



Rebuilding Green

The American Recovery and Reinvestment Act and the Green Economy

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BLUEGREEN
ALLIANCE



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EXECUTIVE SUMMARY

As we mark the second anniversary of the American Recovery and Reinvestment Act (ARRA or the Recovery Act), it is an appropriate

time to evaluate the impacts of this landmark legislation.

President Barack Obama signed the ARRA into law on February 17, 2009. It was a response to the great financial crash of 2008 that devastated the U.S. economy, destroyed millions of jobs, created millions more long-term unemployed, and forced a tax-payer bailout unparalleled in American history. The ARRA's enactment represented a dramatic attempt to resuscitate a U.S. economy in free-fall.

Two years later, the Recovery Act's public investments have not only saved and created millions of jobs, but have also represented an unprecedented down payment on the nation's emerging green economy. As outlined in this report, *Rebuilding Green: The American Recovery and Reinvestment Act and the Green Economy*, the success of that down payment makes a strong case for additional public investment in the green economy as a centerpiece of a national strategy to solve the continuing unemployment crisis.

This report, a joint effort between the BlueGreen Alliance and the Economic Policy Institute, takes a comprehensive view of the Recovery Act, examining the success of this legislation as a response to a major economic crisis, and more specifically, its success in creating and saving jobs through critical green investments.

The report finds that through the end of 2010, the Recovery Act:

- **Committed \$93 billion in public investment to green economy activities** across a range of industry sectors.
- **Creates or saves nearly 1 million American jobs with this \$93 billion investment.** These 997,000 jobs include both the "green jobs" created directly by investment in specific industries and indirectly by their suppliers, as well as the additional jobs created when workers spend their incomes back into the economy.

- **Provides jobs for some of the country's most vulnerable workers.** These include workers who have been on the losing end of structural trends in the labor market over the past generation – including those in the middle of the wage distribution and those with less than a four-year college degree.
- **Increases U.S. Gross Domestic Product (GDP) by \$146 billion with its green economy investment.**

The report also examines the evidence on the overall effectiveness of ARRA in stemming the economic crisis, from its passage until the middle of 2010. This evidence demonstrates clearly that during this period ARRA:

- **Created or saved up to 3.4 million jobs;**
- **Boosted GDP by up to \$520 billion;** and
- **Reduced the unemployment rate up to 1.8 percentage points.**

Rebuilding Green shows how the Recovery Act was designed as an effective response to the economic crisis that required confronting three intersecting challenges faced by the United States:

- **Transforming energy** – Our economy was designed to function in a world where fossil fuels are forever abundant and forever cheap. Today, as increasing demand for oil comes up against a dwindling supply, prices are rising to reflect that reality and are projected to continue rising;
- **Addressing climate change** – Climate change is upon us and is close to reaching a tipping point, with devastating consequences for the country's – and

the world's – ecological and economic systems; and

- **Restoring competitiveness** – In 2009 China took first place among G-20 countries for overall investment in clean energy, pushing the United States to second place. The U.S. is also lagging behind G-20 countries by other key indicators of clean energy competitiveness. In all of the countries outstripping the United States, domestic policy is spurring the rapid scale-up of their green economies, with national standards for renewable energy and energy efficiency and carbon pricing providing long-term market clarity, alongside other supports like low- or no-cost finance.

Rebuilding Green finds that aggressive investment in the green economy, starting with the down payment contained in the Recovery Act, confronts each of these challenges head-on by addressing pressing problems in the short-, medium-, and long-term:

- **In the short-term**, the transition to a green economy creates good jobs, provides workers with income that can be spent in the economy, and helps bring the overall unemployment rate down.
- **In the medium-term**, this job creation leads, in turn, to lasting wage growth, which re-orientes the economy toward wage-led growth, rather than debt-led growth. Such a transition makes the distribution of economic rewards more equitable and leads to an economy less prone to risky and unregulated financial transactions. These medium-run benefits will move the U.S. economy down a path toward borrowing less from the rest of the world, thereby reducing our chronic trade deficit

and positioning the country to be a leader in the new growth industries of the future.

- **In the long-term**, investments of this nature meet the most pressing challenge for the American and global economies: the need to transition to production that is far less carbon-intensive. Because green investments represent an increase in the nation's capital stock, there is no "crowding-out" of private sector investment. In fact, the Recovery Act's green investments are "crowding in" private sector investment by requiring co-investments, many of which would likely not have occurred otherwise in a low-performing economy. Thus, an aggressive green investment strategy plays a critical role in solving the long-run climate crisis in an economically beneficial way.

The report also details how the Recovery Act was designed to provide extraordinary fiscal support to prevent the economy from falling into a depression. The ARRA's support was divided among tax cuts, transfer payments to states and individuals, and infrastructure investment – with an emphasis on green infrastructure. It shows how the impact on the economy of the Recovery Act's tax cuts and transfer payments have largely run their course, whereas substantial new green investments are still coming on-line and boosting jobs, incomes and overall demand in an economy that still requires it.

In addition to documenting the jobs and economic impacts of the Recovery Act's green investments and overall spending, *Rebuilding Green* shows how green investments have been translated into economic activity in remarkably diverse ways, varying by program, industry sector and region of the country. These case studies attempt to capture some of this diversity and the successes and challenges of the Recovery Act's implementation, and in the process illustrate how green jobs are central to the overall economy and scalable *with the right policies*.

And while this report outlines the positive impact of the Recovery Act, as of December 2010, the U.S. economy still needs 11 million jobs to return unemployment to its pre-recession level.

Given this need, a smart policy path forward requires a national jobs plan utilizing strategies that are effective in spurring growth and employment. Further investments in green infrastructure would help catalyze a full economic recovery while building upon the foundation laid by the Recovery Act. Such investments would allow the United States to successfully confront the unavoidable long-term challenges of fossil fuel dependence and climate change and, in so doing, to win the most important world-wide economic development race of the 21st century.

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INTRODUCTION

The American Recovery and Reinvestment Act (ARRA or the Recovery Act) was signed into law on February 17, 2009, passed as a response to what is now known as the Great Recession. Given that the Great Recession officially ended 20 months ago, in June of 2009, and that ARRA was designed to provide large-scale support to the economy for roughly two years, its second anniversary seems a reasonable time to step back and assess its impact.

The efficacy of ARRA is one of the most-debated topics in politics and economics in recent years. This report aims to summarize what is known about its impact on the economy and the jobs crisis that has continued well after the recession. We find that ARRA effectively provided the economic support promised by its architects in stimulating business and spurring employment. Besides highlighting its overall impact, however, this report also demonstrates how one key aspect of ARRA – its unprecedented investments in

the green economy – should be examined to judge the true legacy it leaves behind.

While some of the largest outlays in ARRA have already run their course, the Act's green investments continue to impact the economy and provide job growth. We find that the green investments injected into the economy through December 2010 create or save just under 1 million jobs and increase GDP by \$146 billion. We find that these jobs predominantly boost demand for workers without a four-year college degree – a group that has been in sore need of raises for most of the past couple of decades. We also note that the green investments are some of the largest parts of ARRA that are still filtering out into the economy and creating jobs, while many of the rest of the spending increases and tax reductions of the Act are winding down. (For more information on the job impacts of green investments, see page 18.)

We also review the evidence on the effectiveness of ARRA coming from both public and private evaluations. This evidence argues clearly that by the middle of 2010 ARRA created or saved up to 3.4 million full-time equivalent (FTE) jobs, boosted GDP by up to \$520 billion, and reduced the unemployment rate up to 1.8 percentage points.

The overall economics of how ARRA supports economic activity are straightforward – the bursting of the housing bubble inflicted a huge negative shock to spending throughout

the U.S. economy. When real estate prices plummeted both households and businesses radically cut back their demand for goods and services while new construction dried up and household wealth evaporated. ARRA helped fill in some of this spending gap, by having the public sector increase its purchasing as the private sector pulled back. In the very short-run, ARRA provided a variety of spending increases and tax cuts (the latter much more heavily weighted than realized by most).

ARRA did not simply throw money into the economy – many of the spending increases contained in it were targeted to meet one of the greatest challenges faced by the U.S. economy: the need to transition to a green economy that emits fewer greenhouse gases and averts catastrophic global climate change while positioning this country to win the most important economic development race of the 21st century. In essence, ARRA could be thought of as a large down payment on making the transition to a green economy for the United States.

Of course, like any down payment, the benefit is lost if future payments are not kept up. The ARRA started us down a path to a cleaner economy tomorrow, but we are far from there. Spurring further green investments should continue to be an important policy goal. Just like those contained in ARRA, further green investments will continue helping the economy recover from the worst recession since the Great Depression, will provide a more-solid foundation for growth and competitiveness

in the medium-run, and will greatly ease the inevitable journey our economy (and the global economy) must make toward producing cleaner energy and emitting fewer greenhouse gases.

This report provides evidence that public investment in the green economy creates jobs. It details the economic, climate, and competitiveness crises facing the United States and how ARRA helped meet each one. It summarizes the evidence to date on its effectiveness in fighting the effects of the Great Recession, and highlights the specific use of green investments in this economic stabilization. It also examines the types of jobs likely created or saved by these green investments, and sketches out their implications for labor-market developments in coming years. Lastly, this report provides case studies of how the green investments contained in ARRA sparked or sustained multiple private- and public-sector initiatives to move toward a low-carbon economy that provides opportunity and quality jobs for working people.

THE CHALLENGES WE FACE

THE ECONOMIC CRISIS

The Great Recession had deep roots. During the 2001-07 business cycle, an underperforming labor market (employment grew 0.6% annually, two-thirds slower than the 1.8% annual growth in the previous cycle) failed to give typical working families any significant boost to earnings. Median family incomes were essentially flat between 1999 and 2007 – nearly a decade of stagnation.

In a development that seemed fortunate at the time, however, rapidly rising home prices in the 2000s allowed these households to afford the increase in living standards that their wage and salary incomes had not. By the peak of the housing mania, households were withdrawing home equity each year that equaled nearly 8% of total disposable household income – giving themselves an 8% raise through home equity that the job-market was not giving them through wage growth. In retrospect, of course, this was all unsustainable (although several economic commentators warned of this at the time, they were largely ignored by both finance professionals and policymakers. The marginalization of critics was no surprise – acting to keep the bubble from inflating to disastrous proportions would have required firm supervision of Wall Street, which would have run counter to the prevailing ideology arguing that finance was self-regulating).

Given the failure to overrule Wall Street and halt the bubble's inflation, the episode ended as badly as some had feared – plunging home

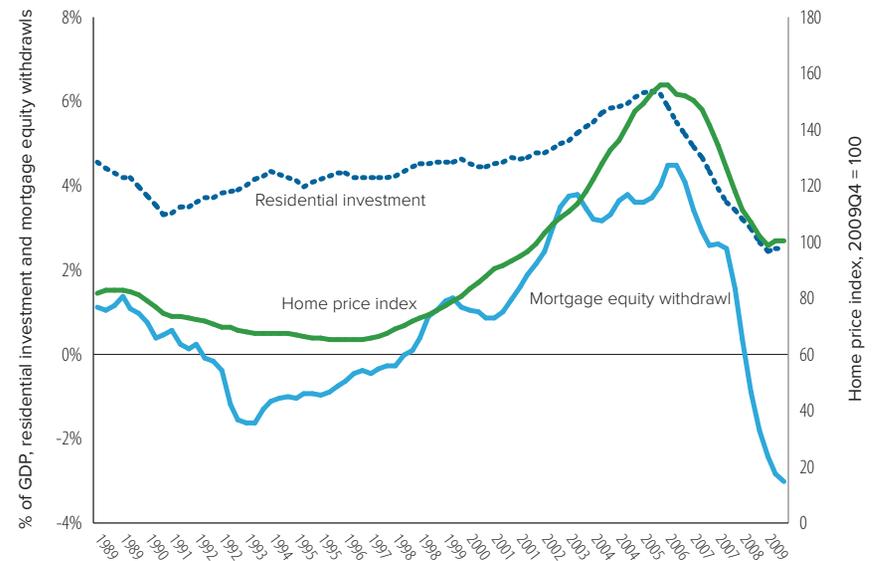
prices from 2007 to 2009 destroyed trillions of dollars of household wealth, robbing households of purchasing power and also convincing them to start saving much more to pay for retirement and educational needs that they had once assumed would be met through the appreciation of their homes.

Furthermore, plunging home prices made builders realize that they had too large an inventory and that new home production would not be needed for some time, leading to a crash of the residential construction industry (the commercial building sector is also seeing a less-extreme dynamic of falling prices and reduced construction). (See figure 1)

Lastly, the enormous pullback in consumer spending robbed businesses of all kinds (not just construction companies) of potential customers. It also convinced these firms to put expansion plans on hold, leading to sharply falling rates of investment in equipment and software.

When the recession hit, the economy suffered a shock to *aggregate demand*, or consumer purchasing power. American workers did not lose their skills in December 2007, nor did American factories become obsolete that month, and American managers did not forget how to organize production. In short, there was no disruption to the American economy's ability to *supply* goods and services. Instead, the disruption was to American households' and businesses' desire and ability to *purchase*

FIGURE 1. Home prices and residential investment and mortgage equity withdrawals as % of GDP



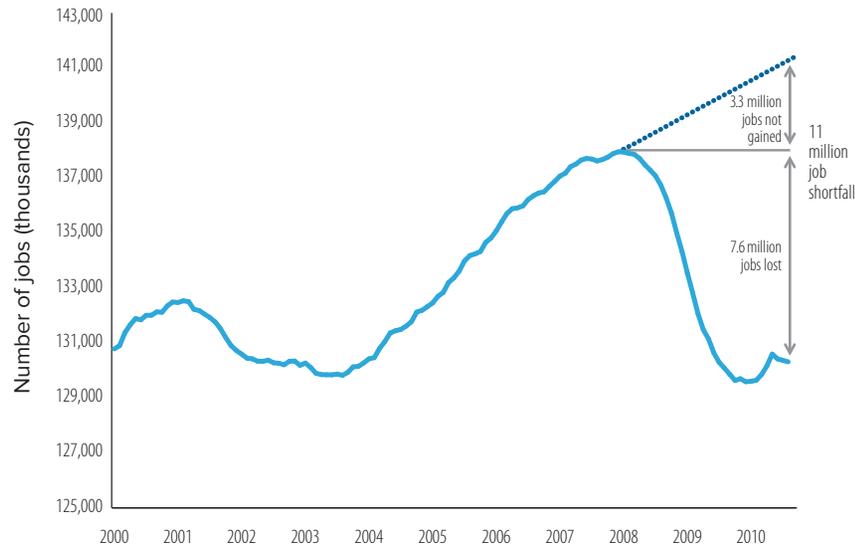
Source: Case-Shiller 20-city home index deflated by the PCE deflator, national income and product accounts (NIPAs) from the Bureau of Economic Analysis (BEA), and Federal Reserve Flow of Funds (FOF).

these goods and services – the rising housing wealth that had buoyed consumption for the 2000s had disappeared, taking purchasing power with it.

This initial demand shock quickly cascaded into reduced business investment in equip-

FIGURE 2. Recession has left in its wake a job shortfall of 11 million

Payroll employment and the number of jobs needed to keep up with the growth in working-age population



Source: EPI analysis of Bureau of Labor Statistics data.

ment and software and led to budget crises in state governments, which saw revenues collapse due to lower incomes and higher spending for safety net programs. As nearly all state governments are required to balance budgets, this led to a policy response to cut spending and increase revenue, both of which further robbed demand from the economy.

By some estimates, the initial shock to demand spurred by the bursting housing price bubble was greater than the shock that led to the Great Depression. This was a shock that led to 2.2 million jobs being lost *just between November 2008 and January 2009* – essentially between President Obama’s election and

inauguration. And this was a shock that the American Recovery and Reinvestment Act was meant to counter.

Did it work? Yes, although the United States still suffered through the harshest recession since World War II. But ARRA made the situation much better than it otherwise would have been: the Congressional Budget Office (CBO) estimates that ARRA created or saved up to the 3 to 4 million jobs that were promised with its passage, and it kept the unemployment rate up to 2 percentage points lower than if it had not passed. (Later sections of this report will make the argument about ARRA’s effectiveness in more detail.)

