

C3.ai Digital Transformation Institute

Second Call for Proposals

February 2, 2021

Digital Transformation and AI for Energy and Climate Security

Introduction

The C3.ai Digital Transformation Institute (C3DTI) was established in March 2020 by C3 AI and Microsoft and co-led by the University of California, Berkeley (UC Berkeley) and the University of Illinois at Urbana-Champaign (UIUC), with consortium partners Carnegie Mellon University, KTH Royal Institute of Technology, Lawrence Berkeley National Laboratory (LBNL), Massachusetts Institute of Technology, Princeton University, Stanford University, and University of Chicago, and with high-performance computing support from LBL and the National Center for Supercomputing Application (NCSA) at UIUC. The goal of C3DTI is to catalyze cooperative research activities and advances in mathematical, statistical, and computing research, combining machine learning (ML), artificial intelligence (AI), the internet of things (IoT) and ethics and social responsibility in the development and fielding of technology. C3DTI is aimed at establishing the fundamental set of scientific advances, algorithms, designs, and business change management practices necessary to establish the Science of Digital Transformation of Societal Systems.

C3DTI will contribute to the new and emerging field of Digital Transformation Science by leveraging the personnel, laboratory, and research facilities at UC Berkeley, UIUC, and consortium partner institutions to form dynamic teams of the best researchers in the world to advance IoT and AI techniques for industrial, commercial, and public sector applications. This rich ecosystem will help address some of the most complex issues inherent in a massive societal Digital Transformation and build the foundation for a new Science of Digital Transformation.

Digital Transformation and AI for Energy and Climate Security

The energy industry is being digitally transformed by investment at all levels of production, generation, transmission, and distribution: sensors, data analytics, new privacy-aware markets, and usage of smart meters in homes are all part of this transformation. However, the transformation of energy to be resilient to large environmental changes, faults (including maintenance errors), and cyber-attacks is still a work in progress. The early lead of energy operators in embracing digital transformation has enabled those systems to use digital transformation not only to enhance energy efficiency but also to lead the way to a lower-carbon, higher-efficiency economy that will enhance both energy and climate security.

This C3DTI [Second Call for Proposals](#) addresses the challenges for AI and Digital Transformation for Energy and Climate Security.

Areas of interest include but are not restricted to:

1. **Sustainability:** Applying AI/ML and advanced analytic techniques to support sustainability initiatives. Areas of focus may include scalable and trustworthy techniques for energy consumption analysis, supply chain and Scope 3 energy and emissions analyses (see [EPA Scope 3 Inventory Guidance](#)), tracking water use across full-stream operations, and optimizing energy and water intensity of hydrocarbon production, storage, and transportation.
2. **AI for Carbon Sequestration:** Applying AI/ML techniques to increase the scale and reduce the cost of carbon sequestration. Areas of focus may include AI for advanced materials research to build better extraction of carbon dioxide (CO₂) from the atmosphere, petrochemical process optimization for carbon capture, fossil fuel decarbonization, site-specific modeling of geophysical sequestration and emissions containment, and new sequestration technologies.
3. **AI for Leaks and Emissions Detection:** Applying advanced AI/ML techniques for large scale emissions detection, facility-level data reconciliation and gap analysis for emissions sensors, prediction of emissions risk, and analysis and optimization of flaring intensity across upstream and downstream operations.
4. **Safe Hydrocarbon Production and Transportation Infrastructure:** Applying analytic and AI/ML modeling techniques to increase the safety and reduce emissions from oil and gas extraction, petrochemical production, and hydrocarbon transportation. Areas of focus may include AI-based video and imaging algorithms to detect potential hazards and reduce accidents, with particular application in multi-modal sensing and drone-based real-time detection of methane and CO₂ leaks, AI-based predictive maintenance, AI-enabled corrosion detection, AI-supported augmented reality systems for maintenance support, and next-generation AI-based digital twinning to support the modeling of hydrocarbon systems.
5. **AI for Advanced Energy and Carbon Markets:** Enabling dynamic, automated, and real-time pricing of energy generation sources. Areas of focus may include distributed resources, spinning reserve and voltage support, renewables, peer-to-peer energy transactions, improved energy and carbon price forecasting, and mechanism design to positively incentivize energy and carbon markets and prevent free riding and adverse selection.
6. **Cybersecurity of Power and Energy Infrastructure:** Leveraging AI/ML techniques to improve the cybersecurity of our critical power and energy assets, as well as smart connected factories and homes. Areas of focus may include AI/ML for distributed hardware and network management, detection of anomalous network activity and log monitoring, and the cohesive analysis of hybrid Information Technology (IT) and Operational Technology (OT) systems.
7. **Smart Grid Analytics:** Applying AI and other analytic approaches to improve the efficiency and effectiveness of grid transmission and distribution operations. Areas of focus may include Volt/VAR optimization, non-technical loss reduction, predictive maintenance for the grid, accelerated outage detection and recovery, automated

