



Enabling Hybrid Buses to Act as Mobile Power Generators

The FTA Bus Exportable Power Supply (BEPS)
Research and Demonstration Project

APTA Annual Meeting
October 10, 2017

Setting the Stage

Problem:

- Manmade and natural disasters disrupt the electrical grid.
- Traditional sources of backup power are often unreliable or take long to implement.

Idea:

Can hybrid electric buses be deployed to areas without power and export electricity from the bus to a facility?

Technology Overview

Imagine a hybrid bus broken into its basic building blocks



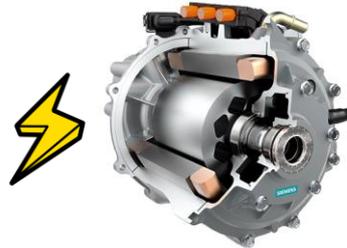
Technology Overview

Imagine a hybrid bus broken into its basic building blocks

diesel/CNG engine



creates electricity



spins the wheels



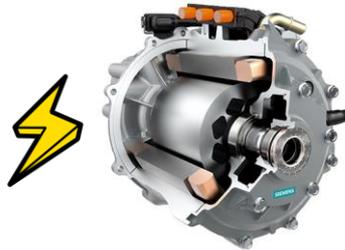
Technology Overview

Can we park the bus and export its electricity to a medical center, gas station, or communications center to help with emergency response?

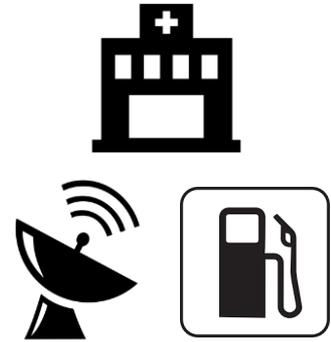
diesel/CNG engine



creates electricity



export power to
outside systems



FTA Funded Research

FTA is sponsoring a project to investigate the Bus Exportable Power Supply (BEPS) idea.

Task 1: System Design and Demonstration

“Is it technical feasible?”

“What are the design challenges?”

“Show us that it’s possible.”



Task 2: Strategy Planning

“Is this useful?”

“How would this be used?”

“Who would pay for it?”

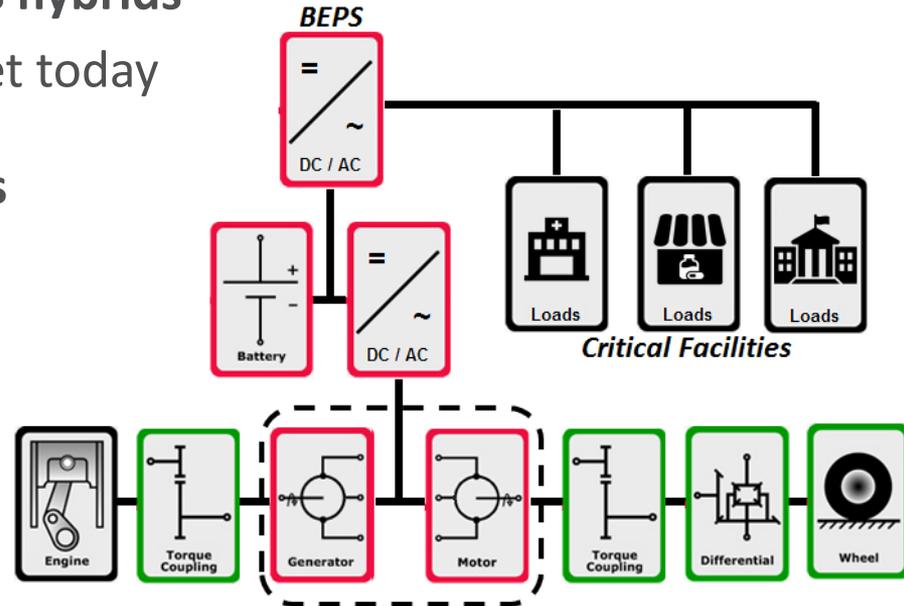


HAGERTY

Task 1: System Design and Demonstration

System Design

- BEPS may be **integrated into the bus or stored on a shelf**
- Suitable for both **parallel and series hybrids**
 - Series hybrids dominate market today
- Power output up to **150 kW per bus**
 - Possible to parallel buses to power larger loads
 - Need to work with OEM to understand control logic and thermal design



Typical Facility Loads

EMS Facilities:	15 - 25 kW
Fire Station:	15 - 25 kW
Police Stations:	15 - 25 kW
EOCs:	15 - 25 kW
Comm. Centers:	35 - 75 kW
Radio Tower:	35 - 75 kW
Gov. Office:	100 - 200 kW
Schools:	200 - 300kW
Urgent Care:	200 - 300 kW
Hospitals:	800 - 2,000 kW

