FTA RESEARCH

FEDERAL TRANSIT ADMINISTRATION

Wireless Power Transfer (WPT) for Electric Transit Applications

October 22, 2014

2014 AERIS Workshop:
Moving Toward Deployment
Washington, DC

U.S. Department of Transportation
Federal Transit Administration

Overview

- Wireless Power Transfer
- Transit Market
- TIGGER Program
- NREL
- TIGGER Projects & WPT
- Volpe Report on WPT
- International Experience
- Future Benefits

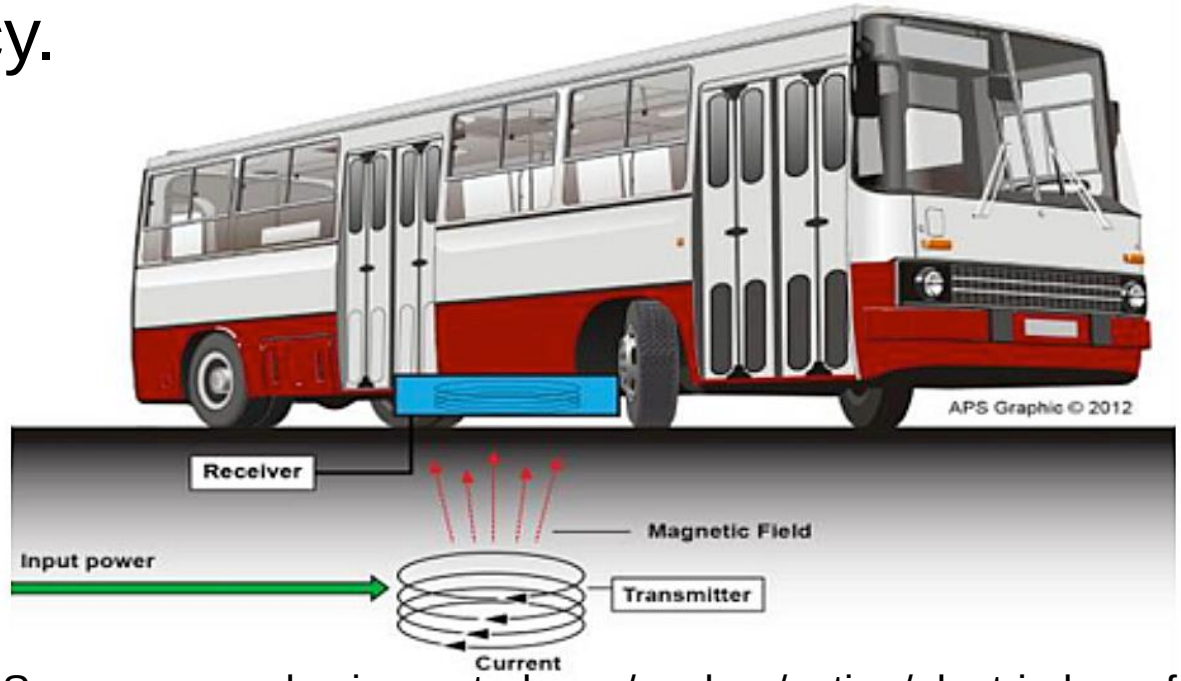
Today's Transit Market

- More than 35% of U.S. public transit buses in 2011 featured advanced power-train technologies and/or used cleaner alternative fuels:
  - All-Electric,
  - Hybrid,
  - Fuel Cell, and
  - Alternative Fuels

SOURCE: "Transit on cutting edge of clean technologies," APTA Policy Development and Research, Sept. 2012, at: http://www.apta.com/resources/statistics/Documents/Transit-Clean-Technology.pdf

Wireless Power Transfer

The transmission of electrical energy from a power source without conductors, or near field transmission of electrical energy between two coils that are tuned to resonate (magnetic resonance) at the same frequency.



Source: www.physicscentral.com/explore/action/electric-bus.cfm.

