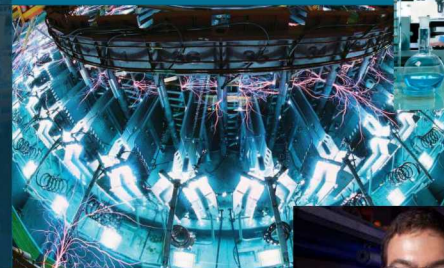SAND2019-4630PE

Sandia National Labs:
Excerpts from the Mk21 Fuze Replacement Program, and Techno-Economic Analysis with ParaChoice.

Camron Proctor

April 26, 2019

Agenda

Sandia
- National Security
- Opportunities to Connect

Mk21 Fuze Program
- NNSA's Role
- Mk21 Story
- Thunderpipe Video

ParaChoice
- What is ParaChoice?
- Why do we trust it?
- How is it used?

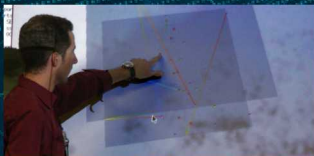# Fulfilling Our National Security Mission

Nuclear Deterrence

Defense Nuclear Nonproliferation

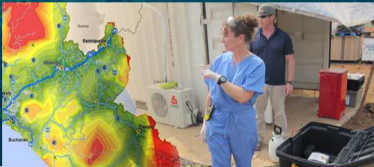**National Security Programs**

Energy & Homeland Security

Advanced Science & Technology

Sandia's Impact

As a multi-faceted national security laboratory, Sandia develops advanced technologies to ensure global peace.
Sandia is often called upon to respond to high-profile events, including 9/11 and the Ebola outbreak.

Ebola Outbreak

Sandia contributes to global response of Ebola outbreak by developing a sample delivery system cutting the wait time and potentially fatal exposure.

Cleanroom invented 1963

$50 billion worth of cleanrooms built worldwide. They're used in hospitals, laboratories and manufacturing plants today.

9/11

Sandia sets contingency plans for release of materials and aircraft attacks on critical facilities immediately after 9/11. Search dogs are equipped with cameras for search and rescue K-9 handlers. The capability allowed search efforts to be carried out in spaces inaccessible to humans.

Detecting IEDs

Combat personnel now have a new tool for uncovering improvised explosive devices: Sandia's highly modified miniature synthetic aperture radar system, which is being transferred to the U.S. Army.

Internships

Encourages qualified students to develop interests in critical skills areas related to our mission, with the ultimate objective of developing our pipeline for our future. Available for Summer, Year Round and Co-op.

Eligibility Criteria

- Min. cumulative GPA (3.0 Undergrad/Grad)

- Have U.S. citizenship for positions that require clearance or as stated in the job posting

- Full-time enrollment status at an accredited college, university, or local high school

- At least 16 years of age

Postdoc Opportunities

Key areas for post-docs at Sandia:.

- Computer science/Computer Engineering
- Electrical Engineering
- Mechanical Engineering
- High-performance computing
- Microelectronics and microfluidics
- Nanotechnology

- Physics
- Chemistry/ Electro Chem
- Biosciences and biotechnology
- Radiation & electrical sciences
- Engineering sciences
- Pulsed power sciences
- Materials science & engineering

Eligibility Criteria

- A recent PhD (conferred 5 years prior to employment) or the ability to complete all PhD requirements before hire date.

