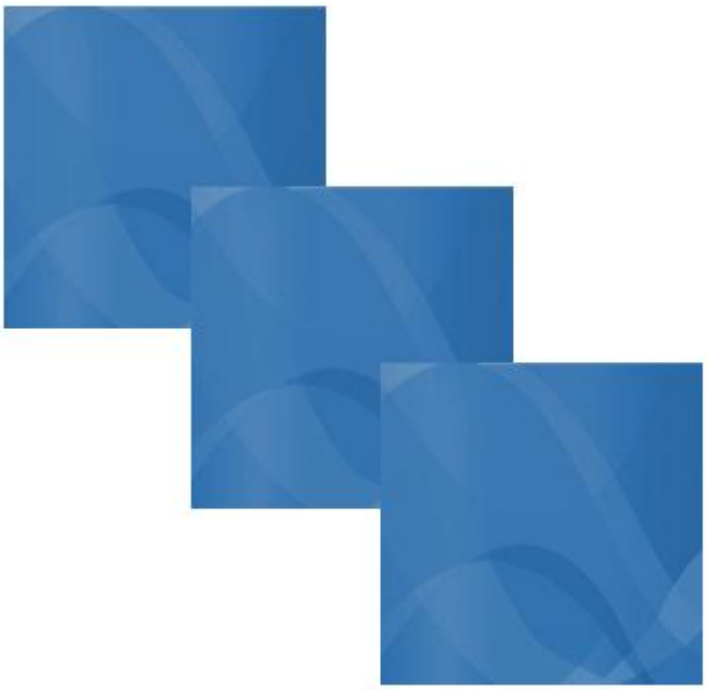

The application of summertime in Europe

A report to the European Commission Directorate-General for Mobility and Transport (DG MOVE)

19 September 2014

Disclaimer

ICF International presents a study on “The application of summertime in Europe”.

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A report submitted by ICF

Date: 19 September 2014

Job Number 30260247

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Document Control

Document Title	The application of summertime in Europe
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Date	19 September 2014

Contents

Executive summary

At present summertime is applied on a harmonised basis across the European Union (EU). The objective of this study is to examine the implications, for the internal market, business and citizens of the application of summertime no longer being synchronised.

Summertime arrangements have been widespread in Europe since the 1970s. They were introduced for the purposes of energy savings and increased time for leisure activities (through having longer daylight hours in the evenings), and then spread as countries coordinated their approach with that of their neighbours. At the end of the 1970s, all nine members of the European Economic Community had implemented summer time arrangements via their own national laws. However, a lack of alignment of these arrangements created problems for consumers and businesses. European policy measures began to be introduced, leading to the present day situation, where Directive 2000/84/EC requires Member States to put their clocks forward one hour on the last Sunday of March and change them back on the last Sunday of October each year.

Similar summertime arrangements are observed by Turkey, Norway and Switzerland, all of which have aligned themselves to the EU's summertime schedule. Summertime (also known as daylight saving time, DST) arrangements are also in place in the USA, Canada, New Zealand, Mexico, Brazil, Chile, Paraguay and Uruguay, and most territories in Australia. Countries which do not have summertime arrangements in place include Russia, China, Japan, India and Iceland.

The effects of summertime arrangements can be split into two main categories: domestic (restricted to the country in question and trans-boundary (relating to the synchronisation of arrangements between countries). In general, the majority of responses to the stakeholder consultations conducted for this study, the Member State government responses to the survey, and the findings in the literature, related to the domestic impacts of summertime arrangements rather than the effects of asynchronous summertime arrangements within Europe.

At a domestic level there is evidence of an association between summertime arrangements and activity in the tourism and leisure industry and also on crime reduction. There is stronger, albeit still mixed, evidence, of the effect of summertime arrangements on energy consumption. Some studies suggest a reduction in energy consumption, others find no impact. Most Member State governments stated that having summertime arrangements reduced energy consumption by a small amount, but could not quantify this effect. There is evidence from some countries that having summertime arrangements reduces the number of road traffic accidents, again through having more daylight hours in the evening. Although some more historical studies also found summertime arrangements were associated with an increase in accidents in the morning, this did not offset the effect in the evening, providing a net reduction in accidents.

There is some evidence that summertime arrangements can affect sleep patterns. Some Member State governments also stated a positive effect of summertime arrangements on health, through people being exposed to more sunlight and vitamin D, and reducing mental health issues such as Seasonal Affective Disorder, but no scientific evidence was provided to support this view.

Asynchronous summertime arrangements can affect networked industries that work across borders. A lack of harmonised summertime arrangements would lead to transport providers (both passenger transport and freight transport) having to re-schedule their timetables. In the energy sector, having asynchronous summertime arrangements increases the complexity of capacity planning for energy providers though, if given enough notice, the challenge is not significant.

Current arrangements for the synchronised application of summertime across Europe emerged through a step by step process that was driven by a consensus on the value of harmonisation. Harmonisation provides convenience and predictability for business and citizens alike. Intra-EU transport and communication providers only have to programme for one change in timetables. Businesses that work across countries within the EU can plan their work knowing that the time difference (if any) between their EU offices, suppliers, partners and customers is consistent throughout the year. The harmonised approach provided by the EU Directive thus benefits the internal market of goods and services. Compared to an asynchronous arrangement it provides lower costs, greater convenience and improved productivity.

A shift away from a harmonised approach has the potential to inconvenience large numbers of people. The effects are most visible in the transport sector (e.g. airline passengers missing flights) but are likely to extend across business and everyday life (e.g. in the scheduling of telephone calls and meetings). The impacts would be experienced not just in the Member State which changed its summertime schedule, but also in the Member States connected to it.

In addition, international evidence suggests that cross-border trade and investment is stronger when time is harmonised. This suggests that changes which reduce time harmonisation in Europe are more likely to have a negative impact on investment than a positive impact.

The majority of Member State Governments stated that they were satisfied with the current arrangements for summertime in Europe. Responses from five of the eighteen Member States stated that if Directive 2000/84/EC was not in place, their country might consider different summertime approaches. However, there was no consistent response in terms of how they would consider changing their arrangements, with two responses stating that they would consider removing summertime arrangements all together, one response saying they would consider keeping summertime arrangements throughout the year; and two responses saying they would consider altering summertime arrangements by a short period (so they were no longer harmonised with the rest of Europe), but maintain having summertime arrangements.

The consultations with business and consumer groups suggest no wider drive for change. The research team contacted 230 organisations, of which only 26 were motivated to provide interviews. Few saw harmonisation as an issue important enough to invest time discussing. Very few had given consideration to the impacts of asynchronous summertime. The practice of harmonised application of summertime appears to be well-embedded and accepted as a common sense solution.

This lack of interest suggests that there is not a large degree of dissatisfaction with synchronous summertime arrangements in the European Union as a whole. There are some areas of debate with regard to the application of summertime but it is clear that the harmonisation of summertime arrangements in the EU provides benefits to all Member States.

1 Introduction

This is the Final Report of a study by ICF International on the application of summertime in Europe. The study was commissioned by DG Mobility and Transport (DG MOVE) of the European Commission (hereinafter 'the Commission')[1].

At present summertime is applied on a harmonised basis across the European Union (EU). All Member States put their clocks forward one hour on the last Sunday in March and change them back one hour on the last Sunday in October. This synchronised approach, which is the end point of an evolutionary process lasting several decades, is codified in European law[2]. The objective of this study is to examine the implications, for the internal market, business and citizens of relaxing current practice such that summertime was no longer obligatory and was not harmonised across the Member States.

The study is concerned solely with the synchronisation of summertime in Europe, not whether the application of summertime in itself is a valid public policy objective. The analysis is based on a review of the literature, consultations with Member State governments, businesses, non-governmental organisations and other interested stakeholders and development of scenarios illustrating the implications of a move away from the current harmonised approach.

1.1 Summertime, which began as a means of cutting energy use in time of war, became standard across Europe by the 1980s

This section describes the development of summertime arrangements in Europe and briefly discusses equivalent arrangements in other areas of the world.

1.1.1 Countries have adopted summertime for a variety of strategy, economic and social reasons

Europe had its first experience of summertime arrangements during the First World War. Germany, France, the UK and Austria-Hungary, among others, introduced summertime with the principal objectives of allowing better exploitation of the available daylight hours and reducing the use of energy (Reincke et al, 1999). Most countries abandoned it when the war ended. Summertime reappeared during the Second World War then lapsed with the onset of peace.

The application of summertime became much more widespread during the 1970s. Motivating factors included (Reincke et al, 1999):

- Energy savings: many countries introduced summertime arrangements as a response to the energy crisis of the 1970s. Denmark, for example, estimated that the energy saving associated with the summertime switch could reach 0.5 per cent of the total electricity consumption or 8,000 tonnes of oil (Reincke et al,1999);
- Providing people with more leisure opportunities by making the most of daylight time;
- Harmonisation/synchronisation: some Member States, such as Bulgaria and Sweden, introduced summertime arrangements with the aim of harmonising their own practice with that of other neighbouring countries.

Table 1.1 summarises the date and principal motivations for summertime arrangements.

1.1.2 The move to legislate at European level was motivated by a desire to reduce the problems caused by uncoordinated application of summertime across the EEC

Collective action at European level to harmonise the application of summertime dates back to the early 1980s. By the end of the 1970s all nine members of the European Economic

[1] The study was commissioned under the Multiple Framework Service Contract MOVE/ENER/SRD.1/409-2012 Lot 5.

[2] The most recent of a series of Directives relating to summertime is Directive 2000/84/EC.

Community[3] had implemented summer time arrangements through national laws. These arrangements were not always aligned, such that there were differences in the dates adopted for the start and end of summertime. It was recognised that this lack of alignment between practices in different Member States created problems for consumers and businesses, and undermined the efficiency of the internal market. Policy initiatives were developed to address this problem.

Table 1.1 The date of adoption of current national summertime arrangements in Europe

Member State	Year of implementation	Time zone	Rationale
Austria	1981	GMT +1	■ Energy saving ■ Harmonisation ■ More leisure opportunities
Belgium	1977	GMT +1	
Bulgaria	1979	GMT +2	■ Harmonisation
Croatia	1983	GMT +1	
Cyprus	1975	GMT +2	
Czech Republic	1979	GMT +1	
Denmark	1980	GMT +1	■ Energy savings ■ Harmonisation
Estonia	1981	GMT +2	
Finland	1980	GMT +2	■ Request from farmers and transport sector
France	1976	GMT +1	■ Energy savings
Germany	1980	GMT +1	■ Harmonisation ■ Energy savings ■ Leisure
Greece	1971	GMT +2	
Hungary	1980	GMT +1	■ Energy savings
Ireland	1970	GMT	
Italy	1966	GMT +1	■ Energy savings
Latvia	1981	GMT +2	
Lithuania	2003	GMT +2	
Luxembourg	1977	GMT +1	
Malta	1966	GMT +1	
Poland	1977	GMT +1	
Portugal	1977	GMT	
Romania	1979	GMT +2	
Slovakia	1979	GMT +1	
Slovenia	1973	GMT +1	
Spain	1974	GMT +1	
Sweden	1980	GMT +1	■ Harmonisation
The Netherlands	1977	GMT +1	
UK	1970	GMT	

Source: Reincke et al., 1999

[3] Belgium, Denmark, France, Germany, Ireland, Italy, Luxemburg, the Netherlands and the United Kingdom.

The observance of summertime is a practice adopted by individual countries. European legislation has been focused on coordinating these national practices in the common interest. The stated rationale for action at European level to harmonise the application of summertime is that it would:

- Remove obstacles to the free movement of goods and services;
- Ensure the proper functioning of sectors such as transport, communications and other industries through stable, long-term planning (Directive 2000/84/EC, para. 4).

The key steps in the development of European law on the application of summertime were (European Commission, 2007):

- The establishment of a unified date for the start of the summertime period through the adoption of Directive 80/737/EEC;
- Successive Directives which laid down a common date for the beginning, i.e. the last Sunday in March, and two dates for the end: one on the last Sunday in September applied by the continental Member States and the other on the fourth Sunday in October for the United Kingdom and Ireland;
- The establishment, via the seventh Directive (94/21/EC), of a common end date, i.e. the last Sunday in October, from 1996 onwards;
- The extension of these arrangements for a period of four years (from 1998 to 2001 inclusive) in the eighth Directive (97/44/EC);
- The extension, via the ninth Directive (2000/84/EC) of the provisions of the eighth Directive for an unlimited period and the application of summertime being made legally binding.

The cumulative effect of this succession of laws is that all Member States are now obliged to observe summertime, starting it on the last Sunday of March and ending it on the last Sunday of October.

1.1.3 Summertime is also observed beyond the EU

The application of summertime is not restricted to the EU. Figure 1.1 shows countries where summertime arrangements are known to be in place.

At the EU's borders, summertime is observed by Turkey, Norway and Switzerland, all of which have aligned themselves to the EU's summertime schedule. Saving energy and avoidance of trade disruptions with EU partners have been identified as motivations for the adoption of summertime in those countries (Mirza and Bergland, 2011; Timeanddate, 2008).

In some cases different summertime arrangements apply within the same country:

- In the US, the 2005 Energy Saving bill extended existing summertime arrangements by one month. This extension was introduced with the aim of reducing energy consumption. All US States except Arizona and Hawaii observe daylight saving time (DST). Arizona trialled DST in 1966 for one year, but due to a negative public reaction decided not to adopt it, despite the energy savings. Hawaii has chosen not to apply DST due to its geographic location (Timeanddate, 2014). The US Department of Energy estimated that in 2007 the total energy savings from DST corresponded to 0.03 per cent of national electricity consumption (U.S. Department of Energy, 2008);
- DST arrangements in Canada are the same as for the majority of the USA, except for the majority of the province Saskatchewan, where no DST arrangements are in place (Government of Saskatchewan, 2014)[4];
- In Australia, some states apply DST, whereas other states do not implement any clock changes. A three year trial of DST was introduced in Western Australia in 2006 to reduce the time gap with the business centres of Melbourne and Sydney (Hamermesh,

[4] A small number of cities in Saskatchewan which border other Canadian provinces do have DST arrangements.

Knowles Myers and Pocock, 2006). However, DST was subsequently abolished when 56 per cent of voters opposed DST in a referendum held in 2009 (Timeanddate, 2009).

Figure 1.1 Map of countries (coloured in red) which are known to have summertime arrangements in place

Source: ICF International

Note: some territories/regions within the following countries do not apply summertime: Australia, Canada, Brazil, US, Western Sahara, Greenland.

Where summertime is observed there is no harmonisation of summertime arrangements either at a global level or in the northern and southern hemispheres. Table 1.2 provides examples of when summertime begins and ends in different countries.

Table 1.2 Global arrangements where summertime applies

Region	Summertime begins	Summertime ends
Europe	Last Sunday in March	Last Sunday in October
USA, Canada and Mexico	Second Sunday in March	First Sunday in November
Australia	Fist Sunday in October	First Sunday in April
New Zealand	Last Sunday in September	First Sunday in April
Brazil	Third Sunday in October	Third Sunday in February
Chile	First Sunday in September	Last Sunday in April
Paraguay	First Sunday in October	Third Sunday in March
Uruguay	First Sunday in October	Second Sunday in March

Observation of summertime is by no means universal. There is, for example, currently no application of summertime in Russia, China and Japan. Both Russia and China have observed summertime in the recent past but subsequently abandoned the practice.

In 2011, Russia abolished clock changes to avoid negative health impacts#. A decision was made to apply DST all year round in order to 'prolong daylight' (Timeanddate, 2011b). This was part of a wider revision of time arrangements in Russia aimed at reducing the number of time zones across the country (Russian Life, 2010).

The abolition of summertime arrangements in Russia influenced the arrangements in place in Belarus and Ukraine. In Belarus, a Committee including representatives from the Ministry of Energy and the Ministry of Health recommended alignment to the Russian decision, taking into account the significant economic and cultural ties between the two countries and the potential health risk related to summertime arrangements. The potential health impacts and

the proximity to Russia also led to the 2011 proposal to abolish DST in Ukraine (Timeanddate, 2011a).

China observed summertime from 1986 to 1991. The application of summertime is estimated to have led to electricity savings of 700 million kilowatt-hours in 1986. Nonetheless, summertime arrangements were abandoned in 1992 owing to 'the inconvenience of the system'. They have not been reintroduced although in 2007 Chinese political advisors recommended the reestablishment of summertime because of the energy savings likely (Feng, 2007).

Japan does not currently apply summertime arrangements. However, the application of DST for energy saving purposes was considered as part of the 2008 'Action Plan for Achieving a Low Carbon Society' (OECD, 2010).

Iceland does not apply summertime arrangements. This is due to its geographic location at a high latitude (64°N) with lengthy daylight hours in the summer.

The way that EU neighbours have coordinated their summertime practice with that of the EU, and both Belarus and the Ukraine aligning their summertime practice with that of Russia, illustrates the 'gravity' effect that major economies can have on the time policy of smaller, closely connected countries.

The application of summertime is likely to be seen as having a bigger effect in southern EU Member States than in northern Member States. This is because in the north daylight hours are already long in the summer months due to the high latitude; sunset in the summer months is significantly later than in winter months even in the absence of summertime arrangements. In southern Member States, the move to summertime arrangements extends daylight hours in the evening by one hour. In the absence of summertime there would not be as large a difference between the time of sunset in winter and summer months.

1.2 The debate about summertime arrangements continues in some parts of Europe

Whereas summertime arrangements have been uncontentious in many countries, certain Member States have a history of internal debate on summertime arrangements. These debates are manifest in:

- The presence of associations against or in favour of summertime arrangements: this includes, for example, the French association against double summertime (Association contre l'heure d'été double, ACHED);
- The publication of position papers by various stakeholder groups (for example road safety campaign groups); and
- The publication of research commissioned by both public and private bodies over the different impacts of summertime arrangements (for example research in the UK commissioned by the Department for Transport).

These debates have often been running for many years and are referenced in previous studies on this topic. In 1999 Reincke *et al*, for instance, noted that there were countries with an active debate about summertime arrangements and harmonisation, and others where there is limited or no discussion over summertime arrangements and their harmonisation (a group that includes Ireland, Italy, Luxembourg, Netherlands, Poland, and Hungary).

1.3 A majority of Member State governments do not see a case for changing summertime arrangements

Member State governments were consulted for this study. A majority of those responding (eleven of the 18 Member States that replied) stated that no other summertime arrangements would be considered at present. Responses from five Member States stated

that if Directive 2000/84/EC was not in place, their country might consider different summertime approaches[5]. These included:

- Aligning with the real daylight period in the country (leading to summertime a few weeks shorter than the current summertime arrangements) (two responses, one Western European and one Southern European Member State);
- Agreeing across the whole EU to apply summertime (this would avoid any asynchronous arrangement costs) (one response, a Northern European Member State);
- Having no summertime arrangements (two responses, one Northern European and one Eastern European Member State)[6].

Four of these responses would lead to asynchronised summertime arrangements in Europe. The reasons behind these proposed changes, as stated by representatives of Member State governments, include:

- Summertime arrangements have made no difference to the country since they were introduced, and are therefore not necessary; (one Northern European Member State)
- The period of summertime arrangement should be adopted according to the latitude of the country (which causes differences in daylight hours); and
- Applying summertime all year round would increase light in the country within working and commuting hours to help reduce energy consumption and road traffic accidents.

There has been some activity in national legislatures in recent years. For example, a private member's bill was introduced in the UK parliament requiring the UK Government to consider moving the UK to a double summertime arrangement in 2011. However, it was not passed, and since 2011 the issue has not been raised again. At around the same time, the summertime issue was raised in the Irish parliament, but again no motion was passed. In the 2014 European elections, one party manifesto included the policy of removing summertime arrangements, stating that summertime arrangements cause disruption to work organisation and causes negative health effects[7].

1.4 The application of summertime is overlaid on the time zone policies of Member States

Summertime is not the only source of time variation among countries. The application of summertime is, as discussed above, a means of accommodating the variation in daylight hours seen over the course of the year. That practice sits on top of the use of time zones which, in broad terms, align time with the 24 hour cycle of day and night. EU Member States are located in three different time zones (Figure 1.2):

- Greenwich Mean Time (GMT): Also known as Western European Time (WET), this is observed by countries that have adopted the Greenwich Time Zone or Universal Time Zone (UT), i.e. the time zone centred on the prime meridian. There are three EU countries located in this time zone: the UK, Ireland and Portugal;
- GMT +1: Also known as Central European Time (CET), this time zone is one hour ahead of GMT countries. Most EU Member States observe GMT +1;
- GMT +2: Also known as Eastern European Time (EET), this time zone is two hours ahead of GMT. Eastern Member States such as Greece and Romania are located in this time zone.

