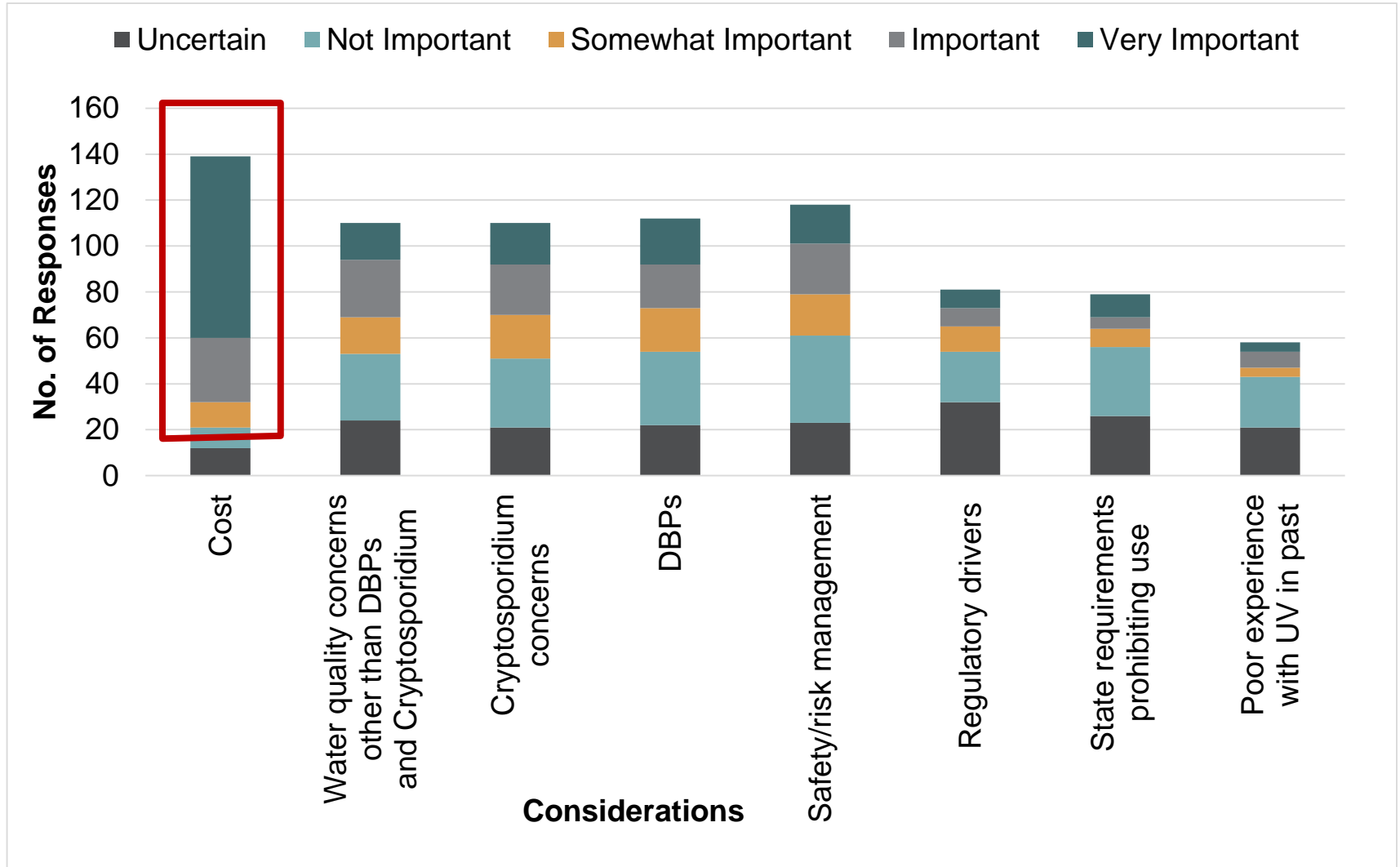
# UV Disinfection

- Limited usage (9%) but increasingly being considered as an alternative:
- Not a long history of use: 75% of installations built in the last 10 years
- Predominantly surface water
- Relatively even size distribution
- Benefits / Drivers
  - Additional protection against *Cryptosporidium*
  - No DBPs
  - Ensures disinfection compliance
  - Chemical-free process

