

Validating Pre-regulatory Cost Estimates for the Revised Arsenic MCL

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Background

- For decades EPA sought to revise the 50 $\mu\text{g/l}$ Maximum Contaminant Level (MCL) for arsenic
- In 2001 the MCL was lowered to 10 $\mu\text{g/l}$
- Enforceable as of January 2006
- Uncertainty and controversy
 - health effects
 - compliance costs

Retrospective

- Now that the rule is established
- Can we resolve any of these controversies?
 - Learn and improve the process

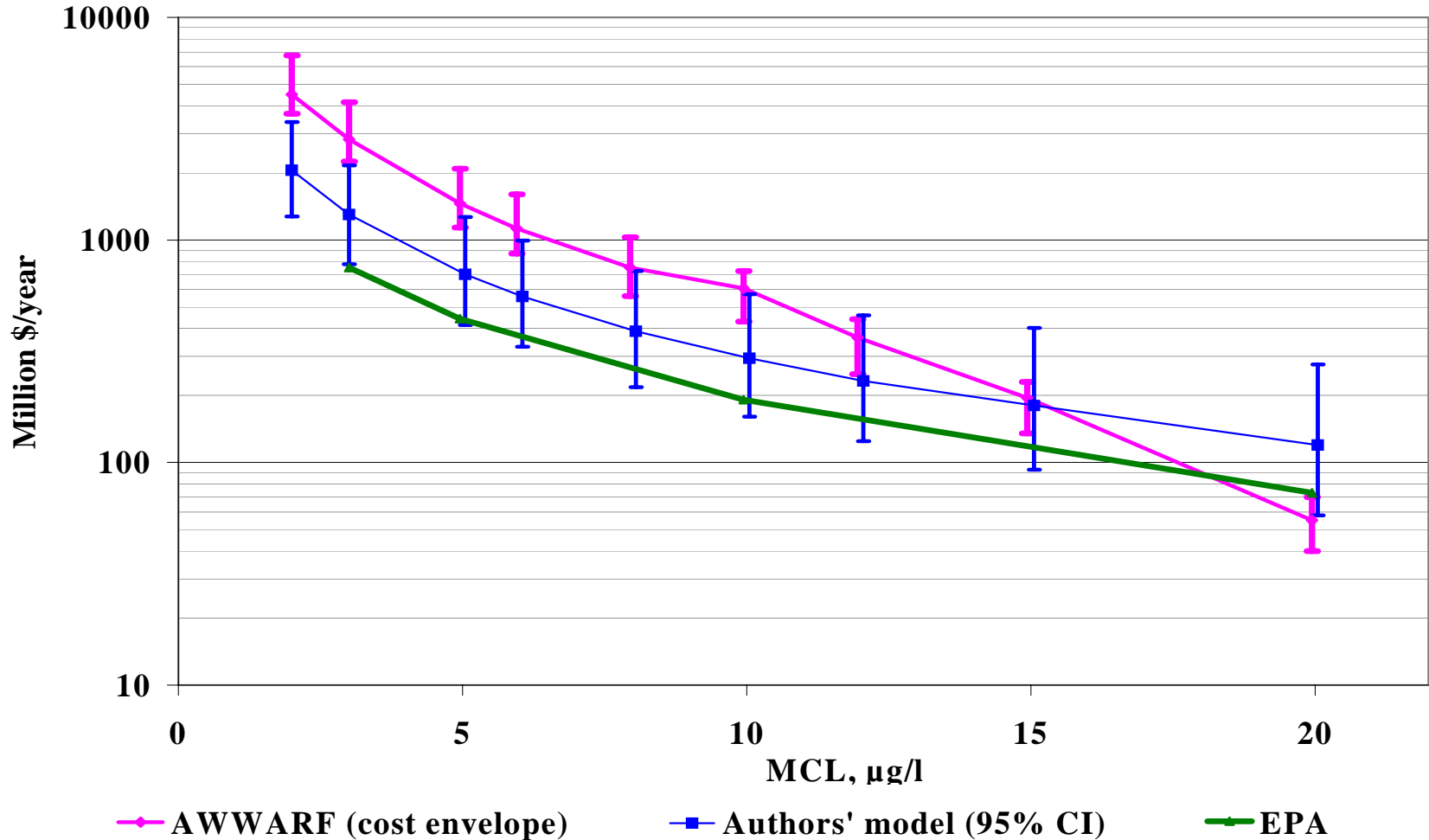
Sources of controversy: Health risks

- Risk based on epidemiological studies in Taiwan
- Exposures of $> 100 \mu\text{g/l}$
- Health risk from arsenic at low levels found in U.S.
 - Reduction of dozens of bladder cancers out of over 50,000 cases of bladder cancer annually (<http://cpmcnet.columbia.edu/texts/gcps/gcps0027.html>)
