



Center for Gas Resource Development
(C-GaRD)
White Paper



May 2011

A Proposal to Develop the Center for Gas Resource Development (C-GaRD)

University of Pittsburgh is located in the center of the most intense gas development in the state. In addition, the University has had a long tradition of working with industry as a partner in regional development and continues to do so in the case of unconventional gas resource development. The **U.S. Department of Energy** recently selected the University of Pittsburgh as one of nine national partners, and the **only one in the Commonwealth of Pennsylvania**, to develop techniques for curtailing the possible environmental and health hazards associated with tapping the massive natural gas reserves lying beneath Pennsylvania and surrounding states. Professor Vidic, who is the Chair of the Department of Civil and Environmental Engineering, has also been very active in providing data driven, unbiased input to the public on issues of interest related to Marcellus Shale development. In recognition of his efforts, the **Pittsburgh Post-Gazette** recently named him as one of the **“Top 10 People Shaping the Debate”** on this issue.

In response to the challenges and opportunities associated with the Marcellus Shale and other unconventional sources of natural gas, the University of Pittsburgh Swanson School of Engineering proposes to establish the **Center for Gas Resource Development (C-GaRD)**.

Vision – To promote the utilization of unconventional natural gas resources in ways that simultaneously protect human health and the environment while promoting economic development in Pennsylvania.

Mission – C-GaRD will be an international leader in the research and development of new technologies for cost-effective gas resource development that is protective of human health and the environment.

Approach – Proposed C-GaRD approach to resolve the barriers to Marcellus Shale and other unconventional gas resource utilization is outlined below.

Holistic Management of Flowback Water

C-GaRD will develop cost-effective treatment option for disposal and/or re-use of flowback waters, with emphasis on high levels of Total Dissolved Solids (TDS), naturally occurring radioactive matter (NORM) and specific organics present in these waters. As part of this task, C-GaRD will establish state-of-the-art testing facility with associated requisite analytical laboratory at the University of Pittsburgh UPARC facility in Harmarville, PA. Capabilities will include different water treatment modules with detailed analysis and characterization of pre- and post-treatment water quality. The facility will be a unique resource where industry members of C-GaRD can bring water samples for analysis and evaluation of various treatment options. C-GaRD industry members involved in developing treatment technologies (filters, scrubbers, reactors, thermal treatment, etc.) will be able to utilize the facility to test their products using actual water from Marcellus Shale wells and other unconventional gas sites. Collected analytical data will support treatment technology development and will be disseminated to all industry members, regulatory agencies and the public. The C-GaRD will also focus on the development of innovative approaches for the use of impaired waters, particularly acid mine drainage (AMD), for hydraulic fracturing operations in an effort to reduce fresh water withdrawal for gas development and reduce adverse impacts from legacy environmental issues.

Produced Water Management

C-GaRD will develop cost-effective management option for disposal and/or re-use of produced water from Marcellus Shale and other unconventional gas plays. In addition to

developing and testing new treatment technologies, C-GaRD will evaluate the possibility of using low-grade heat that is readily available at thermoelectric power plants and compressor stations for combined treatment of produced water and different wastewater streams generated by associated industries (e.g., cooling tower blowdown, wet scrubber discharge, drilling fluids). The most promising technologies will be evaluated under relevant process conditions to establish parameters needed for pilot-scale testing and scale up to field demonstrations.