# Challenges of UV



# Barriers to Adoption of UV



**What Else?**

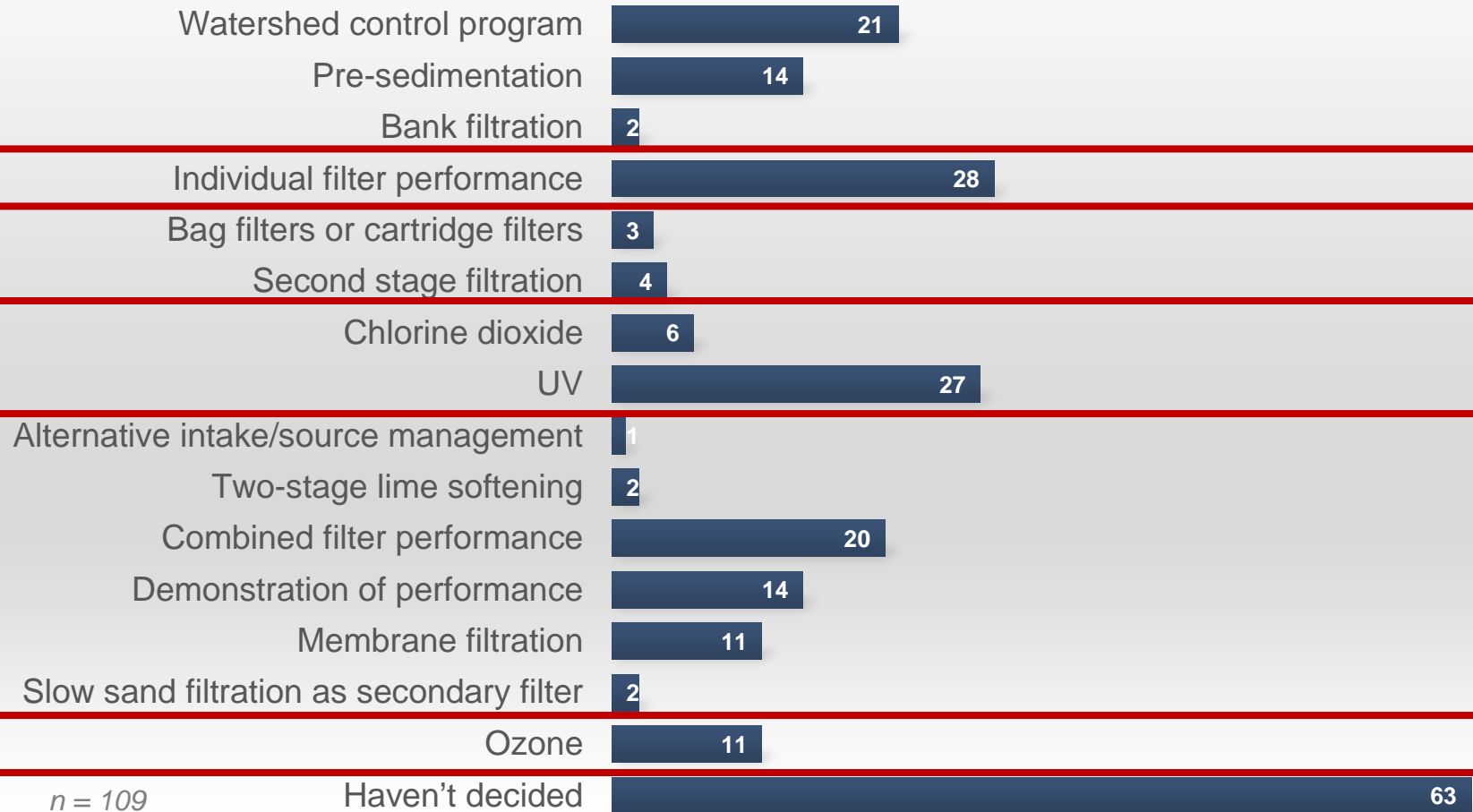
**LT2 Impacts**

*Legionella*

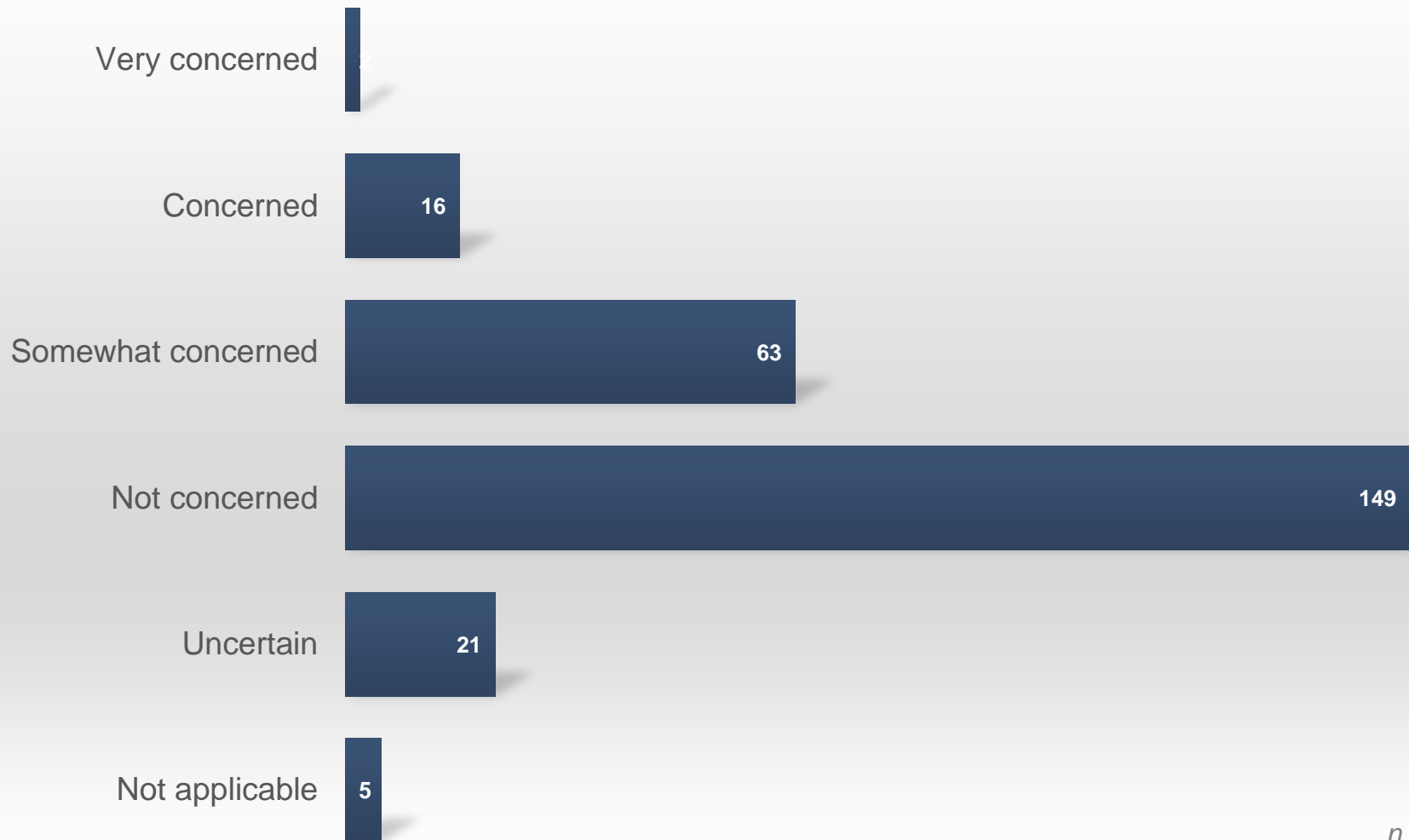
**Unregulated DBPs**



If additional *Cryptosporidium* treatment is required under LT2, will you seriously consider, or have plans to utilize, the following Microbial Toolbox Options as defined in the LT2 regulations?  
Choose all that apply.

