

# Transportation-to-Grid

**New Business Models to Capture  
Value in the Energy Cloud**



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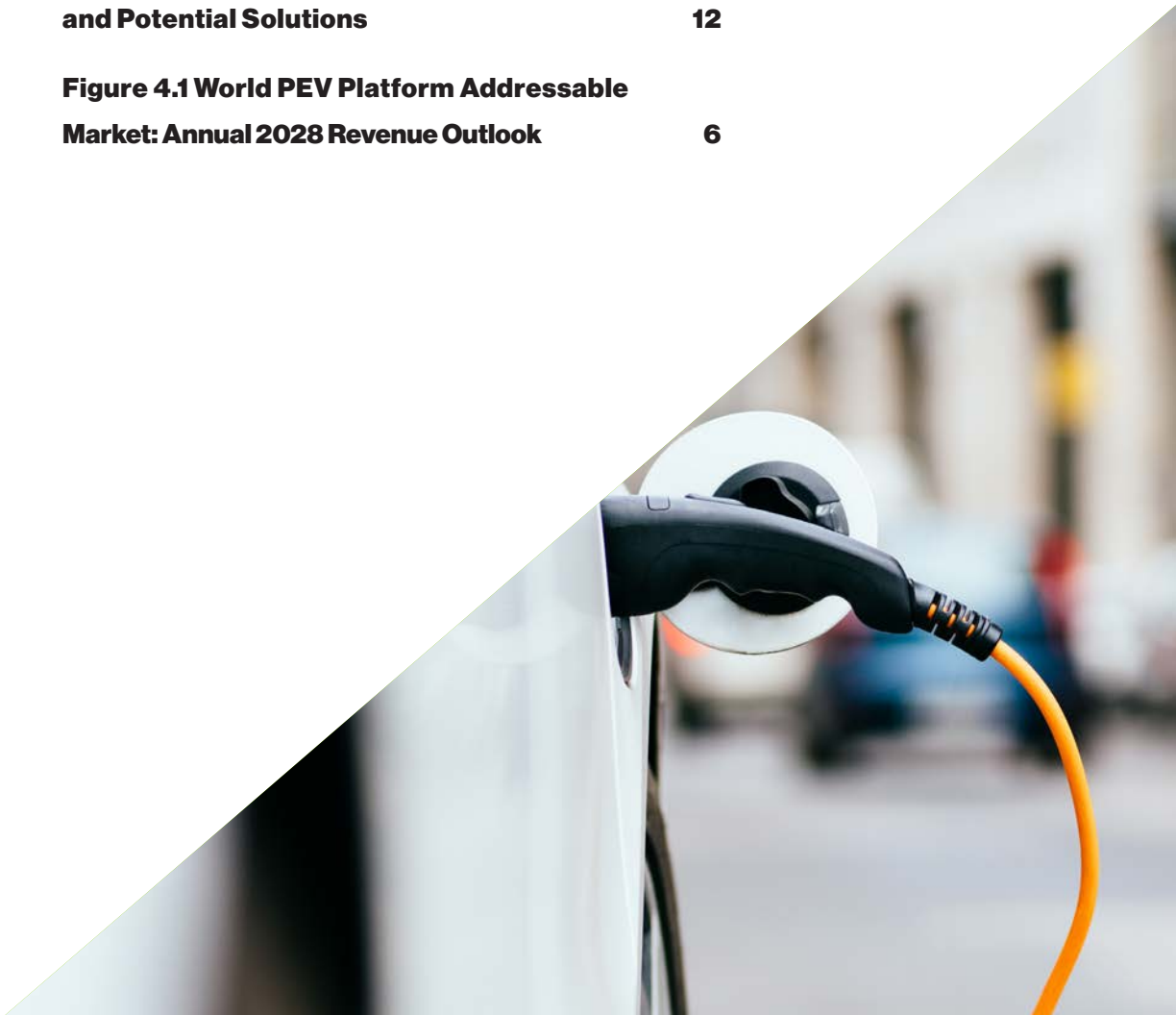
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## Energy

# Transportation-to-Grid

## New Business Models to Capture Value in the Energy Cloud

### 1 Introduction

Two fundamental building blocks of 20th century civilization are being upended: energy and transportation. Fueled by multilateral efforts to address climate change by decarbonizing the global economy and coupled with the increasingly autonomous, connected, electric, and shared (ACES) transportation, these accelerating megatrends have instigated transformation. Energy companies, utilities, automakers, and many other impacted stakeholders are all seeking traction for innovative solutions to transport people and goods around the planet.

