Driving Fuel Cell Electric Bus Volume

North American Fuel Cell Bus Conference

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The New Flyer Group of Companies
North America’s Leading Bus & Coach Manufacturer

- **87 Years** of Experience
- **> 5,800** Employees
- **31 Locations** throughout North America
- Manufacture approximately **3,800** buses and coaches, annually*
  - Delivered **45%** of North American heavy-duty transit buses in 2016
  - Delivered **39%** of North American motor coaches in 2016
- Support **41%** of heavy duty transit buses in service
  - Supply **33%** heavy duty transit bus parts
  - Supply **40%** motor coach parts

* Equivalent Units
New Flyer of America

• **Delivering Advanced Innovation on a Proven Platform**
  • 32,000 heavy duty transit buses delivered, of which 6,400 buses have electric propulsion. Our approach is progressive yet prudent; providing an innovative and reliable product.

• **4 World Class, Award-Winning Bus Manufacturing Facilities**
  • Incorporating LEAN principles, Quality Roadmap, and Safety Culture.

• **Robust, Certified Management Processes**
  • ISO9001: Quality Management Systems
  • ISO14001: Environmental Management
  • ISO18001: Occupational Health and Safety
  • First and only bus manufacturer to achieve all 3 ISO certifications

• **Experienced and Dedicated Personnel**
  • Our team of 3,300 employees has a successful track record of delivering on our commitments to our customers.
Xcelsior Heavy Duty Transit Buses
Transforming Your Community with Sustainable, Clean Transit Technology

Proven Heavy Duty Transit Bus

- > 12,000 Xcelsior buses delivered and on-order
- Broadest Range of Propulsion Options
- Only Platform with all 3 Types of ZEB
- Built for Accessibility
- Designed for Maintainability
- Flexible Battery Pack Design – Evolves with Battery Technology

LOW EMISSIONS

Clean Diesel

Natural Gas

Hybrid-Electric

Electric-Trolley

Hydrogen Fuel-Cell
Advancing Innovation in Transit
New Flyer Fuel Cell Bus Evolution

Pre-1993:
Conventional Fossil Fuels (Diesel, Gas)
Early electric trolleys (1960s and 1970s)

1993: Electric Trolley
Delivered to San Francisco MUNI

1994: Compressed Natural Gas
Delivered to San Diego Transit Commission

2002: Diesel–Electric Hybrid
Delivered to Seattle

2010: Hydrogen Fuel Cell Buses
Delivered to BC Transit

2012: e-Accessories
Delivered to Minneapolis Metro

2014: Launch of the Xcelsior XE40 Electric Bus
Delivered to Chicago Transit Authority
Delivered to Winnipeg Transit

2015: Launch of the Xcelsior XHE60 Fuel Cell Bus (FTA, Calstart & Ballard) Altoona start Q2 2016, Service Evaluation @ AC Transit

2016: Launch of the Xcelsior XHE40 Fuel Cell Bus (CEC, Hydrogenics & Siemens): Altoona start Q4 2017, Service Evaluation @ Sunline Transit

2017: Xcelsior CHARGE Launch including Long Range Batteries, High Grade Package, Interoperable Depot and On-Route Charging
Advancing Innovation in Transit
New Flyer Active Fuel Cell Bus Commercialization Programs

1. **FTA National Fuel Cell Program**
   - Active Program for (1) XHE60 Battery-Electric Bus with a Ballard Fuel Cell, stainless steel structure, and center driven axle technology for traction challenged applications.

2. **California Energy Commission (CEC)**
   - Design and Manufacture (1) XHE40 battery electric bus with a Hydrogenics fuel cell (SunLine Transit Agency)

3. **California Climate Investment (Air Resources Board AQIP Program)**
   - 10 XHE40 Fuel Cell Buses for AC Transit
   - 10 XHE40 Fuel Cell Buses for OCTA
   - 5 XHE40 Fuel Cell Buses for SunLine

4. **FTA Low-No Program**
   - Champaign-Urbana Mass Transit District
Advancing Innovation in Transit
Driving Volume & Technology Adoption

1. Build Agency Awareness through Product Marketing
Advancing Innovation in Transit
Build Industry Awareness through Product Marketing

- Product Brochures
- Technical Specifications
- Customer Presentations
- Speaking Engagements and Round Tables
Advancing Innovation in Transit
Driving Volume & Technology Adoption

1. Build Agency Awareness through Product Marketing

2. Provide Technical Learning Opportunities
Our Vision: To be America’s leader in the exploration and advancement of bus and coach technology connecting people to places.

