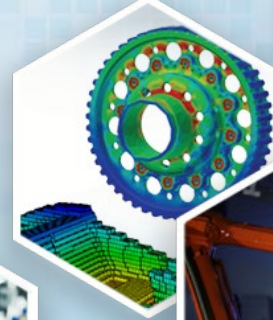


Manufacturing Valuable Coal-Derived Products in Southern Appalachia

PI: Charles Sims, University of Tennessee

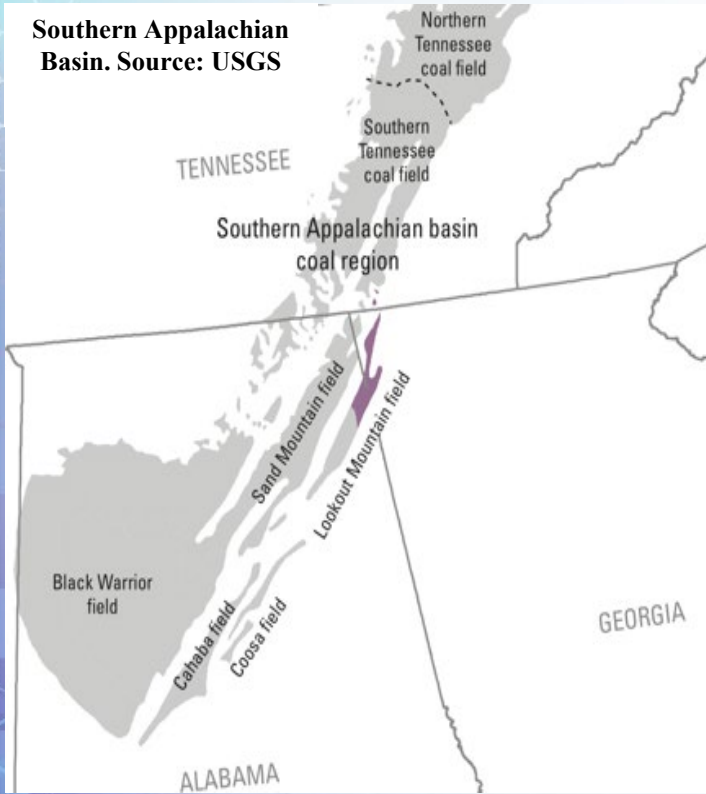
November 1, 2021



Convene. Connect. Catalyze.

Project mission and objectives

Southern Appalachian Basin. Source: USGS

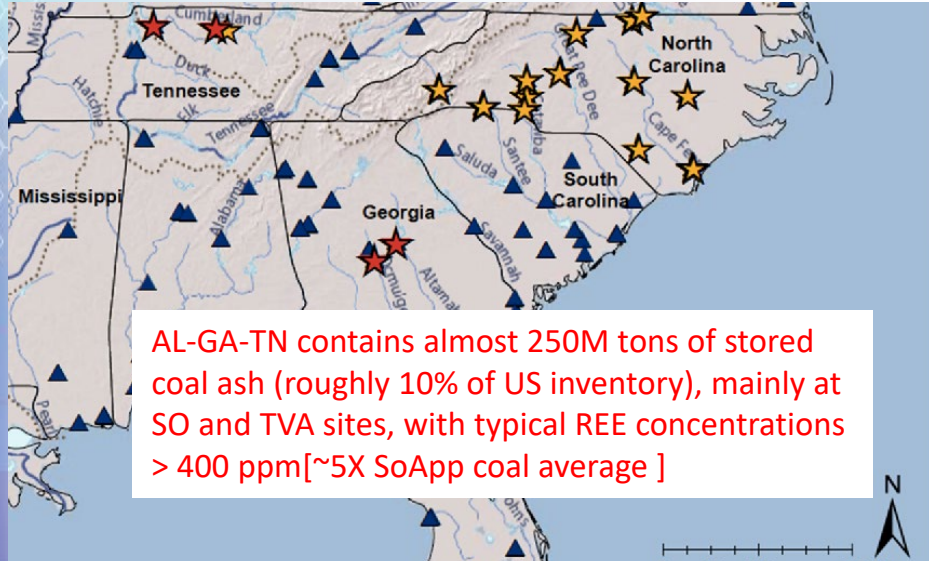


Mission

1. Revitalizing distressed Southern Appalachian coal communities
2. Reducing reliance on foreign imports of REE and CM

Objective: Develop and deploy new technologies for manufacturing rare earth elements (REE), critical minerals (CM), and valuable non-fuel, carbon-based products (CBP) from coal and/or coal waste in the Southern App Basin

