

22nd March 2023

FREQUENTLY ASKED QUESTIONS on **DAYLIGHT SAVING TIME**





CONTENT

Does DST save energy?	3
Do the tourism and leisure industries need DST?	4
Is DST good for retail and other industries?	6
Does DST help farmers?	7
Does adopting permanent natural time zones in Europe cause a patchwork of time zones within Europe?	8
Would different time zones disadvantage the economy?	9
Does stopping the clock change and/ or changing the time zone involve IT costs?	10
Are border workers in Europe affected by implementing natural time zones?	11
Does implementing permanent natural time zones mean that I have to change my daily habits?	13
Will implementing permanent natural time cause more heat during the work day and require "summer schedules" in certain countries?	15
If we go back to our natural time zone (closer to our solar time) won't the early sunrise in June and July cause sleep problems?	16
Will abolishing DST and implementing permanent natural time zones mean that children will be able to play outside less after school and thus get less sunlight and exercise?	17
Sources	18

DOES DST SAVE ENERGY?

Will the implementation of permanent natural time zones lead to an increase in energy consumption?

No, DST does not save energy. In fact, there is mounting evidence that DST actually **increases** energy consumption, especially heating and cooling, making it an irresponsible policy given the current energy crisis. Permanent natural time zones would in turn save energy and reduce pollution.

- Researchers now believe that a lot of publications on the topic of energy in the European Union express a bias, and almost all focus exclusively on electrical energy. The consensus is that, for the EU, electricity savings with DST can be safely rounded to 0% [10].
- In the USA, a 2008 report to Congress on the effects of DST on energy consumption found practically no savings with DST (0.02-0.03%) and no savings in fuel [6], but a 2011 study for the state of Indiana found that energy expenditure actually **increased** 2-4% during their adoption of permanent DST [7]. In Portugal, a 2018 report to the Portuguese government stated that no significant advantages (0.02%) were found in adopting DST in saving electricity during summer [8]. But a historical analysis during the periods of 1992-1996, where Portugal adopted DST and double DST, showed that energy consumption increased all year, especially during winter mornings, for extra heating and lighting [9].
- Furthermore, a publication on fuel (gas, coal) consumption in France and Belgium observed an increase in fuel consumption with DST due to extra driving. [11]. This study indicates that DST is **harmful for the environment**, which is also corroborated by studies on pollutant dispersion and maintenance of the atmosphere, which are highly dependent on the time of the natural day.
- Natural time zones as close as possible to solar time better align daily light and temperature curves with our schedules. This leads to energy savings as:
 - Natural time zones will save on early morning industrial and other **lighting**, especially in early spring, late autumn and winter.
 - In the morning, people get up and commute to work an hour later, which saves on early morning **heating** during the colder months.
 - Less **air conditioning** is needed in the car on the commute after work and in the evening at home, and people go to bed when temperatures are low enough to allow sleep, so less or even no air conditioning is needed at night.

DO THE TOURISM AND LEISURE INDUSTRIES NEED DST?

No, there is no conclusive evidence that DST is better than natural time for the tourism and leisure industry. These sectors will more likely **benefit** economically when DST is abolished.

- Tourism and leisure businesses are largely dependent on school holidays. As DST takes place during summer months, there is this false **perception** that DST is what is driving tourism, when in fact it is simply the time when most are on summer holiday.
- There is **no conclusive data** regarding the impact of DST on tourism. It is impossible to base conclusions about this sector on clear and concrete evidence, since most of the material used comes from the opinions, premonitions, and assumptions of those working in this sector, as said by an EU study [1]. One Australian study based on interviews claimed an increase in tourism of 3%, which the authors attribute to bias of the interviewed [2]. In another Australian study, 15% say they perceive a benefit due to DST, 52% are indifferent and 33% of interviewed businesses say DST has been detrimental to tourism.
- DST has been associated with a **decrease in participation** in cultural activities, such as cinema, theatre, and museum visits [5, 16]. Upon changing to permanent natural time, these tourism and leisure industries are likely to see an increase in participation.
 - During non-work days, people generally use alarm clocks less and sleep past sunrise more [18]. During DST, businesses open and close one hour earlier than natural time, relative to the sun. Thus, DST **shortens the amount of time** leisure and tourism attractions may be visited.
 - During DST, theatre and cinema showings more often begin when it is still daylight, and people are **less inclined** to visit them. When permanent natural time is restored, twilight will come earlier in summer, and activities best enjoyed without daylight (such as movies, concerts, and fireworks) would benefit from it.
 - People who have to **get up early** to go to work or school are less inclined to participate in evening leisure activities. One hour less light in the evening could drive promoters of evening events to start their sessions at an earlier clock time, which would attract more participation from such people.
 - Natural time would **align leisure activities** opening hours with human internal clocks, when they are more inclined to do such activities. For example, many bars, clubs, and restaurants now in effect close an hour earlier during DST, when

