GORE® Mercury Control System

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Creative Technologies Worldwide

W.L. Gore and Associates, Inc

- Founded in 1958
- Inventors of ePTFE membrane
- Privately-held / Associate-owned
- Over 8,500 Associates
- Sales of over $3 Billion in fiscal year 2010
- Ranked in the U.S. and Europe by Fortune Magazine as one of the top 100 companies to work for
- Enterprise committed to innovation

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Worldwide Locations

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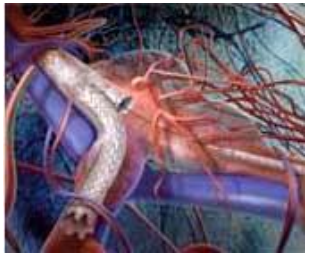
Manufacturing in U.S., Germany, Scotland, Japan, and China
45 plants and sales locations globally

W.L. Gore and Associates Inc.

- Fabrics Division
- Medical Division
- **Industrial Products Division**
  - Venting
  - Micro-Filtration
  - Sealants
  - **Filtration Technologies**
    - **Industrial Dry Filtration**
      - GORE® Filter Bags
    - Liquid Filtration
    - Cleanstream
    - Turbine Filters
  - Fibers
  - Micro-Contam. Control
  - Fuel Cells
- Electronic Products Division

GAS REMEDIATION

- Mercury Control System
- REMEDIA® Catalytic Filtration
- DeNOx

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Existing Strategies for Mercury Control

1. Remove in liquid phase in wet FGD scrubber
   - Relies on conversion of mercury to oxidized form upstream of scrubber
     - Sensitive to coal type
     - Additives can cause corrosion
     - Waste water treatment
     - Hg Re-emissions
2. Remove mercury from gas phase using sorbents
   - Activated Carbon Injection (ACI) is most common
     - Handling and disposal issues
     - Contamination of fly ash
     - Complicates PM compliance
     - Sensitive to coal type (SO_3, halogen content)

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Fixed Bed Sorbent Technology

- Because of the drawbacks associated with these approaches, fixed-bed technologies have been pursued
- Compared to ACI, fixed beds have inherent advantages:
  - Simple passive operation
  - No contamination of fly ash
  - Minimal solid waste generation
- However, due to saturation by SOx and other acid gases, fixed sorbent beds typically require frequent regeneration:
  - Energy-intensive, complicated regeneration processes
  - Adds significant cost (capital and operating)

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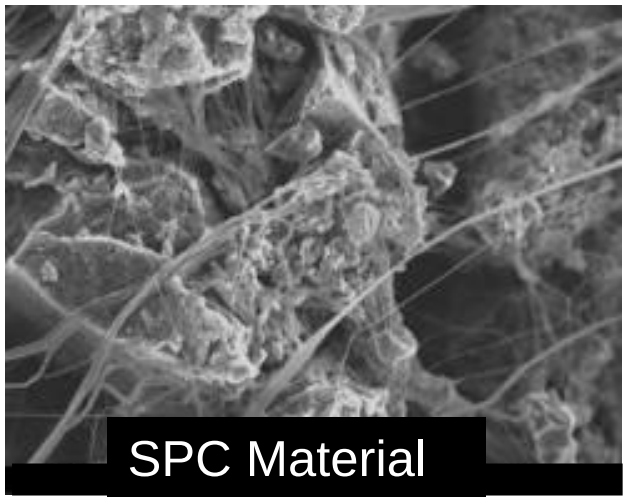
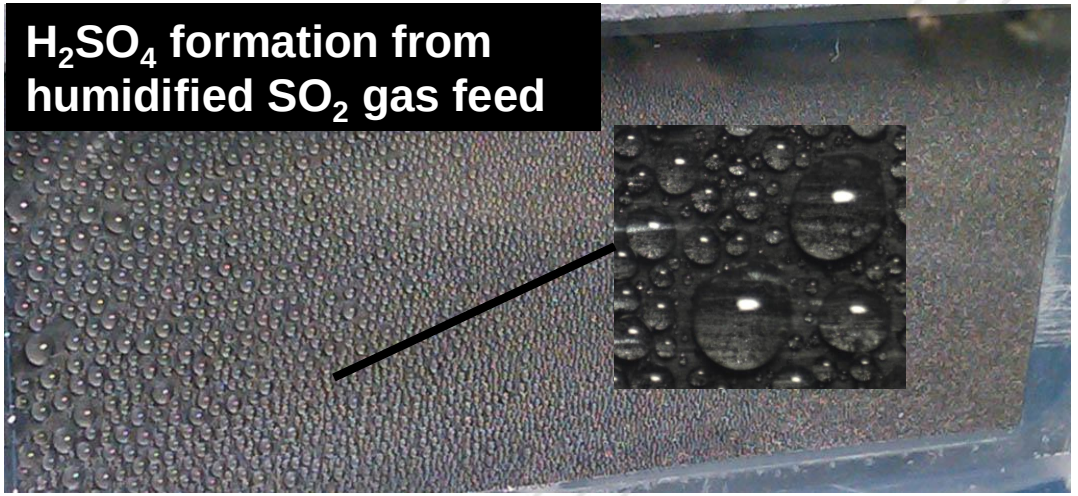
Material Innovation by Gore

