



# Melbourne Knowledge Week 2022

## Evaluation

Event: Melbourne Knowledge Week  
Date: 9-15 May 2022

### Event description

Melbourne Knowledge Week (MKW) is an annual festival that brings Melburnians together to explore and discuss, to share ideas, to challenge assumptions, and to spark new ways of thinking. Across seven days, the broad program of events included workshops, performances and interactive exhibits of which FLEET participated in the latter. FLEET's interactive display used the mobius strip, jumping rings, Van der Graff machine and a build-a-circuit kit for kids (and adults) to experiment with and build different circuits. We had up to three FLEET volunteers (four on weekends) managing the exhibit at any time to engage with the public.

### FLEET objectives for the event

I developed the event to achieve the following outcomes:

- An appreciation/awareness of the purpose and value of FLEET research and physics generally.
- Increased public awareness of the increasing demand for and energy consumption of computation, and the implications of this.
- A public thinking critically about the meaning and value of FLEET research.
- Primary and secondary students with a greater interest in and awareness and appreciation of physics
- FLEET researchers with improved communication skills and greater understanding of audience values and perceptions of physics/FLEET research

### Audience and number of engagements

The following is an estimate of the number of people that visited the FLEET exhibit.

Weekday (Mon-Frid): 25-30 people per day

Weekend (Sat-Sun): 90-120 people per day

Similar to the 2021 MKW event, a significant element of the public engagement was the quality of each engagement. The shortest conversation with any member of the public was about 5 minutes. The longest was at least 30 minutes with most being about 10 minutes. In-depth conversations were most prevalent on the weekend days. Any conversation covered the motivation for FLEET's research, the varied research problems that underpin the research, the research itself and the social implications of FLEET's research.

Most of the audience were adults, though on the weekends a lot of families with younger children (<10 years) came to the event. This year, there were no organized school groups at the event, though two small groups of secondary students visited the exhibit that were in the city for other reasons.



## Key engagements

- Melbourne Lord Mayor, Sally Capp, and three councillors visited the FLEET exhibit
- Channel 31 TV interviewed Jason Major for a segment in Ch31 programming.

## Key findings

- The public had zero or only low awareness of the increasing energy use of digital technologies. Once aware of the problem, the public had a relatively high concern, which is a similar finding to the 2021 MKW survey.
- The role of ESG (Environment, Social and Governance) was a key concern in the context of FLEET research and how it might be applied.
- A sustainable digital future was the ultimate outcome that people sought, though it had to come via responsible innovation.
- People thought critically about FLEET research at FLEET's research problem.
- Dialogue was important to facilitate acceptable research and sustainable outcomes
- Volunteers gained a new perspective and understanding of the public as an audience that enabled more effective communication. They saw value in communicating with the public. There was reinforcement that their research has value and meaning.

## Evaluation

To evaluate Melbourne Knowledge Week the following pre- and post-evaluation tools were developed:

- A short pre-evaluation, two-question survey
- Mind map
- Notes on conversations with the public
- Online exit survey

There was no direct evaluation of the jumping rings, mobius strip or the circuit building activity except for observational notes and use of relevant comments in the exit survey.

### Pre-evaluation short survey

A short, two-question survey on a laminated A3 paper was placed on a wall visible to the public. The public were asked to contribute to the survey upon entry to the exhibit and before any engagement. It contained the following statement and two questions with the public to select answers from a 5-point Likert scale:

Statement: The demand for computation is increasing 70% each year. Digital technologies use about 10% of global energy and this figure is doubling every decade.

Two survey questions:

1. Describe your level of awareness of the facts in this statement
2. What is your level of concern about the facts in this statement?

### Mind map and observation notes

One of the post-evaluation activities asked the public to contribute to a mind map. This year we took advantage of the glass walls and used coloured paint pens to create the mind map directly on the wall. See Figure 4 below.

Observation notes were also made on some of the more interesting conversations or points that were being raised continually by members of the public. Data from these notes is integrated into the analysis of the mind map.



## Exit survey

An online survey was also conducted that asked the following six questions:

1. Participant’s age
2. Write one interesting thing you remember from your experience with FLEET?

The demand for computation is increasing 70% each year. Digital technologies use about 10% of global energy and this figure is doubling every decade. In the context of this problem, indicate your level of agreement/disagreement with the following statements:

3. My experience today has changed my understanding about society’s use of digital technology
4. Low-energy technologies are unlikely to make a difference to the lives of ordinary people
5. I am unconcerned because there is always a technological solution to problems such as the energy consumption of digital technologies
6. Public money spent on research that could reduce the energy used in digital technologies is well worth spending

## Results

This report examines the pre-evaluation data, then the post-evaluation. I then draw conclusions about what this data means relative to the FLEET’s objectives/outcomes for the event.