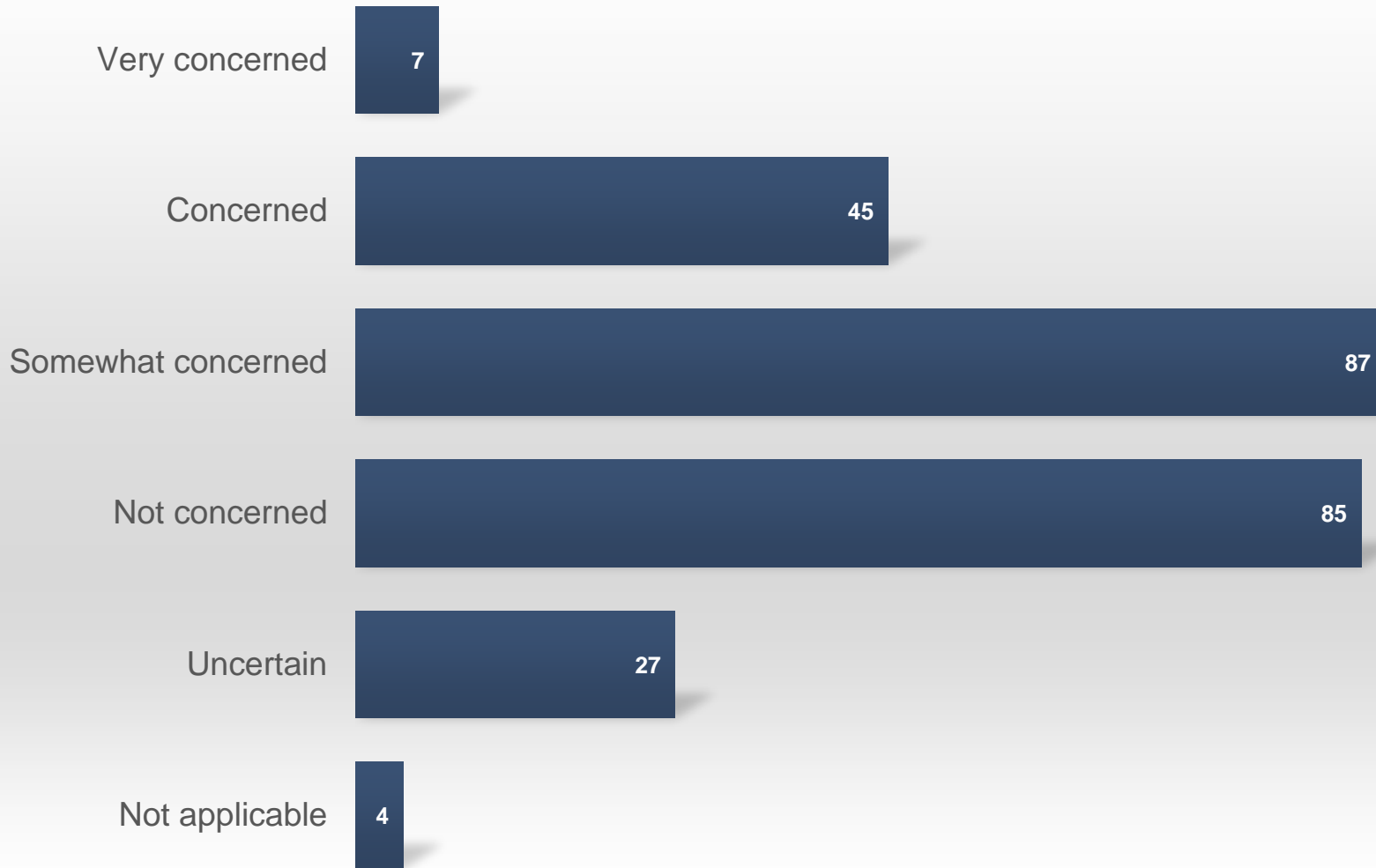


## Do you have concerns about Legionella or other pathogens of emerging concern in your distribution system?



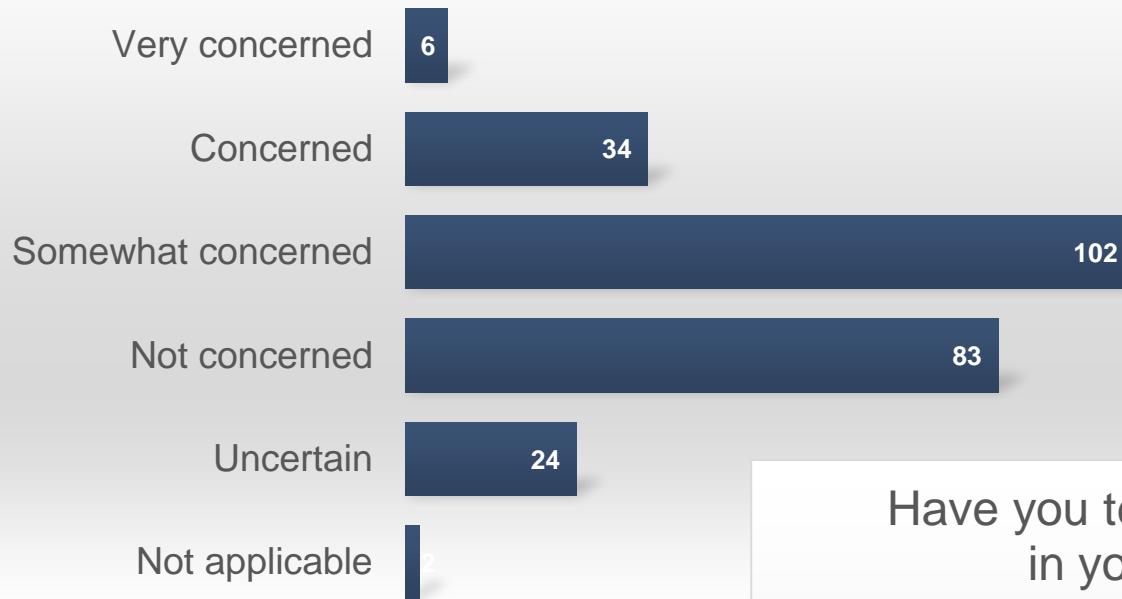
*n* = 256

Do you have concerns about Legionella or other pathogens of emerging concern within end-user plumbing (premise plumbing)?