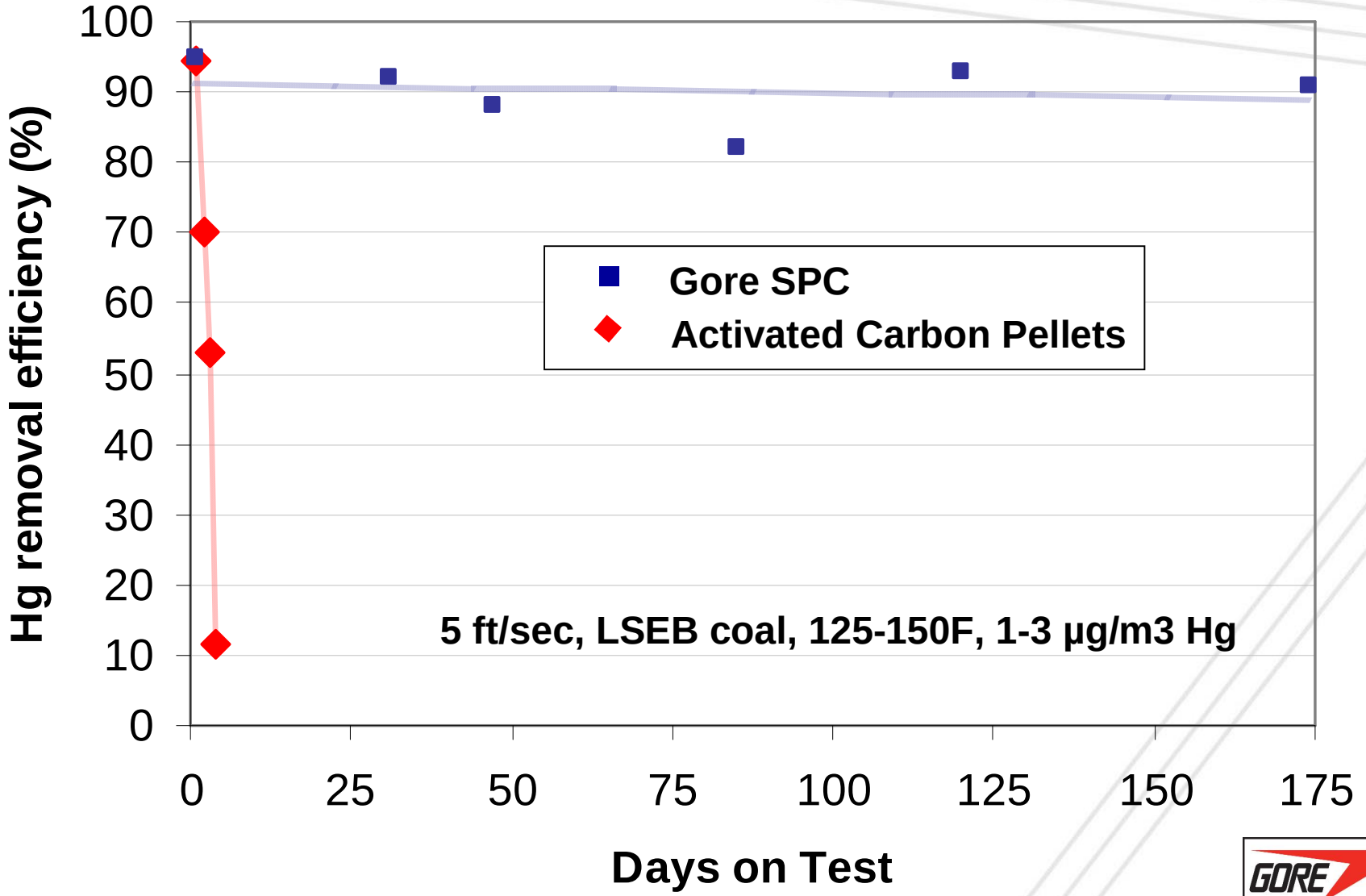
- Sorbent Polymer Composite (SPC) material
  - Efficiently captures both elemental and oxidized mercury Hg
  - High capacity for mercury storage
  - Does not require regeneration
- Unique physical-chemical nature of the SPC material
  - Acid gases are converted into aqueous solution and expelled to SPC material's outer surfaces
- SO_2 reduction is a co-benefit of this technology





Testing of Fixed Beds

Southern Company (Plant Yates)



Data generated by URS, EPRI, and Southern Company

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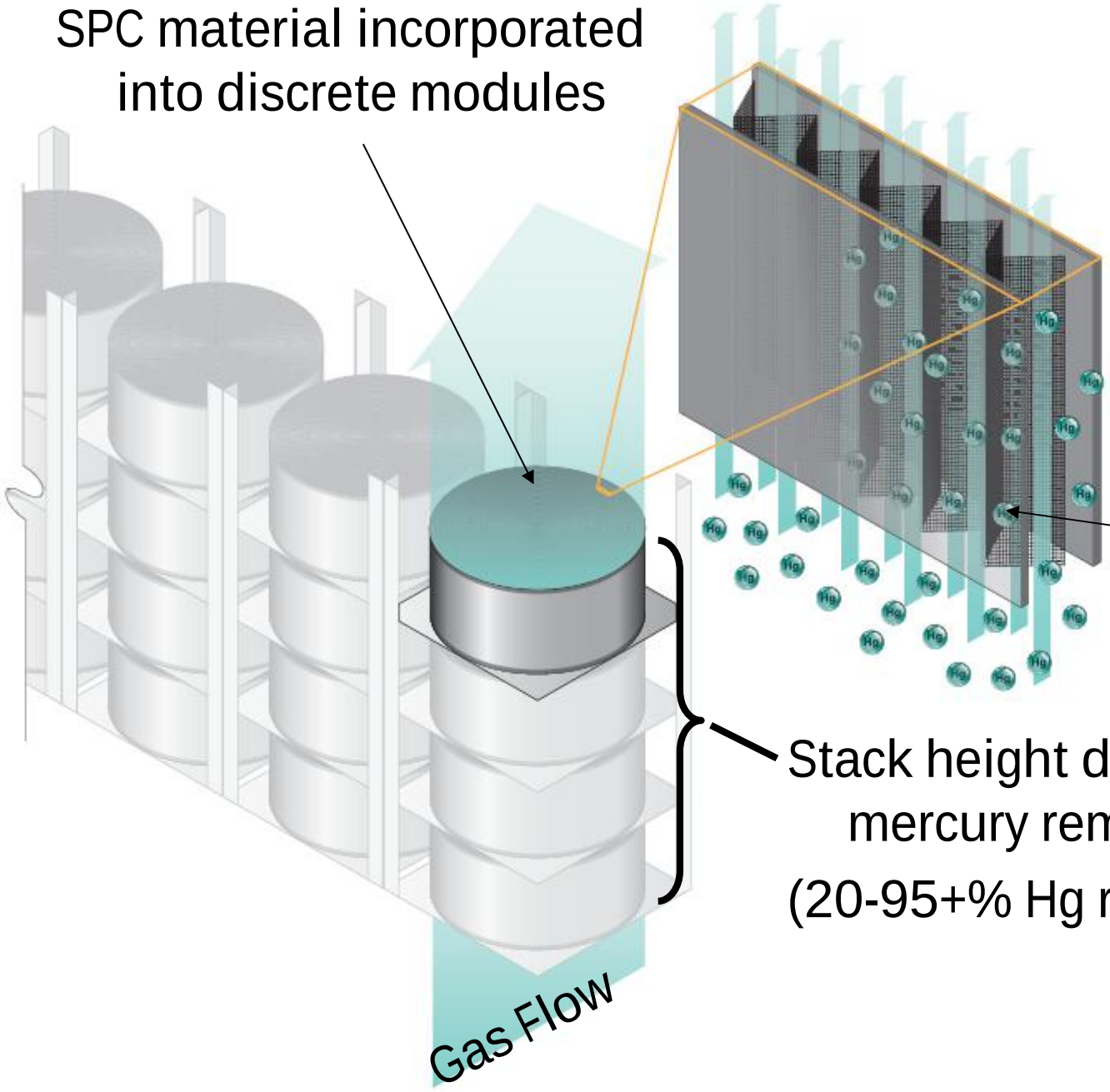
SPC material incorporated into discrete modules



