WORLD RESOURCES INSTITUTE

Fact Sheet

POWER SECTOR OPPORTUNITIES FOR REDUCING CARBON DIOXIDE EMISSIONS: ARKANSAS

MICHAEL OBEITER, KRISTIN MEEK, AND REBECCA GASPER

CONTACT

Michael Obeiter
Senior Associate
Climate and Energy Program
mobeiter@wri.org

Kristin Meek
Associate
Climate and Energy Program
kmeek@wri.org

Rebecca Gasper
Research Analyst
Climate and Energy Program
rgasper@wri.org

WHAT WILL CO_2 STANDARDS MEAN FOR ARKANSAS?

President Obama announced a national climate plan in June 2013, and directed the U.S. Environmental Protection Agency (EPA) to set carbon pollution standards for the power sector. Once EPA establishes those standards, states will implement their own plans for achieving those reductions. In this fact sheet, WRI examines opportunities for Arkansas to reduce power plant emissions.

HOW ARKANSAS CAN REDUCE POWER SECTOR EMISSIONS

WRI analysis shows that Arkansas has many opportunities to reduce carbon pollution from its power sector. Arkansas can place itself in a good position to meet moderately ambitious emissions standards for existing power plants in the near- to medium-term by taking advantage of existing infrastructure, building on its existing energy efficiency standard, and increasing renewable electricity generation. Carbon dioxide emissions from Arkansas' power sector were 36 percent above 2005 levels in 2011 (the most recent year for which we have emissions data for Arkansas). According to reference case projections based on the Energy Information Administration's (EIA) *Annual Energy Outlook 2012 (AEO 2012)*, emissions are expected to rise to 11 percent above 2011 levels by 2020 and 13 percent above 2011 levels by 2030.[1]

Box 1 | **What's Ahead for the Power Sector?**

The power sector is the leading source of carbon dioxide (CO_2) emissions in the United States, but also offers some of the most cost-effective opportunities to reduce those emissions. Despite recent decreases in power sector emissions—due to the recession, increasing competition from renewable energy and the low price of natural gas— current projections show that, absent policy action, emissions will increase in the coming decades.[2]

NEW POWER PLANTS: On September 20, 2013, EPA proposed CO_2 emissions standards for new power plants.[3] These standards will provide a backstop ensuring new power plants produce significantly lower CO_2 emissions per megawatt-hour of power generation than the average existing coal plant, requiring coal plants to achieve emissions rates of 1,000–1,100 pounds of CO_2 per megawatt-hour (lbs. per MWh), large natural gas plants to achieve 1,000 lbs. per MWh, and smaller natural gas plants to achieve 1,100 lbs. per MWh.[4] However, because new coal plants are unlikely to be built even in the absence of the standards—due to relatively low natural gas prices, among other factors[5]—it is unlikely that these standards will have a significant impact on near-term CO_2 emissions.

EXISTING POWER PLANTS: EPA also has been directed to (a) propose CO_2 emissions standards for existing power plants by June 1, 2014; (b) finalize these standards by June 1, 2015; and (c) require states to submit their proposed implementation plans by June 30, 2016. The Clean Air Act provides EPA with considerable flexibility in setting guidelines for states to meet these standards. States could be allowed to pursue a range of programs that encourage activities—such as fuel switching, dispatch of existing low-carbon power plants, increased generation by renewable sources, and energy efficiency, among other options—for meeting emissions targets. EPA also could set guidelines that allow for emissions rate averaging across power sector generation units to help meet the standard.

Arkansas can reduce power sector CO_2 emissions to 22 percent below 2011 levels in 2020 by taking advantage of the CO_2 reduction opportunities using the existing infrastructure listed below.[6] This is equivalent to a 6 percent increase in emissions above 2005 levels. While these reductions are significant, without additional reductions—for example, from continuing to implement energy efficiency targets or increasing renewable generation—the state would fall short of meeting moderately ambitious standards for existing power plants.[7]

CO_2 REDUCTION OPPORTUNITIES USING AVAILABLE INFRASTRUCTURE

USING MORE COMBINED HEAT AND POWER (CHP). Arkansas can build more CHP systems—which use waste heat to generate electricity more efficiently than the average power plant—at sites like universities, hospitals, and farms. *Increasing the use of CHP by 33 percent above current levels can cut power sector CO_2 emissions by 2 percent in 2020 compared to 2011 levels.*

