Are transportation solutions doomed to fail climate-change actions? A book review

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Are Transportation Solutions Doomed to Fail Climate-Change Actions? A Book Review

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Title of the Book:
Drawdown: The Most Comprehensive Plan Ever Proposed to Reverse Global Warming

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Abstract

I review a New York Times best-seller book, *Drawdown: The Most Comprehensive Plan Ever Proposed to Reverse Global Warming*, edited by Paul Hawken (Hawken, 2017). *Drawdown* provides many interesting solutions, descriptions, and arguments regarding the global impacts of climate change. Indeed, the book sets forth around 80 solutions and 20 coming to attractions (future options for combating climate change). In this review, however, I focus primarily on the book's transport solutions. Overall, the book comes short of offering innovative and cost-effective solutions, in contrast to other sectors' solutions. I believe the reason is the book's narrow view regarding the overall impacts of transportation (Rouhani et al., 2016; Do et al., 2020) and latent opportunities in the sector (Chapman, 2007; Green et al., 2010).

Keywords

Transportation; Climate change; Policies; GHG emissions.

Perspectives on *Drawdown*

As an engineer, I first review the GHG reduction potentials. Figure 1 shows all proposed solutions in the above tree-map chart as well as the transportation solutions in the bottom pie chart. The book categorizes solutions into seven categories: food, energy, land use, women, materials, cities/buildings, and transportation. The figure shows the size of CO_2 reductions that each solution will achieve by 2050. As the largest box, the food-related solutions provide the highest total "drawdowns."

The transport-related solutions, however, are the least impactful overall, with only 4% of total reductions. Such contributions seem trivial since the sector accounts for 15% of global emissions (World Resources Institute, 2020). One reason is the absence of innovative transport solutions in the book, which I will address later. In terms of the overall reduction, no proposed transport options are among the top 10 solutions. Unfortunately, the top transport solution, "Electric Vehicles" (EVs), is ranked as 28th in terms of its potential drawdowns (10.8 giga tons). As shown in the bottom pie chart, the transport solutions in their potential-drawdown order are as follows: EVs, ships, mass transit, trucks, airplanes, cars, bike infrastructure, telepresence, high-speed trains, electric bikes, trains, and ridesharing.

