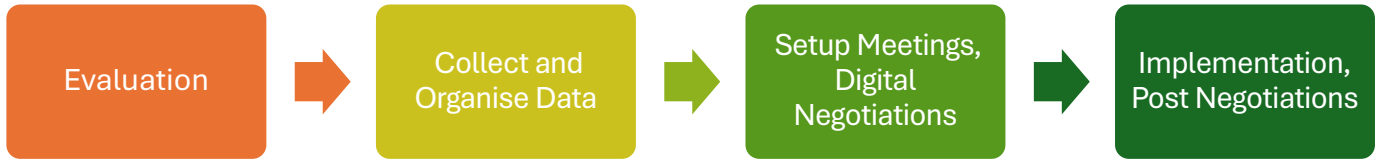
About GeoDesign Hub

A digital platform that empowers collaborative decision-making through sophisticated, digitally powered negotiations.

Stakeholders

- Property Developers
- Community Organizations
- Portfolio Managers
- Local Authorities
- Urban Designers/Planners



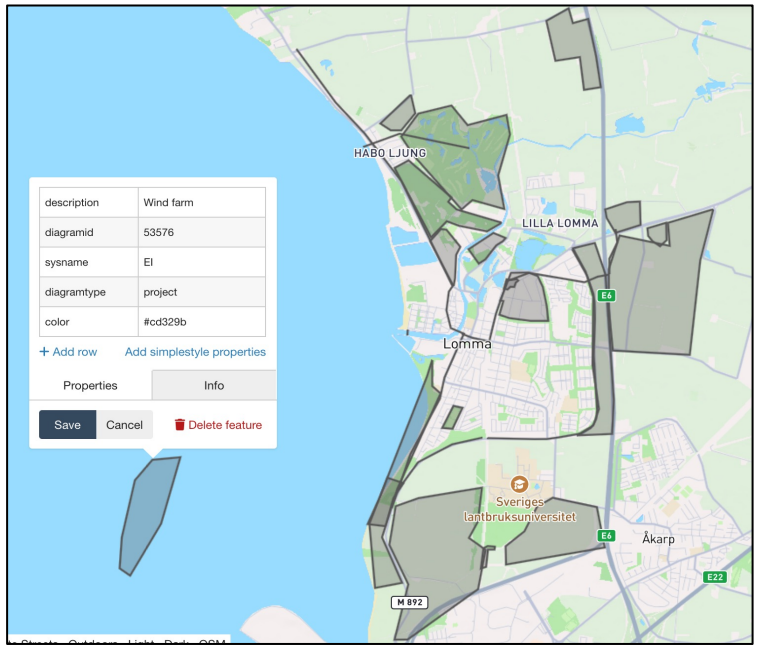
Project Deliverables

1. 30-year Financial Model
2. Financial Comparison Reports
3. Interviews with Stakeholders

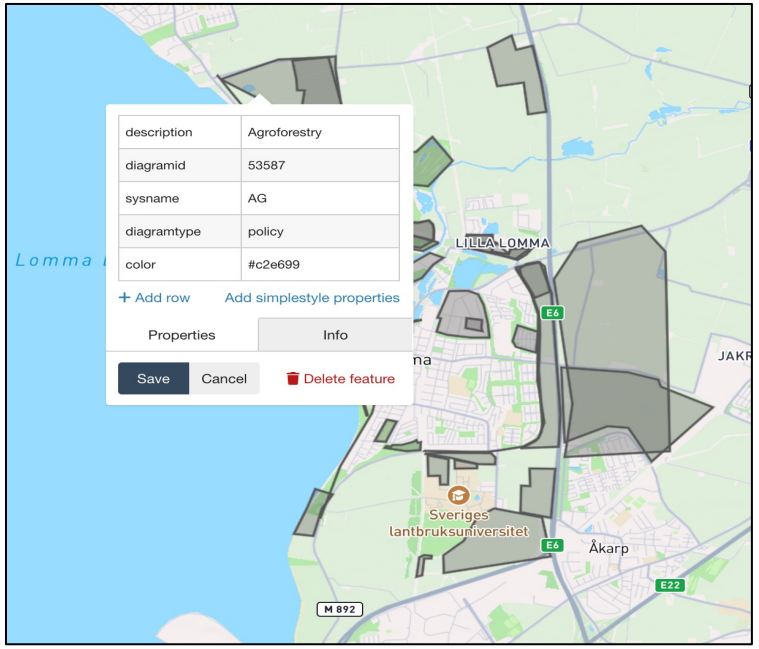
How does this help GeoDesign Hub's process & Stakeholders?

