

# ARPA-E OPEN 2021 Solicitation

Advanced Research Projects Agency - Energy  
Funding Opportunity in Energy Technology

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# Overview

- ARPA-E the Agency as an Organization in the Department of Energy
- OPEN 2021 Solicitation
- the ARPA-E Process
- The “Big Idea” – Questions to Ask Before Writing your Proposal
- Elements of a Good Concept Paper
- Beyond Concept Paper
- Next Steps ....

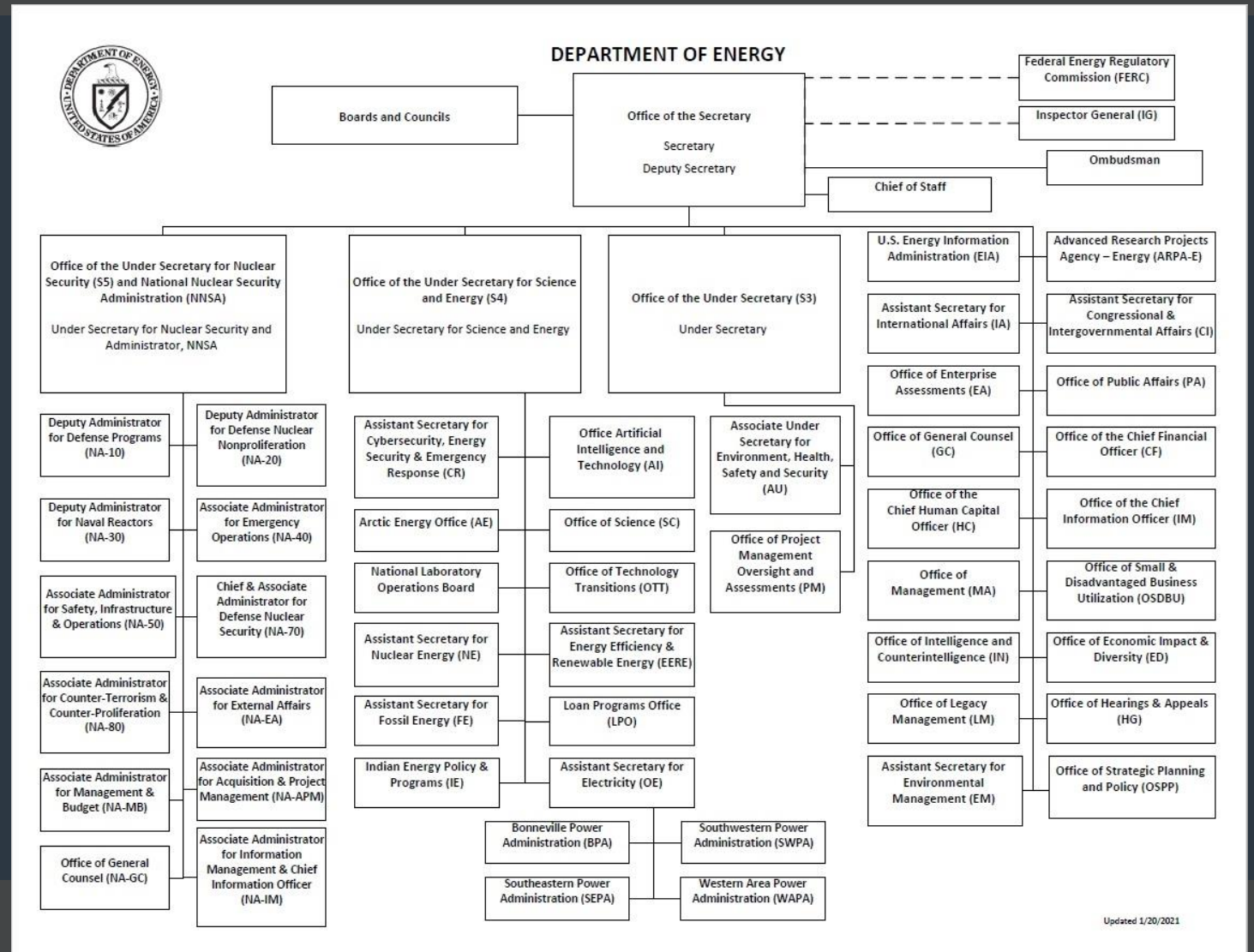


# What is ARPA-E?

- Advanced Research Projects Agency – Energy
- Stand-Alone Funding Agency within US Department Of Energy
- Reports Directly to Secretary of Energy – Outside of Undersecretary for Science and Energy Structure
- Goal: “Transformational Technologies” with potential for “Disruptive Impact” in energy
- Mission: “to Enhance the economic and energy security of the United States through the development of energy technologies that:
  - i) reduce imports of energy from foreign sources;
  - ii) reduce energy-related emissions, including greenhouse gases;
  - iii) improve the energy efficiency of all economic sectors;
  - iv) provide transformative solutions to improve the management, clean-up, and disposal of radioactive waste and spent nuclear fuel; and
  - v) improve the resilience, reliability and security of infrastructure to produce, deliver and store energy ....

# DOE Organizational Structure

- Secretary Confirmed:  
Sec. Jennifer Granholm
- Non-Confirming Leadership  
Chief of Staff Tarak Shah
- Acting Officials Still in Most  
Confirmable Positions
- ARPA-E Director is Senate  
Confirmed Position
- Deputy Director:  
Dr. Jennifer Gerbi



# Relationship Between ARPA-E & Rest of DOE

- \$5B**
  - Office of Science: Supports Basic Research  
Foundational Research without strong ‘Consideration of Use’  
Grand Challenges and Basic Research Need (BRN) Prioritization
- \$5B**
  - Applied Energy Offices: [ex. Energy Efficiency and Renewable Energy]  
Supports Development of Technology to a Specific End-Use, Often on an  
Industry Driven Roadmap (MYPP) to an Organizational Prioritization Plan.
- \$450M**
