U.S. DEPARTMENT OF ENERGY

Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

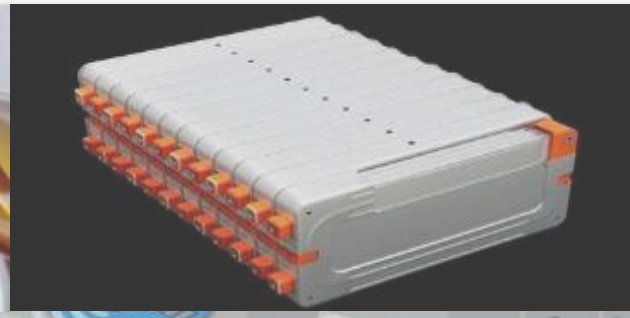
VEHICLE TECHNOLOGIES OFFICE

The Future of Mobility

Michael R. Berube

Director, Vehicle Technologies Office






TRANSPORTATION IS FUNDAMENTAL TO OUR WAY OF LIFE

The U.S. population is growing and aging

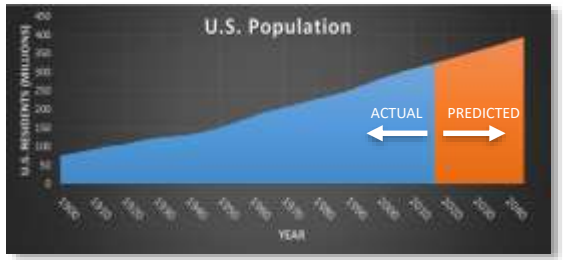
Population density is increasing—**75% of the population** lives in urban mega-regions

Technologies and fuel choices are expanding

Transportation costs are high—second only to housing expenses

CONVERGING TRENDS ARE SHAPING MOBILITY

Population



Population expected to grow by **70 million** in next **30 years**

75% of population concentrated in **11** Megaregions

Demographics

Americans are Living Longer

By 2045, the number of Americans over age 65 will increase by **77%**.

About **one-third** have a disability that limits mobility.

Millennials are Connected & Influential

There are **73 million** Americans aged 18 to 34.

They drove **20%** fewer miles in 2010 than at the start of the decade.

Technology

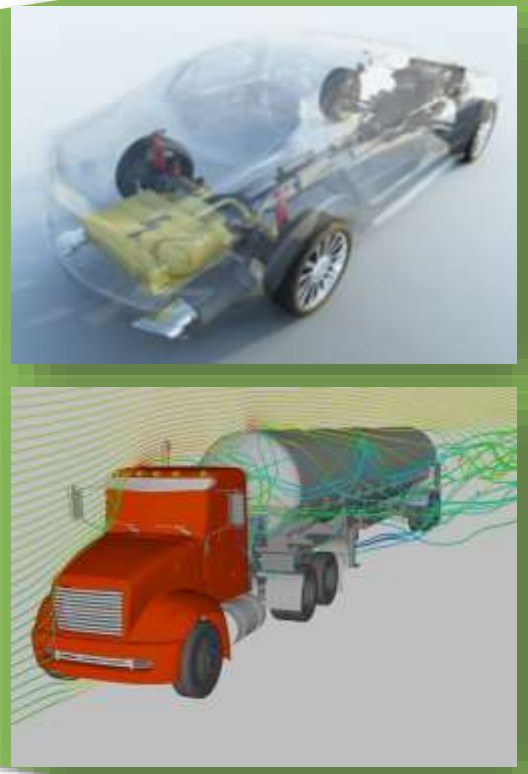
- **Integration of Connected & Automated Technologies**
- **Introduction of Shared Service Platforms**
- **Advancements in Energy Storage Technology**
- **Deeper Application of Big Data**
- **Faster Processing Speeds at Decreasing Cost**

