Operating the Proposed Baltimore-Washington Maglev Would Increase Greenhouse Gas Emissions, the Federal Railroad Administration Finds

By Owen Kelley (okelley@gmu.edu), 11 April 2021

The plot has thickened with regard to the climate-change impact of the "maglev"—the magnetic-levitation rail line that has been proposed to connect Baltimore and Washington, DC. Last year, the present author estimated that constructing the maglev would release hundreds of millions of kilograms of carbon dioxide. This earlier analysis was published in the Issues Forum of the Prince George's County group of the Sierra Club.

Since then, a regulatory agency has published an analysis that covers the other side of the question: how much would *operating* the maglev increase annual carbon-dioxide emissions. The regulatory agency's findings, however, are being ignored by some companies and news organizations. This unfortunate situation will be discussed and clarified in the present article.

It was in January 2021 that the regulatory agency—the Federal Railroad Administration—published the draft environmental impact statement for the proposed maglev. This document indicated that operating a maglev between Baltimore and Washington would increase annual carbon-dioxide emissions by more than a hundred million kilograms because of the large amount of electricity that the maglev would consume. This part of the impact statement directly contradicted claims that had been broadcast for years by the company that wanted to and still wants to build the maglev, a company called Baltimore Washington Rapid Rail (BWRR).[1]

Apparently ignoring the draft environmental impact statement, BWRR and its parent company, The Northeast Maglev, continue to repeat their claims that the maglev would reduce greenhouse gas emissions. Several newspapers mentioned later in this article have echoed the companies' claims. Such reporting serves to more completely hide from public view the greenhouse-gas findings of the Federal Railroad Administration.

The Federal Railroad Administration bears some responsibility for this situation because of several editorial choices that were made in the draft environmental impact statement that the agency managed, reviewed, approved, and published. Specifically, the impact statement buries greenhouse-gas findings in an appendix and makes no mention of greenhouse gas emissions in the document's Executive Summary.

What We Knew Before This Year

To understand the draft environmental impact statement that was published this year, it helps to review prior years' statements about the proposed maglev's greenhouse gas impact.

In 2015, Wayne L. Rogers, the chairman of Baltimore Washington Rapid Rail, testified before

[1] Emission increase due to maglev operation in the DEIS (FRA 2021), Appendix D4, as described in the present article; statements by BWRR and TNEM at https://bwrapidrail.com and https://northeastmaglev.com.

the Maryland Public Service Commission that the maglev would reduce greenhouse gas emissions by 2 million short tons (1,814 million kilograms). Rogers stated that this figure came from a report authored by Louis Berger, a consulting company.[2]

A summary of the Louis Berger report was also submitted as evidence in this 2015 case, and the 2 million short tons that were quoted by Rogers turn out to be an estimate for the entire lifetime of the project, not the per-year emission savings. The Louis Berger report summary states an estimate of carbon dioxide emissions from operating the maglev over the project's lifetime with no mention of the emissions that would result from constructing the maglev in the first place. Louis Berger started with an estimate of the CO_2 emissions to generate the electricity to run the Baltimore-Washington maglev. From this value, the company subtracted its estimate of the CO_2 emissions that would be avoided because of a reduction in car travel. The reasoning is that some travelers would switch from driving to using the maglev.[3]

On an annual basis, the Louis Berger estimate of CO_2 savings is rather small. One can convert project-lifetime emissions to annual emissions by dividing by 60 years, a value found in the literature. The result is a rather small savings of only 33 million kilograms of CO_2 per year.

In comparison, the Maryland Department of Energy estimates that a much more significant reduction in annual CO_2 emissions could be achieved, at much lower cost, by expanding telework opportunities in Maryland: a 300-to-790-million-kilogram reduction each year. This impact would be about ten times greater than above-mentioned Louis Berger estimate for the proposed Baltimore-Washington maglev. An even more significant reduction could be achieved in Maryland, again at low cost, by increasing the fuel-economy standard for gasoline-powered cars: a 3,680-million-kilogram reduction per year. This impact would be about a hundred times greater than the impact from the proposed maglev.[4]

Even if the Louis Berger CO_2 emission estimate were accurate, it would still take the maglev about a decade or two to cancel out the CO_2 emissions from constructing the maglev. In December 2020, the present author published his estimate that constructing the maglev track and tunnel between Baltimore and Washington would release between 316 and 815 million kilograms of carbon dioxide. It appears that no organization or other individual has published an estimate for the amount of CO_2 that would be emitted to construct a maglev between Baltimore and Washington.

New In 2021

In terms of maglev developments, 2021 has already been an eventful year.

