Cost Benefit Analysis (CBA) of Digital Switchover

Summary

Economists in the Department of Trade and Industry (DTI), the Department for Culture, Media and Sport (DCMS), and (up to December 2003) the Radiocommunications Agency (RA) have developed a model to evaluate the **costs and benefits to the UK** of completing digital switchover. The switching off of analogue terrestrial transmissions and subsequent use of the UHF spectrum is compared with continuing with both analogue and digital transmissions.

The model uses estimates provided by various industry stakeholders of costs of conversion of the network and of benefits to broadcasters from not having to maintain analogue networks. Estimates of the benefits from future use of spectrum and of costs to consumers who would not voluntarily convert before switchover derive from survey work commissioned by the DTI. The Office for Communications (OFCOM) has also contributed to estimates.

The central case shows quantifiable benefits in the region of **£1.1 – £2.2 billion in NPV terms**. Sensitivity analysis gives results that show the positive Net Present Value (NPV) reducing under some assumptions but remaining substantially positive under most likely combinations of assumptions. The model shows that the outcome in terms of NPV is most sensitive to estimates of the value of extended coverage of digital terrestrial services and released spectrum.

These results give a clear message that switching off, rather than maintaining dual transmission systems, is in the economic interest of the UK. The model does not show indisputably that there is one preferred year for completing switchover, though it indicates that sooner is better than later. The model shows the costs and benefits for particular groups, such as consumers or broadcasters.

DTI/DCMS
10 February 2005

Introduction

1. This paper gives the results presented to Ministers in November 2004 of the CBA of digital switchover, with minor revisions to 9 February 2005. The model has been reviewed by independent economic auditors.

2. The CBA is a summation of all the costs and benefits associated with the digital television project of switchover to digital TV transmission only. This project is compared with the alternative scenario of a continuation of the current duplicate transmission of digital and analogue. This paper discusses the quantifiable results from the CBA model. The results include estimates of the cost of environmental effects. This paper does not discuss in detail the distributional aspects of the project i.e. the equity of the flow of costs and benefits which will arise from the project. There is no discussion in the paper of the non-quantifiable benefits e.g. the public service aspects of the digital TV project.

3. We have built the CBA using a spreadsheet model which shows the input variables (estimated costs and benefits) in the year when they will occur. All estimates are in real terms. The model discounts all figures back to 2004 (i.e. converts them to Present Value), using the Treasury discount rate of 3.5 % p.a. All benefits are summed and costs subtracted to arrive at an estimate of Net Present Value (NPV). The input estimates can be varied to test the effect on the NPV in sensitivity analysis.

3. The year of switchover is a key variable which can be changed in runs of the model to show the consequent NPV. The year of switchover is varied in the model from 2010 (the earliest year in which it was considered possible to reuse spectrum) for each of the following five years to 2015 (in all cases a date refers to the end of year). The period over which costs and benefits are estimated and compared is from the end of 2004 to the end of 2026 (when the licences for digital multiplexes granted in 2002 to BBC and Crown Castle reach the end of their second period of 12 years).

4. Figures 1 and 2 overleaf summarise the elements in the CBA and show how the work on various elements has fed into the estimates used in the CBA model.