 - We will not feasibly be able to resolve this uncertainty

Sources of controversy: Costs

- Several pre-regulatory studies of impacts
 - EPA 2001
 - Frey et al. 2000 (AWWARF-sponsored, independent)
 - Gurian et al. 2001 (EPA-sponsored, independent)
- They all disagreed

Pre-regulatory cost estimates conflict



Cost discrepancies

- These cost discrepancies are potentially resolvable after the implementation of the new MCL
- It is beginning to be possible to do this
 - Survey utilities
 - EPA pilot systems program
- Preliminary study

Survey

- Student survey in Fall of 2003
- Present results for six utilities for which Frey et al. (2000) conducted detailed pre-regulatory analyses
 - Industry leaders: substantial progress toward meeting standard by 2003
 - Only specific utilities for which we found detailed pre-regulatory studies

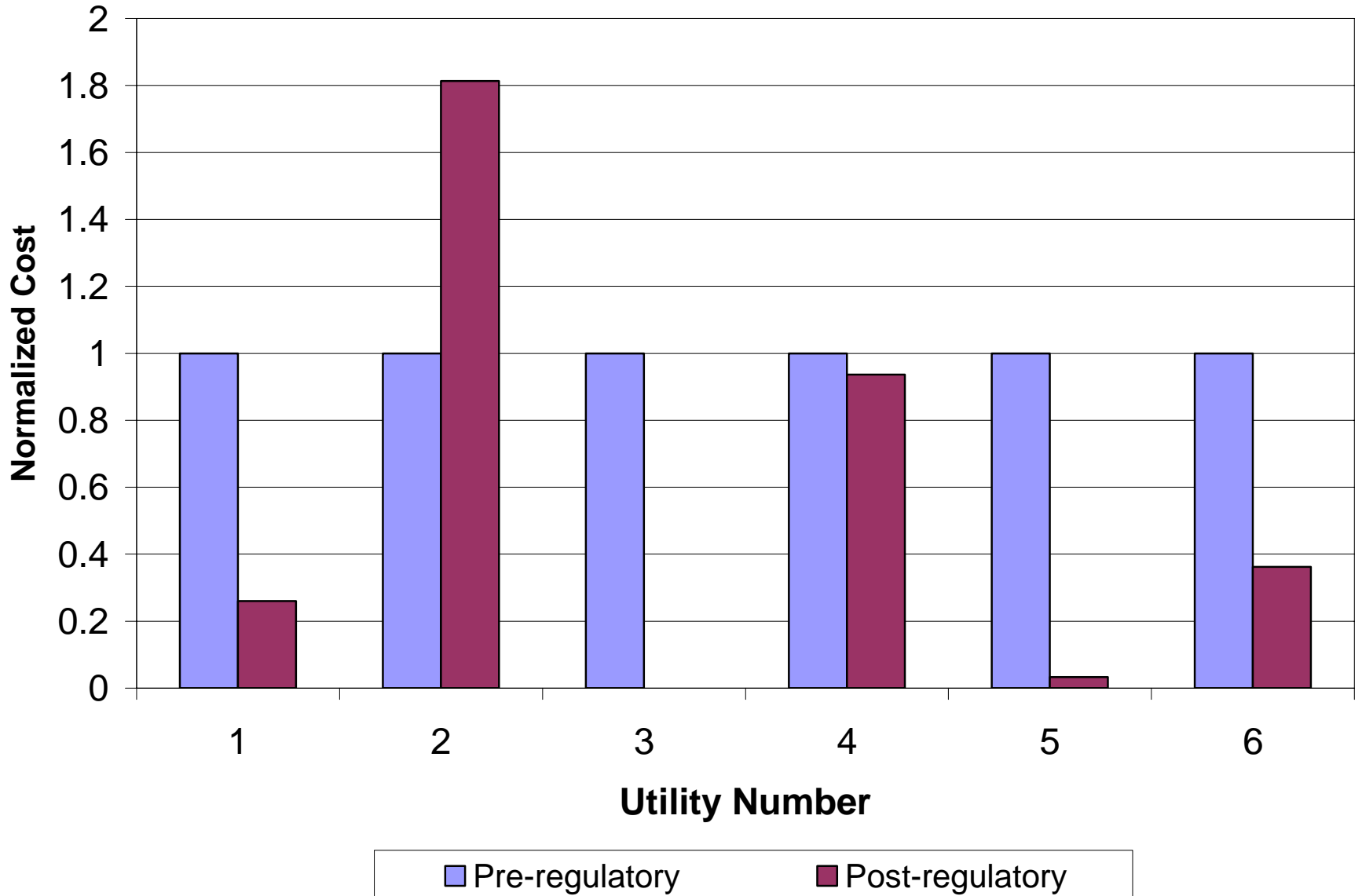
Why focus on Frey et al.?

