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March 24, 2026

The Secretariat
NSW Legislative Council
Public Accountability and Works Committee

Re: Submission to the NSW Parliamentary Inquiry into Data Centres

Dear Committee Members,

The University of Sydney welcomes the opportunity to make a joint submission to the NSW Parliamentary Inquiry into Data Centres, coordinated through the Net Zero Institute (NZI) and the Centre for AI, Trust and Governance (CAITG).

This submission brings together interdisciplinary expertise across energy systems, artificial intelligence, governance, urban planning, environmental sustainability, and infrastructure policy. It reflects the University of Sydney's capability to support evidence-based policy and regulatory reform for data centres in New South Wales and positions the University as a trusted, independent thought partner as government, industry and communities navigate this rapidly evolving infrastructure class.

The submission comprises two complementary documents:

1. **NSW Parliamentary enquiry on Data Centres Response_20260327.docx**, which is the University of Sydney's submission to the NSW Legislative Council Public Accountability and Works Committee *Inquiry into data centres*. It responds to the Committee's Terms of Reference and outlines evidence-based considerations on the rapid expansion of data centres in NSW, including implications for energy demand, emissions, water and land use, planning systems, governance

frameworks, and community outcomes. The submission draws on research capability across the University to highlight how data centre growth intersects with the energy transition, AI development, and long-term public value.

2. **NZI AI and Data Centres Capability Map_20260327**, which provides an overview of the University of Sydney's research capabilities relevant to AI-enabled data centres and associated digital infrastructure. It reflects comprehensive expertise from across the University spanning AI, computing, energy systems, sustainability, and governance, and is intended to inform future policy development, research collaboration, and strategic planning.

The joint submission has been developed through collaboration between NZI and CAITG contributors, including:

- Tamar Resnik, Net Zero Institute
- Dr Sophia Maalsen, Centre for AI, Trust and Governance
- Dr Rob Nicholls, Centre for AI, Trust and Governance
- Ellissa Nolan, Centre for AI, Trust and Governance

We would like to confirm that Dr Rob Nicholls would also be available to give evidence at the inquiry. We thank the Committee for the opportunity to contribute to this important inquiry and would welcome the opportunity to provide further information or engage in future discussions as required.

Yours sincerely,
Tamar Resnik
Senior Research Officer
Net Zero Institute
The University of Sydney
On behalf of the Net Zero Institute and the Centre for AI, Trust and Governance

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NSW Parliamentary enquiry on Data Centres

Response and Joint contribution from The Centre of AI and Trust Governance (CAITG) and The Net Zero Institute (NZI) at The University of Sydney

Overview

The University of Sydney, through the Net Zero Institute (NZI) and the Centre for AI, Trust and Governance (CAITG), welcomes the opportunity to contribute to the NSW Legislative Council Public Accountability and Works Committee inquiry into data centres in New South Wales. The University's contribution focuses on how data centre development intersects with energy systems, water and land use, governance, urban planning, and Australia's emerging AI and digital infrastructure landscape.

Data centres, particularly those supporting AI workloads are rapidly becoming a defining infrastructure class. Their scale, intensity of electricity and water demand, locational impacts, and governance implications mean they now sit at the intersection of energy transition policy, planning systems, community outcomes, and national capability. The University of Sydney brings interdisciplinary expertise across engineering, energy systems, urban planning, environmental science, law, governance, and AI to inform evidence based policy responses.

This submission outlines priority areas where research capability at the University of Sydney can support government to better understand cumulative impacts, manage risks, and design policy and regulatory frameworks that align data centre growth with emissions reduction, resource stewardship, social license, and long-term public value.

Our Contribution to the Response

The University's contribution draws on four complementary inputs:

1. **The Inquiry's Terms of Reference**, which frame the policy questions around scale, planning, electricity, water, land use, governance, workforce and international lessons.
2. **Existing NZI and CAITG capability mapping**, which identifies relevant research expertise across cooling technologies, power systems, AI enabled optimization, urban integration, law and governance.

3. **A synthesis of recent national and international analysis on AI and data centres**, highlighting emerging pressure points including grid congestion, water stress, emissions accounting, and sovereignty.
4. **Direct researcher inputs provided through the call for contributions**, which reflect current research priorities and areas of active engagement relevant to the inquiry.

