PROPOSAL ON IMPLEMENTING PERMANENT TIME ZONES IN THE EUROPEAN UNION

24th October 2022

Working group on natural time -
Barcelona Declaration on Time Policies

CONTENT

EXECUTIVE SUMMARY: IMPLEMENTING NATURAL TIME ZONES IN THE EUROPEAN UNION

Considering the benefits of geographically correct time zones and the negative consequences of misaligned clocks:

- The **EU Commission** has the responsibility to reactivate the political process on this subject.

- The **EU Member States** have the responsibility to ratify the EU proposal (*European Directive on Discontinuing seasonal changes of time*) and agree to adopt the permanent time zones which are as close as possible to their solar time (natural time).

For the **European continent** there is an **easy solution** which does not require a patchwork of time zones. Figure 1 shows these recommended time zones for the European continent. Table 1 shows the recommended time zones and steps to be taken for all 27 EU member states. Specific solutions need to be found for European territories outside the European continent.

The identified territories where different solutions can be applied are:
- Northern Ireland and Ireland.
- France and Corsica.
- Portugal and Spain
- Continental Greece and the Greek islands.

Figure 1: *Recommended time zones for the European continent*

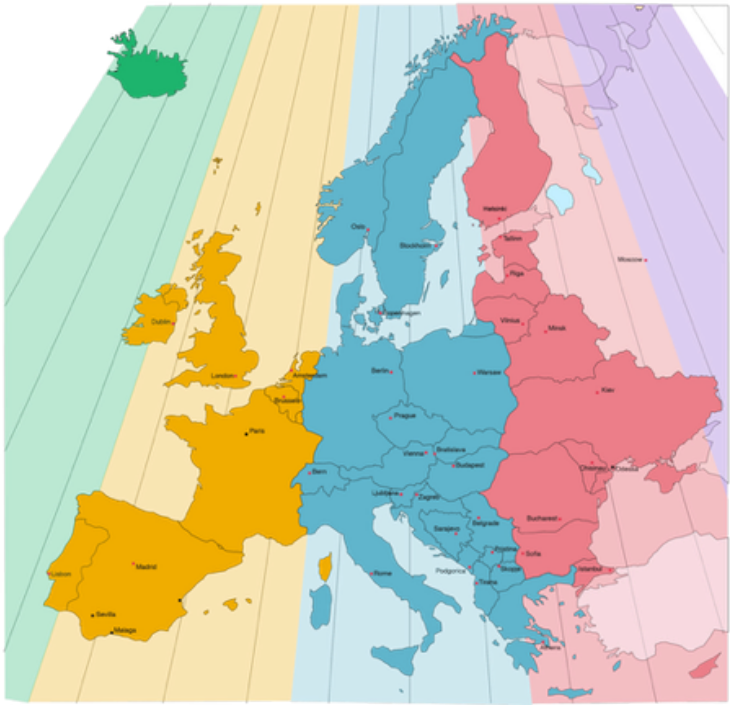

Table 1: *Recommended time zones and steps to be taken for the European mainland of the EU member states*

EU Member State	Recommended time zone	Steps to be taken
Bulgaria Cyprus Estonia Finland Latvia Lithuania Romania	Eastern European time = UTC+2 (current Standard time)	1. Abolish clock changes and stay on Standard time
Greece	Central European time = UTC+1	1. Abolish clock changes 2. Change the Standard time from Eastern European time (UTC+2) to Central European time (UTC+1)
Austria Croatia Czechia Denmark Germany Hungary Italy Malta Poland Slovakia Slovenia Sweden	Central European time = UTC+1 (current Standard time)	1. Abolish clock changes and stay on Standard time
Belgium France Luxembourg Netherlands Spain	Western European time (UTC)	1. Abolish clock changes 2. Change the Standard time from Central European time (UTC+1) to Western European time (UTC±0)
Ireland	Western European time (UTC)	1. Abolish clock changes 2. Change the Standard time (currently used during the DST period) from Irish Standard time (UTC+1) to Western European time (UTC±0)
Portugal	Western European time (UTC) (current standard time)	1. Abolish clock changes 2. Stay on Standard time

1. RECOMMENDATIONS FOR THE TRANSITION

After agreement of a common date within the EU, we recommend doing the transition in 1 to 2 steps depending on the member state:

Step 1: All EU countries abolish the clock change to Daylight Saving Time* in spring and remain on the clock time they use in winter. For those countries whose recommended time zone is their current standard time, no further steps need to be taken.

