The Severn Estuary Eco-Barrier: Situation, Background and Issues!

Environment and Ecosystem

The Severn Estuary, in Southwest England, is a unique environment:

- Owing to its particular formation and the effects of tidal resonance, the Estuary experiences some of the highest tides in the world, with spring tides regularly topping 14m several times each year
- The surrounding coastline is a mix of low-lying land, cliffs, with rivers pouring in fresh water to mix with the incoming seawater to create turbulent waters with varying salinity gradients
- The resulting ecosystem (biome?) is particularly complex, with:
    - Sites of Special Scientific Interest (SSSIs),
    - Heritage Coasts,
    - Areas of Outstanding Natural Beauty (AONB),
    - archaeological sites,
    - an important, major inter-tidal feeding zone for wading birds,
    - the Somerset Levels, much in the news last year due to extensive and long-lasting floods of farmland
    - a population in excess of 1 million and rising rapidly, many living and working in…
    - .. towns, cities and resorts, including Cardiff, Minehead, Watchet. Burnham-on-Sea, Weston-super-Mare, Clevedon, Penrith, Barry, and many more…

Figure 1 shows a landscape map of the Severn Estuary, with surrounding terrain: Quantock Hills, Somerset Levels, Mendips, Cotswolds, Wye Valley, AONB, Heritage Coasts, Power Stations (including Hinckley Point), maritime access to Bristol Docks, Avonmouth, etc., rivers including those draining the Levels, Severn Crossings, and of course, many popular resorts towns.

Obsession with Barrages

The unusually high tidal range has attracted the attention of those seeking to harness tidal power as an alternative source of energy for the nation. There has been considerable interest in forming a tidal barrage across the estuary at various points, the latest being from Penarth to Brean Down; like many before it, the proposal has been rejected.

Unfortunately, tidal barrages – wherever they may be sited – have the propensity to seriously degrade and disturb local ecosystems. A barrage effectively dams the estuary or river: building the barrage, then, involves:

- diverting the flow of water during the (5 year?) building phase, which virtually destroys the local ecosystem,
- damming the estuary/lagoon twice per day when in operation, so ensuring that the

original ecosystem could not recover, even if it were possible.

Instead, a substantially different mix of flora and fauna would eventually emerge… Governments, including those in the UK, have been reluctant to approve barrage schemes for these reasons, considering that the energy, which would be derived from a barrage, would not really compensate for the disruption/destruction of complete ecosystems, the outcome from which disruption would be unknowable, but would surely not be beneficial…

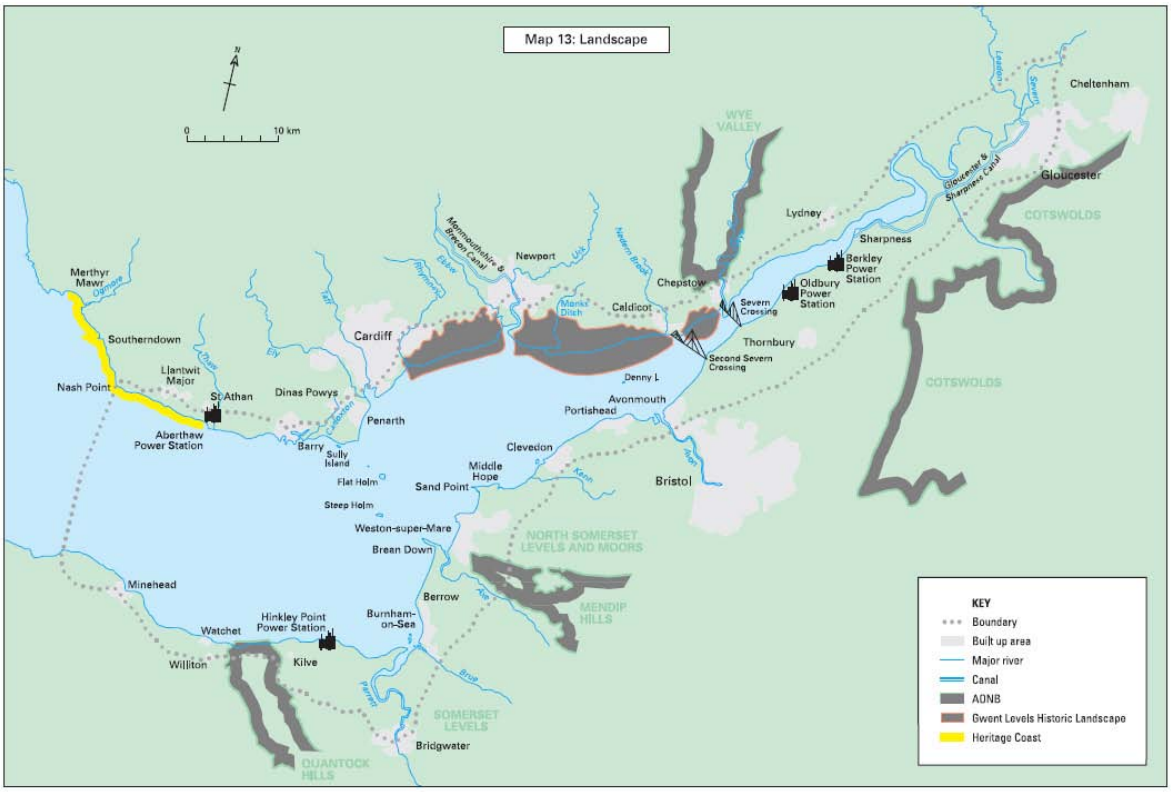


Figure 1. Severn Estuary Landscape & Topography. **(Severn Estuary Partnership Maps)** Showing the main hill formations, Somerset Levels, power stations (including Hinckley C nuclear), resort towns, AONB, and built-up areas outside the nominal boundary of the Severn Estuary.

Existential Threat to the Severn Estuary: Storm Tides/Storm Surges

Concern over tidal barrages has diverted attention from the *existential threat* to the Severn Estuary: Storm Tides/Storm Surges. A storm tide is a tsunami-type event associated with low atmospheric pressure, which can raise the level of the sea, creating a storm surge of 5-6m above mean sea level. Should a low-pressure event (storm) moving up the Bristol Channel coincide with a high spring tide, then a Storm Tide/Surge would sweep up the Severn Estuary, overwhelming even recently-reinforced sea defences, inundating the land, destroying property, habitats, SSSIs, archaeological sites, and drowning many people.

