



NARUC CENTER FOR PARTNERSHIPS AND INNOVATION

INNOVATION WEBINAR SERIES

DECEMBER 19, 2019

**DREAM MACHINE: AFTER THE RESEARCH &
DEVELOPMENT (R&D) ECOSYSTEM –
DEPLOYMENT AND COMMERCIALIZATION**

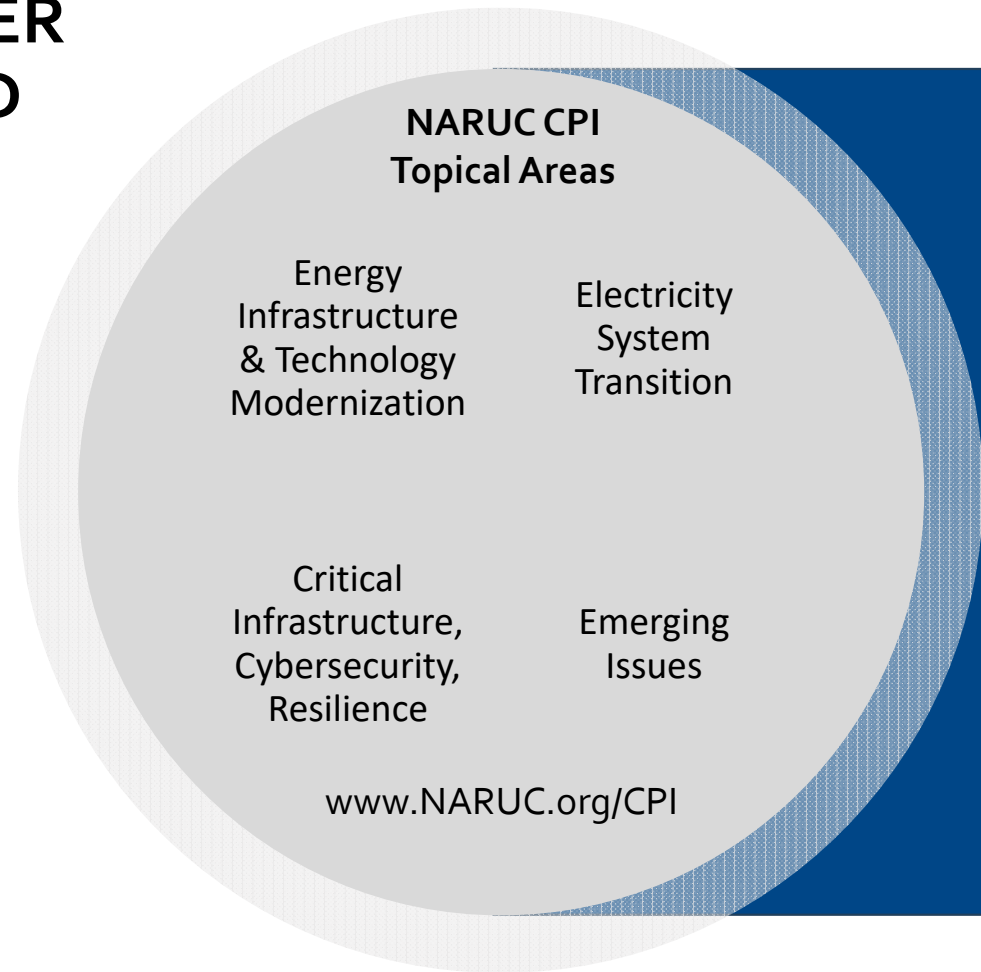
WHAT IS NARUC

- The National Association of Regulatory Utility Commissioners (NARUC) is a non-profit organization founded in 1889.
- Our Members are the state regulatory Commissioners in all 50 states & the territories. FERC & FCC Commissioners are also members. NARUC has Associate Members in over 20 other countries.
- NARUC member agencies regulate electricity, natural gas, telecommunications, and water utilities.



WHAT IS NARUC'S CENTER FOR PARTNERSHIPS AND INNOVATION?

- Grant-funded team dedicated to providing technical assistance to members.
- CPI identified emerging challenges and connects state commissions with expertise and strategies.
- CPI builds relationships, develops resources, and delivers trainings.





DREAM MACHINE: AFTER THE RESEARCH & DEVELOPMENT (R&D) ECOSYSTEM – DEPLOYMENT AND COMMERCIALIZATION

MODERATOR:

THE HON. SARAH FREEMAN, INDIANA

PANELISTS:

JANET GAIL BESSER, SMART ELECTRIC POWER ALLIANCE (SEPA)

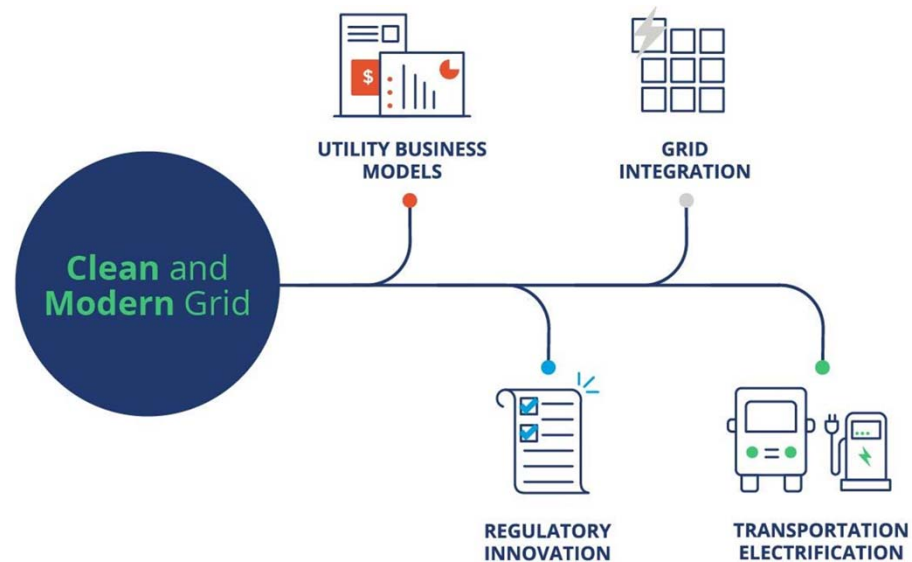
CYRIL YEE, ROCKY MOUNTAIN INSTITUTE (RMI)

PAUL LOEFFELMAN, AMERICAN ELECTRIC POWER (AEP)

Unleashing Innovation: Regulation & Utility RD&D

Janet Gail Besser
Managing Director,
Regulatory Innovation &
Utility Business Models

NARUC CPI Webinar
December 19, 2019



Smart Electric
Power Alliance

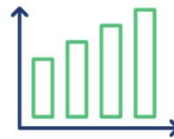
SEPA Mission



SEPA's mission is to facilitate the electric power industry's smart transition to a clean and modern energy future through education, research, standards and collaboration.



COMMUNITY



DATA



INSIGHTS

SEPA's Pathways

Tackling the Most Daunting Challenges the Electricity Sector Faces Today



Utility Business Models



Utilities need sustainable business models and practices to allow the utility to serve customers in new ways based on their evolving needs.

Regulatory Innovation



State regulatory processes must be flexible and agile, enabling the timely and effective deployment of new technologies, partnerships and business models.

Grid Integration



Clean energy must be easily integrated and result in maintained or improved levels of affordability, safety, security, reliability, resiliency and customer satisfaction.

Transportation Electrification



The nation's fleet of light, medium and heavy-duty vehicles should be powered by carbon-free electricity.

Renovate Initiative



The **Renovate** mission is to spur the evolution of state regulatory processes and practices to enable **innovation**, with a focus on **scalable deployment of new technologies and operating models**, to meet customer needs and increasing expectations while continuing to provide all with clean, affordable, safe, and reliable electric service.

