digital twin
CONSORTIUM

WEBINAR

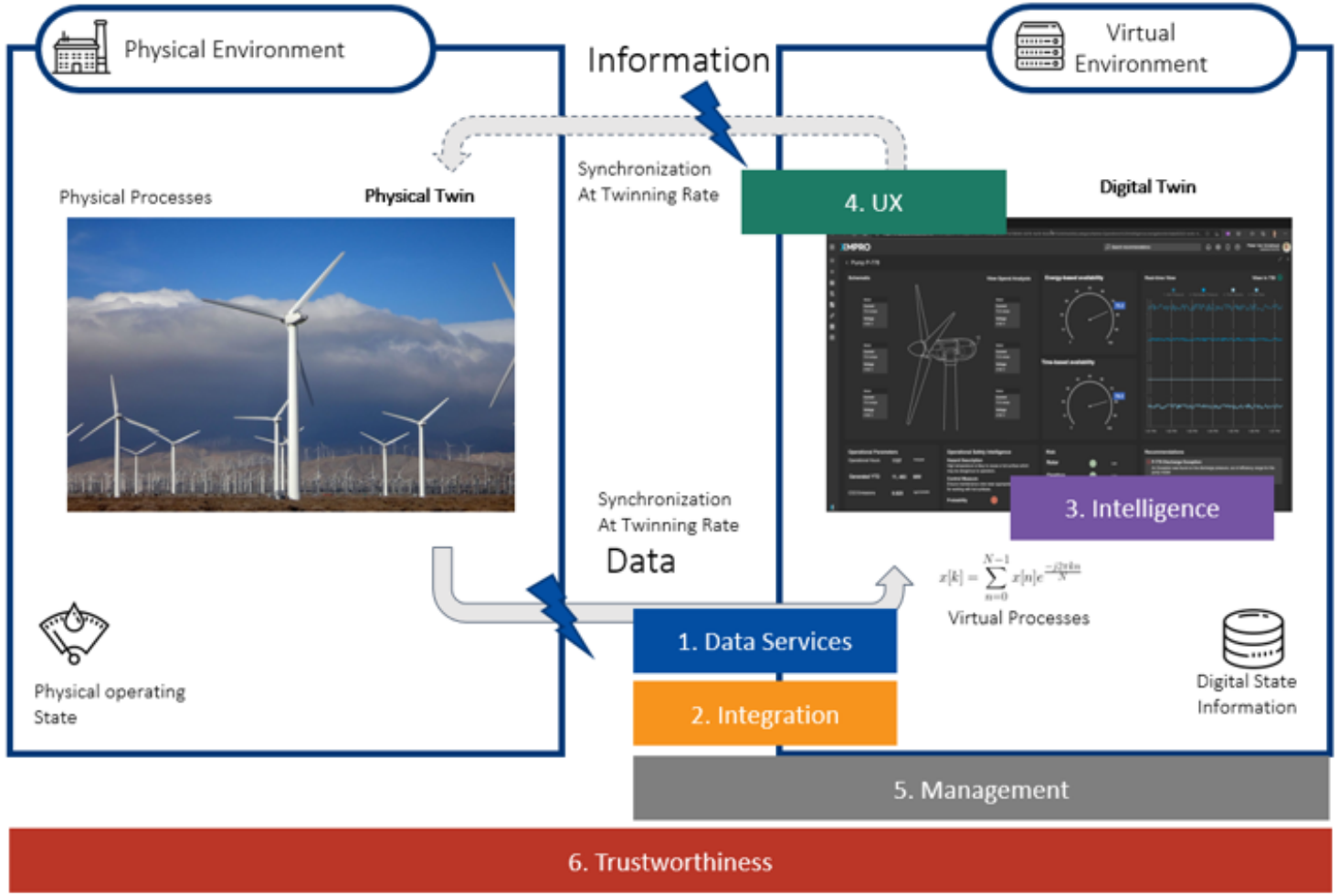
Accelerating the Journey To Net Zero With Regional Digital Twins

NOVEMBER 30, 2022 | 11:00 AM EST

Register Here

Digital twin definition

A digital twin is a virtual representation of real-world entities and processes, **synchronized** at a specified frequency and fidelity.