- **Informed Decision Making**
- **Transparency in Financial Considerations**
- **Optimum Resource Allocation**

Data



GeoDesign - A



GeoDesign - B

Properties:

1. diagramid
2. description
3. sysname
4. diagramtype
5. color
6. geometry

GeoDesigns are digital representations of potential development plans, often created using GeoJSON, a common data format for encoding geographic data.

Project Management and Team Dynamics

Financial Modelling: 3 members

- In-depth analysis on each system types and its assumptions
- Develop the financial model
- Create Python script to reflect financial metrics and calculations for each GeoDesign

Reporting & Visualisation: 2 members

- Research on feasible reporting tools
- Utilise JSON output from Python script for dashboards
- Create user-friendly and interactive interface to display financial feasibility

Project Management and Team Dynamics

Internal:
Team collaboration

- **Regular Meetings**
  - Progress check-in
  - Problem resolution
  - Next steps
- **Task Allocation**
  - Clear assignment of roles and expected outcomes
- **Communication Platforms**
  - Daily updates through WhatsApp, Teams meetings & Emails

External:
Industry Partner Engagement

- **Bi-weekly Progress Meetings**
  - Progress report
  - Maintain feedback loop
  - Next steps
- **Feedback Integration**
  - Ensure that solutions meet actual business needs and user expectations

Financial Model

Sysname	System Type
LDH	Low Density Housing
HDH	High Density Housing
IND	Industry & Commerce
GI	Green Infrastructure
EI	Energy Infrastructure
BI	Blue Infrastructure
INST	Institutional
AG	Agriculture
TRANS	Transport

Financial Model for 6 System Types:

1. System specific assumptions
2. Input values by stakeholders
3. Python script for financial metric calculations

Sustainability metrics to assess Socio-Economic Impacts

System Specific Assumptions

Industry and Commerce
Construction Period In Years
Annual Construction Expenses
Average lease rate/sqft (£)
Operating Expenses, Annual (£)
Occupancy Rate (%)
Initial Investment (£)
Cap Rate (%)
Growth Rate (%)

Low-Density and High-Density Housing
Construction Period In Years
Annual Construction Expenses
Expected Annual Units Rented
Unit Sale Price (£)
Annual Operating Expenses (£)
Annual Expected Rent Per Unit
Annual Expected Units Sold
Initial Investment (£)
Cap Rate (%)
Growth Rate, Sale/Rent (%)
Growth Rate, Expenses (%)

Green Infrastructure
Initial Investment(£)
Annual Construction Expenses(£)
Construction Period In Years(Year)
Annual Maintenance expenses(£)
Annual Insurance Costs(£)
Annual Advertising Revenue(£)
Cap Rate (%)
Growth Rate (%)

System Specific Assumptions

Blue Infrastructure
Initial Investment(£)
Annual Construction Expenses(£)
Construction Period In Years(Year)
Annual Decommissioning Costs(£)
Annual Water Resource Management Costs(£)
Annual Water quality monitoring costs(£)
Annual Insurance Costs(£)
Annual Water purification costs(£)
Cap Rate (%)
Growth Rate (%)

Energy Infrastructure
Initial Investment(£)
Annual Construction Expenses(£)
Construction Period In Years(Year)
Annual Operation and Maintenance Costs(£)
Energy Sale Price(£)
Estimated Annual Energy Production(KW/h)
Annual Decommissioning Costs(£)
Annual Insurance Costs(£)
Cap Rate (%)
Growth Rate (%)

