Managing a Nation’s Real Estate Assets in a Profitable and Sustainable Way

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The Crown Estate (UK)
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• Our Real Estate Portfolios
• Offshore Portfolio
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    Offshore windfarm cost of energy example
  - How we understand how potential opportunities can be realised in a sustainable way (alongside other users and users of space)
    Marine Resource System example
• Summary
The Crown Estate

- Public property of the UK Monarch
- 3 property portfolios, combined value of £11.5b
- All profit returned to government for the benefit of the nation

Rural & Coastal (Pink)

Urban (Purple)

Offshore (Blue)

<table>
<thead>
<tr>
<th>Portfolio</th>
<th>Value</th>
<th>Revenue</th>
<th>Approx. Holdings</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban</td>
<td>£8.2b</td>
<td>£264m</td>
<td>~1,300 Properties</td>
<td>• Well mapped</td>
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<tr>
<td></td>
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<td></td>
<td></td>
<td>• Largely static</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Data rich</td>
</tr>
<tr>
<td>Rural &amp; Coastal</td>
<td>£1.7b</td>
<td>£51m</td>
<td>~10,000 Properties</td>
<td>Rural</td>
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<tr>
<td></td>
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<td></td>
<td>• Relatively static</td>
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<td></td>
<td></td>
<td>• Good mapping/data</td>
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<tr>
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<td></td>
<td>Coastal</td>
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<tr>
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<td></td>
<td></td>
<td>• Dynamic</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Less certain mapping/data</td>
</tr>
<tr>
<td>Offshore</td>
<td>£0.9b</td>
<td>£51m</td>
<td>~500 Properties (850,000 km²)</td>
<td>Very Dynamic</td>
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<tr>
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<td></td>
<td></td>
<td>• Largely unmapped</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td>• Large uncertainty/risk</td>
</tr>
</tbody>
</table>

Increasing:
- Area
- Complexity
- Uncertainty
- Risk
- National importance
- Dominant ownership

= More opportunity for GIS to add value
Offshore Portfolio

- Large Space (3 times the size of UK land area)
- Large latent opportunity
- Limited data & largely unmapped
- Competition for space
- Need to understand where opportunities exist

**Solution = Cost of Energy Model (Python)**

- Need to understand how opportunity can be sustainably delivered alongside other interests and users of marine space

**Solution = MaRS Marine Resource System (Custom Extension)**
Cost of Energy Modelling

- Offshore windfarm site selection is driven by cost
- Costs are driven by market factors and physical conditions
- Our Levelised Cost of Energy Model (LCoE) identifies where conditions are optimal in UK Waters to support lower cost offshore windfarms
- This helps us to understand where there are development opportunities within our offshore real estate
The LCoE Model
(Developed in partnership with Geospatial Enterprises Ltd.)

- The model utilises spatial data describing physical conditions in UK waters - wind speed, water depth, seabed sediments, wave climate, tidal flows, and distance to shore.

- Costs relating to windfarm foundations, installation, electrical systems and operational & maintenance are calculated based on the physical conditions at each square kilometre of UK waters (735,000 cells).

- The result is a comprehensive prediction of the cost to construct and operate an offshore windfarm at any location in UK waters, expressed as the cost per MW of electricity predicted to be generated in the 20 year life of a windfarm.

- The model consists of 139 python scripts linked through a GUI interface. It has 175 user-definable inputs, 11,382 cost coefficients that are utilised in 1,450 cost functions. It uses 500mb of input GIS data and generates 12.5GB of output spatial data with run times < 1hour on a standard desktop pc.
Sustainability Analysis using MaRS

- Once we understand where opportunity exists we must ensure it can be delivered in a sustainable way.
- Our Marine Resource System (MaRS) provides a toolset to analyse proposed developments in our offshore real estate alongside social, cultural, and environmental interests and other marine industries.
MaRS – Sustainability Analysis

- Multiple datasets from a wide range of providers
- Integrated data management – full metadata, confidence assessed and quality assured
- 400+ layers
- 42 data providers
Sustainability Analysis