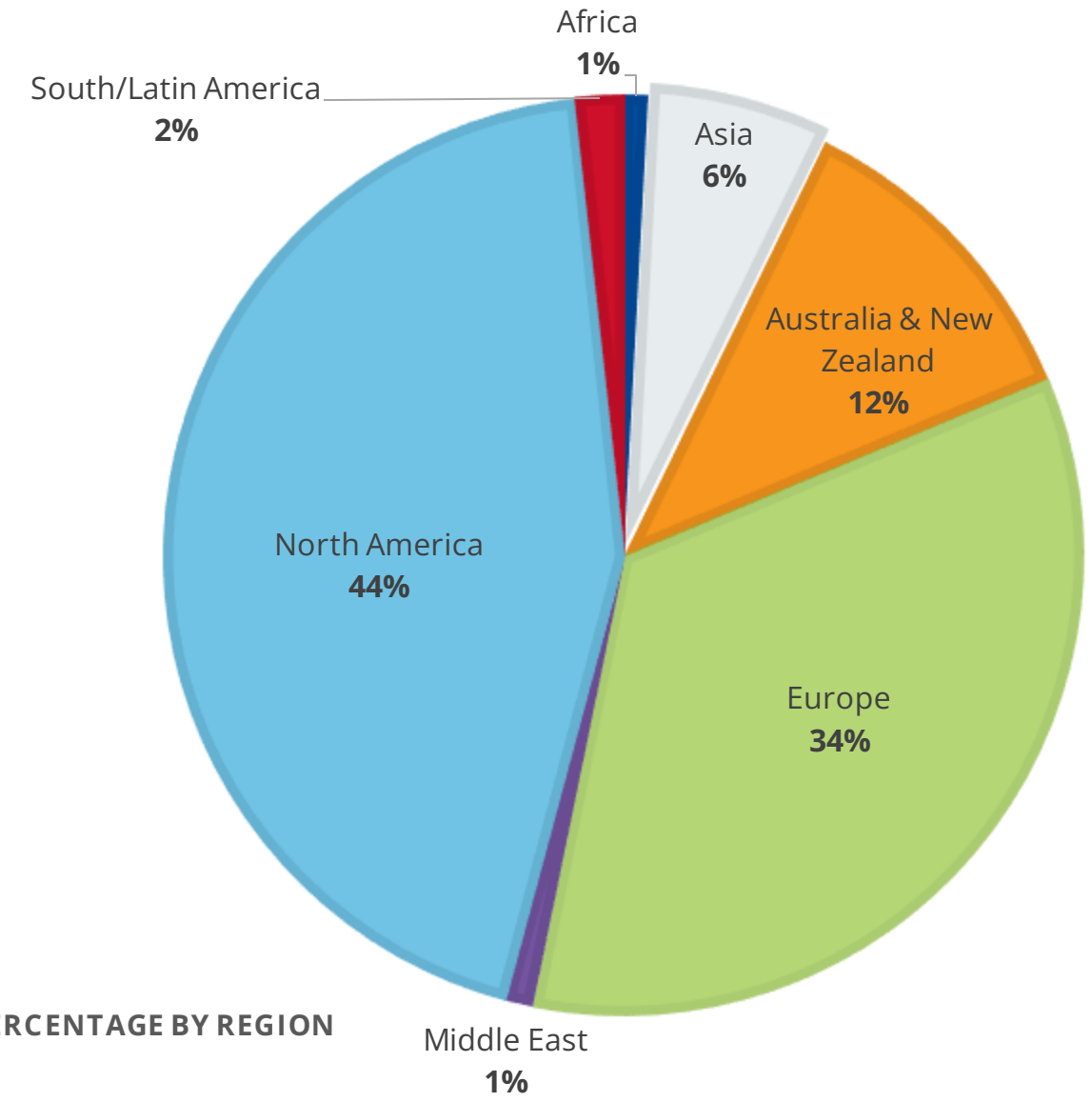


Digital Twin Consortium Steering Committee

Global Membership

33 Countries Represented

- Australia
- Belgium
- Brazil
- Bulgaria
- Canada
- Chile
- Finland
- France
- Germany
- Hong Kong
- India
- Ireland
- Israel
- Japan
- Kenya
- Lithuania
- Mexico
- Netherlands
- New Zealand
- Nigeria
- Poland
- Portugal
- Russia
- Singapore
- Slovakia
- Slovenia
- Spain
- Sweden
- Switzerland
- Turkey
- U.S.A.
- United Arab Emirates
- United Kingdom



PERCENTAGE BY REGION

Working Groups

Academia & Research
- Develop digital twin program
- Accelerator program
- POC, Pilot Programs
- Educational collateral

Aerospace & Defense
- Land
- Maritime
- Air
- Cyber
- Space

Architecture, Engineering, Construction & Operations
- Infrastructure
- Smart cities, buildings
- Real estate
- consortium.

Agriculture, Food & Beverage
- Agriculture (field to fork)
- Aquaculture (ocean to plate)
- Supply chains, value chains
- Goods and services

FinTech
- Value
- Payments
- Ownership
- Information
- Risk
- Access control

Healthcare & Life Sciences
- Healthcare management
- Medical devices
- Patient journey
- Pharmaceuticals

Manufacturing
- Manufacturing equipment
- Product development
- Supply chain

Mobility & Transportation
- Airports, seaports, rail
- Containers and cargo
- Supply chains and corridors
- Goods and services

Natural Resources
- Oil & gas
- Mining
- Water
- Solar
- Wind

3T
- Terminology
- Taxonomy
- Security & Trustworthiness
- Platform stacks

Rob Harwood, COO, Slingshot Simulations

Tim O'Callaghan, Project Consultant, Electric Places

Introductions: Our Speakers

SLINGSHOT SIMULATIONS

Rob Harwood
COO

A digital twin software as a service solution provider focused on sustainable location-intelligence based applications:

- A ground breaker member of the Digital Twin Consortium
- Delivered multiple location intelligence based digital twins, including
  - The Yorkshire Geospatial Twin Partnership
  - Sustainable Future Mobility Hub Planning
  - Ecosystem Protection
- Focused on democratising access to the value of digital twins

digital twin™ CONSORTIUM

Conservation Circle RAINFOREST TRUST MEMBER

RAINFOREST TRUST

ROYAL ACADEMY OF ENGINEERING

UKRI Innovate UK

HM Government

Electric Places ACCELERATING THE TRANSITION

SLINGSHOT SIMULATIONS

https://www.electriccorby.co.uk/
https://www.slingshotsimulations.com/

Introductions: Our Speakers

Electric Places
ACCELERATING THE TRANSITION

Tim O'Callaghan
Project Consultant

We develop and promote projects for the private and public sector that actively enhance the economic and environmental strength of places, people and businesses:

- A not-for-profit community interest company that produces strategies and delivers projects that support the transition to Net Zero
- Supporting organisations with their net zero carbon agenda
  - Local Authorities
  - Housing Developers
  - Renewables Consortia
- Delivering clean tech R&D projects

HM Government

Horizon 2020
European Union Funding
for Research & Innovation

UKRI
Innovate
UK

RE cognition

Flexunity

Zero Energy Bill Homes

etopia CORBY
CHESS SET UP

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Agenda

- Introductions
- Regions in Context of Net Zero and a UK Perspective
- Case Study: NN2NZ
  - North Northamptonshire to Net Zero (NN2NZ): Developing a Roadmap
  - Why a Digital Twin?
  - Solution Demonstration:
    - Data Integration and Contextualisation
    - Visualisation
    - Analytics and Simulation
    - Engagement and Action
- Summary
- Q&A

Regions in Context of Net Zero and a UK Perspective

"We urgently need every business, investor, city, state and region to walk the talk on their net zero promises. We cannot afford slow movers, fake movers or any form of greenwashing."

António Guterres,
UN Secretary General

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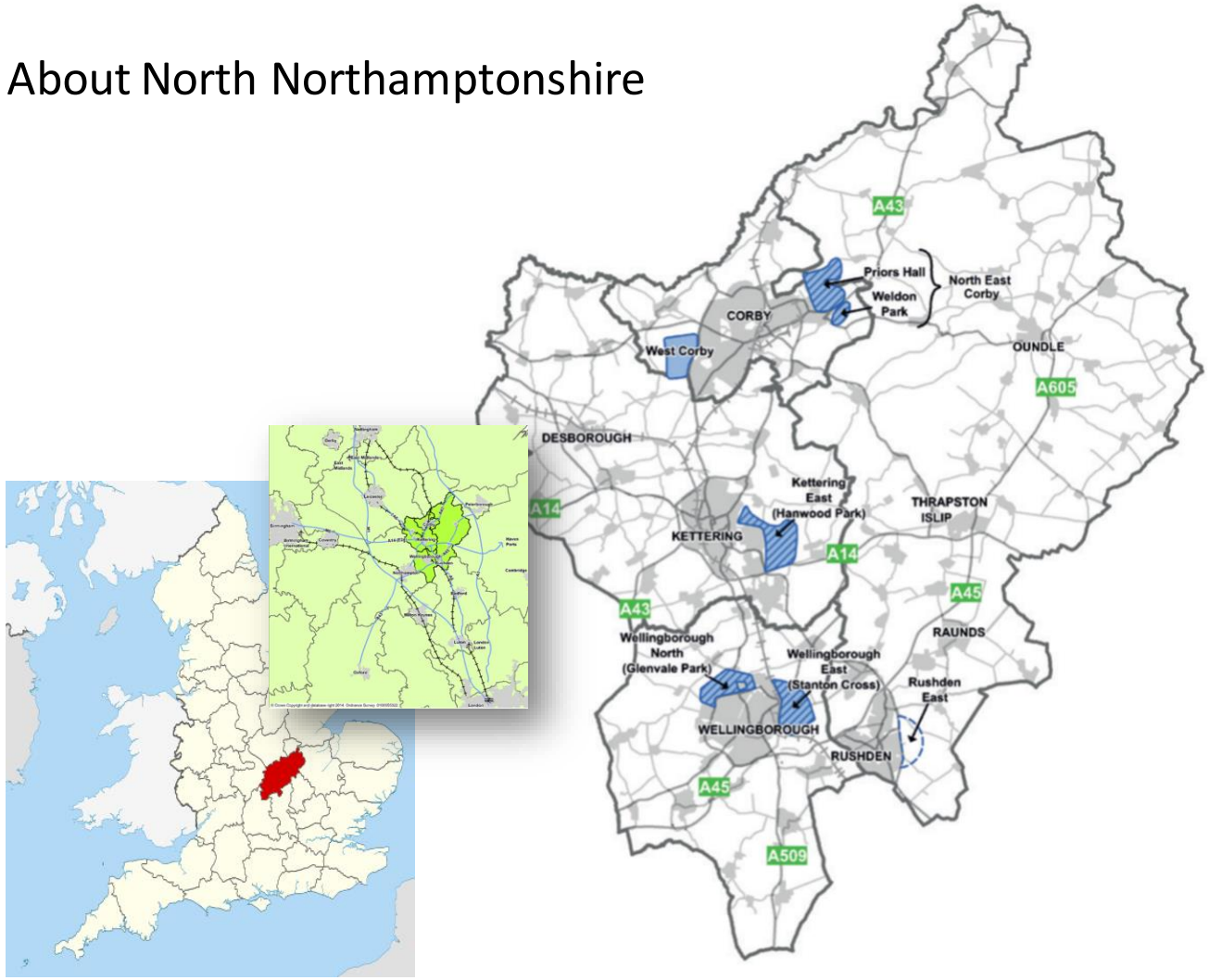
ClientEarth

