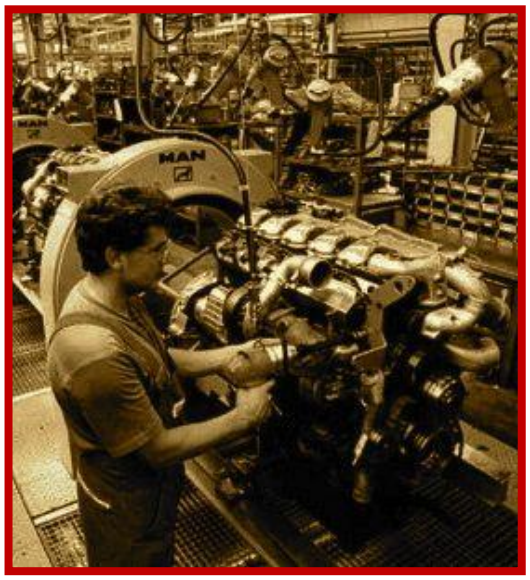
Creating U.S. Manufacturing Jobs:

How "Buying American" Can Raise the Job-Creation Potential of Public Transit Investments



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RESEARCH BRIEF
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INTRODUCTION

Across the United States, transit agencies at all levels of government—local, state, and federal—make annual purchases of new vehicles for their public transportation systems. Current investments in new railway vehicles and buses average about $5.6 billion (2012 dollars) annually.[1] Concerns over pollution, traffic, and climate change may push the nation to reach for a more expansive goal: to double ridership in 20 years. This would require an estimated $12.8 billion worth of annual rolling stock purchases.[2]

The Federal Transportation Administration (FTA) uses a "Buy America" requirement to raise the job-creation potential of such public investments that uses its funds. Specifically, the Buy America provision requires that all final assembly of the railway vehicles and buses purchased with FTA grant dollars must occur within the U.S., and all components and subcomponents must have more than 60 percent domestic content. The goal of this Buy America requirement is to insure that U.S. taxpayers' dollars create jobs in the U.S., rather than overseas by promoting greater domestic content in these vehicles.[3]

A key policy question therefore is: How many jobs does the U.S. economy gain when manufacturers raise the domestic content of their products? This research brief presents estimates which show that, on average, when manufacturers fully source the components and subcomponents of their vehicles domestically they create at least 26 percent more jobs than manufacturers that only meet the 60 percent Buy America requirement. Clearly on a case-by-case basis, stronger requirements would significantly raise the number of U.S. jobs created from these public investments.

An increase in jobs of this magnitude can also meaningfully boost U.S. manufacturing employment, particularly when considered in combination with efforts to gradually increase public transit ridership. To double public transit ridership over 20 years

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[1] These investment levels are reported in *Reviving the U.S. Rail and Transit Industry: Investments and Job Creation* by Joan Fitzgerald, Lisa Granquist, Ishwar Khatiwada, Joe McLaughlin, Michael Renner, and Andrew Sum (Table 10 on p. 22). See also: Appendix A of the American Public Transportation Association's *2013 Fact Book* (Washington DC: American Public Transportation Association, 2013).

[2] The current investment level is as of 2008, expressed in 2012 dollars. I chose the 2008 year in order to avoid any temporary influx of federal spending due to the American Recovery and Reinvestment Act of 2009.

[3] For a description of the "Buy America" program see: http://www.fta.dot.gov/newsroom_546.html

would likely involve $10.2 billion of annual spending on railway vehicles and buses tied to federal assistance. At this level of investment, raising the domestic content of these rolling stock purchases from 60 to 100 percent would create an estimated 21,400 more Full-Time Equivalent (FTE) jobs[4], 9,300 of which would be in related manufacturing.[5] Adding this many new jobs to the durable manufacturing sector would lift its current rate of annual job growth by nearly one-fifth (17 percent)—from 0.72 percent to 0.85 percent.[6]

The Domestic Content of Today's Public Transit Vehicles

Today's public transit manufacturers appear to range widely in terms of the domestic content of their vehicles. Two case studies suggest a range of between 60 percent and 100 percent domestic content among major public transit vehicle manufacturers.[7]

In 2012, two major railway vehicle manufacturers—Siemens and Kinkisharyo Limited—submitted production plans in their contract bids for supplying 78 light rail vehicles to the Los Angeles County Metropolitan Transportation Authority. Their bids to produce the same product diverged sharply in terms of the level of domestic content of their railway vehicles.

Of the ten most expensive inputs for these railway vehicles, eight are components. The other two major cost inputs include final assembly, and design and engineering. Table 1 lists the eight components, and whether each manufacturer planned to source the component domestically.

