Oakland's Advanced Mobility Infrastructure

By John Benson

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1. Introduction

My colleagues at Microgrid Labs occasionally work on projects with electrified buses. They help the agencies that own the buses create a charging infrastructure, and any supporting infrastructure (like a microgrid).

But this post is not about Microgrid Labs. Although it briefly covers multiple mobility infrastructure projects, it is about Oakland Unified School District who just acquired a large fleet of Electric School Buses through a partnership with Zum, a company that provides the full infrastructure around electric buses.

Also, Oakland is hosting the first hydrogen hub in California and in the U.S. In the article about this facility, several other hydrogen facilities in Oakland are mentioned in passing.

Early on, I read that Zum uses the fleet of School buses as a Virtual Power Plant (VPP) to help companies displace peak power pricing. Zum's website is very good, but as is the case for all good sites, it is totally focused on their primary customers (school administrators and school-age children's parents). Thus, it took me a while to find some text on the VPP, but I finally did.

Imagine if the nation's fleet of school buses could serve as a battery, providing power back to the grid. School buses have predictable daily schedules and are typically used only a few hours each day, sitting idle during peak power usage times—making them an ideal resource for communities. At Zum, we've recently partnered with AutoGrid's Virtual Power Plant technology (VPP) platform to deploy 10,000 electric school buses in the next four years to create over one gigawatt of flexible capacity—the equivalent of powering more than one million homes for one to four hours—when the electricity grid is overloaded. When fully deployed, this is expected to be one of the largest VPPs in the world. If we collectively build on this critical infrastructure, student transportation can play an even deeper and more important role in our communities.[1]

2. Electrifying School Transportation

Student transportation is the largest mass transit system in the U.S., with 27 million students traveling twice per day.

The U.S. school bus fleet is double the size of all other mass transit combined, including buses, trains and airlines. Transportation is schools' second-highest cost category, after salaries, totaling $28 billion a year nationwide. Yet the system is riddled with inefficiencies, from circuitous routes to under-capacity vehicles to one-size-fits all schedules that force students to spend too many precious hours each week in transit, rather than on critical learning and development.

[1] https://www.ridezum.com/company/vision/

At a time when transparency and agility rule the day in other industries, busing remains opaque. Parents have no visibility into where children are at any given moment or—often—who is driving them. Bullying and other safety incidents can take months to come to light. These and other problems translate into thousands of wasted hours and unnecessary stress for students and parents.

The technology currently exists to infuse our nation's student transportation system with the flexibility, efficiency and transparency we have come to expect from all manner of other services. By modernizing student transportation, we can improve the equity, accessibility and sustainability at a societal scale. And we can do all of this while increasing safety for our children and building community among schools, families, and a trusted network of drivers.

The school bus system, as an essential component of public education in this country, was designed to extend opportunity. But too often, it falls woefully short—and can even perpetuate inequality. These days, children from low-income households and those with special needs are more likely than their peers to depend solely on yellow buses for transportation—and are therefore disproportionately impacted by the system's shortcomings.

At Zum, we have already helped 4,000 U.S. schools begin this transportation transformation, we envision a world where school districts have the best available tools and technologies at their fingertips. With these, they can share infrastructure with other nearby districts, deploy appropriately sized vehicles, create efficient routes, meet families' changing transportation needs and, in the process, save millions of dollars that can be poured back into the classroom.

We envision a world where inefficiencies and inequities embedded in the school transportation system are rectified in real time, and where bus drivers receive the support they need to prioritize safety on the road and in their vehicles.

The technology exists to do this now, to do it safely and to do it well.

3. The Zum Experience

3.1. Completely New, Built Around Families' Needs

Zum delivers the peace of mind that comes from knowing where your kids are, and that they're getting the safest, most reliable rides possible. A convenient app lets you see when the bus is coming, know your drivers, send feedback, and get your kids to school on-time and stress-free.[2]

Zum helps manage all aspects of operations to make it easy for drivers and operators to focus on what matters most: safe, efficient, and sustainable transportation. Deploying fleets of multi-size vehicles that include EVs, we monitor vehicle health and driver performance, offer tools to manage staffing, and optimize routes for less miles on the road.

