Advanced Transportation Technologies: Autonomous, Connected, Electric, Shared

Bellevue Transportation Commission Presentation

January 23, 2020

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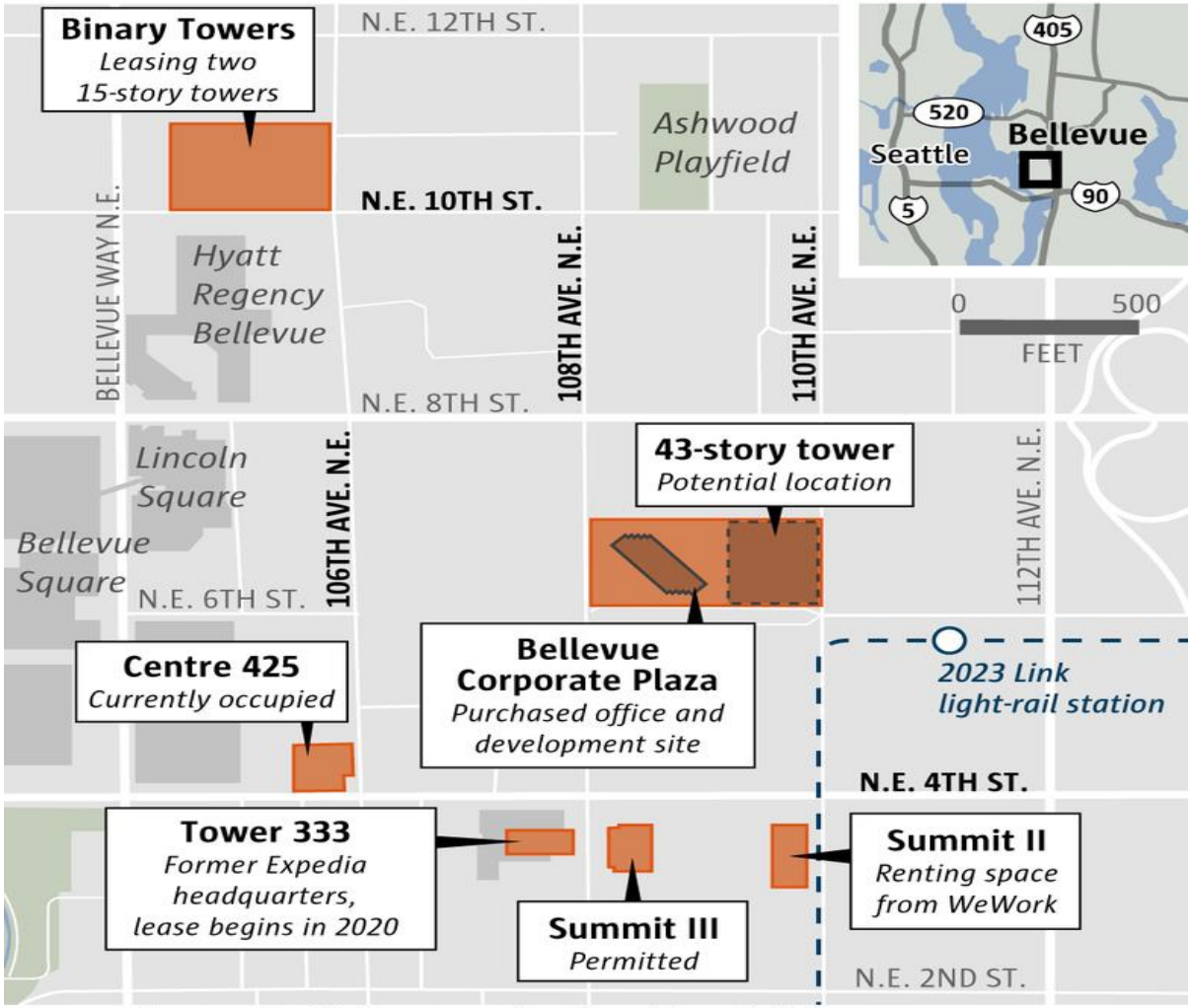
“HQ, too: Amazon's future in Bellevue could rival Washington, D.C., plans”



Sources: Amazon, Seattle Times reporting, Sound Transit, Esri

EMILY M. ENG / THE SEATTLE TIMES

State and Local Transportation Goals

- Target Zero/Vision Zero. Zero vehicle deaths and serious injuries by 2030
- Cut Green House Gas to 1990 levels by 2020
- Commute Trip Reduction Act Goals

Unmet Goals

Target Zero: Traffic deaths and serious injuries in Washington are up.

