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Briefing: Oil tanker to eco-community

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The sustainable construction team (SCT) at Scott Wilson, an international multi-disciplinary consultancy group, has designed an off-grid sustainable community on board a disused oil tanker for the 2007 Royal Institute of British Architects USA 'Building a Sustainable World—Life in the Balance' design competition.

The team's prototype, the 'Ark', was shortlisted for the final, and it was awarded an honourable mention at the presentation symposium in Los Angeles, California. The proposal was chosen from 65 submissions, including more than 170 architects, city planners, engineers, students and designers from 18 countries worldwide.

The need for significant changes in current attitudes towards the environment and sustainability are presented to us almost on a daily basis. Images in the media of devastating floods, drought, burning rainforests and melting ice caps vividly portray an unchecked, unsustainable lifestyle. As the global population continues to rise, so too does the pressure on the planet's fragile ecosystems and resources to meet our ever-increasing demands. Environmentally friendly practices and long-term cost-effective solutions for issues such as climate change are essential if society is to prepare for the menacing consequences of predicted climatic shifts.

Approximately 3 billion people, about half of the world's population, currently live within 200 km of a coastline. With this figure likely to double by 2025, the proposed Ark prototype could be applied to serve a multitude of functions on shores around the world. The prototype uses an oil tanker, a very large crude carrier (VLCC), to house a maximum-capacity, sustainable community to address predicted consequences of shifts in global climate.

As current estimates indicate that both oil and gas will be depleted in 35–40 years, existing infrastructure will become obsolete and there will be an abundance of oil tankers to be decommissioned. Reuse of these existing 'brownfield' structures will provide ample opportunity to increase our habitable area on the planet. Currently, disused oil tankers are detoxified in their home countries and sent to Asia for dismantling; instead these could be adapted and 'docked' to reserve landmass for agriculture and support services.

The regularity of the oil tanker's structure is ideal for modular construction, which will reduce waste and be easy to construct. Current cruise ship construction practices can be applied, environmentally conscious specifications standardised and implemented throughout. One VLCC will accommodate approximately 2000 people.

The lowest three storeys have been reserved for support functions. Rainwater, greywater, freshwater, waste and food storage will all be contained in the lower part of the hull of the ship, as well as all desalination and mechanical plant equipment. Commercial, educational and other public functions will be located within a double-height storey directly above the storage area. The rear (external) portions will provide additional storage and service spaces and the double height will enable mezzanine levels to offer variation and mimic an 'urban' street level to provide a central community space while virtually eliminating the need for automobile transportation. Residential units will then stack vertically to the top, with roof gardens provided for agriculture and recreation spaces, such as sports pitches.

An 'umbilical cord' will connect the ship to the land for waste disposal and reloading of resources although it can be disconnected at any time in the event of unforeseen circumstances, such as a natural disaster. The 'off the grid' community was required to be as autonomous and self-sustaining as possible; the prototype will be equipped to self-sustain for up to 3 months. Hydroponic roof gardens feature greenhouses and 1 m^2 of external agricultural space per dwelling on board the ship will provide continual agricultural capabilities. Figs 1 and 2 illustrate the proposed design and layout of the Ark.

Wave energy technology is estimated to be hundreds of times denser than other forms of renewable energy, with close to 100% availability in many locations. Every ship will be moored with a wave dragon, and the device will utilise the energy produced by the motion of the draining water that overtops it as waves impact. The wave dragon is equipped with a series of 16 hydro-turbines, individually started and stopped, in order to facilitate as smooth an electricity production as possible. UK applications have already predicted an annual output of 12 264 000 kWh per wave dragon. Surplus electricity will be converted to hydrogen and stored for vehicle fuel or calm or emergency situations.

