community energy meeting write-up

*Transition Town Dorchester Energy Group*

*Steve Atkins*

# SEARASER

## Wave Energy Converter

by Dartmouth Wave Energy Ltd

version 1.0

## Contents

# 1. Introduction

29th October 2009
Dartmouth Wave Energy Ltd presented Searaser to community members.
The meeting was hosted by Transition Weymouth and Portland and 34 people attended.

Searaser is a fascinating new British invention by *Alvin Smith* of Dartmouth Wave Energy Ltd (DWE), designed to float at sea as a wave energy converter to provide clean renewable energy on demand.

The device works by bobbing up and down in the sea working on a piston. There are two floats, one held at a fixed depth by an anchor chain, and the larger one floating up and down on the swells. As a result of this up and down action sea-water is pumped in both directions under pressure to a higher ground, where it can be stored in a holding tank.

From the holding tank / or reservoir the sea-water can be released back downhill through a hydro-electric-turbine to produce renewable electricity, before finally returning back to sea.

DWE claim 11,000 full size Searaser's could power all UK domestic demand (although they do not envisage that number being deployed in UK waters). The Large Scale 1200 Searaser device is forecast to output 932kW, (1MW of electricity would be enough to power 1,700 homes).

The inventor *Alvin Smith*, and his colleague *Geoff White*, calculate that one full-size device would be able to pump enough water to keep 1,720 homes supplied with electricity [at 13kWh per home per day]

Local area key statistics:

| Area | Population | Dwellings | % Energy Efficient Dwellings | Dwelling Energy MW per annum | Renewable Energy MW per annum |
|---|---|---|---|---|---|
| Dorchester | 18000 | 8500 | ? | ? | ? |
| Weymouth | 53000 | 25000 | ? | ? | ? |
| Portland | 13000 | 5500 | ? | ? | ? |

Dorset is in a position to seriously consider how it might

- become more energy efficient
- invest to generate **community owned** renewable electricity.

The alternative could be steeply rising energy costs supplied by the big energy companies. To power 33,700 homes in Weymouth and Portland would require about 18MW.

| Type | Cost/ pence per kWh |
|---|---|
| Searaser 1200 (forecast) | 1.6p |
| Nuclear | 2.4p |
| Gas | 2.5p |
| Onshore Wind | 3.2p |
| Coal | 3.3p |
| Offshore Wind | 5.5p |
| Biomass | 6.8p |

Comparable costs to produce electricity
[figures from Searaser presentation]:

DWE manufactured a small scale prototype of Searaser which was trialled in April 2009 and proved to be successful, they have not yet made and therefore tested the larger scale 1200 device.

*Alvin Smith* and his co-director *Geoff White* feel that manufacture of the device would not be as demanding as with some other devices.
They also hope for new jobs for people in the Weymouth & Portland area if Searaser could be manufactured and deployed there.

DWE Ltd applied for support from The Carbon Trust - completed a lot of forms - got sent another batch to complete - before becoming disheartened with the level of bureaucracy. They have also contacted members of parliament for support of the Searaser project.

On 29th October 2009 DWE Ltd met with Weymouth Council planning department who were very positive towards the project, but said it is not something the Council can fund.

*"There are features of the Searaser design which I feel give it the edge over its competitors, and I do hope they succeed.*
*There is a lot to be done before electricity can be generated on a significant scale, and I do hope that financial and other support can be found within the UK...*

*In the past too many British inventions have been left to other nations to exploit. I am not convinced that enough has been done to reverse this tendency."*