USING MORE GAS. Arkansas' most efficient natural gas plants—combined cycle (NGCC) units—generated much less electricity than they were capable of producing in 2012. *Running existing NGCC plants at 75 percent can cut power sector CO_2 emissions by 30 percent in 2020 compared to 2011 levels.*

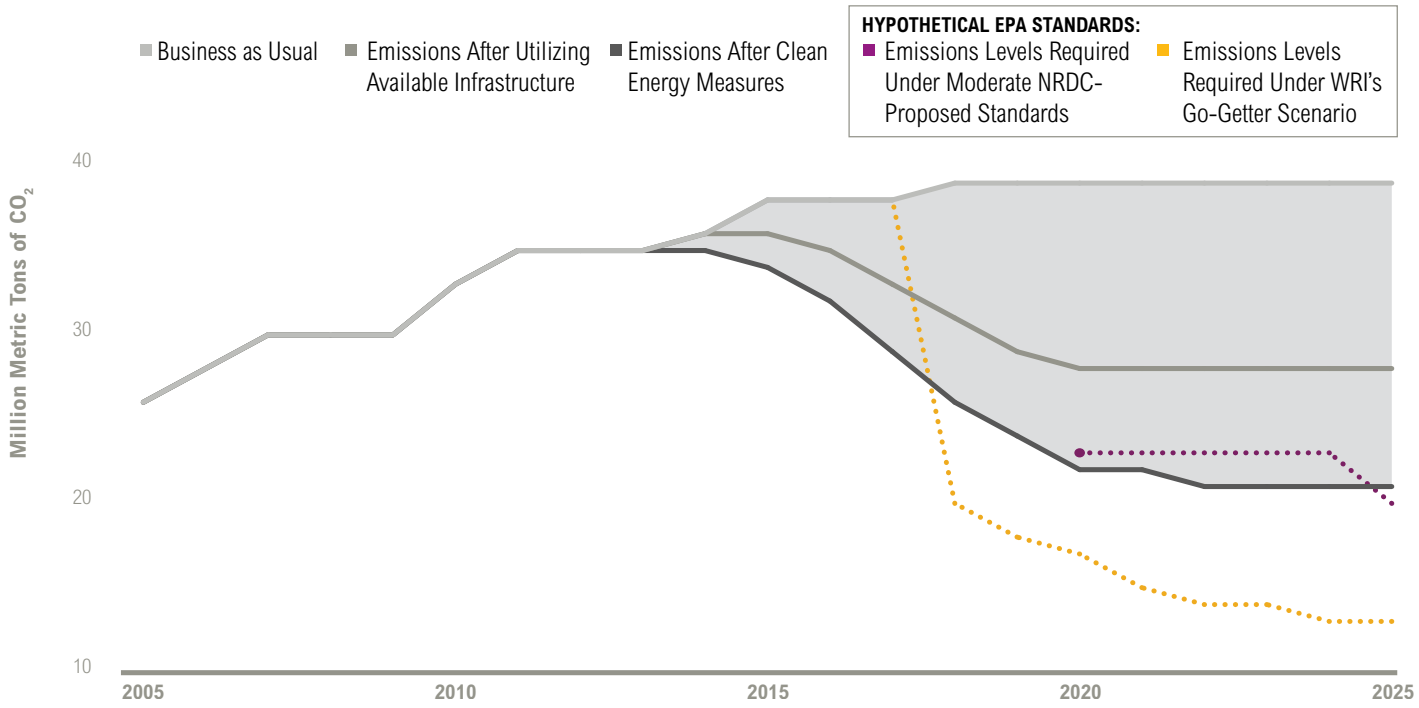
INCREASING EXISTING COAL PLANT EFFICIENCY. Existing coal plants could save energy by upgrading their equipment and making other operational improvements. *Increasing coal plant efficiency by 2.5 percent could cut power sector CO_2 emissions by 1 percent in 2020 compared to 2011 levels.*

Arkansas can reduce power sector CO_2 emissions even further, to 39 percent below 2011 levels in 2020, by increasing energy efficiency standards and adopting new policies that promote renewable energy.[8] This is equivalent to an 18 percent reduction in emissions from 2005 levels. While these measures would require action from the Arkansas Public Service Commission or new legislation, reductions of this magnitude could meet moderately ambitious standards for existing power plants in the near- to medium-term.

