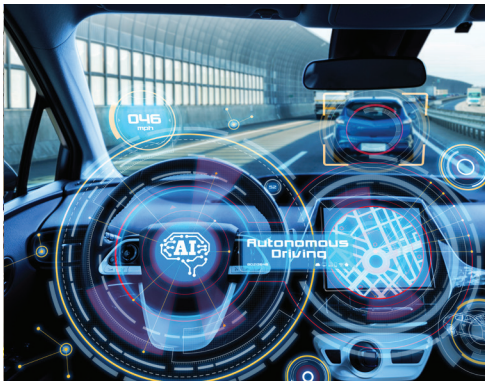
NATIONAL PARKING ASSOCIATION™

Smart Solutions for Parking in an

Autonomous Future

Looking Ahead
L4 & L5 Autonomy
2030 and Beyond







The National Parking Association engaged PricewaterhouseCoopers, LLC to develop a position paper on *An Ecosystem Approach to Reducing Congestion*. This position paper provides facts and future focused recommendations valuable to city planners, policy makers, transportation planners, as well as those interested in shaping policy to reduce congestion. NPA leadership has written the following policy brief in reaction to PwC's projections on autonomous vehicles.

Autonomous Implications for the Future

The full impact of Autonomous Vehicles (AVs), particularly L5 autonomy is beyond 2030. In the meantime, robo-taxis will be deployed across large metros in geo-fenced areas, but will remain a small percentage of the total passenger miles traveled.

Given the timing of the coming trends in autonomy, there are a series of actions the parking industry must consider in the short to mid-term L1-L3 and other actions in the long-term L4-L5 future.

Safety — Paramount in the Conversation

At the 2019 Consumer Electronics Show (CES), pedestrian safety was cited as the emerging issue with autonomous vehicles. The ethical and moral dilemma surrounding safety of drivers, pedestrians, and cargo, and which to prioritize in the event of a collision, is one that will not be solved quickly.

The connected car and assisted driver technologies will continue to emerge quickly. Full autonomy will likely emerge first in delivery vehicles. As a result, autonomous delivery vehicles that will always decide to protect pedestrians and other drivers before its cargo, may emerge more quickly. Further innovations on driver assisted autonomy for parking and collision avoidance are likely to emerge first to make driver assisted autonomy the near-term focus.

Implications for Parking

The L1-L3 autonomous future will result in parking companies focusing on building databases of customer data; becoming channel marketing leaders for their clients; and dramatically enhancing the ability of vehicles to quickly find and monetize spaces with dynamic pricing, much like the hotel industry.

The impact of L5 autonomous vehicles on society will be significant. Fleet ownership will take precedence over private vehicle ownership. Vehicles will also change dramatically, including the size and design.

Parking demand may remain strong and increase for storage of autonomous fleets and/or as owners who operate fleets within the city center use off street parking as a competitive advantage for fast access to automobiles.

Further, the role, design, location, and capabilities required of parking owners and operators will change if managing fleets, serving as staging areas or managing fleet logistics and short/long term storage, becomes standard practice.

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Near-Term Implications for

Mitigating Congestion

Concerns are beginning to emerge regarding autonomous vehicles and congestion. Taking a position on reducing congestion near term and long term positions the parking industry as forward thinking and contributing to solutions.

As a commercial or valet parking operator, the importance of engaging in your local county, city and state is growing.

As an employer who pays wages, sales tax, corporate tax, real estate tax and who indirectly fosters revenue and taxes from your clients—parking is providing support to public infrastructure. You have a vested interest in the development, maintenance and policy surrounding that infrastructure.

Trends Shaping the Future

Reducing congestion is a focal area of cities and transportation planners. The condition of U.S. infrastructure has been given a D+ grade by The American Society of Civil Engineers' 2017 Infrastructure Report Card.

- As cities continue to become more **urbanized, densification should create demand** for unused inventory.
- As cities reduce or **eliminate parking minimums**, building costs in the near term will depress the construction of new parking assets. Short-term these factors should have a rising downstream effect on parking prices.
- **Long-term parking shortages could develop** if population continues to increase, parking occupancy increases and in 20-plus years when autonomous fleets may be stored in inner ring or outer ring parking facilities in or near cities.
- Be aware that an opposing trend could emerge with **public pressure to reduce vehicles** on the road **or impose congestion pricing fees**, which could increase parking demand for rideshare and carshare storage, seeking to avoid geo-fenced gating fees into cities.

The National Parking Association engaged PwC to develop a position paper on Reducing Congestion for Shared Mobility. This position paper provides the parking industry with facts and future focused recommendations valuable to city planners, policy makers, transportation planners, as well as those interested in shaping policy to reduce congestion.

NPA further explores congestion trends and the autonomous innovations that will emerge.

Parking related recommendations for reducing congestion center on three key areas:

1. Reinventing the curb.
2. The mobility ecosystem.
3. Planning models focused on public/private collaboration.

Mitigating Congestion and Responding

to changing policy environments and streetscapes in office buildings, hotels, event venues, hospitals and college campus environments provides common ground with policy makers and asset owners to ensure that the parking industry has a seat at the table and a role in shaping cities of the future.

