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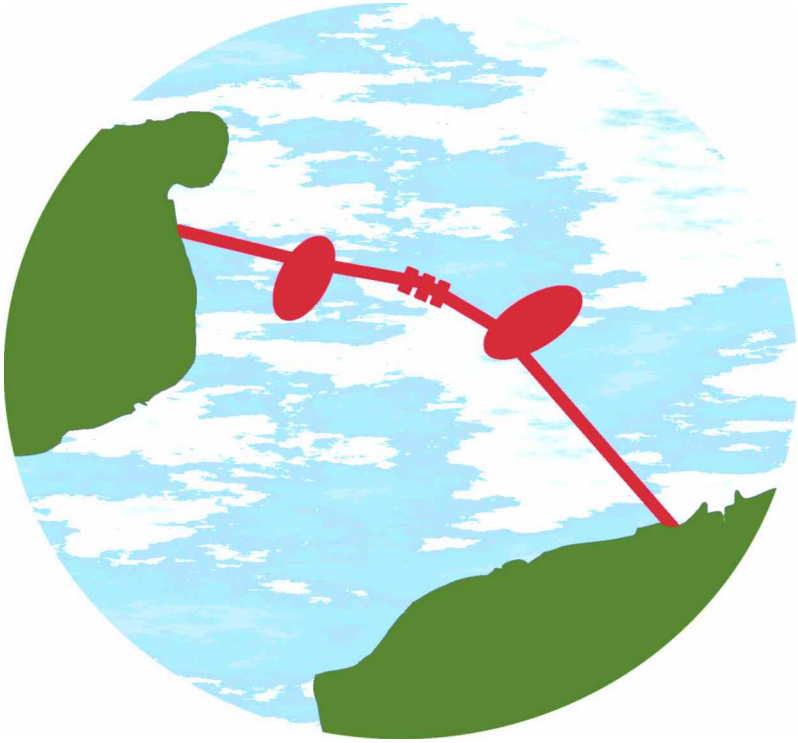
Goodwin International Airport and Cross-Channel Barrage



An economically viable 24/7 airport with a near zero noise profile, a renewable energy generation capability meeting the UK's 2010 target, incorporating a second cross-channel fixed link at a price that is affordable.

Goodwin Airport & Channel Barrage

Executive Summary

1) We like airports to be close by, but not so close that the environmental impact of air travel becomes a personal issue. We also like 'solutions' to infrastructure 'problems' to be as environmentally friendly as possible. This proposal achieves a balanced approach to providing increased air capacity at the same time as being the single most important European renewable energy generation project.

2) Goodwin International Airport and Cross-Channel Barrage is a fully integrated transport and green energy design for the twenty-first century. The design encompasses a 24/7 airport with a near zero over-land noise profile, a renewable energy generation capability meeting the UK's 2010 target, a seaport and a second cross-channel fixed link.

3) The initial assessment of the costs and revenues carried out, and detailed in this report for the project indicate that it has the potential to be an affordable and good value infrastructure investment. Each of the five elements of the project needs the others. The airport needs the barrage for its transport links. The cross-channel fixed link needs the barrage for its support. The revenue from the generation of electricity from the tides in the English Channel financially supports both itself and the other elements of the project. The wind turbines along the barrage also act as navigation warning beacons to shipping. The seaport is needed to go some way to alleviate the obstruction to shipping caused by the barrage, as are the locks.

4) This report looks at the project in some detail, although still at an introductory level. It contains the first detailed financial assessment. The initial assessment is that the project cost will be of the order of 50 £Bn in constant prices, or 62.1 £Bn in current prices (actual prices). (in Euro, 75 €Bn and 93 €Bn) The individual elements of the project, if built separately, would cost an estimated 30% more.

5) Behind these estimates lies an ability to generate tidal energy amounting to an estimated 35 Twh/yr and wind energy of an estimated 2.3 Twh/yr. (Twh/yr = Terra watt hours per year) Combined these renewable energy generation capacities will go a long way towards meeting the UK's stated aim of 10% of energy generated from renewables by 2010, as well as contributing to similar aims in France.

6) This report sets out a framework for further work to more firmly establish the costs and benefits of the scheme. This will require development of a full outline design, a detailed environmental impact assessment and model as well as a wider economic assessment of the project's impact upon the trade, economy, environment, fishing, shipping and air transport of surrounding regions, and indeed Nations.

7) The conclusions reached within this report are supported by a number of independently produced and referenced reports produced for both the British Government and the European Union. The Financial Appendix to this report details a discussion of the impacts of inflation, a phased build and operating the project over the period of fifty years. The financial assessment concludes that the project, although large, is capable of providing a satisfactory financial return

8) This report concludes that the project deserves to be subject to detailed examination. The project's design has the potential of being the most environmentally friendly and greenest way possible, within the limitations of present technology, to provide for an improvement in air transport facilities along with the second cross-channel fixed link, a major shipping hub and clean source of electricity.

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Overview

9) Goodwin International Airport is part of a five-way energy and transport solution. The five elements work together synergistically. Each element relies on the others for its support and by so doing the costs of the individual projects are reduced by up to 30%.

The five elements are:

Transport Infrastructure

1. Goodwin International Airport
2. Second Cross-Channel Fixed Link
3. Sandettié International Container Port

Renewable Energy Electricity Generating

4. Channel Tidal Barrage
5. Channel Wind Farm

Synergy

10) The Goodwin International Airport is to be sited on the Goodwin Sands, presently a dynamic sandbank, hazard to shipping and a place where an annual cricket match is played. The noise pollution profile is minimal as takeoffs and landings will be over water. No homes will be demolished to make way for the Airport. No presently designated Sites of Special Scientific Interest (SSSIs) will be destroyed.

11) The Second Cross-Channel Fixed Link is an element of the intergovernmental contractual agreement to build the existing Tunnel, and should be built soon to keep to the original agreement.

12) Sandettié International Container Port is a container port to be sited on the Sandettié Bank and is essentially an opportunistic proposal and a logical requirement if a Channel Barrage is built to provide for the alterations to shipping that will arise.

