The Appalachia Partnership Initiative’s Investments in Education, Workforce Development, and the Community

Analysis of the First Stage, 2014–2016

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The tristate Appalachia region of southwestern Pennsylvania, northern West Virginia, and eastern Ohio is anticipated to face shortages of workers with science, technology, engineering, and math (STEM) skills for the energy and advanced manufacturing industries over the coming decade. In 2014, the Appalachia Partnership Initiative (API) launched in order to invest in K–12 STEM education and workforce development programs and initiatives that could help address these shortages by improving skills and opportunities for the region’s population.

This report assesses the API’s progress toward its vision, covering the first years of the API: October 2014 through July 2016. Interim assessments will be conducted annually from 2016 to 2019. A final summative evaluation, forthcoming in 2020, will analyze the effect of API efforts through time and report on short-term outcomes.

Key findings

- The Appalachia Partnership Initiative (API) sponsored K–12 STEM education programs that incorporated hands-on and project-based instructional models that aimed to improve skills acquisition. API K–12 science, technology, engineering, and mathematics (STEM) education programs served 11 percent of the region’s 680,000 school-age children.
- Workforce programs engaged with industry leaders to support employability of participants, but few focused specifically on transitioning workers.
- The API programs were heavily represented in Pennsylvania and West Virginia, but lightly represented in Ohio.
- Supportive government, industry, and education partners were key to sustainability.
- Programs with varied funding sources viewed themselves as more financially sustainable.
- There is a vibrant tristate regional STEM-supportive ecosystem. The API served as a key partner in this system and started to engage in policy advocacy.
- Universities served as key resources for API programs, and many funders contributed to the API programs, but their efforts were not coordinated.
- The API can further its vision for the region through ongoing efforts to broaden regional awareness of STEM career opportunities, strengthening STEM teacher training and development, and facilitating collaboration across networks.
- To support the longer-term financial sustainability of API programs, the API could further leverage existing networks of STEM education and workforce development funders; these networks offer opportunities to engage long-lasting sources of support within the region.
1. THE NEED FOR STEM EDUCATION AND WORKFORCE DEVELOPMENT INVESTMENTS IN APPALACHIA

The combination of horizontal drilling and hydraulic fracturing to tap natural gas has resulted in the Utica and Marcellus shales becoming major sources of natural gas supply within the United States. This is predicted to bring significant, long-term economic benefits in employment to the tristate Appalachia region encompassing parts of Ohio, West Virginia, and Pennsylvania. The U.S. Energy Information Administration (EIA) estimated that the Marcellus and Utica shales contributed to 85 percent of the increase in natural gas production between January 2012 and January 2015 within the United States. According to a 2013 estimate, the number of jobs supported by the shale gas industry is projected to increase by 1.8 million between 2012 and 2025, contributing approximately $1.6 trillion to U.S. government revenue within the same time period. In 2015 and 2016, there were lower-than-anticipated oil and gas prices and consequently a reduction in the immediate production and extraction of natural gas and oil in the tristate region. Yet, the need for workers is expected to resume over the medium and longer term once oil and gas prices recover, particularly in middle-skilled jobs. Middle-skilled positions typically require a high school education, with some additional postsecondary training or occupational certification. Employers have reported difficulty in filling middle-skilled jobs that require STEM skills. The growing need for a STEM-skilled workforce is likely to further intensify given impending retirements of large numbers of older workers; nationally, nearly 25 percent of workers employed in extraction and production occupations are over age 55 and nearing retirement. There is also demand for improvement in STEM curricula in the region to prepare students for future job opportunities in the energy sector. A 2014 study found that 40 percent of surveyed parents, educators, and business leaders in the tristate Appalachia region reported that they believe the local school systems need to do a better job of preparing students for future jobs. The study also found a lack of awareness—especially in the rural areas examined—about how STEM education can prepare students for lucrative job opportunities in the future. Importantly, the study found that rural regions “represent one of the greatest, yet underexploited, opportunities for STEM education to impact workforce development.”

To support the development of a skilled workforce that meets the needs of the energy and advanced manufacturing industries, the API launched in 2014. The initiative was led by the Social Investment Team of Chevron North America’s Appalachian Mountain Business Unit. Chevron committed to investing $20 million to support K–12 STEM education and STEM workforce development programs to educate and train local adult workers, and to catalyze community engagement and policy advocacy on issues related to STEM education and workforce development in 27 counties in the tristate region (see Figure 1).

The API consists of an expanding network of partner organizations from the business, foundation, nonprofit, research, and education sectors. In addition to the Chevron Corporation, founding members (referred to as API leaders) include the Allegheny Conference on Community Development and the Claude Worthington Benedum Foundation. Recent new members are the Grable Foundation (2016) and Catalyst Connection (2017). Membership is
expected to expand over time. The RAND Corporation serves as the external research and analysis lead for the API.

