BILL037(26)
Testimony

MISC. COMM. 239

COUNCIL

COUNCIL Meeting

Meeting Date: Jun 3, 2026 @ 10:00 AM

Support: 3

Oppose: 0

I wish to comment: 0

Name:	Email:	Zip:
Jacob Wiencek	jacob.m.wiencek@pm.me	96815
Representing:	Position:	Submitted:
Self	Support	Jun 1, 2026 @ 03:46 PM

Testimony:

Aloha Councilmembers,

I am testifying in strong support of Bill 37. The housing crisis facing O'ahu residents is not an abstraction — it is the lived reality of working families paying over a third of their income in rent, of young families leaving the islands they love because they cannot afford to stay, and of a real estate market that has left the middle class behind. Removing the Agricultural District classification from 14.837 acres of land that the Planning Commission itself has found has "low, if any, potential for agricultural productivity" — land already functionally converted to transportation and utility infrastructure — is a sensible, targeted step that opens the door to the kind of compact, transit-proximate development that O'ahu desperately needs. The Right to Farm conditions attached to this reclassification demonstrate that the Council has thoughtfully protected neighboring agricultural operations, and the unanimous support from public agencies and the lack of any opposition testimony further confirm that this is a measured and well-vetted action.

I strongly urge the Council SUPPORT Bill 37!

Name:	Email:	Zip:
Sam Kim	skim@hrcc-hawaii.com	96817
Representing:	Position:	Submitted:
Hawaii Regional Council of Carpenters	Support	Jun 2, 2026 @ 07:45 AM

Name:	Email:	Zip:
Andrew Pereira	apereira@prp-hawaii.com	96813
Representing:	Position:	Submitted:
Pacific Resource Partnership (PRP)	Support	Jun 2, 2026 @ 11:04 AM

HAWAII REGIONAL COUNCIL OF CARPENTERS

June 3, 2026

TO: The Honorable Tommy Waters, Chair
The Honorable Andria Tupola, Vice Chair
Members of the Honolulu City Council

RE: TESTIMONY IN STRONG SUPPORT OF BILL 37 (2026) — TO AMEND PORTIONS (APPROXIMATELY 14.837 ACRES) OF THE STATE LAND USE DISTRICT BOUNDARY MAPS (SCHOFIELD QUADRANGLE AND 'EWA QUADRANGLE) FROM THE AGRICULTURAL DISTRICT TO THE URBAN DISTRICT FOR CERTAIN LANDS SITUATED AT KAPOLEI AND HONOULIULI IN 'EWA, O'AHU, HAWAII.

Aloha Chair Waters, Vice Chair Tupola, and Members of the Honolulu City Council,

The Hawaii Regional Council of Carpenters (HRCC), representing over 6,000 union carpenters and tradespeople across the Hawaiian Islands, submits this testimony in strong support of Bill 37 (2026). This measure reclassifies approximately 14.837 acres of land in 'Ewa from the State Land Use Agricultural District to the Urban District, enabling the planned expansion of the Transit-Oriented Development (TOD) Special District and the implementation of the East Kapolei Neighborhood TOD Plan.

The Hawaii Business Magazine reported, state administrative rules, state laws, and county ordinances still rely on outdated land classifications that were based on data organized before Hawai'i became a state in 1959, including surveys from the 1930s.[1] It also mentions how a 2024 state report concluded that these legacy classifications obscure the true potential of Hawai'i's lands and complicate efforts to adapt to modern agricultural and land development needs. Of Hawai'i's total area of 4.11 million acres, approximately 47 percent, or 1.93 million acres, is classified as agricultural, yet only 120,632 acres were farmed for crops in 2020. In other words, vast amounts of land in Hawai'i carry an agricultural designation that has nothing to do with how the land is used or whether it is suitable for farming.

Bill 37 is a great step in correcting a designation that no longer reflects reality on the ground. As noted by the Planning Commission, the petition area has "low, if any, potential for agricultural productivity due to being comprised of remnant SLU Agricultural District lands with extensive modification and conversion to urban types of uses for transportation and utility purposes." The land is also not designated as Important Agricultural Lands. Reclassifying these specific 14.837 acres of urbanized remnant parcels is exactly the evidence-based correction that the state and county should be making.

Furthermore, HRCC has long supported TOD as one of the most important strategies available to Hawai'i for addressing the housing crisis, reducing car dependency, and building durable, livable communities. Bill 37 advances that strategy directly. The reclassification facilitates the East Kapolei Neighborhood TOD Plan and unlocks proposed zone changes to AMX-2 Medium Density Apartment Mixed-Use, B-2 Community

[1] Perry Arrasmith, "Outdated Classifications Still Guide the Use of Hawai'i's Ag Lands, Hawaii Business Magazine," July 14, 2025, https://www.hawaiibusiness.com/outdated-classifications-still-guide-the-use-of-hawaiis-ag-lands/.

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Business, BMX-3 Community Business Mixed-Use, and IMX-1 Industrial-Commercial Mixed-Use districts. These are the building blocks of compact, mixed-use, transit-served neighborhoods.

By concentrating housing, jobs, retail, and public amenities near Skyline rail stations, TOD allows working families to live within walking distance of transit, reducing both household transportation costs and dependence on single-occupancy vehicles. It maximizes the public's substantial investment in the Skyline system by ensuring riders, employment, and economic activity are located near the stations. It supports the diversified, multimodal transportation system that the Oʻahu General Plan and ʻEwa Development Plan have long called for. And it concentrates growth where infrastructure already exists, rather than pushing development outward into truly productive agricultural land or open space. For our members, TOD allows for dense, vertical, infrastructure-rich building that sustains long-term construction employment for Hawaiʻi's skilled trades and creates the housing supply that allows our workers to live in the communities they help build.

In light of these reasons, we respectfully ask this Council to consider these great benefits to the county and move Bill 37 (2026) forward.

Mahalo for the opportunity to provide testimony.

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Testimony of
Pacific Resource Partnership

Honorable Members of the Honolulu City Council
Wednesday, June 3, 2026

Subject: Strong support for Bill 37, to amend portions (approximately 14.837 acres) of the State Land Use District Boundary maps (Schofield Quadrangle and 'Ewa Quadrangle) from the agricultural district to the urban district for certain lands situated at Kapolei and Honouliuli in 'Ewa, O'ahu.

Aloha Chair Waters, Vice Chair Tupola, and esteemed members of the council:

Pacific Resource Partnership (PRP) represents the Hawai'i Regional Council of Carpenters and its 6,000 members, along with more than 250 signatory contractors. We promote safe, high-quality construction, fair labor standards, and full regulatory compliance across Hawai'i.

PRP **strongly supports Bill 37**, which would help address our island's severe housing shortage by enabling the creation of much-needed affordable and workforce housing along the Skyline rail corridor.

PRP commissioned the Honolulu Transit-Oriented Development (TOD) Scenarios Study (July 2013, attached), which modeled four alternative futures for accommodating O'ahu's projected growth through 2050. The study's most ambitious "Corridor Focus" scenario (Scenario D) demonstrated conclusively that concentrating growth in compact, mixed-use development along the rail corridor dramatically reduces land consumption. While the "Business as Usual" scenario would consume 21.8 square miles of previously undeveloped land, the Corridor Focus approach requires only 7.1 square miles — a 68% reduction.

With land already critically scarce on O'ahu, Bill 37's support for denser development along Skyline is not just smart policy — it is essential for preserving our remaining open space, agricultural lands, and natural resources while meeting housing demand.

Equally important, the creation of new affordable and workforce housing units along Skyline will have a powerful "filtering" effect on the existing housing stock. Groundbreaking research released by the

(Continued From Page 1)

University of Hawai'i Economic Research Organization (UHERO) in November 2025 confirms this dynamic. In their analysis of a major Honolulu multifamily project, UHERO found that each new unit — including income-restricted affordable and workforce units — generates a chain of vacancies in older, more affordable housing throughout the island. These "downmarket" moves free up existing homes for current residents, expanding housing options across price points without displacing anyone. (See UHERO Working Paper 2503: The Downmarket Impact of New Multifamily Housing: Evidence from a Honolulu Condo Tower.)

By prioritizing transit-oriented, higher-density housing along Skyline, Bill 37 will deliver:

- Less land consumption and more efficient use of infrastructure already serving the corridor;
- Greater housing choice that matches the evolving needs of O'ahu's families, seniors, and working households; and
- Economic multipliers that strengthen local construction jobs, supplier industries, and overall island prosperity.

PRP urges the council to **advance Bill 37** expeditiously. We stand ready to work with you, the administration, and all stakeholders to ensure these housing opportunities are built responsibly, with high-quality union construction that benefits our entire community.

Mahalo for the opportunity to testify in strong support of this important measure.

Andrew Pereira
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Honolulu Transit Oriented Development Study Scenarios

RESULTS REPORT

Introduction

The Honolulu Transit-Oriented Development (TOD) Scenarios Study was undertaken to inform discussions about the role that rail transit and growth focused around transit can play in addressing the challenges facing Oahu today and into the next decades. The scenarios produced in this project posit varying futures in which population and job growth is more or less focused around the Honolulu Rail Transit corridor. These scenarios are analyzed for their impacts on a full range of fiscal, environmental, transportation, and quality of life indicators to express the island-wide costs, benefits, and consequences of land use, transportation, and related policy and investment decisions on Oahu.