Despite ARRA’s success, most forecasters, both public and private, do not forecast a sustained return to December 2007 rate until 2014 or even 2015. Furthermore, there are plenty of reasons to think that downside surprises could make it take even longer than that to reach unemployment rates near the pre-recession levels.¹ (See figure 2)

Additionally, each year that unemployment remains high relative to its full-employment potential is another year that will see sluggish (or even negative) growth in hourly wages and family incomes. The urgency remains for measures that will reliably create jobs and boost living standards. The investments still forthcoming from ARRA, particularly in areas that can create green jobs, will produce necessary economic benefits in the medium term. The more that such investments can be expanded through legislative action in the coming months, the more promising our economic recovery will be.

Lastly, a key challenge even when unemployment returns near to pre-recession levels is to build a better foundation for future

economic growth. The foundation of the 2000s – consumer spending purchased by taking on ever-higher levels of debt – proved disastrous and should not be repeated. One way to ensure that a more-durable foundation underpins future growth is to base it less on consumption and more on investments (in both the private and the decades-neglected public capital stock), especially those that will ease the economy’s transition to cleaner forms of energy.

THE ENERGY CRISIS

The need to make the transition to a low-carbon green economy could not be more urgent. Our economy is currently powered almost exclusively by fossil fuels, which supply 93% of the energy used in the United States. These are non-renewable resources and long-run supplies are limited, by definition. The more we consume, the less we have and the more it will cost us over time. The laws of supply and demand are pretty basic and make dwindling resources more and more expensive.²

Unfortunately, our economy was designed to function in a world where fossil fuels are forever abundant and forever cheap. Today, as those fuels – and especially oil – become increasingly scarce, prices are rising to reflect that reality. In the year 2000, a barrel of crude oil cost just under \$40 per barrel. At the start of 2011 the cost was almost \$90 per barrel in real dollars.³ A dip at the height of the Great Recession was the only interruption to a decade of steadily rising prices.

And experts predict the cost will keep rising. The Energy Information Administration (EIA) estimates the price of West Texas Intermediate (WTI) crude oil – used as a benchmark in oil pricing – will average

about \$93 per barrel in 2011. For 2012, EIA projects WTI prices to continue to rise, with a forecasted average price of \$99 per barrel by the end of the year. Gas prices at the pump will rise accordingly. EIA projects regular-grade gas retail prices to average \$3.17 per gallon this year, 39 cents per gallon higher than last year, and \$3.29 per gallon in 2012.⁴

The essential reason for this rise is that oil supplies can no longer keep pace with demand. This global demand is skyrocketing – especially from growing economies such as India and China. As both countries blossom into full-blown economic superpowers, energy demand from the Asian continent will only increase. On the supply side, oil companies are not finding significant new fields to keep pace with demand. Some experts even fear that global oil production has already peaked and that supplies are headed for a permanent, worldwide decline – even as demand goes up.

And while oil gets scarcer and more expensive, we import it from dangerously unstable countries. In November 2010, 40% of the 332 million barrels of oil that we imported were from the member states of OPEC, the four biggest being Saudi Arabia, Venezuela, Nigeria, and Algeria,⁵ nations characterized by authoritarian governments, domestic unrest, terrorism, or an official policy of hostility toward the United States. Furthermore, our exposure to insecurity is even wider than our strict market share coming from these countries would indicate – the price of oil is set in global markets and the U.S. economy is effectively dependent on the marginal supplier to this global market. So long as the marginal supplier in that global market is a country with a problematic relationship to U.S. interests, then the case for ending this dependence is strong.

The bottom line: the days of cheap oil fueling our economy are over. At the same time, dependence on oil imports handcuffs our national interests in ways that make the real cost of oil even higher.

THE CLIMATE CRISIS

The real cost of dependence on fossil fuels rises higher still when factoring in the impact of their use on the natural systems that undergird our society and economy. Climate change – caused by rising emissions of carbon dioxide and other heat trapping gases, resulting primarily from human activity – is close to reaching a tipping point, with devastating consequences for the world's environmental and economic systems.

In 2009, a remarkable report, *Global Climate Change Impacts in the United States*, was released by a consortium of federal offices charged with integrating federal research on changes in the global environment and their implications for society. The report synthesized and summarized the 'state of knowledge' of the science of climate change and the impact of climate change in the United States, now and in the future. It exhaustively documented the fact that climate-related changes are *already* observed in the United States and its coastal waters. These include increases in heavy downpours, rising temperature and sea level, rapidly retreating glaciers, thawing permafrost, lengthening growing seasons and ice-free seasons in the ocean and on lakes and rivers, earlier snowmelt, and alterations in river flows. It projects global average temperatures to rise by up to 11.5° F by 2100 on our current emissions path, with devastating potential consequences in the United States, including wide-spread drought, flooding, crop failure, the inundation of coastal areas, and increased and multiplying risks to human health.⁶

The full human and environmental impacts of such climate-driven changes are increasingly well established. In addition, the strictly economic impacts are calculable to a degree of magnitude – and the data are startling. Economists at Sandia National Laboratories in New Mexico developed a macroeconomic model that estimates impacts on the U.S. economy of climate-driven changes in precipitation and water availability (the resulting drought effect, it should be emphasized, being one of several other climate-driven changes not incorporated into the modeling). The report estimates that net losses in U.S. gross domestic product (GDP) between 2010 and 2050 will reach as high as \$1.9 trillion, and decreases in job-years range from 6.6 to 13 million.⁷ The Sandia report joins a host of other studies that estimate the costs of inaction with respect to climate change. The most comprehensive of these is a review of the economics of climate change for the British Treasury overseen by Sir Nicholas Stern, which concluded that global warming may cost the world close to \$10 trillion by the next century. The bottom-line of these reports: unmitigated climate change is a job-killer.

THE COMPETITIVENESS CRISIS

There is overwhelming evidence that climate change and over-dependence on fossil fuels hurts the United States. This is also true with respect to the competition for leadership in the global economy, given that the development and deployment of green technologies will likely be the most important global economic development race of the 21st century.

This reality is certainly realized by our biggest economic competitors, China foremost among them. In 2009 China took first place among

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G-20 countries for overall investment in clean energy, pushing the United States to second place (the United States may have fallen further behind if not for the initial spend-out of ARRA investments). There were other measures of slipping international competitiveness in this key sector during 2009. In proportion to the size of their economies, Spain invested five times more and Brazil, and the United Kingdom invested three times more in clean energy than the United States. In all of the countries outstripping the United States, domestic policy acted as spur to investment, with national standards for renewable energy and energy efficiency and carbon pricing providing long-term market clarity and price signals, alongside other supports like low- or no-cost finance.⁸

Furthermore, given that the prime competitiveness problem facing the United States currently is the very large trade deficit in manufactured goods, letting a potential new growth industry that will demand many manufactured inputs be set up mostly abroad would be folly. The inputs to the new clean-energy economy will clearly be concentrated in export sectors with very high rates of global demand growth, and thus could strongly ameliorate the U.S. trade deficit.

The trends of dwindling fossil fuel resources, rising global energy demand, and climate change are converging. Smart investors and entrepreneurs around the world recognize that this unprecedented intersection translates into clean energy being the most significant growth opportunity of the global economy. That is where these smart investors are putting their money and directing their innovation and business plans. National governments will squander competitive advantage if they fail to create certainty that such green investments will be able to compete on a level playing field going forward, and/or fail to provide the complementary public investments for transitioning to a clean-energy economy. If the United States is slow to act, it will not only hurt its own future economic performance and lose out on a most promising growth-sector of the future, it also will greatly slow down the race to avert catastrophic global climate change.

THE TRIPLE-WIN OF INVESTMENTS IN THE GREEN ECONOMY

Investments in the green economy, started now, solve each of these crises by addressing pressing problems in the short-, medium-, and long-run.

In the short-run, what is most needed in the economy is more demand for goods and services. This demand can be spurred most directly by increasing the federal budget deficit to finance either direct public spending or tax cuts. *Any* increase in the deficit, no matter how poorly targeted, would tend to push demand in the right direction. But of all the ways to use deficit spending to boost activity in the short-run, it turns out that investments in the green economy (and infrastructure investment of all kinds) are among the most efficient in translating a given dollar's addition to the deficit into greater economy-wide activity and job growth.

The reason for this efficiency is simple – additions to the deficit should be targeted where the money will be *spent*, not saved. Transfer payments (such as unemployment insurance) to unemployed workers are well-targeted – this group is by definition cash-strapped and will likely spend incremental income quickly. Tax breaks to high-income households are not well-targeted; this group is much more likely to save marginal income gains and hence not send them circulating back through the economy. Infrastructure projects represent money spent, not saved, *by definition*. Each dollar in the first-round of spending actually hires labor and capital to begin working again. Numerous studies have

found that infrastructure investments have a particularly high “bang-for-buck” in spurring output and job growth.

In the medium-run, the pressing problem for the U.S. economy is to sustain overall activity and keep unemployment low as the economy re-orient itself away from consumer spending and toward (both public and private) investment and net exports. To be clear, this re-orientation need not be radical – in the 2000s business cycle, consumer spending represented roughly 70% of overall GDP, while between 1948 and 2000 this share was about 66%. To return to historically normal levels of consumption, we need some combination of increased public and private investment and higher net exports to add up to roughly 4% of GDP. The Great Recession is essentially the first, unplanned lurch toward this lower consumer-spending economy. But because there was not time for the other sectors to take up the slack left by retreating consumers, the economy entered a downturn instead of seeing other new sectors rise up to take the consumers' place.

Over time, the healthier medium-run shape of the U.S. economy will involve more rapid wage growth for typical workers, less debt, and less reliance on consumer spending as the engine of growth. Green investments will help facilitate this kind of economic growth. These investments create more jobs than investments in fossil fuels, due to greater labor intensity and higher levels of domestic content. An analysis conducted by the Political Economy

Research Institute shows that clean energy investment creates roughly three to four times as many jobs as the same level of investment in fossil fuel industries.⁹ This analysis is consistent with a broad range of studies which demonstrate that it just takes more work to manufacture, install, and maintain one's energy sources than it does to extract them from the earth and refine and burn them. Investments in energy efficiency only add to this job creation gap; the amount of work that goes into making an existing building more efficient is exponentially more than the work that goes into letting it waste energy, which is often no work at all.

In short, the transition to a clean-energy economy would not just help bring the overall unemployment rate down over the short-run, but it would also boost demand for labor and lead to durable wage growth (even for those workers that have been largely shut-out of wage growth in recent decades, such as those with less than a four-year college degree). Such investments would re-orient the economy toward wage-led, rather than debt-led growth over the medium-run, as well.¹⁰ This would not just make the distribution of economic rewards more equitable, it would lead to an economy less prone to repeating the build-up of debt that led to the Great Recession. In short, the medium-run benefits of a program to invest in clean energy will make the U.S. economy move toward a path where it borrows less from the rest of the world to finance living standards growth. This will help us reduce our chronic trade deficit

more by becoming a leader in the new growth industry of the future, putting us firmly on the path to greater competitiveness.

In addition, for reasons detailed above, undertaking an aggressive investment program in clean energy today plays a huge role in solving the long-run climate crisis in an economically beneficial way. There is a clear, urgent need for this kind of investment to meet the most pressing *long-run* challenge for the American and global economies: the need to transition to production that is far less carbon-intensive. The benefit of investing in clean energy technologies and strategies today far exceeds their cost. This high long-run return to green investments makes them immune to the most traditional arguments against other forms of short-run economic stimulus: that by financing them with debt, the government is “crowding-out” private-sector investment and leaving future generations with a smaller capital stock to work with, making them less productive. Because green investments are, in fact, investments – that is, an increase in the nation's capital stock – there is no “crowding-out” even if they are debt-financed. Future generations may be left with a smaller non-green capital stock than otherwise, but the overall capital stock will be no smaller and will in fact be better suited for an economy that needs to be producing in a less carbon-intensive fashion.

THE AMERICAN RECOVERY AND REINVESTMENT ACT

THE BASICS

While ARRA was first and foremost an emergency measure aimed to fill the hole in purchasing power left by the bursting housing bubble, the Obama administration also managed to use it as a vehicle to make a down payment on the investments needed to transition to a clean-energy economy.

The bursting bubble led to rapid reductions in both construction and consumer spending; these effects cascaded through businesses investment decisions (after all, who needs to build new factories when output from the current ones is sitting unsold) and ultimately led to a global recession, suppressing demand for U.S. exports as well. Given that the recession led to spending pullbacks from consumers and businesses, both domestic and foreign, the only spending that could hold the line on rapidly rising unemployment was that fueled by public funds.

The general case for using fiscal support to stabilize the economy

This view of recessions and the role of policies like the Recovery Act in fighting them is basic economics, but a kind that does not always make common sense. As private households and businesses reduce their spending and try to work off their overhang of debt, the only way to keep unemployment from spiking in the meantime is to have the public sector

fill the gap by *increasing* its debt and using it to finance spending on safety net programs, investments, or tax cuts. Increasing public debt to cushion the economic shock of falling private debt just sounds wrong to many, but it is not. It is, in fact, the only way to hold the line on rising unemployment until the private sector has paid down enough of its debt to begin spending again.

One testament to the generic observation that rising budget deficits act as a shock absorber against collapsing private sector spending is the fact that essentially *no* professional economist criticized the increase in the budget deficit that arose *before* the passage of the Recovery Act; one can find no professional economist at the time arguing that policy should have kept the budget deficit from rising between January 2008 and February 2009. This mechanical rise in the deficit came about as tax collections followed incomes in plummeting as the recession gained steam and as safety net programs began paying out more as joblessness and underemployment rose. This mechanical rise in the deficit was a powerful buffer against the shock of the bursting housing bubble and is a key reason why a second Depression did not occur. And, again, this mechanical rise in the deficit was not decried by a single economist at the time.

The Recovery Act – recognizing that extraordinary fiscal support was needed

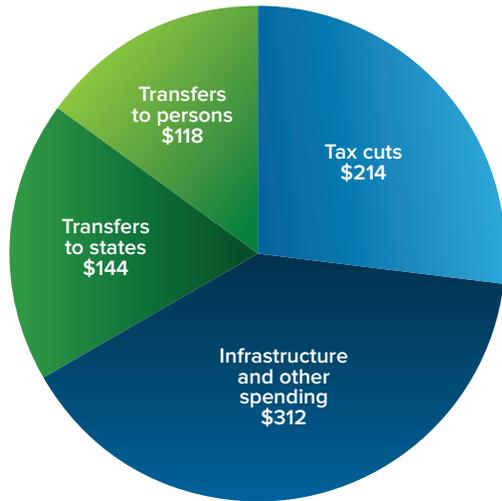
The Recovery Act represented the correct assessment that the shock absorption provided by the purely *mechanical* rise in the deficit was too small (even when paired with the interest rate cuts undertaken by the Fed) to provide a quick recovery. So, the ARRA was constructed to provide an even larger cushion to the economy. Despite being premised on *exactly the same theory* as the rationale for automatic stabilizers, because it had a clear political sponsor (the Obama Administration), it became flypaper for criticism of all kinds.

One controversy surrounding the Recovery Act concerns the *composition* of the act, with many critics arguing that it was too heavily weighted toward spending at the expense of tax cuts to stimulate the economy. However, less than 40% of the Recovery Act's appropriations actually funded direct government spending. More than a quarter of the appropriations were for tax cuts (and even more than this in the first two years of the ARRA – many of the tax changes were deferments, so large tax cuts, especially for corporations, in the first two years are recouped later), while the remainder, roughly 35%, went to transfer payments to individuals (unemployment insurance, food stamps and other safety net programs) and states. (See figure 3)

Besides just being wrong, this criticism about ARRA's composition is ironic given that most macroeconomic research indicates that tax cuts are actually *far less* efficient in generating output and jobs than direct government spending.

FIGURE 3. What was in the Recovery Act?

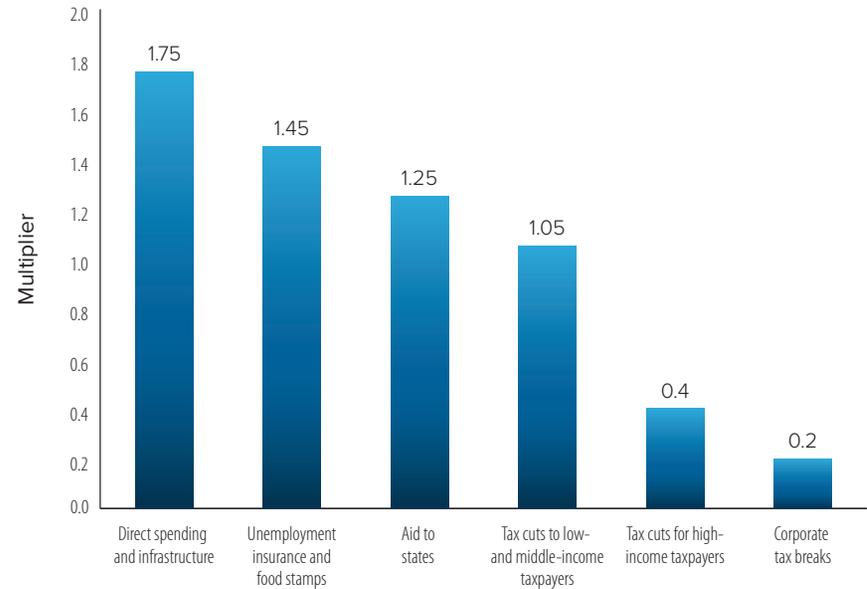
(Billions of dollars)



Source: Congressional Budget Office

FIGURE 4. What is the most effective stimulus?

