

SYMPHONIC WAVE

Solar Acoustic Resonator embedded Facade_

A concept for the Land Art Generator Initiative_ Intended for location at Site 2_

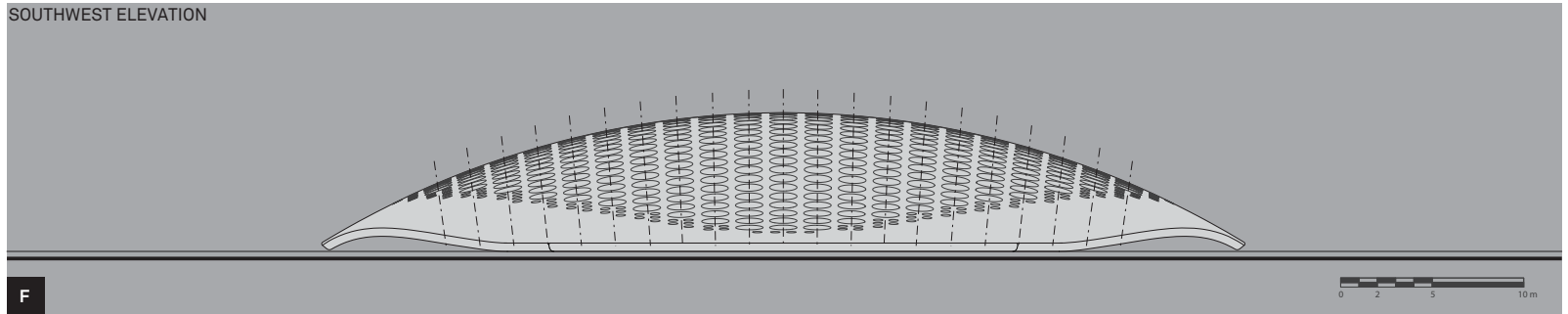
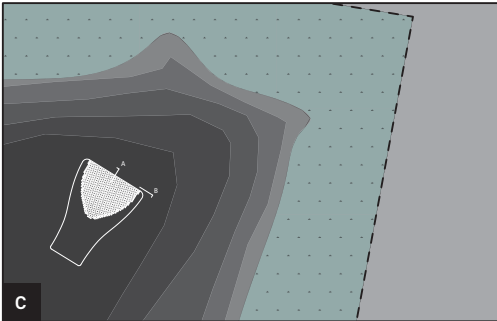
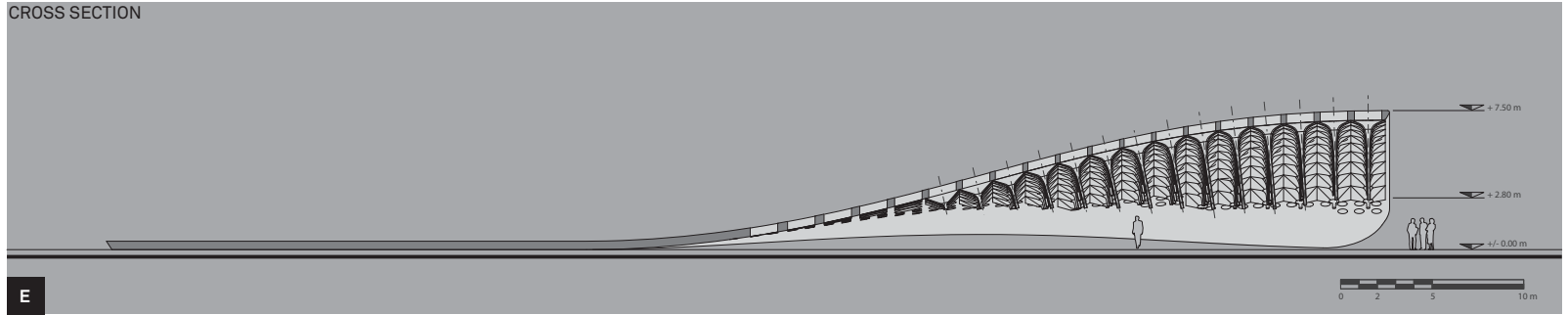
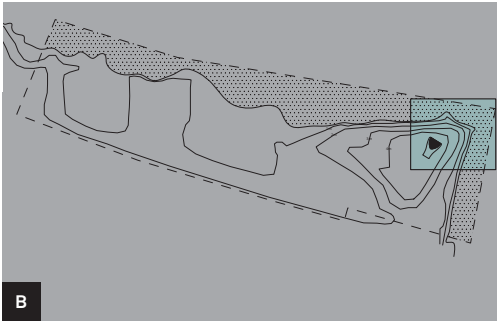
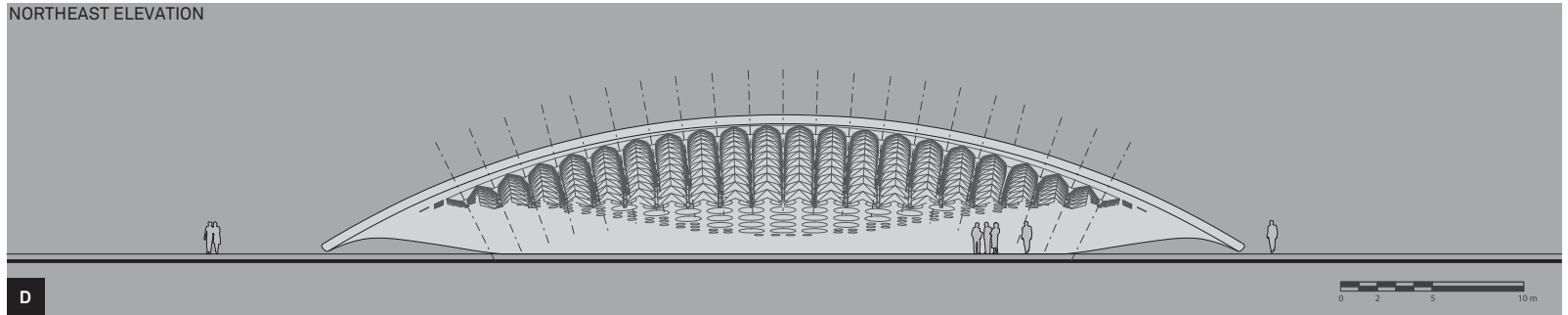
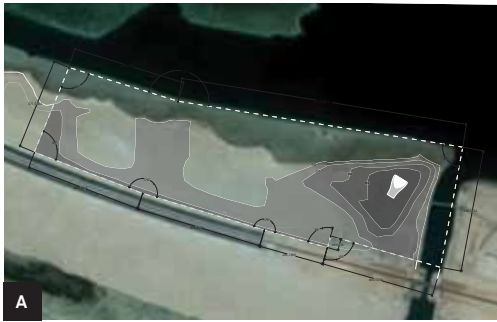
Team Identifier No. BR2106

