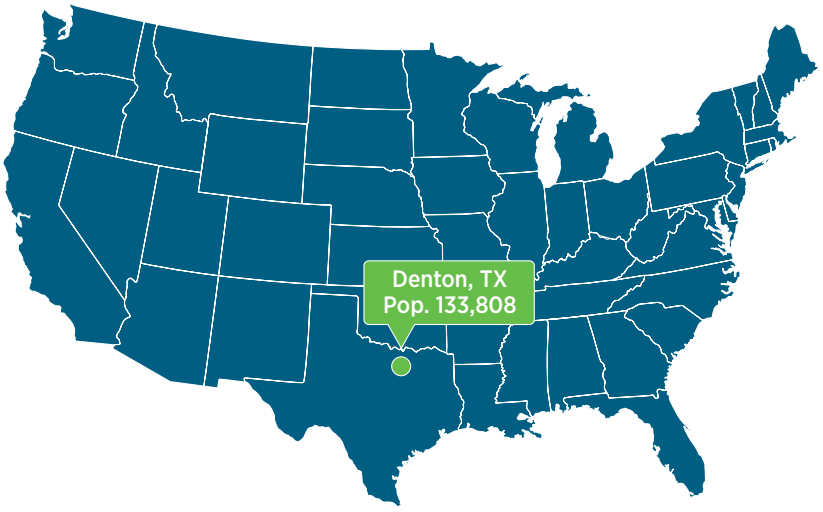
U.S. DEPARTMENT OF ENERGY

Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

Denton, Texas: Using Transportation Data to Reduce Fuel Consumption

The City of Denton partnered with the Energy Department and the National Renewable Energy Laboratory (NREL) to demonstrate how data and analysis can inform more strategic energy decisions. NREL based its analysis in-part on the City Energy Profiles on the State and Local Energy Data (SLED) website (*eere.energy.gov/sled*). The profiles contain data compiled by SLED and the Cities Leading through Energy Analysis and Planning (Cities-LEAP) program. Cities across the country can follow the same approach and use data-driven analysis in their own energy planning.



> "With population growth as a driving air quality issue in Denton and the rest of the Dallas-Fort Worth Metroplex, we understand that reducing transportation vehicle miles traveled is a core strategy to creating a healthier place to live, work, and play. The analysis that NREL completed in this report will help to strengthen the deployment of programs and policies that move us in the right direction."
>
> *— Jonathan Gregory, Conservation Program Coordinator, City of Denton*

City Energy Goals

As Denton, Texas, embarks on an update to its 2012 sustainability plan and greenhouse gas inventory, the city is seeking to address significant local air quality concerns. Vehicle emissions rank among the largest sources of smog, soot, and other air pollutants. Therefore, Denton is focusing on actions to reduce vehicle emissions by reducing fuel consumption, and needs data on fuel consumption, vehicle miles traveled (VMT), and other transportation indicators.

Data and Analysis

Previously, Denton relied on regional transportation data supplied by the North Central Texas Council of Governments. As that data set is not city-specific, applying it to Denton can be difficult. To help cities better understand their city-specific transportation context, NREL developed robust, city-specific data estimates on VMT and fuel consumption. This data is available on SLED and provides the foundation for this analysis.

Vehicles Miles Traveled and Fuel Consumption

According to SLED, Denton's estimated total VMT was 1.04 billion in 2013, or approximately 9,200 vehicle miles traveled per person. Interstate and arterial VMT account for an estimated 46% and 44% of total VMT, respectively, with collector roads making up the remaining 10% (see Figure 1).

