RTI International Annual Report

State Fiscal Year 2015–2016 Report of Program Activities, Objectives and Accomplishments; and Itemized Expenditures and Fund Sources

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reports@ncleg.net

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Research Triangle Institute d/b/a/ RTI International
3040 Cornwallis Road
Research Triangle Park, N.C. 27709

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REPORT OVERVIEW

- For the 2015–2016 fiscal year (FY), RTI received a recurring State appropriation of $800,000 to match U.S. Department of Energy research and development funds.
    - RTI utilized the full $800,000 of the State's investment in this program, allowing RTI to attract $3,415,325 in federal energy research funds, along with additional private sector investment.
- As a result, for every $1 in State FY 2015-2016 funds utilized by RTI, North Carolina attracted $4.27 in corresponding federal investment to support its economy.

As provided in Session Law 2013-360, Section 15.25, RTI International (RTI) is pleased to submit this report of State fiscal year program activities, objectives, and accomplishments and prior State fiscal year itemized expenditures and fund sources.

ABOUT RTI

In 1958, the idea of Research Triangle Park (RTP) was born with the guidance and support of government, education, and business in North Carolina. Located in the rolling hills of the Piedmont, the Research Triangle is defined by outstanding universities in the Triangle's three cities: North Carolina State University in Raleigh, Duke University and North Carolina Central University in Durham, and the University of North Carolina at Chapel Hill. RTI was the original anchor tenant in RTP.

As RTP expanded and prospered after its inception, so did RTI. Growing from a handful of scientists in central North Carolina in 1959 to a staff of more than 4,100 in more than 75 countries today, RTI is now one of the world's leading independent, nonprofit research and development organizations.

Our activities both mirror and support national priorities and policies as well as diverse commercial, industrial, and academic endeavors. For instance, as public and government interest in environmental protection grew in the 1960s, so did related programs at RTI, building on our expertise in statistical, physical, and life sciences.

As our mission affirms, we are dedicated to improving the human condition by turning knowledge into practice through cutting-edge study and analysis in health and pharmaceuticals, education and training, surveys and statistics, advanced technology, international development, economic and social policy, energy and the environment, and laboratory and chemistry services.

We are proud of our scientific stature and our reputation for innovation. By continuing to conduct impartial, reliable, multidisciplinary research and by helping to develop and broker new technologies for our clients, we seek to be the world's preferred resource for turning knowledge into practice.

ENERGY RESEARCH AT RTI

RTI's innovative energy research is geared toward solving national and global concerns by developing efficient, economic, and sustainable energy solutions. Our scientists and engineers address challenges across the power, chemical, petroleum, gas processing, and

transportation industries to produce novel technologies from ideation to pilot scale to commercialized systems.

Our state-of-the-art facilities and laboratories are equipped to provide high-quality R&D for process technology licensors, gas processing companies, oil refiners, chemical manufacturers, clean-fuels developers, electric power generators, catalyst manufacturers, and other commercial clients, as well as for the U.S. Department of Energy (DOE), Department of Defense, and other government agencies. Our capabilities range from lab- and bench-scale experiments to pilot plants and large-scale pre-commercial demonstration.

Our energy R&D programs are focused into seven primary areas, all of which are important for the production and utilization of clean, secure, and safe domestic energy in our state and in our nation:

- Syngas clean-up and conversion (such as from coal, petroleum residues, biomass, and wastes)
- Natural gas (extraction, clean-up, and conversion)
- Biomass conversion into fuels and chemicals
- Carbon capture and utilization
- Industrial water treatment and recycle/reuse
- Solid-state lighting
- Emerging sustainable energy (such as solar energy transfer and storage)

