Agenda

- Our Journey
- Our Vision
- Program Management
- Technical Approach
- Performance Measurement
- Privacy
- System Engineering Approach
- Data Management
- Support for Independent Evaluation
- Safety Management and Safety Assurance
- Communication
- International Collaboration
- Standards and Architecture
OUR JOURNEY

December 7, 2015

February 4, 2016

March 12, 2016

59 DAYS

• VISION
• POLICY
• PROJECTS
• APPROACH
• BUY-IN
OUR JOURNEY

March 30, 2016
April 4, 2016
April 14, 2016
April 20, 2016
April 27, 2016
May 16, 2016
May 23, 2016

73 DAYS
OUR JOURNEY

May 23, 2016
June 8, 2016
June 23, 2016
OUR JOURNEY

August 18, 2016

September 12, 2016
THE SMART CITY = COLUMBUS
THE COLUMBUS WAY
America’s TEST MARKET

Scalable — Replicable

Innovative — Implementable
More Distance!

USDOT and VULCAN

$50M

USDOT and VULCAN

$140M
Engaging with USDOT Partners

U.S. Department of Energy
Autodesk
DC Solar
AT&T
Vulcan
Continental
Mobileye
Sidewalk Labs
NXP
Amazon Web Services
Engaging with Partners

17 Local Partners
Program Management

#SMARTCOLUMBUS
Smart Columbus Governance Structure

- Leadership Team
  - Executive Committee
    - City of Columbus Program Management Office
      - Project Working Groups
      - Smart City Collaborative
USDOT program

Program Management Communications and Outreach

System Engineering

Develop, Procure, Deploy

Operations & Maintenance

Data Collection

Data Analysis

Project

Year 1

Year 2

Year 3

Year 4

#SMARTCOLUMBUS
CITY PMO SUPPORTED BY THE HNTB TEAM & ENGAGE PUBLIC AFFAIRS

LOCAL PARTNERS
- $5M
- $1M
- <$1M

CITY AGENCIES
- Technology
- Public Safety
- Public Service
- Utilities

THE CITY OF COLUMBUS
ANDREW J. GINther, MAYOR

#SMARTCOLUMBUS
Potential Challenges

- **POTENTIAL CHALLENGE:** Balance between empowering team leads to operate autonomously and maintaining centralized program management to keep all teams informed and connected, especially across Vulcan and USDOT project tasks.

- **POSSIBLE STRATEGY:** Define an agreed upon project management structure, clear lines of communication, and schedule routine project management meetings to monitor status.

- **POTENTIAL CHALLENGE:** Task relationships are complex and many critical documents have overlapping/redundant content.

- **POSSIBLE STRATEGY:**
  - Documents should be treated as ‘living documents’ and each progressive document should be reconciled with prior documents.
  - Quality Control / Quality Assurance should include staff with no other project involvement.
  - Develop a Reconciliation Document for tracking ‘connected’ changes.
Potential Challenges

🎬 POTENTIAL CHALLENGE: Aggressive delivery schedules

🎬 POSSIBLE STRATEGY:
  • Maintain and actively track the status of deliverables to ensure the on-time completion of the project
  • Schedule sufficient time to account for procurement cycles

🎬 POTENTIAL CHALLENGE: Some critical deliverables will require multiple reviews (e.g., draft, revised, final)

🎬 POSSIBLE STRATEGY:
  • Ensure high quality deliverables by engaging in early review of an expanded outline to promote understanding & consistency in deliverable expectations before writing the draft.
  • Budget more time for reviews (more than one iteration and more than one-week turnaround time)
  • Avoid multiple deliverables having the same due date
Risk Management

Steps taken for each risk identified

RISK: USDOT document review cycle takes longer than allocated.

RISK GROUP: All (CCTN, Program Management, Outreach, Districts)

PHASES: All phases (Concept, Procurement, Design, Deployment)

TYPE: Threat

DESCRIPTION: USDOT reviews are planned for 10 days and if not achieved will extend schedule of that group activities

RISK TRIGGER: Submittal of Review Documents

PROBABILITY of OCCURANCE: Low (Low, Moderate, High, Very High)

OWNER: Ryan Bollo

APPROACH: Mitigate

RESPONSE: Contact USDOT 2 weeks prior to submittal of documentation and follow-up with emails during review

MONITORING AND CONTROL: Active (Active, Completed)
Technical Approach
Enabling Technologies

