

Employment Creation through Green Locomotive Manufacturing at Wabtec's Erie, Pennsylvania Facility

GREGOR SEMIENIUK

Assistant Research Professor, PERI
University of Massachusetts Amherst

ROBERT POLLIN

Distinguished University Professor of Economics and
Co-Director, Political Economy Research Institute (PERI)
University of Massachusetts Amherst

Table of Contents

Summary	1
Introduction	2
Generating Employment Estimates	3
Job Creation per \$1 Million in Spending	3
Expanding Locomotive Manufacturing at Lawrence Park	7
Job Creation Estimates Based on Assumed Production Levels and Costs	8
Impact on Erie, Pennsylvania Employment Conditions	11
Accounting for Labor Productivity Gains over Time	13
<i>Endnotes</i>	14
<i>References</i>	15
<i>Acknowledgments</i>	16
<i>About the Authors</i>	16

Summary of Study

This report estimates the prospects for job creation through expanding green locomotive manufacturing at the Westinghouse Air Brake Technologies (Wabtec) Corporation's Lawrence Park facility in Erie, Pennsylvania. We consider the employment effects of three types of green locomotive manufacturing activities at Wabtec's Lawrence Park site: 1) Tier 4 diesel-electric locomotives; 2) battery-electric locomotives *without* onsite battery production and 3) battery electric manufacturing *with* onsite battery production.

We estimate employment creation under 2 scenarios: an initial Phase 1, in which Wabtec produces 500 green locomotives per year at Lawrence Park and a Phase 2 in which production at Lawrence Park expands to 1,000 green locomotives per year. As of 2008, Wabtec had been producing locomotives at the Phase 2 level of about 1,000 locomotives per year. Phase 2 would therefore just return the Lawrence Plant facility to its earlier level of manufacturing activity.

We estimate that by producing 1,000 green locomotives per year at Lawrence Park, employment creation would range as follows, depending on which specific locomotive production activities are operating at the plant:

- 3,400 – 5,100 jobs at Lawrence Park itself;
- 3,060 – 5,100 jobs in Erie County outside of Lawrence Park;
- 9,860 – 14,960 in the U.S. economy overall.

About 800 people are currently employed at Lawrence Park directly involved in locomotive production. Expanding production to 1,000 locomotives per year would therefore produce a *net increase* in employment at the facility by between roughly 2,600 – 4,300 workers.

Expanding green locomotive manufacturing production at Wabtec's Lawrence Park facility will produce major gains in employment conditions in Erie County. This will be true both through the increase in the number of job opportunities relative to the 126,000 people that currently comprise the area's labor market, and through the relatively high compensation levels associated with jobs at the Lawrence Park facility itself.

Introduction

This report estimates the employment impact of expanding green locomotive manufacturing production at the Westinghouse Air Brake Technologies (Wabtec) Corporation's Lawrence Park facility in Erie, Pennsylvania. We consider two categories of locomotives that can be accurately considered to be "green" locomotives. The first category is the so-called "Tier 4" diesel-electric locomotive. The Tier 4 designation refers to the emissions requirements established by the Environmental Protection Agency for locomotives built after 2015.¹ The emissions generated by Tier 4 locomotives are between 50 – 90 percent lower than those produced by the first regulated "Tier 0" models. The second category of locomotives are fully battery-electric vehicles. With battery-electric locomotives, emissions during operation can be cut to zero if the power source for the electricity is renewable energy.

Wabtec's Lawrence Park facility in Erie has been operating since 1907. Its current production facilities are capable of producing Tier 4 diesel-electric locomotives. Wabtec is also currently developing battery-electric locomotive technology. The company's website states as follows:

Wabtec is leading the transition to a low-carbon rail network with FLXdrive. The world's first heavy-haul, 100 percent battery-electric vehicle...With haulage capabilities comparable to its diesel equivalent, the FLXdrive locomotive is designed to replace a diesel locomotive within a consist, unlocking new levels of operational flexibility.²

The capacity for large-scale growth in manufacturing production at Lawrence Park is substantial. Scott Slawson, the President of Local 506 of the United Electrical, Radio, and Machine Workers of AmEriea (UE) describes, as of April 2023, the resources available and potential for growth at Lawrence Park as follows:

As recently as 15 years ago, the Erie locomotive facility employed a workforce of about 4,000 manufacturing workers producing as many as 20 locomotives a week, or up to 1,000 per year, for both domestic and international railroads. The plant currently can have over 40 locomotives in the build process at the same time but has significant excess capacity due to a severe downturn in the purchase of new locomotives by U.S. railroads, resulting in a current hourly workforce of about 1,400. Given that the facility encompasses over 900 acres, ramping up production is simply a matter of increasing the workforce to shorten the cycle times necessary for the build.³

In short, there is, at present, an extensive base of underutilized resources at Lawrence Park. These underutilized resources will serve as a benchmark for the estimates we will generate as to the potential for job creation through a major expansion of green locomotive manufacturing at the plant.

