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COMPARATIVE ANALYSIS OF DAYLIGHT TIME LOSSES AND ELECTRICAL ENERGY LOSSES WHEN TRANSITION TO PERMANENT WINTER OR SUMMER TIME

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Recently, the discussion on the feasibility of the annual transition to summer and winter time has significantly intensified in the society of many countries in the world. Considering a certain discomfort from daylight-saving, the most people suggest to abandon it. But there is no final reasoned decision on permanent time: winter (zone, standard) or summer time. Daylight-saving was introduced to save electricity, but currently there are no accurate calculations to confirm it. The article is devoted to solving the urgent problem of determining the most effective order of calculating time for more complete use of sunlight and, accordingly, to reduce the electrical energy losses for lighting in the life of modern world society. The purpose of the study is to develop a technique for precise calculating the lost daylight hours and electrical energy losses for lighting in different countries of the world under different time calculation scenarios – when applying the transition to summer time; when refusing summer time and final introducing winter (zone, standard) time; when applying permanent summer time. The article presents the main arguments of supporters and opponents of the introduction of permanent winter and summer time. The calculation and comparative analysis of the losses of daylight hours and, as a result, the losses of electrical energy for lighting per year have been carried out under different time calculation options. The approximate cost of electrical energy losses for lighting under different time calculation options for some European countries has been calculated. To increase the accuracy of the calculations, the sociological aspect of the study was considered in combination with the astronomical one. The developed technique is recommended to be used in calculations when determining the optimal order of time calculation in different countries of the world for its introduction at the international or national legislative level.The application of the technique will allow saving significant quantity of electricity during the evening peak energy consumption, that will contribute to the stability of the country's energy system and preservation of the fuel and financial resources. References 19, figures 7, tables 6.
Keywords: electrical energy losses, loss of daylight hours, winter time, summer time, daylight hours, daylight-saving, standard time, zone time.

Introduction. Recently, in many countries of the world, the discussion regarding the feasibility of daylight-saving, which is used in almost 70 countries of the world, has significantly intensified.

The lack of accurate calculations of electricity savings, as well as a certain discomfort for people during the transition from winter to summer time and back with long-term adaptation lead to the fact that there are more and more supporters of canceling the transition to summer time. But there is no consensus on the time which should be finally chosen after ending a clock change – summer or winter time.

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Daylight Saving Time (DST), when clocks move forward one hour in the spring and back one hour in the fall, was first introduced in Europe in 1916. At the time, Germany, that was still at war, tried to reduce its coal consumption in power plants so as to use it at its gunpowder factories. Most countries in Europe, the United Kingdom, the United States, and Australia have also introduced daylight saving time.

This practice was largely abandoned in Europe after World War II, but was revived in the 1970s due to the oil crisis in an attempt to reduce the need for artificial lighting and therefore energy consumption.

Daylight saving time has been introduced across most of the United States territory since 1966, after it was first implemented in 1918. The year-round daylight savings time was used during World War II and was reintroduced in 1973 in an attempt to reduce the energy consumption due to the oil embargo.

On March 15, 2022, the US Senate unanimously passed a bill that made daylight saving time permanent and canceled the biannual clock change starting in 2023 [1]. This bill was called the Sunlight Protection Act. The law was pushed by advocates for brighter days and greater economic activity.

The House of Representatives held a hearing on this issue in the specialized Energy and Trade Committee, where the following arguments of supporters and opponents of the bill were discussed:

– adoption of the law will help children play outdoors longer and reduce seasonal depression;
– the time has come for the idea of refusing clock change;
– not to allow children to go to school in the dark;
– since 2015, about 30 US states have passed a law prohibiting clock change twice a year, with some states offering to do so only if the neighboring states do the same;
– the loss of that one hour of sleep affects people for several days after the clock change, disrupting the sleep patterns of children and pets;
– in 2019 social survey showed that 71 % of Americans prefer not to change the clock twice a year anymore;
– the law can prevent a small increase in the number of car accidents, which usually occurs during the time change;
– conducted medical studies indicate a slight increase in the frequency of heart attacks and strokes shortly after the time change;
– this law could help businesses like golf courses that could benefit more from evening daylight;
– adoption of the law will have real consequences for the economy and everyday life;
– the bill would allow Arizona and Hawaii, which do not implement daylight saving time, to remain on standard time, as well as American Samoa, Guam, the Northern Mariana Islands, Puerto Rico and the US Virgin Islands;
– most people support the end of clock change, but undecided whether to maintain daylight saving time or standard time as a permanent choice.