GHG reduction: “Added carbon pollution”

Commute Trip Reduction: “A 22 % increase in urban delays due to congestion”

“A world with zero crashes, zero emissions and zero congestion”

“The future will be driven by the convergence of electrification, autonomous vehicles, connectivity and shared mobility services.”

--Mary Barra, CEO of General Motors

Bellevue's Smart Mobility Plan 2018

1. Make Bellevue a nationally recognized leader in advanced transportation technologies
2. Improve safety in support of Vision Zero
3. Improve the efficiency of the roadway network and support regional mobility
4. Enhance sustainability by reducing vehicle emissions
5. Pursue private and public-sector partnerships in advancing Bellevue's Smart Mobility strategy

Presentation in Guangzhou

International Smart Shared Mobility Congress 2018

Industry Inflection Point: The ACES

Autonomous

TESLA
Google
UBER
MOBILEYE

Connected

INRIX
TOMTOM
here

Electric

NISSAN LEAF
TESLA
BMW
VOLT

Shared

UBER
CAR2GO
DiDi
ZIPCAR
lyft

INRIX

Benefits of the ACES

- ✓ Reduced Congestion
- ✓ Increased Safety
- ✓ Lower Cost of Transportation
- ✓ More Convenient
- ✓ More Environmentally Friendly
- ✓ Cities Open Up
- ✓ More Accessible