  - ARPA-E: Research with a Definite Purpose. Something Scientifically and  
Technically New, that if Solved will Matter. Find a new scientific opportunity  
outside of existing Grand Challenge Framework, that When Solved Matters.

# ARPA-E Organization

**Flat Structure: Minimized Hierarchy from Director – Generally Operate Independent from Rest of DOE**

**Deputy Directors: Technology, Tech-2-Market and Operations**

**Program Directors: Non-Permanent Feds with Science AND Business backgrounds.**

**(High Autonomy: Manage Selection, Project Oversight, and goals for All Project)**

**Tech-2-Market Advisors: Business and Tech-Transfer advisors**

**Fellows: Scientific Post-Doc in Energy Innovation**

**Operations: Legal, Contracting, Public Affairs, PM Contractors. Tech Contractors**

**PDs Recommend All Selections: Make Your Proposed Concept their Success.**

**OPEN Solicitations are often how PDs test an idea or new area that might lead to entire focused program.**

# ARPA-E Solicitations

- ARPA-E has supported various solicitations from 2009 - present
  - Open Solicitations: 2009, 2012, 2015, 2018 and **NOW/2021**
  - Ideas Solicitations: 2013 and onward, rolling / Periodic (seedling projects)
  - Prizes and Scale-Up: Ongoing since 2018 (relatively new)
  - Topical Solicitations: Ongoing since 2009, annual
- ARPA-E supports Cooperative Agreements, not Grants
  - Significant Federal Involvement with Go/No-Go Milestones and Quarterly Reviews
  - Tip:** If submitting to OPEN in an area of an existing topical area,
    1. read prior FOAs to understand earlier approaches explored, and
    2. explain how your approach is new/different/complementary, or can solve a specific and focused new problem within the existing portfolio.

# PRIOR FOCUSSED ARPA-E PROGRAMS

ADEPT 2010  
ALPHA 2015  
AMPED 2012  
ARID 2015  
BEEST 2010  
BEETIT 2010  
CHARGES 2014  
DELTA 2014  
ElectroFuels 2010  
FOCUS 2014  
GENI 2011  
GRIDS 2010  
HEATS 2011

IMPACCT 2010  
METALS 2013  
MONITOR 2014  
MOSAIC 2015  
MOVE 2015  
PETRO 2011  
RANGE 2013  
REACT 2011  
REBELS 2014  
REMOTE 2013  
SolarADEPT 2011  
SWITCHES 2013  
TERRA 2015  
TRANSNET 2015