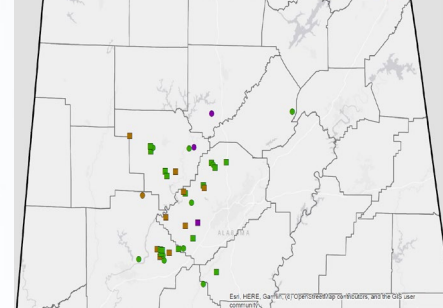
Key locations reflecting our unique resource base



AL-GA-TN contains almost 250M tons of stored coal ash (roughly 10% of US inventory), mainly at SO and TVA sites, with typical REE concentrations > 400 ppm [~5X SoApp coal average]

REE data will be obtained for 420 ash/CCP samples (30 distributed samples per pond) collected from 14 different ash ponds

Coal surface and underground mines, coal preparation plants

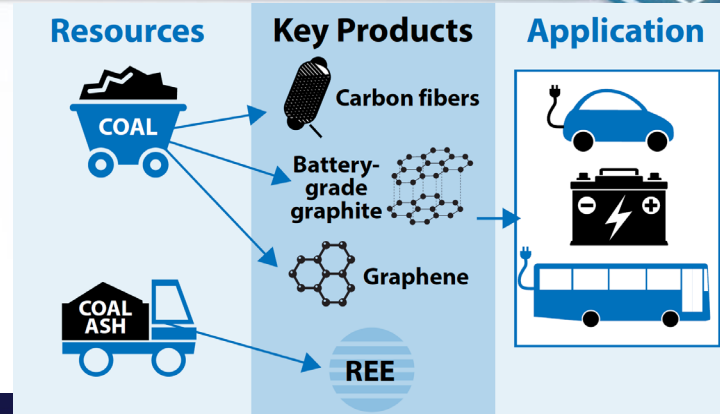


Other potential sources

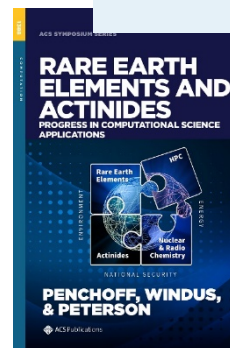
- Coal mine refuse piles (low-quality coals and shale interbeds) will be assessed for REE-CM and CBP potential
- Acid mine drainage (AMD) wastes
- Co-produced water from coal-bed methane wells
- Coal de-watering projects
- Coal prep plant waste
- Coal mine tailings (typically shales and clays)

3 key features of our CORE-CM program

- ◆ **Incomparable REE innovation ecosystem** with massive coal ash inventory (~ 10% of US coal ash is in AL-GA-TN typically containing > 400 ppm REE);
- ◆ **Unique manufacturing R&D capabilities** in carbon fibers, 3D printing, batteries, and graphite
- ◆ **Novel separations expertise**
 - ◆ HPC modeling of REE separations
 - ◆ Biological processing (ORNL, UT)
 - ◆ Electromagnetic processing (ORNL)
 - ◆ Thermochemical (Nth Cycle, American Renewable Metals)



