Designing renewable energy interfaces for rural Rwandan communities

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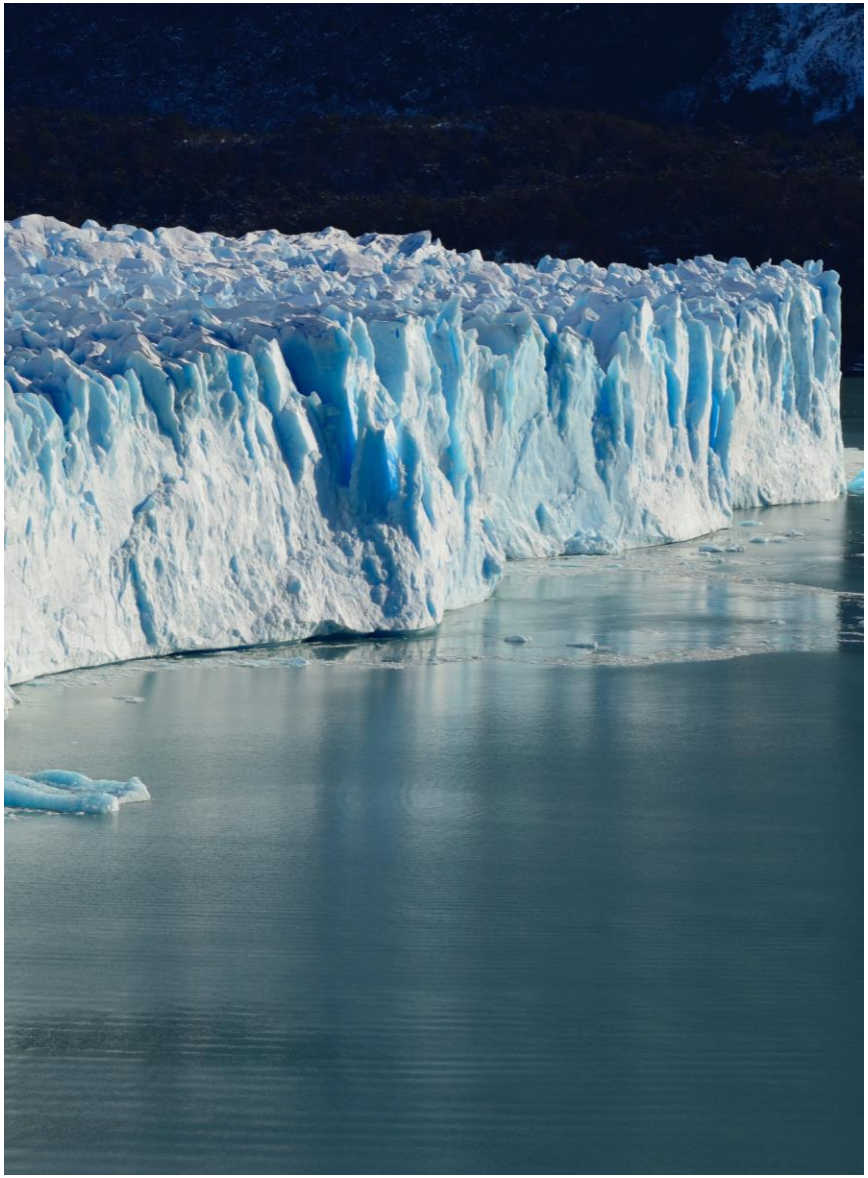
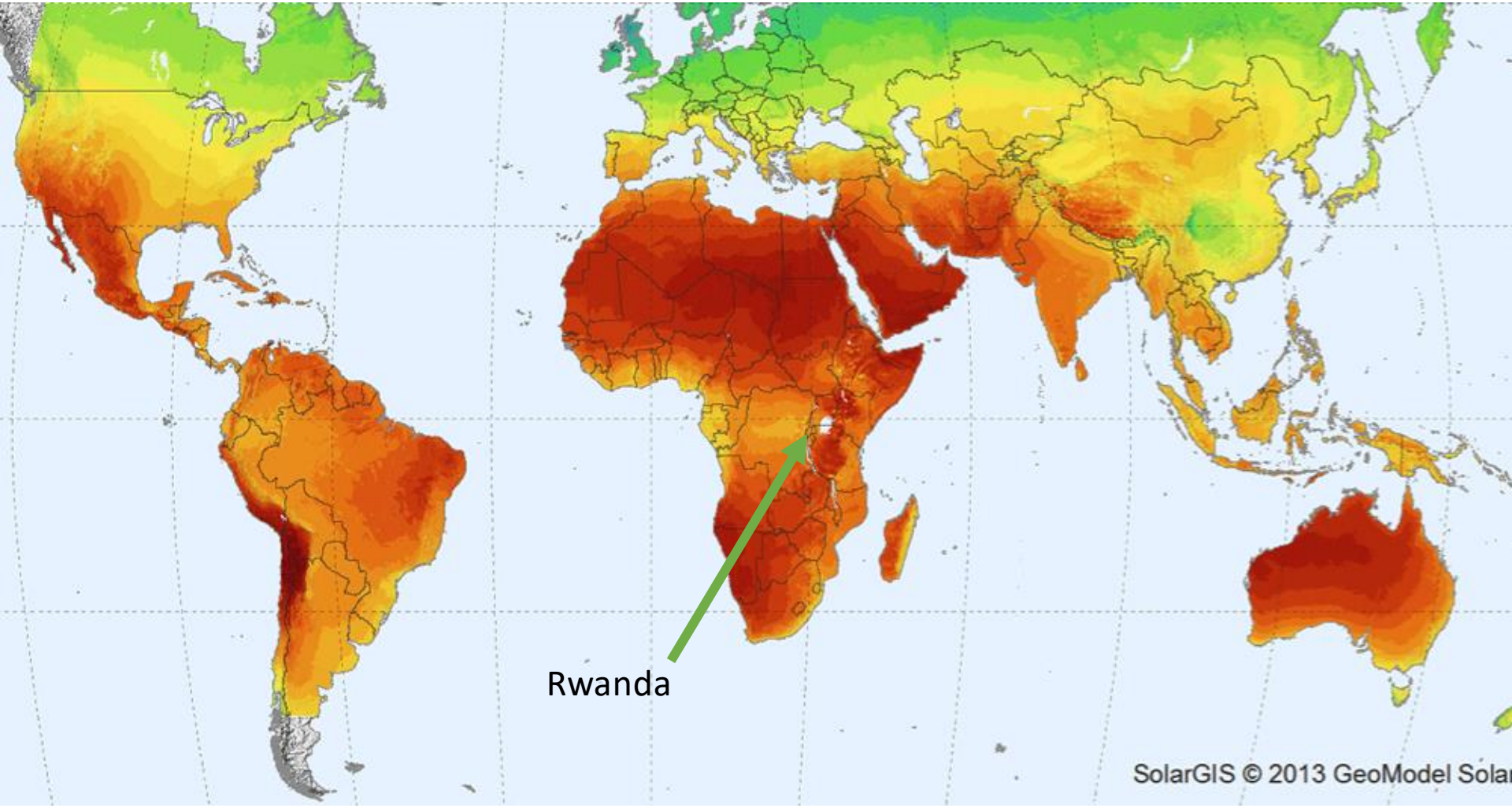
Paris Climate Agreement

