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EN TELECOMMUNICATIE

MEDEDELING VAN DE RAAD VAN HET BIPT
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BETREFFENDE
DE STUDIE VAN AETHA CONSULTING LIMITED "ECONOMIC BENEFITS FROM USE OF THE 790-862 MHz BAND FOR DTT AND MOBILE BROADBAND"

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Context

Het BIPT deed in 2012 een beroep op een onafhankelijke consultant om de problematiek van de 800 MHz-band te bekijken met het oog op het formuleren van aanbevelingen voor het vastleggen van de technische parameters en de regels voor de toewijzingsprocedure die op nationaal vlak geïmplementeerd moeten worden. Deze studie werd uitgevoerd door Aetha Consulting Limited in samenwerking met NERA Economic Consulting en resulteerde in het rapport "Regulations for award of the 790-862 MHz band" van 31 oktober 2012.

Het BIPT publiceerde dit rapport bij wijze van mededeling van de Raad van 14 november 2012.

De minister bevoegd voor telecommunicatie verzocht het BIPT om een bijkomende studie te laten uitvoeren aangaande de evaluatie van de waarde van de 800MHz band voor elk van de 2 gevallen: het gebruik door digitale terrestriële Televisie (DTT) en het gebruik door mobiele breedbanddiensten. Tot voor kort werden enkel waarderingen uitgevoerd op basis van extrapolaties van de situatie in andere Europese landen en op basis van parameters (vb. duurtijd van de vergunningen) die inmiddels gewijzigd zijn.

De bijkomende studie werd uitgevoerd door Aetha Consulting Limited en resulteerde in het rapport "Economic benefits from use of the band 790-862 MHz for DTT and broadband mobile" van 27 februari 2013.

Er moet rekening worden gehouden met het feit dat de in deze studie geformuleerde adviezen en voorstellen, toebehoren aan de auteurs ervan.

Bijlage

Het rapport is in bijlage hernomen.

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Economic benefits from use of the 790-862MHz band for DTT and mobile broadband

Report for BIPT

27 February 2013

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0 Executive summary

This report has been prepared by Aetha Consulting Limited (Aetha) for the Belgian Institute for Postal Services and Telecommunications (BIPT) as a summary of an assessment we have undertaken of the economic benefits arising from the use of the 790-862MHz band for both digital terrestrial television (DTT) and mobile broadband.

0.1 Background

The switch-off of analogue terrestrial television has resulted in the creation of the so-called 'digital dividend', part of which is being utilised to create a new internationally harmonised frequency band for electronic communications services in the frequency range 790-862MHz – the so-called "800MHz band[1]".

The objective of this study is to estimate the economic benefits that arise from use of the 790-862MHz frequency range in Belgium under two alternative scenarios:

- if the 790-862MHz had continued to be available for digital terrestrial television
- if the 790-862MHz band is used for electronic communications services.

The purpose of this study differs from previous studies on the same topic. Previously, the intention was to identify the highest value use within the 790-862MHz band and ensure that the frequency range can be made available for this use. Based on the decision of the European Commission, it has already been decided to make available the 790-862MHz band for electronic communication services under a set of harmonised technical conditions[2,3]. However, we understand that BIPT requires the results of our analysis in support of discussions that are taking place between the Belgian federal, regional and community governments. The purpose of these discussions is to assess whether there is a requirement for "compensation" for this (formerly broadcasting) spectrum which is now made available for electronic communications services in line with EU requirements.

To-date, the only estimates of the value of the 790-862MHz band that have been made for Belgium comprise a relatively simple extrapolation[4] (e.g. scaling with population) of the results from detailed economic studies that were undertaken by consultants on behalf of the French, Netherlands and the UK governments/regulators. This process yielded estimates for the economic value of the 790-862MHz band of EUR681 million if the band was used for DTT and EUR2922 million if the band was used for mobile broadband services (both numbers are net present values over a period of 15 years).

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1 Within this report, we refer to the term '800MHz band' only when discussing the impact on mobile services, as the term is commonly used to refer to a specific band plan which could not be used by broadcasting technology. In the case of broadcasting technology, we simply refer to the relevant frequency range of '790-862MHz band'.

2 European Commission (2009), "Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions - Transforming the digital dividend into social benefits and economic growth"

3 European Commission (2010), "Commission Decision of 6 May 2010 on harmonised technical conditions of use in the 790-862 MHz frequency band for terrestrial systems capable of providing electronic communications services in the European Union"

4 Analysys Mason (2010), "Report for BIPT: Future regulation of wireless access in the 790MHz-3400MHz"

Within this report, we present a more detailed bottom-up estimation of the value of the 790-862MHz band when used for DTT or mobile which takes account of the latest developments within both the television and mobile markets and reflects their impact on the economic value of the 790-862MHz band.

0.2 Approach to assessment of economic benefits

As indicated above, the aim of our analysis is to assess the economic benefits resulting from making available the 790-862MHz band for either of two potential services:

- **Digital Terrestrial Television (DTT) services** – Using the 790-862MHz band for DTT would effectively enable the platform to include more television channels in the service line-up. This could attract more subscribers and could make the television service more attractive/beneficial to (existing) subscribers. These benefits have to be weighed against the cost of installing and operating additional multiplexes to support such a larger service line-up.

- **Mobile broadband services** – The principal benefit of the 800MHz band is that it is currently the only frequency band which provides cost-effective widespread availability of high-speed mobile broadband services using Long-Term Evolution (LTE) technology. In the absence of the 800MHz band, LTE network availability could be provided solely using higher frequency bands (1800MHz and 2.6GHz), but with less widespread network coverage, leading to a loss of benefits for a significant proportion of the Belgian population until other low-frequency bands (e.g. the 900MHz band) could be made available for LTE deployment.

Within our analysis, we assess the *incremental* economic benefits, i.e. the additional value which the respective services derive from using the 790-862MHz band in addition to any other spectrum assignments. This is quite important in the context of DTT and mobile broadband use, as neither of the services is dependent on the availability of the 790-862MHz band to ensure the general provision of services. Instead, both uses can provide a more attractive / efficient service if they were to gain access to the 790-862MHz band.

This is reflected in our modelling, as we compare the value derived in a Counterfactual scenario (i.e. provision of DTT/mobile services without 790-862MHz spectrum) with the value of (one or more) Factual scenarios (i.e. provision of DTT/mobile services with 790-862MHz spectrum).

For each of these two alternative uses of the 790-862MHz band, we have calculated the incremental benefit of the band in respect of:

- **Producer surplus** – the profit earned by the producer of the service, which is the essentially the difference between revenues from the service and the cost of providing the service.
- **Consumer surplus** – the difference between consumers' valuation/willingness to pay for the service and the prices actually paid.

Our analysis focuses on the quantifiable benefits which are derived from the use of the 790-862MHz band by either DTT or mobile services, i.e. increases in the efficiency of operations (e.g. cost savings) or benefits derived from a better service (e.g. larger subscriber bases, higher willingness to pay by consumers).

The economic value estimations provided in this report are based on the net present value of the sum of the consumer and producer surplus over a 20-year period (2014-2033) using a social discount rate of 3.5%.

The 20-year period has been chosen to align with the proposed duration of the 800MHz licences and the discount rate is a social discount rate based on current literature on this topic.

0.3 Economic benefits from use of the band for DTT

DTT currently occupies a niche position in the Belgian television market. With cable subscriptions being the most widely used platform (78% take-up of Belgian households), DTT is utilised as a primary viewing platform by only about 1% of households (IPTV and satellite services are other main delivery platforms). A further 1.5% of households utilise DTT for secondary television sets[5].

We note that there are significant regional differences in the availability of DTT content in Belgium. Within the Flanders and Brussels regions, subscribers potentially have access to free-to-air (FTA) services as well as subscription DTT services. In the Wallonia region, access is mainly limited to the French-speaking Belgian PSB channels. However, in order to simplify our analysis, we have not differentiated between the two Belgian regions. Instead, we assume that, over time, a subscription DTT service will also become available in the Wallonia Region. We note that this is an assumption which is likely to provide a higher value for the use of the 790-862MHz band for DTT.

We expect that the retention of the 790-862MHz band for DTT would result in the ability to deploy two additional multiplexes, and therefore additional channels. The availability of two additional multiplexes from using the 790-862MHz band is an optimistic assumption, designed to determine the upper bounds of the value of this band when utilised by DTT. Typically, the availability of 790-862MHz spectrum is assumed to allow for 1 – 1.5 additional multiplexes to be deployed.

Within our analysis, we consider three different scenarios to estimate the incremental economic benefits derived from using these additional multiplexes for the provision of DTT in Belgium:

- **Counterfactual scenario:** This represents the case where the 790-862MHz band is not used for broadcasting services and there are therefore no additional multiplexes available.
- **Factual 1:** The 790-862MHz band is used for DTT and the incremental multiplexes provide FTA services.
- **Factual 2:** The 790-862MHz band is used for DTT and the incremental multiplexes provide subscription DTT services.

Within the two factual scenarios, we expect that an increased number of channels available on the DTT platform would impact consumer surplus in two ways:

- An increased number of channels generally increases the attractiveness of the DTT platform relative to competing television platforms. This could lead to an increase in DTT platform take-up, although we expect that most of the increase will be from secondary television sets.
- With more channels being available on the platform, new and existing users attach an increased value (willingness to pay) to the available services.

We calculate the producer surplus for DTT using a simplified model of an integrated broadcaster. This means that, in order to limit the complexity of our analysis, we only consider a single 'producer' which combines the revenues and cost streams which are typically incurred separately by multiplex operators

[5] Conferentie van regulatoren voor de elektronische communicatiesector (CRC) (2011), "Betreffende de analyse van de markt voor televisieomroep in het Nederlandse taalgebied"

(such as Norkring), broadcasters (e.g. RTBF) and platform operators/retailers (e.g. Telenet). Within our analysis, we estimate producer surplus by:

- considering the revenues which operators may derive from operation of a DTT network, notably from subscription fees
- weighing these revenues against the cost of installing and operating a DTT network as well as any increase in production costs from a more extensive viewing share.

Our model does not consider incremental advertising revenues. We assume that total advertising expenditure across the audio-visual broadcast market is fixed and any increase in producer surplus on the DTT platform would merely represent a transfer from other platforms and therefore would not constitute an increase in total welfare generated in Belgium.

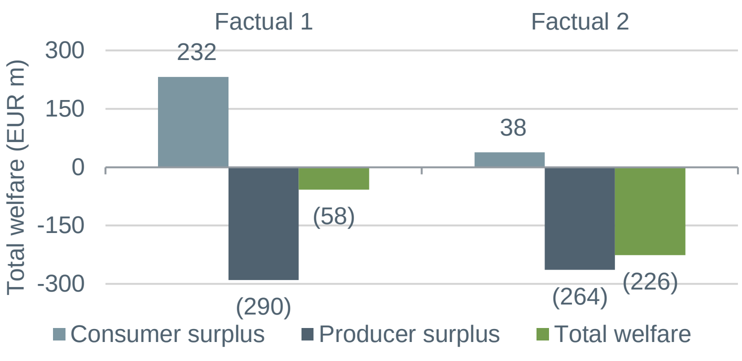
Throughout our analysis, we have applied optimistic assumptions which, if anything, are likely to overvalue the impact of using the 790-862MHz band for DTT:

- We assume that DTT penetration grows to more than 5% of households in the different factual scenarios, which constitutes more than a doubling in penetration relative to today.
- We expect that all DTT viewing will be secondary viewing, i.e. any consumer surplus created by DTT viewing is a complement (rather than a substitute) to existing viewing.

Despite using such highly optimistic assumptions, the results of our analysis suggest that the total surplus derived from making the 790-862MHz band available for DTT services would be negative. We estimate that the value in the Factual 1 scenario (availability for FTA services) would be around -EUR58 million and that it would be around -EUR226 million in the Factual 2 scenario (availability for subscription services).

The split of welfare between producer surplus and consumer surplus in both scenarios is summarised in Figure 0-1 below.

Figure 0-1: Split of total welfare in the factual scenarios from use of the 790-862MHz band for DTT (base case)



We have also carried out sensitivity analysis to understand the potential upside if we were to apply the most optimistic (in respect of maximising welfare) assumptions to our models. We have carried out such sensitivity analysis on the value of the 790-862MHz band for DTT for three key input parameters:

- the willingness to pay of consumers for television services
- the take-up of DTT services following a release of the 790-862MHz band for DTT
- the cost of installing and operating DTT multiplexes in Belgium.

The results of this analysis are summarised in Figure 0-2.

Figure 0-2: Summary of sensitivity analysis regarding the value of the 790-862MHz band for DTT

Scenario (EUR m)	Base Case (EUR m)	Sensitivity 1 – WTP (EUR m)	Sensitivity 2 – Take-up (EUR m)	Sensitivity 3 – DTT cost (EUR m)
Factual 1	-58	53	45	32
Factual 2	-226	-180	6	-136

The maximum value we can establish for use of DTT in the most aggressive scenario is EUR53 million in case of the Factual 1 scenario, assuming an average willingness to pay per DTT household of EUR28 per month. This compares to our base case assumption of a willingness to pay of EUR20 per household per month.

0.4 Economic benefits from use of the band for mobile broadband

In order to calculate the surplus derived from use of the 800MHz band for mobile broadband, we consider two scenarios:

- **Counterfactual scenario:** Mobile operators do not gain access to the 800MHz band. In the short term, this means that they will not gain access to suitable low-frequency spectrum for LTE coverage and they will therefore have to rely on other, higher frequency bands to provide (less economical) LTE coverage.
- **Factual scenario:** Mobile operators will be awarded 800MHz spectrum. This allows them to provide cost-efficient mobile coverage to ~99% of population, i.e. it will allow for ubiquitous LTE coverage and thereby assist the rapid deployment of LTE technology.

Within our assessment, we apply the term 'producers' to refer to Belgian mobile operators. The availability of the 800MHz band for mobile services will provide two main sources of incremental producer surplus for these operators:

- Network savings from the availability of suitable low-frequency spectrum to achieve LTE coverage. This means that operators are not forced to densify their networks in order to provide competitive levels of LTE coverage.
- The availability of suitable low-frequency spectrum for LTE coverage is likely to accelerate the deployment of LTE and also extend to areas of Belgium which would be uneconomic to cover without low frequency spectrum. This in turn will drive faster take-up of (higher value) LTE services and can provide additional revenues to mobile operators.