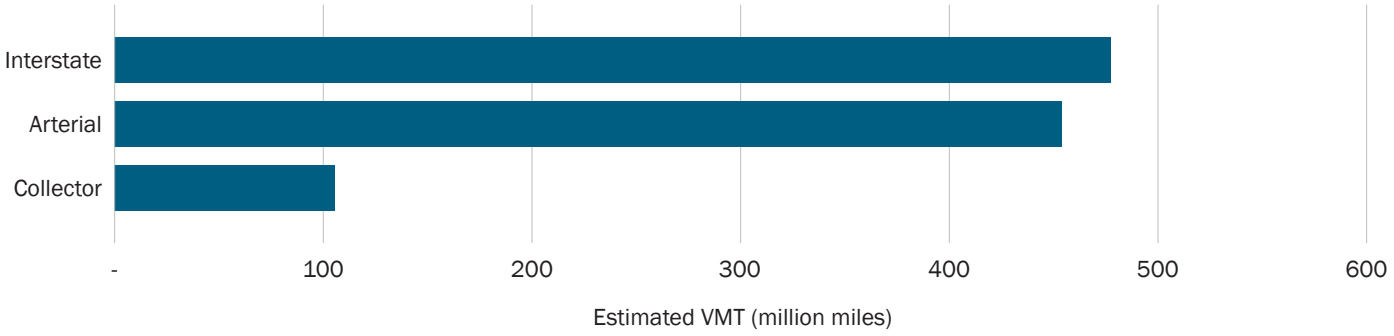


Figure 1. Annual vehicle miles traveled (VMT) by road class (2013) for Denton, Texas (Source: SLED)

Denton's estimated on-road vehicle fuel use is well above average compared to the 211 cities with similar population sizes and climate zones (cohort cities)[1] generated by a SLED algorithm (see Figure 2). Denton's estimated gasoline use of 56 million gallons in 2013 is approximately 88% higher than the cohort average, and its estimated 19 million gallons of diesel use is approximately 205% higher than average for similarly sized cities.

However, compared to nearby Texas cities (see Table 1), Denton is below Dallas and Fort Worth in total and per capita VMT and fuel consumption. This comparison also reveals the extent to which population and the length of interstate highway road segments within city limits are major predictive factors in the methodology used to estimate VMT.

To better understand Denton in relation to similar cities that are integrated with nearby metro areas and therefore integrated in air quality, we compared Denton with five other western cities with comparable populations that are also located within major metropolitan areas (see Table 2). This limited comparison indicates that Denton has higher total VMT and VMT per capita than these comparable cities and illustrates the influence of population density.

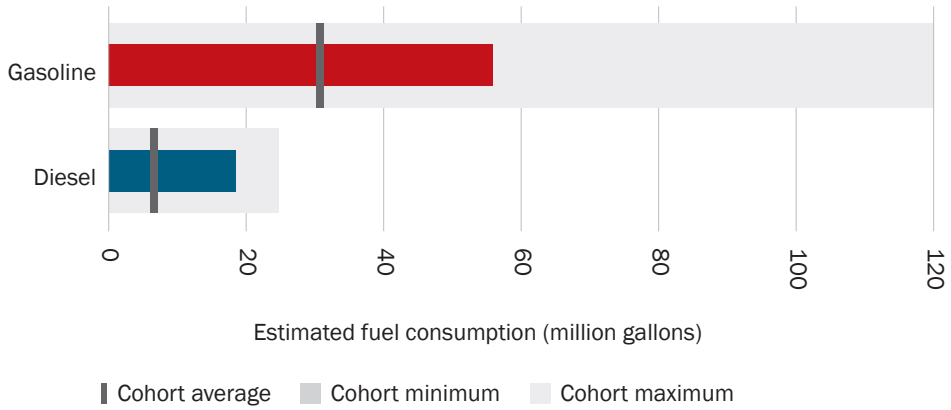


Figure 2. Annual on-road vehicle fuel use (light, medium, and heavy duty) by fuel type (2013) for Denton, Texas (Source: SLED)

Alternative Fuel Vehicles

Denton had a higher-than-average percentage of registered hybrid electric vehicles in 2013, ranking in the top 14% out of the more than 23,400 cities with vehicle type data analyzed by Cities-LEAP. Light-duty vehicles registered in Denton as of 2013 had an average fuel economy of 23 miles per gallon, placing the city in the top 13% of the cities analyzed.

Flex fuel is the most common type of alternative fuel vehicle (AFV) in Denton at 8% of all registered light-duty vehicles, followed by diesel and biodiesel (3%) and hybrid electric (1%) (see Figure 3). Of the approximately 2,300 registered heavy- and medium-duty vehicles in Denton, the SLED 2013 data indicate that none are AFVs.