Together, these inputs allow the University to respond to the inquiry in a way that is systems oriented, evidence based, and grounded in current research and policy debates. The contribution is structured around priority areas and touch points that align directly with the Terms of Reference, followed by crosscutting areas of focus for government consideration.

Priority Areas and Touch Points the University of Sydney Can Address

1. Electricity Demand, Grid Impacts and Emissions (Terms of Reference c)

AI enabled data centres represent a step change in electricity demand. Unlike traditional commercial loads, AI workloads are continuous, high density, and often volatile, placing new stresses on generation, transmission, and distribution systems. Research at the University of Sydney addresses:

- Grid aware optimization of computing workloads to reduce peak demand and align load with renewable generation availability.
- Demand response mechanisms within data centres that support grid stability rather than exacerbate congestion.
- Integrated planning of renewable generation, storage, and firming to reduce reliance on diesel and gas backup systems.
- Carbon aware scheduling and emissions accounting approaches that move beyond annual renewable matching toward more transparent, location based measures.

This work is directly relevant to understanding how data centre growth interacts with NSW emissions targets, grid investment needs, and long-term system reliability.

2. Water Use, Cooling and Climate Resilience (Terms of Reference d)

Cooling is a critical and growing constraint for data centres, particularly under hotter and drier climate conditions. University research addresses both technical and governance dimensions of water use:

- Advanced cooling technologies, including immersion cooling, microchannel cooling, and phase change systems that significantly reduce water intensity.

- System level optimisation of cooling, power and compute to improve both energy and water efficiency.
- Evaluation of non-portable and recycled water pathways and their feasibility at scale.
- Trade-offs between water efficiency and energy demand, which are often poorly captured in planning assessments.

This research supports more robust assessment of water security risks, infrastructure cost allocation, and transparency of water use commitments.

3. Planning Frameworks, Land Use and Urban Integration (Terms of Reference b, e, f)

Data centres increasingly compete with housing, employment land, and other strategic uses, particularly in Western Sydney and growth corridors. University expertise contributes to:

- Early integration of data centre infrastructure into metropolitan and precinct level planning, rather than project by project assessment.
- Analysis of cumulative impacts, including heat, noise, traffic, and infrastructure demand.
- Urban design approaches that integrate data centres with surrounding land uses and enable circular resource loops, such as waste heat reuse.
- Examination of opportunity costs where land allocated to data centres may constrain housing delivery or other public priorities.
- Planning in line with guidelines set out in the NSW Government Planning Department's Connecting with Country Framework.

This work is relevant to whether current planning arrangements adequately balance economic, social and environmental objectives.

4. Governance, Transparency and Accountability (Terms of Reference h)

As data centres become critical infrastructure, governance arrangements have not kept pace with their scale and impact. Research at the University addresses:

- Public reporting frameworks for resource use, emissions and environmental performance.
- Governance risks associated with accelerated approval pathways and whole of government facilitation mechanisms.
- Regulatory sandboxes that allow innovation in low carbon and low impact data centre design while maintaining accountability.

- Inclusive governance and consultation models, including engagement with affected communities and Traditional Owners.

These contributions support clearer accountability, improved public trust, and more consistent regulatory outcomes.

5. Economic, Workforce and Distributional Outcomes (Terms of Reference g, i)
While data centres attract significant investment, their broader economic and workforce impacts are uneven and often poorly understood. University research addresses:

- Distribution of costs and benefits between communities hosting data centres and broader system users.
- Workforce development needs across construction, operations, energy systems and digital infrastructure.
- Skills shortages and productivity constraints that may affect delivery timelines and costs.
- The role of procurement, labor standards and local capability development in maximizing public value.

This work informs more nuanced assessment of economic benefits beyond headline investment figures.

6. National Capability, Sovereignty and International Lessons (Terms of Reference j, k)
AI enabled data centres are increasingly linked to national security, data sovereignty and strategic capability. University expertise contributes to:

- Legal and governance frameworks for data sovereignty, cross border data flows, and foreign ownership.
- Comparative analysis of international approaches, including jurisdictions that have introduced moratoria or stricter controls on data centre growth.
- Lessons from global efforts to align AI infrastructure with clean energy, water stewardship and public accountability.

This perspective supports NSW policy settings that are informed by international experience while tailored to local conditions.