The Department of Transportation (DOT) reports that daylight savings time saves energy, prevents traffic accidents and reduces crime. DOT controls time zones and uniform daylight-saving time.

Due to disagreements over whether to choose the final daylight-saving time or winter time, the Sunlight Protection Act did not pass the US House of Representatives and was not signed into law by President Joe Biden.

The newly elected US President Donald Trump announced in December 2024 the need to cancel daylight saving time. He wrote on social media: “The Republican Party will use its best efforts to eliminate Daylight Saving Time, which has a small but strong constituency, but shouldn’t! Daylight Saving Time is inconvenient, and very costly to our Nation” [2]. At the same time, Trump did not specifically indicate which time should be permanently left after the abolition of the transition – summer or winter time.

Congress has not held new hearings on this issue in more than two years. Now the Senate will have to consider it again.

In the European Union, the transition to summer time is defined by Directive 2000/84/EC of the European Parliament and of the Council of 19 January 2001 on summer-time arrangements [3].

In Europe, the issue of switching to summer time is also intensifying. Non-governmental organizations and experts demand that politicians include the rejection of clock change in Europe in the EU election programs. The International Alliance for Natural Time (IANT) and the public organization Time Use Initiative were created. They issued the EU Manifesto on Time Use Policy [4].

The Manifesto includes 12 necessary changes that Europe must make at legislative level to guarantee the "right for time" for all Europeans. Time is becoming an increasingly scarce and unequal resource. 20% of European citizens and 34% of European women with children experience a lack of time. The consequences of time scarcity and time inequality have far-reaching consequences, affecting both individual well-being and social cohesion.

One of the key proposals of the Manifesto is that the EU should put an end to seasonal time changes – this is the way to quickly get benefits for health, the economy and the environment. The Manifesto proposes to formulate a Roadmap for the abolition of daylight-saving time (seasonal clock change) until 2026.

In turn, in the European Union from July 4 to August 16, 2018, the largest online survey in the history of the EU regarding the procedure for calculating time was held, about 4.6 million people participated. More than 80% of survey participants were in favor for canceling of time change [5].

On September 12, 2018, the European Commission, based on the results of an opinion poll, presented a plan for the European Union to abandon the seasonal clock change.

The Commission suggested that EU countries permanently abandon the time change from 2019.

According to the proposals of the European Commission, the seasonal adjustment of clocks must be canceled throughout the European Union. However, the key point is that the Commission gives member countries the freedom to decide in which time they want to live – winter or summer time.

The European Commission proposes that the neighboring countries take decisions in a coordinated manner to ensure the proper functioning of the internal market and to avoid a situation where some member states decide to keep clock change while others abandon the practice.

The proposal of the European Commission had to be approved by the European Parliament and the EU Council. In 2019, the European Parliament supported the abolition of the mandatory clock change to summer and winter time. This means that each country that is a member of the European Union can choose for itself: to keep the current system of changing the clock or to abandon it.

After 2019, no political decisions were made regarding the procedure for calculating time at the level of the European Union.

The **purpose** of the study is to develop a technique of accurate calculation of the lost daylight hours and, as a result, the loss of electrical energy for lighting per year in different countries of the world under different options for calculating the time – when applying the transition to summer time; when refusing summer time and the final introduction of winter (standard, zone) time; at permanent summer time, as well as to conduct a comparative analysis of the loss of daylight hours when applying the transition to summer time, when introducing permanent summer or permanent winter time in certain European countries. The essence of the technique is to find the difference between the average time of awakening of the people and the time of sunrise of a certain calendar day, which is the lost daylight hours. After that, the lost daylight hours for each day are summed up for the whole year. The obtained value of the lost daylight hours for the year with different options for calculating time allows to perform comparative analysis with the determination of the optimal time calculating scenario. Solving these problems requires consideration of the sociological and astronomical aspects.

1. **Sociological and astronomical aspects of the study.** The main criterion for the correct choice of the order of time calculation is the maximum use of daylight hours by the majority of the country's population. Therefore, the solution of this issue requires the study of two aspects – sociological and astronomical.

The *sociological aspect* involves determining the average time of morning awakening and the time of going to bed in the evening for most people in the country. The specified times differ from country to country, from region to region, and are determined historically by lifestyle, associated with job and economic activity.

These times have a pronounced subjective character, depend on the nation, culture, age and occupation.