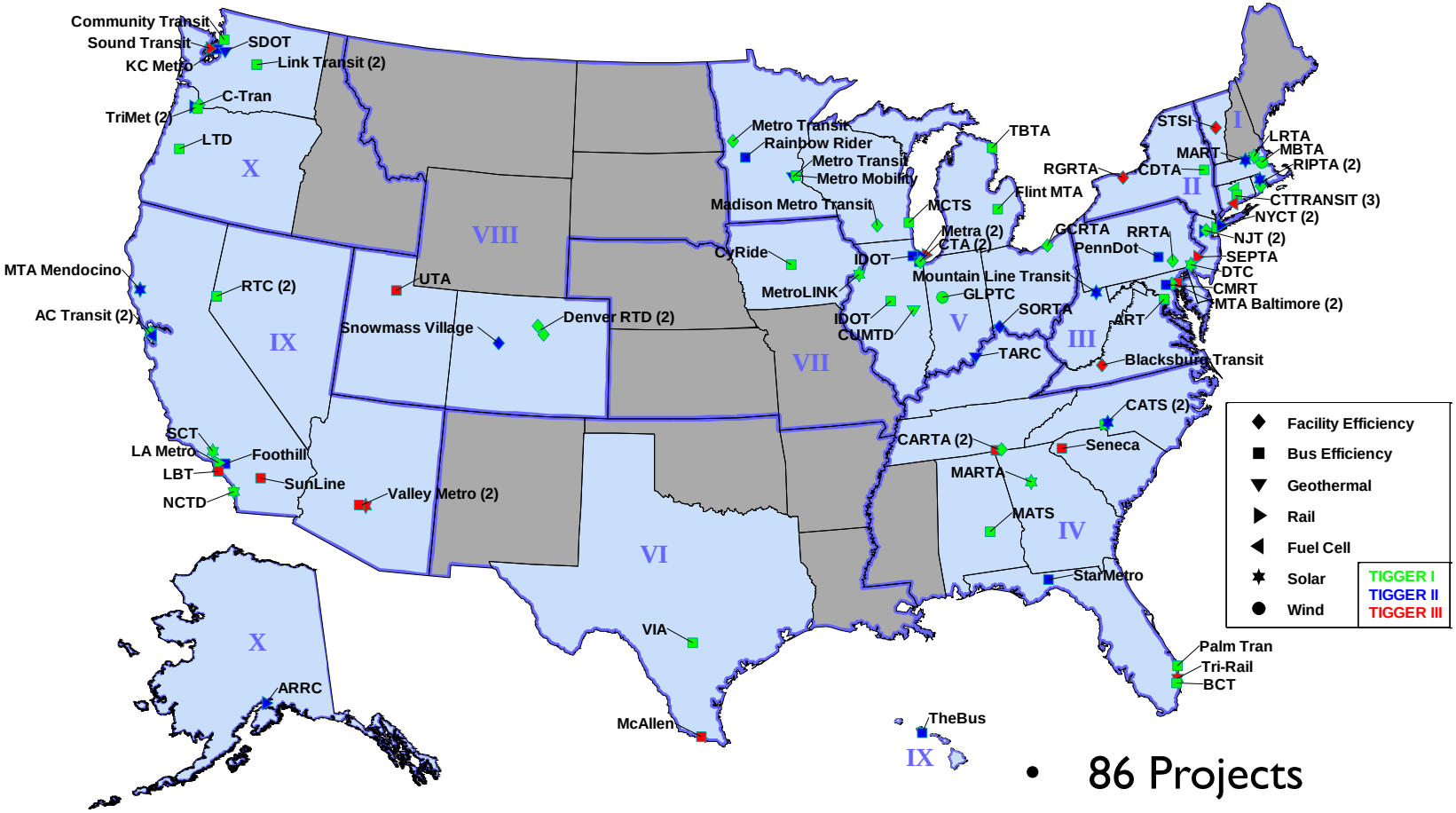
TIGGER Transit Investments for Greenhouse Gas & Energy Reduction

- Capital program to advance **innovative technologies** which **reduce GHG and Energy use within transit industry**
- Part of larger effort to **improve transit efficiency,** provide **environmentally-sustainable transportation** solutions and **demonstrate economic feasibility**
- **Program funded at $224.9 Million Federal** (FY 2009-11)
- Through **TIGGER evaluation program** FTA is investigating with assistance from the **National Renewable Energy Lab (NREL)** a variety of technologies to determine which have the most potential.
- **NREL is collecting data and information** on each project, and **analyzing results to determine overall impacts** and assess how each has contributed toward program goals.

