



Pacific Northwest  
NATIONAL LABORATORY

Proudly Operated by **Battelle** Since 1965

# Leading the Nation in Clean Technology



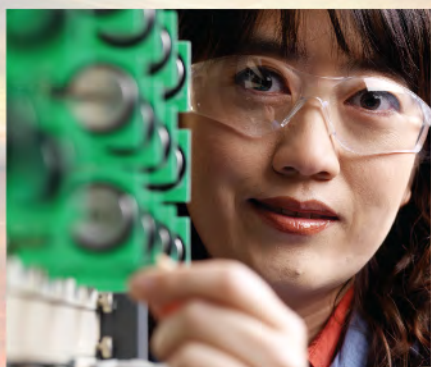
**Dr. Steven Ashby**

Laboratory Director  
Pacific Northwest National Laboratory

June 27, 2016

DISCOVERY

*in Action*





**\$955M**

FY15 Budget



**4,400**

Employees



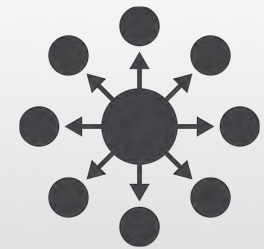
**181**

R&D100 and FLC  
Awards



**2,469**

U.S. and International  
Patents

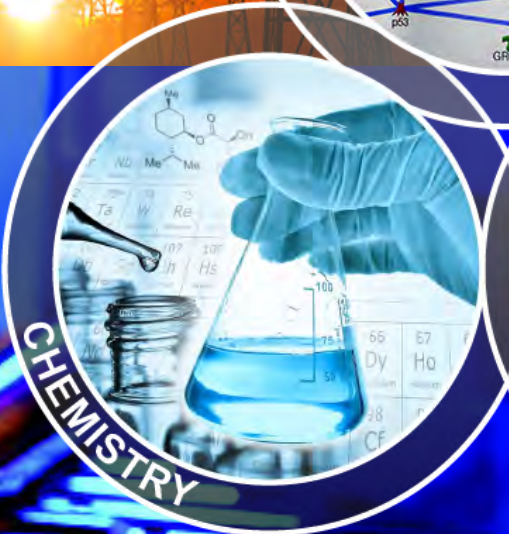
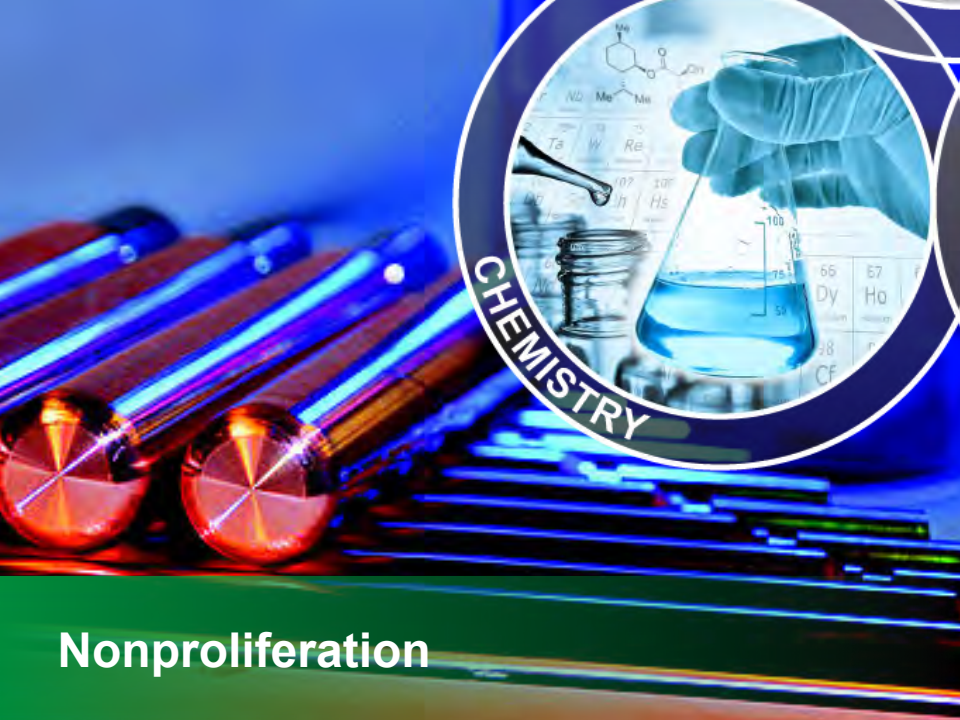
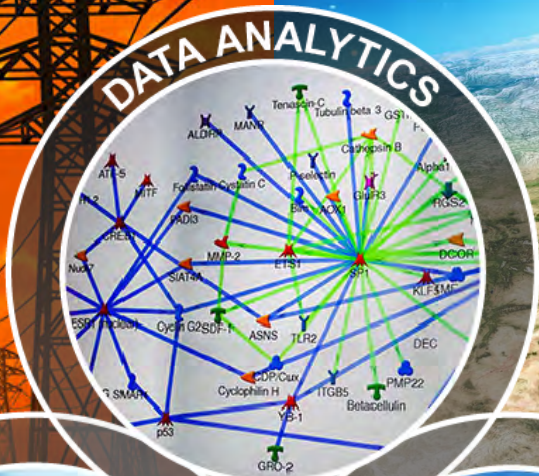