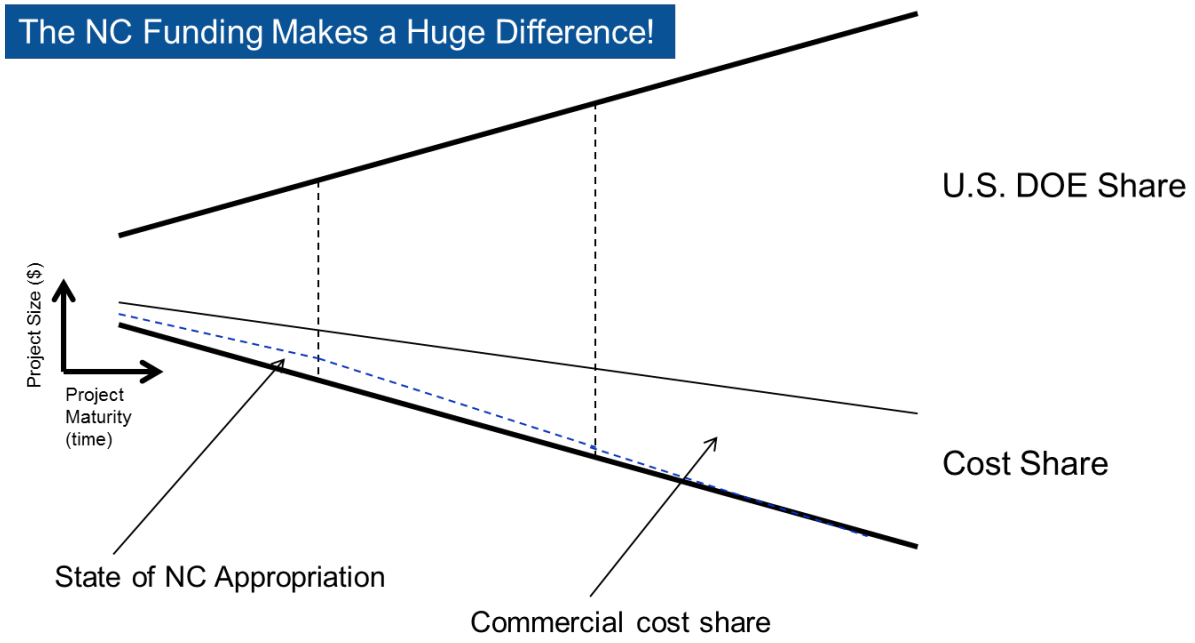
RTI develops advanced technologies for energy applications from concept to large scale demonstration, with a focus on applied research. We partner with the largest energy and chemical companies in the world and leverage our state support to enter new R&D areas, build new technology platforms, and build a technology base for future commercialization of new energy technologies. RTI is unique in North Carolina, with a world class reputation in the energy sector.

IMPORTANCE AND VALUE OF THE GRANTS APPROPRIATED TO RTI IN THE STATE BUDGET

North Carolina State Funding as an Investment in Energy Technology Development

RTI develops advanced energy technologies mainly under the funding from the U.S. DOE. These federal research awards require a cost share or match from non-federal sources, typically 5% or 20%, depending on the funding program. RTI's first priority is to develop partnerships with industry that can attract this cost share match from the private sector, and RTI has a successful track record for building these industry alliances. However, the development of new technologies often makes it difficult to attract such cost share

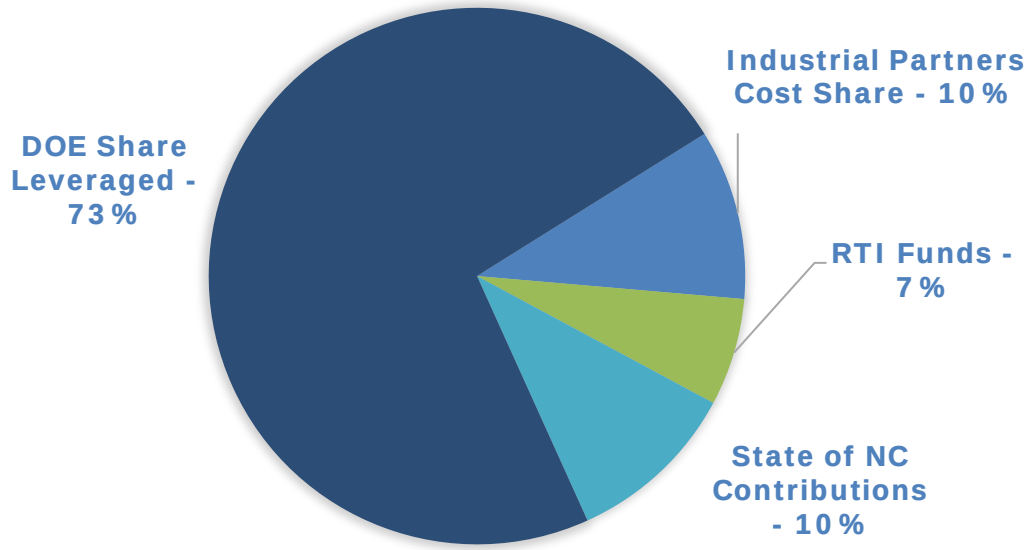
requirements until the technologies are sufficiently proven to attract private sector investment. State matching funds allow RTI to cover this early cost share gap and to demonstrate the viability of new technologies – and then attract private sector investment as they mature. As projects are further advanced, industry often picks up the full funding load for U.S. DOE cost share requirements.