With respect to manufacturing battery-electric vehicles specifically at Lawrence Park, we estimate employment creation under two scenarios. In the first scenario, we assume that the batteries for the locomotives are manufactured outside the Lawrence Park facility. At present, the existing equipment at Lawrence Park does not include capacity for manufac-

turing batteries. However, there is at the plant enough warehouse space that could be converted to battery manufacturing production. In addition, the tax credit provisions of the 2022 Inflation Reduction Act (IRA--Section 45X) include support for battery manufacturing. Wabtec will be able to qualify for this subsidy opportunity to lower the costs for installing its battery manufacturing line.

Under either the first or second scenario, Wabtec will spend approximately the same amount of money on the batteries they install in the battery electric locomotives they produce at Lawrence Park. But job creation will be significantly higher under the second scenario, since battery manufacturing itself will take place onsite, rather than elsewhere.

Generating Employment Estimates

We generate our job creation estimates at Lawrence Park based on two considerations. The first consideration is our estimate of how much employment would be generated through producing green locomotives at the plant for any given level of spending by Wabtec. For example, how many jobs would be created if Wabtec spends \$1 million on manufacturing green locomotives? The second consideration is our assessment as to how much the Lawrence Park plant is capable of expanding its green locomotive manufacturing activity. Our estimate of the potential for job creation at the facility will follow from our figures on: 1) job creation per \$1 million in spending on locomotive manufacturing; and 2) the capacity for expanding manufacturing at the plant. We now proceed to estimate these two sets of figures.

Job Creation per \$1 Million in Spending

We generate estimates on job creation for a given spending level, such as \$1 million, on green locomotive manufacturing on the basis of an “input-output” statistical model. An input-output model traces the interrelationship between all activities in an economy, showing the range of *inputs*, such as raw metals, glass, engine components as well as workers, that are utilized to produce any given *output*, such as locomotive trains. Within the framework of this input-output statistical model, we are able to generate employment/output ratios—i.e. for a given total amount of spending, such as \$1 million, channeled into the economy to produce an output, such as a locomotive, the employment/output ratio shows how many workers this spending employs.⁴

Spending on green locomotives, as with every other activity in the economy, creates employment through three channels: direct, indirect, and induced effects. These three channels can be described as follows:

- *Direct effects*: the jobs created by manufacturing the locomotive engine and body. This category will correspond closely to the job creation at a given production site for any specific project. That would include, in this case, the Lawrence Park facility itself.

- *Indirect effects*: the jobs associated with the industries that supply intermediate goods for this manufacturing, such as raw metal products, glass, and engine components. Indirect effects, in other words, refer to the employment created through the ‘supply chain’ of goods that are required for manufacturing locomotives.
- *Induced effects*: the expansion of employment that results when people who are newly employed to build locomotives—through either the direct or indirect employment channel—in turn spend their income on any and all goods and services in the economy. Induced effects are also referred to as ‘multiplier effects’ in standard economic analysis.

In Table 1, we show our estimates for direct, indirect, and induced employment creation for manufacturing green locomotives at the Lawrence Park facility in Erie County, Pennsylvania. We report these figures for manufacturing both diesel-electric and battery-electric locomotives. We also break out employment creation into four geographic categories. These are:

- Jobs created at the Lawrence Park facility itself;
- Jobs created within Erie County outside of Lawrence Park;
- Jobs created within the state of Pennsylvania outside of Erie County; and
- Jobs created within the United States, outside of Pennsylvania.

As Table 1A shows, considering first manufacturing of Tier 4 diesel-electric locomotives, we estimate that there will be 1.5 direct jobs created at Lawrence Park when Wabtec spends \$1 million on manufacturing diesel-electric locomotives at this facility. This level of spending by Wabtec will also generate 0.5 indirect jobs and 0.9 induced jobs in Erie County beyond the Lawrence Park facility. In addition, 0.4 jobs will be created elsewhere in Pennsylvania, and another 1.2 jobs in U.S. states other than Pennsylvania. Total job creation throughout the U.S. generated by Wabtec through manufacturing diesel-electric locomotives at Lawrence Park will therefore be 4.5 jobs per \$1 million in spending.