[2] https://www.ridezum.com/experience/school-transportation-solutions/

Zum's cloud-based platform can be implemented in hours, reducing costs and increasing efficiency by optimizing each route, vehicle, and schedule, resulting in up to a 20% reduction in transit time. A system dashboard gives administrators unprecedented access to real-time data for smarter decision-making, and multichannel customer support creates an end-to-end solution for any school or district.

By saving school districts money and energy, Zum empowers communities to invest more in education, reduce traffic congestion and noise pollution, and enjoy cleaner, healthier air. Plus, more sustainable school transport creates new green jobs and contributes less to climate change, securing a better future for kids everywhere.

3.2. How It Works

Zum is student transportation completely transformed, putting safety and transparency at the forefront. It all comes together on an easy-to-use app that ensures the peace of mind that comes with knowing where your kids are in real time. A live bus map lets you know when the bus is coming, when your child arrives at school, and when they are heading home. Plus:[3]

- *RFID check-ins & check-outs track attendance*
- *Useful alerts notify you about things like route changes*
- *Support for students with special needs*
- *Accommodates children from co-parenting homes*

Gone are the days of passing your kid off to a stranger who drives them to school. Zum lets you know who your kid's drivers are, and student profiles let your drivers know your kid. We strive to provide for each child's unique situation and experience. As a company we ensure:

- *Drivers are vetted above and beyond state standards*
- *Safe-driving performance tracking*
- *Parent feedback via the app*
- *On-board monitoring reduces potential incidents*

3.3. Benefits

At Zum we are committed to having an all-electric fleet by 2027. And the reasons speak for themselves. In addition to reducing air pollution, electric vehicles cut energy costs by 80 percent and maintenance costs by 60 percent—savings that can be reinvested into classrooms. Our intelligent platform creates better routes, ensuring less time on the bus, so kids get to school with more energy to learn. Plus, new electric vehicles mean safer, quieter rides, better air quality, no diesel fumes, and overall reduced carbon emissions for a more sustainable future for us all.

Zum's contact information: 275 Shoreline Dr, Ste 200, Redwood City, CA
(855) 743-3986

[3] https://www.ridezum.com/parents/how-zum-works/

4. The Oakland Project

An Oakland, California, school district is the first in the US to transition to a 100% electric school bus system with vehicle-to-grid (V2G) technology.[4]

Student transportation platform Zum has provided Oakland Unified School District with a fleet of 74 electric school buses and bidirectional chargers, and the buses made their debut last week when the school year started.

Utility Pacific Gas and Electric (PG&E) supplied 2.7 megawatts (MW) of capacity to Zum's Oakland EV-ready facility. The fleet will be managed through Zum's AI-enabled platform.

Photo: Zum

"Oakland becoming the first in the nation to have a 100% electric school bus fleet is a huge win for the Oakland community and the nation as a whole," said Kim Raney, executive director of transportation at Oakland Unified School District. "The families of Oakland are disproportionately disadvantaged and affected by high rates of asthma and exposure to air pollution from diesel fuels."

Although Zum manages all fleet-level functions, BYD in Southern California manufactured these buses. See https://en.byd.com/bus/school-bus/ .

Although Zum some information on their history on the site linked below, they had very little information on their location. https://www.ridezum.com/company/story/

The site below has their location (city) and more information on their history. https://en.wikipedia.org/wiki/Zum_(company)

[4] Michelle Lewis, Electrek, "Oakland is now first in the US to deploy a 100% electric school bus fleet… ," Aug 19 2024, https://electrek.co/2024/08/19/oakland-is-now-first-in-the-us-to-have-a-100-electric-school-bus-fleet-and-its-v2g/

4.1. Other Pioneering Projects in Oakland

Last month, California officially became the first state in America to launch a clean, renewable hydrogen hub...[5]

A $12.6 billion agreement signed in July includes up to $1.2 billion in federal funding. The Alliance for Renewable Clean Hydrogen Energy Systems (ARCHES) was the first of seven hydrogen hubs throughout the country to sign their agreement with the Department of Energy. California had a novel approach for its hydrogen hub and created a coalition of more than 400 partners. Furthering the state's hydrogen hub investments, the Biden-Harris administration today awarded California $12 million for three hydrogen projects across the state.