Lawyers put local authorities on notice over climate inaction

> Laws and regulations are only effective if they can be, and are, enforced. We work to ensure that laws require concrete action and, if that action does not materialise, we will hold governments and companies to account.

Case Study: NN2NZ

About North Northamptonshire



- Population of c.350,000, significant economic potential
- Mix of large ("growth") market towns and over 100 villages
- Planned strategic growth to 2031 and beyond…
  - 31,100 new jobs
  - 35,000 new homes
- "*…a showpiece for modern green living and well managed sustainable development: a resilient area where local choices have increased the ability to adapt to the impact of climate change and to global economic changes*"

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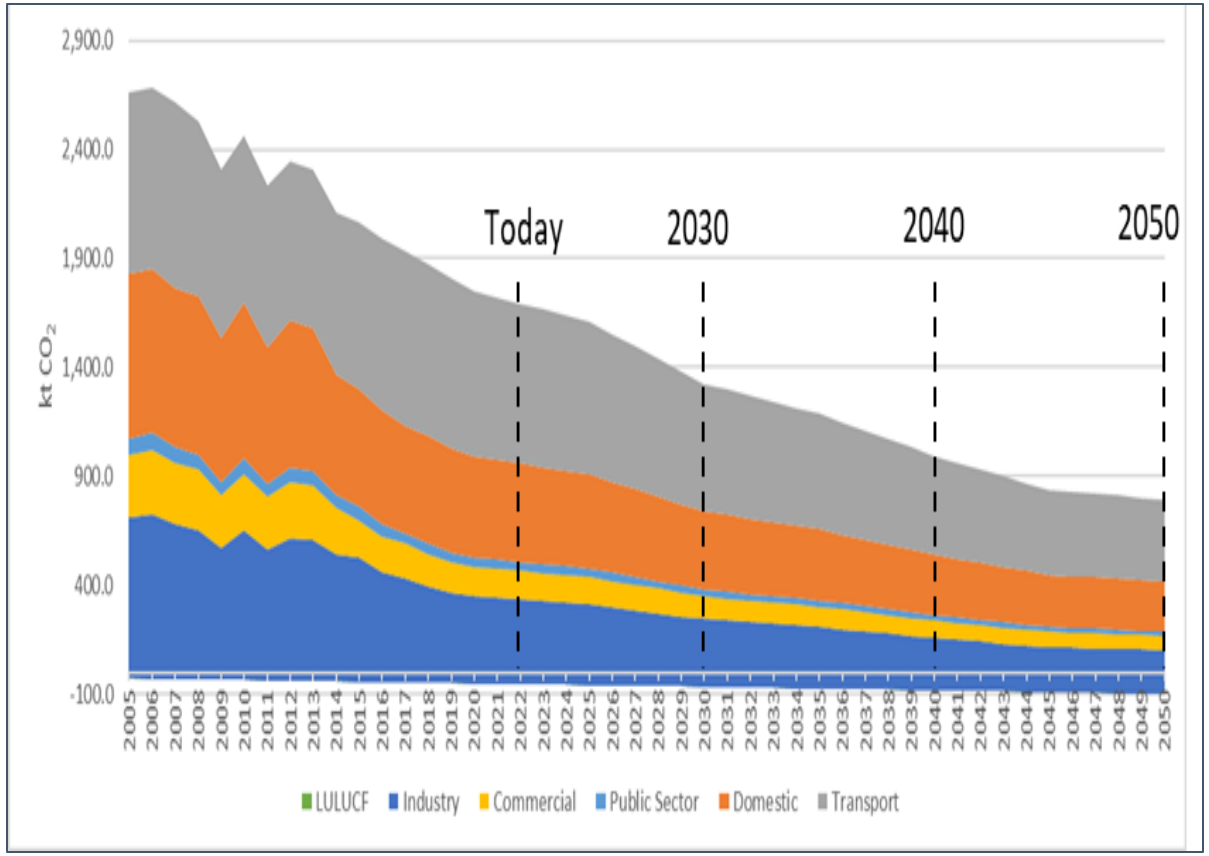
NN2NZ | HM Government

This project is funded by the UK Government through the UK Community Renewal Fund.

Case Study: NN2NZ

Developing a roadmap to achieve NZ

- UK Parliament declared a climate emergency in 2019, along with goal of being net zero by 2050. Many are trying to beat this. Emissions are coming down, but significantly more needs to be done to reach net zero.
- NN2NZ aims to develop and recommend a programme of initiatives that would enable NN to reach Net Zero ahead of 2050, along with a robust framework for assessing new ideas as they emerge
- Follow-on funding for trialling and roll-out of the key initiatives will be sought to enable success for NN



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Case Study: NN2NZ

Key Challenges:

- How to create a holistic view from hundreds of data sets?
- Which interventions to prioritise?
- How to link intervention to impact on a data and evidence basis?
- How to forecast scale and impact over time against the CO2 gap?
- How to interactively engage a diverse set of stakeholders from policy makers to the general public

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Case Study: NN2NZ

The Complexity of Intervention Options

>8000 projects analysed – no stone left unturned. What if…..

