IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

PGR2023-00039

DECLARATION OF DR. FENGQI YOU

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I, Fengqi You, declare as follows:

1. I have been retained on behalf of Upstream Data Inc. ("Upstream" or "Patent Owner" or "PO") to offer technical opinions relating to U.S. Patent No. 11,574,372 (the "'372 patent"). I understand that the '372 patent is subject to a petition by Crusoe Energy Systems, LLC ("Crusoe" or "Petitioner") requesting the Patent Trial and Appeal Board ("PTAB" or "Board") to institute a post-grant review ("PGR").

2. I have been asked to provide my independent analysis of the '372 patent, Crusoe's PGR petition, the prior art cited therein and the arguments and analysis in the petition and declarations submitted by Crusoe, in particular the declarations by Dr. Michael Nikolaou (EX1003) and Mr. Vernon Kasdorf (EX1004) stating their opinions regarding the validity of the '372 patent. For this declaration I was asked to focus on certain aspects of the petition and declarations, such as the motivation to combine and whether the prior art in the petition was substantially similar to prior art considered during '372 patent prosecution. I also address patentability of the challenged claims under 35 U.S.C. § 101 and the related opinions by Nikolaou and Kasdorf.

3. My opinions in this declaration are made from the perspective of one of ordinary skill in the art at the time of the invention.

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4. I am not and never have been an employee of Upstream. I received no compensation for this declaration beyond my normal hourly compensation for my time actually spent preparing this declaration, including analysis of the petition and materials cited therein. This compensation is not contingent on the nature of my findings or the outcome of this PGR or any other proceeding or litigation related to the ’372 patent.

I. QUALIFICATIONS

5. I am a Professor at Cornell University, where I also hold the Roxanne E. and Michael J. Zak Chair Professorship in the School of Chemical and Biomolecular Engineering. Within Cornell, I also serve as the Chair of Ph.D. Studies in Systems Engineering, Co-Director of the Cornell University AI for Science Institute, Co-Lead of the Schmidt AI in Science Program, and Co-Director of the Cornell Institute for Digital Agriculture. I also have teaching and research appointments in eight other engineering and science departments at Cornell University. These include Computer Science, Electrical and Computer Engineering, Operations Research and Information Engineering, Systems Engineering, Mechanical and Aerospace Engineering, Civil and Environmental Engineering, Applied Information Systems, and Applied Mathematics. I actively mentor over 30 graduate students across the aforementioned science and engineering departments, guiding them in their original research projects and

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assisting with their dissertations. I also routinely supervise 5 post-doctoral scholars, in addition to dozens of undergraduate students.

6. I earned a Bachelor of Engineering degree in Chemical Engineering from Tsinghua University in Beijing, China, in 2005, followed by a PhD in Chemical Engineering with a concentration on Process Systems Engineering and Artificial Intelligence (AI) from Carnegie Mellon University in Pittsburgh, Pennsylvania, in 2009. Before joining Cornell University in 2016, I spent two years in the Mathematics and Computer Science Division at Argonne National Laboratory. I also served for five years at Northwestern University as an Assistant Professor of Chemical and Biological Engineering, and of Industrial Engineering and Management Sciences.

7. In my role as a Professor at Cornell University I teach both undergraduate and graduate courses and give guest lectures every year for the various engineering and science departments listed above. The courses and lectures cover a wide range of topics, ranging from chemical engineering, energy systems, process engineering, artificial intelligence (AI), renewable energy, sustainability, computational modeling, computer science and engineering, process design, industrial manufacturing, chemistry, physics, materials science and processing, biological engineering, life sciences, food and agriculture, climate, automation and

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control, electrical and electronic engineering, quantum computing, infrastructure, transportation, buildings and architecture, among many others.

8. I have authored over 250 refereed articles in high-impact journals such as *Science*, *Nature Sustainability*, *Nature Communications*, *Science Advances*, and *Proceedings of the National Academy of Sciences of the United States of America* (*PNAS)*. I have also published over 160 peer-reviewed conference proceedings, one book and authored nine book chapters on various aspects of science and engineering. Parts of my research have earned editorial highlights in *Science* and *Nature*, features on dozens of journal covers (e.g., *Energy & Environmental Science*, *Environmental Science & Technology*, *ACS Sustainable Chemistry & Engineering*, *AIChE Journal*, *Industrial & Engineering Chemistry Research*), and coverage in leading media outlets (e.g., *New York Times*, *BBC*, *Reuters*, *Washington Post*, *Wall Street Journal*, *Fortune*, *Daily Mail*, *Agence France-Presse*, *Bloomberg*, *Scientific American*, *Newsweek*, *BusinessWeek*, *Hill*, *Guardian*, *New Scientist*, *Popular Science*, and *National Geographic*). I serve as an editor of *Computers & Chemical Engineering*; associate editor of AAAS journal *Science Advances* and *IEEE Transactions on Control Systems Technology*; consulting editor of *AIChE Journal*; subject editor of *Advances in Applied Energy*; guest editor of *Energy*, *Journal of Cleaner Production*, and *Renewable & Sustainable Energy Review*s; and is on the editorial boards of *ACS Sustainable*

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Chemistry & Engineering, *Industrial & Engineering Chemistry Research*, *PRX Energy*, and more. I have delivered over 100 plenary or keynote lectures at leading academic conference domestically and abroad. I was invited by the USPTO's Patent Examiners Technical Training Program (PETTP) to present a lecture on the topic of AI in process industries in the past spring.

9. I serve regularly as a peer reviewer at dozens of major engineering and scientific journals as well as at federal and international funding agencies, including National Science Foundation (NSF), Department of Energy, ACS Petroleum Research Fund, ETH Research Commission, Switzerland, Qatar National Research Fund, Ontario Research Fund, Canada, Ministry of Education and Science, Republic of Kazakhstan, Natural Sciences and Engineering Research Council, Canada, Engineering and Physical Sciences Research Council, UK, United Arab Emirates University Advanced Research Program, UAE, Swiss National Science Foundation, Austrian Science Fund (FWF), Technology Foundation STW, Netherlands, Fondazione Cariplo, Italy, Israeli Ministry of Science, Technology and Space, Netherlands Organisation for Scientific Research (NWO), Chilean National Science and Technology Commission (CONICYT – Chile), São Paulo Research Foundation (FAPESP), Luxembourg National Research Fund (FNR), French National Research Agency (ANR), Czech Science Foundation, Italian Medicines Agency (AIFA), National Research Foundation of

Singapore, National Science Center, Poland, The Science Foundation Ireland (SFI), Ministry of Earth Sciences (MoES) in India, Indian Council of Social Science Research (ICSSR), among others.

10. I have been recognized as an award-winning scholar and teacher, earning over 20 major national and international accolades in the last six years. These come from notable professional organizations and societies, such as the American Institute of Chemical Engineers (AIChE), American Chemical Society (ACS), Royal Society of Chemistry (RSC), American Society for Engineering Education (ASEE), American Automatic Control Council (AACC), in addition to multiple best paper awards. Selected ones include NSF CAREER Award (2016), AIChE Environmental Division Early Career Award (2017), AIChE Research Excellence in Sustainable Engineering Award (2017), Computing and Systems Technology (CAST) Outstanding Young Researcher Award from AIChE (2018), Cornell Engineering Research Excellence Award (2018), ACS Sustainable Chemistry & Engineering Lectureship Award (2018), AIChE Excellence in Process Development Research Award (2019), AIChE Innovations in Green Process Engineering Award (2020), Mr. & Mrs. Richard F. Tucker Excellence in Teaching Award (2020), ASEE Curtis W. McGraw Research Award (2020), O. Hugo Schuck Award from AACC (2020), AIChE Sustainable Engineering Forum Education Award (2021), AIChE George Lappin Award (2022), and Stratis V. Sotirchos

Lectureship Award by Foundation for Research & Technology – Hellas (FORTH) (2022). Furthermore, I am an elected Fellow of the Royal Society of Chemistry (FRSC), Fellow of the American Institute of Chemical Engineers (AIChE), and Fellow of the American Association for the Advancement of Science (AAAS).

11. My research interests and broad research experience span multiple disciplines across engineering, chemistry, physical sciences, and life sciences. For instance, I have authored over 50 peer-reviewed publications in the realm of fuel and natural gas processing in the last decade. My work encompasses a range of topics, including modular chemical manufacturing for natural gas and energy systems for blockchain mining. My research in energy systems for blockchain mining has been published in high-impacts journals, including *Proceedings of the National Academy of Sciences* (*PNAS*) [Lal and You, 2023], *Energy & Environmental Science* [Niaz, Shams, Liu, and You, 2022], *ACS Sustainable Chemistry & Engineering* [Lal, Zhu, and You, 2023], and *Journal of Cleaner Production* [Niaz, Liu, and You, 2022]. The papers in *Energy & Environmental Science* and *ACS Sustainable Chemistry & Engineering* have been featured on the covers of these high-impact journals. The PNAS paper was reported by leading media outlets, including *Fortune*, *ScienceDaily*, and *Tech Xplore*.

12. My curriculum vitae, which includes a complete list of my publications, is included as Appendix A. I am being compensated at a rate of $700

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per hour for my work in this case. This compensation is not contingent on the nature of my findings or the outcome of this litigation.

13. I am over the age of 18 and am competent to write this declaration. I have personal knowledge, or have developed knowledge, of the technologies discussed in this declaration based upon my education, training, or experience with the matters discussed herein.

II. SUMMARY OF OPINIONS

14. With regard to the five grounds asserting obviousness:

- **Ground 1:** Challenged claims (1-4, 8, 16-30, and 34) are not obvious over Dickerson and CryptoKube in view of Szhmigielski and Kheterpal at least because a person of ordinary skill in the art (or "POSITA") would not have motivation to combine said references and would not expect a reasonable expectation of success.
- **Ground 2:** Challenged claims (1-4, 8, 10-12, 15-30, 34-37, and 40) are not obvious over Dickerson, CryptoKube, and Belady-989 in view of Szhmigielski and Kheterpal at least because a POSITA would not have motivation to combine said references and would not expect a reasonable expectation of success.
- **Ground 3:** Challenged claims (1-4, 7-12, 15-30, 34-37, and 40) are not obvious over Dickerson, CryptoKube, Belady-989, and Boot in

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view of Szmigielski and Kheterpal at least because a POSITA would not have motivation to combine said references and would not expect a reasonable expectation of success.

- **Ground 4:** Challenged claims (1-4, 8, 16-30, and 34) are not obvious over MAGS system and the Polivka miner at least because a POSITA would not have motivation to combine said references and would not expect a reasonable expectation of success.
- **Ground 5:** Challenged claims (1-4, 8, 10-12, 15-30, 34-37, and 40) are not obvious over MAGS system, the Polivka miner, and Belady-989 at least because a POSITA would not have motivation to combine said references and would not expect a reasonable expectation of success.

III. PERSON OF ORDINARY SKILL IN THE ART

15. I have reviewed Petitioner's proposal for a POSITA definition and I disagree to the extent it implies that a POSITA did not need to have experience in oil and gas industry, including with wellsite power generation, *and* experience with crypto mining. The '372 patent advanced the state of the art by combining these two previously separate fields. While this combination of casinghead gas power generation and crypto mining was beyond the ordinary skill at the time, a POSITA would have needed at least a reasonable grounding in both technologies.

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16. For purposes of forming my opinions expressed in this declaration I assumed the definition proposed by Petitioner. My opinions and conclusions in this declaration would not change if a POSITA had some experience in both technologies.

IV. LEGAL PRINCIPLES

17. I have been advised of the following legal standards and principles which I have applied in forming my opinions.

1. Claim Construction

18. Patent claim terms are construed by referring to intrinsic evidence, which includes the claim language, the patent specification, and the prosecution history and extrinsic evidence. The words of patent claims are to be given their ordinary or customary meaning (also referred to as plain and ordinary meaning) unless the inventor has defined them (acted as their own lexicographer) or used them differently (i.e., in a manner inconsistent with the ordinary and customary meaning). The prosecution history of a patent, and related patents and applications, may limit the interpretation of the claim, especially if the patentee disavowed or disclaimed any claim scope in order to obtain allowance of the claim.

2. Obviousness

19. I understand that a patent claim is rendered obvious if the claimed invention would have been obvious to a person of ordinary skill in the art as of the

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date of invention. A determination of obviousness is made after weighing the following factors: (1) level of ordinary skill in the pertinent art; (2) the scope and content of the prior art; (3) the differences between the prior art as a whole and the claim at issue; and (4) as appropriate, secondary considerations of non-obviousness.

20. In evaluating obviousness, both the prior art and claimed invention should be viewed through the knowledge and understanding of a person of ordinary skill in the art at the time of the invention – one should not use his or her own insight or hindsight in deciding whether a claim is obvious. A claim may be rendered obvious if a person of ordinary skill in the art would understand the claimed invention as a predictable variation of a prior art reference. I further understand that an obviousness evaluation can be made on a single reference or a combination of several prior art references. I understand that where the claim is an obvious variant of a prior art product or system, any modification of the prior art product or system must be supported by a suggestion, motivation, or reason to make the modification. I further understand that obviousness analysis recognizes that market demand often drives innovation, and that a motivation to modify a product or system may be supplied by the direction of the marketplace.

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21. On the other hand, I further understand that a claim may not be obvious if a person of ordinary skill would not be motivated to combine or modify the prior art, or would not have a reasonable expectation of success in doing so.

22. A particular modification of a prior art system or product may be made by showing that it was obvious to try the modification. For example, common sense is a good reason for a person of ordinary skill to pursue known options when there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions. I understand that obviousness analysis may take into account the inferences and creative steps that a person of ordinary skill in the art would employ under the circumstances. I understand that the combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results. When a work is available in one field of endeavor, design incentives and other market forces can prompt variations of it. If a person of ordinary skill in the art can implement a predictable variation, then the patent claim may be obvious.

23. I understand that at least the following rationales may support a finding of obviousness: (1) combining prior art elements according to known methods to yield predictable results; (2) simple substitution of one known element for another to obtain predictable results; (3) use of a known technique to improve similar devices (methods, or products) in the same way; (4) applying a known

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technique to a known device (method, or product) ready for improvement to yield predictable results; (5) "obvious to try"—choosing from a finite number of identified, predictable solutions, with a reasonable expectation of success; (6) a predictable variation of work in the same or a different field of endeavor if a person of ordinary skill would be able to implement the variation; (7) there existed a known problem for which there was an obvious solution encompassed by the patent's claims at the time of the claimed invention; (8) known work in one field may prompt variations of it for use in either the same field or a different one based on design incentives or other market forces if the variations would have been predictable to one of ordinary skill in the art; and (9) some teaching, suggestion, or motivation in the prior art that would have led one of ordinary skill to modify the prior art reference or to combine prior art reference teachings to arrive at the claimed invention.

24. I have been informed that one or more so-called "secondary considerations of non-obviousness" may impact the obviousness analysis if they are present. I have been informed that secondary considerations may include: (1) whether the invention proceeded in a direction contrary to accepted wisdom in the field; (2) whether there was a long felt but unresolved need in the art that was satisfied by the invention; (3) whether others had tried but failed to make the invention; (4) whether others copied the invention; (5) whether the invention

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achieved unexpected results; (6) whether the invention was praised by others; (7) whether others have taken licenses to use the invention; (8) whether experts or those skilled in the art at the making of the invention expressed surprise or disbelief regarding the invention; and (9) whether products incorporating the invention have achieved commercial success that is attributable to the invention.

25. I also understand that another indication of obviousness may be that others having ordinary skill in the field independently made the claimed invention at about the same time the inventor made the invention.

26. I also understand that for any such secondary consideration to be relevant, there must be a connection or "nexus" between the secondary consideration and the claimed invention. For example, commercial success of a product is relevant to obviousness only if the success of the product is attributable to the patented features of the claimed invention. If, on the other hand, commercial success is due to features of the product not claimed in the patent, due to claimed features that existed in the prior art, and/or due to advertising, promotion, salesmanship or the like, then any commercial success should not be considered an indication of non-obviousness.

3. Section 101

27. I understand that a two-step framework is used to determine whether patent claims are directed towards patent-eligible subject matter. First, a

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determination must be made as to whether the claims are directed towards one of the three patent-ineligible subjects: laws of nature, natural phenomena, and abstract ideas. If the claims do not fall within one of these three patent-ineligible subjects, I understand that the claims satisfy 35 U.S.C. § 101 and there is no need to proceed to the second step. However, if the claims are determined to be directed towards one of these patent-ineligible subjects, then the analysis must proceed to step two. I further understand that the examination of whether a claim is directed to an abstract idea may also weigh whether the claim recites the practical application of the subject matter of the claim.

28. At step two, I am informed that the inquiry is whether an inventive concept such as an element or combination of elements is recited that is sufficient to ensure that the patent in practice amounts to significantly more than a patent upon the abstract idea itself. At step two, I understand it is also necessary to consider whether the claim elements or the claimed combination are well-understood, routine, conventional.

V. OVERVIEW OF '372 PATENT

29. The following is a brief summary of the '372 patent based on my review. The '372 patent claims priority to provisional application 62/456,380, filed on February 8, 2017. *See* EX1001. The patent is "related to blockchain mining at an oil or gas facility." EX1001, 1:6-7. The '372 patent explains that "[i]n upstream

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production of oil and gas, natural gas may be produced … as a by-product of oil production, for example from an oil well." EX1001, 6:51-54. This form of natural gas is referred to as undesirable casinghead gas, casing gas or simply raw gas. EX1001, 4:62-63, 8:66-9:3.

30. The prior art knew some ways to utilize casinghead gas. For example, it was known to consume it as "on-site fuel or for instrumentation pressure." EX1001, 6:56-58. If there was a significant gas volume beyond what could be consumed onsite, gas could be sold to market through a connection to a pipeline network, compression, or liquefaction to transportable LNG. EX1001, 6:59-64. If a grid connection was available, casinghead gas could be used to generate electricity for sale to the power grid. EX1001, 6:63-67.

31. However, gas "may be located at a remote oil and gas site" that lacks "accessible infrastructure such as an external pipeline network (sales line) or external power grid to sell into" and may be "hundreds of kilometers outside of the nearest town." EX1001, 7:46-49, 8:20-23. In such cases "it may not be economically feasible … to take the gas, or resultant electricity … to market, for example due to significant capital expense required or when the volume of gas is insufficient to pay out the investment." EX1001, 7:49-54, 8:11-23. As is known in the art, the gas is "stranded." EX1001, 7:54-56.

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32. In such cases, a common solution is to vent or flare (burn) the stranded gas. EX1001, 1:11-13, 7:61-8:10. However, this prior art solution is undesirable because it creates greenhouse gas emissions, wastes the potential energy of the gas, requires capital expenditure, and may pose health risks. *Id.*

33. The novel solution taught by the ’372 patent is to use stranded gas to power a portable blockchain mining device instead of flaring the gas. EX1001, 2:18-24.

34. As discussed in the ’372 patent, “[a] blockchain is a form of database, which may be saved as a distributed ledger in a network of nodes that maintains a continuously-growing list of records called blocks.” EX1001, 11:45-47. “The administration of BITCOIN currency is currently the primary use for blockchain technology.” EX1001, 11:57-60. “Maintaining a blockchain database is referred to as mining, which refers to the distributed computational review process performed on each block of data in a block-chain.” EX1001, 13:5-7. “Those involved in BITCOIN mining are rewarded for their effort with newly created BITCOINs and transaction fees.” EX1001, 13:9-13.

