72. **Land of a later-rising sun - how much and when?**

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Abstract

Selected social- and electricity-saving-benefits are compared for two time-change alternatives to the existing (fixed) national time in Japan. The alternatives are: 1) daylight savings time (DST), and 2) a permanent one-hour change plus DST. The purpose is to quantify passive means that can be used to better match available daylight with current living and working patterns. Three longstanding objections against DST are reviewed while potentials for improving the quality of sleep and limiting peak electricity use are advanced.

Documented records are used to evaluate the three longstanding objections in the current context. These objections concern agriculture, safety for school children, and weekday evening leisure activities. Current literature meanwhile is used to support the argument for better quality sleep, especially for urban dwellers. Lastly, peak electric lighting and cooling load reductions are estimated for a prototypical office building.

It is concluded that the longstanding arguments against DST can be refuted. The benefits to improved sleep meanwhile are hypothesized but remain unproven. For the office building, it is shown that DST alone, but even moreso a two-hour delay, can effectively displace the growing summer peak demand for electricity while providing available daylight later into the evening. For either case, DST would fit most neatly between the spring and fall equinox holidays, providing time for adaptation as well as celebration. Significant social and economic benefits meanwhile could be realized throughout Japan.

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Introduction

Standard time has been used without interruption in Japan since (to be confirmed), when daylight savings time (DST) was last used. Elsewhere, DST is widely used to stretch available daylight - in the northern hemisphere - by setting the clocks forward one hour between spring and fall each year. While the recent history of objections against DST in Japan is complicated, the debate surrounding the current Ministry of Trade & Industry (MITI) proposal to bring it back focuses on when it should begin and end each year. The potential benefits of DST throughout Japan meanwhile suggest that a full one-hour change in addition could well be justified.

Method

Documented records, primarily since World War II, are reviewed to evaluate three longstanding objections to the use of DST in Japan. These objections concern agriculture, safety for schoolchildren, and weekday evening leisure activities. Similarly, the current body of literature is reviewed to support the argument for using the proposed time changes to improve the quality of sleep, notably for urban dwellers. Finally, the effect on the proposed time changes on peak electricity use is estimated for a prototypical open plan office building, the current standard in Japan.

Findings

It is concluded that the longstanding arguments against DST in Japan can be largely refuted. Agriculture, overall, could in fact benefit from the changes while the safety of school children is no longer linked to available daylight. In addition, increased opportunities for weekday evening leisure activities are consistent with MITI proposals for shorter work weeks and for opportunities for workers to spend more time with their families.

The effects of the proposed time changes on improving the quality of sleep meanwhile remain unproven. Nevertheless, this survey shows that most workers now rise after sunrise year-round and commute to indoor office, industrial, or institutional workplaces that do not take advantage of daylight. With urban office workers frequently returning home after 2200, many do not work shorter days but longer ones. They also retire later, following dinner and late-night TV, making the center of their workday between 1500 and 1600 rather than noon. The proposed time changes would help correct this imbalance while increasing opportunities to experience sunrise and/or sunset. This could help calibrate body rhythms that correlate with productivity as well as physiological and psychological health and well-being. These benefits have not yet been adequately accounted for.

The estimated effects of the proposed time changes on peak electricity use in a prototypical open plan office building are more convincing. Peak electricity use determines the need for costly new electricity generating capacity – power plants. In Japan this peak occurs on hot summer afternoons when the (growing) cooling load is greatest, in residential as well as commercial building types. Accordingly, the proposed time changes would delay this peak (largely due to solar heat gain) while providing for the use of daylight, a "cooler" light source than any electric alternative, longer into the evenings (see Figure 1).

figure to be completed

Figure 1. A comparison of summertime (worst-case) hourly peak (electric-lighting and cooling versus total) electricity loads for a prototypical open plan office building, for 1) existing national standard time, 2) daylight-savings time, and 3) a permanent one hour change plus daylight-savings-time

Meanwhile, for either time-change alternative, DST would fit most neatly between the spring and fall equinox holidays, providing time for adaptation as well as celebration. Significant social and economic benefits, however, could be realized throughout Japan.

Relevance

This proposal is intended to respect Japan's limited physical dimensions (about one hour wide in terms of longitude) as well as its current distribution of agricultural, industrial, and population centers. In addition, neither of the proposed time changes would require significant additional infrastructures. In fact, either could help to avoid costly and controversial new infrastructures, notably new electric power generating facilities.

The potential benefits meanwhile would be distributed throughout Japan, affecting the entire population as well as peak electricity loads for the entire building stock. Finally, this proposal could have more extensive relevance elsewhere, notably in China and the former Soviet Union.

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References