Maine's Public Universities
UNIVERSITY OF MAINE SYSTEM

DATE: Feb. 15, 2024
TO: Joint Standing Committee on State & Local Government
Senator Rick Bennett
FROM: Samantha Warren, UMS Director of Government & Community Relations
samantha.warren@maine.edu / (207) 632-0389
RE: **University of Maine System Study on Potential Effects of Maine Adopting Permanent Eastern Standard Time or Permanent Eastern Daylight Time**

In order for any area in the United States to move from one time zone to another, permission must first be granted from the U.S. Department of Transportation. Per U.S. DOT, "The principal standard for deciding whether to change a time zone is the convenience of commerce, which is defined very broadly to include consideration of all of the impacts upon a community that would result in a change in its standard of time."

In recognition that there has been continued legislative and public interest in Maine ending the practice of changing its clocks twice each year and that the University of Maine System (UMS) is a tremendous resource to the state for world-class independent research, the 131st Maine Legislature directed the System to study the potential effects of Maine adopting permanent Eastern Standard Time or permanent Eastern Daylight Time.

Enabling language and a $15,000 appropriation for the study was originally proposed through *LD 989, Resolve, Directing the University of Maine System to Study the Potential Effects of the State's Adopting Atlantic Standard Time* sponsored by Sen. Rick Bennett and ultimately enacted through Part BB of the State budget that became effective on Oct. 25, 2023 (Public Law 2023, Chapter 412).

UMS selected Dr. Andrew Crawley, an Associate Professor of Regional Economic Development in the School of Economics at the R1 University of Maine, to lead the study, in large part because of the need for the study to focus on the convenience of commerce. Consistent with the university's commitment to support paid research learning experiences for its students, UMaine Graduate Research Assistant Elinor Hunt, of Bangor, and Undergraduate Research Assistant Ruth Griffith, of Guilford, were integral to the study.

To best leverage the relatively small appropriation and time frame for the study, UMaine/UMS decided to conduct a review of existing relevant scientific literature and a survey of Maine stakeholders. The university wishes to thank the Maine State Chamber of Commerce, the Maine Municipal Association, the Maine Hospital Association, the Maine Association of Broadcasters and various other trade associations in the state for distributing our survey to their members. In total, more than 200 Maine business and community leaders responded.

Additionally, the university purchased data detailing which time zones the state currently does business with from Camoin Associates, a private economic development consulting firm, that was recently commissioned by the State to study Maine's trade flows.

The study is attached to this memo. Among its key findings:

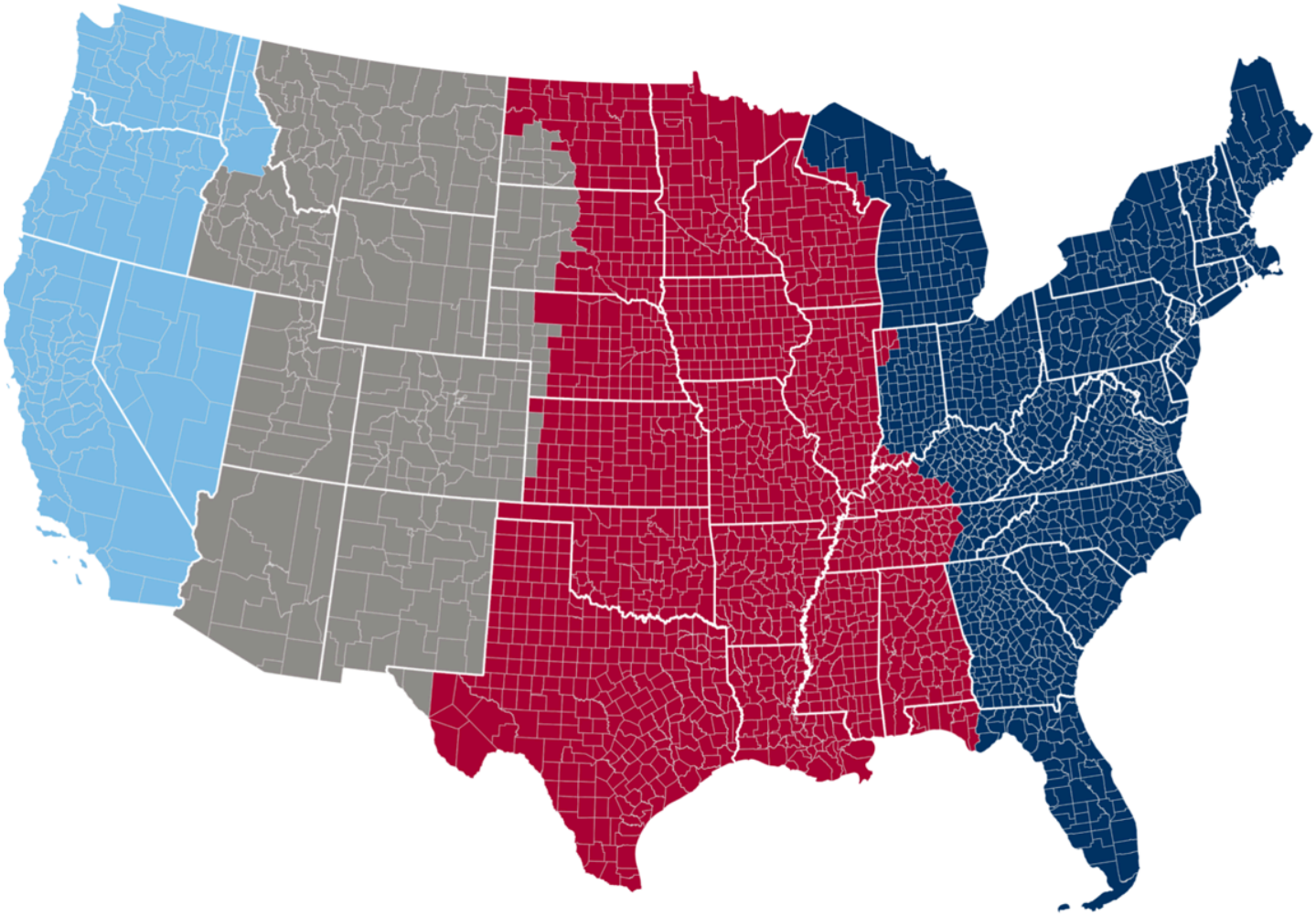
- Previous research studies indicate that even small changes in circadian misalignment are linked to adverse health outcomes, emphasizing the importance of maintaining a regular circadian rhythm.
- Sleep deprivation resulting from time zone transitions may negatively impact motivation, attention, and alertness, potentially increasing accident rates.
- 72% of Maine business and community leaders who responded to our survey expressed a desire to discontinue the twice annual time change, but concern was expressed about Maine being inconsistent with other states in the region. Among those who preferred to eliminate time changes, 75% favored permanent Daylight Savings Time.
- While Maine trades across the nation and world, 65% of the state's total domestic imports and 63.5% of its domestic exports are in the Eastern Standard Time zone, and nearly all construction products are imported within EST zone. (Please note this does not include trade within Maine.)

UMaine/UMS encourages your close review of the study and welcomes the opportunity to review this with your Committee or interested parties in the future.

Daylight Savings Time: A Summary of Evidence

For the 131st Maine Legislature

February 15, 2024



camoin associates

EDA U.S. ECONOMIC DEVELOPMENT ADMINISTRATION

1865 THE UNIVERSITY OF MAINE

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Introduction

As enabled by funding provided in Public Law 2023, Chapter 412, the purpose of this report is to provide the Maine Legislature a summary of evidence around the potential effects on public health and the state's economy that may arise should the State adopt permanent Eastern Standard Time (EST) or Eastern Daylight Time (DST). In carrying out this exercise there is a particular focus on whether adopting a new time will serve the convenience of commerce as required by the United States Department of Transportation. Eastern Daylight Time, or Daylight Savings Time, is currently observed annually between the months of March and November. Should the State permanently adopt Eastern Daylight Time, it will remove twice-yearly clock changes. This report is organized into three sections. The first section is a detailed review of relevant literature, not specific to Maine but containing findings relevant to Maine. This is followed by the results of a primary survey of Maine stakeholders. The third section assesses Maine trade across US time zones.

Three core areas were identified from previous studies: public health, workforce, and ease of commerce. Findings suggest that physical and mental health can be affected by the changing of the clocks. There is also much evidence that road traffic accidents greatly increase during darker periods, indicating that a switch to DST can have significant impacts.

Workplace impacts include reduced productivity and increased workplace injuries during the transition to DST. Time zone differences also affect employee collaboration and have implications for workplace injuries. Time zone differences affect commerce, influencing trade, communication, and worker productivity, with varying effects on services and goods trade.

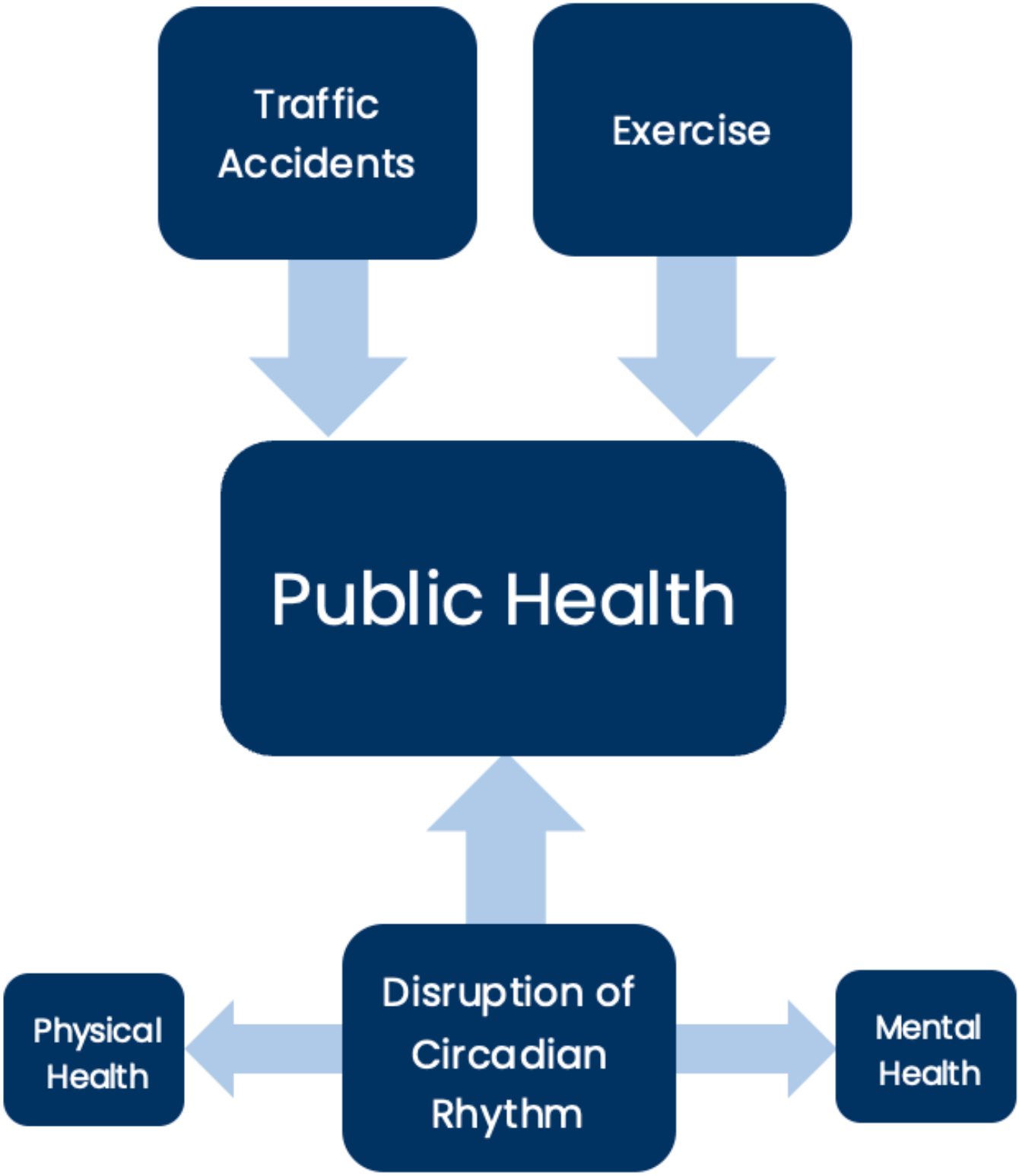
The primary survey was sent to both private and public organizational stakeholders across the state of Maine to understand their views on making adjustments to changing the clocks. 72% of respondents were in favor of putting an end to twice annual time changes. Of these respondents, a further 75% also indicated that they support switching to permanent DST.

The final section looks at trade in Maine with other parts of the US. Ease of commerce was evaluated by measuring Maine's import and export trade relationships with each of the six time zones in the US in 2022. Findings indicate that the EST zone plays a strong role in Maine's existing domestic commerce. Overall, counties in the EST account for about 64% of Maine's domestic exports and 65% of Maine's domestic imports.

Looking at exports, the EST zone plays a more critical role as a destination for construction and agricultural products, while durable and nondurable goods as well as services also have strong links with other time zones.

For imports, Maine also has strong trade relationships with counties in the Central Standard Time (CST) zone in addition to EST. Counties in CST accounted for approximately one-fifth of all domestic imports into Maine in 2022. The time zone is a strong import partner for agricultural products, nondurable goods, and construction in particular.

Previous Studies



Public Health

Disruption of Circadian Rhythm

A circadian rhythm is the body's 24-hour internal clock that regulates sleep, metabolism, hormone secretion, digestion, and heart functions. Circadian rhythms align with solar time, regulating the body to rise when the sun rises and sleep when the sun sets. However, the establishment of time zones force people to operate according to a social clock, set by the time zone, rather than solar time. Due to the structure of time zones in the United States, most people experience a one-hour misalignment with solar time when operating in Standard Time (ST) and a two-hour misalignment with solar time when operating in Daylight Savings Time (DST) (Johnson & Malow, 2023).

Misalignment between social and solar time create social jet lag. Social jet lag is the phenomenon that occurs when there is a difference in sleep time between days with and without work as a result of long-term discrepancies between social and circadian clocks (Rishi et al., 2020). Social jet lag has major long-term implications. Two key areas of concern were identified throughout the literature: physical health and mental health.

Physical Health

Social jet leg, the chronic misalignment of and individual's circadian rhythm and social clock, is associated with an increased risk of numerous health conditions like obesity, metabolic syndrome, and pre-diabetes (Roenneberg et al., 2012) (Koopman et al., 2017).

"[One study found that] social jet lag was associated with a 2-fold increased risk of the metabolic syndrome and diabetes mellitus or pre-diabetes, especially in younger (<61 years) participants. These results confirm that even small changes of circadian misalignment are associated with adverse health outcomes, such as metabolic syndrome and even diabetes/pre-diabetes." (Koopman et al., 2017).

Other health conditions associated with social jet lag include cardiovascular disease, specifically myocardial infarctions, pro- and anti-inflammatory protein development, metabolic syndrome, and pre-diabetes. Additionally, disruptions in circadian rhythm alignment have been found to impact cortisol levels (Manfredini et al., 2018) (Wright et al., 2015) (Grimaldi et al., 2016) (Koopman et al., 2017).

Mental Health

Social jet lag is associated with higher degrees of mental illnesses like depression. One study looking at the impact of DST on adolescents found that an increased number of adolescents reported having social jet lag and mental health disorders during DST (Gaski & Sagarin, 2011).

"[The study concluded that] morning light improves mood and evening light and more delayed circadian rhythms can worsen depression and other mental health disorders." (Johnson & Malow, 2023)

It was found that DST has a negative impact on suicide rates (Popoli & Curry, 2020).

"[T]here are significantly more suicides committed during the DST months [March-October] than during the non-DST months (November - February)." (Popoli & Curry, 2020)

However, the study only hypothesized as to why this trend has occurred and did not state a definitive reason.