- Columbus Connected Transportation Network (CCTN)
- Integrated Data Exchange
- Enhanced Human Services
- Electric Vehicle Infrastructure

Districts

- Residential District
- Commercial District
- Downtown District
- Logistics District
CCTN

1  PROJECT  Connected Vehicle Environment

2  PROJECT  Smart Street Lighting

3  PROJECT  Transit Pedestrian Collision Avoidance System

#SMARTCOLUMBUS
Integrated Data Exchange (IDE)
5 PROJECT
Common Payment System

6 PROJECT
Multi-Modal Trip Planning Application

7 PROJECT
Smart Mobility Hubs

8 PROJECT
Mobility Assistance for People with Cognitive Disabilities
Connected Electric Automated Vehicle
### 15 Projects

#### ENABLING TECHNOLOGIES

<table>
<thead>
<tr>
<th>CCTN</th>
<th>1</th>
<th>Connected Vehicle Environment</th>
<th>2</th>
<th>Smart Street Lighting</th>
<th>3</th>
<th>Transit Pedestrian Collision Avoidance System</th>
</tr>
</thead>
<tbody>
<tr>
<td>IDE</td>
<td>4</td>
<td>Integrated Data Exchange (IDE)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### DISTRICTS

<table>
<thead>
<tr>
<th>RESIDENTIAL</th>
<th>5</th>
<th>Common Payment System</th>
<th>6</th>
<th>Multi-Modal Trip Planning Application</th>
<th>7</th>
<th>Smart Mobility Hubs</th>
<th>8</th>
<th>Mobility Assistance for People with Cognitive Disabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>COMMERCIAL</td>
<td>9</td>
<td>Connected Electric Automated Vehicle</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DOWNTOWN</td>
<td>10</td>
<td>Delivery Zone Availability</td>
<td>11</td>
<td>Enhanced Permit Parking</td>
<td>12</td>
<td>Event Parking Management</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LOGISTICS</td>
<td>13</td>
<td>Truck Platooning</td>
<td>14</td>
<td>Oversize Vehicle Routing</td>
<td>15</td>
<td>Interstate Truck Parking Availability</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Performance Measurement

#SMARTCOLUMBUS
Performance Measurement

The Performance Measure System will be implemented within the IDE and include:

- Real-Time measurement tracking
- Dashboard of impacts

Data may be provided to the USDOT ITS Deployment Tracking Database

<table>
<thead>
<tr>
<th>Goal</th>
<th>Performance Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improve access to jobs through expanded mobility options</td>
<td>The number of commuters using electric autonomous vehicles for job commute</td>
</tr>
</tbody>
</table>
| Better connect Columbus residents to safe, reliable transportation | - Number of missed prenatal and pediatric visits scheduled with the Enhanced Human Services Module  
- Amount of food receiver per family per targeted Residential District through the Mid-Ohio Foodbank |
Expected Outcomes

- **Improve Safety** – By using advanced technologies, including connected vehicle technologies, to reduce the number of collisions, fatalities, and injuries for both vehicle occupants and non-vehicle occupants.

- **Enhance Mobility** – By providing real-time traveler information and emerging mobility services to improve personal mobility for all citizens including people with lower incomes, people with disabilities, and older adults.

- **Enhance Ladders of Opportunity** – By providing access to advanced technology and its benefits for underserved areas and residents, increasing connectivity to employment, education and other services, and contributing to revitalization by incentivize reinvestment in underserved communities.

- **Address Climate Change** – By implementing advanced technologies and policies that support a more sustainable and cost-effective relationship between transportation and the environment through more efficient fuel use and emissions reductions.
Potential Challenges and Solutions

❖ POTENTIAL CHALLENGE: No agreement on what “good” looks like.

❖ POSSIBLE SOLUTION: Work with stakeholders at the start of the demonstration to reach consensus on meaningful performance targets that are achievable within the timeframe of the Smart City Demonstration.

❖ POTENTIAL CHALLENGE: Validity of experimental findings can be distorted due to the presence of confounding factors.

• For example, deployment in an area undergoing significant re-development can result in inaccurate representation of the system performance if the experimental design is not chosen carefully.

❖ POSSIBLE SOLUTION: Use appropriate experimental designs (e.g., randomized experimental design with control and treatment groups), statistical techniques (e.g., cluster analysis, counterfactual modeling), or modeling and simulation to control for confounding factors.
Potential Challenges and Solutions

- **POTENTIAL CHALLENGE:** Limited resources often result in limited data quality checks and erroneous data. Performance measurement based on erroneous data can be misleading, and lead to lack of credibility and usefulness of estimated performance.