35. Blockchain mining (also referred to as crypto mining) differs from many other types of computing in that it is “intentionally designed to be resource-intensive and difficult so that the number of blocks found each day by miners remains steady.” EX1001, 13:29-33, 13:44-48. This is unlike most other

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computational loads (such as those running in a conventional data center) which are typically designed to be as efficient and computationally economical as possible. This intentionally energy-intensive problem comprises "a cryptographic hashing algorithm." EX1001, 13:49-52.

36. Since the energy cost of crypto mining is the primary operating cost, the prior art mines were located primarily in places with low-cost hydroelectric power such as China or the Pacific Northwest in the United States. EX1001, 14:4-20; EX1009, 105.

37. Decentralizing crypto mining away from hydroelectric power to make use of stranded gas at remote oil and gas production facilities required innovative thinking and solutions disclosed in the '372 patent. For example, unlike existing crypto mines which could depend on reliable power sources (e.g., a hydroelectric power plant connected to the grid), the '372 patent's bitcoin mine had to solve the problem of variable casinghead gas production. The '372 patent discloses solving this problem by, for example, the mining controller modulating the mining power load (also referred to as the hashrate) in real time to respond "to variations in a supply or production rate of natural gas." EX1001, 17:61-18:15. In addition, crypto mining power levels may be adjusted to a daily minimum or maximum gas production rate as different strategies to mitigate the variable production. EX1001, 18:34-19:13.

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VI. CLAIM CONSTRUCTION

38. I have considered Petitioner's proposals for construction of certain claim terms from the perspective of one of ordinary skill at the time of the invention, taking into account the '372 patent's teachings, the prosecution file history, and the knowledge of a POSITA. For the following reasons, I disagree with the Petitioner's proposals regarding the meaning of the claim terms addressed below.

4. "Blockchain Mining Devices" and "Mining Processor"

39. In my opinion, the intrinsic evidence of the '372 patent (that is, the '372 patent specification, including claims, and the prosecution file history) does not support Petitioner's constructions. First, Petitioner nearly equates the meaning of a "blockchain mining devices" with a "mining processor." Pet. 4-6. However, the specification makes clear (including with reference to Figure 4) that the "mining device 12" is made of up of many components, such as a power meter 72, a step-down transformer 80, "a controller 86, network equipment 88 such as a modem and a network switch, … *and one or more mining processors 92* such as processors 92A-E." EX1001, 16:32-39 (emphasis added); *see also* 17:23-29. With respect to the mining processors 92, the '372 patent details that "[e]ach mining processor 92 may have a variety of configurations, but generally may include at least a power supply, a controller board and mining circuity, such an ASIC circuit.

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Various mining circuitry examples include CPU (central processing unit), GPU (graphics processing unit), FPGA (Field-Programmable Gate Array), and ASIC (application specific integrated circuit). The components of an ASIC mining processor include the hash boards (each board has numerous chips that is doing the hashing), a controller (to communicate with the network and optimize the mining processors chip frequency and fans for colling), and a power supply (typically converts AC input power to DC power for the ASIC)." EX1001, 17:9-21. A person of ordinary skill in the art, therefore, would understand that a mining processor is "a processor with blockchain mining circuitry."

40. Second, Petitioner primarily relies on disclosure pertaining to a "network of nodes" to reach its conclusion regarding the terms "blockchain mining devices" and "mining processor." Petitioner, however, appears to confuse the existence of nodes within a network of nodes that "maintain … records" with mining processors that include "circuitry for mining blockchain blocks." For example, while the nodes are described as "stor[ing] a copy of the global ledger" within the blockchain database (EX1001, 14:22-43), the '372 patent specification describes the mining processor as providing the "require[d] computational effort" measured by the "hashrate" (EX1001, 13:49-58). As the specification makes plain, a simple node may be "desktop computers, laptop computers, tablet computers, cellular telephones, servers, or other suitable devices" used for storing already

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computed blocks within a blockchain. EX1001, 14:30-33. But, the "[m]ining circuitry 130, for example integrated circuit chip, may be used to perform data mining operations, for example verifying cryptocurrency transactions." EX1001, 14:57-63; *see also* 17:9-21.

41. Accordingly, a node that simply stores a copy or partial copy of the blockchain database may or *may not* have a mining processor. The teaching of the specification is consistent with the language of the independent claims of the '372 patent that describe "blockchain mining devices" as "each hav[ing] a mining processor" and a "connection to a network interface." EX1001, claims 1 and 24. Because the claim language itself informs a person of ordinary skill as to the meaning of the "blockchain mining devices," in my opinion no construction of that term is necessary.

42. Finally, Petitioner offers no support for its proposal to attach the negative limitation "without regard to processor speed or power" to either identified claim term. There is no claim language in the '372 patent, no specification support within the '372 patent, and no reason to be gleaned from the prosecution history to graft the notion of "any processor … without regard to processor speed or power" into the claims. To the contrary, the specification repeatedly teaches that the "computation effort" is important, so much so that the '372 patent teaches optimizing the hashrate by, for example, "changing … the

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clock rate of the processor." *See* EX1001, 13:49-54. For these reasons, a POSITA would find no support in the intrinsic record for a requirement that the blockchain mining devices" or "mining processor" exist "without regard to processor speed or power."

5. "Continuous Flow of Combustible Gas"

43. In my opinion, Petitioner's construction of "continuous flow of combustible gas" similarly divorces the claim term from the surrounding claim language, the specification's description of the source of combustible gas, and ignores the prosecution history. Petitioner's proposal renders superfluous the word "continuous" in the claim because it suggests that any "time period" where "a flow" is present, no matter how small the time period may be, is "continuous." For example, under a literal reading of Petitioner's proposal, a flow of combustible gas that occurred for a few minutes and then disappeared would meet the limits of "a flow of combustible gas that is continuous for at least a time period." Thus, Petitioner's proposal is inconsistent with the plain meaning of the claim language requiring a *continuous* flow.

44. The '372 patent specification confirms that the "continuous" character of the natural gas in the '372 patent derives from the fact the natural gas is a by-product of hydrocarbon (oil) production, storage, or processing, and cannot be avoided during production. EX1001, 6:35-39 ("Natural gas may naturally separate

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from the oil stream as it is produced up the well …"), 6:48-51 (Natural gas may also be liberated out of solution from the oil as it is treated …"). In remote areas, where an oil field operator is confronted with this continuous source of natural gas, "the operator is forced to do something with the excess or stranded gas and is left with few options" such as "venting … flar[ing], … or ceasing production…." EX1001, 7:54-60. The natural gas that is the focus of the '372 patent is "[c]asing gas, also known as casinghead gas, [that] is produced as a byproduct from a producing oil well …." EX1001, 8:66-9:1; 9:63-66. The recitation of a "continuous flow of combustible gas" reflects that the combustible gas is a continuous (albeit at varying production rates) byproduct of "hydrocarbon production, storage, or processing." This is consistent with the ordinary meaning of a "continuous flow of combustible gas" that would be applied by a person of ordinary skill in the field.

45. Petitioner identifies a portion of the '372 patent specification describing an aspect of the invention that uses a controller to modulate the blockchain mine load in relationship to a varying gas supply. EX1001, 17:47-60. The portion of the specification identified by Petitioner teaches the advantageous use of controller settings to deliver a stable and consistent load from the mining processors throughout the day, even during periods of time where the production rate of combustible gas exceeds the minimum production rate. EX1001, 18:16-27.

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Contrary to Petitioner's proposed construction, the implementation of these controller settings does not disclose a supply of combustible gas present for merely "a time period," but instead describes a varying production rate between a minimum and maximum production rate.

46. Finally, Petitioner and its declarant opine that "the gas supply from any given oil field is limited, and will eventually dry up" to support the proposal that requires a supply of combustible gas during "any time period." This opinion does not find support in the specification and is not pertinent to the problem of casinghead gas that is a byproduct of oil production described in the '372 patent. That a well may at some point stop producing hydrocarbons does not justify the "any time period" language because the '372 patent is directed to a problem that exists while casinghead gas is produced. Thus, a person of ordinary skill in the art would not accept Petitioner's proposed construction for the "continuous flow of combustible gas."

VII. GROUND 1

6. Motivation To Combine

47. I have reviewed the Petition's description of the motivation to combine the references in this ground and the corresponding portions of the Nikolaou and Kasdorf declarations. I note that the Nikolaou and Kasdorf declarations are virtually identical for this and the other grounds and closely track

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the Petition. Accordingly, for ease of reference I will cite to the Petition unless I am specifically addressing the declarations. For the following reasons it is my opinion that Petitioner and Messrs. Nikolaou and Kasdorf have not shown a motivation to combine or a reasonable expectation of success which I understand it is their burden to demonstrate.

48. Petitioner asserts that the claimed invention had "been done before," (Petition, 1), but Ground 1 relies on *four* references even for the independent claims. Petitioner ignores the pioneering nature of the '372 invention which materially advanced the knowledge in the art and appears to be reconstructing the '372 patent claims using references that a POSITA would not have combined. Tellingly, the two primary references – Dickerson and the so-called "CryptoKube system" – are from what a POSITA would have considered as disparate and unrelated fields of art before the invention of the '372 patent:

- Dickerson relates to a "mobile apparatus… for processing and using raw natural gas that is normally flared at the site of oil and gas field operation facilities" comprising "a membrane separation unit for separating useful fuel gas from raw natural gas" and a "gas engine that uses the fuel gas to generate electricity that is returned to the facility." EX1005, ¶¶2,6. Dickerson never mentions datacenters or cryptocurrency mining, nor does it teach any use of its apparatus to mine cryptocurrency. This is not

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unexpected because power generation at remote oil and gas facilities was known in the art as useful to power oil and gas mining equipment, not crypto mining equipment.

- The CryptoKube system purportedly discloses "a commercialized industrial Bitcoin mining system." EX1004, ¶63. The CryptoKube Brochure discloses that "CryptoKube can run inside a large warehouse, outside in a parking lot or in a server pod farm where the power is cheapest." EX1006, 4. Yet there is no indication in the CryptoKube references of *any* actual or even hypothetical use of CryptoKube with a generator at an oil or gas production facility which "are typically located in remote areas where no utility power is available" as explained by Dickerson. EX1005, ¶24. Nor does Mr. Kasdorf – identified as "the owner and partner in KubeData Systems Inc." – provide even a single instance of CryptoKube powered by flare gas at a remote oil or gas production facility.

49. Given this lack of any connection between Dickerson and CryptoKube, unsurprisingly the two primary references in this Ground do not in themselves offer a motivation to combine and I do not understand Petitioner to argue that they do. Instead, Petitioner uses a third reference – the Szhmigielski book on cryptocurrency mining – for the purported motivation to combine. *See*

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EX1009; Petition, 19-20. This use of yet another reference to supply the missing motivation to combine underscores that before the ’372 invention a POSITA would not have considered generators utilizing flared gas at remote oil and gas facilities as suitable to power a cryptocurrency miner like CryptoKube. Rather, before the ’372 invention, a POSITA considered crypto mining and power generation from flare gas at remote oil production facilities as two disparate and unrelated fields.

50. Petitioner relies on Szhmigielski’s statement that “[o]ne of the biggest costs for Bitcoin miners is the cost of electricity” as the motivation to combine Dickerson and CryptoKube. Petition, 20; EX1009, 105. Szhmigielski describes his book as “show[ing] you how to mine for yourself” and “explain[ing] step by step what is necessary and how to do it.” EX1009, 12. Yet this 2016 how-to cryptocurrency mining volume that post-dates both primary references never identifies remote oil and gas facilities as a suitable location or power source; rather, it identifies other electricity sources such as “inexpensive hydroelectric power.” EX1009, 105. This focus on locating crypto mining around sources of inexpensive hydroelectric power is discussed in the ’372 patent specification as resulting in undesirable concentration of bitcoin mining in certain locations such as China. EX1001, 14:4-20. The ’372 patent taught a solution to this undesirable concentration by moving crypto mining operations away from reliance on hydroelectric power. *Id.*

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51. Petitioner asserts that, based on the statement in Szhmigielski, a "POSITA would have been motivated to couple a device capable of digital currency mining to Dickerson's system to utilize the free excess electricity." Petition, 20. I disagree that a POSITA would be motivated, given the disparate fields of the primary references and the lack of any teaching regarding the suitability of generators at remote oil and gas production sites (Dickerson) to power cryptocurrency miners like CryptoKube.

52. I also disagree with the Petition's assertion that, because "the Dickerson system and CryptoKube are containerized," "it is easy to combine the two." Petition, 20. This statement is without support in the actual references (which do not disclose any such combination) and untethered from the knowledge of a POSITA at the time of the invention. As I've explained, before the '372 invention a POSITA would not have considered generators utilizing flared gas at remote oil and gas facilities as suitable to power a cryptocurrency miner like CryptoKube. Rather, before the '372 invention, a POSITA considered crypto mining and power generation from flare gas at remote oil production facilities as two disparate and unrelated fields.

53. Petitioner asserts that "CryptoKube discloses a mobile Bitcoin miner that can be easily transported to a remote oil and gas production facility." Petition, 20. However, as I've noted, the CryptoKube documents never mention oil and gas

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facilities. Moreover, as discussed in greater detail below, Petitioner has not shown that a POSITA would have considered CryptoKube suitable for the harsh environment of a remote oil and gas production facility.

54. Likewise, Petitioner asserts that Dickerson's generator provides "free excess electricity" to power CryptoKube, thereby somehow motivating the combination. Petition, 20. However, as I will explain, a POSITA would understand based on Dickerson's disclosure that any such "excess power" may be highly variable leading a POSITA to not consider Dickerson's system as a suitable power source for CryptoKube.

55. In this regard, Szhmigielski teaches that, in addition to being inexpensive, electrical power for crypto mining must be "*reliable*" to power "the hardware and the associated cooling systems." EX1009, 105. Dickerson, on the other hand, teaches that its electrical power is *unreliable* because the system is located "in remote areas" where "no utility power is available." EX1005, ¶24. The main purpose of the Dickerson generator is "to generate electricity that is returned to the facility" rather than powering a power-hungry external load like a crypto miner. EX1005, ¶6. Moreover, the amount of gas available to power Dickerson's generator varies such that only "in some cases the amount of electrical power required… may be small compared to the amount of power that can be produced with the gas available." EX1005, 39. Even in these cases, Dickerson teaches

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sending any excess power to the grid if it is connected. *Id.* In fact, Dickerson teaches that "raw natural gas flow will be interrupted" and "there will likely be periods when the production facility will require electricity but will be generating no or low levels of raw natural gas" to run its generator, underscoring the *unreliability* of its power to run the production facility, let alone to supply "excess power" to CryptoKube. EX1005, ¶21.

56. Dickerson further teaches using a diesel generator as a backup source to mitigate unreliability. EX1005, ¶21. However, even if a diesel generator or a grid connection was available for backup, this would not comprise free or cheap "excess" electric power derived from waste gas that could motivate a POSITA to combine a crypto miner with Dickerson. In this regard, a POSITA would understand that when running on backup power the Dickerson system would be supplying electricity to the oil and gas facility (Dickerson's primary purpose) and there would not be "excess" or "free" electricity to feed a power-hungry cryptocurrency miner. To the contrary, the need for Dickerson to rely on expensive diesel or grid power for backup further demonstrated to a POSITA that Dickerson could not *reliably* supply free or cheap power for crypto mining.

57. Before the '372 invention, a POSITA would have considered the variable and occasional excess power generation in Dickerson to be *unreliable* and therefore unsuitable for a bitcoin miner such as CryptoKube under the guidelines

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established by publications such as Szhmigielski. EX1009, 105. The ’372 patent contemplates that at least a primary purpose of its generator is to supply electricity for crypto mining, whereas Dickerson’s primary load is the wellsite equipment, meaning that “excess” electricity may be occasional at best. Moreover, the ’372 patent teaches addressing the variability of available gas by, for example, a controller regulating the crypto mining power load relative to wellhead gas production. *See e.g.*, EX1001, 17:61-64, 18:16-19:13. On the other hand, neither Dickerson nor CryptoKube indicate that the known unreliability of power supply at a remote well could be resolved by a POSITA in the proposed combination without undue experimentation. Therefore, contrary to Petitioner’s allegations, a POSITA would not have considered it “easy” to combine Dickerson and CryptoKube even assuming, *arguendo*, that a POSITA considered the combination of these disparate references at all.

58. The unreliability of Dickerson’s power was especially important to a POSITA because crypto mining operations are highly computationally and energy-intensive by design, as explained in the ’372 patent and known in the art. EX1001, 13:29-36, 13:49-58. This is unlike typical data center computing which is commonly optimized to consume the least possible computational resources. In this regard, to the extent Petitioner equates data centers and crypto miners based on Szhmigielski, it is in error because it ignores Szhmigielski’s express inclusion of

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power *reliability* as necessary for successful crypto mining. The energy-intensive nature of crypto mining imposes additional demands on the reliability of electrical power and requires special adaptations to computing architecture (e.g., regulating the hashrate relative to wellhead gas production as taught by the '372 patent) that are unique to crypto miners.

59. Accordingly, a POSITA would understand that Szhmigielski teaches away from the combination of Dickerson and CryptoKube because it sets forth the requirement that electrical power for crypto mining must be reliable, unlike Dickerson's variable and even occasional "excess" electrical output.

60. I also have considered whether a POSITA would have a reasonable expectation of success in making the proposed combination of references. Aside from the allegation that it was "easy" to combine Dickerson and CryptoKube, the Petition does not appear to address the reasonable expectation of success prong of obviousness analysis. As already established, a POSITA understood that the highly variable nature of "excess" electric power delivered by Dickerson's generator was unsuitable for crypto mining equipment such as CryptoKube. (Not only are crypto miners power-hungry, but bitcoin mining rewards miners who compute a solution to the cryptological problem before others which also requires reliable power.) Given the lack of any provision in CryptoKube to adjust for the variability of available wellhead gas, and more specifically for the variability of Dickerson's

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"excess" electricity (which also depended on the power draw of on-site oil and gas equipment), a POSITA did not have a reasonable expectation of success in combining it with Dickerson's system.

61. In addition, it was known that remote oil and gas production facilities such as the North Dakota Bakken formation cited in Dickerson were often subject to extreme heat, dust, humidity and cold. EX1005, ¶3. The '372 patent teaches mitigating these harsh operating conditions with chillers, backup heaters, filters and/or dehumidifiers that can be installed in its crypto mining enclosure as needed. EX1001, 2:35-43, 15:66-16:3. There is no evidence that CryptoKube was or could be equipped with any such additional equipment. *See* EX1006, 1-4.

62. To the contrary, while CryptoKube is alleged to be operable in the -10C to 30C temperature range, the recitation of large warehouses, parking lots and server farms as possible locations suggests it was designed for a much less challenging operating environment than a remote oil facility. EX1006, 2, 4. (This is unsurprising because it was not known to locate crypto miners like CryptoKube at oil and gas facilities.) In fact, CryptoKube touted its sole reliance on air cooling, but this eliminated equipment such as chillers and cooling systems that may be necessary for operation in the harsh environment of Dickerson's generator: "The selection of fresh air cooling means that there are no condensers, chillers or power hungry cooling systems." EX1006, 4. These disclosures in CryptoKube are

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additional indications that it was not intended for remote oil and gas production fields. This was yet another reason for a POSITA to reject the proposed combination with Dickerson as lacking a reasonable expectation of success.