This project builds on the station-area TOD studies completed or being undertaken by the City and County of Honolulu and other agencies, and adds a higher-level, corridor-wide perspective to studies of demand, capacity, and development potential along the Honolulu Rail Transit corridor. It sheds critical light on the island-wide impacts and fiscal implications of how and where growth occurs on Oahu, providing a broader context for the public TOD station-area planning process and discussions of the role rail transit and related investments play in the future of Honolulu.

Project Working Group and Consultant Team

The Honolulu TOD Study Scenarios Project was commissioned by the Pacific Resource Partnership (PRP) to analyze the development potential and full range of impacts of transit corridor-focused development. PRP assembled a diverse project working group to provide crucial input and bring a broad set of perspectives and opinions to discussions about TOD, rail, and future growth and development on Oahu. This group includes leaders and key stakeholders from environmental, business, development, finance, social equity, and public policy groups.

The project is led by Calthorpe Associates, a national and international leader in TOD planning and scenario development and analysis. Market analysis and TOD implementation expertise is provided by Strategic Economics, and the firm Bowers + Kubota adds critical local expertise and perspective.

The Pacific Resource PARTNERSHIP

CALTHORPE ASSOCIATES
URBAN DESIGNERS, PLANNERS, ARCHITECTS

Rev. July 2013

Contents

p 4 ***Scenario Planning for Oahu***

p 6 ***Scenario Drivers***

Growth

Housing Demand

Rail Corridor Capacity

p 8 ***Scenario Building***

RapidFire Model

Land Development Categories

p 10 ***Honolulu TOD Study Scenarios Overview***

Scenario A

Scenario B

Scenario C

Scenario D

p 12 ***Scenario Metrics Summary***

p 14 ***Scenario Metrics***

Land Consumption

Fiscal Impacts

Transportation

Residential and Commercial Building Energy

Residential Water Use

Greenhouse Gas Emissions Summary

Cost Summary

Scenario Planning for Oahu

Oahu is a place of natural splendor, rich history, diverse people, and world-renowned quality of life. It is also, like many cities across the United States, facing significant challenges as it settles into the 21st century. Oahu and its nearly one million residents are faced with stressed city budgets and aging infrastructure, high levels of traffic congestion and auto dependence, extremely high costs of living, housing affordability gaps, rising obesity rates and related health issues, dependence on foreign oil for transportation and electricity, and greenhouse gas and other air pollution issues. This project serves to answer fundamental questions about how the shape of growth on the island impacts each of these issues. By comparing a business-as-usual development pattern and transportation investment policies with future patterns that are more walkable, less auto-dependent, and more closely coordinated with transit investments, the scenarios explore the specific impacts of different options for accommodating projected population and job growth.



Rail corridor area – see map at right

Land Consumption

Between 1992 and 2005, nearly

10 square miles

of land were newly developed on Oahu.[1]

Traffic Congestion

Honolulu has the worst traffic congestion in the U.S., surpassing Los Angeles, San Francisco, and New York.

The average driver spent

58 hours in traffic

in 2011.[2]

Honolulu Rail Transit Corridor

Transportation investments are key to supporting the growth that will shape Oahu's future. Phase 1 of the fixed-guideway Honolulu Rail Transit system will run from West Oahu to Ala Moana Center. Extensions are planned to the west through Kapolei, and to the east to the University of Hawaii-Manoa campus and Waikiki.



Electricity Prices

Oahu has among the highest electricity prices in the U.S.

Per kilowatt-hour, residents pay

over two and a half times the national average.[5]

Housing Affordability

Honolulu is among the most expensive housing markets in the nation, with the median house or condo valued at $550,000.[3]

Over half of residents spend more than 30% of their income on housing.[4]

Energy Supply

Imported petroleum provides nearly

90% of all energy

consumed in Hawaii.[6]

Emissions per kilowatt-hour of electricity and gallon of gas are thus much higher in Hawaii than on the mainland.[7]

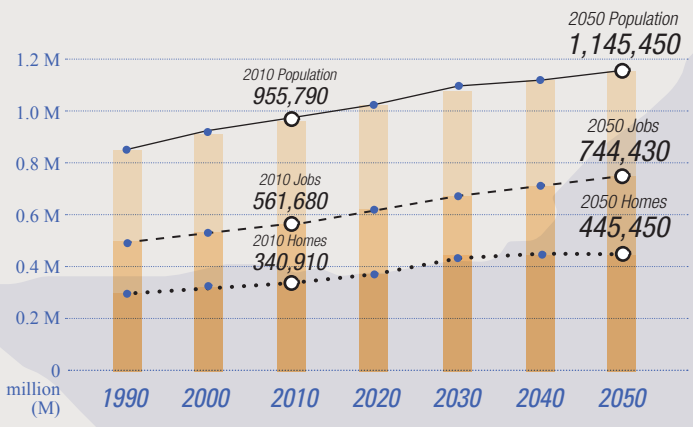
Scenario Drivers

This project's scenarios help to address a number of important questions and issues about Oahu's future growth and the specific role that the Honolulu Rail Transit corridor can play in shaping that growth.

Growth

How much will Oahu grow between now and 2050? Each of the scenarios tested in this study accommodates the same number of people, homes, and jobs. The study uses official state and city/county projections for population and employment through 2050. According to these projections, Oahu will need about 104,500 additional homes to accommodate its resident population.

Growth Forecasts



Growth 2010 to 2050



Housing Demand

What kind of housing do the residents of Oahu need now and into the future? A growing body of research suggests that housing demand in the US and Hawaii is shifting to favor more compact housing types and neighborhoods that offer convenient access to transit, shopping, and entertainment.[8] Over the coming decades, residential demand will be driven in large part by the housing preferences and needs of the two largest generations: the Baby Boomers and the Echo Boomers. Demographic changes, as well as increased considerations for accessibility, affordability, and quality of life, impact the types of housing needed to meet the needs of current and future residents.

Currently, Oahu's housing mix is relatively more compact than the national average. Over the last decade, single family detached homes have accounted for the majority of new construction, about 64%, with attached and multifamily homes making up the other 36%.[9] However, married couples with children, the primary market for single-family detached homes, now account for only 22% of all Oahu households[10], a proportion that continues to shrink each year.

By contrast, the proportion of singles, single parents, empty nesters, and seniors — many of whom prefer more compact single family and multifamily housing types — has grown steadily. The city's projections forecast the number of one- and two-person households to climb from 55% today to 60% by 2035. As these demographic trends continue, it is evident that a tighter connection between housing supply and demand, achieved through a greater diversity of housing types, will be necessary.

Projected Oahu Housing Demand to 2050, by Unit Type

Unit Type	Existing Units (2010)	Demand (2050)	Net New Units needed by 2050
Multifamily	146,100 (43%)	196,850 (44%)	50,760 (49%)
Single Family Attached	29,280 (9%)	59,400 (13%)	30,120 (28%)
Smaller Lot (<5,500 sq ft)	59,590 (17%)	83,260 (19%)	23,760 (23%)
Larger Lot (>5,500 sq ft)	105,940 (31%)	105,940 (24%)	0[11] (0%)

Source: Strategic Economics, 2012

Analyzing changing household demographics and expressed preferences in the context of existing supply yields a projection in which demand for more compact and more transit-compatible residential types increases. The table above shows the projected demand for new homes by type, and the resulting end-state mix of all homes in 2050. The figures are tied to recent growth projections by the City and County of Honolulu. This new growth housing unit mix — 23% smaller-lot single family, 28% single family attached, and 49% multifamily — reflects local housing preferences, as well as the tradeoffs people make in response to affordability considerations and neighborhood characteristics.

Rail Corridor Capacity

How much growth can the rail corridor realistically accommodate over the next decades? This study explores the critical question of corridor capacity from the perspective of ongoing City/County efforts, and includes a data-driven assessment of the physical and financial capacity of corridor-area lands to accommodate additional housing and employment growth. These analyses serve to bracket the range of development potential of the corridor. (For the purposes of this study, the corridor is defined as a roughly one-mile radius around the planned stations, including the first phase of the planned rail system, known as the Minimum Operating Segment, or MOS, as well as the extensions planned for both the Ewa (west) and Diamond Head (east) ends of the system.)

Station Area Plans. The City and County of Honolulu has been working on station-specific development studies since 2009, and has either completed or is in the process of developing plans for nearly all the stations along the first phase of the planned rail line.[12] Together, these station-area plans, which focus on the half-mile radius around 21 stations, accommodate about 58,000 new housing units. This assessment of "planned capacity" is an important component to the scenarios developed in this study, as it defines the city/county perspective on approximate potential in the half-mile station areas. Because it has been demonstrated that rail supports ridership from a one-mile distance[13], this study extends the TOD area to include areas within a one-mile radius of the Phase 1 and rail extension stations.