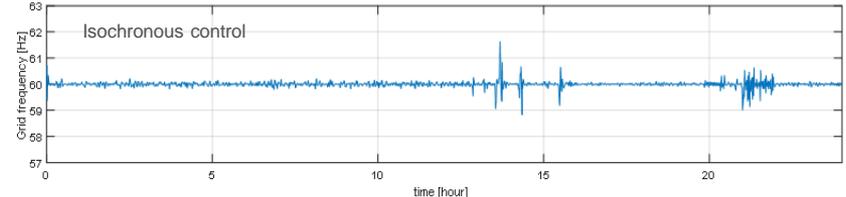
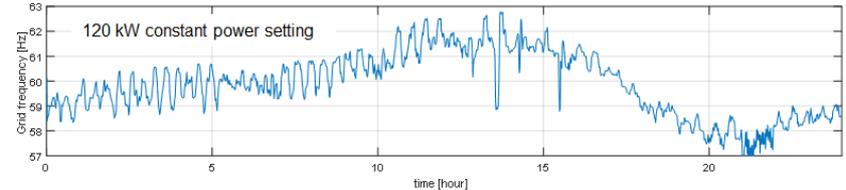
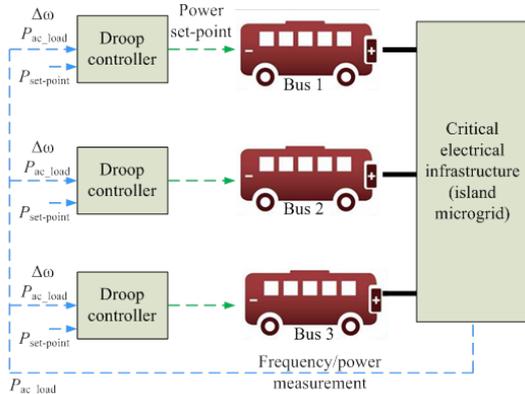
power output of BEPS equipped bus could be near 150kW

multiple buses must be configured together to power facilities with high loads

Simulating a BEPS System

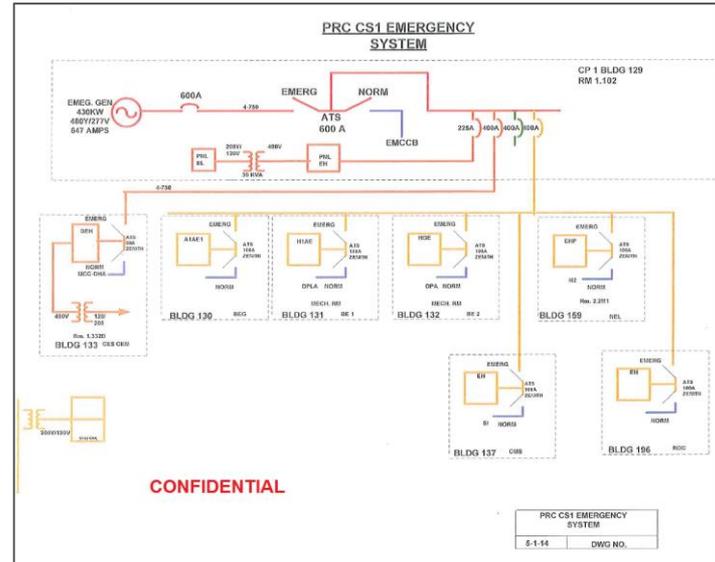
Computer model of the BEPS system to better understand:

- how BEPS buses could be linked together to power high-load facilities
- control strategy to regulate frequency and voltage at nominal values
- fuel consumption
- thermal load as the bus idles and exports power



Demonstration Activity

- Q1 2018
- export electricity from a hybrid Ebus to facility on University of Texas campus



Task 2: Strategy Planning

Question:

Is exportable power useful? If so, how will it be used and who is responsible for it?

Approach:

Get input from stakeholders.



Expert Panel Meetings



US Army Corps
of Engineers.



American
Red Cross



Federal Transit
Administration



Walgreens



BAE SYSTEMS

Key Findings

Utilization/Deployment

- **Site prep and skilled labor are needed to deploy generators**
 - Traditional back-up generators are not “plug and play”
 - BEPS would require similar deployment support, unless facilities were selected and outfitted with equipment beforehand
- **EM agencies could work with transit agencies to deploy BEPS**
 - Establish the process before the emergency occurs
 - Transit and EM already collaborate during emergencies for evacuation support
- **BEPS has strong potential at the local level**
 - All emergencies initially are the responsibility of the local EM agency where back-up power resources may be limited
 - Can be used to “fill the gap” until state/federal support arrives

Key Findings

Procurement/Adoption

- **Traditional trailer-mounted backup generators with similar power output to BEPS are \$30k - \$60k each**
 - Comparable to estimated BEPS equipment costs
- **Transit agencies are more interested in BEPS if it is designed, built, and warranted by the bus OEM, compared to a third-party vendor**
 - ROI is currently unknown, creating hesitation for OEMs to invest
- **Federal incentives may motivate adoption**
 - Spare ratio calculations

Key Findings

Constraints/Challenges

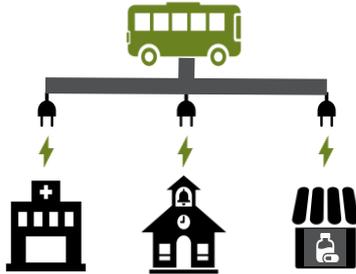
- **Size of modern hybrid-electric buses**
 - Positioning a bus close to the electrical connection at a facility may not always be possible
- **Future popularity of hybrid-electric buses**
 - BEPS technology is most effective with diesel and CNG fueled hybrid buses (high energy density and easy refueling)
 - BEPS could be packaged with hydrogen fuel cell hybrid-electrics
- **Balancing transit agency resources immediately following an emergency**
 - Evacuations vs. providing regular service vs. BEPS

Next Steps and Future Work



**Gather more data from stakeholders!
Conduct surveys and document findings.**

- Emergency Management Agencies
- Transit Agencies



Build and Demonstrate a BEPS system with a hybrid-electric bus.



Publish findings in a comprehensive report.



Project Team – Points of Contact



Blake Whitson
Technical Project Manager
Center for Transportation and
the Environment
blake@cte.tv



HAGERTY

Ashley Wargo
Managing Associate
Hagerty Consulting
ashley.wargo@hagertyconsulting.com



CENTER FOR ELECTROMECHANICS

Michael Lewis
Sr. Research Engineer
University of Texas at Austin –
Center for Electromechanics
mclewis@cem.utexas.edu

Discussion

Supplemental Slides