VEHICLE TECHNOLOGIES OFFICE FOCUS

ALL LEVELS

U.S. Department of Energy

National Labs



Component — Vehicle — System

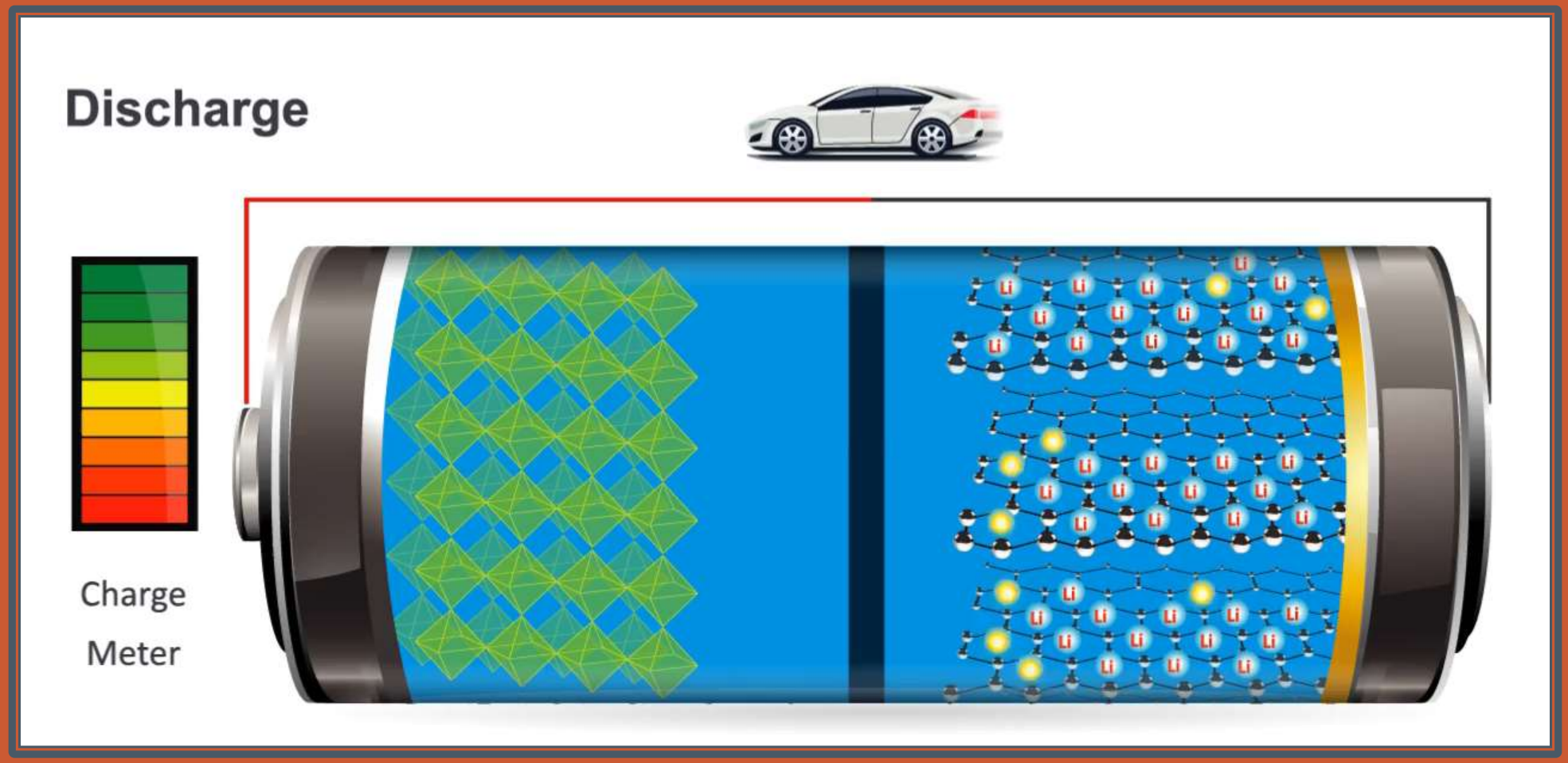
A BRIDGE TO THE FUTURE…

MATERIALS

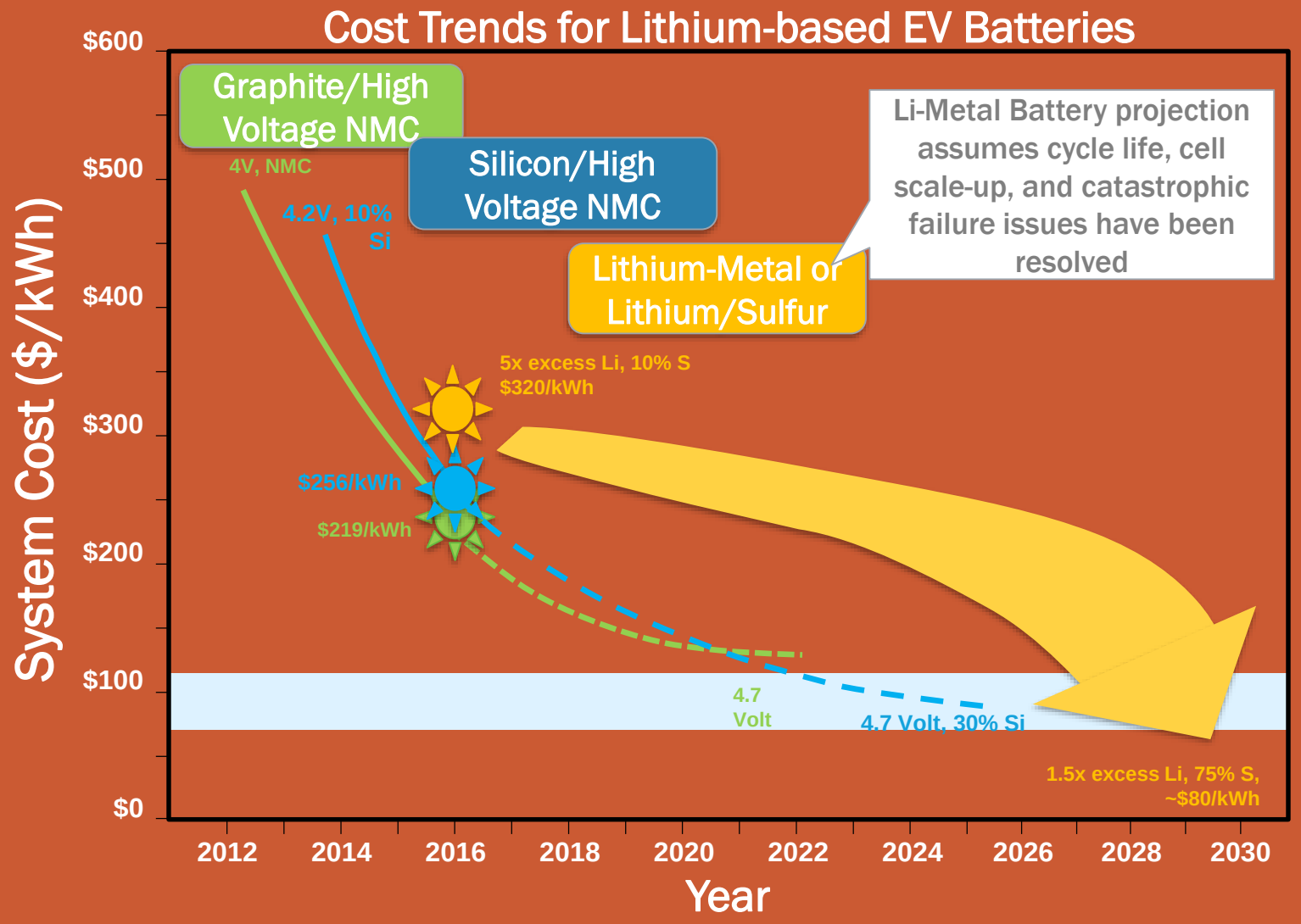
ADVANCED COMBUSTION & FUELS

CO-OPTIMIZATION

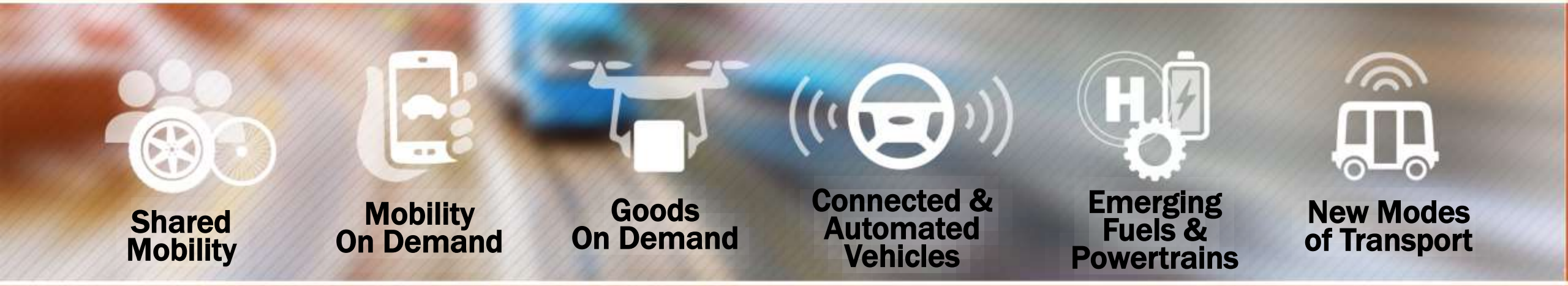
ELECTRIFICATION



BATTERIES

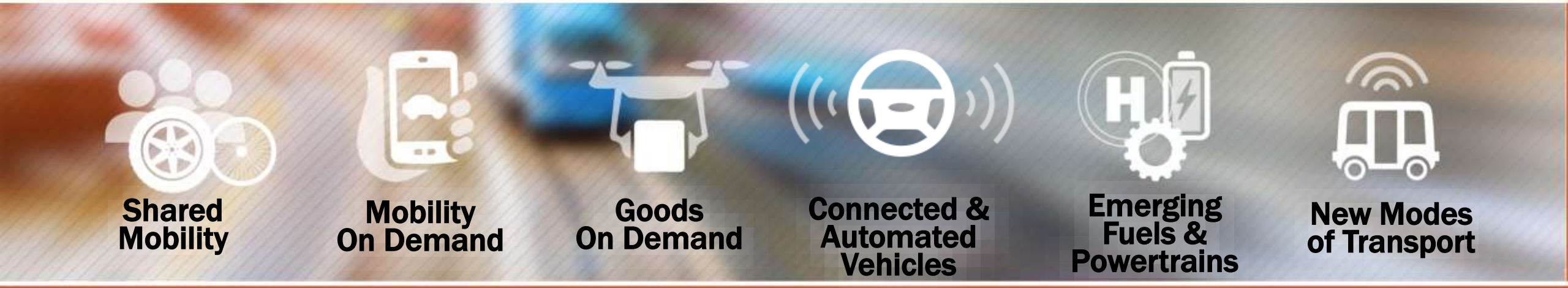

Cost Trends for Lithium-based EV Batteries
System Cost ($/kWh)
$600
$500
$400
$300
$200
