TESTIMONY OF

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on the subject of

CLEAN AIR ACT AND JOBS

before the

SENATE COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS

SUBCOMMITTEE ON CLEAN AIR AND NUCLEAR SAFETY and the SUBCOMMITTEE ON GREEN JOBS AND THE NEW ECONOMY

UNITED STATES SENATE

March 17, 2011

Good morning, Senators. My name is Barbara Somson and I am the Legislative Director of the UAW. I thank you for inviting the UAW to testify before these two subcommittees.

On behalf of the UAW's one million active and retired members, I am pleased to have this opportunity to share our views on the jobs impact of the Clean Air Act. I speak from our experience representing workers in both the auto and heavy truck industries. What our experience shows us is that the Environmental Protection Agency's regulation of greenhouse gas emissions from vehicles under the Clean Air Act is good for our industries and good for American jobs.

Based on our experience, the regulation of mobile sources has been a "win-win" that results in greater oil independence for our nation; a cleaner, healthier environment for ourselves and our children; and an increased number of jobs in the auto sector. The simple equation for understanding how this job creation occurs is that the new technology required to meet tailpipe emissions standards represents additional content on each vehicle, and bringing that additional content to market requires more engineers, more managers, and more construction and production workers.

Moreover, greater fuel efficiency allows consumers to spend less on fuel, which frees up that money to be spent on other goods and services, rather than flowing to the producers of oil for the U.S. market, the majority of which comes from foreign nations. So, in addition to creating jobs, these regulations are a key mechanism for protecting American families and their standard of living from the effects of rising and unstable oil prices. In other words, this is a bread and butter issue for American families.

The UAW's membership is heavily concentrated in the vehicle and vehicle component sector. The recent crisis in this sector had a devastating impact, with 635,000 U.S. auto jobs list since the year 2000 despite a modest rebound of 72,000 jobs since mid-2009. Not surprisingly, the UAW has been very interested in developing and supporting policies to alleviate this crisis by promoting job creation. Especially important to us – since production workers are the bulk of the UAW's membership in the auto sector – are policies to promote domestic manufacturing.

In 2003 the UAW began building support for federal policies to increase fuel efficiency and reduce greenhouse gas emissions from the light-duty vehicle sector and at the same time promote domestic auto employment. This work was joined by labor, environmental, and business communities and it gained bipartisan support for several pieces of legislation that support the domestic manufacturing of advanced technology vehicles and their key components. These policies – embodied in the Energy Policy Act of 2005, the Energy Independence and Security Act of 2007 (EISA), and the American Recovery and Reinvestment Act (ARRA) – have encouraged and leveraged billions of dollars in private investment in the domestic automobile industry and have established a proven track record of supporting the creation of tens of thousands of automobile industry jobs.

One year ago, the UAW released a report with the National Resources Defense Council and the Center for American Progress entitled "Driving Growth." This report estimates that federal policies to save oil combined with federal manufacturing incentives could result in the creation of as many as 150,000 new automobile industry jobs for American workers by 2020. Evidence that this 2010 projection is accurate is found in two more recent Department of Energy reports. (Copies of each of these three reports are attached.)

A Department of Energy report on its loan programs, available on the Department's website, shows that nearly 40,000 jobs are supported by the five loans made to date under the Section 136 Advanced Technology Vehicles Manufacturing Program authorized in EISA. More Section 136 loans – therefore more jobs – are expected this year. And a July 2010 report from the Department of Energy on ARRA grants to support advanced batteries and electric vehicles contains more impressive data. In 2009, the United States had only two factories manufacturing advanced vehicle batteries and produced less than two percent of the world's advanced batteries. With matching grants under ARRA, we will have 30 plants operational by 2012, producing twenty percent of the world's advanced batteries. By 2015, we are projected to produce forty percent.

The construction of these 30 facilities will employ thousands of construction workers, and tens of thousands more permanent production jobs will be created when all the plants are operational. Moreover, the economy of scale created by these new facilities is expected to significantly decrease the cost of advanced batteries, a savings that will be passed on to consumers of advanced technology vehicles.

A long list of firms have seen significant business opportunities flowing from the need to meet the EPA-NHTSAs regulations, including all of the major automakers, union and nonunion; new innovative start-ups like Fisker in Delaware and Tesla in California; producers of completely new technologies such as Johnson Controls and A123; and many other firms such as Dow who are supplying the materials that go into advanced-technology vehicles.

The success of these policies is dependent in large measure on the regulation of tailpipe emissions under the Clean Air Act, which provides regulatory and market certainty for manufacturers of advanced-technology vehicles. In many ways the continuing recovery of the automobile industry in the United States has as its foundation the regulatory certainty of these tailpipe emission standards, which is driving innovation in every company and in every vehicle segment.

Absent continued federal regulation by both EPA and NHTSA, the UAW is concerned that we might repeat the troubled history that preceded the Obama administration's one National Standard program in 2009, which both the UAW and the auto industry strongly supported. We believe that without such federal regulation, we could experience another period of lawsuits, political warfare, and public campaigns that would distract the industry's attention and divert them from the clear and certain path it is on now.

The UAW and the automakers strongly supported the one National Standard that will run from Model Year 2012 to Model Year 2016, and we are all currently working with EPA and NHTSA on the 2017-2025 standard. We do not wish to see this work disrupted.

In conclusion, the members of the UAW are also citizens who are deeply affected by the environment in which they live and raise their families. They are concerned about the effects of human-induced climate change for themselves and for future generations. The benefits to human health and welfare flowing from the regulation of greenhouse gasses under the Clean Air Act are substantial and have decided positive economic effects. The UAW believes strongly that the regulation of tailpipe emissions under the Clean Air Act will help bring about these benefits while also creating jobs in the automobile industry and helping to ensure a smooth and stable recovery for the industry.

Thank you for considering our views on these important matters, and I look forward to answering any questions you may have.

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Driving Growth: How Clean Cars and Climate Policy Can Create Jobs

Report prepared for the Natural Resources Defense Council, United Auto Workers and Center for American Progress

by

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THE EARTH'S BEST DEFENSE
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Center for American Progress
www.americanprogress.org

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About NRDC
The Natural Resources Defense Council (NRDC) is a national nonprofit environmental organization with more than 1.3 million members and online activists. Since 1970, our lawyers, scientists, and other environmental specialists have worked to protect the world's natural resources, public health, and the environment. NRDC has offices in New York City, Washington, D.C., Los Angeles, San Francisco, Chicago, Montana, and Beijing. Visit us at www.nrdc.org.

About UAW
The UAW is one of the nation's largest unions with more than 390,000 active members and 600,000 retirees. Members are in over 750 local unions in the United States, Puerto Rico and Canada. Headquartered at Solidarity House in Detroit, the UAW is affiliated with the American Federation of Labor-Congress of Industrial Organizations (AFL-CIO), the International Metalworkers Federation (IMF) and the International Trade Union Confederation (ITUC). Chartered 75 years ago as the United Automobile Workers of America, the UAW has since become a union for all workers. While still representing skilled and production workers in the automotive and parts suppliers sectors, the UAW also represents workers in aerospace and defense, heavy trucks, farm and construction equipment, and other heavy and light manufacturing industries. The union's technical, office and professional sector represents workers in state and local government, universities, hospitals, casinos, media, technical and design centers, libraries, museums, zoos and legal services, as well as free-lance writers and in-home child-care providers. Visit us at www.uaw.org.

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Preface

Reducing America's dependence on imported oil will not only enhance our national security, but it will create substantially more jobs than continuing on our current path of waste and unsustainable resource use. Reengineering the U.S. automobile fleet to use energy more efficiently will require new investments in advanced technology, increasing demand for skilled labor. Instead of presenting a threat to the auto industry, reigning in reliance on oil and cutting pollution from fossil fuels can demonstrably create jobs, accelerate innovation, and increase demand for advanced manufacturing.

Yet, while it is clear that increasing America's fuel economy can create more jobs, which nations will capture the economic benefits of this shift to a more fuel-efficient fleet, has yet to be determined. How Congress chooses to address comprehensive clean energy and climate legislation will strongly shape whether American workers enjoy the good jobs, competitive advantage, and sustained economic growth that will come with the move to a new clean energy economy.

This study offers two key insights on the nature of clean energy jobs in the automobile sector, each with profound implications for policy makers and the economy.