As we see in Table 1B, our estimate of job creation per \$1 million in spending will be lower for manufacturing battery-electric locomotives. We estimate that total direct employment at the Lawrence Park plant will be 1.0 jobs per \$1 million in spending. Another 0.9 jobs will be generated within Erie County outside of Lawrence Park. Including the rest of Pennsylvania and rest of the U.S., we estimate that total job creation will be 2.9 jobs per \$1 million in spending.

The major factor causing the lower level of employment creation through manufacturing battery-electric locomotives versus diesel-electric locomotives is that, with battery-electric locomotives, producing the battery itself represents a significant share of the overall manufacturing operation. We therefore present in Table 2 our estimate of the employment impact of producing the batteries that power locomotives. In Table 2A, we show our estimate for battery production itself, assuming that Lawrence Park plant is producing the batteries onsite. Table 2B then shows the full employment impact of Wabtec producing both the battery and the full locomotive at Lawrence Park.

TABLE 1. Job Creation per \$1 Million in Spending on Locomotive Manufacturing at Lawrence Park Facility, Erie County, Pennsylvania

1A) Job Creation for Tier 4 Diesel-Electric Locomotives

	1) Direct Jobs <i>[=Jobs at Lawrence Park]</i>	2) Indirect Jobs	3) Induced Jobs	4) TOTAL: Direct + Indirect + Induced Jobs
1) Lawrence Park	1.5	0.0	0.0	1.5
2) Erie County outside of Lawrence Park	0.0	0.5	0.9	1.4
3) Pennsylvania outside of Erie County	0.0	0.2	0.2	0.4
4) U.S. outside of Pennsylvania	0.0	0.7	0.5	1.2
5) Total Job Creation throughout U.S.	1.5	1.4	1.6	4.5

1B Job Creation for Battery-Electric Locomotives without Onsite Battery Manufacturing

	1) Direct Jobs <i>[=Jobs at Lawrence Park]</i>	2) Indirect Jobs	3) Induced Jobs	4) TOTAL: Direct + Indirect + Induced Jobs
1) Lawrence Park	1.0	0.0	0.0	1.0
2) Erie County outside of Lawrence Park	0.0	0.3	0.6	0.9
3) Pennsylvania outside of Erie County	0.0	0.1	0.1	0.2
4) U.S. outside of Pennsylvania	0.0	0.5	0.3	0.8
5) Total Job Creation throughout U.S.	1.0	0.9	1.0	2.9

Source: IMPLAN.

As we see in Table 2A, we calculate that the battery manufacturing operation at the Lawrence Park site will generate 0.5 direct jobs at Lawrence Park per \$1 million in spending on battery-electric locomotives by Wabtec. In addition, battery manufacturing will generate 0.1 indirect jobs and 0.5 induced jobs within Erie County itself, for a total of 0.6 jobs per \$1 million in Erie County outside of Lawrence Park through spending on battery-electric locomotives. Battery manufacturing at Lawrence Park will also generate a total of 0.2 additional jobs per \$1 million in spending in the rest of Pennsylvania and 0.2 jobs in the U.S. outside of Pennsylvania. Overall, battery manufacturing at Lawrence Park will generate 1.5 jobs per \$1 million in spending.

TABLE 2: Job Creation per \$1 Million in Spending *with* Onsite Battery Manufacturing at Lawrence Park Facility, Erie County, Pennsylvania

2A) Job Creation for Battery Manufacturing

	1) Direct Jobs [=Jobs at Lawrence Park]	2) Indirect Jobs	3) Induced Jobs	4) TOTAL: Direct + Indirect + Induced Jobs
1) Lawrence Park	0.5	0.0	0.0	0.5
2) Erie County outside of Lawrence Park	0.0	0.1	0.5	0.6
3) Pennsylvania outside of Erie County	0.0	0.1	0.1	0.2
4) U.S. outside of Pennsylvania	0.0	0.1	0.1	0.2
5) Total Job Creation throughout U.S.	0.5	0.3	0.7	1.5

2B) Job Creation for Battery Manufacturing + Battery Electric-Locomotives (figures from Tables 1B + 2A)

	1) Direct Jobs [=Jobs at Lawrence Park]	2) Indirect Jobs	3) Induced Jobs	4) TOTAL: Direct + Indirect + Induced Jobs
1) Lawrence Park	1.5	0.0	0.0	1.5
2) Erie County outside of Lawrence Park	0.0	0.4	1.1	1.5
3) Pennsylvania outside of Erie County	0.0	0.2	0.2	0.4
4) U.S. outside of Pennsylvania	0.0	0.6	0.4	1.0
5) Total Job Creation throughout U.S.	1.5	1.2	1.7	4.4

Source: IMPLAN.