The following practices for determining the statistical average time of awakening and bedtime are used more often:

– statistical processing; analysis of traffic of mobile operators;
– the use of wearable electronic devices that record biorhythms and the times of going to sleep and waking up;
– the use of appropriate mobile applications for tracking sleep indicators (ENTRAIN, etc.);
– sociological survey (Exit Poll).

Researchers from the National University of Singapore and Finnish sleep technology startup Oura Health processed the anonymous data collected from the popular wearable device between January 2021 and

January 2022. The sleep habits of more than 220.000 people in 35 countries were analyzed [6, 7]. While sleep study has historically relied on survey data from a small number of people at once, the sleep tracking applications can objectively track the sleep by movements, heart rate, and body temperature of many users over long time.

The obtained average times of going to sleep and waking up (working days of the week) for different countries are shown in Fig. 1 [6 – 9].

The *astronomical aspect* involves determining the loss of daylight hours based on the waking time of the majority of people in the country and the astronomical time of sunrise. The losses of daylight hours will take place when the sunrise occurs earlier than most people wakes up:

$$t_{lls} = \overline{t}_{wut} - \overline{t}_{ss},$$

where t_{lls} is the losses of daylight hours; $\overline{t}_{wut}$ is the average waking time of the country's population; $\overline{t}_{ss}$ is the average astronomical time of sunrise in the country.

To simplify the calculation technique, we will assume that every person wakes up at the same time throughout the year, which depends on the start time of the working (school) day. Then the average waking time of the country's population per day will be a constant value. Since the astronomical time of sunrise varies from day to day, the loss of daylight hours each day will be different.

2. Determination and comparative analysis of daylight hours losses per year. To determine the total loss of daylight hours per year, it is necessary to sum up the loss of daylight hours for each day during the year:

$$t_{ly} = \sum_{i=1}^{366} \left(\overline{t}_{wut} - \overline{t}_{ss_i} \right).$$

The determination of the loss of daylight hours is considered by the examples of such cities as Kharkiv, Kyiv, Lviv, Sofia, Athens, Berlin, London and Barcelona.

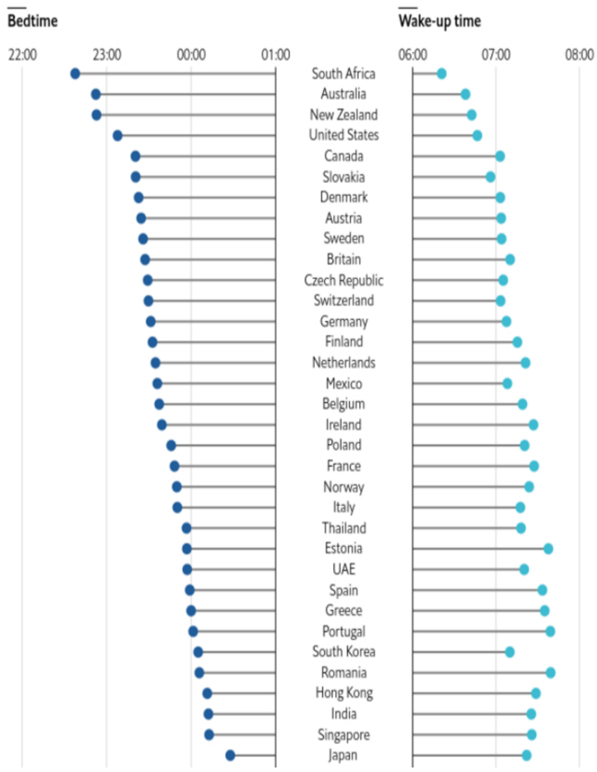

Fig. 1

The example of calculating the loss of daylight hours in Kyiv when transitioning from winter to summer time and back is given in Table 1.

