EU summer-time arrangements under Directive 2000/84/EC

Ex-post impact assessment

STUDY

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EU summer-time arrangements

under Directive 2000/84/EC

Study

On 27 June 2017, the Committee on Legal Affairs (JURI) requested an ex-post evaluation of Directive 2000/84/EC, which regulates the time change between winter and summer time in the EU. According to the request the evaluation should constitute a follow-up to the joint public hearing on summer time the JURI, ITRE and TRAN committees held on 24 March 2015 and should take into account the most recent research findings regarding the effects of daylight saving time on different aspects of the economy, health and safety. Moreover, it should analyse certain aspects linked to the 'better regulation' initiative.

This analysis was prepared in-house by the Ex-Post Evaluation Unit of the Directorate for Impact Assessment and European Added Value, within the European Parliament's Directorate-General for Parliamentary Research Services. It aims to outline the rationale and application of Directive 2000/84/EC, examines the evidence available in the various areas daylight saving time touches upon and seeks to thereby provide an impartial contribution to the debate.

Abstract

The purpose of summer time is to capitalise on natural daylight. By turning the clock one hour forward as the days get longer in spring, sunset is delayed by this same hour, until the clock is set back again in autumn. This practice is applied in over 60 countries worldwide. In the EU, Member States draw on a long tradition of daylight saving time (DST), and many have developed their own DST schemes. Harmonisation attempts began in the 1970s, to facilitate the effective operation of the internal market. Today, the uniform EU-wide application of DST is governed by Directive 2000/84/EC; most European third countries have aligned their summer-time schemes with that of the EU. Much academic research has been invested in examining the benefits and inconveniences of DST. It appears that:

- summer time benefits the internal market (notably the transport sector) and outdoor leisure activities, and it also generates marginal savings in energy consumption;
- the impact on other economic sectors remains largely inconclusive;
- with regard to inconveniences, health research associates DST with disruption to the human biorhythm ('circadian rhythm').

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Executive summary

The purpose of summer time is to shift an hour of daylight from the morning to the evening during the summer months to provide more daylight hours after work. Most EU Member States have been applying summer time continuously since the 1970s or 1980s, initially according to their own schedules. To prevent the internal market, and in particular the transport sector, from being hampered by uncoordinated national schedules, summer-time arrangements were gradually harmonised under EU law. This process began in 1975 and was completed in 2001 by means of Directive 2000/84/EC, the ninth Summer-Time Directive.

This paper puts summer time – or daylight saving time (DST), as it is commonly referred to – first into context: it recalls the initial purpose of summer time and shows its worldwide observance today. It also explains the variations in the actual effect of DST across EU Member States. Indeed, DST makes more of a difference in the South where the sun sets relatively early in summer (e.g. Greece) than in the North (e.g. Sweden). These differences are due to the relationship between time and daylight on the one hand, and countries' geographical position and choice of time zone on the other.

Furthermore, this analysis looks at the DST-related activities of the European Commission and the European Parliament and examines the findings of academic research. In recent years the Commission has out-sourced a number of studies to assess the impact of DST. Their main purpose was to inform the successive Commission proposals prior to amending the summer-time legislation. These studies and more recent research sources suggest that:
- DST benefits the internal market, leisure activities and generates marginal energy savings;
- the available scientific evidence on the impact of DST on various other sectors (e.g. agriculture and safety) remains inconclusive; whereas
- with regard to health, chronobiological research findings suggest that the effect on the human biorhythm may be more severe than previously thought.

Beyond considerations on the effects, repeal of the Summer-Time Directive would not automatically abolish summer time across the EU. It would just end EU-wide harmonisation and bring the issue of summer time back into the competence of the Member States. Member States would be free to decide about their individual time regimes: they might opt to retain summer time (at the current or a modified DST schedule) or to end summer time. Abolishing summer time would in the first place result in year-round standard time ('winter time'), which by definition entails darker evenings in spring and summer. To obtain year-round summer time Member States would technically need to change time zone. However, uncoordinated national time arrangements would likely have negative repercussions on the internal market.

No EU government has called for a change to the current DST provisions. However, individual Members of the European Parliament have questioned the effectiveness of DST, in particular in a hearing in March 2015. Finally, a number of citizens have voiced their dissatisfaction with the clock change by means of citizens' initiatives, petitions or in surveys. Nevertheless, there is a knowledge gap regarding public opinion, since no EU-wide representative survey has recently tested citizens' attitudes towards summer time.

1. The EU's summer-time arrangements

1.1. The essence of Directive 2000/84/EC

The EU's summer-time arrangements are governed by Directive 2000/84/EC, which defines summer time as the period of the year during which clocks are put forward by 60 minutes compared with the rest of the year. Summer time begins on the last Sunday of March and ends on the last Sunday of October. Hence, the starting date falls between 25 and 31 March and the end date between 25 and 31 October of any given year. The directive applies to all EU Member States, but not to the EU's overseas territories, which, for geographical reasons, are exempted from summer time.

1.2. The historical process that led to Directive 2000/84/EC

Strictly speaking, EU legislation did not introduce summer time in the EU, but instead harmonised existing national legislation by unifying Member States' summer-time schedules. This purpose is reflected in the choice of legal basis, namely the general Treaty provision regulating the adoption of measures for the approximation of laws to improve the functioning of the internal market.[1]

Indeed, most Member States had already developed their individual DST schemes before summer time was regulated at Community level, or else, in the case of the newer Member States, long before they acceded to the EU (see Annex 1). In fact, the majority of today's 28 Member States have a very long tradition of summer time, going back to the First and Second World Wars. As a war-time measure to conserve energy, many countries discontinued DST after the wars and revived it only much later. Most Member States reinstated summer time in the 1970s, in the wake of the oil crisis, or in the 1980s, and have been applying it ever since. Energy savings were just one of the drivers for national governments to adopt summer time; other triggers included leisure opportunities in the evening and the synchronisation of national DST practices with neighbouring countries and other European trading partners.[2]

It was in 1975 that a Commission communication[3] first addressed the adverse effects of diverging national DST practices on the internal market, notably in the areas of cross-border transport, communications (e.g. telephone and broadcasting) and commerce. At that time only three of the then nine Member States observed summer time (the UK, Ireland and Italy; France was about to introduce it). Moreover, as was highlighted in the subsequent Commission proposal,[4] a few European third countries with whom the Community maintained close ties (e.g. Spain) had their own DST schemes in place.

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[1] Now Article 114 of the Treaty on the Functioning of the European Union (TFEU - Treaty of Lisbon); formerly Article 95 of the Treaty establishing the European Community (TEC – Treaty of Amsterdam), Article 100a of the Treaty on European Union (TEU – Treaty of Maastricht) and Article 100 of the Treaty Establishing the European Community (TEEC - Treaty of Rome).

[2] See Summer time: thorough examination of the implications of summer-time arrangements in the Member States of the European Union. Study carried out at the request of the European Commission. Research voor Beleid International, 1999, pp. 9-22.

[3] Introduction of summer time in the Community – COM(75) 319.

[4] Proposal for a Council directive on summer time arrangements – COM(76) 27.

By the time the first EC Summer-Time Directive[5] was adopted in 1980, after four years of negotiations, all nine Member States had introduced DST. However, although some countries – e.g. Germany and Denmark – had done so primarily so as to be aligned with their neighbours, harmonisation of summer-time arrangements across the EU did not happen overnight. It took no less than nine directives, adopted over a time span of 20 years, to put a uniform and open-ended EU-wide system in place.

The first directive of 1980 provided only for a common date for the beginning of summer time. Successive directives retained a different end date for the United Kingdom (UK) and Ireland, until the seventh Summer-Time Directive (94/21/EC) eventually unified the beginning and end date for all EU Member States. In this way, full harmonisation of the application of daylight saving time across the EU was achieved; but it was limited to two years (1996 and 1997). The validity period was prolonged for another four years by means of the eighth directive (97/44/EC). Eventually, the current ninth directive (2000/84/EC), adopted on 19 January 2001, extended the provisions indefinitely, drawing on the argument that the functioning of the internal market required 'stable, long-term planning'.

The Commission proposal for the ninth directive was informed by an external study.[6] It comprised a literature review and stakeholder consultation for the EU-15 (plus Hungary and Poland, at the time candidate countries), covering the sectors that were thought to be most affected, including agriculture; energy; tourism, recreation and leisure; transport and road safety; health; and trade and services.

A specific monitoring provision required the Commission to report by the end of 2007 on the directive's implementation and impact 'on the sectors concerned' (Article 5), and to initiate adjustments to the directive accordingly, if deemed appropriate by the review.

1.3. The compulsory nature of the Summer-Time Directive

Article 2 of Directive 2000/84/EC stipulates that the summer-time period shall begin, *in every Member State*, at 1 a.m., Greenwich Mean Time, on the last Sunday in March. Similarly, the first recital in its preamble recalls that the eighth Summer-Time Directive had introduced a common date and time in *all* Member States. Hence, the directive is legally binding on all EU Member States. The compulsory nature of the directive is fundamental with regard to two scenarios:

- an EU Member State's potential wish to opt out of the EU summer-time scheme;
- a country's accession to the EU.

In the early days of summer-time harmonisation, the Commission considered it to be desirable to make summer-time provisions binding on all Member States, but acknowledged that this was politically not feasible at the time. By way of example, the explanatory memorandum to the first summer-time proposal from 1976 stated that the adoption 'would not oblige Member States to introduce summer time' (point 11), while stressing the advantages 'the adoption of summer time by the Member States as a whole and by as many as possible of the non-member countries' would have (point 12).

[5] Council Directive 80/737/EEC of 22 July 1980 on summertime arrangements.
[6] Research voor Beleid International.

This opt-out interpretation is deemed no longer valid, as the Commission has underlined on several occasions. In 2000, in the explanatory memorandum to the proposal for the ninth Summer-Time Directive, it reasoned: 'When the Member States adopted the 8th Directive after thorough legal consultation and extensive discussion they refused, by a very broad majority, to include an exemption in the Directive that allowed one Member State not to apply the summer-time arrangements. In so doing they felt that the Community Directive was binding in its entirety […]'[7]

The Commission upheld this view in 2015, in its reply to a written question, arguing that Directive 2000/84/EC 'obliges all Member States to switch from winter- to summer-time and vice-versa, at the precise points in time specified therein. The aim is to ensure the proper operation of the internal market, notably (but not exclusively) in the areas of transport and communications. Omission by a Member State […] would amount to a breach of the Summertime Directive.'[8]

2. Daylight saving time in context

2.1. The original purpose of summer time

The purpose of summer time is to capitalise on natural daylight. By turning the clock one hour forward when the sun rises earlier in spring, people benefit of longer daylight in the afternoon and evening. When the days get shorter again in autumn, the clock is put back to standard time.

The original idea is attributed to British builder William Willett (1856-1915),[9] whose pamphlet 'The Waste of Daylight' (1907) promoted lower lighting costs and extended outdoor activities as the two main arguments in favour of DST. The subsequent first draft bill before the UK's House of Commons (1908) brought the leisure-time argument to the fore, claiming that DST would bring 'the hours of work and pleasure nearer to the sunlight'.[10] The bill was defeated on account of fierce opposition from scientists and farmers.

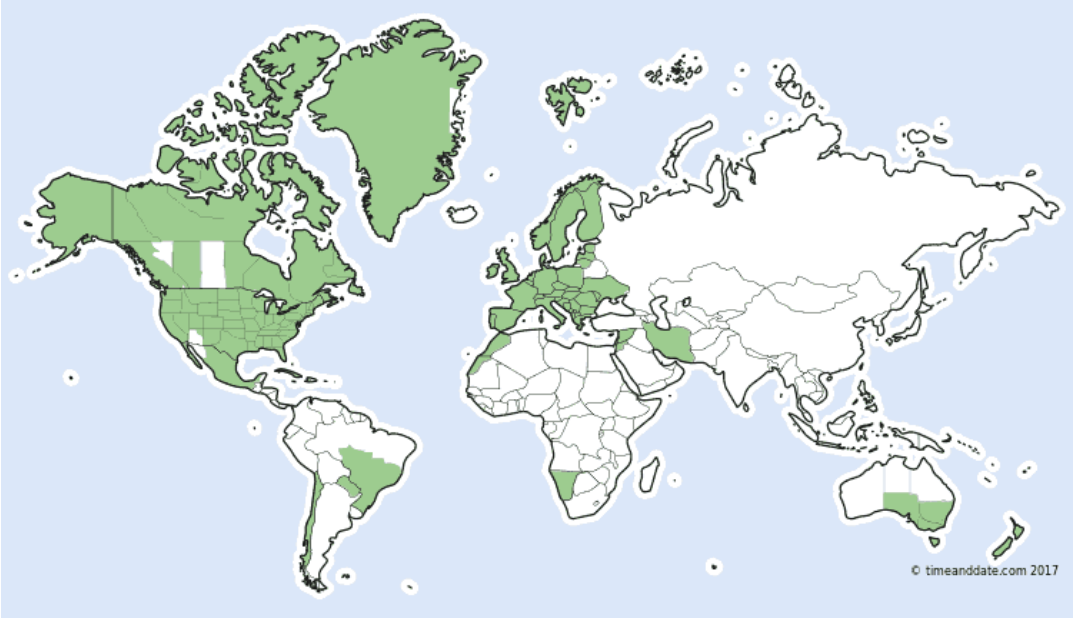
When DST was first instituted in 1916, during the First World War in Germany – closely followed by other European countries and the United States of America (USA) –, energy saving considerations prevailed. Countries sought to conserve electricity, gas and oil for their war efforts by observing DST. Ensuing evaluations reportedly confirmed the desired effect. The energy argument was taken up again in the 1970s, when countries revived DST in the wake of the oil crisis. Newer studies confirm the energy saving effects of DST in today's world, although these effects are considered to be marginal (see Chapter 6.3.1).

