Total Cost of Vehicle Ownership – Development of Analysis Tool and Visualization

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SAND2020-8022PE

Total Cost of Vehicle Ownership Analysis Tool

Simplified View

Vehicle Body: Compact Sedan

Powertrain: ICE-SI

Model Year: 2020

Regionality: Alabama

Show Powertrain Comparison

 | Link to documentation for calculations | Link to analysis results

Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

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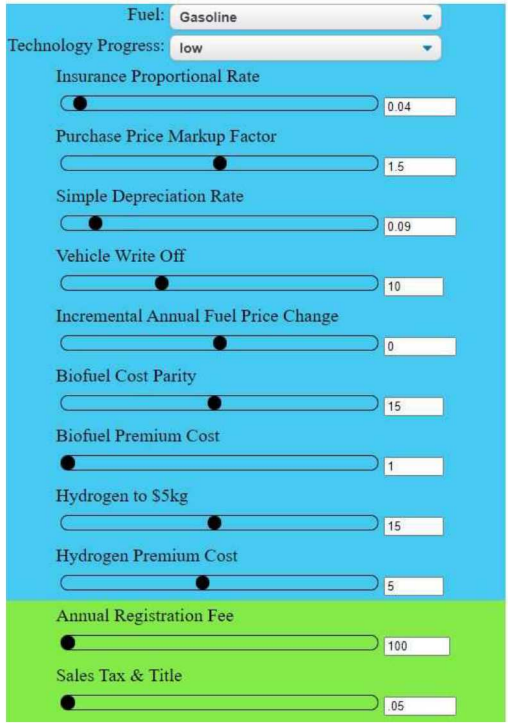
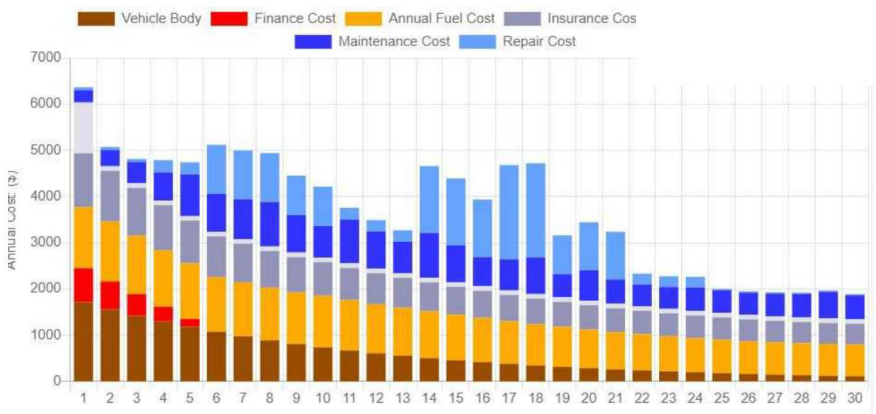
Outline

- Goals & Objectives
- Possible Audiences
- Technology Used In Development
- HTML – page content
- CSS – page styles
- JavaScript – page behaviors
- Research Techniques to create an effect
- Conclusion

Goals & Objectives of the Tool

- Create a platform for users to compare ownership cost data between vehicles with different cost components
- Show cost data visually to make comparing data easy to understand
- Create custom inputs to allow maximum cost component customization to increase the tools functionality across different vehicle types
- Provide transparency through documentation of the data and analysis methodology





The webtool is the culmination of a multi-lab TCO effort by:

Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

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Possible uses of the tool

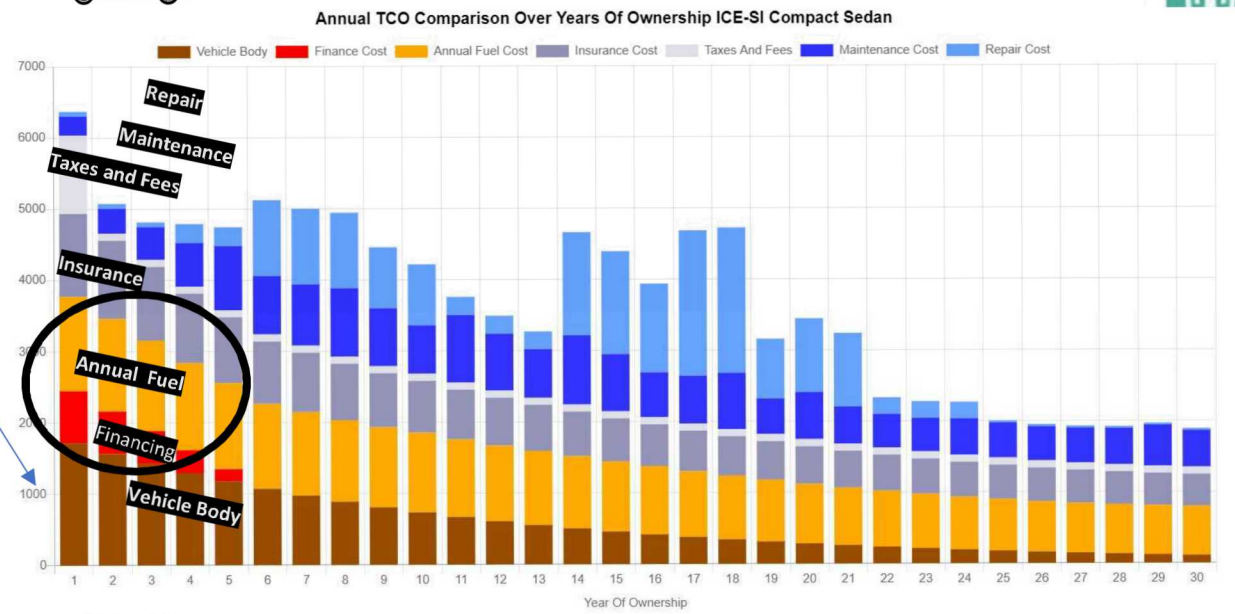
What is the most cost-efficient car I could purchase right now?

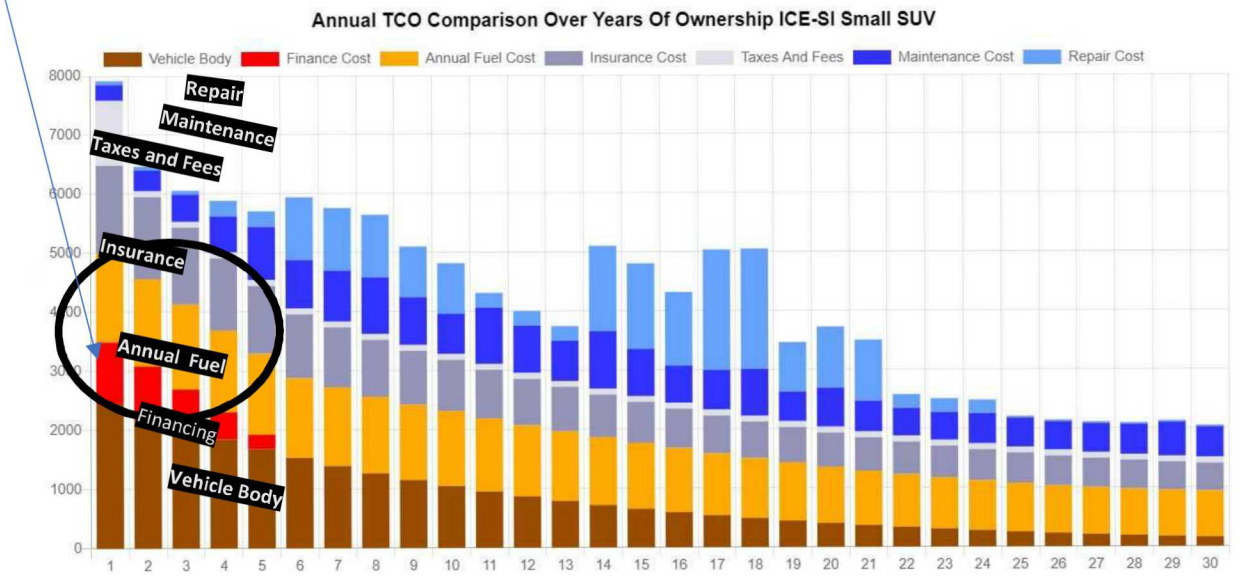
- First Time Buyers
- Transition Buyers
- Uber/Lyft Drivers
- Farmers/Laborers
- Researchers
- Policy-makers

How long is it cost efficient to drive the car I have now?

How much could I save in fuel by transitioning to an electric car?

How much more cost efficient are electric cars likely to become in the future? Is it cost efficient to transition to an electric car now or in the future?





