Intended for
Ocean Village (St Annes) Ltd

Project no.
1620000164

Date
22 June 2015

OCEAN SPA PLAZA, GIBRALTAR

ENERGY STATEMENT

Revision History

Revision	Date	Purpose / Status	Document Ref.	Comments
-	22/06/15	Draft for Comment	61032964.ES	
A	25/06/15	Final	61032964.ES	Client comments incorporated.

Prepared By	Reviewed By	Approved By
Sam Pugh	**Tony McGlory**	**Tony McGlory**
Design Engineer	Director	Director

Ramboll
2nd Floor, The Exchange
St John Street
Chester CH1 1DA
United Kingdom

Tel: +44 (0)1244 311 855
chester@ramboll.co.uk

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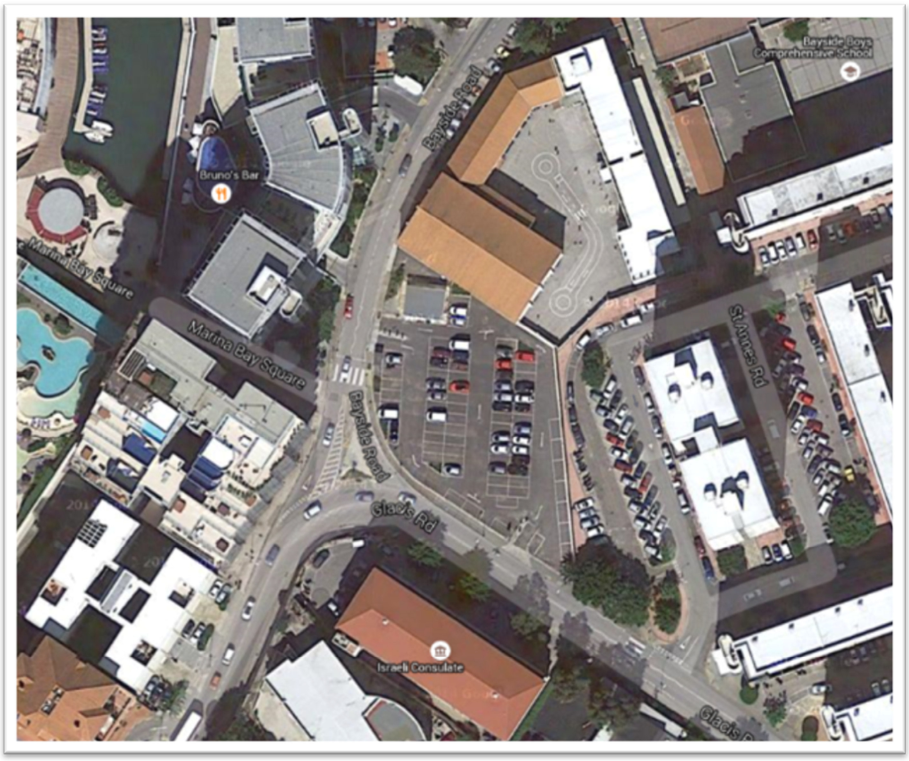
1. INTRODUCTION

Ramboll have been appointed by Ocean Village (St Annes) Ltd to prepare a statement to indicate the design strategy that will be applied to the Ocean Spa Development with respect to minimising energy consumption and integrating renewable energy technologies.

2. EXISTING SITE DESCRIPTION

The development is located in West side of Gibraltar, off Bayside and Glacis Road. The existing development site is brown field land and comprised of public car parking facility. The site is also bound by the Local School and Constitution House Parking area.



The proposed building is a mixed use development incorporating car parking, commercial, retail and residential elements. The first 7 floors accommodate 591 car parking spaces, commercial office space and a Ford motor dealership. Above this are 120 apartments set in an elliptical tower over 10 floors. On the roof of the residential and the residual space of the car park are gardens, pools and spa facilities.