Problem Statements



#1 People & Knowledge

The steep learning curve for policy makers, commissioners, commission staff, industry, and other stakeholders in acquiring knowledge and understanding of new technologies, and their benefits and costs for customers can complicate and lengthen the decision making process.

#2 Managing Risk & Uncertainty

Current regulations and structures favor tried and true technologies, operations and approaches, in the name of prudence, strictly applying the “used and useful” principle. For new technologies and operating practices, there is uncertainty about the processes to identify and quantify benefits and costs, outline the full range of investment and operating options, and communicate and align incentives with agreed goals for the benefit of all customers.

Problem Statements



#3 Managing Increased Rate of Change

Regulatory proceedings on grid investments and customer programs often take so long that relevant technology providing customer benefit has advanced before a commission assessment can be completed or decision can be reached.

#4 Complexity of Objectives / Cross-Coordination

Commissions have a mandate to serve the public interest, but increasingly, numerous priorities must be considered and balanced under an expanding definition of “public interest,” including: reasonable rates, customer choice, customer protection, environmental protection, current system structure, evolving system structure, with both short-term and long-term perspectives.

Utility Role in R&D (&D)



- **Context**
 - Utilities are last in R&D spending among all industries – 0.2% of sales
- **What should utility role be?**
 - Research & Development?
 - Or Deployment?
- **Regulatory framework influences innovation**
 - In 1990s regulators discouraged utility spending on R&D
 - In 2010s regulators began to encourage utility spending on grid mod demonstrations – the second D
- **Regulatory evolution to enable innovation**

Barriers & Solutions

- **Today's barriers**
 - Knowledge – what are capabilities (and benefits and costs) of new technologies and business models?
 - Risk and Uncertainty – what if demo “fails”?
 - Timeliness – can pilot be approved quickly?
- **Potential Solutions**
 - Innovation funds (addresses risk and uncertainty)
 - Preapproval of budget; Review prudence of execution
 - Examples: RIIO Innovation Fund, MA Grid Mod order (2014)
 - Review process (addresses timeliness)
 - NY REVConnect
 - Regulatory Sandbox
 - Faster review for projects that meet certain criteria (Australia)
 - Partnerships
 - Utilities / Tech Companies / Start Ups / EPRI / Labs

Next Steps to Unleash Innovation



TOOLS:

- **New Practices and Processes** that can be adopted/adapted to different state circumstances & provide demonstrated roadmaps for change.

ACTIONS:

- **Adoption of Proposed Changes, Shifted Perspectives, Ongoing Education** for regulators, legislators, stakeholders to enable adoption of new/modified regulatory practices, processes and structures to support a system that enables/manages innovation and adopt.

DESIRED IMPACTS:

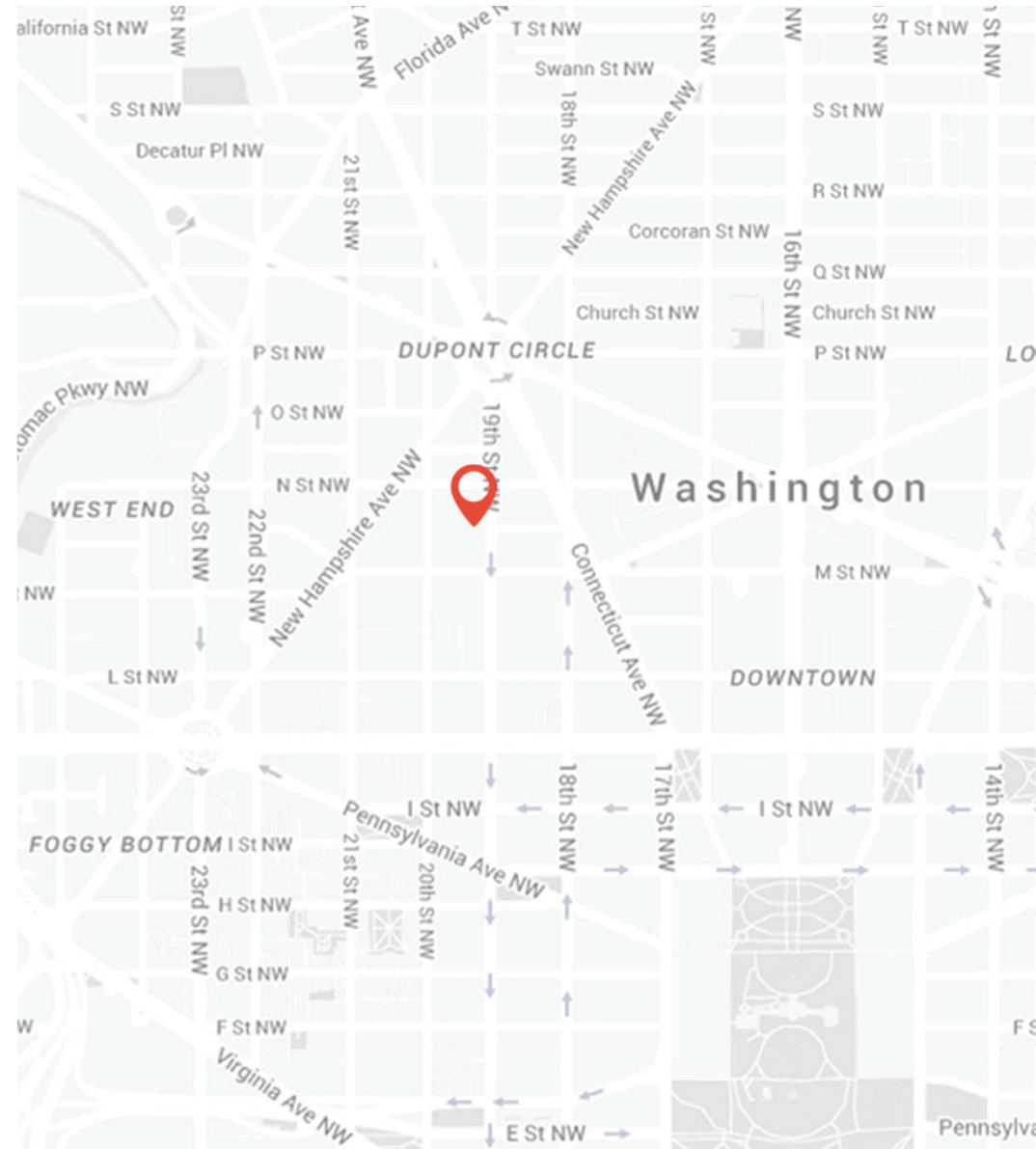
- **Increased Meaningful Collaboration & Innovation in the Energy System** to advance innovation & protect consumers through improved regulatory process.
- **Informed Decisions and Investments Result in Increased Customer and Societal Benefit** as investments are made that support and promote a clean, modern, reliable, resilient and flexible grid.

Contact Information

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Challenges in VC Investment for Utility Facing Technologies

ROCKY MOUNTAIN INSTITUTE

Transforming global energy use to create a clean, prosperous, and secure low-carbon future.