The draft Royal Decree specifies that three lots of 2×10MHz of 800MHz spectrum will be made available in the auction[6]. Within our assessment of the economic benefits of 800MHz spectrum use, we assume that all available lots in the auction will be acquired by three different operators allowing them to provide low-frequency LTE coverage. Within the modelling, we have refrained from modelling specific operators but instead refer to an 'average' operator.

Consumers of mobile broadband would also benefit from the use of the 800MHz band for mobile services as the mobile network operators would be able to provide them with better LTE coverage more swiftly. We

[6] Source: http://datanews.levif.be/ict/actualite/le-gouvernement-espere-tirer-360-millions-d-euros-du-dividende-numerique/article-4000243382127.htm

assume that mobile users would value such access to faster mobile services, which is expressed by an increased willingness to pay for these services. Hence, a faster LTE take-up is the key driver underlying any increase in consumer surplus in case the 800MHz band is available to mobile operators.

Our analysis of the economic benefits of using the 800MHz band for mobile services establishes an overall welfare impact of about EUR1056 million in the base case, of which about 66% arises from consumer surplus (EUR692 million) and 34% is from producer surplus (EUR364 million).

In addition, we have carried out a range of sensitivity analysis on some of the key inputs on which there is a significant degree of uncertainty. We have carried out such sensitivity analysis on the value of the 800MHz band for mobile services for three key input parameters:

- the final coverage level using 1800MHz spectrum in case the 800MHz band is not available
- the price elasticity of demand for mobile services
- the mark-up which is placed on LTE services.

The results of this analysis are summarised in Figure 0-3.

Figure 0-3: Summary of sensitivity analysis regarding the value of the 800MHz band for mobile services

Scenario (EUR m)	Base Case (EUR m)	Sensitivity 1 – LTE coverage (EUR m)	Sensitivity 2 – Price elasticity (EUR m)	Sensitivity 3 – LTE mark-up (EUR m)
Factual	1056	1056 – 1407	828 – 1435	886 – 1397

Notably, our base case estimation of EUR1056 million is closer to the lower bound of our range than to the upper bound. This is due to our decision to select relatively conservative assumptions for the mobile case in order to minimise the risk of overestimating the value to mobile services.

0.5 Conclusions

Within this study for the Belgian Institute for Postal Services and Telecommunications, we have assessed the economic benefits which can be derived from use of the 790-862MHz band for either DTT or mobile broadband services in Belgium. The purpose of the study is to inform discussions between the Belgian federal, regional and community governments on the potential need for "compensation" for this (formerly broadcasting) spectrum which is now made available for electronic communications services in line with EU requirements. The conclusions of our study are as follows:

- We expect there to be very limited value to use of the band by DTT. Within our base case analysis, we estimate that the value for use of the frequencies for FTA services would be about –EUR58 million, and the value for use by DTT subscription services would be about –EUR226 million.

- In contrast, we expect there to be significant value for use of the band by mobile broadband services. Our model expects that overall surplus derived from use of the band could be EUR1056 million.

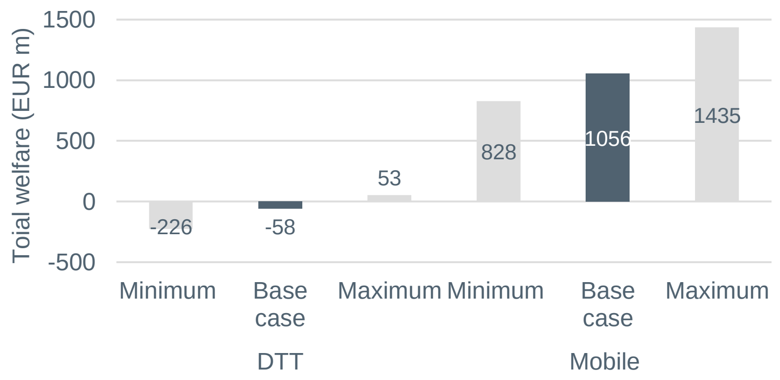
We are confident that our results are a valid representation of the potential surplus within the context of the Belgian market. Despite generally applying optimistic assumptions when estimating the economic benefits of using the 790-862MHz band for DTT services, we cannot establish a significant positive value. The main reasons for this are as follows:

- Even though we expect some incremental take-up in DTT household penetration from the installation of incremental multiplexes, the cost of installing and maintaining the infrastructure outweighs the potential benefits to consumers. This conclusion is not surprising, as a nationwide infrastructure needs to be maintained to serve the secondary viewing demand of an estimated 5% of all Belgian households.

- Market evidence from Belgium supports this conclusion:
  - Currently, only 2.5% of households are using the DTT platform. Research conducted by the regional media regulators established that consumers would not consider switching to DTT from their current (cable) subscription, even in case of significant price increases on the cable platform[5].
  - Only three channels are being broadcast on the current FTA multiplex. This indicates a lack of demand for additional FTA services. Effectively, only 50% of the capacity of a single multiplex is being used for FTA television content.
  - Telenet, the commercial DTT subscription operators in Belgium, recently wrote down more than 90% of the value of its DTT assets which it has only held for about 2 years.

Based on a number of sensitivities, we have established a range for our estimates of the economic value of both services, as shown in Figure 0-4. This further strengthens our conclusions, as the value of using the 790-862MHz band for DTT only turns positive in a small number of low-probability scenarios. Further, it never exceeds 6% of the value of the lowest value scenario for mobile services.

Figure 0-4: Range of estimates for total welfare from use of the 790-862MHz band



Notably, the economic benefits calculated in this study are somewhat lower than high-level estimates made by Analysys Mason as part of a project for BIPT in 2010[4]. The previous estimates of economic benefits were based on simple extrapolation of the results of economic studies undertaken in several other European countries, that the value for DTT could be around EUR681 million whilst it could be EUR2922 for mobile services. We believe that there are a number of reasons which explain the differences between the previous study's estimates and our estimates:

- Regarding the value for DTT:
  - The results from other countries were not scaled to take account of DTT penetration. One of the countries within the benchmark is France, which has a DTT penetration of 62%[7]. It is not surprising that a country with a more than 40-fold increase in DTT penetration has a significantly higher value for DTT services.
  - Scaling appears to have been undertaken based on the total value per multiplex – and several of the underlying studies estimated the total economic benefits of DTT (i.e. the benefits of the entire UHF spectrum band) rather than just the economic benefits of spectrum in the 790-862MHz band. This

[7] As reported by the European Audiovisual Observatory at: mavise.obs.coe.int/country?id=1

approach ignores the decreasing marginal value per multiplex. Clearly, an increase from 1 to 2 multiplexes is likely to provide much larger incremental surplus than a move from 5 to 6 (or 6 to 7) multiplexes given the relative increase in the number of broadcast channels on the platform. By using an average value per multiplex, the result of the calculation might therefore significantly overestimate the incremental value of the 790-862MHz band in contributing to the overall value of DTT services in the frequency range below 1GHz.

- Regarding the value for mobile services:
  - We have taken a relatively moderate view on the increase in value from LTE compared to other technologies. This reflects recent trends in the mobile communication markets which have led to a continuous decrease in revenues and EBITDA margins and a reduced belief that operators will be able to charge significant premiums for new services in an increasingly competitive environment.
  - More importantly, we assume that suitable alternative bands for the 800MHz band will soon be available to mobile operators, such as the 900MHz, or even the 700MHz band. This leads to a situation where any benefit from having 800MHz spectrum is only temporary and therefore, significantly reduced in scale. This information was not necessarily available at the time that earlier studies on the value of the 800MHz band were undertaken, and therefore may have led to higher estimates of the longer-term value of the 800MHz band.
  - In addition, the previous study quotes a range for the value of mobile services from EUR263 – EUR5581 million to account for the uncertainty of the estimates. Clearly, the results of this study are well inside this range.

Finally, we would like the reader to note that we have looked to provide well-founded analysis to justify key inputs throughout our analysis in order to arrive at realistic estimates for the economic benefits of using the 790-862MHz band. As with any analysis assessing consumers' preferences, there remains an unavoidable degree of uncertainty around the accuracy of our estimates. However, we have carried out sensitivity analysis on some of the key input factors in our models and can conclude that the qualitative conclusions remain unaffected, even when comparing the worst-case scenario for mobile and the best-case scenario for DTT.

1 Introduction

This report has been prepared by Aetha Consulting Limited (Aetha) for the Belgian Institute for Postal Services and Telecommunications (BIPT) as a summary of an assessment we have undertaken of the economic benefits arising from the use of the 790-862MHz band for both digital terrestrial television (DTT) and mobile broadband.

1.1 Background

The switch-off of analogue terrestrial television has resulted in the creation of the so-called ‘digital dividend’ which is primarily being utilised to provide additional television channels but part of the dividend is also being utilised to create a new internationally harmonised frequency band for electronic communications services in the frequency range 790-862MHz – the so-called “800MHz band[8]”.

The objective of this study is to estimate the economic benefits that arise from a use of the 790-862MHz frequency range in Belgium under two alternative scenarios:

- if the 790-862MHz had continued to be available for digital terrestrial television in Belgium (including rights to use the frequencies for high-power broadcast transmissions)
- if the 790-862MHz band is used for electronic communications services – in practical terms this means enabling the band to be used for mobile broadband services utilising technologies such as LTE.

The purpose of this study is somewhat different from previous studies carried out on the same topic. Previously, the intention was to identify the highest value use within the 790-862MHz band and ensure that the frequency range can be made available for this use. Based on the decision of the European Commission, it has already been decided to make available the 790-862MHz band for electronic communication services under a set of harmonised technical conditions[9,10]. However, we understand that BIPT requires the results of our analysis in support of discussions that are taking place between the Belgian federal, regional and community governments. The purpose of these discussions is to assess whether there is a requirement for “compensation” for this (formerly broadcasting) spectrum which is now made available for electronic communications services in line with EU requirements.

To-date, the only estimates that have been made of the value of the 790-862MHz band for Belgium comprise a relatively simple extrapolation[11] (e.g. scaling with population) of the results from detailed economic studies that were undertaken by consultants on behalf of the French, Netherlands and the UK

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8 Within this report, we refer to the term ‘800MHz band’ only when discussing the impact on mobile services, as the term is commonly used to refer to a specific band plan which could not be used by broadcasting technology. In the case of broadcasting technology, we simply refer to the relevant frequency range of ‘790-862MHz band’.

9 European Commission (2009), “Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions - Transforming the digital dividend into social benefits and economic growth”

10 European Commission (2010), “Commission Decision of 6 May 2010 on harmonised technical conditions of use in the 790-862 MHz frequency band for terrestrial systems capable of providing electronic communications services in the European Union”

11 Analysys Mason (2010), “Report for BIPT: Future regulation of wireless access in the 790MHz-3400MHz”

governments/regulators. This process yielded estimates for the economic value of the 790-862MHz band of EUR681 million if the band was used for DTT and EUR2922 million if the band was used for mobile broadband services (both numbers are net present values over a period of 15 years).

Within this report, we present a more detailed bottom-up estimation of the value of the 790-862MHz band when used for either DTT or mobile. This is particularly relevant, as a simple extrapolation might omit critical factors which account for differences in the value of the band between countries, such as differences in the importance of the DTT platform. In addition, most of the underlying economic studies have been carried out prior to recent key developments in the mobile telecommunications market, e.g. regarding the future availability of alternative bands for LTE (the timing of widespread availability of LTE equipment that can operate in the 900MHz band is now much clearer), and might therefore include a bias in the estimates for which a study today can correct.

As a result, this study has been tailored to reflect the latest developments within both, the television and mobile markets and reflect their impact on the economic value of the 790-862MHz band for both uses.

1.2 Structure of this document

In order to present our derivation of the value of the 790-862MHz band to DTT and mobile broadband, the remainder of this document is structured as follows:

- Section 2 presents details of our overall approach to the estimation of economic benefits of the 790-862MHz band
- Section 3 outlines our detailed approach to the assessment of the benefits of use of the band for DTT, including key assumptions, the results of the assessment and relevant sensitivity analysis.
- Section 4 outlines our detailed approach to the assessment of the benefits of use of the band for mobile broadband, including key assumptions, the results of the assessment and relevant sensitivity analysis.
- Section 5 summarises the findings and conclusions from our study.

2 Approach to estimating economic benefits

Within this section, we provide an overview of the high-level approach we have used to estimate the economic benefits of use of the 790-862MHz band for DTT or mobile broadband. We first discuss the general framework within which we carry out our analysis (Section 2.1). Thereafter, we present the key concepts of our welfare analysis, namely producer and consumer surplus (Section 2.2), and conclude the section by discussing specific parameters which are common across both models (Section 2.3).

Please note that the focus of this section is to provide an illustration of the general concepts applied in our analysis. More detail on the specific modelling approach used to derive consumer and producer surplus is provided in Sections 3and 4.

2.1 General framework for our analysis of economic benefits

The aim of our analysis is to assess the economic benefits resulting from making available the 790-862MHz band for either of two potential services:

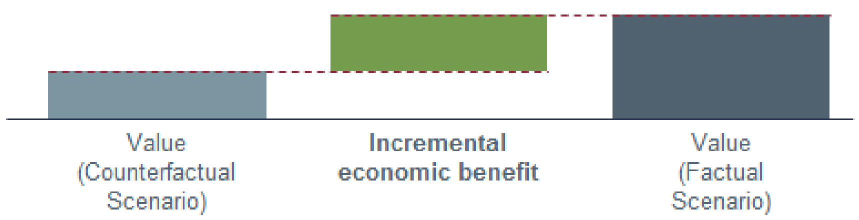
- **Digital Terrestrial Television (DTT) services** – Using the 790-862MHz band for DTT would effectively enable the platform to include more television channels in the service line-up. This could attract more subscribers and could make the television service more attractive/beneficial to (existing) subscribers. These benefits have to be weighed against the cost of installing and operating additional multiplexes to support such a larger service line-up.