System Specific Assumptions

Institutional
Initial Investment (£)
Annual Operating Expenses (£)
Capacity (units)
Operational Efficiency (%)
Resource Utilisation Rate (%)

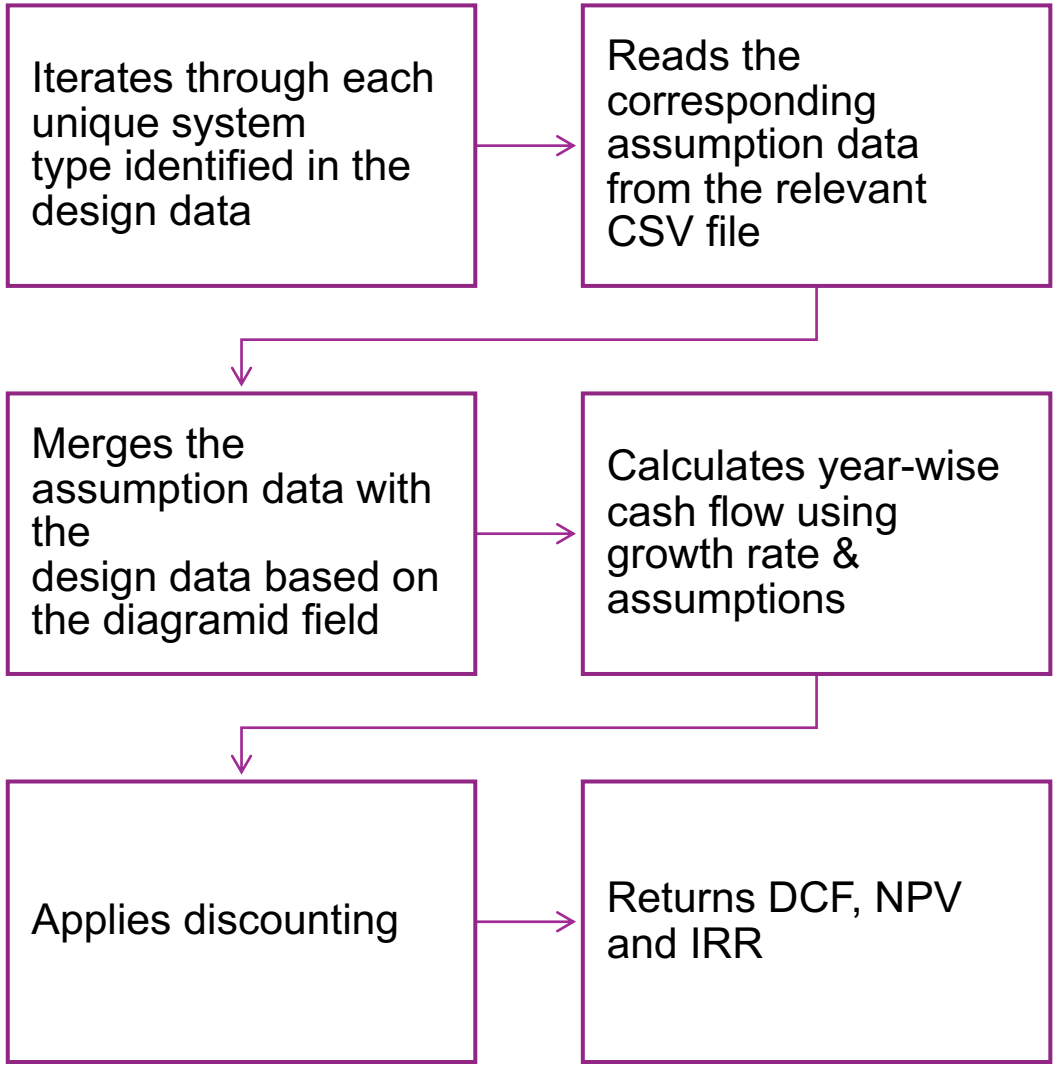
Transportation
Initial Investment (£)
Distance/Route length (km)
Average Annual Passengers
Annual Operating Expenses (£)
Capacity Utilisation (%)
Route Optimisation (km/day)
Fuel Efficiency (km/l)
Travel time/km (mins/km)