Contradicting the 2015 Louis Berger report, the draft environmental impact statement published in January 2021 asserted that maglev operation would significantly increase greenhouse gas emissions. Specifics are provided in the next section of the present article.

On February 9, 2021, the editorial board of the Baltimore Sun published an opinion that mentioned in passing that the maglev would

[2] Rogers 2015, pg. 19; 1 short ton is about 907.2 kilograms, and 1 metric ton is exactly 1,000 kilograms.

[3] 2.185 million short tons (1,982 million kilograms): Louis Berger 2015, pg. 7.

[4] The Louis Berger report summary did not state the company's estimate for the maglev's lifetime. Kato and Shibahara (2005) used 60 years for the useful life of the maglev track. Maryland DOE (2021) states impact of expanded telework (Table 3.2-8, pg. 103) and car emission standards (Table 3.2-5, pg. 91).

reduce greenhouse gas emissions. The Baltimore Sun presented no data to support its opinion.

On April 2, 2021, the Washington Post published an article claiming that the maglev would "help cut greenhouse gas emissions" because the maglev would take "about 16 million car trips off the road annually." The Post's argument is specious: superficially plausible but actually flawed.

Contrary to what the Washington Post published, the amount of car travel that the maglev replaces does not determine whether maglev operation causes a net increase or decrease in greenhouse gas emissions. What determines the sign and the magnitude of net emissions is whether or not generating the electricity to run the maglev would emit more carbon dioxide than would be avoided through the maglev-related reduction in car travel. It also matters how much carbon dioxide would be emitted to construct the maglev track and related facilities. The next two sections of the present article examine in greater detail the greenhouse gas impact of maglev operation and construction.[5]

CO_2 from Operating the Maglev

The bottom line is that the draft environmental impact statement (DEIS) indicated that operating the maglev would emit 286 to 336 million kilograms more carbon dioxide each year than would be emitted if the maglev were not operated. This information is found in Appendix D4 of the DEIS. The mathematical details are explained in the appendix of the present article and are shown schematically in Figure 1 of the present article.

The case for building the maglev is weakened because the DEIS identified an *increase* in

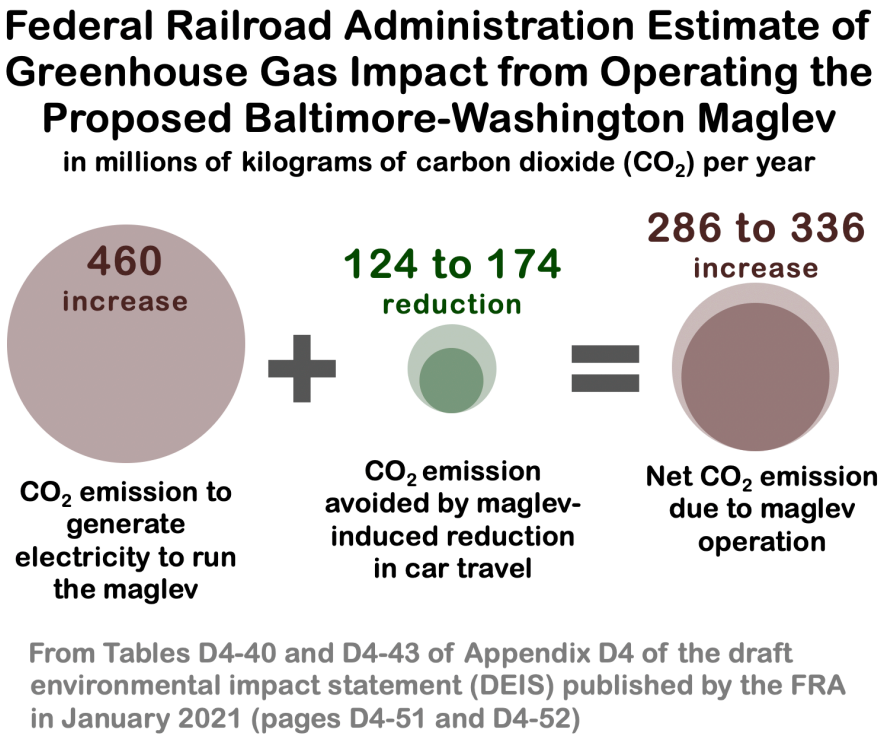

Figure 1. A schematic diagram of how the January 2021 draft environmental impact statement estimates the climate impact of operating the proposed Baltimore-Washington maglev.