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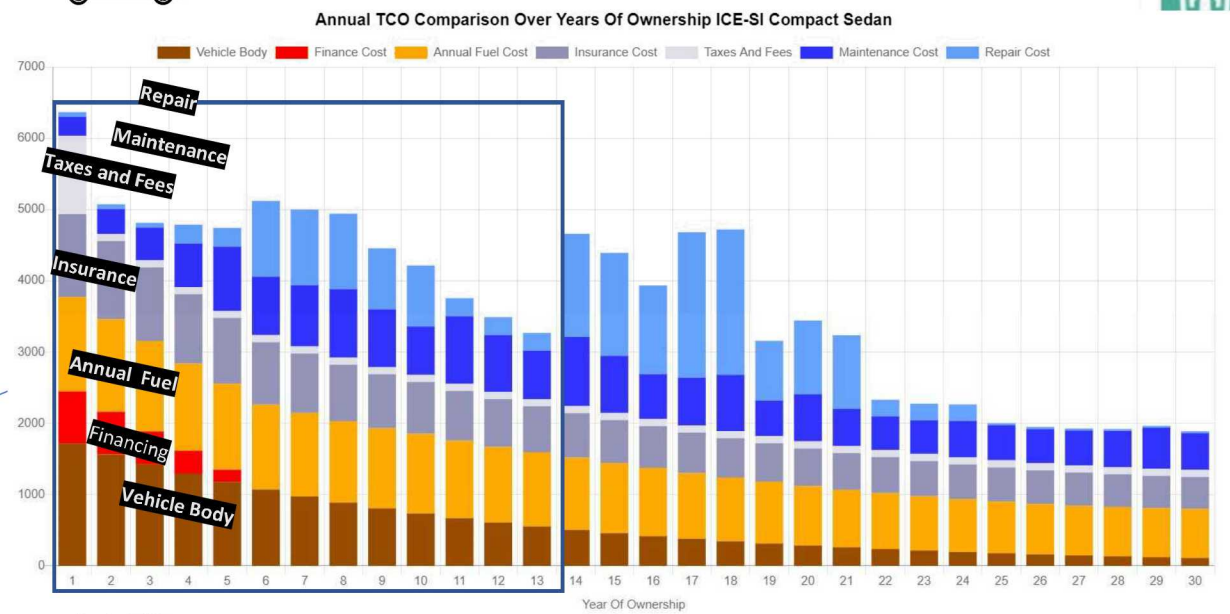

