Supplemental Information

Sensitivity Analysis Economic Impacts

2030 GGRA Plan

Sensitivity and In-and-Out Analysis

Commissioned by
Maryland Department of the Environment

Regional Economic Studies Institute
Daraius Irani, Ph.D., Chief Economist
Nada Shokry, Economist
Nicholas Wetzler, Economist
Jacob Leh, Senior Research Associate

December 1, 2021

TOWSON UNIVERSITY™ | Regional Economic Studies Institute

Table of Contents

TU TOWSON UNIVERSITY. | Regional Economic Studies Institute

Table of Figures

1. Introduction

The Maryland Department of the Environment (MDE) tasked the Regional Economic Studies Institute (RESI) of Towson University to provide a coherent set of analyses to inform the development of MDE's proposed plan to reduce statewide greenhouse gas emissions by roughly 50 percent from 2006 levels by 2030. In early 2021, MDE released the 2030 GGRA plan which was created to satisfy its obligations under the Greenhouse Gas Emission Reduction Act (GGRA) Reauthorization. To form the Project Team, RESI contracted with Energy and Environmental Economics, LLC (E3) to model changes in emissions arising from various policy bundles under consideration. E3 previously presented two sensitivity scenarios designed by MDE to reflect different levels of potential federal actions. MDE further designed other in-and-out scenarios to evaluate the impact of key state policies and measures on GHG emissions from key sectors, using the PATHWAYS model. RESI is tasked to evaluate the economic impacts of two of the in-and-out scenarios as well as of the sensitivity scenarios using the REMI model and to present a comparison to the Final GGRA plan.[1]

2. Description of the Sensitivity and In-and-Out Scenarios

The Sensitivity Scenarios were designed to measure the robustness of the Final GGRA Plan to various headwinds and tailwinds that the Plan might encounter. The In-and-Out Scenarios represent the isolated impacts of certain subcomponents of the Plan; namely, Transportation and Climate Initiative (TCI) and medium- and heavy-duty vehicle electrification.

2.1 Sensitivity Scenario 1: The Pessimistic Scenario
The Pessimistic sensitivity scenario reflects a lack of federal actions that result in slower pace of electrification and efficiency improvement compared to the Final GGRA. It achieves a 41 percent reduction in gross emissions by 2030, compared to 50 percent as projected in the 2030 GGRA Plan. The higher GHG emissions in the Pessimistic scenario, in the near term, are attributable to the early retirement and replacement of Calvert Cliffs nuclear power plant in 2023 by carbon-emitting imports, as well as to reduced vehicle efficiency improvement. By 2050, the net emissions are projected to be more than twice as large for the Pessimistic scenario compared to the 2030 GGRA Plan in the Transportation sector, mainly due to reduced levels of building electrification, efficiency improvement and zero-emission vehicle adoption. The Pessimistic scenario only achieves half of the energy efficiency, half of electrification levels as well as half of Light-Duty Vehicle (LDV) and Medium- and Heavy-Duty Vehicles (MHDV) electrification levels achieved in 2030 GGRA Plan.

2.2 Sensitivity Scenario 2: The Optimistic Scenario
The Optimistic sensitivity reflects additional federal investment in green buildings, electric vehicles, low-carbon electricity, biofuels, and agricultural management practices, compared to the 2030 GGRA Plan. It achieves 54 percent reduction by 2030 and 84 percent by 2050 on a gross emissions basis. Although it has a small impact in 2030, a much more significant impact should be observed by 2050 due to 30 years of compounded adoption of electric heat pumps,

---

[1] All analyses were conducted using REMI Version 2.2.2

TOWSON UNIVERSITY | Regional Economic Studies Institute

electric vehicles, and efficient appliances. The Optimistic scenario achieves a 100 percent nationwide carbon-free electricity by 2035 based on President Biden's proposed infrastructure plan, compared to 75 percent Clean and Energy Standard (CARES) by 2030 and 100 percent by 2040 in the 2030 GGRA Plan. It also achieves 100 percent high efficiency electric sales by 2030 compared to 50 percent in the 2030 GGRA Plan. When it comes to building code and electrification of buildings, the optimistic scenario aims for 50 percent of retrofit building by 2030 reflecting federal investments in green buildings and a 50 percent heat pumps sales increase by 2025, as opposed to only 25 percent of retrofit building in the 2030 GGRA Plan and achieving the same level of heat pump sale increase but five years later in 2030 through the 2030 GGRA plan. Moreover, the Optimistic scenario reflects higher levels of Federal investment in Zero Emission Vehicles (ZEV), in bioenergy development, in agricultural management practices improvement and in advanced carbon-removal technologies, compared to the 2030 GGRA Plan.