3. LIMITATIONS

This report has been prepared for Ocean Village (St Annes) Ltd and shall not be relied upon by any third party unless that party has been granted a contractual right to rely on this report for the purpose for which it was prepared.

The findings and opinions in the report are based upon information derived from a variety of information sources. Ramboll believe these information sources to be reliable.

This report has been prepared on the basis of the information available at the current stage of design development. The information on which this report is based will be subject to design development.

It should be noted that some of the aspects considered in this study are subject to change with time. Therefore, if the development is delayed or postponed for a significant period then it should be reviewed to confirm that no changes have taken place, either at the site or within relevant legislation, which could affect the findings of this report.

4. SCOPE AND OBJECTIVES

This report has been prepared in support of the Planning Application for Ocean Spa Plaza to convey the design approach with regard to minimising energy consumption and incorporating renewable energy technologies into the project.

The project is at an early stage and there are many issues to be considered and developed. The client brief to the designers includes;

i Ensuring energy use is reduced through utilisation of passive energy efficiency measures in the first instance.
ii Maximising efficiency of installed systems
iii Utilising Low and Zero Carbon (LZC) technologies

The benchmarks to be used for developing the above will be the Gibraltar energy efficiency requirements defined in the Building Rules 2007 and the development of predictive energy assessments.

This report will identify the options the design team will consider to minimise energy consumption, maximise efficiency and implement renewable technologies. These items will be continually assessed, optimised and refined throughout the design process.

This report will also briefly review the advantages and disadvantages of Low and Zero Carbon (LZC) systems in relation to their use on this development. The successful application of a LZC system is entirely dependent on the building design, use, location and site constraints. The purpose of this report is to evaluate all the options and select the technologies that warrant further investigation for our unique circumstances during detailed design.

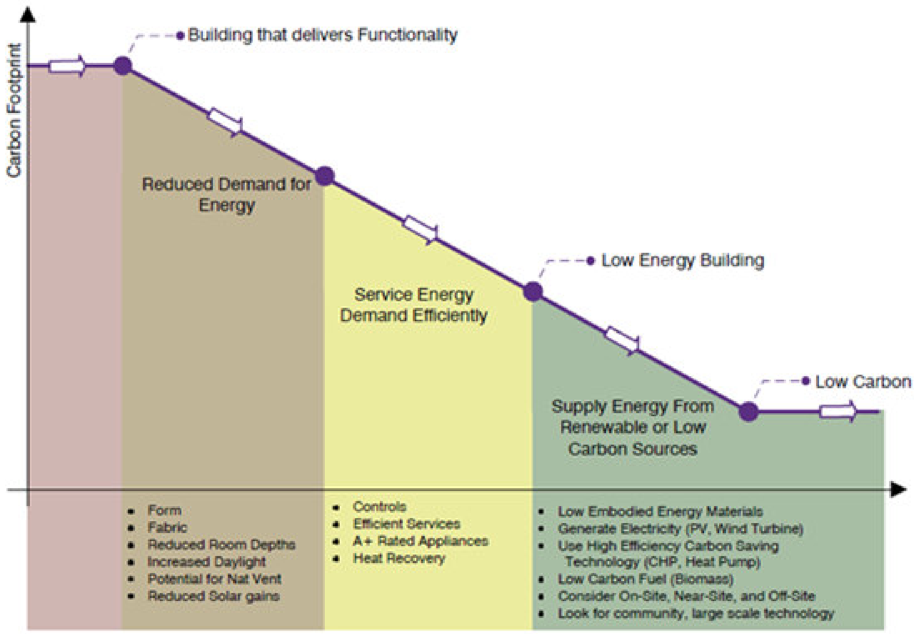
5. DEMAND MINIMISATION

The Gibraltar Building Rules set targets to achieve target CO_2 emissions, which encourage minimisation of energy consumption.

It is vital that buildings are designed to be as sustainable as possible on a whole life basis. The holistic design approach for the Ocean Spa Plaza will be aligned to embed sustainability into every design decision.

