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Robert Pollin, Shouvik Chakraborty and Heidi Garrett-Peltier

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By Robert Pollin, Shouvik Chakraborty and Heidi Garrett-Peltier
Department of Economics and Political Economy Research Institute (PERI)
University of Massachusetts-Amherst

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Abstract: *This paper develops a sketch of a clean energy investment program for Spain. This program is capable of making three major contributions to advancing broadly-shared well-being in Spain: 1) Producing dramatic reductions in carbon dioxide (CO_2) emissions generated within the Spanish economy; 2) Dramatically reducing Spain's current level of oil import dependency; and 3) Generating hundreds of thousands of new jobs throughout the Spanish economy. Through all three of these channels, operating in combination, this clean energy investment program is also capable of serving as one major component of an overall program to reverse the austerity agenda that has dominated economic policymaking in Spain since the onset of the global financial crisis and Great Recession in 2007 – 09.*

This paper was written at the request of the economics team of the Spanish political party Podemos. We are grateful to comments on a previous draft by many members of the team, including Nacho Alvarez, Marta Victoria and Ivan Calvo. We also greatly benefitted from comments by Michael Ash and Francisco Louca.

This paper develops a sketch of a clean energy investment program for Spain. We argue that this program is capable of making three major contributions to advancing broadly-shared well-being in Spain: 1) It can produce dramatic reductions in carbon dioxide (CO_2) emissions generated within the Spanish economy. CO_2 emissions, in turn, are, by far, the most important factor causing global climate change; 2) It can dramatically reduce Spain's current level of oil import dependency; and 3) It can generate hundreds of thousands of new jobs throughout the Spanish economy. As such, the program can be one force to fight mass unemployment in Spain, which, as of 2015.2, stood officially at 22.4 percent.[1]

Through all three of these channels, operating in combination, this clean energy investment program is also capable of serving as one major component of an overall program to reverse the austerity agenda that has dominated economic policymaking in Spain since the onset of the global financial crisis and Great Recession in 2007 – 09.

Of course, Spain has long been a global leader in developing its clean energy economy, especially in the area of wind energy production. Indeed, Spain's electrical grid operator Red Electrica de Espana reported that for the month of March 2015, 47 percent of the country's electricity was generated from clean renewable energy sources, mainly from wind power but with a small solar energy sector that has been growing as well.[2] However, as a result of the economic crisis and onset of austerity policies, since 2013, government subsidies for renewable energy have been sharply curtailed. These subsidy cuts have created major difficulties throughout Spain's renewable energy sector.[3]

We aim to show here how a revival of investments in solar, wind and other renewable energy sources, along with major investments as well in energy efficiency, can serve as a major counterforce to the austerity agenda in Spain. At the same time, the development of a new large-scale commitment to clean energy investments in Spain should not be regarded as an opportunity for large private corporations to gain increasing dominance over Spain's clean energy economy. Rather, as we discuss, reviving a large-scale clean energy investment program for Spain should also been seen as an opportunity to promote small-scale community ownership as well as off-grid distributed energy suppliers.

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1 http://www.ine.es/dyngs/INEbase/en/operacion.htm?c=Estadistica_C&cid=1254736176918&menu=ultiDatos&idp=1254735976595

2 http://www.ree.es/en/press-office/press-release/2015/04/demand-electrical-energy-fell-0-2-march

3 See, e.g.: http://www.nytimes.com/2013/10/09/business/energy-environment/renewable-energy-in-spain-is-taking-a-beating.html

CLEAN ENERGY INVESTMENTS, CO_2 EMISSIONS AND JOB CREATION

In its essentials, the clean energy investment program for Spain that we sketch here consists of two basic components. These are investments that will 1) dramatically raise energy efficiency standards throughout the Spanish economy; and 2) equally dramatically, expand Spain's supply of renewable energy sources Spain's capacity to produce clean renewable energy.

We have designed this program at an annual spending level equal to 1.5 percent of Spain's GDP, with the program proceeding on this basis over a 20-year investment cycle.[4] Spain's GDP in 2013 was approximately $1.4 trillion. This means that total clean energy investments in Year 1 of the program will be $21 billion.

This $21 billion level of Spanish clean energy investment spending in Year 1 includes the total of both public and private clean energy investments. We discuss below issues around the how to divide this total level of investment spending between the public and private sectors. For now, the general idea is that most new investment will be private, though supported by a range of public policy incentives. We also anticipate that a significant proportion of new private investments will include small-scale and community-owned enterprises. We are not assuming that new private investment in clean energy will be dominated by large-scale corporations.

Moving forward over the full 20-year investment cycle, we assume that, over the 20-year period, Spain's GDP grows at an average rate of 2.4 percent per year.[5] This means that the amount of money spent on clean energy investments will rise correspondingly at 2.4 percent per year, in order to maintain the proportion of clean energy investments at 1.5 percent of annual GDP. Based on this framework, Spain's GDP will be $2.25 trillion in Year 20 of the program. Clean energy investments will therefore be $34 billion in Year 20.

Energy efficiency investments will include, as leading priorities, retrofitting buildings of all types—commercial, residential, and institutional—to substantially lower their energy consumption without reducing the functioning of the buildings; upgrading the electrical grid system; expanding public transportation; and a range of industrial efficiency measures, such as combined heat-and-power (CHP) systems. CHP systems

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[4] Why scale the program at 1.5 percent of annual GDP? As we discuss in Pollin et al. (2015), this is roughly the level at which many countries throughout the world have targeted their clean energy programs. We therefore are remaining within this mainstream policy framework in setting the investment target at 1.5 percent of GDP.

[5] Our GDP growth assumption follows from this source: The European Commission Directorate-General for Energy, 2010. "EU Energy Trends to 2030 – Update 2009." We also use this source for the Business-as-Usual forecast for both the level and composition of Spain's energy consumption as of 2035, which we present below.

dramatically improve energy efficiency by using waste process heat to generate a productive low-cost energy source.

Investments in clean renewables will include wind, solar, geothermal, small-scale hydro, and low-emissions bioenergy sources, including ethanol from switchgrass, agricultural wastes and waste grease. We will give greater weight to investments in wind, first of all, as well as, secondarily, to solar and bioenergy, as these are the clean renewable sectors with the greatest potential for ongoing growth in Spain. We are not including high-emissions bioenergy sources, such as corn ethanol or wood-burning, as a "clean renewable" energy source. CO_2 emissions from these sources are roughly equivalent to those produced by burning coal.