**THE APPALACHIA PARTNERSHIP INITIATIVE’S VISION FOR THE REGION**

The API’s vision is to promote “a sustainable regional energy and manufacturing education and employment ecosystem that supports the region’s broader economic development.” From March through July 2015, API leaders developed a strategic framework to meet this vision for its programming with RAND facilitation (see Figure 2). The API strategic framework is a logic model\(^\text{10}\) that maps the types of programs the API expects to fund, desired outputs and outcomes of programming, and a communitywide next-generation vision illustrated on the far right of Figure 2. We also developed accompanying indicators for outputs and outcomes of the strategic framework to measure the API’s progress.\(^\text{11}\) API leaders aim to achieve this vision by supporting programs and activities in three categories:

- **K–12 STEM-related educational opportunities** that will expand and maintain the pipeline of local talent qualified for jobs in the energy and advanced manufacturing sectors
- **workforce development programs** that aim to build the capacity of local workers so they are prepared for and have access to jobs in the energy and advanced manufacturing sectors
- **community-catalyst efforts** that build integrative relationships among the region’s corporate, nonprofit, government, and community leaders.
As of December 2016, the API sponsored the following K–12 STEM programs in the API footprint:12

- The Carnegie Science Center managed three programs with an emphasis on informal museum-based learning: the Student Energy Summit, Grand Slam Science on the Road, and a stationary and mobile Fabrication Laboratory (Fab Lab).
- Intermediate Unit 1 also managed a mobile Fab Lab.
- The Children’s Museum of Pittsburgh operated Explore Making and Building the West Virginia Network, initiatives with an emphasis on informal, museum-based learning.
- Education Alliance developed an educational model for STEM Network Schools in West Virginia.
- Project Lead the Way provided professional development in new curricula focused on project-, problem-, and activity-based STEM instructional approaches in schools in Pennsylvania, Ohio, and West Virginia.

Two grantees developed or operated programs that focus on both K–12 STEM and workforce development: Catalyst Connection launched seven different programs focused on engaging students with employment in manufacturing, and Central Greene School District developed a commercial driving course, Natural Resources.

Workforce development programs included the following:
- ShaleNET is a partnership among employers and four technical colleges in Pennsylvania, Ohio, and West Virginia.
- Southwest Training Services operated employment services for coal workers recently laid off or dislocated.
• The Energy Innovation Center managed the Energy Safety Passport program, a safety training program for energy employees.

Figure 3 shows a time line of when the API started funding programs and the grantees that manage the programs.

**Figure 3. Time Line of Initiation of Funding for API Grantees and Programs**

<table>
<thead>
<tr>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
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<tbody>
<tr>
<td>Student Energy Summit, Grand Slam Science</td>
<td>Southwestern Training Services, Inc.</td>
<td>Alliance</td>
<td>Energy Safety Passport</td>
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<tr>
<td>API Announcement (October 21, 2014)</td>
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**REPORT OBJECTIVES AND APPROACH**

RAND is conducting a multiyear assessment of the API’s progress toward its vision. Interim assessments will be conducted annually from 2016 to 2019. This report summarizes findings from our first interim assessment and covers the first years of the API: October 2014 through July 2016. It establishes a baseline against which subsequent analyses can be compared. Because this is a first snapshot, this descriptive portrait describes activities and documents outputs as specified in Figure 2, but does not aim to assess outcomes. A final summative evaluation, forthcoming in 2020, will analyze the effect of API efforts through time and report on short-term outcomes.

This baseline assessment asked four questions:13

• **Strategic alignment:** Were the API’s programs and activities aligned with the API’s vision and strategy, as documented in the API Strategic Framework?

• **Geographic scope and beneficiaries:** What was the geographic scope of API programs, and which beneficiaries did the programs reach?

• **Sustainability:** How sustainable were the API programs?

• **Community catalyst:** What steps did API leaders take to catalyze a community of stakeholders to work toward similar goals?

To answer these questions, we relied on four sources of data:14

• **Interviews and site visits.** Between June and August 2016, we interviewed API program administrators, visited program sites, and reviewed program documentation. Interview questions focused on program activities and mission, beneficiaries, facilitators and barriers to implementation, sustainability, funding or in-kind support, and reported effectiveness to date.15
- **Quantitative indicators.** Between August and October 2016, program administrators submitted to us quantitative indicators, such as numbers of participants in the programs, based on a data collection template that we sent to each program. Program administrators were asked to provide as much data as feasible, covering the period between when the API started funding their program to July 2016. All K–12 STEM education programs provided us with the data requested. About one-half of the workforce development programs provided us with the data requested.16

- **Survey of API leaders.** In November 2016, API leaders provided written responses to a questionnaire that we administered. These questions focused specifically on the role each API leader took through July 2016 to serve as a community catalyst, the nature of their community relationships, and connections.17

- **Review of literature.** To inform our understanding of the extent to which programs were incorporating evidence-based practices in their programming, we conducted a literature review of select topics, including museum-based informal education; activity-, problem-, and project-based instructional approaches; sector-based career pathways; promising models in workforce development programs; network analysis in nonprofit settings; and related policies and activities in K–12 STEM education and workforce development. We analyzed the interview notes and API leader questionnaire responses by organizing responses according to the four research questions and aggregating similarities and differences. We compared programs’ activities and outputs with those outlined in the strategic logic model. A Pittsburgh-based technology and design firm, Informatics Studios, used program quantitative indicators to create an infographic map to pictorially describe the geographic scope and key output indicators.18

Using data from the data-collection templates, interviews, and API leader questionnaire, we produced network-analysis diagrams to analyze relationships among API programs, funders, and regional partners.19 We created network diagrams of these connections to assess overall network composition, pinpoint opportunities for the API to leverage existing links between programs and organizations, and highlight opportunities to leverage networks to advance API goals.