63. Finally, Petitioner's assertion that it was "easy" to combine Dickerson and CryptoKube by connecting them or placing them in a single container (Petition, 20) at best amounts to an argument that a POSITA *could have* made the combination. However, as I've discussed, a POSITA was not motivated to transport CryptoKube to a remote oil facility where it could be connected to Dickerson's generator at least because the generator's excess electrical output was unreliable or unavailable. A POSITA was not motivated to combine Dickerson's generator and CryptoKube in the same enclosure for the same reason. Moreover, each of Dickerson's generator and CryptoKube is itself a container, and combining the two would result in a large enclosure that may not be easily transportable. EX1005, ¶11; EX1006, 1, 4. This would defeat the desired ease of deployment for both CryptoKube (EX1006, 1-2) and Dickerson, both of which are containerized for transportation. EX1005, ¶14.

64. In my opinion, statements made by Petitioner in its own patent that post-dates the '372 patent but is directed to substantially the same subject matter further illustrate the non-obviousness of the challenged claims. In August, 2018, approximately a year and a half after the priority date of the '372 patent, Petitioner

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filed provisional U.S. patent application No. 62/713,368 which issued as U.S. Pat. No. 10,862,307, assigned to Petitioner. Like the challenged ’372 patent, the ’307 patent was directed to a “natural gas processing system [which] may process raw natural gas into a fuel gas stream that may be used to power any number of on-site power generation modules” including “mobile data centers… adapted to mine cryptocurrency.” [EX2002, US Pat. No. 10,862,307, Abstract.] During prosecution Petitioner’s patent claims were rejected over U.S. Pat. Pub. 2020/0051184 to Barbour which corresponds to the ’372 patent. [EX2003, Excerpt of Prosecution History of ’307 patent, Office Action of 05-07-2020.]

65. The ’307 specification’s Background section described the state of the art and asserted that “there remains a need for systems and methods for generating electricity from natural gas produced from oil wells,” and that “[i]t would be beneficial if such electricity could be produced and consumed on-site, for example by using it to operate power-intensive, modular processing units… employed to mine cryptocurrency.” [EX2002, 2:35-42.] The ’307 summary section described as novel “convert[ing] raw natural gas into a fuel gas stream to power any number of on-site power generation modules” which in turn power “distributed computing units” that “may be adapted to mine cryptocurrency.” *Id.*, 2:45-55.

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66. Thus, a year and a half after the priority date of the ’372 patent Petitioner in its own patent application asserted that there was still no solution for combining remote well site gas generators with crypto mining equipment.

67. The fact that Petitioner itself as late as mid-2018 considered powering a data center with electricity generated from oil well gas to be novel demonstrates that this was not obvious to a POSITA in early 2017. Moreover, the ’372 patent further illustrates that a POSITA did not consider remote oil well facilities to be in the same field of art as crypto mining or data centers more generally.

68. Put another way, as I have explained, oil wells and crypto currency mining did not (yet) mix at the time of the invention. The remote location, harsh environment, and lack of reliable power at oil and gas facilities were known impediments that prevented a POSITA from considering the combinations proposed in the Petition. The energy intensive nature of crypto mining (and the dependence of financial reward on prompt computation) makes it especially sensitive to energy reliability which was known to be lacking in prior art remote oil field waste gas generation facilities such as Dickerson, MAGS (grounds 4 and 5) or Belady-989 (grounds 2, 3 and 5).

69. In my opinion the disparate nature of oil and gas production and crypto mining before the ’372 invention is further illustrated by Petitioner’s two declarants: Dr. Michael Nikolaou and Mr. Vernon Kasdorf. EX1003, EX1004. Dr.

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Nikolaou professes relevant experience in "oil & gas industry and oil refining & petrochemicals," among others. EX1003, ¶8. However, Dr. Nikolaou does not identify any experience with crypto currency mining. In fact, he states that "Crusoe has specifically asked for my analysis from the perspective of a POSITA in the gas and oil industry. To the extent this declaration provides opinions on subject matter related to bitcoin mining, I am relying on the opinions of Mr. Vernon Kasdorf." EX1003, ¶2.

70. Conversely, Mr. Kasdorf states that "Crusoe has specifically asked for my analysis from the perspective of a POSITA in the bitcoin mining industry. To the extent this declaration provides opinions on subject matter related to the gas and oil industry, I am relying on the opinions of Dr. Michael Nikolaou." EX1004, ¶2.

71. This division of labor and opinions between two experts further shows that, even today, oil and gas and crypto currency mining are largely distinct arts, with subject matter experts in both disciplines few and far between. As I've explained, this was even more true at the time of the '372 invention.

72. Thus, it appears that the two declarants provide opinions from the "perspective" of two *different* POSITAs – one in the oil and gas industry and the other in the bitcoin mining industry. Yet, they "rely" on each other to pronounce in virtually identical opinions that some presumably hybrid POSITA would have

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found the proposed combinations obvious. EX1003, ¶¶91-99; EX1004, ¶¶89-97. However, there is no evidence that such a POSITA existed even under Petitioner's overbroad definition, let alone that this hybrid POSITA would have been motivated to combine the references at issue before the invention of the '372 patent.

VIII. GROUND 2

1. Motivation to Combine and Reasonable Expectation of Success

73. My review of Ground 2 shows that it combines the primary references of Ground 1 (Dickerson and CryptoKube) with Belady-989. Petition, 99-100. Petitioner does not offer any additional rationales for combining Dickerson and CryptoKube beyond those discussed above for Ground 1. Accordingly, as I already explained for that ground, in my opinion a POSITA did not have a motivation to combine or reasonable expectation of success for those two references.

74. In Ground 2, Petitioner alleges that it was obvious to combine Belady-989's so-called gas shock absorber with the "Dickerson's mobile power generation system" and the "CryptoKube's mobile Bitcoin miner." Petition, 50. The purported motivation for this further combination is to "improve the energy usage efficiency." Petition, 51.

75. I note that the Petition does not explain how a POSITA was supposed to combine the Belady-989 gas shock absorber with Dickerson, nor does the Petition address the reasonable expectation of success.

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76. In my opinion, there are several reasons why a POSITA would not be motivated to combine Belady-989 shock absorber with Dickerson or with CryptoKube.

77. As an initial matter, Dickerson already teaches addressing "no or low levels of raw natural gas" with "an auxiliary means for providing electricity" comprising a "stand-by diesel generator" or a CCHP (combined cooling, heating, and power) unit. EX1005, ¶21. There is no evidence that a POSITA would consider layering the complex gas shock absorber in Belady-989 on top of the proven solutions already provided by Dickerson.

78. Furthermore, as I discussed for Ground 1, the main purpose of the Dickerson generator is "to generate electricity that is returned to the facility" rather than powering another load. EX1005, ¶6. Moreover, the amount of gas available to power Dickerson's generator varies such that only "in some cases the amount of electrical power required… may be small compared to the amount of power that can be produced with the gas available." EX1005, 39. Even in these cases, Dickerson taught sending any excess power to the grid if it was connected. *Id.* A POSITA would understand that at times when auxiliary power is required due to lack of feed gas, Dickerson's generator could not supply "excess" power to an external load such as CryptoKube because no "excess" power is available.

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79. Likewise, if Belady-989's shock absorber was hypothetically substituted for Dickerson's auxiliary power, a POSITA would understand that gas from the shock absorber tank would be drawn at times when not enough feed gas was available from the well. In this regard, Belady-989 taught that gas was provided by the shock absorber at times of a "negative pressure spike" when feed gas pressure is low. EX1011, ¶25. A POSITA would understand that during such a "negative pressure spike" Dickerson's generator would then use the provided gas for its primary purpose of powering the oil production facility rather than an external load.

80. Accordingly, a POSITA would not be motivated to add Belady-989's complex gas shock absorber because doing so would not solve the unreliability of Dickerson's "excess" electrical output for powering a power-hungry external load like CryptoKube.

81. Moreover, Belady-989's gas shock absorber operated in a manner that was incompatible with crypto mining's need for reliable power as articulated by Szhmigielski. EX1009, 105. Gas shutoff during positive pressure spikes interrupted gas flow to the Belady-989 generator which would prevent CryptoKube miner from operating. EX1011, ¶23. The incompatibility of Belady-989's operation during positive pressure spikes with CryptoKube's requirement of reliable power

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indicates that a POSITA would not have considered the combination and would not have had a reasonable expectation of success.

82. Gas shutoff would also disable Dickerson's generator, preventing it from powering oil field equipment or CryptoKube. The incompatibility of Belady-989's gas shock absorber with Dickerson's requirement to power mining equipment indicates that a POSITA would not have considered the combination and would not have had a reasonable expectation of success.

IX. GROUND 3

1. Motivation to Combine and Reasonable Expectation of Success

83. Ground 3 combines the primary references of Ground 1 (Dickerson and CryptoKube) and Ground 2 (Belady-989) with Boot. Petition, 67-68. Petitioner does not offer any additional rationales for combining Dickerson, CryptoKube and Belady-989 beyond those discussed above for Grounds 1 and 2. Accordingly, as I explained for those grounds, Petitioner has not shown a motivation to combine the first three references. There was also no motivation to combine with Boot for the reasons I explain below.

84. I note the lack of clarity in the Petition and declarations regarding what elements of Boot are being combined. For example, Petitioner's analysis of limitation 1[b] implies that it is relying on Boot for the "generator" limitation. Petition, 69-70. If that is the case, the Petition is silent on what role, if any,

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Dickerson's generator or other components play in the proposed combination. In this regard, for limitation 1[c], which recites "blockchain mining devices connected to the generator," the Petition cites to Ground 2 without any further explanation. Petition, 70. However, Ground 2 does not include Boot so it is unclear whether Petitioner is relying on Boot's, Dickerson's or Belady-989's generator for element 1[c].

85. The Petition asserts that a POSITA was motivated "to include Boot's load bank because Boot teaches that the load bank can keep the engine within its preferred operating parameters." Petition, 67. However, the Petition is silent as to why this may be so for any of the other three references in Ground 3.

86. Boot teaches a specialized system "to provide power to an electric submersible system position in a well that produces petroleum products." EX1012, 1:50-53. The system comprised a genset 102 connected to loads 108 which may "include surface pumps, water processing equipment, battery pumps, waste treatment equipment, lighting and transfer pumps" as well as components that "consume power during a selected operation, such as, for example, electric motors, computers, motor controllers, lighting, heating and other electrical equipment." EX1012, 2:29-41.

87. Boot's specialized system is unlike Dickerson's generator that supplied power for the entire oil or gas production facility. EX1005, ¶11. The small

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number and power requirements of the pump-related loads supplied by Boot "cause the power demand to be relatively volatile." EX1012, 2:55-58. To keep the genset engine from over-revving when a load goes offline, Boot proposed a load bank 110 "activated to take-up the excess power and stop the engine 112 from racing." EX1012, 3:8-10. Boot described the load bank as optional even in its specialized system. EX1012, 2:27-28.

88. Boot is not directed to full-facility generators like Dickerson. A POSITA would understand that a load bank was unnecessary in Dickerson's system because it powered a larger number of loads and included other mechanisms for soaking up excess power. For example, Dickerson teaches adding a gas chiller where "only a small portion of the raw natural gas generated by the facility is needed to power the facility." EX1005, ¶22. Unlike a load bank that dissipates energy unproductively, "the chiller is powered by electricity from the generator, and the chiller's consumption of electricity furthers the goal of reducing flaring, since the added electricity demand enables the generator to unitize more methane." EX1005, ¶22. Thus, instead of dissipating energy in a load bank, the chiller soaked up electricity, reduced flaring by keeping up methane consumption, and produced NGLs (natural gas liquids) that could be sold offsite. EX1005, ¶22. Therefore, a POSITA would not seek to combine Boot's load bank with Dickerson.

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89. Likewise, a POSITA would not seek to combine Boot with the CryptoKube miner. As noted above, Boot emphasized the volatile nature of its system's power demand. EX1012, 2:55-58. As discussed for Grounds 1 and 2, a POSITA understood that crypto miners were energy-intensive and required a reliable power source that could deliver a lot of power in a stable fashion. Boot does not disclose powering any external loads, let alone a power-hungry crypto miner like CryptoKube. Given the specialized nature and volatility of Boot's system, a POSITA would not expect Boot to provide reliable power for CryptoKube and would not combine the two for this reason.

90. A POSITA would not combine Boot with Belady-989 for substantially the same reasons as Dickerson and CryptoKube. There is no evidence that Belady-989's datacenter would suddenly reduce its load so as to require Boot's load bank. To the contrary, Belady-989 taught stabilizing the datacenter's load by requesting more work from other datacenters or reducing processing cost to entice more work whenever its compute load drops. EX1011, ¶35. Accordingly, there was no reason for a POSITA to add Boot's load bank to Belady-989.

91. Petitioner also asserts that a "POSITA would have been motivated to gather oil and gas from multiple wells on a multi-well pad because doing so can increase supply and increase the amount of electricity generated." Petition, 67-68. It is unclear how this alleged motivation is related to Boot. Petitioner cites to Boot

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3:42-46 for the proposition that "Boot further discloses in FIG. 2 that the flare gas can be derived from more than one oil pumps or more than one well heads." Petition, 67. However, Fig. 2 and the cited disclosure do not teach that Boot's genset is powered by gas from more than one well head. Rather, it teaches that surface facilities 120 comprise "gathering lines used to separate, store and transfer the pumped petroleum products from the well 118" and that "fewer or greater" numbers of pumps may be powered by Boot's system. EX1012, 3:42-46. Accordingly, this disclosure is directed to a single well 118 and not to "more than one oil pumps or more than one well heads" feeding Boot's genset as Petitioner appears to allege. Therefore, this additional motivation to combine is not supported by Boot and would not motivate a POSITA.

X. GROUND 4

1. Motivation to Combine

92. For the following reasons it is my opinion that Petitioner and Messrs. Nikolaou and Kasdorf have not shown a motivation to combine or a reasonable expectation of success with regard to Ground 4, which I understand it is their burden to demonstrate:

93. Like the Dickerson-based grounds considered above, Ground 4 relies on a combination of remote wellsite gas processing equipment (MAGS) and a crypto miner (Polivka). The relevant aspects of these references as presented by

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Petitioner are similar to Dickerson and CryptoKube such that many of the same reasons would lead a POSITA to *not* combine these references. In fact, a comparison of the Petition's motivation to combine sections for Grounds 1 and 4 shows that Petitioner and its declarants have merely substituted MAGS for Dickerson and Polivka for CryptoKube while repeating almost verbatim the same rationale based on Smigielski. Petition 19-20, 81-83.

94. As with Dickerson and CryptoKube, MAGS and Polivka are from what a POSITA would have considered as disparate and unrelated fields of art before the invention of the '372 patent. In fact, a POSITA would consider MAGS to be even less suitable for the proposed combination than Dickerson. This is because, unlike Dickerson, there is no teaching that MAGS could produce excess electrical output even occasionally. Instead, as described by Petitioner, MAGS separated input gases into three streams: "one can be captured in tanks and shipped off for sale, another powers generators that run the drilling operation, and a third powers MAGS itself." Petition, 81-82. Thus, all the energy produced by MAGS – whether in the form of gas or electric power – was already spoken for. Some of the output was liquefied or compressed and shipped for sale, some energy went to power the operation that produced the input gas and the rest went to power MAGS itself. EX1013, 2.

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95. Therefore, in my opinion Petitioner is incorrect in stating that "a POSITA would have understood that MAGS can produce cheap or free electricity using flare gases" because the electrical output supplied either MAGS itself or the oil or gas production equipment. Petition, 82. Accordingly, aside from Petitioner's contention, there is no evidence that MAGS was suitable to power a notoriously power-hungry external load such as Polivka's bitcoin miner.

96. With regard to Polivka, the references cited by Petitioner do not support its assertions regarding the motivation to combine. Petitioner implies that the references disclose that Polivka's miner "can be easily transported to a remote oil and gas production facility." Petition, 82, *citing* EX1015, 1-10. This is not the case – EX1015 (a printout of an online forum with multiple participants including one with the handle "Polivka") does not mention oil and gas production facilities or wellhead gas as a suitable power source for Polivka's miner. Likewise, Petitioner states that "Polivka can be powered by gas using a combustion engine" and cites to EX1015. Petition, 82, *citing* EX1015, 18. However, there is no teaching on that page or elsewhere to support Petitioner's statement. The discussion on page 18 is Polivka responding to a post by Bicknellski regarding the need for additional heat input in biogas production. EX1015, 17-18. Polivka responded, in part, by stating that "I guess this is for gas production only - as soon as you use the gas in a combustion engine to produce electricity you should have

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heat in abundance." EX1015, 18. This statement is not directed to the Polivka miner but is a comment distinguishing burning gas in an engine where heat is produced from biogas production where heat is consumed.

97. As with the other grounds, Petitioner cites Szhmigielski for the motivation to combine: "one of the biggest costs for digital currency miners is the cost of electricity and access to cheap power is desired." Petition, 82, *citing* EX1009, 90 (105 with exhibit pagination). Setting aside that the cited page does not state that "access to cheap power is desired," Petitioner fails to consider Szhmigielski's teaching on the same page that power must also be *reliable*. EX1009, 105. A POSITA would not have considered MAGS as a suitable power source because, as I've described, MAGS consumed all of the power it produced or supplied it to the wellhead equipment. Even if some electrical output could be hypothetically allocated to an external load, it would vary considerably based on gas flow and power needs of MAGS and wellhead equipment, similarly to Dickerson's generator.

98. Moreover, the overall electrical output is unlikely to be sufficient for Polivka's miner. For example, the Young reference provides an example of a MAGS-200 system consuming gas of a composition typical for the Bakken formation. EX1014, ¶¶143-145. The system was projected to produce about 450kWh of electrical power per day. EX1014, ¶144-145. The Polivka reference

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provides an example of Polivka's miner consuming 120.3kW. EX1015, 25. At that power level Polivka's miner would consume the entire daily electrical output of MAGS in less than four hours even assuming an unlikely scenario where none of the power was used to power MAGS or wellhead equipment. Operating a crypto miner for a few hours every day is prohibitively uneconomical. For example, as I've explained, the rewards to successful miners are based on a prompt solution of the computational problem which would be unlikely if the miner had to shut down for all but a few hours. However, it is highly unlikely that MAGS could supply the current necessary to operate Polivka at 100kW or more given its relatively low total output. In that case, Polivka's miner could not operate at all or would have to be throttled down. Either scenario is highly undesirable and, once again, shows that MAGS was too unreliable a power source for a POSITA to consider combining with Polivka.

99. In addition, Petition alleges that MAGS internal generator output 480 VAC. Petition, 78, *citing* EX1014, ¶198. Polivka's miner, on the other hand, appears to have operated on 240 VAC. EX1015, 25. Accordingly, MAGS electrical output (even if its internal generator could hypothetically power an external load) was incompatible with Polivka. In any case, the internal generator identified by Petitioner drove "the compressors and electrical components onboard the MAGS system" rather than an external load like Polivka's miner. EX1014, ¶198. All of

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these factors would have precluded a POSITA from considering MAGS as a power source for a power-hungry crypto miner such as Polivka.

100.

101. I also have considered wither a POSITA would have a reasonable expectation of success in combining MAGS and Polivka. The Petition states only that a "POSITA would have had a reasonable expectation of success in the combination at least because 'the first MAGS field unit was tested in the spring of 2014 and units were sent to North Dakota later that fall.'" Petition, 83, *citing* EX1013, 3. It is unclear how the testing of MAGS in North Dakota could bear on the expectation of success in combining MAGS with Polivka. A POSITA would not be motivated to combine MAGS with a crypto miner just because MAGS had been tested, where there was no evidence of success of said testing and no indication of testing with a power-hungry external load like a crypto miner. In any case, a POSITA would have no reasonable expectation of success given the incompatibility of MAGS power output with Polivka's requirements discussed above.

