National Grid proposals for new overhead lines from Bramford to Twinstead: Response by the Dedham Vale Society

Executive summary

A The options for strengthening the electricity transmission system in East Anglia need to be reviewed, with environmental factors an integral part, to take into account (1) the Round 3 wind farms and the high probability that high-voltage direct current (HVDC) will be the preferred option for connecting them; (2) the timing uncertainties inherent in the new generating capacity proposals;

B The consultation is invalidated by failing to address the fundamental issue involved, which is the trade-off between financial cost and the environment. Environmental factors should be assessed by means of social cost-benefit analysis informed by data on public willingness-to pay to protect nationally designated landscapes;

C All of the options offered by National Grid (NG) are objectionable on environmental grounds, and none is materially less bad in environmental terms than another;

D More extensive avoidance of the environmental detriments may well be more justifiable than more limited avoidance.

Introduction:
The Dedham Vale Society

The Dedham Vale, perhaps even better known as Constable Country, stretches through undulating fields and along the water meadows of the River Stour in countryside famous for its great wool churches and picturesque villages like Flatford and Stoke by Nayland.

The aims of the Dedham Vale Society (DVS) as set out in its constitution are *the maintenance, protection and, if possible, the enhancement of the natural and architectural beauties and amenities of the Area of Outstanding Natural Beauty (AONB) known as Dedham Vale and to stimulate public consciousness to those ends.*

DVS was created long before the AONB, and was influential in its creation. For over seventy years the Society has worked to resist the excesses of developers, the utilities and individuals who would seek to damage the fragile landscape either wilfully, perhaps through ignorance, or just sheer opportunism.

The Society's influence has been wide and many campaigns have been fought with much success. Bodies such as the water and electricity-generating companies, building-developers and, most recently, the Civil Aviation Authority have been persuaded – if necessary by legal action - that their proposals have not been in the interest of this tiny and fragile AONB.

Two of National Grid's Route Corridor options, 1 and 2, go through the AONB.

Extension of the AONB

Since the introduction of the AONB forty years ago, DVS has pressed for its extension up the Stour valley, to Bures and Lamarsh ("Gainsborough Country") and ideally beyond. This has very recently become a real possibility, following a meeting between the Chairman and officers of the Dedham Vale AONB & Stour Valley Project Partnership and the Chief Executive of Natural England, the government body which decides these matters.

At the Partnership meeting of 10th November a motion was passed

That the Partnership issue a statement of intent to Natural England seeking an extension of the Dedham Vale AONB boundary, including westward toward Sudbury , and to evaluate and provide a substantive case and detail in support of the extension.

If it is agreed, the extension could well come into effect earlier than any new transmission lines.

All of National Grid's Corridors 1 - 4 go through the proposed extension.

Submission

A Demand for transmission capacity, and its timing

By 2013, the capacity of the power stations feeding into the system via East Anglia (the demand for transmission) will be 5.3 GW[1]. The NG transmission facilities in East Anglia (the supply of transmission capacity) will be a 4.4 GW line via Walpole near Kings Lynn and the 4.4 GW line via Bramford. Both can be increased, by replacing the cables by higher capacity ones ("re-conductering"), to 6.6 GW, giving 13.2 GW in total. This might seem ample, but NG is required to be able to cope if a complete line of pylons is out of action. Consequently, once the demand for transmission exceeds 6.6 GW, NG is obliged to provide additional facilities. This increased demand is expected to arise before 2020.

By the time Sizewell C is in operation, some time after 2020, an extra 7.7 GW of generating capacity will require transmission facilities, giving 13 GW in all (5.3 GW up to 2013 plus 7.7 GW subsequently). The proposed 2nd Bramford – Twinstead line would provide 6.6 GW, giving 13.2 GW with a complete line of pylons out of action.

Shortly thereafter, on present plans, further transmission capacity will be needed for the 7.5 GW of the Round 3 wind farms off the coast of East Anglia.

Since the Round 3 wind farms will take some years to complete, there is a pattern of an increment of about 1 GW in generating capacity each year over the next 15 – 20 years. While transmission is provided by pylons, transmission capacity comes in lumps of 6.6 GW, equivalent to seven or eight years of growth in generating capacity.

The Round 3 wind farms will require the equivalent of a complete new line of pylons, from out in the North Sea to London. The economics of HVDC undersea transmission become much more favourable in this case than for on-shore generation. Using financial criteria alone, HVDC is recognised as economic (a) between asynchronous electricity systems (so, typically, internationally); (b) over long distances. The economics improve when the electricity source is off-shore. As noted below, HVDC becomes more attractive when its environmental benefits are taken into account.

