

Nimna S. Wickramasingha , **Supervisor:** Dr Salma M. S. Al Arefi

1. Background

Today, decrease global crop yield due to climate change, increase in global population threatening food security and increasingly urbanizing global poverty remain to be alarming(1). Renewed interest in urban agriculture (UA) continue to emerge as a sustainable alternative. Digitalised systems using Internet of Things(IoT) infrastructure produces a higher quantity and quality of crop to meet global food demand along with environmental benefits. To ensure such promising development is done sustainably decarbonising solution need to be co-delivered.

2. Objectives

A critical review analysis for opportunities and challenges of sustainable urban farming and its digitalisation

3. IoT infrastructure for UA application

1.Physical layer

Actuators, sensors, wireless sensor networks, hardware boards etc.

2.Network layer

Short range (WiFi, ZigBee, Bluetooth), Low-power wide-area (LoRaWan etc.), Cellular area (3G,4G,5G).

3.Middleware layer (LinkSmart, OpenIoT, FIWARE etc.).

4.Service layer

Artificial intelligence, Predictive analytics, Big data analytics, Cloud/Fog computing, Edge computing etc.

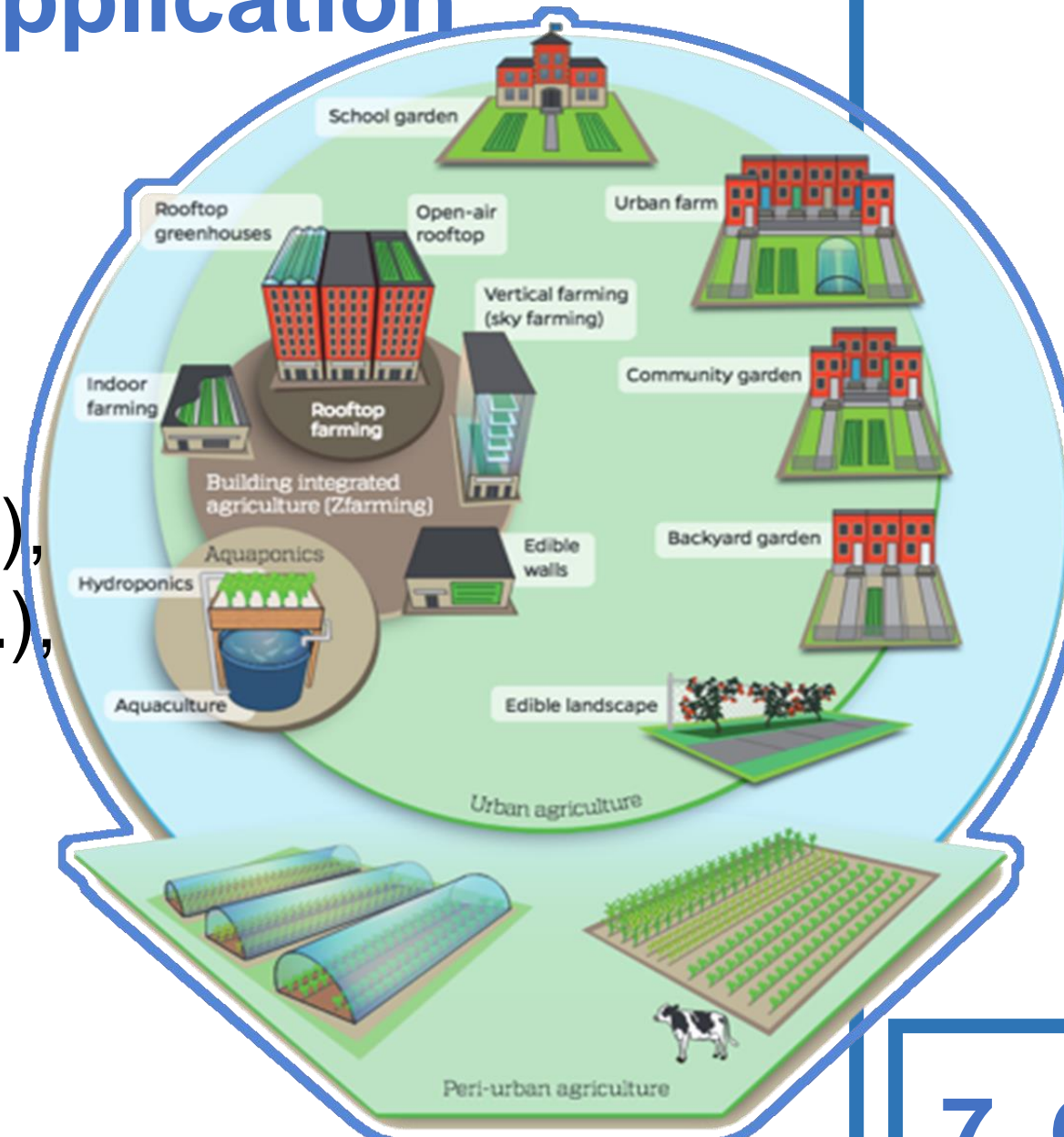


Figure 1. Various urban farming applications (2)