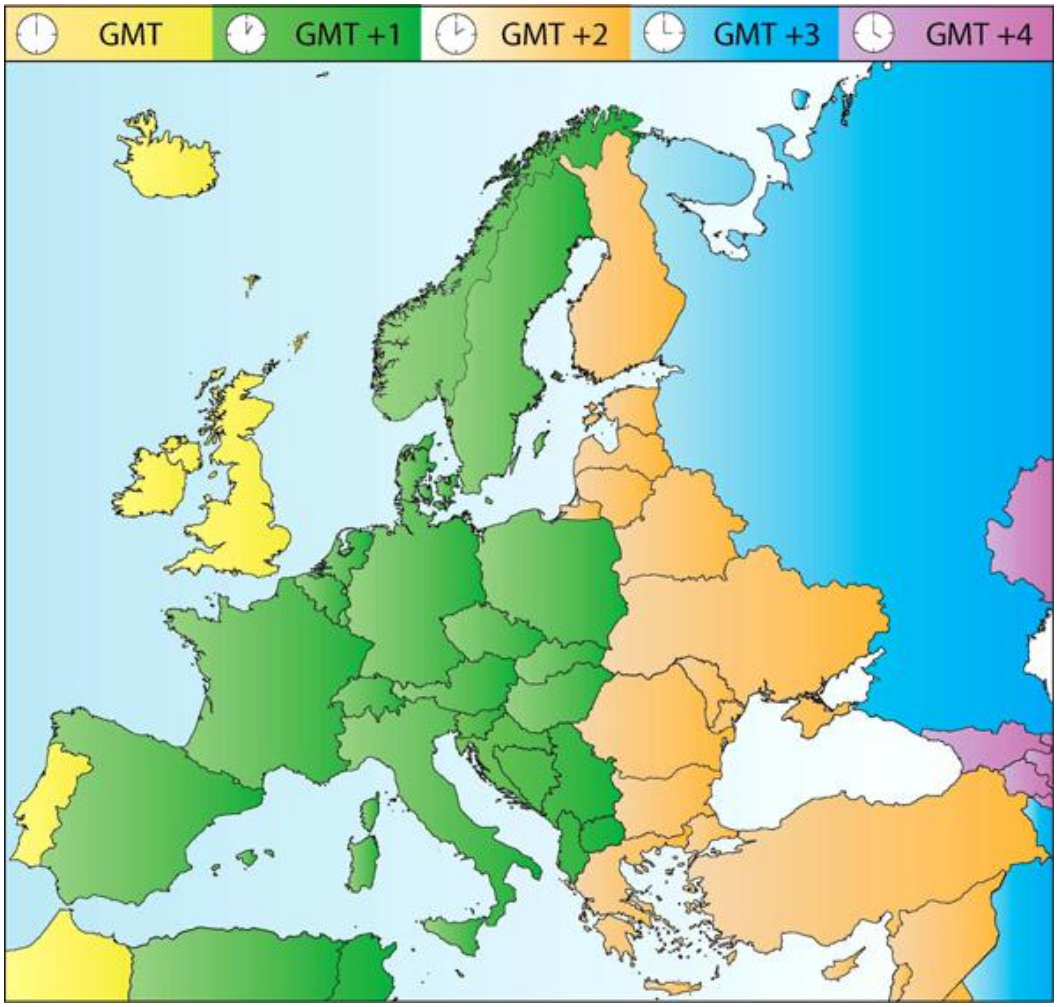
The debate about choice of time zones is beyond the scope of this study but the fact that time is not harmonised across Europe forms part of the context to the analysis.

[5] Two Member States did not provide a response to this question.

[6] 18 countries responded to the survey. There were responses from four Eastern European Member States; eight Northern European; two Southern European; and four Eastern European Member States. Multiple responses were received from Hungary, one of which stated different arrangements to the others.

[7] http://www.novinky.cz/domaci/332635-zrusme-letni-cas-v-cele-evrope-vyzyvaji-lidovci.html

Figure 1.2 EU Member States operate in three time zones



Source: European Commission Audio-visual department,
http://ec.europa.eu/avservices/photo/photoByMediaGroup.cfm?sitelang=en&mgid=38

1.5 The study conclusions are informed by desk research and stakeholder consultation

The method adopted for this study involved a mix of primary and secondary research on summertime arrangements, and the potential impact of non-harmonised summertime arrangements within Europe. The approach taken to the literature review is described in Annex 2. Consultees are listed at Annex 3.

The literature on the domestic impacts of summertime arrangements and harmonisation/non-harmonisation of summertime arrangements was reviewed, considering research from both within Europe and beyond Europe. In total, 139 relevant pieces of literature were identified and reviewed. The majority of the literature focussed on domestic impacts of summertime arrangements (for more information see Annex 1).

Twenty six stakeholders were interviewed. Contact was made with 230 organisations via email and telephone, and 350 phone calls were made in to request consultations with stakeholders. Twenty interviews were completed with business groups or employers and six with citizen groups. In addition, a survey was sent to representatives of all EU Member State governments by email and followed up by email and telephone. Eighteen Member State governments responded.

Trade and transport data for Europe were analysed to show how European countries are linked through trade, and therefore what the likely impacts of summertime arrangements would be.

Four different illustrative scenarios for alternative summertime arrangements within the EU have been appraised, and compared with the current summertime arrangements. The scenarios considered are:

- Scenario 1: A country with high levels of connectivity with multiple countries in the European Union (in terms of transport links and energy) changing its summertime arrangements on a different schedule such that it is out of sync with the rest of the EU for two weeks each year;
- Scenario 2: A country with lower levels of connectivity with multiple countries in the European Union (in terms of transport links or energy) changing its summertime arrangements such that it is out of sync with the rest of the EU for two weeks each year;
- Scenario 3: A country with high levels of connectivity with multiple EU countries abandoning the application of summertime and therefore being out of sync with the rest of the EU for seven months each year; and
- Scenario 4: A country with lower levels of connectivity with multiple EU countries abandoning the application of summertime and therefore being out of sync with the rest of the EU for seven months each year.
- Scenario 5: The Member State in Scenario 1 is joined on the same alternative schedule by one other Member State, such that both are on a different schedule for two weeks each year; an alternative scenario where the two Member States are on different schedules to each other and the rest of the EU is also presented; and
- Scenario 6: Three Member States change their summertime arrangements such that they are on a different schedule from the rest of the EU for two weeks each year. All Member States will have the same summertime arrangements, and one of the Member States will be the same as in Scenario 2, to aid comparison between options. As with Scenario 5, an alternative scenario is presented where all three Member States are on different schedules to each other and the rest of the EU.

1.6 Structure of the report

This report is structured as follows:

- Section 2 explains the impacts of summertime, and its harmonised application, on different business sectors;
- Section 3 discusses the impacts of summertime arrangements on citizens and Member State governments;
- Section 4 discusses the six scenarios on asynchronised application of summertime; and
- Section 5 provides conclusions on the potential impact of no longer having a harmonised summer-time arrangement, the influence on the internal market, and impact on business and citizens.

2 The impact of summertime on business and the economy

This section discusses the effect of the application of summertime on businesses in the EU. The findings come from the literature review, consultations with businesses and business groups, data analysis and survey responses from Member State Governments. The effects of domestic summertime arrangements for each business area are discussed and followed by a discussion of the effects of the harmonisation of summertime arrangements. Examining the impact of summertime arrangements on business and the economy is particularly important given that trade between EU Member States is high. Over 63% of goods traded by EU Member States were with other EU Member States (intra-EU trade) in 2010, and over half of the trade in services was also intra-EU[8].

Studies on time zones have examined the relationship between time coordination and the intensity of commercial relationships across countries (Hamermesh, Knowles Myers and Pocock, 2006; Gaski, 2012; Stein and Daude, 2007). These studies do not always focus on summertime; however, they provide a useful perspective on the potential trade impacts from the lack of harmonised time arrangements. These studies indicate that a lack of harmonisation has a negative effect on cross border trade. Therefore, the sectors which have a higher degree of intra-EU trade are anticipated to be more affected by asynchronous summertime arrangements than sectors with less significant intra-EU trade.

2.1 Agriculture

Nearly 11 million people were employed in the EU's agriculture sector in 2012. Over €300 billion of agricultural produce is imported and exported by EU countries each year; the majority of this activity is intra-EU trade.

2.1.1 Evidence on the effects of the application of summertime on agriculture

In the early 1970s, when several Member States introduced summertime arrangements, farmers' organisations and opponents of summertime reported potential negative impacts on agriculture. They voiced concern that farm animals would be forced to adjust to man-made time, and that time adjustments imposed by the application of summertime affected animals' biological rhythms with effects that included, for example, a fall in milk output (Reincke *et al*, 1999). Some organisations also reported that the application of summertime imposed additional impacts and costs, such as requiring some farmers to work in darkness for a considerably larger part of the summer (Reincke *et al*, 1999).

More recent assessments tend to conclude that currently there are no significant impacts on agriculture (e.g. Policy Studies Institute 2010, cited in Bennett, 2012). This may be linked to the development of technology applied in the farming sector. For example, the National Farmers Union in Scotland, a representative body for farmers, has recently stated that, '*An extra hour of morning daylight for farmers is no longer really an issue—before modern-day machinery and lighting, daylight was crucial, but now farmers have the technology to deal with it*.' (Bennett, 2012).

A few Member State governments identified, in the consultation conducted for this study, impacts from summertime on agriculture. These include:

- Biorhythm effects for both farmers and animals, which negatively affects workflows and productivity for a period of weeks;
- More efficient use of the early morning and late evening hours in agricultural activities during the summer season, especially during hot summer periods; and
- Energy savings for farmers from being able to work longer in the evenings without having to use artificial light.

[8] 56.1% of all exported services and 58.4% of all imported services were intra-EU trade in 2010. Eurostat, (2012), 'Intra EU share of EU-27 trade in goods, services and foreign direct investments remains more than 50% in 2010'

Most Member State respondents to the survey did not identify any costs or benefits of summertime arrangements to the sector.

2.1.2 Evidence on the potential effects of asynchronous application of summertime on agriculture

No evidence has been found on the impact of asynchronous application of summertime arrangements in Europe on the agriculture sector. No such impacts were identified in the Member State survey responses or any interviews with consultees. There is a potential impact on the transportation of produce between countries but this is common to other trading activity and is considered here in section 2.2.3 on the transport and logistics sector.

2.2 Transport

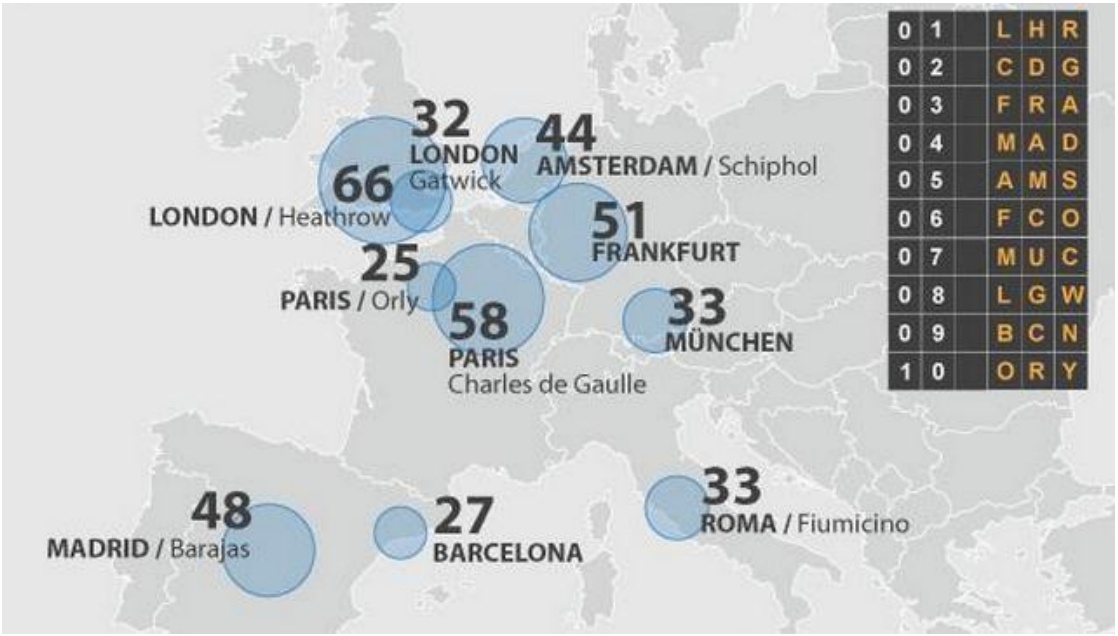
In the Communication from the Commission to the Council, the European Parliament and the European Economic and Social Committee under Article 5 of Directive 2000/84/EC on summer-time arrangements, transport was identified as one of the main sectors affected by the Directives on summertime applications (European Commission, 2007).

The transport sector employs over nine million workers in the EU in more than one million enterprises. The majority of trade in the sector is domestic. Around half of the transport services exported by the EU28 countries was to other EU28 countries (intra-EU trade), and just over half of the transport services imported by EU28 countries were from other EU28 countries.

2.2.1 Passenger air transport

The air transport sector in Europe employs half a million people (LFS, 2012) and had a turnover of €127 billion in 2011 (SBS, 2011). Figure 2.1 presents the number of passengers passing through the 10 largest airports in Europe; approximately 417 million passengers flew from these airports in 2009. There were approximately 351 million intra-EU air passenger journeys in 2012 (Eurostat, 2013b).

Figure 2.1 The number of passengers passing through the 10 largest airports in Europe



Source: Eurostat, European Parliament. Graphic sourced from http://www.europarl.europa.eu/news/en/news-room/content/20130709FCS16918/4/html/EU-air-traffic-in-figures

2.2.1.1 Evidence on the effects of the application of summertime on the air transport sector

The Member State governments' survey, research and consultations with stakeholders have not yielded evidence that summertime arrangements have an effect on passenger air travel. Given this lack of evidence, it is anticipated that there are no material impacts on the passenger air travel sector from domestic summertime arrangements in Europe. Airlines have adjusted to practice and have systems in place to ensure operations continue undisrupted.

2.2.1.2 Evidence on the potential effects of asynchronous application of summertime within the EU on air transport

The evidence in the literature suggests that a lack of harmonisation in summertime arrangements between countries can impact on the airline sector. The literature examined suggests that differences between countries in their application of summertime make transport operations more costly and complicated. The purpose of harmonisation at EU level was to address the problems arising from an uncoordinated application of clock changes in the course of the year (Reincke *et al*, 1999). This is particularly important in the airline sector, with large numbers of passengers travelling through European airports.

The importance of synchronisation has also been highlighted by transport operators outside the EU. In 2005, the US Government proposal to modify existing summertime arrangements prompted reactions from air transport representatives. Airlines for America expressed its concern over the potential disruptions from the lack of synchronisation between the US and EU timings. According to the association, the initial US proposal to extend summertime by two months would have led to losses of US$147 million for the airline industry through effects on transatlantic air traffic, as Europe was not altering its timings simultaneously (Fialka, 2005). Anthony Concil, spokesperson for the International Air Transport Association (IATA), stated that, "*When Europe and the US are on different times, connections become less convenient. Right now there is one week of discord between the U.S. and Europe so it's sort of at a manageable level … you might have a month-long period where you have lousy connections, so from a traveller's perspective it's not going to be particularly good*." (Handwerk, 2005).

Airline representatives explained (in the literature referenced above) that one of the main issues was the so-called 80/20 slot rule: a plane must be present in an airline's assigned slot for 80 per cent of the time assigned to the airline, otherwise it risks having the slots assigned to other operators. The extension of DST could have led to the loss of slots due to the time shift (Handwerk, 2005).

The findings from the literature review suggests busier airports with organised slot allocation systems are most likely to be affected by asynchronous application of summertime in Europe. However, the consultations with airline sector representatives present a more mixed view. One consultee suggested that if the application of summertime was not harmonised there could be problems relating to the allocation of slots and airlines being able to have their flights in the correct slots. Other consultees suggested that there would not be a large impact on airlines or airports, provided plenty of notice was given about the change of summertime arrangements. This is because, with enough notice, airlines will be able to negotiate acceptable landing slots even at the busiest airports. There is a potential issue for late night and early morning landing slots where there are curfews on flights but at these times there are still spare slots available even at the busiest airports in Europe. In summary, there would be an administrative cost to the sector arising from the need to re-schedule timetables and some slot arrangements but it should not be onerous.

A bigger concern for the consultees was the potential impact on passengers – ensuring that they turn up on time for the flight (if the times have to be changed), booking the correct connecting travel and general confusion with the change in time arrangements.

The results from the survey of governments show that one of the main advantages of having harmonised summertime arrangements is that it helps scheduling of international travel, particularly air travel. Four responses specifically mentioned how summertime arrangements have an impact on air transport, and in particular how asynchronous

arrangements could cause disruption to air transport, and that it is important that summertime arrangements are harmonised. However, many more of the responses mention the scheduling of transport more generally as a potential issue if summertime arrangements are not harmonised. The response from a Member State which borders non-EU countries which do not harmonise summertime arrangements used difficulties in transport links to these countries as examples of potential problems that could be encountered within the EU if summertime arrangements were altered, and suggested that this could be a significant issue.

There are not thought to be any costs or benefits of the harmonisation of summertime for support industries in the air transport sector. For example, stakeholder consultations with air traffic controllers indicated that they work on Coordinated Universal Time (UTC), which remains constant in all areas of the world throughout the year. As a consequence, they would not be affected by changes to summertime arrangements.

2.2.2 Passenger rail transport

The most recent data available for each country suggests that nearly nine billion railway journeys are taken each year in Europe (Eurostat Rail transport statistics). The majority of rail transport is domestic, rather than between countries. Just 6% is non-domestic travel (on a passenger-kilometre basis, see Table 2.1).

Table 2.1 The vast majority of rail travel within Europe is domestic

Indicator	
Total rail passenger kilometres completed in EU (million pkm)	424,400
Total international[9] passenger kilometres completed (million pkm)	25,418
Percentage of completed rail passenger kilometres completed in Europe that are international journeys	6.0%

Source: Eurostat, Passenger transport by type of transport (detailed reporting only) (million pkm) [rail_pa_typepkm]

Examining these data at a country level shows that the highest number of international passenger kms are completed in France (10,698 million pkm). Luxembourg has the highest proportion of international passenger kms. Among the countries which do have some rail links with other countries, Bulgaria has the lowest number of international passenger kms and the lowest proportion of international passenger kms.

Figure 2.2 illustrates the core EU transport network (including current and planned rail networks) as identified by the European Commission (DG MOVE, 2013).

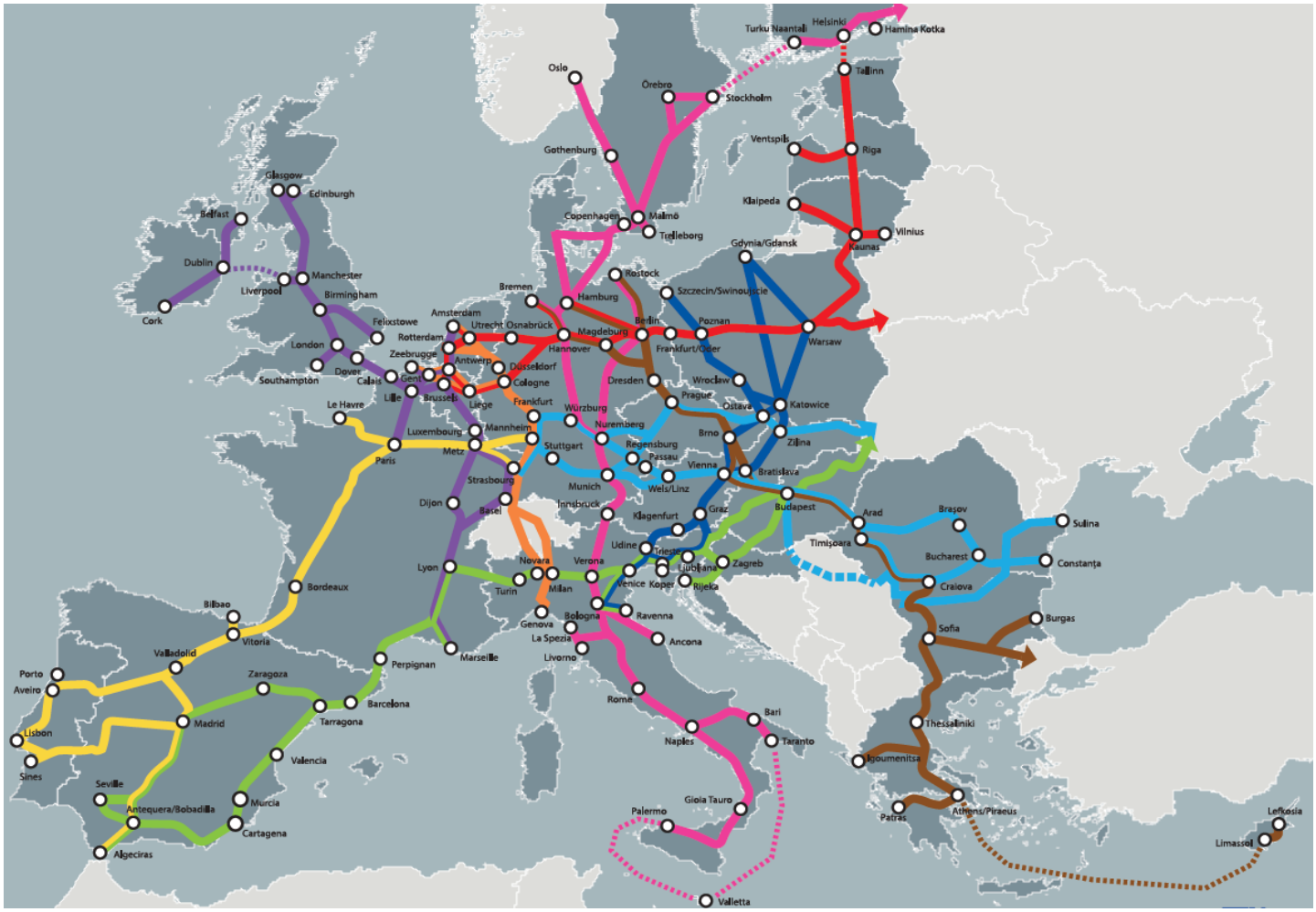
2.2.2.1 Evidence on the effects of the application of summertime on the passenger rail transport sector

Consultations with rail transport stakeholders suggest the application of summertime requires that:

- Train timetables are adjusted at the start and end of summertime: for example, arrival times may be shifted by one hour. Adjusted timetables are prepared and applied twice a year: during the day of start and during the day of end of summertime. 'Standard' timetables are used for the rest of the year. As explained by consultees, this timetabling process is generally automatic and therefore does not represent a problem: operators are used to existing arrangements and timetabling software can easily cope with the adjustments required by summertime. It can be assumed that few resources are required; and
- Rail operators need to communicate timetable changes to all interested parties, including other carriers and passengers, before the start and end of summertime.

