

# ARIES: A PROGRESS REVIEW

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THE VIRGINIA CENTER FOR COAL AND ENERGY RESEARCH  
AT VIRGINIA TECH



# THE APPALACHIAN RESEARCH INITIATIVE FOR ENVIRONMENTAL SCIENCE | ARIES

- Scholarly work and other public forums have strongly suggested that energy production - including coal mining, unconventional gas fracking and production, and electricity generation- has negative impacts on the health, social and economic fabric and the natural environment of communities
- Recent accidents involving coal preparation chemicals and coal combustion residuals have heightened public concerns
- Expansion of unconventional gas production and use of proprietary chemicals also causes community concerns
- Recognizing that **energy production (coal, gas and electricity) does have significant upstream (i.e., permitting, operating) and downstream (utilization) impacts**, the VCCER Board approved an initiative to develop an **independent research** program that lead to the ARIES concept.
- Funded as an industrial affiliates program, ARIES is a **+\$10million** effort over 5 years

What does the science really show?



# ARIES BACKGROUND

- Mining, gas and energy sectors in Appalachia have been facing growing pressure to reduce their impacts on the environment and communities from regulators and the public
- There has been a dearth of published science addressing the upstream (mining, drilling and processing) and downstream (water, land, and air) environmental impacts of these industry sectors
- The energy resources of Appalachia are critical to the economies of the Appalachian states, as well as other states that rely on Appalachian energy



# WHAT IS ARIES?

- A consortium of major research universities to address the environmental and community impacts of the discovery, development, production and use of energy resources in Appalachia
- Supported by industrial affiliates committed to the need for good science to ensure the long-term health of the environment and communities and the dissemination of the results for the benefit of all stakeholders
- Research conducted by a spectrum of world-class researchers whose work has been sponsored by federal and state agencies, environmental and community organizations and industry



# ORIGINAL STATED GOALS OF ARIES

- Conduct scientific inquiry and research
- Foster publication and contribute to the relevant literature
- Engage in outreach efforts to share and disseminate research results

Initial focus has been on coal mining, but scope is expanding



# ORIGINAL RESEARCH AREAS UNDER ARIES

- Area 1: Assessment of Mining Impacts on Ecosystem Health and Diversity
- Area 2: Treatment and Minimization of Constituent Discharges
- Area 3: Accurate Prediction of Constituent Releases by Overburden and Refuse
- Area 4: Overburden Handling Plans and Fill Designs
- Area 5: Next-generation Design of Eco-friendly Mining Systems
- Area 6: Evaluating and Optimizing the Impacts of Mining on Community Well-being



# ORIGINAL ARIES RESEARCH QUESTIONS

- AREA 1: Aquatic Impacts
  - What are the impacts of coal mining water and aquatic organisms?
- AREA 2: Treatment Technologies
  - What are the current and innovative technologies to treat water impacted by coal mining?



# ARIES RESEARCH QUESTIONS (CONT.)

- AREA 3: Water Impact Prediction
  - How can we predict where coal mining operations may impact water?
- AREA 4: Materials Handling Techniques
  - Are there ways to handle coal mining materials and water flow to prevent water impacts?



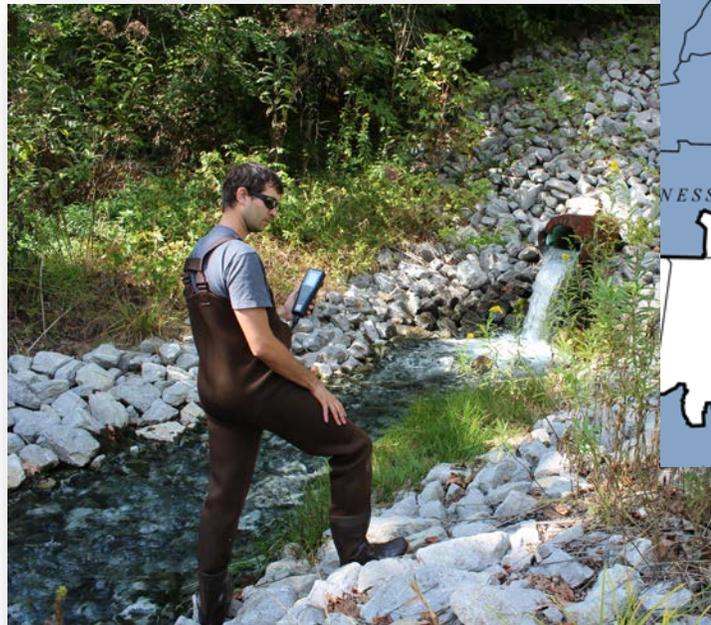
## ARIES RESEARCH QUESTIONS (CONCL.)

- AREA 5: Next generation mining systems
  - How can surface and underground coal mining and coal processing be done to improve environmental performance?
- AREA 6: Community Health and Well-being
  - What are the positive and negative contributions of coal mining to community well-being?
  - What are the benefits and impacts of coal mining on society and communities in Appalachia?
  - What can all interested parties - industry, government and communities - do to ensure that coal mining contributes to sustainable development?