2.3 In-and-Out Scenario 1: No TCI Scenario

The No Transportation and Climate Initiative (TCI) scenario model removes TCI proceeds to increase electric vehicle sales and reduce miles traveled or vehicle fuel consumption to project the size of TCI investment impact in the GGRA Plan. The No TCI scenario assumes only 42 percent increase in ZEV light duty auto (LDV) sales by 2030 compared to 65 percent in the 2030 GGRA Plan and 8 percent ZEV LDT sales as opposed to 25 percent in the GGRA Plan. It also removes the share of TCI proceeds in total state investment for Maryland Department of Transportation (MDOT)'s measures, which is 9 percent lower than in 2030 GGRA Plan. Without TCI investments, there will be higher levels of GHG emissions, especially in the long-run, due to more vehicle miles traveled, higher vehicle fuel consumption, and fewer electric light-duty vehicles.

2.4 In-and-Out Scenario 2: No MHDV Electrification Scenario

The No Medium-and-Heavy-Duty Vehicle (MHDV) Electrification scenario removes the aggressive sales of ZEV MHDVs; 35 percent sales of ZEV MHDVs by 2030 and 100 percent by 2050, from the GGRA Plan's model to estimate its size of impact. Without MHDV, Maryland would have higher consumption of fossil fuels, which in turn increases GHG emissions.

3. Final GGRA Plan's Economic Impact

This section will help visualize the economic impact results of the GGRA plan before the comparison to the sensitivity and in-and-out scenarios. Figure 1 below shows employment differences under the scenario with and without MDOT spending.

Figure 1: Total Employment Forecast with MDOT vs. without MDOT 2020-2050
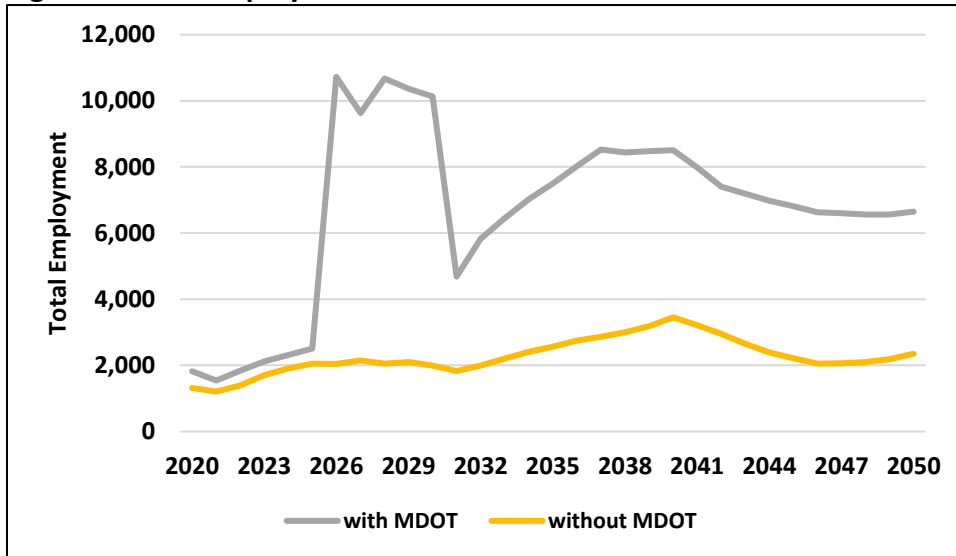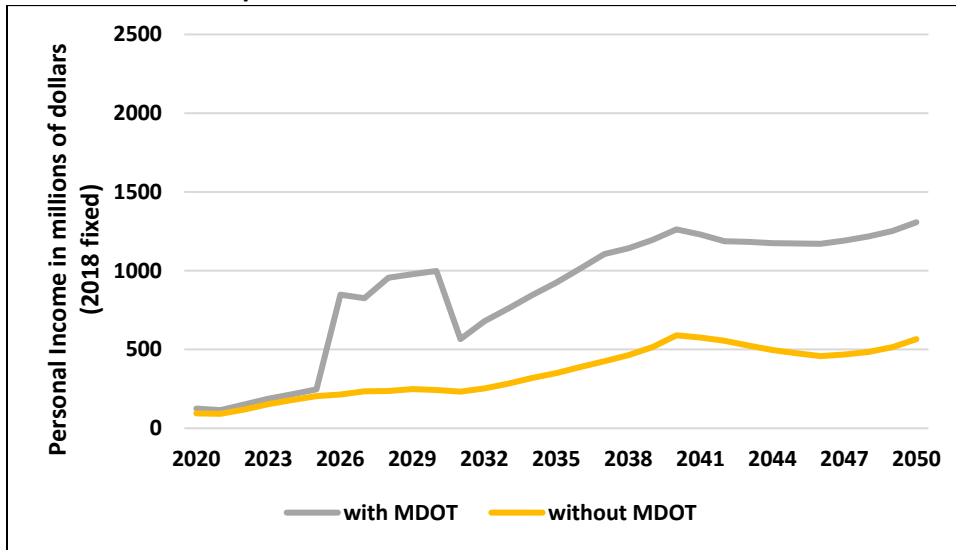

Source: E3, MDE, RESI

Notably, between 2026 and 2030, MDOT spending is expected to cause a huge spike in employment due to MDOT transportation infrastructure projects. On average, MDOT spending supports 3,977 more jobs annually through 2030 compared to the no-MDOT-spending case. MDOT difference remains positive with an average of 4,391 more jobs between 2020 and 2050. The steady increase in employment after 2030 is due in part to the capital cost to fuel cost ratio, as well as the increased demand for state-produced renewable energy. Because total spending is lower, consumers have more money to spend on other goods and services, and businesses are profitable.