Table 1

Date	Day number from the beginning of the year	Sunrise time	Average wake-up time	Sunset time	Average bedtime	Lost daylight hours, min
Mon, 1 Jan.	1	7:56	7:42	16:05	0:26	–
Wed, 31 Jan.	31	7:33	7:42	16:49	0:26	9
Thu, 1 Feb.	32	7:31	7:42	16:51	0:26	11
Thu, 29 Feb.	60	6:40	7:42	17:39	0:26	62
Fri, 1 Mar.	61	6:38	7:42	17:41	0:26	64
Fri, 29 Mar.	89	5:37	7:42	18:27	0:26	125
Sat, 30 Mar.	90	5:35	7:42	18:28	0:26	127
Sun, 31 Mar.	91	6:33	7:42	19:30	0:26	69
Mon, 1 Apr.	92	6:31	7:42	19:32	0:26	71
Tue, 2 Apr.	93	6:29	7:42	19:33	0:26	73
Tue, 30 Apr.	121	5:31	7:42	20:18	0:26	131
Wed, 1 May.	122	5:30	7:42	20:19	0:26	132
Fri, 31 May.	152	4:49	7:42	21:01	0:26	173
Sat, 1 Jun.	153	4:49	7:42	21:02	0:26	173
Thu, 20 Jun.	172	4:44	7:42	21:15	0:26	178
Sun, 30 Jun.	182	4:48	7:42	21:15	0:26	174
Mon, 1 Jul.	183	4:48	7:42	21:14	0:26	174
Wed, 31 Jul.	213	5:23	7:42	20:45	0:26	139

Date	Day number from the beginning of the year	Sunrise time	Average wake-up time	Sunset time	Average bedtime	Lost daylight hours, min
Thu, 1 Aug.	214	5:24	7:42	20:43	0:26	138
Sat, 31 Aug.	244	6:09	7:42	19:46	0:26	93
Sun, 1 Sep.	245	6:11	7:42	19:44	0:26	91
Mon, 30 Sep.	274	6:55	7:42	18:39	0:26	47
Tue, 1 Oct.	275	6:57	7:42	18:37	0:26	45
Fri, 25 Oct.	299	7:36	7:42	17:47	0:26	6
Sat, 26 Oct.	300	7:37	7:42	17:45	0:26	5
Sun, 27 Oct.	301	6:39	7:42	16:44	0:26	63
Mon, 28 Oct.	302	6:41	7:42	16:42	0:26	61
Tue, 29 Oct.	303	6:42	7:42	16:40	0:26	60
Thu, 31 Oct.	305	6:46	7:42	16:36	0:26	56
Fri, 1 Nov.	306	6:47	7:42	16:35	0:26	55
Sat, 30 Nov.	335	7:33	7:42	15:59	0:26	9
Sun, 1 Dec.	336	7:35	7:42	15:58	0:26	7
Sun, 22 Dec.	357	7:54	7:42	15:58	0:26	–
Tue, 31 Dec.	366	7:56	7:42	16:05	0:26	–
Lost daylight time per year, min						**29 596**
Lost daylight time per year, hr						**493 hr 16 min**

By analogy with Table 1, the lost daylight hours are calculated for such cities as Kharkiv, Lviv, Sofia, Athens, Berlin, London and Barcelona.

The average wake-up time and bedtime for the countries under study are given in Table 2.

Table 2

№	Country	Average wake-up time	Average bedtime
1	Ukraine	7:42	0:26
2	Bulgaria	7:40	0:00
3	Greece	7:40	0:00
4	Germany	7:10	23:30
5	Great Britain	7:10	23:25
6	Spain	7:35	0:00

In the calculations, it was taken into account that the average wake-up time and bedtime in Ukraine are, according to [6, 10 – 11], 7.42 and 0.26 hours, respectively (Table 2).

Fig. 2 shows the sunrise/sunset plots for Kyiv at transitioning from winter to summer time and back with the area of lost daylight hours. The area, bounded by the sunrise plot line and the line of average wake-up time, and shown by yellow, illustrates the lost daylight hours during the year. Fig. 3 shows the sunrise/sunset time plots for Berlin when transitioning from winter to summer time and back with the same section of lost daylight hours.