The design team will produce extensive analysis and carefully propose the most appropriate, sustainable, commercially feasible low carbon technologies in order to meet all regulations, policies and targets stipulated.

The use of LZC technology will be considered during the design process as a means of carbon reduction. However, it must not be forgotten that the most significant carbon reductions can be made by the use of good design via demand minimisation, as indicated by the diagram below.



Our approach therefore, will at first, concentrate on minimising energy demand through passive design techniques.

The proposed building will be analysed using thermal modelling software during detailed design to identify the optimum building form and fabric arrangements to limit the scale and complexity of the engineering services required to maintain comfortable environmental conditions.

The remaining energy demand will be satisfied using systems that are designed to operate at maximum efficiency.

Adopting the above approach reduces the building energy demand by its maximum and thus, maximises the portion of building energy demand that can be delivered by renewable means.

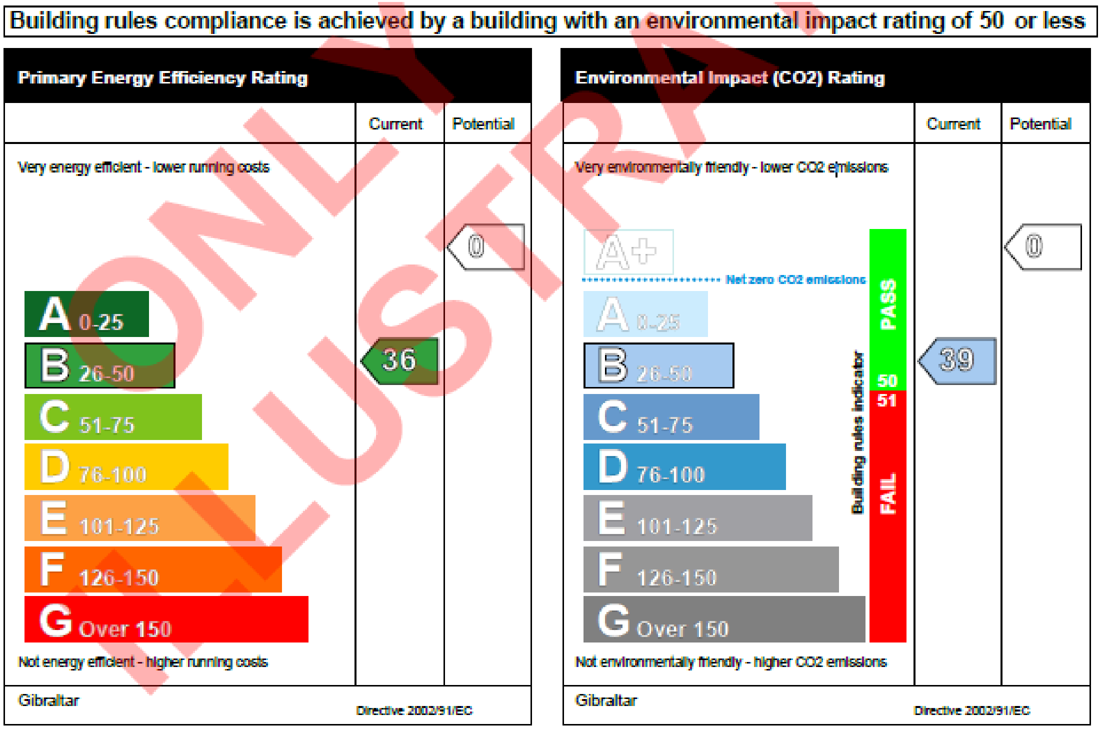
This makes good sense, as the reduction in demand will increase the impact of any LZC technology, and will also reduce the lifetime running costs of a development.

