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The PERI Report on Clean Energy: The Wrong Question and a Misleading Result

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A recent report by Robert Pollin, James Heintz, and Heidi Garrett-Peltier[1] from the Political Economy Research Institute (PERI) purports to study the "economic transformation" that the American Recovery and Reinvestment Act (ARRA)[2] and the American Clean Energy and Security Act (ACES)[3] will produce. Their analysis begins with the "three interrelated objectives that will define the *entire enterprise*"[4] and concludes by stating a need "to promote an aggressive policy agenda now to defeat global warming."[5]

In the context of the ARRA and ACES, the authors analyze a hypothetical scenario in which $150 billion per year is invested in clean energy industries versus spending the same amount in carbon-based fuel industries and conclude that it would produce a net gain of 1.7 million jobs.

However, the number, 1.7 million net jobs, is incomparable to other macroeconomic impact studies. First, the results of the experiment cannot be subtracted to achieve a net jobs number. Second, the jobs created are not for the overall economy because, among other faulty assumptions, the report ignores the general equilibrium effects of "investment spending"[6] and fails to account for the price effects induced by a cap-and-trade scheme. Price changes will cause far-reaching adjustments that affect the transition of the economy. Without a consistent baseline to compare against, the results are meaningless.

In short, the PERI analysis is not an economic analysis. The study poses an irrelevant question and then uses an ill-conceived investigation method to answer

Talking Points

- The PERI report does not estimate the economic impact of any policy currently being debated, and the job number finding is not the overall impact to the U.S. economy.
- The report studies the effect of a hypothetical large investment dropped into clean energy industries versus the effect of the same drop into carbon-based energy industries.
- The methodology used by the authors is deeply flawed. Among other faulty assumptions, it ignores the general equilibrium effects of "investment spending," fails to account for the price effects induced by a cap-and-trade scheme, and ignores efficiency trade-offs.
- The report does imply that large-scale investments in clean energy industries waste more resources than they create, particularly valuable labor resources.

This paper, in its entirety, can be found at:
www.heritage.org/Research/EnergyandEnvironment/bg2303.cfm

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the question. The report contains many economic assumptions that are not supported by economic theory or empirical studies. The report contains many economic conjectures that are unsupported by the analysis. The report makes generalized claims without citing specific studies to back up these assertions.

The Wrong Question

In their report, the authors ask: "How many jobs will spending on clean energy create relative to spending the same amount of money on investment in high-carbon fuel industries?" They answer: "Spending on clean energy will create a higher net source of job creation in the United States relative to spending the same amount of money on high-carbon fuels."[7] Specifically, they report that spending $150 billion per year on clean energy will produce a net gain of 1.7 million in the number of jobs that the economy would use to produce the same amount of energy. Yet the study reports the net job gain from investing in clean energy as if it is the overall macroeconomic effect. Indeed, the methodology used to answer this question renders the actual interpretation of the result highly ambiguous.

Further, this is not the question the authors should have posed, nor one that Congress and the public should be considering. Indeed, it is irrelevant to the current debate on the cap-and-trade bill. It does not perform a simulation of the effects of the ACES, and the "counterfactual" it sets up, dumping the same amount of funding into carbon-based fuel, is not the alternative.

They should have asked: Should the U.S. borrow billions of dollars to invest in new energy technology, cap emissions, and force businesses to divert resources from employing people to buying and selling CO_2 emission indulgences?

The Wrong Method

The PERI study ignores general equilibrium effects of investment spending and simply assumes that the spending is either dropped into clean energy industries or reallocated dollar for dollar from carbon-based energy industries.

This methodology of dumping $150 billion per year for 10 years into clean energy industries and then running an "alternative" of the same helicopter drop into a static input-output model for the fossil fuel industry attempts to combine two static estimates to mimic some sort of dynamic economic model that accounts for the rest of the economy. However, this analytical technique is not based on good economics, nor does it provide useful policy advice.