Figure 1: Summary of elements in the CBA

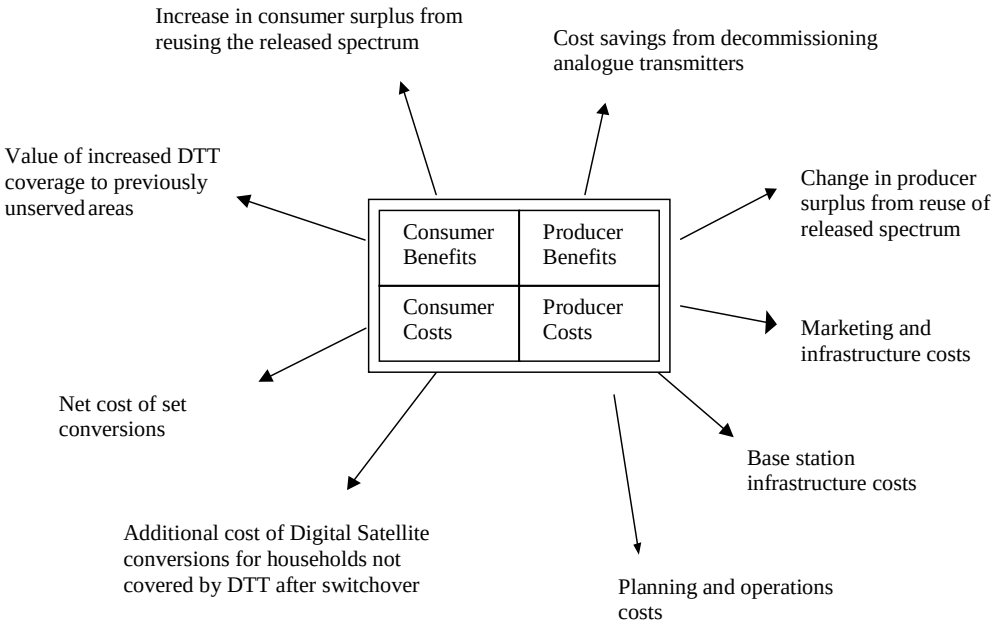
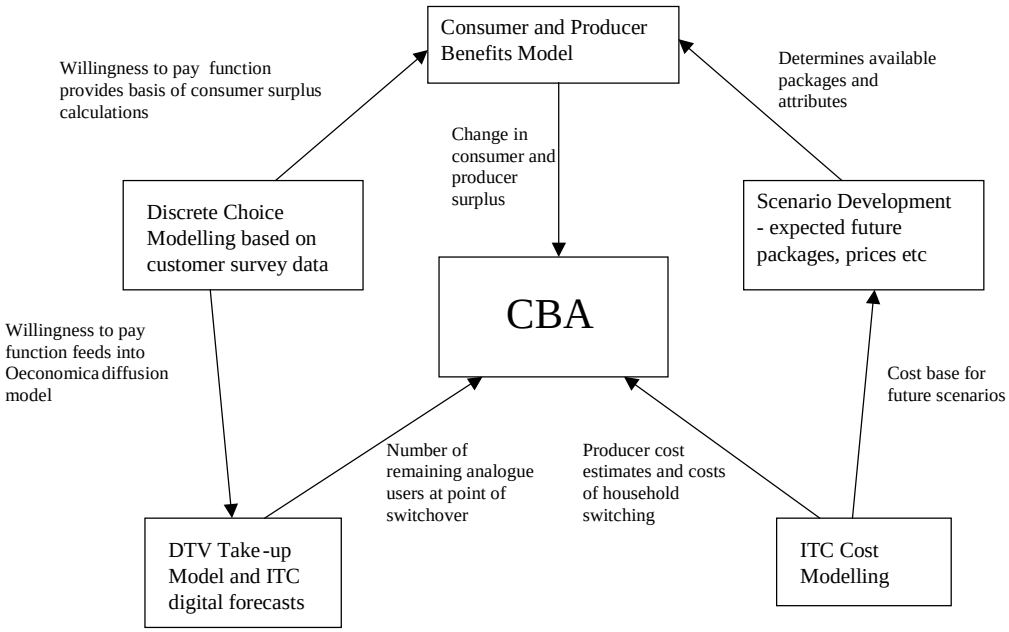


Figure 2: Models and assumptions feeding into the CBA



Estimates of costs and benefits

5. Because we are comparing digital switchover with the alternative of dual transmission, the estimates of costs and benefits used in the CBA are of the difference between the switchover scenario and the dual transmission scenario. Costs and benefits which would be the same in both scenarios are excluded from the CBA. As is normal in CBA, "sunk costs" are also excluded. For this purpose, the counting of costs will start from a "decision point" in the near future where a decision would be possible not to proceed with

the plan for switchover i.e. to continue with the scenario of dual transmission. On the basis of the CBA results of July 2003, it was announced in September 2003 that switchover was now a question not of whether, but of how and when.

6. Table 1 shows the elements of costs and benefits that we have used in the runs of the CBA model. The figures used rely in many cases on information provided in strict confidence to members of the CBA group.

