

THE DAYLIGHT SAVING TIME STUDY

Executive Summary. Final Report on the Operation
and Effects of Daylight Saving Time



A REPORT TO CONGRESS
FROM THE
SECRETARY OF TRANSPORTATION
JULY 1975

U.S. DEPARTMENT OF TRANSPORTATION
OFFICE OF THE ASSISTANT SECRETARY FOR
POLICY, PLANS AND INTERNATIONAL AFFAIRS
Washington, D.C. 20590

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THE SECRETARY OF TRANSPORTATION
WASHINGTON, D.C. 20590

July 29, 1975

Honorable Nelson A. Rockefeller
President of the Senate
United States Senate
Washington, D. C. 20510

Dear Mr. President:

I am transmitting for the consideration of Congress the final report and recommendations on the two year daylight saving time experiment, as required by the Emergency Daylight Saving Time Act of 1973, as amended (P.L.93-182, P.L.93-434).

The report indicates modest overall benefits might be realized by a shift from the historic 6-month DST system (May through October) to an 8-month DST system (March through October), in the areas of energy conservation, overall traffic safety and reduced violent crime. The potential benefits of an 8-4 system are small and difficult to isolate from the larger effects of seasonal variations and of changes in energy availability and prices. We believe however, that the findings, while not conclusive, do support our recommendation that the Nation use an 8-4 system for two more years to permit further analysis and more effective measurement of public acceptance and response.

Sincerely,


William T. Coleman, Jr.

Enclosure



THE SECRETARY OF TRANSPORTATION

WASHINGTON, D.C. 20590

July 29, 1975

Honorable Carl Albert
Speaker of the House
House of Representatives
Washington, D. C. 20515

Dear Mr. Speaker:

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Sincerely,


William T. Coleman, Jr.

Enclosure

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16. Abstract In Dec. 1973 Congress enacted the Emergency Daylight Saving Time Energy Conservation Act of 1973 which placed the nation on Year-Round Daylight Saving Time for a two year trial period starting Jan. 6, 1974. While energy savings was the main purpose, other benefits in safety and crime were also considered to be possible effects. The Act required that the Secretary of Transportation prepare interim and final reports on the operation and effects of the Act. The interim report was based on preliminary analysis of data from less than half a year of operation of the Act. It was submitted to Congress in June 1974. As recommended in the interim report, Congress amended the Act of 1973 which continued the two year experiment but included a period of standard time from November 1974 through February 1975. This final report is based on a multi-agency study and includes more extensive analyses of the larger body of data resulting from both years of the experiment. However, some data items, e.g., 1974-75 highway accidents and fatalities, involve considerable time lags and were not available for analysis. Therefore, it was necessary to infer some DST impacts for the 8-4 experiment. Indications of beneficial DST effects were found in electricity use, fatal motor vehicle accidents and crime. The study findings suggest that a modest overall benefit might be realized by a shift from the historic 6-6 system to an 8-4 DST system. Public opinion in 1975 favored an 8-4 system by a 2 to 1 ratio.					
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1. EXECUTIVE SUMMARY

1.1 INTRODUCTION

In December 1973 Congress enacted the Emergency Daylight Saving Time Energy Conservation Act of 1973 which placed the nation on Year Round Daylight Saving Time (YRDST) for a two-year trial period. In addition to the expected energy saving in electrical power consumption, other energy economies were anticipated. One of the hoped-for effects of YRDST was that it would actively involve the American people in an energy conservation effort and that this involvement would engender a sensitivity to energy usage on the part of individual citizens. The magnitude of the resultant energy savings, however, was impossible to predict at the time of the passage of the Act. Also, a number of ancillary benefits were anticipated, including reduced crime, improved traffic safety, and more afternoon and evening daylight for increased shopping and recreation opportunities. These benefits were also impossible to quantify when the Act was passed.

To acquire a broader understanding of the effects of YRDST, Congress included in the Act a requirement that the Secretary of Transportation prepare interim and final reports on the operation and effects of the Act. After less

than half a year of operation, an interim report, based upon a preliminary analysis, was completed and submitted to Congress. As recommended in the interim report, the Congress amended the Act to include a period of standard time from November 1974 through February 1975. A broader investigation followed, involving a more extensive analysis of data. This document, which is the required final report, contains the results of the investigation. A second volume containing the details of supporting studies will be available on request.