The Paris Agreement's long-term goal is to keep the increase in global average temperature to well below 2 °C above pre-industrial levels; and to limit the increase to 1.5 °C, since this would substantially reduce the risks and effects of climate change.



The Location



The Partner

- Solapak Ltd

  Specialises in solar power for industrial customers in challenging, remote environments.

Electricity in Rwanda

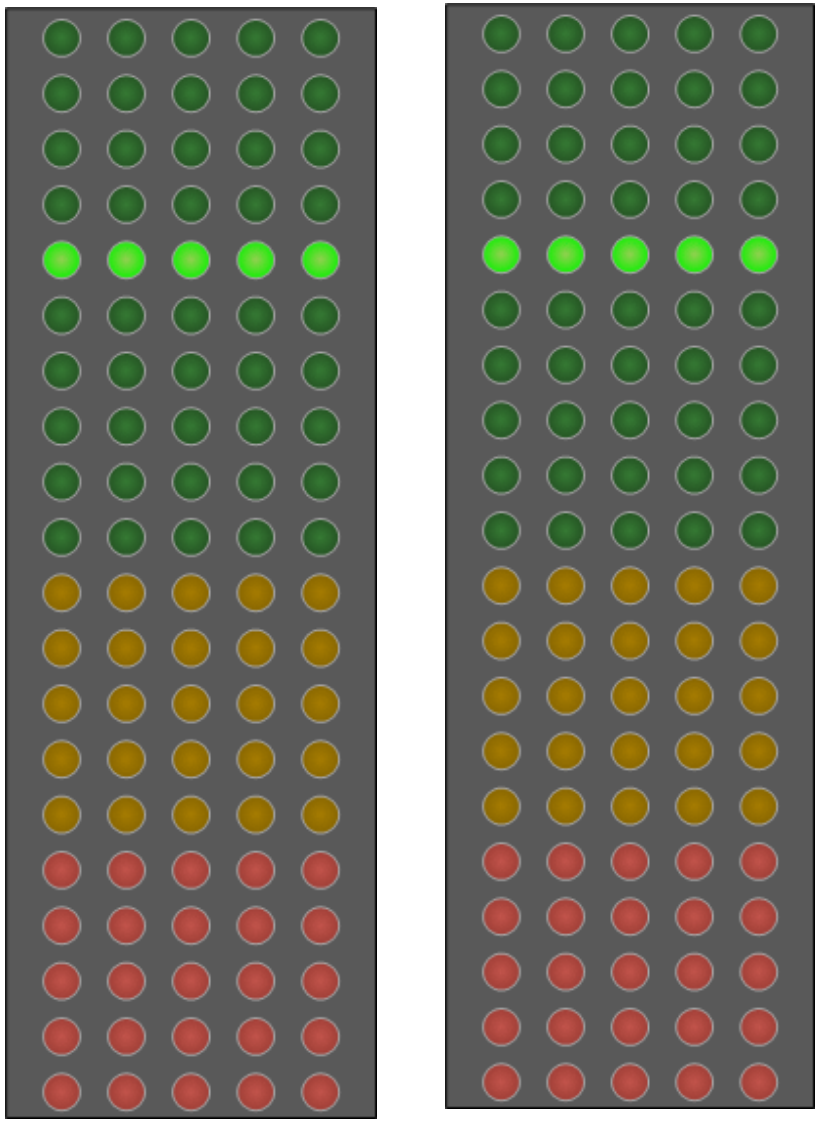
- Installed Capacity: ~200 MW (Mostly Hydroelectric)
- Current Access Rate: 30%
  - Rural: 12% Urban: 72%
  - 7m with no access to electricity, let alone reliable electricity
- Target: Universal access by 2024 (52% on-grid, **48% off-grid**)
- The powerplant of the steelworks in Port Talbot has about 100MW capacity.

