



Engineering Our Future

Inspiring and attracting
tomorrow's engineers

nationalgrid

The power of action.™



The National Grid Engineering Our Future Report provides an assessment of current attitudes towards engineering and insights into how we can attract young people to careers in engineering.

The report is based upon extensive opinion research and a study by the National Academy of Engineering. Qualitative and quantitative research including individual interviews, focus groups and an online survey were conducted with pre-teens, teenagers and parents. In addition, individual interviews with engineers, educators, and opinion leaders and focus group “triads” (same sex groups of three 9 – 11 year olds) provided further clarification on the perceptions of engineering as a career choice.

The research revealed that most Americans are unaware of the impact of engineering on their daily lives, the wide range of what engineers actually do and the opportunities available through an engineering education.

These research findings and discussions within National Grid has led us to develop a new set of programs designed to encourage more young people to become engineers over the next twenty years.

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Introduction

In the United States today, we take reliable energy for granted. When we flip a switch, the lights turn on. When we need to recharge an appliance, we plug it in. For the most part, we live our busy lives without thinking about why or how power gets to our home or office.

But what if we did stop to think about it? If we traced the steps of how power is generated, transmitted and delivered, we would discover advanced technology, complex systems, and large-scale grids. But most importantly, we would discover people.

Not just the people who work for companies like National Grid, but the people who worked for decades to put these complex systems in place, the people who determined the best, fastest and most efficient way to deliver energy.

And what do those people have in common? Many of them are engineers.

At National Grid, our engineers are the lynchpin of our workforce. Without them, we simply could not deliver our end product: energy. We could not understand how to be more efficient, we could not discover how to reduce our energy use, and we could not determine where our energy will come from in the next century. Engineers are critical to advancing our business and the energy industry.

But despite engineers' increasing importance to the industry and our nation's economy as a whole, their ranks are dwindling. Fewer and fewer people are getting advanced engineering degrees. As demand outpaces supply, there will be engineering jobs left unfilled at companies and government agencies across the country.



National Grid wants to solve this problem. We care not only because we depend on engineers to deliver our product and serve our customers, but also because we are committed to playing a major role in the transition to a low carbon economy. We cannot make that transition without a corps of smart, dedicated and highly trained engineers.

This report aims to illuminate some of the reasons that young people are not choosing engineering as a career, and suggest some solutions to that problem. These solutions are not things that National Grid can do alone. They will require cooperation from the academic world, government and other corporations.

It's a big task, so let's start small: Next time you turn on a light, think about the engineers who have studied, trained and worked to bring you energy. We depend on them every single day.

Tom King
President,
National Grid U.S.

The Challenge



The decline in qualified engineers entering the workforce is well-documented. According to the American Society for Engineering Education, Engineering bachelor's degrees declined in 2007 for the first time since the 1990s, ending seven years of growth. The trend is predicted to continue for several years, because undergraduate enrollment dropped both in 2004 and 2005. Engineering master's degrees show an even sharper drop than bachelor's degrees, having declined 8.8 percent since 2005.¹

At the same time that engineering is becoming a less popular career choice, demand for engineers is going up. The U.S. Bureau of Labor Statistics has projected a need for 160,000 more engineering positions over the 10-year period between 2006 and 2016.

The trend is particularly troubling in the electric utility sector. According to a 2009 report by the U.S. Power and Engineering Workforce Collaborative, over the next five years, approximately 45 percent of engineers in electric utilities will be eligible for retirement or could leave engineering for other reasons. If they are replaced, then there would be a need for over 7,000 power engineers by electric utilities alone: two or three times more power engineers may be needed to satisfy needs of the entire economy.²

American Competitiveness

At the same time that engineering is being overlooked in the U.S., other countries are improving their higher education systems and accelerating the study of math, science and engineering.

In January, the National Science Board released its Science and Engineering Indicators 2010 report. It shows that U.S. dominance of world science and engineering has eroded significantly in recent years, primarily because

of rapidly increasing capabilities among East Asian nations, particularly China, and that American 15-year-olds are losing ground in science and math achievement compared to their peers around the world.³

To be sure, we cannot find renewable energy solutions without maintaining our presence as leaders in the engineering field – but we also cannot rebuild our economy. The United States has long been at the leading edge of scientific discovery and technological innovation. In order to stay competitive in a global economy, we must keep pace with countries like China and India, and that means staying at the forefront of the latest developments in science and technology. By creating a corps of competent engineers, we will not only be adding to our national competitiveness, but we will also be retaining talent in places across the United States that need economic development. For instance, providing job opportunities for engineers in upstate New York will help to stop the “brain drain” that is hurting the region.