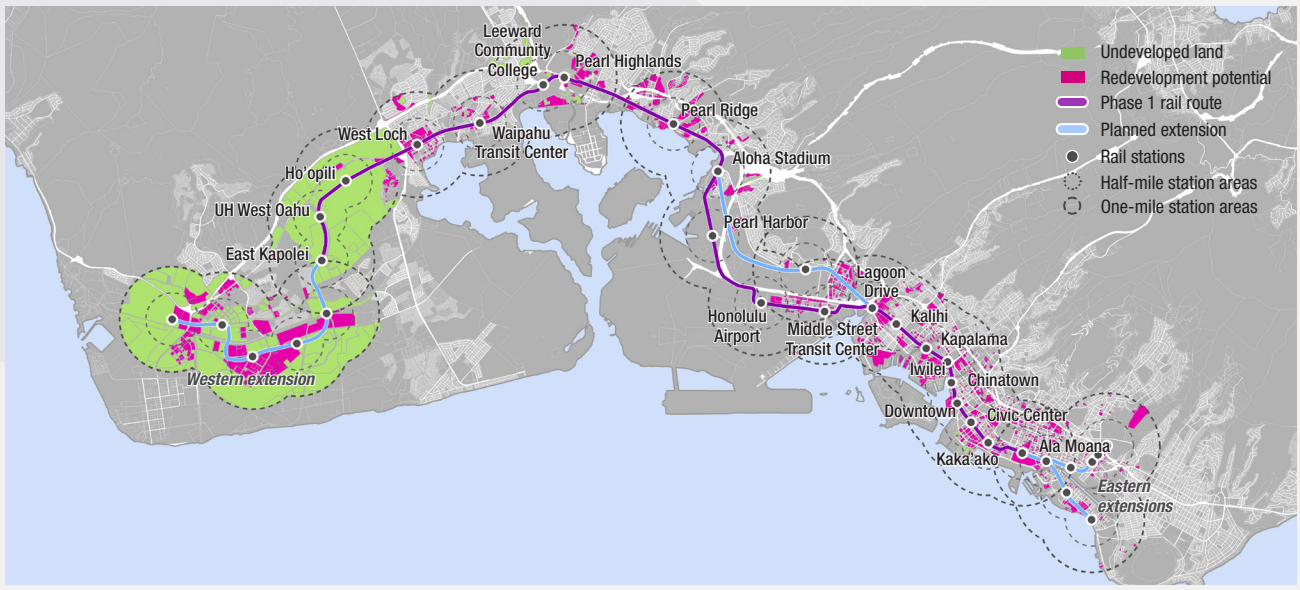
Undeveloped Land and Redevelopment Capacity Analysis. This study used extensive parcel, building, and land cover data from the Honolulu Department of Planning and Permitting (DPP), along with state and aerial imagery sources to determine the total undeveloped land area along the rail corridor, and assess the likelihood that developed land along the corridor will redevelop to more intense or different uses over time. A combination of form- and value-based analyses (performed using floor-area ratios (FAR) and improvements-to-land (I-L) ratios), combined with DPP data on existing and pipeline projects, was used.

The resulting ranges for development potential depend on the assumptions applied; specifically, using relatively moderate sets of FAR and I-L ratio thresholds[14], between 3,000 and 3,650 acres of currently developed land could be expected to redevelop or intensify over the next decades. This acreage is supplemented by the approximately 6,750 acres of previously undeveloped land along the corridor.



The illustrative at left depicts the plan for the Pearlridge rail station area. The plan, created by Van Meter Williams Pollack for the City and County of Honolulu, envisions the Pearlridge Station Area as a major urban center and regional shopping destination.

The graphic below highlights undeveloped land (green) and the redevelopment potential (pink) within the half- and one-mile radii of the rail stations.



Scenario Building

The Honolulu TOD Study scenarios produced for this report depict the growth choices facing the island by combining different land patterns with variations in housing type mix, proximity to transit investments and concentrations of development, and the proportion of growth accommodated either through infill and redevelopment on already-urbanized "refill" land, or on previously undeveloped land.

Land use scenarios are defined by the proportion of growth allocated to the Urban Infill, Mixed-Use Walkable, and Standard Suburban "land development categories" (LDCs). The LDCs represent distinct forms of land use. Each is associated with a unique set of assumptions describing housing type mix, travel behavior, land consumption, infrastructure costs, and other key factors. This allows the RapidFire model to estimate the impacts of varying different island-wide land use patterns over time.

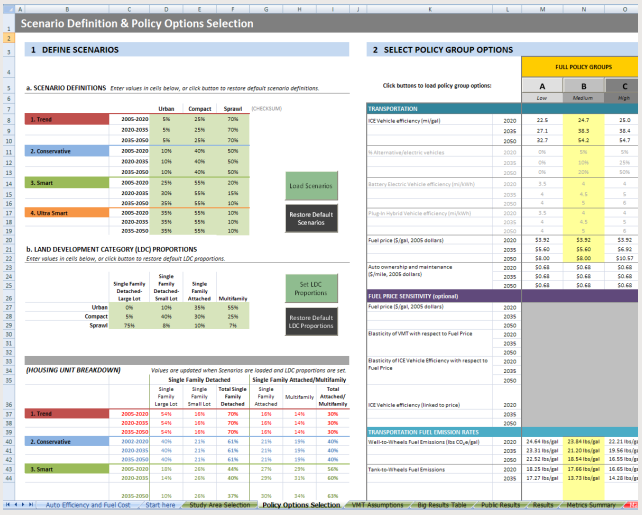
The RapidFire Model

The Honolulu TOD Study scenarios were produced using the RapidFire scenario modeling tool, developed by Calthorpe Associates. The model is a user-friendly, spreadsheet-based tool used to develop and evaluate scenarios at the national, state, regional, county, corridor, and local scales. It constitutes a single framework into which data and research-based assumptions about the future can be loaded to test the impacts of corridor and local land use patterns.

The RapidFire model emerged out of the near-term need for a comprehensive modeling tool that could inform state, regional, and local agencies and policy makers in evaluating climate, land use, and infrastructure investment policies across the United States.

The model produces results for a range of metrics including:

- GHG (CO_2e) emissions from cars and buildings
- Air pollution and public health impacts
- Fuel use and cost
- Building energy and water use, and cost
- Land consumption
- Fiscal impacts: capital infrastructure costs, operations and maintenance costs, and local revenues



Results are summarized so that users can compare the impacts of different scenarios. All assumptions are clearly identified and can be easily modified to test varying land use and policy choices. A detailed description of the RapidFire model can be found in the RapidFire Technical Summary, available at www.calthorpe.com/scenario_modeling_tools.

Land Development Categories

Urban Infill

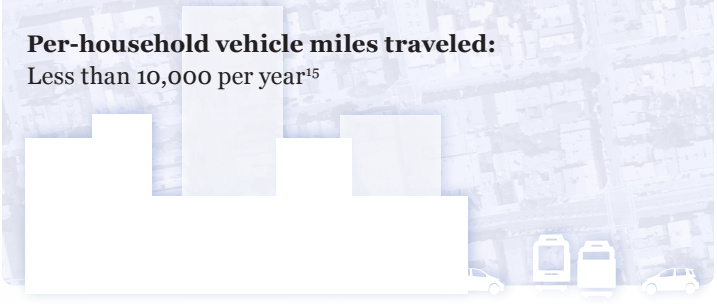
Land Use Characteristics

The most intense and most mixed land development category (LDC), often found within and directly adjacent to moderate- and high-density urban centers. Virtually all Urban Infill growth would be considered infill or redevelopment, and much of it would occur in the existing urban core in and around Downtown Honolulu. The majority of housing in Urban Infill areas is multifamily and attached single family (townhome), with some smaller-lot single family homes. These housing types tend to consume less water and energy than the larger types found in greater proportion in less urban locations.

Transportation Infrastructure

Supported by high levels of regional and local transit service. Well-connected street networks and the mix and intensity of uses result in a highly walkable environment and relatively low dependence on the automobile for many trips.

Per-household vehicle miles traveled:
Less than 10,000 per year[15]



Mixed-Use Walkable

Land Use Characteristics

Less intense than Urban Infill, but highly walkable with a rich mix of retail, commercial, residential, and civic uses. The Mixed-Use Walkable LDC is most likely to occur as new growth on the urban edge or in large-scale redevelopment projects. It contains a rich mix of housing, from multifamily and attached single family (townhome) to smaller- and medium-lot single family homes. Housing types in Mixed-Use Walkable areas tend to consume less energy and water than the larger types found in the Standard Suburban LDC.

Transportation Infrastructure

Well served by regional and local transit service, but may not benefit from as much service as Urban Infill growth, and is less likely to occur around major multimodal hubs. Streets are well connected and walkable, and destinations such as schools, shopping, and entertainment areas can typically be reached via a walk, bike, transit, or short auto trip.

Per-household vehicle miles traveled:
10,000 to 15,000 per year[16]



Standard Suburban

Land Use Characteristics

Represents the majority of separated-use, auto-oriented development that has occurred on Oahu, and dominated the American suburban landscape since World War II. Densities tend to be lower than those of the Mixed-Use Walkable LDC, with uses that are not highly mixed or organized to facilitate walking, biking, or transit service. The Standard Suburban LDC can contain a wide variety of housing types, though medium and larger-lot single family homes comprise the majority of this development form. These larger single family homes tend to consume more energy and water than those in the Urban Infill or Mixed-Use Walkable LDCs.

Transportation Infrastructure

Not typically well served by regional transit service. Local street networks are not well connected, discouraging walking and bike trips. Most trips are made via automobile.