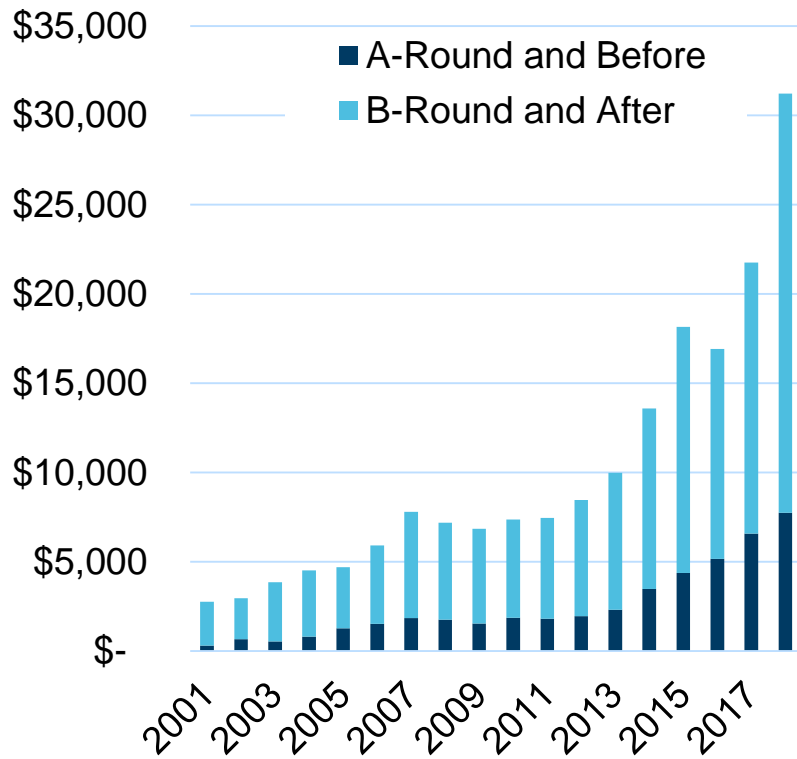
Cyril Yee, RMI Ventures Lead | Dec 19, 2019 | NARUC Webinar

There is wide consensus that climate change is occurring
and we need new technologies to fight it

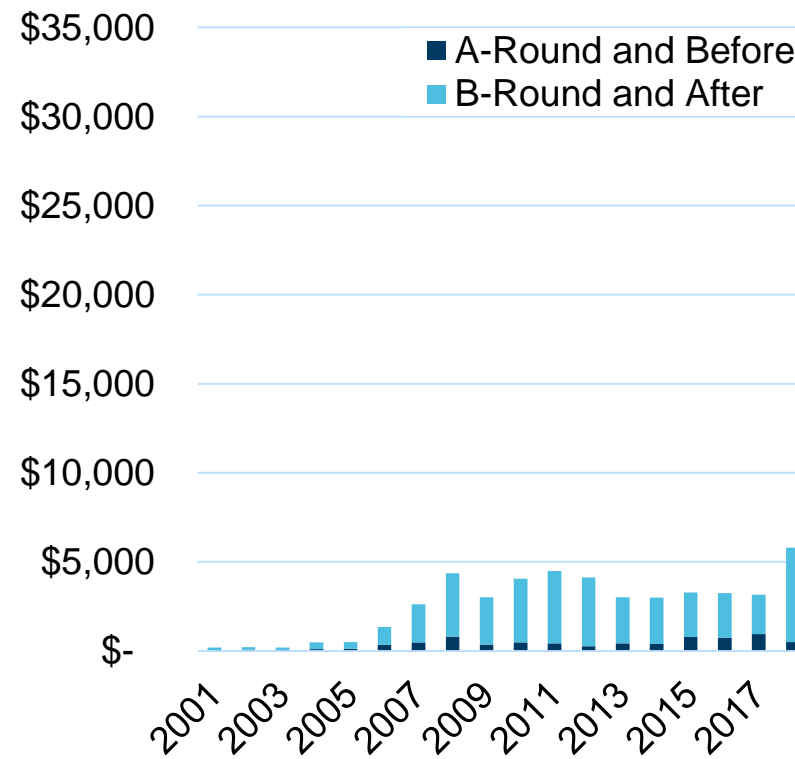


However, cleantech is not receiving the investment relative to the need and market opportunity

US Medtech VC Funding

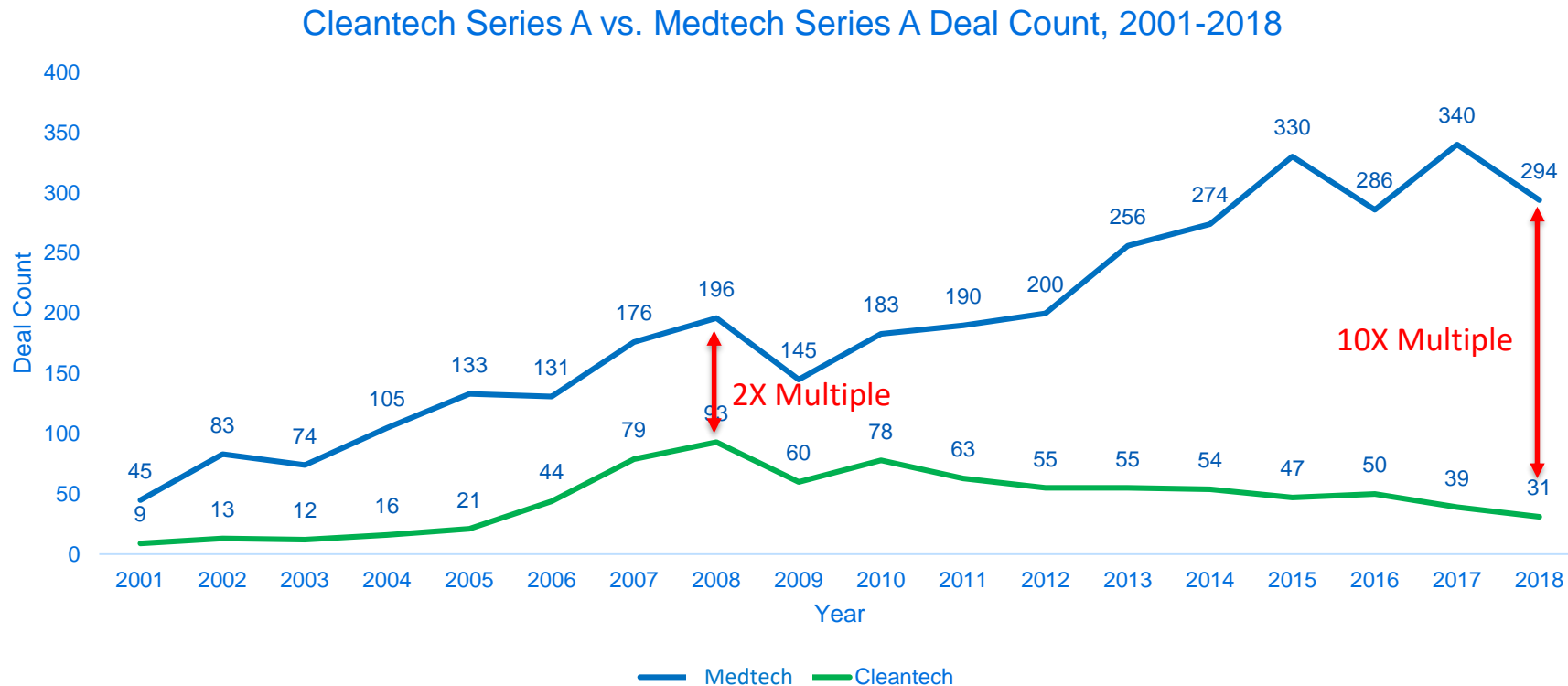


US Cleantech VC Funding
(Million USD)