Climate Change

Fighting global climate change is a challenge that affects all of us. At National Grid, we have adopted a long-term target of reducing our greenhouse gas emissions by 80 percent against our baseline by 2050. We have also set an intermediate objective of a 45% reduction in our emissions by 2020. How will we do it? Our engineers have put together a plan.

Without engineers, National Grid could not meet this challenge. And without talented engineers working on the problems, our country will not be able to transition to a low carbon economy. We need engineers to find renewable energy sources and convert them into effective and cost-efficient supplies.

What Is Behind the Challenge?

We know there are fewer engineers, and we know that increasing the engineering workforce is an imperative for not only National Grid but also the United States economy. So why is this critical sector in decline?

Perception Problem

A large part of the answer is a perception problem. Research from several sources shows that negative perceptions about engineering are held by young people and segments of the public at large. These negative perceptions are compounded by the fact that the public has a generally narrow understanding of what engineers actually do.

A major 2008 study conducted on behalf of the National Academy of Engineering used qualitative and quantitative research to uncover and analyze some of the most common misperceptions and negative feelings about engineering. The findings were published in *Changing the Conversation: Messages for Improving Public Understanding of Engineering*.

The study found that among 9–11-year-olds:

- ◆ Most students understand that engineers “design and build things” but have a limited sense of what engineers actually do.
- ◆ Students have a generally positive impression of engineers, but many feel that they are not smart enough to become engineers.
- ◆ Many students believe engineering work is sedentary, performed mostly on computers, and involves little contact with other people.
- ◆ While most girls believe women can be engineers as well as men, when asked to name famous engineers, most students could only name men.

- ◆ Examples of engineering related to familiar objects and activities stimulated the most interest in learning more about engineering

Among young people ages 12 through 19, qualitative research found:

- ◆ Engineering is poorly understood by most students, even among those who are most informed about the field.

“Engineering is you fix things like cars and stuff.” – Teen, 16-19, Raleigh

“Someone who fixes things... Buildings and fixing cars and trains... Kind of like architecture.” – Teen, 16-19, Phoenix

“Being able to fix things, things that are part of the engine.” – Teen, 12-15, Phoenix

- ◆ If some students think engineers are much smarter, creative and imaginative than just ‘being good at math and science,’ many young people also think that engineers only sit at their desks or computers and have little interpersonal contact in their work.

“Seems like a lot of engineers sit behind a desk and don’t do much fieldwork ... It’s a desk job. I’d beat my head against the wall if I had to do that.” – Teen, 16-19, Raleigh

“They have a stereotype of being geeky... shut up in their workshop and doing the same thing over and over again.” – Teen, 12-15, Phoenix

- ◆ When students learn more about engineering, they react far more positively toward the field, and many find that they can relate personal interests to engineering in a way they had not considered or known about before.

“If you told somebody that they could invent the next Xbox, you’d get a lot of kids who’d want to be an engineer.” – Teen, 16-19, Phoenix

“It sounds kind of cool, it’s like the whole world is there...You get to build something that no one has ever seen before...It’s fun to build things and help people, I’d be able to design things and take stuff apart and know how it works.” –Boy, 10-11, Phoenix

- ◆ Children repeatedly express a desire for well-paying jobs that are engaging and conducive to making a positive difference in the world.
- ◆ Girls, particularly, tend to associate ‘helping people’ and ‘making a difference’ with fields like medicine or teaching – not engineering.
- ◆ Students are curious about the challenges for problem-solving in society, like inventing technologies that relieve human hunger, preserving rainforest habitats, or creating the DNA diagnostics and pharmaceutical products that save lives.

“Engineering is behind the scenes, helping people. They design the machines that help people. I think most of engineers’ work is taken for granted because you don’t see what they’ve done.” –Teen, 16-19, Raleigh

“You don’t directly help people like a doctor, you invent something that will help them later.” –Teen, 12-15, Raleigh

Clearly, students have misconceptions about engineering and need to be better educated. The research also found, however, that parents see engineering as a career path that will provide good job security. Outreach to correct misperceptions and better position engineering should be geared to the students, since they are the most in need of positive messaging, and make up the audience that is considering choosing these careers.

Educational Preparedness

In addition to the perception problem, we cannot ignore the need to make sure that all of our students have the option to choose engineering as a career path, and that means being properly prepared in elementary, middle and high school. Right now, there are signs that the U.S. education system is not doing an adequate job to prepare students for engineering careers.