This first assessment had three important limitations:

- Any overall judgment of API effectiveness in achieving its vision would be premature. Therefore, this early-stage assessment measures progress toward the vision and offers suggestions for future decisionmaking regarding programming, funding, or API direction.

- This report evaluates the API *portfolio*, not individual programs. It focuses on how programs collectively promote the API’s goals and where gaps exist.

- This analysis incorporates data from multiple sources, some of which were self-reported or incomplete because of the nascence of the API programs and their data-collection efforts. Future reports will include more comprehensive data.

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### STRATEGIC ALIGNMENT

The strength of a portfolio of programs depends, in part, on the extent to which programs’ activities and goals match those articulated in a logic model. To determine this, we analyzed API programs’ activities and goals and documented how aligned those were with the activities and outputs illustrated in the API Strategic Framework in Figure 2. This first-year description of alignment can provide API leaders with information on potential redundancies or gaps in programming, which could be used to make decisions about where to pursue further programming. The next sections provide summaries about the findings are related to skills acquisition (for both K–12 STEM and workforce development); professional development; skills alignment; and industry engagement, networks, and awareness (for both K–12 STEM and workforce development).

### Programs Incorporated Hands-on and Project-Based Instructional Models That Aimed to Improve Skills Acquisition

API’s central goal was to fund innovative, hands-on, and project-based learning experiences in formal and informal education settings as a way to improve students’ acquisition of STEM skills and to improve their connection to careers in the 21st-century STEM labor market. The API strategically funded programs that were either pilot efforts or that used promising instructional models meant to improve participants’ skills. Although these programs and their instructional methods had not yet been rigorously tested to determine their effectiveness, API investments allowed for these approaches to be tried out; eventually, if proven to be successful, the API would encourage that these approaches be scaled up.
Table 1 lists instructional models employed by K–12 STEM and workforce development programs. Some of these programs, such as the ones at the Carnegie Science Center and the Children’s Museum of Pittsburgh, exposed children to STEM concepts and helped them develop STEM skills in informal settings, such as through maker spaces and fabrication laboratories. Other programs employed hands-on, practice-based learning approaches to improve students’ and workers’ acquisition of STEM skills in traditional classroom-based settings, such as Project Lead the Way, ShaleNET, and the Natural Resources course at Central Greene School District.

### API-Funded Teacher Professional Development Efforts Were for Current Teachers, Not for Pre-Service Teachers

All of the API’s K–12 educational programs offered professional development to train teachers in the instructional practice and hands-on learning techniques used in the API programs, such as project-based learning or particular technologies used in the FabLabs or MakerSpaces. For example, Project Lead the Way offered extensive training before and during the school year to teachers on teaching methods for the Project Lead the Way engineering and computer science curriculum. At the time of this study, 961 teachers in API-sponsored K–12 programs

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**Table 1.**

<table>
<thead>
<tr>
<th>API Grantee</th>
<th>Skills Acquisition Model</th>
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<tbody>
<tr>
<td><strong>K–12 STEM Education Programs</strong></td>
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<tr>
<td>Carnegie Science Center: Chevron Center</td>
<td>Hands-on learning experience for students to create their own projects (Student Energy</td>
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<tr>
<td>for STEM Education and Career Development</td>
<td>Summit)</td>
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<td></td>
<td>Hands-on, multimedia experience integrating lessons in physics with baseball (Grand Slam</td>
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<td></td>
<td>Science, On the Road)</td>
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<td></td>
<td>Hands-on STEM learning experience for students to digitally fabricate own products (FabLab)</td>
</tr>
<tr>
<td>Children’s Museum of Pittsburgh</td>
<td>Hands-on learning experience for students to create and make their own crafts and projects to take home (Explore Making)</td>
</tr>
<tr>
<td></td>
<td>Student crafts and projects in maker spaces (Building the West Virginia Network)</td>
</tr>
<tr>
<td>Education Alliance</td>
<td>Strategic planning process to include industry (STEM Network Schools)</td>
</tr>
<tr>
<td>Project Lead the Way</td>
<td>Project-, problem-, and activity-based instructional approaches</td>
</tr>
<tr>
<td><strong>K–12 STEM Education/Workforce Development Programs</strong></td>
<td></td>
</tr>
<tr>
<td>Natural Resources at Central Greene School District</td>
<td>Hands-on technical training, courses that cover the scientific background for the industry, commercial driver’s license training, safety training and certificates.</td>
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<tr>
<td>Catalyst Connection</td>
<td>Student-made videos about “what makes manufacturing cool,” partnered with a manufacturing company (Middle School Student Video Contest)</td>
</tr>
<tr>
<td></td>
<td>Student research-based projects partnered with a manufacturing company (Adventures in Technology)</td>
</tr>
<tr>
<td></td>
<td>Project-based learning training for adults (Adventures in Technology)</td>
</tr>
<tr>
<td></td>
<td>Project-based learning training for teachers (Professional Development Related Activities)</td>
</tr>
<tr>
<td></td>
<td>Supporting manufacturing companies in the development of internships and apprenticeship opportunities</td>
</tr>
<tr>
<td><strong>Workforce Development Programs</strong></td>
<td></td>
</tr>
<tr>
<td>ShaleNET</td>
<td>Stackable credentialing (with multiple entry and exit points, where individuals may build degrees after obtaining technical certificates or credentials) and career pathways</td>
</tr>
<tr>
<td>Southwest Training Services, Inc.</td>
<td>Work-based learning</td>
</tr>
<tr>
<td>Energy Innovation Center’s Energy Safety Passport</td>
<td>Hands-on learning of a cross-company safety curriculum</td>
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</tbody>
</table>
received professional development training.