$100
$0
2012
2014
2016
2018
2020
2022
2024
2026
2028
2030
Year
Graphite/High Voltage NMC
4V, NMC
Silicon/High Voltage NMC
4.2V, 10% Si
Lithium-Metal or Lithium/Sulfur
Li-Metal Battery projection assumes cycle life, cell scale-up, and catastrophic failure issues have been resolved
5x excess Li, 10% S
$320/kWh
$256/kWh
$219/kWh
4.7 Volt
4.7 Volt, 30% Si
1.5x excess Li, 75% S, ~$80/kWh

NEW TECHNOLOGIES & BUSINESS MODELS ARE DRIVING DISRUPTION



PIONEERING RESEARCH

EXPLORES POTENTIAL ENERGY IMPACTS



NEW CHALLENGES BRING NEW OPPORTUNITIES

IN THE ENERGY EFFICIENT MOBILITY SYSTEMS PROGRAM

ACHIEVING GOALS

Advanced R&D Projects

Living Labs

THROUGH FIVE EEMS ACTIVITY AREAS

Smart Mobility Lab Consortium

Core Evaluation & Simulation Tools

HPC4Mobility & Big Transportation Data Analytics

Advanced Fueling Infrastructure

Connected & Automated Vehicles

Urban Science

SMART MOBILITY LAB

CONSORTIUM

7 labs, 30+ projects, 65 researchers, $34M* over 3 years.

