



**Report of the  
Special Commission on  
the Commonwealth's Time Zone**

**November 1, 2017**

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## Executive Summary

### Purpose of the Special Commission

In the summer of 2016, the Legislature passed *An Act relative to job creation and workforce development*. Section 136 of the bill established a special commission with the purpose of conducting “a comprehensive study relative to the practical, economic, fiscal and health related impacts of the commonwealth remaining on Eastern Daylight Time, 4 hours behind coordinated universal time, also known as Atlantic Standard Time, throughout the calendar year.”

### Structure of the Special Commission

The statute that established the special commission required that the commission consist of 11 members appointed by the governor, the speaker of the House, the president of the Senate, the House minority leader, and the Senate minority leader.

### Background

Twice a year, as Massachusetts residents are reminded to set their clocks forward or back an hour, media outlets inundate the public with anecdotes and opinions about this practice. Until the formation of this Commission, however, the Commonwealth had not tasked any group with researching or analyzing the wisdom of maintaining the status quo of switching back-and-forth between daylight saving time (“DST”) and standard time.

The tradition of moving the clocks forward one hour and back one hour annually may appear longstanding, but DST was only introduced in the United States during World War I, and then federally abandoned (although intermittently used by some states) until 1966 when Congress passed the Uniform Time Act, which established DST as running from the last Sunday of April until the last Sunday in October. DST dates have been amended several times since 1966. The current dates for “springing forward” and “falling back” – the second Sunday in March and the first Sunday in November – have been in place since 2007.

One of 17 states in the Eastern Time Zone, Massachusetts currently follows Eastern Daylight Time (“EDT,” coordinated universal time minus 4 hours) when observing DST, and Eastern Standard Time (“EST,” coordinated universal time minus five hours) when observing standard time. Although DST is observed in 48 states (Hawaii and Arizona – with the exception of the Navajo Nation – do not participate), a surprising lack of uniformity exists around the world. DST is employed in only about 70 countries. Most of Africa and Asia do not observe DST, and South America is split, with many of its northern countries not observing DST, while nations like Paraguay and southern Brazil following DST. Even countries that observe DST have inconsistent start and end dates. For example, Canada follows the U.S.’s DST dates, Europe observes DST but switches its clocks a few weeks after the U.S., and parts of Australia that observe DST do so during the brighter months of the Australian year, October through April.

No mechanism exists through which Massachusetts could adopt year-round DST, as federal law only allows states to opt out of DST. But the state could effectively achieve that goal by moving

from the Eastern Time Zone to the Atlantic Time Zone and then opting out of DST. Several states are considering bills that would move them to year-round DST, including four of the five other New England states. If Massachusetts does move to the Atlantic Time Zone and opt out of DST, then the Commonwealth would be an hour ahead for roughly four months each year.

## Findings

This Commission researched and evaluated the impact of DST to understand whether the inconvenience of changing clocks twice per year is fulfilling goals in various policy areas from energy to crime to public health. Following this analysis, the Commission considered whether Massachusetts should move to the Atlantic Time Zone (effectively observing year-round DST).

The Commission utilized a data-driven approach in reaching its findings and recommendations, relying on experts, academic papers, facts, and data. The Commission finds as follows:

- *Economic Development: Commerce and Trade.* The U.S. has a history of adjusting the clocks or the calendar to increase retail sales, and year-round DST has the potential to create economic growth in Massachusetts as people tend to shop, dine out, and engage in commercial activities more in after-work daylight. Year-round DST could also increase the state's competitiveness in attracting and retaining a talented workforce by mitigating the negative effects of Massachusetts' dark winters and improving quality-of-life.
- *Labor and Workforce.* Eliminating the spring transition to DST could increase productivity and cut down on both the number and severity of on-the-job injuries, which would lead to lower costs for businesses (e.g. more productivity, lower rates for workers' compensation insurance, and less need for hiring and training replacement workers).
- *Public Health.* Adopting year-round DST could improve public health in the Commonwealth by eliminating the annual spring transition to DST—and the corresponding increase in traffic fatalities, workplace injuries, and heart attacks—and also by providing residents with additional evening daylight during the winter, which would lead to increased physical activity among residents.
- *Energy.* Year-round DST has the potential to produce energy savings for Massachusetts residents. Due to the timing of those savings and New England's current energy portfolio, year-round DST could lead to meaningful reductions in both future energy costs and greenhouse gas emissions.
- *Crime and Criminal Justice.* Research suggests that year-round DST would reduce street crime, produce substantial social cost savings, and also reduce inequities within the criminal justice system.
- *Transportation.* Year-round DST could have a mixed impact on transportation, and create additional business complexity in moving goods and services. While year-round DST would lead to fewer traffic fatalities, unilateral action by Massachusetts would complicate interstate travel.

- *Broadcasting.* Year-round DST may have some negative effects on broadcasters and scheduled television programming unless other states also adopt year-round DST.
- *Education and School Start-Times.* With current school schedules remaining in place, year-round DST could pose a safety risk during the winter to children waiting for the school bus in the dark and to adolescents driving in the early morning. Those risks could be mitigated by delaying school start-times, which is a cost-effective way to alleviate safety concerns as well as improve students' physical and mental health, attendance and graduation rates, tardiness and dropout rates, and grades and standardized test scores.

## Recommendations

Based on its research and findings, and after weighing the costs and benefits associated with the observance of time in Massachusetts, the Commission believes that, under certain circumstances, the Commonwealth could make a data-driven case for moving to the Atlantic Time Zone year-round (effectively observing year-round DST). Although there are appreciable costs associated with making this change, on balance the Commission finds that doing so could have positive benefits that largely stem from the absence of a spring transition to DST and the additional hour of winter evening daylight.

However, the Commission does not recommend a simple switch to the Atlantic Time Zone, and cautions that several qualifiers should accompany future conversations or legislative proposals with respect to how Massachusetts observes time. The Commission offers the following blueprint of concerns for a thoughtful implementation of year-round DST, should Massachusetts ever decide to pursue this policy change:

- *Regional action.* Massachusetts should only move to year-round DST if a majority of other Northeast states – possibly including New York – also do so. To facilitate regional action, the Legislature and Governor should raise this issue with other Northeastern legislative and executive bodies, including the National Conference of State Legislatures, the Council of State Governments, Coalition of Northeast Governors, and gatherings of New England Governors and Eastern Canadian Premiers.
- *Later school start-times.* Any move to year-round DST should be accompanied by statewide standards for delaying school start-times to mitigate safety issues; improve student academic performance, health, and well-being; and add significantly to the other economic benefits related to year-round DST.
- *Public awareness.* The Commonwealth should not adopt year-round DST unless it simultaneously commits funding to educate the public about the implications of the change. Even if Massachusetts does not adopt year-round DST, public awareness initiatives about transitions to and from DST would still be beneficial. For instance, public health announcements preceding the spring transition to DST would help residents prepare for the sleep loss caused by the transition so that they could try to mitigate its negative consequences.

## **Purpose of the Commission**

In the summer of 2016, the Legislature passed *An Act relative to job creation and workforce development*. Section 136 of Chapter 219 of the Acts of 2016 established that:

[T]here shall be a special commission to conduct a comprehensive study relative to the practical, economic, fiscal and health related impacts of the commonwealth remaining on eastern daylight time, 4 hours behind coordinated universal time, also known as Atlantic standard time, throughout the calendar year. The commission shall focus on the impact to local and regional economies, education, public health, transportation, energy consumption, commerce and trade if the time zone is altered.

To carry out its purpose, the Commission held several public meetings during which it received testimony from a variety of experts and stakeholders. Experts reported on a variety of subjects, including the history of times zones in the United States, economic and retail development, criminal activity, the region's energy system, transportation, broadcasting, public health, and school start-time/student performance impacts related to daylight and time zones.

For a complete list of meeting participants, subject matters, and testimony offered, please refer to Appendices A and B of this report.

## **Structure of the Commission**

The statute that established the Commission also delineated its structure and required that the Commission be made up of eleven members appointed as follows:

The commission shall be comprised of the following members: 3 members to be appointed by the governor, 1 of whom shall be a member of the executive office of health and human services and 1 of whom shall be a member of the executive office of education; 3 members to be appointed by the president of the senate, 1 of whom shall have expertise in economic development and 1 of whom shall have expertise in energy; 1 member to be appointed by the senate minority leader; 3 members to be appointed by the speaker of the house of representatives, 1 of whom shall have expertise in interstate commerce and 1 of whom shall have expertise in transportation; and 1 member to be appointed by the house minority leader.

In accordance with the statutory guidelines, the members of the Commission are:

**Senate president appointments:**

Senator Eileen Donoghue, Chair  
First Middlesex District

Mr. Peter Shattuck (replaced by Ms. Amy Boyd in September 2017)  
Acadia Center

Mr. Thomas Emswiler  
Public health advocate

**Speaker of the House appointments:**

Representative Daniel Cahill  
Tenth Essex District

Representative Michael Finn  
Sixth Hampden District

Dr. Judith Owens  
Director of the Center for Pediatric Sleep Disorders, Boston Children's Hospital

**Governor appointments:**

Mr. Tim Miley (replaced by Ms. Jennifer Barrelle in August 2017)  
Department of Public Health

Mr. Robert LePage  
Assistant Secretary for Career Education, Executive Office of Education

Mr. John Warren  
General Manager of the Sports Licensed Division, Reebok International, LTD

**Senate minority leader appointment:**

Dr. Yvonne Spicer  
Vice President for Advocacy & Educational Partnerships, National Center for Technological Literacy

**House minority leader appointment:**

Representative Paul Frost  
Seventh Worcester District

## Background

DST began during World War I when Germany moved its clocks back to reduce electricity usage and make more coal available for other uses.<sup>1</sup> The United States followed suit, passing the Standard Time Act of 1918, which established the four time zones still found across the continental United States.<sup>2</sup> The national observation of DST ceased after the war, but many states, counties, and even individual municipalities continued the practice, creating a confusing patchwork of DST observance across the country.<sup>3</sup>

The lack of a standardized approach to DST complicated commerce, particularly in the transportation and broadcasting industries, which prompted Congress to act.<sup>4</sup> The Uniform Time Act of 1966 created a system in which every state observed DST beginning on the last Sunday in April and ending on the last Sunday in October, unless an entire state opted out of DST.<sup>5</sup> The Act was later amended so that a state straddling two time zones could exempt a portion of the state from DST. The Uniform Time Act ended the country's slapdash geographical calendar of DST observances.<sup>6</sup>

During the oil embargo of 1973, Congress experimented with year-round DST to conserve fuel.<sup>7</sup> The experiment was intended to last from January 6, 1974, to April 27, 1975, although the country returned to an abbreviated period of standard time after parents raised concerns about children walking to school in the dark.<sup>8</sup> In 1975, the U.S. Department of Transportation evaluated the experiment and determined that extending the DST period from six to eight months could have modest benefits “in the areas of energy conservation, overall traffic safety, and reduced violent crime.”<sup>9</sup>

In 1986, Congress advanced the start date of DST by three weeks to the first Sunday in April in another attempt to conserve energy.<sup>10</sup> Then, in 2007, following the passage of the Energy Policy Act of 2005, the start date of DST moved forward an additional three weeks to the second Sunday in March, and the end date moved back one week to the first Sunday in November.<sup>11</sup>

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<sup>1</sup> Matthew J. Kochten & Laura E. Grant, *Does Daylight Saving Time Save Energy? Evidence from a Natural Experiment in Indiana*, 93 Review of Econ. and Stat. 1172, 1172 (2011).

<sup>2</sup> Daniel S. Hammermesh et. al, *Cues for Timing and Coordination: Latitude, Letterman, and Longitude*, 26 J. Lab. Econ. 223, 227 (2008).

<sup>3</sup> Jody Brumage, *The Uniform Time Act of 1966*, Robert C. Byrd Center for Congr. History and Educ. (Mar. 15, 2009), [www.byrdcenter.org/byrd-center-blog/the-uniform-time-act-of-1966](http://www.byrdcenter.org/byrd-center-blog/the-uniform-time-act-of-1966).

<sup>4</sup> *Id.*

<sup>5</sup> Beth Cook, Cong. Research Serv., R44411, *Daylight Saving Time* (2016).

<sup>6</sup> *Id.*

<sup>7</sup> *Id.*

<sup>8</sup> *Id.*

<sup>9</sup> Office of the Assistant Sec'y for Policy, Plans, and Int'l Affairs, U.S. Dep't of Transp., *Exec. Summary of the Final Report on the Operation and Effects of Daylight Saving Time* (1975).