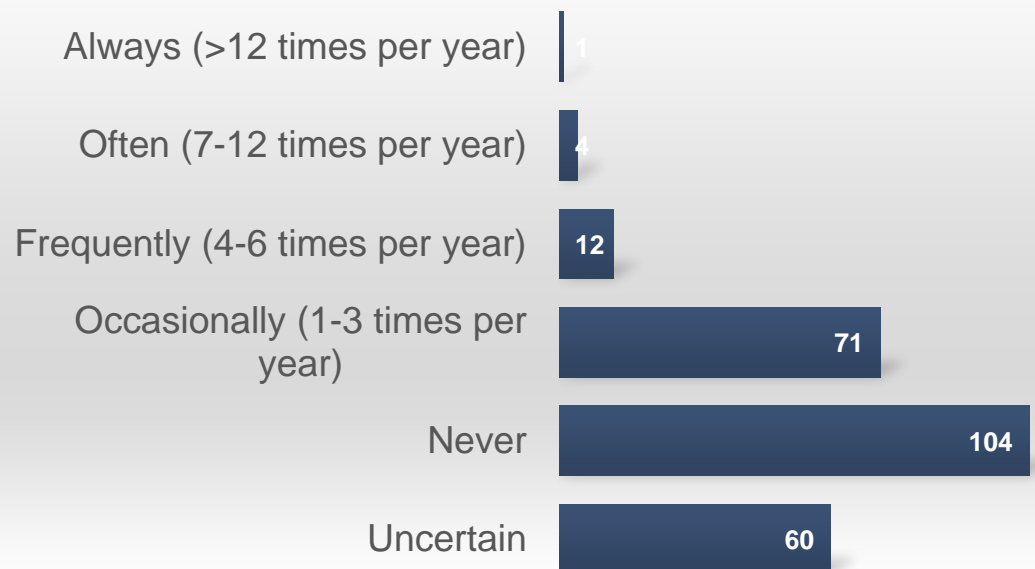


*n* = 255

## Do you have concerns about non-regulated DBPs in your distribution system?

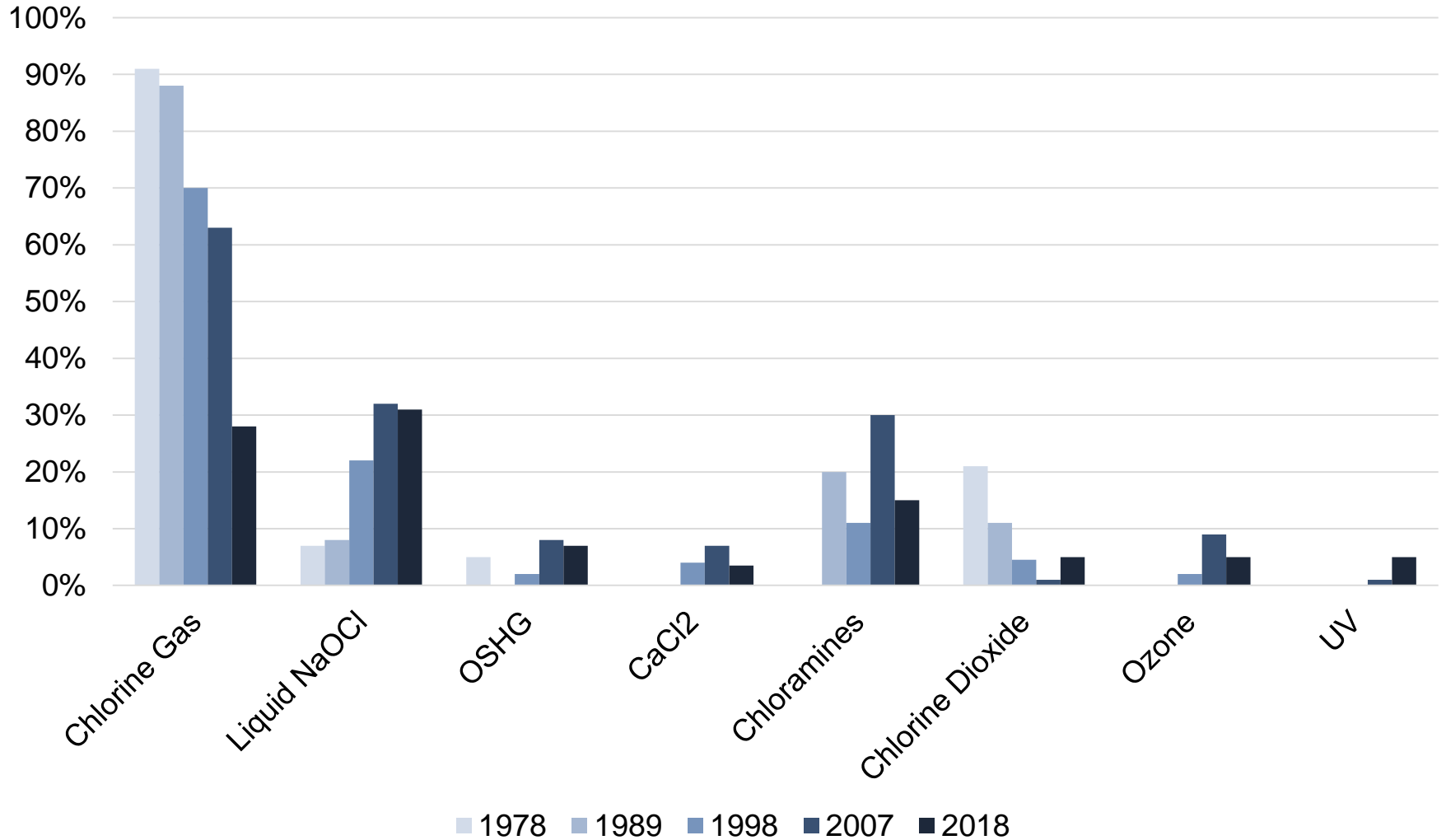


