What is a microgrid and how can it help our school afford electrifying our fleet?

MIDWEST Facility Masters CONFERENCE

Today's Speakers

TIM FARQUER

Superintendent
Williamsfield Schools
Administrative Lead
Bus-2-Grid Initiative
Senior Advisor
World Resources Institute

KATY GLYNN

Account Executive
Siemens Smart Infrastructure
Energy & Performance Services

MICROGRID PROJECT OPERATING SINCE 2014
Princeton Industrial Research Building

PLUGTOGRID™ DESIGN:
Siemens Electrical infrastructure, battery storage, PV, EV Chargers and SCADA integration (Microgrid) for a complete solution providing "green" energy for EV charging and backup power for the building.

Options for Winners and "Waiters"

Awards this month: $965 million

Going forward: $5 billion over 5 years

- How many buses?
- How many in IL?
- How many in WI?

Who is in the room?

For those getting money,
let's maximize the positive impact!
For the rest of us,
let's get a strong foundation in place!

Unique Value Propositions of Transportation as a Service

- Reduced **carbon footprint**
- **E2E value chain** coverage
- **Vendor agnostic** to complement Siemens and other best-in-class offerings
- **Assuming** and **managing operational risk** for customers
- **Collaborating with optimal solution partners** to mitigate risks, create exceptional customer value
- Enabling **new, competitive TaaS models** via **unique financing arrangements** and partners

Transportation as a Service (TaaS)

OPEX

- Real estate
- Planning & iinstall
- EV fleet
- PV/ PPA(1)
- Site equipment
- Charging infrastructure
- Battery
- Microgrid
- Infrastructure operations
- Fleet operations
- Energy operations
- Customer success
- Financing

Depot planning and development

Depot management/ managed services

Fleet Electrification financing

1) Power purchase agreement

What Can You Hope to Get Out of This Session?

1) What is Causing Interest in Electric School Buses?

2) What is a Microgrid?

3) Should I Explore a Microgrid for My School?

4) How Can a Microgrid Help My District Afford to Electrify Our Transportation Fleet?

Case Study:
Williamsfield Schools, IL

Everybody's Going Green!

Dirty Buses = Sick Kids

School buses are the largest form of mass transportation in our country, transporting **25+million kids each day**

Children breathe **50% more air per pound of body weight** than adults and their lungs are still developing, making them especially vulnerable to cancer and respiratory diseases caused by diesel pollution.

A child sitting in the back of a school bus with windows closed is exposed to **4x more diesel** pollution than a child riding in a car in front of the same bus.

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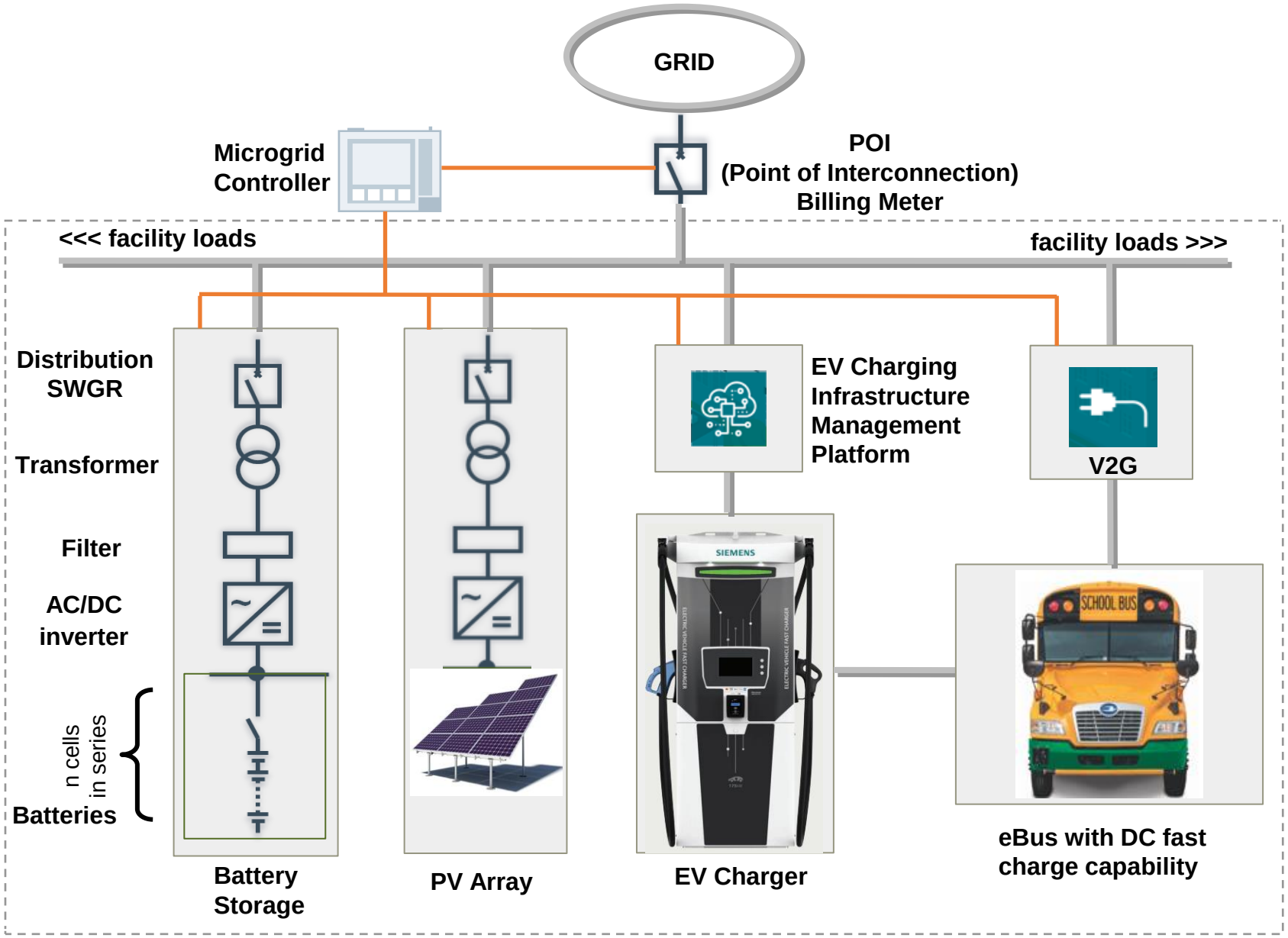