The Opportunity/Challenge

- To provide off-grid solar energy services to rural communities in Rwanda.
- To provision efficient DC equipment and avoid inefficient DC-AC conversion
- To train users to act efficiently (e.g. avoid leaving fridge door open)
- To develop a user display to enable **resource constrained** - energy-poor developing world - **communities** to understand a finite but replenishable resource; primarily electricity in a battery charged by solar.

The Initial Prototype

Solapak developed a prototype display as part of an Innovate-UK energy catalyst project to relay information on battery capacity and rate of consumption.



Field Testing Results

User display was learnable, but not entirely intuitive to use.

Participants mentioned that they are familiar and comfortable with mobile phones

Milk Collection Centres were identified as potential sites for solar installations.

The Context

Milk is brought to these stations from up to 25km distant by bicycle and motobike and power failure results in thousands of litres of spoilt milk.

The Context - Milk

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- Milk is bought at 150RWF (~13p) per litre
- Milk is sold at 180RWF (~15p) per litre

- Subsistence farmers typically have 3-10 cows. And typically bring 10L (during dry season) and 25L (during rainy season) of milk per day.
- Dairy accounts for 6% of GPD (~$500m)

- Milk represents primary source of income.
- Milk collection centres structured as cooperatives

The Context - Replacing Diesel

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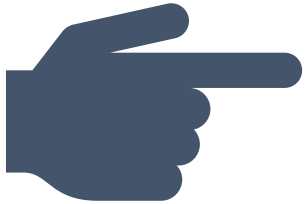
- MCCs are powered by diesel generators
- In Rwanda diesel costs about what it costs here.
- However ...
  - Rwanda's **average** annual **household income** is about $400
  - The **median** annual **income** in the **UK**, according to the most recent Annual Survey of Hours and Earnings, is £28,677 for full-time employees
- Consequently, MCCs sometimes shut down during dry season.

Interlude – Tools we use in HCI

- Paper & Post it notes
  - Brainstorming
  - Sketching
- Whiteboards
  - Affinity diagramming
- Prototype
  - Low-fidelity Paper/PowerPoint
  - High-fidelity
- Guidelines
  - Heuristics
  - Google's Material Design
  - Apple's Human Interface Guidelines

Adding to that list

Books



The perspective you **choose** to adopt.

Technical knowledge is not enough!

Technology is increasingly colonizing almost all aspects of life:

- how we communicate and relate to one another
- the stuff we use to develop and portray identity is increasingly becoming digital - music, photos, videos.

Likewise technology is being deployed, adapted, and appropriated in places far removed from the centres of technology innovation in which they are imagined and created.

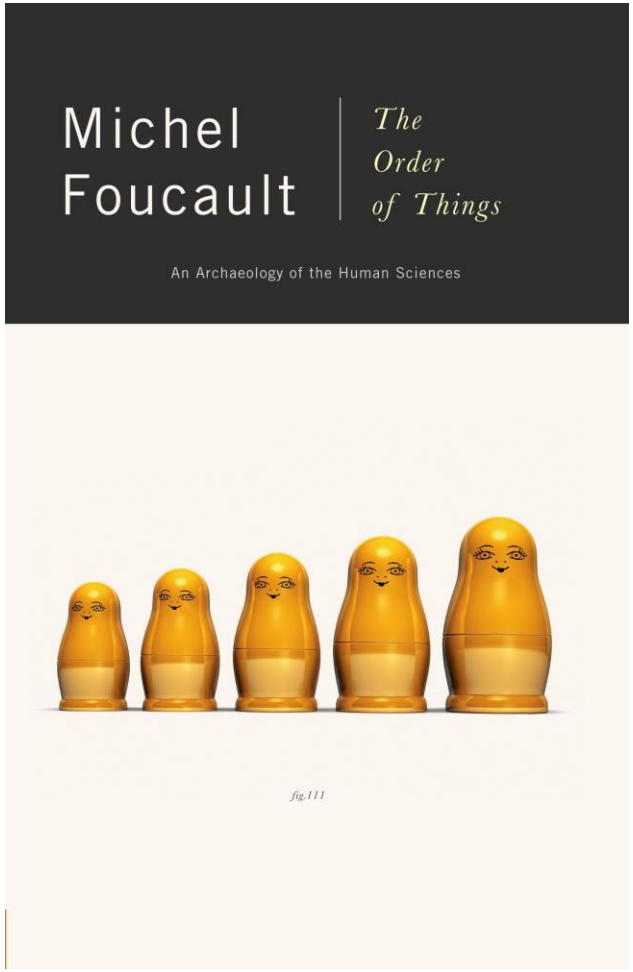
Technical knowledge is not enough!

- There are academic disciplines and people that know a lot more about these issues than you or I do:
  - Anthropology: people and cultures
  - Sociology: social interaction, structures, practices
  - Philosophy: knowledge and reason
- Go chat and work with them.
- If you can't, read their books.
- Take their perspectives on board and use them to **frame** your problem/project.