Step 2: Those EU countries whose recommended time zone is not yet their current standard time, additionally turn back their clocks one last time by one hour in autumn, in order to adopt their recommended time zone as their new standard time.

2. FURTHER RECOMMENDATIONS FOR MEMBER STATES AND AMONGST CITIZENS

- **Create and implement a transition plan per member state** that allows for public and private institutions to facilitate the change, with special focus on those sectors that may expect a higher impact (e.g. emergency and transport services). It is proposed that each Member State collect the national concerns, evaluate them, and either assuage them or find solutions to tackle them.
    - The European Commission should be able to review and ensure the coordination among the member states to ensure the implementation of the measures. Some key aspects will require this inter-state coordination, as for example regional trains and other means of transports.
- **Raise awareness** amongst citizens about the benefits of living in their own time zone, and the negative conseuqences of the current system. Do this with the help of the press, social media, and apps such as *Solar Time*, which shows solar time for people to compare clock time with the real (solar) time of day.

**In this proposal we use the international term 'Daylight Saving Time (DST)' instead of the European 'summertime'*

3. CONTEXT OF CLOCK TIME IN EUROPE

3.1. History

Over thousands of years, people lived by their biological clocks, which are set by the natural day-night-cycle[1-2]. The clock was invented with the purpose to measure the time of the day (solar time) in order to facilitate social organisation[2].

Before the end of the 19th century, clock time was aligned with solar time (natural time) everywhere on Earth and therefore reflected reliably the time of the day, with the sun being at its highest point at 12.00 noon local clock time[1-2].

At the end of the 19th century, 24 artificial time zones were implemented worldwide to facilitate coordination for transportation and telecommunication purposes[3]. Within each time zone the sun is at its highest point at 12.00 o'clock only on the meridian of that time zone, and clocks are misaligned with solar time up to 30 minutes towards the east and 30 minutes towards the west of the meridian. This way, clocks display the time of day with a maximum error of only 30 minutes relative to solar time.

During the Second World War, Western European states were forced to adopt Central European Time by Hitler and Franco. After the war, this was not revoked, leaving the Western European states at a disadvantage to the Central European states due to the detrimental effects of misaligned clocks (see details below).

In the 1970s and 1980s Daylight Saving Time (DST), popularly known as "summertime" in the EU, was implemented in most European countries with the intent to save energy[1]. This increased the clock misalignment by one extra hour for part of the year. In 2000, the switch to and from DST was regulated EU wide in Directive 2000/84/EC. In addition DST was extended to 7 months of the year[4].

3.2. Current political situation

On September 12, 2018, the European Commission presented a proposal for a Directive of the European Parliament and of the European Council discontinuing the clock changes and repealing Directive 2000/84/EC.

On March 26, 2019, the European Parliament adopted the EU proposal to abolish the clock changes between Standard Time and Daylight Saving Time.

The EU proposal was put on hold by the Transport, Telecommunications and Energy Council (TTE) of the European Union, composed by the respective Ministers of the national governments of the Member States. They must ratify the proposal and state in which time zone they wish to remain permanently, in order for the proposal to enter into force.

For the past 3 years there has been no political progress on this matter.

4. WHY SHOULD PERMANENT TIME ZONES BE AS CLOSE AS POSSIBLE TO SOLAR TIME?

4.1. Summary of benefits

The proven benefits of clocks being aligned with solar time and the negative impact of misaligned clocks on health, economy, education, safety and environment urge for the implementation of permanent time zones as close as possible to solar time (natural time) in Europe.

