Areas of Focus

Urban Living Labs - Stem School Challenge

Water

Water is an essential infrastructure of any urban development. Apart from needing to supply drinking water and remove and treat wastewater, urban areas have high risks during drought and are sources of large amounts of rainwater runoff that is a cause of flooding and contaminant transport. There is a need to redesign our urban areas to better manage water and to support cooling and greening initiatives

Future options examples
- Greater amount of recycled water for different uses (including for drinking water)
- Capture and slow down rainwater runoff to reduce flooding and environmental damage
- Increase urban greening
- Use to reduce urban heat
- Production of hydrogen and other green products

Links to other Pillars
- Energy – e.g., increased urban greening and capture/slowing of urban stormwater can cool air which reduces energy for cooling; hydrogen production requires water as a source of water.
- Circular economy – e.g., recycling wastewater.
- Agriculture – e.g., urban agriculture needs water, but water source shouldn't be drinking water.
- Health – improved urban cooling improves health of residents; good water quality is important for human and environmental health.
- Urban Development – can we move away from water from a centralised source and capture rain when it falls?

Energy

Along with water, energy is one of the most important infrastructure issues for urban developments. There is an awareness of the need to transition from fossil fuels to more

environmentally friendly options. Current solar and wind technology suffer from issues relating to storage when sun/wind is not present. Current renewable sources need greater surface areas than available roof areas in most urban centres, and it is still unclear what energy sources will we use for future transport in order to replace oil-based fuels.

Future options examples
• Improved and increased renewable energy • Hydrogen
  ● Energy storage
  ● Energy sharing and trading

Links to other Pillars
  ● Transport – moving away from fossil fuels to renewables
  ● Smart Cities – Smart city sensors and devises can reduce energy waste and maximise renewable energy production and storage.
  ● Water – water is often needed to assist the production of energy
  ● Urban Development – can we move away from lots of wires delivering energy from a centralised source?

Circular Economy

Circular economy relates to the eliminating waste and pollution, circulating materials and products to provide increased value. Waste can be considered not only solid wastes from industry and domestic sources, but also water, excess heat and unused energy. It is recognised that Australian towns and cities can no longer afford to collect and dispose of waste to landfill. Authorities are now encouraging the reuse of waste products for other purposes along with economic and environmental benefits.

Future options examples
  ● Designing products to not create waste or be easily disassembled or repurposed
  ● Shared waste reuse between industries.
  ● Capture of compostable wastes for energy and/or fertiliser production.
  ● Use of waste heat for heating of homes.
    Links to other Pillars
  ● Energy – Circular economy applications to waste can either save energy, or may need more energy. Organic wastes can be used to produce biogas or soil amendments.
  ● Water – Water recycling, including the reuse of the solid waste collected during treatment of the wastewater.
  ● Agriculture – composting degradable organic wastes into fertilisers.

- Urban Development – redesigning how buildings are constructed can help the capture, separation and collection of different wastes; new buildings and infrastructure can be built and installed using methods that minimise the production of waste.
- Smart Cities – use of sensors and AI can help monitor and control the collection and reuse of wastes; Smart cities applications can help reduce the production of wastes

Health

Healthy towns and cities are happy and efficient places to live. Healthy towns are not only designed to help people who are sick, but also are designed to improve the well-being of residents and visitors. It is becoming recognised that green, pleasant urban environments can improve mental health and well-being of people as well as improving health by encouraging active mobility, reducing urban heat and pollution.

Future options examples
- The use of drones to deliver medicines to elderly and incapacitated residents.
- Sensors in the home and workplace can automatically adjust temperature and air quality within buildings.
- Planting appropriate trees and bushes along walking paths can encourage increased active transport (e.g., walking, bike riding etc).

Links to other Pillars
- Water – water can be used to help cool urban areas, which can improve health and well-being as well as encouraging active transport; good quality water is healthy water for people and environments.
- Smart Cities – sensors and AI applications monitor indoor and outdoor conditions to provide optimal conditions for health; indoor sensors can monitor personal conditions and
- Transport – reducing the use of personal cars and greater use of public transport and active transport which can improve air quality and personal fitness.
- Urban Design – Designing ways to ensure low energy performing buildings that have high indoor comfort and air quality.