### Pre-evaluation

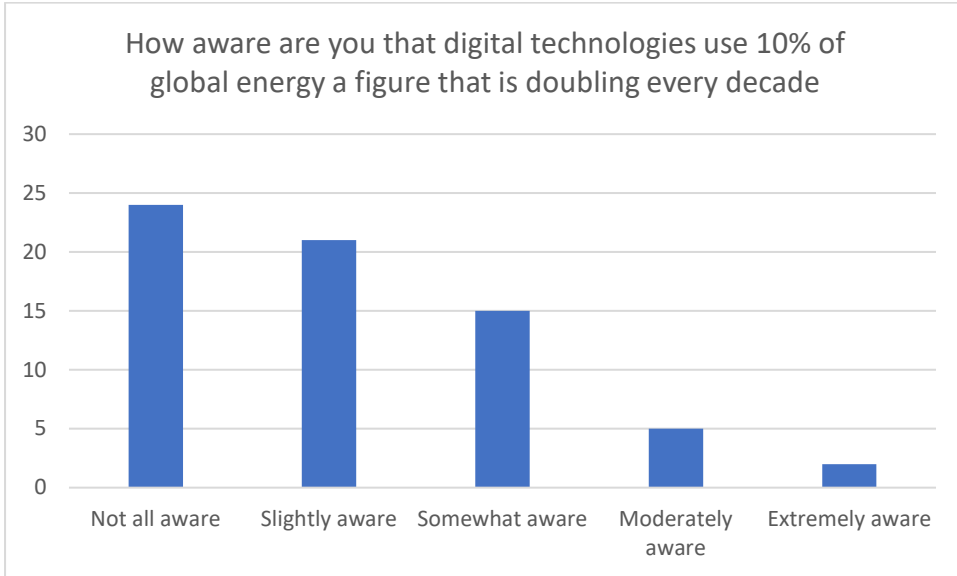
The pre-evaluation involved the two-question survey that explored the public’s awareness and concern about the energy use of digital technology. Table 1 and Figure 2 suggest that most of the public visiting the FLEET exhibit had zero or low awareness of the increasing energy use of digital technologies, the problem motivating FLEET research. Once aware of the problem, the public had a relatively high concern with most people being moderately or extremely concerned about the increasing energy consumption of digital technologies. See Tables 1 and 2 and Figures 1 and 2.

**Table 1** Entry survey responses of visitors to the FLEET MKW exhibit: How aware are you that digital technologies use 10% of global energy a figure that is doubling every decade?

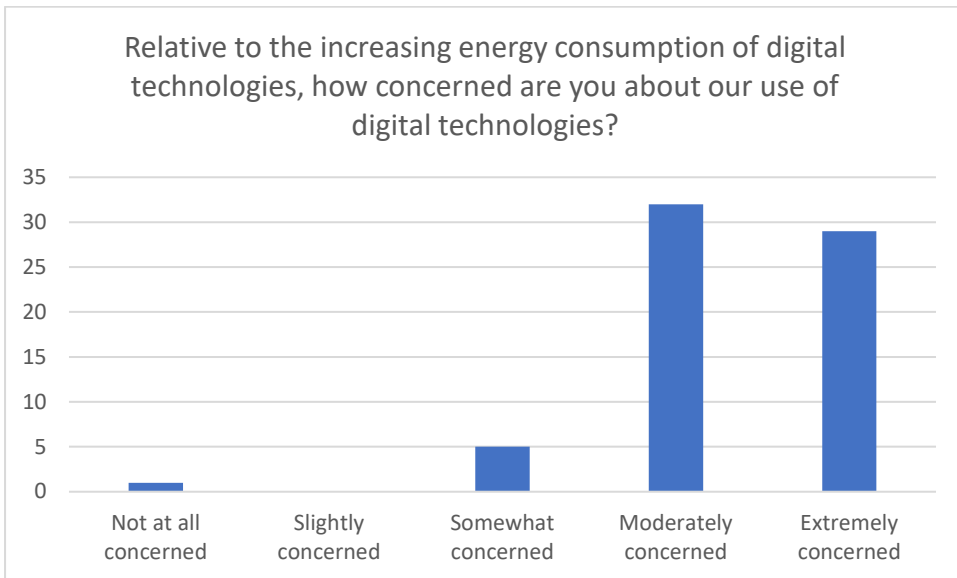
Not all aware	Slightly aware	Somewhat aware	Moderately aware	Extremely aware
24	21	15	5	2

**Table 2.** Entry survey responses of visitors to the FLEET MKW exhibit: Relative to the increasing energy consumption of digital technologies, how concerned are you about our use of digital technologies?

Not at all concerned	Slightly concerned	Somewhat concerned	Moderately concerned	Extremely concerned
1	0	5	32	29



**Figure 1** Entry survey responses of visitors to the FLEET MKW exhibit: How aware are you that digital technologies use 10% of global energy a figure that is doubling every decade



**Figure 2.** Entry survey responses of visitors to the FLEET MKW exhibit: Relative to the increasing energy consumption of digital technologies, how concerned are you about our use of digital technologies?

### Mind map and observation notes

The mind map was used to encourage critical thinking about FLEET's research and its research problem. For FLEET it is also a tool to understand how the public perceive FLEET, how they value our research and the public perception of the FLEET research problem: the unsustainable energy use of digital technologies.

Using paint pen, FLEET wrote the following comment to trigger a discussion and start a mind map: Digital technology uses a lot of energy.



People visiting the FLEET exhibit were asked to think about and contribute their thoughts on the comment following their engagement with the FLEET exhibit at the MKW event. All the ideas were analyzed thematically and modelled in Figure 3 below. Because the same themes emerged in the two data sets, the mind map data is integrated with our observation notes that include records of conversations with visitors to the FLEET exhibit.

Two core themes emerged from the mind map and observation notes: The role of ESG (Environment, Social, & Governance), and Research and Development. A secondary theme, dialogue, was also important and closely linked to the contributions in the core themes. The outcome that all mind map participants were targeting was a sustainable digital future. We did not delve into what a sustainable digital future meant for participants, though for many contributors it needs to involve responsible innovation. In nearly every contribution to the mind map and what was recorded in the observation notes there is evidence of critical thought that is based on concerns about the research into low-energy electronics and the implications of any technology that might be commercialized from such research. See Figure 3 below and Appendix 1 that has the raw data from the mind map and collated observation notes.

The observation notes generated a third sub-theme under Research and Development: Economics. In this sub-theme visitors raised questions and generated conversation about the business case for FLEET research, the implications of not doing such research in Australia and how do we measure the value of investment into such research. Each theme is analysed in more detail below. Contributions in [square brackets] are paraphrased sentences from the observation notes. Those within quote marks are contributions to the mind map.

