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Perspectives on Advanced Nuclear—Human Capacity Development

Southern States Energy Board

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December 12, 2018

TEXAS A&M UNIVERSITY

TEES | TEXAS A&M ENGINEERING EXPERIMENT STATION

Global Interest in Nuclear Energy

- Interest in nuclear is growing substantially around the world
- Many countries have no other recourse to reliable energy sources
- Current technologies may not be well suited to the power grids of many potential “newcomer” countries
- Many are looking at advanced technologies that may be a better fit to their national needs
- A prime example is Africa

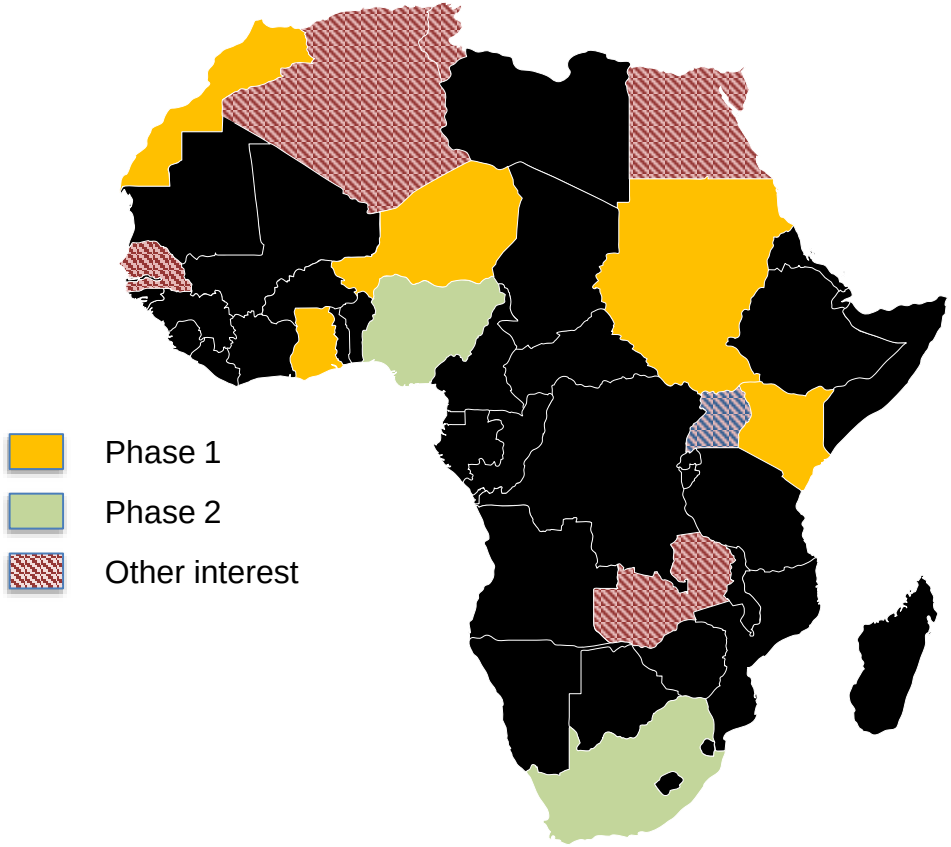
Countries Expressing Interest in Power Applications

- Integrated Nuclear Infrastructure Review

- South Africa
- Nigeria
- Kenya
- Morocco
- Ghana
- Niger
- Sudan

Other Interest

- Egypt
- Tunisia
- Uganda
- Algeria
- Zambia
- Senegal



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Companies are Creating Innovative Advanced Reactors

Light Water Small Reactors
Three in development

NuScale Power Module
60 MWe

GEH BWRX-300

Holtec SMR-160

Non-Water Small Reactors
Dozens in development

X-energy
75 MWe

Terrestrial Energy
192 MWe

GE PRISM
165 MWe and 311 MWe

ThorCon
250 MWe

Micro-Reactors
Ten in development

Westinghouse eVinci
200 kWe to 25 MWe

OKLO
2 MWe

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Human Resource Development for the Nuclear Industry