First, this paper documents that saving oil will create good jobs, not in the abstract, but directly by driving demand for specific additional manufactured components. The move to greater fuel economy means greater labor content per vehicle and higher employment across the fleet. This will include new investment in a host of incremental improvements to conventional gasoline powered internal combustion engines, from new controls for valves and timing, to variable speed transmissions and advanced electronics. It will also include entirely new systems like hybrid drive trains and advanced diesel engines.

Together these investments add up. By 2020 this analysis shows that, all things being equal, supplying the U.S. automobile market with more efficient cars could provide a net gain of over 190,000 new jobs from improvements to fuel economy alone.

The second finding is equally profound. While it is certain that the production of new technology will create demand for workers, *where* those jobs locate will be the product of policy choices. Of the over 190,000 jobs anticipated by 2020, the number of *domestic* jobs created could vary greatly. Fewer than 50,000 jobs might go to American workers, or, with different incentives, more than three times that number, as many as 150,000 U.S. workers, could find employment as a result of new investments in the engineering and production of the technology needed to improve fuel economy. It's up to us which path we take.

Many factors will shape where individual firms decide to produce fuel-efficient vehicles and their key components, and whether this new demand will be met through domestic sourcing or imports. But, it is clear that specific incentives can work to promote domestic production and drive new investment into existing plants and the skills of workers.

Strong comprehensive energy and climate legislation will ensure sustained reductions in oil use and carbon emissions. At the same time, it can capture economic growth through specific manufacturing conversion incentives funded through dedicated carbon allowance revenues. Legislation that sets a firm declining limit on global warming pollution is uniquely suited to this task for two reasons. First, it sends a critical message to markets and investors. Secondly, it provides a steady revenue source to drive long term, economic and environmental gains in the domestic auto sector and to assist in retooling assembly lines and retraining workers so that the United States continues to have a globally competitive auto industry that produces advanced clean vehicles. This integrated clean energy and jobs approach can expand opportunities for both U.S. firms and American workers, particularly in hard hit industrial states like Michigan, Indiana, and Ohio.

It is also worth noting that while the analysis undertaken in this paper shows substantial positive economic and jobs impacts from pursuing improved fuel economy, many additional benefits of energy independence do not even figure in this calculation. Therefore, as positive as this opportunity looks on paper, the real benefits go further.

Avoided fuel costs put real dollars back in the pockets of consumers, increasing consumption and economic benefits. At the same time, reducing demand for oil helps buffer price volatility, while decoupling the growth of the economy from rising energy imports reduces vulnerability to price spikes and supply disruptions. Further, by pursuing the high efficiency and low carbon emission technology path outlined in this report, U.S. auto makers will preserve access for American made cars to global markets, to serve the rapidly growing consumer demand for cleaner cars. As Americans use less oil to fuel our cars, we can also slow the flow of resources overseas to unstable and undemocratic nations, and invest instead in American jobs. By acting quickly, we can help to make the country less vulnerable to rising prices when global economic growth returns.

Clean energy manufacturing can drive the future prosperity of American workers if we creatively engage this opportunity. Our closest economic competitors in Asia and Europe are investing today in diversifying and expanding their manufacturing of clean energy technology. If the U.S. fails to make the same transition, we risk being left behind. However, climate legislation that includes manufacturing conversion incentives could help drive economic recovery and restore American leadership in the global automobile market and the global economy.

Which choice we make has yet to be determined. The future remains to be written.

— Bracken Hendricks
Senior Fellow
Center for American Progress

I. Economic Opportunity through Efficient Vehicles

The United States recently adopted standards to increase the fuel efficiency of the new vehicle fleet after more than two decades of inaction. The first measure, contained in the Energy Independence and Security Act of 2007, would have increased fleetwide fuel economy to at least 35 miles per gallon (mpg) by 2020. This standard was strengthened in May 2009 through a new program that established national harmonized fuel economy and greenhouse gas tailpipe standards. Under the latter program, the new passenger vehicle fleet will achieve, on average, 250 grams of CO_2 equivalent per mile by 2016. This is roughly equal to 35.5 mpg, requiring new vehicle fleet average fuel consumption to fall by 30 percent from 2012 to 2016.

Compliance with the regulations now adopted by the federal government will require a substantial deployment of new technology. The new technology represents additional content on each vehicle; content that will require more engineers and more workers to produce. This document identifies existing technologies that will enable automakers to meet the new standards, and uses illustrative combinations of technologies to make estimates of the *potential* for job creation in the auto industry and the industries that supply it.

While the media often equate fuel-efficiency gains with hybrids, wider adoption of more mundane clean-technology packages, many of which are already in use, will be critical. For instance, efficient gasoline engines and transmissions provide excellent fuel economy benefits at modest cost. Similarly, higher fleet fuel economy in Europe and Japan make it clear that clean diesel can play a large role.

To evaluate the opportunities to improve fuel efficiency and create clean energy auto sector jobs, the Natural Resources Defense Council (NRDC), the United Auto Workers (UAW), and Center for American Progress (CAP) commissioned The Planning Edge (TPE) and the Michigan Manufacturing Technology Center (MMTC) to model the 2014 U.S. new car and light truck market, considering North American-assembled vehicles, engines, and transmissions.

The production forecasts are based on a 2014 market size (U.S. sales) of 15.7 million, substantially higher than the current sub-10-million level, though well below the 1998–2006 average of 16.7 million. This analysis forecasts that 13.3 million cars and light trucks will be assembled in North America in both 2014 and 2020. Nine million of those will be produced in the United States. These levels of domestic and North American vehicle production are comparable to those of model year 2008. This similarity allows a straightforward comparison of auto sector jobs with and without the contributions of advanced vehicle technologies. The results suggest that clean vehicles can provide substantial employment benefits. The question left unanswered is where those jobs will be located—off shore or in the U.S.?

Our analysis conservatively assumes that gasoline and diesel prices will remain at today's level, in real terms. Thus, the mix of sales across traditional segments, i.e., small and large cars, and the various classes of light trucks, is held constant. By holding these factors constant we can ask the question: Other things equal, what ***existing fuel-saving technologies can be applied widely enough in the same-mix new vehicle fleet to meet the model year (MY) 2016 standard and to sustain a 4 percent annual improvement through MY 2020?***

In this report, TPE and MMTC evaluate the likely contribution of the commercially available technologies that firms will use to meet the 2016 standard and to make annual improvements beyond 2016. Toward this end, the report examines two benchmark years. First, it assesses clean technology deployment for MY 2014. This year is chosen because TPE's near-term forecast includes supplier information and automotive business forecasts extending through that time. Second, the report examines technology deployment for 2020. The 2020 technology forecast assumes that manufacturers make annual 4 percent improvements beyond their 2016 performance targets. Taken as a whole, this time frame represents the steady adoption of clean technology as manufacturers work toward, meet, and eventually exceed the existing targets.

Finally, the report assesses the economic benefits, focusing on job creation, associated with growing demand for fuel-saving technologies. Several findings are shown below:

- By 2014, the light-duty vehicle fleet modeled in this study would achieve 31.5 mpg. This will add about $848 to the manufacturing cost of each car and light truck assembled in North America. If this cost is applied across 13.3 million North American assemblies, $11.3 billion more in content will be added to North American-built vehicles.
- This will create 62,000 additional jobs, of which 20,000–54,000 will be in the United States. Just under 40 percent of these jobs will be in the auto and auto parts sector. The remaining 60 percent will be either in the broader manufacturing supply chain, including raw materials such as steel or intermediate goods (stamped, machined, molded, cast and forged parts), or in nonmanufacturing jobs elsewhere in the economy. Recaptured energy expenditures could provide further economic benefits, though those effects have not been modeled in this study.
- Achieving 40.2 mpg by MY 2020 would add an additional $1,152 to the manufacturing cost of each vehicle, for a total increase of $2,000 over 2008. The added production of $15.4 billion in vehicle content (a total of $26.6 billion over 2008) across North American assemblies will produce 191,000 jobs beyond 2008, of which 49,000–151,000 will be in the United States. Roughly 40 percent of the domestic jobs will be in the auto sector, while the balance will be in other industries such as services and the broader manufacturing supply chain.
- The wide variation in jobs created is due to the unknown potential for the United States to capture the production of these advanced vehicle technologies. The short record so far indicates that policies supporting the domestic manufacture of advanced technology vehicles can be successful. (For greater detail, refer to the section on Lithium Ion Takes Off in the United States.)