- **Mobile broadband services** – The principal benefit of the 800MHz band is that it is currently the only frequency band which provides cost-effective widespread availability of high-speed mobile broadband services through LTE. In the absence of the 800MHz band, LTE network availability could be provided solely using higher frequency bands (1800MHz and 2.6GHz), but with less widespread network coverage, leading to a loss of benefits for a significant proportion of the Belgian population until other low-frequency bands (e.g. the 900MHz band) could be made available for LTE deployment.

Within our analysis, we assess the *incremental* economic benefits, i.e. the additional value which the respective services derive from using the 790-862MHz band in addition to any other spectrum assignments. This is quite important in the context of DTT and mobile broadband use, as neither of the services is dependent in on the availability of the 790-862MHz band to ensure the general provision of services. Instead, both uses can provide a more attractive / efficient service if they were to gain access to the 790-862MHz band.

This is reflected in our modelling, as we compare the value derived in a Counterfactual Scenario (i.e. provision of DTT/mobile services without the 790-862MHz band) with the value of (one or more) Factual scenarios (i.e. provision of DTT/mobile services with the 790-862MHz band). This concept of deriving the incremental value of the factual scenarios is illustrated in Figure 2-1 below.

Figure 2-1: Derivation of incremental value of the 790-862MHz band



Our analysis focuses on the quantifiable benefits which are derived from the use of the 790-862MHz band by either DTT or mobile services, i.e. increases in the efficiency of operations (e.g. cost savings) or benefits derived from a better services (e.g. larger subscriber bases, higher willingness to pay by consumers). Our analysis does not consider other non-quantifiable impacts, such as the impact of a more attractive DTT platform on overall competitiveness in the television market.

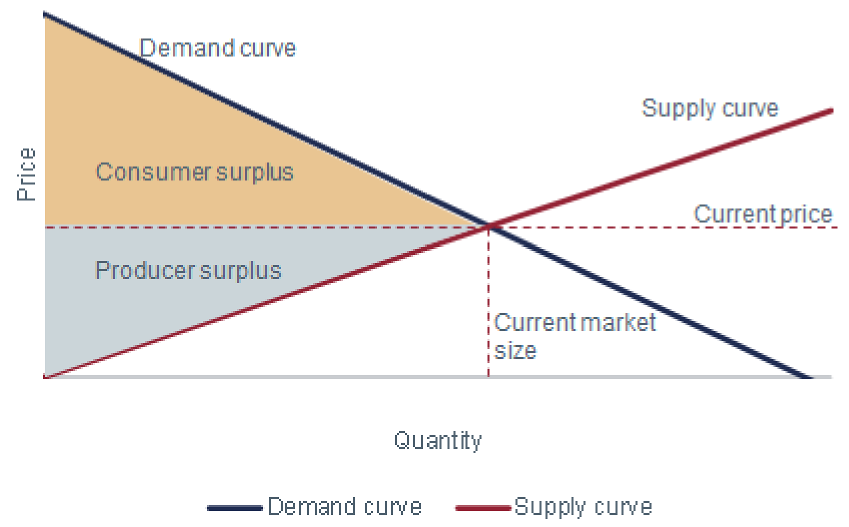
2.2 Key elements of our welfare analysis

For each of these two alternative uses of the 790-862MHz band, we have calculated the incremental benefit of the band in respect of:

- **Producer surplus** – the profit earned by the producer of the service, which is the essentially the difference between revenues from the service and the cost of providing the service.
- **Consumer surplus** – the difference between consumers' valuation/willingness to pay for the service and the prices actually paid.

These concepts are illustrated in Figure 2-2 below, which, for reasons of simplification, assume linear supply and demand curves, and that current supply and demand are in equilibrium.

Figure 2-2: Derivation of producer and consumer surplus



The demand curve in Figure 2-2 represents the number of subscribers willing to pay a given price for the service, whilst the supply curve represents the quantity of the service that a producer would be willing to produce at any given market price, or equivalently the marginal cost of producing the service at a given quantity. Thus the consumer surplus can be estimated as the area between the current price and the demand curve, whilst the producer surplus can be estimated as the area between the supply curve and the current market price.

We have calculated consumer surplus for both DTT and mobile broadband services as per Figure 2-2, by deriving demand curves. However, the supply curve is more difficult to estimate and may vary significantly from the linear curve that is shown as an illustration in Figure 2-2. For both DTT and mobile broadband services, we have instead calculated producer surplus directly from the above definition, i.e. by calculating revenues and costs for the producer.

2.3 Common parameters across both DTT and mobile broadband models

Within our analysis, we develop separate models for each of the two services to determine the change in consumer and producer surplus which could be derived from the use of the 790-862MHz band. There are a number of parameters which have been aligned across the two models:

- The models assess the economic benefits of spectrum use over a period of 20 years, i.e. from 2014 to 2033. The duration of our analysis is based on the proposed length of the licence duration for 800MHz spectrum, as specified in the latest draft Royal Decree regarding the 800MHz auction[12]
- Where applicable, we apply a long-term inflation rate of 2%.
- The models derive the net present value of the producer and consumer surplus by applying a social discount rate of 3.5%. This rate has been set based on the current academic literature which calculates the rate as between 3% and 4% for EU countries[13,14]. Further, recent studies by governments in the UK, France and the USA have resulted in revised social discount rates of 3.5%, 4.0%, and 3%, respectively[15].

The alignment of these parameters is critical to ensure that our analysis provides results which are directly comparable and are consistently derived. Otherwise, this would introduce a bias in our estimates which would unduly overestimate the benefits of the 790-862MHz band to one of the services relative to the other service.

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[12] Source: http://datanews.levif.be/ict/actualite/le-gouvernement-espere-tirer-360-millions-d-euros-du-dividende-numerique/article-4000243382127.htm

[13] D. Evans (2006), "Social discount rates for the European Union"

[14] E. Pálinkó & M. Szabó, (2012), "Application of Social Discount Rate in Public Projects"

[15] C. Gollier (2011), "Pricing the future: The economics of discounting and sustainable development"

3 Benefits of use of the band for DTT

In order to estimate the economic benefits of the 790-862MHz band for DTT, we have developed a bottom-up model, which summarises all relevant benefits to consumers and producers.

In this section, we first summarise the current state of DTT in Belgium (Section 3.1). We then in turn discuss our approach to the estimation of consumer and producer surplus and the results of this analysis (Sections 3.2 and 3.3, respectively) before presenting the results of a sensitivity analysis on key inputs (Section 3.4). We conclude the section by providing a summary of the key results (Section 3.5).

3.1 DTT in Belgium

DTT currently occupies a niche position in the Belgian television market. With cable subscriptions being the most widely used platform (78% take-up of Belgian households), DTT is utilised as a primary viewing platform by only about 1% of households. A further 1.5% of households utilise DTT for secondary television sets[16].

Historically, terrestrial television services have only been provided by public service broadcasters (PSB), offering a small number of free-to-air channels. At present, we understand that the PSBs have deployed a single multiplex and broadcast three television channels in standard definition (SD) quality – although different multiplexes are available in the Flanders and Wallonia regions, which offer access to the respective PSB channels[17].

More recently, an additional three multiplexes have been made available to private companies for the transmission of subscription DTT services[18]. The first service launched in the middle of 2012, with subscriber numbers yet to be disclosed[19]. This service currently offers 10 subscription channels, utilising two multiplexes, in addition to the freely broadcast public channels. All services are transmitted in SD quality. Norkring, the operator of the commercial DTT network in Flanders and Brussels, has indicated that it plans to upgrade its network to DVB-T2 and HD in the forthcoming years. At this point, the subscription DTT service is mainly limited to the Flanders and Brussels Region, in line with Norkring's licence/transmitter network footprint. Norkring and Telenet, the regional cable operator, have signed a leasing agreement under which Telenet provides programme services on the Flemish part of Belgium's DTT platform. The services are available in Flanders and Brussels[20].

It follows that there actually is a regional difference in the availability of DTT content. Within the Flanders and Brussels regions, subscribers potentially have access to free-to-air (FTA) as well as subscription DTT services. In the Wallonia region, access is mainly limited to the French-speaking Belgian PSB channels. In

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16 Conferentie van regulatoren voor de elektronische communicatiesector (CRC) (2011), "Betreffende de analyse van de markt voor televisieomroep in het Nederlandse taalgebied"

17 The situation for PSB DTT transmission for the Flemish Broadcaster VRT is summarised on its webpage: http://www.vrt.be/ontvangst-dvb-t. The situation is very similar for RTBF in Wallonia.

18 Norkring AS (2010), "Planning, building & operating future-proof broadcasting networks"

19 Telenet, a Belgian cable operator launched a subscription DTT product called 'Teletenne' in July 2012. No annual report has been published since this date, nor have any media releases discussed the take up of this new product.

20 See: http://www.norkring.com/about-us/norkring-story/

order to simplify our analysis, we have not differentiated between the two Belgian regions. Instead, we assume that, over time, a subscription DTT service will also become available in the Wallonia Region. We note that this is an assumption which is likely to provide a higher value for the use of the 790-862MHz band for DTT.

We understand that there is a potential spectrum assignment for an additional fifth multiplex available in Belgium, but we have not been able to identify any information as to how DTT operators intend to use this multiplex. As explained in more detail in Section 3.2.2 below, we assume that this multiplex would be used for the transmission of HD content from PSBs.

The availability of the 790-862MHz band for DTT services would allow DTT operators to transmit (up to) two additional multiplexes. This could consequently increase the total number of multiplexes available for DTT transmission in Belgium from a total of five multiplexes to seven multiplexes. This study focusses on the incremental social welfare that could be derived from these additional two multiplexes.

For the purposes of this study, we assume that there are no restrictions on broadcasting power levels due to concerns on causing interference to neighbouring countries. In practice, because the rest of Europe will use the 790-862MHz band for electronic communication services, restrictions would apply limiting power levels in Belgium and would significantly impact the value which could be derived from a continued use of the 790-862MHz band for broadcasting services.

3.2 Assessment of consumer surplus

In this section, we present our approach to estimating the consumer surplus generated by use of the 790-862MHz band for DTT together with the results of this assessment.

One critical input for our analysis is the assessment of the value attached by consumers to watching television, discussed in more detail in Section 3.2.4. There is a natural degree of uncertainty on this input, given that even a high-level assessment would require a significant amount of primary research. In view of the limited time available for the study, it was not possible to carry out any such surveys, which could provide more accurate insights on consumers' actual preferences. In the absence of such information, we have based our assumptions on economic analysis and benchmarks from previous studies. In addition, we have carried out sensitivity analysis on the most critical input parameters to provide a potential range of values of the economic benefits as detailed in Section 3.4.

3.2.1 Approach

We expect that the retention of the 790-862MHz band for DTT would result in the ability to deploy two additional multiplexes, and therefore additional channels. The availability of two additional multiplexes from using the 790-862MHz band is an optimistic assumption, designed to determine the upper bounds of the value of this band when utilised by DTT. Typically, the availability of 790-862MHz spectrum is assumed to allow for 1 – 1.5 additional multiplexes to be deployed.

Within our analysis, we consider three different scenarios to estimate the incremental economic benefits derived from using these additional multiplexes for the provision of DTT in Belgium:

- **Counterfactual scenario:** This represents the case where the 790-862MHz band is not used for broadcasting services and there are therefore no additional multiplexes available
- **Factual 1:** The 790-862MHz band is used for DTT and the incremental multiplexes provide FTA services

- **Factual 2:** The 790-862MHz band is used for DTT and the incremental multiplexes provide subscription DTT services.

Within the two factual scenarios, we expect that an increased number of channels available on the DTT platform would impact consumer surplus in two ways:

- An increased number of channels generally increases the attractiveness of the DTT platform relative to competing television platforms. This could lead to an increase in DTT platform take-up, although we expect that most of the increase will be from secondary television sets.

- With more channels being available on the platform, new and existing users attach an increased value (willingness to pay) to the available services.

The modelling of consumer surplus is therefore reliant on a number of key parameters describing the impact of an increased number of channels. Key parameters to the model include:

- defining the expected services offered on the additional two multiplexes
- estimating the resulting changes in platform take-up by Belgian consumers
- estimating the change in willingness to pay for the services by consumers.

The following sections will outline our approach to estimating each of these key parameters.

3.2.2 Multiplex usage

At the moment, the use of four of the available five multiplexes has been defined. Whilst Multiplex 1 is used by PSBs to offer FTA services, Multiplexes 2 – 4 are assigned to a subscription DTT service[21]. The fifth multiplex is currently unused. Within our analysis, we have assumed that this fifth multiplex will be used by FTA broadcasting due the fact that there is only a single FTA multiplex in use at the moment.

As mentioned above, the 790-862MHz band could potentially be used to offer (up to) two additional multiplexes in Belgium (Multiplexes 6 and 7). Within our two factual scenarios, we consider that these additional multiplexes could be used for either FTA or subscription services.

Figure 3-1 below summarises the two scenarios of multiplex use that we considered in this study.

Figure 3-1: Assumed utilisation and deployment dates for Belgian multiplexes

Multiplex	1	2	3	4	5	6	7
Counterfactual	FTA (PSB) – SD	Subscription – SD	Subscription – SD	Subscription – HD	FTA – HD	n/a	n/a
Factual 1	FTA (PSB) – SD	Subscription – SD	Subscription – SD	Subscription – HD	FTA – HD	FTA - SD	FTA - SD
Factual 2	FTA (PSB) – SD	Subscription – SD	Subscription – SD	Subscription – HD	FTA – HD	Subscription – SD	Subscription – SD
Deployment date	already deployed	already deployed	already deployed	2014	2014	2016	2016

[21] We note again that, although there is currently only a DTT subscription service available in the Flanders and Brussels region, we assume that such a service will also emerge over time in the Wallonia region.

We assume that each multiplex will be used in the most efficient manner, i.e. it is broadcasting the maximum number of channels possible. European benchmarks show that multiplexes have sufficient capacity for either 8 SD or 5 HD channels[22]. A result of this assumption is that we assume the current PSB multiplex would increase the number of broadcast channels from three to eight.

This requirement for an efficient use has also been the driver underlying our assumption on the deployment year of the Multiplexes 4 – 7. We have assumed a swift deployment, i.e. all 7 multiplexes are in operation by 2016. This will also maximise any possible consumer surplus from the use of the 790-862MHz band for broadcasting.