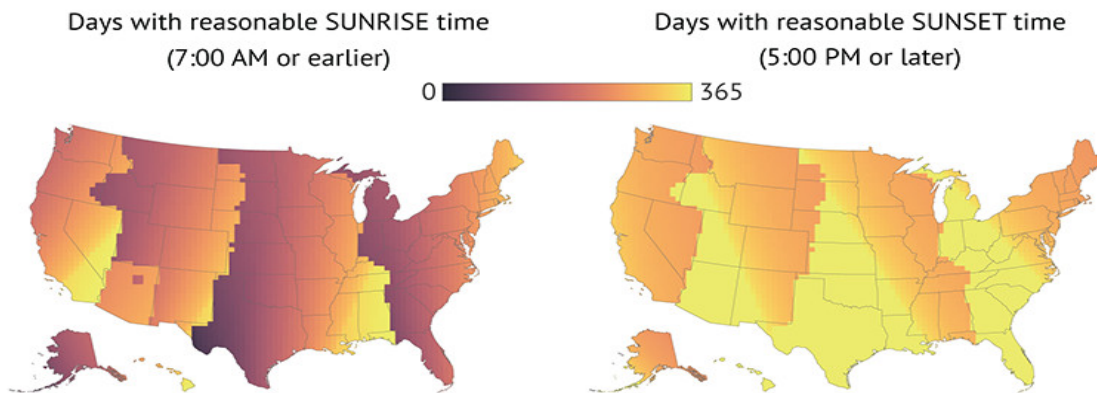
<sup>10</sup> Kochten, *supra* note 1.

<sup>11</sup> *Id.*

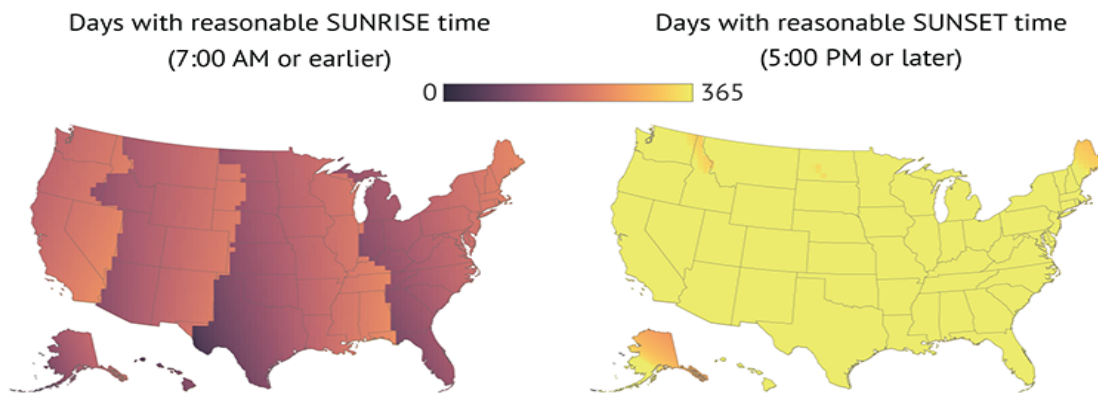


Most U.S. states and territories observe DST, with the exceptions of American Samoa, Arizona (except the Navajo Nation, which does observe DST), Guam, Hawaii, the Northern Mariana Islands, Puerto Rico, and the Virgin Islands.<sup>12</sup> Thus, after several decades and two separate extensions, the United States ended up with eight months of DST, the system that remains in place today.<sup>13</sup>

## Daylight Saving Time as currently observed



## If Daylight Saving Time were always in effect



<sup>12</sup> Cook, *supra* note 5.

<sup>13</sup> Brian Resnick, *The awfulness of daylight saving time, mapped*, Vox (Mar. 12, 2016, 9:15 am), [www.vox.com/science-and-health/2015/11/19/9762276/daylight-saving-time-bad-mapped](http://www.vox.com/science-and-health/2015/11/19/9762276/daylight-saving-time-bad-mapped).

Although DST is observed in 48 states, a surprising lack of uniformity exists globally. DST is employed in only about 70 countries.<sup>14</sup> Most of Africa and Asia do not observe DST,<sup>15</sup> and South America is split, with many of its northern countries not observing DST, while places like Paraguay and southern Brazil follow DST.<sup>16</sup> Even those countries that do observe DST have different start and end dates. For example, Canada follows the United States, Europe observes DST but switches its clocks a few weeks after the United States, and the parts of Australia that observe DST do so from October through April.<sup>17</sup>

No mechanism exists through which Massachusetts could adopt year-round DST, as federal law only allows states to opt out of DST,<sup>18</sup> but the Commonwealth could effectively achieve that goal by moving from the Eastern Time Zone to the Atlantic Time Zone and then opting out of DST.<sup>19</sup> A geographic area can change its time zone through an act of Congress, or through regulations issued by the U.S. Secretary of Transportation.<sup>20</sup> Under the regulatory route—the only approach used in recent decades—a state government petitions for a change in time zone, and the Secretary of Transportation evaluates the petition based on the change’s impact on commerce.<sup>21</sup>

Several other states are considering bills that would move them to year-round DST, including four of the other five New England states.<sup>22</sup> A bill that would have made such a change in Maine—but only if Massachusetts and New Hampshire also participated—passed both legislative chambers but was ultimately laid aside.<sup>23</sup> A similar bill passed New Hampshire’s House but was rejected by its Senate.<sup>24</sup> Bills establishing year-round DST were also filed in the Connecticut and Rhode Island legislatures, and in the legislatures of Illinois, Michigan, Mississippi, New Mexico, and Wyoming.<sup>25</sup>

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<sup>14</sup> Meeting of the Special Comm’n on the Commonwealth’s Time Zone [hereinafter Comm’n], statement of Dr. David Prerau (Apr. 12, 2017).

<sup>15</sup> *Worldwide Daylight Saving Time*, Web Exhibits: Daylight Saving Time (2008), [www.webexhibits.org/daylightsaving/g.html](http://www.webexhibits.org/daylightsaving/g.html) (accessed 9/12/17).

<sup>16</sup> *Id.*

<sup>17</sup> *Id.*

<sup>18</sup> Cook, *supra* note 5.

<sup>19</sup> Matt O’Brien, *Could New England Secede from Eastern Standard Time?*, Bos. Globe (Mar. 11, 2016), [www.bostonglobe.com/metro/2016/03/11/will-new-england-secede-from-eastern-standard-time/4T9tNuLYXX3rz3SKWMpkZI/story.html](http://www.bostonglobe.com/metro/2016/03/11/will-new-england-secede-from-eastern-standard-time/4T9tNuLYXX3rz3SKWMpkZI/story.html).

<sup>20</sup> U.S. Dep’t of Transp., *Procedure for Moving an Area from One Time Zone to Another* (2013).

<sup>21</sup> *Id.*

<sup>22</sup> See Time Zone Report: Following Daylight Saving Time legislation in the U.S., [timezonereport.com/](http://timezonereport.com/) [hereinafter Time Zone Report].

<sup>23</sup> Joe Lawlor, *Maine legislators set aside bill to end twice-a-year clock changes*, Press Herald (Jun. 12, 2017), [www.pressherald.com/2017/06/12/atlantic-standard-time-zone-bill-all-but-dead-in-legislature/](http://www.pressherald.com/2017/06/12/atlantic-standard-time-zone-bill-all-but-dead-in-legislature/).

<sup>24</sup> David Brooks, *Senate votes down push to switch N.H.’s time zone*, Concord Monitor (May 11, 2017), [www.concordmonitor.com/time-zone-change-atlantic-9808198](http://www.concordmonitor.com/time-zone-change-atlantic-9808198).

<sup>25</sup> Time Zone Report *supra* note 22.

If Massachusetts does move to the Atlantic Time Zone and opts out of DST, then the Commonwealth would be an hour ahead of the rest of the East Coast for roughly four months each year.<sup>26</sup>

The following table breaks down the periods of the year when Massachusetts would be in or out of sync with the rest of the Eastern Time Zone:

	Massachusetts	Rest of Eastern Time Zone	Difference
Second Sunday in March until first Sunday in November (34 weeks, roughly 2/3 of the year)	Coordinated Universal Time minus four hours	Coordinated Universal Time minus four hours	No difference
First Sunday in November until second Sunday in March (18 weeks, roughly 1/3 of the year)	Coordinated Universal Time minus four hours	Coordinated Universal Time minus five hours	Massachusetts one hour ahead

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<sup>26</sup> *Supra* note 14, statement of Dr. David Prerau (Apr. 12, 2017).

## Findings

Twice a year, as Massachusetts residents are reminded to set their clocks forward or back an hour, media outlets inundate the public with anecdotes and opinions that usually bemoan (and occasionally celebrate) this ritual switching. Until the formation of this Commission, however, the Commonwealth had not requested any group to analyze the wisdom of maintaining the status quo and switching back-and-forth between EDT and EST.

This Commission researched and evaluated the impact of time zones and DST in terms of energy, crime, and public health to help to determine the advisability of Massachusetts moving to the Atlantic Time Zone (effectively observing year-round DST). The Commission utilized a data-driven approach in determining its findings and recommendations, and relied on experts, academic papers, and data to evaluate the merits of questions about time zones. The Commission reached the following findings:

### Economic Development: Commerce and Trade

The United States has a history of adjusting the clocks or the calendar to increase retail sales.<sup>27</sup> For example, Thanksgiving has been moved to an earlier date to lengthen the shopping season leading up to Christmas,<sup>28</sup> and the 2007 extension of DST was at least partially motivated by a desire to increase evening retail sales.<sup>29</sup> Year-round DST represents another opportunity to fuel consumer spending.

Jon Hurst, president of the Retailers Association of Massachusetts, surveyed his organization's members about DST in March 2017 and shared the results with the Commission. A majority of the responding retailers did not believe that Massachusetts should continue the status quo and switch between standard time and DST, and while no clear consensus existed about the choice that Massachusetts should make, a plurality of respondents indicated that Massachusetts should adopt year-round DST.<sup>30</sup> Mr. Hurst emphasized that New England adopting year-round DST as a region would be preferable to Massachusetts acting alone.<sup>31</sup>

Many of the retailers surveyed by Retailers Association of Massachusetts cited the positive impact of additional evening daylight on consumer spending as the reason for supporting year-round DST.<sup>32</sup> A 2016 study conducted by JPMorgan Chase & Co. compared consumer spending in Los Angeles, where DST is observed, and Phoenix, where it is not, during the 30 days before

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<sup>27</sup> Comm'n *supra* note 14, statement of Mr. Jon Hurst (Mar. 15, 2017).

<sup>28</sup> Lily Rothman, *FDR Moved Thanksgiving to Give People More Time to Shop*, TIME (Nov. 28, 2014), [time.com/3603622/fdr-moved-thanksgiving/](http://time.com/3603622/fdr-moved-thanksgiving/).

<sup>29</sup> Lucas Powers, *Daylight Saving Time 2016: How Big Business Benefits from More Sunshine*, CBC News (Mar. 12, 2016), [www.cbc.ca/news/business/daylight-saving-business-energy-1.3485281](http://www.cbc.ca/news/business/daylight-saving-business-energy-1.3485281).

<sup>30</sup> Comm'n *supra* note 14, statement of Mr. Jon Hurst (Mar. 15, 2017).

<sup>31</sup> *Id.*

<sup>32</sup> *Id.*

and after DST started and ended.<sup>33</sup> The study found that relative to consumer spending in Phoenix, consumer spending in Los Angeles increased by 0.9 percent at the start of DST and decreased by 3.5 percent at the end of DST.<sup>34</sup>

Several Commissioners raised the question of whether being temporally out of sync with East Coast markets like New York City would increase the costs of doing interstate business, particularly in financial services. Data show that some people in jurisdictions that do not observe DST end up changing their work schedules to stay in sync with business partners in nearby states, which suggests that interstate synchronization of schedules has economic value.<sup>35</sup>

Another Commissioner raised the prospect of year-round DST giving the Commonwealth's businesses a competitive advantage in terms of employee recruitment and retention. In large sectors like financial services and technology, Massachusetts businesses compete for talent with New York City and Silicon Valley, where the earliest sunsets of the year occur at 4:28 p.m. and 4:50 p.m., respectively.<sup>36</sup> In Boston, the earliest sunset of the year currently occurs at 4:11 p.m.<sup>37</sup> Year-round DST would push back the earliest sunset to 5:11 p.m., giving Massachusetts a small, but potentially meaningful, competitive advantage.<sup>38</sup>

A 2003 report on Massachusetts' retention of college graduates—commissioned by The Boston Foundation and the Greater Boston Chamber of Commerce—identified Greater Boston's climate as one of students' main frustrations with the region.<sup>39</sup> The report also found that students seeking relief from Greater Boston's long, dark winters often relocated to the San Francisco metropolitan area after college.<sup>40</sup> Massachusetts cannot rectify this problem by changing its weather or the length of its seasons, but might make its winters more palatable to college graduates by making evenings less dark.

Although some questions about coordination with East Coast markets remain unanswered, the Commission found that year-round DST would positively impact consumer spending, which in turn could help the Commonwealth attract and retain more talented workers.

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<sup>33</sup> See Diana Farrell et. al, *Shedding Light on Daylight Saving Time*, JPMorgan Chase Inst. (Nov. 2016), [www.jpmorganchase.com/corporate/institute/document/jpmc-institute-daylight-savings-report.pdf](http://www.jpmorganchase.com/corporate/institute/document/jpmc-institute-daylight-savings-report.pdf).