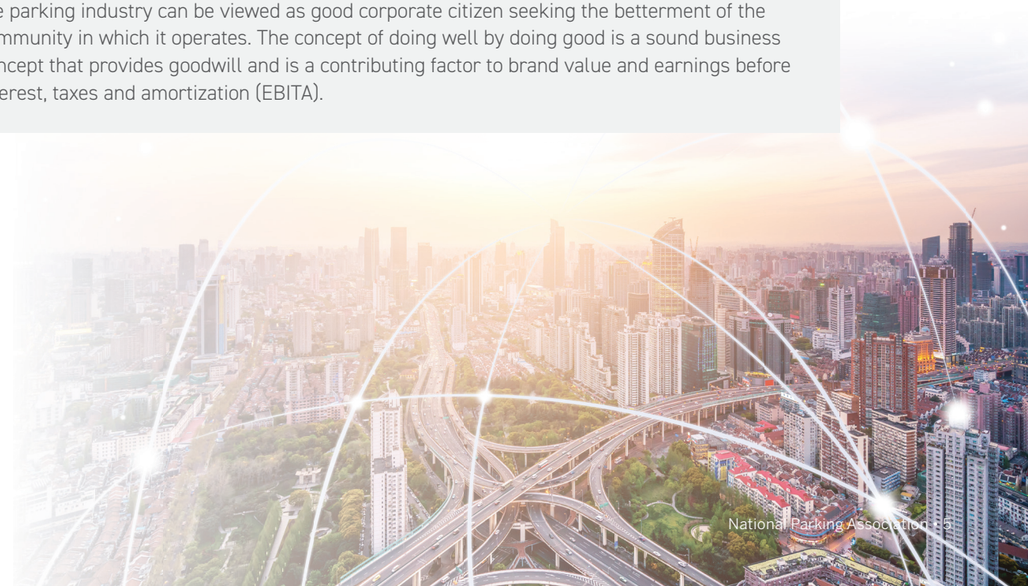
Reducing Congestion improves the flow of goods, services and people in cities. Congestion increases infrastructure costs, taxes and expenses.

"In the longer term, fully autonomous vehicles (those categorized as attaining 'Level 5' autonomy in the Society of Automotive Engineers' classification system) will be radically disruptive, but may not provide congestion relief. In fact, congestion may worsen due to induced demand from lower transportation costs and a decrease in public transportation ridership. In any case, Level 5 autonomous vehicles are unlikely to arrive en masse before 2030." — *An Ecosystem Approach to Reducing Congestion, PwC Strategy&*

Demonstrate Good Corporate Citizenship to Reduce Congestion

In the near-term, it is important for the parking industry to focus on building a public discourse and become active in the community as a voice of proactive near-term action that can help mitigate congestion—by helping to solve a shared problem congestion.

By establishing relationships, positive ideas to improve city livability, safety and efficiency—the parking industry can be viewed as good corporate citizen seeking the betterment of the community in which it operates. The concept of doing well by doing good is a sound business concept that provides goodwill and is a contributing factor to brand value and earnings before interest, taxes and amortization (EBITA).





Work with Cities to Manage Parking Restrictions

On-street parking, in its current form, is a big driver of congestion. PwC recommends the following be done to help reduce congestion near the curb with respect to on-street parking.

- **Repurpose or Reprice On-Street Parking**. The space could be reused to add an additional traffic lane or create a drop-off point for TNCs or delivery companies, which should reduce circling.
- **Reduce or Eliminate Parking Minimums**. Allow market demand to determine the appropriate supply of parking. This will reduce the cost of development and result in a better balance of parking supply and expected demand for the specific real estate application.

The parking industry must work with stakeholders and regulators to ensure that on-street and off-street parking is managed effectively and does not further contribute to congestion. Any increase in revenue must also be invested into congestion mitigation programs.

Further, it's critical that the parking industry drive operational improvements, taking advantage of congestion related opportunities and preparing for the autonomous future.

> *"The role of the parking attendant and operator may change. Technology could automate many of the current processes and makes a centralized command center more cost effective. While amenity and concierge services will focus on increasing service levels in life, play, and work settings."*
>
> -An Ecosystem Approach to Reducing Congestion
> PwC Strategy&

5 Ways Parking is Relevant in an Autonomous Future

1. Focus on Operational Improvements Using Data

A core focus on acquiring, maintaining and deploying customer data is critical for establishing a relationship with the customer. This can be attained through amenities, loyalty programs, parking privilege/upgrade services to increase stickiness to the brand and a unique take on parking services.

Data for customer reporting, understanding customer trends and building back office capability in this area is an immediate and primary area for action. This action extends to the ability to market facilities, offer dynamic pricing and track occupancy in the same manner as the hotel industry.

2. Develop New Hospitality Competences and Relationships

As a retail service business that directly interacts with the consumer, the last mile experience is critical to the reputation of the parking industry and its component members.