However, the professional development offered was in-service training, for those already working as teachers, as opposed to pre-service training, which would take place while potential teachers are gaining their certification. Program administrators reported that attrition among the program-specific trained teachers was a common problem: When teachers depart, they would take their new skills with them.

**Few Workforce Programs Focused Specifically on Transitioning Workers**

A core population of interest for API leaders was transitioning workers, such as veterans or dislocated workers. Transitioning workers hold skill sets that could transfer to energy-and manufacturing-sector jobs. The API therefore set out to fund programs that supported the transferability of skills of transitioning workers or provided reskilling so that prior competencies and skills could be incorporated in current employment. We found that two of the five workforce development grantees explicitly focused on transitioning workers: ShaleNET and Southwest Training Services. ShaleNET colleges recruited and tracked veterans to enter their stackable credential coursework, and Southwest Training Services program specifically focused on displaced coal miners. At the time of this study, program administrators documented 46 veterans and displaced coal miners who had participated in these programs. The API can now determine whether to sponsor more programs that focus on transitioning workers or whether this is sufficient for the time being.

**Programs Engaged with Industry Leaders to Support Employability of Participants**

All of the workforce development programs reported they had engaged industry leaders (over 100 companies in total). Fifteen companies provided in-kind expertise and time, 16 collaborated on curriculum, and three partnered with industry in job-placement efforts, through career counseling, job databases, or exposure to companies with possible job openings. Industry supported workforce development programs by providing technical expertise in curriculum design to meet on-the-job demands, equipment to ensure that students practiced their skills using the most up-to-date materials, and workplace experiences for students, whether through internships, visits to companies, or guest lectureships.

Administrators of K–12 programs reported offering various ways to link secondary students with industry. These included:

- Helping secondary students make connections with local industry for jobs that require a secondary degree through career guidance, guest speakers, and mentoring field trips.
- Collaborating with companies to provide materials, equipment, and input on curriculum.
- Training high school guidance counselors on the availability of STEM career options.

**Programs Included Strategies to Improve Awareness, but Efforts Were Not Linked to an Overarching Strategy**

As explained earlier in this report, research has demonstrated there is little awareness about STEM career pathways in the region. Therefore, the API Strategic Framework lists improved awareness as a key output of both K–12 education and workforce development programs. At this early stage, our analysis was not able to measure improved awareness of program participants. Instead, we reviewed efforts by the programs that aimed to improve awareness. We found that both K–12 education and workforce programs sought to improve awareness of STEM careers through their approaches to teaching, training, and public activities. Program administrators noted that the experiential learning methods used in classroom- and museum-based K–12 STEM programs were intended to bring about a “cultural shift” or “mindset change” in how students viewed STEM education and careers; it was considered one way to excite students and motivate them to pursue STEM-
related careers. Workforce program administrators aimed to improve awareness through instruction and training techniques and by establishing connections between students and energy and manufacturing employers. Two indicators reveal programs’ early efforts to increase awareness around STEM career opportunities: Between October 2014 and July 2016, K–12 and workforce development programs received eight public awards—casting attention on their programs—and hosted 65,323 attendees at the programs’ public events.

While interviewees lauded that there seemed to be more attention to improving STEM skills or awareness across the region, interviewees perceived that programs’ activities were isolated from one another and unconnected to a broader API systemwide strategic view of how to change student interest, engagement, or awareness of STEM career pathways. Moreover, there was no direct measure of awareness about STEM careers and whether awareness has increased across the region.

GEOGRAPHIC SCOPE AND BENEFICIARIES

Our analysis in this section documents where API programs were located across the 27 counties listed in Figure 1, the number of people the programs reached (scope and scale), and the percentage of all potential beneficiaries who were reached by API-funded programs. Yet it is important to note that the API recognized that its programs alone could not feasibly reach all individuals across the entire 27-county footprint. Thus, the findings reported in this first snapshot of scope and scale can inform API leaders on where to pursue further programming: Should the API focus on increased breadth of its programming or pinpoint specific regions where there might be gaps in programming?