Key Areas of Focus for the Inquiry
Drawing these themes together, the University of Sydney highlights several cross-cutting areas for consideration:

1. **Cumulative and systems level impacts**: Data centres should be assessed not only as individual projects, but as clustered, long-lived infrastructure with compounding impacts on energy, water, land and communities.
2. **Alignment with emissions and climate commitments**: Without deliberate policy alignment, rapid data centre growth risks locking in higher emissions and undermining climate targets.
3. **Infrastructure sequencing and readiness**: Planning approvals should be better aligned with realistic timelines for grid, water and workforce capacity.
4. **Transparency and public trust**: Clear reporting, consultation and governance frameworks are essential to maintaining social license.
5. **Strategic opportunity**: With the right settings, NSW can position data centres as part of a low carbon, high value digital economy rather than a source of unmanaged risk.

The University of Sydney stands ready to support the Committee with further evidence, analysis and engagement as the inquiry progresses.

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AI and Data Centres
University of Sydney Capability Outline

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1: RESEARCH THEME: COOLING

TOPIC 1: INTEGRATED SYNERGY
About: HTS Cryo-Cooling & Hydrogen Power Generation: Highly integrated low-carbon infrastructure maximizing energy efficiency through simultaneous cooling and power delivery
Dr Arman Siahvashi
Faculty: Faculty of Engineering
Sub-research themes

1. Dual purpose energy medium (LH2): Cryogenic storage
2. Enabling superconductivity: Cryogenic circulation
3. Hydrogen gas resource recovery

TOPIC 2: ENHANCING IMMERSION COOLING USING "ACTIVE" PARTICLES
Professor Chengwang Lei
Faculty: Faculty of Engineering
Sub research themes:

1. Immersion cooling using non-conductive liquid with active particles for enhanced thermal management.
2. Active particles response to thermal gradients, buoyancy to sustain circulation.
3. Self-sustaining particle motion enhances momentum and heat transport in RBC systems.
4. High-density computing infrastructure

TOPIC 3: MICROCHANNEL COOLING USING PHASE CHANGE EMULSIONS:
Direct cooling applications target GPU and CPU (industry partner engaged)
Professor Chengwang Lei
Faculty: Faculty of Engineering
Sub research themes:

1. Develop and characterise emulsions for thermophysical properties and microchannel flow heat transfer.
2. Testing flow behaviour and heat transfer performance in microchannels.

TOPIC 4: THERMAL MANAGEMENT IN AI SYSTEMS
Professor Chengwang Lei
Faculty: Faculty of Engineering
Sub research themes:

1. Photovoltaic panels to improve system efficiency and longevity

2: RESEARCH THEME: POWER AND ENERGY

TOPIC 2A: DEMAND RESPONSE IN DATA CENTRES
Professor Jin Ma
Faculty: Faculty of Engineering

Sub research themes:

1. Internal optimization with Intelligent dispatch of computing jobs in hyperscale data centres to reduces peak power consumption
2. External optimization aligns computing loads with variable renewables and enables flexible energy demand, reduces capacity constraint violations

TOPIC 2B: STABLE & CLEAN POWER SUPPLY

Professor Jin Ma
Faculty: Faculty of Engineering
Sub research themes:

1. Designing renewable and storage systems with OEMs for data-centre operations
2. Reduce dependence on diesel backup generator
3. Maintain high reliability while minimizing carbon footprint

3: RESEARCH THEME: URBAN INTEGRATION OF AI

TOPIC 3A: INTEGRATING AI INFRASTRUCTURE INTO CITY PLANNING

Professor Albert Zomaya, Aysu Kuru, Tooran Alizadeh, Sophia Maalsen, Kurt Iveson
Faculty: Faculty of Engineering, Architecture, Design and Planning, Faculty of Science
Sub research themes:

1. Early Integration in urban planning
2. Sustainability and resilience in designing AI infrastructure
3. Synergies with urban systems, transport, housing and green space
4. Future workload scenario planning

TOPIC 3B: CIRCULAR RESOURCE LOOPS

Assoc Professor Ali Hadigheh, Prof Stuart Khan, Dr Aisha Faruqi, Rosa Taghikhah
Faculty: Engineering, School of Business
Sub research themes:

1. Community engagement importance
2. Resource demands and trade-offs, demand significant land, energy, and water, raising ecological and priority trade-offs.
3. Circularity, repurposing waste heat and recycling cooling water supports sustainable urban ecosystems and reduces environmental impact
4. Collaborative Sustainable Design

TOPIC 3C: GREEN DATA DESIGN

Faculty: Science, SOLES,
Sub research themes:

1. Community engagement importance
2. Resource demands and trade-offs, demand significant land, energy, and water, raising ecological and priority trade-offs.

