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Is There a Case for Extending Daylight Saving Time?

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Author: Sylvie Trottier[1] (Sylvie.trottier@ecometrica.com)
Internal Reviewer: Vanessa Boudreau-Sannier[1]

[1]Ecometrica

Introduction

It's that time of year again. As we turned back our clocks on November 4th, the prospect of long, dark, and dreary winter evenings caused many of us to ask once again – why is it exactly that we use Daylight Saving Time (DST)?

Originally instituted during the First World War, DST's primary objective was as an energy saving measure to conserve coal. The exact start and end dates vary, but broadly speaking, clocks are moved forward by one hour during the spring. This means that the sun sets later, allowing people to take greater advantage of daylight in the evenings (and thus burn less coal, as the reasoning went). When DST ends in the fall, the clock is moved back by an hour, and Standard Time commences.

It seems that ever since this practice began, debate has raged on the potential benefits and disadvantages of the bi-annual ritual. We increasingly hear arguments advocating for extending DST year-round, mostly on an environmental basis: if DST saves energy, why not make it permanent, and thereby reduce national GHG emissions?

We thought we would take a closer look at this reasoning. By examining the results of a study that found 0.5% reductions in electricity use for each day of extended DST in the U.S., we will see how the complex interaction between factors makes it challenging to extrapolate these savings year round, and explain why the applied energy mix is the most important factor in terms of GHG emissions.

Using the USDOE study to predict the impact of year round DST

The Energy Policy Act of 2005, which went into effect in 2007, extended daylight saving time in the U.S. by four weeks. The start date went from the first Sunday in April to the second Sunday in March, and the end date went from the last Sunday in October to the first Sunday in November. The U.S. Department of Energy (USDOE) used both heuristic (average changes in electricity use between 2006 and 2007) and statistical (using a regression model for a sample of 67 electric utilities) methods to measure the impact on electricity use across the country. In a report submitted to Congress, they found that 0.5% of electricity consumption was saved for each day of extended DST.[1]

With this information, can we make a viable prediction of how much electricity use and GHG emissions would change from extending DST from November to March? A quick calculation assuming average savings of 0.5% per day allows us to roughly estimate the electricity and GHG savings. Using EIA figures, retail sales of electricity to customers in the U.S. totaled 1,261,003 million KWh from November 4, 2007 to March 9, 2008[2]. In such a scenario, 6305 million kWh (approx.) of electricity would have been reduced, which translates to 3,716,524 tCO_2e emissions avoided.[3]

How does extending DST affect electricity use?

However, saying that electricity savings would stay at 0.5% per day of extended DST is a very large assumption. Let's take a closer look at the factors affecting this figure, starting with the possible reasons for electricity savings.

Lighting. If businesses and households keep their schedules, lighting needs are greater in the morning as people wake to a darker day, and lightning needs are less in the evening since they enjoy more daylight after work. We can also note that using energy efficient lighting, such as CFLs, would influence the potential for savings. The more widespread the use of energy efficient lighting, the less potential there would be for a change to DST to impact electricity and GHG savings.

Heating and cooling. The amount of electricity used for temperature control, whether heating in the winter, or air conditioning in the summer, can also play a role. The study's statistical model (which accounted for differences in weather between 2006 and 2007) found that during the spring extension, use of air-conditioning increased in the South, and use of heating decreased in the North. How big an impact this has depends on the magnitude of the temperature variation for the days of extended DST, as well as the portion of heating or cooling that comes from electrical sources (since the study only considered changes in use of electricity).

Recreational activity. Another aspect potentially affecting the amount of electricity used is behaviour during lighter evenings and darker mornings. When DST occurs in warm weather, people tend to engage in more outdoor activities during the lighter hour in the evenings. If these outdoor activities require less electricity, then DST could reduce energy use.

What factors cause variation in electricity savings?

Next we can examine three main factors that cause variation in electricity savings.

[1] Belzer, D. B. ; Hadley, S. W. ; Chin, S-M, 2008, Impact of Extended Daylight Saving Time on National Energy Consumption Report to Congress, USDOE Office of Energy Efficiency and Renewable Energy

[2] Retail sales were added for months of December 2007, January 2008, and February 2008. Average was taken to add to total million kWh for 26 days in November 2007, and 8 days in March 2008. DOE/EIA-0226 (2009/12). Table 5.1. Retail Sales of Electricity to Ultimate Customers: Total by End-Use Sector, 1995 through September 2009 http://www.eia.gov/electricity/monthly/backissues.html

[3] Calculations performed using data from *ourimpacts* for assessment period November 4, 2007-March 8, 2008 for national average of United States

Geographic location: The DOE report found that Southern states realized lower electricity savings than states in the upper latitudes (0.42% compared with 0.51%, respectively, using the statistical analysis; both regions realized 0.48% savings using the heuristic analysis). The study points to the increased use of air conditioning in the South as a primary explanation for the difference. However, the study does not examine how changes in the timing of sunrises and sunsets could affect electricity consumption as well. For example, if at a given latitude, the sun has already risen when people get up, with or without DST, then there should be no change in electricity use.

Time of year: The report also found that savings were greater during days following the spring 'jump' forward (0.5%), than days leading up to the 'leap back' in the fall (0.38%). The explanation provided in this instance is the greater potential for outdoor activity in warmer weather. The time of year also affects the weather, which plays into what extent heating or cooling needs are dominant.

Time of Day: The study determined that electricity savings were concentrated over a three-to-five hour period in the evening (5:00 to 9:00PM, on average), which was somewhat offset by a small increase in electricity use in the early morning (7:00 to 8:00AM). We can draw the conclusion that these observations are driven by a greater increase in electricity usage in the evenings.