- No disrespect is intended
- Control for large inter-system variability by comparing pre- and post-regulatory costs at the same systems
- Other studies (Gurian et al., EPA) modeled idealized systems

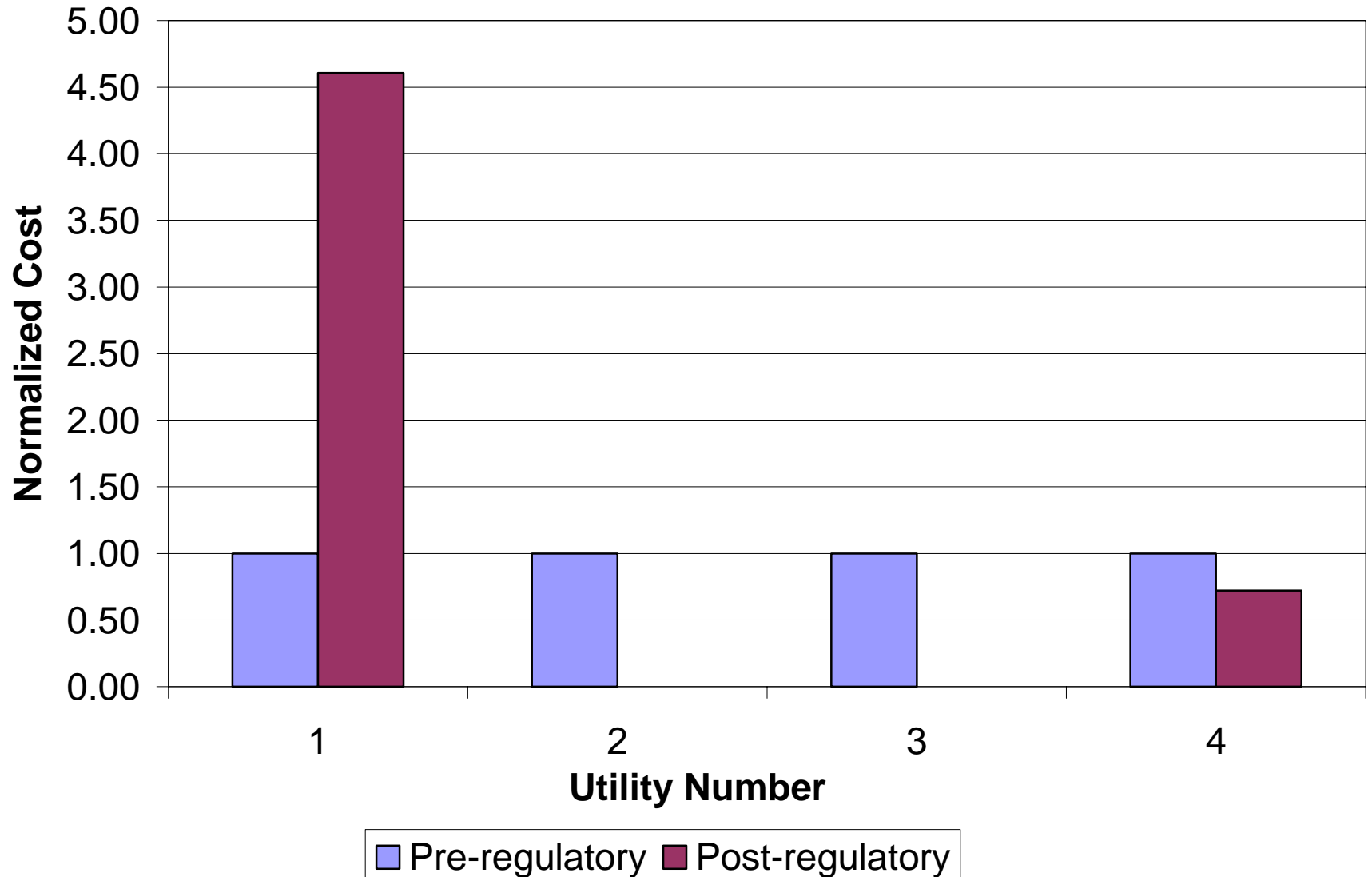
Survey results

- 5 out of 6 case study utilities provided information on capital costs
- Information on the 6th from website
- 4 out of six provided information on operations and maintenance (O&M) costs
- Thanks!
- One expressed concern about giving details of budgeted costs so we present results anonymously and numbering of utilities is not consistent

Capital costs



O&M costs



Compliance approach

Utility Number	Treatment Technology	
	Survey	Frey et al.
1	source switching	C/MF
2	coagulation-filtration and iron-based media	C/MF
3	source switching	ion exchange
4	blending	C/MF
5	blending	C/MF
6	iron-based media and blending	activated alumina

Results of comparison

- Discrepancies observed
 - Capital
 - O&M
 - Compliance method
- Note that Gurian et al. made similar predictions
 - Predicted conventional filtration for large plants

