

**Small Town, Big Ideas: Advanced Technologies and Rural Development in
Appalachia**

The University of Tennessee

**Dr. Greg Reed
Associate Vice Chancellor for Research
UT Knoxville Office of Research
1534 White Ave.
Knoxville, TN 37996-1529
Phone: (865) 974-3466
Fax: (865) 974-7400
Email: research@utk.edu February**

1, 2013 – June 30, 2014

May 21, 2014

**Dr. Tim Ezzell
Research Scientist
Howard H. Baker Center for Public Policy
University of Tennessee
Suite 311, UT Conference Center
Knoxville, TN 37996-4134
865-974-9036
tezzell@utk.edu**

Final Report Narrative

Title of Project: Small Town, Big Ideas: Advanced Technologies and Rural Development in Appalachia

Grant Period: February 1, 2013 – June 30, 2014

Grantee Name: The University of Tennessee, Knoxville

Project Director: Dr. Tim Ezzell

Description of Project:

Students from the ATP Class, POLS 410/554 evaluated the potential for three significant emerging technologies in rural communities. Using Ducktown, Tennessee as a case study, students explored applications for electric vehicles, 3D printing, and contour crafting in Appalachian areas.

Activities:

Students in the class conducted the following activities:

- Students conducted research on the emerging technologies and developed recommendations and implementation strategies for the Ducktown community.
- Students surveyed local stakeholders to gauge their awareness of and enthusiasm for the project technologies.
- On October 29th, 2013 students met with local officials and stakeholders, including faculty and staff from Copper Basin High School at the school's Learning Center in Ducktown Tennessee, to develop project recommendations and discuss project findings. Facilitated discussions led to the idea of obtaining a 3D printing workstation for the Learning Center facility.
- Students organized and conducted a campus forum on November 12, 2013 to discuss the future of Appalachia at the Baker Center for Public Policy on the UT Knoxville campus. Students presented their project findings before forum participants. The forum also included a panel discussion with ARC Co-Chair Earl Gohl, ETDD Director Terry Brobrowski, and Dr. Mary English, a distinguished UT researcher. Forum activities were attended by students and faculty from several departments and were supported by the UT MPPA program. Tennessee's ARC Program Manager also took part in the day's activities.

- Students identified potential funding agencies to implement recommendations and developed a funding strategy for the community.
- Students participated in the ATP conference in Washington, DC (Arlington) on December 6th and 7th, 2013 and presented their findings.
- Students developed a project poster and displayed it at the December ATP meeting.

Please note that the original project proposal also called for a possible examination of solar projects in the community. The students found, after assessing recent solar progress in Ducktown, that this topic had already been adequately addressed.

Project Outcomes:

Students shared recommendations with local community members and discussed implementation plans with local officials.

Students helped raise the profile of Ducktown with ARC leadership and key state officials.

In February 2014 students worked with area stakeholders to develop a funding request for a 3D printer with the local United Way. The effort was unsuccessful, but did lead to additional discussions about funding strategies.

Problems Encountered:

The unusually harsh winter led to unforeseen difficulties. First, students found themselves stranded in Washington after the ATYP meeting due to flight cancellations. Thankfully, ARC arranged for accommodations for the students, who made it back to Knoxville the following day. The University of Tennessee is very grateful for ARC's thoughtful and gracious assistance.

Weather issues also hampered efforts to conduct an additional presentation in the Copper Basin, as cancellations and road conditions made scheduling an additional planned event very difficult.

Program Continuation and Sustainability:

Dr. Ezzell is considering a crowdfunding project for his 2014 ATP class to assess the potential of civic crowdfunding for rural communities and to raise funds for the proposed 3D printer. Dr. Ezzell has held discussions with neighbor.ly, a leading civic crowdfunding site, who have agreed to partner on this project and support this effort.

Dr. Ezzell has also held discussions with staff from the UT Provost's office to consider the Copper Basin and other parts of Polk County for inclusion in the University's new Sustainable Communities Initiative Project. If approved, the UT SCI project would assign ten or more UT classes to work in the community over the course of an academic year.

Conclusions and Recommendations:

The class found that there is considerable enthusiasm for the technologies discussed in the project, but that awareness of these trends needed to be increased.

Student research also found considerable potential for 3D printing technologies in rural areas. Small-scale advanced manufacturing could thrive in these communities, but schools need to better prepare students to work with these technologies.

While 3D printing will likely create important opportunities and benefits, it could also threaten existing craft and fine arts industries. More research is needed on the copyright implications of low-cost 3D printing.

Contour crafting is still a developing technology, but it has the potential to radically revolutionize the affordable housing industry. It has the potential of providing homes that are more durable, more efficient, and safer than existing low-cost housing at comparable or lower costs. As such, the technology could reap significant benefits, but could also cause short-term economic disruptions. As such, additional research is needed on rural contour crafting. The class believes that Ducktown would make an ideal representative case study for a potential research project.

Attachments (in PDF format):

Project materials and photos are attached on the following pages.

POLS 410/554
Special Topics - Sustainable Communities
Fall 2013
T 9:40-12:25
HBC 205

Dr. Tim Ezzell

Office: Suite 311 UT Conference Center
Office Hours: 10:00-12:00 MWF or by appointment
Office Phone: 974-9036
Email: tezzell@utk.edu

Course Description and Purpose

This course provides both classroom instruction and real-world experience in the design and implementation of asset-based sustainable development strategies in existing communities. Course students gain understanding and experience in the following areas:

- Identification of local resources (natural, cultural, built, and human)
- Creation of local asset inventories
- Understanding of conventional development strategies and their impacts
- Public participation and community engagement
- Development of strategic alternatives for policy or project development
- Development of implementation and funding strategies
- Understanding the strengths and limitations of local governments and other agencies

The course is largely project-based and students work together to help resolve a real-world community sustainability issue. The project is usually based in an East Tennessee community or centered on an important regional issue. The project theme or community is selected using an established network of community contacts and awareness of current needs and issues. Students work closely with local officials and stakeholders to identify local opportunities or areas of concern and develop a sustainable project ideas or policy solutions. Students will combine classroom instruction, individual research projects, and team tasks to develop and present final project findings and recommendations.