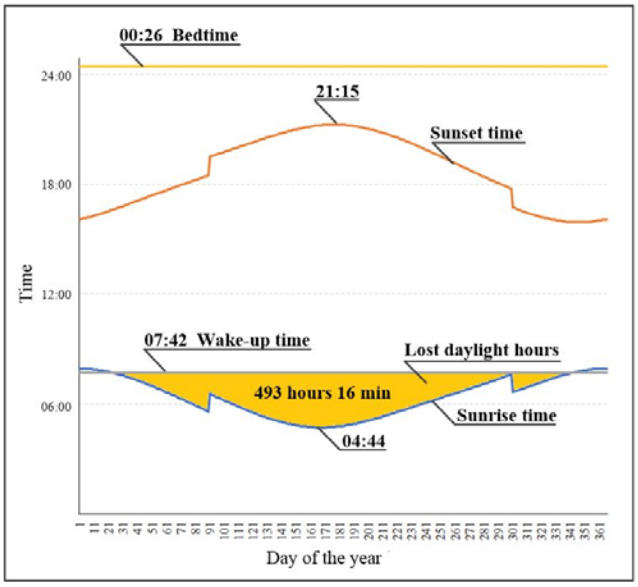

Fig. 2

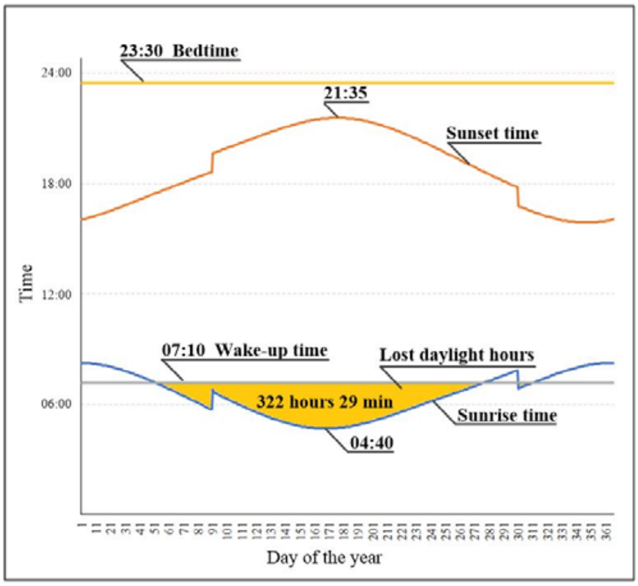

Fig. 3

Fig. 4 shows the sunrise/sunset time plots for Kyiv when using only winter (zone) time with a section of lost daylight hours. Fig. 5 shows the sunrise/sunset time plots for Berlin at only winter (zone) time with a section of lost daylight hours.

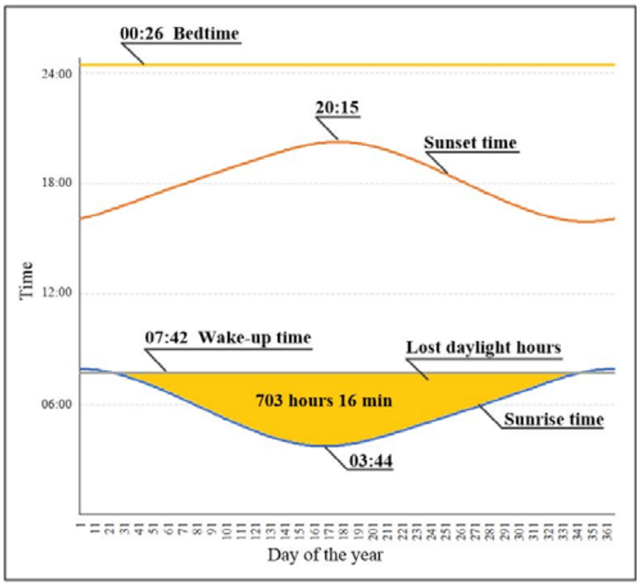

Fig. 4

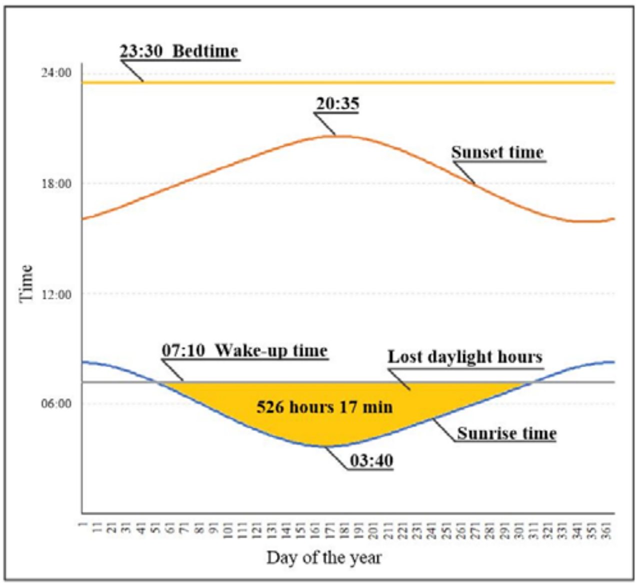

Fig. 5

Fig. 6 gives the sunrise/sunset time plots for Kyiv when only summer time is applied. Fig. 7 presents the analogous plots for Berlin at only summer time.