Some of the elements which we will continue to review during the detailed design stage include:

- i High standard of thermal performance - U values of building fabric, in compliance with Approved Document F2A will be the starting point. Following this we will optimise these values using IES thermal modelling to best suit the building usage and application.
- ii Optimising fenestration design to ensure solar radiation is minimised using high quality glazing with high solar energy reflectance properties and high light transmission properties.
- iii The above will enable maximum use of natural daylight.
- iv External solar shading where this can be integrated sympathetically with the Architecture.
- v Green walls and planters to assist shading of the building and provide an element of filtration.
- vi Provision of internal blinds to reduce direct solar energy transmission.
- vii Control East / West summer sun penetration.
- viii Increase air tightness standards of the building envelope, potentially to a design target of around $7m^3$/hr at 50Pa, though the calculations will be set at 10m3/hr at 50Pa to provide a margin of comfort.
- ix Maximise the use of natural ventilation systems were appropriate.
- x Incorporate heat recovery systems were mechanical ventilation systems are proposed.
- xi Use of low energy luminaires, with LED luminaires as far as possible.
- xii Provision of lighting controls to minimise energy usage in unoccupied spaces.
- xiii Energy metering of all the buildings individual tenants.
- xiv Maximise the use of thermal mass, to maximise where the Architecture allows, the time lag between incident solar gain and penetration into the occupied space.
- xv Low water use sanitary accommodation to ensure low water usage, including the use of waterless urinals.
- xvi Provision of rainwater capture techniques to reduce water use for irrigation.
- xvii Lifts with energy capture technology.
- xviii High efficiency heat pump technology to provide heating and cooling.
- xix White goods and fixed equipment with "A" rated energy performance.
- xx Provision of electric vehicle charging points in the car park to encourage the use of electric vehicles in Gibraltar.

6. BUILDING RULES

In order to comply with the Building Rules an environmental impact rating of less than 50 is required. The predictive assessments will be developed for the project and these would be maintained live throughout the design phase, so that design changes can be assessed and the energy implications understood prior to implementation.



Even at this early stage of the project our Client has already arranged for the draft assessments to be prepared so that strategic design decisions undertaken at the planning stage can be understood from an energy consumption perspective.

7. LOW & ZERO CARBON OPTIONS

7.1. Introduction

Detailed on the following pages are the various LZC options that have been considered for this building to date and the advantages and disadvantages they provide for this development. It is worth noting that application of these technologies is often bespoke to the building type, and therefore it is not unusual for similar projects to have different LZC technology solutions.

7.2. Biomass Fuelled Heating

The use of wood powered heating to provide part of the heating demand for the site. Biomass boilers, or heaters could be integrated to provide base heat load for buildings. Over recent years this technology has been extensively developed and has become more commonplace with more installers and manufacturers represented across Europe.

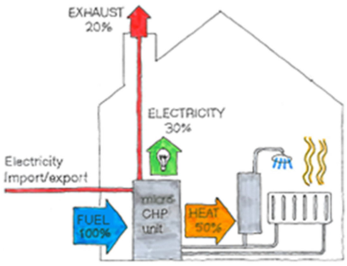
- **Advantages**
  - i Currently biomass fuel is classed as almost Carbon Neutral (wood pellets have 14% of the CO_2 emissions of natural gas) as managed woodland replacement offsets the carbon produced in the burning of the fuel. The acknowledged carbon content of the fuel is in its production and transportation. This content would be significantly increased for Gibraltar due to delivery / transportation issues.
  - ii Large reduction in CO_2.

- **Disadvantages**
  - i Predominately used as fuel for heating. Buildings in Gibraltar are predominantly cooling dominated.
  - ii Careful management of local public opinion required to overcome fears of local pollution due to flue discharge and associated emissions.
  - iii Can be difficult to progress through the planning process in certain areas.
  - iv Regular deliveries of fuel by lorry (possibly daily). Fuel delivery can be problematic in city centre locations because of increased vehicle movements.
  - v Increased maintenance costs over a conventional heating systems.
  - vi Availability of maintenance expertise will be limited in Gibraltar.
  - vii Fuel delivery is noisy if a blown system is used – ie storage area is remote from delivery point.
  - viii Fuel availability is limited with no local supply chain and there is high risk of disruption and supply availability.
  - iii Requires a large ground floor space to house both plant and fuel storage for a central system.
  - iv Unfamiliar technology to local installers.