Some analysts consider "clean energy" to include nuclear power and carbon capture and sequestration (CCS) technologies. We do not. Nuclear power does generate electricity without producing CO_2 emissions, but it also creates major environmental and public safety concerns, which have only intensified since the March 2011 meltdown at the Fukushima Daiichi power plant in Japan. Similarly, CCS technologies present hazards. These technologies aim to capture emitted carbon and transport it, usually through pipelines, to subsurface geological formations, where it would be stored permanently. But such technologies have not been proven at a commercial scale. The dangers of carbon leakages from flawed transportation and storage systems will, in any case, only increase to the extent that CCS technologies are commercialized. As such, the most cautious program for clean energy demands investments in technologies that are well-studied, already improving rapidly, and will not pose major public safety and environmental problems. This means focusing the 1.5 percent of Spain's GDP every year on investments in energy efficiency and clean renewables.

We have designed the program so that the breakdown in clean energy investments is 1 percent per year for clean renewable energy sources and 0.5 percent per year for energy efficiency. The main reason to divide total spending in this way is that it is much cheaper to generate a given amount of energy savings from energy efficiency investments than to expand energy production through renewable sources—or, for that matter, non-renewable sources. At the same time, these spending proportions could be adjusted, depending on specific needs and circumstances at any given time. For example, as we discuss later, for the initial years of this program, it may be appropriate to increase energy efficiency investments, especially in the area of building retrofits, as the single most efficient short-term stimulus initiative among the clean energy investments.

We review the basics of our calculations with respect to both the energy efficiency and clean renewable energy estimates in Tables 1 and 2.

Energy Efficiency

We developed our estimates as to the cost effectiveness of energy efficiency investments for Spain as follows. We start with an estimate of the average investment costs for achieving a given level of efficiency gains. The available research varies widely on this figure—i.e., specifically, the spending needed to achieve a quadrillion BTUs (Q-BTU) of saving relative to a Business-as-Usual (BAU) framework for Spain's economy and energy infrastructure. To be conservative in our assumptions, we work with a very high end estimate of these average costs—i.e. $30 billion per 1 Q-BTU of saving. We derive this figure based on research from the U.S. National Academy of Sciences.[6] Even beyond this basic average figure, we are also assuming that the costs of achieving efficiency gains will rise sharply once Spain has reached a "high efficiency" level throughout the economy. We define this "high efficiency" level as being roughly equal to the level of efficiency that the German government has projected for its economy as of 2035.[7]

Finally, we assume that the distribution of energy efficiency investment funds is: 50 percent for building retrofits; and 16.7 percent respectively for public transportation, electrical transmission grid upgrades and industrial efficiency processes. The efficiency investment proportions we have chosen reflect three points: 1) buildings in Spain, as in most other advanced economies, operate on average at low efficiency levels; 2) the costs of achieving efficiency gains in buildings is generally lower than through other efficiency investments; and 3) the energy efficiency building retrofit projects will generate large numbers of jobs for construction workers. The construction industry in Spain contracted sharply as a result of the global financial crisis, and has yet to recover. This, in turn, has served as a major drag on recovery and job creation throughout the Spanish economy.[8]

Based on these assumptions, we see in Table 1 that, through investing 0.5 percent of GDP per year in energy efficiency, overall energy consumption in Spain as of Year 20 will fall relative to the projected BAU figure from 6.87 Q-BTUs to 4.69 Q-BTUs. This is a 32 percent decline in Spain's absolute consumption level. Spain would achieve this

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[6] Other estimates include an average of $2 billion per Q-BTU from a 2009 World Bank study and $11 per Q-BTU from a study by the leading global business consulting firm McKinsey and Company. See Pollin et al. (2015) for further details on these estimates.

[7] This "high efficiency" level, more specifically is an "energy intensity" ratio of 2 Q-BTUs per $1 trillion of GDP. At present, Spain's energy intensity ratio is at roughly 4 Q-BTUs per $1 trillion of GDP, which is approximately equal to that for Germany.

[8] See, "Spain: Record Joblessness Mainly Caused by Collapse of Construction Sector," *Center for Economic and Business Research*, 4/26/13, for one perspective on this question. This article reports that the number of jobs lost directly in construction between 2007.3 and 2013.1 amounted to 43 percent of all employment losses over this period. But this article also states that the employment multiplier in construction is very high, at 2.8. If this multiplier figure is accurate, it suggests that the collapse of construction in Spain has itself caused an employment contraction on the order of 4.5 million jobs. http://www.cebr.com/reports/spain-record-joblessness-mainly-caused-by-collapse-of-building/

absolute decline in consumption even while we are assuming that economic growth proceeds at an average rate of 2.4 percent per year.[9]

TABLE 1 BELONGS HERE

Possible Rebound Effects?

Could rising energy efficiency standards encourage consumers to expand their energy-using activities—what is termed the "rebound effect?" The economist William Stanley Jevons first described this phenomenon in 1865, when he observed that the invention of more efficient steam engines led to more, not less, coal consumption in nineteenth-century Britain. However, unlike British coal users in Jevons's time, most energy consumers in Spain today will not want to heat, cool, and light buildings, drive long distances, or operate appliances substantially more than they already do. Any rebound effect that may emerge as a byproduct of economy-wide energy efficiency investments should therefore not be large enough to counteract the significant environmental benefits. Nevertheless, the most effective way to limit rebound effects is to combine efficiency investments with complementary measures to change the economy's overall energy mix. In this sense, as well as others, it is crucial that we expand the supply of clean renewable energy and raise the prices of oil, coal, and natural gas relative to renewables in order to discourage consumers from relying on fossil fuels.

Clean Renewable Energy

We present our assumptions and cost estimates for clean renewable energy investments in Table 2. We base our assumptions at the average costs of expanding productive capacity for clean renewable energy sources based on research by both the International Renewable Energy Agency (IRENA) and the U.S. Department of Energy.[10] From these sources, we are assuming that, over the full 20-year investment cycle, the average cost of expanding clean renewable energy will be $200 per Q-BTU additional productive capacity.

We also assume that, over the full 20-year investment cycle, new investments in renewable energy will be distributed as follows: 50 percent for wind; 20 percent for both solar and bioenergy; and 5 percent each for geothermal and small-scale hydro. These percentages reflect, first, the demonstrated success of Spain's wind power sector as well

[9] We also note that if we assumed no constraint on achieving further efficiency gains beyond the German-level "high-efficiency" standard that Spain could push energy consumption down further through maintaining energy efficiency investments at 0.5 percent of GDP over 20 years.
[10] Details on our methodology for estimating these costs are presented in Pollin et al. (2015) and Pollin and Chakraborty (2015).

as the strong future prospects for both solar and low-emissions bioenergy. The prospects for geothermal and small-scale hydro are probably more limited.[11]

TABLE 2 BELONGS HERE

As we see in Table 2, through investing an average of $18.5 billion per year over the full 20-year investment cycle, Spain will produce 1.85 Q-BTUs of clean renewable energy as of Year 20 above the BAU scenario of 1.07 Q-BTUs. This brings total clean renewable energy production as of Year 20 to 2.92 Q-BTUs—a 173 percent expansion in clean renewable production relative to the BAU case.

