IEDC ECONOMIC FUTURE FORUM

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Autonomous Vehicles: Implications for Real Estate & the Economy

Kent Gardner, Ph.D., Chief Economist

Center for Governmental Research, Rochester, NY

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About CGR

- Established in 1915 by Kodak's George Eastman
- 501(c)(3) nonprofit serving state & local government & social service nonprofits in multiple states, although concentrated in New York
- Major areas of focus
  - Needs assessment/program evaluation
  - Interactive, data-rich community profiles in NYS, Pennsylvania, Massachusetts, Florida, Tennessee, Delaware & Arkansas
  - Economic impact analysis
  - Public sector structure analysis—merger/consolidation studies in over 100 communities in NYS, New Jersey, Pennsylvania, Ohio, Maine & Massachusetts

CGR's Cost Benefit Solution

INFORMANALYTICS

- Real-time economic/fiscal impact assessment
- Consistent estimation across projects
- Meaningful information for stakeholders; reliable valuation for decision makers
- Clear & intuitive data entry
- Intelligible, transparent & comprehensive reports
- Customized to your local community
- No "off the shelf" calculations
- Data fields tailored to meet your needs
- Can accommodate mixed use & phased development
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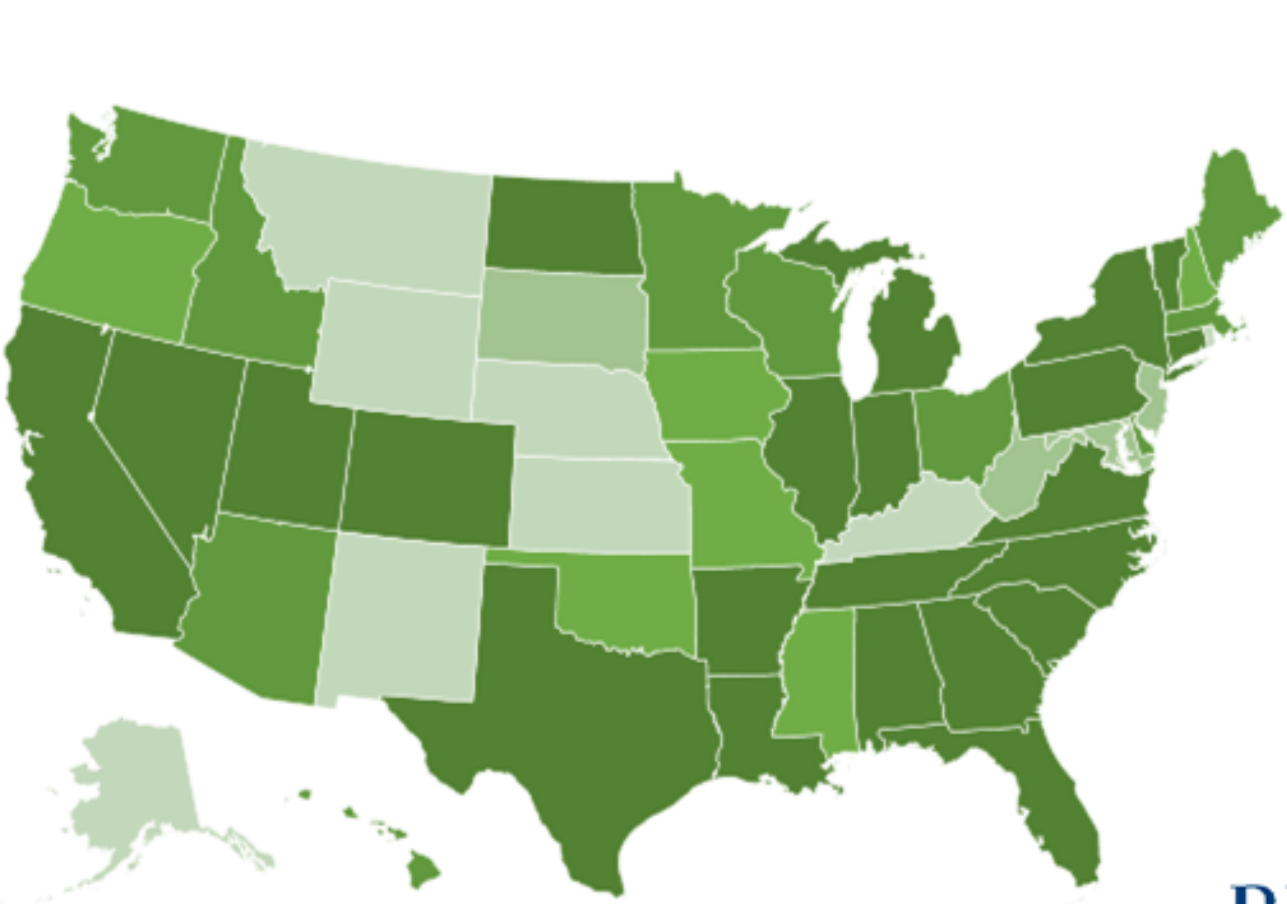
On to autonomous vehicles