# ARIES | RESEARCH STRATEGY BASED ON SD APPROACHES

- A research strategy was chartered and approved for 2011 to 2016
- ARIES is an *open door* initiative; companies and universities are encouraged to join
- Broad ARIES Research Areas
  - Environmental Management
    - Water Impacts
    - Waste Management
  - Zero-Impact Energy Production
  - Community Development
    - Economic
    - Social
    - Health



# ARIES | COLLABORATORS & SPONSORS

## Universities

- Virginia Tech (lead)
- West Virginia University
- University of Kentucky
- Ohio State University
- Pennsylvania State University
- University of Pittsburgh
- Marshall University
- Edward Via College of Osteopathic Medicine
- Consultants in Epidemiology & Occupational Health LLC
  - (Georgetown, Johns Hopkins)



## Industry

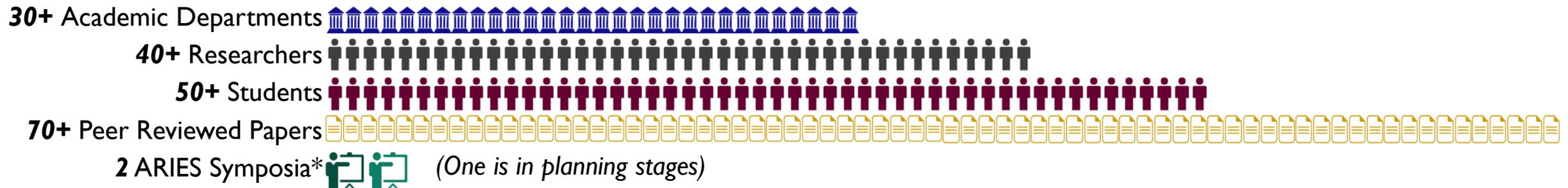
- Alpha Natural Resources
- Arch Coal
- Natural Resource Partners
- TECO Coal Corporation
- Patriot Coal Corporation
- Cliffs Natural Resources
- Norfolk Southern Corp.
- CSX Corporation



# THE ARIES MODEL

- Funded by industry managed and implemented by academic institutions
- Answers basic questions about cause and effect
- Allows for development of best practices and innovation
- Reduces environmental costs and promotes addressing key issues
- Removes regulatory conflicts by creating new focus on real problems and science
- Informs the public discussion and creates opportunity for **social license**

## ARIES by the numbers...



## KEY RESULTS FROM ARIES

- ARIES has already produced meaningful results and over 70 peer-reviewed publications in less than three years
- Program of research managed for efficiencies
- Coal mining focus for early years being expanded to utility, unconventional gas issues
- ARIES has assembled an elite cadre of researchers in various disciplines at a number of institutions which can be expanded as needed to address research questions



# REMINDER ABOUT “ENVIRONMENTAL CONSIDERATIONS IN ENERGY PRODUCTION” SYMPOSIUM

- Symposium Held in Charleston, WV, April 14-18, 2013
- Nearly 230 attendees
- Fourteen technical sessions with 70 presentations
- Over 45 peer-reviewed papers in proceedings volume published by SME



# FOLLOW UP TO APRIL 2013 SYMPOSIUM

- Planning beginning for similar meeting in 2015 (to be held in Pittsburgh, PA, September 19-22, 2015) which will also have peer-reviewed proceedings volume published by SME
- ARIES is co-sponsoring ASMR meeting in Lexington, KY in June 2015 and other opportunities to share results of research work
- New research opportunities
  - Opportunities in expanded field of research (e.g., birth defects, health studies)
  - New connections to other ongoing work created
  - New research areas can be explored (e.g., environmental issues in gas production)



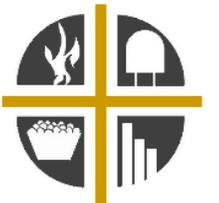
# ARIES UPDATE

- Third Year of research ended June 30, 2014
- Fourth Year research is focused on previous success
  - Focus on key issues and plans for Year 5 research
  - Reflects completion of some work
  - Reflects budget cuts
- Different Emphasis
  - Expansion of health and community impacts research
  - Focus on new concerns in mining and energy development



## ARIES UPDATE (2)

- ARIES Website with new information [www.energy.vt.edu/ARIES](http://www.energy.vt.edu/ARIES)
- CURRENT ARIES EMPHASIS AREAS
  - Emphasis Area A: Stream Protection and Restoration
  - Emphasis Area B: Materials characterization and handling
  - Emphasis Area C: Water impacts of UG coal mining
  - Emphasis Area D: Community and health impacts



# CURRENT ARIES ACTIVITIES

- Pursuing new funding and research opportunities including new areas of work
- New connections to other ongoing work at VT and other universities are being created
- ARIES next steps
  - Directing continued research and publications for remainder of project
  - Looking for opportunities for continued outreach on ARIES and results
  - Seeking continued and expanded support for Year 5 (and beyond?)
    - Resources are the key to results



## RECENT ARIES DEVELOPMENTS

- ARIES graduate student researcher Eric Merriam at WVU received a “Science to Achieve Results” fellowship from EPA based in part on ARIES research
- ARIES research on economic effects of coal mining in Appalachia conducted by OSU cited in an article in the Washington Post
- ARIES-sponsored health research being published in leading medical journals and presented at high-level medical conferences (*Birth Defects Research Part A, Journal of Occupational and Environmental Medicine, American College of Epidemiology meeting, International ENTIS/OTIS Teratology Conference*)
- Other ARIES research continuing to mature and to be published and considered by peer-reviewed journals (*Journal of the American Water Resources Association; Geochemistry: Exploration, Environment, Analysis; International Journal of Coal Science & Mining Engineering*)



## WHAT IS SPECIAL ABOUT ARIES?

- ARIES is multi-disciplinary, multi-university, multi-priority
- ARIES is independent, researcher led peer-reviewed science
- ARIES was created with private resources, and is built on cooperation and communication
- ARIES has developed a network of top-notch researchers to address the spectrum of issues
- ARIES includes the capability to address new problems quickly drawing on our established network



# CONTACT INFORMATION

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