- In March 2007, the nuclear utilities in Texas approached the Texas A&M University System for assistance in workforce development
- Power stations were anticipating upcoming retirements, and four new reactors were planned
- The need was for the technical workforce, engineers and technicians, in fields other than nuclear
- In December 2007, the A&M System Board of Regents established the Nuclear Power Institute

Department of Nuclear Engineering at Texas A&M University

- *Largest department* of nuclear engineering in the U.S., with 300 undergraduates (excluding freshman) and 150 grad students
- Only university in the U.S. with *two nuclear reactors*
- Exceptional facilities
- Well-known faculty
- Robust, well funded research program
- Recognized on national and international levels
- Website: nuclear.tamu.edu

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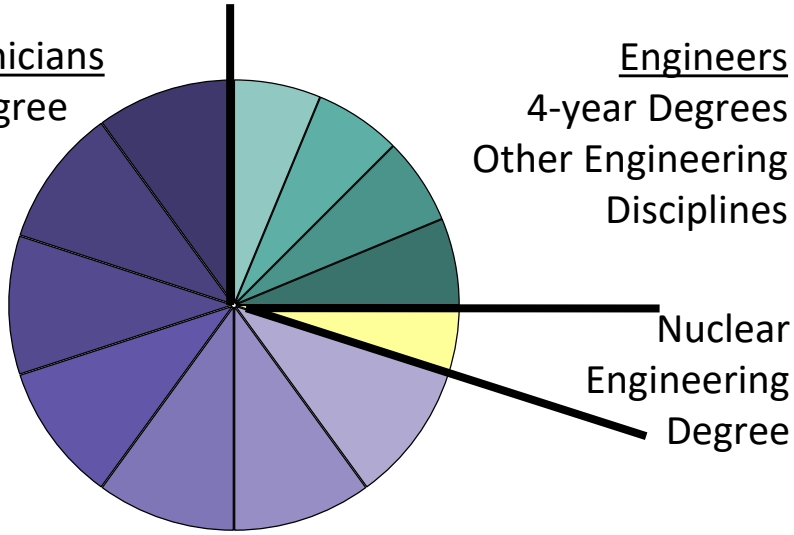
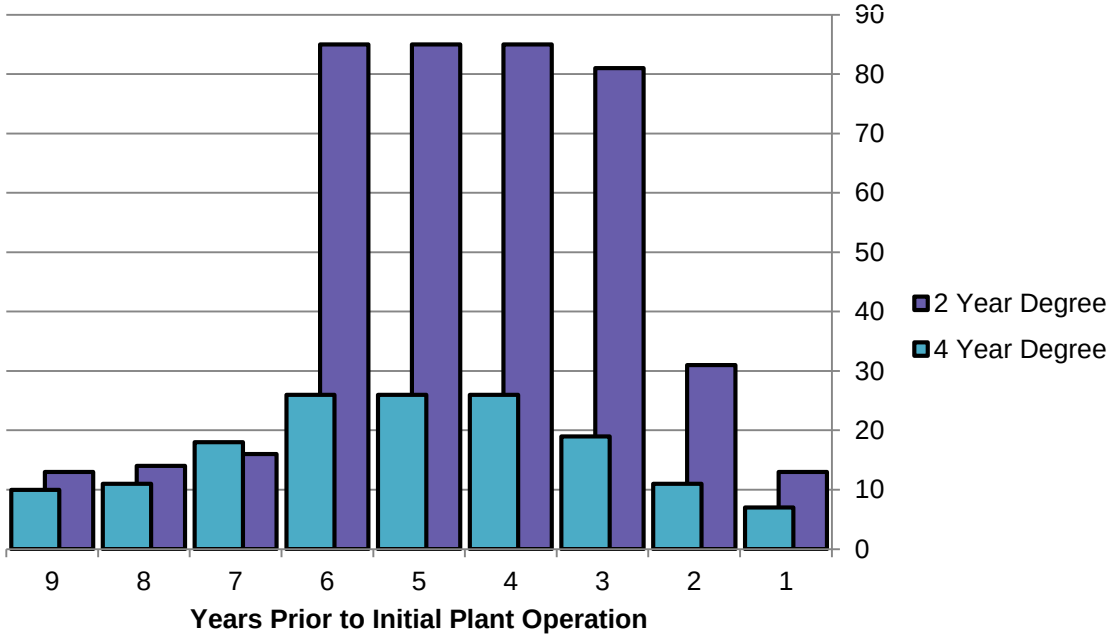
Industry Needs