The State Budget approved by the legislature for Fiscal Year (FY) 2015–2016 included an $800,000 recurring grant to assist RTI in winning federal energy research grants that require cost share or match. The goal of this grant is to help RTI advance energy research in North Carolina and create jobs in this important and growing part of the state's economy. The key points of how RTI utilizes the grant and benefits to the State can be summarized as follows:

- North Carolina state funding helps RTI to initiate development of at least three to five additional energy technology concepts per year. This year, a total of seven development projects have benefited from the state funding.
- This fiscal year RTI utilized the full $800,000 of the State's funding to attract $3,415,325 in federal energy research funds, along with additional private sector investment. As a result, for every $1 in State FY 2015-2016 funds utilized by RTI, North Carolina attracted $4.27 in federal investment to support its economy.
- Together with U.S. DOE funding and in partnerships with leading industrial companies RTI builds a pipeline of innovative technologies addressing the energy challenges of our state and of our nation.

- Since 2010, the State of North Carolina has invested $3.2 million to help RTI attract federal and private funding for energy technology development in NC. Based on success of the initial funding, the allocation was raised in FY 2016 to $800,000 and made recurring. This total State funding to date has helped attract approximately $28 million in total new technology investment to NC's economy, including investments made by the federal government, industry, and RTI.

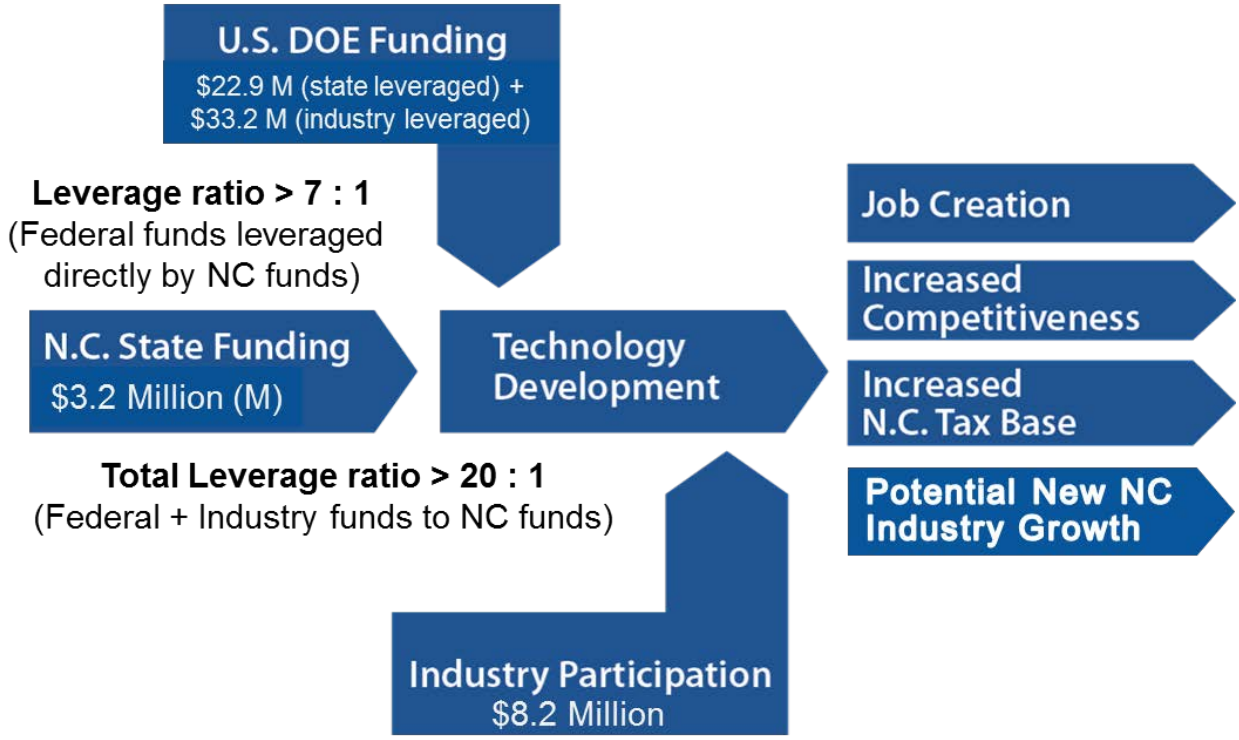


FY11-FY16 RTI Total Energy Funding Breakdown

- Total state funding during the past six years has allowed RTI to attract over $22.9 million in federal research grants to the state (based on only the federal investment cost-shared directly by these state funds). This amounts to over $7 in federal funds for every $1 in state funds, using the most conservative method for this calculation.