### **Role of the ESG**

There was a reasonable spread of mind map contributions and observation notes connected to each of the ESG components (Environment, Social and Governance). Visitors that raised concerns linked to the environment, raised questions about the source of new materials, where and how they might be mined and the energy consumption of data centres.

[One deep learning model is equivalent to 2 return trips to New York]

A core concern to emerge from the social component was a perceived requirement for responsible innovation. Specifically, participants indicated concern for who will have access to any research advancements and what are the responsible uses of technologies such as AI, managing data privacy, etc. For example, I had an in-depth discussion with a member of the public about whether ESG applies at the fundamental level of research that FLEET conducts. She argued that it didn't, but should. We had a long discussion about the concepts of Responsible Research and Innovation and social innovation and their potential for application at the fundamental research level.

“At what cost – have we got the balance right (cost/benefit)?”

“We need to sacrifice convenience and achieve change in behaviour.”

[It is also the minorities and marginalized affected negatively.]

Or this recollection from a FLEET volunteer:

“One memorable chat I had was about whether technology was ‘natural’ or not, and whether we should be sacrificing some of the conveniences technology brings, to try and lower the amount of energy we require. Because we don't need the technology to live and the further it advances the more energy it demands. The conversation progressed to contemplating human nature, whether people would make these sacrifices, and how we could limit people's access to technology



without impinging on their human rights. As for whether technology is natural or not, we discussed that the smart human brain was able to develop technology, so is that not a natural consequence of our crazy natural human brain? If our brains were able to develop technology, hopefully they are clever enough to also figure out how to solve the energy problems that arise from it.”

At the governance level, visitors raised questions about who has access to the technology, funding basic science in Australia and policy questions about our research priorities and transitioning to renewable energy.

“...who has access? If malicious actors take control, then what?”

### **Research and Development**

The second core theme was research and development. The contributions were fewer in this theme and there were strong links to the role of governance. For example, while it was considered important that we invest in R&D in this space, one participant noted a need to forge greater international collaborations; another thought that the public demand will outpace any policy and that it will be the private sector that will finance and lead the research in this space. Others were strictly about the R&D, such as one contribution that said we need to “find more efficient process such as coding that requires fewer computations.”

A sub-theme that emerged from the observation notes was about the economics and business case for FLEET’s research that raised questions about cost of not doing the research and how we value the investment. At least two of the visitors that generated comments in this sub-theme were economists.

[What is the opportunity cost if we don’t do this (FLEET) research and someone else discovers it? Even if someone else discovers it first, if we have the local expertise, we have the base for local production. But if we don’t have the local expertise, we will have to import everything.]

[How do we measure the value of innovation investment, eg patents, the value of jobs, etc?]

### **Dialogue**

A secondary core theme was dialogue. Participants perceived a lack of awareness about the FLEET research problem and emphasized a need to raise awareness and understanding, and to make any change accessible to the public through appropriate and accessible dialogue. This secondary theme is intimately connected to the core themes, the role of ESG and Research and Development, because neither of these will be effective without appropriate dialogue.



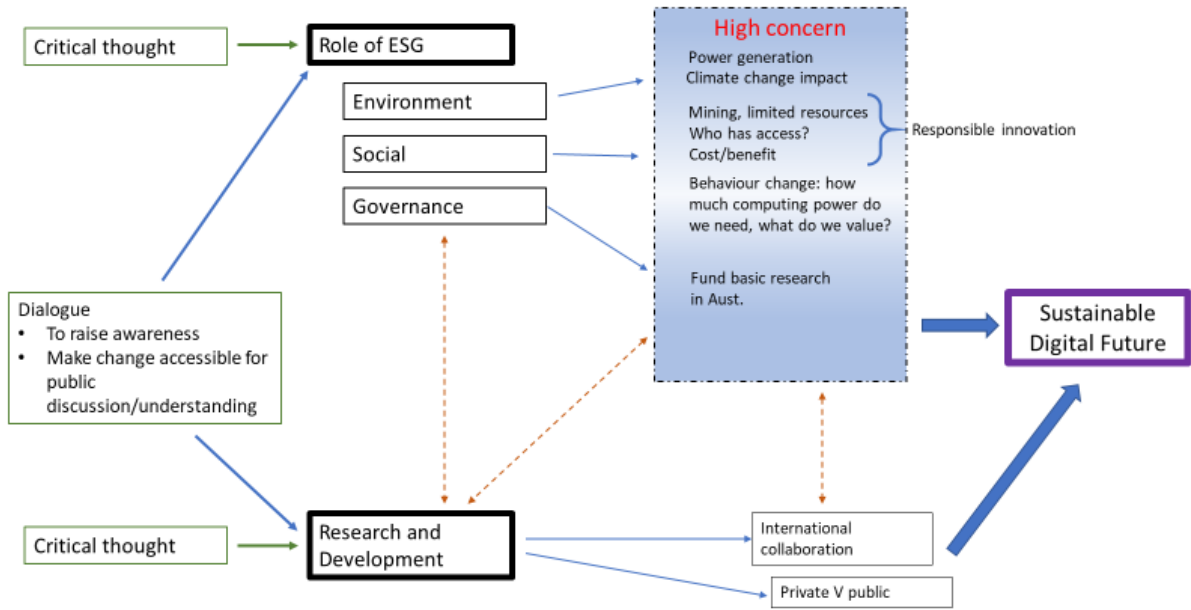


Figure 3 Model of themes and concepts that emerged from the 2022 Melbourne Knowledge Week Mind Map and observation notes