It has happened before. In 1953, a major flood was caused by a heavy storm. A combination of high spring tide and severe European windstorm over North Sea caused a storm tide along the east coast of England and Scotland; wind, high tide, and low pressure saw the water level rise by some 5.6 metres (18.4 ft.) above mean sea level.

It overwhelmed sea defences and caused extensive flooding.[1] In England, 307 people were killed in Lincolnshire, Norfolk, Suffolk and Essex. As a direct result, the Thames Barrier programme was started to secure central London against future storm tides. But, the Severn Estuary, which is as much–*if not more*–at risk from Storm Tides, ***has no such Barrier***.

This, despite a history of storm tides affecting the Somerset Levels,[2] which are at risk from both tidal *and* land-based floodwaters:

- The Bristol Channel Floods of 1607 which resulted in the drowning of an estimated 2,000 or more people, with houses and villages swept away, an estimated 200 square miles (51,800 ha) of farmland inundated and livestock destroyed, wrecking the local economy along the coasts of the Bristol Channel and Severn Estuary
    - The coasts of Devon and the Somerset Levels as far inland as Glastonbury Tor, 14 miles (23 km) from the coast, were also affected. The sea wall at Burnham-on-Sea gave way and the water flowed over the low-lying levels and moors.
    - Eyewitness accounts of the disaster told of "huge and mighty hills of water" advancing at a speed "faster than a greyhound can run" and only receding 10 days later.
- Great storm of 1703, waves came 4 feet (1.2 m) over sea walls.
- Sea wall breached in 1799, filling Axe valley with seawater.
- 1872, flood covered 7,000 acres (28 km^2), and in…
- 1919, 70,000 acres (283 km^2) were inundated with seawater, *poisoning the land for up to 7 years*.

From the above, we may reasonably deduce that the threat to the Estuary and the Somerset Levels may be infrequent, since the last major event was in 1919. Alternatively, if the interval between such events is observed to be about 100 years, then we might expect another such storm tide within a decade? Or sooner?

However, that would be to reckon without the effects, already being felt around our coasts, of global warming, which is having several coordinated effects:[3]

- The mean sea level is set to rise by about 1m by the end of the century, which implies a very large increase in the amount of water in the seas around our coast.
- The mean global temperature, which has already risen by over 1˚C since the start of the Industrial Revolution, is set to rise by another 1˚C – or more – by the end of the century, which implies a major increase in both the energy and humidity in the atmosphere.

These two taken together indicate that: tides will be higher; depressions will become deeper; storms (and surges) will become more severe; will be more frequent; and will precipitate more rainwater…which can amplify the effects of tidal surge as the heavy rains drain off surrounding land into rivers feeding the estuary upper reaches…

For the Severn Estuary in particular, this means that the probability of occurrence, the

---

[1] https://en.wikipedia.org/wiki/North_Sea_flood_of_1953

[2] https://en.wikipedia.org/wiki/Somerset_Levels

[3] Notwithstanding COP21/SIF15, the agreements from which have yet to be ratified and implemented…

frequency of occurrence, and the severity of storm tides/storm surges when they do occur, will increase in the coming years. The effects of global warming are already noticeable around our battered shores…

Governments of all persuasions have been properly concerned over the potential damage that would be wreaked by proposed tidal barrages. Meanwhile, with attention diverted by such "barrage issues," the *existential and burgeoning threat* to the environment, ecosystem and over one million inhabitants of the Severn Estuary from storm tides/storm surges appears to have been largely overlooked… together with the potential to generate eco-friendly tidal *stream* power using invisible, submerged turbines.

Is there anything to be done?

Well, we could do nothing and trust to luck that a Storm Tide and a Spring Tide do not coincide…History suggests that would be a foolish course, and certainly one that would be inconsistent with government's duty of care for the environment and for the people.

It may be, however, that we have a limited time upon our hands, before the next Storm Tide devastates the Estuary. How much? That would be a gamble, and odds shorten against us the longer we leave it.

Could we construct an Eco-Barrier against Storm Tides?

Which goes to suggest that we may have a little time to construct a barrier, a Severn Estuary Eco-Barrier, that we may invoke at any time to block the surge of a Storm Tide, but which otherwise has no negative effect on the Estuarine environment and ecosystem(s).

Could we, for instance, build an Eco-Barrier across the Estuary at some convenient point, with its shutters normally open, allowing water to flow, erosion and deposition to continue, drift to, uh, drift: an Eco-Barrier that would have zero effect on ecosystem, flora and fauna, salinity, deposition, erosion, etc., all the year round? Such an Eco-Barrier's shutters would be closed if, and only if, there was a Storm Tide surging up the Bristol Channel…at which time, it would protect and conserve the Severn Estuary, its ecosystem(s), habitats, SSSIs, AONB, archaeological sites, RAMSAR[4] sites, and it's ever-growing population, from the destructive Tidal Surge.

Such a Severn Estuary Eco-Barrier may not appear unreasonable in principle, but it would surely:

- be a major challenge to span the Estuary, which is some 20km across at its boundary;
- take a long time to build;
- disturb the Estuarine ecosystem(s) in the process, see Figure 2;
- be fundamentally *unaffordable;*
- interfere with shipping going in and out of Avonmouth and the Bristol Docks, and…
- be an eyesore, at the very least damaging an area of Outstanding Natural Beauty

[4] RAMSAR sites are wetlands of international importance designated under the RAMSAR Convention.

(AONB)?

Suppose we could overcome those very real objections, could we *then* have a Severn Estuary Eco-Barrier to protect, conserve and preserve the precious and unique Estuarine environment and ecosystem(s), peoples, properties, farmland, habitats, SSSIs, etc., etc? And, could we harness a modest proportion of the tidal stream energy flowing through the Eco-Barrier, pursuant to both *conserving* the estuarine ecosystem *and affording* the Eco-Barrier?

These, and many more questions indicate the need for an objective examination of the *concept* of a Severn Estuary Eco-Barrier against Storm Tide, one which explores the many ramifications of introducing such an Eco-Barrier which, although intended to conserve and protect, would seem inevitably destined to disturb and upset in the process…

Such a concept study would ***not*** necessarily provide a proven design and affordable implementation plan for a Severn Estuary Eco-Barrier. It would, however, show at least one way in which such an Eco-Barrier to conserve and protect the precious and unique Severn Estuary ecosystems, environments and people might be constructed and afforded in a sensible timescale.