2012 Class Project

Ducktown Tennessee, population 427, is a small city located in the Copper Basin in Southeast Tennessee. The community lies within an ARC designated distressed area in Polk County, a county classified as “At Risk” by the agency. Like all Copper Basin communities, Ducktown carries a legacy of environmental devastation and remediation. It is also a town in the midst of economic change as it transitions from an extractive resource based economy to one focused on tourism and small business development.

Despite its small size and rural nature, Ducktown has, in recent years, garnered a reputation as an innovative and progressive community. The community has developed one of the most ambitious municipal solar programs in Tennessee and has assumed a leadership role in the state's rural development community. For this reason, it is an ideal location to assess the potential

impact of new and emerging technologies on rural communities.

The 2013-2014 University of Tennessee ATP project will examine the potential economic impact and social consequences of new and emerging technologies on small rural communities. Using Ducktown as a case study, the class will examine policies and development strategies based on several new technologies, including the following:

- Renewable energy - Ducktown's experience working with solar technologies make it a strong candidate for renewable energy development. Students will examine strategies to leverage solar investments and grow local renewable energy opportunities.
- Alternative fuel vehicles - Students will investigate the impact of EV adoption on rural communities and examine the potential for fuel-cell vehicles and other alternative fuel technologies in small Appalachian towns.
- 3D printing - Many researchers view 3D printing as the "next" industrial revolution, with the potential to allow for small-scale manufacturing in remote and rural areas. Students will assess the potential for 3D printing technologies by evaluating possible applications in Ducktown.

As part of the assessment process, students will examine a wide range of issues and policy topics, including workforce development, infrastructure, local perceptions, and local capacity.

Appalachian Teaching Project

This course is part of a larger regional effort, the Appalachian Teaching Project (ATP). The ATP is sponsored by the Appalachian Regional Commission (ARC) - a Federal Agency. UT is one of a dozen Appalachian colleges and universities participating in the ATP. As part of the course, select students will travel to Washington D.C. and present their project findings before the leadership and staff of the ARC. ARC provides \$4,000 to support this travel and course activities. UT has participated in the ATP every year since it was established in 2000. The ATP experience has proven invaluable for students and has provided much-needed professional level services for participating communities.

This year's ATP meeting will be December 6th -7th and will be held at the Crystal City Marriott in Pentagon City, just minutes via subway from downtown Washington. The ARC grant will pay for all student transportation and lodging costs. ATP activities normally take place on Friday and Saturday mornings and students are free to enjoy DC sites and activities in the afternoons and evenings.

While the ATP is not a competition, UT teams have historically performed well. My expectation is that our class will have the best project, best poster, and best presentation at the conference.

Course Deliverables

Per our agreement with ARC, the class must fulfill the following requirements:

- A team of students will travel to Washington and present at the ATP meeting.
- The class will prepare a poster, describing our project, to display at the Washington

- meeting.
- We will present our class project at a conference or before a local community organization.

In the past, students have also presented course outcomes at academic or professional conferences. Students have also included their ATP work in their professional portfolios or graduate school applications.

University/College/Departmental Curricular Requirements Met

The class meets the general requirements of the BA and MPPA programs and serves as a breadth course for Bredesen Scholars and other special campus programs.

Program Level Learning Objectives That the Course Supports

This course will support the following learning objectives:

- Students will develop the ability to use appropriate analytical tools to investigate and make judgments about data and research issues, problems, or questions.
- Students will develop an understanding of the issues and challenges in evaluating programs that inform decisions about research designs to investigate issues.
- Students will develop an accurate understanding of the political, legal, and economic aspects of government and the public policy process.
- Students will develop the ability to apply best management practices to address issues and problems.

Required Textbook(s) and/or Course Packets

There is no text for this class, but you will be assigned readings. Your first assignment, for example, will be to read and summarize a research report from the Appalachian Regional Commission and ARC’s Strategic Plan.

Required Instructional Technology

The class requires no special technology aside from a personal computer or laptop. Students working on the poster or display materials will have free access to a large format printer.

Student Assessment and Evaluation Methods

Student grades are based on assignments given during the semester, their level of participation, and the quality of their project work. All work must be done by the assigned deadlines. Students are expected to contribute to team assignments. Students will have both individual and workgroup assignments.

Grades will be determined as follows:

ARC research memo	5%
Community profile presentation (group assignment)	10%
Local assets and opportunities memo	5%
Case study memo	5%
Workgroup alternatives presentation (group assignment)	10%

ARC technology memo	5%
Workgroup recommendation report (group assignment)	15%
Final report materials	15%
Participation	30%

Attendance and Participation

Participation in class and in class activities will contribute to the participation grade. Lack of attendance in class will count against credit for class participation. Students must also positively contribute to their group work. Late memo assignments will automatically be downgraded one grade, with further downgrading possible depending on the circumstances.

Grading scale

A	93 - 100%
A-	90 - 92%
B+	87 - 89%
B	83 - 86%
B-	80 - 82%
C+	77 - 79%
C	73 - 76%
C-	70 - 72%
D+	67 - 69%
D	63 - 66%
D-	60 - 62%
F	Less than 60%

Course Calendar

Date	Topic	Project Task	Assignment Due
August 27	Class Introduction Introduction to Appalachia		

Sept. 3	Defining “Sustainable Community”; Rural barriers and opportunities	Create project identity; Establish project timetable	ARC research memo (1-2 pages)
Sept. 10	Emerging technologies ARC energy and tech strategies Preliminary site visit	Define research areas and workgroup tasks	Community profile presentations
Sept. 17	Finding case studies and best practices, conduct policy research Report from site visit team	Discuss local workshop format, Identify local stakeholders	Local technology memos (1-2 pages)
Sept. 24	Discuss case studies and best practices	Discuss local workshop	Local workshop planning assignments
Oct. 1	Develop project and policy alternatives Develop evaluation criteria	Local workshop updates	Case study memo (1-2 pages)
Oct. 8	Evaluate alternatives Select project and policy recommendations	Local workshop updates, assign workshop tasks	Workgroup alternatives presentation
Oct. 15	Final recommendation updates Implementation strategies	Discuss and review research progress and workshop preparations	ARC technology memo (1-2 pages)
Oct. 22	Final recommendation reports	Review draft workshop materials	Workgroup recommendation reports (4-6 pages)
Oct. 29	Public Participation Local Workshop Dry Run	Make final workshop preparations	Final local workshop presentation and materials
Nov. 5	Community workshop -		

	Ducktown		
Nov. 12	Review workshop outcomes	Design project poster, outline DC presentation	Memo on community workshop
Nov. 19	No Class - Thanksgiving		
Nov. 26	Review draft ATP Materials		Draft ATP materials
Dec 3	Dry Run - ATP presentation		Final DC Presentation, poster and handouts
December 6-7	ATP Conference, Washington D.C.		Final report materials due

Outside of Class Activities

The nature of this class requires that students will have to participate in some activities outside of the classroom. We will have three of these events during the course of the semester. In early September we will conduct a site visit to Ducktown. This is tentatively scheduled for the week of the 10th. In early November, we will conduct a local workshop or presentation for a community group in Ducktown. Lastly, we will be participating in the ATP conference in Washington on December 6th-7th.