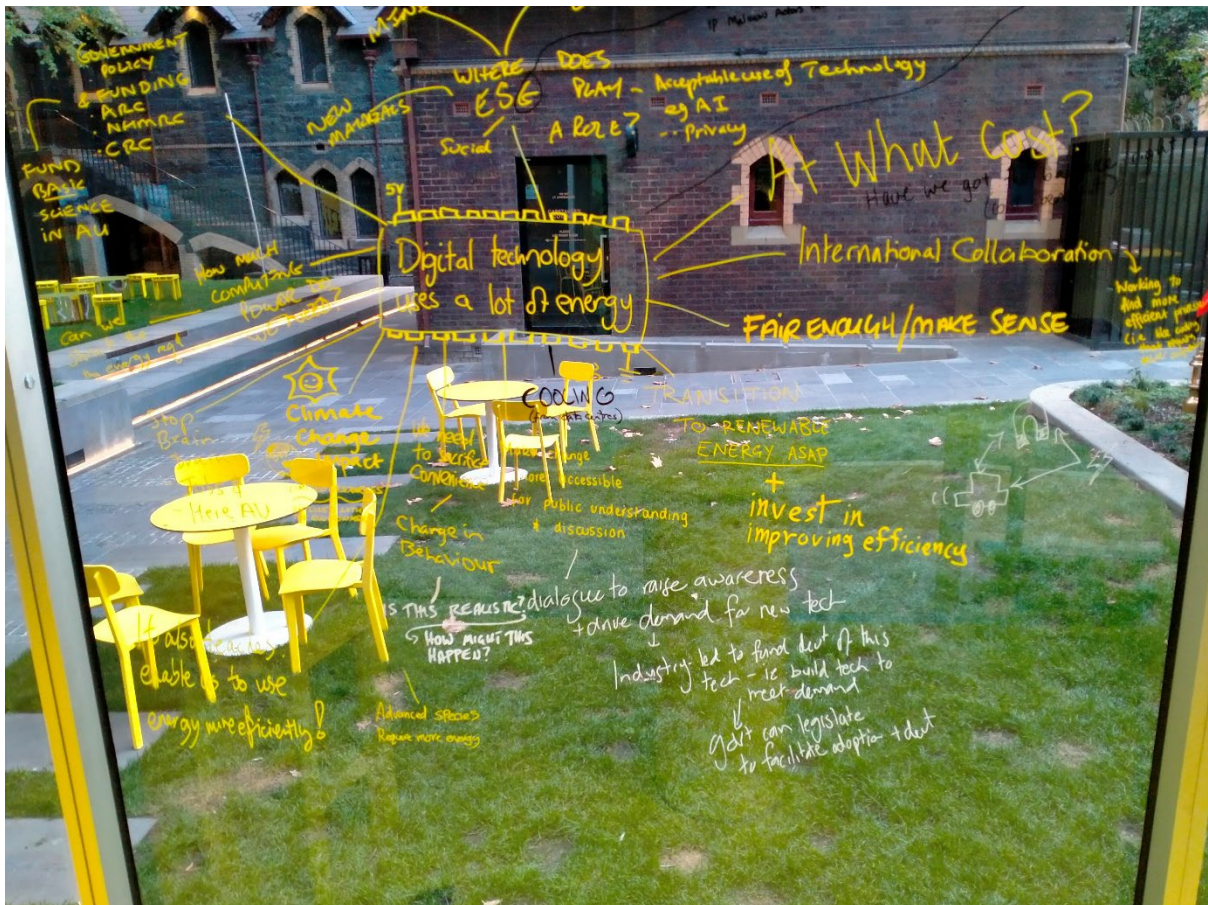


Figure 4. The FLEET mind map drawn on the walls of FLEET's exhibit at Melbourne Knowledge Week



## Post-evaluation: Online survey

Number of responses to the survey: N=22

The number of responses to the 2022 survey is low (N=22) and this places limitations on that data and its use to determine the impact the FLEET exhibit relative to our objectives.

The results from each of the survey questions is presented below.

### Survey question 1. Your age (years)

Most people that visited during the week were people working in nearby office buildings. Few children or students visited on the weekdays. Most of the children visited on the weekend and only one child <18 years completed the survey (though with parental help). See Table 3 for age-related data of those that completed the survey. This is likely not an accurate reflection of visitors to the exhibit.

*Table 3 Age data for visitors to the FLEET exhibit at MKW 2022*

Average age (years)	40
Youngest (years)	10
Oldest (years)	70
Median age (years)	42

### Survey question 2: Write one interesting thing you learned from your experience with FLEET?

The responses to this question were grouped under the following six themes:

- Scientific effort
- Remembering Cool tech/research
- Remembering some science
- Environmental concerns – digital energy consumption
- Social concerns – responsible innovation
- ARC fundamental research recognition

Across some of the themes was evidence of critical thought. These and the above six themes are analysed in more detail below.

#### *Scientific effort*

Comments were indicative that people recognized and placed some value on the scientific efforts to develop tech that could have a positive impact on the energy efficiency of digital technologies.

“The possibility of no resistance currents for operating tech in the future”

“Topological conductors, and about other areas of research that are currently being undertaken in the energy conservation space.”

“The possibility of no resistance currents for operating tech in the future.”

#### *Remembering Cool tech/research*

People considered the research as “cool” or their recollection was of a specific technology such as the superconductor or topological insulators.

#### *Remembering some science*

Respondents recalled some science such as how magnetic locks work, or that resistance = heat.



***Environmental concerns – digital energy consumption***

Responses reflected the concern about the increasing energy consumption of digital technologies and the potential environmental impacts of this.

“how the use of more efficient conductors can help solve the power crisis.”