**99**

Spin-off Companies  
**71 in Washington**

Grid

Climate



Nonproliferation

Remediation

# KEEPING THE LIGHTS ON

in a safe, secure, and sustainable manner

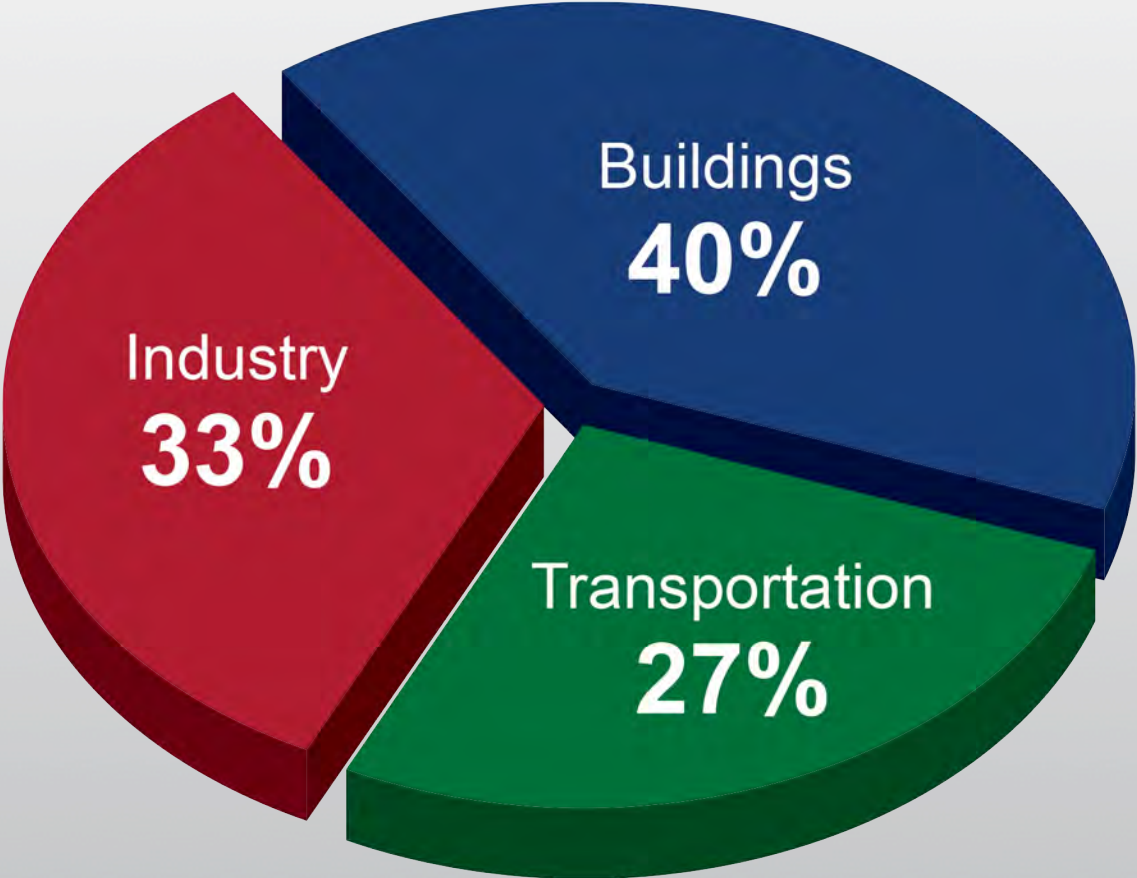


# WHAT BRINGS US TOGETHER TODAY?

A shared passion for a clean, sustainable future  
*driven by Northwest innovation*



# 2014 U.S. Energy Consumption by Sector



Source: U.S. Energy Information Administration (2015)

An aerial view of a multi-lane highway with heavy traffic. The highway is elevated and runs through a city. In the background, several large stadium domes are visible, including the Lumen Field stadium. The sky is overcast. The text "Electric & Hybrid VEHICLES" is overlaid in the center of the image.