Open-channel design provides low pressure drop

Hg is strongly bound to SPC material

Stack height determines mercury removal efficiency

(20-95+% Hg removal possible)

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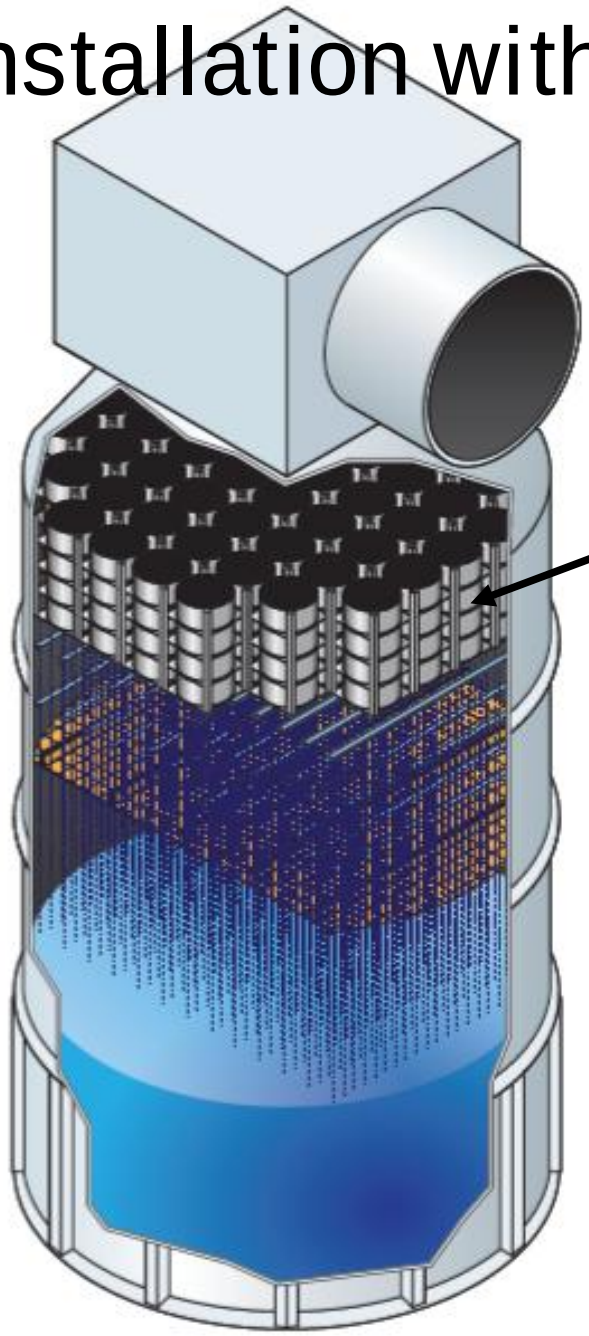
Installation within a Wet FGD Scrubber



GORE® Mercury Control Modules

- Modules provide mercury removal and SOx polishing.
- Prevents mercury re-emissions from a wet scrubber

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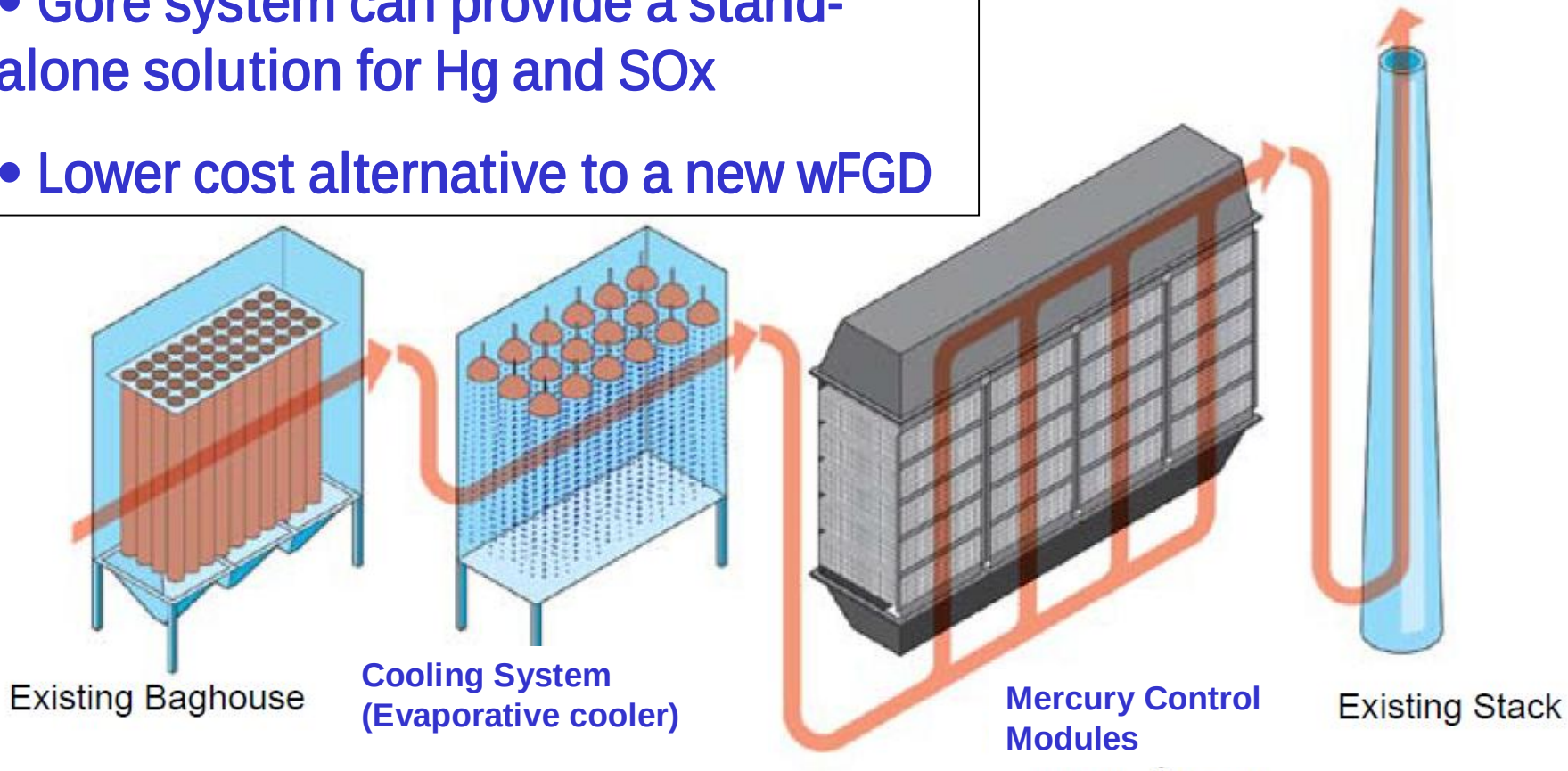
Installation without wFGD Scrubber