For Siemens, these eight components made up 70 percent of the total value of its more than $3 million light rail vehicle and would be sourced domestically. All components, including these eight, add up to 82 percent of the total railway vehicle's value. I use these figures to estimate the possible range of domestic content of the proposed Siemens railway vehicle, since I do not have information on all the components. Assuming that the components not listed in Table 1—which make up 12 percent of the total railway vehicle value—have *foreign* sources, then the domestic content of the railway vehicle would be, at minimum, 86 percent (70 percent/82 per-

[4] All job numbers discussed here and throughout refer to "job-years." For example, a one-time investment of $10 billion will support 21,400 FTE job-years, i.e., 21,400 full-time jobs that each last one year. If the $10 billion is an annual investment, then these 21,400 FTE positions would be sustained each year.

[5] "Related manufacturing" refers to the 15 manufacturing sectors with the largest gains in jobs associated with an increase in the final demand of railway vehicles and buses. These include such industries as: plate work and fabricated structural product manufacturing, relay and industrial control manufacturing, iron and steel mills and ferroalloy manufacturing, primary smelting and refining of copper, paint and coating manufacturing, and others.

[6] 0.72 percent is the employment growth rate for durable manufacturing. This growth rate is estimated by comparing the average employment level from January 2012-September 2012 (7.46 million) to the average employment level from January 2013-September 2013 (7.51 million; September is the latest available data at the time of this writing). If the average employment level during 2013 had been 9,300 higher, the annual employment growth rate would have been 0.85 percent. These estimates are from the establishment data of the Bureau of Labor Statistics Current Employment Statistics program.

[7] To my knowledge, no systematic research exists on the question of the range of domestic content among finished railway vehicles produced for the U.S. market.

cent = 86 percent). At maximum, assuming now that the components not listed in Table 1 have *domestic* sources, then the Siemens railway vehicle would have 100 percent domestic content. In other words, based on Siemens' bid proposal, the domestic content of its railway vehicles would have a domestic content level in the range of about 90 percent to 100 percent.

In contrast, Kinkisharyo uses foreign sources for the two highest value major components – the railway vehicle's bogie and carshell (see rows 1 and 2 of Table 1). These two components make up 24 percent of its railway vehicle value. The remaining six components in Table 1, all with domestic sources, make up 29 percent of Kinkisharyo's railway vehicle.[8]

TABLE 1: DOMESTIC CONTENT OF LIGHT RAIL VEHICLES PROPOSED BY TWO MAJOR RAILWAY VEHICLE MANUFACTURERS: SIEMENS AND KINKISHARYO

Component Costs	Siemens		Kinkisharyo	
	Domestic Source?	% of Total Value	Domestic Source?	% of Total Value
1. Truck/Bogie	Yes	24%	No	6%
2. Carshell	Yes	12%	No	18%
3. Exterior/Interior/Underfloor items	Yes	11%	Unknown	9%
4. Propulsion System & Controls	Yes	6%	Yes	9%
5. Friction Break and Pneumatic control	Yes	6%	Yes	4%
6. Passenger Doors & Controls	Yes	4%	Yes	3%
7. Automatic Train Protection & Train-to-Wayside Communications	Yes	4%	Yes	2%
8. Coupler & Draft Gear	Yes	3%	Yes	2%
% of Total Railway Vehicle Value: Components Listed	70%		53%	
% of Total Railway Vehicle Value: All Components (including those not listed here)	82%*		66%*	

Source: The Los Angeles Alliance for the New Economy (LAANE) collected these production costs data directly from manufacturers and supplied them to the author.

** The remaining railway vehicle value not made up by components (18% for Siemens and 33% for Kinkisharyo) includes such inputs as final assembly, design and engineering, tests, freight costs, etc.*

Here again, I can estimate the possible range in domestic content for the components of this railway vehicle by making some assumptions about the components not listed in Table 1. All components, including those not listed in Table 1, make up 66 percent of the railway vehicle's value. Assuming that the components not listed in Table 1 have foreign sources, Kinkisharyo's railway vehicle would have, at minimum, a domestic content level of 44 percent (44 percent = 29 percent/66 percent). If the unlisted components have domestic sources, then the railway vehicle's domestic content would rise to a possible 63 percent [63 percent = (29 percent + 13 percent)/66 per-

[8] I assume for this exercise that the Exterior/Interior/Underfloor items have a *domestic* source.

cent]. Therefore, based on Kinkisharyo's bid proposal, the domestic content of its railway vehicles would have a domestic content level in the range of about 40 percent to 60 percent.