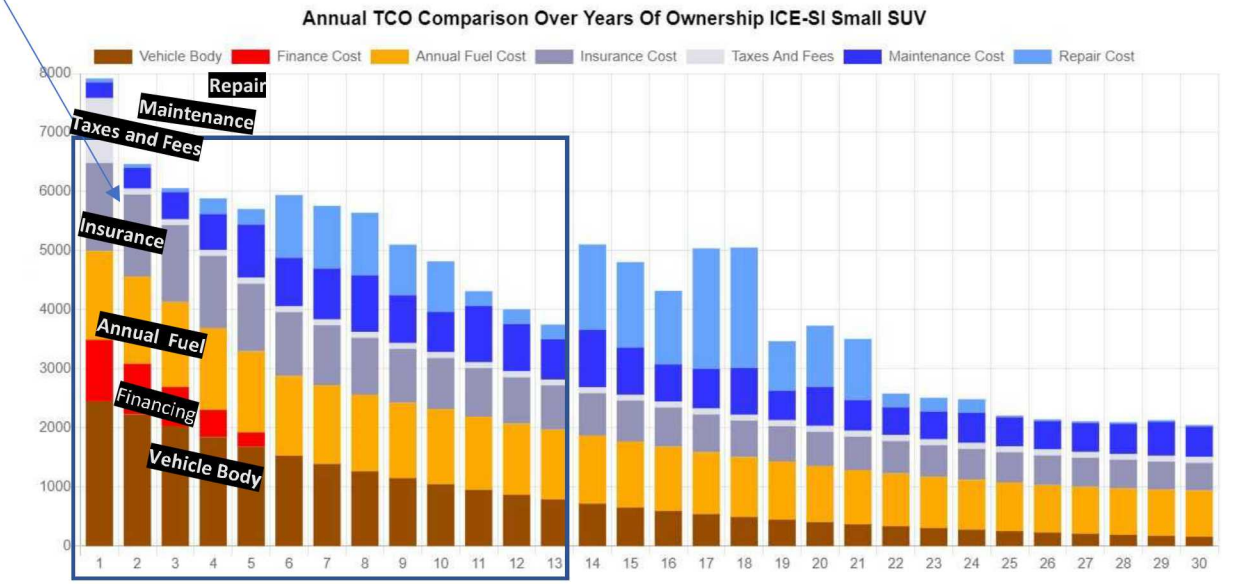

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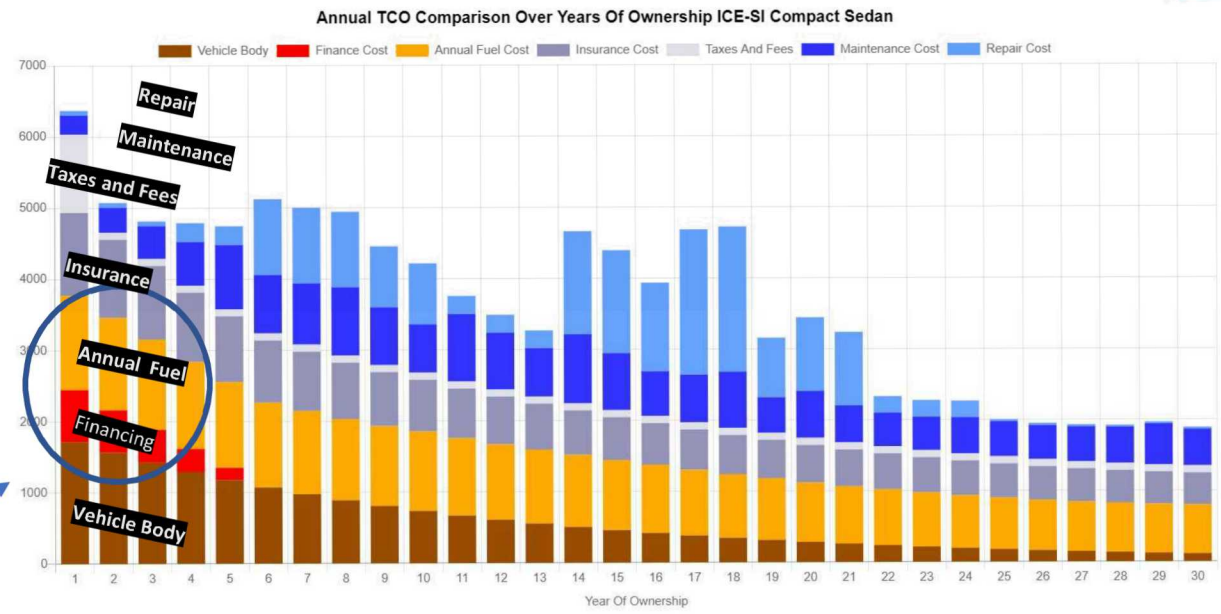