4.2. The scientific consensus on natural time

The decision to abandon clock changes was welcomed by scientific organisations worldwide[5–12]. According to the **scientific consensus** it is best for human health, economy and safety to adopt permanent time zones as close as possible to solar time (natural time). That means implementing the current Standard Time permanently and, in the case of the Western European member states, to reinstall the geographically correct time zone[5–13].

Misaligned clocks that make schedules **even earlier** within the natural day-night cycle (like in Western European member states and everywhere during DST) increase sleep deprivation[14–16], which is the main cause for the negative effects on human health, economy and safety.

4.3. Health

- From a medical and chronobiological point of view[5–13], it is best for human mental[17–22] and physical health[22–26], learning and work performance and alertness[14 27–31], when clock time is aligned with solar time and consequently with people's biological (circadian) clocks.
- While clock changes provoke an acute disruption of people's circadian health[16 30 32–37], living permanently with a clock time that is misaligned to solar time, provokes a permanent disruption on people's circadian rhythms, resulting in health implications, such as an increased risk of cancer[22–24 38], metabolic syndrome[22 39], heart problems[5 22 32 38], sleep problems[14–15] and depression[18 40].
- In addition, the new field of chronomedicine shows the importance of a stable and correct clock time to make accurate health recommendations, such as timing for harmful UV rays from the sun and the precise timing of medical and surgical interventions and treatments.

4.4. Economy

- There are no proven benefits for the economy of clocks being misaligned to solar time (e.g. during DST). However, it is known to have negative economic effects due to the reduction of health[14] [30] [41], productivity[14] [30] [31] [37] and safety[16] [36] [41].
- In the case of DST, these negative effects are both experienced acutely[16] [30] [36] [37] [41], the week after the switch to DST in spring, and chronically throughout the DST months[14] [30] [31].
- There is on average no significant effect of DST on energy savings[42] [43]. While some studies show only insignificant energy savings, others show an increase in energy spending[42–48].

4.5. Safety & environment

- Publications on the topic of road safety establish that misaligned clocks due to DST increase the number of car accidents, not the opposite[33] [41] [49] [50].
- Sleep deprivation causes a marked decline in waking performance, judgement, and decision-making[16] [51] [52] [64]. Sleep-related fatigue is an independent risk factor in work-related injuries and fatalities[52]. Some of the most devastating human and environmental health disasters have been partially attributed to sleep loss and night shift work-related performance failures, including the tragedy at the Bhopal, India, chemical plant; the nuclear reactor meltdowns at Three Mile Island and Chernobyl; as well as the grounding of the Star Princess cruise ship and the Exxon Valdez oil tanker[52].
- Misaligned clocks and clock changes also cause extra pollution with negative impact not only on human societies but also on our planet's ecosystems and biodiversity[42] [43] [53–57]. This is because natural mechanisms that assist in pollutant dispersion and maintenance of the atmosphere depend on the time of the day[56–59]. Shifting social activity (industrial and otherwise) to earlier times, interferes with pollutant dispersion[53] [54] [56] [59], ozone maintenance and production[42] [53] [54] [56] [59], and it increases primary pollutants from fuel burning[42] [43] [53] [54]. DST has also been associated with increased man-made wildfires[57]. Not only are these effects worsened by the increasing light pollution[60] and global warming[61] [62], they can in return amplify these catastrophes: earlier social schedules increase industrial early-morning light pollution and traffic jams at the times of day when UV radiation is the strongest, which increases air pollution.

