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This study focus on exploring how digitalisation can enhance advancements in the bioenergy sector, fostering cross-disciplinary collaboration and informing the UK's research priorities.

Introduction

- Despite some digital initiatives, bioenergy systems face ongoing barriers to full digitalisation and longstanding challenges that limit scalability and efficiency.
- We focus on identifying the key challenges and opportunities for the adoption of digital technologies in bioenergy systems.
- To explore these objectives, we employ a mixed-method approach, combining insights from an academic/industrial workshop with an industrial survey.

Industrial Survey

Industrial Survey on Digitalisation in Bioenergy Processes

Quantitative Qualitative Targeted

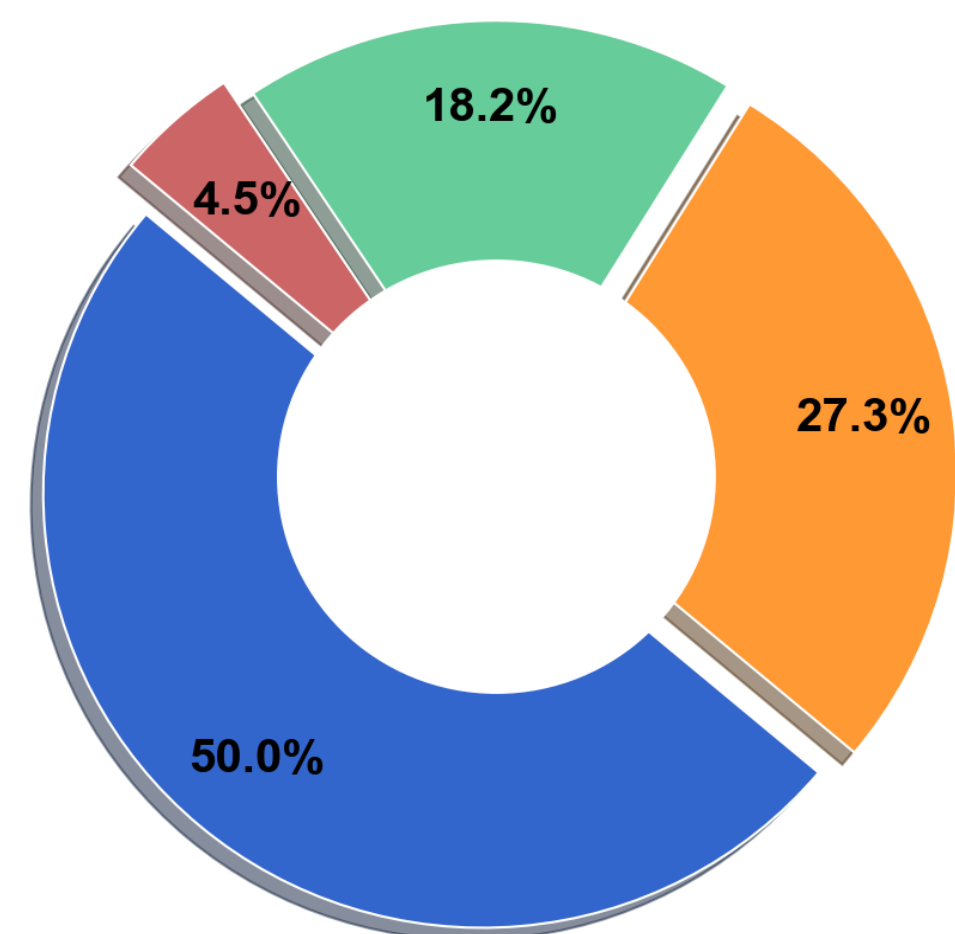
Data Collection Methods, Implementation & Outreach

Structured Questionnaires Semi-Structured Interviews Bienergy Site Visits Workshops & Seminars
Direct Email Outreach Professional Networks Industry Partnerships Stakeholder Collaboration