It is understood that not everyone will be able to participate in all of these activities. I expect, however, that everyone in class contribute to these efforts. I will make every attempt to schedule our events at convenient times. Please keep in mind, though, that we will be respectful of our local partner's time and schedule.

Due to budget constraints, participation in the Washington meeting is limited. I will make every effort to take everyone who wants to attend, but reserve the right to select the UT ATP representatives and the final presentation team.

Academic Integrity

All rules concerning academic honesty as set out in the current edition of Hilltopics will be enforced. Particular attention should be paid to the section on plagiarism. Students are reminded of their obligation to abide by the UTK Honor Code: "An essential feature of the University of Tennessee, Knoxville is a commitment to maintaining an atmosphere of intellectual integrity and academic honesty. As a student of the university, I pledge that I will neither knowingly give nor receive any inappropriate assistance in academic work, thus affirming my own personal commitment to honor and integrity."

Disabilities that Constrain Learning

Any student who feels he or she may need an accommodation based on the impact of a disability

should contact the Office of Disability Services (ODS) at 865-974-6087 in 2227 Dunford Hall to document their eligibility for services. ODS will work with students and faculty to coordinate reasonable accommodations for students with documented disabilities.

The Student's Role in Improving Teaching and Learning through Course Assessment

At UT, it is our collective responsibility to improve the state of teaching and learning. During the semester, you may be requested to assess aspects of this course either during class or at the completion of the class. You are encouraged to respond to these various forms of assessment as a means of continuing to improve the quality of the UT learning experience.

University Civility Statement

Civility is genuine respect and regard for others: politeness, consideration, tact, good manners, graciousness, cordiality, affability, amiability and courteousness. Civility enhances academic freedom and integrity, and is a prerequisite to the free exchange of ideas and knowledge in the learning community. Our community consists of students, faculty, staff, alumni, and campus visitors. Community members affect each other's well-being and have a shared interest in creating and sustaining an environment where all community members and their points of view are valued and respected. Affirming the value of each member of the university community, the campus asks that all its members adhere to the principles of civility and community adopted by the campus: <http://civility.utk.edu/>.

Small Town, Big Ideas

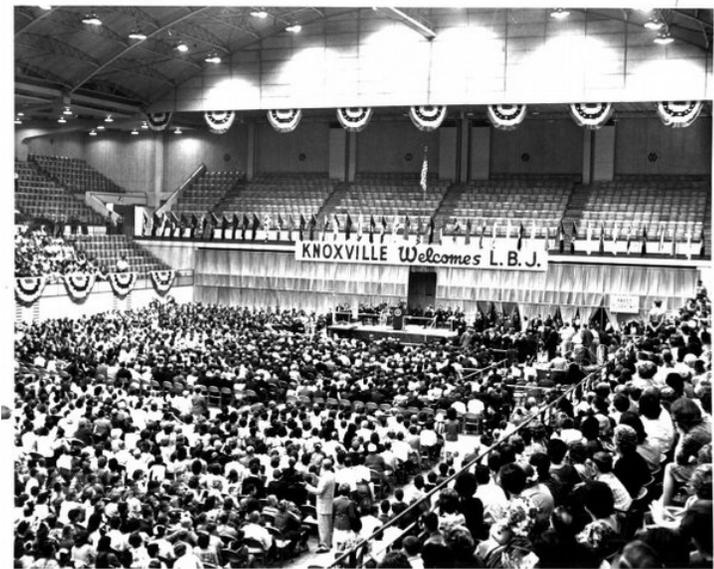
Advanced Technologies and Rural
Development in Appalachia

May 7, 1964



May 7, 1964

“help us do those things which need doing for the benefit of those who need help, to make sure that in this abundant land no child goes unfed; to make sure that in this abundant land no youngster goes unschooled; to make sure that in this abundant land no sick baby goes unattended; to make sure that there are jobs for those who want them, and sustenance for those in need”



Our Project Theme

- This year we are looking at the ways two important emerging technologies could impact rural Appalachian communities
- *Electric Vehicles (EVs) – Will EVs, with their limitations, improve rural areas or lead to new problems?*
- *3D Printing – Will rural communities benefit from the predicted 3D printing revolution? What opportunities will this create?*

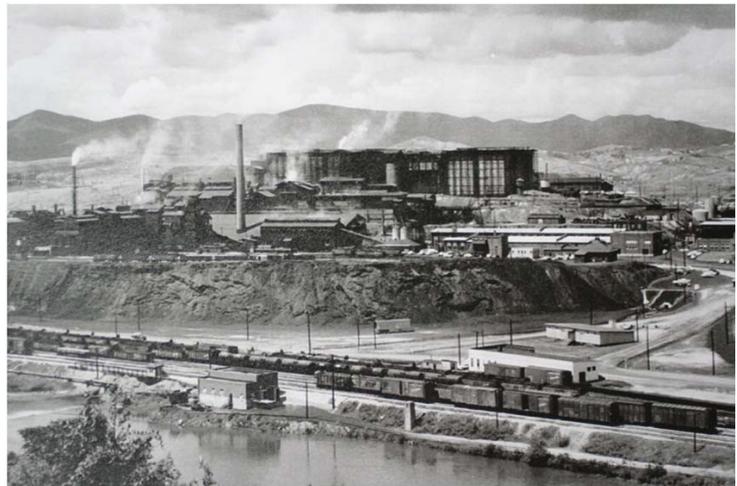
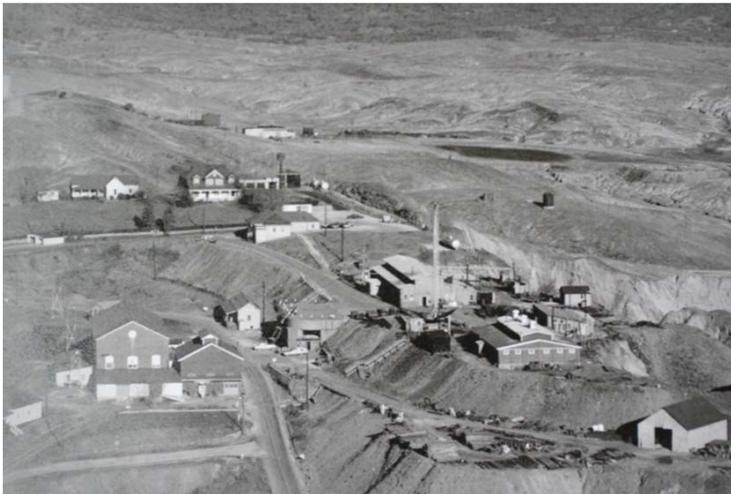
Our Case Study Community