***Social concerns – responsible innovation***

Only one response under this theme, but it was recognition that any research needs to be considered alongside its potential social cost.

“New materials will minimise energy use on digital tech, but will still come at cost (socially, environmental)”

***ARC fundamental research recognition***

Responses mentioned ARC either in the context of the fundamental research they funded or their connection with Centres of Excellence.

**Critical thought**

Critical thought reflected in what survey respondents learned is represented in how respondents’ thought about the implications of FLEET’s research problem and the research itself.

“The problems facing our planet in terms of energy consumption.”

“New materials will minimise energy use on digital tech, but will still come at cost (socially, environmental).”

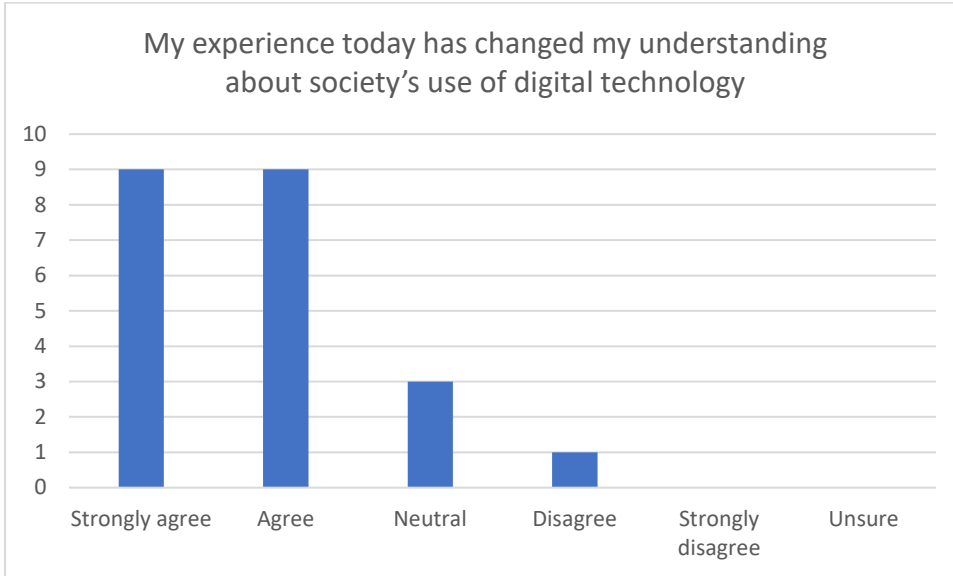
“The possibility of no resistance currents for operating tech in the future.”

“How the use of more efficient conductors can help solve the power crisis.”

Questions 3-6 are based on the statement, The demand for computation is increasing 70% each year. Digital technologies use about 10% of global energy and this figure is doubling every decade. In the context of this problem, indicate your level of agreement/disagreement with the following statements.

**Survey question 3. My experience today has changed my understanding about society’s use of digital technology**

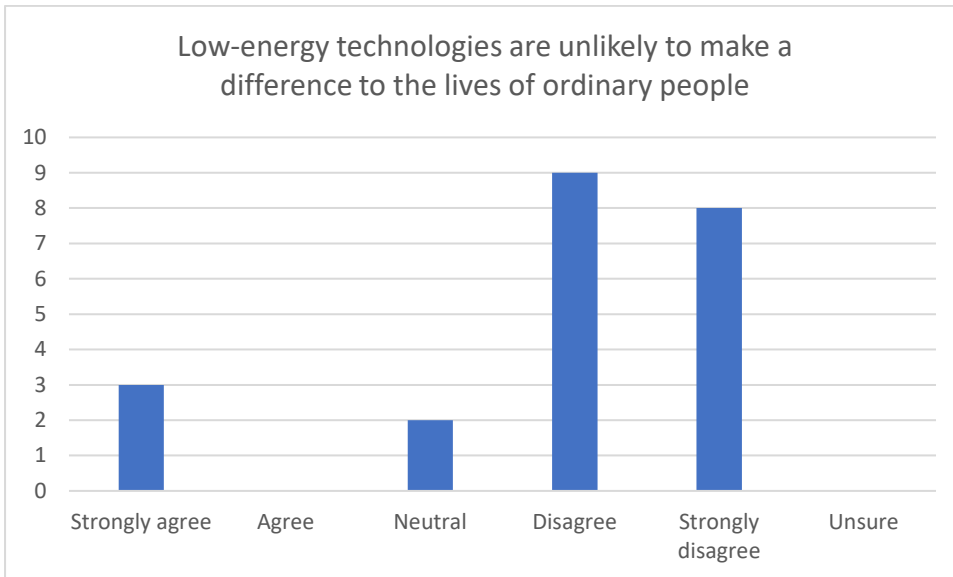
There was strong agreement among the survey respondents that their experience with FLEET at MKW changed their understanding about how society uses digital technology with 18 of the 22 responses saying they either strongly agree or agree that their understanding was changed. This reflects the pre-evaluation data indicating a zero-low awareness of the energy consumption of digital technologies. See Figure 5.