Figure 2 below shows changes in personal income levels under the Final GGRA plan with MDOT spending compared to without MDOT spending, which remain positive through 2030.

Figure 2: Personal Income Forecast with MDOT vs. without MDOT 2020-2050 (in millions of fixed 2018 dollars)
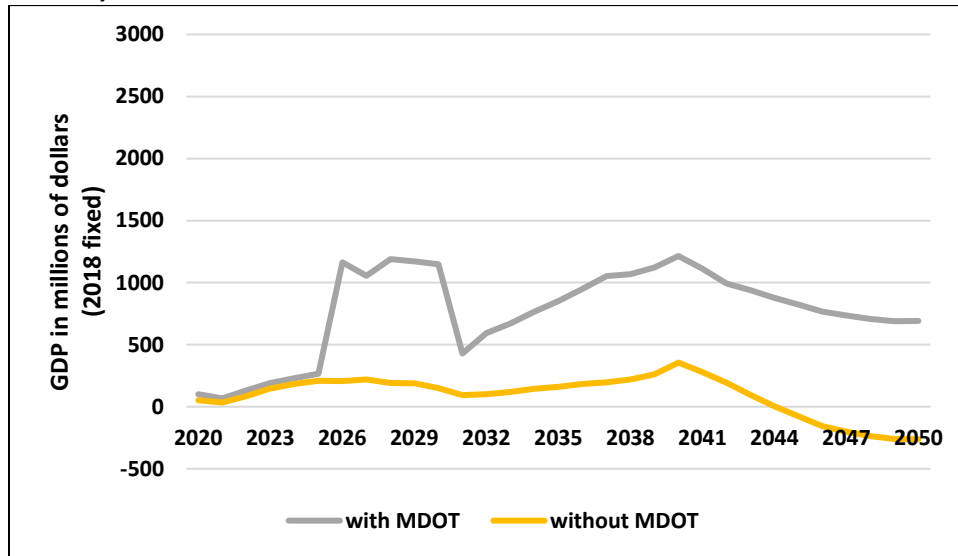

Source: E3, MDE, RESI

The Final GGRA plan shows gains of $330 million on average through 2030 with MDOT spending. As illustrated in Figure 2, the Final GGRA plan shows a decrease in personal income after 2030, due to a combination of the expiration of large MDOT transportation projects, as well as the increased expenditures on capital relative to fuel savings. However, personal income steadily increases until 2040 after the initial drop in 2031 to levels higher than those before 2030.

Figure 3 shows the expected changes to the GDP under the Final GGRA Plan with MDOT spending and without MDOT spending, presented in millions of fixed 2018 dollars.

Regional Economic
Studies Institute

TOWSON
UNIVERSITY.

Figure 3: GDP Forecast with MDOT vs. without MDOT 2020-2050 (in millions of fixed 2018 dollars)

Source: E3, MDE, RESI

The average positive difference in GDP due to MDOT spending is $459 million 2018 fixed dollars through 2030. Similar to the personal income curve, the difference decreases after 2030 and starts steadily increasing again through 2040. Without MDOT spending, the Final GGRA Plan starts showing negative GDP effects, relative to the reference case, in 2045 through 2050, while GDP in the Final GGRA Plan with MDOT spending remains positive throughout the whole period.

The decline in the GDP difference between the reference case and the Final GGRA plan could be explained by the observed drop in two GDP components in the latter years of the forecast: exports and gross fixed private investments in the residential sector. Declining exports could be a result of transitioning to in-state solar energy production instead of fossil-fuel energy production which does not leave Maryland with excess production to export. In the residential sector, gross fixed investments typically consist of investments in private residential structures and residential equipment. Some types of equipment that are built into residential structures are heating and air-conditioning equipment. As energy production costs gradually decline when achieving certain policy goals, purchases of residential equipment will be more cost efficient and prices in the residential sector might go down. Examples of such policy goals are the Electricity Standard policy which mandates 100 percent Clean and Renewable Energy Standard (CARES) by 2040 with a carveout for in-state clean energy resources reaching 30 percent by 2040 or the accelerated Regional Greenhouse Gas Initiative (RGGI) cap which achieves 100 percent reductions by 2040. Potentially, all of the above-mentioned factors are contributing to the slowing down of GDP growth after 2040 under the Final GGRA, compared to the reference case.