Postdoctoral Fellowships

- Harry S. Truman Fellowship

- Jill Hruby Fellowship

- John Von Neumann
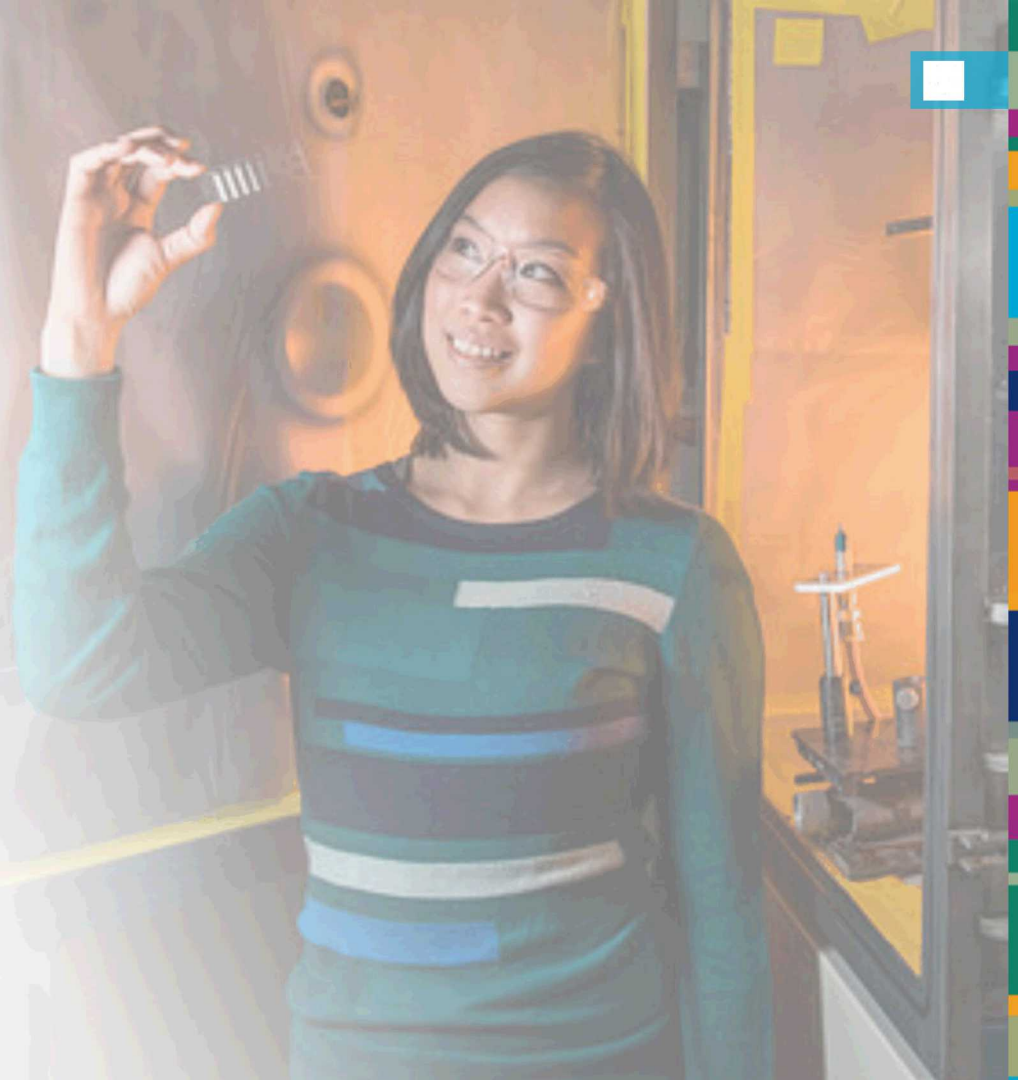
Agenda

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ParaChoice
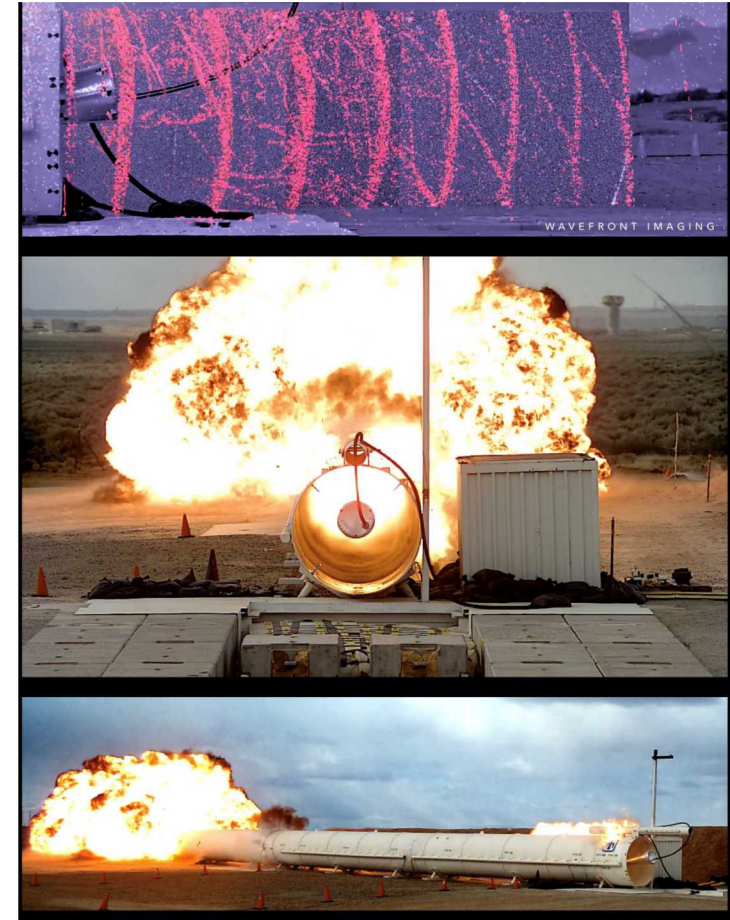- What is ParaChoice
- Why do we trust it?
- How is it used

