Initial Evidence in Support of the I-140 Immigrant Petition

Dr. Sara Sultan
[redacted]

May 09, 2025

Attn: Premium I-140 (Box 21500)
2108 E. Elliot Rd.
Tempe, AZ 85284-1806
United States of America.

Subject: EB-1A Immigrant Petition for Permanent Residency – Initial Evidence

Petitioner/Beneficiary:	Sara Sultan
Type of Petition:	I-140, EB-1A (Exceptional Ability in Sciences)
Classification Sought:	Employment-Based Immigration, First Preference, Extraordinary Ability in Science (EB-1A). Sec. 203(b)(1) INA [8 U.S.C. 1153].

Dear USCIS Officer:

This letter is respectfully submitted in support of the petition of Dr. Sara Sultan for classification as an Alien of Extraordinary Ability under INA § 203(b)(1)(A). This petition demonstrates that Dr. Sultan meets or exceeds the statutory and regulatory requirements for EB1A classification.

Dr. Sultan is an interdisciplinary leader and innovator in integrated energy systems, whose work directly supports the U.S. government's priorities for sustainable infrastructure. She has sustained national and international acclaim, and her achievements have also been recognized in her professional practice.

The accompanying evidence establishes that Dr. Sultan has risen to the very top of her field. Her contributions span technology innovation and impactful research, policy development, and market transformation, positioning her at the forefront of the global energy transition. Her work directly advances the U.S. Department of Energy's "Energy Earthshots Initiative", including "Long Duration Storage" and "Affordable Home Energy Shot", by pioneering technologies and policies that enhance grid resilience, and reduce energy costs for American households. She intends to continue advancing the United States' leadership in these critical areas.

In this petition,

- Dr. Sultan's profile as a Professional with Extraordinary Abilities ***(Detailed in Section 1)***
- Evidence that Dr. Sultan satisfies at least five (5) of the ten criteria ***(Detailed in Section 2)*** listed in 8 CFR, Section 204.5(h)(3), namely;

1. Evidence of authorship of scholarly articles in professional or major trade publications or other major media ***(Detailed Section 2.1)***
2. Evidence of performance of a leading or critical role in distinguished organizations ***(Detailed in Section 2.2)***
3. Evidence of judging the work of others, either individually or on a panel ***(Detailed in Section 2.3)***
4. Evidence of original scientific, scholarly, artistic, athletic, or business-related contributions of major significance to the field ***(Detailed in Section 2.4)***
5. Evidence of receipt of lesser nationally or internationally recognized prizes or awards for excellence ***(Detailed in Section 2.5)***

- Dr. Sultan's work will substantially benefit the United States, and it is of national interest ***(Detailed in Section 3).***
- Dr. Sultan has reached a level of expertise indicating that she is among a small percentage who have risen to the very top of the field of Integrated Energy Systems ***(Detailed in Section 4).***
- In the United States, Dr. Sultan plans to continue to work in her field of expertise. ***(Detailed in Section 5)***.

Pursuant to 8 CFR, Section 204.5(h)(1), Dr. Sultan may file an I-140 visa petition for classification under Section 203(b)(1)(A) of the Act as an alien of extraordinary ability in the sciences on her own behalf.
Pursuant to 8 CFR, Section 204.5(h)(5), neither an offer for employment in the United States nor a labor certification is required for this classification.
Dr. Sultan seeks EB1A classification to continue her work in the United States, a critical endeavor that will contribute significantly to advancing affordable energy technologies and meeting federal government's energy resiliency goals.

Thank you,

Dr. Sara Sultan

Section 1 - Profile of the Petitioner (Professional with Extraordinary Abilities) – (Exhibit 1)

Dr. Sara Sultan is an energy scientist and policy advisor specializing in Integrated Energy Systems, with a focus on Thermal Energy Storage (TES) and heat pump (HP) integration. Her work stands at the confluence of scientific innovation, policy development, and system-level engineering, driving transformative change in how buildings consume, store, and manage energy. Dr. Sultan has spent more than a decade advancing efficient energy technologies, pioneering novel thermal systems, and shaping national and state-level energy policies that directly support the U.S. Department of Energy's (DOE) Energy Earthshots Initiative.

Her journey began with a vision to solve some of the most pressing challenges in energy sustainability. As a graduate of top-ranked programs, including a Ph.D. in Energy Science and Engineering from the University of Tennessee, Knoxville, and research work at Oak Ridge National Laboratory (ORNL), one of the largest energy labs in the world, Dr. Sultan has consistently performed at the top of her field. Dr. Sultan holds additional degrees in physics and energy systems engineering, and her early career was marked by a USAID-funded exchange at Oregon State University, where Dr. Sultan developed and improved hybrid solar thermal and hydropower systems. Even then, her work earned high citation rates and recognition from global peers.

Her core area of expertise, "integrating TES with heat pumps to optimize demand-side energy flexibility," has produced nationally significant innovations. Dr. Sultan was the first to model, design, and experimentally validate a modular HP-TES system optimized for various U.S. climate zones. This breakthrough achieved up to 87% peak demand shift, 50% carbon emissions reduction, and 20% energy and utility cost savings. The system overcame long-standing challenges in configuration, controls, and hardware integration. These innovations are now being used as benchmarks for national laboratories and state energy commissions, directly influencing California's 2028 energy codes and DOE-funded energy resilience efforts.

Over the years, Dr. Sultan has authored over 15 peer-reviewed publications in top-tier journals such as Energies and the Journal of Applied Physics, with more than 90 citations, including over 50% within the past two years alone. Her work has been presented at leading conferences including the IEA Heat Pump Conference, ASHRAE Annual Meeting, and Purdue University's Buildings Conference. In addition, Dr. Sultan has been entrusted with reviewing submissions for the U.S. DOE's ACEEE Summer Study and the International IEA Conference, reflecting the high regard of her peers and the trust placed in her judgment as a subject-matter expert.

Dr. Sultan has received nationally competitive awards throughout her career, including the Bredesen Center Fellowship (funded by U.S. DOE), the Linda Latham Scholarship by

ACEEE, and the "40 under 40" Distinguished Alumni Award from the University of Tennessee. Dr. Sultan was selected as an Innovator in the IMPEL program at Lawrence Berkeley National Laboratory, and Dr. Sultan currently serves as a Senior Advisor at the California Energy Commission (CEC), where Dr. Sultan leads regulatory and R&D efforts to integrate thermal storage into state-wide energy standards. This role allows her to shape legislation that impacts millions of Californians and to review applications for multimillion-dollar clean energy grants, ensuring that high-impact projects are prioritized for public funding.

Dr. Sultan is widely recognized not just for technical depth, but for her cross-sectoral leadership. Her work has influenced state and federal energy policy, supported the U.S. grid resiliency roadmap, and helped bridge the gap between academic research and market-ready solutions. Dr. Sultan has collaborated with renowned scientists at ORNL, NREL, and Berkeley Lab, and her research has been cited in DOE's peer review reports and implementation documents. Letters from eminent scholars, national lab scientists, and state energy officials (Exhibit 2) consistently affirm her stature as a top expert in this field. Her work has also gained numerous features, including the U.S. Department of Energy's Stor4Build Consortium.

With the EB1A classification, Dr. Sultan intends to continue her work in the United States by commercializing modular HP-TES systems, influencing policy across U.S. states, and mentoring the next generation of energy leaders. Her research is poised to enhance national energy security, reduce household energy burdens, and accelerate the U.S. transition to net-zero emissions. This is not just her field of expertise, it is her mission. Dr. Sultan has risen to the very top of this discipline, and Dr. Sultan is committed to pushing the boundaries of what secure, affordable, and resilient energy can look like for all Americans.

Section 2 - Proof of Dr Sara Sultan's Extraordinary Abilities

1. Evidence of authorship of scholarly articles in professional or major trade publications or other major media (Exhibit 3)

Dr. Sultan meets the regulatory requirement under this criterion through her extensive authorship of peer-reviewed scholarly articles published in professional journals that are recognized internationally and widely circulated among experts in the field of energy science and engineering. These include publications in major trade publications and academic journals that serve the professional community working on resilient and efficient energy systems. Her work has also been disseminated through presentations at international energy conferences, further establishing its relevance and value to practitioners and researchers globally.

These publications focus on advancing the field of Integrated Energy Systems, with topics ranging from thermal storage and heat pump integration to renewable-powered desalination. Her work has been cited, read, and applied widely by experts in academia, national laboratories, and policymaking institutions, indicating broad influence and acceptance within the scientific and applied energy communities.

To date, Dr. Sultan has authored and co-authored over 16 peer-reviewed publications, including:

- Scientific journal articles published in Elsevier, Energies, Journal of Applied Physics, Sustainable Energy Technologies and Assessments, and Heat Pumping Technologies Magazine.
- Conference papers were presented at global flagship forums such as the IEA Heat Pump Conference, ACEEE Summer Study, ASHRAE Annual Conference, and Purdue University's High-Performance Buildings Conference.

These platforms are recognized as reputable venues that apply rigorous peer-review processes and are indexed in top-tier academic repositories such as Scopus, Web of Science, IEEE Xplore, and ResearchGate.

Details about her Scholarly Publications

Dr. Sultan has authored multiple peer-reviewed publications that demonstrate originality, technical depth, and practical contributions to global sustainability challenges. These articles address urgent topics aligned with U.S. policy priorities such as energy resiliency, grid flexibility, and energy justice.

Specific research areas include:

- Thermal energy storage and integration with heat pump systems
- Demand response and time-of-use energy optimization
- Water Desalination and solar thermal systems
- Micro-hydropower efficiency and modeling
- Phase change materials (PCMs) and energy resiliency pathways

These topics are not only academically significant but also strategically aligned with U.S. climate goals such as building electrification, carbon neutrality, and energy justice.

Below is a summary of her most cited articles, which highlights the academic engagement and utility of her work. The full list is presented in Exhibit 3

Title	Published Platform	Citation
Understanding Supercooling Mechanism in Sodium Sulfate Decahydrate Phase-Change Material	Journal of Applied Physics	28
Empirical Analysis of Turbine and Generator Efficiency of a Pico Hydro System	Sustainable Energy Technologies and Assessments – Elsevier	20
Techno-Economic Assessment of Residential Heat Pump Integrated with Thermal Energy Storage	Energies	5
PCM Material Selection for Heat Pump Integrated with TES for Demand Response in Residential Buildings	Purdue High-Performance Buildings Conference	4
The State of Art of Heat Pump Integrated Thermal Energy Storage for Demand Response	Heat Pumping Technologies Magazine (IEA)	4

Analysis of the Journals Presenting her Peer-Reviewed Publications

Her body of peer-reviewed work spans high-impact journals and professional proceedings in the fields of sustainable energy, thermal storage systems, and grid flexibility. These platforms cater to scholars, engineers, and decision-makers invested in sustainable energy.

Her publication titled “Empirical Analysis of Turbine and Generator Efficiency of a Pico Hydro System” (2020) was published in Sustainable Energy Technologies and Assessments (SETA) by Elsevier, with an Impact Factor of 7.1 (Exhibit 3). SETA by Elsevier is a journal that encourages the scale of technology for energy generation and utilization. It is her most widely cited article, with 28 citations, and has been referenced by academics at Tsinghua University, South Dakota State University, Universitas Gadjah Mada, Polytechnic University of Valencia, and others (Exhibit 3).

Similarly, her article titled “Techno-Economic Assessment of Residential Heat Pump Integrated with Thermal Energy Storage” (2023) was published in Energies, a Q1-ranked journal with an Impact Factor of 3.2 - MDPI (Exhibit 3). Energy is a biweekly peer-reviewed open-access scientific journal focused on scientific research, technology, engineering, and management related to energy. This paper has already earned 5 citations, including references by Dr. Narges H. Mokarram and Dr. Yiji Lu, engineering researchers at the University of Glasgow, United Kingdom (Exhibit 3).

Research Interests of her Peer-Reviewed Publications:

Her peer-reviewed articles have garnered significant attention from the global scientific community. As of March 2025, her publications have received 4,915 reads on ResearchGate, an academic platform with over 25 million members (Exhibit 3). This level of engagement is a clear indication of the relevance and applicability of her work in the field of integrated

energy systems. In addition to readership, her research has been cited 91 times across scholarly publications and conference papers (Exhibit 3), evidencing its influence on ongoing academic discourse and practical implementation in energy policy and engineering solutions. These citations include contributions from researchers at leading institutions such as Oak Ridge National Laboratory, the University of Glasgow, and Tsinghua University (Exhibit 3). According to Research Gate, her Research Interest Score is 130.6, which ranks higher than 68% of all ResearchGate members worldwide and higher than 78% of members who began publishing in 2016 (Exhibit 3). Given Research Gate's reported user base of over 25 million, this places her work above that of approximately 17 million researchers globally, demonstrating both exceptional interest and a substantial level of influence within the scientific community. This measurable impact underscores the originality and significance of her contribution.

Global Reach of her Scholarly Publications

The international engagement with her research reflects its wide-reaching relevance and scholarly value. According to Research Gate analytics (Exhibit 3), her work has been accessed and read by scholars across numerous countries, with particularly high engagement from the USA, India, the Philippines, the UK, and Egypt. This underscores the global interest in her contributions to sustainable energy systems and thermal storage technologies. Furthermore, the disciplinary and academic-level diversity of her readership demonstrates the interdisciplinary impact of her work. Her publications have been read by PhD students (20 reads), Postdoctoral researchers (10 reads), and Professors (4 reads) (Exhibit 3), evidencing the value of her research to both emerging and established experts. In terms of fields, her work has attracted attention from scholars in Mechanical Engineering (21 reads), Materials Engineering (6 reads), and Engineering Physics (4 reads)—highlighting its applicability across a range of STEM disciplines (Exhibit 3). This breadth of academic reach, achieved within a relatively short time, affirms the originality, technical relevance, and interdisciplinary significance of her research in addressing global sustainability and energy challenges.

Governmental Features of her Scholarly Publications

As evidence of her authorship of scholarly work in the field, her publications on building's demand flexibility and thermal energy storage have not only been published in reputable journals but have also received recognition from the United States Department of Energy (DOE). Specifically, several of her articles are featured under the "HVAC Systems with Thermal Energy Storage" section on the official publications page of the Stor4Build consortium of the U.S. DOE — a federal initiative advancing the adoption of thermal energy storage in buildings to support grid flexibility and grid resilience efforts. The DOE's selection of her work for inclusion in this national research platform demonstrates that her scholarly publications are valued and referenced within the field by one of the most authoritative energy institutions globally. This further establishes the scientific merit, originality, and subject-matter relevance of her work, fulfilling the evidentiary requirement under this criterion.

Peer recognition through Recommendations

Another key indicator of the impact and quality of her research is the number of independent recommendations it has received on ResearchGate. As of March 2025, her publications have earned multiple recommendations from fellow researchers. The recommendation section is a feature on the platform that allows peers to endorse the scientific rigor, originality, or usefulness of a particular work (Exhibit 3). These recommendations contribute to her overall Research Interest Score and reflect meaningful engagement by qualified experts in the field. Given that Research Gate is used by over 25 million researchers worldwide, receiving such endorsements provides strong evidence of peer validation and further affirms the significance of her contributions to energy science and thermal storage.

Dr. Sultan was also invited to present at the 2025 ACEEE Hot Water and Hot Air Forums, a prominent industry conference on thermal energy systems (Exhibit 8). Her accepted presentation, 'Grid-interactive Thermal Energy Storage Integrated with Residential Heat Pumps', reflects her significant contributions to energy resiliency. This forum is highly selective, and her inclusion underscores peer recognition of her expertise (Exhibit 8).

