VEHICLE-TO-GRID OPPORTUNITIES

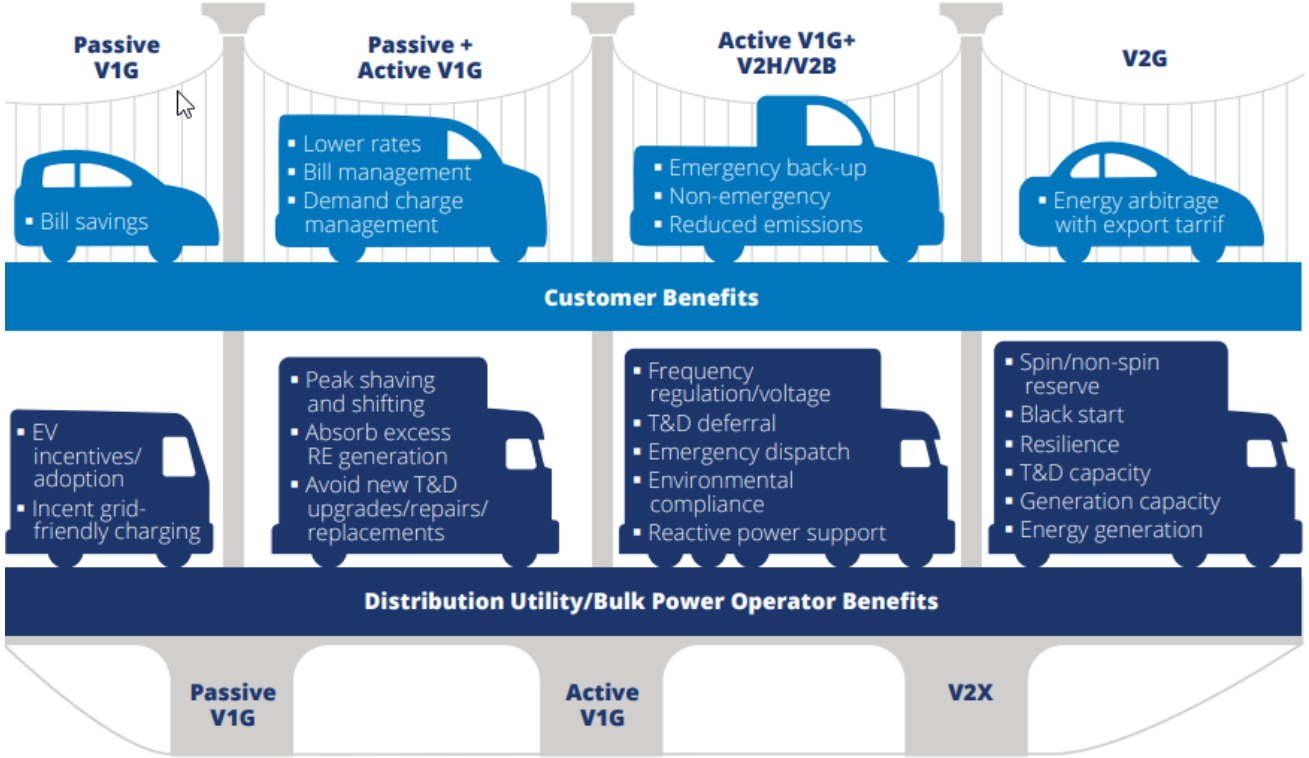
WHAT IS VEHICLE-GRID INTEGRATION?

	Passive	Active
Managed Charging (V1G)	This includes behavioral load control strategies like text messages or time-varying rates.	This includes direct load control strategies where bi-directional or uni-directional commands are exchanged to turn up, turn down, turn on or turn off a charging event, in response to grid/system needs.
Vehicle-to-Everything (V2X)*		Similar to *Active V1G* but signals include both charging and discharging capabilities between the vehicle battery and either a local grid (building, campus, microgrid) or utility grid. It also includes autonomous functionalities where charge and discharge rate is adjusted based on local voltage or frequency deviations.

*V2X is an emerging technology and the appropriate capabilities and management approaches are developing.