# Electric & Hybrid VEHICLES

VEHICLES  
10,000+ LBS  
PROHIBITED  
IN LEFT LANES



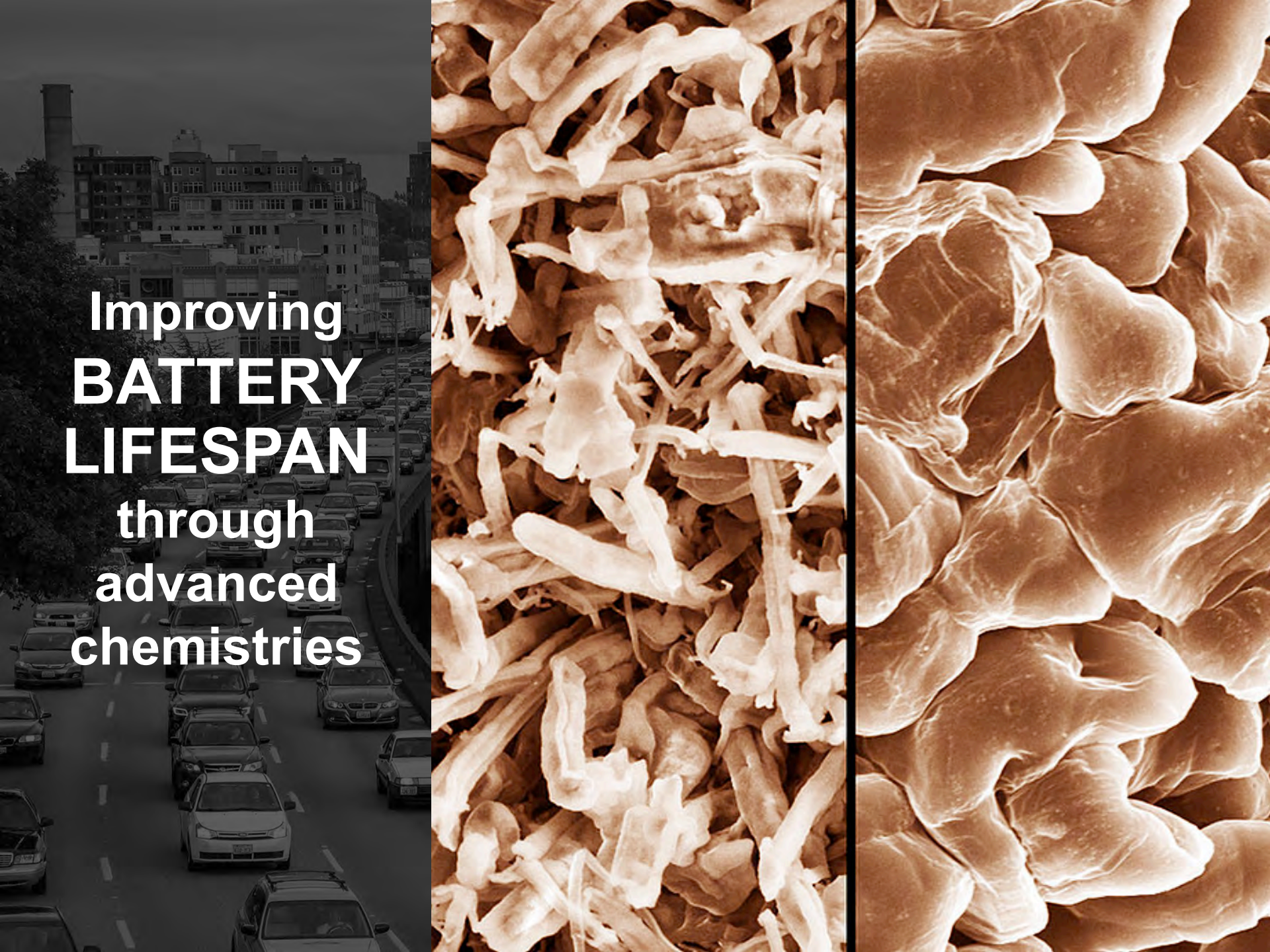
**26% of all U.S. greenhouse gases**

**27% of all U.S. energy use**



EVs  
represent  
less than  
1%  
of the U.S.  