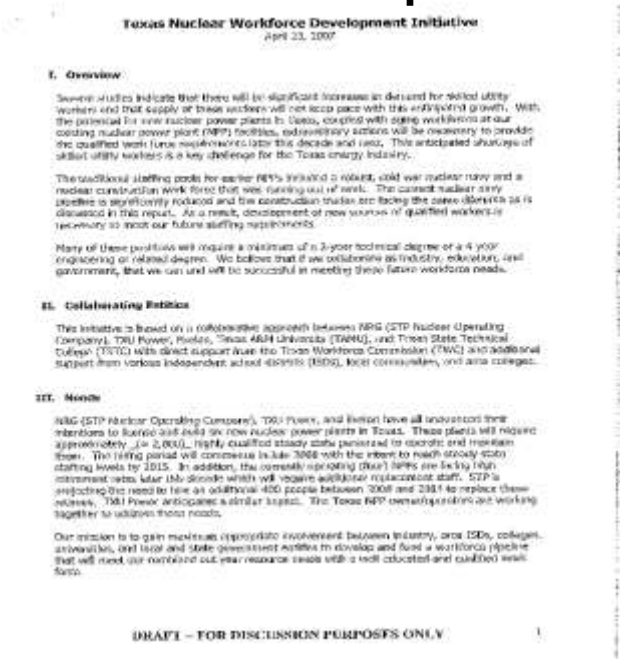
Broader Needs for the Nuclear Workforce
The "Other than Nuclear" Challenge



Timing of Workforce Employment Before Plant Operation



Roadmap



Texas Nuclear Workforce Development Initiative

April 23, 2007

I. Overview

Several studies indicate that there will be significant increases in demand for skilled utility workers and that supply of these workers will not keep pace with this anticipated growth. With the potential for new nuclear power plants in Texas, coupled with aging workforces at our existing nuclear power plant (NPP) facilities, extraordinary actions will be necessary to provide the qualified work force requirements into this decade and next. This anticipated shortage of skilled utility workers is a key challenge for the Texas energy industry.

The traditional staffing pools for earlier NPP's included a robust, cold war nuclear navy and a nuclear construction work force that was running out of work. The current nuclear navy pipeline is significantly reduced and the construction trades are facing the same dilemma as is discussed in this report. As a result, development of new sources of qualified workers is necessary to meet our future staffing requirements.

Many of these positions will require a minimum of a 2-year technical degree or a 4 year engineering or related degree. We believe that if we collaborate as industry, education, and government, that we can and will be successful in meeting these future workforce needs.

II. Collaborating Entities

This initiative is based on a collaborative approach between NRG (STP Nuclear Operating Company), TXU Power, Huston, Texas A&M University (TAMU), and Texas State Technical College (TSTC) with direct support from the Texas Workforce Commission (TWC) and additional support from various independent school districts (ISDs), local communities, and area colleges.

III. Needs

NRG (STP Nuclear Operating Company), TXU Power, and Exelon have all announced their intentions to license and build six new nuclear power plants in Texas. These plants will require approximately [illegible] highly qualified steady state personnel to operate and maintain them. The hiring period will commence in late 2008 with the intent to reach steady state staffing levels by 2015. In addition, the currently operating Texas NPPs are facing high retirement rates later this decade which will require additional replacement staff. STP is projecting the need to hire an additional 400 people between 2008 and 2011 to replace these retirees. TXU Power anticipates a similar impact. The Texas NPP owners/operators are working together to address these needs.