Example BESS Sizing & Features:

500 kW Modular Blocks

Advanced controls allow integration of PV assets

Advanced safety features for Li-Ion batteries

Critical loads can be fed from BESS during grid disturbances

Building will not see impact of charging load and PV+battery will also:

- ✓ Lower Capacity and Transmission Charges
- ✓ Reduce Energy Consumed from Grid
- ✓ Demand Response Revenues

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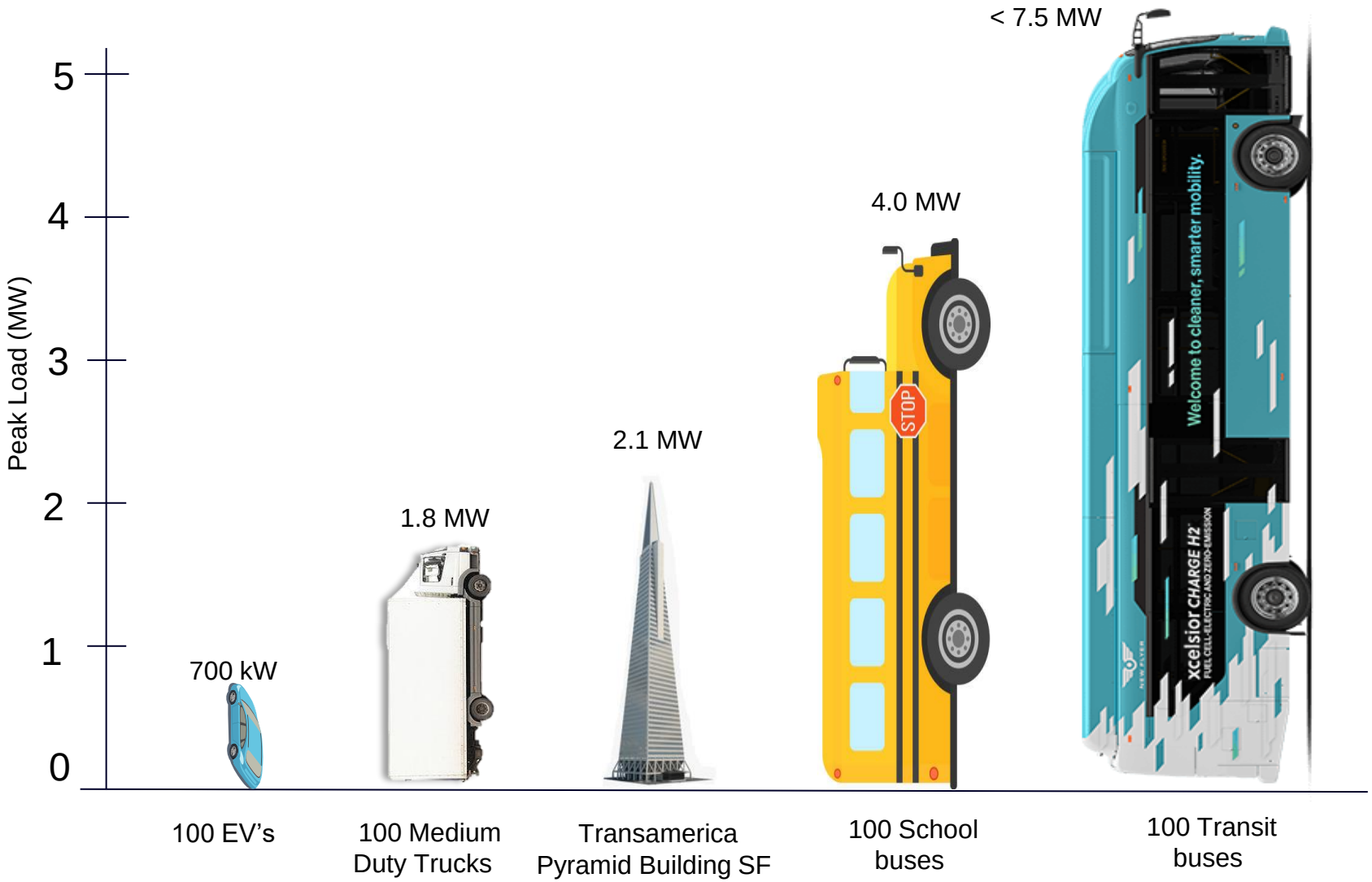
Case Study:
Williamsfield Schools, IL

PlugtoGrid™ Scale Up



Highlights

- Siemens one of a few capable in market for scaled deployments
- Load Management is a critical enabler for scale up
- New build planning for scaled up charging infrastructure deployments, up front consulting
- Microgrids and Renewables integration will address choke points for deployment in existing facilities and new build facilities.

Distributed Energy System Buildout
Phase I - EV Charging of 10 School Buses

Hour Ending	10 Bus Fleet L2 Chargers Only	Phase 1 - Energy Needs (kWh)
0:00	1625	115
1:00	1740	115
2:00	1855	115
3:00	1970	115
4:00	2065	95
5:00	2100	35
6:00	2100	0
7:00	1845.00	0
8:00	1590.00	0
9:00	1335.00	0
10:00	1287.5	57.5
11:00	1402.5	115
12:00	1355.00	57.5
13:00	1100.00	0
14:00	845.00	0
15:00	590	0
16:00	705	115
17:00	820	115
18:00	935	115
19:00	1050	115
20:00	1165	115
21:00	1280	115
22:00	1395	115
23:00	1510	115
	Daily Sum	**1,740**
	Driving Days	200
	Annual Sum	**348,000**