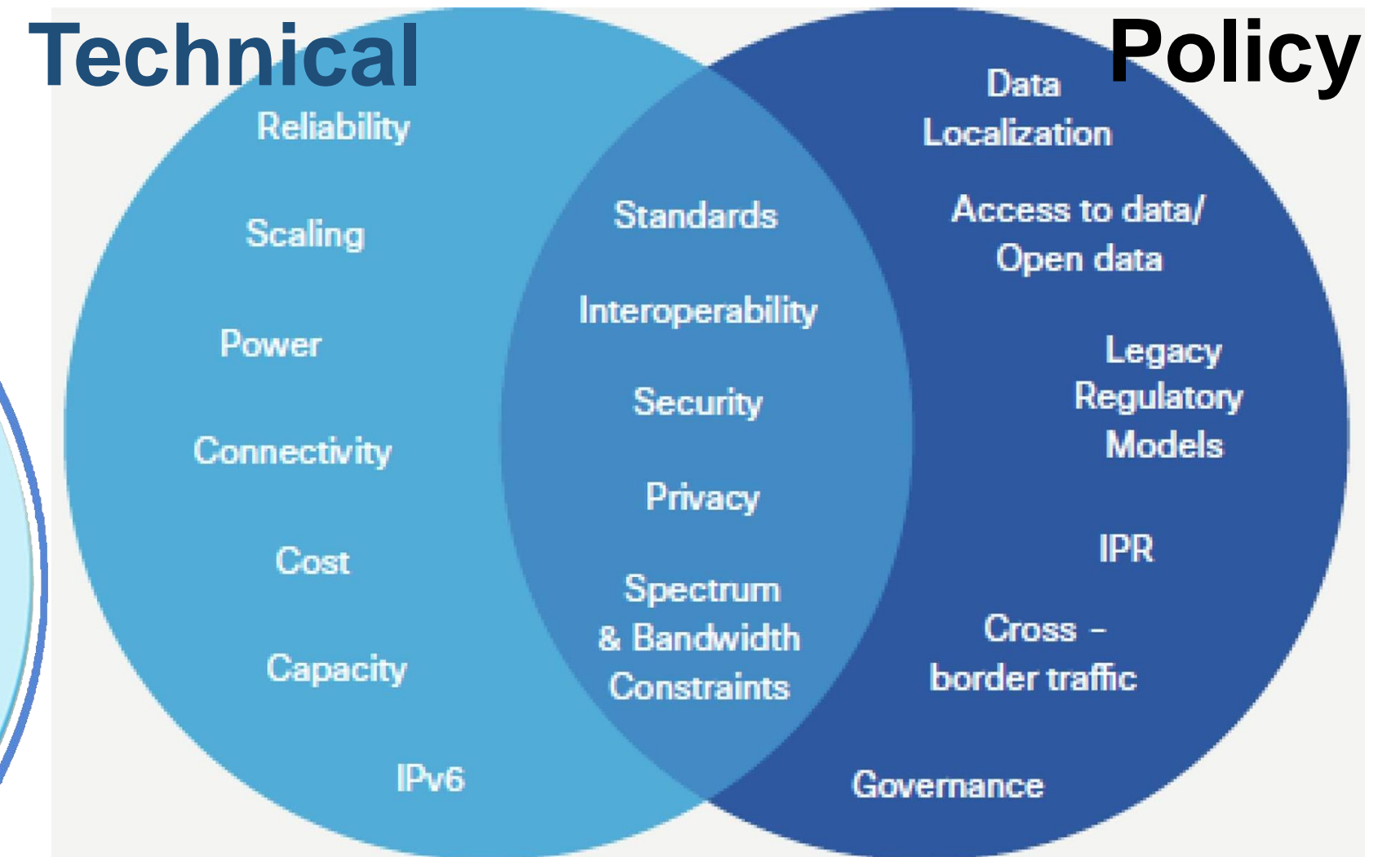


Figure 2. Technological and policy barriers for uptake of IoT infrastructure (3)

4. Current application

- UA is widely adopted in developed countries.
- Uptake of UA and clean new technologies is slow in developing nations where the need for it is greater.(6)

5. IoT for urban planning, policy making, and making UA feasible

- Using a remote-sensing and GIS-based modelling framework and using geoprocessing and spatial analysis tools to identify available areas for urban farming (7).
- Using decision analytics and online data sharing to coordinate and scale-up production from independent urban farms, respond to consumer demands and minimize waste (8).

6.Overcoming challenges

- Further improvement in commercial technologies and creating industry awareness by researchers and engineers.
- Technological industries and governments increase efforts for commercialisation and uptake of UA models, technologies and decarbonising alternatives
- Providing farmers with financial support, access to new technology and knowledge.
- Introducing new policies, business models and reallocating and mobilising resources.