[7] See COM(2000) 302, explanatory memorandum point 3.
[8] Written question E-015476/2015, answer by Commissioner Violeta Bulc, 3 February 2016.
[9] See David Prerau, *Seize the daylight: the curious and contentious story of Daylight Saving Time*, New York, 2005, Chapter 1 (pp. 1-24).
[10] Prerau, p. 9.

2.2. International DST observance

During the last century, countries on all continents experimented with DST in one way or another. Some states permanently abandoned the twice-a-year-switch, others retained it, while others ended and subsequently reinstituted it. The UK, for instance, has even tried out models of single/double summer time. Today, DST is observed in over 60 countries worldwide, predominantly in the industrialised world.[11]

Figure 1 – Worldwide use of DST, as per 2017



Countries/territories applying DST at some period during 2017
Source: https://www.timeanddate.com/time/dst/2017.html.

DST is particularly wide-spread in Europe, North America and Oceania. With the exception of Iceland, Russia, Belarus and Turkey, which have abolished DST, all non-EU European countries have aligned themselves with the EU's summer-time schedule;[12] this facilitates inter alia cross-border trade, transport, communications and travel. For similar purposes, the USA and Canada synchronised their DST timetable.[13] In the southern hemisphere, where DST is applied from autumn to spring, Australia[14] and New Zealand observe DST, and so do Chile and Paraguay, some parts of Brazil and a few islands in the South Pacific (Fiji, Tonga). By contrast, there is very little occurrence of DST in Africa and Asia. In 2017, only two African countries adhere to DST: Morocco and Namibia. On the

[11] An updated list is maintained at https://www.timeanddate.com/time/dst/. Examples of industrialised countries that do not (or no longer) use DST include Japan, South Korea and Iceland.
[12] This includes the countries of the Western Balkans, Norway, Switzerland and Liechtenstein, the microstates Andorra, San Marino, and Monaco, and also the Republic of Moldova and Ukraine. It should be noted that even if Ukraine synchronised its summer time with that of the EU, DST has been abolished in the Donetsk and Luhansk regions, which are not under the full effective control of the Government of Ukraine, as well as on the Crimean peninsula, which was illegally annexed by Russia in 2014.
[13] In Canada, DST is not observed in the province of Saskatchewan.
[14] In Australia, where DST falls under the responsibility of the states, five out of eight states observe DST (all but Queensland, the Northern Territory and Western Australia).

Asian continent, 'current use is limited to the Middle East (notably Israel, Jordan, Lebanon, Syria and Iran).

In the EU's neighbourhood, Turkey, Russia and Belarus have abandoned DST in recent years. Turkey, which had stuck to Europe's summer-time arrangements for some time, switched to permanent (i.e. all year round) summer time in September 2016. Technically, this equals a change of time zone. And Russia even altered its DST scheme twice: after having observed DST for three decades, it moved to permanent summer time in 2011, to counter the alleged negative effects on the biorhythm of human beings. However, as the resulting dark winter mornings were highly unpopular, a new law reversed the decision in 2014, establishing permanent winter time instead.

The case of the USA

As was the case in Europe, daylight saving time was first instituted in the USA as a war-time measure, to conserve fuel. Strong opposition from farmers, however, led to the federal act being repealed straight after the First World War. Subsequently, states and cities were free to determine whether or not to observe summer time, and to define their own timetables. This resulted in patchwork use of DST across the USA, until in 1942 a Congress act superseded all local DST provisions throughout the Second World War. When the war ended, the law was repealed, and once again states and counties could decide on their local use of DST. This led to fragmentation and 'piecemeal daylight saving here and there over the country', as President Harry Truman reportedly described it. The patchy local use of DST of the post-war period impacted particularly heavily on transport and communication/broadcasting. Timetables became increasingly confusing; e.g. long-distance trains often applied a different time than local trains, even if their journey started in the same place.

With increasing public mobility, pressure built for a federal regulation. When Congress passed the Uniform Time Act of 1966, it established a nationwide system for the uniform application of DST, with binding begin and end dates. Also, it designated the US Department of Transportation to oversee and regulate DST. However, the act did not harmonise the application of DST entirely, as it allowed states to opt out. At present, two states, Arizona and Hawaii, make use of the exemption. (Indiana and Michigan were exempted, too, at a certain point, but returned to DST.) In addition, the US overseas territories of Puerto Rico, Guam, the Northern Mariana Islands, American Samoa and the Virgin Islands do not observe DST.

The Uniform Time Act was twice amended, in 1986 and in 2005, so as to extend the DST period. Today, American clocks spring forward on the second Sunday in March and fall back on the first Sunday of November. Thus, US DST spreads over nearly eight months, compared to seven in the EU. It is worth noting that last amendment was passed through enactment of the Energy Policy Act of 2005, which suggests that in the USA, a direct link is made between DST and energy conservation.

A number of federal bills seeking to change the DST regime have been introduced in Congress. They have been aimed for instance at applying summer time throughout the year (H.R. 2636, 95th Congress) or modifying the State exemption provisions (H.R. 1646, 108th Congress). Yet, none of these bills have been enacted. At state level, initiatives to abolish DST by opting out of the nationwide DST scheme have emerged in the past, but so far none of them has been put into law. Recent examples include Alaska, California, Colorado, Florida and Utah.

2.3. The link between geographical position and time[15]

As explained above, the main purpose of DST is to shift an hour of daylight from the morning to the evening during the warmer, brighter months. However, what difference the application of DST effectively makes in a country depends on its geographical location and time zone. This chapter explains the relationship between time and daylight on the one hand and geographical location on the other, and shows the implications for EU territory.

The geographical position of any place on Earth is defined by its longitude and latitude ('coordinates'). Longitude plays a key role in determining a place's local time, whereas latitude (i.e. the distance from the equator) impacts on the hours of daylight (day length) throughout the year, with seasonal variations.

2.3.1. Latitude and daylight

Near the equator the time of sunrise and sunset does not differ much throughout the year. This may explain why DST is barely observed in equatorial regions (e.g. Africa and South America). Conversely, the further a country is away from the equator, the more the times of sunset and sunrise – and hence also the number of daylight hours – vary throughout the seasons. When DST is observed at places located at a very high latitude, the one-hour time shift delays what is in any case a late sunset even more during the summer months. Seasonal changes are extreme at (and beyond) the Arctic Circle, located at a latitude of approximately 66 degrees north. There, the sun does not go down at all in summer, and does not rise at all in winter.

Such variations in day length result from the fact that the Earth revolves on a tilted axis around the sun (rather than a vertical axis). It takes the planet one year (364 ¼ days, to be precise) to complete the rotation. For the part of the year a place is tilted away from the sun, days appear shorter (i.e. winter in the northern hemisphere), and during the period it is tilted towards the sun, the hours of daylight are longer (summer).

Geographically, the territory of the European Union is located at fairly high latitudes in the northern hemisphere. It spans from about 35 degrees north in the south (e.g. Malta, Crete and Cyprus) to almost 70 degrees north in Finland's High North.[16] Or, when only more densely populated regions are considered, from about 38 degrees north (e.g. Athens and Lisbon) to 60 degrees north (e.g. Helsinki). This leads to considerable variations in day length between Northern and Southern Europe. In the north, on the shortest day of the year (winter solstice), Riga and Stockholm for instance get no more than six hours of sunlight, and Helsinki even less. By contrast, at summer solstice, the sun is out in Helsinki for almost 19 hours. Day length is more balanced in the south: for instance, Athens and Lisbon enjoy approximately 15 hours of daylight at summer solstice, and still 9½ hours in mid-December.[17] DST cannot alter the total hours of daylight (day length) a place gets at a specific time of the year, it can only shift the time when sunrise and sunset occur.

[15] All time-related data are taken from the website www.timeanddate.com.
[16] Obviously, this indication does not take into account the EU's outermost regions.
[17] Summer solstice occurs between 20 and 22 June and winter solstice between 20 and 23 December, depending on the year. The data used are for 2017, when the solstices fall on 21 June and 21 December.

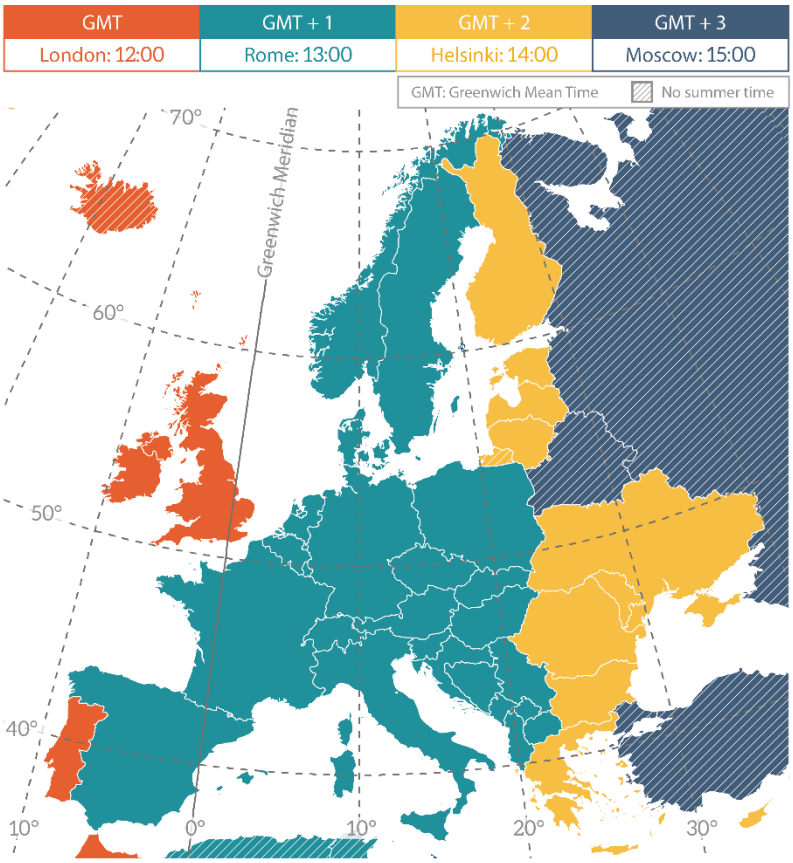
2.3.2. Longitude and time zone

Day length is just one part of the time puzzle however. The other important part is geographical longitude, which determines a place's local time. As the Earth rotates once per day around its axis, it moves at approximately 15 degrees per hour. According to the concept of solar time, it is 12 'noon when the sun is at its highest position ('zenith'), at any place of the world. In practice though, in an attempt to standardise local time, the planet has been divided into 24 time zones (24 x 15 degrees =360 degrees), the time in each differing one hour from the next.[18] Within one and the same time zone, the same local time applies, although solar time might vary considerably.

The EU stretches from 9 °W (Portugal) to 33 °E (Cyprus), and covers three time zones:

- Western European Time (WET): Coordinated Universal Time (UTC)+0, also known as Greenwich Mean Time (GMT)
- Central European Time (CET): UTC+1 or GMT+1
- and Eastern European Time (EET): UTC+2 or GMT+2.

Figure 2 – Europe's time zones[19]



Source: EPRS based on information from timeanddate.com and the European Commission

[18] This is actually a simplification; in fact, there are more than 24 time zones, because some of them are only 30 or 45 minutes apart. See https://www.timeanddate.com/time/current-number-time-zones.html.
[19] Note: Ukraine adheres to time zone GMT+2; however, the illegally annexed Crimean peninsula and the regions of Donetsk and Luhansk operate under time zone GMT+3, along with Russia. Cyprus has had two time zones since September 2016, when the northern part of the island decided to follow Turkey to GMT+3 and to abolish DST.