Table 2B combines the results from Table 2A with those from Table 1B. In other words, Table 2B shows our estimate of job creation assuming that Wabtec manufactures both battery-electric locomotives and the batteries for these locomotives onsite at the Lawrence Park facility. We estimate that this combination of manufacturing activities will generate, per \$1 million in spending, 1.5 direct jobs at Lawrence Park, as well as another 1.5 indirect and induced jobs in the rest of Erie County. Beyond these, the \$1 million in spending will generate 0.4 jobs within Pennsylvania outside of Erie County, and 1.0 jobs in the U.S. outside of Pennsylvania. Total job creation throughout the U.S. will therefore be 4.4 jobs per \$1 million for manufacturing battery-electric locomotives and batteries at Lawrence Park.

Expanding Locomotive Manufacturing at Lawrence Park

Working with our estimates on job creation per \$1 million in spending, we still need to establish, by assumption, two sets of figures on Wabtec's spending level at Lawrence Park in order to estimate job creation prospects generated through the facility's expanded green locomotive manufacturing activity. These two sets of figures include 1) the extent to which green locomotive manufacturing can expand at the Lawrence Park facility; and 2) the average costs of producing green locomotives at Lawrence Park. We consider these in turn.

As noted above, about 1,400 people are currently employed at Lawrence Park. About 700 – 800 of these workers are directly involved in locomotive production. Working with the higher end current employment figure of 800, our estimates for job creation at the facility will include these workers currently employed at the facility. We will therefore be able to estimate from this base of 800 currently employed workers the extent of *new* job creation through expanding green locomotive manufacturing at Lawrence Park.

Expanding production activity. We have noted above that the capacity for expanding manufacturing activity at Lawrence Park is substantial. According, again, to UE Local 506 President Scott Slawson, the Lawrence Park facility produced up to 1,000 locomotives per year as recently as 2008. It is therefore reasonable to allow that Wabtec is capable of expanding green locomotive manufacturing back to this approximate production level of 1,000 locomotives per year.

Of course, returning production at Lawrence Park to this previous level will create a range of significant challenges, even as the physical resources to undertake such an expansion are mostly available onsite. Our approach is therefore to estimate job creation potential at Lawrence Park under two scenarios, occurring in sequence: a Phase 1 scenario, in which production expands by 500 locomotives per year over the current production level for an initial 2 – 3 year period; and a Phase 2 scenario, in which, after the 2-3 year initial phase in, production increases to 1,000 green locomotives per year over the current level.

Average production costs. According to a 2022 *Forbes* article, the average price for purchasing a battery-electric locomotive is \$4 million. According to UE Local 506 President Slawson, the costs to purchase Tier 4 diesel-electric locomotives is somewhat lower, ranging between \$3 - \$3.5 million.⁵

These figures for purchase prices include the manufacturer's mark-up over its production costs. According to Wabtec's 2022 *Annual Report*, the company earned profits that year of 14.4 percent over their production costs.⁶ Thus, if we assume that Wabtec's average production costs for locomotive manufacturing are 86 percent of their sales price, that would imply that production costs would range between \$2.6 - \$3 million for manufacturing diesel-electric locomotives and \$3.4 million to manufacture battery-electric locomotives. For the purposes of our estimates, we will assume, through rounding upward modestly, that production costs average \$3 million for diesel-electric and \$3.4 million for battery-electric locomotive production.

Job Creation Estimates Based on Assumed Production Levels and Costs

In Tables 3 and 4, we report a range of estimates for job creation through producing both 500 green locomotives per year in Phase 1 (Table 3) and 1,000 green locomotives per year in Phase 2 (Table 4) at Lawrence Park. For both Phase 1 and Phase 2, we report 5 different production scenarios at Lawrence Park:

1. Diesel-electric production only, at \$3 million/locomotive;
2. Battery-electric production *without* battery manufacturing only, at \$3.4 million/locomotive;
3. Battery-electric production *with* battery manufacturing only, at \$3.4 million/locomotive;
4. Combined production: 50 percent diesel-electric and 50 percent battery-electric *without* battery production; and
5. Combined production: 50 percent diesel-electric and 50 percent battery-electric *with* battery production.

In Table 5, we then show the range of our job creation estimates under the five scenarios. We report separate job creation ranges for Lawrence Park itself, Erie County outside of Lawrence Park and total job creation, including all of Pennsylvania and the overall U.S. economy. Of course, our job creation estimates for Phase 2 are simply twice those of our estimates for Phase 1. This follows from our assumption that under Phase 2, locomotive production at Lawrence Park doubles from 500 to 1,000 locomotives per year.⁷

The summary figures in Table 5 convey clearly the broad job creation prospects under the alternative scenarios we have estimated. As we see in Table 5, with production at 500 locomotives per year during Phase 1, between roughly 1,700 – 2,500 jobs will be generated at Lawrence Park itself. Another roughly 1,500 – 2,500 will be generated in Erie County outside of Lawrence Park, and about 4,900 – 7,500 jobs will be created in total throughout the U.S.