While the number of registered electric vehicles (EVs) in Denton more than tripled between 2013 and 2016, there were still fewer than 100 EVs registered as of 2016.

Table 1. Estimated Annual VMT and On-Road Vehicle Fuel Use for Denton, Texas, and Nearby Cities

	Denton	Dallas	Fort Worth	McKinney
VMT/capita	9,200	10,100	9,700	4,500
Total VMT	1,037,335,200	12,006,250,000	7,011,583,000	568,332,400
On-road vehicle gasoline consumption/ capita (gal)	450	530	490	210
On-road vehicle diesel consumption/ capital (gal)	150	160	140	75
Total on-road vehicle gasoline consumption/ year (gal)	56,496,900	665,847,200	388,905,400	31,120,500
Total on-road vehicle diesel consumption/ year (gal)	18,702,900	202,027,300	113,450,800	11,123,800

Source: Data from SLED.

[1] Climate zones are based on definitions developed by Pacific Northwest National Laboratory. The data sources and methodologies used to determine cohort cities and estimate fuel consumption and VMT are available on SLED.

Table 2. Peer City VMT and Population Density Comparison (2013)

City	VMT/capita	Total VMT	Population density (people/km²)
Denton, Texas	9,200	1,037,335,200	549
Westminster, Colorado	7,200	764,159,300	1,348
West Valley City, Utah	6,200	795,258,200	1,459
Arvada, Colorado	4,700	504,287,400	1,116
West Jordan, Utah	3,600	363,995,000	1,376

Land area from TIGER/Line files, National Historical Geographic Information System 2010; population from U.S. Census American Fact Finder.

Alternative Fueling Stations

According to the DOE Alternative Fueling Station Locator (accessible through the transportation tab of Denton's city energy profile on SLED and also at *afdc.energy.gov*), Denton has 16 public alternative fueling stations, including 11 electric (3 of which are for Teslas only), 3 ethanol (E85), and 2 liquefied petroleum gas. While there is limited information available to determine an ideal ratio of number of EVs to public charging stations, an NREL analysis noted that the average U.S. county hosted approximately 43 public plug-in stations for every 1,000 registered EVs by the end of 2015.[2] In comparison, Denton has more than double the number of public plug-in stations than the average U.S. county as of 2016.

Strategies for Reducing On-Road Vehicle Fuel Consumption

DOE's Clean Cities program, which leverages nearly 100 local coalitions to cut petroleum use in transportation, reports that AFVs contributed 87% of the reductions in petroleum consumption from Clean Cities activities in 2015. The remaining savings were from increased fuel economy, reduced vehicle idling, and strategies to lower VMT.[3]

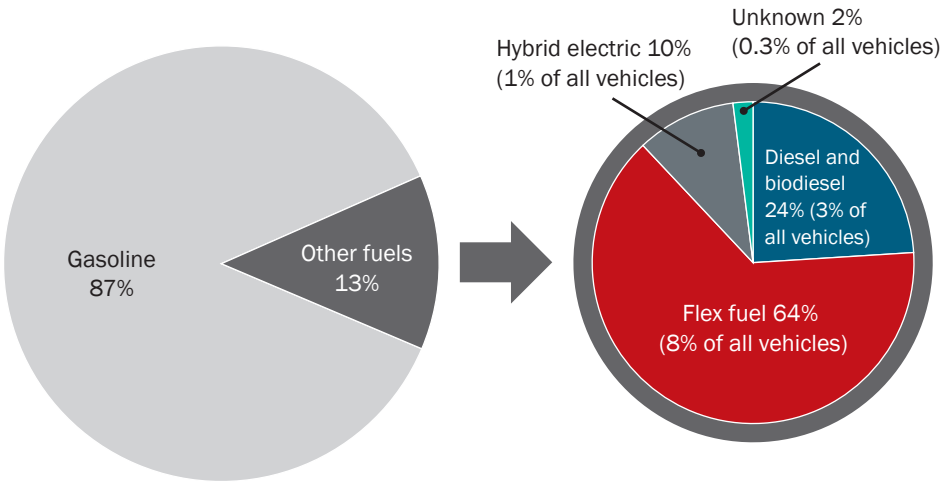


Figure 3. Light-duty conventional and alternative fuel vehicles by type (2013) registered in Denton, Texas (Source: SLED)

Flex-fuel vehicles, which are optimized to use either E85 (a blend of up to 85% ethanol and 15% gasoline) or regular gasoline, comprise the largest percentage of AFVs in Denton (see Figure 3). However, E85 vehicles are more often fueled with regular gasoline.[4] With only three E85 fueling stations in Denton, many flex-fuel vehicles in the city are likely purchased for other attributes and primarily fueled with gasoline.