2.3.3. The implications of these factors for EU territory

As opposed to summer time, which is regulated by EU law, the decision as to which time zone an EU Member State should belong to is a matter of exclusive national competence.[20] In fact, some EU Member States chose to adhere to a time zone that does not correspond to their 'natural' time zone exactly (according to the logic of the 15 ° longitude division). This is the case for instance with Spain, France and Belgium, which observe a standard time that is de facto one hour ahead of their natural solar time. Consequently, for these countries, the effect of summer time is more pronounced.[21] This may explain why opposition against summer time has traditionally been stronger in France than in other EU countries.[22]

The aforementioned standardisation of local time (through time zones) and countries' choice of time zone is the reason why the moment of sunrise or sunset can differ greatly in places that are located at a similar latitude and within one and the same time zone. This is the case for instance with Brest, a port in Brittany (France) and Košice in Eastern Slovakia. They share the same latitude (48 °N), but are located at the opposite extremes of their time zone (GMT+1): Brest is at 4 °W and Košice at 21 °E. This means that although their clocks show the same local time, there are 1¾ hours of time difference in their respective times of sunrise and sunset at any time of the year, regardless of the season.[23]

The comparison between Brest and Košice is admittedly an extreme example. Nonetheless, time differences of roughly one hour between two places situated at the same latitude and within the same time zone are common within the EU. Examples include

- Amsterdam (4 °E) and Warsaw (21 °E), both at a latitude of 52 °N; and
- Paris (2 °E) and Vienna (16 °E), both located at a latitude of 48 °N.

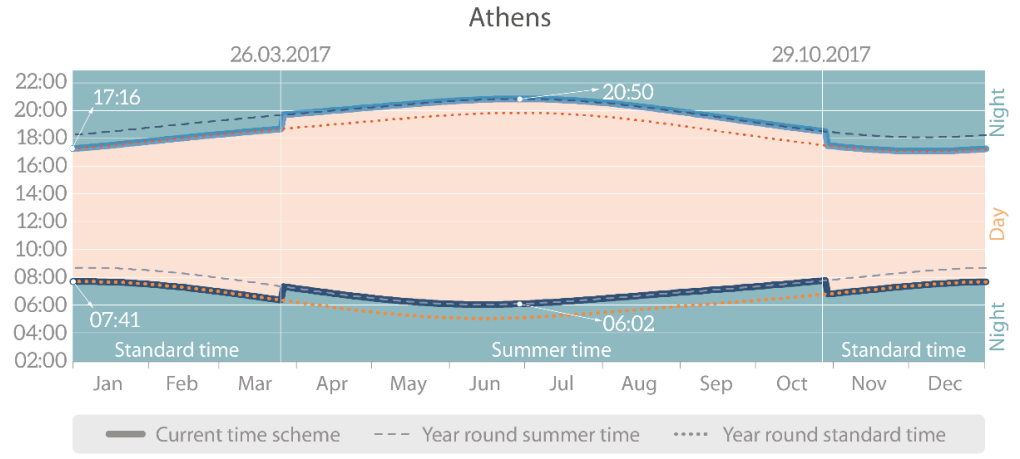
This interplay of latitude, longitude and time zone is also the reason why, in places that are geographically as different as Lisbon, Warsaw, Bucharest and Vienna, the sun sets at approximately the same moment on the day of the summer solstice (at around 9 p.m.) In Athens, on that very same day, the sun goes down even earlier, at 8.50 p.m., under observance of summer time. Without DST, the night would fall over Athens even earlier than 8 p.m. on the longest day of the year. This would also be the case for Ljubljana, Bratislava, Rome, Budapest and Valletta[24] – despite the fact that most of these cities are located significantly further north than Athens. The most extreme case is Nicosia, where the sun would set shortly after 7 p.m. under permanent standard time (i.e. winter time). This could impact on tourism, leisure pursuits, the service sector and people's well-being.

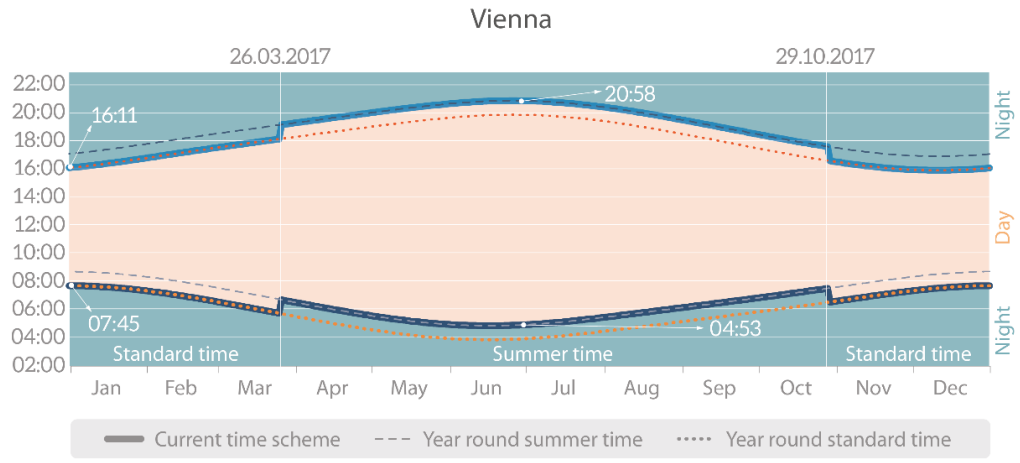
The aforementioned examples show that the effect of summer time on evening daylight is not limited to Southern Europe, but is also very tangible in more centrally located parts of the Union. Conversely, in northern countries, where summer days are in any case bright until the late evening, DST delays the sunset still more. This is particularly pronounced in

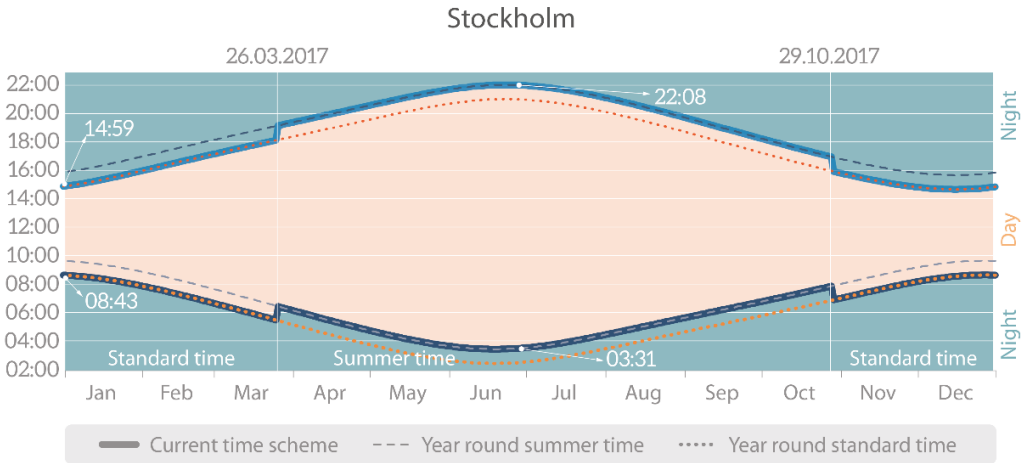
[20] This is reiterated in the explanatory memorandum of the 9th Summer-Time Directive: 'time arrangements normally in force in the Member States, or in other words those applying outside summer time, continue to be solely the purview of the Member States'.
[21] This is elaborated in Research voor Beleid International, pp. 2-4.
[22] Cf. Research voor Beleid International, p. 11.
[23] On 21 June 2017, the sun rose in Brest at 6.16 a.m., compared with 4.32 a.m. in Košice. Sunset that day was at 10.22 p.m. in Brest and at 8.41 p.m. in Košice.
[24] In descending order.

Helsinki and Tallinn (sunset at 10.49 p.m. and 10.42 p.m. respectively on 21 June). But also a number of other capitals in the north and north west have long daylight hours: in Riga, Stockholm and Amsterdam night falls after 10 p.m., and in Brussels, Vilnius, Copenhagen, Paris, Dublin and Madrid just before 10 p.m. around the summer solstice (see Annex 2).

How divergent the pattern of day length and the time of sunrise and sunset is in the different EU countries in the course of a calendar year is exemplified in the three graphs below for Athens, Vienna and Stockholm. The graphs also give an idea of the day and night pattern for the hypothetical case of year-round summer time and year-round winter time.







Source: EPRS, based on data from timeanddate.com and inspired by the TAB Office of the Bundestag.

3. Activities of the EU institutions

3.1. Commission studies and reports

Over the years, the European Commission has contracted out a series of studies to inform Community legislation on summer time, and in particular the proposals for the successive directives. These include:

- Policy Studies Institute: Summer time in the European Community, 1989;
- David Simmonds Consultancy (DSC): Summer time in the European Community: evaluation of the costs of different dates for return to winter-time, 1993;
- ADAS: Summer time in Europe, 1995 ;
- Research voor Beleid International: Summer time: thorough examination of the implications of summer-time arrangements in the Member States of the European Union, 1999;
- ICF International: The application of summertime in Europe, 2014.

The **DSC study** (1993) examined the impact of having different dates for returning to winter time (as was the case with the UK and Ireland at the time) and of the costs incurred. It provided input for the proposal for the seventh directive[25] (explanatory memorandum).

The **ADAS study** (1995) fed into the Commission proposal for the eighth directive.[26] It looked into the impact of summer time on various sectors (including energy consumption, public health, working conditions and lifestyles, agriculture, road safety and the tourism and leisure industries) and comprised a consultation of stakeholders and Member States. On the basis of the study, the Commission found that all sectors consulted agreed on the need for full harmonisation of summer-time arrangements.[27]

The aim of the study out-sourced in 1999 and carried out by **Research voor Beleid International** was to inform the Commission's proposal for the ninth Summer-Time Directive.[28] It examined the impact of summer time on the main economic sectors as well as on health and leisure, using a country-by-country approach. The study produced the following results for the various sectors:[29]

- The questionnaire (sample: 600 respondents from 15 countries) evidenced strong support for maintaining the summer-time status quo.
- In the agricultural sector, there was little discussion about summer time, as technical progress and modernisation had attenuated prior concerns.
- For the environment, the various studies examined came to differing results; 'to draw universally conclusions […] on the basis of these estimations seems to be impossible'.
- The study found a positive – albeit modest – effect on the energy sector.
- In the tourism, recreation and leisure sector, it 'proved 'almost impossible to base any conclusions […] on clear, hard evidence'.

[25] Proposal for a seventh Council Directive on summer-time arrangements, COM(93) 439.
[26] Proposal for an eighth directive on summer-time arrangements, COM(96) 106.
[27] Explanatory memorandum of COM(96) 106, point 3.
[28] Proposal for a directive on summer-time arrangements, COM(2000) 302.
[29] All quotations are taken from the study's executive summary (published separately).

- For the sector transport, communication and road safety, the study identified a slight reduction in traffic accidents on the positive side, but 'some inconvenience and extra cost' for train and air transport, however conceding that most problems had disappeared with the harmonisation of summer time.
- With regard to health, the study found both positive and negative effects, in particular increased exposure to sunlight and outdoor activities, versus disturbed biorhythm and sleep patterns during the spring time transition. The study concluded that it nevertheless appeared that the body adjusted within days or a maximum of two weeks, so 'that the negative effects disappear rather quickly and do not endanger health'.
- The effects on the industry sector appeared to be very modest, and the construction sector warned against extending summer time into the winter, as 'frost and darkness would be counterproductive and hazardous for workers'.
- And finally, for the trade and services sector, effects appeared not to be strong; though the study revealed a positive effect on consumer behaviour.

These findings were summarised *in extenso* in the explanatory memorandum of the proposal to the ninth directive. In terms of an overall conclusion, the study stated that 'in most countries and most sectors the summer-time clock is a non-issue' (executive summary, p. 55), and that in many areas it was impossible to draw definite conclusions. It found that 'hard (quantitative) evidence' was lacking, and therefore recommended 'that more energy be given to an EU-wide collection of comparable and reliable detailed data', notably in the transport, health and tourism sectors. Against this background, it drew a 'first cautious conclusion' that 'there does not seem to be a strong argument against the continuation of the current summer-time arrangements' (p. 56).

The findings of the 1999 study deserve such detailed attention because they were partly reused in the **Commission's first implementation report of 2007.**[30] Indeed, Article 5 of Directive 2000/84/EC required the Commission to report by the end of 2007 on the impact of summer time 'on the sectors concerned'. Under this obligation, the Commission issued its brief summary report in November 2007. The conclusions were drawn on basis of three sources: information submitted by the Member States in response to their reporting duties,[31] newer studies transmitted by the Member States, and the conclusions drawn from the external study that Research voor Beleid International had carried out for the Commission precisely in preparation of the ninth directive.

In its 2007 report, the Commission declared the conclusions from the external study to be still valid, given that the input received from Member States did not counter the findings. However, the fact of using the conclusions of a study that had previously served to inform the directive's legislative debate, to later assess the effectiveness of that same directive, appears to be a major methodological weakness.