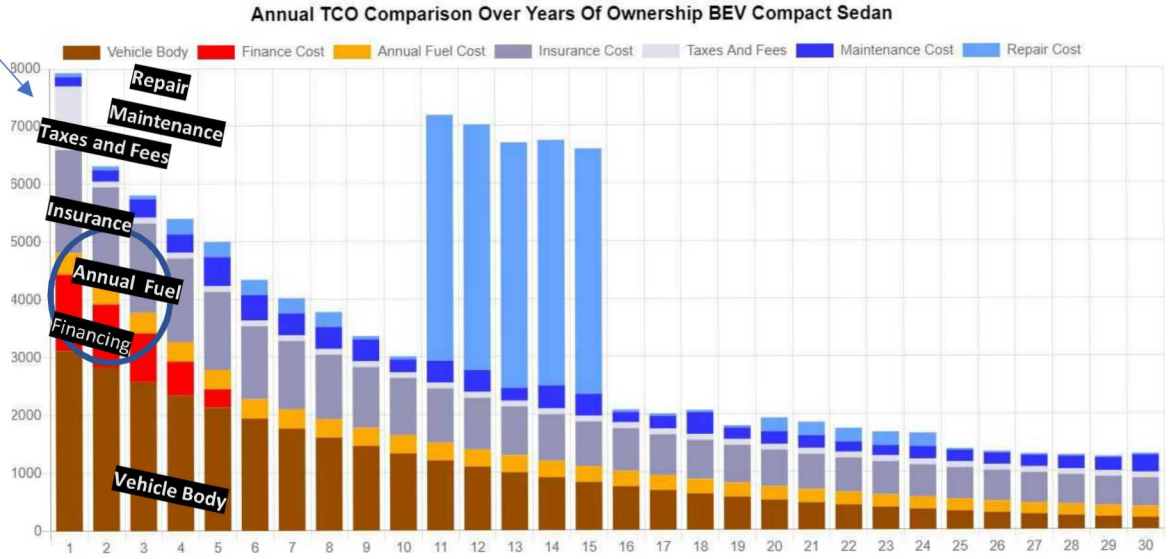

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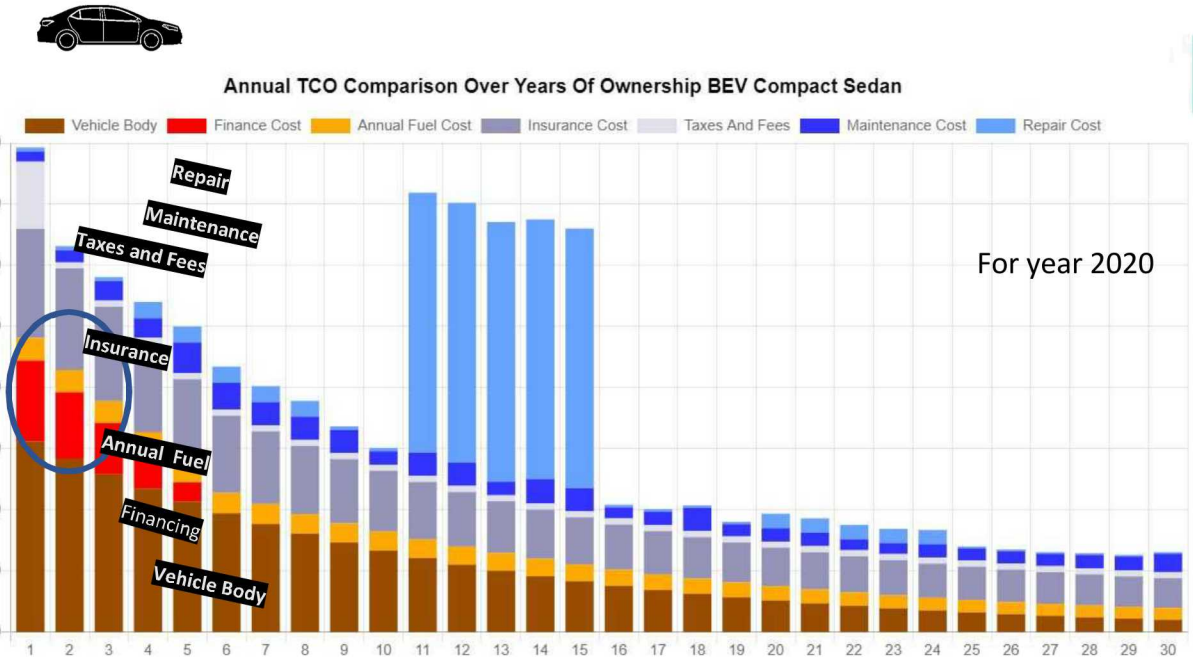
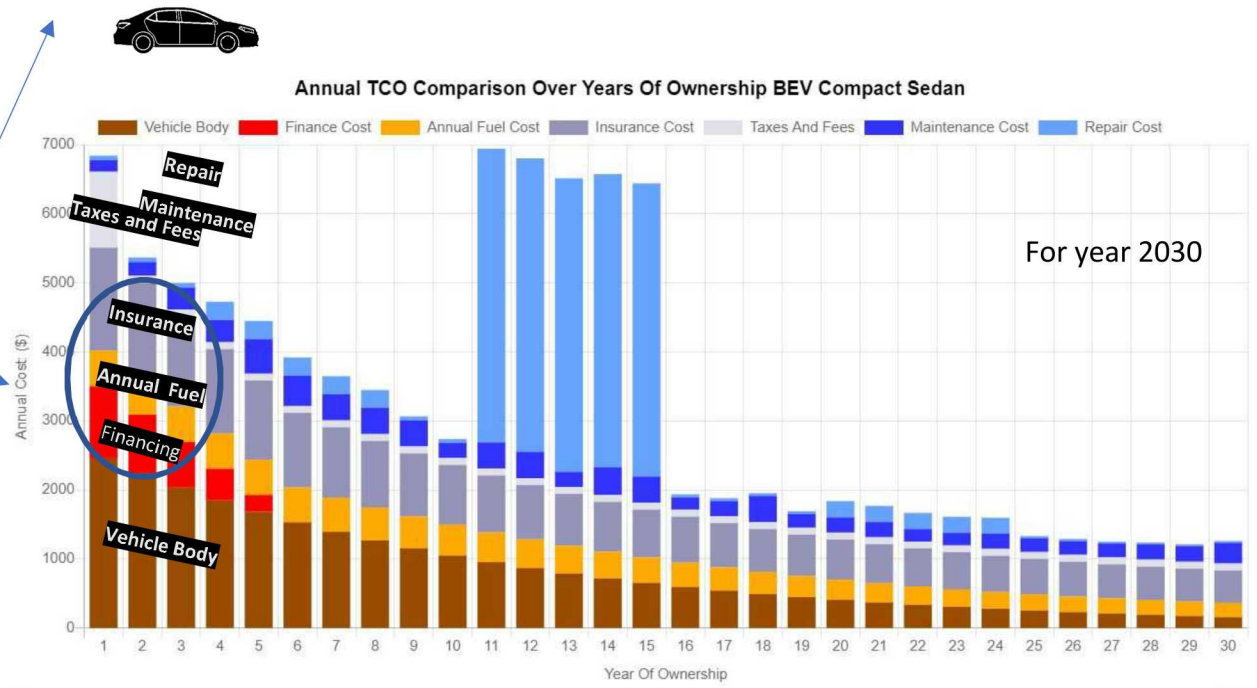