Agriculture
Initial Investment(£)
Yield/Land Area (units/sqft)
Yield Improvements (%)
Water Usage Reductions (l/sqft)
Carbon Emission Reductions (g/sqft)

Python Script for Financial Metric Calculation

Data Access:

- **Input:** Geodesigns (.geojson), assumptions (.csv)
- **Output:** Analysis (.json)
- The JSON output is provided to the reporting team for creating visualisations.



Financial Analysis Framework

- **System-Specific Formulas**

- **Discounted Cash Flow Analysis**:
  - Estimates an investment's intrinsic value by considering all future cash flows.
  - Factors in the time value of money.
  - The model spans 30 years, with columns for Year 0 through Year 30.
  - Key financial components include:
    - Effective Gross Potential Revenue (£)
    - Operating Expenses (£)
    - Net Operating Income (£)

- **Net Present Value:** Estimated present value of the property

- **Internal Rate of Return:** Annualized return rate an investment is expected to generate over its lifetime.

Discounted Cash Flow	Year 0	...	Year 30
Gross Potential Revenue			
Operating Expenses			
Net Operating Income			

A simplified version of the DCF model.

MANCHESTER 1824
The University of Manchester

System Specific Formulas for DCF

System Type	Gross Potential Revenue	Operating Expenses
LDH	Annual Expected Rent Per Unit * Expected Annual Units Rented + Annual Expected Units Sold * Unit Sale Price	Annual Operating Expenses
HDH	Annual Expected Rent Per Unit * Expected Annual Units Rented + Annual Expected Units Sold * Unit Sale Price	Annual Operating Expenses
IND	(Average Lease Rate/sqft * area) * (Annual Occupancy Rate (%)/100)	Annual Operating Expenses
GI	Annual Advertising Revenue	Annual Maintenance Expenses + Annual Insurance Costs
BI	Entertainment Revenue + Revenue From Fishing And Aquatic Products	Annual Water Resource Management Costs + Annual Insurance Costs + Annual Water Quality Monitoring Costs + Annual Water Purification Costs + Annual Decommissioning Costs
EI	Energy Sale Price * Estimated Annual Energy Production	Annual Operation and Maintenance Costs + Annual Insurance Costs + Annual Fuel Costs + Annual Energy Storage and Distribution Costs