Example: Philosophy

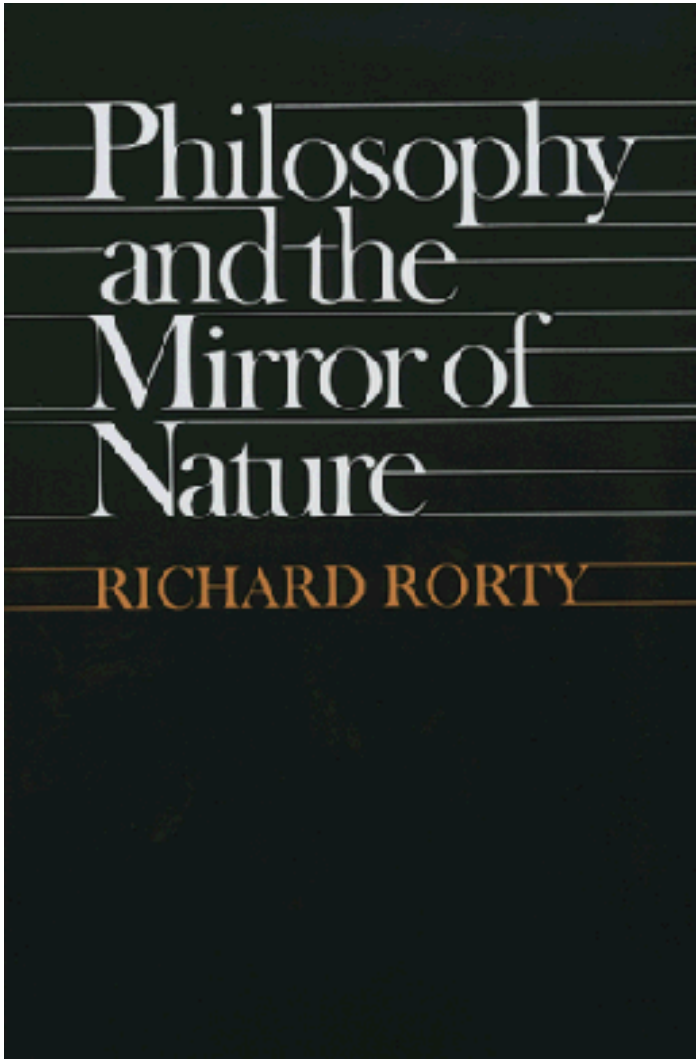
- Enquires involving people always emphasise particular aspects of human agency and exclude others.

- That is, we create the subjects we investigate.



Example: Philosophy

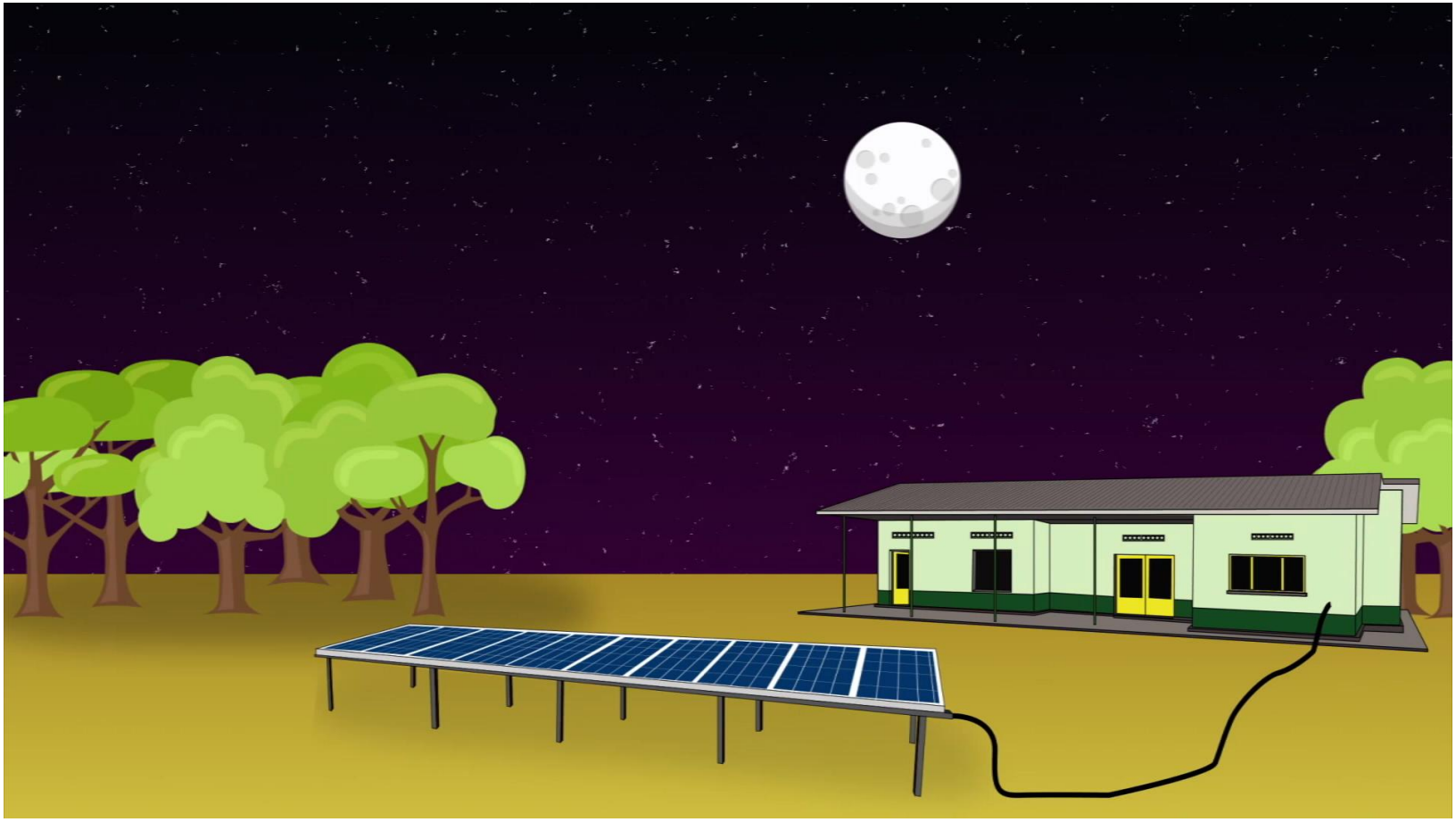
One ought to judge the value of any particular rendering of human agency by the practical implications that view generates.