**Figure 5. Responses to survey question, My experience today has changed my understanding about society's use of digital technology**

#### **Survey question 4. Low-energy technologies are unlikely to make a difference to the lives of ordinary people**

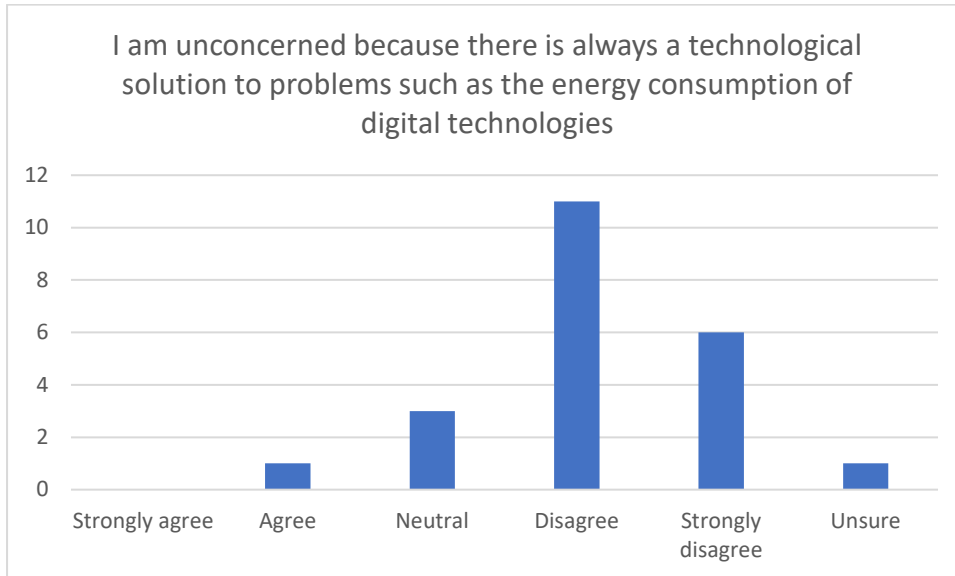
The majority of respondents to this question think that low-energy technologies will have some impact on their lives. Despite their concerns for the role of ESG, people still consider that these technologies will make a difference. See Figure 6.



**Figure 6. Responses to survey question, Low-energy technologies are unlikely to make a difference to the lives of ordinary people**

#### **Survey question 5. I am unconcerned because there is always a technological solution to problems such as the energy consumption of digital technologies**

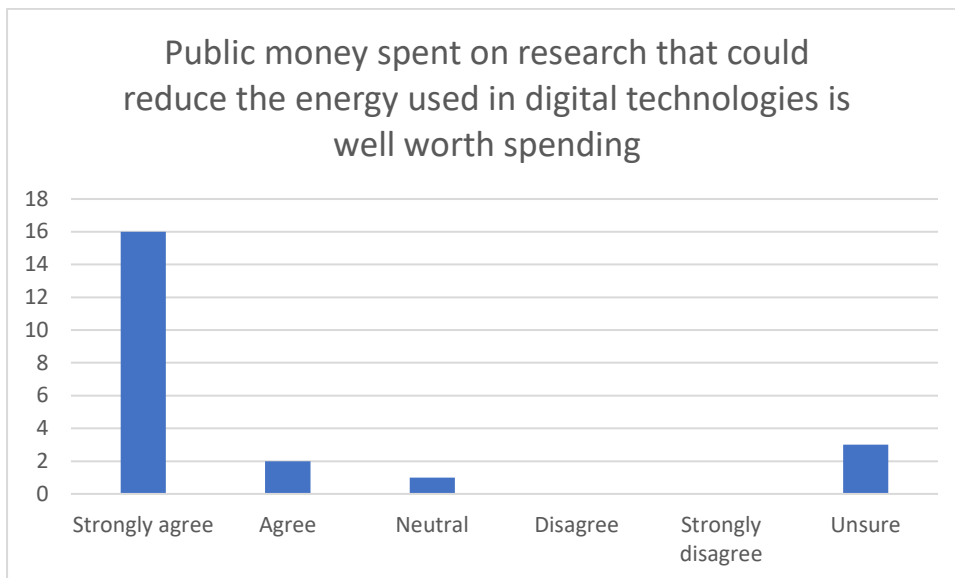
The majority of respondents disagree with the idea there is always a technological solution to problems such as the energy consumption of digital tech, which suggests they believe we cannot rely entirely on science to fix such problems. This reflects discussions and commentary that there must be social solutions considered alongside technical ones.



**Figure 7. Responses to the survey question, I am unconcerned because there is always a technological solution to problems such as the energy consumption of digital technologies**

### Survey question 6. Public money spent on research that could reduce the energy used in digital technologies is well worth spending

In hindsight this is an inappropriate question, but included here for reference. The question is somewhat of a ‘Dorothy Dicks’ given the audience. In a different context it might work, but would not use it again in public outreach. Survey respondents, however, place a high value on public money being spent on low-energy digital technologies.



**Figure 8. Responses to the exit survey question, Public money spent on research that could reduce the energy used in digital technologies is well worth spending**

### Build-a-circuit / jumping rings

The lack of children visitor on the weekdays meant it was only on the weekend that the jumping rings and circuit-building kits were extensively used, though the jumping rings demonstration is an excellent way to demonstrate resistance and it gets used in conversations with all age groups.



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The jumping rings was only operated by the FLEET staff unless strictly supervised by a FLEET member. In contrast the circuit building kit was developed for children to play freely with. Indeed, this is what they did. Most children that visited the FLEET exhibit spent some time building circuits. Some children spent 30 or more minutes experimenting with the components. FLEET members were there to help and answer questions. There was no direct evaluation done on the impact of the jumping rings and circuit building, but one comment from the survey evaluation indicates at least the jumping rings were memorable.

The Copper Experiment - how much resistance is from heat



**Figure 9(a).** FLEET members Yik Lee and Karen Bayros help a visitor build circuits at the FLEET exhibit at Melbourne Knowledge Week 2022





*Figure 9(b) Children and parents get together to build circuits at the FLEET exhibit at Melbourne Knowledge Week 2022*

## **FLEET volunteer outcomes**

FLEET had nine volunteers helping over the week of the event.

FLEET's objective for volunteers conducting outreach is to achieve researchers with improved communication skills and greater understanding of audience values and their perceptions of physics/FLEET research.