- Private industry has invested an additional $8.2 million in cash and in-kind services in the RTI energy projects directly supported with state funding, and these industry investments have enabled the leveraging of $33.2 million in additional federal investment.

- If one considers this additional private sector investment in RTI energy projects and the resulting combined federal investment that is leveraged, North Carolina's overall return on investment is over $20 in external funding for every $1 in state funding.



LEVERAGING OF FY2011-FY2016 RTI STATE FUNDING

- Investment in new technologies leads to increased economic competitiveness. It creates high-paying jobs, typically attracting talent from outside of the state and resulting in significant economic input to the state of North Carolina. Since North Carolina began investing in RTI's energy research in FY 2010-2011, RTI has created or supported approximately 50 to 80 high-tech jobs associated with this research.

- In addition to jobs, RTI estimates that for every $1 in state funds invested in RTI energy research, North Carolina has received approximately $2.90 back in state and local taxes.

- State-supported research at RTI regarding solid-state (LED) lighting has also benefited the N.C. State Construction Office, the Department of Environmental and Natural Resources, the Department of Public Health, UNC-Chapel Hill, and N.C. State University and other agencies.

STATE FISCAL YEAR 2015–2016 PROGRAM ACTIVITIES, OBJECTIVES, AND ACCOMPLISHMENTS

In this 2015-2016 state fiscal year, utilizing the full $800,000 of the State's funding has greatly assisted in further building RTI's technology development pipeline, directly attracting $3,415,325 in federal research dollars (4.27:1 federal leverage ratio) along with approximately $2,500,000 in industry and other funding to the state plus approximately $10,000,000 in additional federal research dollars leveraged by this industry funding, successfully retaining and creating jobs in the state of North Carolina. The table below shows the leveraging of Federal funds directly associated with State funding.

Leveraging of Federal Funds through State Funding for State FY 2015-2016

PROJECT / PROPOSAL	NC FUNDS USED ($)	FEDERAL DOLLARS LEVERAGED ($)
50-MW WARM SYNGAS CLEANUP TESTING AND OPERATIONS	249,540	998,160
CO_2 CAPTURE LAB AND BENCH SCALE SORBENT DEVELOPMENT	184,069	736,276
TRANSITIONAL TECHNOLOGY DEVELOPMENT TO ENABLE HIGHLY EFFICIENT POWER SYSTEMS WITH CARBON MANAGEMENT: LOW-ENERGY WATER RECOVERY FROM SUBSURFACE BRINES	145,833	583,332
SOLID-STATE LIGHTING (SSL) LUMINARIES	84,922	339,688
CARBON, HYDROGEN, AND SEPARATION EFFICIENCIES (CHASE) IN BIO-OIL CONVERSION PATHWAYS	52,439	209,756
AUTOCAMMS METHANE SENSOR	43,065	387,585
FOULING-RESISTANT MEMBRANES FOR TREATING CONCENTRATED BRINES FOR REUSE IN ADVANCED ENERGY SYSTEMS	40,132	160,528
TOTALS	**800,000**	**3,415,325**

Specific projects benefiting from State of NC funds and the goals of and accomplishments within those projects are highlighted below:

1. **50-MW Warm Syngas Cleanup Testing and Operations.** RTI used $249,540 of FY15-16 state funding to secure $998,160 of U.S. DOE funding to test the performance of this technology on actual industrial syngas. This game-changing technology enables high-sulfur gas streams, such as warm synthesis gas (syngas) from coal or petcoke gasification, to be cleaned at elevated temperatures, thus reducing or eliminating the need for substantial gas cooling and expensive heat recovery systems. This increases the overall process efficiency, avoids waste of valuable energy, reduces greenhouse gas emissions, and also reduces the capital and operating costs of the entire gas cleanup block by as much as 50 percent or more when compared to conventional cleanup technologies.

2. **CO_2 Capture Lab and Bench-Scale Sorbent Development**. RTI used $184,069 of FY 2015-2016 state funding to secure $736,276 of U.S. DOE funding. The efficiency and cost of carbon capture can be improved if a solid sorbent can be developed and demonstrated that can capture carbon dioxide at elevated temperatures with low regeneration energy penalty. RTI has developed sorbent formulations that hold great promise and state funding was used to leverage U.S. DOE funding to test the performance of these sorbents at lab and bench scales.