Limited fuel supply availability, suitability and delivery distances will render this fuel source prohibitive, there are also likely to be issues around the public perception of biomass – particularly in the adjacent properties. This in itself may prejudice its use.

7.3. Gas or Oil Fired Combined Heat and Power (CHP) Generation

Gas or oil fired generation of electricity to feed into the site electrical infrastructure with the heat recovered from the engine cooling process used to heat domestic hot water, or provide absorption cooling.



- **Advantages**
  - i Flues/chimneys are visually no different to gas heating boilers though will need to be taller for oil due to the sulphur content of the fuel.
  - ii Can be coupled to absorption chillers to provide cooling.

- **Disadvantages**
  - i Requires a stable base thermal load, throughout the year, to be viable.
  - ii Requires careful design to match the thermal output with the base thermal load and electrical load to avoid inefficient heat rejection.
  - iii Requires continuous full load operation to be effective.
  - iv Lower operation life than conventional plant.
  - v More maintenance intensive than conventional boiler plant.
  - vi Absorption cooling requires intensive and expert maintenance which may be difficult to procure in Gibraltar.
  - vii Annual maintenance will include downtime which has to be programmed. Duplicate systems will be required to accommodate this.
  - viii No mains gas supply in Gibraltar. Supply from bottle gas storage would be impractical. Oil is significantly less environmentally friendly fuel than gas for CHP. Unlike gas systems, oil filled systems are not available as packaged systems and are not tried and tested in this application.
  - iii Require large, regular, fuel oil deliveries to maintain operation if oil used as fuel. Impact on traffic movements and congestion in the area.
  - iv Chimney would need to be significantly taller than the building itself and may cause height issues for the nearby Gibraltar Airport.
  - ix Requires significant additional plant space for CHP unit and supporting plant, which would impact on the buildings amenity space and public areas.
  - x Requires permission from Gibelec to install an electrical generator that will be connected to the grid (presently this is not acceptable).

With the intermittent nature of domestic loads, a large base thermal load will not exist. Only gas fired CHP units can render major carbon reduction savings. With no fixed gas supply in Gibraltar, the system would have to be powered by oil. The carbon reduction benefit using oil is significantly reduced. The level of fuel storage required and frequency of top ups from delivery vehicles would render the solution impractical. Chimney height and emissions from oil fired systems would be seen as detrimental.

It is presently not permissible to install electricity generating equipment into the Gibelec grid. This could change in the future.

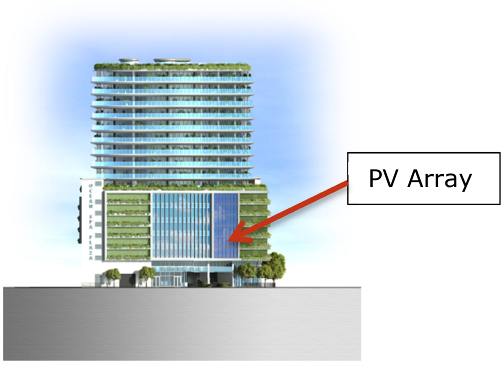
7.4. Solar Photovoltaic (PV) Cells

The use of Solar PV cells to convert sunlight into electricity**.**

- **Advantages**
  - i Low maintenance.
  - ii Unobtrusive operation – though there could be reflectivity issues that would need to be investigated due to proximity of runway.
  - iii Visible statement of environmental credentials.
- **Disadvantages**
  - i The roof is earmarked for leisure facilities and the space that could be made available for PV is limited.
  - ii Requires permission from Gibelec to install an electrical generator that will be connected to the grid (presently this is not acceptable).
  - iii Low energy yield per unit area.