Instead of recognizing the helicopter drop assumption behind their analytical approach, the authors "account" for the resources by assuming that the $150 billion per year will be shifted dollar for dollar from fossil fuel investments to clean energy investments.[8] In reality, the investments are not shifted dollar for dollar from one type of energy technology to another, but must be borrowed instead. The borrowing represents forgone investments in many different industries, not just energy.

1. Robert Pollin, James Heintz, and Heidi Garrett-Peltier, "The Economic Benefits of Investing in Clean Energy: How the Economic Stimulus Program and New Legislation Can Boost U.S. Economic Growth and Employment," Center for American Progress and University of Massachusetts, Amherst, Political Economy Research Institute, June 2009, at *http://www.americanprogress.org/issues/2009/06/pdf/peri_report.pdf* (July 20, 2009).
2. American Recovery and Reinvestment Act of 2009, Public Law 111–5.
3. American Clean Energy and Security Act of 2009, H.R. 2454, 11th Cong., 1st Sess.
4. The three objectives are "dramatically increasing energy efficiency," dramatically reducing the costs of producing renewable energy, and mandating limits on pollution from fossil fuels. Pollin *et al.*, "The Economic Benefits of Investing in Clean Energy," p. 1.
5. *Ibid.*, p. 46. This type of language alone raises flags that this is an investment proposal soliciting a financing commitment, not an overall economic analysis that would contribute informative results to the current policy debate.
6. *Ibid.*, p. 5.
7. *Ibid.*, p. 27.
8. *Ibid.*, pp. 26 and 33.

Opportunity Cost and Relative Price Effects

Because we have unlimited wants but limited resources, everyone faces trade-offs. This means that we must make choices about how best to use our scarce resources to produce the goods and services that we need and want. Because every decision involves a trade-off, economists measure costs not only in terms of actual money flows, but also in terms of the next best choice that is given up—what economists call the opportunity cost of a choice.

Conducting economic policy analysis requires first establishing a baseline for how resources are being used in the economy and the level of economic benefit that this baseline economy provides. Then, this baseline is compared to what would happen if a policy altered the use of resources. The difference is the opportunity cost of the policy for the entire economy.

Why does a policy that changes the price of an underlying resource in any one market have far-reaching effects that change the overall performance of the economy? In a market economy all markets become linked, directly or indirectly, through the interdependencies created by the ability to specialize and trade. Market prices, then, provide a standardized measure of the opportunity cost of other goods and services being traded—the value of other goods and services given up. For example, buying Product A means not buying Product B, when the choice is only between Product A and Product B. This relativity of prices means changing prices for one good or service will have ripple effects throughout the economy. As individuals make different trade-off decisions, in order to adjust to the changed opportunity cost of their resources, the prices in those markets change. This causes changes in the opportunity cost of resources for yet other markets.

All of these adjustments are made in an attempt to get the most value out of our scarce resources. Without a comparison against a baseline, we would never know whether a policy caused individuals to achieve a lower or higher overall value from their resources than they otherwise could have.

Assuming all forgone investments will occur in the carbon-based fuel industries is simply not plausible.

The study also fails to account for the price effects of implementing a carbon cap-and-trade scheme. Instead, the authors assume that prices will hold constant[9] and argue that these spending and emissions capping policies form a unified and complementary "combination of incentives [to] create the overall investment environment for clean energy."[10]

A Meaningless Result from Faulty Assumptions

The theoretical construct and assumptions made throughout the Pollin *et al.* report are not based on any policy being debated or economic reality, in the sense that it does not account for the opportunity cost of redistributing scarce economic resources. The study also suffers from many logical inconsistencies. This section briefly examines seven of the study's faulty assumptions. (For a list of other flaws in the study, see the Appendix.)

Assumption #1: Comparing the results from two static economic models is an acceptable and preferable approach rather than establishing a baseline and using a dynamic economic model.

The methodological approach used by the authors to calculate "net jobs" is first to drop the spending into clean energy industries to calculate gross employment creation in clean energy industries. Using a static input-output model, they estimated that the $150 billion per year investment in

9. *Ibid.*, p. 24.