[9] International journey is defined as a train journey where the place of loading/embarkation is in a different country to place of unloading/disembarkation

Figure 2.2 Core rail networks across the EU



DG MOVE, 2013. TEN-T Core Network Corridors http://ec.europa.eu/transport/infrastructure/tentec/tentec-portal/site/maps_upload/09_01_2014SchematicA0_EUcorridor_map_outlined.pdf

Trains that run overnight require more detailed planning. When clocks are set backward, the train may either be scheduled to arrive an hour earlier at the destination, or simply stop for an hour en route. When clocks go forward, planning is required in order to avoid that night trains interfere with other services.

One eastern Member State representative and one rail operator added that there may also be difficulties and costs related to the assessment of working times and the calculation of salaries with relation to the days when clocks are changed.

The operations described do not cause significant disturbances to passengers, as night passenger transport by rail is limited and passengers are generally aware of clock changes.

2.2.2.2 *Evidence on the potential effects of asynchronous application of summertime within the EU on passenger rail transport*

Based on the literature analysed for this study and on the inputs provided from rail sector stakeholders, the harmonisation of summertime is beneficial for rail transport operations.

A European Commission response to a European Parliament petition about summertime arrangements stated that benefits from harmonisation are confirmed by transport operators: 'EU-wide arrangements facilitate for instance the co-ordination of train timetables in international traffic. This useful aspect has always been highlighted by the transport sector,' (European Commission statement, quoted in European Parliament, 2013). Rail operators, Member States and sector representatives consulted for this study believe that a lack of harmonisation could add complexity to the current situation. For example, if two Member

States adopt different summertime starting and ending dates, then train operators would need to adapt timetables four times a year for each of the starting and ending dates respectively adopted by the two countries. This can make rescheduling more complicated and create some confusion for passengers travelling across the EU, as timetables would be changed four times a year rather than twice.

This could also affect national timetables: the stations with international rail traffic may need to adapt the timetables of other national trains to adjust to the new scheduling imposed by different summertime arrangements.

The consequences of asynchronous arrangements could include periods of reduced service (fewer trains running) on certain routes. Additional trains and staff resources may be required to ensure sufficient service, as well as additional staff time which would be required to produce new, and more complicated timetables.

The potential effects arising from lack of harmonisation depend on the intensity of cross-border railway services and on the length of the period during which asynchronous arrangements are in place. Countries that are more closely linked – such as France, Spain and Italy – would see a larger impact.

Some Member States are closely connected with countries outside the EU where different summertime arrangements are in place. For example, Latvia has rail connections with Russia. The representative of Latvian railways interviewed for this study did not recall any major errors or disruptions as a consequence of the Russian decision to abolish clock changes in 2011; very limited changes were required, and timetables were easily adapted.

2.2.3 Freight transport

A much larger proportion of freight transported on the railways travels between different countries than for passengers carried, with nearly 40% of completed tonne kms travelling between different countries (see Table 2.2).

Table 2.2 A much larger proportion of freight is transported internationally on railways than for passenger transport, but over half is still domestic transport

Indicator	
Total millions of tonne kilometre transport completed on railways in the EU	407,491
International millions of tonnes kilometre transport completed on railways in the EU	160,325
Percentage of completed tonne kilometres completed in Europe that are international journeys	39.3%

Source: Eurostat, Railway transport – Goods transported, by type of transport (million tkm) [rail_go_typeall]

There is considerable variation between countries, as there is with passenger rail transport figures. The proportion of freight transport that is international varies between 2% in the UK, to 90% in Latvia. Germany has the largest amount of freight on international journeys, with 43,470 million tonne kms in 2012.

The majority of the goods transported between countries in Europe travels between two Member States (intra-EU transport). Over half of the goods that arrive in EU Member States by rail come from other EU Member States, whereas over 80% of goods transported by rail from EU Member States are transported to other EU Member States (Table 2.3).

Again, there is significant variation in the proportion of international rail freight which is intra-EU transport between countries. In Finland only 0.4% of goods arriving via rail come from other EU countries, and 3.4% of goods leaving go to other European countries. Germany has by far the largest amount of freight leaving and coming from other European countries.

Table 2.3 The proportion of international rail transport that is within the EU is high, particularly for goods being exported by EU countries

Indicator	
Total millions of tonne kilometre transport completed for goods arriving in EU countries	85,887
Total millions of tonne kilometre transport completed for goods arriving in EU countries from other EU countries	45,971
Percentage of goods arriving via railways that comes from other EU countries	53.5%
Total millions of tonne kilometre transport completed for goods leaving EU countries	59,827
Total millions of tonne kilometre transport completed for goods leaving EU countries to other EU countries	48,320
Percentage of goods leaving EU countries via railway that go to other EU countries	80.8%

Source: Eurostat, International annual railway transport from the loading country to the reporting country (million tkm) [rail_go_intcmgn], and International annual railway transport from the reporting country to the unloading country (million tkm) [rail_go_intgong] Slight differences in totals due to different data sets.

2.2.3.1 *Evidence on the effects of the application of summertime on the rail freight sector*

The same observations on passenger rail transport also apply to freight transport according to rail operators: additional planning and timetabling is required during the beginning and end of summertime.

Freight transport is more intensive at night than passenger transport. Twice a year, some companies involved in night deliveries may need to modify their working hours in order to adapt to the summertime train timetables. However, as explained by an EU representative organisation for the rail sector, freight operators are well informed about summertime arrangements and are used to accommodating time changes.

2.2.3.2 *Evidence on the potential effects of asynchronous application of summertime within the EU on rail transport services*

Harmonisation is regarded by consultees (Member States, rail operators, a national rail regulator and an EU rail sector representative) as beneficial to freight transport, and current arrangements are commonly accepted by operators.

The rail operators and the regulator interviewed believed that the absence of harmonisation could lead to timetabling and resource issues that are similar to those described for rail passenger transport. Freight operators would need to adapt to the different arrangements implemented by Member States, with additional complexities and possible disturbances to cross-border movements.

There could also be additional issues for freight which is to be delivered at the opening time of a factory or another business: if on-time delivery cannot be ensured due to asynchronised arrangements, this could cause short term adverse effects on production. Intermodal transport could also be affected. Freight trains arriving at ports for shipping have to arrive in time for the ship. The difference in summertime arrangements could cause difficulties for businesses in this respect.

2.3 Energy

Nearly 2 million people are employed in the energy sector in the EU, and there are over 60,000 enterprises involved in the sector. Citizens and businesses in Europe depend on the sector to supply them with gas, electricity and other forms of power in order for them to carry out their jobs, activities and daily lives. Therefore, it is a strategically important sector in Europe. It is also a sector which the literature research has identified as being affected by summertime arrangements.

The percentage of electricity which is imported by EU countries is small compared to total electricity available (suggesting that asynchronous summertime arrangements will be smaller

in the electricity sector than other sectors). A much higher percentage of gas is imported by EU countries, the majority of gas from countries outside the EU. This suggests that the impact of asynchronous summertime arrangements might be smaller in this sector than other industrial sectors.

2.3.1 Evidence on the effects of the application of summertime on the energy sector

One of the main reasons why Member States introduced summertime in the 1970s was the reduction of energy consumption; less electricity was needed for lighting in the evening (European Commission, 1996, Proposal for an eight European Parliament and Council Directive on Summer-Time Arrangements).

In 2007, the European Commission published a review of existing evidence of energy savings gained through summertime applications (European Commission, 2007). The Commission concluded that energy savings were relatively small. Additionally, the Commission observed that a potential increase in energy consumption for heating during the morning could outweigh the savings related to lighting.

A literature review of the effect of DST on lighting energy use assessed studies at EU and international level and concluded that existing knowledge was 'limited, incomplete, or contradictory' (Aries and Newsham, 2008). The literature review reported that several studies estimated possible savings of around 0.5 per cent of the total national consumption; however, the review also concluded that 'there are just as many studies that suggest no effect, and some studies suggest overall energy penalties'.

More recent sources have also reported potential savings in relation to energy consumption:

- The Terna Group, a transmission grid operator, estimated that in 2013 the total energy savings related to summertime application in Italy amounted to 544 gigawatt-hours, representing €90 million of cost savings for Italian consumers. The reported energy savings correspond indicatively to the average annual energy consumption of 180,000 families (Terna, 2013);
- A 2011 study estimated that the average annual electricity consumption reduction corresponding to DST equals 519 and 882 gigawatt-hours (GWh) for southern Norway and Sweden respectively. This results in an annual financial saving of around €16 million and €30 million, respectively (Mirza and Bergland, 2011);

However, the savings in electricity consumption from the application of summertime arrangements may not be as large as stated in the studies above, as the introduction of energy efficient lamps throughout Europe has reduced the energy requirements for lighting. Any savings in energy consumption from lighting may also be offset by increases in the use of heating or air conditioning (ACHED, 2009).

A 2013 study looked at time-shifting and energy consumption, making use of the fact that the United States spans multiple time zones. The study calculated the solar times of sunrise and sunset across the US, then combined this with information on different time zones and daylight-saving regimes. Moving from the east to the west, places get daylight later until a time zone boundary is hit (irregularities are because of time zone boundaries, or because particular states had different daylight-saving policies in the early 2000s). The study identified communities with, say, different solar time, but the same 'official' time or daylight-saving policies, and compared energy use in western and eastern areas of the zone – both have the same 'official' day but the latter get the sun earlier, and then compared counties on each side of a time zone border. Here, 'solar' time is the same but 'official' days differ because of policy factors. Comparing the north and the south of the US, the research found that counties that get earlier daylight in the north have lower annual residential electricity consumption. In the south early daylight is associated with higher electricity consumption (Weinhardt, 2013). This would imply that summertime arrangements could reduce electricity consumption in northern Europe, whereas in southern Europe electricity consumption could increase.

Overall, the literature presents mixed results about the effects of summertime arrangements in Europe, with some research pointing to energy savings and other research suggesting

that there is no change in energy consumption. Thirteen of the Member State governments responding to the survey suggested that summertime arrangements result in a small decrease in energy consumption, although it was not possible to quantify this change[10]. The decrease in energy use was mainly caused by a decrease in lighting requirements, however some Member States indicated that because of higher temperatures and longer waking hours, energy consumption in other areas could increase as a result of summertime arrangements (for example an increase in the use of air conditioning). In Estonia, the decrease in energy consumption was estimated to be less than 1%, in Denmark 0.2 percentage points, and in Hungary, according to MAVIR Hungarian Independent Transmission Operator Company Ltd., Hungarian energy consumption is 120 GWh (one-day electricity consumption in Hungary) lower annually due to summertime application.

The responses from consultees in the energy sector were mixed. Some suggested that summertime arrangements had a limited impact on their sector. However, one consultee suggested summertime arrangements cause significant administrative problems. This is due to one day a year being 25 hours long and one day a year being 23 hours long, and the need for gas suppliers to book pipeline flow and storage for the gas with the Transmission System Operators. Each supplier needs to negotiate with this for each day, rather than for a longer period, therefore a day which is a different length requires more calculation of the flow and storage capacity needed, and negotiations with Transmission System Operators and other energy supply companies are required. If the supplier exceeds the flow or storage capacity that has been booked, they will be fined by the Transmission System Operator.

The European Commission introduced the European Network of Transmission System Operators for Electricity (ENTSO-E) in 2009 to allow for more efficient management of the electricity transmission network and pave the way for trade and supply of electricity across borders in the EU. The Framework Guidelines for Capacity Allocation and Congestion Management stipulate the introduction of a coordinated European intraday market by the end of 2014. The Network Code on Capacity Allocation and Congestion Management (CACM) defines the rules for a continuous intraday market that allows market participants to trade up to at least one hour before real-time. Coupling national intraday markets should lead to higher intraday liquidity which benefits the market exchange process.

It is unclear if these changes to the energy wholesale market will have an impact on the costs described by the consultee above, but some of the additional administration time for negotiation and planning are expected to continue. The information provided by the consultee suggests that even if there are energy savings associated with summertime arrangements, there are still costs associated with the change for energy suppliers.

2.3.2 Evidence on the potential effects of asynchronous application of summertime within the EU on the energy sector

EU Member States import and export energy from each other, as well as from countries outside the EU (particularly gas). This means any change in summertime arrangements could have an impact on the volume of energy traded between countries (if, as suggested in some of the research above, there are differences in energy consumption as a result of summertime arrangements). No research on the impact of non-harmonised summertime arrangements on the trade of energy has been located, although this is a potential impact of summertime arrangements.

A lack of harmonisation of summertime arrangements in Europe is not expected to have an impact on the volume of energy consumed in Europe. No Member State governments identified energy consumption or trading as a potential impact of non-harmonised summertime arrangements. However, the administration and negotiation costs for energy providers are expected to increase if Member States have different summertime arrangements, as there will be more occasions where at least one Member State has a day which is either 23 hours or 25 hours long, meaning that energy companies will have to spend

[10] The Member States which reported potential energy savings were from northern, eastern, southern and western Europe.

more time planning and negotiating with Transmission System Operators (TSOs), and the probability of suppliers being fined by the TSOs increases. If TSOs and energy companies are aware of exactly when the changes to and from DST are going to happen then problems should be avoided as they can plan to provide the required capacity. A lack of certainty of when or if countries are going to move to and from DST would be more problematic to the energy sector.

A representative of an electric utility company consulted for the study explained that if summertime arrangements were not harmonised there could be issues with asynchronised electricity consumption curves which could cause some problems in managing electricity flows between highly interconnected systems, such as the electricity systems in central European countries. The relative timing of peak demand for electricity would change across Member States as a consequence of different time arrangements, and this would have to be managed by the electric utility companies. However, no consultees have been able to provide any evidence of this effect being observed in practice.

In summary, examples of potential national level impacts have been identified in terms of changes in energy consumption. There is a potential for asynchronous implementation of summertime arrangements to have impacts on the functioning of the internal market for energy but the scale and consequences of such risks are not determined.

2.4 Tourism and Leisure

The tourism and leisure sector is a large employer in Europe, with over 10 million people working in nearly 2 million enterprises. The vast majority of the sector is intra-EU; only 13% of visitor nights are by tourists from outside the EU.

2.4.1 Evidence on the effects of the application of summertime on the tourism and leisure sector

In its 2007 Communication, the European Commission reported that in most Member States there was no indication of any significant impact of summertime arrangements on tourism. These conclusions are based on the results of consultations with the tourism sector.

Reincke *et al* (1999) consulted with sector representatives assessed the impact of summertime on the leisure and tourism sectors and concluded that, *'It has proven almost impossible to base any conclusions in this sector on clear, hard evidence….most of the material… comes from opinions, guesses and assumptions of those active in the sector'*. Although quantitative evidence was limited, the study concluded that ample qualitative evidence was available in support of the beneficial effects of summertime on leisure and tourism (particularly the effect on outdoor activities in the evenings of the working days).

Wolff and Makino (2012) investigated the possible effects on leisure activities resulting from the application of DST in the US. The study used data from the American Time Use Survey, which collects statistics on the amount of time spent by people doing activities such as work, sport activities and watching television. The authors examined American Time Use Survey (ATUS) data from 2005 to 2008, and concluded that the length of time people spend on outdoor recreational behaviour increases significantly during DST: the advantage of having longer evenings implies that approximately 30 additional minutes per person per day are spent on outdoor recreational behaviour as compared to a situation without DST. The study concluded that the additional time spent on outdoor recreational activity implies a 10 per cent increase in calories burnt, with potential reductions in the health costs related to obesity.

In the UK, representatives from the tourism sector commissioned research on the potential impacts of setting UK clocks forward by one hour throughout the year (Hillman, 2008). The study only investigated the national impacts from changing time arrangements, and concluded that moving clocks by one hour would increase useable daylight outside work hours, increase tourism expenditure by up to £3.5 billion and create up to 80,000 new jobs (measured as full time equivalents). This research relates to a change of time zone, but altering summertime arrangements to a situation where the UK was effectively on GMT+1 all year round would lead to a shift in time zone for five months a year. So although a change in

summertime arrangements would not have the same effect as a change of time zone, the findings from this research imply that summertime arrangements have a positive impact on the UK tourist industry.

Some of the stakeholders consulted for this study (four Member State representatives – three northern European and one eastern European - and a tourism association) saw summertime as being beneficial for tourism. Examples of the advantages of an additional hour of summertime daylight mentioned by these consultees include:

- The possibility for extended opening of tourism and leisure facilities (restaurants, museums, sightseeing trips, swimming pools), leading to an increase in the number of visitors and therefore higher incomes for business operators;
- An increased sense of safety for tourists as a consequence of longer evenings and additional daylight.

None of the stakeholders consulted for this study reported any disadvantage for tourism and leisure as a consequence of summertime arrangements. The representative of an EU association of travel agents and tour operators stated that summertime has not been raised as an issue by member organisations. The interviewee added that current arrangements have been in place for a long time and thus are easily understood by consumers.

2.4.2 Evidence on the potential effects of asynchronous application of summertime within the EU on the tourism and leisure sector

No significant impacts on cross-border operations within the tourism and leisure sector were identified in the literature review. According to stakeholders consulted for this study (Member States representatives and a business association) harmonisation is advantageous for both tourist business operators and citizens. The lack of synchronisation could cause confusion for consumers travelling between different countries in the European Union. Travellers could lose track of the different clock changes implemented by EU countries, and travel scheduling could be more complex for tourism operators.

2.5 Business sector

The business sector, which includes financial services, accounting, legal services and IT and telecommunications, employs over 14.5 million employees in Europe, and covers nearly 6 million enterprises. Over half of the imports and exports in this sector are intra-EU imports and exports, suggesting a fairly high degree of trade integration in Europe in these sectors.

The text below considers impacts on selected areas of the business sector: IT and communications and financial services. One of the challenges posed by analysis of this sector is that information on intra-EU data flows and telecoms traffic is scarce. The networks and transactions potentially affected by asynchronous summertime are less easily observed than transport networks and trade in physical goods.

2.5.1 Evidence on the effects of the application of summertime on the IT and communications sector

IT and communications are networked industries for which the observed time is defined by software which needs to be able to accommodate shifts in the scheduling of summertime if problems are to be avoided. Costs arise where systems need to be reprogrammed and reconfigured.

An illustration of this is provided by a recent US example. In 2007, the US Energy Bill modified pre-existing summertime arrangements through the extension of DST by one month (beginning DST three weeks earlier and ending one week later than before). The time change was expected to cause software malfunctions and software adjustments were required to prevent possible impacts in sectors largely relying on computer networks and smart technology. The potential IT issues were compared to those expected as a consequence of the ‘year 2000 bug’ (Y2K), although at a lower scale (InfoWorld, 2007).

The IT sector was expected to incur significant costs from the 2007 change. An IT research company (Gartner Research) estimated software updates costs could exceed $500 million (Arnoldy, 2007). In some cases, the costs incurred by software vendors were expected to be charged to consumers with the sale of software updates (Arnoldy, 2007). However, evidence on whether the actual costs incurred were close to the projections has not been located.

For users of IT systems, the potential problems determined by the transition to a new arrangement could include, "missed meetings, hospital orders not being picked up in time, operating-room scheduling issues, security-log problems and issues with "smart" technologies that work on time-based controls" (Modern Healthcare, 2007). However, this would only be the case if IT system operators failed to update their systems to the new summertime arrangements. If a country gave enough notice of their intention to change summertime arrangements, these costs should not be incurred.

The potential for such impacts implies the risk of disruption of cross-border trade. Clock changes could be expected to affect processes based on automated timekeeping in sectors such as banking, airline scheduling, freight tracking, and industrial processes (Conry-Murray, 2007).

