www.cet-power.com

Belgium, Luxembourg, China, India, United States, United Kingdom, Germany, Russia, Malaysia, Australia.

The three Zeros strategy - A review and lessons learned

Case study

September 27

Our 3 strategy pillars

ZERO DOWNTIME

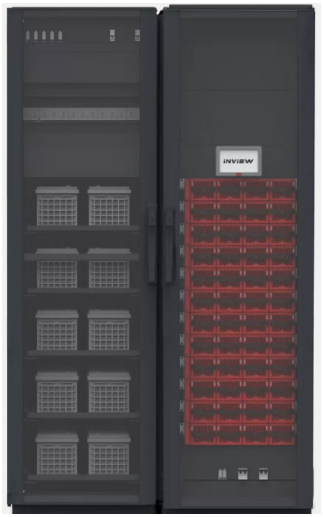
ZERO COST

ZERO CARBON FOOTPRINT

Products platform at a Glance

Stabiliti 30C3

PV + Storage Hybrid Inverter
for C&I Market



Sierra, Bravo

Smart UPS/Critical Power
for Data centers, cell phone
towers, critical infrastructures

Monitoring & Control

Power Management System

CET AMERICA

Diesel Generator replacement

Executive summary

Diesel generators have long been the power backup for critical applications. However, with emerging environmental concerns, data center operators are looking to replace them with more sustainable options.

There is no obvious choice for a direct replacement of diesel generators for a long runtime backup-only application.

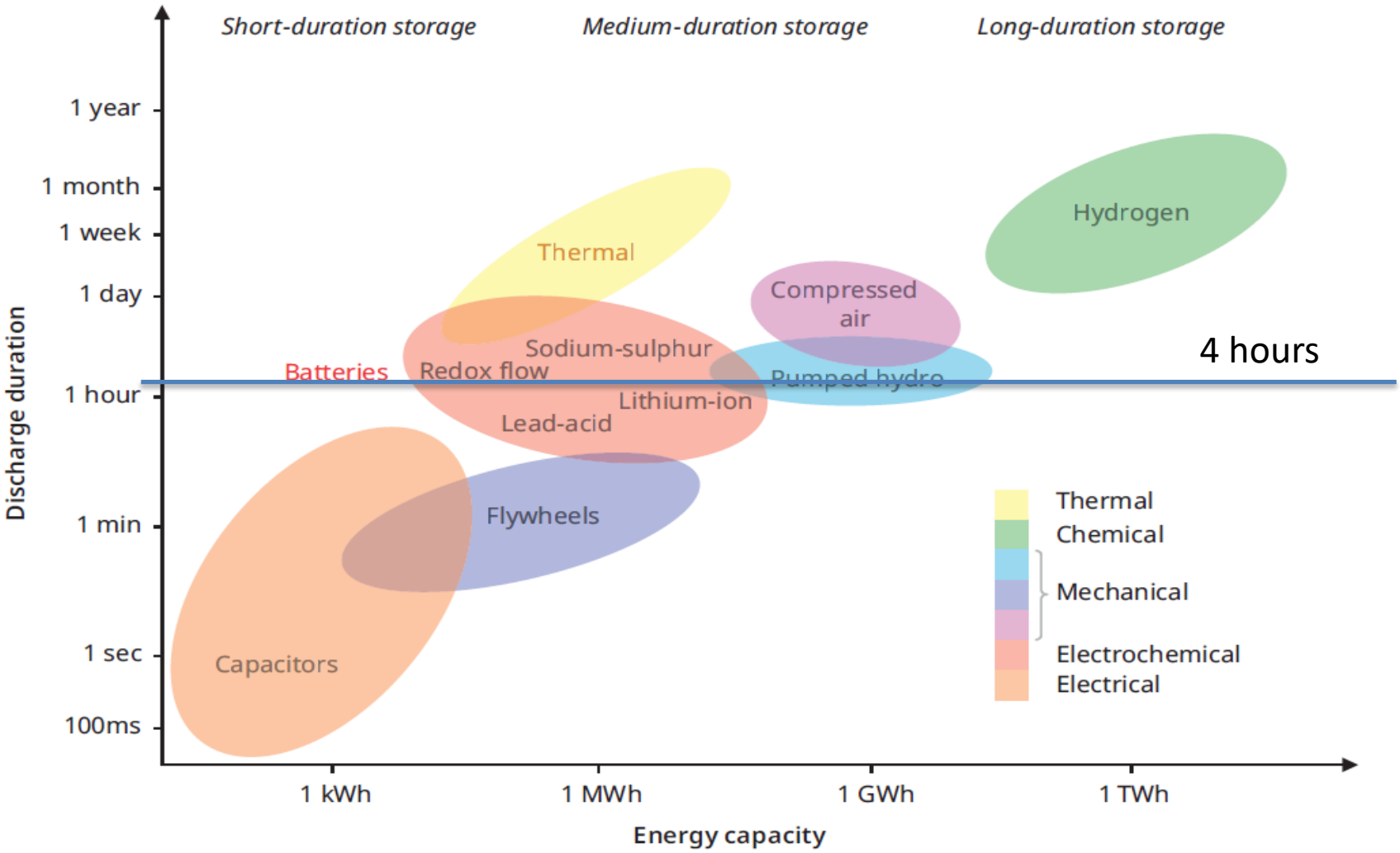
The most practical alternatives today are using either natural gas generators or sustainable diesel fuel options.

Lithium-ion batteries are not well-suited for 24-hour backup.

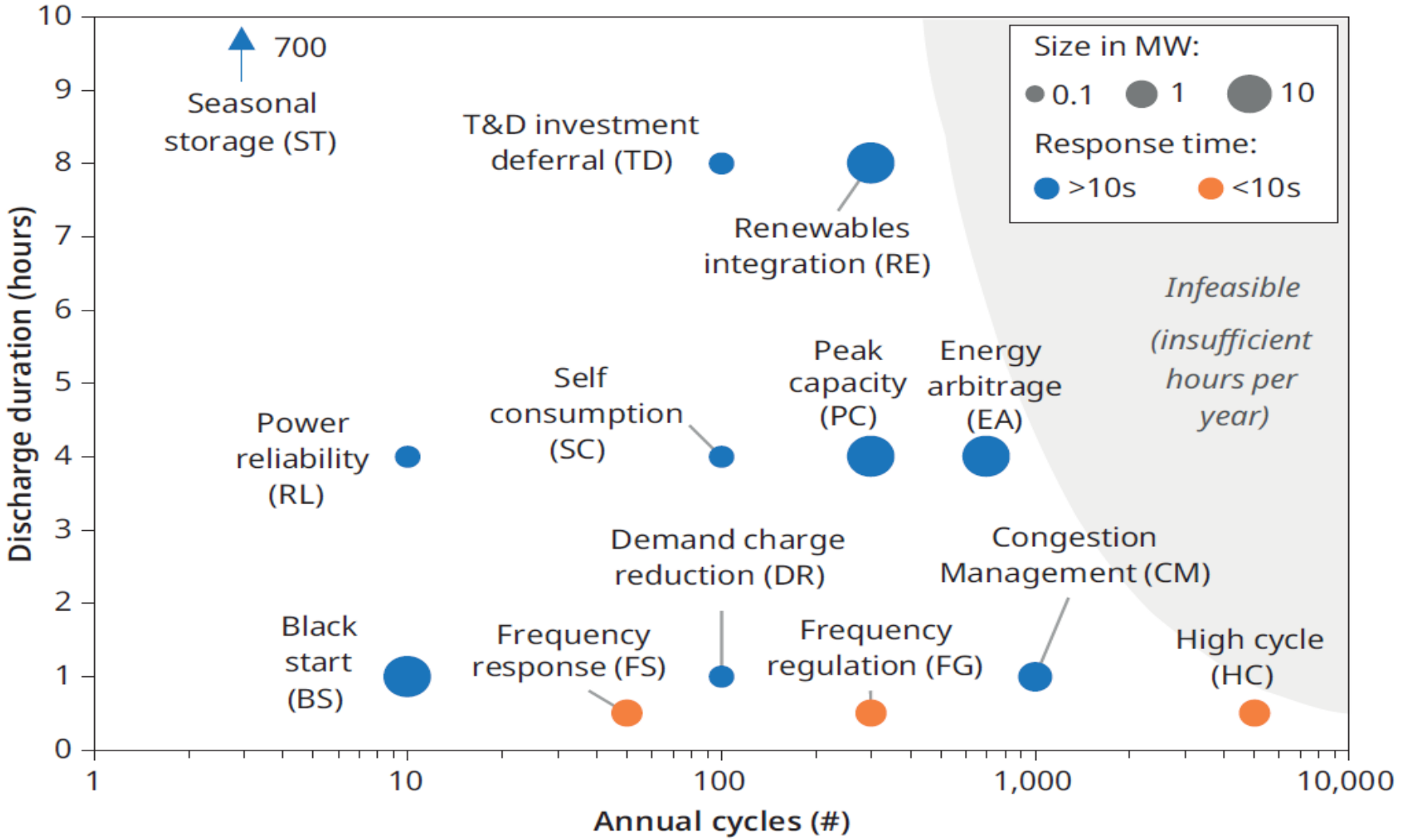
While PEM fuel cells are the main contender from an emissions' standpoint, this technology requires further cost reduction in CAPEX and fuel cost to become economically feasible.