Desalination facilities will also be employed. Systems can be fitted to produce either electricity or freshwater from wave energy with no greenhouse gas emissions, and they have a

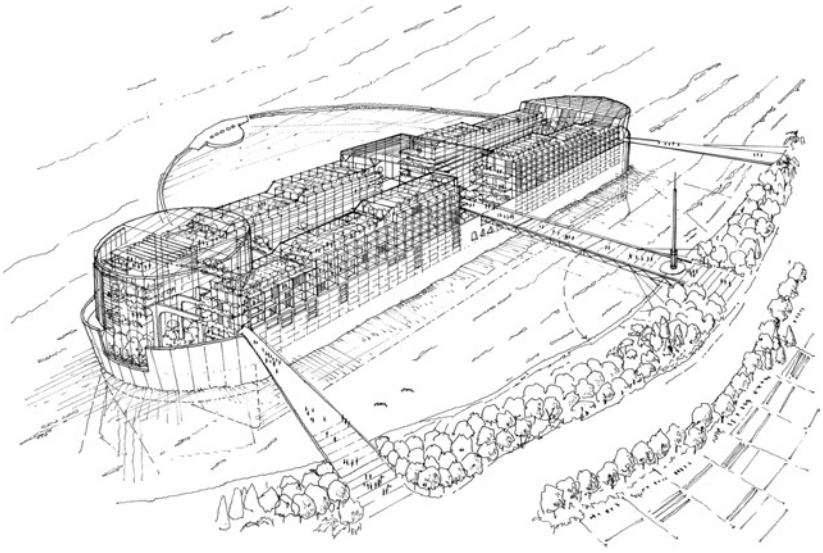

Fig. 1. External schematic of the Ark

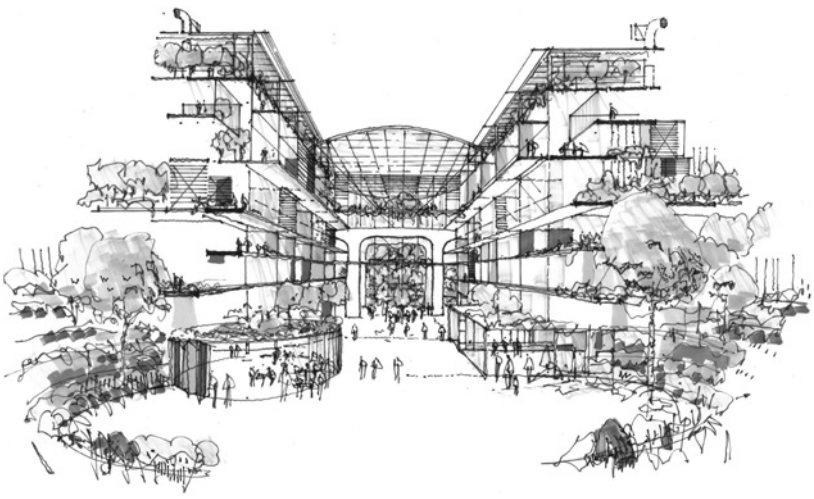

Fig. 2. Internal schematic of the Ark

potential payback period that is competitive with coal or gas-fired base load power plants.

While the average CO_2 emission in the UK is 10 983 kg/person/year, the CO_2 emission per ship inhabitant has been reduced to below the recommended 2500 kg/person/year threshold through local food production, energy efficiency, renewable energy generation and virtual elimination of fossil fuel transportation. Walking within the ship and cycling between ships will provide commuting transportation and automobiles will be restricted to agricultural and industrial purposes on land and transportation from land to ship.

It is not, however, intended that this community will exist in isolation. As land mass decreases and additional agricultural land is required for increased population numbers, other ships would be converted for a variety of uses. There already exist hospital ships, prison ships and aircraft carriers for military and governmental uses, but the converted tankers could also provide other specific functions for the general public, such as university and vertical farming ships. The proposed Ark could easily be applied to coastlines around the world and appropriate renewable energy schemes developed on a site-specific basis.

The SCT designed the Ark as a long-term solution to issues such as climate change and to assist in the development of more sustainable lifestyles.