3. Circularity, repurposing waste heat and recycling cooling water supports sustainable urban ecosystems and reduces environmental impact
4. Collaborative Sustainable Design
5. Biodiversity and ecological impact of data centres, such as effects on bee populations and biodiversity.

Professor Kurt Iveson
Faculty: School of Geosciences, Faculty of Science
Expertise: At early stages of research on contemporary data infrastructures, via ARC DP 'Wiring Australian Cities' which is examining the ways that land, labour, finance, materials and governance are assembled in the production and reproduction of Australian telecommunications infrastructures.
Sub-research themes:

1. Early integration in urban planning
2. Community engagement
3. resource demands
4. regulation of responsible AI
5. data sovereignty
6. locational drivers including connectivity and latency

4: RESEARCH THEME: ALGORITHM AND HARDWARE

TOPIC 4A: ALGORITHMS FOR DATA VARIETY AND MULTIMODAL INTELLIGENCE

Professor Chang Xu, Yunke Wang
Faculty: Engineering
Sub research themes:

1. Multimodal and heterogeneous data representation and learning
2. Understanding the underlying structure, properties, and relationships across diverse data sources
3. Algorithmic frameworks for integrating information from multiple modalities (e.g. vision, language, temporal and spatial data)
4. Learning from large-scale, distributed, incomplete, and unstructured datasets
5. Theory-driven algorithm design for robust decision-making under data diversity
6. Foundations for human-like information fusion and reasoning in AI systems

5: RESEARCH THEME: SYSTEMS LEVEL FRAMEWORK

TOPIC 5A. FRAGMENTED COLLABORATION ACROSS THE DATA CENTRE VALUE CHAIN

Professor Albert Zomaya
Faculty: Engineering
Expertise:

- Distributed systems orchestration & cooperative computing

- Large-scale system integration & cross-layer optimization
- Academic–industry ecosystem building and consortia leadership

Sub research themes:

1. System-Level Digital Twin Ecosystems
    a. Create AI-driven digital twin platforms integrating hyperscalers, EPCs, OEMs, and utilities.
    b. Model lifecycle performance from design → deployment → operation.
2. Collaborative Edge Intelligence Framework
    a. Introduce federated coordination across vendors via shared orchestration layers.
    b. Reduce silos using standardized interoperability architectures.
3. Industry Consortium Leadership
    a. Lead multi-stakeholder research hubs linking academia, utilities, OEMs, and hyperscalers.
4. **Impact:** transforms OEMs from component suppliers → ecosystem partners.

TOPIC 5B. LACK OF INTEGRATED ENERGY & COOLING SOLUTIONS

Professor Albert Zomaya

Faculty: Engineering

Expertise:

- Energy-efficient high-performance computing
- Thermal-aware scheduling & workload orchestration
- Sustainable AI infrastructure

Sub research themes:

1. **AI-Optimized Integrated Energy-Cooling Orchestration**
    a. Co-optimise compute load placement, cooling, and power delivery.
    b. Improve PUE, WUE, and carbon intensity simultaneously
2. **Thermal-Aware Workload Scheduling**
    a. Shift workloads based on cooling efficiency and thermal zones.
3. **Control-Layer Intelligence**
    a. Develop orchestration middleware integrating power, cooling, and compute control loops.
4. **Impact:** transitions from hardware integration → intelligent energy ecosystems.

TOPIC 5C. LIMITED DIGITAL INTEGRATION & DEMAND RESPONSE ENABLEMENT

Professor Albert Zomaya

Faculty: Engineering

Expertise:

- Agentic AI and autonomous systems
- IoT/Edge orchestration frameworks
- Real-time distributed decision systems

Sub research themes:

1. **API-First Intelligent Infrastructure**
    a. Create unified telemetry and control architecture.
2. **Autonomous Demand Response Agents**
    a. Edge AI agents dynamically adjust cooling, generation, and workloads.
3. **Grid-Aware Optimization Platforms**
    a. Real-time price, carbon, and grid load signals drive automated responses.
4. **Impact:** transforms static infrastructure → autonomous energy-responsive systems.