Additionally, one study found that social jet lag is associated with higher drug use. For some individuals, the consumption of alcohol and nicotine, act as coping mechanisms to handle difficult social demands (Steinhausen & Metzke, 1998). In particular, social jet lag is associated with a higher probability of drinking alcohol, consuming caffeine, and failing to quit smoking (Wittmann et al., 2006).

Further, there is an association between social jet leg and cognitive performance. A study comparing SAT scores over a 10-year period between a school district that observed DST and a school district that did not, found that test scores for students in the DST region were on average 16 points lower its non-DST counterpart (Johnson & Malow, 2023).

“This increase in test scores was attributed to increased sleep, as well as factors such as fewer absences and more time at home with their parents.” (Johnson & Malow, 2023)

Traffic Accidents

Daylight Savings Time negatively impacts the level of traffic accidents in the short run, but positively impacts traffic accidents in the long run.

One hour is lost during the transition from ST to DST. Studies have reported that this time lost reduces sleeping time, rather than awake time. Sleep deprivation following this transition reduces alertness and control, two factors essential for safe driving. In fact, it was found that the transition to DST is associated with an increased risk of a fatal car crash of 5-6.5%. In fact, the risk of fatal car accidents is higher for up to six days following the transition to DST (Smith, 2016).

“Back-of-the-envelope calculations suggest that the spring transition into DST caused over 30 deaths annually at a social cost of $275 million.” (Smith, 2016)

A shift in daylight hours has further reaching impacts on traffic accidents beyond the temporary increase in sleep deprivation. DST shifts the light resulting in less light in the morning and increased light in the evening. Thus, operating on DST increases risk of accidents in the mornings while decreasing the accidents during the evenings (Carey & Samara, 2017) (Devine et al., 2023).

Additionally, the additional hour of daylight in the evenings increased the amount of pedestrian traffic by 62% and cyclist traffic by 38% (Uttley & Fotois, 2017).

“Of the nine studies that analysed DST effects on different types of road users, the beneficial effects of DST were most pronounced for pedestrians and cyclists . . . [T]he onset of DST in spring was associated with a reduction in casualties that was particularly pronounced for pedestrians (36%) and cyclists (11%).” (Carey & Samara, 2017)

Exercise

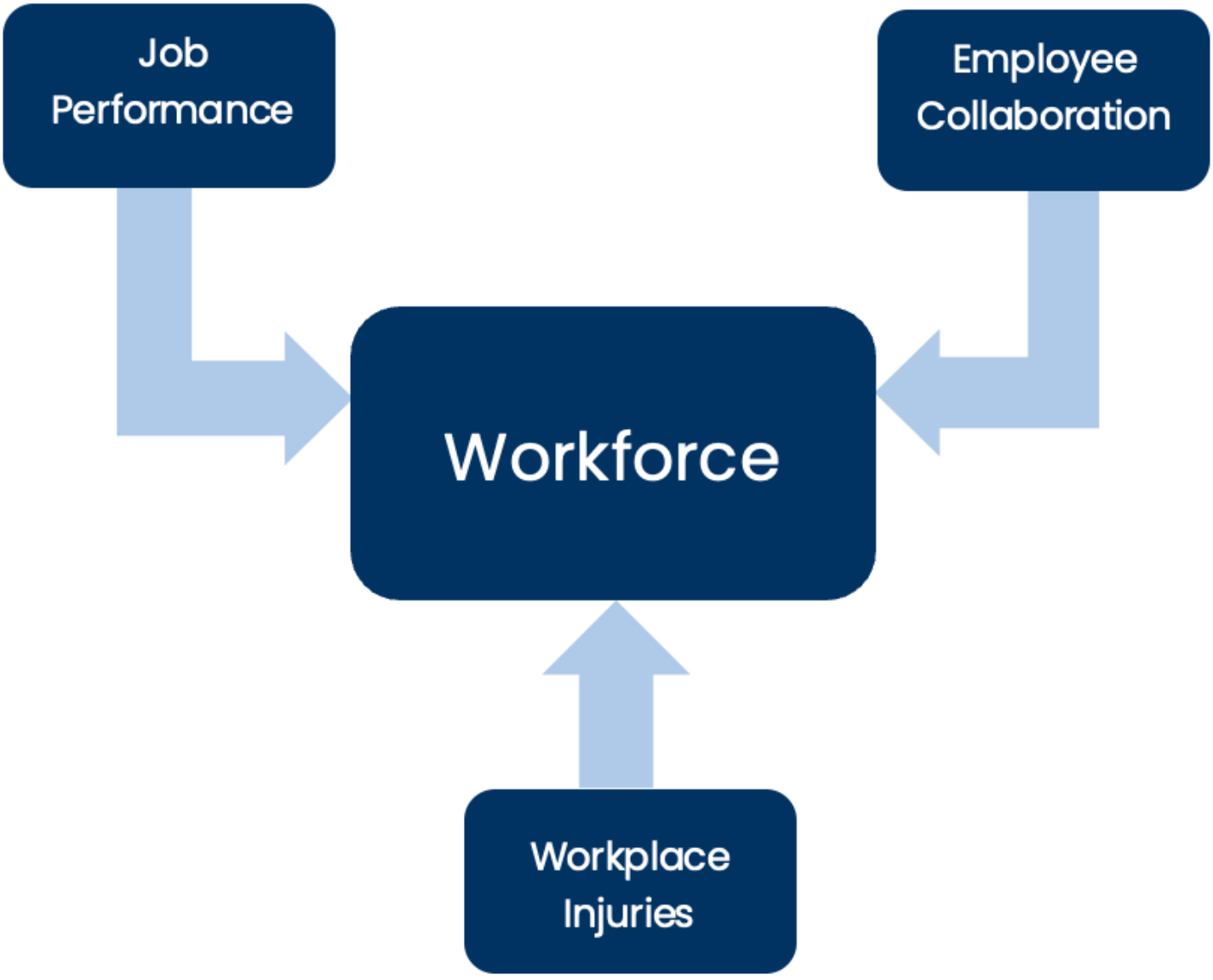
Increased activity arises from operating on Daylight Savings Time. DST increases daylight into the evenings allowing for outdoor activities to occur following work and school hours.

“DST has the potential to increase outdoor activity by 30 minutes and burns an additional 10% of calories.” (Wolff & Makino)

Another study showed that DST was associated with higher levels of physical activity amongst children ages 5-16 as well (Goodman et al., 2014).

“[I]t seems possible that additional daylight- saving measures could shift mean population child physical activity levels by an amount which, although small in absolute terms, would not be trivial relative to what can feasibly be achieved through other approaches.” (Goodman et al., 2014)

Previous Studies



Workforce

Job Performance

Changes in worker performance on the job were highlighted by the literature as a side effect of changes in time zones. Most literature focused on the short-term impact of switching between time zones on worker productivity, highlighting that the switch from Standard Time (ST) to Daylight Savings Time (DST) decreased worker productivity. One study looked at the change in cyber loafing, defined as using the Internet to conduct non-work-related tasks, as a result of the transition from ST to DST. They found that cyber loafing increased following the transition to DST in the spring due to lack of sleep (Wagner et al., 2012).

"The quasi-experiment in Study 1 indicated that non-work-related Internet searches had considerably higher search volume on the Monday immediately following DST than on the comparison Mondays, suggesting that the shift to DST leads people to cyber loaf more than on comparison work days." (Wagner et al., 2012)

There is limited literature on the long-term effects of DST on worker productivity and performance. However, it has been found that time zone differences negatively impact worker productivity (Christen, 2015). This is particularly relevant in jobs that require significant travel.

In general, communication between workers has been found to decrease in response to a 1-2 hour increase in temporal distance. One study observed a general communication decline of 9.4%, and a decline in synchronous communication by 11% (Chauvin et al., 2021).

> ". . . east–west distance is more severe since a jet lag may affect the productivity of business travelers." (Christen, 2015)

Employee Collaboration

Time zone differences have been found to impact employee collaboration. The ability of workers to collaborate between businesses in different time zones depends on temporal distance between the workers.

"[I]ncreases in temporal distance lead such collaborators to conduct more of their communication before or after traditional work hours, leading to the emergence of a dynamic work day." (Chauvin et al., 2021)

In general, communication between workers has been found to decrease in response to a 1-2 hour increase in temporal distance. One study observed a general communication decline of 9.4%, and a decline in synchronous communication by 11% (Chauvin et al., 2021).

Workplace Injuries

The third worker-related impact of shifting between time zones identified in the literature was workplace injuries.

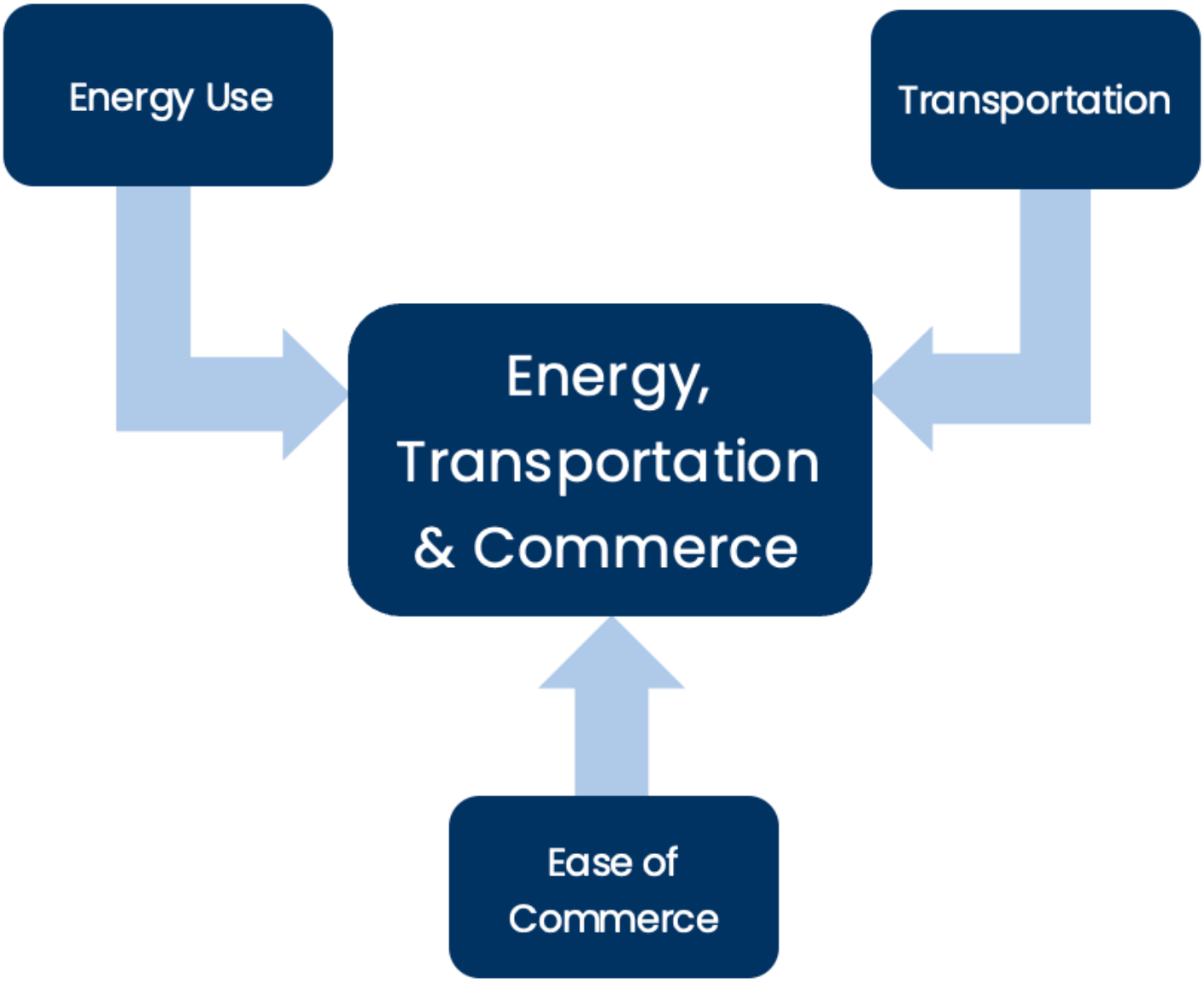
“Sleep deprivation may have negative effects on motivation, attention and alertness and thus it is possible that transitions into and out of DST may increase accident rates.” (Lahti et al., 2011)

From 1983-2006, data on mining related injuries showed an increase of 3.6 injuries on average for the day following the transition to Daylight Savings Time, costing workers a 68% more lost work days than other workers (Barnes & Wagner, 2009).

However, more recent studies conducted in Finland and Ontario, Canada found no difference in workplace injuries following the transition to DST (Morassaei & Smith, 2010) (Lahti et al., 2011)

Literature on workplace injuries surrounding DST focused on the transition between time zones, however did not highlight any long-term impacts of operating on DST and workplace injuries.

Previous Studies



Energy, Transportation & Commerce

Energy Use

One factor in the implementation of Daylight Savings Time (DST) was reduction in energy use. DST reduces electricity usage in the evenings due to decreased time spent at home (Sexton & Beatty, 2014) (Aries & Newsham, 2008). However, due to the extra hour of darkness in the morning, energy consumption increases in the morning hours (Kellogg & Wolff, 2008). This is due to increased demand for lights and heat, especially in more northern climates (Sexton & Beatty, 2014).

A 2008 study conducted by the U.S. Department of Energy (DOE) found that extended DST could lead to a small overall reduction in electricity use (Belzer, 2008).

“The total electricity savings of Extended Daylight Saving Time were about 1.3 Tera Watt-hour (TWh). This corresponds to 0.5 percent per each day of Extended Daylight Saving Time, or 0.03 percent of electricity consumption over the year. In reference, the total 2007 electricity consumption in the United States was 3,900 TWh.” (Belzer, 2008)

The DOE's findings are supported by a study conducted on the electricity usage in Ontario, Canada as a result of DST. This study found that energy usage declined following the transition to DST (Rivers, 2017). That being said, other studies have contradictory results. One study was unsure about the total impact of DST on energy use because of its dependence on behavior changes (Sexton & Beatty, 2014).

Another study claimed that reduction in evening electricity use following the transition to DST wasn't enough to offset the increase in electricity use in the morning (Kellogg & Wolff, 2008).

The differences in these findings may be attributed to location. One study suggests that countries farther from the equator have more energy savings due to DST in comparison to other countries (Havranek et al., 2018). This difference may be attributed to air conditioning use (Sexton & Beatty, 2014).

"The largest electricity savings from DST are enjoyed by countries with the longest daylight summer hours; the closer to the equator we go, the smaller the savings we observe." (Havranek et al., 2018)

Transportation

In their 2008 study on the energy use implications of extended DST, the DOE did not find any significant impact from extended DST on traffic or gasoline consumption (Belzer, 2008).

That being said, studies have found that DST does negatively affect the safety of commuting at different times.

"Under permanent DST, morning rush hour would have a greater percentage of darkness that could increase risk during a time period of reduced commuter effectiveness due to night shift workers returning home and greater traffic congestion, given the overlap between day workers and students commuting to school and night shift workers commuting home." (Devine et al., 2023)

More information can be found in the subsection titled "Traffic Accidents" on pages 9-10.

Ease of Commerce

Time zone differences have been found to impact trade of goods and services, and communication between businesses. Time zone differences increase temporal distance between locations. Thus, they increase transaction costs associated with trade and communication (Christen, 2015).

“In east–west direction, time zone differences are present in real-time communication as well as in travel and increasing east–west distance can have major negative impacts on both.” (Christen, 2015)

The study attributed negative communication impacts to different working hours, coordination of business operations, and time sensitivity of communication. Further, time zone differences impact worker productivity when workers are traveling due to jet lag (Christen, 2015).

One study found that the impact time zones have depends on the type of good being traded. Positive time zone effects are more common in services trade while negative time zone effects are more common in manufacturing and goods trade (Christen, 2015).