- **POSSIBLE SOLUTION:** Allocate resources for data quality verification. Calibrate equipment regularly, establish data quality standards, and check for quality using a combination of automated and manual procedures.

- **POTENTIAL CHALLENGE:** Failure in hardware can result in missing data.

- **POSSIBLE SOLUTION:** Data gaps can be addressed using simple heuristics and imputation techniques.

- **POTENTIAL CHALLENGE:** Observed changes in performance may not be statistically significant due to lack of sufficient data.

- **POSSIBLE SOLUTION:** Supplement performance measurement using observed data analysis with modeling and simulation.
Potential Challenges and Solutions

- **POTENTIAL CHALLENGE:** Stovepipe approach to task activities such as, systems engineering, data collection, and performance measurement will be detrimental to the demonstration.

- **POSSIBLE SOLUTION:** Cross functional coordination within the team is absolutely critical. Early involvement in activities such as System Requirements will help facilitate meaningful measurement.

- **POTENTIAL CHALLENGE:** Understanding and fine tuning the system to identify appropriate thresholds for applications can take time. Failure to distinguish between the transition period and the post transition period can result in an underestimation of benefits.

- **POSSIBLE SOLUTION:** Performance measure estimates should be monitored frequently for the period immediately after deployment start, and differentiated between the transition and post transition periods.
Overview: Privacy

- **Personally Identifiable Information (PII)**
  - Information which is linked or linkable to an individual
  - Requires a case-by-case assessment of the specific risk that an individual can be identified by examining the context of use and combination of data elements both internal and external to the system.

- **Sensitive Personally Identifiable Information (SPII)**
  - A subset of PII which if lost, compromised or disclosed without authorization, could result in substantial harm, embarrassment, inconvenience, or unfairness to an individual. Sensitive PII requires stricter handling guidelines because of the increased risk to an individual if the data are compromised.
    - Social Security Number
    - Passport Number
    - Vehicle Identification Number (VIN)
    - Biometrics
Overview: Privacy

**Security Controls**
- Physical protection of devices
- Technical protection of information
- Policy guides organizational procedure and processes; for instance, access controls, policies on acceptable uses of data

**Privacy Controls** (8 types defined in NIST SP 800-53)
- Authority and Purpose, Risk Management, Data Quality and Integrity, Data Minimization and Retention, Individual Participation and Redress, Security, Transparency, Use Limitation

**Standards Based Approach to Guide Implementation & Operations**
- National Association of State CIOs (NASCIO) offer State-based best practices
- FTC's Fair Information Practice Principles (FIPP)
Potential Challenges

- **POTENTIAL CHALLENGE:** Survey data can include name, home address, personal records, etc.
  - **POSSIBLE STRATEGY:** Get IRB approval and keep data separate from research data, utilize encryption while storing and accessing surveys electronically.

- **POTENTIAL CHALLENGE:** GPS Trajectories can identify an individual and where they live/work
  - **POSSIBLE STRATEGY:** De-identify sensitive locations and all strings of trip trajectories to USDOT specifications

- **POTENTIAL CHALLENGE:** DSRC transmitted data can include information about the vehicle, or entries from malicious software
  - **POSSIBLE STRATEGY:** Using SAE J2735 standard will help safeguard transmission

- **POTENTIAL CHALLENGE:** Tracking an individual or stealing their identity can be accomplished through stolen Personally identifiable information
  - **POSSIBLE STRATEGY:** All data collection needs justification and protection
Systems Engineering Approach

#SMARTCOLUMBUS
Systems Engineering

A Systems Engineering approach will be utilized throughout the project to:

- Reduce the risk of schedule and cost overruns
- Increase the likelihood of meeting user needs

The City will leverage Lessons Learned from other USDOT Projects including but not limited to:

- Safety Pilot Model Deployment (Ann Arbor, MI)
- Connected Vehicle Pilot Deployments (Tampa, Wyoming, and New York)
- USDOT Michigan Connected Vehicle Testbed
- Ann Arbor Connected Vehicle Test Environment
Overview: Systems Engineering Approach

- Integrates all the disciplines and specialty groups into a team
- Forms a structured development process
- Proceeds from concept to production to operation
- The “V” model chosen by USDOT (Systems Engineering Guidebook for ITS and ITS PCB Module 2: Systems Engineering)
Data Management

#SMARTCOLUMBUS
The City anticipates generating and collecting three (3) types of data:

1. Non-Traditional Transportation Data: Connected Vehicle Data, such as Basic Safety Messages (BSM), Traveler Information Messages (TIM), Signal Phase and Timing (SPaT), and Map Messages, etc.