13) The Channel Tidal Barrage will generate electricity in considerable quantities, up to 10% of the UK's annual usage from the tides running in the Channel between the English Channel and the North Sea.

14) The Channel Wind Farm takes advantage of the barrage as a site for wind power generators and at the same time provides for a visible locator for the barrage and other facilities to help avoid collisions.

15) The Goodwin International Airport needs good transport and the causeway and High Speed Rail Link on the barrage provide this. The High Speed Rail Link between the Goodwin International Airport links directly to a large catchment area from Belgium and France as well as the UK.

16) Once the Channel Barrage is built it is inevitable that shipping routes will be changed and this gives rise to the need to provide not only transit locks but also a major port. The Sandettié International Container Port itself needs good transport communications and what better than a High Speed Rail Link to the rest of the UK and Europe.

17) This proposal is not only about an Airport for the South East of England, but also a major infrastructure project for Europe. There are several other potential benefits available, such as the possibility of using vast quantities of waste and refuse (up to 100 Million cubic metres) that presently go for landfill in the UK (and France) in the building of the Channel Barrage.

Goodwin Airport & Channel Barrage

18) Preliminary estimates suggest that the project will cost 50 £Bn (75 €Bn). If the separate elements were built on their own the cost might be some 30% greater. (This is a cost saving of 15 £Bn (22 €Bn) - or looking at it another way, Goodwin International Airport, or the Second Fixed Link is 'free'.)

Goodwin International Airport vs the rest

19) Goodwin International Airport is by far the most green and most environmental friendly solution to the problem of providing increased airport capacity in the South East of England. (That is insofar as any airport, or indeed air travel can be considered to be environmental friendly!)

20) Goodwin International Airport's landings and takeoffs will take place over the sea and the noise profile over populated countryside and town and cities will be minimal. No other proposed solution is capable of achieving this. Goodwin International Airport's will be able to operate 24 hours a day seven days a week without limitation, all other airports will be subject to environmental restrictions.

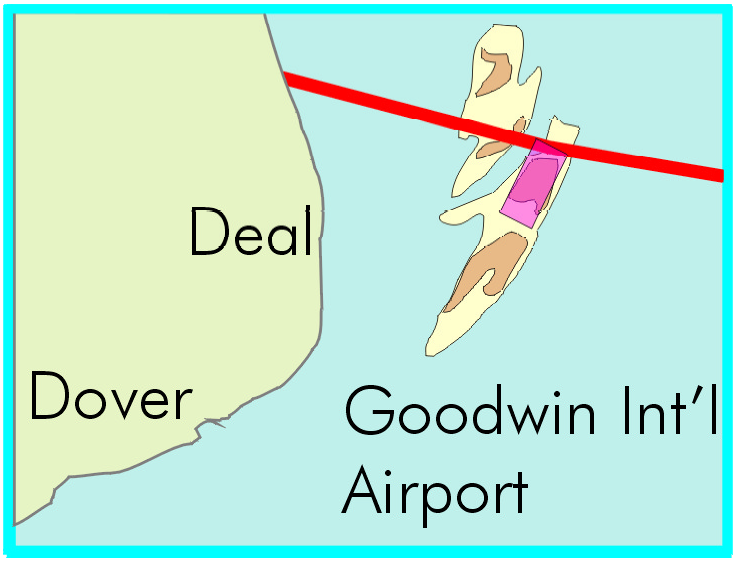
21) Goodwin International Airport will be no more distant from centres of population than some of the South East's existing Airports in terms of travel time as it will be on the High Speed train link from London to Europe. It will also be about two hours from Charles De Gaulle Airport, Paris and Brussels bringing genuine international opportunities.

22) Goodwin International Airport will be no more expensive to build than any other airport, and given that it is part of a larger scheme it will be both less expensive and a more environmentally sensitive solution.

23) Goodwin International Airport will bring increased employment opportunities to Eastern Kent, including the areas of Margate, Ramsgate and Dover. Dover will be expected to see a substantial decline in the cross-channel ferry traffic after completion of the road on the Channel Barrage. Dover is already expanding its role as a Cruise Terminal and this business will be expected to remain. There will also be an opportunity to expand the tourist exploitation of Historic Dover and its Castle. Perhaps the project might consider rebuilding Dover's seaside pier. Similar considerations should apply to Calais.

Goodwin International Airport in more detail

24) Goodwin International Airport will be sited on The Goodwin Sands, an ancient sandbank in the English Channel off the Kent coast near Deal. The sands are dry at low water, that is at zero metre depth, and are both a hazard to shipping and a ship graveyard. The area of the sands is roughly twice the area of Heathrow Airport. The site provisionally selected is some 9 miles (14 km) off shore.



Key to map above
Red = Channel Barrage / Fixed Link / Train / Road, **Yellow** = 10 m depth contour, **Brown** = 0 m depth contour, **Pink** = Heathrow Airport to same scale

Goodwin Airport & Channel Barrage

The Whole Scheme

25) The Goodwin International Airport proposal is an integral part of a major infrastructure project that has five main parts. Three of the five parts are essential to one another. The three are the Goodwin International Airport, the Second Cross-Channel Fixed Link and the Channel Tidal Barrage. All three need each other. Without the Barrage the Fixed Link cannot be built. Without the Fixed Link providing transport to and from the Goodwin International Airport it cannot be built. It would be possible to build the Goodwin International Airport with a hovercraft or hydrofoil access but this is simply not realistic. The three elements of Airport, Fixed Link and Barrage need each other.

26) The Sandettié International Container Port is predicated on the need to provide for the overcoming of the obstruction to shipping that the Channel Barrage will cause. It will also benefit substantially from being on a high-speed rail and major road link to both the UK and Europe. A possible design might be to provide docks along a considerable length of the Barrage itself rather than a more localised Port.

27) The Channel Wind Farm is essentially opportunistic and it also contributes to the whole by providing a very obvious physical identification of the location of the barrage to shipping. Without the wind turbines some other from of masts and navigation lights would be needed.