Roughly equivalent to an Elementary load

Distributed Energy Sy
Phase 2

Hour Ending	Phase II - 30 buses, 5 L3
0:00	345
1:00	345
2:00	345
3:00	345
4:00	285
5:00	105
6:00	0
7:00	0
8:00	0
9:00	0
10:00	322.5
11:00	595
12:00	322.5
13:00	0
14:00	0
15:00	0
16:00	395
17:00	395
18:00	395
19:00	345
20:00	345
21:00	345
22:00	345
23:00	345
Daily Sum	**5,920**
Driving Days	200
Annual Sum	**1,184,000**

Roughly half the load of large high school

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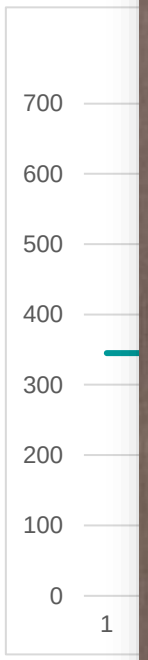

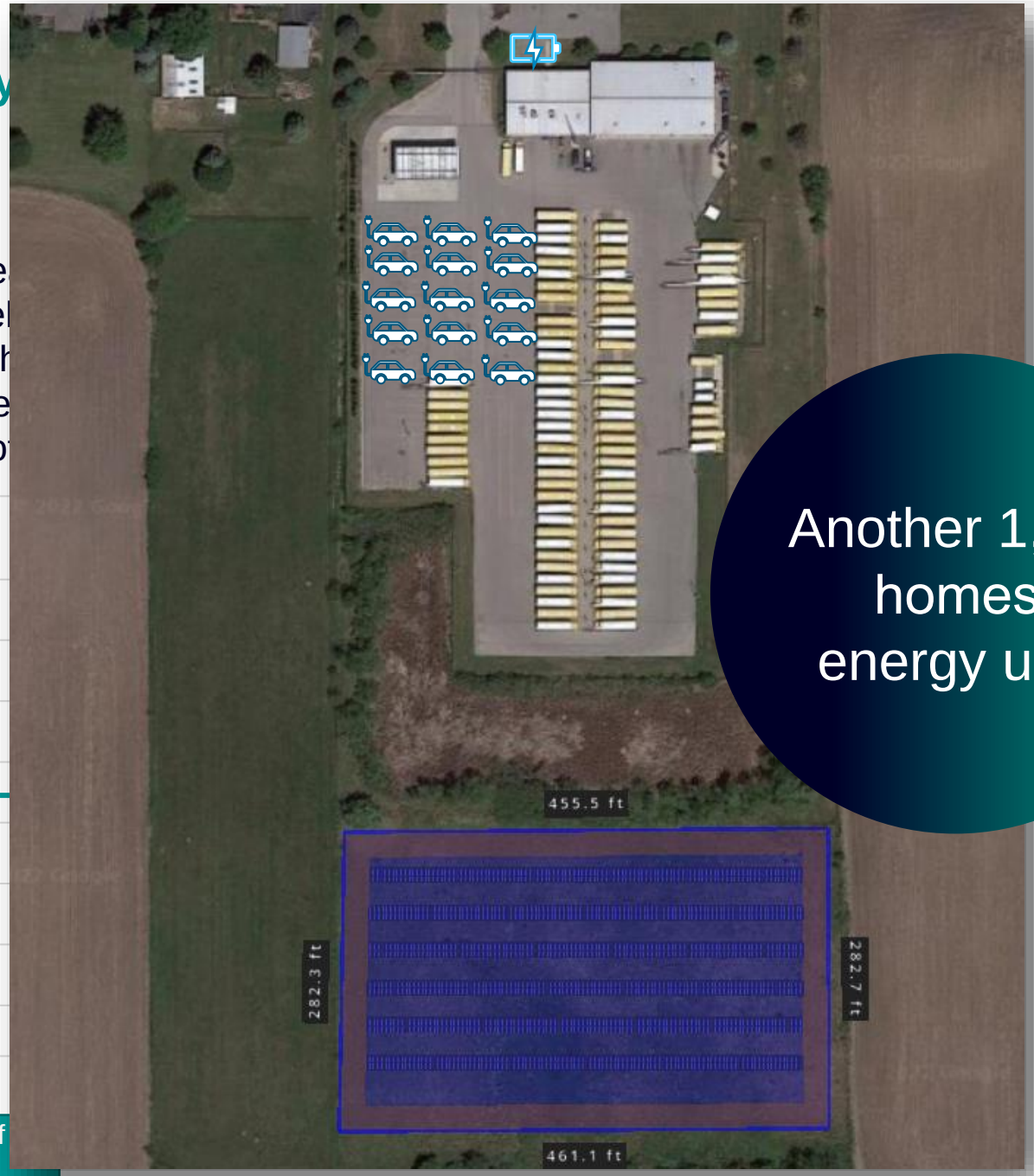

Another 1,000 homes' energy use.