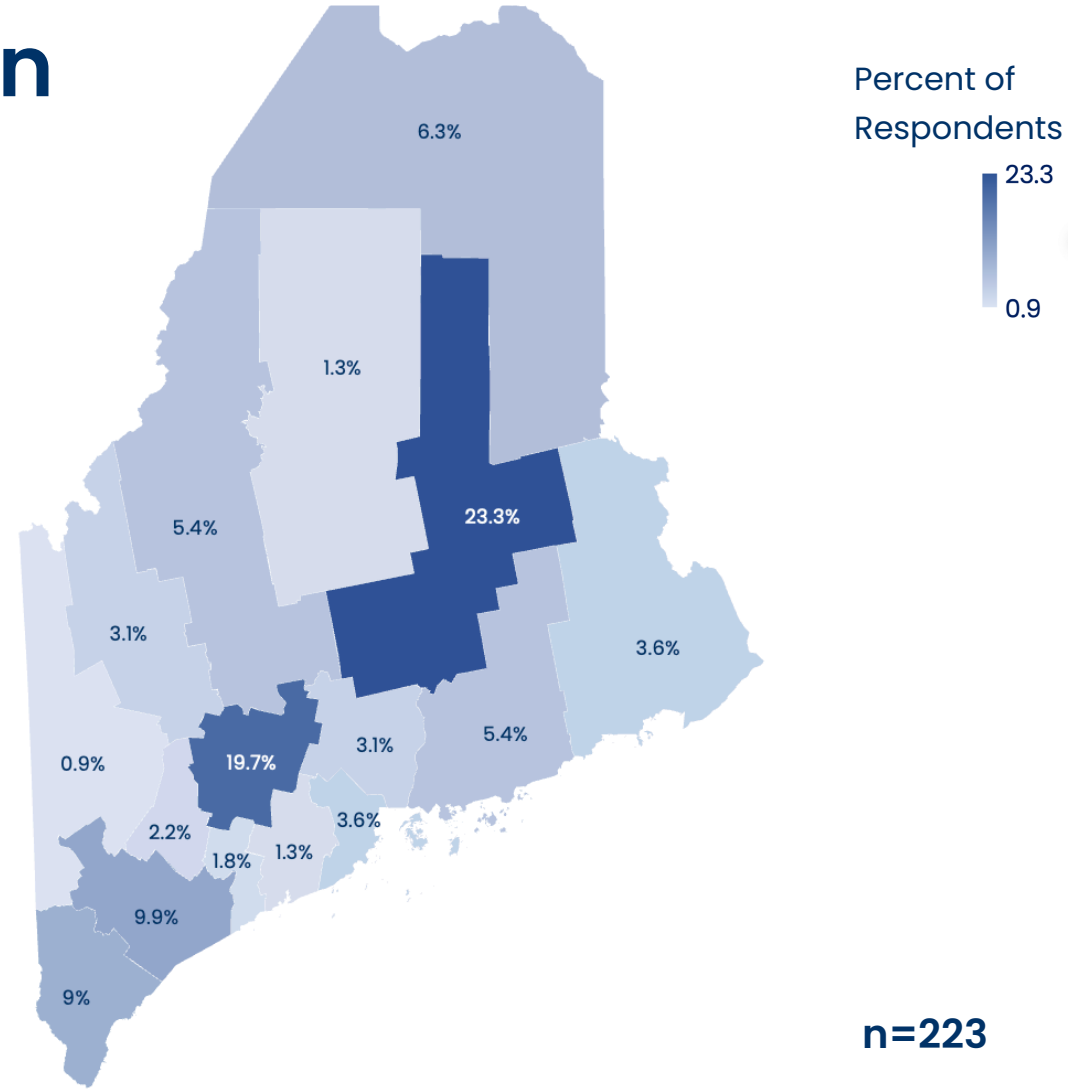
“[I]ncreased time zone differences give countries a comparative advantage in services trade as they might allow for a business to operate 24 hours a day.” (Christen, 2015)

Conversely the negative time zone effects observed for goods trade were attributed to difficulty coordinating business operations (Christen, 2015).

Survey Results

This section of the report summarizes the findings from surveys that were sent by the university with the support of the Maine Chamber of Commerce, Maine Municipal Association, and others to businesses and municipalities concerning possible changes to Daylight Savings Time. The survey focused on attitudes and preferences of any change to daylight savings particularly with regard to how this might impact day-to-day activities as well as how employees might be affected. In presenting the findings, where appropriate we note the location and industry respondents represent.

Business/Municipality Primary Location



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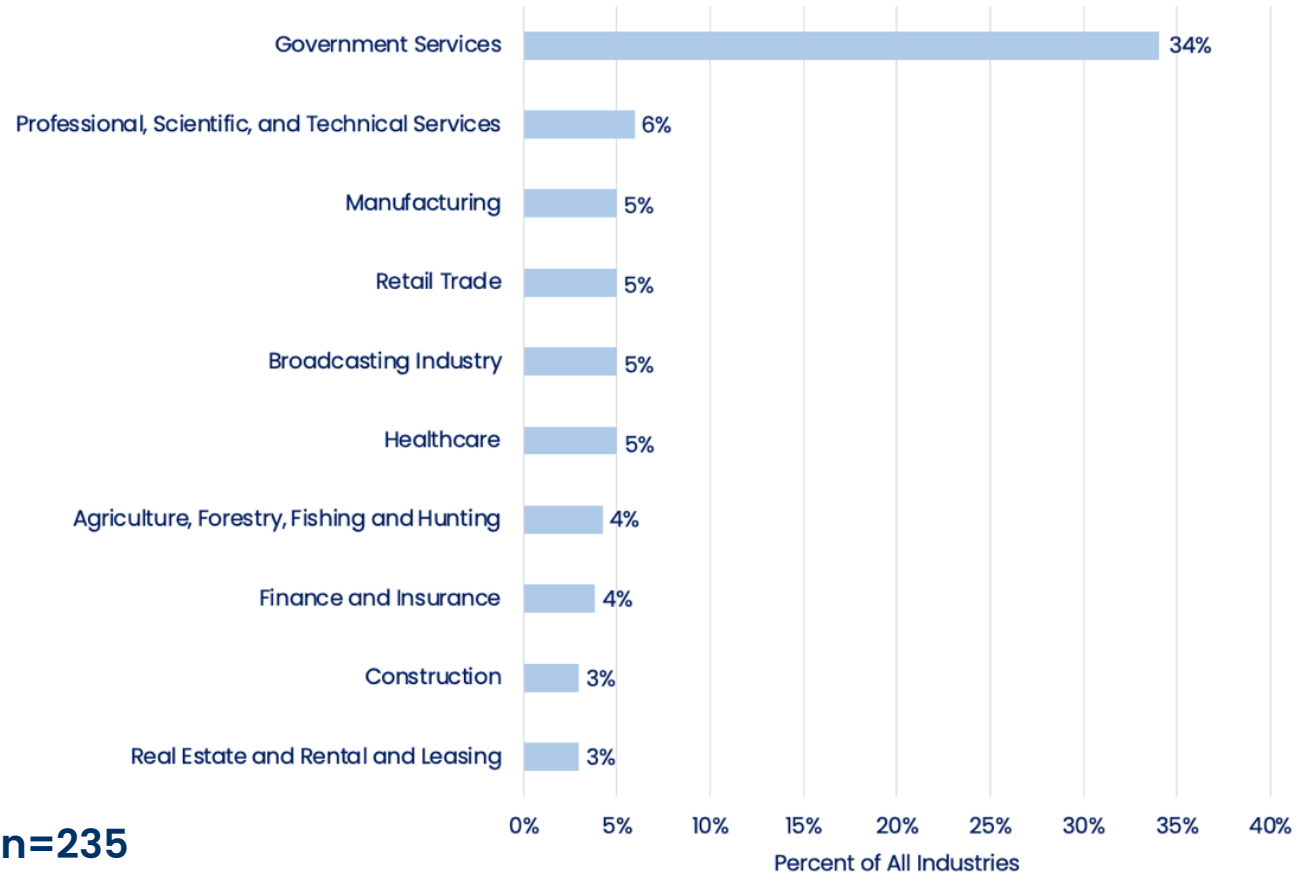
About Our Respondents

Penobscot had the largest response rate to our survey, at just over 23%, followed by Kennebec at just under 20% and Cumberland at 10%. In total every county in Maine was represented by at least one respondent. In terms of business sectors, there were a mix from both manufacturing (5%) and construction (3%) as well as medical (5%) and retail (5%). The public sector made up 34% of survey respondents. Small and medium size businesses made up 56% of responses, while large firms with more than 300 employees were 11% of the sample.

Top Ten Industries Represented by Respondents



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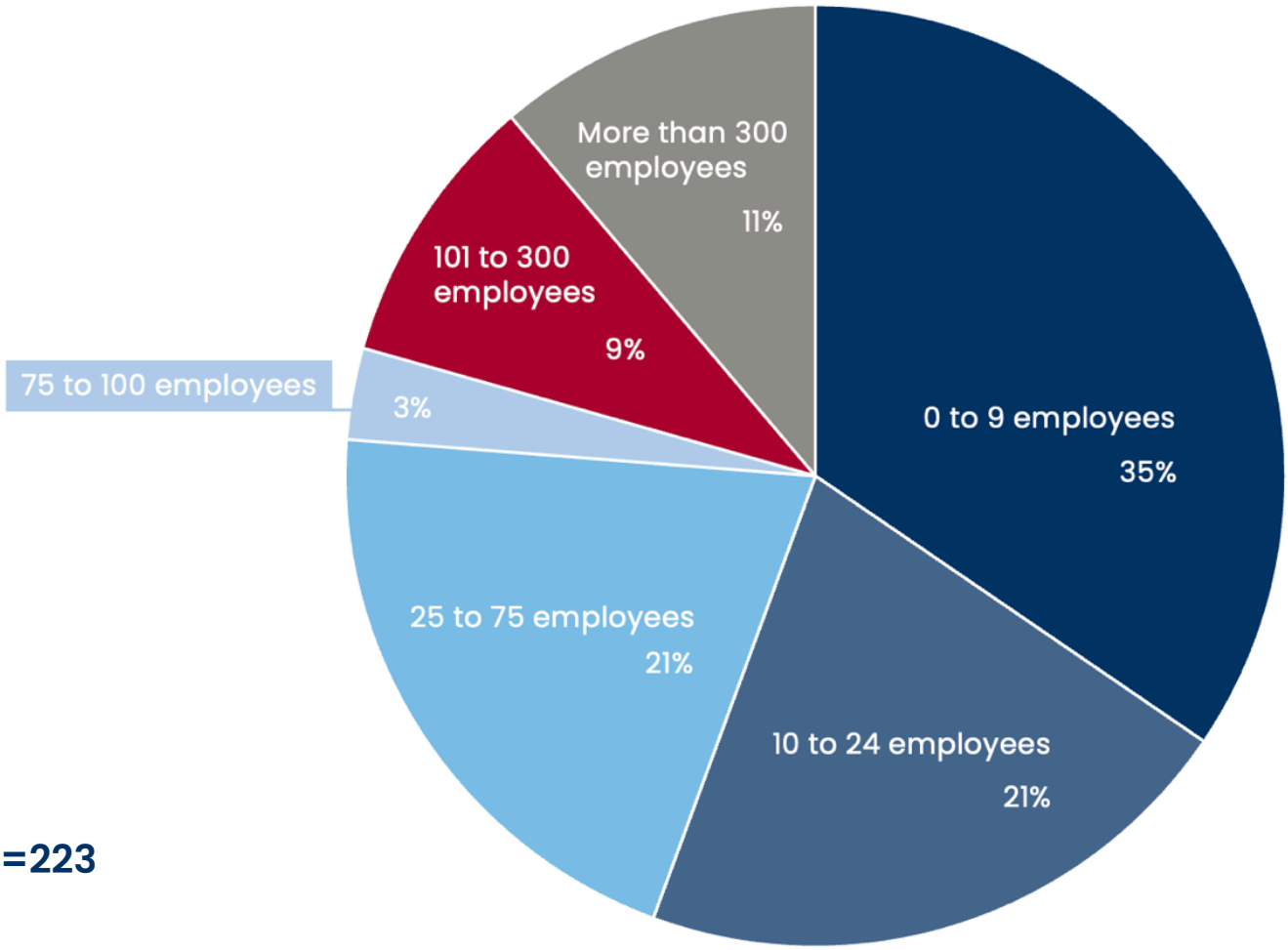
NOTE: This graph represents the top 10 sectors represented by survey respondents, thus it does not add up to 100%. Respondents in other industries not represented in this graph make up the remaining 26% of total respondents.

Business/Municipality Employment



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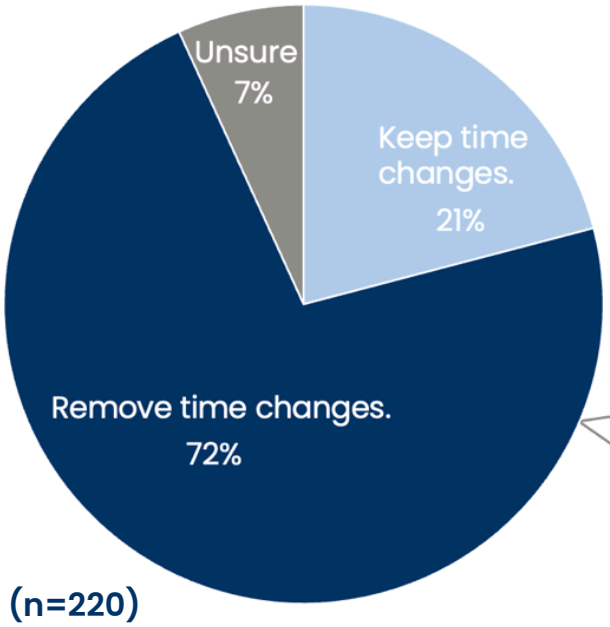
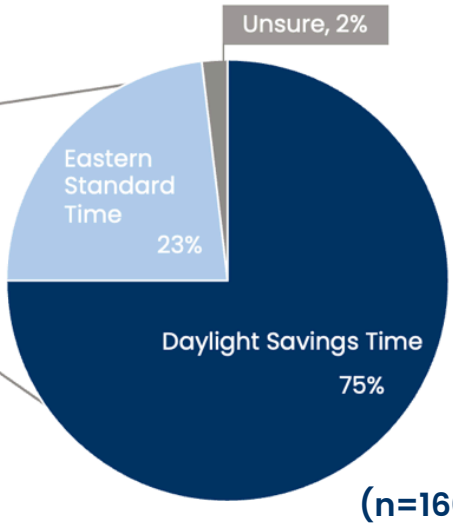
When asked whether Maine should remove the twice annual time change, 72% of respondents said they wanted to stop changing the clocks. Respondents who stated they would prefer to remove time changes were then asked if they would prefer permanent Eastern Standard Time (EST) or Daylight Savings Time (DST). Of these respondents, 75% wanted permanent Daylight Savings Time while only 23% wanted Eastern Standard Time. Further, when respondents were asked how they thought permanent Daylight Savings Time would impact their business, 51% thought that DST would have a positive impact on their primary activities, 52% that productivity would be positively improved, and 62% thought it would benefit their employees.

Would you prefer to keep or remove the twice annual time changes?



(n=220)

If remove, would you prefer permanent EST or DST?



