

A digital twin for London's underground farm

What happened?

ASG-funded researchers at The Alan Turing Institute worked with [Zero Carbon Farms](#) to develop a [bespoke digital twin](#) for their hydroponic farm as part of the [Growing Underground](#) project. The farm occupies over 1,000m² of tunnels below the streets of Clapham and supplies 100-150 tonnes per year of microsalads to shops and restaurants. The digital twin uses a physics-based model to forecast conditions in the tunnels based on outdoor conditions but is, crucially, [calibrated with real data from sensors](#) around the farm. It provides a platform for data analysis to help improve the farm's output, while also enabling remote and automated operation.

What are the real-world impacts?

- The digital twin platform ('CROP') built by the Turing's [Research Engineering Group](#) (REG) allows growers to analyse past and current conditions on the farm, and predict future conditions up to three days in advance, guiding proactive responses.
- Sensors provide farm managers with 24/7 data on water quality, temperature, humidity, light, air speed and CO₂ levels at 10-minute intervals.
- Forecasting functions enable farm managers to virtually test out coping strategies for weather events like heatwaves without loss of crops or associated economic losses.
- CROP was recently updated for tracking of individual salad trays with QR codes via an app built by [Purple Crane](#). This allows semi-automated collection of yield data, helping growers to analyse yields in relation to environmental conditions over time.
- CROP is currently providing data on new crops that the farm team is experimenting with, which are destined for herbal, medicinal and cosmetic products.
- The open-source software could provide the basis of a standardised platform for other unconventional farms to use as digital twins.

Why was the Turing's [ASG programme](#) uniquely placed to do this?

- The research team needed additional statistical expertise to complement its existing engineering knowledge and implement the hybrid data-physics models that form an integral part of CROP. Through connections within the Turing network, identifying and convening the relevant researchers was a seamless, yet critical, process.
- The REG provides a wealth of expertise in software development that is crucial to making the digital twin usable by growers, enhancing its functionality in line with their needs and, eventually, generalising it for more widespread use.

What's next?

- Automation of data analysis as well as of farm operations, for instance, controlling ventilation in response to the forecasted temperature.
- Further automation of yield tracking through computer vision and moving sensors.
- Modularising the existing digital twin so that it can be offered as a technology platform for other growers seeking digital twins for their urban agriculture businesses.

“The collaboration has provided us with arguably the most advanced tool possible to manage and improve our operation in terms of yield and resource use efficiency.”

Jakob Thomas, Data Platform Lead, Growing Underground