- Gore system can provide a stand-alone solution for Hg and SOx
- Lower cost alternative to a new wFGD



GORE® Mercury Control Modules operate best in the temperature range of 125-225°F (50-100°C)

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GORE® Mercury Control System

- Captures Elemental and Oxidized Mercury
  - Avoids need for upstream additives
    - Cost, complexity, corrosion concerns
    - Insensitive to raw material composition changes that impact mercury species
  - Resolves FGD mercury re-emissions concerns
    - Simplifies FGD operation
  - Doesn't rely on SCR catalyst health
- Low Operating Cost
- Self-Contained Sorbent
- Modular Compliance Solution

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GORE® Mercury Control System

- Captures Elemental and Oxidized Mercury
- Low Operating Cost
- Self-Contained Sorbent
- Modular Compliance Solution

– Long Module Lifetime
  - Modules have very high capacity for mercury storage
– Simple Operation
  - No adjustments needed to account for changes in mercury concentration or speciation
  - Little to no maintenance or energy required to operate
  - No regeneration

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GORE® Mercury Control System

- Captures Elemental and Oxidized Mercury
- Low Operating Cost
- Self-Contained Sorbent
- Modular Compliance Solution

Unlike Activated Carbon Injection:

- No contamination of fly ash
- No impact to particulate collection devices
- Minimal waste generation
- Simplified logistics
  - Avoids need for continuous transport, safe storage, disposal of PAC
- Allows fuel flexibility
  - Insensitive to flue gas composition changes (SO_3, halogen content, VOCs, Hg species)

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GORE® Mercury Control System

- Captures Elemental and Oxidized Mercury
- Low Operating Cost
- Self-Contained Sorbent
- Modular Compliance Solution

  - Mercury reduction determined by number of modules
    - Compliance assured by design
  - Flexibility to meet future regulations / process changes
    - Additional layer of modules for higher mercury capture represents minimal investment
  - Co-benefit of SO_2 reduction
    - Typically >50% SO_2 converted to H_2SO_4

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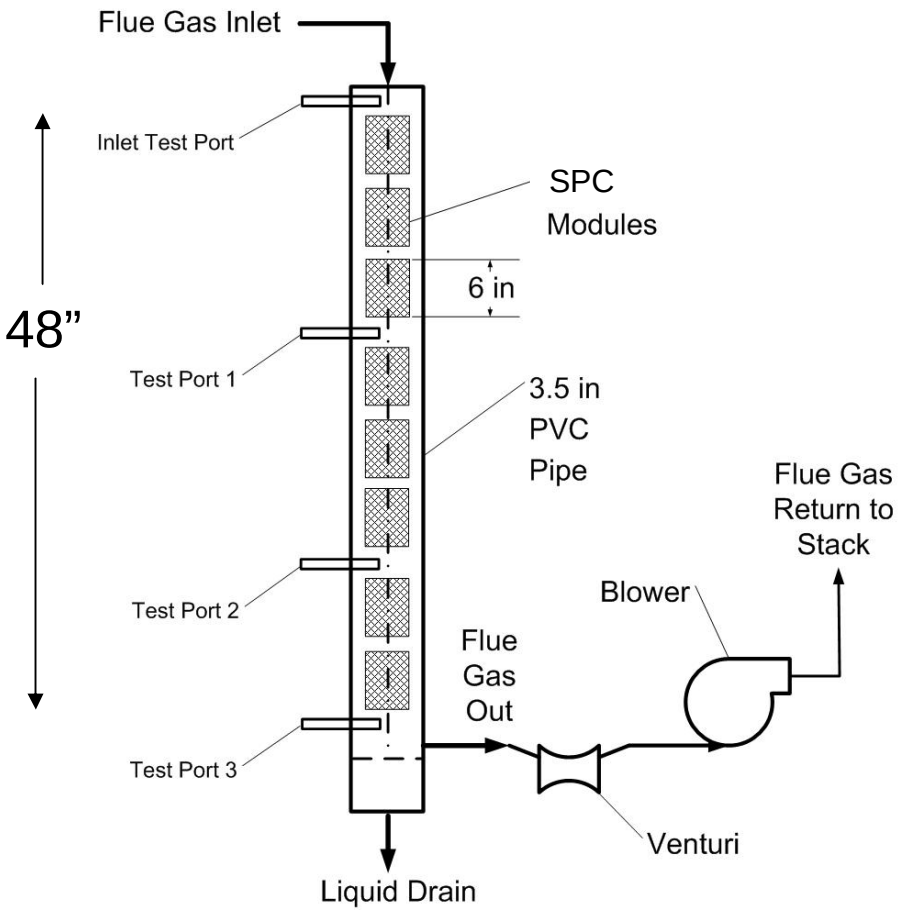
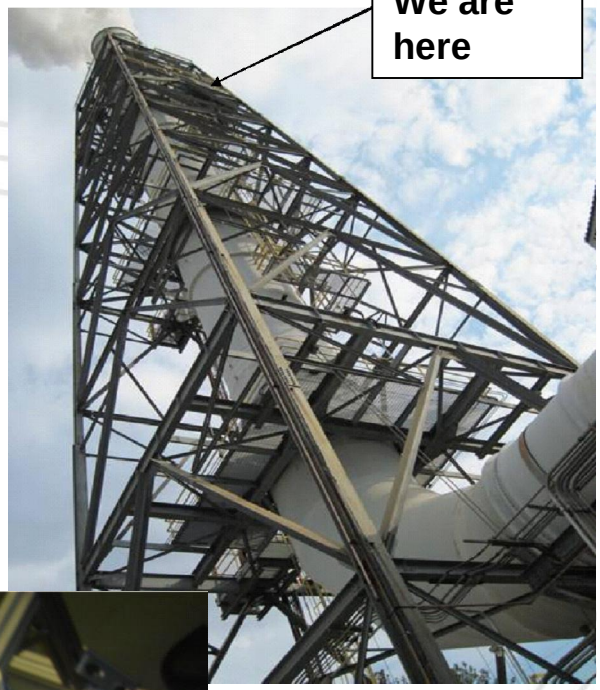
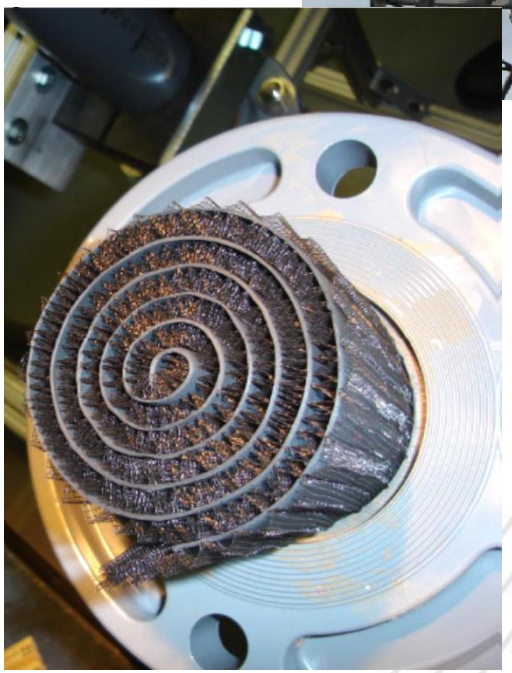
Plant Yates Demonstration (2010)