<sup>34</sup> *Id.* at 2.

<sup>35</sup> Hammermesh *supra* note 2, at 244-245.

<sup>36</sup> Tom Emswiler, *Why Mass. should defect from its time zone*, Bos. Globe (Oct. 4, 2014), [www.bostonglobe.com/ideas/2014/10/04/why-massachusetts-should-defect-from-its-time-zone/zusFxWGPOmwv6bfUb1ssxH/story.html](http://www.bostonglobe.com/ideas/2014/10/04/why-massachusetts-should-defect-from-its-time-zone/zusFxWGPOmwv6bfUb1ssxH/story.html).

<sup>37</sup> *Id.*

<sup>38</sup> *Id.*

<sup>39</sup> The Bos. Consulting Grp., *Preventing a Brain Drain: Talent Retention in Greater Boston* 18 (2003), [www.tbf.org/~media/TBFOrg/Files/Reports/Preventing%20Brain%20Drain%20report.pdf](http://www.tbf.org/~media/TBFOrg/Files/Reports/Preventing%20Brain%20Drain%20report.pdf).

<sup>40</sup> *Id.* at 10

## Labor and Workforce

The spring transition to DST causes people to lose sleep, not only on Sunday—the day following the transition—but also during that work week. Using sleep data from the Bureau of Labor Statistics, University of Washington professor Christopher M. Barnes and University of Oregon professor David T. Wagner—who have done extensive research on sleep and fatigue issues in the workplace—found that workers lost an average of 40 minutes of sleep on the Monday following the spring transition.<sup>41</sup> That lost sleep can profoundly affect both productivity and safety.<sup>42</sup>

Professors Barnes and Wagner investigated the impact of lost sleep on workplace safety by analyzing 23 years of data from the Mine Safety and Health Administration.<sup>43</sup> Mines are useful workplaces to examine when considering the effect of transitioning to DST because mining work occurs largely underground; therefore, differences in sunlight do not skew the data.<sup>44</sup> The analysis showed a 5.7 percent increase in the number of injuries on days following the spring transition to DST and a 67.6 percent increase in the number of days lost due to injury, suggesting an increase in the severity of the injuries.<sup>45</sup>

In addition to compromising workers' safety, the spring transition to DST compromises their productivity. Professors Barnes and Wagner collected Google search data from the Monday following the spring transition to DST and measured an increase in traffic to entertainment-related websites of between 3.1 and 6.4 percent, which suggested that workers were too tired to focus on their jobs.<sup>46</sup> A lab experiment also revealed that an hour of disturbed sleep led study participants to “cyberloaf” for, on average, 20 percent of the duration of an assigned task.<sup>47</sup>

The Commission finds that eliminating the spring transition to DST would increase productivity and cut down on both the number and severity of on-the-job injuries, which would lead to lower costs for businesses (e.g. more productivity, lower rates for workers' compensation insurance, and less need for hiring and training replacement workers).

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<sup>41</sup> See Christopher M. Barnes and David T. Wagner, *Changing to Daylight Saving Time Cuts Into Sleep and Increases Workplace Injury*, 94 J. Applied Psychol. 1305 (2009).

<sup>42</sup> *Id.*

<sup>43</sup> *Id.* at 1310.

<sup>44</sup> Comm'n *supra* note 14, statement of Mr. Christopher M. Barnes (Apr. 12, 2017).

<sup>45</sup> *Supra* note 41, at 1305, 1310-1311 (2009).

<sup>46</sup> Christopher M. Barnes et. al, *Lost Sleep and Cyberloafing: Evidence from the Laboratory and a Daylight Saving Time Quasi-Experiment*, 97 J. Applied Psychol. 1068, 1071 (2012).

<sup>47</sup> *Id.* at 1073.

## Public Health

DST, as currently observed, has several impacts on public health. The spring transition itself has negative consequences, most of which result from lost sleep, while the additional evening daylight provided during DST improves public health by increasing physical activity among residents.<sup>48</sup> As previously stated, people lose a significant amount of sleep in the days following the spring transition to DST, which leads to an increase in traffic fatalities and an increase in both the frequency and severity of on-the-job injuries.

In addition to those risks, the spring transition to DST has another potentially fatal consequence: a higher incidence of acute myocardial infarction—also known as heart attack.<sup>49</sup> A study published in the *New England Journal of Medicine* in 2008 found that the incidence of heart attack significantly increased during the three weekdays following the spring transition, but significantly decreased for only one weekday following the fall transition.<sup>50</sup> The authors stated that “the adverse effect of sleep deprivation on cardiovascular health” was the “most plausible explanation” for their findings.<sup>51</sup>

The public health benefits of year-round DST do not just stem from the elimination of the spring transition. A study that followed more than 23,000 children before and after the clocks changed found that more evening daylight correlated with a small, but meaningful, increase in their physical activity levels.<sup>52</sup> The impact occurred population wide, which is important, according to the authors, “because even small changes to the population mean can have important public health consequences.”<sup>53</sup> The authors also noted that the effect size of additional evening daylight compared favorably to the effect size of “intensive, individual-level interventions,” suggesting that daylight saving is a highly efficient means of promoting exercise.<sup>54</sup>

The Commission finds that adopting year-round DST would improve public health in the Commonwealth by eliminating the annual spring transition to DST—with its corresponding increase in traffic fatalities, workplace injuries, and heart attacks—and also by providing residents with additional evening daylight during the winter, which would lead to increased physical activity among residents.

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<sup>48</sup> Heindrik Wolff & Momoe Makino, Does Daylight Saving Time Burn Fat? Time Allocation with Continuous Activities 3 (2014), [econ.washington.edu/sites/econ/files/old-site-uploads/2014/06/Economica-R-and-R-2014-Wolff-Makino.pdf](http://econ.washington.edu/sites/econ/files/old-site-uploads/2014/06/Economica-R-and-R-2014-Wolff-Makino.pdf).

<sup>49</sup> Barbara S. Taylor, M.D. & Scott M. Hammer, M.D., *Shifts to and from Daylight Saving Time and Incidence of Myocardial Infarction*, 359 *New Eng. J. Med.* 1966, 1966 (2008).

<sup>50</sup> *Id.*

<sup>51</sup> *Id.*

<sup>52</sup> Anne Goodman et. al, *Daylight saving time as a potential public health intervention: an observational study of evening daylight and objectively-measured physical activity among 23,000 children from 9 countries*, 11 *Int’l J. Behav. Nutrition and Physical Activity* 1, 7 (2014).

<sup>53</sup> *Id.*

<sup>54</sup> *Id.* at 1.

## Energy

Most of the academic literature on DST and energy focuses on energy usage during the March-to-November DST period. While interesting, that information is not particularly relevant to the Commission, which is charged with investigating how DST would affect energy usage from early November to mid-March rather than how DST affects energy usage during the summer. There is, however, some information that sheds light on the impact that winter DST would have on energy consumption.

According to a presentation made by Commission member Peter Shattuck, a study conducted by the U.S. Department of Energy (DoE) following the 2007 extension of DST provides the energy usage data most relevant to the Commission.<sup>55</sup> This 2007 extension added three weeks of DST in the spring and one week in the fall, creating a natural experiment that can be exploited to measure how energy usage changes when DST encroaches deeper into winter.<sup>56</sup>

The DoE study compared electricity consumption during those four weeks in 2006 and 2007. DoE found a 0.48 percent drop in electricity consumption nationally following the extension of DST and a 0.68 percent drop in New England.<sup>57</sup> In Massachusetts, electricity consumption increased by 1.2 percent in the morning during the spring, but decreased by 3.2 percent in the afternoon and evening.<sup>58</sup> During the fall, electricity consumption increased by one percent in the morning, but decreased by 2.8 percent in the afternoon and evening.<sup>59</sup>

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<sup>55</sup> See U.S. Dep't of Energy, Report to Cong.: Impact of Extended Daylight Saving Time on National Energy Consumption (2008).

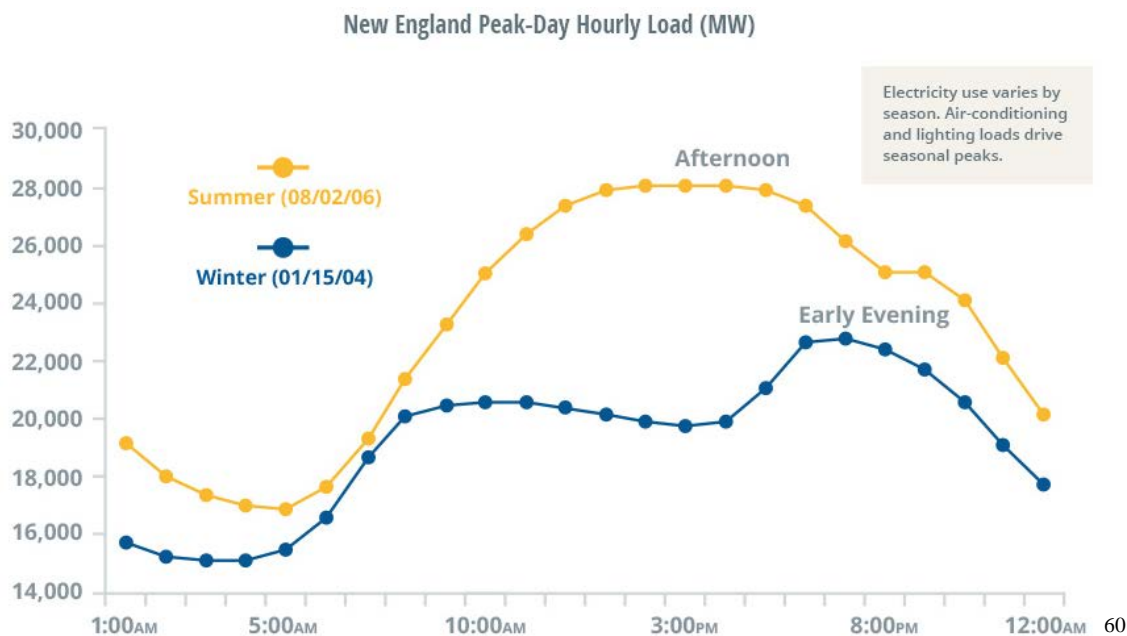
<sup>56</sup> *Id.*

<sup>57</sup> *Id.*

<sup>58</sup> *Id.*

<sup>59</sup> *Id.*





Mr. Shattuck helped put those numbers in context for the Commission, explaining that in New England, peak demand for electricity occurs in the early evening during the winter. He added that peak winter demand poses a problem because the region has developed a heavy reliance on natural gas for electricity generation, and in the winter natural gas is used for heating.<sup>61</sup> Residents have felt the impact of that heavy reliance in recent winters when natural gas was scarce and its price spiked, causing electricity bills to rise sharply.<sup>62</sup>

Because afternoon and evening are the hours of peak winter electricity demand, Mr. Shattuck explained, even a small reduction in afternoon and evening electricity consumption can have significant benefits.<sup>63</sup> If the Commonwealth were having difficulty meeting demand for even a few hours each winter, then Massachusetts might be compelled to invest in costly new energy infrastructure.<sup>64</sup> Even one-half a percentage point reduction in peak demand could obviate the need for that new infrastructure, which would result in lower greenhouse gas emissions and lower costs for ratepayers.<sup>65</sup>

The Commission finds that year-round DST has the potential to produce modest energy savings. The Commission also finds that due to the timing of those savings and New England's current energy portfolio, year-round DST could lead to meaningful reductions in both future energy costs and greenhouse gas emissions.

<sup>60</sup> ISO New Eng., 2015 Regional System Plan (2015).

<sup>61</sup> *Id.*

<sup>62</sup> Megan Woolhouse, *National Grid's Electric Rates Going up for Winter*, Bos. Globe (Sept. 15, 2015), [www.bostonglobe.com/business/2015/09/15/national-grid-electric-rates-going-for-winter-but-not-much-last-year/s3nFnwz4on3IrXD8L4MRoO/story.html](http://www.bostonglobe.com/business/2015/09/15/national-grid-electric-rates-going-for-winter-but-not-much-last-year/s3nFnwz4on3IrXD8L4MRoO/story.html).

<sup>63</sup> Comm'n, *supra* note 22, statement of Mr. Peter Shattuck (Mar. 15, 2017).

