<table>
<thead>
<tr>
<th>Site</th>
<th>Cadiz</th>
<th>Vevey</th>
<th>London</th>
<th>Frederikshavn</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type</strong></td>
<td>apartment block</td>
<td>apartment block</td>
<td>students' accommodation</td>
<td>apartment block</td>
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<tr>
<td><strong>Size</strong></td>
<td>5 floors, 28 apartments, 1873m²</td>
<td>5 floors, 15 apartments, 1095m²</td>
<td>4 floors, 9-11 bedrooms/floor, 646 m²</td>
<td>Two, 3-story buildings, 66 apartments, 5631m²</td>
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<tr>
<td><strong>Period</strong></td>
<td>60s</td>
<td>1900s</td>
<td>70s</td>
<td>40s</td>
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<tr>
<td><strong>Owner</strong></td>
<td>Cadiz City Council</td>
<td>Public Insurance Company</td>
<td>Brunel Estates</td>
<td>Frederikshavn Building Association</td>
</tr>
<tr>
<td><strong>Pre-renovation</strong></td>
<td>Unoccupied, No HVAC</td>
<td>Last significant refurbishment in 1979; The envelope is not insulated</td>
<td>Minimal existing insulation level; Windows replaced with double glazed units and insulation to the roof in 2005; Heating and DHW: central gas-fired boiler plant and hydronic circuits; Natural Ventilation</td>
<td>Addition of 50 mm mineral wool insulation in 1991</td>
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**Global Objectives**
- (a) demonstrate the performance of the ReCO₂ST technologies in operational buildings
- (b) investigate technical practical, legislative and owner requirements with respect to installation of novel ReCO₂ST technologies
- (c) reduced heating and/or cooling consumption after renovation
- (d) target 60% reduction of energy consumption
- (e) maintenance and improvement of quality of life after renovation
- (f) reduced environmental impact of the building after renovation, and all within a framework of economic profitability

**Individual objectives**
- reduce/eliminate the building's heating and cooling needs,
- guarantee an adequate level of air quality and thermal comfort throughout the year,
- produce hot water mainly from a renewable source,
- generate renewable electrical energy
- Core intervention: The improvement of the thermal envelope and HVAC installation. 
- Other improvements: Carried out in order to increase the building attractiveness and value.
- Energy-efficiency retrofit with ReCO₂ST kit technologies and improvement to heating system.
- Energy-efficiency retrofit

**Least-cost methodology**
- The building will not be equipped with heating/cooling system. The cost benefit study was seen as an improvement of interior thermal comfort conditions with envelope interventions with greater demand reduction at lower cost (definition of insulation type and thickness and window U-value)
- The selected scenario includes better U-value for the façades, no thermal insulation for the North architecturally protected façade, installation of 95 m² photovoltaics on the roof and connection to the district heating.
- From the cost efficiency perspective, the most interesting intervention are improvement to the heating system, new extraction fans, and air tightening.
- Systems improvements have the lowest cost efficiency. The largest spread of cost efficiency is also observed for envelope improvements.

**Energy reduction**
- The proposed solution presents average space heating of 19 kWh/m²-year
- The selected scenario results in approx. 57% heating demand reduction
- The proposed renovation scenarios indicate total primary energy saving potential between 34% and 53%.
- Renovation Scenarios developed for the DK demo site indicate total primary energy savings in the range of 8% to 52%

**ReCO₂ST technologies**
- CEVF, Cool Roof, VIPs, NBS, Innovative AHU (IAHU), CPV
- Smart windows, NBS, CPV
- Cool Roof, VIPs, Smart Windows, NBS, Mechanical ventilator with Phase Change Materials Storage; Cool-phase® ventilator, CPV
- VIPs, Smart Windows, NBS

**Other interventions**
- Structural reinforcement, Domestic hot water (DHW), Solar thermal panels (STP), polycrystalline silicon PV modules, 15.84 kWp
- Mineral wool insulation; Replacement of windows, exterior doors and shutters; Addition of balconies; Staircase renovation (fire resistant doors, movement detection lights, smoke outlets); Elevator replacement; Heating and DHW: Wood powered (80%) urban heating, single flow mechanical ventilation with humidity-controlled regulation, 20 kWp PV
- Central heating renovation; LED lighting; one kitchen full renovation and general air-tightness improvement;Flat Solar Panels, 3.6 kWp
- Individual balanced mechanical ventilation units with heat recovery (building 1); Building 1 Extension; New roof covering; New facades and windows; New electric and plumbing (building 1); Simple extraction ventilation system-fresh PAX Calina with extraction from kitchen and toilet. Exhaust through the façade (building 2)

**Status of renovation**
- Pending
- Completed
- Completed
- Pending