Our mission is to gain maximum appropriate involvement between industry, area ISDs, colleges, universities, and local and state government entities to develop and fund a workforce pipeline that will meet our nuclear out year resource needs with a well educated and qualified work force.

DRAFT – FOR DISCUSSION PURPOSES ONLY

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- Established in 2007, NPI is a ***integrated approach and a partnership*** of
  - *industry,*
  - *universities,*
  - *two-year technical and community colleges,*
  - *high/secondary schools and junior highs,*
  - *students and teachers,*
  - *communities,*
  - *stakeholders,*
  - *elected leaders,*
  - *state, federal, and international agencies*

- The NPI focus is on *preparing the workforce* for the nuclear industry and *building public understanding and acceptance* of nuclear energy

Structure of the Programs

1. Partnership with universities for distance delivery programs focused *on engineers in disciplines other than nuclear* (i.e. mechanical, electrical, chemical, civil, environmental and others)
2. New associate degree programs with community colleges to prepare graduates to go into training for *technician positions*
3. *Outreach* to high school and junior high students, teachers and communities with information about the nuclear industry and encourage interest in STEM fields for post-secondary studies
4. Work through a *network*

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Engineers Certificate Program
A Unique and Innovative Approach

Partner Universities

- Mech Engr
- Elec Engr
- Chem Engr
- Civil Engr
- Engr Physics
- Engr Technology

+

NPI Nuclear Power Certificate

- Fundamentals
- Systems-BWR/PWR
- Operations
- Human Performance

- Plus potential new courses

Outcome

Graduates with *Academic Backgrounds, Credentials* and *Hiring Advantages* for Jobs at Nuclear Power Plants

Approach: Distance delivery of courses based on industry input and needs.

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NPI University Partners
Build on Strong Existing Programs

Proximity to plants

Recognized engineering and science disciplines

Develop programs to meet utility needs

Tarleton State University

PRAIRIE VIEW A&M UNIVERSITY 1876
The Panther Pipeline

TEXAS A&M UNIVERSITY 1876

TEXAS A&M UNIVERSITY CORPUS CHRISTI

UNT

TEXAS A&M UNIVERSITY KINGSVILLE

System Engineering Initiative

Engage undergraduate engineering students in *interdisciplinary* & *multilevel team* projects sponsored by government / industry to:

- Problems defined by industry partners
- Visit to nuclear power plants
- Work with industry mentors
- Enhance the engineering education of students through real world experiences
- A new educational approach through “externships”
- Examples of projects: thermal analysis of at STP auxilliary building and a GUI depiction of the spent fuel storage pool

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A&M Students Presenting Their SEI Project at a Conference in Prague, Czech Republic

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NPI Community College Partners

Radiation Protection
Digital Instrumentation and Control
Non-licensed operations
Mechanical and electrical maintenance

Associate of Science degree in Nuclear Power Technology

Advanced Certificate in Nuclear Power Technology

WCJC'S NUCLEAR POWER TECHNOLOGY PROGRAM

First year students generating Power for the first time!!!

Electrical/electronics testing, digital measurements, instrumentation, and motor controls

Motor Operated Valve Training

Donning and doffing

The lab also consists of numerous other related nuclear/power plant "hands-on" training activities.

Industrial rated "advanced power generation "trainer

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Exceptional Career Opportunities for Students

- Strong academic background allows graduates to move directly into utility training programs
- Careers are:
  - Attractive, high tech
  - High paying (starting salaries $67,500 per year for new Associate degree recipients)
  - Long lasting (50 years^{+}), and good stability
  - Good opportunities for advancement
  - *Close to home and family*
  - *In an industry identified as key to the national energy future*