CE+T AMERICA

A wide range of technologies



Energy storage applications



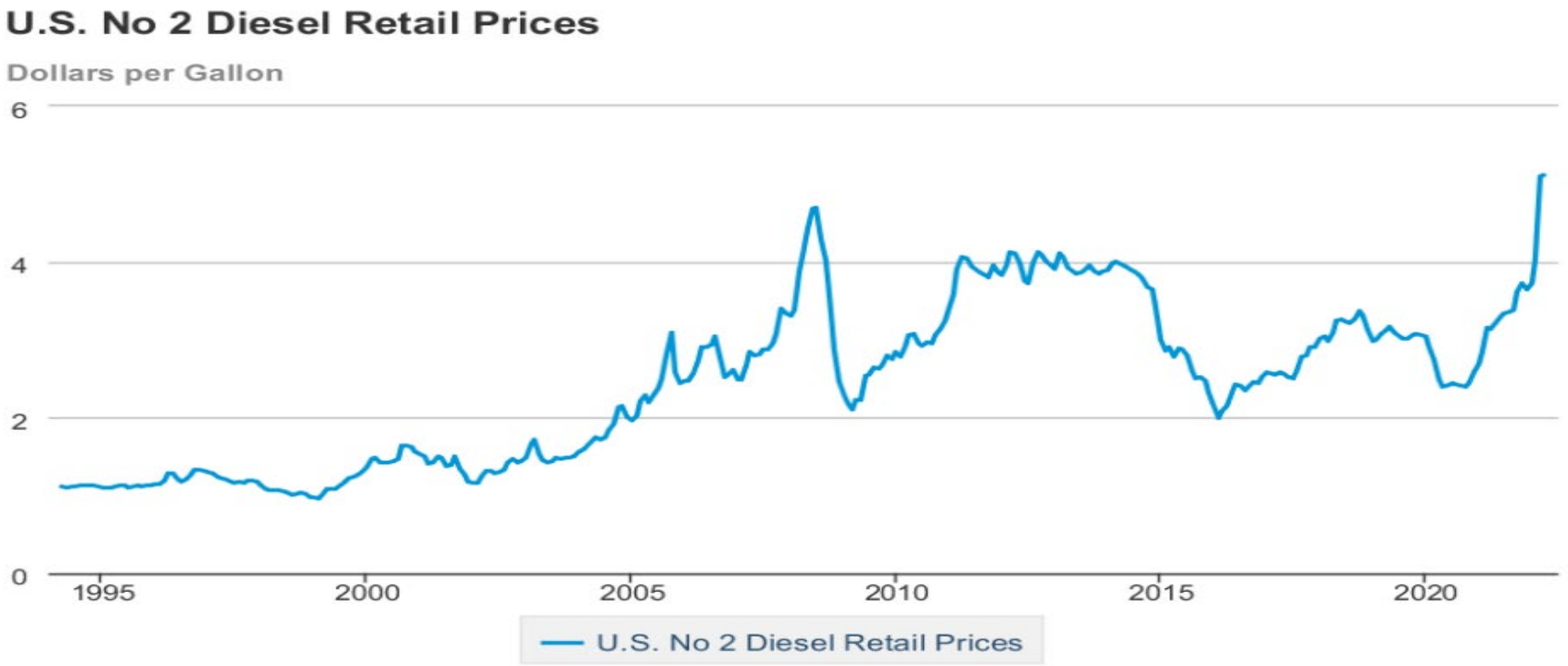
Benchmarking ESS

Characteristics for 24 hours of autonomy, 16.7 operating hrs/year	EPA Tier 4 diesel generator	Natural gas generator (rich burn)	Lithium-ion BESS*	PEM fuel cell w/ green hydrogen
Air quality (kg/MW)				
Annual NO_x emissions	11.2	0.53	0	0
Annual PM emissions	0.50	0.05	0	0
GHG emissions ($kgCO_2e$/MW)				
Annual Scope 1	11,924	10,638	0	0
Annual fuel production	4,325	3,907	1,844	1,411
Embedded carbon	22,000	26,400	1,224,000	112,000
Cost ($/MW)				
CAPEX	$800K - $1,200K	$1,000K - $1,300K	$7,000K - $9,500K	$2,100K - $2,500K
Annual fuel cost	$3,691 - $5,294	$1,887 - $1,937	$545 - $658	$6,329 - $11,356
Annual maint. cost	$9K - $10K	$9K - $10K	$34K - $46K	$8K
10-year TCO[38]	$885,158 - $1,302,624	$1,073,053 - $1,380,098	$7,231,800 - $9,813,079	$2,196,149 - $2,629,880
Other considerations				
Footprint (m^2/MW)	11	30-32	111-139	93-121
Start-up duration (sec)	<10	10-45	<0.1	10-60

Ref : BloombergNEF. Cost of New Renewables Temporarily Rises as Inflation Starts to Bite (2022).