4. Economic Impact of Sensitivity Scenarios

To measure the robustness of the Final GGRA plan results, sensitivity analyses were performed. These scenarios include an optimistic scenario and a pessimistic scenario. The pessimistic sensitivity scenario reflects a lack of federal actions that result in a slower pace of electrification and efficiency improvement compared to the Final GGRA, while the Optimistic sensitivity scenario reflects additional federal investment in green buildings, electric vehicles, low-carbon electricity, biofuels, and agricultural management practices compared to the 2030 GGRA Plan.

This section shows how the sensitivity scenarios, the optimistic and pessimistic scenarios, compare with the Final GGRA plan's economic impact in terms of average forecasted employment, personal income, and GDP through 2030.

Figure 4: Average Forecasted Employment through 2030 by Scenario (individuals/year)
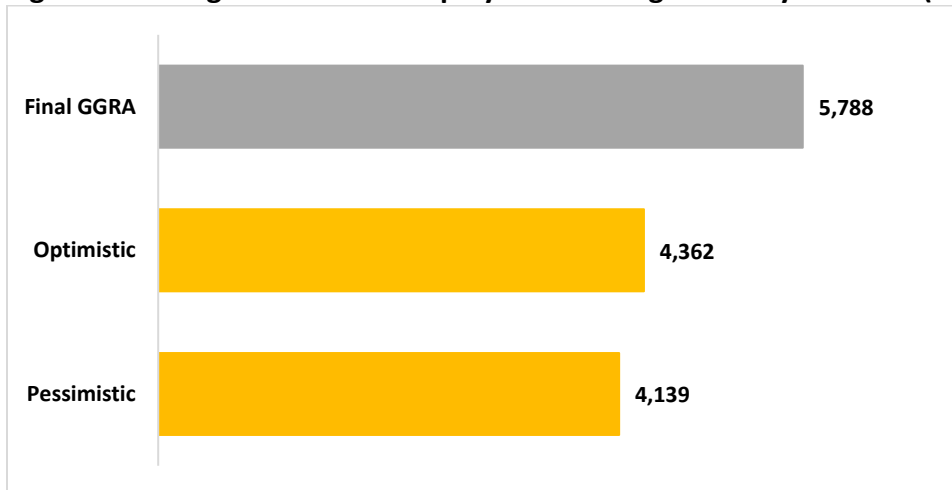
Source: E3, MDE, RESI

As is shown in Figure 4, the Final GGRA plan is showing the best labor allocation compared to both sensitivity scenarios, with a positive average forecasted difference of 1,426 jobs compared to the optimistic scenario, and 1,649 jobs compared to the pessimistic scenario, through 2030. Aggressively investing in certain industries, such as in electric vehicles and green energy as is the case in the optimistic scenario, potentially causes initial job losses in other industries, such as in fossil fuel-reliant industries. These losses may be larger than the gains experienced because of the additional investments. For this reason, the optimistic scenario may be showing lower economic impacts in terms of employment.

Figure 5: Average Forecasted Personal Income through 2030 by Scenario (millions of fixed 2018 dollars/year)
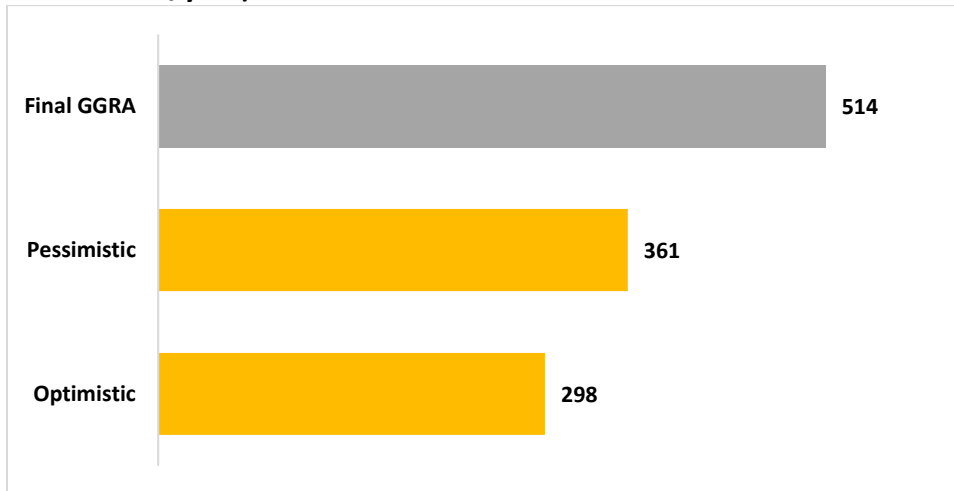
Source: E3, MDE, RESI

As can be inferred from Figure 5, the average forecasted personal income is projected to be highest in the Final GGRA Plan. The pessimistic scenario shows a 30 percent negative average personal income difference from the Final GGRA Plan, and an even larger difference for the optimistic scenario at around 42 percent. Again, the Final GGRA Plan is showing the best resource allocation.