102. As with Ground 1, in my opinion Szhmigielski teaches away from the combination of MAGS and Polivka because it sets forth the requirement that electrical power for crypto mining must be reliable, unlike MAGS' variable, inadequate or unavailable electrical output. EX1009, 105.

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103. As discussed above for Ground 1, Petitioner's own '307 patent further illustrates the non-obviousness of the proposed combination for Grounds 4 and 5. (Both of these grounds are based on a combination of MAGS and Polivka.)

104. As I discuss above, in its '307 patent that postdates the '372 patent by approximately a year and a half, Petitioner described the state of the art and asserted that "there remains a need for systems and methods for generating electricity from natural gas produced from oil wells," and that "[i]t would be beneficial if such electricity could be produced and consumed on-site, for example by using it to operate power-intensive, modular processing units… employed to mine cryptocurrency." [EX2002, 2:35-42.] The '307 summary section described as allegedly novel "convert[ing] raw natural gas into a fuel gas stream to power any number of on-site power generation modules" which in turn power "distributed computing units" that "may be adapted to mine cryptocurrency." *Id.*, 2:45-55.

105. Thus, in mid-2018 Petitioner considered a combination of a raw natural gas to fuel gas converter and generator –a system similar to MAGS – and a crypto miner (Polivka) to be novel. This further demonstrates that this same combination was not obvious in early 2017. More generally, the '307 patent illustrates that a POSITA did not consider remote oil well facilities to be in the same field of art as crypto mining or data centers more generally before the invention of the '372 patent.

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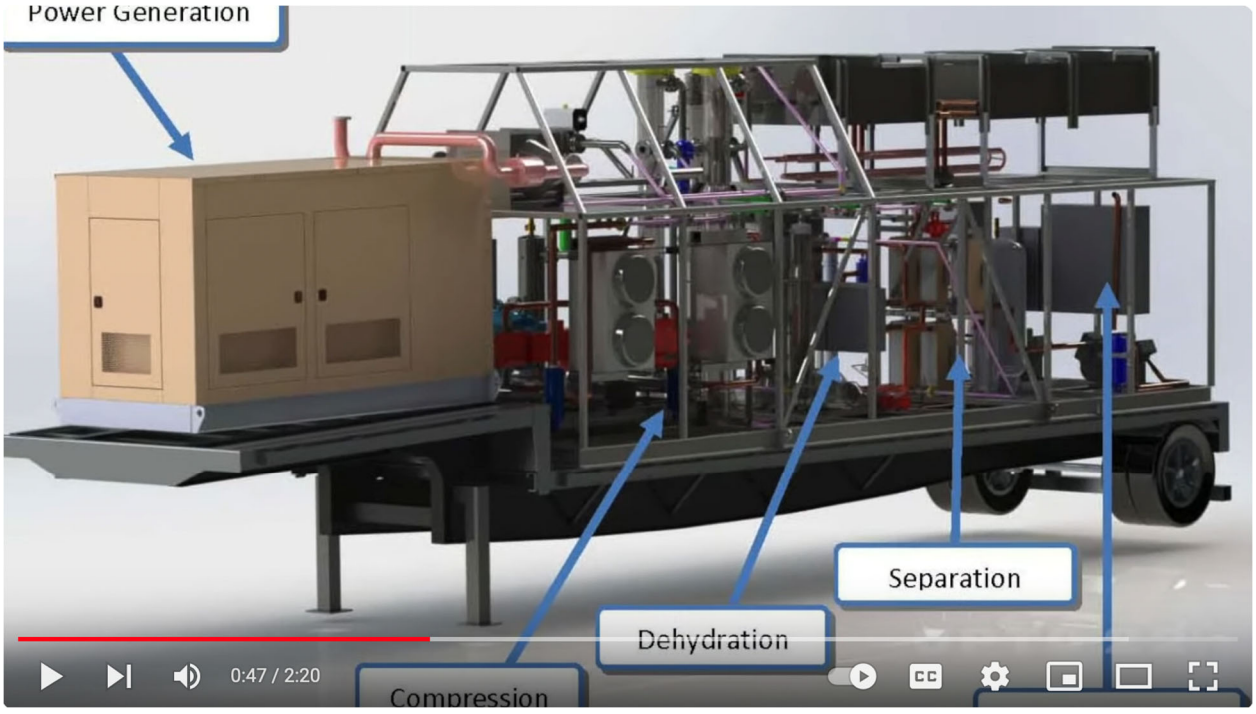
2. MAGS and Polivka in the Prosecution File History of ’372 Patent

a. MAGS

106. I was asked to review disclosures relating to MAGS that are in EX1002, the prosecution file history for the ’372 patent. My review of EX1002 shows that the Examiner found and considered a video available on YouTube titled “Why is natural gas flared? What is the solution?” EX1002, 346. I have reviewed this video which is currently available at the same YouTube URL listed by the Examiner. Starting at approximately the 45 second mark, this video disclosed the MAGS system comprising equipment to separate and consume unusable wellhead gas to generate electrical power, and thereby reduce greenhouse emissions by displacing diesel consumption. [EX2006]. At the 00:47 second mark the video showed MAGS with its components mounted on a trailer for mobility:



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107. Among other aspects of MAGS operation, the video considered by the Examiner (e.g., at approximately 00:45 to 2:20 minutes) explained deployment of MAGS at remote oil sites; using MAGS to consume gas that would otherwise be flared by separating it into three streams; using one stream to power a generator to replace local diesel consumption; using another stream (ethane) to power MAGS; and compressing a third gas stream for offsite consumption. [EX2006]. Accordingly this video comprised substantially the same disclosure regarding MAGS as raised in the Petition.

b. Polivka

108. My review of the '372 prosecution file history (EX1002) shows that while the Examiner did not consider Polivka itself, he considered substantially similar prior art.

109. The Examiner rejected the then-pending claims over Belady-837 (substantially similar to Belady-989 in the Petition) and Gleifchauf. The Examiner took the position that Gleifchauf disclosed the same subject matter that the Petition attributes to Polivka, including:

- "the blockchain mining device has a network interface and a mining processor" EX1002, 338-339.

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- "the network interface is connected to receive and transmit data through the internet to a network that stores or has access to a blockchain database" EX1002, 338-339.
- "the mining processor is connected to the network interface and adapted to mine transactions associated with the blockchain database and to communicate with the blockchain database" EX1002, 338-339.
- "the network is a peer-to-peer network" EX1002, 338-339.
- "the blockchain database stores transactional information for a digital currency" EX1002, 338-339.
- "the mining processor comprises a plurality of mining processors" EX1002, 339.

110. The Examiner also considered another substantially similar prior art reference: the BitFury BlockBox AC Mobile Datacenter ("BlockBox") which was submitted in an IDS (information disclosure statement which I understand was submitted by the patent applicant) and considered by the Examiner on 04/16/2022. EX1002, 361. BlockBox was a containerized and mobile Bitcoin mining unit with "Bitfury's unique 16nm ASIC" mining processors "requiring only a suitable and affordable power source and internet access," as described in the online brochure that the Examiner considered:

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BlockBox AC – Air Cooled Mobile Datacenter

The BlockBox AC is one of the first mobile Bitcoin mining units that has the scale of a full-size data center, allowing for easy access to the Bitcoin network. For the first time, Bitcoin mining can be readily purchased at petahash-scale.

[EX2007, 1.]

111. To a POSITA, BlockBox disclosed substantially the same subject matter as Polivka, comprising a mobile crypto mining container with custom mining processors and network connectivity to to access the Bitcoin Blockchain "within hours of delivery." [EX2007, 1-2] (I note that the network connectivity in Polivka, BlockBox, or CryptoKube may not be robust enough for use at remote oil and gas fields. I reserve the right to provide further opinions on this issue.)

XI. GROUND 5

1. Motivation to Combine and Reasonable Expectation of Success

112. Ground 5 combines the primary references of Ground 4 (MAGS and Polivka) with Belady-989. Petition, 99-100. Petitioner does not offer any additional rationales for combining MAGS and Polivka beyond those discussed above for

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Ground 4. Accordingly, as I explained for that ground, Petitioner has not shown a motivation to combine MAGS and Polivka.

113. In Ground 5, Petitioner alleges that it was obvious to combine Belady-989's so-called gas shock absorber with the "MAGS mobile power generation system" and the "Polivka mobile Bitcoin miner." Petition, 100. The purported motivation for this further combination is to "improve the energy usage efficiency." *Id.*

114. Petitioner does not explain how a POSITA was supposed to combine the gas shock absorber system with MAGS, nor does Petitioner address the reasonable expectation of success.

115. In my opinion, no motivation to combine and no reasonable expectation of success was possible because a POSITA would conclude that Belady's gas shock absorber was incompatible with MAGS. For example, Belady-989 taught shutting off gas flow to the generator when supply gas pressure rises: "were the gas supply 110 to experience a positive gas pressure spike, the gas pressure sensor 171 of the pressure regulating valve 170 could detect such a high-pressure and could trigger the gas shutoff valve 171 to stop the flow of pressurized gas to the gas-to-electricity converter 180." EX1011, ¶23.

116. If Belady's system was connected to MAGS as proposed in Ground 5, a POSITA would understand that the sudden loss of feed gas could be substantially

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detrimental to MAGS operation. This is because inlet gas flow rate and system operating pressure were two "key" system parameters in MAGS. EX1014, ¶16. MAGS required the use of specialized flow controllers and valves to carefully manipulate these parameters to achieve the desired methane number of the dry gas stream. EX1014, ¶18. The Young patent application (EX1014) further noted that MAGS required its inventors to "carefully select[] the process operations and process parameters." EX1014, ¶167. The sudden loss of gas pressure caused by Belady-989 gas shock absorber operation during a positive pressure spike could disrupt MAGS' carefully selected and adjusted gas flow and system pressure process parameters and even damage the MAGS equipment.

117. Accordingly, a POSITA would understand that at the very least a substantial amount of experimentation and changes to MAGS and Belady-989 would be required to determine whether these systems could operate together. The outcome would be uncertain at best because MAGS was so dependent on controlling gas flow rates. In any case, combining Belady-989 and MAGS would require a volume of experimentation and process knowledge beyond the level of one of ordinary skill as articulated by Petitioner.

118. Belady-989's gas shock absorber was also incompatible with crypto mining's need for reliable power as articulated by Szhmigielski. EX1009, 105. Gas shutoff during positive pressure spikes interrupted gas flow to the Belady-989

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generator which would prevent Polivka's miner from operating. EX1011, ¶23. As another example, when gas storage 160 had an insufficient amount of gas, Belady-989 expected the data center to offload work or throttle down its processors. EX1011, ¶33. Yet there is no evidence that Polivka's miner was capable of doing so or could be modified without undue experimentation. The power stoppages and requirement for offload or throttling down depending on gas storage 160 would lead a POSITA to conclude that Belady-989's gas shock absorber resulted in power that was too unreliable to combine with Polivka. Therefore, a POSITA would not have a reasonable expectation of success and would not attempt the combination in Ground 5.

XII. SECTION 101

119. I have reviewed the Petition's discussion of whether the '372 patent claims cover subject matter that is appropriate for patenting and the related opinions by Dr. Nikolaou and Mr. Kasdorf.

120. I disagree with the opinions expressed by Nikolaou and Kasdorf regarding whether the focus of the challenged '372 patent claims is the idea of using natural gas to power a block chain mine. It is my opinion that both the '372 patent specification and the claims of the '372 patent make clear that much more is required from a technology or engineering standpoint than simply the use natural gas to power a blockchain mine. For example, claims 1 and 24 recite a generator

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capable of using a continuous flow of natural gas (including raw natural gas as known as casinghead gas) from a hydrocarbon production, storage or processing facility to electrically power mining processors within blockchain mining devices that connect to a network interface with access to a blockchain database storing transactions associated with digital currency. To arrive at their opinions, the declarations of Nikolaou and Kasdorf ignore the majority of the claim language. A person of ordinary skill in the art, both when reading the claims as separate elements and as a whole system, would readily conclude that the claims are a recitation of concrete, physical elements (which includes the combination of the generator, the blockchain mining devices, the mining processors, the network interfaces, etc.) and that the claims are not directed to an abstract idea.

121. For one, the Petition and the declarations of Nikolaou and Kasdorf ignore several limitations of the claims that require that the source of combustible gas for the generator recited in the claims of the ’372 patent not simply be a residential gas line that can be turned-off without consequences. To the contrary, the claims are directed to sources of combustible gas from a hydrocarbon facility that continuously flows combustible gas used by the generator. The Petition and the declarations of Nikolaou and Kasdorf also ignore that the mining processors must be “adapted to mine transactions associated with the blockchain database” which are energy intensive thus requiring multiple blockchain mining devices.

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Instead, the Petition and the declarations of Nikolaou and Kasdorf suggest that the mining processors are common laptops or common computers. To the contrary, the claims of the '372 patent recite computer architectures that incorporate mining processors within multiple larger blockchain mining devices to affect the mining of digital currency. EX1001, Claims 1 & 24.

122. Each independent claim resoundingly emphasizes the presence of a specialized generator that can receive raw natural gas as a continuous flow to produce electrical power and resilient mining processors that are powered from the generator's electrical output (and not solely from a connection to electrical grid power) to mine digital currency using a network interface. Both as separate elements, and as combination, the challenged independent claims do not cover every instance of using natural gas, which supports the conclusion that the '372 patent claims do not claim an abstract idea.

123. The integration of the special-purpose generator of the independent claims that receives the continuous flow of combustible casinghead gas and the mining processors within the supportive blockchain mining devices represents a significantly concrete practical application of technology to a person of ordinary skill in the art.

124. The challenged claims expressly include practical applications because, for example, (1) the generator of the independent claims uses natural gas

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from a hydrocarbon production, storage, or processing facility (not from a utility sales-gas line) that produces a continuous flow to improve oil field waste gas technologies, (2) the independent claims recite multiple (not only one) blockchain mining devices that allow the modulation of the load applied to the generator to improve the cost effectiveness of blockchain mining and overall power generation reliability, (3) the generator, mining processors, and network interface of the independent claims form a particular machine that is integral to the claims.

125. Of course, the Petition misapprehends the independent claims insofar as it contends that the claimed system and method need not be proximate to the hydrocarbon facility that is the source of the claimed "continuous flow of combustible gas." The claims themselves recite that the "generator [is] connected to the source of combustible gas" that is "produced from a … hydrocarbon production, storage, or processing facility." EX1001, claims 1 & 24. By disassociating the claimed elements, the Petition is incorrect in its assertion that the claims do "not require the computers be located at or near such a facility." Pet. at 116.

126. Relatedly, the Petitioner and the declarations of Nikolaou and Kasdorf wrongfully dilute the inventive concept of the challenged claims by proposing a construction of "continuous flow of combustible gas" that does not ascribe meaning to the term "continuous." I discuss the meaning of "continuous flow of

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combustible gas" from the perspective of one of ordinary skill in the art above in my declaration. The '372 patent explains that "[i]n upstream production of oil and gas, natural gas may be produced … as a by-product of oil production, for example from an oil well." EX1001, 6:51-54; 4:62-63 ("The source of combustible gas comprises raw natural gas."); 8:66-9:3. The '372 patent describes this source of raw gas as having a "continuous flow" that must be consumed or otherwise disposed of. *Id.*, 9:28-32. Often oil wells are remote, and with respect to the natural gas, may be "lacking in accessible infrastructure such as an external pipeline network (sales line) …." *Id.*, 7:46-49; 8:49-63. The '372 patent teaches that the oil well operator is left with few desirable options to dispose of the raw natural gas, such as "venting the gas to atmosphere un-combusted [or] combusting the gas on site via flare …." *Id.*, 7:56-60; 8:5-10. The '372 patent therefore directs the casinghead gas to a generator used to operate blockchain mining devices with mining processors. *Id.*, 11:24-36. The '372 patent teaches the ability to "[c]hang[e] the blockchain mine electrical load over time in response to changes in the excess or stranded gas volume availability." *Id.*, 5:35-37. Using the '372 patent's invention, a well operator can "[m]inimize[e] the vented or flared gas volumes by changing the mining hardware load in reaction to observed changes in average natural gas source rates over time." *Id.*, 5:38-41. Thereby, "relatively less gas is wasted during operation." *Id.*, 11:35-36. This advantage of the invention is

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captured in the first two limitations of the challenged independent claims, which Petitioner wrongly proposes be misread to allow for the mere presence of any type of gas from any source, for any duration of time. Without this error, it is clear that the elements of the independent claims reveal an inventive concept that is significantly more than using natural gas to power a blockchain mine.

127. The Petition commits a similar error where it divorces the blockchain mining devices that each include mining processors and network interfaces from their application to blockchain mining. I discuss the meaning of "blockchain mining devices" and "mining processor" in the context of the '372 patent from the perspective of one of ordinary skill in the art above in my declaration. The Petition alludes to a "conventional blockchain miner," but provides no evidentiary support for that "conventional" blockchain miners existed, and certainly applications of blockchain were far from conventional at the time the inventor filed the '372 patent. The '372 patent recounts that "[t]he first block chain was conceptualized by Satoshi Nakamoto in 2008 and implemented the following year as a core component of the digital currency, BITCOIN…." EX1001, 11:51-55. With respect to the claimed "mining processor," the '372 patent recommends the capability to control the "hashrate" by "changing the core voltage or the clock rate of the processor[s]." *Id.,* 13:52-58. The '372 patent details that "[e]ach mining processor 92 may have a variety of configurations, but generally may include at least a power

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supply, a controller board and ***mining circuity, such as an ASIC circuit***. Various mining circuitry examples include CPU (central processing unit), GPU (graphics processing unit), FPGA (Field-Programmable Gate Array), and ASIC (application specific integrated circuit). The components of an ***ASIC mining processor*** include the hash boards (each board has numerous chips that is doing the hashing), a controller (to communicate with the network and optimize the mining processors chip frequency and fans for colling), and a power supply (typically converts AC input power to DC power for the ASIC)." *Id.,* 17:9-21 (emphasis added). The '372 patent explained that it is the "[m]ining circuitry 130, for example integrated circuit chip, [that] may be used to perform data mining operations, for example verifying cryptocurrency transactions." *Id.,* 14:57-63. Far from being a generic home computer as the Petition suggests, the mining processor is described and recited as a specialized computer processor. The mining processor was far from conventional at the time of the filing of the '372 patent.

128. Even the references relied upon in the Petition confirm that the challenged claims, especially when read as the combination of elements, were far from conventional or routine. The '372 patent explains that blockchain mining operations are highly computationally and energy-intensive by design. EX1001, 13:29-36, 13:49-58. The Szhmigielski reference (which Petitioner identifies as pertinent prior art) teaches that, in addition to being inexpensive, electrical power

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for crypto mining must be "*reliable*" to power "the hardware and the associated cooling systems." EX1009, 105. Yet, Petitioner's other art, including particularly the Dickerson reference, teaches that its electrical power is *unreliable* because the system is located "in remote areas" where "no utility power is available." EX1005, ¶24. As such, a person of ordinary skill in the art would not view the '372 patent claims as conventional or routine, but instead would be skeptical that such a system would work reliably.

129. Thus, having studied the '372 patent claims from the perspective of a person of ordinary skill in the art at the time of the filing of the '372 patent, it is my opinion as I have detailed in this section that the (1) the '372 patent claims are not focused on an abstract idea, (2) the '372 patent claims recite the practical application of the limitations of the claims, and (3) the '372 patent claims provide an inventive concept that was not conventional or routine at the time of the filing of the '372 patent.

I declare under penalty of perjury that the foregoing is true and correct. Executed on October 23, 2023.