The remainder of this executive summary will describe the highlights of the study: conclusions and recommendations; the scope of the DST studies; the findings, including the results of the technical studies and the public opinion survey; a summary of the administration and operation of the Act, including the results of the time zone boundary survey; and a description of alternative time system options.

1.2 CONCLUSIONS AND RECOMMENDATIONS

We conclude that modest overall benefits might be realized by a shift from the historic 6-month DST system (May through October) to an 8-month DST system (March through October), in the areas of energy conservation, overall traffic safety and reduced violent crime.

The potential benefits, however, are small and difficult to isolate completely from the larger effects of seasonal patterns and changes in energy availability and prices. In addition, actual data for some impact areas such as traffic fatalities and accidents were not available for the 1974-75 experimental period. Therefore, the study's findings are based on the best available evidence and statistical techniques but do not provide conclusive support for recommending permanent changes in the Uniform Time Act of 1966 under which the 6-month DST System is now in operation. In view of the evidence suggesting favorable impacts of an 8-month DST system, we recommend using an 8-month system for two more years to permit further analysis and more effective measurement of public acceptance and response.

Examples of such evidence follow:

a. There are probable electricity savings of approximately 1 percent in March and April. However, the net energy savings are unknown since further study may reveal partially offsetting increases in gasoline use.

b. There are indications of reductions in total motor vehicle fatalities for March and April of about 0.7%,

or approximately 50 lives and 2000 injuries.

c. It is inferred that there is no statistically significant national DST impact on fatal accidents during March and April involving school-age children.

d. There is evidence of a 10 to 13% reduction in violent crimes during March and April in Washington, D.C.

e. No indications of significant disbenefits from the 8-4 system were found in this study.

f. Public opinion polls during the 1974 and 1975 study periods indicated public acceptance of DST for the months of March and April.

With respect to time zone boundaries, we recommend maintenance of all existing time zone boundaries. Governors of the 25 states bordering on, or divided by, a time zone were queried regarding the need to change time zone boundaries. Thirteen of the fourteen Governors responding favored no changes in existing boundaries, and one favored a system in which the country was divided into only two time zones.

Table 1.4-1 Results of DST Impact Studies: The Experimental Eight-Four System vs. the Historical Six-Six System

<u>Area</u>	<u>DST Impact</u>	<u>Comments</u>
Travel	None perceived by our techniques; Technique would not perceive effect of less than 1.0 percent	Seasonal changes in travel obscure DST effects at DST transitions.
Electricity Usage	Approximate saving of 1% or 49,200 megawatts per day for March and April; No evidence of significant peak shaving.	Savings related to DST measured at transitions in October (1973 and 1974), in April (1973), and in January (1974)
Gasoline Consumption	None perceived by our techniques. Estimated maximum possible <u>undetected</u> impact of 0.5%.	Statistical analysis revealed a small DST effect (0.4%) which was not statistically significant.
Home Heating Fuel Consumption	Saving of less than 0.1%	A maximum saving of 3000 barrels of oil and the equivalent of 5000 barrels of natural gas per day might occur in south and southwestern states only.
Fatal Motor Vehicle Accidents	Reduction of approximately 0.7% or about 50 lives and 2000 injuries for March and April	Reduction is observed in a comparison between March and April 1974 (DST) and March and April 1973 (non-DST). Also, spring and fall transition analysis of 1973 provide consistent results.
Motor Vehicle Fatal Accidents of School-Age Children	No special hazard to children compared to the total population at any time of day.	Two studies were conducted. The findings were that during the DST period of January to April, 1974, school-age children did not suffer greater fatalities than those of the total population in accidents involving pedestrian/pedalcyclists, motor vehicles and their total, at any time of day

Table 1.4-1 Results of DST Impact Studies (con't.)

<u>Area</u>	<u>DST Impact</u>	<u>Comments</u>
A.M. Radio Broadcasting	0.01% loss per station	
Crime	Evidence of 10 to 13% reduction in violent crimes in Washington, D.C.	
Advance in School Hours	Essentially No Change	A few schools in two west and midwest states advanced hours where bus routes were long.
Election Day	Increases daylight during existing polling hours in almost all states.	A nine month system of DST would be required to cover all election days.