It is plausible that HVDC will be the logical solution for the Round 3 wind farms. Once that is accepted, it becomes a question of *when* the investment is made, not *whether* it is made. Given that the unit size of investment in HVDC is 1 GW or less, an early investment in HVDC undersea for the offshore wind capacity due to come on stream before 2020 would enable the Bramford – Twinstead investment to be postponed.

The timing of new generating capacity is highly uncertain. For example, the NG Strategic Optioneering report[2] underlying the present proposals envisaged the first reactor at Sizewell C

[1] 1 GW, short for gigawatt, is 1 million kilowatts.
[2] See www.nationalgrid.com/NR/rdonlyres/8A844CE2-585E-4207-BF9D-E32B3FCDA517/38243/Strategicoptionsreport2.pdf

coming on stream in 2016 and the Round 3 wind farms by the same date. Both have already gone back by about five years. There is therefore value in transmission options that come in smaller units than the 6.6 GW of a new pylon line, and attract less opposition.

DVS recommends that the transmission options for East Anglia be reviewed to take into account (1) the Round 3 wind farms and the high probability that HVDC will be the preferred option for connecting them; (2) the timing uncertainties inherent in the new generating capacity proposals.

B The trade-off between financial cost and the environment

The fundamental issue involved in the decisions underlying this consultation is the trade-off between financial cost and the environment. NG's analysis, options and consultation fail to address this. This failure deprives the consultation of its validity.

- There is no doubt that the cheapest options involve above-ground transmission lines ("pylons").
- There is equally no doubt that pylons are environmentally detrimental.
- There is no doubt that there are options for long-distance bulk electricity transmission which avoid – or largely avoid - the environmental detriment of pylons.

The question is whether the greater financial cost of those alternative options is acceptable.

NG's analysis avoids this question. The options NG offers in the current consultation all carry similar cost. NG puts them forward ostensibly needing to be ranked according to their relative environmental detriment, which NG invites consultees to assess.

NG's position on more-costly less environmentally-damaging alternatives is muddled. NG emphasises the higher cost of such alternatives, implying that this alone rules them out. At the same time, it recognises that in some circumstances it is justifiable to adopt such alternatives. But it offers no guidance on how to decide when, and how far, to adopt these alternatives.

NG has indicated[3] that because in the past public inquiries and similar processes have decided against undergrounding transmission lines (except, sometimes, in nationally designated landscapes including AONBs), this is to be regarded as "settled law": a similar pattern of costs and benefits applies, so a similar result is to be assumed.

This is quite powerful in a pragmatic sense, but

- This was not put forward explicitly, still less substantiated, in the consultation documents. DVS recognises the factual contention to be broadly true, but is aware of considerable exceptions (eg the undergrounding at the Bramford end of Corridor 2, well outside the AONB, to take an example within the scope of the present consultation). Asserting "settled law" requires a good deal more than showing that most decisions have gone one way rather than another;
- There is a notable exception to the "settled law" contention. Transmission lines in conurbations are put underground as a matter of course. DVS acknowledges that the cost of land in these circumstances complicate the decision, but there seems no reason to doubt that there are corridors (eg railway lines, motor ways) where it would be feasible to route transmission lines at relatively low cost compared to undergrounding,

[3] In a meeting held as part of the consultation, on 15 February 2010

but that the public outrage which would be expressed at such a suggestion means it is not even contemplated;

- The exception for nationally designated landscapes is unclear. It is not absolute (eg the recent Beauly – Denny decision, to permit 137 miles of pylons through the Scottish Highlands National Park). What is the "settled law" here?

- The place of alternative transmission technology, especially undersea HVDC, needs to be established as part of the general approach to new transmission facilities. Since undersea HVDC is an environmentally preferable alternative to above-ground high voltage AC transmission lines, the environmental benefit needs to be brought into the process of deciding eg the break-even distance between the alternatives. If HVDC breaks even with HVAC at 100 miles on conventional financial criteria, what is the distance when environmental considerations are taken into account? 90 miles? 50 miles?

- Attitudes to the environment have changed over time. What was acceptable is not necessarily so now. An example which is central to the energy policy underlying the Bramford – Twinstead proposal is the decision to locate large scale wind farms offshore, rather than onshore where the financial costs and engineering risks would be far less[4], but where the environmental detriment would be far greater.