This technology is a viable option for the Ocean Spa Plaza, the main obstacle is finding areas where PV can be installed without compromising the space designated for public amenity. As a result the use of a vertical PV array of over 100m² is currently proposed. Such an array on the building façade will create a clear visible statement of the buildings environmental credentials.

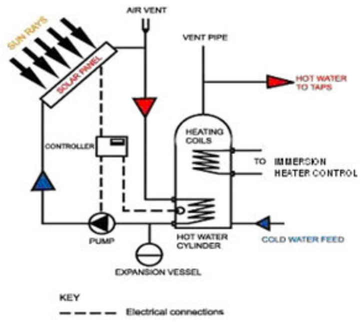
We believe there are presently no vertical PV arrays installed in Gibraltar at the moment so this installation would be quite experimental and would help identify whether a vertical PV array would perform well in the Gibraltar urban environment. Although vertical PV arrays may not be positioned to the optimum, the diffuse irradiation is strong in Gibraltar and could still yield effective performance. The intention would be to separately meter the energy generated from the array and the results of this could be shared with the Gibraltar Government to aid planning and development of installations of this type in the future.



It is presently not acceptable to install electricity generating equipment into the Gibelec grid. However, the PV cells, electrical infrastructure and containment could be installed initially, but remain unconnected so that PV could be energised once permitted by Gibelec.

7.5. Solar Thermal Domestic Hot Water Heating

The use of solar energy to heat a hot water store that will act as a pre heater to the main domestic hot water storage system.



- **Advantages**
  - i Low maintenance
  - ii Unobtrusive operation
  - iii Visible statement
  - iv Familiar and simple technology.

- **Disadvantages**
  - i The roof is earmarked for leisure facilities and the space that could be made available for solar thermal panels are limited.
  - ii Thermal store system will be required which will require space.
  - iii Fixed solar thermal system will not co-ordinate well with multiple dwellings.
  - iv Careful design required to minimise legionella risks.

Solar thermal hot water generation is possible in multi residential buildings, however, the system will be complex, difficult to manage and require a significant amount of space to house plant and equipment. We do not consider it practical to install a centralised solar thermal system that could feed dwellings and commercial areas.

It would be feasible however, to install a system that benefits all residents and significantly reduce carbon dioxide emissions by using solar energy to heat the buildings spa's and swimming pools.

7.6. Wind Turbine

A building mounted wind turbine to generate electricity to supply the building and supply any excess back into the grid.

- **Advantages**
  - i Visual statement of green credentials
  - ii Low maintenance costs.

- **Disadvantages**
  - i Obtrusive – both visually and potentially noisy.
  - ii Large scale unit would be required to make meaningful energy building reduction.
  - iii Complex controls and mains synchronisation
  - iv Output highly dependent upon location – often wind turbines under perform in an urban environment.
  - v Difficulty in controlling vibration noise transmitted through the building structure, with building mounted units.
  - vi Requires permission from Gibelec to install an electrical generator that will be connected to the grid (presently this is not acceptable).

A wind turbine installed for this development would need to be building mounted to place it in a relatively undisturbed wind path. The wind patterns in city centre locations are not ideal for wind generation. The use of large building mounted turbines cause issues with buildability by adding complexity to the structural design and future maintenance. A wind turbine mounted on the roof may cause height issues for the nearby Gibraltar Airport. Wind turbines proposals for urban areas usually meet considerable objections from the public.

It is presently not acceptable to install electricity generating equipment into the Gibelec grid. This could change in the future.

To achieve at meaningful reduction in CO2 emissions, medium to large wind turbines would be required. Realistically, it is unlikely that it would be acceptable to install any form of wind turbine on this site, bearing in mind the proximity of the airport and residential areas.

7.7. Ground Source Heat Pump

Utilisation of the constant ground temperatures of around 12 centigrade to extract heat for use in heating and cooling production.