A UAW Local 909 worker assembles transmissions at the General Motors Powertrain plant in Warren, Michigan. REBECCA COOK

Lithium Ion Takes Off in the United States

Lithium-ion batteries are a key enabling technology in the advancement of hybrid vehicles and are necessary for the market introduction of plug-in hybrids and electric vehicles. This technology was largely developed in the United States, but production is currently dominated by Asian-Pacific nations, especially Japan, China, and Korea. A 2006 study by the National Institute for Standards and Technology (NIST) makes clear that these nations use public policy to encourage the development of the industry, and especially the production of the battery cells themselves.[1]

These nations realize that if vehicle electrification emerges as the wave of the future, advanced battery production will be a core competency that allows them to maintain or develop from scratch a domestic automobile industry. Were the United States to fail that test, the long-term economic and security consequences could be harsh.

In 2007, the Energy Independence and Security Act established incentives for the domestic manufacturer of advanced batteries. The American Recovery and Reinvestment Act of 2009 subsequently funded these incentives. Earlier this year, the federal government announced the first wave of awards under these programs. The results are spectacular—48 projects have been announced to develop and deploy batteries and electric vehicle components in the United States.[2]

The bottom line is that the United States could emerge as a leading producer of lithium-ion batteries in less than five years because of government policies that lower the cost and risk of critical technology development. That is smart policy for jobs, energy security and carbon avoidance, and shows what well-structured government stimulus policies can achieve.

II. Methodology

This report illustrates the potentially large economic benefits of advanced-technology vehicle deployment under the right set of conditions: policies that encourage better fuel economy and domestic manufacturing. The sizable benefits underscore the federal government's critical role in introducing new technology through an appropriate policy combination of regulation and incentives for manufacturers. Such a combination will result in clean and efficient vehicles that are produced domestically. Toward the end of the report, we examine different degrees of economic benefit linked to the level of domestic manufacturing activity.

In the scenarios modeled here, MY 2014 vehicles will achieve an average (new definition—see note 3) CAFE rating of 31.5 mpg, as compared to 27 mpg in 2008. As previously mentioned, this will require an additional $848 per vehicle. If fuel economy reaches approximately 40.2 mpg in MY 2020, an additional $1,152 per unit will be required. This fuel economy estimate is chosen for simplicity and reflects a 4 percent annual performance improvement over the MY 2016 standard. It is roughly a continuation of the 2012–2016 fuel economy trajectory already in progress.

A determined federal initiative could push fuel economy beyond levels contemplated in this study. The Union of Concerned Scientists estimates that fleet average fuel economy could reach 42 mpg by 2020 if hybrid sales, already undergoing rapid adoption, reach 25 percent of the new vehicle market (rather than the 11 percent in our projection).[3] Federal policies that are successful in sufficiently lowering the cost of plug-in hybrids would enable even higher fuel economy. However, such programs are beyond the scope of this report. The analysis therefore makes the fuel economy assumptions listed in the table below.

Table 1. Forecast of Domestic and North American Vehicle Production

Metric	Model Year 2008	Model Year 2014	Model Year 2020
U.S. Car & Light Truck Production	9.7 million	9.3 million	9.3 million
North American Car & Light Truck Production	14 million[4]	13.3 million	13.3 million
Car mpg (new definition)[5]	31.5	36.5	44.1
Truck mpg (new definition)	22.2	24.8	34.1
Overall mpg (new definition)	26.7	31.5	40.2

Fuel economy improvements will utilize a broad range of technologies and benefit a diverse set of workers and businesses. TPE considered the expansion or first application of 15 technologies and components as changes and additions from current practice:

Hybrid and diesel vehicles:

- Switching from six- and some four-cylinder gasoline engines to four-cylinder diesel engines ("4D"). All 2014 and 2020 diesels are assumed to include after-treatment systems.
- Switching from eight- and some six-cylinder gasoline engines to six-cylinder diesel engines ("6D")
- Switching from eight-cylinder gasoline engines to eight-cylinder diesel engines ("8D")
- Switching from conventional gasoline-engine-only vehicles to full gas-electric or plug-in hybrids, in which an electric motor, new controls, regenerative braking, and a lithium-ion battery pack are added and a power-split device replaces the conventional transmission ("full hybrid")
- Switching from conventional gasoline-engine-only vehicles to so-called mild hybrids, with added power controls, an integrated starter-generator, and (particularly for Honda) additional features ("mild hybrid")

Four technologies that can be applied to gasoline and diesel engines, often at the same time:

- Direct injection, for both gasoline ("GDI") and diesel ("DDI") engines, in which traditional fuel injection is replaced by a more efficient system that improves the combustion of fuel. GDI and DDI are often referred to as "common rail."
- Turbocharging ("turbo"), in which additional power is generated from smaller-displacement engines, permitting them to replace larger-displacement engines
- Variable valve lift (VVL) and timing (VVT), in which new mechanical and electronic controls optimize the position of engine valves for a variety of driving situations
- Cylinder deactivation ("CD"), in which up to half of an engine's cylinders are shut down when power requirements drop (e.g., flat and downhill highway driving)

Three modified automatic transmissions:

- Switching from four- and five- to six-speed automatic transmissions ("A6")
- Switching from four- and five-speed to continuously variable transmissions ("CVT") in nonhybrids
- Switching from four- and five-speed to dual-clutch transmissions ("DCT")

Three features compatible with most vehicles (e.g., full hybrids already have Start-Stop):

- Switching to high-efficiency alternators ("HEA") in order to generate high levels of power at low speeds, thereby reducing the load on the engine and reducing the loss of energy
- Adding "Start-Stop," in which the gasoline or diesel engine turns off during extended stops (long red lights, traffic jams)
- Adding electric power steering ("EPS"), which is more compact than the traditional mechanical system and draws electric power from the engine only as needed

The table below shows the forecasted North American technology application rates (in thousands of vehicles). As modeled here, fuel economy of 40.2 mpg for 2020 requires that two technologies—high-efficiency alternators and electric power steering—not in use in 2008 become nearly universal, and that dual-clutch transmissions be applied to 30 percent of the U.S.-produced new vehicle fleet. The rest of the technologies are already in use, and nearly all will have at least 10 percent penetration by 2014.

Regarding V8 diesels, the technology application rates shown below only include vehicles weighing less than 8,500 pounds. Although heavier diesel vehicles are not addressed in this report, their engines are important because the U.S. facilities that produce them are prime locations for new six-cylinder diesels as well. Smaller diesel engines will share components with larger diesels, allowing these plants production efficiencies at lower volumes.

Application rates were achieved by examining every vehicle-engine-transmission combination and deciding which technologies, if any, to apply to each. Those decisions were informed by production logic, e.g., whether it would make sense to apply a technology to a very small number of engines. They were also based upon the particular manufacturers' strengths and their near- and midterm production plans. Thus, for example:

- The report assumes higher application rates of three technologies to engines with Ford's EcoBoost design, which combines GDI and turbo and soon will be matched primarily to dual-clutch transmissions.
- The report assumes faster dieselization of Chrysler vehicles because of Chrysler's connections to Fiat in North America and Europe. Similarly, it assumes faster dieselization of Honda vehicles, given their advanced designs in this area.

This report also favors applying technology to engines that have, or are slated to have, complementary features, e.g., adding GDI to engine families with VVL/VVT. Conversely, it is least likely to apply more expensive technologies to vehicle-engine-transmission combinations in the lowest-price vehicle tiers. Buyers of these vehicles are assumed to be the most price sensitive. Production volumes below reflect the number of vehicles assembled in North America that use each of the technologies. These advanced technology components could be produced inside or outside the United States. Production figures, reported in thousands, are for model years (typically October through September).