Per-household vehicle miles traveled:
Above 15,000 per year[17]



Honolulu TOD Study Scenarios Overview

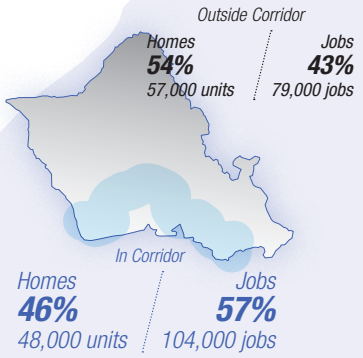
Each of the scenarios represents a different way of accommodating projected housing and job growth on Oahu to approximately the year 2050. Each includes the same total number of people, homes, and jobs, but varies in where and how they are located on the island. The scenarios also vary in terms of the types of homes that will be built in the coming decades, and the extent to which their mix of housing types meet the demands of Oahu's current and future residents.

Percent of New Growth in Rail Corridor

Scenario A

Business as Usual

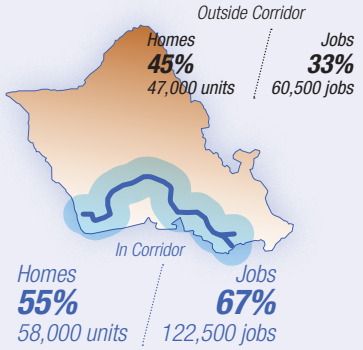
This scenario extends the land development and transportation investment choices of the past decades forward to 2050. It accommodates about 46% of projected housing growth—about 48,000 homes—within the one-mile transit corridor area, but does not include the planned Honolulu Rail Transit line. Most new growth (81%) tends toward suburban, auto-oriented development, and more than 80% of growth occurs on previously undeveloped land, much of that outside of the rail corridor. The majority of new housing is single family detached; about 30% of new housing is multifamily.



Scenario B

Forecast Future

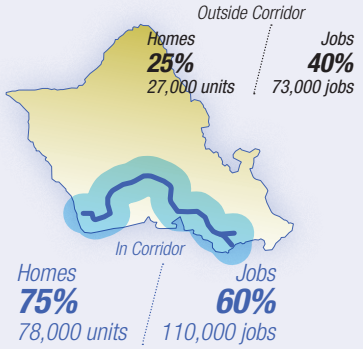
This scenario represents the housing and job distribution forecast in official state and city/county projections. It is very close to the distribution used in the rail ridership forecasting for the federally required environmental impact statement. The Forecast Future sees about 55% of new growth occur on the corridor, accounting for about 58,000 new homes. While the majority of new growth occurs in auto-centric patterns and locations, there is somewhat more Mixed-Use Walkable and Urban Infill development in this scenario. Nearly 75% of growth occurs on undeveloped land, and most new housing remains single family detached in this scenario; there is more multifamily development than in Scenario A.



Scenario C

Station Area Plans

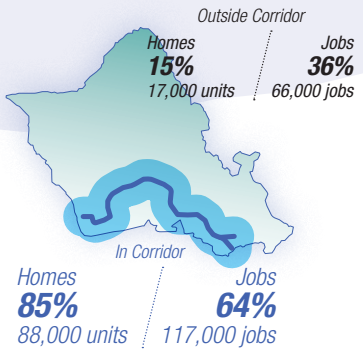
This scenario is built upon the City and County of Honolulu's station-area planning efforts and focuses significantly more growth along the rail corridor than Scenarios A or B. The city/county station-area plans, which focus on the half-mile radius around the 21 stations along the first phase (MOS) of the rail program, accommodate about 58,000 new housing units. This scenario looks out to the one-mile radius and includes the rail extensions, accommodating about 75% (78,000 homes) of new housing growth within the rail corridor; about 27,000 homes are built outside of the corridor. More than two-thirds of new growth occurs in moderate-intensity, mixed-use, less auto-dependent patterns; 16% occurs in urban infill locations; and 17% in Standard Suburban areas. About 60% of growth occurs on undeveloped land. This scenario comes closer to, but does not meet, projected housing demand by type.



Scenario D

Corridor Focus

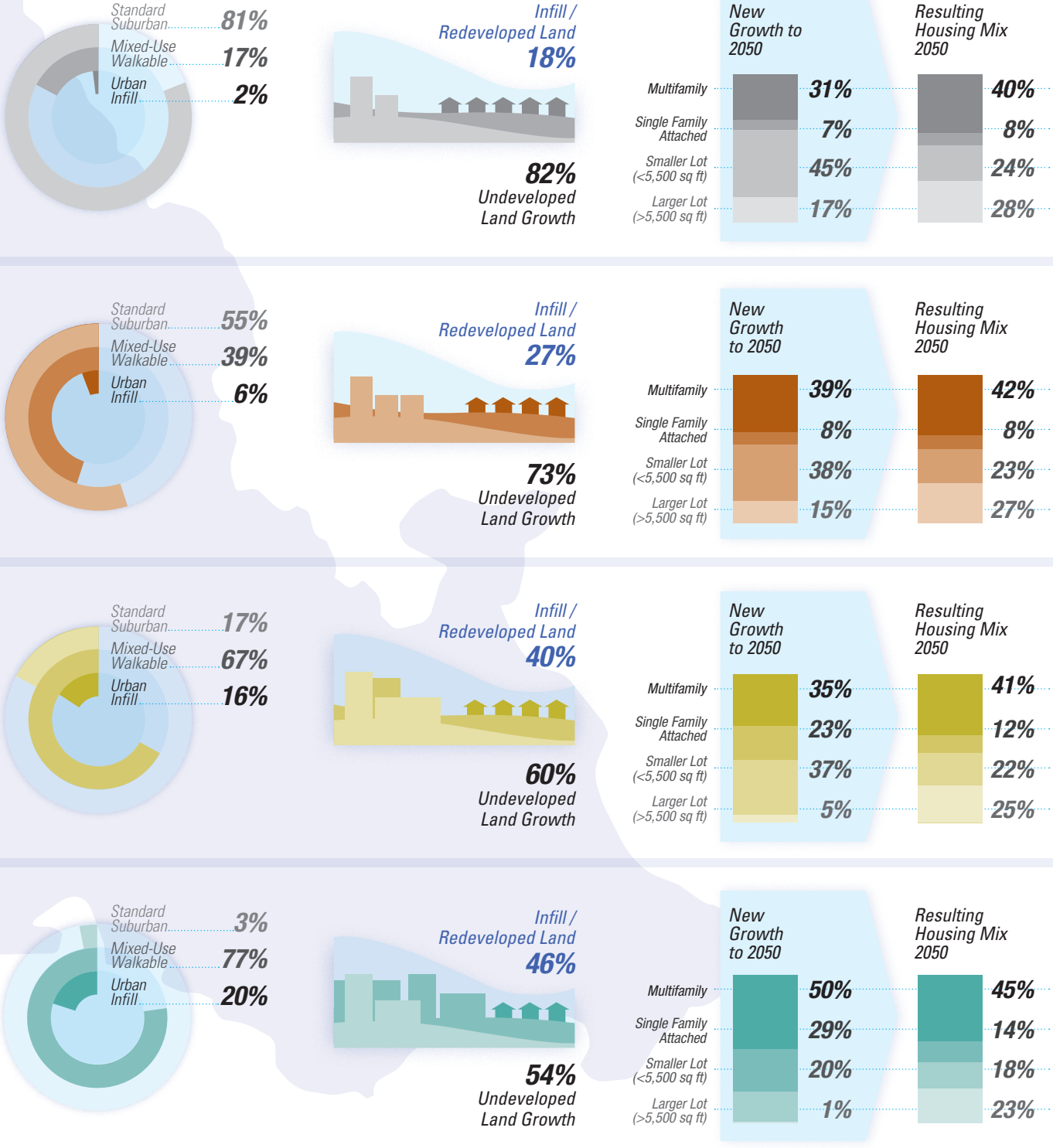
This scenario takes greatest advantage of the planned rail investment, while also seeking to meet projected housing demand by type. It accommodates about 85% of new homes, about 88,000 units, along the rail corridor, with another 17,000 homes located outside of the corridor. Growth along the corridor is focused in compact, walkable communities that include a range of single and multi-family types, and more than 25% of growth occurs through urban infill and redevelopment. Only about 3% of growth occurs in suburban, auto-oriented patterns. Growth in this scenario is split equally between infill and undeveloped locations. The housing mix in this scenario aligns with projected housing demand by type of housing, with new housing construction focused on single-family attached and townhome products, multi-family housing, and smaller-lot single family homes.



Land Development Category Proportions

Infill / Redeveloped Land vs. Undeveloped Land

Housing Unit Mix



Scenario Metrics Summary

The comparative scenario metrics summarized here are described in detail in the following sections. For clarity, values are rounded. All costs are expressed in 2011 dollars.



Land Consumption

Includes all previously undeveloped land that will be urbanized in a scenario.



Vehicle Miles Traveled (VMT)

Miles driven in passenger vehicles on Oahu.



Highway and Arterial Roadway Costs

Capital and ongoing operations and maintenance costs of additional roadway capacity needed to accommodate VMT increases.



Building Energy Use

Energy (electricity and gas) consumed by new and existing residential[18] and commercial buildings.

Scenario A — Business as Usual

This scenario extends the land development and transportation investment choices of the past decades out to 2050.