TOPIC 5D. BARRIERS TO HYPERSCALER & COLOCATION ECOSYSTEM ENTRY

Professor Albert Zomaya

Faculty: Engineering

Expertise:

- Platform ecosystems & scalable architectures
- International partnerships and commercialization pathways
- Systems standardization leadership

Sub research themes:

1. **Reference Architecture & Certification Frameworks**
    a. Define open interoperability standards and compliance frameworks.
2. **Energy-as-a-Service Intelligence Platforms**
    a. Support new commercial models via predictive performance and SLA assurance.
3. **Global Operational Optimization Models**
    a. AI-driven reliability and maintenance prediction.
4. **Impact:** reduces vendor qualification friction through standardization & intelligence.

TOPIC 5E. GROWING LOW-CARBON REQUIREMENTS

Professor Albert Zomaya, Rosa Taghikhah

Faculty: Engineering, Business School

Expertise:

- Sustainable AI & Green Distributed Systems
- Carbon-aware computing
- Environmental impact of large-scale AI systems

Sub research themes:

1. **Carbon-Aware Workload Scheduling**
    a. Shift workloads based on carbon intensity signals.
2. **Waste Heat Reuse Optimization**
    a. AI optimization for district heating & industrial reuse.
3. **Low-Carbon Infrastructure Intelligence**
    a. Integrate renewables, liquid cooling, and efficiency optimization.
4. **Impact:** enables carbon-neutral or carbon-negative digital infrastructure.

TOPIC 5F. DIFFICULTY CREATING REGIONAL AGGREGATED DEALS
Professor Albert Zomaya
Faculty: Engineering
Expertise:

- Multi-stakeholder ecosystem coordination
- Infrastructure-scale optimization and planning
- Policy-aware technology strategy

Sub research themes:

1. **Regional Energy Infrastructure Optimization Models**
    a. AI modelling of multi-site deployment economics and grid impact.
2. **Consortium Frameworks & Risk Models**
    a. Develop technical frameworks supporting PPPs and regional deployments.
3. **Cross-Region Resource Orchestration**
    a. Enable coordinated load distribution across data centre clusters.
4. **Impact:** unlocks economies of scale and sovereign digital infrastructure capability.

6: RESEARCH THEME: REGULATION AND GOVERNANCE

TOPIC 6A: REGULATION
Dr Rob Nicholls, Associate Prof Tooran Alizadeh
Centre: Centre for AI, Trust, and Governance
Expertise:

- AI and technology regulation
- Energy and infrastructure regulatory frameworks
- Cross-jurisdictional regulatory compliance and policy design

Sub research themes:

1. **Regulatory Frameworks for AI Infrastructure**
    a. Develop adaptive regulatory models for data centre siting, energy use, and emissions.
    b. Map existing regulatory gaps across planning, environment, and energy law.
2. **Standards and Compliance Architectures**
    a. Align national standards with international frameworks (ISO, IEC, IEEE) for AI infrastructure.
    b. Create compliance pathways for operators across multiple regulatory jurisdictions.
3. **Regulatory Sandbox and Innovation Policy**
    a. Design sandbox mechanisms enabling controlled testing of novel AI and data centre technologies.
    b. Evaluate regulatory incentive structures for low-carbon and efficient AI infrastructure.
4. **Impact:** provides operators and policymakers with clear, actionable regulatory frameworks that reduce compliance burden while accelerating sustainable AI infrastructure deployment.

TOPIC 6B: LAW

Professor Kimberlee Weatherall, Dr Rob Nicholls
Centre: Centre for AI, Trust, and Governance
Expertise:

- Technology and cyber law
- Data sovereignty and privacy law
- Contract, liability and intellectual property in AI systems

Sub research themes:

1. **Data Sovereignty and Cross-Border Legal Frameworks**
    a. Analyse legal obligations around data localisation, sovereignty, and transborder data flows.
    b. Develop model contractual frameworks for hyperscaler and colocation arrangements.
2. **Liability and Risk Allocation in AI Infrastructure**
    a. Examine liability exposure across the data centre value chain, including OEMs, operators, and cloud providers.
    b. Develop legal risk allocation models for AI-driven infrastructure failures and outages.
3. **Intellectual Property and AI-Generated Innovation**
    a. Address IP ownership questions arising from AI-optimised infrastructure design and operations.
    b. Examine open-source and proprietary licensing tensions in AI stack deployments.
4. **Impact**: reduces legal uncertainty for infrastructure developers and operators, enabling faster and more confident investment, contracting, and deployment decisions.