1.3 SCOPE OF THE DAYLIGHT SAVING TIME (DST) STUDIES

The interim report on Year-Round Daylight Saving Time (YRDST) included an analysis of public opinion, as well as separate studies of: energy effects (electricity, gasoline, and home-heating fuel); motor vehicle fatal accidents; school-age children fatal accidents; changes in school hours; crime; utilization of parks and recreation areas; and effects on agriculture, domestic commerce, and foreign trade. This final report covers these areas in greater detail, and also examines the effects of daylight saving time on business activity and transportation operations.

1.4 OVERVIEW OF FINDINGS

DST is likely to impact those activities that are both clock and light dependent. Examples are:

(1) Automobile fatal accidents are influenced by both the time of day (e.g., rush hours vs. non-rush hours) and the presence or absence of daylight.

The hypothesized reason for the safety effect is that daylight saving time increases daylight during the evening traffic period, which has

higher traffic volumes than the morning period. (Shopping and recreational travel are heavier during the evening traffic period, while commuting travel is about the same in both the morning and evening peak periods).

(2) Electricity usage is influenced by the presence or absence of daylight and by the time that households arise.

Because sunset occurs an hour later under DST, most households save approximately one hour of electricity in the evening. This saving may be wholly or partially offset by additional electricity consumption in the morning. For those households arising at sunrise or later, there is a savings of a full hour, and for those arising before sunrise, there is only a partial saving or no saving.

Since most households arise after sunrise in the summer, DST generally reduces illumination requirements by one hour. However, during the winter (when there is a shorter daylight period) rising times often result in an additional hour (or some fraction of an hour) of electrical use in

the morning. Thus, the saving in residential lighting loads due to DST is maximized in the summer, minimized in the winter, with the fall and spring months intermediate between the two.

(3) Commission of certain types of crimes are influenced by both the time of day and the presence or absence of daylight.

The underlying mechanism hypothesized for crime reduction is that the percentage of violent crimes committed out-of-doors is higher in the dark evening hours than in the morning hours. Since the dark evening hours are reduced by one hour under DST, the exposure of people to violent crimes committed out-of-doors would be reduced by DST.

The findings in this report were derived from four separate lines of inquiry:

(1) Technical Studies. Where suitable data were available in a particular impact area, these data were analyzed with a variety of techniques.

(2) National Public Opinion Survey. In March 1975

a national survey of opinion regarding DST was conducted under sponsorship of the Federal Energy Administration.

(3) Solicitation of Opinions from Public and Private Organizations. Letters soliciting opinions on DST impacts were written to federal departments and agencies, municipal agencies, companies, labor unions, transportation associations, trade groups, and citizen groups.

(4) Time Zone Boundary Analysis. Governors of 25 states whose states are either divided or bordered by time zones were queried concerning their views on the need to change time zone boundaries.

1.4.1 Results of Technical Studies

The results of the DST studies are summarized in Table 1.4-1. Significant results related to DST were found in four areas: national electricity use was reduced by about 1%; national motor vehicle fatalities were reduced by about 0.7%; national school-age children fatal accidents were not significantly affected; and violent crime was reduced by 10 to 13% in Washington, D.C. These results are discussed below.

(1) ELECTRICITY USAGE

There are indications of an approximate 1% reduction in aggregate electrical load related to DST. These savings were found at four DST transitions: two fall transitions (October 1973 and 1974, 0.91% and 1.76% respectively); one spring transition (April 1973, 1.32%); and one winter transition (January 1974, 0.74%). The results compared morning and evening electrical loads a few days before and after the transitions and used the midday and night electrical loads as a control to account for the non-DST factors.

(2) MOTOR VEHICLE FATALITIES, TOTAL POPULATION

There are indications of an approximate 0.7% reduction in total motor vehicle fatalities during March and April.

A comparison between national motor vehicle fatal accidents in March and April 1974 (with DST) and March and April 1973 (without DST) revealed a reduction in DST-related traffic fatalities of 0.71%, which corresponds to a saving of about 25 lives per month. Historically, the ratio of

fatalities to injuries in motor vehicle accidents has been approximately 40 to 1. Therefore, we infer that DST during March and April could result in an approximate saving of 50 lives and 2000 injuries. A similar analysis for January and February revealed a negligible net effect.