VISION

A transition from a world powered by fossil fuels to a world powered by renewable resources is built on two pillars, technology and culture. The technology must exist to harness the energy that is present in our environment, and culture must support the changes that our planet requires. We propose that we must reach back into our cultural legacy to find a forgotten figurehead for technological and cultural progress, the musical organ. An object, which when reappropriated for the 21st century can demonstrate the latent power that exists in the environment around us, while simultaneously speaking to every viewer through the most elegant of languages, music_

Powered only by the sun, using a technology known as thermoacoustics, the Symphonic Wave will produce both sound and electricity. Viewers will have a chance to walk within the organ's structure, absorbed by the soft ethereal tones of this musical instrument, knowing that as it produces sound it is also feeding energy back into the grid. We propose that the Symphonic Wave to act as a way to both reveal the untapped renewable energy present in the environment and to act as an international platform for musical expression. Contemporary composers and musicians will manipulate the mechanics of the solar organ, allowing the very movement of the sun to play their melodies. Those who have walked through the site will leave with a glimpse of an energy future that works together with a changing culture to create elegant and beautiful solutions to our most pressing problems_

- A** Exterior view approaching the installation from the north east
- B** A deep interior view shows the arrangement of the solar resonators
- C** Aerial view showing the relationship between the smart glass screens and the glass tubes
- D** Night perspective of the pavilion evidencing optional LED lighting within the glass tubes