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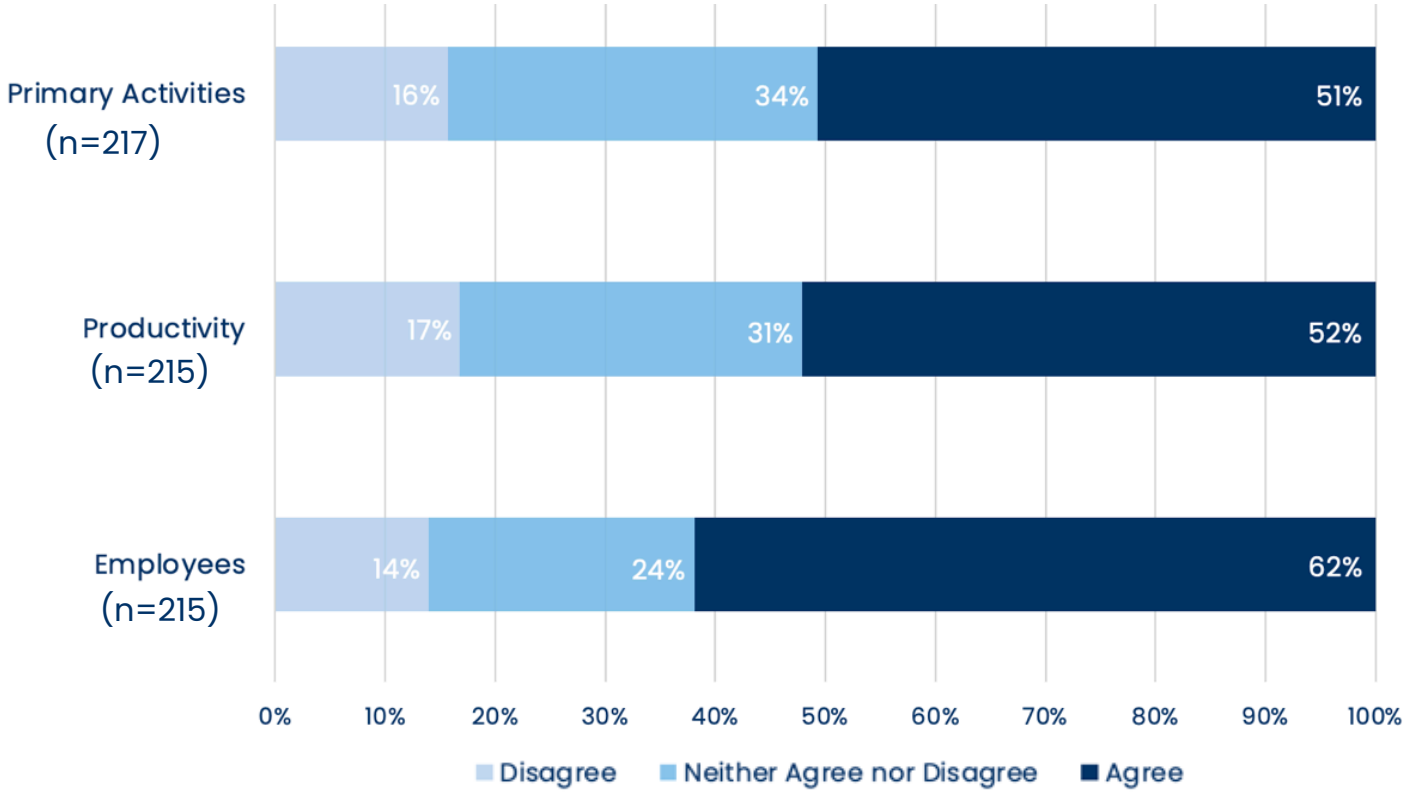
Would permanent daylight savings time positively affect the following aspects of your organization?



"It would be problematic if Maine did this and our neighbors did not. We shouldn't be an individual outlier like Indiana or Arizona, which can come off as a laughingstock."

"What is most important is consistency with other states . . . I would advocate Maine moving to permanent DST only as part of a national move, or at least along with other New England states."

"We can't be different from the rest of the states around us. It would be too confusing."

Consistency with Other States: Many respondents emphasized the importance of Maine aligning its stance on daylight saving time with neighboring states or as part of a national move to avoid being an outlier.

Core Themes

"I think permanent daylight savings would benefit our employees and operations as there will be light toward the end of the day to improve late day productivity and safety of commuting."

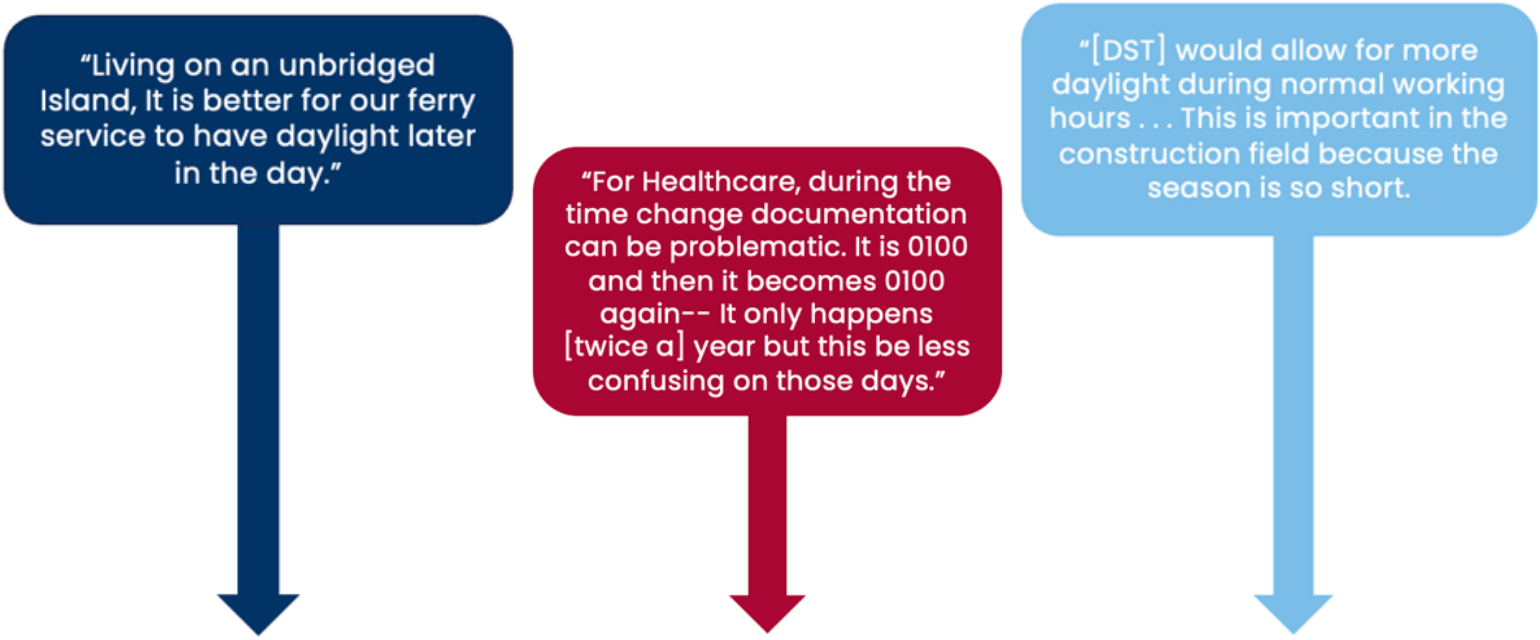
"I would rather see more lighted hours in the evenings. I believe this would be more productive overall."

"Some of my employees have a fairly long commute with heavy traffic. Having them drive home in daylight is preferable by them especially in the winter."

Benefits of Permanent Daylight Saving Time (DST): Many also believed that permanent DST would benefit employees and operations by providing more daylight at the end of the day, improving late-day productivity and commuting safety. They express a preference for more lighted hours in the evenings, especially for employees with long commutes.

Indifference to Time Choice: While many respondents have noted a preference for permanent DST, they convey an overall indifference to whether standard time or DST is chosen. However, they strongly advocate for picking one and sticking with it to provide more consistent daylight during normal working hours throughout the year.

Core Themes



Different sectors: It also became clear that different industries also expressed differing concerns, for example the construction sector pointed out the importance of daylight especially due to the short season. They suggest keeping the current system of changing time in the spring and fall.

Ease of Commerce

To better understand how a potential change in the State of Maine's time zone could impact the ease of interstate commerce, the following section details Maine's existing trade flows with each of the time zones in the United States. Overall, Maine has strong domestic trade links with areas in the Eastern Standard Time (EST) zone, which accounts for approximately two-thirds of Maine's total domestic imports and exports. However, other time zones have varying levels of significance for trade for each individual commodity type.

Methodology

Data

The analysis was completed using data from IMPLAN's trade flows data set[1]. This data set provides commodity-specific domestic trade flows between counties in the United States. The underlying data that is used to create these county-to-county domestic trade flows includes two data sets. The first is the Freight Analysis Framework created by the Oak Ridge National Laboratory. This data set provides both the mode of transportation used to carry freight as well as the distance that freight is carried, provided in ton-miles on a state-to-state basis. The second data set is the Commodity Flows Survey produced by the US Census Bureau, which provides further data on the average distance that commodities travel from production to consumption. IMPLAN applies these two data sources to a gravity model, which assumes that trade between regions depends on supply and demand for a given commodity across regions as well as the distance between regions. The gravity model methodology has been used widely to predict trade flows between regions since the early 1960s, notably by the Federal Highway Administration.

IMPLAN is currently used by over 1,000 entities to provide impact modeling and economic analytics.

Time Zones

Use of the IMPLAN trade flows data set allows for commodity-specific trade flows with counties being the smallest available unit of geographies. Therefore, each county in the United States was sorted into its corresponding time zone. Note that a small set of counties in the United States fall under two different time zones. In these rare instances, time zones were assigned based on the county's centroid. In other words, the time zone was selected if it covered more than 50% of the county's land area.

Acronyms

EST: Eastern Standard Time
CST: Central Standard Time
MST: Mountain Standard Time
PST: Pacific Standard Time
AST: Alaska Standard Time
HAST: Hawaii-Aleutian Standard Time

[1] For more information about this data set, please see IMPLAN's Gravity Model and Trade Flow RPCs Report at https://support.implan.com/hc/article_attachments/18593460186139

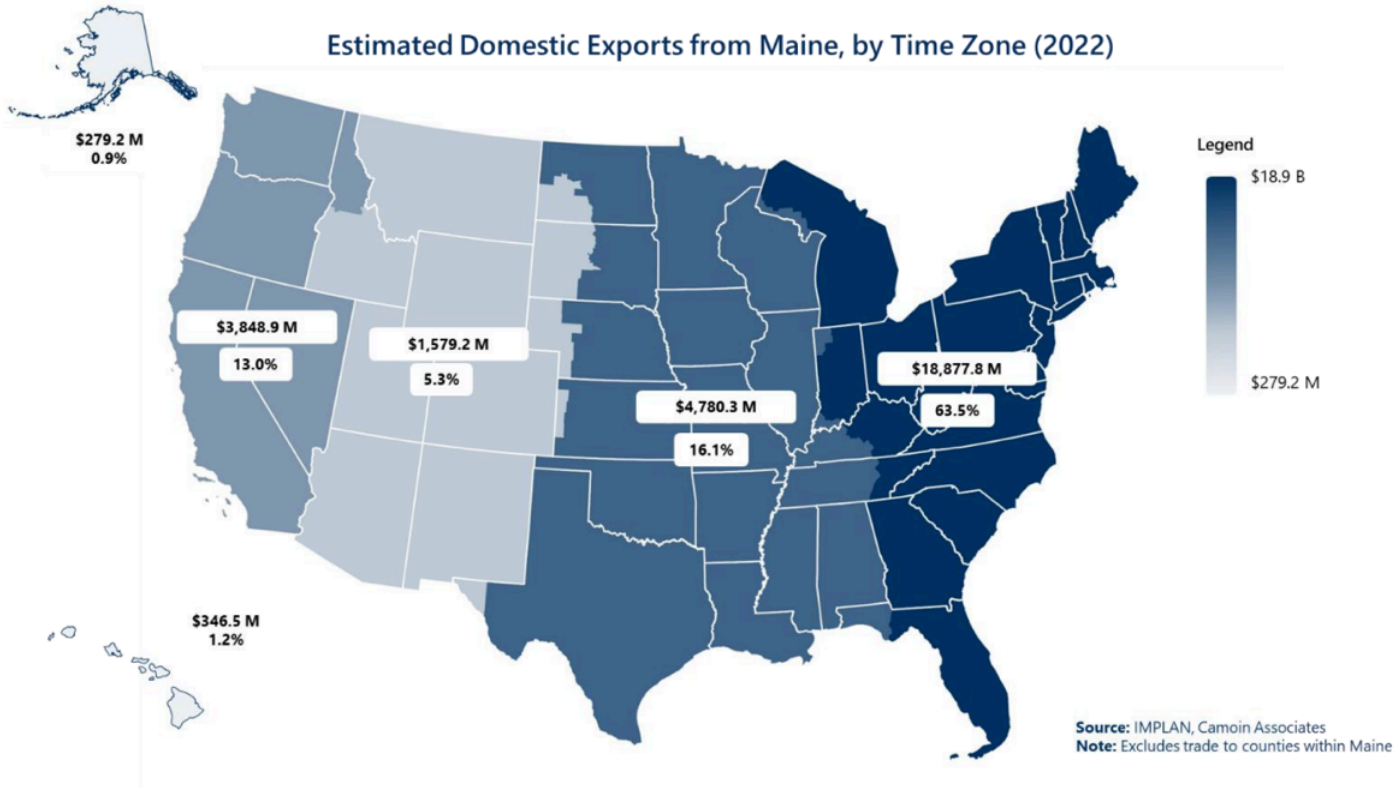
Export Flows

Maine has strong export relationships with other counties in the EST time zone. A total of $18.9 billion of goods and services were exported to EST counties in 2022, which accounted for over 60% of domestic exports from Maine. The EST is followed by the CST time zone, which was the destination of $4.7 billion of Maine's exports in 2022.

It is important to note that these figures exclude any intra-state trade, and instead focus only on trade occurring with other states. Intra-state trade accounted for nearly 79% of the total value of Maine's domestic sales in 2022.

Map 1 below demonstrates the concentration of domestic exports from Maine to each time zone in 2022.

Map 1:



The geography of trade varies depending on the commodity being traded. For example, Agricultural Products are traded almost exclusively with areas in the EST zone, although a smaller share of products is exported to areas in the CST zone. Similarly, nearly 100% of all Construction is exported within the EST time zone.

Conversely, manufactured goods including both Nondurable and Durable Goods, as well as Services, are exported more widely across the United States. While the EST zone accounts for a strong majority of this trade, significant volumes are also exported to areas in the CST and PST zones, with smaller but still notable trade volumes to areas in the MST, AST, and HAST zones.

Table 1 below demonstrates the flow of trade between Maine and the six US time zones by high-level commodity group.

Table 1: Total Value of Trade by time zone and Commodity

Domestic Exports from Maine by Time Zone, 2022

Time Zone	Agricultural Products	Durable Goods	Nondurable Goods	Oil, Gas, & Mineral Resources	Utilities	Construction	Services	Total
Alaska Standard Time	$88,050	$21,792,393	$27,689,444	$0	$384,340	$19,864	$229,672,073	$279,646,164
Central Standard Time	$268,719,146	$1,622,384,179	$1,592,337,156	$2,125	$1,712,324	$13,436	$1,512,039,742	$4,997,208,107
Eastern Standard Time	$261,042,379	$5,049,869,413	$6,779,376,509	$21,320,529	$201,234,371	$57,362,400	$6,343,965,958	$18,714,171,560
Hawaii-Aleutian Standard Time	$220,124	$24,729,654	$48,086,369	$0	$45,129,311	$299	$273,429,631	$391,595,388
Mountain Standard Time	$30,603,764	$716,229,207	$389,092,246	$0	$208,201	$23,415	$472,580,141	$1,608,736,974
Pacific Standard Time	$108,968,933	$1,199,593,899	$1,099,784,704	$3	$118,192,705	$207,981	$1,546,973,646	$4,073,721,870
Total	$669,642,394	$8,634,598,745	$9,936,366,429	$21,322,657	$366,861,251	$57,627,395	$10,378,661,191	$30,065,080,062

Source: IMPLAN, Camoin Associates

Note: Expressed in 2023 Dollars. Excludes trade from within Maine.