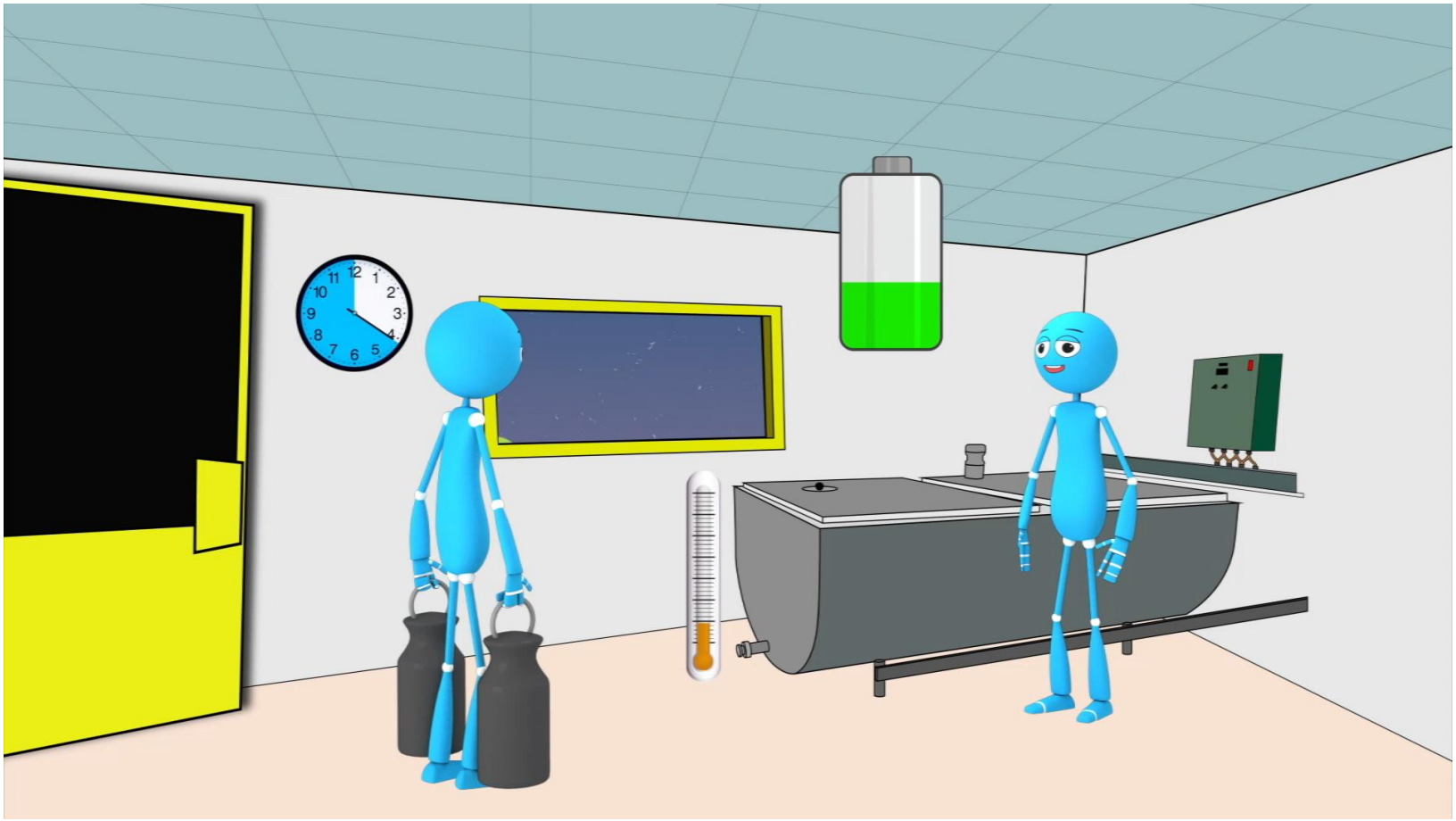
Constructing the user: The CS/Engineering Perspective

- Farmers and MCC operators are **lacking:**
  - income
  - education
  - reliable power
  - understanding of how solar power works.
- Their view is partial and contrasted with the wisdom of the researcher/solar engineer.
- MCC is a technical/economic site for chilling, buying, and selling milk.
- Motivates: Efficient equipment, training people to become efficient users, providing power and knowledge of how that power works.