4.6. Human rights

Considering the current scientific knowledge about the negative impact on people's health and wellbeing, continuing the clock changes and the application of wrong time zones would be against human rights.
According to article 12 paragraph (1) of the International Covenant on Economic, Social and Cultural Rights[63]:

> *The States Parties to the present Covenant recognize the right of everyone to the enjoyment of the highest attainable standard of physical and mental health.*", which is followed by paragraph (2) *"The steps to be taken by the States Parties to the present Covenant to achieve the full realization of this right shall include those necessary for:*
>
> *(a) […] the healthy development of the child;*
> *(b) The improvement of all aspects of environmental and industrial hygiene;*
> *(c) The prevention of […] epidemic, endemic, occupational and other diseases*

Call for action

Implementing natural time in the EU requires support from all over the continent. There are several ways you can help such a project in order to contribute to a healthier, more just and egalitarian, more sustainable and more productive Europe:

- **Join in** the Barcelona Declaration Working Group on natural time in order to contribute with your research, either as an individual researcher or as a research group.
- **Spread the word** sharing this proposal with your fellows —especially if you are a public official, it is important that municipalities, regions and states from all over Europe know the benefits of adopting permanent natural time zones.
- **Organise awareness actions** by doing events, performances, or any other creative ways to raise awareness about the importance of living in the right time zone. Contact us for ideas and support.

5. ANNEX

5.1. Working group members

As representatives of organisations that have **signed the Barcelona Declaration on Time Policies**:

European Biological Rhythms Society
-
Martha Merrow

European Medical Association
-
Guglielmo Trovato

Workers´ Group of the European Economic and Social Committee
-
Maria Nikolopoulou

International Alliance for Natural Time
-
Ticia Luengo Hendriks, Manuela Lipinsky Nunes

Verein zur Verzögerung der Zeit / Association To Delay the Time
-
Martin Liebmann

Deutsche Gesellschaft für Zeitpolitik
-
Dietrich Henckel

ARHOE - Comisión Nacional para la Racionalización de los Horarios Españoles
-
Ángel Largo

Fundación Estivill Sueño
-
Carla Estivill Domènech

Barcelona Time Use Initiative for a Healthy Society
–
Marta Junqué Surià and Ariadna Güell Sans

Several organisations have already endorsed the text. They are listed here: https://www.timeuse.barcelona/proposal-end-dst-eu

As individual experts contributing to the text:

Diego Golombek, Ph.D, Chronobiologist (Argentina)

Maria de los Angeles Rol de Lama, Ph.D, Chronobiologist (Spain)

Erik Herzog, Ph.D, Neuroscientist specialised in circadian rhythms in mammals (USA)

Gonzalo Pin, Pediatrician specialised on pediatric sleep medicine (Spain)

Till Roenneberg, Ph.D, Chronobiologist and sleep researcher (Germany)

5.2. References

1. K. Benediktsson and S. D. Brunn, "Time Zone Politics and Challenges of Globalisation," Tijdschrift voor economische en sociale geografie, vol. 106, no. 3, pp. 276–290, 2015, doi: https://doi.org/10.1111/tesg.12114

2. D. Kehlmann, Measuring the World. Hachette UK, 2010.

3. Various, International Conference Held at Washington for the Purpose of Fixing a Prime Meridian and a Universal Day. Gibson Bros., Printers and Bookbinders, 1884. Accessed: Jun. 07, 2022. [Online]. Available: https://www.gutenberg.org/files/17759/17759-h/17759-h.html

4. T. Roenneberg, E. C. Winnebeck, and E. B. Klerman, "Daylight Saving Time and Artificial Time Zones – A Battle Between Biological and Social Times," Front. Physiol., vol. 10, p. 944, Aug. 2019, doi: 10.3389/fphys.2019.00944.

5. J. R. Carter, K. L. Knutson, and B. Mokhlesi, "Taking to 'Heart' the Proposed Legislation for Permanent Daylight Saving Time," American Journal of Physiology-Heart and Circulatory Physiology, May 2022, doi: 10.1152/ajpheart.00218.2022.

6. T. Roenneberg et al., "Why Should We Abolish Daylight Saving Time?," J Biol Rhythms, vol. 34, no. 3, pp. 227–230, Jun. 2019, doi: 10.1177/0748730419854197.

7. M. A. Rishi et al., "Daylight saving time: an American Academy of Sleep Medicine position statement," Journal of Clinical Sleep Medicine, Aug. 2020, doi: 10.5664/jcsm.8780.

