Federal Remediation Technologies Roundtable Virtual Meeting

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The Federal Remediation Technology Roundtable at 30 1990-2020

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FRTR: Where it started

- Initial meeting of Senior Executive-level program managers of Agencies with both cleanup programs and technology development and demonstration programs
- Relationships: "We're from EPA and we're here to help you"
- No basis for collaboration; enforcement history
- Started small-jointly documenting information and demonstrations
- Needed to build momentum to cooperate

The Starting Point: Innovative Technologies in 1990

- Innovative Treatment Technologies: Technologies whose routine use is inhibited by lack of data on performance and cost.
- 1990 Mandates/Drivers
  - Preference for treatment (Superfund Amendments and Reauthorization Act or SARA)
    - Move away from "dig and haul," capping
    - Permanence
  - Land Disposal Restrictions – In Situ
  - Very limited menu of treatment options
    - Soil: Incineration, maybe solidification
    - Groundwater: pump and treat
- A new area of scientific endeavor

The Starting Point

	Containment	Treatment
Soil Remedies	75%	25%
	Pump & Treat	**In-Situ Treatment**
Groundwater remedies	90+ %	3%

- Soil Treatment:
  - *Ex situ*
  - Incineration
  - Solidification/stabilization
- Site characterization
  - Monitoring wells
  - Lab analyses
  - Fate and transport?

RD&D: Many Options

- U.S. EPA: Superfund Innovative Technology Evaluation (SITE) Program
- Department of Energy, EM-50
- Department of Defense
- State programs
- International
- Non-profit, private sector
  - NETAC
  - PERF
- Cost and performance information at a premium

Technology Innovation Directions: c 1990

- Treatment, soil (surface, vadose zone)
- Groundwater treatment, very limited options
- Characterization, *not so much*
- Bioremediation
  - Exxon-Valdez
  - Natural attenuation, *hmmm….*
- Ex-situ treatments
  - Soil washing
  - Solvent extraction
  - Thermal desorption
  - Bioreactors

FRTR Direction – 1990's

- Sharing cost and performance information, information resources
- Better information for decision makers
- Demonstration projects
- Information exchange
- Public-private partnerships
  - Remediation Technology Development Forum
  - Clean Sites
  - Technology testing centers
- Leveraging investment
- Biggest focus on remediation
- Subgroups
- Internet

Evolution of Technology: 1995-2015

- Treatment trains
- Platforms vs. individual technologies
- Greater focus on groundwater, broader use of alternative technologies
- RD&D money, a shrinking pie
- Emerging concepts
  - Triad-emphasis on field analytics, real time decisions
  - Optimization
  - Reuse, land revitalization
- Building library of cost and performance information, case studies