In the 2006 Programme for International Student Assessment (PISA) comparison, American students ranked 21st out of 30 in science literacy among students from developed countries, and 25th out of 30 in math literacy. And on the 2009 National Assessment of Educational Progress math tests, 4th graders showed no signs of progress for the first time in many years, and 8th graders made only modest gains.



Solutions



For all of the organizations, associations, corporations and government bodies that care about improving the field of engineering, there remains plenty of work to do.

Perception Problem

We must change the way students view engineering. We cannot attract the best and brightest talent without showing top students why they should want to be engineers and what the field has to offer them. This is not a problem that can be tackled by one employer or one university. Rather, the engineering community, and all those who care about its health, should engage in coordinated, consistent, effective communication to “reposition” engineering as an inspiration and aspirational field.

The positioning statement developed by the NAE, after their research program, is:

No profession unleashes the spirit of innovation like engineering. From real world applications, engineers constantly discover how to improve our lives by creating bold new solutions that connect science to life in unexpected, forward-thinking new ways. Few professions turn so many ideas into so many realities. Few have such a direct and positive effect on people’s everyday lives. We are counting on engineers and their imaginations to help us meet the needs of the 21st century.

The NAE study also determined the most effective key messages for repositioning engineering. They are:

- ◆ Engineers make a world of difference
- ◆ Engineers are creative problem-solvers
- ◆ Engineers help shape the future
- ◆ Engineering is essential to our health, happiness and safety

Educational Preparedness

The Obama administration has made improving the participation and performance of America’s students in science, technology, engineering, and mathematics (STEM) a priority, and they have announced a number of programs to meet the challenge, including the Education to Innovate initiative. Educate to Innovate involves:

- ◆ Increasing STEM literacy so that all students can learn deeply and think critically in science, math, engineering, and technology.
- ◆ Moving American students from the middle of the pack to the top in the next decade.
- ◆ Expanding STEM education and career opportunities for underrepresented groups, including women and girls.

Educate to Innovate is just one program – there are many initiatives that provide opportunities for corporate and non-profit partners to join the effort. We must all recognize this as our national responsibility and do our part to contribute to educational efforts across the country.

National Grid's Approach

At National Grid, we are committed to focusing a significant portion of our community investment on building a qualified and successful engineering workforce. Through our corporate giving programs, employee volunteerism and internal leadership and development activities, we have created a comprehensive program dedicated to advancing this cause. The program is called **Engineering our Future, and it has three goals: to INSPIRE, ATTRACT and DEVELOP future engineers.** National Grid has already invested more than \$3 million in this program to target students of all ages and backgrounds to encourage them to study science, technology, engineering and math.

PHASE 1: INSPIRE

The process of building a strong engineering corps starts with inspiring our youth to be interested in science, technology, engineering and math (STEM). National Grid's Engineering our Future initiative aims to accomplish this by:

- ◆ Applying a multi-level approach to reach students at all levels of the educational system
- ◆ Reaching out to students both in conventional and unconventional ways
- ◆ Funding research centers to support new and exciting technologies
- ◆ Partnering with organizations that provide programs to educate teachers as well as students

Examples of how we provide multi-level educational support :

- ◆ **Energy Explorer Program** provides an interactive website and educational materials for use in K-8 classrooms. The materials focus on building science, technology, engineering and math skills, and they aim to enhance energy efficiency awareness among teachers and students.
- ◆ National Grid is supporting the **Green Education Foundation's** Green Energy Challenge. It is a comprehensive educational program designed to teach PreK-12 students the science of energy, non and renewable sources and conservation strategies. The program is composed of several hands-on energy science experiments that will help students learn first-hand how to harness the elements to provide clean energy. Experiments include building lab sized wind and water turbines, solar houses and cars. The program also includes all the educational materials required for teachers and students to participate in energy lessons specific to math, science and technology.
- ◆ National Grid is sponsoring **Carbon Crew**, a joint effort of the Audubon New York Montezuma Center and the Syracuse Boys & Girls Clubs. The program will engage urban youth from the Syracuse area in meaningful projects that will focus on native plantings and invasive species management in the Montezuma Wetlands Complex and the Syracuse area during the summer and after school during the fall school year.