API Programs Were Heavily Represented in Pennsylvania and West Virginia, and Lightly Represented in Ohio

As shown in Figures 4 and 5, API programs were available in all 27 API counties. Although there appeared to be geographic parity, a closer look revealed that most API-funded programs were available in southwestern Pennsylvania, with a concentration of programs in Allegheny County, where there was also the largest number of public schools, school-age children (age 3–17), and working age adults (age 18–64). All API workforce development programs were available in counties in northern West Virginia and in Allegheny County. There were few API-sponsored programs available in Ohio counties (two workforce development programs and two K–12 STEM programs).

This distribution of programs presents an opportunity for API leaders to consider how to balance investments across the three states. Programs are currently concentrated both in Chevron’s locations across the region and in more-populated counties. Given the API’s stated emphasis on rural communities, going forward, API leaders could consider to either continue to focus efforts in more-populous counties or in rural counties with fewer programs in place that might have the greatest need. To make these types of decisions, API programs will need to be able to collect data on the number of beneficiaries served by each program in each county (to date, not all programs are able to collect that information).

API Programs Reached Targeted Beneficiaries

At the time of this study, K–12 STEM education programs served 11 percent (75,316) of the region’s 680,000 school-age children in informal museum-based settings or in formal education settings in 122 schools (of which 87 were in rural communities). Fifty-five percent of those served fell under each program’s definition of low income. API programs were thus reaching a proportion of the populations that API leaders wanted to focus attention on: schoolchildren
in rural communities or those in lower-income families. The workforce development programs that provided us with data reported 383 participants, and 77 instructors received occupation-related professional development. Five postsecondary institutions supported by the API were based in rural counties.

**SUSTAINABILITY**

Promoting sustainable programs that continue into the future without API funding was a key goal of API leaders. Therefore, we analyzed which factors facilitated or inhibited API programs’ sustainability—the extent to which the benefits of an activity are likely to continue into the future and in particular after donor funding has been withdrawn—and programs’ ability to achieve desired goals.

**Supportive Government, Industry, and Education Partners Were Key to Sustainability**

Program administrators identified three factors central to supporting their ability to meet program goals and future sustainability:

- **Government support:** For some programs, federal, state, and local governments provided supportive policy contexts or apportioned funds for K–12 STEM and workforce development, which in turn provided more secure financing and ability to develop capacity of staff. For example, ShaleNET launched with grants from the U.S. Department of Labor’s Education and Training Administration, totaling $19.9 million. At the state level, the West Virginia governor’s STEM Council, the Pennsylvania governor’s STEM Planning Committee, and the Ohio State Department of Education considered policies in support of K–12 STEM initiatives.

- **Industry support:** Industry leaders engaged with and provided in-kind or financial support to API programs, including staff time and expertise, equipment, or access to work sites.

- **Education support:** Program administrators emphasized the “enthusiasm” and “commitment” of teachers, school administrators, and trainers in participating programs because of a perceived need for new STEM approaches. This, in turn, facilitated programs being able to meet expected goals.

**Multiple Challenges Could Impede Programs’ Sustainability**

Program administrators also identified challenges to meeting current and future goals:

- **Perceptions about STEM careers:** Program administrators reported that youth, parents, guidance counselors, and adult workers continued to have misperceptions or lacked awareness about opportunities in STEM careers, required skills of STEM jobs and tasks, and potential salaries.

- **Weak links between education and STEM careers:** Program administrators pointed to a lack of clear pathways between K–12 education and middle-skill STEM jobs; it would be important for students, parents, school leaders, teachers, and guidance counselors to understand which courses in middle or high school were in demand in the workplace. While Ohio developed such career pathways, Pennsylvania and West Virginia had not.

- **Teacher qualifications and turnover:** When teachers or instructors in particular programs left, programs needed to train anew. Administrators of K–12 education programs lamented that pre-service teacher colleges do not educate their teachers-in-training with needed skills in project-based instruction or particular subject-matter expertise. The workforce development program administrators reported competing for quality instructors with the private sector.

- **Inconsistent leadership support:** Program administrators believed that leadership support at the school or district level for STEM K–12 education programs was uneven. They speculated that this lack of support might stem from competing priorities, the need to adhere to state testing requirements that leave little flexibility in curricula and scheduling, constrained budgets, and lack of understanding of new STEM learning approaches, project-based instructional methods, or informal learning models.
Industry fluctuations: Program administrators that provided certifications in the manufacturing or energy sectors found it difficult to attract participants between 2015 and 2016 because of decreased employment in those sectors in comparison with the initial shale gas boom between 2011 and 2015. Employment demand was expected to increase again, but program administrators feared that their programs that are dependent on enrollment to survive could fold before the economy rebounds.

Programs with Varied Funding Sources Viewed Themselves as More Financially Sustainable

Most API programs received financing from multiple sources, including foundations and corporations (such as API partners), tuition and fees, fundraisers, federal and state government funding, and in-kind contributions (e.g., expertise, equipment, site access to companies). Program administrators who reported that they had a financially sustainable model to
continue their efforts typically were those with a diverse set of funding sources. In contrast, program administrators with heavy reliance on a single source of funding expressed concern over risks to the continuity of their programs. They noted that their budgets were often unpredictable because of changing or conflicting national and state priorities. Several programs described the benefit of having one or two respected funders: The name recognition of the funders made it easier to obtain other external funding.