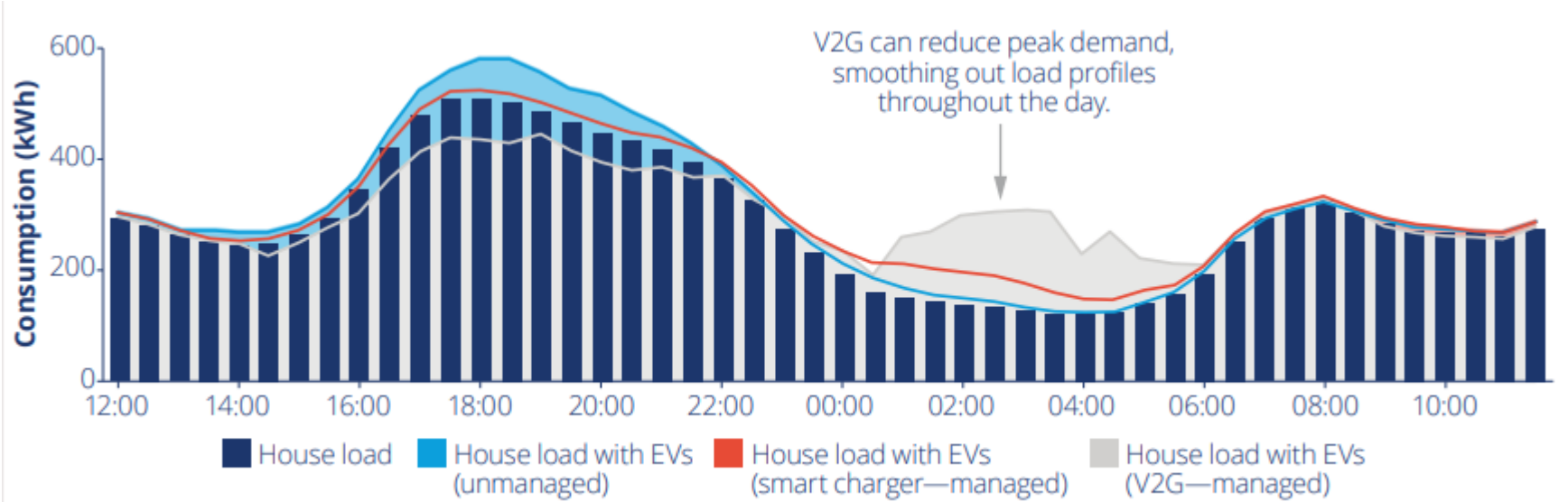
Source: Smart Electric Power Alliance, 2020.

BENEFITS OF VEHICLE-GRID INTEGRATION



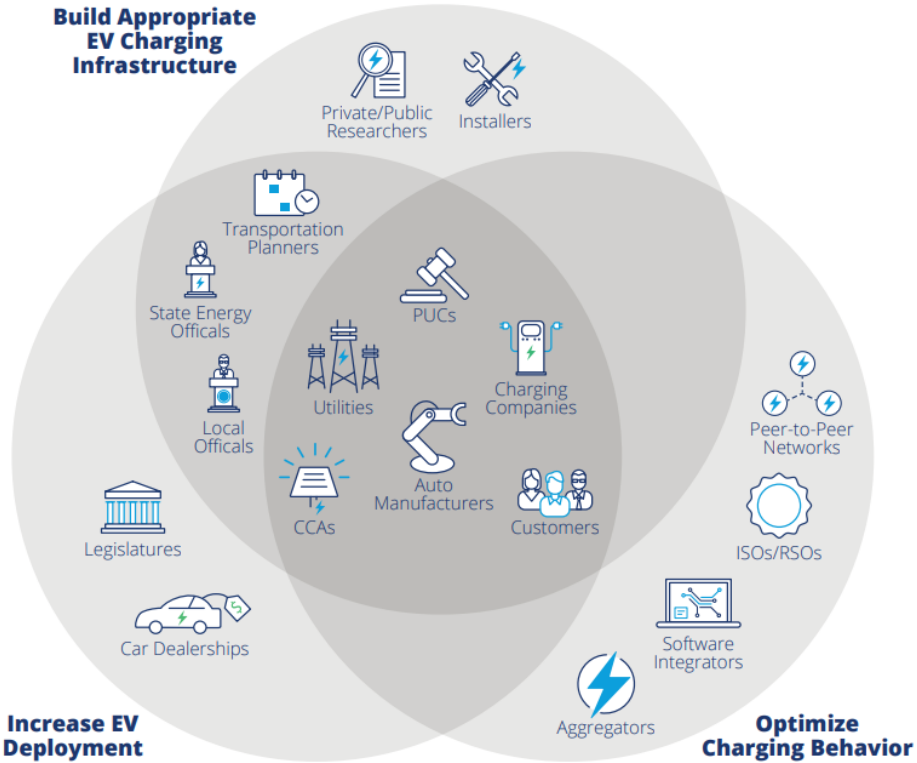
Source: Smart Electric Power Alliance, 2020.