people is naturally still wide awake and eager to enjoy them. One could counter argue that these businesses could stay open longer, but that would cause conflict with the social schedule of having to get up an hour earlier under DST as well.

- DST has also been associated with **increased accidents** [3] and disease in general [4]. An increase in sick days has been observed [4]. This is not good for a sector heavily dependent on hard workers and in turn may also reduce the amount of people that participate in leisure activities, because people who are or feel sick will not go out.
- There are no studies on the effect of DST on winter tourism. But we can argue that the hotel industry would suffer from permanent DST, especially in winter. In many northern European countries, dark mornings will hinder activities and breakfasts between 8h00 and 10h00 would be taken mostly in the dark. Example: December sunrise in Germany with DST would be between 9 and 9h30.

IS DST GOOD FOR RETAIL AND OTHER INDUSTRIES?

No, there is no evidence that DST is beneficial for retail and other industries.

- Most arguments related to economic benefits are **argumentative and not substantiated by evidence**. Those who favour DST claim that it benefits the golf and retail industries [12]. Those who favour standard time make the same claims about theatre, cinema, television, streaming, personnel and business services. [5, 12] However, no reliable numerical values for these statements (based on independent research, demonstrating that DST either increases or decreases a business percentually) can be found in the available literature.
- During the work week, there are not many changes under DST in terms of commerce, as people have to continue with their **set social schedules** and arrange shopping activities around these clock times. On the weekend, however, most people sleep in to compensate for sleep deprivation, enhanced by DST. Their wake-up time is also later under DST clock time than under standard time (a person who naturally wakes up at 9 o'clock will wake up at 10 o'clock under DST). Consequently, most customers have less time to shop on the weekend. When changing to permanent Standard Time, retailers are likely to see an increase in return on the weekend.
- (3) Shops used to be open until 22.00h / 10 p.m. in London before the advent of electricity, when streets were still very badly lit: [17]

"The widespread belief that people in the pre-industrial world went to bed at nightfall seems to be based entirely on the presumption that anyone deprived of robust illumination would be driven by frustration to retire. In fact, it appears that most people didn't retire terribly early – nine or ten o'clock seems to have been standard for most people in the days before electricity, and for some, particularly in cities, it was even later.

For those who could control their working hours, bedtimes and rising times were at least as variable then as now, and appear to have had little to do with the amount of light available. [...] There certainly seems to have been no rush to bring the day to a close. Visitors to eighteenth-century London often noted that the shops were open till 10 at night, and clearly there would be no shops without shoppers. [...]

If anything drove people to bed early in the pre-electrified world, it was not boredom but exhaustion. Many people worked immensely long hours."

Bill Bryson, *At home – a short history of private life*, 2010, pg.123.

DOES DST HELP FARMERS?