To help understand the volunteers' experience and the impact relative to the above objective, I asked volunteers their thoughts on the questions below. Their responses were thematically analysed and presented below. Only three volunteers responded, which places limitations on the conclusions that can be drawn from the data, but the themes closely reflect those from the volunteers in the 2021 survey that suggest some rigour is emerging in the data.

### **Volunteer survey questions**

1. In the context of the value you got from volunteering at Melbourne Knowledge Week, can you tell me about your experience?
2. How did volunteering at Melbourne Knowledge Week contribute to your skill set as a scientist?
3. What did you learn about the public's perspective on FLEET's or your own research?





4. How, if at all, did this awareness of the public's perception of FLEET/your research make you think about the role of communication/engagement and how you communicate to others outside your area of research expertise?

### **Themes from 2022 FLEET volunteer survey analysis**

Three core themes emerged from the 2022 analysis of the volunteer survey responses: Understanding the public. Enjoying Conversations, connecting, and Sci Comm skills. These are examined in more detail below.

#### **Understanding the public.**

This theme is based on volunteers getting a new and broader understanding of how the public perceive their research that helped them reflect on and shift how they communicate their research to the public. Further, volunteers learned that although the public are largely unaware of and lack an in-depth understanding of FLEET's science, they are actually interested in and appreciate the research. Two sub-themes, 'social perspective' and 'communication urgency' indicate specific aspects that volunteers learned about the public they engaged with that affected how they engage with the public and their perceived value of public engagement. The following volunteers' survey responses below reflect this

"I learned just how inaccessible our work can be to the general public sometimes, and how important it is to strip it back and talk about the overarching goal (devices that use less energy). People don't really even know that research centres like FLEET exist."

"... people are quite interested in what we do, in spite of their knowledge being in general very limited.

**Sub-theme: Social perspective.** Volunteers learned that the public often perceive their research and its value differently from how they themselves perceive it. Volunteers learned they have to put their research into a social context to more effectively engage the public because the public typically put greater emphasis on the implications of their science than on the science itself.

"[Volunteering] also helped me view my research from a different, broader perspective, people bring up relevant social aspect issues about our research that I don't usually consider."

"Most people are not really aware of our general motivation, the energy crisis brought on by IT. When made aware, they usually are supportive of our research. But they are also concerned about the ethics and sustainability of our proposed solutions. A lot of people had a basic understanding of electricity from high school but did not realise how it relates to the energy problem."

**Sub-theme: Communication urgency.** Volunteers learned that their audience was largely unaware of FLEET's research problem and that to garner social licence for their research they perceived an urgent need to engage the public more effectively and more often.

"We still need to do more to communicate the energy problem better. Everybody is aware of the climate change crisis, but a lot of people don't know the wide range of research being done to help solve the problem outside of green energy. People can't be supportive if they don't know we exist"

"We get so caught up in getting the work done that we forget that our work is supposed to impact the world in some way, and for people to care about that we need to be able to communicate our work to the general public"

#### **Enjoying Conversations, connecting**

This theme contains two components: a volunteer's joy engaging interested members of the public about their research, and that such conversations enabled them to reconnect with the reasons they do science and reinforce the value of their work.

"I found particular value in meeting people from very different backgrounds (government workers, teachers, business people etc.) and from different age groups. I found it useful in learning



to listen to what people are asking and having a conversation at a level they are comfortable with.”

“I enjoyed speaking with the people that stopped by, both the kids and their parents.”

“Volunteering for MKW or outreach in general helps renew my passion in science, seeing the excitement and wonder that people have towards science reduces the feeling of being burnt out that the PhD process brings.”

### **Sci Comm skills**

Volunteers appreciated and acknowledged the opportunity to develop skills in communicating science.

“...The questions they [public] asked definitely helped me think about how I can engage with the public in a way that resonates with their interests.”

“It was definitely beneficial for my scientific communication skills, having to communicate my research / physics concepts to different levels. But I also found it useful to revisit some more 'basic' scientific concepts which I don't work with regularly. We get so used to doing the same thing every day in our research, I sometimes forget the basics I learned in undergrad.”

“It helped improve my communication skills, specifically in terms of communicating with the general public. It also helped refresh my knowledge and understanding of general physics, as demonstrating and explaining basic physics principles outside of my research required me to remember and understand things I learned in undergrad or high school but can't say I really understood.”

### **Outreach impact for volunteers**

In 2021, two core themes emerged from the volunteer survey analysis: Connecting with the public and Confronting unexpected public value. Volunteers got value and enjoyment by being able to connect with the public about their research. They found some justification for their research because of this connection through dialogue. Volunteers were also confronted by a public who placed a meaning and value on FLEET research that was unexpected or they had not previously considered. These two themes strongly reflect the 2022 themes, Enjoying Conversations, connecting, and the sub theme social perspective.

The strong alignment with the 2021 and 2022 volunteer data suggests that volunteers do get a new perspective and understanding of the public as an audience that enables them to shift how they engage with this audience to ensure more effective communication. They see a value in communicating with the public. Importantly, also there is some reinforcement that their research has value and meaning, which reignites a passion for their work. In 2021 and 2022, volunteers reported that such experiences improved their communications skills.

### **MKW Impact**

While FLEET only engaged with about 300-350 people over the period of Melbourne Knowledge Week, each engagement was of high quality relative to achieving our objectives. Nearly all conversations with visitors were in-depth and examined not only FLEET research, but the implications and perceived value of the research.