In any case, according to the Commission's 2007 report, 25 Member States provided information on the directive's impact at national level. A majority of them stressed the continued need for harmonised EU-wide summer-time arrangements; in this respect, a

[30] Commission communication under Article 5 of Directive 2000/84/EC on summer-time arrangements, COM(2007) 739.
[31] Pursuant to Article 5 of Directive 2000/84/EC the report was to be drawn up 'on the basis of the information made available to the Commission by each Member State by 30 April 2007 at the latest'.

particular emphasis was placed on transport policy. Most importantly, none of the responding governments expressed a desire to change the current scheme. Only Belgium stated that, whilst being in favour of the current arrangements, it would also be open to switching to year-round summer time. From the report it appears that Member States did not raise any negative effects of summer time. On the contrary, two Member States highlighted the positive effect of summer time on specific sectors, notably on tourism/leisure (Latvia) and the construction sector and agriculture (Italy). The report also considered a number of studies that individual Member States had provided, relating to the impact of summer time on energy, road safety and health, as well as the results of some national opinion polls.

Overall, the Commission concluded that 'summer time has little impact and the current arrangements are not a subject at the forefront of people's minds in the EU Member States', and that the provisions laid down by Directive 2000/84/EC 'continue to be appropriate',[32] even more so, as no Member State had called for changes. Consequently, it saw no need to propose any adjustments to the directive.[33] The Commission also upheld this argument in response to numerous written questions asked by Members of the European Parliament.[34] The 2007 report is the latest official Commission document examining the implications of the EU's DST arrangements.

However, the Commission ordered another external study in 2013, for which it sought expert input on the impact of summer time on a hypothetical scenario: it looked into the implications that asynchronous summer-time arrangements would have across the EU. According to the terms of the tender,[35] the contractor had to examine the two following questions:

- What is the potential impact of no longer having a harmonised summer-time arrangement?
- Would the absence of a harmonised summer-time arrangement have a specific influence on the functioning of the internal market? What would be the impact on citizens and businesses?

This study did not therefore set out to judge whether the application of summer time as such was a valid public policy objective, but targeted solely the harmonisation aspects, and the implications a lack of harmonisation would have. The study was drawn up in 2014 by the consultancy **ICF International**,[36] following a consultation of Member States and stakeholders (representing both businesses and citizens) and a literature review of the latest research. The study concluded that the 'harmonised approach provided by the EU Directive is assumed to provide benefits the internal market of goods and services. Compared to an asynchronous arrangement it provides lower costs, greater convenience and improved productivity'. Abandoning the uniform scheme 'has the potential to

[32] COM(2007) 739, p 8.
[33] Article 5 of the directive stipulates that 'Commission shall, if necessary and following the conclusions of the report, make appropriate proposals.'
[34] For instance: E-006095/2014, E-004523/2013, E-009802/2011 and E-9209/2011.
[35] Contract reference N° MOVE/A1/2013-310/SI2.
[36] The application of summertime in Europe: a report to the European Commission Directorate-General for Mobility and Transport (DG MOVE), ICF International, September 2014.

inconvenience large numbers of people. The likely effects are most visible in the transport sector […] but are likely to extend across business and everyday life' (p. 48).

One interesting aspect of the study is the low response rate to the consultancy's questionnaires: from amongst the EU governments, only 18 provided feedback; moreover, of the 230 stakeholder organisations ICF International contacted only 26 were available for interview. The consultancy considered the low response rate as indicating a certain degree of indifference towards the topic, which in itself may be interpreted as overall satisfaction with the status quo.

A **further Commission study is currently in progress**, set to be ready 'in the course of 2017'. It was announced in October 2016, during a plenary debate at the European Parliament, as an in-house examination of the implications of summer time, based on available evidence.[37] If and what kind of follow up this study will entail is yet to be seen, as the Commission stated in January 2017 in response to a parliamentary question: 'It would be premature to conclude at this stage whether or not this could lead to further studies or to an impact assessment.'[38]

3.2. European Parliament

3.2.1. Discussion of the directives

Since the Treaty of Maastricht (1993), the EU summer-time directives have been adopted under the co-decision procedure, with the European Parliament acting as co-legislator. This concerns the seventh, eighth and current ninth directives.

Parliament's first reading report on the eighth directive (A4-0333/96; rapporteur: Spalato Bellerè, NI, Italy) endorsed the principal objective of the proposal, namely full harmonisation of the summer-time period for the proper functioning of the internal market. However, Parliament tried to amend the proposal in such a way that the harmonised summer-time scheme would be non-mandatory, i.e. allowing Member States to decide not to observe DST. To this end, the report proposed to add twice the wording 'where applicable'. Parliament reasoned that summer time was more beneficial in southern Europe, where days in summer are shorter, whilst in northern Europe DST effects are different. The Council and the Commission rejected the rapporteur's view that the decision on whether or not to apply DST should fall within the purview of the Member States. The Council regarded the amendments even as contrary to the main aim of the directive, arguing that an opt-out by some Member States 'might lead to serious disruption in the transport and communications sectors, similar to that caused by the absence of harmonisation'.[39] This issue was subsequently clarified in the proposal on the ninth directive (explanatory memorandum), which explicitly states that the directive is binding in its entirety for all Member States (see Chapter 1.3.).

From the Bellerè report it appears that, at the time, Parliament had an overall positive attitude towards summer time. The report makes reference to favourable public opinion and positive effects on energy savings, tourism and leisure activities. It however raises

[37] Commissioner Tibor Navracsics in the parliamentary debate of 27 October 2016 on the switch between summer and winter time.
[38] Written question E-008237/2016, answer by Commissioner Violeta Bulc, 23 January 2017.
[39] Statement of the Council's reasons, Common position No 19/97, OJ C 157, 24.5.1997, p. 8.

concerns about negative impacts DST may have on human health, in particular on sleeping patterns owing to the disruption to the circadian rhythm, but considered these effects to be 'temporary and negligible'.

In the legislative procedure regarding the adoption of the ninth directive (A5-0356/2000; rapporteur: Mary Honeyball, S&D, UK), the competent committee (TRAN) voted in favour of an unmodified Commission proposal. However, the report contains a minority opinion that recommends a regular rather than a one-off review of the directive (every five years).

Parliament has not adopted any formal view on DST since the Honeyball report, however, in recent years a number of individual Members across political parties have expressed a critical view towards summer time. In the current legislative term, to date, Members have addressed three questions for oral answer and almost 20 written questions to the Commission. Some of the latter call overtly for a repeal of Directive 2000/84/EC. Parliament's recent activities related to summer time include two parliamentary debates in plenary, on 29 October 2015 and on 27 October 2016 respectively, and a joint public hearing held by the JURI, TRAN and ITRE committees on 24 March 2015.

3.2.2. The public hearing of 24 March 2015: the issues at stake

The public hearing held in March 2015 ('Time to revisit summer time?')[40] was broad in scope, with expert presentations covering the aspects of road safety, health, better law-making and energy. First, the Commission representative recapped the rationale behind the Summer-Time Directive as well as the conclusions of the 2007 implementation report and the 2014 study, stressing that 'the directive is an essential instrument in guaranteeing harmonised time-tables that ensure the proper functioning of the internal market'.

An expert on road safety brought forward statistical evidence (based mostly on UK data) for DST's favourable impact on road accidents. He presented data showing that lighter afternoons and evenings lowered the crash risk, a factor that was only partially outweighed by the higher accident risk owing to darker mornings and increased evening travel activity. However, the expert emphasised that the impact may diverge in some parts of the EU, depending on geographical location, since the effects of DST were not even across the EU, as Chapter 2.3 shows. In the discussion, Members also recalled other studies that had come to contradictory conclusions.[41] The expert conceded that it was not always easy to establish causality (i.e. to prove whether the effect could be attributed directly to the clock change or whether other external factors played a role).

In the expert contribution on the impact of DST on the human body clock ('circadian rhythm') a chronobiologist explained the interplay between light and darkness and the internal biological clock of all living organisms, including the human body. The underlying 24-hour rhythm arises from the rotation of the Earth. The speaker elucidated the concept of 'social jetlag': adjusting the daily rhythm to social schedules (e.g. work or school) in ways that do not correspond to a human being's internal body clock leads to social jetlag, an effect that is comparable to the jetlag experienced when travelling through time zones. Its

[40] The recording of the hearing is available under: http://www.europarl.europa.eu/ep-live/en/committees/video?event=20150324-1600-COMMITTEE-JURI-TRAN-ITRE.

[41] They referred for instance to: Jason Varughese and R P Allen, 'Fatal accidents following changes in daylight savings time: the American experience', in *Sleep medicine* 2(1), 2001, pp. 31-36. This study reported a small increase in fatal road traffic accidents on the day following the clock change.

manifestations are chronic sleep deprivation, fatigue and lack of concentration. According to chronobiological research, social jetlag can impact on the human metabolism by for instance triggering weight problems or depression and is also associated with nicotine, alcohol and caffeine addiction. On top of the acute (temporary) effect that putting the clocks forward has on health (e.g. accidents and heart attacks), there is, according to the expert, also a scientifically proven long-term effect of chronic social jetlag, which entails health issues and performance deficits because the body clock does not respond to DST changes.

In the following, Members heard an expert who looked at the Summer-Time Directive from the point of view of the 'better regulation' initiative. He recognised that the directive predated the Commission's obligations under the 'better regulation' guidelines. Nevertheless, he argued that the directive's justification (outlined in the explanatory memorandum of the Commission proposal) showed considerable weaknesses and would not stand up to today's law-making standards. He criticised in particular the justification in terms of choice of legal basis, proportionality and subsidiarity as 'unconvincing', claiming that notably the justification for the legal basis had little to do with Article 114 TFEU (harmonisation of national law for the internal market). Furthermore, he advocated a 'higher standard of ex post evaluation and this perhaps on a returning basis'. The 'better regulation' dimension is discussed further in Chapter 7.

Finally, in the hearing's last contribution, an energy expert reported that the energy saving effects of DST were negligible.

In the discussion, Members tended to agree that the issue that caused inconvenience was the changing of the clocks rather than the application of summer time per se. They questioned the purpose of the clock change in the light of scientific research that appeared to show little or no benefits/gains, and called on the Commission to undertake a robust review of the summer-time issue that would be based on solid data and facts and stand up to scientific criteria.

In the course of the hearing, a discussion emerged on the potential abolition of DST EU-wide and its consequences. Much attention was paid to discussing procedural options. In this context, the Commission representative emphasised the Commission's obligations under 'better regulation' policy: putting forward a proposal for repeal would imply a fully-fledged impact assessment that would explore the various options; and above all, it would need to be based on solid evidence (data and facts). The Commission speaker took a cautious view regarding a repeal of the directive, warning of the potential risk that individual Member States might still unilaterally wish to maintain DST in their countries. This could lead to a situation of uncoordinated DST schemes similar to that which existed before summer time was harmonised. In that context she recalled the conclusions of the aforementioned 2014 study by ICF on the implications a non-harmonised approach would have. Moreover, the Commission representative put the actual need for change into question, arguing that businesses appeared to be satisfied with the current status quo.

Repealing the Summer-Time Directive would indeed have certain implications. It would not automatically abolish summer time across the EU Member States, but would just end EU-wide harmonisation and bring the issue of DST back to the competence of the Member States. They would then be free to decide about their individual time regimes. Individual Member States, in particular those where the sun sets early in summer, might opt to retain

DST, with a timetable that suited their geographical positions best. Others might opt to abandon summer time altogether. Abolishing summer time would in the first place result in year-round standard time ('winter time'), which by nature entails darker evenings in spring and summer. To obtain year-round summer time, as is sometimes suggested as the preferred alternative, Member States would technically need to change time zone. (The choice of time zone is the exclusive purview of the Member States and thus outside EU competence.) Therefore, a repeal of Directive 2000/84/EC bears a risk of fragmented time arrangements across the EU, unless a new EU measure prevented such national action. An uncoordinated time scheme would likely have negative repercussions on the internal market.

3.2.3. Plenary debates based on oral questions

The European Parliament hearing was followed up by two plenary debates in October 2015 and October 2016, which took the form of questions for an oral answer to the Commission. On both occasions a majority of speakers across the political groups voiced dissatisfaction with the Commission's non-response to some of the findings of the hearing. Members argued that the initial reasons for introducing and subsequently maintaining DST may be outdated and urged the Commission to take account of new scientific evidence, in particular in the area of health and the economy. No Parliament resolutions were voted after these debates.

Members appeared to agree on the need for harmonised time arrangements across the EU, but, with only few exceptions, most spoke out against the clock change. Some Members emphasised that, should the Commission come up with a proposal to repeal the existing directive, Member States would need to agree on a uniform time arrangement (permanent summer time or permanent winter/standard time). In this context, the particular situation of certain Member States was evoked, where the local time (time zone) does not correspond to the meridian and which are therefore ahead of their natural time (see Chapter 2.3.).