System efficiencies for Ground source systems are typically in the range of;

- CoP Heating 5.4
- CoP Cooling 6.7

- **Advantages**
  - i Unobtrusive
  - ii Low ongoing costs
  - iii Proven technology
  - iv Good ground conditions for ground source are anticipated in this location, though no testing has been carried out.
  - v Significant carbon savings over standard heating and cooling systems if high efficiencies that can be achieved.

- **Disadvantages**
  - i Horizontal systems require extensive site area, which is not available on this project
  - ii Vertical systems are expensive to install due to the cost of the boreholes required, and can still require a larger area to accommodate these than is available.
  - iii Increased design complexity to integrate into the building services installation.
  - iv Significant increase in required plant space.
  - v Site specific. Will require on site investigation and testing ground thermal conductivity to finalise design.
  - vi Successful use of heat produced dictates the heating solution applied to the building.

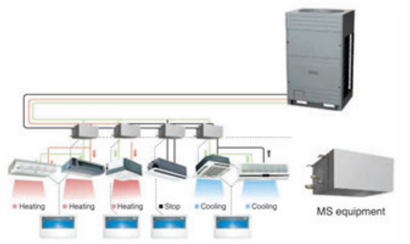
vii Most compatible with centralised systems, which doesn't coordinate well with multiple residential building.

This site has insufficient area for a horizontal system to be installed to satisfy the demands of the entire building. The costs of a vertical system would be high in this location, and the cost risk is still present until onsite investigation is completed. Similarly, a salt water extraction, delivered by an open borehole system could be adopted. However, this will require additional plant space and warrant marine grade plant and equipment which will significantly increase the required investment for only a disproportional enhancement in performance. The investigations undertaken so far indicate that the site is contaminated, hence minimising the amount of works in ground will be important. With this in mind it is difficult to see haw ground source systems could be preferred over air source systems for this building.

7.8. Air Source Heat Pump (ASHP)

Extraction of energy from surrounding air for heating and hot water production. Although air source heat pumps are not as efficient in the main as ground source systems, the efficiencies of VRF systems with integrated heat recovery are now approaching that of ground source heat pumps, without the significant additional capital investment that ground source systems require. For example;

CoP Standard Air Source system heating 4.6
CoP Standard Air Source system Cooling 6
CoP air source VRF Heating 5
CoP air source VRF Cooling 6.5



The latter is typical at full heating, or full cooling, whereas manufacturers claim CoP's of 5 and beyond when systems are at part load with heat recovery taking place.

- **Advantages**
  - i Low on-going costs.
  - ii Proven technology.
  - iii Lower capital cost than Ground Source heat.
  - iv Waste heat available if it can be used.

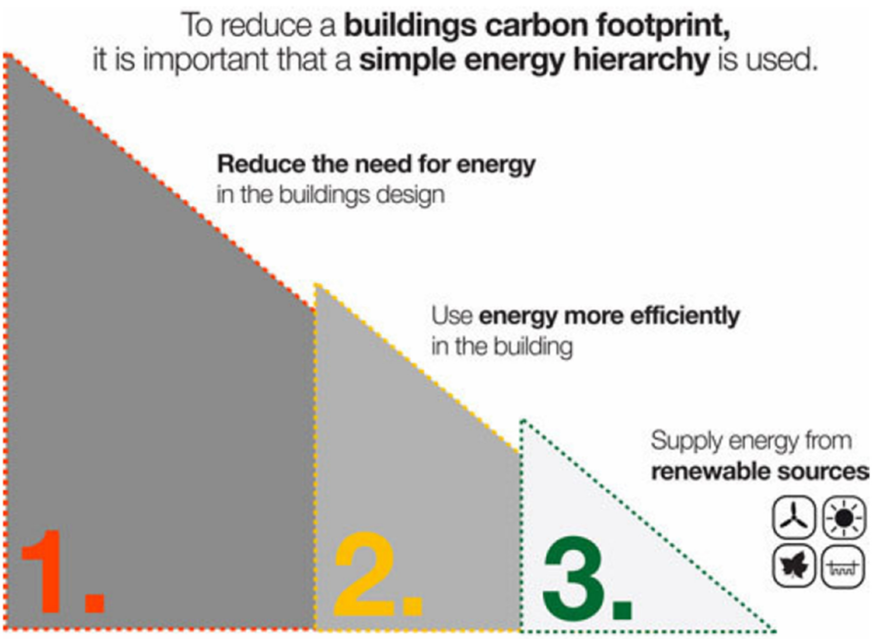
- **Disadvantages**
  - i Coefficient of Performance lower than for ground source installations (though only slightly in the dominant cooling mode.
  - ii Visual impact of the significant array of heat pumps would require screening.
  - iii External space required – either on roof, balcony, or adjacent to building