10. *Ibid.*, p. 7.

clean energy will create 2.5 million jobs due to the direct, indirect, and induced effects. They then drop the same amount into carbon-based fuel industries and, using a second static input-output model, calculate that it would create 800,000 jobs. They then use the increased number of jobs in carbon-based fuel industries as the opportunity cost of moving $150 billion out of carbon-based fuel industries and subtract it from the number of jobs created in clean energy industries to calculate the net job creation of 1.7 million jobs.

Analysis: Without a baseline and a credible estimate of the opportunity cost of jobs lost by diverting investments, the estimated net gain of 1.7 million jobs is not credible.

The authors assume that the only effect of this shift in resources is the opportunity cost of 800,000 jobs in the fossil fuel industry.[11] The authors do not establish a true baseline and instead use a crude method to estimate an opportunity cost and, therefore, a "net impact." The 800,000 jobs created in the fossil fuel industry were due to investment, not a reduction in employment because of reduced spending. Removing $150 billion per year from the carbon-based energy sector would likely have a much different effect on job creation (and elimination) than investing the same amount. The study simply does not make a serious attempt to quantify the true opportunity cost of reallocating resources to clean energy; the net gain of 1.7 million jobs is a meaningless measure.

Assumption #2: Dynamic forecasting models "are generally unreliable in predicting future GDP growth."

Throughout the analysis the authors routinely mix dynamic and static assumptions. Seemingly unaware of this inconsistency, the authors make a strenuous but irrelevant argument regarding why they do not use a dynamic model.

Analysis: In policy analysis, dynamic forecasting models provide a consistent baseline against which a policy change can be measured.

The authors' main argument against using dynamic forecasting models is that "these models are generally unreliable in predicting future GDP [gross domestic product] growth."[12] However, forecasting GDP growth is more relevant as a tool for business decisions. For policy analysis, dynamic forecasting serves as a tool to provide coherent policy advice to policymakers. These models perform this valuable function by providing a consistent baseline that gives a benchmark against which a policy change can be measured. To estimate what will be lost and what will be gained because of a particular policy requires a projection of the economy without the policy in order to run the counterfactual of the economy with the policy. Thus, policy analysis needs the model to isolate an effect of a policy, not to provide an exact forecast.

A forecasting model's baseline trend typically provides the best unbiased estimate (average) of all potential paths the economy could take. While the exact forecast can affect the quantitative results, it would rarely affect the qualitative results. The magnitude of a result from a dynamic analysis against a trend forecast can be viewed as an average result barring any unforeseen major economic events.

This is an appropriate and standard practice. However, it is not acceptable to make no baseline assumption, thereby ignoring all economic opportunity costs, and still claim to estimate the overall economic effect.

Assumption #3: The study's static, linear, input-output model is superior to a dynamic forecasting model because dynamic models make many more assumptions.

The authors admit that one of the many flaws in their input-output model is "that prices remain fixed, regardless of changes in demand."[13]

Analysis: Their model's assumption of fixed prices is implausible and not theoretically defensible.

These price effects are essential to conducting a full economic analysis because prices transmit vital

11. *Ibid.*, p. 33.
12. *Ibid.*, p. 21.
13. *Ibid.*, p. 24.

economic signals throughout a market economy. Holding them constant in a model masks the inevitable ripple effects of a policy change. In the real world, price effects change decisions, which then alter the course of the economy.

Holding other prices constant and doing a *ceteris paribus* (all else equal) analysis is a static partial equilibrium approach that can be used to isolate the likely directional effect of a policy. It is arguably appropriate for specific microanalysis for an industry, consumer group, or business. For example, it might indicate whether a policy will cause an industry's relative prices to rise, and if so, which decisions the industry should change. However, at the macroeconomic level, the actual effect will be determined by the combination of decision changes affected by the policy and, therefore, a static partial effect industry input-output model is the wrong tool for the job.

Assumption #4: Transition costs will not affect the economic outcome of the transition to clean energy.

By using a static model, the authors make another major assumption "of how transitions affect the results eventually."[14] That is, they assume a static framework and jump to some future point where we could be if we had this technology.

Analysis: Transition effects determine a large share of opportunity costs. The effect of this transition cannot simply be leapfrogged to reach an assumed new green technology future.