"Bang-for-buck" multipliers*



* Measures total increase in economic activity associated with a \$1 increase in the deficit.

Source: Congressional Budget Office data.

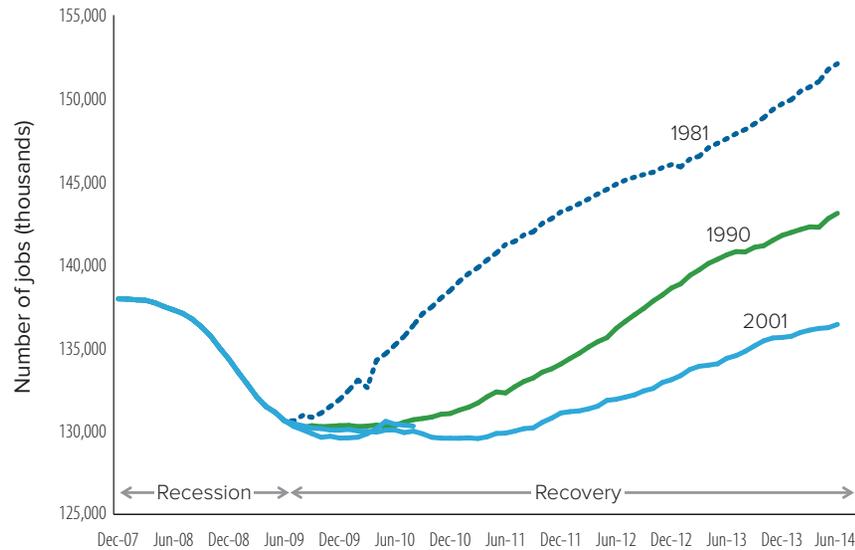
Compounding this irony, the tax cuts preferred by many of the Recovery Act's critics – those going to businesses – were far and away *the least effective* stimulus included in ARRA. Tax cuts are less efficient job-creators (especially those not targeted to lower-income households) because they may be saved instead of spent, and because many of the business tax cuts were essentially windfalls (often retroactive) that rewarded activity that would have been done (or had actually already happened) even without the Act.

On the other hand, safety net programs—such as unemployment insurance, nutrition assistance, and health insurance supports – are by definition well-targeted: they go to those families whose incomes have fallen below a threshold or who have recently suffered job loss. Consequently, recipients are much more likely to spend these payments – they have to. And in terms of making sure that all increases in public debt are spent, infrastructure spending is best of all – none of it can be saved; it all must be spent.

In essence, if Congress had included more tax cuts aimed at high-income households and businesses, the effectiveness of the Recovery Act would have been seriously reduced. It is confounding that some of ARRA's critics will argue in one sentence that the Act didn't go far enough, then in the next suggest it needed to contain more tax cuts, which would have only scaled back its effectiveness further. (See figure 4)

FIGURE 5. What will recovery look like?

Three possible paths to recovery: following the path of recoveries in the '80s, '90s, and 2000s



Source: EPI analysis of Bureau of Labor Statistics data.

Is infrastructure investment “timely” enough to fight recessions?

Another criticism aimed at ARRA was that it outlaid money too slowly. Infrastructure investments in general are often criticized for not being “timely” enough to work well as anti-recession measures – the “timely” mantra was one reason, for example, why infrastructure investments were dismissed almost across-the-board by policymakers when the first stimulus package of January 2008 was debated and passed.¹¹

Given the length of the Great Recession, and the projected time it will take even from today to reach full-employment, it seems safe to say that this argument can be put to rest: we are in no danger of starting infrastructure programs of any kind that will “miss” the economy’s need for more demand. (See figure 5)

In regards to ARRA, this criticism of its untimeliness is particularly wrong given that its boost to economic growth had actually fallen to nearly zero by the last half of 2010 – just as economic growth was decelerating. In short, the biggest boost to the economy from ARRA has come and gone, and the need for more demand remains. This fade-out of ARRA’s overall effect happened even as substantial new green investments were still coming on-line and boosting jobs and incomes.

The mechanics behind these two facts – that ARRA’s overall impact is fading while valuable green investments are still coming on-line each day – is simple: the bulk of ARRA’s overall spending and tax cuts were actually (and contrary to the “untimeliness” charge) quite front-loaded. Many of the tax cuts were largely spent in the first year of its implementation, and transfers to state governments and to households were often just a matter of expanding existing programs, so these started boosting purchasing power right away.

By 2011, however, many of these tax cuts and state transfers had started to expire (some of the transfers to households also expired, though the largest – the boost to unemployment insurance benefits – has been extended through 2011). Because the rate of spend-out from the ARRA was falling by the last half of 2010, its impact on growth was falling as well.

However, this falling rate of spend-out would be even greater if the green investments that continue to roll out each day were not still in the pipeline. While these green investments that continue to come on-line are not large enough to make up entirely for the massive withdrawal of ARRA’s spending on transfers and tax cuts, they *do* still provide a real boost to the economy by cushioning the withdrawal of these other spending categories.

GREEN ECONOMY INVESTMENTS IN THE RECOVERY ACT

While any sort of direct government spending could have played a useful role in moderating the extent of the economic downturn, the architects of ARRA actually thought hard about not just putting people back to work, but also about what they would build and the legacy ARRA would leave to future generations.

As such, beyond its substantial achievement in moderating the rise in unemployment that would have happened absent its passage, the ARRA also represented an historic investment in the green economy. But determining how big an investment it was, and detailing those investments, begs definitional questions. How the green economy and green jobs should be defined has been the subject of a robust public debate since the terms first gained currency. A useful analytical framework was developed by authors writing on behalf of the Occupational Information Network (O*NET), which prepared a 2009 report for the U.S. Department of Labor entitled *Greening of the World of Work*. The report analyzes the impact of the growing green economy on occupational requirements and on the broader systems of industrial and occupational categorization

used by workforce and economic developers to track industry demand for specific occupations. These systems, the North American Industrial Classification System (NAICS) and the Standard Occupational Classification (SOC) don't recognize separate "green" categorizations for either industries or occupations. Therefore, the report is necessarily cross-cutting in its approach, not least in the definition it offers of the 'green economy,' which spans multiple industries.

*The green economy encompasses the economic activity related to reducing the use of fossil fuels, decreasing pollution and greenhouse gas emissions, increasing the efficiency of energy usage, recycling materials, and developing and adopting renewable sources of energy.*¹²

The report goes on to identify 12 broad industry sectors that involve activities meeting this definition, including renewable energy generation, transportation, energy efficiency, green construction, environment protection, manufacturing, and waste reduction and recycling.

Building on this work, the Bureau of Labor Statistics defines green jobs as *either* jobs in businesses that produce goods or provide services that benefit the environment or conserve natural resources, *or* jobs in which workers' duties involve making their establishment's production processes more environmentally friendly or use fewer natural resources. And BLS usefully emphasizes that green jobs are for the most part existing occupations, the "greenness" of which depends on the kind and degree of economic activity.¹³

The Council of Economic Advisors (CEA), in its quarterly reports on the economic impacts of the ARRA, classifies the public investment spending of ARRA into 10 functional

categories. A distinct green economy category is not one of the 10, but we can use the O*Net and BLS definitions and identification of industry sectors to construct a green economy public investment category for the purpose of this analysis that builds on the CEA categorizations. The category we have developed encompasses spending accounts, in whole or part, from the following CEA categories:

- **Clean Energy:** CEA includes both direct investment and tax incentives in this category. In CEA's second quarterly report they break it down into different subcategories: Energy Efficiency; Renewable Generation; Grid Modernization; Advanced Vehicles and Fuels Technologies; Traditional Transit and High Speed Rail; Carbon Capture and Sequestration; Green Innovation and Job Training; and Clean Energy Equipment manufacturing. We include all of these as Green Economy investments.
- **Construction of Transportation Infrastructure:** The major green economy-building investments in high speed rail and transit were classified by CEA in the clean energy category. But we also include as Green Economy investments the portion of highway, road, and bridge infrastructure improvements that directly contribute to promoting fewer cars on the road and alternative forms of transportation, such as projects to build HOV (high-occupancy vehicle) lanes or bike paths.
- **Construction of Buildings:** There were a number of ARRA investments in construction and operations and maintenance. We include the portion of this spending invested in green building to an industry recognized certification, for example LEED, or in energy-efficiency improvements.

- **Environmental Cleanup and Preservation:** There were a number of ARRA investments in the cleanup of hazardous waste and remediation of contaminated sites and homes, in projects leading to cleaner and safer drinking water and water efficiency, and in projects that restore landscapes and habitat and reduce the likelihood of fires and flooding. We include all of these activities as Green Economy investments.
- **Broadband:** The build-out of broadband infrastructure holds the potential to revolutionize energy management in the United States and allows a set of services, including telehealth, long-distance business communication, distance learning, and e-commerce, all of which reduce travel and associated fuel use. We therefore classify the Recovery Act's significant broadband investments in our Green Economy category.

It is important to note what we do *not* include as green economy investments for the purpose of estimating job impacts, simply because of lack of available data. First, there were allocations made to states, tribes, cities, and other local government entities that were used for both green and non-green purposes. Federal agencies often don't have information detailed enough to discern which investments can be designated as green. Where we don't have that information, we don't include the investments.

Second, there were a number of bond programs supported by the Recovery Act, most significantly the new Build America Bonds (BABs), which made it more affordable for states and cities to pursue capital projects that build infrastructure by providing a federal subsidy equal to 35% of the taxable borrowing cost. BAB issuances totaled over \$180 billion through the end of 2010.¹⁴ But states make the issuance for BABs and other bonds, and

there is no requirement for them to report on what they use it for, so we don't have sufficient information to include any of them as Green Economy investments. In the case of bond programs that had to be used for exclusively green purposes – Clean Renewable Energy Bonds and Qualified Energy Conservation Bonds – there is a long lag on available data because state and local governments have to claim the interest subsidy, or bond holders must claim the tax credit, when they file their tax returns with the IRS.

Third, a number of investments were made through the tax code, and the law prohibits the IRS from releasing any information about their use. In the case of the Advanced Manufacturing Tax Credit program ("48C") – the ARRA's largest, most important direct investment in clean energy manufacturing – we can assume that most of these tax credits were used, but we can't determine how many were not in cases where companies lacked any tax liability. So these significant job-creating investments cannot be included either (although a case study of the program is included below).

IV. THE ARRA AT TWO YEARS

What is often unappreciated in public debate is that the consensus among economic forecasters, both private and public, is that ARRA worked about as projected to create or save 3 to 4 million jobs. In short, for those whose salary depends on knowing what moves the economy from quarter to quarter, there is unanimity that the Recovery Act saved or created millions of jobs.

OVERALL IMPACT ON THE ECONOMY

The most contentious political controversy surrounding ARRA is simply whether or not it helped *at all* to stabilize economic output and create or save jobs. A facile debating technique used by those contending that the Recovery Act did nothing invokes the Obama administration's forecast that the unemployment rate would rise to roughly 9% if the Recovery Act was not passed, but would not reach 8% if it was enacted¹⁵ – a forecast which even its makers now acknowledge underestimated the size of the spending shock hitting the economy in 2008 and 2009. When unemployment peaked at 10.1% *after* its passage, critics pounced, with some claiming that it had even somehow made things worse.

The problem with this interpretation is that it fails to consider the fact that it was not the Recovery Act that failed, but rather the imagination of economic forecasters (both within as well as outside the Obama administration) about how much damage would be inflicted on the economy by the failure of both regulators and the entire financial sector to contain the massive housing bubble.

In short, the difference between an economy with and without the Recovery Act has come in just as advertised: by the middle of 2010 *the economy had up to 3.4 million jobs more than it would have had if the Act had not passed*. The underlying trend of the economy, however, was far worse than most forecasted. The unemployment rate without the Recovery Act would have reached nearly 12%, not the 9% foreseen by the Obama administration.

A good metaphor for this controversy is the temperature in a log cabin on a cold winter's night. Say that the weather forecast is for the temperature to reach 30 degrees. To stay warm, you decide to burn three logs in the fireplace. You do the math (and chemistry) and calculate that burning these three logs will generate enough heat to bring the inside of the cabin to 50 degrees – or 20 degrees warmer than the ambient temperature.

But the forecast is wrong – and instead temperatures plummet to 10 degrees and burning the logs only results in a cabin temperature of 30 degrees. Has log-burning failed as a strategy to generate heat? Of course not. Has your estimate of the effectiveness of log-burning been wildly wrong? No – it was exactly right – it added 20 degrees to the ambient temperature. The only lesson to be learned from this is a simple one: since the weather turned out worse than expected, you needed more logs.

Evidence of ARRA's impact

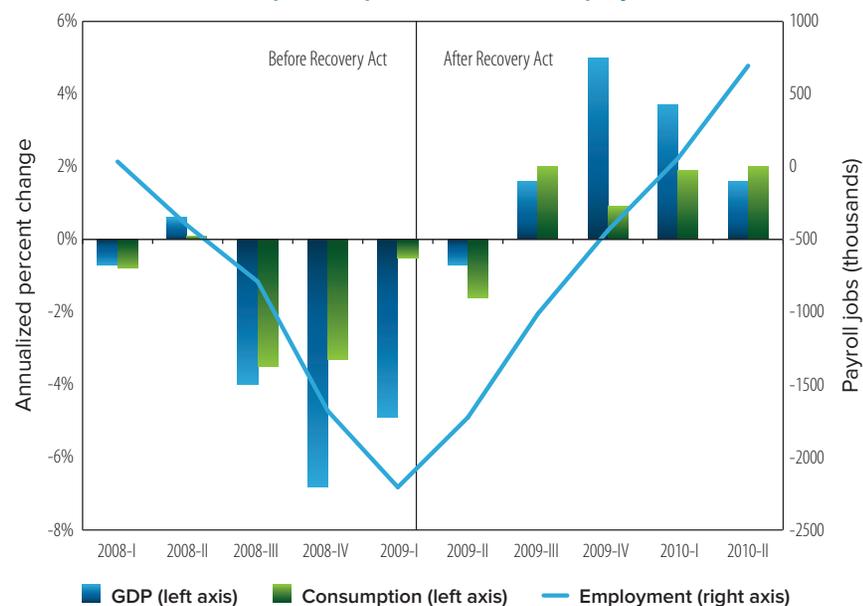
What is often unappreciated in public debate is that the *consensus* among economic forecasters, both private and public, is that ARRA worked about as projected to create or save 3 to 4 million jobs. In short, for those whose salary depends on knowing what moves the economy from quarter to quarter, there is unanimity that the Recovery Act saved or created millions of jobs.

There are a number of factors that explain the near-unanimity among forecasters who have examined the impact of ARRA.

First, it is firmly in line with what mainstream economic theory teaches is the likely effect of deficit-financed tax cuts, transfers, and spending in an economy that has high unemployment even in the presence of rock-bottom interest rates (i.e., is in a liquidity trap). The effect of increasing deficits to finance tax cuts, transfers, and spending in a *healthy* economy is ambiguous, and there are many complications to assessing it. However, in a liquidity trap, these complications fade away and the impact of these policy maneuvers become quite straightforward: they unambiguously push the economy closer to its potential, lowering the unemployment rate.