Data

Exclusions

Policy, Weights, Scores

Restrictions

Sustainability mapping

Hard Constraints that Prevent Development

MaRS - UK Exclusion Model

- Active Cables
- Territorial Water Limit
- UK Continental Shelf Limit
- United Kingdom
- Europe

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Positions shown relative to WGS 84

MaRS
Marine Resource System

1:5,500,000

THE CROWN ESTATE
Sustainability Analysis

Data

Exclusions

Policy, Weights, Scores

Restrictions

Sustainability mapping

Hard Constraints that Prevent Development

MaRS - UK Exclusion Model

MaRS - Marine Resource System

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Sustainability Analysis

Data

Exclusions

Policy, Weights, Scores

Restrictions

Sustainability mapping

Hard Constraints that Prevent Development

MaRS - UK Exclusion Model

- Active Cables
- Active Pipelines
- Territorial Water Limit
- UK Continental Shelf
- United Kingdom
- Europe

MaRS
Marine Resource System

1.5,500,000

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Positions shown relative to WGS 84
Sustainability Analysis

- Data
- Exclusions
- Policy, Weights, Scores
- Restrictions
- Sustainability mapping

Hard Constraints that Prevent Development
Sustainability Analysis

Data

Exclusions

Policy, Weights, Scores

Restrictions

Sustainability mapping

Hard Constraints that Prevent Development

MaRS - UK Exclusion Model

- Active Cable
- Active Pipeline
- Windfarm Area
- Tidal Lease
- Wave Lease
- Aquaculture Lease
- Dredging Area
- Oil & Gas Infrastructure
- Well
- IMO Route
- Wreck
- Territorial Water Limit
- UK Continental Shelf
- United Kingdom
- Europe

Multi-Criteria Analysis

Sustainability Analysis

Data

Exclusions

Policy, Weights, Scores

Restrictions

Sustainability mapping
Sustainability Analysis

- Data
- Exclusions
- Policy, Weights, Scores
- Restrictions
- Sustainability mapping

Exclusion Result

MaRS - UK Exclusion Model

- Exclusion Model
- United Kingdom
- Europe

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Priorities Defined Through Internal and External Policies

Data

Exclusions

Policy, Weights, Scores

Restrictions

Sustainability mapping

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Marine Policy Statements
for Policy Administrators

**Windfarm Cables**

- **Infrastructure**
  - **Wind Farm**
    - Activity Name: Wind Farm
    - Influence on Planning Models: 2 - Medium
    - Last Updated: 05 May 2010

- **Legislation and Government Policy**
  - **Legislation**
    - Crown Estate Act 1961
  - **Government Policy**
    - United Nation Convention on Law of the Sea

**Specific Policy**

The Crown Estate adopts the same rational for windfarm cables as other subsea power cables that generate electromagnetic fields. That is, a buffer of 250 metres of no works either side (statutory requirement for distance from cables and pipelines – UK Cable Protection Committee). Special consent required for an additional 250 metres from this.

MaRS Guidance

Buffer of 250 metres of no works either side. Special consent required for an additional 250 metres from this.
Sustainability Analysis

Soft Constraints Assessed Through Weights and Scores

Data

Exclusions

Policy, Weights, Scores

Restrictions

Sustainability mapping
Sustainability Analysis

Data

Exclusions

Policy, Weights, Scores

Restrictions

Sustainability mapping

Soft Constraints Assessed Through Weights and Scores

ENVIRONMENTAL RESTRICTIONS

MaRS - Restriction Model

- Territorial Water Limit
- UK Continental Shelf
- United Kingdom
- Europe

MaRS
Marine Resource System

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Soft Constraints Assessed Through Weights and Scores

Sustainability Analysis

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Restrictions

Sustainability mapping
Restriction – Exclusion = Sustainability Analysis Output
Summary

The Crown Estate manages a very diverse portfolio of UK Real Estate including Urban, Rural, Coastal and Offshore assets.

In area of less traditional real estate, GIS provides a very powerful tool for identifying opportunity and ensuring that new revenue is delivered in a truly sustainable way.

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