

CLIENT ADVISORY BOARD



SMITHGROUP

NAVIGATING THE IMPACTS OF

ARTIFICIAL INTELLIGENCE & ENERGY IN RESEARCH-DRIVEN ORGANIZATIONS

VISIONARY LEADERS EXPLORE THE POWER AND
THE POTENTIAL OF AI WITHIN THEIR INDUSTRIES

THE RAPID EVOLUTION OF ARTIFICIAL INTELLIGENCE WILL RESHAPE RESEARCH AS WE KNOW IT. HOW CAN WE ANTICIPATE AND GUIDE WHAT THIS MEANS FOR OUR RESEARCH ENVIRONMENTS AND THE EXPANDED ENERGY CAPACITY THAT AI DEMANDS?



“We have an opportunity to define what being human is uniquely and what our value in this new world will be.”

CHRIS TIDRICK
CIO, GIES BUSINESS SCHOOL | CHAIR, GENERATIVE
AI SOLUTIONS HUB, UIUC

THE ARTIFICIAL INTELLIGENCE AND ENERGY CLIENT ADVISORY BOARD gathered a compelling think tank of experts who are facing first-hand the often-intangible impacts of artificial intelligence within their fields. Together with SmithGroup’s Science & Technology, Engineering and Climate Action leadership, we explored the critical issues, opportunities and challenges AI and its energy demands might pose for research organizations.

The discussions revealed the many ways organizations are already benefitting from AI in their current operations, as well as noting some uncertainties about its applications. The development of clean energy infrastructure emerged as one key factor in sustaining AI’s growth. This and other peer insights gave participants new ideas and incentives for how they might optimize AI to advance the next generation of research.





WATCH THE VIDEO RECAP HERE.

SmithGroup is grateful to these leading organizations who joined us for a deep-thinking discussion about the implications of artificial intelligence (AI), a topic often shrouded in uncertainty. The conversations helped define how AI might impact their organizations, research environments, our climate, and society as a whole.

NASA

ASSOCIATION OF EDISON COMPANIES

UNIVERSITY OF ILLINOIS
URBANA CHAMPAIGN

UNIVERSITY OF ARIZONA

WESTINGHOUSE

DREXEL UNIVERSITY

CRUISE



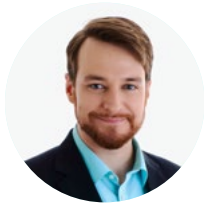


THE EFFECTS OF AI ON PEOPLE AND THE PHYSICAL ENVIRONMENT

HOW WILL THE INTEGRATION OF ARTIFICIAL INTELLIGENCE IN RESEARCH ENVIRONMENTS TRANSFORM THE ROLE OF HUMAN RESEARCHERS AND THE NATURE OF SCIENTIFIC DISCOVERY?

WE KNOW THE ARRIVAL OF AI to scientific research environments is underway and we fully expect it to be transformative. The question remains how can we most effectively integrate AI and its rapidly advancing related technologies with the humans that are already operating there? What are the ethical and social implications?

The Client Advisory Board embarked on thought-provoking conversations about the impact humanoid robotics, augmented and virtual reality, and other technologies might have on researchers and research environments.



“With AI tool building, 80% of what most organizations need is very similar. The last 5% is specific to your use case and that’s where your IP lives.”

JAMES VILLARRUBIA
CTO | APPLIED AI EXPERT | PRESIDENTIAL INNOVATION FELLOW, NASA



AUGMENTED & VIRTUAL REALITY

CURRENT USES AND BENEFITS

Researchers are already using AR and VR technologies for data collection, simulation and monitoring brain activity. AR and VR also enhance remote interactions and virtual collaboration.

CHALLENGES AND FUTURE NEEDS

Today’s AR/VR devices are bulky and not mainstream. Future form factors and iterations need to become as user-friendly and ubiquitous as smartphones. Tech is partnering with fashion to influence this.