The main factor that makes this major expansion in clean renewable energy production a realistic prospect is that the trajectory for prices and costs for renewables is becoming increasingly favorable. According to research published by IRENA, under a wide range of conditions, renewable energy electricity generation is already at cost parity with non-renewables, or will be so within the next 5 – 10 years.[12] In addition, the price gap that may still exist between fossil fuel energy and clean renewables would close altogether through the establishment of a carbon cap or carbon tax. As we discuss below, either a carbon cap or tax would raise prices for oil, coal, and natural gas relative to renewables.

It is also important to recognize that the costs for generating clean renewable power will decline sharply as these technologies are increasingly deployed. With respect to solar energy, for example, IRENA (2013) estimates that costs will fall by as much as 22 percent for every doubling in solar generating capacity. This figure is especially favorable because solar energy currently provides perhaps one-quarter of one percent of global energy supply. It is realistic to anticipate that solar energy production will increase between five and tenfold over the next 20 years, in Spain and elsewhere, which would then mean that solar costs could fall by between about 60 – 80 percent.

Spain's Year 20 Energy Consumption and Emissions

Table 3 brings together the results from the energy efficiency and clean renewable energy investments presented in Tables 1 and 2. Thus, in Table 1, we saw that investing 0.5 percent of GDP per year on energy efficiency will generate 2.18 Q-BTUs of energy saving relative to the 2035 BAU scenario. We then saw in Table 2 that investing 1.0 percent of GDP per year on clean renewables will generate a net increase of 1.85 Q-BTUs of clean renewable capacity.

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[11] See Análisis del recurso. Altas eólico de España. Estudio técnico PER 2011-2020. IDEA and Report Greenpeace '*Renovables 2050 Greenpeace Un informe sobre el potencial de las energías renovables en la España peninsular'* for perspectives on prospects for small-scale hydro and geothermal in Spain. We are grateful to Marta Victoria and Ivan Calvo for clarifying these points and providing valuable references.
[12] See IRENA (2013), Figure ES-2.

In addition to these two new energy sources, we assume that nuclear energy generation in Spain will fall from its current level of 0.6 Q-BTUs to zero over the span of our 20-year investment cycle. This is because the operating nuclear power plants in Spain were installed in the 1980s. Assuming productive lifetimes of these plants at between 35 – 40 years, these plants should be closing between 2018 – 2028. We are assuming that no new plants will be built in the interim. This is because, as noted at the outset, public safety and environmental concerns with nuclear are increasing with time; but also because, after sixty years of operation, the costs of nuclear power generation remain high relative to both fossil fuels and most renewable sources.[13]

Within our overall clean energy investment framework, total fossil fuel energy demand in Year 20 is derived as the residual—i.e. the total level of Spanish energy consumption in Year 20 minus the supply of energy provided by renewable sources, assuming that nuclear energy supply falls to zero. As a result, as we show in Table 3, total demand for fossil fuel energy in Year 20 will be 1.77 Q-BTUs. This is a 66 percent decline in Spanish fossil fuel consumption relative to the Year 20 BAU scenario.[14]

TABLE 3 BELONGS HERE

A good rough approximation of the extent of CO_2 emissions generated through burning oil, coal and natural gas in Spain is 70 million tons of CO_2 per Q-BTU of fossil fuel consumption. That therefore means that total CO_2 emissions in Spain as of Year 20 will be 123.9 million tons. This amounts to 2.6 tons per capita as of Year 20. This is a 62 percent decline in per capita emissions for Spain relative to the BAU assumption of 6.9 tons per capita. This massive reduction in per capita emissions would be achieved, again, even as we assume that the Spanish economy grows at an average annual rate of 2.4 percent per year over the full 20-year investment cycle.

[13] See Pollin et al. (2015), pp. 69 – 71 for details and further discussion on comparative costs of electricity generation by alternative energy sources. We also benefitted from discussions with Marta Victoria and Ivan Calvo for sharing their perspectives on the state of Spain's nuclear energy industry.

[14] We recognize that a significant share of the total fossil fuel supply—specifically here, the supply of oil—will be needed as a liquid fuel for Spain's transportation sector. Specifically, we estimate that liquid fuels for transit will constitute approximately 25 percent of Spain's overall energy demand as of 2035. This amounts to about 1.13 Q-BTUs of overall demand. We also estimate that clean biofuels can provide about 0.25 Q-BTUs of liquid energy supply as of 2035 (see European Commission 2006 and European Renewable Energy Council 2009 for details). This means that 0.88 Q-BTUs of liquid fuels from oil will be needed for Spain's transportation sector. As we have seen in Table 3, we are assuming that total demand for fossil fuels as of 2035 will be 1.77 Q-BTUs, more than double the level of liquid fuels needed for Spain's transport sector. As such, we conclude that providing adequate levels of liquid fuel supply for transportation in Spain will not act as a constraint on successfully implementing the green investment program we have outlined over the next 20 years.

Three Major Benefits of Spain's Clean Energy Investment Program

The clean energy investment program we have outlined will generate major benefits for Spain, along three fundamental dimensions: 1) CO_2 emissions and climate stabilization; 2) Eliminating oil import dependency; and 3) Job Creation. We consider these in turn.

CO_2 emissions and Climate Stabilization

As of 2009, Spain's CO_2 emissions were at 308 million tons, which amounts to 6.5 tons per capita.[15] This is already a strong performance relative to other advanced economies. For example, as of the World Bank's most recent 2010 comparative global figures, emissions are at 17.6 tons for the United States and 14.7 tons for Canada. Relative to other European economies, Germany is 9.2 tons per capita, the UK is at 7.9, Italy is at 6.9, and Norway is at 11.7. Only France is lower, at 5.6 tons per capita. But this is because France relies on nuclear power to generate roughly 25 percent of all its energy, including 83 percent of its electricity. In Spain, the share of total energy supply generated by nuclear power is only 11 percent.

In any case, within the next 20 years, the Intergovernmental Panel on Climate Change has concluded that global CO_2 emissions need to fall from its current level of about 33 billion tons to 20 billion tons. On a per capita basis, this means that average emissions will need to fall from its current level of 4.6 tons to 2.4 tons. The implication is clear for Spain and other countries at similar emissions levels. That is, it is imperative that Spain, along with the other countries at similar emissions levels, achieve dramatic emissions reductions over the next 20 years if the world is going to have a reasonable prospect of bringing global emissions down to 2.4 tons per capita.