Fengqi You

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Appendix A

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    - Cornell University AI for Science Institute (*Co-Director*)
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- AIChE George Lappin Award, 2022
- Stratis V. Sotirchos Lectureship Award, Foundation for Research & Technology - Hellas, 2022
- Fellow, Royal Society of Chemistry (FRSC), 2021
- AIChE Sustainable Engineering Forum Education Award, 2021
- De Gruyter Best Paper Award, 2021
- American Automatic Control Council (AACC) O. Hugo Schuck Award, 2020
- Curtis W. McGraw Research Award, ASEE, 2020
- AIChE Innovations in Green Process Engineering Award, 2020
- Mr. & Mrs. Richard F. Tucker Excellence in Teaching Award, 2020
- Associate Editor, *Science Advances*, 2020 – present
- Associate Editor, *IEEE Transactions on Control Systems Technology*, 2020 – present
- Senior Member, IEEE, 2020
- AIChE Excellence in Process Development Research Award, 2019
- ACS Sustainable Chemistry & Engineering Lectureship Award, 2018
- Computing and Systems Technology (CAST) Outstanding Young Researcher Award, AIChE, 2018
- Cornell Engineering Research Excellence Award, 2018
- Editorial Board, *Industrial & Engineering Chemistry Research*, 2018 – present
- AIChE Sustainable Engineering Research Excellence Award, 2017
- Consulting Editor and Editorial Board, *AIChE Journal*, 2017 – present
- AIChE Environmental Division Early Career Award, 2017
- Editorial Board, *ACS Sustainable Chemistry & Engineering*, 2017 – present
- *I&EC Research* Inaugural Class of Influential Researcher, 2017
- Zdenek Burianec Memorial Award, 2017, 2022
- Editor, *Computers & Chemical Engineering*, 2016 – present
- Roxanne E. and Michael J. Zak Professorship, Cornell University, 2016 – present
- National Science Foundation CAREER Award, 2016-2021
- Croll Sesquicentennial Faculty Fellow, Cornell University, 2016
- No. 1 Top cited article published in *AIChE Journal*, from 2012, from 2013, from 2014, & from 2015
- Excellence in Review Award, *Industrial & Engineering Chemistry Research*, 2016, 2017, 2018, 2019, 2020
- Northwestern-Argonne Early Career Investigator Award for Energy Research, 2013
- Searle Center for Teaching Excellence Faculty Fellow, Northwestern University, 2012-2013
- Top Reviewer Award, *Computers & Chemical Engineering*, 2011 and 2013

- Most cited articles published in *Computers & Chemical Engineering*, 2010-2012
- W. David Smith Jr. Best Publication Award, AIChE CAST Division, 2011
- Northwestern University Faculty Recognition Award, 2011
- Ken Meyer Award for the Best Doctoral Thesis, Carnegie Mellon University, 2010
- Argonne Director's Postdoctoral Fellowship, Argonne National Laboratory, 2009-2011
- Symposium Award, 30th ChEGSA Symposium, Carnegie Mellon University, 2008
- Yang Outstanding Research Award, Yang Foundation, 2005
- Best Undergraduate Diploma Thesis, Tsinghua University, 2005
- First-Class Scholarship for Academic Excellence, Tsinghua University, 2003 and 2004

TEACHING EXPERIENCE

Cornell University Ithaca, NY
Instructor and Lecturer 07/2016 – present

- ChemE 6888 / SysEn 5888: Deep Learning (Fall 2023)
- ChemE 6880 / SysEn 5880: Industrial Big Data Analytics and Machine Learning (Spring 2023)
- ChemE 6800 / SysEn 6800: Computational Optimization (Fall 2022)
- ChemE 6880 / SysEn 5880: Industrial Big Data Analytics and Machine Learning (Spring 2022)
- ChemE 6800 / SysEn 6800: Computational Optimization (Fall 2021)
- ChemE 6888 / SysEn 5888: Deep Learning (Summer 2021)
- ChemE 6880 / SysEn 5880: Industrial Big Data Analytics and Machine Learning (Spring 2021)
- ChemE 6886 / SysEn 5886: Quantum Computing and Artificial Intelligence (Spring 2021)
- ChemE 6800 / SysEn 6800: Computational Optimization (Fall 2020)
- ChemE 6888 / SysEn 5888: Deep Learning (Summer 2020)
- ORIE 3310/5310: Optimization II (Summer 2020)
- ChemE 6880 / SysEn 5880: Industrial Big Data Analytics and Machine Learning (Spring 2020)
- ChemE 6800 / SysEn 6800: Computational Optimization (Fall 2019)
- ChemE 6888 / SysEn 5888: Deep Learning (Summer 2019)
- ORIE 3310/5310: Optimization II (Summer 2019)
- ChemE 6880 / SysEn 5880: Industrial Big Data Analytics and Machine Learning (Spring 2019)
- ChemE 6800 / SysEn 6800: Computational Optimization (Fall 2018)
- ORIE 3310/5310: Optimization II (Summer 2018)
- ChemE 6880 / SysEn 6880: Industrial Big Data Analytics and Machine Learning (Spring 2018)
- ChemE 4620: Chemical Process Design (Spring 2018)
- ChemE 6800 / SysEn 6800: Computational Optimization (Fall 2017)
- ChemE 4620: Chemical Process Design (Spring 2017)

Northwestern University Evanston, IL
Instructor and Lecturer 09/2011 – present

- Chem Eng 352: Chemical Engineering Design Projects (Winter 2016)
- Chem Eng 322: Heat Transfer (Winter 2016)
- Chem Eng 352: Chemical Engineering Design Projects (Winter 2015)
- Chem Eng 345: Process Optimization for Energy and Sustainability (Spring 2015)

- Chem Eng 352: Chemical Engineering Design Projects (Winter 2014)
- Chem Eng 345: Process Optimization for Energy and Sustainability (Spring 2014)
- Chem Eng 352: Chemical Engineering Design Projects (Winter 2013)
- Chem Eng 345: Process Optimization (Spring 2013)
- Chem Eng 352: Chemical Engineering Design Projects (Winter 2012)
- Chem Eng 345: Process Optimization (Spring 2012)

Carnegie Mellon University Pittsburgh, PA
Teaching Assistant 08/2005 – 05/2008

- Tutor and grader, *06-361: Unit Operations of Chemical Engineering*, Fall 2006
- Substitute lecturer, tutor and grader, *06-720: Advanced Process System Engineering*, Spring 2007
- Substitute lecturer, tutor and grader, *06-461: Process Design Project*, Spring 2008
- Substitute lecturer, tutor and grader, *06-462: Economics and Optimization*, Spring 2008
- Assistant for course document preparation and project evaluator, *06-815: Special Topic in Process System Engineering*, Spring 2008

Tsinghua University Beijing, China
Teaching Assistant 02/2005 – 06/2005

- Assisted in preparing course documents and held tutorial sessions for *Computer Simulation of Fluids and Its Advances*, Spring 2005.

PUBLICATIONS

Google Scholar (Citations: 21,056; *h*-index: 80): scholar.google.com/citations?user=3ixInr8AAAAJ&hl
Scopus (Citations: 16,038; *h*-index: 71): www.scopus.com/authid/detail.url?authorId=56750277000

I. Refereed Journal Articles *(* denotes that F. Y. is the corresponding author)*

[J1] Lal, A. & You, F.* (2023). Climate Concerns and the Future of Non-Fungible Tokens: Leveraging Environmental Benefits of the Ethereum Merge. *Proceedings of the National Academy of Sciences* (*PNAS*), 120, e2303109120. [**Select Media Coverage:** *Cornell Chronicle* (July 10, 2023), *Tech Xplore* (July 10, 2023), *Science Daily* (July 10, 2023), *ScienMag* (July 10, 2023), *Newswise* (July 10, 2023), *ScienceNewsNet* (July 10, 2023), *Mirage News* (July 10, 2023), *ScienMag* (July 10, 2023), *News Azi* (July 10, 2023), *Verve Times* (July 10, 2023), *Tech Times* (July 11, 2023), *Swift Telecast* (July 11, 2023), *AZoCleantech* (July 11, 2023).]

[J2] Tao, Y., Yang, L.*, Jaffe, S., Amini, F., Bergen, P., Hecht, B., & You, F.* (2023). Climate mitigation potentials of teleworking are sensitive to changes in lifestyle and workplace rather than ICT usage. *Proceedings of the National Academy of Sciences (PNAS)*, 120, e2304099120. [Research Highlight in ***Nature*** (September 19, 2023).] – [**Select Media Coverage:** *Cornell Chronicle* (September 18, 2023), ***Scientific American*** (September 18, 2023), ***The Washington Post*** (September 18, 2023), ***Fortune*** (September 21, 2023), ***The Guardian*** (September 18, 2023), *ScienMag* (September 18, 2023), *Science Daily* (September 18, 2023), *ScienMag* (September 18, 2023), *Phys.org* (September 18, 2023), ***The Hill*** (September 19, 2023), *Anthropocene* (September 19, 2023), ***The Boston Globe*** (September 19, 2023), *My Droll* (September 19, 2023), *SwiftTelecast* (September 19, 2023), *Business Mayor* (September 19, 2023), *Daily Kos* (September 19, 2023), *WION* (September 19, 2023), *Today Headline* (September 19, 2023), *The Science Times* (September 19, 2023), *Stern* (September 19, 2023), *Weekly Voice* (September 19, 2023), *Prokerala* (September 19, 2023), *East Coast Daily* (September 19, 2023), (September 19, 2023), *Wonderful Engineering* (September 19, 2023), *L'Indépendant* (September 19, 2023), *ABC News* (September 19, 2023), *Herald* (September

19, 2023), *The Telegraph* (September 19, 2023), *Centre Times Daily* (September 19, 2023), *The Olympian* (September 19, 2023), (September 19, 2023), *Lab Manager* (September 19, 2023), *Entrepreneur* (September 19, 2023), *The Pioneer* (September 20, 2023), ***CNN News*** (September 20, 2023), *ZME Science* (September 20, 2023), *Technology Networks* (September 19, 2023), *HuffPost* (September 22, 2023), *Taipei Times* (September 22, 2023), ***Bloomberg*** (September 26, 2023), *The Costa Rica News* (September 27, 2023), *New York Times* (October 16, 2023).]

[J3] Zhang, C., Zhao, X., Sacchi, R., & You, F.* (2023). Trade-off between critical metal requirement and transportation decarbonization in automotive electrification. *Nature Communications*, 14, 1616. [**Select Media Coverage:** *Cornell Chronicle* (April 11, 2023), *Tech Xplore* (April 11, 2023), *ScienMag* (April 11, 2023), *NanoWerk* (April 11, 2023), *Newswise* (April 11, 2023), *Environmental News Network* (April 11, 2023), *AZoCleantech* (April 12, 2023), *ScienceDaily* (April 11, 2023), *SpaceDaily* (April 12, 2023), *Rinnovabili* (April 12, 2023), *Homeland Security News Wire* (April 13, 2023), *Swift Telecast* (April 14, 2023), *Green Car Congress* (April 17, 2023), *Rinnovabili* (April 17, 2023), *greenreport* (April 17, 2023), *mining.com* (April 18, 2023), *wpn.pl* (April 18, 2023), *Mongabay* (April 20, 2023), *South Africa Today* (April 23, 2023), *Lab Manager* (May 8, 2023), *Foreign Affairs New Zealand* (May 9, 2023), ***CBC News*** (May 18, 2023), *Chemical Engineering Progress* (July 1, 2023), *Mongabay* (September 6, 2023), *KrAsia* (September 26, 2023).]

[J4] Liang, H., & You, F.* (2023). Reshoring silicon photovoltaics manufacturing contributes to decarbonization and climate change mitigation. *Nature Communications*, 14, 1274. [**Select Media Coverage:** *Cornell Chronicle* (March 9, 2023), *Tech Xplore* (March 9, 2023), *News Azi* (March 10, 2023), *TechNewsBoy* (March 10, 2023), *Today Headline* (March 10, 2023), *Newswise* (March 10, 2023), *Environmental News Network* (March 10, 2023), *Solar Daily* (March 13, 2023), *AZoCleantech* (March 16, 2023), *Utility Dive* (March 16, 2023), *PV Magazine* (March 20, 2023), *Anthropocene Magazine* (March 21, 2023), *electrek* (March 25, 2023), *Daily Tidings* (April 9, 2023), ***National Science Foundation (NSF) Research News*** **(May 8, 2023)**, *CleanTechnica* (May 9, 2023), *Technology.org* (May 14, 2023), *TheBigCircuit* (May 14, 2023), *Morning News* (May 19, 2023).]

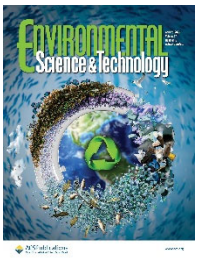
[J5] Lal, A. & You, F.* (2023). Will reshoring manufacturing of advanced electric vehicle battery support renewable energy transition and climate targets? *Science Advances*, 9, adg6740. [**Select Media Coverage:** *Cornell Chronicle* (June 14, 2023), *Tech Xplore* (June 14, 2023), *Mirage* (June 14, 2023), News *Azi* (June 15, 2023).]

[J6] Zhao, N., & You, F.* (2023). Growing Metaverse Sector Can Reduce Greenhouse Gas Emissions by 10 Gt CO2e in the United States by 2050. *Energy & Environmental Science*, 16, 2382-2397. [**Cover Art of June 2023 issue of *Energy & Environmental Science***] [**Select Media Coverage:** *Cornell Chronicle* (June 14, 2023), *ScienceDaily* (June 14, 2023), *Today Headline* (June 15, 2023), *Tech Xplore* (June 15, 2023), *Mirage* (June 15, 2023), News *Azi* (June 15, 2023), *Knowledia* (June 15, 2023), *Verve Times* (June 17, 2023), *Swift Telecast* (June 17, 2023), *DT Next* (June 17, 2023), *Hubli Express* (June 17, 2023), *Digital Information World* (June 18, 2023), *Environmental Leader* (June 19, 2023), *Ahmedabad Mirror* (June 19, 2023), *News9 Live* (June 19, 2023), *NFTevening* (June 20, 2023), *Technology.Org* (June 24, 2023), *Smart Energy International* (June 26, 2023), *Scitech Daily* (August 27, 2023), *The Science Times* (August 28, 2023),]

[J7] Tian, X., Roose, B., Stranks, S.D., & You, F.* (2023). Periodic Module Rejuvenation Provides Early Market Entry for Circular All-Perovskite Tandem Photovoltaic Technologies. *Energy & Environmental Science*, DOI: 10.1039/D2EE03198A

[J8] Ajagekar, A., & You, F.* (2023). Molecular Design with Automated Quantum Computing-based Deep Learning and Optimization. *npj Computational Materials*, 9, 143.

[J9] Zhao, X., & You, F.* (2023). Cascading Polymer Macro-Debris Upcycling and Microparticle Removal As An Effective Life Cycle Plastic Pollution Mitigation Strategy. *Environmental Science & Technology*, 57, 16, 6506–6519. [**Cover Art of April 2023 issue of *Environmental Science & Technology***]



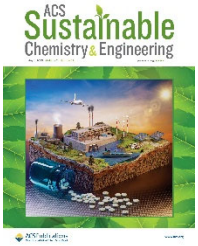
[J10] Mukherjee, F., Shi, A., Wang, X., You, F.*, & Abbott, N.L.* (2023). Liquid Crystals as Multifunctional Interfaces for Trapping and Characterizing Colloidal Microplastics. *Small*, 19, 2207802.

[J11] Ajagekar, A., & You, F.* (2023). Deep Reinforcement Learning Based Unit Commitment Scheduling under Load and Wind Power Uncertainty. *IEEE Transactions on Sustainable Energy*, 14, 803-812.

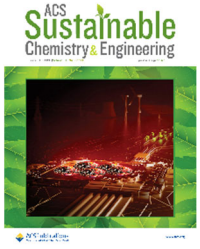
[J12] Lal, A., & You, F.* (2023). Targeting Climate-Neutral Hydrogen Production: Integrating Brown and Blue Pathways with Green Hydrogen Infrastructure via A Novel Superstructure and Simulation-based Life Cycle Optimization. *AIChE Journal*, 69, e17956. [**Cover Art of January 2023 issue of *AIChE Journal***] [**Select Media Coverage:** *Chemical Engineering Progress* (January 1, 2023).]

[J13] Bang, R.S., Bergman, M., Li, T., Mukherjee, F., Alshehri, A.S., Abbott, N.L., Crook, N.C., Velev, O.D., Hall, C.K., & You, F.* (2023). An integrated chemical engineering approach to understanding microplastics. *AIChE Journal*, 69, e18020.

[J14] Tao, Y., Zhu, S., Smith, J., Lakhani, N., & You, F.* (2023) Environmental Sustainability of the Globalized Pharmaceutical Supply Chains: The Case of Tenofovir Disoproxil Fumarate. *ACS Sustainable Chemistry & Engineering*, 11, 17, 6510–6522. [**Cover Art of May 2023 issue of *ACS Sustainable Chemistry & Engineering***] [**Select Media Coverage:** *Cornell Chronicle* (May 8, 2023), *phys.org* (May 8, 2023), *Newswise* (May 8, 2023), *AZoCleantech* (May 8, 2023].]



[J15] Lal, A., Zhu, J., & You, F.* (2023). From Mining to Mitigation: How Bitcoin Can Support Renewable Energy Development and Climate Action. *ACS Sustainable Chemistry & Engineering*, DOI: 10.1021/acssuschemeng.3c05445 [**Cover Art of November 2023 issue of *ACS Sustainable Chemistry & Engineering***]



[J16] Xiao, T., & You, F.* (2023). Building thermal modeling and model predictive control with physically consistent deep learning for decarbonization and energy optimization. *Applied Energy*, 342, 121165.

[J17] Xie, J., Ajagekar, A., & You, F.* (2023). Multi-Agent attention-based deep reinforcement learning for demand response in grid-responsive buildings. *Applied Energy*, 342, 121162.

[J18] Hu, G., & You, F.* (2023). A Novel AI Framework Integrating Physics-Informed Neural Network with Predictive Control for Energy-Efficient Food Production in the Built Environment. *Applied Energy*, 348, 121450.

[J19] Xiao, T., & You, F.* (2023). Physically consistent deep learning-based day-ahead energy dispatching and thermal comfort control for grid-interactive communities. *Applied Energy*, 353, 122133.

[J20] Lal, A., Renaldy, T., Breuning, L., Hamacher, T., & You, F.* (2023). Electrifying light commercial vehicles for last-mile deliveries: Environmental and economic perspectives. *Journal of Cleaner Production*, 416, 137933.

[J21] Kumdokrub, T., Carson, S., & You, F.* (2023). Cornell university campus metabolism and circular economy using a living laboratory approach to study major resource and material flows. *Journal of Cleaner Production*, 421, 138469.

[J22] Zhu, S., Preuss, N., & You, F.* (2023). Advancing sustainable development goals with machine learning and optimization for wet waste biomass to renewable energy. *Journal of Cleaner Production*, 422, 138606.

[J23] Jiang, P., Zhang, L., You, S., Fan, Y.V., Tan, R.R., Klemeš, J.J., & You, F. (2023). Blockchain technology applications in waste management: Overview, challenges and opportunities. *Journal of Cleaner Production*, 421, 138466.

[J24] Zhang, Q., Yan, J.*, Gao, H.O.*, & You, F.* (2023). A Systematic Review on Power Systems Planning and Operations Management with Grid Integration of Transportation Electrification at Scale. *Advances in Applied Energy*, 9, 100147.