Among alternative fuel vehicles, Clean Cities reports varying amounts of petroleum saved and greenhouse gas emissions reduced from Clean Cities activities (see Figure 4). The significant difference in the amount of petroleum saved across AFV types is attributed to four factors that may be considered when targeting fuel reduction actions:

1. The frequency with which the AFV uses alternative fuel (dedicated AFVs tend to displace more petroleum than flex-fuel vehicles, which can use either gasoline or E85)
2. The annual mileage of the AFV (higher mileage displaces more petroleum)
3. The AFV's fuel economy (vehicles with lower fuel economy—such as waste-hauling vehicles, school buses, and other heavy-duty vehicles—consume more fuel per mile; and switching to alternative fuels displaces more petroleum consumption)
4. The amount of petroleum contained in the alternative fuel (ethanol and biodiesel blends contain significant quantities of petroleum).

AFV bulk purchasing programs offer opportunities to collaborate across the region to increase AFV adoption. Fleets for the Future facilitates bulk orders of AFVs with fleet discounts on propane, electric, plug-in hybrid electric, and natural gas vehicles. The Dallas-Fort Worth region[5] and other areas have regional initiatives that officials can contact for assistance.

[2] E. Wood, S. Raghavan, C. Rames, J. Eichman, and M. Melaina, *Regional Charging Infrastructure for Plug-In Electric Vehicles: A Case Study of Massachusetts*, NREL (2017), http://www.nrel.gov/docs/fy17osti/67436.pdf.
[3] C. Johnson and M. Singer, *Clean Cities 2015 Annual Metrics Report*, NREL (2016), https://www.afdc.energy.gov/uploads/publication/2015_metrics_report.pdf.
[4] S. Pouliot and B. Babcock, "The Demand for E85: Geographical Location and Retail Capacity Constraints," *Science Direct* 45 (September 2014): 134–143.
[5] Fleets for the Future Dallas - Forth Worth region: http://www.fleetsforthefuture.org/dallas-fort-worth.