**COMMUNITY CATALYST**

Recognizing that the set of API programs, on their own, would not be sufficiently at scale to achieve the API’s next-generation vision, API leaders aimed to mobilize a community of education, workforce, private-sector, foundation, government, and nonprofit leaders to work toward similar goals. As illustrated in the API Strategic Framework in Figure 2, API leaders sought to leverage financial and in-kind contributions, engage in policy advocacy, mobilize community involvement, and develop net-
works for change. The analysis provided in this section assesses the extent to which API leaders have catalyzed a community to date. We found several trends, gaps, and opportunities for the API to further act as a community catalyst. API leaders can use the findings from this analysis to consider how they can most effectively manage their individual and collective relationships to achieve the community catalyst goals.²⁹

There Is a Vibrant Regional STEM-Supportive Ecosystem

At the time of this study, other initiatives related to API goals were underway in all three states, with variation in partnerships at the local, state, and interstate levels. In Pennsylvania, Pittsburgh-based organizations had been active in developing new K–12 STEM education models, such as through Pittsburgh’s Remake Learning Network and Pittsburgh’s nationally leading role in “the Maker Movement.” Pittsburgh and Youngstown, Ohio, had both received federally designed “Maker City” status. West Virginia had a number of K–12 STEM initiatives, yet some interviewees noted that, in general, West Virginia lagged behind other states in regional and national partnerships, a view that, as a state, they were “not as plugged in as other states.” Ohio initiatives included the Ohio STEM Hub Network, Ohio Career Pathways, the “Choose Ohio First” scholarship, and the federally designated Manufacturing Hub status of Youngstown, Ohio. Despite the rich policy environment in Ohio, few API programs have been engaged with state or local government entities in Ohio, unlike the API program engagement with government in Pennsylvania and West Virginia. All three states had federally funded Manufacturing Extension Partnerships and Workforce Investment Boards, along with membership in the Appalachian Regional Commission, a federally funded regional economic development organization.

The API Served as a Key Partner in the Regional STEM-Supportive Ecosystem and Started to Engage in Policy Advocacy

API leaders and program administrators held leadership positions in other related STEM education and workforce development initiatives. In particular, the Chevron Corporation, Benedum Foundation, and Allegheny Conference on Community Development cosponsored the Tri-State Shale Summit of October 2015. There, the governors of the three states signed the Tri-State Regional Cooperation Agreement, which committed the states to “optimize added economic value to the Tri-State Region in a safe and environmentally responsible manner.” There has not been tristate coordination of K–12 STEM education activities similar to the tristate cooperation agreement for workforce development.

As another example, multiple API programs (such as Carnegie Science Center, the Children’s Museum of Pittsburgh, and the Intermediate Unit 1 Fab Lab) have been involved in efforts such as defining and developing the “STEM Ecosystem Community of Practice”³⁰ and “the Maker Movement,”³¹ which are national collaborative efforts, both at a regional level.

The API Initiated Networks Across Programs and Among Industry and Higher Education Partners

K–12 STEM Programs Were More Connected with One Another Than Were Workforce Development Programs

Figure 6 shows the relationships among API leaders and programs. K–12 STEM programs and Catalyst Connection (which conducted both K–12 and workforce development programs) reported consistent interaction and cooperation with one another: they knew of one another, met face-to-face, and/or shared promising practices. (It is important to note that lines between shapes signal that the two entities have a connection, as reported by the API program administrator; the lines do not signify the depth or length of that relationship.) In contrast, workforce development programs reported fewer connections with one another. While the four ShaleNet colleges collaborated regularly (in quarterly meetings), no other workforce development program worked in conjunction with others of its kind. Consequently, API leaders may wish to bring the workforce development program administrators together to share information or plan informal or formal collaborative activities. Nurturing the spontaneous formation of “ecosystems” would be one way to promote long-term sustainability of API programs.

Programs’ Networks Were Largely Isolated from One Another

Figure 7 shows the relationships between API programs and other entities, such as businesses, government organizations, or civic associations.³² As the diagram shows, API programs
are individually connected with many organizations, yet their networks were largely isolated from one another. Having better information exchanges and coordination among these networks could improve overall collaborative success. Some benefits of such deliberate coordination could include shared curriculum development, improved economies of scale, and collaborative activities toward common goals. The API could serve as a central hub for this type of cooperation.

Universities Served as Key Resources in These Networks

Figure 8 shows collaborations among API programs and higher-education institutions in the region, including public and private universities, as well as community or technical colleges. It shows that the largest number of higher-education institutions that collaborated with API programs were located in Pennsylvania, followed by West Virginia and then Ohio. Carnegie Mellon University and the University of Pittsburgh were clearly central to the network, having had a significant number of collaborations with API programs. API leaders might reference this diagram in considering which relationships to create, develop, or strengthen with higher-education institutions, for example; to draw on for resources, knowledge, and convening capability; or to advise on curriculum development, offering courses for particular skills needed by industry, and teacher training.