CO_2 REDUCTIONS FROM CLEAN ENERGY MEASURES

MEETING ENERGY EFFICIENCY TARGETS. The state's existing energy efficiency standard requires investor-owned utilities to implement programs that help customers save energy. *If all Arkansas utilities met the state's 2015 savings goal (0.9% of 2013 electricity sales) each year going forward, the state can cut power sector CO_2 emissions by 7 percent in 2020 compared to 2011 levels.*

Figure 1 | **Arkansas Carbon Dioxide Reduction Opportunities for Power Sector Compliance Under The Clean Air Act**



Note: EPA has not yet proposed a national emissions standard for existing power plants. For purposes of illustration, this analysis shows emissions reductions that would occur if EPA adopted the "moderate" case from the latest proposal from the Natural Resources Defense Council (NRDC), which would require CO_2 emissions reductions in Arkansas to 35 percent below 2011 levels in 2020. We also show the emissions reductions that would occur if EPA adopted a more ambitious "go-getter" reduction schedule, which aligns with a national reduction pathway necessary to meet the Administration's goal of reducing emissions 17 percent below 2005 levels by 2020.[9] National power sector emissions in the "go-getter" scenario drop 38 percent from 2005 to 2020; we show the equivalent percent reductions applied to Arkansas' power sector (54 percent from 2011 to 2020). Note, in their latest proposal, NRDC proposed a new set of more ambitious standards that would achieve a 42 percent reduction in Arkansas' CO_2 emissions in 2020 compared to 2011 levels. See endnote 7 for additional explanation.

INCREASING USE OF RENEWABLE ENERGY. Six percent of the state's electricity came from biomass and hydropower in 2012. The state has the opportunity to encourage further development of renewable resources, including wind and solar power, by implementing new strategies (e.g., tax credits, rebates, or renewable energy standards). *If 15 percent of the state's electricity came from renewable sources by 2020, it could cut power sector CO_2 emissions by 9 percent compared to 2011 levels.*

OPPORTUNITIES IN DETAIL

INCREASING CHP AT COMMERCIAL AND INDUSTRIAL FACILITIES. According to ICF International, Arkansas has significant technical potential for CHP, with the potential to add over 1.4 gigawatts (GW) of new CHP for a total of nearly 2.0 GW.[10] As of July 2013, Arkansas had 493 megawatts (MW) of installed CHP capacity, about 26 percent of its technical potential.[11] Arkansas can encourage additional CHP deployment in many ways, including net metering and interconnection standards, financial incentives, financing options, and technical support.[12]

If the state ramped up CHP capacity on a path to achieve 25 percent of the 1.4 GW of additional technical potential for new CHP by 2030 (for a total of 42 percent of total technical potential), it could reduce CO_2 emissions by 2 percent below 2011 levels by 2020 and 4 percent in 2030.

UTILIZING SLACK NATURAL GAS CAPACITY. According to EIA data, the capacity factor of Arkansas' existing combined cycle natural gas fleet was only 36 percent in 2012—meaning that these plants generated much less electricity than they are capable of producing.[13] Increasing the capacity factor of these existing units to 75 percent would cut power sector CO_2 emissions by 30 percent in 2020 compared to 2011 levels.[14,15] (See Box 3 for additional information on Arkansas' power sector.)

INCREASING EFFICIENCY AT EXISTING COAL PLANTS. According to the National Energy Technology Laboratory (NETL) and researchers at Lehigh University, it is likely that the existing coal fleet could achieve a 5 percent increase in efficiency on average.[16] For purposes of this analysis, we conservatively assume that Arkansas' coal fleet would achieve a 2.5 percent increase in efficiency, half of these potential levels. While there are high upfront costs associated with refurbishing existing coal units, the resulting increase in unit efficiency will lead to annual fuel savings.[17] Existing coal plants can increase efficiency through refurbishment and improved operation and maintenance practices, though the actual efficiency potential depends on plant age and other physical limitations.[18,19] Another option to reduce the emissions intensity of a coal plant is co-firing with natural gas using the igniters that are already built into many existing pulverized coal boilers.[20] These actions can lead to reductions in power-sector CO_2 emissions of 1 percent compared to 2011 levels in 2020.