Share of Total Domestic Exports from Maine by Time Zone, 2022

Time Zone	Agricultural Products	Durable Goods	Nondurable Goods	Oil, Gas, & Mineral Resources	Utilities	Construction	Services	Total
Alaska Standard Time	0.0%	0.3%	0.3%	0.0%	0.1%	0.0%	2.2%	0.9%
Central Standard Time	40.1%	18.8%	16.0%	0.0%	0.5%	0.0%	14.6%	16.6%
Eastern Standard Time	39.0%	58.5%	68.2%	100.0%	54.9%	99.5%	61.1%	62.2%
Hawaii-Aleutian Standard Time	0.0%	0.3%	0.5%	0.0%	12.3%	0.0%	2.6%	1.3%
Mountain Standard Time	4.6%	8.3%	3.9%	0.0%	0.1%	0.0%	4.6%	5.4%
Pacific Standard Time	16.3%	13.9%	11.1%	0.0%	32.2%	0.4%	14.9%	13.5%
Total	100%	100%	100%	100%	100%	100%	100%	100%

Source: IMPLAN, Camoin Associates

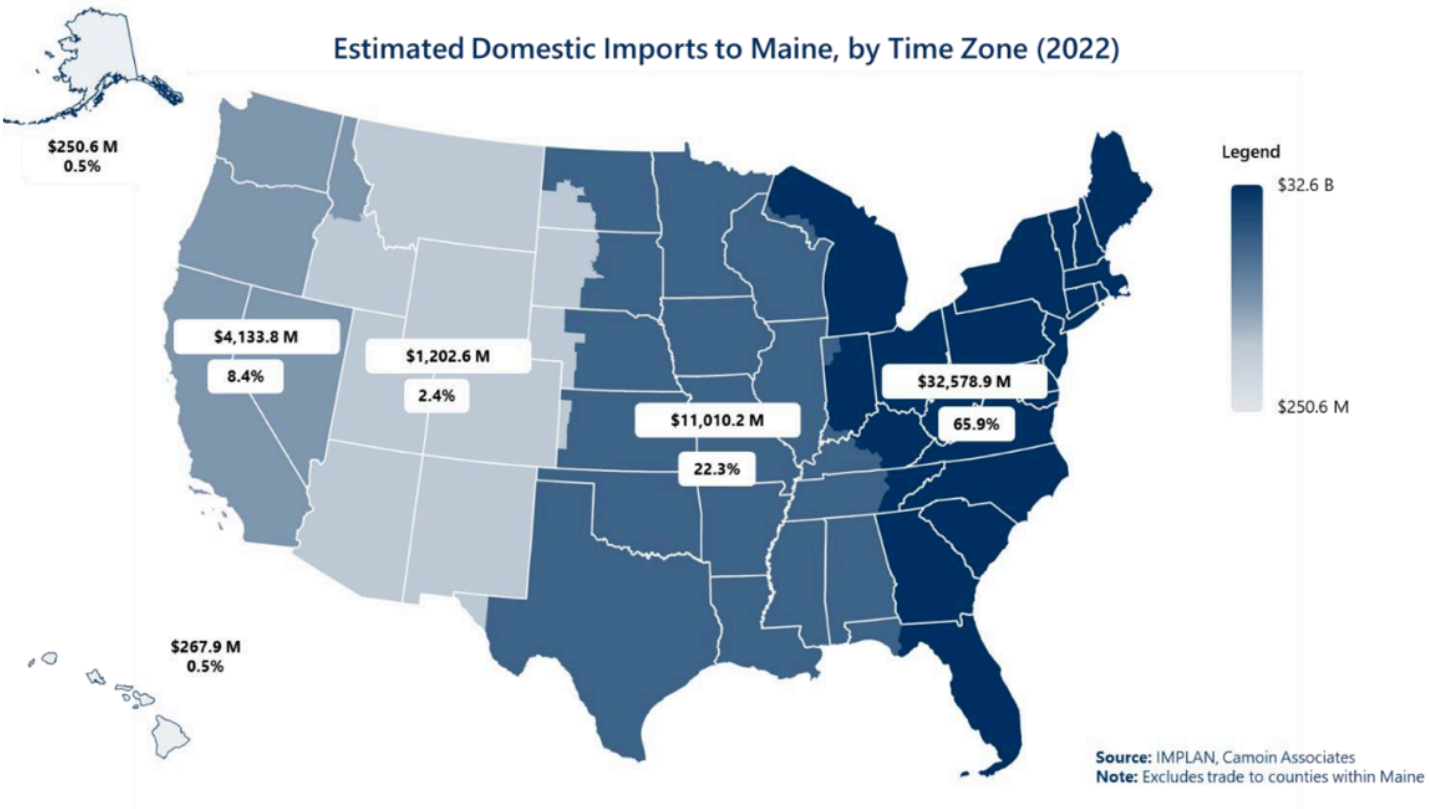
Note: Expressed in 2023 Dollars. Excludes trade from within Maine.

Import Flows

Similar to export flows, Maine has strong import relationships with other counties in the EST time zone. A total of $32.6 billion of goods and services flowed into Maine from other areas in the EST zone in 2022, which accounted for over 65% of domestic imports into Maine. The EST is followed by the CST zone, which was the source of $11.0 billion of Maine's domestic imports in 2022. Like exports, these figures exclude intra-state trade, which accounted for approximately 69% of the total value of Maine's domestic purchases in 2022.

Map 2 below demonstrates the concentration of domestic exports from Maine to each time zone in 2022.

Map 2:



The geographic patterns of trade for each commodity group varies compared to exports. For example, Agricultural Products are imported into Maine in relatively equal volume from areas in both the EST and CST time zones, with smaller but still significant volumes being sourced by the PST zone. This is generally the same pattern that is present for both Durable Goods and Nondurable Goods. Looking at Construction, Maine imports the largest volume from areas in the CST zone, followed by areas in the EST zone, and a small amount from areas in the MST zone. Meanwhile, nearly all Services are imported from areas in the EST zone, although the CST and PST zones each account for around $1.7 billion of domestic imports into Maine.

Table 2 below demonstrates the flow of trade between Maine and the six US time zones by high-level commodity group.

Table 2: Total Value of Trade by time zone and Commodity

Domestic Imports to Maine by Time Zone, 2022

Time Zone	Agricultural Products	Durable Goods	Nondurable Goods	Oil, Gas, & Mineral Resources	Utilities	Construction	Services	Total
Alaska Standard Time	$88,050	$3,006,817	$34,441,641	$99,950,344	$842,809	$49	$213,032,711	$351,362,421
Central Standard Time	$268,719,146	$3,164,918,751	$5,809,465,674	$943,246,539	$1,932,477	$56,382,395	$1,710,684,115	$11,955,349,097
Eastern Standard Time	$261,042,379	$6,536,533,336	$6,794,532,135	$89,734,926	$559,990,110	$31,082,401	$18,955,705,440	$33,228,620,727
Hawaii-Aleutian Standard Time	$220,124	$2,224,502	$10,435,905	$1,689	$57,315,935	$0	$255,001,409	$325,199,564
Mountain Standard Time	$30,603,764	$413,999,341	$435,768,955	$69,391,688	$921,293	$2,036,955	$320,144,008	$1,272,866,004
Pacific Standard Time	$108,968,933	$1,324,845,800	$1,021,049,816	$11,987,091	$413,557,514	$191	$1,678,942,197	$4,559,351,542
Total	$669,642,394	$11,445,528,548	$14,105,694,127	$1,214,312,276	$1,034,560,139	$89,501,991	$23,133,509,880	$51,692,749,355

Source: IMPLAN, Camoin Associates

Note: Expressed in 2023 Dollars. Excludes trade from within Maine.

Share of Total Domestic Imports to Maine by Time Zone, 2022

Time Zone	Agricultural Products	Durable Goods	Nondurable Goods	Oil, Gas, & Mineral Resources	Utilities	Construction	Services	Total
Alaska Standard Time	0.0%	0.0%	0.2%	8.2%	0.1%	0.0%	0.9%	0.7%
Central Standard Time	40.1%	27.7%	41.2%	77.7%	0.2%	63.0%	7.4%	23.1%
Eastern Standard Time	39.0%	57.1%	48.2%	7.4%	54.1%	34.7%	81.9%	64.3%
Hawaii-Aleutian Standard Time	0.0%	0.0%	0.1%	0.0%	5.5%	0.0%	1.1%	0.6%
Mountain Standard Time	4.6%	3.6%	3.1%	5.7%	0.1%	2.3%	1.4%	2.5%
Pacific Standard Time	16.3%	11.6%	7.2%	1.0%	40.0%	0.0%	7.3%	8.8%
Total	100%	100%	100%	100%	100%	100%	100%	100%

Source: IMPLAN, Camoin Associates

Note: Expressed in 2023 Dollars. Excludes trade from within Maine.

Summary

Previous Studies

i. Public Health

- The establishment of time zones, especially DST, creates a misalignment between social and solar time, leading to social jet lag.
- Studies indicate that even small changes in circadian misalignment are linked to adverse health outcomes, emphasizing the importance of maintaining a regular circadian rhythm.
- DST shifts daylight hours, impacting traffic accidents, with a reduction in accidents during the evenings but an increase in the mornings.
- Increased daylight in the evenings under DST has the potential to enhance physical activity levels, particularly among children.

ii. Workforce

- Worker productivity decreases following the switch to DST, with studies indicating an increase in cyber loafing due to lack of sleep. However, there is limited literature on long-term effects, but time zone differences.
- Communication between workers tends to decrease in response to a 1-2 hour increase in temporal distance, with observed declines in general and synchronous communication.
- Sleep deprivation resulting from time zone transitions, such as DST, may negatively impact motivation, attention, and alertness, potentially increasing accident rates.

iii. Energy, Transportation and Commerce

- DST reduces electricity usage in the evenings, due to decreased time spent at home, and increases energy consumption in the morning hours, due to the use of light and heat.
- Time zone differences increase temporal distance between locations, leading to higher transaction costs associated with trade and communication.

Summary

Survey Results

- 72% of business and municipal respondents in Maine expressed a desire to discontinue the twice annual time change.
- Among those who preferred to eliminate time changes, 75% favored permanent DST, while only 23% preferred permanent EST.
- Permanent DST is perceived as beneficial due to the extension of daylight hours at the end of the day.

Ease of Commerce

- Maine has strong export relationships with countries in the EST time zone.
- In 2022, Maine exported a total of $18.9 billion worth of goods and services to EST countries.
- This accounted for over 60% of Maine's total domestic exports in 2022.
- Almost 100% of Construction products are exported within the EST time zone.
- Manufactured goods, including both Nondurable and Durable Goods, as well as Services, are traded more widely across the United States.

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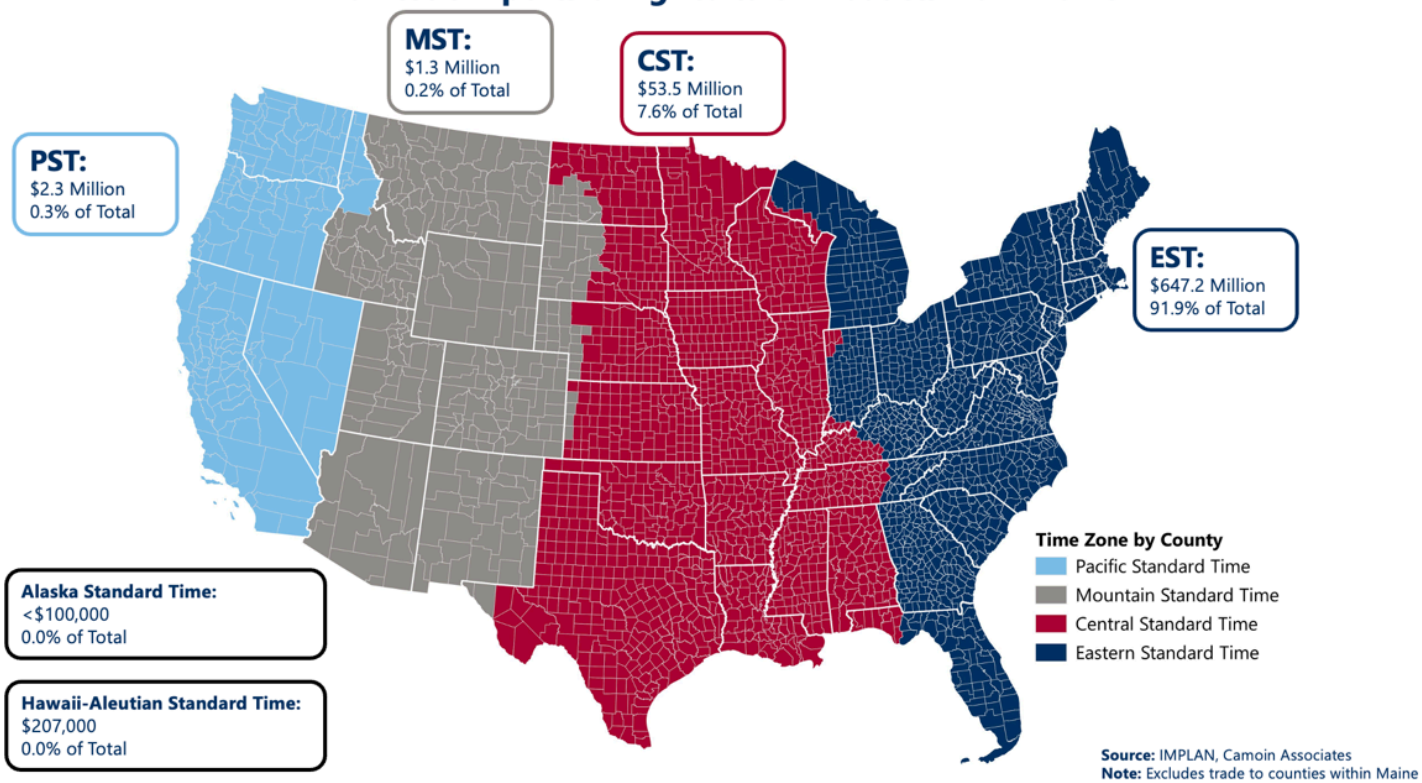
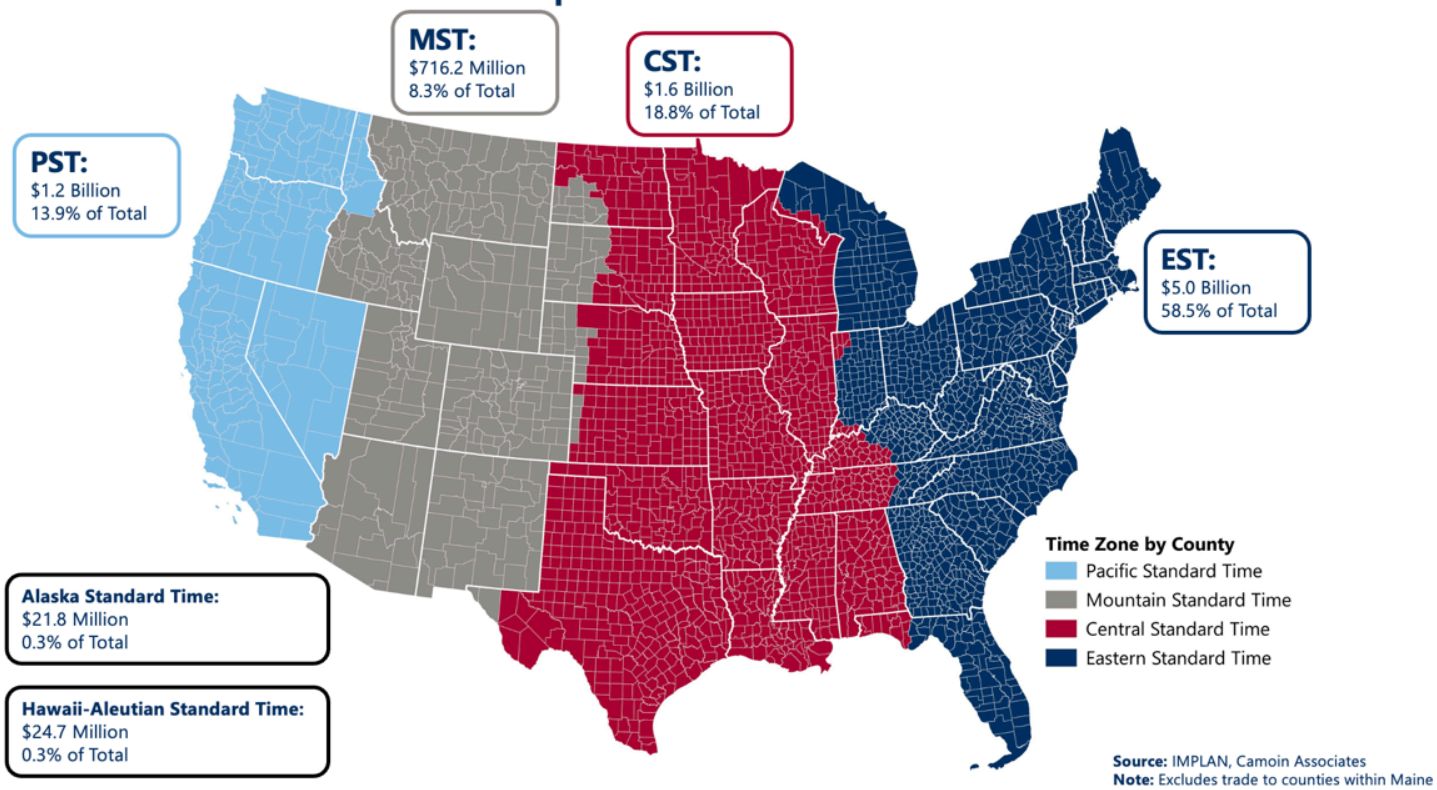
Appendix