Our Mission:

• Explore and advance bus and coach technology through sustainable research and development, fresh innovation, progressive manufacturing, and bold thinking;

• Foster dialogue through discussion, education, and training on the latest zero-emission and autonomous driving vehicle technologies;

• Engage learning through current and interactive exhibits, simulation and hands-on experiences, and observations;

• Generate energy and commitment to clean air quality, safety, and economic benefits for people, communities, and business; and

• Harness the positive influence of collaboration, environmental stewardship, and social change to advance mobility solutions.

Features of the Center:

• Interactive Technology Exhibit Space
• Demonstrator Buses with Custom Transport Rig
• New Flyer Institute Manufacturing Lab
• Classroom Training
• Charging and Hands On Training Bay
• Engineering Testing Area
• Battery Assembly Area
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Driving Volume & Technology Adoption

1. Build Agency Awareness through Product Marketing

2. Provide Technical Learning Opportunities

3. Develop Bold Long Term Cost Objectives
Advancing Innovation in Transit
Develop Bold Long Term Cost Objectives

Fuel Cell Bus Costs are Declining with Technology Advancements and Manufacturing Volume
Advancing Innovation in Transit
Driving Volume & Technology Adoption

1. Build Agency Awareness through Product Marketing

2. Provide Technical Learning Opportunities

3. Develop Bold Long Term Cost Objectives

4. Design Architecture / Commonality with Battery-Electric Buses
Xcelsior XHE Fuel Cell Electric Bus
Design Architecture / Commonality with Battery-Electric Buses

- Available in 35, 40, and 60-foot bus rapid transit articulated models.
- Builds on the proven Xcelsior transit bus platform
- Proven, Reputable Suppliers of Electric & Fuel Cell Components
- Industry leading gradeability
- Highest gross weight distribution, ensuring best passenger capacity.

BALLARD®
PUTTING FUEL CELLS TO WORK

HYDROGENICS®
SHIFT POWER | ENERGIZE YOUR WORLD

SIEMENS

NEW FLYER OF AMERICA®
Xcelsior XHE Fuel Cell Electric Bus
Design Architecture / Commonality with Battery-Electric Buses

- Common Electric Accessories
- Electric Heating, Ventilation and Air Conditioning (HVAC) System (Common)
- Hydrogen Storage Similar to CNG
- Power Electronics / Inverters (Common) Propulsion and Accessory
- Common Battery Technology
- Rear Driven Direct Drive (Common) (1) Electric Motor with Regen
- Center Driven Axle (Common) (2) Electric Wheel-End Motors with Regen

High Gradeability Traction Motor Options (Common)
Advancing Innovation in Transit
Driving Volume & Technology Adoption

1. Build Agency Awareness through Product Marketing

2. Provide Technical Learning Opportunities

3. Develop Bold Long Term Cost Objectives

4. Design Architecture / Commonality with Battery-Electric Buses

5. Complete Product Validation

8,300 Track Miles Completed to Date
Advancing Innovation in Transit
Driving Volume & Technology Adoption

1. Build Agency Awareness through Product Marketing
2. Provide Technical Learning Opportunities
3. Develop Bold Long Term Cost Objectives
4. Design Architecture / Commonality with Battery-Electric Buses
5. Complete Product Validation
Advancing Innovation in Transit
Develop Life Cycle Cost Models & Comparisons

- Cost of Hydrogen
- Infrastructure Investment
- Preventative Maintenance
- Energy Consumption
- Mid Life Update
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Driving Volume & Technology Adoption

1. Build Agency Awareness through Product Marketing
2. Provide Technical Learning Opportunities
3. Develop Bold Long Term Cost Objectives
4. Design Architecture / Commonality with Battery-Electric Buses
5. Complete Product Validation
7. Support Partnership Opportunities
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Support Partnership Opportunities
Advancing Innovation in Transit  
Driving Volume & Technology Adoption

Top Challenges with Fuel Cell Electric Bus Adoption:
• Hydrogen Supply and Infrastructure is Lagging
• Acquisition Cost Reduction is Dependent on Volume
• Battery-Electric Bus Extended Range Buses Have “Closed the Gap” on Fuel Cells
• Life Cycle Costs for Fuel Cell Electric Buses are Unknown at this Time

**Ultimately, Marketplace Economics will Determine the Success of this Zero-Emissions Solution**
It’s bright ahead.
Innovation to RELY ON.

• **Technology that Works.** Transforming Your Community with Sustainable Clean Technology

• **Investment in Our Communities:** Leading Transit with Investment in American Jobs

• **Progressive, but Prudent Innovation.** Supporting Smart Cities with Technology, Training and Collaborative R&D

• **For More Information:**

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