Figure 3-2 below summarises our assumptions on the number of channels offered by the FTA and subscription DTT services under the three scenarios. The number of channels provided by subscription services is shown excluding the freely available FTA channels that consumers would be able to receive. This means that subscription DTT consumers would actually be able to watch a total of 50 channels (13 on FTA, 37 on the subscription service) in the Factual 2 scenario.

Figure 3-2: Assumed number of available DTT channels by scenario

	FTA (SD)	FTA (HD)	Subscription (SD)	Subscription (HD)
Counterfactual	8	5	16	5
Factual 1	24	5	16	5
Factual 2	8	5	32	5

3.2.3 Market forecast

The current use of DTT in Belgium is significantly below the European average. One of the key reasons for this is the historically high penetration of cable television, driven by the platform's near ubiquitous availability as well as the rapid take-up of IPTV services provided over the VDSL platform. Satellite is another delivery platform. This leads to only 1% of households utilising DTT as their primary television service, whilst another 0.5-1.5% of households utilise DTT as a secondary television service[16]. The first subscription DTT service in Belgium was launched in mid-2012 and subscriber numbers for this new service have not yet been made public.

Due to the low penetration of DTT services in Belgium and the very recent launch of a subscription DTT service, any forecast on future take-up includes an unavoidable degree of inaccuracy.

However, we have considered the experiences in a country with a similarly dominant cable platform to provide an indication as to the potential for DTT to increase penetration. In the Netherlands, KPN[23] acquired the licence to operate a subscription DTT service in 2002. Within 8 years, the service achieved a market share of approximately 11% of the Dutch television market. Whilst this highlights the potential for DTT services, we note that there are a number of reasons as to why we consider that a similar outcome is highly unlikely to be achievable in Belgium:

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[22] In the UK and Sweden, the majority of multiplexes transmit between 7 and 9 SD channels. Ofcom plans for two new HD multiplexes in the UK assuming that five HD channels can be broadcast per multiplex. We note that whilst the transmission of 8 SD channels is done using DVB-T technology, a transmission of 5 HD channels would require the use of DVB-T2 technology.

[23] KPN was initially a joint-venture partner in the Digitenne service, yet since 2006 has been the majority shareholder.

- In the Netherlands, the service was offered by fixed incumbent KPN as a means to compete heads-on with its main competitors, the cable operators. The service was therefore aggressively marketed.
- Subscription DTT is currently only offered in Flanders and Brussels in partnership with the incumbent cable television operator. Any marketing push of the DTT platform as a primary platform would directly cannibalise the cable operator's own cable revenues. This suggests that subscription DTT in Belgium will be viewed as an option for secondary television viewing or possibly as a service in holiday homes.
- Research in Belgium suggests that consumers would not consider switching from cable to DTT, even in case of significant price increases on the cable platform[16]
- In the Netherlands, DTT penetration has strongly decreased in recent years, following the introduction of a fibre-based television offer. This further suggests that DTT will struggle to remain a competitive platform in a country with strong fixed internet and cable penetration, such as Belgium.
- In Germany, the RTL media group decided in January 2013 to leave the DTT platform due to the fact that it does not consider there to be a positive business case for DTT in Germany under current conditions[24].

Therefore, we predict that DTT will, at the most, reach a take-up of approximately 50% of that experienced in the Netherlands, i.e. around 5 – 6% of households. We estimate that the additional 2 multiplexes could help drive penetration of the DTT platform by ~0.75-1.5% of households, depending on the chosen factual scenario. We note that these estimates are aggressive, i.e. the resulting estimate for the economic benefits of a DTT use for mobile services will present an upper bound of the likely range of values.

In addition, we assume in our analysis that the vast majority of any increase in DTT penetration would be driven by secondary viewing, with people valuing DTT as a low-cost and mobile solution to their existing (cable) television subscription. Again, this is an aggressive assumption, i.e. an assumption that will lead to a higher value for DTT use in the 790-862MHz band. If we were to assume that DTT could represent a substitute to existing (cable) services, any increase in DTT penetration would decrease take-up of other television platforms, thereby reducing consumer surplus on these platforms. We would consequently have to net these effects off our results.

Figure 3-3 illustrates the impact on our assumptions on the development of FTA penetration comparing the results for the Counterfactual and Factual 1 scenarios. We assume an increase in penetration when an additional FTA multiplex is made available. At the time that the 5th multiplex is launched (i.e. around 2014) the number of available channels effectively doubles. We translate this increase in the number of channels with a 50% increase in the take-up of DTT (i.e. a 1% increase in penetration from 2.5% to 3.5%). At the time that the 6th and 7th multiplexes are launched, we increase FTA penetration by another 1%, as the number of FTA multiplexes doubles again.

24 RTL media group released a press release on this issue on 16 January 2013: http://www.mediengruppe-rtl.de/de/pub/presse/i47085_1.cfm

Figure 3-3: Development of DTT penetration for FTA viewing in the Counterfactual and Factual 1 scenarios

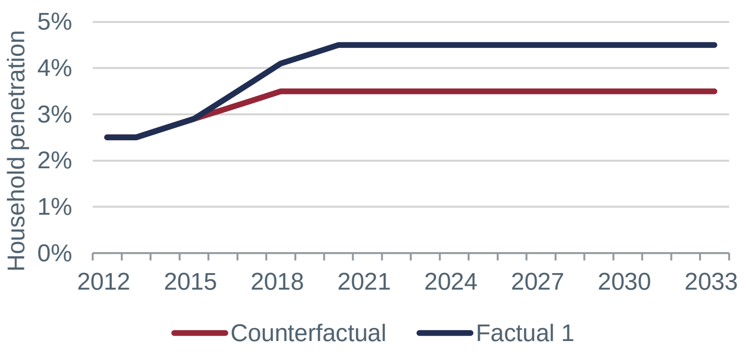


Figure 3-4 below summarises our assumptions on the increase in DTT penetration within the three modelled scenarios.

Figure 3-4: Summary of assumptions on DTT take-up by scenario

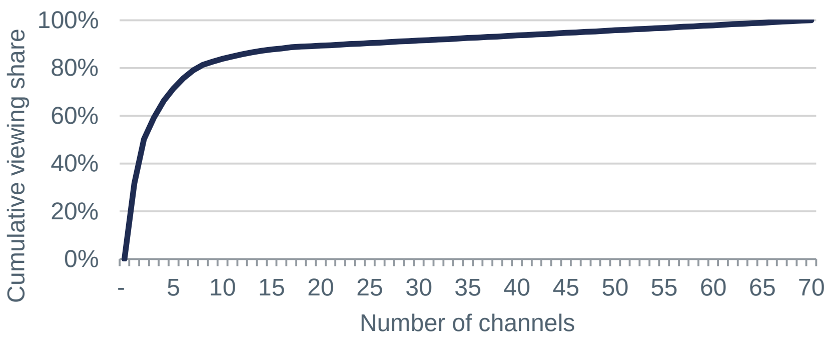
Scenario	FTA	Subscription	Total
Counterfactual	3.5%	1.5%	5.00%
Factual 1	4.5%	2 %	6.50%
Factual 2	3.5%	2.25%	5.75%

3.2.4 Willingness to pay

In order to derive consumer surplus, we need to understand the value that consumers place on using television services. We estimate this value through defining a curve which describes the willingness to pay for television services depending on the number of channels offered.

The rationale underlying our modelling is that the value attached to television services by consumers is primarily driven by the number of channels which are offered by a service. We assume that the incremental value for each channel is derived directly from its share of viewing. Using publicly available information[25] on the viewing shares of television channels thereby allows us to derive the curve shown in Figure 3-5.

Figure 3-5: Distribution of viewing shares across a package of 70 basic television channels [Source: CIM, Aetha estimates]



As can be seen in Figure 3-5 above, 80% of viewing time in Belgium is contained within the seven most popular channels, i.e. these channels contain 80% of the value of television services to consumers.

In addition, we need to define the maximum value (in EUR per month) that consumers place on watching the most commonly offered television channels. In Belgium, the most widely taken-up cable package

25 Centrum voor Informatie over de Media (2012), "CIM TV - Marktaandelen - 2012"

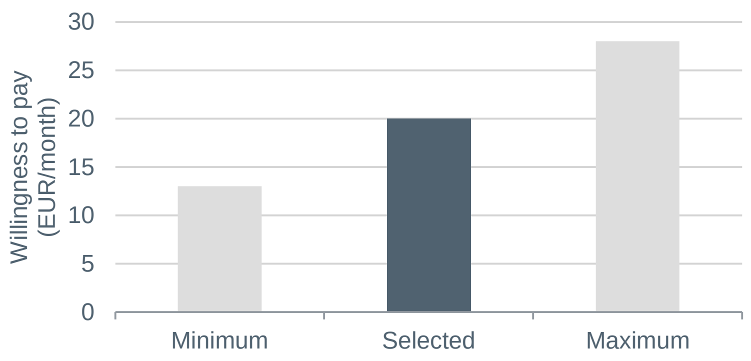
includes about 70 television channels. Due to a lack of primary research on the topic, we estimate the maximum value places on access to basic television content using a combination of economic analysis and benchmarking.

We have calculated the lower bound of the WTP for television services by analysing the current cable television offering and comparing it to the available DTT FTA offer. About 60% of the viewing on the cable television is on channels that are unavailable on current DTT FTA service. Assuming that willingness to pay is primarily based upon the viewing share of available channels, the price of basic cable (i.e. EUR8 per month) must be equal to at least 60% of the total WTP. This implies that the total willingness to pay for all 70 channels must be at least EUR13 per month.

We have estimated the upper bound of the willingness to pay by considering the assumptions made in a similar economic study to assess the value of DTT in the Netherlands[26]. Compared to current retail prices in Belgium, the values used in this report was very high (the quoted numbers suggest an assumed maximum willingness to pay of about 28 EUR per month). We believe that this value would represent an upper bound for the average television users, and that it is highly unlikely that the value in Belgium would be higher in light of the lower price that is charged for basic cable services.

Within our model, we have therefore chosen a value of EUR20 per month (approximately the mid-way point between the minimum and maximum values) as a potentially realistic estimate of the willingness to pay for television services in Belgium, as illustrated by Figure 3-6.

Figure 3-6: Assumed willingness to pay for Belgian television



It should be noted that this is the willingness to pay for SD services. Based on retail pricing information from the UK, we estimate that the incremental value placed on HD services is about 13% of the SD value[27]. Our estimate for the willingness to pay also excludes any value attached to so-called ‘premium content’ (Hollywood movies, live sports) which we do not expect to become available on the DTT platform.

We forecast that WPT will increase in line with inflation over the modelling period. This is based on the assumption that consumers are willing to spend a fixed proportion of their income on television services.

Within our factual scenarios, the WTP will increase following an increase in the number of available channels. Figure 3-7 illustrates the development of the WTP for FTA subscribers over time, taking into

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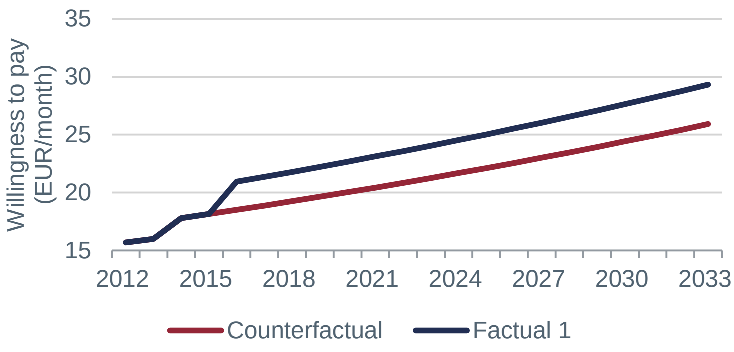
26 Analysys Mason (2008), “Economic and Social Limitations to Alternative Uses of ‘Digital Dividend’ Spectrum – A report for the Dutch Ministry of Economic Affairs”

27 This estimate was derived by looking at the proportion of the HD component in BSkyB’s estimated ARPU for television services in the UK in 2012.

account both increases in the number of available channels (first for the 5th multiplex, thereafter following use of the 790-862MHz band for additional multiplexes) and inflation.

Figure 3-7: Willingness to pay for FTA DTT



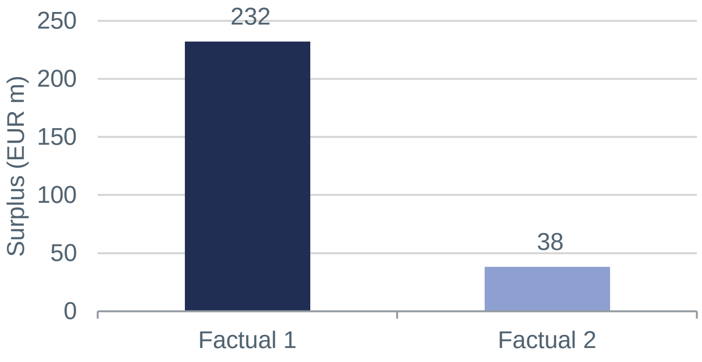
3.2.5 Results

Combining our forecasts for multiplex usage, subscriber developments and WTP allows us to derive the consumer surplus obtained from use of the 790-862MHz band for DTT use.

The results of our analysis are shown in Figure 3-8. The consumer surplus is larger when FTA channels utilise the 790-862MHz band (EUR232 million) compared to when the incremental capacity provided by the 790-862MHz band is used to provide improved subscription services (EUR38 million). This is due to a number of factors:

- We expect there to be a larger impact on overall DTT penetration if channels are made available for FTA, as this will affect the number of channels available to FTA and subscription users.
- In addition, subscription users must pay a monthly fee to watch subscription television – in essence, this transfers consumer surplus to the producers.