8. Associação Portuguesa de Sono (APS), "Parecer da Associação Portuguesa de Sono (APS) sobre a mudança da Hora," Associação Portuguesa de Sono, Mar. 2021. Accessed: Apr. 17, 2021. [Online]. Available: https://apsono.com/images/2020/mudana_da_hora.pdf

9. Canadian Society for Chronobiology, "Official statement of the Canadian Society for Chronobiology in support of year-round Standard Time." Canadian Society for Chronobiology, Apr. 13, 2022. Accessed: Jun. 07, 2022. [Online]. Available: https://static1.squarespace.com/static/529c9b13e4b044b187f8472f/t/6256fd5557c41c1bcf418d2f/1649868118035/CSC+official+statement+on+time+change+2022+EN.pdf

10. Deutschen Gesellschaft für Schlafforschung und Schlafmedizin (DGSM), "Stellungnahme der Deutschen Gesellschaft für Schlafforschung und Schlafmedizin (DGSM) zur Beibehaltung / Abschaffung der Sommerzeit." Deutschen Gesellschaft für Schlafforschung und Schlafmedizin (DGSM), 2018. Accessed: Jun. 07, 2022. [Online]. Available: https://www.dgsm.de/fileadmin/dgsm/stellungnahmen/2018_Sommerzeit%20_2018.pdf

11. European Biological Rhythms Society (EBRS), European Sleep Research Society (ESRS), and Society for Research on Biological Rhythms (SRBR), "To the EU Commission on DST." Accessed: Oct. 19, 2020. [Online]. Available: https://esrs.eu/wp-content/uploads/2019/03/To_the_EU_Commission_on_DST.pdf

12. Slaapgeneeskunde Vereniging Nederland (SVNL), "Zomertijd afschaffen." Slaapgeneeskunde Vereniging Nederland (SVNL), Oct. 27, 2018. Accessed: Jun. 07, 2022. [Online]. Available: https://www.nswo.nl/zomertijd-afschaffen/

13. M. Meira e Cruz et al., "Impact of Daylight Saving Time on circadian timing system: An expert statement," European Journal of Internal Medicine, vol. 60, pp. 1–3, Feb. 2019, doi: 10.1016/j.ejim.2019.01.001

14. O. Giuntella and F. Mazzonna, "Sunset time and the economic effects of social jetlag: evidence from US time zone borders," Journal of Health Economics, vol. 65, pp. 210–226, May 2019, doi: 10.1016/j.jhealeco.2019.03.007

15. M. F. Borisenkov et al., "Seven-year survey of sleep timing in Russian children and adolescents: chronic 1-h forward transition of social clock is associated with increased social jetlag and winter pattern of mood seasonality," Biological Rhythm Research, vol. 48, no. 1, pp. 3–12, Jan. 2017, doi: 10.1080/09291016.2016.1223778

16. C. M. Barnes and D. T. Wagner, “Changing to daylight saving time cuts into sleep and increases workplace injuries.,” Journal of Applied Psychology, vol. 94, no. 5, pp. 1305–1317, 2009, doi: 10.1037/a0015320

17. M. F. Borisenkov et al., “Sleep characteristics, chronotype and winter depression in 10-20-year-olds in northern European Russia,” J Sleep Res, vol. 24, no. 3, pp. 288–295, Jun. 2015, doi: 10.1111/jsr.12266

18. R. Levandovski et al., “Depression Scores Associate With Chronotype and Social Jetlag in a Rural Population,” Chronobiology International, vol. 28, no. 9, Art. no. 9, Nov. 2011, doi: 10.3109/07420528.2011.602445

19. R. G. Foster, S. N. Peirson, K. Wulff, E. Winnebeck, C. Vetter, and T. Roenneberg, “Sleep and Circadian Rhythm Disruption in Social Jetlag and Mental Illness,” in Progress in Molecular Biology and Translational Science, vol. 119, Elsevier, 2013, pp. 325–346. doi: 10.1016/B978-0-12-396971-2.00011-7

20. M. Wittmann, M. Paulus, and T. Roenneberg, “Decreased Psychological Well-Being in Late ‘Chronotypes’ Is Mediated by Smoking and Alcohol Consumption,” Substance Use & Misuse, vol. 45, no. 1–2, pp. 15–30, Jan. 2010, doi: 10.3109/10826080903498952.