IMPROVING ENERGY EFFICIENCY. Arkansas has taken several steps to improve energy efficiency over the past several years. In 2007, the Public Service Commission (PSC) approved rules requiring electric and gas utilities to develop energy efficiency programs for their customers.[21] In 2010, the PSC enacted an energy efficiency resource standard requiring investor-owned utilities to achieve annual savings of 0.25 percent of 2010 electricity sales in 2011, rising to 0.5 percent in 2012, and 0.75 percent in 2013.[22] To meet their targets, Arkansas' utilities offer a variety of programs including rebates, energy evaluations, and financial assistance programs. The state's local-option, property-assessed clean energy (PACE) financing program, which went into effect in 2013, enables municipalities and/or counties to form energy improvement districts that provide loan financing for energy efficiency improvements, CHP, and water conservation projects, as well as renewable installations.[23, 24]

The state's 2013 energy efficiency target of 0.75 percent of 2010 sales has been extended through 2014, and the target for 2015 has been set as 0.9 percent of 2013 electricity sales while the state conducts a study to help determine future goals. The next set of energy efficiency standards, which will apply from 2016 through 2018, will be finalized in 2015. The PSC's proposed targets for this period are increasingly ambitious, beginning at 1 percent of 2013 sales in the first program year, rising to 1.25 percent in the second year, and 1.5 percent in the third year.[25] If all electric utilities in the state could achieve savings goals of just 0.9 percent of 2013 sales from 2015 onward, the state could reduce electricity generation by 6 percent in 2020 compared to business-as-usual levels and reduce power sector CO_2 emissions by 7 percent in 2020 compared to 2011 levels. Pursuing the more ambitious proposed targets could help the state reduce emissions even further. If all the state's utilities achieve the proposed reductions of 1.5 percent per year from 2018 forward, the state could reduce electricity generation by 11 percent in 2020 compared to business-as-usual levels and reduce CO_2 emissions by 11 percent in 2020 compared to 2011 levels.

In addition to reducing emissions, energy efficiency measures can save money for electricity customers. A study by Georgia Tech and the Nicholas Institute found that an 8 percent reduction in energy consumption in Arkansas in 2020 would lead to $1.8 billion in total energy savings in 2020, with the average household saving $303 on their annual energy bill.[27]

Box 2 | **About This Series**

In *Can The U.S. Get There From Here?*, WRI identified four key actions the Obama Administration must take in the absence of congressional action in order to meet the U.S. commitment to reducing greenhouse gas (GHG) emissions by 17 percent below 2005 levels by 2020. These actions include setting performance standards for existing power plants, reducing consumption of hydrofluorocarbons, reducing fugitive methane emissions from natural gas systems, and increasing energy efficiency. Of these four actions, the greatest opportunity for reductions comes from the power sector. In his Climate Action Plan, President Obama directed EPA to work expeditiously to finalize carbon dioxide (CO_2) emissions standards for new power plants and adopt standards for existing power plants. As states prepare to comply with these standards, it will be necessary to understand available opportunities for reducing CO_2 emissions from the power sector. This series of fact sheets aims to shed light on these opportunities by illustrating the CO_2 emissions reduction potential from measures in a variety of states. We show how these emissions savings stack up against the reductions that could be required under forthcoming standards. This series is based on WRI analysis conducted using publicly available data. See the appendix for additional information on our methodology and modeling assumptions.[26]

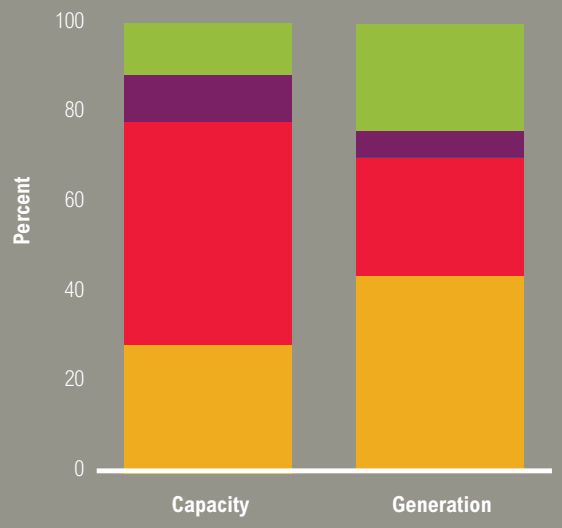
INCREASING USE OF RENEWABLE ENERGY. Renewable energy sources, primarily biomass and hydropower, comprised around 6 percent of the state's generation mix in 2012, but Arkansas has yet to take advantage of its tremendous technical potential for utility-scale solar and wind development.[28, 29] The state provides loan options for renewable projects through its PACE financing program, but there are a number of other ways the state could encourage more renewable development, including financial incentives, rebates, or establishment of a renewable energy standard. Implementing any of these strategies would likely require new regulation or legislation.