With the exception of achieving in students a greater interest and awareness of physics, FLEET achieved all of its other objectives. Most people that visited the FLEET exhibit were previously unaware of the increasing energy consumption of digital technologies and the implication of this. In the exist survey, mind map and observation data, visitors overall reported awareness and concern for the increasing energy consumption of digital technologies; there appears to have been an impact on visitors' understanding of society's use of digital technology; visitors thought critically about the implication of this problem and



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research such as FLEET's that is trying to develop technologies to help solve the problem, for instance visitors revealed a strong social concern that any technology must have social acceptance, but that science is not the only solution to the problem. There was an appreciation for what FLEET was trying to achieve, even if for a lot of people there were questions about ESG.

There were insufficient students that visited the exhibit to understand if we had an impact of student appreciation and awareness of physics. We have raised this in feedback to the City of Melbourne because we think this is a good excursion opportunity for schools and with planning we could develop materials and activities for students to do while visiting event.

FLEET Volunteers gained a new perspective and understanding of the public as an audience that enabled more effective communication. They saw a value in communicating with the public. There was reinforcement that their research has value and meaning and all volunteers that responded reported they perceive such experiences improved their communication skills.

### **Caveats/Limitations**

As noted already the survey response was low and alone it is not a strong indicator of impact, but it supports and strengthens the other evaluation data used.

### **Reflections**

Because the reality of computational demand and energy use is complex a lot of context was missing from our dialogue with the public. For example, driving computing to the cloud where data is managed in the more ultra-efficient data centres can help reduce energy consumption. A more contextualized dialogue on some issues might have led to different perceptions from the public FLEET engaged with at this event. For example, to support FLEET's narrative in the 2021 MKW event we used the "fact" that in about 10-15 years the world may struggle to generate sufficient energy to support the expected computational demand. I noted in the MKW 2021 report that I considered this "fact" to be a bit rubbery because of the variables that can affect this potential outcome. I have still used this "fact" but with the caveat that there are many variables that could affect this outcome and that reports differ on the time frame. I am unsure how this amended version affected the dialogue and concern the public expressed.

As noted in the 2021 report, while the issue of growing computational demand is real and there is a potential social cost to this (energy consumption, etc), I would argue it is more appropriate to simply pose the question, how do we meet the energy demands of our increasing computational needs? How do we generate the energy? What are the appropriate/acceptable solutions? What will this tech/energy bottleneck mean for our digital future? This will avoid getting people to draw conclusions based on less-than-rigorous data or scenarios, and instead get them to think critically about what is an acceptable digital future. We have explored some of these questions with students in school workshop, but we have not done so explicitly with the general public at events such as MKW. The mind map exercise, however, suggests some people thought critically about some of these questions.



## Appendix 1 Mind Map and Observation data

Table 1. Mind map and observation data collated into core themes and sub-themes

Theme from core concept [Observation data]	Sub themes [observation data]
Where does Environment, social, governance (ESG) play a role?	<p><b><i>Environment</i></b>  New materials  Mining  Power generation  Cooling from data centres  Climate change impact - Limited resources  It also teaches. Enable us to use energy more efficiently  [One deep learning model is equivalent to 2 return trips to New York]</p> <p><b><i>Social</i></b>  Acceptable use of technology, eg AI, privacy.  At what cost – have we got the balance right (cost/benefit)?  We need to sacrifice convenience and achieve change in behaviour → Is this realistic? How might this happen?  How much computing power do we need?  Can we shrink the energy required?  *International collaboration - working to find more efficient process, eg coding that requires fewer computations.  [Does ESG apply to fundamental research like FLEET's? It should]  [Interested in the social equity of any tech that eventuates from FLEET research. 'It is also the minorities and marginalized affected negatively.]  [Should we be sacrificing convenience because technology is just a convenience, it's unnatural.]</p> <p><b><i>Governance</i></b>  Who has access? If malicious actors take control, then what?  **Govt policy and funding ARC, NHMRC, CRC → Fund basic science in Australia → Public demand will outpace policy – private sector will finance and lead.  Stop brain drain/jobs here in Australia.  ***Transition to renewable energy asap → Invest in improving efficiency</p>



	[We can only get change is vested interested (ie big business) allows change] [OK, how much of an issue is energy use in digi tech compared to other sources of energy use, eg transport, etc. Where should we put our priorities. That is, is digi-tech a priority?]
<b>Dialogue</b>	
Make change more accessible for public understanding and discussion	Dialogue to raise awareness and drive demand for new tech → Industry-led to fund devt of this tech – ie build tech to meet demand. → Govt can legislate to facilitate adoption and devt [Outreach is important] [Highly concerned because of the energy consumption – that we are just not aware that it is making climate change worse]
<b>Research and Development</b>	
Research investment	*International collaboration → working to find more efficient process, eg coding that requires fewer computations **Govt policy and funding ARC, NHMRC, CRC → Fund basic science in Australia ***Transition to renewable energy asap → Invest in improving efficiency
[Economics]	
[We don't need any more computing power, we need to find ways to save money, use less energy...But what about sustainability]  [What is the opportunity cost if we don't do this (FLEET) research and someone else discovers it? Even if someone else discovers it first, if we have the local expertise, we have the base for local production. But if we don't have the local expertise, we will have to import everything.]  [How do we measure the value of innovation investment? - eg patents, value of jobs, etc]	
<b>Miscellaneous</b>	
Advanced species require more energy	
Fair enough/makes sense	
How broad can it be in the future?	Meaning/context is unclear





FLEET

ARC CENTRE OF EXCELLENCE IN  
FUTURE LOW-ENERGY  
ELECTRONICS TECHNOLOGIES

Note: the observational notes used in Table ? are not quotes, but paraphrased notes based on the original conversation with the visitor to the FLEET exhibit.

\* indicates the contribution is relevant in more than one themes/sub-themes