21. C. Randler and C. Vollmer, “Aggression in Young Adults — A Matter of Short Sleep and Social Jetlag?,” Psychol Rep, vol. 113, no. 3, pp. 754–765, Dec. 2013, doi: 10.2466/16.02.PR0.113x31z7

22. H. Zhang, T. Dahlén, A. Khan, G. Edgren, and A. Rzhetsky, “Measurable health effects associated with the daylight saving time shift,” PLOS Computational Biology, vol. 16, no. 6, p. e1007927, Jun. 2020, doi: 10.1371/journal.pcbi.1007927

23. M. F. Borisenkov, “Latitude of Residence and Position in Time Zone are Predictors of Cancer Incidence, Cancer Mortality, and Life Expectancy at Birth,” Chronobiology International, vol. 28, no. 2, Art. no. 2, Mar. 2011, doi: 10.3109/07420528.2010.541312

24. F. Gu et al., “Longitude Position in a Time Zone and Cancer Risk in the United States,” Cancer Epidemiol Biomarkers Prev, vol. 26, no. 8, Art. no. 8, Aug. 2017, doi: 10.1158/1055-9965.EPI-16-1029

25. H. Wu, S. Dunnett, Y.-S. Ho, and R. C.-C. Chang, “The role of sleep deprivation and circadian rhythm disruption as risk factors of Alzheimer’s disease,” Frontiers in Neuroendocrinology, vol. 54, p. 100764, Jul. 2019, doi: 10.1016/j.yfrne.2019.100764

26. G. D. M. Potter, D. J. Skene, J. Arendt, J. E. Cade, P. J. Grant, and L. J. Hardie, “Circadian Rhythm and Sleep Disruption: Causes, Metabolic Consequences, and Countermeasures,” Endocrine Reviews, vol. 37, no. 6, Art. no. 6, Dec. 2016, doi: 10.1210/er.2016-1083

27. M. F. Borisenkov, E. V. Perminova, and A. L. Kosova, “Chronotype, Sleep, Length, and School Achievement of 11- to 23-Year-old Students in Northern European Russia,” Chronobiology International, vol. 27, no. 6, pp. 1259–1270, Jul. 2010, doi: 10.3109/07420528.2010.487624

28. L. Tonetti, V. Natale, and C. Randler, “Association between circadian preference and academic achievement: A systematic review and meta-analysis,” Chronobiology International, vol. 32, no. 6, Art. no. 6, Jul. 2015, doi: 10.3109/07420528.2015.1049271

29. R. Á. Haraszti, K. Ella, N. Gyöngyösi, T. Roenneberg, and K. Káldi, “Social jetlag negatively correlates with academic performance in undergraduates,” Chronobiology International, vol. 31, no. 5, pp. 603–612, Jun. 2014, doi: 10.3109/07420528.2013.879164

30. L. Jin and N. R. Ziebarth, “Sleep, health, and human capital: Evidence from daylight saving time,” Journal of Economic Behavior & Organization, vol. 170, pp. 174–192, Feb. 2020, doi: 10.1016/j.jebo.2019.12.003

31. M. Gibson and J. Shrader, “Time Use and Labor Productivity: The Returns to Sleep,” The Review of Economics and Statistics, vol. 100, no. 5, pp. 783–798, Dec. 2018, doi: 10.1162/rest_a_00746

32. J. O. T. Sipilä, J. O. Ruuskanen, P. Rautava, and V. Kytö, “Changes in ischemic stroke occurrence following daylight saving time transitions,” Sleep Medicine, vol. 27–28, pp. 20–24, Nov. 2016, doi: 10.1016/j.sleep.2016.10.009