As the nation's NNSA Engineering Lab, Sandia is responsible for a large portion of Stockpile Management

❑ NNSA Core mission is to ensure safe secure &

reliable nuclear stockpile.

❑ Most weapons were produced during 1950s & 1960s

❑ The United States Voluntarily ended underground
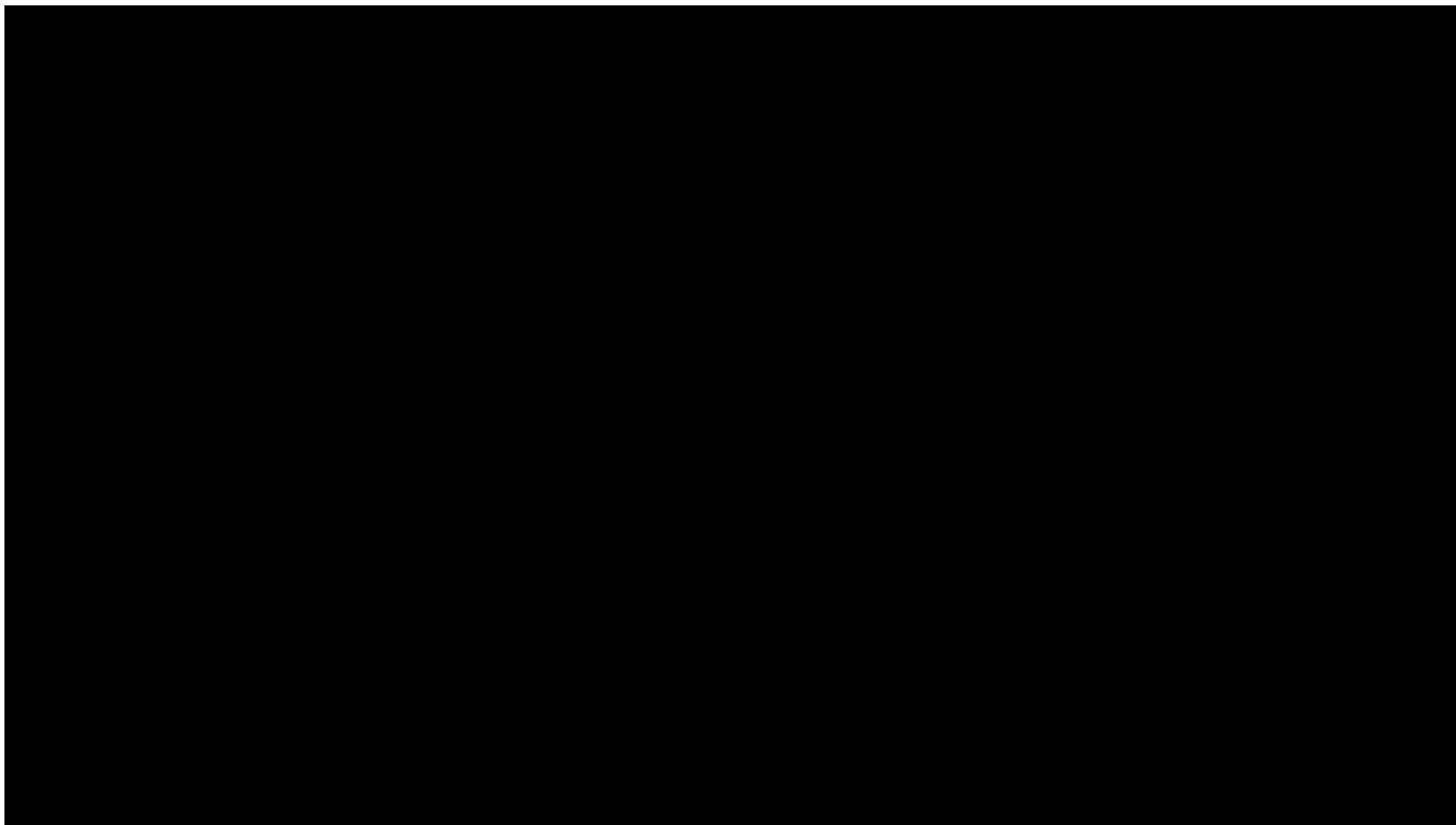
nuclear explosive testing