4. Member States' views

The Commission's monitoring report from 2007 states that 'no Member State has expressed a wish to abandon summer time or change the provisions of the current directive'.[42] This still appears to be valid: in the aforementioned parliamentary debate of October 2016, Commissioner Navracsics reiterated that 'the Commission has not received any official requests from the Member States on the issue of summertime or wintertime'.

The 2014 study by ICF International also sought to gather Member States' views. The study reported that no Member State was pushing for reform. Furthermore, one survey question related to possible alternatives. To that end, the consultancy asked Member States what kind of summer-time arrangements they would consider if Directive 2000/84/EC were not in place. In response to this question, 11 governments (out of 18 respondents in total) stated that they were not considering any other summer-time arrangements; and five governments replied that they might consider alternative summer-time arrangements, if there were no harmonisation under EU law. The suggested alternatives included:

[42] COM (2007) 739, p. 8.

- working out a different (shorter) DST time-table, tailored to a country's de facto daylight periods and thus adapted to its geographical latitude;
- applying summer time all year round;
- agreeing to apply summer time across the entire EU; and
- abandoning summer time in specific Member States, thus applying standard time throughout the year.[43]

A small number of individual Member States' parliaments are reported to have taken initiatives – legislative and non-legislative – relating to summer time'. However, although these parliamentary initiatives evidence some opposition to the current summer-time scheme, they do not represent governments' official views. Examples are provided below:

- In the British parliament, debates and legislative proposals emerge regularly. The British Government explicitly stated at the end of 2015 that it had no intention of changing the status quo in the UK, given the fact that there is no UK-wide consensus on the issue and that it had not made any recent assessment of the potential benefits.[44]
- In 2015, the Lithuanian Seimas passed a resolution[45] touching upon the question of subsidiarity. Backed by a large majority, the resolution called on the Lithuanian government to submit a proposal to the European Commission that summer time should be brought back to the competence of the Member States. It argued that it would be more favourable to public health if time arrangements were adjusted to the geographical location and the time zone of a country. However, following consultation within the ministries concerned, the government decided in March 2016 not to refer the issue to the European Commission.[46]
- In October 2016, the regional parliament of the Balearic Islands voted an initiative to remain on summer time all year long. However, the Spanish government made it clear that the Balearics could not unilaterally modify the summer-time arrangement.[47] This would be in breach of Directive 2000/84/EC.
- Most recently, in June 2017, the German Bundestag voted down an opposition group's motion to abolish summer time.[48]

5. Public opinion

5.1. Surveys

A lack of recent EU-wide polls or surveys makes it difficult to assess public attitudes towards summer time across the EU. The last Eurobarometer surveys relating to summer time were conducted in the 1980s and 1990s. At the time, advocates of summer time prevailed by far over opponents: in 1988, over two thirds of Europeans (68 %) were in

[43] Cf. ICF study, pp. 5-6 and 28.
[44] Oliver Bennett and Hannah Cromarty: British Summer Time. House of Commons Library briefing paper. 10 March 2016, p. 10 ff., and written question PQ 19740.
[45] Seimas press release: Seimas suggests the Government should submit a summer time proposal to the European Commission. 26 November 2015.
[46] Information obtained by email from the Office of the Seimas, 2 October 2017.
[47] 'Baleares pide al Gobierno no retrasar la hora', *El Mundo*, 25 October 2016.
[48] See *Das Parlament*, No 26, 26 June 2017, p. 11 ('Uhren müssen auch in Zukunft umgestellt werden.')

favour of summer time, and 23 % against.[49] In 1990, 57 % of people declared themselves satisfied with summer time, as opposed to 26 % who expressed non-satisfaction.[50] However, these surveys are outdated and no longer representative, given that they date from a time when the EU had only 12 Member States.

Recent opinion polls conducted in different Member States suggest a change in public attitudes towards summer time in some countries. The German polling institute Forsa, for instance, conducts regular DST polls for a health insurance company. They evidence increasing opposition to summer time in Germany: in 2017, 74 % of respondents stated they would prefer summer time to be abolished (compared with 73 % in 2015 and 69 % in 2013).[51] In France, a 2015 survey saw a majority of 54 % opposed to the clock change (compared with 17% in support of DST).[52] High levels of dissatisfaction with summer time are reported also for Latvia, where an opinion poll from 2014 suggested a rejection rate of 76 %.[53]

Conversely, in the UK, the 2017 YouGov poll found that 50 % of British citizens were in favour of continuing to apply DST, while 38 % thought it should be abolished. Support for DST was even higher in Scotland (58 %).[54] The 2014 study by ICF International also provided some indications on public opinion. The consultancy asked the Member States about their perception of public satisfaction regarding the harmonisation of summer time. It reported that 10 of the 18 responding governments saw their citizens as either in favour of DST or neutral to the question, as opposed to three governments that estimated public attitude in their respective countries to be negative.[55]

The aforementioned surveys reflect the situation for individual Member States, but they do not allow valid conclusions to be drawn for the EU-28. Testing the assumption of summer-time fatigue would require representative, current and EU-wide survey data.

5.2. Petitions and citizens' initiatives

Other public opinion indicators include petitions and citizens' initiatives. Summer time is indeed a recurring topic in the work of the European Parliament's Petitions Committee (PETI). According to Parliament's petitions database, roughly 100 subject-related petitions have been received since 2006, incidentally most of them from German citizens. Most petitioners advocate the abolition of summer time, arguing primarily on the basis of health concerns. Some petitioners maintain that the clock change has a particularly negative impact on vulnerable groups, such as children and the elderly. Given that abandoning

[49] According to Eurobarometer No 29/1988 (p. 72 and table A24), 47 % of Europeans were in favour of applying DST during the summer months, an additional 21 % would have liked to see summer time introduced all year round, as opposed to 23 % opposed to summer time and 8 % who did not express a preference.
[50] 32 % of people indicated that they were 'very satisfied' and an additional 25 % 'fairly satisfied', as opposed to 10 % of people declaring themselves 'not very satisfied', and 16 % 'not at all satisfied'. A further 17 % remained indifferent on the subject. (Eurobarometer 33/1990).
[51] Forsa: Meinungen zur Zeitumstellung, Summary of results 2017 and 2015.
[52] OpinionWay survey results 2015.
[53] ICF International, p. 23.
[54] YouGov survey results 2017.
[55] ICF International, p. 23. The remaining five Member States either did not reply to the question or stated that they did not know.

summer time would result in year-round standard time ('winter time'), some petitioners suggest switching to permanent summer time instead, which would bring about brighter mornings in winter. PETI has discussed DST-related petitions in its committee meetings, for instance in July 2015.[56]

Most petitions are submitted by individual citizens. However, some are co-signed, in exceptional cases by thousands of citizens. A collection of signatures is currently ongoing in the Netherlands, for the petition 'Abolish daylight saving time', which is set to be submitted to the European Parliament by the end of October 2017. At the time of writing this in-depth-analysis, the petition had gathered close to 40 000 signatures. Similarly, a German petition addressed to the Bundestag that aimed to end DST[57] was co-signed by 55 000 citizens in 2013 and was apparently forwarded to the European Parliament.

Summer time is also reported to be a recurring issue for Parliament's Citizens' Enquiries Unit (AskEP), which recorded some 110 questions from individual citizens between January 2015 and June 2017. Citizens voice almost unanimous dissatisfaction with the clock change, with some even calling for its abolition.

Summer time has not to date been the subject of a European Citizens' Initiative.[58] However, national citizens' initiatives exist. In June 2017, for instance, a Finnish citizens' initiative[59] aimed at abolishing DST and signed by 70 000 people was handed over to the Finnish Parliament (Eduskunta). It is currently being dealt with at committee level.[60]

The EU's summer-time arrangements have even been the subject of a court case before the Court of Justice of the European Union (CJEU): in 2001, just a few months after the adoption of Directive 2000/84/EC, a French non-governmental organisation (NGO) representing citizens opposing the biannual clock change ('Association contre l'heure d'été') lodged an action before the Court seeking the annulment of the directive. The Court of First Instance dismissed the application as inadmissible, reasoning that the members of the NGO were 'not directly or individually concerned by that directive'.[61]

To conclude on public opinion, there are obviously a number of initiatives that reflect a certain degree of dissatisfaction with DST amongst EU citizens. However, although these voices must be taken seriously, their representativeness is to be assessed with caution, since summer time is a typical issue on which opponents tend to speak out, whilst those who are in favour of longer daylight during summer evenings and those who are indifferent tend to keep silent. As said above, it would require a specific EU-wide survey (Eurobarometer) to obtain an objective picture of citizens' attitudes.

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[56] See the minutes of PETI meeting of 14 July 2015, agenda point 9.
[57] Petition 'Beibehaltung der Normalzeit – Abschaffung der Sommerzeitverordnung'. This petition is addressed to the German Bundestag, but the Bundestag's petitions committee has adopted a policy of forwarding petitions related to summer time to the European Parliament (see press release, 5 November 2014), arguing that changes to the current summer-time arrangements are possible only at European level.
[58] A European Citizens' Initiative can ask the Commission to table a legislative proposal, if it finds the support of at least one million European citizens.
[59] Citizens' initiative to dump daylight saving time heads to Finnish lawmakers, Yle.fi, 8 June 2017.
[60] Information obtained by email from the Finnish parliament, 10 October 2017.
[61] T-84/01 – Association contre l'horaire d'été (ACHE) v Council of the EU and European Parliament.

6. Sectoral implications of DST: the latest research

6.1. Introduction

As is clear from above, much has been said and much research carried out on the impact of summer time on the various sectors and issues. Yet, the multitude of studies on specific aspects and related meta-studies could in many areas not provide definite conclusions. Sometimes, results are even contradictory.

As described in Chapter 3.1., the European Commission has contracted out several major studies over the years to inform decision-making relating to the EU's summer-time legislation. Contractors have reviewed the existing literature and complemented it with their own surveys and stakeholder consultations; yet, for many sectors it has proved difficult to draw clear conclusions. The Commission's last official report dates from 2007; it was the review mandated by the directive's monitoring provision. To recall, it concluded that overall 'summer time has little impact'; clear benefits could be identified only in very few areas.

This 2007 Commission report was the starting point for a major research project carried out by the Office of Technology Assessment at the German Bundestag (TAB), an independent science institution that advises the German Bundestag and its committees on questions of scientific and technological change. The ensuing research report 'Bilanz der Sommerzeit'[62] was published in February 2016 and is (to date) available only in German. It is the most comprehensive study ever undertaken on the topic of DST. It is referred to below as the 'TAB report'. The study departed from the assumption that there have been changes in the contextual environment in some areas since the Commission's 2007 assessment, such as:

- shifts between economic sectors, new employment schemes;
- changes with regard to mobility;
- changes in leisure behaviour; and
- changes in energy efficiency (including solar energy and light bulbs).

The project team examined the available evidence (scientific and non-scientific) that has been published since 2007 and compared the conclusions with the findings from before 2007. Moreover, to complement the evidence base, it consulted representative organisations and experts. In addition, it carried out model simulations in the area of energy. The central question was whether the Commission's overall conclusions from 2007 on the impacts of DST are still valid, or whether a substantial reassessment is to be recommended.

[62] Claudio Caviezel and Christopher Revermann, Bilanz der Sommerzeit: Endbericht zum TA-Projekt, TAB, Office of Technology Assessment at the German Bundestag, Report No 165, February 2016, English summary available ('Assessment of daylight saving time').

Not only does the TAB report compare the findings of a multitude of studies, but it also critically examines the methodology underlying each research paper. It thereby shows that in many cases seemingly contradictory results are owing to different methodological approaches (e.g. short-term impact on the day following DST transition versus longer-term impacts comparing effects over several weeks, or different types of modelling). From a methodological point of view, the TAB report identifies weaknesses and gaps in the study design in some of the studies examined (e.g. very small samples). Furthermore, it argues that there is a lack of transnational comparative studies, which would take into account 'cultural, mentality-related, socio-economic and geographical aspects'.

TAB's research report for the German Bundestag (2016): overall conclusions

'Altogether, it can be concluded that the available scientific evidence base and state of knowledge with regard to possible implications of DST is still very limited and rather fragmentary. Nevertheless, it does not reveal any indications that the application of DST would induce serious positive or negative implications for energy consumption, economy or health. In this respect, the question whether the current DST arrangements will be maintained, amended or abandoned will continue to be – for the foreseeable future – the subject of political and public debates which can rely on scientific facts only to a very limited extent.' (English summary, p. 4)

This chapter draws largely on the TAB assessment for the German Bundestag. It sums up the findings of the TAB report and adds recent research findings, wherever appropriate and available.

6.2. Internal market

The main objective of the summer-time directive was to ensure the proper functioning of the internal market by harmonising national provisions on DST beginning and end dates. This concerned mainly the transport and communications sectors, but also other sectors of industry. The extension for an 'unspecified period' (Article 4 of the directive) was justified by the 'stable, long-term planning' the various sectors required.

