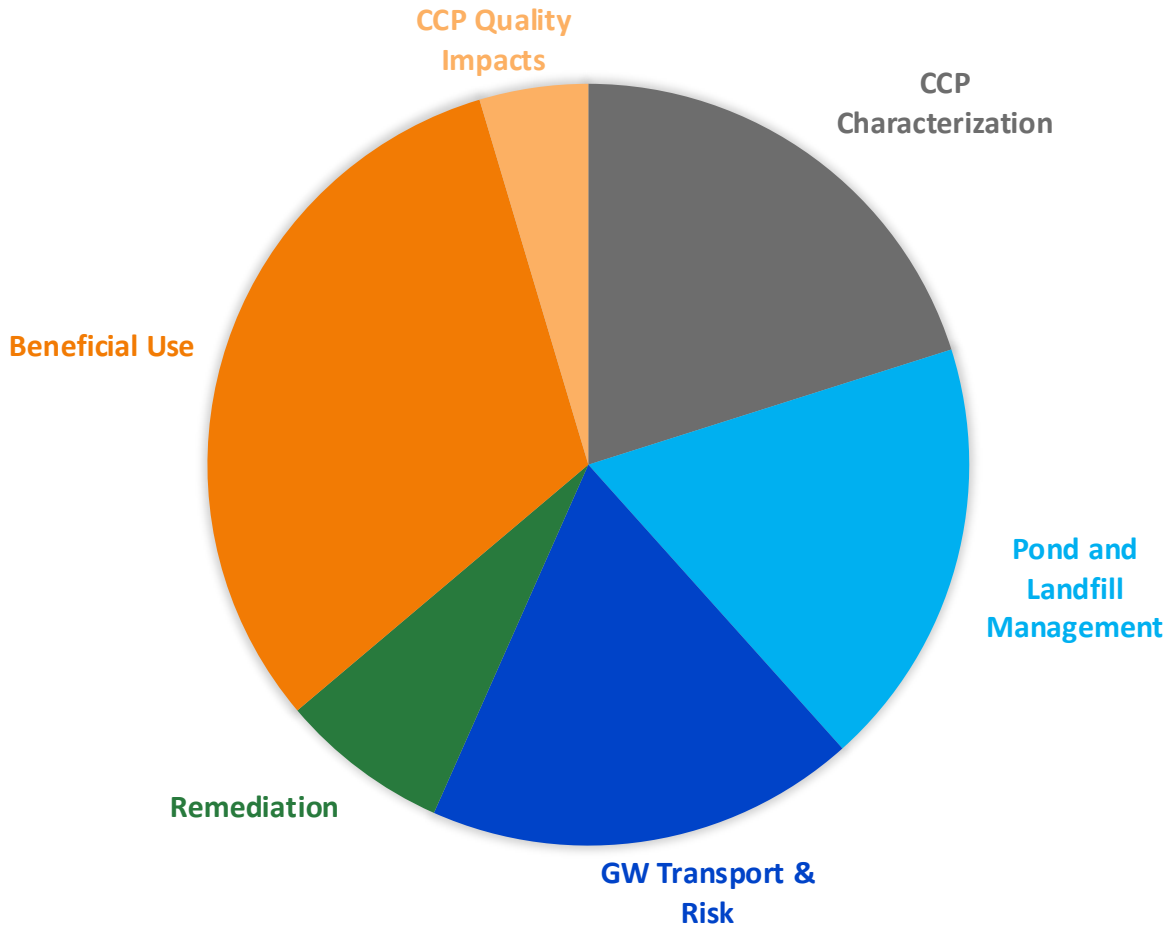
Overview of EPRI Environmental and Sustainability Research on CCPs

Bruce Hensel, Principal Technical Leader

ADAA International Symposium 2024
October 8, 2024

Topics

- About EPRI
- CCP Management in the US
- Research Overview



EPRI: Advancing Safe, Reliable, Affordable, and Clean Energy for Society Through Global Collaboration, Science and Technology Innovation, and Applied Research

About EPRI

Vision

To be a world leader in advancing science and technology solutions for a clean energy future

Mission

Advancing safe, reliable, affordable, and clean energy for society through global collaboration, science and technology innovation, and applied research.

Together…Shaping the Future of Energy™

COLLABORATION

EPRI's collaborative platform is unrivaled. Our R&D:

- Leverages your research dollars
- Connects you to a global network of peers
- Accelerates deployment of technology
- Mitigates the risk and uncertainty of going it alone
- Positions you as a leader in addressing industrywide challenges

CREDIBILITY

EPRI's independent research is guided by our mission to benefit the public. We offer:

- Objective solutions
- A proven track record
- Scientifically based research you can trust

EXPERTISE

For more than 50 years, EPRI has been applying R&D to help solve real challenges. With EPRI, you can:

- Reduce expenses and increase productivity
- Be more resilient today and better prepared for tomorrow
- Access an industry repository of collective experiences, technical expertise, and training resources
- Extend your staff and make your teams more robust and more confident
- Benchmark, learn and share best practices
- Increase your awareness of challenges that others are facing and alternate solutions to challenges you might be facing
- Save time and money troubleshooting problems EPRI and its stakeholders have seen before

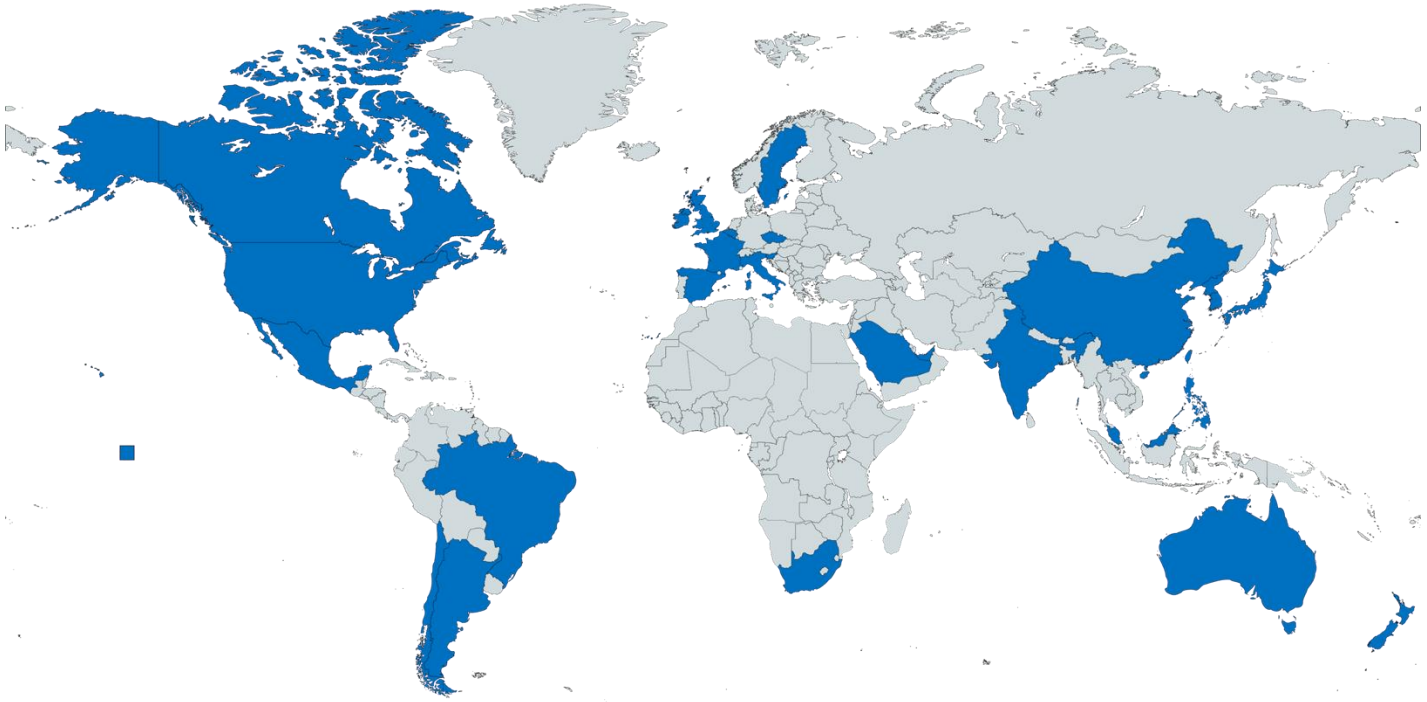
Who We Are

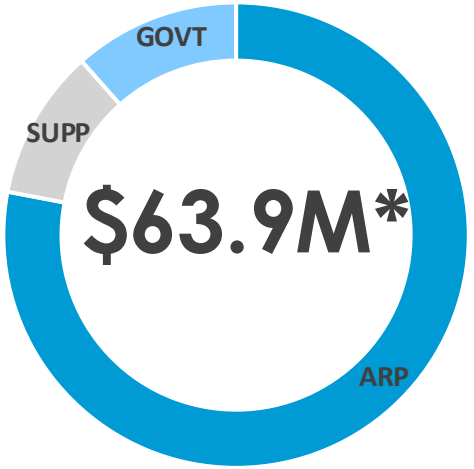
EPRI is a non-profit organization that performs research to advance safe, reliable, affordable, and clean energy for the public benefit.