<sup>64</sup> *Id.*

<sup>65</sup> *Id.*

## Crime and Criminal Justice

Proponents of DST have long speculated that its observance reduces crime, which academic researchers have recently confirmed. University of Virginia professor Jennifer Doleac and Cornell University professor Nicholas Sanders, both of whom offered expert testimony to the Commission, used transitions to and from DST as a natural experiment to measure the impact that shifting daylight from the morning to the evening has on crime. They published their results in 2015.<sup>66</sup>

The study found a seven percent decrease in robberies due to an additional hour of evening daylight, including a 27 percent reduction during evening commuting hours, with no corresponding increase in crime during morning commuting.<sup>67</sup> The study also found suggestive but not conclusive evidence of a decrease in the incidence of rape.<sup>68</sup> Commuting hours offer the most potential victims to would-be robbers, which might be why preventing those hours from occurring in darkness leads to such a significant reduction in crime.<sup>69</sup>

Professors Doleac and Sanders estimated that the three-week extension of DST in the spring of 2007 generated \$59.2 million in national social cost savings due to a reduction in robberies.<sup>70</sup> If that reduction were consistent throughout the year, then year-round DST would generate \$1 billion in national social cost savings compared to year-round standard time.

The transition to DST also has several impacts on the criminal justice system. Researchers have demonstrated that people of color are more likely to be searched arbitrarily and arrested in the days following the transition.<sup>71</sup> In addition, judges hand out longer sentences in the wake of the annual transition to DST.<sup>72</sup> Unlike the effect of evening daylight on crime, which last through the duration of DST, these effects are limited to the days following the spring transition to DST.<sup>73</sup>

Based on the strength of the academic research, the Commission finds that year-round DST could reduce street crime and produce significant social savings, and could also reduce criminal-justice inequities.

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<sup>66</sup> See Jennifer L. Doleac and Nicholas J. Sanders, *Under the Cover of Darkness: How Ambient Light Influences Criminal Activity*, 97 *The Review of Econ. and Stat.* 1093 (2015).

<sup>67</sup> *Id.* at 1094.

<sup>68</sup> *Id.* at 1100.

<sup>69</sup> *Id.* at 1101.

<sup>70</sup> *Id.* at 1102.

<sup>71</sup> Comm'n *supra* note 14, statement of Mr. David Wagner (Apr. 12, 2017).

<sup>72</sup> Kyongmin Cho et. al, *Sleepy Punishers are Harsh Punishers: Daylight Saving Time and Legal Sentences*, 28 *Psychol. Sci.* 242, 245 (2016).

<sup>73</sup> *Id.*

## Transportation

Moving Massachusetts' time zone out of sync with other eastern states from November to mid-March has the potential to cause confusion at the Commonwealth's airports. José C. Massó, director of policy at Massport, told the Commission that although airports use universal time to communicate with each other, they use local time to communicate with the public.<sup>74</sup> He warned that an hour time difference would likely confuse passengers traveling to or from destinations served by Logan International Airport including New York City, Washington, D.C., and Atlanta.<sup>75</sup>

Mr. Massó informed the Commission that during the three weeks of the year when the United States observes DST but Europe does not, manageable logistical challenges for both passengers and airports result.<sup>76</sup> Ed Freni, Massport's director of aviation, testified that extra resources are needed to plan for the complexity of those three weeks, and additional staff is needed to assist passengers.<sup>77</sup> Year-round DST could cause airports located in the Commonwealth to incur those additional costs over a longer period and for more flights.<sup>78</sup>

Regional action would help mitigate the negative impacts to airports caused by a change to year-round DST, according to Mr. Massó.<sup>79</sup> He would prefer that all the New England states and possibly New York act together to minimize the costs and confusion that would ensue if Massachusetts acted alone.<sup>80</sup>

While having a clear impact on modes of transportation like air and rail that rely on carefully calibrated schedules, DST also impacts vehicular traffic. A study conducted by Austin C. Smith, an economist at the University of Colorado, found a 5.4 to 7.6 percent increase in fatal crashes during the six-day period following the beginning of DST.<sup>81</sup> Mr. Smith estimated that over a decade, the spring transition caused 302 deaths and resulted in a social cost of \$2.75 billion.<sup>82</sup>

Mr. Smith found that the fall transition to standard time had no aggregate impact on traffic fatalities.<sup>83</sup> The reallocation of light from the evening to the morning did lead to a corresponding reallocation of fatal crashes from the morning to the evening, but those changes balanced each other out.<sup>84</sup> Other researchers have reached different conclusions. Paul Fischbeck and David Gerard of Carnegie Mellon University found that brighter mornings and darker evenings led to a

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<sup>74</sup> Comm'n *supra* note 14, statement of Mr. José C. Massó (Mar. 15, 2017).

<sup>75</sup> *Id.*

<sup>76</sup> *Id.*

<sup>77</sup> Comm'n *supra* note 14, statement of Mr. Ed Freni (Mar. 15, 2017).

<sup>78</sup> Comm'n *supra* note 14, statement of Mr. José C. Massó (Mar. 15, 2017).

<sup>79</sup> *Id.*

<sup>80</sup> *Id.*

<sup>81</sup> Austin C. Smith, *Spring Forward at Your Own Risk: Daylight Saving Time and Fatal Vehicle Crashes*, 8 Am. Econ. J.: Applied Econ. 65, 79 (2016).

<sup>82</sup> *Id.* at 89

<sup>83</sup> *Id.* at 68

<sup>84</sup> *Id.* at 80

net increase in pedestrian fatalities, with more lives lost in the evening than saved in the morning.<sup>85</sup> Their findings suggest that observing DST throughout the winter would save lives.<sup>86</sup>

The Commission finds that year-round DST would have a mixed impact on transportation. While evidence suggests that year-round DST would lead to fewer traffic fatalities, unilateral action by Massachusetts would likely complicate travel air and train travel.

## Broadcasting

Adopting year-round DST could prove problematic for Massachusetts broadcasters.<sup>87</sup> If Massachusetts adopted year-round DST on its own, national evening news programs would broadcast an hour later from early November to mid-March, as would the 8 p.m. to 11 p.m. slot for national programming.<sup>88</sup> Those changes could disrupt local news programs, which are the biggest sources of revenue for local broadcasters, according to Jim Smith, general counsel to the Massachusetts Broadcasters Association.<sup>89</sup> The fact that Central time zone audiences often have television shows broadcast an hour earlier, however, suggests that the logistical issues arising from the four-month shift may have manageable solutions.

Live television events would pose additional challenges to broadcasters.<sup>90</sup> As currently programmed, an event like the Oscars that ended after midnight this year would instead end after 1 a.m., which would likely diminish viewership.<sup>91</sup> Primetime sports events like Sunday, Monday, and Thursday night football would begin broadcasting after 9 p.m. and conclude well after midnight. Broadcasters and producers might have to take into account the relative size and market power of Massachusetts when deciding when to air certain programs between November and March. Leagues and major events would not alter their schedules to accommodate Massachusetts alone, according to Mr. Smith, because the need to capture the West Coast market is greater than the need to capture the Massachusetts market.<sup>92</sup>

Mr. Smith additionally informed the Commission that even if all six New England states observed year-round DST they would still be outliers, adding that there would likely be no changes in national live broadcast schedules unless New York or Pennsylvania joined New England in making the change.<sup>93</sup> He said that New England acting alone presents issues to

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<sup>85</sup> David Gerard, *The Spring Time Change Saves Lives*. N.Y. Times: Room for Debate (Mar. 6, 2014), [www.nytimes.com/roomfordebate/2014/03/06/daylight-saving-time-at-what-cost/the-spring-time-change-saves-lives?mcubz=0](http://www.nytimes.com/roomfordebate/2014/03/06/daylight-saving-time-at-what-cost/the-spring-time-change-saves-lives?mcubz=0).

<sup>86</sup> *Id.*

<sup>87</sup> Comm'n *supra* note 14, statement of Mr. Jim Smith (Apr. 12, 2017)

<sup>88</sup> *Id.*

<sup>89</sup> *Id.*

<sup>90</sup> *Id.*

<sup>91</sup> *Id.*

<sup>92</sup> *Id.*

<sup>93</sup> *Id.*

broadcasters, which is why the Massachusetts Broadcasters Association opposes a change to year-round DST.<sup>94</sup>

Moving national television programming and live events to a later hour could also impact the sleep habits of some Massachusetts residents. The Commission discussed how the national programming slot, which ends at 11 p.m. in the Eastern and Pacific Time Zones and at 10 p.m. in the Central and Mountain Time Zones, has been exploited by researchers looking to measure the effect of television schedules on people's behavior. Researchers have found that the one-hour difference in schedules had a meaningful effect on when people went to bed in the evening and when they woke up and went to work in the morning.

People in the early zones (Central and Mountain) are 6.4 percentage points less likely to watch television between 11 p.m. and 11:15 p.m. than those in the later zones (Eastern and Pacific).<sup>95</sup> Those nighttime television habits lead to corresponding changes in morning habits. People in the early zones (who stopped watching television at an earlier hour) are 3.4 percentage points less likely to be asleep at 7 a.m. and 3.4 percentage points more likely to be at work at 8 a.m. than people in the later zones.<sup>96</sup> Based on that information, a Massachusetts move to year-round DST may alter the sleep schedules of residents.

The Commission finds that year-round DST could have some negative effect on broadcasters, unless other states adopted year-round DST. Additionally, the Commission finds that some residents would change their sleep habits due to later television schedules by either sleeping less or waking up later.

## Education and School Start-Times

Year-round DST would shift one hour of daylight from the morning to evening from early November to mid-March, leading to darker mornings as children head to school, but lighter afternoons as children engage in end-of-school and after-school activities. Parents have long worried that darker mornings make traveling to school more dangerous, and both the available data and other factors such as puberty, sleep, and alertness suggest they might be correct.<sup>97</sup>

Although the Commission has not learned of recent studies on the effects of daylight on the safety of schoolchildren's commute, in a 1976 report to Congress on the impacts of the nation's year-round DST experiment, the National Bureau of Standards ("NBS") found evidence of increased fatalities among school-aged children from January to April of 1974, when DST was in effect, compared with the same period (non-DST) in 1973.<sup>98</sup> However, NBS could not determine what part of the increase, if any, was due to DST rather than other factors. Further,

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<sup>94</sup> *Id.*

<sup>95</sup> Hammermesh, *supra* note 2, at 233.

<sup>96</sup> *Id.*

<sup>97</sup> Cook, *supra* note 5; *see also* Judith A. Owens, MD, *School Start Times for Adolescents*, 134 *Pediatrics* 642, 642 (2014).

<sup>98</sup> Cook, *supra* note 5.

when these same data were analyzed on a month-by-month basis for March and April, no significant difference was found for fatalities among school-age children in the morning.<sup>99</sup>

According to Commission member Dr. Judith Owens, dark winter mornings also might make high school students more prone to exacerbated seasonal affective disorder and increased car accidents.<sup>100</sup>

One way to avoid the downsides of year-round DST for school-aged children would be to delay school start-times until after there is sufficient daylight for safe travel.<sup>101</sup> Civil twilight, which occurs roughly half an hour before sunrise, is the moment when there is generally enough natural light to engage in outdoor activities, such as walking or driving to school.<sup>102</sup>

The following table shows the range of civil twilight times in Massachusetts from November 2017 to March 2018 under both standard time and DST:

	Nov	Dec	Jan	Feb
Civil Twilight EST	5:53-6:21am	6:22-6:41am	6:29-6:42am	5:54-6:28am
Civil Twilight DST	6:53-7:21am	7:22-7:41am	7:29-7:42am	6:54-7:28am
Sunrise EST	6:23-6:52am	6:53-7:13am	6:59-7:13am	6:22-6:58am
Sunrise DST	7:23-7:52am	7:53-8:13am	7:59-8:13am	7:22-7:58am

- If school starts at 7-7:30am, en route will be in complete darkness (before civil twilight) for almost all of 4 months and before sunrise for all 4 months
- If school starts at 7:30-8am, en route will be before civil twilight for 3 months and before sunrise for most of 4 months
- If school starts at 8-8:30am, en route will be before civil twilight for 2 months and before sunrise for 2 months
- If school starts at 8:30am or later, en route will be after civil twilight for all 4 months and after sunrise for most of 4 months

\*assuming average commute time of 30 minutes

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<sup>99</sup> *Id.*

<sup>100</sup> Comm'n, *supra* note 14, statement and presentation of Dr. Judith Owens (May 31, 2017).

<sup>101</sup> *Id.*

<sup>102</sup> *Id.*

<sup>103</sup> *Id.*

During the 2014-2015 academic year, the average start time for a Massachusetts middle or high school was 7:37 a.m., meaning that the average middle or high school would open in the dark for much of December and January under year-round DST.<sup>104</sup> However, most schools are not in session for a week or more during the darkest period in late December and early January. Pushing back start-times to 8 a.m. would mean that schools never open in the dark, even under year-round DST, while pushing start-times to 8:30 a.m. would mean that few students would even have to commute to school in the dark under year-round DST.