No. Farmers have opposed DST for decades [5]. The notion that Daylight Saving Time was implemented to benefit farmers is a **debunked US myth** created in 1917 by the Boston Chamber of Commerce. [16]

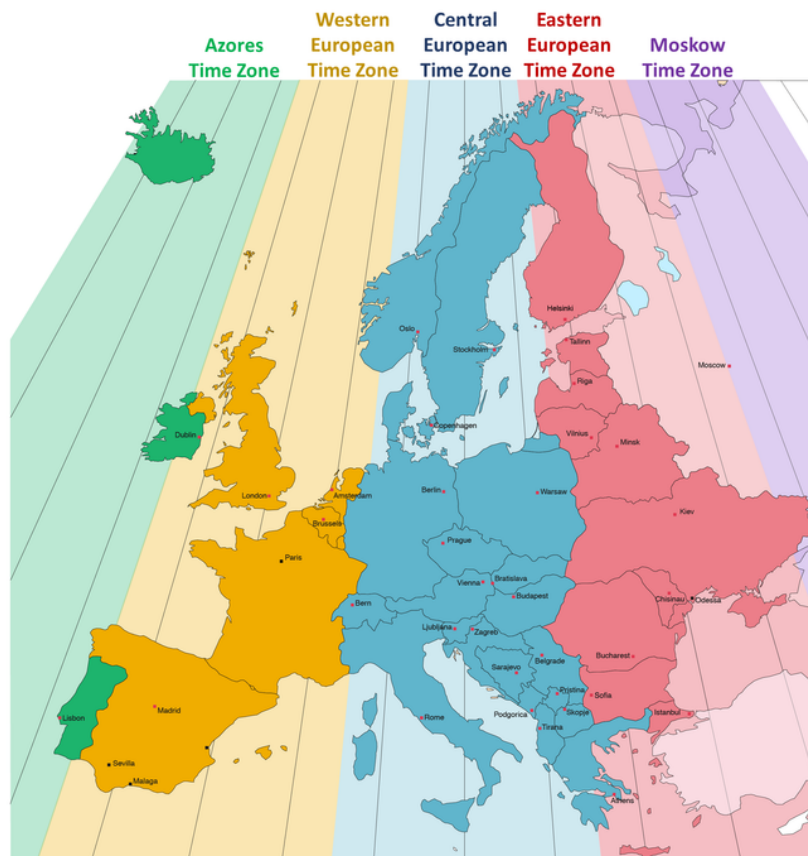
The agriculture industry actually lobbied vociferously **against** daylight saving time for a large part of the 20th century. [5] In the US, farmers were the only organized lobby against daylight saving in history and the reason they never had a peacetime daylight saving time until 1966.

Farming is highly dependent on the natural environment. DST actually shortens and darkens farmer's time on the fields in the morning, leaving them with an **hour less** sunlight to get crops to market. [5] Changing milking times to comply with earlier collection schedules affects milk production, and if workers have to wait an extra hour for daylight to start or dew to evaporate from the fields in order to start working, less work gets done in a day.

DOES ADOPTING PERMANENT NATURAL TIME ZONES IN EUROPE CAUSE A PATCHWORK OF TIME ZONES WITHIN EUROPE?

No, implementing permanent natural time zones in Europe does not cause a patchwork. Adopting geographically appropriate natural time zones would result in four logical stripes across the continent, in effect rearranging the four time zones that Europe already has in use. Time-zone borders would align almost perfectly both with natural time and national borders (see fig. 1).

Figure 1: Recommended time zones for the European continent



WOULD DIFFERENT TIME ZONES DISADVANTAGE THE ECONOMY?

(Acting as trade barriers and reducing trade?)

Different time zones are not disadvantageous to the economy, as demonstrated in large time zone spanning nations such as the US. Several time zones within an economic area do not affect trade significantly and therefore is not a real problem for the economy. Distance is the major trade barrier that needs to be overcome; time zone barriers are estimated to bring only an overall extremely meagre loss to trade of ca. 0.0025% per hour in time zone difference [13] (the economic forces driving trade can be consulted in more detail in <https://en.gobettertimes.org/trade>).

Additionally, the costs to the economy of DST is by current estimations at least 1% of the GDP (depending on the country and how misaligned the clocks are), since it lowers productivity, increases health costs, and actually **increases the energy bills** [3, 4, 10, 11, 14]. The cost of DST far surpasses any potential loss in trade due to the choice of several time zones.