Our Members

EPRI members represent 90% of the electricity generated and delivered in the United States, with international participation extending to nearly 40 countries.

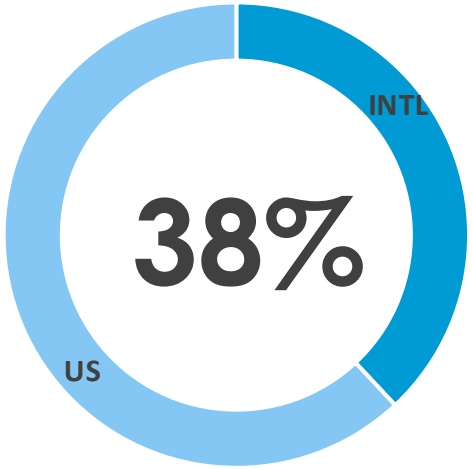
Generation Sector at a Glance





GENERATION SECTOR RESEARCH PORTFOLIO SCOPE

*YTD Funding (06/7/24)



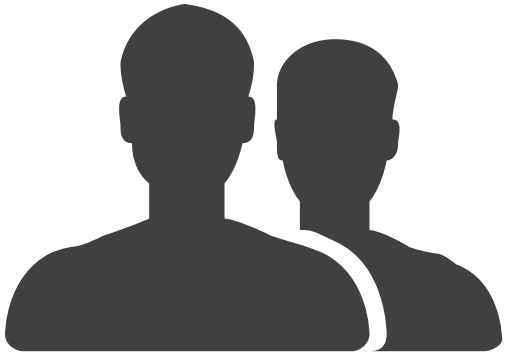
INTERNATIONAL OVERALL PARTICIPATION

26 COUNTRIES REPRESENTED

45 ORGANIZATIONS ACROSS THE SUPPLY CHAIN

70 INTERNATIONAL PARTICIPANTS

183 TOTAL US AND INTERNATIONAL PARTICIPANTS



OUR TEAM

~150 TECHNICAL GENERATION STAFF

2,000+ YEARS OF INDUSTRY EXPERIENCE

Power Companies – OEMS – Suppliers
Engineering Firms – Academia – Government

Australia Well-Represented in EPRI

EPRI Generation Sector Australian Workshop

5 November 2024 – 7 November 2024

8:00 am-5:00 pmAEST

InterContinental Sanctuary Cove Resort

Manor Circle Hope Island, QLD(AUS) 4212

Open to EPRI Members and Non-members

EPRI 2024 Workshop
Intercontinental Sanctuary Cove Resort, Gold Coast

November 5 8:00 am to 9:00 am	Breakfast		
November 5 9:00 am to 12:30 pm	Plenary Session: Australia Energy Transition & EPRI R&D		
November 5 12:30pm to 1:30 pm	Lunch		
November 5 1:30 pm to 5:00 pm	Materials Program 229	Chemistry Program 226	Heat Rate & Flexibility Program 223
November 6 8:00 am to 9:00 am	Breakfast		
November 6 9:00 am to 12:30 pm	Pressure Parts (Boiler) Program 214	Steam Turbines Program 219	Generators Program 220
November 6 12:30pm to 1:30 pm	Lunch		
November 6 1:30 pm to 5:00 pm	Pressure Parts (Piping) Program 215	Steam Turbines Program 219	Generators Program 220
November 6 6:00 pm to 8:00 pm	Reception		
November 7 8:00 am to 9:00 am	Breakfast		
November 7 9:00 am to 12:30 pm	Pressure Parts (HRSG) Program 218	Turbine Generator User Group Program 219/220	Fly Ash Erosion Session
November 7 12:30pm to 1:30 pm	Lunch		
November 7 1:00 pm to 5:00 pm	Pressure Parts – Cross Cutting Program 214/215/218	Turbine Generator User Group Program 219/220	Future Generation Session

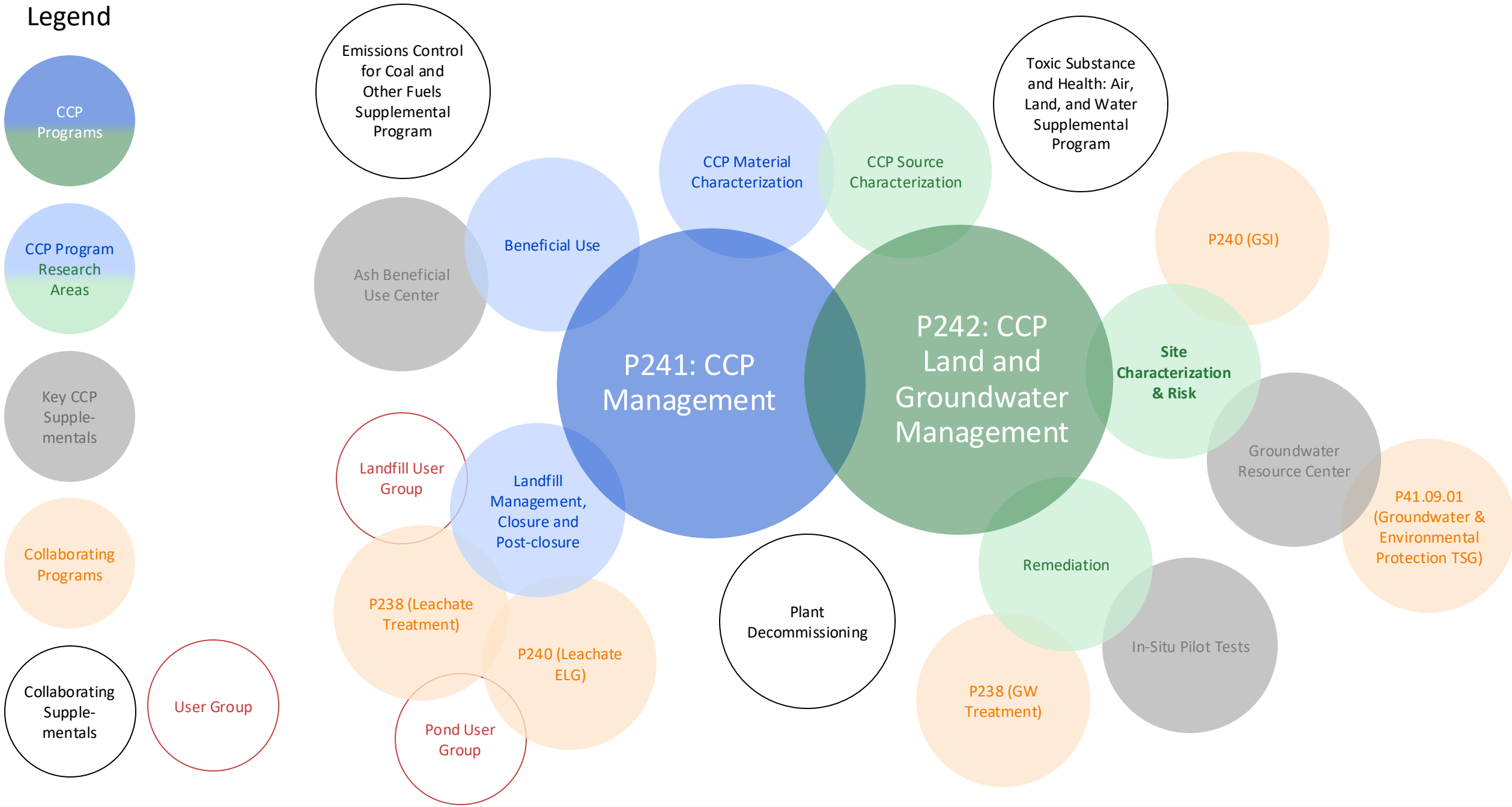
EPRI's CCP Team

- Bruce Hensel
  650-308-6472
  Bhensel@epri.com
  - P242 Lead (2024)
  - CCP Leaching
  - Environmental Issues
  - Site Characterization
  - Risk
  - Statistics
  - Remediation
  - Groundwater Resource Center