V2G CAN BALANCE DEMAND LOCALLY



Source: OVO Energy, 2020.

VGI ENABLEMENT IS COMPLEX



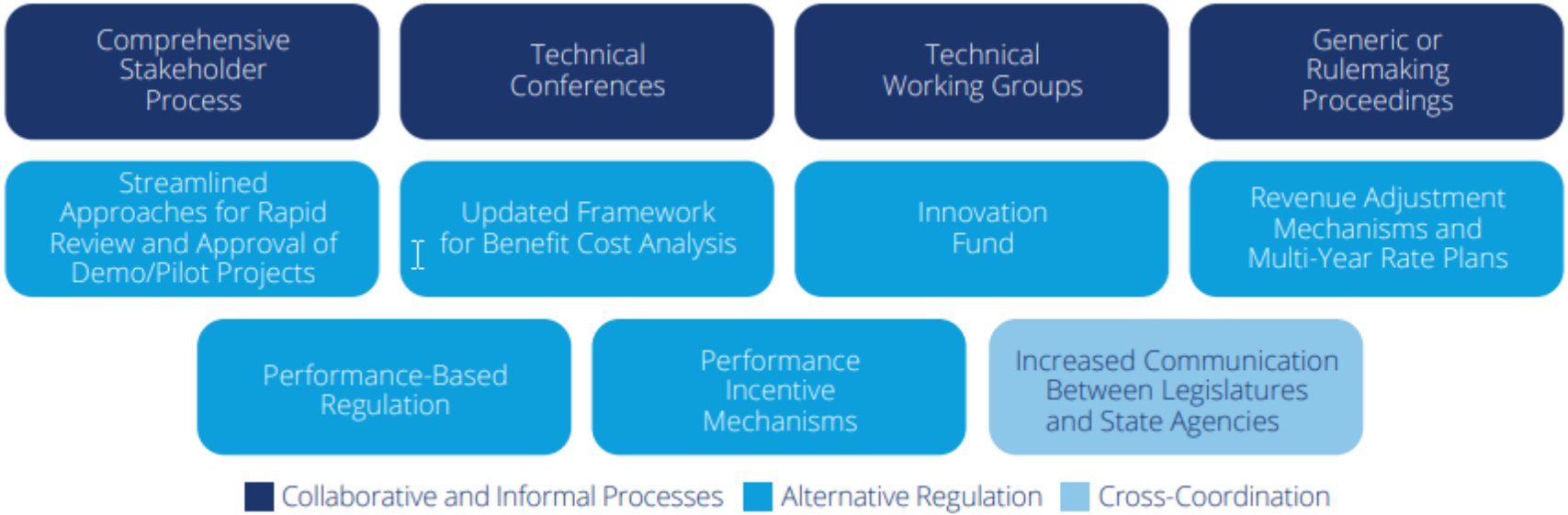
Source: Rocky Mountain Institute, 2016.