[5] Baltimore Sun on 9 Feb 2021; Luz Lazo in the Washington Post on 2 April 2021; In April 2021, The Northeast Maglev website still claims that the maglev would reduce greenhouse gas emissions by 2 million short tons.

greenhouse gas emissions due to maglev operation. The DEIS-identified increase certainly paints the maglev in a different light than the *decrease* in emissions suggested by the 2015 Louis Berger report that was discussed earlier in the present article.

While Appendix D4 of the DEIS shows that maglev operation would increase greenhouse gas emissions, the DEIS contains two misleading statements on this topic.

First, consider Section 16 of Chapter 4 where it claims that the "FRA did not quantify the powerplant emissions required for [maglev] train operations and facilities" (pg. 4.16-3). In actual fact, the Federal Railroad Administration did provide an estimate for one kind of emissions. Specifically, it provide an estimate for the CO_2 emissions from powerplants providing the maglev its electricity. The agency did so in Table D4-43 of Appendix D4.

An even more misleading statement in Section 16 is that operating the maglev "will not increase greenhouse gas emissions." A careful reading of this statement's rather convoluted context reveals that the statement is meaningless. Here is the statement in its context with italics added:

> The SCMAGLEV system will operate entirely on electricity, with the exception of certain maintenance vehicles. As a result, the SCMAGLEV train ***will not increase greenhouse gas emissions***. However, as described in Section 4.19 Energy, the SCMAGLEV system will result in an increase in power consumption in the region. Therefore, an increase in greenhouse gas emissions from powerplants would likely occur. (Chapter 4.16, pg. 4.16-11)

It is embarrassing that the Federal Railroad Administration would be willing use such tortured logic in a effort to insert a misleading statement (the maglev "will not increase greenhouse gas emissions") into the DEIS.

To be perfectly clear, it is a true statement that the maglev would decrease CO_2 emissions if one looks only at the forecasted reduction in car travel due to the maglev and one ignores the CO_2 emissions from generating the electricity to run the maglev. This statement is true but beside the point. The important question is the net effect of operating the maglev. This important question is addressed in Appendix D4 of the DEIS as discussed in the preceding paragraphs.

CO_2 from Constructing the Maglev

The DEIS does not quantify the greenhouse gas emissions that would result from manufacturing the material needed to construct the maglev's elevated track, tunnel, and associated facilities. In fact, the DEIS does not even mention that such emissions would occur.[6]

For this reason, the analysis in Kelley (2020) appears to be the only publicly available estimate of the greenhouse gas impact of constructing any portion of the Baltimore-Washington maglev. A common simplification employed by planners is to estimate the greenhouse gas impact of a construction project based on the emissions to manufacture just the cubic meters of concrete and tons of steel that the project would require.

Kelley (2020) estimated these quantities and found that constructing the tunnel and elevated track for the proposed Baltimore-Washington

[6] In Chapter 4.16 starting on pg. 4.16-3, the DEIS explains its CO_2 emission-modeling method. The DEIS emission numbers are found in Appendix D4 pg. D4-51 to D4-53.

maglev would release 316 to 815 million kilograms of carbon dioxide. This emission range is assuredly an underestimate because Kelley did not attempt to estimate the carbon dioxide emissions that would result from constructing the maglev stations, control facility, or train-maintenance facility.

Is the Maglev "Green"?

When evaluating whether or not a project would be environmentally friendly, there is more to consider than just kilograms of carbon dioxide.

Speaking in broad terms, the proposed maglev would involve building massive concrete structures, which would decimate green space here and there. It would involve trying to entice people to travel farther and faster at great expense and with great expenditure of energy. In many ways, such a project would be the opposite of environmentally friendly. Environmental harm, expense, and "induced" travel are each documented in the draft environmental impact statement that was published in January 2021. Such evidence suggests that the maglev isn't "green." [7]

A green future is possible for the Baltimore-Washington region. Efforts are being made to realize such a future. The maglev would do little if anything to contribute to this effort. Let's talk specifics.

Each community within the region could be strengthened so that it better meets the employment and recreation needs of its residents. Such a transformation would reduce the need for long-distance travel across the region, and in turn, would reduce the region's carbon footprint. In addition, expanded options for teleworking could be made available for when interaction with a distant workplace is required. Just this sort of vision was articulated years ago and has motivated decisions within a planning body called the Metropolitan Washington Council of Governments. Describing the idea, this organization has stated the following:

> Locating homes, employment centers, schools, and other activities in closer proximity, and expanding transit, telecommuting, bicycling, and walking options can reduce vehicle miles of travel per capita and improve accessibility throughout the region (MWCOG 2010, pg. 18)

The Council states elsewhere that it intends for "expanding transit" to mean the following: expanding transportation options that maximize accessibility and affordability. The proposed Baltimore-Washington maglev would fail to contribute to this goal because the ticket price would be $40 to $80 one way, per person.[8]