We have seen that, under our framework in which 1) Spain devotes 1.5 of GDP per year in energy efficiency and clean renewable investments; 2) Nuclear energy is phased out entirely by 2035; and 3) the Spanish economy grows at an average rate of 2.4 percent per year, emissions in Spain will fall to 2.6 tons per capita. That is, under this clean energy investment program, Spain will be able to bring its emissions down to a level approximately equal to the 2.4 tons per capita target that is minimally necessary as an intermediate global target for climate stabilization. This would represent a fundamental contribution to the global project of climate stabilization.

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[15] This figure comes from European Commission Directorate-General for Energy, 2010. "EU Energy Trends to 2030 – Update 2009." Luxembourg: Publications Office of the European Union. A more recent figure, from the World Bank's World Development Indicators, gives figures for 2010. This reference puts Spain's emissions as of 2010 at 5.8 tons per capita. We are using the European Commission's baseline figures here for consistency, since this source provides more detail on the composition of Spain's energy consumption levels as well as the BAU projections for 2035.

Eliminating Oil Import Dependency

As of 2014, Spain imported about $74 billion in fossil fuel products. About 60 percent of this was crude oil, with most of the rest being refined oil and natural gas. This amounted to about 5.3 percent of Spain's 2014 GDP. At the same time, Spain did also export about $23 billion in fossil fuel products, in this case, mostly refined oil as well as smaller amounts of natural gas. Spain's net fossil fuel import bill in 2014 was therefore $51 billion, or 3.6 percent of GDP. As a result of the 20-year clean energy investment program, Spain's net fossil fuel imports will fall steadily, as the economy's overall level of energy consumption falls with rising efficiency, and as clean renewable energy supplies rise. This will generate three major benefits to the Spanish economy.

1. Enabling self-financing of clean-energy investment program. As a rough approximation, based on crude oil prices averaging about $100 per barrel over the 20-year investment cycle, we estimate that Spain's net fossil fuel imports would fall by nearly 80 percent, to 0.8 percent of GDP by Year 20. If we assume that the decline in Spain's fossil fuel import ratio falls steadily from its current level of 3.6 percent of GDP to 0.8 percent of GDP by Year 20, this implies that the average fossil fuel imports/GDP ratio over the 20-year investment cycle will be 2.2 percent. Put another way, the average annual *reduction* in the net fossil fuel import ratio will be 1.4 percent of GDP. Again, this is the difference between the current 3.6 percent of GDP ratio to the average figure under our 20-year scenario of 2.2 percent of GDP. What these rough calculations show is that our clean energy investment project, operating at a 1.5 percent of GDP level over the 20-year investment cycle, could be virtually self-financed through capturing the benefits of this energy import-substitution program—i.e. substituting an average of 1.4 percent of GDP in fossil fuel energy imports for investments in energy efficiency and clean renewable energy at 1.5 percent of GDP. We return to this point below, in discussing financing issues in more detail.

2. Promoting job creation. The decline in net fossil fuel imports will enable the Spanish economy to grow more quickly, because the balance-of-payments constraint on growth that it now faces will be increasingly relaxed over the 20-year investment cycle.

Spain's recent experiences with its trade account are instructive. That is, Spain ran modest balance-of-payments surpluses between 2012 – 2014 in 2012 and 2013, since 2012, but held deficit positions from 2005 – 11. The Bank of Spain reported in October 2014 that the previous surpluses had been effectively eliminated, because of both the ongoing high energy import bill—even though that import bill had declined modestly—and the decline in exports to offset these energy imports.[16] The fact that the clean energy investment program will relax Spain's oil import dependency and balance-of-payments

[16] http://www.bde.es/f/webbde/GAP/Secciones/SalaPrensa/NotasInformativas/14/Arc/Fic/presbe2014_47en.pdf

constraints will therefore allow job opportunities to expand more generally as an accompaniment of steady positive growth rates.

3. Supporting wage increases. The fact that Spain's balance-of-payments constraint on growth will be relaxed through rising energy efficiency standards and expanded renewable energy production also, in turn, creates a more favorable environment for wages to also rise. This is because the requirement to keep labor costs low as a means of maintaining global competitiveness will become less significant as oil import dependency declines.

Clean Energy Investments Create Jobs

In addition to supporting job creation and rising wages through reducing Spain's oil import dependency, the clean energy investment program will also advance job creation in Spain through the more direct channel of the increased investment activity itself. Our overall findings through this job creation channel are as follows.

We estimate that in Year 1 of the program, in which $21 billion is spent on clean energy investments, about 300,000 new jobs will be generated. This is about 1.3 percent of the Spanish labor force. By Year 20, we estimate that total job creation will rise to about 410,000 jobs. This will be about 1.8 percent of Spain's labor force as of Year 20. For purposes of this estimate, we assume that labor productivity in Spain's clean energy sectors rises at an average rate of 1 percent per year over the 20-year investment cycle.[17]

Some of the specifics steps through which we estimated these employment figures from the clean energy investment program are as follows. The most basic point is that clean energy investments will generate new employment opportunities through three channels. These are:

1. **Direct jobs:** the jobs created, for example, by retrofitting buildings to make them more energy efficient or by building and installing wind turbines;

2. **Indirect jobs:** the jobs associated with industries that supply intermediate goods for building retrofits or wind turbines, such as lumber, steel, and transportation; and

3. **Induced effects:** the jobs that are generated people who are paid in the construction, steel or transportation steel industries spend the money they have earned on other products in the economy.[18]

[17] See Pollin et al. (2015) for details on calculating changes in employment/spending ratios and labor productivity within the framework of a 20-year clean energy investment cycle.
[18] We are assuming an employment multiplier of 0.5. We take this to be a conservative assumption, based on Spain's input-output model and a review of the relevant recent literature.

There are two basic reasons why this program will generate an overall expansion of jobs, including direct, indirect, and induced jobs. First, job creation will result through the injection of more investment spending in Spain's economy. The extent of job creation will depend on two factors: a) the amount of money that is spent on clean energy investments; and b) the employment/spending ratio—i.e. how many jobs get generated through spending a given amount of money.

In addition to this, unlike in other countries that are fossil fuel energy producers, the injection of spending in clean energy investments will not be counteracted by a reduction in domestic spending on fossil fuels. Rather, as we have seen, Spain operates with a net fossil fuel import ratio at 3.6 percent of GDP. This means that the spending on clean energy investments will be matched by a decline in Spain's fossil fuel import dependency. Thus, over the full 20-year investment cycle, the annual spending injections at 1.5 percent of GDP to advance the clean energy investment program will represent a pure positive increase in Spanish employment. This includes the induced job creation—i.e. the multiplier effects—generated by the expansion of direct and indirect jobs. In countries that have significant fossil fuel production activity that would be declining over the 20-year clean energy investment cycle, the positive induced effects generated by the expansion of clean energy jobs would be counteracted by the negative induced effects of employment retrenchments in the country's fossil fuel sectors.