Advancing Fleets & Technology

- Demonstration of All-Electric Bus
- Pursuing Onboard & Wayside Energy Storage Systems
- Advancing Inductive Charging Technologies
- Implementing Efficient Operating & Maintenance Strategies
- First Capital Purchase of Fuel Cell Bus

TIGGER Project Locations



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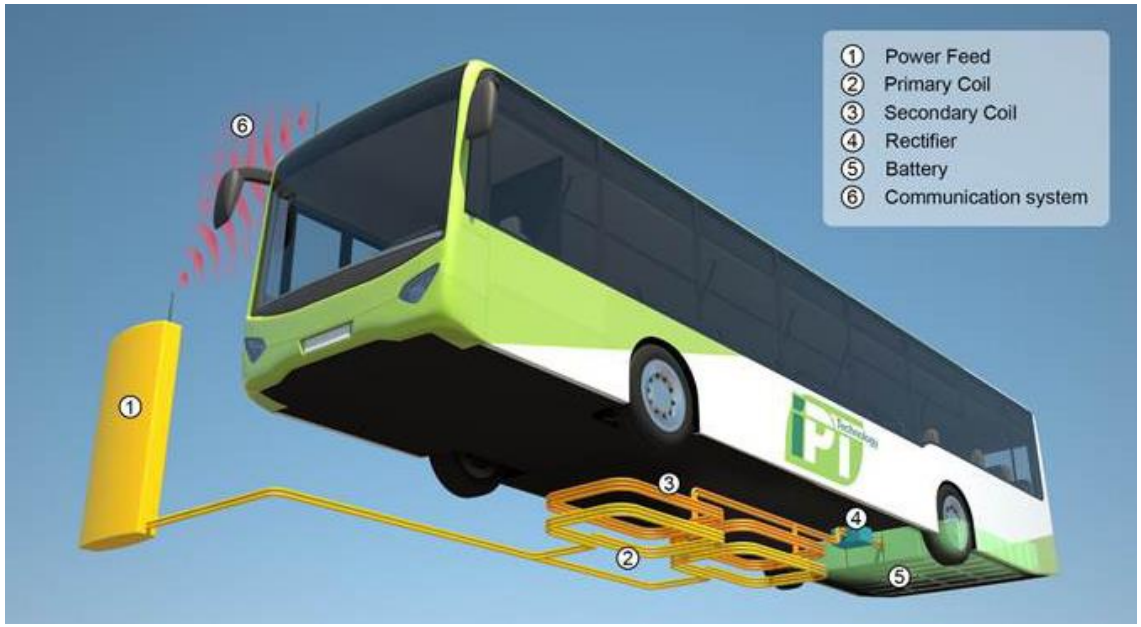
- 86 Projects
- 35 States
- 69 Transit Agencies

TIGGER WPT Projects

- Salt Lake City, Utah
- Howard County, Maryland
- McAllen, Texas
- Chattanooga, Tennessee



SOURCE: Conductix-Wampfler (now IPT Technology)
IPT@Charge System

Salt Lake City, Utah

- University of Utah Campus Shuttle Electrification
- Utah Transit Authority
- Award Amount: $2,692,000
- Award Year: 2011
- PPP between UTA, Wireless Advanced Vehicle Electrification (WAVE), the University of Utah, and Utah State's Energy Dynamics Laboratory
- Bus refurbishment by Complete Coach Works

University of Utah & WAVE

McAllen, Texas

- Project Name: On-Line Electric Vehicle Project
- Transit Agency: City of McAllen
- Award Amount: $1,906,908
- Award Year: 2011
- Three of McAllen's older diesel buses will be retrofitted as electric buses capable of charging through wireless power transfer on current bus route.

Columbia, Maryland

- Howard County Electric Bus Project
- Transit Agency: Maryland Department of Transportation
- Award Amount: $3,777,826
- Award Year: 2010
- Replacement of 3 currently operating, worn diesel-on-chassis buses to be replaced with 3 battery-electric buses and a supportive inductive charging system