Transport Infrastructure

Goodwin International Airport

28) Goodwin International Airport is an Airport for the South East of the UK. The idea for the Airport came about to its creators as the result of the considerations and controversy around the previously discussed options.(see Reference [1])

29) Goodwin International Airport provides a 24/7 airport with virtually no noise profile over inhabited areas with virtually no environmental impact compared to many of the other options. The Goodwin Sands as far as has been ascertained are relatively inert. There are no species of unique wildlife threatened by the Airport. The fauna that do currently use the sandbanks in the channel are essentially washed on and off them with the rising and falling of the tides, as far as it has been possible to ascertain at present.

30) The costs and design of the airport have been taken from the Cliffe Airport Study[2]. The area of the airport has been compared to that of Heathrow Airport for assessment of available space and this indicates that the Goodwin Sands could accommodate two Heathrows at sea level, 0 m depth.

31) An airport needs good communications, and what could be better that an international high-speed train link and cross-channel motorway. Goodwin International Airport would be no further from the centres of population than many of South East England's other airports. It is also important to consider the proximity of much of northern France and Belgium in looking at the possibilities of revenue generation for the Airport.

Second Cross-Channel Fixed Link

32) The existing Channel Tunnel was built under an agreement that the operators were required to build a second link of equal capacity between ten and twenty years after opening the first. The time is up and a second fixed link should now be at least on the drawing board.

33) The cost of the link along the top of the Channel Barrage has been taken from an estimated inflated cost of the original link deflated for the different mode of construction and is very much an estimate.

Goodwin Airport & Channel Barrage

Sandettié International Container Port

34) Sandettié International Container Port is proposed as the logical result of two things. Firstly as the Sandettié sandbank is available and secondly because of the disruption to shipping routes that the barrage will create.

35) The South Falls Locks designed into the Channel Barrage will inevitably disrupt shipping and may have to provide free transit to established shipping lines. Providing a container port on the Channel Barrage makes sense because the shipping port will be on the High-Speed Rail link to Europe and the UK as well as the motorway/autoroute on the barrage.

36) In terms of established national borders the barrage route crosses from British waters to French waters and the Goodwin Sands are in British waters and the Sandettié Bank is in French. The designed path of the Channel Barrage does not pass into Belgian waters.

37) It is perhaps a good idea to consider making both the Airport and the Container Port 'International' in terms of duties and customs - but that would need more careful analysis.

Renewable Energy Electricity Generating

38) The Renewable Energy Generation aspects of the project are the Barrage Tidal Generation system and the Wind Farm. The Tidal Barrage would be far the most important aspect, generating fifteen times the output of the Wind Farm. It would also cost some forty four times as much as the wind farm and thus is about three time more expensive in terms of the cost of generation. However this does not take into account the contribution from and dependency upon the Channel Barrier of the Airport, Fixed Link and Sea Port. When these are taken into consideration the tidal energy is only a third more expensive and perhaps on a par with the wind generation. (This itself is an interesting conclusion from the analysis.)

Channel Tidal Barrage

39) The design for the Channel Barrage relies heavily on the work already done of the Severn Barrage. [3] The Severn Barrage is shorter but is designed to work in water of similar depth. Indeed the turbine caissons are designed to work in the 30m water depths of the Channel, just as they are to work in the 30m depth channels of the Severn estuary.

40) The costings used for the proposed Channel Barrage are an expanded version of those used for Severn Barrage. The building methods for the Severn Barrage have all been declared to be well within modern construction techniques. [3]

41) The electricity generation potential is an extrapolation of those for the Severn Barrage. This is estimated to be between 25 and 50 TWh/yr about 10% of the UK annual electrical energy requirement. The project joins the main island of the British Isles to France and as such will have to be a joint project, jointly financed and with a shared access to the electricity generated. Nevertheless, as it is envisaged that the electricity generated would be made available to both electricity grids by cables running along the barrage, this should not be a problem.

Channel Wind Farm

42) Wind turbine technology has developed sufficiently according to recent reports to build turbines at sea so the wind turbines along the length of the barrage would be quite feasible.

43) The design used and the costs and generating capacity has been based on figures for a large planned project in Denmark at Omo [4 - Table 4.1 in report]. Although this project is for one fifth of the number of wind turbines it seemed to represent a comparable and scalable system.

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44) The wind farm is designed around 50km of turbines, spaced at 100 meters giving 500 turbines in total rated at 1.5Gw each giving some 750 Gw in total yielding 2.3 Twh/yr and costing 0.75 £Bn.. This is only one fifteenth of the energy obtainable from the Tidal Generation system, but as has been stated before - without the wind turbines acting as 'lighthouses' along the barrage something else would have to be in their place.

Financial Assessment

45) A financial assessment of the whole project has been undertaken. It must be stressed that these figures are preliminary and the base data upon which these figures are generated are not well tested themselves.

46) The table below outlines a set of costs and annual revenues for the project. The whole project is budgeted to cost £50Bn (75 €Bn) and the annual income generated is estimated to be 3.0 £Bn /yr (4.50 €Bn /yr). These are huge sums as might be expected for such an ambitious project, however as has already been outlined, the advantages of the project are the combination of its elements - the parts gain from being part of the whole by as much as a 30% reduction in cost.

Initial Costing and Projected Revenue *(Constant Prices)*

(For Current Price discussion - see Financial Appendix)

COST			
	Cost	Synergy	**Notes** **(See Financial Appendix)**
Goodwin Airport	12	-5	priced as Cliffe
Channel Barrage & Wind Farm	34		multiple of Severn Barrage + Wind
Sandettié Port	5	-1	estimate
Channel Tunnel -2	12	-9	priced as old tunnel inflated
	-15	-15	*-30% reduction by synergy*
contingency	2		
TOTAL COST	**50**	**£ Bn**	
	75	**€ Bn**	
INCOME			
	Revenue		
Airport	1.50		£30 x 50 million passengers
Electricity	0.70		35 Twh/yr * tide @ £20 / Mwh
	0.05		2.3 Twh/yr * wind
Road Tolls	0.25		£50 for 5 million vehicles
Train	0.10		estimate
Port	0.40		estimate
Annual Income	**3.00**	**£ Bn /yr**	
	4.50	**€ Bn /yr**	

* Table note - Twh/yr = Terra Watt Hours per year, Mwh = Mega Watt hour

47) The computations and assumptions behind the financial assessment can be made available at the appropriate time and under the appropriate arrangements. (All are copyright Dr. John Starr 2003.)