TOPIC 6C: GOVERNANCE

Associate Professor Danny Gozman, Dr Rob Nicholls, Kurt Iveson, Sophia Maalsen, Tooran Alizadeh
Centre: Centre for AI, Trust, and Governance
Expertise:

- Corporate and public sector governance of digital infrastructure
- Multi-stakeholder governance models
- Ethics, accountability, and transparency in AI systems

Sub research themes:

1. **AI Infrastructure Governance Frameworks**
    a. Develop governance models for responsible siting, operation, and decommissioning of data centres.
    b. Integrate ESG accountability mechanisms into data centre governance structures
2. **Multi-Stakeholder and Public Participation Models**
    a. Design inclusive governance processes involving communities, government, and industry.
    b. Develop transparent reporting and accountability standards for AI infrastructure operators.

   c. Indigenous stakeholders should be actively involved in decision making. This is especially important considering the significant impact data centres would have on Country and the guidelines NSW State Government Department of Planning details in its Connecting with Country Framework.

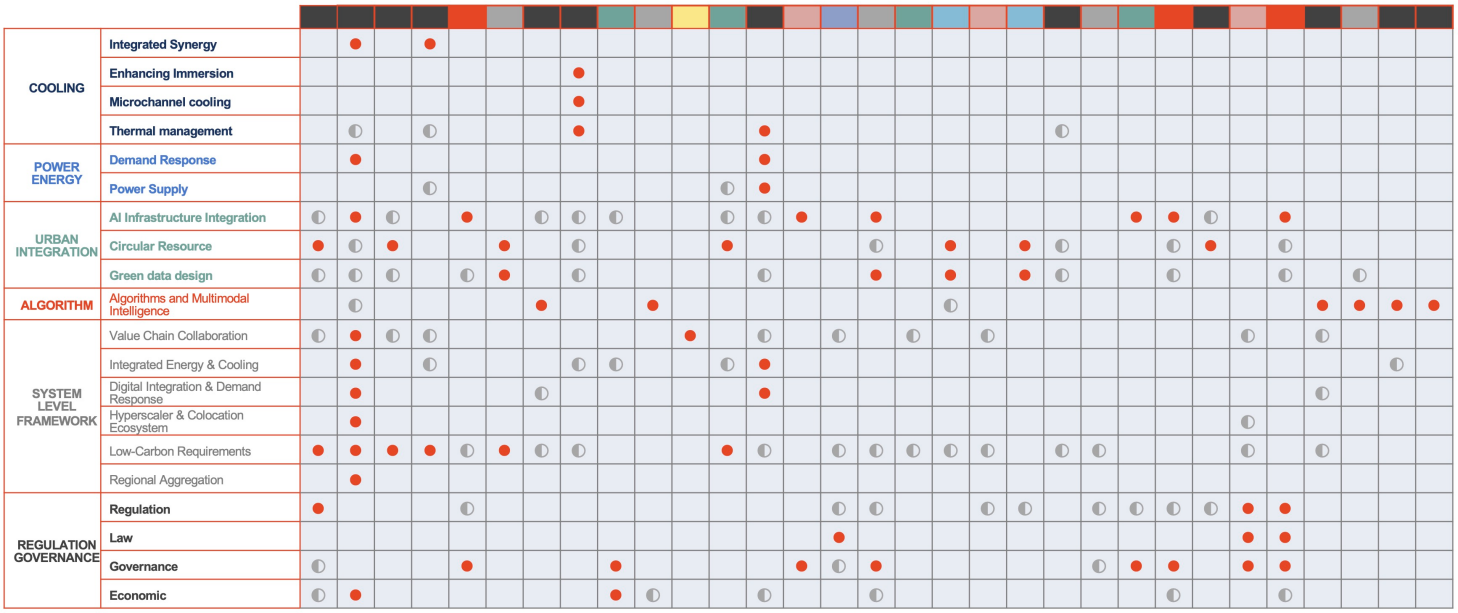
3. **Ethics and Accountability in Automated Decision-Making**
   a. Establish governance principles for AI systems managing critical infrastructure.
   b. Address algorithmic accountability in energy dispatch, cooling control, and demand response.
4. **Impact:** builds societal trust in AI infrastructure through transparent, accountable, and inclusive governance that balances innovation with community and environmental responsibility.