Delaying school start-times for middle and high school students would also be consistent with the health recommendations of the American Academy of Pediatrics<sup>105</sup> and the Massachusetts Medical Society.<sup>106</sup> Adolescents naturally fall asleep and wake up later, so delayed school start-times enable them to obtain an adequate amount of sleep.<sup>107</sup> For teenagers, receiving adequate sleep lowers stress and risk of obesity; improves executive functioning and mood; and reduces risk-taking behavior.<sup>108</sup> Adolescents who sleep for eight or more hours nightly are also less likely to be involved in physical altercations, smoke, drink alcohol, be sexually active, feel sad, and consider suicide.<sup>109</sup>

In addition, later middle and high school start-times have led to higher attendance rates, lower tardiness and dropout rates, and improved grades and test scores in schools in Massachusetts and around the country.<sup>110</sup> When Nauset Regional High School pushed first period back from 7:25 to 8:35 a.m. in 2012, the tardiness rate dropped by 35 percent, and the number of “D”s and “F”s fell by half.<sup>111</sup> After delaying its start from 7:25 to 7:55 a.m. in 2016, Hanover High School saw a 32 percent drop in “D”s and “F”s and a 10 percent jump in “A”s in first-period classes.<sup>112</sup>

According to a macroeconomic state-by-state analysis conducted by the RAND Corporation, a delay in school start-times to 8:30 a.m. nationwide correlates with an annual increase in the national economy of approximately \$9.3 billion, an increase in high school graduation rates of 13.3 percent, and an increase in college attendance of 9.6 percent.<sup>113</sup> The stronger academic and professional performance for students reflected in these numbers, along with as a reduction in car crash rates among adolescent drivers, could lead to an estimated additional \$83 billion

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<sup>104</sup> *Id.*

<sup>105</sup> Owens, *supra* note 91.

<sup>106</sup> See *Massachusetts Medical Society Physicians Adopt New Resolutions at Interim Meeting*, Mass. Med. Soc’y (Dec. 5, 2015), <http://www.massmed.org/News-and-Publications/MMS-News-Releases/Massachusetts-Medical-Society-Physicians-Adopt-New-Resolutions-at-Interim-Meeting/#.WbLms2eWyUm>.

<sup>107</sup> Owens, *supra* note 91, at 644.

<sup>108</sup> See Stacy Simera, MSSA & Mary Haymaker, JD, *Massachusetts School Start Time Legislation Parameters and FAQs*, Start Sch. Later, Mass. Chapter (2017).

<sup>109</sup> *Id.*

<sup>110</sup> Owens, *supra* note 91, at 644.

<sup>111</sup> James Vaznis, *Students Find More Awareness with Later Starts*, Bos. Globe (Mar. 10, 2016), [www.bostonglobe.com/metro/2016/03/09/students-see-benefits-from-later-school-start-times/OOb4vtHm4XZTBLm5X78V9L/story.html?event=event12](http://www.bostonglobe.com/metro/2016/03/09/students-see-benefits-from-later-school-start-times/OOb4vtHm4XZTBLm5X78V9L/story.html?event=event12).

<sup>112</sup> Comm’n, *supra* note 22, from presentation by Dr. Judith Owens (May 31, 2017).

<sup>113</sup> See Hafner et. al, *Later School Start Times in the U.S.: An Economic Analysis*, The RAND Corp. (2017), [www.rand.org/pubs/research\\_reports/RR2109.html](http://www.rand.org/pubs/research_reports/RR2109.html).

contribution to the U.S. economy within the next decade.<sup>114</sup> Effects from delayed school start-times could be felt within a year of making this shift.<sup>115</sup> This report estimates that this kind of change could have a cost-benefit ratio *specifically in Massachusetts* such that the Commonwealth would, at minimum, break even after just two years, and would achieve a cost-benefit ratio of 4.5 after 10 years; meaning that for every dollar spent to make the start-time change, the *return would be more than four-fold the cost*, due to improved academic achievement and reduction in car crash rates.

The Commission finds that with current school schedules remaining in place, adopting year-round DST can pose a public safety risk to school-aged children in the winter months. Those risks could be mitigated by delaying school start-times, however, which would also bring additional benefits, including healthier adolescents and better academic performance by middle and high school students.

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<sup>114</sup> *Id.*

<sup>115</sup> *Id.*



## Recommendations

Based on its research and findings, and after weighing the costs and benefits associated with the observance of time in Massachusetts, the Commission believes that under certain circumstances the Commonwealth could make a data-driven case for moving to the Atlantic Time Zone year-round (effectively observing year-round DST). Although appreciable costs associated with making this change would result, on balance the Commission finds that doing so could have positive benefits that largely stem from the absence of a spring transition to DST and the additional hour of winter evening light.

Providing an additional hour of winter evening light could bring societal benefits to Massachusetts largely by boosting consumer spending and economic development opportunities, reducing certain types of crime, increasing the population's physical activity level, and cutting greenhouse gas emissions and associated energy costs for residences in Massachusetts from early November to mid-March, when Massachusetts currently observes standard time.

The adoption of year-round DST also would eliminate the spring transition to DST and the week of population-wide sleep loss that results. Preventing that sleep loss could have broad and powerful impacts on public health in the Commonwealth. During the week in question, Massachusetts residents could experience fewer traffic fatalities, workplace injuries, and heart attacks, with many lives and tens of millions of dollars saved as a result.

However, the Commission does not recommend a simple switch to the Atlantic Time Zone, and cautions that several qualifiers should accompany any future conversations or legislative proposals with respect to how Massachusetts observes time. The Commission offers the following blueprint of concerns for a thoughtful implementation of year-round DST, should Massachusetts ever decide to pursue this policy change:

### Regional Action

Any move to year-round DST should be regional, because acting alone would make Massachusetts a significant outlier, and could disrupt commerce, trade, interstate transportation, and broadcasting. The Commission recommends that the Legislature adopt year-round DST only if a majority of other Northeast states – possibly including New York – do so as well. To facilitate regional action, the Legislature and Governor should raise this issue with other Northeastern legislative and executive bodies, including the National Conference of State Legislatures, the Council of State Governments, Coalition of Northeast Governors, and gatherings of New England Governors and Eastern Canadian Premiers.

As stated previously, several other Northeast states are already considering bills that would have them observe DST year round. Maine's bill passed both legislative chambers before being laid aside. New Hampshire's passed the House but was rejected in the Senate. Connecticut and Rhode Island are considering such bills but have not voted on them. Vermont is not currently

considering legislation related to year-round DST, but is weighing a resolution urging Congress to abolish DST.<sup>116</sup>

If a group of Northeast states does decide to pursue year-round DST, then they should also recruit New York, as benefits described in the Findings section of this report would likely be applicable to it and other states as well.

For Massachusetts to spur regional action, the Legislature could consider passing a bill that instructs the Secretary of the Commonwealth to petition the U.S. Secretary of Transportation to place Massachusetts in the Atlantic time zone and—pending the U.S. Secretary of Transportation’s approval of the petition—amend section 10 of chapter 4 of the General Laws in order to opt the Commonwealth out of observing DST. Such a bill should condition the shift taking place only after a majority of other Northeast states have passed legislation to the same end.

### Later School Start-Times

Year-round DST would bring darker mornings from early November to mid-March, and without changes to school schedules, could lead to children traveling to school in darkness when the sun rises latest. Although there would be more daylight for after-school activities and travel home for these children (and there are winter school breaks during parts of this time), the early-morning transit time has the potential to pose public safety risks. Moreover, independent of public safety concerns, the Commission has found compelling data that indicate that the early-morning start-times can negatively impact some students’ academic performances, with students not fully awake when they begin classes.

The Commission therefore recommends that any move to year-round DST should be accompanied by statewide standards for delaying school start-times to mitigate safety issues; improve student academic performance, health, and well-being; and add significantly to the other economic benefits related to year-round DST — for example, 8 a.m. for elementary schools and 8:30 a.m. for middle and high schools. These standards could mitigate the negative effects of darker mornings, ensuring that children head to school in the dark for only a handful of days each winter. They could also improve both students’ performance in school, and their physical and mental health.

### Public Awareness

The Commission found that the change to year-round DST could cause confusion in broadcasting, commerce, and interstate transportation. That confusion—and any ensuing economic disruption—could be minimized through effective communication with the public. For that reason, the Commission believes that the Legislature should not adopt year-round DST

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<sup>116</sup> Time Zone Report *supra* note 21.

unless it simultaneously commits funding to educate the public about the implications of the change.

The Legislature would need to focus its public awareness efforts on communities in close proximity to new time zone boundaries. If New York did not join New England states in adopting year-round DST, for example, then people on both sides of the border between Massachusetts and New York would need to be fully informed about the change. Public awareness would be the best way to avoid disruptions caused by confusion around the four-month time difference.

The Legislature would also need to work with Amtrak, Massport, the Massachusetts Department of Transportation, and others to ensure that people traveling to and from Massachusetts would be aware that the Commonwealth does not observe Eastern Standard Time from early November to mid-March. Public awareness campaigns would need to be repeated each November when most states transition from DST back to standard time.

Even if Massachusetts does not adopt year-round DST, public awareness about transitions to and from DST would still be beneficial. A public awareness campaign preceding the spring transition to DST would help residents prepare for the sleep loss caused by the transition so that they could try to mitigate its negative consequences.

## APPENDIX A: **Individuals Invited to Testify**

### **Meeting 1 (January 11, 2017):**

- Commissioners only

### **Meeting 2 (Mar. 15, 2017):**

- Jennifer Doleac, University of Virginia Professor, and Nicholas Sanders, Cornell University professor, co-authors of the paper “Under the Cover of Darkness: How Ambient Light Influences Criminal Activity”
- Jon Hurst, President of the Retailers Association of Massachusetts
- Peter Shattuck, Member of the Commission, Director of Acadia Center’s Clean Energy Initiative and Director of the Massachusetts Office

### **Meeting 3 (Apr. 12, 2017):**

- Christopher M. Barnes, University of Washington Professor, and David T. Wagner, University of Oregon Professor, co-authors of the papers “Changing to Daylight Saving Time Cuts Into Sleep and Increases Workplace Injuries” and “Lost Sleep and Cyberloafing: Evidence From the Laboratory and a Daylight Saving Time Quasi-Experiment”
- David Prerau, DST researcher, historian, and author of the book “Seize the Daylight: the Curious and Contentious Story of Daylight Saving Time”
- Jim Smith, General Counsel to the Massachusetts Broadcasters Association
- José C. Massó, Director of Policy at Massport
- Nancy Donoghue, Director of Government Affairs at Massport
- Ed Freni, Director of Aviation at Massport

### **Meeting 4 (May 31, 2017):**

- Dr. Judith Owens, Director of the Center for Pediatric Sleep Disorders at Boston Children’s Hospital, Neurology Professor at Harvard Medical School, and member of the Commission
- Thomas Emswiler, Member of the Commission, public health advocate

### **Meeting 5 (September 20, 2017):**

- Commissioners only

### **Meeting 6 (November 1, 2017):**

- Commissioners only

## APPENDIX B: Meeting Minutes

### *Special Commission on the Commonwealth's Time Zone*

*Wednesday, January 11, 2017 (Meeting 1)*

**Massachusetts State House  
Hearing Room 222  
Boston, MA 02133**

**Members present (appointed by):**

Representative Daniel Cahill (Speaker), Chairman Eileen M. Donoghue (Senate President), Thomas Emswiler (Senate President), Representative Michael Finn (Speaker), Representative Paul Frost (House Minority Leader), Tim Miley (Governor), Peter Shattuck (Senate President), John Warren (Governor)

**Members absent:**

Robert LePage (Governor)

**Members yet to be appointed:**

One from the Speaker of the House  
One from the Senate Minority Leader

### **Meeting Minutes**

Senator Donoghue welcomed and thanked the members of the special commission for being in attendance. She introduced the members present in the room and then spoke about the creation of this special commission through Chapter 219 of the Acts of 2016, also known as the economic development bill. She noted that the special commission is charged with conducting a comprehensive study on the commonwealth remaining on Eastern Daylight Time throughout the entire year, with attention paid to the impact that this change would have on the economy as a whole, on the education system, on public health, on the transportation system, on energy consumption, and on commerce. Senator Donoghue said that the special commission is tasked with filing a report by March 31, 2017, a deadline that it will do its best to meet. She stated her hope that the commission would take a data-driven approach.

Members of the special commission then introduced themselves and spoke briefly about their background, their goals for the special commission, and topics they would like to consider at future meetings.

John Warren said that he had worked as a CFO and COO for Reebok and Adidas and would bring his business background to bear on the special commission's work.

Peter Shattuck said he was interested on potential energy and climate change impacts and suggested that the special commission could examine data on energy usage in the weeks before and after time changes.

Thomas Emswiler noted that his op-ed published in the *Boston Globe* two years ago was the first step towards the creation of the commission. He thanked Senator Keenan for filing by request a bill to form the commission and stated his intention to remain objective throughout the process.

Representative Cahill said that he represented Lynn, a gateway city near Boston where transportation is an important issue, and that he will focus on the impact of a time zone change on transportation.

Senator Donoghue reintroduced herself, noting that she was appointed by Senate President Rosenberg, and said that as the Senate chair of the Joint Committee on Economic Development and Emerging Technologies she will be particularly interested on the economic development component of the commission's work.

Representative Finn said that he was new to the idea of changing time zones and that research about its public health effects had caught his attention. He added that the commission was a good opportunity to discuss an issue that the commonwealth might not have otherwise had the chance to address.