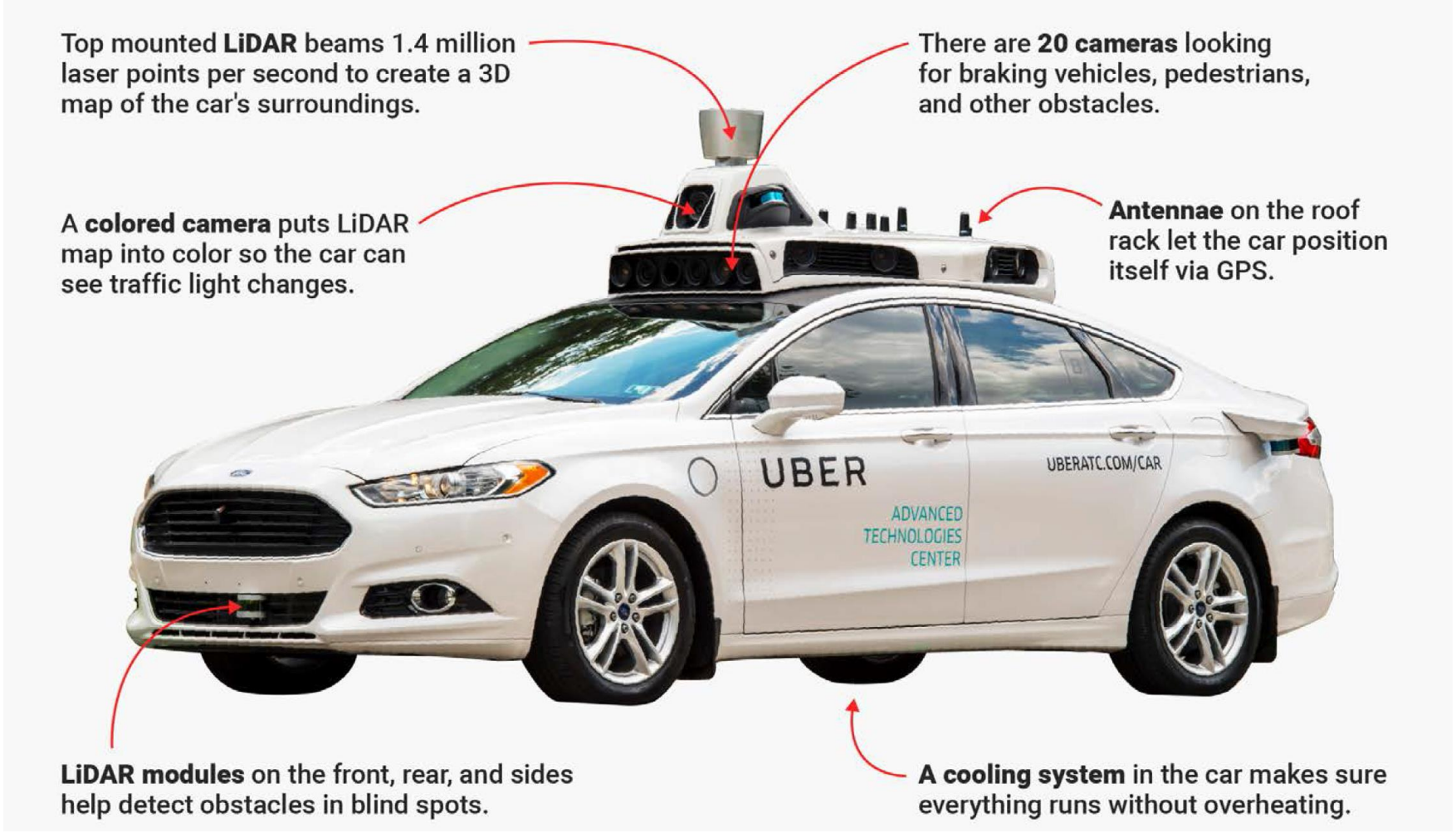
INRIX

INRIX

Major trends in automated, connected, electric and shared mobility

- Cheaper battery costs
- Cheaper sensor costs
- Second half of the chess board on computing power
- Major automakers and tech companies in full competitive mode

Affordable Advanced Sensors and GPU Chips



Government policies are accelerating electric vehicle adoption

- World policies will accelerate the transition from oil to electricity.
- France, the UK, India, Norway, the Netherlands and Scotland announced they would ban the sale of fossil fuel vehicles, with the most imminent ban by the Netherlands in 2025. EU carbon limits imposed on January 1, 2020.
- Germany's national legislature passed a resolution to ban the internal combustion engine starting in 2030 and allow only "zero emission passenger vehicles to be approved."
- China's policy is to be the world leader in electric vehicles

Tesla's Model 3 in China

5 Levels of Autonomy
SAE: Society of Automotive Engineers

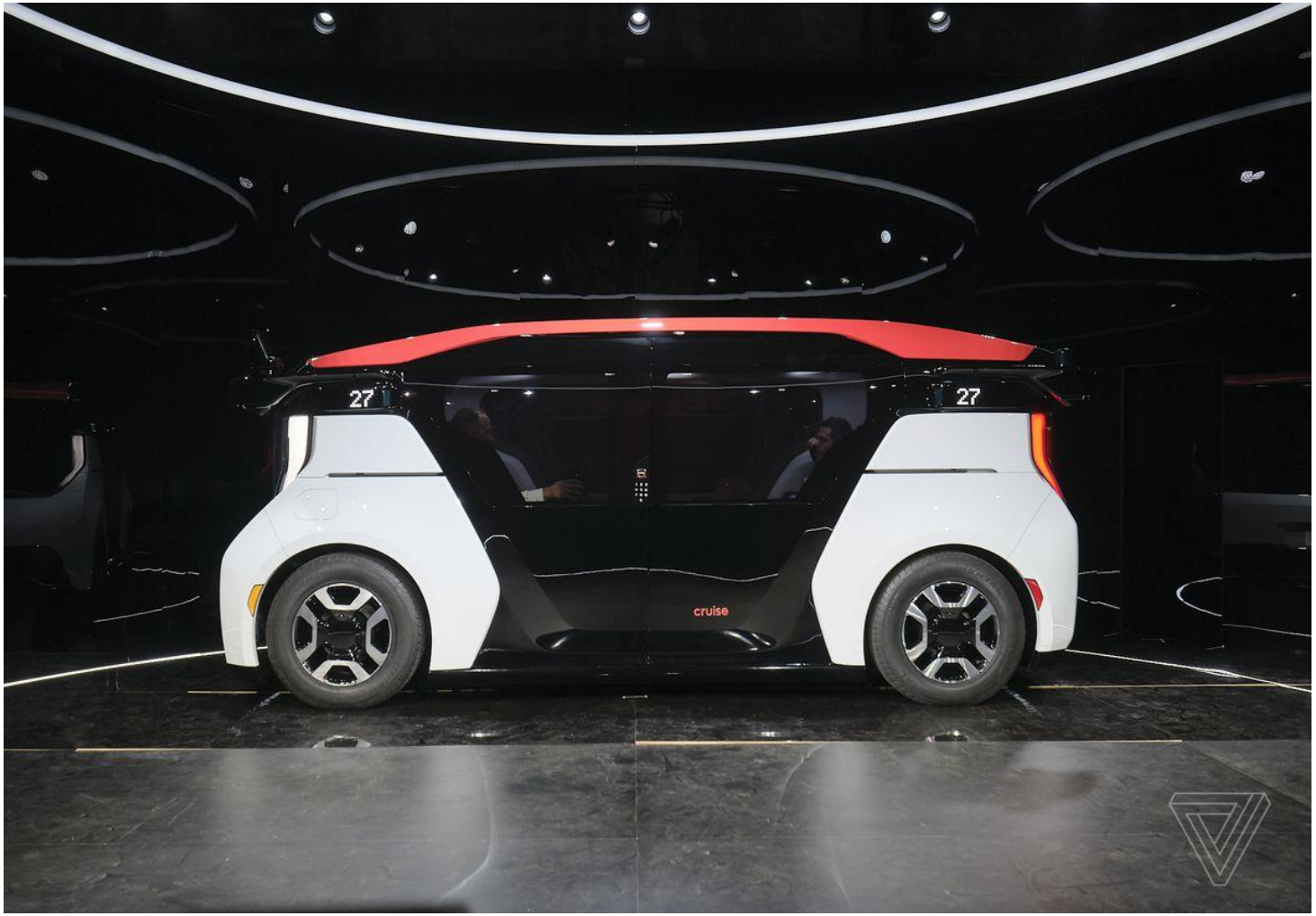
0	1	2	3	4	5
No Automation	**Driver Assistance**	**Partial Automation**	**Conditional Automation**	**High Automation**	**Full Automation**
Zero autonomy; the driver performs all driving tasks.	Vehicle is controlled by the driver, but some driving assist features may be included in the vehicle design.	Vehicle has combined automated functions, like acceleration and steering, but the driver must remain engaged with the driving task and monitor the environment at all times.	Driver is a necessity, but is not required to monitor the environment. The driver must be ready to take control of the vehicle at all times with notice.	The vehicle is capable of performing all driving functions under certain conditions. The driver may have the option to control the vehicle.	The vehicle is capable of performing all driving functions under all conditions. The driver may have the option to control the vehicle.