UTILITY-BASED VGI CHALLENGES

Figure 5: Internal Utility VGI Program Approval Challenges

Source: Smart Electric Power Alliance, 2020. N = 115

REGULATORY TOOLS AND APPROACHES FOR VGI

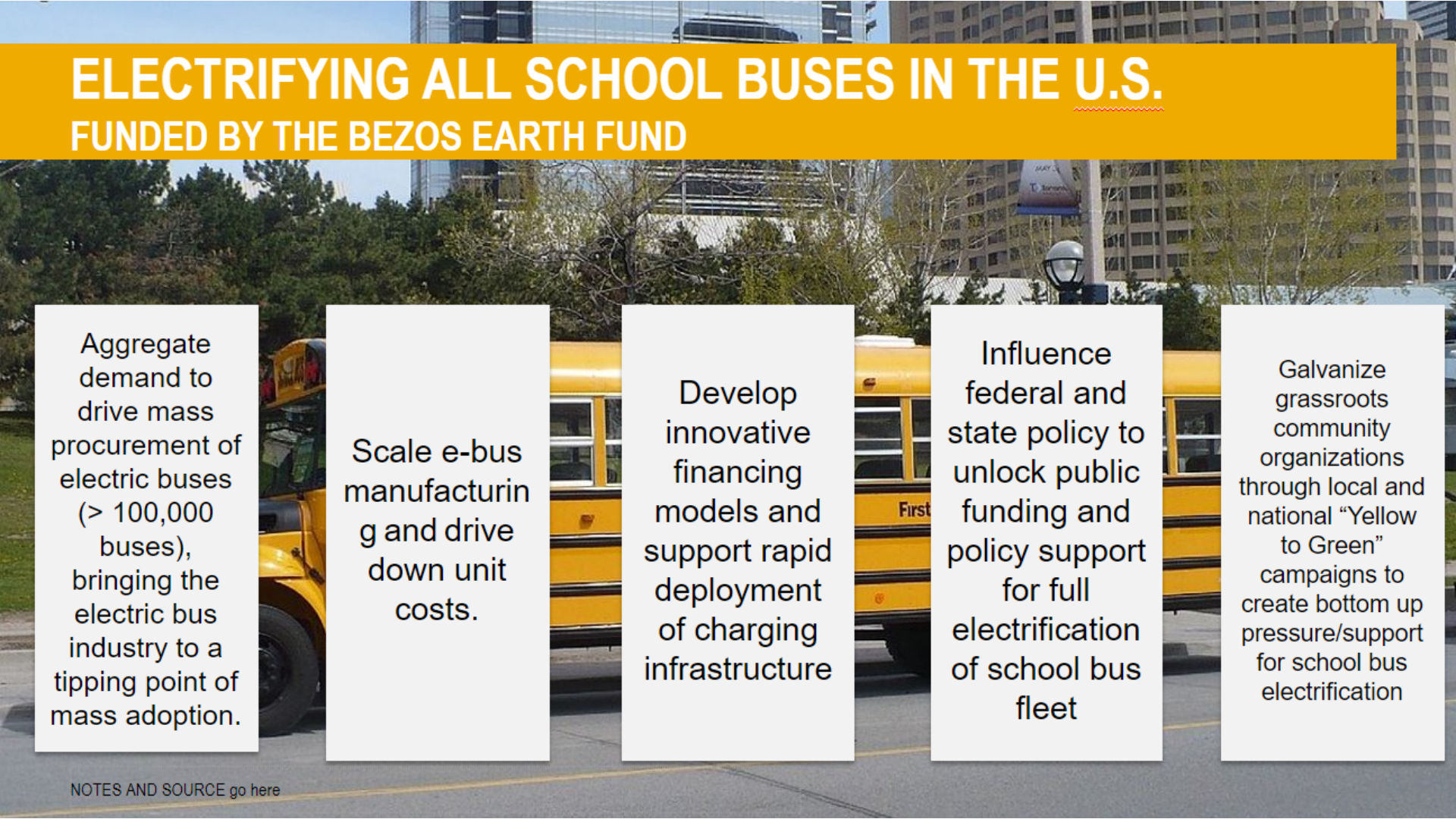


Source: Smart Electric Power Alliance, 2020.

USE CASE:
ELECTRIC SCHOOL BUS

ELECTRIFYING ALL SCHOOL BUSES IN THE U.S.

FUNDED BY THE BEZOS EARTH FUND



Aggregate demand to drive mass procurement of electric buses (> 100,000 buses), bringing the electric bus industry to a tipping point of mass adoption.

Scale e-bus manufacturing and drive down unit costs.