3. **Transitional Technology Development to Enable Highly Efficient Power Systems with Carbon Management: Low-Energy Water Recovery from Subsurface Brines.** RTI used $145,833 of FY 2015-2016 state funding to secure $583,332 of U.S. DOE funding to help provide a solution to the water management issues encountered when CO_2 emissions from power plants are captured and stored underground to reduce climate impact, an approach called carbon capture and storage (CCS). In these instances, impaired waters with a very high mineral content can pose a significant water treatment challenge. Under this project, RTI has been developing a low-cost, low-energy water treatment process for the economical extraction of clean potable water from high-total dissolved solids (TDS) brines. TDS is a concentration of minerals dissolved in water which requires treatment before the water can be used for other processes.

4. **Solid-State Lightning (SSL) Luminaries**. RTI used $84,922 of FY 2015-2016 state funding to secure $339,688 U.S. DOE funding for long-term performance and reliability characterization of LED solid-state lighting systems to be conducted in cooperation with Cree, a prominent lighting company located in the Research Triangle Park in NC. State funds were leveraged to complete the guidance documents and provide additional technical insights to state lighting engineers. The results of this work will aid individual, commercial, industrial, and state-funded entities in their decisions regarding the viability and utilization of these advanced lighting systems which hold great promise for reducing energy consumption and costs.

5. **Carbon, Hydrogen, and Separation Efficiencies (CHASE) in Bio-oil Conversion Pathways**. RTI used $52,439 of its FY2015-2016 state funding to secure $209,756 of leveraged funding from the U.S. DOE to advance RTI's process technology for the cost competitive production of transportation fuels from biomass. RTI has been developing a catalytic biomass pyrolysis process over the past several years and is now operating a one ton per day pilot plant at its Energy Technology Development Facility in Research Triangle Park to convert biomass into a "biocrude" that can be upgraded to transportation fuel using technology commonly used in petroleum refining. Effective hydrogen utilization is a major factor in increasing the cost competitiveness of bio-based fuels. Under this project, RTI has been developing a novel catalyst technology that will reduce the overall hydrogen demand and a process to improve the carbon efficiency by

recovering carbon that leaves the process in a waste water stream and returning it to beneficial use in the process. Veolia Water, a global leader in water treatment technologies with major offices in Cary, NC, has been helping RTI to optimize the overall process by recovering valuable carbon from process wastewater.

6. **AutoCAMMS Methane Sensor.** RTI used $43,065 of FY 2015-2016 state funding to secure $387,585 of U.S. DOE funding for the development of small-footprint sensors for detection of fugitive methane emissions from oil and gas extraction wells. Such fugitive emissions are a significant concern because methane has a much greater near-term greenhouse gas impact than carbon dioxide. This project was conducted in cooperation with Duke University. During this past year, the project successfully demonstrated a laboratory prototype of the novel gas sensing technology as a proof of concept that this novel approach can detect and speciate methane and other volatile organic compounds.

7. **Fouling-Resistant Membranes for Treating Concentrated Brines for Reuse in Advanced Energy Systems**. RTI used $40,132 of FY2015-2016 state funding to secure $160,528 of leveraged funding from the U.S. DOE for this project. The complex range and high concentrations of salts, minerals, and metals that make up the total dissolved solids (TDS) found in concentrated brines generated throughout the fossil fuel lifecycle severely limit current treatment and disposal options. The high TDS levels in concentrated brines (often 8 times higher than that of seawater) make current approaches to water treatment untenable. In this project, funded by the DOE, RTI has been developing a low-cost, novel water treatment process using electrically conductive membrane distillation (ECMD) for the reuse of concentrated brines. This project's goal is to develop a new class of advanced ECMD membranes that will mitigate the fouling issues that often occur during water treatment, paving the way for expanded water reuse and discharge options beyond what is currently feasible. Anticipated benefits/outcomes of the advanced technology include at least 50% reuse of treated water, 35% to 90+% reduction in water treatment cost, and improvement in membrane fouling relative to existing membranes. RTI is collaborating with Veolia Water, a global leader in wastewater services with major offices in Cary, NC.

STATE FISCAL YEAR 2015-2016 ITEMIZED EXPENDITURES AND FUND SOURCES

The $800,000 in appropriation funds used by RTI were applied to labor costs inclusive of indirect overhead charges. See **Appendix A** for details of the expenditure of RTI state funds for this past fiscal year.