Additional studies, summarized below, support this finding and indicate that the impact may be as high as 1% rather than the 0.71% stated above.

Analysis of the 1973 spring DST transition at the end of April showed a reduction in fatal accidents of 1.7%, while the fall transition to standard time in late October resulted in an increase of fatal accidents by approximately 1%. Thus, a net reduction in fatalities of approximately 1% is indicated. Reductions in fatalities for March and April can also be inferred from the 1973 transition analysis, based on the following rationale.

Analysis of the sunrise symmetric 8-4 system indicates that the best transition dates to minimize late sunrises occur approximately at the end of the first week of March and the last week

of October. The fall transition date is identical to the one used in the 1973 fatality analyses, where an approximate 1% increase in fatal accidents was observed after the transition from DST to standard time. Since sunrises in early March occur at the same time as those in late October, it is reasonable to infer that an early March transition would yield a fatality change of the same magnitude (but opposite in effect). Thus, for an 8-4 system, a March transition could be inferred to result in a reduction in fatalities of about 1%.

(3) MOTOR VEHICLE FATALITIES, SCHOOL-AGE CHILDREN

A comparison between the DST period, January-April 1974, and the non-DST period, January-April 1973, revealed that there was no significant difference between school-age children fatal accidents and those of the total population during the morning, midday or evening periods. From the finding that school-age children fatal accidents and those of the total population are not significantly different, we could infer an approximate 1% reduction in school-age children fatal accidents based on the results in item (2),

above, which indicate a 1% reduction in total population motor vehicle fatalities. The problem with this inference is that school-age children fatalities represent such a small number of incidents relative to the total that random occurrences in any year make statistical analyses difficult. Therefore, it was concluded that DST in March and April appears to have no significant national effect on school-age children fatalities.

(4) CRIME

Using data for two cities (Los Angeles, California and Washington, D.C.) for 1973, 1974, and 1975, decreases in violent crime of 10 to 13% were found in Washington, D.C., but no effects were found in Los Angeles. The more detailed data available for Washington, D.C. permitted a more sophisticated analysis than was possible with the coarse data for Los Angeles.

1.4.2 National Public Opinion Poll

Table 1.4-2 shows that slightly over half the people surveyed had a favorable opinion of DST during the two experimental periods. In the March 1975 poll, the ratio of favorable to unfavorable opinion was nearly 2 to 1. Thirty-seven percent of the respondents favoring DST liked it because, "there is more light in the evenings/can do more in the evenings". Eight percent of the negative respondents just, "don't like EST", and seven percent expressed concern for children traveling to school in the dark. Table 1.4-3 reveals a marked regional bias in reactions to DST, the East polling the most favorable and the South polling the most unfavorable. Note also that an approximate 15 percentage

point variation exists between regions for both the favorable and unfavorable responses.

Survey Date	DST System in Effect	Opinion of DST (%)		
		Positive	Neutral	Negative
March 1974	YFDST	54	9	38
March 1975	Eight-month DST	51	21	28

Table 1.4-2 Public Opinion of DST

Region	Opinion of DST (%)		
	Positive	Neutral	Negative
East	60	16	24
Midwest	45	27	28
South	50	14	36
West	53	27	20

Table 1.4-3 Regional Opinions of DST, March 1975

One further result bears mention. In the 1974 poll, the 38% minority who disapproved of YFDST were asked: "What months would you prefer not to be on DST?" Fewer than 10% disapproved of DST for April through September; approximately 30% disapproved of DST in October and March; and a majority disapproved of DST only during the four months, November through February.

<u>Activity</u>	<u>DST Effects</u>
Manufacturing	DST generally beneficial, except where commuting of workers is adversely affected
Domestic Trade	Urban store managers like DST because of energy savings and increased safety on the streets
Finance	No effect within U.S. since the entire investment community is tied to New York time
Foreign Trade	No effect on trade with Japan due to lack of a trade window overlap. Increase in communications with Europe may have occurred as a result of expanded trade window due to DST
Construction, Harbor Operations, Shipbuilding	No effect on harbor operations or shipbuilding. Construction contractors prefer DST spring transition which minimizes late sunrises
Public Transportation	Prefer at least 60 day notice of a time transition in order to minimize DST impact on schedule changes. Want strict adherence to uniformity provision of the Uniform Time Act
(1) Railroads and Trucking	
(2) Urban Mass Transit	DST preferred if it conserves energy or results in evening traffic peaks occurring in daylight
(3) St. Lawrence Seaway	DST time differential across the Seaway in spring prior to Canada's transition to DST at the end of April causes minor scheduling problems

