



SCHOOL OF ENERGY RESOURCES



Annual Report of the Advanced Conversion Task Force to
The Joint Minerals, Business, and Economic Development Interim Committee

September 30, 2017



UNIVERSITY OF WYOMING

ANNUAL REPORT

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(W.S. 21-17-121c)

This report summarizes the activities of the Advanced Conversion Technologies Task Force for Fiscal Year 2017 (July 1, 2016 – June 30, 2017). For the purposes of this report, the Advanced Conversion Technologies Task Force will hereafter be referred to as the Task Force and the Advanced Conversion Technologies Research Account will be referred to as the Account.

As detailed in this report, the Task Force fulfilled all statutory obligations by the legislatively mandated sunset date of June 30, 2017. Therefore, this will be the final annual report of the Task Force.

Task Force Creation, Appropriations and Assignments

In 2007, House Bill 301 created the Task Force consisting of the current voting members of the University of Wyoming (UW) Energy Resources Council (ERC). That legislation appropriated \$2.5 million of state general fund dollars into the Account which could only be expended upon appropriation by the Legislature. The legislation also directed the Task Force to solicit proposals for research in clean coal technologies and required that the appropriation could not be disbursed unless the project demonstrated a dollar-for-dollar match from non-state funds.

The Account was created to stimulate research and development in the area of low-emissions and advanced conversion technologies. The objectives of the program were to:

- Enable and accelerate demonstration and early commercial deployment of conversion technologies that have the potential to enhance and improve the use of sub-bituminous coal at high altitudes, specifically in Wyoming.
- Generate and test new ideas for significant improvement and cost reductions in next-generation, low-emissions, and advanced conversion technologies.
- Support collaborative research and development (R&D) in accomplishing the above objectives.

The Account supported proposals addressing the following:

- Research and development of new or improved conversion technologies that reduce emissions
- Pilot-scale demonstration of emerging technologies
- Engineering scale-up of demonstrated technologies
- Integration and operation of carbon capture technologies

Chapter 57 of the Legislature of the State of Wyoming's 2009 General Session Law extended the sunset date for the Task Force from June 30, 2010 to June 30, 2013. Section 5(a) provided that the 2007 general fund appropriation of \$2.5 million into the Account would not revert, would be

interest bearing and could continue to be used for clean coal research for the duration of the program. Since 2007, four additional appropriations of funds, each with a reversion date, were made to the Account (Table 1). In the 2012 budget session, SF15/SEA3 revised the sunset date of the Task Force from June 30, 2013 to June 30, 2017 to ensure the Task Force would have oversight of the program one year after the June 30, 2016 Account reversion date.

Table 1: Funds Appropriated for Advanced Conversion Research

Appropriation	Amount	Reversion Date
2007 Appropriation	\$2,500,000	No reversion date
2008 Appropriation	\$3,800,000	June 30, 2012
2009 Appropriation	\$10,613,047	June 30, 2012
2010 Appropriation	\$14,000,000	June 30, 2014
2012 Appropriation	\$10,000,000	June 30, 2016
Total	\$40,913,047	---

Abandoned Mine Land (AML) Funds - Redirected

In the 2012 budget session, HB121/HEA25 provided for the submittal of grant applications by the Wyoming Department of Environmental Quality (DEQ) to the Federal Office of Surface Mining for future funds and redirection of prior Abandoned Mine Land (AML) fund authorizations. Redirected funds derived from several sources including the Account and the Wyoming Carbon Underground Storage Project (WYCUSP). A portion of these funds was appropriated to the UW School of Energy Resources (SER) to fund research projects under guidance of the Task Force (Table 2). The status of each of these programs is discussed in more detail below.