Figure 6: Average Forecasted Gross Domestic Product (GDP) through 2030 by Scenario (millions of fixed 2018 dollars/year)
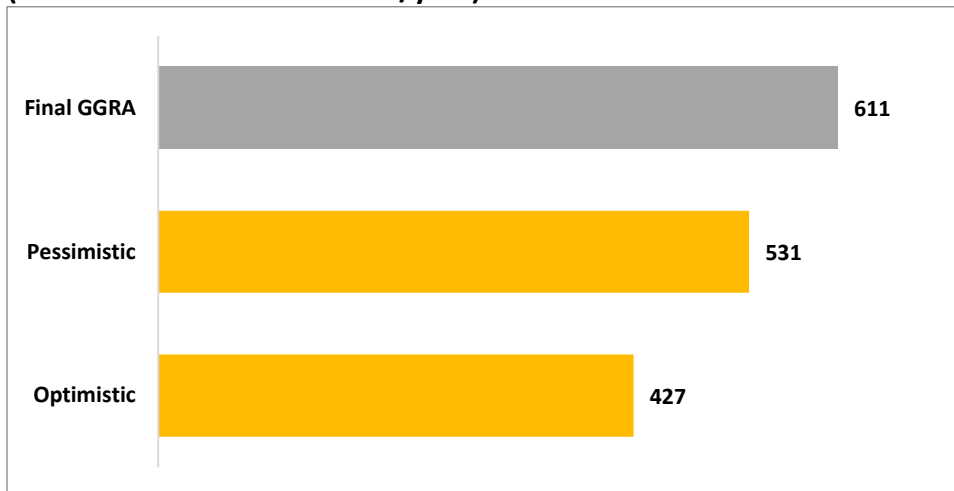
Source: E3, MDE, RESI

Figure 6 shows the impact of the different scenarios on the average forecasted GDP through 2030, compared to the Final GGRA. Both the optimistic and pessimistic scenarios show lower forecasted GDP levels compared to the Final GGRA plan's level, with a difference of $80 million and $184 million, respectively.

5. Economic Impact of TCI

Separately from the sensitivity scenarios, in-and-out analyses were performed to understand the economic costs and benefits of different policies. First, a No TCI scenario was constructed to show the impact attributable to TCI contributions.

This section shows the size of economic impact TCI contributions have on the Final GGRA Plan in terms of average forecasted employment, personal income, and GDP through 2030.

Figure 7: Average Forecasted Employment through 2030 by Scenario (individuals/year)

Source: E3, MDE, RESI

As seen in Figure 7, under the No TCI scenario, average forecasted employment would fall from 5,788 to 5,008. This means that the net contribution that TCI has on the Final GGRA Plan is roughly 780 jobs.

Figure 8: Average Forecasted Personal Income through 2030 by Scenario (in millions of fixed 2018 dollars/year)
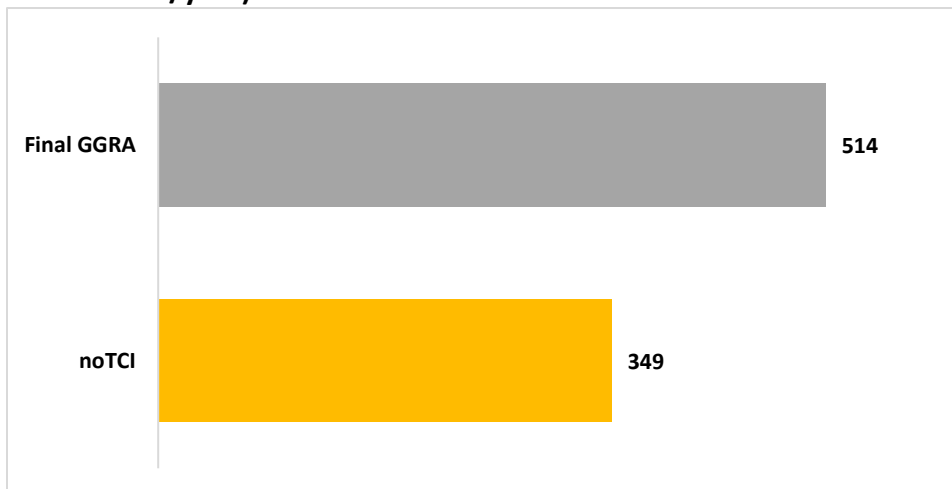
Source: E3, MDE, RESI

According to Figure 8, excluding TCI proceeds would result in a negative difference of $165 million or a loss of 32 percent of Final GGRA Plan's average forecasted personal income.