2. New Smart Columbus Data: data specific to City projects, such as Mobileye, EV, Payment System, Parking, etc.

3. Traditional Transportation Data: Data Types currently collected by the City, such as Speed, Volume, Occupancy, Transit, Travel Time, etc.
Data Management

The City anticipates using data collected as part of the project to support the following users:

- Smart City Applications
- Other TBD 3rd Party and City Applications (Developer Network)
- Performance Measurement calculation\evaluation
- The Independent Evaluator
Data Management

Data Sharing Agreements and Procedures will be developed for the following organization classifications:

• Public
• Private
• Academic
• Non-profit
• USDOT (Research Data Exchange (RDE))
Integrated Data Exchange (IDE) Implementation

 שימוש האטומאטיizado של:

- Amazon Web Services (Partner)
  - AWS Elastic and long-term storage strategies to keep storage costs low (S3, Glacier)
  - AWS Real-time data platforms to support high-end performance (Kinesis, Redshift)
  - AWS Security and Governance practices
- US DOT
  - Situation Data Warehouse (SDW)
  - Situation Data Clearinghouse (SDC)
- Regional Data Clearinghouse for Smart Columbus
- Create and Support Smart Columbus Developer Network
Standards And Architecture
Overview

- Maximize use of published and developed ITS architectures and standards
  - Identify additional needs, improvements or corrections
  - Make lessons learned available to ITS architecture and standards developers

- Participate in select Standards Development Organization (SDO) working groups / committees
  - Provide technical input to SDOs where appropriate
  - SDOs include international and national standards bodies

- Provide one expert to participate in standards working groups
  - Estimated 6 meetings of 3 days each, per year
  - 4 meetings within US, 2 international meetings
  - Provide meeting report (outcomes, impacts to Smart City Demonstration, inputs provided by expert) for each in-person meeting attended
Potential Challenges

- POTENTIAL CHALLENGE: Not all ITS Standards needed for implementation are available, stable or sufficiently tested.
- POSSIBLE STRATEGY: Incorporate publication of standards into city’s schedule for least impact; expert attends working group meetings to remain engaged in standard’s progress to publication. Remain connected to USDOT Standards Program to monitor changes and progress of ITS Standards.

- POTENTIAL CHALLENGE: CV Architecture differs from preferred engineering solutions.
- POSSIBLE STRATEGY: Cooperate with architecture team to evaluate revising CV reference architecture vs. revising SCC systems architecture.

- POTENTIAL CHALLENGE: Interfaces needed with architectures outside of the SCC ITS/CV architecture which are not included in CV/ITS reference architecture.
- POSSIBLE STRATEGY: Develop candidate engineering solution and cooperate with architecture team to evaluate revising CV reference architecture to accommodate.
Overview

Two primary areas of responsibility within Task F

Safety Management
- Establish approach and process for managing safety of Smart Columbus activities
- Design, Operate, and Manage Safely

Human Use Assurance
- Provide assurance of compliance with human use regulations through Institutional Review Board (IRB) oversight
- Follow human subjects research principles (Respect for Persons, Beneficence, Justice)
Safety Scenarios ➔ Risk Assessment ➔ Safety Operational Concept

**Goal:** Establish and use a systematic process to identify, assess and minimize/manage safety risks for Smart Columbus project

- Gather relevant stakeholder input
- Select Safety Assessment Process (e.g. Hazard and Operability Study (HazOp), Systems-Theoretic Process Analysis (STPA)) tailored to needs of the project
- Identify & Assess Safety Risks
  - Safety Scenarios
  - Exposure / Severity / Controllability
  - System (deployment-wide) Level as well as Application-specific
- Plan Design and Operational Measures (including backup plans) to minimize and manage safety risks
- Document (and update) plans, processes, and organization
Potential Challenges

- **POTENTIAL CHALLENGE:** Identifying adequate supporting information to conduct safety risk assessment
  - **POSSIBLE STRATEGY:** Bring in experts familiar with applications/technology to assist with safety assessment.

- **POTENTIAL CHALLENGE:** Supporting IRB’s familiarity with technologies being researched
  - **POSSIBLE STRATEGY:** Ensure that IRB understands key risks/nature of vehicle automation and other new technologies through a short introductory briefing.