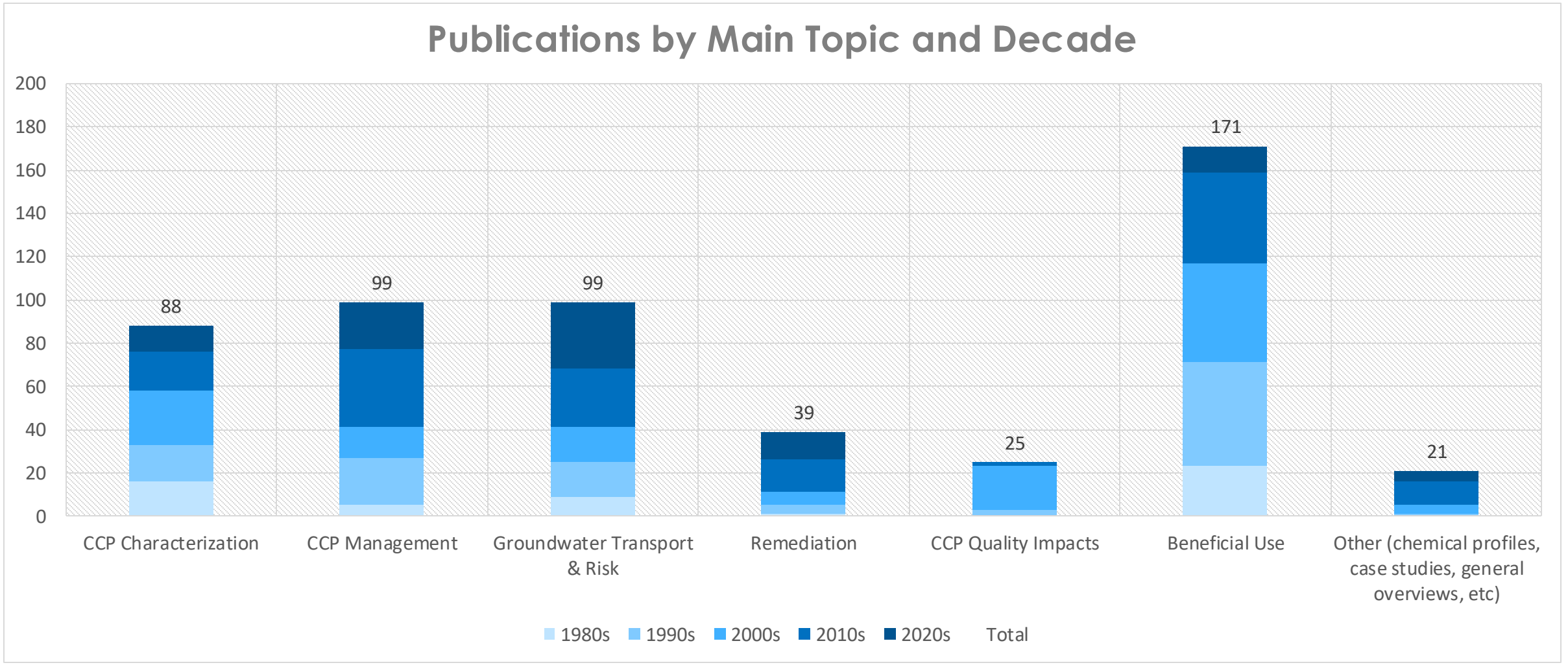
- Ben Gallagher, PE
  650-338-8653
  BGallagher@epri.com
  - P241 Lead
  - Beneficial Use
  - CCP Operations/Engineering
  - Landfill/Impoundment Management
  - Pond Closure
  - Ash Beneficial Use Center

- Lea Millet
  470-747-2552
  LMillet@epri.com
  - P242 Lead (2025+)
  - CCP Leaching
  - Environmental Issues
  - Site Characterization
  - Remediation
  - AI/ML Applications
  - Plant Decommissioning

Please do not hesitate to contact us!