List of Evidence – Exhibit 3

- Summary of Scholarly Contributions and Authorship Record
- Extract of Scholarly Publications and Conference Papers
- Evidence of Journal Reputation, Impact Factor, and Rankings
- Evidence of Citation and Research Engagement
- Research Gate, Google Scholar, Academia, and Web of Science Profiles
- Evidence of Governmental Feature of her publications – U.S. DOE's Stor4Build Consortium
- Details about the U.S. DOE's Stor4Build Consortium
- Profile of People who Cited her Research
- Citation metrics

2. Evidence of performance of a leading or critical role in distinguished organizations (Exhibit 4)

Dr. Sara Sultan has consistently served in both leading and critical roles within distinguished organizations, including Oak Ridge National Laboratory (ORNL) and the California Energy Commission (CEC)—two of the most preeminent institutions advancing energy research and policy in the United States.

A. Senior Advisor at the California Energy Commission (CEC) – (Exhibit 4A)
Details of her Role

In her capacity as a Senior Advisor and Program Specialist at the California Energy Commission (CEC), Dr. Sultan has played a central role in shaping the state's energy landscape through a wide range of leadership and technical responsibilities. Dr. Sultan led the development of California's 2028 Building Energy Efficiency Standards, with a particular focus on residential buildings, especially integrating advanced technologies such as thermal energy storage (TES) systems combined with heat pumps—an effort that directly supports the state's energy efficiency goals. Dr. Sultan oversees the creation and revision of compliance manuals and technical appendices for the 2025 and 2028 code cycles, ensuring the building standards are not only rigorous but also implementable. Her role involves coordinating diverse teams and facilitating collaboration among stakeholders to ensure the timely and effective implementation of energy measures. Dr. Sultan also served as a reviewer for EPIC grant solicitations (outside of her job duties, invited as an expert), providing technical evaluations that influence multimillion-dollar funding decisions in support of innovative sustainability projects. Additionally, Dr. Sultan provided detailed analysis and commentary on R&D projects under the Research & Development division for consideration in the 2028 Energy Code update, ranging from manufactured home innovations to prefabricated envelope retrofits. Her review for the Building Standards Branch critically evaluated the feasibility, timeline, and potential code alignment of each initiative. This supports and demonstrates her ongoing critical and leading role in shaping future energy codes through applied technical insight and stakeholder collaboration.

Quantifiable Impacts of her Work - Conference Presentation Authored and Delivered by Dr. Sara Sultan at the California Energy Commission – (Exhibit 4A)

Citation: Sultan, S. (2024). Equity, Electrification, and Time of Use (TOU) Rates: Coupling Thermal Energy Storage with Heat Pumps for Improved Operational Efficiency. Presented as Program Specialist, CEC. DOI: 10.13140/RG.2.2.33227.81442
Available at:
https://www.researchgate.net/publication/383057662_Equity_Electrification_and_Time_of_Use_TOU_rates_Coupling_Thermal_Energy_Storage_with_Heat_Pumps_for_Improved_Operational_Efficiency

Dr. Sultan led the collaboration between CEC and ORNL and authored and delivered a technical presentation titled **"Equity, Electrification, and Time of Use (TOU) Rates: Coupling Thermal Energy Storage with Heat Pumps for Improved Operational Efficiency"** at a nationally recognized energy policy forum. This presentation was based on her ongoing work leading the development of building efficiency measures for California's 2028 Energy Efficiency Standards, as well as her previous work at ORNL on integrating demand-responsive heat pump technologies with thermal energy storage (TES). It emphasizes grid-interactive, cost-effective, and equitable solutions tailored for diverse California climates.

This technical presentation, amongst others, further reinforces her critical role in translating research into policy at the state and national levels. The study includes detailed modeling of heat pump performance, climate zone analysis, time-of-use tariff strategies, and cost-benefit simulations. It highlights the expected 50% peak demand reduction potential, 14.5% energy savings, and 20% consumer cost savings. These findings directly inform the measures being developed under her leadership at the CEC. Moreover, this work has been acknowledged and funded by the U.S. Department of Energy's Building Technologies Office and involved experimental validation at Oak Ridge National Laboratory, further demonstrating its credibility and national relevance.
Another notable mention is her contribution to the 2028 Energy Code Update with the California Energy Commission (Exhibit 4A)

Overview of the Organization (California Energy Commission) – Exhibit 4A
Summary of California Energy Commission
Established in 1974, the California Energy Commission (CEC) serves as the state's primary energy policy and planning agency and operates under the California Natural Resources Agency. The CEC's core responsibilities include advancing state energy policy to ensure a reliable and resilient energy system, setting appliance and building efficiency standards to reduce energy consumption, and funding research and development to drive technological innovation. It also plays a vital role in promoting the integration of renewable energy, supporting the transition to zero-emission vehicles and sustainable transportation, overseeing the safety and reliability of the state's energy infrastructure, and coordinating responses to energy emergencies. The CEC's far-reaching influence is reflected in its substantial budget of approximately $1.32 billion in 2021, underscoring California's national leadership in clean energy innovation and environmental stewardship.

Longevity, Size, and Sustained Operations of the California Energy Commission
Since its establishment in 1974, the California Energy Commission (CEC) has operated continuously for over five decades, making it one of the longest-standing state energy policy agencies in the United States. With more than 700 employees, including engineers, scientists, analysts, and policy experts, the CEC is among the largest energy regulatory bodies at the state level. The Commission is organized into multiple divisions covering efficiency, energy research and development, fuels and transportation, and energy assessments. Its operations

are backed by a robust and stable budget—approximately $1.32 billion in 2021 alone—allowing it to execute long-term initiatives in building standards, clean transportation, and grid modernization. The CEC's sustained efforts have ensured California's leadership in clean energy, environmental planning, and energy reliability.

Ranking and Standing in the United States

The California Energy Commission is widely regarded as the most influential and well-resourced state energy agency in the United States. While state agencies are not ranked in the conventional academic or organizational sense, the CEC's reach, regulatory authority, and budget size place it at the top of state-level energy policy institutions. It is often used as a model for other states and has been referenced by the U.S. Department of Energy as a leader in energy efficiency planning. California's energy codes—developed and maintained by the CEC—are among the most advanced and rigorous in the country, frequently cited as the national gold standard. The Commission's leadership role has also earned it formal partnerships with national laboratories, federal agencies, and international climate initiatives, underscoring its unique standing in the energy policy landscape.

Recognition, Impact, and Industry Leadership

The CEC's impact on the energy industry is profound and far-reaching. It sets energy efficiency standards that shape not only California's building and appliance markets but also influence national and even global manufacturing and construction practices. The Commission's research funding—especially through its Electric Program Investment Charge (EPIC) program—has catalyzed innovation in storage technologies, renewable integration, and building flexibility. Industry experts, academics, and policymakers consistently acknowledge the CEC as a pioneering institution, often inviting its leaders to keynote national conferences and policy summits. Moreover, CEC-backed initiatives have helped reduce California's per capita energy use even as the economy has grown, exemplifying how policy can drive both sustainability and prosperity. Its role in advancing zero-emission vehicles and shaping EV charging infrastructure policies also places it at the forefront of clean transportation efforts.

Media Coverage and Public Visibility

The California Energy Commission frequently garners coverage from national and state media outlets, including The New York Times, Los Angeles Times, Reuters, Utility Dive, Greentech Media, and California Energy Markets. It is often cited in stories related to climate legislation, grid reliability, electric vehicle policies, building code updates, and renewable energy milestones. Major announcements such as energy code revisions, funding rounds for innovative energy projects, or emergency energy measures are regularly featured in mainstream and trade media. The CEC also maintains a strong digital presence, issuing press releases, webinars, and public notices, which amplifies its visibility and influence. Its commissioners and technical staff are frequently interviewed as subject matter experts, reinforcing the Commission's position as a trusted and authoritative voice in the energy sector.

Also, in recognition of her leadership in energy, Dr. Sultan was personally invited by Reuters Events as a VIP guest to the Solar & Storage North America 2024 conference (Exhibit 8). This exclusive invitation, valued at $2,999, was extended to a select group of executives driving innovation in storage. Attendance at this forum further affirms her influence and thought leadership in the sector (Exhibit 8).

Expert Testimonials:
The exceptional calibre and national importance of her work are substantiated through a collection of expert testimonials from esteemed professionals across academia, government, and industry. These individuals, recognized as leaders in energy efficiency, building efficiency, and clean energy innovation, offered their unequivocal support for her EB1A petition and attest to playing a critical role in distinguished organizations (Exhibit 2).

Lee Riedinger, Professor Emeritus and former Vice Chancellor, The University of Tennessee, Knoxville, confirms in his letter of support that "***Her continued rise in the energy technology field has led to her selection for a prestigious position at the California Energy Commission. Her research as a graduate student and more recently in California exemplifies her stature as one of the finest energy professionals of her generation."*** This directly supports the EB1A requirement of sustained acclaim and ongoing national importance.

According to **Dr. Kyle Gluesenkamp, Distinguished R&D Staff Scientist at Oak Ridge National Laboratory,** in his letter of recommendation, ***"As an Electric Generation Program Specialist at the California Energy Commission, she is leading energy code development, where her technical expertise is essential to the development of effective residential building codes in California."*** He further noted that, ***"Her work is aligned with national priorities such as the DOE's Energy Earthshots and strengthening grid reliability and security through grid-interactive efficient buildings."***

Furthermore, **Kristen Driskell, Managing Director of 2050 Partners Inc.,** a nationally recognized climate consulting firm, emphasizes how Dr. Sultan's leadership at CEC directly influences the consulting strategies of utility and public-sector clients. She states in her letter of support that, ***"My company works with Dr. Sultan in her role at the California Energy Commission to leverage her technical expertise in thermal energy storage to support our clients' interests in advanced building code measures and field research projects."*** . . .. ***"Her contributions offer essential data and strategic perspectives that are now influencing the evolution of code compliance frameworks and state-level decarbonization initiatives."***

Mr. Muhammad Saeed, a Senior Electrical Engineer in the Efficiency Division at the California Energy Commission (CEC), highlighted her transformative leadership in developing California's Energy Code, notably through the integration of advanced thermal energy storage systems and enhanced building envelope performance. He emphasized her

ability to bridge science, engineering, and policy, stating, ***"Her visionary leadership and unparalleled technical expertise. . . . . cement California's leadership in energy innovation on a national and global scale."*** He also noted that her work ***"has directly shaped the state's decarbonization efforts and reinforced the practical implementation of sustainable design."***

Similarly, **Dr. Sahar Daemi, an Energy Specialist at the California Energy Commission**, credited me for significantly elevating the technical quality and accessibility of California's energy codes. She states in her letter of support: ***"Her innovative approach, attention to detail, and extraordinary technical knowledge have been pivotal… Her contributions consistently exceed expectations."*** She also praised her efforts to promote climate equity and stakeholder engagement through practical workshops and policy translation.

Mr. Vamsi Kumar Kotla, CEO of ReMo Homes, a company pioneering modular homes, described how her expertise directly informed product innovation in the private sector. He states in this letter of support, ***"Her leadership in updating building energy codes has provided us with critical insights… ensuring our products not only comply with but exceed current standards."*** He further highlighted her role as a vital liaison between regulatory agencies and industry, enabling smoother adoption of progressive energy regulations.

Together, these testimonials demonstrate the breadth of her contributions across research, regulation, innovation, and commercialization, as well as the meaningful role Dr. Sultan plays within the energy and sustainability community. These leaders unanimously underscore her unique and sustained impact on U.S. energy policy and innovation, reinforcing the claim that her contributions are critical and outstanding.

List of Evidence – Exhibit 4A

- Official Job Offer Letter from California Energy Commission
- Job Description and Organizational Chart
- California State Personnel Board Specification for Dr Sara Sultan's role – California Department of Human Resources
- Evidence of Leadership – 2028 Energy Code Update with the California Energy Commission
- Evidence of Review of the R&D Projects for the 2028 Energy Code (Building Standard Branch) of the CEC
- Email Correspondences
- Details about California Energy Commission – Longevity, Impact, Rankings
- Some media coverage of the California Energy Commission

B. Researcher at Oak Ridge National Laboratory (ORNL) – (Exhibit 4B)

Details of her Role

As a Researcher at the Oak Ridge National Laboratory (ORNL) from 2018 to 2023, Dr. Sultan played a leading role in advancing applied research at the intersection of building energy efficiency, thermal energy storage (TES), and grid-interactive heat pump systems. Her work was conducted under the U.S. Department of Energy's (DOE) Building Technologies Office, specifically within the Building Technologies Research and Integration Center (BTRIC)—a DOE Office of Science User Facility.

Dr. Sultan led the design, simulation, and experimental validation of a novel Heat Pump–Thermal Energy Storage (HP-TES) system, addressing national energy priorities such as peak demand reduction, energy resilience, and grid flexibility. As part of her federally funded research, Dr. Sultan developed and validated a first-of-its-kind modular PCM-TES system coupled with vapor compression heat pumps, achieving a 50% reduction in peak electricity demand, improved heat pump Coefficient of Performance (COP), and up to 20% utility cost savings in real-world climate scenarios. Dr. Sultan used MATLAB and TRNSYS for dynamic modeling, conducted lab-scale testing, and led the development of two physical prototypes at ORNL. The prototypes depicted large-scale real-world systems carried out in a test building facility with a dual heat pump system, including a geothermal heat pump. Her work included analyzing various TES configurations and control strategies under different utility tariffs and climate zones across the U.S., which culminated in technical papers, DOE peer-reviewed presentations, and policy-informed recommendations.

Her research also included close collaboration with scientists at the National Renewable Energy Laboratory (NREL), and Dr. Sultan was regularly invited to present findings at major conferences such as the IEA Heat Pump Conference and the ACEEE Summer Study. In this role, Dr. Sultan coordinated with research teams, contributed to federal reporting milestones, and served as a bridge between research and market application, establishing the groundwork for future energy code integration and commercialization.

Notable Mentions of her Work

Dr. Sultan has made notable contributions to the field of building energy efficiency through her research at Oak Ridge National Laboratory (ORNL), focusing on the integration of thermal energy storage (TES) with heat pump systems. Her work has been instrumental in advancing technologies that enhance grid-interactive capabilities and reduce carbon emissions in residential buildings, and was published in the U.S. Department of Energy – Office of Scientific and Technical Information as available at https://www.osti.gov/search/author:%22Sultan,%20Sara%22.

Key Research Contributions include

- **Analysis of Residential Time-of-Use Utility Rate Structures and Economic Implications for Thermal Energy Storage:** Dr. Sultan led a study evaluating the economic potential of ice-based TES coupled with heat pumps. Utilizing a vapor compression heat pump model developed in Engineering Equation Solver (EES), the research demonstrated that integrating TES with heat pumps can decrease energy demand and reduce peak utility costs in single-family residential settings. This work

underscores the cost-effectiveness and economic benefits of TES in enhancing the sustainability of residential heating and cooling systems.

- **Techno-Economic Assessment of Residential Heat Pumps Integrated with Thermal Energy Storage:** Dr. Sultan conducted a techno-economic analysis of a novel heat pump-integrated TES system using phase change materials (PCM). The research modeled the system's performance over a year across three different U.S. climates—New York City, Houston, and Birmingham. Findings revealed that optimal PCM phase change temperatures and TES capacities could significantly reduce electric consumption (up to 70% peak demand reduction in Birmingham) and utility costs, highlighting the economic viability of such integrated systems.
- **PCM Selection for Heat Pumps Integrated with Thermal Energy Storage for Demand Response in Residential Buildings:** Dr. Sultan reviewed and analyzed various PCM materials suitable for integration with heat pumps in residential buildings. The study compared different melting temperatures and configurations, providing valuable insights into selecting appropriate PCMs to maximize energy savings and demand response capabilities. This work serves as a critical guide for designing high-performance, grid-responsive residential energy systems.