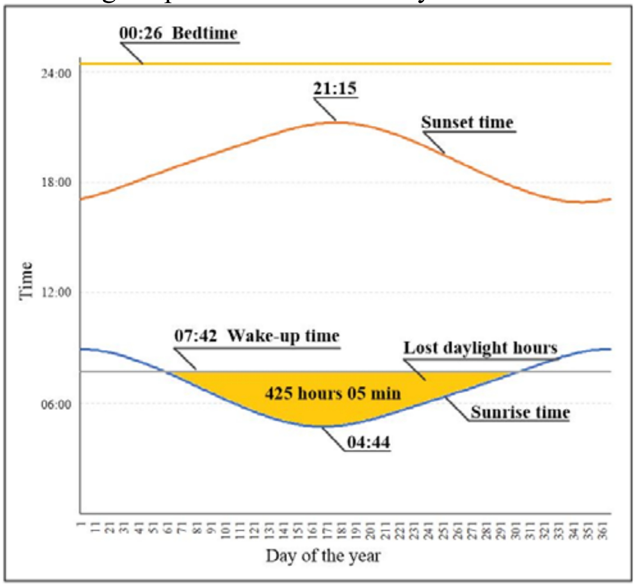

Fig. 6

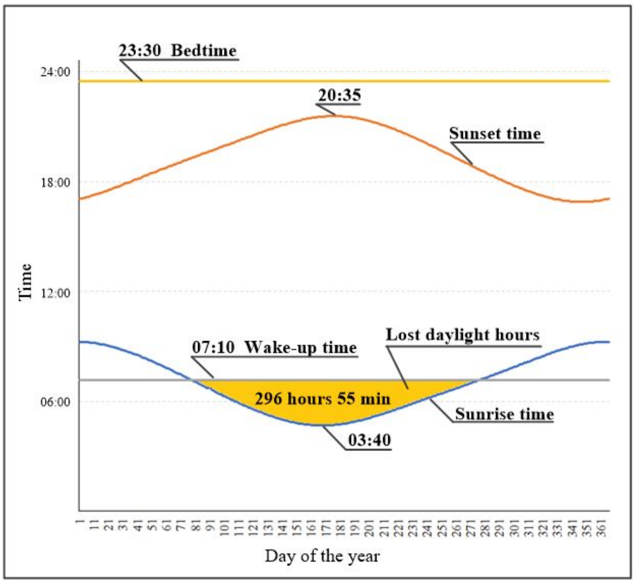

Fig. 7

The lost daylight hours per year for Kharkiv, Kyiv, Lviv, Sofia, Athens, Berlin, London, and Barcelona are shown in Table 3.

Table 3

№	City, country	The lost daylight hours per annum, time/year			
		With transition from winter to summer time, min/year	**Only winter (zone) time all the year round,** min/year	**Only summer time all the year round,** min/year	**The difference between winter and summer time,** min/year
1	Kharkiv, Ukraine	624 *h* 49	834 *h* 49	513 *h* 55	320 *h* 54
2	Kyiv, Ukraine	493 *h* 16	703 *h* 16	425 *h* 05	277 *h* 32
3	Lviv, Ukraine	361 *h* 31	569 *h* 18	242 *h* 23	326 *h* 55
4	Sofia, Bulgaria	298 *h* 05	507 *h* 02	246 *h* 04	260 *h* 58
5	Athens, Greece	293 *h* 00	503 *h* 00	223 *h* 01	279 *h* 59
6	Berlin, Germany	322 *h* 29	526 *h* 17	296 *h* 55	229 *h* 22
7	London, Great Britain	338 *h* 09	542 *h* 49	306 *h* 01	236 *h* 48
8	Barcelona, Spain	161 *h* 54	359 *h* 50	140 *h* 35	219 *h* 15

Table 3 shows that in all the considered cities, regardless of their geographical location, the smallest losses of daylight hours occur at permanent summer time. The difference in losses is from 219 hours 15 min. (Barcelona, Spain) to 326 hours 55 min. (Lviv, Ukraine).

3. Calculation and comparative analysis of electrical energy losses per year. To estimate the quantity of lost electrical energy for different time options, we will make the assumption that one person uses at least 6 W of electricity for lighting per 1 hour. This is equal to the power of energy-saving LED lamp with energy consumption class A according to the European Union Directive 2005/32/EC (2010).

Then the electricity consumption per hour in general for country is determined by the formula:

$$E_{\Sigma,1h} = P_{1p} \cdot N_{pc} \cdot 1\,hour,$$

where P_{1p} is the power of electricity consumption for lighting by one person, at least 6 W; N_{pc} is the number of people in the country.