Clearly, Siemens and Kinkisharyo have made distinctly different choices about where to source their components. The bids of these two railway vehicle manufacturers suggest that there exists a wide range in the level of domestic content in new railway vehicles produced by today's major competitors.

The bus manufacturing industry appears to operate in a similar way. As of 2010, five companies dominated the transit bus market, covering 98 percent of sales. Of these, three are subsidiaries of foreign firms, and two are U.S. companies. Researchers at Northeastern University found that, "Only one of the five, Gillig, does all of its product development and vehicle manufacturing exclusively in the United States; the others produce domestically only what is required under the Buy America provisions."[9]

Overall then, there appears to exist a wide range – roughly between 60 percent and 100 percent – in the level of domestic content among both railway vehicles and buses. That observation, in turn, suggests that raising the domestic content requirement significantly above 60 percent could have a real impact on the employment levels generated by investments in public transit. What jobs impact would result from increasing the domestic content level from the low-end to the high-end of this range? I turn next to that question.

Potential Sources of Job Gains

There are three basic channels through which an increase in the domestic content of railway vehicles and buses can cause the number of jobs created by public transit investments to rise.

(1) Direct Jobs. Direct jobs are the jobs involved in the production of the final product of railway vehicles and buses. In other words, these are jobs directly generated by original equipment manufacturers (OEMs), also called railway vehicle builders and bus builders.

The typical railway vehicle or bus OEM is not vertically integrated, i.e., its main activity is to complete the final stages of the production process, relying on other firms to produce most of the components it uses.[10] As a result, the impact of raising the

[9] See p. 15 of *Reviving the U.S. Rail and Transit Industry: Investments and Job Creation* by Joan Fitzgerald, Lisa Granquist, Ishwar Khatiwada, Joe McLaughlin, Michael Renner, and Andrew Sum (Boston, MA: Northeastern University, 2008).
[10] This is documented in the following industry reports: (1) *U.S. Manufacture of Rail Vehicles for Intercity Passenger Rail and Urban Transit* by Marcy Lowe, Saori Tokuoka, Kristen Dubay, and Gary Gereffi (Durham, NC: Center on Globalization, Governance, and Competitiveness, Duke University, 2010); (2) "Public Transit Buses: A Green Choice Gets Greener," In *Manufacturing Climate Solutions: Carbon-Reducing Technologies and U.S. Jobs* by Marcy Lowe, Bengu Aytekin, and Gary Gereffi (Durham, NC: Center on Globalization, Governance, and Competitiveness, Duke University, 2009); and (3) "Rolling Stock: Locomotives and Railway vehicles, Industry and Trade Summary," Office of Industries, Publication ITS-08, March 2011 Control No. 2011001, Washington, DC: United States International Trade Commission.

domestic content of components will not have its strongest impact on direct jobs. However, OEMs in both sectors commonly manufacture a select number of their own components. Railway vehicle OEMs typically manufacture their own car shells and some of their propulsion components. Bus OEMs typically manufacture their own bus chassis, bus bodies and interiors.

Raising the domestic content of the components that OEMs produce themselves will raise the number of "direct" jobs – the jobs created by the railway vehicle builders and bus builders themselves. These are, therefore, all jobs in the manufacturing sector.

TABLE 2. NUMBER OF FTE JOBS CREATED BY $1 MILLION PUBLIC INVESTMENTS IN NEW MASS TRANSIT VEHICLES, AT DIFFERENT LEVELS OF DOMESTIC CONTENT

A. Railway vehicles	Employment Multiplier (FTE jobs per $1 million in spending)			
Employment with domestic content level of:	Direct jobs	Indirect jobs	Induced jobs	Total jobs
60%	1.8	3.2	3.2	8.2
70%	1.8	3.5	3.4	8.7
80%	1.9	3.7	3.6	9.2
90%	2.0	4.0	3.8	9.8
100%	2.0	4.3	4.0	10.3
Total Job Gain from Raising Domestic Content 60% to 100%:				+2.1 (+26%)
B. Buses	Employment Multiplier (FTE jobs per $1 million in spending)			
Employment with domestic content level of:	Direct jobs	Indirect jobs	Induced jobs	Total jobs
60%	1.0	3.3	2.8	7.1
70%	1.0	3.5	3.0	7.5
80%	1.0	3.9	3.2	8.1
90%	1.1	4.2	3.4	8.7
100%	1.1	4.5	3.6	9.2
Total Job Gain from Raising Domestic Content 60% to 100%:				+2.1 (+30%)

Sources: IMPLAN3 with 2010 data.