48) The question of how to finance the project is still open to consideration. However it should be noted that the combined project looks overall to make financial sense and it may be possible to engage both public and private sources of finance. The financial history of the previous cross-channel adventure will however dampen private sector enthusiasm, but it should be pointed out that the Channel Barrage project is inherently technically easier and more stepwise in its execution. For example a partly competed barrage might link to a container port or airport prior to closing the gap between the two, also the wind

farm can be constructed and made operational as soon as the barrage is built to that point. This differs from the Channel Tunnel, as it was entirely impossible to generate any revenue until the tunnel was completed.

49) The Channel Barrage project will be the biggest renewable energy project in the World (as far as it has been possible to ascertain at this stage.) It should, and needs to, attract major EU support as well as support from both National Governments.

Further Work

Construction Planning

50) The project will take, perhaps a decade from inception to completion. Building a Barrage is inherently easier and more manageable than building the original Channel Tunnel. The Severn Barrage - Definition Study [3] gives strong support to the belief that the technology for building the barrage is within currently available engineering skills. The Channel Barrage project is somewhat larger although no different in concept from the Severn Barrage project. The turbine chambers designed for the Severn Barrage are designed to work in 30 m of water, precisely the same conditions that apply for the Channel Barrage.

51) Detailed undersea survey of the proposed route for the Channel Barrage, and its ports and locks.

52) Detailed examination of the landward infrastructure on both sides of the Channel.

Financial Assessment

53) The financial assessment is quite preliminary and will need continuous reassessment. The major risk factors are that the technology and engineering will fail, the volume of Air Traffic or cross-channel traffic is under or over estimated, the price that the market will sustain has been over, or under estimated. Etc…

Environment

54) It is of prime importance that there is a detailed study of the likely secondary effects of the Channel Barrage. This will include, inter alia, the likelihood and extent of possible coastal flooding, the alteration of tidal flows and silting.

55) This study will require the building of both physical and computer models of the way in which the waters of the southern North Sea and the English Channel behave throughout the year and with the expected range of weather conditions.

56) It will also be necessary to consider larger issues such as the effect on the changes of water flow on the dispersal of waste discharged into the sea in the areas concerned.

57) Fish and fish spawning grounds will also need to be assessed.

58) The reduction in the risk of oil spills by the removal of the collision risk with the (former) cross-channel ferries should also be taken into consideration in an overall assessment.

59) It is highly probable that there will be an alteration in the depositing of silt and hence the coasts and sandbanks and this will need to be modelled.

Political

60) Initial discussions with local councils on both sides of the channel and the French state will be required. The economic advantages to adjacent regions of both countries should be examined in detail.

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References

1.Channel Barrage - Dr John Starr March 2003 (submitted as a '.pdf' file to the consultation)

2. Cliffe Airport Report, An Interim Appraisal, Oct 2002 - Gravesham Borough Council

3. The Severn Barrage - Definition Study, Final Report: January 2002, Etsu Report No. T/09/00212/00/Rep - Sir Robert McAlpine Limited on behalf of The Severn Tidal Power Group

4. “Prospects For Offshore Wind Energy” A report written for the EU (Altener contract XVII/4.1030/Z/98-395) by The British Wind Energy Association (BWEA).

5. Seaports - South East, London and East of England Regional Ports Strategy, WSP Transportation for The South East and Anglian Ports Local Authority Group (SEAPLAG) Jan 2002.

6. Report of Dover Harbour Board’s, Fifth Annual Consultative Meeting - held on 29th May 2002

7. South East and East of England Regional Air Services Study - up to February 2003 - DfT

8. The Energy Report (DTI 4088) 2000

9. DTI Energy White Paper Feb 2003

Various Maps and Charts

Numerous Internet web sites and Google.

Goodwin Airport & Channel Barrage

Financial Appendix

61) All projects and enterprises that are worth doing need an evaluation of their worth. This appendix sets out an initial appraisal of the value of the whole project. It includes all elements of the project, as all elements are to a greater or lesser extent dependent on all other elements.

62) Make no mistake, this project is a very major infrastructure project and will need much more extensive detailed work. However if any project does not stand up on an initial assessment then it is seldom worth considering. It was I think the late Lord Weinstock, of GEC, who had a predilection for seeing projects, no matter how large or small, presented to him on a single sheet of paper. This is that sheet of paper.

63) This Financial Analysis is a preliminary overview. It has been prepared by one person from data publicly available, but in some detail and from data previously prepared by others for similar purposes for similar projects. The very much smaller project of the Channel Tunnel, for example is part of the input to the analysis as are all of the published accounts and reports of businesses that operate in the area, and the reports and advice offered to both the EU and the British government. Data from similar developments world-wide, such as the building of the new Hong Kong airport and the trading and statistics of the major European North Sea and English Channel container ports has also been reviewed.

Key Results

Current Prices computation
(That is the computation of the likely actual financial sums in the prices of the actual years)

Project cost	56.4 £Bn
Total Maximum Indebtedness	62.1 £Bn
'Loan' repaid after	25 years
Or looking at it another way	
Project estimated cost - Constant Prices	50.0 £Bn
Capital Inflation during construction	6.4 £Bn
Finance cost	5.7 £Bn
Total Maximum Indebtedness	62.1 £Bn

Key Assumptions in Constant Price to Current Price conversion (see Tables 1 and 2)

Long term interest rate	2.5%
Inflation	4.0%

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Cost Assumptions

Goodwin International Airport

Cost 12 £Bn (constant prices)

64) All airports are essentially the same and as such Goodwin International Airport is no different from similarly designed virgin site Airports in other places. Gravesham Borough Council carried out a reasonably detailed assessment of what it would cost to build an airport on sea marsh on the Kent coast at Cliffe. [2] Whilst it is true that the site of Goodwin International Airport is quite obviously different from that at Cliffe, however in many ways the building processes are similar. The site still needs preparing, that is stopping the sea from inundating it on every tide. The Goodwin Sands are only 20 m lower that the Cliffe marshes. Initial access will in both cases require building an access to the site. The site on what is now only sometimes dry land is (probably?) already owned by the Crown; it is certainly in British territorial waters. It was felt that the higher estimate for Cliffe was a good starting basis for the cost of Goodwin International Airport. The Cliffe project included the necessary infrastructure costs.