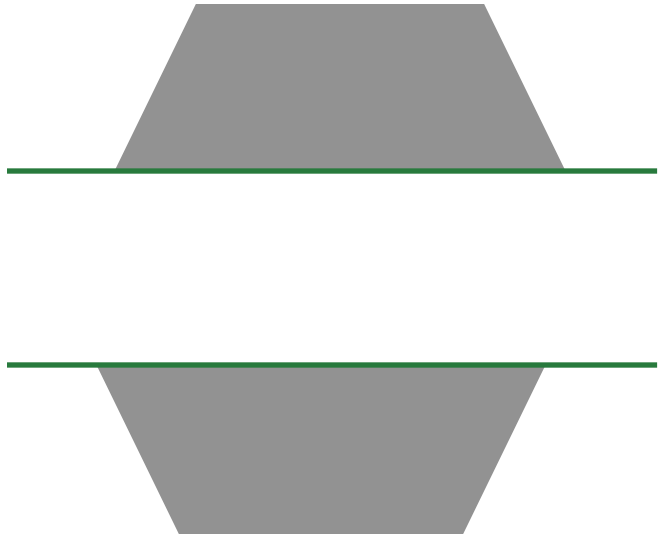
CCP Research

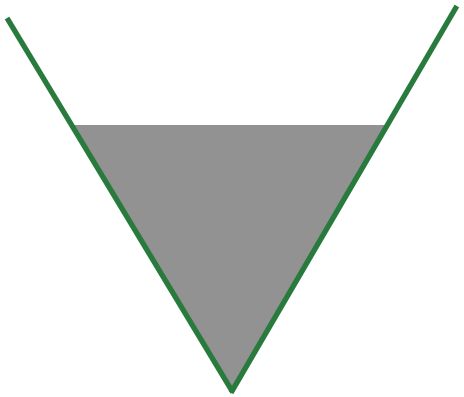


500+ CCP Research Publications 1979-2024

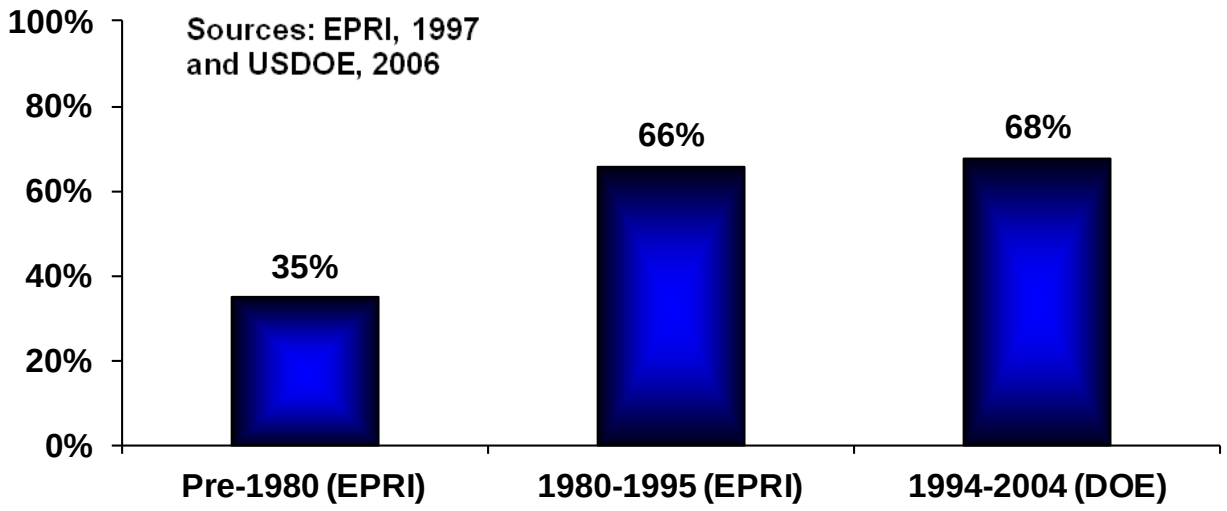
CCP Management in the US

Historically A Mix of Designs

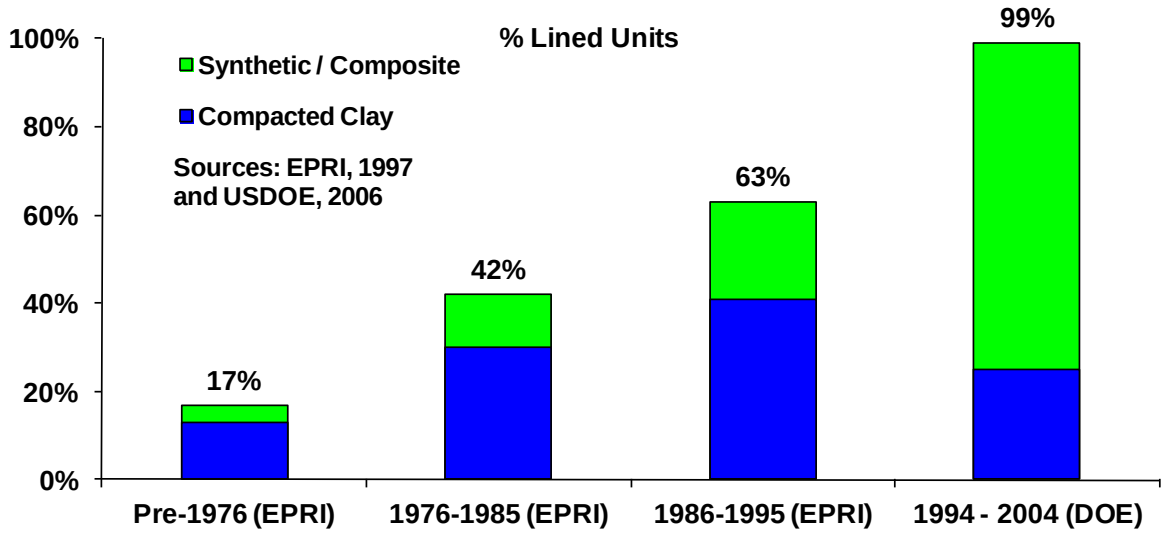




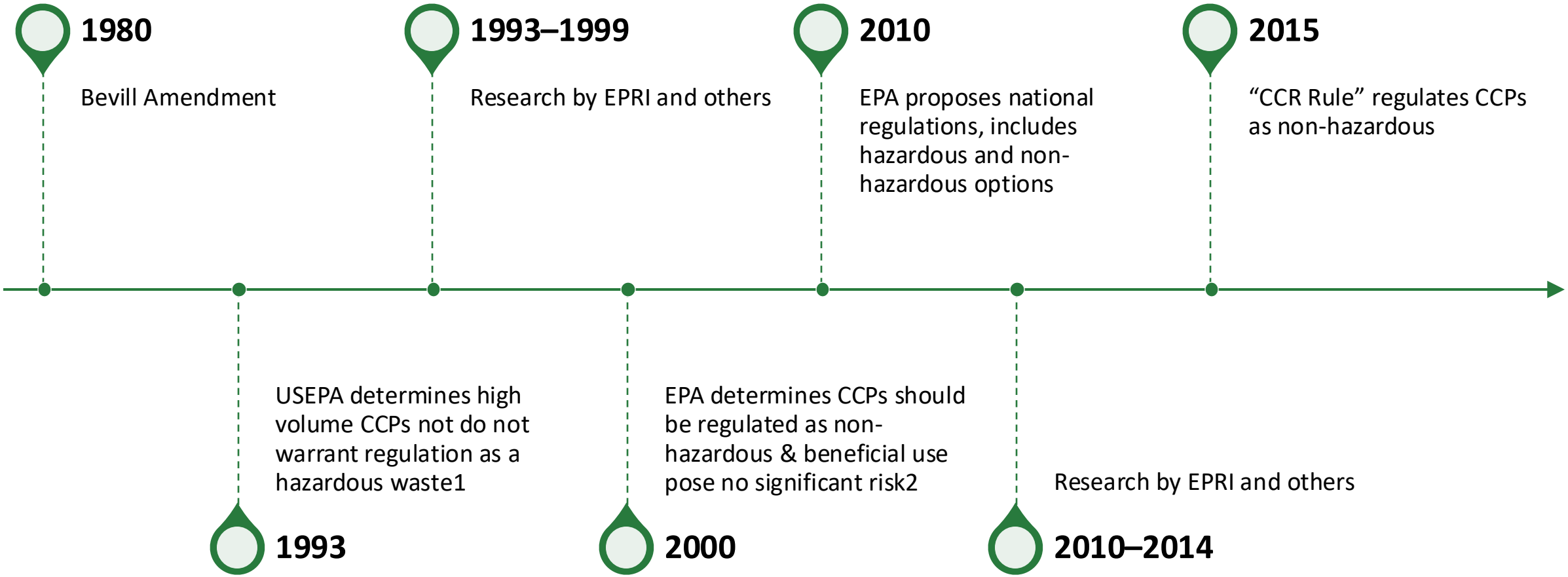
Trending to Composite-Lined Landfills with Leachate Collection



EPRI 1023741, 2012



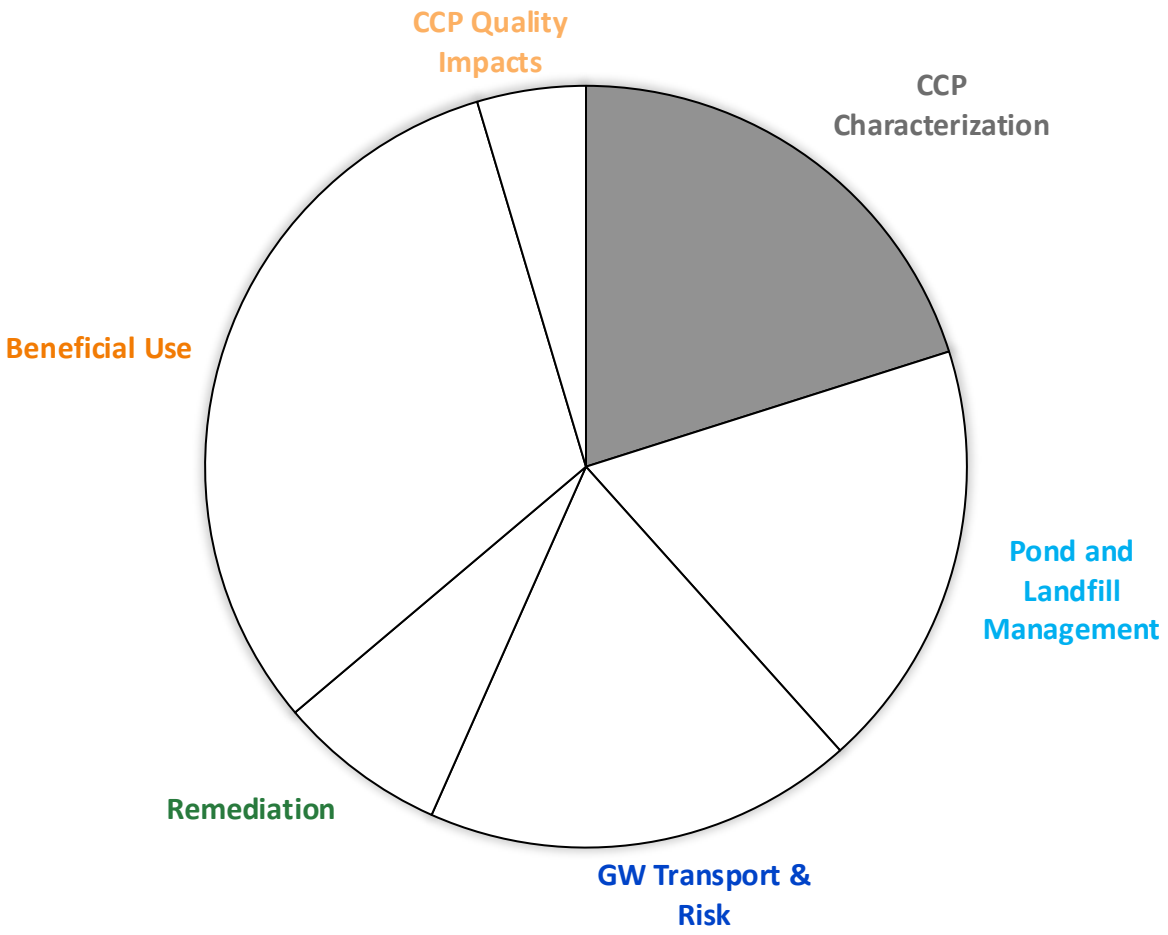
A Word About CCP Regulation in the US



- [1] “Hazardous” for US regulatory purposes designates means cradle to grave regulation and would make it difficult to beneficially use the materials
- [2] The “no significant risk” determination excluded mine placement, which required more information