Land Consumption	Vehicle Miles Traveled (VMT)	Highway and Arterial Roadway Costs	Building Energy Use
21.8 square miles (cumulative to 2050)	**6.2** billion miles (annual in 2050)	**$ 10.2** billion (cumulative to 2050)	**22.2** trillion Btu (annual in 2050)
	12,720 miles / year (per new household, 2050)	**230** lane miles (to 2050)	**5,800** kWh / year[19] (per new household, 2050)

Scenario B — Forecast Future

This scenario represents the housing and job distribution forecast in official state and city/county projections.

Land Consumption	Vehicle Miles Traveled (VMT)	Highway and Arterial Roadway Costs	Building Energy Use
16.8 square miles (cumulative to 2050)	**5.8** billion miles (annual in 2050)	**$ 9.4** billion (cumulative to 2050)	**21.7** trillion Btu (annual in 2050)
	10,650 miles / year (per new household, 2050)	**155** lane miles (to 2050)	**5,450** kWh / year (per new household, 2050)

Scenario C — Station Area Plans

This scenario is built upon the City and County of Honolulu's station-area planning efforts, and focuses significantly more growth along the rail corridor than Scenarios A or B.

Land Consumption	Vehicle Miles Traveled (VMT)	Highway and Arterial Roadway Costs	Building Energy Use
10.8 square miles (cumulative to 2050)	**5.1** billion miles (annual in 2050)	**$ 3.0** billion (cumulative to 2050)	**21.1** trillion Btu (annual in 2050)
	6,950 miles / year (per new household, 2050)	**35** lane miles (to 2050)	**5,300** kWh / year (per new household, 2050)

Scenario D — Corridor Focus

This scenario takes greatest advantage of the planned rail investment, while also seeking to meet projected housing demand by type.

Land Consumption	Vehicle Miles Traveled (VMT)	Highway and Arterial Roadway Costs	Building Energy Use
7.1 square miles (cumulative to 2050)	**4.8** billion miles (annual in 2050)	**$ 0** billion (cumulative to 2050)	**20.8** trillion Btu (annual in 2050)
	5,350 miles / year (per new household, 2050)	**0** lane miles (to 2050) [No add'l miles because VMT is held close to current rates]	**4,950** kWh / year (per new household, 2050)



Water Consumption

Water used to serve and maintain new and existing homes.

1,515
billion gallons
(cumulative to 2050)

105,700
gallons / year
(per new household, 2050)

1,500
billion gallons
(cumulative to 2050)

101,850
gallons / year
(per new household, 2050)

1,480
billion gallons
(cumulative to 2050)

93,200
gallons / year
(per new household, 2050)

1,455
billion gallons
(cumulative to 2050)

84,200
gallons / year
(per new household, 2050)



GHG Emissions

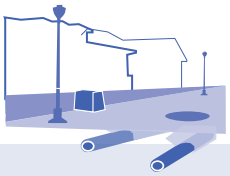
CO_2e emissions from passenger vehicles, and residential and commercial buildings.

Transportation Buildings
1.65 2.93
4.58
MMT / year
(annual in 2050)

Transportation Buildings
1.53 2.86
4.39
MMT / year
(annual in 2050)

Transportation Buildings
1.35 2.78
4.13
MMT / year
(annual in 2050)

Transportation Buildings
1.28 2.75
4.03
MMT / year
(annual in 2050)



Fiscal Impacts of Development

Capital and ongoing operations and maintenance costs for new local roads, sewer, water, and wastewater infrastructure. *For public-sector revenues, see detailed results on page 17.*

$8.6
billion
(cumulative to 2050)

$81,900
(per new household, 2050)

$8.0
billion
(cumulative to 2050)

$76,300
(per new household, 2050)

$7.5
billion
(cumulative to 2050)

$72,000
(per new household, 2050)

$7.1
billion
(cumulative to 2050)

$68,000
(per new household, 2050)



Rail Transit Ridership

Daily transit boardings on the proposed Honolulu Rail Transit line.

(Scenario A does not include rail)

Phase 1 Extensions
140,000
trips
(daily in 2035)

Phase 1 Extensions
200,000
trips
(daily in 2035)

Phase 1 Extensions
160,000
trips
(daily in 2035)



Household Costs

Automobile transportation (fuel, insurance, maintenance) and home energy and water costs.

$16,950
(per new household, 2050)

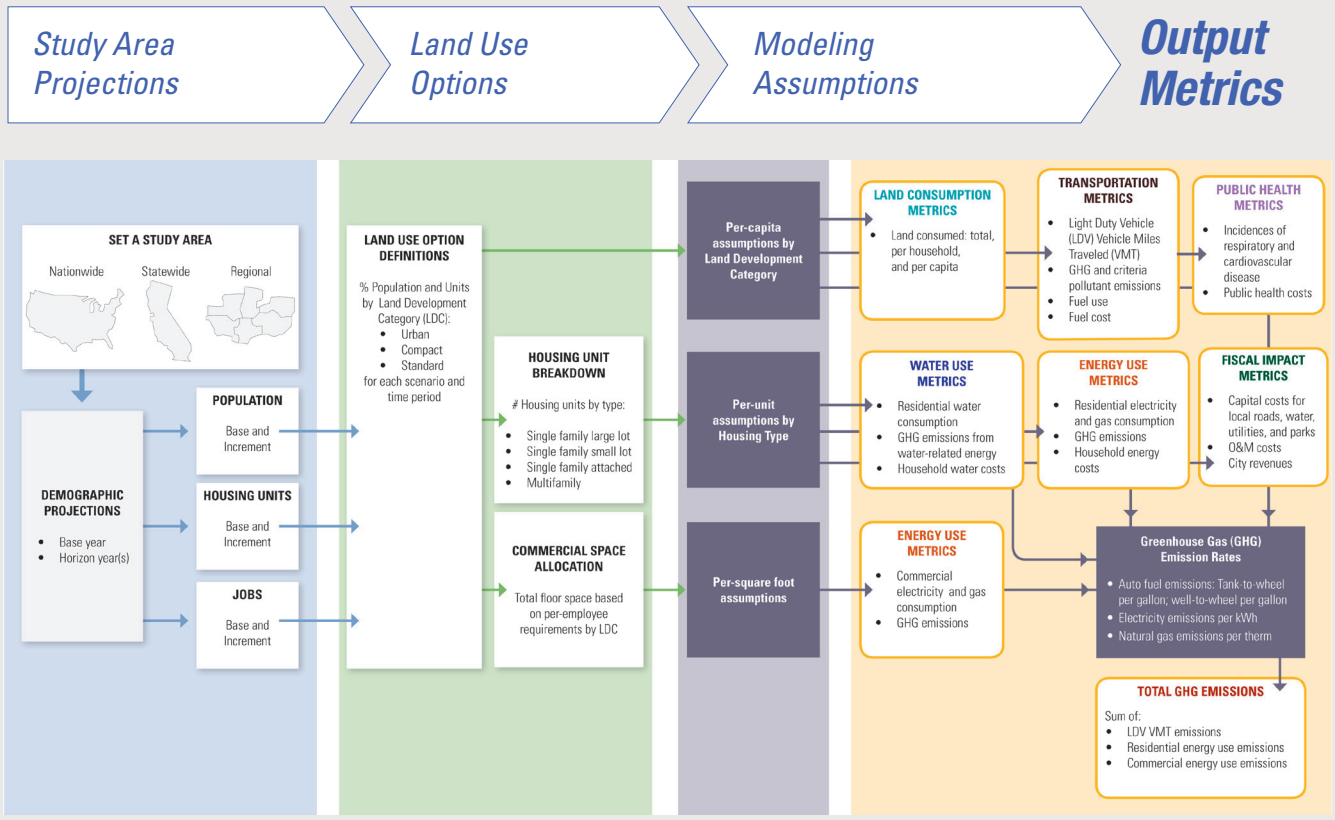
$14,750
(per new household, 2050)

$11,150
(per new household, 2050)

$9,300
(per new household, 2050)

Scenario Metrics

This section explores the impacts of the Honolulu TOD Study scenarios for a range of fiscal, environmental, and transportation impacts. The RapidFire model was used to develop and model the full range of metrics for the four scenarios. Island-wide results are presented here; input assumptions for the metrics are summarized in the Appendix. Note that "cumulative" results reflect sum totals over many years (e.g., 2010 to 2050), while "annual" results reflect values in a single year.



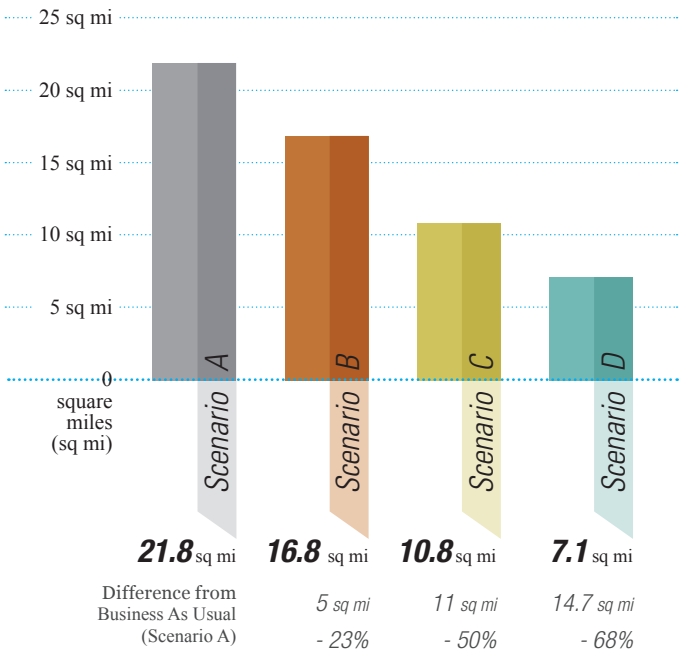
The methodology for calculating scenario metrics is outlined in the RapidFire Technical Summary, available at www.calthorpe.com/scenario_modeling_tools.