2.5.2 Evidence on the potential effects of asynchronous application of summertime within the EU on the IT and communications sector

Some consultees (one northern and one southern Member State, and five businesses involved in cross-border transactions) commented on the impacts of harmonisation on IT and communication. Consultees agreed on the fact that harmonisation is beneficial for communications and that asynchronous application of summertime could cause disturbances. For example, one interviewee mentioned that variation in summertime arrangements could create confusion and issues may arise when setting answering machines or sending emails. However, consultees felt that most of the issues would occur in other sectors, such as the transport and energy sectors.

2.5.3 Financial and legal services

2.5.3.1 Evidence on the effects of the application of summertime on financial and legal services

The businesses and Member State representatives consulted for this study did not report any significant problem or benefit from the adoption of summertime within the financial and legal sector. Current summertime arrangements are well understood by operators and businesses can easily cope with them. One consultee explained that, as clock changes happen during the night, this does not cause issues for daytime operations.

The literature review highlighted potential impacts on the financial sector when summertime arrangements are modified. In 2007, US banks and other financial institutions had to devote significant resources to updating the software and systems used for financial transactions in response to the US decision to modify the start and end dates of DST (Crittenden, 2007 and Wolfe, 2007). Unprepared companies risked implementing transactions at the wrong time, with potential losses to be incurred by clients (Wolfe, 2007)[11].

There is some published research on the relation between summertime, sleep disruption and financial markets volatility. The results of these studies are mixed. Some authors argue that the time changes lead to loss of sleep and to consequent negative returns on US financial markets (Kamstra, Kramer and Levi, 2000; Kamstra *et al*, 2013). Other studies contest these assumptions and have not identified any significant impact in terms of increased volatility or decreased financial returns in the US (Berument, Dogan and Onar, 2010; Hakan and Doga, 2011) and in Chile, Brazil and Mexico (González *et al*, 2011). These effects, if they exist, are transitional and confined to the day(s) after summertime begins and ends.

[11] This could also generate unexpected profits, if prices move in a different way. However, the increase in uncertainty about the value of a trade would be detrimental to businesses.

2.5.3.2 *Evidence on the potential effects of asynchronous application of summertime within the EU on the financial services and legal sector*

Only one southern Member State representative commented on the implications of harmonisation within the financial services and legal sectors, suggesting that synchronisation helps to facilitate banking and other financial transactions. According to the businesses interviewed, harmonisation allows for commercial transactions to run smoothly and without confusion. Conversely, the lack of harmonisation could cause difficulties in communicating with partners and clients in other Member States. One consultee based in Germany added that the main issue is currently the lack of time zone coordination with the UK, rather than the application of summertime.

2.6 Other sectors

Most of the literature on the impacts of summertime and harmonisation is focused on the sectors covered above. This section discusses the impacts on other parts of the economy and on investment and cross border trade.

2.6.1 Evidence on the effects of the application of summertime on other sectors

There is little in the literature on the effects of summertime arrangements on sectors other than those described above. One sector mentioned is construction, particularly in southern Europe. The time at which the sun rises and sets has an effect in the sector because many activities have to be carried out in daylight and above a certain ambient temperature. However, a survey of the industry indicated that most of the industry is willing to maintain summertime, as working hours can be adjusted to exploit the lighter evenings to offset the darker mornings and the summer midday heat (European Commission, 2007). One northern Member State government consulted for this study regarded summertime arrangements as being beneficial for the construction sector.

Another impact described by four (southern and western) Member States was a general improvement in productivity for workers in all sectors. The reasons behind this are as described for the construction sector (for sectors involving outdoor work), people working longer hours with longer hours of daylight, and employees being more productive due to an improvement in wellbeing and increased exposure to daylight increasing the intake of vitamin D. However, no studies have been located showing a causal relationship between summertime arrangements and productivity.

2.6.2 Evidence on the potential effects of asynchronous application of summertime within the EU on other sectors

Stein and Daude (2007) explored the effects of time zones on the flow of investments across different countries around the world. The authors use a gravity model to explore the variables affecting investment flows, such as the presence of a common border, the cultural and historical similarities between countries and the time zone. The study observes that time zone differences have a significant negative impact on cross-border investments. Time differences impose additional transaction costs, especially when real-time interactions are necessary between a firm's headquarters and its foreign affiliates. The authors conclude that time differences are expected to become more relevant in the future because of the increased number of multinational businesses investing in foreign countries.

Hamermesh, Knowles Myers and Pocock (2006) examined the impact of lack of coordination of summertime arrangements within the same country. The USA and Australia were taken as case studies: within these countries there are some areas which apply summertime arrangements and others which do not. The authors observed that coordination of economic activities across regions generates economic efficiencies. The study concluded that

'people in locations that do not switch to daylight saving time, both in the United States and Australia, alter the timing of their work to synchronize activities more closely with those of their compatriots when the latter switch on or off DST'.

Extrapolated to the European context, this finding suggests that if a Member State was to shift from the harmonised EU summertime schedule then some of its domestic business operations would shift their schedules to maintain alignment with the EU norm.

Gaski (2012) argues that the economic impacts of asynchronised time arrangements vary depending on the 'economic potency or value', or the trade volumes between countries observing different time arrangements. The author focusses on the time zones adopted by the state of Indiana, and the neighbouring regions. Trade flows are considered as a key variable for the identification of the optimal time zone choice.

The literature suggests that asynchronous summertime arrangements have a negative effect on cross border trade and investment. A similar effect was also highlighted by Member State governments, particularly around trade, with many governments stating it was important to have the same summertime arrangements as their neighbours and major trading partners to facilitate trade. Additionally, one government suggested that asynchronous arrangements could have an impact on cross-border employment.

Some of the consultees that were interviewed raised a concern that a change to asynchronous summertime arrangements could lead to businesses incurring additional costs, with the additional costs being passed on to the consumers in the form of higher prices. No peer-reviewed studies from the literature quantifying these effects in an EU context have been identified.

2.7 Summary

Most of the impacts of the application of summertime are concentrated in a few sectors. The transport and energy sectors are seen as being particularly affected by summertime arrangements. The domestic impacts of summertime arrangements are most keenly felt in the energy sector. This is not surprising, given one of the main aims of introducing summertime arrangements was to save energy. However, there is some dispute as to how much energy is saved through the application of summertime, as there have been advances in the efficiency of lighting, and more industries are able to operate outside daylight hours.

Summertime arrangements are observed to have a positive impact on the tourism and leisure sector. The effect on the agricultural sector is thought to be less of an issue than it was historically, as modern farming techniques have reduced the need for daylight to carry out agricultural work.

EU governments from Northern, Eastern, Southern and Western Europe believe that asynchronous summertime arrangements would have a negative impact on cross-border business, trade and investment, and thus on the European economy, however, no definitive evidence was found in the literature to back up this claim.

The impacts of asynchronous summertime arrangements are expected to be most keenly felt in the transport sector, particularly in the scheduling of rail and air services, and on passengers making onward transport arrangements. Impacts also seem likely in the business and finance sectors where firms are working across borders, though these are harder to detect.

There are transition costs when summertime arrangements are changed from one schedule to another. These are most significant for the software sector and IT-dependent economic sectors such as transport, communications and business and financial services.

3 Citizen perspectives on the application of summertime

This section presents the findings from the research on the effect of the application of summertime on quality of life and the environment. The findings come from the literature review, consultations with citizen groups and survey responses from Member State governments.

3.1 Public satisfaction

3.1.1 Public satisfaction with summertime

In its 2007 Communication on summertime, the European Commission reported the results of previous EU and national polls on summertime, and concluded that the small number and low degree of representativeness of surveys did not enable valid conclusions to be drawn, especially since results varied across Member States.

In the consultations carried out for this study only one Member State (Latvia) reported the results of a March 2014 poll on summertime. This reported high levels of public dissatisfaction (76% dissatisfied or very dissatisfied) with summertime arrangements and mixed views on the best alternative arrangement, with 45 per cent preferring not to have any summertime arrangements and 33 per cent preferring summertime throughout the year. There were more than 6,200 responses but the design parameters of the poll are not known. Representatives from the business and transportation sectors highlighted the importance of having synchronous arrangements with other countries in the European Union.

3.1.2 Public satisfaction with harmonisation of summertime arrangements in the EU

The Member States consulted for this study were asked about their perception of the current level of public satisfaction with the harmonisation of summertime. Ten of the eighteen respondents stated that citizens either have a neutral opinion or are satisfied; only three consultees believed that citizens are dissatisfied or very dissatisfied. The other five did not reply to this question, or did not know the current level of satisfaction. Of those who suggested that citizens were dissatisfied, two countries did not provide an explanation while the third cited health concerns as the source of the discontent.

Other consultees (businesses, regulators and trade associations) generally agreed that harmonisation is beneficial or had a neutral view on harmonisation, and no issues related to harmonisation have been reported.

3.2 Road safety

3.2.1 The relationship between summertime and road safety

The link between summertime arrangements and road safety has been researched more than most aspects of summertime. The main issue, as reported by the Commission, '*is whether darker mornings, in particular in spring and autumn, and lighter evenings have an impact on the number of traffic accidents'* (European Commission, 2007). In its 2007 Communication, the Commission concluded that, based on available evidence, it was not possible to establish a definite causal link between summertime and the number of accidents.

A 2008 literature review of the impacts of summertime arrangements (Aries and Newsham, 2008) noted that the results of investigations into summertime's road safety impacts were often contradictory, with some studies suggesting improved road safety, and others demonstrating potential increases in road accidents related to the alteration of sleeping patterns.

A 2010 UK assessment (Road Safety Analysis, 2010) concluded that summertime arrangements '*do not provide any significant overall road safety benefit. If anything, the status quo may contribute to some increase in overall road risk. Any modest reductions in risk at certain times for particular areas or road user groups are more than outweighed by*

more substantial negative effects at other times'. The study also reports that other relevant factors should be considered when completing the road safety assessment, including the geographical distribution of risks and the mode of transport.

The Belgian Institute of Road Safety (BIVV) analysed road accidents in Belgium and the time and date at which they occurred (BIVV, 2012). This research established a link between the concentration of road traffic accidents involving pedestrians and the shift from DST to standard time. Following the publication of this research, the Institute for Road Safety Research in the Netherlands (SWOV, 2013) examined the number of accidents at different times of the year in the Netherlands. This research found that an increase in the number of accidents in the Netherlands coincided with the end of summertime arrangements as well. However, the higher number of accidents was also found in consecutive months, which suggests that setting back the clock in itself does not necessarily have an effect on road safety. The research concluded that it was more likely that the effect was due to the fact that in winter a greater proportion of the evening traffic takes place during twilight and in the dark.

In the UK, road safety campaigners are more concerned with the impact of moving from GMT to GMT +1, than maintaining summertime. Research commissioned by the UK Government found that if the UK had been on GMT +1 instead of GMT, between 1991 and 1994 there would have been a reduction of 2.6% to 3.4% in fatalities as a result of road traffic accidents, and a reduction of 0.7% of people seriously injured in road traffic accidents (Broughton and Stone, 1998; and Department for Transport, 2009).

Six of the Member State governments (four northern, one eastern and one western) that responded to the survey conducted for this study indicated that they expect summertime arrangements to help reduce road traffic accidents. This is because observation of summertime means that more driving takes place in daylight hours, which helps to reduce the risk of accidents. However, none offered references to peer-reviewed research proving a causal relationship between summertime arrangements and a reduction in road traffic accidents. The consultations with road safety organisations also yielded mixed results, with one organisation saying that summertime arrangements did not have an impact on road safety and the number of accidents and a second consultee suggesting that summertime provides a small decrease in the number of road traffic accidents, for the reason outlined above. Neither could provide any scientific research demonstrating the presence (or absence) of impacts.

3.2.2 The relationship between asynchronous observation of summertime and road safety

No literature has been identified linking harmonisation of summertime and road safety. Consultations with road transport interest groups indicate that there are no effects on road safety due to asynchronous application of summertime. No Member State governments raised this as an issue. Therefore, it is anticipated that any changes to the current situation of harmonised summertime would not have a measurable impact on road safety.

3.3 Health

3.3.1 The relationship between summertime and health

The potential impacts of summertime on health mainly relate to the fact that the body has to adapt to the change in time in March and October (European Commission, 2007). Health may be affected due to the change in the biorhythm of the body, with potential sleep and mood disturbances.

Research on summertime and sleep (Roenneberg *et al*, 2007, Lahti *et al*, 2006) suggests seasonal adaptation to the changing photoperiods is disrupted by the introduction of summertime. Summertime arrangements have also been linked to health problems, such as an increase in heart attacks (Janszky *et al*, 2013) and an increase in accidents at work (ACHED, 2010).

The potential health effects of summertime arrangements are similar to those associated with jet lag for air passengers who cross time zones during their flight (World Health Organisation, 2011). Despite the health issues associated with jet lag,[12] large numbers of people continue to fly between time zones. However, the difference for any health impacts as a result of changing to summertime arrangements is that people are making a personal choice to fly between time zones (with the knowledge that they will suffer some effects of jet lag), whereas summertime arrangements, and any consequential effects on health, are imposed by law on all.

The biorhythm effect was stated as a health issue by six Member State Governments in their response to the survey, with references being made to insomnia, which may affect concentration and cause accidents (both inside and outside the workplace). One Member State suggested that the change to summertime could increase drug and alcohol consumption, which would have a negative effect on human health. One Member State response indicated that the change to summertime increases exposure to vitamin D and therefore improves health, although no links to scientific research on this topic were provided.

Stakeholder consultations for this project which included a discussion of health impacts suggested that there could be positive effects from a change to summertime, although no research was available to reinforce the views of the consultees. Examples of the positive effects of summertime include:

- An increase in wellbeing caused by an increase in exposure to sunlight; and
- An increase in people taking part in active pursuits (due to increase in daylight hours), which could have potential public health benefits.

3.3.2 The relationship between asynchronous observation of summertime and health

No literature was identified which examined the effects of asynchronous summertime arrangements on health. The consultations carried out with interest groups and the surveys with Member States did not produce any information on the health effects of asynchronous summertime arrangements, other than consultees' opinions that it would have little impact.

Asynchronous summertime arrangements on health might be a source of additional stress for employees who work across different countries (due to difficulties adjusting work patterns etc.) and for citizens travelling between countries. However, these were the only potential effects mentioned by Member State governments and consultees, and no published research to support this as an effect has been identified.

3.4 Crime

3.4.1 Evidence on the effects of the application of summertime on crime

Some authors (including Hillman, 2010; Bennet, 2012; and David Simmonds Consultancy, 2012) have linked summertime arrangements and crime levels. According to these sources, summertime may offer possible benefits in terms of crime reduction: summertime arrangements provide an extra hour of evening daylight, and crimes such as robberies, rape and vandalism are believed to be committed mainly when it is dark. These studies also report that additional daylight enables people to feel safer during the evenings and thus conduct more outdoor activities.

Limited evidence is available on these benefits. One US study (Doleac and Sanders, 2012) measured the decrease in crime rates during the hour of sunset following the shift to DST in the spring. The study estimated a significant decrease in crimes such as robberies (51 per cent decrease in robbery rates), murder (48 per cent) and rape (56 per cent).

[12] Health issues associated with jet lag are: insomnia, sleepiness, impaired performance, diminished alertness, irritability, depressed mood, and gastrointestinal distress.

Consistent with the observations reported by the literature, the Member State representatives consulted for this study regard summertime arrangements as a factor that could potentially reduce crime levels.

3.4.2 Evidence on the potential effects of asynchronous application of summertime within the EU on security and crime

One Member State representative reported that for international cooperation in criminal matters in the EU, it is more practical to have the same harmonised arrangements in place across EU countries. Besides these observations, the review of the literature and the consultation of stakeholders did not highlight any relevant link between harmonisation of summertime arrangements and crime.

3.5 Environment

3.5.1 The environmental impacts of the observation of summertime

In its 2000 proposal for a Directive on summertime arrangements (COM/2000/0302 final), the Commission stated that summertime could have potential indirect effects on the environment. These effects were related to the fact that temperature and solar radiation affect the process of ozone formation, and that time changes could influence this process by impacting on traffic and on the time at which pollutants are emitted. The proposal concluded that these effects were not deemed significant in most parts of Europe.

The 2007 Commission Communication on summertime (European Commission, 2007) reported that based on available studies it was not possible to draw conclusions on the environmental impacts of summertime arrangements.

More recent evidence on the issue of environmental impacts suggests that there may be a link between energy savings and reductions in ozone emissions. For example, the Terna Group estimated that in 2011 energy savings related to summertime lead to a significant reduction of carbon emissions, estimated at more than 300,000 tonnes of carbon dioxide a year in Italy (Terna, 2011). Additional research at EU and international level (Vogel and Vogel, 2009; Muñoz, 2012) suggest that there may be a link between daylight saving time and emissions of pollutants such as nitrogen dioxide and particulate matter (PM_{10}).

The responses to the Member State government surveys highlight the reduction in energy consumption as having an impact on the environment. However, some responses explained that it was unclear if there would be any benefit on the environment. Despite a reduction in energy usage, there would be more leisure-related vehicle journeys so any decrease in energy usage could be offset by an increase in exhaust emissions.

One Member State government noted that owing to the longer daylight hours, people are outside for more of the day and evening. This leads to an increase in the amount of garbage which is left in public areas. This has implications for the public authorities responsible for clearing public areas of garbage.

The interviews with stakeholders which covered environmental issues suggested that there is no significant impact on the environment from summertime arrangements. It was suggested that historically there would have been more of an issue, owing to a larger share of industry operating only during daylight hours. However, most businesses can now operate 24 hours a day if needed, so there is no energy savings expected from businesses. One consultee explained that the effect of saving energy from lighting had diminished significantly recently, with the introduction of energy saving light bulbs.

3.5.2 The relationship between asynchronous observation of summertime and the environment

No literature was identified which examined the effects of asynchronous summertime arrangements on the environment. The consultations carried out with interest groups and the surveys with Member States produced responses that there would be no effect on the

environment from asynchronous summertime arrangements. Therefore, it is anticipated that asynchronous summertime arrangements have no impact on the environment.

3.6 Summary

The main effects of summertime arrangements for the public relate to domestic summertime arrangements, rather than the effects of the harmonisation of summertime arrangements. The positive effects of summertime arrangements on road safety, the environment and crime are not thought to be related to the harmonisation of summertime arrangements and neither are the effects on health. The strongest evidence of the effects of summertime arrangements relates to health and crime.

4 Appraisal of summertime arrangements in the European Union

This section illustrates the impacts of asynchronous application of summertime by reference to six hypothetical scenarios in which there is a shift from the current harmonised approach. It begins with details of the responses provided by Member State governments to questions about summertime arrangements that might be considered if the matter was not harmonised under EU law.

4.1 Member State governments views on strategies that might be adopted in the absence of Directive 2000/84/EC

Most of the responses to the Member State government survey stated that no other summertime arrangements would be considered (11 Member States). Responses from five Member States stated that if Directive 2000/84/EC was not in place, they might consider alternative approaches, specifically:

- Aligning with the real daylight period in the country (in practice summertime being a few weeks shorter than the current summertime arrangements) (two responses, one Western Member State and one Southern Member State);
- Agreeing across the whole EU to apply summertime (this would avoid any asynchronous arrangement costs) (one response, a Northern Member State);
- Having no summertime arrangements (two responses, one Northern and one Eastern Member State)[13].

Four of these responses would lead to asynchronised summertime arrangements in Europe. The reasons behind these proposed changes, as stated by representatives of Member State Governments, include:

- Summertime arrangements have made no difference to the country, and are therefore not necessary;
- The period of summertime arrangement should be adopted according to the latitude of the country (which causes differences in daylight hours); and
- Applying summertime all year round would increase light in the country within working and commuting hours to help reduce energy consumption and road traffic accidents.

If Directive 2000/84/EC was no longer in place, Member States would have the freedom to change summertime arrangements. Where these arrangements are written into national legislation any change would entail certain administration costs to the Member State government, such as:

- Consulting with public / interest groups about the new legislation;
- Drafting new legislation;
- Agreeing the new legislation among the Member State Government; and
- Providing information to the public about new summertime arrangements.

These costs could be minimal in some countries, and substantial in others, depending on the legislative process. The respondents did not quantify the time and administrative effort it would take to change their national legislation.

[13] There were multiple responses from representatives in Hungary, where some representatives stated different arrangements to the responses from their colleagues. Two Member States did not provide an answer to this question.

4.2 The scenarios

Six different summertime arrangements within the EU have been compared with the current summertime arrangements of all Member States beginning summertime arrangements on the last Sunday in March, and ending summertime arrangements on the last Sunday in October. These scenarios are not, for avoidance of doubt, proposals for policy change. They are hypothetical propositions created by the study authors for the purposes of exploring the implications of the asynchronous application of summertime. The scenarios relate to summertime only; the time zone differences across Europe remain.

The theory underlying the specification of the scenarios is that impacts are likely to be influenced by the extent to which the Member State concerned is 'networked' to other countries in Europe, and by the fraction of the year which the Member State is not synchronised with the rest of the EU.

If summertime arrangements are altered in a Member State with higher levels of connectivity with other Member States, the impact on the EU is likely to be more significant than if summertime arrangements altered in a Member State with lower levels of connectivity, regardless of population size. This is because more international train services, flights, movements of freight, energy trades and business transactions will be affected by the non-harmonisation of summertime than in a country with high levels of connectivity. *A priori*, we expect greater total impacts if countries that have a 'hub' function within Europe networks move to a different summertime schedule than similar countries that are on the edge of those same networks.