- **POTENTIAL CHALLENGE:** Achieving consistency between IRB Application and other task areas (e.g., Performance Measurement, Data Privacy, etc.)
  - **POSSIBLE STRATEGY:** Clearly define aspects of project that are subject to IRB review and engage with IRB early on to minimize delays. Hold discussion with key task leads on tradeoffs early in project.
Support for Independent Evaluation
Independent Evaluation Support

- The system must be capable of generating and collecting data needed to evaluate the overall performance of the system over time.

- This will demonstrate how well the system is performing with respect to performance measures and targets identified in the Performance Measurement Plan.

- Not only will the City measure and evaluate the performance of the system, but the USDOT will appoint an Independent Evaluator to validate our findings and provide supplementary evaluation with respect to a broader set of safety, environmental, mobility and public agency efficiency measures.
Evaluation Framework
Potential Challenges and Solutions

- **POTENTIAL CHALLENGE:** Retention of knowledge can be an issue as a result of possible staff turnover due to the long duration of the demonstration; can lead to wasted resources and falling behind schedule.

- **POSSIBLE SOLUTION:** Document procedures, processes, challenges, and resolutions frequently and share with the IE; share public information through ITS JPO or Smart City's web site and/or discussion forums.

- **POTENTIAL CHALLENGE:** If roles and responsibilities are not clearly scoped out, operations can be disrupted if the IE needs to conduct additional field tests.

- **POSSIBLE SOLUTION:** Clearly scope out support provided to evaluators, liability issues, cost, and schedule.
Potential Challenges and Solutions (cont.)

**POTENTIAL CHALLENGE:** Support and coordination activities with multiple entities on multiple facets of data provision and evaluation can be a drain on resources if not carefully planned.

**POSSIBLE SOLUTIONS:**

- Allocate resources and time for coordination and support
- Assign dedicated staff knowledgeable in various aspects of demonstration
- Maintain an open platform of communications with the IE to help identify issues in a timely manner
- Validate end-to-end data acquisition, quality assessment, processing, and transfer of data and performance measures to IE prior to the demonstration
- The sooner the evaluators can get their hands on preliminary data samples to verify data formatting, structure, and accuracy, the better
- There WILL be data errors and issues to work through; so we (USDOT, Smart City and the IE) must be prepared to do that in an efficient manner
Communication

#SMARTCOLUMBUS
Communication

- Flexible, usable, owned by all
- Aligned with the collaborative brand of Columbus
- Responsive
- Our residents first
Overview: Communications and Outreach

- Develop a comprehensive communications and outreach program that covers both outreach activities and the accommodation of requests for site visits by media, researchers, and others.
- Coordinate with USDOT communications staff to facilitate the branding, re-use and re-distribution of materials developed by USDOT and the Smart City Demonstration team.

THE SMART CITY CHALLENGE
- US Department of Transportation (USDOT) competition
- Open to Midsize American cities (250,000-850,000)
- 78 cities competed (5 in Ohio)
- 7 finalists named in March
- 1 finalist to be named summer, 2016
  - $40 million+ for over 4 fiscal years
  - Work plan to deploy projects in 6 months
  - Cost share not required but encouraged
Overview: Communications and Outreach (cont.)

- Promote and increase the awareness of the Smart City Demonstration
- Engage with the stakeholders and the surrounding communities about the status of the demonstration
- Educate the general public of what changes to expect during the demonstration
## Where we’ve been

<table>
<thead>
<tr>
<th>EVENT</th>
<th>DATE, LOCATION</th>
<th>WHO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business First Editorial Forum</td>
<td>Sept. 20, Columbus, OH</td>
<td>Mayor Andrew J. Ginther</td>
</tr>
<tr>
<td>American Planning Association</td>
<td>Sept. 28,29, Washington, DC</td>
<td>Ryan Bollo &amp; Jeff Ortega</td>
</tr>
<tr>
<td>American Council of Engineering Companies</td>
<td>Sept. 30, Columbus, OH</td>
<td>Jennifer Gallagher</td>
</tr>
</tbody>
</table>

## Where we’re scheduled

<table>
<thead>
<tr>
<th>EVENT</th>
<th>DATE, LOCATION</th>
<th>WHO</th>
</tr>
</thead>
<tbody>
<tr>
<td>OTEC</td>
<td>Oct 25-26, Columbus, OH</td>
<td></td>
</tr>
<tr>
<td>OSU Center for Automotive Research Advisory Board Meeting</td>
<td>Oct. 28, Columbus, OH</td>
<td></td>
</tr>
<tr>
<td>Transportation Research Board Annual Meeting</td>
<td>Jan. 8-12, 2017, Washington, D.C.</td>
<td></td>
</tr>
</tbody>
</table>
Communication

Greater Columbus Arts Council partnership
“We know everyone is eager to know how they can get involved; we ask for everyone’s patience while we get organized to deliver on our commitments.”