ASCEND 2019  
ATLANTIS 2019  
BETHE 2020  
BREAKERS 2018  
CIRCUITS 2017  
DAYS 2018  
DIFFERENTIATE 2019  
ECOSynBio 2020  
ENLITENED 2017  
FLECCS 2020  
GAMOW 2020  
GEMINA 2019  
GENSETS 2015  
GRIDDATA 2015  
HITEMMP 2018

INTEGRATE 2018  
IONICS 2016  
MEITNER 2018  
NEXTCAR 2016  
NODES 2015  
PERFORM 2020  
PN-DIODES 2017  
REEACH 2019  
REFUEL 2016  
REPAIR 2020  
ROOTS 2016  
SENSOR 2017  
SHARKS 2020  
SHIELD 2016  
ULTIMATE 2020



# Prior ARPA-E OPEN Solicitations

<u>OPEN 2009:</u>	41 Projects	9 Areas	\$177M	15 States	\$4.3M avg
<u>OPEN 2012:</u>	66 Projects	15 Areas	\$179M	25 States	\$2.7M avg
<u>OPEN 2015:</u>	39 Projects	9 Areas	\$120M	19 States	\$3.1M avg
<u>OPEN 2018:</u>	77 Projects	13 Areas	\$199M	30 States	\$2.6M avg
<u>OPEN 2021:</u>	\$100M – Present Solicitation				

**Note:** This Is SMALLEST ARPA-E OPEN FOA as a Percentage of their Annual Appropriation  
Expect High Competition with Low Probability of Success. Concept Paper is Only 4 Pages

# Other Types of Solicitations

GO Competition 2018: Prize Competition

IDEAS: Rolling Open FOA

Scale-Up: Tech-2-Market led Internal Follow-On Funding to Take Previously Supported Idea to Scale

Plus-Ups: Internally Competed Follow-On Funding to Existing, Competitively Funded Projects (pitched by Project Program Director)

ARPA-E Does NOT Support Continuation Grants

# Activities and Organizations Supported

- Science and Technology Project: Research is Funded
- Research Results must have Subsequent Impact : Tech-2-Market
- Supported Organizations: Universities
  - National Labs and Non-Profits
  - Start-Ups / Small Businesses
  - Large Businesses
  - Combination of the Above
- Matching Funds: 20% [More Considered for Large Businesses, less for Labs]

**Tip:** Provide a validated vision of HOW Technology may specifically Achieve Impact through technology-to-market (T2M) activity, start-up formation, follow-on funding, partnership development, etc. Link to plan. Necessary, not Sufficient.

# OPEN Solicitation

- Teaming / Partner List issued: December 2020
- Concept Paper Funding Opportunity Announced: Feb 11
- Concept Papers Due: April 6
- Estimated Schedule -
  - Concept Paper Recommend / Not-Recommend: mid-May
  - Full Applications Due: early-July
  - Selections Announced: ~ September
  - Initial Contracting: End-of-Year & Kick-off in March

<https://arpa-e-foa.energy.gov/Default.aspx#Foald2b1605fb-a156-4d55-aa5b-b4c1a213c736>

# Concept Papers

Funding Probability: Concept Paper Submissions - 5000  
Recommendation for Full Application – 500  
Selected Projects for Funding – 50

Average Project: \$2.5M for 3 Years - Formal Budget NOT Required for Concept Paper

Cost Match and Partnership Commitments: NOT Required for Concept Paper

Format: 4 Pages Maximum ( follow Font Size and Margin requirements)

- 1.) Concept Summary
- 2.) Innovation and Impact
- 3.) Proposed Work
- 4.) Team and Organization

**Pro Tip:** Figures and Images Communicate in Small Spaces. But DO NOT Shrink Down to Point of Unreadability. Work on Images to Make Clearly Communicative. Not the place for making a Subtle or Nuanced Point

# Concept Paper Review Criteria

- Review Criteria: 50% Potential for Impact Relative to FOA Targets  
50% Scientific and Technical Merit
- Policy Factors: Not Primary Issue in Review, but For Building Out Portfolio
- Result: Encourage / Not-Encouraged for Full Application
- First Page Needs a Strong Bottom Line Up Front: A Clear Big Idea  
Program Directors will Each Read 400 – 800 Concept Papers over 4 Weeks.