Text on HPC modeling of REE separations, edited by a team member



Bicycle parts made with hi-modulus pitch carbon fiber



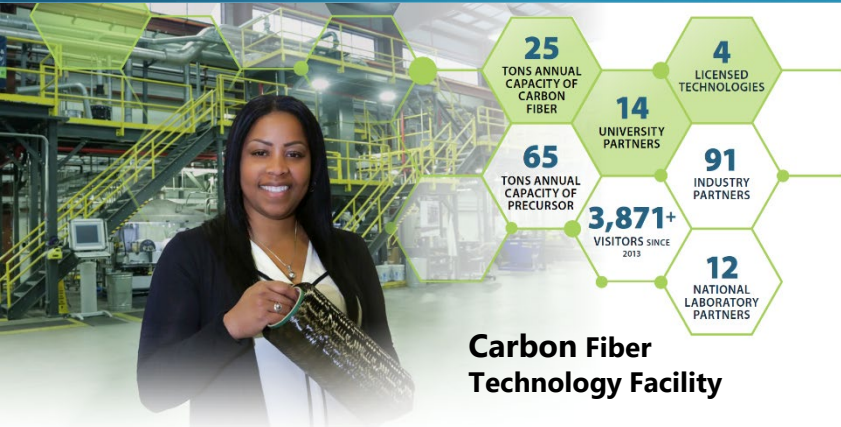
Spallation Neutron Source



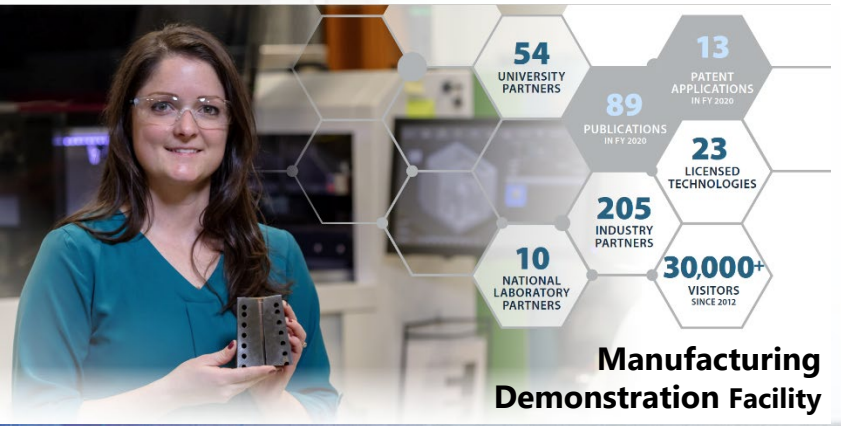
Oak Ridge Leadership Computing Facility



Technology Innovation Center



Carbon Fiber Technology Facility



Manufacturing Demonstration Facility

- ◆ Follows and leverages IACMI's distributed innovation network "affiliate" model
- ◆ Composites: > 200k sq ft of uniquely equipped facilities in 6 states valued > \$300M
- ◆ CORE-CM: Facilities identified at ORNL, Southern Company, UAB, UTK; more potential



Ash Beneficial Use Facility

A diverse and experienced team



IACMI (Applicant – Managed by Collaborative Composites Solutions Corporation)
Geological Survey of Alabama (GSA)
Oak Ridge National Laboratory (ORNL)
Roane State Community College (RSCC)
Southern Company (SO)
Tennessee Geological Survey (TGS)
University of Alabama-Birmingham (UAB)
University of Alabama-Tuscaloosa (UA)
University of Tennessee-Knoxville (UTK)

	Prime Recipient: John Hopkins, CEO IACMI		Principal Investigator: Charles Sims Baker Center for Public Policy University of Tennessee
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Task 1: Project Management
Erin Brophy, IACMI
Heather Castleberry, IACMI
Catherine Ross, IACMI

Task 2: Resource Assessment
Rona J. Donahoe, UA
Marcella McIntyre-Redden, GSA
Barry W. Miller, TGS
Riley Flowers, SO

Task 3: Waste Stream Reuse
Riley Flowers, SO
Eric Pierce, ORNL
Manoj Mahapatra, UAB

Task 4: Strategies for Infrastructure, Industries and Business
Charles Sims, UTK
Matthew Murray, UTK
Randall Jackson, EconAlyze
Deborah Penchoff, UTK
Jill Welch, UTK
John Hopkins, IACMI

