ARPA-E H2SENSE Program Kickoff

Washington, D.C.

December 6, 2024

TECHNOLOGY TO MARKET

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Built on Defense Advanced Research Projects Agency (DARPA) foundation, but with key differences…



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If it works, will it matter? ARPA-E Impact Indicators 2024

Since 2009
ARPA-E has provided
$4.07 billion
in R&D funding to
more than **1,690 projects**
+ 59 selected projects

250 projects
have attracted more than
$13.5 billion
in private-sector follow-on funding

166 companies
formed by
ARPA-E projects

32 exits
market valuations worth
$22.2 billion
from mergers, acquisitions, and IPOs

372 projects
have **partnered with other government agencies**
for further development

7,818
peer-reviewed
journal articles
from ARPA-E
projects

1,187 patents
issued by
U.S. Patent and
Trademark Office

416 licenses
reported from
ARPA-E projects

As of September 2024

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Tech-To-Market supports tech translation with four main approaches



SCOPE

Provide strategic market insights necessary to create innovative, commercially relevant programs

MANAGE

Manage project teams' T2M efforts through T2M plans and jointly developed milestones

ADVISE

Support project teams with skills & knowledge to align technology with market needs

PARTNERSHIPS

Engage third-party investors and partners to support technology development towards the market

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Manage: Project Milestones

Negotiation and Setting of T2M Milestones

- Awardees are required to have T2M milestones along with technical milestones

Ongoing Management of T2M Activity

- Frequent discussions with awardees
- Content includes milestone review, market observations, advising, ideation, and analysis of opportunities

Team Approach

- Participation from program directors, technical advisors, other T2M advisors

Manage: Tech to Market Plan Elements



Projects are required to create and execute a Tech-to-Market Plan

Projects include dedicated Technology Transfer & Outreach funding

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Advise: Product-Market Fit Hypothesis

Value Proposition	Features	Problem	Customer Segment
	Channel	Revenue Model	
Market	External Risks	Key Performance Indicators	

Thoughts about Intellectual Property

Evaluation of the intellectual property (IP) landscape in and around your technology

What IP do you own?

What IP do you expect to create?

What is your freedom to operate?