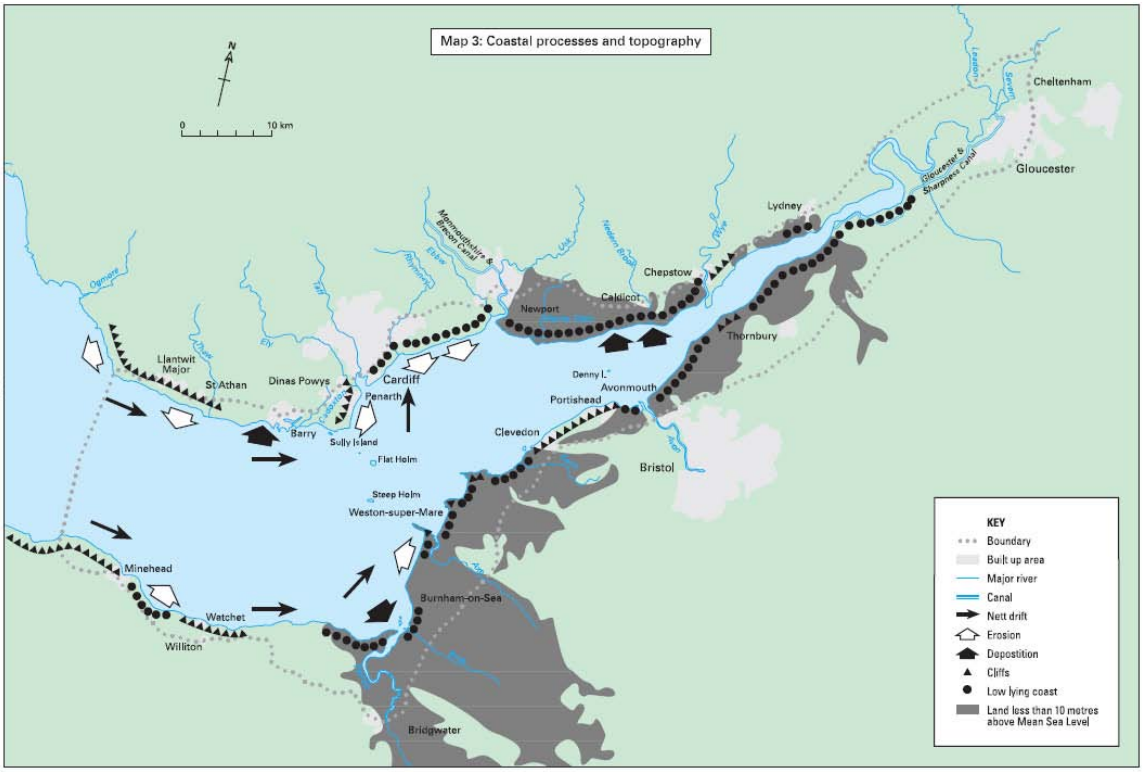


Figure 2. Coastal Processes & Topography. (Severn Estuary Partnership Maps) Shows the continuing processes of drift, erosion and deposition, together with cliffs, low-lying coast, and land less than 10m above Mean Sea level, which would be threatened by storm-tide/storm surge.

Severn Estuary Eco-Barrier Concept Study

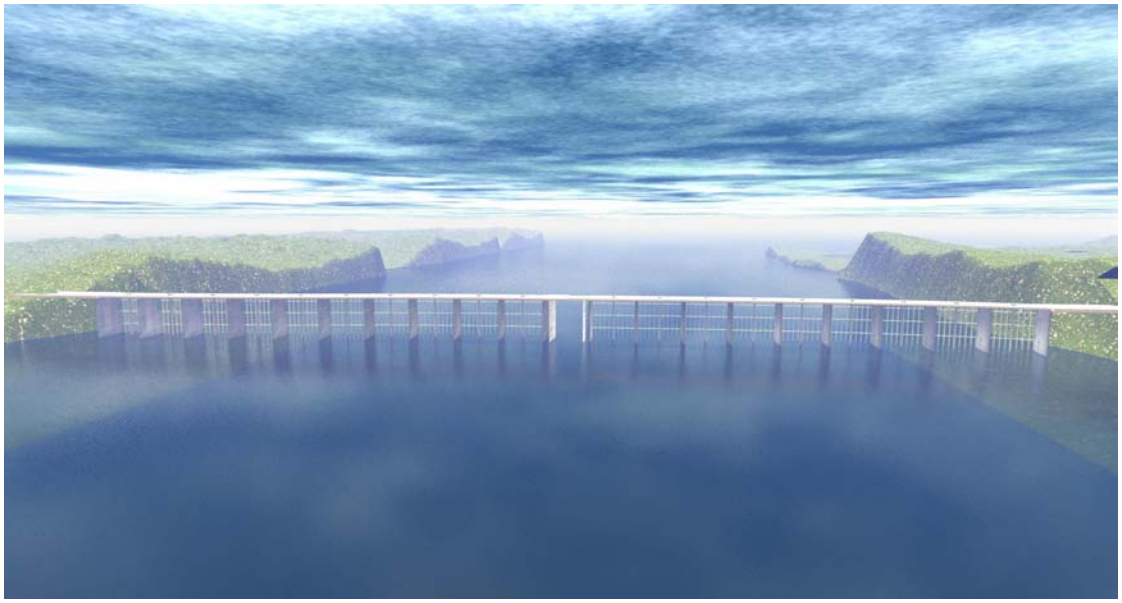


Figure 3. Severn Estuary Eco-Barrier Concept Many bays are connected together to form an Eco-Barrier across the opening, and between cliffs on opposing banks. Each bay is fitted with shutters, shown open. In addition there is an open lock (surge gate), which may have a drawbridge over it. The whole offers little or no resistance to the flow of Estuary waters… Surge gates and shutters would be closed only to block Tidal Surge. Underwater turbines may be operating, but are not evident…The upper deck, in this artist's impression, is bare…but need not be in practice.

The Challenge

Is it practicable to build a ***Severn Estuary Eco-Barrier*** (corresponding with the ***Thames Barrier***, i.e., ***not*** to be confused with *a barrage)* that:

1. Protects low-lying coast, inc. population, towns, cities, power stations, resorts, Somerset Levels, etc., against storm tide — *which would overwhelm current sea defences*
2. Future-proofs Estuary's, habitats, litoral/intertidal/subtidal zones, archaeological sites, RAMSAR, SSSIs, AONB, hydrology and salinity etc. in face of rising tides and global warming
3. Conserves unique, precious, dynamic Estuarine ecosystem(s)
4. Assists with draining floods from Somerset Levels
5. Generates sufficient energy to fund its own construction, consistent with 1 - 4?