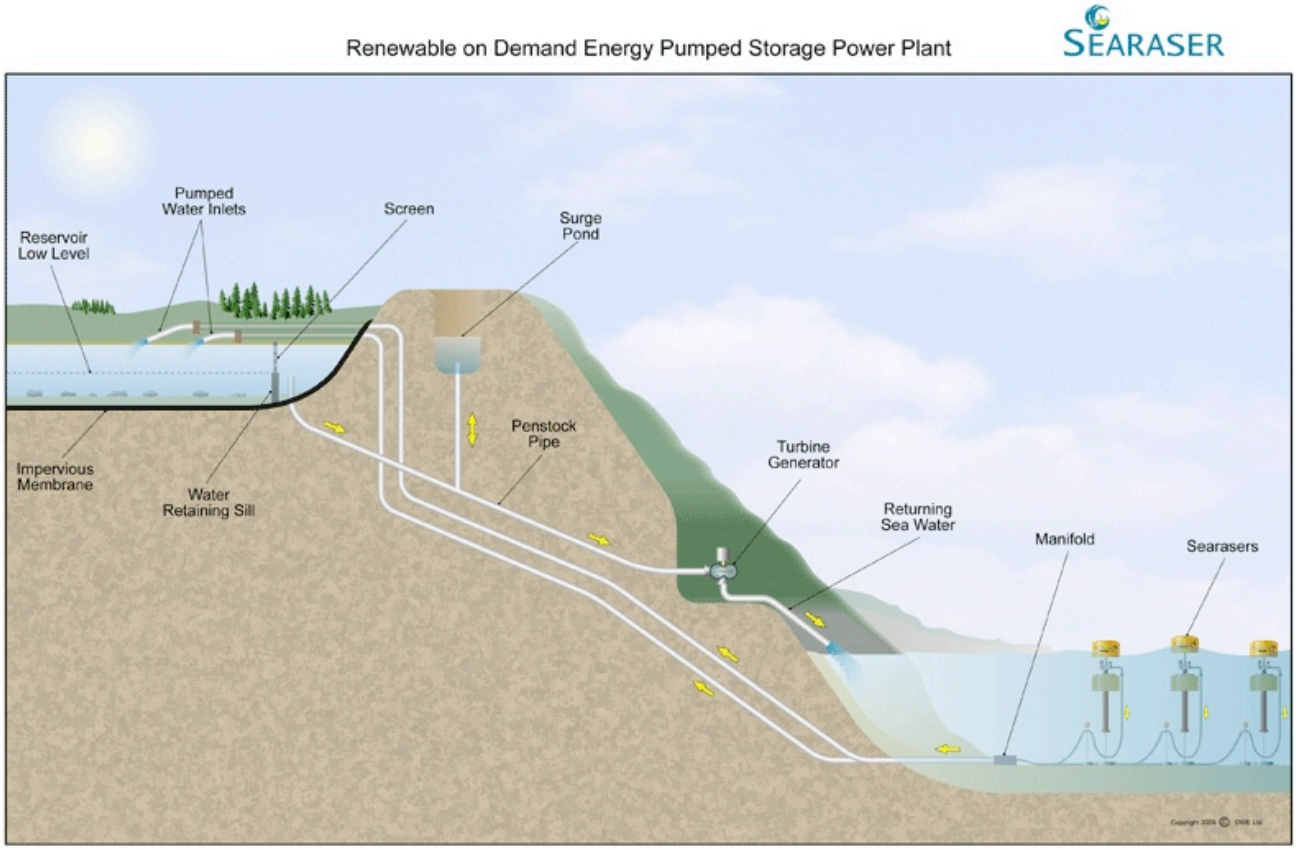
*Transition Weymouth & Portland*
*Independent organiser of the Searaser meeting;*
*David Smith*

# 2. Practical Tests

## Quotes from the inventor

“In 2007 and 2008 we pumped water to heights of 20 to 50 metres using Renewable Energy only.
I have found no prior work in the UK that has achieved this using wave power, not even at University level.
We have a simple but clever pump that works very well and will scale up to what will prove to be an optimum size for a particular location. This size will become apparent once various scale sizes have been tested but I believe it will have in the region of an 800mm to 1200mm diameter piston.
I do not agree with putting electrics in the sea and that is why I am following a sea hydraulics device.”
*Alvin Smith / DWE*

“I regularly go to the hill at Blackpool Sands on the South Devon Coast, where the beach is protected from the South Westerly approaches, situated in the North within Start Bay. This hill location in April of 2009 where with just a slight sea, I stood with *Sir Geoffrey Newman* the Owner, watching the achievement of the pumping of sea water from a Searaser 500 yards out at sea, using purely Swell Clean Renewable Energy. *Sir Geoffrey*, I am sure, would be happy to verify this.”
*Alvin Smith / DWE*



# 3. Scientific

## energy group member feedback

"I find your achievements so far with the 83mm version of Searaser to be clever and impressive. Searaser will no doubt benefit from scaling up in size dependent on the situation in which they are deployed.

I would like to point out a few salient scientific facts about available wave power to inform your decisions about how far to scale up to the 1/4 size and 1200mm version;
with reference to: http://en.wikipedia.org/wiki/Wave_power :

- Wave power resource for a clean wave train of 3m amplitude several km offshore is 36kW per metre of coastline. This may not be available very often near Portland, Dorset.
- A small fraction of the wavepower can be extracted by a given device, especially in a confused sea.
- The wikipedia URL suggests that mean power would be less than 10% of peak design power output. (Similar to wind turbines being 20-25%).
- A flotation buoy that is much larger than the wavelength will have upthrust and downthrust forces at the same time causing a drop off in performance. A 500 tonne ship is only lifted by the longest of waves (we're not talking tides here).
- If you have an array of buoys, the energy extracted by the first row will not be available to subsequent rows (not important if the energy extracted is small or the buoys well separated).
- The Pelamis website says that all the recoverable wave power resource around the UK would only provide about 20% of UK electricity demand.
- You claim that 11000 full size Searasers could provide the whole of UK electricity demand (41 GW); I believe this deserves further research.

I trust you find my independent observations to be constructive towards further projections."