Many Funders Contributed to API Programs, but Their Efforts Were Not Coordinated

Figure 9 shows the overall funding network for API programs, including the additional 26 funders outside of the API. (Since
the completion of data collection for this report, the Grable Foundation joined API leadership. Future diagrams will include their contributions. Similar to the relationships among API programs and other entities, this diagram shows a disconnected network of funders. Each API program had its own separate network of multiple funders. With few exceptions, apart from API leaders, other funders in this network rarely funded more than one API program, although they might fund programs outside of the API. Going forward, API leaders may consider how to strategically broaden, coordinate, and leverage the API funding base. Knowing where new networks may form, mapping potential academic ties to those networks and identifying related philanthropic benefactors could support financial sustainability of API programs for years to come.

LOOKING AHEAD

The API has set an ambitious, next-generation vision to improve the region’s energy and manufacturing education and employment ecosystem in support of broader economic development, both through investing in particular programs and through catalyzing a community of likeminded stakeholders to work toward these goals. This analysis reported on the vision, programs, beneficiaries, sustainability, and networks of the API during its first two years. However, as this is just the beginning of the API, this report did not aim to assess how effective the API has been or will be in reaching its long-term vision to support the region’s economic development, and indeed, it would be too early to tell.

At this early stage in the API, we have found that the programs’ activities and goals were fairly well aligned with the API’s vision and were geographically reaching beneficiaries across the 27-county API footprint. Documenting these API strategies, advocacy, and community connections, as well as
API programs’ services and network, provided a basis for distinguishing successes in the API’s portfolio and spotting emerging gaps and opportunities for new directions. Such information will help API leaders, as well as other STEM education and workforce development stakeholders, determine where future resources and initiatives can best be deployed.

RECOMMENDATIONS

Looking ahead, we offer the following recommendations organized by the four research questions that this study considered.

**Strategic Alignment**

- **Continue to gauge participants’ perceptions and awareness of STEM careers and API programs.** With the collection of data through field-participant surveys of teachers, students, and other program participants, the API could track the progress of its programs in meetings their goals with respect to changing awareness and perceptions about STEM education and careers.
- **Map pathways between K–12 education and middle-skilled jobs.** Career pathways are models that show which skills, degrees, and certifications can lead to specific STEM-related careers and middle-skilled jobs. However, there are no regional career pathways that map the high school coursework, badges, or skills that a student should...
obtain for entry into postsecondary education, training programs, or middle-skill entry-level positions. These could be useful to support awareness and understanding among youth, parents, high school guidance counselors, and human resource professionals.

**Beneficiaries and Geographic Scope**

- **Fill programming gaps.** Although the API has funded multiple new experimental instructional models in K–12 STEM education and workforce development, certain programming gaps, with respect to the goals articulated in the API strategic logic model, merit attention. API leaders could consider funding efforts for (1) a coordinated top-down strategy to promote stakeholder awareness of STEM careers; (2) pre-service teacher training; (3) workforce development programs that support adult workers who are most in need of employment, particularly dislocated and transitioning workers; and (4) efforts that galvanize the stakeholder community to support local, state, regional, and federal policies that promote K–12 STEM education and workforce development.

**Sustainability**

- **Strengthen and expand networks of relationships with regional funders.** Programs relied on financial support from 26 different funders (in addition to the API). The API
could serve as a strategic facilitator between these funders and its programs to more effectively finance initiatives.33

- **Determine priority challenges for API to focus on solving.** API has sponsored multiple individual programs that address particular local needs and use innovative models to support skills acquisition and awareness. Yet, a regional analysis of the most significant challenges facing K–12 STEM education and workforce development is missing. The API is now well positioned to develop such a strategic high-level vision, which would be useful for policymakers as well as regional funders. For example,
  - K–12 STEM program administrators reported that attrition of teachers and school leaders undermine their effectiveness. New teachers and instructors must be retrained, since they lack pre-service professional development for the activity-based or problem-based models. Here, a priority may be to support university programs that might offer pre-service teacher training on these types of instructional practices.34
  - Programs encountered challenges to their sustainability at the policy level. API leaders could consider which of these challenges they might be able to influence through funding or policy engagement. An analysis of challenges, as well as prioritization of the main problems to solve, could inform what the API funds or where to direct community catalyst efforts in the future.

### Community Catalyst

- **Sponsor tristate meetings for K–12 STEM education.** During the annual Tri-State Shale Summit meetings, the API could convene a meeting for policymakers, philanthropic foundations, and education stakeholders to promote and coordinate K–12 STEM education policies, data sharing, and outcomes. Enhancing information exchanges and coordination among the K–12 STEM networks could foster collaboration; enhance connections among programs, community leaders, and policymakers; and support the development of a coherent vision for K–12 STEM education in the region.

- **Focus on deepening connections among workforce development programs.** Our network analyses revealed less collaboration among workforce development programs than among their K–12 STEM counterparts. While API programs individually had many connections, their networks were largely isolated from one another, limiting prospects for sharing promising practices. Better information exchanges and coordination among the networks could improve individual and collaborative success. For example, as a start, the API could convene a workshop among its workforce development programs to share lessons learned and discuss possible synergies.