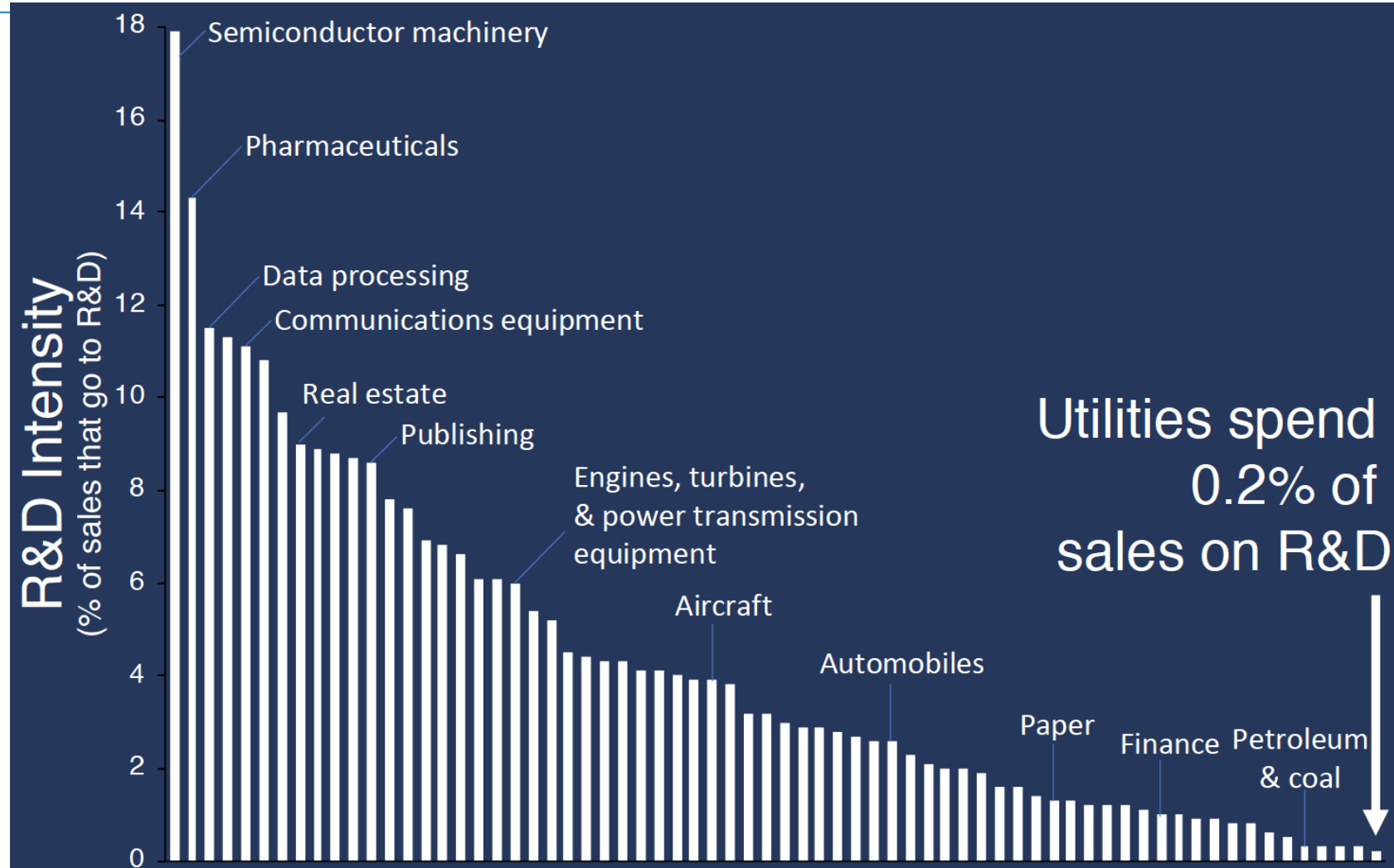
- Energy related sectors are larger than VC addressable healthcare sector
- For cleantech, early-stage and hardware struggle, in particular

Throttling of early-stage (non-software) investment is particularly pronounced



- Only 31 Cleantech Series A deals done in 2018; 1/10th of total number of Medtech
- Overall trend in Cleantech investing is declining even as opportunity and need grow

In the US, utilities are last in terms of R&D expenditure



Key Challenges for Selling to Utilities



Decisions require approval from multiple stakeholders operating in a complex ecosystem