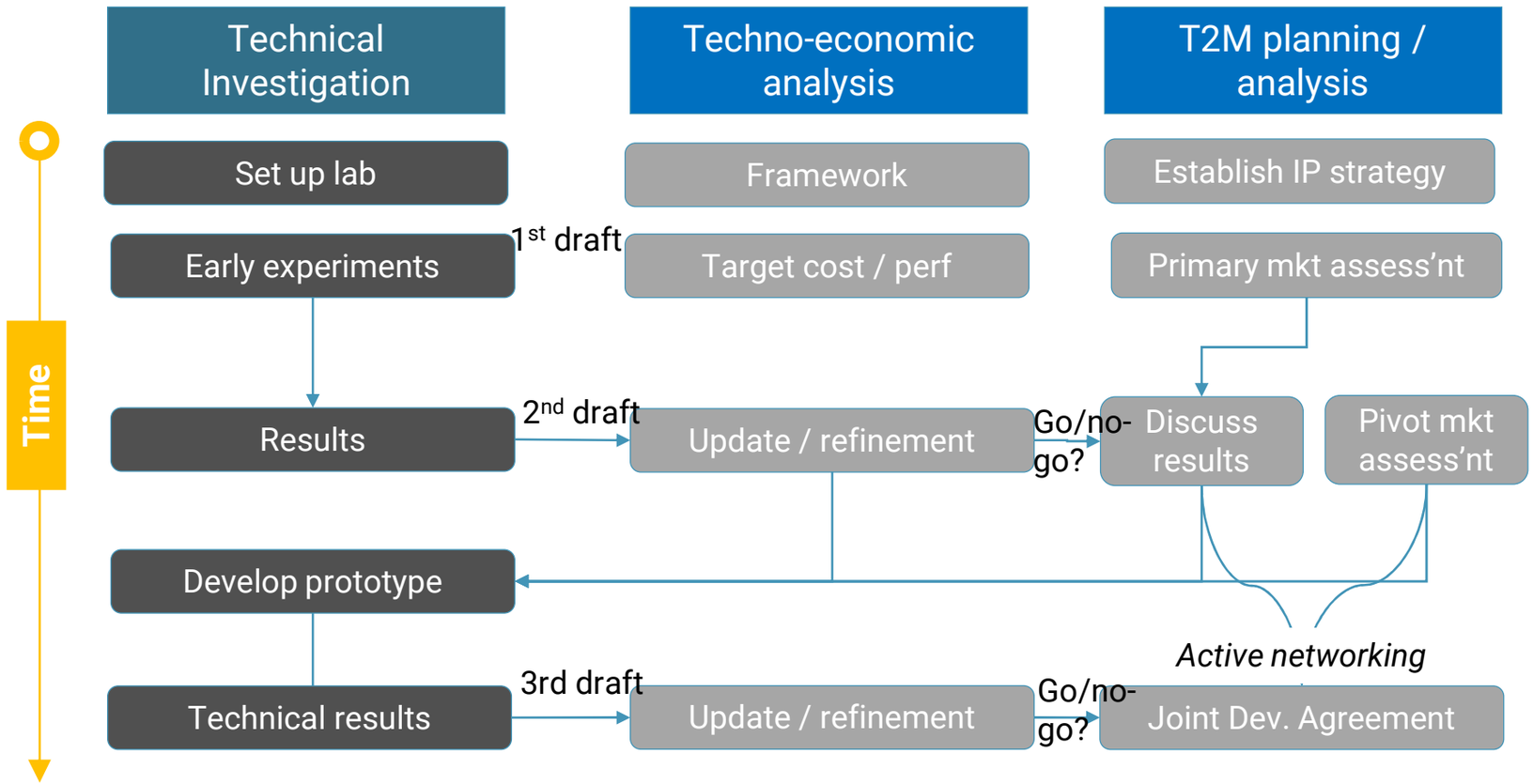
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Techno economic analysis should be designed to provide actionable, data-driven insights

What you learn in the process is as important as the answer itself	Example TEA Types	
	Component in a system	**Should Cost Estimate**
Output	Breakeven cost, below which the system provides customer value	Estimated cost to produce the product
Architecture	Excel, ASPEN, ChemCad, SAM, HOMER, etc.	Excel
Data inputs	Commodity prices, published system costs	Bill of materials, mfg system costs, labor
Use in program	• Establish FOA / Program metrics • Assess trade-offs in materials, design. • Determine does it matter?	• ID cost drivers • Form initial views on supply chain requirements, constraints • Form views on mfg. processes

Generalized flow of T2M milestones (see also the T2M template Gantt chart)

Each milestone should be purposefully assigned to <u>inform</u> or <u>build on</u> other milestones, and they should stem from the <u>technical investigation</u>



Advise: Customer Discovery

- **UNDERSTAND THE CHALLENGE**
  - What are the customer's biggest challenges?
  - What resources are currently being put into solving these problems?
  - How well does your solution address the problem?
- **UNDERSTAND THE EXPECTATIONS**
  - Who are the decision makers, influencers, approvers and potential saboteurs for adoption in the customer's organization?
  - Who in the customer's organization is buying the current solution, how many do they buy, how often do they buy, what do they cost?
- **UNDERSTAND THE PROCESS**
  - If it were free, would the customer implement it today?
  - What is the customer's history with adopting similar, or any, technology?
  - What barriers are present that prevent the adoption of new solutions?