APPENDIX

A: CAPABILITY MATRIX

The capability matrix provides an at-a-glance map of the University of Sydney's strengths relevant to themes and categories of AI and data centres. It highlights where expertise is concentrated across key domains and will support where cross-disciplinary collaboration can be activated.

University of Sydney AI Connectivity

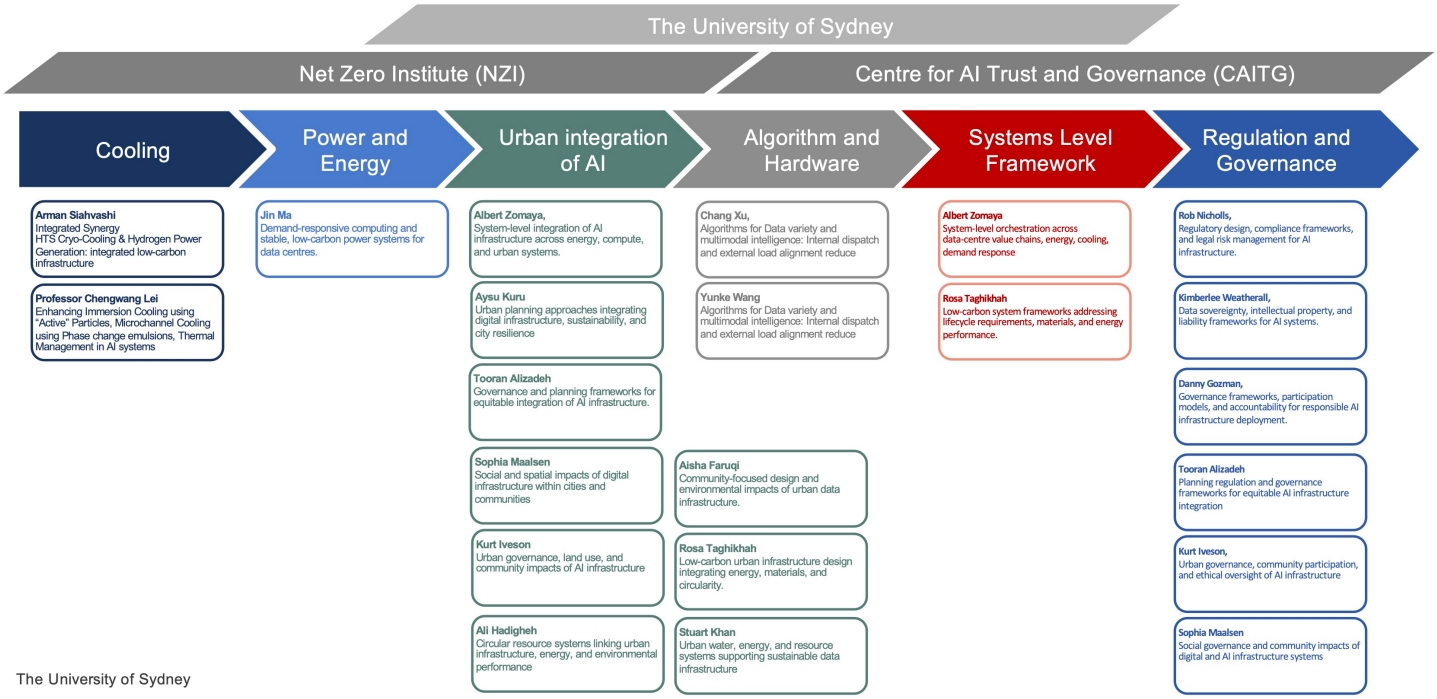


The University of Sydney

B: CAPABILITY ACROSS VALUE CHAIN

This value-chain view shows where University of Sydney capabilities align across the lifecycle, with cross section contribution has been identified. The figure is included to support conversations about collaboration pathways and high-impact intervention points.

Input / output: AI and Data Centers value chain



Please contact nzi@sydney.edu.au for further information