Gore, EPRI, URS, and Southern Company

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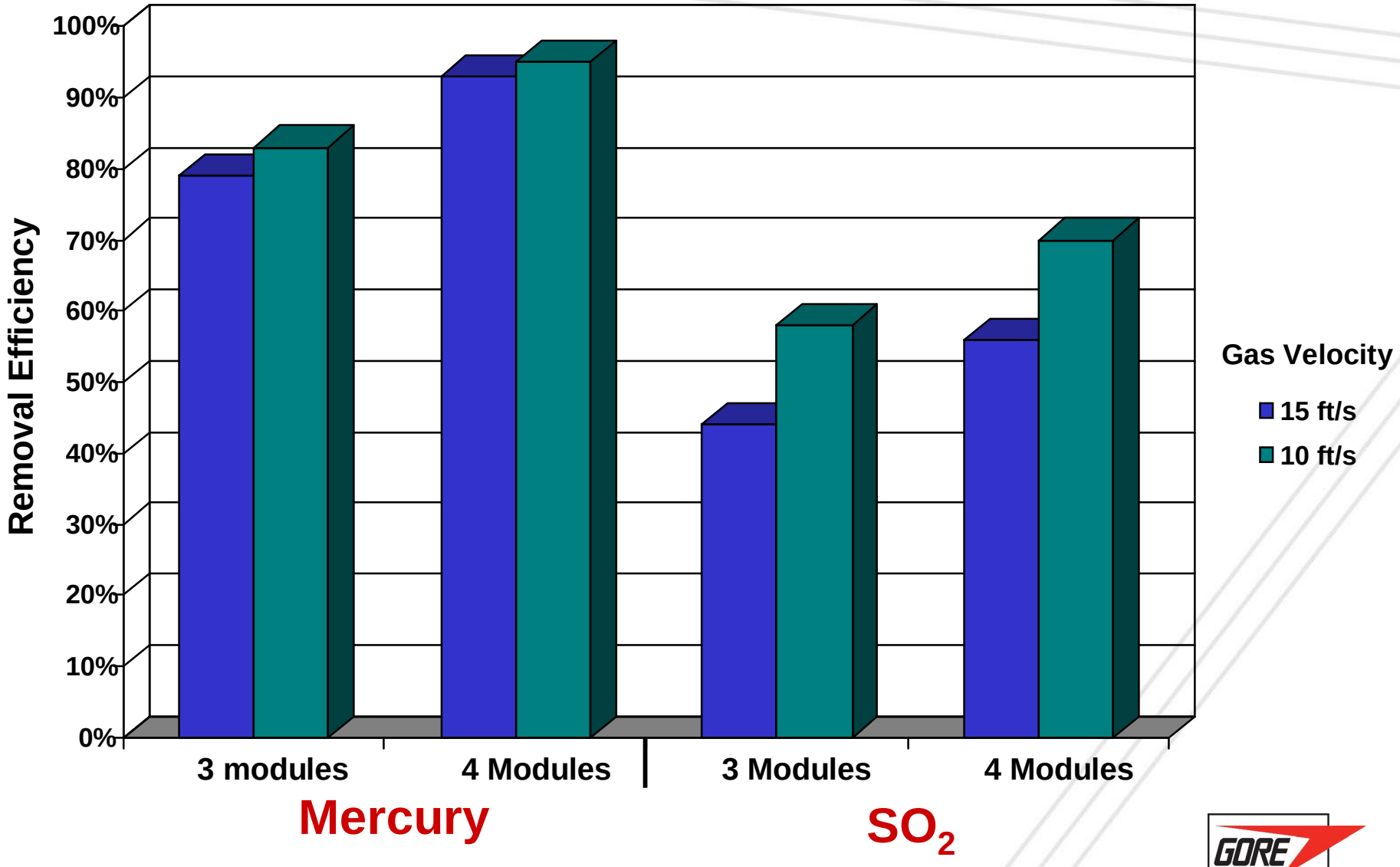
Average Removal Efficiency During 65 Day Test