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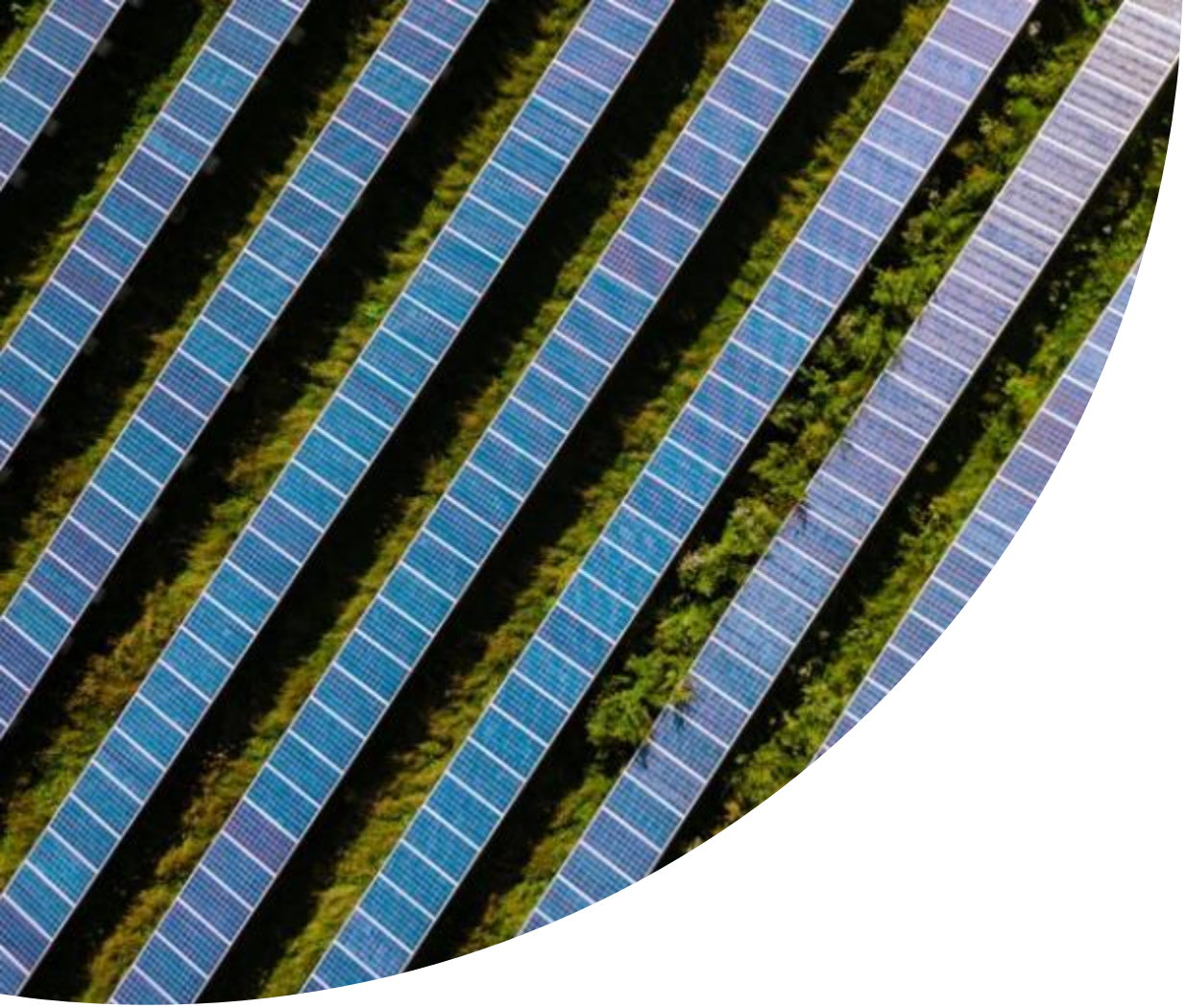
Williamsfield Schools (Williamsfield, IL)



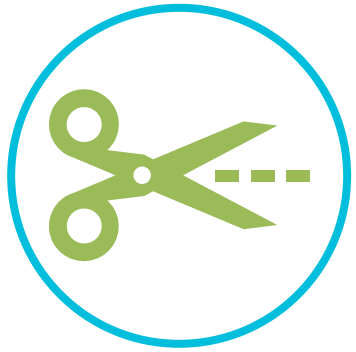
MORE

- Founder of the Bus-2-Grid Initiative (B2G)
- In Illinois, B2G is a service of IEC Powered by Future Green
- B2G has a comprehensive list of industry partners
- B2G is a partner of the World Resources Institute
- Helped secure funding for 2 electric school buses (ESBs) in central Illinois (Pekin & Hollis)
- Helped secure IL-VW funding last fall (Huntley, River Trails, Troy Triad, Waukegan)
- Secured ISBE school maintenance grant for ESB infrastructure (Williamsfield Schools)
- Secured ESSER III funding for a repowered electric school bus & charging infrastructure
- Helped schools apply for Clean School Bus funding (Fall 22)
- Helping schools plan & procure buses/chargers

BENEFITS

HEALTHY

Provide healthy environments for school bus riders



EFFICIENCY

Improve operational efficiency (cost reduction + stability)