Outreach Programs

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Teacher Programs

Student Programs

Communities and Leaders

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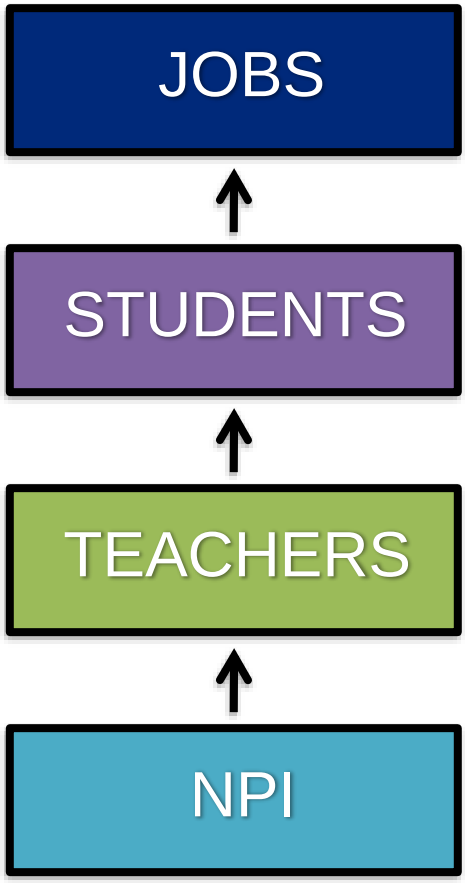
NPI Programs for Teachers



Progression of Programs
International Teacher Exchange
Counselors Making Occupational Readiness Exciting (C-MORE)
Science on Saturday (SOS)
Teacher Research Academy (LLNL)
Teacher Sponsors
Teacher Workshops
Conference for the Advancement of Science Teaching (CAST)

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Outreach to Teachers
Teachers are the KEY!

South Texas Chapter of the Health Physics Society
Interaction of Radiation with Matter
Health and Dose Effects

Conference for the Advancement of Science Teaching (CAST)

- 7000 high school science teachers
- 2000 information packets distributed on nuclear technology

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Teacher Exchanges—Meeting Teachers and Students in Texas

Palacios High School, Palacios, Texas

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Teacher Exchanges—Meeting Decision Makers

Judge Philip Spenrath, Wharton County, Texas

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Teacher Research Academies

TRA

Outreach to Students

- The message moved beyond careers in the nuclear industry
- Encouraged students to consider studies in all STEM fields (Science, Technology, Engineering and Mathematics)
- Many fields needed in nuclear
- Become familiar with nuclear energy
- However, the wider approach has resulted in much broader appeal and more significant impact

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Opportunities for Students

POWER SET

***P**owerful **O**pportunities for **W**omen*
***E**ager and **R**eady for **S**cience,*
***E**ngineering and **T**echnology*

POWER SET and their WIN Mentors

Mentoring younger students 4th, 5th & 6th graders

…to A&M

POWER SET Field Trips…

…to STP

Valerie Segovia, Director of NPI Outreach and Development

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Outcomes

- The outreach effort to teachers and students has been very successful
- Now involves ~1700 students in 18 school districts
- Primarily focused in the vicinity of the nuclear power plants
- The results:
  - Of any group of students graduating from high school/secondary schools and going on for further education
  - Approximately ***15%*** will study in STEM fields
  - For those students who have participated in NPI programs, that percentage is ***83%***
- In addition, these students:
  - Have visited nuclear power plants
  - Have become familiar with nuclear energy
  - Taken away anxieties and mysteries of nuclear energy
- Building a generation that is knowledgeable, comfortable and supportive of nuclear energy

83%

Going Into STEM

15%

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SOS
Science on Saturday
For students and the community

- Demonstrations and experiments geared to junior high and high school students and to families

- Organized and presented by POWER SET and WIT members

- SOS aims to stimulate scientific inquiry and promotes student interest

- Tenth event held April 21, 201 at Stephenville High School

- Anticipated 350 participants, over 500 took part

- Next event, El Campo High School, February 23, 2019

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NPI International Collaboration