Develop innovative financing models and support rapid deployment of charging infrastructure

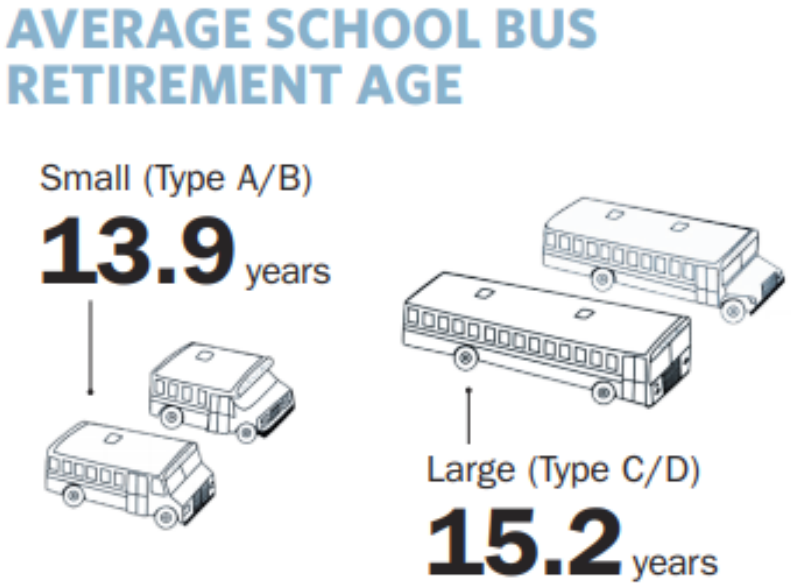
Influence federal and state policy to unlock public funding and policy support for full electrification of school bus fleet

Galvanize grassroots community organizations through local and national “Yellow to Green” campaigns to create bottom up pressure/support for school bus electrification

NOTES AND SOURCE go here

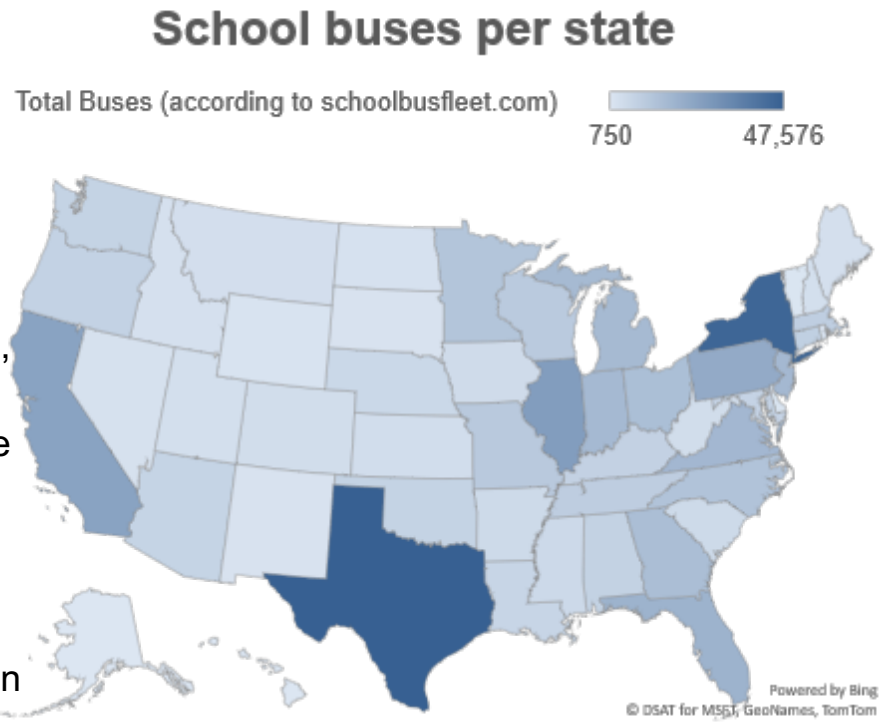
WHY SCHOOL BUSES

- Our goal is to electrify the entire fleet of 480,000 U.S. school buses by 2030
- Every day school buses transport 26 million students
- Average fleet age is 9.1 years



SCHOOL BUS FACTS

- States with most school buses:
  1. Texas – 47,576
  2. New York – 45,600
  3. Illinois – 26,322
  4. **California - 24,213**
- In CA, districts with large shares of students relying on the school bus tend to be small, rural, and largely low-income
- Nationally, 60% of low-income students take the school bus, compared to 45% of non-low-income students
- Electrifying the entire school bus fleet can unlock **72 GW** of storage capacity (~22 million homes), enabling utilities to integrate more clean energy on their grids. In CA that could be **3.6 GW** or 1.1 million homes.



1. https://www.schoolbusfleet.com/download?id=10117405&dl=1
2. Storage capacity based on 150kW battery size estimate (BlueBird Type C&D is 155kW)

QUESTIONS?

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