RESILIENCE

Increase energy resilience

SUSTAINABLE

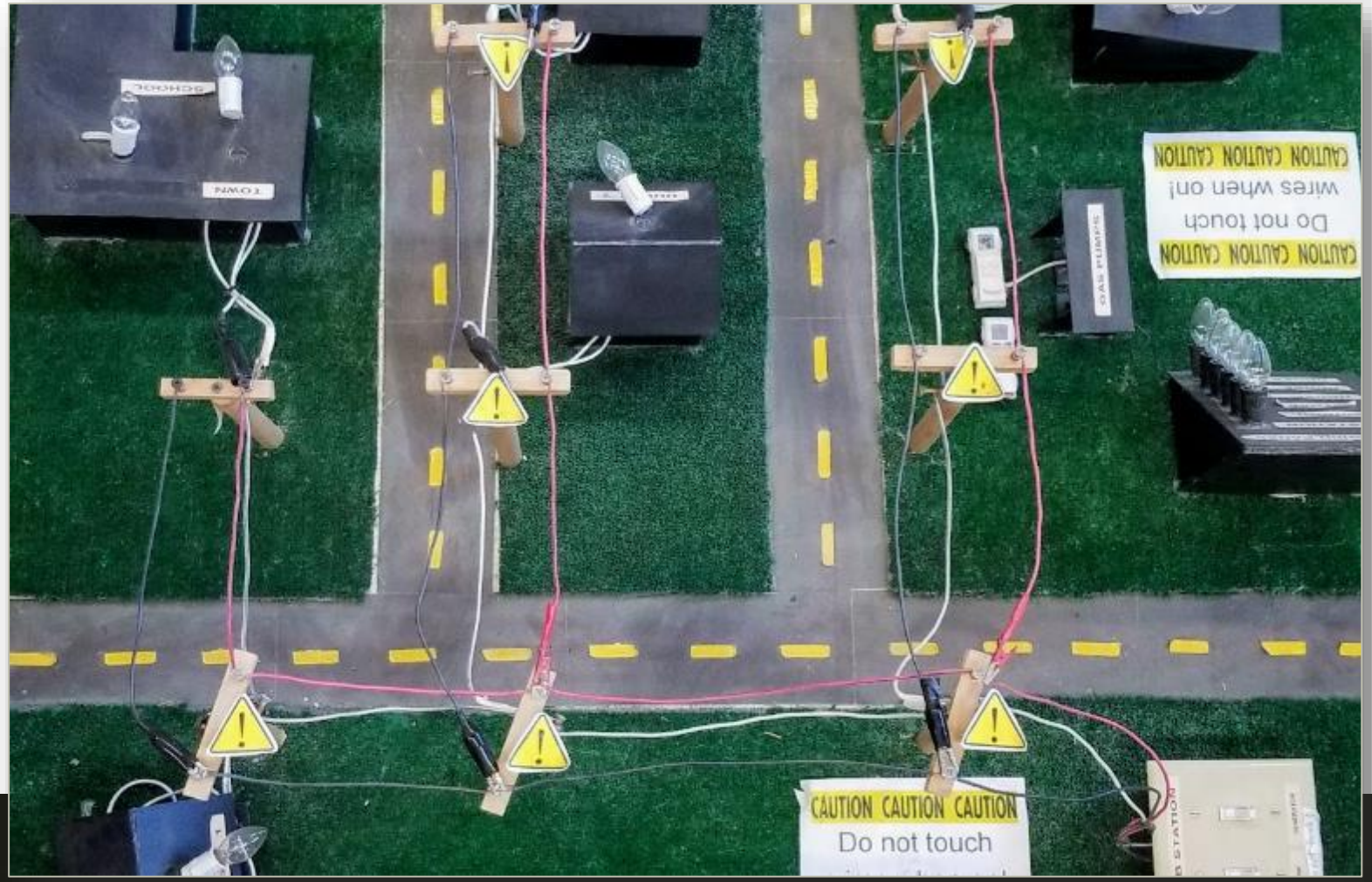
Decrease our carbon footprint

BACKGROUND

2011-2014 Eleven Outages (744m per year), 2 lasting more than 7 hours

2015-2019 Twenty Outages (1776m per year), 6 lasting more than 7 hours

March 2014
Students build Microgrid project



July 2015
Illinois Clean Energy Community Foundation Solar Grant

Sept 2015
Student Microgrid Project

Arne Duncan
US Secretary of Education

March 2018
Received first electric bus bid for $400,000

Jan 2019
Lost power and pipes began to freeze

2015-2019

- Twenty Outages (1776m per year)
- 6 lasting more than 7 hours

2011-2014

- Eleven Outages (744m per year)
- 2 lasting more than 7 hours

April 2019
Adjustable Block Program Renewable Energy Credit Lottery

August 2019
Ready for solar grid to go live and looking to electrify our fleet.
Realized our buses sit motionless 92% of the calendar year.

Can our fleet of bus batteries be used for energy storage?

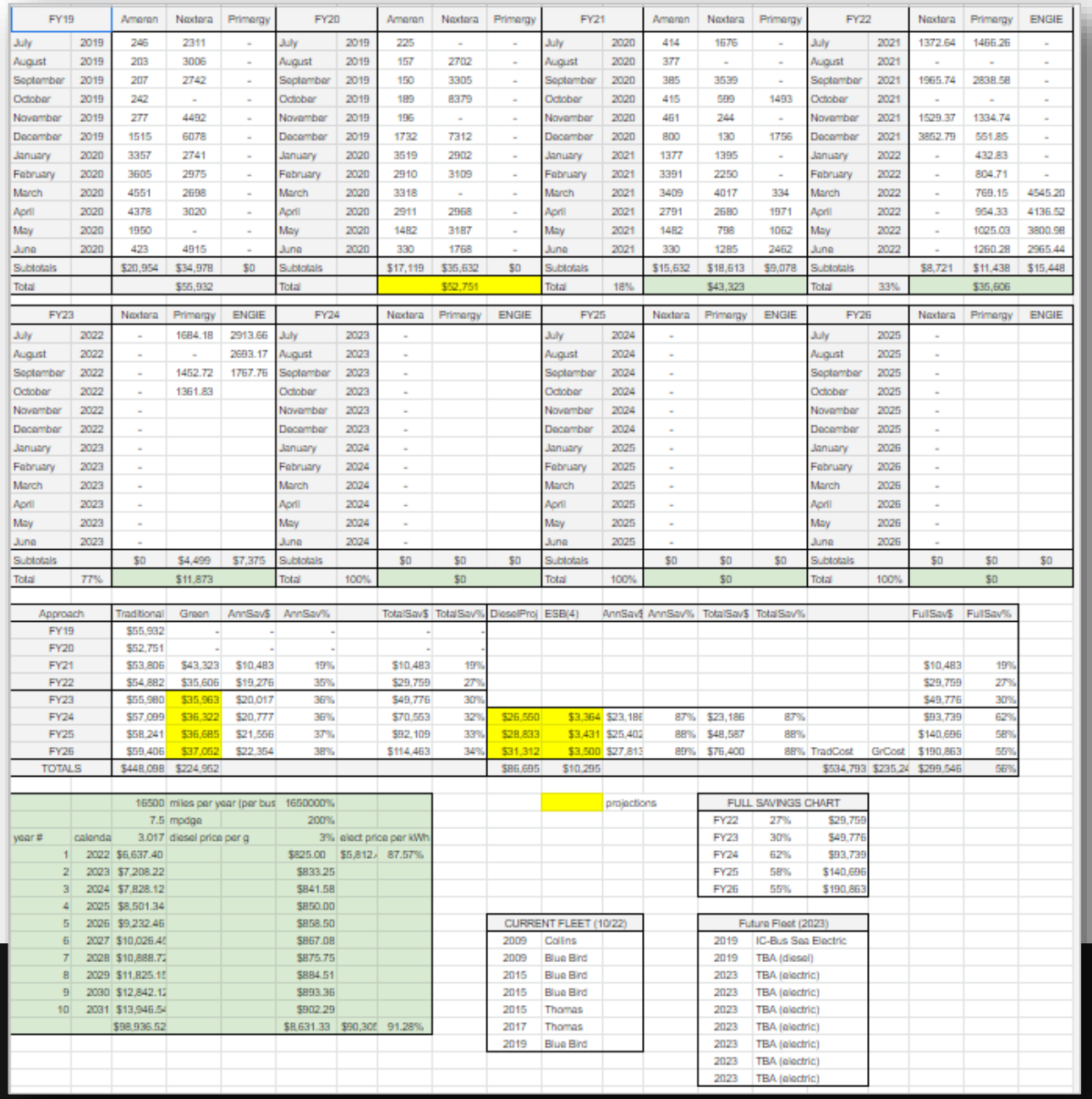
April 2019

- Established the Bus-2-Grid Initiative and designed our campus mini-microgrid.
- Helped Pekin & Hollis secure funding for electric buses.
- Submitted unsuccessful DERA applications in 2020 & 2021. Looking for way to fund the project!