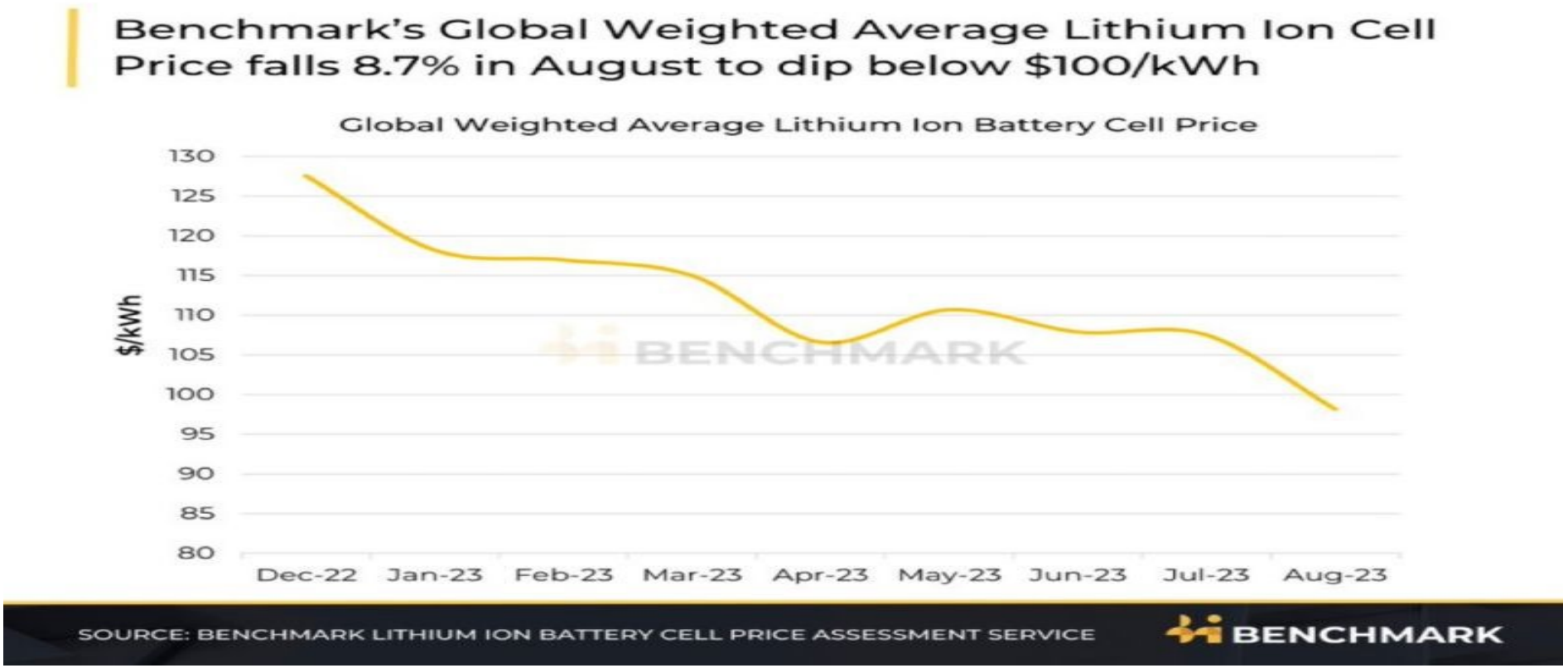
CE+T AMERICA

Diesel Retail Price



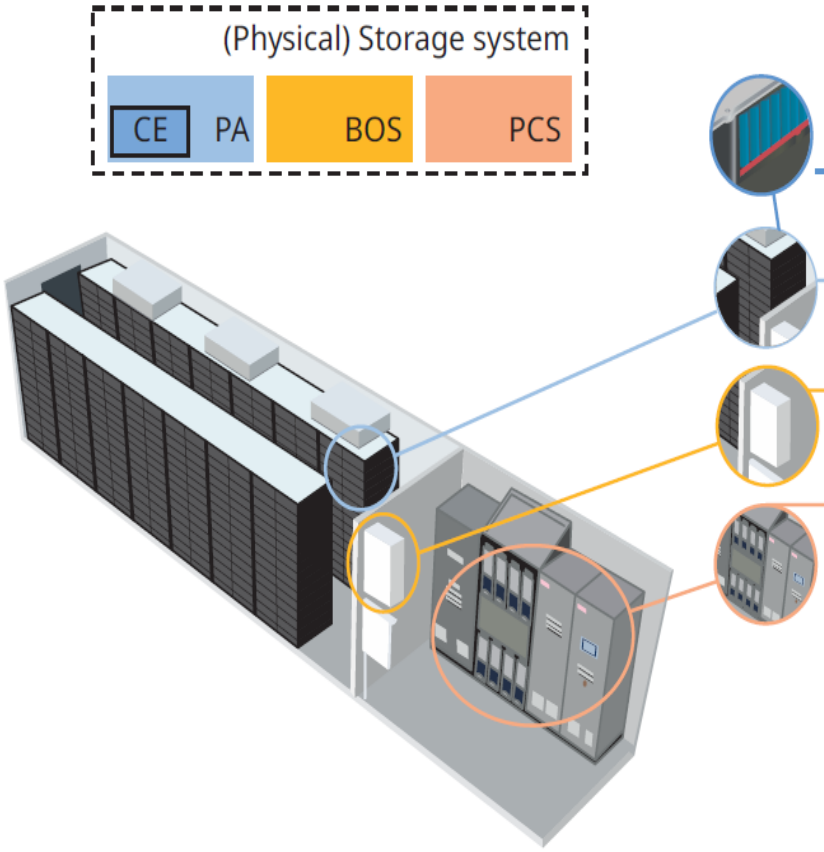
- In USA, diesel price ranged from $3.16/US gal to $4.54/US gal in Q1 ‘2212.
- Diesel genset consumes around 70 US gallons per MWh, hence this translates to a fuel cost range from $221/MWh to $317/MWh. (USA – 2021)

Lithium Ion price falling



This suggests that by 2030,
lithium-ion packs for EVs could fall to 60 USD/kWh and large-scale 4-hour ESS to 100 USD/kWh.

Defining the price point..



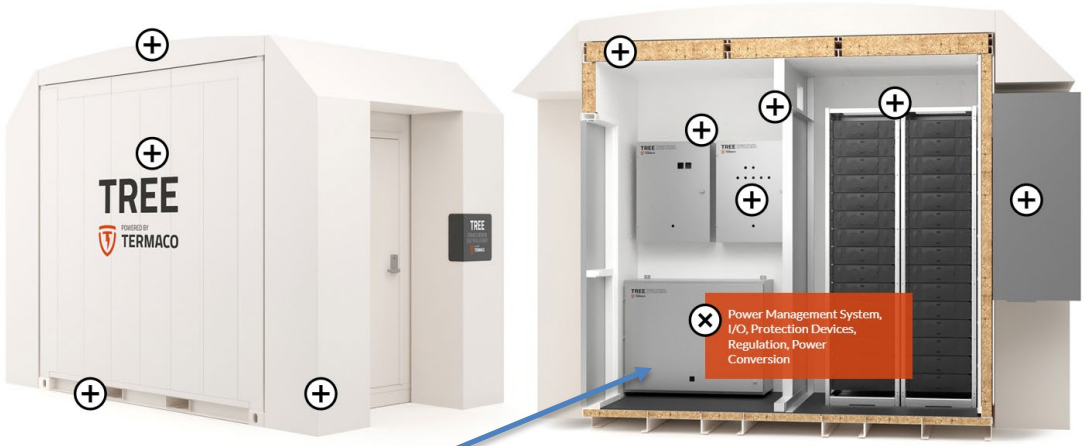
System scope		Components		Cost share
CE	Cell	• Electrodes • Electrolyte	• Electrical contacts	~35%
PA	Pack	• Cell connectors • Housing	• Battery mgmt. system ("BMS")	~15%
BOS	Balance-of-system	• Container • Monitors, controls	• Thermal control • Fire suppression	~10%
PCS	Power conversion	• Inverter/converter • Data management	• Energy mgmt. system ("EMS")	~10%
SI	System integration	• Assembly of components	• Tailoring to application	~5%
PD	Project development	• Land acquisition • Permits	• Financial and technical studies	~10%
D&I	Distribution & Installation	• Engineering • Procurement	• Construction • Commissioning	~15%

Portable Power Termaco using Stabiliti

TREE – Termaco Reserve Electrical Energy

- Portable power system designed by Termaco (Montreal)
- TREE uses solar panels and Kore Power lithium battery for reducing generator usage.
- Maestro PMS works with Termaco PLC for system control.
- Portable power for construction sites.
- 5 KW or 30 KW – 1 to 4 hours reserve + solar

Embedded ESS with Stabiliti



CE+T Inside

- Bi-directional 3 ports Power converter 30 KW (DC-DC-AC)
- 100 VDC to 1000 VDC
- 480 VAC, 3 ph.
- PMS energy control
- Microgrid capability
- Black start

CE+T AMERICA

Portable Electric – Sierra inside

Simple, simultaneous charging

Charge multiple electric vehicles simultaneously, including e-bikes and other alternative transportation options—no installation required.

Off-grid charging

Embrace the freedom of off-grid charging. Charge your vehicles anywhere, anytime, without relying on traditional power infrastructure.

Versatile applications

This caters to all your electric vehicle needs, from boost charging to temporary charging sites or deployable recharging on demand.

Seamless integration

Connect your Voltstack to our proprietary software, NeuronOS™ and gain complete control. It's an intelligent charging solution that puts you in the driver's seat.

Recharging flexibility

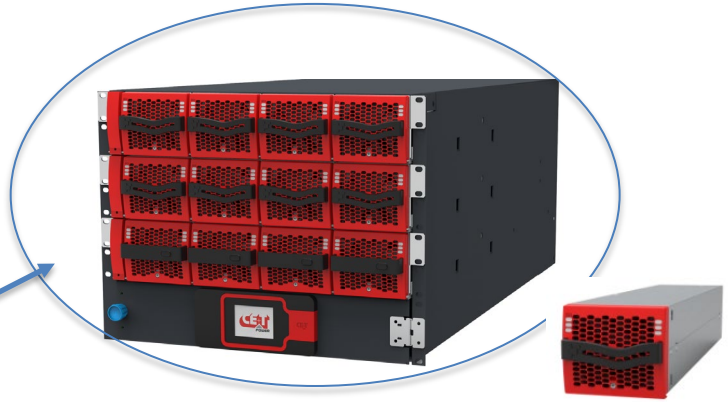
To recharge, use its AC inputs or tow the Voltstack Level 3 e-Charger to any Level 2 EV charging station.

Silent and emissions-free

This Mobile EV Charger provides a clean, quiet charging experience while reducing your carbon footprint.