- "it's unlikely that any on-road vehicles will feature "fully autonomous" drive technology in the short term (for instance, by 2020–22)"

  -McKinsey, June 2015

- The future is now
  - California approved testing of vehicles without "safety driver" on April 2
  - Arizona & Nevada had already approved this statewide & many companies have active programs
  - Uber-caused death in Tempe, Arizona raises caution flag, however.
    - ∞ Only fatality in 2 million miles logged by Uber
    - ∞ But national average is 1.25 fatalities per 100 million miles traveled



BROOKINGS

- See legal status at NCSL: http://www.ncsl.org/research/transportation/autonomous-vehicles-self-driving-vehicles-enacted-legislation.aspx
- 36 states either allow testing through legislation or executive order or both

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New York & Adjacent States

- NYS: Commissioner of motor vehicles may approve autonomous vehicle tests & demonstrations. Requires direct supervision of the state police for testing & assigns NYS Police Superintendent to regulate testing.
- CT: Pilot program in 4 munis; operator in car required
- MA: Study begun by Exec Order to lead to legislation
- NJ: No action
- OH: Testing approved by Exec Order; operator need not be in vehicle
- PA: Provides $40m pool of funds for R&D
- VT: DOT to convene stakeholders & make recommendations

Full autonomy will happen slowly

- Level 1 Driver Assistance
  - Car controls either the steering or the vehicle speed, but not both (adaptive cruise, automatic braking)
- Level 2 Partial Automation
  - Car can steer, accelerate, and brake in certain circumstances
- Level 3 Conditional Automation
  - Car can manage most aspects of driving, including monitoring the environment; prompts the driver to intervene when needed (remotely?)
- Level 4 High Automation
  - Car can operate without human input or oversight but only under select conditions
- Level 5 Full Automation
  - Car can operate on any road and in any conditions

Manufacturer announcements of Level 4 automation

- GM (Cruise Automation): 2019
- Honda (Waymo) & Toyota: 2020
- Renault-Nissan (Microsoft): 2020 in urban conditions; 2025 for Level 5
- Volvo (Uber): 2021 (highway)—accepts full liability for cars in autonomous mode
- Hyundai: 2020 (highway), 2030 for Level 5
- Fiat-Chrysler (Waymo): 2021
- Tesla: Elon Musk- “3-6 months” January 2017

Level 1/Level 2 available now

More theatrically . . .

What are implications for land use?

Premise: Your car can drop you off, then go park itself

- McKinsey forecasts 5.7B sq meter reduction in demand for parking overall
- How much land is devoted to parking in our most congested cities?
- Consider Manhattan
  - 8 million sf is devoted to parking structures on 5.2 million square feet of real estate
  - Full value of parking structures & lots was $1.9 billion in 2016
  - Office properties are worth 5.2 times as much on a per acre basis
  - Tax revenue from a conversion from parking to office (Manhattan alone) would bring in $470 million annually