Table 2. Application of Technology in Thousands of Vehicles

Technology	2008 Actual	2014	2020	% of 2020 Assemblies	Change, 2008-2020
D4	69	339	709	5.34%	640
D6	144	297	329	2.48%	185
D8	130	509	534	4.02%	404
All Diesels	343	1145	1572	11.84%	1229
Full hybrid	85	665	1442	10.86%	1357
Mild hybrid	5	52	51	0.38%	46
GDI/DDI	668	1807	3577	26.94%	2909
Turbo	247	1132	2556	19.25%	2309
VVL/VVT	2139	4125	9426	70.98%	7287
CD	1126	1032	1003	7.55%	(123)
A6	1926	5944	5708	42.99%	3782
CVT, excluding hybrids	747	960	1201	9.05%	454
DCT	0	388	4173	31.43%	4173
HEA	0	8515	10460	78.78%	10460
Start-Stop, excluding hybrids	0	0	11633	87.61%	11633
EPS	41	1170	11428	86.07%	11387

TPE evaluated unit technology costs by averaging data from as many as four sources.[6] These estimates inform what might be called the "minimum efficient volume." From previous work, TPE defines this as roughly 400,000 units for components and 200,000 for complex assemblies such as diesel engines and hybrids.[7] Based on widely used engineering cost studies, this study estimates that unit cost would be substantially higher at lower volumes and up to 17 percent lower at higher volumes. The table below expresses the assumed cost-volume relationship. A technology with a unit cost of $500 at 400,000 units has a unit cost of about $700 at 100,000 units and about $415 at 2 million units. There are two exceptions to the rule that production volumes under 400,000 units incur cost penalties: for diesels and full hybrids, 200,000 units constitute an economic module. Unlike many of the discrete fuel-saving technologies, diesel engines and hybrids are more complex, multicomponent assemblies. For components, this analysis uses the following table to adjust unit cost for deviation in application volumes from the 400,000 *numeraire*.

Table 3. Deviation Cost Adjustments

Forecasted Volume	Percent of Numeraire	Example: $500 Technology
Less than 100,000	150	$750
100,000 – 249,999	130	$650
250,000 – 399,999	110	$550
400,000 - 499,999	100	$500
500,000 – 999,999	96	$480
1,000,000 – 1,999,999	89	$445
2,000,000 or more	83	$415

Unfortunately, one cannot determine technology costs by total production. For example, turbochargers are estimated to reach 1,132,000 units in 2014. However, this does not produce a unit cost of 90 percent of its *numeraire* value of $450. This is because not all of the forecasted 1,132,000 turbochargers will be built by one supplier in one facility. Since there is no precise way to determine how the volume will be divided, TPE divided production volumes more or less equally among three suppliers.[8] Thus the 1,132,000 turbos are really three packets of 377,000, so their unit cost is estimated at 110 percent of the $450 *numeraire*, or $495. The table below depicts the unit technology costs used in this study.

Table 4. Unit Cost and Fuel Saving Estimates

Technology	Gross Unit Cost at 400,000 Units	Content Displaced	Cost Displaced	Net Unit Cost at 400,000 Units	Illustrative Fuel Savings
D4	$3,400	Gas engine	$1,000	$2,400	25.0%
D6	$4,375	Gas engine	$1,200	$3,175	22.0%
D8	$5,700	Gas engine	$1,500	$4,200	20.0%
Full hybrid	$4,600	Various	$1,100	$3,500	45.0%
Mild hybrid	$1,500	Various	$500	$1,000	20.0%
GDI/DDI	$900	Conventional	$325	$575	16.8%
Turbo	$450			$450	8.4%
VVL/VVT	$305			$305	9.8%
CD	$193			$193	8.4%
A6	$1,020	A3, A4, A5	$900	$120	7.7%
CVT, excluding hybrids	$1,150	A3, A4, A5	$900	$250	8.4%
DCT	$1,400	A3, A4, A5, A6, CVT	$900	$500	13.0%
HEA	$140	Conventional	$35	$105	2.1%
Start-Stop, excluding hybrids	$600			$600	10.8%
EPS	$160			$160	2.8%

Data averaged from EPA (2008), MARTEC (2008), Meszler (2008) and Hammett (2004).

After determining technology application rates and the net unit costs, TPE and MMTC calculated the total cost of the added technologies across the 2014 and 2020 fleets. These figures, which reflect additional vehicle content, produce a substantial number of jobs. The costs are more than offset by avoided petroleum expenditures.

Economic estimates used in this report rely heavily on TPE's previous research.[9] Custom runs by Regional Economic Models, Inc. (REMI) were used to delve into the employment implications of domestic hybrids and advanced diesel production. Using the latest technical coefficient and intra-U.S. trade flow data then available, REMI associated each "packet" of 100,000 traditional U.S.-made vehicles with 21,270 U.S. jobs. REMI's estimates have proven highly accurate in the past.[10] The analysis then makes several downward adjustments to reflect declining labor intensity during subsequent years. First, it slightly reduces jobs per 100,000 vehicles to 20,175, accounting for manufacturing efficiency gains.[11] While production efficiency could be expected to cause larger reductions, those losses have been offset by increases in average vehicle content (e.g., airbags, navigation systems, etc.). Similarly, clean vehicle technologies illustrate an environmentally favorable way to balance productivity improvements with robust auto sector employment. However, as shown later, federal policy will play an important role in ensuring that both jobs and the manufacture of vehicle content are located in the United States.

Finally, TPE made a second conservative downward adjustment to reflect the recent shift toward transplant facilities. It is possible that these facilities will use lower North American content than their "Detroit Three" counterparts. To that extent, the U.S. jobs-per-100,000 figure was reduced a further 16 percent to about 17,000 for 2014 and 2020. Even under these assumptions, clean technologies deliver significantly more jobs than vehicles without the same features.

This conclusion is reached by applying labor intensities to the component cost analysis outlined above. For 2008, J.D. Power & Associates report a median new car and light truck pretax transaction price of $25,594. Based on prior analysis, TPE and MMTC estimate that 20 percent of this amount is attributable to brand marketing, transportation, dealer markup, warranty repair, interest, and other costs that apply to full vehicles but not to their components. The cost to design, manufacture, and test each vehicle averages about $20,000, which is a critical number to the analysis. TPE and MMTC assume that employment is proportional to cost. Thus, a fuel-saving technology that adds $500 to the cost of each vehicle is associated with 2.5 percent of the $20,000 vehicle cost. It is therefore associated with 2.5 percent of the 17,000 jobs per 100,000 units. If the technology is applied to 1 million vehicles, it would create 4,250 U.S. jobs.

III. Job Potential and Policy Implications

The methodology discussed above shows that efficient vehicle technologies will produce significant net employment benefits. The table below illustrates the jobs associated with TPE's 2014 and 2020 technology application rates. For 2014 and 2020, unit costs have been adjusted depending on the application rate of the new technology and total volume divided among three suppliers. For 2008, it is assumed that all technologies were produced at *numeraire* volumes, many of them outside of North America. Not all of the numbers in the chart below are U.S., or even North American jobs. They are total jobs, *anywhere in the world*, associated with the forecasted technology application on vehicles assembled in North America.

Table 5. Total Jobs Associated with Clean Vehicle Technologies

Technology	Net unit cost at forecasted volume	2008 Jobs	2014 Jobs	2020 Jobs
D4	$2,400	1761	6916	14464
D6	$3,175	4862	8015	8879
D8	$4,200	5807	18171	19062
Diesels		12430	33102	42405
Full hybrid	$3,500	3014	19784	42900
Mild hybrid	$1,000	46	443	434
GDI/DDI	$552 (2014), $518 (2020)	4085	8479	15750
Turbo	$495 (2014), $432 (2020)	1182	4763	9386
VVL/VVT	$275 (2014), $253 (2020)	6938	9642	20271
CD	$212	2311	1860	1807
A6	$107	2458	5406	5192
CVT, excluding hybrids	$275 (2014), $250 (2020)	1986	2244	2552
DCT	$650 (2014), $445 (2020)	0	2144	14720
HEA	$87	0	6297	7736
Start-Stop, excluding hybrids	N/A (2014), $498 (2020)	0	0	49242
EPS	$176 (2014), $133 (2020)	70	2380	12919
All		34520	96544	225314
Change from 2008			62024	190794

Potential for New Jobs to be Created at U.S. Facilities

Clearly, enhancing the value of cars and light trucks with fuel-saving technologies will result in a large number of additional jobs—62,000 more between 2008 and 2014 and another 128,000 in the subsequent six years. ***But there is no guarantee that the United States will capture all, or even most of these jobs.*** Both Europe and Japan have substantial leads in hybrids, diesels, DDI, and turbochargers. Most of these technologies have high value-to-weight ratios, making them eminently shippable. Nearly all of the key components in Nissan, Honda, Toyota, Ford, and Mercury hybrids sold in the United States are made in Japan.