For example, we have already witnessed increasing food prices associated with allocating fields away from producing food and toward producing biomass for fuel. These opportunity costs determine the transition path and affect real people's lives and livelihoods and cannot simply be ignored for the good of the enterprise.

Assumption #5: Clean energy technologies will improve quickly in an environment of higher energy costs.

The authors criticize growth forecasting models for not predicting possibly new major breakthroughs in renewable fuel technologies and claim forecasting models "therefore leave aside by assumption the real possibility that energy technologies will improve quickly and produce a stronger positive expansion in employment than households or businesses operating in the models with 'perfect foresight' could have anticipated."[15]

Analysis: Higher costs for traditional energy sources will both encourage the development of alternative energy sources and limit the resources to invest in these alternative technologies.

The authors assume that making current energy sources more scarce by artificially raising the cost of production with the added cost of emission indulgences will somehow increase the probability of finding new technologies.

Higher costs for traditional energy sources create opposing forces. On one hand, the reward for energy-conserving technology and alternative sources will increase. On the other hand, higher energy costs reduce the resources that firms can invest in finding alternative technologies. True economic models embody decades of experience with price fluctuations and give estimates of the net impact of these countervailing pressures. Input-output tables, such as those used by the authors, do not.

Assumption #6: Productivity differences between industries are not relevant.

The authors choose to compare employment estimates for the carbon-based and clean energy industries on the basis of employment per dollar "invested" in the industry rather than employment per amount of energy produced in the industry. Thus the authors explicitly ignore productivity differences between the industries because:

> [T]he number of jobs needed to produce a given level of BTUs [British thermal units] in solar would be very high compared to the number of jobs needed to produce that level of energy production through coal. This would have simply been due to the fact that the cost per BTU for solar power is still much higher than the cost per BTU of coal.[16]

14. *Ibid.*, p. 23.

15. *Ibid.*, p. 45.

Analysis: Ignoring efficiency trade-offs violates rules of basic economics and ignores the whole reason why this policy imposes a high economic cost.

Basic efficiency considerations are at the core of economic analysis. Ignoring these efficiency trade-offs violates basic principles of economic analysis and puts the report's conclusions in the realm of fantasy.

To the authors' credit, they clearly acknowledge throughout the study that destroying capital and rebuilding less efficient energy capacity, which makes all workers less productive,[17] means hiring more people to produce the same amount of goods and services. "The relatively high level of domestic content in clean energy products and services is—along with high labor intensity [i.e., less productive]—a major factor generating the higher level of job creation relative to fossil fuels for a given level of spending."[18]

The authors further acknowledge that the economy could experience a loss in productivity:

> This expansion of job opportunities would occur strictly as a result of the shift in spending of a given $150 billion in favor of clean energy and away from fossil fuels. It will *not* be necessary for U.S. GDP to grow more quickly in order for these positive job effects to emerge though a clean-energy agenda.[19]

In other words, if more people are working to produce the same overall output (GDP), then future generations will be hindered with less efficient energy production, rendering them less productive and less able to use their time for other pursuits. If more workers do not "cause GDP to grow more quickly," then the larger workforce (2.5 million jobs needed to produce alternative energy) will need to be paid with the same value of goods and services, which means wages must fall.

Assumption #7: Reducing oil imports will lower the U.S. trade deficit.

The authors try to paint some optimistic scenarios of economic growth without doing any real economic modeling. This leads them to argue results and conclusions that their analysis neither proves nor supports. Economic modeling would have forced them to be consistent and logical to prove their conjectures. For example, they claim, "Reducing the U.S. trade deficit through cutting oil imports means, by definition, a higher proportion of spending by U.S. households, businesses, and governments will happen within the domestic U.S. economy."[20]

Analysis: Reducing oil imports could allow increased consumption of other types of imports.

Cutting oil imports will not necessarily lower the trade deficit. For example, the U.S. could reduce oil imports, but increase spending on imports from other parts of the world, such as China.