- This semester we are working with the town of Ducktown (pop. 427), located in Polk County, TN
- Ducktown is the smallest of three communities in the historic Copper Basin
- Ducktown has a long history of mining, industrial production, and environmental devastation and remediation
- Close to site of 1996 Olympic whitewater competition on Ocoee River
- A progressive community and a leader in rural solar adoption
- Located along proposed Corridor K route, an ARC highway

Ducktown History

- Once home to one of the nation's largest copper mining operations.
- Mining began in 1850 and continued until 1987.
- Smelting process released sulfur dioxide, killing vegetation for approximately 30 square miles around the area.
- Massive sulfuric acid plant built in early 20th century to recapture and use residual sulfur.
- Operations ceased in the late 1980s and plant is largely disassembled.
- Decades of remediation – 16 million acid resistant trees planted in the area.

Historic Copper Basin



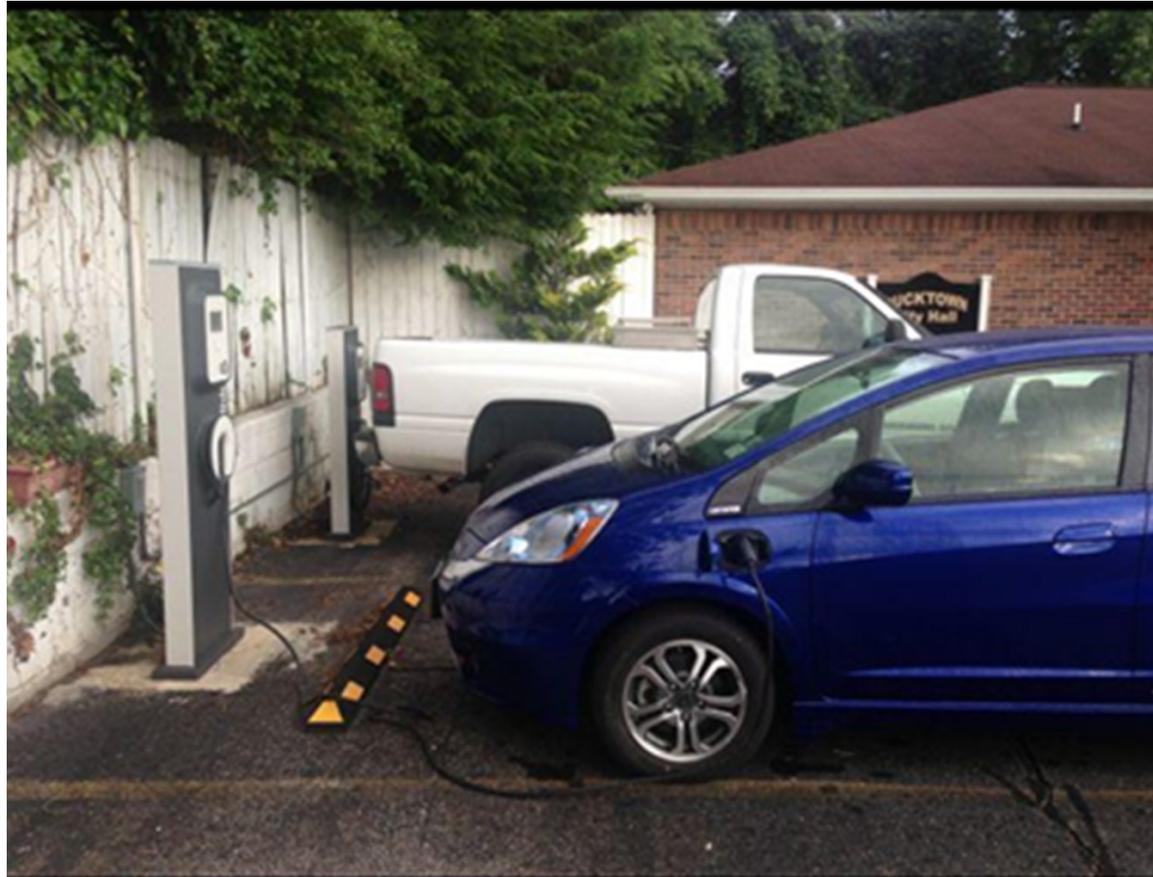
Copper Basin Today



Class Activities

- We have assessed technological implications of 3D printing and electric vehicles
- Focused on 3 topic areas – Electric Vehicles, 3D Printing, and Contour Crafting
- We surveyed local stakeholders to gauge local perceptions and levels of awareness
- We identified barriers to local adoption of these technologies
- We have met with local officials and with local educators to discuss our ideas
- We are working on strategies and ideas to help promote tech adoption in Ducktown and other rural communities

Rural EV adoption



Research Questions around EVs

- What economic and social consequences, and to what degree, would the introduction of EV's have on the local community?
- What opportunities exist for the East Tennessee Clean Fuels Coalition (ETCFC) to raise awareness on the EV cost, maintenance, financial incentives and longevity? Would ETCFC organize a demonstration at the school?
- What is the level of EV interest and potential ownership within the community? Who would want an EV? Would the city government benefit from an EV? Are there any untapped funding sources for EV market penetration?