The last bullet is of particular interest. The notion of generating energy will smack to many of a tidal barrage scheme in a rather thin disguise. That would be quite incorrect. There is

an alternative to the damaging tidal *barrage* for generating electrical energy from the tide, a.k.a. Tidal Energy Conversion (TEC): *tidal stream* employs submerged propeller turbines (like small wind turbines) to generate more modest amounts of electrical power four times per day using the kinetic energy of both ebb and flood tides. Tidal stream turbines, used exclusively in this instance to fund the otherwise unaffordable Eco-Barrier, would have little effect on the flow of water…and the vast amount of estuary water would continue through the Eco-Barrier around, over, under and through the turbines unimpeded, with minimal or no risk to marine life.

After successful trials, part DTI-funded research at nearby Lynmouth is showing promise for tidal stream power generation. Twin 600kW propeller turbines mounted on a single pile driven into the bedrock (SeaGen) are to be installed to generate power for the local area.[5] The Lynmouth location benefits from a particularly high tidal stream velocity, which suggests that propeller turbines submerged in the bays of a Severn Estuary Eco-Barrier might not generate quite as much tidal stream power, per bay, since the water may not flow quite so fast. On the other hand, it may be possible to shape the plinths of each bay, such that the water "streamlines"/speeds up as it passes between each bay's plinths (Venturi effect), so enhancing the potential to generate power, which is proportional to the cube of the water velocity. Further, there might be 400 such bays, so that the aggregated power from all of these bays could prove an invaluable legacy.

So, provided it can be done with zero impact on the Severn Estuary ecosystem(s), it seems "not unreasonable" to mount relatively small, submerged tidal stream turbines in each of the many bays that will go to make up the Severn Estuary Eco-Barrier, and to sell the electrical power so produced to the National Grid, as a means of funding construction. And thereby can be glimpsed the essence of a plan…

Construction: Concept of Operations

Broad philosophy: introduce successive parts of structure in sequence, very few at a time, without any dams or other impediments to flow. Piers, plinths, etc., to be constructed from the water's surface downward:

- e.g. drive piles into bedrock from tethered platform/boat;
- fit preformed blocks around piles;
- lower gently to bottom, to construct reinforced plinths each with a hydrofoil plan-form.
- Pile-drivers will disturb above and below water, but minimally and for limited period…

Carefully phased introduction. Allow Estuary to rest and recover between activities. Ecosystem disturbance and recovery to be monitored by ecologists, who should research, plan and test reasonable rates of introduction.

The whole to progress in phases, and to be spaced out irregularly across the estuary, with recovery-breaks punctuating phases…

---

[5] http://www.reuk.co.uk/Worlds-First-Open-Sea-Tidal-Turbine.htm

Orchestrating the Eco-Barrier

It will prove necessary to control each and every bay, individually and collectively to ensure and maintain the natural flow, drift, deposition, turbulence, etc., of the waters. This may be referred to as "Orchestrating the Eco-Barrier," i.e. operating the whole Eco-Barrier, bay-by-bay, and as a complete suite of bays: playing the equivalent of 'chords,' 'arpeggios,' etc., as might be played on a rather large organ.

Orchestration will deploy several means of control to create harmony and optimum operation:

- Individual bay shutters may be open or closed,
- Turbines may be engaged, idling, or driven-as fans to clear deposition, to accelerate or decelerate flow. They may be raised or lowered in the water to access different stream velocities at different levels in their respective water columns…
    - There may be several kinds and configurations of propeller turbine. Each bay would be different, with different water columns, etc., and stream velocities that vary with depth…and there would be a degree of bay-to-bay interaction to manage…

Activating these various features differentially on a bay-by-bay basis should allow the control/modification/restitution of water and deposition dynamics to be maintained at "pre-Barrier levels."

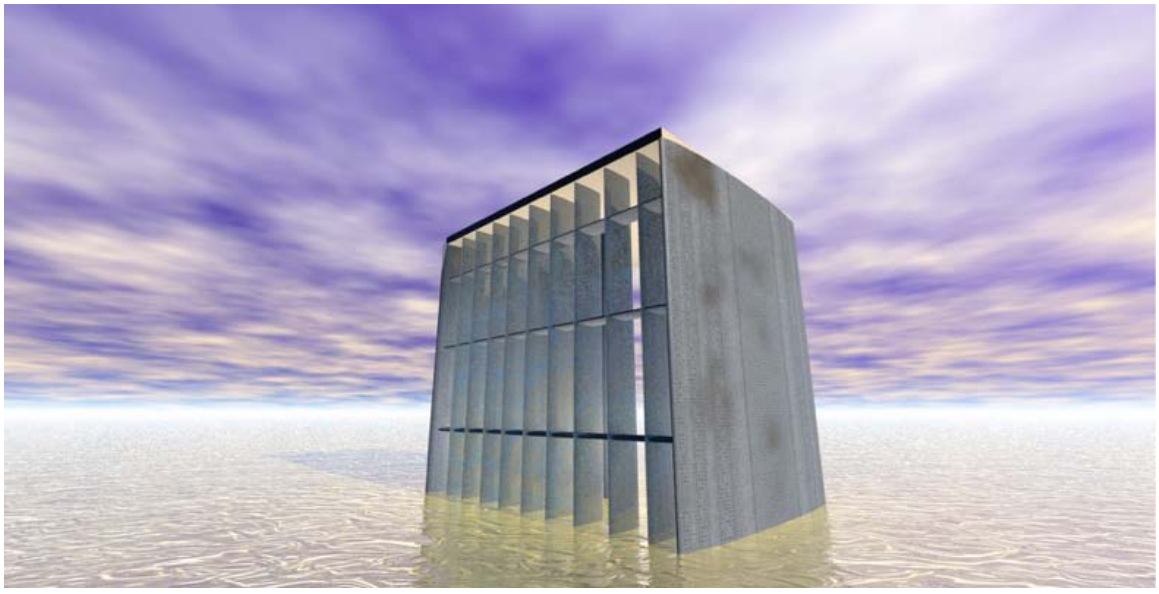


Figure 4. First Bay Complete. Each Bay consists of two reinforced end-plinths, a top deck, horizontal louvre supports, full-length sectioned louvres with top-mounted drive motors, and–barely visible–a shaft (pile?) extending from the top deck down to submerged turbine(s). Each Bay is under-lit using light-pipes to convey sun/daylight from the top deck underneath, to prevent shadows of the deck attracting marine life.

