Transition to Alternative Fuel Vehicles
A Distributive Justice Perspective

Wissam EL Hachem, Pietro De Giovanni, ESSEC Business School, France

Re-Conceptualization of the transportation sector is currently underway. The 'Transition' of the transportation system from its current Internal Combustion Engine (ICE) dominated state to an AFV dominated one is propelled by endogenous emergent behavior, the latter catalyzed by disruptive innovation such as the 2008 Tesla Roadster sports car. This innovation is fueled by a decrease in the ICE energy return on investment (EROI) coupled with an increase of AFV EROI.

The transition to a more sustainable transportation system is a complex and dynamic process (Zhang et al., 2011; Struben&Sterman, 2008), and like any major technological development, it is path dependent rendering the transitional dynamics crucial to any realistic investigation of the feasibility and effectiveness of suggested policies.

The literature focuses on the environmental and economic impacts (Boussauw&Vanoutrive, 2017; Harrison, 2013; Martens et al., 2012) arising from our current unsustainable consumption of fossil fuels. In this paper, we adopt a new and necessary angle when investigating the transition to AFV that is distributive justice. We define distributive justice following Martens et al. (2012) as fair access to transportation and justify its relevance following Walzer (1983) by considering access to transportation as a vital need for people to actualize their full capabilities in society.

As seen in (Boussauw and Vanoutrive, 2017), current sustainable transportation policies result in paradoxical outcomes. This is due to the tradeoffs between ecological sustainability and distributive justice. The former implies an upper limit of consumption with maximum policy efficiency, while the later implies a lower limit of consumption with maximum policy equity.

Policy makers are interested in defining feasible objectives and achieving them in the quickest and smoothest way possible. Tradeoffs are a prime example of unintended consequences (or paradoxes) that act as friction when moving the system from its initial to its desired state. Such tradeoffs are the result of the unavoidable structural complexity of the system. To counteract such tradeoffs, we can increase the operational complexity by focusing on the interactions between the system's components and increasing their coordination.

By considering this extra dimension of distributive justice, we are not only offering a more wholesome and sustainable assessment of the AFV transition, we are as well tackling policy tradeoffs by explaining and reducing some of the noted transportation policy paradoxes in (Boussauw&Vanoutrive, 2017). Our addition of distributive justice as a novel policy objective increases the operational complexity of the system and consequently creates another layer of tradeoffs between the components themselves of distributive justice (Hulle et al., 2017; Colquitt&Rodell, 2015): Equity, Equality and Need. However, this extra layer of tradeoffs proves to be relatively small and the system as a whole benefits as seen by an overall reduction in the intensity of the tradeoffs (i.e. reduction in dysfunctional complexity) and a more swift transition to AFV's. Our results confirm that we need to consider simultaneously the environmental objective to catalyze the AFV transition while incorporating distributive justice as a social objective to constrain the transitional dynamics (from our current ICE dominated state to the desired AFV state) to remain within socially acceptable boundaries avoiding repercussions which are avoidable in a non-zero sum system.

Such a transition entails deep changes to a large socio-technical system that is non-linear (i.e. learning…), plagued with long delays (infrastructure installation, production capacity buildup, consumer awareness…) and intertwined in a web of feedback loops (supply/demand/prices of vehicles…). Such a system is consequently prone to "lock-in" the current dominant ICE technology (Struben&Sterman, 2008) by counter-balancing AFV policies. For the reasons aforementioned, this paper relies on the System Dynamics (SD) simulation methodology to capture the most important feedback loops at play in such a transition while keeping track of the possible tradeoffs to offer insights into policy design that benefit from synergies between the different components of the system and minimize the tradeoffs.

Our SD model focuses on light to mid duty vehicles in the private transportation sector. It investigates the impact that technological development of the AFV's coupled with marketing efforts and policy interventions will have on their market share in the future while measuring the novel distributive justice objective. Each of the three components of distributive justice (Equity, Equality and Need) are given an operationalized definition within our specific AFV transition context.

References

1- Boussauw, K., Vanoutrive, T. 2017. Transport policy in Belgium: Translating sustainability discourses into unsustainable outcomes. Transport Policy, 53: 11-19.
2- Colquitt JA, Conlon DE, Wesson MJ, Porter CO, Ng KY. 2001. Justice at the millennium: a meta-analytic review of 25 years of organizational justice research. Journal of Applied Psychology 86 (3), 425.
3- Hulle, S., Liebig, S., May, M. 2017. Measuring Attitudes Toward Distributive Justice: The Basic Social Justice Orientations Scale. Social Indicators Research, 136(2): 663-692.
4- Harrison, G., Shepherd, S. 2013. An interdisciplinary study to explore impacts from policies for the introduction of low carbon vehicles. Journal of Transportation Planning and Technology, 37(1): 98-117.
5- Martens, K., Golub, A., Robinson, G. 2012. A Justice-Theoretic approach to the distribution of transportation benefits: Implications for transportation planning practice in the United States. Transportation Research A, 46: 684-695.
6- Struben, J., Sterman, J. 2008. Transition challenges for alternative fuel vehicles and transportation systems. Environmental and Planning B: Planning and Design, 35: 1070-1097.
7- Walzer, M., 1983. Spheres of Justice: A Defense of Pluralism and Equality. Basic Books.
8- Zhang, T., Gensler, S., Garcia, R. 2011. A study of the diffusion of alternative fuel vehicles: an agent-based modeling approach. Journal of Product Innovation Management, 28: 152–68.