* *These figures are for job-years. See technical appendix for details on the methodology used to produce these estimates.*

(2) Indirect jobs. Indirect jobs are those at the firms that supply OEMs with their inputs, including manufacturing jobs at the suppliers of their components and subcomponents. Strengthening the Buy America provision would therefore clearly impact the number of indirect jobs.[11] Indirect jobs also include those created by firms

[11] Note that in order for a component to count as "domestically produced," its contents (subcomponents) must also meet a 60 percent domestic requirement. Therefore, the Buy America provision also applies to the parts that go into the components, including the parts that OEMs need to purchase for the components they manufacture themselves.

that supply the OEMs with a range of inputs such as telecommunication services, natural gas service, and building maintenance and repair services.

(3) Induced jobs. Induced jobs result when workers holding direct and indirect jobs spend their paychecks at U.S. businesses, and stimulate further economic activity that supports even more U.S. jobs. Therefore, as the direct and indirect jobs increase due to a rise in domestic content, so too do induced jobs.

Table 2 presents figures for the level of jobs supported by a $1 million investment in railway vehicles (panel A) and a $1 million investment in buses (panel B). The jobs figures are broken down by job type—direct, indirect, and induced, as well as by domestic content level—60 to 100 percent.

Total increase in jobs. Overall, when a railway vehicle builder that just meets the current Buy America 60 percent domestic content requirement manufactures $1 million worth of railway vehicles, this activity supports 8.2 FTE jobs, including direct, indirect, and induced jobs. This figure would rise to 9.2 FTE jobs if the domestic content of these railway vehicles increased to 80 percent. This represents a 12 percent increase in the total number of jobs. If the domestic content rose further, so that 100 percent of the components are manufactured in the U.S., the number of FTE jobs would rise to 10.3, a 26 percent increase.

In the case of bus manufacturers, the total number of FTE jobs would rise from 7.1 FTE jobs to 8.1 FTE jobs, or 14 percent, if the domestic content increased from 60 percent to 80 percent. At 100 percent domestic content, the total number of FTE jobs supported by $1 million in spending would equal 9.2. This last figure represents a 30 percent increase from the number of FTE jobs supported at 60 percent domestic content.

In sum, U.S. job gains can range between 26 percent and 30 percent, when public transit vehicle manufacturers produce vehicles with components sourced fully from domestic supplies instead of the Buy America requirement of 60 percent. As expected, in both cases, indirect jobs contribute the largest share of this increase.

Buy America's Potential Overall Impact on Manufacturing Employment

Clearly, in both the railway vehicle and bus manufacturing industries, raising the domestic content level could significantly increase the number U.S. jobs generated on a case-by-case basis—with jobs rising as much as 30 percent. To understand the potential for these job gains to impact manufacturing employment more generally, I turn now to consider the overall size of this job gain given expected public investments in railway vehicles and buses nationwide.

I specifically consider two levels of public investment. First, current spending levels: public transit agencies at all levels of government (local, state, and federal) invest, on average, about $5.6 billion annually in new railway vehicles and buses. Second, a combination of pressures—climate change, rising fuel prices, air pollution and con-

gested urban roads—may push government agencies to invest a more ambitious level of spending. One estimate suggests that public investments on the order of $12.8 billion annually would enable public transit ridership to rise at a faster rate of 3.5 percent annually compared to the 2.4 percent average annual rate.[12] And, at that higher pace, the nation could double public transit ridership over two decades. [13]

Buy America provisions would cover most but not all of such spending on new railway vehicles and buses. In 2011, for example, 80 percent of public transit agency purchases involved some sort of federal financial assistance.[14] This suggests that, of the two investment levels I am considering here – $5.6 billion and $12.8 billion – the Buy America provision would likely cover about $4.4 billion and $10.2 billion, respectively. In Figure 1, I present jobs estimate for the two levels of public investments that can be expected to have domestic content requirements.

For investments on a scale of $4.4 billion annually—the current average level of public investment made in railway vehicles and buses with federal assistance—the total jobs gain from an increase in domestic content from 60 percent to 100 percent equals 9,400 FTE positions. Among these 9,400, over two-fifths are in related manufacturing sectors (4,100).

The larger scale $10.2 billion annual investment that would double public transit ridership over 20 years would add 21,400 more FTE jobs—including 9,300 related manufacturing jobs—by raising the domestic content level.

At the lower level of spending of $4.4 billion these job gains are meaningful, if modest, when considered in the context of the broader durable manufacturing sector. Now, only counting the added 4,100 related manufacturing jobs, these new jobs represent a 8 percent boost to the durable manufacturing sector's weak annual growth rate of 0.72 percent in 2013 to 0.78 percent.[15] At the $10.2 billion spending level, raising the domestic content requirement would lift the job growth rate in durable manufacturing by a sizeable 17 percent, from 0.72 percent to 0.85 percent by adding 9,300 more related manufacturing jobs.