Table 1 Quantified estimates of costs and benefits in model

COSTS	**Source of estimates**
DTT transmission capital and operating costs based on a digital network of 1100 transmitter sites	ITC, OFCOM, TDN (collectively and individual members), Mentor
Marketing and Communications costs	DTI/DCMS/ITC
Planning, management, operating costs of switchover	DTI/DCMS/ITC
Cost of converting non-digital primary TV sets	Forecasts of non-digital primary sets from Oeconomica and OFCOM
Size of population X cost of STB	OFCOM and TEG for costs of STB
Extra energy costs	DEFRA/DTI
Cost of converting non-digital secondary TV sets and VCRs	Forecasts from OFCOM and Intellect
Size of population x cost of STB	
Extra energy costs	DEFRA/DTI
BENEFITS	
Savings on analogue network transmission operating, energy and maintenance costs	OFCOM
Value of DTT to areas previously unserved. Re-use of cleared spectrum for TV (14 channels clear plus channels interleaved between DTT multiplexes)	Estimation studies commissioned by DTI

DTT = Digital terrestrial television
STB = Set top box
TEG = Technology and Equipment Group of the Digital Television Project
TDN= The Digital Network (broadcasters and transmission providers)
ITC – the Independent Television Commission (the ITC functions are now carried out by Ofcom)

Costs

Capital and running costs of new digital terrestrial transmitter sites

7. The Government issued a statement in January 2003 which confirmed that the frequency assignments made to main public service multiplexes at switchover would be based upon the conversion of the current analogue assignments to digital. The Spectrum

Planning Group (SPG) developed a switchover spectrum plan based upon this principle, which is now being taken forward by the Joint Planning Project. It is the combination between the number of sites, the power levels and the transmission mode which will determine the coverage of the public services by DTT once switchover is completed. Today's analogue network uses around 1100 transmission sites. Today's digital network uses 80 of these sites. The analysis presented in the paper is based on conversion at all the existing 1100 sites. This should mean that all current analogue viewers could receive the public services they receive now by DTT.

Consumer Reception costs

8. When switchover is implemented, all consumers who have not already taken up digital television services and are using analogue equipment will need to bear various receiver equipment costs needed if digital reception is to be possible. We begin with a forecast of the number of consumers who will take up digital TV through whatever channel (terrestrial, cable, satellite) according to normal market development.

9. We have two sources for the forecasts of digital TV take-up: a forecasting model constructed for us by academic consultants, Oeconomica; and forecasting work commissioned by OFCOM. The OFCOM forecasts are to the year 2012, whereas the Oeconomica forecasts are to 2015. Both give high and low projections. The OFCOM projections are broadly comparable to the projections of Oeconomica (OFCOM projections are higher in the first years but fall below Oeconomica forecasts for later years). The runs of the model discussed in this paper are based on the Oeconomica projections.

10. For all households who have not gone digital at the time of switchover, there will be the cost of converting their analogue set. We have estimated this cost by assuming it will be done by purchasing a STB. However, this cost will be an overestimate of the net economic effect. When switchover comes some of these consumers will have been very close to buying into digital i.e. they value digital TV at some level below the cost of a STB but greater than zero. To model this, we have made the assumption that the implicit demand curve for digital is a straight line from the cost of a STB to zero. Therefore the average valuation by these consumers of the benefit will be half the cost of a STB. We reduce the costs of the new equipment by half to measure its net effect on overall economic welfare. We have made a reduction in these imputed benefits to avoid any double counting in those areas of the country which do not yet receive digital terrestrial signals, as the benefits to consumers in these areas are estimated as benefits due to extended coverage (see paragraph 14 on).

11. At switchover it is not only non-digital primary TV sets which will lose functionality but all non-digital TV sets and VCRs. We know that the average ownership of TVs per household is currently about 2.5 sets and the current total population of TVs is around 55 million. Forecasting the size of the population of non-digital TVs and VCRs in the future is complex. As consumers buy new TV sets, old sets are often not scrapped but retained in use. In addition, a growing number of consumers who have converted their primary set to digital also convert other sets. In the case of VCRs, forecasting is made difficult by the prospects of growth in the sales of Personal Video Recorders (PVRs). Some projections from industry are very optimistic about the growth of sales of STBs and PVRs with VCR sales dwindling rapidly. Also many consumers would retain their VCRs but use them only

for playing previously recorded videos. In the face of these uncertainties we have used a fairly conservative set of assumptions to build projections of the population of analogue only TV sets and VCRs that would need conversion. We have done sensitivity analysis around these central projections. As is the case for primary sets we have netted out an estimate of the benefit which consumers obliged to convert will obtain from their converted sets.

12. We have included estimates of the additional energy costs that will be incurred by consumers using the additional STBs that are bought because of the switchover policy. These estimates include an estimate for the social cost of carbon.