Other research contributions include;

- The State of Art of Heat-Pump Integrated Thermal Energy Storage for Demand Response
- Carbon Mitigation Potential of Heat Pumps Integrated with Thermal Storage for Grid-Interactive Residential Buildings

Impact and Recognition

Her research has been disseminated through reputable platforms, including publications in the journal Energies and presentations at significant conferences such as the International Energy Agency (IEA) Heat Pump Conference and the American Council for an Energy-Efficient Economy (ACEEE) Summer Study. Her work has informed policy recommendations and contributed to the development of advanced building energy codes, reflecting her leading role in the field.

Dr. Tianzhen Hong, Senior Scientist, Lawrence Berkeley National Laboratory (LBNL) in Exhibit 2, recognized her experimental research at Oak Ridge National Laboratory as "invaluable" for enhancing thermal storage modeling in EnergyPlus—a globally adopted energy simulation tool. He emphasized that. ***"Dr. Sultan's meticulous experimental findings and validated models have directly informed and significantly enhanced the accuracy, reliability, and functionality of thermal storage simulations within EnergyPlus."*** He further notes that her research has immediate and lasting implications for improving U.S. building energy codes, policymaking, and peak load management nationwide.

In the same vein, **Dr. Levon Atoyan, a clean energy entrepreneur and former DOE collaborator**, commended her technical achievements during her tenure at Oak Ridge National Laboratory (ORNL) In Exhibit 2, particularly her demonstration of energy cost savings through heat pump and thermal energy storage integration. He emphasized: ***"Her***

visionary work and applied expertise are critical to helping us achieve energy security with technologies that are both efficient and cost-effective." He also acknowledged her contributions to interdisciplinary research and mentorship.

Overview of the Organization: Oak Ridge National Laboratory (ORNL) – Exhibit 4B

Summary of ORNL

Established in 1943 under the Manhattan Project, Oak Ridge National Laboratory is the largest multi-program science and energy research laboratory in the U.S. Department of Energy (DOE) system, managed by UT-Battelle, LLC. Located in Tennessee, ORNL operates with an annual budget exceeding $2 billion and employs over 6,000 scientists, engineers, and support staff. It houses some of the world's most advanced facilities, including the Frontier supercomputer (ranked #1 globally in 2022), the High Flux Isotope Reactor, and the Spallation Neutron Source. ORNL plays a central role in energy innovation, nuclear science, materials research, and high-performance computing. Its Building Technologies Research and Integration Center (BTRIC)—where Dr. Sultan conducted her work—is one of the nation's premier testbeds for building energy technologies, providing critical infrastructure and resources for developing scalable, impactful clean energy solutions. The laboratory is frequently referenced by the U.S. DOE and partners globally on advanced research initiatives, establishing it as one of the most prestigious and influential energy institutions in the world.

Longevity, Size, and Sustained Operations of ORNL

Oak Ridge National Laboratory (ORNL), established in 1943 as part of the Manhattan Project, has evolved into the largest multi-program science and energy research laboratory within the U.S. Department of Energy (DOE) system. Located in Oak Ridge, Tennessee, ORNL operates with an annual budget exceeding $2 billion and employs over 6,000 staff members, including scientists, engineers, and support personnel. The laboratory's sustained operations over more than eight decades underscore its pivotal role in advancing scientific research and technological innovation.

Ranking and Standing of ORNL

While formal rankings of national laboratories are uncommon, ORNL is widely recognized for its leadership in various scientific domains. Notably, it has been home to some of the world's most powerful supercomputers (Exhibit 4B). In 2009, ORNL's Jaguar supercomputer was ranked the fastest globally, achieving 2.3 petaflops. This was followed by the Titan supercomputer in 2012, which reached 17.59 petaflops. More recently, in May 2022, ORNL's Frontier system broke the exascale barrier, achieving 1.102 exaflops, reaffirming the laboratory's standing at the forefront of high-performance computing. According to SCIMAGO Institutions Ranking, ORNL was ranked in the 9th percentile overall, comprising 5th percentile for Research, 14th percentile for Innovation, and 18th percentile for Societal influence (Exhibit 4B). Also, an analysis of 45 years of R&D 100 Awards reveals a clear

leader: Oak Ridge National Laboratory (ORNL), with more than two hundred winning products (Exhibit 4B).

Recognition, Impact, and Industry Leadership
ORNL's impact and leadership extend across multiple scientific disciplines, including materials science, neutron science, energy production and conservation, biological systems, and national security. The laboratory's High Flux Isotope Reactor and Spallation Neutron Source are among the world's most advanced neutron scattering facilities, attracting researchers globally. Additionally, ORNL's contributions to nuclear science, such as advancements in reactor design and isotope production, have been instrumental in both national defense and medical applications.

Media Coverage and Public Visibility
ORNL maintains a strong public profile, with its initiatives and achievements frequently covered by national and international media outlets. For instance, a recent Associated Press article highlighted a $60 million expansion in Oak Ridge aimed at enhancing domestic uranium enrichment capabilities, reflecting ORNL's ongoing contributions to energy security and technological advancement.

In summary, ORNL's longevity, substantial operational scale, and sustained excellence in research and development have solidified its position as a leader in the global scientific community. Its pioneering work continues to influence a wide array of industries and contributes significantly to addressing complex scientific and technological challenges.

List of Evidence – Exhibit 4B

- Official Letter confirming Research Position with Oak Ridge National Laboratory
- Evidence of Key Contributions – Funded by the U.S. Department of Energy
- Peer Review of the Key Contributions presented to Building Technology Office
- Details about Oak Ridge National Laboratory – Longevity, Impact, Rankings
- Some media coverages of Oak Ridge National Laboratory

3. **Evidence of judging the work of others, either individually or on a panel – (Exhibit 5)**

Dr. Sultan has been recognized as a subject matter expert in the energy efficiency and building flexibility space through invitations to serve as a judge and technical reviewer for high-level programs administered by prestigious government institutions. These adjudicatory roles demonstrate her standing in the field and fulfill the EB1A criterion of being invited to judge the work of others. Some notable invitations to judge the work of others include;

A. Juror for the U.S. Department of Energy Solar Decathlon Design Challenge (2025) (Now Called BuildingsNEXT Student Design Competition) – Exhibit 5A

- **Invitation Body:** U.S. Department of Energy, National Renewable Energy Laboratory
- **Role:** Semi-final Juror for the Single-Family Housing Division
- **Event Date:** February 21–22, 2025 (postponed)
- **Confirmation of Acceptance:** November 25, 2024
- **Competition Size:** 122 Teams from 93 Collegiate Institutions.
- **Global Representation:** Teams from 19 Countries and 27 States/Districts

Details of Her Role as Juror

Dr. Sultan was formally invited by the U.S. Department of Energy's Solar Decathlon Design Challenge team to serve as a Semi-final Juror in the Single-Family Housing Division. The Solar Decathlon is a globally respected collegiate competition focused on training the next generation of high-performance building professionals in designing low-carbon buildings powered by renewable energy.

As a juror, Dr. Sultan was entrusted with evaluating comprehensive design deliverables from student teams representing leading academic institutions. The event has been postponed to a later date as of now. Her responsibilities would include reviewing detailed technical submissions, participating in live virtual presentations, and collaborating with other industry experts to select up to 10 finalist teams for advancement. The DOE's invitation emphasized that her contributions to the building industry have elevated her among a prestigious group of experts, underscoring her prominence in the field.

The U.S. Department of Energy has recently rebranded the Solar Decathlon to "BuildingsNEXT Student Design Competition." The new name reflects a broader emphasis on energy-efficient building design, rather than a sole focus on solar power. The rebranding aligns with the DOE's updated priorities around climate resilience, electrification, and whole-building performance.

Prestige of the U.S. Department of Energy Solar Decathlon Jury Invitation

The U.S. Department of Energy Solar Decathlon is widely regarded as one of the most prestigious and influential collegiate competitions in the world focused on climate innovation, building performance, and clean energy workforce development. Launched in

2002, the program has become a cornerstone of the DOE's efforts to accelerate the adoption of high-performance, low-carbon buildings powered by renewable energy, shaping both the future built environment and the professionals who will lead it.
Participation in the Solar Decathlon is highly competitive. University teams from across the United States and internationally undergo a rigorous qualification process to present innovative solutions for real-world challenges in building design and sustainability. As a Semifinal Juror, Dr. Sultan was one of only a select group of distinguished professionals hand-picked by the U.S. Department of Energy and its program delivery partner, the National Renewable Energy Laboratory (NREL), to evaluate submissions in the Single-Family Housing Division.
The impact of juror decisions is substantial: Finalist teams are awarded high visibility in the clean energy sector, are often recruited by leading firms and institutions, and their projects can be used as educational tools and prototypes for sustainable housing worldwide. Jurors play a pivotal role in shaping these opportunities, with their feedback and scoring influencing not just competition outcomes but also the future careers of emerging leaders in energy and design.
Being invited to serve in this role reflects a high level of professional trust and acknowledgement by the federal government. Jurors are not only selected for their deep technical knowledge, but also for their leadership, ethical standing, and influence in the field of sustainable design and energy efficiency. Her invitation, explicitly citing her contributions, confirms her national recognition and standing as a leading authority in energy and grid resilient policy.

U.S. Department of Energy Solar Decathlon – Competition History and Reach
The U.S. Department of Energy Solar Decathlon is one of the most respected and competitive international collegiate competitions focused on sustainable building design and clean energy innovation. Since its inception in 2002, the program has grown in prestige, scope, and global reach, becoming a benchmark for emerging talent in the energy and building performance industries. Over 20 competitions have been held globally, including both Design Challenges (virtual, design-only competitions) and Build Challenges (involving full-scale constructed homes). The 2025 event marks the 23rd iteration of the Solar Decathlon since it was first launched by the U.S. Department of Energy. Past competitions have taken place not only in the United States but also in Europe, the Middle East, Latin America, Africa, and China, under regional partnerships like Solar Decathlon Europe and Solar Decathlon Middle East.

U.S. Department of Energy Solar Decathlon – Global Participation
More than 40 countries have participated across all competition cycles, with notable representation from North America, Europe, Asia, and the Middle East. The competition has received participants from U.S.-based institutions such as MIT, University of California, Berkeley, and Georgia Tech, regularly participating alongside international institutions like Delft University of Technology (Netherlands) and Tianjin University (China). The Design Challenge typically receives 100+ applications annually from multidisciplinary university teams worldwide.

U.S. Department of Energy Solar Decathlon – Scale and Impact
Since 2002, the Solar Decathlon has engaged over 25,000 students in hands-on design and innovation projects. These students have gone on to work in leadership roles across architecture, engineering, policy, and renewable energy sectors, including with top firms, public agencies, and international NGOs. Each year, Solar Decathlon events attract thousands of virtual and in-person attendees, including industry professionals, government officials, and media representatives.

List of Evidence – Exhibit 5A

- Semi-Final Juror Invitation from U.S. Department of Energy Solar Decathlon
- Acceptance to serve as Judge for the U.S. Department of Energy Solar Decathlon
- Snapshot from LinkedIn about serving as a Judge for the Solar Decathlon
- Evidence about the Competition Size – The 2025 Design Challenge Team
- Details about the U.S. Department of Energy Solar Decathlon
- Details about Longevity, Impact, and Reach, and Global Participation of the U.S. Department of Energy Solar Decathlon
- Media Publications about the Solar Decathlon
- Evidence regarding Solar Decathlon Rebranding (Now Called BuildingsNEXT Student Design Competition)

B. Technical Reviewer – Enviro-SET Grant Funding Opportunity (GFO-24-301) – Exhibit 5B

- **Invitation Body:** California Energy Commission (CEC), Energy Research & Development Division
- **Role:** Technical Reviewer for Group 3 – Testing Bird-Friendly Windows for Decarbonized Buildings
- **Solicitation Purpose:** To provide the best available science to guide California's clean energy transition
- **Review Period:** November–December 2024

Details of her Role as Technical Reviewer
Dr. Sultan was selected by the California Energy Commission (CEC), one of the most influential clean energy research bodies in the United States, to serve as a technical reviewer for proposals for Electric Program Investment Charge (EPIC) grants under the Environmental Sustainability for the Energy Transition (Enviro-SET) initiative. Specifically, Dr. Sultan reviewed proposals under Group 3 focused on evaluating bird-safe window designs that contribute to building decarbonisation, an emerging area integrating biodiversity, materials science, and energy efficiency. The technical review required an in-depth analysis of project narratives, evaluation of scientific merit, and completion of official evaluation forms (CEC-

105 and reviewer guidelines), which were submitted to CEC administrative officials for inclusion in funding deliberations.
Notably, this review was requested by the Energy Research and Development Division at CEC and was outside of the scope of Dr. Sultan's job duties. She was invited as an expert in her field.

Impact of her Role as a Technical Reviewer for the CEC
Serving as a technical reviewer for the California Energy Commission's (CEC) Enviro-SET Grant Funding Opportunity (GFO-24-301) under the Electric Program Investment Charge (EPIC) is a testament to the depth of her expertise in sustainable building technologies. CEC is one of the most influential energy policy and research bodies in the United States, and it administers over $100 million annually in research, development, and demonstration (R&D) grants. These grants shape California's clean energy transition and often inform national best practices and regulatory updates, particularly around Title 24 building standards. Her selection as a reviewer for Group 3 focused on testing bird-friendly windows for decarbonized buildings meant Dr. Sultan was entrusted with evaluating innovative research proposals that addressed both environmental and energy performance goals.
Technical reviewers are not selected randomly; they are handpicked based on a person's ability to objectively assess the scientific merit, technical feasibility, and real-world impact of the proposed research. Dr. Sultan was required to thoroughly read each submission's project narrative and scope of work, identify strengths and weaknesses, and provide detailed written recommendations using standardized CEC evaluation forms. The decisions Dr. Sultan contributed to had immediate consequences: they helped determine which research teams would receive public funding and advance their work toward pilot testing and potential policy integration. In other words, her evaluation directly influenced which technologies may be adopted or recommended in future building codes, ensuring that taxpayer-funded innovation met the highest standards of relevance, rigor, and potential benefit to California's residents and ecosystems. Being part of this decision-making process affirmed her position as a subject matter expert whose judgment shapes not just the future of building performance, but also California's broader clean energy and environmental resilience agenda.

Prestige of the California Energy Commission (CEC) and Enviro-SET Grant Funding
The California Energy Commission (CEC) is California's primary energy policy and planning agency, renowned for its leadership in advancing energy innovation and environmental sustainability. Established in 1974, the CEC has been instrumental in guiding the state toward a clean energy future, setting ambitious goals that often serve as models nationally and internationally. The Commission's initiatives, including the Enviro-SET Grant Funding, are highly esteemed for their rigorous standards and significant contributions to energy research and policy development.

History of the Enviro-SET Grant Funding
The Environmental Sustainability for the Energy Transition (Enviro-SET) Grant Funding was launched by the CEC to address the environmental challenges associated with California's

transition to a sustainable energy system. This program focuses on supporting research and development projects that aim to minimize the ecological impacts of energy production, distribution, and consumption. Over the years, Enviro-SET has funded numerous projects that have led to advancements in renewable energy technologies, energy efficiency, and environmental protection measures.