Each utility is unique



Utilities experience perverse financial incentives



Some utilities are resistant to change



Departments are siloed with conflicting priorities

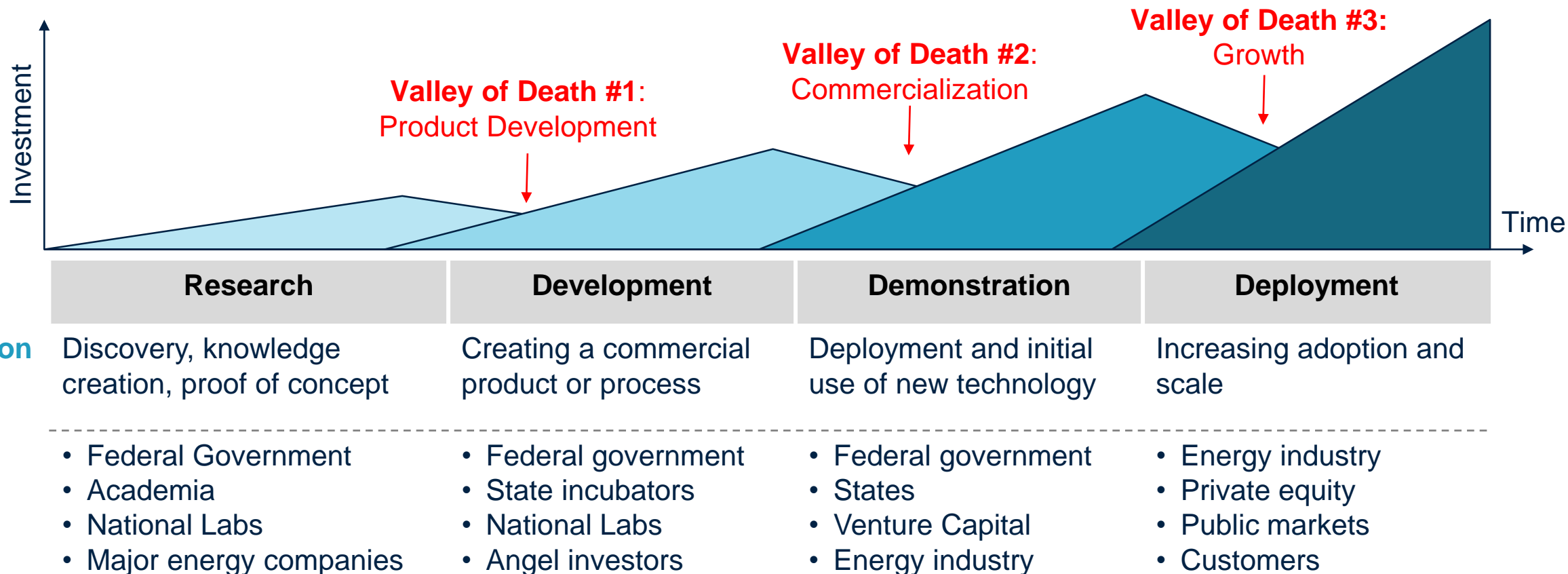


Relationship business that is hard to break into

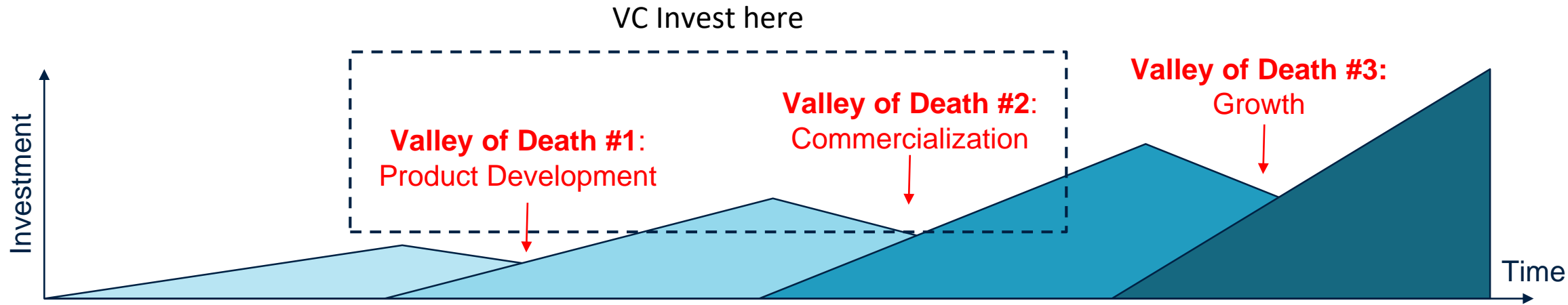


Pilots often don't become full scale deployments

Handoffs in commercialization create the well-known Valleys of Death

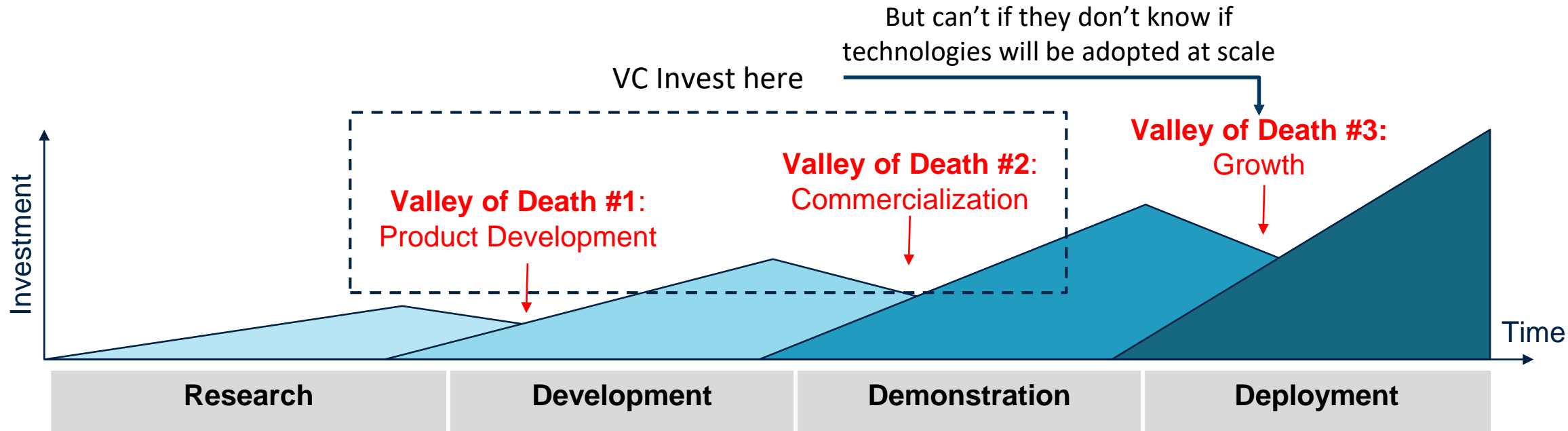


Handoffs in commercialization create the well-known Valleys of Death



	Research	Development	Demonstration	Deployment
Description	Discovery, knowledge creation, proof of concept	Creating a commercial product or process	Deployment and initial use of new technology	Increasing adoption and scale
Key players	<ul style="list-style-type: none"> Federal Government Academia National Labs Major energy companies 	<ul style="list-style-type: none"> Federal government State incubators National Labs Angel investors 	<ul style="list-style-type: none"> Federal government States Venture Capital Energy industry 	<ul style="list-style-type: none"> Energy industry Private equity Public markets Customers

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Description

Discovery, knowledge creation, proof of concept

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Key players

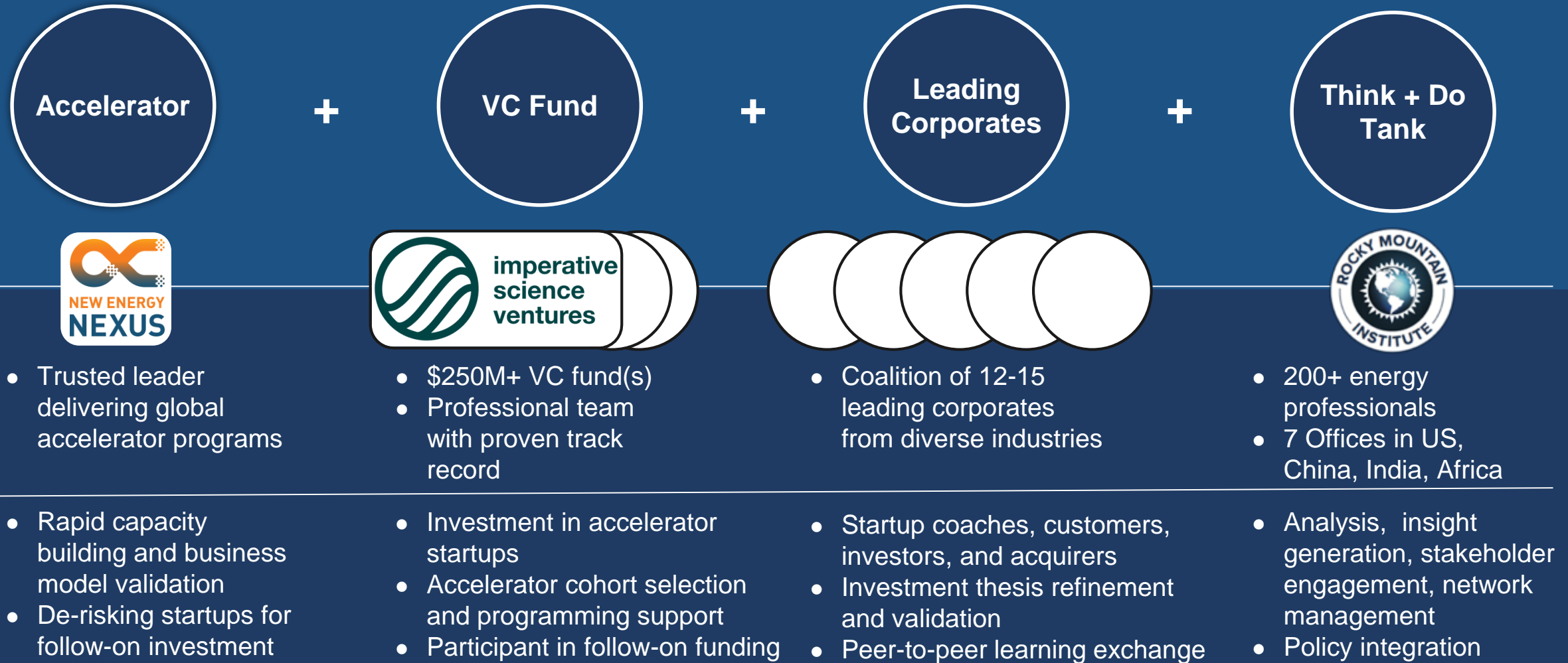
- Federal Government
- Academia
- National Labs
- Major energy companies

- Federal government
- State incubators
- National Labs
- Angel investors

- Federal government
- States
- Venture Capital
- Energy industry

- Energy industry
- Private equity
- Public markets
- Customers

A New Global Innovation Ecosystem: The Energy Collaborative (“TEC”)



Ecosystem that addresses critical commercialization challenges

Thank You

Cyril Yee

Lead, RMI Ventures

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ROCKY MOUNTAIN INSTITUTE

Transforming global energy use to create a clean, prosperous, and secure low-carbon future.





BOUNDLESS ENERGYSM



NARUC Center for Partnerships and Innovation Webinar:
**Global scouting and piloting startups to provide operational
and customer benefits**

Paul Loeffelman, AEP Innovation and Technology Group
phloeffelman@aep.com
December 19, 2019

For the next 10 minutes, imagine that you are the head of an energy startup company looking for a corporate partner among 70,000 people networking at the Lisbon, Portugal global WebSummit.