Technology used for development

- The webtool uses html to define the layout of the webpage CSS to alter the style of the webpage and JavaScript to give the page functionality without reloading the page
- The backend is built using php as the programming language and MySQL for the database
- Code is written using visual studio code and hosted on GitHub
- The web-tool uses usbwebserver as a temporary web server until it becomes hosted online

```
function submittedAjaxForm()
{
    let form = document.getElementById("vehicleInfoForm");
    let canvas = document.querySelector(".canvasContainer");

    let vehicleData = [];
    let financingData = [];
    let annualFuelData = [];
    let insuranceData = [];
    let taxData = [];
    let maintenanceData = [];
    let repairData = [];
    let vmtData = [];

    canvas.style.display = "none";

    form.onsubmit = function()
    {
        event.preventDefault();
        let dataForm = $(this).serialize();
        let bodyType = document.getElementById("vehicleBodyMenu");

        $.ajax({
            type: 'POST',
            url: "assets/PHP/processForm.php",
            data: dataForm
        }).done(function(data)
```

JavaScript Snippet

```
.inputContainer{
    margin-left: 50px;
    padding: 5px;
}

.slider::-webkit-slider-thumb{
    -webkit-appearance: none;
}

.slider:focus{
    outline: none;
}

.slider::-ms-track{
    width: 100%;
    cursor: pointer;

    background: transparent;
    border-color: transparent;
    color: transparent;
}
```

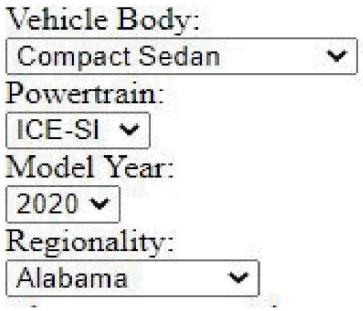
CSS snippet

```
    <img src="assets/page_pictures/banner_cropped.jpg" class="bannerPicture">
  <nav>
    <!--navigation bar to go between the pages of the site easily-->
    <div class="navBar">
      <input type="checkbox" id="toggleButton" class="toggleSwitch">
      <label for="toggleButton" class="toggleLabel"><span class="labelText">Simplified View</span
    </div>
  </nav>
</header>
<main>
  <form action="assets/PHP/processForm.php" method="POST" name="vehicleInfo" id="vehicleInfoForm">

    <div class="technologyGroup">

      <div class="dropDownMenu">
        <div class="label">
          <label for="vehicleBody">Vehicle Body:</label>
        </div>
        <div class="border">
          <select name="vehicleBody" class="selectMenu" id="vehicleBodyMenu">
            <option value="Compact Sedan">Compact Sedan</option>
            <option value="Midsize Sedan">Midsize Sedan</option>
            <option value="Small SUV">Small SUV</option>
            <option value="Medium SUV">Medium SUV</option>
            <option value="Pickup">Pickup</option>
            <option value="Luxury Compact">Luxury Compact</option>
            <option value="Luxury Midsize Car">Luxury Midsize Car</option>
            <option value="Luxury Small SUV">Luxury Small SUV</option>
            <option value="Luxury Medium SUV">Luxury Medium SUV</option>
            <option value="Luxury Pickup">Luxury Pickup</option>
            <option value="Tractor Sleeper">Tractor Sleeper</option>
            <option value="Tractor Day Cab">Tractor Day Cab</option>
            <option value="Class 8 Vocational">Class 8 Vocational</option>
            <option value="Class 6 Pickup Delivery">Class 6 Pickup Delivery</option>
            <option value="Class 3 Pickup Delivery">Class 3 Pickup Delivery</option>
            <option value="Class 8 Bus">Class 8 Bus</option>
            <option value="Class 8 Refuse">Class 8 Refuse</option>
```