auto fleet  
today

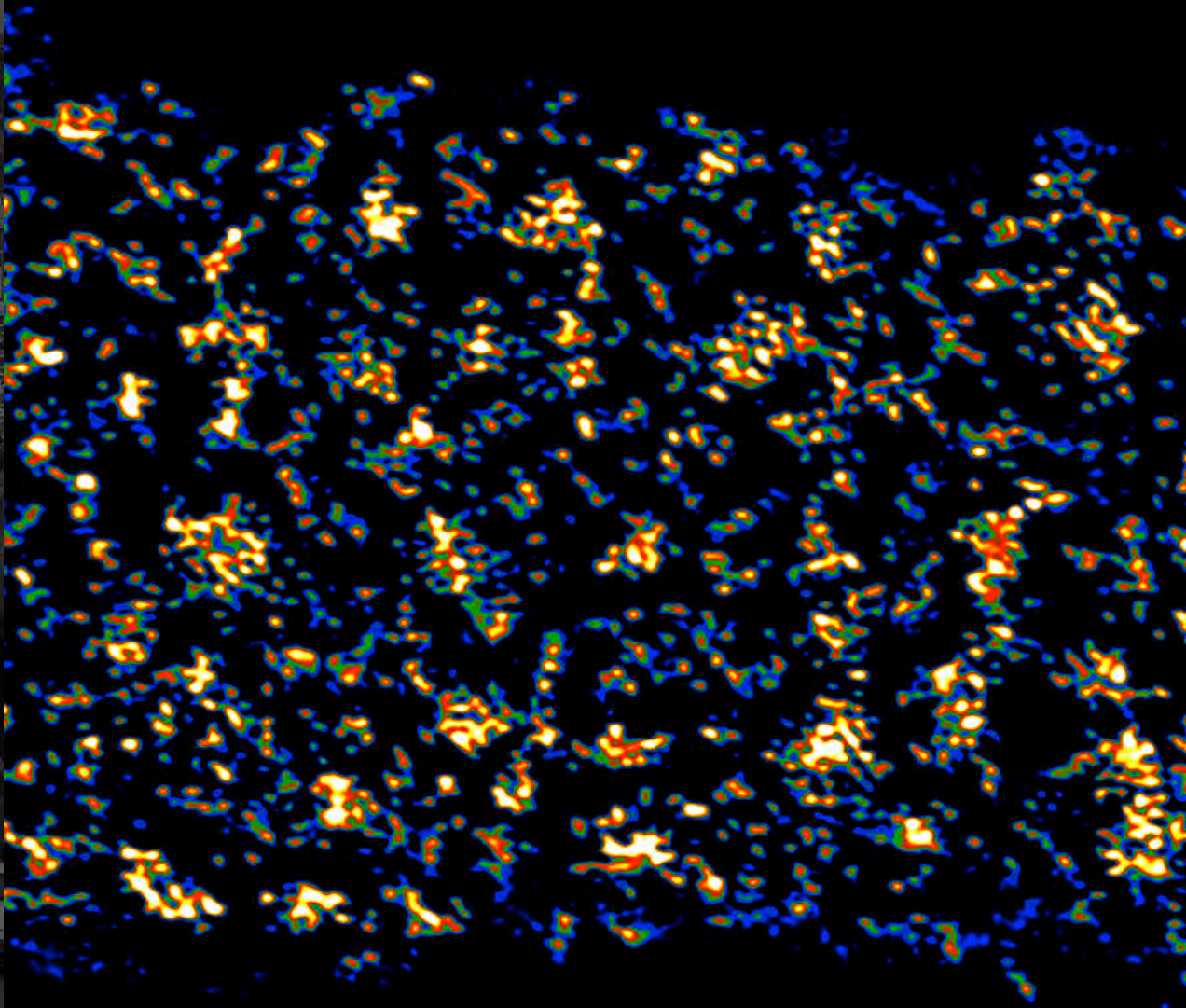




Improving  
**BATTERY**  
**LIFESPAN**  
through  
advanced  
chemistries



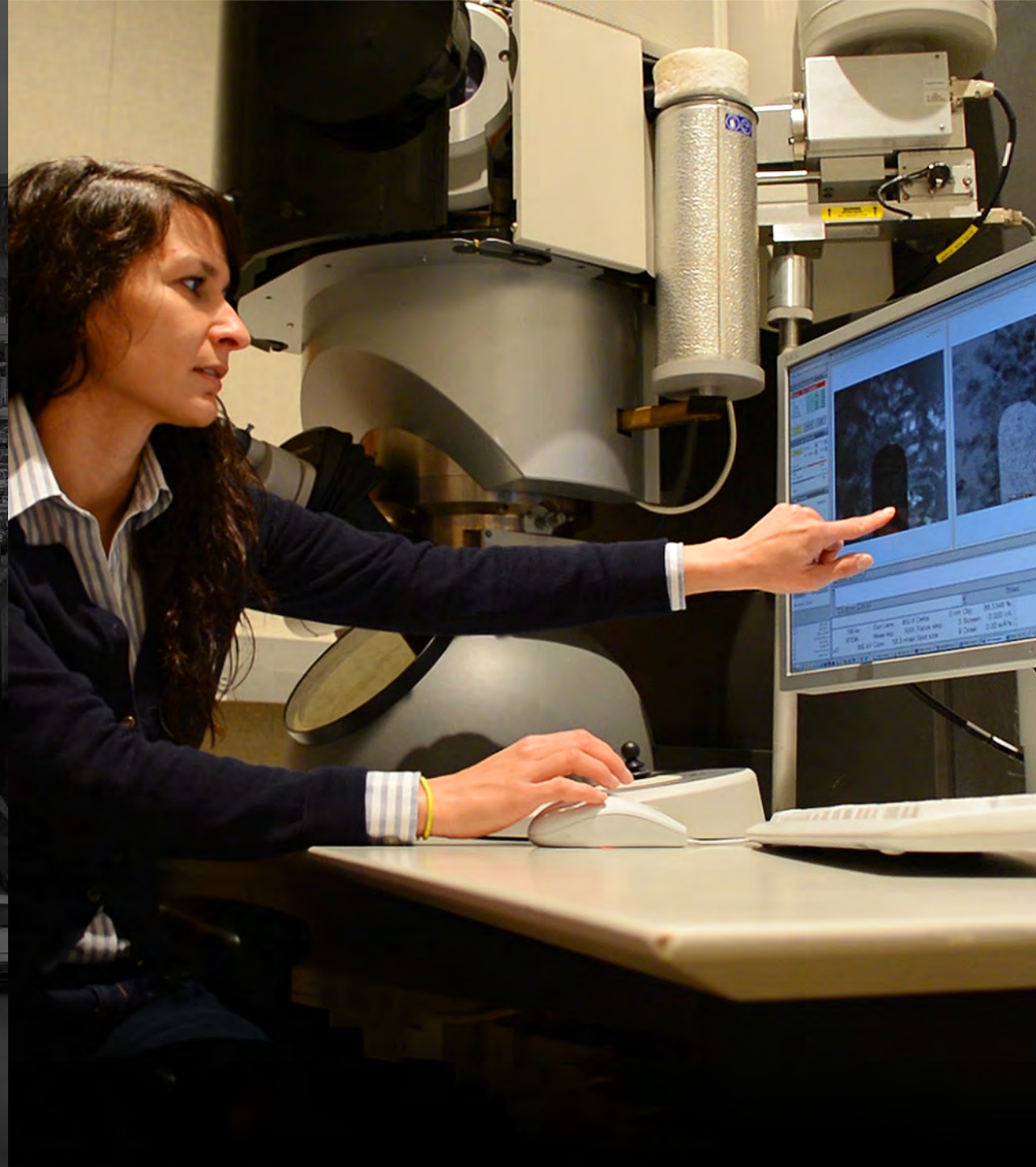
Improving  
**BATTERY**  
**CAPACITY**  
through  
materials  
synthesis