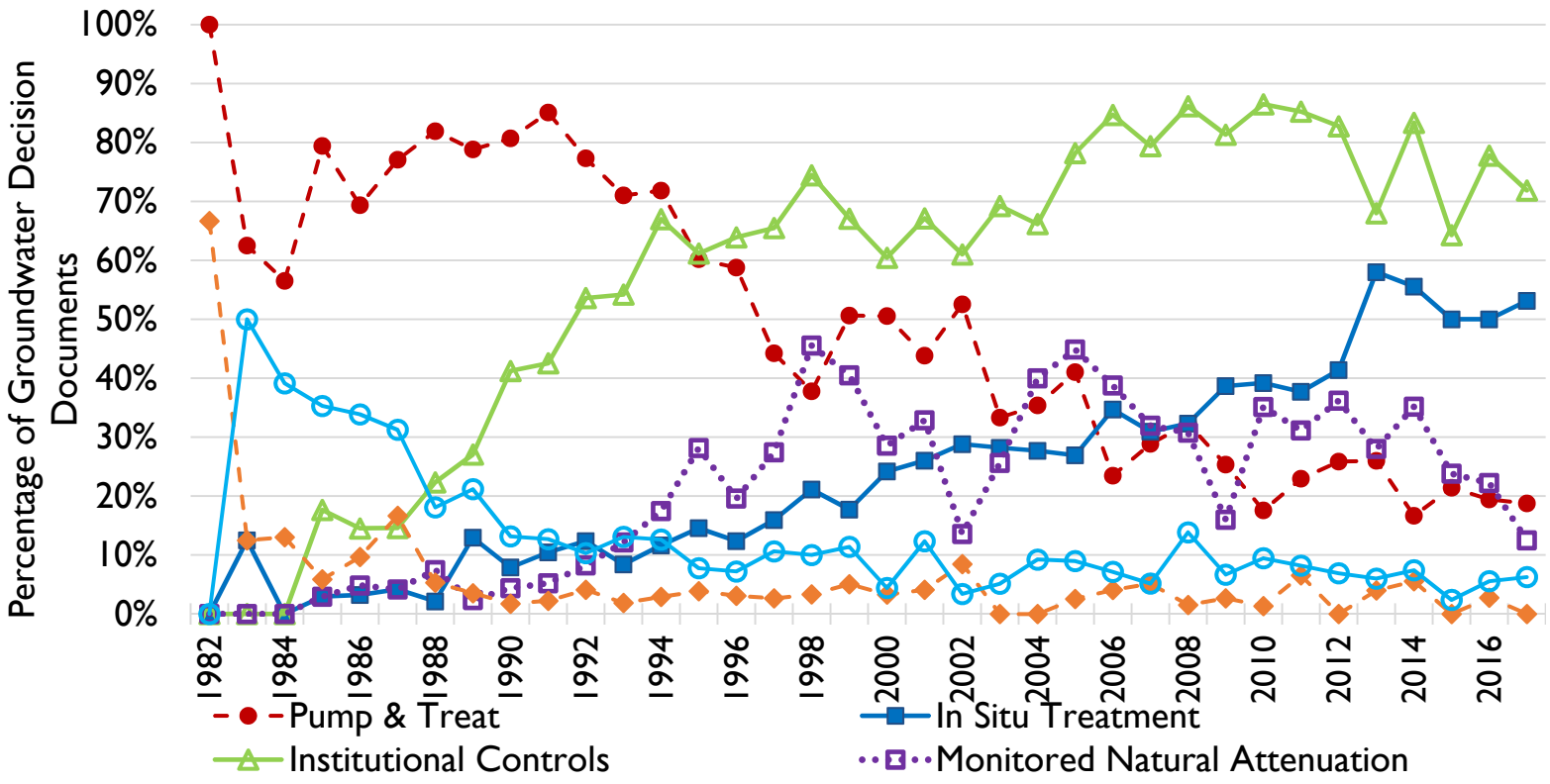
Recently Selected Source Remedies (FY 2015-2017)

Source Decision Documents = 175

Technology	Number of Decision Documents (FY15-17)	Percent Source Decision Documents
In Situ Treatment	35	20%
Solidification/Stabilization	**9**	**5%**
Soil Vapor Extraction	**9**	**5%**
Thermal Treatment	**8**	**5%**
Bioremediation	**6**	**3%**
Chemical Treatment	**5**	**3%**
Cap (amended, in situ sediment)	2	1%
Amendments (in situ sediment)	2	1%
Multi-phase Extraction	2	1%
Electrokinetics	1	1%
Flushing	1	1%
Soil Amendments	1	1%
Ex Situ Treatment	**50**	**29%**
Containment/Disposal	**117**	**67%**
MNR/EMNR	6	3%
Institutional Controls	**124**	**71%**
Other	43	25%