Training Video Examples



Training Video Examples



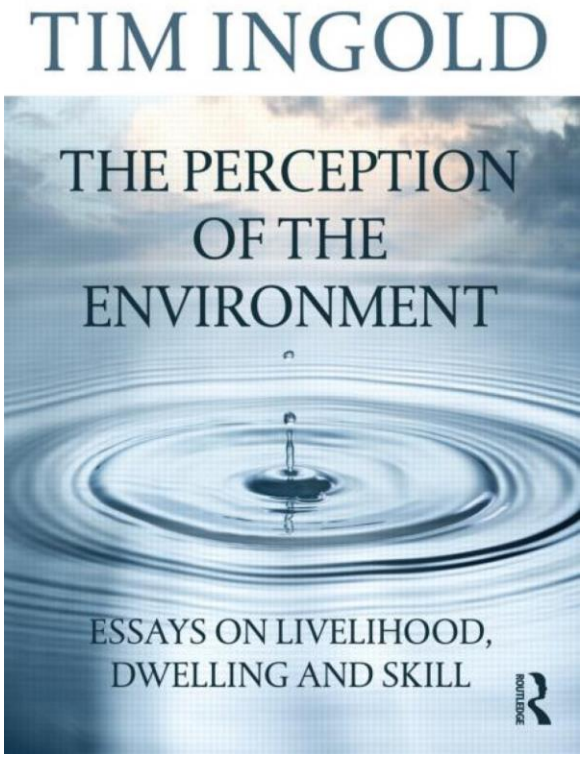
Method: Questionnaires

- How full was the battery at the beginning of the day?
- How full was the battery at the end of the day?
- Why did the operator only accept one urn of milk?

Example: Anthropology

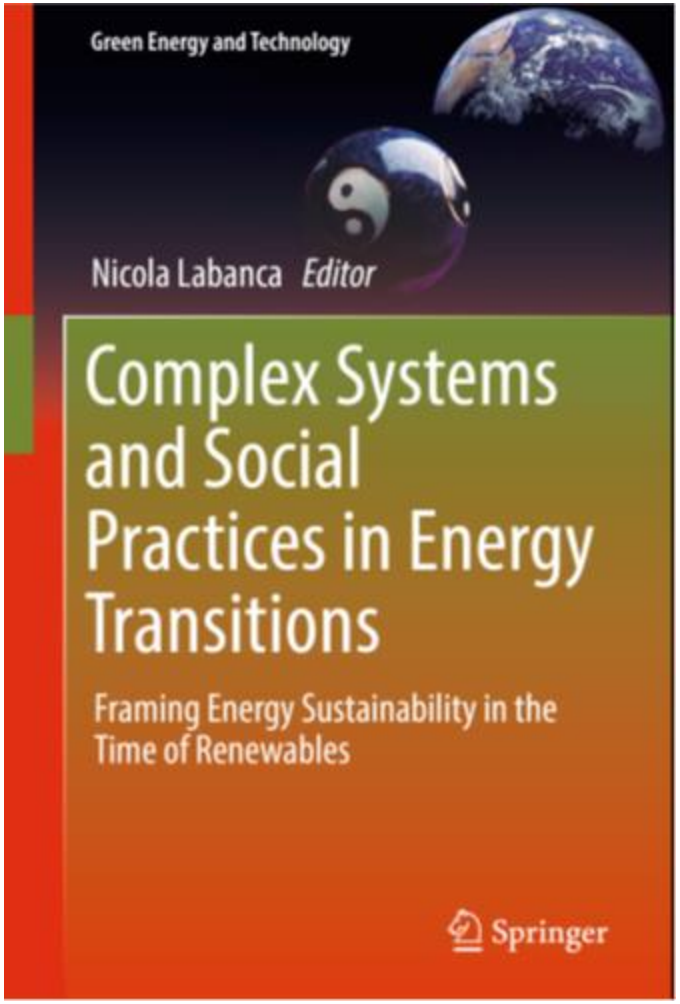
- All people are experts in their own ways.
- Non-western orientations to time is perhaps particularly suitable to using renewable energy.

- The skill of the farmer is to bring quotidian activities into resonance not only with those of other living things but also with a whole host of other rhythmic phenomena – the cycles of day and night and of the seasons, the winds, the tides, the needs of animals, and so on.