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PLAN

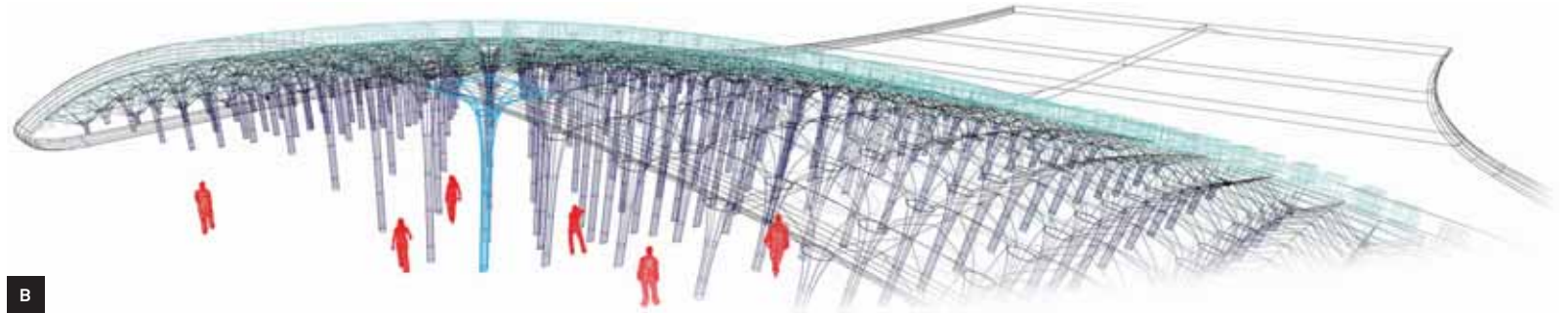
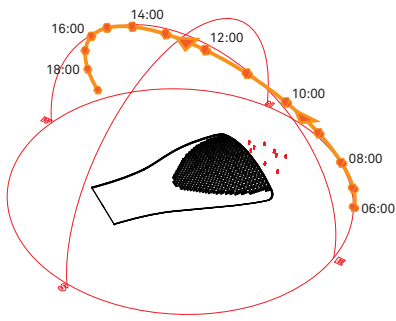
The primary role of the Symphonic Wave is to convert solar energy into sound and electricity. Known as a thermoacoustic heat engine, the Symphonic Wave will transform heat from the sun into a high-amplitude standing sound wave. Symphonic Wave demonstrates to viewers the incredible amount of ambient energy present in a desert environment, and the potential for that energy to be harnessed in many forms. The Symphonic Wave has 27 distinct musical notes, each consisting of seven major components in a self-contained unit. The Symphonic Wave functions by absorbing heat from the sun, which heats their within the unit, generating a standing sound wave_

This sound wave will both create pure musical tones to be heard by viewers as well as powering a linear generator, which converts pressure fluctuations into electricity. As the Symphonic Wave requires time to absorb heat from the sun in order to create sound, it cannot be "played" like a conventional musical instrument. Rather, the Symphonic Wave can be programmed through control of switchable smart glass. The smart glass can quickly shift between being opaque and transparent allowing for precise control over the solar load received by each unit, thus controlling the timing of notes and the creation of polyphonic chords. For example, the Symphonic Wave could be programmed so that it will only play at dawn or at dusk. The Symphonic Wave's malleable nature means that this large instrument will offer an incredible range of expression with its ethereal but powerful tones, all the while generating electricity to be fed back into the grid_

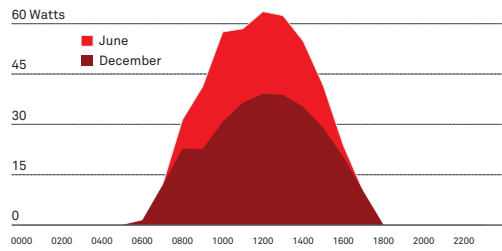
A Satellite image showing the site's border limits and the proposed position for the intervention

B C The site has a gentle elevation on the northeastern tip, the organ will be placed here with the opening facing the body of water

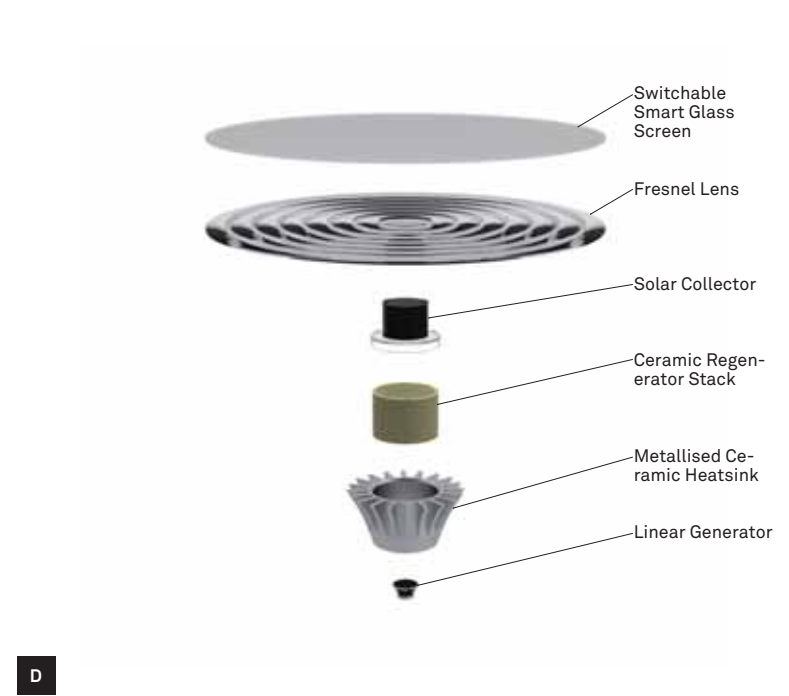
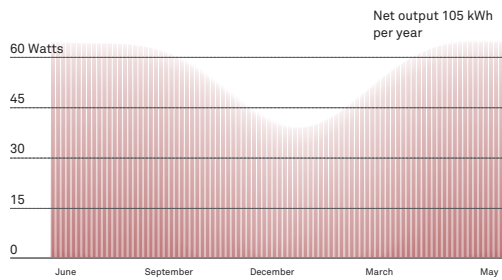
D E F Architectural section and elevation drawings