Sandia provides an opportunity to work on complex multidisciplinary projects, like the Mk21 Fuze.

- ❑ Fuzing means sending the signal to detonate
- ❑ DOD has responsibility of Arming and Fuzing
- ❑ For Safety, Security and Reliability Reasons a drop in replacement is being designed for the Mk21/W87

Thunderpipe Test Video

Agenda

Sandia

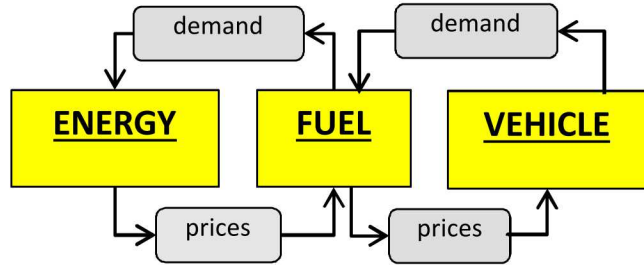- National Security
- Opportunities to Connect

Mk21 Fuze Program

- NNSA's Role
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- Thunderpipe Video

ParaChoice

- What is ParaChoice
- Why do we trust it?
- How is it used

ParaChoice Projects the adoption of new technologies, emissions, and petroleum consumption out to 2050

Takes a full system model approach leveraging the interrelated nature and complexity of the transportation space

Understand and Mitigate the inherent uncertainty from data sources and simplifying assumptions

Identifies Trade Spaces Tipping Points and Sensitivities
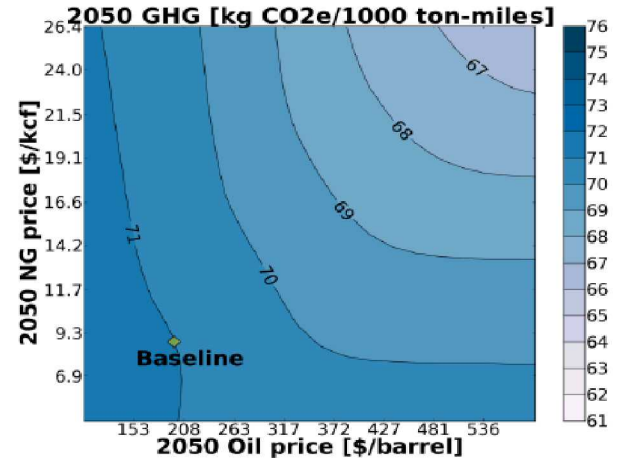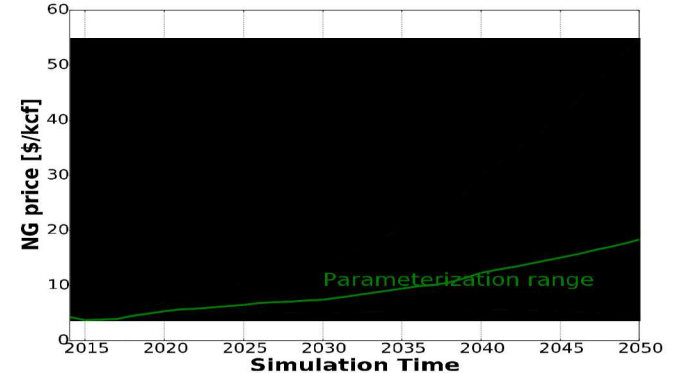
ParaChoice provides projections not predictions.