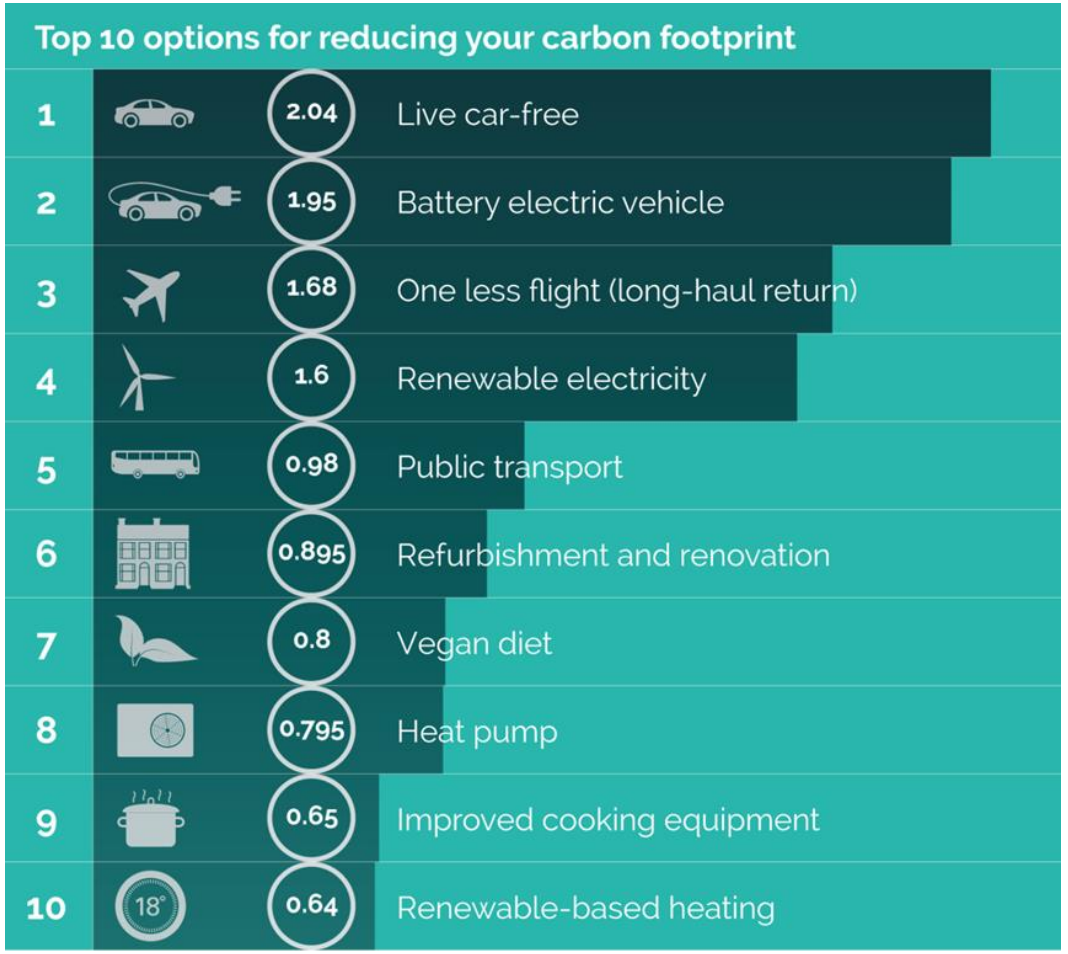
- every south-facing roof had solar
- every car park had solar and wind
- people gave up their second cars
- no-one drove to work…

Cranfield University validating emissions calculations and relationships

% impact		Mitigation (tCO2eq/cap pa)	NN total impact (tCO2e pa)	% take-up
35.2%	ENERGY			
2.1%	Solar PV on every roof	0.75	57,273	60%
7.5%	Solar PV car port canopies on every car park	0.03	200,152	60%
6.3%	Small scale 10m wind turbines on every park above the solar canopies	0.03	166,793	50%
0.4%	Earth bank thermal solar seasonal heat storage and heating for new housing	0.68	9,521	50%
11.0%	green the grid - homes buy 100% renewable energy from grid	7.38	293,654	30%
2.0%	Personal domestic home efficiencies - only heat/boil the water you need	0.30	52,158	50%
3.6%	Improved cooking equipment - more efficient cooking	0.55	96,332	50%
0.9%	Lower room temperature	0.14	24,337	50%
0.5%	Less energy use for washing clothes	0.07	12,794	50%
0.2%	Better use of appliances (only switch on when needed)	0.04	6,137	50%
0.7%	Shift to more efficient appliances	0.11	18,686	50%
34.8%	TRANSPORT			
3.2%	20% of cars and vans are electric by 2030	2.01	86,465	
1.2%	20% are hybrids	0.73	31,374	
0.7%	20% have shifted to smaller vehicles	0.42	18,191	
0.7%	50% of households who own more than one car (38%) give up their second car	0.77	18,460	
2.1%	Those households with no cars/vans doubles from 20% to 40%	2.10	55,655	
2.0%	Those who keep their car share through lifts for school runs and regular commutes	0.32	52,361	
8.3%	90% of non-EVs switch to electric by 2040, as most vehicles replaced in 10 years	2.01	220,232	
0.7%	Leaving 10% as ICE cars, switch to green e-fuels	1.44	17,543	
0.7%	Other vehicles switch to green e-fuels	5.30	17,490	
0.6%	Remaining buses switch to green e-fuels	38.88	15,551	
14.6%	Remaining trucks switch to green e-fuels	138.91	388,942	
0.1%	and engage in more fuel efficient driving	0.28	2,768	
0.1%	Switch to public transport	0.99	2,426	
0.1%	Switch to walking & cycling	0.79	1,922	
	TOTAL FORECAST		2,664,194	
	CURRENT CO2		-1,900,000	
	NET POSITION		764,194	