DOES STOPPING THE CLOCK CHANGE AND/ OR CHANGING THE TIME ZONE INVOLVE IT COSTS?

Yes, there will be minor one-time software costs involved with abolishing the clock changes. However, these one-time costs do not weigh up against the **current costs** of having to take the clock changes into account with each new IT design and in production, administrative and accounting processes.

The one-time costs that we can expect are:

- The automatic updating of the clock times is integrated in every software package currently in use. This feature will have to be switched off, which is a small and easy fix that can be included in any software release (**update**).
- When in 2021 the nation of Samoa abolished DST, their government published a statement to this effect. IT engineers managing libraries for date times then updated, tested, and released their new code. The IT engineers who manage code dependent on those libraries received this update, tested it on their own code, made any necessary updates, and then **released their new code**. No more effort was involved.
- Many production, administrative and accounting processes will have to adjust to **no longer having to deal with one 23 hr and one 25 hr day in each fiscal year**. This may take some additional effort depending on the industry.

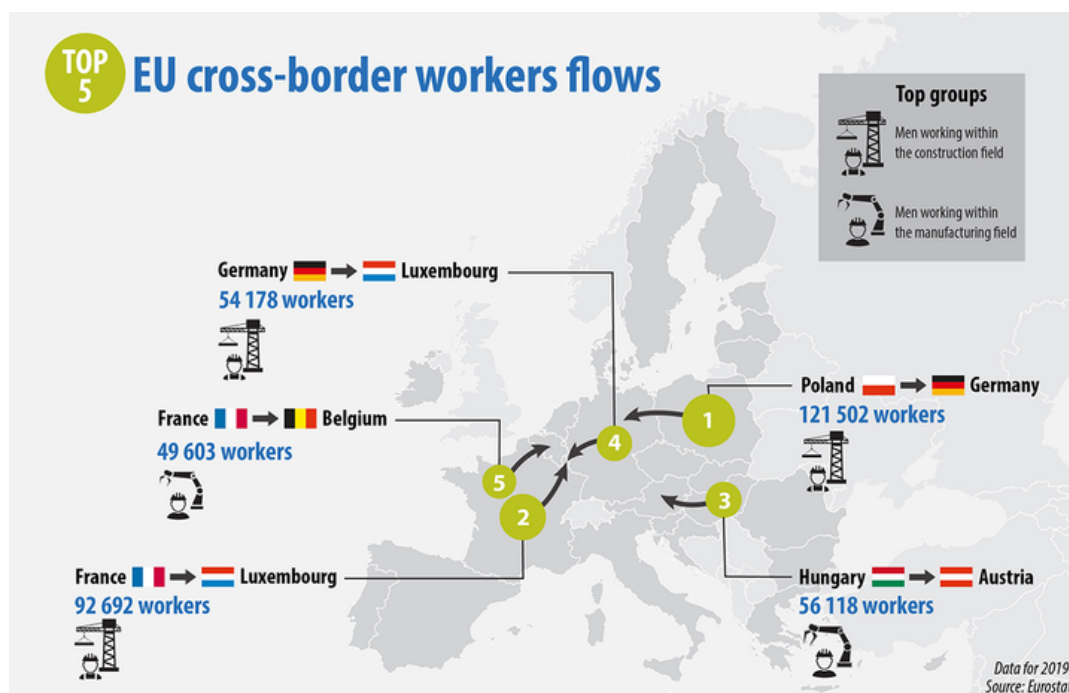
The current costs that would be avoided after abolishing clock change are:

- The IT industry **will benefit** from no longer having to deal with the DST switch and the 23 hr / 25 hr day issue when developing new software and processes. In effect, many industries and IT systems already ignore DST and record their data only using standard time to simplify their processes.
- The manual clock changes in the buildings of public areas and of work places demand **workforce intervention twice a year**. This cost is avoided when abolishing the seasonal clock change. As an example, the Parliamentary clock mechanics in the UK, aside from taking care of changing the clock in Elizabeth Tower (nicknamed "Big Ben"), also have to manually adjust 2,000 other clocks throughout the Palace of Westminster and across the Parliamentary Estate.