The half-day event showcased cutting-edge hydrogen-powered transportation projects in Oakland, demonstrating not only what has already been accomplished in California, but what is coming thanks to ARCHES' renewable hydrogen hub.

"Clean hydrogen is the 'Swiss Army Knife' of energy technologies and a solution to decarbonizing the industries we cannot live without," said U.S. Secretary of Energy Jennifer M. Granholm. "President Biden and Vice President Harris have developed a modern, industrial strategy to build a clean hydrogen industry here at home—with California and the ARCHES Hydrogen Hub leading the way."

[5] Governor Gavin Newsom News, "Governor Newsom, state and federal leaders celebrate launch of California's first-in-the-nation hydrogen hub," Aug 30, 2024, https://www.gov.ca.gov/2024/08/30/governor-newsom-state-and-federal-leaders-celebrate-launch-of-californias-first-in-the-nation-hydrogen-hub/

The group traveled in the world's first hydrogen-powered passenger ferry, then on AC Transit and SamTrans hydrogen fuel cell electric buses, to the True Zero Hydrogen Fuel Station, which can support 200 semi-trucks.

Author's comment: Although there a small number of hydrogen-fueled light-vehicles in California, heavy vehicles will be the main users of hydrogen-fuel-cell technology. A recent post on the hydrogen-ferry mentioned above is summarized and linked below.

Hydrogen On the Water: I write about this subject once or twice a year. Weaning maritime applications from diesel fuel to mitigate climate change will be a tough job, but a necessary one. Probably the initial drop-in solutions will involve biodiesel or some other green fuel. Using an electric power-plant will require some significant changes to vessel's design, but may be the ultimate solution.

There are two approaches to electrification: battery-electric, and hydrogen-fuel-cell electric. The bad news about the former is that batteries are heavy, have limited energy-storage and need a long full-recharge time. Using hydrogen fuel-cells increases the energy storage, but this comes with its own challenges, as described in this article.

https://energycentral.com/c/cp/hydrogen-water

4.2. The Cluster Concept

The Bipartisan Infrastructure Law, passed by Congress in 2021, includes up to $7 billion to fund a Regional Hydrogen Hubs Program. The U.S. DOE, states that its goal is to facilitate the creation of "large-scale, commercially viable hydrogen ecosystems." In its main publications on the program, the Department of Energy does not detail how taxpayer dollars for hydrogen ecosystems will translate into the holy grail of "commercial viability" for green hydrogen. Yet there is reason to believe that the Hubs concept can help bring about this outcome. The key idea is that of the "cluster."[6]

The term "cluster" as an economic construct was explained by Harvard Business School Professor Michael Porter in 1998 as "geographic concentrations of interconnected companies and institutions in a particular field." The sprawling set of activities around the production of wine in California is one of many examples Porter advances. The great benefit of clusters, Porter says, is that they encourage interactions across cluster members that foster a variety of productivity enhancements. He describes how the bases of competition at play in the pre-globalized twentieth century have lost their force in the globalized twenty-first century: "The enduring competitive advantages in a global economy lie increasingly in local things – knowledge, relationships, motivation – that distant rivals cannot match."

Without the cluster framework, the parties sponsoring each of the seven hydrogen hub projects selected for funding by the Department of Energy would appear to have a somewhat random aspect. To take the Pacific Northwest Hydrogen Hub (PNWH2) as an example, one notes representation on the Board of Directors from energy engineering and equipment company Mitsubishi Heavy Industries and hydrogen production companies Fortescue Future Industries and NovoHydrogen. This certainly makes sense. If the goal is to encourage green hydrogen production, a hub needs to include technologists and producers. And if this were a twentieth-century undertaking, hub membership might stop there.