Waymo's Autonomous, Electric Vehicles

GM's Cruise Autonomous Vehicles

Autonomous, Electric Shuttles

GM’s Cruise Origin—January 21, 2020



Urban Air Mobility

Port of Seattle

Urban Air Mobility Workshop

November 1, 2019

Location: **Sea-Tac Airport Conference Center – Amsterdam**

Time: **12:00 – 3:30pm**

2:10 - 12:30, Lunch Presentation: Why talk about UAM now and what c
n the Puget Sound Region? -Tim Toerber, Port of Seattle

2:30-13:00, UAM Planning in the Greater Los Angeles Region -Adrienn

3:00 – 13:45, NASA Overview of the 2020 Grand Challenge and curren
ndustry (remote interactive presentation from Glenn Research Center)

- Parimal Kopardekar (PK), Director NASA Aeronautics Research Inst

PACCAR's Autonomous Trucks


Motivation – Mobility Energy Productivity (MEP) Metric
How do you quantify mobility?
No 'open' and practical method to quantify mobility
Existing performance metrics measure utilization or efficiency of road network
Vehicle miles travelled / VC ratios
A metric needed quantifies accessibility by all modes, relative to travel time, affordability, and energy
Productivity = Mobility Benefits/Costs
DOE's Energy Efficient Mobility System will identify and support technologies and innovations that encourage Maximum-Mobility, Minimum-Energy Future.
"From MPG to Mobility per Gallon"
Mobility : The effectiveness of a network or system to connect people to goods, services and employment that define a high quality of life.
NREL
EXIT
Prasad Gupta
Myra Blanco

DOE ANNOUNCES NOTICE OF INTENT TO ISSUE DE-FOA-0002197

- Silicon-Based Anode
- Low Cost Electric Traction Drive Systems Using No Heavy Rare Earth Materials
- Utility Managed Smart Charging
- Platinum Group Metals (PGM) Content Reductio to Enable Cost-Effective Aftertreatment for Gasoline and Diesel Engines
- Improved Efficiency of Medium- and Heavy-Duty Natural Gas and Propane (LPG) Engines
- Energy-Efficient Off-Road Technologies Directly Applicable to Agriculture and/or Other Off-Road Vehicles
- Lightweight and High-Performance Fiber-Reinforced Polymer Composites for Vehicle Applications