Member States had to transpose the directive into national law by 31 December 2001. No problems have been reported regarding the transposition and application. The internal market objective appears to have been fully achieved through the harmonisation measure. The benefits of DST for the internal market may not be obvious; however, the costs in the absence of harmonisation would likely be substantial, as was demonstrated in the study that ICF International (2014) carried out for the European Commission. It examined the hypothetical implications a non-harmonised summer-time scheme would have, notably on the functioning of the internal market and concluded that an asynchronous arrangement would generate higher costs, greater inconvenience and lower productivity, notably in the internal market for goods and services. (p. 48).

6.2.1. Transport

Cross-border transport and logistics was one of the sectors that benefited most directly from EU-wide harmonisation of the summer-time schedule.[63] Prior to that, extra costs occurred for adjusting schedules and timetables. With harmonisation, the formerly recurring costs for the multi-party DST readjustments of schedules for international transport connections became one-off costs. By way of example, one argument for harmonisation with the UK (and thus Ireland, which was in sync with the UK) was the 1994 opening of the Channel Tunnel connecting the UK with Europe's mainland.

The timetable adjustment process under the Summer-Time Directive is now automatic, owing to timetabling software. There are however inconveniences linked to rail transport connections on the very day the clocks are changed; these affect transport operators and passengers alike. When clocks are put forward in spring and one hour is effectively skipped, thorough planning is needed to ensure that train schedules do not overlap. When the clocks are put back in autumn, the night of the change has an extra hour. In this case, trains may either arrive one hour earlier or stop for one hour during the journey.

In air transport, it is passengers that are most affected by clock changes, as they need to be aware of the local time in order to catch corresponding flights or other means of transport. As regards air schedules, operators throughout the sector use universal time (UTC).[64]

DST changes have also an impact on freight transport, which operates to a large extent at night. Freight operators need to reschedule working hours to adjust to DST, which however appears to be a routine activity rather than a challenge. ICF International cites an EU transport representative organisation that does not see any issues with the switch to DST, as 'freight operators are well informed about summertime arrangements and are used to accommodating time changes'.[65]

No other recent research regarding the impact of summer time on the transport sector was identified.

6.2.2. Communications and commerce

Despite the fact that the recitals of the successive EU summer-time directives (including those of the ninth directive) cite communications or telecommunications – together with transport – as the sectors most affected by DST, the impact of summer time on communications is not really elaborated upon in any of the Commission's explanatory memoranda nor the studies carried out for the Commission. The first Commission proposal of 1976 (COM(76)27) makes reference to 'international telecommunications, such as social or business telephone calls', which 'may also suffer from the uncertainty which tends to result from repeated changes of the time relationship'.

Yet, technological progress in terms of information technology has substantially changed the operation of the internal market for goods and services. Information technology barely

[63] The TAB report (2016) and the two studies by Research voor Beleid International (1999) and ICF International (2014) provide a good understanding of the issues related to DST and the transport sector; the latter study also examines the implications non-harmonisation would have on transport.
[64] See TAB report, pp. 75-76.
[65] ICF International, p. 15.

existed when summer-time harmonisation began in the 1970s. There is no specific research looking into this aspect, but the TAB report concludes that today, after more than 30 years of DST practice, technical problems no longer seem to cause any concerns.[66] Technological advances have revolutionised cross-border communications since the times when summer time was harmonised across the EU (information and communication technologies (ICT), internet, email, etc.) With regard to technological progress, it may also be worthwhile mentioning that the inconvenience of physically changing the clocks has diminished, since many modern electronic devices update themselves automatically.

Similarly, in the area of broadcasting, technological advances in terms of recordable programmes and internet television (i.e. digital distribution of television content via the internet) have made television and radio programmes less dependent on the clock.

6.3. Individual economic sectors

6.3.1. Energy

In a few EU Member States, albeit not all, energy saving considerations were a decisive argument for introducing DST (notably after the 1973 oil crisis). However, they were not the key arguments for the harmonisation attempts at EU level, even if the first Commission communication on the topic (COM(75)319) thought that DST would be in line 'with the energy conservation policy to which all Member States have subscribed'.

Much research has looked into whether DST brings about energy savings, with partly mixed results. Two recent meta-studies and a paper comparing European countries conclude that DST does generate modest energy savings in Europe.

The TAB report finds that in the area of energy, the Commission's conclusions of 2007 are still valid, despite technological and behavioural changes. To recap, the Commission found that small energy savings were confirmed by quantitative studies. Overall, the Bundestag Office of Technology Assessment found that the energy impact of DST could be positive or negative, depending on the 'geographical, economic and cultural framework' of the countries the examined studies referred to (e.g. climate and the available daylight linked to the geographical location). For these reasons, results obtained in some countries might not be directly transferable to other countries. Moreover, it concluded that methodologically, it was not always possible to assign the changes to the summer-time switch (attribution bias).

The study examined various aspects:

- With regard to power consumption, marginal savings could be determined for private households in two thirds of the studies, but not for industrial consumption.
- For room heating, no significant effects could be found.
- For air conditioning, the result was not clear; it appears there are strong variations between countries owing to climate and cultural differences.

[66] TAB report, p. 79.

In addition to the Bundestag office's literature assessment, model simulations were carried out for the research project. They looked at the quantitative impact of DST on two specific aspects of power consumption in German private households:

- the use of energy efficient lighting (for which a decrease of 0.8 % in relation to annual power consumption was found); and
- the increasing use of solar energy in private households; it serves primarily for energy self-sufficiency, and in addition any excess power generated is fed into the public power grid (here, some savings were confirmed).

The slightly positive overall energy saving effects of DST for power consumption are confirmed by a seemingly methodologically sound literature review of the available research, issued in 2016 by Czech researchers.[67] They analysed a total of 44 studies from recent decades and concluded that average savings from DST amounted to 0.34 % of total energy consumption. This figure is an overall average. Individual research results varied considerably, and some studies even suggested a clear increase in energy consumption during the DST period. The meta-study attributed the result variations to the following factors: data frequency, methodology or modelling, and, most importantly, the geographical latitude of the respective country.

The latitudinal argument of the Czech study was most recently tested in a comparative analysis[68] based on a reportedly consistent data set relating to energy consumption for 35 European countries. The authors reached the following conclusion: 'We find very clearly that DST has an energy saving effect across of all Europe [sic]. The magnitude varies from less than 0.5 percent to more than 2.5 percent. Furthermore we find that latitude plays an important role in explaining differences in energy savings from DST with a larger effect of DST in southern locations compared to northern locations.' These conclusions need to be read with some caution, however, since for the time being only a conference abstract of this research work has been published.

6.3.2. Agriculture

In his monograph '*Seize the daylight: the curious and contentious story of daylight saving time*', David Prerau describes in detail the fundamental opposition of farmers in the UK and the USA alike in the early days of DST. Critics argued that farming was a sector that followed the rhythm of the sun (rather than that of an imposed clock) and that many activities could only be performed in daylight, or after the morning dew had disappeared from the fields (e.g. harvesting). Notably livestock farmers deemed DST to be incompatible with agricultural working practices, since already under standard time their day started very early. The transition to DST made it harder to get the produce or animals out to the markets. Also, farmers were concerned that DST would reduce the milk yield during the DST transition, because cows would stick to their natural milking rhythm.

[67] Tomas Havranek, Dominik Herman and Zuzana Irsova, Does daylight saving save energy? A meta-analysis, IES Working Paper 24/2016, IES FSV, Charles University, November 2016.
[68] Bergland, Olvar and Mirza, Faisal: Latitudinal Effect on Energy Savings from Daylight Saving Time. Paper presented at the 2017 annual conference of the International Association for Energy Economics, Singapore.

Modern agricultural equipment and practices have revolutionised farming in a way that makes most of these concerns no longer appear relevant. Accordingly, farmers' attitudes towards DST also appear to have changed over time. This was already reflected in the study Research voor Beleid International carried out in 1999, which in general reported 'limited interest among agricultural representatives'[69] in the topic. For instance, only just under one third of respondents to a questionnaire considered DST to be an issue.[70] The cons related mostly to the biorhythm of animals as well as to farmers' working conditions; conversely, the extra-daylight hour in the evening was welcomed for field and winery work.

Recent research specifically examining the impact of DST on the agricultural sector could not be identified. However, the 2016 TAB report provides some evidence for farmers' nowadays rather neutral attitude towards DST. A German farmers' association (Deutscher Bauernverband) reports that farmers no longer have a problem with DST, on the contrary, they benefit from longer daylight hours for working the fields and harvesting. The association dispels concerns regarding farm animals, stating that they get used to the DST schedule within a few days; also, farmers can help dairy cows by changing the milking schedule incrementally rather than all at once.[71] A positive attitude is also reported for Scottish farmers, who are overall in favour of retaining the DST status quo.[72]

6.3.3. Leisure, sports and tourism

There appears to be a general consensus that DST encourages the practice of all kinds of outdoor leisure activities in the evening (sports, cafe and restaurant activities, gardening, etc.) A preliminary study from 2012[73] for instance provides empirical data for the USA that suggests that longer daylight hours in the evening induce people to spend more time outdoors. The increased physical activity contributes to a more active social life and benefits the health and wellbeing of adults and children alike.[74] Furthermore, an empirical study from 2014[75] looking into the outdoor gain among children (aged 5 to 16) found a 'small increase in daily physical activity'.

The TAB report for the Bundestag states that it is difficult to test the assumption of positive effects, since they are difficult to measure and empirical studies that look into the relationship between DST and leisure activities are rare.

Some sources also point to one drawback of DST for parts of the leisure sector, in the sense that indoor facilities such as theatres, cinemas or sport halls appear to lose out.

[69] Research voor Beleid International, p. 73.
[70] Research voor Beleid International, p. 74.
[71] TAB report, p. 75.
[72] Bennett, p. 21.
[73] Hendrik Wolff and Momoe Makino, Extending Becker's time allocation theory to model continuous time blocks: evidence from daylight saving time, IZA discussion paper No 6787, 2012.
[74] ICF International, p. 25.
[75] Anna Goodmann [et al.], Daylight saving time as a potential public health intervention: an observational study of evening daylight and objectively-measured physical activity among 23,000 children from 9 countries, in *International journal of behavioral nutrition and physical activity*, 2014, 11:84,

6.4. Health

The potentially adverse health effects of DST have been the subject of numerous studies and debates. In fact, the spectrum of DST-related health issues is broad, encompassing short-term (i.e. during the days following the switch) and long-term effects as well as positive and negative effects.

On the downside, the internal body clock is upset during the days following the sudden clock change. This effect is comparable to the minor jetlag that results from travelling across different time zones. It usually takes the body a few days to adjust. In many cases people get less sleep. The combined effect of disrupted body rhythm and sleep deprivation has a short-term impact on concentration and cognition and may lead to fatigue, dizziness and lack of attention, and increase the risk of accidents.

The European Commission concluded in 2000 that DST adjustments in the transition period were short-term and would not pose any risk to human health. In 2007, it considered its conclusions still relevant. The TAB report examined the basis for this Commission statement and took the view that these conclusions were grounded on a rather weak evidence base.[76] Regarding health impacts, the Bundestag researchers undertook a comprehensive review of the recent scientific literature in the areas of sleep patterns, the circadian rhythm, the risk of heart attack, accidents at the work place and psychological effects (e.g. suicide rates, life satisfaction).

According to the TAB report, new scientific findings suggest that the human biological rhythm adjusts less easily to the spring clock change than previously thought. Contrary to previous assumptions, according to which the transition phase would last only a few days, newer research suggests that it may take certain chronotypes of people several weeks to adjust; some appear not to adapt at all. The effect of the fall back in autumn poses fewer problems.

As already explained in Chapter 3.2., chronobiological research indicates that the human body is scheduled according to an internal body clock ('circadian rhythm'). This biological rhythm is synchronised with the Earth's rotation, and notably with the natural cycle of daylight and darkness. The body clock regulates various physiological body functions, such as sleep patterns, hormone release or the body's metabolism. If the body clock is disrupted, for instance by travelling across different time zones, the body reacts with the typical symptoms of jetlag. Researchers found that a similar jetlag effect occurs when the clock is switched to DST, and that the body does not adjust to an externally imposed clock.[77]

The TAB report concludes that the 'relevant impact of disturbances in the biological rhythm due to time change on human health is still unclear' and recommends further in-depth research regarding the process of adaptation to the time change.

[76] TAB report, p. 90.
[77] Thomas Kantermann [et al.], 'The human circadian clock's seasonal adjustment is disrupted by daylight saving time', in *Current biology,* Vol. 17, No 22, November 2007, pp. 1996-2000.