Domestic Exports of Agricultural Products from Maine



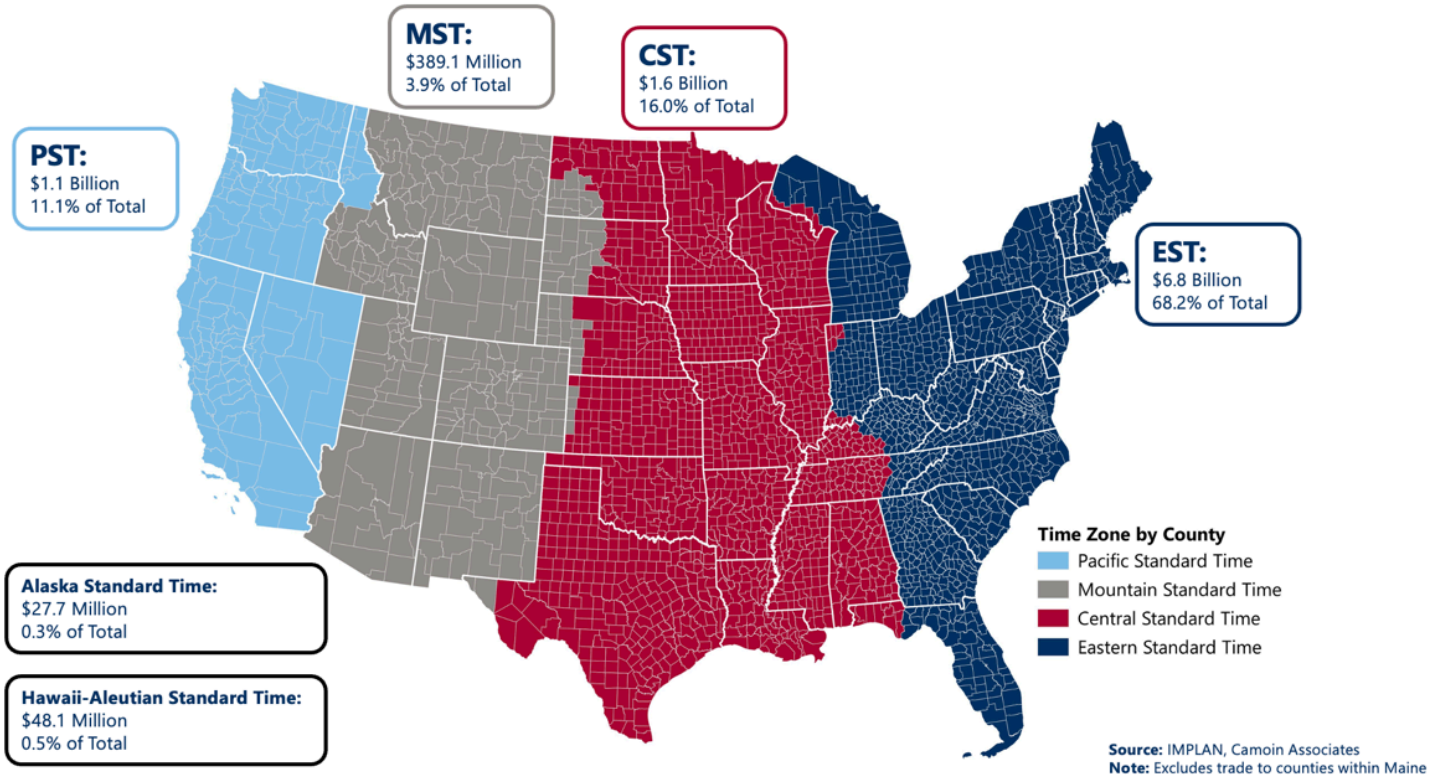
Source: IMPLAN, Camoin Associates
Note: Excludes trade to counties within Maine

Domestic Exports of Durable Goods from Maine



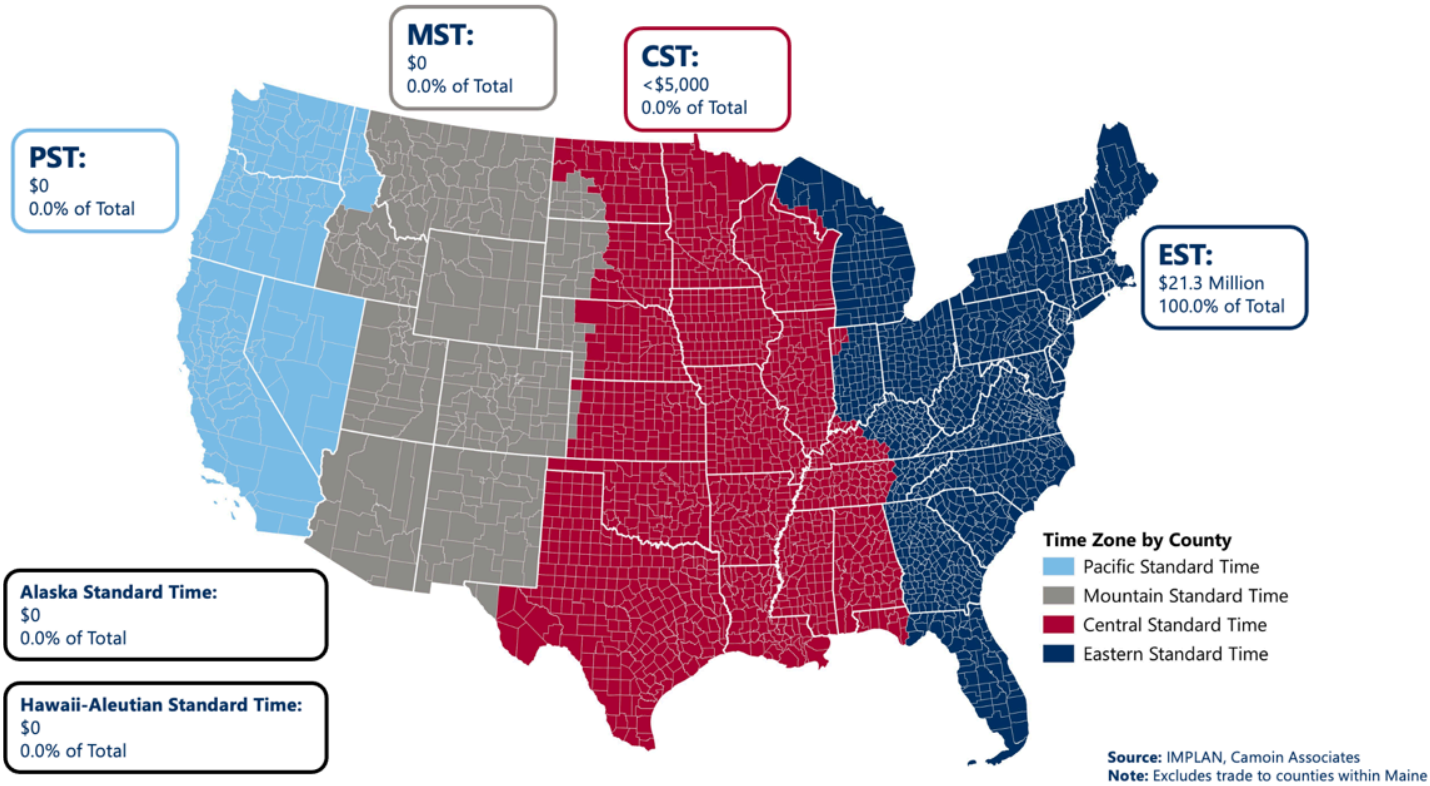
Source: IMPLAN, Camoin Associates
Note: Excludes trade to counties within Maine

Domestic Exports of Nondurable Goods from Maine



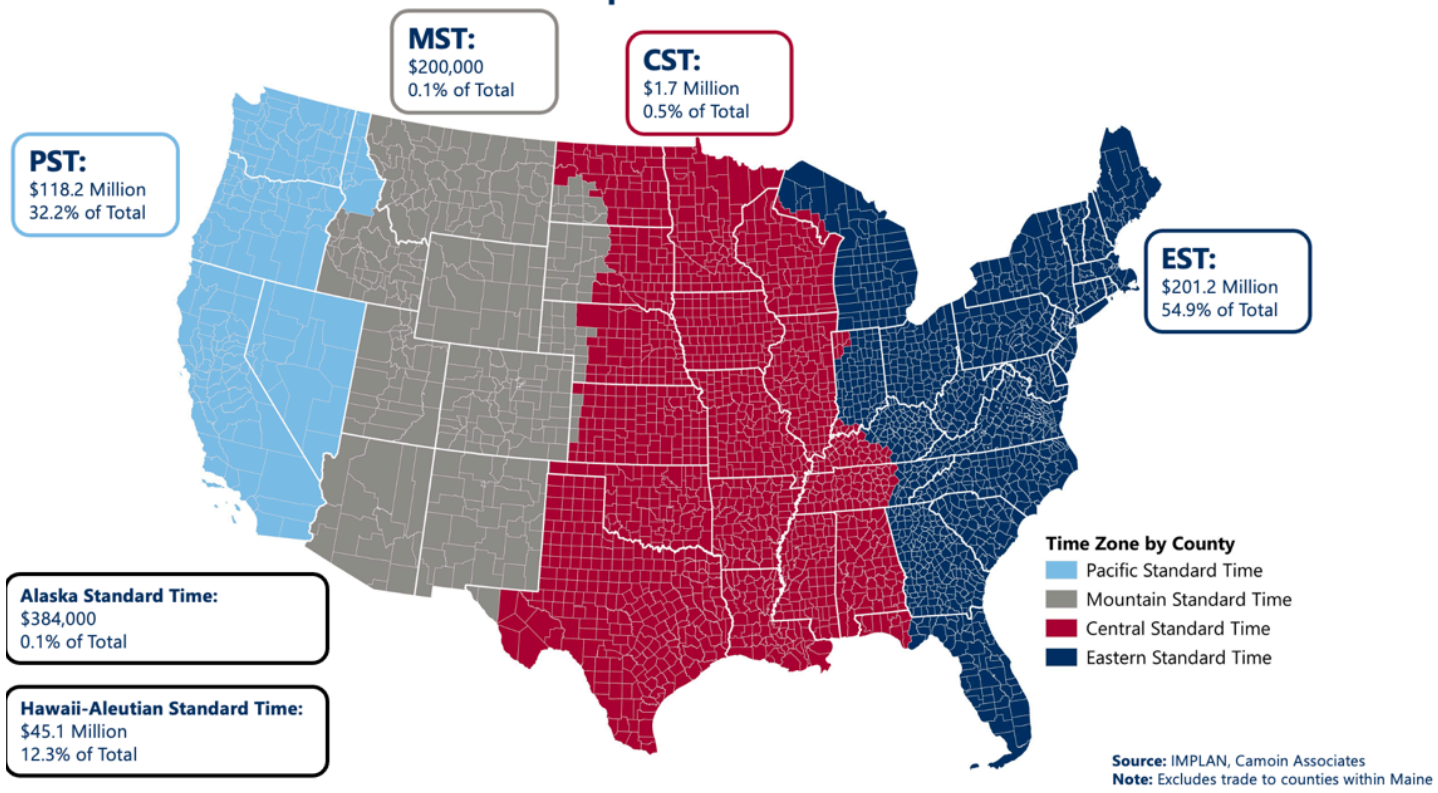
Source: IMPLAN, Camoin Associates
Note: Excludes trade to counties within Maine

Domestic Exports of Oil, Gas, and Mineral Resources from Maine



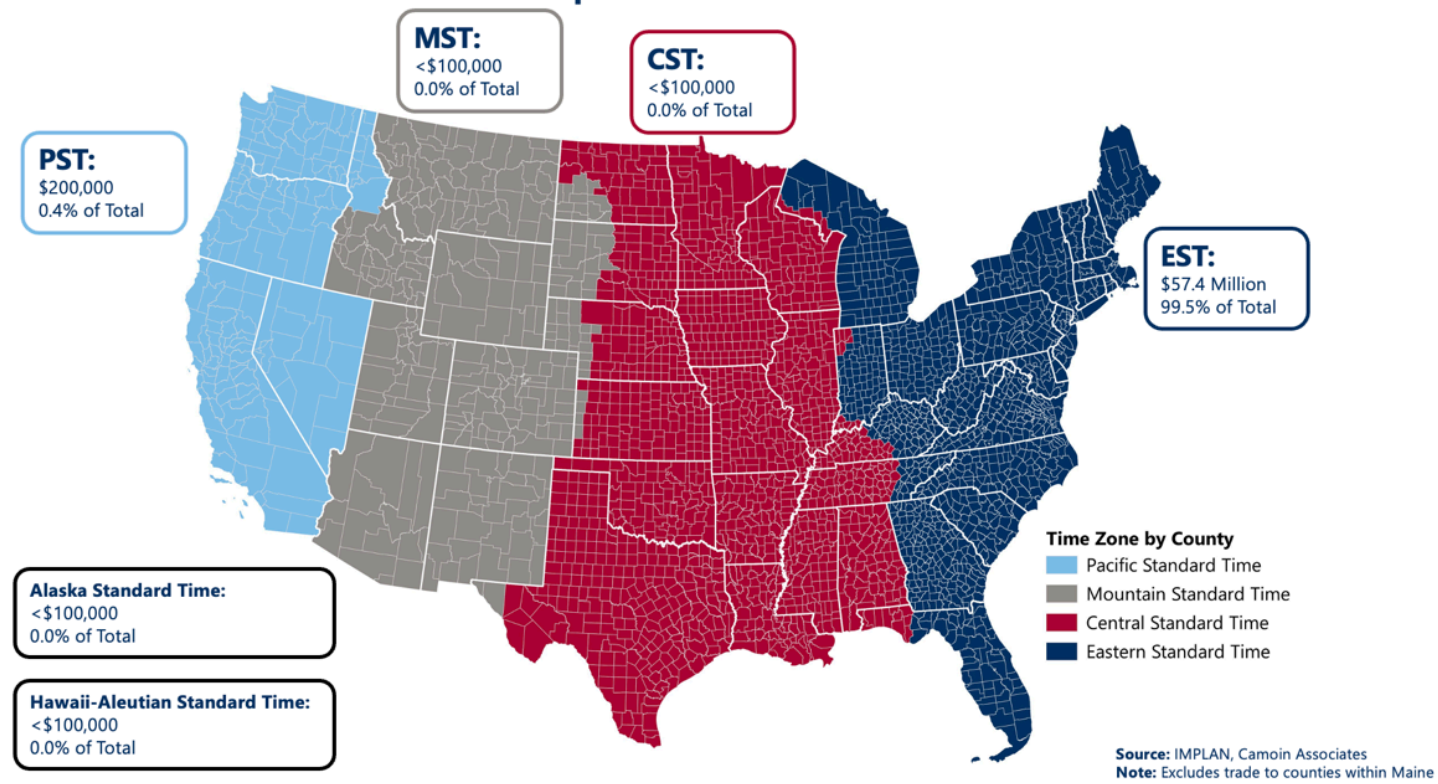
Source: IMPLAN, Camoin Associates
Note: Excludes trade to counties within Maine