80 kWh Capacity	27 kW Continuous output	34 kW Peak power (5 sec)	120/208 VAC three phase, pure sine wave output voltage
4,000 Lifecycle (80% capacity)	3.5 hours Charge time	1 x Level 3 SAE Combo/CHAdemo connector	

Sierra 25 Multi-Directional modular Converter

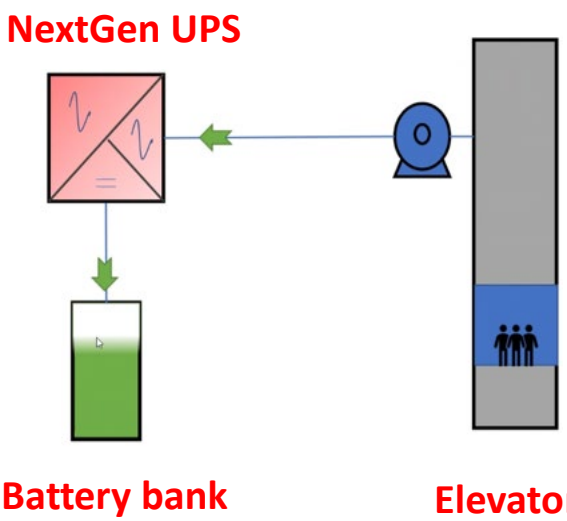


- Bi-directional Power converter 2.75kVA/2.25KW
- AC/DC out: Max Capacity
- 48 or 380VDC – 208Y/120, 480Y/277 VAC

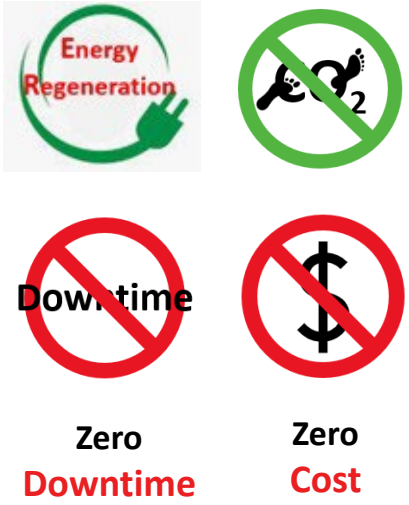
A perfect fit for the film industry

Energy Regeneration UPS in Elevator applications

- Convert the Elevator System into a Renewable Sources by NextGen UPS
- 60, 90 and 120 KW UPS with 2 hrs reserve
- ROI within 2-4 years (depending on usage and the rating)
- 20% of consumed Energy Recycled
- UL924 Listed, UL1741SB coming soon



Value-Proposition:



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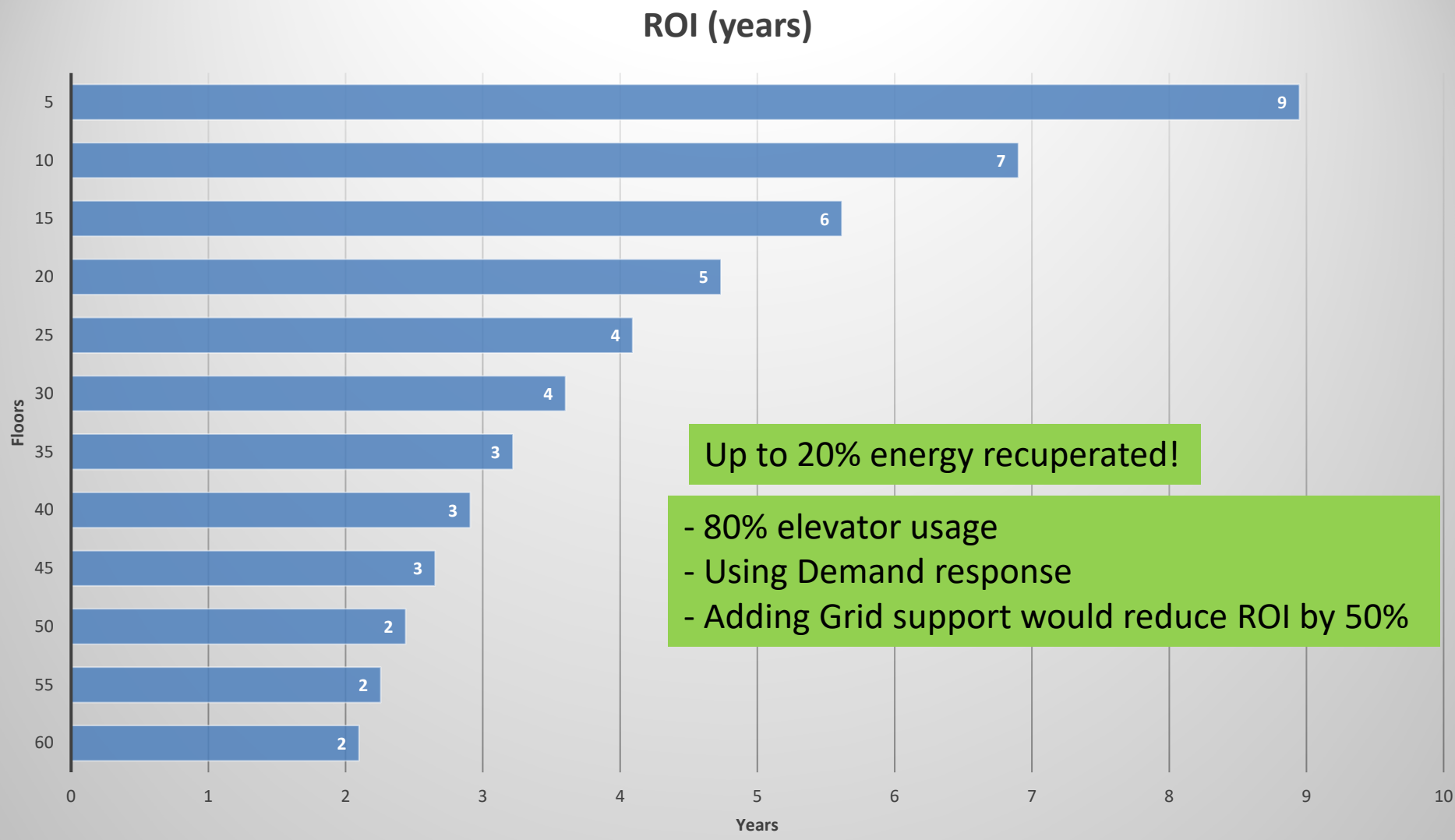
ROI vs Floors

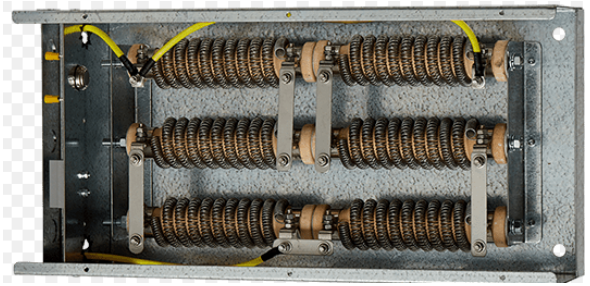


Up to 20% energy recuperated!

- 80% elevator usage
- Using Demand response
- Adding Grid support would reduce ROI by 50%

Lessons learned

- NFPA adoption has been a challenge. The braking resistor is a building code inspection check point!



- Building energy initiaves (LED lighting, VFD, etc..) leads existing regeneration systems to wasting energy through the braking resistors.

Hydrogen market – The rising star

"With governments throwing their weight behind hydrogen, investor excitement has been kicked into overdrive."

Investors' Chronicle – March 2021

"The 21st century will likely witness the rise of a mega-billion hydrogen fuel industry. Countries are taking first steps – and it's breathtaking."

Forbes – December 2019

"As the oil-and-gas industry struggles to secure its place in a world shifting away from fossil fuels, major energy companies are making a grab for the rising hydrogen market."

Wall Street Journal – June 2022

KEY INSIGHT

In 2030, six electricity storage technologies may dominate seven distinct application categories based on current assumptions for cost and performance parameters and their expected improvement towards 2030:

	Category	Duration	Annual cycles	Technology
1	Short-to-medium discharge	1–8 hours	< 500	Lithium ion
2	Medium-to-long discharge	8–20 hours	< 30	Compressed air
3	Long discharge	> 20 hours	< 30	Hydrogen
4	High throughput—medium discharge	> 4 hours	> 500	Pumped hydro
5	High throughput—short discharge	1–4 hours	> 500	Vanadium flow
6	Power provision—few cycles	< 1 hour	< 1,000	Lithium ion
7	Power provision—many cycles	< 1 hour	> 1,000	Flywheels

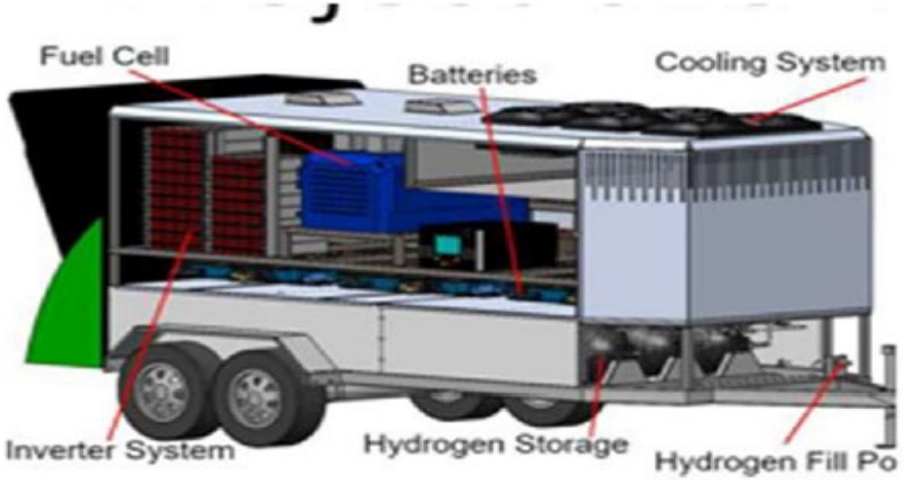
Reference: Mayr F and Beushausen H. 'Navigating the Maze of Energy Storage Costs' (2022) 5 PV Magazine 84–8