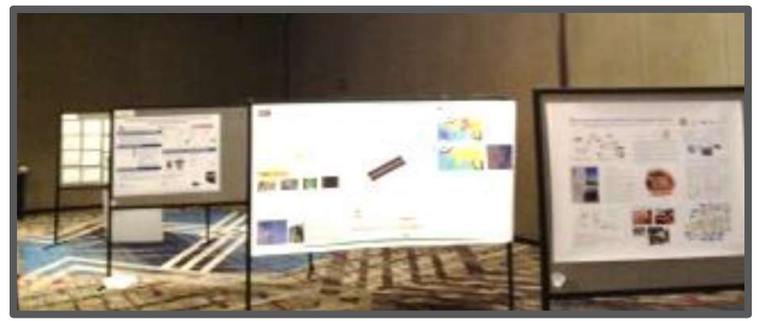
Partnerships: Follow-on Funding



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Partnerships: Program Kickoff & Annual Review

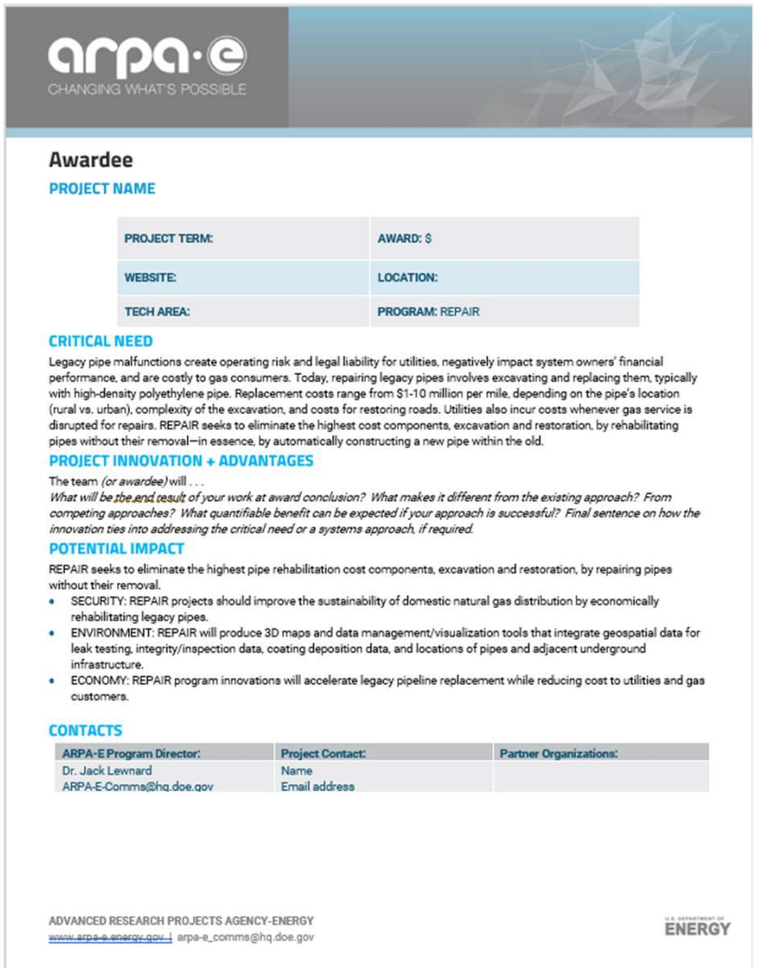
- Technology-specific deep dives and networking sessions
- Build new community of ARPA-E awardees, investors, customers, other government agencies
- Potential investors and strategic partners observe progress throughout the program lifecycle
- Build relationships to advance commercialization beyond ARPA-E funding





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Near-term items: Slick Sheets and T2M Template



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Awardee

PROJECT NAME

PROJECT TERM:	**AWARD:** $
WEBSITE:	**LOCATION:**
TECH AREA:	**PROGRAM:** REPAIR

CRITICAL NEED

Legacy pipe malfunctions create operating risk and legal liability for utilities, negatively impact system owners' financial performance, and are costly to gas consumers. Today, repairing legacy pipes involves excavating and replacing them, typically with high-density polyethylene pipe. Replacement costs range from $1-10 million per mile, depending on the pipe's location (rural vs. urban), complexity of the excavation, and costs for restoring roads. Utilities also incur costs whenever gas service is disrupted for repairs. REPAIR seeks to eliminate the highest cost components, excavation and restoration, by rehabilitating pipes without their removal—in essence, by automatically constructing a new pipe within the old.