According to estimates from the National Renewable Energy Laboratory, Arkansas could generate over 100 times its 2012 electricity sales from solar and wind resources alone.[30] By developing even a small fraction of these resources, Arkansas could reduce emissions while supporting its economy. If the state could generate 15 percent of its electricity from renewable sources by 2020 and 25 percent by 2030, it could reduce emissions by 9 percent and 11 percent compared to 2011 levels, respectively.

Box 3 | Arkansas Power Sector Profile

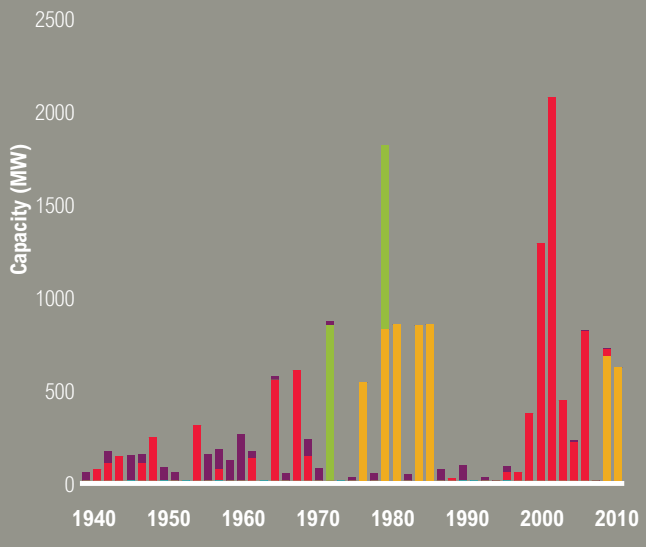
Until the late 1980s, most large capacity additions built in Arkansas were coal-fired, natural-gas fired, or nuclear power. Since then, natural gas has comprised the bulk of new capacity additions, although the two most recent major additions in 2010 and 2012 were two new coal plants.[31] Nearly all of Arkansas' renewable energy comes from biomass and hydropower. As of 2014, the state had not yet installed any solar or wind projects greater than 1 MW. Coal comprised 44 percent of in-state generation in 2012, while natural gas and nuclear sources comprised 26 percent and 24 percent, respectively. In 2011, Arkansas contributed 1.6 percent of total U.S. CO_2 emissions in the power sector and 1.5 percent of electricity generation, with a state CO_2 emissions intensity of 1,730 lbs. per MWh. While this is significantly higher than the U.S. average (about 1,200 lbs. per MWh), our analysis shows that by taking advantage of the opportunities described in our analysis, Arkansas could reduce the carbon intensity of its power sector to around 1,054 lbs. per MWh by 2020.

Arkansas Generation and Generating Capacity by Fuel, 2012



Source: U.S. Energy Information Administration Form EIA-860 and Annual Energy Review

New Electric Generating Capacity Additions by Fuel Type



Source: U.S. Energy Information Administration Form EIA-860, which includes existing electric generating units at plants with at least 1 MW capacity (electric utilities, independent power producers, and combined heat and power plants) that are connected to a power grid. Data represents installed summer capacity.

BOTH CHARTS USE THE FOLLOWING LEGEND: Coal | Natural Gas | Oil | Other Fossil | Renewables | Nuclear

OUTLOOK FOR ARKANSAS

While Arkansas' energy efficiency policies are a good first step toward reducing emissions in the near-term, the state has the opportunity to go further. By implementing additional strategies to reduce emissions, such as the proposed increased efficiency standards, Arkansas can place itself in a better position to comply with forthcoming EPA standards for existing power plants. In fact, by continuing to improve efficiency, encouraging growth of renewable energy, and taking advantage of underutilized resources, Arkansas can meet moderately ambitious standards in the near- to mid-term. Through federal and state-level actions, the United States can meet its commitment to reduce emissions 17 percent below 2005 levels by 2020.