22 Survey Participants

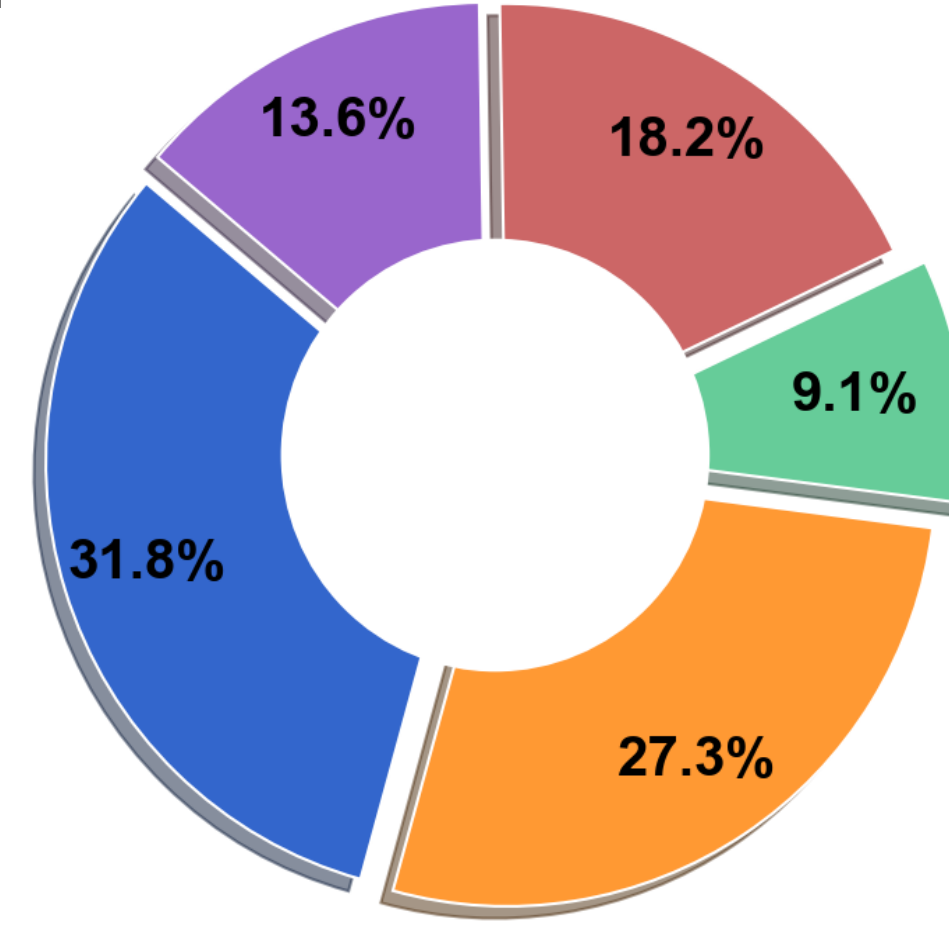
Participants Rols

Technical/Engineering
Academic/Research
Executive/Management
Specialists/Other



Years of experience

0-5 years
6-10 years
11-15 years
16-20 years
21-25 years



Workshop

Increasing Uptake of Digitalisation and Artificial Intelligence in the Bioenergy Industry

Event: Supergen Bioenergy Impact Hub Annual Assembly
Location: Sheffield
Date: 5-6 November

Workshop Participants and Structure

80+
Diverse Backgrounds, 8 Mixed-Discipline Groups, Promoting Cross-Sector Interaction

Engineers Industrialists Academics
Policy Makers Early-career Researchers Supergen Bioenergy Hub Members