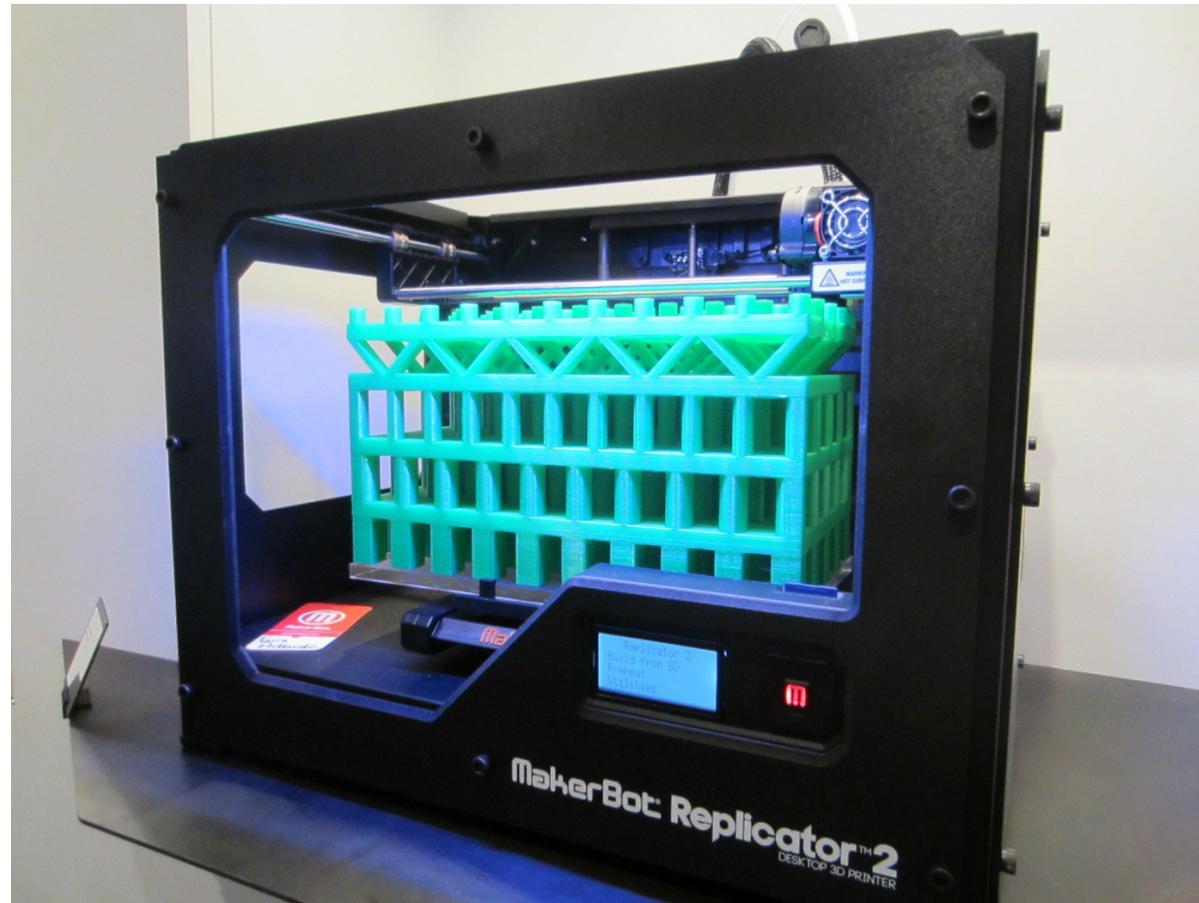
Community Research around EVs

- Two existing charging stations see little use
- Stations have potential to attract visitors to revitalized downtown, especially after downtown improvements and corridor K construction
- Survey showed interest in EVs, but 70% were concerned about current EV cost, and 30% were concerned about the limited range for travel
- Respondents expressed interest in adding an additional charging station at the Piggly Wiggly

Focus on Developing

- With EV advantages and disadvantages in mind, the group suggests the following project focuses for the class to develop:
 - Market Analysis of EV adoption in small isolated communities (including range anxiety and societal pressures of perception, as well as practicality in a non-urban lifestyle.
 - Charging at home and on the road: a study of specific locations for charging stations that could reach the largest target populations.
 - Tourism and EV's: a study of impact to the local market for catering to a visiting population and potential economic stimulation from time-intensive charging stop-overs.

3D Printing



3D Printing

- Survey finds that residents are aware of 3D printing – most know “some” or very little”
- They believe it will become a very important technology, but are not sure how it might impact their community
- Local youth and the local workforce appear to be unprepared for the anticipated 3D printing revolution

Copper Basin High School

- 7-12 Grades
- 349 students
- 72% eligible for free or reduced lunch
- 99% White
- No technology classes
- Learning Center



3D Printing and High School STEM Enhancement

“Teachers are currently preparing students for jobs that don’t yet exist.”

- Bring emergent technology into classroom
- Incorporate STEM into all classes
- Training for jobs after high school
- Introduction to technology for future engineers
- Practical skills for a changing world
- Creativity and art skills