Urban Development

Current building and urban infrastructure building rules rarely encourage innovation or consider broader social and environmental benefits. New infrastructure is also often built using lower value materials and are high in wastage. Better built infrastructure uses and requires less energy, lower emissions and decreased environmental impact, and has passive cooling and

lighting and encourages healthy environments.

Future options examples
- There is a need to develop ways to build infrastructure that is future proof i.e., can incorporate new technologies as they become available.
- Redesigning how the construction of infrastructure minimises construction waste.
- Infrastructure that can use sensors and AI technology to monitor the environment to reduce waste and health impacts.

Links to other Pillars
- Water – Infrastructure can be built to assist the capture and slow movement of stormwater that reduces flooding, aids irrigation of trees and helps cool urban environments.
- Energy – well designed and built infrastructure can require less energy in construction and use, however, some constructions may require more energy to build even if save energy in the long run; some infrastructure can be designed to help generate energy (e.g., a location to site PV cells).
- Smart Cities – sensors and AI applications are incorporated in the design to assist maintenance and the local environment.
- Circular Economy – The built environment can be designed to assist improved collection and separation of waste. Developments can be designed and built to minimise waste.

Transport

Australian cities have largely been built around personal cars. This has created a range of problems including heavy traffic, air pollution, and reductions in physical activity. In addition, roads cost large amounts of money to build and maintain. The potential for self- driving vehicles to become available in the near future, there are opportunities to think about how people move around our cities and towns.

Future options examples
- The use of autonomous public transport to move people from homes to centralised places,
- The use of AI technology to improve personal transport using autonomous vehicles.
- Use of more, smaller autonomous public transport and heavy vehicle delivery services to reduce the need for personal vehicles.

Links to other Pillars

- Energy – Car will move from relying on fossil fuels to renewable energy sources. Where will this energy come from?
- Urban Development – designing urban centres to be more people focused and less car focused.
- Circular Economy – small autonomous rubbish trucks can collect specific waste on-demand, reducing the pressure on roadways.
- Smart Cities – Sensors and AI can help reduce heavy traffic by directing vehicles through multiple routes to similar destinations.

Smart Cities

No one wants to live in a dumb city! Sensors and AI technology has the potential to do many things, however, there needs to be serious consideration on what data is collected and how it is shared, along with being focused on what issues Smart Cities applications trying to solve. Many of the issues need much more data and understanding for Smart Cities applications to be successful. Done well, such applications can improve the function and liveability of urban areas.

Future options examples
- Technologies that improve health and well-being in homes and buildings.
- Monitoring environmental conditions in urban areas and changing energy and water uses in response.
- Monitoring the production and collection of waste to improve circular economy Efforts.

Links to other Pillars
- Smart Cities is linked to all the other Pillars, and can have significant benefits for each Pillar, and between individual Pillars when set up well.

Agriculture

Traditionally many people had home gardens where they grew fruit and vegetables for personal consumption. With increasing high density living, this is becoming more difficult. Research is showing, however, that urban farming can have many social and mental wellbeing benefits. Community farms can also be located in areas that are flood prone and assist with flood control (and manageable problems when flooding occurs). Urban agriculture can also be an important part of circular economy efforts. There could be benefits and potential risks for attracting native biodiversity.

Future options examples
- Using the by-products from biogas generation form organic wastes as a fertiliser source.

- Use of fruit trees as shade trees along paths and roads.
- Vertical farming to provide fresh vegetables and salads for local consumption.

Links to other Pillars
- Water – a place for recycled water and captured stormwater to be used.
- Energy – may require energy for food production, particularly for vertical farming.
- Circular Economy – can use organic waste and water treatment by-products as a fertiliser source.
- Smart Cities – Sensors to assist optimal watering of plants.
- Health – improved mental well-being of residents due to outdoor gardening and social interactions.
- Urban Development – fruit trees used as shade trees. Designing small areas a herb and vegetable gardens.