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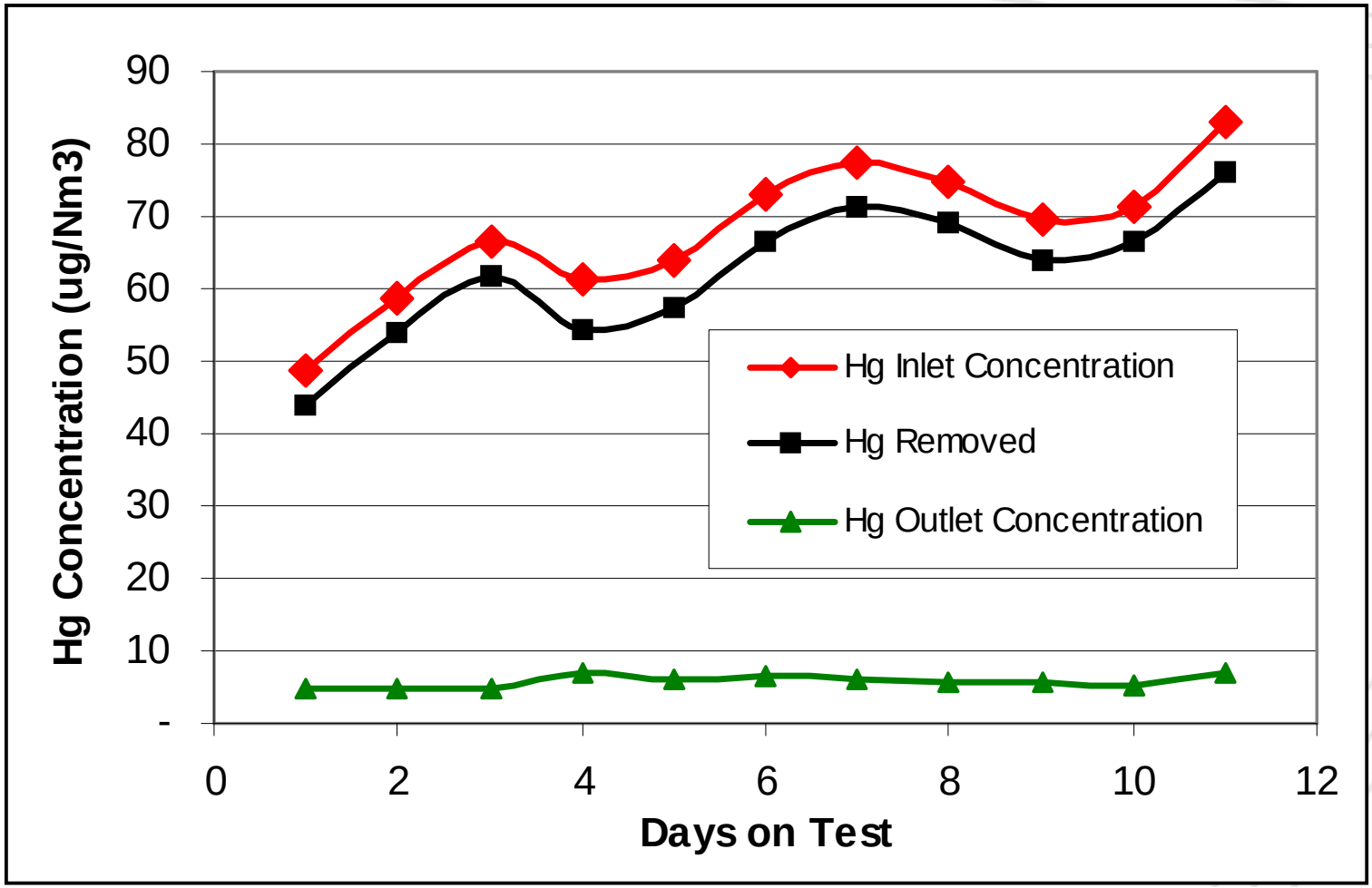
Passive Solution for Variable Inlet Concentrations



Significant changes in mercury inlet concentrations do not require any adjustments or changes to the modules

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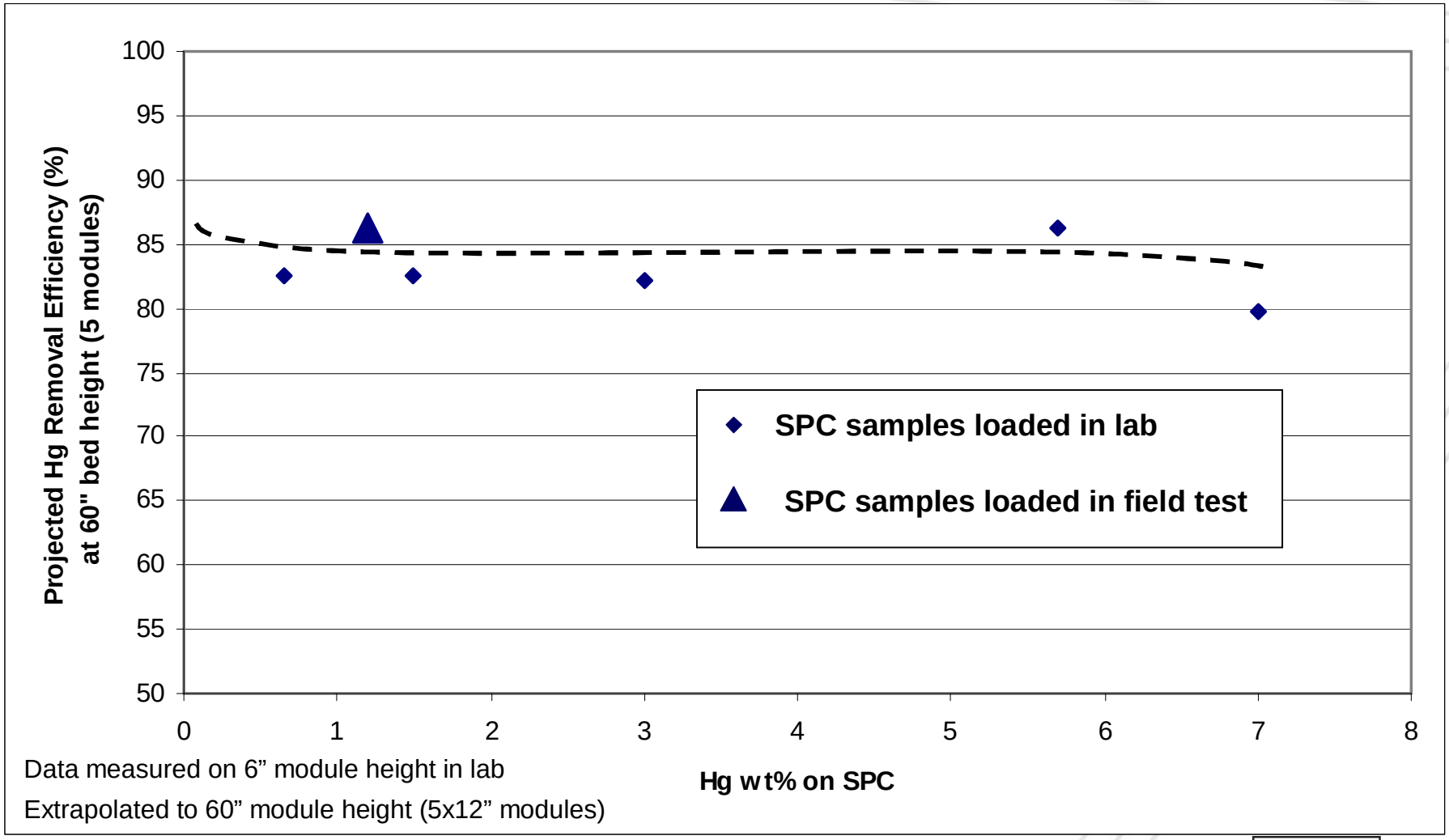
Lifetime Projections