33. J. Fritz, T. VoPham, K. P. Wright, and C. Vetter, “A Chronobiological Evaluation of the Acute Effects of Daylight Saving Time on Traffic Accident Risk,” Current Biology, vol. 30, no. 4, pp. 729-735.e2, Feb. 2020, doi: 10.1016/j.cub.2019.12.045

34. I. Janszky et al., “Daylight saving time shifts and incidence of acute myocardial infarction – Swedish Register of Information and Knowledge About Swedish Heart Intensive Care Admissions (RIKS-HIA),” Sleep Medicine, vol. 13, no. 3, pp. 237–242, Mar. 2012, doi: 10.1016/j.sleep.2011.07.019

35. A. Sandhu, M. Seth, and H. S. Gurm, “Daylight savings time and myocardial infarction,” Open Heart, vol. 1, no. 1, p. e000019, Mar. 2014, doi: 10.1136/openhrt-2013-000019

36. B. P. Kolla, B. J. Coombes, T. I. Morgenthaler, and M. P. Mansukhani, “Increased Patient Safety-Related Incidents Following the Transition into Daylight Savings Time,” J GEN INTERN MED, Aug. 2020, doi: 10.1007/s11606-020-06090-9

37 D. T. Wagner, C. M. Barnes, V. K. G. Lim, and D. L. Ferris, “Lost sleep and cyberloafing: Evidence from the laboratory and a daylight saving time quasi-experiment.,” Journal of Applied Psychology, vol. 97, no. 5, pp. 1068–1076, 2012, doi: 10.1037/a0027557

38. F. Rutters et al., “Is Social Jetlag Associated with an Adverse Endocrine, Behavioral, and Cardiovascular Risk Profile?,” J Biol Rhythms, vol. 29, no. 5, pp. 377–383, Oct. 2014, doi: 10.1177/0748730414550199

39. A. D. M. Koopman et al., “The Association between Social Jetlag, the Metabolic Syndrome, and Type 2 Diabetes Mellitus in the General Population: The New Hoorn Study,” J Biol Rhythms, vol. 32, no. 4, pp. 359–368, Aug. 2017, doi: 10.1177/0748730417713572.

40. A. S. Polugrudov, A. S. Panev, V. V. Smirnov, N. M. Paderin, M. F. Borisenkov, and S. V. Popov, “Wrist temperature and cortisol awakening response in humans with social jetlag in the North,” Chronobiology International, vol. 33, no. 7, pp. 802–809, Aug. 2016, doi: 10.3109/07420528.2016.1168829

41. A. C. Smith, “Spring Forward at Your Own Risk: Daylight Saving Time and Fatal Vehicle Crashes,” American Economic Journal: Applied Economics, vol. 8, no. 2, pp. 65–91, Apr. 2016, doi: 10.1257/app.20140100

42. W. Hecq, Y. Borisov, and M. Totte, “Daylight saving time effect on fuel consumption and atmospheric pollution,” Science of The Total Environment, vol. 133, no. 3, pp. 249–274, Jun. 1993, doi: 10.1016/0048-9697(93)90248-5

43. M. J. Kotchen and L. E. Grant, “Does Daylight Saving Time save energy? Evidence from a natural experiment in Indiana,” The Review of Economics and Statistics, p. 14, 2009.

44. Z. Irsova, T. Havranek, and D. Herman, “Daylight saving saves no energy,” VoxEU.org, Dec. 02, 2017. https://voxeu.org/article/daylight-saving-saves-no-energy (accessed Jun. 13, 2020).

45. T. Havránek, D. Herman, and Z. Iršová, “Does Daylight Saving Save Electricity? A Meta-Analysis,” The Energy Journal, 2018, doi: 10.5547/01956574.39.2.thav

46. J. Silva, A. Couto, and J. Duque, “Análise Técnica Do Impacto Da Mudança De Hora Legal Na Penetração Da Geração De Energia Renovável Não Controlável No Consumo Em Portugal Continental,” Laboratório Nacional de Energia e Geologia, I.P. (LNEG), Lisboa, Technical note 235-UER-2018, Oct. 2018.