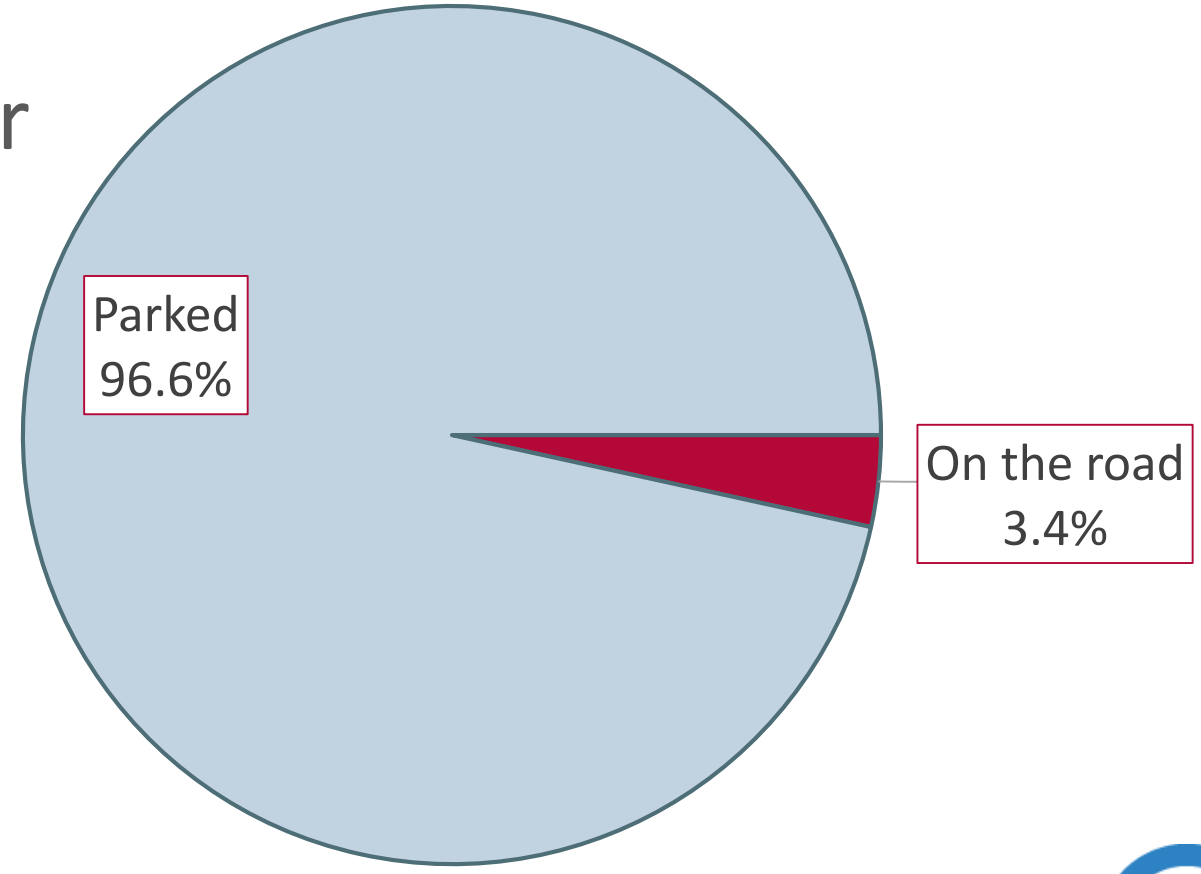
Premise: Your car can drop you off, then go park itself

- Consider cities with relatively stagnant economies
  - In Rochester, city-owned parking brings in $13m per year, just under cost of O&M
  - If parking is no longer scarce, rates will fall but the liability of the structures will remain until growth catches up (if it does)
- The *pro forma* of many facilities are built on parking revenue
  - The Monroe County International Airport posted net parking revenue of over $8 million in 2017
  - The Buffalo Niagara International Airport posted net parking revenue of nearly $18 million in FY17
  - At a minimum, rates will fall significantly as “off airport” facilities can undercut “on airport” with expense of a shuttle
- Proposed performing arts center in Rochester closes budget gap with anticipated $300,000 in annual parking revenue
- “Banking” open land as parking less viable as rates plummet

Premise: If ride hailing is cheap & convenient, why own a car?

- *Status quo*
  - My office is 6 miles from my home, a 20 minute drive
    - ∞ In a 5 day workweek, that's 60 miles and 3 hours, 20 minutes per week
  - Assume I double the daily driving on weekends
    - ∞ That's another 48 miles and 2 hours, 40 minutes
  - Trust my math: My car sits idle for 97% of the year

It’s a nice life . . .