Overall then, a stronger Buy America requirement has the potential to meaningfully increase the number of U.S. jobs created with public investments in mass transit, especially if combined with efforts to expand public transit ridership.

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[12] These estimates come from a report commissioned by the American Public Transportation Association (APTA) and the American Association of State Highway and Transportation Officials (AASHTO) titled, *State and National Transportation Needs Analysis,* prepared in 2008 by Cambridge Systematics, Inc., Bethesda, MD.

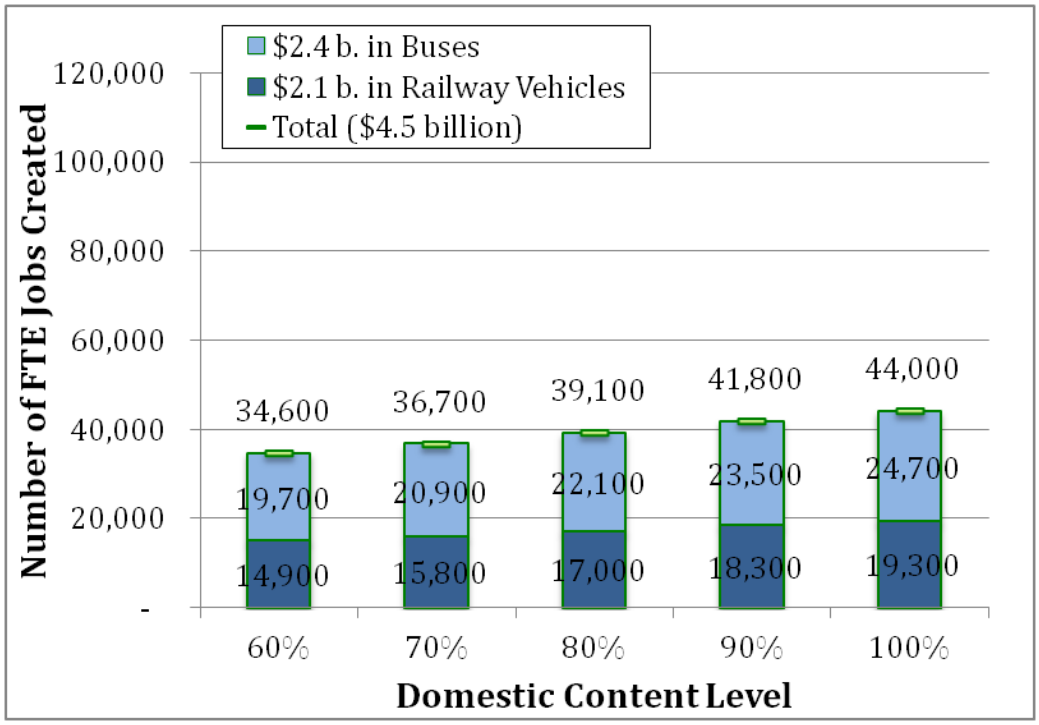
[13] Ibid.

[14] See Table 13 of the report, "Public Transportation Investment Data," 7th edition (updated July 1, 2013), published by APTA. Note that while the figure cited in the table for rail is 36 percent with no federal funding, the main text of the report states that, "The lower value of the percent using federal assistance for rail vehicles compared to buses may be due in part to the age of the rail vehicles…over one-fifth of rail vehicles were purchased before 1980 when the federal financial program was relatively small (p. 21)." Therefore, I estimate that for *future* purchases, the proportion of rail vehicles that use federal assistance will be comparable to buses. The APTA report is available at: http://www.apta.com/resources/reportsandpublications/Documents/Public-Transportation-Investment-Background-Data.pdf