A DAILY NET ENERGY GENERATION
Single Solar Resonator for Musical Note -yF



C ANNUAL NET ENERGY GENERATION
Single Solar Resonator for Musical Note -yF



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TECHNOLOGY

Sunlight is concentrated through a Fresnel lens on to a solar collector, which heats the end of a thermoacoustic regenerator stack in the solar resonator. A standing sound wave is induced in the resonator by heating the end of the regenerator stack and keeping the other end cool_

As the sound wave propagates up and down the solar resonator, the air inside is subjected to fluctuations in speed and pressure. The phasing of these fluctuations is governed by several factors, including the temperature of the heat source, the diameter of apertures in the regenerator stack and the diameter and length of the solar resonator_

The physical characteristics of each solar resonator is optimised to create pure instrumental notes, which can heard from underneath the installation. Pressure fluctuations in the pipes are harnessed by a linear generator to create electrical energy_

There are no intrinsically expensive components in a solar resonator and their construction is simple; they do not require exotic materials, close tolerances or lubrication. The technology offers an environmentally friendly and elegant demonstration of renewable solar energy_

A Solar path over the installation. As the solar resonators are exposed to sunlight, smart glass screens can be switched allowing light to pass through and induce a sound wave

B Installation structure showing arrays of solar resonators

C Single solar resonator with cutaway showing position of components

D Thermoacoustic generator stack and heat exchangers

EMBODIED ENERGY

FACADE STRUCTURE

2000 Tonnes of Reinforced Concrete:
4,870 GJ 553 tons CO₂

RESONATOR ARRAY

26 Solar Acoustic Resonators:
2,200 GJ 76 tons CO₂

Total Embodied Energy
7090 GJ

Total Embodied CO₂
629 tons CO₂

ENERGY GAINS

ANNUAL ENERGY GAINS FROM THE RESONATOR ARRAY

Single Acoustic Resonator per Annum
104kWh

Symphonic Acoustic Resonator Array per Annum
26,638 kWh

CO₂ PAYBACK

CO₂ SAVED FROM USE OF RENEWABLE ENERGY

CO₂ for each kWh produced by renewable energy
0.546 kg / kWh

Time to neutralize embodied CO₂ in the build
43 years

7.1 TeraJ
629 tons of CO₂

is embedded in the materials of the build

27MWh
Electricity Generated

per annum in ideal conditions

43 YEARS
For CO₂ payback

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ENERGY

The Symphonic Wave comprises 256 solar resonators. The power generated by each solar resonator is proportional to the temperature difference achieved across its thermoacoustic regenerator stack, its diameter and length. The length of each of solar resonator has been computed, in order to produce a pure musical note, and there is a range of 27 notes. At full working temperature, an individual solar resonator generates between 20 and 90 Watts, depending on its physical characteristics as described above. When all solar resonators are working simultaneously, the Symphonic Wave generates a net amount of electrical power of 12.2 kW. This is a net figure, as a small amount of power is consumed

by switching screens of smart glass, which cover each solar resonator, to their transparent state. Controlling the state of these smart glass panes regulates the amount of sunlight that solar resonators are exposed to and thereby allows the Symphonic Wave to be programmed to 'play' a musical score. Thus the electrical power generated by the Symphonic Wave is dependent on the installation's programmed sequence. Over a year, the Symphonic Wave can generate 26,638 kWh of energy_

The embodied energy of the Symphonic Wave is significantly increased by using reinforced concrete for the main structure. All materials have been specified to ensure the installation is durable and lasting for generations to come_