Chattanooga, Tennessee

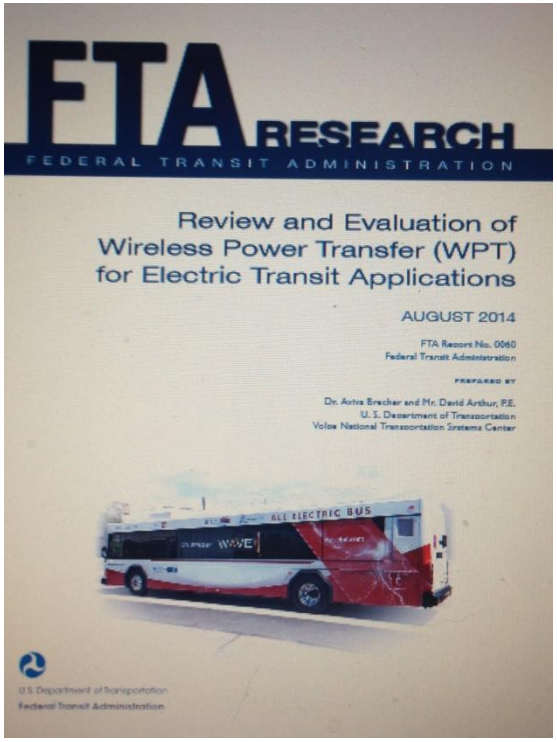
- Wayside Inductive Power Transfer System for Electric Buses
- Transit Agency: Chattanooga Area Regional Transportation Authority
- Award Amount: $2,502,400
- Award Year: 2011
- Replacement of 3 old diesel buses with 3 battery-electric buses outfitted with a wayside inductive power transfer system.

TIGGER Evaluation

- NREL Evaluation will include:
  - environmental impacts,
  - reduction of fossil fuel use,
  - emission savings,
  - economic impacts,
  - viability of technologies adopted, and
  - benefits versus costs.

- First Assessment Report published in July 2012.
- Second Assessment Report to publish in Fall 2014.
- Final Assessment Report to be published in Late 2015.

Review and Evaluation of Wireless Power Transfer (WPT) for Electric Transit Applications



- Report published Aug 2014
- Volpe, The National Transportation Systems Center
- Aviva Brecher, Ph.D., Principal Investigator

FTA WPT Report Overview

- Technology Brief
- Review of Organizations and Demonstrations
- Safety, Health, and Environmental (SHE) issues
- Electromagnetic Spectrum and IPT Frequency Bands related to IPT
- International Technical Standards
- U.S. Technical and Safety Standards for WPT
- Research Issues and Needs

Technologies

- IPT Technology, and Charge e-Mobility formerly Wampfler and then continued as Conductix *(German)*
  - *provides wireless opportunity charging of hybrid and electric buses equipped with secondary receiver coils*
  - *Demonstrations in Genoa and Turin since 2002*
- Shaped Magnetic Field in Resonance (SMFIR) Technology for Online Electric Vehicle (OLEV) *(Korean)*
  - *Developed by The Korean Advanced Institute of Science and Technology (KAIST) research university in Daejon*
  - *More than 180 patents on SMFIR and related technologies*
  - *Campus test site and Gumi, South Korea operations*

Technologies, *continued*

- Wireless Advanced Vehicle Electrification (WAVE) *(United States)*
  - Utah State University (USU) spun off the WAVE startup
  - Initial WAVE technology bus demonstration prototype was a campus shuttle
  - Documenting 90 percent power transfer efficiency
- Bombardier PRIMOVE IPT for Electric Buses *(German)*
  - Proprietary high power (200 kW) rapid IPT opportunity charging system for buses
  - Demonstrations underway in Mannheim and Berlin, Germany, and in Bruges, Belgium

Future Benefits

- WPT technologies promise to improve electric bus and light rail mobility, logistics, and user convenience
- Shorter station dwell times for recharging on vehicle batteries, or wayside energy storage systems promise operational efficiency
- WPT technologies in transit can assist with interoperability, ease-of-use, and environmental sustainability, as well as lower lifecycle cost and higher energy efficiency
- WPT could reduce vehicle cost by allowing for smaller, lighter, and lower capacity batteries

Contact & Questions

Matthew Lesh

Transportation Program Specialist

U.S. Department of Transportation

Office of Mobility Innovation

Research, Demonstration & Innovation

Federal Transit Administration

1200 New Jersey Ave., SE

Washington, DC 20590

matthew.lesh@dot.gov


Clean Air Hybrid
151
ROCKSTAR GAMES
L.A. NOI
MAY 17
Federal Transit Administration
www.fta.dot.gov