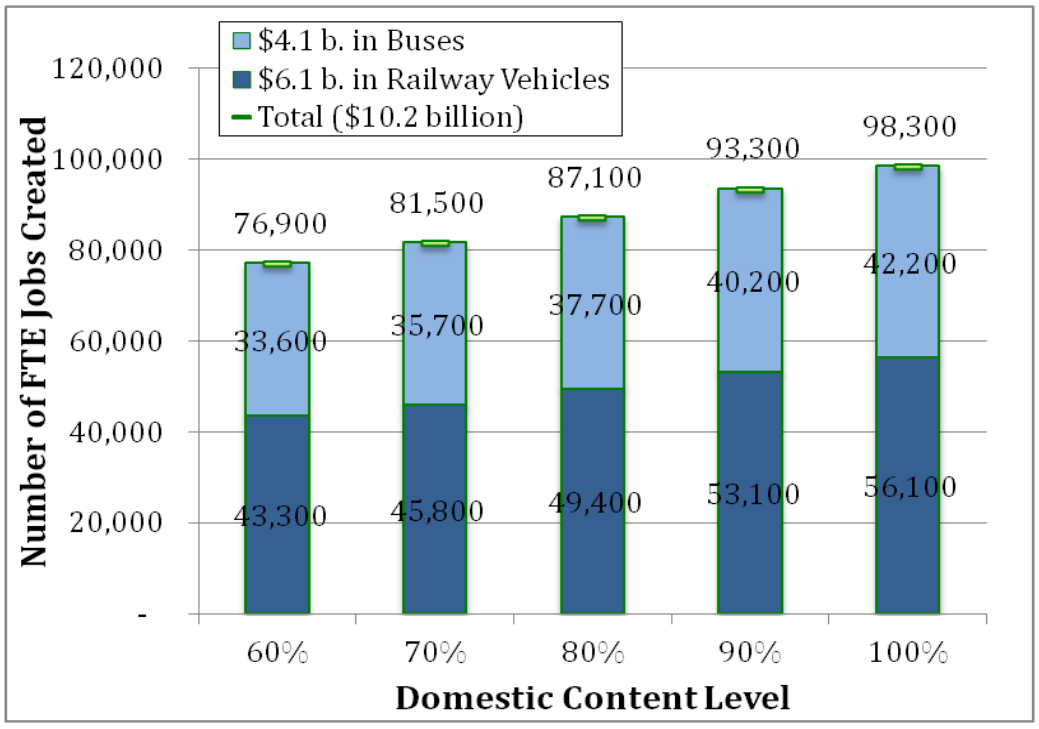
[15] This compares to a roughly two percent annual growth rate for the private sector in 2013 (through September) overall according to the BLS' Current Employment Statistics.

Figure 1. Potential Jobs Created by Public Investment in New Mass Transit Vehicles, At Different Levels of Domestic Content

A. $4.5 Billion: Current Level of Annual Investment with Federal Assistance



B. $10.2 Billion: Annual Investment Needed to Double Ridership with Federal Assistance



Strengthening the Buy America Policy

Increasing the domestic content of buses and trains – buying "American" – clearly adds jobs, including many manufacturing jobs, to the U.S. economy. Requiring a high domestic content level in mass transit equipment can therefore help public transit agencies accomplish two important goals with the same taxpayer dollar: (1) acquire equipment for essential public transit service, and (2) promote decent employment opportunities necessary for a robust economy.

The Buy America policy can also serve a third, longer-run, purpose. By supporting U.S.-based production, the policy can help advance American transit manufacturing into a more internationally competitive position across the industry's entire supply chain, including, for example, high-value railcar bogies and car shells. This would maximize the sector's ability to generate high-quality jobs in the U.S. These three goals provide a clear rationale for a Buy America policy.

Buying American, however, should not be a goal in and of itself. The three goals listed above need to be squarely front and center when evaluating how strong Buy America policies should be. If, for example, a "Buy America" policy results in U.S. jobs with poor working conditions, poorly performing manufacturers, or making public transit projects cost-prohibitive then the policy would need to be reformed. Otherwise, Buy America policies can get sidetracked from these specific economic objectives and fixate on a single goal of preserving jobs for U.S. workers only, fostering damaging xenophobic attitudes. Such a nationalist impulse can also work at cross-purposes with efforts to promote decent employment worldwide.

This brief begins the research necessary to evaluate the economic rationale for a stronger Buy America policy. Specifically, this research note asks: If the mass transit equipment purchased with taxpayer dollars exceeds the domestic content level called for by current regulation, i.e., 60 percent, would the U.S. experience a meaningful gain in employment? The answer is yes.

TECHNICAL APPENDIX

1. Methodology for estimating employment multipliers

I begin by using IMPLAN 3.0[16] with 2010 data to model a $100 million (in 2012$) increase in demand for railway vehicles and locomotives, and (separately) a $100 million increase in the demand for buses. IMPLAN specifically allows the analyst to model a $100 million increase in the demand for output from railroad rolling stock manufacturing firms (NAICS 336510) and heavy duty truck manufacturing (NAICS 336120). All the figures are based on a national model.