% impact		Mitigation (tCO2eq/cap pa)	NN total impact (tCO2e pa)	% take-up
16.9%	FOOD FARMING & FORESTRY			
1.2%	If 10% of people become vegans (up from 1% today)	0.91	31,760	10%
1.4%	If a further 20% of people became vegetarians (up from 11% today)	0.52	36,119	20%
1.1%	If a further 20% of people shifted to fish and plant based diet (no red meat)	0.42	29,551	20%
1.3%	If a further 20% of people cut down on red meat by 50%	0.48	33,536	20%
0.4%	If a further 10% of people reduced their food intake, to just what they needed	0.30	10,555	10%
0.8%	Leaving 20% of people who will not change except from reducing wasted food to cut bills	0.32	22,347	20%
0.5%	If 10% of people grew their own vegetables	0.36	12,688	10%
1.2%	And 20% of people only bought locally grown food (requiring a supply chain shift)	0.44	30,945	20%
0.5%	And further 20% of people only ate seasonal fresh food and froze less	0.21	14,288	20%
6.1%	If fossil fuel fertilisers were banned so everyone ate organicfood	0.47	164,028	100%
0.8%	Planting Rockingham forest	0.02	22,000	100%
1.6%	Planting every roadside verge with trees	0.02	43,482	90%
0.0%	Planting trees around every new development (@ 1 tree per home)	0.02	616	100%
9.0%	BUILDINGS			
2.4%	Better insulation of existing roofs (homes)	0.20	63,433	90%
1.3%	Better insulation of existing walls (homes)	0.17	35,878	60%
0.7%	Full thermal insulation of houses (New sealings, ventilation, additional façade & roof insu	0.11	19,674	50%
0.6%	All new homes insulated to passive standards	0.54	15,052	100%
0.0%	Low carbon construction methods for all new buildings	0.05	1,306	100%
2.5%	All gas-heating switched to ASHPs.	0.75	66,881	80%
0.2%	All oil-fired heating switched to ASHPs	1.75	5,822	80%
0.1%	solar thermal heating of water	0.07	2,885	30%
1.1%	Co-housing. 95% of homes occupied and 50% of 51% spare space occupied	0.34	30,013	25%
4.0%	INDUSTRY/COMMERCE			
0.2%	Material efficiencies	0.29	4,584	100%
0.1%	Energy Management systems driven efficiencies	0.23	3,636	100%
0.7%	All those who can work from home should – 1/3 people's jobs can be done from home.	0.44	18,729	80%
0.1%	Similarly, business travel should be discouraged – business travel should be cut in half	0.83	3,291	50%
1.3%	People should be encouraged to share, re-use and upcycle & commerce incentivised	0.52	35,993	20%
0.2%	Existing buildings refurbished rather than re-built where possible.	0.93	4,411	30%
0.3%	Plastics should be designed out of new goods, and always recycled from waste.	0.08	7,914	30%
0.6%	Less packaging should be used	0.16	16,724	30%
0.2%	Better council recycling of waste is recycled & carbon capture & methane to energy	0.06	6,012	30%
0.1%	The council needs to recycle organic waste, so as much as carbon is recycled as possible	0.03	2,823	30%

Summary CO2 gap closure for North Northamptonshire



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Case Study: NN2NZ

Why a Digital Twin?

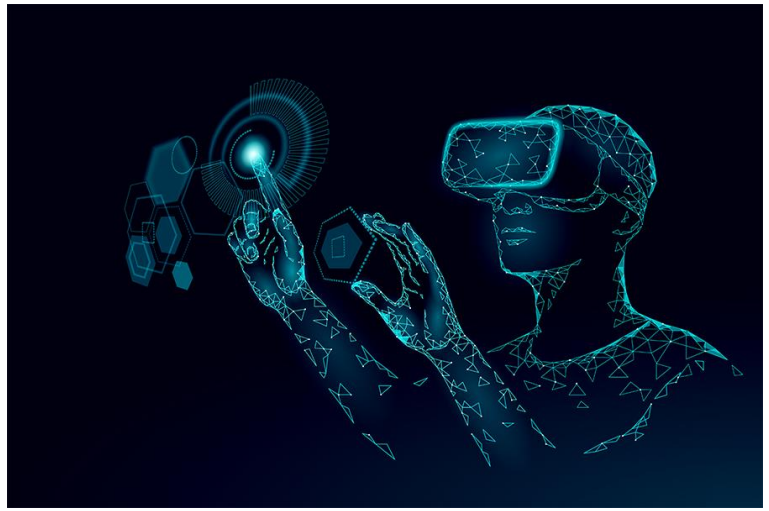
To assess the feasibility of promising interventions we need to model and map their impacts on existing infrastructure and understand populations that may disproportionately benefit from or pay for interventions.

Aggregate

- A single platform which acts as an NN evidence base for decision making
- Collating data from diverse sources (e.g. Land use mapping, DNO, Traffic, EVCP, housing, carbon conversion factors, social indicators, census data)

Analyse

- Calcs can be performed in Excel but challenging to simulate time-related:
  - Geospatial impacts (e.g. impact of EVs on regional NO_2 and congestion)
  - Location specific quick wins or barriers (e.g. impact of PV in areas with export headroom but not affected by curtailment issues)



Interpret

- Visualise heat maps and RAG rated infrastructure/metrics to help decision making

Communicate

- Maps with overlaid metrics, dashboards ,3D renders, intractability enable evidence based engagement with planners, councillors, developers and the public.

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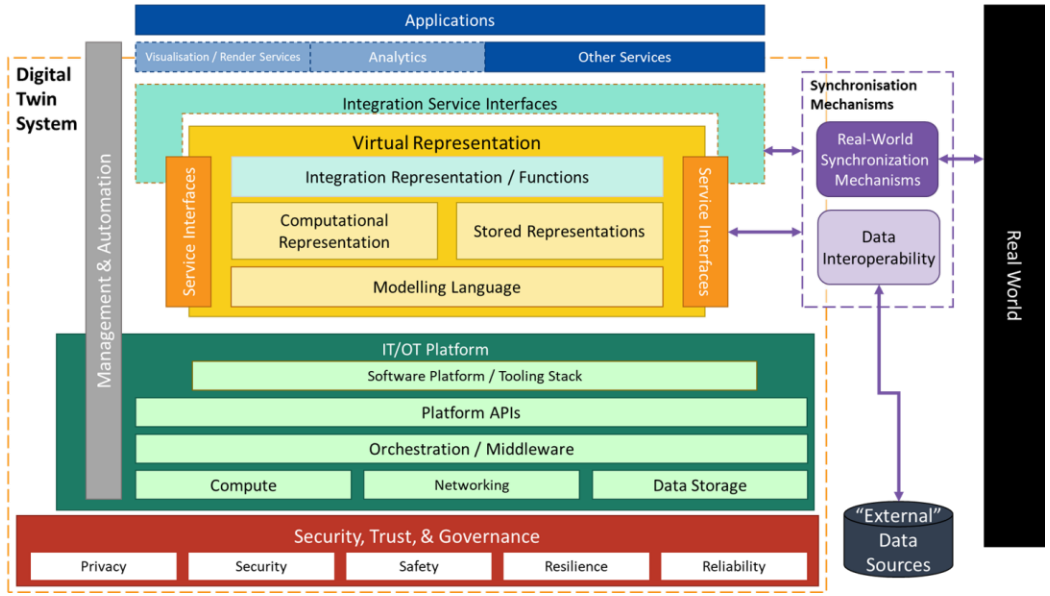
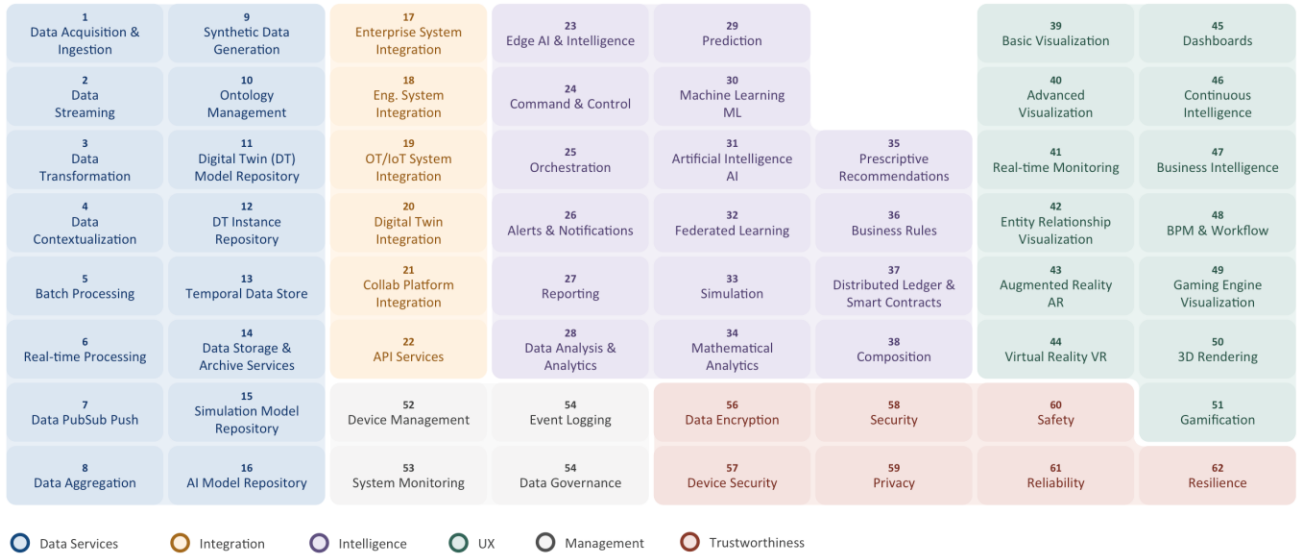
Under the Hood of the Digital Twin