3D Printer Options

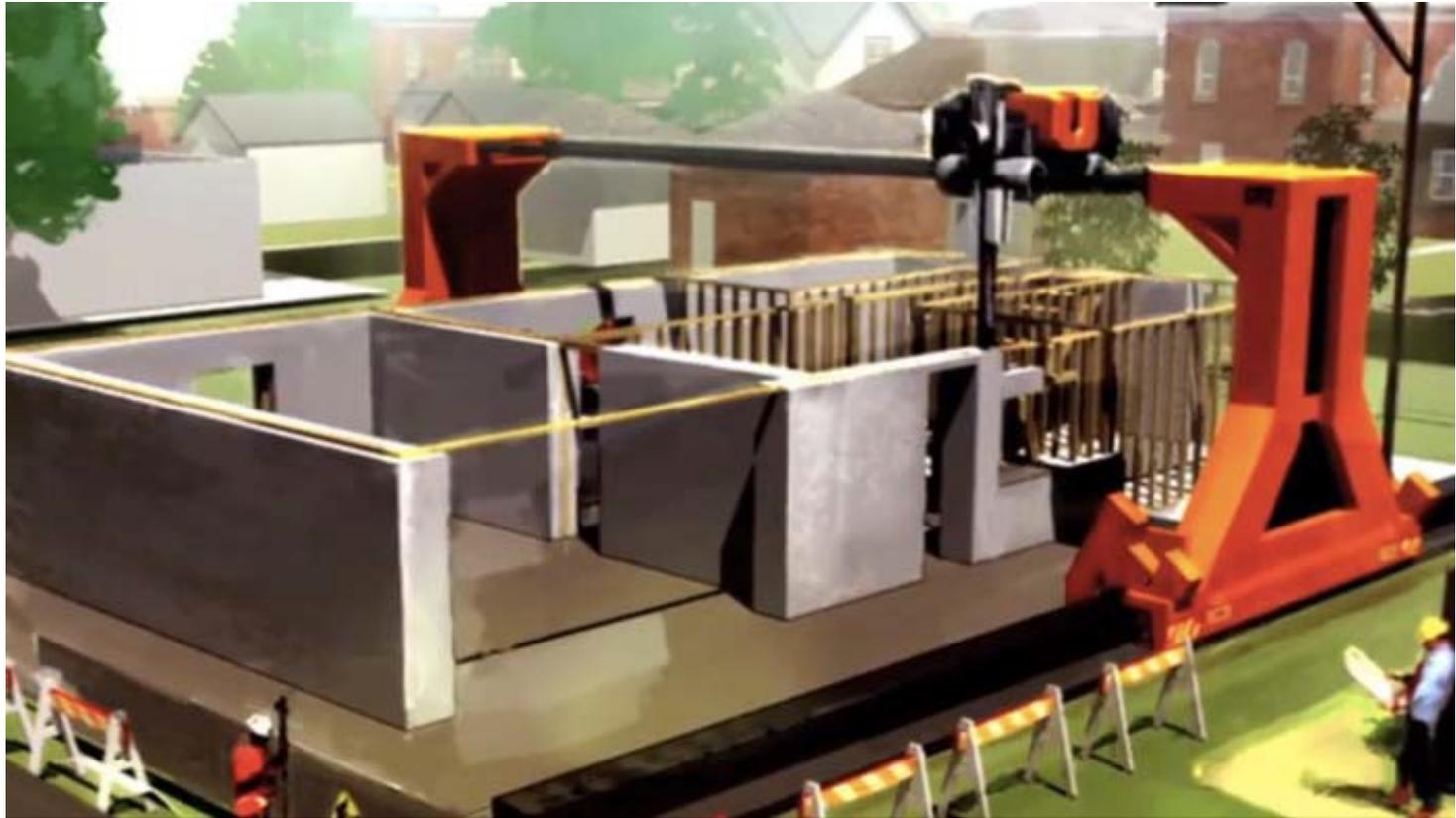
	Option A	Option B	Option C	Option D
Printer Hardware	\$499	\$799	\$1299	\$2208 +350
Parts/Materials	~\$150	\$86+	\$100	\$96
Computer	\$380	\$380	\$450	\$450
Printing Software	Free	Free	Free	Free
3D Software	Free	\$150	\$150	(license)
Total	\$1029	\$1565	\$1999	\$3104+

Grant Options

- Dollar General Foundation Grant
- Appalachian Community Fund (teacher training)
- Appalachian Regional Commission
- Perkins Reserve Fund Grant (CTE)



Contour Crafting



Contour Crafted Housing

- Contour crafting is an emerging technology to 3D print entire homes
- Structures are “printed” with large on-site printers using fast-drying cement
- Pipes, conduit and other home systems are printed into the walls
- Homes are well insulated, tornado resistant, and affordable
- Home shell can be printed in less than 24 hours with little waste
- Cost same or less than manufactured home, but are durable and should retain value
- Potential as a disruptive technology – could displace existing workforce

Ducktown Applicability

- Community dominated by old company housing
- Median age of homes is 49 years, compared to national average of 36 years
- Many are below code, and have been exposed to high levels of acid rain and other pollution
- Median income well below national and state averages, with 33.4% of population below national poverty line and unemployment rate significantly above national and state averages
- Ducktown has proven commitment to being a green, forward thinking community

Jurisdictional Barriers

- Building codes and zoning regulations could be a major barrier to 3D printed homes
- Ducktown is currently in the early stages of managing local residential code enforcement. This would pose as a good opportunity to incorporate and define 3D construction and develop a case study for other cities
- The State of Tennessee's Residential code makes no mention of 3D constructed homes. Collaboration between Ducktown and the State of Tennessee could be the example across ARC communities and the nation

Recommendations

- Partner with the city of Ducktown and contour crafting experts to develop a strategy for constructing new homes in the Ducktown area
- Based on the progress of Ducktown partnerships, prepare a case study reflecting the challenges, Opportunities, successes, and impact made to the community

Potential Agency Partners

- USDA
 - Rural Development Grant Assistance
 - Rural Community Development Initiative
- Department of Housing and Urban Development
 - Capacity Building for Sustainable Communities
 - Community Development and Affordable Housing
 - Choice Neighborhood Implementation Program
 - Choice Neighborhood Planning Grant
- Department of Energy
 - Energy Efficiency and Conservation Block Grant (EECBG) Program
- FEMA
- ARC