PROJECT INNOVATION + ADVANTAGES

The team *(or awardee)* will . . .
What will be the end result of your work at award conclusion? What makes it different from the existing approach? From competing approaches? What quantifiable benefit can be expected if your approach is successful? Final sentence on how the innovation ties into addressing the critical need or a systems approach, if required.

POTENTIAL IMPACT

REPAIR seeks to eliminate the highest pipe rehabilitation cost components, excavation and restoration, by repairing pipes without their removal.

- SECURITY: REPAIR projects should improve the sustainability of domestic natural gas distribution by economically rehabilitating legacy pipes.
- ENVIRONMENT: REPAIR will produce 3D maps and data management/visualization tools that integrate geospatial data for leak testing, integrity/inspection data, coating deposition data, and locations of pipes and adjacent underground infrastructure.
- ECONOMY: REPAIR program innovations will accelerate legacy pipeline replacement while reducing cost to utilities and gas customers.

CONTACTS

ARPA-E Program Director:	Project Contact:	Partner Organizations:
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ADVANCED RESEARCH PROJECTS AGENCY-ENERGY
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ENERGY

Mkt Prep Activities	Definition
Market Strategy	
Market Analysis	Define broad landscape in which your technology fits, where you are and identify key players
Competitive Analysis	Conduct Strength/Weakness/Opportunity/Threat (SWOT), Customer, and Market Analyses to identify opportunities and assess team's ability to meet them
Market Entry Strategy	What is the best fit for your product at this point that aligns to a validated market need and FOA vision? Select first and long-term markets
Regulatory and Industry Approval	Identify regulatory requirements and ensure business strategy meets them. Identify key codes, standards and industry implementation requirements to ensure that product is viable
Strategic Partnerships	Identify key market stakeholders, and develop strategic partnerships
IP Strategy	
Define Initial Assets	Define what you have invented
Determine Prior Art	Determine what's unique by reviewing prior art, refine your existing technology based on this analysis
Aggressively File IP	File for what patents you can
Expand Scope	Define what else you might patent to expand scope around core IP and broaden your commercial protection. Suggest research strategy to prove viability of this approach, and resources to execute this strategy
Product Development	
Product Concept	Define what product you wish to provide
Product Design	Define product specifications and build prototype
Demo Product	Test product in controlled settings. Iterate as learnings are gained and build improvements into product design
Customer Acceptance of Product	Test product with customers and validate performance for real world settings. Identify implementation hurdles and develop strategy to overcome them
Organizational Development	
Create financial models and select optimal revenue model	Conduct product cost/benefit analysis (TEA), and identify optimal revenue generation strategy
Staffing Strategy	Identify key staffing needs, recruitment strategy, and hire essential staff
Operational Readiness*	

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Proposed T2M activities should build on your T2M plan and promote business formation or commercialization

Typical T2M Activities by Year and T2M Plus Up Activity Options

Year 1	Year 2	Year 3
TEA (Preliminary Economic Model for REPAIR program) v1 T2M plan v1 Market study/Customer Inquiries IP review	TEA v2 T2M plan v2 Customer value model Freedom to operate analysis Business model canvas Transition plan	Company formation/fundraising Customer segmentation Product specification Supply chain development Business plan In field trials

Gray items likely to have already been included in originally negotiated Year 3 T2M activities

Target outcomes

- **SCALEUP**
- Private investment
- Strategic investment

May also be used for program level requests (e.g., using consultants or developing reports seeking regulatory approval for safety matters (e.g., PHMSA)