The digital twin was architected in accordance with the Digital Twin Consortium best practice reference architecture and with guidance from the capabilities periodic table (images courtesy of the Digital Twin Consortium):

Reference Architecture



Capabilities Periodic Table



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Aggregation

Using Slingshot Simulation's digital twin solution, over 100 large, disconnected mostly spreadsheet based data sets were integrated. The solution is based on unique graph technology IP that enables rapid and automatic data linking and contextualisation that results in up to 80% time savings.

Energy Data

- Solar panel locations
- Wind power
- Substation and power network locations
- Gas to heat pump heating systems
- Insulation

Mobility Data

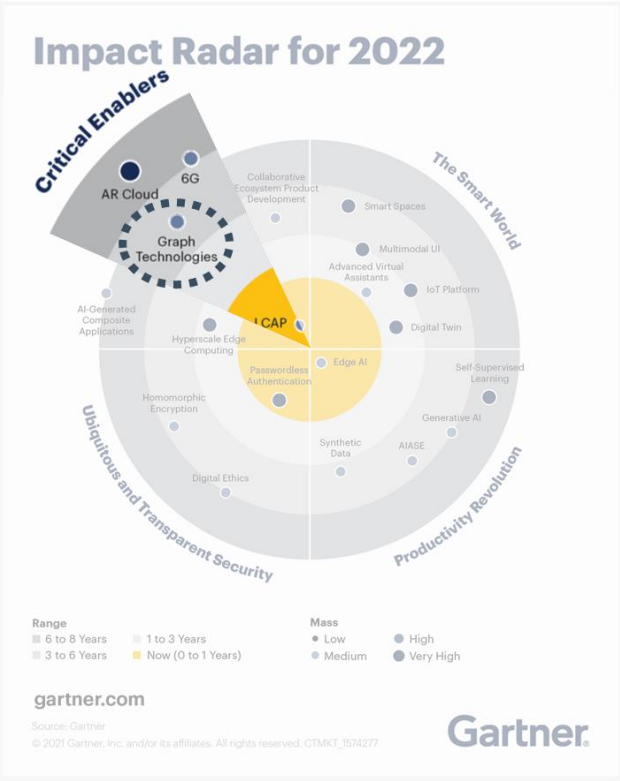
- Origin/destination
- Modality
- EV adoption over time
- EV charging infrastructure
- Public transport schedules
- Traffic count and simulation

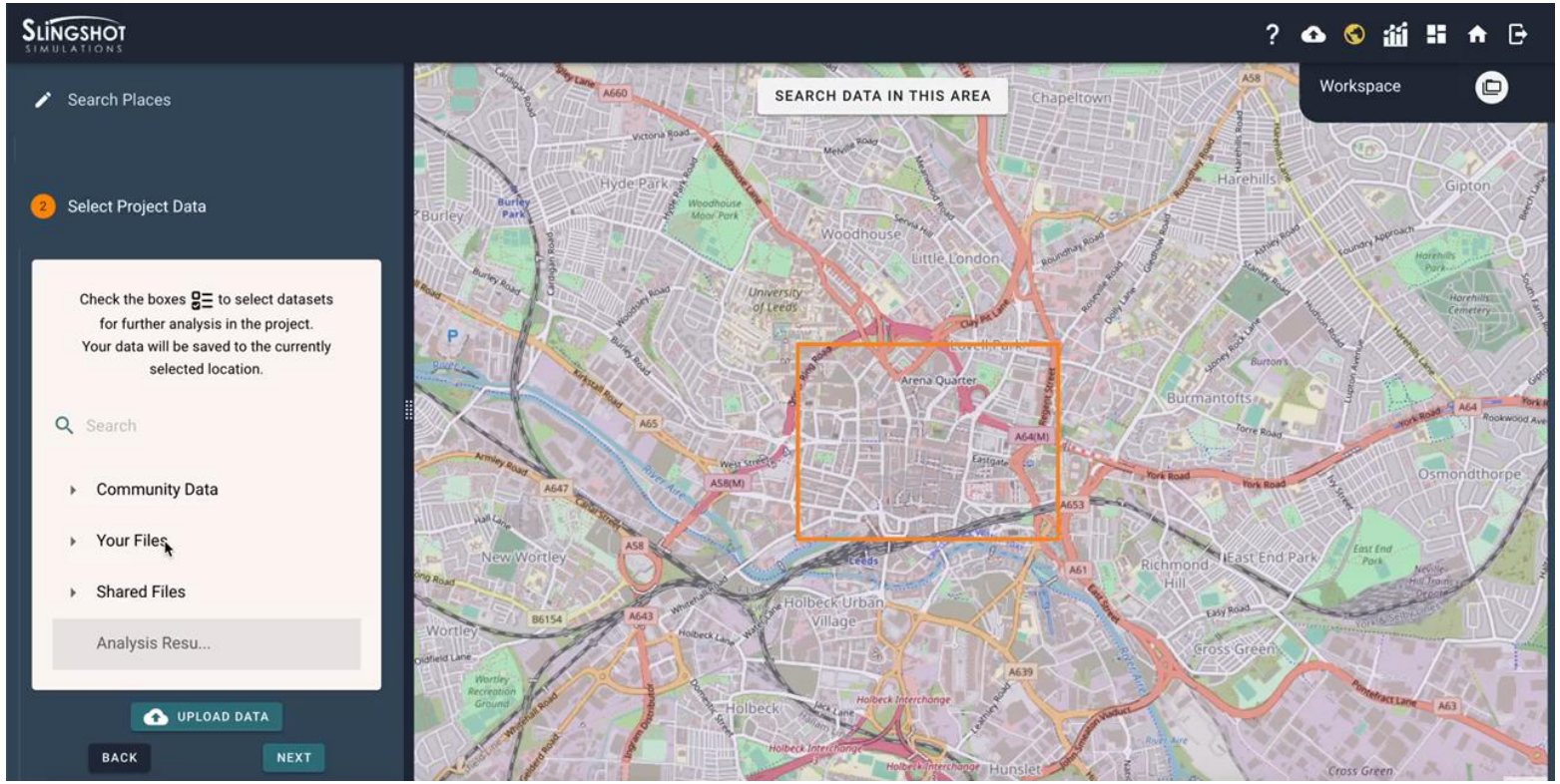
Land Use, Housing, Social and Commercial Data