## Have you tested for non-regulated DBPs in your distribution system?

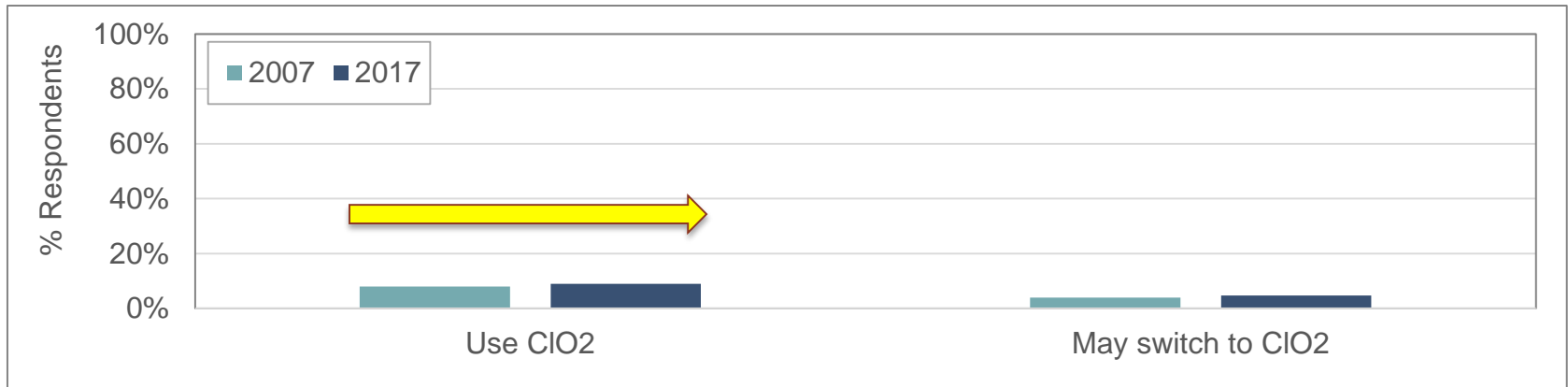


# Survey Trends

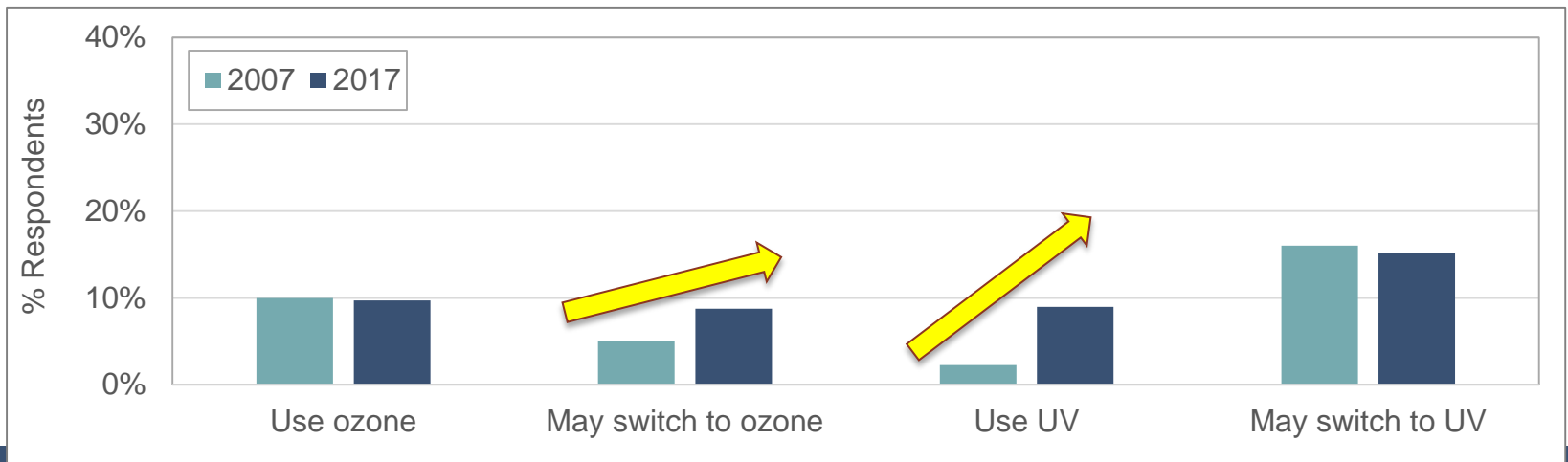
# Chlorine Gas Use Continues to Decrease