The doubling of locomotive production at Lawrence Park to 1,000 locomotives per year during Phase 2 will then produce: between about 3,400 – 5,100 jobs at Lawrence Park itself; between about 3,000 – 5,100 jobs in Erie County outside of Lawrence Park; and between about 9,900 – 15,000 jobs overall throughout the U.S. economy.

Focusing on Lawrence Park itself, we show in row 2 of Table 5 *net increase* in employment at the facility, i.e. after factoring in the roughly 800 workers who are currently directly involved there in locomotive manufacturing. As we see, we estimate this net increase in employment to be between 900 – 1,750 jobs with annual production at 500 locomotives per year and between 2,600 – 4,300 with annual production at 1,000 locomotives per year.

**TABLE 3. Total Job Creation under Phase 1:
Lawrence Park Production at 500 Green Locomotives per Year**

3A) Job Creation through Single Manufacturing Operation at Lawrence Park Facility

	1) Diesel-Electric <i>Annual production costs = \$1.5 billion</i>	2) Battery-Electric without Battery Manufacturing <i>Annual production costs = \$1.7 billion</i>	3) Battery-Electric Locomotives with Battery Manufacturing <i>Annual production costs = \$1.7 million/locomotive</i>
1) Lawrence Park	2,250	1,700	2,550
2) Erie County outside of Lawrence Park	2,100	1,530	2,550
3) Pennsylvania outside of Erie County	600	340	680
4) U.S. outside of Pennsylvania	1,800	1,360	1,700
5) Total Job Creation throughout U.S.	6,750	4,930	7,480

3B) Job Creation through Multiple Manufacturing Operations at Lawrence Park Facility

	1) 50% Diesel-Electric Locomotives; 50% Battery- Electric Locomotives without Battery Manufacturing	2) 50% Diesel-Electric Locomotives; 50% Battery- Electric Locomotives with Battery Manufacturing
1) Lawrence Park	1,975	2,400
2) Erie County outside of Lawrence Park	1,815	2,325
3) Pennsylvania outside of Erie County	470	640
4) U.S. outside of Pennsylvania	1,580	1,750
5) Total Job Creation throughout U.S.	5,840	7,115

Sources: See Tables 1 and 2.

**TABLE 4. Total Job Creation under Phase 2:
Lawrence Park Production at 1,000 Green Locomotives per Year**

4A) Job Creation through Single Manufacturing Operation at Lawrence Park Facility

	1) Diesel-Electric <i>Annual production costs = \$3 billion</i>	2) Battery-Electric without Battery Manufacturing <i>Annual production costs = \$3.4 billion</i>	3) Battery-Electric Locomotives with Battery Manufacturing <i>Annual production costs = \$3.4 million/locomotive</i>
1) Lawrence Park	4,500	3,400	5,100
2) Erie County outside of Lawrence Park	4,200	3,060	5,100
3) Pennsylvania outside of Erie County	1,200	780	1,360
4) U.S. outside of Pennsylvania	3,600	2,720	3,400
5) Total Job Creation throughout U.S.	13,500	9,860	14,960

4B) Job Creation through Multiple Manufacturing Operations at Lawrence Park Facility

	1) 50% Diesel-Electric Locomotives; 50% Battery- Electric Locomotives without Battery Manufacturing	2) 50% Diesel-Electric Locomotives; 50% Battery- Electric Locomotives with Battery Manufacturing
1) Lawrence Park	3,950	4,800
2) Erie County outside of Lawrence Park	3,630	4,650
3) Pennsylvania outside of Erie County	990	1,280
4) U.S. outside of Pennsylvania	3,160	3,500
5) Total Job Creation throughout U.S.	11,680	14,230

Sources: See Tables 1 and 2.

TABLE 5. Job Creation Ranges for Phases 1 and 2

	Phase 1: Production at 500 Locomotives/year	Phase 2: Production at 1,000 Locomotives/year
1. Lawrence Park	1,700 – 2,550	3,400 – 5,100
2. Net Job Creation at Lawrence Park (= row 1 – 800, with current loco- motive manufacturing at ~ 800)	900 – 1,750	2,600 – 4,300
3. Erie County outside of Lawrence Park	1,530 – 2,550	3,060 – 5,100
4. Total (= rows 1 + 3)	4,930 – 7,480	9,860 – 14,960

Sources: Tables 3 and 4.