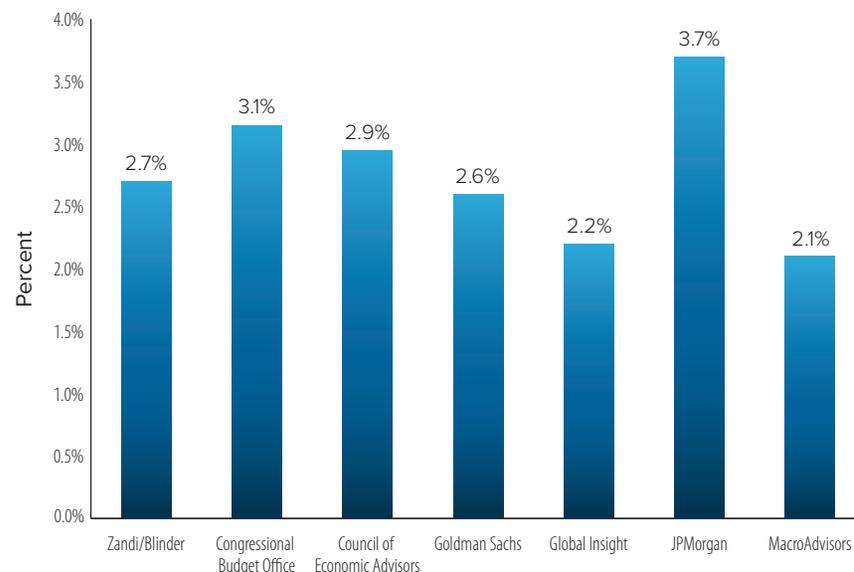
Second, the timing of the Recovery Act coincides perfectly with the halt in the downward spiral of both economic output and employment.¹⁶ In the six months before the Act began paying out funds, GDP *contracted* at a -5.9% annualized rate, while in the six months after its passage, the economy *grew* at a 0.75% annualized rate.

FIGURE 6. Quarterly change in real GDP, consumption expenditures, and employment



Source: EPI analysis of Bureau of Labor Statistics data and Bureau of Economic Analysis data.

FIGURE 7. Contribution of Recovery Act to GDP by the second quarter of 2010



Source: Data from sources listed above.

In the six months before the Recovery Act took effect, average monthly employment declined by over 700,000, while in the six months after its passage, these declines fell nearly in half to 369,000. In the second six months of the year following its passage, average employment was roughly stable, and began growing consistently thereafter.¹⁷ (See figure 6)

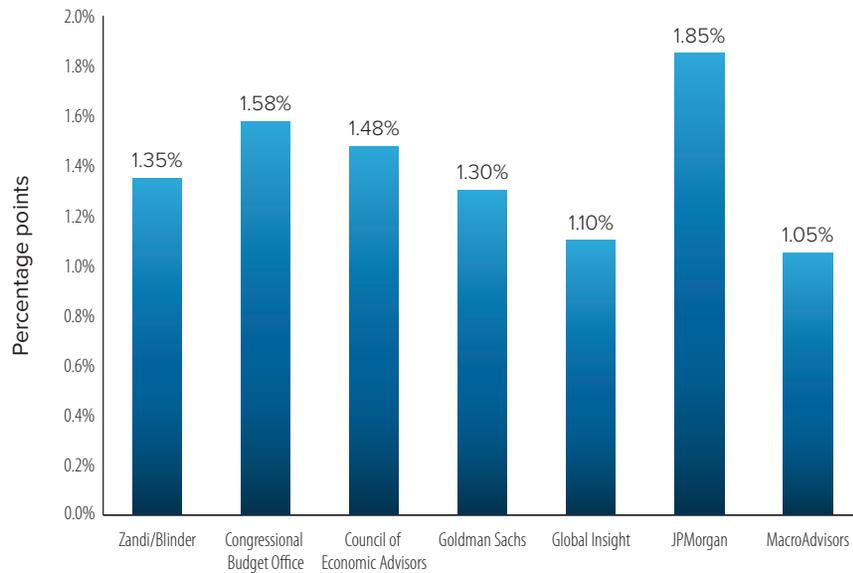
In the end, given the wealth of evidence arguing that the ARRA has boosted employment and output growth, we think it best to assess its effect by simply surveying the estimates of the forecasters (public and private) that have

examined it. The full range of these estimates are presented below, which show that ARRA had boosted GDP by up to \$520 billion and employment by up to 3.4 million jobs by the middle of 2010 and had lowered the unemployment rate by up to 1.8 percent relative to what would have happened without its passage. It should be noted that these figures show the averages of each study's assessment of the ARRA's impact – each study allows for the probability that the ARRA had much greater effect than this on the economy – and preliminary evidence shows that some parts of the ARRA (unemployment insurance, for example) actually provided more stimulus

than even high-end estimates of its effect before the ARRA would have suggested.^{18,19}

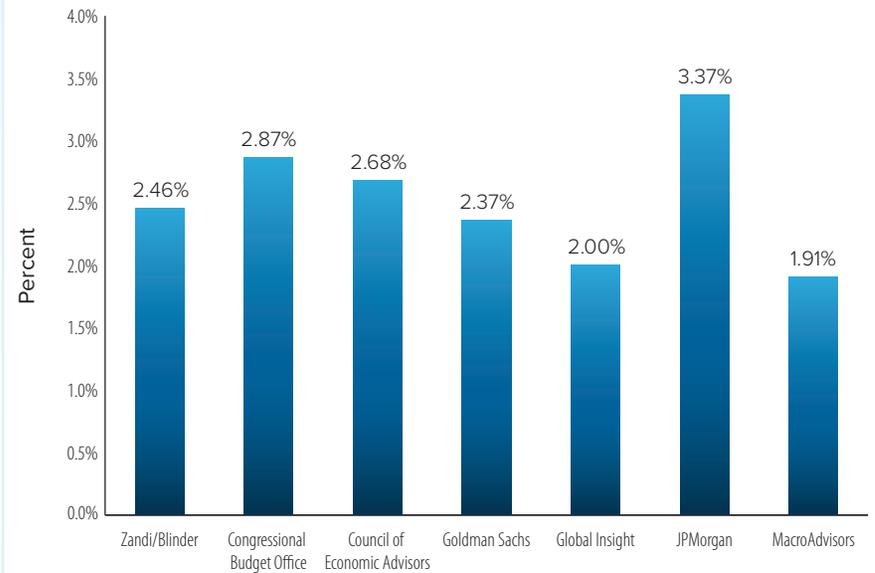
Figures 7-9 show the effect of the Recovery Act on GDP, jobs, and unemployment, respectively.

FIGURE 8. Percentage-point decrease in unemployment rate due to Recovery Act by the second quarter of 2010



Source: Data from sources listed above.

FIGURE 9. Contribution of Recovery Act to employment by the second quarter of 2010



Source: Data from sources listed above.

IMPACT OF GREEN ECONOMY INVESTMENTS

Methodology

For a detailed explanation of our methodology, see Appendix B.

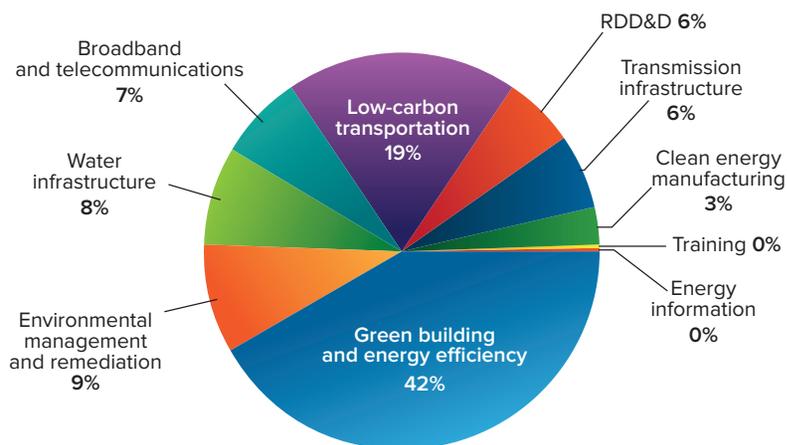
Running the Numbers

Inputs

This section estimates the labor market impact of the green investments contained in the Recovery Act. The specific programs, their associated spending, and the portion that can be specified as green can be found in Appendix A. A detailed explanation of how these programs were mapped to the BLS industries is available by the authors upon request.

For this report we used obligations to measure the portion of the green investments that have impacted the economy. The difference between obligations and outlays resides in government's specific role in the contractual process for these funds: obligations represent how much money has already been legally committed to specific projects, while outlays measure how much money has actually gone out the door. A popular analogy is that an obligation is like writing a check to another person, while an outlay is like that person actually cashing the check.

FIGURE 10. Composition of ARRA green investments to date
(obligations)



Source: EPI analysis of Recovery.gov ARRA Spending Account data and portions of the obligation and outlays used for Green Economy activities as determined by administering agencies

For most categories of spending, it is proper to measure the economic impact by using outlays. But infrastructure investment – which is how we can characterize the vast majority of the Recovery’s green investment – is unique, in that infrastructure projects tend to use a reimbursement-based system, where the outlays occur only *after* work is completed. This means that obligations – not outlays – drive economic activity, as it is the obligation of funds that spurs companies to hire or retain workers and begin projects.

Findings

We find that the Recovery Act obligated \$93 billion through the end December 2010 to green economic activities in a broad range of industry sectors (see Figure 10 and Table 1). Using standard macroeconomic multipliers applied to direct government spending and infrastructure investments we find that these green investments boost overall GDP by \$146 billion and create or save approximately 997,000 total jobs. These jobs include both the green jobs within the primary industries that meet the additional demand for goods

TABLE 1. Job impact of ARRA green investment

Broad Industry/Occupations	Green Jobs		
	Direct	Indirect	Total
BROAD INDUSTRIES			
Natural Resources and Mining	4,411	8,765	13,175
Construction	259,062	2,490	261,552
Manufacturing – Total	20,769	56,092	76,861
Wholesale Trade	0	17,255	17,255
Retail Trade	0	23,586	23,586
Information	11,347	11,965	23,312
Financial Activities	1,419	15,413	16,832
Professional and Business Services	19,081	41,698	60,778
Education Services	0	524	524
Leisure and Hospitality	0	17,101	17,101
Other Services	35,635	36,234	71,869
Utilities	3,724	1,339	5,062
Transportation and Warehousing	11,367	16,766	28,133
Government – Total	0	12,508	12,508
BROAD OCCUPATIONS			
Mgt, Bus and Fin	40,188	42,834	83,022
Professional	24,092	37,349	61,441
Service	4,568	26,254	30,822
Sales & Related	5,578	28,476	34,054
Office & Admin Support	28,434	43,062	71,496
Farm, Fish, Forest	425	3,591	4,017
Construction & Extraction	185,502	7,960	193,462
Install, Maintain & Repair	21,871	12,646	34,518
Production	18,293	33,253	51,546
Transport	37,862	31,477	69,339

The Council of Economic Advisors identifies ARRA's clean energy investments as leveraging the largest amount of co-investment, with \$46 billion of federal funds supporting more than \$150 billion of additional investment, most of it from the private sector.

and services (direct jobs) and in the secondary industries that supply those primary industries with intermediate goods and services (indirect jobs). This total also includes the jobs created by the effect of incomes being re-spent back into the economy (induced jobs).

We then turn to an input-output model to characterize the types of jobs likely created through the first-round of direct spending on these green investments. We find that the types of jobs created through these investments also disproportionately benefit those who have been on the losing end of structural trends in the labor market over the past few decades. While about 72% of the labor force does not have a four-year college degree, over 80% of the jobs are filled by such workers (see Table 2 on the following page). Yet despite lower education, most of these workers are actually paid better – fewer jobs fall into the lowest wage quintile and more fall into the middle of the wage distribution. About 20% of the jobs are filled by Hispanics, a group that which right now constitutes only 15% of the jobs in the overall economy.

These green investments, however, do not benefit the entire labor market proportionately: the jobs associated with these investments skew heavily in favor of men, with only 24% of the direct and indirect jobs going to women. (That said, it's worth noting that the full impact of the investments – which includes the jobs created by re-spending – would not be as skewed toward men). In addition, 9% of the direct and indirect jobs go to African Americans, lower than the 11% in the overall labor market. This skewing is primarily the result of many of these jobs being concentrated in the construction sector, where both groups are under-represented. It is important to note that our modeling

cannot capture the very intentional ways in which many ARRA-funded projects involve strategies that create pathways for under-represented workers to access the jobs created by these projects. The training programs of the Laborers' International Union of North America (LIUNA) and the Utility Workers Union of America (UWUA) that are referenced in the case studies section below include such pathways, and the case study on Kansas City's Green Impact Zone demonstrates how multiple ARRA projects can be coordinated and leveraged to target communities that have too often been at the losing end of the U.S. labor market.

These examples provide the building blocks for a policy agenda that confronts head-on the challenge of gender and racial inequities in certain industry sectors (for example, "construction career" strategies that lift up job standards in the construction industry and develop new recruitment and training standards that help new workers get into the jobs). Such strategies are integral to building a green economy that provides opportunity for all Americans.

Co-investment

We should note that these job estimates include only the impact of money allocated *directly* through the Act. Yet many of the provisions of the Act were actually designed to spur substantial co-investment from the private sector, by providing tax incentives or matching funds to firms undertaking green investments. The Council of Economic Advisors identifies ARRA's clean energy investments as leveraging the largest amount of co-investment, with \$46 billion of federal funds supporting more than \$150 billion of additional investment, most of it from the private sector.²⁰

For the purposes of this report, if, for example, ARRA appropriated \$5 billion to be given to firms undertaking an equivalent amount of their own investment in clean energy, then only the \$5 billion allocated through the Act is counted in the above jobs analysis. But the \$5 billion put up by the private-sector firm may well have never happened without the spur provided by ARRA and probably represents a net boost to the economy as well. Because we do not have a good way to assess just how much of the private-sector co-investment would or would not have happened in the absence of ARRA, we do not quantify its impact in this report – although it should be noted that in an economy performing significantly below potential, more of these private co-investments would not have otherwise occurred. Thus, our job estimates are quite conservative and likely underestimate the total job impact of the Recovery Act's green investments.

Economic models vs. recipient reporting

It's important to note that using multipliers based on macroeconomic models and input-output models is necessary to capture the full impact of spending on green investments. The jobs numbers reported on Recovery.gov are often cited, and their relatively low levels have fed critics of ARRA who claim they prove that the spending is not translating into job-creation efficiently.

But, the recipients' reports that form the basis of the Recovery.gov reporting system, while hugely valuable for oversight reasons, are inappropriate for calculating the full job impacts spurred by the Recovery Act's public investments or the composition of those jobs. Most importantly, they omit re-spending, or induced jobs. That is, while a construction

company that receives ARRA funds reports the direct jobs supported by the project, construction workers who have money because of the ARRA grant may then go buy lunch at the local diner, supporting employment of cooks and waitresses. These jobs, supported through “re-spending” effects of the initial round of spending that hired the construction company, are not going to be captured in the recipients’ reports. And these re-spending effects are large – up to 40% of total jobs created.

Further, recipients’ reports will miss supplier jobs as well. Again, while the construction company reports its own employees supported by an ARRA grant, it does not calculate the number of steel company employees needed to make the girders used in the construction project. For capital-intensive industries that are direct recipients, these supplier jobs can be a large part of the total. Knowing the composition of these supplier jobs are key to characterizing the types of jobs supported by the investments decisions of the ARRA. Finally, some of ARRA’s public investments were made through the tax code, and the users of these tax credits are not required to report even the direct jobs supported by their receipt of these funds.

TABLE 2. Job impact of ARRA green investment

Job Characteristics	Green Jobs			Induced Jobs	Total Job Impact	Direct	Indirect	Green Jobs Total	Overall Economy
	Direct	Indirect	Total						
Totals	366,814	268,483	635,297	362,119	997,416	58%	42%	100%	
GENDER									
Male	311,956	167,915	479,871	*	*	85%	63%	76%	60%
Female	54,858	100,568	155,426	*	*	15%	37%	24%	40%
RACE									
White	237,744	183,624	421,368	*	*	65%	68%	66%	67%
Black	29,090	29,363	58,453	*	*	8%	11%	9%	11%
Hispanic	85,988	39,918	125,906	*	*	23%	15%	20%	15%
Asian	7,565	11,054	18,619	*	*	2%	4%	3%	4%
Other	6,428	4,523	10,951	*	*	2%	2%	2%	2%
UNION STATUS									
Covered	57,622	24,269	81,890	*	*	16%	9%	13%	12%
Non-covered	309,192	244,214	553,406	*	*	84%	91%	87%	88%
EDUCATION									
Less than High School	76,013	31,342	107,355	*	*	21%	12%	17%	11%
High School Only	146,542	87,376	233,919	*	*	40%	33%	37%	31%
Some College	91,031	77,485	168,516	*	*	25%	29%	27%	30%
BA or greater	53,227	72,280	125,507	*	*	15%	27%	20%	28%
WAGE QUINTILES									
First (lowest)	46,586	51,677	98,263	*	*	13%	19%	15%	19%
Second	80,422	53,848	134,269	*	*	22%	20%	21%	21%
Third	88,037	54,948	142,985	*	*	24%	20%	23%	20%
Fourth	84,285	54,503	138,788	*	*	23%	20%	22%	20%
Fifth (highest)	67,485	53,507	120,991	*	*	18%	20%	19%	20%

* Induced job characteristics are not included because the input/output model only predicts direct and indirect job characteristics. However, they would likely mirror the overall economy.