The rising transportation-to-grid (T2G) platform is the nexus of transformation for the multitrillion-dollar industries of energy and transportation. In *Energy Cloud 4.0*, Guidehouse describes an increase in energy-related transactions initiated within and delivered through customer-centric platforms like T2G.<sup>1</sup> Across emerging Energy Cloud platforms, concentrated demand, technology democratization, innovation, and potential for industry coupling lay the foundation for new business models. Such models will facilitate multiple levels of value in the form of energy, data, and financial products and services.

This paper explores the T2G platform and its transformative business models through the lens of transportation electrification, with a specific focus on plug-in EVs (PEVs). PEVs include plug-in hybrid EVs (PHEVs) and battery EVs (BEVs). Each T2G business model brings new opportunities for delivering value as well as new complexities. From utilities to automotive OEMs, market players must rethink their traditional business model approaches in energy and transportation to embrace new partners, new service offerings, and new sources of value.

### 2 The T2G Platform: Disrupting the Transportation and Energy Value Chains

Efforts to decarbonize the global transportation sector are gaining momentum. According to the [Climate Action Tracker](#),<sup>2</sup> if countries were to double fuel economy standards in new cars by 2030 and achieve 50% PEV adoption by 2050, most would get close to the emissions reduction pathway that would limit warming to 2°C in line with Paris Agreement goals. To go from a 2°C to a 1.5°C pathway, however, zero global aggregate emissions would need to be reached around 10 years earlier—a daunting task based on current trends.

1. Guidehouse, *Energy Cloud 4.0*, 2018..

2. NewClimate Institute, Ecofys, and Climate Analytics, *The Road Ahead: How Do We Move Car Fleets?*, 2016..

A growing number of countries are announcing commitments to ban the sale of petrol and diesel cars, including China, the UK, France, and India (the second, fifth, sixth, and seventh largest economies in the world, respectively). These promising developments suggest T2G platform opportunities will continue to increase in significance and importance. Countries like Norway, which announced in 2016 that it will require all new vehicles sold within the country to be zero emissions by 2025, are a reminder that disruption to the global transportation system is just around the corner—if not already here.

Traditional channels of distribution are changing. The well-established supply chain path of manufacturer to dealer to buyer is fading—Tesla has cut out the middlemen by selling direct to buyers. The same goes for petroleum moving from refineries to pipelines to gasoline stations to customers. The traditional linear value chains of energy and transportation are fracturing into complex networks of market players and evolving value propositions.

For example, with the increased adoption of EVs seemingly anyone with an electrical outlet can become a fueling station. According to Navigant Research\* analysis, PEVs will be the single largest addition of energy demand

to the grid across many countries in the developed world. By 2020, Guidehouse expects PEVs to annually consume more than 80,000 GWh of electricity globally. Simultaneously, multimodal transportation options in the mobility as a service (MaaS) space—from ridesharing to fleet electrification—and their overlap with PEVs, will provide new opportunities for mobility providers to leverage the electric grid-integration capabilities of fleets.

### 3 ACES Vehicles: The Foundation of T2G Business Models

In its broadest sense, the T2G platform describes the opportunities created by the electrification of transportation—from passenger vehicles to transit systems to port operations—and the electricity grid. The supporting electric charging infrastructure, along with distributed intelligent devices, software, data, and communications, adds a layer of locational flexibility (and unpredictability) that potentially unlocks value and transformative business models across the grid.