[6] MSN Money, "How the US Is Building a Sustainable Hydrogen Economy," https://www.msn.com/en-us/money/smallbusiness/how-the-u-s-is-building-a-sustainable-hydrogen-economy/ar-AA1pkcjI?ocid=msedgntp&pc=DCTS&cvid=827386f8e17845eea29932a33645cae7&ei=36

However, one also notes Board representation from ammonia producer Atlas Agro, natural gas utility AltaGas, and public transit provider Lewis County Transit. The heterogeneous nature of these parties notwithstanding, it can quickly be seen that each is a potential consumer of green hydrogen. For Atlas Agro, green hydrogen is the main feedstock for the production of green ammonia. For AltaGas, green hydrogen could be blended into its pipeline natural gas to reduce its carbon footprint. For Lewis County Transit, green hydrogen will fuel its small but growing fleet of fuel-cell-powered transit buses. Porter argues that the co-existence of suppliers and customers in a cluster can create a virtuous cycle in which heightened awareness of customer needs drives improvement of product/service bundles, and heightened awareness of producer capabilities leads to articulation of evolving customer needs—all without breaking down the arm's length relationships at the heart of competition-based economies.

Author's comment: Note the above "*The sprawling set of activities around the production of wine in California is one of many examples (of a cluster)"* is highlighted above. So, in California we certainly understand clusters. Also, I thought the "*Pacific Northwest Hydrogen Hub*" was another supporting example, so I left it in.

4.3. Additional Information

See the recent posts below for more information on hydrogen technology and potential users:

New Heavy Truck and Train Rules in California: The California Air Resources Board (CARB) is almost always the first-mover when it comes to regulations that reduce greenhouse gases and other sources of pollution. CARB recently approved world-leading regulation to phase out the sales of medium and heavy-duty greenhouse gas emitting trucks in California by 2036.

CARB also approved first-in-the-nation regulation to limit train pollution.
https://energycentral.com/c/ec/new-heavy-truck-and-train-rules-california

Participants in the Last Clean-Vehicle Segments Emerge: I have written enough papers on hydrogen-fueled vehicles to know their potential advantages verses battery-electric vehicles (BEV):

- Fast refueling
- Very long run-time without refueling

There are two segments of vehicles that appear to be unable to easily transition to designs with no greenhouse gas (GHG) emissions:

- Construction vehicles (bulldozers, front loaders, dump trucks, backhoes, etc.)
- Long-range/duration road vehicles (interstate transports, heavy tow trucks, etc.)

There seems to be a match between the above "advantages" and "vehicles" that might suggest the emergence of some hydrogen-fueled vehicles to meet the needs of the two vehicle segments.
https://energycentral.com/c/ec/participants-last-clean-vehicle-segments-emerge

Efficient Hydrogen Storage for Big Rigs: One class of likely mobile users of hydrogen are large road vehicles, ESPECIALLY IF the space required for storage of the hydrogen could fit into current big rig tractor designs and provide a non-stop range comparable to existing diesel-fueled tractors. Although there are quite a few details to work out, this goal appears to be much closer to reality.

https://energycentral.com/c/ec/efficient-hydrogen-storage-big-rigs

Hydrogen Hubs: For roughly the last month or so, I've danced all around the subject / title of this brief paper with the posts referenced below. However, I've seemed to do this without bringing these together, as this post will do.

So, what is a hydrogen hub? It is a major user of green hydrogen that will use renewable electricity from the grid to produce adequate supplies of green hydrogen from water via an electrolyzer and store this hydrogen in high pressure tanks. The storage might have several functions:

- The electrolyzer can be sized based on average demand rather than peak demand.
- Storage potentially disassociates times of production and use to allow the electrolyzer to use the least-cost renewable power for the former when it's available.
- Stored hydrogen can be used for backup when there is an electric outage.

https://energycentral.com/c/ec/hydrogen-hubs