Mobility Decision Science

Multi-Modal Transport

* Based on anticipated funding

ADVANCED

RESEARCH & DEVELOPMENT

4 University Projects, $6.4M
11 arpa-e NEXTCAR Projects

Vehicle & Traffic Control Algorithms

CAV Vehicle & Transportation Simulation

CAV Vehicle-in-the-Loop Testing

Data Collection from CAV Deployments

Transportation System Optimization

USING [illegible] DATA TO UNDERSTAND ENERGY IMPACTS

[illegible]VING LABS

[illegible]ojects, $4.8M

$20 million in New Living Lab Projects Just Announced – Covering 6 Key Research Areas

[illegible]enve[illegible]

[illegible]W [illegible]nNow

ELECTRIC LAST MILE
Austin

Pecan Street, CapMetro

ENERGY EFFICIENT FREIGHT LOGISTICS
NYC-Albany Corridor

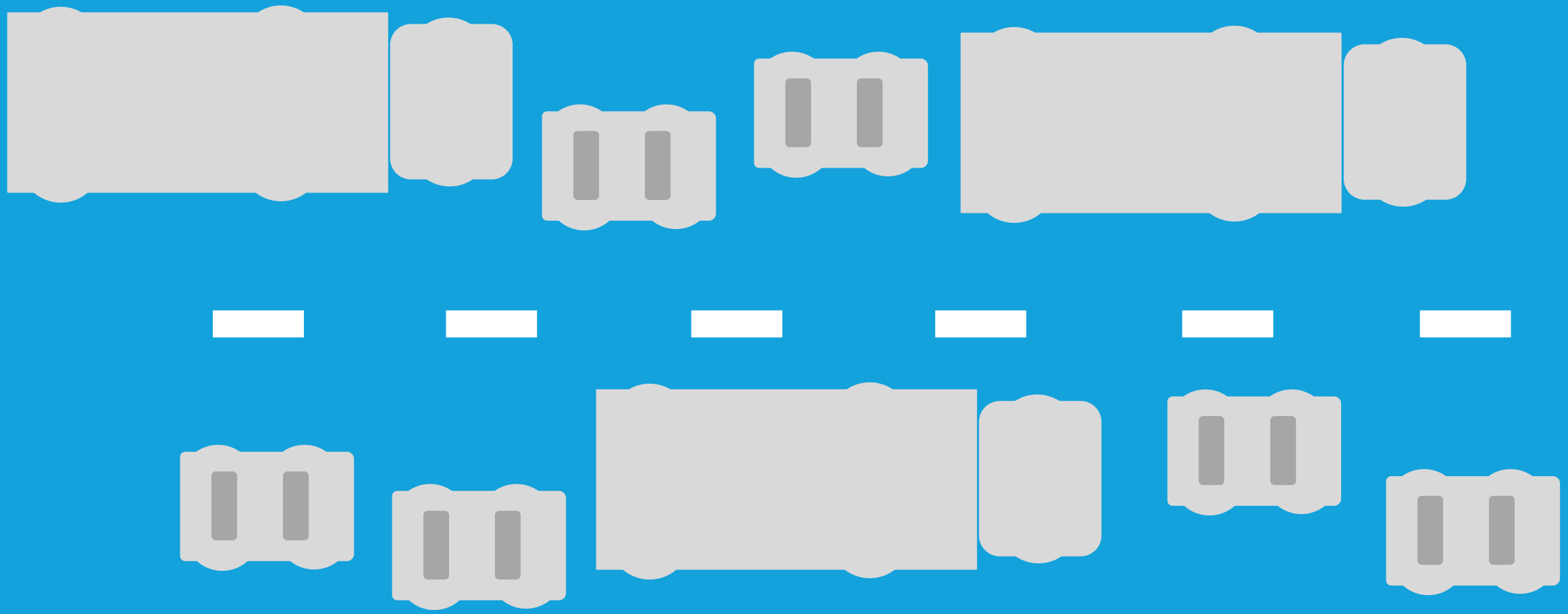
Rensselaer Polytechnic Institute, freight carriers & receivers, urban supply chain