**Pro Tip:** A Graphic On Front Page of Concept Paper that Provides Overall Vision Helps Reviewers Remember Proposal at Time of Selection

# Big Ideas: Hielmeyer Catechism

- What Problem are You Trying to Solve ? (Explain with No Jargon)
- Why Does this Problem Matter ? (for Energy) – Who Cares
- How is this Problem being Addressed Today ?
- What New Science / Technology Approach is Proposed and Why Might this Address This Problem?
- Why Would this Be Hard to Accomplish? (What are the Risks?)
- How Will Success Be Measured (Short, Medium, and Long Term)
- How Long will it Take? (Project and End Solution)
- How Much Will It Cost? (Project and End Solution Targets)

Considers Both Technical and Non-Technical (Tech-2-Market) Challenges

# Elements of a Strong Concept Paper

- Clear, Well Articulated and Significant Energy Problem (1 Quad problems)
- Identification of a New Scientific or Technical Approach to Problem
- Evaluation of how un-met Scientific or Technical challenges / Risks / Unknowns would be Overcome through Directed R&D
- Identification of How the Scientific or Technical Findings would Subsequently Change Approaches to Energy Problem
- Team: How will address Science Challenge and have Follow-On Impact

**Pro Tip:** Research only leading to the need for more research is not an outcome. Quantify how scientific result in project would have impact on energy.



# Negative Approaches to a Concept Paper

- Cheerleading Moral Imperatives Falls Flat. All Reviewers understand the Energy and Climate issues that need to be addressed
- Ad-hominem Criticisms of Already Supported Projects / Program Decisions Usually Fall Flat
- Extended Personal Motivations or 'Passions', while interesting, just takes up page space.
- Economic development or Political impact without science is weak
- Proposing Policy Solutions without Technical Approach is weak

Understanding Policy and Economic Framework is Essential, but not a Stand-Alone Criteria

# Negative Approaches to a Concept Paper (2)

- Research based only on addressing a Grand Science Challenge
- Development Addressing Existing DOE Roadmap Goal and Approaches
- Innovative Business Models alone
- Well-Funded Research Concepts, without something New
- Well-Funded Research Group, without a Differentiated Approach
- Previous funding justifying new funding: ARPA-E isn't Follow-on

**Tip:** Strategy for Existing Technical Areas: Explicitly state how Proposed work either: 1) Intensifies (goes deeper), 2) Extends (goes further) or 3) Complements prior work

# ARPA-E and Risk

- ARPA-E Reputation for Supporting “High-Risk / High-Reward”
- Program Directors gone in Three Years: Risk Doesn’t Stick with Them
- Risk Managers vs. Risk Takers
- Risk is Perceived Relative to Individuals Identifying and Addressing Risks
- Risk Management is about When to STOP an Approach and PIVOT

Identify How Your Idea is “Too Risky” for Your Organization (Private Sector, Lab, etc.)

# Technical Topic Areas: OPEN

- Topics Used to Categorize / Sort Proposals
- Identical to 2018 and prior OPEN FOA Topics
- Solicitation Developed under Prior Leadership
- New Leadership at ARPA-E Will be in Place By Time of Selection
- New Authorization Language (Bipartisan)
  - Passed in Dec 2020
  - Explicitly Included EM and Infrastructure

- Topic 1: Grid
- Topic 2: Transportation
- Topic 3: Building Efficiency
- Topic 4: Power Generation
- Topic 5: Renewable Power
- Topic 6: Bioenergy
- Topic 7: Other Energy

# 20 Particular Interest Areas: Webinars

- Microalgae Utilization
- Nuclear Resource Utilization
- Wireless Power Transmission
- Urban Air Mobility
- Iron and Steel
- Demand Flexibility
- Carbon Farming
- Underground Mines & Wells
- Next-Generation Biorefining
- Alternate Anodes & Cathodes for EV
- Stationary Hydrogen Storage
- Comminution of Mineral Ores
- Accelerated Geomineralization
- Data Center Cooling
- CO<sub>2</sub> Mineralization for Mineral Extraction
- Fusion Energy with Advanced Fuels
- Urban Waste Recovery
- Fast-Charging Li-Metal Batteries
- Electricity Transmission
- Negative Emissions Technologies

<https://arpa-e.energy.gov/open-2021/webinars>

# TOPICS: 1 GRID

- Grid Transmission
- Grid Distribution
- Modeling, Software, Algorithms and Control for the Grid
- Grid Scale (Battery) Storage
- Grid Scale (Non-Battery) Storage
- Grid Reliability
- Grid - Other