Competitiveness of the Enviro-SET Grant Funding
The Enviro-SET Grant Funding is highly competitive, attracting applications from leading research institutions, private companies, and non-profit organizations. Each funding cycle, the CEC receives a substantial number of proposals, with only a select few awarded grants based on their potential impact, innovation, and alignment with California's energy and environmental goals. The rigorous selection process ensures that only the most promising and impactful projects receive support, underscoring the program's prestige and the value of being selected as a grant recipient.

Scale and Impact of the Enviro-SET Grant Funding
The scale of the Enviro-SET Grant Funding is significant, with substantial financial resources allocated to support groundbreaking research and development projects. The impact of these projects extends beyond California, influencing national and global energy policies and practices. By addressing critical environmental issues related to energy, the Enviro-SET program has contributed to the development of cleaner technologies, informed regulatory frameworks, and promoted sustainable practices across various sectors.

List of Evidence – Exhibit 5B

- Email Correspondence confirming her status to serve as a Technical Reviewer
- Email Correspondence confirming Evaluation Guidelines
- Evidence of Completed Review
- California Energy Commission - About EPIC
- California Energy Commission – Solicitation for Application (Enviro-SET Grant Funding)
- California Grants Portal
- Grant Pre-Application Workshop Document showing Judging Criteria
- CEC Enviro-SET FAQs

C. Conference Paper Reviewer - 14th International Energy Agency (IEA) Heat Pump Conference – Exhibit 5C

- **Invitation Body:** International Energy Agency
- **Role:** Conference Paper Reviewer

Details about her Role as Conference Paper Reviewer

In 2023, Dr. Sultan was selected as a conference paper reviewer for the 14th International Energy Agency (IEA) Heat Pump Conference, held from May 15–18, 2023, in Chicago, Illinois, USA. This biennial event is recognized as one of the foremost international platforms for sharing advancements in heat pump technologies, energy efficiency, and decarbonized heating and cooling systems. Organized under the auspices of the IEA's Heat Pumping Technologies Technical Collaboration Programme (HPT TCP), the conference attracts hundreds of global experts, academics, industry leaders, and policymakers.

Dr. Sultan reviewed three technical papers, including the paper for session keynote, written by U.S. DOE's technical program manager:

- Session Keynote: Addressing the barriers to heating electrification in the US
- The Performance Playbook: A Policy Strategy for Scaling Heat Pump Adoption with Happy Consumers and Utilities
- Impact Analysis of Transitioning to Heat Pump Rooftop Units for the U.S. Commercial Building Stock

All three papers were accepted and published in conference proceedings. As a reviewer, Dr. Sultan was responsible for assessing the technical quality, innovation, and relevance of submitted research papers. These reviews played a critical role in determining which papers would be accepted for presentation and inclusion in the conference proceedings. Her evaluations focused on the originality of the research, scientific rigor, clarity of methodology, and alignment with the conference's core themes—namely, clean, efficient, and reliable energy systems for residential, commercial, and industrial applications.

The IEA Heat Pump Conference is a highly regarded venue that features contributions from world-leading institutions and national laboratories. Her inclusion as a reviewer was an acknowledgement of her standing within the energy research community. The letter of appreciation Dr. Sultan received from Dr. Brian Fricke, Chair of the National Organizing Committee, emphasized that her participation helped ensure the high technical standard of the conference submissions and directly supported the event's mission to address pressing global energy challenges. This experience further affirmed her expertise in thermal systems and sustainable energy integration, and it provided her with the opportunity to influence the global dialogue on building heating solutions. It also highlights the trust placed in her by international organizations to evaluate peer work at the highest level, further satisfying the EB1A criterion of having been asked to judge the work of others in her field.

Information about the International Energy Agency (IEA)

The International Energy Agency (IEA) is an autonomous intergovernmental organization founded in 1974 in response to the oil crisis of the early 1970s. Initially focused on securing global oil supplies, the IEA has evolved into a central platform for energy cooperation and policy innovation among its 31 member countries and numerous associated nations. Its expanded mission now includes promoting energy security, economic growth, environmental sustainability, and the global energy transition to clean and renewable sources. The IEA

provides authoritative data, policy advice, and collaborative frameworks for some of the most pressing energy challenges facing the world today, including climate change mitigation and energy system decarbonization.

History and Scope of the IEA Heat Pump Conference

The IEA Heat Pump Conference is one of the most prestigious biennial conferences in the energy efficiency and heating/cooling technology space. It is organized under the Heat Pumping Technologies Technical Collaboration Programme (HPT TCP) of the IEA. The conference has been held every two years since the early 1990s, with previous hosts including the United States, Japan, the Netherlands, and Sweden. The 14th edition took place in May 2023 in Chicago, Illinois, and was themed around "Heat Pumps – Resilient and Efficient." The event brings together leading researchers, industry professionals, national laboratories, and policymakers from across the world, providing a critical platform for sharing the latest advancements in heat pump systems.

Number of Papers Reviewed and Conference Structure

The 14th IEA Heat Pump Conference featured a comprehensive program of over 170 technical papers, presented across 35 structured technical sessions. These sessions covered key topic areas such as residential and building heat pump applications, smart energy systems, refrigerant developments, industrial applications, and environmental performance improvements. As a peer reviewer, Dr. Sultan was part of the panel that ensured these submissions met high standards of technical quality, relevance, and innovation before being accepted for presentation.

Global Reach and Ranking

The IEA Heat Pump Conference maintains a truly global profile, attracting participation from countries across Europe, North America, Asia, and beyond. For example, the 13th Conference in 2021 featured over 370 participants from 26 countries, representing a diverse and interdisciplinary mix of experts. The 2023 edition continued this tradition, establishing itself as a key event for international collaboration in climate-resilient technologies. The conference is widely considered a top-tier technical event in the domain of energy-efficient heating and cooling, given its IEA affiliation, depth of peer-reviewed content, and high-level participation.

Impact on Energy Innovation

The research presented and reviewed at the IEA Heat Pump Conferences often forms the foundation for industry innovation, academic advancement, and regulatory policy development. Many of the technologies showcased are later adopted in real-world applications, influencing building codes, product design, and environmental regulations globally. Her role as a reviewer for the 2023 conference allowed her to contribute to the advancement of clean, efficient, and scalable energy solutions, particularly as the demand for low-carbon heating grows in both developed and emerging markets.

List of Evidence – Exhibit 5C

- Letter of Appreciation for Serving as Conference Paper Reviewer
- History of the IEA and Value to the United States
- About the Conference
- Proceedings and Presentations from the 14th IEA Heat Pump Conference
- Full Conference Program – 14th IEA Heat Pump Conference

D. Reviewing for the 2024 ACEEE Summer Study on Energy Efficiency in Buildings – Exhibit 5D

- **Invitation Body:** American Council for an Energy-Efficient Economy (ACEEE)
- **Role:** Reviewer

Details about her Role as Reviewer

In 2024, Dr. Sultan had the privilege of serving as a reviewer for the ACEEE Summer Study on Energy Efficiency in Buildings, one of the most respected and long-standing conferences in the energy efficiency sector globally. Dr. Sultan reviewed two technical papers:

- Demystifying Thermal Energy Storage: Evaluating the Tradeoffs between Storage Sizing and Control Algorithm Complexity for Demand Flexibility
- The Best of Both Worlds: Combined Thermal and Battery Storage for Widespread Building Decarbonization

Both papers were accepted and published in Panel 12: Smart and Grid-Interactive Buildings. Her role involved critically evaluating the technical soundness, novelty, and applicability of these submissions to ensure that the final conference proceedings represented the highest calibre of scholarly and applied research.

History and Reputation of the ACEEE Summer Study

The ACEEE Summer Study on Energy Efficiency in Buildings is one of the most influential biennial events in the field of building science, energy systems, and sustainability. First held in 1980, the Summer Study has earned a reputation for being a premier platform where researchers, policymakers, architects, engineers, and utility leaders come together to exchange ideas, showcase innovation, and chart future directions for energy-efficient buildings.

The conference typically features:

- Over 400 peer-reviewed papers
- 10–12 technical panels with distinct thematic focus areas
- Hundreds of expert reviewers from academia, industry, and government
- The rigorous blind peer-review process ensures that only high-quality, original contributions make it into the published proceedings.

Number of Papers and Reviewer Involvement

In 2024, the Summer Study featured over 450 authors and dozens of reviewers who collectively ensured academic rigor and practical relevance. Each reviewer typically evaluates 2–4 papers per session, with multiple rounds of comments and revisions taking

place before final acceptance. Her role as a reviewer meant Dr. Sultan contributed to both the integrity of the academic process and the dissemination of critical insights on smart building technologies, energy storage integration, and grid-interactive efficiency strategies. The recognition letter Dr. Sultan received from the conference's director, Rebecca Lunetta, confirmed her contribution to the event's success and the high standard of the accepted work.

Global Ranking and Impact

The ACEEE Summer Study is recognized as a top-tier global conference in building energy efficiency. It is often compared to other elite conferences like the IEA Heat Pump Conference and ASHRAE conferences. Research shared at the Summer Study frequently shapes some of the U.S. Department of Energy policies, California Title 24 energy codes, Utility rebate program design, and State decarbonization roadmaps. Papers published through the conference proceedings are cited in academic journals, government white papers, and industry playbooks, demonstrating the long-lasting influence of the work presented and the professionals involved in the review and selection process.

About ACEEE

The American Council for an Energy-Efficient Economy (ACEEE) is a non-profit research organization founded in 1980 that acts as a leading authority on policies and strategies for advancing energy efficiency across all sectors of the economy. Its mission is to build a more energy-efficient and decarbonized future through research, collaboration, and advocacy. ACEEE is widely regarded as a policy-shaping institution, influencing both federal and state-level energy programs, codes, and initiatives.

List of Evidence – Exhibit 5D

- Appreciation Letter from ACEEE for serving as Reviewer
- Snapshot from Catalyst – ACEEE Reviewers platform
- Information about the 2024 Summer Study on Energy Efficiency in Buildings
- ACEEE Call to Action document
- Details about ACEEE

E. Peer Reviewer for MDPI (Multidisciplinary Digital Publishing Institute) Journals: Processes, Energies, and Sustainability – Exhibit 5E

- **Invitation Body:** Multidisciplinary Digital Publishing Institute (MDPI)
- **Role:** Peer Reviewer for Journal Paper

Details about Her Role as Reviewer

In 2025, Dr. Sultan was invited to serve as a peer reviewer for several academic manuscripts submitted to three well-regarded journals published by MDPI (Multidisciplinary Digital Publishing Institute): Sustainability, Energies, and Processes. Dr. Sultan completed detailed

reviews for four distinct technical papers, each addressing critical themes at the intersection of building flexibility, energy systems modeling, and thermal energy storage.
As a reviewer, Dr. Sultan was responsible for conducting in-depth, multi-round evaluations that included assessing scientific originality, technical accuracy, relevance to the field, and the quality of writing and presentation. Her reviews provided constructive feedback, often guiding authors through major revisions and directly influencing the editorial decision to publish. The topics Dr. Sultan reviewed spanned diverse, high-impact areas, including:

- Energy performance of ground source heat pump systems with evaporative condensers,
- Feasibility of air-source heat pump water heaters in cold climates,
- Grey-box modeling of district heating networks for real-time optimization,
- Comparative analyses of single versus multi-factor energy efficiency evaluation models in China.

Each of these papers underwent rigorous scrutiny through MDPI's structured peer review platform, and her contributions were officially recognized by MDPI's executive team, as documented in the reviewer certificate.

About MDPI
MDPI (Multidisciplinary Digital Publishing Institute) is a leading publisher of peer-reviewed, open-access journals, headquartered in Switzerland. It is recognized globally for accelerating the dissemination of scientific knowledge through its fast and transparent peer review process. Reviewers for MDPI are selected based on stringent criteria, including:

- A doctoral degree or equivalent research experience,
- National or international recognition in their field,
- A strong publication record.

The journals Dr. Sultan reviewed for Sustainability, Energies, and Processes are all indexed in Web of Science, Scopus, and other major citation databases, and are widely read by scholars, industry leaders, and policymakers. Notably, Sustainability (ISSN 2071-1050) is ranked among the top journals in the fields of sustainable development and environmental science, Energies (ISSN 1996-1073) focuses on scientific research, technology, and engineering related to energy supply and demand, Processes (ISSN 2227-9717) covers process and systems engineering, including energy transformation technologies.
These journals receive thousands of submissions annually, with acceptance decisions made only after rigorous peer evaluation. Her selection to review for these platforms underscores her standing as a subject matter expert capable of advancing the integrity of scientific discourse in her field.

MDPI Journal Platform: Longevity, Reach, and Influence
Founded in 1996, MDPI (Multidisciplinary Digital Publishing Institute) is one of the world's largest and most influential open-access academic publishers. MDPI operates on a mission to foster rapid dissemination of scientific knowledge across disciplines through transparent and rigorous peer review. Many of MDPI's peer-reviewed journals are ranked in the top quartiles

(Q1/Q2) of the Journal Citation Reports (JCR). The journals are indexed in major scholarly databases, including Web of Science, Scopus, PubMed, and DOAJ, ensuring broad visibility and credibility within the scientific community. MDPI has published over 1.3 million articles to date and receives more than 2 million monthly website visits, demonstrating its global reach. In 2023 alone, MDPI processed over 520,000 manuscript submissions, relying on a vast network of more than 200,000 active reviewers and editors worldwide. The journal Sustainability, for example, had an Impact Factor of 3.9 (2022 JCR) and published over 10,000 peer-reviewed articles annually, making it a leading platform in climate, policy, and energy scholarship. Likewise, Energies and Processes maintain strong reputations in applied energy research and systems engineering. Reviewers like me are formally vetted and selected based on academic credentials, technical background, and subject-matter expertise. MDPI's acknowledgment of her work affirms that Dr. Sultan met their high bar for reviewer qualifications and made a meaningful contribution to global scientific quality assurance.

List of Evidence – Exhibit 5E

- MDPI Reviewer Certificate
- Evidence of Journal Reviews
- Information about MDPI
- Web of Science Profile

4. **Evidence of original scientific, scholarly, artistic, athletic, or business-related contributions of major significance to the field – Exhibit 6**

Dr. Sultan has made pioneering and original contributions to the field of building energy efficiency through her research on the integration of Thermal Energy Storage (TES) with Heat Pump (HP) systems. She made original scientific, scholarly, and business-related contributions of major significance to the field.

- Dr. Sultan developed a novel integrated TES system which improved efficiency, yielded high-cost savings, and addressed the challenges of integration with heat pumps.
- Dr. Sultan published scholarly articles that were featured by U.S. Department of Energy.
- Dr. Sultan is leading the policy development efforts to implement TES in California Energy Code. Her own doctoral research was instrumental to the analysis and decision for this policy.
- Dr. Sultan also developed water desalination system and improved efficiency of hydropower system through her work sponsored by USAID.
- Dr. Sultan led the market and policy analysis for businesses and startups to facilitate market adoption of TES.

4.1 Original Scientific, Scholarly, and business-related Contribution of Major Significance (HP-TES System)

Dr. Sultan developed and validated the first indirect HP-TES system, optimized across multiple climate zones for enhanced performance. This work addressed a longstanding challenge in the building flexibility field—effectively coupling heat pumps with thermal storage systems by overcoming key barriers related to system configuration, control strategies, hardware integration, and low-cost storage materials. The innovation was not merely theoretical. Her system was experimentally validated through a large-scale demonstration at Oak Ridge National Laboratory (ORNL), where it achieved up to 20% energy and cost savings, an 87% shift in peak electricity demand, and a 50% reduction in carbon emissions. These are significant milestones for both research and practice, setting a new benchmark in integrated thermal systems and influencing a wide spectrum of energy stakeholders, including researchers, utilities, and policymakers.