- Columbus Mayor Andrew J. Ginther
Potential Challenges

- **Target Audience:** Sending the right message to the right group

> **POSSIBLE STRATEGY:** Develop a comprehensive communications and outreach plan identifying target groups and messages to be sent

- **Coordination/Consistency:** Coordinating with USDOT/local agencies/media/training to send consistent messages

> **POSSIBLE STRATEGY:** Conduct dedicated Communications and Outreach meetings monthly with USDOT (by phone)

- **Sensitive Policy Issues:** The media raises questions related to security, privacy, spectrum, etc.

> **POSSIBLE STRATEGY:** Send all policy related media inquiries through the federal AOR lead and outreach lead to get approval from USDOT Public Affairs
International Collaboration

- International Collaboration is important for exchanging Lessons Learned and promoting and collaborating on interoperability between the US and other Countries.

- Sharing Lessons learned and collaborating with other countries enables easier and faster deployments for everyone.

- Transportation Systems behaving in a similar fashion and providing similar services will ease the transition of Citizen traveling from 1 country to another.
International Collaboration

- Collaboration may include:
  - Hosting foreign scanning tours
  - Aligning evaluation activities
  - Partial alignment of deployment activities

- Scope: One 3-day international collaboration meeting per year

- Discussion items
  - What is the ideal result of the international collaboration?
  - How will collaborations be set up?
  - What are they expected to involve?
International Partners

**European Commission**
European Commission (EC) DGs Connect, DG MOVE and DG RTD

**Mexico**
Secretariat of Communications and Transport (SCT)

**Japan**
Ministry of Land, Infrastructure, Tourism, and Transport (MLIT)

**Canada**
Transport Canada (TC)

**Korea**
Ministry of Land Infrastructure, and Transport (MOLIT)

**Australia**
National Transport Commission (NTC)
# 9 Projects

<table>
<thead>
<tr>
<th>FLEET</th>
<th>1</th>
<th>Public Fleet Adoption</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Private Fleet Adoption</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Car Sharing Fleet Adoption</td>
<td></td>
</tr>
<tr>
<td>CHARGING INFRASTRUCTURE</td>
<td>4</td>
<td>Charging Program</td>
</tr>
<tr>
<td>GRID MODERNIZATION</td>
<td>5</td>
<td>Utility-Scaled Commercial Renewable Energy Program</td>
</tr>
<tr>
<td>6</td>
<td>Grid Modernization Program</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Consumer Education and Demonstration Strategies</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Workplace EV Adoption Program</td>
<td></td>
</tr>
<tr>
<td>CONSUMER</td>
<td>9</td>
<td>Dealer EV Sales Staff Education and Incentives</td>
</tr>
</tbody>
</table>
Charging Infrastructure is Growing

Source: U.S. Department of Energy

New Business Models for EV Charging

September 8, 2016
WHY ELECTRIC VEHICLES?
ELECTRICITY IS
DIVERSE
DOMESTIC
CLEANER
Electric Vehicle Infrastructure

Electricity Supply
Decarbonization

Outcomes

- 915 MW Solar/Wind Statewide
- 3.4 MW Installed
Electric Vehicle Infrastructure

Fleet Electrification

Outcomes

- Fleet Electrification
- 300 Public Fleet EVs
- 30 Car Share/Ride Share EVs
- 448 Private Fleet EVs
Electric Vehicle Infrastructure

Transit, Autonomous, & Multi-Modal Systems

Outcomes

• 6 EAVs
• 50 EV Pedal Assist Bicycles
Electric Vehicle Infrastructure

Driving Consumer Adoption

Outcomes
- 3,200 Registered EVs by 2018
Electric Vehicle Infrastructure

Charging Infrastructure

Outcomes
• 1,600 New Level 1 Chargers
• 300 New Level 2 Chargers
Stay in Touch!

www.columbus.gov/smartcolumbus

Facebook, Twitter

smartcolumbus@columbus.gov