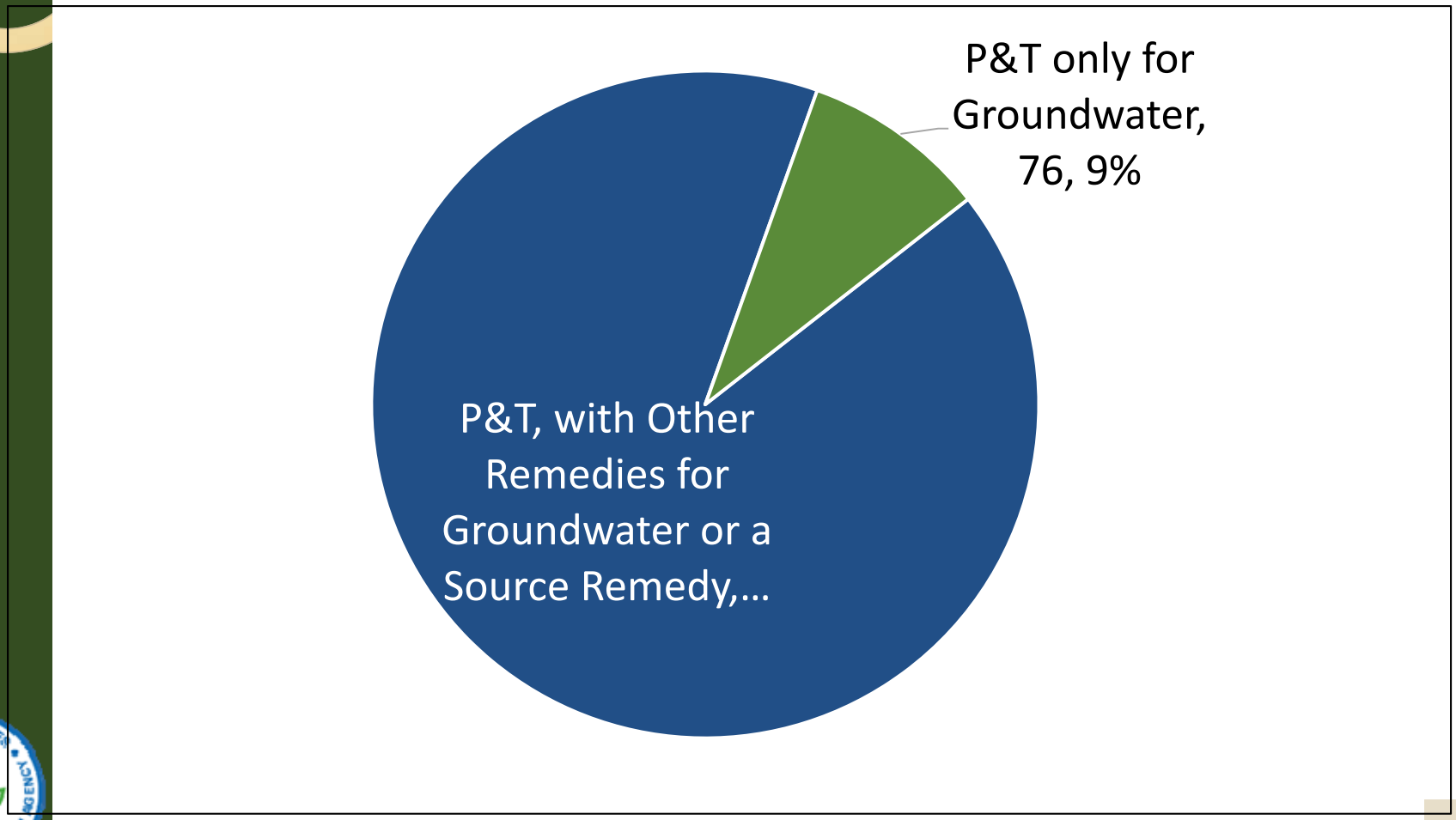
Selection Trends for Decision Documents with Groundwater Remedies (FY 1982–2017)

Groundwater Decision Documents = 2,541



Summary of Selected Groundwater P&T Remedies (FY 1981-2017)

Total P&T Sites = 845



Recently Selected Groundwater Remedies (Part 1) (FY 2015–2017)

Groundwater Decision Documents = 110

Remedy	Number of Decision Documents (FY15-17)	Percent Groundwater Decision Documents
Ex Situ Treatment (P&T)	**22**	**20%**
In Situ Treatment	**56**	**51%**
Bioremediation	**30**	**27%**
Chemical Oxidation/Reduction/ Neutralizaition	**26**	**24%**
Thermal Treatment	**6**	**5%**
Permeable Reactive Barrier	**5**	**5%**
Multi-phase Extraction	4	4%
Air Sparging	3	3%
Solidification/Stabilization	2	2%
Electrokinetics	1	1%
Flushing	1	1%
Phytoremediation	1	1%
Vapor Extraction	1	1%
Monitored Natural Attenuation	**22**	**20%**
Containment (Vertical Engineered Barriers)	1	1%
Institutional Controls	**78**	**71%**
Alternative Water Supply	5	5%

Continued…

The Last Five Years (2015-Present)

- Land and material reuse
- Understanding the importance of characterization, data
- Optimizing remedies
- Big sites
- Maximizing responsible use of models
- Emerging issues
  - Resiliency
  - Contaminants (e.g., PFAS)

FRTR Impacts

- Moved the concepts of innovation to dialogue and action among decision makers, users
- Federal technology and cleanup programs have led to significant innovation; FRTR:
  - Leveraged experience
  - Leveraged knowledge
  - e.g., direct push
  - e.g., thermal treatment
- Cooperation and collaboration
- Expanding membership (NIEHS, NRC)
- Continued education
- Federal "markets" large-will drive practice