Department of Energy (DOE) – Weatherization Assistance Program

An analysis of the data can only provide a limited understanding of the impacts of the Recovery Act’s green investments. These investments have been translated into economic activity in remarkably diverse ways, varying by program, industry sector and region of the country. This section attempts to capture some of this diversity and the successes and challenges of the Recovery Act’s implementation, and in the process illustrate how the green economy and green jobs are not some abstract niche of the overall economy, but rather central to it and scalable with the right policies.

The vast potential of building efficiency – to reduce energy costs and greenhouse gas (GHG) emissions while creating jobs – has been articulated by many, not least of whom being Secretary of Energy Steven Chu, who refers to it as “the fruit lying on the ground.” America’s 300 billion square feet of building stock account for roughly 40% of U.S. energy consumption and GHG emissions, a larger share than either transportation or industry.²¹ As with the U.S. energy system generally, however, buildings are strikingly inefficient energy consumers, and the application of cost-effective efficiency measures to them can cut these costs dramatically.

In response to this opportunity, the Recovery Act invested heavily in building efficiency. The single largest investment of \$5 billion went to DOE’s Weatherization Assistance Program (WAP), a program that has helped more than 6.2 million low-income families make energy-efficiency improvements to their homes since its inception more than three decades ago.

But the implementation of the Recovery Act’s \$5 billion for WAP was slowed by a combination of factors. The program had received roughly \$225 million annually in the years leading up to the passage of ARRA, and the more than a 10-fold increase in allocation strained capacity of states and providers to ramp up quickly while maintaining program quality. Issues at the state level – in particular state hiring freezes and furloughs – delayed the ability of certain states to prepare plans

and implement other provisions. The ARRA also included new requirements that took time to understand and implement, most notably Davis-Bacon prevailing wage requirements, which were applied to the program for the first time in order to address the inconsistent and often low quality of jobs within the weatherization industry. Prevailing wages for weatherization workers had not previously been determined by the Department of Labor (DOL); it was not until October 2009 that DOL determined such wages and issued the necessary guidance.²²

The intersection of these factors led to serious, unexpected delays. The state of Nevada was representative in this regard: Nevada received a \$37.3 million WAP allocation under ARRA,²³ But by the end of 2009, according to DOE’s Inspector General, only 84 units in total had been weatherized in the state of Nevada.²⁴

Though slow to start, WAP implementation in Nevada did eventually gain great momentum, nowhere more so than in the southern part of the state, where HELP of Southern Nevada, a community action agency, has administered WAP for the past 18 years. HELP and its contractors retrofitted 2,695 units over a six-month period, from mid-December 2009 through the end of May 2010, more than doubling the agency’s ARRA goal (1,222 units over a 12-month period) in just half the expected time. These installed measures will save each home an average of \$430 annually on energy costs.²⁵ In Nevada

as a whole 5,542 units were weatherized with ARRA WAP funds through November 2010. Nationwide, 300,000 units were weatherized with ARRA funds through the end of 2010, putting WAP on target to meet its goal of 600,000 units.²⁶

HELP’s ability to achieve its outcomes depended on a dramatically expanded capacity: HELP hired 19 new staff – energy auditors, inspectors, trainers, and accountants – and doubled from four to eight their contractor base, which collectively employed 120 workers on the weatherization projects. And it depended on an extremely skilled and productive workforce. For example, all of HELP’s assessors/inspectors have been trained in all aspects of weatherization and all have Building Performance Institute or other industry-recognized certifications, while all other staff are required to have skill certifications in their respective occupations.²⁷

The emphasis on skills extended to the contractor and crews that did the installation. One of HELP’s contractors, Better Building Systems (BBS) of Las Vegas, was able to ramp up so quickly because of project managers with long experience renovating hotels and casinos on the Las Vegas strip and a because of a workforce represented by LIUNA Local 872, which used its own training infrastructure to train its workers in weatherization skills, including new members for whom the training and jobs served as a pathway out of poverty. (Local 872’s efforts to recruit workers who

are typically under-represented in the building trades is illustrated by the demographics of the 166 individuals who went through their weatherization training program in 2009-2010: 66% were people of color including 30% who were African American; and 15% who were women.²⁸⁾ In addition, Local 872's hiring hall approach allowed BBS to recruit new crews of highly trained, ready-to-go workers whenever it needed, without having to take time to find and interview candidates for the job.

HELP and its contractors, having spent all of their regular WAP ARRA funds, are now about to start implementing a \$4.6 million SERC (Sustainable Energy Resources for Consumers) grant, additional ARRA funds awarded to high-performing local weatherization providers across the country, which HELP will use to install solar water heaters and other energy-saving measures on homes. But once this money is spent, the future of the home retrofit industry's growth in southern Nevada, as across the country, is unclear.

ARRA appropriation:
\$5,000,000,000

Obligated as of December 31, 2010:
\$4,961,682,732

Outlaid as of December 31, 2010:
\$2,139,312,148

Jobs created/saved, Oct-Dec, 2010:
15,530²⁹ (quarterly, not cumulative)

Homes weatherized as of
December 31, 2010: **300,000**



Photo courtesy of Southern Nevada LECET

DOE – Industrial Technologies Program

A critical factor in the global competitiveness of American industry is the degree to which those industries are energy efficient. Industrial sectors in the U.S. economy use more than 30% of U.S. energy, and are responsible for nearly 30% of U.S. GHG emissions. At the same time, by one estimate, the use of available energy-efficiency technologies could reduce industrial energy consumption up to 21% by 2020, saving U.S. industry \$47 billion per year.³⁰

It is symptomatic of the United States' ongoing lack of a coherent industrial policy that the primary program for promoting energy-efficiency improvements for American manufacturing, DOE's Industrial Technologies

Program (ITP), had an annual base budget in 2009 of only \$90 million. The ITP's mission is to help research, develop, and deploy – in partnership with industry – innovative technologies that companies can use to improve their energy productivity, reduce carbon emissions, and increase their competitiveness.³¹

In 2009, the ITP received \$150 million of ARRA funds, and in November of that year awarded nine grants for energy-related projects across the country. The largest of the grants awarded was \$31.6 million to ArcelorMittal Indiana Harbor in East Chicago.³² Indiana Harbor is the largest steelmaking facility in North America, employing nearly 6,000 workers, covering thousands of acres, and operating

multiple blast furnaces that transform raw materials into almost 10 million tons of high-quality, finished steel annually.³³

For a number of years the facility has used the waste gas from its blast furnaces, combusting it in blast furnace stoves and steam boilers to create energy. Most of the steam produced is for generating electricity, while the remainder is used to drive rotating equipment and for heating purposes throughout the plant.

However, prior to the project, approximately 80% of the blast furnace gas was used for operations and approximately 20% was wasted by “flaring” it into the atmosphere, emitting pollutants in the process. This was due to the plant not having the facilities to capture and use the gas efficiently. Seeing this opportunity to use the flared waste gas, ArcelorMittal began evaluating potential projects more than a decade ago. Most recently, a cost-benefit analysis was done in 2008 to review and re-estimate the project to determine what it would take to convert the flared gas to electricity.

But the project was not able to move forward at the time due to its high cost and insufficient return on investment when compared to competing projects. The ITP grant solicitation completely changed the cost-benefit calculation. By providing a 50% matching grant, the project became attractive and cost competitive for ArcelorMittal. With the total \$63.2 million investment, the facility will add an additional boiler to co-generate both steam and electricity, generating enough to power the equivalent of nearly 30,000 American

homes for a year, and allowing the company to decrease GHG emissions by approximately 333,000 tons annually – the equivalent of taking over 60,000 cars off the road.

Just as important are the economic impacts. Although the project only broke ground in October 2010, it will create, according to estimates, 360 jobs related to the design, construction, and manufacture of the equipment alone (for example, the new boiler that has been ordered is manufactured by Indeck at its plant in Erie, Penn.). It will also employ 200 local construction workers, and, through the thousands of cost savings it yields, support the thousands of workers who rely on the plant for jobs.³⁴ The project will help increase the sustainability of ArcelorMittal Indiana Harbor for the future and its ability to provide steel and jobs in a fiercely competitive global marketplace.

ARRA appropriation:
\$256,000,000

Obligated for Industrial Efficiency grants as of December 31, 2010:
\$150,400,042

Invoiced for Industrial Efficiency grants as of December 31, 2010:
\$35,580,701

Jobs created/saved, Oct.-Dec. 2010:
146 (quarterly, not cumulative)³⁵



Photo courtesy of ArcelorMittal

DOE – Western Area Power Administration Borrowing Authority

The United State is home to enormous resources of clean energy. But it lacks a modern transmission grid infrastructure that can deliver that clean energy – often sourced most productively from sparsely populated areas such as the Great Plains and desert Southwest – to areas of high population density and energy use, in particular at the west and east coasts.

The Recovery Act attempted to address this problem by providing significant new borrowing authority to the Western Area and Bonneville Power Administrations (WAPA and BPA), two of the four power administrations within the Department of Energy that are tasked with marketing and transmitting electricity from federal power generators to consumers across multiple states. The purpose of the borrowing authority that WAPA received from the Recovery Act was to expand and upgrade their electric power transmission systems to enable the transmission of new renewable electricity resources.

WAPA issued a solicitation for loans in March of 2009 and received applications from over 200 transmission line projects. Despite such strong demand, WAPA determined that only two of the projects were ready to move forward to construction in the near term. As of this writing, only one has broken ground, and WAPA has spent only a small portion of the borrowing authority given it by ARRA.

Such a low ratio of applications to approved projects – and thus WAPA’s disappointing progress in making investments in transmission infrastructure – is only understandable in the context of how many barriers need to be surmounted in order to get transmission line projects to the starting line in the United States. These are primarily policy barriers that make up a crazy quilt pattern of different planning, siting, and cost allocation regimes. Unless these barriers are addressed, it is unlikely that the United States can scale up its transmission capacity to meet the demand for electricity from renewable sources.

The sole project that proved to be “shovel ready,” and one that illustrates the promise of these investments, is the Montana-Alberta Tie Line – a green power transmission line connecting the electricity markets of Montana and Alberta, Canada (electrons don’t stop at borders, and neither do electricity markets). The project developer, Tonbridge Power, spent five years getting the necessary permits, negotiating the necessary land deals for siting the line (over 400 separate deals with individual landowners, not including additional consultation with neighbors and other landowners within a one-mile radius of the right of way), and lining up investors. But with the onset of the global economic crisis in 2008, the commitment letters from banks disappeared overnight, and Tonbridge was stranded with \$70 million of sunk costs and no investors. WAPA’s loan offered the project a lifeline when it was most needed. The loan, for up to \$161 million, was issued in the fall of 2009, and ground was broken on the project before

the end of the year. The ground breaking would almost certainly not have happened when it did without the Recovery Act, given the meltdown in the commercial markets.³⁶

The project’s green power source is wind, which Montana has in abundance (the state is ranked third among states in wind energy potential). The transmission line will carry electricity generated by a 309 MW wind farm in Montana called Rim Rock, which will capture wind coming off the Rocky Mountains. The wind farm developer, NaturEner, will sell the American-made energy – call it a clean energy export – to consumers in Alberta. The 206 turbines for the wind farm will be manufactured by Acciona Wind Power, which plans to supply most of the turbines from their West Branch, Iowa plant.³⁷ Two other wind farm developers, GreenHunter and Invenergy, have also reserved space on the line and will sell power to U.S. markets, including the Portland, Oregon area.

About a quarter of the Tie Line is now completed; Tonbridge expects it to be finished by the end of 2011. Rocky Mountain Contractors, based in Helena, employed 120 construction workers – including linemen, electricians, welders, and mechanics – in December 2010 to build the line and substations, as well as 37 engineering designers, surveyors, geotechnical personnel, and management staff.³⁸ Project developers estimate that the wind farms will also create an additional 50 to 75 jobs, ranging from operators to turbine maintenance technicians.

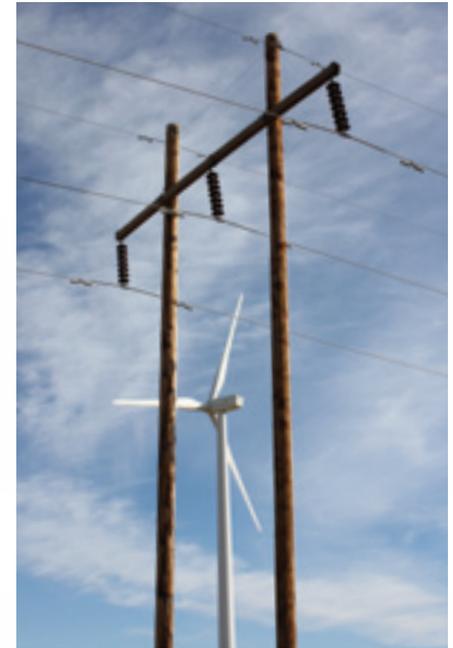


Photo courtesy of Rob Van Beers

ARRA borrowing authority:
\$3,250,000,000

Obligated as of December 31, 2010:
\$140,000,000

Invoiced as of December 31, 2010:
\$97,190,599

Jobs created/saved, Oct.-Dec. 2010:
see case study³⁹

DOE – Grants for Electric Vehicle and Component Manufacturing and Transportation Electrification

Americans drive cars – a lot. Increasingly, the rest of the world does, too. The intersecting trends of dwindling oil supplies, rising gas prices, increasing global demand for cars, and climate change makes investments in low-carbon automotive technologies simultaneously imperative and an enormous economic opportunity.

The Recovery Act doubled down on electric-drive vehicle technologies. Its targeted portfolio of investments in electric vehicles is creating a domestic battery and transportation electrification industry that is positioning itself to command significant global market share. When the Recovery Act passed, the United States produced less than 2% of the world's hybrid batteries. By 2012, the United States will have the capacity to produce 20% of the world's lithium-ion batteries for advanced vehicles. By 2015, this share will rise to 40%.⁴⁰ In that same year, 30 factories located in 19 states will have the combined capacity to supply 500,000 electric-drive vehicles annually.

When the Recovery Act passed, the United States produced less than 2% of the world's hybrid batteries. By 2012, the United States will have the capacity to produce 20% of the world's lithium-ion batteries for advanced vehicles.

The resources provided by ARRA for electric vehicle technologies resulted in more than 70 awards worth more than \$2.5 billion. These awards were targeted at each level along the innovation chain: from research and development, to component and battery manufacturing, to deployment of vehicles and charging stations. The awards went to:

- Nine battery-manufacturing projects;
- Eleven facilities to manufacture battery components;
- Ten projects to manufacture electric-drive components;
- Eight demonstration projects that will deploy 13,000 vehicles and 20,000 chargers in more than 20 cities around the country;
- Ten education programs to train the workforce required for the new electric-vehicle industry; and
- More than 20 transformative R & D projects with the potential to develop next generation technologies for batteries and electric-drive components.⁴¹

The investments are helping to overcome the major barrier to scaling up the electric vehicle industry: the cost and performance of batteries. When the Recovery Act passed, batteries were too heavy and too bulky and wore out too easily. The grants are investing across several lithium-ion chemistries to make batteries more affordable, lighter, longer-lasting, and higher-performance.

Although it is not an ARRA-funded program, the Advanced Technology Vehicle Manufacturing Program should be noted because its low-interest loans for the domestic production of advanced-technology vehicles and their key components are so complimentary: more than \$8.6 billion in loans have been made to advanced vehicle manufacturers. The projects announced to date include \$1.4 billion to Nissan to establish battery production and assembly of the Leaf in Tennessee, support for major expansions for start-ups Tesla and Fisker, and loans that helped Ford establish 13 projects supporting 30,000 jobs.

The bottom line: the Recovery Act is helping build a competitive auto industry at a critical moment in its evolution, while accelerating the pace of improvement in vehicle technology. And it is creating and supporting jobs: to date all nine battery factories have started construction. Twenty-six of 30 battery, suppliers, and component factories have broken ground, as well. Two companies – A123 and Johnson Controls – started high-volume production in September 2010.