Benefits

Savings in analogue transmission costs

13. When analogue transmission ceases there will be a saving in the running, upkeep, energy and capital replacement costs of analogue transmission sites. These costs would be incurred in the non-project scenario, so they are counted as benefits in the project scenario.

Benefits of released spectrum

14. When analogue transmission ceases, there will be a release of 14 channels of clear radio spectrum. The economic value of this spectrum will depend upon how it is used. The RA commissioned work which fed into the estimates on two broad options: television and mobile telecommunications. Generally, these estimates of the value of the spectrum gave higher values for mobile telecommunications. However, because of risks and uncertainties attached to the possibility of using the spectrum for mobile telecomms, arising from the need for international agreements, the analysis in this paper is based on the assumption that the released spectrum is used for digital television services. The RA estimates for television have been updated by work based on a consumer survey commissioned by DTI in 2004.

15. At switchover there will also be a benefit arising from the fact that digital TV coverage will be available for the first time to a substantial part of the population (during dual transmission it will be technically impossible to reach these households through terrestrial transmission). We refer to this class of benefits as “extended coverage” benefits. There will also be the potential for additional services using the interleaved spectrum available between the digital television multiplexes.

16. The DTI has made estimates of the value of the benefits arising from the three categories above. A study was carried out in 2004, updating earlier surveys done for the RA, of how consumers would value the new digital TV services, in terms of their willingness to pay, based on Revealed and Stated Preference survey work. This is inherently a difficult exercise because consumers are being asked to value services some of whose features are novel and which would arise some time in the future. As a result, and because of other assumptions which are needed for forecasting, the estimates of the value of these services have a wide range.

17. We have made a simplifying (and conservative) assumption that the producer surplus for the operators of the new services on released spectrum would be competed away.

Results

18. These are set out in Table 2 overleaf. The figures shown are the overall Net Present Value of the digital TV switchover as compared with the alternative of continued dual transmission. The analysis is done varying the year of switchover for each of the years 2010 to 2015 (end year in all cases). Switchover in years earlier than 2010 has not been modelled as it has become clear that in broad terms the lead times needed for planning and implementation make 2010 the earliest feasible date. The overall result is broken down to show the NPV for broad groups affected by switch-over. This shows that the main categories of benefits are the consumer surplus which will be generated by the extension of digital services to new parts of the population and new services provided over released spectrum. The broad groups of consumers and broadcasters both have a substantial positive net benefit.

Table 2 Results from CBA model

NPV **£ million (2004)**

Year of completion of Switch-over	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Benefits						
Consumer benefit in current non-DTT areas	3246	2987	2725	2495	2262	2035
Consumer benefit from additional services in retailed spectrum	787	724	659	605	548	493
Consumer benefit from re-use of released spectrum	1181	1086	1011	907	821	740
Imputed consumer benefit of compulsory migration	689	678	657	626	599	574
Broadcaster benefit from savings on analogue transmission and energy costs	1377	1282	1191	1103	1018	936
Total benefits	**7280**	**6759**	**6244**	**5736**	**5247**	**4778**
Costs						
Non-voluntary consumer costs on reception equipment	2504	2454	2357	2220	2082	1963
Additional consumer energy costs (incl. social cost of carbon)	1651	1529	1412	1297	1187	1081
Broadcaster investment in digital infrastructure	702	660	619	580	542	505
Marketing & practical support costs (excluding any targeted assistance)	174	169	163	157	152	147
Total costs	**5031**	**4812**	**4551**	**4254**	**3963**	**3696**
Total NPV	**2249**	**1947**	**1692**	**1482**	**1285**	**1082**

19. To summarise the main assumptions in the central case:

- - the project duration is from 2004 until the year 2026 (when licences granted to the existing multiplex operators end following one renewal)
- digital take-up of primary sets follows the Oeconomica forecast;
- it is assumed that released spectrum is used for services using broadcasting technology;
- discount rate of 3.5% p.a. is used following Treasury guidance in the Green Book.

20. The central case figures show a positive NPV for switchover in each year, starting at around £2.25 billion with 2010 switchover. The NPV falls for each year that the switchover is delayed by around £250 -£300 million. This reflects that the loss of benefit from delaying switchover is greater than the lower costs. However, given the magnitude of the input figures and the range of uncertainty this is not a particularly robust result i.e. the difference in the NPV resulting from delaying switchover from one year to the next could well be smaller (see sensitivity analysis in paragraph 21 onward). However, the effect of a five-year delay is likely to be around £1.2 billion in NPV terms.