[J25] Yang, S., Gao, H.O.*, & You, F.* (2023). Integrated optimization in operations control and systems design for carbon emission reduction in building electrification with distributed energy resources. *Advances in Applied Energy*, 9, 100144.

[J26] Hu, G., & You, F.* (2023). Multi-zone building control with thermal comfort constraints under disjunctive uncertainty using data-driven robust model predictive control. *Advances in Applied Energy*, 9, 100124.

[J27] Zhang, C., Yan, J., & You, F.* (2023). Critical metal requirement for clean energy transition: A quantitative review on the case of transportation electrification. *Advances in Applied Energy*, 9, 100116.

[J28] Yang, S., Gao, H.O.*, & You, F.* (2023). Building electrification and carbon emissions: Integrated energy management considering the dynamics of the electricity mix and pricing. *Advances in Applied Energy*, 9, 100141.

[J29] Ajagekar, A., Mattson, N.S., & You, F.* (2023). Energy-efficient AI-based Control of Semi-closed Greenhouses Leveraging Robust Optimization in Deep Reinforcement Learning. *Advances in Applied Energy*, 9, 100119.

[J30] Zhao, N., Zhang, H., Yang, X., Yan, J.*, & You, F.* (2023). Emerging Information and Communication Technologies for Smart Energy Systems and Renewable Transition. *Advances in Applied Energy*, 9, 100125.

[J31] Huang, W., Zhang, Q., & You, F.* (2023). Impacts of Battery Energy Storage Technologies and Renewable Integration on the Energy Transition in the New York State. *Advances in Applied Energy*, 9, 100126.

[J32] Zhong, R., Zhu, Y., Wang, X., Li, H., Wang, B., You, F., Rodríguez, L.F., Huang, J., Ting, K.C., Ying, Y., & Lin, T. (2023). Detect and attribute the extreme maize yield losses based on spatio-temporal deep learning. *Fundamental Research*, DOI:10.1016/j.fmre.2022.05.006

[J33] Bernal, D.E., Ajagekar, A., Harwood, S.M., Stober, S.T., Trenev, D., & You, F.* (2022). Perspectives of Quantum Computing for Chemical Engineering, *AIChE Journal*, 68, e17651. **[Cover Art of June 2022 issue of *AIChE Journal*]**

[J34] Alshehri, A.S, Tula, A., You, F.*, & Gani, R.* (2022). Next Generation Pure Component Property Estimation Models: With and Without Machine Learning Techniques. *AIChE Journal*, 68, e17469.

[J35] Liang, H., Tsuei, M., Abbott, N.A., & You, F.* (2022). AI Framework with Computational Box Counting and Integer Programming Removes Quantization Error in Fractal Dimension Analysis of Optical Images. *Chemical Engineering Journal*, 446, 137058.

[J36] Alshehri, A.S, & You, F.* (2022). Deep learning to catalyze inverse molecular design. *Chemical Engineering Journal*, 444, 136669.

[J37] Ajagekar, A., Al Hamoud, K., & You, F.* (2022). Hybrid Classical-Quantum Optimization Techniques for Solving Mixed-Integer Programming Problems in Production Scheduling. *IEEE Transactions on Quantum Engineering*, 3, 3102216.

[J38] Ning, C., & You, F.* (2022). Deep Learning based Distributionally Robust Joint Chance Constrained Economic Dispatch under Wind Power Uncertainty. *IEEE Transactions on Power Systems*, 37, 191-203.

[J39] Chen, W., & You, F.* (2022). Semi-Closed Greenhouse Climate Control Under Uncertainty via Machine Learning and Data-Driven Robust Model Predictive Control. *IEEE Transactions on Control Systems Technology*, 30 (3), 1186-1197.

[J40] Niaz, H., Shams, M.H., Liu, J.J., & You, F.* (2022). Mining Bitcoins with Carbon Capture and Renewable Energy for Carbon Neutrality Across States in the USA. *Energy & Environmental Science*, 15, 3551-3570. [**Cover Art of September 2022 issue of *Energy & Environmental Science***] [**Select Media Coverage:** *Cornell Chronicle* (September 14, 2022), *Tech Xplore* (September 14, 2022), *Mirage* (September 14, 2022), *News Update* (September 14, 2022), *Vermont News* (September 14, 2022), *Morning News* (September 14, 2022), *Tech Newsboy* (September 14, 2022), *News Azi* (September 14, 2022), *AskByGeeks* (September 15, 2022), *Technology.org* (September 16, 2022), *Newswise* (September 19, 2022), *Environmental News Network* (September 19, 2022), *Barlettaweb* (September 19, 2022), *NSF News Prime* (September 19, 2022), *SmartechEnergy* (September 19, 2022), *Barlettaweb* (September 19, 2022), *AZoCleantech* (September 20, 2022), *CrypDesk* (September 25, 2022), ***Fortune*** **(September 26, 2022)**, *MoneySenator* (September 26, 2022), *Crypto News BTC* (September 26, 2022), *Evisos* (September 26, 2022).]

[J41] Zhao, X., & You, F.* (2022). Life Cycle Assessment of Microplastics Reveals Their Greater Environmental Hazards than Mismanaged Polymer Waste Losses. *Environmental Science & Technology*, 56, 16, 11780–11797.

[J42] Chen, W., & You, F.* (2022). Sustainable building climate control with renewable energy sources using nonlinear model predictive control. *Renewable & Sustainable Energy Reviews*, 168, 112830.

[J43] Ajagekar, A., & You, F.* (2022). Quantum computing and quantum artificial intelligence for renewable and sustainable energy: A emerging prospect towards climate neutrality. *Renewable & Sustainable Energy Reviews*, 165, 112493.

[J44] Zhao, N., & You, F.* (2022). Sustainable power systems operations under renewable energy induced disjunctive uncertainties via machine learning-based robust optimization. *Renewable & Sustainable Energy Reviews*, 161, 112428.

[J45] Hu, G., & You, F.* (2022). Renewable energy-powered semi-closed greenhouse for sustainable crop production using model predictive control and machine learning for energy management. *Renewable & Sustainable Energy Reviews*, 168, 112790.

[J46] Tian, X., Zhou, Y., Morris, B., & You, F.* (2022). Sustainable design of Cornell University campus energy systems toward climate neutrality and 100% renewables. *Renewable & Sustainable Energy Reviews*, 161, 112383.

[J47] Zhao, X., Klemeš, J.J., & You, F.* (2022). Energy and environmental sustainability of waste personal protective equipment (PPE) treatment under COVID-19. *Renewable & Sustainable Energy Reviews*, 153, 111786. [**Select Media Coverage:** *Cornell Chronicle* (January 27, 2022), *Tech Xplore* (January 27, 2022), *DigitalGarner* (January 27, 2022), *NewsTime* (January 27, 2022), *Newsaxes* (January 27, 2022), *Ghana On 24 News* (January 27, 2022), *AZoNetwork* (January 28,

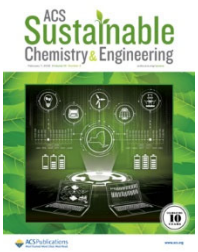
2022), *Lab Manager* (January 28, 2022), *Waste Today* (January 31, 2022), *Laboratory Equipment* (January 31, 2022), *India Education* (January 31, 2022), *Waste Advantage* (February 1, 2022), ***Newsweek*** (February 1, 2022), *Sustainability Matters* (February 3, 2022), *LocalSyr* (February 10, 2022), *WETM* (February 10, 2022), *NEWS10 ABC* (February 11, 2022), *EnviroTec Magazine* (March 7, 2022), ***Popular Science*** (March 24, 2022), *GovInsider* (May 19, 2022).]

[J48] Chen, W., Mattson, N.S., & You, F.* (2022). Intelligent control and energy optimization in controlled environment agriculture via nonlinear model predictive control of semi-closed greenhouse. *Applied Energy*, 320, 119334.

[J49] Yang, S., Gao, H.O., & You, F.* (2022). Model Predictive Control in Phase-Change-Material-Wallboard-Enhanced Building Energy Management Considering Electricity Price Dynamics. *Applied Energy*, 326, 120023.

[J50] Yang, S., Gao, H.O., & You, F.* (2022). Model Predictive Control for Demand- and Market-Responsive Building Energy Management by Leveraging Active Latent Heat Storage. *Applied Energy*, 327, 120054.

[J51] Zhao, N., & You, F.* (2022). Toward Carbon-Neutral Electric Power Systems in the New York State: a Novel Multi-Scale Bottom-Up Optimization Framework Coupled with Machine Learning for Capacity Planning at Hourly Resolution. *ACS Sustainable Chemistry & Engineering*, 10, 1805–1821. **[Cover Art of February 2022 issue of *ACS Sustainable Chemistry & Engineering*]** [**Select Media Coverage:** *Cornell Chronicle* (February 23, 2022), *Tech Xplore* (February 23, 2022), *Mirage.News* (February 23, 2022), *EQ Mag Pro* (February 25, 2022), *Energy Tower* (February 25, 2022), *India Education* (February 26, 2022), *Technology.org* (February 27, 2022), ***Communications of the ACM*** (March 3, 2022).]



[J52] Sun, L., Kaufman, M.F., Sirk, E.A., Durgaa, S., Mahowald, N.M., & You, F.* (2022). COVID-19 impact on an academic Institution's greenhouse gas inventory: The case of Cornell University. *Journal of Cleaner Production*, 363, 132440. [**Select Media Coverage:** *Cornell Chronicle* (June 29, 2022), *India Education* (June 30, 2022), *Environmental News Network* (July 6, 2022), *Tompkins Weekly* (July 13, 2022), *Anthropocene Magazine* (July 19, 2022), *AZoCleantech* (July 7, 2022).]

[J53] Niaz, H., Liu, J.J., & You, F.* (2022). Can Texas mitigate wind and solar curtailments by leveraging bitcoin mining? *Journal of Cleaner Production*, 364, 132700.

[J54] Zhao, X., Klemeš, J.J., Saxon, M., & You, F.* (2022). How sustainable are the biodegradable medical gowns via environmental and social life cycle assessment? *Journal of Cleaner Production*, 380, 135153. [**Select Media Coverage:** *Cornell Chronicle* (December 15, 2022), *Phys.org* (December 16, 2022), *ScienceDaily* (December 20, 2022), *AZoCleantech* (December 21, 2022), *Hindustan Times* (December 21, 2022), *MINT* (December 21, 2022), *Lokmat Times* (December 21, 2022), *ResearchMD* (December 22, 2022), *Medindia* (December 22, 2022), *Digital Journal* (December 24, 2022), *MedicalUpdateOnline* (December 24, 2022), *QS Study* (December 24, 2022), *Study Finds* (December 27, 2022), *Tech Explorist* (December 29, 2022), *India Education* (January 3, 2023), *Current Science Daily* (January 3, 2023), *SciTechDaily* (January 28, 2023).]

[J55] Alshehri, A.S, & You, F.* (2022). Machine learning for multiscale modeling in computational molecular design. *Current Opinion in Chemical Engineering*, 36, 100752.

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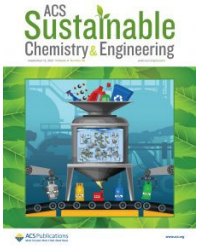

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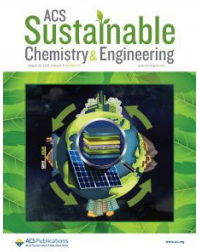

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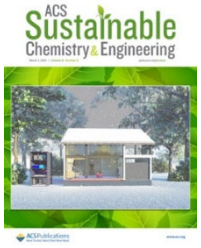

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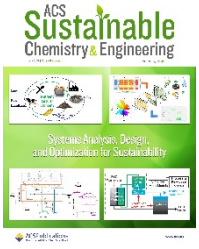

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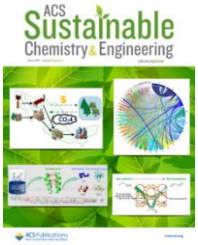

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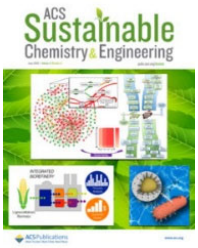

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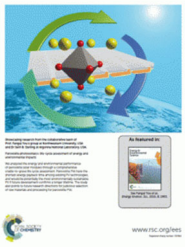

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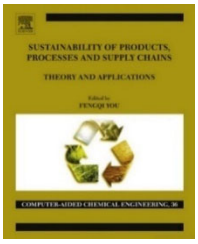

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- *Herald* (September 1, 2022; September 19, 2023)
- *Hindustan Times* (December 21, 2022)
- *Jersey Tribune* (June 25, 2015), *Evanston Tribal* (October 14, 2011), *Chicago Inno* (July 9, 2015; July 20, 2015), *Asharq Al-awsat* (February 12, 2019), *WKBW Buffalo* (April 22, 2020), *MPNnow* (April 22, 2020), *Fox 40* (April 22, 2020), *Toronto Sun* (August 7, 2021), *Nigeria On 24 News* (December 9, 2021), *ESI Africa* (December 11, 2021), *The Denver Channel* (December 21, 2021), *California News Times* (December 21, 2021), *USPOST* (December 21, 2021), *WTVB* (January 28, 2022), *KFGO* (January 28, 2022), *WIKY* (January 28, 2022), *WSAU-AM* (January 28, 2022), *WKZO* (January 28, 2022), *WHBL* (January 28, 2022), *Toronto Telegraph* (April 14, 2022), *Iosco County News Herald* (April 25, 2022), *The Independent* (May 7, 2022), *Tompkins Weekly* (July 13, 2022), *Vermont News* (September 14, 2022), *WENY* (November 28, 2022), *KrAsia* (September 26, 2023), *L'Indépendant* (September 19, 2023).

Technical Media

- *Science Daily* (May 29, 2014; June 25, 2015; July 20, 2015; October 17, 2016; August 30, 2018; July 19, 2019; August 3, 2020; December 18, 2020; June 24, 2021; September 20, 2021; November 9, 2021; December 20, 2022; April 11, 2023; June 14, 2023; July 10, 2023; September 18, 2023)
- *R&D Magazine* (February 8, 2011; May 30, 2014; June 26, 2015; July 21, 2015; October 27, 2016)
- *Popular Science* (March 24, 2022; May 31, 2022)
- *Chemistry World* (February 8, 2011; June 10, 2014; August 17, 2015; February 16, 2016; June 21, 2016)
- *ChemistryViews* (May 5, 2015)
- *American Institute of Physics Inside Science* (November 7, 2016)
- *DOE - Science - ASCR - Monthly News* (January 2011)
- *Phys.Org* (May 29, 2014; June 25, 2015; July 21, 2015; October 17, 2016; August 30, 2018; February 6, 2019; July 17, 2019; October 22, 2020; September 20, 2021; December 16, 2021; December 16, 2022; May 8, 2023; September 18, 2023)
- *Materials Today* (July 29, 2015; November 2, 2016)
- *Tech Xplore* (February 6, 2019; August 3, 2020; December 18, 2020; June 24, 2021; September 29, 2021; November 8, 2021; January 27, 2022; February 23, 2022; September 14, 2022; March 9, 2023; April 11, 2023; June 14, 2023; June 15, 2023; July 10, 2023)
- *Inside Higher Ed* (August 3, 2022)
- *PhysicsCentral* (November 14, 2016)
- *Marketplace* (December 27, 2021)
- *Mongabay* (January 4, 2022; April 20, 2023; September 6, 2023)
- *The Conversation* (April 14, 2022)
- *Global Advisors* (April 14, 2022)
- *Geography Directions* (April 21, 2022)
- *Anthropocene Magazine* (July 19, 2022; March 21, 2023; September 19, 2023)

ClickGreen (May 29, 2014), *Today's Energy Solutions* (February 14, 2011), *PV Magazine* (June 2, 2014; June 30, 2021; March 20, 2023), *Photonics* (May 30, 2014), *Manufacturing.Net* (June 26, 2015), *ChemInfo*

(June 26, 2015), *Science Island* (July 21, 2015), *Science Newsline* (May 29, 2014; June 26, 2015), *ScienceBlog* (May 30, 2014), *Green Building Elements* (May 29, 2014), *ClimateWire* (June 4, 2014), *Renewable Energy World* (June 5, 2014), *Technobahn* (May 29, 2014), *Softpedia* (May 30, 2014), *SiliconIndia* (May 30, 2014), *Nanowerk* (May 30, 2014; July 20, 2015; April 11, 2023), *Manufacturers' Monthly* (May 30, 2014), *PCBDesign* (June 1, 2014), *Solar Daily* (June 1, 2014; July 7, 2021; March 13, 2023), *Solar Power Today* (June 2, 2014), *Daily Fusion* (June 2, 2014), *PV Buzz* (June 5, 2014), *TechNews* (August 29, 2014; July 13, 2021), *Peak Oil News* (June 2, 2014), *Chinatopix* (June 2, 2014), *Hot Air* (June 3, 2014), *Daily Energy Dump* (June 4, 2014), *Topix* (May 30, 2014), *SolarBe* (June 2, 2014), *EnergyTrend* (June 3, 2014), *QualEnergia* (June 9, 2014), *Nextgen* (May 30, 2014; August 7, 2015), *Devon Eco Energy* (June 25, 2014), *Renewable Energy Jobs* (February 7, 2011), *Sun and Wind Energy* (February 9, 2011), *Photovoltaik-Kosten* (February 11, 2011), *SciGuru.com* (February 12, 2011), *Green Future Energy* (February 13, 2011), *Solar Server* (February 10, 2011), *Solar Knowledge* (February 19, 2011), *Electronics News* (February 9, 2011), *Scandinavian Oil-Gas Magazine* (February 9, 2011), *Marcellus Drilling News* (June 25, 2015), *My Solar News* (February 10, 2011), *Solar Energy Guide* (February 13, 2011), *BioFuels Journal* (June 13, 2013), *Biomass Magazine* (July 22, 2013), P*rocurement Insight* (March 16, 2011), *Military Technologies News* (June 25, 2015), *ECN Magazine* (June 26, 2015), *Oil Gas Daily* (June 28, 2015), *ECN Magazine* (July 20, 2015), *I-Connect007* (July 21, 2015), *Science and Technology Research News* (July 20, 2015), *Technology.org* (July 22, 2015; February 27, 2022; September 16, 2022; May 14, 2023; June 24, 2023), *Nanotechnology Now* (July 20, 2015), *Solarify* (July 25, 2015; September 25, 2021), *Relia Wire* (July 21, 2015), *Manufacturing Business Technology* (June 29, 2015), *Silicon Public* (August 6, 2015), *Energy Harvesting Journal* (August 7, 2015), *PlanetSave* (July 28, 2015), *Space Daily* (October 26, 2016), *Network for Business Sustainability* (August 2, 2017), *Investing News Network* (April 30, 2018), *The Maritime Executive* (August 30, 2018), *Ingeniøren* (August 31, 2018), *Sciences et Avenir* (August 31, 2018), *Eurasia Review* (September 1, 2018), *AZoCleantech* (September 3, 2018; December 17, 2021; April 27, 2022; July 7, 2022; September 20, 2022; December 21, 2022; March 16, 2023; April 12, 2023; May 8 , 2023; July 11, 2023), *Gazette Byte* (September 3, 2018), *Futurity: Research News* (February 5, 2019), *Lab Manager* (February 5, 2019; July 22, 2019; September 21, 2021; December 17, 2021; January 28, 2022; September 19, 2023), *ScienceBlog* (February 5, 2019), *Environmental News Network* (February 6, 2019; July 19, 2019; June 25, 2021; July 6, 2022; September 19, 2022; March 10, 2023), *Energy Daily* (February 7, 2019), *Engineering.com* (February 7, 2019), *Market Business News* (February 7, 2019), *Green News* (February 7, 2019), *Tech2.Org* (February 7, 2019), *Energy Manager Today* (February 7, 2019), *Technology Networks* (February 7, 2019; September 21, 2021; November 10, 2021; September 19, 2023), *Knowridge* (February 7, 2019), *15 Minute News* (February 7, 2019), *Brightsurf* (February 7, 2019), *Engerati* (February 7, 2019), *TechZiffy* (May 21, 2019), *Water Online* (July 17, 2019), *Ruminantia* (July 19, 2019), *Eurasia Review* (July 20, 2019), *Water Canada* (July 22, 2019), *Sonnenseite* (July 25, 2019), *DairyBusiness* (July 25, 2019), *Post Journal* (July 30, 2019), *Ars Technica* (October 1, 2019), *Medical Xpress* (April 23, 2020), *News AKMI* (July 31, 2020), *ScienceNewsNet* (August 3, 2020; September 20, 2021; November 9, 2021; July 10, 2023), *NewsWise* (August 2, 2020; October 8, 2020; June 24, 2021; September 20, 2021; November 9, 2021; December 16, 2021; August 31, 2022; September 19, 2022; March 10, 2023; April 11, 2023; May 8 , 2023; *Newswise*), *Plug-In Solar* (August 3, 2020), *Scienmag* (August 3, 2020; June 24, 2021; April 11, 2023; July 10, 2023; September 18, 2023), *7thSpace* (August 3, 2020), *Everydaynews* (August 4, 2020), *Sortiwa* (August 4, 2020), *Knowridge* (August 4, 2020), *RealClearEnergy* (August 5, 2020), *Innovation Toronto* (August 5, 2020), *NCYT* (August 5, 2020), *Energy in Demand* (August 8, 2020), Climax News Room (August 9, 2020), *Printed Electronics World* (August 10, 2020), *All About Circuits* (August 19, 2020), *WRAL TechWire* (October 21, 2020), *Mirage News* (June 25, 2021; September 20, 2021; November 8, 2021; December 16, 2021; February 23, 2022; September 14, 2022; June 14, 2023; June 15, 2023), *List.Solar* (June 26, 2021), *Daily Solar Power News* (June 26, 2021), *EcoInventos* (June 27, 2021), *PVbuzz* (June 27, 2021), *Printed Electronics World* (June 28, 2021), *DeepTech* (August 6, 2021), *MIT Technology Review* (August 6, 2021, November 17, 2021), *ANI News* (September 26, 2021), *Big News Network* (September 21, 2021; December 21, 2021; April 14, 2022), *True Viral News* (September 21, 2021), *Dailyhunt* (September 21, 2021), *Chem Europe* (September 22, 2021; December 22, 2021), *New Kerala*