Impact on Erie, Pennsylvania Employment Conditions

Employment Level. As of February 2023, the overall labor force in Erie County, Pennsylvania was 126,000. Of that total, 119,200 people were employed and 7,000 were unemployed. This amounts to an unemployment rate in the region of 5.5 percent.⁸

A gain of roughly 2,000 jobs at Lawrence Park itself and another roughly 2,000 jobs in Erie County under Phase 1, with Lawrence Park producing 500 locomotives per year, would represent an increase in employment in the area of over 3 percent. Considered relative to the area’s current pool of 7,000 unemployed workers, the increase of about 4,000 jobs would be equivalent to a nearly 60 percent reduction in this pool of unemployed workers.

The impact on the regional job market would be greater still under Phase 2, with Lawrence Park manufacturing 1,000 locomotives per year. Relative to the current Erie County labor market, the roughly 4,000 jobs at Lawrence Park itself and the additional 4,000 jobs in Erie County would be equal to an employment expansion in the region of over 6 percent. The total of roughly 8,000 new jobs in the area—including those at Lawrence Park and throughout the county—would be larger than the current overall pool of 7,000 unemployed people in Erie County.

It is notable here that, as of 2008, at the time when Wabtec was producing about 1,000 locomotives per year, overall employment in Erie County was at 134,000—i.e. 15,000 more people were employed in the county than at present. The area’s labor market should not face major difficulties to expand back to its 2008 level in conjunction with Wabtec increasing locomotive manufacturing at Lawrence Park back to roughly its 2008 production level.

Compensation Levels. Based on current labor market conditions, the newly created direct jobs at the Lawrence Park facility would be high-paying relative to other economic sectors in Erie and throughout Pennsylvania. The average employee compensation (wages and benefits) in direct jobs at the facility is \$114,837. Of course, there are also wide pay differences at the facility between the more highly paid engineers and the various craft positions. Table 6 reports estimates for the ten most common occupations involved in rolling stock manufacturing. All occupations pay well above the median 2021 wage in Pennsylvania of \$44,570.⁹ All but two of the listed occupations pay 1.5 times or more than the Pennsylvania median wage. Newly created indirect jobs within Erie County currently pay well below the figures for locomotive manufacturing. The indirect jobs within Erie County currently pay an average of \$63,517 in total compensation and the average for induced jobs is \$48,521.

Overall then, expanding green locomotive manufacturing production at Wabtec’s Lawrence Park facility will produce major gains in employment conditions in the area. This will be true both in terms of the increase in the number of job opportunities available in the area and especially in terms of the compensation levels associated with jobs at the facility itself.

TABLE 6. Average Wages and Compensation (wages and benefits) for the Most Common Occupations at the Factory in Descending Order of Number of Jobs

Occupation	Annual Wages	Annual Total Compensation
Metal Workers and Plastic Workers	\$74,550	\$93,748
Assemblers and Fabricators	\$69,458	\$87,352
Other Production Occupations	\$73,698	\$92,556
Material Moving Workers	\$50,223	\$62,281
Vehicle and Mobile Equipment Mechanics, Installers, and Repairers	\$81,660	\$101,469
Engineers	\$142,661	\$179,025
Business Operations Specialists	\$90,709	\$112,120
Other Installation, Maintenance, and Repair Occupations	\$87,477	\$109,005
Supervisors of Production Workers	\$116,958	\$146,965
Motor Vehicle Operators	\$49,403	\$61,081

Sources: IMPLAN.

Accounting for Labor Productivity Gains over Time

Our estimates on employment creation, per \$1 million or \$1 billion in spending, respectively, are based on the U.S. Commerce Department's most recent survey figures on production methods used for manufacturing locomotives in the Erie, Pennsylvania region.

To provide a broader set of results on employment creation prospects through expanding green locomotive manufacturing at the Lawrence Park facility, it will be useful to consider how the trajectory of employment at Lawrence Park could proceed over time. To illustrate this, we consider a scenario in which, extending our Phase 2 scenario over a decade, Wabtec produces 1,000 green locomotives per year over this 10-year period.¹⁰ As Wabtec maintains this manufacturing operation over a decade, it will certainly incorporate some improvements in its production methods. These improvements will translate into gains in labor productivity. This means that, over a decade, Wabtec will be able to produce 1,000 new diesel-electric and/or battery-electric locomotives through employing a smaller number of workers. We can estimate how much employment creation will decline through gains in labor productivity by working with an assumption as to what the average rate of productivity growth is likely to be over the decade.