Html Snippet

HTML – page content

Drop Down Menu from the tool



HTML code to create a dropdown menu

```
<select name="powertrain" class="selectMenu" id="powertrainMenu">
    <option value="ICE-SI">ICE-SI</option>
    <option value="ICE-CI">ICE-CI</option>
    <option value="HEV-SI">HEV-SI</option>
    <option value="PHEV">PHEV</option>
    <option value="FCEV">FCEV</option>
    <option value="BEV">BEV</option>
</select>
```

CSS – page style

Drop Down Menu from the tool

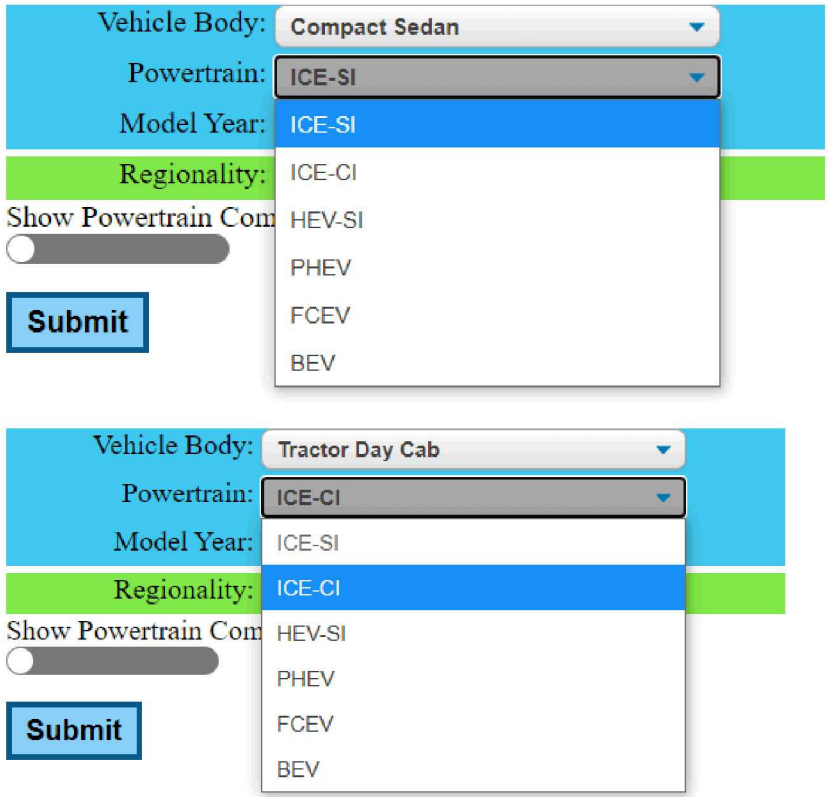
CSS code to add styling elements to the dropdown menu

```
.selectMenu{
    display: inline-block;
    font-size: 15px;
    font-family: sans-serif;
    font-weight: 700;
    color: #444;
    padding: 5px;
    width: auto;
    min-width: 300px;
    box-sizing: border-box;
    margin: 0;
    border: 1px solid #aaa;
    box-shadow: 0 1px 0 1px rgb
    border-radius: .5em;
    -moz-appearance: none;
    -webkit-appearance: none;
    appearance: none;
    background-color: #fff;
    background-repeat: no-repeat,
    background-position: right .7
    background-size: .65em auto,
    background-image: url('data:i
      linear-gradient(to bottom,
      cursor: pointer;
      padding: 5px 10px;
```

```
.technologyGroup{
    width: 550px;
    background-color: rgb(70, 202, 241);
}
```