(September 22, 2021), *Waste Advantage Magazine* (September 22, 2021; February 1, 2022), *Devdiscourse* (September 26, 2021; January 28, 2022; April 15, 2022), *LatestLY* (September 26, 2021), *DailyHunt* (September 26, 2021), *The Hindustan Times* (September 27, 2021), *News4Social* (September 27, 2021), *RepublicWorld* (September 27, 2021), *Waste Management World* (September 28, 2021), *The Times of Truth* (September 28, 2021), *HPCwire* (September 30, 2021), *Roxxcloud* (September 29, 2021), *The Hack Posts* (September 29, 2021; November 8, 2021), *The Logical Indian* (September 29, 2021), *MCUTimes* (September 29, 2021), *QNewsHub* (September 30, 2021), *Energy Metal News* (September 30, 2021), *Tech Orange* (October 1, 2021), *Smart Energy* (October 1, 2021), *European Business Press* (October 4, 2021), *New York Ag Connection* (October 5, 2021), *Energy Central* (November 13, 2021), *AZoM* (November 12, 2021), *TechiAI* (November 13, 2021), *ESI Africa* (December 11, 2021), *Technology.org* (December 12, 2021), *Innovation News Network* (December 13, 2021), *Wonderful Engineering* (December 14, 2021; September 19, 2023), *Kavli Foundation* (December 16, 2021), *Market Research Biz Reports* (December 21, 2021), *TrueViralNews* (December 16, 2021), *E-ACADEMY* (December 17, 2021), *News Concerns* (December 17, 2021), *Newsaxes* (December 17, 2021; January 27, 2022), *Verve Times* (December 17, 2021; July 10, 2023), *TweakTown* (December 17, 2021), *NNM.WORLD* (December 18, 2021), *P-Education* (December 19, 2021), *Axios* (December 20, 2021), *Green Savers* (December 20, 2021), *24Tech.dk* (December 20, 2021), *Yumda* (December 21, 2021), *Sustainability Times* (December 21, 2021), *Bionity* (December 22, 2021), *Somag News* (December 23, 2021), *EcoPortal* (December 26, 2021), *Future Timeline* (December 29, 2021), *El Confidencial* (January 3, 2022), *EnviroLink* (January 4, 2022), *Eco-Business* (January 5, 2022), *ZME Science* (January 5, 2022), *News Logged* (January 5, 2022), *The Planetary Press* (January 11, 2022), *Covering Climate Now* (January 12, 2022), *The Energy Mix* (January 13, 2022), *The Indian Wire* (January 16, 2022), *Stuff* (January 17, 2022), *Business Standard* (January 28, 2022), *Sharenet* (January 28, 2022), *DailyAdvent* (January 28, 2022), *GreenBiz* (February 1, 2022), *Aron Health* (February 1, 2022), *News of the World* (February 1, 2022), *Callaway Climate Insights* (February 1, 2022), *DigitalGarner* (January 27, 2022), *NewsTime* (January 27, 2022), *AZoNetwork* (January 28, 2022), *Waste Today* (January 31, 2022), *Laboratory Equipment* (January 31, 2022), *India Education* (January 31, 2022; February 26, 2022; June 30, 2022; November 10, 2022), , *Sustainability Matters* (February 3, 2022), *LocalSyr* (February 10, 2022), *WETM* (February 10, 2022), *NEWS10 ABC* (February 11, 2022), *EQ Mag Pro* (February 25, 2022), *Energy Tower* (February 25, 2022), *EnviroTec Magazine* (March 7, 2022), *Habere Guven* (April 17, 2022), *Fast Company* (April 18, 2022), *Green Building Africa* (April 18, 2022), *BusinessFast* (April 18, 2022), *BusinessMayor* (April 18, 2022), *The Next Web* (April 18, 2022), *Interesting Engineering* (April 23, 2022), *KPVI* (April 25, 2022), *New India Tech* (April 27, 2022), *Tech Register* (May 7, 2022), *Environmental News Bits* (May 17, 2022), *Engineers Ireland* (May 23, 2022), *Batteries News* (June 6, 2022), *News Update* (September 14, 2022), *Morning News* (September 14, 2022), *Tech Newsboy* (September 14, 2022), *News Azi* (September 14, 2022; March 10, 2023; June 14, 2023; June 15, 2023; July 10, 2023), *AskByGeeks* (September 15, 2022), *Barlettaweb* (September 19, 2022), *NSF News Prime* (September 19, 2022), *SmartechEnergy* (September 19, 2022), *Barlettaweb* (September 19, 2022), *CrypDesk* (September 25, 2022), *MoneySenator* (September 26, 2022), *Crypto News BTC* (September 26, 2022), *Evisos* (September 26, 2022), *ZME Science* (October 19, 2022; September 20, 2023), *Lokmat Times* (December 21, 2022), *MINT* (December 21, 2022), *ResearchMD* (December 22, 2022), *Medindia* (December 22, 2022), *Digital Journal* (December 24, 2022), *MedicalUpdateOnline* (December 24, 2022), *QS Study* (December 24, 2022), *Study Finds* (December 27, 2022), *Tech Explorist* (December 29, 2022), *India Education* (January 3, 2023), *Current Science Daily* (January 3, 2023), *AZoRobotics* (January 10, 2023), *The Engineer* (January 13, 2023), *NBIC+* (January 13, 2023), *SciTechDaily* (January 28, 2023), *TechNewsBoy* (March 10, 2023), *Today Headline* (March 10, 2023; June 15, 2023), *Utility Dive* (March 16, 2023), *electrek* (March 25, 2023), *Daily Tidings* (April 9, 2023), *SpaceDaily* (April 12, 2023), *Rinnovabili* (April 12, 2023), *Homeland Security News Wire* (April 13, 2023), *Swift Telecast* (April 14, 2023), *Green Car Congress* (April 17, 2023), *Rinnovabili* (April 17, 2023), *greenreport* (April 17, 2023), *mining.com* (April 18, 2023), *wpn.pl* (April 18, 2023), *CleanTechnica* (May 9, 2023), *TheBigCircuit* (May 14, 2023), *Knowledia* (June 15, 2023), *Verve Times* (June 17, 2023), *Swift Telecast* (June 17, 2023), *DT Next* (June 17, 2023), *Hubli Express* (June 17, 2023), *Digital Information World* (June 18, 2023),

Environmental Leader (June 19, 2023), *Ahmedabad Mirror* (June 19, 2023), *News9 Live* (June 19, 2023), *NFTevening* (June 20, 2023), *Smart Energy International* (June 26, 2023), *Tech Times* (July 11, 2023), *Swift Telecast* (July 11, 2023; September 19, 2023), *Scitech Daily* (August 27, 2023), *The Science Times* (August 28, 2023; September 19, 2023), *My Droll* (September 19, 2023), *Business Mayor* (September 19, 2023), *Daily Kos* (September 19, 2023), *WION* (September 19, 2023), *Today Headline* (September 19, 2023), *Stern* (September 19, 2023), *Weekly Voice* (September 19, 2023), *Prokerala* (September 19, 2023), *East Coast Daily* (September 19, 2023), *The Telegraph* (September 19, 2023), *Centre Times Daily* (September 19, 2023), *The Olympian* (September 19, 2023), (September 19, 2023), *Entrepreneur* (September 19, 2023), *The Costa Rica News* (September 27, 2023).

PROFESSIONAL SERVICE

- **Journal Editorial Role**
    - Associate Editor*, Science Advances,* 2020 – present
    - Associate Editor*, IEEE Transactions on Control Systems Technology*, 2020 – present
    - Consulting Editor*, AIChE Journal,* 2017 – present
    - Editor, *Computers & Chemical Engineering*, 2018 – present
    - Editorial Board Member, *ACS Sustainable Chemistry & Engineering,* 2017 – present
    - Field Chief Editor, *Frontiers in Chemical Engineering,* 2019 – present
    - Editorial Board, *PRX Energy*, 2021-present
    - Editorial Board, *IEEE Quantum Computing Newsletter*, 2021- present
    - Subject Editor, *Advances in Applied Energy*, 2021-present
    - Editorial Advisory Board, *Industrial & Engineering Chemistry Research*, 2019 – present
    - Guest Editor, *ACS Sustainable Chemistry & Engineering,* 2017 – 2018
    - Guest Editor, *Energy,* 2018 – 2019
    - Guest Editor, *Renewable & Sustainable Energy Review,* 2021 – present
    - Guest Editor, *Journal of Cleaner Production,* 2021 – present
    - Editorial Board Member, *Computers & Chemical Engineering*, 2015 – present

- **Conference Committees**
    - International Programming Committee, Winter Simulation Conference (WSC), 2023.
    - Scientific Committee and Theme Coordinator, the 33th European Symposium on Computer Aided Process Engineering (ESCAPE-33), 2023
    - Scientific Planning Committee, ACS Campaign for a Sustainable Future, 2022
    - International Program Committee, 11th Symposium on Control of Power and Energy Systems (CPES), 2022
    - International Program Committee, 13th IFAC Symposium of Dynamics and Control of Process Systems (DYCOPS), 2022
    - Scientific Committee, the 32nd European Symposium on Computer Aided Process Engineering (ESCAPE-32), 2022
    - International Programming Committee, 11th International Symposium on Advanced Control of Chemical Processes (ADCHEM), 2021
    - International Programming Committee, The 14th International Symposium on Process Systems Engineering (PSE), 2021

- Scientific Committee, the 31st European Symposium on Computer Aided Process Engineering (ESCAPE-31), 2021
- International Program Committee, 7th International Symposium on Advanced Control of Industrial Processes (AdCONIP), 2020
- Associate Editor, IFAC World Congress, 2020
- International Program Committee, 6th IFAC Conference on Sensing, Control and Automation Technologies for Agriculture (AgriControl 2019), 2019
- International Programming Committee, Winter Simulation Conference (WSC), 2019.
- International Scientific Committee, 17th Global Conference on Sustainable Manufacturing (GCSM), 2019
- Advisory Committee, Foundations of Process Analytics and Machine learning (FOPAM), 2019
- International Programming Committee, the 9th International Conference on Foundations of Computer-Aided Process Design (FOCAPD), 2019
- Steering Committee, 8th International Congress on Sustainability Science & Engineering (ICOSSE), 2019
- International Advisory Committee, 5th International Conference on Sustainable Chemical Product and Process Engineering (SCPPE), 2019
- Scientific Committee, the 29st European Symposium on Computer Aided Process Engineering (ESCAPE-29), 2019
- Program Committee, 6th World Congress on Global Optimization (WCGO 2019), Metz, France.
- Organizing Committee and International Scientific Committee, MIT Applied Energy Conference, 2019
- Scientific Advisory Committee, 14th Conference on Sustainable Development of Energy, Water and Environment Systems (SDEWES), 2019
- International Programming Committee, Winter Simulation Conference (WSC), 2018.
- International Programming Committee, 10th International Symposium on Advanced Control of Chemical Processes (ADCHEM), 2018
- International Program Committee, the 13th International Symposium on Process Systems Engineering (PSE-2018), 2018.
- Topic Coordinator & Scientific Committee, the 28st European Symposium on Computer Aided Process Engineering (ESCAPE-28), 2018.
- International Programming Committee, Winter Simulation Conference (WSC), 2018.
- International Scientific Committee, 16th Global Conference on Sustainable Manufacturing (GCSM), 2018
- Program Committee, 14th Int'l Global Optimization Workshop (LeGO-2018), 2018.
- Program Committee, Global Optimization Conference (GOC-2017), 2017
- Technical Advisory Committee, the 7th International Conference on Foundations of Computer-Aided Process Operations (FOCAPO), 2017.
- Scientific Advisor & International Scientific Committee, the 27st European Symposium on Computer Aided Process Engineering (ESCAPE-27), 2017.
- International Programming Committee, Winter Simulation Conference (WSC), 2017.
- International Scientific Committee, Jubilee 20th Conference Process Integration, Modelling and Optimisation for Energy Saving and Pollution Reduction (PRES'17), 2017.

- Associate Editor & International Program Committee, 6th International Symposium on Advanced Control of Industrial Processes (AdCONIP), 2017
- Scientific Committee, Workshop: PSE State of the Art, 2017
- International Advisory Committee, 4th International Conference on Sustainable Chemical Product and Process Engineering (SCPPE), 2016.
- International Scientific Committee, the 26st European Symposium on Computer Aided Process Engineering (ESCAPE-26), 2016.
- Technical Committee, International Symposium on Sustainable Systems and Technology (ISSST), 2016
- International Scientific Committee, 19th Conference Process Integration, Modelling and Optimisation for Energy Saving and Pollution Reduction (PRES 2016), 2016.
- International Programming Committee, Winter Simulation Conference (WSC), 2016.
- International Scientific Committee, the 12th International Symposium on Process Systems Engineering and 25st European Symposium on Computer Aided Process Engineering (PSE-2015/ESCAPE-25), 2015.
- International Scientific Committee, the 12th International Conference on Chemical and Process Engineering (ICheaP12), 2015.
- International Programming Committee, Winter Simulation Conference (WSC), 2015.
- International Programming Committee, the 8th International Conference on Foundations of Computer-Aided Process Design (FOCAPD), 2014.
- International Academic Committee, 3rd International Conference on Sustainable Chemical Product and Process Engineering (SCPPE), 2013.
- Scientific Committee, the 4th International Conference on Biorefinery (ICBB), 2013.
- Organizing Committee, the 6th International Conference on Foundations of Computer-Aided Process Operations (FOCAPO), 2012.

- **Panelist/Reviewer of Grant Proposals**
  - Multiple programs at National Science Foundation, 2011, 2012, 2013, 2014, 2015, 2017, 2018, 2019, 2020
    - Process and Reaction Engineering
    - Environmental Sustainability
    - SusChEM
    - Manufacturing Machines and Equipment
    - National Artificial Intelligence (AI) Research Institutes
    - Graduate Research Fellowships Program
  - Department of Energy
  - ACS Petroleum Research Fund
  - ETH Research Commission, Switzerland
  - Qatar National Research Fund
  - Ontario Research Fund, Canada
  - Ministry of Education and Science, Republic of Kazakhstan
  - Natural Sciences and Engineering Research Council, Canada
  - Engineering and Physical Sciences Research Council, UK
  - United Arab Emirates University Advanced Research Program, UAE

- Swiss National Science Foundation
- Austrian Science Fund (FWF)
- Technology Foundation STW, Netherlands
- Fondazione Cariplo, Italy
- Israeli Ministry of Science, Technology and Space
- Netherlands Organisation for Scientific Research (NWO)
- Chilean National Science and Technology Commission (CONICYT - Chile)
- São Paulo Research Foundation (FAPESP)
- Luxembourg National Research Fund (FNR)
- French National Research Agency (ANR)
- Czech Science Foundation
- Italian Medicines Agency (AIFA)
- National Research Foundation of Singapore
- National Science Center, Poland
- The Science Foundation Ireland (SFI)
- Ministry of Earth Sciences (MoES) in India
- Indian Council of Social Science Research (ICSSR)
- Dutch Research Council
- European Science Foundation

- **Reviewer for Journals** (600+ papers from 100+ journals)

  ACS Sustainable Chemistry & Engineering, AIChE Journal, Annals of Operations Research, Applied Energy, Applied Mathematical Modelling, Applied Thermal Engineering, Biochemical Engineering Journal, Biofuels, Bioproducts & Biorefining, Bioresource Technology, Catalysis Today, Chemical Engineering Communications, Chemical Engineering Research and Design, Chemical Engineering Science, Chemosphere, Computational Optimization and Applications, Computers & Chemical Engineering, Computers & Electrical Engineering, Computers & Industrial Engineering, Decision Support Systems, Energies, Energy, Energy and Buildings, Energy Conversion and Management, Energy & Environmental Science, Energy & Fuels, Environment, Development and Sustainability, Environmental Science & Technology, Environmental Technology, European Journal of Operational Research, Frontiers in Energy Research, Frontiers in Robotics and AI, Greenhouse Gases: Science and Technology, IBM Journal of Research & Development, IEEE Systems, Man and Cybernetics, IEEE Transactions on Control Systems Technology, IIE Transactions, Industrial & Engineering Chemistry Research, INFORMS Journal on Computing, International Journal of Control, International Journal of Hydrogen Energy, International Journal of Information Technology & Decision Making, International Journal of Life Cycle Assessment, International Journal of Production Research, International Journal of Production Economics, International Journal of Sustainable Engineering, Journal of Agricultural Research, Journal of Applied Mathematics, Journal of Cleaner Production, Journal of Energy Engineering, Journal of Engineering Manufacture, Journal of Global Optimization, Journal of Hazardous Materials, Journal of Heuristics, Journal of Industrial Ecology, Journal of Optimization Theory and Applications, Journal of Process Control, Journal of the Operational Research Society, Journal of the Royal Society Interface, Journal of Scheduling, Journal of Service Science and Management, Journal of System Science and System Engineering, Mathematical Problems in Engineering, Nano Energy, Nature, Nature Energy, Nature Materials, Omega, Operational Research, Operations Research, Operations Research for Health Care, Optimization and Engineering, Optimization Letters, PLOS ONE, Processes, Progress in Photovoltaics: Research and Applications,