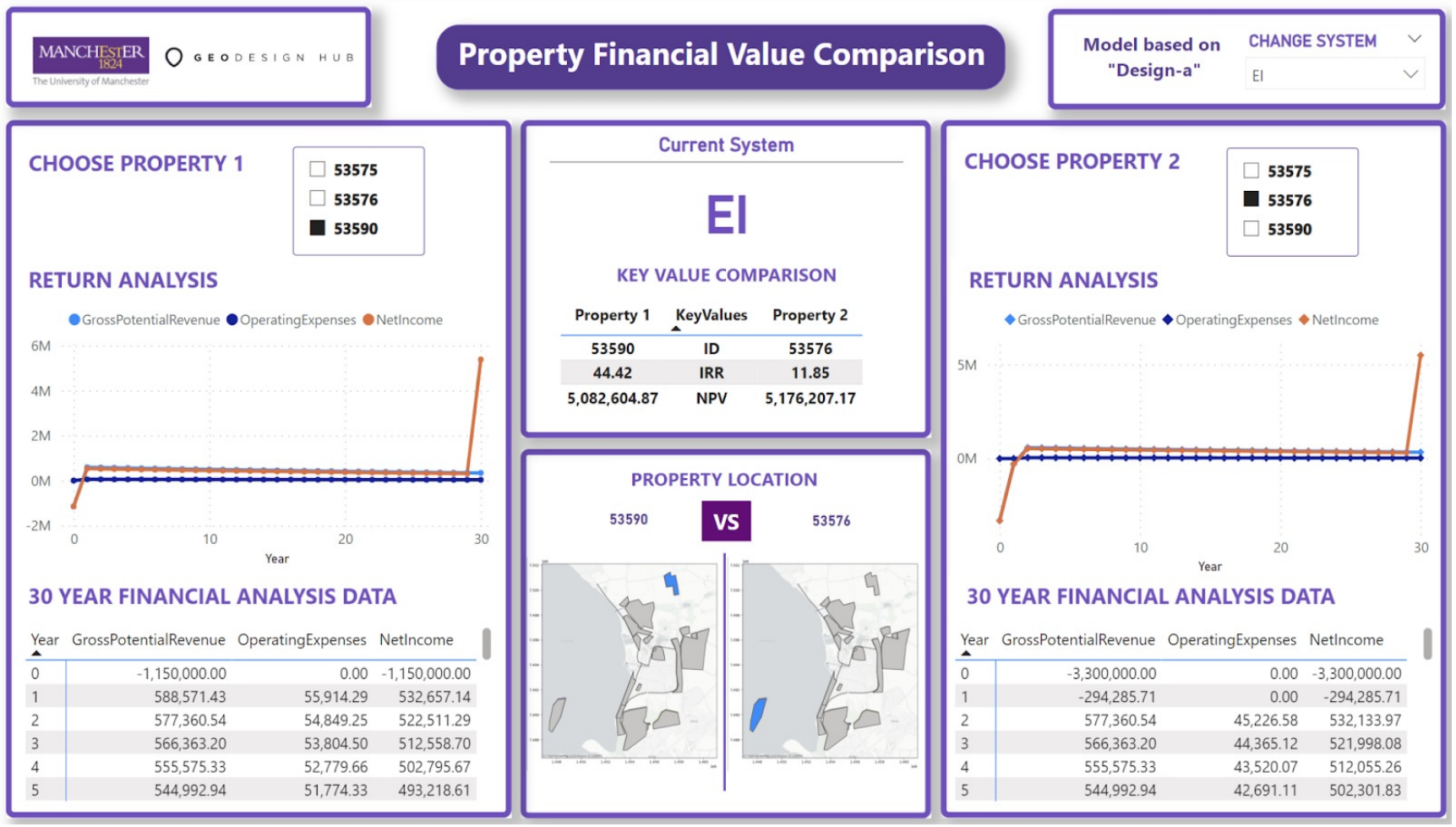
Comparative Financial Analysis Reports

Two interactive dashboards were created:

1. **PowerBI dashboard :**
    - Powerful business intelligence platform develop by Microsoft.
    - Allows users to connect to various data sources, transform and analyse data, and create interactive visualisations and reports.

2. **HTML financial visualisation tool:**
    - Unlike the Power BI dashboard, which relies on a JSON input format received from the python script, the HTML tool allows users to directly input financial parameters within the user interface.
    - A JavaScript code attached to each HTML dashboard, tailored to different system types acts as the calculation engine.
    - This streamlines the data input process and potentially simplifies integration with the GeoDesign Hub platform.

PowerBI Dashboard



Key Features:

1. System Selection
2. Diagram Selection
3. Return Analysis
   a. Colour-Coded Lines
   b. Tooltip Functionality
4. 30-Year Financial Analysis Data Table
5. Property Location Comparison
6. Key Value Comparison

HTML Tool

- Six different HTML files for each system.
- In this, the user can input different set of values and get a corresponding output immediately.
- This potentially provides a simplified integration with the GeoDesign Hub platform.