CCP Environmental and Sustainability Research

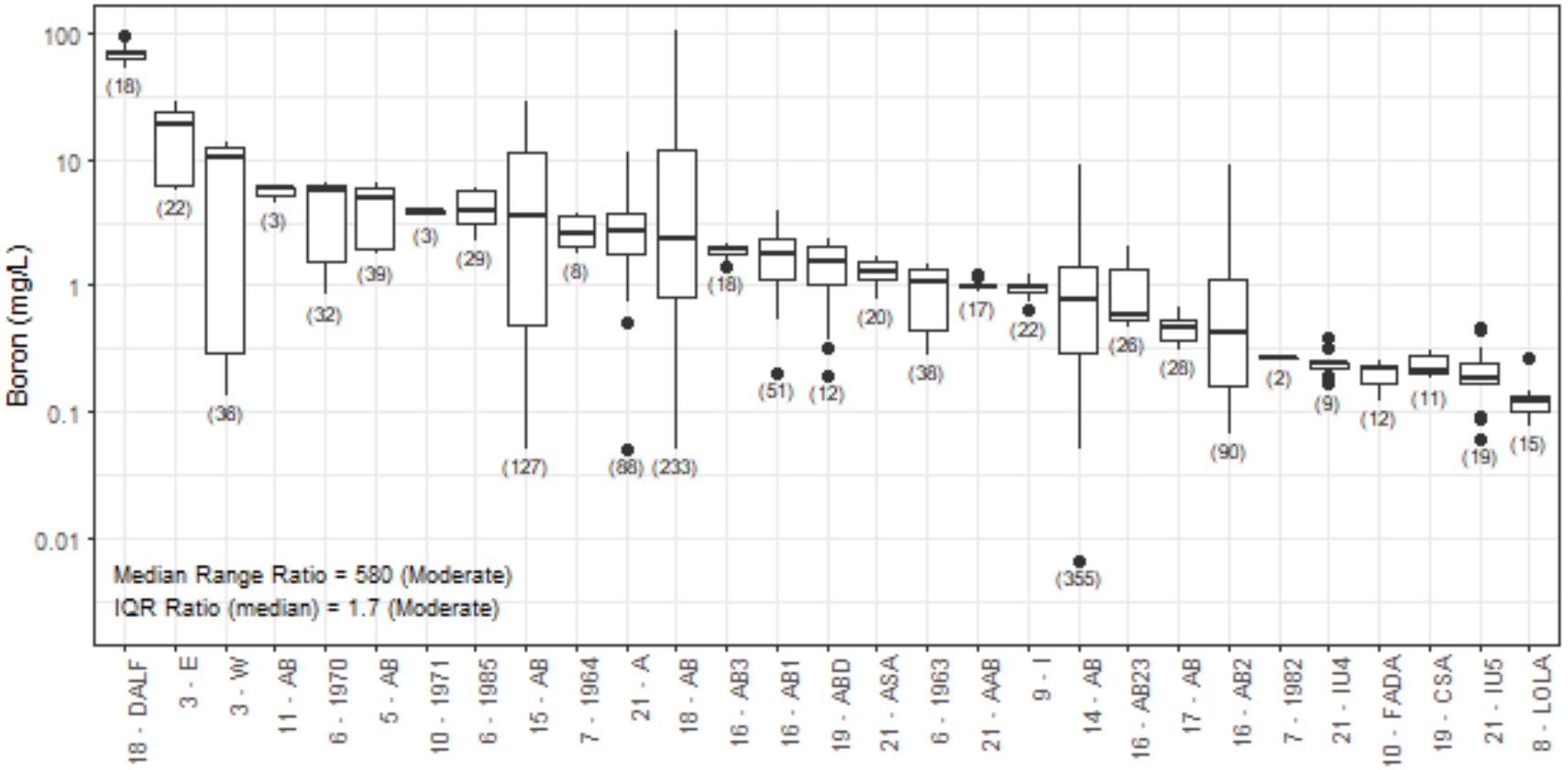
(Very) High Level Overview



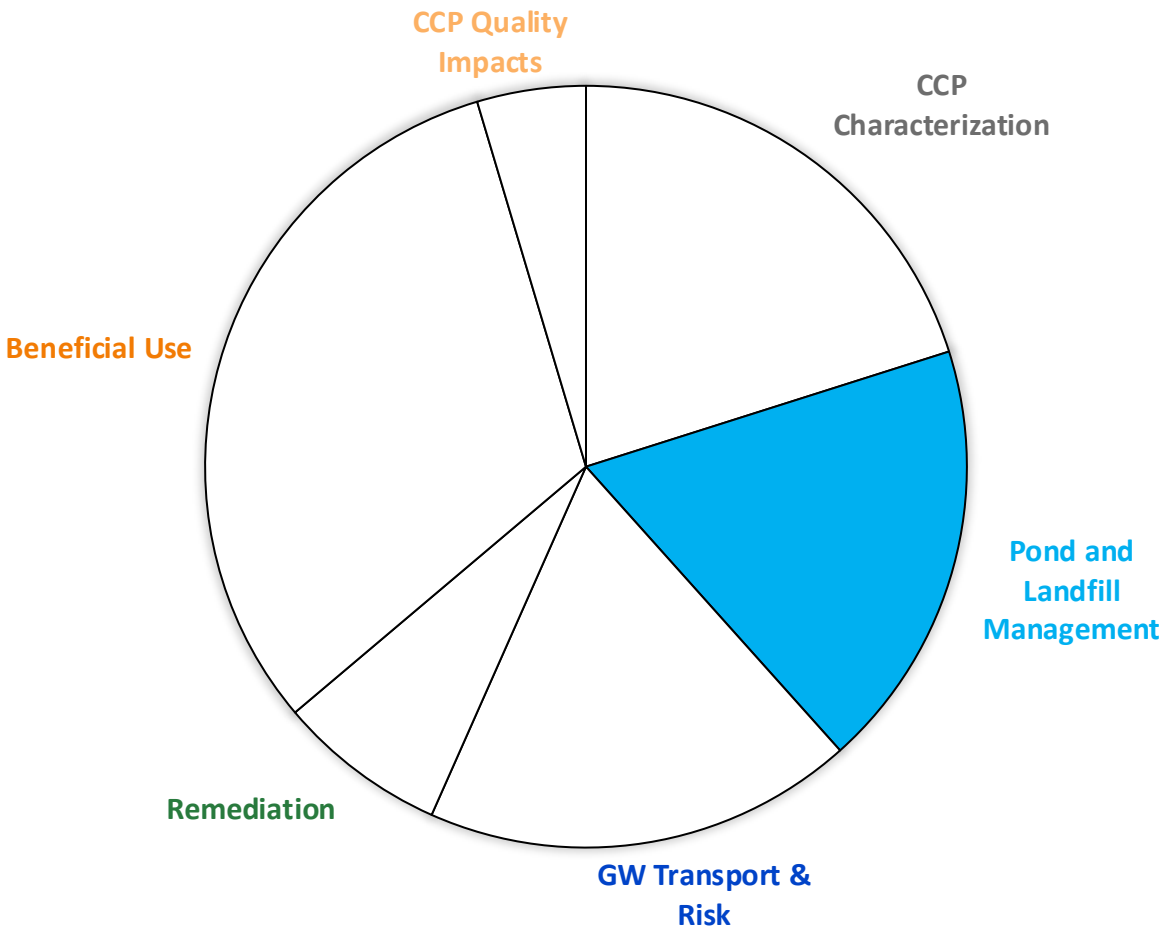
- 40 Years of leaching research
  - CCP type
  - Coal source/grade
  - Management method
  - Air emission controls
  - Geochemistry
- CPInfo database
- Leach test research
- Geotechnical properties
- Ash characterization methods

To Do: How does geochemistry change after closure?