Energy Cost Comparison

Year	Savings	Assets & Partners
FY21	19%	Solar & Nextera
FY22	35%	Solar & IEC-FG
FY23	36%	Solar & IEC-FG
FY24	*61%	Solar, IEC-FG, & ESBs (4)
FY25	*56%	Solar, IEC-FG, & ESBs (4)
FY26	*53%	Solar, IEC-FG, & ESBs (4)

* Does not include peak shaving & potential V2G credits



FY19		Ameren	Nextera	Primergy
July	2019	246	2311	-
August	2019	203	3006	-
September	2019	207	2742	-
October	2019	242	-	-
November	2019	277	4492	-
December	2019	1515	6078	-
January	2020	3357	2741	-
February	2020	3605	2975	-
March	2020	4551	2698	-
April	2020	4378	3020	-
May	2020	1950	-	-
June	2020	423	4915	-
Subtotals		$20,954	$34,978	$0
Total			$55,932	

FY20		Ameren	Nextera	Primergy
July	2019	225	-	-
August	2019	157	2702	-
September	2019	150	3305	-
October	2019	189	8379	-
November	2019	196	-	-
December	2019	1732	7312	-
January	2020	3519	2902	-
February	2020	2910	3109	-
March	2020	3318	-	-
April	2020	2911	2968	-
May	2020	1482	3187	-
June	2020	330	1768	-
Subtotals		$17,119	$35,632	$0
Total			$52,751	

FY21		Ameren	Nextera	Primergy
July	2020	414	1676	-
August	2020	377	-	-
September	2020	385	3539	-
October	2020	415	599	1493
November	2020	461	244	-
December	2020	800	130	1756
January	2021	1377	1395	-
February	2021	3391	2250	-
March	2021	3409	4017	334
April	2021	2791	2680	1971
May	2021	1482	798	1062
June	2021	330	1285	2462
Subtotals		$15,632	$18,613	$9,078
Total	18%		$43,323	

FY22		Nextera	Primergy	ENGIE
July	2021	1372.64	1466.26	-
August	2021	-	-	-
September	2021	1965.74	2838.58	-
October	2021	-	-	-
November	2021	1529.37	1334.74	-
December	2021	3852.79	551.85	-
January	2022	-	432.83	-
February	2022	-	804.71	-
March	2022	-	769.15	4545.20
April	2022	-	954.33	4136.52
May	2022	-	1025.03	3800.98
June	2022	-	1260.28	2965.44
Subtotals		$8,721	$11,438	$15,448
Total	33%		$35,606	

FY23		Nextera	Primergy	ENGIE
July	2022	-	1684.18	2913.66
August	2022	-	-	2693.17
September	2022	-	1452.72	1767.76
October	2022	-	1361.83	
November	2022	-		
December	2022	-		
January	2023	-		
February	2023	-		
March	2023	-		
April	2023	-		
May	2023	-		
June	2023	-		
Subtotals		$0	$4,499	$7,375
Total	77%		$11,873	

FY24		Nextera	Primergy	ENGIE
July	2023	-		
August	2023	-		
September	2023	-		
October	2023	-		
November	2023	-		
December	2023	-		
January	2024	-		
February	2024	-		
March	2024	-		
April	2024	-		
May	2024	-		
June	2024	-		
Subtotals		$0	$0	$0
Total	100%		$0	

FY25		Nextera	Primergy	ENGIE
July	2024	-		
August	2024	-		
September	2024	-		
October	2024	-		
November	2024	-		
December	2024	-		
January	2025	-		
February	2025	-		
March	2025	-		
April	2025	-		
May	2025	-		
June	2025	-		
Subtotals		$0	$0	$0
Total	100%		$0	

FY26		Nextera	Primergy	ENGIE
July	2025	-		
August	2025	-		
September	2025	-		
October	2025	-		
November	2025	-		
December	2025	-		
January	2026	-		
February	2026	-		
March	2026	-		
April	2026	-		
May	2026	-		
June	2026	-		
Subtotals		$0	$0	$0
Total	100%		$0	

Approach	Traditional	Green	AnnSav$	AnnSav%		TotalSav$	TotalSav%
FY19	$55,932	-	-	-		-	-
FY20	$52,751	-	-	-		-	-
FY21	$53,806	$43,323	$10,483	19%		$10,483	19%
FY22	$54,882	$35,606	$19,276	35%		$29,759	27%
FY23	$55,980	$35,963	$20,017	36%		$49,776	30%
FY24	$57,099	$36,322	$20,777	36%		$70,553	32%
FY25	$58,241	$36,685	$21,556	37%		$92,109	33%
FY26	$59,406	$37,052	$22,354	38%		$114,463	34%
TOTALS	$448,098	$224,952					

DieselProj	ESB(4)	AnnSav$	AnnSav%	TotalSav$	TotalSav%			FullSav$	FullSav%
								$10,483	19%
								$29,759	27%
								$49,776	30%
$26,560	$3,364	$23,186	87%	$23,186	87%			$93,739	62%
$28,833	$3,431	$25,402	88%	$48,587	88%			$140,696	58%
$31,312	$3,500	$27,813	89%	$76,400	88%	TradCost	GrCost	$190,863	55%
$86,695	$10,295					$534,793	$235,24	$299,546	56%