Air source heat pumps can be easily accommodated in Ocean Spa Plaza. Potentially, in commercial areas, waste heat could be used to generate domestic hot water for the WC and kitchen areas. This warrants further investigation.

7.9. LZC Summary

Following our initial review of the LZC options above, the solutions to best suited to be taken forward to detailed design stage for the Ocean Spa Plaza development are;

- Vertical solar PV array on the building façade over 100m² combined with metering and data logging system to inform actual performance.
- Horizontal solar thermal array for heating swimming pools and spa’s.
- High efficiency air source heat pumps for heating and cooling applications.



7.9.1. Energy Hierarchy www.themertonrule.org

8. CONCLUSION

It is recognised that the demand minimisation approach will achieve significant energy saving measures for the Ocean Spa Plaza. However, there will also be an important contribution from LCZ's to reducing the buildings Carbon Dioxide emissions. The features planned for this development include;

- A high standard of thermal performance for the building fabric.
- Use of thermal mass where the Architecture allows, to maximise the time lag between incident solar gain and penetration into the occupied space.
- A fenestration area that is sympathetic to cooling load reduction whilst maximising the passage of natural daylight.
- The use of high specification solar glazing which reduces solar energy transmission by 60% but allows 70 % of natural light through to the building interior.
- Provision of external solar shading using deep balcony's, reducing solar gain but enable day light transmission.
- Control East / West summer sun penetration using internal blinds.
- A high standard of air tightness for the building envelope, potentially to a design target of around 7m3/hr at 50Pa, though the calculations are set at 10m3/hr at 50Pa to provide a margin of comfort.
- Naturally ventilated car park.
- Natural ventilation to conditioned spaces benefiting from "mixed mode" free cooling.
- Inclusion of heat recovery on mechanical ventilation systems to precondition supply air.
- Use of low energy luminaires.
- Provision of lighting controls to minimise energy usage in unoccupied spaces.
- Daylight dimming to commercial areas to reduce the artificial light output when daylight levels permit.
- Metering system to monitor end use energy of LZC installations.
- Selection of low water usage sanitary appliances to reduce water consumption, hot water heating load and burden on the Gibraltar Water Infrastructure.
- Provision of rainwater capture techniques to reduce water use for irrigation and burden on the Gibraltar Water Infrastructure.
- Provision of decentralised high efficiency air source heat pumps.
- Use of waste heat from the buildings cooling system to generate domestic hot water for commercial areas.
- Provision of 100m² vertical PV array and associated electrical infrastructure ready for energising once Gibelec's rules permit.
- Provision of solar thermal array used to heat swimming pools and spa areas.
- Provision of lifts with energy capture technology.
- Provision of electric vehicle charging points in the car park to encourage the use of electric vehicles in Gibraltar.
- Provision of cycle parking to promote the use of bicycles in Gibraltar.
- White goods and fixed equipment with "A" rated energy performance.

Each of these measures will make a contribution to the buildings environmental impact through reducing energy and minimising the impact on Gibraltar's utility resources.