Variable chemistry between and within units



EPRI [3002024214](), 2022

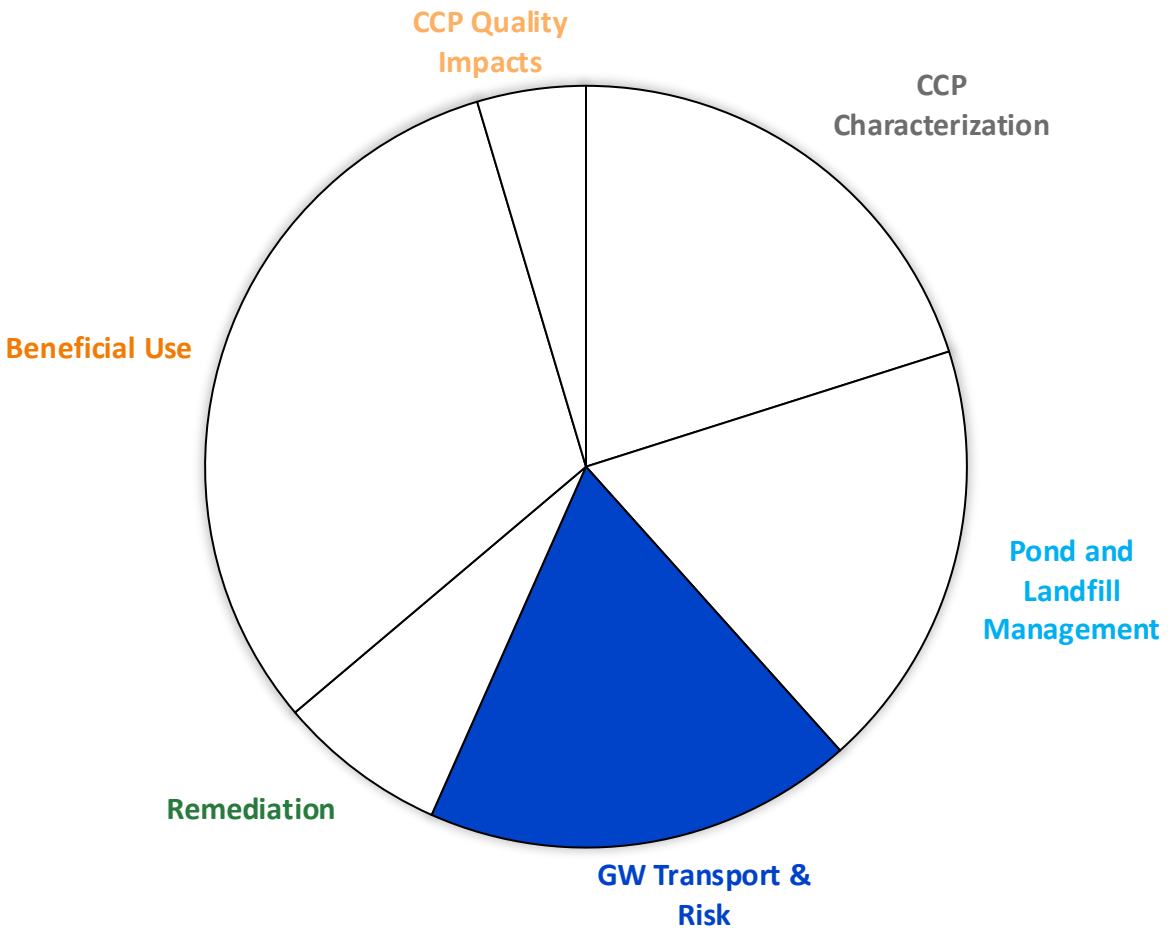


- Liner compatibility
- Geotechnical stability
- Dust control
- Worker exposure & risk
- Leachate management
- Cap alternatives
- Closure: Relative risk framework

Ongoing: Landfill Design On-Demand Training

Geotechnical Research For Surface Impoundments

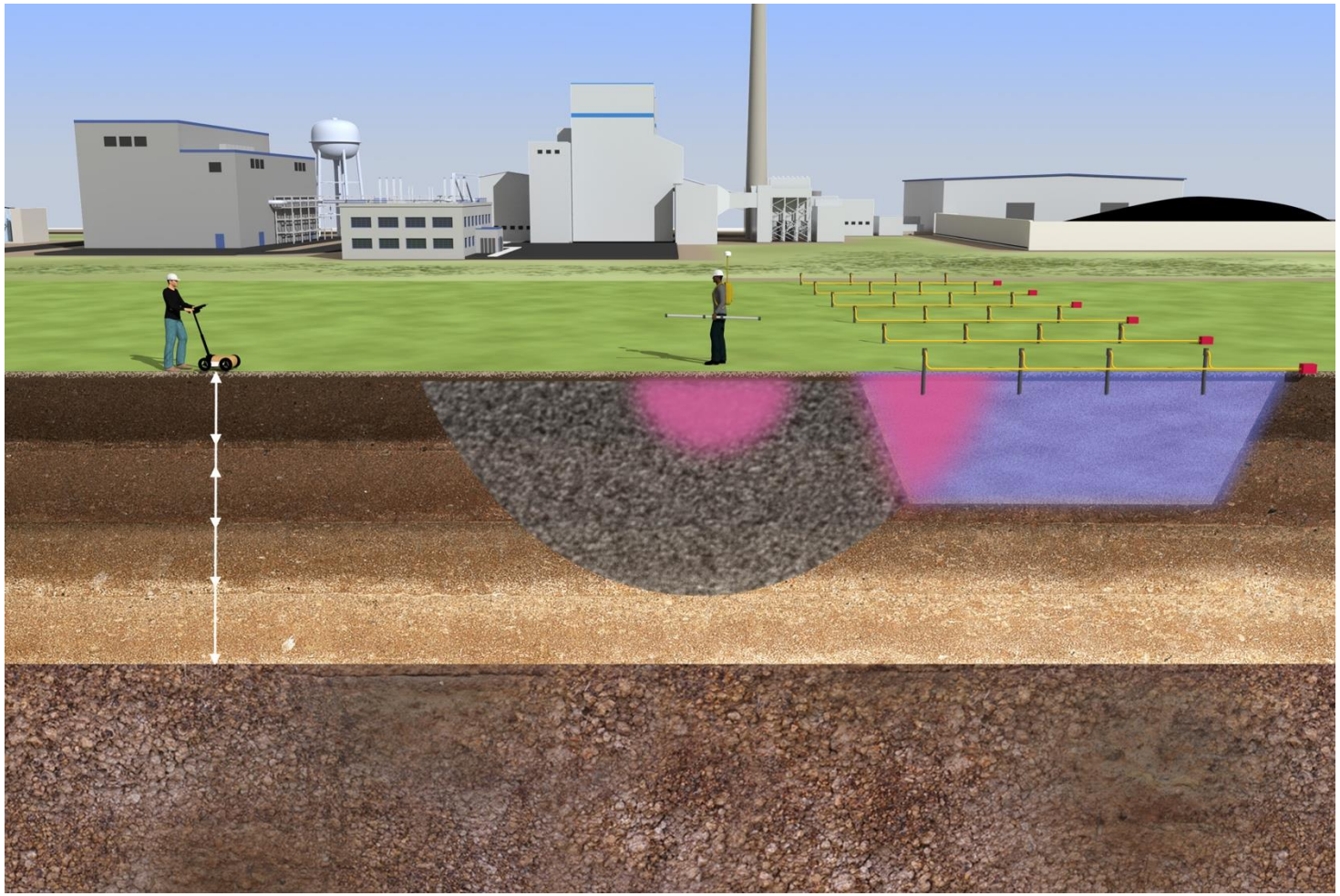
- 2012
  - Ash Static Liquefaction and Geotechnical Properties of Fly Ash and Potential for Static Liquefaction: Volume 2 - Data Summary
- 2013
  - Embankment Loading on Saturated Coal Ash: Centrifuge Demonstration Test
- 2014
  - Engineering Correlations for Geotechnical Parameters for Ponded Fly Ash: Database Review and Plate Load Test
- 2014
  - Guidance for CCR Pond Closure and Overfills and Guidance for Construction Over Closed or Closing Ponds
- 2015
  - Centrifuge Models of Embankment Failures on Saturated Coal Ash and Potential Failure Mode Analysis for CCR Ponds: Guidance
- 2016
  - Evaluation of Potential Failure Modes for CCR Impoundments
- 2018
  - Geotechnical Properties of Ponded Class C Fly Ash and Flue Gas Desulfurization Solids
- 2020
  - Evaluation of Fly Ash Diagenesis Potential
- 2021
  - Geotechnical Centrifuge Tests to Assess Stability of Slurry-Deposited Coal Fly Ash: Runout and Dewatering Behavior Analysis
- 2024
  - Estimated Displacement of Coal Fly Ash from a Breached Containment: Analyses for Centrifuge Model Tests