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[7] 15% of maglev trips would be "induced" travel, i.e., travel between Baltimore and Washington that would not have occurred if the maglev were not built: Appendix D4, Table D4-29, pg. D-45. Construction cost of $15 to $17 billion: Appendix D4, Table D4-8, pg. D-21. Negative impacts would occur to the following areas of kinds of resources: historical sites (Chapter 4.8); scenic resources (Chap. 4.9); recreational facilities (Chap. 4.7); environmental justice (Chap. 4.5); quality-of-life (Chap. 4.4); hazardous waste sites (Chap. 4.15); forests, forest-interior species, and habitats of rare, threatened, and endangered species (Chap. 4.12); wetlands (Chap. 4.11); economic harm during construction (Appendix D4, pg. D-18 to D-30); and lost revenue for Amtrak and MARC commuter trains (Appendix D4, Table D4-47, pg. D-54).

[8] Accessibility quote: MWCOG 2010, pg. 9; ticket price: Appendix D2, pg. D-107, D-108.

Conclusion

The Federal Railroad Administration has determined that the proposed Baltimore-Washington maglev would increase greenhouse gas emissions each year that it were operated. This increase is relative to the emissions that would occur otherwise if the maglev did not operate and people used other transportation options. This greenhouse-gas emission increase is based on information stated on pages D4-51 to D4-53 of Appendix D4 of the draft environmental impact statement (DEIS). The Federal Railroad Administration published this document in January 2021.

The greenhouse-gas discussion in the DEIS is summarized by the following list:

- Maglev operation would increase net CO_2 emissions by 286 to 336 million kilograms per year relative to the No Build option
- The net CO_2 emissions are the sum of two factors: 460 million kilograms of CO_2 emissions annually from generating the electricity to run the maglev and 124 to 174 million kilograms of CO_2 emissions avoided annually assuming that some car travel would be replaced by maglev travel
- The net CO_2 emissions are not stated explicitly in Appendix D4, but they may be calculated from data found in two tables of Appendix D4
- The DEIS does not estimate the CO_2 emissions from manufacturing the concrete and steel to build the maglev's elevated track, tunnel, and other facilities
- The DEIS Executive Summary makes no mention of the maglev's impact on CO_2 emissions

It is unclear what would motivate the Federal Railroad Administration to deemphasize in the DEIS its findings about the greenhouse-gas emission impact of maglev operation. It is also unclear why the agency did not estimate the greenhouse-gas emission impact that would result from maglev construction.

Appendix

This appendix describes the mathematical details of how the Federal Railroad Administration expressed the greenhouse-gas emission impact of operating the maglev. This information is found in Appendix D4 of the draft environmental impact statement (DEIS) that was published in January 2021.

Increase in CO_2 Emissions Due to Electricity Generation

Table D4-43 of Appendix D4 states that 460 million kilogram per year of CO_2 would be emitted to generate the electricity to run maglev trains, stations, control facility, and train-maintenance facility. These CO_2 emissions are the product of two variables: the amount of electricity used and the CO_2 emission rate for that generating facility.

Table D4-43 arrives at the electricity-generation CO_2 emissions in the following way: 100,322 megawatt-hours of Washington power that emits 0.1991 metric tons of CO_2 per megawatt-hour plus 1,161,678 megawatt-hours of Maryland power that emits 0.3791 metrics tons of CO_2 per megawatt-hour. These values assume that the downtown Baltimore maglev station is located at Camden Yards, but the values would be similar if the station were located in Cherry Hill instead. The present article refrains from endorsing the DEIS's per-megawatt-hour rates. Kelley (2020) reported that a somewhat higher emission rate was more appropriate in this situation, which would serve to somewhat increase

the CO_2 released by generating the electricity to run the maglev.[9]

Decrease in CO_2 Emissions Due to Reduced Car Travel

Table D4-40 of Appendix D4 states that \$124,431 to \$348,536 of CO_2 emission savings would accrue annually because of the forecasted number of people switching from driving cars to riding the maglev. The bottom of this range is determined by the Cherry Hill track alignment in 2030 when the DEIS values CO_2 at \$1 per metric ton. The top of this range is determined by the Camden Yards track alignment in 2045 when the DEIS values CO_2 at \$2 per metric ton.[10]

The present article does not comment on whether the DEIS per-ton cost is the true social cost of CO_2 emissions, but merely identifies that these rates are the ones used in the DEIS.

Using the DEIS conversion rates, the dollar savings explicitly stated in the DEIS imply 124 to 174 million kilograms of CO_2 emissions savings due to the forecasted maglev-related reduction in car travel.