Channel Barrage + Wind Farm

Cost 33.25 + 0.75 = 34.0 £Bn (constant prices)

65) The Channel Barrage is the most expensive part of the whole project, however a very recent reappraisal of the Severn Barrage by Sir Robert McAlpine Limited [3] provides an excellent starting point.

66) The Severn Barrage is designed to link Wales, south of Cardiff, to England, south of Weston-super-Mare and is some 18km long as against the designed Channel Barrage at 57km long. The Severn Barrage envisages a major lock for shipping as well as a road links on the barrage exactly similar to that designed for the Channel Barrage.

67) The envisaged Severn barrage has a tidal generation capacity built in the 30 m deep channels in the Severn Estuary and this method of construction would also suit the identical depth in the Channel Barrage.

68) The chosen method of scaling the Severn Barrage's costing to give a measure of the Channel Barrage's cost is to compare the relative cross-section of the barrages. The cross-section method was chosen as this represents the relative quantity of the largest element, by volume and weight, of the necessary building materials. The acquisition, transporting and installation of the materials for the barrage itself represent the largest element of the construction. This gave rise to a multiple of 2.77 times, and a estimated cost of 33.25 £Bn.

69) The Channel Barrage has a cross-section of 1,477,500 square metres and the Severn Barrage 532,500 square metres - derived by examination of the approximate depth details of the designed track of both barrages. (See refs. [1] and [3])

70) The Wind Farm design used, and the costs and generating capacity, has been based on figures for a large planned project in Denmark at Omo [ref. 4 - Table 4.1]. Although this project is for one fifth of the number of wind turbines it seemed to represent a comparable and scalable system.

71) The wind farm is designed around 50km of turbines, spaced at 100 meters giving 500 turbines in total rated at 1.5Gw each giving some 750 Gw in total yielding 2.3 Twh/yr and costing 0.75 £Bn..

Sandettié Container Port

Cost 5£Bn (constant prices)

72) Container Ports are nearly always built on dry land, but it is envisage that the Sandettié Bank a sandbank formation on the French side of the channel somewhat deeper than the Goodwin Sands would make a good place to construct what would be one of Europe's largest Container Ports.

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73) Sandettié Container Port would serve both northern continental Europe as well as the south of the British Isles. The advantage of building a container port on the Sandettié bank is that ships will be able to load and discharge cargo without needing to traverse the South Falls Locks thereby saving them time. Both a motorway / autoroute and the high-speed train service will serve the Channel Barrage and thus the Sandettié Container Port. The Sandettié Container Port will be secure as it will not have direct land access and thus the security problems experienced by the Channel Tunnel and ferries will be minimised.

74) Precisely how many kilometres of dockside and cranes and other physical details have been left for later computation. The costing has been based on some published figures for the building of the Thames Container Port at the former Shell Refinery on the Thames and the expansion of the Felixstowe facility. (The former seems to be budgeted for about 0.7 £Bn and the latter somewhat less.) To this has been added a substantial sum for the construction of the port in water rather that on dry land. A total of 5 £Bn has been estimated.

Channel Tunnel - 2

Cost 12 £Bn (constant prices)

75) The works required to create a second channel tunnel has been estimated to be the same as the first tunnel with added inflation since its construction. This is quite obviously far too high for the construction of a railway-line on top of an existing barrage, but represents the likely cost of having to create the link in another way - by building a tunnel.

Shared Synergy

Cost reduction 15 £Bn (constant prices)

76) The costs and capabilities of the individual elements have now been outlined above so this discussion quite properly turns to the question of the interdependence of the projects, or project synergy.

77) One of the main points of this whole construction project is the interdependence of one major project on another. The airport needs a transport service. The barrage that provides the physical support for the transport service will obstruct the tides and thus some way for the tides to run through the barrage will be required. It would be a shocking waste of the potential electrical generating capacity of all that moving water not to generate electricity from it. To prevent ships from colliding with the barrage some form of highly visible navigation beacons will be required and what better than a line of wind turbines. Shipping will inevitably be impeded so a port that they could use looks sensible.

78) The assessment of the benefit by one part from another is complex. A major part of constructing an Airport is the transport links and after examining the Cliffe Airport proposal and the Hong Kong Airport build my estimate is that about 5 £Bn would be an appropriate contribution from the airport towards the cost of the barrage and the rail link.

79) Sandettié Port also needs the barrage to provide its infrastructure and this I have assessed as 1 £Bn which would otherwise have to be spent to create its vital road and rail links.

80) The biggest beneficiary of the contribution from the Barrage is the Second Fixed Link. The majority of the cost of a second Channel Tunnel would be in the building of the actual tunnel. I have assessed the likely cost of creating the rail infrastructure for 51 km of track and associated lines on both sides of the Channel to be about 3 £Bn and thus the Fixed Link would benefit from a saving of some 9 £Bn by using the Channel Barrage.

Contingency

2 £Bn (constant prices)

81) Every project needs one and I have chosen 2 £Bn as a construction contingency. Note that finance costs and inflation uplifts are dealt with separately and together amount to a further 12.1 £Bn.

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Revenue Assumptions

Goodwin International Airport

Annual Revenue 1.50 £Bn / Year (constant prices)

82) Goodwin International Airport will be able to provide a 24/7 airport not being subject to the restrictions on night flying that are rightly imposed on all other land sited airports. It will have a unique capability to handle long-haul services round the clock. Incidentally, as the airport is built 'on the sea' rather than on sea marshes the bird strike problem predicted for Cliffe will not exist.

83) The revenue per passenger capable of being derived is estimated at £30. This is made up of the transportation passenger tax of £15. The retail revenue obtained per passenger at £5 (being the figure obtained by BAA from existing airports, uplifted to the projected start date). The remaining £10 is the revenue from transporting the passenger to and from the airport and/or parking. The number of passengers should be related to the passenger catchment area of the new airport. An estimated 50 million passengers has been assumed as a reasonable view of the potential throughput, given that the airport is uniquely able to operate round the clock.