Figure 9: Average Forecasted Gross Domestic Product (GDP) through 2030 by Scenario (in millions of fixed 2018 dollars/year)
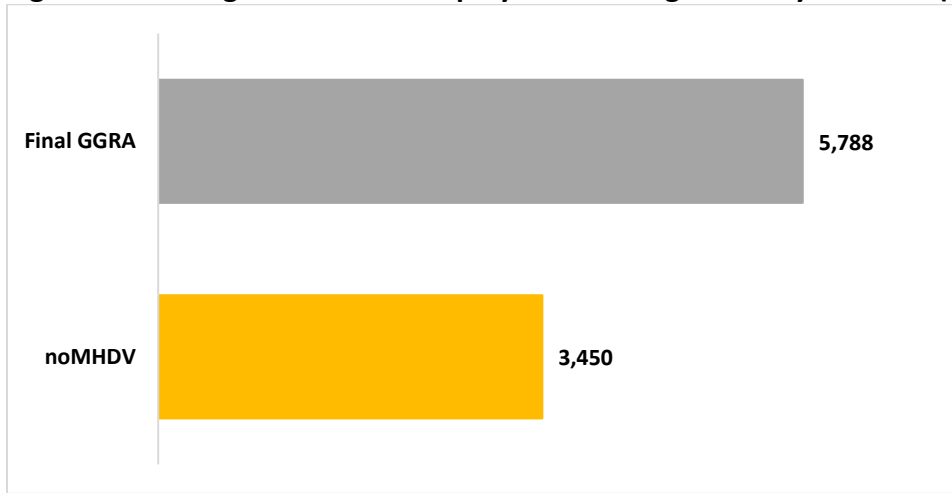

Source: E3, MDE, RESI

It is clear from Figure 9 that 20 percent, or $121 million, of the GGRA Plan's forecasted average GDP is generated through TCI proceeds.

6. Economic Impact of Medium – and Heavy-Duty ZEV MOU

Finally, a No Medium-and-Heavy-Duty Vehicle Zero Emissions (MHDV) Electrification scenario was run. This scenario was created to show the contribution of pursuing policies regarding the electrification of medium- and high-duty vehicles.

This section shows the size of the economic impact MHDV electrification has on the Final GGRA Plan in terms of average forecasted employment, personal income, and GDP through 2030.
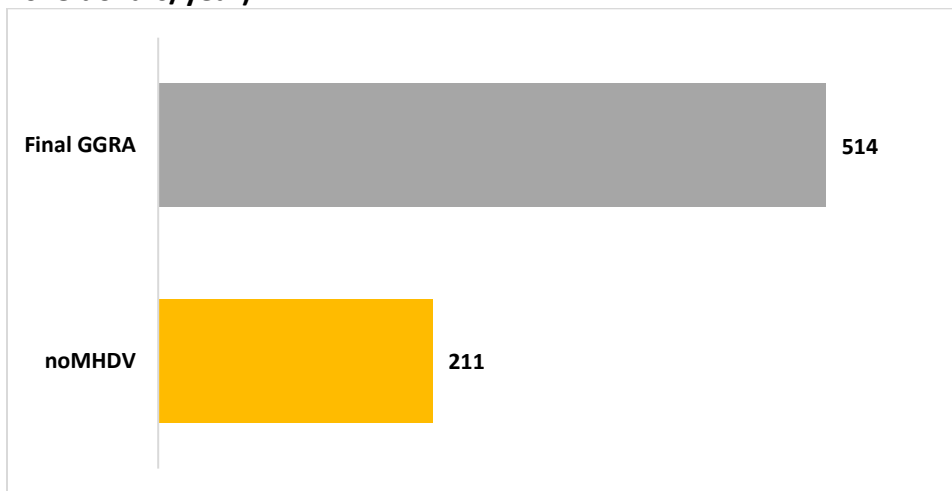
Figure 10: Average Forecasted Employment through 2030 by Scenario (individuals/year)

Source: E3, MDE, RESI

According to Figure 10, not pursuing policies related to medium- and high-duty ZEVs has a larger impact at 2,338 jobs.

Figure 11: Average Forecasted Personal Income through 2030 by Scenario (in millions of fixed 2018 dollars/year)

Source: E3, MDE, RESI

The average forecasted personal income expected to be generated by MHDV projects is around $303 million or 59 percent of the Final GGRA Plan's average forecasted personal income.

Figure 12: Average Forecasted Gross Domestic Product (GDP) through 2030 by Scenario (in millions of fixed 2018 dollars/year)
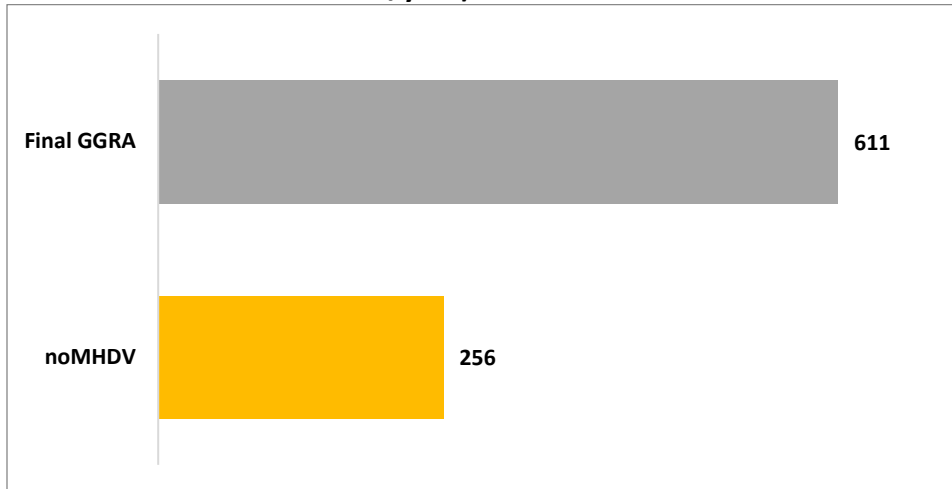
Source: E3, MDE, RESI