For example, in Ukraine the quantity of electricity consumed for lighting per hour is equal to:

$$6W \cdot 38.0\,million\ person \cdot 1\,hour = 228\,MW \cdot 1\,hour.$$

Then, using the data from Table 3, we can obtain the quantity of electricity used for lighting in all country owing to the loss of daylight hours per year with different time calculation options.

The rough indicators of minimum losses of the electricity used for lighting per year for some European countries with different time calculation options are given in Table. 4.

Table 4

№	Country	Population, million	Electricity consumed for lighting per hour, MWh	Lost electrical energy for lighting per annum			
				With transition from winter to summer time, GWh	Only winter (zone) time all the year round, GWh	Only summer time all the year round, GWh	The difference between winter and summer time, GWh
1	Ukraine	38.0	228.0	112.5	160.3	96.9	63.4
2	Bulgaria	6.5	39.0	11.6	19.7	9.6	10.2
3	Greece	10.4	62.4	20.1	31.4	13.9	17.5
4	Germany	83.8	502.8	162.2	264.6	149.3	115.3
5	Great Britain	67.0	402.0	135.9	218.2	123.0	95.2
6	Spain	47.8	286.8	46.4	103.2	40.3	62.9

Analysis of Table 4 shows that the loss of electrical energy for lighting with permanent summer time is significantly less than with permanent winter time. The difference in losses ranges from 10.2 GWh (Bulgaria) to 115.3 GWh (Germany).

The average power consumption of electricity by population for lighting and lost electricity as a part of total generation capacity in some countries its percentage of the total generating capacity of the power system of the countries [12-18] are given in Table 5.

Table 5

№	Country	Average power consumption of electricity for lighting, *GW*	Total generation capacity of the country's power system, *GW*	The lost electricity as a part of total generation capacity, %
1	Ukraine	0.228	11.435	1.99
2	Bulgaria	0.039	12.668	0.31
3	Greece	0.062	15.0	0.41
4	Germany	0.503	267.9	0.19
5	Great Britain	0.402	74.8	0.54
6	Spain	0.287	124.0	0.23

How significant are these numbers? For example, the capacity of most of the power units of nuclear power plants operating today is 1.0 GW each. According to the National Energy Company "Ukrenergo", the total losses of electricity generation in Ukraine as a result of Russian attacks as of June 30, 2024 are estimated to be 22.565 GW. Theoretically, only about 11.435 GW of capacity remains. A significant part of them are solar power plants. They do not generate too much electricity in winter [18]. This leads to a significant electricity shortage and disconnections. Therefore, the loss of daylight hours is especially critical in winter.

4. Calculation and comparative analysis of the cost of lost electrical energy per year. Based on the cost of electricity for householders in European countries (as of June 2024) [19], using data from Table 4, we will determine the cost of lost electricity per year for different time calculation options (Table 6).

Table 6

№	Country	Cost of 1 kWh, €	The cost of electricity consumed for lighting per hour, thousands of €	Cost of lost electrical energy for lighting per annum, millions of €				
				With transition from winter to summer time	Only winter (zone) time all the year round	Only summer time all the year round	The difference between winter and summer time	The difference between transitional winter-summer time and year-round summer time
1	Ukraine	0.1	22.8	11.25	16.03	9.69	6.34	1.56
2	Bulgaria	0.12	4.68	1.392	2.364	1.152	1.212	0.24
3	Greece	0.22	13.728	4.422	6.908	3.058	3.85	1.384
4	Germany	0.42	211.176	68.124	111.132	62.706	48.426	5.418
5	Great Britain	0.43	172.86	58.437	93.826	52.89	40.936	5.547
6	Spain	0.23	65.964	10.672	23.736	9.269	14.467	1.403

Analysis of Table 6 shows that the difference in the cost of lost electrical energy in the considered countries with permanent winter (zone) and summer time ranges from €1.212 million (Bulgaria) to €48.426 million (Germany). The difference in cost at transitional winter-summer time and year-round summer time ranges from €0.24 million (Bulgaria) to €5.547 million (United Kingdom).

Conclusion.