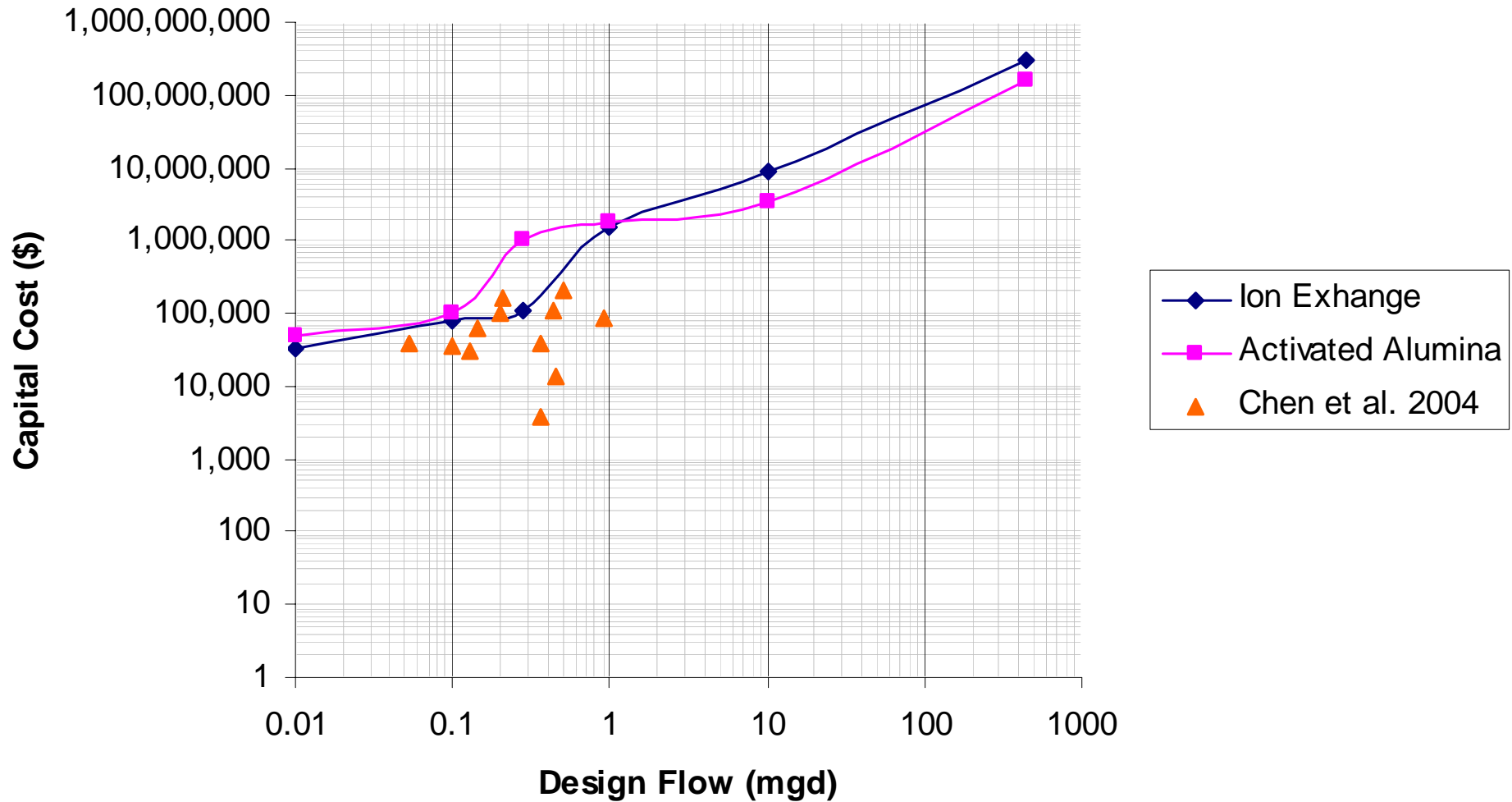
Why the discrepancies?

- Overestimates tended to result when non-treatment (source switching or blending) options were available
 - Pre-regulatory assumption that large systems would not find sufficient alternate resources
- Costs at the one utility that did treat rather than blend or switch were substantially underestimated
 - Arsenic concentrations are variable and additional wells were treated to provide safety factor
 - Pumping and piping costs were substantial, 27% of pre-regulatory cost estimate
- Large (ground water) utilities are an aggregation of many sources and facilities

Small system treatment costs

- Post-regulatory: Chen et al. (2004) capital costs from EPA pilot systems program
 - Mostly iron-based adsorptive media
- Pre-regulatory EPA Technologies and Costs for Removal of Arsenic from Drinking Water (SAIC and Malcolm Pirnie, 1999)
 - Ion exchange
 - Activated alumina

Capital Cost Comparison



Small system treatment results

- In 10 out of 12 cases pilot site capital costs were below 1999 estimates
- A random sample would probably have included utilities using alternative sources, regionalizing, blending, etc. which would further lower average costs
- However, operational costs often dominate for small systems
- The nightmare scenario of small systems operating complex residual treatment systems does not seem to have materialized, perhaps partly because of iron-based adsorbents

Conclusions

- Can we learn anything from such a small survey?
- Yes: Gurian et al. were wrong
 - On costs, Gurian et al. also addressed national exposure assessment methodological issues, novel regulatory strategies
- Two separate errors
 - Missed technological change: iron-based adsorbents
 - Missed extent to which large systems (particularly large ground water systems) are an aggregation of small systems: missed opportunities to switch sources
- Warrants further study to improve modeling for future regulations
 - Need to validate disaggregated models

Benefits of following compliance behavior

- Learn how to improve regulatory impact models
- Identify most promising compliance strategies in reality
- What's the best way to do this?