ARE BORDER WORKERS IN EUROPE AFFECTED BY IMPLEMENTING NATURAL TIME ZONES?

The only main flow of border workers that would be affected concerns the flow from Germany to Luxembourg, an estimated 3.6% of border workers in 2019, equalling **0.028% of all workers in Europe**. For this small percentage of the population, specific problems can be identified, and local solutions can be found.

- Out of a total of 191.5 million European workers, 1.5 million are border workers, equalling 0.78% of all workers in Europe. [15]
- If natural time zones are adopted, the only main flow that would be affected concerns the flow from Germany to Luxembourg (see figure 2). This flow comprises 3.6% of all border workers, and thus 0.028% of all workers in Europe.



- Making certain time zone choices to cater to a small percentage of border workers (0.028% of all workers in Europe) is not justified compared to the reduction in productivity, health and well-being that the majority of non-border workers experience under unnatural time zones. Local and specific solutions need to be tailored to those who face problems, if indeed it turns out to be a problem and not just a preference or habit.
 - As an example, Germans working in Luxembourg would start work one hour later by German clock time (because of the time zone difference between Germany and Luxembourg), which does not create conflicts with kindergarten and school start times.

- They would also finish work an hour later by German clock time. For that, a school and kindergarten with childcare in the afternoon may be chosen.
- Work hours for some jobs are flexible and can be adjusted accordingly. Many employers are very open to earlier work starting times.
- For border workers commuting in the opposite direction there may be adjustment issues due to needing childcare to start an hour earlier – however, this is a common problem for a lot of families in Europe, which needs tackling.
- The clock of all electronic devices, including that of border workers, updates automatically when crossing a time zone, so there is no issue on the technical side.

DOES IMPLEMENTING PERMANENT NATURAL TIME ZONES MEAN THAT I HAVE TO CHANGE MY DAILY HABITS?

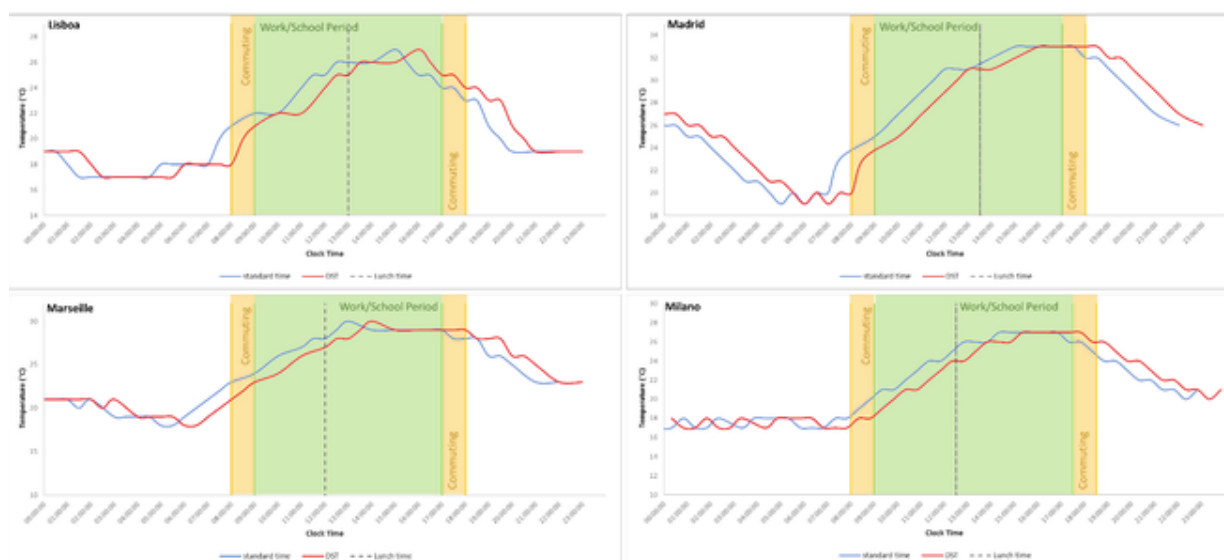
Implementing the permanent sun-based time zones does not mean that you need to change your habits, since they **are already constant** throughout the year by clock time, and can remain the same. We are only adjusting the clock time to reflect the real time of day and nothing more.