ARRA appropriation for Electric Vehicle and Component Manufacturing: **\$2,000,000,000**

Obligated as of December 31, 2010: **\$1,989,495,263**

Invoiced as of December 31, 2010: **\$469,077,204**

Jobs created/saved, Oct.-Dec. 2010: **1,109 (quarterly, not cumulative)**

ARRA appropriation for Transportation Electrification: **400,000,000**

Obligated as of December 31, 2010: **\$386,232,871**

Invoiced as of December 31, 2010: **\$51,172,770**

Jobs created/saved, Oct.-Dec. 2010: **259 (quarterly, not cumulative)⁴²**

Department of Treasury – Section 1603 Grant-in-Lieu-of Tax Credit Program

The wind energy sector has been the fastest growing of U.S. renewable energy industries in recent years. From 2005 to 2009, the domestic wind industry saw record-breaking growth – a quadrupling of wind turbine installations over that period, culminating in 10,000 megawatts installed in 2009. Given the onset of the Great Recession, 2009 was not expected to be a record breaker; in fact, wind installations were projected to drop by 50%.⁴³ However, due to an essential provision in ARRA, the wind industry was able to continue installing new capacity at a recession-defying pace. Section 1603 of ARRA extended the Production Tax Credit (the PTC, a policy instrument crucial to the wind industry's growth) through 2012, and allowed developers to convert the PTC into a 30% Investment Tax Credit that could be converted into an equivalent cash grant through the end of 2010 (extended by Congress in December of that year through the end of 2011). By monetizing the primary financial incentive for the industry at a time when a tax credit was of little value to most investors due to a frozen equity market for tax credits, ARRA provided a huge boost to the industry and paved the way for a record-breaking year.

These renewable energy tax credits, as with almost all tax credits, are only available after an investment is made. In the case of wind, before a tax credit is accessible, developers must first move a project through a multi-year development process, raise millions in private capital, construct the project and bring it online to

deliver power to the grid. The certainty of the tax credit's availability creates a strong incentive to make these multi-million dollar investments in the U.S. The economic crisis in late 2008 created extreme uncertainty, eroding the ability to raise capital, causing projects to stop in their tracks, and creating serious risk of layoffs and derailing of investment.

One of the projects saved by 1603 was a new wind farm developed in Illinois by Iberdrola Renewables, called Streator Cayuga Ridge, where construction had begun in October 2008. The financial crisis imperiled the future of the project and the company's overall investment plans in the United States. Iberdrola Renewables' global parent company, Iberdrola SA, contemplated reducing its U.S. wind power investment by approximately 50%. Turbines that were to be allocated to U.S. wind power projects were being considered for reallocation to the company's affiliates in other countries with more long-term market stability. Section 1603 enabled Iberdrola Renewables to resume not just the construction of the Streator Cayuga Ridge project, but the entirety of its U.S. investment plans.⁴⁴

Construction of the wind farm was completed in March 2010. Over the course of the project, the workforce on site averaged 180 construction workers – Mortenson Construction, based in Minnesota, was the primary contractor – with a peak of more than 400 workers. (To give a sense of scale, the founda-



Photo courtesy of Iberdrola Renewables

tion of just one wind turbine requires 51 truckloads of concrete.) Twenty to 30 jobs, primarily in wind turbine operations and maintenance, are supported on site currently. The 150 wind turbines that were installed came from Gamesa North America, based in Pennsylvania, which made the turbine blades at their Ebensburg plant and assembled the hubs and nacelles at their Fairless Hills plant.

continued >

Additional blades were made by LM Wind Power USA in North Dakota. The towers were manufactured by Tower Tech Systems in Wisconsin. The other turbine components were made by a range of manufacturers, and many were most likely imported. The U.S. wind energy industry has made considerable progress in increasing the domestic content of its turbines, particularly for bigger parts like blades and towers. (For example, Gamesa's domestic content on U.S.-made turbines is over 60%, one of the highest standards in the industry.) But a challenge remains to source nacelle internals – smaller yet highly complex, high-value components – domestically, which in turn requires assisting U.S. manufacturers to transition their production and connect to the supply chains of the wind industry's OEM's (Original Equipment Manufacturers) and first-tier suppliers.

It is estimated that the Streator Cayuga Ridge wind farm will contribute between \$2.7 and \$3.5 million annually to the local tax base in rural Illinois and pay approximately \$1.2 million annually in total to local landowners (who will also continue to use their land for farming). The 300 MW generated by the wind farm is being sold to the Tennessee Valley Authority under a 20-year power purchase agreement.⁴⁵

Section 1603 was vital to other renewable energy sectors, as well. For example, the program supported the deployment of over 4,000 solar energy systems, helping the U.S. solar industry continue its strong growth, which saw the installation of 429 MW in 2009, 38% above the 2008 total.⁴⁶ The program continued to be integral to the wind industry in 2010 as tax equity markets remained tight; 81% of wind capacity installed in the first three quarters of 2010 used the 1603 tax credit option.⁴⁷ And yet the upward growth trajectory of the wind industry has stalled, with only 5,115 MW of wind power brought online in 2010, barely half of 2009's record pace. The main problem: continued uncertainty of federal policies – in particular the lack of a national Renewable Electricity Standard or a price on carbon – which in turn deprives U.S. wind developers and manufacturers of the long-term and stable market signal that many other countries have put in place to support companies as they take risks on big capital investments.

TABLE 3. 1603 grants awarded through the end of 2010⁴⁸

Industry	Grants	Total \$
Biomass (open loop, cellulosic)	12	\$105,933,765.00
Biomass (open loop, livestock)	17	\$9,504,950.00
Combined Heat & Power	6	\$4,733,064.00
Fuel Cell	8	\$4,411,775.00
Geothermal	3	\$2,230,290.00
Geothermal Electricity	6	\$260,674,171.00
Geothermal Heat Pump	19	\$4,212,522.00
Hydropower (incremental)	6	\$6,764,908.00
Landfill Gas	12	\$20,229,384.00
Marine	1	\$215,990.00
Microturbine	3	\$82,500.00
Small Wind	115	\$48,995,885.00
Solar Electricity	4,279	\$468,937,927.00
Solar Lighting	1	\$6,625.00
Solar Thermal	123	\$3,451,037.00
Trash Facility	2	\$2,748,064.00
Wind	137	\$4,888,323,166.00
Total	4,750	\$5,831,456,023.00

Tax credit recipients are not required to report the job impacts of the credit. If and hopefully when the program is extended again, it should include new provisions that require the Secretary of Energy to establish goals for the creation and retention of domestic jobs through the program and require recipients to report the number of jobs created and retained. As more federal investments for infrastructure migrate from traditional appropriations to the tax code and other innovative financing approaches, it is essential that federal prevailing-wage protections are included. The consistent application of these prevailing-wage laws assures that federal investments do not undermine local community standards of living.

Department of Treasury/DOE – Advanced Manufacturing Tax Credit Program (48C)

The transition to a green economy holds the potential to revitalize American manufacturing. Instead of importing or extracting the sources of our energy, green technology sources of energy can be made in the United States in high-value, labor-intensive ways. Indeed, we are starting to see this happen. For example, the wind energy industry employs 18,500 workers in the manufacturing sector, with 14,000 more in the pipeline, as turbine manufacturers develop domestic supply chains to reduce transportation costs, decrease currency risk, and increase just-in-time turbine availability, product quality, and service.⁴⁹

Yet competition for green manufacturing is fierce, particularly from countries where government policy provides support to its own manufacturers and bolsters long-term market certainty (or additionally, in the case of China, manipulates its currency to keep the price of its manufactured goods artificially low).

U.S.-based manufacturers need federal policy to level the global playing field. The Recovery Act included a new Advanced Energy Manufacturing Tax Credit (also known as “48C” for its place in the tax code) to do just that. ARRA authorized the Department of Treasury to award \$2.3 billion in tax credits for qualified investments, providing a 30% credit for investments in new, expanded, or re-equipped advanced energy manufacturing projects. In January 2010, 183 projects in 43 states were awarded a tax credit. The demand was so great that qualified applicants exceeded available tax credits by a factor of three to one. Recipients of 48C included manufacturers from wind, solar, battery, biomass, smart grid, automotive, and geothermal sectors. And yet despite such demand, the program was not included in the tax extenders package passed by Congress at the end of 2010.

One of the tax credits – for \$141.8 million – went to the Hemlock Semiconductor Group, a joint venture in which Dow Corning is the principal owner. It supported a \$1 billion expansion of its polycrystalline silicon (polysilicon) production facility in Hemlock, Michigan. Polysilicon is a cornerstone raw material of the solar industry, used to produce solar cells that harvest renewable energy from sunlight. It is one of the solar manufacturing

sectors where U.S.-based companies command a significant global market share. In 2009 an estimated 40% of global supply was produced in the United States.⁵⁰ A large portion of that came from the Hemlock Semiconductor site in Michigan, which even before the ARRA-supported expansion was the largest polysilicon production facility in the world.

This is the third major expansion at the Michigan facility in the last five years. The latest expansion will add up to 13,000 metric tons of capacity to the site, which is close to having the footprint of a small city. The construction, which Hemlock Semiconductor expects to be complete this year, has supported the employment of approximately 800 construction workers. The new expansion will add an additional 300 to 500 permanent new jobs, ranging from mechanical engineers to pipefitters to chemical operators.

continued >

In January 2010, 183 projects in 43 states were awarded a tax credit. The demand was so great that qualified applicants exceeded available tax credits by a factor of three to one.

The U.S.-based Dow Corning has a large amount of polysilicon production in the United States, but faces pressure to place that capacity near key markets for the solar industry.⁵¹

But the vast majority of the polysilicon produced at Hemlock Semiconductor won't be used in the United States. In 2009 the United States exported 12 times more polysilicon than it imported (\$1.1 billion to \$83.9 million).⁵² Consistent with this trade flow, Hemlock Semiconductor will export most of the polysilicon it produces – to countries like Japan, China, and Germany. Why? Because the markets are there, not in the United States.

TABLE 4. 48C awards:⁵³

Tech Area	Number of Projects	Total Tax Credit Requested
Battery	6	\$ 32,810,400
Biomass	2	\$ 29,304,480
Buildings	23	\$ 178,839,742
CCS	2	\$ 4,842,438
Fuel Cell	2	\$ 5,510,100
Geo/Buildings	2	\$ 9,054,126
Hydro	2	\$4,053,733
Industrial	10	\$ 169,118,509
Nuclear	2	\$ 73,800,000
Smart Grid	9	\$ 35,652,663
Solar	58	\$ 1,125,546,921
Vehicles	4	\$ 196,790,145
Wind	42	\$ 291,302,368
Not specified	19	\$ 135,712,113
Total	183	\$ 2,292,337,738

The companies awarded 48C tax credits estimated they would create, in sum, 17,000 jobs. However, as with the Section 1603 program, there is no reported data available for the number of jobs supported by the program. If the program is extended again, as it should be, then new provisions should be added that require the Secretary of Energy to establish goals for the creation and retention of domestic jobs through the program and require recipients to report the number of jobs created and retained. In addition, the program's job creation potential should be maximized by adding a selection criterion giving the highest priority to projects that manufacture – rather than simply assemble – advanced energy components. And, finally, the tax credit should be refundable so that pre-revenue firms that don't yet have tax liability can use it immediately.

Environmental Protection Agency – Clean Water State Revolving Fund

Communities, environments, and economies rely on clean, safe water. Unfortunately, present day water usage and water infrastructure consumes vast amounts of energy and contributes to climate change in ways that threaten the availability of clean, safe water resources in the future. The way we produce energy involves the consumption of vast amounts of water, making energy production the second highest user of water in the country.⁵⁴ In addition, the collection, distribution, and treatment of drinking water and wastewater in the United States releases approximately 116 billion pounds of carbon dioxide annually, the equivalent of 10 million cars worth.⁵⁵ Water efficiency can help reduce drought likelihood, lower consumers' utility bills, and combat global warming pollution.

The ARRA appropriated \$6 billion to the EPA's Clean Water State Revolving Fund (CWSRF) and Drinking Water State Revolving Fund (DWSRF), which are federal/state partnerships established to create a permanent source of financing for America's wastewater and water infrastructure needs, thereby reducing energy use, ensuring the resilience of water systems, and helping to meet public health goals. Water infrastructure improvements such as fixing pipes and water treatment processes also increase energy efficiency and conserve water resources; drinking water systems lose as much as 20% of treated drinking water due to leaks in their pipe networks every year.⁵⁶

Through these state revolving fund (SRF) programs, funds are allocated to the states, which then lend it to borrowers to finance their infrastructure needs. The repayments of these loans, along with additional grant dollars from the EPA, allow these state SRF funds to grow and address further infrastructure needs. Over the life of these programs, over \$100 billion has been provided to borrowers to fund infrastructure projects.

The implementation of the ARRA funds was not without its speed bumps. States were required to dedicate 20% of their allocations to a "green reserve" for projects that were particularly innovative in addressing water or energy efficiency and other environmental goals. EPA's Inspector General (IG) later concluded that the agency did not give clear and comprehensive guidance to states to determine the eligibility of such projects.⁵⁷ Another IG analysis found delays in contracting for projects at the local level, due to state and local budget cuts, and difficulty understanding and implementing new ARRA requirements.⁵⁸ However, all state SRF programs ultimately met, or exceeded, the 20% green reserve requirement and met the February 17, 2010, deadline to have all ARRA funds under contract.

Despite these challenges, the funds got out to states and projects around the country. One of those went to the town of Batesville, Arkansas, which received a \$10 million loan from the state's ARRA CWSRF. The loan was for the replacement of the town's wastewater force mains, which were over 40 years old, the larger of the two often submerged by the nearby White River, where pipes can leak raw discharge into the river if damaged. It had not been possible for Batesville to attract a loan of this size and terms (over \$6.3 million of the principal is forgiven) from a commercial lender, a not uncommon problem in rural parts of the state, or anywhere in rural America with low per-capita income.

The loan funds a project to replace the aging wastewater mains with a new 3,100 foot gravity sewer – 1700 feet of which is tunneled and the first of its kind in Arkansas – which will connect to the city's wastewater treatment plant. Tunneling for the sewer began in April 2010, and will likely be completed in the summer of 2011, six months ahead of schedule. The project has supported 40 construction jobs, most of them associated with boring the tunnel through which the gravity sewer runs. When completed, this new wastewater system will realize over 60% energy savings annually, or about 700,000 KW per year. And the White River, the town's life line, will no longer face the threat of pollution from raw sewage.

ARRA CWSRF appropriation:
\$4,003,157,730

Obligated as of December 31, 2010:
\$4,003,148,154

Outlaid as of December 31, 2010:
\$2,953,774,911

Jobs created/saved, Oct.-Dec. 2010:
6,361 (quarterly, not cumulative)

Projects started / completed as
December 31, 2010: **2,084 / 445⁵⁹**

General Services Administration – High Performance Green Building Program

The United States is home to over five million commercial buildings and 120 million residential units that consume a substantial amount of energy and resources, as noted above. McKinsey and Company estimates that increased building efficiency would save the U.S. economy \$130 billion per year, while reducing emissions by 1.1 gigatons a year.⁶⁰ Green buildings are a low-cost, high-return investment strategy to reduce energy consumption and emissions while creating jobs and lowering utility bills.⁶¹

The Recovery Act provided the General Services Administration (GSA) with \$5.5 billion in funds, which included \$4.5 billion to convert existing facilities into high-performance green buildings, as well as \$1.0 billion for new high-performance green federal buildings,

U.S. courthouses, and land ports of entry. GSA, the federal government's support agency that serves as the landlord of its buildings, was an early adopter of green buildings, based on a belief that the federal government can save taxpayer dollars and create significant demand in the marketplace by constructing and maintaining its building stock to rigorous green building standards, such as LEED.

Recovery Act funds are helping to modernize the Hipolito Garcia U.S. Courthouse in San Antonio, Texas. Built in 1937, the Courthouse is currently undergoing renovations to its heating ventilation, air conditioning, plumbing, roof, and exterior and interior finishes. Plans for modernizing the building had been in the works prior to the Recovery Act, but ARRA funding helped to make the project more

ambitious and meet a more stringent green building designation, LEED Gold. One of the project's most innovative elements will be the addition of a vegetated green roof, which also serves as a light court for the building's upper five stories. The green roof will capture rainfall for use, and will itself be watered by condensate harvested from the outdoor exterior of the building. The building's 70 year-old fixtures are being replaced with the low-flow water fixtures. Storm windows are being added to the interior, preserving the building's historical status, while effectively blockading the super-highway of air that until now has allowed heat to enter and leave the building almost at will. And an advanced "smart" meter system is being added, which will allow GSA to monitor and adjust the building's energy and water use from its Fort Worth office.