POLICY FRAMEWORK AND INTERACTION

This analysis assumes the existing policies and other reduction opportunities listed above are fully implemented. Depending on the combination of measures actually implemented by Arkansas, each will have different impacts on the generation mix and resulting emissions. For example, increasing the efficiency of existing coal-fired power plants results in fewer emissions reductions in this analysis than would be the case if it were considered in isolation because energy efficiency improvements, increased use of renewable energy, and increased use of natural gas all decrease the state's coal-fired generation. The emissions reductions presented in the text are a result of each policy in combination with all other policies.

When considering measures that make better use of existing in-state infrastructure, we first increased CHP capacity and increased utilization of existing natural gas capacity compared to the reference case. Next, we increased the efficiency of any remaining coal plants. When considering the new clean energy measures, we applied the gains in energy efficiency to the reference case and then applied the expanded renewable generation to the resulting adjusted demand, followed by the measures that make better use of existing in-state infrastructure.

Equally as important is the policy framework, which will define how each of these measures counts toward compliance under EPA's standards. We assumed that the emissions reductions from each measure would count directly toward the standard. State measures may be counted differently in the actual standards, thus actual compliance levels could potentially be greater or less than what was modeled. See the appendix for additional information on our methodology and modeling assumptions.[32]

ENDNOTES

1. Because EIA does not produce state-level projections, we relied on regional projections of annual electricity generation growth rates by fuel from *AEO 2012*. Because neighboring states have varying policies that will affect future in-state generation differently, these regional projections may not fully capture all the relevant trends that are expected to occur within a state's power sector.
2. According to the Energy Information Administration's 2013 *Annual Energy Outlook* reference case, CO_2 emissions from the power sector will be 14 percent below 2005 levels by 2020 and only 5 percent below 2005 levels by 2035. See U.S. Department of Energy/Energy Information Administration. 2013. "Energy-Related Carbon Dioxide Emissions by Sector and Source, United States, Reference Case." In U.S. DOE/EIA. *Annual Energy Outlook 2013*. Washington, D.C.: Government Printing Office. Accessible at: <http://www.eia.gov/forecasts/aeo/>.
3. For more information, see http://www2.epa.gov/carbon-pollution-standards/2013-proposed-carbon-pollution-standard-new-power-plants.
4. A supercritical pulverized coal unit emits about 1,768 lbs. CO_2 per MWh, while a natural gas combined cycle unit emits about 804 lbs. CO_2 per MWh (National Energy Technology Laboratory, *Cost and Performance Baseline for Fossil Energy Plants Volume 1: Bituminous Coal and Natural Gas to Electricity*. Exhibit ES-17 CO_2 Emissions Normalized by Net Output, Revision 21, September 2013 < http://www.netl.doe.gov/energy-analyses/pubs/BitBase_FinRep_Rev2.pdf>).
5. U.S. Department of Energy/Energy Information Administration. 2013. "Electric Generating Capacity, Reference Case." In U.S. DOE/EIA. 2013. *Annual Energy Outlook 2013*. Washington, D.C.: Government Printing Office. Accessible at: <http://www.eia.gov/forecasts/aeo/>. For more details, see also: <http://www.wri.org/publication/us-electricity-markets-increasingly-favor-alternatives-to-coal>.
6. The sum of reductions from the individual measures listed—along with the reductions captured in the reference case—may not match this total due to rounding. We calculated emissions reductions for existing policies using the annual reference case emissions rates for each fuel type. See the appendix for additional information on the assumptions and methodology used for this analysis (available at: <http://pdf.wri.org/power_sector_opportunities_for_reducing_carbon_dioxide_emissions_methodology.pdf).
7. EPA has not yet proposed a national emissions standard for existing power plants. To illustrate the possible stringency of the future standards, this analysis shows emissions reductions for two scenarios. For an example of moderately ambitious standards, we used the "moderate" case from the latest proposal from the Natural Resources Defense Council (available at: < http://www.nrdc.org/air/pollution-standards/>), which would result in CO_2 emissions reductions in Arkansas of 35 percent below 2011 levels in 2020. We also show the emissions reductions that would occur if EPA adopted a more ambitious standard based on the "go-getter" scenario from WRI's *Can the U.S. Get There From Here?* (available at: <http://pdf.wri.org/can_us_get_there_from_here.pdf>), which aligns with a national reduction pathway necessary to meet the Administration's goal of reducing emissions 17 percent below 2005 levels by 2020. The "go-getter" scenario would achieve a 38 percent reduction from the power sector nationally between 2005 and 2020; for Arkansas, this is equivalent to a 54 percent reduction from 2011 levels. (It is unlikely that EPA standards would require identical reductions in each state, given the wide variation in emission intensities when the standards will be implemented.) Note, in their latest proposal, NRDC proposed a new set of more ambitious standards that would achieve a 42 percent reduction in Arkansas' CO_2 emissions in 2020 compared to 2011