Table 2: AML Funded Efforts Assigned to the Task Force and SER

Program Name	Appropriation	End Date or Fund Reversion Date	Project Status
Advanced Conversion Technology Research - 2012	\$10,000,000	Reverted June 30, 2016	10 projects funded, all completed
Minerals to Value-Added Products Feasibility Study - 2012	\$500,000	Study end date, September 30, 2012, Reverted June 30, 2014	2 projects funded, both completed
Commercial-Scale Minerals to Value-Added Products Facility - 2012	\$9,000,000	Reverted June 30, 2016	No funding deployed, all funds reverted
Natural Resources to Manufacture Glass and Glass Products in Wyoming - 2012	\$100,000	Reverted June 30, 2014	All funds repurposed to rare earth element research
Rare Earth Elements (Assigned to SER) - 2015	\$316,764	Reverted June 30, 2016	3 projects funded, all completed

Advanced Conversion Technology Fund Research

All of the appropriations directed toward clean coal and advanced conversion technology research since 2007 were awarded to 52 different projects. Of the 52 projects originally funded, 46 were completed, 3 projects were terminated prior to completion and 3 projects failed to negotiate a contract. All projects were completed by June 30, 2016. The executive summaries for each of the funded and completed projects can be found on the SER website at: <http://www.uwyo.edu/ser/research/advanced-conversion-research/final-executive-summary-reports.html>. Because researchers seldom spend their budgets down to a zero balance and because a couple of projects were terminated early, all but \$331,439 of the \$41,526,133 appropriated to the Task Force was spent.

By legislation, the 2007 funds do not have a reversion date (Table 1). In addition, the 2007 funds were set up as an interest bearing account. The original 2007 appropriation of \$2.5 million accumulated interest when the account was set up; however, over time the rate of interest growth has slowed as the 2007 funds have been spent on research projects. Since 2007, this account accumulated \$613,066 in interest, a portion of which was deployed by the Task Force as supplemental funding to some clean coal projects. According to the State of Wyoming, Department of Administration and Information Accounting Office, the balance of interest on the 2007 account as of September 13, 2016 was \$285,000. At the August 19, 2016 meeting of the Task Force, they voted to return the unspent 2007 interest funds to the state of Wyoming. The overall budget for the Account from 2007-2016 is shown in Table 3.

Since completion of the advanced conversion research projects, SER staff conducted two surveys - one in August 2015 and one in August 2016 - asking for information on continued research and steps toward pilot or commercial scale-up of the technologies funded by the Task Force. The survey also asked the researchers to identify any barriers they have encountered to scaling up their technology.

The 2015 survey was sent to 25 researchers and the 2016 survey was sent to 21 researchers. Between 2015 and 2016, several of the researchers retired or changed jobs. The number of survey respondents in 2015 was 7 out of 25 and in 2016 the number of respondents was 9 out of 21. A couple of important outcomes of the survey were that 8 of 9 respondents in 2016 were continuing scale-up of their technology and 4 of them have reached pilot- or commercial-scale. One project is a 200 kW fluidized bed chemical looping combustion system for CO₂ capture that uses Wyoming Powder River Basin coal as one of its two target fuels. The system is the largest in North America and second largest in the world.

Table 3. Advanced Conversion Technology Account Balance

Appropriation	Amount
2007 Appropriation	\$2,500,000
2008 Appropriation	\$3,800,000
2009 Appropriation	\$10,613,047
2010 Appropriation	\$14,000,000
2012 Appropriation	\$10,000,000
Interest generated on 2007 Funds, 7/1/2007 – 6/30/2016	\$613,066
Subtotal	\$41,526,113
Funds Awarded <i>(includes use of interest funds)</i>	Amount
2007 Awards	(\$2,105,703)
2008 Awards	(\$2,661,573)
2009 & 2009a Awards <i>(From 2007 interest and 2008 and 2009 appropriations)</i>	(\$12,095,909)
2010 & 2011 Awards <i>(From 2010 appropriation)</i>	(\$13,055,026)
2012 Awards <i>(From 2010 and 2012 appropriations)</i>	(\$11,049,338)
Subtotal	(\$41,242,685)
Funds Returned to State	Amount
Unawarded research funds <i>(Appropriations – Awards)</i>	\$283,428
Unspent research funds	\$331,439
2007 Interest Funds Remaining*	\$285,000
Total Funds Returned to State	\$899,867

*Interest amount as of September 13, 2016 from State of Wyoming Department of Administration and Information.

Integrated Test Center

In the 2014 Wyoming legislative session budget bill, HEA41 Section 334(n) appropriated \$15 million to the Wyoming Governor’s Office for the design, construction, and operation of an integrated test center (ITC) to study the capture, sequestration and management of carbon emissions from a Wyoming coal fired power plant. The Governor’s Office then designated the Wyoming Infrastructure Authority as the managing entity of the ITC. In addition, HEA41, Sections 334(n)(ii), (n)(iii), (n)(v), (n)(x), (n)(xi), and (n)(xiii) charged the Task Force with several duties related to the ITC.