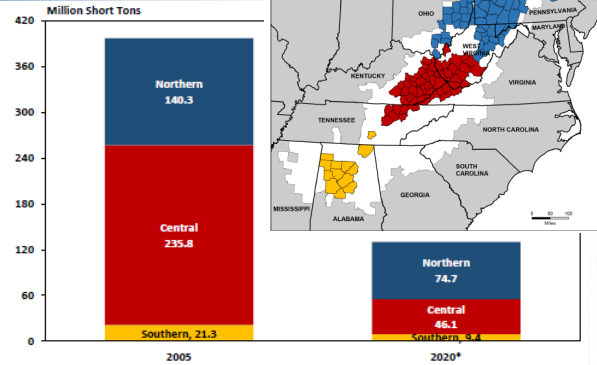
Task 5: Technology Assessment
Edgar Lara-Curzio, ORNL
Art Ragauskas, ORNL
Cliff Eberle, IACMI
Deborah Penchoff, UTK
M. Parans Paranthaman, ORNL
Manoj K. Mahapatra, UAB
Brian Pillay, UAB
Uday Vaidya, UTK

Task 6: Technology Innovation Center
John Hopkins, IACMI
Cliff Eberle, IACMI
Riley Flowers, SO
Charles Sims, UTK
Rona J. Donahoe, UA
Edgar Lara-Curzio, ORNL
Uday Vaidya, UTK
Brian Pillay, UAB

Task 7: Stakeholder Outreach and Education
Joannie Harmon, IACMI
Mark Morrison, IACMI
Kim Harris, RSCC
Teresa Duncan, RSCC
Nikki Luke, UTK

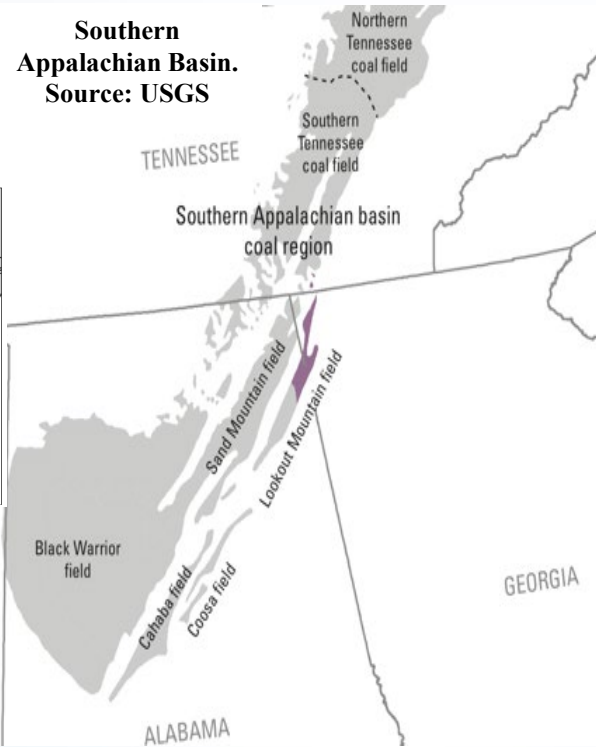
Why is this important to the region?

Coal production in the Southern Appalachian Basin has fallen nearly 70% over the last decade leading to job losses

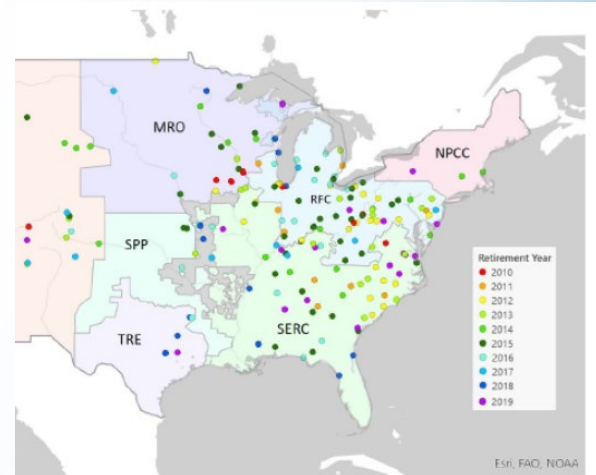


Source: U.S. Mine Safety and Health Administration
Note: * = 2020 production is estimated based on the annualized growth rate of the total production in the first 3 quarters of 2020. Appalachian coal-producing regions include only Appalachian coal-mining counties, defined as those that, based on MSHA data, have non-zero coal production or more than 10 coal-mining jobs in any year between 2005 and 2020.