power routing, grid management given load profiles of Electric Vehicles, and improved control and operation of microgrids.

8. **Distributed Energy Resource Management:** Applying AI to increase the penetration and use of distributed renewables. Areas of focus may include improving grid efficiency with renewables, granular load forecasting, automated demand-response, appropriate policy design, and the optimal dispatching of distributed resources.
9. **AI for Energy-Efficient Buildings and Factories:** Leveraging AI techniques for advanced building and factory control to improve energy efficiency. Areas of focus may include AI-based motor control systems, advanced load disaggregation analyses, direct load control, and optimal pre-cooling or heating to minimize costs and stress on energy networks.
10. **AI for Improved Natural Catastrophe Risk Assessment:** Applying AI to improve modeling of natural catastrophe risks from future weather-related events (e.g., tropical storms, wildfires, floods). Areas of focus may include advanced asset vulnerability models, the prioritization of climate adaptation measures to enable rapid and more effective disaster recovery, and the appropriate portfolio and pricing of risk transfer solutions.
11. **Resilient Energy Systems:** Addressing how the use of AI/ML techniques and markets for energy and carbon introduce new vulnerabilities. Areas of focus may include detecting cyber-attacks, including Advanced Persistent Threats (APTs), mitigating the risks from such attacks, and operating resiliently through such attacks.
12. **AI for Improved Climate Change Modeling:** Using AI/ML to address climate change modeling and adaptation. Areas of focus may include deep-learning based fine-scale cloud models to enhance larger-scale climate models, circulation models of the stratosphere and troposphere, multi-scale modeling of weather phenomena, processes that govern climate variability and change, and methods to predict climate variations, extended weather, and climate predictability.

Eligibility

Proposal Principal Investigators (PIs) must be faculty researchers from C3DTI consortium partner institutions. Co-Investigators may be from C3DTI consortium partner institutions or other institutions. Preference will be given to proposals where the majority of the work and expenditures occur at C3DTI consortium partner institutions. C3DTI strongly encourages the submission of proposals that are interdisciplinary and inter-institutional across C3DTI consortium partner institutions as well as leading research institutions around the world. By submitting a proposal to this solicitation, proposal PIs and co-Investigators agree to serve as reviewers for other proposals submitted to this solicitation.

Available Funding

It is anticipated that up to USD \$5 million in Research Awards will be awarded from this Call for Proposals. In addition to cash awards, funded proposals will include unlimited free access to the C3 AI Suite hosted on the Microsoft Azure Cloud, including between 225,000 and 1.15 million CPU/GPU hours of compute capacity depending upon grant requirements. Proposals can request funding of \$100,000 to \$250,000 for an initial period of one (1) year. A simple budget is required as per the *Proposal Preparation Instructions* section of this document. Research Awards made from this solicitation must be used for direct costs only and no indirect costs or institutional overhead may be charged. There is a potential for an extension of the Research Award beyond the initial period of performance if needed with reasonable justification and approval.