The discussion of the effect of DST on the body clock will likely experience a boost since the 2017 Nobel Prize for Physiology or Medicine was awarded to three US researchers for their work relating to molecular mechanisms controlling the circadian rhythm.[78]

Some empirical studies look into the link between the switch to summer time and the risk of heart attacks. The TAB report compared the findings of seven research papers (from 2008 to 2015), which did not reveal a consistent pattern. Some found an increased risk associated with the spring DST change, while others suggested there was no such effect. A recent German study,[79] based on a broad sample, concluded that the DST transition did not have any influence on the incidence of heart attacks. Conversely, a recent empirical study from Finland analysing the correlation of DST and ischemic strokes found an increased stroke incidence during the first two days following the DST switch.[80]

Relatively few studies highlight the beneficial health effects of DST.[81] On the positive side, DST has favourable long-term effects for general well-being throughout the entire DST period, as people benefit from the longer daylight in the evening with increased outdoor activities after work or school. Sports and exercise in fresh air in general is deemed to be good for physical and mental wellbeing, and in addition, they counter weight problems and obesity. However, on the downside, more sports lead also to more leisure time accidents. Exposure to sunlight benefits the body's creation of vitamin D (sunlight is the main source of vitamin D, which supports calcium absorption in the bones), but it also raises the risk of exposure to UV radiation. In this context, the TAB report recalls that the risk of UV rays is highest when the sun is at its zenith. This generally happens at 12 noon solar time; however, depending on geographical factors (time zone and the exact position within the time zone) this can actually be much later in local time (as late as 2 p.m. in Madrid or Paris, under DST).[82]

In a more general final comment, the TAB report relativises the discussions about the health implications of DST by evoking the masses of shift workers, who are, often over decades, exposed to constant disruption of the biorhythm. Compared with the impact of shift-work schedules it considers the effects of the twice-a-year clock change from and to summer time to be negligible.

6.5. Safety

6.5.1. Road safety

There has been quite some research into the question of whether there is a direct relationship between DST and road traffic accidents. As opposed to many other research areas, studies on road safety avail of accurate data (detailed accident statistics). Thus, DST

[78] Jeffrey Hall, Michael Rosbash and Michael Young, See press release of the Nobel Prize Committee, 2 October 2017.
[79] Inge Kirchberger [et al.], 'Are daylight saving time transitions associated with changes in myocardial infarct incidence? Results from the German MONICA/KORA Myocardial Infarction Registry', in *BMC Public Health* (2015), 15:778.
[80] Jussi O. Sipilä, [et al.], 'Daylight saving time transitions: incidence and in-hospital mortality of ischemic stroke', in *Neurology,* April 5, 2016 Vol. 86, No 16, Supplement S32.008.
[81] COM(2000)302 cites some beneficial considerations under Chapter 3.4., heading 'physical health'.
[82] For the difference between solar time and local time see Chapter 2.3.

effects can be modelled on the basis of statistical evidence. Nonetheless, different studies come to different conclusions.

In principle, putting the clock forward in spring alters the collision risk for two reasons: first, sleep deprivation during the transition from standard time to DST and, second, the change in ambient light conditions. Whilst the former is a short-time factor, the latter is effective during the entire period DST is applied. There seems to be a consensus that driving in the dark provokes more accidents; from that point of view DST is considered to have a positive effect, as it extends daylight hours into the evening. According to empirical research by The British Royal Society for the Prevention of Accidents road accidents rise in autumn, when the clocks go back and sunset occurs earlier in the day.[83] However, there is some attribution bias, since it is not clear what share of the accident rise is due to darkness and what is due to other external factors (e.g. worsening weather conditions). Also, it remains unclear whether the UK findings are directly transferable to other EU countries (e.g. climate, light conditions).

The report by the Bundestag's TAB office compares the findings of four recent research papers relating to road safety. It concludes that, contrary to the pre-2007 assumptions, the clock change does not seem to impact heavily on road safety. Three of the studies find that the DST transition has either no effects or just marginal effects on road accidents, and one (from the UK) reports a slight increase during the first two weeks following the spring transition, and a more pronounced effect (3.9 %) after the autumn shift.[84] Moreover, the TAB report points to an increased risk of collisions with deer and other wildlife during the days or weeks following the spring clock change, when DST obliges commuters to drive at dawn.

Two other recent studies not yet considered in the TAB report have been identified: one stemming from primary research from the USA (2016),[85] and one literature review from the UK (2017)[86]. The US study examines the link between DST and fatal vehicle crashes on the basis of federal US accident statistics for the 2002 to 2011 period and establishes a 6.5 % increase in fatal road accidents during the first six days following the spring transition to DST. The increased number of fatalities is attributed to lack of sleep, which has a kind of jet lag effect on drivers and pedestrians. Contrary to the clock change in spring, the autumn switch back to standard time does not seem to bring about a similar (or opposite) risk exposure.

The UK literature review, which considered a total of 24 topical studies, yielded different results. The findings for the short-term effects of the DST transition were inconclusive, whilst the long-term findings pointed at a positive effect of DST in the sense of risk reduction owing to the change in ambient light. However, some uncertainty remained relating to the question of whether the positive effect could be attributed solely to DST. Also, as the road expert said during the Parliament hearing, it is not clear whether the

[83] Road safety factsheet, Single double British summertime, The Royal Society for the Prevention of Accidents, October 2016.
[84] TAB report, pp. 110-111.
[85] Austin C. Smith, 'Spring forward at your own risk: Daylight saving time and fatal vehicle crashes', in *American Economic Journal: Applied Economics*, 2016, 8(2), pp. 65-91.
[86] Rachel N. Carey and Kiran M. Sarma, Impact of daylight saving time on road traffic collision risk: a systematic review, *BMJ Open*, 2017.

results from one country are directly transferable to other EU countries (further north or south).

6.5.2. Public safety and crime

With regard to public safety, two aspects are of relevance to the DST discussion: whether DST has a crime reduction effect, and whether the additional hour of daylight has any impact on people's perceived safety ('fear of crime'). For both aspects, basic data are collected in the form of crime statistics based on police records for the former, and surveys for the latter (e.g. Eurostat's EU-SILC survey includes questions on how safe people feel when walking home alone at night). Postponing sunset by one hour may reduce the subjective fear of crime, as many people are afraid of being out on the street after dusk.

There is some evidence[87] that a large proportion of criminal offences occur during the late afternoon and evening, when it is (getting) dark. A recent US study[88] undertook to establish a direct link between DST and outdoor crime rates. To that end, it tested the hypothesis that ambient light has a deterring effect on criminal behaviour (i.e. the higher probability of getting caught reduces the propensity to commit a crime). The study drew on data from the national US crime database ('National Incident-Based Reporting System') for the years 2005 to 2008. This period was chosen deliberately, because the US-wide extension of DST in 2007[89] generated counterfactual data.

According to this study, incidents of street robbery dropped US-wide by 7 % during the first weeks following the shift to DST. However, the researchers concede that their conclusions for robbery cannot be easily transferred to other types of violent crime (in particular aggravated assault, rape or murder), owing to various factors. These include, for instance, the time pattern of crime (most street robbery appears to occur 'in the evening around common commuting hours of 5 p.m. to 8 pm', at least in the USA).

7. EU summer-time arrangements in the light of 'Better Regulation'

At the European Parliament's 2015 hearing, Werner Vandenbruwaene from the University of Antwerp looked at the Summer-Time Directive through the lens of the 'Better Regulation' approach. His main conclusion was that the justification for the ninth directive was unconvincing, as it did not mirror the choice of legal basis, and the underlying evidence-base would not match today's 'Better Regulation' standards. He was also critical towards the proportionality and subsidiarity justification as well as the quality of the 2007 monitoring report (which he wrongly calls an evaluation). These arguments are examined in the following section, after a brief outline of the 'better regulation' context.

[87] See e.g. Bennett, p. 17.

[88] Jennifer L. Doelac and Nicholas Sanders, 'Under the cover of darkness: how ambient light influences criminal activity', in *The review of economics and statistics*, December 2015, 97(5), pp. 1093-1103.

[89] Section 110 of the Energy Saving Act of 2005 extended the DST period for approximately four weeks, effective as of 2007.

The overall aim of 'Better Regulation' is to improve the quality of legislation, by making it evidence-based, accountable and transparent. These principles apply to every stage of decision-making (the 'legislative cycle'). The key elements of 'Better Regulation' are broad stakeholder consultation, an ex-ante impact assessment preceding the legislative proposal, monitoring, and finally evaluation after the legislative act has been adopted and implemented. The European Commission has been applying the 'better regulation' principles routinely since 2002.

7.1. Impact assessment

The proposal for the current ninth Summer-Time Directive aimed to amend existing legislation, by extending the summer-time scheme in place (which was limited in time) for an indefinite period of time. It was issued in 2000 and thus predates the Commission's 'better regulation' efforts (as was acknowledged by the abovementioned expert). At that time the pre-legislative phase was less prescriptive than it is today.

The proposal's explanatory memorandum (which served to justify the legislative action and hence had a function comparable to today's impact assessment) was exceptionally detailed regarding the (potential) sectoral effects of summer time itself. However, one of the main drivers behind the initial adoption of the directive (and as reflected in its legal basis) was harmonisation. Yet, it is on the very question of harmonisation that the explanatory memorandum falls short, as it simply builds on the consensus from the previous directives that harmonisation is needed and should be binding.

However, by today's 'better regulation' standards, the reasoning in the explanatory memorandum covered only some elements of an impact assessment, and did not comply fully with the criteria and analytical structure of an impact assessment as would be applied today. More importantly, the directive has now been in place for 16 years and merits an ex-post evaluation in line with current 'better regulation' practice. Indeed, any review of the Summer-Time Directive – without anticipating its outcome (i.e. to repeal, amend or confirm the directive) – would provide a welcome opportunity to correct the 'shortcomings' of the impact assessment from 2000.

An evaluation would have to test the directive against the five standard criteria: effectiveness, efficiency, coherence, relevance, and EU added value. The outcome of this analysis would contribute directly to a better understanding of the issues that a possible review of the legislation would be called upon to address: among others, what are the problems generated by the summer-time switch? What are the drivers of these problems? Who is most affected and to what extent? Does the directive generate any specific or preventable costs or administrative burdens? How is the current situation likely to evolve in future, in the absence of any regulatory change and in the light of other potentially relevant circumstances (e.g. changes in working and transport habits)?

In the light of the evidence available on the impacts of the DST arrangements described in this study, a back-to-back evaluation and impact assessment, as described in the 2017 edition of the European Commission's Better Regulation Toolbox (Tool #52), could be envisaged.

The impact assessment would need in particular to present and assess the available policy options, thereby taking the available empirical and scientific evidence into account, including new evidence collected since the adoption of the directive. There seem to be three possible courses of action:

- maintaining the status quo, i.e. keeping the current DST arrangements;
- repealing the directive; and
- amending the directive; in this regard, an opt-out to the directive might be explored.

An impact assessment would moreover need to present stakeholders' views (following an open consultation) and suggest appropriate monitoring/evaluation provisions. Such monitoring or evaluation could be envisaged as a one-off, or, taking account of societal and technological changes, on a recurring basis (e.g. every 10 years). The importance of well-designed monitoring and evaluation provisions should not be underestimated: only appropriate data and indicators will allow the economic and social impacts of retaining or amending or repealing the directive to be evaluated and a comprehensive evidence base to be built to guide future decision-making on this particular issue. In addition, it would need to look at the questions of subsidiarity and proportionality, i.e. assessing whether the objective could be best achieved at EU level or rather at the level of the Member States, and whether the intended legislative measure does not go beyond what is necessary to achieve the objective, and justify the action accordingly.

7.2. The internal market and choice of legal basis

Furthermore, the necessary evidence base would need to ensure that the justification was consistent with the choice of legal basis. Given that the directive is a harmonisation measure for the internal market, more emphasis should logically be given to that dimension. This aspect remains under-analysed in the explanatory memorandum of 2000.

Given that the EU has grown to 28 Member States (from 15 at the time the directive was adopted in January 2001), the internal market dimension appears to be even more relevant today. If the directive is abolished, the potential benefits of a repeal might not be able to outweigh the overall costs incurred by reducing the harmonisation that is currently in place, notably with regard to the functioning of the internal market. In addition, the likely benefits of abolishing DST arrangements appear *prima facie* to be health-related, while the potential costs seem to be economic (e.g. transport, tourism) in nature.

8. Conclusions

This paper aims to provide an understanding of the EU's summer-time arrangements. The large north-south extension of the EU means that the daylight effects of DST vary across the EU. This was already the case at the time of the first harmonisation attempts in the 1970s, when the EU had only nine members. It is even more pronounced today with 28 Member States. Against this background, it is important to understand the geographical aspects of time (time zone and geographical position), because these factors determine the differences between solar time and local time, as well as seasonal differences in the amount of daylight between the EU Member States.