In Table 4, we show our estimates of the employment/spending ratios for clean energy investments in Spain. As we see in the table, we estimate that, on average, energy efficiency investments—weighted, as stipulated in Table 1—will generate 20.1 jobs per $1 million in spending, including 8.7 direct, 4.7 indirect, and 6.7 induced jobs. Investments in clean renewable energy, weighted, as shown in Table 2, will generate a total of 18.4 jobs per $1 million in spending, including 7.9 direct, 4.4 indirect, and 6.1 induced jobs. When we allow that total clean energy investment spending will be divided, with 67 percent going to renewables and 33 percent to efficiency, we derived the weighted average for total clean energy investments, as we see in column 3 of Table 4. Overall, then, as Table 4 shows, we estimate that overall clean energy investments, weighted according to our assumptions, will generate an average of 19.0 jobs per $1 million in spending.[19]

TABLE 4 BELONGS HERE

In Table 5, we then show how these employment/spending ratios lead to job creation when 1.5 percent of Spain's GDP is channeled into clean energy investments. In

[19] These employment ratios are based on what, in Pollin et al. (2015), we term "lower domestic content" estimates of employment generation. With these estimates, we assume that Spain's tradable industries (which we define as those in which the current share of imported content is greater than 10 percent) do not expand as quickly as the overall demand for clean energy investments. As such, under our assumptions, the rise in clean energy investments will entail an increase in the import content within the affected tradable industries. Our employment estimates reflect this proportional rise in Spain's imports.

Year 1 of the program, we assume Spain's GDP is $1.4 trillion, which means that 1.5 percent of GDP is $21 billion. When we assume that Spain's GDP growth trend will be 2.4 percent per year for 20 years, that means that in Year 20, Spain's GDP will be $2.3 trillion and overall spending on clean energy investments will be $34 billion. We then also assume that of the total budgets for clean energy investments, 80 percent is spent on creating energy efficiency and renewable energy capacity, while 20 percent devoted to financing these projects.[20]

TABLE 5 BELONGS HERE

Based on these assumptions, we see in Table 5 how we derive our overall employment figures, both in Year 1 and Year 20 of the program. As we see, again, in Year 1, job creation will be at 300,000, amounting to 1.3 percent of the Spanish labor force. As of Year 20, we estimate, as a first approximation, that job creation will be at 410,000, or 1.8 percent of Spain's labor force in Year 20.

This level of new job creation will provide significant new opportunities throughout the Spanish economy. But it clearly will not generate full employment in Spain on its own. Still, increasing employment by between 1.3 – 1.8 percent of the Spanish labor force will push the expansion of job opportunities in the right direction. This new wave of job creation will also be working with the relaxation of the oil import dependency constraint to encourage the expansion of job opportunities in Spain more generally. As we will discuss below, it is also possible to consider accelerating parts of the overall clean energy investment program to increase these positive employment gains. This is especially the case in the area of investments in energy efficiency building retrofits, in which the bulk of the new job creation would be concentrated in Spain's construction sector.

POLICIES TO ADVANCE CLEAN ENERGY INVESTMENTS[21]

Successfully advancing a clean energy investment project in Spain will require an effective integration of public investments and incentives for private investors. To the extent that public investments and policies that incentivize private investments are effectively integrated, a critical result will be that the level of direct public expenditure necessary to enable the program to succeed does not have to be large. This is especially true because a fundamental feature of the program is that domestically-produced clean energy resources will be substituting for imported fossil fuel energy. This means that, within a framework of effective public policy incentives, private investors will have access to major new market opportunities within Spain's domestic economy. Further, as

[20] Our assumption that 20 percent of total project spending is devoted to financing charges is works from the idea that these projects will be financed at an overall cost-of-capital that is modestly lower than purely market rates. We discuss such financing issues further below.
[21] This policy framework builds from discussion presented in Pollin (2015).

we discuss below, the increased opportunities for private enterprises in Spain should include small-scale businesses as well as community-owned enterprises.

The Centrality of Industrial Policies

Effective industrial policies will be necessary to achieve a successful clean energy transformation in Spain. Industrial policies will be needed to promote technical innovations and, even more importantly, adaptations of existing clean energy technologies within any given setting. Spanish policymakers will need to deploy a combination of industrial policy instruments, including research and development support, preferential tax treatment for clean energy investments, preferential financing arrangements, and government purchasing policies. Clean energy industrial policies will also include regulations, on both fossil fuel and clean energy prices as well as emission standards. We briefly consider some of the key policy questions at stake.

Technological Adaptation

Within the overall clean energy investment project, there will be some areas in which Spain will want to advance at the technological frontier. Developing highly efficient wind turbines and electricity transmission grids may be two such areas. But even more important will be the ability of Spain to successfully adapt and integrate existing clean energy technologies throughout the economy. This role for industrial policies is described well in Mariana Mazzucato's 2014 book *The Entrepreneurial State*. Mazzucato argues that:

> Governments have a leading role to play in supporting the development of clean technologies past their prototypical states through to their commercial viability. Reaching technological 'maturing' requires more support directed to prepare, organize, and stabilize a healthy 'market,' where investment is reasonably low risk and profits can be made (2014, p. 136).

Public Investments

There is a range of specific interventions that Spanish policymakers can make to 'prepare, organize and stabilize a healthy market.' One area is for the government to itself to become a large-scale investor in both energy efficiency and purchasers of clean renewable energy. A most obvious case in point is for all government entities within Spain to commit to energy efficiency retrofits for the entire publicly-owned building stock. Such investments do not require relying on high-tech equipment that may be unfamiliar in some circumstances . They rather entail utilizing such low-tech operations as upgrading lighting, heating and air-conditioning systems; improving insulation and building shading; and replacing old windows. Such investments will bring immediate gains to taxpayers through lowering the public sector's energy costs. They will also generate jobs in both the short- and longer-term for unemployed construction workers. A large-scale public sector investment in raising building efficiency standards will also encourage similar investments by private building owners, within both the commercial and residential building sectors.