EMERGING TECHNOLOGIES AND ADOPTION

Digital twins (a virtual replica of a physical object, system, process, or person) enhance data visualization and infrastructure management; future potential to dynamically change the workplace as we know it.

POSSIBLE NEXT STEPS

- **Near-term**—Heavy development in tech and form factor is a primary driver for utilization. Work to enhance the user experience and accessibility, with continued utilization in training applications that can utilize the current capabilities. More convergence of AI and AR/VR systems will occur.
- **Mid-term**—Expansion of use cases for AR/VR systems helps move adoption mainstream, increasing utilization and reducing cost.
- **Long-term**—Indispensable and ubiquitous technology, much like smart phones today.

HUMANOID ROBOTICS

HUMAN STRENGTHS VS. ROBOTS

Humans excel in judgment, adaptability and troubleshooting, while robots currently lag in these areas. Conversely, robots are able to more fully leverage AI advancements and are able to train at a scale unattainable to humans.

WORKPLACE INTEGRATION

Humanoid robots could reduce safety protocols and space needs, but their integration raises questions about form factor preferences, psychological impacts, and the need for intuitive interfaces and emotional intelligence.

FUTURE DYNAMICS

As humanoid robots become more intelligent and capable, it will be important for humans to identify what our new roles will be. This will be both in understanding where our current skills are best leveraged as well as understanding the expertise required to function in a new economy.

POSSIBLE NEXT STEPS

- **Near-term**—Companies will expand manufacturing capabilities and increase competition, moving toward capacity to meet the high level of future demand expected.
- **Mid-term**—Humanoid robots will integrate into the national defense sector and hazardous industries, removing humans from dangerous environments. This period will coincide with the baby boomer generation reaching late retirement, increasing the potential use of robots for caregiving and simplifying housekeeping tasks.
- **Long-term**—Humanoid robot companions will support day-to-day care in nursing homes and for individuals with neural disabilities, act as personal companions, and act as a cost reduction tool for removing human labor and inefficiencies from processes across environments.



ARTIFICIAL INTELLIGENCE

INNOVATIONS AND OPTIMIZATION

AI is driving innovations in drug discovery and self-driving labs. AI agents can optimize research by analyzing data and deciding subsequent experiments, raising concerns about job displacement.

ETHICAL AND LEGAL FRAMEWORKS

The rapid advancement of generative AI requires new ethical and legal frameworks for data and intellectual property management, emphasizing data literacy and ethical considerations.

COLLABORATION AND EDUCATION

AI enhances collaboration by connecting researchers with complementary expertise. It transforms test generation and evaluation methods in education, necessitating high-quality data inputs and management of cybersecurity risks. AI will be imperative to maintaining competitiveness in the research world.

POSSIBLE NEXT STEPS

- **Near-term**—The miniaturization of large language models (LLMs) from external servers to on-device chips with embedded LLMs. This move will enhance user privacy, reduce latency, improve energy efficiency, increase scalability, and ultimately reduce costs. Increased legislation around the implementation of AI systems, including identification of country of origin, reflect different approaches worldwide.
- **Mid-term**—The rapid pace of development makes predictions challenging in this time frame. There is some agreement among experts that artificial general intelligence (AGI) could emerge within this timeframe, ushering in a host of currently unimagined advancements and scenarios.
- **Long-term**—Similar to the mid-term next steps, there is the potential for delay in development of AGI that would push those developments into the long-term view.

MARRIAGE OF HUMANS & TECH

ETHICAL AND SOCIAL CONCERNS

Cognitive enhancements raise ethical and social concerns about human identity and equity, while non-invasive technologies are seen as safer options for human augmentation.

AI'S IMPACT ON HUMAN VALUE AND SOCIAL INTERACTIONS

AI challenges humans to redefine their unique value, focusing on creativity, empathy, and complex problem-solving. AI's role in social interactions could broaden networks, but may reduce or replace face-to-face communication skills.