Baseline: S-Curve Model Availability

Historical Model Availability
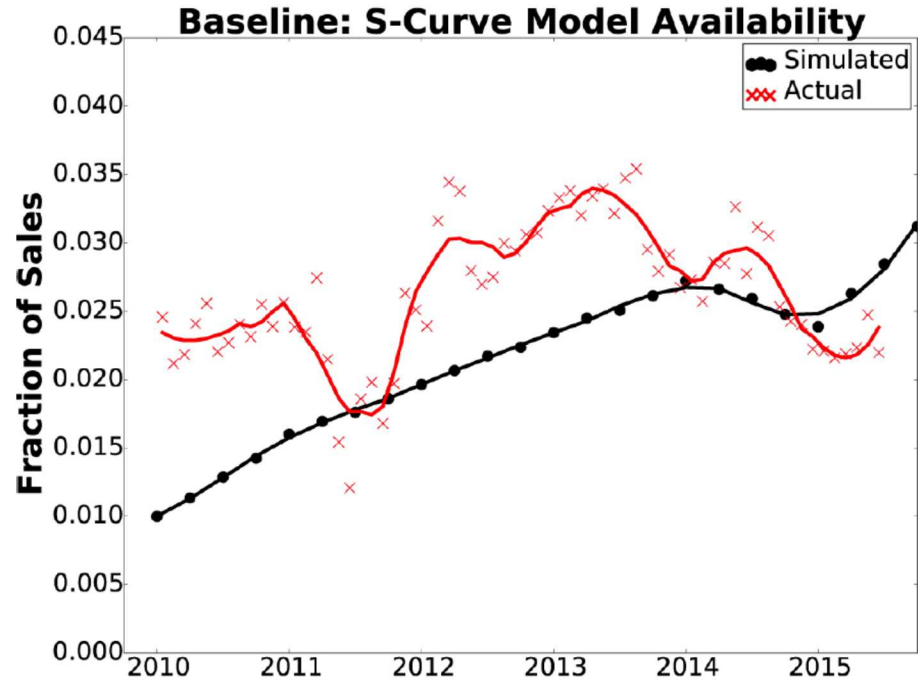
Data shown for hybrid LDV.
- Left is S-Curve adoption assumption
- Right is based on historical data
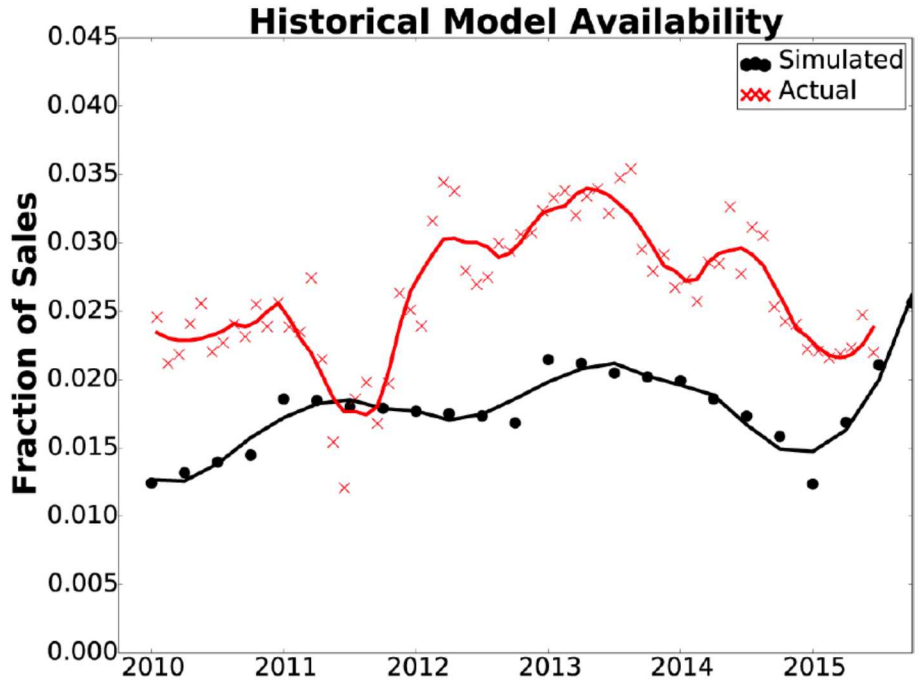
Dip in 2011 attributed to Japanese Tsunami