- **Craft a broad strategy for policy engagement to support tristate education and workforce development.** Our analyses found that, to date, API leaders and programs have engaged networks of community leaders and funding sources. Some program administrators reported individually engaging with policymakers at the school district, city, county, state, or federal level about their program’s needs. Now that the API has established a track record during its beginning years, it is well positioned to develop and advocate for strategic policy goals at the state, city, or district level for K–12 STEM education and workforce development.
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and Nanda, 2017).

A copy of the interview questionnaire is available in Appendix G in the accompanying Technical Appendix (Culbertson, Gonzalez, and Nanda, 2017).

The quantitative indicators were developed in July 2015 in deliberation with API leaders; each indicator linked directly to a component of the strategic logic model. At this point in time, program administrators were able to report on the direct services provided by their programs and number of participants (“outputs” in the strategic logic model). A sample data collection template is available in Appendix H of the accompanying Technical Appendix (Culbertson, Gonzalez, and Nanda, 2017).

The API leader questionnaire is available in Appendix I in the accompanying Technical Appendix.

The static map is included in the accompanying Technical Appendix (Culbertson, Gonzalez, and Nanda, 2017), and online interactive maps will be updated annually to correspond with RAND’s analysis and are available on the API website: http://www.rand.org/appalachiapartnership.html

Interactive maps with specific information about the API and the programs in which it is investing can be found on http://appalachiapartnership.com. For more information about the methodology employed, see Appendix B in the accompanying Technical Appendix (Culbertson, Gonzalez, and Nanda, 2017).


This number may be higher; only two workforce development programs counted veterans or displaced coalminers. Service to Opportunity, an API program that matched veterans with middle-skill jobs in the oil and gas sector, was not included in the study because it had stopped operations in order to modify its design and format. While it was operating, 722 veterans registered for its job matching services. We will include this program in subsequent analyses.

For more information on the data and methods used in the analysis and detailed findings of program sustainability, see Appendix E in the Technical Appendix (Culbertson, Gonzalez, and Nanda, 2017).


The nationwide Maker Movement gained traction through the launch of MAKE Magazine in 2005 by Maker Media in San Francisco. The first Maker Faire hosted by Maker Media was in 2006 in the Bay Area. Since then, numerous Maker Faires have been organized throughout the world, including (1) Flagship Maker Faires (“faire curated and produced by the Maker Media team”), (2) Featured Maker Faires (“larger-scale regional events”), (3) Mini Maker Faires (“community events”), and (4) School Maker Faires (“K–12 Faires [closed to the general public]”). Maker Faires display successful do-it-yourself projects and innovations in any field (e.g., science, art, engineering, performance). For more information, see Maker Faire, “A Bit of History,” 2016. As of December 14, 2016: http://makerfaire.com/makerfairehistory; and Maker Faire, “The Maker Movement,” 2016. As of December 14, 2016: http://makerfaire.com/maker-movement/

The ShaleNet colleges’ connections are not shown in this figure. At the time of this study, three of the four colleges had not provided these data to us.
In October 2016 (after the time of this study), Chevron Corporation, Benedum Foundation, and Grable Foundation convened a meeting with corporate funding community members with interests related to education and the workforce; this was the first time that such a group had met. The meeting facilitated an initial exchange about interests and led to discussions about possibilities for collaboration. This nascent initiative might lead to coordinated funding and leadership action going forward and could be used as a blueprint for engaging other potential funders in the region.

It is important to note that, collectively, the API K–12 STEM programs trained more than 700 teachers at the time of this study. Therefore, although individual programs might experience attrition, it is unknown whether those teachers have applied their knowledge of applied, project-based instruction to other locations or to support other students. This movement, therefore, might have been positive for the entire region.
About This Report

The research was conducted within two units of the RAND Corporation: RAND Education and RAND Justice, Infrastructure, and Environment. The Technical Appendix associated with this report is available at https://www.rand.org/pubs/research_reports/RR2017z1.html, documents the study’s methodology and data and expands on the findings summarized in this report.

This research was sponsored by the Appalachia Partnership Initiative (API). This report should interest two audiences: (1) regional education, business, and community leaders concerned with science, technology, engineering, and mathematics (STEM) education and the career readiness of workers in the energy and advanced manufacturing sectors; and (2) policy analysts interested in how network analyses can help to advance regional innovation.

The Appalachia Partnership Initiative

Chevron North America Exploration and Production (CNAEP) Appalachian Mountain Business Unit’s Social Investment Team was established to meet several goals in the Pennsylvania, West Virginia, and Ohio region. Goals include strengthening science, technology, engineering, and mathematics (STEM) education in middle and high schools and improving pathways for high school graduates and adult learners to careers in the oil and gas industries and in advanced manufacturing. As part of these efforts, in 2014, Chevron’s Social Investment Team launched the Appalachia Partnership Initiative (API), a partnership of businesses, nonprofit organizations, and education institutions in the region. As of April 2017, the API consisted of representatives from Chevron, the Claude Worthington Benedum Foundation, the Grable Foundation, the Allegheny Conference for Community Development, and Catalyst Connections.

The RAND Corporation has served continuously as the independent research and analysis lead for the API. RAND is undertaking annual assessments from 2016 through 2020 to track the progress that API-sponsored programs are making in supporting the API’s goals over time.

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