Two different time periods for the asynchronous application of summertime across the EU have been selected because the impacts of the non-harmonisation of summertime arrangements are likely to be different depending on the length of the period summertime arrangements are not harmonised across the EU. For example, if a Member State's summertime arrangements are not-harmonised with the rest of the EU for two weeks, the impacts on the EU are likely to be less than if the summertime arrangements are not harmonised for seven months.

The scenarios appraised are:

- Scenario 1: A Member State that is well connected to many other countries in the European Union (in terms of transport links, energy, etc.) changes its summertime arrangements such that it is on a different schedule from the rest of the EU for two weeks each year;
- Scenario 2: A Member State that has rather limited connections with other EU countries (in terms of transport links, energy, etc.) changes its summertime arrangements such that it is on a different schedule from the rest of the EU for two weeks of the year;
- Scenario 3: Member State that is well connected to many other countries in the European Union abandons use of summertime and so is not synchronised with the rest of Europe for seven months of the year;
- Scenario 4: A Member State that has rather limited connections with other EU countries abandons use of summertime and so is not synchronised with the rest of the Europe for seven months of the year;
- Scenario 5: The Member State in Scenario 1 is joined on the same alternative schedule by one other Member State, such that both are on a different schedule for two weeks each year; an alternative scenario where the two Member States are on different schedules to each other and the rest of the EU is also presented; and
- Scenario 6: Three Member States change their summertime arrangements such that they are on a different schedule from the rest of the EU for two weeks each year. All Member States will have the same summertime arrangements, and one of the Member States will be the same as in Scenario 2, to aid comparison between options. As with Scenario 5, an alternative scenario is presented where all three Member States are on different schedules to each other and the rest of the EU.

Examples of countries that may be said to have high levels of connectivity with multiple EU countries are those closer to the centre of Europe, e.g. Germany, Netherlands, France, Belgium, Luxembourg, Austria, Hungary, Czech Republic and Slovakia. Countries with lower levels of connectivity with multiple EU countries tend to be nearer to the periphery of the EU, e.g.: Finland, Greece, Bulgaria, Malta, Cyprus, Republic of Ireland and Estonia.

The Member States selected in each of the options have been chosen purely to illustrate the impacts which could arise from the asynchronous application of summertime arrangements in the EU. There is no suggestion that these Member States have indicated that they are considering changing summertime arrangements.

4.3 Scenario 1: A highly connected country moves out of sync for a short period each year

In this scenario one Member State has summertime arrangements which are not harmonised with all other Member States in the EU for a two week period each year. The scenario is illustrated by reference to Germany.

4.3.1 Effects of the asynchronous summertime arrangements

The asynchronous summertime arrangements are most likely to have an effect on four sectors – transport (both passenger transport and freight transport), and following on from this tourism, business and the energy sector. A change in the timing of summertime arrangements by two weeks is assumed to have no impact on the agriculture sector, or on road safety, health, crime or the environment, therefore no discussion of these sectors is provided. This assumption is based on the evidence reported in sections 2 and 3 of this report. The discussion below explains the potential effects of asynchronous summertime arrangements by Germany as compared to the rest of the EU.

4.3.1.1 Transport

Both the passenger travel and freight transport industry would incur costs as businesses would have to re-plan their service timetables, and potentially engineering work (particularly for rail transport, where rail network engineering also needs to be considered). These would mostly be one-off costs - once the timetables were rescheduled, the passenger and freight transport businesses could continue to use the same timetabling software in future years. The consultations conducted for this research suggest that the re-scheduling of transport services would not require employment of additional staff but rather be handled with existing staff resources. This cost would be for all rail, road, air and maritime operators that have services in Germany, not just for German transport businesses having to re-schedule their services. However, it is likely to be a relatively small monetary impact for each company for one year, and is a negligible compared to output in the EU. The number of passenger and freight transport businesses based in Germany and the EU as a whole are shown in Table A5.1, as is the number of employees in the sector.

A more significant cost is likely to be the inconvenience caused to passengers travelling to and from Germany, and for businesses where freight comes to or from Germany. The inconvenience of Germany changing to summertime arrangements at a different time to the rest of the EU would include:

- Passengers failing to make onward travel – passengers from Germany travelling to other EU Member States, or citizens of other EU Member States travelling to Germany, might assume that the time difference between Germany and their origin/destination country is always the same (for example, +1 hour). However, for two weeks a year, this will not be the case. This could lead to passengers making further travel arrangements that they cannot fulfil (for example booking connections that they cannot make);
- Passenger travel overcrowding – some services could become more crowded as a result of summertime arrangements in Germany not being harmonised with the rest of the EU. For example, there might usually be two train services Germany from France arriving by 09.00 but for two weeks there is only one, with the later service arriving after 09:00, meaning that the earlier service is overcrowded);

- Disruption to freight services – freight could arrive from Germany in other EU Member States at a different time to usual for the two weeks that summertime is not harmonised. For example, if freight leaves a German manufacturer at 17:00 each day due to the manufacturing process, for two weeks it will arrive in all other EU Member States one hour earlier or later than usual, or hauliers will need to absorb the difference in their schedules and driver time planning. This type of inconvenience could affect many sectors, from retail to manufacturing.

The text below details the number of passenger journeys made and quantity of freight moved during the period in which summertime was not aligned. These are estimated using the most recent data available[14] and the assumptions presented in Annex 5:

4.3.1.1.1 Passenger transport

Germany is well connected to other EU Member States by the rail network, with nearly 10 million intra-EU rail journeys in or out of Germany each year. If summertime arrangements in Germany are not harmonised with the rest of the EU for a two week period, approximately 300,000 international passenger journeys would be subject to different time arrangements and potential inconvenience. This is nearly 0.5% of all annual intra-EU passenger rail journeys would be affected by the change in summertime arrangements under scenario 1.

If the international rail services have to be rearranged, there could be an adverse effect on domestic train services, either due to international train services affecting the scheduling of domestic rail services, or for passengers booking onward rail travel. In Germany, there would be 98 million domestic rail journeys taken during the period where summertime arrangements were not harmonised (though only a small fraction of these ought to be affected by scheduling issues).

Germany also has strong air transport links to other EU countries. In 2012, 90 million passengers travelled between Germany and another EU country by air, which is 25.6% of all intra-EU air travel. During the hypothetical two week period when summertime arrangements between Germany and the rest of the EU were not aligned, 3.3 million passenger air journeys would take place, and potential be inconvenienced, which is the equivalent of 0.9% of all annual intra-EU air travel.

In 2012, there were 9.6 million maritime passenger journeys between Germany and other EU countries. This represents 8% of all intra-EU maritime travel journeys, and during the two week period where summertime arrangements were not aligned, 228,000 passenger journeys between Germany and other EU Member States would be affected, which is 0.4% of all intra-EU ship passenger travel.

Passengers travelling by road between Germany and other EU Member States in the period where summertime arrangements are not aligned would also face inconvenience, both those travelling in private vehicles and on intra-EU coaches. However, no data are available on the number of road journeys, or coach journeys taken between EU Member States, therefore it has not been possible to estimate the number of road passenger journeys affected by the non-harmonisation of summertime in scenario 1.

In total, excluding road, it is estimated that 3.8 million passenger transport journeys would be taken between Germany and other EU Member States during the two week period in which summertime arrangements were not harmonised, and therefore 3.8 million passengers could incur some form of inconvenience.

4.3.1.1.2 Freight transport

Freight is transported between Germany and other EU Member States by road, rail, sea and air. 292 million tonnes of freight moved through German ports in 2012 to and from all countries in the world, of which 112 million tonnes originated, or was destined for, other EU Member States (38.4% of all maritime freight). The throughput of intra-EU maritime freight during the period summertime would be out of sync is estimated at 4.5 million tonnes.

[14] This relates to transport figures for 2012, as complete annual data for 2013 were not available at the time this research was carried out.

Each year a further 96 million tonnes of freight are transported via the railways and 101 million tonnes moved by road between Germany and other EU Member States. Over the two week period of asynchronous summertime covered by scenario 1, an estimated 3.7 million tonnes of rail freight and 4.0 million tonnes of road freight would be moved. In addition a 45,000 tonne share of the annual throughput of just over 1 million tonnes of airfreight would be moved.

Overall, 1.1 billion tonnes of freight are transported between EU Member States, and over 12 million tonnes of this freight would be affected by the change in summertime arrangements in scenario 1, which is 1.1% of all intra-EU freight transport. So a significant quantity of freight in the European Union would be subject to potential inconvenience caused by asynchronous summertime arrangements in the EU. Not all is time critical but the operators would need to take note of time differences in formulating schedules.

4.3.1.2 Energy

One potential impact of the changes to summertime arrangements is a regulatory impact for energy providers. Gas and electricity suppliers are required to book in advance the amount of capacity and storage they require each day on the European gas and electricity grid. If they over or under estimate this capacity, they risk receiving a regulatory fine. The capacity required is more difficult to estimate under scenario 1 for energy companies which operate in more than one Member State. This is because for some of the countries they would have to estimate electricity and gas and electricity consumption for 23 hours and for Germany for 24 hours, and two weeks earlier they had to estimate electricity and gas consumption for 23 hours in Germany and 24 hours in all other countries. However, the evidence collected in our consultations suggests that so long as there enough warning of the change in summertime arrangements, the risk of fines will be minimal, therefore no cost is expected.

4.3.1.3 Tourism and Leisure

The potential impact on the travel and tourism sector of Germany having asynchronous summertime arrangements follows directly on from the inconvenience described for travel. Data on the number of trips taken and the expenditure of citizens on trips in the period where summertime arrangements are not aligned give an indication of the number of people and scale of the economic activity that is potentially affected by the asynchronous summertime.

In 2012, 22 million visits to Germany were made by EU citizens from other EU Member States. These contributed €9 billion to the German economy. A two week period where summertime arrangements are not harmonised would affect ~600,000 visits to Germany by citizens from other EU Member States worth some €252 million.

German travellers who visit other EU Member States in this period would also need to adjust to the differences in summertime arrangements. German travellers made 61 million visits to other EU Member States in 2012, spending €39 billion. Up to 1.7 million German travellers would be visiting other EU Member States in the period when summertime arrangements were not aligned.

4.3.1.4 Business sector

In the business sector, there would be two main impacts as a result of Germany altering its summertime arrangements – added inconvenience to business transactions and communications, and the cost of adjusting IT systems to accommodate with the revised summertime schedule. The cost will not only affect businesses in Germany, but all businesses that interact with firms in Germany as suppliers, partners or customers.

Germany has the largest economy in the EU. It is a manufacturing, financial and logistics hub for the continent, and has business and trading links that reach around the world. It hosts numerous multi-national companies that work across the EU and beyond. The number of transactions, communications and other interactions potentially affected by Germany adopting a different summertime schedule is not readily determined since the relevant data are not captured by public statistical agencies. It can, however, be envisaged that the change would result in numerous small adjustments having to be made by firms and employees in Germany and in other countries.

All computers, websites and mobile devices use operating systems which use information on the time in each country. If Germany were to change summertime arrangements, each operating system provider would have to alter its operating system to incorporate the new time arrangements. This would have no impact on most businesses in the EU, as computers and machinery using modern operating systems would automatically update, and some operating system providers offer free updates for time changes for individuals or businesses using older systems.

The costs that would be incurred would be to the operating system providers themselves, who would have to ensure that the operating systems showed the correct time in each country. This would involve writing new codes to show that Germany was not in the same time zone as the rest of the countries on GMT+1. There is a relatively high market concentration of operating system providers (three providers dominating for personal computers and laptops, five for website operating systems and seven for mobile devices, with additional providers for game consoles and other specialist markets). Specialist IT systems may require individual adjustments.

4.3.1.5 Citizens

Citizens would be affected by the inconvenience of being on a different summertime schedule when travelling, for business or pleasure, as described in section 4.3.1.1.1, and in other business or personal trans-boundary transactions. The scenario's change to the date of the onset of summertime is, however, expected to have very little or no effect on health, road traffic accidents, crime and the environment. Therefore, although there may be some effects on citizens that do not travel between EU Member States in scenario 1, these effects are expected to be negligible.

4.3.2 Conclusion

The main costs associated with Germany no longer having summertime arrangements which are aligned with the rest of the EU relate to inconvenience. There are one-off costs for the transport sector and the wider business sector relating to replanning timetables and updating operating systems. However, ongoing inconvenience and opportunity costs are likely to be more significant. There are 3.8 million passenger journeys by air, sea or rail between Germany and other EU Member States in the period when the summertime arrangements are not harmonised, and 12 million tonnes of freight shipped between Germany and other EU Member States in the period when summertime is not harmonised. The passenger transport inconvenience could have an impact on the tourism industry within the EU, both within Germany and for German tourists travelling to other EU Member States. Numerous communications and transactions in the business sector would be affected

4.4 Scenario 2: A less well connected country moves out of sync for a short period each year

In this second scenario a less well connected Member State has summertime arrangements which are not harmonised with all other Member States in the EU for less than one month. Again, a two week period has been selected as the length of time of non-harmonisation of summertime arrangements. Greece has been selected to illustrate the scenario.

A change in the timing of summertime arrangements by two weeks is assumed to have no impact on the agriculture sector, or on road safety, health, crime or the environment. The data behind the discussion are presented in Table A5.2.

4.4.1 Effects of asynchronous application of summertime

4.4.1.1 Transport

The transport sector in Greece is less extensively connected to other Member States than is that of Germany, particularly in road and rail transport, due to its geographical location. Both the passenger travel and freight transport industry would incur the same types of cost as described in section 4.3.1.1 (re-planning service timetables), which would again be one-off

costs, and be for all transport businesses operating in/with Greece, not just Greek businesses. Again, it is likely to be a relatively small monetary impact for each company for one year, and is a negligible compared to output in the EU. The number of passenger and freight transport businesses based in Greece and the EU as a whole are shown in Table A5.2, as is the number of employees in the sector. The larger costs associated with asynchronous summertime arrangements in Greece fall on the same sectors as described in scenario 1.

4.4.1.2 Passenger transport

Only about 10,000 passenger rail journeys are made each year between Greece and other EU Member States. International rail journeys represent about 0.3% of all rail journeys made in Greece (of a total of 3.5 million rail journeys). This is a comparable percentage of international rail journeys as in Germany, but the absolute number is much smaller. Under scenario 2, approximately 300 international passenger journeys would be subject to different time arrangements and potential inconvenience.

In 2012, 20 million air passenger journeys were made between Greece and other EU Member States, which was 5.8% of all intra-EU air travel journeys. Around 256,000 air passenger journeys would occur during the period in which summertime arrangements in Greece are not synchronised with those of the rest of the EU for two weeks, which is 0.1% of all intra-EU air passenger journeys.

There are approximately 1.3 million maritime passenger journeys between Greece and other EU countries each year. In the period where summertime arrangements are not harmonised in Greece and the rest of the EU, 28,000 passenger journeys between Greece and other EU Member States would be affected. There would also be some passenger journeys taken by road that could be affected by the change in summertime arrangements, but data on intra-EU passenger road transport have not been located.

In total, it is estimated that just under 0.3 million passenger transport journeys would be taken between Greece and other EU Member States during the two week period in which summertime arrangements were not harmonised, and would potentially be subject to inconvenience.

4.4.1.2.1 Freight transport

Over 131 million tonnes of freight was transported into and out of Greece by sea in 2012, with 17% of this going to or coming from other EU Member States (as compared to 38% for Germany). 877,000 tonnes of freight would be moved between Greece and other EU Member States during the period in which when summertime was not synchronised, which is 0.1% of all intra-EU maritime freight transport. In addition around 106,000 tonnes of road freight, 27,000 tonnes of rail freight and 2,000 tonnes of air freight would be moved during the period when summertime schedules were out of sync (under 0.1% of all intra-EU rail freight and road transport, and 0.2% of all intra-EU air freight and mail).

Overall, just over 1 million tonnes of this freight would be affected by the change in summertime arrangements in scenario 2.

4.4.1.3 Energy

As in scenario 1, there is the potential for problems with capacity planning but if enough notice is given about the change in summertime arrangements, the issues are expected to be minimal.

4.4.1.4 Tourism and Leisure

The potential impacts on the travel and tourism sector of Greece are the same as those described for scenario 1 in section 4.3.1.3. In 2012, eight million visits to Greece were made by EU citizens from other EU Member States. These visits contributed €6 billion to the Greek economy. A two week period where summertime arrangements are not harmonised would affect 210,000 visits to Greece by citizens from other EU Member States. Greek travellers visiting other EU Member States in this period would also be affected, though the numbers involved are smaller.

4.4.1.5 *Business sector*

The types of costs incurred in the business sector would be same as for scenario 1 and would impact on all businesses which had to deal with Greece and other EU Member States. Again, this would be an inconvenience impact on workers in the business sector. It is expected that the total costs will be lower than in scenario 1, as – compared to Germany - Greece has business fewer links to other Member States.

IT systems would need to be adjusted to accommodate the change in summertime arrangements. In general it is expected that costs would be absorbed by system providers.

4.4.1.6 *Citizens*

As with scenario 1, the principal effects on citizens are expected to relate to inconvenience in travel to and transactions with other Member States. Other effects are expected to be negligible.

4.4.2 Conclusion

The main costs associated with Greece no longer having summertime arrangements which are aligned with the rest of the EU relate to inconvenience. As compared to scenario 1, but the scale of the inconvenience is smaller because of the more limited connections, trade and trips. Nonetheless, in the illustrative example worked through here, around 300,000 passenger journeys by air, sea or rail between Greece and other EU Member States would take place during the period in which summertime arrangements were not aligned, and 1 million tonnes of freight exchanged with other Member States. The passenger transport inconvenience could have an impact on the tourism industry within the EU, both within Greece and for Greek tourists travelling to other EU Member States. The number of intra-EU passenger journeys and volume of intra-EU freight transport is much lower than in scenario 1.

4.5 Scenario 3: A well connected country moves out of sync for an extended period each year

In this third scenario a country extensively networked with other Member States, here assumed to be the Czech Republic, is assumed to stop use of summertime and so be out of alignment with other Member States for an extended period of seven months.

It is assumed, based on the evidence provided in preceding chapters, that there is no impact on the agriculture sector, or the environment. Additionally, any impact on road safety and the health of citizens are assumed to be impacts of summertime per se, and not impacts of the lack of harmonisation of summertime arrangements.

The data discussed below is presented in Table A5.3, which includes the number of passengers and volume of freight potentially affected by asynchronous summertime arrangements, the number of businesses and employees in affected sectors in the Czech Republic and the EU.

4.5.1 Effects of the non-harmonisation of summertime arrangements between the Czech Republic and the rest of the EU

As in the previous scenario analysis, this appraisal focusses on four main sectors - the transport sector (both passenger transport and freight transport), and following on from this the tourism sector; the business sector and the energy sector.

4.5.1.1 *Transport*

Firms in the transport sector in the Czech Republic and dealing with the Czech Republic would need to re-plan their schedules to adjust for the new summertime arrangements The larger inconvenience costs associated with asynchronous summertime arrangements in the Czech Republic are the same as those described in section 4.3.1.1, although as summertime arrangements are not harmonised for a longer period, more passenger journeys

and freight transportations could be affected by inconvenience and disruption than in scenarios 1 and 2.

4.5.1.1.1 Passenger transport

A large number of passenger journeys are made between the Czech Republic and other EU Member States, due to the level of connectivity between the Czech Republic and other countries on the rail network. There were 2.8 million intra-EU passenger rail journeys made between the Czech Republic and other EU Member States in 2012, which represent 1.6% of the passenger journeys on the Czech rail network. This is a higher percentage of intra-EU rail journeys than in both Germany and Greece.

If summertime arrangements in the Czech Republic are not harmonised with the rest of the EU for seven months, approximately 1.6 million international passenger journeys would be subject to different time arrangements and potential inconvenience. This is much larger than in scenario 1 or 2, and is 2.7% of all intra-EU rail journeys.

The Czech Republic is also well connected to other EU Member States by air, with 8 million air passenger journeys taking place between the Czech Republic and other EU Member States. During the seven month period when summertime arrangements are not harmonised between the Czech Republic and the rest of the EU, 5.5 million air passenger journeys are made between the Czech Republic and other EU Member States, which is 1.6% of all intra-EU air passenger journeys.

There would also be road passenger journeys taken by road that could be affected by the change in summertime arrangements.

In total, it is estimated that just under rail and air 7 million passenger transport journeys would be taken between the Czech Republic and other EU Member States during the seven months where summertime arrangements were not harmonised.

4.5.1.1.2 Freight transport

Each year nearly 40 million tonnes of freight are transported by road and 37 million tonnes transported via rail between the Czech Republic and other EU Member States. During the seven months in which summertime arrangements are not harmonised between the Czech Republic and other EU Member States, 23 million tonnes of road freight and 22 million tonnes of rail freight will move the Czech Republic and other EU Member States.

A very small proportion of freight is transported between EU Member States by air, and air freight transport between the Czech Republic and other EU Member States is no exception, with nearly 23,000 tonnes of freight transported between the Czech Republic and other EU Member States. During the period that summertime arrangements are not harmonised, nearly 13,000 tonnes of air freight will be transported between the Czech Republic and other EU Member States, which is 0.7% of all intra-EU air freight transport.