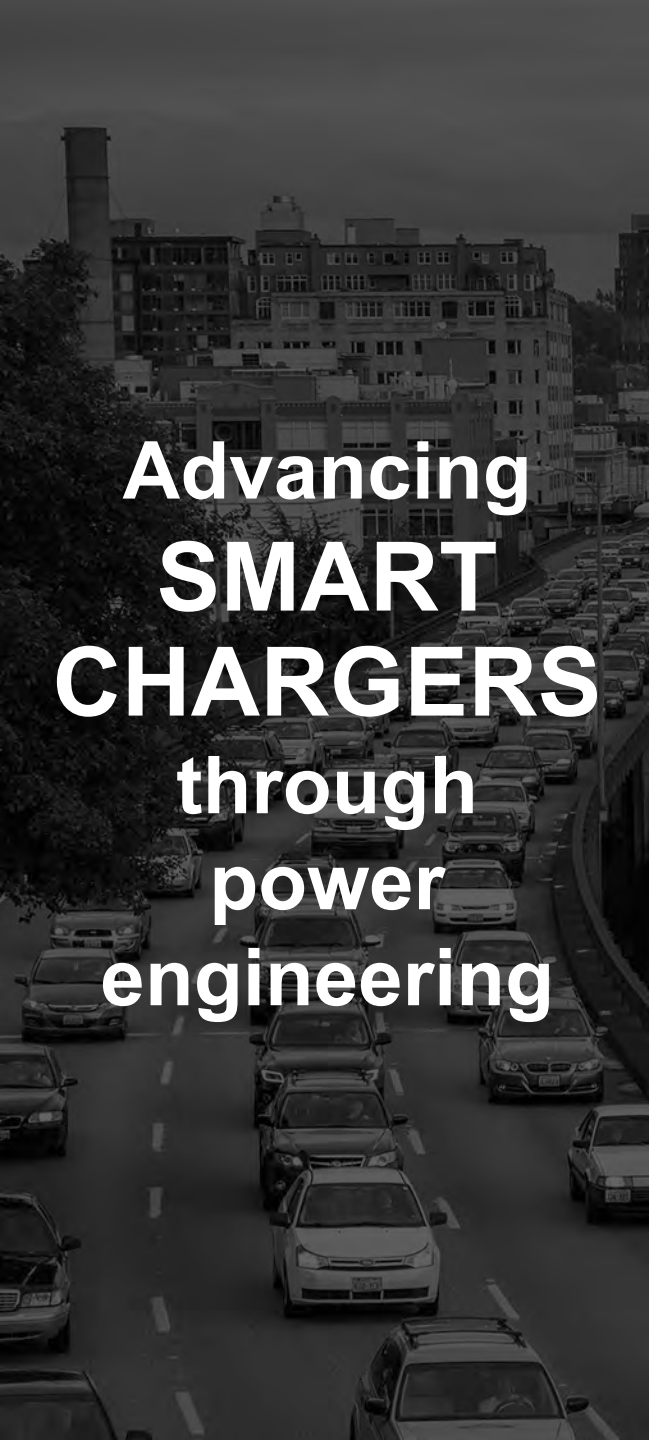


**2 nm**

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Decreasing  
**BATTERY**  
**COSTS**  
through  
electron  
microscopy





Advancing  
**SMART  
CHARGERS**  
through  
power  
engineering



An aerial night view of a city skyline, likely Seattle, with the Space Needle visible in the distance. The city is illuminated with various lights, and the text "More Efficient LIGHTING" is overlaid in the center.

# More Efficient LIGHTING

An aerial, high-angle photograph of a city skyline at night, rendered in a dark, monochromatic style. The image shows a dense cluster of skyscrapers and commercial buildings, with some lights visible on the structures. In the upper left, a prominent tower with a circular observation deck is visible. The overall scene is dark, with the text overlay providing the primary visual information.