WILL IMPLEMENTING PERMANENT NATURAL TIME CAUSE MORE HEAT DURING THE WORK DAY AND REQUIRE “SUMMER SCHEDULES” IN CERTAIN COUNTRIES?

DST does not help to avoid heat during the day, and may actually worsen it. Countries or areas that need summer schedules already have them in place and could simply continue them. Summer schedules, during which schools and businesses tend to open earlier and be closed during the afternoon, are more flexible than DST and can be applied to local areas and shorter periods of time (for example, only the 3 summer months).

- Daily temperature profiles for summer months, such as August, in Southern Europe suggest that the **temperature differences between DST and standard time are small** (see fig. 3).

Figure 3: Daily Temperature curves from Lisbon, Madrid, Marseille, and Milan in August. Red: for DST. Blue: for Standard Time.
Source: CustomWeather, © 2022



- Strong or extreme heat situations take place in the afternoon. Therefore, DST leads to higher overall energy use as the peak of heat is delayed to the afternoon of workdays, **forcing people to use individual cooling appliances** instead of communal ones at work. It also leads to higher fuel use due to cooling needs in traffic while commuting in the afternoon.
- DST causes more **heat at bedtime**, which leads to additional sleep problems and higher energy consumption.

- When implementing permanent natural time zones, schedules do not need to be adjusted in summer, because they will naturally lead to a healthier use of sunlight:
 - The recommended clock time to avoid the sun becomes easier to understand and can be better standardized across Europe (especially important for non-local tourists). This standard recommended clock time between 10:00–14:00 covers lunchtime in all countries, so people will more likely spend these hours in the shade having lunch.
 - In countries such as Portugal, people currently waste a lot of healthy sun time because social schedules tell them to go home at 18:00, which gives people only 2 hours of healthy sun time in the afternoon (the recommended time to avoid the sun is between 12:00 and 16:00). With the correct time zone, they could enjoy healthy sun time from 14:00 to 18:00, which is 4 hours of healthy sun time in the afternoon.

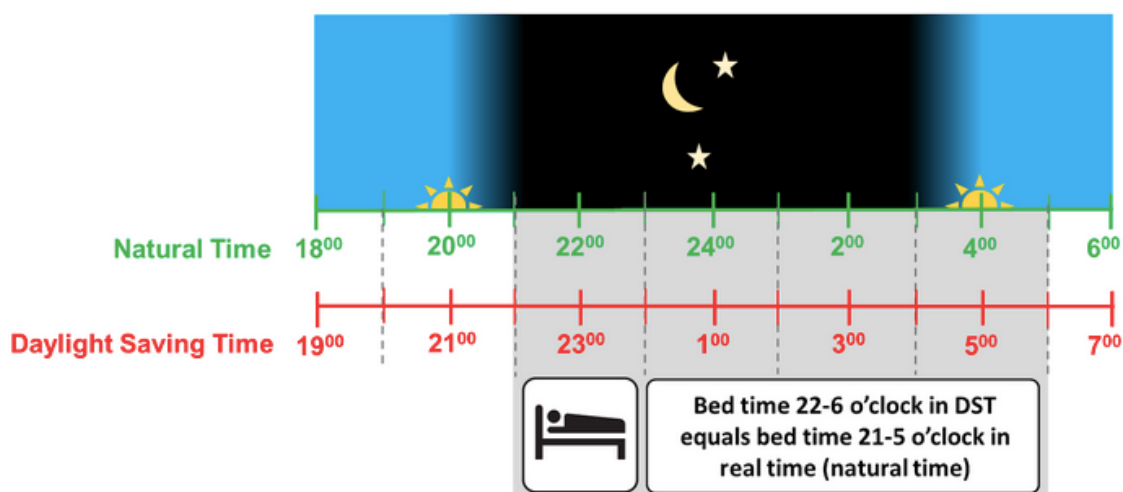
IF WE GO BACK TO OUR NATURAL TIME ZONE (CLOSER TO OUR SOLAR TIME) WON'T THE EARLY SUNRISE IN JUNE AND JULY CAUSE SLEEP PROBLEMS?