# Chlorine Dioxide Use as a Percentage of the Surveyed Population Did Not Change



# Ozone Use Is a Consideration, and UV Use Has Climbed Significantly



# Ozone Dosing Is Similar, UV Dose Has Changed Significantly

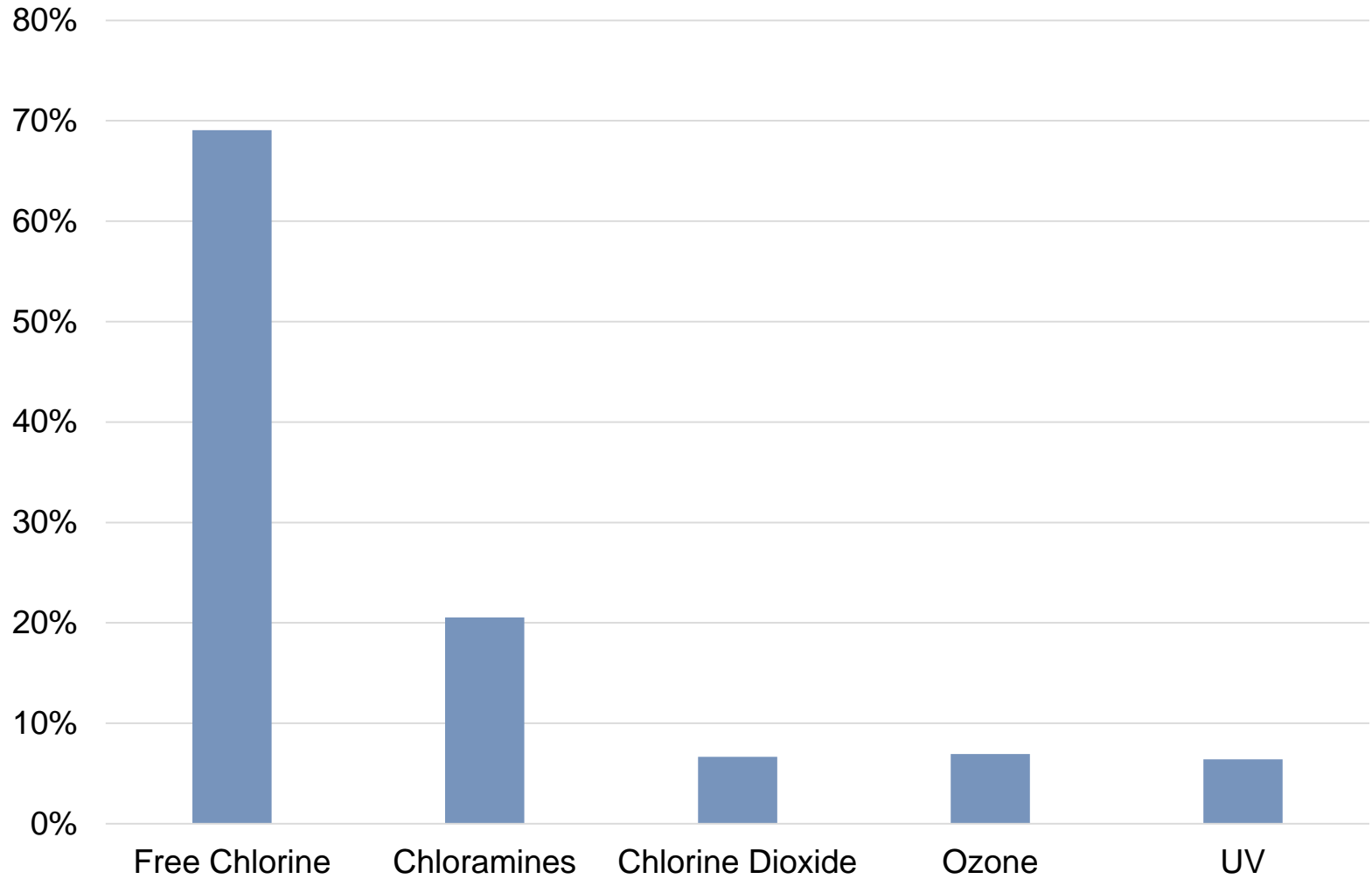
Ozone	2007	2017
Dose, Low (mg/L)	1.2	0.5 to 2
Dose, High (mg/L)	3.5	>4
Dose, Typical (mg/L)	2.2	2 to 4

UV	2007	2017
Dose, Low (mJ/cm <sup>2</sup> )	40	<10
Dose, High (mJ/cm <sup>2</sup> )	45	80 – 120
Dose, Typical (mJ/cm <sup>2</sup> )	40	10 – 20



# Summary

# Chlorine Still Rules



## ...But, critical industry trends are impacting chlorine's use and type

- Usage: Utilities increasingly concerned about:
  - Balancing DBP formation with adequate disinfection
  - Uncertainty over future regulations, and
  - Risks associated with its transport, storage and handling (specifically gas chlorine).
- Type: Liquid hypochlorite has now surpassed gas chlorine as the most commonly used form of chlorine