1.4.4 Administration and Operation of the Emergency Daylight Saving Time Conservation Act of 1973 and Its 1974 Amendment

Primary responsibility for administration of the Emergency Daylight Saving Time Conservation Act of 1973 was entrusted to the Secretary of Transportation. Section 3 of the Act established YFDST and authorized exemptions and realignments of time zone limits. Pursuant to the provisions of this section, exemptions from observing YFDST continued in Arizona, Hawaii, eastern Indiana, Puerto Rico, the Virgin Islands, and American Samoa. Effective in October 1974, the eastern time zone portion of Michigan and the mountain time zone portion of Idaho became exempt. The Idaho exemption, however, was repealed prior to February 23, 1975. In addition, the time zone limit between the eastern and central time zones was shifted in Kentucky, leaving more of the state in the central time zone until October 27, 1974, when the limit reverted to its permanent location.

As was described previously, the Secretary recommended in the interim report that Congress amend the Act for the second year of the experiment to provide for eight months of daylight saving time and four months of standard time. This recommendation was accepted by Congress and was implemented through the 1974 amendment to the 1973 Act.

Upon expiration of the Emergency Act, at 2:00 a.m. April 27, 1975, the Uniform Time Act of 1966 again became effective. Daylight saving time observance under the Uniform Time Act commenced at 2 a.m. April 27th. Thus, during 1975, daylight saving time was scheduled for continuous observance from February 27th to October 26th.

1.5 ORGANIZATION OF THE FINAL REPORT

Following this Executive Summary, the remaining Chapters of Volume I describe the study in more detail. Chapter 2, Background, describes the origins of the Act and sketches a history of daylight saving time; Chapter 3, Administration of the Emergency Daylight Saving Time Energy Conservation Act of 1973, describes the administration of the Act; Chapter 4, Methodology, describes the techniques used to analyze DST effects; Chapter 5, Description of Sunrise and Sunset Times, contrasts daylight saving time with standard time and describes the daylight differences within time zones; Chapter 6, Effects of Daylight Saving Time, describes analyses of effects of DST on fourteen impact areas, but emphasizes those with the most significant potential effects: motor vehicle accidents, crime, and energy; Chapter 7, Public Response to both the Year-Round and Eight-Month Daylight Saving Time Experiments, describes the results of public opinion surveys designed to elicit public opinion on

DST; and Chapter 8, Time-Management Options, describes alternative DST time system options and some considerations in choosing among them.

In the course of the study, opinions were solicited from other Federal agencies concerning the effects of DST. The letters from the Federal agencies responding to these solicitations are reproduced in Appendix 1. Appendix 2 contains the Act of 1973 and the 1974 Amendment.

Volume II, Supporting Studies on the Operation and Effects of Daylight Saving Time, contains more details of the analyses, especially in the areas of effects of DST and options for DST. Volume II will be available on request.

1.4.3 Solicitation of Opinions of DST from Public and Private Organizations

The following government departments were contacted and asked to express an opinion regarding DST impacts on their areas of responsibility:

Department of Agriculture

Department of Commerce

Department of the Interior

Department of Labor

Department of Justice

All agencies reported no DST impact with the exception of the Department of Justice, which reported the results of the studies of crime described above.

The Department of Housing and Urban Development was requested to evaluate the DST impact on home heating fuel use, but no results were provided.

The letters from each of these Departments can be found in Appendix 1.

The Department of Health Education and Welfare furnished the school hours information summarized in Table 1.4-1.

The responses of public and private groups to a solicitation of their views on DST impacts are summarized in Table 1.4-4.

In general, reactions to DST were favorable, but no hard evidence was obtained that the impact of DST was either positive or negative. Problems attributed to DST in all cases were minor. The only specific negative opinion was expressed by the Associated General Contractors, who are opposed to DST from November through March because of difficulty in adjusting work hours during the winter months.