It will not. Problems for certain individual cases can be tackled easily on an individual level.

An early sunrise in summer is a **natural seasonal occurrence**, more so the further north you go in Europe. For example, in Scandinavia there is almost no darkness during the months of June and July. Sleep experts recommend using blinds, eye masks or opaque curtains to prolong the darkness and finish your sleep.

It is **late sunset** that causes sleep problems in summer, not early sunrise. For most people, it is not a problem to sleep beyond sunrise. However, it is quite difficult to fall asleep in the evening when there is still daylight and heat. Having to get up an hour earlier due to DST the next morning, unable to finish your sleep, is what causes sleep deprivation – not the early sunlight.

People who nonetheless have difficulties sleeping in the early morning due to early sunrise can always choose to go to bed one hour earlier in clock time. For example: Instead of sleeping from 22 to 6 o'clock, you can sleep from 21 to 5 o'clock (this is the same time of the day as 22-6 with DST, see picture). School or work schedules are rigid, but do not hinder getting up or going to bed an hour earlier than usual. Therefore, under natural time all of us have more freedom to set our optimal sleep schedule.



*Note: The timing of sunrise and sunset depends on the location and on the time of the year.

WILL ABOLISHING DST AND IMPLEMENTING PERMANENT NATURAL TIME ZONES MEAN THAT CHILDREN WILL BE ABLE TO PLAY OUTSIDE LESS AFTER SCHOOL AND THUS GET LESS SUNLIGHT AND EXERCISE?

- This may be the case for a limited time in spring and autumn, for some school schedules. But there is **no study showing negative health effects of having less light in the evening**. On the contrary, there is ample evidence of the positive health effect of light in the morning and darkness in the evening. This has to do with our circadian rhythm.
- DST is nothing more than advancing their schedule by an hour, making them wake up earlier and thus finish school earlier. But it also means they have to **go to bed an hour earlier and their bodies aren't ready for sleep yet** —especially when there is still daylight outside. All this causes sleep deprivation in a significant portion of children, especially most adolescents and young adults who, due to developmental changes in their brain, become later chronotypes (“night owls”).
- It is healthy for children to play outside and to get enough sunlight, fresh air and exercise during the day. However, this should be **facilitated during the school day** itself, as specifically morning sunlight is essential for their biological clock and health. Also, sleep-deprived children are less inclined to do sports and play outside.
- Sleep deprivation will also impair cognitive function, affecting memory, concentration, and decision-making abilities. This can have a significant impact on **school performance**, as shown in several studies [19, 20]. In addition, sleep plays an essential role in emotional regulation, which is critical for healthy interpersonal relationships and social interactions.