		16500	miles per year (per bus	1650000%		
		7.5	mpdge	200%		
year #	calenda	3.017	diesel price per g	3%	elect price per kWh	
1	2022	$6,637.40		$825.00	$5,812.4	87.57%
2	2023	$7,208.22		$833.25		
3	2024	$7,828.12		$841.58		
4	2025	$8,501.34		$850.00		
5	2026	$9,232.46		$858.50		
6	2027	$10,026.49		$867.08		
7	2028	$10,888.72		$875.75		
8	2029	$11,825.15		$884.51		
9	2030	$12,842.12		$893.36		
10	2031	$13,946.54		$902.29		
		$98,936.52		$8,631.33	$90,305	91.28%

projections

FULL SAVINGS CHART		
FY22	27%	$29,759
FY23	30%	$49,776
FY24	62%	$93,739
FY25	58%	$140,696
FY26	55%	$190,863

CURRENT FLEET (10/22)	
2009	Collins
2009	Blue Bird
2015	Blue Bird
2015	Blue Bird
2015	Thomas
2017	Thomas
2019	Blue Bird

Future Fleet (2023)	
2019	IC-Bus Sea Electric
2019	TBA (diesel)
2023	TBA (electric)
2023	TBA (electric)
2023	TBA (electric)
2023	TBA (electric)
2023	TBA (electric)
2023	TBA (electric)
2023	TBA (electric)

[link to full comparison sheet]

Analyzed Total Cost of Ownership (TCO)

DIESEL		
		$/mile
Bus cost	$95,000	$0.576
Bus life cycle (years)	10	
Miles per year (per bus)	16,500	
Lifetime miles per bus	165,000	
Fuel Economy (mpdge)	7.5	
Fuel cost (per gal.)	3.017	
Lifetime fuel cost	$66,374	$0.402
Lifetime Maint cost	$40,000	$0.242
COST PER MILE		$1.220
TOTAL COST OF OWNERSHIP		$201,374

ELECTRIC		
		$/mile
Bus/charger/infra cost	$392,000	$2.376
Bus life cycle (years)	10	
Miles per year (per bus)	16,500	
Lifetime miles per bus	165,000	
Fuel Economy (kWh/mile)	1.5	
Fuel cost (per kWh)	0.0265	
Lifetime fuel cost	$6,559	$0.040
Lifetime Maint cost	$20,000	$0.121
COST PER MILE		$2.537
TOTAL COST OF OWNERSHIP		$418,559

FUNDING NEEDED TO REACH PRICE PARITY:	
Bus/Charger/Infrastructure cost	$217,185

DIESEL ANNUAL OPERATING COST	
Fuel & Prorated Maintenance	$10,637

ELECTRIC ANNUAL OPERATING COST	
Fuel & Prorated Maintenance	$2,656

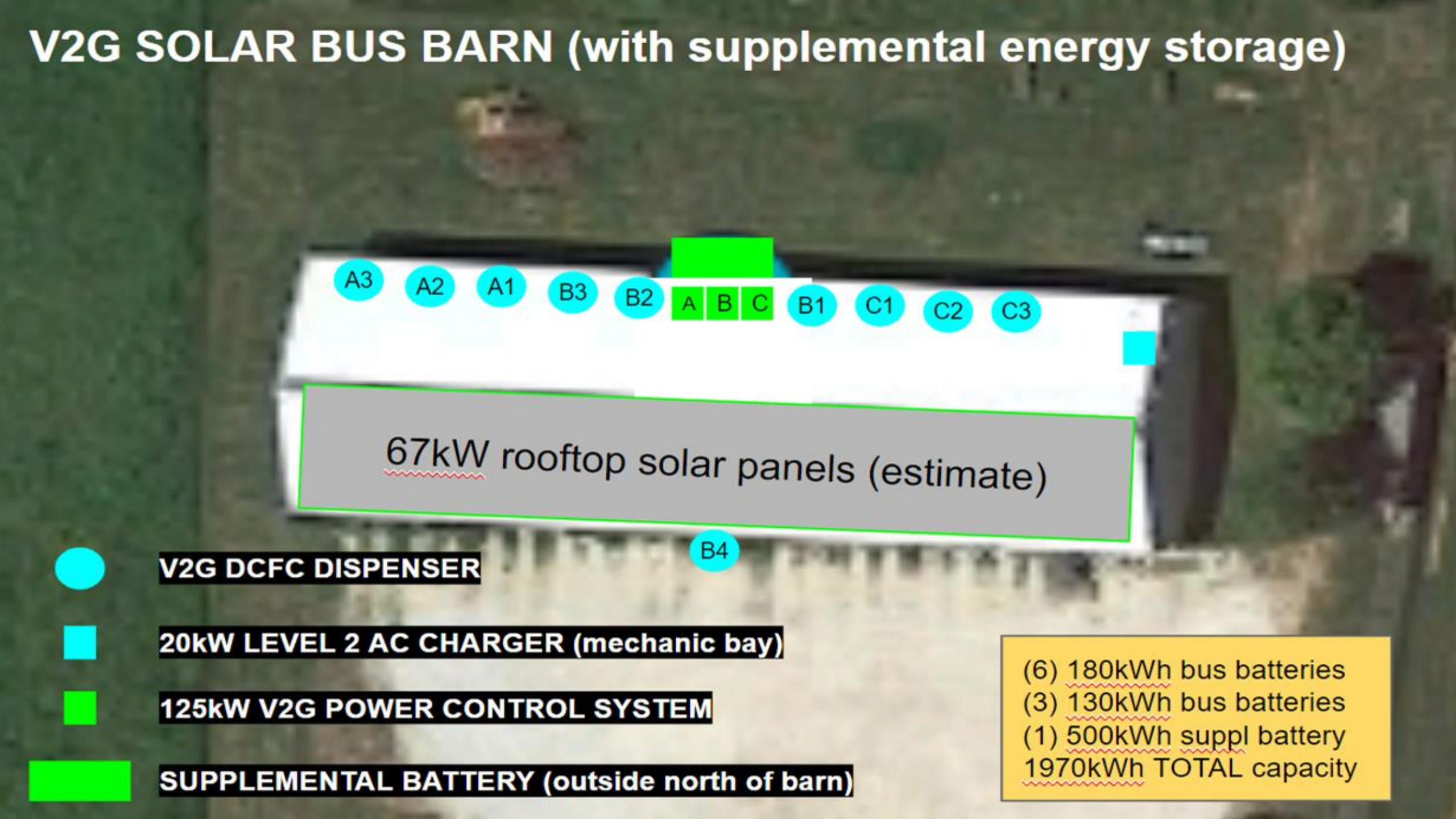
* Does not include peak shaving & potential V2G credits

link to spreadsheet

February 2020
Connected Solar Array & planted empty conduit

Spring 2020
Installed single axis, 204kW, strategically just north of bus barn

V2G SOLAR BUS BARN (with supplemental energy storage)