Figure 3-8: Consumer surplus derived from use of the 790-862MHz band for DTT (base case)



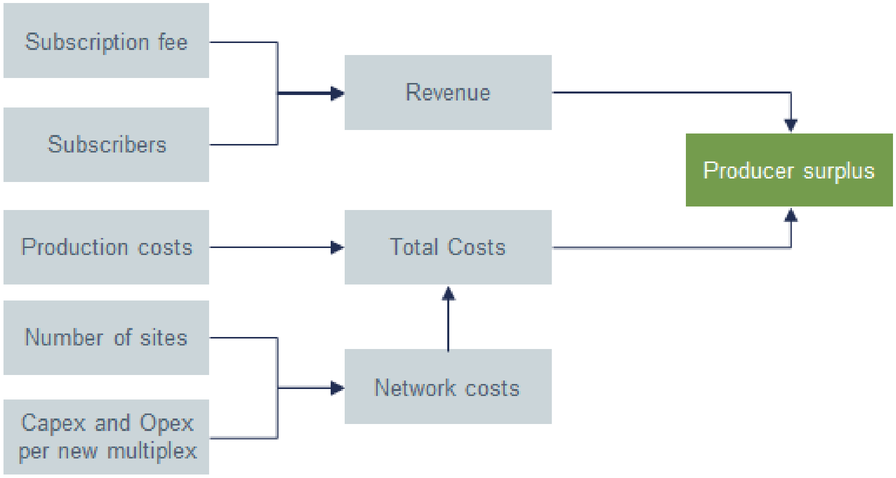
3.3 Assessment of producer surplus

In this section, we provide an overview of our approach to developing a bottom-up estimate of the producer surplus generated by use of the 790-862MHz band for DTT.

3.3.1 Approach

We calculate the producer surplus for DTT using a simplified model of an integrated broadcaster. This means that, in order to limit the complexity of our analysis, we only consider a single 'producer' which combines the revenues and cost streams which are typically incurred separately by multiplex operators (such as Norkring), broadcasters (e.g. RTBF) and platform operators/retailers (e.g. Telenet). This is to ensure that we are not accidentally capturing any transfers between these operators as producer surplus. As shown in Figure 3-9, we estimate producer surplus by considering the revenues and costs (production and transmission) associated with the operation of DTT multiplexes.

Figure 3-9: Approach to calculating producer surplus



Within the current structure of the Belgian DTT market, some broadcasters receive (subscription) revenues from their subscribers. For FTA broadcasters, such subscription fees do not exist, and therefore there would be no incremental revenues.

The costs to DTT broadcasters predominantly pertain to the network upgrades and operational costs required to operate transmitter sites. In addition, we also assume that an increase in the number of channels broadcast would increase content production costs due to the greater number of channels on offer.

Other studies have considered advertising revenues as a possible component of producer surplus. However, we believe that overall television advertising budgets are fixed and that any advertising revenue incrementally generated on the new channels on the DTT platform would merely represent a transfer of advertising revenues from other television platforms. It would therefore not constitute an overall increase in the producer surplus generated by television broadcasting in Belgium.

3.3.2 Calculation of producer costs

Based on publicly available data, we understand that Belgium currently has 26 major broadcast transmission towers[28]. In order to more accurately estimate the costs of installing and operating additional multiplexes on this platform, we have split these transmission towers into two categories based upon their power output. We assume that the larger towers (>10kW output) have larger upgrade (capital expenditure) and operational (operating expenditure) costs.

Using industry benchmarks, we estimate the average capital expenditure (capex) for adding one new multiplex to an existing transmitter site to be around EUR840 000 and the average incremental operating expenditure (opex) for one new multiplex to be around EUR320 000 per year for each site.

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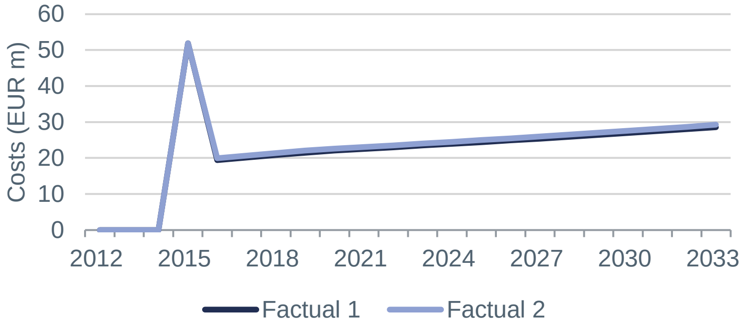
[28] Compiled from http://www.ukwtv.de/sender-tabelle/index.html, http://www.norkring.be/zenderpark/zendmasten-in-kaart/ and http://www.dvbtmap.eu/transmitterlist.html

We are conscious of the fact that our analysis does not calculate the costs of upgrading smaller transmitter sites, such as repeaters. The reason for this is that we have not found a reliable source detailing the number of smaller transmission sites in Belgium. As operating these transmitters implies incurring additional costs, our model could possibly underestimate the cost to producers and thereby provide an optimistic estimate of the producer surplus arising from using the 790-862MHz band for DTT.

Production costs were calculated by assuming an increase of current costs proportional to the increase in viewership.

Transmission opex and production costs are both assumed to increase in line with inflation throughout the model period. Figure 3-10 illustrates the producer costs over time, with the large increase in costs in 2015 being caused by the capex required to upgrade all transmitter sites to include the two additional multiplexes.

Figure 3-10: Development of producer costs over modelling period for both factual scenarios



3.3.3 Calculation of producer revenues

As mentioned above, the only source of incremental producer revenues stems from any incremental fees derived from the DTT subscription service

Such revenue is dependent on the subscriber numbers and average revenue per user (ARPU) within the two factual scenarios. The methodology for predicting the number of subscribers is outlined in Section 3.2.3. We assume that the price charged for a DTT subscription in 2012 is set equal to the current Teletenne offering[29].

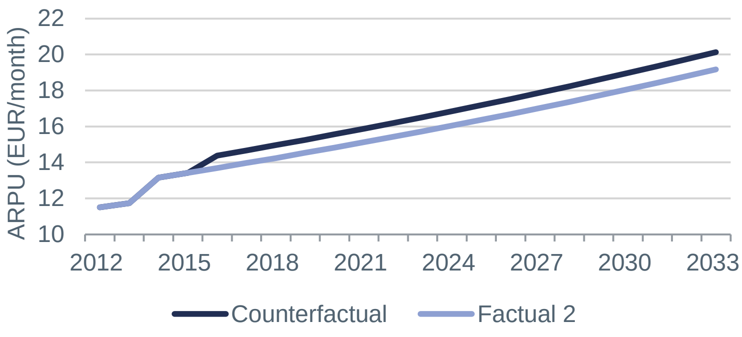
We expect ARPU to increase with inflation and with the number of additional channels that become available. We estimate that the DTT subscription broadcaster will look to increase prices at the time that all three current private multiplexes are put into service to reflect the increased attractiveness of their offer. In addition, we expect another price increase in case the 790-862MHz band becomes available for DTT use and two additional DTT subscription multiplexes are operated (Factual 2). As DTT services are currently priced higher than cable services, we note that it might be required for producers to lower prices to achieve the estimated take-up. However, this would merely constitute a transfer between consumer and producer surplus and would not affect our estimate of total surplus.

The resulting trend for the ARPU from subscription DTT services over the modelling period is shown in Figure 3-11 below. In the Factual 1 scenario, the additional channels are made available on the FTA

[29] As described on: http://telenet.be/3563/nl/thuis/televisie/teletenne

network. Consequently, we assume that the subscription operator is unable to increase ARPU for its own services in such a scenario.

Figure 3-11: Development of subscription ARPU over modelling period comparing the Counterfactual and Factual 2 scenarios

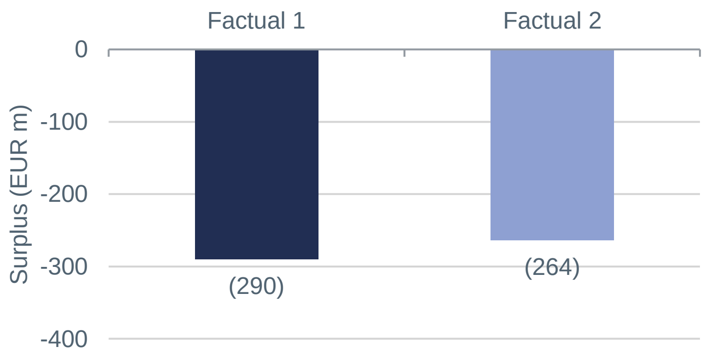


3.3.4 Results

Combining the key assumptions on the producer surplus as outlined above allows us to arrive at an estimate of producer surplus.

The results of our analysis are summarised in Figure 3-12. Within both factual scenarios, the producer surplus is negative and exceeds any expected benefits in consumer surplus. This result highlights the large impact of the additional network costs inform operating two additional multiplexes, especially in relation to a very moderate take-up of television services across the country. The marginally higher producer surplus in the Factual 2 scenario of -EUR264 million is due to incremental subscription revenues transferring surplus from the consumers to the producers.

Figure 3-12: Producer surplus derived from use of the 790-862MHz band for DTT (base case)



3.4 Sensitivities

Due to the uncertain nature of some of the inputs used in our modelling, we have performed sensitivities on several key inputs to determine the possible upper bounds of the value of the 790-862MHz band. Given the very low values already derived for the producer surplus in our base case, we have focused our sensitivity analysis on any upsides that might possibly result from use of the 790-862MHz band for DTT services.

The following sections outline the impact on total surplus for the band when utilising best-case inputs on the following parameters:

- consumers' willingness to pay,
- potential market share gains from incremental multiplexes

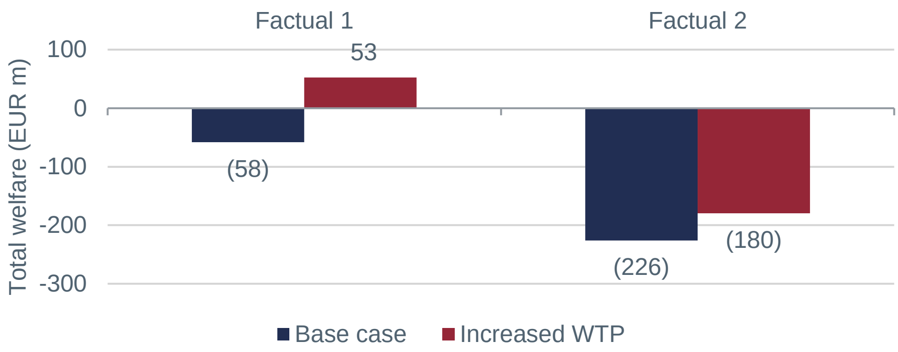
- lower cost of multiplex operations.

3.4.1 Willingness to pay

Within our base case, we estimate that the willingness to pay for television services in Belgium is around EUR20 per month per household. As mentioned in Section 3.2.4, a similar economic study for the Dutch Ministry of Economic Affairs[26] appeared to assume a willingness to pay of EUR28 per month. We consider this estimate to be an absolute upper bound on the willingness to pay for television services in Belgium and have therefore used it as a high-end estimate.

Figure 3-13 summarises the result of our sensitivity analysis using a higher willingness to pay.

Figure 3-13: Impact on welfare from sensitivity analysis on consumers' willingness to pay



The increase in consumer surplus due to a higher willingness to pay results in a total surplus from television services of about EUR53 million in the Factual 1 scenario. For the Factual 2 scenario, the value remains significantly negative, at around -EUR180 million. The effect is more pronounced within the Factual 1 scenario as there is a higher total DTT penetration in this case (6.5%) than in the Factual 2 scenario (5.75%).

3.4.2 DTT market penetration

In the base scenario, we estimate that DTT reaches a market penetration of between 5.0% and 6.5% of Belgian households. In this sensitivity we assume that DTT services reach a take-up of about 11%, which is similar to what was experienced in Germany and the Netherlands. Again this is very much a high-end outcome.

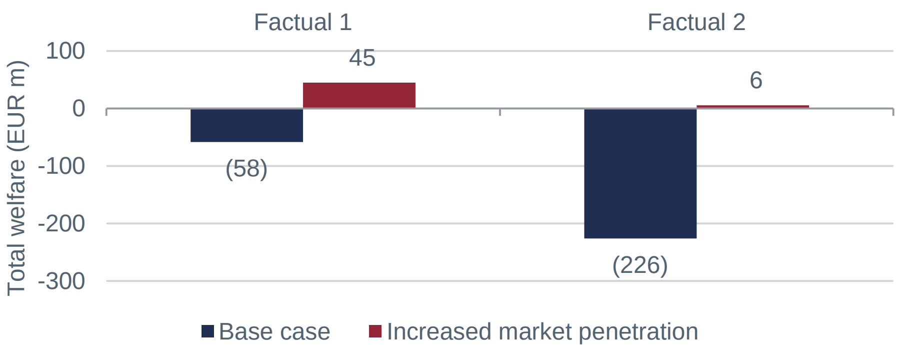
Figure 3-14 details the market penetration assumptions in this high-end case.

Figure 3-14: Sensitivity scenarios for DTT market penetration (% of households)

Scenario	Base case	High-end case
Counterfactual	5%	9%
Factual 1	6.5%	11.25%
Factual 2	5.75%	11%

As shown in Figure 3-15, the increase in DTT penetration results in a significant increase in the economic benefits of using the 790-862MHz band for DTT.

Figure 3-15: Impact on welfare from sensitivity analysis on DTT market penetration



The Factual 1 scenario gives a total surplus of about EUR45 million, whilst Factual 2 becomes marginally positive at about EUR6 million. The key driver for this increase in value is the larger number of consumers benefiting from the additional channels that would be on offer. At 11% of the market, a significant proportion of the population would be using DTT as one of their television services and it is perceivable that the incremental multiplex capacity provided by the 790-862MHz band should create some economic value. However, given the high cable penetration within Belgium and the limited international precedent for such developments, we consider it highly unlikely that this best case scenario could be realised.

3.4.3 Cost of operation

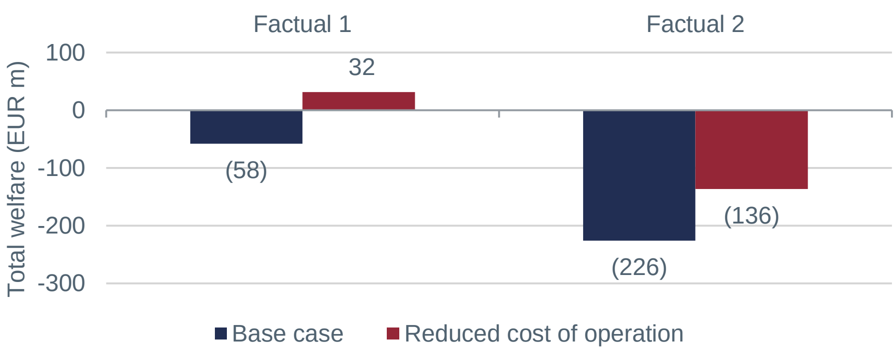
Another major driver of the low producer surplus is the cost of installing and operating the additional multiplexes. Although our estimates are based on international benchmarks, there is always the possibility that the cost of operating these services in Belgium could be lower than we have modelled. For the purpose of this sensitivity, we have assumed that the cost of both upgrading and operating transmitter sites are reduced by 30%.