# TOPICS: 2 TRANSPORTATION

- Alternative Fuels (Non-Bio)
- Engines – Transportation
- Electric Motors – Transportation
- Fuel Cells – Transportation
- Advanced Vehicle Designs & Materials
- Transportation Management
- Power Electronics – Transportation
- Non-Automotive / Sea Transportation
- Air Transportation
- Batteries Storage - Transportation
- Non-Battery Storage – Transportation
- Transportation - Other

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# TOPICS: 3 BUILDING EFFICIENCY

- Combined Heat and Power
- Building Heating and Cooling
- Building Energy Demand Management
- Lighting
- Building Envelope
- Building Efficiency - Other

# TOPICS: 4 POWER GENERATION & ENERGY PRODUCTION: FOSSIL/NUCLEAR

- Combined Processes – Generation with Fossil Fuels
- Stationary Engines / Turbines for Generation with Fossil Fuels
- Stationary Fuel Cells for Generation with Fossil Fuels
- Nuclear Fission Power Generation and Materials
- Nuclear Fusion Power Generation and Materials
- Carbon Capture
- Exploration and Extraction (Non-geothermal) of Conventional and Unconventional Fossil Fuels
- Planning and Operations for Generation with Fossil Fuels
- Infrastructure for Combustible Gas
- Chemical and Biological Conversion from Fossil Fuels
- Water Conservation in Power Generation
- Generation with Fossil Fuels - Other

# TOPICS: 5 POWER GENERATION- RENEWABLE

- Wind – Energy Capture
- Wind – Energy Conversion
- Geothermal Energy
- Hydro Energy
- Solar – PV / CPV
- Solar – Non-PV
- Power Electronics – Renewable Generation
- Renewable Power - Other

# TOPICS: 6 BIOENERGY

- Biomass Production
- Biofuel Production – Biological Methods
- Biofuel Production – Nonbiological Methods
- Bioenergy Supply Chain
- Bioenergy - Other

# TOPICS: 7 OTHER ENERGY TECHNOLOGIES

- Water Production / Reuse
- Thermal Energy Storage
- Advanced Manufacturing
- Appliance and Consumer Electronics Efficiency (End-Use)
- Data Centers and Computation
- Industrial Efficiency – Materials
- Industrial Efficiency – Other
- Heat Recovery
- High Temperature Materials
- Semiconductors
- Portable Power
- Other Energy Technologies – Not Listed Above

# Externalities

- Energy is No Longer Scarce: it is Plentiful.  
How Does This Change Science and Technology Requirements
- Energy Related Emissions and Climate Change  
Are a Priority to Be Addressed
- Economic Opportunity and Equity in Energy Technologies
- Place-based Innovation: Supporting Ideas in Regional Eco-Systems  
that are not the Usual Suspects
- Increased Early Stage Private Sector Capital for Energy Innovation

Start-Ups: ARPA-E Selection can be a Golden Ticket for Venture Capital Support  
Matching Funds can Come from New Investors, but to Need Plan

# More

- Don't Wait Until Last Minute. Use Time to Re-Edit
- Color-Team Project:  
Pink (outline review); Red (First Draft); Gold (Revised Draft); White (Text Edit)
- Compliance: Use FOA Defined Format and Answer Questions they Ask.
- Use Clear Language to Explain: Who, What, Where, When Why and How
- Concept Paper Communicates the Vision, not the Gantt Chart Details.

# Beyond the Concept Paper

- Go Deep on preparing Science and Technology: Assume Expert Due Diligence in Full Application.  
(Concept Papers only need to be Eye catching)
- Technologists: Build a First-Order Techno-Economic model relative to Energy Problem being Solved. Treat this as a hypothesis to be tested in parallel with research program
- Build Best-of-Class Team: Even after Concept Paper Submitted
- Identify Sources of Follow-on Funding: Commitment on Contracting
- Build 'Charisma' around the Big-Idea.  
Not a replacement for science, but shows potential for impact.

Leave the Political Connections at Home: ARPA-E Generally Hates It when People have Their Congressional Representative or Lobbyists Call. It makes PDs Question Whether the Ideas have Stand-Alone Merit.



# Discussion and Dialog

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