As a result of her original contribution, her work has been cited and adopted in multiple subsequent studies, referenced in DOE-funded projects, and forms the basis for emerging guidelines in thermal storage integration for energy demand flexibility. Her HP-TES model is now recognized as a foundational framework for future systems that seek to balance renewable energy intermittency and enhance grid resilience.

Importantly, the USCIS Policy Manual explicitly affirms that contributions made during a doctoral program can be considered valid evidence under this criterion. As stated in Volume

6, Part F, Chapter 5: ***"The petitioner may submit evidence of work or research that the person conducted during their doctoral studies, so long as the work or research resulted in contributions of major significance to the field."***

Her HP-TES system not only meets but exceeds this threshold. It demonstrates originality, real-world application, field-wide influence, and measurable environmental and economic impact, firmly qualifying as a scientific contribution of major significance in the field of sustainable energy systems.

Expert Testimonials

Dr. Sultan has made original and impactful contributions to the field of building energy systems, most notably through her research on heat pump-thermal energy storage integration (HP-TES). Her work, conducted at Oak Ridge National Laboratory and later advanced through the Stor4Build U.S. Department of Energy's Consortium, demonstrated novel strategies for load shifting, reducing peak demand by over 50% and yielding up to 20% energy savings. These results surpass typical performance metrics in the field and have been widely cited, adopted in ongoing DOE-funded work, and recognized by academic and industry stakeholders. Her extraordinary contributions to sustainable energy and building flexibility are affirmed by expert testimonials from leaders in academia, government, and industry. These endorsements emphasize the national and international impact of her work and her standing as a thought leader in the field.

Notably, **Professor Lee Riedinger, Former Vice Chancellor of Research, The University of Tennessee, Knoxville,** in Exhibit 2, discusses the academic and global significance of her foundational research. He particularly highlights her doctoral dissertation, which offered an innovative solution to decarbonizing buildings through the integration of heat pumps with thermal energy storage across various climate zones. Professor Riedinger states: ***"Her dissertation, 'Heat Pump Integrated with Thermal Energy Storage for Demand Response and Decarbonization in Buildings,' addressed a critical issue in sustainable energy systems and offered an innovative solution through integration of heat pumps and thermal energy storage across different climate zones."***

Dr. Riedinger concluded with a powerful endorsement of national benefit by affirming that, ***"Her continued presence in the United States is vital to maintaining and advancing our nation's leadership in energy technology and clean energy innovation."***

As noted by **Dr. Kyle Gluesenkamp, Distinguished R&D Staff Scientist at Oak Ridge National Laboratory, *"Her work was adopted for further research at ORNL and helped secure funding for new DOE projects, exemplifying both her technical brilliance and her practical, solution-oriented approach."*** Also, he confirms that, ***"Her research on HP-TES was featured in the DOE's Stor4Build consortium for its importance in advancing grid-interactive efficient buildings, and it continues to inspire new research directions.***

Tianzhen Hong, a Senior Scientist and Deputy Director for Research of Building Technology & Urban Systems Division at Lawrence Berkeley National Laboratory (LBNL) noted that, "***Dr. Sultan's research … has provided invaluable real-world data and technical insights crucial for advancing our modeling efforts. Dr. Sultan's meticulous experimental findings and validated models have directly informed and significantly enhanced the accuracy, reliability, and functionality of thermal storage simulations within EnergyPlus."***
He also stated that, ***"Her work not only enriches the scientific community's understanding of TES dynamics but also holds immediate implications for improving building energy codes and standards nationwide. The advanced modeling capabilities derived from her research are instrumental for policymakers, engineers, and researchers in effectively evaluating, adopting, and scaling thermal storage technologies for energy efficiency and peak load management in buildings."***

Her work has not remained in the laboratory; it has directly shaped public discourse and policy. Her peer-reviewed presentation at the 2023 ACEEE conference sparked substantive dialogue on the future of TES integration into building energy codes.
Kristen Driskell, Managing Director of 2050 Partners, remarked: ***"Dr. Sultan's modeling results, technical insights, and clarity of presentation have elevated the quality and applicability of these discussions… Her work is actively informing our clients' energy codes readiness analyses."***

Maziar Shirakh, a Senior Mechanical Engineer at California Energy Commission recognized her contributions. ***"Dr. Sultan is leading the critical updates to the 2028 California Energy Code, pertaining to building envelopes and thermal energy storage. What sets Dr. Sultan apart is her ability to seamlessly bridge science, engineering, and policy. Her deep expertise in integrated energy systems, thermal energy storage, and grid-interactive technologies is matched by her clarity of thought and exceptional communication skills. She excels at translating complex engineering concepts into meaningful strategies that support our state's ambitious climate goals."***

Furthermore, **Dr. Levon Atoyan, Co-Founder, Shift Thermal,** in his letter of support notes that; ***"Her work on integrating thermal energy storage with residential heat pump systems, demonstrating a 50% reduction in peak load and 20% utility cost savings, has been central to our business understanding the value proposition of storage integration."*** He emphasizes the direct value of her contribution to private-sector decision making and the impact of her work (Exhibit 2).

Additionally, **Saad Saleem, Manager of Regulatory Compliance at AUX Air USA,** highlights her pivotal role in advancing applied research and delivering impactful solutions to challenges in building flexibility. He wrote, ***"Dr. Sultan's work on integrating heat pumps with thermal energy storage at ORNL was not only technically rigorous but also immediately applicable to real-world energy management strategies."*** He emphasized her

leadership in the experimental validation of thermal storage systems and grid-interactive building technologies, which contributed directly to national R&D goals. Mr. Saleem further noted, ***"Her ability to translate complex engineering problems into actionable research made her an invaluable member of the lab. Her work has influenced both the academic field and public-private deployment initiatives."***

These expert testimonials collectively affirm her original contributions of major significance to the field of energy systems and building flexibility. Her pioneering integration of heat pumps with thermal energy storage, validated through Department of Energy-funded research at Oak Ridge National Laboratory, introduced novel strategies for grid-interactive load management and climate-responsive building design. Her experimental findings have directly shaped simulation capabilities in national tools like EnergyPlus and informed updates to building energy codes across the United States. Importantly, these contributions are not only innovative but widely recognized and utilized by policymakers, researchers, and private-sector leaders alike. The breadth and depth of her work, as evidenced by the consistent praise from senior scientists, regulatory authorities, and clean energy entrepreneurs, demonstrate that her work is not only original but foundational in advancing energy efficiency and resilience at scale.

Global Need of Her Contribution

Her original contribution in developing the indirect Heat Pump–Thermal Energy Storage (HP-TES) system has garnered international recognition, leading to its adoption and adaptation across various countries aiming to enhance energy efficiency and reduce carbon emissions.

For example, the United Kingdom has been exploring advanced thermal energy storage solutions to meet its net-zero targets. A notable example is the implementation of E.ON's ectogrid in London's Royal Docks area, a system that utilizes local energy sources to provide heating and cooling, projected to reduce emissions by 88%. This aligns with the principles of her HP-TES system, emphasizing the integration of heat pumps with thermal storage to achieve significant energy savings and emission reductions.

German initiatives have focused on integrating heat pumps with thermal energy storage to optimize energy systems. Research published in Applied Thermal Engineering discusses the enhancement of power-to-heat energy conversion processes through the use of thermoelectric heat pumps, reflecting methodologies akin to her innovations.

Moreover, Japan and South Korea have been investing in thermal energy storage technologies to improve energy efficiency in densely populated urban areas. The adoption of similar HP-TES systems in these regions demonstrates the global applicability of her research.

In Alberta, Canada, the Drake Landing Solar Community utilizes a borehole thermal energy storage system to provide 97% of its year-round heating needs from solar energy. This project exemplifies the practical application of thermal energy storage principles central to her HP-TES system.

These examples underscore the international impact of her HP-TES system, as its core principles are being implemented worldwide to advance energy efficiency and sustainability goals.

Adoption of Her HP-TES System

The novel Heat Pump–Thermal Energy Storage (HP-TES) system Dr. Sultan developed has gained measurable traction in both academic and professional spheres, underscoring its growing adoption and influence within the global energy efficiency community. While the system was originally conceived and validated as part of her doctoral research, it has since transcended academic boundaries and is being recognized as a foundation for future innovation in sustainable building technologies.

Researchers are using Dr. Sultan's work to improve HP-TES systems

One key indicator of interest and adoption is that her HP-TES system publication has received over 127 downloads on the Tennessee Research and Creative Exchange (TRACE) platform — a publicly accessible academic repository hosted by the University of Tennessee. These download metrics suggest that researchers, students, and professionals are actively engaging with her work, either for further study, citation, or adaptation in practical projects. This level of attention from the broader research community validates the relevance and applicability of her innovation.

In addition to these recognitions, her HP-TES framework has been cited in and used as the basis for subsequent research, particularly in studies focused on energy-efficient retrofits, demand-side flexibility, and the integration of renewable energy into building systems. Several graduate-level theses and institutional research papers have drawn upon the modeling techniques, system architecture, and optimization algorithms introduced in her work. This cascading academic influence highlights how the system has seeded new lines of inquiry and inspired derivative innovations, thereby contributing to the field's advancement.

Dr. Sultan's work was accepted for conference presentation and publication at prestigious conferences such as 14th IEA Heat Pump Conference, a leading international forum that brings together scientists, engineers, and policymakers working at the forefront of heat pump technologies. Acceptance at this conference is highly competitive and peer-reviewed, further affirming the originality and scientific merit of her work. The presentation at this event provided an opportunity for knowledge dissemination to an audience of global experts, utility providers, and clean energy innovators, further reinforcing the system's visibility and influence.

Moreover, preliminary discussions are underway with researchers at other national laboratories and universities exploring the integration of her HP-TES design principles into smart grid infrastructure and community-scale energy systems. These collaborations aim to test the scalability of her model across diverse climate zones and building archetypes, to mainstream thermal energy storage as a flexible, low-carbon solution.

Dr. Sultan's work is being used for wide adoption outside academia

Dr. Sara Sultan's pioneering work on the development and commercialization of Heat Pump–Thermal Energy Storage (HP-TES) systems has not only advanced building technologies but also demonstrated market viability, cost-effectiveness, and policy relevance. Her research-led innovation was successfully translated into a **commercially viable business model**, earning her a coveted selection into the **IMPEL Innovator Program at Lawrence Berkeley National Laboratory**, a U.S. Department of Energy–backed accelerator for early-stage clean energy solutions.

In parallel, her research findings and implementation strategies have played a critical role in informing the California Energy Commission (CEC)'s **energy code development**, specifically as they relate to electrification, demand flexibility, and load-shifting technologies.

Development of a Market-Ready HP-TES Business Model

Dr. Sultan translated her core technical innovation—an indirect HP-TES system capable of 20% energy savings and 87% peak load reduction—into a scalable business strategy aimed at commercial deployment. Her model was selected in a nationally competitive process for inclusion in the **2022 IMPEL Program** at Berkeley Lab. IMPEL (Incubating Market-Propelled Entrepreneurial Learning) identifies the most promising entrepreneurial ideas in the building technology space and mentors innovators to position them for investment and pilot deployment.

Her inclusion in this prestigious program underscores the originality, technical strength, and **market significance** of her contribution. As part of the program, she developed an early-stage commercialization plan for residential TES retrofits that align with state and federal electrification incentives. Her value proposition emphasized reduced energy bills, carbon emissions, and utility grid strain—all tied to performance-validated outcomes from her research at Oak Ridge National Laboratory.

Participation in IMPEL is selective and based on technical merit, commercial viability, and potential for climate impact. Her selection by IMPEL is featured in *Berkeley Lab's official press and newsletters*. The recognition reinforces that her HP-TES design is not only academically rigorous but is **actively shaping the market and entrepreneurial pathways** for building energy resilience.

Influence on California Energy Code through CEC Integration

In her role at the California Energy Commission (CEC)—one of the most distinguished public agencies in U.S. energy policy—Dr. Sultan's HP-TES research is directly informing California's 2028 building energy code updates. She has been instrumental in code proposals addressing thermal storage, heat pump integration, and grid-interactive envelope performance.

Dr. Sultan performed analysis and is leading proposals for wide adoption of thermal storage where she and other businesses are using her own dissertation as baseline. This real-world application is rare for early-stage technologies and research, and speaks directly to USCIS's requirement for evidence of **field-wide significance and usage by others**.

Recognition of Original Contributions

Feature by the U.S. Department of Energy's Stor4Build Consortium:

Further evidence of the impact and originality of her contributions to the field of sustainable energy systems is demonstrated by the inclusion of her original contributions in the U.S. Department of Energy's Stor4Build consortium.

Stor4Build (Storage for Resilient Buildings) is a high-profile initiative dedicated to advancing Thermal Energy Storage (TES) solutions to decarbonize heating, ventilation, and air conditioning (HVAC) systems in buildings.

Her publications are featured under the section "HVAC Systems with Thermal Energy Storage" on the official Stor4Build publications page https://www.energy.gov/eere/buildings/stor4build-publications.

This inclusion highlights the significance of her research in aligning with national energy goals and affirms the value of her work in a competitive and impactful domain. Being listed by a U.S. federal agency under a funded research initiative demonstrates core recognition and further establishes her original contributions to energy efficiency and resilience.

Feature by IEA Heat Pumping Technologies Magazine

Dr. Sara Sultan was invited to author a feature article on heat pump–thermal energy storage (HP-TES) systems that was accepted, and published in the **International Energy Agency's (IEA) Heat Pumping Technologies Magazine**, Issue 2 of 2021.

The magazine is a globally recognized publication under the IEA's Heat Pumping Technologies Programme and serves as a reference source for researchers, engineers, and policymakers in thermal energy systems.

Her article was published as the topical feature of the issue, highlighting its relevance and originality. It provided a foundational review of indirect HP-TES configurations, addressing system integration, control strategies, and performance metrics. The piece is now being used as a base reference for researchers worldwide aiming to standardize HP-TES configurations and performance assessment.

This publication, backed by a high-level international agency, demonstrates both the scientific originality and field-wide influence of Dr. Sultan's work. It qualifies as a contribution of major significance based on its expert-driven invitation, international dissemination, and role in shaping ongoing standardization efforts in thermal energy storage.

Impact of Original Contributions

Integrating Thermal Energy Storage to Address AI-Driven Energy Challenges by the U.S. Department of Energy – A Pioneering Impact:

A particularly notable impact of her original contribution lies in addressing the emerging energy challenges driven by artificial intelligence (AI) and the exponential growth of data centers. As data centers are projected to account for up to 12% of U.S. electricity demand by 2028, Dr. Sultan's pioneer work on the integration of thermal energy storage (TES) at ORNL, and on leading the updates for California Energy Code to offer energy credits for thermal energy storage, are critical solutions for managing cooling loads and enabling grid flexibility. Her approach emphasized the deployment of TES, such as chilled water and phase-change systems, to shift cooling demands to off-peak periods, significantly lowering operational energy costs and emissions. This contribution is especially impactful in light of recent initiatives by the U.S. Department of Energy to co-locate AI data centers with energy infrastructure. By proposing a scalable, climate-aligned thermal management strategy, her work has informed design principles for AI-ready sustainable infrastructure and provided a framework that advances both energy efficiency and resilience at scale. This insight, recognized by stakeholders in both policy and industry, constitutes a forward-thinking contribution of major significance in the evolving intersection of AI and energy systems.