Tax and Dividend

Another policy intervention that can help develop a stable, healthy market for clean energy investments is to set a price on carbon emissions, through either a carbon tax or carbon cap. A carbon tax or cap raises the market prices of oil, coal, and natural gas, to reflect the enormous costs and risks being imposed on societies by ongoing CO_2 emissions. Raising the prices for fossil fuels will also, of course, create increased incentives for both energy efficiency and clean renewable investments. [22]

At present, Spain does already operate with taxes on motor fuel, diesel oil, fuel oil, and kerosene, at 24 Euro/1000 liters. There is also a 4.864 percent tax imposed on the production or import of electricity.[23] One question with respect to these policies is whether the tax rates are set high enough to sufficiently encourage energy consumers to switch from the use of fossil fuels to clean energy sources. At present, in combination, all environmental taxes in Spain are the lowest in the European Union, at 1.6 percent of GDP, as opposed to the EU average of 2.4 percent.[24]

Another equally important issue with respect to carbon taxes or carbon caps is their distributional impact. All else equal, increasing the price of fossil fuels affects lower-income households more than affluent households, since motor fuel, fuel oil, and electricity absorb a higher share of lower-income households' consumption. An effective solution to this problem is a so-called 'tax-and-dividend' or 'cap-and-dividend' policy. Under this arrangement, most, if not all, of the revenues generated by the policy (the tax or cap) would be returned in equal amounts to all people in Spain. The effect would be that lower-income households would receive more money as dividends from the policy than they would pay out in higher energy prices. At the same time, because the revenues

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[22] A carbon cap establishes a firm limit on the allowable level of emissions for major polluting entities, such as utilities. Such measures will then also raise the prices of oil, coal, and natural gas by limiting their supply. A carbon tax, on the other hand, would raise fossil fuel prices directly. There are various specific strengths and weaknesses with either approach (see Pollin et al. 2015 for a discussion of these). For our purposes, the main point is that both can be effective in both raising fossil fuel prices and generating tax revenues.

[23] http://www.cfe-eutax.org/taxation/environmental-taxes/spain.

[24] See European Commission Staff Working Document, *Country Report on Spain 2015*, p. 51, http://ec.europa.eu/europe2020/pdf/csr2015/cr2015_spain_en.pdf

from this policy would be substantial, even if most of it were returned directly to the Spanish people, there could still be a large amount leftover that could help finance the economy's clean energy investment project.[25] We return to this financing issue below.

Feed-in Tariffs

Directly guaranteeing a market with stable prices for clean renewable is also critical here. Such policies fall under the term "feed-in tariffs." These are contracts that require electrical utility companies to purchase electricity from private renewable energy generators at prices that are fixed by long-term contracts.

Feed-in tariffs were first implemented in Spain in 2007. They have been critical to the development of the solar and wind sectors in Spain. Despite this, the Spanish government enacted cuts in the feed-in tariff rate, beginning in July 2013. This has substantially lowered the returns to renewable energy investors in Spain, and thus weakened the incentive for new renewable energy investments. The reason these cuts were made is because the utilities in Spain claimed that they were unable to pass along the costs of these tariffs to their electricity customers. They therefore asserted that they were carrying a large-scale "tariff deficit."[26] Under the present arrangements, the feed-in tariff rate is set at 7.4 percent, which is lower than the interest rates being carried by many Spanish companies who had invested in solar and wind energy production. This has led to more than 400 lawsuits by Spanish companies to counter the government's decision to cut the feed-in tariff rate. For our purposes, the general point which to focus is that feed-in tariffs need to be reformed in ways that will continue to strengthen renewable investments in Spain; but to do so, obviously, in ways that are least burdensome for Spanish energy consumers.

Low-Cost and Accessible Financing

Financing policies will play a major role in supporting Spain's clean energy investment program. Among other things, establishing large-scale clean energy investments that provide low-cost credit to investors will be key to also establishing the appropriate levels at which to set carbon taxes and feed-in tariffs.

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[25] See Pollin et al. (2014) and (2015), as well as Boyce and Riddle (2011) for further discussions around tax-and-dividend policies.

[26] According to a 4/14/15 report in *Greentech*, the government undertook its policy change without taking account of the findings of two consulting firms, Boston Consulting Group and Roland Berger, that the government itself had commissioned to provide recommendations on reform of its feed-in tariff policies. Rather, the government relied solely on internal calculations generated by the Institute for Energy Savings and Diversification. See: http://www.greentechmedia.com/articles/read/spains-solar-feed-in-tariff-cuts-were-based-on-nonexistent-reports

The case of Germany is instructive here, since it has been highly successful among advanced economies in developing its clean energy economy. The German government's financing policies have been critical, for example, to Germany's success in implementing high efficiency standards. The overview of the International Energy Agency's 2013 *Energy Efficiency Market Report* focuses precisely on this point, as follows:

> Germany is a world leader in energy efficiency. Germanys' state-owned development bank, KfW, plays a crucial role by providing loans and subsidies for investment in energy efficiency measures in buildings and industry, which have leveraged significant private funds (IEA 2013c, p. 149).

In addition to this general aim of providing low-cost financing for clean energy investments, a 2013 study by Spratt, Griffith-Jones and Ocampo raises a critical issue on providing subsidized financing for clean energy investments--that it not realistic to expect clean energy investments to consistently generate big profits for private businesses. Spratt et al.'s discussion on this point is specifically focused on conditions in low-income countries. But the point applies more generally, including for the case of Spain. They write that:

> Achieving growth that is both green and inclusive is inherently difficult. Doing so using private investment which requires very high returns may be impossible. Unless investors can be persuaded to adopt more reasonable expectations, alternative sources of finance may be needed if the goal of generating inclusive green growth …is to be achieved, (p. 6).

The requirement that the financing terms for clean energy investments be affordable for borrowers—that is, not always yielding high returns for lenders—strengthens the case for public investment banks to play a major role here.

Prospects for Alternative Ownership Forms

The difficulties emphasized by Spratt et al. of meeting the high profit requirements of large private corporations raises the question: how might alternative ownership forms—including public ownership as well as community ownership and small-scale private companies—play a major role in advancing the clean energy investment agenda?

In fact, throughout the world, the energy sector has long operated under a variety of ownership structures, including public/municipal ownership, and various forms of private cooperative ownership in addition to private corporate entities. The alternative ownership forms operate in all areas of the energy industry, including with both the conventional fossil fuel energy sources and within the renewable sectors.

Indeed, in the oil and natural gas industry, publicly-owned national companies control approximately 90 percent of the world's reserves and 75 percent of production. These publicly-owned firms are almost certainly to remain fully committed to exploiting the fossil fuel reserves that they control. We should therefore not expect that public ownership of energy companies, in Spain or elsewhere, will, by itself, necessarily provide a more favorable framework for advancing effective clean energy industrial policies.