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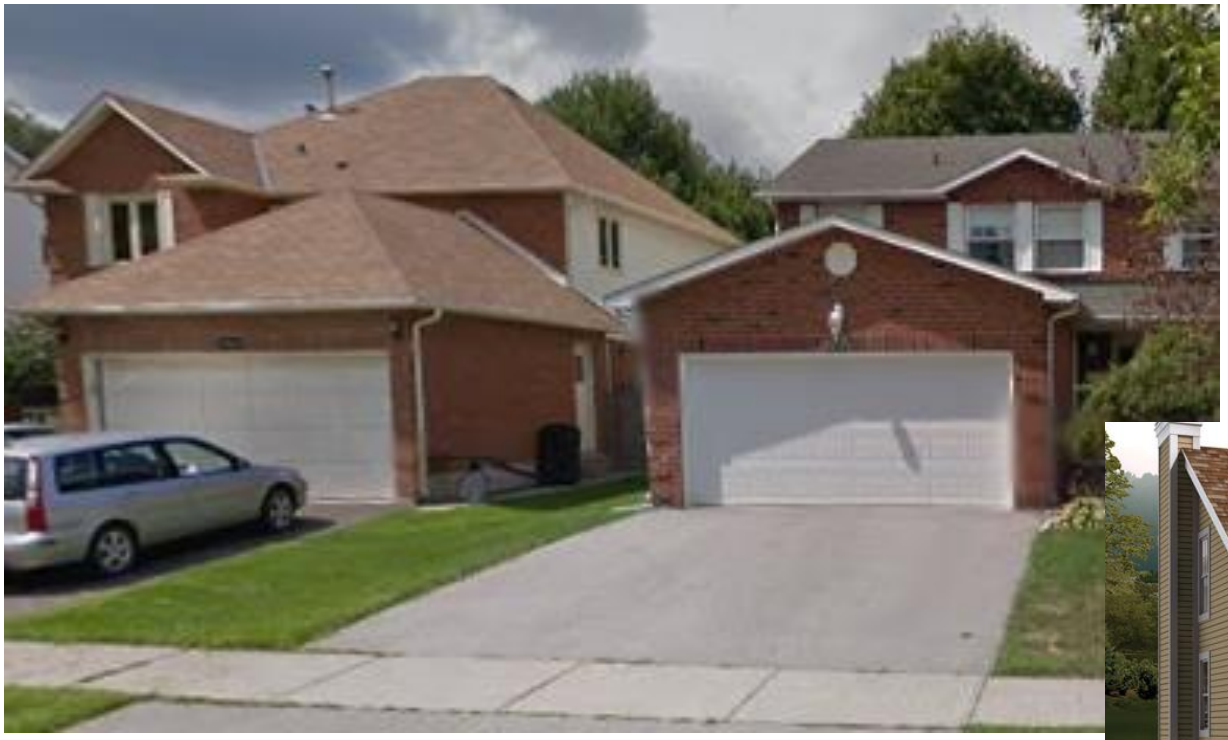
- During the transition, why own two?
  - In 2016, the average household owned 2 motor vehicles
  - Less than 1 in NYC (duh!), the average was over 2 in many big California & Texas cities
- Because they are members of the family?
  - Not to young people: Share of 19 yr olds with licenses dropped 18 percentage points from 1983 to 2014

Premise: If ride hailing is cheap & convenient, why own a car?

- Garage with attached house



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- Shopping centers, too

Without a driver, transit options explode

- Opportunity cost of commuting declines, flattening the property value gradient from major cities
- Fully automated highways will have significantly higher capacity—perhaps double?
- Ride hailing systems & automation puts car pooling on steroids
- Do costly fixed route systems still make sense?