WORKPLACE DYNAMICS AND JOB SECURITY

As with past generations, the advancement of technologies will require an emphasis on development of new expertise, and the reskilling of existing workers, to ensure continued usefulness in the workplace. The integration of AI and human augmentation technologies will reshape workplace dynamics, requiring thoughtful implementation to balance productivity and human well-being.

POSSIBLE NEXT STEPS

- **Near-term**—Expansion of medical device applications that enable real-time monitoring of vitals and other data for medical decision-making will continue. Ongoing advancements in technology will support severe injuries and limitations, dramatically improving the circumstances of those with previously untreatable medical conditions.
- **Mid-term**—Medical devices will interact with the environment, direct individuals to appropriate care, and assist in diagnosis and treatments, decentralizing care and improving access to those in need.
- **Long-term**—Continued technological advances will lead to a wider range of collaborative, caregiving and monitoring relationships between people and humanoid robots, along with new issues related to what constitutes emotional intelligence and empathy in the workplace and healthcare. Selective technological enhancements in humans becomes more mainstream.

TAKEAWAYS

The integration of these technologies into scientific research environments promises to revolutionize creativity, productivity, and collaboration. However, it also necessitates careful consideration of ethical, social and practical implications to ensure a harmonious and beneficial marriage between humans and technology co-existing in physical space.



THE EFFECTS OF AI ON ENERGY DEMAND AND MANAGEMENT

HOW CAN WE SUSTAINABLY MANAGE THE INCREASING ENERGY CONSUMPTION AND ENERGY GENERATION REQUIRED TO POWER ADVANCED AI SYSTEMS?

THE GROWING COMPUTATIONAL NEEDS of artificial intelligence consume enormous amounts of energy. We must develop energy management strategies commensurate with the rapid acceleration of AI, or we risk derailing global conservation efforts.

The Client Advisory Board explored the far-reaching implications of AI energy use and how we might improve efficiencies.



DECARBONIZATION & ELECTRIFICATION

SOUNDING THE ALARM

Artificial intelligence will have significant impacts on the power grid—large-scale data centers can each consume more than 100 megawatts of power. Politicians, the public and other stakeholders need to be educated on the rapid growth of data centers, and how quickly they are likely to threaten local grid capacities and global decarbonization goals.

DATA CENTER DECARBONIZATION

Buildings hosting data centers will need to utilize more sustainable cooling techniques.

CLEANER ENERGY PLANTS

The waste heat resulting from computational power use in data centers is enormous. If captured, data centers can be the new clean heating plants.

POSSIBLE NEXT STEPS

- **Short-term**—Begin quantifying the utility of waste-heat coming off of data-centers.
- **Mid-term**—Identify locations that need clean thermal energy to support grid decarbonization.
- **Long-term**—Utilize data-centers as thermal assets as part of the energy transition.

DATA CENTERS & DISTRIBUTION INFRASTRUCTURES

EDUCATING THE WORKFORCE

A cross-functional curriculum around community and infrastructure building will be a key component of workforce development. The push for robotics and computation has ironically transitioned a lot of America's engineering talent into more micro-level engineering solutions catered towards computer and robotics engineering. Although the US has a history of steam engineers from previous generations, a workforce update is needed to ensure mechanical and electrical engineers are as proficient in district energy design as previous generations.

INCENTIVIZING INFRASTRUCTURE DEVELOPMENT

Robust policy frameworks that include investment tax credits, guaranteed loan programs, and streamlined permitting processes can significantly reduce the financial risks and barriers that currently deter private investment in thermal network infrastructure. By establishing clear regulatory guidelines and creating predictable revenue streams through mechanisms like anchor customer requirements or minimum thermal demand guarantees, policymakers can help unlock the substantial upfront capital needed to develop and scale district heating and cooling systems.

WHO OWNS THIS INFRASTRUCTURE?

Developing district energy systems and more cost-effective battery storage will accelerate decentralization efforts. With the frameworks above established, more investors will likely cycle in. However, how that works as part of a broader utility landscape is still unknown. Who owns these assets? Addressing Identifying the balance between private and/or public ownership and control of decentralized systems will ensure more equitable distribution and management.