Even if the major suppliers of these technologies conclude that future volumes justify North American manufacturing, it does not guarantee that such production will occur in the United States. In Europe, when the market for DDI/common rail for diesels spiked, Bosch built a huge new facility in low-wage Romania from which it supplies more than 80 percent of Europe's demand. The same could happen in North America, with Mexico in the role of Romania.

But there are also reasons why the technology needed to meet higher fuel economy standards could be produced in the United States. Most of North America's high-volume engine and transmission plants are located domestically rather than in Canada or Mexico. The same is true for nearly all advanced vehicle R&D and testing capacity. Many of these technologies "bolt on" to engines, most of which are assembled domestically. While Europe and Japan have a lead in some of them, their focus is on their application in small cars, which do not dominate the U.S. sales or production mix.

Thus, it is critical that federal government play a leading role in capturing for the United States the production of these technologies and the attendant economic output and employment. Comprehensive clean energy and climate legislation is the ideal policy tool because it provides support at the scale, predictability and duration needed to fund a meaningful economic and technological transition. Domestic manufacturing incentives funded through steady allowance revenues, could prove crucial in the choices firms make about where to locate production and our economic stake in these emerging trends. The range of possibilities is set out under three scenarios for U.S. production of fuel-saving technologies:

1. **Low:** U.S. facilities produce only 25 percent of the total technology value and receive 25 percent of the job benefits
2. **Mid:** U.S. facilities produce 50 percent of the total technology value and receive 50 percent of the job benefits
3. **High:** U.S. facilities produce 75 percent of the total technology value and receive 75 percent of the job benefits

There are, of course, exceptions to this rule:

- VVL/VVT, CD, and A6 are already substantially produced domestically, and there is no reason to think that the U.S. share of their production will decline.
- Except for some six-cylinders diesels in Mercedes and BMW models, six- and eight-cylinder diesels are unique to the North American market. This study assumes that 75 percent of these engines will be made in the United States, rather than in Mexico or Canada.
- Four-cylinder diesels may not be made in the United States until volumes grow more than TPE predicts they will through about 2016. But there is a good possibility that they will be made in at least some gasoline and (larger) diesel engine plants.

The table below shows the resulting forecast for U.S. jobs. As discussed above, it outlines the low, mid, and high scenarios that could result from different levels of federal commitment.

Table 6. U.S. Jobs Associated with Clean Vehicle Technologies

Technology	Estimated 2008 U.S. Jobs	2014 U.S. Jobs			U.S. 2020 Jobs		
		Low	Mid	High	Low	Mid	High
D4	0	0	3458	5187	0	7232	10848
D6	3174	6011	6011	6011	6659	6659	6659
D8	5807	13627	13627	13627	14297	14297	14297
Diesels	8981	19638	23096	24825	20956	28188	31804
Full hybrid	301	4946	9892	14838	10725	21450	32175
Mild hybrid	46	111	222	333	108	217	325
GDI/DDI	817	2125	4249	6374	3937	7875	11812
Turbo	473	1159	2318	3477	2346	4692	7038
VVL/VVT	3469	3469	4821	7231	5063	10135	15198
CD	2311	1860	1860	1860	1807	1807	1807
A6	2458	2458	2703	4054	1298	2596	3894
CVT, excluding hybrids	0	0	1122	1683	638	1276	1914
DCT	0	536	1072	1608	3680	7360	11040
HEA	0	1574	3149	4723	1934	3868	5802
Start-Stop, excluding hybrids	0	0	0	0	12310	24621	36931
EPS	0	595	1190	1785	3230	6460	9690
All Domestic Jobs	18856	38471	55694	72791	68032	120545	169430
Change from 2008		19615	36838	53935	49176	101689	150574
Domestic Jobs as a Percent of Total Jobs	59.1%	39.8%	57.7%	75.4%	30.2%	53.5%	75.2%

IV. Conclusion

Clearly, the development and production of clean energy technologies in the light-duty vehicle sector represents an enormous opportunity to maintain and create domestic employment. But the size and ultimate realization of that opportunity depends partly on the decisions of U.S. policymakers. Contingent on fuel economy rules, currency exchange rates, incentives for U.S. production (or the lack thereof), and automakers' and technology suppliers' production location decisions, the United States could gain fewer than 20,000 jobs from 2008 to 2014, or nearly 54,000. By 2020, the U.S. job gain relative to 2008 could be as little as 49,000 or more than 150,000. These figures also include jobs in the broader manufacturing supply chain, including raw materials and intermediate goods, as well as nonmanufacturing jobs created elsewhere in the economy.

Many of these jobs—especially those in diesels and in transmissions—could be expected to be concentrated in the three-state Michigan-Indiana-Ohio region. This region was home to 55 percent of engine and 85 percent of North American transmission production in 2008. Based on each state's 2008 employment shares, Michigan could expect to receive 21 percent of all jobs created by auto sector investment. Indiana could receive 5 percent, and Ohio could receive 7 percent. Applying these estimates to the findings above suggests that Michigan could gain as many as 32,000 jobs as a result of clean technology adoption (compared to 2008). Indiana could gain nearly 8,000, and Ohio could gain nearly 11,000 jobs. The remaining jobs would likely be much more broadly distributed across the United States. Locations of existing Delphi, Bosch, Denso, Aisin, Borg Warner, Siemens, GKN, and ZF facilities may be a useful, if incomplete, guide to the likely spatial distribution of fuel-saving technology production in the United States and the rest of North America.

Endnotes:

1 Ralph J. Brood, *Factors Affecting U.S. Production Decisions: Why Are There No Volume Lithium-Ion Battery Manufacturers in the United States*, National Institute of Standards and Technology, December 2006.

2 U.S. Department of Energy, "President Obama Announces $2.4 Billion in Grants to Accelerate the Manufacturing and Deployment of the Next Generation of U.S. Batteries and Electric Vehicles," http://www.energy.gov/news2009/7749.htm (November 24, 2009).

3 Jim Kliesch, *Setting the Standard: How Cost-Effective Technology Can Increase Vehicle Fuel Economy*, Union of Concerned Scientists, 2008.

4 The sales decline in calendar year 2008 resulted in large inventories and a huge drop in production in model year 2009. A more stable market assumed in 2014 and 2020 results in a more "normal" result where U.S. sales exceed North American production by a significant amount because of imports.

5 The new definition of cars and trucks go into effect in model year 2012. This requires that what would have been previously classified as trucks, namely two-wheel drive utilities under 6,000 pounds gross vehicle weight, be considered cars for fuel economy purposes.

6 EPA, *EPA Staff Technical Report: Cost and Effectiveness Estimates of Technologies Used to Reduce Light-duty Vehicle Carbon Dioxide Emissions*, March 2008; MARTEC, *Variable Costs of Fuel Economy Technologies*, study prepared for The Alliance of Automobile Manufacturers, as amended December 12, 2008; Dan Meszler, Meszler Engineering Services (MES), unpublished report, fall 2008; Patrick Hammett et al., *Fuel-Saving Technologies and Facility Conversion: Costs, Benefits, and Incentives*, study prepared for the National Commission on Energy Policy and Michigan Environmental Council, November 2004.