Small Town, Big Ideas



Advanced Technologies and Rural
Development in Appalachia

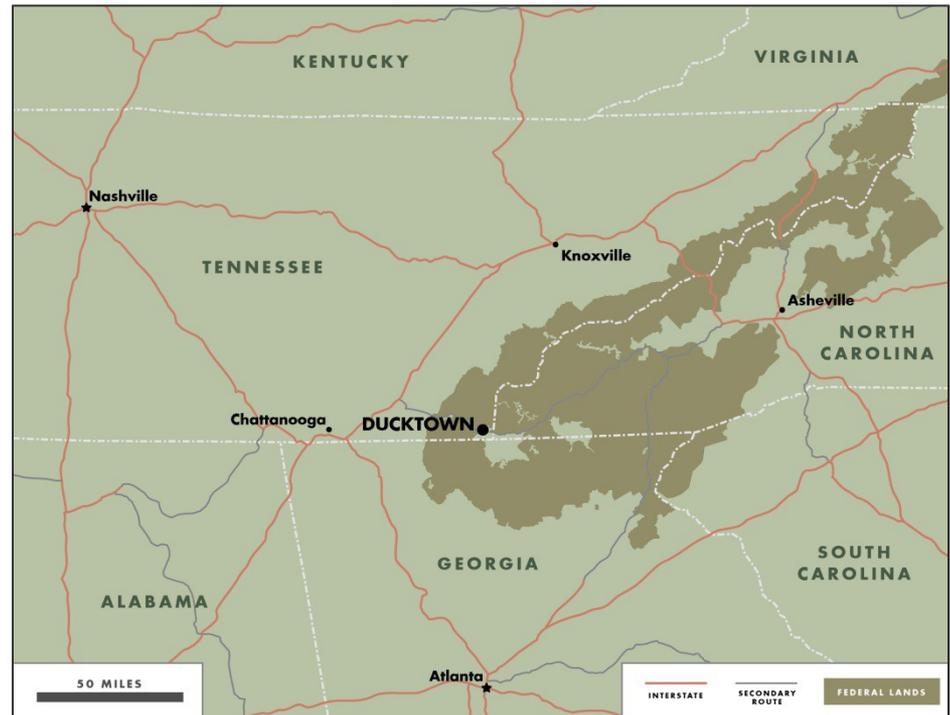
Our Project Theme

- How will emerging technologies impact rural Appalachian communities?
 - *Electric Vehicles (EVs)*
 - *3D Printing*
 - *Contour Crafting*



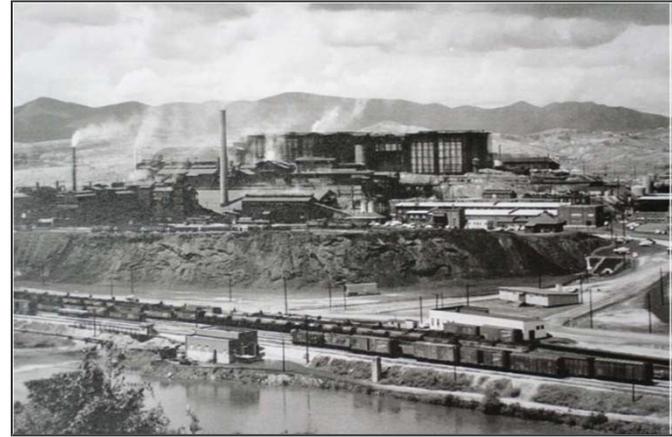
Ducktown, TN

- Population 427
- Southeast corner of Tennessee in Polk County
- One of 3 historic Copper Basin communities
- Located along proposed ARC Corridor K route



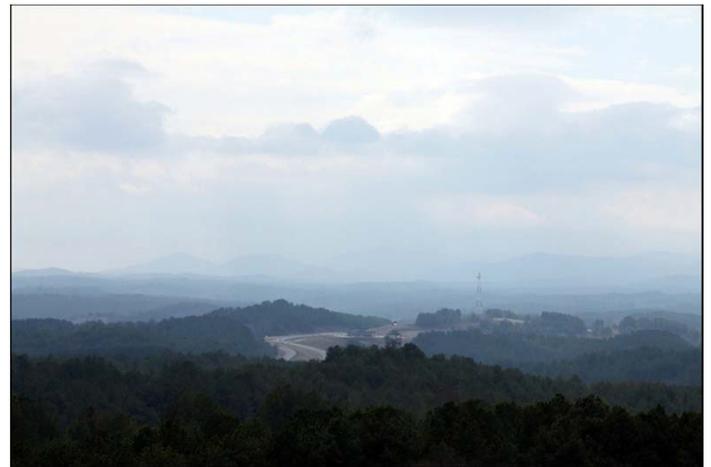
Ducktown History

- Once a major center for copper and sulfuric acid production
- Copper mines operated for more than a century
- Pollution from mine and plants killed surrounding vegetation
- Decades of remediation – 16 million acid resistant trees planted in the area.



Ducktown Today

- Popular destination for whitewater enthusiasts
- Leader in rural solar adoption – city generates 60% of its own power
- Community vision – “to become the greenest small town in America.”



Community Involvement

- Survey
- Site visit
- Meeting with Mayor
- Meeting with school officials
- Meetings and panel discussion with ARC and state officials at UT



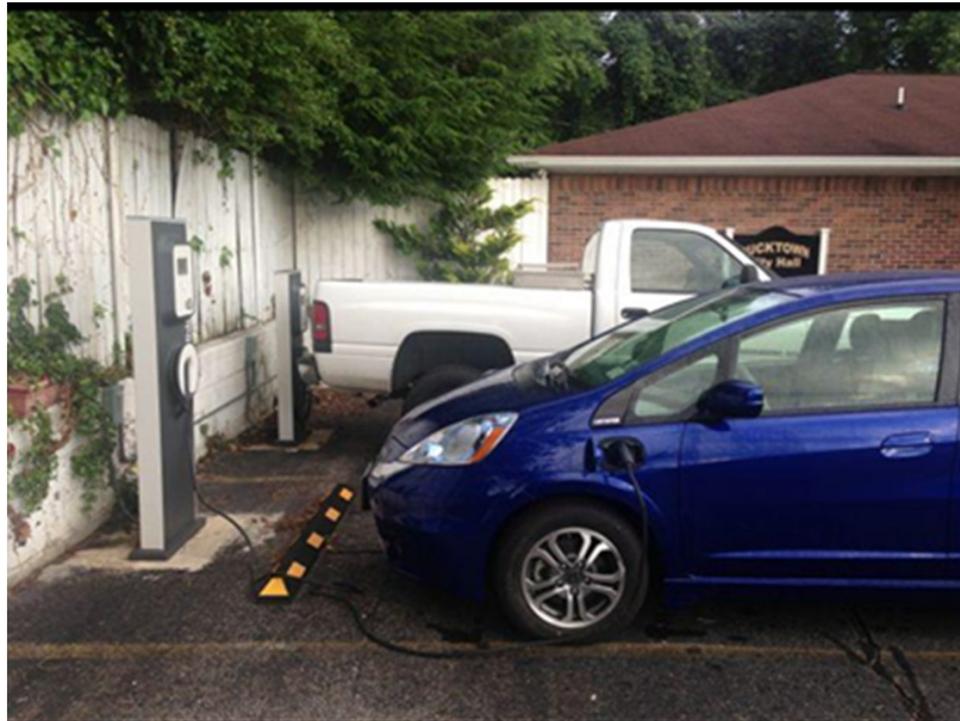
Survey

- Internet survey sent to local educators, officials, and business owners
- Designed to gauge awareness of EV's and 3D printing technologies
- Found that residents were excited about new technologies, but were uncertain about their potential impacts



Research Questions around EVs

- Economic and social consequences
- Opportunities
- Interest and potential ownership



Ducktown and EVs

- Four existing charging stations
- Underutilized, but have potential to attract visitors
- Concerns
 - Cost
 - Travel Range
- Charging station at the Piggly Wiggly



EV Recommendations

- Partnerships to increase awareness
- Charging locations
- Tourism and EV's



3D Printing



Copper Basin High School

- 7-12 Grades
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- 72% eligible for free or reduced lunch
- No technology classes
- Learning Center



High School STEM Enhancement

“Teachers are currently preparing students for jobs that don’t yet exist.”