Figure 3-16: Sensitivity scenarios for the cost of network operations

	Base	High-end case
Average capex (EUR per site)	840 000	580 000
Average opex (EUR per site per annum)	320 000	220 000

The results of this sensitivity are highlighted in Figure 3-17.

Figure 3-17: Impact on welfare from sensitivity analysis on cost of network operations



Due to the fact that the assumed impact on network costs is modelled as fixed costs, the net impact of this sensitivity is equal in both the Factual 1 and Factual 2 scenarios, with an increase in total surplus of about EUR90 million. This leads to a value of EUR32 million for the Factual 1 scenario and –EUR136 million for the Factual 2 scenario.

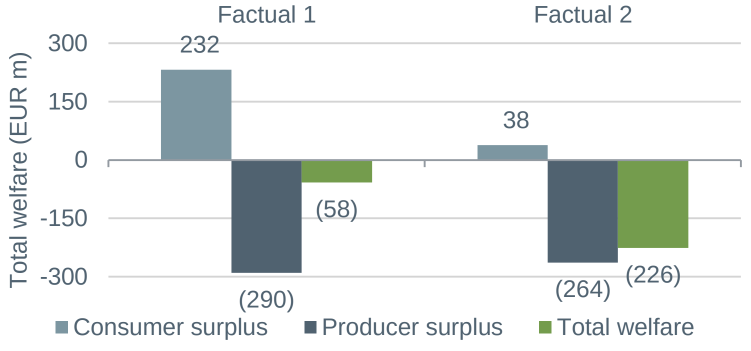
Again, we believe that we have already been quite conservative with regard to our cost assumptions, as we have not taken into account any additional smaller transmission sites in our modelling given the lack of publicly available information on the existence of such site. If such sites were to exist, our base case results would possibly overestimate the value of use of the 790-862MHz band for DTT. We therefore believe that the results of the 'high-end case' are likely to be a low-probability scenario of the value of using the 790-862MHz band for DTT services.

3.5 Summary

The calculation of the economic benefits derived from using the 790-862MHz band for DTT services considered both the resulting incremental producer and consumer surplus. In both scenarios, we have estimated that the total surplus derived from making the band available for DTT would be negative. Our analysis estimates that the value in the Factual 1 scenario (availability of 790-862MHz for FTA services) would be around -EUR58 million and that it would be around -EUR226 million in the Factual 2 scenario.

The split of welfare between producer surplus and consumer surplus in both scenarios is summarised in Figure 3-18 below.

Figure 3-18: Split of total welfare in the factual scenarios from use of the 790-862MHz band for DTT (base case)



We are confident that our results are a valid representation of the potential surplus within the context of the Belgian market. Whilst we believe that there will be potential benefits to consumers, these are highly likely to be outweighed by the costs associated with the installation and operation of the 6th and 7th multiplexes. The main underlying reason for this is that DTT penetration is very low and that it is unlikely to be considered as a substitute to other television platforms.

This is further confirmed by evidence from the Belgian television market:

- Only three channels are being broadcast on the current FTA multiplex. This indicates a lack of demand for additional FTA services. Effectively, only 50% of the capacity of a single multiplex is being used for FTA television content.
- Telenet noted a EUR28.5 million write-down in 2012 for the multiplex assets it purchased in 2010 for EUR30.7 million. This is unlikely to have occurred if there was any significant value from two incremental multiplexes (in addition to the currently unused multiplex which Telenet could already use today for subscription DTT).

In addition, it should also be noted that we have applied optimistic assumptions to our analysis in a number of cases which, if anything, are likely to overvalue the impact of using the 790-862MHz band for DTT:

- We assume that DTT penetration grows to more than 5% in the different factual scenarios, which constitutes more than a doubling in penetration relative to today.
- We expect that all DTT viewing will be secondary viewing, i.e. any consumer surplus created by DTT viewing is a complement (rather than a substitute) to existing viewing.

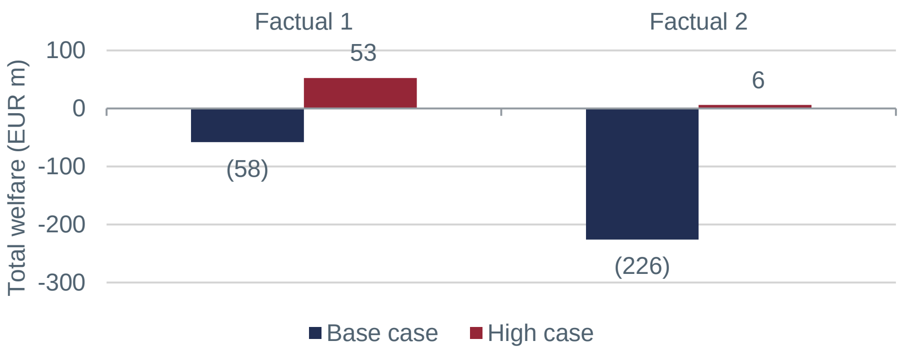
We have also carried out sensitivity analysis to understand the potential upside if we were to apply the most optimistic (in respect of maximising welfare) assumptions to our models. The results of this analysis are summarised in Figure 3-19.

Figure 3-19: Summary of sensitivity analysis regarding the value of the 790-862MHz band for DTT

Scenario (EUR m)	Base Case (EUR m)	Sensitivity 1 – WTP (EUR m)	Sensitivity 2 – Take-up (EUR m)	Sensitivity 3 – DTT cost (EUR m)
Factual 1	-58	53	45	32
Factual 2	-226	-180	6	-136

The resulting range of valuation results is shown in Figure 3-20 below.

Figure 3-20: Range of estimates for total surplus from use of the 790-862MHz band for DTT



The maximum value we can establish for use of DTT in the most aggressive scenario is EUR53 million in case of the Factual 1 scenario, assuming an average willingness to pay per DTT household of EUR28 per month. Based on our argumentation in Section 3.2.4, we consider this to be a low-probability scenario.

Finally, we note that our values for total surplus are significantly lower than the ballpark values previously estimated[11], where it was estimated that DTT could create value of up to EUR681 million from the 790-862MHz band. Whilst it is not fully transparent what the approach underlying these estimates was, we note that:

- The results from other countries were not scaled to take account of DTT penetration. One of the countries within the benchmark it assesses is France, which has a DTT penetration of 62%[30]. It is not surprising that a country with a more than 40-fold increase in penetration has a significantly higher value for DTT services.

- Scaling appears to have been undertaken based on the total value per multiplex – and several of the underlying studies estimated the total economic benefits of DTT rather than just the economic benefits of spectrum in the 790-862MHz band. This approach ignores the decreasing marginal value per multiplex. Clearly, an increase from 1 to 2 multiplexes is likely to provide much larger incremental

30 As reported by the European Audiovisual Observatory at: mavise.obs.coe.int/country?id=1

surplus than a move from 5 to 6 (or 6 to 7) multiplexes given the relative increase in the number of broadcast channels on the platform. By using an average value per multiplex, the result of the calculation might therefore significantly overestimate the incremental value of the 790-862MHz band in contributing to the overall value of DTT services in the frequency range below 1GHz.

4 Benefits of use of the band for mobile broadband

Our analysis of the incremental economic benefits of using the 790-862MHz band to mobile (broadband) services builds on our work carried out on behalf of BIPT in preparation for the award of the 800MHz award[31] in Belgium.

As part of that project, we were provided by BIPT with insights on the current network deployments and network cost structures of Belgian mobile operators. For the purpose of the current model, we have made use of suitably anonymised data describing an 'average' Belgian mobile operator, which should allow us to develop reliable estimates of the resulting producer surplus.

With regard to the derivation of consumer surplus, we note that there is naturally some uncertainty around some of the key inputs, such as the consumers' WTP for mobile services. Given the limited time available for the study, it was not possible to carry out any direct consumer surveys which might provide further guidance on consumers' actual preference. In the absence of such information, we have generally used conservative estimates, i.e. values which are likely to provide a lower bound of the economic benefits of mobile broadband. In addition, we have carried out sensitivity analysis on the most critical input parameters to provide a potential range for our estimated economic benefits.

In this section, we first provide a short overview of the current situation regarding the 800MHz band and its availability for mobile services (Section 4.1). We then in turn discuss our approach to assessing producer and consumer surplus and the results of this analysis (see Sections 4.2 and 4.3, respectively) before presenting the results of our sensitivity analysis on key assumptions (Section 4.4). We conclude the section by providing a summary of our key results (Section 4.5).

4.1 The 800MHz band

For mobile operators across Europe (and other parts of ITU Region 1), the 800MHz band is a key band for the deployment of Long Term Evolution (LTE) mobile technology. LTE provides mobile operators with the ability to offer faster mobile broadband services and is therefore a critical input in an increasingly data-centric mobile market. The 800MHz band is used to complement higher frequency bands (e.g. the 1800MHz and 2.6GHz bands), by providing more cost-effective rural coverage and deeper indoor coverage, based on its superior propagation characteristics.

The 800MHz band has been awarded in several European countries, and with operators having started to offer services using the band, there is an existing ecosystem for network and consumer equipment. As the European market is one of the main adopters of the 800MHz band, most of these devices should be available to Belgian mobile operators, subject to commercial arrangements. As a result, 800MHz spectrum should be of high value to mobile operators, and this has been reflected in recent spectrum auctions (e.g. in Ireland and the Netherlands), which have resulted in increasingly high prices for the spectrum.

In the future, it is likely that the 900MHz band will also be used across Europe for LTE, and potentially the 700MHz band will also become available for LTE, by making further use of the UHF spectrum currently allocated to television. This means that, in the long term, there are alternative low-frequency bands available, which may then impact the value of the 800MHz band. However, neither of these bands is likely

[31] Aetha Consulting and NERA (2012), "Regulations for award of the 790-862MHz band – A report for BIPT"

to be used for LTE in Europe over the next five years, and so it is advantageous for mobile operators to own 800MHz spectrum, as it provides the only current source of low-frequency LTE spectrum.

This value of making the 800MHz band available to mobile operators is discussed in the following sections.

4.2 Assessment of producer surplus

Within our assessment of the economic benefits for mobile broadband use, we apply the term 'producers' to refer to Belgian mobile operators. In order to calculate the surplus they derive from a use of the 800MHz band, we consider two scenarios:

- **Counterfactual scenario:** Mobile operators do not gain access to the 800MHz band. In the short term, this means that they will not gain access to suitable low-frequency spectrum for LTE coverage and they will therefore have to rely on other, higher frequency bands to provide (less economical) LTE coverage.
- **Factual scenario:** Mobile operators will be awarded 800MHz spectrum. This allows them to provide cost-efficient mobile coverage to ~99% of population, i.e. it will allow for ubiquitous LTE coverage and thereby assist the rapid deployment of LTE technology.

The availability of the 800MHz band for mobile services will provide two main sources of incremental producer surplus for those operators:

- Network savings from the availability of suitable low-frequency spectrum to achieve LTE coverage. This means that operators are not forced to densify their networks in order to provide competitive levels of LTE coverage.
- The availability of suitable low-frequency spectrum for LTE coverage is likely to accelerate the deployment of LTE and also extend to areas of Belgium which would be uneconomic to cover without low frequency spectrum. This in turn will drive faster take-up of (higher value) LTE services and can provide additional revenues to mobile operators.

The draft Royal Decree specifies that three lots of 2×10MHz of 800MHz spectrum will be made available in the auction[12]. Within our assessment of the economic benefits of 800MHz spectrum use, we assume that all available lots in the auction will be acquired by different operators allowing them to provide low-frequency LTE coverage. This means that we have to account for the above mentioned sources of value for all three operators. Within the modelling, we have refrained from modelling specific operators but instead refer to an 'average' operator whose network characteristics are based on the current situation of existing operators in the Belgian market.

Within the following sections, we provide an overview of the key assumptions in our modelling of the producer surplus and the resulting value from making the 800MHz band available to mobile operators.

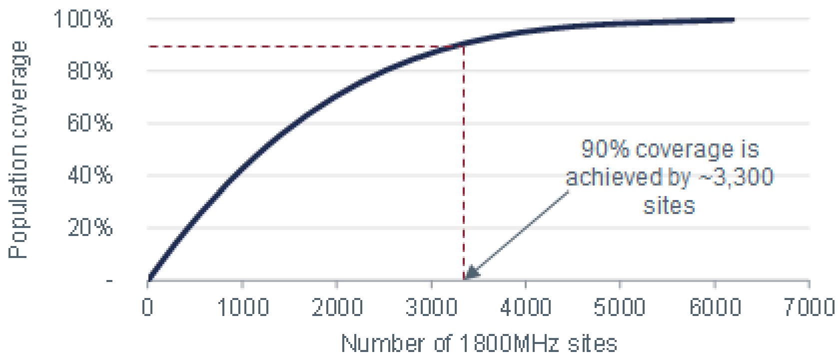
4.2.1 Network savings

If the 800MHz band is not available for mobile broadband, this means that, at least in the short term, there is no suitable low-frequency spectrum available to provide LTE coverage. The most likely band used to provide LTE coverage would then be the 1800MHz band, which has significantly worse propagation characteristics and hence requires the deployment of additional sites to reach coverage levels comparable to the 800MHz band.

In order to provide a competitive service, mobile operators are therefore likely to be required to densify their existing mobile networks in order to provide wide-ranging LTE coverage, as the existing network grids are mostly optimised to provide mobile coverage using the 900MHz band (for GSM and UMTS services) . We have estimated the number of sites required to meet certain population coverage levels based on information on the existing network deployments of operators (as provided by BIPT) and our experience working with operators who had to consider densifying their network in case they would not acquire suitable low-frequency spectrum.

The resulting curve showing the number of 1800MHz sites required by an average Belgian mobile operator to meet certain population coverage levels is shown in Figure 4-1 below. To arrive at the total number of coverage sites which need to be deployed, this number needs to be multiplied by a factor of three to take into account the number of mobile operators gaining access to 800MHz spectrum.