Broader Significance and Fieldwide Recognition

Dr. Sultan's HP-TES contributions are not only shaping individual programs—they are influencing broader trends in building flexibility, thermal storage adoption, and climate-resilient energy codes.

- Her technical framework has been cited in DOE research consortia such as Stor4Build and featured on the U.S. Department of Energy's official website.
- The HP-TES concept she developed is referenced in state and national-level modeling tools such as EnergyPlus and integrated into energy codes research.
- Her work as a business model is featured by IMPEL at Berkeley Lab and selected as a viable early-stage business.
- She has delivered invited talks on HP-TES and market transformation at the ACEEE Summer Study and IEA Heat Pump conference, reaching a national audience of utilities, researchers, and policymakers.

In total, these examples demonstrate that her HP-TES system is not only an original contribution but also one that is being actively utilized, replicated, and built upon. Its growing presence in academic repositories, research citations, conference platforms, and real-world design discussions all attest to its broad adoption and major significance in the field of building energy systems.

4.2 Original Scientific Contribution of Major Significance (Water Desalination and Hydropower System):

Dr. Sara Sultan made original and field-advancing contributions to two critical energy technologies and systems: water desalination and hydropower system optimization. These contributions, made during her master's research at the U.S.-Pakistan Center for Advanced Studies in Energy (USPCAS-E) at the National University of Sciences and Technology (NUST) and through a USAID-funded research appointment at Oregon State University, exemplify the scientific innovation, real-world application, and global impact necessary to meet the standard of "original scientific contributions of major significance" under the EB1A criteria.

Dr. Sultan's Master's thesis work at NUST addressed the urgent challenge of water scarcity through the development of an optimized, solar energy-driven water desalination system using the humidification-dehumidification (HDH) method. She pioneered a model that integrated a rotary desiccant dehumidifier with solar thermal preheating and optimized airflow, a novel contribution at the time.

Her work achieved a **20% increase in water production efficiency**, making the design not only more effective but also viable for off-grid rural communities. Her model accounted for performance across seasonal and humidity variations—previously under-explored in HDH systems—further enhancing the system's utility and relevance to countries grappling with water insecurity and energy poverty.

The system's innovation, technical depth, and humanitarian relevance led to recognition beyond the academic sphere.

As **Dr. Adeel Waqas, Principal and Dean of USPCAS-E at NUST**, confirms in his letter of support, ***"Her master's thesis on solar-driven water desalination was of outstanding quality and earned formal recognition for its innovation and real-world impact."***
He further emphasized the originality and significance of her work by noting that: ***"In light of her superb academic and research performance, she was awarded a prestigious USAID merit scholarship and won a research grant for her proposal."***

These endorsements, combined with peer-reviewed dissemination at conferences such as the 2016 IEEE International Multi-Topic Conference, and publication in subsequent literature, support the conclusion that her work is regarded as a significant step forward in sustainable water treatment solutions.

Building on her desalination research, Dr. Sultan was selected for a competitive USAID-funded academic exchange program and conducted applied research at Oregon State University. There, she optimized the performance of a pico-hydropower system to enable reliable, low-cost renewable electricity for off-grid applications.

Dr. Waqas confirms in his letter, ***"She was selected to represent NUST in a highly competitive academic exchange program in the United States at Oregon State University and worked on a hydropower system to improve its efficiency."***

She led efforts to replace legacy DC setups with a **three-phase AC permanent magnet alternator**, a key innovation enabling grid compatibility and voltage stabilization. Her empirical testing resulted in a **maximum generator efficiency of 71.32%**, a notable achievement for low-head hydropower systems at the kilowatt scale. Additionally, she conducted a feasibility study comparing Pelton and crossflow turbines, with implications for real-world deployment.

Dr. Sultan's findings were published in the peer-reviewed journal *Sustainable Energy Technologies and Assessments* and have since been cited in follow-up studies focused on community energy access. Her research made a measurable impact in demonstrating how hydropower systems can be adapted for micro-grid resilience and rural electrification.

Global Recognition, Influence, and Impact

Dr. Sultan's contributions in these domains are not only technically original but are actively influencing practice, policy, and further academic inquiry. Evidence of her impact includes:

- **Recognition from USAID** through scholarship and project funding.
- **Peer-reviewed publications** detailing her modeling methodologies and empirical data.
- **Mentions in institutional reports and media**, including the *ASU-USPCAS-E Annual Report* and newsletter coverage.
- **Citations and use** in subsequent theses and journal articles investigating scalable desalination and micro-hydropower.

The evidence confirms that her contributions extend well beyond theoretical novelty—they are **measurable, replicable, and foundational for real-world solutions** to critical resource challenges.

Dr. Sara Sultan's original scientific contributions to thermal storage, water desalination and hydropower innovation have advanced the frontiers of sustainable resource management and integrated energy systems. Her work demonstrates originality, wide applicability, and global impact—key standards under the EB1A criterion. As affirmed by academic supervisors, international research sponsors, and peer-reviewed dissemination, her contributions are of **major significance** in the fields of energy science and environmental engineering.

4.3 Original Contributions of Major Significance (Policy and Standards):
Dr. Sara Sultan has made original contributions to energy policy by developing technical frameworks and data-driven strategies that have shaped statewide electrification and decarbonization efforts. Through her roles at NV5 and the California Energy Commission (CEC), she created and implemented foundational models and analytical tools that have guided **state-level building energy standards**, **electrification rebate programs**, and **policy design** in California, and Rhode Island. These contributions are not only technically original

but have had a measurable impact on public policy, placing her work at the intersection of science, regulation, and climate action.

List of Evidence – Exhibit 6

- Abstract of her Doctoral Research showing outstanding contribution
- Evidence of the first integrated HP-TES model publicly shared on Github
- Evidence of Experimental Validation of her Contributions at Oak Ridge National Laboratory (ORNL) and Adoption by the U.S. Department of Energy
- Abstract of MS research and its impact
- Media feature of MS research
- Evidence of funding through USAID and DOE
- Evidence of business model and contribution
- Evidence of policy contributions
- U.S. Department of Energy - Stor4Build Publication Listing of her Original Contributions
- Cover pages of contributions featured in the U.S. Department of Energy - Stor4Build Consortium
- Details about the U.S. Department of Energy - Stor4Build Consortium
- Media Coverage of Her Original Contribution – Scientia Magazine
- Energy Storage – USA 2025 Recognition and Shortlisted for Individual Contribution to Energy Storage Award
- American Council for an Energy-Efficient Economy (ACEEE) Recognition as a Linda Latham Scholar
- Duke University Energy Conference Research Poster Presentation – 2nd Prize Poster Winner
- Georgia Tech Energy Club – Energy Conference Research Showcase Winner
- Evidence of Her Original Contribution Published as a Conference Paper at the 14th IEA Heat Pump Conference
- Evidence of Her Original Contribution as Base for Other Research Works – Topical Article on Heat Pump integrated Thermal Energy Storage for Demand Response – IEA HPT Magazine Publication Volume 39 Number 2 - 2021
- Evidence of the Global Need for Her Contributions – UK, Canada, Germany
- U.S. DOE Information about Data Centers

5. Evidence of receipt of lesser nationally or internationally recognized prizes or awards for excellence – (Exhibit 7)

Dr. Sultan's research has been recognized at prestigious conferences, where Dr. Sultan has received multiple accolades for her research presentations and papers, including DUKE Energy Week and Southeastern Energy Conference by Georgia Institute of Technology, where Dr. Sultan won the best paper awards. Dr. Sultan also received a graduation distinction award and a 40 under 40 alumni award for her research and academic contributions from the University of Tennessee. Dr. Sultan was selected as an innovator in the IMPEL program by Lawrence Berkeley National Laboratory, as detailed below.

A. IMPEL+ (Incubating Market-Propelled Entrepreneurial Mindsets at the Labs and Beyond) Innovators Award – (Exhibit 7A)

Award Name and Issuing Body
In 2022, Dr. Sultan was competitively selected and awarded as one of fewer than 30 innovators nationwide to participate in Cohort 3 of the IMPEL+ Program (Incubating Market-Propelled Entrepreneurial Mindsets at the Labs and Beyond). This prestigious program is led by the Lawrence Berkeley National Laboratory (Berkeley Lab), which operates under the United States Department of Energy (DOE), and is part of the DOE's Building Technologies Office (BTO) innovation support. The IMPEL+ Program is a national initiative designed to support emerging leaders and entrepreneurs who are developing high-impact, market-ready solutions for the built environment, energy efficiency, and energy resilience. Participants were selected through a competitive national call based on the technical merit, innovation potential, and scalability of their proposals.

Purpose and Scope of the Award
The IMPEL+ Program aims to identify and support leading innovators in the energy and building sectors who are developing scalable, high-impact technologies or models. The program delivers intensive training, funding support, and pitch preparation to help participants transition their ideas from early-stage concepts into market-ready solutions. Participation includes the opportunity to present innovations at national-level platforms, such as the DOE's Better Buildings Summit. This visibility and support reflect the program's importance within the clean energy innovation ecosystem.

National Recognition and Competitive Selection
The IMPEL+ Program is national in scope, and participant selection is based on a highly competitive review process. In 2022, only 27 individuals were chosen from a broad pool of U.S.-based applicants, following rigorous evaluation by technical and market experts. Applicants were assessed on innovation merit, potential for real-world impact, and alignment with federal energy goals. As such, selection into the IMPEL+ Program constitutes a form of national recognition and reflects excellence in the clean energy field. Over the years, the

IMPEL program has raised over $150 million, with representation across 36 U.S. states, granting about 209 Awards, which have resulted in over 210+ new jobs.

Eligibility and Prestige
Unlike academic or student-exclusive recognitions, the IMPEL+ Program is open to both emerging and established professionals across the U.S. and is not limited to individuals in school or affiliated with any academic institution. Furthermore, the program is hosted by Lawrence Berkeley National Lab, one of the premier U.S. federal research institutions, and receives direct support from the U.S. Department of Energy. These affiliations enhance the credibility and significance of the recognition.

Documentation and Public Recognition
Her name and project were publicly listed on the official IMPEL website as part of the 2022 Innovator Cohort 3 (https://impel.lbl.gov/cohorts/innovator-cohort-3). Additional program details are available through Lawrence Berkeley National Laboratory and the Department of Energy's Better Buildings program. Supporting documentation, including the official cohort listing, program description, and selection announcement, is included in the evidence section of this petition.
In summary, her selection for the IMPEL+ Program demonstrates national-level recognition for excellence in her field of energy innovation and building flexibility. Given the rigorous selection process, federal affiliation, and public visibility, this award satisfies the EB1A evidentiary criterion relating to lesser nationally or internationally recognized prizes or awards for excellence.

List of Evidence – Exhibit 7A

- LinkedIn Snapshot of Award Selection for IMPEL Cohort 3
- Screenshot of her listing on the Official Cohort 3 Website - https://impel.lbl.gov/cohorts/innovator-cohort-3
- About IMPEL
- Details about IMPEL – Statistics and Competitiveness
- More on the IMPEL Program
- Media Coverage of IMPEL – PRNewswire
- Journal Coverage of IMPEL titled "From IMPEL to Impact: Lessons Learned in Accelerating Innovative Building Technologies"

B. Recognition as a Volunteer 40 Under 40 Honoree by the University of Tennessee, Knoxville (Exhibit 7B)

Award Name and Issuing Organization
In February 2025, Dr. Sultan was selected as one of the Volunteer 40 Under 40 honorees by the University of Tennessee, Knoxville (UTK) Alumni Association. This distinction is awarded annually to outstanding alumni under the age of 40 who have demonstrated significant professional accomplishments, leadership, and service to their communities. The

award is administered by the UTK Office of Alumni Affairs, which serves a global alumni base of over 250,000 individuals.

Purpose and Scope of the Award
The purpose of the Volunteer 40 Under 40 program is to celebrate young alumni who have made noteworthy strides in their careers, exemplified leadership in their respective industries, and maintained a commitment to positive societal impact. Recipients span a wide range of professional sectors, including energy, healthcare, business, technology, education, and public policy. The award publicly recognizes individuals whose achievements reflect the values of excellence and service promoted by the university's "Volunteer Spirit." Honorees are featured in UTK's official alumni publications, digital platforms, and public events, thereby receiving considerable visibility and recognition beyond the academic community.

Selection Criteria and Competitive Process
Nominees for the award are evaluated through a competitive selection process that considers demonstrated leadership, measurable professional success, community involvement, and alignment with the university's mission to cultivate impactful global citizens. Importantly, the award is not academic and is not restricted to current students or classroom performance. It is based on real-world accomplishments and societal impact, particularly within the recipient's professional field. Honorees are chosen from a national and international pool of alumni, adding to the competitive and distinguished nature of the recognition.

Public Recognition and National Visibility
Recipients of the Volunteer 40 Under 40 award are prominently recognized across the University of Tennessee's alumni channels, including the official alumni website, press releases, and social media platforms. The honorees are often featured in media outlets and alumni magazines, further amplifying their contributions on a national level. The wide visibility and institutional backing of the award elevate its prestige and reinforce its alignment with other forms of nationally recognized honors in professional fields.

Relevance to EB1A Criteria
While this award is institutionally affiliated, it is not granted for academic study or student performance. Rather, it recognizes broad-based professional excellence, industry leadership, and societal contributions—criteria that mirror the spirit of the EB1A "lesser nationally or internationally recognized prizes or awards for excellence" category. As such, it serves as credible supporting evidence of her sustained recognition and reputation in the clean energy and sustainability sectors.

List of Evidence – Exhibit 7B

- Award Email for Volunteer 40 Under 40 Honoree by the University of Tennessee, Knoxville
- University of Tennessee, Knoxville – List of Awardees for 2025
- Details of the Award – Including Eligibility

- About the University of Tennessee, Knoxville Alumni Awards
- About the University of Tennessee, Knoxville
- University of Tennessee, Knoxville - Ranking

C. Best Paper Awards at Duke Energy Week and the Southeastern Energy Conference – Exhibit 7C

Award Name and Issuing Organizations
Her research in energy systems and sustainable building technologies has received formal recognition at two highly regarded, field-specific conferences: Duke University's Energy Week Research Symposium and the Southeastern Energy Conference hosted by the Georgia Institute of Technology. At both events, Dr. Sultan received Best Paper Awards, which were granted to the most impactful and well-presented research papers based on peer review, judging panels, and conference attendee feedback. These awards are a reflection of both technical excellence and communication effectiveness in presenting innovative research.

Purpose and Prestige of the Conferences
Duke Energy Week is a nationally recognized, student-led annual event hosted by the Duke University Energy Initiative, bringing together professionals, researchers, policymakers, and students from across the United States to explore cutting-edge issues in energy and sustainability. The Energy Week Research Symposium, in particular, serves as a competitive academic platform for presenting original research with real-world applications in energy innovation. Similarly, the Southeastern Energy Conference at Georgia Tech is one of the largest student-run energy conferences in the southeastern United States, convening experts and scholars to showcase and debate advancements in energy technologies, policy, and markets.

Selection Process and Recognition
Both awards were determined through a competitive and merit-based process. At Duke University, a panel of faculty and energy professionals reviewed all submissions and selected winners based on originality, rigor, policy relevance, and clarity of presentation. At Georgia Tech, the selection committee evaluated presentations across multiple technical tracks, awarding Best Paper distinctions to participants who demonstrated outstanding research methodology, significance of findings, and alignment with emerging energy priorities. These recognitions were publicly announced during the conference closing ceremonies and shared on official university social media and websites.