7. Opportunities for decarbonisation

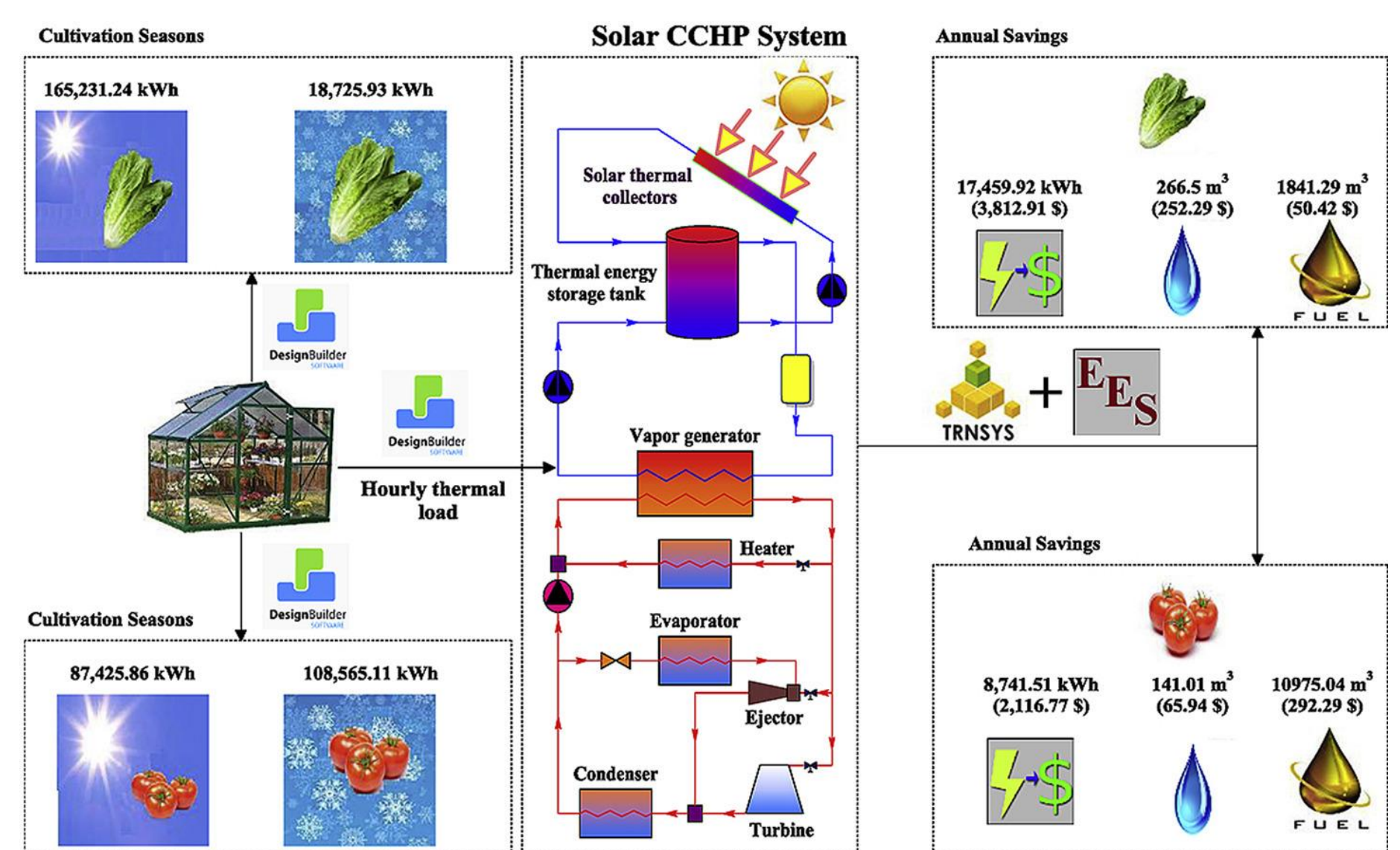


Figure 3. Model of a CCHP system (4)

- a highly efficient combined cooling, heating and power system (CCHP) integrated with RER (Fig 3.)
- Using the process of hydrothermal carbonisation
- Using agrophotovoltaic systems (Fig 4.)
- Using Organic Solar cells



Figure 4. Agrophotovoltaic system (5)

References:

- (1) Pörtner, H.-O., Roberts, D.C., Tignor, M.M.B., Poloczanska, E.S., Mintenbeck, K., Alegria, A., Craig, M., Langsdorf, S., Löschke, S., Möller, V., Okem, A. and Rama, B. (eds.). 2022. *Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change.* (2) Friha, O., Ferrag, M.A., Shu, L., Maglaras, L.A. and Wang, X. 2021. Internet of Things for the Future of Smart Agriculture: A Comprehensive Survey of Emerging Technologies. *IEEE CAA J. Autom. Sinica.* 8(4), pp.718–752.
- (3) Maraveas, C., Piromalis, D., Arvanitis, K.G., Bartzanas, T. and Loukatos, D. 2022. Applications of IoT for optimized greenhouse environment and resources management. *Computers and Electronics in Agriculture.* 198, p.106993.