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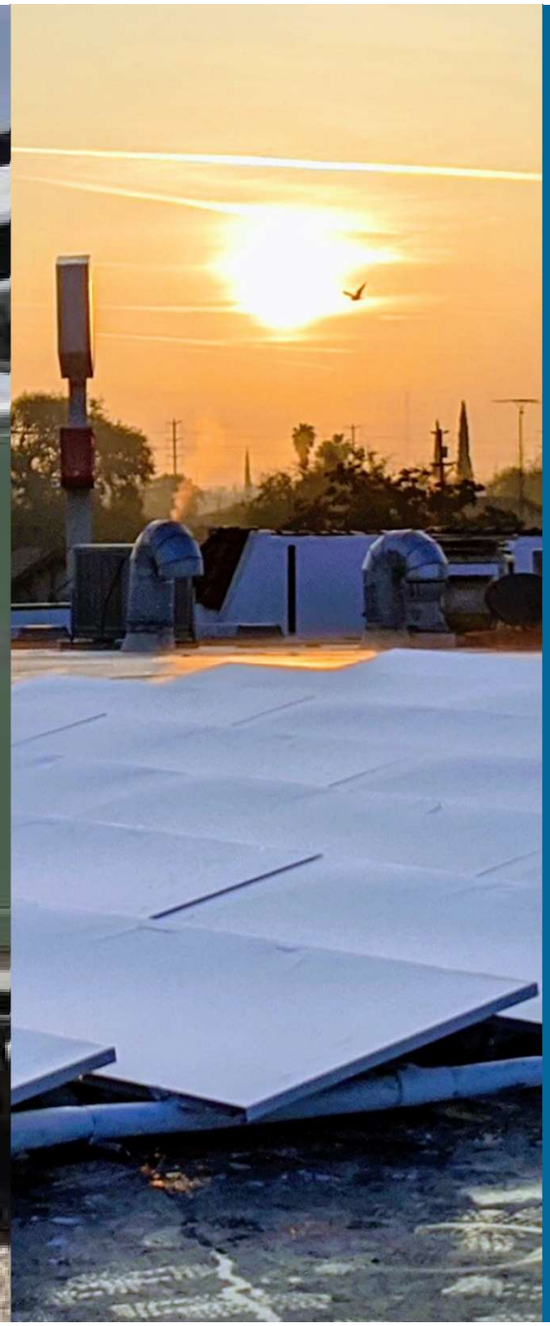
One more thing - Successful performers can request additional T2M funding

- **Purpose** – for successfully performing teams (i.e., meeting milestones), additional T2M funds can be made available for T2M activities beyond those originally proposed if the expenditure would improve the likelihood of market adoption
- **Timing** – Additional T2M funds will typically be provided for the 3rd year of the award. Projects with earlier commercialization milestones can have funds applied to the 2nd year. Scope may extend beyond your original proposed project timeframe.
- **Requirements –** funding contingent on factors stated in H2SENSE ET FOA (e.g., making progress, submitting reports).[1]
- **Funds** – Up to 5% of the budget *at the program level* could be available
  - Not a hard cap
  - Minimum number of awards is zero, max is 9

[1] *Renewal funding is contingent on: (1) availability of funds appropriated by Congress for the purpose of this program; (2) substantial progress towards meeting the objectives of the approved application; (3) submittal of required reports; (4) compliance with the terms and conditions of the award; (5) ARPA-E approval of a renewal application; and (6) other factors identified by the Agency at the time it solicits a renewal application.*







SCALEUP

Seeding Critical Advances for Leading Energy technologies with Untapped Potential

Supports previously funded ARPA-E technologies to commercial viability

*

Enables further technology de-risking of pre-production prototypes

*

Encourages small business, company, and industry participation

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SCALEUP 2019
10 Awardees - $70+ million