SOURCES

- [1] – Reincke, KJ & van den Broek, F (1999) Summer Time: Thorough Examination of the Implications of Summer-time Arrangements in the Member States of the European Union, Research voor Beleid International.
- [2] – Alonso AD & Ogle A (2009) Impact of daylight savings on small hospitality and tourism businesses: A Western Australian case study. *Tour Hosp Res* 9: 314–324.
- [3] – Fritz J, VoPham T, Wright KP & Vetter C (2020) A Chronobiological Evaluation of the Acute Effects of Daylight Saving Time on Traffic Accident Risk. *Current Biology* 30: 729–735.e2.
- [4] – Giuntella O & Mazzonna F (2019) Sunset time and the economic effects of social jetlag: evidence from US time zone borders. *Journal of Health Economics* 65: 210–226.
- [5] – Brian Handwerk: Time to Move On? The Case Against Daylight Saving Time. URL <https://www.nationalgeographic.com/news/2013/11/131101-when-does-daylight-savings-time-end-november-3-science/> – abgerufen am 2020-06-13. – National Geographic News.
- [6] – U.S. Department of Energy (2008) Impact of Extended Daylight Saving Time on National Energy Consumption Report to Congress. Energy Policy Act of 2005, Section 110.
- [7] – Kotchen MJ & Grant LE (2009) DOES DAYLIGHT SAVING TIME SAVE ENERGY? EVIDENCE FROM A NATURAL EXPERIMENT IN INDIANA. *THE REVIEW OF ECONOMICS AND STATISTICS*: 14.
- [8] – Silva, J ; Couto, A ; Duque, J: ANÁLISE TÉCNICA DO IMPACTO DA MUDANÇA DE HORA LEGAL NA PENETRAÇÃO DA GERAÇÃO DE ENERGIA RENOVÁVEL NÃO CONTROLÁVEL NO CONSUMO EM PORTUGAL CONTINENTAL (2018), S. 29.
- [9] – Decreto-Lei 17/96, 1996-03-08 Diário da República Eletrónico
- [10] – Havránek T, Herman D & Iršová Z (2018) Does Daylight Saving Save Electricity? A Meta-Analysis. *The Energy Journal*.
- [11] – Hecq, Walter ; Borisov, Youri ; Totte, Marc: Daylight saving time effect on fuel consumption and atmospheric pollution. In: *Science of The Total Environment* Bd. 133 (1993), Nr. 3, S. 249–274.

SOURCES

- [12] – Farrell, Diana ; Narasiman, Vijay ; Ward, Marvin Monroe: Shedding Light on Daylight Saving Time. In: JPMorgan Chase Institute (2016).
- [13] – Tomasik, Rebecca: Time zone-related continuity and synchronization effects on bilateral trade flows. In: Review of World Economics Bd. 149 (2013), Nr. 2, S. 321–342
pollution. In: Science of The Total Environment Bd. 133 (1993), Nr. 3, S. 249–274.
- [14] – Hafner, Marco ; Stepanek, Martin ; Taylor, Jirka ; Troxel, Wendy M: Why sleep matters -- the economic costs of insufficient sleep: A cross-country comparative analysis. In: RAND Europe (2016), S. 101.
- [15] – European Commission on Employment, Social Affairs & Inclusion Annual report on intra-EU labour mobility (2019) – <https://ec.europa.eu/social/main.jsp?catId=738&furtherPubs=yes&langId=en&pubId=8242>.
- [16] Michael Downing, Spring Forward: The Annual Madness of Daylight Saving Time, 2nd edition. Counterpoint, 2009. Accessed: Dec. 01, 2022. [Online].
- [17] Bryson, Bill: At Home: A Short History of Private Life: Doubleday, 2010. — ISBN 978-0-7679-1938-8.
- [18] T. Roenneberg, L. K. Pilz, G. Zerbini, and E. C. Winnebeck, 'Chronotype and Social Jetlag: A (Self-) Critical Review', Biology, vol. 8, no. 3, Art. no. 3, Sep. 2019, doi: 10.3390/biology8030054.
- [19] J. Gaski and J. Sagarin, 'Detrimental Effects of Daylight-Saving Time on SAT Scores', Journal of Neuroscience, Psychology, and Economics, vol. 4, pp. 44–53, Feb. 2011, doi: 10.1037/a0020118.
- [20] D. Medina, M. Ebben, S. Milrad, B. Atkinson, and A. C. Krieger, 'Adverse Effects of Daylight Saving Time on Adolescents' Sleep and Vigilance', Journal of Clinical Sleep Medicine, vol. 11, no. 08, pp. 879–884, doi: 10.5664/jcsm.4938.



International Alliance for Natural Time

<https://naturaltimealliance.org/>

Proposal on implementing permanent time zones in the European Union

<https://timeuse.barcelona/projects/permanent-time-zones-eu/>

Contact information

info@timeuse.barcelona

Barcelona Time Use Initiative for a Healthy Society

Press enquiries

communication@timeuse.barcelona

Communications Team