NEW OPPORTUNITIES FOR

HPC4MOBILITY & BIG DATA ANALYTICS

Up to $5.5M in FY2018

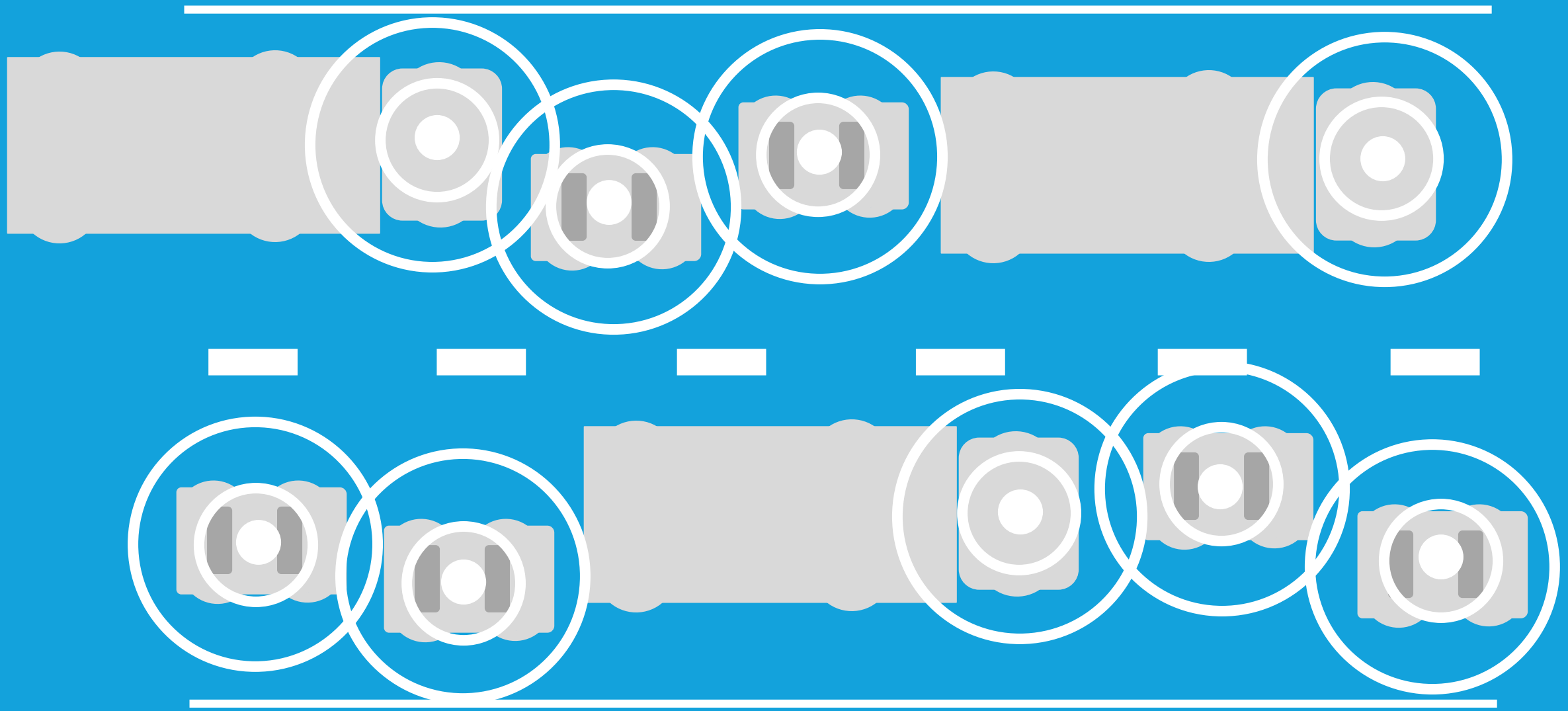
* Based on anticipated funding



Connected Corridors
www.connected-corridors.berkeley.edu

CALIFORNIA PATH

ITS Berkeley
Institute of Transportation Studies



Connected Corridors
www.connected-corridors.berkeley.edu

CALIFORNIA PATH

ITSBerkeley
Institute of Transportation Studies


Connected
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CALIFORNIA
PATH


ITSBerkeley
Institute of Transportation Studies

TOOLS CORE TO ASSESSING TECHNOLOGIES IMPACT ON ENERGY

MathWorks

SINGLE VEHICLE

- Component Targets
- Powertrain Electrification Benefits
- Predictive Control