Once again, as is shown in Figure 12, the MHDV Electrification policies seem to have a highly significant impact on the average forecasted GDP, to which 58 percent of the GGRA Plan's forecasted GDP is attributed.

Note that these scenarios are not additive, meaning that within the economic model, TCI plus Medium- and High-Duty ZEVs plus all other policies will not equal the Final GGRA Plan results.

7. Conclusions

After comparing all components of the in-and-out and sensitivity scenarios' economic impact to those of the Final GGRA plan, three main conclusions can be drawn:

- The optimistic scenario, while employing more aggressive GHG reduction measures, as well as the pessimistic scenario, which slows the pace of GHG reduction measures, both maintain a net positive economic benefit compared to the reference case.
- The Final GGRA performs better than both the pessimistic and the optimistic scenarios in boosting employment, increasing the average personal income as well as achieving a higher average GDP. Clearly, the Final GGRA Plan represents a more optimum allocation of resources from policies and economic drivers than both the optimistic and pessimistic scenarios.
- TCI and especially MHDV Electrification investments and policies are both crucial to the economic benefits of the GGRA Plan. Stopping one of those policies will result in a much lower economic benefit to Maryland.

Appendix A – Sensitivity Scenario Results

Figure 13: Economic Impact Analysis for the Sensitivity scenarios
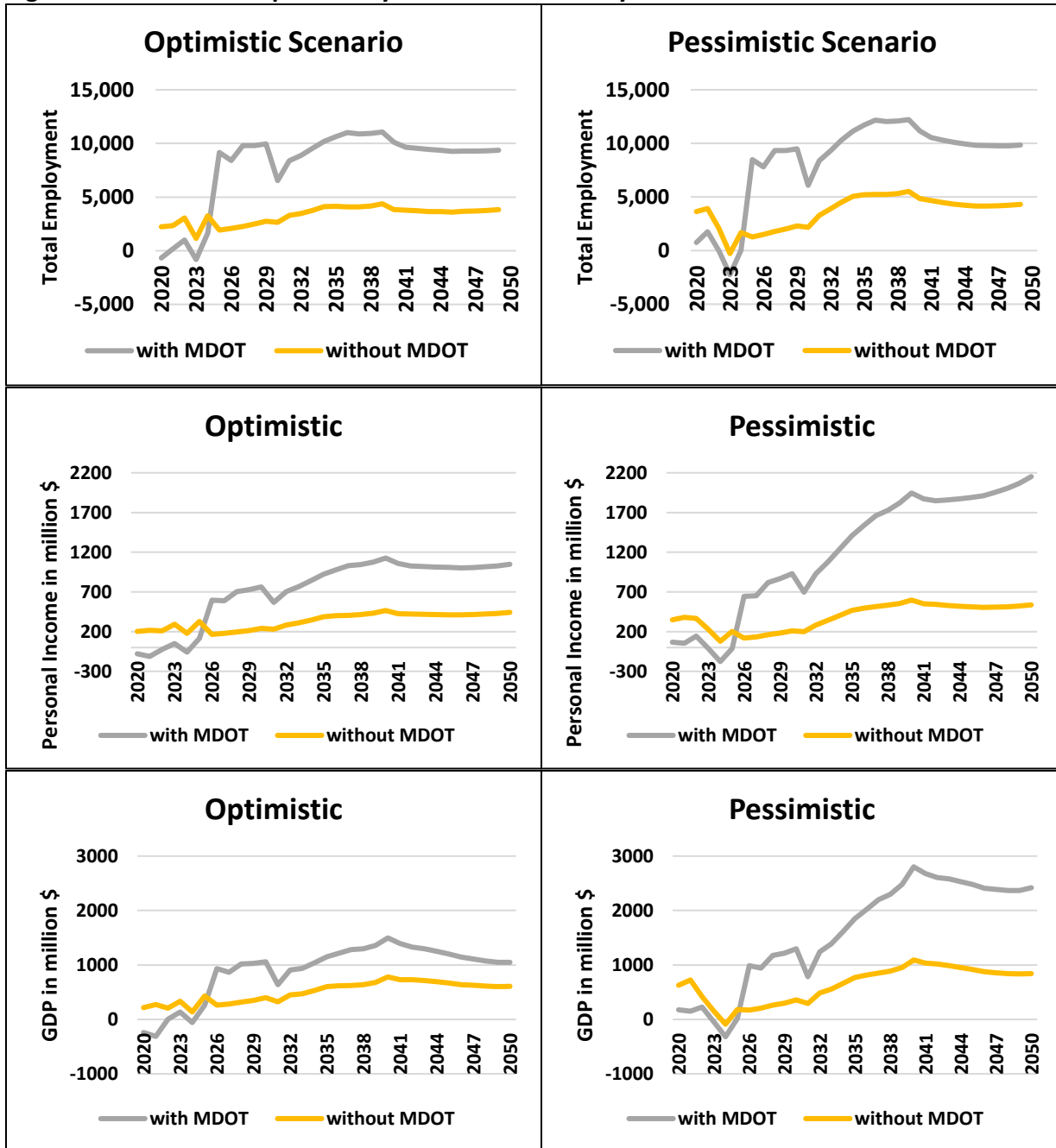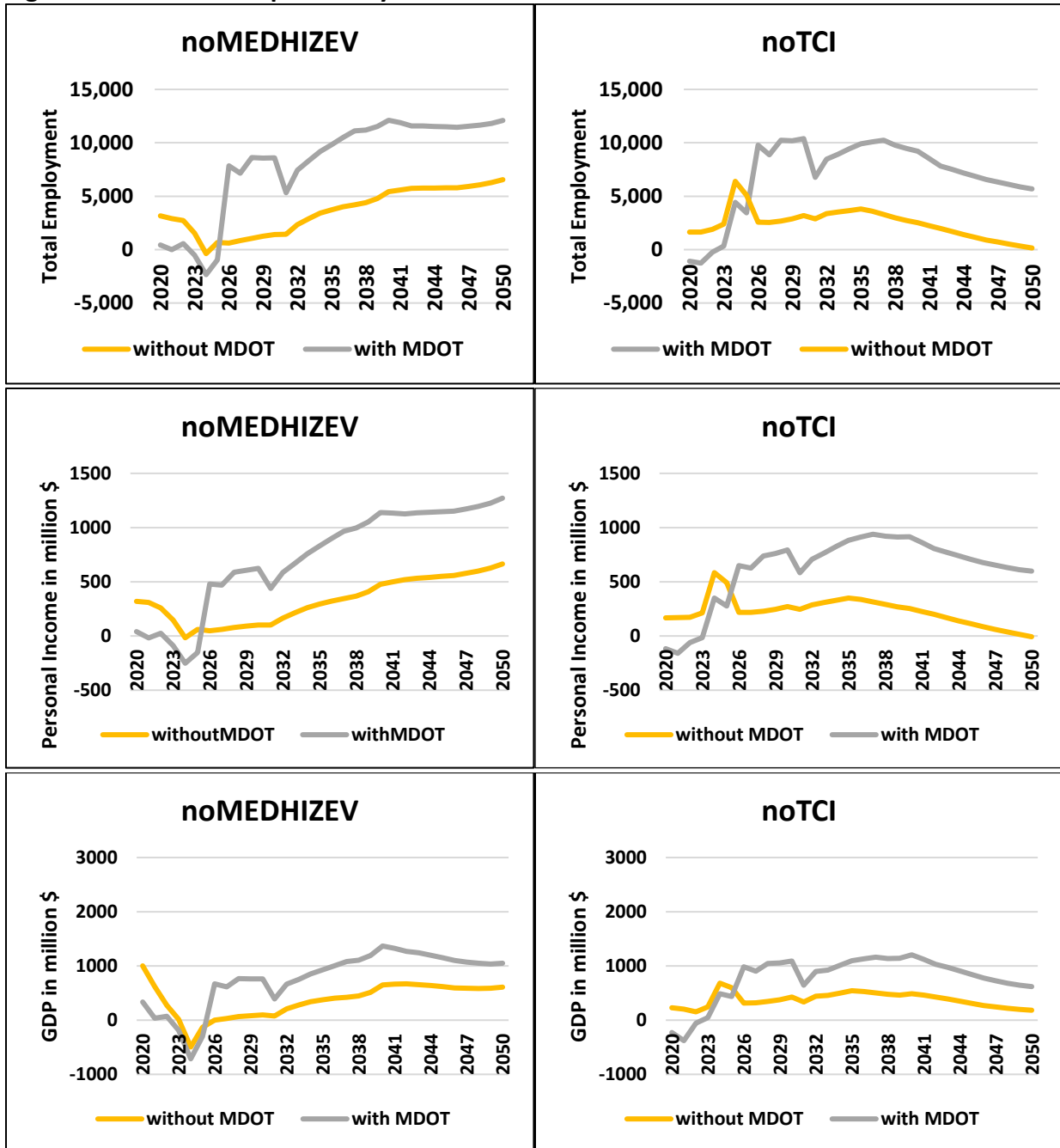

Source: E3, MDE, RESI

Appendix B – In-and-out Scenario Results

Figure 14: Economic Impact Analysis for the In-and-Out scenarios

Source: E3, MDE, RESI

END OF DOCUMENT