Figure 4-1: Population coverage achieved by 1800MHz sites [Source: BIPT, Aetha]



Operators face the issue that there is a point where it is no longer economically beneficial to deploy additional 1800MHz sites to achieve small increases in population coverage. Especially given the prospect of the 900MHz band being available for mobile broadband services around 2020, we estimate that mobile operators will look to reach about 90% population coverage using the 1800MHz band in the scenario where the 800MHz band is not available. Operators have reacted similarly in the past; when low-frequency spectrum for providing UMTS services has been unavailable, operators have densified networks to provide UMTS coverage, though not to the coverage levels provided by GSM services (which had access to low-frequency spectrum). As shown in Figure 4-1, this means that an operator will need to deploy around 3300 LTE1800 sites.

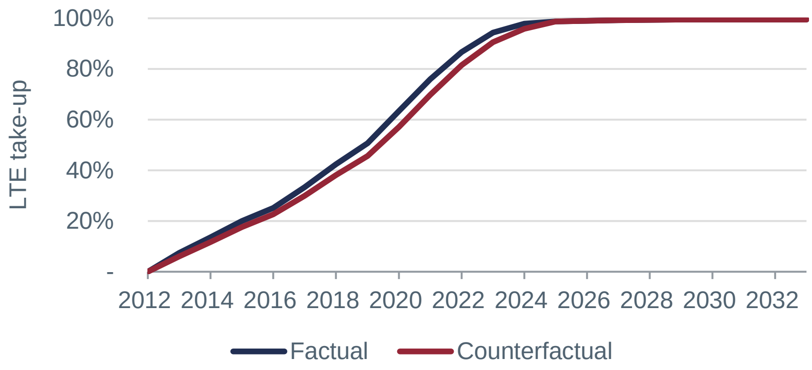
We expect that the mobile operators can use most of their existing sites (~3,000 sites for an average operator) to extend 1800MHz coverage. This means that each operator will need to deploy about 300 additional sites (900 sites in total), which represents a densification of about 10% of their existing network grid. We note that this is potentially a conservative assumption (i.e. an assumption leading to a low value of the 800MHz band for mobile services), as many of the operators' sites are used to provide additional capacity in urban areas and will not be optimally positioned to provide incremental coverage.

The assumptions on unit costs (capex and opex) for the required construction of new sites and site upgrades are based on a combination of anonymised information received from BIPT as well as benchmarks from previous project work. We also assume a replacement cycle of 8 years for equipment on sites.

4.2.2 Additional revenue

As discussed in Section 4.2.1, mobile network operators will need to build new sites in order to provide LTE coverage if they do not gain access to the 800MHz band. Such a densification exercise is likely to be time-consuming, implying that LTE1800 coverage is likely to lag behind the potential LTE800 coverage. In addition, as discussed above, we estimate that operators will restrict their LTE deployments to 90% population coverage, as it would not be economically beneficial to increase coverage further. Combining these two aspects, we expect that LTE take-up will be significantly delayed in the case that the 800MHz band is not available to mobile services. Figure 4-2, below, shows the assumed LTE take-up curve in both cases, with and without mobile use in the 800MHz band, as used in the model.

Figure 4-2: LTE take-up forecasts (% of total mobile subscribers)



The forecast for the case the 800MHz band is used for mobile broadband is based on data from Aetha's previous project work for BIPT. The forecast for the case that the 800MHz band is not used for mobile broadband is based on our assumption regarding LTE1800 coverage. We assume that take-up will initially lag by 20%, as we assume that this would be the difference in coverage if LTE1800 were deployed on all potential LTE800 sites. This gap reduces to 10% as LTE1800 coverage is increased to 90% of population over time. From 2020, we assume that the availability of the 900MHz band for LTE will allow operators to reach ~99% of population, thereby closing the gap in LTE take-up by 2025.

As LTE provides subscribers with a better data service, we assume that operators are able to charge a (temporary) premium for LTE services compared to non-LTE (i.e. GSM/UMTS) services, at least for the time that LTE is not the main mobile technology in the market. Hence, the faster LTE take-up, in the case the 800MHz band is available for mobile services, provides operators with an opportunity to generate incremental revenues.

We have assumed that the increase in ARPU for LTE services over non-LTE mobile services is in-line with the approximate mark-up charged for LTE contracts providing the same bundled minutes, text messages and data allowance as non-LTE contracts[32]. However, this ARPU premium should decrease over time as take-up increases. To take account of this, the model assumes a full erosion of the LTE mark-up by 2019.

Using a forecast of the year average total market subscribers (from BIPT and Aetha's previous project work), total revenues are calculated in both scenarios as the sum of LTE and non-LTE revenues. The

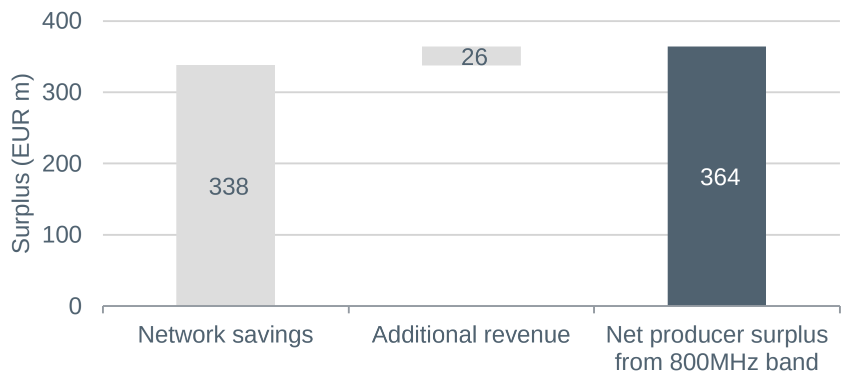
[32] Notably, the UK market provides a reasonable benchmark for this, with EE providing exclusive access to LTE services at this point in time, whilst charging a mark-up of about 12.5% relative to comparable offers by competing mobile operators and its own service offerings which provide HSPA data services but not LTE services.

difference between the revenues in the Counterfactual and Factual scenarios comprises the producer surplus which is gained if the 800MHz band is available for mobile broadband.

4.2.3 Total producer surplus

The total gain in producer surplus, in case the 800MHz is available for mobile services, is derived by combining the additional revenues from an earlier take-up of LTE with the cost savings from not having to deploy a densified network. We have calculated the net present value (NPV) of the surplus over a 20-year licence period using a social discount rate of 3.5%. This provides a value to mobile services of EUR364 million, as shown in more detail in Figure 4-3 below.

Figure 4-3: Producer surplus derived from use of the 800MHz band for mobile services (base case)



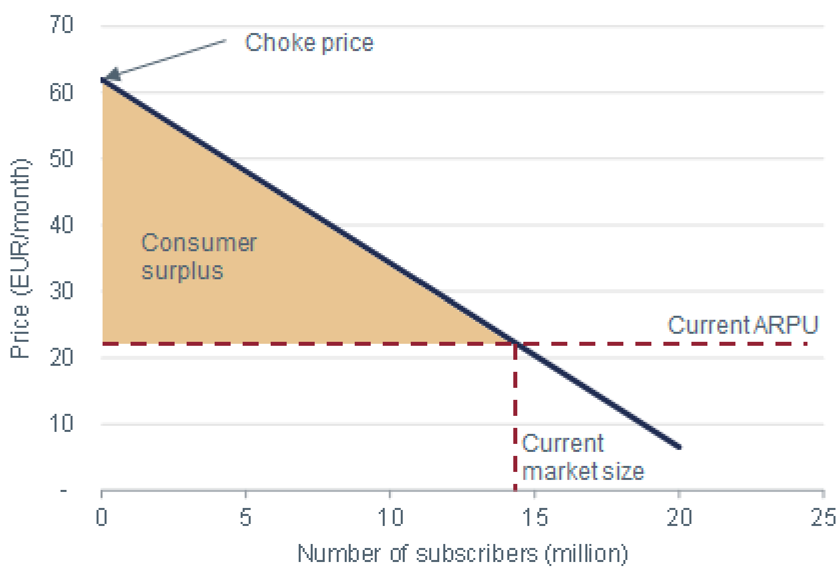
As mentioned previously, we are aware that some of the key inputs into this calculation are subject to significant uncertainty. We have therefore carried out sensitivity analysis on the inputs in Section 4.4.

4.3 Assessment of consumer surplus

Consumers of mobile broadband would also benefit from the use of the 800MHz band for mobile services as the mobile network operators would be able to provide them with better LTE coverage more swiftly. We assume that mobile users would value such access to faster mobile services, which is expressed by an increased willingness to pay for these services. Hence, a faster LTE take-up is the key driver underlying any increase in consumer surplus in case the 800MHz band is available to mobile operators (as discussed in Section 4.2.2).

We calculate consumer surplus by approximating market demand (assuming a linear demand curve) within each licence year for LTE and non-LTE services. We illustrate our approach for the case of 2012 (non-LTE) in Figure 4-4 below.

Figure 4-4: Market demand for non-LTE mobile services in 2012



In order to calculate the market demand curve for mobile services, we use the overall 2012 market size (i.e. the average number of total mobile subscribers across all segments in 2012) and the average price paid by these subscribers (derived from the blended ARPU of mobile operators in Belgium). We thereafter derive the slope of the demand curve by using the price elasticity of demand for the mobile market, allowing us to derive the so-called 'choke price', i.e. the price at which there would be no more demand for mobile services.

The price elasticity is a measure of how a change in the price for mobile services affects the number of subscribers. It is expressed as the percentage change in the number of subscribers resulting from a 1 per cent change in price. Estimates of the elasticity of demand vary significantly between different studies, based on the data used and countries studied. A paper by Grzybowski[33] derives various estimates of economic factors for the telecommunications market in EU countries and in particular the elasticity of demand. For Belgium, the elasticity is estimated as -0.337 for 2002. More recent estimates are available for Europe in general. For example, a paper by Growitsch, Marcus and Wernick[34] estimates long term elasticity to be in the range from -0.52 to -0.61, using data from 16 European countries between 2003 and 2008. A recent paper by Benzoni and Deffains[35] provides a brief survey of studies on elasticity of demand and concludes that a 'symbolic average' of these estimates for the EU15 countries would be -0.55. An estimate for a lower bound on the elasticity (i.e. producing a low value for mobile services) could come from a study on the Austrian market by Dewenter and Haucap[36], which estimates elasticity to be up to -1.1, using data from 1998 to 2002.

33 L. Grzybowski (2008), "The Competitiveness of Mobile Telephony across the European Union"

34 C. Growitsch, J. S. Marcus & C. Wernick (2010), "The Effects of Lower Mobile Termination Rates (MTRs) on Retail Price and Demand"

35 L. Benzoni & B. Deffains (2012), "Market Homogenisation or Regulation Harmonisation? The Welfare Cost of a European Mobile Market without the Later Entrant Operators"

36 R. Dewenter & J. Haucap (2008), "Demand Elasticities for Mobile Telecommunications in Austria, Journal of Economics and Statistics"

Within our model, we estimate the elasticity to be -0.55 and, taking the variation of numbers above into account, we have performed sensitivity analysis on this input in Section 4.4.

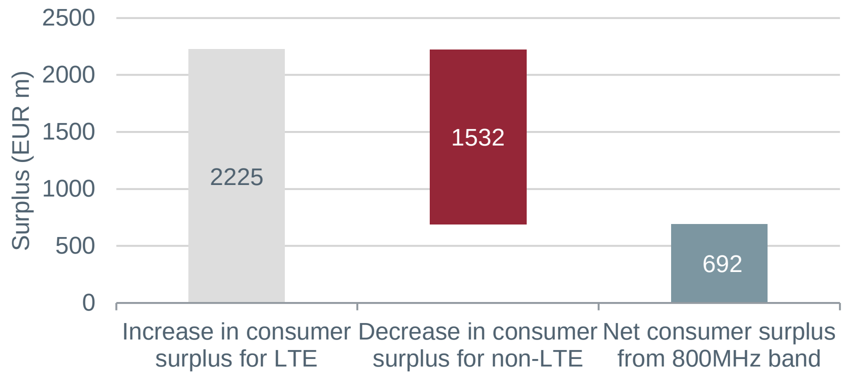
From the market demand curve for non-LTE services in 2012, we have inferred the choke price for non-LTE services. For 2012, we estimate the choke price to be about EUR62 per month. We then forecast the choke price, along with the market subscribers and ARPU forecast for each modelling year. These points effectively define our market demand curve across the modelling period (as we continue to assume linearity). We estimate the choke price for LTE services in 2012 to be about 12.5% higher than for non-LTE services. This assumption is based on the approximate mark-up charged for LTE contracts providing the same bundled minutes, text messages and data allowance as non-LTE contracts.

Regarding the forecast of choke prices, we have assumed that the choke price for non-LTE services will remain constant over the modelling period, whilst the choke price for LTE services increases with inflation (approximated at 2%). This assumption should reflect the fact that the willingness to pay for the latest mobile services should remain approximately constant as a share of overall income, whilst the willingness to pay for outdated mobile technologies will continuously decrease over time.

We derive consumer surplus from the sum of the additional price each current subscriber would be willing to pay for the service. This is approximated by calculating the size of the shaded area shown in Figure 4-4.

For each year, the consumer surplus is calculated as the difference in overall surplus (for non-LTE and LTE services), for the cases with and without the 800MHz band being available for mobile services. The NPV of this gain in consumer surplus is calculated using the discount rate of 3.5%. We estimate the total consumer surplus for mobile services to be around EUR692 million, as shown in Figure 4-5 below. It should be noted that the change in consumer surplus for non-LTE services is negative, as a faster take-up of LTE services corresponds to a faster migration of subscribers from non-LTE to (higher-value) LTE services. This provides a net increase in consumer surplus, as shown below.

Figure 4-5: Consumer surplus derived from use of the 800MHz band for mobile services (base case)



4.4 Sensitivities

As mentioned above, we have performed sensitivity analysis on key inputs that drive the value for the producer surplus and consumer surplus for mobile broadband. The three main drivers of value which carry a significant degree of uncertainty are:

- the LTE1800 coverage level that operators would densify to if the 800MHz band were not available,
- the price elasticity for mobile services
- the price premium for LTE over non-LTE services.