Simulation under predicts this segment

We investigated the effects of Convenient away-from-home charging (CAFHC) to understand the investment opportunity.

Close correlation between being able to charge a PHEV/BEV and purchasing

Enabling new infrastructure will therefore need to precede adoption

Infrastructure is a significant financial investment

○ How much is enough?

○ Is there a point of diminishing returns?

Vehicles with at-Home Charging

Conventional

HEV   BEV 100

PHEV 20

FCEV

PHEV 40

BEV 200, 300

2050 Sales (%)

Extra Range Available (miles/day)
From Convenient Away-From-Home Charging
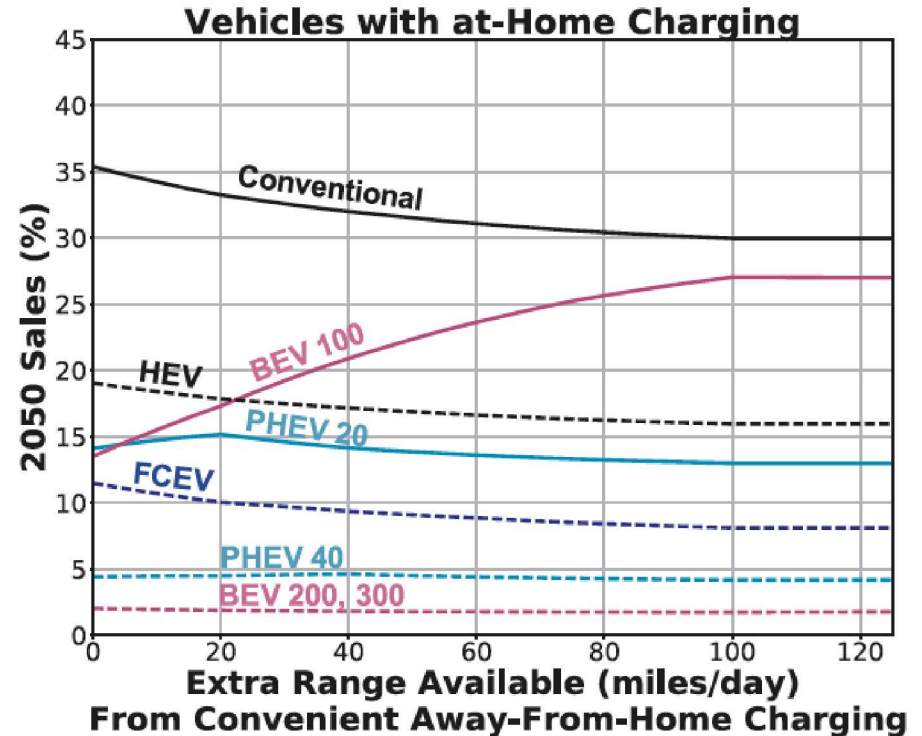
ParaChoice captures the value of investments through different metrics.
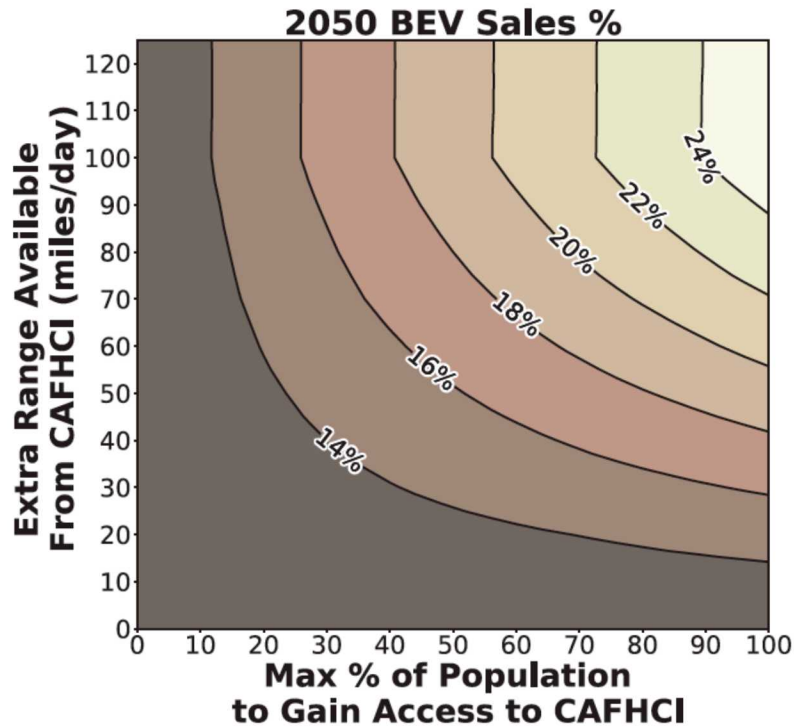
(a) BEV Sales
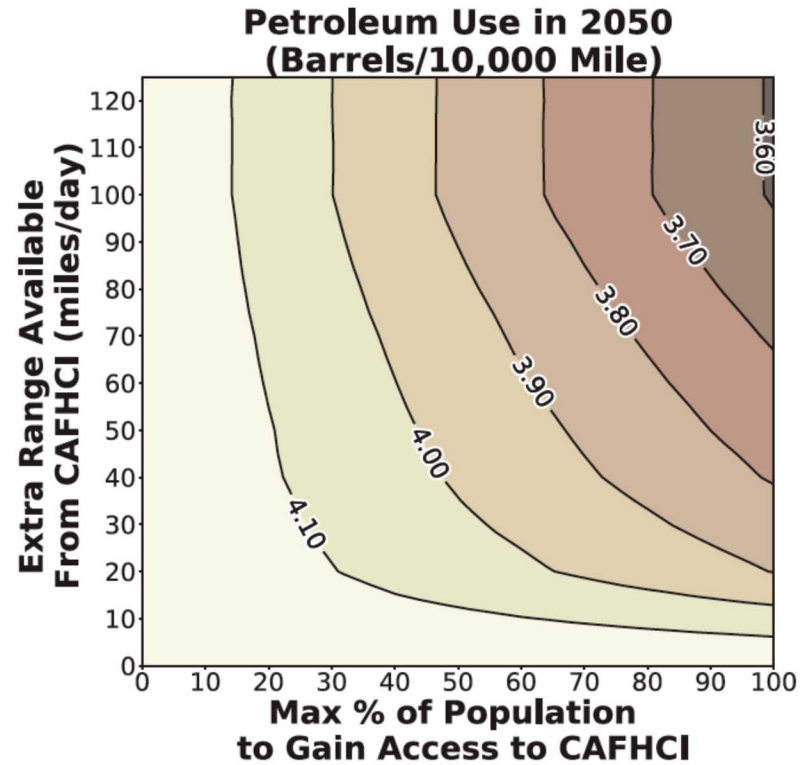
(b) Petroleum Use

We have built a stable and respected LDV capability and we have set our sights on doing the same in the HDV segment.

- ❑ Adding Capabilities to an existing framework
- ❑ Taking a deep dive into HDV to find opportunities for analysis