Domestic Exports of Utilities from Maine



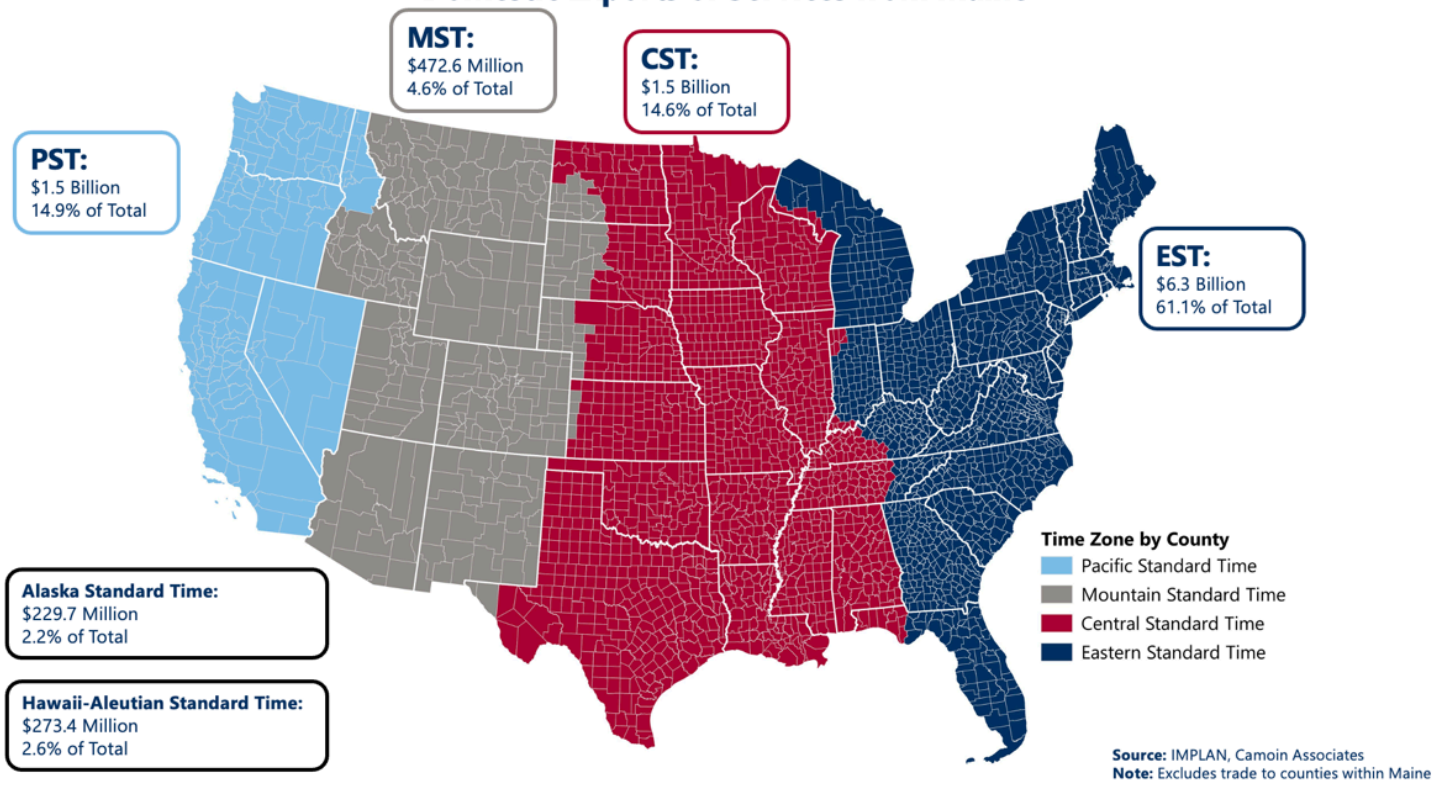
Source: IMPLAN, Camoin Associates
Note: Excludes trade to counties within Maine

Domestic Exports of Construction from Maine

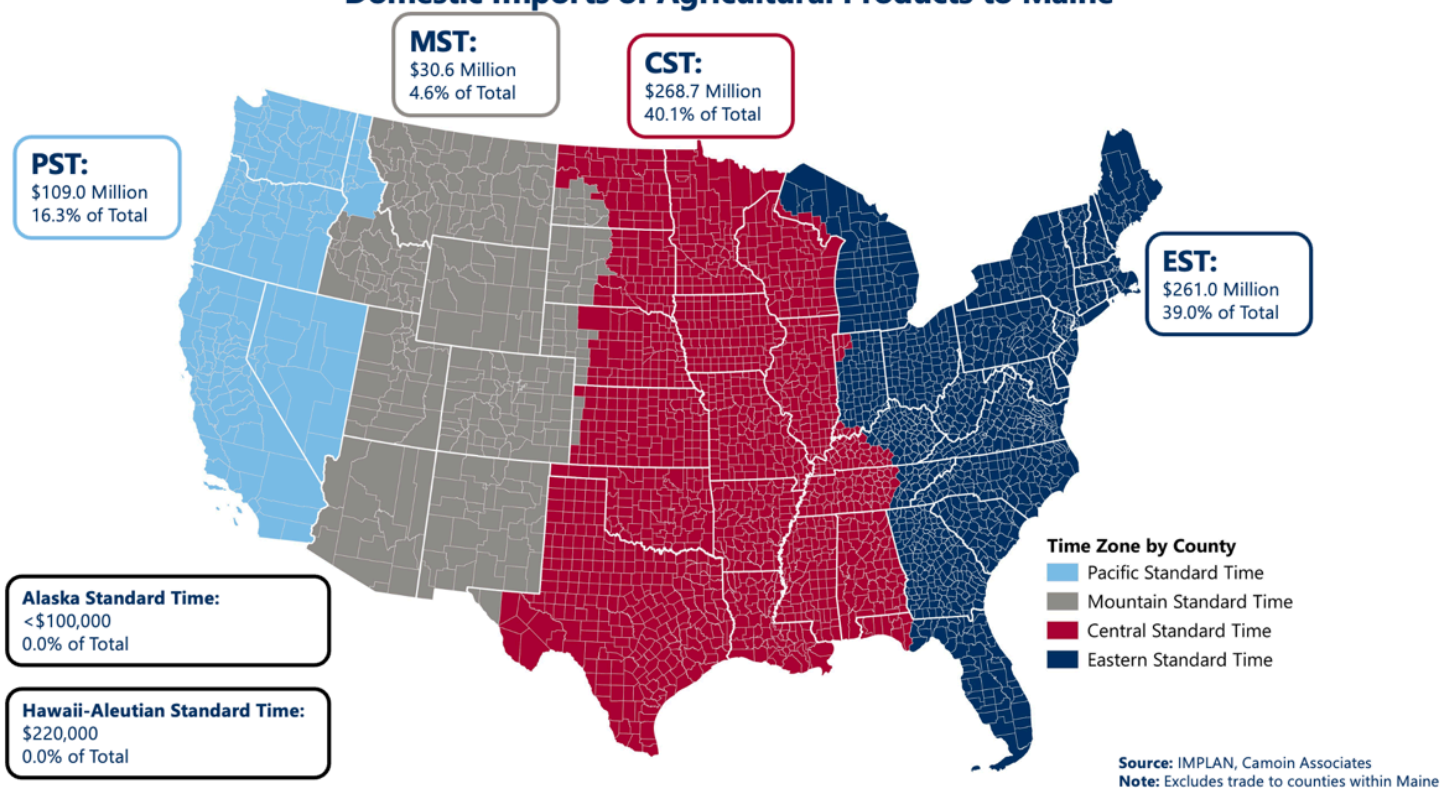


Source: IMPLAN, Camoin Associates
Note: Excludes trade to counties within Maine

Domestic Exports of Services from Maine

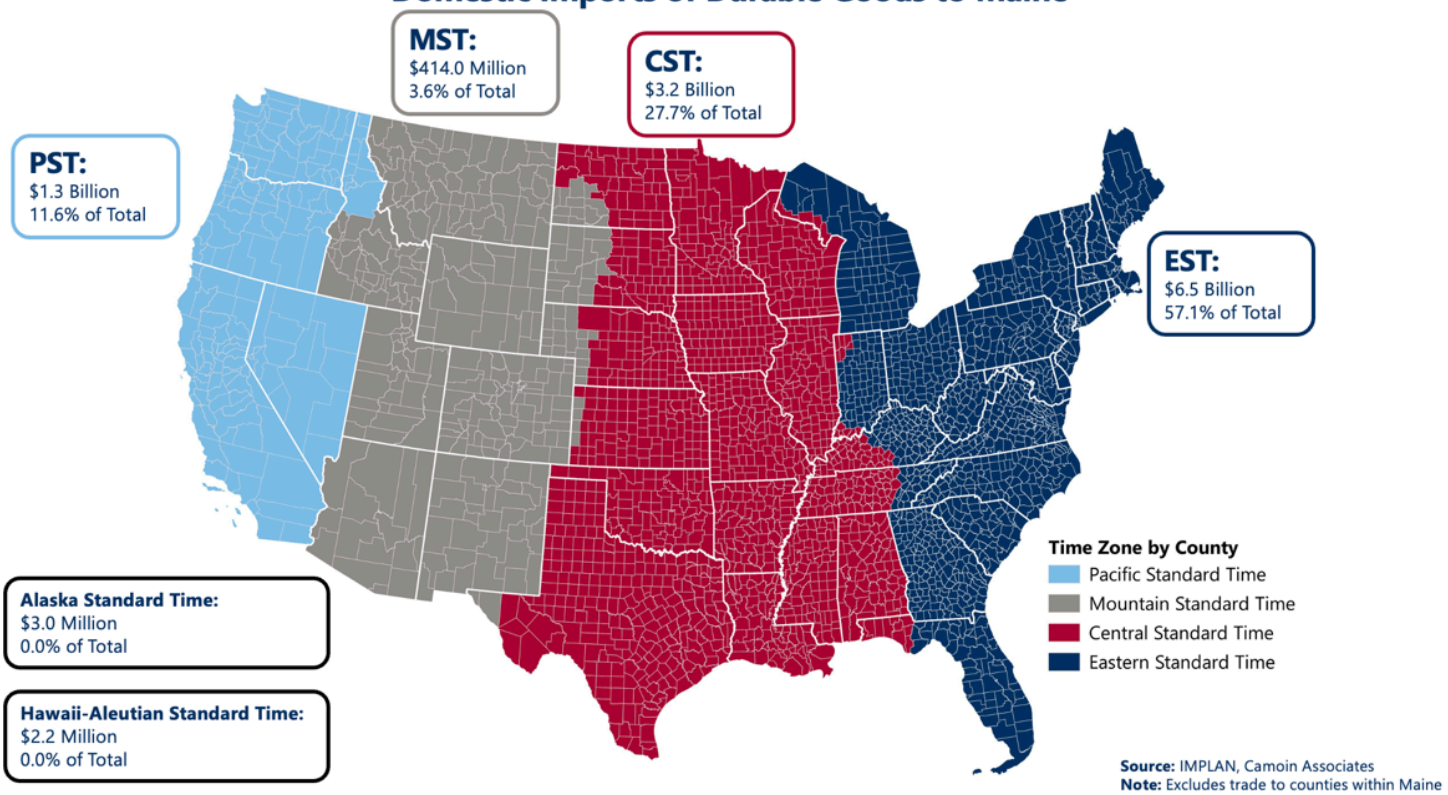


Domestic Imports of Agricultural Products to Maine



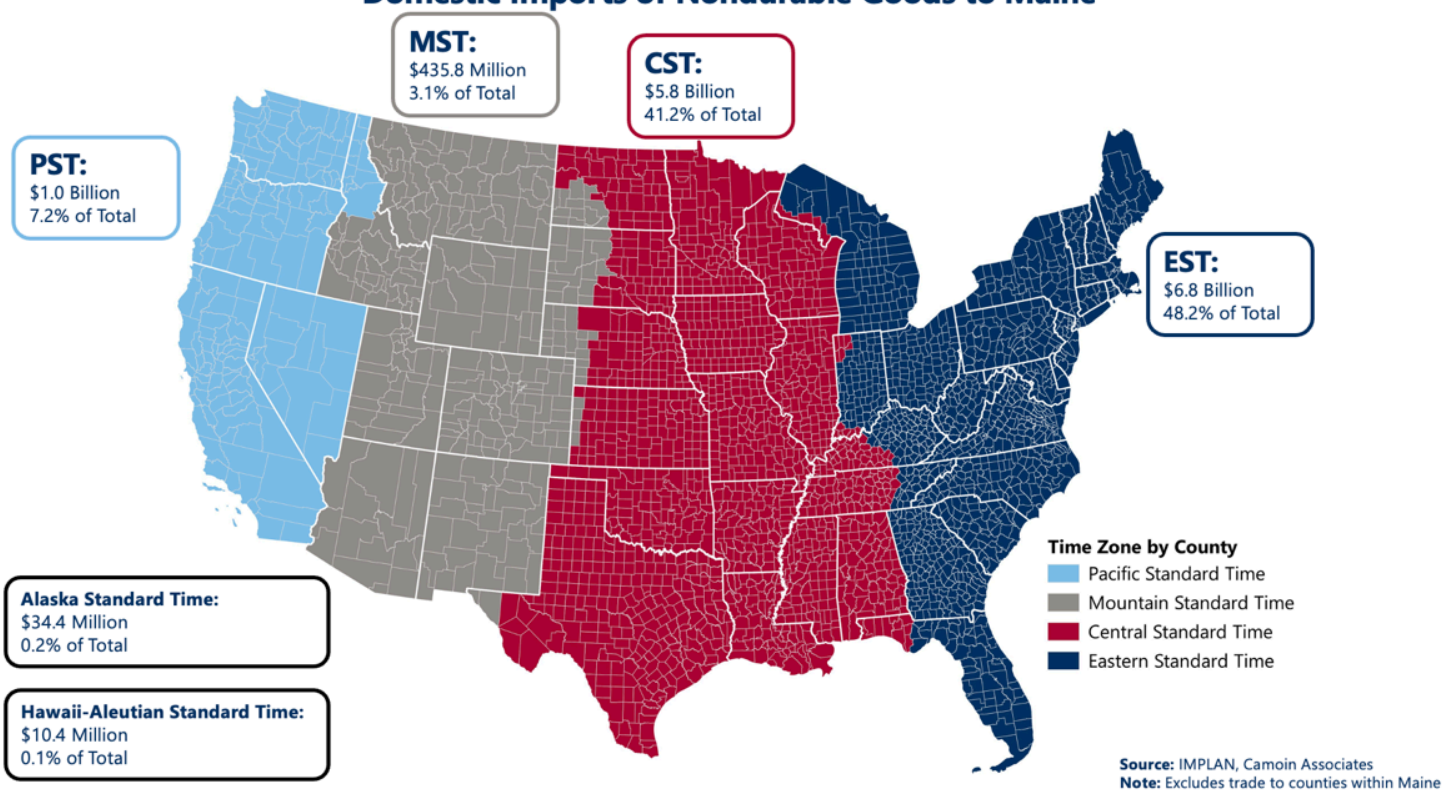
Source: IMPLAN, Camoin Associates
Note: Excludes trade to counties within Maine