The T2G platform is expansive. To illustrate the platform's power and potential, this paper focuses on its most tangible areas, exploring potential new business models that may arise from

\*Navigant Research is now Guidehouse Insights (April 2020). Guidehouse LLP completed its acquisition of Navigant Consulting Inc. and its operating subsidiaries on October 11, 2019. <https://guidehouse.com/news/corporate-news/2019/guidehouse-completes-acquisition-of-navigant>





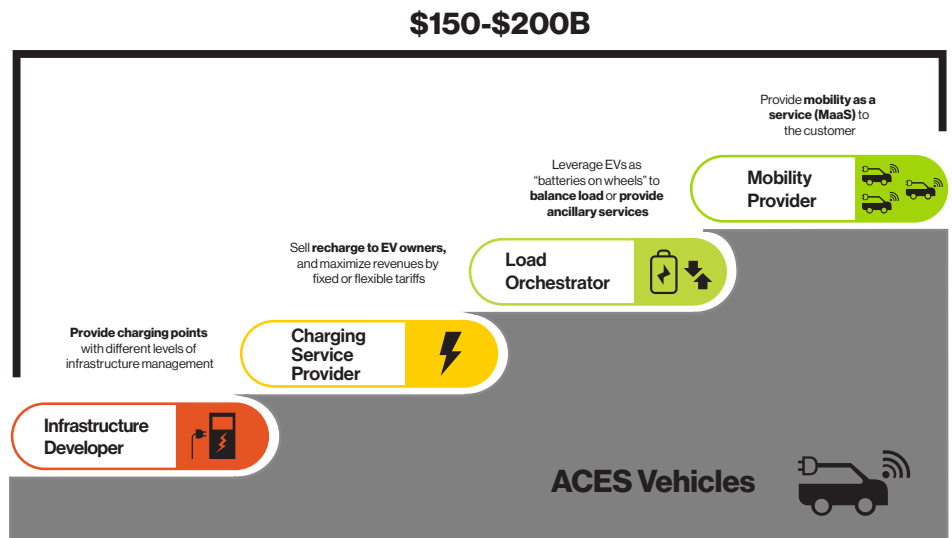
the electrification of vehicles—including light duty (LD), medium duty (MD), and heavy duty (HD). Vehicles in the T2G platform will be electrified, connected with intelligent devices, and eventually leverage equipment for highly automated capabilities. ACES vehicles form the foundation for the T2G business models discussed in this report.

Through 2028 expect the focus to be on the connected and electric portions of ACES delivered through the traditional retail model. Globally, annual LD vehicle sales with built-in telematics—telecommunications and information processing systems—are expected to total 37 million vehicles in 2019 and reach 114 million vehicles in 2028. As ACES vehicles grow in number, sophistication, and complexity, so too grow the business model opportunities in the T2G platform.

## 4 Transportation Electrification Business Models in the T2G Platform

Four key business models—infrastructure developer, charging service provider, load orchestrator, mobility provider—arise in the T2G platform for vehicle electrification built on the foundation of ACES vehicles. (Figure 4.1). The business models are not mutually exclusive, but rather build upon one another as additional opportunities, products, and services that can be offered to customers. The global opportunities of these four business models represent an estimated \$150 billion to \$200 billion in annual revenue in 2028. The following sections explore each business model in terms of its value streams and examples of emerging opportunities.

**Figure 4.1 World PEV Platform Addressable Market: Annual 2028 Revenue Outlook**



Source: Guidehouse

## 4.1 Infrastructure Developer

The growing population of PEVs will require nearly as many charging ports as vehicles, and these ports must be ever more capable and sophisticated. This means higher power capacities and smarter technologies that can relay vehicle and charger information in real-time to property owners, vehicle owners, utilities, and network operators for a variety of use cases.

In the infrastructure developer business model, market players such as ClipperCreek primarily focus on deploying charging infrastructure and other fundamental services of vehicle electrification. Developers deliver physical charging points and varying levels of infrastructure management, software, fleet, and energy management services.