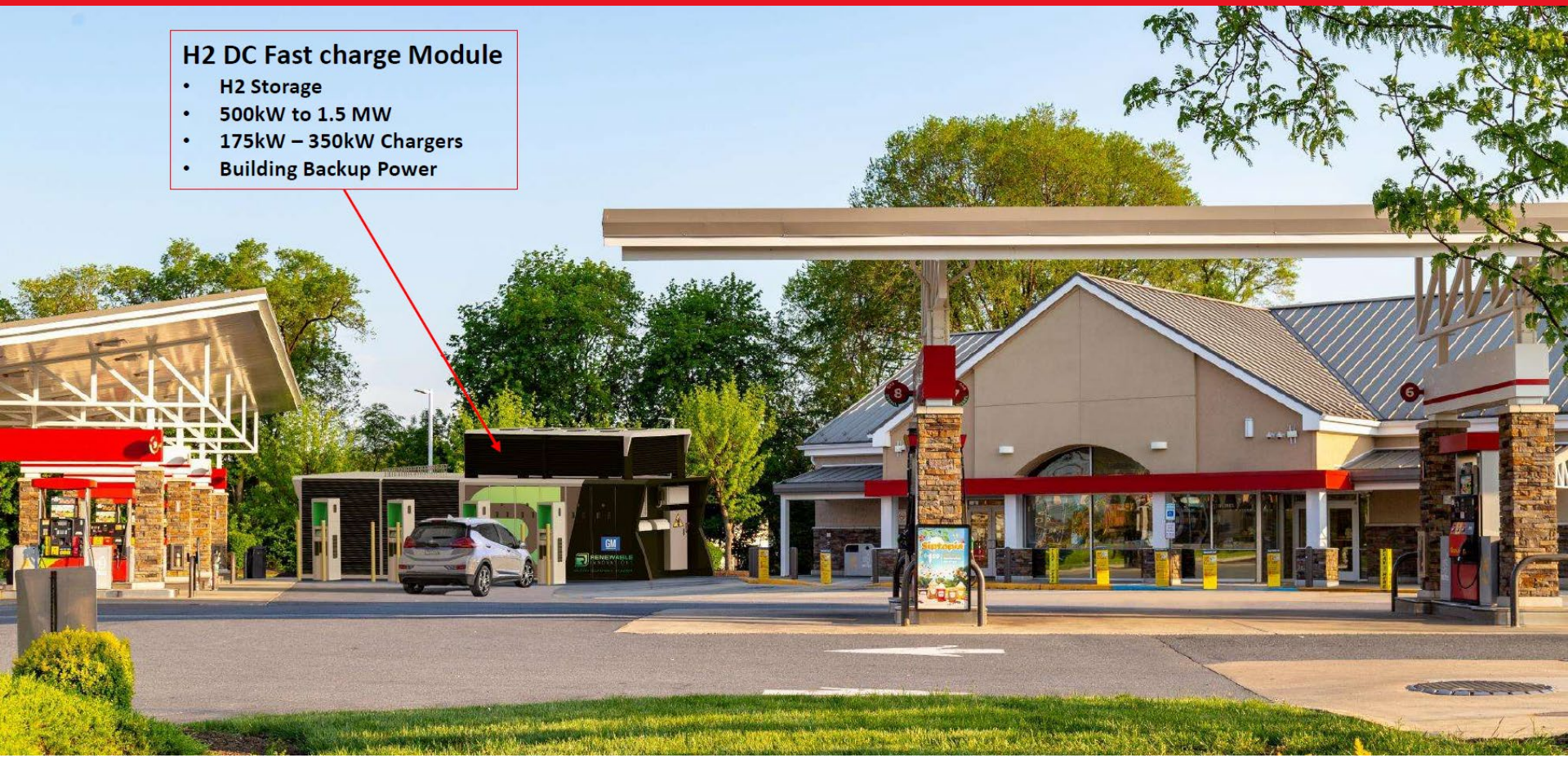
MOBILE POWER GENERATION SYSTEM

- 80kW Fuel Cell
- 180kW Inverter
- 180kWh Li Battery array
- Up to 70 kg H2
- 180 kW DC Fast Charger

RENEWABLE INNOVATIONS
renewable-innovations.com
Clean
Scalable
Power

gm




H2 DC Fast charge Module
• H2 Storage
• 500kW to 1.5 MW
• 175kW – 350kW Chargers
• Building Backup Power

Project summary

Item	Details
Customer	Renewable Innovation for General Motors
Pain points	Space constraint, serviceability ,
System type	Sierra Next Gen UPS with peak shaving and regen function
Specifics	➢ 1.2 MW - 380 VDC , 277/480 Vac ➢ Cabinet of 700x700x800 mm ➢ Hydrogen fuel cell for 180 KWhrs and 480 KWHrs reserve @ 380 volts nominal. ➢ PV , DG , LiFePO4 ready
Value	➢ 0.44 $/watt ➢ Best MTTR ➢ Best Power density ➢ Best reliability
Projected revenue	3 to 8 MUSD a year for the next 10 years.


RENEWABLE


REBELLE
RALLY


211

CE&T based EV Charging Deployments & Future Configurations

Rick Szymczyk, P. Eng, MBA

30+ years General Motors Manufacturing & Design
Started Upstartz in 2007, incorporated in 2017
Led Toronto start-up, eCamion Engineering team to market 2017-2022
Currently serving as Ontario Tech University Automotive Centre R&D Manager
upstartz energy development in parallel
Introduced to Stabiliti in 2018. Successfully integrated across several architectures.
Constant relearning & reinvention!

Agenda

- Selected applications using Stabiliti technology
- Future strategies & opportunities
- Q&A

Red River College (2019-2021)

Repurposed Battery DC Fast Charger

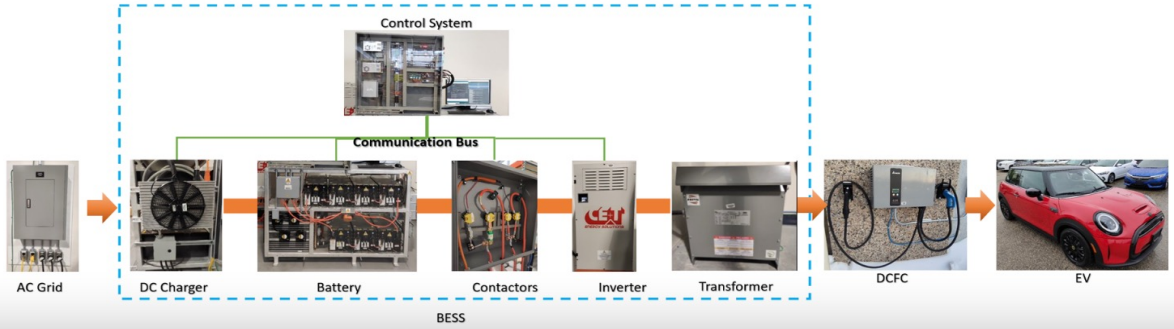
B2U Project Overview

The B2U project involves the second-life use of the batteries from the previous Winnipeg Transit Electric Bus Demonstration. The Vehicle Technology & Energy Centre (VTEC) team designed, built, and tested the system to utilize repurposed batteries as an energy storage system (ESS) to power a 25-kW direct current fast charger (DCFC).

Repurposed battery DC fast charger

The ESS is charged at off-peak times and stores energy for peak use times. The charger is equipped with a combined charging system (CCS) and CHAdeMO dispensers to accommodate most electric vehicles.

KEY COMPONENTS



Charger Status

The State of Charge (SOC) displayed below is for the battery pack powering the charger, not the vehicle battery SOC.

SOC

84%

STATUS

Available

Charger status last updated at 8:31am on July 13, 2023.