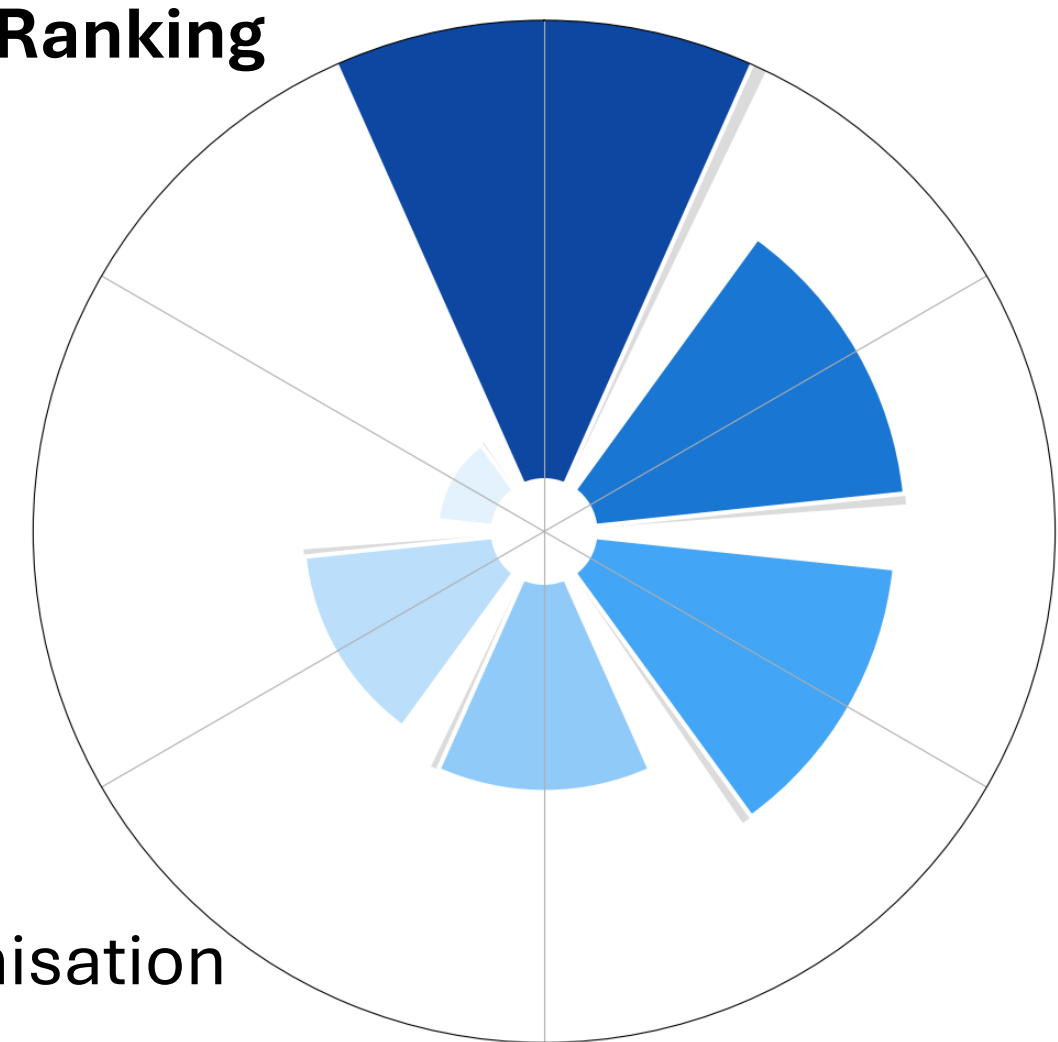
Discussion Questions (20 MIN)

- What are the main challenges you face in adopting digitalisation technologies in bioenergy processes?
- What opportunities do you see for leveraging digitalisation to enhance bioenergy processes?