OUTLOOK FOR STATE FISCAL YEAR 2016-2017

For the State fiscal year 2016-2017, RTI plans to continue to utilize State of NC funding to further strengthen its energy program. The funds are anticipated to be used to leverage federal funds for the following technology development projects for which RTI has received award notices and for which contract negotiations are currently under way:

- **O_2 Binding Materials and Highly Efficient Modular System for Oxygen Production.** RTI will develop innovative oxygen separation materials (sorbents) and technologies based on using oxygen carriers in solid form to reversibly bind oxygen for efficient separation of air to produce greater than 95% purity oxygen. This technology, once developed, would enable lower cost modular production of purified oxygen systems for small scale power generation and for use in the reduction of greenhouse gas emissions.

- **Novel Solid Sorbents for CO_2 Capture.** The efficiency and cost of carbon capture can be improved if a solid sorbent can be developed and demonstrated that can capture carbon dioxide at elevated temperatures with low regeneration energy penalty. In this project, RTI will utilize molecular modeling tools to identify and develop novel sorbents that meet these objectives. RTI will then test the performance of these sorbents at lab and bench scales.

- **Improved Carbon Efficiencies in Bio-oil Conversion.** RTI will use FY 2016-2017 state funding to leverage U.S. DOE funding to demonstrate a novel catalyst technology that will improve carbon efficiency and reduce the overall hydrogen demand for catalytic fast pyrolysis of biomass. Carbon efficiency will be improved through testing of three concepts: converting the carbon in the various aqueous streams to methane for hydrogen production, recovering oxygenated hydrocarbons for hydroprocessing, and upgrading aqueous phase carbon to value-added by-products. RTI will be collaborating with Veolia Water, a global leader in water treatment technologies with major offices in Cary, NC.

- **Building Blocks from Biocrude: High Value Methoxyphenols.** RTI will investigate the technical feasibility and economic potential, as well as the environmental and sustainability benefits, of recovering mixed methoxyphenols from biocrude as high-value building block chemicals, alongside the production of biofuels. If successful, this would create higher overall value from conversion of biomass, improve the overall carbon efficiency, and reduce the economic breakpoint price for production of transportation fuels from biomass.

- **Low-Energy Water Recovery from Subsurface Brines Displaced During Carbon Sequestration.** The project's goal is to develop a cost-effective technology

using solvents to recover potable-quality water from brines from deep aquifers displaced during underground sequestration of carbon dioxide from power plants or industrial sources. RTI has previously identified and developed non-aqueous solvents (NAS) for purposes of carbon dioxide capture. Under this project, RTI will test the capability of NAS to also absorb brines with high-total dissolved solids and release water in a better, cleaner condition. In addition, the kinetics of the process will be maximized through determination and evaluation of optimum conditions.

- **Coded Apertures Miniature Mass Spectrometer – CAMMS.** In collaboration with Duke University, RTI will use FY 2016-2017 state funding to develop miniaturized sensors to accurately detect, measure, and mitigate methane and other emissions from the oil and natural gas industry. For this funded effort, the team will deliver a breadboard prototype of the gas sensing technology, able to be transported to a field testing site. An extensive effort in miniaturization of vacuum systems and electronics control and read-out systems will be conducted to develop a system uniquely suited to detect not only methane, but also the toxic compounds benzene, toluene, ethylbenzene, and xylene.

In addition to supporting these already defined projects, RTI anticipates utilizing the balance of fiscal year 2016-2017 State of NC funding to support 1-2 additional federally-funded projects that are anticipated based on pending proposals but have yet to be finally awarded to RTI.

SUMMARY

All of the funds received by RTI have been used for the purposes for which they were granted. Financial data for all funded projects have been provided for FY 2015-2016. The line item budget for the FY 2015-2016 use of funds is attached in Appendix A. We appreciate the State's support of the above projects and the continued opportunity to hire and retain jobs in the State of North Carolina. Please direct questions regarding technical matters to David L. Denton, Senior Director, Business Development, Energy Technology Division, RTI International, ddenton@rti.org or 919-485-2609. Please direct questions regarding contractual matters to Katherine M. Mangum, Senior Contracting Officer, RTI International, kmm@rti.org or 919-541-8045.