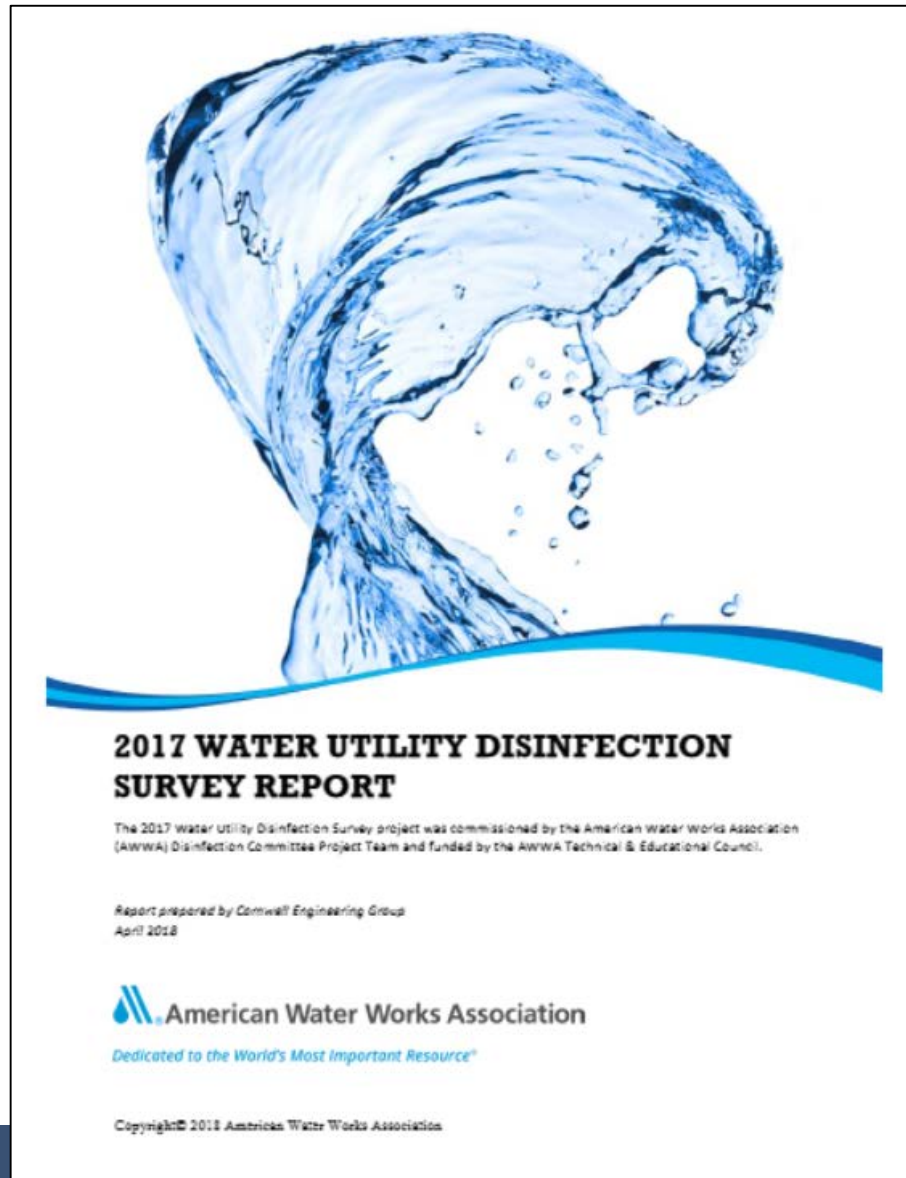
# Three Key Factors for Selecting a Disinfection Technology

- Cost
- Regulations (DBPs)
- Ability to Meet Multiple Objectives (e.g., T&O, Fe/Mn, etc.)

# And the Alternatives to Free Chlorine?

- Appetite appears to be low for chloramines and chlorine dioxide
  - $\text{NH}_2\text{Cl}$  commonly used for secondary disinfection, but other utilities either don't need, will pursue other options, and/or are concerned about nitrification.
  - $\text{ClO}_2$ : Attractive for meeting multiple treatment objectives, but chlorite formation is a restraint.
- Ozone and UV are increasingly being considered
  - While  $\text{O}_3$  was noted as costly and complex, it is attractive for THM/HAA control and ability to meet multiple objectives.
  - UV is perceived as costly, but it is alternative being most increasingly considered as additional *Crypto* protection.

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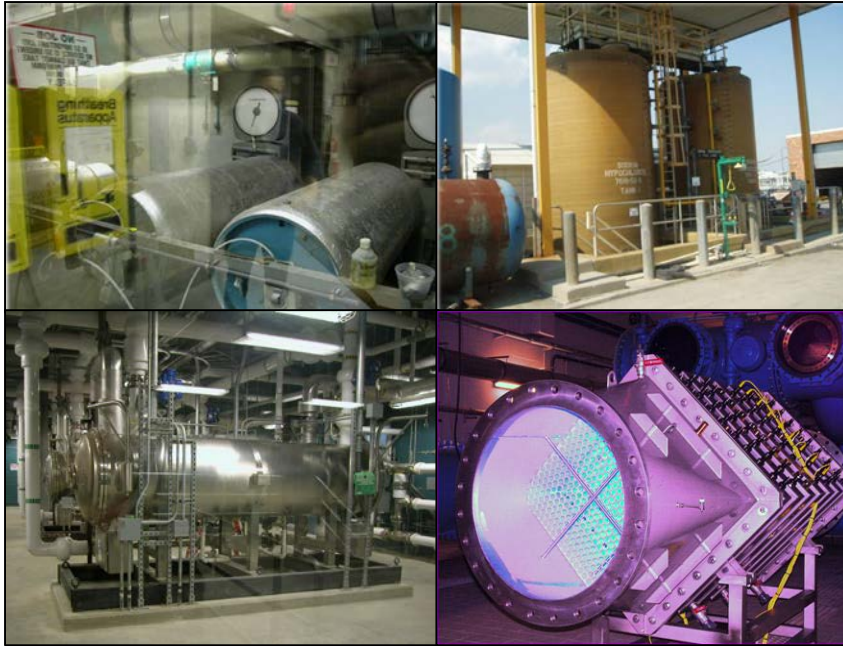
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