Between 2010 and 2022, Wabtec reported an increase of 2.6 percent per year in labor productivity.¹¹ If we assume as a lower-end approximation that labor productivity at the Lawrence Park facility improves at an average rate of 2 percent per year between 2023 – 2032, that implies that labor productivity in 2032 will be approximately 16 percent higher than it was in 2023. It correspondingly means that, by 2032, Wabtec will be able to operate with 16 percent fewer employees in order to produce a given number of green locomotives—e.g. 1,000 locomotives per year under our Phase 2 scenario.

We see the results of this illustrative pattern of labor productivity gains in Table 7. As the table shows, the range of job creation falls as follows:

- At Lawrence Park: from a range of 3,400 – 5,100 jobs per year in 2023 to 2,845 – 4,267 in 2032;
- In Erie County outside of Lawrence Park: from a range of 3,060 – 5,100 jobs per year in 2023 to 2,560 – 4,267 in 2032; and
- Throughout the U.S. overall: from a range of 9,860 – 14,960 jobs per year in 2023 to a range of 8,250 – 12,518 jobs in 2032.

Of course, Wabtec could choose to increase production above our assumed level of 1,000 locomotives per year between 2023 and 2032. In that case, the fall in employment between 2023 – 2032 would be diminished in proportion to the increased production level.

TABLE 7. Phase 2 Job Creation in 2023 and 2032 with 2 Percent Annual Labor Productivity Growth

Phase 2 Lawrence Park Production at 1,000 Green Locomotives/year

Occupation	2023 Employment Range	2032 Employment Range
Lawrence Park	3,400 – 5,100	2,845 – 4,267
Erie County outside of Lawrence Park	3,060 - 5,100	2,560 – 4,267
Total	9,860 – 14,960	8,250 – 12,518

Sources: See Tables 1 and 2.

Endnotes

- 1 For the most part, Tier 4 standards require the use of exhaust gas aftertreatment technologies, such as diesel particulate filters and urea-SCR. However, some commercial locomotive engines were able to meet Tier 4 standards without aftertreatment (Air Resources Board, 2016; Dieselnets, 2023).
- 2 See Wabtec (2023a). For detailed general background on the viability of battery electric locomotives, see Casey (2021) and Popovich et al. (2021).
- 3 Personal correspondence with authors, 4/18/23.
- 4 The input-output table that we use for generating estimates in this study are based on survey data provided by the U.S. Commerce Department. The survey data that we utilize here are focused on input-output data specifically for Erie County, Pennsylvania, as well as for the remainder of the Pennsylvania economy and the rest of the United States. A detailed discussion of the strengths and weaknesses of input-output (I-O) models and their application to estimating employment can be found in Pollin et al. (2014).
- 5 See Ohnsman (2022); the Slawson estimate is from personal correspondence with authors, 4/19/23.
- 6 <https://ir.wabteccorp.com/static-files/d44caffd-48b4-4378-9a99-c3c5ffabea99>.
- 7 To be more specific, this result depends on assuming that the relationships between inputs and outputs in our model are linear. This means that the employment/output ratios that we report in Tables 1 and 2 will remain fixed regardless of whether the spending level for these activities is \$1 million, \$1.5 billion, \$1.7 billion, \$3 billion, \$3.4 billion or any other figure. The viability of working with this linearity assumption is discussed, among other places, in Pollin et al. (2014).
- 8 See BLS (2023).
- 9 See Census (2023).
- 10 We also assume that the purchasing power of this spending will remain constant in 2023 dollars.
- 11 More precisely, they reported an average annual increase in revenue per worker between 2010 and 2022 of 2.6 percent. We calculated this from data provided in the Compustat data files.

References

- Air Resources Board. 2016. *Technology Assessment: Freight Locomotives*. California Environmental Protection Agency. https://ww2.arb.ca.gov/sites/default/files/classic/msprog/tech/techreport/final_rail_tech_assessment_11282016.pdf
- BLS. 2023. *Economy at a Glance: Erie, PA*. U.S. Bureau of Labor Statistics. https://www.bls.gov/eag/eag.pa_erie_msa.htm
- Casey, Tina. 2021. Battery-Electric Freight Trains Could Happen Sooner Than You Think. *Cleantechnica*, Nov 29. <https://cleantechnica.com/2021/11/29/battery-electric-freight-trains-could-happen-sooner-than-you-think/>
- Census. 2023. *Quick Facts: Pennsylvania*. United States Census Bureau. <https://www.census.gov/quickfacts/fact/table/PA/INC110221>
- Dieselnet. 2023. *United States: Locomotives*. Ecopoint Inc. <https://dieselnet.com/standards/us/loco.php>
- Ohnsman, Alan. 2022. The New Frontier In Electric Vehicles: Trains With Batteries Big Enough To Power Small Towns. *Forbes*, March 1. <https://www.forbes.com/sites/alanohnsman/2022/03/01/the-new-frontier-in-electric-vehicles-trains-with-batteries-big-enough-to-power-small-towns/?sh=28db16f71440>
- Pollin, Robert, Heidi Garrett-Peltier, James Heintz, and Bracken Hendricks. 2014. *Green Growth: A U.S. Program for Controlling Climate Change and Expanding Job Opportunities*. Washington DC: Center for AmErian Progress. <https://cdn.amErianprogress.org/wp-content/uploads/2014/09/PERI.pdf>
- Popovich, Natalie D., Deepak Rajagopal , Elif Tasar and Amol Phadke. 2021. Economic, environmental and grid-resilience benefits of converting diesel trains to battery-electric. *Nature Energy* 6, 1017–1025. <https://doi.org/10.1038/s41560-021-00915-5>
- Wabtec. 2023a. *Alternative Fuel Locomotives: FLXdrive*. Wabtec Corporation. <https://www.wabteccorp.com/locomotive/alternative-fuel-locomotives/flxdrive>
- Wabtec. 2023b. *2022 Annual Report*. Wabtec Corporation. <https://ir.wabteccorp.com/investor-relations/annual-reports>