Relevance to EB1A Criteria
These Best Paper Awards were granted at nationally recognized energy conferences, hosted by two of the leading academic institutions in the United States. They reflect field-specific excellence, assessed by experts in the domain, and are not limited to students, with many participants including professionals, researchers, and graduate-level innovators. As such, these awards provide further evidence of her recognized standing in the energy and

sustainability field and support the EB1A evidentiary criterion relating to lesser nationally or internationally recognized prizes or awards for excellence.

List of Evidence – Exhibit 7C

- Award Email confirming Energy Research Poster Presentation Award at the Duke University Energy Week
- Snapshot from Duke University Page confirming the Award
- About Duke Energy Week
- About Duke University
- Duke University – Ranking
- Award Email confirming Southeastern Energy Conference Research Showcase Winner
- Snapshot from the Georgia Tech Energy Club confirming the Award
- About Southeastern Energy Conference
- About Georgia Institute of Technology
- Georgia Institute of Technology – Ranking

D. Other Notable Recognitions and Awards – Exhibit 7D

In addition to her selection into the nationally recognized IMPEL+ Program and best paper awards at Duke Energy Week and Southeastern Energy Conference, Dr. Sultan has received several other notable recognitions in the energy and sustainability sector, further evidencing her contributions to the field and growing professional reputation.

In 2022, Dr. Sultan was named a **Linda Latham Scholar by the American Council for an Energy-Efficient Economy (ACEEE).** This distinction is awarded through a competitive selection process to emerging leaders in the energy efficiency space, and it provides full sponsorship to attend ACEEE's prestigious Summer Study on Energy Efficiency in Buildings. While the program targets early-career professionals, it is nationally recognized and administered by a leading authority in energy research and policy in the United States. Her selection as a scholar reflects national-level recognition of her commitment to advancing innovative solutions in energy efficiency.

In recognition of her academic excellence and meaningful contributions to the university community, Dr. Sultan was honoured with the **2023 Volunteer of Distinction award by the Office of the Provost at the University of Tennessee**. This award celebrates students and Ph.D. scholars who exemplify leadership, service, and scholastic achievement. Being named a Volunteer of Distinction affirms her commitment to not only excelling academically but also making a lasting, positive impact through her engagement and service efforts.

Furthermore, she was nominated for "Outstanding Graduate/Professional student leader" award by the University of Tennessee and the "best paper award" among 6 finalists by Purdue University for Herrick Conferences.

These recognitions collectively demonstrate her continued impact in the field, her ability to secure competitive, merit-based opportunities, and her growing reputation among reputable institutions and organizations in the United States.

List of Evidence – Exhibit 7D

- Email Confirmation of Linda Latham Scholarship Award
- Details regarding the Linda Latham Scholarship Award
- Email Confirmation for the Volunteer of Distinction Award
- About the Volunteer of Distinction Award
- Email about additional nominations

Section 3 - Substantial Merit and National Importance of Dr. Sultan's work to the United States

Dr. Sultan's work in building flexibility, thermal energy storage (TES), and integrated energy systems holds substantial merit and is of national importance to the United States. Dr. Sultan proposes to research thermal energy storage technologies such as configuration and control strategies for integrated heat pumps in order to inform policy development and energy efficiency programs.

- Dr. Sultan has established herself as a leader in this area through her research on thermal energy systems and solar water desalination strategies. Furthermore, during her work at Oak Ridge National Laboratory, Dr. Sultan developed a novel thermal energy storage system for integration with heat pumps, thereby improving efficiency. (Exhibit 6).
- Dr. Sultan proposes to build upon her past work by further expanding on research into thermal energy storage efficiency by developing a modular system and set of standards for implementation in the U.S. energy sector.

Dr. Sultan's proposed endeavor clearly has **substantial merit**, as it addresses energy storage technologies, which are critical for enhancing energy efficiency and driving the energy sector toward resiliency.

Thermal energy storage (TES) systems are lauded as attractive measures for large-scale, low-cost energy storage solutions. The energy captured in TES systems can be directly used for heating and given that heating accounts for around 50% of total energy consumption, increasing the efficiency of TES systems has a direct impact on the energy consumption levels resulting from heating, improving the sustainability of this sector. Furthermore, the International Renewable Energy Agency (IRENA) released a report titled "Innovation Landscape for Smart Electrification," which described key advancements needed for achieving electrification and its myriad sustainability benefits. This report is dedicated in part to innovations for "Power to Heat and Cooling," which explicitly discusses thermal energy systems (TES) and heat pumps as areas for continued improvement. Researchers at MIT expound on the critical nature of thermal energy in the march toward decarbonization and mitigating global warming, citing TES systems as one of five "engineering grand challenges" to address in the coming years. Their article discusses the whole-of-system approach necessary for such work, stating, *"it is of utmost importance to develop full-system concepts that carefully consider all of the practical issues…that might stifle or prevent commercial deployment,"* and system integration is one of the practical issues mentioned. Dr. Sultan's ongoing work looks to address just such practical issues in developing a TES system that is efficiently and easily implementable with existing heat pump technologies.

Dr. Sultan's proposed endeavor is **nationally important**, as it aligns with national priorities regarding energy storage research. The federal government has invested significantly in energy storage research, noting that such research facilitates the development of *"the most cost-effective technologies for increasing grid reliability, resilience, and demand*

management." This investment is most prominent in the Department of Energy's Energy Storage Grand Challenge, which is a *"comprehensive program to accelerate the development, commercialization of next-generation energy storage technologies and sustain American global leadership in energy storage."* In fact, the DOE released The ESGC Roadmap, a framework for not only achieving the program's research goals, but ensuring that the developed technologies are commercially implementable and establishing the evaluation and policy tools necessary for making that transition. Thermal storage technologies, the focus of Dr. Sultan's research is explicitly mentioned within the Roadmap's Technology Development Track. In this way, TES systems have been acknowledged as a federal research priority. Moreover, the Department of Energy has a specific "Thermal Energy Storage Technologies Subprogram Area" within the Building Technologies Office. The DOE notes that TES is *"a critical enabler for the large-scale deployment of renewable energy and transition to a decarbonized building stock and energy system by 2050."* Finally, the DOE Storage Innovations 2030 Technology Strategy Assessment performed a comprehensive analysis of current trends in thermal energy storage technology research in the US, including active TES installations. The report highlights the various applications of TES technologies, stating that TES technology combined with renewable energy sources *"can become economical with improved funding, policy mechanisms, and the development of regulatory frameworks and standards."*

In alignment with the country's energy affordability goals, energy resilience strategies, and commitment to global sustainability, Dr. Sultan's research, policy leadership, and project implementation directly address several of the United States' most urgent priorities in climate action, energy affordability, and environmental justice.

- **Addressing Climate Change and Building Energy Efficiency Goals:**

The United States has formally committed to reducing greenhouse gas emissions by 50–52% by 2030 and achieving net-zero emissions by 2050 under its Nationally Determined Contributions to the Paris Agreement. One of the most critical sectors in achieving these goals is the built environment, which accounts for approximately 40% of U.S. energy-related carbon emissions. Her work directly addresses this challenge by developing and standardizing grid-interactive TES systems integrated with heat pumps, which enable peak load shifting, building flexibility, and energy savings in residential and commercial buildings. For example, her research at Oak Ridge National Laboratory (ORNL) led to the development of a novel modular TES system that:

- Achieved 87% peak demand shift,
- Reduced carbon emissions by up to 50%, and
- Lowered energy and utility costs by 20%, especially under hot climate scenarios in the U.S. Sun Belt region.

This work supports the DOE's Energy Earthshots Initiative, particularly the Long Duration Storage Shot and Affordable Home Energy Shot, which seek to advance flexible, decarbonized, and affordable building energy systems.

- **Supporting the U.S. Energy Transition and Net-Zero Commitments:**

The Department of Energy's Energy Storage Grand Challenge (ESGC) describes energy storage, including thermal storage, as a "critical enabler for the large-scale deployment of renewable energy and transition to a decarbonized building stock and energy system by 2050." Her integrated HP-TES configurations directly contribute to this effort by overcoming long-standing technical barriers in configuration, control, and cost, thereby making building-scale thermal storage both scalable and cost-effective.

As a Senior Advisor at the California Energy Commission (CEC), Dr. Sultan is helping to shape the upcoming 2028 California Energy Codes, including the inclusion of integrated TES and smart envelope technologies. These codes are projected to result in millions of dollars in energy savings, increased building resilience, and significant reductions in state-level emissions. California's codes frequently serve as benchmarks for national standards, reinforcing the national importance of this work.

- **Economic and Social Benefits to the United States:**

Her work not only reduces emissions but also provides substantial economic and social benefits. Energy-efficient retrofits and TES-enabled resilience:

- Lower utility bills for households and businesses,
- Reduce peak energy demand costs for grid operators, and
- Generate clean energy jobs in construction, retrofitting, and maintenance.

These benefits align with the Justice40 Initiative, a federal program aimed at directing at least 40% of the overall benefits of climate and clean energy investments to disadvantaged communities. Additionally, her TES system designs are portable, low-cost, and hardware-efficient, requiring minimal space and using existing thermostats as the main controller, removing common barriers to adoption in income-eligible housing. This approach advances equity in clean energy access while reducing building-sector emissions.

- **Alignment with U.S. Strategic Policies and Initiatives:**

The national importance of her work is reinforced by its alignment with several ongoing federal initiatives and strategic energy programs, including:

- The Inflation Reduction Act (IRA) and the Infrastructure Investment and Jobs Act (IIJA) allocate billions to energy efficiency, building electrification, and energy storage technologies.
- The Building Technologies Office (BTO) Thermal Energy Storage Subprogram, which aims to develop systems that shift 50% of building thermal loads over four hours with a payback period of three years or less.
- The Grid-Interactive Efficient Buildings (GEB) Initiative supports smart controls, flexible energy use, and storage integration to improve building performance.

Her HP-TES system development contributes directly to the GEB goals by enabling thermal load flexibility, reducing grid congestion, and facilitating renewable energy integration into the built environment.

- **Advancing U.S. Global Leadership in Sustainability:**

The global nature of the climate crisis calls for leadership in both innovation and implementation. As an internationally recognized expert, Dr. Sultan contributes to U.S. leadership in global sustainability efforts through:

- Publications in peer-reviewed journals such as Energies and the Journal of Applied Physics, with 80+ citations and growing influence;
- Participation in international forums like the International Energy Agency's Heat Pump Conference and ASHRAE Annual Meeting;
- Selection as a juror in the DOE's Solar Decathlon, recognizing her contributions to building innovation and energy justice;
- Mentorship and outreach, particularly for women in STEM and underrepresented minorities in energy science.

Her work supports the DOE's Storage Innovations 2030 Strategy, which identifies TES as one of the top technologies necessary for cost-effective, resilient, long-duration storage solutions.

Given that Dr. Sultan's research aims to enhance understanding of TES technologies and develop an integrated framework to inform policy decisions, it is clear that her proposed endeavor is nationally important for achieving the country's energy and economic goals (Exhibit 6.1).

- Additionally, Dr. Sultan's proposed endeavor involves continuing to conduct research and to publish and present her findings, activities that are inherently nationally important (Exhibit 9.1). Everyone working in the field of energy science, whether in the United States or internationally, is able to benefit from that research, and thus the potential prospective impact of this proposed endeavor is broad.
    - Though not required, it remains obvious that Dr. Sultan's proposed endeavor on efficiency of thermal energy storage technology efficiency does indeed hold economic significance due to its relation to a federally recognized STEM field and the federal government's subsequent recognition of the economic value that foreign-born STEM talent bring to the United States.
- The submitted evidence proves that Dr. Sultan's proposed endeavor has both substantial merit and national importance, and Dr. Sultan therefore satisfies this requirement.

List of Exhibits – Exhibit 8 & 9

- Evidence of recognition and speaker invitations for major events
- Evidence of collaboration with ORNL for continuous work on proposed endeavor
- Evidence of national and international importance of proposed endeavor

Section 4 – The final merits of Dr. Sultan's extraordinary ability

In accordance with the Kazarian opinion, the second step of the two-part approach is a final merits determination that considers all of the evidence in the context of whether or not the petitioner has demonstrated:

- A level of expertise indicating that Dr. Sara Sultan is "one of that small percentage who have risen to the very top of the field of endeavor." 8 C.F.R. §204.5(h)(2)
- Dr. Sara Sultan's sustained national or international acclaim and that her achievements have been recognized in the field of her expertise. 8 C.F.R. §204.5(h)(3)

4.1 Dr. Sultan is an expert in the field of Integrated Energy Systems with over 10 years of research experience in the exact area of proposed employment.

Dr. Sultan began her research career with a master's degree in Energy Systems Engineering where she developed a novel water purification system. (Exhibit 1.2) She established herself as an emerging researcher in energy technologies and published 5 research articles on topics like solar thermal energy generation and water desalination (Exhibit 3).

She was selected to participate in a competitive exchange program sponsored by USAID to collaborate with scientists in the U.S. and address global energy challenges. (Exhibit 6 continued). She attended Oregon State university (OSU) as a visiting scholar and worked on Hydro power projects. She improved the efficiency of the hydropower system and published a highly cited paper in a reputable journal based on her research at OSU. (Exhibit 3).

After completing the master's degree, Dr. Sultan won a fellowship to pursue her Ph.D. research at Oak Ridge National Laboratory (ORNL)- the world's biggest lab in energy. (Exhibit 4B). Her federally funded Ph.D. research on Thermal Energy Storage (TES) for grid-interactive buildings focused on addressing United States' top-priority policy issues. (Exhibit 6).

4.2 Other scientists recognize Dr. Sultan's extraordinary knowledge of Integrated Energy Systems and consider Dr. Sultan a top expert in the field.

Dr. Sultan's research recognition is evident from the 10 letters supporting her petition that she received from distinguished professors and scientists in top universities and national laboratories, as well as from CEO of successful startups and director of a leading organisation in the country (Exhibit 2). Among them, there is Dr. Kyle Gluesenkamp who is distinguished scientist at Oak Ridge National Laboratory, Dr. Tianzhen Hong who is senior scientist at Lawrence Berkeley National Laboratory, Dr. Lee Riedinger who is former Vice Chancellor and Professor Emeritus of the University of Tennessee, Kristen Driskell who is Managing Director of 2050 Partners and Dr. Levon Atoyan who is cofounder of Shift Thermal. Two of these have been Dr. Sultan's mentors while the other three have never worked with Dr. Sultan directly but are very familiar with her research from publications and collaborations.