Innovation is Not a Linear Process

Feedback: experience, issues, needs

Basic Research

Bench scale develop-ment

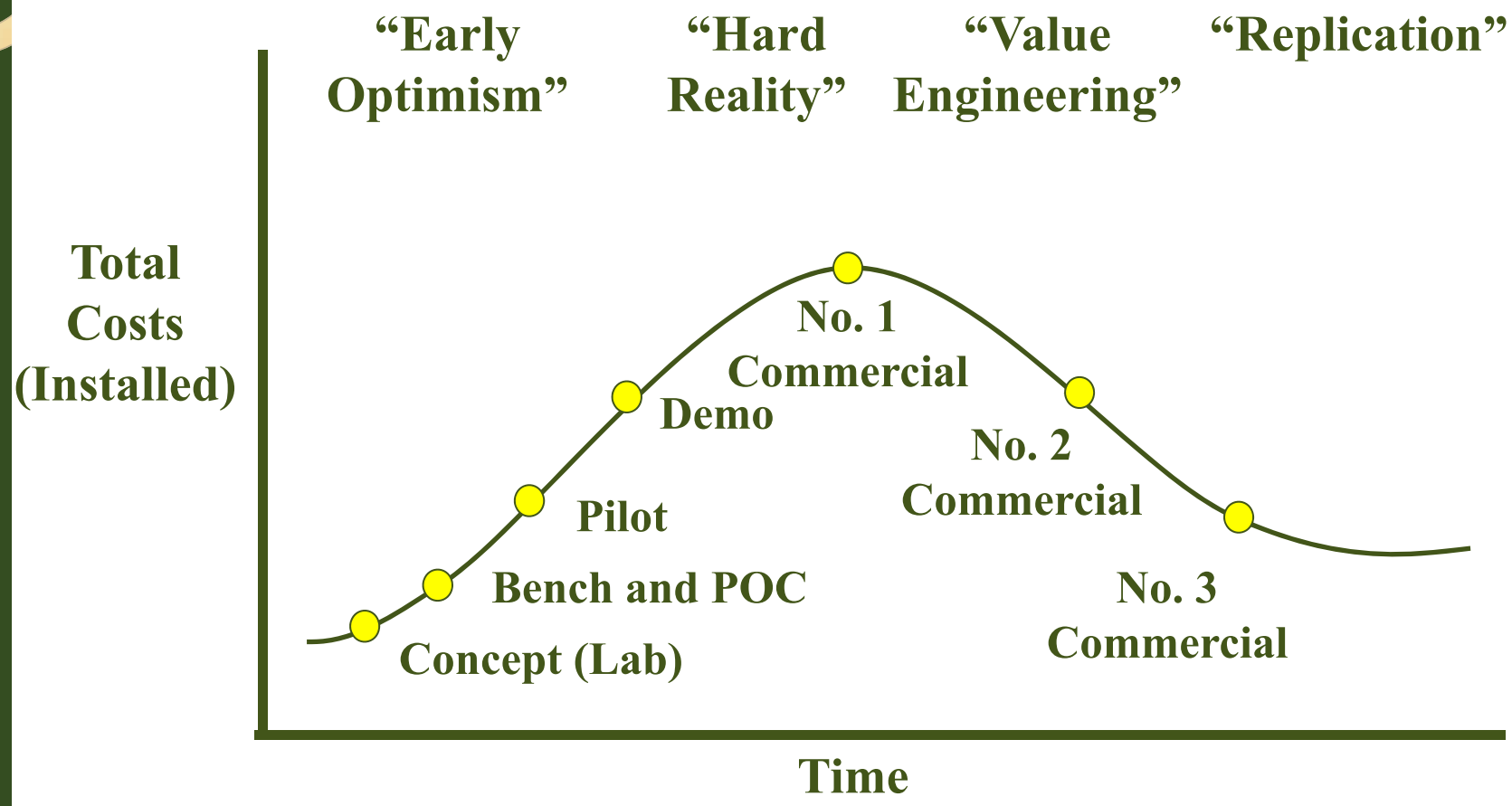
Pilot testing

Field testing/ demo

Full-scale field use

Response: modify, optimize, new solutions

Stages of Technology Commercialization



Evolution of Technology: Moving Forward

- Issues
  - High resolution site characterization approaches
    - Many data points
    - An evolving conceptual site model
    - Data management tools and visualization of data
  - Resiliency
    - Long-term remedies
    - Severe weather impacts
  - Addressing complexity of sites/"big" sites
  - Research to commercialization
  - PFAS, other emerging contaminant issues
  - Critical minerals?
- Information transfer and training – acceptance
- Advocating innovation
  - Communicating needs
  - Leveraging investments

Moving Forward

- Re-Focusing and pursuing site cleanup needs
  - Specifics are important
    - Beyond contaminant/media
    - Clearly stating need
    - Providing performance metrics in statement of need
    - Focus on decisions, decision makers
  - Need a path forward
    - If we decide we need it, what are we going to do about it?
    - Funding options
      - Map
      - Leverage
    - Path to site use
- Bottom line: with the continuing need for technology evolution and innovation, the FRTR will always have a role