Example: Sociology

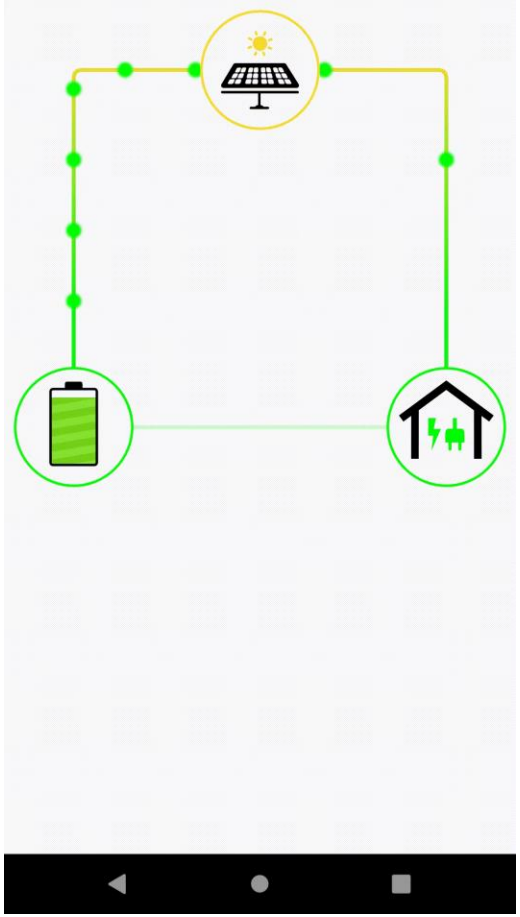
- There are two very different ways of knowing energy:
  - one that proceeds by abstracting (KWh/efficiency)
  - the other by embedding into social-temporal rhythms of generation and use.
- Stop reproducing the fossil-fuel mentality, where energy is an abstract (purified) resource: e.g. watt-time.
- Re-conceptualise and re-entangle energy and social/work practices.



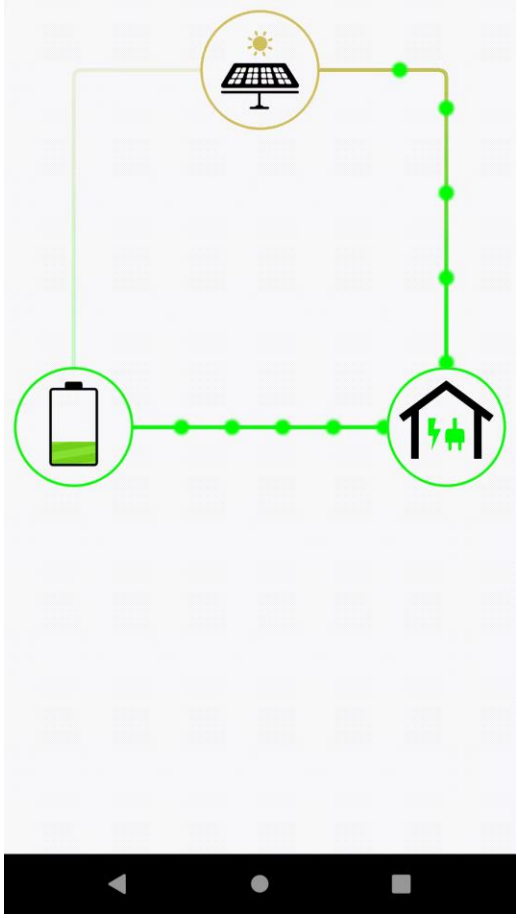
Re-constructing the user: The Socio-Cultural Perspective

- Farmers are **creative, social,** and **skilled** practitioners:
  - Coordinate between needs of family, community, animals and bring varying temporal patterns into quotidian resonance.
- In addition MCC operators:
  - Coordinate and mediate the needs of bigger businesses and farmers.
  - Translate between noncapitalist and capitalist value systems.
- MCC is a social site:
  - A place that farmers visit as they move within and between sites of engagements.
  - A place to rest, meet, catch up, learn, etc.
- Motivates: making energy production, storage, and use directly visible so that they can integrate that information into their decision making.

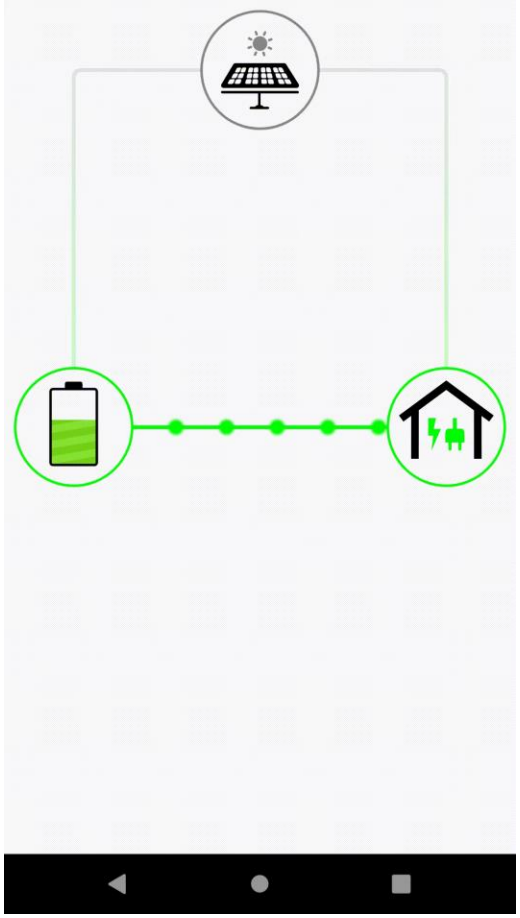
Interface



Interface (cont)



Interface (cont)