You discover this 3 minute reverse pitch video <https://vimeo.com/361786054> by AEP's Innovation and Technology Group inviting you to collaborate with AEP to bring new potential benefits to its distribution grid operations and to its customers. The pitch continues with this presentation and you decide to try out AEP's 5 month piloting process.

Ultimately, your technology is validated by AEP's practitioner experts, and AEP promises to request regulatory commission approval to broadly deploy it.

The Commission is able to quickly decide because the state legislature and the Commission have already adopted new policies to enable this action.

Note to webinar viewers: more details are in the appendix and the January 2020 Public Utilities Fortnightly magazine interview with AEP's CEO, Nick Akins.

- Utilities have a long history of achieving operational and economic efficiency through innovation.
- Today, our customers are asking for new services and products beyond reliable and affordable energy.
- Consumers are savvy and expect AEP and other electric companies to find new ways to deliver enhanced services and benefits. And to do it faster than ever before.
- To be successful in this environment, electric companies need to: (1) scout out new innovation technologies; (2) prove them out at high speed; (3) demonstrate their benefits to customers and policymakers; (4) secure timely regulatory support or contractual approvals for innovation and deployment; and (5) deploy them at scale.
- It is very important for state regulators and lawmakers to better understand what technology innovations are available to benefit customers and the role electric companies need to have in finding and validating advanced energy technologies, especially to integrate into the distribution grid of the future.
- Now is the time to establish new policies to enable these technologies to be quickly and broadly deployed.

What is AEP 'Innovating'?

- Non-Wires Alternatives to traditional, conventional solutions, especially in the distribution grid space
- Business Model – new product, service, solution, or platform, to existing or new customers
- Technology – mostly new software, some new hardware operated by new software, analytics, integration platform
- We scout for new ideas and pilot-ready technologies, but it's the best business models that AEP could utilize that we truly want to find

- Increasing the upside potential to find services, products, investment benefits from start-ups, especially for AEP distribution grid operations and customers
- Quickly and collaboratively refining products and services with receptive start-ups for better-fit solutions, improved performance and cost-effectiveness
- Decreasing uncertainty and risk with minimal resources working with start-ups
- “Innovating” changes to AEP’s existing innovation process for more precise functionality validation, faster speed to yield results, at a much lower cost

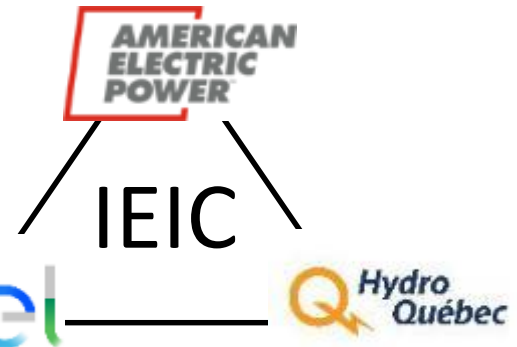
- A multi-departmental team, led by Ram Sastry, vice president, Innovation and Technology, has developed a program to search the globe for innovative technologies that AEP can quickly pilot to potentially integrate into the Distribution Grid. This strategy includes participating in global accelerators, and strategic partnerships with international electric utilities that focus on three key areas:
 - 1. Platforms or advanced software that integrates and optimizes our assets,
 - 2. e-mobility that will be integral to our transportation electrification efforts, and
 - 3. Resiliency which includes energy storage, and nano-and microgrids.

Global and US Accelerators and Partners

FREE
ELECTRONS



STARTER



incubateenergy labs

EPRI
ELECTRIC POWER
RESEARCH INSTITUTE

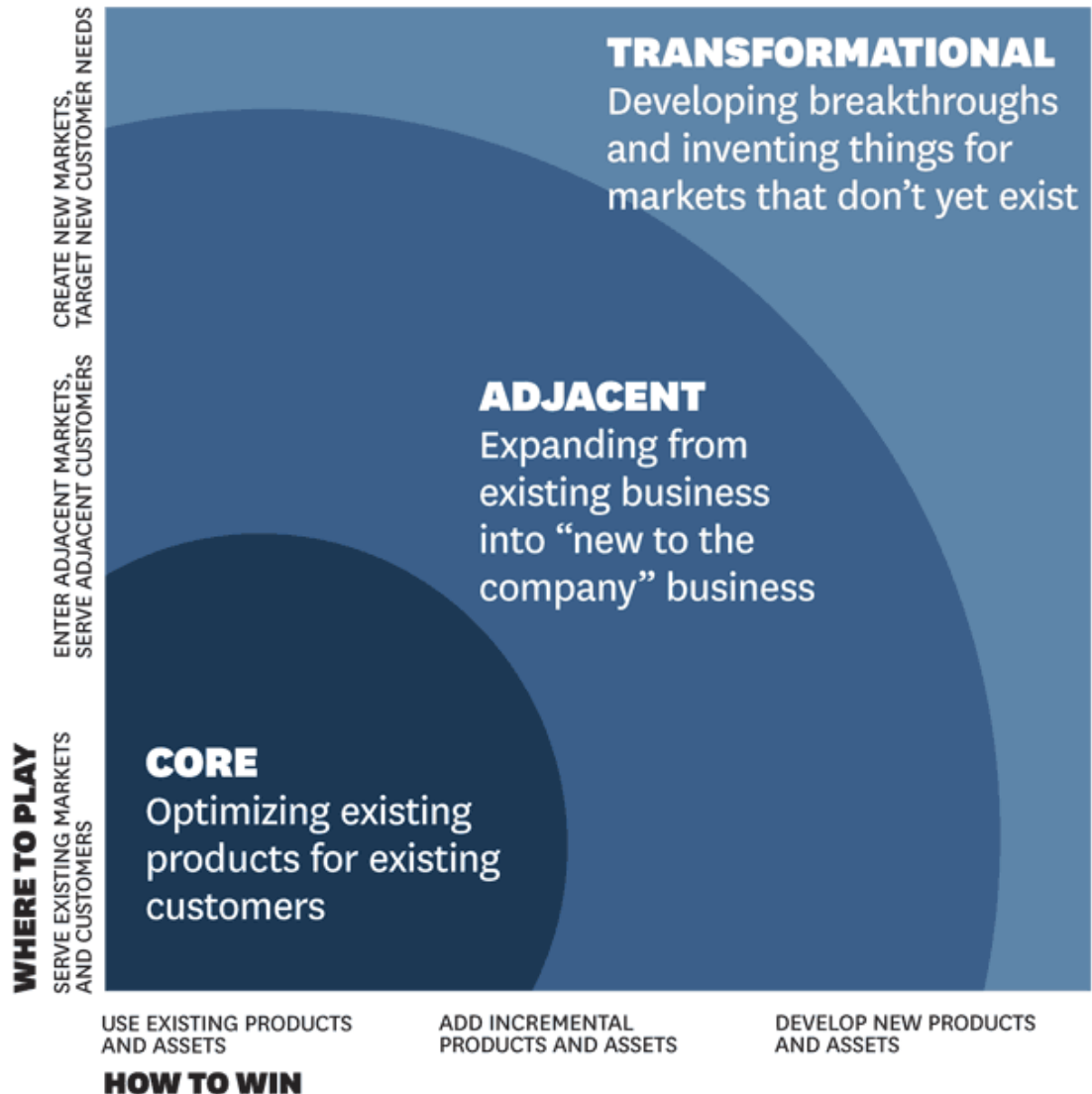
Types of Innovation

H1/Core: Deployable
NOW, Procurement
process-ready

H2/Adjacent:
Deployable 2-5YR

H3/Transformational:
Deployable 5+YR

AEP's H2/H3 Focus
Areas:
Platforms, e-mobility,
Resiliency



Focus Areas and Technology Examples (2-5 Year Deployment Time Horizon)