Key Benefit: Zero Utility cost EV Fast Charging

Ontario Tech – Automotive Centre 2019-2021

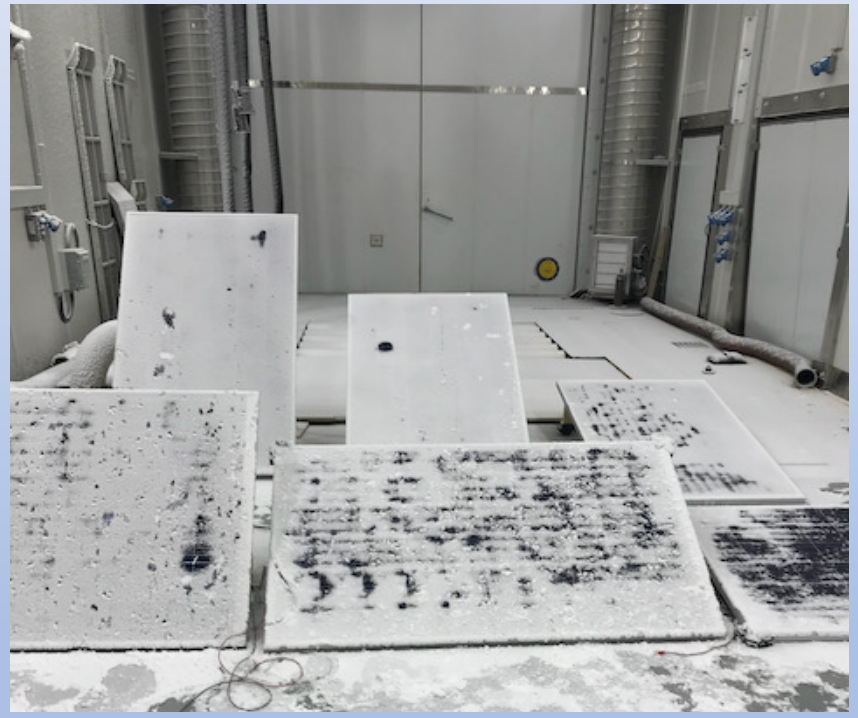
DC Fast Charging with Energy Storage

GEN 1: AC Coupled with Stabiliti (2019)
2x 25kW + 1 x 50 kW
120 kWh Energy Storage
10/30 kW Grid Input
Serves members of general public & University Staff

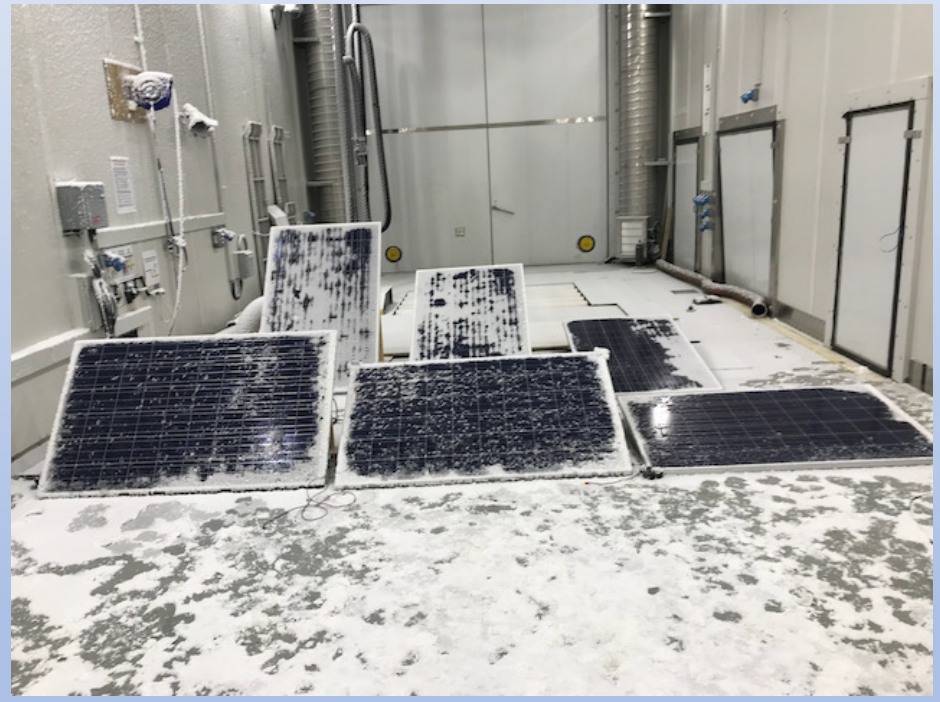
GEN 2: Direct DC coupled (CY2021-2022)
150 kW DC Charging
60 kW Input with CE&T Stabiliti
Served OEM Customers at ACE Climatic Wind Tunnel

Key Benefit: Enables EV Fast Charging revenue in Climatic Wind Tunnel of $250/hour

Winter Solar Efficiency (Snow Melting) Ontario Tech (2021)



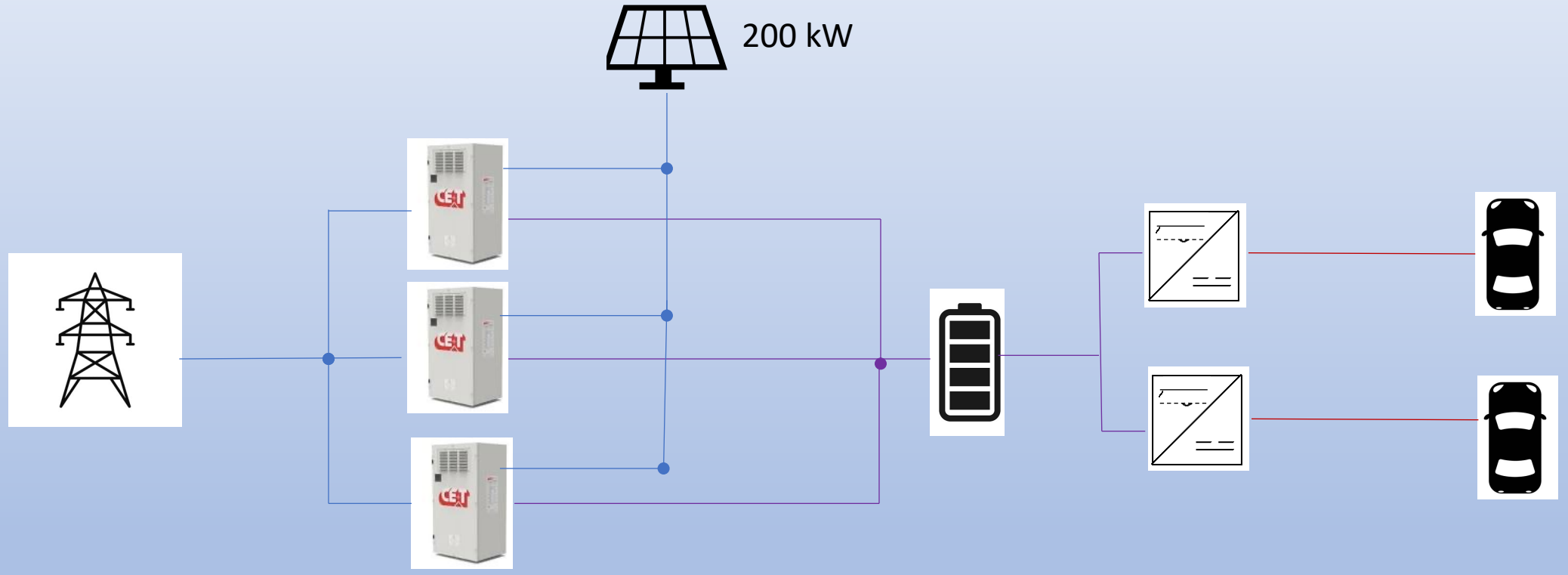
Before



After

Key Benefit: Enables 5% annual, 14% during Winter, improvement in Solar production.