- In the past, the decision was a matter of judgement by one or a few individuals, and this was the only practical method available. But in recent years, social cost-benefit methods have been developed, to provide a better way of taking such decisions. The correct test – DVS submits - is whether the people of Britain are willing to pay the cost of undergrounding in landscapes of different degrees of sensitivity. This is a relatively clear-cut issue, of wide interest. It is therefore amenable to research into people's willingness-to-pay of the sort that has been done with success, and applied to real decisions, in areas, such as the value of preventing fatal road accidents (cf http://www.dft.gov.uk/webtag/documents/expert/unit3.4.php#02) or of prolonging life (cf http://www.nice.org.uk/media/B52/A7/TAMethodsGuideUpdatedJune2008.pdf), of even greater sensitivity than landscape value.

DVS argues

1 The additional cost of alternatives which largely avoid the environmental detriment of pylons needs to be put in one scale, and weighed against the associated environmental benefit in the other scale. That is to say, a social cost-benefit analysis needs to be performed. This is implicit in 2.7.6 and 2.7.10 of EN-5, the Draft National Policy Statement for Electricity Networks Infrastructure[5].

2 It follows that arguments based on cost ratios ("undergrounding costs 12 – 17 times pylons"[6]) simply fail to address the issue.

3 Arguments based on the net cost of undergrounding ("undergrounding Bramford – Twinstead would cost £600 million more than pylons") do provide data for one of the

[4] One estimate puts the cost at £20 billion: see *Sustainable Energy – without the hot air*, DJC MacKay, page 66.
[5] One of several documents recently published by the government, which will when approved govern the decision-making processes of the Infrastructure Planning Commission (IPC). The IPC will decide on National Grid's applications for projects such as the Bramford-Twinstead link. For details of the National Policy Statements see www.energynpsconsultation.decc.gov.uk/home/.
[6] See eg www.nationalgrid.com/uk/LandandDevelopment/SC/Undergrounding, paper on The Technical Issues, page 5.

two scales as at 1. But at best they simply assume, without providing justification, that the weight of the other scale is clearly less.

4 To make the comparison as at 1, the contents of each scale require to be in the same units. This is best done by (i) expressing the additional cost as an annual average amount per person or per household in the relevant population; (ii) discovering how much the average person or household in the relevant population is willing to pay, annually, to avoid pylons in the areas in question. If (ii) exceeded (i), the alternatives should be chosen: if not, not.

5 This calculation needs to be done on a national basis. It would not be justifiable to apply one approach in the Dedham Vale AONB and a quite different one in, say, the Surrey Hills AONB. It would not be justifiable to assume the benefit accrues exclusively to current residents of, say, National Parks and AONBs.

6 It might be thought inequitable for all electricity bills to carry a cost for environmental benefits accruing mainly to residents of protected landscapes. But (i) if it were to prove the case that those resident elsewhere perceived negligible value in the environmental benefits in question, the calculation at 4 above would not favour the higher-cost lower-environmental-detriment alternative; (ii) residents of conurbations already benefit, at the expense of other electricity users, from the absence of pylons in conurbations. It is also conceivable, in principle, that the population would on average be willing to pay to get rid of pylons on a wider scale than only in protected landscapes. Only an exercise to discover people's willingness-to-pay can show.

7 It is possible, using NG's cost data, to show – Appendix I – that it is not out of the question that the calculation at 4 above would favour the higher-cost lower-environmental-detriment alternative.

8 The principles of social cost-benefit analysis should be applied to the detailed design of mitigation measures, just as to the strategic decisions on routeing and technology. Numerical quantification as at 4 may not be practicable in all cases, but the principle of putting cost on one scale and environmental benefit in the other always applies.

9 Data on the population's willingness to pay to avoid environmental detriment is relevant to the assessment of the equivalent of s.106 payments[7] to mitigate or compensate for environmental detriment.

10 A consultation exercise which recognised that the fundamental issue is the trade-off between financial cost and the environment would have either offered cogent evidence that the calculation at 4 decisively rejects all alternatives to pylons, or provided considered costed alternatives to pylons, with careful analysis of their environmental pros and cons. The NG exercise made no attempt to do either. Hence it is rendered invalid.

[7] Obligations imposed on developers as part of granting planning permission. National Policy Statement 1 envisages that the IPC will be able to impose such obligations.

C The options offered by NG

So far as the options offered by NG are concerned, the environmental detriments differ, but there is no reason for concluding that any one is materially less bad in environmental terms than another.