SMALL AREA NETWORK

- Multi-vehicle simulation in environment
- V2V, V2I, I2V
- Eco-Control

CITY / REGION

- Agent-Based Transportation Simulation
- Traveler Demand
- ITS and Network Operations

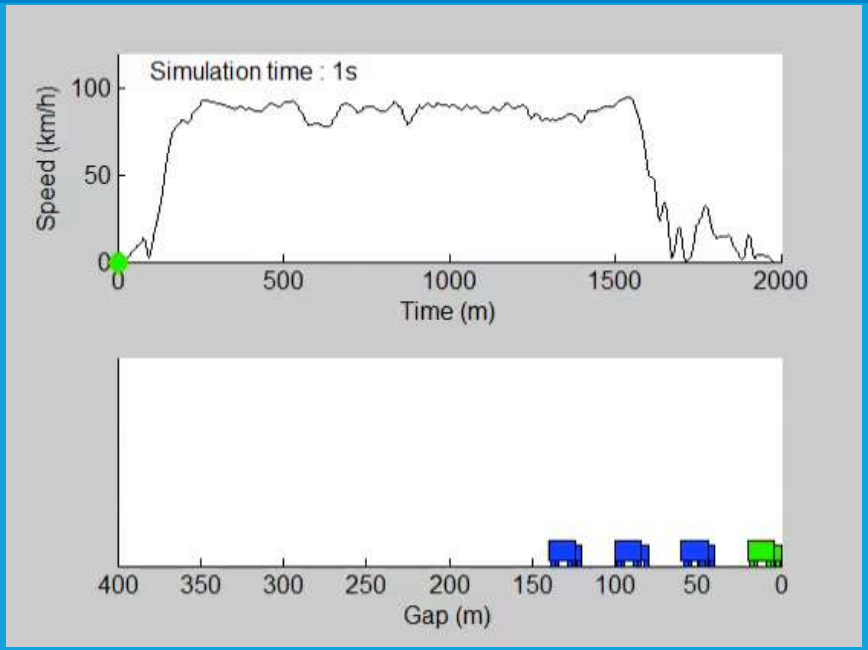
AUTONOMIE

RoadRunner

POLARIS

TOOLS CORE TO ASSESSING TECHNOLOGIES IMPACT ON ENERGY

Platoon Control



MathWorks core to energy impact estimation from individual vehicles to entire metropolitan areas leveraging HPC

VEHICLE TECHNOLOGIES OFFICE

& MathWorks

AVTC

ADVANCED VEHICLE TECHNOLOGY COMPETITION

OUR VISION

ACHIEVING

MOBILITY ENERGY PRODUCTIVITY

more choices

when & where it is needed

more affordable

DEPARTMENT OF ENERGY ANNOUCEMENTS

HOT OFF THE PRESS!