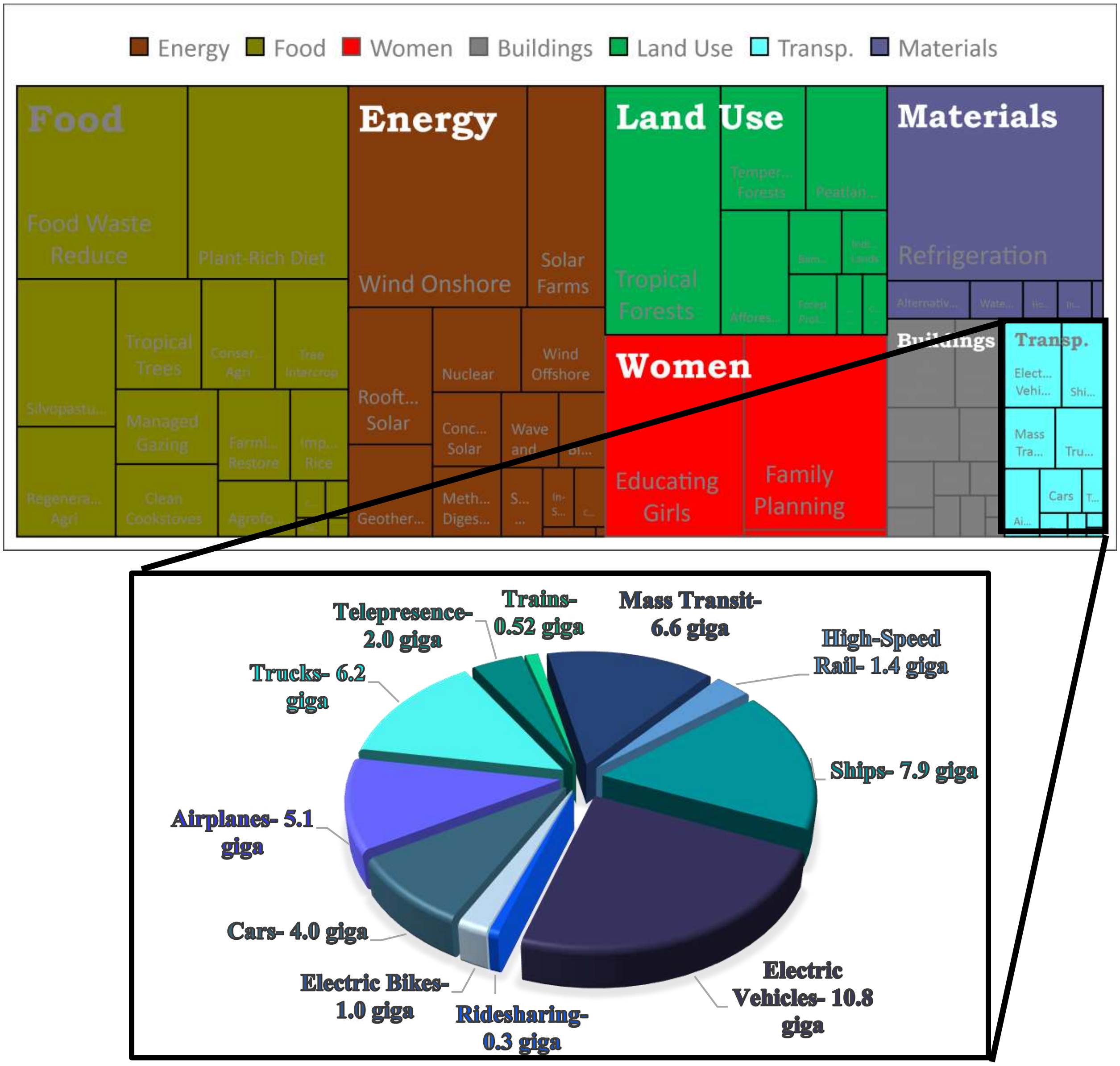

Figure 1: **CO_2 drawdowns by category/solution.**

As an economist, I then study the cost effectiveness of each solution (cost/benefit or $ per each ton of CO_2 reductions). *Drawdown* suggests that hybrid cars is the most cost-effective option; hybrid cars offer around $150/ton benefits to society, i.e., negative costs. I, however, exclude hybrid cars from my analysis because the author appears to disregard their significant costs to society through public subsidies. Figure 2 shows the top 10 solutions in terms of cost effectiveness. Bike infrastructure and ridesharing are the only two transport solutions to make the top 10 list at -$1/ton and close to $0/ton, respectively. Both solutions offer relatively small GHG reductions however, and as a result, they cannot effectively reduce GHG emissions.

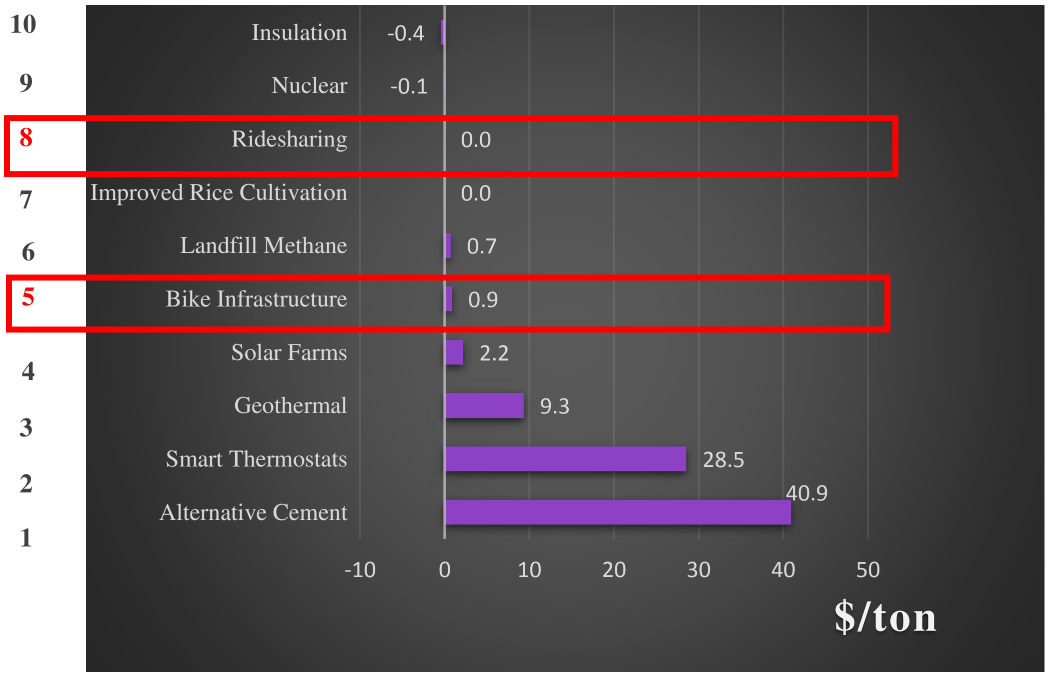

Figure 2: **Top 10 cost-effective solutions ($/ton)**

Finally, as a transportation planner, I compare the transport sector with other sectors. Overall, the transport sector is the last among all seven categories (7th) in terms of total CO_2 reductions. The sector could reduce 46 gigatons while food could provide around 7 times of such reductions. Nevertheless, the book's estimate of 46-gigaton reduction is substantially higher than the estimated potential "drawdowns" by other studies (see e.g., Allen, Golden, & Shockley, 2015). In addition, the transport sector rank last in terms of costs ($18 trillion total). Moreover, its solutions are very inefficient with $453/ton on average, which seem astronomical compared to only $5/ton for food solutions. EVs and trains rank dead last in all 80 solutions, with $1,300/ton and $1,500/ton. In fact, developing countries, if not all countries, should avoid some of book's transport solutions, from the economical perspective.