The two northern corridors, 3 and 4, are similar in these terms. Neither involves the AONB but both involve attractive landscape, presently free from pylons. Residents naturally feel deeply that it is offensive to propose introducing pylons.

The two southern corridors, 1 and 2, are also similar in environmental terms. Both involve the AONB but both already have one line of 400 kv pylons for all or part of their length. The arguments against further intrusion into the AONB are well summarised in the comments by the Dedham Vale AONB & Stour Valley Project.

In essence, it comes down to the arguments against introducing pylons where there are none now, versus those against adding another line to an AONB. It is also worth noting the "Holford Rules"[8] argument against creating a "wirescape" by a concentration of transmission lines (which would be in a sensitive area of the Stour valley), and that (it is understood) there are more people resident in the areas affected by Corridors 1 & 2 than in those affected by Corridors 3 & 4.

NG have also offered an option ("2B") whereby the additional line of 400 kv pylons would follow Corridor 1, the existing 132 kv line on Corridor 2 would be removed, and a new sub-station to supply the 132 kv network built at or west of Twinstead.

In environmental terms, the new sub-station has to be set against the removal of the 132 kv line. The 132 kv line is much less obtrusive than the 400 kv line. Each 400 kv pylon is not only twice the height of a 132 kv pylon , but also twice the width, so four times the bulk as well as visible over a much larger area. Where the two lines run alongside each other, the 400 kv line dwarfs the 132 kv line.

Taking the 2B option into account, there is still no clear reason for concluding that any one of NG's options is materially less bad in environmental terms than another.

D Different extents of avoidance of environmental detriment

The NG discussion of undergrounding[9] implies it is to be confined (in the Bramford – Twinstead context) to the AONB. This is also the thrust of EN-1, the Draft Overarching National Policy Statement for Energy (section 4.24).

If this were to be applied literally to the Bramford- Twinstead Corridors 1 or 2, the environmental benefit would be small. Only about three kilometres lies within the AONB as now defined. Undergrounding involves intrusive installations at the beginning and end of the underground section. Considerable distances of the line would remain conspicuous from well within the AONB.

Undergrounding a longer section, including the prospective AONB extension and the stretches conspicuous from the AONB, ie about half the whole distance Bramford - Twinstead, would have a cost per kilometre materially less than for the shorter section, because the costs of converting from above-ground to underground transmission and letting

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[8] The "Holford Rules" are a series of planning guidelines, endorsed by National Grid, first developed in 1959 by Lord Holford, adviser to the then Central Electricity Generating Board (CEGB) on amenity issues: see EN-5, Draft National Policy Statement for Electricity Networks Infrastructure, paragraph 2.7.3

[9] See eg www.nationalgrid.com/uk/LandandDevelopment/SC/Undergrounding, paper on Approach to new connections

two different sets of contracts would be spread over about four times the kilometres. On the other side of the equation, the environmental benefits per kilometre would be similar, in DVS' submission, to those for the shorter section.

Undergrounding to that extent would go beyond the NG guidelines. But in choosing between these possibilities, the same social cost-benefit approach should be taken as with choosing between pylons and alternatives with negligible environmental detriment, as at **B** above. The difference in net cost is to be compared with the difference in net environmental detriment. This is what the National Policy Statements imply[10], and DVS support this.

Undergrounding the whole distance Bramford- Twinstead would have a cost per kilometre somewhat less than for half the distance Bramford- Twinstead (if only because the distance, if in tunnel, would be somewhat less by reason of taking a straight line route).
The environmental benefits per kilometre might be considered somewhat less, depending on the view taken of the value of landscape outside the AONB as against the value of landscape inside the AONB.

All this is set out in tabular form, with some illustrative figures, at Appendix II.

More exact figures of cost could be obtained from more detailed engineering work. Better estimates of environmental benefit could be obtained, first from a clearer view of the engineering options, second from work to understand people's willingness-to-pay to avoid different sorts of environmental detriment.

What is unlikely to change is the general point, that complete avoidance of the environmental detriments may well be more justifiable than partial avoidance.

[10] See eg EN-1, 4.1.1

How much would it add to electricity bills to put pylons underground?

Transmission companies are allowed 4.4% after-tax return on capital in real terms by OFGEM[11]. This implies a before-tax return of about 4.8%[12].

Their transmission lines will have a life of 50 years or so, so an amortisation rate of 2%.

So the additional capital cost of undergrounding represents an extra annual cost to the consumer of 4.8% + 2.0% = 6.8% per year of that additional capital cost[13].