Representative Frost noted that the Joint Committee on State Administration and Regulatory Oversight had considered time zone changes in the past and said that although he would keep an open mind, he would also play the role of skeptic. He mentioned concerns including the safety of children going to school in the dark, practical issues related to the possibility of Massachusetts acting without other New England states, and potential problems caused by glare on the commutes into and out of Boston from Western Massachusetts.

Tim Miley said that the Department of Public Health had data that is relevant to the commission's work and that he hoped to bring those resources to bear on the study.

Senator Donoghue said that the commission members needed to elect a chair who would organize the commission and handle administrative issues. Mr. Emswiler nominated Senator Donoghue. Representative Cahill seconded the nomination. The commission members unanimously elected Senator Donoghue, who thanked her colleagues, mentioned the possibility of soliciting input from the public, and suggested that the commission would meet once a month with a full agenda before submitting its data-driven report to the legislature by the early spring.

Senator Donoghue adjourned the meeting at 11:43 a.m.

*Special Commission on the Commonwealth's Time Zone  
Wednesday, March 15, 2017 (Meeting 2)*

**Massachusetts State House  
Hearing Room 222  
Boston, MA 02133**

**Members present (appointed by):**

Representative Daniel Cahill (Speaker), Chairman Eileen M. Donoghue (Senate President), Thomas Emswiler (Senate President), Representative Michael Finn (Speaker), Representative Paul Frost (House Minority Leader), Tim Miley (Governor), Robert LePage (Governor), Dr. Judith Owens (Speaker), Peter Shattuck (Senate President), Yvonne Spicer (Senate Minority Leader), John Warren (Governor)

**Meeting Minutes**

Senator Donoghue welcomed the members of the special commission and thanked them for being in attendance. She introduced two members of the commission who had been appointed since the January meeting.

Senator Donoghue said that Yvonne Spicer is the vice president for advocacy and educational partnerships at the National Center for Technological Literacy, a role in which she directs the Museum of Science's efforts to improve K-12 STEM education in Massachusetts and around the world. She added that Ms. Spicer—who has had a distinguished career in STEM education, including stints with the Framingham Public Schools, the Newton Public Schools, and the Massachusetts Department of Elementary and Secondary Education, and several state and national advisory boards related to technology and education—will be a great resource and partner on the commission. Senator Donoghue also noted that Senate Minority Leader Bruce Tarr had appointed Ms. Spicer to the commission.

Senator Donoghue then introduced Dr. Judith Owens, director of the Center for Pediatric Sleep Disorders at Boston Children's Hospital and a member of the faculty of neurology at Harvard Medical School. She said that Dr. Owens is an internationally recognized authority on pediatric sleep, and has written more than 75 research and review articles on the subject and that Dr. Owens' extensive knowledge will be incredibly helpful to the commission as it considers the impact of later winter sunrises on sleep schedules and school start times. She noted that Speaker of the House Bob DeLeo had appointed Dr. Owens to the commission.

Senator Donoghue motioned that the minutes of the commission January 15 meeting be approved. Representative Finn seconded the motion, and the minutes were approved unanimously on a voice vote.

Senator Donoghue introduced University of Virginia professor Jennifer Doleac and Cornell University professor Nicholas Sanders, co-authors of the paper "Under the Cover of Darkness: How Ambient Light Influences Criminal Activity," who joined the commission via conference

call. Ms. Doleac and Mr. Sanders said that their paper examined the effect that shifting daylight from the morning to the evening had on crime. They said that the switch to and from daylight saving time (DST) was a natural experiment that enabled them to measure that effect. They said that they found a seven percent decrease in robberies due to an additional hour of evening daylight, including a 27 percent reduction during evening commuting hours, and no corresponding increase in crime during the morning commuting hours. Ms. Doleac and Mr. Sanders concluded that an additional hour of evening daylight had a big, meaningful impact on street crime, and that making DST permanent would therefore also have a meaningful effect.

Thomas Emswiler noted that the paper estimated that the three-week extension of DST in the spring of 2007 generated \$59.2 million in social cost savings due to a reduction in robberies. He said that he had done some back-of-the-envelope math and calculated that if these savings were consistent throughout the year, year-round DST would generate more than \$1.2 billion in social costs savings. Mr. Emswiler asked if that figure sounded right, and Ms. Doleac and Mr. Sanders said that it did.

Dr. Owens asked if there were any data available on how ambient light affects delinquency. Ms. Doleac and Mr. Sanders said that there was not reliable time-based data for delinquency. Dr. Owens also asked if there were any data about crime during the year-round DST experiment that took place nationally between 1974 and 1975. Ms. Doleac and Mr. Sanders said that a study had found a 10 to 13 percent reduction in street crime in Washington, D.C. during the DST experiment. They said this study was not as reliable as their own, however.

Representative Paul Frost asked how much crime occurred around the time of sunset. He also asked if delaying sunset by one hour would delay criminal activity by one hour, rather than reducing it. Ms. Doleac and Mr. Sanders said that a substantial number of robberies occur during the commuting hours around sunset, when there are more people on the street who can potentially be robbed. They added that their study found that criminal activity was reduced due to a later sunset, and not simply delayed by it.

Peter Shattuck asked for the source of the data. Ms. Doleac and Mr. Sanders said that the data came from 558 jurisdictions around the country, including many in New England.

Senator Donoghue thanked Ms. Doleac and Mr. Sanders for their testimony and introduced Jon Hurst, president of the Retailers Association of Massachusetts (RAM) so that he could discuss small retailers' thoughts about switching to year-round DST.

Mr. Hurst said that there was a history of adjusting the clocks or the calendar to promote sales, including changing the date of Thanksgiving to lengthen the shopping season leading up to Christmas. He noted that 70 percent of the economy is driven by the consumer, and that e-commerce makes it more important than ever to look at how policies affect retailers. Mr. Hurst said that nationally, 18 percent of Christmas shopping took place online last year, and that policies including the sales tax, blue laws, and even time zones can incentivize or dis-incentivize consumers to spend locally. He added that weather and sunshine impact consumer choices.



Mr. Hurst said that he surveyed the 4,000 members of his organization about DST policies and received responses from 5 percent of them. He added that the typical response rate was 2 percent, but that surveys about issues that have a significant impact on sales or expenses receive a good response. Mr. Hurst said that 34 percent of the members who responded favored Massachusetts remaining on DST year round; 24 percent favored Massachusetts remaining on standard time year round; 23 percent did not necessarily disagree with the concept of year-round DST but preferred national action on the issue; and 19 percent favored the status quo. Mr. Hurst noted that a majority of the respondents favored year-round observation of time, rather than switching between standard time and DST. He also noted that respondents had mentioned in their comments the need for consistent regional observation of time, especially since many consumers and employees cross state lines to shop or work. Mr. Hurst concluded by stating that RAM had no official position on whether or not Massachusetts should observe year-round DST.

Senator Donoghue asked how sunlight affected sales. Mr. Hurst said that most shopping takes place on weekday evenings and weekends, and that many retailers believe that extra evening daylight attracts people to go shopping and increases sales.

Representative Michael Finn asked Mr. Hurst which option the plurality of respondents had chosen. Mr. Hurst said that the plurality supported year-round DST in order to increase sales, adding that in an age where people can shop on their iPhones, anything that policymakers can do to keep business in Massachusetts is helpful.

Representative Frost asked if out-of-state consumers and employees would be confused if the change to year-round were not regional, if it did not involve New York, or if it did not involve the rest of the East Coast. Mr. Hurst reiterated that RAM had no official position, adding that personally he believed that Massachusetts should not act alone. He said it was the same case with GMO labeling bills. Mr. Hurst suggested that if the commission did recommend a switch to year-round DST, it could recommend that any related legislation not take effect until a certain number of New England states also pass it.

Representative Daniel Cahill asked if DST affected employee health and productivity and said that he would love to see data in those areas. Mr. Hurst said that it was a great question, but one to which he did not have an answer, and suggested that an organization like the Chamber of Commerce might be able to investigate it.

Mr. Shattuck said that it can be difficult to remember the meanings of the terms DST, standard time, and Atlantic Time Zone and asked how clear the meaning of year-round DST was to the members who responded to the survey. Mr. Hurst said that the survey question framed the issue in terms of sales, crime, and health and that he would be happy to share the text of the question with the commission.

Mr. Emswiler said that it would be helpful to do a deeper dive with RAM members in order to ask them about the potential for a regional switch to year-round DST. He noted that related legislation has been filed in Connecticut, Maine, New Hampshire, and Rhode Island.

Senator Donoghue thanked Mr. Hurst for his testimony and introduced commission member Mr. Shattuck so that he could discuss the potential energy impacts of year-round DST.

Mr. Shattuck said that the U.S. had extended DST by weeks in 2007, adding three weeks in the spring and one in the fall. He said that the Department of Energy (DoE) had compared electricity consumption during those four weeks in 2006 and in 2007, which offers a chance to measure the impact of extended DST. Mr. Shattuck said that the DoE analysis found a 0.48 percent drop in electricity consumption nationally and a 0.68 percent drop in New England. He said that factors like air conditioning in the South and New England's location at the eastern edge of its time zone could help account for that difference. Mr. Shattuck also noted that in Massachusetts, electricity consumption increased by 1.2 percent in the morning during the three spring weeks, but decreased by 3.2 percent in the afternoon and evening; electricity consumption increased by one percent in the morning during the fall week, but decreased by 2.8 percent in the afternoon and evening.

Mr. Shattuck said that the National Bureau of Economic Research (NBER) had studied the energy impact of DST by comparing electricity consumption across Indiana counties, some of which observed DST and some of which did not. He stressed this study focused on the impact of DST as it is currently observed and not the impact of extending DST, which is what the commission is charged with considering. Mr. Shattuck said that the NBER study found a 1 percent overall increase in electricity consumption during DST, attributable largely to air conditioning usage, and an increase of two to four percent in early fall. He said that the key takeaways were that the increase was found in the spring, summer, and fall, but not during the winter, and that Massachusetts and Indiana have different energy profiles and climates.

Mr. Shattuck proceeded to describe the context of energy in Massachusetts and New England. He said that in New England, peak demand for electricity occurs in the afternoon during the summer and in the early evening during the winter. He added that peak winter demand poses a problem because the region has developed an overreliance on natural gas for electricity generation, and in the winter natural gas is used for heating. He said that residents felt the impact of that overreliance in the winter of 2013-2014, when natural gas was scarce and its price spiked, causing electricity bills to rise sharply. Mr. Shattuck said that electricity generators that rely on natural gas have since purchased backup fuels including oil and liquid natural gas to prevent the same problem from recurring. He also pointed to a study conducted by the Attorney General's Office that suggested that Massachusetts could meet its energy needs by investing in renewables and energy efficiency, rather than by constructing new natural gas pipelines.

Mr. Shattuck then stated the he wanted to place the DoE study—and its finding that extended DST reduced electricity consumption by 0.68 percent in New England, with particularly strong effects in the afternoon and early evening—within that broader context of energy in Massachusetts and New England. He said that because afternoon and evening are the hours of peak demand, and because solar stops generating electricity during those hours, even a small reduction in afternoon and evening electricity consumption can have significant benefits in terms of reducing energy infrastructure costs and greenhouse gas emissions. Mr. Shattuck concluded by saying that extended DST could produce modest but meaningful electricity savings.

Dr. Owens asked why there was a greater change in electricity consumption in the evening during DST. Mr. Shattuck said that people's routines are more flexible in the evening, so the amount of electricity they consume in the evening can fluctuate more.

John Warren asked if the data included commercial electricity consumption. Mr. Shattuck said that the data included all electricity, including commercial consumption.

Representative Frost said that he had always heard that the energy savings from DST were negligible and asked for Mr. Shattuck's response. Mr. Shattuck said that while the savings were not massive, they were appreciable. He added that energy efficiency reduced Massachusetts' electricity consumption by three percent, enough to make the commonwealth a national efficiency leader, so even a 0.5 percent decrease due to DST would go a long way in helping Massachusetts avoid new infrastructure and environmental costs.

Robert LePage asked if variations in weather impacted the data. Mr. Shattuck said that between summer and winter that impact would be large, but that when comparing certain months from one year to the next it would not be large. Mr. LePage asked what the dollar value of a 0.5 percent reduction in energy savings would be. Mr. Shattuck said that he would have to get back to Mr. LePage with an answer.

Representative Cahill said that he agreed with the analysis of how extended DST would affect electricity consumption in the morning and in the afternoon and evening, even though the electricity consumption of hospitals and similar organizations is to some extent fixed. Representative Frost said that because hospitals always have their lights on he is not sure that they would see savings. Mr. Shattuck said that savings would flow to everyone if year-round DST prevented a buildup of infrastructure to meet peak demand.

Senator Donoghue asked if the DoE study contained the best data available for the commission's purposes. Mr. Shattuck said that it was the best data available to the commission, and that the DoE study was more relevant than the Indiana study.