Note that whether I model the impact for $100 million or $1 million does not change the relative size of the jobs impact. This is because, as explained in the Pollin et al. 2009 report, *The Economic Benefits of Investing in Clean Energy*, IMPLAN's modeling, "…assumes that a given amount of spending will have a proportionate effect on employment no matter how much the level of spending changes, either up or down. For example, the impact of $1 billion on a [specific] project will be exactly 1,000 times great than spending only $1 million on the exact same project (p. 23)."[17] Therefore, to produce the employment multiplier figures per $1 million, I would simply scale down the IMPLAN figures by a factor of 100 to produce the numbers presented in Table 2.

The employment figures are expressed in terms of full-time equivalent positions (FTEs), equal to 2080 hours per position (52 weeks x 40 hrs./wk.). I convert IMPLAN's job (headcount) estimates into FTE positions by using IMPLAN's conversion factors. These factors are sector specific national averages.[18]

2. Estimating the impact of increasing the domestic content level

Direct jobs. In order to account for the impact of increasing the domestic content of the components manufactured by OEMs, I need to know what share of the total value of the finished product the OEM-produced components represent. I can then increase the level of domestic content of that share of the value of the railway vehicles (or buses), starting from 60 percent.

Based on government data, industry literature, as well as data collected by LAANE (featured in Table 1 above), I approximate that OEM-manufactured components represent 34 percent of the total value of rail vehicles. Specifically, there are two sources on which I base this 34 percent figure.

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[16] I use IMPLAN version 3 software with the 2010 data set constructed by the Minnesota IMPLAN Group, Inc. This data provides 440-industry level detail and is based on the Bureau of Economic Analysis input-output tables.

[17] See *The Economic Benefits of a Clean Energy Economy* by Robert Pollin, James Heintz, and Heidi Garrett-Peltier, Amherst, MA: Political Economy Research Institute, 2009. Available at: http://www.peri.umass.edu/fileadmin/pdf/other_publication_types/green_economics/economic_benefits/economic_benefits.PDF ; accessed April 2013.

[18] See: http://implan.com/v4/index.php?option=com_multicategories&view=article&id=628:628&Itemid=10; accessed 5/16/2013.

First, I estimate from the U.S. Economic Census 2007, that the total value of shipments of products from the Railroad Rolling Stock Manufacturing (RRSM) sector that includes parts represents 47 percent of the total value of shipments of finished rail vehicles from the RRSM sector (see data presented in Table A1, p13).[19] The shipment values do not clearly identify categories of major components, subcomponents, and finished vehicles. Instead this 47 percent figure roughly approximates the value of parts along with other activities, as a ratio of the value of finished rail vehicles. In other words, it is a rough, high end, approximation.

Second, industry studies, including Lowe et al. (2010), find that railway vehicle OEMs typically produce the following components: car shells and portions of their propulsion components.[20] In March 2012, LAANE collected data on the value of these major components as a share of the total value of light rail vehicles from three contract bids, from major manufacturers, made to the Los Angeles County Metropolitan Transportation Authority. Those figures indicate that Siemens, Kinkisharyo, and CAF produce components that are worth 47%, 31% and 24% of the total value of their railway vehicles, respectively. Siemens' high-end estimate (the company is well-known for being more vertically integrated than other railway vehicle manufacturers) matches the high-end estimate above. To approximate the share of the total value of the finished product that OEM-manufactured components represent for the *typical* manufacturer, I use the average of these three figures, or 34%.

Therefore, when modeling the employment impacts with IMPLAN I vary the level of domestic content (with IMPLAN's Local Purchase Percentage) for that 34% share of the $100 million in new spending.[21]

Unfortunately, similar data is not available for the bus manufacturing industry. However, Lowe et al. (2009) provide a detailed report on the value chain of the bus manufacturing industry, including information about what parts OEMs produce themselves.[22]

The bus manufacturing industry appears to have a similar structure as the RRSM industry. According to Lowe's study, bus builders commonly produce their own chassis, bus bodies and interiors. This is similar to the pattern found with RRSM OEMs that produce car shells and parts of the propulsion system (bogies/trucks).

Since the value chain for transit buses largely looks the same as the railway vehicle manufacturing industry, I vary the domestic content for a 34% share of spending on buses as well.

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[19] Specifically, the 47 percent figure is from: (sum of rows 2, 6-12)/(sum of rows 1, 3-5) of Table A1.
[20] Lowe et al. 2010, *op. cit.*
[21] This effectively amounts to setting the LPP to the following values:
1. 86 percent for a 60% domestic content level (i.e., since 60% x 34% = 20%, add that to the remaining 66% and you get 86%); 93% for 80% domestic content level, etc.
[22] Lowe et al. 2009, *op. cit.*

Indirect Jobs. This involves two basic steps. First, I identify the top 15 manufacturing sectors with the largest amount of indirect output associated with the $100 million in increased demand for the finished products based on the IMPLAN output. Second, I then use the average Regional Purchase Coefficient (RPC) for these 15 manufacturing sectors to adjust the number of jobs that would result if U.S. firms supplied 60 percent (or 70 percent, etc.) of the indirect output from these 15 manufacturing sectors.