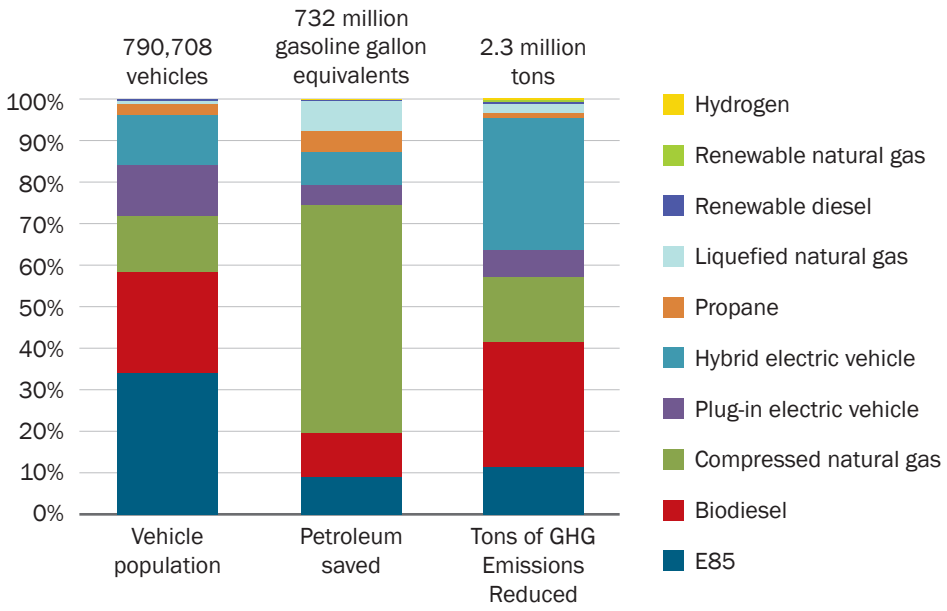


Figure 4. Percent of AFVs, petroleum savings, and greenhouse gas emissions (GHG) reductions by fuel type reported by Clean Cities coalitions (2015) (Source: C. Johnson and M. Singer, *Clean Cities 2015 Annual Metrics Report*, NREL [2016], p. 12)

Strategies to reduce fuel consumption through increased AFV adoption include the following:

- Integrate AFVs into Denton's municipal fleet, and install alternative fueling stations at municipal properties
- Streamline the permitting and inspection of AFV charging installations to reduce costs and development time[6]
- Require EV charging station installation in commercial building codes, as well as development and parking regulations, to integrate EV charging into multifamily buildings and larger workplaces
- Strategically deploy EV charging stations based on dwell time at public locations, trip distances within a single-charge range,[7] and visibility to reduce range anxiety and enable longer electric-only trips
- Provide incentives such as density bonuses and reduced parking requirements for installing EV charging infrastructure in new development[8]
- Adopt zoning ordinance amendments to enable the installation of EV charging stations and encourage their appropriate placement.

Increased population density is correlated with lower VMT per capita,[9, 10] suggesting that land use strategies that support greater density and infill (which, in turn, support active transportation options and public transit ridership) may help Denton reduce VMT per capita. Of the Clean Cities coalition actions to reduce VMT, mass transit projects were the most effective, followed by carpooling.[11]

Resources

The following resources may be useful to guide further research and action steps.

DOE Clean Cities

The Clean Cities program supports local actions to cut petroleum use in transportation. Contact your local coalition for assistance with implementing alternative fuels and advanced vehicle technologies: *https://cleancities.energy.gov*.

VMT and Fuel Consumption

- Alternative Fuels Data Center: *https://www.afdc.energy.gov*
- Transportation Data Book: *http://cta.ornl.gov/data/index.shtml*
- U.S. Energy Information Administration—Alternative Fuel Vehicle Data: *https://www.eia.gov/renewable/afv/index.php*.

Find additional resources in the SLED Local Energy Action Toolbox: *http://apps1.eere.energy.gov/sled/cleap.html*. Resources include examples and guides to action for incentivizing the adoption of alternative fuels, anti-idling measures, VMT reduction incentives, and fuel switching for municipal fleets.

Cities-LEAP is a project funded by the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy (EERE). It is part of an effort by EERE's Strategic Priorities and Impact Analysis Team to empower state and local decision makers with data-driven analysis. ■

[6] For more information, see the California Plug-In Electric Vehicle Collaborative, *Streamlining the Permitting and Inspection Process for Plug-In Electric Vehicle Home Charger Installations*: http://www.pevcollaborative.org/sites/all/themes/pev/files/PEV_Permitting_120827.pdf.

[7] E. Wood, J. Neubauer, and E. Burton, *Measuring the Benefits of Public Chargers and Improving Infrastructure Deployments Using Advanced Simulation Tools*, NREL (2015), http://www.nrel.gov/docs/fy15osti/63422.pdf.

[8] See AFDC Local Laws and Incentives: https://www.afdc.energy.gov/laws/local_examples.

[9] *The Planning Perspective on Health: Community Health as a Goal of Good Design*, ChangeLab Solutions (2007), http://changelabsolutions.org/sites/default/files/documents/Factsheet_PlanningPerspective.pdf.

[10] *Our Built and Natural Environments: A Technical Review of the Interactions Among Land Use, Transportation, and Environmental Quality*, U.S. Environmental Protection Agency (2013), http://contextsensitivesolutions.org/content/reading/built-and-natural.

[11] C. Johnson and M. Singer, *Clean Cities 2015 Annual Metrics Report*, NREL (2016), https://www.afdc.energy.gov/uploads/publication/2015_metrics_report.pdf.

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DOE/EE-1621 • September 2017