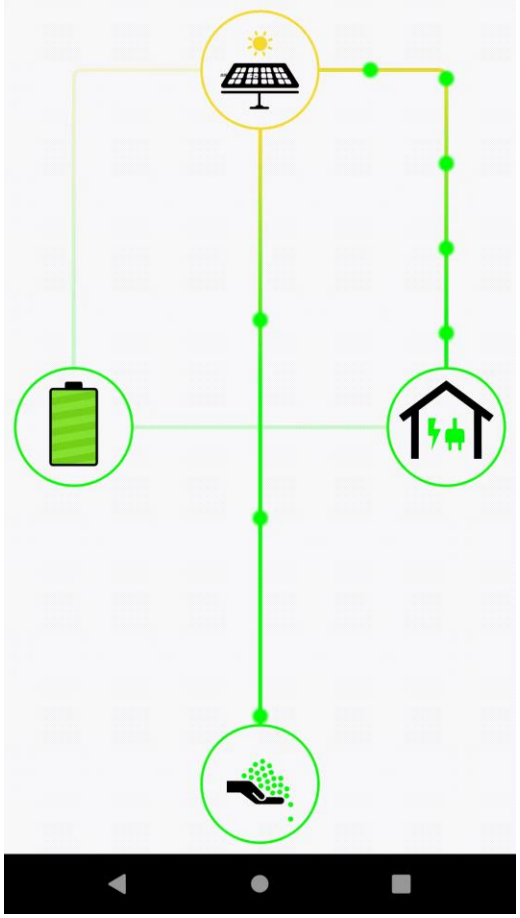
Method: Engaging artists to situate design

ivuka arts

Ivuka Arts Kigali

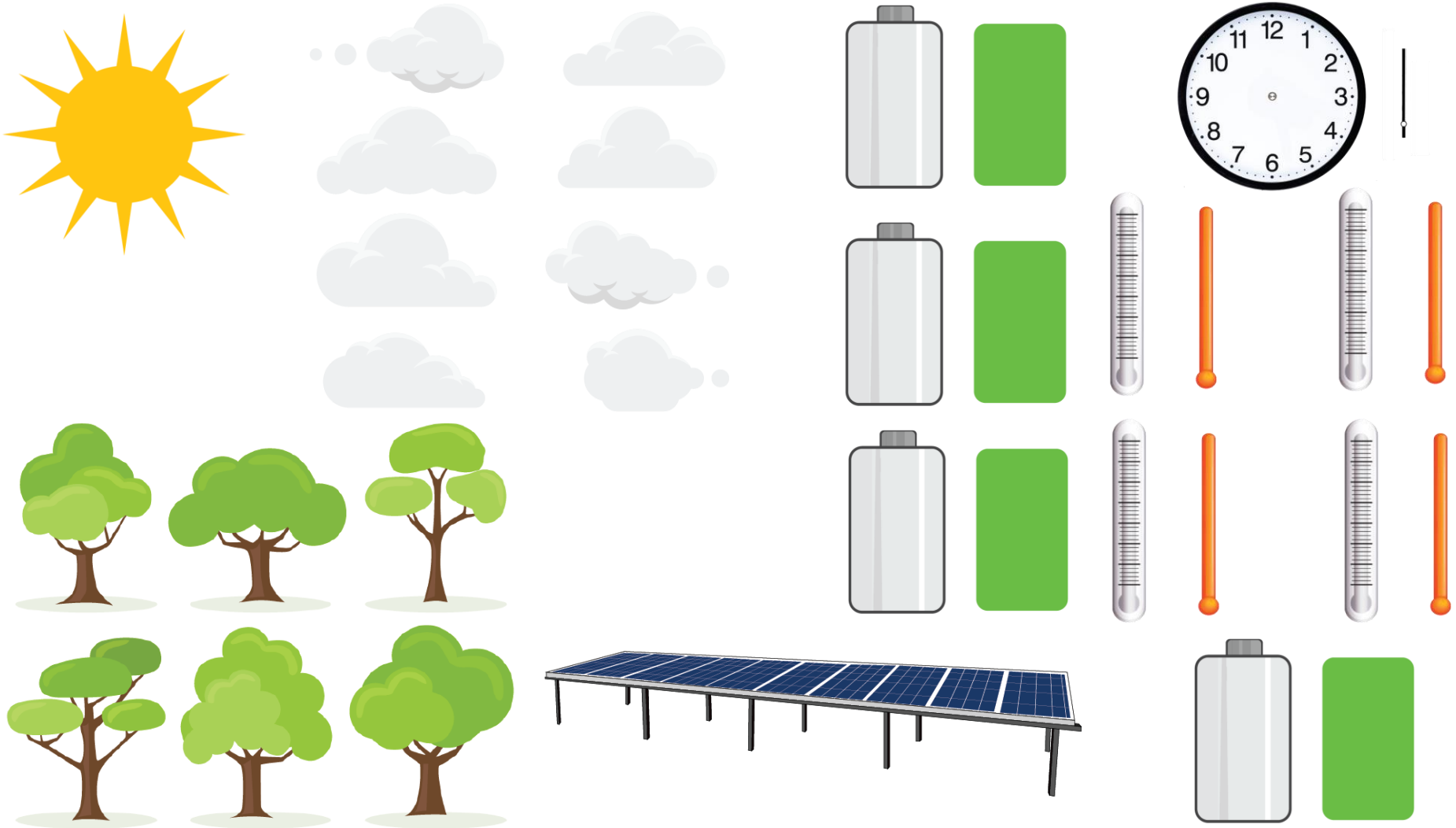
@IvukaArtsKigali

Interface: Excess = Opportunity



Method: Focus Group

Method: Storyboarding



Method: Pivoting

Conclusion

- Attending to and caring about the entanglements between technology and social practice is important and productive.

- Be mindful of the difference between **getting the design right**, which involves problem-framing, and **getting the right design**, which involves iteration and evaluation.