A more likely effect of reducing oil imports is reduced U.S. exports because, among other effects, foreign oil exporters will have fewer dollars to spend on U.S. goods. Therefore, those households that rely on exports will be forced to reduce consumption. The extent to which increased domestic spending on energy offsets U.S. domestic exporters' losses will be one factor that determines how this shift affects overall economic growth.

Basic Technical Problems with the Study

The errors in economic logic made throughout the study are carried through and create technical problems with their analysis.

1. The authors never decided on the timing issue. The study is unclear when the 1.7 million jobs will be created in relation to each year's investment payments ($150 billion per year) and

16. *Ibid.*, p. 51.
17. *Ibid.*, p. 35. This policy could make some people more productive at the microlevel. This is in the inframarginal sense that some previously unemployed workers might be employed simply because of the need for a larger workforce and their productivity would increase to something above zero. This does not aggregate to higher productivity in the economy unless utilizing more workers provides greater value to the economy (overall growth).
18. *Ibid.*, p. 35.
19. *Ibid.*, p. 47 (emphasis added).
20. *Ibid.*, p. 44.

whether any type of present value discounting was applied.

2. They assumed longer-run multiplier effects from the increased spending (dynamic effects) while holding all other dynamic adjustments fixed, thereby mixing dynamic and static analysis.
3. The authors never decided whether they were reallocating the funds from fossil fuel industries to clean energy industries or simply dropping these funds into the economy. If it was a reallocation as they claim, then job losses in the fossil fuel industry would result in consumption and income losses as well, which should have been accounted for in estimating the consumption and income feedback effects. If it was a helicopter drop of money into the sector, then the results are unrealistic and irrelevant for an economic debate.
4. They essentially use a rule-of-thumb approach to estimate the increase in employment resulting from an increase in spending via its effect on employee compensation. Yet they shroud this rough calculation in an econometric and quasi-simulation exercise.

Conclusion

Far from being a complementary set of policies, as the PERI study purports, the ARRA combined with the enactment of the ACES would have numerous off-setting economic effects. Independent macroeconomic analysis finds that losses far outweigh benefits. The Congressional Budget Office and even the Environmental Protection Agency find that these policies will raise costs on consumers.[21]

The economic logic, assumptions, and piecemeal static analysis defies basic economic principles. The authors did not consider economic effects, for example, that investment in new technology means using current resources, such as energy sources, to produce new technology for tomorrow. These effects are transmitted through prices, interest rates, and wages, and they alter the path of the economy, producing a different economic future.

If a policy raises the cost of resources today by forcing everyone to divert those scarce resources from producing things they need or want to paying for emissions indulgences, then fewer resources will be available to invest in new technology. Less investment would make the transition to the new green economy much more difficult. Assuming that the government can cushion the transition by borrowing more money or somehow rearranging the same pool of scarce resources to pay off those who are most directly harmed also ignores the opportunity costs and general equilibrium effects caused by the interdependencies of everyone in the economy.

The method and assumptions applied in the PERI report render the quantitative result meaningless. However, one conclusion that the authors repeat throughout their study seems quite defensible and highly probable: Instead of investing to make labor more productive, their proposal to create a green energy future would put more people to work by reducing economic efficiency, which will lead to reduced wages.

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21. For a comparison of the relevant studies see Nicolas Loris, "Cap and Trade: A Comparison of Cost Estimates," Heritage Foundation *WebMemo* No. 2550, July 20, 2009, at *http://www.heritage.org/research/energyandenvironment/wm2550.cfm*.

APPENDIX
ADDITIONAL TECHNICAL NOTES

1. Citations are needed for the claims regarding the performance of forecasting models.[22]

2. A citation is needed for the relative time for the public sector to invest versus the private sector.[23] Many studies, including a recent paper from the National Bureau of Economic Research,[24] cite significant lag time for public-sector investments relative to private-sector investments.

3. The authors hold the energy generation and use constant. That is, they assume that the U.S. economy will use the amount of electricity in 2020 as projected by the Energy Information Administration's *Annual Energy Outlook 2009*.[25] They use this to estimate how much additional capacity will need to be built to meet the 15 percent mandate in the ACES.