84) It is hoped that the lack of night flying limitations on Goodwin International Airport will relieve the burden on existing airports so that they may be able to improve relationships with their immediate neighbours and let them enjoy a decent night's sleep. Unlike all existing airports there is nobody living, or likely to live, under the landing and take off noise footprints of Goodwin International Airport - this should be a major environmental 'selling point' for this project.

85) Airfreight revenue has not been included, as it has not been possible to compute a figure in the time available to create this report. It should be said however that a major airport with rapid rail and road links to much of northern Europe, including the British Isles, should attract substantial airfreight throughput. The lack of airfreight in the potential revenue estimates for Goodwin International Airport is in effect a contingency.

86) I have chosen to include the Air Travellers Tax as a part of the revenue of the Airport as this is a major national infrastructure project and the national income will be increased by the tax paid.

Channel Barrage + Wind Farm

0.70 £Bn/ Year Tidal (constant prices)
0.05 £Bn/ Year Wind (constant prices)
0.25 £Bn/ Year Road (constant prices)
Annual Revenue 1.00 £Bn/ Year Total (constant prices)

87) This paper has been prepared for an Airport Study, but Goodwin International Airport is only about 20% of the project by itself, however without the other elements of the project the airport cannot be built or function.

88) The most vital element is the Channel Barrage. The Channel Barrage links Goodwin International Airport to its customers. The Channel Barrage is the most expensive part of the project and is itself a substantial renewable energy project - the largest in the world so far planned (at the time of writing and within currently researched information).

89) The revenue derivable from the Channel Barrage depends on three elements: the revenue from selling its tidal generated electricity (0.7 £Bn/Year), the road tolls from its use as a land bridge (0.25 £Bn/Year) and its wind generated electricity (0.05 £Bn/Year).

90) The estimate for tidal generated energy has been computed by scaling the estimated output for the Severn Barrage [3] based on the relative cross-section of the two barrages. This is an untested assumption as the

tides differ and the output might be substantially higher as the whole of the English Channel and the southern North Sea are in effect the 'reservoirs' for the Channel Barrage.

91) The tides and currents in the Staits of Dover are known to be quite substantial and have been the cause of many shipping disasters over the millennia. The barrage will 'harvest' this 'bounty' from the lunar, rotational and wind energy of the earth.

92) The cross-section represents the 'slice' of water that is moved by the tides in both directions with each tidal cycle. This was used to scale the potential output of the tidal electrical generators of the Channel Barrage. It must be noted at this point that a detailed study of the tides has not been undertaken at this point to justify this assumption. There are computerised modelling systems available for the tidal flows but these will only show the water moved without the barrage. What will be required is detailed modelling, probably both physical and computer, to assess the likely electrical generation output of the Channel Barrage. The results of these assumptions are a potential output of 35 Twh/y (Terra Watt Hours per Year.) This output has been valued at £20 per Mwh, the figure used to represent the wholesale price of electricity in several reports.

93) The second element of the revenue of the Channel Barrage is that of road tolls for the fixed link. Presently the annual traffic is of the order of 5 million vehicles per year split roughly half-and-half between the ferry fleets and the existing Channel Tunnel. The Channel Tunnel has shown just how much travellers value the speed of it service by overcoming the inherent nuisance and cost barriers of using its service by taking half of the traffic. This is a strong indication that there is considerable upside in the potential channel road traffic, if the service provided is rapid and inexpensive. It is considered reasonable to allow for a fifty-percent increase in total cross-channel traffic from the present total of 5 million vehicles to 7.5 million by the time the link opens.

94) The Channel Barrage will provide a 50km long link or a half-hour drive or thereabouts. I think is reasonable to assume that and additional 0.25 £Bn/year in revenue should be achievable from road traffic. This has been computed as an average of £50 for 5 million vehicles. This is a fifty-percent increase in vehicle volume, but for the foregoing reasons I believe this to be reasonable. It has also been assumed that the existing Channel Tunnel road business will remain - again quite reasonable if one likens the situation to the road and rail links over and through the Alps.

95) The final element of the revenue from the Channel Barrage (0.05 £Bn/Year) is from the Wind Farm that sits on it and doubles as a set of visible navigation beacons as well as wind turbines. The output of the Wind Farm has been directly scaled from the data within the Prospects for Offshore Wind Energy report presented to the EU. [4]

Sandettié Container Port

Annual Revenue 0.4 £Bn/Year (constant prices)

96) Many millions of people live around the eastern English Channel and southern North Sea. The coastal areas are the entrepôts for much of mainland Europe including Belgium, Holland, much of Germany as well as northern France and the South East of the England. The Channel Barrage will have locks - I have called them the South Falls locks after the name of the sandbanks near to the proposed site. These locks, even if free to use for existing shipping lines with pre-existing services as I propose, will be an impediment to shipping. I therefore propose that there should be a seaport constructed. The sensible place to build this port is on the system of sandbanks on the French and Belgium side of the Channel. These sandbanks are called the Sandettié Bank. These sandbanks are deeper than the Goodwin Sands and thus in logic better suited to a ship port than an airport.

97) Much of the information I have been able to obtain on the building of ports concerns the extension of existing ports such as Felixstowe or the conversion of existing shore facilities to ports such as on those on the Thames.

98) The revenue from the port has been estimated by reference to several sources, including Europort's and Felixstowe's figures, but in the final analysis it is an estimate. Port traffic and revenue seems to rely on the port's transport infrastructure as much as other things. Sandettié Container Port is to be supplied with excellent road and high speed rail links to the southern UK as well as Northern France and Belgium. I looked at estimating the number of twenty-foot container equivalents that might pass through the port, but in the end I concluded a figure of 8% of the cost would be as reasonable as any other estimate. The problem with estimating the revenue and returns for Sandettié Container Port is that the Channel Barrage will change the way in which container traffic travels.