1. In the course of the study, a technique was developed for calculating the daylight hours losses and electrical energy losses for lighting under different time calculation options. The technique allows choosing the most optimal time calculation option based on the criterion of maximum use of daylight by most people in the country. The scientific novelty of the technique lies in the combination of sociological and astronomical aspects of the study.
2. The calculation and comparative analysis of the losses of daylight hours, electrical energy for lighting, as well as financial resources at the existing transition to summer time, at permanent summer or permanent winter time were carried out for some European countries.
3. The analysis of the losses of daylight hours depending on the order of time calculation shows that the greatest losses occur with the year-round use of winter (zone, standard) time. The average indicators take place at changing clocks for summer and winter time, and the smallest losses result from permanent summer time. In the considered cities, the difference in losses between permanent winter time and permanent summer time is from 219 hours 15 min. (Barcelona, Spain) to 326 hours 55 min. (Lviv, Ukraine).
4. The difference in daylight hours loss depending on the chosen order of time calculation is so significant that further refinement of indicators and research methods does not make sense and will not lead to a significant change in the results of comparative analysis of daylight hours losses.
5. The losses of daylight hours in Ukraine are especially critical in winter, because a significant part of electricity is generated by solar power plants.
6. The assertion of supporters of permanent zone (winter, standard) time regarding insignificant losses of energy for lighting does not correspond to reality. Actual calculations for certain European cities show that the electricity losses for lighting depending on time calculation order range from at least 840 Wh per person per year (Barcelona) to 5 kWh per person per year (Kharkiv). On a country scale, the difference in the losses between permanent winter and permanent summer time ranges from 10.2 GWh (Bulgaria) to 115.3 GWh (Germany).
7. The all-year summer time will make the light evening longer. This will allow children to spend more time outside, and other people to spend more time for sports, the domesticities and nature. It will be possible to prolong by one hour such works as construction, maintenance of equipment, etc.
8. Applying winter time without transitioning to summer time will lead to longer dark evenings. That will force children to return from school in the dark, increase the risk of traffic accidents and the danger of crime, and will have a negative impact on the environment due to increased energy consumption for lighting.
9. The technique is recommended to be used for determining the optimal time calculation option in different countries and supporting it at legislative level.

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ПОРІВНЯЛЬНИЙ АНАЛІЗ ВТРАТ СВІТЛОГО ЧАСУ ДОБИ ТА ЕЛЕКТРОЕНЕРГІЇ У РАЗІ ПЕРЕХОДУ НА ПОСТІЙНИЙ ЗИМОВИЙ ЧИ ЛІТНІЙ ЧАС

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Останнім часом у суспільстві багатьох країн світу суттєво загострилася дискусія щодо доцільності щорічного переходу на літній та зимовий час. Враховуючи певний дискомфорт від переведення стрілок годинників, більшість населення пропонує від нього відмовитися. Але не існує остаточного обгрунтованого рішення, на якому часі слід зупинитися як на постійному – зимовому (поясному, стандартному) чи літньому. Перехід на літній час було запроваджено з метою заощадження електроенергії, але на даний час немає точних розрахунків, щодо його підтвердження. Роботу присвячено розв`язанню актуальної проблеми визначення найбільш ефективного порядку обчислення часу з точки зору більш повного використання сонячного світла і, відповідно, зменшення втрат електроенергії на освітлення у життєдіяльності сучасного світового суспільства. Метою досліджень є розробка методики точного розрахунку втраченого світлого часу доби та втрат електроенергії на освітлення населенням різних країн світу за різних варіантів обчислення часу – у разі застосування щорічного переходу на літній та зимовий (поясний, стандартний) час; відмови від переходу на літній час та остаточне введення зимового часу; відмови від переходу та застосування постійного літнього часу. наведено основні аргументи прихильників і супротивників запровадження постійного зимового та літнього часу. Проведено розрахунок та порівняльний аналіз втрат світлого часу доби та, як наслідок, втрат електричної енергії на освітлення за рік за різних варіантів обчислення часу. Здійснено розрахунок орієнтовної вартості втрат електричної енергії на освітлення за різних варіантів обчислення часу для деяких європейських країн. Задля підвищення точності розрахунків розглянуто соціологічний аспект досліджень у поєднанні з астрономічним. Розроблену методику рекомендовано використовувати у розрахунках під час визначення оптимального порядку обчислення часу у різних країнах світу задля введення його на законодавчому рівні. Застосування методики надасть можливість заощадити значні обсяги електроенергії під час вечірніх пікових навантажень енергоспоживання, що сприятиме стійкості енергосистеми країни та збереженню паливних і фінансових ресурсів. Бібл. 19, рис. 7, табл. 6.

Ключові слова: втрати електричної енергії, втрати світлого часу, зимовий час, літній час, світлий час доби, переведення годинників, стандартний час, поясний час.

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