Source: Bowen et al. 2020



Decline in coal production driven by shift away from coal-fired electricity generation that is not expected to reverse



Coal-Fired Generator Retirements 2010-2020

Source: Davis, Holladay, and Sims. 2020

Automotive manufacturing: a regional economic powerhouse

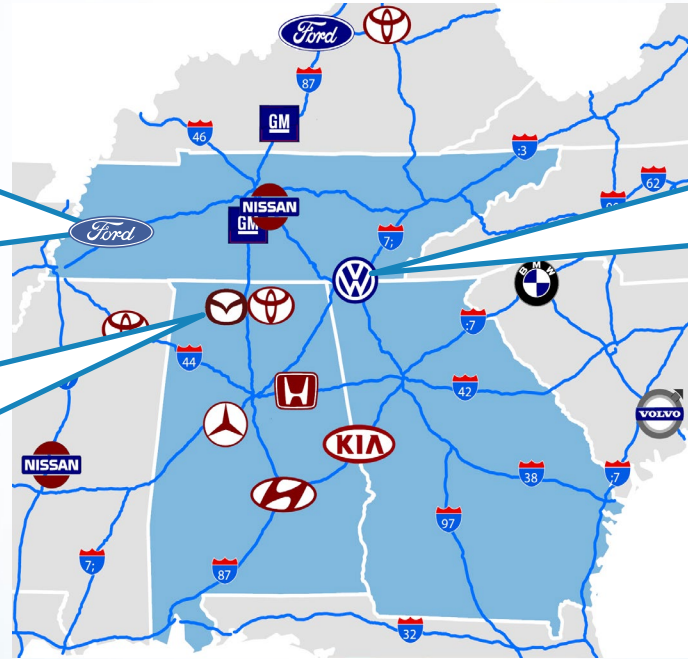


8 major assembly plants with 4 producing electric vehicles

2021: Ford announces new \$5.7B investment in electric vehicle and battery manufacturing plant in West TN

2019: Volkswagen breaks ground on plant expansion to produce and test electric vehicles

2021: Mazda Toyota joint venture in Huntsville, AL begins production



SE US auto assembly plants

Stakeholder Outreach and Education



IACMI will lead stakeholder outreach efforts with planned conversations and meeting, public events and workshops and various forms of media (website updates, press releases, social media posts, etc.) in the basinal areas with:



Local communities



State & local governments



Business & industry partners



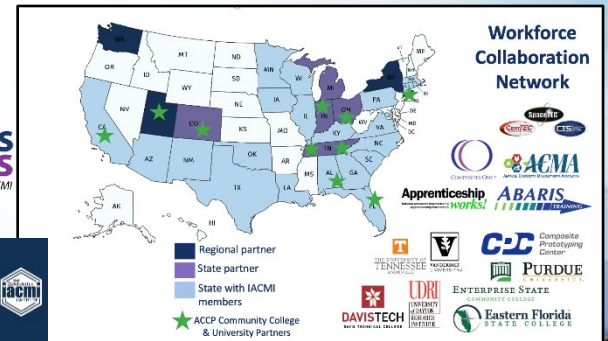
Econ. Dev. groups & Non-profits

Education Programs

- Advanced Composites Career Pathways Program (ACCP) for technician training
- SkillCrafters STEM program
- ACE CNC Machining Tool program AR/VR integration
- Online learning modules



Outreach



Challenges and Opportunities



Fostering a supply chain that doesn't currently exist

- Data exists to characterize upstream (coal, ash) and downstream (REE, CM) supply chain linkages
- Traditional approaches can't characterize critical midstream CORE-CM supply chain linkages as these industries do not yet exist.

Assessing impacts of coal mining and coal waste streams in underserved communities

Step 1: Potentially impacted communities will be identified and impacts on legacy environmental impacts of CORE-CM activities in the SoApp will be assessed

Step 2: Surveys and interviews with member of underserved communities impacts by coal mining and coal waste streams in Alabama and Tennessee.

Utilize existing contacts within social justice organizations in TN and AL to identify members of underserved communities in and around current and legacy coal mining communities and communities impacted by coal waste streams

**Thank you for
attending!!
Questions?**

cbsims@utk.edu

www.iacmi.org