99) The existing ports north of the barrage, the UK and Europe will loose traffic that formerly came up the English Channel in the same way as ports south and west of the Channel Barrage will lose traffic from north of the Channel Barrage. The ports near to the Channel Barrage will lose traffic to the Channel Barrage itself but may gain traffic that can use the Channel to extend their own catchment area across the Channel Barrage.

100) In the end I chose an 8% return on capital or 0.4 £Bn as a reasonable estimate of the income for the port.

Channel Tunnel - 2

Annual Revenue 0.1 £Bn/ Year (constant prices)

101) The second fixed link or 'Channel Tunnel 2' will provide a new rail link between the British Isles and Northern Europe. The quite modest figure of 0.1 £Bn is my estimate of the rail revenue that the additional link will generate from cross-channel passenger and goods traffic. This modest figure represents just 3% return on the cost of creating the rail link. This figure is influenced by the economic performance of the existing Channel Tunnel.

Maintenance

Annual Cost 2.0% (of capital expenditure)

102) I have chosen to include a maintenance figure of just 2% of the capital cost to maintain the project. The reasoning I used is:- that as much of the capital expenditure is for the moving and positioning of infill for the barrage and this in itself requires no maintenance apart from ensuring that the walls that retain the barrage are not breached. The deposition of sediment will also help to stabilise the barrage from erosion in some parts. In a sense, as one does not provide for maintenance on the soil a building is placed upon then one should only provide that maintenance that is required by the project, and not base this on its capital cost.

103) Maintenance is allowed for at some 1.0 £Bn per annum in constant prices.

Goodwin Airport & Channel Barrage

Financial Forecasts - Tables 1 and 2

104) The two tables that follow are a fifty-year cash flow and financial analysis of the whole project.

105) The first table is in constant prices. That is assuming that there is no inflation in costs or revenues and that all borrowings, or the investment, is to be repaid in constant prices.

106) The second table is in Current Prices, or Actual Prices. It represents the ongoing fifty-year analysis of the project as might be actually experienced if a set of accounts were to be produced for the whole project year by year. This is a more realistic description of the project. However all such analyses are bound by their internal assumptions.

107) The Current Price analysis is not only the result of the assumptions on the actual costs and revenues for building and running the project but also of inflation and the prevailing interest rate so whilst it is more realistic it is also more dependent on assumptions.

108) The financial assumptions are a long-term interest rate of 2.5% and inflation at 4.0% for both costs and revenues. The 'loan' to build the project would be paid back after 25 years (current prices).

109) There are quite obviously huge complexities and unknowns in producing such a computation as is set out here, but it is in my opinion still worth the effort to both produce it, and to refine the assumptions behind it as this focuses attention on the details of the project.

110) There are many omissions from these analyses, not the least of which, is the opportunity cost of doing, or not doing the project.

111) What, for example, will be the fate of the people and towns of eastern Kent and the Nord-pas de Calais without the project? Will they be better off with it, or without it? This has been ignored in the project's financial analysis.

112) What would be the economic benefit to the people living under the flight-paths of the inland airports of an improved night's sleep in economic terms? Again this has been ignored.

113) There is one question that seems to be answered however, and that is that the project is in financial terms of net benefit and most probably a good investment for both Nations as well as a good choice for a new airport for the region.

114) The environment has an opportunity cost as well so it is reasonable to ask what the benefit of this large renewable energy scheme might be? This is highly complex and is not just the value of the electricity generated - but that is all that has been taken into the financial analysis presented here.

NB

When interpreting the tables overleaf please note that the 'totals' for each table are totals, except for the final column 'balance' - this is the maximum borrowing requirement for the project.

Goodwin Airport & Channel Barrage

Table 1 Constant Prices (£Bn)

Year	Phase	Build	Maintain.	Income	Cash Flow	Cum CFlow	Finance	Balance
0		3.0	0.1	0.0	3.1	3.1	0.1	3.2
1		8.0	0.2	0.0	8.2	11.3	0.3	11.7
2		10.0	0.4	0.0	10.4	21.7	0.5	22.6
3		9.0	0.6	0.0	9.6	31.3	0.8	33.0
4	Airport Start	9.0	0.8	0.0	9.8	41.1	1.0	43.8
5	Port Start	7.0	0.9	1.6	6.3	47.4	1.2	51.3
6	Generating Start	3.0	1.0	2.0	2.0	49.4	1.2	54.5
7	Link Start	1.0	1.0	2.2	-0.2	49.2	1.2	55.6
8			1.0	3.0	-2.0	47.2	1.2	54.7
9			1.0	3.0	-2.0	45.2	1.1	53.9
10			1.0	3.0	-2.0	43.2	1.1	53.0
11			1.0	3.0	-2.0	41.2	1.0	52.0
12			1.0	3.0	-2.0	39.2	1.0	51.0
13			1.0	3.0	-2.0	37.2	0.9	49.9
14			1.0	3.0	-2.0	35.2	0.9	48.8
15			1.0	3.0	-2.0	33.2	0.8	47.6
16			1.0	3.0	-2.0	31.2	0.8	46.4
17			1.0	3.0	-2.0	29.2	0.7	45.1
18			1.0	3.0	-2.0	27.2	0.7	43.8
19			1.0	3.0	-2.0	25.2	0.6	42.4
20			1.0	3.0	-2.0	23.2	0.6	41.0
21			1.0	3.0	-2.0	21.2	0.5	39.5
22			1.0	3.0	-2.0	19.2	0.5	38.0
23			1.0	3.0	-2.0	17.2	0.4	36.4
24			1.0	3.0	-2.0	15.2	0.4	34.8
25			1.0	3.0	-2.0	13.2	0.3	33.2
26			1.0	3.0	-2.0	11.2	0.3	31.4
27			1.0	3.0	-2.0	9.2	0.2	29.7
28			1.0	3.0	-2.0	7.2	0.2	27.8
29			1.0	3.0	-2.0	5.2	0.1	26.0
30			1.0	3.0	-2.0	3.2	0.1	24.1
31			1.0	3.0	-2.0	1.2	0.0	22.1
32			1.0	3.0	-2.0	-0.8	0.0	20.1
33			1.0	3.0	-2.0	-2.8	-0.1	18.0
34			1.0	3.0	-2.0	-4.8	-0.1	15.9
35			1.0	3.0	-2.0	-6.8	-0.2	13.7
36			1.0	3.0	-2.0	-8.8	-0.2	11.5
37			1.0	3.0	-2.0	-10.8	-0.3	9.2
38			1.0	3.0	-2.0	-12.8	-0.3	6.9
39			1.0	3.0	-2.0	-14.8	-0.4	4.5
40			1.0	3.0	-2.0	-16.8	-0.4	2.1
41			1.0	3.0	-2.0	-18.8	-0.5	-0.4
42			1.0	3.0	-2.0	-20.8	-0.5	-2.9
43			1.0	3.0	-2.0	-22.8	-0.6	-5.5
44			1.0	3.0	-2.0	-24.8	-0.6	-8.1
45			1.0	3.0	-2.0	-26.8	-0.7	-10.7
46			1.0	3.0	-2.0	-28.8	-0.7	-13.5
47			1.0	3.0	-2.0	-30.8	-0.8	-16.2
48			1.0	3.0	-2.0	-32.8	-0.8	-19.1
49			1.0	3.0	-2.0	-34.8	-0.9	-21.9
50			1.0	3.0	-2.0	-36.8	-0.9	-24.8
	Totals (etc.)	**50.0**	**48.0**	**134.8**	**-36.8**		**12.0**	**55.6**