**Table 4.1 Summary of Infrastructure Developer Business Model**

Business Model Description	Incremental Value Streams
Provide charging points with different levels of infrastructure management, including software.	<ul style="list-style-type: none"> <li>• EV supply equipment (EVSE)</li> <li>• Utility make-ready infrastructure</li> <li>• Equipment siting optimization</li> </ul>
Example Company: Infrastructure Developer in Action	Example Solutions
ClipperCreek is a PEV charging equipment manufacturer with a portfolio of products that contains a variety of Level 1 and Level 2 EVSE units for both residential and commercial usage. The company has primarily focused on offering moderately priced, non-networked chargers for market segments that are price sensitive and where networking is not critical.	<ul style="list-style-type: none"> <li>• Offer white-glove EVSE siting advisory services</li> <li>• Deploy home charging infrastructure turnkey solutions</li> <li>• Deploy heavy bus, truck, and fleet charging infrastructure turnkey solutions in private depots</li> </ul>

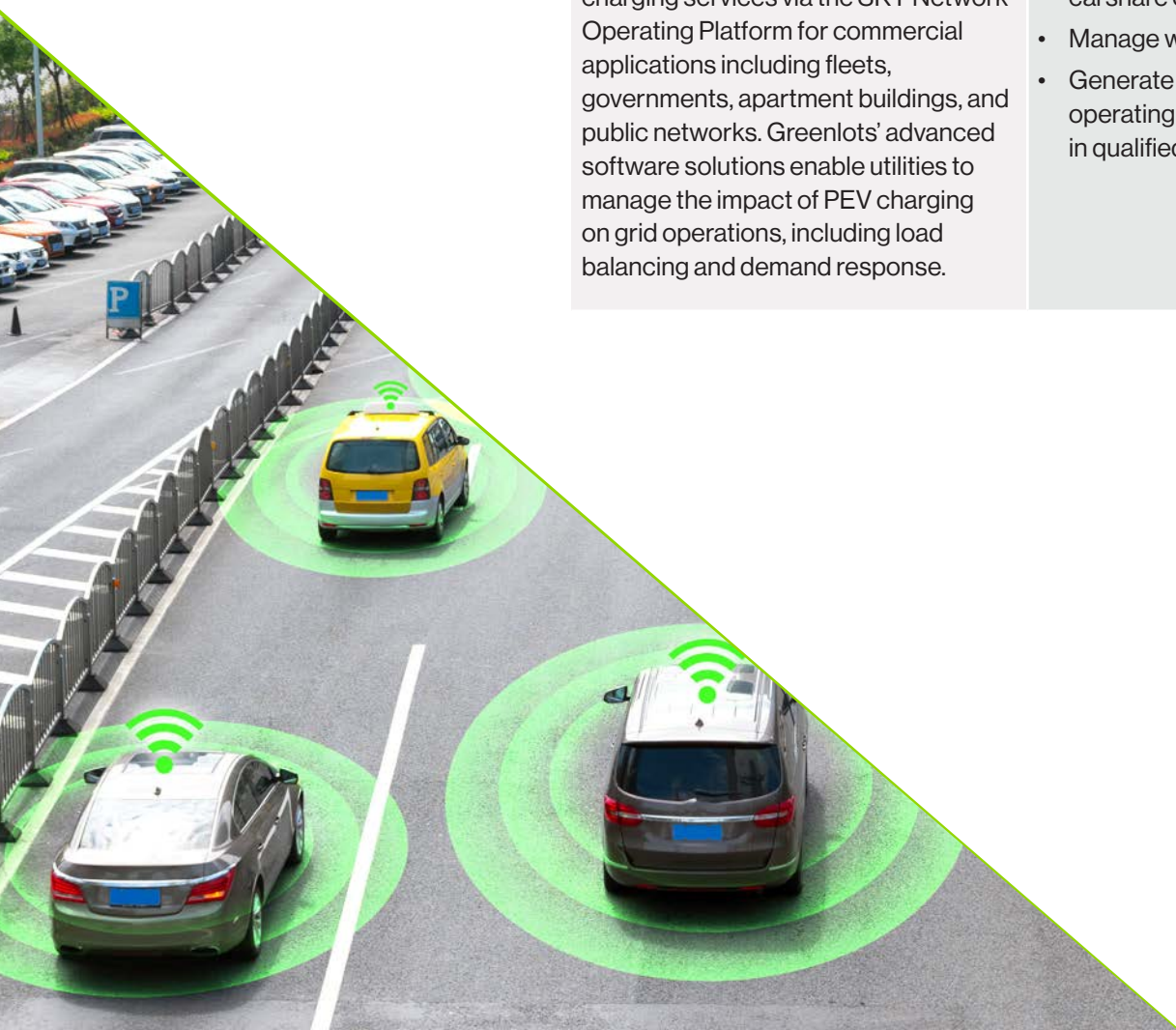


## 4.2 Charging Service Provider

A charging service provider goes beyond an infrastructure developer to manage the services associated with vehicle charging. For example, a charging service provider could manage a network of DC fast-charging infrastructure as a branded fast-charge corridor that also generates carbon credits—based on energy sales—to monetize in qualified voluntary carbon markets.

**Table 4.2 Summary of Charging Service Provider Business Model**

Business Model Description	Incremental Value Streams
Sell recharge to PEV owners and maximize revenue by fixed or flexible tariffs in the public and private space.	<ul style="list-style-type: none"><li>• Energy (kilowatt-hour)/carbon credits</li><li>• Networked payment settlements</li><li>• Cybersecurity/data protection</li></ul>
Example Company: Charging Service Provider in Action	Example Solutions
Founded in 2008, Greenlots focuses on charging services via the SKY Network Operating Platform for commercial applications including fleets, governments, apartment buildings, and public networks. Greenlots' advanced software solutions enable utilities to manage the impact of PEV charging on grid operations, including load balancing and demand response.	<ul style="list-style-type: none"><li>• Fleet charging service for rideshare/ carshare customers</li><li>• Manage workplace charging service</li><li>• Generate carbon credits by operating PEV charging stations in qualified markets</li></ul>





### 4.3 Load Orchestrator

Vehicle-grid integration (VGI) enables PEVs to participate as generation or as demand assets for grid operators. Automotive and electric power sector industry market players have increased interest in VGI because it can make a PEV purchase decision easier and increase the efficiency of grid reliability. VGI covers:

- **Unidirectional (V1G):** PEV provides services to the grid by changing the rate at which it consumes power in response to an external signal, i.e., vehicle-to-grid (V2G) communications for charge management.
- **Bidirectional (V2G):** PEV is capable and enabled by electric distribution network provider to supply power back to the grid, i.e., V2G power transfer.

Providers in the load orchestrator business model treat PEVs as variable-load and/or batteries on wheels. These providers use existing or virtually assembled fleets of PEVs to serve grid needs by controlling their charging and discharging to balance load or provide ancillary services as part of a larger energy management service. Actively managing and spreading the load across infrastructure assets and time via VGI can help prevent infrastructure upgrade costs. These technologies can also decrease grid balancing costs—an increasingly important aspect as more intermittent renewable resources, such as wind and solar, are added to generation portfolios. Notably, there are few pure VGI plays globally, such as Nuvve. Most VGI activities are an added capability of market players that are, or supply, charging service providers.

**Table 4.3 Summary of Load Orchestrator Business Model**

Business Model Description	Incremental Value Streams
<p>Use PEVs (one or more, e.g., fleets) as batteries on wheels (or stationary second life batteries) by controlling their charging and discharging to balance load or provide ancillary services.</p>	<ul style="list-style-type: none"> <li>• Unidirectional (V1G) energy conservation*</li> <li>• Bidirectional (V2G) energy transfer*</li> </ul> <p><i>*Includes light (e.g., passenger), medium (e.g., fleet), and heavy (e.g., transit bus) vehicles</i></p>
Example Company: Load Orchestrator in Action	Example Solutions
<p>European utility company Enel has been a lead developer of V2G technologies through partnerships with Nissan, Mitsubishi, and Nuvve, primarily in Europe. The company and its partners now offer one of the few available commercialized V2G solutions for fleets.</p>	<ul style="list-style-type: none"> <li>• Utility grid services supplier</li> <li>• Grid services aggregator for city bus agencies</li> <li>• Grid services aggregator for public parking lot locations</li> </ul>





#### 4.4 Mobility Provider

MaaS solutions such as carsharing, ride-hailing, and micro transit provide flexibility for users and enable the replacement of individually owned vehicles. Electrification enables widespread MaaS deployment since emission reductions and improved air quality are important megatrends underway in the transportation and energy transformation.