- Census
- Building efficiency to post code level
- Land use
- Car parks
- Bus and cycle routes
- Air quality
- Diet choices

Aggregation – How it Works

Slingshot Simulation's digital twin platform using unique IP to link and contextualise disconnected data sets into a "knowledge graph". This transforms the way we can connect data – like the paradigm shift from an Encyclopaedia to Wikipedia





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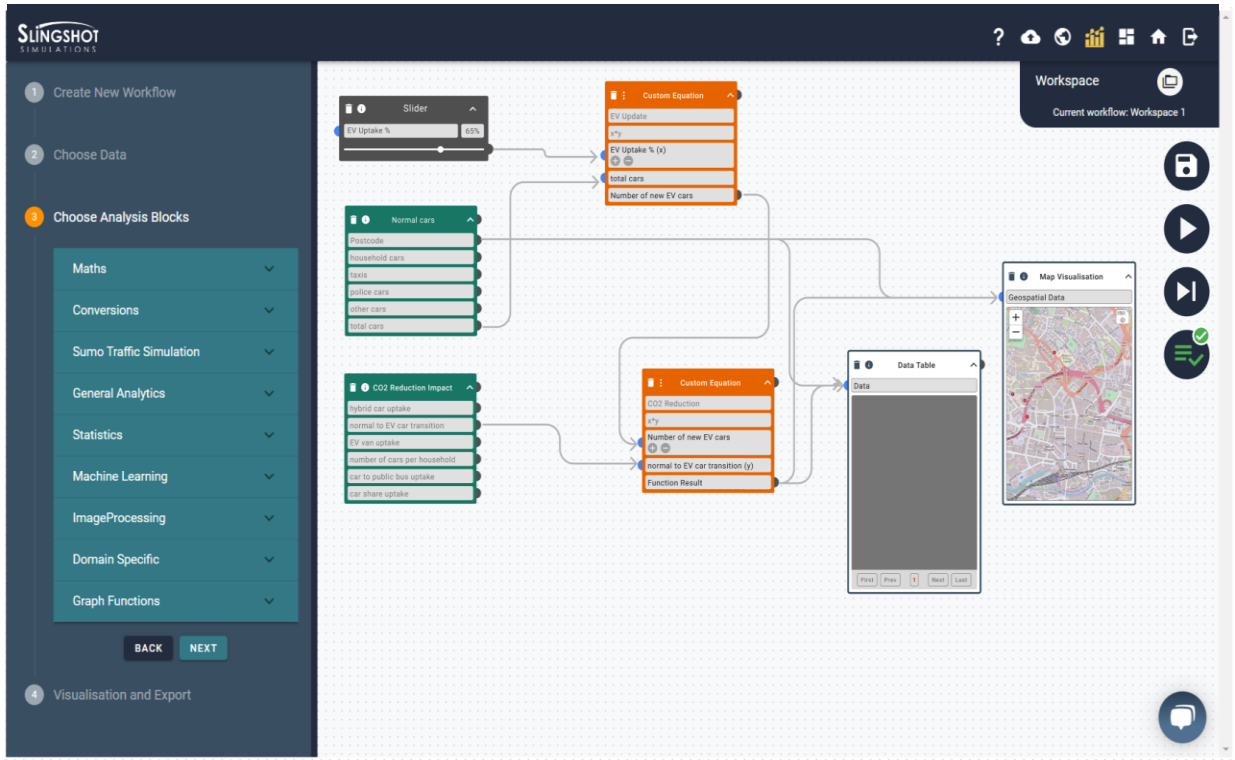
Analyse

The no code analytics engine of the digital twin was used to simplify complex analytics in to “drag and drop” workflows thatcan be configured by non data scientists to answer a wide range of intervention questions.



Example: EV Uptake Impact Analysis

- Number of total cars at postcode level
- CO2 impact figure (per unit converted)
- Slider & Equation gives the number of cars converted per postcode
- Equation gives total impact on CO2 per postcode
- Visualisation (on map)
- Data results (in data table)

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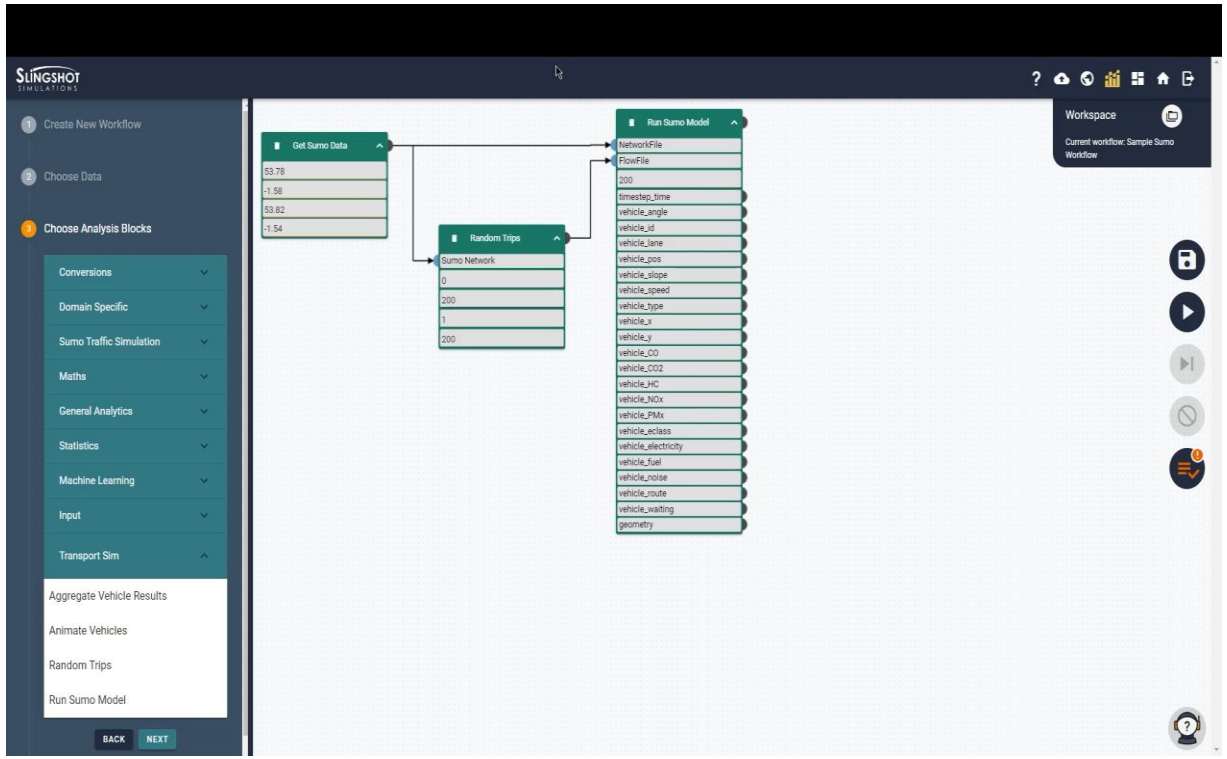
Analyse