The initial motivation for the EU Summer-Time Directive, as reflected in its legal basis, was harmonisation for the proper functioning of the internal market. Therefore, any assessment underpinning a potential decision to maintain, amend or repeal the current DST arrangements needs first to pay specific attention to the internal market dimension, before exploring the wide spectrum of sectoral impacts that arise from daylight saving time as such, and from the EU measure.

The research project carried out by the German Bundestag's Office of Technology Assessment represents a milestone in the assessment of summer time. It is the most comprehensive study so far, and any further DST assessment should take this comprehensive, methodologically sound study as a starting point. For the purpose of this study, the findings of the TAB report were complemented with other relevant recent research papers.

8.1. The effects of the directive by sector

With regard to the implications for the economy, health and safety, the following conclusions can be drawn:

- In the area of **energy**, the recent scientific literature confirms the marginal energy saving effect of DST the Commission had assumed in its 2007 report. These savings are indeed relatively small (0.34 % of total energy consumption, and specifically in Europe between 0.5 % and 2.5 % depending on the country, as geographical location plays a role).
- For other sectors of the economy like **transport or agriculture**, according to stakeholders the DST impact seems to have become a non-issue, as the sectors have adjusted to it over time. No recent studies could be identified.
- Research findings regarding safety, and notably **road safety**, are inconclusive. There appears to be an increased accident risk during the days immediately following the DST transition (though different studies reach different conclusions) and a positive long-term effect of DST in terms of risk reduction owing to the change in ambient light. The different conclusions reached by the various studies can often be explained by methodological differences or country-specific external factors.
- The area that probably deserves most attention is **health**. In particular, chronobiological research findings regarding disruption to circadian rhythm suggest that the effects of DST may be longer-term than previously thought. In this context more research can likely be expected, given that this year's Nobel Prize for Medicine was awarded to chronobiologists.

  The health arguments brought up require further attention, possibly on the basis of paragraph 8 of Article 114 TFEU (approximation of laws), even if not invoked for the time being: 'When a Member State raises a specific problem on public health in a field which has been the subject of prior harmonisation measures, it shall bring it to the attention of the Commission which shall immediately examine whether to propose appropriate measures to the Council.'

  It would be desirable to focus future research or data collection on another health aspect, too, namely on the favourable health impacts of DST in terms of increased physical outdoor activities. This might enable more conclusive results to be reached

for instance on whether the benefits of increased leisure or sports time outweigh the negative health costs in terms of altered circadian rhythms.

Apart from the open questions regarding the significance of the effect of DST on health (circadian rhythm, sports), the conclusions of the TAB study appear to be appropriate. The study found no indications that 'the application of DST would induce serious positive or negative implications for energy consumption, economy or health. In this respect, the question of whether the current DST arrangements will be maintained, amended or abandoned will continue to be – for the foreseeable future – the subject of political and public debates'.

8.2. Possible future changes to the current DST regime and its consequences

Under current EU law, individual Member States or territories cannot decide to opt out of DST. This would be in breach of Directive 2000/84/EC. Any change of the current DST regime would require a change of this directive. Any consideration of a repeal of the directive would require reflections (and public support) on the preference between year-round summer time or year-round standard (winter) time, in particular at national level.

Against this background, there are essentially three possible courses of action at EU level:

- keeping the current DST arrangements in place;
- repealing the directive; or
- revising the directive and allowing, for instance, for opt-outs.

Given that the Member States have transposed the directive into national law, repealing the directive would not automatically abolish summer time EU-wide. It would only end the harmonisation arrangements and bring the competence on summer time back to the level of the Member States. In absence of a summer-time directive, Member States could:

- either opt to retain summer time. This might be of interest in countries where the sun sets early during the summer; however, they would be free to decide individually on a timetable that suited their geographical situation;
- or end summer time, which would first result in year-round winter time (standard time). Depending on the country, this may not be countries' or citizens' preferred option. Year-round summer time could be achieved through a change of time zone.

Returning summer time to national competence bears a risk of fragmentation. An uncoordinated approach would likely lead to distortions in the internal market and inconveniences for citizens and businesses alike.

Introducing an opt-out scheme (as it is the case in the USA) would also have a stronger impact on harmonisation, which was among the main drivers for adopting the directive in the first place.

In any event, each approach has advantages and disadvantages that would warrant further analysis.

On this point, it is worth stressing that the 'better regulation' guidelines were not applicable when the directive was adopted in January 2001, and thus, naturally, the accompanying analysis undertaken at the time does not fully meet today's impact assessments standards. Moreover, the directive itself, which has been in operation now for 16 years, has not been subject to an evaluation at EU level. A possible review of the directive would provide a welcome opportunity to address this gap and provide an updated evidence base, covering economic and social aspects, so as to decide whether to continue or alter the current DST arrangements.

Regarding public opinion, there is no conclusive empirical evidence available on citizens' current attitudes towards DST. There are many critical voices (e.g. petitions and citizens' initiatives), but it remains unclear what attitude towards DST those who do not speak out have. Recent results from a few national polls suggest an increasingly critical trend, but there is no EU-wide data available. A specific EU-wide survey (e.g. a Eurobarometer) could help to close this knowledge gap.

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Annex 1:
Historical overview of summer-time observance in the EU-28

Country	First use of DST	Continuous use of DST since	Comments
Austria	1916	1980	Observed DST in 1916–1918, 1920, 1940–1948 (as part of Germany between 1940–1945) and since 1980.
Belgium	1916	1977	Observed DST in 1916–1940, 1942–1946 and since 1977.
Bulgaria	1943	1979	Observed DST in 1943–1944 and since 1979.
Croatia	1916	1983	Observed DST in 1916–1918 (as part of the Austrian-Hungarian Empire), in 1941–1945 and since 1983.
Cyprus	1975	1975	Observed DST since 1975. DST was abandoned in the northern part of the island in 2016.
Czech Republic	1916	1979	Observed DST in 1916–1918 (as part of the Austrian-Hungarian Empire), 1940–1949 and since 1979.
Denmark	1916	1980	Observed DST in 1916, 1940–1948 and since 1980.
Estonia	1918	1981	Observed DST in 1918, 1940–1944 and since 1981.
Finland	1942	1981	Observed DST in 1942 and since 1981.
France	1916	1976	Observed DST in 1916–1945 and since 1976.
Germany	1916	1980	Observed DST in 1916–1918, 1940–1949, and since 1980.
Greece	1932	1975	Observed DST in 1932 and since 1975.
Hungary	1916	1980	Observed DST in 1916–1920, 1941–1950, 1954–1957 and since 1980.
Ireland	1916	1972	Observed DST in 1916–1968 and since 1972.
Italy	1916	1966	Observed DST in 1916–1920, 1940–1948 and since 1966.
Latvia	1918	2001	Observed DST in 1918–1919, 1941–1944 and since 1981.
Lithuania	1941	2003	Observed DST in 1941–1944, 1981–1999 and since 2003.
Luxembourg	1916	1977	Observed DST in 1916–1946 and since 1977.
Malta	1916	1966	Observed DST in 1916–1920, 1940–1948 and since 1966.
Netherlands	1916	1977	Observed DST in 1916–1945 and since 1977.
Poland	1916	1977	Observed DST in 1916–1919, 1940–1949, 1957–1964 and since 1977.
Portugal	1916	1977	Observed DST in 1916–1921, 1924, 1926–1929, 1931–1932, 1934–1949, 1951–1965 and since 1977.
Romania	1932	1979	Observed DST in 1932–1939 and since 1979.
Slovakia	1916	1979	Observed DST in 1916–1918 (as part of the Austrian-Hungarian Empire), 1940–1949 and since 1979.
Slovenia	1916	1983	Observed DST in 1916–1918 (as part of the Austrian-Hungarian Empire), in 1941–1945 and since 1983.
Spain	1917	1974	Observed DST in 1917–1919, 1924, 1926–1929, 1937–1946, 1949 and since 1974. On the Canary Islands DST is observed since 1980.
Sweden	1916	1980	Observed DST in 1916, in a test run, and continuously since 1980.
United Kingdom	1916	1972	Observed DST since 1916, with episodes of year-round summer time and double summer time.

Source: https://www.timeanddate.com/time/dst/2017.html, complemented by Wikipedia and national sources.

Annex 2:
Comparison of the time of sunrise/sunset in the EU-28 at summer/ winter solstice

The table below shows the link between the geographical position (coordinates) of all EU Member States and their time-zones on the one hand, and day length and the time of sunrise and sunset on the other. Data are provided for each EU capital, grouped by time zone. For ease of reading, the geographical coordinates (values of latitude and longitude) are simplified to integers. To illustrate how big the differences across the EU can be, data were selected for the longest and the shortest days of the year, i.e. 21 June and 21 December (summer and winter solstice). The most extreme differences are highlighted.

Time zone	Country	Coordinates	21 June			21 December		
			sunrise	sunset	day length	sunrise	sunset	day length
WET UTC+	**Ireland**	53° N 06° W	04:56	**21:56**	17 h 00	08:38	**16:08**	7 h 29
	Portugal	38° N 09° W	06:12	**21:04**	14 h 52	07:51	**17:18**	9 h 27
	United Kingdom	51° N 00° W	04:43	**21:21**	16 h 38	08:03	**15:53**	7 h 49
CET UTC+1	**Austria**	48° N 16° E	04:53	**20:58**	16 h 04	07:42	**16:02**	8 h 20
	Belgium	50° N 04° E	05:28	**21:59**	16 h 31	08:42	**16:38**	7 h 56
	Croatia	45° N 15° E	05:06	**20:49**	15 h 43	07:34	**16:14**	8 h 39
	Czech Republic	50° N 14°E	04:52	**21:15**	16 h 23	07:58	**16:02**	8 h 03
	Denmark	55°N 12° E	04:25	**21:57**	17 h 32	08:37	**15:38**	7 h 01
	France	48° N 02° E	05:47	**21:57**	16 h 10	08:41	**16:56**	8 h 14
	Germany	52° N 13° E	04:43	**21:33**	16 h 49	08:15	**15:54**	7 h 39
	Hungary	47° N 19° E	04:46	**20:44**	15 h 58	07:28	**15:55**	8 h 26
	Italy	41° N 12° E	05:35	**20:48**	15 h 13	07:34	**16:42**	9 h 07
	Luxembourg	49° N 06° E	05:28	**21:46**	16 h 18	08:29	**16:37**	8 h 08
	Malta	35° N 14° E	05:45	**20:21**	14 h 35	07:08	**16:51**	9 h 43
	Netherlands	52° N 04° E	05:18	**22:06**	16 h 48	08:48	**16:28**	7 h 40
	Poland	52° N 21° E	04:14	**21:01**	16 h 46	07:43	**15:25**	7 h 42
	Slovakia	48° N 17° E	04:51	**20:55**	16 h 04	07:39	**16:00**	8 h 20
	Slovenia	46° N 14° E	05:10	**20:56**	15 h 45	07:41	**16:19**	8 h 38
	Spain	40° N 03° W	06:44	**21:48**	15 h 03	08:34	**17:51**	9 h 17
	Sweden	59° N 18° E	03:31	**22:08**	18 h 37	08:43	**14:48**	6 h 04
EET UTC+2	**Bulgaria**	42° N 23° E	05:48	**21:08**	15 h 19	07:53	**16:56**	9 h 02
	Cyprus	35° N 33° E	05:32	**20:04**	14 h 31	06:51	**16:38**	9 h 47
	Estonia	59° N 24° E	04:03	**22:42**	18 h 39	09:17	**15:20**	6 h 03
	Finland	60° N 24° E	03:54	**22:49**	18 h 55	09:23	**15:12**	5 h 49
	Greece	37° N 23° E	06:02	**20:50**	14 h 48	07:37	**17:09**	9 h 31
	Latvia	56° N 24° E	04:29	**22:21**	17 h 52	08:59	**15:43**	6 h 43
	Lithuania	54° N 25° E	04:41	**21:59**	17 h 17	08:39	**15:54**	7 h 14
	Romania	44° N 26° E	05:31	**21:03**	15 h 32	07:48	**16:38**	8 h 50

Source: timeanddate.com; data for 2017.

The purpose of summer time is to capitalise on natural daylight. By turning the clock one hour forward as the days get longer in spring, sunset is delayed by this same hour, until the clock is set back again in autumn. This practice is applied in over 60 countries worldwide. In the EU, Member States draw on a long tradition of daylight saving time (DST), and many have developed their own DST schemes. Harmonisation attempts began in the 1970s, to facilitate the effective operation of the internal market. Today, the uniform EU-wide application of DST is governed by Directive 2000/84/EC; most European third countries have aligned their summer-time schemes with that of the EU. Much academic research has been invested in examining the benefits and inconveniences of DST. It appears that:
- summer time benefits the internal market (notably the transport sector) and outdoor leisure activities, and it also generates marginal savings in energy consumption;
- the impact on other economic sectors remains largely inconclusive;
- with regard to inconveniences, health research associates DST with disruption to the human biorhythm ('circadian rhythm').

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