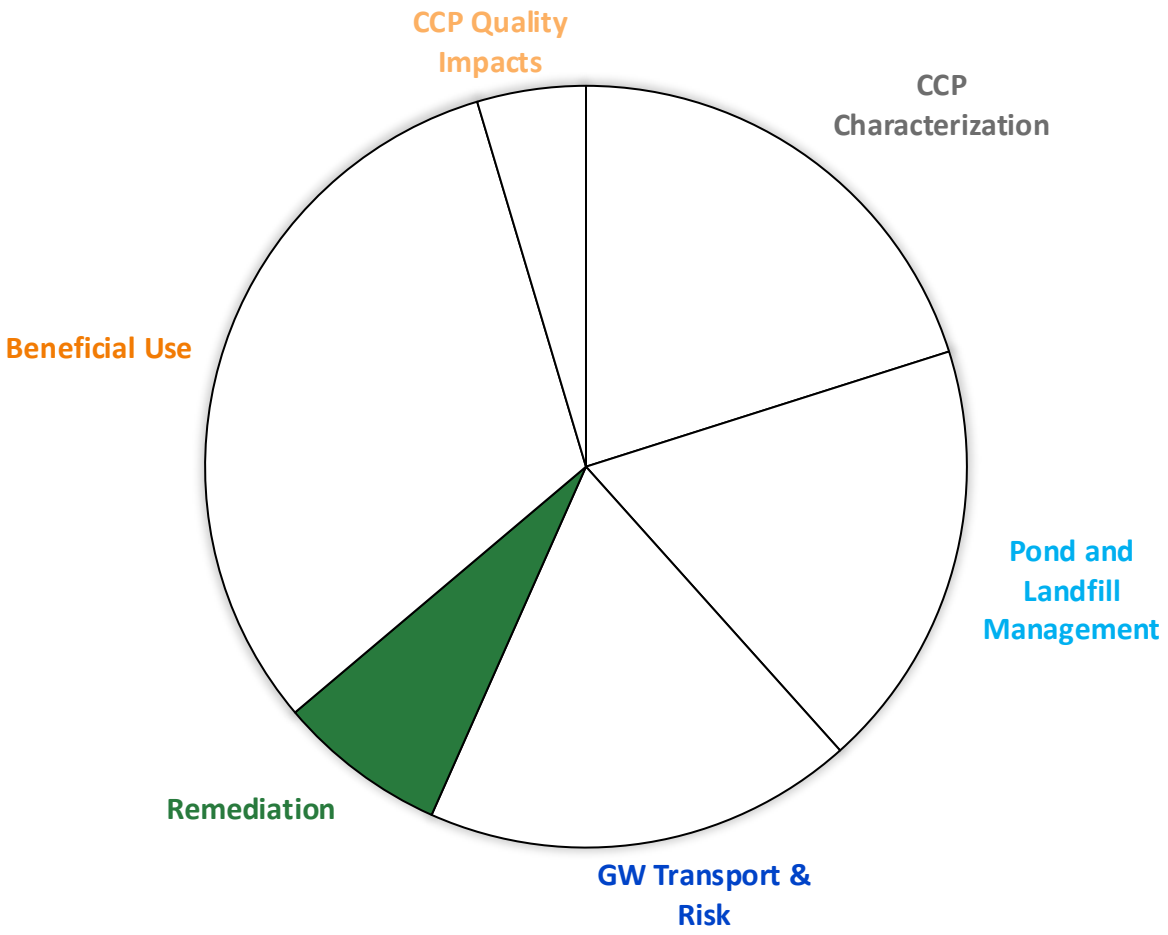
- Groundwater sampling
- Groundwater-surface water interactions
- High resolution site characterization
- Geochemical attenuation
- Educational resources for power company project managers & the public
  - Statistics
  - Modeling
  - Geochemistry
  - Risk & risk assessment

Ongoing: isotopes, microbiology, and advanced statistic use in GW forensics

Geophysical methods that can help locate buried coal ash deposits



EPRI 3002030067, 2024

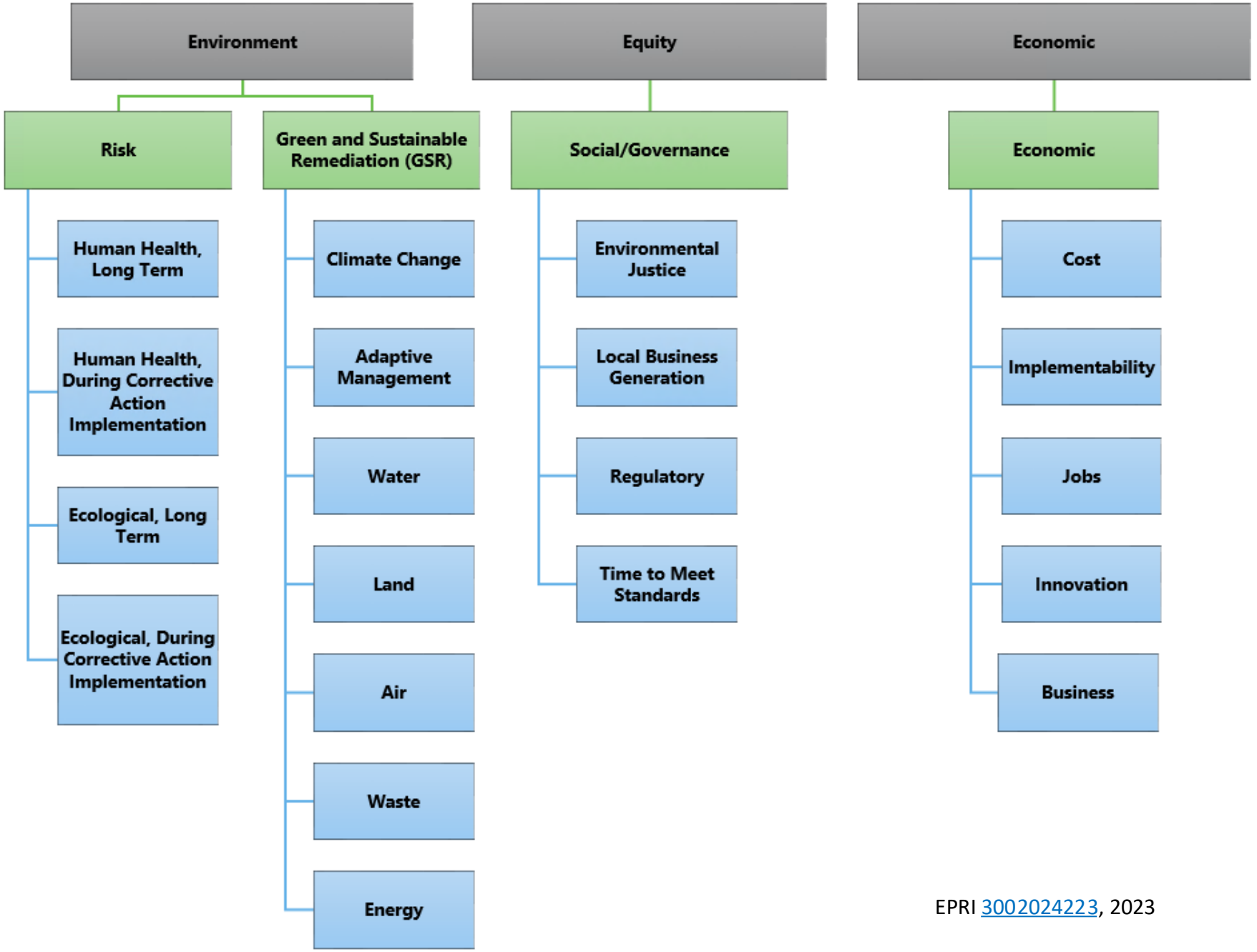


- Technology profiles
- Holistic Decision Support Tool
- Monitored Natural Attenuation (MNA)
  - Ultimate sustainable remediation method when applicable