7 Hammett et al., 2004.

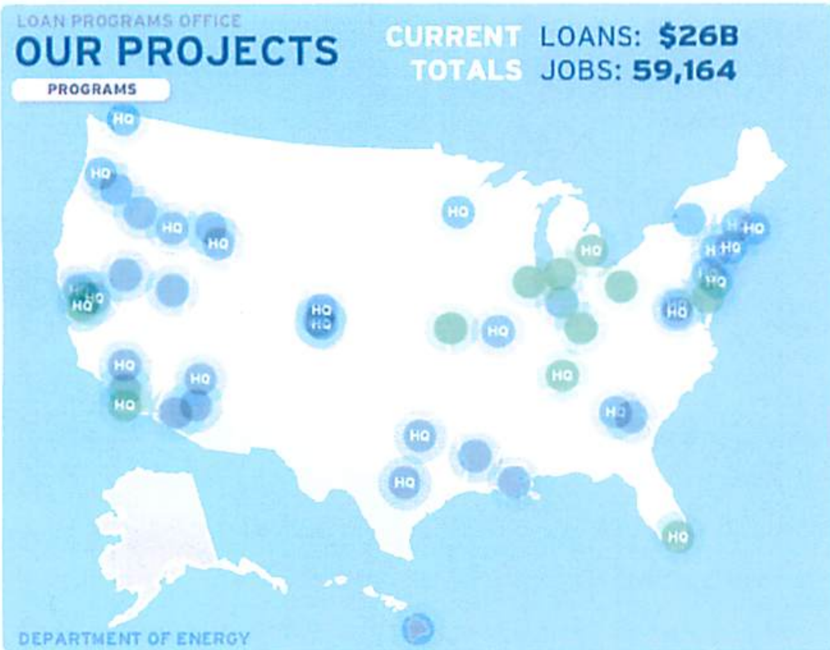
8 This assumption, while apparently arbitrary, is surprisingly robust. In component system after component system, the rule that three competitors share the vast majority of the market seems to hold. In North America, Bosch, Delphi, and Siemens split many powertrain components. Delphi, Denso, and Visteon divide much of the HVAC market, though they must share some components with Valeo. Aisin, ZF, and American Axle divide the market for many axle and drivetrain components. Borg Warner, GKN, and Magna compete in many chassis and powertrain areas. Magna, Ogihara, and Budd dominate outsourced frames, subframes, and body panels. In Europe and Japan, such Tier 1 triads are also common.

9 Hammett et al., 2004

10 At that time, about 45 percent of these jobs were in auto and auto parts, and the other 55 percent in other sectors. Thus, in a year such as 2005 in which 11.5 million light-duty vehicles were assembled in the United States, REMI would have forecasted 2,446,000 U.S. jobs, including about 1,100,000 in auto and auto parts, almost exactly the figure (1,096,700) reported by the Bureau of Labor Statistics.

11 By 2008, the Bureau of Labor Statistics estimate for U.S. motor vehicle and parts jobs had declined to 877,000. The REMI method would have therefore estimated 1,950,000 total U.S. jobs of which 45 percent would have been in the auto sector (this number is now closer to 40 percent). Dividing by 21,270 U.S. jobs per 100,000 vehicles would have predicted production of 9,170,000 units; in fact, 9,666,000 were produced. Thus the 21,270-per-100,000 ratio had declined modestly to about 20,175.

Home > Our Projects



The Financing Force Behind America's Clean Energy Economy

The Department of Energy's Loan Programs enable DOE to work with private companies and lenders to mitigate the financing risks associated with clean energy projects, thereby encouraging their development on a broader and much-needed scale. LPO is one of the largest and most productive energy project finance operations in the world and has committed over $26 billion to support 25 clean energy projects. These projects create or save almost 59,000 jobs across 20 states.

LPO has issued conditional commitments to eight power generation projects with cumulative project costs of over $21 billion. This represents a greater investment in clean energy generation projects than the entire private sector made in 2009 ($10.6 billion), and almost as much as was invested in such projects in 2008 – the peak financing year to date ($22.6 billion).

In the last 12 months, LPO closed or offered 15 loans or loan guarantees totaling nearly 17 billion (over $26 billion in total project costs), including:

- Diamond Green Diesel, a biodiesel project that will nearly triple the amount of renewable diesel produced domestically;
- Abengoa Solar Inc. and BrightSource Energy, Inc., two of the world's largest solar thermal projects;
- Georgia Power Company's Vogtle project, a 2,200 megawatt (MW) nuclear power plant – the nation's first in the last three decades;
- Caithness Shepherds Flat, the world's largest wind farm with generating capacity of 845 MW; and
- Vehicle Production Group, the first wheelchair-accessible vehicle that will run on compressed natural gas.

To learn more, click and explore our Project Map above.

Program	Loan Guarantee Amount	Jobs (permanant/ construction)	Date of agreement	Locations	Status

1703

Georgia Power Company	$8.33 billion	800/3,500	Feb 2010	Atlanta, GA Tucker, GA Waynesboro, GA	Conditional Commitment
AREVA	$2 billion	310/1,000	May 2010	Idaho Falls, ID	Conditional Commitment
Red River Environmental Products, LLC	$245 million	70/500	Dec 2009	Littleton, CO Coushatta, LA	Conditional Commitment
SAGE Electrochromics, Inc.	$72 million	160/210	Mar 2010	Faribault, MN	Conditional Commitment

1705

Abengoa Solar, Inc.	$1.45 billion	80/1,600	July 2010	Gila Bend, AZ	Closed
Abound Solar	$400 million	1,500/2,000	July 2010	Longmont, CO Tipton, IN	Closed
AES Corporation	$17 million	5/30	July 2010	Johnson City, NY	Closed
Beacon Power Corporation	$43 million	14/20	Aug 2010	Tyngsboro, MA Stephentown, NY	Closed
BrightSource Energy, Inc.	$1.4 billion	86/1,000	Feb 2010	Oakland, CA Baker, CA	Conditional Commitment
Nevada Geothermal Power Company, Inc.	$78.8 million	14/200	Sept 2010	Humbolt County, NV	Closed
Kahuku Wind Power, LLC.	$117 million	10/200	July 2010	Boston, MA Kahuku, Oahu, HI	Closed
Nordic Windpower USA, Inc.	$16 million	75/	July 2009	Berkeley, CA Pocatello, ID	Conditional Commitment
Solyndra Inc.	$535 million	1,000/3,000	Sept 2009	Fremont, CA	Closed
US Geothermal, Inc.	$102.2 million	10/150	June 2010	Boise, ID Malheur County, OR	Conditional Commitment
Caithness Shepherds Flat	$1.3 billion	35/400	Oct 2010	Gilliam and Morrow Counties, OR	Closed
LS Power (ON Line)	$350 million	15/400	Oct 2010	Ely to Las Vegas, NV	Conditional Commitment
Agua Caliente	$967,000,000	10/400	Jan 2011	Yuma County, AZ	Conditional Commitment
Diamond Green Diesel	$241,000,000	63/700	Jan 2011	Norco, LA	Conditional Commitment
SoloPower	$197,000,000	500/270	Feb 2011	Wilsonville, OR	Conditional commitment
Record Hill Wind	$102 Million	/200	Mar 2011	Roxbury, ME	Conditional Commitment

Program	Loan Amount	Jobs (created/ saved)	Date of agreement	Number of Projects
Ford Motor Company	$5.9 billion	33,000	Sept 2009	13
Fisker Automotive	$529 million	2,000	Apr 2010	2

Nissan North America, Inc.	$1.4 billion	1,300	Jan 2010	2
Tesla Motors	$465 million	1,500	Jan 2010	2
The Vehicle Production Group LLC	$50 Million	900	Nov 2010	1

DEPARTMENT OF ENERGY

THE RECOVERY ACT:

TRANSFORMING AMERICA'S TRANSPORTATION SECTOR

BATTERIES AND ELECTRIC VEHICLES

WEDNESDAY, JULY 14, 2010

Embargoed until 8:00 PM EDT

The Recovery Act:
Transforming America's Transportation Sector

Batteries and Electric Vehicles

The Obama Administration is investing in a broad portfolio of advanced vehicle technologies. These investments—investments in American ingenuity, innovation, and manufacturing—are driving down the costs associated with electric vehicles and expanding the domestic market. Investments in batteries alone, for example, should help **lower the cost of some electric car batteries by nearly 70 percent before the end of 2015.** What's more, thanks in part to these investments, **U.S. factories will be able to produce batteries and components to support up to 500,000 electric-drive vehicles annually by 2015**. Overall, **these investments will create tens of thousands of American jobs.**

As part of the Department of Energy's $12 billion investment in advanced vehicle technologies, the Department is investing more than $5 billion to electrify America's transportation sector. These investments under the American Recovery and Reinvestment Act and DOE's Advanced Technology Vehicle Manufacturing (ATVM) Loan Program are supporting the development, manufacturing, and deployment of the batteries, components, vehicles, and chargers necessary to put millions of electric vehicles on America's roads.

The Recovery Act included $2.4 billion to establish 30 electric vehicle battery and component manufacturing plants and support some of the world's first electric vehicle demonstration projects. For every dollar of the $2.4 billion, the companies have matched it at minimum dollar for dollar. Additionally, DOE's Advanced Research Projects Agency-Energy (ARPA-E) is providing over $80 million for more than 20 transformative research and development projects with the potential to take batteries and electric drive components beyond today's best technologies, and the Advanced Energy Manufacturing Tax Credit program is helping expand U.S.-based manufacturing operations for advanced vehicle technologies.

