**Project Report: AI for SDG 9 – Smarter Auto Repair Infrastructure**

**1. Project Overview**  
This project presents an AI-powered solution aimed at optimizing auto repair infrastructure by predicting the availability of ASE (Automotive Service Excellence) certified mechanics across various U.S. locations. Built as part of the United Nations Sustainable Development Goal 9 (SDG 9) initiative—"Industry, Innovation, and Infrastructure"—the project addresses the need for equitable and efficient distribution of skilled labor in the auto repair sector.

**2. The SDG 9 Problem Addressed**  
A key challenge in many urban and rural areas is the uneven distribution of skilled auto mechanics, which results in long repair times, high consumer costs, and inefficiencies in transport systems. In underserved communities, particularly in rural or economically disadvantaged regions, locating certified mechanics can be difficult. This scarcity impedes vehicle uptime and negatively impacts both personal mobility and economic productivity.

**3. Proposed Solution**  
Our solution uses historical data on auto repair and towing facilities, enriched with location, facility name, and service details, to train a machine learning model that can estimate the number of certified mechanics at any given facility. This predictive model empowers policymakers, logistics companies, and automotive service chains to identify service gaps and plan workforce allocation effectively.

**4. Machine Learning Approach**  
The model employs a **Random Forest Regressor**, a robust ensemble-based machine learning algorithm suitable for non-linear, high-dimensional data. The dataset underwent comprehensive preprocessing, including:

* Text analysis on facility addresses using TF-IDF vectorization
* Feature engineering for ZIP codes, address length, and keyword indicators
* Ordinal encoding of state and city names

The model was trained on 80% of the data and evaluated on 20%, with performance metrics such as RMSE and R² score indicating reliable prediction capability. Hyperparameter tuning was performed using GridSearchCV for optimal performance.

**5. Results and Impact**  
The final model demonstrates solid accuracy, offering valuable insights into mechanic availability by location. It supports:

* Better resource planning for repair networks
* Strategic expansion by automotive chains
* Data-driven decision-making in public infrastructure investment

**6. Conclusion**  
This AI-driven system aligns with SDG 9 by enhancing industrial infrastructure through predictive analytics. By addressing the labor distribution gap in vehicle repair services, it promotes inclusive and sustainable industrial development, making mobility more resilient, especially in underserved areas. This tool can scale beyond Maryland to national or global applications, further supporting smart city and intelligent transport system initiatives.