A HOLISTIC APPROACH

Decarbonizing at the district-level might make the most sense when thinking of the local needs for decarbonized heating and cooling, as well as the rapid acceleration and deployment of renewables. Plus, the integration of things like EV's and new rapid transit are likely to increase "local energy loads".

POSSIBLE NEXT STEPS

- **Short-term**—Establish comprehensive workforce development programs and policy frameworks that immediately address the critical gap in infrastructure engineering talent while creating financial incentives for thermal network development.
- **Mid-term**—Create clear regulatory and ownership structures for district energy systems that balance public and private interests while streamlining permitting processes to accelerate deployment.
- **Long-term**—Develop fully integrated district-level energy systems that seamlessly incorporate increased local loads from electrification while ensuring equitable distribution through well-structured cooperative ownership models.

AI WILL BE IMPERATIVE TO MAINTAINING COMPETITIVENESS IN THE RESEARCH WORLD.

ENERGY DATA & CONTROLS

DATA-SHARING PROTOCOLS

Control systems can enable building-to-grid integration to optimize energy use. As building energy systems controls and grid controls become more connected, there will be a need to establish protocols for sharing data and cybersecurity.

THE CHICKEN-OR-EGG OF DATA CENTERS

The cloud can measure and control decentralized energy systems, but this is highly dependent on robust and usable data. Predictive algorithms will be needed to manage grid responsiveness in data centers, but are also likely to create additional data needs. Identifying the correct level of data to inform grid responsive buildings will be critical to "overharvesting data" and thus, adding to the carbon footprint of data centers themselves.

MISSING CARBON CALCULATIONS

Data centers and computation are often excluded from carbon accounting measures, mainly as data centers often fall underneath scope 3 carbon goals (which are still being developed for many organizations). Identifying the true impact of data on decarbonization goals is important for understanding/emphasizing the importance of data centers as part of organizational carbon portfolios.

POSSIBLE NEXT STEPS

- **Short-term**—Organizations should be calculating the impacts of their data center design on their carbon footprints.
- **Mid-term**—Industry specifications and shared resources on building-to-grid controls are needed.
- **Long-term**—Standardizing data collection time interval series is critical to managing data consumption.

POWER PARADIGM SHIFT

ADAPTING NEW VALUES TOWARD ENERGY CONSUMPTION

Although the push for renewable energy is impacting a grid-wide shift, there's a lack of attention to sustainable end-use consumption. This could be addressed with a more value-based system that incentivizes responsible energy use and innovation.

DECENTRALIZED ENERGY INFRASTRUCTURE

Creating community-connected district energy systems would enhance resilience and efficiency. Moving toward a decentralized system would require support and funding at the federal level.

AI-DRIVEN DECISION MAKING

More trust and transparency in how energy data is shared and managed could lead to energy savings. If building owners and grid operators shared data, AI could be effective in optimizing energy management.

EQUITABLE ENERGY PLANNING

Democratizing data will ensure greater transparency in how energy is delivered. Involving communities in energy planning will lead to more equitable and sustainable development.

POSSIBLE NEXT STEPS

- **Short-term**—Integrate impacts of data centers into national, state and regional level decarbonization forecasts and targets; develop goals for 'clean heating and cooling' just as we have for a clean power grid.
- **Mid-term**—Develop thermal decarbonization plans.
- **Long-term**—Deploy clean energy thermal networks.

TAKEAWAYS

Leveraging AI to enhance utility services and democratize information can lead to significant cost savings for consumers, creating a win-win scenario. However, self-interests and a lack of trust are major obstacles to the adoption of AI-driven energy solutions. Circular energy systems, which convert waste into energy, offer a promising approach. Additionally, new value-based regulatory frameworks will incentivize and responsibly manage the integration of AI in the energy sector.



Design a Better Future

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