Below is a list of the ACTTF responsibilities for the ITC in the exact language taken from HEA41 Section 334(n) with the current status of each item shown in italics:

1. Section 334(n)(ii) – “The advanced conversion technologies task force created by W.S. 21-17-121 shall first receive a written commitment from one (1) or more willing and able partners to share equitably with the state of Wyoming in the operational expenses of the test center.” *(Completed - agreements for matching fund contributions in the amount of \$5 million from Tri-State Generation and Transmission Association and \$1 million from the National Rural Electric Cooperative have been executed.)*
2. Section 334(n)(iii) – “The advanced conversion technologies task force, with the assistance of the school of energy resources, shall establish a cooperative effort for the construction, management and operation of the facility between any institution, instrumentality or political subdivision of the state and any accepted partner in the test facility;” *(Completed - an agreement between WIA and the School of Energy Resources (SER)/Task Force to establish a cooperative effort was executed on September 4, 2015. Since the Task Force had a sunset date of June 30, 2017, SER will continue to work with WIA as needed.)*
3. Section 334(n)(v) – “The test center shall contain separate research facilities which are under the control of partners in the test center and their research tenants and research facilities which are under the control of the state of Wyoming and its research tenants. The governor, upon recommendation of the advanced conversion technologies task force, shall determine the necessary and adequate manner and size of the research facilities in the test center which are under the control of the state of Wyoming;” *(Completed - design is complete and construction is underway of the state of Wyoming research facility.)*
4. Section 334(n)(x) – “The governor may request a determination by the advanced conversion technologies task force that the construction of the test center has a reasonable likelihood of:
 - (A) Increasing the knowledge base within the state of Wyoming on the capture, sequestration and management of carbon emissions from coal fired power plants with the potential benefit of improving the future marketability of Wyoming carbon based energy sources;
 - (B) Increasing the national and international exposure of the state of Wyoming and its institutions, instrumentalities and political subdivisions as participants and locations for innovation in the use of energy;
 - (C) Adding ancillary or supplemental value to Wyoming products or by-products; or
 - (D) Inducing the development of methods or products which may advance the future use of Wyoming carbon based natural resources.” *(Completed - items A-D have been addressed and SER in particular is focusing on items C and D with funding from a separate legislative appropriation known as the Carbon Engineering Initiative.)*
5. Section 334(n)(xi) – “The governor may prohibit or suspend the expenditure of funds for the integrated test center if the advanced conversion technologies task force determines that construction of the test center will not result in the satisfaction of one (1) or more of the elements of paragraph (x) of this subsection;” *(The ACTTF has not made any such determination and the project is moving forward.)*

6. Section 334(n)(xiii) – “If the advanced conversion technologies task force receives more expressions of interest in partnering in the test center than can be reasonably accommodated, it shall recommend to the governor those applicants to accept as partners. The governor, in his sole discretion, shall award partnerships under this subsection. No determination by the governor under this subsection is appealable.” *(All expressions of interest in partnering in the ITC have been accommodated and the Task Force has no recommendation for the Governor regarding this item.)*

The Task Force has completed all of their statutory obligations for the ITC and the sunset date of June 30, 2017 for the Task Force has elapsed. Going forward, SER will respond to any requests of support or advice from the WIA for the ITC.

The ITC project continues to move forward. The ITC consists of five small test bays managed by the NRG-COSIA Carbon XPrize and a large test bay managed by WIA, all housed at the Basin Electric – Dry Fork Station in Gillette, WY. The ITC effort has \$15 million of financial support from the state of Wyoming, \$5 million from Tri-State Generation and Technology, and \$1 million from the National Rural Electric Cooperatives Association.

The ITC test bays are anticipated to be ready to host demonstration facilities in November of 2017. The ITC is one of the world’s larger scale CO₂ demonstration test facilities, capable of processing up to 25 MW equivalent of actual post-combustion flue gas per day. The XPrize is evaluating proposals to select the first occupants of their five test bays. The WIA is also seeking interest for occupancy of the large test bay. Occupants of the test bays will be expected to evaluate their technology for efficiency of CO₂ capture and to assess the economic and environmental performance of their systems at scale.