APPENDIX A: STATE OF NORTH CAROLINA COST SHARE FUNDING, FY 2015-2016

Summary

State of NC Funding $800,000

Project/Proposal	Start Date	Total Cost	DOE Award	Cost Share Requirement	Use of NC Funds	Federal Dollars Leveraged
50-MW Warm Syngas Cleanup Testing and Operations	10/1/2015	$8,750,000	$7,000,000	$1,750,000	**$249,540**	$998,160
CO_2 Capture Lab and Bench Scale Sorbent Development	10/1/2015	$1,104,415	$883,532	$220,883	**$184,069**	$736,276
Transitional Technology Development to Enable Highly Efficient Power Systems with Carbon Management: Low-Energy Water Recovery from Subsurface Brines	9/1/2015	$937,500	$750,000	$187,500	**$145,833**	$583,332
Solid-State Lighting (SSL) Luminaries	10/1/2015	$718,504	$574,803	$143,701	**$84,922**	$339,688
Carbon, Hydrogen, and Separation Efficiencies in Bio-oil Conversion Pathways (CHASE Bio-oil Pathways)	9/1/2014	$3,925,639	$3,140,526	$785,113	**$52,439**	$209,756
AutoCAMMS Methane Sensor	5/14/2015	$636,851	$573,165	$63,686	**$43,065**	$387,585
Fouling-Resistant Membranes for Treating Concentrated Brines for Reuse in Advanced Energy Systems	10/1/2014	$625,000	$500,000	$125,000	**$40,132**	$160,528
			TOTAL	**$3,275,882**	**$800,000**	**$3,415,325**
			Unallocated Funding (to return to state):		***$0***	
			DOE-to-State Funds Leverage Ratio:		***4.27***	

Funding Breakout - by Project by Quarter

7/1/15 - 6/30/16 = Actuals	Q1	Q2	Q3	Q4	Total
	7/1/15 - 9/30/15	**10/1/15 - 12/31/15**	**1/1/16 - 3/31/16**	**4/1/16 - 6/30/16**	
50-MW Warm Syngas Cleanup Testing and Operations					
Labor (w/ Fringe)	$0	$59,996	$239,420	$193,610	$493,026
Travel, Services, etc.	$	$194,007	$281,600	$149,721	$625,328
Equipment, Materials, Subcontractors	$	$230,414	$2,054,915	$2,287,835	$4,573,164
Overhead (Indirect) Costs	$0	$142,575	$468,908	$398,954	$1,010,437
Total	**$0**	**$626,992**	**$3,044,843**	**$3,030,120**	**$6,701,955**
Labor (fully loaded)	**$0**	**$140,074**	**$563,942**	**$456,039**	**$1,160,055**
Labor (fully loaded) towards State Cost Share Funds	**$0**	**$0**	**$249,540**	**$0**	**$249,540**

Funding Breakout - by Project by Quarter					
7/1/15 - 6/30/16 = Actuals	**Q1**	**Q2**	**Q3**	**Q4**	**Total**
	7/1/15 - 9/30/15	**10/1/15 - 12/31/15**	**1/1/16 - 3/31/16**	**4/1/16 - 6/30/16**	
CO2 Capture Lab and Bench Scale Sorbent Development					
Labor (w/ Fringe)	$0	$7,422	$46,024	$56,357	$109,803
Travel, Services, etc.	$	$	$1,351	$12,034	$13,385
Equipment, Materials, Subcontractors	$	$	$6,044	$11,069	$17,113
Overhead (Indirect) Costs	$0	$9,877	$63,880	$84,097	$157,854
Total	**$0**	**$17,299**	**$117,299**	**$163,557**	**$298,155**
Labor (fully loaded)	**$0**	**$17,299**	**$108,407**	**$132,746**	**$258,453**
Labor (fully loaded) towards State Cost Share Funds	**$0**	**$16,520**	**$107,645**	**$59,904**	**$184,069**

Funding Breakout - by Project by Quarter

7/1/15 - 6/30/16 = Actuals	Q1	Q2	Q3	Q4	Total
	7/1/15 - 9/30/15	10/1/15 - 12/31/15	1/1/16 - 3/31/16	4/1/16 - 6/30/16	
Transitional Technology Development to Enable Highly Efficient Power Systems with Carbon Management: Low-Energy Water Recovery from Subsurface Brines					
Labor (w/ Fringe)	$5,233	$60,214	$43,811	$48,286	$157,544
Travel, Services, etc.	$	$	$3,052	$3,534	$6,586
Equipment, Materials, Subcontractors	$	$8,107	$1,861	$2,653	$12,621
Overhead (Indirect) Costs	$6,885	$80,421	$61,087	$72,165	$220,558
Total	**$12,118**	**$148,741**	**$109,811**	**$126,638**	**$397,308**
Labor (fully loaded)	**$12,118**	**$140,343**	**$103,195**	**$113,735**	**$369,391**
Labor (fully loaded) towards State Cost Share Funds	**$0**	**$89,054**	**$56,779**	**$0**	**$145,833**