This level of control and regulation will require embedded Estuarine sensors to monitor and adjust overall Eco-Barrier "behaviour" to maintain Estuarine ecosystems, hydro-dynamics, to optimally-extract tidal stream power and, of course to anticipate storm tides!!!

Not only will this "orchestration" be essential for the Eco-Barrier complete, but it will be

the subject of research, tests and trials, too, during development when the Eco-Barrier is still incomplete, with bays, blocks of bays, and gaps…the Estuarine sensors will initially establish a database showing the varying conditions within the Estuary at different points, depths, times of tide/day/month/season. The database will show the natural state of the Estuary *in the absence of any Eco-Barrier*. Subsequently, and as the Eco-Barrier is constructed, the "orchestration" features of the part-complete, and eventually fully-complete, Eco-Barrier may be employed to maintain the eco-environment in line with its pre-Barrier state, according to the tide, time, season, etc.

This might seem like a challenging prospect, and it will be, but it is both feasible and sensible. In the event, much of this "orchestration" will be amenable to automatic control and management, driven conceivably by genetic algorithms formulated during the development and implementation processes…

Figure 5. Block of 5 Bays. All bays under-lit, shutters open in streamlined position. The bays will be of a height greater than the highest storm tide, allowing for rising tides and global warming. They will have to be sufficiently robust, too, to resist the impact of Storm Tides that, like a tsunami, may have the potential to arrive as a powerful wave front. This suggests that each bay may be of limited width, as shown, so that there are many reinforced plinths and that louvres are strongly supported and robust.

Project Design Outline

One potential approach to initiating, organizing and managing such an Eco-Barrier project is illustrated in Figure 6. The focus of the model is the building of individual bays, including submerged tidal stream generators. As each bay is commissioned, it will generate tidal stream power, which will be sold to the National Grid. The money accrued in this fashion will contribute to financing a second bay, which will also sell power to the grid, so accruing more money, and so on.

To make this so-called "bootstrap" system work requires "pump-priming:" the injection of sufficient funds at the outset to set the process in motion, i.e., to build and commission the first few bays, until a point is reached where there are sufficient bays selling sufficient power to the National Grid at a pre-agreed price for the remainder of the project to be self-funding, and eventually profitable, enabling the repayment of the initial pump-priming funds. The whole project essentially "pulls itself up by its bootstraps."

Of course, before any of this "hands-on" project work can be started, there will be the need for much investigation, research, modelling, test and trial work. Which will also require funding…and which would best be carried out by cross-discipline teams established at appropriate universities, including–presumably–the Universities of Bristol and Wales as the most immediately concerned…

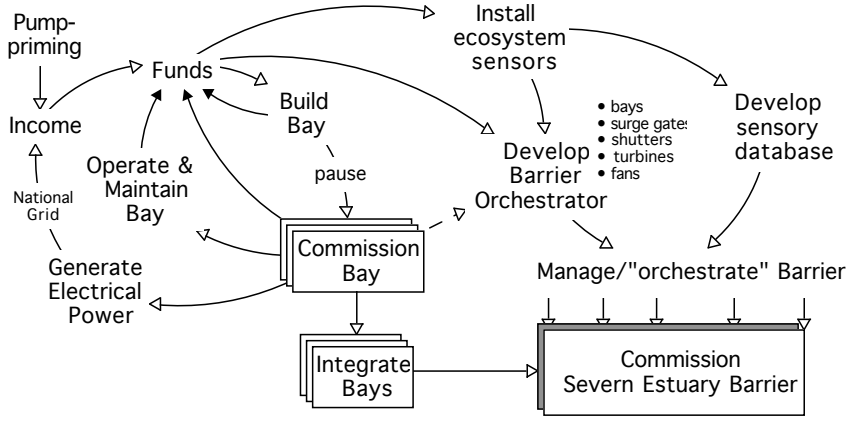


Figure 6. A Causal Loop Model (CLM) of the Severn Estuary Eco-Barrier Project

One necessary research facility would seem to be a working scale model of the Bristol Channel and the Severn Estuary, so that the conditions leading to storm tides and storm surges may be reproduced and the resulting surges observed, including the effects of associated heavy rain, sustained storm winds, etc., on the formation, height and angles of moving wave fronts…Such a model could be used to observe the effects of a Severn Estuary Eco-Barrier both when open and when closed to curb a storm tide. Driven by strong winds, water levels may build up against the closed Eco-Barrier, and there could be a counter-wave reflected off the Eco-Barrier. Heavy rain over the Estuary and river drain-off from surrounding land may raise levels upstream of the Eco-Barrier, too; but, by how much, and to what effect? Clearly, there is a need for much research and planning. And