In all, the project will help reduce indoor water consumption by 50%, outdoor water consumption by 100%, and energy use by 20%. The primary contractor, Beck Group, and its subcontractors, are currently employing 115 construction workers on the site; approximately 200 were employed at the project's peak. The renovation of Hipolito Garcia Courthouse is on schedule for completion in June 2012.

But the jobs created by the building's modernization don't end at the courthouse walls. The Recovery Act's Buy America provision – which requires that iron, steel, and manufactured goods used for ARRA-funded public buildings or public works projects be produced in the United States – has ensured supply

chains of American jobs. For example, the solar PV array installed on the upper roof is using panels manufactured by the Hillsboro, Oregon-based SolarWorld. In addition, project developers estimate that \$600,000 worth of materials and goods were made within a 500 square mile radius of San Antonio, which allows them to claim more points for the LEED Gold standard.⁶²

Moving beyond the Recovery Act, President Obama's ground breaking Executive Order 13514 – Federal Leadership in Environmental, Energy, and Economic Performance – requires all federal agencies to achieve greenhouse gas reduction and energy efficiency improvement goals, and includes a requirement that all new federal buildings be designed to achieve zero-net-energy by 2030. We should be seeing many more Hipolito Garcia's in the future.

ARRA appropriation:
\$5,545,000,000

Obligated as of December 31, 2010:
\$5,221,117,481

Outlaid as of December 31, 2010:
\$1,298,034,527

Jobs created/saved, Oct.-Dec. 2010:
6,190 (quarterly, not cumulative)⁶³



Photo courtesy of U.S. General Services Administration

Department of Labor – Green Job Training

When the Green Jobs Act was passed in the 2007 Energy Bill, it was premised on two intersecting notions: renewable energy and energy-efficiency industries need skilled workers in order to realize the full economic potential of the transition to a green economy; at the same time, workers need pathways into quality training programs that lead to career-track jobs.

The drafters of the Recovery Act subscribed to the same notions – recognizing that job creating investments require corresponding investments in the skills of workers – and appropriated \$500 million to the U.S. Department of Labor (DOL) to train workers for energy industries defined in the Green Jobs Act. In June 2009, DOL issued five grant solicitations to competitively award the funds.

DOL received close to 1,000 applications that met the requirements of the grants, and ultimately issued awards to the winners in late 2009 and early 2010. One of those awards, for close to \$5 million, went to the Utility Workers Union of America (UWUA), which runs a program to train workers for the utility industry. UWUA initiated the project recognizing that the current, aging utility workforce is approaching a demographic cliff – new workers will be needed for as many as 30-40% of the nation's current electric power workforce by 2013 – and that changing technologies in the sector will require new skills.⁶⁴ UWUA's goal is to train 359 entry-level workers and 360 incumbent workers with the grant in local labor markets in three different states, Massachusetts, New Jersey, and California, where they and their employers have identified demand for workers with particular skills.

The California program, in partnership with Southern California Gas Company, Southern California Edison, CA Water Service Company, and Golden West Water, targets 300 incumbent workers, many of them meter readers and meter techs, who will require updated skills. The utilities are transitioning to smart meter and other new energy technologies, and the question of how this impacts the existing workforce – and whether they will benefit from the new jobs that come with this transition – has become very contentious. As this debate plays out, UWUA is providing career ladder training for the jobs they know will be there at the utilities, including customer service and residential energy technician positions. They are also training, based on labor market analysis, 100 new entry level workers for in-demand jobs at water utilities. The training they receive will prepare them to earn the Water Treatment and Water Distribution certifications required by the state to fill these positions.

The New Jersey program, in partnership with PSEG and Elizabeth Town Gas, also targets both incumbent and entry-level workers. As in California, workers (in this case incumbent workers) are being trained to attain Water Quality and Compliance certifications, as well as Waste Water and Water Distribution certifications. Entry-level workers are receiving the skills necessary for LEED and BPI (Building Performance Institute) energy auditor certifications necessary to perform the utilities' retrofitting of residential and commercial buildings.

The Massachusetts program, in partnership with NStar, targets mostly entry-level workers and a handful of incumbents. These workers undertake a rigorous two-year program

that prepares them to be relay techs (responsible for setting up the underground wiring necessary for a smart grid to function) and overhead linemen.

In each region, UWUA also partners and in some case subcontracts with local community colleges, workforce investment boards, community-based organizations, and government agencies, which provide recruitment, training, support, and job placement services and typically bring their own leveraged resources to the table. Classes are delivered in traditional classrooms but sometimes via distance learning and – in California – a mobile lab provided by Los Angeles Trade Technical College, so working adult students can better access them. These are for-credit classes, so workers can link them as part of a career pathway.

The results: through the end of 2010 the UWUA programs in the three sites have collectively enrolled 281 workers (of whom 51% are Hispanic, 31% are African American and 33% are women), with 179 workers currently in training. The more than one hundred who have completed training received an industry-recognized credential and in some case an Associate's degree. Fifty-six of the entry-level workers have been placed in new jobs at starting hourly wages that range from \$17.82 to \$29.56.⁶⁵ The stories of some of these students and workers can be found at a blog developed by UWUA: <http://accordnow.org/index.php/programs1/program-2/gj-gj-blog/>



Photo courtesy of UWUA and ACCORD – Community First

ARRA appropriation:
\$500,000,000

Obligated as of September 30, 2010:
\$159,809,536

Outlaid as of September 30, 2010:
\$57,350,618

Participants entered education and training as of September 30, 2010:
8,393

Participants completed education and training as of September 30, 2010: **3,586**

Participants entered new jobs after program completion as of September 30, 2010: **466⁶⁶**

Department of Housing and Urban Development – Lead Hazard Reduction Program

The Recovery Act aims to “invest in a strong foundation for a 21st century economy.” That strong foundation includes healthy people ready to accept the challenges of building a new green economy. ARRA dollars spent on creating and preserving jobs that improve the environmental health of American families are green economy investments with an extra dividend for our common future.

Today, according to the Centers for Disease Control and Prevention, chronic disease is the leading cause of death and disability among Americans. New studies report that, over the last 40 years, the incidence of infertility, breast and testicular cancer, heart disease, and diabetes have increased in adults, and asthma, autism, certain birth defects, cancer, and learning disabilities are affecting more children. Exposure to toxic chemicals is one of the factors in this increased disease burden for U.S. families. New studies have also added to our understanding of how even the smallest exposure to chemicals like lead and PCBs (Polychlorinated Biphenyls) can impact human health, especially the normal development of a pregnancy or young child.

ARRA made significant investments in programs administered by a number of federal agencies that share promotion of environmental health as a common denominator, paying for projects like the clean-up of PCBs and metals at the Cornell Dubilier Electronics site in South Plainfield, New Jersey, the lead and arsenic project in the Jacobsville Neighborhood of Evansville, Indiana, and the PCB remediation effort at the Outboard Marine Corp site in Waukegan, Illinois.

While some ARRA funded projects, like those described above, have focused on cleaning up toxic chemicals at Superfund toxic dumpsites, other projects are focused on eliminating toxic chemicals in our homes. The Healthy Homes and Lead Hazard Control project in Malden, Massachusetts is one such project, administered by the Department of Housing and Urban Development (HUD). Lead is a highly toxic substance that can cause health problems at any level of exposure. Lead can harm a child’s brain, kidneys, bone marrow, and other body systems. At high levels, lead can cause coma, convulsions, and death. Low levels of exposure, like those a pregnant woman or child would get from inhaling the dust in an older home that still has lead-based paint, are associated with impaired cognitive function, behavior difficulties, fetal organ development, reduced intelligence, impaired hearing, and reduced stature.

With Recovery Act funding, the Healthy Homes and Lead Hazard Control Project has allowed the Malden Redevelopment Authority (MRA) to retain five public-service employees who would have been laid off, add 2 new full-time Rehabilitation Specialist positions, and provided additional job opportunities in lead-based paint hazard-control projects for 35 contractor, labor, and trades positions. The project’s increased volume of construction work has given local contractors the ability to add an additional six full-time positions, including several for Malden public housing tenants.

The \$3 million grant has, to date, paid for the rehabilitation work to make some 200 homes healthy and safe for the people who live in them. In partnership with Healthy Malden, Inc., Tri-City Community Action Program, and the Malden Board of Health, the project is also providing lead-abatement training scholarships for 40 local people, expanding their blood lead testing program and educating 10,000 people about how to protect and enhance the health of their homes.

The \$3 million grant has, to date, paid for the rehabilitation work to make some 200 homes healthy and safe for the people who live in them.

ARRA appropriation:
\$100,000,000

Obligated as of December 31, 2010:
\$98,909,099

Outlaid as of December 31, 2010:
\$43,767,642

Jobs created/saved, Oct.-Dec. 2010:
364 (quarterly, not cumulative)

Number of units completed through December 31, 2010:
2,459⁶⁷

Department of Transportation – Supplemental Discretionary Grants for a National Surface Transportation System

Many of the funding initiatives of ARRA were designed to reduce fuel use and increase transportation options for Americans. One such initiative, the Transportation Investment Generating Economic Recovery (TIGER) grants program, administered by the U.S. Department of Transportation, awarded grants competitively to projects around the country of regional or national significance. They were selected based on a variety of criteria, including the likelihood that they would increase economic competitiveness, livability, safety, and sustainability while reducing energy usage and dependence on foreign oil, and preventing pollution and greenhouse gas emissions.

One of the recipients was the Green Impact Zone in Kansas City, Missouri, where TIGER funding is being synergized with multiple ARRA investments to support an innovative partnership that is creating jobs and restoring communities. The Green Impact Zone, now in its second year, is a comprehensive initiative to rebuild and revitalize a distressed 150-square-block area of Kansas City's urban core, leveraging and coordinating the resources of ten neighborhood organizations and 16 other local partners. Through targeted job training, green infrastructure investment and community outreach, the initiative combines its TIGER grant with ARRA funds from the Weatherization Assistance Program, Energy Efficiency and Conservation Block Grant (EECBG), Smart Grid, and workforce

development programs, to create jobs – over 100 to date, many of them zone residents – train workers for them, and put the community on track for environmental and economic sustainability.

Rebuilding and expanding local infrastructure is one of the Green Impact Zone's central pillars. In February 2010, the Kansas City Metro was awarded a \$50 million TIGER grant. Of this funding, \$26.2 million is being used for transportation infrastructure improvements in the zone, including improvements to pedestrian access, transit facilities, traffic signals, street rehabilitation and the addition of a pedestrian bridge. The remaining \$23.8 million is being used for improvements to regional transit corridors, building on the launch, in 2010, of a new bus rapid transit service. The route serves the city's highest ridership corridor, which transects the Green Impact Zone, and features hybrid electric buses, rain gardens, and a park-and-ride facility built with a special concrete that helps protect local water quality. Green Impact Zone staff are contributing to a new streetscape plan for one of the area's main boulevards, readying the way for new construction jobs this year and creating a more accessible, walkable neighborhood.

The pedestrian and transit elements are especially crucial in meeting the livability and sustainability components of the TIGER program, giving better access to employment for the zone's residents and reducing household transportation costs, while also helping to reduce their carbon footprint.

Energy and water efficiency projects are also creating jobs within the zone. The projects are made possible by an investment of \$20 million in ARRA Energy Efficiency and Conservation Block Grant funds. Funding from this grant is supporting EnergyWorks KC, a local partnership providing zone and other Kansas City residents with energy audits and retrofits. Funding from the grant is also providing staff capacity to support, coordinate, and encourage a wide variety of other weatherization and efficiency projects. For example, Kansas City Power & Light has already installed 3,000 advanced smart meters and 700 MySmart Displays through a Smart Grid grant to help customers save energy and money through increased efficiency. Another efficiency project is the Green Impact Zone's Community Crews initiative, which is putting teams of young people to work on stormwater diversion projects after their training in concrete finishing by the Ivanhoe Community Council. Eighty-six projects have already been completed.⁶⁸

ARRA appropriation:
\$1,304,046,828

Obligated as of December 31, 2010:
\$1,304,046,828

Outlaid as of December 31, 2010:
\$24,718,443

Jobs created/saved, Oct.-Dec. 2010:
243 (quarterly, not cumulative)⁶⁹

The Green Impact Zone is living up to its name and creating tangible results in terms of employment and strengthening the fabric of community. These projects are making Kansas City a more sustainable city, saving money and ensuring that community residents who most need work are doing the work that most needs to be done.

CONCLUSION: THE CASE FOR FURTHER INVESTMENT IN THE GREEN ECONOMY

In short, the greatest near-term challenge facing the U.S. economy is finding enough work for un- or underemployed Americans, while the greatest long-term challenge facing the United States and global economies is constructing a smooth transition to much less carbon-intensive forms of economic activity. Investments in the green economy help ameliorate both challenges. Not undertaking them would squander an enormous opportunity.

Every serious effort to evaluate the impact of ARRA has indicated that it worked as advertised: the U.S. economy would have 3 to 4 million fewer jobs today and would be hundreds of billions of dollars poorer had it not been passed. In this report, we find that \$93 billion of green investments were injected into the economy by the Recovery Act through the end of 2010, creating or saving nearly a million jobs.

Yet, as of December 2010 the U.S. economy still needs 11 million jobs to return unemployment to its pre-recession level. Clearly more fiscal support is needed.⁷⁰

Given this need, an effective policy path forward would be to pursue strategies that spur growth and employment in the near-term. As Figure 2 showed, infrastructure investments are clearly excellent near-term fiscal support in terms of the additional output and employment generated through each dollar of spending.

Further green investments would also clearly be timely enough to help ameliorate the current jobs crisis – remember, even relatively optimistic forecasts do not predict unemployment rates returning to pre-recession levels again until 2015.⁷¹ Unlike some other forms of economic stimulus, if by some chance there is an unexpected economic recovery that leads to very low rates of unemployment very soon, additional green investments would not, *even*

if they are debt-financed, “crowd-out” other investments and lead to a smaller economy-wide capital stock. Thus, the case for these investments is still strong even if the economy didn’t need new jobs.

The value of investments in green infrastructure has been recognized by many – including President Obama. In the State of the Union speech the president called for a historic commitment to meeting the clean energy challenge – and promised federal dollars to back this commitment up:

“...And in a few weeks, I will be sending a budget to Congress that helps us meet that goal. We’ll invest in biomedical research, information technology, and especially clean energy technology, an investment that will strengthen our security, protect our planet, and create countless new jobs for our people...instead of subsidizing yesterday’s energy, let’s invest in tomorrow’s.”

This commitment of federal dollars, combined with other policy changes to complement them – like mandating targets for the generation of electricity from renewable sources, and greater energy efficiency, or ensuring that the full cost of carbon emissions is actually reflected in market prices – is exactly what the U.S. economy needs to fight joblessness in the short-run and the threat of catastrophic climate change in the long-run. And in between it will provide a foundation for economic

growth based on a labor market that provides jobs and raises wages for the broad swath of American workers.

In short, the greatest near-term challenge facing the U.S. economy is finding enough work for un- or underemployed Americans, while the greatest long-term challenge facing the United States *and* global economies is constructing a smooth transition to much less carbon-intensive forms of economic activity. Investments in the green economy help ameliorate both challenges. Not undertaking them would squander an enormous opportunity.