Land Consumption

The amount of land needed to accommodate new growth varies widely among the scenarios. Land consumption includes all land that will be newly urbanized, including residential and employment areas, roadways, open space, and public lands. Through infill, redevelopment, and more efficient use of previously undeveloped land to accommodate new growth, scenarios with a greater share of Urban Infill and Mixed-Use Walkable development consume less land overall. By contrast, scenarios that place a greater share of new growth in the Standard Suburban development pattern consume more land.

Scenario A, the business-as-usual scenario that puts most homes outside the corridor and continues past patterns of dispersed growth through 2050, consumes 21.8 square miles of previously undeveloped land — more than three times as much as Scenario D , the corridor-focused scenario. Scenario B (Forecast Future) consumes 16.8 square miles; Scenario C (Station Area Plans) consumes 10.8 square miles; Scenario D consumes 7.1 square miles. There were approximately 150 square miles of urbanized or developed land on Oahu as of 2005.[20]

Cumulative New Land Consumption to 2050



Fiscal Impacts

Infrastructure and Operations and Maintenance Costs

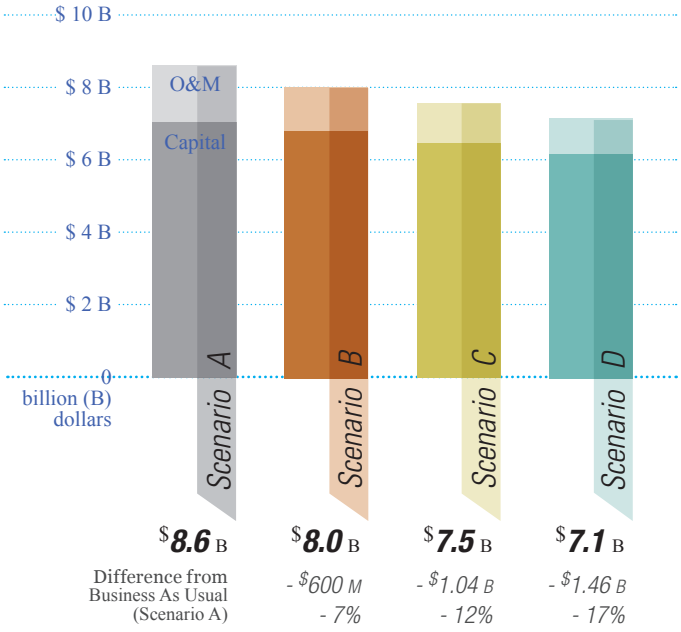
Increased land consumption can lead to higher costs for local infrastructure, as growth on previously undeveloped land requires significant capital investments to extend or build new local roads and water and sewer systems. Growth focused in existing urban areas takes advantage of existing infrastructure and capitalizes on the efficiencies of providing service to higher concentrations of jobs and housing. (While it is true that some infill locations on Oahu are currently in need of costly infrastructure upgrades, many of these costs will ultimately need to be borne regardless of where future growth is concentrated.) Accommodating growth within focused urban areas will help to ensure that future infrastructure investments generate a high return on investment in the form of quality neighborhoods.

The cost difference between compact and more dispersed development increases when public-sector operations and maintenance (O&M) costs are taken into account. O&M costs include the ongoing city expenditures required to operate and maintain the infrastructure serving new residential growth, along with providing other services included in the city's operating budget.[21] Engineering and public works costs are strongly linked to the physical form of infrastructure. More dispersed development, which entails greater lengths of roads and sewer pipes, incur higher O&M costs than more compact development, which capitalizes on the economic efficiencies of shared infrastructure capacity. The same is true for many services such as police and fire, which cost more to provide when development is more dispersed.

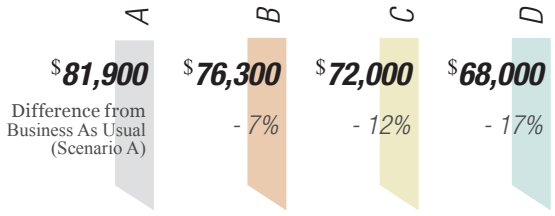
Focusing growth within the corridor area would reduce costs significantly, as demonstrated by reviewing the capital infrastructure and ongoing O&M costs for each scenario. As compared to Scenario A (Business as Usual), following the development pattern of Scenario B (Forecast Future) would save $595 million to 2050; Scenario C (Station Area Plans) would save $1.0 billion; and Scenario D (Corridor Focus) would save $1.5 billion — 17% less on the whole than Scenario A, and an average savings of $13,900 per new home.

Note that the capital infrastructure and O&M costs detailed here represent those associated with residential growth only. It is expected that the inclusion of non-residential fiscal impacts would compound the cost and revenue differences that have been evidenced between dispersed and compact development patterns.

Cumulative Capital Infrastructure Costs and Operations and Maintenance (O&M) Expenditures (2011 dollars)



Cumulative Infrastructure Costs and O&M per New Home to 2050 (2011 dollars)

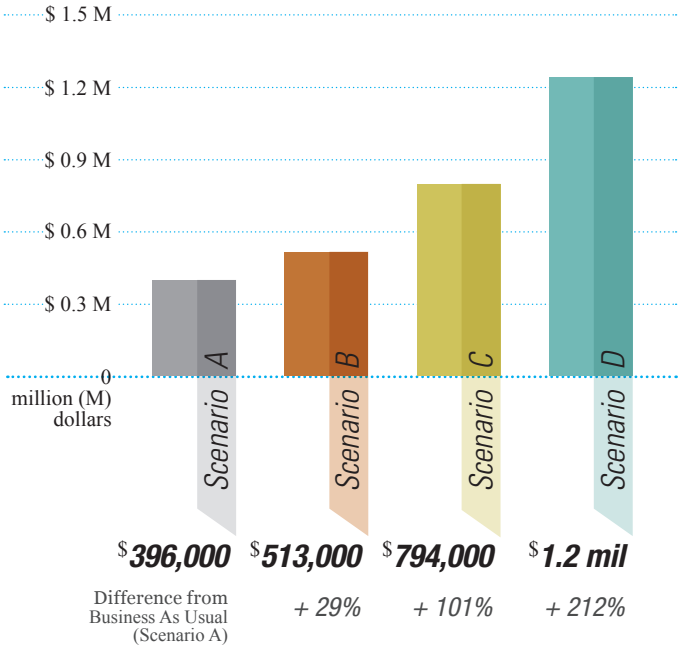


Revenues

Potential public-sector revenues associated with different development patterns are estimated from local residential property and property transfer taxes. Compact development can generate higher local revenues than more dispersed development, because denser locations tend to have higher property values[22]. Close proximity to major transit systems also boosts property values. Some of this increased value and the resulting higher home and rental prices are offset by the benefits of living in a more efficient location: the scenarios demonstrate that new households in Scenario D save an average of $6,300 per year on transportation costs (see the Household Costs Summary section on page 27) — a difference that is highest for households living on the rail transit corridor in the most walkable, mixed-use communities.

The relationship between development patterns and revenues is made clear when reviewing on a per-acre basis — by 2050, Scenario A generates $396,000 per newly developed acre, while Scenario B generates $513,000, Scenario C generates $794,000, and Scenario D generates $1.2 million per acre — three times as much as Scenario A. To 2050, Scenario D generates $42 million more than Scenario A. Note that these revenue estimates assume a provision for affordable housing in each scenario, with 30% of units available for households with a range of income levels below 120% of area median income.

Cumulative Revenues per Acre to 2050 (2011 dollars)



Transportation

Transportation system impacts — including vehicle miles traveled (VMT), transit ridership, fuel use and cost, roadway needs and costs, and greenhouse gas (GHG) emissions — vary significantly across the scenarios. The land use patterns described in each scenario result in distinct differences in the rates of passenger auto use, measured as VMT, which in turn impacts fuel consumption, fuel cost, and emissions.

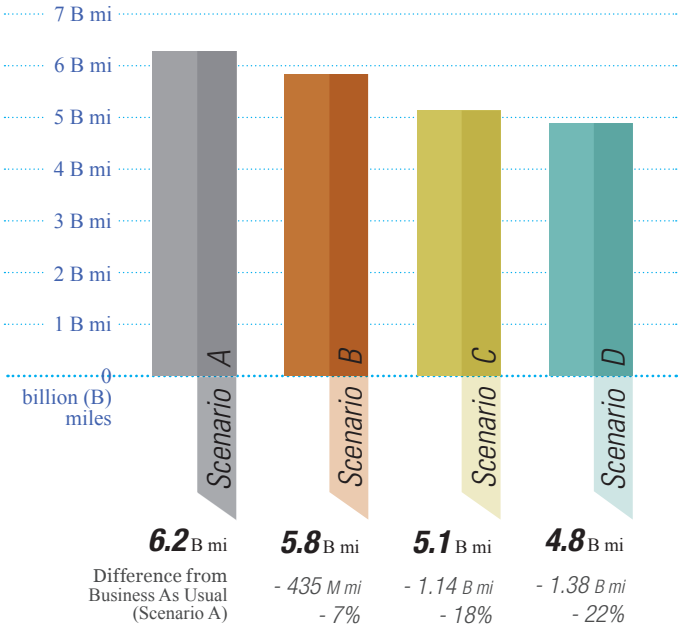
Vehicle Miles Traveled (VMT)

VMT is calculated by applying assumptions about the distances people drive each year to projected population growth. These assumptions, which differ by Land Development Category, are based on current driving rates, and data showing that per-capita VMT of both new and existing population vary based on the form of new growth.[23] For example, when a majority of new growth occurs as Mixed-Use Walkable or Urban Infill development, over time most people — including those living in existing neighborhoods — will be able to drive less because more jobs, daily destinations, and services will be closer. Likewise, if a majority of new growth occurs as Standard Suburban development, many people will be likely to drive more, as workplaces and other destinations will grow farther apart.