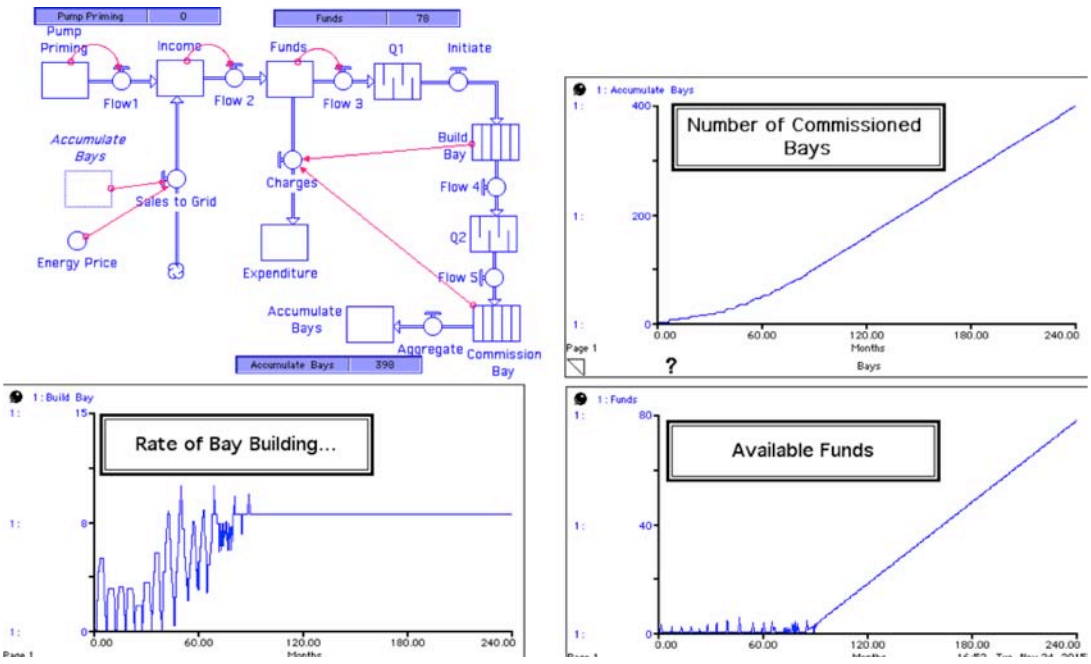


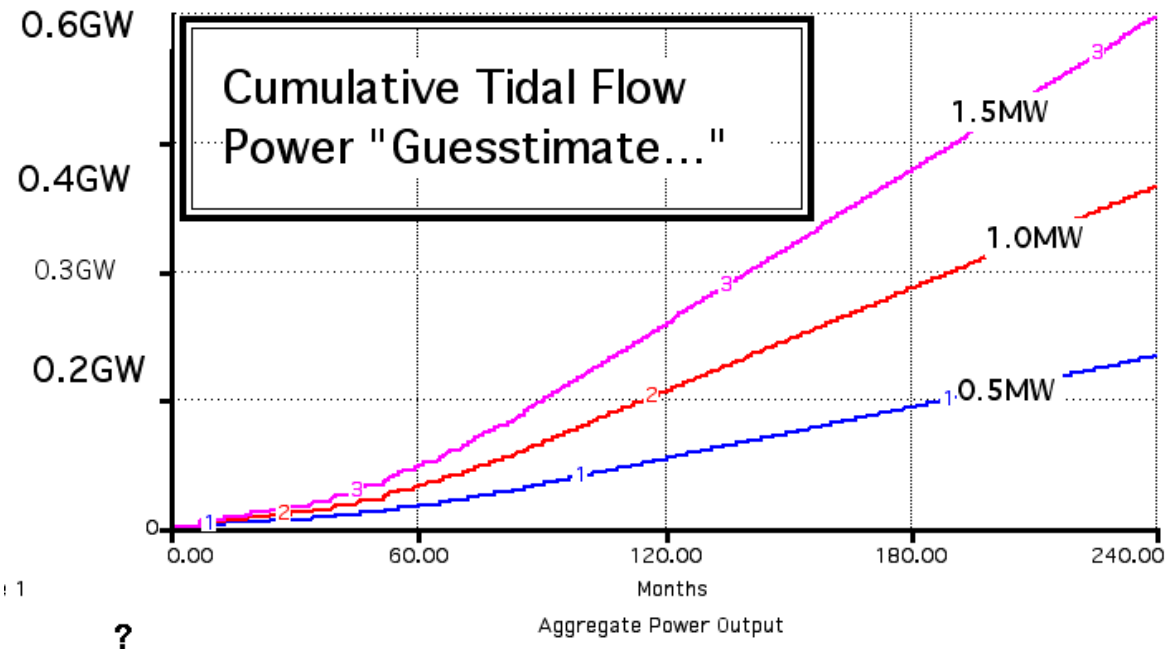
Figure 7. Dynamic Model of the Severn Estuary Eco-Barrier Project

time may not be on our side!

Figure 7 shows a dynamic simulation of the Severn Estuary Eco-Barrier Project, based on the model of Figure 6 At top left is a system-dynamic model: the three graphs result from running the model, using notional figures for the costs of building, the selling price of power to the National Grid, the number of bays needed to span the Estuary, etc. Using these notional figures, then, shows that the Rate of Bay Building, bottom left graph, gets off to a slow start–which is in keeping with the philosophy of "gentle introduction," but which is actually the result of restricted funding, as shown on the Available Funds graph. This graph also shows that, at about Month 100, i.e. some 8+ years into the project using the notional figures, the project comes into sufficient income and funds to undertake a steady process of building and commissioning bays. The model, again using only notional figures, completes in some 240 months, i.e. 20 years, having built, commissioned and joined into a single working Eco-Barrier, some 400 bays.

How much power would the Eco-Barrier, complete, generate? That is a difficult question…

Tidal stream technology is not yet mature; competing approaches show promise in different locations and environments. And the SeaGen experience at nearby Lynmouth may not be representative of the power to be safely and sensibly extracted in each and every one of the 400 or so bays of the Severn Estuary Eco-Barrier: some might extract more, some less… It is reasonable, too, to expect that there will be further developments over the next 20 years to enhance generated power performance, and reduce problems of corrosion, damage, repair, maintenance and outages.



Graph 1. Notional Eco-Barrier Power Generation…

As a broad "guesstimate," then, it might be "not unreasonable to assume" that the power per bay, some twenty years from now, and using two, three or more turbines as appropriate, might be between O.5MW and 1.5MW, or 1 ± 0.5MW. Graph 1 shows three lines, for each

of the three notional power generated levels, over a total build time of 240 months, during which times some 400 bays come on line. From the graph, it can be seen that the power build-up is gradual, and reaches its potential (after 20 years using this particular project model) of 0.4 GW ± 0.2GW. Being tidal power, this output would vary daily, weekly monthly and seasonally.

As a reference, Hinckley C Nuclear Power Station is expected to produce some 3.2GW, and that would be less likely to vary…Aberthaw Power Station, also nearby, generates some 1.56GW, using a mix of coal-fire and biomass; suggestions that it should become a nuclear powered site have been rejected as it is too near habitation, but its future as a coal-fired site must surely be in doubt.

The Eco-Barrier, however, is primarily there to protect, conserve and future-proof. Power generation may be a means to an end, rather than an end in itself: nonetheless, 0.4GW ± 0.2GW would afford a healthy legacy of exceedingly green, highly predictable/dependable, totally renewable energy of some 2,600GWh per annum.