The Obama Administration has also provided nearly $2.6 billion in ATVM loans to Nissan, Tesla and Fisker to establish electric vehicle manufacturing facilities in Tennessee, California and Delaware, respectively.

Projects have now begun constructing new manufacturing plants, adding new manufacturing lines, building electric vehicles, and installing electric vehicle charging stations, creating thousands of new jobs across the country. These combined investments are helping the economy grow now, while positioning the U.S. for global leadership in the electric vehicle industry for years to come.

Recovery Act Investments in Electric Vehicles

Through the Recovery Act, the country is making comprehensive investments in each part of the electric vehicle ecosystem. In sum, the Act included approximately $4 billion to support domestic manufacturing and deployment for advanced vehicle and clean fuel technologies. To date, there have been over 70 awards, worth more than $2.5 billion, to promote electric vehicle technologies. This includes cost-shared projects at each level along the innovation chain – from battery and component manufacturing to commercial deployment of vehicles and charging stations to advanced research and development that will help identify the next generation of electric vehicle technologies.

- **Manufacturing –** 26 of 30 battery and component manufacturing plants have started construction, which includes breaking ground on new factories or installing new equipment in existing facilities.

    - 9 battery manufacturing projects, including a $249 million project by A123 to support the construction of 3 Michigan facilities to produce advanced batteries for vehicles, grid storage, and other applications. They have already started construction of a low-volume manufacturing facility in Livonia, which they expect to begin operations in September, and have begun planning for larger-volume facilities in Romulus and Brownstown, Michigan. Nine of the nine new battery plants opening as a result of Recovery Act investments will have started construction by tomorrow – and four of those will be operational by the end of the year.

    - 11 battery component manufacturing facilities, including Celgard LLC in North Carolina, who won a $49.2 million grant to expand its production capacity for separators, a key component in the lithium-ion batteries needed for the growing electric drive vehicle market. When Celgard completes expanding its facility in Charlotte, North Carolina, the company will be able to produce an additional 80 million square meters of separator per year—enough to support up to a million electric-drive batteries per year. Celgard is also building a new manufacturing facility in Concord, North Carolina to support additional increased demand for electric vehicle batteries.

    - 10 electric drive component manufacturing projects, including Delphi Automotive Systems, the largest North American supplier of power electronic components for electric vehicles. The company received $89.3 million in Recovery Act support to build a power electronics manufacturing facility in Kokomo, Indiana. The plant will have the production capacity to support at least 200,000 electric drive vehicles by the end of 2012.

- **Deployment –** 8 innovative demonstration projects, representing the world's largest electric vehicle demonstration to date. In total, these projects will lead to an additional 13,000 grid-connected vehicles and 20,000 charging stations in residential, commercial and public locations nationwide by December 2013**.**

    - Coulomb Technologies received a $15 million Recovery Act grant to support the ChargePoint America program, which will deploy 5,000 residential and commercial charging stations and 2,600 electric drive vehicles in nine major metropolitan areas around the country.

- **Advanced Research and Development -** More than 20 breakthrough research projects to support potential game-changing technologies like semi-solid flow batteries, ultracapacitors and "all-electron" batteries that could go well beyond today's best lithium-ion chemistries are being funded. **If successful, these breakthroughs could cut battery costs by as much as 90 percent and expand vehicle range three to six-fold.** In turn, this would decrease the upfront cost of electric cars to roughly that of gas-powered cars and give them a longer range, likely further increasing demand for the vehicles in the long-term.

    - Fluidic Energy won $5 million to pursue "metal air" batteries that could have 10 times the energy density of today's lithium-ion technologies, at a third of the cost. The Scottsdale, Arizona company is working with Arizona State University to develop ultra stable new materials, or "wonder fluids" that could allow metal-air batteries to be successfully developed and deployed for the first time, enabling widespread deployment of low cost, very long range electric vehicles.

Taken together, the impact of these investments is greater than the sum of their parts. The investments interact to stimulate both supply and demand for electric vehicles. The investments are lowering barriers to ownership: driving down the cost of batteries while improving their functionality and building a network of charging stations. Meanwhile, they are actively putting more electric cars on the road and supporting the long-term domestic production of low-cost, clean energy vehicles.

Federal investments in electric vehicles are being matched by private sector funding, helping to move private capital off of the sidelines. This combination of private and public investments in advanced vehicles is stimulating economic growth, creating jobs in both the short- and long-term, and increasing the country's global competitiveness.

These jobs represent a shift—the shift of important industries moving jobs back to American shores and the growth of a domestic battery industry. The Recovery Act is laying the groundwork for long-term, sustainable recovery by ensuring that the industries of the future are American industries. In 2009, the United States had only two factories manufacturing advanced vehicle batteries and produced less than two percent of the world's advanced vehicle batteries. By 2012, thanks in part to the Recovery Act, 30 factories will be online and the **U.S. will have the capacity to produce 20 percent of the world's advanced vehicle batteries. By 2015, this share will be 40 percent.**

This shift has additional benefits, too. Today, oil provides 95% of the power to move America's cars, trucks, ships, rail, and planes, and over half of America's oil is imported. Electric vehicles and other advanced vehicle technologies can reduce this dependence and help the country control its energy future.

Electric Vehicle Supply Chains and Networks

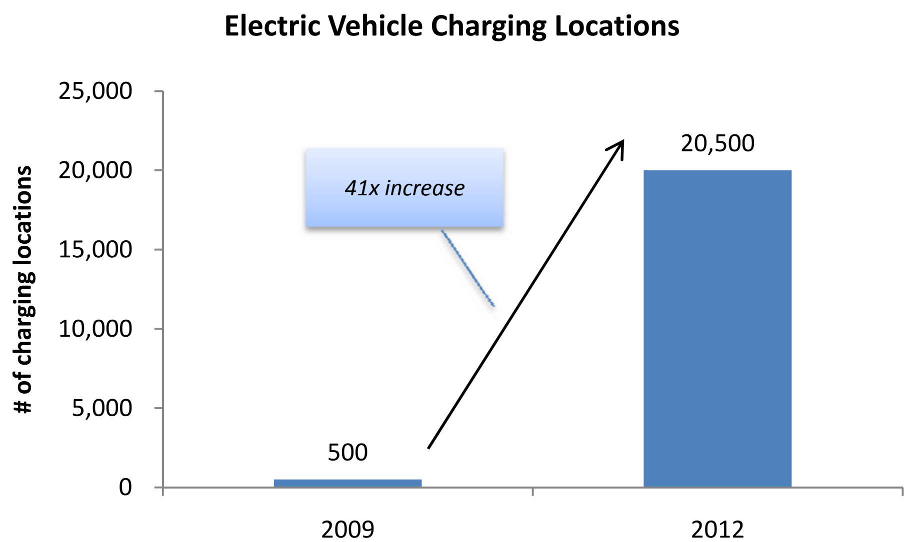
Through the Recovery Act and the ATVM program, DOE is invigorating a nationwide advanced vehicle supply chain centered in the Midwest. Michigan is an example of how clusters can multiply the impact of Recovery Act funds and create synergies within and across corporate walls. A concentration of Michigan's engineers, workers, and managers are innovating more quickly because they are near one another – and drawing in more and more advanced vehicle expertise each day.

The Recovery Act is supporting 14 vehicle awards in Michigan. This includes several large battery factories (e.g. A123, GM, Johnson-Controls, Dow-Kokam, and LG Chem), electric drive component factories (e.g. GM, Ford, Magna), and three workforce training programs (University of Michigan, Michigan Technological University, and Wayne State). Under the Department's loan program, DOE is supporting multiple Michigan-based factories that will hire the workers trained in these universities to assemble the batteries and components into some of the world's most advanced vehicles.

For example, a $105 million grant to GM is expanding a facility to package batteries for the Chevy Volt – the grant is creating hundreds of jobs at the Brownstown facility and invigorating a chain of local factories. GM will deliver batteries from Brownstown to a plant in Detroit. Here, hundreds of workers will assemble components made in Warren, Grand Blanc, and three factories in Flint. This network of Volt-related investments is attracting other companies to Michigan. To supply battery cells to the Brownstown facility, Compact Power, Inc. is building its first American factory in Holland, Michigan. The $151 million grant is helping Compact hire workers in Holland and purchase battery components and supplies from U.S. factories. Compact will purchase its separator material from Celgard, and is evaluating other Midwestern suppliers for its other components like cathodes, electrolytes, additives, and binders.