Goodwin Airport & Channel Barrage

Table 2 Current Prices (£Bn)

Year	Phase	*Inflation*	Build	Maintain.	Income	Cash Flow	Cum CFlow	Finance	Balance
0		*1.00*	3.0	0.1	0.0	3.1	3.1	0.1	3.2
1		*1.04*	8.3	0.2	0.0	8.5	11.6	0.3	12.0
2		*1.08*	10.8	0.4	0.0	11.2	22.9	0.6	23.8
3		*1.12*	10.1	0.7	0.0	10.8	33.7	0.8	35.5
4	Airport Start	*1.17*	10.5	0.9	0.0	11.5	45.1	1.1	48.1
5	Port Start	*1.22*	8.5	1.1	1.9	7.7	52.8	1.3	57.0
6	Generating Start	*1.27*	3.8	1.3	2.5	2.5	55.3	1.4	60.9
7	Link Start	*1.32*	1.3	1.3	2.9	-0.3	55.1	1.4	62.1
8		*1.37*		1.4	4.1	-2.7	52.3	1.3	60.6
9		*1.42*		1.4	4.3	-2.8	49.5	1.2	59.0
10		*1.48*		1.5	4.4	-3.0	46.5	1.2	57.2
11		*1.54*		1.5	4.6	-3.1	43.4	1.1	55.2
12		*1.60*		1.6	4.8	-3.2	40.2	1.0	53.0
13		*1.67*		1.7	5.0	-3.3	36.9	0.9	50.6
14		*1.73*		1.7	5.2	-3.5	33.5	0.8	48.0
15		*1.80*		1.8	5.4	-3.6	29.9	0.7	45.1
16		*1.87*		1.9	5.6	-3.7	26.1	0.7	42.1
17		*1.95*		1.9	5.8	-3.9	22.2	0.6	38.7
18		*2.03*		2.0	6.1	-4.1	18.2	0.5	35.1
19		*2.11*		2.1	6.3	-4.2	13.9	0.3	31.3
20		*2.19*		2.2	6.6	-4.4	9.6	0.2	27.1
21		*2.28*		2.3	6.8	-4.6	5.0	0.1	22.7
22		*2.37*		2.4	7.1	-4.7	0.3	0.0	17.9
23		*2.46*		2.5	7.4	-4.9	-4.7	-0.1	12.9
24		*2.56*		2.6	7.7	-5.1	-9.8	-0.2	7.5
25		*2.67*		2.7	8.0	-5.3	-15.1	-0.4	1.8
26		*2.77*		2.8	8.3	-5.5	-20.7	-0.5	-4.2
27		*2.88*		2.9	8.7	-5.8	-26.4	-0.7	-10.7
28		*3.00*		3.0	9.0	-6.0	-32.4	-0.8	-17.5
29		*3.12*		3.1	9.4	-6.2	-38.7	-1.0	-24.7
30		*3.24*		3.2	9.7	-6.5	-45.2	-1.1	-32.3
31		*3.37*		3.4	10.1	-6.7	-51.9	-1.3	-40.3
32		*3.51*		3.5	10.5	-7.0	-58.9	-1.5	-48.8
33		*3.65*		3.6	10.9	-7.3	-66.2	-1.7	-57.8
34		*3.79*		3.8	11.4	-7.6	-73.8	-1.8	-67.2
35		*3.95*		3.9	11.8	-7.9	-81.7	-2.0	-77.2
36		*4.10*		4.1	12.3	-8.2	-89.9	-2.2	-87.6
37		*4.27*		4.3	12.8	-8.5	-98.4	-2.5	-98.6
38		*4.44*		4.4	13.3	-8.9	-107.3	-2.7	-110.2
39		*4.62*		4.6	13.8	-9.2	-116.6	-2.9	-122.3
40		*4.80*		4.8	14.4	-9.6	-126.2	-3.2	-135.1
41		*4.99*		5.0	15.0	-10.0	-136.1	-3.4	-148.5
42		*5.19*		5.2	15.6	-10.4	-146.5	-3.7	-162.5
43		*5.40*		5.4	16.2	-10.8	-157.3	-3.9	-177.2
44		*5.62*		5.6	16.8	-11.2	-168.6	-4.2	-192.7
45		*5.84*		5.8	17.5	-11.7	-180.2	-4.5	-208.9
46		*6.07*		6.1	18.2	-12.1	-192.4	-4.8	-225.8
47		*6.32*		6.3	19.0	-12.6	-205.0	-5.1	-243.6
48		*6.57*		6.6	19.7	-13.1	-218.2	-5.5	-262.2
49		*6.83*		6.8	20.5	-13.7	-231.8	-5.8	-281.7
50		*7.11*		7.1	21.3	-14.2	-246.0	-6.2	-302.0
	Totals (etc.)		**56.4**	**156.6**	**459.1**			**-56.0**	**62.1**