In a MaaS environment, operating costs are a key factor in the business model. In most cases the MaaS provider model will use ACES vehicles through leasing opportunities; customers would be charged on a per-mile basis. Providers could also use additional opportunities to ensure the successful deployment and efficiencies of these vehicles—including PEV fleet readiness evaluations and fleet mobility data archiving.

In the fleet scenario, the significantly lower cost of running on electricity has a larger positive impact on the total cost of ownership of high mileage vehicles than it does for individual ownership. So too with these “parking lots of batteries” comes an opportunity to transition their remaining value from a road-facing life into a grid-facing life as ancillary service assets.

There is a significant life cycle financial value proposition to adopt electrification for MaaS, even if the upfront cost is higher.

**Table 4.4 Summary of Mobility Provider Business Model**

Business Model Description	Incremental Value Streams
Provide MaaS to customers, either on a narrow (business-to-consumer [B2C]) or wider (business-to-business [B2B] and municipalities) scope.	<ul style="list-style-type: none"> <li>• B2B/B2C: Transport, connectivity, navigation optimization services</li> <li>• Public: Traffic, parking optimization services</li> </ul>
Example Company: Mobility Provider in Action	Example Solutions
Nissan and Enel partnered on the Parker Project targeting aggregation of light commercial vehicles in V2G services. The Parker Project launched in Denmark in 2016 to provide grid balancing services to a fleet of PEVs owned by Copenhagen-based utility Frederiksberg Forsyning.	<ul style="list-style-type: none"> <li>• Turnkey EV fleet solution for parcel delivery providers</li> <li>• Dedicated rideshare/carshare fleet charging services</li> <li>• Fleet logistics data service provider</li> </ul>

## 5 Value Stacking T2G Business Models

Market players can tackle one or more of these business models through value stacking, or the ability to deliver multiple T2G services at the same time. Examples of value stacking are found in Table 5.1.

**Table 5.1 Examples of T2G Value Stacking**

Infrastructure developer	<b>Infrastructure Developer + Charging Service Provider</b>
Charging service provider	Global oil majors, such as Shell and BP, have acquired PEV charging infrastructure players. Shell acquired one of Europe's largest PEV charging providers, NewMotion, in October 2017, and Greenlots in January 2019. In June 2018, BP purchased Chargemaster, the UK's largest PEV charging company.
Load orchestrator	
Mobility provider	
Infrastructure developer	<b>Infrastructure Developer + Charging Service Provider + Mobility Provider</b>
Charging service provider	Maven, GM's personal mobility brand, and Uber teamed up to provide drivers using the Uber platform with the option to lease qualified vehicles by the week or longer. In true value stacking fashion, GM announced in May 2019 that it plans to enter into the PEV charging infrastructure and services business models through a partnership with Bechtel, creating a separate corporation that will build thousands of PEV charging stations across the US. Taking a similar approach to Tesla's Supercharger Network, GM intends that its network support the 20 new PEV models the automaker plans to have introduced by 2023.
Load orchestrator	
Mobility provider	
Infrastructure developer	<b>Infrastructure Developer + Charging Service Provider + Load Orchestrator</b>
Charging service provider	Italian energy company Enel X continues to grow its PEV charging infrastructure and services into a multi-layer value stacking approach to address new customer service opportunities for PEV owners. In September 2018, Enel X expanded its Juice product offering to support managed charging (i.e., load orchestration), to provide a value stacked solution set that includes:
Load orchestrator	<ul style="list-style-type: none"> <li>• JuiceBox: Connected charging station for homes to enable drivers to remotely monitor the charging status of their vehicle, with the ability for bidding into the day-ahead wholesale energy market in California.</li> <li>• JuicePole: Roadside charging station that can be activated with Enel X's Recharge app.</li> <li>• JuiceLamp: Variation of JuicePole that can provide video surveillance and air quality monitoring).</li> <li>• JuiceStation: Fleet management capabilities.</li> </ul>
Mobility provider	

## 6 Business Model Challenges and Complexities

Table 6.1 highlights that the complexity for T2G business models lay primarily in that these spaces are rising from the wake of the ensuring paradigm shift. Regulatory structures are still being defined for investor-owned utilities, mass market customer solutions are still under development, and the potential demand is still evolving.