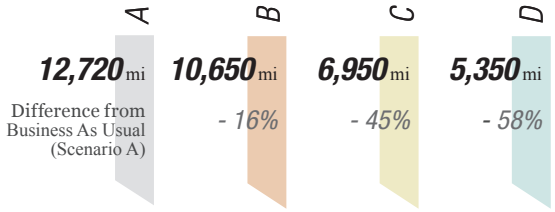
The scenarios assume that requisite transportation investments go hand-in-hand with growth patterns, such that scenarios with a greater focus on Mixed-Use Walkable and Urban Infill development would see increased transit, bicycle, pedestrian, streetscape, and livability investments. Conversely, scenarios dominated by Standard Suburban development would see larger budget outlays to highway and road expansion. Scenario A is modeled without the Honolulu Rail Transit corridor; Scenarios B, C, and D include the rail corridor and vary in the proportions and concentrations of growth, and hence investments, along it.

Scenario results for VMT indicate a wide variation in passenger vehicle use related to the form of new growth. The consequence of putting more homes in dispersed patterns is high: Scenario A, which accommodates 80% of growth in auto-oriented Standard Suburban development, produces an average annual VMT of 12,720 per new household, per year by 2050. This is 2,060 miles more than Scenario B (Forecast Future); 5,770 more than Scenario C (Station Area Plans); and 7,360 more than Scenario D (Corridor Focus).

Vehicle Miles Traveled (VMT) in 2050



Annual VMT Per New Household in 2050



In total, Scenario A results in an annual VMT of 6.2 billion miles. This is 435 million miles more per year than Scenario B, and 1.1 billion miles more than Scenario C. At the lowest end, Scenario D results in an annual total of 4.8 billion miles, 1.4 billion less than Scenario A. The difference between Scenario A and Scenario D is equivalent to taking nearly 160,000 cars off Honolulu's roads each year.

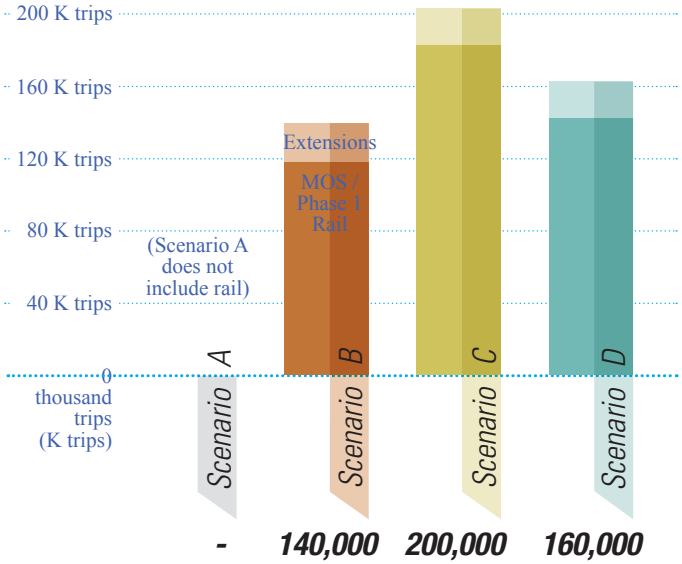
Rail Transit Ridership

Rail transit ridership projections for each of this study's scenarios were developed using the Oahu Metropolitan Planning Organization (OMPO) travel demand model. This is the same model used to produce the official rail ridership projections of the federally-required environmental impact statement (EIS) for the Honolulu Rail Transit program. The model was used to produce ridership estimates for both the first phase of rail, the 21-station line known as the minimum operating segment (MOS), and the rail system with the western (to West Kapolei) and eastern (to Waikiki and the University of Hawaii Manoa campus) extensions. The model produces ridership estimates for the year 2035, and all model runs include a complete network of highways and roadways and all local transit service. More information about the OMPO travel model can be found at www.oahumpo.org/programs/ortpcurrent.html.

Ridership modeling illustrates the benefits to rail ridership and system efficiency that come from locating more homes and jobs in and around the rail corridor. Ridership in Scenario B (Forecast Future), which places about 58,000 new homes in the rail corridor and represents the official distribution of population and employment used in the EIS, matches the official ridership projection of about 116,000 daily rail boardings on the first MOS phase of the rail; with the rail extensions, ridership rises to about 140,000 boardings. Scenario C (Station Area Plans), with 77,000 new homes located within the one-mile rail transit corridor, sees rail ridership grow significantly to more than 180,000 boardings per day on the MOS, and more than 200,000 boardings with the extensions. Scenario D (Corridor Focus) also sees significant gains in rail ridership, with about 160,000 daily boardings with extensions in 2035 — nearly 45,000 boardings more than the EIS Phase 1/MOS system.

Scenario D ridership is lower than that of Scenario C, even with a higher proportion of growth in the corridor, because Scenario D presents a more balanced approach to the overall corridor; homes, jobs, and daily needs like schools, shopping, and parks are more mixed and integrated throughout the corridor, thereby reducing the need for both auto and rail transit trips. Thus, while Scenario D shows lower ridership than Scenario C, it also shows significantly lower VMT due to an increase in conditions where people are more likely to walk, bike, take local transit, or drive shorter distances for many trips. Scenario A (Business as Usual) does not include the proposed Honolulu Rail Transit line.

Daily Rail Boardings in 2035



Hawaii Clean Energy Initiative (HCEI)



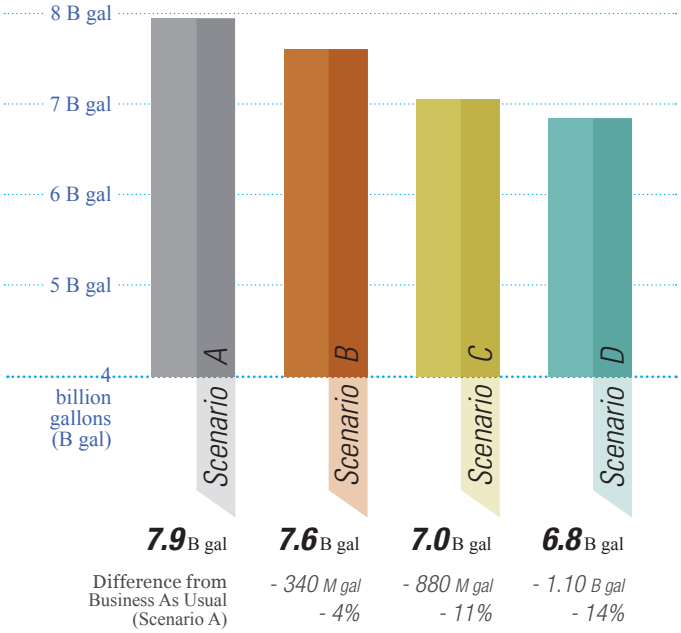
Launched in 2008, the Hawaii Clean Energy Initiative (HCEI), a partnership between the state and the U.S. Department of Energy, lays out a roadmap for Hawaii's energy independence, with overarching goals for energy efficiency and the use of renewable sources. For the transportation sector, HCEI will involve reducing VMT — by increasing the use of non-auto modes as well as reducing trip lengths — as well as improving vehicle efficiency, expanding the use of alternative fuels, and accelerating the deployment of electric vehicles. Only through a combination of these strategies can the the goal of using clean energy to supply 70% of Hawaii's ground transportation needs be met.

Automobile Fuel Use and Cost of Driving

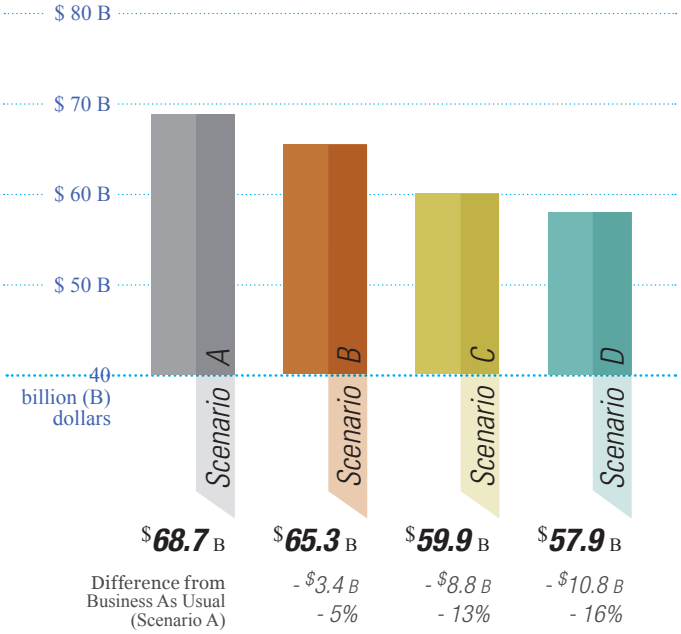
Variations in passenger VMT lead to substantial differences in the amount of gas (or equivalent) used. These differences will vary depending on how efficient cars become. Assuming the same modest vehicle fuel economy improvements (37 mpg, in line with a federal Energy Information Administration Reference case scenario[24]) for all scenarios, there would be substantial differences in fuel use due to land use-related VMT variations. By 2050, Scenario A (Business as Usual) would require 168 million gallons of fuel annually. Scenario B (Forecast Future) would require 11.8 million gallons less, Scenario C (Station Area Plans) would require 30.9 million gallons less, and Scenario D (Corridor Focus) would require 37.3 million gallons less.