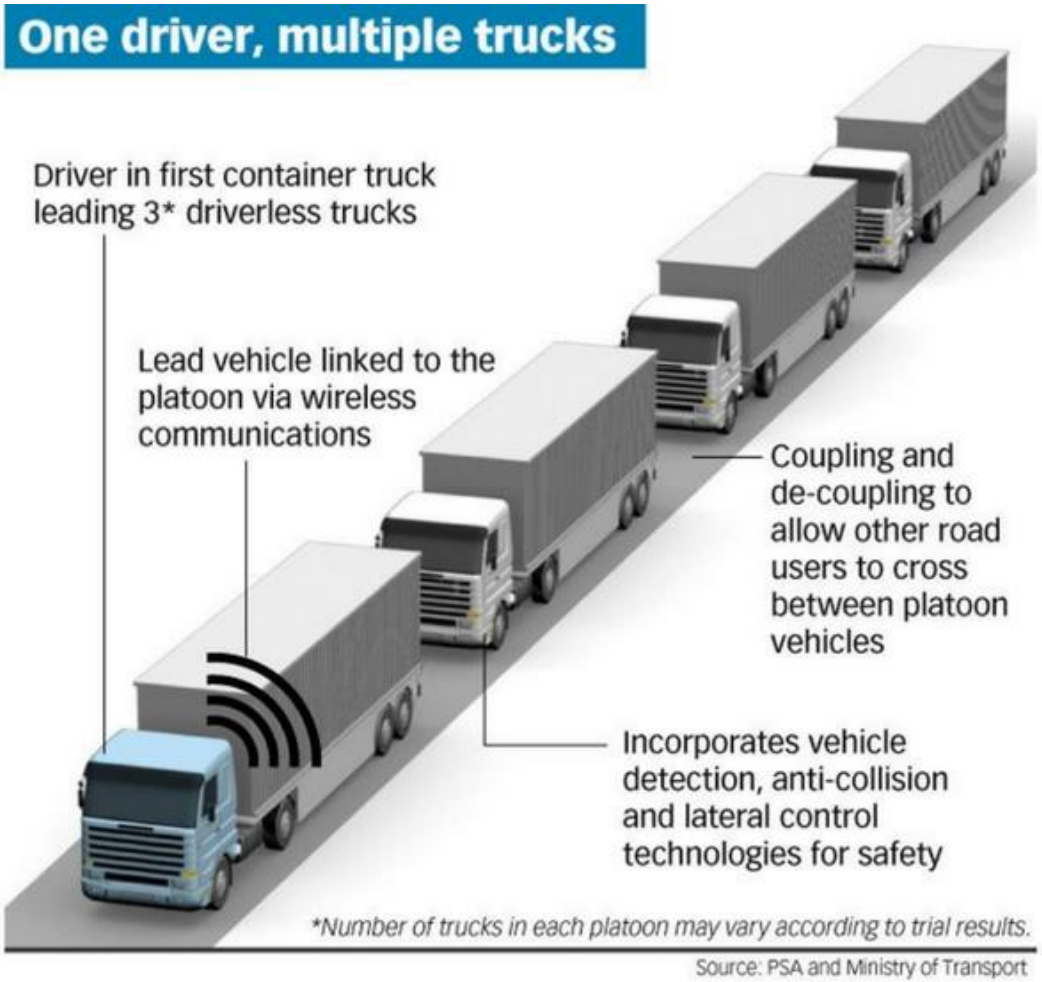
Potential Increased Capacity of Exclusive Bus Lane (XBL) Using Cooperative Adaptive Cruise Control (CACC)

(Assumes 45 toot (13.7 m) buses @ with 57 seats)

Average Interval Between Buses (seconds)	Average Spacing Between Buses (ft)	Average Spacing Between Buses (m)	Buses Per Hour	Additional Buses per Hour	Seated Passengers Per Hour	Increase in Seated Passengers per Hour
1	6	2	3,600	2,880	205,200	164,160
2	47	14	1,800	1,080	102,600	61,560
3	109	33	1,200	480	68,400	27,360
4	150	46	900	180	51,300	10,260
5 (Base)	212	64	720	-	41,040	-

What happens to employment?

- Platooning for over the road trucks will be technically feasible very soon



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- Platooning for over the road trucks will be technically feasible very soon
- 1.7 million heavy & tractor-trailer truck drivers in U.S.
  - Annual payroll of $70 billion
  - 3,660 fatal accidents annually—2/3 of deaths in cars (no surprise!)
- Demand for truck haulage expected to rise 30% by 2026
- Key scarcity is DRIVERS: Within 8 day period, drivers limited to 70 hours; $200,000 rig idle for at least 122 hours in every 8 day period

What happens to employment?

- Uber & Lyft has demonstrated that the taxi business is ripe for disruption
  - 181,000 tax drivers nationwide
  - Taxi, Uber & Lyft drivers must all compete with the Avs
- And if the Gardners don't need two cars? Or can get by without?
  - Motor vehicle & parts manufacturing employ 1 million
  - Motor vehicle & parts dealers employ another 2 million
  - Maintenance required on vehicles is declining—particularly for electric propulsion
  - Typical internal combustion engine 10,000 moving: Tesla Model S has about 150

Summing up . . .

- Real estate upended
  - Fabulous for congested cities
  - Disrupts financial model where scarcity doesn't create new opportunities
  - Transforms design: Office/commercial/residential
- Balance from rural/ex-urban/small urban to major urban continues apace
- Transit scales down; scale economies for light rail come to bus/van service
- Entire sectors lose massive share of jobs—good for some, bad for others

Questions to Kent Gardner

kgardner@cgr.org

585.466.4273