levels. Under NRDC's ambitious scenario, nationwide CO_2 emissions would be reduced by roughly 40 percent below 2005 levels by 2020.

8. Because the existing infrastructure measures were initially considered in isolation from the clean energy policies, the sum of reductions from the individual measures listed here—along with the reductions from utilizing existing infrastructure and those captured in the reference case —may not match the total sum of reductions achieved when all policies and measures are considered at once. See the *Policy Framework and Interaction* box at the end of this fact sheet for additional explanation. We calculated emissions reductions from clean energy policies using the annual reference case emissions rates for each fuel type. See the appendix for additional information on the assumptions and methodology used for this analysis (available at: <http://pdf.wri.org/power_sector_opportunities_for_reducing_carbon_dioxide_emissions_methodology.pdf).
9. Nicholas Bianco, Franz Litz, Kristin Meek, and Rebecca Gasper. 2013. *Can The U.S. Get There From Here? Using Existing Federal Laws and State Action to Reduce Greenhouse Gas Emissions*. Washington, DC: World Resources Institute. Accessible at: <http://pdf.wri.org/can_us_get_there_from_here.pdf>.
10. ICF International. 2009. *Effect of a 30 Percent Investment Tax Credit on the Economic Market Potential for Combined Heat and Power*. Accessible at: <http://www.localpower.org/WADE_USCHPA_ITC_Report.pdf>.
11. ICF CHP database. Accessible at: < http://www.eea-inc.com/chpdata/>.
12. In 2012, Arkansas ranked 37th on ACEEE's State Energy Efficiency Scorecard for CHP based on its lack of the measures listed here. For more details, see <http://www.aceee.org/sites/default/files/publications/researchreports/e13k.pdf)
13. WRI estimates based on data from U.S. Energy Information Administration, *EIA-923 Generation and Fuel Data*, <http://www.eia.gov/electricity/data/eia923/>; and *EIA-860 Annual Electric Generator Data*, <http://www.eia.gov/electricity/data/eia860/>.
14. NGCC units are designed to be operated up to 85 percent capacity (see http://mitei.mit.edu/system/files/NaturalGas_Chapter4_Electricity.pdf), but actual maximum capacity factors may differ among units. We assume a conservative maximum capacity factor of 75 percent.
15. We did not account for the increases in methane associated with the increased production of natural gas due to a higher demand for the fuel. Going forward, industry should work with EPA to reduce methane leakage rates from natural gas systems. For additional information, see: <http://www.wri.org/publication/clearing-the-air>.
16. Phil DiPetro and Katrina Krulla. 2010. *Improving the Efficiency of Coal-Fired Power Plants for Near Term Greenhouse Gas Emissions Reductions*. National Energy Technology Laboratory, Office of Systems, Analyses and Planning. DOE/NETL-2010/1411. Accessible at: <http://www.netl.doe.gov/energy-analyses/pubs/ImpCFPPGHGRdctns_0410.pdf>. Chris Nichols, Gregson Vaux, Connie Zaremsky, James Murphy, and Massood Ramezan. 2008. *Reducing CO_2 Emissions by Improving the Efficiency of the Existing Coal-fired Power Plant Fleet.* National Energy Technology Laboratory, Office of Systems, Analyses, and Planning, and Research and Development Solutions, LLC. DOE/NETL-2008/1329. Accessible at: <http://www.netl.doe.gov/energy-analyses/pubs/CFPP%20Efficiency-FINAL.pdf>. "Analyses Show Benefits of Improving Unit Heat Rate as Part of a Carbon Mitigation Strategy." *Lehigh Energy Update* 28 (1), February 2010. Accessible at: <http://www.lehigh.edu/~inenr/leu/leu_65.pdf>.