Nevertheless, the development of clean energy systems does open opportunities for smaller-scale enterprises, which could be organized through various combinations of public, private and cooperative ownership structures. One area where this has been clear is with various sorts of community-based wind farms in Western Europe, especially Germany, Denmark, Sweden and the UK. The performance of these non-corporate business enterprises has generally been quite favorable relative to the traditional corporate firms. Despite this, to date, there has not been a significant development of community-owned wind farms in Spain, despite the fact that the industry is operating at a large scale.

Bolinger (2001, 2005) at the U.S. Department of Energy, along with separate other researchers, have highlighted four important advantages to community ownership structures in the wind industry relative to traditional corporate ownership forms. These include:

1. *Acceptance of lower rates of profit.* Community-based wind projects in Western Europe have been able to rely on a wide array of relatively small-scale local investors, whose profit requirements are lower than those of private corporations. This in turn means that the costs of expanding wind power capacity falls, which in turn promotes a more rapid expansion in new investments.

2. *Increased public support*. Direct community ownership of wind projects has raised public awareness in Europe and increased the number of local people who have direct financial stakes in such projects. This has reduced community resistance to projects at the planning and permitting stages.

3. *Potential for lower electricity transmission costs*. The relatively small size of community-owned projects enables projects to be more easily located within, or nearby, the communities themselves. This creates the possibility for significant reductions in the costs of transmitting energy over the grid. Such benefits can be especially large when community wind projects are established in more densely populated areas.

4. *Electricity price stability*. Community-owned wind projects operate at arms-length from the two forces that are most responsible for creating instability in electricity prices—that is, the global market for oil and the speculative commodities futures

market for energy, including electricity. By their basic ownership structure, community-based wind projects will continue to operate independent of the global price of oil as well as the commodities futures markets. This should create long-term conditions supportive of electricity price stability.

Community-based wind projects do also operate with disadvantages. The most significant is that community-owned projects will tend to be smaller in scale than corporate-owned wind farms. Large-scale corporate wind farms are thus better equipped to spread the costs of any given project, including permitting and legal costs and the full range of construction and transmission costs. However, the experiences in Germany, Denmark, Sweden, and the UK make clear that community-based ownership structures can succeed in the wind industry.

The development of affordable renewable energy is also, increasingly, creating realistic prospects for private individuals, businesses, and small-scale community organizations to own their own renewable energy supplies that are off the grid altogether. These are termed *distributed energy* supply systems, powered by solar, wind and other renewable sources. For example, in January 2015, the *Financial Times* reported that "across the U.S., about 45,300 businesses and 596,000 homes have solar panels….Over the past four years, the numbers have risen threefold for businesses and fourfold for homes, as the costs of solar power have plunged," (1/13/15). This trend has led the Edison Electric Institute, the U.S. electricity utility industry association, to warn that that the utilities were facing 'disruptive challenges' comparable to the way that the traditional land-line telephone industry was shaken up by the emerge of mobile telephone technology. As this development proceeds, it will create expanding opportunities for alternative small-scale ownership forms within Spain's emerging clean energy economy.

Financing the Clean Energy Investment Program

The series of policy considerations we have reviewed shows how the clean energy investment project for Spain can be advanced through a combination of public investments and private investment incentives. Such policies will include the development of opportunities for community ownership and small-scale, localized distributed energy supply systems.

This policy framework makes clear that, over the full 20-year investment cycle, the clean energy investment project will not have to rely on a large-scale expansion of government spending in order to succeed. At the same time, in the short-term, to reverse the current conditions of huge unemployment and austerity, it will be necessary for public clean energy investments to jump-start the overall project. However, as mentioned above, these public investments are self-financing over the medium- and long-term. There are three reasons for this:

1. Energy efficiency investments are self-financing. By definition, energy efficiency investments entail cost savings over time for all energy consumers. These cost savings can be used as the direct source of funds to cover the financing costs tied to the capital expenditures for efficiency investments. The return flow of funds coming from paying off the initial wave of efficiency investments can then also serve as the revolving fund to finance subsequent rounds of efficiency investments.

2. Revenues from carbon taxes. These revenues will provide financing source for clean energy investments. The extent of the level of revenues available will, of course, depend on the tax rate and the proportion of funds that are returned directly to the Spanish people through the 'tax-and-dividend' system. As an initial rough approximation, we estimate that, beyond the tax revenues generated by the existing energy taxes in Spain, a carbon tax that rises over 20 years from $25 to $75 per ton over the 20-year investment cycle would generate an average tax revenue flow on the order of $5 billion per year. This amounts to $100 billion in total tax revenues over the full 20-year investment cycle.[27] If we assume that 75 percent of this tax revenue is returned directly to all Spanish citizens in equal shares, that still leaves $25 billion to support the clean energy investment program. Given that the overall level of spending at 1.5 percent of GDP per year would be about $560 billion, these revenues from an incremental carbon tax would cover about 4.5 percent of the total costs of the program. Further, given that we would expect the direct public spending on the program can be a relatively small share of the total amount of investment spending, this $25 billion could be a significant supplemental funding source.

3. Declining oil import dependency. The dramatic decline in Spain's ratio of net fossil fuel imports as a share of GDP does not, on its own, create a direct source of public-sector revenues that can be channeled into financing the clean energy investment program. At the same time, all else equal, it will generate higher levels of income and employment throughout the Spanish economy, by relaxing the country's balance-of-payments constraint on growth. This rise in employment and income will increase, in turn, the tax revenue stream that the government can utilize to cover the public investments and subsidy programs in support of the clean energy investments.

Prospects for Scaling Up

[27] We emphasize that these figures are only rough first approximations. We derive them through scaling to the Spanish economy the revenue estimate we generated from the same level of carbon prices over 20 years for the U.S. economy. See Pollin et al. (2014) for the details of the calculations for the U.S. economy.

Advancing a clean energy investment project at an annual rate of 1.5 percent of Spanish GDP is itself a large-scale undertaking. In general, it would be difficult to advance this project at a significantly larger scale without encountering supply bottlenecks and inefficiencies. At the same time, as noted above, there are specific areas of the overall program that probably could be scaled up to higher annual spending levels early in the program, thereby supporting a larger initial stimulus as one element of a broader program to reverse Spain's currently still dominant austerity agenda.

This is especially the case in the area of investments in energy efficiency building retrofits, in which the bulk of the new job creation would be concentrated in Spain's construction sector. As discussed above, the construction experienced a massive contraction as a result of the global financial collapse and Great Recession. To date, employment levels remain well below pre-recession levels. This means that there is considerable slack in Spain's construction industry. This will minimize the onset of supply bottlenecks if investments in building retrofits were to expand rapidly.

