Dealing with victor's history in renewable energy education for transportation applications

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ABSTRACT

Renewable energy utilization in transportation applications (RES-T) belongs to the key fields of climate change mitigation. RES-T education is needed for evading climate crisis, but it faces serious obstacles. Low awareness among the general public and technology professionals of opportunities offered by RES-T technologies is attributable to various non-technical issues. One of these issues is misrepresentation of crude oil based fuels in many historical accounts of transportation technology evolution. It is argued that this phenomenon has resemblance to the famous bias found in war history, the tendency to write history from the perspective of the victors. In this case victors are companies instead of armies. However, although the end result is similar, the process is different.

It is usually not recognized in relevant educational curriculums that all transport modes were originally RES-T powered and RES-T technologies have always been utilized in varying degrees, also today. The relevant educational curriculums also tend to ignore both technological and environmental advantages offered by RES-T, in comparison with current conventional transportation technologies. Victor's history bias requires immediate attention as one of the core challenges underlying these educational problems.

1. Introduction

Renewable energy sources in transportation (RES-T[1]) cover only 3% of global transportation energy demand. As a comparison, renewables have well over 20% share of global energy demand in electricity (RES-E) and thermal energy (RES-H/C) sectors. Only 4% of global renewable energy supply is consumed in the transportation sector (IEA, 2017).

Despite continuously increasing political efforts to address environmental problems originating from fossil fuels, progress in the transportation sector has been very slow. Shortcomings in both general education and professional technical education have contributed to this failure.

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technology evolution.

RES-T technologies have outstanding historical foundation to base on. Almost all transportation modes and vehicle types were originally powered by renewables. Coal is the only fossil energy source that has contributed to emergence of new transportation modes and vehicle types. Some of the historical merits of RES-T technologies are well known to the general public, especially the role of wind energy in water transportation. But there are many cases where pioneering credits are conventionally misplaced in favor of crude oil. This has negatively impacted understanding of the role RES-T technologies have played so far and, therefore, what roles they could play in the future.

The resulting lack of awareness has detrimental effects in policies combating climate change and other environmental problems caused by fossil fuel consumption. Ignoring the opportunities offered by RES-T technologies bears ominous resemblance to the aircraft accident type called "controlled flight into terrain" (CFIT). In 2010–2014 it was the

second largest fatal aircraft accident category globally, and the most severe type of accident, as 91% of these accidents involved fatalities (IATA, 2015). It is an accident, where a functional aircraft crashes unintentionally by pilot control. It is caused by the loss of situational awareness, which means fixation into non-essentials and ignoring essentials. In all these accidents multiple warnings have been given to the pilots by the aircraft electronics and almost always also by crew members.

In the analogous case of climate change control, the threat became clear to physicists in the 1960s: they submitted a request for immediate problem solving action to the United Nations, which took the issue in its agenda in 1970 (Weart, 1997). Since the first UN environmental summit in 1972, the pilots of the Earth have received warnings with increasing severity, but situational awareness still has not been achieved. Fixation into fossil fuels blocks warnings and prevents application of correct controls to avert the impending catastrophe.

2. The educational challenge

This section is devoted to description of the underlying educational challenge. Traffic lights with colors having well established familiar meanings are applied here as educational tools (Fig. 1).

All kind of decision making processes – including aircraft control, steering climate policies and choosing next car based on energy sources it is able to utilize – involve different types of inputs. Five basic input types are represented in Fig. 1 by traffic lights. Green light (information) means correct input based on scientific method. Red lights mean incorrect inputs originating from honest misunderstandings (misinformation) or purposefully created incorrect information (disinformation). Both green and red lights represent inputs based on physical reality, whether they are right or wrong. Therefore, all of them include "information" in their labels. Yellow lights represent inputs that

are not explicitly tied to physical reality. Unconscious inputs are actions, e.g. hand or foot control, generated directly by visual and other sensory signals, without mental processing between them. Free thought means inputs generated by mental processes with insufficient data basis. Yellow color is used here, because both of these input types may produce correct, incorrect or neutral (no impact) decisions.