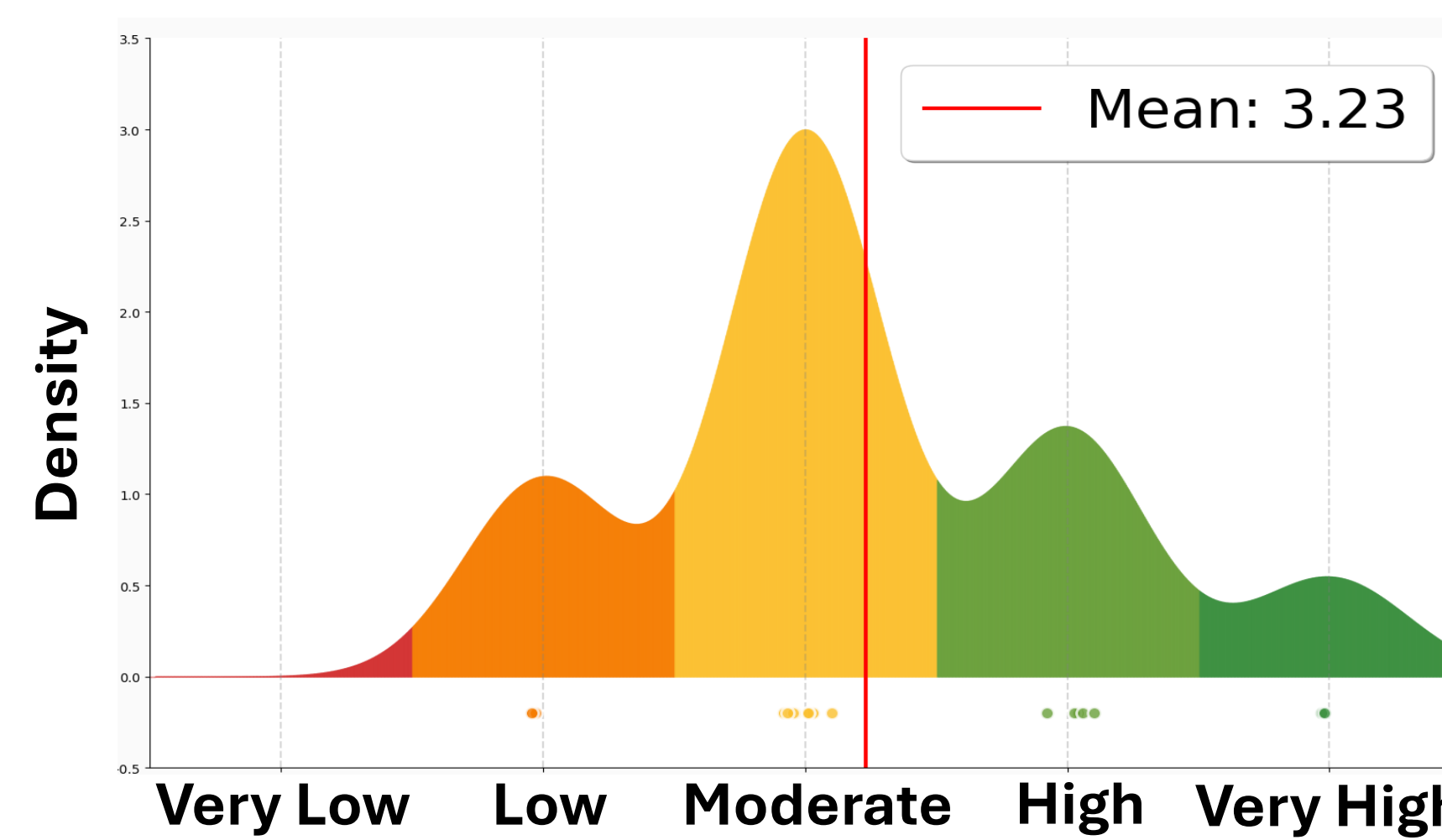
Results

Process Familiarity Ranking

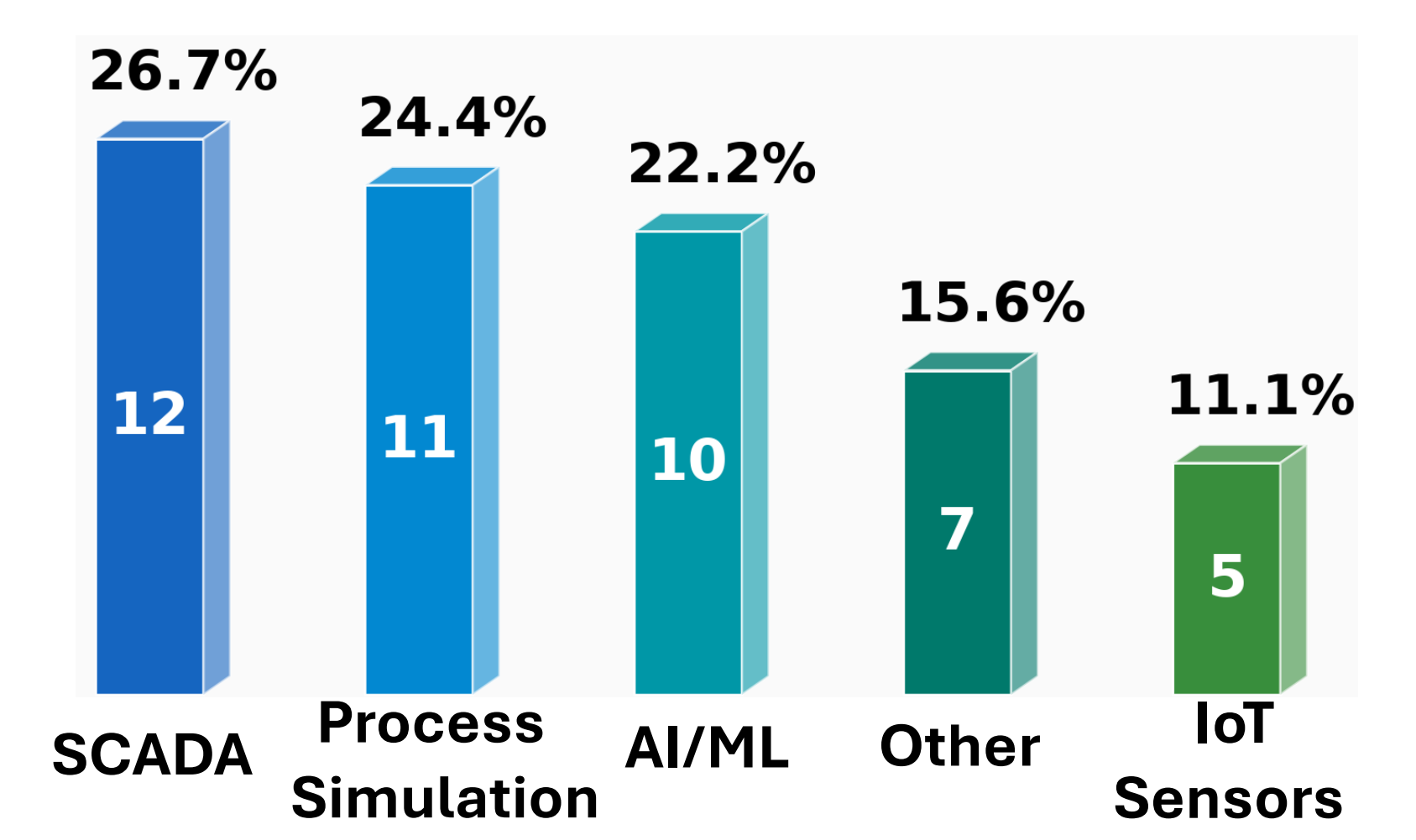
#1 Anaerobic Digestion
#2 Fermentation
#3 Combustion
#4 Pyrolysis
#5 Gasification
#6 Hydrothermal Carbonisation



Organisational Digitalisation Level



Digital Technologies in Bioenergy Processes



Identified Challenges and Opportunities for Digitalisation in Bioenergy

Technical/Technological		Economic		Policy & Regulatory	
Fragmented data infrastructure	AI integration for decision-making	High initial capital investment	Increased operational efficiency	Lack of supportive digitalisation policies	Development of enabling policies
Inadequate real-time monitoring & control	Development of digital twins	Uncertain short-term returns	Long-term cost savings	Regulatory uncertainty	Regulatory support for innovation
Cybersecurity vulnerabilities	Cloud-based data management	Limited funding for digitalisation	Reduction in downtime costs	Data privacy & ownership concerns	Harmonisation across regions
Technical training gaps	Enhancement of security solutions	Hidden maintenance costs	Value creation from data	Absence of digital standards	Open data initiatives
CHALLENGES	OPPORTUNITIES	CHALLENGES	OPPORTUNITIES	CHALLENGES	OPPORTUNITIES

Conclusions

- The study categorised the challenges and opportunities in digitalisation into technical, economical, and policy.
- The potential of digitalisation in advancing the bioenergy sector exists but is currently limited by systemic barriers.
- To accelerate progress, stakeholders must prioritise collaborative frameworks, policy incentives, and ethical governance models that align digital innovation with sustainability goals.

Acknowledgements

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SUSTAINABLE BIOENERGY SYSTEMS FOR OUR LOW-CARBON FUTURE