- (4) Rostamzadeh, H., Ebadollahi, M., Ghaebi, H. and Shokri, A. 2019. Comparative study of two novel micro-CCHP systems based on organic Rankine cycle and Kalina cycle. *Energy Conversion and Management.* 183, pp.210–229.
- (5) Weselek, A., Ehmann, A., Zikeli, S., Lewandowski, I., Schindele, S. and Högy, P. 2019. Agrophotovoltaic systems: applications, challenges, and opportunities. A review. *Agronomy for Sustainable Development.* 39(4), p.35.
- (6) Badami, M.G. and Ramankutty, N. 2015. Urban agriculture and food security: A critique based on an assessment of urban land constraints. *Global Food Security.* 4, pp.8–15.
- (7) Saha, M. and Eckelman, M.J. 2017. Growing fresh fruits and vegetables in an urban landscape: A geospatial assessment of ground level and rooftop urban agriculture potential in Boston, USA. *Landscape and Urban Planning.* 165, pp.130–141.
- (8) Ghandar, A., Theodoropoulos, G., Zheng, B., Chen, S., Gong, Y. and Zhong, M. 2018. A Dynamic Data Driven Application System to Manage Urban Agricultural Ecosystems in Smart Cities *In: 2018 4th International Conference on Universal Village (UV).*, pp.1–7.