**Table 6.1 T2G Business Model Complexities and Potential Solutions**

T2G Business Model	Complexity	Potential Solutions
<b>Infrastructure Developer</b>	<ul style="list-style-type: none"> <li>Structuring charging options for homes without parking spaces or multi-dwelling units</li> <li>Commercial property owners may not understand the value proposition</li> <li>Market and regulatory constraints</li> </ul>	<ul style="list-style-type: none"> <li>Siting community charging hubs in right-of-way locations near high traffic flows</li> <li>Exploring fleet electrification opportunities</li> <li>Educating individuals and businesses about the individual and collective benefits of PEV ownership and charging</li> </ul>
<b>Charging Service Provider</b>	<ul style="list-style-type: none"> <li>Primary charging (home) and secondary charging (workplace) skew demand away from public charging networks</li> <li>Public charging must compete against low cost, high convenience home charging</li> <li>Costs for services and subscriptions can outweigh potential benefits for many would-be EVSE owners</li> <li>Business proposition varies across jurisdictions relative to urban densities, access to public transit</li> </ul>	<ul style="list-style-type: none"> <li>Focusing on intercity travel and expanding the customer base of PEV owners without primary charging locations</li> <li>Exploring fleet electrification opportunities</li> <li>Working with utilities that have an interest networking residential charging stations to better manage PEV load</li> </ul>
<b>Load Orchestrator</b>	<ul style="list-style-type: none"> <li>A single vehicle provides limited value to grid services and major grid services markets have minimum capacity requirements</li> <li>VGI technology is in its infancy with lack of uniformity in communication protocols, standards, and commercial applications</li> <li>VGI business case can be confusing because PEVs are road-facing assets first, grid-facing assets second</li> </ul>	<ul style="list-style-type: none"> <li>Focusing on aggregation</li> <li>Exploring opportunities to use electrified fleets</li> <li>Demonstration projects in markets with high or increasing solar and wind penetrations that are likely to value VGI more due to higher electricity generation costs attributed to renewable generation intermittency issues</li> </ul>
<b>Mobility Provider</b>	<ul style="list-style-type: none"> <li>Need to ensure vehicles are recharged at appropriate times</li> <li>Decreased utilization due to limited range and downtime for charging</li> <li>Real-estate costs for service depots around city to minimize dead-head, or wasteful, miles</li> </ul>	<ul style="list-style-type: none"> <li>Understanding vehicle use cases, vehicles with more predictable patterns can provide a jump-start for mobility efforts</li> <li>Considering how MaaS can bring scale with PEV fleets to improve the viability of V2G</li> <li>Swapping battery to decouple charging and operation, enables short downtime and V2G</li> <li>Providing vehicle subscription service model to allow consumers to have the desired vehicle at the desired time</li> </ul>

Market players invested in developing solutions that can address these challenges and support the overarching success of T2G platform business models should consider the following:

- Which market players are best positioned to partner across business models to maximize efficiencies for value stacking?
- Will fragmented activities between the two key intersecting industries— transportation and electricity—and their regulators stall consumer adoption of ACES vehicles?
- How will impacts from mass Chinese production of, and demand for, T2G platform assets like ACES vehicles reverberate throughout global mobility markets?

### 6.1 Evolving Platform for Key Market Players

The T2G platform ushers in new opportunities for market players as long-held industry approaches give way to disruptive experiments. This evolving platform is changing the game for key market players, including the following types of companies:



.....  
**Global oil & gas companies must rethink the fueling station**

Although they have a significant hold on traditional fueling supplies, fuel companies face a significant threat in terms of evolving business models and the roles they will play in the electrification of transportation. Global oil & gas companies can consider how charging infrastructure and services will play a role in their future fueling stations.