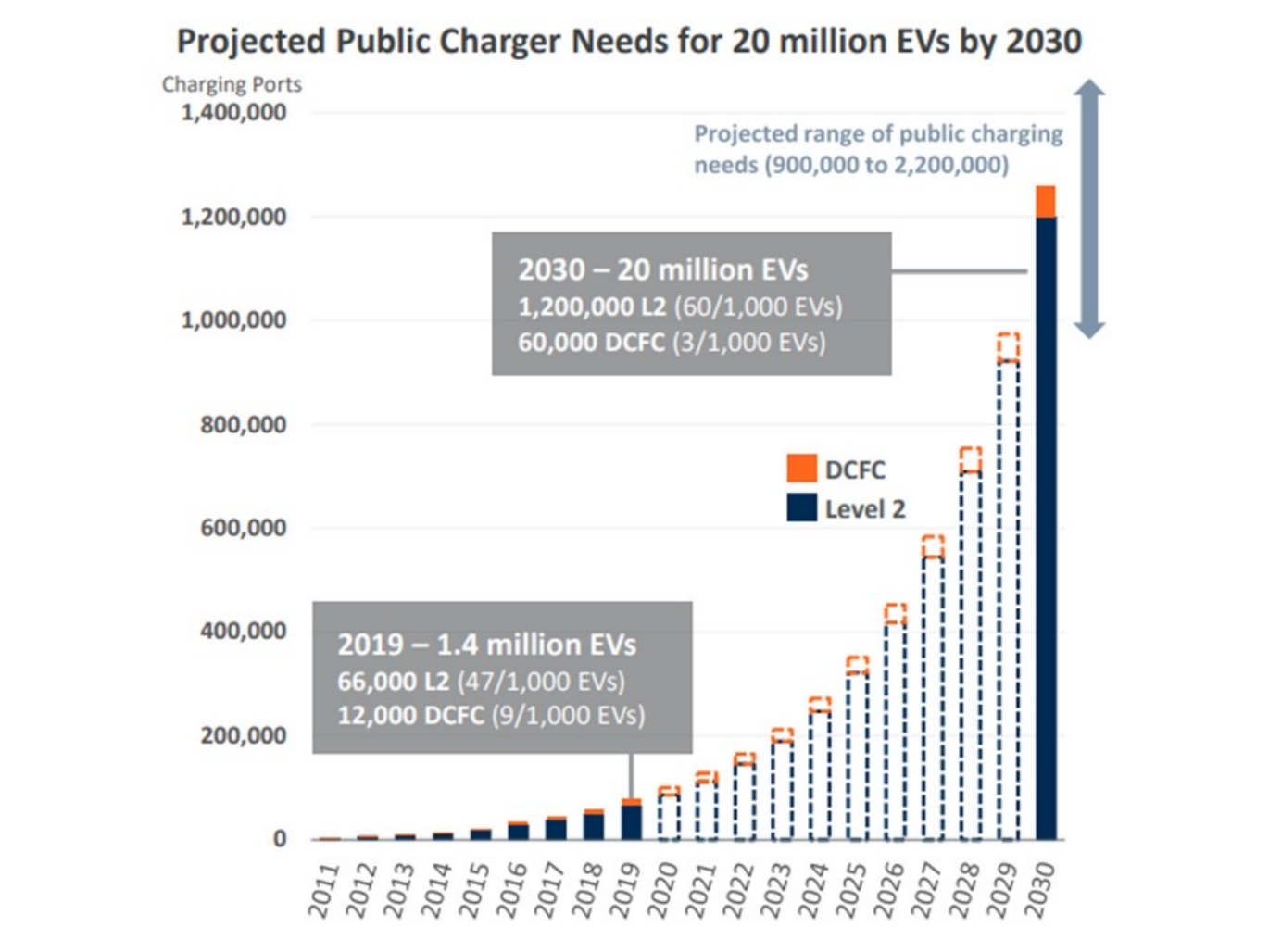
New York, USA
EV charging + ESS+ Solar (2023)



Key Benefit: ROI of approx. 20% when leveraging incentives.

Future Strategies to accelerate the adoption of Stabiliti based technology

Market Potential EV Chargers - USA



Challenges

Capital Cost

Grid Capacity

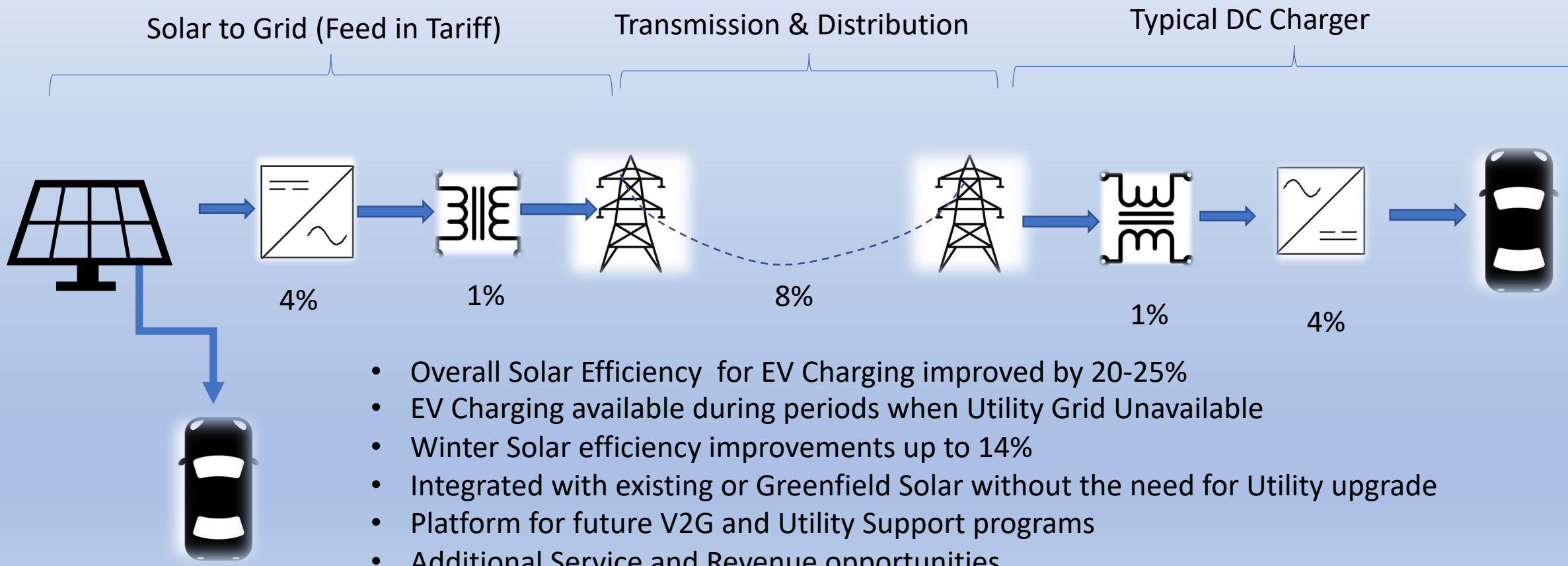
Material Availability

Profitability

Interoperability

Point of Use Solar EV Charging
A Technology & Paradigm shift

How Grid Solar & EV charging systems are generally installed today

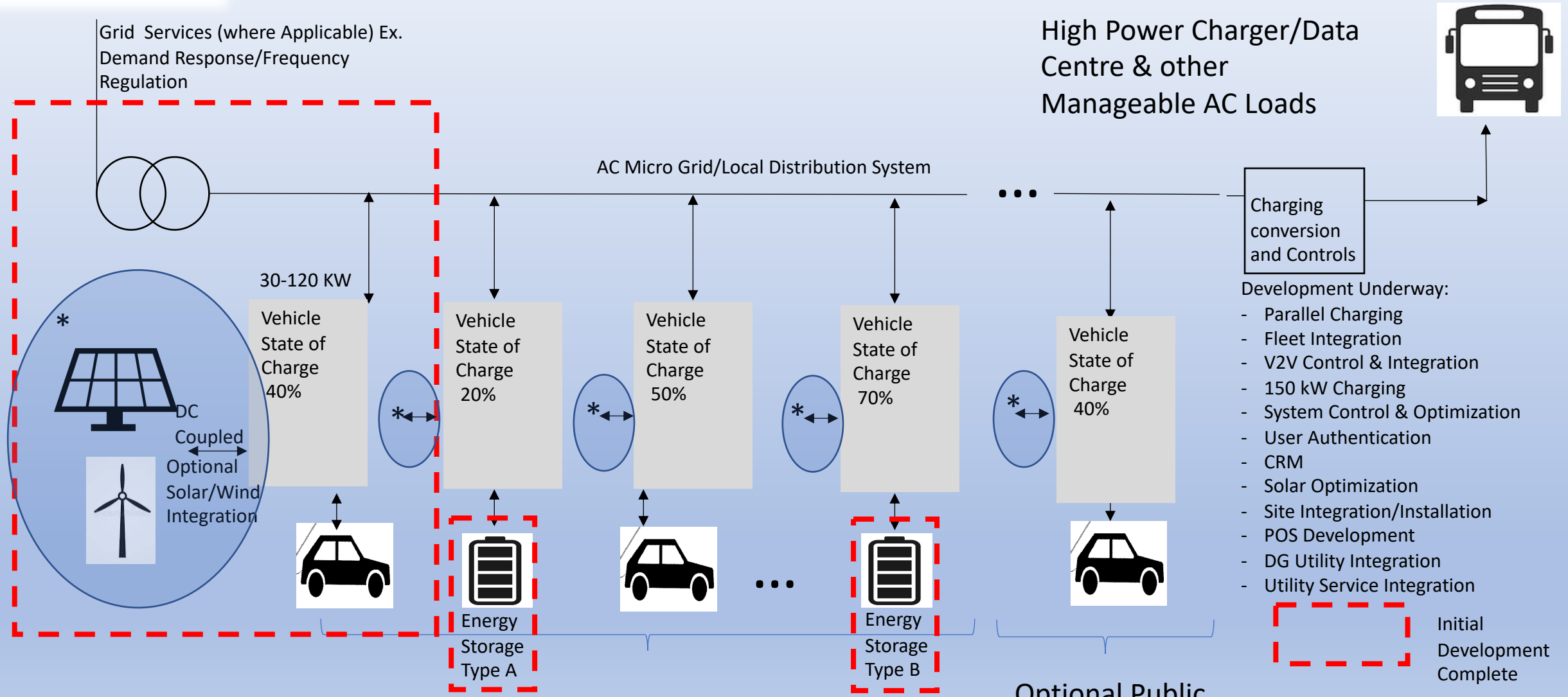


- Overall Solar Efficiency for EV Charging improved by 20-25%
- EV Charging available during periods when Utility Grid Unavailable
- Winter Solar efficiency improvements up to 14%
- Integrated with existing or Greenfield Solar without the need for Utility upgrade
- Platform for future V2G and Utility Support programs
- Additional Service and Revenue opportunities
- Viability is highly sensitive to specific site and jurisdiction