For each of these inputs, we discuss the impact of raising and lowering the inputs in order to provide a range of possible values for the producer surplus and consumer surplus. Note that the base case uses the assumptions discussed above in Sections 4.2 and 4.3, which we have intentionally set at a conservative level, in order to provide a relatively low value for the overall economic benefits of using the 800MHz band for mobile broadband.

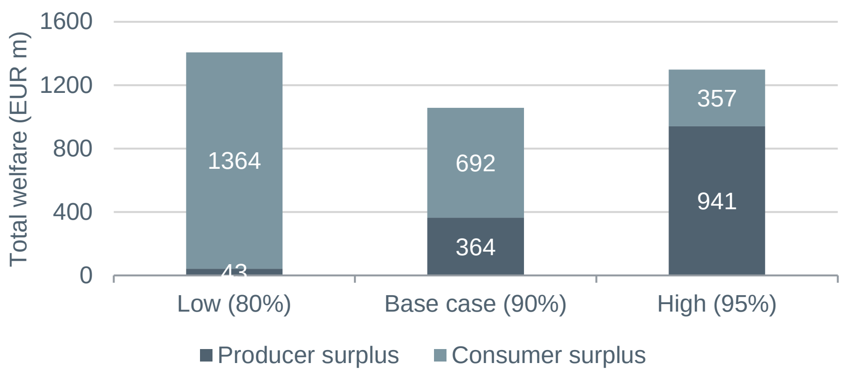
4.4.1 LTE1800 coverage level

In our base case, we assume that operators would densify their LTE1800 networks to reach 90% of the population in the case the 800MHz is not available for mobile services. We have assessed two further cases for this assumption:

- A low coverage case, assuming 80% population coverage. This would mean that operators only use their current coverage sites for LTE1800. However, this is unlikely to occur in reality as there will be competitive pressure from competitors given the relatively limited cost of providing incremental coverage to at least 90% of population.
- A high coverage case, assuming 95% population coverage. However, this is also unlikely as a relatively large number of new sites would be needed for the small amount of extra coverage. Also, the future availability of the 900MHz band for LTE would allow operators to provide better LTE coverage in the long-term.

The results of the sensitivity analysis on this value are shown below in Figure 4-6.

Figure 4-6: Impact on welfare from sensitivity on LTE1800 coverage level (% population covered)



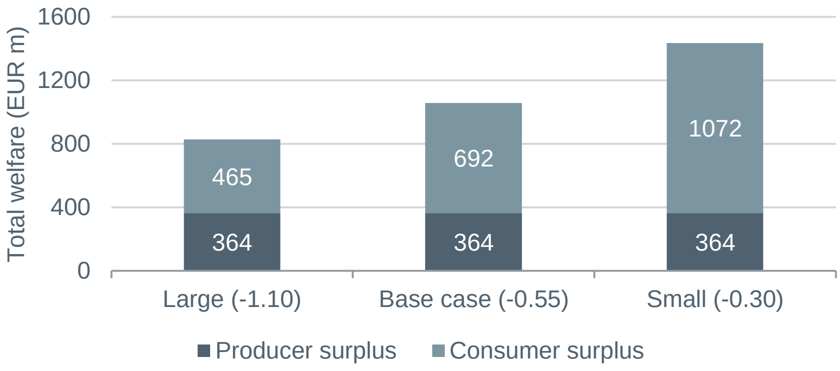
As can be seen in Figure 4-6, the producer surplus rises with increased coverage levels, whilst the consumer surplus decreases. This is because to provide a better coverage the operators would need to build more new sites, leading to significant savings from having access to 800MHz spectrum. At the same time, higher coverage levels would mean that the LTE take-up would lag behind less and therefore reduces the consumer benefits compared to a case where the 800MHz band were available for mobile services.

4.4.2 Price elasticity of demand

As discussed in Section 4.3, there is a large variation amongst different studies in the provided estimates for the price elasticity of demand for mobile services. To account for this, we have calculated the producer surplus and consumer surplus with 2012 price elasticities of -0.3 and -1.1, representing approximate upper and lower bounds from the relevant studies. This directly affects the estimates for consumer surplus, producing a range from EUR465 million to EUR1 072 million.

The results of the sensitivity analysis on this value are shown below in Figure 4-7.

Figure 4-7:
Impact on welfare from sensitivity on price elasticity of demand



4.4.3 Price premium for LTE

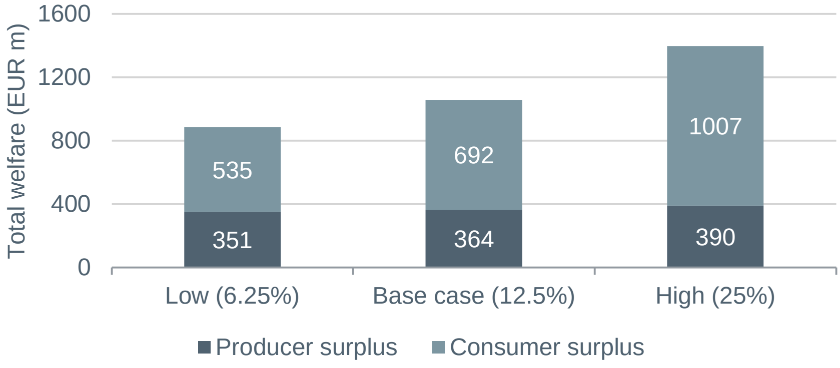
The price premium for LTE services over non-LTE services is used in two places in the calculation of producer and consumer surpluses:

- The ARPU mark-up, which affects consumer surplus as well as the additional revenues in producer surplus.
- The choke price mark-up, which affects the consumer surplus.

In the base case, we have assumed a value based on current contract mark-up for LTE of 12.5%. Within our sensitivities, we again introduce a low and high case, which, respectively, halves and doubles our estimate of the mark-up for LTE. As expected, an increase in the mark-up increases both consumer and producer surplus, leading to an increase in the total benefits of 32%, from EUR1056 million to EUR1 397 million.

Figure 4-8 below shows the results of this sensitivity analysis.

Figure 4-8:
Impact on welfare from sensitivity on price premium for LTE



4.5 Summary

Our analysis of the economic benefits of using the 800MHz band for mobile services has established an overall welfare impact of about EUR1056 million in the base case, of which about 66% arises from consumer surplus (EUR692 million) and 34% is from producer surplus (EUR364 million).

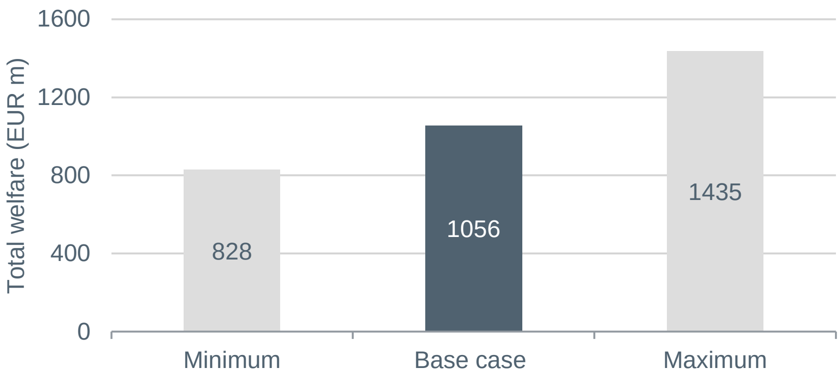
In addition, we have carried out a range of sensitivity analysis on some of the key inputs on which there is a significant degree of uncertainty. The results of this analysis are summarised in Figure 4-9.

Figure 4-9: Summary of sensitivity analysis regarding the value of the 800MHz band for mobile services

Scenario (EUR m)	Base Case (EUR m)	Sensitivity 1 – LTE coverage (EUR m)	Sensitivity 2 – Price elasticity (EUR m)	Sensitivity 3 – LTE mark-up (EUR m)
Factual	1056	1056 – 1407	828 – 1435	886 – 1397

The resulting range of valuations is summarised in Figure 4-10 below.

Figure 4-10: Range of estimates for total welfare from use of the 800MHz band for mobile services



Notably, our base case estimation of EUR1056 million is closer to the lower bound of our range than to the upper bound. This is due to our decision to select relatively conservative assumptions for the mobile case in order to minimise the risk of overestimating the value to mobile services.

In a report for BIPT, Analysys Mason estimates the value of the 800MHz band for mobile services as being around EUR2922 million[11]. Our estimates, even with the more optimistic assumptions, only reach about 50% of this value. However since the previous study's estimate was based on a high-level extrapolation, it is not entirely clear what the main drivers are for the differences in value. However, we note that, within our calculations:

- We have taken a relatively moderate view on the increase in value from LTE compared to other technologies. This reflects recent trends in the mobile communication markets which have led to a continuous decrease in revenues and EBITDA margins and a reduced belief that operators will be able to charge significant premiums for new services in an increasingly competitive environment.
- More importantly, we assume that suitable alternative bands for the 800MHz band will soon be available to mobile operators, such as the 900MHz, or even the 700MHz band. This leads to a situation where any benefit from having 800MHz spectrum is only temporary and therefore, significantly reduced in scale. This information was not necessarily available at the time that earlier studies on the value of the 800MHz band were undertaken, and therefore may have led to higher estimates of the longer-term value of the 800MHz band.
- In addition, the previous estimates produced by Analysys Mason quote a range for the value of the 800MHz band for mobile broadband services as being within the range EUR263 million to EUR5581 million to account for the uncertainty of the estimates. Clearly, the results of our study are well inside this range.

5 Conclusions

Within this study for the Belgian Institute for Postal Services and Telecommunications, we have assessed the economic benefits which can be derived from use of the 790-862MHz band for either DTT or mobile broadband services in Belgium. The purpose of the study is to inform discussions between the Belgian federal, regional and community governments on the potential need for "compensation" for this (formerly broadcasting) spectrum which is now made available for electronic communications services in line with EU requirements. The conclusions of our study are as follows:

- We expect there to be very limited value to use of the band by DTT. Within our base case analysis, we estimate that the value for use of the frequencies for FTA services would be about –EUR58 million, and the value for use by DTT subscription services would be about –EUR226 million.

- In contrast, we expect there to be significant value for use of the band by mobile broadband services. Our model expects that overall surplus derived from use of the band could be EUR1056 million.

Although we have generally applied optimistic assumptions when estimating the economic benefits of using the 790-862MHz band for DTT services, we do not believe that it is likely that use of the band for DTT will result in a significant positive value. The main reasons for this are as follows:

- Even though we expect some incremental take-up in DTT household penetration from the installation of incremental multiplexes, the cost of installing and maintaining the infrastructure outweighs the potential benefits to consumers. This conclusion is not surprising, as a nationwide infrastructure needs to be maintained to serve the secondary viewing demand of an estimated 5% of all Belgian households.

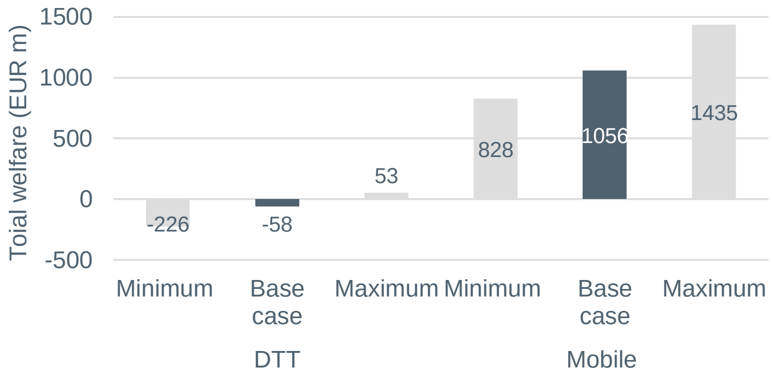
- Market evidence from Belgium supports this conclusion:

  - Currently, only 2.5% of households are using the DTT platform. Research conducted by the regional media regulators established that consumers would not consider switching to DTT from their current (cable) subscription, even in case of significant price increases on the cable platform[16].

  - Telenet, the commercial DTT subscription operators in Belgium, recently wrote down more than 90% of the value of its DTT assets which it has only held for about 2 years.

Based on a number of sensitivities, we have established a range for our estimates of the economic value of both services, as shown in Figure 5-1. This further strengthens our conclusions, as the value of use of the 790-862MHz band for DTT only turns positive in a small number of low probability scenarios. Further, it never exceeds 6% of the value of the lowest value scenario for mobile services.

Figure 5-1: Range of estimates for total welfare from use of the 790-862MHz band



Notably, the economic benefits calculated in this study are somewhat lower than high-level estimates made by Analysys Mason as part of a project for BIPT in 2010[11]. This previous study estimates, based on simple extrapolation of the results of economic studies undertaken in several other European countries, that the value for DTT could be around EUR681 million whilst it could be EUR2922 for mobile services. We believe that there are a number of reasons which explain the differences between our estimates:

- Regarding the value for DTT, the extrapolation of results from other countries does not appear to scale for the values for differences in DTT penetration. As two of the countries used in the extrapolation process have a very high DTT penetration (France, UK), this will introduce a strong bias in any estimates, especially when applying it to a country like Belgium, which has an exceptionally low DTT penetration.

- Regarding the value for mobile services, we have taken a relatively moderate view on the increase in value from LTE compared to other technologies. In addition, we assume that suitable alternative bands for the 800MHz band will soon be available to mobile operators, such as the 900MHz, or even the 700MHz band. This implies that any benefit from having 800MHz spectrum is only temporary and therefore, significantly reduces in scale. At the time that the original economic studies on the value of the digital dividend were undertaken, there was less clarity and no certainty on the timing of availability of LTE consumer equipment capable of operating in the 900MHz band.

Finally, we would like the reader to note that we have looked to provide well-founded analysis to justify key inputs throughout our analysis in order to arrive at realistic estimates for the economic benefits of using the 790-862MHz band. As with any analysis assessing consumers' preferences, there remains an unavoidable degree of uncertainty around the accuracy of our estimates. However, we have carried out sensitivity analysis on some of the key input factors in our models and can conclude that the qualitative conclusions remain unaffected, even when comparing the worst-case scenario for mobile and the best-case scenario for DTT.