Figure 8. Dusk View of the Eco-Barrier, showing Hazard Lights

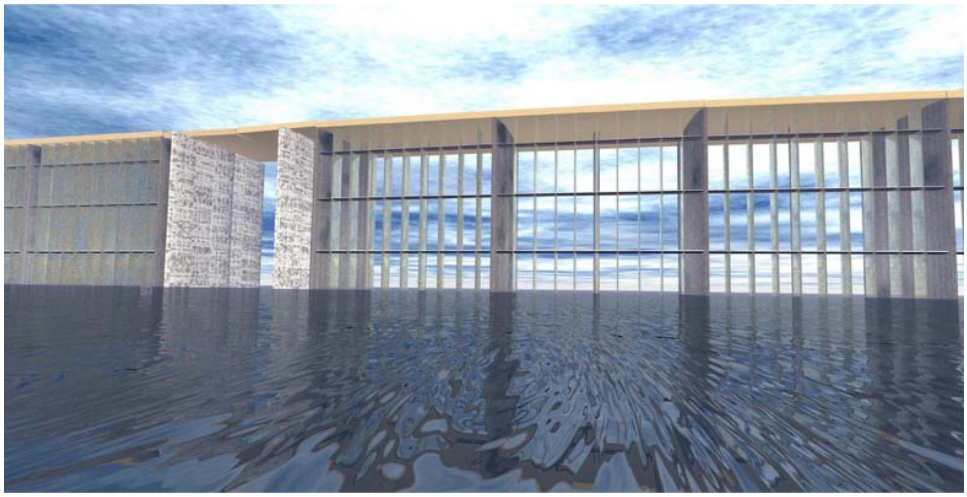


Figure 9. The Eco-Barrier: Open, Ready for Business. One surge gate is shown in the open position. There could be several such gates, to facilitate the passage of shipping. The height of the Eco-Barrier may be sufficient to pass shipping underneath; else drawbridges will be needed over the surge gates.

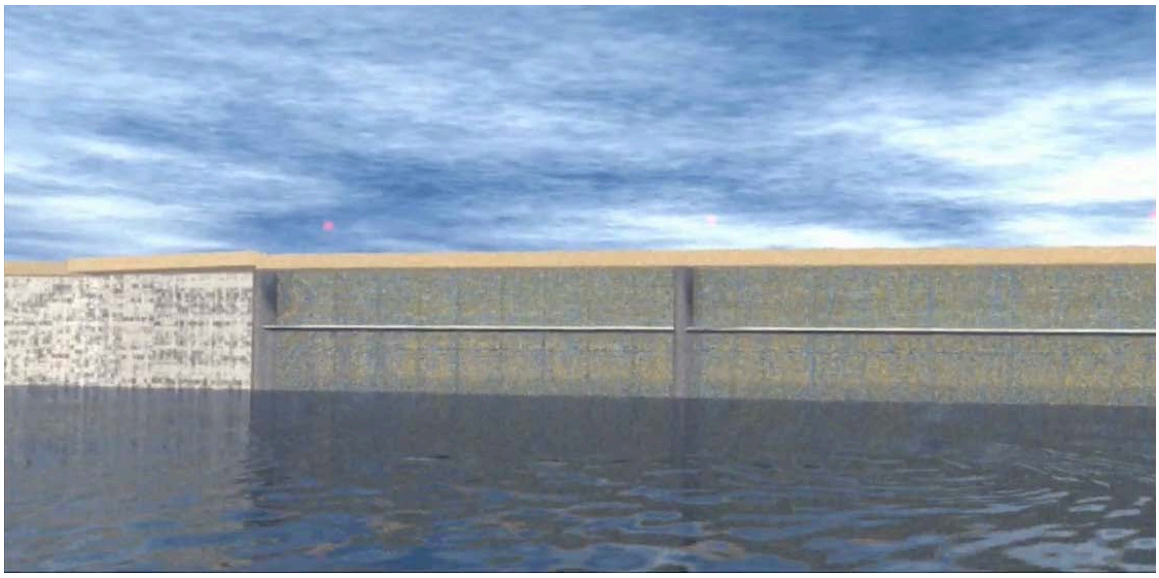


Figure 10. Eco-Barrier Closed! In the face of imminent Storm Tide. Both Surge Gates and shutters are closed as the water rises to dangerous levels…

Draining the Somerset Levels

The Severn Estuary Eco-Barrier could, in principle, aid in draining the Somerset Levels.

The mouth of River Parrett, principal drain of the Somerset Levels, is tidal, which can cause drain-off to back up, rather than flow into the Estuary, so prolonging flooding on the Levels. This happened during the damaging 2014 floods, which covered much of the levels for months… and is likely to recur when there is a low-pressure storm event coming up the Bristol Channel, with accompanying heavy rain.

In such extreme circumstances, the Eco-Barrier could close-off incoming waters, such that only a low neap tide occurred, reducing/stopping tidal back up in the Parrett and other rivers, but without undue effect on Estuarine wildlife….

This would be a rare occurrence, necessary only after the Storm Tide/Storm Surge had subsided, or when–as in 2013/14–heavy rains had flooded the levels, but appears both feasible and reasonable…

Locating the Severn Estuary Eco-Barrier

The preferred location would, on the face of it, appear to coincide with nominal boundary of the Severn Estuary: see Figure 1 and Figure 2.

- An Eco-Barrier at that location would protect most, if not all, vulnerable sites and situations
- There would be cliffs at both ends, to prevent water from skirting around the ends of the Eco-Barrier
- There is adequate water tidal stream velocity, etc., although faster would be better: tidal stream energy is proportional to the cube of the water stream velocity

However…locating the Seven Estuary Eco-Barrier on, or near, the Estuary boundary:

- To the South, would impinge on the Exmoor Heritage Coast and the South-West Coast Path in West Somerset
- To the North, would impinge on the Glamorgan Heritage Coast

So, a second question arises:

Is it possible to reconcile an Eco-Barrier on the Estuary boundary with the interests of preserving the unique natural environment of the Severn Estuary?