Overall, 45 million tonnes of freight transported between the Czech Republic and other EU Member States would be affected by the non-harmonisation of summertime arrangements in scenario 3, would be affected by the change in summertime arrangements in scenario 2, which is 4.1% of all intra-EU freight transport.

4.5.1.2 Energy

As the Czech Republic would effectively be removing summertime arrangements, the research review suggests that energy consumption could increase by about 0.5% (Aries and Newsham, 2008), which is equivalent to nearly 283 gigawatt hours of electricity and 1,435 terajoules of gas. However, some of this increase in energy consumption could be offset by decreases in spending on car fuel, as citizens use their cars less to take part fewer in leisure activities.

The planning of national energy capacity would be simplified in that there would be no days in the Czech Republic where energy firms had to take account of a 23 hour or a 25 hour day, though there would need to be some adjustment of any cross-border arrangements.

However, this is anticipated to be a small one off opportunity cost to energy firms in the Czech Republic.

4.5.1.3 Tourism and Leisure

Travel and tourism is a less significant part of the Czech economy than for Greece but the differences in summertime practice nonetheless have the potential to inconvenience large numbers of people.

During a typical summertime period an estimated 4.2 million visits would be made to the Czech Republic (worth €1.5 billion) and 3.5 million trips taken by Czech citizens to other EU Member States (worth €1.2 billion).

4.5.1.4 Business sector

The impacts on each employer in the business sector under scenario 3 would be the same type of costs as those described for scenario 1, with complications for communication and other cross-border transactions, and IT system operating companies having to rewrite codes to ensure that computer systems show the correct time in the Czech Republic. The ongoing inconvenience for workers arranging meetings would apply to all firms that dealt with the Czech Republic, and would be higher than in scenario 1 and 2 because the period of non-harmonisation is longer. The costs for changing the time on all operating system would be identical to those incurred under scenario 1 for each firm having to change the time codes on an operating system, although the number of firms affected in Germany is higher than in the Czech Republic (section 4.3.1.4).

4.5.1.5 Citizens

Removing summertime arrangements in the Czech Republic (under scenario 3) would remove any risk to health arising from changes to time (see section 3.3), The evidence on such effects is not well enough developed for quantification of those benefits to be feasible here.

The evidence in the literature and the views of Member State Governments suggest that removing summertime arrangements would have a negative impact on crime (an increase in the crime rate). This would be because there would be an extra hour of darkness in the evenings in the summer, when crimes are more likely to be committed. However, only one research paper was discovered which attempted to quantify these effects, and it would not be appropriate to extrapolate these findings to attempt to quantify the effects on crime in the Czech Republic under Scenario 3. It is likely that there would be a negative effect on the crime rate in the Czech Republic (an increase in crime) as a result of the summertime arrangements in Scenario 3 being introduced.

The effect of the change in summertime arrangements in Scenario 3 on the environment is unclear. Although there is evidence to suggest that the change would lead to an increase in energy use (electricity and gas), there could also be a decrease in the amount of fuel used for transport, as people take part in fewer outdoor activities. Therefore, using current evidence it is not possible to state if the change in summertime arrangements in the Czech Republic would have an impact on the environment.

There is no conclusive evidence on the link between road traffic accidents and summertime arrangements and as such no firm basis on which to determine whether there would be changes in the number of accidents in the Czech Republic following the introduction of new summertime arrangements under Scenario 3.

4.5.2 Conclusion

If one Member State abandons use of summertime there is the potential for impacts on trade, transactions and communications elsewhere in Europe and in its domestic economy. If the Member State is closely networked with others these impacts are more extensive than if it is not. The impacts are, for the most part, matters of inconvenience rather than additional capital expenditure. In scenario 3, there will still be one-off opportunity costs in the transport sector and the wider business sector relating to having to alter timetables and

operating systems. In the illustrative example of the Czech Republic, the ongoing nearly 7 million passenger journeys would be made between countries that were no longer harmonised, and 45 million tonnes of freight moved.

4.6 Scenario 4: A less well connected country moves out of sync for an extended period of time

The fourth scenario presents a situation where a Member State that is less extensively networked to other Member States abandons the application of summertime and so is out of alignment with other EU Member States for seven months. It uses the example of Bulgaria.

The data discussed below are presented in Table A5.4, which includes the number of passengers and volume of freight potentially affected by asynchronous summertime arrangements, the number of businesses and employees in affected sectors in the Bulgaria and the EU.

4.6.1 Effects of the non-harmonisation of summertime arrangements between the Czech Republic and the rest of the EU

4.6.1.1 Transport

The ways in which the transport sector would be affected by the changes in summertime arrangements under scenario 4 would be the same ways as those outlined in scenario 1, as described in section 4.3.1.1(transport businesses re-planning their service timetables). These costs are one off costs for all transport businesses operating in the Bulgaria. The larger costs associated with asynchronous summertime arrangements in Bulgaria are the same as those described in section 4.3.1.1, although as summertime arrangements are not harmonised for a longer period, more passenger journeys and freight transportations could be affected by inconvenience and disruption than in scenarios 1 and 2.

Many passengers and freight travel between Bulgaria and Russia and Belarus, which do not have summertime arrangements. So passengers and freight travelling between these countries would have less inconvenience under the summertime arrangements in scenario 4 than under present arrangements. However, passengers and freight traffic between Bulgaria and other EU Member States is larger than that between Bulgaria and Russia and Belarus, so the overall impact is likely to be negative.

4.6.1.1.1 Passenger transport

The geographic location of Bulgaria, in the South East of the EU, mean that there is a limited amount of passenger transport between Bulgaria and other EU Member States by rail, and none by sea. 234,000 intra-EU passenger rail journeys made between the Bulgaria and other EU Member States in 2012, which represent 0.9% of the passenger journeys on the Bulgarian rail network.

During the period in which summertime arrangements are not harmonised between Bulgaria and the rest of the EU in scenario 4, 135,000 passengers rail journeys between Bulgaria and other EU Member States will be affected by asynchronous summertime arrangements. This is a much smaller number of journeys than in scenario 3, which is explained by the relative degrees of connectivity in the rail networks of the Czech Republic and Bulgaria and other EU Member States.

Most intra-EU travel to and from Bulgaria is done by air travel, with 4.9 passenger air journeys taken between Bulgaria and other EU Member States in 2012 (1.4% of total intra-EU air travel). During the seven month period when summertime arrangements are not harmonised between Bulgaria and the rest of the EU, 3.8 million air passenger journeys are made between Bulgaria and other EU Member States, which is 1.1% of all intra-EU air passenger journeys.

In total, it is estimated that just under rail and air 4 million passenger transport journeys would be taken between Bulgaria and other EU Member States during the seven months where summertime arrangements were not harmonised.

4.6.1.1.2 Freight transport

Bulgaria transports most of its freight by road, with six million tonnes of freight transported between Bulgaria and other EU Member States by road; 3.4 million tonnes by sea and 1.3 million tonnes by rail in 2012.

During the seven months in which summertime arrangements are not harmonised between Bulgaria and other EU Member States, 3.9 million tonnes of road freight, 3.4 million and 740,000 tonnes of rail freight will be transported between Bulgaria and other EU Member States, and could therefore be subject to inconvenience. This is 0.6% of all intra EU maritime freight, 1.3% of all intra-EU road transport, and 0.4% of all intra-EU rail freight transport.

Just over 13,000 tonnes of freight and mail were transported between Bulgaria and other EU Member States by air in 2012. During the period that summertime arrangements are not harmonised, nearly 8,000 tonnes of air freight will be transported between Bulgaria and other EU Member States, which is 0.5% of all intra-EU air freight transport.

Over 8 million tonnes of freight transported between Bulgaria and other EU Member States would be affected asynchronous summertime arrangements in Bulgaria and the rest of the EU in scenario 4, which is 0.7% of all intra-EU freight transport.

4.6.1.2 Energy

No evidence has been found which suggests that having asynchronous summertime arrangements in the EU will have any impact of the use of energy. The removal of summertime arrangements in Bulgaria could lead to energy consumption increasing by about 0.5% (Aries and Newsham, 2008). This would relate to nearly 139 gigawatt hours of electricity and 513 terajoules of gas. However, some of this energy consumption increase could be offset by decreases in spending on car fuel. The costs and benefits of this are for the Member State, and are the impacts of summertime.

4.6.1.3 Tourism and Leisure

Bulgaria has a relatively small number of traveller visits from other EU Member States, with 1.7 million travellers visiting Bulgaria from other EU Member States in 2012. These travellers spent €1 billion in Bulgaria. During the period when summertime arrangements are not harmonised, 1.2 million visits to Bulgaria are made and €709 million is spent by visitors. Additionally, 200,000 trips taken by Bulgarian citizens to other EU Member States, with and expenditure of €76 million would be subject to inconvenience caused by the non-harmonisation of summertime arrangements.

4.6.1.4 Business sector

The impacts on the business sector under scenario 4 would be the same as those described for scenario 1, with complications for workers arranging meetings with colleagues / clients / other individuals based in other EU Member States, and IT system operating companies having to rewrite codes to ensure that computer systems show the correct time in the Bulgaria. The costs for changing the time on all operating system would be identical to those incurred under option 1 for each business affected. However, the total one-off opportunity costs for correcting operating systems will be higher under scenario 1 and 3, due to the higher number of businesses that would be required to update their systems. The ongoing opportunity cost of inconvenience for workers arranging meetings would apply to all firms that dealt with Bulgaria, and would be higher than in scenario 1 and 2 because the period of non-harmonisation is longer, although the costs would be lower than in scenario 3 due to fewer businesses and employees being inconvenienced, as fewer businesses operate across Bulgaria and other Member States.. The costs for changing the time on all operating system would be identical to those incurred under option 1, if Germany changed summertime arrangements (as described in section 4.3.1.4).

4.6.1.5 Citizens

As presented in section 4.5.1.5, there is limited or inconclusive evidence with which to quantify the effects of Scenario 4 on the citizens of Bulgaria. Any summertime-related risks

to health would be removed (see section 3.3). The evidence suggests that rates of crime are more likely to rise than fall when summertime is abandoned.

4.6.2 Conclusion

In scenario 4, the abandonment of summertime has potential impacts on trade and transport with other EU Member States, as well as having domestic effects. As Bulgaria is not as closely networked with other EU Member States as other countries, the impacts in scenario 4 are likely to be lower than those presented in scenario 3, despite being similar impacts. The one-off costs in the transport sector and the wider business sector for alteration of timetables and operating systems are likely to be lower than in scenario 3, and the number of passenger journeys (4 million) and volume of freight (8 million tonnes) that are potentially inconvenienced are lower than in scenario 3

4.7 Scenario 5: Two Member States move out of sync with the rest of Europe for a short period of time

The fifth scenario presents a situation where two Member States change their summertime arrangements together for a two week period at the beginning of summer, and are no longer aligned with other EU Member States. It uses the example of Germany and Poland. Germany has been selected again so as to compare the effects of two Member States changing to that of single Member State changing arrangements. The scenario where the same two Member States change their summertime arrangements so that they are no longer aligned with the EU, but also no longer aligned with each other is also presented.

The data discussed below are presented in Table A5.5, which includes the number of passengers and volume of freight potentially affected by asynchronous summertime arrangements, the number of businesses and employees in affected sectors in the Germany, Poland and the EU. A brief description of the effects on each sector is presented below.

4.7.1 Effects of the non-harmonisation of summertime arrangements between Germany, Poland and the rest of the EU

4.7.1.1 Transport

The effects of a change in summertime arrangements in Scenario 5 on transportation would be the same effects as those described in section 4.3.1.1(transport businesses re-planning their service timetables). However, the number of businesses and passengers affected by this change will be larger than in Scenario 1, due to two Member States changing their arrangements rather than one.

4.7.1.1.1 Passenger transport

As in Scenario 1, there are passenger transport journeys made by air, rail and sea which are potentially affected by a change in summertime arrangements in Germany and Poland. If summertime arrangements are not aligned between Germany, Poland and the rest of Europe, then 390,000 intra-EU rail passenger journeys will be affected by asynchronous summertime arrangements. There would be an estimated 634,000 and 28,000 maritime passenger journeys affected if there were asynchronous summertime arrangements in Germany, Poland and the rest of the EU.

Intra-EU air and maritime passengers travelling during the period of asynchronous summertime arrangements would also be affected. In the period of asynchronous summertime arrangements, 3.8 million air passengers travelling between Germany and Poland and the rest of the EU would be affected, and 268,000 maritime passenger journeys would be affected.

In total, it is estimated that over 4.4 million intra-EU passenger journeys would be affected by asynchronous summertime arrangements during the two week period in which summertime arrangements were not aligned between Germany, Poland and the rest of the EU.

If Germany and Poland had asynchronous summertime arrangements from each other as well as from the rest of the EU, the number of passenger transport journeys affected would rise to 4.7 million passenger journeys.

4.7.1.1.2 Freight transport

As with passenger transport, the transportation of freight by different modes of transport would be affected by asynchronous summertime arrangements in Germany and Poland and the rest of the EU. Freight transported between EU Member States by road, rail, sea and air would all be affected by the asynchronous summertime arrangements. Overall, in the two week period when summertime arrangements are not harmonised, just under 17 million tonnes of freight would be affected, made up of:

- 5.8 million tonnes of maritime freight;
- 6.9 million tonnes of freight transported by road;
- 4.3 million tonnes of rail freight; and
- 46,000 tonnes of air freight and mail.

This represents 1.6% of annual intra-EU freight transport.

If Germany and Poland's summertime schedules differed from those of each other as well as from the rest of the EU, then 5.8 million tonnes of maritime freight, 8.6 million tonnes of road freight, 4.9 million tonnes of rail freight and 49,000 tonnes of air freight and mail would be affected. This is a total of 19.3 million tonnes of freight, which represents 1.8% of annual intra-EU freight transport.

4.7.1.2 Energy

As in scenario 1, there is the potential for problems with capacity planning but if enough notice is given about the change in summertime arrangements, the issues are expected to be minimal.

4.7.1.3 Tourism and Leisure

The potential impacts on the travel and tourism sector of Germany and Poland are the same as those described for scenario 1 in section 4.3.1.3, and follow directly on from the passenger transport impacts. It is estimated that there would be 754,000 visits to Germany and Poland made by EU citizens from other EU Member States during the two week period when summertime arrangements are not aligned, which would contribute €281 million to the German and Polish economy. German and Polish travellers also visit other EU Member States, with an estimated 1.8 million visits made by German and Polish citizens to other EU Member States during the two week period when summertime arrangements were not harmonised, spending an estimated €1.2 billion.

In the alternative scenario, where Germany and Poland had asynchronous summertime arrangements from each other as well as from the rest of the EU, it is estimated that 843,000 visits to Germany and Poland, and €310 million of traveller spending would take place during the period when summertime arrangements were not aligned. A further 1.9 million visits and €1.2 billion of spending by German and Polish travellers would take place in the period when summertime arrangements were not harmonised.

4.7.1.4 Business sector

The types of costs incurred in the business sector would be same as for scenario 1 and would impact on all businesses which had to deal with Germany and/or Poland and other EU Member States. Again, this would be an inconvenience impact on workers in the business sector. It is expected that the total costs will be higher than in scenario 1, as businesses which deal with Poland would be affected.

If Germany and Poland introduced new summertime arrangements that were not aligned with each other, then the costs to businesses in the EU will be slightly higher. This is because businesses in Germany dealing with organisations in Poland (and vice versa) would face a situation where summertime arrangements are not aligned for a longer period of time

than if Germany and Poland had aligned summertime arrangements. Therefore the inconvenience for these workers will be for a longer period of time, and the cost will therefore be higher.

The same number of IT systems would need to be adjusted whether Germany and Poland have aligned summertime arrangements or not, and the cost is expected to be absorbed by system providers in both scenarios. However, the cost to the system providers will be higher if Germany and Poland have different summertime arrangements to each other.

4.7.1.5 Citizens

As discussed in section 4.3.1.5, the effects on citizens, other than those that travel between EU Member States have not been presented, as the effects are estimated to be negligible.

4.7.2 Conclusion

In scenario 5, the change in summertime arrangements has potential impacts on trade and transport with other EU Member States, but the domestic effects are expected to be minimal. As all passengers and freight transported to and from Germany and Poland would be affected for a two week period, the impacts of scenario 5 will be higher than in Scenario 1, despite the impacts being of the same type. If Germany and Poland were to introduce summertime arrangements that were not aligned with the rest of the EU or each other, the potential impacts on trade and transport are even higher.

4.8 Scenario 6: Three Member States move out of sync with the rest of Europe for a short period of time

The sixth scenario presents a situation where three Member States change their summertime arrangements for a two week period at the beginning of summer, and are no longer aligned with other EU Member States. It uses the example of Greece, Bulgaria and Romania, which have selected so as to compare the effects of three Member States changing to that of single Member State changing arrangements in Scenario 2. The scenario where the same three Member States change their summertime arrangements so that they are no longer aligned with the EU, but also no longer aligned with each other is also presented.

The data discussed below are presented in Table A5.6, which includes the number of passengers and volume of freight potentially affected by asynchronous summertime arrangements, the number of businesses and employees in affected sectors in Greece, Bulgaria, Romania, and the EU. A brief description of the effects on each sector is presented below.

4.8.1 Effects of the non-harmonisation of summertime arrangements between Greece, Bulgaria and Romania and the rest of the EU

4.8.1.1 Transport

The effects of a change in summertime arrangements in Scenario 6 on transportation are the same as those described in section 4.3.1.1. The number of businesses and passengers affected by this change should be compared to scenario 2, where only a single Member State changed summertime arrangements. The impacts of Scenario 6 will be larger than for Scenario 2 due to the number of Member States changing their summertime arrangements.

4.8.1.1.1 Passenger transport

As in Scenario 2, there are passenger transport journeys made by air, rail and sea which are potentially affected by a change in summertime arrangements. However, the passenger transport by sea only affects Greece, as there is no maritime passenger transport between Bulgaria, Romania and any other EU Member State. If summertime arrangements are not aligned between Greece, Bulgaria and Romania and all other EU Member States, 14,000 intra-EU rail passenger journeys will be affected by asynchronous summertime arrangements, as would 634,000 air travel journeys.

In total, it is estimated that 660,000 intra-EU passenger journeys would be affected if summertime arrangements were not harmonised in Greece, Bulgaria and Romania and the rest of the EU for two weeks.

If Greece, Bulgaria and Romania had asynchronous summertime arrangements from each other as well as from the rest of the EU, the number of passenger transport journeys affected would rise to 690,000.

4.8.1.1.2 Freight transport

Freight transported between Greece, Bulgaria and Romania and the rest of the EU would also be affected during the period when summertime arrangements were not harmonised. Freight transported between EU Member States by road, rail, sea and air would all be affected. During the two week period when summertime arrangements are not harmonised, it is estimated that 1.2 million tonnes of maritime freight, 551,000 tonnes of freight transported by road, 157,000 tonnes of rail freight, and 3,000 tonnes of air freight and mail would be affected. Overall, this is an estimated 1.9 million tonnes of freight, which represents 0.2% of annual intra-EU freight transport.

In the scenario where Greece, Bulgaria and Romania have summertime arrangements that are not aligned with the rest of the EU, but also not aligned with each other, a total of 2.2 million tonnes of freight would be affected, made up of:

- 1.2 million tonnes of maritime freight;
- 730,000 tonnes of freight transported by road;
- 229,000 tonnes of rail freight; and
- 4,000 tonnes of air freight and mail.

This represents 0.2% of annual intra-EU freight transport.

4.8.1.2 Energy

As in scenario 2, there is the potential for problems with capacity planning but if enough notice is given about the change in summertime arrangements, the issues are expected to be minimal.

4.8.1.3 Tourism and Leisure

The potential impacts on the travel and tourism sector are the same as those described for scenario 2 in section 4.4.1.4, and are potential costs due to potential problems with passenger transport.

It is estimated that during the two week period where summertime arrangements are not harmonised, there would be 286,000 visits to Greece, Bulgaria and Romania made by EU citizens from other EU Member States. These visits would contribute an estimated €218 million to the Greek, Bulgarian and Romanian economy. Greek, Bulgarian and Romanian travellers also visit other EU Member States. An estimated 24,000 visits by travellers from these Member States to other EU Member States would be undertaken during the two week period when summertime arrangements are not harmonised, spending an estimated €12 million.

In the alternative scenario, where Greece, Bulgaria and Romania had asynchronous summertime arrangements from each other as well as from the rest of the EU, it is estimated that 302,000 visits to Greece, Bulgaria and Romania, and €220 million of traveller spending would take place during the period when summertime arrangements were not aligned. A further 37,000 visits and €16 million of spending by Greek, Bulgarian and Romanian travellers would take place in the period when summertime arrangements were not harmonised.

4.8.1.4 Business sector

The types of costs incurred in the business sector would be same as for scenario 2 and would impact on all businesses which had to deal with Greece, Bulgaria and/or Romania and

other EU Member States. Again, this would be an inconvenience impact on workers in the business sector. It is expected that the total costs will be higher than in scenario 2, as businesses which have to deal also with Bulgaria and Romania would be affected.