- Improving Transportation System Efficiency through Better Utilization
- Enabling Vehicle and Infrastructure Connectivity
- Improving Mobility, Affordability, and Energy Efficiency through Transit
- Gaseous Fuels Technology Demonstration Projects
- Alternative Fuel Proof-of-Concept in New Communities and Fleets
- Electric Vehicle and Charging Community Partne Projects
- Technology Integration Open Topic
- Transportation and Energy Analysis

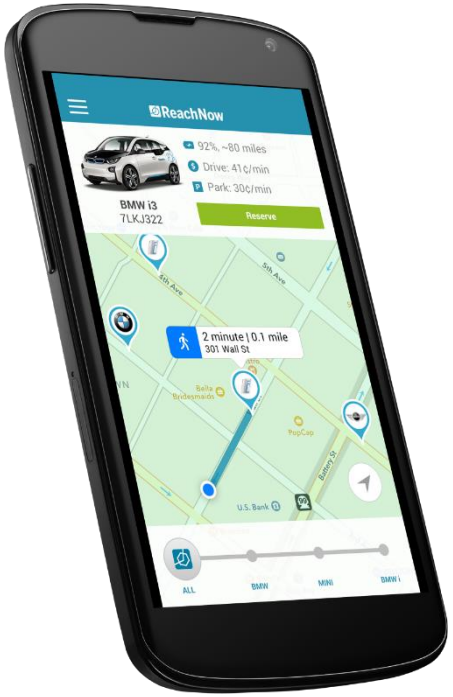
https://www.energy.gov/eere/vehicles/funding-opportunities

Employer Objectives

- Provide tangible business/employer benefits
  - Easier, faster commute for employees
  - Improved access to labor
  - Enable the use of employer based parking for other purposes
- Change the mindset of commuters
  - Provide incentives for people not to drive alone
  - Use flexible electric, automated and shared (pooled) vehicles
- Expand the labor pool
  - Improve access for people with lower incomes
  - Improve access for people with limited mobility

6 Building Blocks for Connected Autonomous Vehicles in Urban Areas

Implementing an app-based system



Advanced TransTech partners

Washington State is Preparing for AVs

June 7, 2017 Governor Signs Executive Order 17-02 on Autonomous Vehicles in Bellevue

JAY INSLEE
Governor

STATE OF WASHINGTON
OFFICE OF THE GOVERNOR
P.O. Box 40002 • Olympia, Washington 98504-0002 • (360) 902-4111 • www.governor.wa.gov

EXECUTIVE ORDER 17-02

AUTONOMOUS VEHICLE TESTING & TECHNOLOGY IN WASHINGTON STATE AND AUTONOMOUS VEHICLE WORK GROUP

GOVERNOR INSLEE'S ANNOUNCEMENT

"Washington state is already a leader in autonomous vehicle technology. We are an early-adopter that welcomes innovation and the safe testing and operation of AVs," Inslee said. "AVs could help save countless lives, reclaim time spent in traffic, improve mobility and be an important tool in our efforts to combat climate change."
–Governor Jay Inslee

In 2016, Governor Inslee worked with Google executives to recruit their self-driving car program to Washington state. That program (now known as Waymo) has successfully tested AVs throughout the City of Kirkland without incident. Over twenty AV technology companies — both established companies and start-ups — have developed a presence in Washington state. On June 7, 2017, Governor Inslee signed an executive order to further support the safe testing and operation of autonomous vehicles.

- March 22, 2018 Legislature created the Autonomous Vehicle Work Group

WASHINGTON STATE
AUTONOMOUS VEHICLE
WORK GROUP


King County
METRO
VANPOOL

All-Electric Metro Buses in Bellevue

Technology change can be fast

Kodak FY 2000: Record Results

- FY 2000 Financial Results:
  - Revenues: $14 B
  - Operating Earnings: $2.2 B
  - Net Profits: $1.4 B
- "Picture-taking at an all-time high worldwide:"(1)
  - Record # of Pictures taken: 80 billion.
  - Record # of Prints ordered: 100 billion.
- 2012 - Kodak Filed for **Bankruptcy Protection**

"A great brand, a great balance sheet, cash flow. This is a very smart time to be in the picture business"

Daniel Carp, CEO, Kodak
Letter to Investors, FY 2000

(1) Kodak, Annual Report 2000, Letter to Investo
Sources: Data and Image : Kod


a.bacall
"This really is an innovative approach, but I'm afraid we can't consider it. It's never been done before."


PROTERRA CATALYST™
NOT IN SERVICE
BATTERY ELECTRIC
ZERO EMISSIONS