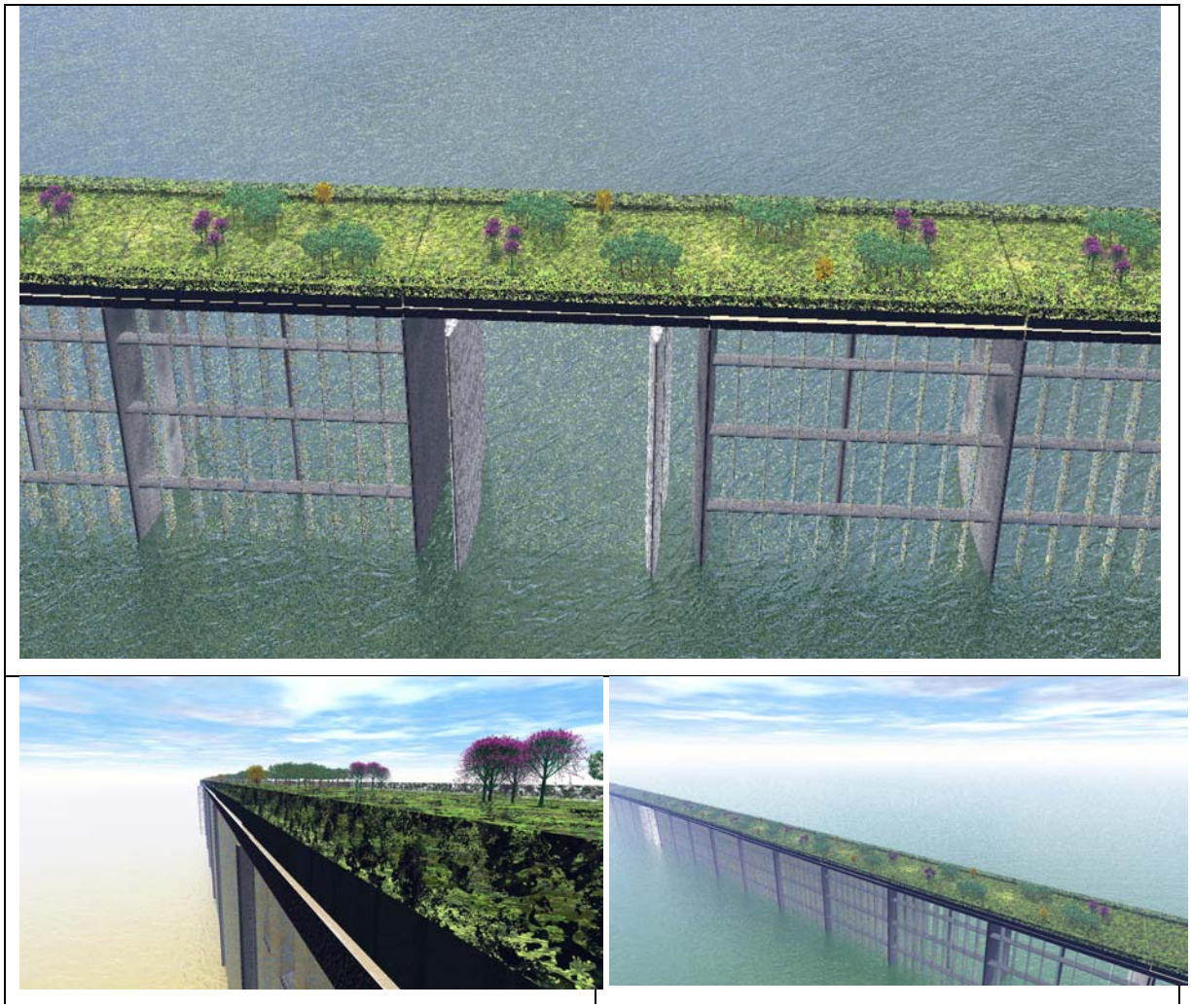


Figure 11. Greening the Eco-Barrier. Three views of the Severn Estuary Eco-Barrier showing the top deck protected by stout hedges to serve as security fencing and windbreaks (the flowering trees may be overkill!). The top would be planted out with soil and flora indigenous to the South Wales and West Somerset coasts, would connect at either end with their respective Heritage Coast environments, with paths for walkers, cyclists, joggers, etc., so becoming a tourist attraction and promoting local wildlife

"Greening" the Eco-Barrier

First, the Severn Estuary Eco-Barrier would be very green anyway… It would

- Protect/conserve the estuarine environment against destructive and deadly storm tides

- Invisibly-generate v. green "lunar" tidal power - as opposed to fossil fuel, nuclear, bio-fuel, wind-farms, etc.

But, the Eco-Barrier can also be *physically* "greened," see **Figure** 11, by…

- planting the upper deck with trees, bushes, grasses, etc., indigenous to the two interconnected coastlines, and…
- .. turning the Eco-Barrier deck into a natural park area, accessible by the public via existing coastal pathways, etc., and a natural habitat and corridor for birds, insects, small mammals, etc.
- providing pathways for pedestrians and joggers, buggies for the disabled, cycle paths for cyclists, i.e.,
- creating potential tourist attraction, and income, for both Glamorgan and West Somerset

Conclusions

Can we protect the Severn Estuary against impending, highly- destructive storm tides?

It seems 'doable…' - challenging, yet potentially feasible, but…can we afford it?

Using an "eco-sensible" project model, we can have:

- A self-funding Eco-Barrier that preserves, possibly even *enhances*, the unique Severn Estuary environment/ecosystem/biome…
- A healthy supply of truly renewable, exceedingly green energy for the nation
- Income for thru-life development, operating and maintenance costs…

Looks like a "win-win!"

On a more sober note, Government has a "duty of care" to preserve and protect Severn Estuary against increasingly severe storms, rising tides and temperatures from global warming – already threatening our coastlines

It appears feasible & potentially affordable to construct a *Severn Estuary Eco-Barrier* against storm-tides – corresponding to existing *Thames Barrier,* also built to combat storm tides…

This is most definitely NOT some hare-brained scheme for sliding a disguised tidal barrage power-generating scheme under the proverbial door. The primary purpose and function of the Severn Estuary Eco-Barrier would be to protect and conserve: tidal stream would generate only a fraction of that power that might otherwise be obtained from a damaging, full-width Estuary barrage, but should be sufficient to fund construction (given a reasonable, pre-agreed price from the National Grid) and to avoid any damage to the precious and unique Estuarine ecosystem/biome (?)

It would be a major civil engineering project, phased-in over many years, and would need government backing, careful *planning, research, design, development, technology, project & financial management*. But, on the plus side, it would bring protection, conservation, employment, income *and energy* to a deprived area with little current prospect for employment…

The project could be largely self-funding, harnessing *tidal stream* renewable/lunar energy that, with care, *will not damage* — may even *enhance* — the unique & precious estuarine ecosystem/environment, allowing time for natural evolution.

Government initiative recommended soonest…most likely in the form of an official, EU-supported feasibility study. We may have a little time, who knows, but not much…

(Derek Hitchins) December 2015