Health, Safety and Environmental Protection at Drilling Sites

C-GaRD will develop technologies and procedures that promote health, safety and environmental protection at drilling sites, including:

- Best management practices and associated risk management options for drilling for unconventional gas resources
- Concrete casings for shallow aquifer protection and long term protection of subsurface environment
- Monitoring devices and procedures for methane and other combustible gases encountered during drilling and well exploitation
- Best management practices for surface impoundments that are used to collect and store water during well development, including water blending, liner integrity testing, and control of biological activity
- Air quality assessment and associated best management practices at representative drilling sites

Transportation Issues

C-GaRD will develop technologies and procedures that mitigate impact to Commonwealth transportation system from heavy vehicle traffic associated with Marcellus Shale and other unconventional gas drilling and water management activities. C-GaRD will examine the current methods available under the motor vehicle code and the municipal planning code to support PennDOT system of permitting access for drilling sites (and other heavy vehicle users such as mining and logging trucks) to ensure that adequate funds are collected for future rehabilitation and prevent an unfunded future liability for PennDOT. In addition, best practices for road construction and repair will be analyzed and recommended to potential users.

Environmental Life Cycle Assessment

This C-GaRD project goal is to gather sufficient information to perform an LCA of natural gas from the Marcellus Shale. While it is generally agreed that natural gas burns with far fewer particulates and has a lower carbon intensity per BTU than coal or oil, overall climatic and energy costs are still uncertain, particularly related to methane leaks. In order to deal with both different practices and conditions specific to the Marcellus rather than other shales, such as the Barnett, data on production, transport, and water usage will be collected from companies operating in the Marcellus. Particular metrics that will be examined include global warming potential and net energy returned on investment.

Workforce Development

Strong growth in the global demand for energy is projected for the next half-century and beyond. This growth will provide great opportunities for Southwestern Pennsylvania (SWPA) companies that are leaders in the chain of industries that generate, transmit and distribute electric power. While great opportunities await these companies, they are all preparing for the impact of workforce and technology development neglect that was dominant in their industries in the 1980s and 1990s. Representatives of these industries have indicated that up to half of their engineering workforce will be eligible for retirement within the next decade. To address this engineering workforce gap, these companies have

solicited the University of Pittsburgh's Swanson School of Engineering to develop the following programs:

- Introduction of new undergraduate and graduate certificate programs in Electric Power Engineering, Mining Engineering, and Nuclear Engineering. These certificates require students to complete 4 to 5 courses specific to these fields at the undergraduate level, and also include extensive curriculum and courses at the graduate level.
- To provide the curriculum for these programs, the School has initiated the development and delivery of 31 new Power & Energy courses. These courses have enrolled over 1,000 students (cumulatively) since the program was initiated. At steady state we anticipate that the University will award between 50-100 certificates annually.
- Strong research components in all three of these engineering areas have also rapidly developed, with advanced work in future directions of energy supply, delivery, and end-use; including areas such as Smart Grids, renewable and green energy integration, energy efficiency, energy storage, advanced energy materials, and other emerging areas.

In all cases, the education programs were developed with significant input and participation from our industrial partners. Indeed, most of the new courses will be taught by industry experts serving as Adjunct Professors within the Swanson School of Engineering, and many of the new courses are being offered through state-of-the-art distance learning techniques, allowing more opportunities for greater diversity in overall student participation. The research components also involve strong industry collaborations.

The Swanson School of Engineering is prepared to develop similar certificate programs in Unconventional Gas Resource Development through C-GaRD.

Public Outreach & Economic Development

C-GaRD will increase public awareness of unconventional gas resource potential and environmental issues that can be resolved through careful planning and meticulous execution of all phases in the development of these resources. The C-GaRD outreach program will include the following components:

- Monthly newsletter/email blast covering unconventional gas issues and recent accomplishments at C-GaRD
- Annual report summarizing C-GaRD accomplishments
- Annual C-GaRD Open House and tours for the public
- Short courses on technical topics of interest to industry members

C-GaRD will support Pennsylvania economic development by advancing the safe use of unconventional gas resources. This will support economic development and job creation in Pennsylvania in a number of ways, including:

- Jobs associated with expanded drilling activities
- Plentiful natural gas resources available for Pennsylvania companies (and for those companies considering a move to Pennsylvania) and for export outside of the Commonwealth.
- Development of new technologies and start-up companies focused on water treatment that can be deployed in other tight shale gas formations around the world