Acknowledgments

This project was commissioned by the United Electrical, Radio & Machine Workers of America (UE). We greatly appreciate UE's financial support as well as the fact that they respected our terms of engagement. Those terms included full autonomy in drafting the study and reaching the conclusions presented here.

The study benefitted substantially from discussions with Carl Rosen, General President of UE, Scott Slawson, President, UE Local 506, and Steve Herzenberg, Executive Director of the Keystone Research Center. We also benefitted through discussions with our PERI co-workers Shouvik Chakraborty and Jeannette Wicks-Lim. Kim Weinstein produced this highly readable document at lightning speed.

About the Authors

Gregor Semieniuk (Ph.D., Economics, New School for Social Research, 2015) is Assistant Research Professor at PERI and the Department of Economics at University of Massachusetts Amherst. His research focuses on the energy and resource requirements of global economic growth and on the political economy of rapid, policy-induced structural change that is required for the transition to a low carbon economy. Gregor has testified before the U.S. Senate Committee on the Budget, consulted for the United Nations Environment Program and the UK Government on policies spurring low-carbon innovation, and has won grants to study these matters as well as transition risks for finance.

Robert Pollin is Distinguished University Professor of Economics and Co-Director of the Political Economy Research Institute (PERI) at the University of Massachusetts Amherst. He is also the founder and President of PEAR (Pollin Energy and Retrofits), an Amherst, MA-based green energy company operating throughout the United States. His books include *The Living Wage: Building a Fair Economy* (co-authored 1998); *Contours of Descent: U.S. Economic Fractures and the Landscape of Global Austerity* (2003); *An Employment-Targeted Economic Program for South Africa* (co-authored 2007); *A Measure of Fairness: The Economics of Living Wages and Minimum Wages in the United States* (co-authored 2008), *Back to Full Employment* (2012), *Greening the Global Economy* (2015), and *Climate Crisis and the Global Green New Deal: The Political Economy of Saving the Planet* (co-authored 2020). In 2018, he co-authored *Economic Analysis of Medicare for All*. He has worked as a consultant for the U.S. Department of Energy, the International Labour Organization, the United Nations Industrial Development Organization and numerous non-governmental organizations in several countries and in U.S. states and municipalities on various aspects of building high-employment green economies. He has also directed projects on employment creation and poverty reduction in sub-Saharan Africa for the United Nations Development Program. He has worked with many U.S. non-governmental organizations on creating living wage statutes at both the statewide and municipal levels, on financial regulatory policies, and on the economics of single-payer health care in the United States. Between 2011–2016, he was a member of the Scientific Advisory Committee of the European Commission project on Financialization, Economy, Society, and Sustainable Development (FESSUD). He was selected by *Foreign Policy* magazine as one of the “100 Leading Global Thinkers for 2013.”

POLITICAL ECONOMY RESEARCH INSTITUTE

The Political Economy Research Institute (PERI) promotes human and ecological well-being through our original research. Our approach is to translate what we learn into workable policy proposals that are capable of improving life on our planet today and in the future. In the words of the late Professor Robert Heilbroner, we at PERI “strive to make a workable science out of morality.”

Established in 1998, PERI is an independent unit of the University of Massachusetts, Amherst, with close ties to the Department of Economics. PERI staff frequently work collaboratively with faculty members and graduate students from the University of Massachusetts, and other economists from around the world. Since its founding, PERI has become a leading source of research and policy initiatives on issues of globalization, unemployment, financial market instability, central bank policy, living wages and decent work, and the economics of peace, development, and environmental sustainability.