Average annual ton-mileage per vehicle by vocation
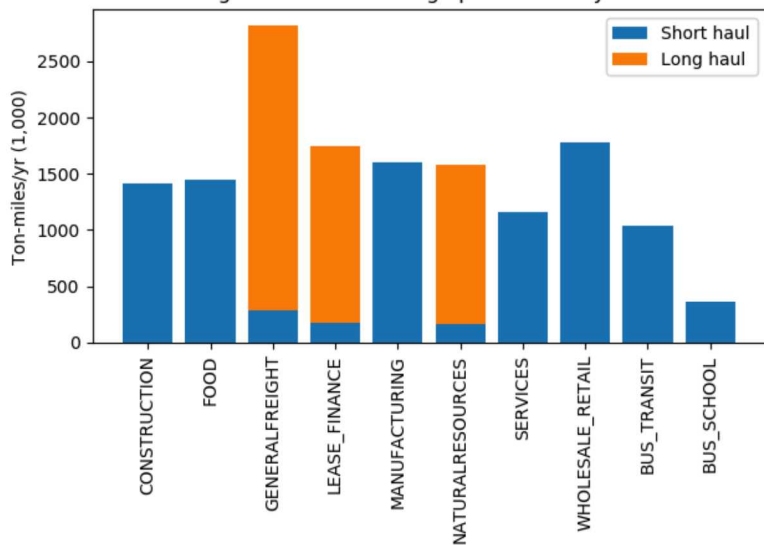
Ton-miles/yr (1,000)

Legend: Short haul, Long haul

X-axis: CONSTRUCTION, FOOD, GENERALFREIGHT, LEASE_FINANCE, MANUFACTURING, NATURALRESOURCES, SERVICES, WHOLESALE_RETAIL, BUS_TRANSIT, BUS_SCHOOL

Row Categories*
- Energy Sources
- Vehicles
- Fuel Production
- Infrastructure
- Consumers
- Economics

*Total of ~100 data types

Column Headers
- Parameter
- In ParaChoice
- Data Quality
- Analysis Impact
- Analysis Question
- Citations
- Opportunities

Fuels
- Diesel Petroleum
- LNG Petroleum
- CNG petroleum
- Biodiesel
- Fisher-Tropsch
- Methane Reformation
- 5 H2 Pathways
- DME
- Electricity
- (Fossil)
- Electricity (Renewable)
- Electricity (Biomass)

Powertrains
- Conventional
- Biodiesel
- CNG
- LNG
- FC
- BE

Vehicles (Class 7 & 8)
- TT- Van Basic
- TT- Van refrigerated
- TT- Dump
- TT- Flatbed/stake /platform
- TT- Tank
- SUT- Van Basic
- SUT- Van Refrigerated
- SUT- Refuse
- SUT- Construction
- SUT- Dump
- SUT- Flatbed/platform/stake
- SUT- Tank
- Motorhome
- Bus- School
- Bus- Transit

Summary

National Security mission encompasses nearly all STEM fields

Numerous openings for graduate students and Postdocs

Sandia is hiring for Nuclear Deterrence work like the Mk21 Fuze

Non-nuclear work is available on projects like ParaChoice.

Thank You!

Backup Slides

Thunderpipe Video Backup

[Mk21 Fuze Video- Youtube](#)

Available Videos
Videos require wifi in order to play

[Sandia Mission Video](#) (4:36)
[Sandia Our Roots](#)(3:05)

Location Videos
[Sandia New Mexico Location](#) (3:23)
[Sandia California Location](#) (3:41)

Diversity & Inclusion Videos
[Black Leadership Outreach](#)
[Asian Leadership Outreach](#)
[American Indian Outreach](#)
[Hispanic Leadership Outreach](#)

*For more Sandia Videos refer to [Sandia's YouTube Channel](#)

Institute Internships

Institute Programs Website

- AutonomyNM
- Center for Computing Research (CCR)
- Interns for Security, Arms Control, and Force Protection Engineering (iSAFE)
- Mathematics & Analytics Research Technical Internship for Advanced National Security (MARTIANS)
- Mission Services Talent Acquisition Team (MSTAT)
- Nonlinear Mechanics and Dynamics (NOMAD)
- Nuclear Weapons Summer Product Realization Institute (NWSPRINT)
- Research and Applications of Mechanics of Structures (RAMS)
- Science of Extreme Environments Research Institute (SEERI)
- SENTINL: Energy Surety Incubator (ESI)
- TITANS: Center for Analysis Systems and Applications (CASA)
- TITANS: Center for Cyber Defenders (CCD)
- TITANS: Interdisciplinary Design, Engineering, and Assurance Students (IDEAS)
- TITANS: Monitoring Systems and Technology Intern Center (MSTIC)
- TITANS: RISE

Template Slide

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