The ability to choose green inputs, reject red inputs and govern yellow inputs in decision making processes is a skill, which in complicated issues need to be refined by educational curriculums. The airline industry and administration combat the CFIT problem by CRM (Crew Resource Management). It is an educational curriculum for increasing the awareness of the whole crew and for establishing communication protocols to enable swift delivery of crucial information to pilots from all crew members, and via cabin crew also from passengers. This addresses governance of the yellow inputs, which may prevent green inputs from reaching pilot attention. It is a more subtle issue than handling the red inputs, which in the case of aircraft mean technical malfunctions (misinformation) and sabotage (disinformation).

Climate change related decision making still suffers from overwhelming burden of red inputs (arising from climate skepticism, industrial protectionism, etc.) and yellow inputs (arising from low environmental awareness, inadequate education, etc.). They maintain policy inertia at all levels: from households to companies and organizations, and from subnational to national and global administrations. This policy inertia, called carbon lock-in, is described by Unruh (2000, 817) the following way: "…carbon lock-in creates persistent market and policy failures that can inhibit the diffusion of carbon-saving technologies despite their environmental and economic advantages." The climate change crisis can be solved, if attention is focused on proper management of the flows of different types of signals. This is the educational core problem. The ozone layer crisis provides a valuable lesson and encouragement. Removal of the red inputs (arising from ozone
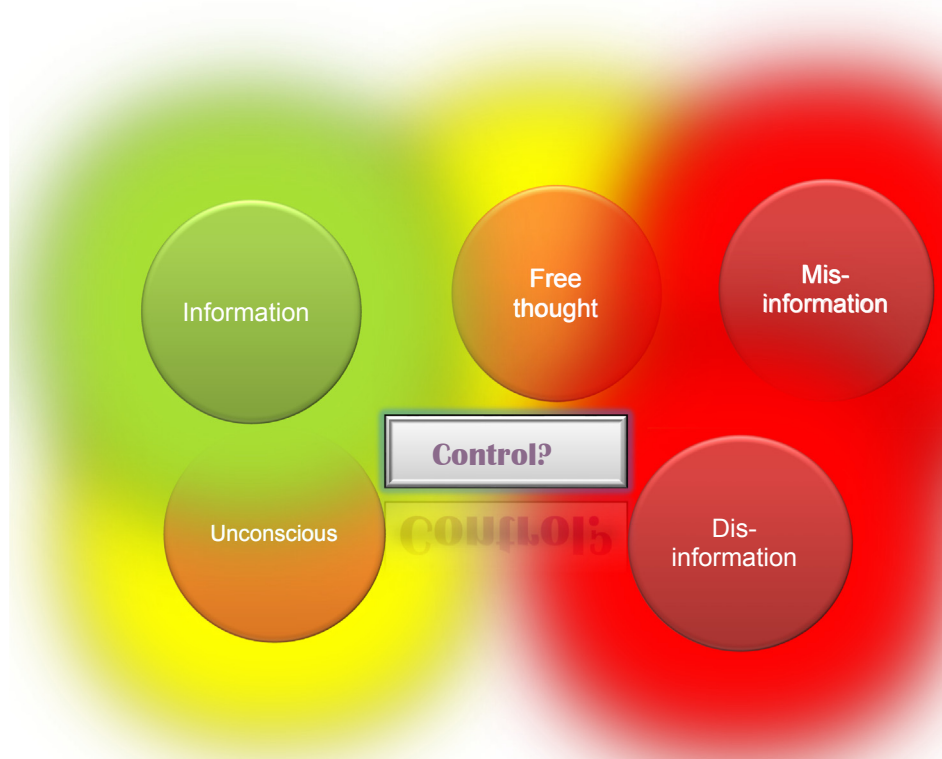

Fig. 1. Green, yellow and red inputs for decision making processes. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)