Sensitivity analysis

21. All our input variables are subject to uncertainty and we have run the model with different values for all of them, on a high, central, and low basis. The main results are summarised in Table 3.

Table 3 Sensitivity analysis

				NPV in £million (2004) with switchover in year shown		
Year switch-over completed	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
1 Central case	**2249**	**1947**	**1692**	**1482**	**1285**	**1082**
2 Low consumer benefits	1207	989	814	680	559	428
3 High consumer benefits	3824	3342	2913	2534	2174	1814
4 High energy consumption	1435	1192	996	842	699	549
5 Efficient energy consumption	3028	2664	2351	2111	1860	1606
6 High infrastructure costs	1546	1254	1010	809	622	428
7 High Reception costs	2138	1764	1437	1155	910	665
Note to table: Each scenario alters one key variable relative to the central case						

22. The low and high consumer benefits cases refer to the outer ranges of estimation based on the consumer preference surveys. The high infrastructure cost case uses the higher range estimates of the investment and running costs of the new digital TV transmission infrastructure. The high reception costs case assumes a greater number of TV sets and VCRs requiring conversion.

23. As one would expect, the NPV results are most sensitive to the input variables of the greatest magnitude and with the widest range around their central estimate. In descending order the central results are most sensitive to: the valuation of the consumer benefits of extended coverage and released spectrum; the energy efficiency of reception equipment and its use; the estimated cost of transmission infrastructure; and the population of non-converted reception equipment. These are discussed further below.

Varying estimates of benefits of extended coverage and released spectrum

24. The DTI work on estimating these benefits gives us a central estimate of their value of £530 million p.a., a high case of £690 million p.a., and a low case of £424 million p.a. If the low case is used, with all other variables the same as in the central case, then these annual figures convert into an NPV which is lower than the central case by between £0.6 billion and £1 billion depending on the year of switchover. For example, for switchover in 2012 the NPV in the central case is £1.7 billion but in the low benefits variant the NPV comes down to £0.8 billion. On the upside, if consumer benefits are higher, the overall NPV would be £2.9 billion for 2012 switchover, higher by £1.2 billion than the central case.

Varying assumptions about the energy efficiency of equipment and use

25. The CBA model uses estimates of the amounts of the net additional consumption of energy which will be brought about as the result of switchover. It also includes estimates of the additional costs of the externalities of this extra energy use, through the inclusion of the costs of equivalent tons of carbon. Forecasts of extra energy consumption depend upon forecasts of future purchases of equipment e.g. Set Top Boxes, the energy efficiency of this equipment and upon consumer behaviour. Government will have an influence on the last two factors through promoting energy efficiency. Given the number of assumptions that have to be used in the forecasts, there is a wide range in the results of the sensitivity analysis. If switchover is completed in 2012, the difference between the central case and either of the two energy use variants is around £700 million in NPV terms.

Varying estimates of transmission infrastructure equipment costs

26. Using higher estimates of these costs has a substantial effect on the NPV. For 2012 switchover, the central NPV of £1.7 billion would reduce by nearly £700 million to around £1.0 billion.

Varying estimates of reception equipment costs

27. This variant of the central case uses higher estimates of the future population of non-converted TV sets and VCRs i.e. we have taken a pessimistic view of the voluntary

conversion of second TV sets and of VCRs For 2012 switchover, the NPV comes down compared to the central case by about £ 250 million. This leaves it at around £1.4 billion.

Conclusions

28. On the basis of the central case and sensitivity analysis it seems highly probable that the quantifiable benefits of switchover compared with dual transmission would be substantial, for 2012 switchover most likely in the region of £1.0 - £2.9 billion in NPV terms with a central estimate of £1.7 billion. The results are most sensitive to the estimated value of extended coverage and released spectrum.

29. In terms of timing, the central case shows a loss of NPV for every year of delay in switchover from 2010 of around £250-£300 million a year. The dominant reason for this result is that delay loses the substantial benefits of the extended and new services on released spectrum and this has a greater effect than that of lower costs. The sensitivity analysis shows that under some assumptions this penalty of delay reduces to about £ 200 million a year in NPV terms but delay always has a substantial cost. A delay of five years under the central assumptions has a cost of about £1.2 billion in NPV terms. Along the time dimension the central case NPV varies from £2.2 billion to £1.1 billion.

DTI/DCMS
10 February 2005