- Algeria
- Antigua and Barbuda
- Argentina
- Australia
- Bahamas
- Bangladesh
- Belarus
- Brazil
- Bulgaria
- Chile
- China
- Croatia
- Czech Republic
- Dominica
- Egypt
- Finland
- France
- Ghana
- Hungary
- Indonesia
- Jamaica
- Japan
- Jordan
- Kenya
- Malaysia
- Mexico
- Mongolia
- Niger
- Nigeria
- Philippines
- Poland
- Romania
- Russia
- Saudi Arabia
- Slovakia
- Slovenia
- South Africa
- South Korea
- Spain
- Sri Lanka
- Thailand
- Trinidad and Tobago
- Tunisia
- Turkey
- Uganda
- Ukraine
- UAE
- UK
- Vietnam
- Zambia

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Group Fellowship Training and Scientific Visits

- In collaboration with the IAEA, these are opportunities for newcomer countries
- Develop *tailor-made* training programs to address the needs identified by the participants
- Workshops for countries considering the use of nuclear energy
- One to four weeks in length
- 10-30 participants
- Usually multi-disciplinary groups
- Utilize capabilities at Texas A&M and in Texas
- Lecturers drawn academia, industry, government, legal and financial communities

Specialized Workshops on Topics of Interest

- Implications of a National Nuclear Energy Program
- Role of an Independent Regulatory Body
- Safety
- Nuclear Communications, Outreach and Public Acceptance
- Emergency Preparedness and Response
- Senior Executive Leadership Training
- Key Decision Maker Workshop

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Meet with Decision Makers/Elected Officials

- An opportunity to interact with elected officials regarding public acceptance and public communication about nuclear energy

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Visit to Operating Nuclear Power Plants

- Meet with CEO's, CNO's and senior officials
- Briefings on many aspects including operations, radiation protection, siting, regulation, security, human resources, recruiting

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Emergency Preparedness and Response February 18-March 2, 2018

- Attend a “dress rehearsal” for an EPR exercise at STP
- See first hand how emergency management and response is implemented
- Attended by NRC and FEMA
- Exercises at “Disaster City”, a unique training facility
- Next event: June 2-14, 2019

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Participation in the STP Drill

Matagorda County Emergency Operations Center

STP Emergency Operations Facility

Joint Information Center

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Key Decision Maker Workshop

- Members of the Kenyan Parliament
- May 21-26, 2017
- Three members of the Kenyan National Assembly, including the chair, vice chair and incoming chair of the Energy Committee
- Program included meeting with elected officials and their representatives, visit with the business community in Matagorda County, tour of the Comanche Peak Nuclear Power Plant, visit to Wharton County Junior College, tour of Disaster City and lunch with students at Glen Rose High School
- Next event, August 26-31, 2018 with Members of Parliament and Ministers of Government from Uganda

Lunch with Students

Members of POWER SET and WIT at Glen Rose High School

The visitors hear about life in Texas!

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Evaluation/Perspectives

- *Meeting with the judges: "It was great hearing directly from the leadership at the grassroots…on nuclear issues."*
- *Meeting with the business community: "Splendid. Heard first hand of the support for the nuclear power plant."*
- *Visit to CPNPP: "This was the highlight of the visit." "Safety and security were clearly outstanding."*
- *Overall value: "The whole program will be very useful to Kenya as we work to implement what we learnt. The partnership of Texas A&M and KNEB is a great idea that must be encouraged to grow further." "A great eye-opener. We have a lot to do in Kenya." "Inspiring"*

NPI – A Vibrant and Robust Partnership

- *A comprehensive, integrated approach*
- *Working with industry* on needed programs
- Bringing together the *2-year community colleges and 4-year universities*
- Informing and involving *civic and elected leaders, and stakeholders*
- Developing effective *outreach and recruiting* programs with teachers and students
- Responding to the *key human resource development challenge*
- An *"end-to-end"* program, starting with pre-schoolers through graduate students, teachers and professionals
- Share experiences and lessons learned nationally and internationally

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The Desired Outcome

A Key Goal!