**Largest source of energy use  
in commercial buildings**

**12% of total electricity use in U.S.**

Efficient lighting  
will cut  
electricity use

**IN HALF**

by 2030,  
delivering

**\$26B**

in annual savings

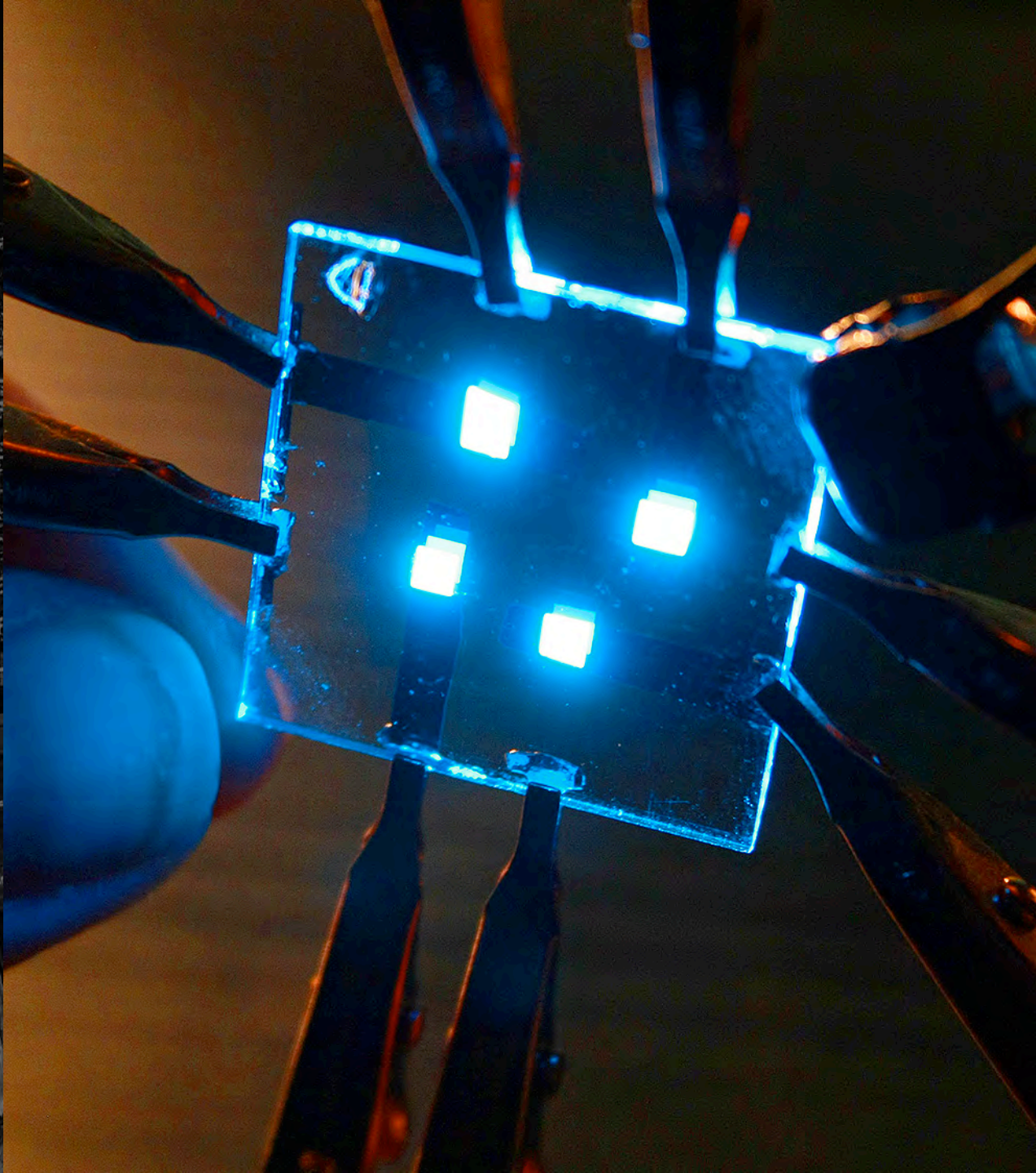






Solid-state lighting:

**Increasing  
LED  
efficiency  
by 25%**



Market Adoption:

Converted

**41,000**

Seattle street  
lamps to LEDs,

saving

**\$2.5M**

annually





# Residential & Commercial **BUILDINGS**



ALL PERSONS  
MUST REPORT  
IMMEDIATELY TO  
THE POLICE OFFICE  
BY PHONE OR IN PERSON  
IF YOU SEE ANY  
SUSPICIOUS ACTIVITY



**38% of all U.S. greenhouse gases**

**40% of all U.S. energy use**



Low-Emissivity  
Windows:

**10-35%  
INCREASE**  
in home  
efficiency  
**at 1/3 the cost  
of new windows**

Building Codes &  
Appliance Standards:

**\$65B**  
**SAVINGS**  
from  
**Appliance**  
**Standards**  
in 2015



Smart and  
Connected  
Buildings:

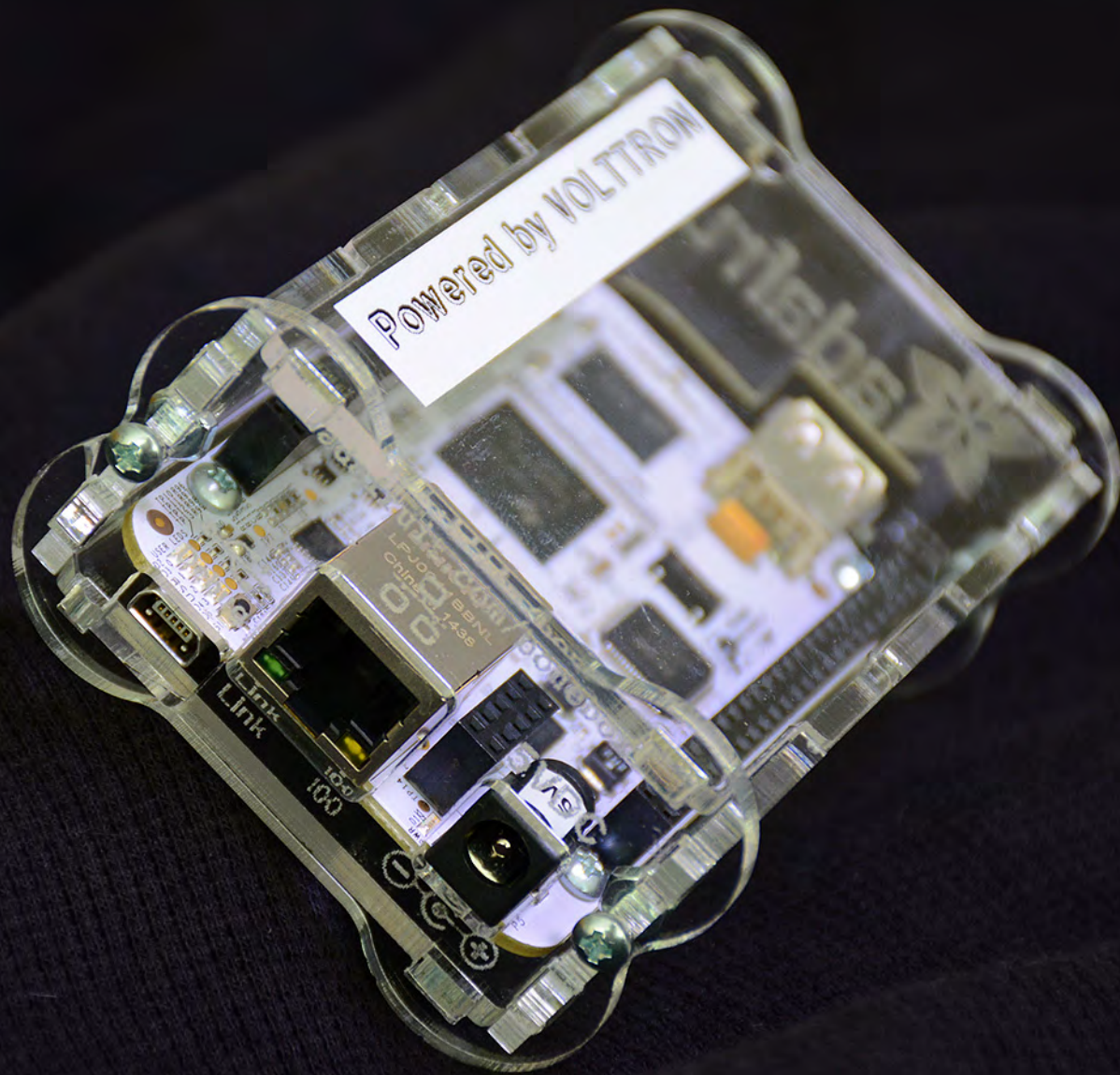
**\$490B**  
**market**

for smart/connected  
home devices  
by 2019



VOLTRON:

**FREE  
PLATFORM**  
that integrates  
**SMART  
DEVICES**  
within a building  
and to the grid







VOLTRON  
Connected Buildings  
Challenge:

Competition  
underway  
to identify  
**MOST  
CREATIVE**  
uses



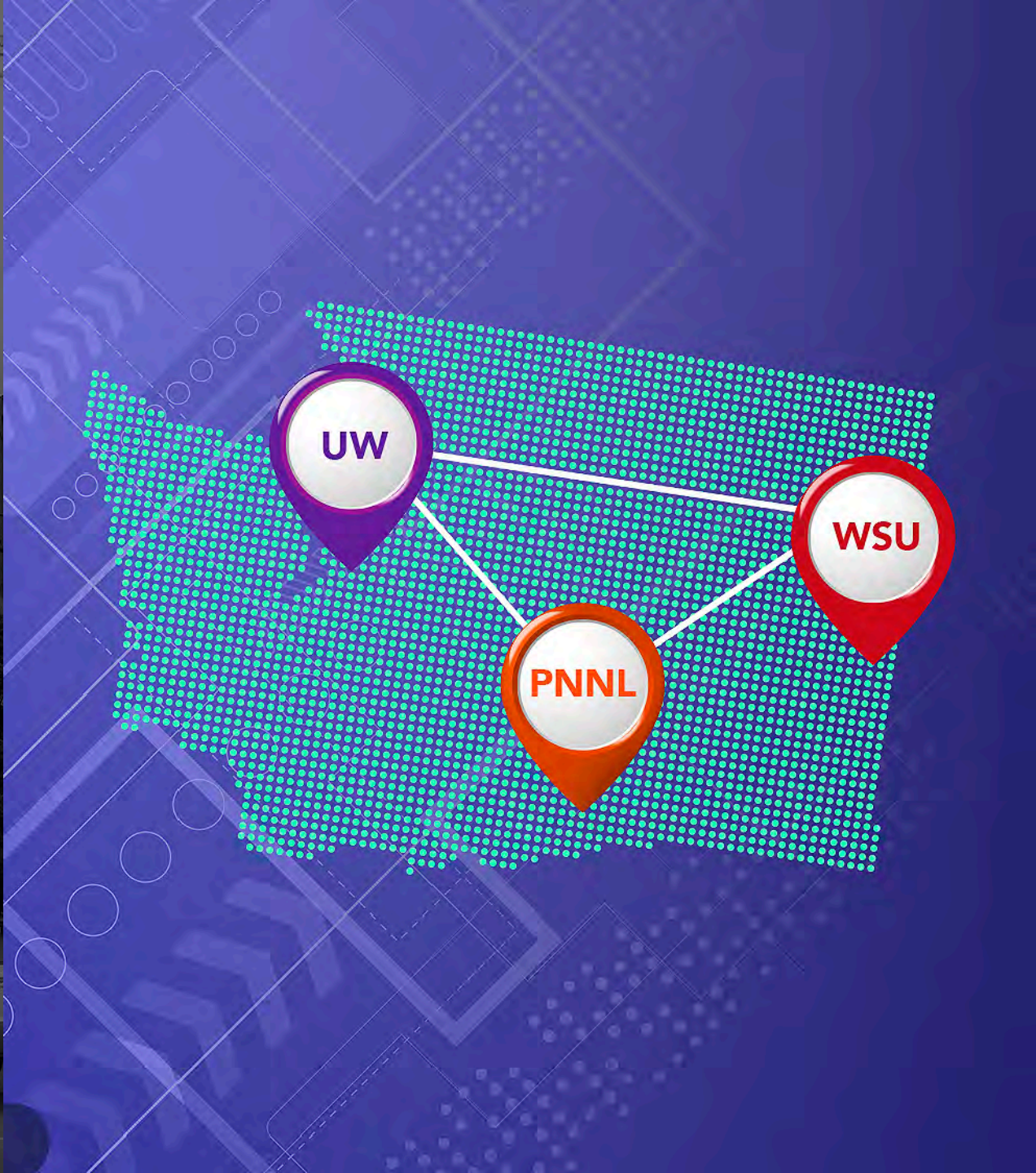
Connected  
Campus:

# Connecting smart buildings across an **ENTIRE CAMPUS**



UW / WSU / PNNL  
Transactive Campus:

**Connecting  
smart campuses  
across  
WASHINGTON  
STATE**





# Creating the Future **POWER GRID**



**100-year-old machine**

**Cheap, reliable energy**

**Must evolve to meet future demands**

**147**  
**GIGAWATTS**  
of renewable  
electricity  
onboarded  
in 2015

=

**LARGEST**  
annual increase  
**EVER**



Grid-Scale Storage:  
TODAY

Vanadium  
redox battery

=

**70%**  
**INCREASE**  
in energy density



Grid-Scale Storage:  
NEXT-GENERATION

New  
**FLOW  
BATTERIES**  
with increased  
density, reduced  
size and cost





Electricity Infrastructure  
Operations Center:

Where it  
**ALL**  
comes  
together





# WHERE DO WE GO FROM HERE?



# A Smart Manufacturing Revolution

VOICE OF THE MID-COLUMBIA

## Tri-City Herald

50 cents Wednesday, June 22, 2016 tricityherald.com

PACIFIC NORTHWEST NATIONAL LABORATORY

### Obama chooses PNNL to lead new center

Richland chosen for 1 of 5 regional centers nationwide

Focus on energy-intensive manufacturing industries

Will partner with Northwest universities, other experts

Pacific Northwest National Laboratory will lead one of five centers nationwide to improve the efficiency of U.S. manufacturing.

The national lab will focus on some of the most energy-intensive industries in the region – food processing, advanced materials, and forest products.

Advances in smart sensors, digital process controls and information technology could radically reduce energy use in manufacturing and improve

facturing Innovation Institute. President Obama made the announcement this week.

“The idea is to fast track development and adoption of smart sensors and other technologies, providing manufacturers the information and tools that will allow better energy management,” said Mike Rinker, PNNL’s manager for energy efficiency and renewable energy.

The center will partner with experts from Washington State University,

other organizations in the Northwest.

Nationally, the Smart Manufacturing Innovation Institute, headquartered in Los Angeles, will assemble more than \$140 million in combined public/private investments to revolutionize smart manufacturing for energy intensive, clean energy and energy dependent industries.

The Northwest Regional Center will apply those advancements to advance and implement smart manufacturing

reduce energy used in manufacturing and deliver more energy efficient technologies,” said Rinker. “A large focus of the center will be to transfer the technology from those who have developed tools and technologies to those companies who can use them in the manufacturing process.”

Officials expect that industry participation in the regional center will grow as small and large companies ramp up efforts in smart



**PNNL to Lead Northwest Smart Manufacturing Hub**



CONTINUE TO INVEST IN THE FUTURE:

**Keep the  
NORTHWEST  
at the forefront of  
INNOVATION**



**PNNL**

Thank You