APPENDIX A: ARRA GREEN ECONOMY SPENDING BY TREASURY ACCOUNT

Agency - ARRA Spending Account (Recovery.gov)	Appropriations	Obligations (as of 12/31/10)*	Green Economy Obligations (as of 12/31/10)**	Outlays (as of 12/31/10)	Green Economy Outlays (as of 12/31/2010)***
CORPS - Construction	2,000,000,000	2,135,452,189	530,700,000	1,027,425,964	226,900,000
CORPS - Formerly Utilized Sites Remedial Action Program	100,000,000	99,303,991	99,303,991	52,682,259	52,682,259
CORPS - Mississippi River and Tributaries	375,000,000	364,817,121	38,300,000	267,130,585	8,400,000
CORPS - Operation and Maintenance	2,075,000,000	2,035,462,839	157,700,000	1,555,487,482	118,300,000
DOC - Broadband Technology Opportunities Program	4,200,000,000	4,260,343,353	4,260,343,353	208,018,499	208,018,499
DOD - Military Construction, Defense-wide, Recovery Act	1,450,000,000	1,122,464,606	1,128,394,000	92,575,648	92,575,648
DOD Air Force - Family Housing Construction, Air Force, Recovery Act	80,100,000	77,211,674	77,211,674	54,615,110	54,615,110
DOD Air Force - Military Construction, Air Force, Recovery Act	180,000,000	163,382,616	163,382,616	74,011,125	74,011,125
DOD Air Force - Military Construction, Air National Guard, Recovery Act	50,000,000	48,676,449	48,676,449	46,304,502	46,304,502
DOD Air Force - Operation and Maintenance, Air Force, Recovery Act	1,034,959,000	1,007,648,154	473,409,000	872,750,605	360,194,000
DOD Air Force - Operation and Maintenance, Air Force Reserve, Recovery Act	11,187,000	10,866,189	364,000	8,030,240	364,000
DOD Air Force - Operation and Maintenance, Air National Guard Recovery Act	23,348,000	23,245,502	47,000	20,067,736	47,000
DOD Army - Military Construction, Army, Recovery Act	180,000,000	161,123,874	161,123,874	72,549,261	72,549,261
DOD Army - Military Construction, Army National Guard, Recovery Act	50,000,000	46,992,916	46,992,916	32,676,642	32,676,642
DOD Army - Operation and Maintenance, Army, Recovery Act	1,361,025,000	1,360,649,350	531,414,000	924,331,764	343,007,000
DOD Army - Operation and Maintenance, Army National Guard, Recovery Act	265,304,000	265,292,426	224,468,000	194,149,778	153,365,000
DOD Army - Operation and Maintenance, Army Reserve, Recovery Act	94,769,000	94,733,549	16,027,000	56,490,305	7,149,000
DOD Marines - Military Construction, Navy, Recovery Act	280,000,000	234,890,441	234,890,441	102,220,544	102,220,544
DOD Marines - Operation and Maintenance, Marine Corps, Recovery Act	106,865,000	103,823,702	96,847,000	86,129,923	79,431,000
DOD Marines - Operation and Maintenance, Marine Corps Reserve, Recovery Act	38,909,000	38,094,739	1,106,000	17,823,491	61,000
DOD Marines - Operation and Maintenance, Navy, Recovery Act	623,051,000	608,012,828	397,940,000	267,844,340	133,258,000
DOD Marines - Operation and Maintenance, Navy Reserve, Recovery Act	47,083,000	44,928,615	3,937,000	32,319,555	2,199,000
DOD Army - Research, Development, Test, and Evaluation, Army, Recovery Act	75,000,000	74,982,864	74,982,864	24,185,692	24,185,692
DOD Air Force - Research, Development, Test, and Evaluation, Air Force, Recovery	75,000,000	74,976,592	74,976,592	53,455,697	53,455,697
DOD Marines - Research, Development, Test, and Evaluation, Navy, Recovery Act	75,000,000	74,532,720	74,927,000	61,353,819	63,379,000
DOD - Research, Development, Test, and Evaluation, Defense-wide, Recovery	75,000,000	72,993,572	72,993,572	40,795,064	40,795,064

Agency - ARRA Spending Account (Recovery.gov)	Appropriations	Obligations (as of 12/31/10)*	Green Economy Obligations (as of 12/31/10)**	Outlays (as of 12/31/10)	Green Economy Outlays (as of 12/31/2010)***
DOE - Energy Efficiency and Renewable Energy	16,803,000,000	16,665,322,140	16,665,322,140	5,100,490,095	5,100,490,095
DOE - Energy Transformation Acceleration Fund	400,000,000	386,773,416	386,773,416	54,803,377	54,803,377
DOE - Fossil Energy Research and Development	3,400,000,000	3,379,417,816	3,379,417,816	133,532,713	133,532,713
DOE - Electricity Delivery and Energy Reliability	4,500,000,000	4,475,615,475	4,475,615,475	736,378,958	736,378,958
DOE - Environmental Management	11,370,000,000	5,961,726,508	5,961,726,508	3,314,769,979	3,314,769,979
DOE - Title 17 Innovative Technology Loan Guarantee Program	5760000000	401,055,666	401,055,666	76,559,494	76,559,494
DOE - Uranium Enrichment Decontamination and Decommissioning Fund	390,000,000	388,796,813	388,796,813	228,915,197	228,915,197
DOE - Western Area Power Administration, Borrowing Authority, Recovery		140,000,000	140,000,000	97,190,599	97,190,599
DOE - Bonneville Power Administration Fund		381,023,084	381,023,084	381,023,084	381,023,084
DOE - Advanced Technology Vehicles Manufacturing Loan Program	10,000,000	9,089,711	9,089,711	8,232,772	8,232,772
DOI - Construction	180,000,000	140,094,944	29,908,766 *	97,508,167	17,555,077 †
DOI - Construction	180,000,000	136,174,687	29,071,833 *	72,223,011	17,555,077 †
DOI - Construction and Major Maintenance	589,000,000	549,181,457	117,244,342 *	245,555,418	44,209,058 †
DOI - Management of Lands and Resources	125,000,000	93,780,071	20,021,038 *	52,830,567	9,511,456 †
DOI - Operation of Indian Programs Recovery Act (3 Year)	40,000,000	361,194,935	77,111,239 *	234,879,638	42,287,023 †
DOI - Operation of the National Park System	146,000,000	141,885,047	30,290,934 *	108,773,220	19,583,203 †
DOI - Resource Management	165,000,000	158,990,909	33,942,851 *	118,503,037	21,334,930 †
DOI - Surveys, Investigations, and Research	140,000,000	143,275,077	30,587,690 *	75,185,796	13,536,224 †
DOI - Water and Related Resources	950,000,000	879,886,040	187,846,219 *	356,629,046	64,206,419 †
DOI - Wildland Fire Management	15,000,000	14,572,911	3,111,160 *	11,564,681	2,082,070 †
DOL - Training and Employment Services	3,910,500,000	3,920,004,794	159,809,536	2,577,699,151	57,350,618
DOT - Capital Assistance for High Speed Rail Corridors and Intercity Passenger Rail Service	8,000,000,000	4,278,661,338	4,278,661,338	60,019,688	60,019,688
DOT - Capital Grants to the National Railroad Passenger Corporation	1,300,000,000	1,302,193,744	1,302,193,744	1,180,951,578	1,180,951,578
DOT - Capital Investment Grants	750,000,000	745,497,815	745,497,815	742,599,968	742,599,968
DOT - Fixed Guideway Infrastructure Investment	750,000,000	746,110,481	746,110,481	400,595,266	400,595,266
DOT - Highway Infrastructure Investment	27,500,000,000	26,854,576,906	1,213,542,145	17,413,023,252	749,503,661
DOT - Supplemental Discretionary Grants for a National Surface Transpo	1,500,000,000	1,304,046,828	1,304,046,828	24,718,443	24,718,443
DOT - Transit Capital Assistance	6,900,000,000	7,314,187,602	7,314,187,602	3,782,107,565	3,782,107,565
EPA - Hazardous Substance Superfund	600,000,000	633,873,969	633,873,969	443,041,135	443,041,135
EPA - Leaking Underground Storage Tank Trust Fund	200,000,000	190,402,079	190,402,079	100,723,991	100,723,991

Agency - ARRA Spending Account (Recovery.gov)	Appropriations	Obligations (as of 12/31/10)*	Green Economy Obligations (as of 12/31/10)**	Outlays (as of 12/31/10)	Green Economy Outlays (as of 12/31/2010)***
EPA - State and Tribal Assistance Grants	6,339,000,000	6,247,434,160	6,247,434,160	4,413,378,107	4,413,378,107
GSA - Energy-Efficient Federal Motor Vehicle Fleet Procurement, Recove	300,000,000	299,989,103	299,989,103	299,954,475	299,954,475
GSA - Federal Buildings Fund	5,545,000,000	5,221,117,481	5,221,117,481	1,298,034,527	1,298,034,527
HUD - Assisted Housing Stability and Energy and Green Retrofit Investments	125,000,000	178,973,083	40,589	61,904,421	61,904,421
HUD - Green Retrofit Program (Loans) for Multifam Housing - Recov Act	125,000,000	68,526,789	68,526,789	68,526,789	68,526,789
HUD - Lead Hazard Reduction	100,000,000	98,909,099	98,909,099	43,767,642	43,767,642
HUD - Public Housing Capital Fund	4,000,000,000	3,978,019,743	596,929,920	2,562,549,973	90,921,632
TREAS - Grants for Specified Energy Property in Lieu of Tax Credits, Rec		5,821,377,096	5,821,377,096	5,821,377,096	5,821,377,096
TREAS - Tax Incentives for Energy Efficiency and Renewable Energy		9,258,000,000	9,258,000,000	9,258,000,000	9,258,000,000
USDA - Capital Improvement and Maintenance	650,000,000	621,839,512	621,839,512	382,632,595	382,632,595
USDA - Distance Learning, Telemedicine, and Broadband Program	2,500,000,000	2,423,535,858	2,423,535,858	27,053,172	27,053,172
USDA - Rural Water and Waste Disposal Program Account	1,380,000,000	1,328,206,116	1,328,206,116	130,145,005	130,145,005
USDA - Watershed and Flood Prevention Operations	290,000,000	288,760,906	288,760,906	168,834,338	168,834,338
USDA - Wildland Fire Management	500,000,000	498,311,528	498,311,528	225,297,966	225,297,966
VA - Medical Facilities	1,000,000,000	997,327,676	486,000,000	463,369,018	167,000,000
Total	134,354,100,000	134,032,643,282	93,064,651,229	69,701,279,637	42,732,340,523

* Some Obligations are larger than Appropriations due to transfers between accounts

** The portion of the obligation used for Green Economy activities as determined by administering agency

*** The portion of the outlay used for Green Economy activities as determined by administering agency

† The Department of Interior provided a single estimate of green obligations and outlays. We calculated programmatic estimates by assuming each program had a proportional share

APPENDIX B: METHODOLOGY

The first question that arises in this sort of modeling exercise is how to characterize the policy input for the model to analyze, that is, we need to know how federal, state, and local policies will change spending levels overall and across industries. In the current case, these inputs are the investments in green projects and technologies that represented an economically and politically significant portion of the Recovery Act. These data on the obligations and outlays of the Recovery Act through December 2010 are from Recovery.gov, while the green shares (where necessary to calculate because only a portion of a spending account was used for green economy activities) were provided by the specific agencies.

These investment flows are then inputted into our jobs model. The first step requires judgments both on how much spending is being called for and into which industries the spending flows. Generally, this judgment has been based on research reports, interviews with experts, and other sources to get a sense of how the overall spending package will be allocated to the different industrial sectors identified in our model.

Jobs model

Once inputs have been specified, we use experience gained in previous research that merges industrial data on input-output relationships with household-level data on demographic and labor market variables to characterize the job outcomes that would result from the change in industrial mix accompanying increased green investment.

The jobs model allows us to identify both the (relative) number and type of direct and indirect jobs created for a given amount of spending in a particular industry. This includes the workers directly hired in the construction industry as well as the workers newly hired by industries that supply construction (heavy equipment, for example). The model also provides us a total job impact number that includes induced jobs, which stem from incomes being re-spent back into the economy, as in the new wait staff hired at a diner near a construction site to handle increased demand from the site's workers

It is also important to note that these estimates are based on currently existing patterns of employment across sectors. As such, the final results tell us how many and what kinds of jobs would be created with our current economy. However, to the extent that the new investments are aimed at transforming the economy or labor market, our results are not precisely indicative of the true impact. For example, policy restrictions on the kinds or quality of jobs created and specific policy tar-

geting of job creation would lead to different outcomes than estimated here. The numbers presented here compose an estimated baseline for policy makers to consider.

How many jobs?

Calculating the total number of jobs supported by a given stream of green investment takes four steps. First, we use the Employment Requirements Matrix Input/Output table from the Bureau of Labor Statistics (BLS) to translate a given amount of spending into the number of jobs directly supported in the receiving industries. Second, using the same table, we then calculate how many jobs are needed to produce the output in supplier industries that expand to support the output generated by the industries directly receiving the investment flows. The construction industry (for example) is a purchaser of cement, steel, heavy equipment, as well as less obvious supplies – such as accounting and legal services. These supplier industries will need to expand to support final output of the construction industry when it expands.

Third, we use a multiplier for infrastructure investment of 1.57 estimated by Mark Zandi to calculate the induced jobs from the re-spending effects.⁷² While not all of this spending can be characterized as infrastructure investment, other more generic multipliers for general government spending have very similar magnitudes.⁷³ This multiplier is applied to the amount of spending to get the

total amount of generated economic activity. We then use the conventional economic rule of thumb that each 1% increase in GDP corresponds to 1 million new jobs.

Finally, we apply this total job impact number back to the results of the input/output table. By dividing the total by 1.57, we get the total amount of direct and indirect jobs (i.e., no induced jobs), and by applying the results from the input/output table, we calculate the demographic data and are able to break it down by direct and indirect jobs.

What kinds of jobs?

To estimate the characteristics of jobs created through the green investment portion of the Recovery Act, we use data from the Current Population Survey (CPS) to calculate the share of each industry's employment by relevant categories (gender, race, ethnicity, wage levels, etc.). To ensure we have a large enough sample size, we pool together data from 2005 to 2007.

To match up the CPS data on demographic and labor market variables with the BLS data on industry input-output relationships, we construct a crosswalk between the industry coding schemes used in the respective datasets. The crosswalk matches up both the CPS and the BLS industry codes to the North American Industrial Classification System, or NAICS that maps cleanly onto both the CPS and BLS data. (This crosswalk is available from the author upon request.)

Next, we multiply the number of jobs created in each industry (either through direct spending or through supplier effects) by the industry demographic shares, and then sum these up

across industries to get the total number of jobs in each category (both direct and supplier jobs) that are created through a given amount of green spending.

Limitations to the model

The model directs the green investments into an assortment of different industries included in the 202 industry series from BLS. As expected, one of the main industries that these investments flow into is construction. Unfortunately this industry series includes a single undifferentiated construction category (limitations in the CPS industry series prevents us from using more detailed BLS industries). This construction category does not capture the differences between commercial vs. residential construction or heavy vs. light construction. We have made alterations to the model to account for the different employment impacts of highway, transit, and maintenance and repair of the transportation infrastructure⁷⁴, but generally speaking the model's overreliance on a broad construction category remains a problem that we are continually trying to solve.

Endnotes

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- 16 In this context, the Recovery Act is dated as beginning April 1, 2009. While it was passed in late February and some money was spent before this, April 2009 is the first month during which significant amounts of money were spent.
- 17 While there were months with job-losses in the second half of the year following ARRA's passage, these were mostly attributable to layoffs occurring due to the end of the decennial census – private sector employment has grown consistently since January 2010.
- 18 It's worth noting that this employment number is simply how much higher employment is at the end of 2010 than would have been the case without ARRA. But, because some of these 3.4 million employees will have had their jobs for over a year, the number of job-years spurred by ARRA is much larger – roughly 50-60% larger. Further, it is also important to note that a significant portion of the new labor demand spurred by the ARRA was absorbed through increasing the hours of incumbent employees. If the metric used is full-time equivalent employees, then the jobs created by the ARRA would be increased by roughly 20% - so the number rises to well over 3 million even by the middle of 2010.
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- 27 Interview with Terrie D'Antonio, January 13, 2011.
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- 29 Email communication from Jaime Carlson, DOE, February 2, 2011. All job creation information is generated from recipient-report job numbers in FederalReporting.gov (FR.gov). Unfortunately, the guidance established for defining job creation in FR.gov, agreed to by both the Recovery Act Transparency Board and Congress, does not differentiate between a job "created" and "saved" and only requires quarterly (not cumulative) job data. The logic here was that any job "saved," is by definition a job "created," in that a job was created for someone who would otherwise lose his/her job. DOE Recovery Act recipients reported over 43,000 full-time equivalent (FTE) jobs created and/or saved between October and December 2010. Since DOE cannot differentiate between jobs "created" and "saved" there is no way to calculate cumulative job figures by adding together quarters. This methodology would result in double counting of job figures. DOE did discuss with OMB the option of DOE collecting cumulative job figures from recipients independent of FR.gov. However, approval was not granted for fear of adding cumbersome reporting requirements on recipients.
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