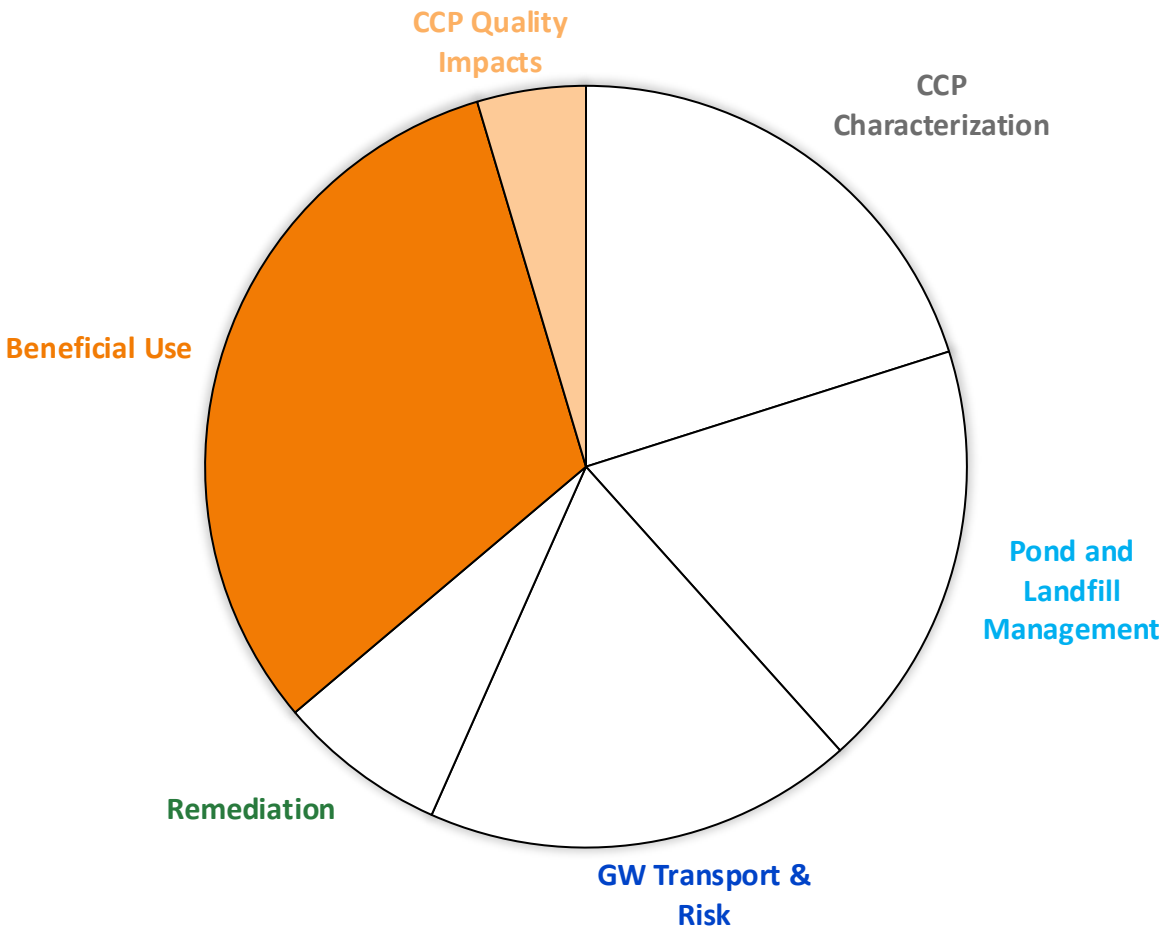
Ongoing: reactive media for in-situ treatment

Holistic Decision Support Tool

Factoring sustainability into remediation decisions



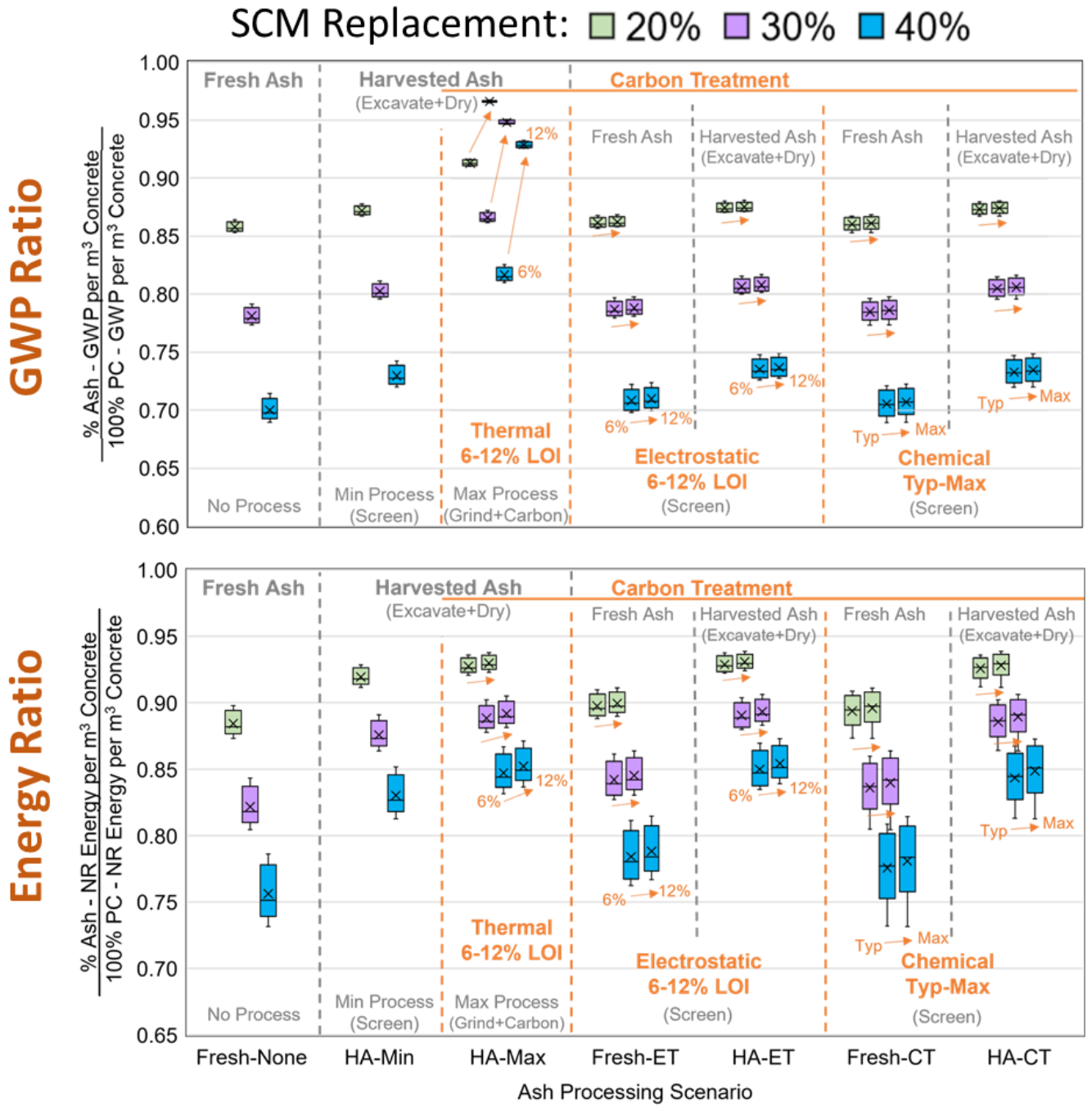
EPRI 3002024223, 2023



- Beneficiation technologies
- Beneficial uses
- Sustainability aspects:
  - Quantifying the Benefits of Using Coal Combustion Products in Sustainable Construction https://www.epri.com/research/products/000000000001020552
  - Harvested Coal Ash Used as a Cement Replacement in Concrete: Life-Cycle Impacts https://www.epri.com/research/products/000000003002024165

More in Next Presentation

Using harvested ash as a supplemental cementitious material (SCM) has sustainability benefits



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