   Therefore, making this investment will mean spending more to produce the same amount of energy. The main cause of this increased spending is because non-carbon-based fuel is less energy efficient than carbon-based fuel, as the authors acknowledge. "Policy measures on this large a scale will certainly accelerate energy efficiency measures and lower renewable energy prices such that they become *increasingly competitive with* high-carbon energy sources."[26]

4. The authors claim, "Spending money in any area of the U.S. economy will create jobs since people are needed to produce any good or service that the economy supplies."[27]

   a. This statement is imprecise because it is unclear whether the authors are referring to an actual new higher level of employment or merely a reallocation of a job from one area to another.

   b. Economic analysis recognizes that spending in any area involves trading off spending in another area. Therefore, whether spending in any area creates jobs depends on whether the reallocated funds were invested more productively than the alternative and thus created more growth.

   c. Thus, this statement is not true *a priori*. The purpose of economic analysis is to determine whether it is true for a particular policy. The fact that the authors assume this effect explicitly and then find this as their effect renders their analysis moot.

5. The authors recognize that their static input-output model assumes too large a propensity to consume out of employee compensation.[28] They claim this causes the induced employment effects to be too large. They undertake to estimate their own dynamic empirical model econometrically. They do this by regressing current consumption expenditure on lagged values of itself and current employee compensation. From this estimate, they find the total impact (including the feedback effects captured

22. Pollin *et al.*, "The Economic Benefits of Investing in Clean Energy," p. 24.
23. *Ibid.*, p. 8.
24. Eric M. Leeper and Todd B. White, "Government Investment and Fiscal Stimulus in the Short and Long Runs," National Bureau of Economic Research *Working Paper* No. 15153, July 2009, at *http://www.nber.org/papers/w15153* (July 16, 2009).
25. U.S. Department of Energy, Energy Information Administration, *Annual Energy Outlook 2009*, updated April 2009, at *http://www.eia.doe.gov/oiaf/aeo* (July 21, 2009).
26. Pollin *et al.*, "The Economic Benefits of Investing in Clean Energy," p. 25 (emphasis added).
27. *Ibid.*, p. 27.
28. *Ibid.*, p. 53.

by lagged variables) on consumption from an increase in employee compensation. Since they use aggregate data and lagged values, the estimate includes all the direct, indirect and induced effects that have occurred throughout the economy.

6. It seems irregular to combine an estimate of a general equilibrium dynamic relationship between aggregate income and aggregate consumption with the model's parameter of only the direct and indirect partial equilibrium relationship between consumption and income at the household level and call it the "induced household consumption" from a change in income. Perhaps a Vector autoregression (VAR) could have been estimated and an accumulated impulse response analysis performed and the *difference* between the econometric estimate and the model's direct and indirect effect might be a rough estimate of the induced effect.

7. It is a rule-of-thumb method to estimate an increase in employment from an increase in spending via its effect on employee compensation. An increase in spending could be used to hire people temporarily. If this increase in employment generated more productivity than the current level, then employee compensation will increase. If not, either employment will be destroyed, wages will decrease, inflation will occur, or some combination of the three. Thus, the theoretical construct of the exercise is based on a tenuous transmission mechanism.

8. There are calculation errors:

   a. They calculate the gigawatts (gW) of renewable energy capacity needed to meet the requirements to be 153.8.[29] Based on their reported relationship of 0.2 gW of capacity to 1 billion kilowatt hours (kWh) of generation, this number should be 138.5.

   b. They report a weighted average capital cost of $2,800 per kW of capacity and then multiply this by the 53 gW of capacity they estimated that still needs to be built to calculate the amount that would need to be invested by 2020 in renewable fuel capacity ($148 billion).[30] First, the additional needed capacity is only 38 gW. Second, either the weighted average is very heavily weighted toward onshore wind, landfill gas, and hydro, or they used the cost estimates for 2020, not 2012. In the latter case, this would be incorrect because the capacity would presumably be built in 2012 at the higher cost structure, not at the lower 2020 costs projected by the Energy Department.

29. *Ibid.*, p. 50.

30. *Ibid.*