Dissemination of Project Results

C3DTI encourages Research Award recipients to disseminate the results of their research during the award period in publicly accessible repositories and more generally in the open literature for the public benefit. Such resulting publications should acknowledge the support of C3DTI. Research Award recipients are asked to provide technical reports during and at the conclusion of the Research Award period. Due to the rapidly changing environment about energy and climate security, Research Award recipients may be requested to provide additional information about their projects during the life of the Research Award.

Algorithms and Software Development

Proposals are required to use the C3 AI Suite and Microsoft Azure to show how the algorithms can be applied to real world data. Hence, proposals should explain how the C3 AI Suite and Microsoft Azure will be used to deal with new computational challenges and analyze complex data at scale. C3DTI will make cloud computing resources available to enable the utilization of the C3 AI Suite on the Microsoft Azure stack. C3 AI Suite capabilities include development and deployment of AI applications, data aggregation, and support for flexible REST interfaces. Also provided to Research Award recipients are C3 AI and C3DTI training materials on the use of the C3 AI Suite and computing platforms and technical support by C3DTI staff. Proposals that include an HPC requirement (e.g., large-scale data training or simulation) can be supported through scientific (super) computing resources contributed by NCSA and LBL NERSC. Research Award recipients are strongly encouraged to share algorithms and software as open source for the public benefit.

Proposers are strongly encouraged to consult with C3DTI technical staff on how they can leverage the C3 AI Suite and C3DTI computing resources to accomplish their proposed research. C3DTI will offer information sessions and scheduled office hours with technical staff, as well as make technical staff available to introduce proposers to the capabilities of the C3 AI Suite and the Microsoft Azure cloud computing and NCSA/LBNL scientific computing environments. Details of these events and contact information will be posted to the C3DTI website at <https://c3dti.ai/>.

No-cost, integrated technical support may be made available to select teams, whereby a C3DTI technical staff member is “embedded” with the Research Award recipient team to support and contribute to project work. Such arrangements should be jointly planned with the C3DTI technical team, which retains discretion and authority over selection of integration projects. These arrangements should be discussed before proposal submission and interested proposers should include details in the optional one-page description described in the *Proposal Preparation Instructions* section of this document.

Review Criteria

Projects will be peer-reviewed on the basis of scientific merit, prior accomplishments of the PI and Co-PIs, the use of AI, machine learning, data analytics, and cloud computing, and the suitability for testing methods at scale. While all proposals are required to show how the C3 AI suite and Azure will be used in their projects, no prior experience with C3 AI Suite and Azure is required. If proposers do not have prior experience with the C3 AI suite and Azure, it is strongly encouraged that they consult with the C3.ai DTI development operations staff for details on the functionality of the C3 AI suite and Azure, and their help in addressing the computational challenges of their projects. Projects that leverage other sources of funding are welcome.

Proposal Preparation Instructions

All proposals should be submitted online via EasyChair at:
<https://easychair.org/conferences/?conf=c3dticfp2>

Proposals must be submitted to EasyChair before 11:59 pm PDT ~~March 29, 2021~~ April 5, 2021. Awards will be announced in late May 2021, with start dates of June 1, 2021.

Please use the Proposal Submission Template available in EasyChair when preparing your proposal. When finished, save your proposal in PDF format and upload all sections to EasyChair as a single PDF.

Proposals should use 11 point font and have 1" margins. The proposal structure and page limits are as follows, with additional instructions for each section provided below:

- Title Page: 1 page
- Project Description: 5 pages
- C3 AI Suite and Computing Platform Plan: 1 page
- Bibliography: 3 pages
- Key Personnel: 3 pages
- Budget and Budget Justification: 2 pages
- C3DTI DevOps Support (optional): 1 page

Title Page

Please include the following items:

- Full title of your proposed project
- Principal Investigator full name, title, affiliation, e-mail address, and phone number
- Co-Investigator full name(s), title(s), affiliation(s), e-mail address(es), and phone number(s)
- Lead Institution Authorized Organizational Representative full name, title, affiliation, mailing address, e-mail address, and phone number
- Lead Institution Grant Administrator Contact full name, title, affiliation, mailing address, e-mail address, and phone number
- Proposal Abstract (maximum 250 words)

Project Description

Please provide details about how your project will address each of the subsections below. Note that figures, tables, equations, etc. count toward the page limit.