Funding Breakout - by Project by Quarter					
7/1/15 - 6/30/16 = Actuals	**Q1**	**Q2**	**Q3**	**Q4**	**Total**
	7/1/15 - 9/30/15	**10/1/15 - 12/31/15**	**1/1/16 - 3/31/16**	**4/1/16 - 6/30/16**	
Solid-State Lighting (SSL) Luminaries					
Labor (w/ Fringe)	$0	$48,984	$45,825	$23,665	$118,474
Travel, Services, etc.	$	$4,313	$3,419	$5,486	$13,218
Equipment, Materials, Subcontractors	$	$34,462	$14,953	$11,231	$60,646
Overhead (Indirect) Costs	$0	$64,717	$60,960	$36,559	$162,236
Total	**$0**	**$152,476**	**$125,157**	**$76,941**	**$354,574**
Labor (fully loaded)	**$0**	**$111,445**	**$107,938**	**$55,742**	**$275,125**
Labor (fully loaded) towards State Cost Share Funds	**$0**	**$68,776**	**$16,146**	**$0**	**$84,922**

Funding Breakout - by Project by Quarter

7/1/15 - 6/30/16 = Actuals	Q1	Q2	Q3	Q4	Total
	7/1/15 - 9/30/15	**10/1/15 - 12/31/15**	**1/1/16 - 3/31/16**	**4/1/16 - 6/30/16**	
Carbon, Hydrogen, and Separation Efficiencies in Bio-oil Conversion Pathways (CHASE Bio-oil Pathways)					
Labor (w/ Fringe)	$90,237	$86,699	$66,968	$44,579	$288,483
Travel, Services, etc.	$18,675	$11,295	$2,555	$4,202	$36,727
Equipment, Materials, Subcontractors	$14,288	$18,593	$4,060	$2,284	$39,225
Overhead (Indirect) Costs	$124,888	$118,662	$92,905	$68,689	$405,144
Total	**$248,088**	**$235,249**	**$166,488**	**$119,754**	**$769,579**
Labor (fully loaded)	**$210,329**	**$172,700**	**$157,740**	**$105,004**	**$645,772**
Labor (fully loaded) towards State Cost Share Funds	**$0**	**$52,439**	**$0**	**$0**	**$52,439**

Funding Breakout - by Project by Quarter					
7/1/15 - 6/30/16 = Actuals	**Q1**	**Q2**	**Q3**	**Q4**	**Total**
	7/1/15 - 9/30/15	**10/1/15 - 12/31/15**	**1/1/16 - 3/31/16**	**4/1/16 - 6/30/16**	
AutoCAMMS Methane Sensor					
Labor (w/ Fringe)	$12,619	$10,083	$51,330	$48,095	$122,127
Travel, Services, etc.	$216	$22,000	$757	$101	$23,074
Equipment, Materials, Subcontractors	$58	$1,079	$20,086	$12,415	$33,638
Overhead (Indirect) Costs	$12,386	$16,923	$70,112	$64,422	$163,843
Total	**$25,279**	**$50,085**	**$142,285**	**$125,033**	**$342,682**
Labor (fully loaded)	**$25,118**	**$25,597**	**$120,905**	**$113,285**	**$284,906**
Labor (fully loaded) towards State Cost Share Funds	**$0**	**$13,423**	**$5,652**	**$23,990**	**$43,065**

Funding Breakout - by Project by Quarter

7/1/15 - 6/30/16 = Actuals	Q1	Q2	Q3	Q4	Total
	7/1/15 - 9/30/15	10/1/15 - 12/31/15	1/1/16 - 3/31/16	4/1/16 - 6/30/16	
Fouling-Resistant Membranes for Treating Concentrated Brines for Reuse in Advanced Energy Systems					
Labor (w/ Fringe)	$19,816	$23,125	$41,331	$34,051	$118,323
Travel, Services, etc.	$72	$12	$2,507	$1,236	$3,827
Equipment, Materials, Subcontractors	$14,031	$14,662	$17,537	$3,576	$49,806
Overhead (Indirect) Costs	$26,894	$31,307	$58,110	$50,403	$166,714
Total	**$60,814**	**$69,105**	**$119,485**	**$89,266**	**$338,670**
Labor (fully loaded)	**$46,189**	**$53,901**	**$97,353**	**$80,205**	**$277,649**
Labor (fully loaded) towards State Cost Share Funds	**$0**	**$37,801**	**$2,331**	**$0**	**$40,132**