Platforms

Advanced software that integrates and optimizes our assets

- EV Fleet Management and Optimization
- Distributed Energy Resource Management Systems (DERMS)
- Machine Learning (ML)/Artificial Intelligence (AI) Use Cases for Energy Management for Commercial Customers

Resiliency

Includes energy storage and advanced nano- and micro-grids

- Resiliency as a service
- Reliability as a service
- Micro and nano grids
- Residential distributed solar plus storage
- Second life storage

E-Mobility

Advanced technologies integral to our transportation electrification efforts

- Vehicle to Grid, etc. (V2x) applications (Grid and Home)

OPERATING MODEL



Scout

Surface promising technologies, concepts, and players and evaluate the potential to engage



Accelerate & Validate

The quickest way to innovate often is to partner with a startup or innovator that is solving a problem we share



Deploy

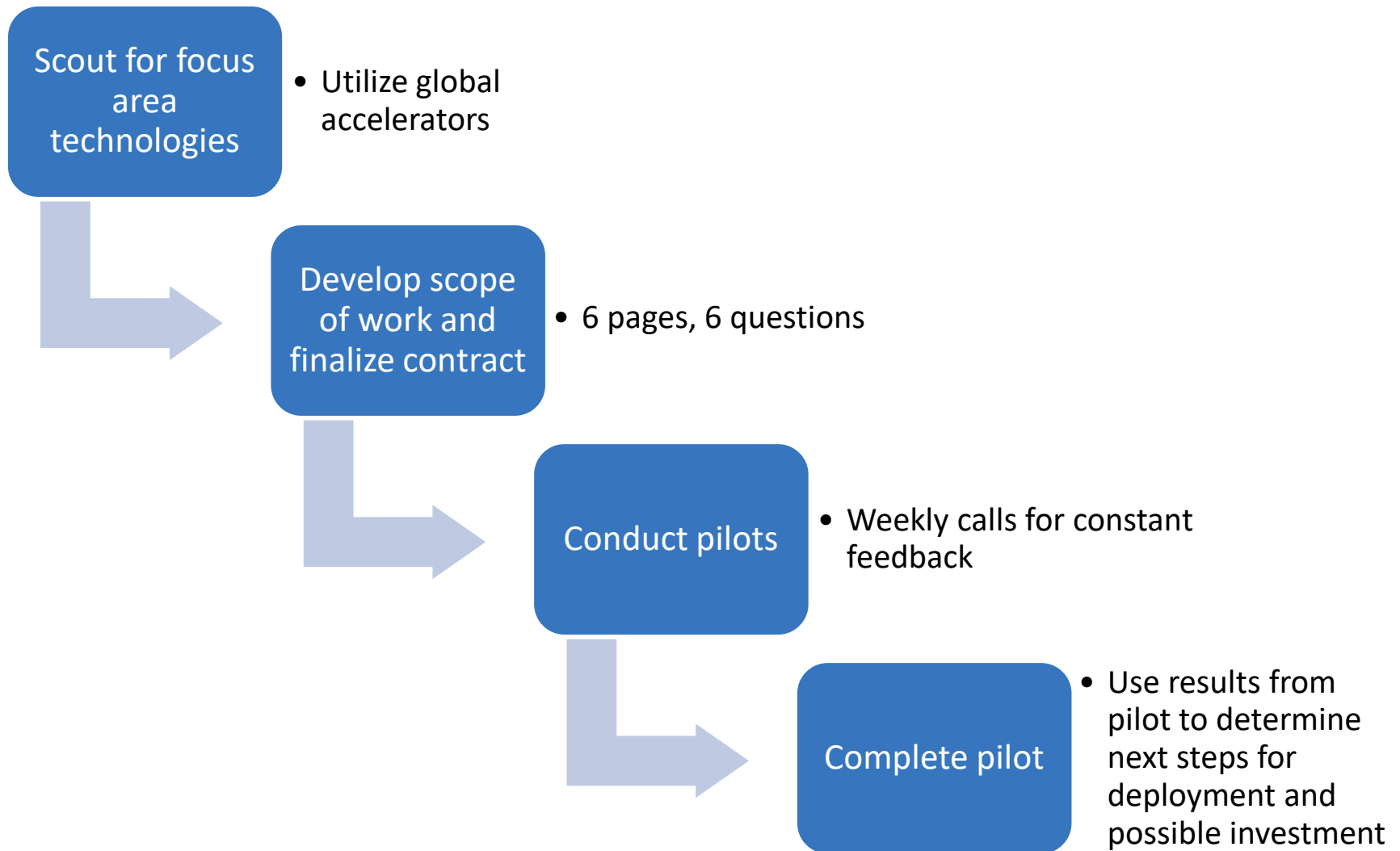
Bring concepts to life in ways that test and refine value propositions and outline a path to growth



Partner & Invest

Realize value outside of direct deployments by providing resources and expertise to promising companies

Improving our Start-Up Engagement Process



6 questions, speed to results, judging benefits

We ask start-ups to answer 6 questions in less than 6 pages to develop the first draft of a Scope of Work (SOW) that could become part of a contract

- What is the challenge your technology can solve for AEP?
- What is the solution that your technology provides?
- Describe a pilot with the minimum, fastest to complete activities that would demonstrate its benefits to AEP and its customers
- What would you need from AEP to have a successful pilot?
- What would be the approximate cost of your pilot?
- What would be the milestones and duration of your pilot?

During weekly teleconferences with an AEP team, operating company and business unit practitioner experts, the SOW is quickly finalized in parallel with adjustments to our standard terms and conditions that the start up requests and we agree to make.

Startups are under contract ready to execute pilots in approximately five weeks.

It usually takes 4 to 6 months before benefits (or insufficient benefits) are known, determined by comparing to existing required standards and/or performance, cost and other criteria.

Simultaneous pilots with many different startup companies allows AEP to discover potential ways to link multiple technologies to create a more complete solution

STARTUP ENGAGEMENT EXPERIENCE



- A startup based in Dublin, Ireland transforms demand side resources into revenue opportunities for commercial and industry (C&I) customers and their energy provider. Commercial Operations is piloting the technology with EDP, the Portuguese utility member.
- A company in Massachusetts developed a microgrid platform that integrates distributed energy resources with reduced deployment time and automatically controls and optimizes their performance. SWEPCO is piloting the technology in Louisiana.
- A British startup that developed software that detects daily behavior pattern changes by a family member, an elderly one for example, using home appliances. The software sends an alert to caregivers. PSO is validating the technology in Oklahoma.
- A Colorado-based company that is customer-friendly (UL Certified) battery backup, targeted at outlets for cable and network power backup. AEP's Dolan Technology Center is testing the performance of the storage devices. Innogy, a FE member, is co-piloting.
- This California startup automates plug load management and enables behind-the-meter visibility and controls for increased C&I facility energy efficiency. I&M is piloting this at a service center in Indiana.

Pilots with 2018 & 2019 startups from the Free Electrons (FE) Global Energy Accelerator Program (cont'd)



- A startup that developed a software energy management storage platform that optimizes and automatically balances building loads, EV charging, storage and distributed energy generation. They were purchased by a company from California. AEP Ohio has validated the technology in Columbus.
- An Australian startup developed an advanced battery management system (power electronics and software that could repurpose retired electric vehicle batteries for very cost-effective residential and grid support. AEP's Dolan Technology Center is validating the technology with support from Nissan.
- Advanced artificial intelligence and machine learning technology that uses smart meters for distribution situational awareness such as load flows and congestion from a startup in France. AEP Texas is conducting the pilot.
- Based in London, England, this company uses advanced software optimizing residential EV charging to shift load. Pilot to include installations at homes of a small number of Ohio employees. We are co-piloting with FE member Innogy.
- A startup based in Spain that uses advanced software analyzing commercial building smart meter data and comparing it to 60,000 monitored buildings in its global portfolio for cost-effective energy efficiency, demand side and demand response management recommendations. AEP Ohio is conducting this pilot with data from 100 buildings.