The just stated DEIS estimate of the maglev's ability to reduce car-related emissions is more than double the car-related emission reduction estimated by Kelley (2020). The difference can be attribute to two factors. The DEIS assumed that the maglev would divert more car travel than Baltimore Washington Rapid Rail had thought possible in 2015. Writing before the publication of the DEIS, Kelley (2020) had used BWRR's 2015 figures. The DEIS also assumed that gas-powered cars would emit more CO_2 per vehicle-mile than Kelley (2020) had assumed based on figures published by AAA.

Both the DEIS and Kelley (2020) likely overestimate the CO_2 emissions that will come from cars in 2030 to 2045 for two reasons. Both analyses ignore that gas-powered cars may be more fuel efficient in the future and that electric cars may replace many gas-powered cars by 2030 or 2045. The problem with overestimating CO_2 emissions from cars is that it leads to overestimating the maglev's ability to reduce CO_2 emissions by reducing car travel.[11]

Net Increase in CO_2 Emissions from Maglev Operation

The last step is to sum the two CO_2 emission estimates just described from Appendix D4. Taken together, the small reduction from reduced car travel and the larger increase from generating electricity to run the maglev would result in a net increase of 286 to 336 million kilograms of CO_2 emissions per year ([286,336] = 460 - [124,174]).

The DEIS states that carbon dioxide is by far the dominant greenhouse gas related to maglev operation and so carbon dioxide is the only greenhouse gas that the DEIS estimates. The

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[9] 1 metric ton per megawatt-hour is equal to 1 kilogram per kilowatt-hour; annual emission from electricity generation to run maglev: 460×10^6 kg y^{-1} = 100.3×10^6 kW·h (y^{-1}) · 0.1991 kg $(kW\cdot h)^{-1}$ + $1{,}162\times10^6$ kW·h (y^{-1}) · 0.3791 kg $(kW\cdot h)^{-1}$; data source: Appendix D4, Table D4-43, pg. D-52.

[10] \$1 per ton vs. \$2 per ton cost: Appendix D4, Table D4-43, pg. D4-52.

[11] 138 million kg y^{-1} = \$138,000 y^{-1} · \$1 t^{-1} · 1000 kg t^{-1}, where metric ton is abbreviated "t." \$1 per metric ton conversion factor: Appendix D4, Table D4-43, pg. D-52. \$138,000: Appendix D4, Table D4-40, pg. D-51. Kelley (2020) estimated only 59 million kilograms of car-related emission reduction rather than the DEIS's 138 million kilograms. In 2021, the DEIS estimated that the maglev would divert 316.1 million car vehicle-miles per year: Appendix D2, Table D2-3, pg. A-3. In 2015, BWRR estimated that the maglev would divert 165 million car vehicle-miles per year: Rogers 2015, pg. 11, 18.

present author agrees that this simplification is a reasonable one.[12]

Avoid Becoming Confused by Poorly-Constructed Table D4-44

As has been discussed so far, Appendix D4 reports that an increase in greenhouse-gas emissions would result from maglev operation. The reader, however, could become confused by Table D4-44. The way to avoid becoming confused is keep in mind that Table D4-44 does not show net greenhouse gas emissions. Instead, Table D4-44 is trying to show net air-pollution emissions that include both greenhouse gases and non-greenhouse gases.

The second issue with Table D4-44 is tangential to the greenhouse-gas discussion, but it is worth mentioning because it is a shocking case of the DEIS failing to effectively communicate technical information. The text around Table D4-44 claims that the table shows net savings from all air pollutants. In actual fact, only the table's auto-and-bus row includes all pollutants (CO, NO, PM2.5, VOC, and CO_2). The maglev row, in contrast, includes only CO_2. The mismatch between the gasses included in the first two rows of Table D4-44 means that the table's Total row is meaningless. You can't compare apples and oranges. This problem with Table D4-44 can be verified by tracing back the entries in the auto-and-bus row of Table D4-44 to data in Table D4-40 and by tracing back the entries in the maglev row of Table D4-44 to data in Table D4-43.

In partial defense of the DEIS, the DEIS did state in Section 16 of Chapter 4 that the "FRA did not quantify the powerplant emissions required for [maglev] train operations and facilities" (pg. 4.16-3). But, for this reason, the text of Appendix D4 has no business claiming that Table D4-44 shows net air-pollution emissions from operating the maglev. Finally, Appendix D4 is certainly sloppy to title Table D4-44 "net emissions" because that title might confuse a casual reader into thinking incorrectly that Table D4-44 shows that maglev operation would decrease net CO_2 emissions.

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