

ABSTRACT

- Samaritan Health Services (SHS), like many modern companies, saw the economic and environmental benefits of electric vehicles (EVs) and wanted to make the switch.
- The capstone focused on finding the best vehicle purchase plan over the next 15 years to convert the fleet to fully electric.
- The provided purchase plans, outlined in the center column, incorporate the fluctuating lead times from EV manufacturers and variability in EVs coming to market to provide a plan that works.
- Additional to the purchase plans, the capstone team provided a vehicle purchase plan tool, outlined on the right, for SHS to utilize if route and vehicle needs change.

COST SAVINGS

- Due to the lower maintenance and fueling costs from EVs, annual costs are lower for the EV purchase plans compared to the ICE plan.
- With the Baseline EV Purchase Plan, there is a potential for :

\$36,000 lower annual costs over 15 years!

ENVIRONMENTAL BENEFITS

- By converting to electric vehicles over 15 years, SHS can achieve significant carbon savings to help the environment.
- With both the Baseline and Conservative Electric Vehicle Purchase Plans, there is the potential for

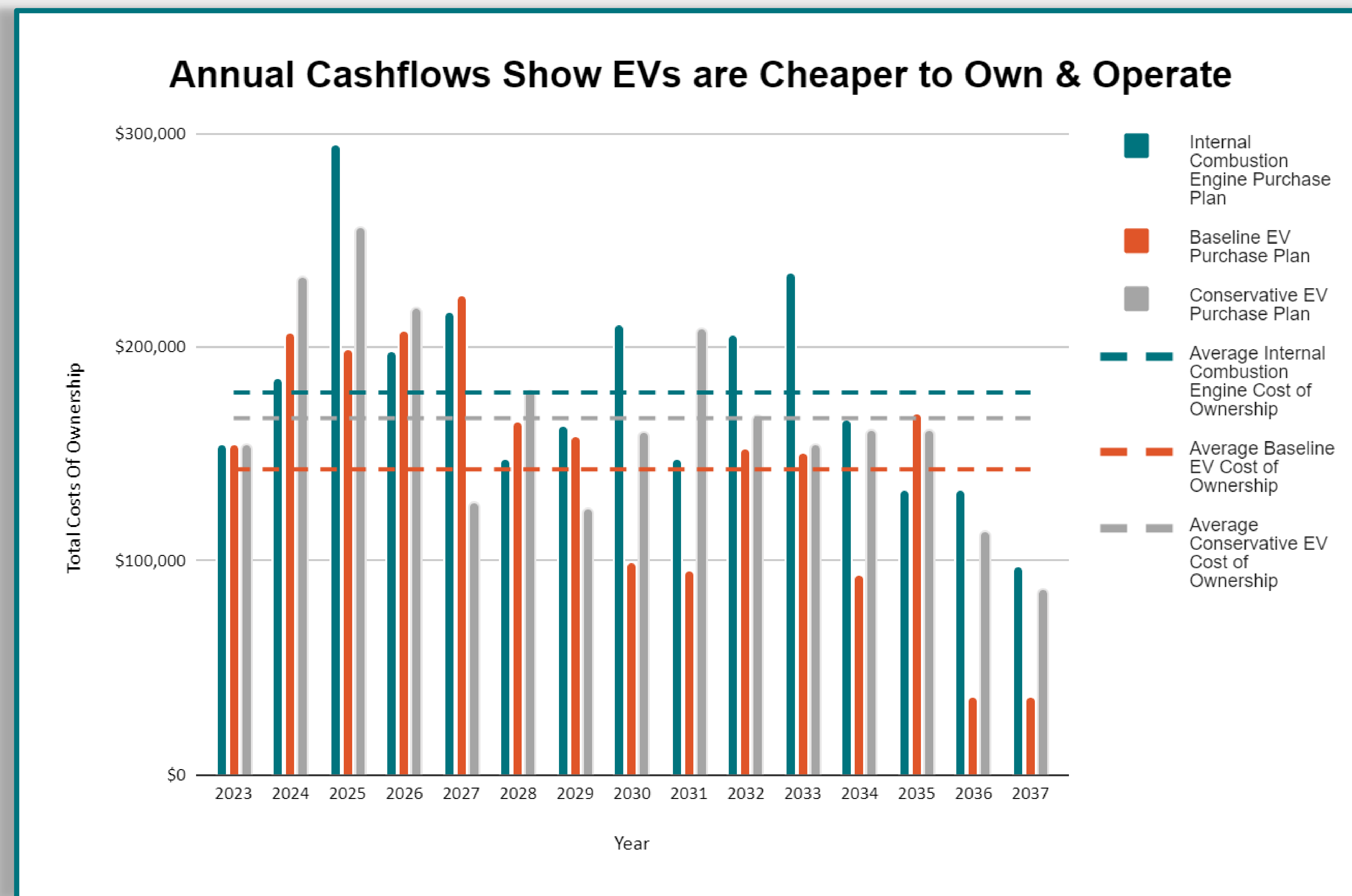
30% carbon emission savings over 15 years!



POWERING HEALTHCARE BY SWITCHING GEARS: ELECTRIFYING SAMARITAN HEALTH SERVICES COURIER FLEET WITH OPERATIONS RESEARCH

Assisting Samaritan Health Services (SHS) with the tools to plan future courier vehicle purchases, leveraging the benefits of electric vehicles (EVs).

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PURCHASE PLAN

- We provide the most optimized route assignment and purchase plan to our project sponsor.
- Three purchase plans were created to incorporate the uncertainty of EVs coming to the market.
 - #1 **Baseline EV Purchase Plan** - best estimate for future EV releases.
 - #2 **Conservative EV Purchase Plan** - removes less well-known EV vehicles from the plan.
 - #3 **Internal Combustion Engine Purchase Plan** - no EVs for the purpose of cost comparison.

COST MINIMIZATION TOOL

- Linear Programming is a decision making tool for complex situations.
- This strategy takes in many different aspects and constraints of the decision to optimize the final solution.
- We used Mixed Integer Linear Programming to minimize the lifetime costs of electrifying the fleet subject to the route requirements and vehicle constraints.

Goal: Minimize cost of electrifying the fleet.

Output: What vehicles to buy and when.

Inputs:
 Vehicle specifications
 Route requirements

Decision Variables:
 If vehicle is bought
 If vehicle is on route
 If vehicle switched routes

Helper Variables:
 Current mileage of vehicle

Objective Function:
 Minimize lifetime courier fleet costs.

Constraints:
 Only if in production
 Avoid duplicate indices
 Stay below max mileage
 1 Vehicle per Route
 Only assign owned vehicles
 Meet Range Requirements

Meet Capacity Requirements

Vehicles = # of Routes
 Don't want vehicle switching routes

PYTHON PROGRAMMING

- We programmed an executable file that runs our Mixed Integer Linear Program so Samaritan Health Services can rerun the electric fleet purchasing plan as new electric vehicles are released.



Samaritan Health Services