- Innovation and technology development is happening worldwide
- Global utilities are interested in creating synergies with AEP to co-pilot, co-develop, invest, share experience
- Our piloting experience is revealing ways to multiply benefits by combining technologies
- Advanced technologies are close to ready for regulatory approvals to broadly deploy them much more quickly than the slow speed of traditional previous approaches

Thank you

Appendix with supplemental information

(More details are in the January 2020 Public Utilities
Fortnightly magazine interview with AEP's CEO, Nick Akins)

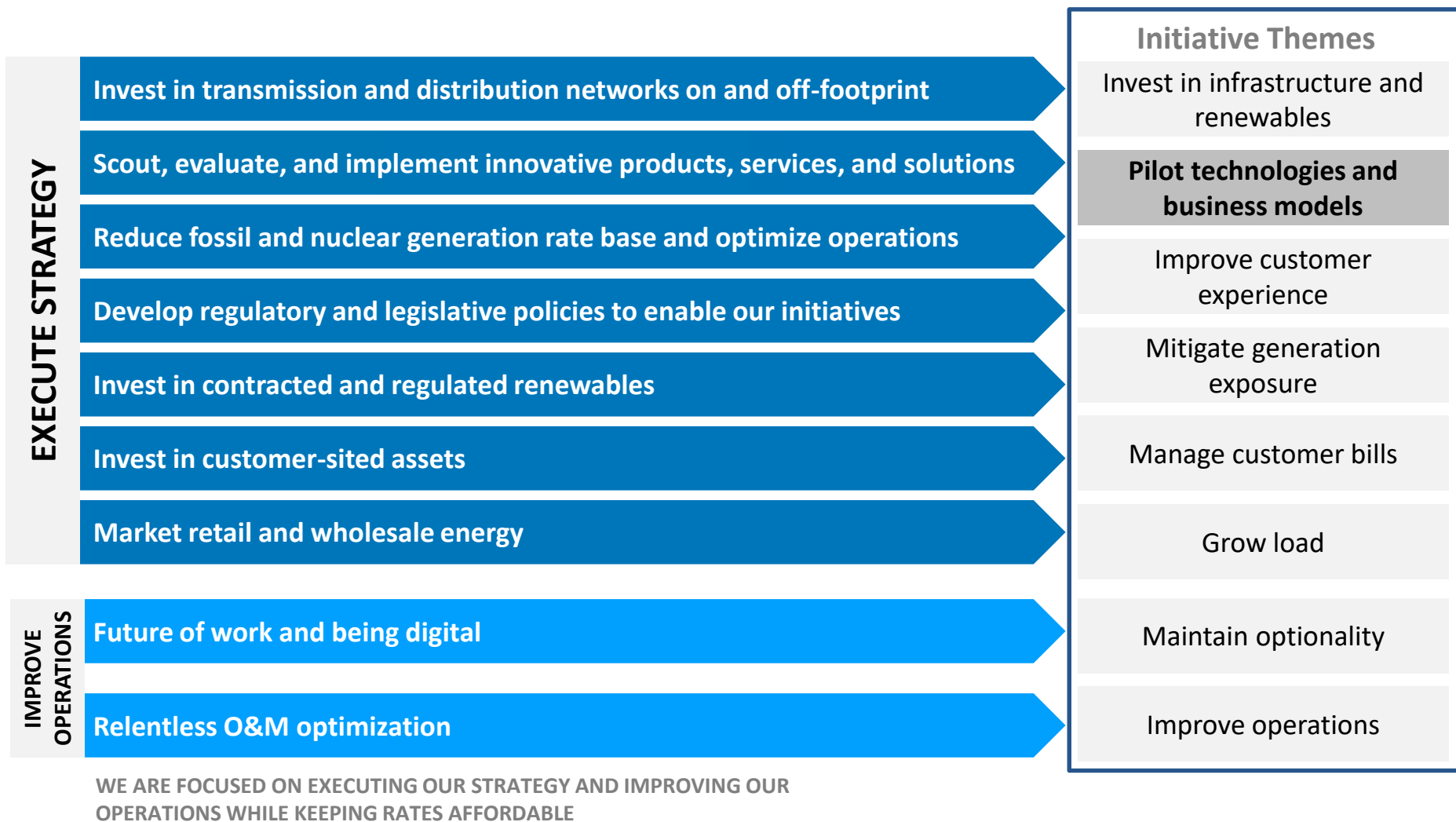
AEP IS GLOBALLY LOOKING FOR NEW TECHNOLOGIES



Nick Akins, Chairman, President and CEO recently said:

"I am confident in our ability to transform our industry for the benefit of the communities we serve. AEP is globally searching for, and validating innovative, advanced technologies, especially to integrate into the distribution grid of the future, for all of our customers and for our operations. Our electrification activities need to improve the lives of all members of society."

AEP 2023 Vision and Execution



The Grid of the Future



Decentralized

Intelligent devices from substations to customers' homes and premises – Industrial Internet of Things



Digitalized

Network services across multiple platforms providing customers with greater control over energy products and services



Decarbonized

Cleaner, greener more sustainable energy options

Why Adjacent and Transformational Innovation?

- Responding to the real threats
- Creating real, sustainable opportunities (see innovation definition)
- Why now?
 - Keep moving forward
 - Customer
 - Speed



Team skills

- Scouting, Approver for Scope of Work and Contracts
- Legal/Contracts
- Procurement/Contracts
- Project Management
- Investment
- Scouting/Expediter
- We try to find solutions to start-up contract and Scope of Work issues before we say no

- The Free Electrons Accelerator (www.freetheelectron.com) is an example of how we are able to efficiently find and prove out advanced technologies.
- AEP is the only North American utility member.
- Over two editions, the program received more than 1,000 applications, from 65 different countries to pitch their technologies to the 10 member utilities.
- We are validating 10 from the best 2018 and 2019 applicants that have the potential to improve AEP operations and to provide benefits to our customers.
- By asking them a few questions, the corporate team, our operating companies and business units are able to collaboratively develop cost-effective scopes of work to show us functionality results, usually in a matter of months.

- **Gain intelligence** from U.S. and global utilities and startups for midterm and long term time horizon (H2 and H3) opportunities and threats
- **Develop business offerings** and business models for AEP to meet customer needs and make money
- **Improve operations**, reliability, safety cost-effective and cleaner energy of our business with technology investments regulators will approve
- **Collaborate with practitioner experts in the Operating Companies and Business Units** to execute pilots and demonstrations of medium and long term technologies and business models to learn what works and what does not work
- **Take “small” and “many” bets – learn, pivot, or scale**

Executing Pilots Faster at Lower Cost

- Pilots for services or products are functionality tests that are now typically less than 5 weeks for Scope of Work development and contract negotiation and now 4 to 6 months long by requiring minimum, fastest to achieve activities
- Our investment manager is embedded in the process to understand the technology and to quickly begin to explore investment possibilities when the start-up's service/product is validated in the pilot
- We typically apply technologies to anonymized customer data or on our own facilities, avoiding delays
- Operating company/business units practitioner experts help develop the Scope of Work and remain involved during the pilot execution
- Start-ups like the focus and speed to pilot execution so they collaborate with AEP (they don't have to)

NARUC INNOVATION WEBINAR SERIES

Hosted on a Thursday each month from 3:00 p.m. to 4:00 p.m. ET

- **January 16, 2020:** Renewable Energy Options for Large Utility Customers
- **February 20, 2020:** Who You Gonna Call? How Commissions Coordinate with their Partners during Energy Emergencies

www.naruc.org/cpi

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