JavaScript – page functionality

Drop Down Menu from the tool

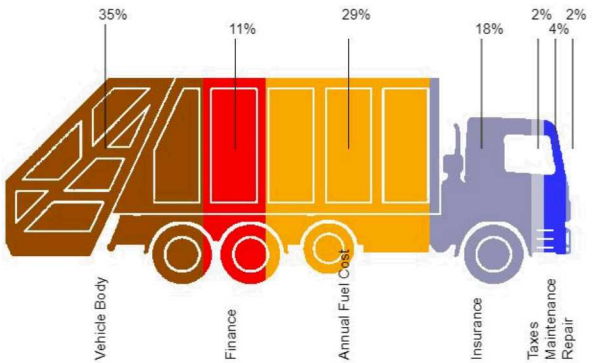


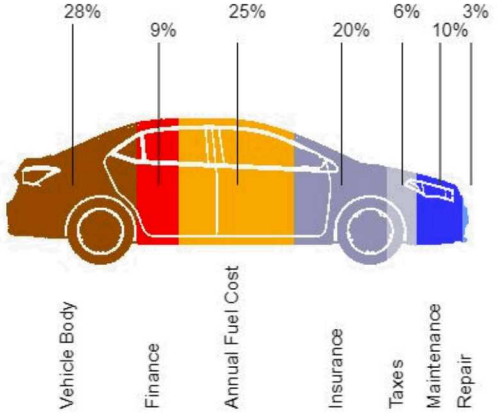
JavaScript code to disable ICE-SI option on certain vehicle body types

```
vehicleBodyMenu.addEventListener("change", function(){
    switch(vehicleBodyMenu.selectedIndex)
    {
        case 10:
            powertrainMenu.options[0].disabled = true;
            powertrainMenu.options[1].selected = true;
            break;
```

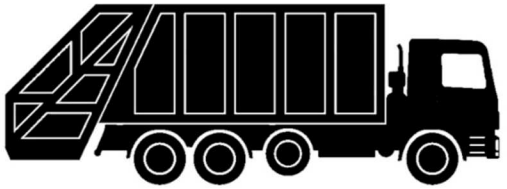
Using research techniques to achieve a desired outcome

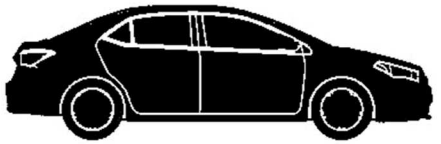
Colored Pictures





Original Pictures





```
// finds and returns the first and last column with a pixel part of the car image
function totalAreaCovered(canvas, ctx)
```

Step 1: finding the total area of the uncolored image

```
// create the start and end value for the changeColor function
function partitionImage(canvas, ctx, startRow, percentage, red, green, blue)
```

Step 2: dividing the total area into a part based on the percentage of that cost component

```
// change the color of the picture
function changeColor(canvas, ctx, startValue, endValue, red, green, blue)
```

Step 3: change the color of that part to match the color used to represent that cost component

```
function colorImage(canvas, ctx, startRow, img)
```

Step 4: color all the image parts into their desired color

```
ctx.font = "15px Arial";
ctx.fillText("Vehicle Body", 80, (startValue[0] + st) / 2);
ctx.fillText("Finance", 80, (st + st2) / 2);
ctx.fillText("Annual Fuel Cost", 80, (st2 + st3) / 2);
ctx.fillText("Insurance", 80, (st3 + st4) / 2);
ctx.fillText("Taxes", 80, (st4 + st5) / 2);
ctx.fillText("Maintenance", 80, (st5 + st6) / 2);
ctx.fillText("Repair", 80, (st6 + st7) / 2);
```

Step 5: add labels to each color to convey information to the user

Conclusion

- This webtool will provide a wealth of information for people interested in learning abut the total cost of owning a vehicle

- The webtool can be used to answer many questions people have about the different costs associated with owning different types of vehicles

- Working on this tool has increased my knowledge on web development and taught me much about costs involved with owning a vehicle