Measured Hg-removal efficiency of SPC material with different amounts of captured Hg



Efficiency for Hg capture remains steady beyond 6 wt% Hg on SPC

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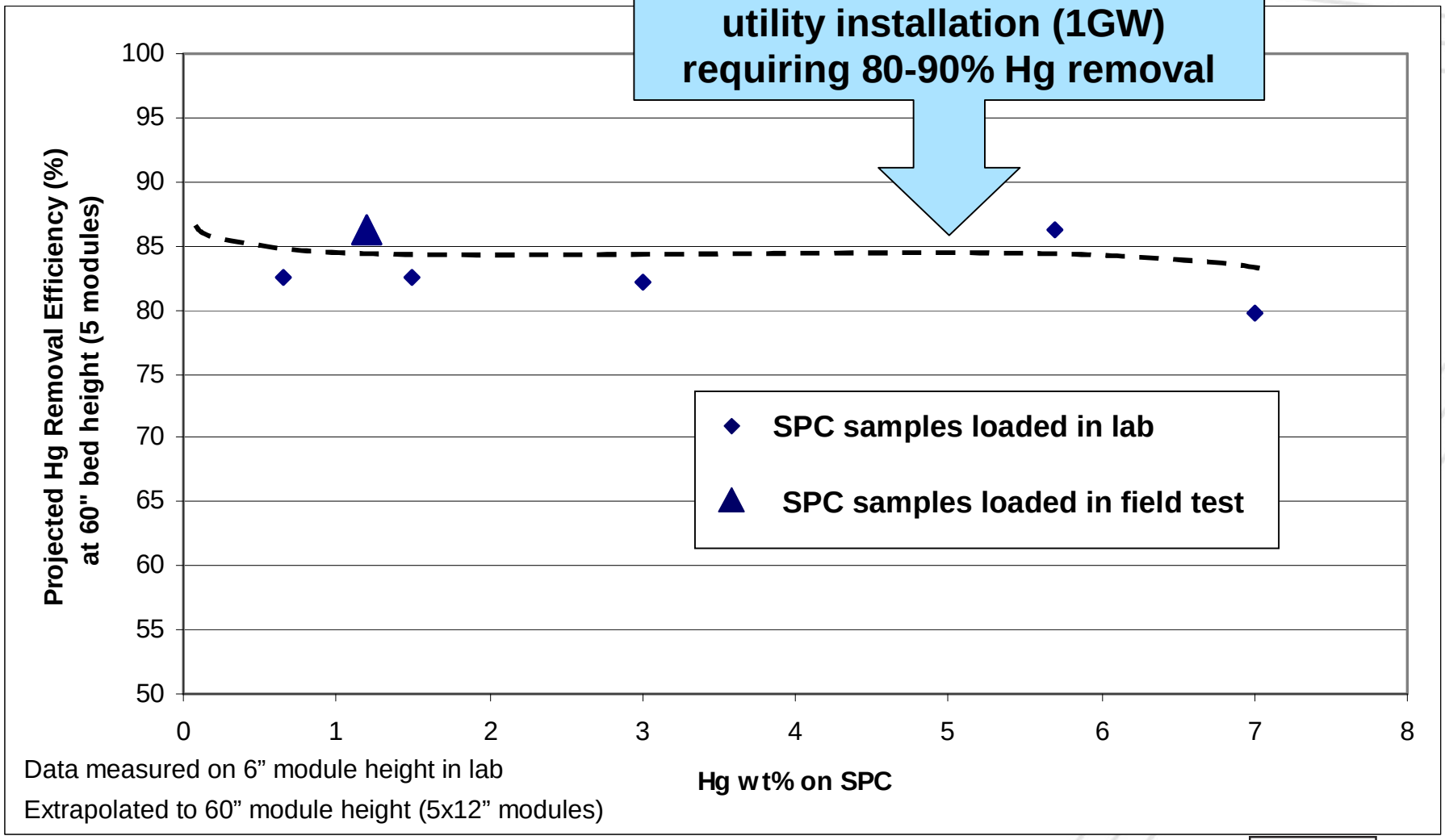
Lifetime Projections

Measured Hg-removal efficiency of SPC mat

5 wt% is equivalent to one ton of Hg removed for typical size utility installation (1GW) requiring 80-90% Hg removal



Data measured on 6” module height in lab

Extrapolated to 60” module height (5x12” modules)

Efficiency for Hg capture remains steady beyond 6 wt% Hg on SPC

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Economic Analysis

- Performed by URS (Austin, Texas)
- ~600 MW unit
  - Wet FGD Scrubber, ESP, no SCR, lignite coal
  - ~70% Hg reduction needed
  - Ash sales practiced
- Four options considered
  - 1) ACI (5 lb/MMacf)
  - 2) Bromide additives (200ppm)
  - 3) ACI + Bromide additives (1 lb/MMacf + 50 ppm)
  - 4) Gore® Mercury Control System installed in scrubber
    - 3-year and 6-year module lifetime modeled