Senator Donoghue thanked Mr. Shattuck for his testimony and opened the commission meeting to general discussion. Representative Frost said that he remained concerned about children going to school in the dark and mentioned a study conducted in the 1970s that addressed the issue. He added that the commission should hear from Massport and also from television broadcasters, because residents might have to stay up late to watch the Patriots on Sunday Night Football. Representative Finn said that he would like to hear from the entire New England Region. Mr. LePage said that he wanted to hear about the impact year-round DST would have on student and employee performance, the financial services industry, and television broadcasters. In addition to the question of children going to school in the dark, Mr. Emswiler suggested that commission consider a paper published by the American Academy of Pediatrics recommending that school start times be pushed back to a later hour. Dr. Owens noted that she had written the paper. Mr. Emswiler added that Massachusetts could throw its weight around and force Sunday Night Football to start earlier. Representative Frost said that Roger Goodell would never agree to that.

Senator Donoghue said that it was clear that the commission members were very invested in the issue and that the commission would continue to learn more about it.

Senator Donoghue adjourned the meeting at 12:41 p.m.

*Special Commission on the Commonwealth's Time Zone  
Wednesday, April 12, 2017 (Meeting 3)*

**Massachusetts State House  
Hearing Room 222  
Boston, MA 02133**

**Members present (appointed by):**

Representative Daniel Cahill (Speaker), Chairman Eileen M. Donoghue (Senate President), Thomas Emswiler (Senate President), Representative Michael Finn (Speaker), Representative Paul Frost (House Minority Leader), Tim Miley (Governor), Robert LePage (Governor), Yvonne Spicer (Senate Minority Leader), John Warren (Governor)

**Members absent (appointed by):**

Dr. Judith Owens (Speaker), Peter Shattuck (Senate President)

**Meeting Minutes**

Senator Donoghue welcomed the members of the special commission and thanked them for being in attendance. She motioned that the minutes of the commission March 15 meeting be approved. Representative Cahill seconded the motion, and the minutes were approved unanimously on a voice vote.

Senator Donoghue introduced University of Washington professor Christopher M. Barnes and University of Oregon professor David T. Wagner, authors of the papers "Changing to Daylight Saving Time Cuts Into Sleep and Increases Workplace Injuries" and "Lost Sleep and Cyberloafing: Evidence From the Laboratory and a Daylight Saving Time Quasi-Experiment," who joined the commission via conference call. Senator Donoghue noted that Mr. Barnes and Mr. Wagner specialize in, among other things, sleep and fatigue issues in the workplace and that of particular interest to the commission is their research and writing about the impact that transitioning to daylight saving time (DST) has on workplace injuries, workplace productivity, and even the sentencing habits of judges. She added that Mr. Barnes has also authored a paper making sleep-related public health policy recommendations.

Mr. Barnes and Mr. Wagner said that their study on workplace injuries measured the effect that transitioning in and out of DST has on sleep using data from the Bureau of Labor Statistics. They said that while they found no effect from the fall transition, workers lost an average of 40 minutes of sleep on the Monday following the spring transition. Mr. Barnes and Mr. Wagner then proceeded to describe the second piece of the study, which relied on 23 years of data from the Mine Safety and Health Administration. They noted that mines were a particularly useful workplace to examine, because mining work occurs largely underground and differences in sunlight would therefore not confound the data. Mr. Barnes and Mr. Wagner said that they found a 5.7 percent increase in the number of injuries on days following the spring transition to DST and a 67.6 percent increase in the number of days lost due to injury, suggesting an increase in the severity of the injuries.

Mr. Barnes and Mr. Wagner then moved on to their study on cyberloafing, the first part of which used Google search data from 203 metropolitan areas to determine whether workers were more likely to visit websites that were unrelated to their jobs on the Monday following a transition to DST. They said that they measured an increase in traffic to entertainment-related websites of between 3.1 and 6.4 percent, which they interpreted as a sign that workers were too tired to focus on their jobs. Mr. Barnes and Mr. Wagner explained that the second part of their study used data from a laboratory experiment to determine the impact of sleep interruption on cyberloafing. They said that they found that an hour of disturbed sleep led study participants to cyberloaf for, on average, 20 percent of the duration of an assigned task.

Mr. Barnes and Mr. Wagner then ran through many of their other studies, which have found that following the spring transition to DST judges hand out longer sentences, minorities are more frequently searched and arrested frivolously, the rates of heart attacks and fatal vehicle accidents increase, and children are less attentive in class and receive lower scores on the SAT. Thomas Emswiler asked if Mr. Barnes and Mr. Wagner could share those studies with the commission. Senator Donoghue said the commission would welcome them, and Mr. Barnes and Mr. Wagner said they would share the studies.

Senator Donoghue thanked Mr. Barnes and Mr. Wagner for their testimony and introduced Dr. David Prerau, a DST researcher, historian, and author. She noted that Dr. Prerau is a world-renowned authority on DST, the author of the book *Seize the Daylight: The Curious and Contentious Story of Daylight Saving Time*, which details the history, science, and politics of the practice, contributed to the largest ever technical study on DST, coauthored three reports to Congress on the subject, and served as a consultant to both the U.S. Congress and Britain's Parliament on legislation related to extensions of DST.

Dr. Prerau said that he was happy to be able to share his 40 years of expertise on DST with the commission. He noted that DST was first practiced during World War I and is now observed in 70 countries and in 48 states. He said that although people can adapt to losing an hour of sleep during the spring transition to DST, there are effects that resemble those caused by jet lag. Dr. Prerau added that these effects could perhaps be mitigated by a public health information campaign leading up to the transition date. He cautioned commission members to carefully distinguish between the effects of the transition to DST and the effects of the period itself.

Dr. Prerau said that one of the major benefits of year-round DST—more sunlight during winter afternoons—has a flipside: darker winter mornings. He noted that with year-round DST in place, January sunrise times would be as late as 8:23 a.m. in Boston and late as 8:23 a.m. in Williamstown. Dr. Prerau said that when Congress experimented with year-round DST in the 1970s there was a negative effect on the safety of children walking to school in the dark, prompting Congress to institute an eight-month DST schedule—longer than the usual six-month schedule, but shorter than the year-round experiment. He added that creating darker, colder commutes during January, the coldest month, could make roads icier or snowier, although he said there was no related data available.

Dr. Prerau said that year-round DST would create a four-month, one-hour time difference between Massachusetts and business and political capitals in New York City and Washington,

D.C., respectively. He noted that the difference would put the commonwealth out of sync with both the stock market and large markets along the East Coast, but had no data on what impact that might have.

Dr. Prerau went on to say that uniformity is a major concern when it comes to the observation of time, noting that after World War II there was hodgepodge of states and cities observing DST on different schedules, which caused chaos. He added that the Uniform Time Act of 1966 instituted national start and end times for DST. He added that following the 2007 extension of DST, Canadian provinces had to choose whether to adjust their DST calendars to match the U.S., and that ultimately every province elected to adopt the new U.S. calendar. He said that a lack of uniformity can affect business by causing confusion around deliveries, calls, and deadlines.

Dr. Prerau then mentioned a number of additional concerns related to Massachusetts ceasing to be in sync with the rest of the Eastern Time Zone, including potential confusion around flight schedules, later start times for live, nationally broadcast events like Sunday Night Football, the State of the Union address, and the Oscars, and the unpleasantness of living near the border between time zones.

John Warren asked if there are any studies of how lack of uniformity in DST observation affects the business community. Dr. Prerau said that there was anecdotal evidence of businesses choosing not to locate in Indiana and noted that the Indiana Chamber of Commerce preferred uniformity.

Representative Frost said he had not thought about the problem of kids going to school in the morning when—in addition to being dark—it is cold and icy. He noted that Massachusetts school districts sometimes delay school due to icy conditions or extreme cold. Dr. Prerau said that in 1974 some schools sought to avoid those problems by starting an hour later, which caused some conflicts with work. He added that some schools distributed reflective tape to students.

Senator Donoghue thanked Dr. Prerau for his testimony and introduced Jim Smith, general counsel to the Massachusetts Broadcasters Association (MBA), a trade organization that represents more than 200 radio and television broadcasters in the commonwealth.

Mr. Smith said that year-round DST would be hard to implement for Massachusetts broadcasters. He said that national evening news programs would be broadcast an hour later during the four-month period when Massachusetts would be out of sync with the rest of the Eastern Time Zone, affecting local evening shows. He added that the 8 p.m. to 11 p.m. slot for network programming would become a 9 p.m. to midnight slot, disrupting local news broadcasts, which are important to broadcasters' bottom lines and to the public interest.

Mr. Smith mentioned the potential for additional confusion in places like the Berkshires, where broadcasts are often coming from Albany. He said there would also be a need to educate broadcasters about the implications of the change to year-round DST, noting that there are sometimes restrictions on when syndicated shows can be broadcast. *The Ellen DeGeneres Show*, he said, is embargoed until a certain time. Mr. Smith said that radio would also be affected by the

change to year-round DST. He said that national news shows, for example, have to be coordinated across time zones.

Mr. Smith went on to say that the biggest complication of year-round DST would be the scheduling of live television events. He said that an event like the Oscars, which ended at around 12:10 a.m. this year, would instead end at around 1:10 a.m. With regard to sports, Mr. Smith said that p.m. is primetime for school and work night events and leagues would not alter their schedules to accommodate Massachusetts because the need to capture the West Coast market is greater than the need to capture the Massachusetts market. He said that even if every New England state observed year-round DST they would still be outliers, adding that there would be no changes in national live broadcast schedules if New York or Pennsylvania did not join New England.

Mr. Smith concluded by stating that the practical concerns of observing year-round DST are too great for the MBA to support it and by thanking the commission for including the MBA.

Representative Frost asked whether the MBA would be more supportive if New York changed to year-round DST in addition to New England. Mr. Smith said yes, reiterating that New England acting alone presents enormous issues to broadcasters.

Mr. Emswiler asked if local news was the biggest revenue source for broadcasters. Mr. Smith said it was. Mr. Emswiler asked if there were local news shows during morning hours. Mr. Smith said there were. Representative Frost asked if revenue earned from an additional hour of local news in the morning would offset revenue lost due to changes in local news schedules in the evening and at night. Mr. Smith said that it would not, because the 6 p.m. and 11 p.m. slots are the biggest revenue generators.

Senator Donoghue thanked Mr. Smith for his testimony and introduced José C. Massó, director of policy at Massport. She noted that Mr. Massó has also served as Massport's director of community relations and that he advises the agency on policies that might affect its ownership and management of Boston Logan International Airport, Hanscom Field, Worcester Regional Airport, and the Port of Boston.

Mr. Massó said that he was joined by Nancy Donoghue, Massport's director of government affairs, and Ed Freni, Massport's director of aviation. He noted that airports used universal time to communicate with each other, but not with the public, and said that a change to year-round DST would cause confusion in nearby destinations served by Logan International Airport, including New York City, Washington, D.C., and Atlanta. Mr. Massó added that a number of transportation services that connect to Logan, including rail and bus services, would have to adjust their schedules.

Mr. Massó said that Logan serves 36 million passengers each year, with millions of them taking international flights. He said that there is already a three weeks of the year during which the U.S. observes DST and Europe does not, which causes confusion and creates new challenges. Mr. Massó commented that there would be similar confusion were Massachusetts to observe year-round DST, although the situation might be better if all the New England states acted together.



Representative Frost asked whether Massport would be more supportive if New York changed to year-round DST in addition to New England. Mr. Massó said that it is important not to be an outlier, but the bigger the better when it comes to the size of the region observing year-round DST.

Representative Frost asked if the change to year-round DST would cause confusion for business travelers. Mr. Eni said that there would be a new layer of confusion.

Mr. Miley asked for further explanation of the challenges associated with the three weeks during which the U.S. observes DST and Europe does not. Mr. Eni said that during those three weeks there is a need for additional staff at gates and resources are needed to plan for the additional complexity. He added that the entire U.S. is dealing with that complexity during those three weeks.

Robert LePage asked about the impact on travelers going to airports in Hartford or Albany from Western Massachusetts. Mr. Eni said that if Massachusetts were out of sync with a neighboring state, then travelers would have to do the same mental calculations that they do now when traveling to a different time zone.

Mr. Warren asked if there were significant costs to nonconformity. Mr. Eni said that he did not have specific numbers, but that there would be staff costs, scheduling costs, and transaction costs.

Mr. Emswiler asked if most of Logan's passengers were from New England. Mr. Eni said yes, but not exclusively.

Representative Frost asked if there would be costs to an advertising campaign educating passengers about the change to year-round DST. Mr. Massó said there would be costs to such a campaign.

Mr. Miley asked what percentage of Logan's 36 million annual passengers stop at the airport to make a connection. Mr. Eni said about 10 percent of passengers are making a connection.

Senator Donoghue thanked Mr. Massó for his testimony and adjourned the meeting at 12:50 p.m.