$65 MILLION IN COOPERATIVE RESEARCH FUNDING

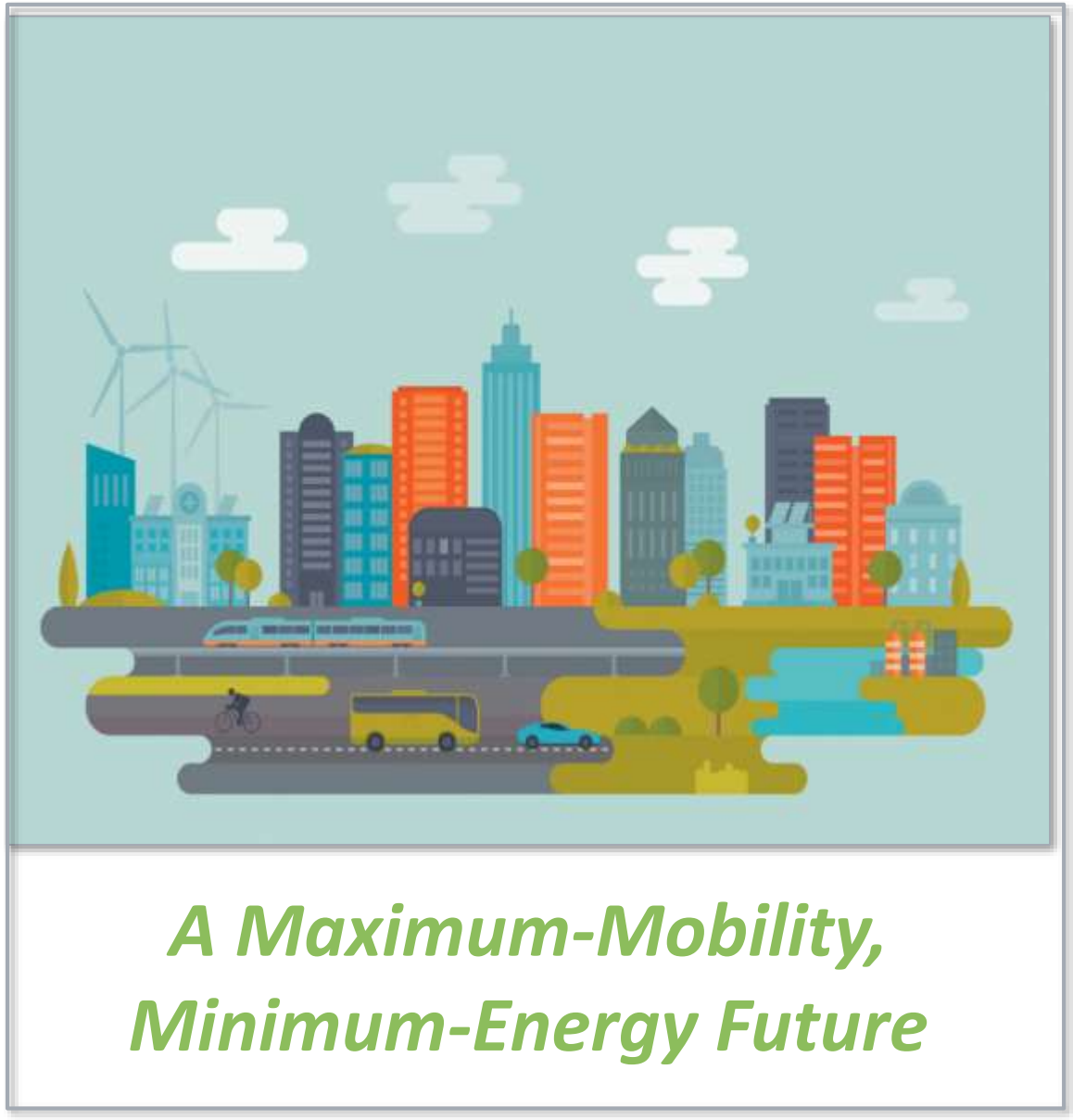
Breakthrough research including:

- Next Generation Batteries
- New Engines & Fuels
- CyberSecurity of EV Charging
- Truck Platooning
- HPC & AI to optimize Transit hubs
- Mobility Data / Analytics for Cities

$19 MILLION – PROJECTS SELECTED: BATTERIES & ELECTRIFICATION RESEARCH TO ENABLE EXTREME FAST CHARGING

FY 2018 Advanced Vehicle Technologies Research FOA
DE-FOA-0001919

Visit Grants.gov or eere-exchange.energy.gov



A Maximum-Mobility, Minimum-Energy Future

Thank You

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Energy.gov/vehicles