*Dr G Stevenson/ Oceanographer/ TTD Energy Group*

**Wave power formula** In deep water where the water depth is larger than half the wavelength, the wave energy flux is:

$$P = \frac{\rho g^2}{64\pi} H_{m0}^2 T_e \approx \left(0.5 \frac{\mathrm{kW}}{\mathrm{m}^3 \cdot \mathrm{s}}\right) H_{m0}^2 \, T_e,$$

## response from the inventor Alvin Smith DWE

"I have read a lot of research for the past three years by people swapping theory.
Our reference to 11,000 Searaser's supplying UK demand would be possible if 11,000 full sized Searaser's were working at full output.

The Interesting question to me is of the theory:

- Why are waves or swells given an extraction of Kilowatts available in a particular wave or swell when Wave Energy Converter devices extract the energy in different ways?

For example a device such as the Pelamis (wave energy sea snake) could be seen as the first tank obstructing the energy to the tank behind because the first tank extracted the energy, but in reality this does not happen as the swell continues due to the pressure and weight of water either side retaining the varying height of swell continuing along the body of the device along it's length, to provide the dynamic and varying buoyancy heights for the further extraction of energy, by the second and third tanks.

Other Wave Energy Converters (WEC) extract the energy in other ways.
I have studied the lone Searaser lift as the swell passes under it and the swell "non deformed" continues in it's original form and height. Whilst a larger, say five metre diameter, float with matched buoyancy to the designed increase in weight will react similarly in pumping water pressure. At the point where a VERY LARGE diameter float could not follow down into the trough and risks "bridging" the swell; I agree the Searaser wave float would be too large for the swell and subsequent trough.

It is for this reason we will try the quarter size first and only then go to approximately a 1200mm piston to compare whether it produces a four times output of the quarter size. Practical real time Sea tests are the absolute answer to all these questions, this is where Searaser's modular system made up of independent units is so much more economical to carry out these real world tests, to prove Searaser's viability.

A breaking wave obviously loses nearly all of it's energy on breaking, but swell travels on. Most sea defences used are of the barrier break water type which effectively have to block the path of swells and waves to dissipate their powerful energy. It is for this reason I have found that devices that use swell as the energy as opposed to breaking wave energy, appear to be more economical in utilising energy extraction and this so far is the reason that Searaser is at this stage is showing this conversion efficiency.

If we deploy two Searaser's and monitor these very precisely by ejecting water through the top of the Searaser firstly through a preset pressure valve and secondly through a calibrated flow meter we leap frog all theories and predictions of wave amplitude and deliver exactly what the device is capable of in that particular preferred location, this will also be interesting to watch as it will also be a visible display from the shore, bearing in mind the water passes through a preset pressure valve and flow meter before ejecting the water into the air.

I am currently completing the engineering drawings in 2-D and 3-D CAD, and in January 2010 we will be ready to manufacture these first two quarter size by volume Searaser's (visibly half size).

By end of March 2010 they will be available for deployment if permission from all the necessary departments have been obtained and funding has been successful."
*Alvin Smith / DWE*

# 4. Comments arising from the presentation

- Concerns that only a small prototype of Searaser has so far been manufactured
- The sea- trial for the prototype was within a short period of time
- There are issues to be faced in development of Searaser, therefore risk in investment
- Positive support for the idea, would really like to see further research & development
- Concern about anchoring to the seabed / not investigated Portland area seabed conditions / would a large version Searaser require a single or multiple anchor?
- as far as I'm aware there are no wave devices anywhere in the world that have yet reached large-scale commercial operation, although many have worked well on the small-scale
- The simplicity of the design makes it more probable that it will prove scaleable than some other technologies

# 5. Further Reading & References

## Searaser

Searaser/ Dartmouth Wave Energy website: http://dartmouthwaveenergy.com/
June 2009 Guardian: http://tinyurl.com/mqvh4u
April 2009: BBC Spotlight video: http://news.bbc.co.uk/1/hi/england/devon/7990179.stm
Nov 2008 IET http://kn.theiet.org/magazine/issues/0820/push-and-pull.cfm
Nov 2008 Times: http://tinyurl.com/5n8tnj
Sept 2008: BBC Spotlight video: http://news.bbc.co.uk/1/hi/england/7608630.stm
Feb 2008: BBC Spotlight video: http://tinyurl.com/yaqa5qm
Searaser patent: http://tinyurl.com/y9klds8

## Other references

Dorset area key statistics: http://www.dorsetforyou.com/index.jsp?articleid=332791
Pelamis Wave Energy Converter / sea-snake): http://www.pelamiswave.com/
Oyster Wave Energy Converter: http://www.aquamarinepower.com/technologies/
Wave power, wikipedia: http://en.wikipedia.org/wiki/Wave_power
Carbon Trust: http://www.carbontrust.co.uk
Ceto: http://www.carnegiecorp.com.au/
Transition Network: http://transitiontowns.org/TransitionNetwork/TransitionNetwork
Transition Weymouth & Portland: http://www.transitiontown-news.org/
Transition Town Dorchester: http://transitiontowndorchester.org/

## Summary

This community meeting write-up is independent and not-for-profit.
It's purpose has been to investigate Searaser as a potential solution towards:

- significantly building resilience (in response to peak oil)
- drastically reducing carbon emissions (in response to climate change)