**Special Commission on the Commonwealth's Time Zone  
Wednesday, May 31, 2017**

**Massachusetts State House  
Hearing Room 222  
Boston, MA 02133**

**Members present (appointed by):**

Chairman Eileen M. Donoghue (Senate President), Thomas Emswiler (Senate President), Representative Michael Finn (Speaker), Representative Paul Frost (House Minority Leader), Yvonne Spicer (Senate Minority Leader), John Warren (Governor); Dr. Judith Owens (Speaker), Representative Daniel Cahill (Speaker),

**Members absent (appointed by):**

Peter Shattuck (Senate President), Tim Miley (Governor), Robert LePage (Governor)

**Meeting Minutes**

Senator Donoghue welcomed the members of the special commission and thanked them for being in attendance. She motioned that the minutes of the commission April 12 meeting be approved. The minutes were approved unanimously on a voice vote.

Senator Donoghue introduced commission member Dr. Judith Owens, director of the Center for Pediatric Sleep Disorders at Boston Children's Hospital and a professor of neurology at Harvard Medical School, to discuss the impacts of year-round DST on student sleep, health, and safety.

Dr. Owens began her presentation by introducing basic background information on the function of sleep. She explained that sleep is regulated by two simultaneous processes, the 24 hour circadian rhythm of sleep/wakefulness and the sleep drive. Dr. Owens said that the sleep drive is contingent on a number of factors including how long a person has been awake, the quantity and quality of the person's previous night's sleep, and the person's individual sleep needs. She then provided a more thorough explanation of the circadian timing system, the governing function of all physiologic systems in the human body. She explained that each cell in the body possess an internal clock that must be synchronized with other cells and with the environment, adding that misalignment between the internal clock and the external light-dark cycle can have negative consequences for a person's physiologic function and health. Dr. Owens stressed that it is not just how much a person sleeps, but also when a person sleeps that has a significant impact on well-being. Dr. Owens explained that sleep regulation consists of two competing functions, the homeostatic sleep drive and the circadian wake drive, which fluctuate throughout the day and impacts a person's level of alertness.

Dr. Owens said that it is critically important for adolescents to get a healthy amount of sleep every night. She explained that all adolescents experience a shift in their sleep patterns, especially with the onset of puberty, and that as a result of this biological shift, sleep times and wake times change drastically. According to Dr. Owens, adolescents are biologically programmed to wake up at 8 a.m. or later, but due to school start times, many teens are required

to wake up much earlier, at a point in their sleep cycle when they are the least alert. As a result, Dr. Owens said, many adolescents are not sleeping enough during the week and trying to compensate by sleeping in on weekends. She added that from a biological perspective, sleeping in cannot make up for insufficient sleep during the week and can actually exacerbate problems with the body's sleep cycle, a phenomenon known as "social jet lag" that can persist for up to three days, causing daytime sleepiness, poor concentration, or a depressed mood. Dr. Owens stated that eight to 10 hours of average sleep is needed for middle school and high school students to maintain optimal health, safety, and achievement, while children ages six to 12 need nine to 12 hours of sleep.

Dr. Owens then discussed sleep's effect on performance, health, and safety. She explained that either too much sleep or too little sleep can drastically change the brain's ability to function in response to the environment, impacts gene activation, slows the ability to recover from stress, and causes the release of stress hormones. Dr. Owens added that lack of sleep has serious negative impacts on executive functions such as planning, problem solving, decision making, divergent thinking, judgment, motivation, and emotional response. In addition, she said that the reward-related functions of the brain undergo changes during adolescence that, if combined with insufficient sleep, can impact teen's decision making behaviors and their ability to perceive negative consequences, which leads to increased risk taking. Dr. Owens said that teens who slept for fewer than eight hours on average were more likely to be involved in physical altercations, smoke cigarettes or marijuana, drink alcohol, be sexually active, feel sad or hopeless, and have considered suicide than teens who slept for eight or more hours on average.

Dr. Owens went on to explain the effects of sleep loss on a person's diet. Dr. Owens stated that studies have shown that lack of sleep can be associated with an increased risk of obesity; as a person's sleep duration affects hunger, food intake, eating patterns, physical activity, and insulin metabolism.

According to Dr. Owens, drowsy driving accounts for roughly 7% of all crashes in which a vehicle is towed from the scene, 13% of crashes that result in hospital admission, and 16-21% of all fatal crashes. Dr. Owens expounded upon this by stating that driver who are 16 to 25 years of age are involved in more than 50% of the 100,000 police-reported fatigue-related crashes each year. Dr. Owens stressed the dangers our drowsy driving by informing the commission that sleep loss impairments can be just as dangerous as alcohol intoxication in drivers.

Dr. Owens then transitioned her presentation to the topic of school start times and how adolescents would greatly benefit from additional sleep. Dr. Owens shared with the committee that the American Academy of Pediatrics recommended that schools not start until 8:30 AM or later, to allow teens to get the appropriate amount of sleep during the growth years.

Dr. Owens presented information that supports the concept of delayed school start times and went on to explain that even a modest delay of 30 minutes has been shown to have significant impacts on student health and academic achievement. Dr. Owens continued to support this claim by stating that students who get more sleep have improved attendance, lower rates of tardiness, higher grades, and a declined dropout risk. Dr. Owens also shared delayed start times are

associated with improvements in mood, health, and safety; as there is a significant decline in early morning car accidents amongst teenaged drivers.

Dr. Owens then went on to present information on elementary school start times and how the data is not as extensive as studies that have been done on middle school and high school students. Dr. Owens says that this lack of data is due to school-aged children being more likely to be “morning people” who have a strong preference for earlier bed and wake times.

Dr. Owens included detailed information on Massachusetts public school start times. According to a study presented by Dr. Owens, the average start time for public schools in Massachusetts was 7:53 AM in the 2011-2012 school year, but dropped to 7:37 AM in the 2014-2015 school year. Dr. Owens also shared that in the 2011-2012 school year only 8% of all Massachusetts public schools started before 7:30 AM, but that average has increased to 26% during the 2014-2015 school year.

Dr. Owens then proceeded to explain the concept of civil twilight. According to Dr. Owens, civil twilight is when the sun is just below the horizon and there is enough natural light to have high visibility to do most outdoor activities. Dr. Owens stated that civil twilight occurs in Massachusetts approximately 30 minutes before sunrise.

Dr. Owens presented information highlighting the impact that shifting time zones has on civil twilight and sunrise in Massachusetts. According to Dr. Owens, civil twilight and sunrise occurs 30 minutes to an hour later during daylight saving time in the months of November, December, January, and February than when on Eastern Standard Time. Dr. Owens proceeded to explain what this effect has on school start times.

According to Dr. Owens, if school starts between 7:00 AM and 7:30 AM, commutes will be in complete darkness for almost all four months and before sunrise for all four months; if school starts between 7:30 AM and 8:00 AM, commutes will be before civil twilight for three months and before sunrise for most of four months; if school starts between 8:00 AM and 8:30 AM, commutes will be before civil twilight for two months and before sunrise for two months; and if school starts at 8:30 AM or later, commutes will be after civil twilight for all four months and after sunrise for most of four months.

Dr. Owens went on to discuss safety concerns for elementary school students in regards to early morning commutes. According to Dr. Owens, shifting time zones would increase the number of days that elementary school children would be waiting for the bus or walking to school before sunrise. Dr. Owens stated that additional safety measures may be needed, such as; lighted bus stops, neighborhood school bus stop monitoring by parents when it is dark in the winter; and walking patrols.

Dr. Owens then discussed potential safety concerns for high school students. Dr. Owens explained that high school students may be more prone to exacerbated seasonal affective disorder and increased car accidents due to lack of light in the morning hours of winter. Dr. Owens also provided information showing that there are significantly more teen involved car crashes in the morning during the school year than during the summer.

Dr. Owens concluded her presentation by stating that she would support Massachusetts changing time zones only if delayed school start times would be considered in the commission's final recommendations. Dr. Owens stated that due to concerns for sleep, health, and wellbeing, all Massachusetts schools should start after 8:00 AM and all middle school and high schools should start after 8:30 AM.

Senator Donoghue then introduced commission member and public health advocate Thomas Emswiler. Mr. Emswiler greeted the commission and began a presentation on the public health impacts that daylight saving time has on the human body.

According to Mr. Emswiler, shifting daylight patterns and sleep deprivation accounted for 30 daylight saving time related fatalities annually in the United States between 2002 and 2011. Mr. Emswiler also elaborated to explain that daylight saving time had a societal cost of \$275 million annually in the United States.

Mr. Emswiler then went on to explain the immediate health impacts that daylight saving time has on public health. According to Mr. Emswiler, there is an increased likelihood of heart attack within the first three days of transitioning to daylight saving time, with those under the age of 65 being affected the most.

Mr. Emswiler also stated that when the United States expanded daylight saving time in the United States, there was a 30 minute increase in daily outdoor recreation, a nine minute decrease in television viewing, and people burned 10% more calories; one pound of body fat every 2.5 weeks.

Mr. Emswiler then concluded his presentation by explaining that the shift to daylight saving time is responsible for increased workplace injuries and springing forward is bad for people's health.

Senator Donoghue thanked the speakers for their testimony.

The Commission members engaged in general discussion concerning the testimony from the speakers. The meeting was adjourned at 12:45 p.m.

**Special Commission on the Commonwealth's Time Zone  
Wednesday, September 20, 2017**

**Massachusetts State House  
Hearing Room 222  
Boston, MA 02133**

**Members present (appointed by):**

Chairman Eileen M. Donoghue (Senate President), Thomas Emswiler (Senate President), Representative Michael Finn (Speaker), Representative Paul Frost (House Minority Leader), Dr. Yvonne Spicer (Senate Minority Leader), Dr. Judith Owens (Speaker), Representative Daniel Cahill (Speaker), Mr. Peter Shattuck (Senate President), Ms. Jennifer Barrelle (Governor), Mr. Robert LePage (Governor)

**Members absent (appointed by):**

Mr. John Warren (Governor)

**Meeting Minutes**

The meeting opened at 2:00 p.m. as Senator Donoghue welcomed the members of the special commission and thanked them for being in attendance. She motioned that the minutes of the commission May 31 meeting be approved. The minutes were approved unanimously on a voice vote.

Senator Donoghue introduced new commission member Jennifer Barrelle, Chief of Staff to the Department of Public Health. Ms. Barrelle will fill the commission appointment previously held by Tim Miley, formerly of the Department of Public Health.

Senator Donoghue explained that the purpose of today's meeting is to have a general discussion about the draft report that was circulated to the commissioners, and that there would not be a vote during this meeting.

Senator Donoghue opened the session to comments from fellow commissioners.

Representative Frost offered comments about the draft report and said that he believed Massachusetts could not switch time zones without New York, and expressed concern about the safety of children in the dark if a switch were to be made. He offered further comments cautioning about potential negative implications of pushing everyone back and suggested that the remedy to his concerns may be the need for more study. He also thanked the commissioners for a good commission with spirited debate and stated it was his belief that the commission was worthwhile even if they did not all agree.

Senator Donoghue responded and said she first wanted to recognize that this commission was a result of a citizen's petition to explore a serious and worthwhile issue, and that she appreciated the civic participation in the Legislature. Senator Donoghue went on to explain that the report was a data-driven analysis that looked into many factors and found there is no solid data as to

why we continue to spring forward and fall back in 2017. She also emphasized the positive economic development and public safety implications of making a switch and went over the recommendations being offered including the need for a regional approach, the idea of starting school start times later to ameliorate safety concerns, and the need to engage in educational public outreach programs if any switch were to be effected.

Dr. Owens spoke next and commented that she viewed the report as a superb draft that captured the substance of the testimony. Dr. Owens asked about when the report and recommendations would be implemented and what kind of lead time would be required. Senator Donoghue said that the final report would be issued to the Legislature and then it would be up to the body to decide whether to file legislation to move the process forward. She added that public involvement would be critically important. Mr. Emswiler added that the last time the dates for recognizing daylight saving time changed, the state had three years to prepare, and suggested that nothing should be done without at least one year of lead time.

Representative Cahill inquired about when comments to the draft should be submitted and it was decided that comments would be due to the Chair by Monday, October 2, and that a final meeting to vote on the report would occur on November 1.

Mr. Shattuck suggested that the draft include reference to forums at the executive level to continue the discussion and recommend that the executive branch is directed to bring this issue up with other governors/administrations including the Coalition of Northeast Governors (CONEG) and the annual gathering of New England Governors and Eastern Canadian Premiers (NEG-CEP).

Mr. Emswiler asked the commission what members thought would be the right number of states or percentage of the New England population to consider necessary in order to have regional action to make a switch. There was general discussion of this issue with Representative Frost and Mr. LePage stating that a change would need to include New York because New York is more important to Massachusetts' commerce than Vermont. Mr. LePage added that, regardless of the number of states that would make a switch in the future, we as a state should do more now to help manage our current system better. Public health announcements or campaigns about the impacts of "springing forward" and "falling back" might be useful.

The meeting was adjourned at 2:45 p.m.