Summer 2020

Electric infrastructure upgrades as part of HVAC project with full fleet electrification in mind

Summer 2020

Pekin power control system (PCS) & dispenser (V2G DCFC)

Hollis Level 2 charging station

Studied EV charger market with energy aggregation and V2G revenue opportunities in mind

What do electric motors look like?

Blue Bird electric motor

Lion Electric electric motor

IC-Bus electric motor

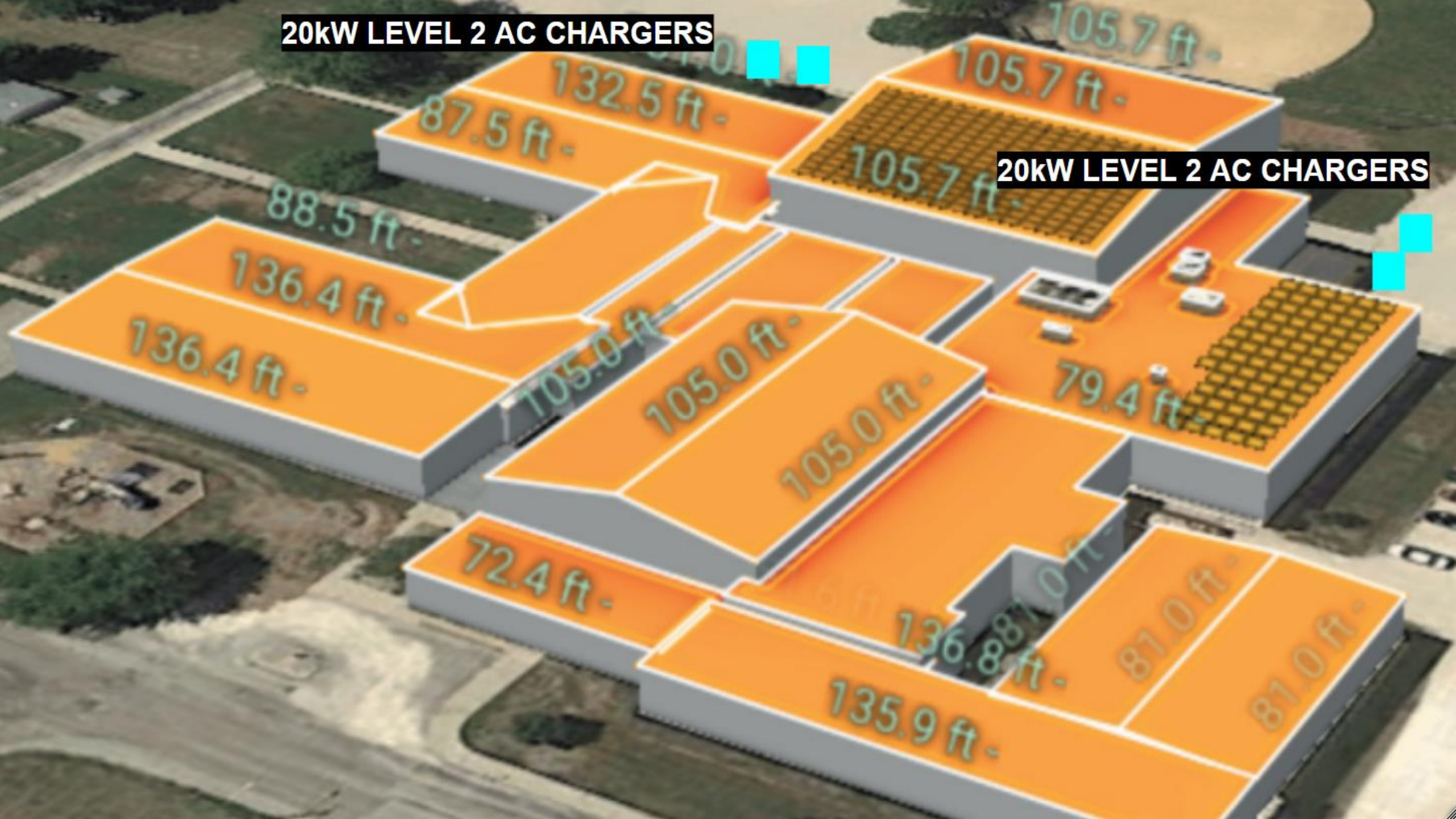

SCHOOL BUS


Power of Choice
Electric Powered


SCHOOL BUS


SCHOOL BUS

Oct 2022
Ordered an IC-Bus Repowered Bus
ESSER III grant approved for Repowered Bus & infrastructure


20kW LEVEL 2 AC CHARGERS
132.5 ft
87.5 ft
105.7 ft
105.7 ft
105.7 ft
20kW LEVEL 2 AC CHARGERS
88.5 ft
136.4 ft
136.4 ft
105.0 ft
105.0 ft
105.0 ft
79.4 ft
72.4 ft
136.8 ft
81.0 ft
81.0 ft
135.9 ft

We can’t wait to flip the switch!

If we can do it, any district can!

CONTACT INFO

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KATY GLYNN

katy.glyn@siemens.com
(224) 200-9287

Questions to guide a course of action

1. How many miles is each daily route?
2. What portion of the year do your buses sit still?
3. Is your bus barn/depot behind the same meter as a school building? If not, could it be?
4. Do you want to use ESBs for energy resiliency? If so, where?
5. Do you want to position yourself to leverage future V2G credit/revenue opportunities?
6. Design your ideal scenario