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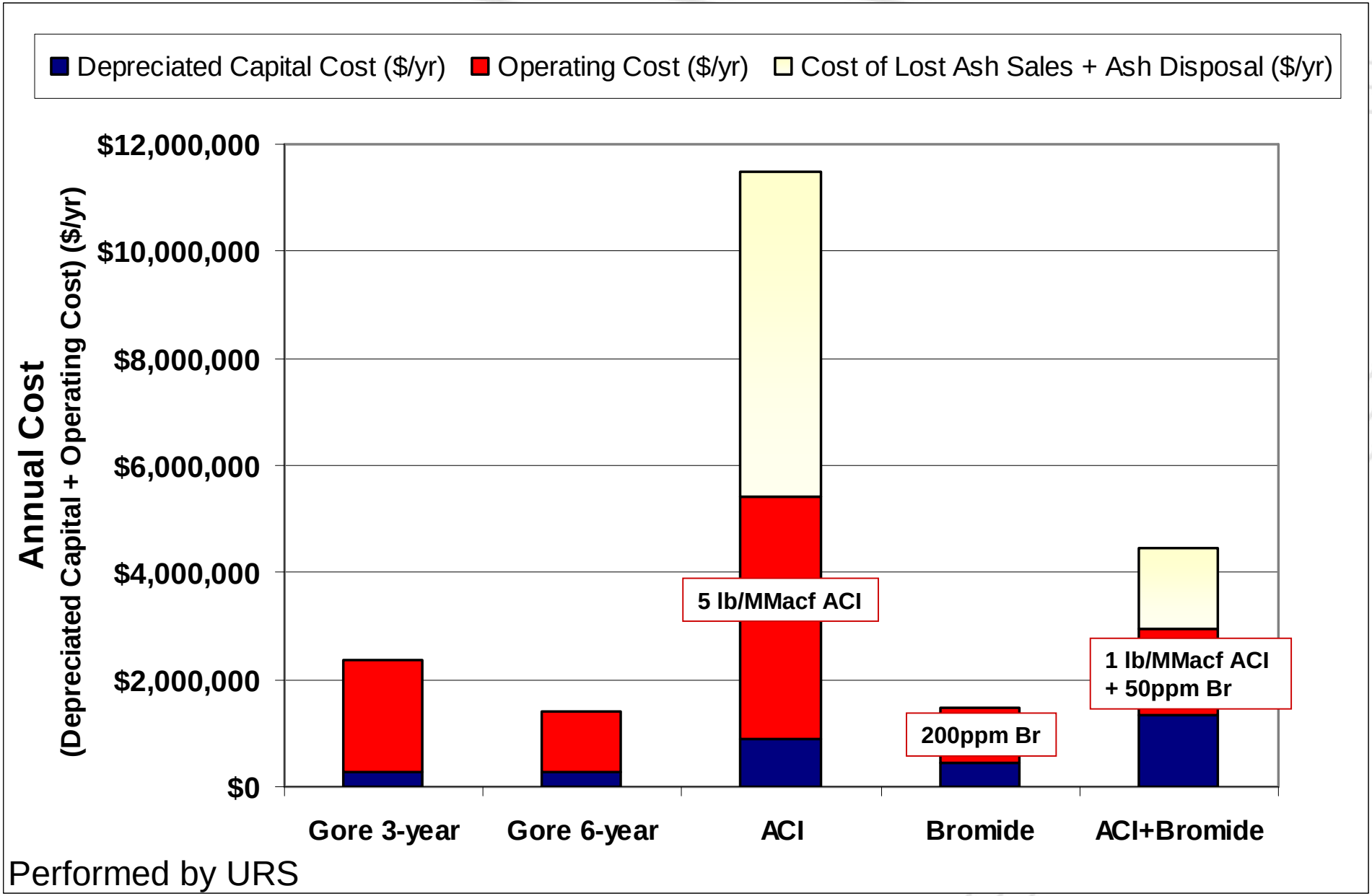
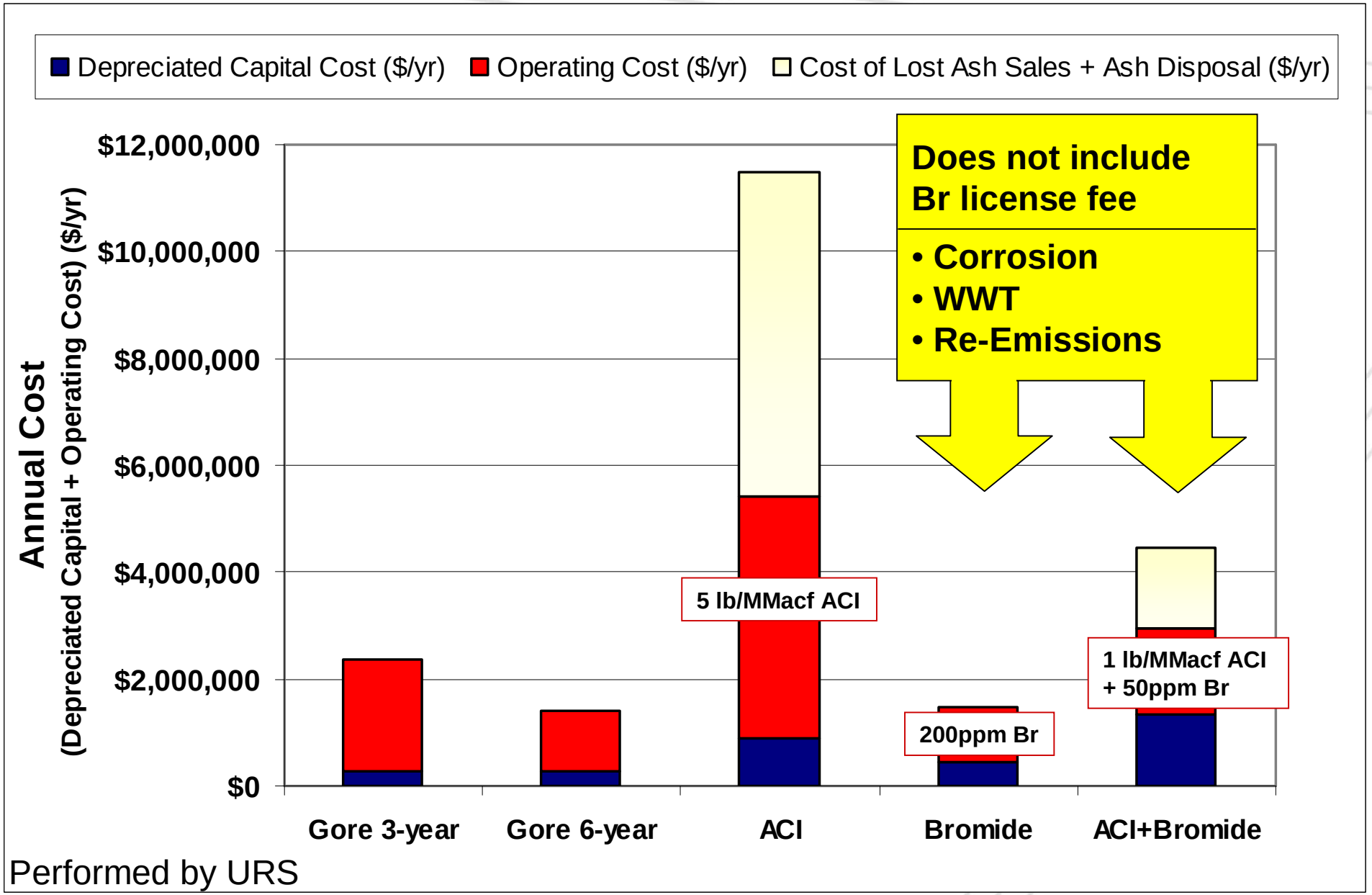
Economic Analysis



Performed by URS

Economic Analysis



Performed by URS

Summary

- Gore has a new approach to mercury control
  - Simple, robust, low-maintenance solution
  - Low cost (capital and operating)
  - SOx reduction co-benefit
- Field testing has demonstrated high efficiency and long lifetime
  - Additional post-scrubber and in-scrubber pilot tests starting this year
- Full scale installations proposed for next year
  - Seeking additional early adopter sites

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