In addition, unlike in some other areas of clean energy investments, energy-efficiency retrofits do not entail integration of new types of high-tech equipment that may be unfamiliar to workers. As mentioned, these investments rather are concentrated in such low-tech activities as upgrading lighting, heating, cooling and shading systems; upgrading insulation; and replacing old windows. Finally, as we have also discussed above, the financial payoffs from energy efficiency building retrofits begin immediately—i.e. the very day in which the more efficient equipment is in place. This means that financing these investments on a greater scale should still provide an immediate new stream of revenues available to cover the financing costs of these investments.

By way of conclusion, we would just emphasize again the preliminary nature of the policy framework and research findings that we have presented here. We are confident that a major clean energy investment program for Spain is capable of yielding major benefits that can be broadly shared—in terms of reducing both CO_2 emissions and oil import dependency, as well making a major contribution toward reducing mass unemployment. We are also confident that the policies we have sketched here can provide one useful component of a broader anti-austerity agenda. But understanding the specifics through which these various considerations can be melded together most effectively is beyond the scope of this paper. As such, we look forward to having this paper serve as one resource in advancing discussions around developing a new economic policy program for Spain—that is, a program capable of, at once, promoting job creation at a scale equal to the challenge defined by the country's current 22 percent unemployment rate; while, equally, enabling Spain to make a significant contribution toward confronting the global ecological crisis of climate change.

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Table 1. Energy Efficiency Investments

Efficiency Gains through Clean Energy Investment Program

Energy Efficiency Investment Spending Levels-- 0.5% of GDP	
-- Spending level in Year 1	$7.0 billion
-- Average spending over 20-year program	$9.3 billion
Composition of Energy Efficiency Investments	
-- Building retrofits	50%
-- Public transportation	16.7%
-- Transmission grid upgrades	16.7%
-- Industrial energy efficiency	16.7%
Average cost for energy efficiency gains ***(constrained case)***	$30 billion per Q-BTU of energy savings *(with Germany equivalent "high efficiency" constraint)*
Overall Year 20 efficiency gains relative to Business-as-Usual case	
Year 20 energy consumption under BAU	6.87 Q-BTUs
Year 20 energy consumption under clean energy investment program	4.69 Q-BTUs
Efficiency gains as of Year 20 relative to BAU	2.18 Q-BTUs *(= 6.87 – 4.69 Q-BTUs)* 32% gain in energy efficiency

Note: Year 20 BAU estimates from European Commission Directorate-General for Energy, 2010. "EU Energy Trends to 2030 – Update 2009." Luxembourg: Publications Office of the European Union.

Table 2. Clean Renewable Energy Investments

Expansion of Productive Capacity through Clean Energy Investment Program

Clean Renewable Investment Spending Levels—1.0% of GDP	
-- Spending level in Year 1	$14 billion
-- Average spending over 20-year program	$18.5 billion
Composition of Clean Renewable Investments	
-- Wind	50%
-- Solar	20%
-- Low-emissions bioenergy (biofuels for transport; biomass for CHP)	20%
-- Geothermal	5%
-- Small-scale hydro	5%
Average cost for clean renewable investments	$200 billion per Q-BTU of increased productive capacity
Overall Year 20 renewable capacity production levels relative to Business-as-Usual case	
-- Year 20 clean renewable production under BAU	1.07 Q-BTUs
-- Year 20 energy clean renewable production under clean energy investment program	2.92 Q-BTUs
-- Clean renewable capacity expansion as of Year 20 relative to BAU	1.85 Q-BTUs (= 2.92 – 1.07 Q-BTUs) 147% expansion in clean renewable productive capacity

Note: Year 20 BAU estimates from European Commission Directorate-General for Energy, 2010. "EU Energy Trends to 2030 – Update 2009." Luxembourg: Publications Office of the European Union.

Table 3.
Impact of 20-Year Clean Energy Investment Program relative to 2035 BAU Scenario

	2010 (Current)	2035 BAU Scenario	2035 Under Clean Energ Investment Program
1. Total Energy Consumption (Q-BTUs)	5.65	6.87	4.69 *(= 6.87 – 2.18 Q-BTUs in efficiency gains)*
2. Total Clean Renewables (Q-BTUs)	0.51	1.07	2.92 *(= 1.07 + 1.85 Q-BTUs in renewable expansion)*
3. Total Nuclear (Q-BTUs)	0.60	0.62	0
4. Total Fossil & high-emissions bioenergy (Q-BTUs)	4.54	5.19	1.77 *(= row 1 – rows 2 + 3)*
5. Total CO_2 emissions *(millions of tons; assumption is CO_2 emissions average 70 million tons per Q-BTU of fossil fuel consumption)*	308.4	363.2	123.9
6. Per capita CO_2 emissions (tons per person) *with 2035 population = 48.4 million*	6.5	6.9	2.6

Note: Year 20 BAU estimates from European Commission Directorate-General for Energy, 2010. "EU Energy Trends to 2030 – Update 2009." Luxembourg: Publications Office of the European Union.

Table 4.
Employment Creation in Spain through Clean Energy Investments: Jobs per $1 Million in Expenditure

	Energy Efficiency	Clean Renewable Energy	Weighted Average of Efficiency and Renewables *(Renewables = 67%; Efficiency = 33%)*
Direct Employment	8.7	7.9	8.2
Indirect Employment	4.7	4.4	4.5
Induced Employment *(= (Direct + Indirect) x 0.5)*	6.7	6.1	6.3
Total Employment	20.1	18.4	19.0

Sources:
1. Input-Output Tables: StanDatabase, OECD;
2. Employment Figures by Industry (2008): Instituto Nacional de Estadistica based on Economically Active Population Survey. Census 2011 (CEAPS) (http://www.ine.es/)

Note: Employment totals are based on "lower domestic content" estimates, in which we assume that "tradable" industries (those with a current share of imported content greater than 10%) do not expand as quickly as overall demand for clean energy. See Pollin et al. (2015) for details on methodology.

Table 5.
Employment Impacts of Clean Energy Investment Program:
Clean Energy Investments at 1.5% of Spain's GDP

	Year 1 of Investment Program -- Spending level = $21 billion -- Labor force = 23.2 million	Year 20 of Investment Program -- Spending level = $35 billion -- Labor force = 23.2 million -- Labor productivity averages 1%
Total Job Creation: Direct + Indirect + Induced Employment	300,000 jobs	410,000 jobs
Total Job Creation as Share of Spain's Labor Force	1.3%	1.8%

Key Assumptions:

- GDP growth averages 2.4% per year
- Labor productivity in clean energy sectors averages 1% per year.
- Annual clean energy investments = 1.5% of GDP
  - 67% clean renewable energy
  - 33% energy efficiency
- 80 percent of investment for capacity creation/production
- 20 percent for financing costs