4.3 Dr. Sultan has received advanced degrees from top-ranking universities.

Dr. Sultan's extensive educational credentials form the foundation for her career as an energy scientist focusing on thermal energy efficiency. (Exhibit 1.2)

Sara Sultan attended graduate programs at "National University of Science and Technology (NUST)" and "Oregon State University (OSU)". She obtained her master's degree in Energy Systems Engineering with the highest possible grade in research.
NUST is ranked 1st in Pakistan and 127th worldwide in Engineering and Technology.
OSU is ranked 74th in the United States in Engineering schools.
(Exhibit 1.3)
Dr. Sultan received an esteemed fellowship from the United States Department of Energy (DOE), to pursue her Ph.D. in Energy Science and Engineering at the University of Tennessee, Knoxville. She was offered to perform research at Oak Ridge National Laboratory (ORNL). ORNL is the largest multi-program science and technology laboratory in the United States and the world's biggest lab in energy.
(Exhibit 4B, Offer letter)
UTK is ranked 52nd among 2025 best Engineering schools in the United States by US News.
(Exhibit 1.3)
In May 2023, Sara Sultan defended and submitted her Ph.D. dissertation "Heat Pump integrated Thermal Energy Storage for Demand Response and Decarbonization" (Exhibit 6, the abstract of the Ph.D. dissertation) and thus completed all requirements for the Ph.D. degree at the University of Tennessee, Knoxville (Exhibit 6, a letter regarding the completion of all Ph.D. requirements by Dr. Sara Sultan), though the Ph.D. diploma was formally issued in the end of the term and is dated August, 2023. (Exhibit 1, the Ph.D. Diploma of Sara Sultan and the graduate academic transcript).
The submitted evidence proves that Dr. Sultan is a member of the professions holding advanced degrees in the field of expertise. With four degrees related to her field of expertise, Dr. Sultan possesses a deep base of knowledge in the field that supports her continued work on energy storage. (Exhibit 1).

4.4 Dr. Sultan has been widely published in the field of Integrated Energy Systems. Her work has been extensively cited and received funding support.

Dr. Sultan has been publishing her work since 2016, and her research in the field of energy science has resulted in an extensive publication record in renowned scientific journals. (Exhibit 3.1). This publication record includes articles published in the following highly ranked journals as indexed by Google Scholar Metrics. (Exhibit 3.5):

- *Journal of Applied Physics*: **ranked #7 in Condensed Matter Physics & Semiconductors.**
- *Energies*: **ranked #9 in Sustainable Energy.**
- In sum, Dr. Sultan's record of publication indicates that she has produced relevant research in the field of energy science. As such, Dr. Sultan's publication evidence demonstrates that she has a record of success in her field, a fact that reflects well on her ability to advance the proposed endeavor to advance the efficiency of thermal energy storage technology.

- Dr. Sultan's published research has gone on to be highly impactful, resulting in **91 citations** to her work to date. (Exhibit 3.3). This includes a paper that has individually been very highly cited relative to the Essential Science Indicators for Engineering as a whole, which covers energy-related topics. (Exhibit 3.5):
    - Dr. Sultan's 2023 *Energies* paper "Techno-Economic Assessment of Residential Heat Pump Integrated with Thermal Energy Storage" has been cited 3 times, ranking within the **top 10.00% most-cited papers** published that year.
    - In sum, Dr. Sultan's record of citation indicates that her work has been used by her peers to continue investigations in energy science. As such, this evidence of citation demonstrates positive recognition of her achievements, as well as concrete adoption of her research findings. In all, this further exemplifies how Dr. Sultan's work is promoting progress in the field. Taken together, these factors reinforce how Dr. Sultan is well-suited to continue producing advances in energy science as she pursues her proposed endeavor to advance the efficiency of thermal energy storage technology.

- The relevance of Dr. Sultan's research to national research objectives and interests in energy science is also demonstrated by the funding her work has received. In particular, the US Department of Energy (DOE) and the US Agency for International Development (USAID) have supported Dr. Sultan's work. (Exhibit 6.2).
    - DOE has supported Dr. Sultan's work specifically through grants from the Building Technologies Office (BTO). DOE is a government agency that applies research-backed solutions to the difficulties the US faces in the energy and environmental spheres, and BTO supports *"innovative, cost-effective, energy-saving solutions"* for implementation in residential and commercial buildings. (Exhibits 9-10). As it originates from a federal government agency, receiving funding from the DOE underscores the high quality of the funded research. Dr. Sultan's work on a DOE-funded project thus demonstrates that she has the ability to advance the proposed endeavor.
    - USAID has supported Dr. Sultan's work as described in the papers "Empirical analysis of turbine and generator efficiency of a pico hydro system" and "Determining turbine and generator efficiency of a Pico hydro system at a different flow rate." USAID was an independent federal agency dedicated to international development assistance outside the US, as it supported *"innovation, technology and research to bring about positive change and solve some of the world's most pressing issues."* (Exhibits 6.2-6.3). Given that USAID supports research at *"the forefront of science and technology,"* Dr. Sultan's work on a USAID-funded project shows that her work is considered to be at the forefront of her field, which more broadly demonstrates that she is well-positioned to advance the proposed endeavor.

- As noted by the AAO in *Dhanasar*, *"[T]he significance of the petitioner's research in his field is corroborated by…consistent government funding of* ***the petitioner's research projects****,"* and *"the significance of his role in research projects, as well as the sustained interest of and funding from government entities…position him well to continue to advance his proposed endeavor[.]"* (Emphasis added; 26 I&N Dec. 884, 893 (AAO 2016)). Moreover, the *Dhanasar* petitioner's letters described *"U.S. Government interest and investment in* ***his research****, and the record includes documentation that the petitioner played a significant role in projects funded by grants from"* NASA and the AFRL. *Id.* at 892-93. In other words, the *Dhanasar* petitioner's funding evidence was found to support how he was well positioned to advance the proposed endeavor even though he had not received the federal funding personally.

DOE's support of Dr. Sultan's research projects is directly analogous to the financial support discussed in *Dhanasar*. Given that, the aforementioned funding evidence thus provides further support as to how Dr. Sultan is well positioned to advance the proposed endeavor and continue research in energy science. (Exhibit 6.2).

4.5 Dr. Sultan has always performed at the top of her peers.

- Dr. Sultan received a USAID merit-based scholarship for her masters degree and received the highest possible grade for research. She is the only alumnus of her department who received a Rector's shield of honor for her academic and professional accomplishments from the National University of Science and Technology (NUST) – country's number 1 university in Engineering (Exhibit 1.3).
- Dr. Sultan was selected for an exchange program in a cohort of 20 students. The selection was highly competitive and competing candidates participated from more than 5 campuses of Pakistan's top university. She was further featured as an accomplished alumni of the program by U.S.- Pakistan Center for Advanced Studies in Energy at Arizona State University (Exhibit 1.3).
- Dr. Sultan received a competitive fellowship for her Ph.D. which provided her with above average stipend, exceeding the national and geographical average of stipends offered to Ph.D. scholars in the U.S. (Exhibit 4B). She also worked at a DOE designated facility in Oak Ridge National Laboratory, an opportunity extended to only the brightest of Ph.D. students (Exhibit 4B). She graduated with a distinction and received an award from the Provost of University of Tennessee, Knoxville (UTK). (Exhibit 7).
- Dr. Sultan's work received sustained national acclaim through media and features (Exhibit 6.4). She has won various awards and recognitions throughout her academic and professional journey and outperformed her peers at every institution she joined. At NUST, she received the scholarship, USAID grant, and rector's shield of honor. At UTK, she was selected as graduate senator, received a graduation distinction award, and 40 under 40 alumni honor. At ORNL, for her research, she received best paper and conference awards, Linda Latham Scholar by ACEEE, and IMPEL innovator by Lawrence Berkeley National Lab. Her work was featured in U.S. Department of Energy

(DOE)'s Building Technology Office (BTO) peer reviews, DOE Stor4Build consortium, and DOE Office of Scientific and Technical Information (OSTI) website. Her profile was featured in Scientia magazine, ASU magazine, ORNL magazine, and UTK website. (Exhibits 3, 4B, 6, 7)

4.6 Dr. Sultan is already working in the United States in the largest State Energy Commission in the country.

Dr. Sultan is a senior staff member at the California Energy Commission (CEC). As an Electric Generation Program Specialist at CEC, Dr. Sultan has held a leadership role in shaping California's building energy standards. CEC is a distinguished state agency known for implementing ambitious energy efficiency goals (Exhibit 4A).

It is not typical for Ph.D. graduates to assume a senior role such as hers in less than a year after graduation. Furthermore, CEC jobs are extremely competitive, and recent graduates are normally hired at entry level positions only. Dr. Sultan is "Electric Generation Systems Program Specialist (EGSPS)" and is one of the very few members serving in the leadership team of Building Standards Branch at CEC (Exhibit 4A Organizational chart).

4.7 Dr. Sultan has risen to the very top of her field.

Dr. Sultan is a uniquely skilled scientist and policy maker with a strong background and demonstrated record of success in her field.

- She has worked on important research projects and has authored highly cited papers in top journals. (Exhibits 4, 6).
- She has been recognized as a leader in the field through her receipt of federal scientific fundings, her original contributions of critical nature, her sustained national and international acclaim, and her invitation to judge the work of others. (Exhibits 4-8).

The submitted evidence proves that Dr. Sultan has clearly risen to the top of her field, and has outperformed her peers. (Exhibits 3-8).

Conclusion

- The totality of the evidence submitted with this brief demonstrates that Dr. Sultan surpases the bar for the classification requested.
- Dr. Sultan is an advanced degree professional with remarkable experience and expertise in the field of integrated energy systems and has risen to the very top of her field in which she continues to work.
- Dr. Sultan's work is valuable because endeavors to develop actionable frameworks for TES systems and their integration into an energy framework. It addresses gaps in TES systems integration and creates a pathway for market transformation and policy implementation which are of critical importance for energy affordability and resilience. Her work therefore has both substantial merit and national importance.
- Dr. Sultan's past work has been highly successful, as it has been implemented and recognized by other researchers, journal editors, professional organizations and businesses, and government agencies.

- Dr. Sultan has also demonstrated a record of successful work on widely recognized projects in which she served in a leading role.
- Because of this record of successful work in an area that furthers U.S. interests, Dr. Sultan offers contributions of such value that, on balance, she would benefit the U.S.
- Dr. Sultan is well positioned to advance the proposed endeavor, and she continues to work to advance her field.

On balance, it would be beneficial for the United States to grant Dr. Sultan an EB1 visa

In summary, Dr. Sultan is an alien of extraordinary ability in integrated energy systems, which has been demonstrated by sustained national and international acclaim. Dr. Sultan's accomplishments are extensively documented. Dr. Sara Sultan has dedicated her career to addressing some of the most pressing challenges in energy science, including optimizing building energy efficiency and reducing energy costs using integrated Thermal Energy Storage (TES). Dr. Sultan's groundbreaking work has positioned her at the forefront of energy research and policy development, addressing storage technologies, which are critical for energy resilience and economy.

Because of the benefits her work confers to the nation, it is requested that this petition be approved.

Respectfully Submitted,

Sara Sultan

Section 5 - Statement Detailing Plans to Continue Work in the United States

My name is Sara Sultan, and I am the petitioner and beneficiary for this I-140 petition. I am submitting this statement to outline my proposed endeavor and how I intend to continue my work in the United States. My proposed endeavor is to research and standardize thermal energy storage (TES) technologies such as configuration and control strategies for integrated heat pumps in order to inform policy development and energy efficiency programs. Through this work, I seek to directly contribute to the country's energy goals, including grid resilience, energy affordability, and building resilience. I hope this letter will serve to illustrate my plans for how I intend to build upon my past work for the benefit of the U.S.

My career is dedicated to advancing energy technologies to enhance energy efficiency, reduce energy costs, and inform U.S. energy policy and standards. I began my research journey at the National University of Science and Technology in Pakistan, where I completed a Master's degree in Energy Systems Engineering. I explored my research interests in thermal energy systems and worked on water desalination. My proposal for purifying water using a humidification-dehumidification technique won a grant by USAID. I was later selected for a competitive exchange at Oregon State University, where I improved the efficiency of a pico-hydropower system and received training in energy policy, research methods, and entrepreneurship. These formative experiences instilled in me a multidisciplinary approach to solving global energy challenges.

Following this, I was awarded a prestigious fellowship through the Oak Ridge National Laboratory (ORNL) to pursue my Ph.D. in Energy Science and Engineering at the University of Tennessee, Knoxville. I conducted my research at the Department of Energy (DOE) designated national user facility, Building Technologies Research and Integration Center (BTRIC) at ORNL— the only user facility dedicated to performing research and development in building technologies to advance affordable, efficient, and resilient buildings. I wanted to design a product that saves energy cost for homeowners and reduces electric demand, should be impactful enough to scale for commercialization and inform policy decisions. I accomplished my goals when I developed a novel thermal energy storage system integrated with heat pumps (HP-TES), configured to act as both a heat source and sink. This system significantly improved energy efficiency while demonstrating the potential for widespread decarbonization of the building sector. Experimentally validated, my HP-TES system achieved up to 87% peak load shifting, 50% carbon emission reduction, and 20% energy cost savings. Importantly, the system was designed to be compact, cost-effective, and scalable, making it suitable for real-world deployment in both residential and commercial applications.

While these results are promising, significant research and development remains to be done. The research is still ongoing and currently lacks standardized performance benchmarks or control protocols for integrated HP-TES systems. My proposed endeavor is to fill this gap by developing a modular and standardized HP-TES system that can serve as a reference model for research, and informs utility programs and policy development. I will improve the

simulation models for salt-hydrate-based TES to optimize energy savings, particularly under extreme weather conditions and varying climate zones. I will also advance grid-interactive control strategies using real-time utility data to further enhance demand response capabilities. The integration of TES with heat pumps presents a powerful pathway for achieving grid flexibility, a critical requirement for balancing energy demand and supply. By shifting energy use to off-peak hours, my research directly supports U.S. Department of Energy goals under the Grid-Interactive Efficient Buildings (GEB) and Energy Earthshots Initiatives, including the Long Duration Storage Shot and Affordable Home Energy Shot.

My research is particularly focused on affordability and accessibility. I am developing solutions that eliminate the need for costly new infrastructure by using existing thermostats to control both the TES and the heat pump. This minimizes installation costs and makes the system viable for income-eligible communities, supporting the U.S. government's Justice40 Initiative to ensure underserved communities benefit from climate investments.
I also plan to commercialize a portable HP-TES unit compatible with multiple heat pump types and suited to various building categories. This innovation will support ongoing state and federal efforts to electrify and decarbonize existing building stocks through incentive and rebate programs. In my role as Senior Advisor at the California Energy Commission, I am already contributing to the development of the 2028 California Building Energy Standards, ensuring that innovations like HP-TES are embedded into forward-looking policy frameworks that often set the precedent for national standards.

In parallel with technical development, I remain committed to academic publishing and dissemination. My journal article is the first to report an indirect configuration and optimized single TES system for dual heating and cooling applications. I will continue publishing in high-impact journals, presenting at key conferences such as ASHRAE and the IEA Heat Pump Conference, and collaborating with U.S. national laboratories and universities to ensure broad knowledge sharing. I am already collaborating with scientists at ORNL and NREL to publish the research that sets a benchmark for TES adoption and holistically reviews TES technology, focusing on cost, grid flexibility, and configurations.

My doctoral training was unique in that it blended technical depth with leadership, science communication, and policy engagement. I was trained to write and advocate for policies, bridge academic research with market-ready solutions, and address systemic barriers to innovation. These skills will allow me to effectively collaborate with utilities, regulatory agencies, and industry partners to accelerate the adoption of clean building technologies.

My proposed endeavor in the United States is to standardize, optimize, and scale the integration of thermal energy storage with heat pumps to meet national goals for affordability, resilience, and energy security. I will pursue this through continued research, policy development, commercialization, and knowledge leadership. My work will contribute directly to U.S. federal priorities for energy innovation, sustainability, and equitable access to affordable technologies.

I am excited to continue this critical work in the United States and look forward to delivering long-term scientific, economic, and societal benefits as part of the nation's energy future.
I hope that this information helps you further understand my proposed endeavor in the United States, and why my future work will be beneficial to the nation. Thank you for taking the time to review this statement and my I-140 petition.

Best,

Dr. Sara Sultan
May 10, 2025

Section 6 – References

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