



San Bernardino County  
Transportation Authority

# ZERO-EMISSION RAIL TECHNOLOGY

## Overview

The San Bernardino County Transportation Authority (SBCTA) is leading the charge for a greener passenger rail future by piloting zero-emission rail technology for the new Arrow service between San Bernardino and Redlands.

In 2024, SBCTA will debut the first in North America, battery and hydrogen-powered passenger train. The Zero-Emission Multiple Unit (ZEMU) rail vehicle will use a hybrid hydrogen fuel cell/battery technology to propel the vehicle, providing a cleaner transit option for the community.



## Project Benefits

While California's air quality is affected by many factors and sources, cars, trucks, buses, and freight trains are a significant contributor to air pollutants and can drive climate change. SBCTA and the State of California's investment of \$30 million to provide a zero-emission passenger train will reduce greenhouse gas emissions and offer an eco-friendly regional transit system for generations to come.

Fuel cell technology uses hydrogen and oxygen in a chemical reaction to make energy. The zero-emission passenger train will generate electrical power by combining hydrogen and oxygen in an on-board fuel cell, between two train cars. Eliminating the need for an internal combustion engine, the hydrogen-fueled passenger train can operate without the most significant source of noise, thus making it quieter and more efficient than a standard diesel locomotive.

The Arrow's zero-emission passenger train will:

- Use hydrogen as a primary fuel source
- Provide a seating capacity for 108 passengers and offer a generous amount of space for standing passengers
- Reduce greenhouse gas emissions on transit systems
- Improve air quality within the region
- Provide clean air by eliminating rail emissions and air pollutants

## Funding

STATE	\$30 Million
TOTAL	\$30 Million

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June 2021

# Plan. Build. Move.

## Schedule

### APRIL 2018

SBCTA awarded a \$30 million grant from the State of California from the California Transit and Intercity Rail Capital Program (TIRCP) to develop a zero-emission multiple unit (ZEMU).

### NOVEMBER 2019

SBCTA signs contract with Stadler US to begin manufacturing hydrogen-powered ZEMU train

### 2022

Begin operating Arrow service with DMUs

### LATE 2023

Begin testing zero-emission train along rail line

### LATE 2024

Integrate zero-emission train with Arrow's rail fleet and begin operating zero-emission passenger train

## Frequently Asked Questions

### HOW DOES A ZERO-EMISSION MULTIPLE UNIT (ZEMU) RAIL VEHICLE WORK?

ZEMU rail vehicles use a combination of both hydrogen fuel cells and batteries to propel the vehicle. ZEMU vehicles generate electrical power by combining hydrogen and oxygen in an on-board fuel cell, between two train cars in the power cab. The used hydrogen reunites with oxygen from the air to form purified water and heat. When the hydrogen-hybrid ZEMU operates, it emits only water, meaning cleaner air, less global warming and healthier, and quieter neighborhoods.

### ARE THERE ANY SAFETY RISKS ASSOCIATED WITH TRAVELING ON A HYDROGEN-POWERED TRAIN?

When used in accordance with proper guidelines, hydrogen fuel is safe for public transportation. Today, hydrogen-powered buses and private automobiles are currently being used in parts of California and nationally. SBCTA's zero-emission train will be the first for passenger rail use in the United States. SBCTA and Metrolink, will follow strict fueling protocols and guidelines to protect its rail operators and ensure hydrogen fuel safety for its future passengers and surrounding community.

### WHERE WILL THE ZERO-EMISSION TRAIN REFUEL ITS HYDROGEN?

A hydrogen storage and fueling facility is being proposed at the southern end of the existing Arrow Maintenance Facility located in San Bernardino. The proposed facility will be constructed in compliance with state and local requirements. Construction of the facility is anticipated to begin in late 2022.

### WHAT ARE THE BENEFITS OF A HYDROGEN-POWERED PASSENGER TRAIN?

Hydrogen-powered passenger trains operate emission-free – meaning cleaner air, less global warming, a healthier environment for the region and quieter neighborhoods. A zero-emission train will not only bring forward improved air quality, it will also put San Bernardino County on the map as an innovative testing hub for green technology.

### ARE THERE OTHER HYDROGEN-POWERED PASSENGER TRAINS IN THE US OR THE WORLD?

The Arrow's ZEMU will be the first of its kind in the United States to provide passengers a greener way to get to and from San Bernardino and Redlands. A similar hydrogen-hybrid passenger rail train recently completed 18 months of regular route testing on a 62-mile route in Germany.

## We Plan.

SBCTA envisioned a new passenger rail service that could re-connect San Bernardino and Redlands but also have the ability to connect commuters to Los Angeles in a cleaner, pollutant-free way. In 2016, the nine-mile service was officially dubbed Arrow and three diesel multiple unit (DMU) vehicles were ordered from the rail manufacturer. In 2018, a California State Transportation Agency grant allowed SBCTA to begin research and development of a low or zero-emission rail passenger vehicle to be operated along the Arrow corridor.

## We Build.

A contract signing in 2019 between Stadler US and SBCTA cleared the path to begin the manufacturing of the first two-car hydrogen-powered passenger train to operate in the United States. Providing a hydrogen-powered rail vehicle to passengers is a critical milestone demonstrating SBCTA's investment in the county's sustainable future, zero-emission transportation options and the transition away from using fossil fuels to protect the health of its 2.1 million residents and visitors.

## You Move.

The Arrow service is scheduled to begin operations in 2022 and will use eco-friendly DMUs to operate along the line. After the ZEMU vehicle testing is completed, it will be operational for passenger use in 2024. ZEMU will offer passengers the most environmentally rail friendly vehicle in the United States and deliver a balanced and sustainable transportation system for San Bernardino County's future.

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