The book's future (coming to attraction) options are not promising either. Hyperloops might cost far more than the already-costly transport solutions (Rob et al., 2019), and autonomous vehicles could increase vehicle-miles travelled because of their potential rebound effects (Harper et al., 2016; Do et al., 2019b). In effect, both solutions could negatively impact climate change. The book's only promising future transport option is smart highways, which I will discuss later.

Missing and Future Solutions

Three basic strategies are used to reduce the climate-change impacts of transportation activities (Wright and Fulton, 2005; Rouhani, 2013). Prior to discussions, note that it is intrinsically difficult to mitigate transportation footprints. This is due to institutional complexities, dispersed sources of emissions, and the lack of less-carbon-intensive energy substitutes (Sperling & Salon, 2002; Zegras, 2007). Hence, policy makers should advocate for innovative solutions that could lead to transformative changes. That being said, I do not intend to overlook traditional/existing solutions, most suggested by the book. The planet ultimately needs all potential solutions in order to manage climate change. I, however, focus on other more efficient solutions. I categorize them into three strategies.

The first strategy comprises of policies/initiatives/projects aimed at modifying travel behavior. Worldwide, transport users spend billions of dollars in costs/energy, waste billions of hours in travel time, and emit billion tons of GHGs. The goal is to reduce/optimize travel demand, in terms of travel-mode choice, vehicle choice, travel activity, and vehicle occupancy. The demand-side solutions are: (*i*) network-wide road pricing (Rouhani et al., 2015a; Rouhani, 2016); (*ii*) mobility as a service (MaaS) tools (Hensher, 2017; Behestian et al., 2020); (*iii*) managed priced lanes (Do et al., 2019a); (*iv*) telecommuting (Handy and Mokhtarian, 1996; Allen et al., 2015), as opposed to expensive telepresence proposed by the book; (*v*) multi-modal transportation systems (Kramers, 2014) equipped with advanced traveler information systems (Rouhani and Gao, 2014), and (*vi*) changing perceptions regarding travel behavior (Daher et al, 2018). The COVID-19 phenomenon shows that many trips, even work trips, could be skipped without substantial negative economic impacts (De Vos, 2020). The book's main suggested solution under this strategy is ridesharing, which seems ineffective as it offers the least amount of drawdowns.

The second strategy relates to infrastructure expenditures (Moretti and Loprencipe, 2018; Rouhani et al., 2018). The development of smart systems/cities —based upon the "internet of things"—has perhaps the highest potential for GHG reductions (Yang et al., 2018). *Drawdown* engages its readers with only one of such solutions. Smart highways are, in my opinion, the best transport solution proposed by the book. Current highway systems are far behind in terms of offering innovative opportunities. The book elaborates on one example in this regard. On a stretch of highway in Atlanta, Georgia, a transformative initiative called "The Ray" is exploring what future highways might look like (The Ray, 2019). The highway houses a 1-megawatt solar photovoltaic farm and a charging station where EVs can recharge for free in less than 45 minutes. In addition, the highway is equipped with creative design features such as kinetic-energy-capturing mosaic pavement, noise barriers lined with PV panels, and weather sensors. Promoting other innovative possibilities, smart highways could usher in a revolution in transport infrastructure, partially attenuating the high social costs of EVs.

The third strategy aims at improving vehicle technologies (Bansal et al., 2016), fuel types (Atabani et al., 2011), and energy consumption (Rouhani et al., 2015b). While *Drawdown* discusses such improvements in relative detail, it overlooks a few fuel-switch options. Termed "regret solutions" by the book, compressed natural gas (CNG) and biofuels could substantially mitigate GHG emissions over short run. Especially, second-generation biofuels from waste could offer many co-benefits (Nguyen et al., 2017). Additionally, hydrogen-fueled vehicles might offer the cleanest option from the GHG lifecycle perspective over long run (Gurz et al., 2017). The fuel cell technology has recently become commercially available (Singla et al., 2021). The book disregards such fuel switch options.

Conclusion

Overall, the book offers a short and interesting overview of the solutions to reduce climate-change footprints. However, many transport solutions are missing. As a result, the transportation sector offers the least drawdowns out of all sectors. Effective GHG drawdowns, however, might require focusing on innovative options like smart highways. Moreover, researchers should seek improvements in costly and conventional options like EVs. We must "take action as individuals, neighborhoods, towns, cities, states, provinces, businesses, investment firms"(Hawken, 2017). Ultimately, the planet needs a variety of efficient and effective solutions to overcome climate-change risks.

Copyright Note

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