*

SCALEUP 2021
8 Awardees - $100 million

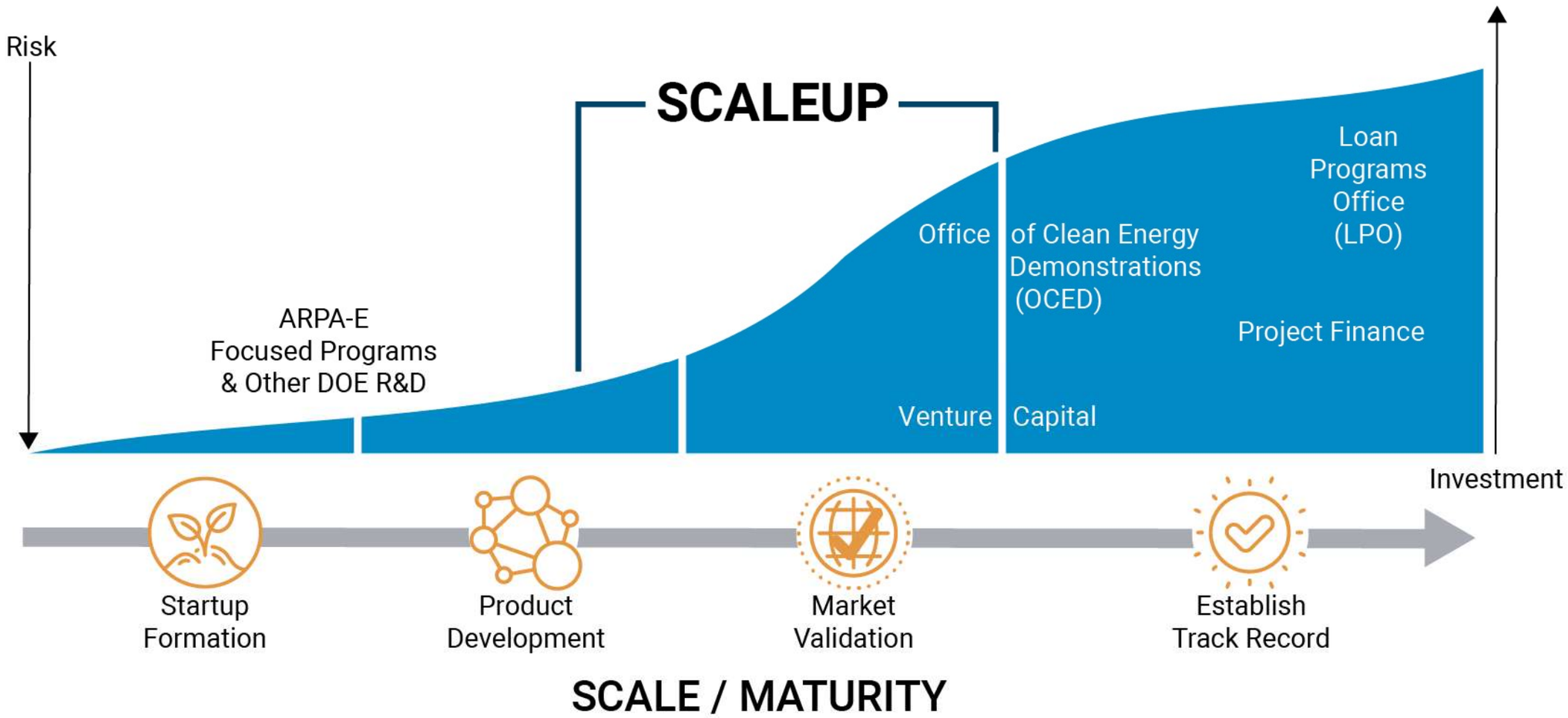
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SCALEUP 2023
4 Awardees - $63.5 million

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SCALEUP Ready
Up to $50 million

SCALEUP



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As of September 2022



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