IT systems would need to be adjusted to accommodate the change in summertime arrangements. In general it is expected that costs would be absorbed by system providers.

As in Scenario 5, if the three Member States introduced new summertime arrangements that are not aligned with each other, then the costs to businesses in the EU will be slightly higher. The costs to IT systems providers would also be higher if summertime arrangements in the three Member States were not aligned.

4.8.1.5 Citizens

As discussed in section 4.3.1.5, the effects on citizens, other than those that travel between EU Member States have not been presented, as the effects are estimated to be negligible.

4.8.2 Conclusion

In scenario 6, the change in summertime arrangements has potential impacts on trade and transport with other EU Member States. These effects are larger than in Scenario 2, where only Greece altered its summertime arrangements, but the effects are much smaller than in Scenario 5, due to the size and location of the countries which altered their summertime arrangements in Scenario 6. The domestic effects in Scenario 6 are expected to be negligible. If Greece, Bulgaria and Romania introduced summertime arrangements that were not aligned with each other or the rest of the EU, the costs to the EU would be higher than if the three Member States had harmonised arrangements.

4.9 Quantification of impacts and comparison between scenarios

In this section, an attempt has been made to quantify and monetise the impacts which are estimated to arise from the change in summertime arrangements in each of the scenarios, and then a comparison between the scenarios has been made, to show which would have the largest impact on the internal EU market.

No other studies estimating the monetary value of asynchronous summertime arrangements within the EU have been found. For the purposes of this study an approach has been developed for the quantification of travel-related costs (lost productivity and re-purchasing of tickets). The figures and monetary values in this section should be viewed as illustrative, and are used to show the differences between scenarios, rather than presenting a robust cost of asynchronous arrangements. Due to the degree of uncertainty in these estimations, a range of values has been presented for each impact (low, medium and high), and are annual values. The assumptions which have been used for these calculations are presented in Annex 5, and a discussion of the impacts which it has not been possible to provide an estimate for is included. Table 4.1 to Table 4.3 show these impacts. The largest impact, on freight and passenger transport is in Scenario 3, where a well-connected Member State has asynchronous summertime arrangements for seven months. However, the tables also show that as more Member States choose asynchronous summertime arrangements, the cost to the internal market increases. In Scenarios 5 and 6, the text in grey italics shows the impact if the Member States have asynchronous summertime arrangements from each other, as well as the rest of the EU, and the black text shows the impact if the Member States change their summertime arrangements in the same way.

Table 4.1 Low estimates of the impact of asynchronous summertime arrangements, Scenarios 1-6

Impact	Scenario 1		Scenario 2		Scenario 3		Scenario 4		Scenario 5		Scenario 6	
	No.	€('000)	No.	€('000)	No.	€('000)	No.	€('000)	No.	€('000)	No.	€('000)
Passenger transport – missed rail journeys (lost productivity)	275	18	0	0	1,626	76	136	6	390 *441*	18 *21*	14 *17*	1 *1*
Passenger transport – missed rail journeys (re-purchased tickets)	234	47	0	0	1,382	276	115	23	331 *375*	66 *75*	12 *15*	2 *3*
Passenger transport – missed air journeys (lost productivity)	3,322	389	256	30	5,467	640	3,819	447	3,758 *3,995*	440 *467*	634 *658*	74 *77*
Passenger transport – missed air journeys (re-purchased tickets)	2,824	565	218	44	4,647	929	3,246	649	3,194 *3,395*	638 *679*	539 *559*	108 *112*
Passenger transport – missed sea journeys (lost productivity)	228	13	28	1	0	0	0	0	268 *268*	13 *13*	28 *28*	1 *1*
Passenger transport – missed sea journeys (re-purchased tickets)	0	0	0	0	0	0	0	0	0	0	0	0
Freight transport (1,000 tonnes)	12.3	-	1.0	-	45.1	-	8.1	-	17.0 *19.3*	-	1.9 *2.2*	-
Energy (GWh)	-	-	-	-	0	0	0	0	-	-	-	-
Tourism and Leisure	-	-	-	-	-	-	-	-	-	-	-	-
Business sector (qualitative assessment)	It is not possible to quantify the effect of asynchronous summertime arrangements on the output of the business sector. This is due to no information being available for the number of employees who work either in the Member State with asynchronous summertime arrangements that are required to deal with workers or organisations in other EU Member States, or staff in other EU Member States that deal with individuals in the Member State with asynchronous summertime arrangements. However, it is likely the largest costs will be incurred in Scenarios 3, 5 and 1, and the lowest costs incurred in Scenario 4.											
Citizens health (qualitative assessment)	-	-	-	-	The impact on citizens health is estimated to be larger in Scenario 3 than Scenario 4, due to the population of CZ being larger than in BG.				-	-	-	-
Crime rate (qualitative assessment)	-	-	-	-	The increase in the number of crimes committed is estimated to be larger in Scenario 3 than Scenario 4, as more crimes are committed in CZ than BG.				-	-	-	-
Total		1,024		75		1,922		1,125		1,175 *1,255*		186 *194*

Table 4.2 Medium estimates of the impact of asynchronous summertime arrangements, Scenarios 1-6

Impact	Scenario 1		Scenario 2		Scenario 3		Scenario 4		Scenario 5		Scenario 6	
	No.	€('000)	No.	€('000)	No.	€('000)	No.	€('000)	No.	€('000)	No.	€('000)
Passenger transport – missed rail journeys (lost productivity)	2,751	129	3	0	16,257	761	1,356	63	3,899 *4,409*	182 *206*	143 *171*	7 *8*
Passenger transport – missed rail journeys (re-purchased tickets)	2,339	468	3	0	13,819	2,764	1,153	231	3,314 *3,747*	663 *749*	121 *146*	24 *29*
Passenger transport – missed air journeys (lost productivity)	33,222	3,887	2,563	300	54,673	6,397	38,187	4,468	37,575 *39,945*	4,396 *4,674*	6,338 *6,579*	742 *770*
Passenger transport – missed air journeys (re-purchased tickets)	28,239	5,648	2,179	436	46,472	9,294	32,459	6,492	31,939 *33,954*	6,388 *6,791*	5,387 *5,593*	1,077 *1,119*
Passenger transport – missed sea journeys (lost productivity)	2,285	107	280	13	0	0	0	0	2,683 *2,683*	126 *126*	280 *280*	13 *13*
Passenger transport – missed sea journeys (re-purchased tickets)	0	0	0	0	0	0	0	0	0	0	0	0
Freight transport (1,000 tonnes)	123.0	-	10.1	-	450.7	-	80.8	-	169.6 *193.4*	-	19.2 *21.7*	-
Energy (GWh)	-	-	-	-	682	60,423	282	15	-	-	-	-
Tourism and Leisure	-	-	-	-	-	-	-	-	-	-	-	-
Business sector (qualitative assessment)	It is not possible to quantify the effect of asynchronous summertime arrangements on the output of the business sector. This is due to no information being available for the number of employees who work either in the Member State with asynchronous summertime arrangements that are required to deal with workers or organisations in other EU Member States, or staff in other EU Member States that deal with individuals in the Member State with asynchronous summertime arrangements. However, it is likely the largest costs will be incurred in Scenarios 3, 5 and 1, and the lowest costs incurred in Scenario 4.											
Citizens health (qualitative assessment)	-	-	-	-	As the population of CZ is larger than that of BG the total potential human health impact is larger in Scenario 3 as compared to Scenario 4.				-	-	-	-
Crime rate (qualitative assessment)	-	-	-	-	The increase in the number of crimes committed is estimated to be larger in Scenario 3 than Scenario 4, as more crimes are committed in CZ than BG.				-	-	-	-
Total		10,238		749		79,639		26,647		11,755 *12,546*		1,863 *1,939*

Table 4.3 High estimates of the impact of asynchronous summertime arrangements, Scenarios 1-6

Impact	Scenario 1		Scenario 2		Scenario 3		Scenario 4		Scenario 5		Scenario 6	
	No.	€('000)	No.	€('000)	No.	€('000)	No.	€('000)	No.	€('000)	No.	€('000)
Passenger transport – missed rail journeys (lost productivity)	13,756	644	16	1	81,287	3,804	6,781	317	19,493 *22,043*	912 *1,032*	714 *856*	33 *40*
Passenger transport – missed rail journeys (re-purchased tickets)	11,693	2,339	14	3	69,094	13,819	5,764	1,153	16,569 *18,736*	3,314 *3,747*	607 *728*	121 *146*
Passenger transport – missed air journeys (lost productivity)	166,110	19,435	12,817	1,500	273,364	31,984	190,937	22,340	187,877 *199,727*	21,982 *23,368*	31,690 *32,897*	3,708 *3,849*
Passenger transport – missed air journeys (re-purchased tickets)	141,194	28,239	10,894	2,179	232,359	46,472	162,296	32,459	159,696 *169,768*	31,939 *33,954*	26,937 *27,963*	5,387 *5,593*
Passenger transport – missed sea journeys (lost productivity)	11,423	535	1,400	66	0	0	0	0	13,415 *13,415*	628 *628*	1,400 *1,400*	66 *66*
Passenger transport – missed sea journeys (re-purchased tickets)	0	0	0	0	0	0	0	0	0	0	0	0
Freight transport (1,000 tonnes)	614.9	-	50.6	-	2,253.0	-	404.1	-	847.9 *966.8*	-	95.8 *108.4*	-
Energy (GWh)	-	-	-	-	682	60,423	282	15,393	-	-	-	-
Tourism and Leisure	-	-	-	-	-	-	-	-	-	-	-	-
Business sector (qualitative assessment)	It is not possible to quantify the effect of asynchronous summertime arrangements on the output of the business sector. This is due to no information being available for the number of employees who work either in the Member State with asynchronous summertime arrangements that are required to deal with workers or organisations in other EU Member States, or staff in other EU Member States that deal with individuals in the Member State with asynchronous summertime arrangements. However, it is likely the largest costs will be incurred in Scenarios 3, 5 and 1, and the lowest costs incurred in Scenario 4.											
Citizens health (qualitative assessment)	-	-	-	-	As the population of CZ is larger than that of BG the total potential human health impact is larger in Scenario 3 as compared to Scenario 4.				-	-	-	-
Crime rate (qualitative assessment)	-	-	-	-	The increase in the number of crimes committed is estimated to be larger in Scenario 3 than Scenario 4, as more crimes are committed in CZ than BG.				-	-	-	-
Total		51,191		3,747		156,502		71,662		58,775 *62,728*		9,315 *9,693*

5 Conclusions

This section considers:

- The potential impact of no longer having a harmonised summertime arrangement;
- Whether the absence of a harmonised summer-time arrangement would have a specific influence on the functioning of the internal market;
- The impact on business and citizens.

The evidence gathered suggests that if the application of summertime was not harmonised in Europe there would be impacts on both the Member State(s) that deviated from the harmonised schedule, and on the rest of the EU.

International evidence suggests that cross-border investment is stronger when time is harmonised. This suggests that changes which reduce time harmonisation in Europe are more likely to have a negative impact on investment than a positive impact.

Current arrangements for the synchronised application of summertime across Europe emerged through a step by step process that was driven by a consensus on the value of harmonisation. Harmonisation provides convenience and predictability for business and citizens alike. Intra-EU transport and communication providers only have to programme for one change in timetables. Businesses that work across countries within the EU can plan their work knowing that the time difference (if any) between their EU offices, suppliers, partners and customers is consistent throughout the year. The harmonised approach provided by the EU Directive is assumed to provide benefits for the internal market of goods and services in the form of lower costs, greater convenience and improved productivity.

A shift away from a harmonised approach has the potential to inconvenience large numbers of people. The likely effects are most visible in the transport sector (e.g. airline passengers missing flights) but are likely to extend across business and everyday life (e.g. in the scheduling of telephone calls and meetings). The impacts would be experienced not just in the Member State which changed its summertime schedule, but also in the Member States connected to it.

A shift to asynchronous application of summertime would require some businesses to make one-time investments in IT system adjustments to accommodate the revised time schedule. It would also introduce additional complexity to timetabling of cross-border transport and logistics services for companies and countries in (and connected to) the Member State that moved away from the harmonised schedule. Some domestic schedules might also be affected.

The scale of these impacts for Europe as a whole could vary according to factors that include:

- The extent to which the Member State concerned was integrated into business, transport and other intra-EU networks;
- The duration of the period for which summertime schedules were out of sync.

Overall, the evidence suggests that a shift away from a harmonised approach would not be positive for the internal market.

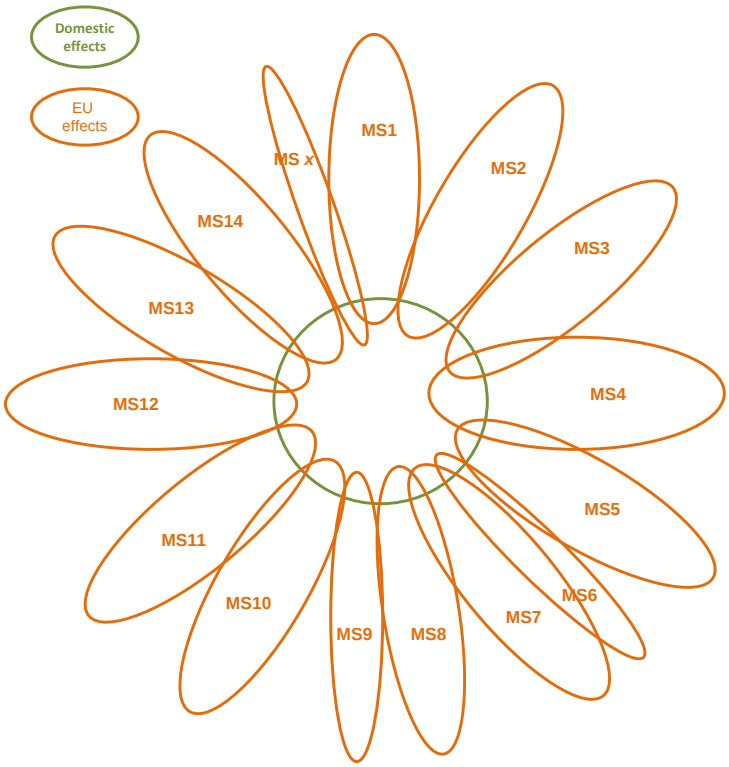
Consultations conducted for this study suggest a majority of Member State governments responding were in favour of the *status quo*. The consultations with business and consumer groups suggest no wider drive for change. The research team contacted 230 organisations, of which only 26 were motivated to provide interviews. Few saw harmonisation as an issue important enough to invest time discussing. Very few had given consideration to the impacts of asynchronous summertime. The practice of harmonised application of summertime appears to be well-embedded and accepted as a common sense solution.

The analysis confirms that there is an EU dimension to national decisions on the application of summertime. A change from the current harmonised approach to the application of summertime could trigger:

- 'Domestic' impacts within the Member States that change their timetable for the application of summertime. These impacts relate to effects on activities contained within those Member States, potential examples being changes to road accidents and changes to national energy consumption; and
- 'Trans-boundary' impacts experienced in other Member States and at a European level (i.e. within the Member States that change their summertime timetable but also those other countries that have trade, travel, business and other connections with the Member States that have moved to a new timetable).

In appraising the effects of a given country scheduling summertime it is therefore necessary to take into account not only the immediate domestic issues but also the transboundary impacts, both on that Member State and on the EU as a whole. If the decision imposes significant inconvenience on other Member States the impacts to the EU as a whole might very well be much larger than the impacts on the individual country (Figure 5.1). In effect there are externalities to a national decision on the application of summertime.

Figure 5.1 Total EU impacts of a switch by a country to a new summertime timetable might well be much larger than the impacts on the country concerned



ANNEXES

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Annex 2 Literature review methodology

A2.1 Literature review – overview

A2.1.1 Research questions

The literature review looked at:

- The reasons why countries adopt summertime (the scientific and political reasons);
- The history of countries adopting summertime;
- The impacts of summertime; and
- The impacts of harmonisation of summertime.

The literature review also aimed to identify relevant information:

- Across EU Member States and countries outside the EU; and
- For different sectors of relevance for this study.

A2.1.2 Inclusion criteria

Table A2.1 Inclusion criteria

Characteristics of the literature	Scope to be included in the literature review
Time period	Primary focus on documents published following the 2007 Communication on Summertime (COM(2007) 739 final).Previous documents were considered, where relevant.
Geographical context	Primary focus on EU documents. Relevant third countries were considered.
Topics and areas	■ History of summertime ■ Sectoral impacts of summertime ■ Impacts of the transition to summertime ■ Impacts of the harmonisation of summertime arrangements
Type of publication	■ EU and national legislation and policy papers ■ Peer reviewed journal articles ■ Non-peer reviewed academic research outputs (reports; working papers; discussion papers; conference papers) ■ EU and national commissioned research outputs ■ Grey literature ■ Publications of other research organisations / think tanks / advocacy bodies

A2.1.3 Sources

ICF has a subscription with EBSCO, a leading provider of online information resources to researchers in colleges and universities, research organisations, and government institutions. The EBSCOhost Electronic Journals Service (EJS) acts as a gateway to 20,000 e-journals containing millions of articles from hundreds of different publishers. The subscription covers 20 databases. The EBSCO subscription allowed the study team to efficiently and effectively:

- Identify specific journals and articles which are of particular relevance;
- Locate and obtain articles by searching for keywords in the titles, abstracts, and full text of articles; and
- Scan the references of articles which have been identified to find further articles of relevance.

Our academic experts also have access to subscription-only resources, enabling the study team to cover a wide range of sources.

Table A2.2 Sources of material

Type of source	Source to be consulted
Journal databases	■ EBSCO ■ Science Direct ■ Social Sciences Citation Index (Web of Knowledge) ■ Ingenta ■ JSTOR
EU institutions and agencies	■ European Commission ■ Joint Research Centre – Publications Repository ■ European Parliament
International institutions	■ OECD iLibrary ■ WHO Library (IRIS Repository) ■ Websites of national governments of countries outside the EU
Contacts	Experts will be contacted to help identify 'grey literature'
Website searches	Google Scholar

A2.1.4 Search Terms

Search terms were based on the research questions (e.g. "summertime arrangements" and "harmonisation") and on the key sectors characterising the summertime debate. Possible terms were also identified by analysing the keywords necessary to retrieve from online databases some of the sources preliminary identified. A list of possible synonyms and alternative terms is provided in the table below.

Preliminary searches were been performed to identify those terms most relevant to the review. Research terms have also been tested in order to identify the most meaningful combinations in order to yield relevant information (e.g. "daylight saving time" yielded more relevant results than "summertime arrangements").

Additional search terms were used for country-specific analysis (EU Member States and countries outside the EU).

Table A2.3 Search terms

Primary	Alternative	AND
Summertime	■ Summertime arrangements ■ Daylight saving time ■ DST ■ Summertime application ■ Clock changes ■ European summertime	European Union
		Directive 2000/84/EC
		Harmonisation
		Standardisation
		Synchronisation
		Coordination
		Impacts
		Trade
		Transport
		IT and communication
		Disruptions
		Citizen survey
		Health impacts
		Energy
		Financial market
		Commercial services
		Agriculture
		Tourism
		Environment

A2.1.5 Data extraction

Titles and abstracts/summaries were first screened according to the inclusion criteria and relevance to the specific review questions. The selected literature was then screened through a full text reading. Applicable and useful content was extracted into a data extraction form. An indicative form is given below.

Table A2.4 Data extraction form

Author	Year	Geographical focus	Type of publication	Sector	Type of impact analysed
		■ EU ■ Member State ■ International / extra-EU	■ EU policy documents and legislation ■ Journal articles and books ■ Position papers ■ Other	■ Health ■ Energy ■ Communication ■ Transport ■ Tourism and leisure ■ Financial ■ Environment ■ Other	■ National impacts ■ Harmonisation ■ Transition to new arrangements ■ Other (e.g., history of summertime)

A2.1.6 Results

A summary of the literature search results is provided below.