Meanwhile, under the Recovery Act's Transportation Electrification program, grantees will deploy 20,000 additional electric charging locations, up from 500 locations today. These 8 demonstration projects are also putting 13,000 electric vehicles on the road, including more than

4,700 Chevy Volts, across more than a dozen cities to show how electric cars perform under real driving, traffic and weather conditions.



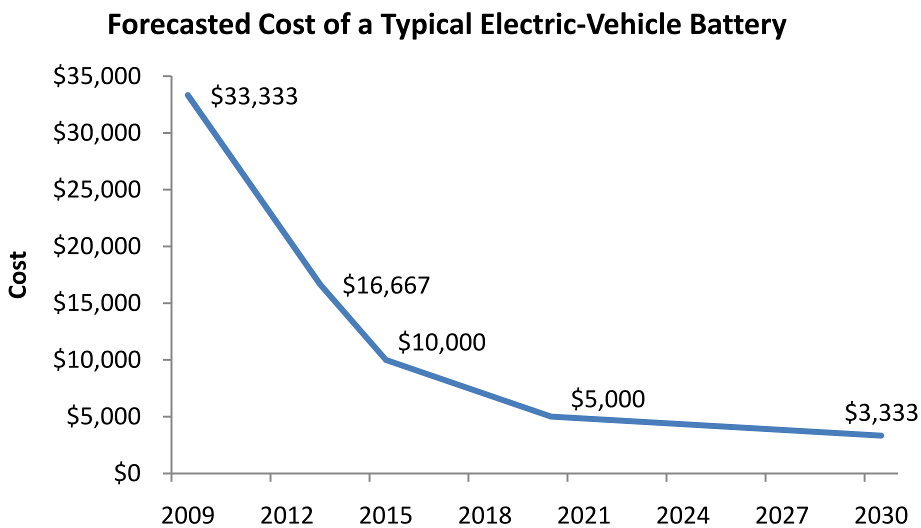
Innovation in Batteries

The Obama Administration's investments in advanced vehicles are creating a sustainable future for American industry and American workers. But investments in batteries demand special attention. The lack of affordable, highly-functional batteries has been a particularly high barrier to the widespread adoption of electric vehicles. When the Recovery Act passed, batteries were too costly, too heavy, too bulky and would wear out too quickly. Recovery Act investments are literally reshaping electric batteries and reshaping the economics of battery production and distribution.

More Affordable

Before the Recovery Act, the only highway-enabled electric vehicle on the road cost more than $100,000. This high cost resulted in large part from the high cost of batteries—a car with a 100 mile range required a battery that cost more than $33,000.

Between 2009 and 2013, the Department of Energy expects battery costs to drop by half as 20 Recovery Act-funded factories begin to achieve economies of scale. By the end of 2013, a comparable 100 mile range battery is expected to cost only $16,000. By the end of 2015, Recovery Act investments should help lower the cost of some electric car batteries by nearly 70 percent to $10,000. The same cost improvement applies to plug-in hybrids – cars that can travel roughly 40 miles on electricity before their gasoline engine kicks in. The cost of a 40-mile range battery is falling from more than $13,000 in 2009, to roughly $6,700 in 2013, to $4,000 in 2015.



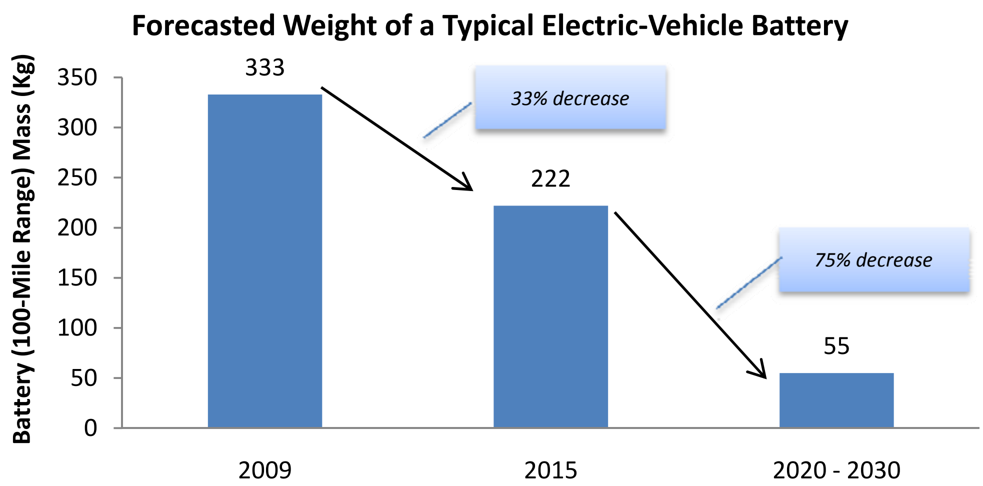
Note: Assumes 3 miles per kilowatt hour and 100-mile range. Source: U.S. DOE Vehicle Technologies Program.

This dramatic drop in cost should result in more affordable, mainstream electric cars. Fisker, GM, Nissan, Tesla, and other automakers are introducing more affordable electric vehicles. At the end of this year, consumers will be able to purchase electric vehicles that cost between $25,000 and $35,000, after tax credits. In addition, drivers will save money over a car's lifetime. Using electricity to power a car is only about 30 percent of the cost of using three-dollar-a-gallon gasoline.

Lighter Weight

Low energy density, i.e. heavier batteries, significantly limits vehicle range and acceleration. Under the Recovery Act, DOE is supporting innovations to reduce battery weight and increase the energy density, which allows batteries to store more energy in a smaller, lighter package. These smaller, lighter batteries will pack **more power, performance, and range.**

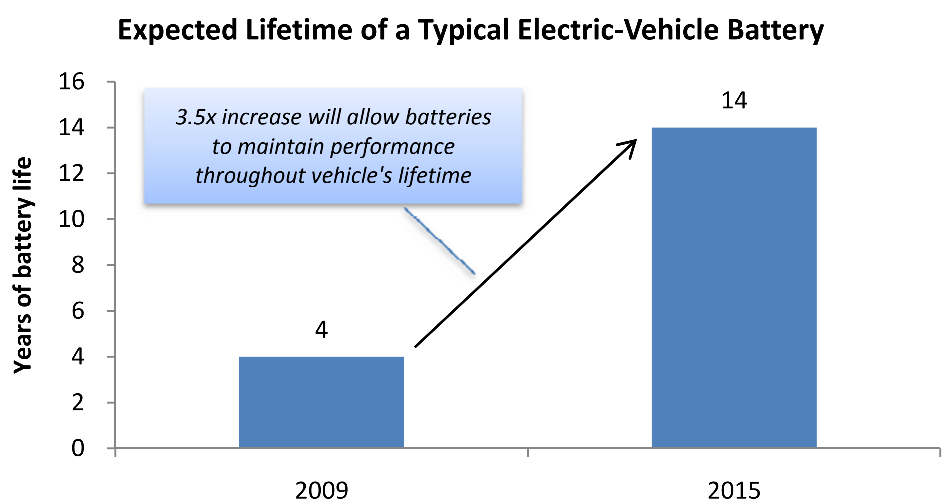
Between 2009 and 2015, increases in energy density will reduce the typical weight of an electric vehicle battery by 33 percent. Meanwhile, ARPA-E projects are pursuing innovations that have the potential to improve battery density up to six times its current level.



Note: Assumes 3 miles per kilowatt hour and 100-mile range. Source: U.S. DOE Vehicle Technologies Program.

Longer Lasting

Batteries are also getting more durable. In the next few years, domestic manufacturers should be able to produce batteries that last up to 14 years. This should give consumers confidence that electric vehicle batteries will last the full life of the vehicle. In addition, longer lasting batteries reduce the potential for used batteries to become waste material.[1]



Note: Assumes drivers will charge their vehicles 1.5 times per week. Source: U.S. DOE Vehicle Technologies Program.

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[1] Calendar life is assumed for advanced electric vehicle battery technologies. Current batteries for PHEV vehicles are designed to achieve significantly higher calendar life, but trade-off performance and cost to achieve that life.