Mobility Hubs of the future will feature retail and service amenities. Mobility as a Service (MAAS) will be integral to operation performance. Garages will likely feature first- and second-story retail, and valet amenity services for dry cleaning and/or package delivery directly to the vehicle.

3. Develop New Facilities

New investments must be examined with a careful eye on location and industry serviced given the long financial payback periods. Missteps can be extremely costly. Securing assets in today's dollars in anticipation of further densification and scarcity of real estate offers opportunity for long term gains.

PwC notes that parking facilities will need to be redesigned over the long term to accommodate AVs:

- **New facilities will require a higher electrical load to handle the electrification of vehicles.** Most AVs in the future will be electric. It may be advantageous (or, depending on the course of regulatory change, required) for some or all parking stalls in a facility to offer charging infrastructure.
- **The optimal layout for parking structures will change, as AVs can be packed more tightly together.** Facilities will not require the same amount of space per vehicle as they do today.
- **New technologies may increase capacity.** Lift systems or elevators may be used to pack vehicles more closely together and additional sensors for parking may be added. Automated parking technologies may allow for greater utilization of space.

4. Adopt Future-Friendly Technology Focused on Livability

To the extent that parking companies or their asset owner customers invest in new technologies, they distinguish their facilities as progressive, modern and offering amenities. Often amenities are offered in sync with indicated preference, but ahead of actual consumer demand.

Coupling technology investment with premium parking space locations, high-turnover short time periods and amenity services such as an intra city (within the city) house car for drop off within a geofenced area—offers consumers choice and value. That value may come with a premium price.

Those who can invest in the future can optimize features as benefits and monetize services and consumer experience.

5. Explore New Business Opportunities

Parking operators and owners can also find new business opportunities that are driven by these transportation and congestion related trends.

New partnerships need to be explored that will also help mitigate congestion within cities. Two examples are:

- **Partner with TNCs.** Parking can play a key role in getting TNC vehicles off the street. With facilities placed in convenient locations across the city, parking can be a critical asset to act as a dynamic ride-hailing stand, essentially an extension of the curb.
- **AV Fleet Maintenance.** Shared fleets will require a place both within and outside of city centers to clean, maintain and charge their vehicles. If relationships and new capabilities are developed, parking operators could fill this need.



2030 — 2050 Long-term

AV Implications

Parking garages will turn into Mobility Hubs of the future. Autonomous parking for in-city staging and vehicle storage in high-density urban areas will increase transportation access and minimize wear and tear on vehicle storage at greater distances.

In NPA's thought piece Smart Solutions for Shared Mobility, NPA laid out a vision for long term implications that AVs will have on parking structures, including:

- **Mechanical and Automated Parking** Automated parking structures will increase based on their ability to maximize usage per square foot for parking in high-cost-per-square-foot real estate markets.
- **Fleet Logistics Staging Off-Street** Automated, shared, leased, and fleet vehicles will be part of a diverse ecosystem. Effective staging of fleet vehicles in city and near city will contribute to effective storage, accessibility, and servicing of fleets near operating areas.
- **Expanded EV Charging** EV charging access at parking structures will increase in areas experiencing greater adoption of electric vehicles.







Progression of Autonomous Vehicles

Level 0: **No automation.** The driver maintains control of all driving functions at all times.

Level 1: **Driver assistance.** Steering or accelerating/braking are handled by the vehicle in certain driving modes, but dynamic driving tasks are performed by the driver. (Example: adaptive cruise control.)

Level 2: **Partial automation.** Steering and accelerating/braking are handled by the vehicle in certain driving modes, but dynamic driving tasks are performed by the driver. (Example: adaptive cruise control with lane keeping assistance.)

Level 3: **Conditional automation.** The vehicle handles all aspects of driving, including dynamic driving tasks, but with the expectation that a human driver will respond to a request to intervene. (Example: Adaptive cruise control with automated lane change.)

Level 4: **High automation.** The vehicle handles all aspects of driving, including dynamic driving tasks, and can serve as a fallback if the driver does not respond to a request to intervene. (Example: Operates fully autonomous in a geo-fenced area under a limited number of environmental conditions.)

Level 5: **Full automation.** The vehicle can perform all critical driving functions for an entire trip; driver is not expected to be available for control. (Example: Free-roaming autonomous vehicle.)

-An Ecosystem Approach to Reducing Congestion
PwC Strategy&



Conclusion

Parking will continue to evolve along with the shifts in transportation trends. As congestion continues to increase in the short-term, numerous solutions are necessary to mitigate the effects of congestion.

Parking is part of that future. Industries that modernize within and promote positive policies for communities build their strength as a brand, employer, tax generator and in delivering shareholder and investor value. The interrelationship of revenue/growth and profitability as an employer and taxpayer are critical elements in public discourse.

Pressures on the public sector budgets will result in an increase in public private partnerships and in increasing the rate of privatization of assets. Private sector business practices and efficiencies through the use of technology will increase both revenue and profits generated from parking assets.

As mobility evolves towards autonomy, parking industry participants must increase awareness and take measurable steps to adapt in the near term and look ahead to longer term opportunities.

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