We understand from NG that 100% pylons Bramford – Twinstead would cost £39 million, while 100% undergrounding in tunnel[14] costs £720 million, an excess of £680 million.

6.8% of £680 million is £46 million per year.

National Grid's income from electricity transmission in Britain is about £2.6 billion per year[15]. £46 million is 1.8% of £2.6 billion.

So recovering £46 million per year means an increase in their charges to the electricity consumer of 1.8%.

The typical annual household electricity bill is now £500 per year[16]. Transmission costs represent 3% of this[17], or £15 per year. 1.8% of £15 is 27p.

So 100% undergrounding of the new Bramford – Twinstead link would add to the typical household electricity bill 27p per year. There is also an indirect effect, via the electricity used in other goods and services, about three times the direct effect. So the total effect is about £1 per year.

Bramford – Twinstead is about 26 kilometres. The total length of existing high-voltage transmission in National Parks[18] is about 180 km[19] ie 7 times the Bramford – Twinstead distance. 7 times £680 million is £4.8 billion. If all existing high-voltage transmission in National Parks was put underground over 14 years, the typical household would pay, directly and indirectly, an extra 50p per year, each year, ie an extra £76 per year by the end of the 14 year period.

Whether this would be justifiable is to be decided, it is contended in the body of the paper, by investigating the willingness-to-pay of the population at large.

Note that this approach does not consider NG's financing arrangements[20]. The question is to decide the balance of social advantage. How the resulting decision is implemented is a separate and subordinate question.

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[11] http://www.ofgem.gov.uk/NETWORKS/TRANS/PRICECONTROLS/TPCR4/Pages/TPCR4.aspx
[12] On the basis of RAV gearing of 58% - NGET Annual Report & Accounts, page 19
[13] Strictly, less on average over the 50 years, as amortisation reduces the capital outstanding.
[14] This avoids the additional maintenance costs of trench burial
[15] NGET Annual Report & Accounts, page 17
[16] OFGEM:
http://www.ofgem.gov.uk/Markets/RetMkts/ensuppro/Documents1/Quarterly%20Wholesale%20Retail%20Price%20Report%20November%202009.pdf
[17] OFGEM Factsheet 81, http://www.ofgem.gov.uk/Media/FactSheets/Documents1/updatedhouseholdbills09.pdf
[18] We would like to give figures for AONBs, but do not have them at present
[19] CPRE Press release of 5 November 2009: Note 5, figures from National Grid
[20] Which are alleged to involve "front-end loading" of the recovery of investment costs.

Appendix II

If partial undergrounding is valid, then 100% undergrounding is even more so

Row		*Financial costs of undergrounding*	*Financial benefits of undergrounding*	*Environmental benefits of undergrounding*	*Environmental costs of undergrounding*
1	All above ground, Corridor 1 ("base case")	Zero	Zero	Zero	Zero
2	U/G in existing AONB only Relative to base case (Row 2 minus Row 1)	U/G – surface transition x 2 3 km U/G £116 m: **£38.5 m / km**	Zero	3 km U/G Partial respect for AONB	U/G – surface transition x 2
3	U/G wherever visible from existing or prospective AONB ("50% U/G") Relative to base case (Row 3 minus Row 1)	U/G – surface transition x 2 13 km U/G £400 m: **£31 m / km**	Zero	13 km U/G Full respect for AONB	U/G – surface transition x 2
4	50% U/G Relative to U/G in existing AONB only (Row 3 minus Row 2)	10 km U/G £285 m: **£28.5 m / km**	Zero	10 km U/G More respect for AONB	Zero
5	100% U/G Relative to base case (Row 5 minus Row 1)	U/G – surface transition x 2 23 km U/G £681 m: **£30 m / km**	Ability to phase investment	26 km U/G Full respect for AONB	U/G – surface transition x 2 but at Bramford sub-station & Twinstead Tee
6	100% U/G Relative to U/G in existing AONB only (Row 5 minus Row 2)	20 km U/G £566 m: **£28 m / km**	Ability to phase investment	26 km U/G More respect for AONB Lesser U/G – surface transition	Zero
7	100% U/G Relative to 50% U/G (Row 5 minus Row 3)	10 km U/G £280 m: **£28 m / km**	Ability to phase investment	13 km U/G Lesser U/G – surface transition	Zero
Costing assumptions: Pylons: £1.5m / km; Tunnels: shafts, other end installations and set-up costs: £5m per end; Total costs of 100% in tunnel: £720m, from figures given by NG at a meeting at Hintlesham					