17. For example, the National Energy Technology Laboratory found a payback period of less than 4 years for a refurbishment technology that achieves a 2 percent heat rate improvement. For more information, see *Benefits of the Big Bend Power Station Project*, National Energy Technology Laboratory. Accessible at: <http://www.netl.doe.gov/technologies/coalpower/cctc/ccpi/pubs/tampa.pdf>; and "Analyses Show Benefits of Improving Unit Heat Rate as Part of a Carbon Mitigation Strategy." *Lehigh Energy Update* 28 (1), February 2010. Accessible at: <http://www.lehigh.edu/~inenr/leu/leu_65.pdf>.
18. Phil DiPetro and Katrina Krulla. 2010. *Improving the Efficiency of Coal-Fired Power Plants for Near Term Greenhouse Gas Emissions Reductions*. National Energy Technology Laboratory, Office of Systems, Analyses and Planning. DOE/NETL-2010/1411. Accessible at: <http://www.netl.doe.gov/energy-analyses/pubs/ImpCFPPGHGRdctns_0410.pdf>.
19. "Regulating Greenhouse Gas Emissions Under the Clean Air Act." 73 Register §147(2008). Accessible at: <http://www.gpo.gov/fdsys/pkg/FR-2008-07-30/pdf/E8-16432.pdf>.w
20. Personal communication with Tomas Carbonell, Environmental Defense Fund, July 12, 2013.
21. Arkansas Public Service Commission, Docket No. 06-004-R, 2006. Accessible at: <http://www.apscservices.info/efilings/docket_search_results.asp?CaseNumber=06-004-r>.
22. Arkansas Public Service Commission, Docket Number 08-144-U, December 2010. Accessible at: <http://www.apscservices.info/pdf/08/08-144-U_153_1.pdf>.
23. State of Arkansas 89th General Assembly, 2013. Senate Bill 640. Accessible at: <http://www.arkleg.state.ar.us/assembly/2013/2013R/Acts/Act1074.pdf>.
24. PACE programs provide municipal loans to help cover upfront costs of efficiency upgrades or renewable installations that customers repay over time through their property taxes. In this way, customers can begin accruing energy savings as they pay for their upgrades.
25. Arkansas Public Service Commission, Docket Number 13-002-U, January 2013. Accessible at: <http://www.apscservices.info/pdf/13/13-002-u_1_1.pdf>.
26. World Resources Institute. 2013. *Power Sector Opportunities For Reducing Carbon Dioxide Emissions. Appendix A: Detailed Overview of Methods*. Washington, DC: World Resources Institute. Accessible at: <http://pdf.wri.org/power_sector_opportunities_for_reducing_carbon_dioxide_emissions_methodology.pdf>.
27. Energy reductions compared to business-as-usual energy use in 2020. Energy savings include both electricity and natural gas energy savings. In 2020, monetary savings from electricity use amounted to 67 percent of energy savings including both electricity and natural gas ($1.2 billion, 2007$). Marilyn Brown, Etan Gumerman, Xiaojing Sun, Youngsun Baek, Joy Wang, Rodrigo Cortes, Diran Soumonni, E*nergy Efficiency in the South: Appendices*, Georgia Tech and Nicholas Institute for Environmental Policy Solutions, Accessible at: <http://cepl.gatech.edu/drupal/sites/default/files/Energy%20Efficiency%20in%20the%20South%20Appendices_0.pdf>.
28. *EIA-923 Generation and Fuel Data*. Accessible at: <http://www.eia.gov/electricity/data/eia923/>.
29. National Renewable Energy Laboratory. July 2012. *U.S. Renewable Energy Technical Potentials: A GIS-Based Analysis*. Accessible at: <http://www.nrel.gov/docs/fy12osti/51946.pdf>.
30. Ibid.
31. Unless otherwise indicated, we relied upon the U.S. Energy Information Administration *Annual Energy Review* and *Form EIA-860* for data reported in Box 3.
32. World Resources Institute. 2013. *Power Sector Opportunities For Reducing Carbon Dioxide Emissions. Appendix A: Detailed Overview of Methods*. Washington, DC: World Resources Institute. Accessible at: <http://pdf.wri.org/power_sector_opportunities_for_reducing_carbon_dioxide_emissions_methodology.pdf>.

ABOUT WRI

WRI is a global research organization that works closely with leaders to turn big ideas into action to sustain a healthy environment—the foundation of economic opportunity and human well-being.