Table A2.5 Literature search results

Source	All results	Relevant results (excluding duplicates)
EBSCO: 217	217	118
ScienceDirect	82	5
OECD	1	1
WHO	0	0
Google Scholar/online search	-	14
Total		***137***

Annex 3 Consultations

Table A3.1 Table of organisations consulted

Organisation	Sector	Type of organisation
ENEL	Energy	Business
SSE	Energy	Business
Deutsche Börse AG	Finance	Business
Hungarian Development Bank	Finance	Business
Graf von Westphalen	Law firm	Business
Lawin	Law firm	Business
NCTM Studio Legale Association	Law firm	Business
LDZ (Latvia)	Railways	Business
OBB (Austria)	Railways	Business
International Federation of Air Traffic Controllers	Air travel	Business Group
European Council for an Energy Efficient Europe (ECEEE)	Environment / Energy	Interest group
Forum Train Europe	Railways	Business Group
The Community of European Railway and Infrastructure Companies	Railways	Business Group
Maltese Aviation Directorate	Air travel	Business Group
Office of Rail Regulation	Railways	Business Group
Brake	Road Safety	Interest group
VTI	Road Safety	Interest group
Cyprus Consumers Association	Consumer rights	Interest group
ENAC	Air travel	Business Group
European Public Health Association	Health	Interest group
ECTAA – Group of European Travel Agents' and Tour Operators' Associations within the EU	Tourism	Business Group
EASEE-gas	Energy	Business Group
Association of Low Cost Airlines	Air travel	Business Group
International Air Transport Association (IATA)	Air travel	Business Group
l'Association Française Contre l'Heure d'été Double (*ACHED*)	-	Interest Group
European Network of Transmission System Operators for Electricity (ENTSO-E)	Energy	Business Group

Table A3.2 Member State responses

Austria (W)	Ireland (N)
Bulgaria (E)	Latvia (N)
Cyprus (S)	Lithuania (N)
Denmark (N)	Malta (S)
Estonia (N)	Netherlands (W)
Finland (N)	Poland (E)
France (W)	Slovakia (E)
Germany (W)	Sweden (N)
Hungary (E)	United Kingdom (N)

Annex 4 Sector data

Table A4.1 Agricultural sector data

Indicator title	Source	Year	Data
Employment	LFS	2012	10.9m
Number of enterprises	European Commission factsheets	2010	12.8m[15]
Total imports (food and live animals)	International Trade data, Eurostat	2012	€327,375m
Total exports (food and live animals)	International Trade data, Eurostat	2012	€315,961m
Total intra-EU imports	International Trade data, Eurostat	2012	€241,832m
Total intra-EU exports	International Trade data, Eurostat	2012	€245,870m
Percentage of imports which are intra-EU imports	International Trade data, Eurostat	2012	73.9%
Percentage of exports that are intra-EU exports	International Trade data, Eurostat	2012	77.8%

LFS, International traded data, European Commission (2014) Member State Factsheets, Eurostat (2013) Agriculture, forestry and fishery statistics

Table A4.2 Transport sector data

Indicator title	Source	Year	Data
Employment	LFS	2012	9.2m
Enterprises	SBS	2011	1.1m
Turnover	SBS	2011	€1,320,000m
Total imports	International trade in services, Eurostat	2012	€262,406m
Total exports	International trade in services, Eurostat	2012	€291,472m
Total intra-EU imports	International trade in services, Eurostat	2012	€144,863m
Total intra-EU exports	International trade in services, Eurostat	2012	€147,794m
Percentage of imports which are intra-EU imports	International trade in services, Eurostat	2012	55.2%
Percentage of exports that are intra-EU exports	International trade in services, Eurostat	2012	50.7%

LFS, SBS, Eurostat International trade in services (since 2004) [bop_its_det]

[15] Note: Differences in the number of enterprises and the number of people employed is due to data being extracted from different sources, and for different years.

Table A4.3 Energy sector data

Indicator title	Source	Year	Data
Indicator title	Source	Year	Data
Employment	LFS	2012	1.7m
Enterprises	SBS	2011	63,200
Turnover	SBS	2011	€1,350,000m
Total consumption electricity	Eurostat electricity consumption data	2011	2,787,931GWh
Total imports electricity	Eurostat, Imports (by country of origin) – electricity	2011	315,814GWh
Percentage electricity imported	Imports (by country of origin) - electricity	2011	11.3%
Total exports electricity	Eurostat, Exports (by country of destination) - electricity	2011	315,675GWh
Total intra-EU imports electricity	Eurostat, Imports (by country of origin) - electricity	2011	241,064GWh
Total intra-EU exports electricity	Eurostat, Exports (by country of destination) - electricity	2011	244,395GWh
Percentage of imports which are intra-EU imports electricity	Eurostat, Imports (by country of origin) - electricity	2011	76.3%
Percentage of exports that are intra-EU exports electricity	Eurostat, Exports (by country of destination) - electricity	2011	77.4%
Total consumption gas	Eurostat, Supply, transformation, consumption - gas	2011	16,908,148Tj
Total imports gas	Eurostat, Imports (by country of origin) - gas	2011	16,366,606Tj
Percentage of gas consumed from imports	Eurostat, Imports (by country of origin) - gas	2011	96.8%
Total exports gas	Eurostat, Exports (by country of destination) – gas	2011	3,980,452Tj
Total intra-EU imports gas	Eurostat, Imports (by country of origin) – gas	2011	2,854,255Tj
Total intra-EU exports gas	Eurostat, Exports (by country of destination) – gas	2011	2,957,244Tj
Percentage of imports which are intra-EU imports gas	Eurostat, Imports (by country of origin) – gas	2011	17.4%
Percentage of exports that are intra-EU exports gas	Eurostat, Exports (by country of destination) - gas	2011	74.3%

Source: LFS, SBS, Supply, transformation, consumption - electricity - annual data [nrg_105a], Imports (by country of origin) - electricity - annual data [nrg_125a], Exports (by country of destination) - electricity - annual data [nrg_135a], Supply, transformation, consumption - gas - annual data [nrg_103a], Imports (by country of origin) - gas - annual data [nrg_124a], and Exports (by country of destination) - gas - annual data [nrg_134a]

Table A4.4 Tourism and leisure sector data

Indicator title	Source	Year	Data
Employment	LFS	2012	10.4m
Enterprises	SBS	2011	1.9m
Turnover	SBS	2011	€644,615m
Total number of nights spent at tourist accommodation	Eurostat, Nights spent at tourist accommodation establishments	2012	2,026m
Number of nights spent at tourist accommodation by visitors from the EU	Eurostat, Nights spent at tourist accommodation establishments	2012	1,761m
Percentage of visitor nights from the EU	Eurostat, Nights spent at tourist accommodation establishments	2012	86.9%

Source: LFS, SBS, Eurostat, Nights spent at tourist accommodation establishments by country/world region of residence of the tourist [tour_occ_ninraw]

Table A4.5 Business sector data

Indicator title	Source	Year	Data
Employment	LFS	2012	14.5m
Enterprises	SBS	2011	5.6m
Turnover	SBS	2011	€2,347,981m
Total imports	Eurostat, International trade in services	2011	€171,559m
Total exports	Eurostat, International trade in services	2011	€253,082m
Total intra-EU imports	Eurostat, International trade in services	2011	€106,804m
Total intra-EU exports	Eurostat, International trade in services	2011	€140,786m
Percentage of imports which are intra-EU imports	Eurostat, International trade in services	2011	62.3%
Percentage of exports that are intra-EU exports	Eurostat, International trade in services	2011	55.6%

Source: LFS, SBS, Eurostat International trade in services (since 2004) [bop_its_det]

Table A4.6 Number of deaths as a result of road traffic accidents in Europe, 2012

Type of road user	Number of deaths
Driver	17,361
Passenger	4,924
Pedestrian	5,833
Other	8
Total	28,126

Source: Road Safety Evolution in EU (2013), European Commission (using data from the CARE database or national publications) (http://ec.europa.eu/transport/road_safety/specialist/statistics/index_en.htm). For the breakdown by type of road user, the most recent ratio of deaths by road user has been calculated from Eurostat, Persons killed in road accidents by road user (CARE data) [tran_sf_roadus] (for Lithuania, for which data are missing, the ratios from Latvia have been used as a proxy measure).

Annex 5 Data for scenario analysis

A5.1 Assumptions for data scenario calculations

The number of passenger journeys which could be subject to passenger inconvenience, and the volume of freight which could provide inconvenience to businesses in the EU, have been calculated using the most recent data available[16] and the following assumptions for all four scenarios:

- The time when summertime arrangements are not harmonised with the rest of the EU for scenarios 1 and 2 is two weeks in March, therefore the data used for calculations is March data where monthly data is available and quarter 1 data where quarterly data is available,
- The time when summertime arrangements are not harmonised with the rest of the EU in scenarios 3 and 4 is from the end of March to the end of September) therefore the data used for calculations is quarter 2, quarter 3 and quarter 4 data where only quarterly data is available, and for monthly data the months April to October have been used;
- For periods of data where summertime arrangements are both harmonised and not harmonised (either quarter 4, or the full year for rail freight), the distribution is assumed to be even across the entire period, and a proportion of the period has been assumed to have asynchronous summertime arrangements[17].

In order to estimate the number of visits to Germany, Greece, the Czech Republic and Bulgaria in the period when summertime arrangements are not harmonised in scenarios 1, 2, 3 and 4, the following data and assumptions were made:

- Annual data on the number of visits and expenditure of visits for EU citizens visiting the four countries and of their citizens visiting other EU Member States;
- Quarterly data of total travel expenditure (from all Member States to all destinations) has been used to estimate the number of trips and expenditure to the four countries by EU citizens and by their citizens to other EU Member States.
  - For scenarios 1 and 2, the percentage of total travel expenditure in quarter 1 has been multiplied by the annual number of visits to Germany and Greece and by German and Greek citizens visiting other EU Member States to estimate the visits in quarter 1 to and from Germany and Greece.
  - The distribution of expenditure and number of visits in quarter 1 is assumed to be even across the quarter.
  - For scenarios 3 and 4, the percentage of total travel expenditure in quarters 2, 3 and 4 have been multiplied by the annual number of visits to the Czech Republic and Bulgaria and by Czech and Bulgarian citizens to other EU Member States to estimate the visits in quarters 2, 3 and 4 to and from the Czech Republic and Bulgaria.
  - The distribution of expenditure and number of visits in quarter 4 is assumed to be even across the quarter, and one third of quarter 4 is assumed to have asynchronous summertime arrangements.

[16] This relates to transport figures for 2012, as complete annual data for 2013 was not available at the time this research was carried out.

[17] Monthly data are available for passenger air transport and air freight and mail; quarterly data are available for road freight transport, maritime passenger and freight transport, and the distribution of these is assumed to be even across the whole period. For rail freight transport, only annual data are available, and therefore the distribution is assumed to be even across the year. For intra-EU rail transport, annual data are available, but quarterly data is available for the total number of rail journeys taken. Therefore, the distribution across quarters of international rail journeys is assumed to be the same as the distribution for all rail journeys. The distribution of this estimate within quarter 4 is assumed to be even, and a proportion of this quarter is assumed to have asynchronous summertime arrangements.

– The number of visitors to the Czech Republic and Bulgaria and by Czech and Bulgarian citizens to other EU Member States and expenditure by these visitors in the third of quarter 4 which is assumed to have asynchronous summertime arrangements has been summed to the number of visitors and expenditure in quarter 2 and quarter 3, when there are also asynchronous summertime arrangements.

A5.2 Tables presenting the results of scenario analysis

Table A5.1 to Table A5.4 present the results to the scenario analysis, which is discussed in section 4 of the report.

Table A5.1 Appraisal of scenario 1

Sector	Employment in Germany	Employment in the EU	Businesses in Germany	Businesses in the EU	Potential effect of change
Transport sector employment	100,000	6,707,000	535	1,142,551	
Passenger transport journeys affected by change in summertime arrangements ('000)					3,826
Number of international rail journeys affected ('000)					275
Number of international air journeys affected ('000)					3,322
Number of international maritime journeys affected ('000)					228
Tonnes of freight transport affected by change in summertime arrangements ('000 tonnes)					12,299
Rail freight affected ('000 tonnes)					3,678
Maritime freight affected ('000 tonnes)					4,535
Air freight affected ('000 tonnes)					45
Road freight affected ('000 tonnes)					4,041
Tourism sector employment	1,717,800	10,382,000	232,127	1,917,089	
Tourism trips affected ('000 trips)					2,271
Tourism expenditure affected (€ million)					1,132
Business sector employment	2,561,500	13,247,200	488,038	5,511,397	
Energy sector employment	385,000	1,683,000	1,510	63,200	

ICF calculations

Table A5.2 Appraisal of scenario 2

Sector	Employment in Greece	Employment in the EU	Businesses in Greece	Businesses in the EU	Potential effect of change
Transport sector employment	167,900	6,707,000	67,618	1,142,551	
Passenger transport journeys affected by change in summertime arrangements ('000)					285
Number of international rail journeys affected ('000)					0.3
Number of international air journeys affected ('000)					256
Number of international maritime journeys affected ('000)					28
Tonnes of freight transport affected by change in summertime arrangements ('000 tonnes)					1,012
Rail freight affected ('000 tonnes)					27
Maritime freight affected ('000 tonnes)					877
Air freight affected ('000 tonnes)					2
Road freight affected ('000 tonnes)					106
Tourism sector employment	284,700	10,382,000	-	1,917,089	
Tourism trips affected ('000 trips)					220
Tourism expenditure affected (€ million)					176
Business sector employment	237,100	13,247,200	-	5,511,397	
Energy sector employment	26,500	1,683,000	10	63,200	

ICF calculations

Table A5.3 Appraisal of scenario 3

Sector	Employment in Czech Republic	Employment in the EU	Businesses in Czech Republic	Businesses in the EU	Potential effect of change
Transport sector employment	231,700	6,707,000	41,153	1,142,551	
Passenger transport journeys affected by change in summertime arrangements ('000)					7,093
Number of international rail journeys affected ('000)					1,626
Number of international air journeys affected ('000)					5,467
Number of international maritime journeys affected ('000)					0
Tonnes of freight transport affected by change in summertime arrangements ('000 tonnes)					45,066
Rail freight affected ('000 tonnes)					21,758
Maritime freight affected ('000 tonnes)					0
Air freight affected ('000 tonnes)					13
Road freight affected ('000 tonnes)					23,295
Tourism sector employment	191,600	10,382,000	66,626	1,917,089	
Tourism trips affected ('000 trips)					7,617
Tourism expenditure affected (€ million)					2,715
Business sector employment	277,000	13,247,200	249,906	5,511,397	
Energy sector employment	50,900	1,683,000	5,192	63,200	
Change in electricity usage (gigawatt hours)					+283
Change in gas usage (terajoules)					+1,435

ICF calculations

Table A5.4 Appraisal of scenario 4

Sector	Employment in Bulgaria	Employment in the EU	Businesses in Bulgaria	Businesses in the EU	Potential effect of change
Transport sector employment	136,600	6707,000	19,062	1,142,551	
Passenger transport journeys affected by change in summertime arrangements ('000)					3,954
Number of international rail journeys affected ('000)					136
Number of international air journeys affected ('000)					3,819
Number of international maritime journeys affected ('000)					0
Tonnes of freight transport affected by change in summertime arrangements ('000 tonnes)					8,083
Rail freight affected ('000 tonnes)					740
Maritime freight affected ('000 tonnes)					3,408
Air freight affected ('000 tonnes)					8
Road freight affected ('000 tonnes)					3,927
Tourism sector employment	157,100	10,382,000	27,685	1,917,089	
Tourism trips affected ('000 trips)					2,007
Tourism expenditure affected (€ million)					785
Business sector employment	112,300	13,247,200	51,943	5,511,397	
Energy sector employment	44,200	1,683,000	1,703	63,200	
Change in electricity usage					+139
Change in gas usage					+513

ICF calculations

Table A5.5 Appraisal of scenario 5

Sector	Employment in Germany and Poland	Employment in the EU	Businesses in Germany and Poland	Businesses in the EU	Potential effect of change
Transport sector employment	1,431,100	6,707,000	235,643	1,142,551	
Passenger transport journeys affected by change in summertime arrangements ('000)					4,416 *4,704*
Number of international rail journeys affected ('000)					390 *441*
Number of international air journeys affected ('000)					3,758 *3,995*
Number of international maritime journeys affected ('000)					268 *268*
Tonnes of freight transport affected by change in summertime arrangements ('000 tonnes)					16,958 *19,336*
Rail freight affected ('000 tonnes)					4,260 *4,921*
Maritime freight affected ('000 tonnes)					5,735 *5,735*
Air freight affected ('000 tonnes)					45 *49*
Road freight affected ('000 tonnes)					6,898 *8,613*
Tourism sector employment	2,087,300	10,382,000	120,570	1,917,089	
Tourism trips affected ('000 trips)					2,513 *2,722*
Tourism expenditure affected (€ million)					1,449 *1,545*
Business sector employment	3,278,800	13,247,200	846,286	5,511,397	
Energy sector employment	549,300	1,683,000	4,507	63,200	
Change in electricity usage					-
Change in gas usage					-

ICF calculations

Table A5.6 Appraisal of scenario 6

Sector	Employment in Greece, Bulgaria & Romania	Employment in the EU	Businesses in Greece, Bulgaria & Romania	Businesses in the EU	Potential effect of change
Transport sector employment	629,700	6,707,000	50,775	1,142,551	
Passenger transport journeys affected by change in summertime arrangements ('000)					676 *703*
Number of international rail journeys affected ('000)					14 *17*
Number of international air journeys affected ('000)					634 *658*
Number of international maritime journeys affected ('000)					28 *28*
Tonnes of freight transport affected by change in summertime arrangements ('000 tonnes)					1,917 *2,169*
Rail freight affected ('000 tonnes)					157 *229*
Maritime freight affected ('000 tonnes)					1,205 *1,205*
Air freight affected ('000 tonnes)					3 *4*
Road freight affected ('000 tonnes)					551 *730*
Tourism sector employment	670,700	10,382,000	52,305	1,917,089	
Tourism trips affected ('000 trips)					310 *339*
Tourism expenditure affected (€ million)					230 *235*
Business sector employment	634,500	13,247,200	118,246	5,511,397	
Energy sector employment	180,700	1,683,000	2,759	63,200	
Change in electricity usage					-
Change in gas usage					-

ICF calculations

A5.3 Assumptions for the monetisation of impacts

This section presents the assumptions which have been made in order to monetise some of the impacts of asynchronous summertime arrangements, and discusses why it has not been possible to provide monetary values.

A5.3.1 Cost of inconvenience – cost of missing transport journey

The cost of inconvenience for passengers travelling between EU Member States has been estimated for passengers who miss their flight, train or ferry journey. There are no statistics which show how many passengers miss their transport journey under current summertime arrangements. It has been assumed that the same number of individuals who miss their journey under current summertime arrangements would continue to miss their journey in each scenario, but an additional number of passengers will now also miss their journey. This additional number of passengers has been estimated as:

- 0.1% of intra-EU journeys affected by asynchronous summertime arrangements in each Scenario;
- 1% of intra-EU journeys affected by asynchronous summertime arrangements in each Scenario; and
- 5% of intra-EU journeys affected by asynchronous summertime arrangements in each Scenario.

The cost of missing a journey has been estimated using the average EU labour cost of €23.4 per hour, as it is not possible to know where all passengers have come from. Not all of the passengers will be employed, but there are costs for all lost time to individuals, and the average labour cost has been used to estimate this. The lengths of time individuals are assumed to be inconvenienced for are:

- 5 hours for a flight;
- 2 hours for a rail journey; and
- 2 hours for a maritime journey.

A5.3.2 Cost of inconvenience – rebooking travel tickets

Individuals who miss their transport journey may have to re-book a ticket in order to make their journey. It is assumed that individuals taking maritime journeys will be able to rebook their journey at no additional cost, but that travellers by rail or air who have not bought flexible tickets will have to re-book their journey at their own expense. It is assumed that 85% of international travellers who have missed their flight or train do not have flexible tickets, and will incur costs. It is assumed that the average cost of buying a replacement ticket is €200 per traveller.

A5.3.3 Cost of inconvenience - overcrowded journeys

A further inconvenience cost for travellers is overcrowding on transport journeys. However, it is not possible to estimate a cost to travellers as a result of overcrowding. A cost of this type would usually be calculated through “revealed preferences” research, where the price people pay for a journey would be higher for quieter services, thus placing a value on quiet services. However, as people pay for transport when they require to be somewhere, and the price paid is not influenced by how busy a service is, therefore it is not possible to estimate the value of a quiet travel service.

A5.3.4 Cost of inconvenience – freight transport

It is not possible to estimate the cost of inconvenience in the freight sector. This is because it is not possible to know how a delay in freight transportation will affect business decisions in the manufacturing and retailing sectors, and no information has been discovered in the course of this study which shows how businesses may be affected. Therefore, the quantitative estimates are limited to the volume of freight which may be affected by inconvenience. As with passenger transport, three values for the volume of freight which is impacted have been presented, and these are:

- 0.1% of intra-EU freight affected by asynchronous summertime arrangements in each Scenario;
- 1% of intra-EU freight affected by asynchronous summertime arrangements in each Scenario; and
- 5% of intra-EU freight affected by asynchronous summertime arrangements in each Scenario.

A5.3.5 Energy sector

The impacts of asynchronous summertime arrangements on the energy sector have been calculated for Scenario 3 and 4, and the impact in the other scenarios is assumed to be minimal. The impact on the energy sector in the low estimate is assumed to be zero, but in the medium and high estimates the monetary impact on the energy sector has been calculated by multiplying the change in energy consumption by an energy price (this has been selected as the price without taxes included).

A5.3.6 Tourism and Leisure

The impact on the tourism and leisure sector are the same impacts as for passenger transport – if passengers choose not to travel to a country because of the change in summertime arrangements it would have an impact on the tourism industry. However, it is likely that there would be a large degree of displacement within the European tourism industry if passengers decide not to travel to a certain Member State due to asynchronous summertime arrangements. For example, if an individual decides not to holiday in Germany because of asynchronous summertime arrangements, they are likely to substitute this holiday with a trip to another European country, and individuals travelling for business or family reasons are unlikely to alter their travel arrangements. Therefore, it is assumed at a European level there is no impact on the tourism industry.