Example Scale Up Strategy

- Ontario, Canada currently has 3,000 MW of existing Solar capacity
  - Leverage existing sites and integrate Solar based EV Charging without significant upgrades to utility infrastructure
  - Integrate enhanced features such as V2G & utility support using open standards to support existing infrastructure
  - Integrate Electrified mobility including EV conversions to accelerate the transition
- Integrate potential across Ontario for 3,000 MW of Solar by 2030
  - Integrate EV Charging with new Solar installations

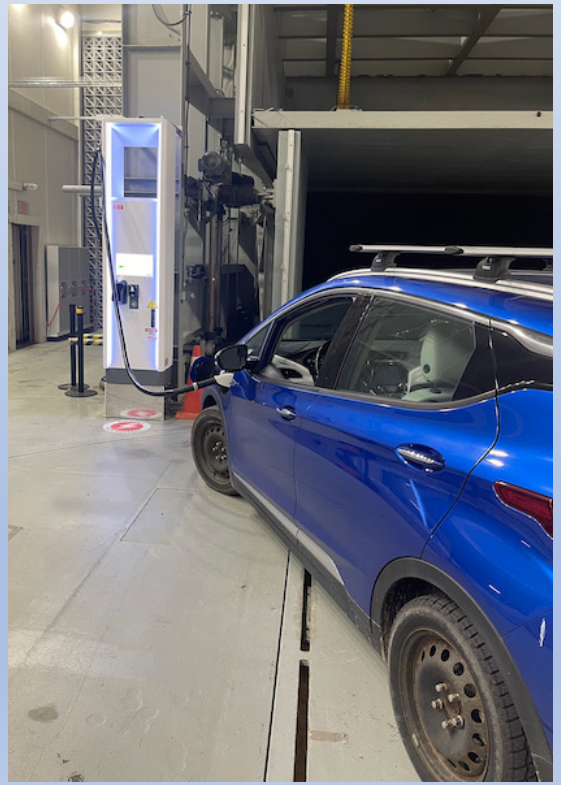
Grid Independent EV Mobility Fleet with Renewable Generation & Storage



Ontario Tech – Automotive Centre of Excellence

- Climatic Wind Tunnel capable of testing virtually any type of automotive vehicle
  - 40 to +60C
  - Up to 250 km/hour active Dynamometer
  - Rain, Snow, Sunlight, Freezing conditions
  - 350 kW fast Charging inside the Chamber

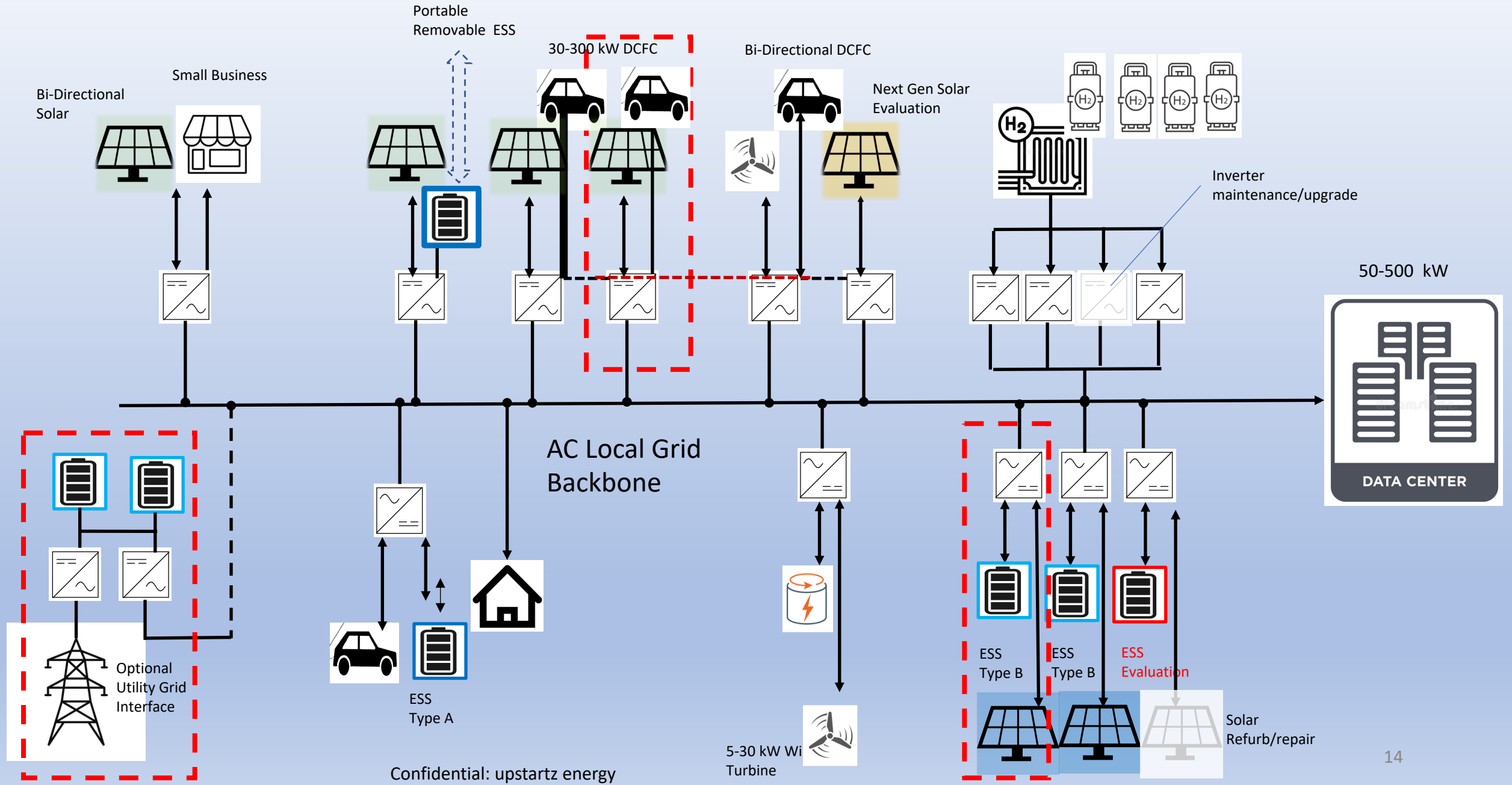
  - Opportunity to develop/deploy next Gen using Stabiliti
    - Bi-Directional Power Flow
    - Charging & performance Diagnostics
    - Lower Support Cost
    - Localized Manufacturing & Support



Benefits of DG/DE Producers

1) **More efficient:** Up to 10% of Energy is lost in transmission & Distribution alone.
2) Solar **output higher**, up to 14% more during winter months
3) **Enhanced Grid Stability**: Distributed Energy can enhance stability.
4) **Less Range Anxiety for EV drivers**. Higher numbers of EV chargers distributed throughout the community provide more options when charging is needed.
5) **More Equitable distribution** of wealth:
    1) Grid Structure could do better at distributing fixed costs across the system.
    2) High Fixed cost structure penalizes those who invest in conservation.
    3) Lower Cost structure possible through distribution
6) **Measurement could be more accurate**. Ex. Power Factor improvements, loading factor assessments.
7) **Lower risk of disruptions**
8) **Lower inflationary pressures** because of increases in supply options.
9) Higher **propensity for Innovatio**n from smaller producers. Entreprenural spirit prevails.

ACE Current - Renewable Energy Production – Sustainable Storage – Manageable Loading – EV Mobility -



Thank You

Questions & Feedback