RSC Advances, Science, Science Advances, Science of the Total Environment, Scientific Research and Essays, Sustainable Production and Consumption, Transportmetrica A: Transport Science, Transportation Research Part B, Transportation Research Part D, Transportation Research Part E, Transportation Science, Water Research

- **Reviewer for Publishers**
    - Wiley
    - Springer
    - Elsevier
    - Taylor & Francis

- **Service at Northwestern University**
    - Departmental Seminar Organizer, Department of Chemical and Biological Engineering, 2012 – 2016
    - Undergraduate Advisor, McCormick School of Engineering, 2011 – 2016
    - Graduate Admissions Committee, Department of Chemical and Biological Engineering, 2011 – 2015

- **Service at Cornell University**
    - Undergraduate Advisor, College of Engineering, 2016 - present
    - Chair of Ph.D. Studies, Systems Engineering Program, 2016 – present
    - Executive Committee, Systems Engineering Program, 2016 – present
    - Graduate Field Committee, Smith School of Chemical and Biomolecular Engineering, 2016 – present
    - Space Committee, Smith School of Chemical and Biomolecular Engineering, 2016 – present
    - Computing Committee, Smith School of Chemical and Biomolecular Engineering, 2018 – present
    - Website Committee, Smith School of Chemical and Biomolecular Engineering, 2018 – present
    - Awards Committee, Smith School of Chemical and Biomolecular Engineering, 2019 – present
    - Teaching Awards Committee, College of Engineering, 2018-2020
    - Ad Hoc Tenure Review Committee, 2017 – present
    - Faculty Search Committee, Systems Engineering Program and School of Electrical and Computer Engineering, 2017 – 2018
    - Faculty Search Committee, School of Operations Research and Information Engineering, 2017 – 2018
    - Energy Institute Strategic Planning Committee, 2017 – 2018
    - University Travel Expense Policy Committee, 2018 – present
    - Faculty Leadership Committee, Cornell Institute of Digital Agriculture, 2017 – present
    - Faculty Advisor, Cornell Energy Systems Club, 2018 – present
    - Associate Director, Cornell Energy Systems Institute, 2018 – present
    - Faculty Search Committee, Department of Computer Science and Systems Engineering Program, 2018 – 2019

- Faculty Senator on behalf of Smith School of Chemical and Biomolecular Engineering, Cornell University Faculty Senate, 2020 – 2022
- Faculty Search Committee Co-Chair, Smith School of Chemical and Biomolecular Engineering, 2021 – 2022
- CESI Director Search Committee, Cornell Energy Systems Institute (CESI), 2021 – present
- Awards & Recognitions Committee, Smith School of Chemical and Biomolecular Engineering, 2021 – present
- Communication Committee, Smith School of Chemical and Biomolecular Engineering, 2021 – present
- M.Eng. Committee, Smith School of Chemical and Biomolecular Engineering, 2021 – present
- Chair of Energy & Sustainability Graduate Admission Sub-Committee, Smith School of Chemical and Biomolecular Engineering, 2021 – present
- Associate Director, Cornell Institute of Digital Agriculture, 2021 – present
- Senior Faculty Fellow, Cornell Atkinson Center for Sustainability, 2021 – present
- Co-Director, Cornell University AI for Science Institute, 2022 – present
- Program Co-Lead, Schmidt AI in Science Fellowships at Cornell, 2022 – present

STUDENTS AND SCHOLARS MENTORED

- **Postdoctoral Researchers**
  - Xin Sun (09/2023 – present)
  - Shuangqi Li (09/2023 – present)
  - Bu Zhao (09/2023 – present)
  - Benjamin Decardi-Nelson (07/2022 – present)
  - Qianzhi Zhang (05/2022 – 06/2023)
    - Placement: Assistant Professor of ECE, University of Alabama
  - Chunbo Zhang (02/2022 – 11/2022)
    - Placement: Postdoc, University College London
  - Shiyu Yang (07/2021 – present)
    - Placement: Assistant Professor (ECE), Oregon Tech
  - Chao Ning (08/2020 – 02/2021)
    - Placement: Assistant Professor of Automation, Shanghai Jiaotong University
  - Lu Sun (04/2021 – 09/2021)
    - Placement: Associate Professor, Xi'an Jiaotong University
  - Inkyu Lee (09/2018 – 08/2019)
    - Placement: Assistant Professor, Pusan National University
  - Daison Manuel Yancy Caballero (04/2018 – 07/2020)
    - Placement: Research Scientist, National Energy Technology Laboratory
  - Chao Shang (10/2016 – 10/2018)
    - Placement: Assistant Professor, Department of Automation, Tsinghua University
  - Yunfei Chu (09/2011 – 08/2014)
    - Placement: Research Engineer, ExxonMobil Chemical
  - Berhane H. Gebreslassie (12/2011 – 09/2012)

- Placement: Research Engineer, Vishwamitra Research Institute

- **Ph.D. Students**
  - Chao Shang (08/2023 – present)
  - Bingzheng Wang (08/2023 – present)
  - Apoorv Lal (08/2023 – present)
  - Nathan Preuss (08/2022 – present)
  - Tianqi Xiao (08/2022 – present)
  - Fah Kumdokrub (08/2021 – present)
  - Anye Shi (08/2021 – present)
  - Guoqing Hu (08/2020 – present)
  - Wei-Han Chen (08/2020 – present)
  - Yanqiu Tao (08/2021 – present)
    - Thesis Title: Climate and environmental sustainability of trend toward occupational-dependent hybrid work
  - Xiang Zhao (01/2020 – present)
    - Thesis Title: Sustainable Chemical Recycling of Plastic Debris From Macro to Micro Levels
  - Xueyu Tian (09/2020 – present)
    - Thesis Title: Perovskite Materials and Scalable Manufacturing in The Era of Multi-Terawatt Photovoltaics Deployment
  - Abdulelah Alshehri (08/2019 – present)
    - Thesis Title: Deep Learning for Computational Molecular Design
  - Akshay Ajagekar (08/2018 – present)
    - Thesis Title: Quantum Computing and Quantum Artificial Intelligence for Renewable and Sustainable Energy
  - Chao Ning (12/2015 – 08/2020)
    - Thesis Title: Data-Driven Optimization Under Uncertainty in The Era of Big Data and Deep Learning: General Frameworks, Algorithms, and Applications
    - O. Hugo Schuck Award, AACC, 2020
    - SEF Student Paper Award, AIChE, 2019
    - Placement: Assistant Professor of Automation, Shanghai Jiaotong University
  - Daniel J. Garcia (03/2014 – 02/2019)
    - Thesis Title: Life Cycle Optimization of Sustainable Water-Energy-Food Nexus Systems and Networks
    - Honorable Mention, NSF Graduate Research Fellowship, 2014, 2015
    - Ryan Fellow, 2013-2015
    - ISEN Cluster Fellow, 2015-2016
    - Presidential Fellowship of Northwestern University, 2017 – 2018
    - SEF Student Paper Award, AIChE, 2018
    - Placement: Research Engineer, ExxonMobil
  - Karson T. Leperi (12/2013 – 07/2018) co-advised with Prof. Randall Q. Snurr
    - Thesis Title: Integrated Material and Process Development for Metal-Organic Frameworks in Post-Combustion Carbon Capture Applications
    - Ryan Fellow, 2013-2015

        - Placement: Systems Design Engineer, Intel
    - Jiyao Gao (12/2013 – 07/2018)
        - Thesis Title: Sustainable Design and Optimization of Shale Gas Energy Systems
        - SEF Student Paper Award, AIChE, 2017
        - Graduate Student Travel Award, CAST Division, AIChE, 2017
        - Placement: Senior Algorithm Engineer, Cardinal Operations
    - Jian Gong (12/2012 – 07/2017)
        - Thesis Title: Sustainable Design and Synthesis of Energy Systems
        - Zdenek Burianec Memorial Award, PRES, 2017
        - Placement: Senior Analyst, Goldman Sachs
    - Dajun Yue (12/2011 – 06/2016)
        - Thesis Title: Multi-Scale Optimization of Biomass-to-Bioenergy Supply Chains
        - Graduate Student Travel Award, CAST Division, AIChE, 2013
        - 3M Fellow, 2014-2015
        - Honorable Mention, SEF Student Paper Award, AIChE, 2014
        - Outstanding Self-financed Student Abroad Award, 2015
        - Distinguished Graduate Researcher Award, ChBE, Northwestern Univ., 2015
        - Placement: Operations Research Scientist, Amazon.com

- **M.S. Students**
    - Rishi Balaji (08/2022 – present)
    - Roohi Menon (08/2021 – present)
    - Vikram Raghavan (08/2021 – present)
    - Akash Ajagekar (08/2021 – present)
    - Jeet Dhoriyani (08/2021 – present)
    - Tianhong Tan (10/2021 – 10/2023)
        - Thesis Title: Soil Organic Carbon Predicted by Terrain More Than Climate
        - Placement: PhD student, Cornell University
    - Shoudong Zhu (10/2021 – 08/2023)
        - Thesis Title: Advancing sustainable development goals with machine learning and optimization for wet waste biomass to renewable energy
        - Placement: PhD student, Cornell University
    - Apoorv Lal (10/2021 – 03/2023)
        - Thesis Title: Targeting climate‐neutral hydrogen production: Integrating brown and blue pathways with green hydrogen infrastructure
        - Placement: PhD student, Cornell University
    - Jason Huang (01/2020 – 12/2022)
        - Thesis Title: Impacts of Battery Energy Storage Technologies and Renewable Integration on the Energy Transition in the New York State
        - Placement: Data Scientist, Geico
    - Yanqiu Tao (08/2018 – 10/2020)
        - Thesis Title: Second life and recycling: Energy and environmental sustainability perspectives for high-performance lithium-ion batteries
        - Placement: PhD student, Cornell University
    - Xueyu Tian (09/2017 – 10/2020)

        - Thesis Title: Carbon-neutral hybrid energy systems with deep water source cooling, biomass heating, and geothermal heat and power
        - Placement: PhD student, Cornell University
    - Wenhe Ye (12/2013 – 06/2015)
        - Placement: ATCG Solutions
    - Emeline Sukamtoh (12/2013 – 12/2014)
        - Placement: Solidarity Bridge
    - Rongzhi Xu (12/2013 – 12/2014)
        - Placement: Nielsen
    - Jian Gong (12/2012 – 11/2013)
        - Placement: PhD student, Northwestern University
    - Prasad Khatav (12/2011 – 06/2012)
        - Placement: Process Control Engineer, PiControl Solutions LLC
    - Yuan Yao (12/2011 – 10/2012)
        - Placement: Assistant Professor, Yale University
    - Victoria Perez (12/2011 – 11/2012)
        - Placement: Oak Tree Investments
    - Belinda Wang (02/2011 – 11/2012)
        - Placement: Research Scientist, Honeywell

- **M.Eng. Students**
    - Sindhuja Vaddeboina (09/2023 – 12/2023)
    - Ivan Bourov (09/2023 – 12/2023)
    - Zidong Huang (09/2023 – 05/2024)
    - Ruiyang Jiang (09/2023 – 05/2024)
    - Fanchen Kong (09/2023 – 05/2024)
    - Sanath Kumar (09/2023 – 05/2024)
    - Miaocheng Li (09/2023 – 05/2024)
    - Zekai Li (09/2023 – 05/2024)
    - Yijun Lu (09/2023 – 05/2024)
    - Teppei Matsutake (09/2023 – 05/2024)
    - Han Meng (09/2023 – 05/2024)
    - James Jun Hao Ong (09/2023 – 05/2024)
    - Kaili Sun (09/2023 – 05/2024)
    - Fengkai Tang (09/2023 – 05/2024)
    - Allison Virgo (09/2023 – 05/2024)
    - Shuchen Wu (09/2023 – 05/2024)
    - Tongze Xu (09/2023 – 05/2024)
    - Jieying Yang (09/2023 – 05/2024)
    - Rui Yang (09/2023 – 05/2024)
    - Jacob Lashin (01/2023 – 05/2023)
    - Hao Chen (09/2022 – 05/2023)
    - Wooyoung Cho (09/2022 – 05/2023)
    - Sizhe Gao (09/2022 – 05/2023)
    - Shuxian Jiang (09/2022 – 05/2023)

- Xiang Lan (09/2022 – 05/2023)
- Xingze Li (09/2022 – 05/2023)
- Ziyuan Lin (09/2022 – 05/2023)
- Yifan Liu (09/2022 – 05/2023)
- Zihao Liu (09/2022 – 05/2023)
- Anusha Nambiar (09/2022 – 05/2023)
- Kingsley Odae (09/2022 – 05/2023)
- Xuning Shao (09/2022 – 05/2023)
- Kailing Shen (09/2022 – 05/2023)
- Zhongqi Tao (09/2022 – 05/2023)
- Jinxuan Wang (09/2022 – 05/2023)
- Yuning Xia (09/2022 – 05/2023)
- Xin Zhang (09/2022 – 05/2023)
- Yunquan Zhang (09/2022 – 05/2023)
- Zhiyuan Zhang (09/2022 – 05/2023)
- Weizhe Zhao (09/2022 – 05/2023)
- Xi Zhao (09/2022 – 05/2023)
- Xianmin Zhao (09/2022 – 05/2023)
- Keyi Zhou (09/2022 – 05/2023)
- Yuting Zhou (09/2022 – 05/2023)
- Guanlin Zhu (09/2022 – 05/2023)
- Sarah Alruwaily (09/2022 – 05/2023)
- Sanjana Namreen (09/2022 – 05/2023)
- Emily Chou (09/2022 – 12/2022)
- Rachel Lee (09/2022 – 12/2022)
- Yousef Dakhel Aloufi (01/2022 – 05/2022)
- Naif Alghamdi (01/2022 – 05/2022)
- Bryan Tantisujjatham (09/2021 – 05/2022)
- Ruobing Shui (09/2021 – 05/2022)
- George Pan (09/2021 – 05/2022)
- Owais Khalid (09/2021 – 05/2022)
- Sindhu Iyer (09/2021 – 05/2022)
- Jinyang Dai (09/2021 – 05/2022)
- Chenghui Li (09/2021 – 05/2022)
- Nuo Tan (09/2021 – 05/2022)
- Ziyin Wang (09/2021 – 05/2022)
- Rong Xu (09/2021 – 05/2022)
- Haiyang Yu (09/2021 – 05/2022)
- Mingkai Zheng (09/2021 – 05/2022)
- Hanxin Yu (01/2021 – 05/2021)
- Ruobing Shui (09/2020 – 12/2020)
- Chang Wei (09/2020 – 12/2020)
- Ruby Jin (09/2020 – 12/2020)
- Shristi Varshney (09/2020 – 12/2020)

- Raaj Bora (08/2018 – 08/2020)
- Khalid Fihat Alanazi (01/2020 – 12/2020)
- Karthik Suresh Menon (01/2020 – 12/2020)
- Anmol Singh (01/2020 – 12/2020)
- Jianmin Su (01/2020 – 12/2020)
- Yangmengyuan Zhao (09/2019 – 05/2020)
- Xinyi Cai (09/2019 – 05/2020)
- Tiancheng Yuan (09/2019 – 05/2020)
- Shivam Tewari (09/2019 – 05/2020)
- Yuhua Ma (09/2019 – 05/2020)
- Xinni Cheng (09/2019 – 05/2020)
- Akshit Patel (09/2019 – 05/2020)
  - Outstanding M. Eng. Project Award (Spring 2021)
- Jessica Hwang (09/2019 – 05/2020)
- Yiying Sheng (09/2019 – 05/2020)
- Alwin Thomas (09/2019 – 05/2020)
  - Outstanding M. Eng. TA Award (Spring 2021)
  - Placement: Merck
- Boru Wang (09/2019 – 05/2020)
- Lesley Sun (09/2019 – 05/2020)
- Venkat Akshay Chintalapati (09/2019 – 05/2020)
- Brian Davey (09/2019 – 05/2020)
- Tigran Mehrabyan (09/2019 – 12/2019)
  - Outstanding M. Eng. Project Award (Fall 2020)
- Raaj Bora (01/2019 – 08/2020)
- Jiwei Yao (01/2019 – 08/2020)
- Siming Zou (01/2019 – 12/2019)
- Allen Yang (01/2019 – 12/2019)
- Aasim Ayaz Wani (01/2019 – 12/2019)
- Sivaji Gudipati (01/2019 – 12/2019)
- Yuan Jiang (09/2018 – 12/2019)
- Minghan Shi (01/2019 – 05/2019)
- Tsung-Hsun Lin (09/2018 – 05/2019)
- Jiahe Zhou (09/2018 – 05/2019)
- Deeksha Anand (09/2018 – 05/2019)
- Xuyang Xiao (09/2018 – 05/2019)
- Chengnan Xu (09/2018 – 05/2019)
- Yiqi Shao (09/2018 – 05/2019)
- Heena Ugale (09/2018 – 05/2019)
- Yiyang Huang (09/2018 – 05/2019)
- Wei Shih Tu (09/2018 – 05/2019)
- Varun Harnathka (09/2018 – 05/2019)
- Rosa Wu (09/2018 – 05/2019)
- Qixuan Li (09/2018 – 05/2019)

        - Outstanding M. Eng. Project Award (Spring 2019)
    - Mengyun Wang (09/2018 – 05/2019)
    - Tian Yu (09/2018 – 05/2019)
    - Zeyu Zhang (09/2018 – 05/2019)
    - Yifan Zhu (09/2018 – 05/2019)
    - Ziqi Wang (09/2018 – 05/2019)
    - Zhaoqi Song (09/2018 – 05/2019)
    - Lianghui Li (09/2018 – 12/2018)
    - Jieneng Yang (09/2018 – 12/2018)
    - Mengyu Ye (09/2018 – 12/2018)
    - Wei-Han Chen (09/2017 – 05/2018)
        - Outstanding M. Eng. Project Award (Spring 2018)
    - Raquel R Mayorga (03/2018 – 05/2018)
    - Haokai Huang (09/2017 – 05/2018)
    - Xinyan Bai (09/2017 – 05/2018)
    - Xiu Wang (09/2017 – 05/2018)
    - Jun Yang (09/2017 – 05/2018)
    - Natalia L. Juncua (09/2017 – 05/2018)
    - Azhir Barodawala (09/2017 – 05/2018)
    - Schuyler Gardner (09/2017 – 12/2017)
        - Outstanding M. Eng. Project Award (Fall 2017)
        - Placement: Celgene
    - Kenny Wronka (09/2016 – 05/2017)
    - Ivy Lai Miller (09/2016 – 05/2017)
        - Outstanding M. Eng. TA Award (Spring 2017)
        - Placement: Symetra Financial
    - Imran Yasin (09/2016 – 05/2017)
        - Outstanding M. Eng. Project Award (Spring 2017)
        - Placement: BASF
    - Aqdas Nida (09/2016 – 05/2017)
        - Placement: Commonwealth Edison
    - Bingqing Ma (09/2016 – 12/2016)
        - Placement: Cornell CS PhD program
    - Minhao Li (09/2016 – 12/2016)
        - Outstanding M. Eng. Project Award (Fall 2016)
    - Mandy Teng (09/2016 – 12/2016)
        - Placement: Merck
    - Yuting Tian (09/2016 – 12/2016)