47. The Department of Energy (DOE), “Impact of Extended Daylight Saving Time on National Energy Consumption - Report to Congress.” The Department of Energy (DOE), Oct. 2008.

48. M. López, “Daylight effect on the electricity demand in Spain and assessment of Daylight Saving Time policies,” Energy Policy, vol. 140, p. 111419, May 2020, doi: 10.1016/j.enpol.2020.111419

49. R. N. Carey and K. M. Sarma, “Impact of daylight saving time on road traffic collision risk: a systematic review,” BMJ Open, vol. 7, no. 6, p. e014319, Jun. 2017, doi: 10.1136/bmjopen-2016-014319

50. Varughese and Allen, “Fatal accidents following changes in daylight savings time: the American experience,” Sleep Med., vol. 2, no. 1, pp. 31–36, Jan. 2001, doi: 10.1016/s1389-9457(00)00032-0

51. P. Kelley, Body Clocks: The Biology of Time for Sleep, Education and Work. John Catt Educational, Limited, 2019

52. I. of Medicine, Sleep Disorders and Sleep Deprivation: An Unmet Public Health Problem. 2006. doi: 10.17226/11617

53. Christine Mlot, “Daylight Saving and Pollutant Production,” Environment, vol. 30, no. 7, p. 23, 1988.
54. J. C. Dechaux, P. Coddeville, and V. Zimmermann, “Etude sur modèle de l’influence de l’heure d’été sur la pollution photo-oxydante,” Pollut. atmos, vol. 28, no. 112, pp. 248–256, 1986.

55. Jean Briane, “Recommendation 1432: Observance of the system of European time zones.” Council of Europe. Accessed: Jun. 14, 2022. [Online]. Available: https://pace.coe.int/en/files/16732/html

56. A. G. Williams et al., “Radon as a tracer of atmospheric influences on traffic-related air pollution in a small inland city,” Tellus B: Chemical and Physical Meteorology, vol. 68, no. 1, p. 30967, Dec. 2016, doi: 10.3402/tellusb.v68.30967

57. Y. Kountouris, “Human activity, daylight saving time and wildfire occurrence,” Science of The Total Environment, vol. 727, p. 138044, Jul. 2020, doi: 10.1016/j.scitotenv.2020.138044

58. H. Stark et al., “Nighttime photochemistry: nitrate radical destruction by anthropogenic light sources,” 2010.

59. S. S. Brown et al., “Vertical profiles in NO3 and N2O5 measured from an aircraft: Results from the NOAA P-3 and surface platforms during the New England Air Quality Study 2004,” Journal of Geophysical Research: Atmospheres, vol. 112, no. D22, 2007, doi: 10.1029/2007JD008883

60. F. Falchi et al., “The new world atlas of artificial night sky brightness,” Science Advances, vol. 2, no. 6, p. e1600377, Jun. 2016, doi: 10.1126/sciadv.1600377

61. NASA, “Scientific Consensus: Earth’s Climate is Warming,” Climate Change: Vital Signs of the Planet. https://climate.nasa.gov/scientific-consensus (accessed Jun. 18, 2022).

62. W. J. Ripple, C. Wolf, T. M. Newsome, P. Barnard, and W. R. Moomaw, “World Scientists’ Warning of a Climate Emergency,” BioScience, vol. 70, no. 1, pp. 8–12, Jan. 2020, doi: 10.1093/biosci/biz088

63. United Nations, “International Bill of Human Rights,” in International Bill of Human Rights, United Nations publication, 2003.

64. Ben Simon E, Vallat R, Rossi A, Walker MP (2022) Sleep loss leads to the withdrawal of human helping across individuals, groups, and large-scale societies. PLoS Biol 20(8): e3001733. https://doi.org/10.1371/journal.pbio.3001733

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Contact information
info@timeuse.barcelona
Time Use Initiative

Press enquiries
communication@timeuse.barcelona
Communications Team
Time Use Initiative