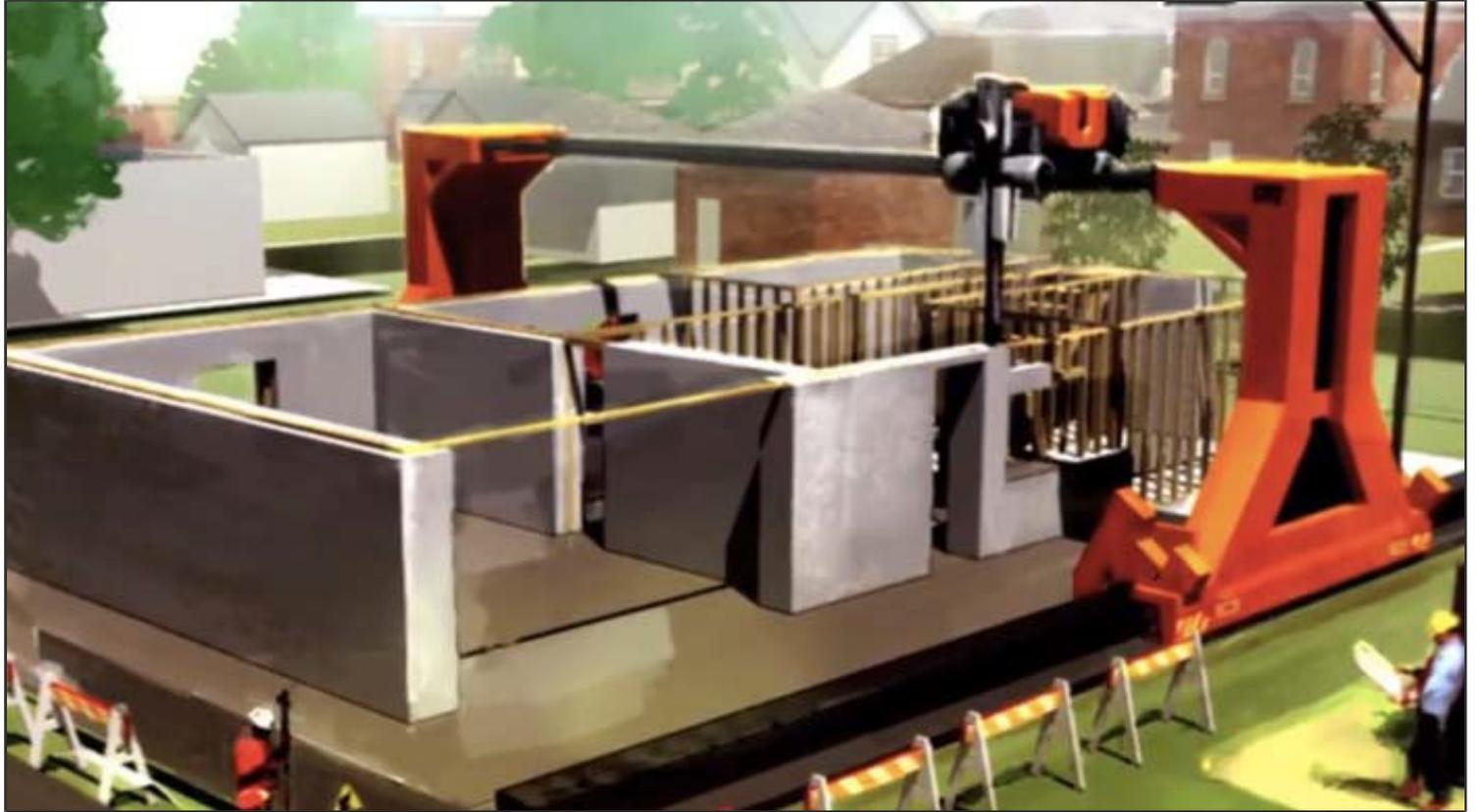
- Bring emergent technology into classroom
- Incorporate STEM into all classes
- Practical skill training for jobs
- Introduction to emergent technology
- Creativity and art skills

3D Printing Recommendations

- Identify funding sources to purchase a 3D printer for the high school
- Conduct teacher training sessions with the University of Tennessee at Chattanooga
- Utilize existing curriculum to incorporate 3D printing into classroom activities



Contour Crafting



Ducktown

Suitability

- Old company housing
 - Below code
 - Pollution exposure
- Low income
- High unemployment

Barriers

- Building and zoning codes
- Still in development
- Perception of job loss

CC Recommendations

- ARC should develop a partnership with HUD, USDA, FEMA and other agencies to determine rural applications for contour crafting
- Agencies should also take steps to adapt the workforce for new types of construction jobs
- Ducktown is an ideal case study community to test affordable contour crafted homes

Visions

- Leverage current EV infrastructure to support green tourism
- Build capacity for the high school to enhance STEM education through 3D printing technology
- Work with agency partners to investigate contour crafting possibilities for Ducktown

Thank You

- Thanks to the ARC for sponsoring the ATP and to ETSU for coordinating ATP activities
- Special thanks to Mr. Earl Gohl for visiting the University of Tennessee campus

The 2013 UT ATP Team

Amanda Brank

Amanda Kaeser

Jay Lauderback

Andrew Morelock

Catherine Olsen

Susanna Sutherland

Elizabeth Guyol-Meinrath

Kristine Kennedy

Tevin Manuel

Liz Norred

Madeline Shelly

Grant Williams