By embedding impact models and forecasts, forward looking simulations of “what if?” scenarios were performed.



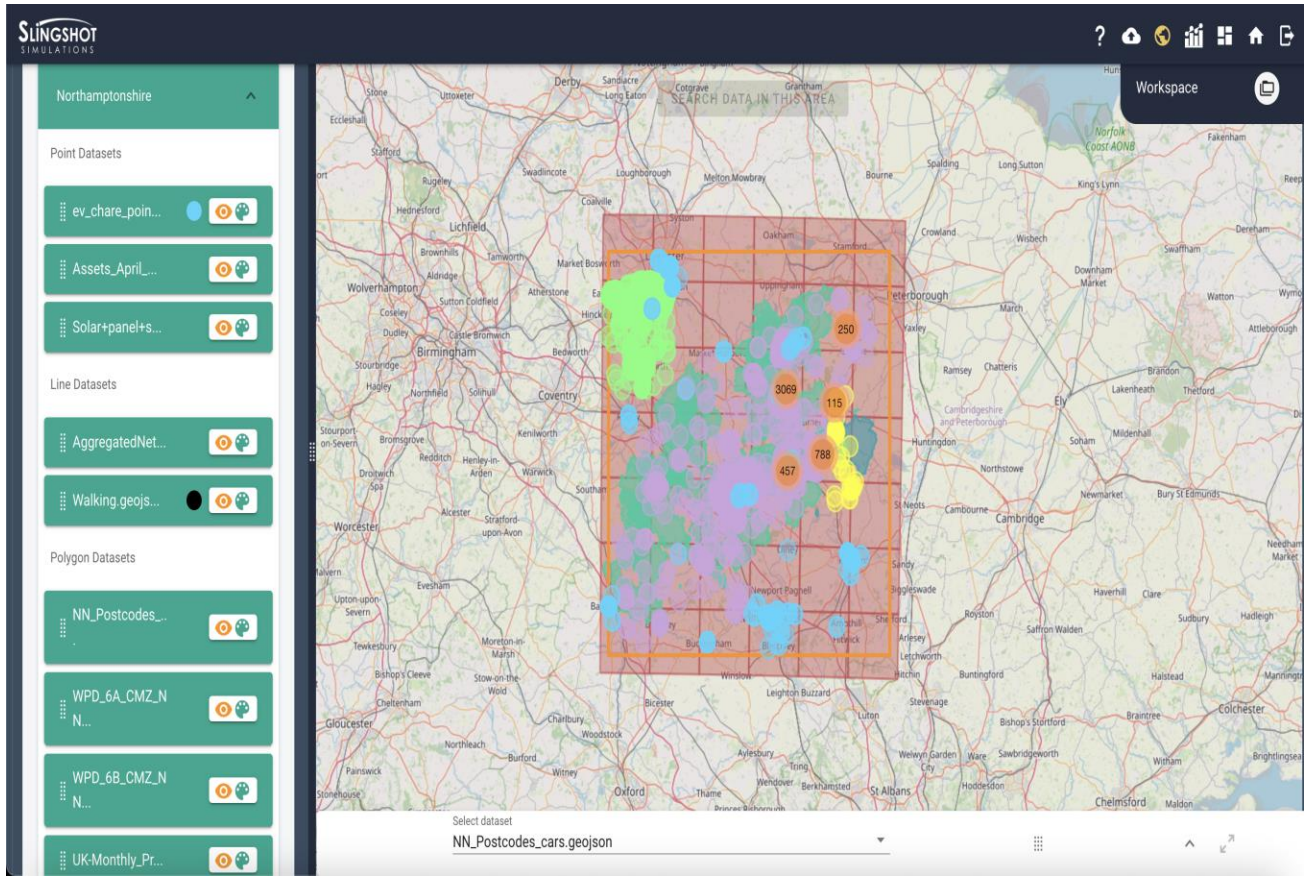
Example: Simulated Impact on Future Traffic Volume

Predicting impact on emissions from:

- Mode shift
- New developments
- Population change
- Clean air zones/restricted access
- …..

Case Study: NN2NZ

Interpret



The power of integrated and contextualised data

This snapshot shows the relationships between:

- Land Use
  - Council managed assets
- Energy
  - Power distribution substations
  - EV charging infrastructure
- Mobility
  - Walking and cycling networks
- Environmental
  - Rainfall

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Case Study: NN2NZ

Communicate

Outcomes: The So What?

- A **centralised** platform that enables **forecasting and impact** analysis (**energy, emissions, cost)** of potential interventions covering **transport, buildings, energy systems, food & farming, industry**.

- Analyses will enable recommendations to **promote and enable key trends** for net zero:
  - Transition away from petrol/diesel vehicles
    - EV uptake impacts, use of alternative fuels, clean air zones, modal shift
  - Electric heating revolutions
    - ASHP, shift to renewables
  - Behavioural changes
    - Dietary changes
    - Modal shift
  - Impacts on deprived vs. affluent areas
    - Energy/cost savings per household, EPC improvements, access to infrastructure, CO_2 impacts

- **Continually updated** inputs and **scaling of potential interventions**
  - Total addressable opportunity vs. Realistic obtainable opportunity (e.g. PV, wind coverage)

Summary

- Accelerating the transition to net zero is critical – multiple social, political and legal forces are driving the agenda
- Data is key to making better decisions faster. However, pervasive connectivity has created a data deluge resulting in siloed, disconnected decision making
- Digital twins, proven in multiple industry sectors, can play a critical role helping towns, cities and regions achieve their stated goals
- A solution for North Northamptonshire has been developed by combining digital twin expertise with net zero intervention know how
- This is being used to accelerate and prioritise strategic intervention decision making and mobilise key stakeholders to action
- Contact us to understand how you can use this solution to accelerate your region's transition to net zero

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Q&A

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