And as part of the effort to develop and build skills in future engineers, National Grid is actively working with a number of partners around the region to invest in external training and education programs. Here are just a few examples:

University of Buffalo - UB 2020

A partnership with the University of Buffalo (UB) and the City of Buffalo aims to develop and deliver a five-year program preparing Buffalo's K-12 students to pursue an education and careers in the biomedical and green energy industries. National Grid will provide funding for support facilities, equipment and personnel associated with the delivery of two timely and important programs:

- ◆ **Biomed Industries** — UB's newly launched department of Biomed Engineering will enroll 50 BS, 30 MS and 20 PhD students per year starting in the fall of 2010, with a total student population of 300 to 400 students in five years. As a requirement for graduation, each student's course work will include a research and design project that incorporates an educational service component: to build and deliver active learning projects to students in Buffalo Schools.
- ◆ **Green Energy** — In a parallel program developed and led by the UB Engineering Student Excellence Program, Buffalo Engineering Awareness for Minorities (BEAM) Office and the UB Engineering student organization Engineers for a Sustainable World, we will design and deliver active learning projects to K-12 students to increase understanding of their impact on world's climate.

Clarkson University

National Grid has endowed the "National Grid Student Research Opportunities in Sustainable Energy," which will fund up to eight summer research opportunities each year in the area of sustainable energy. In addition, this funding supports the Clarkson Honors Program, which is built upon current and emerging problems in Science, Technology and Society.

City College of New York

National Grid is making a grant to the Success in Undergraduate Engineering (SUE) program at CCONY, which will offer recruitment and outreach programs and activities to the New York City pre-college population to increase diversity in the engineering student pipeline, as well as the retention and graduation of undergraduate engineers at City College. The program will include a May 2010 event called "Introduce a Girl to Engineering Day," for up to 100 girls in the 6th, 7th and 8th grades.

PHASE 2: ATTRACT

We want engineering graduates to see National Grid as a great place to work.

That's why the centerpiece of Engineering Our Future is a new program called the **Engineering Pipeline Program**. The Pipeline is a six-year development program that creates a recruitment pathway, beginning after junior year in high school, for promising students who want to become engineers. Each year, sixty high school juniors who have strong grades and interest in studying engineering in college will be accepted into the Pipeline. If they study engineering in college, keep their grades up, and participate in ongoing activities – including a paid internship at National Grid, as well as educational, job shadowing and mentoring activities – they will be fast-tracked for full-time employment at National Grid upon graduation.

Summer programs will focus on giving students:

- ◆ Knowledge of the energy industry and an insight into engineering careers at all levels.
- ◆ The confidence to make informed career choices.
- ◆ Positive and inspirational experience in a vital industry with a company that they may know little about.

PHASE 3: DEVELOP

Once engineers are working at National Grid, we want to grow and develop their talents with comprehensive learning programs.

National Grid's formal internal engineering development includes:

- ◆ Engineering Graduate Development Program designed to accelerate the time to competency for new hires
- ◆ Customized technical training programs
- ◆ On the job training and mentoring

- ◆ Annual Expert Training
- ◆ Customized Personal Development Plans
- ◆ Engineering training courses for new technologies
- ◆ Engineering rotation programs designed to enhance competencies
- ◆ Online engineering degree programs

National Grid works to facilitate two-semester Overhead Electric Line Worker certificate programs with the following Community Colleges:

- ◆ Hudson Valley Community College, NY
- ◆ Erie Community College, NY
- ◆ Onondaga Community College, NY
- ◆ Quinsigamond Community College, MA
- ◆ North Shore Community College, MA
- ◆ Middlesex Community College, MA



The Future

We are incredibly excited about Engineering our Future, but we recognize that it is only a small part of what must be done to rebuild the national engineering workforce. We need other corporations, government, education systems and non-profits to band together and contribute to the effort. It may seem like a daunting challenge, but we must keep in mind the historic importance of the end goal. For as long as people have used tools, we have depended on engineers to figure out new ways to explore, improve and build our world.



Engineers discovered irrigation systems, and we had modern agriculture. Engineers saw a route between the Atlantic and Pacific, and we built the Panama Canal. Engineers assembled a rocket ship, and we landed on the moon.

What the next generation of engineers will give us is unknowable. We cannot afford to let engineering become anything less than a critical, treasured part of our workforce. Investing in engineering is investing in our future.

1 ASEE: U.S. is graduating fewer engineers despite rising need. American Society for Engineering Education. June 18, 2008. Web. January 22, 2010. <<http://www.asee.org/about/news/press-release-061808.cfm>>

2 U.S. Power and Energy Engineering Workforce Collaborative. Preparing the U.S. Foundation for Future Electric Energy Systems: A Strong Power and Energy Engineering Workforce. April 2009.

3 Koizumi, Kei, "Science and Engineering Indicators 2010: A Report Card for U.S. Science, Engineering, and Technology." The White House Blog. January 18, 2010. January 22, 2010. <<http://www.whitehouse.gov/blog/2010/01/18/science-and-engineering-indicators-2010-a-report-card-us-science-engineering-and-tec>>

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