- Project Relevance to Energy and Climate Security
- Project Methodology
- Expected Research Accomplishments
- Criteria for Success
- Approach Novelty and Likelihood of Success
- Research Team Related Prior Accomplishments
- Computational Challenges and Resources Needed

C3 AI Suite and Computing Platform Plan

Please provide a plan for how the C3 AI Suite tools and the Azure cloud computing platform will be used to solve the computational challenges on your proposed project.

Bibliography

Please provide citations to all references in your proposal. There is no set format for citations.

Key Personnel

Please provide a list of Key Personnel and brief (~100 word) biographical sketches for each person. Key Personnel should include the Principal Investigator, Co-Investigators, and other Senior Researchers. Links to full CVs for Key Personnel are allowed.

Budget and Budget Justification

Please provide a budget and a short (one page maximum) budget justification. Research Awards made from this solicitation must be used for direct costs only and no indirect costs or institutional overhead may be charged. The following budget items should be included:

- Research Personnel
 - This should include the cost and amount of time for faculty, students, postdoctoral scholars, and technical staff. Benefit costs are allowable.
- Administrative Support
 - A modest amount of project-related administrative support may be included if it is needed to conduct the proposed work. This should include the cost and time of administrative staff. Benefit costs are allowable.
- Travel
 - This should include travel-related expenses to disseminate the results of the research and collaborate with proposal partners.
- Materials and Supplies
- Other and Miscellaneous
 - This should include the cost and justification for any special equipment or needs.

C3DTI DevOps Support

This section is optional. If relevant, please provide information on expected requests for assistance from the C3DTI Development Operations (DevOps) staff on the proposed project.

Additional Resources and Contact

C3DTI will host a series of online information sessions and to provide an overview of the call for proposals and discuss the computing resources available to Research Award recipients as well as office hours with technical staff. Below are the dates and times for each information session and details about office hours.

General Information Sessions (Online)

- Monday, February 15, 11 am – 12 pm PT / 2 – 3 pm ET
 - This online information session will provide an overview of the C3.ai DTI and the second call for proposals and provide an opportunity for proposers to ask questions or get clarification as they prepare proposals.
- Wednesday, February 17, 11 am – 12 pm PT / 2 – 3 pm ET
 - This online information session will provide an overview of the C3.ai DTI and the second call for proposals and provide an opportunity for proposers to ask questions or get clarification as they prepare proposals.

Computing Resources Information Sessions (Online)

- Friday, February 19, 10 – 11 am PT / 1 – 2 pm ET
 - This online information session will provide an overview of the C3 AI Suite and the available supporting resources.
- Tuesday, February 23, 2 – 3 pm PT / 5 – 6 pm ET
 - This online information session will take a deeper dive into the capabilities of the C3 AI Suite.
- Tuesday, March 2, 10 – 11 am PT / 12 – 1 pm ET
 - This online information session will discuss Ex Machina, a C3 AI tool that enables anyone to develop, scale, and apply AI insights without writing code.

Weekly Office Hours

Additionally, the C3DTI Develop Operations and C3 AI technical support teams will be available every Tuesday from 2 – 3 pm PT / 5 – 6 pm ET between February 30 and March 23.

Please refer to the C3DTI Call for Proposals web page at <https://c3dti.ai/research/ai-for-energy-and-climate-security/> for additional details, including information on how to participate in the information sessions and office hours.

Questions about general eligibility, proposal preparation, or research awards should be directed to the C3DTI by e-mail at proposals@c3dti.ai.