Problems with determining the impact of year round DST

The complexity of these interactions strongly suggests that an assumption of 0.5% daily electricity reduction cannot be applied to assess year round DST savings. Would the savings be larger or smaller for each additional day of DST? We can hypothesize there would be more savings in northern regions because heating is a more important factor from November to March than air conditioning. We could also postulate that savings would be less than 0.5% per day when averaged over the year because there is less potential for outdoor activities in cooler weather. Unfortunately, the 2007 study fails to pinpoint to what extent each driver contributes to the measured energy savings, which makes it difficult to determine the advantages or disadvantages of extended DST with more certainty. More research would be needed to actually model these different factors and obtain better predictions of their interactions year round.

The impact of the applied energy mix on GHG emissions

In order to develop a clearer picture of the potential advantages of extending DST, it is important to consider how this affects associated GHG emissions. The composition of energy sources used to generate the electricity being consumed is ultimately the biggest determinant of the environmental benefits of DST.

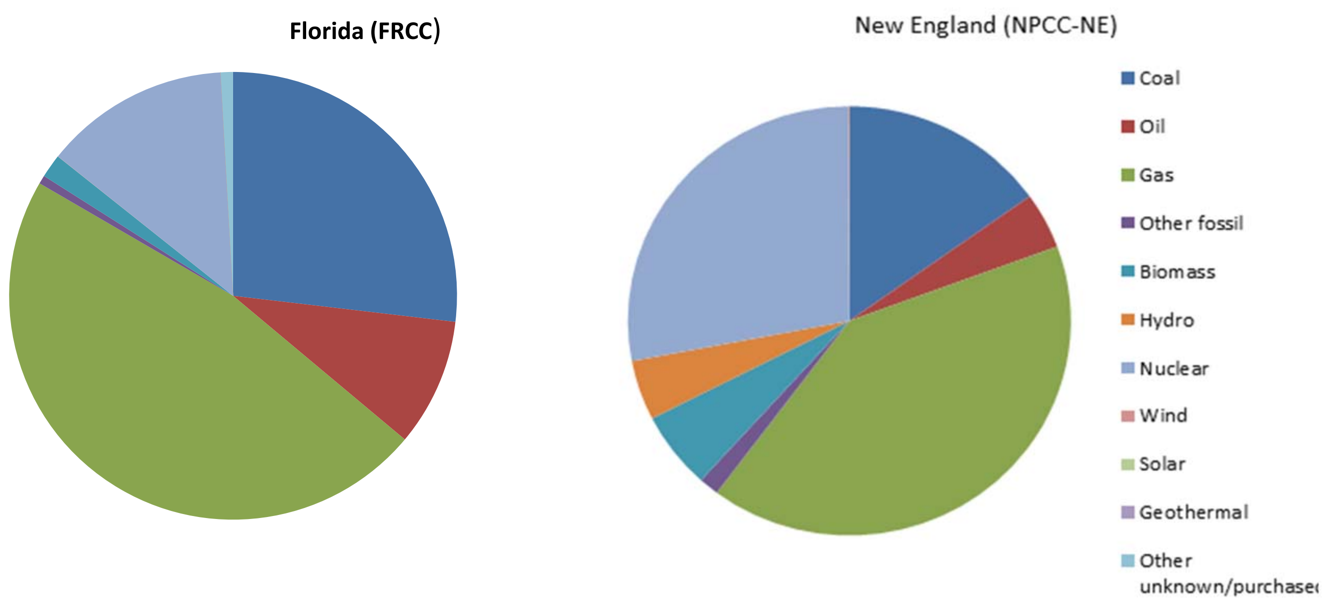
For example, let's compare the heuristic model results for New England and Florida. Using the data from NERC[4] regions, the study found total savings during the four-week extension period of 2007 of 68 GWh in New England (NPCC-NE) and 60 GWh in Florida (FRCC). However, this 11% difference in electricity savings is eclipsed by the GHG savings due to the grid electricity emission factors for each of these

[4] North American Electric Reliability Corporation. For more information on eGRIDs, visit *www.epa.gov/egrid/*

regions (see table). Even though total electricity savings were greater in New England, the realized GHG savings were greater in Florida due to the higher emissions associated with its energy mix.

	Florida (FRCC)	New England (NPCC-NE)
Total electricity savings during the four-week extension period	60 GWh	68 GWh
Grid electricity emission factors[5]	555,962 $kgCO_2e/GWh$	378,481 $kgCO_2e/GWh$
Total emission reductions	33,358 tCO_2e	25,737 tCO_2e

Energy Mix for Florida and New England[6]



Conclusion

So, what does this mean for the arguments in favor of year round DST? Yes, the argument that energy savings would occur can be supported. However, by far the more important factor to consider, at least from an emissions standpoint, is the composition of energy used for electricity generation in each region and the direct affect this composition has on GHG emissions and the potential for savings. If we want to get serious about reducing emissions, changes that affect how we produce our energy would have a much greater impact than changing the clocks. On the other hand, a bit more sunlight to brighten the long winter evenings certainly can't hurt.

5 Calculations performed using data from *ourimpacts* for assessment period 2007-2008 for eGRID FRCC All (Florida) and NPCC NE (New England)

6 EPA, 2011. eGRID2010 Version 1.1. Year 2007 eGRID Subregion Resource Mix. http://www.epa.gov/cleanenergy/documents/egridzips/eGRID2010V1_1_year07_SummaryTables.pdf