Domestic Imports of Durable Goods to Maine



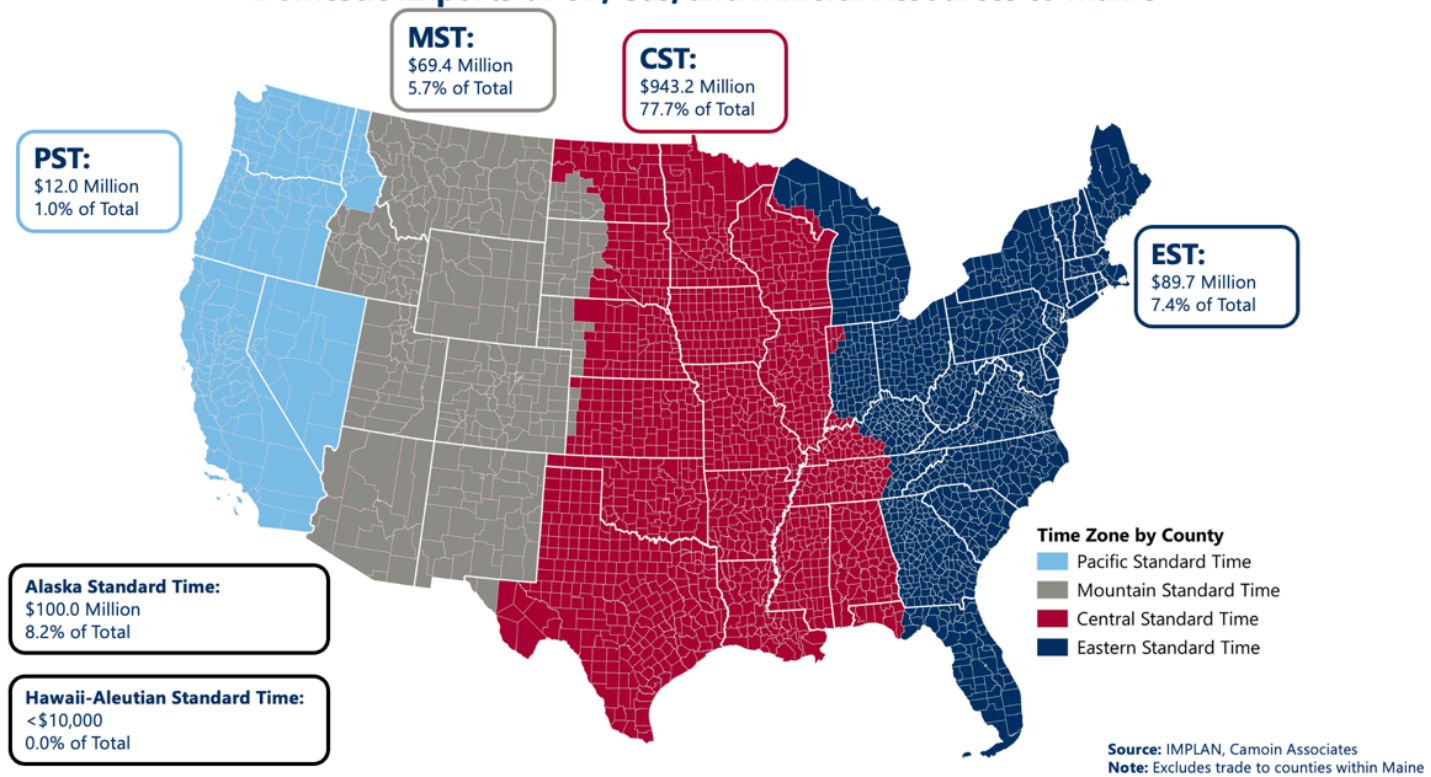
Source: IMPLAN, Camoin Associates
Note: Excludes trade to counties within Maine

Domestic Imports of Nondurable Goods to Maine



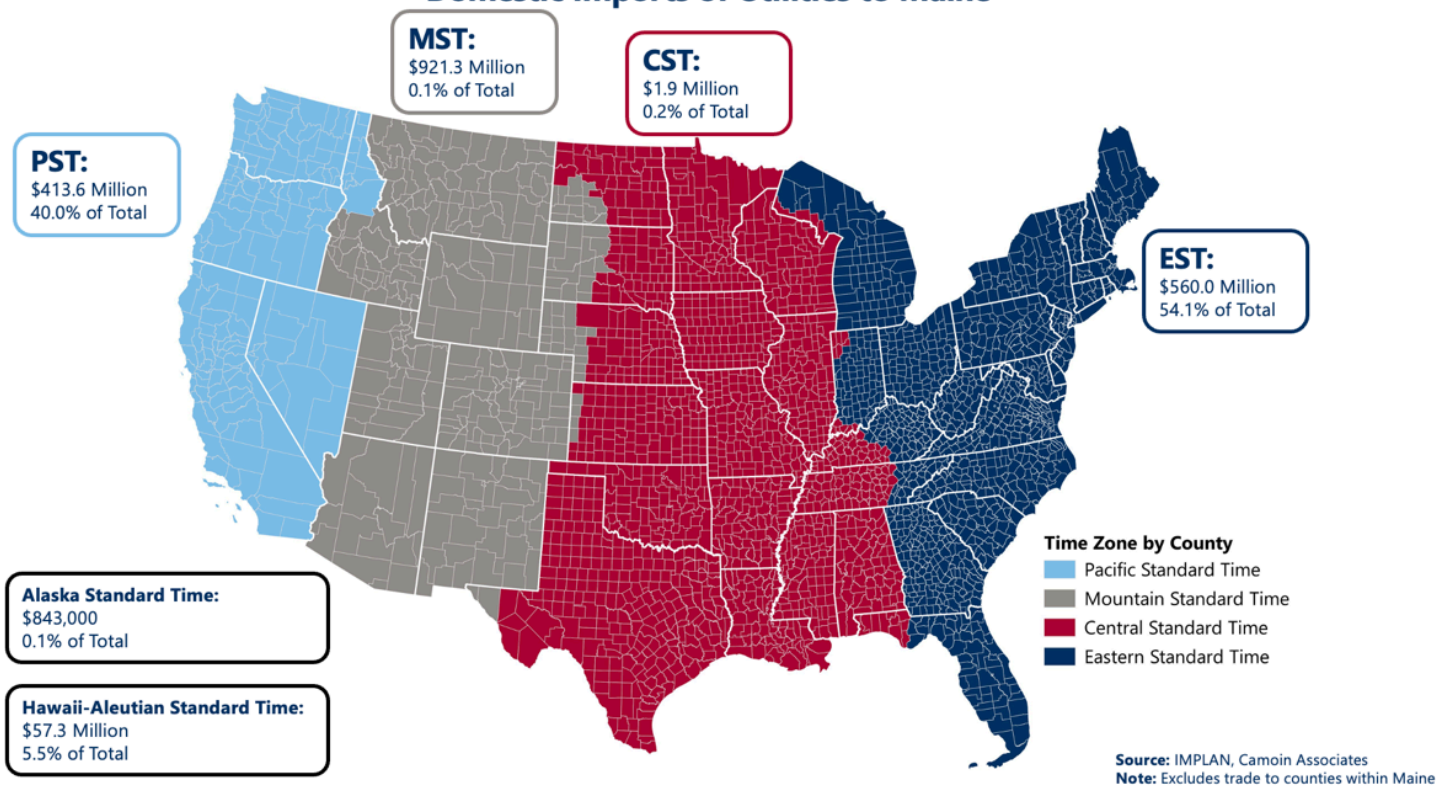
Source: IMPLAN, Camoin Associates
Note: Excludes trade to counties within Maine

Domestic Imports of Oil, Gas, and Mineral Resources to Maine



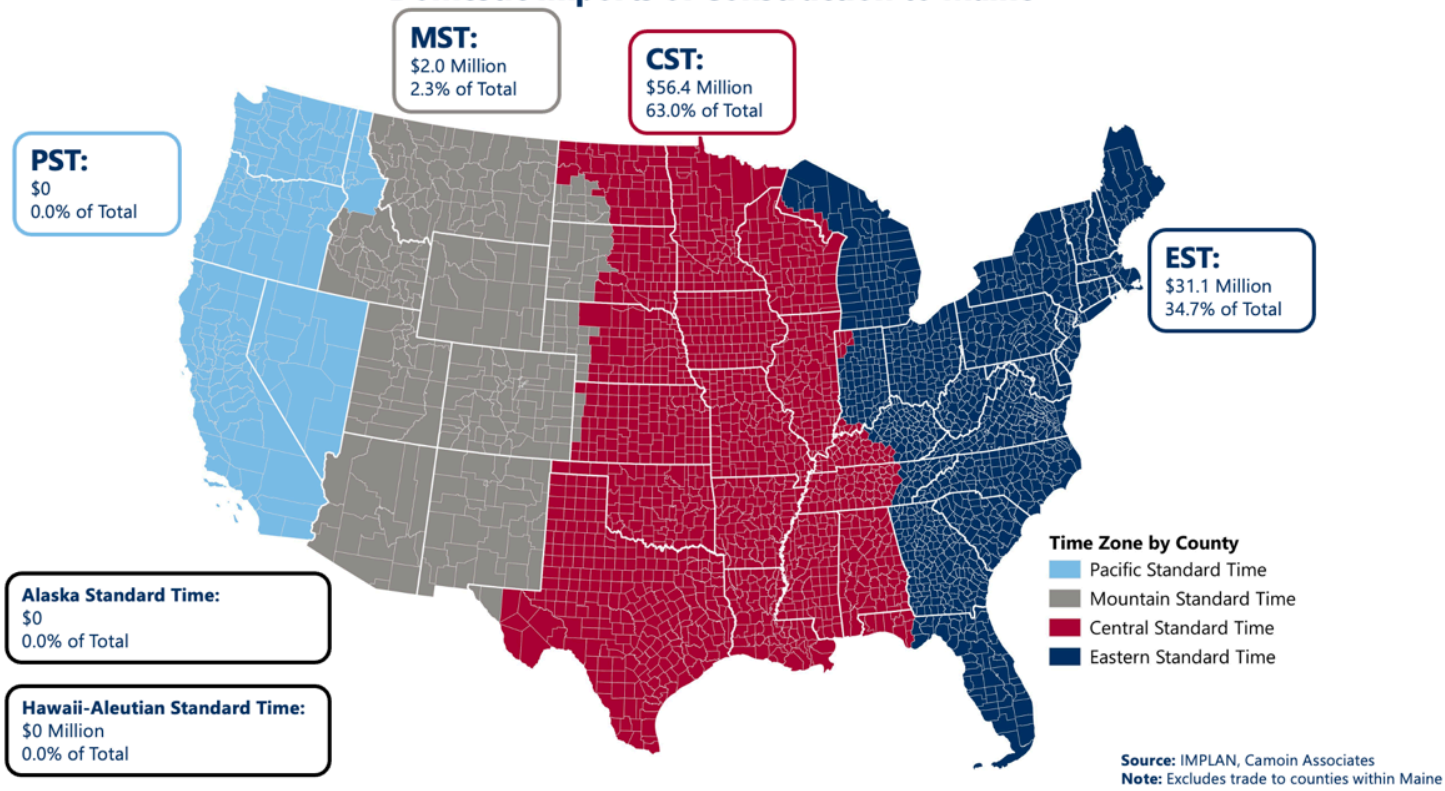
Source: IMPLAN, Camoin Associates
Note: Excludes trade to counties within Maine

Domestic Imports of Utilities to Maine

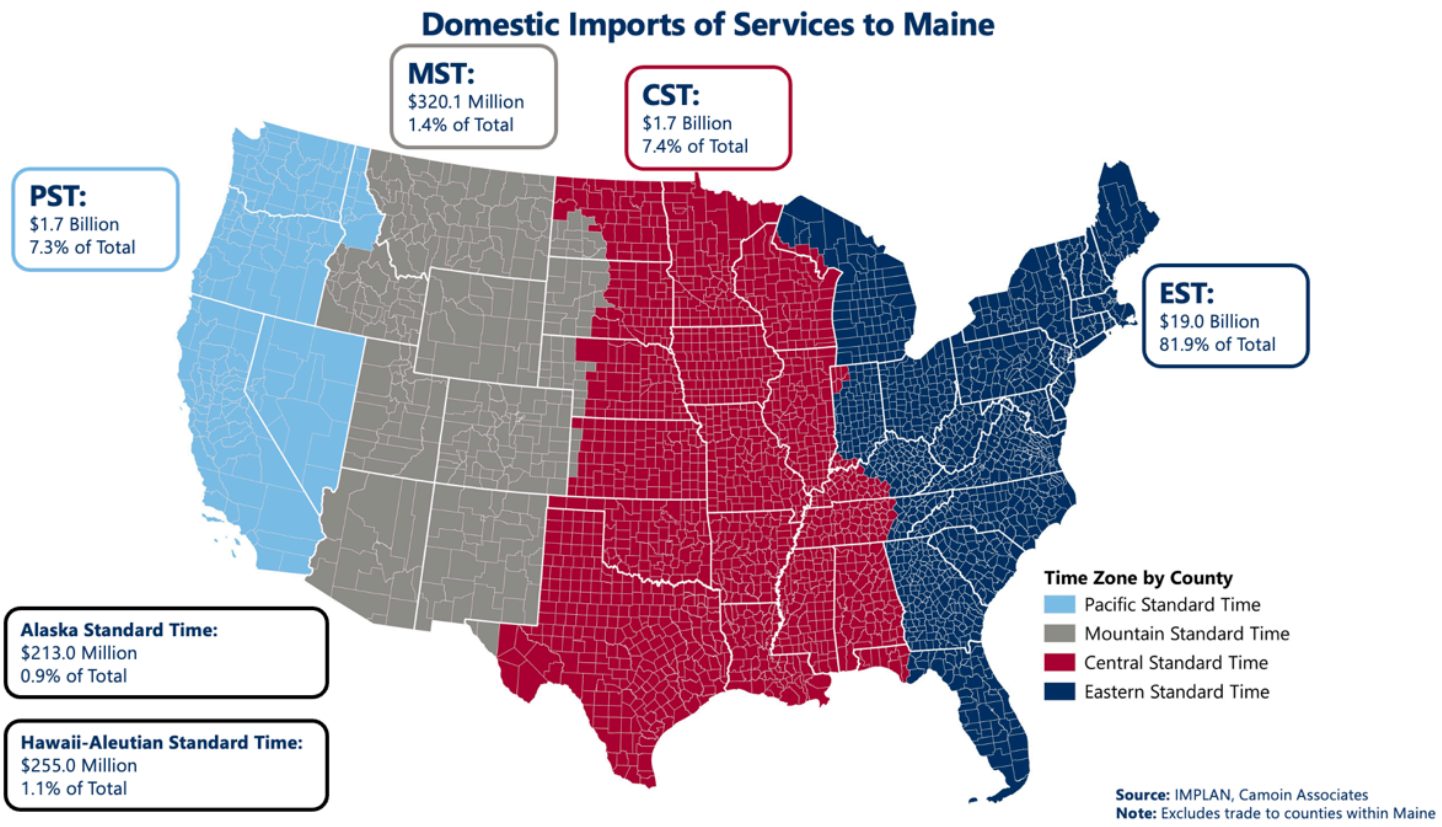


Source: IMPLAN, Camoin Associates
Note: Excludes trade to counties within Maine

Domestic Imports of Construction to Maine



Source: IMPLAN, Camoin Associates
Note: Excludes trade to counties within Maine


Domestic Imports of Services to Maine
MST:
$320.1 Million
1.4% of Total
CST:
$1.7 Billion
7.4% of Total
PST:
$1.7 Billion
7.3% of Total
EST:
$19.0 Billion
81.9% of Total
Alaska Standard Time:
$213.0 Million
0.9% of Total
Hawaii-Aleutian Standard Time:
$255.0 Million
1.1% of Total
Time Zone by County
Pacific Standard Time
Mountain Standard Time
Central Standard Time
Eastern Standard Time
Source: IMPLAN, Camoin Associates
Note: Excludes trade to counties within Maine