.....  
**OEMs can embrace mobility over ownership**

Automotive OEMs have significant opportunities to adapt their business models and value chains to deliver more PEVs and engage more deeply in the energy industry. Many OEMs are taking advantage of PEV opportunities; however, changing customer preferences could mean that vehicle ownership becomes less important, giving way to service-based mobility, i.e., the mobility provider model.



.....  
**EVSE companies must build enhanced services**

EVSE companies are already capitalizing on the opportunities presented by vehicle electrification. As standalone entities, their market position is under threat in the emerging shared transportation marketplace as other market players enter the PEV charging infrastructure business, to provide additional products and services for customers. Market consolidation has been commonplace over the past 2 years.





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### **Utilities and energy providers can redefine themselves**

Utilities as electric distribution network providers have an opportunity to enter the transportation space by delivering electricity to PEVs, and building out their networks to support PEV charging infrastructure. At the same time, customers threaten the utility business model with their increased access to distributed renewables and energy storage, and the opportunity to engage with third-party energy service providers. The traditional utility-customer relationship will never be the same. Transportation electrification is an opportunity for utilities to proactively and positively redefine the nature of customer engagement.



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### **Solution providers should leverage their platforms to offer services**

With a variety of technologies and services to address the digitization needs of this space, solutions providers are well-positioned to deliver new value in the T2G platform. Large technology companies—including Google, Amazon, Microsoft, and Apple—are positioning themselves to deliver on the service-based models of the T2G platform.



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### **Governments can transform their concepts of transportation & promote electrification efforts**

Governments, particularly municipalities, can provide their communities with access to greater transportation and fueling options through the T2G platform. These efforts can support a variety of municipal goals from better addressing climate change to delivering greater equity for its most vulnerable citizens.



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### **Investors have a time-bound opportunity to invest**

Investors will continue to play their market role of seeking to be on the socially responsive side of the money among the markets in their portfolios. They will continue to seek balanced risk profiles in service of customer financial performance goals through positions in the energy sector. The emerging, multimodal electric transportation sector represents new ground to cover. Investors must be able to quickly consume information about this fast-evolving space to meet financial objectives, while controlling the risks inherent with disruptive innovation and uncertain business models. If they cannot, the energy portions of their portfolios may suffer relative to historical performance as legacy fossil fuel-based energy investments are eclipsed by companies embracing the T2G platform.

## 6.2 Recommendations

It is time for market players in the transportation and energy marketplaces to unlock additional value streams, accelerate new product and service offerings, and maximize the opportunities for success in the T2G platform. Market players must embrace new business models and address key questions, including:

- **Identify and target your organization's unique strengths for delivering products and services:** Opportunities abound in the emerging T2G platform, and it is important to consider how your organization can use its existing strengths to best position itself to serve the marketplace's changing needs. For example, which MaaS models does your organization have experience in providing service-based offerings? If not, which market partners can best support the offering?
- **Find synergistic go-to-market partnerships:** Many of the business models described in this paper could be addressed by a variety of market players. It would be difficult, however, for any one organization to control an entire market or single-handedly

deliver a solution due to the complexity and risks associated with still-evolving products and services. Partnerships provide one possible path to consolidate fragmented activities for success in the T2G platform.

- **Explore service-based models:** Services, particularly through MaaS business models, offer opportunities to stack and create significant value beyond T2G platform assets, such as ACES vehicles. Charging services that bring vehicle electrification assets together are ready to grow and will deliver increased value. Service providers and orchestrators that connect value to customers sit at the center of highly disruptive innovation and enable multisided value exchanges among many market players for value stacking.

## 7 Acronym and Abbreviation List

ACES	Autonomous, Connected, Electric, and Shared
BEV	Battery Electric Vehicle
EV	Electric Vehicle
EVSE	Electric Vehicle Supply Equipment
GWh	Gigawatt-hour
HD	Heavy Duty
LD	Light Duty
MaaS	Mobility as a Service
MD	Medium Duty
PEV	Plug-in Electric Vehicle
T2G	Transportation-to-Grid
US	United States
V2G	Vehicle-to-Grid
VGI	Vehicle-Grid Integration



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