I use the top 15 manufacturing sectors because supplying firms of components and subcomponents are scattered across various sectors. For example, in the 2010 report by Lowe et al., the researchers found that among the 159 firms that identified as Tier 2 firms that provide railway vehicle and locomotive firms with parts, they only identified 26 through rail-related NAICS codes. Therefore, in order to capture the suppliers of all components and subcomponents, I use a broad category: any manufacturing sector that produces a significant share (i.e., within the top 15) of indirect output.

Induced jobs. There are a variety of ways to estimate the number of induced jobs from increased spending.

The IMPLAN model uses the following approach, again as described in Pollin et al. (2009), "Induced effects are often estimated by endogenizing the household sector in the input-output model. The assumption is that increases in employee compensation (or value added) finance greater household spending, as reflected in the vector of household consumption in overall final demand."[23] In the literature, there exists a range of estimates as to the ratio of induced jobs to the number of direct and indirect jobs produced by investments. Those based on endogenizing the household sector in the way just described tend to produce high-end estimates. As Pollin et al. (2009) explain, "The endogenous household model often yields very large induced effects, in part because the propensity to consume out of employee compensation (or value-added) implicit in the endogenous household input-output model is large."[24] As a result, instead of using IMPLAN's estimates directly, I use the methodology developed by Pollin et al. (2009). See pages the technical appendix of that report for details (http://www.peri.umass.edu/fileadmin/pdf/other_publication_types/green_economics/economic_benefits/economic_benefits.PDF).[25]

Specifically, I begin with the basic IMPLAN estimates of the employment and output generated (and associated labor income) from $100 million in spending in each of the two areas (railway vehicles and locomotives, and then also for buses). I then use these figures combined with Pollin et al.'s (2009) finding that about $1 million in in-

[23] Pollin et al. 2009, *op. cit.*, p. 52.
[24] Ibid., p. 53.
[25] Pollin et al. 2009, *op. cit.*

creased labor income (in 2009$) generates sufficient economic activity to support 8.7 (induced) jobs.[26]

Miscellaneous notes. I assume that the RRSM sector primarily consists of the Tier 1 OEM firms. This is not strictly correct since there are some firms within that category that are involved in other activities aside from producing finished railway vehicles. However, as I noted above, OEMs are not, for the most part, well integrated with their suppliers, and most suppliers are not categorized as part of the RRSM sector. Therefore, it is reasonable to assume that the RRSM sector is primarily dominated by the activities of Tier 1 OEMs.[27]

TABLE A.1: DISTRIBUTION OF THE VALUE OF SHIPMENTS WITHIN THE RAILROAD ROLLING STOCK MANUFACTURING SECTOR, 2007

Product of Railroad Rolling Stock Manufacturing Sector (NAICS: 336510)	% of Total Value of Shipments
1. Locomotives, diesel-electric, new and rebuilt (excluding engines)	26.5%
2. Locomotive parts, excl. fuel lubricating and cooling medium pumps	15.6%
3. Train and train cars, freight and passenger, new, except parts	30.1%
4. Train cars, passenger and freight, rebuilt	4.6%
5. Cars (street/sub./trolley/rapid trans), self-propel/non, rebuilt	5.1%
6. Railway maintenance of railway equipment, except railway vehicles	2.3%
7. Other work/service of railroad vehicles, exc. locomotive cranes	1.2%
8. Airbrakes and other brake equipment, railroad and streetcars	1.7%
9. Prts./acs. for rrds./strcrs/tr. asm/rwy. mnt. of rwy. wy eqp.,etc	6.9%
10. Cars (rebuilt) & railway maintaince of equipment & parts, nsk	0.7%
11. Railroad rolling stock mfg, nsk, nonadministrative-records	3.7%
12. Railroad rolling stock mfg, nsk, administrative-records	1.6%
Total	100.0%

Source: 2007 U.S. Economic Census Table EC0731I2, "Manufacturing: Industry Series: Products Statistics for the United States: 2007"; See: http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk; accessed April 2013.

[26] Ibid., p. 54.

[27] For a definition of the narrowest industry category that includes railway vehicle firms available in the NAICS code (336510, railroad rolling stock manufacturing) see NAICS definition at http://www.census.gov/econ/industry/def/d336510.htm).

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