Key Features:

1. User-Defined Inputs
2. Visualisation
3. 30 Year Financial Analysis Data Table

The University of Manchester

GI Financial Model

Enter Financial Parameters:

Initial Investment(£): 2000000

Annual Construction Expenses(£): 100000

Construction Period In Years(Year): 2

Annual Maintenance Expenses(£): 50000

Annual Insurance Costs(£): 10000

Annual Advertising Revenue(£): 200000

Growth Rate (%): 2

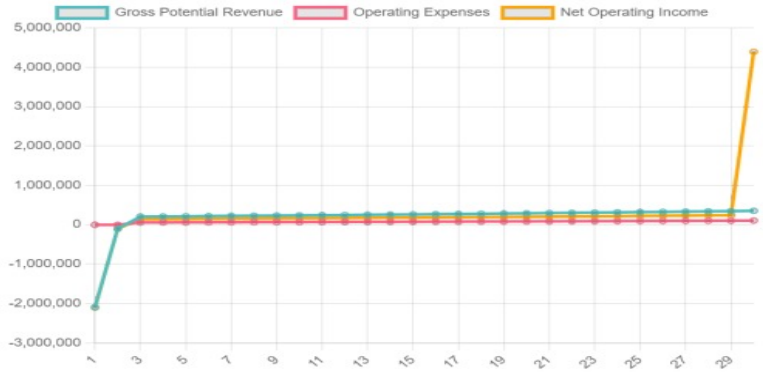
Cap Rate (%): 6

Compute and Draw Chart

Valuation for Year 30: 4143637.61

IRR: 8.14%

30-year Financial Chart



Financial Data Table

Year	Gross Potential Revenue	Operating Expenses	Net Operating Income
1	-2100000.00	0.00	-2100000.00
2	-102000.00	0.00	-102000.00
3	208080.00	62424.00	145656.00
4	212241.60	63672.48	148569.12
5	216486.43	64945.93	151540.50
6	220816.16	66244.85	154571.31
7	225232.48	67569.75	157662.74
8	229737.13	68921.14	160815.99
9	234331.88	70299.56	164032.31
10	239018.51	71705.55	167312.96
11	243798.88	73139.67	170659.22
12	248674.86	74602.46	174072.40
13	253648.36	76094.51	177553.85
14	258721.33	77616.40	181104.93
15	263895.75	79168.73	184727.03
16	269173.67	80752.10	188421.57
17	274557.14	82367.14	192190.00
18	280048.28	84014.49	196033.80
19	285649.25	85694.77	199954.47
20	291362.23	87408.67	203953.56
21	297189.48	89156.84	208032.64
22	303133.27	90939.98	212193.29
23	309195.93	92758.78	216437.15
24	315379.85	94613.96	220765.90
25	321687.45	96506.23	225181.21
26	328121.20	98436.36	229684.84
27	334683.62	100405.09	234278.54
28	341377.30	102413.19	238964.11
29	348204.84	104461.45	243743.39
30	355168.94	106550.68	4392255.87

Interviews with Stakeholders

- Aimed to test and validate the understanding and usefulness of our model outputs and reporting UI
- Stakeholders: two academics with specialised backgrounds in urban development & planning
- Their suggestions and comments are illustrated below:

Stakeholder 1:
Specialises in Real Estate Economics

1. Apply DCF instead of cash flow analysis.
2. Start DCF from 'Year 0' instead of 'Year 1'
3. Positive feedback on utilising NPV and IRR, could include pay-back period
4. Report UI was easily interpretable

Stakeholder 2:
Specialises in Town Planning

1. To include socioeconomic perspective parameters in the model such as UN population projections and climate change parameters
2. Reduction of 30-year time horizon

Conclusion

Goals achieved

- Financial modeling framework
- Interactive Dashboards
- Stakeholder Feedback

Bottlenecks & Challenges

- Long 30-year timeframe and rapid pace of environmental changes diminishing forecast accuracy
  → *adjust models for shorter timeframes*
- Steep learning curve due to team members' lack of financial modelling knowledge
  → *seeking support from industry partner and academics*
  → *managing project timeline to allow for more time on knowledge acquisition*

Learning Outcomes & Career Development

- Financial modeling
- Data visualisation
- Project management skills
- Industry insights
- Application of theoretical concepts in data science to real-world scenarios