Reduced VMT and fuel use leads to lower costs for all households. When compared to Scenario A, Scenario B saves the average Oahu household $900 per year in driving costs in 2050 (including auto ownership, maintenance, and other driving-related costs); Scenario C saves $2,350; and Scenario D saves $2,700 — significant savings that could be applied to housing and other essentials. For the entire island in 2050, the annual savings total as much as $1.2 billion in Scenario D. Adding up all costs to 2050 (taking into account rising fuel prices and gradual population growth), Scenario D would save a cumulative total of $24 billion.

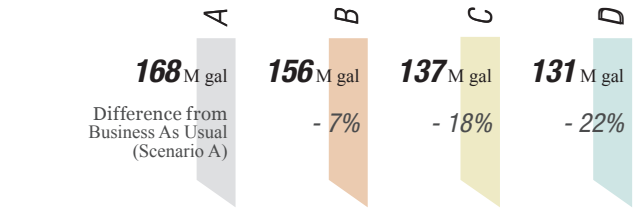
Cumulative Passenger Vehicle Fuel Consumption to 2050 (gallons gasoline equivalent)



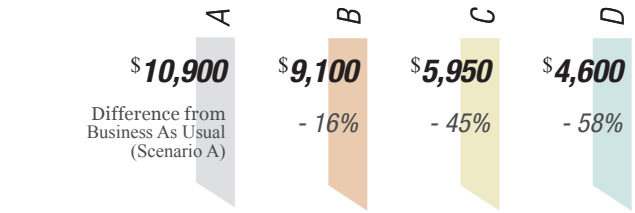
Cumulative Fuel Costs to 2050 (2011 dollars)



Annual Passenger Vehicle Fuel Consumption to 2050 (gallons gasoline equivalent)



Annual Driving Costs per New Household in 2050 (2011 dollars)



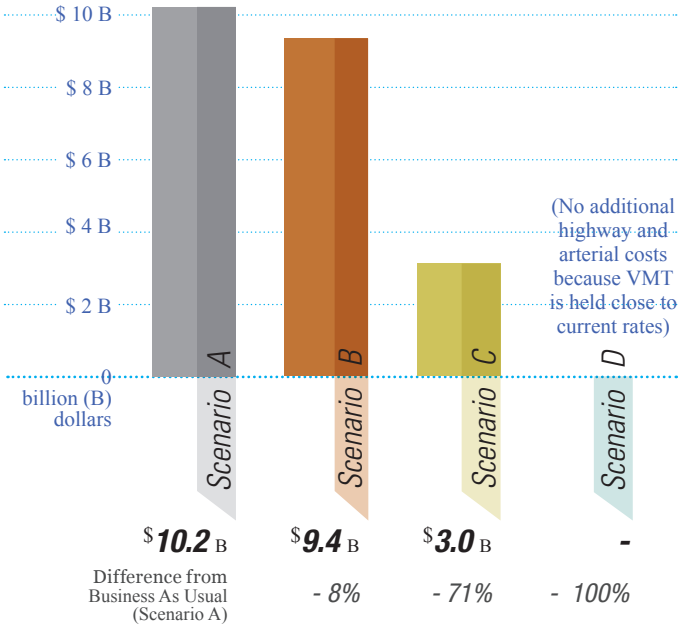
Highway and Arterial Roadway Costs

Reducing vehicle travel demand relieves pressure to expand roadway capacity. In Honolulu, where highway expansion options are limited, the costs of adding lane-miles are very high — the estimate for an elevated, two-direction, managed-lane facility along and parallel to the H-1 corridor from the H-2/ Waiawa Interchange to Pacific Street in Iwilei was estimated to cost $3.77 billion in capital costs alone[25]. Even assuming that roadway expansion would also include less-intensive, lower-cost roadway construction projects, the costs and impacts of new highway and arterial miles — which include land acquisition needs and adverse effects on urban areas and the natural environment — are significant.[26]

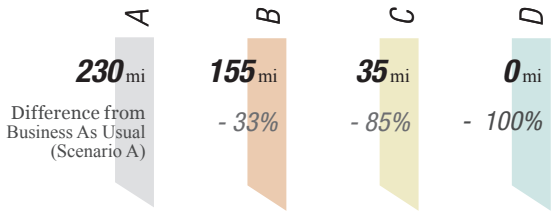
Assuming today's rates of roadway utilization into the future, the travel demand generated by Scenario A would require an additional 230 lane-miles of highway and arterial roadways (including about half highways and half arterials), at a total cost of about $10.2 billion; Scenario D, which approximately maintains current annual VMT rates[27] and includes the rail investment with growth focused around that investment in more walkable communities, requires almost no additional highway or major arterial lane miles to 2050. Scenario B would require 155 lane-miles, at a cost of $9.4 billion; Scenario C would require 35 lane-miles, at a cost of $3.0 billion.

Operations, maintenance, and system preservation costs add to the initial capital costs of adding roadway capacity.[28] According to Oahu's 2035 Regional Transportation Plan, these costs account for over $3 billion, or 13% of planned spending to 2035. Looking at preventative maintenance costs alone (the costs of resurfacing new freeways once every ten years, which staves off more costly repairs down the line), Scenario A would cost an additional $22 million to 2050, Scenario B would cost an additional $14 million, and Scenario C would cost an additional $3.3 million.

Cumulative Cost for Additional Highway and Arterial Lane Miles to 2050

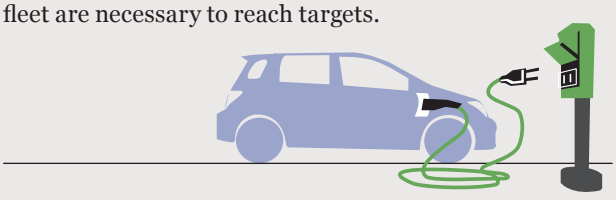


Additional Highway and Arterial Lane Miles Needed to 2050



Alternative Vehicle Impacts

Electric and other alternative fuel vehicles play an important role in reducing GHG emissions from transportation. These scenario results implicitly capture the impacts of electric vehicle use because the fuel economy and GHG emission rate assumptions used in the RapidFire model are based on adopted and/or proposed policies for improving vehicle fuel economy and decreasing fuel carbon intensity — each of which assumes that growing shares of electric and other alternative fuel vehicles in the on-road fleet are necessary to reach targets.



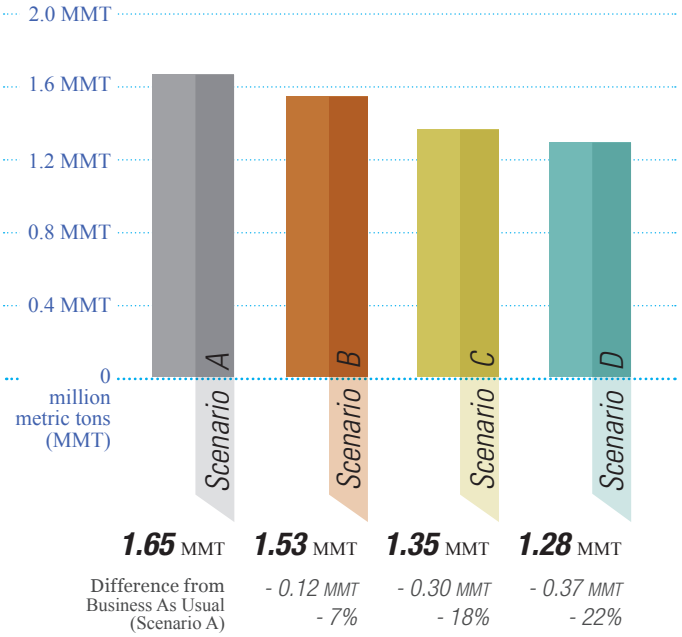
GHG Emissions from Passenger Vehicles

Hawaii's Act 234, passed in 2007, sets the state's goal for reducing greenhouse gas emissions (GHG) to 1990 levels by 2020. This forward-thinking legislation has been an impetus for Oahu to address its climate change impacts through the close coordination of land use and transportation planning. The challenge is substantial: between 1990 and 2005, statewide emissions associated with passenger vehicle transportation and building energy use — sectors influenced by the form and amount of urban growth — grew by approximately one-third.[29] By planning for more focused growth in complete communities, Oahu has the potential to significantly reduce GHG emissions by minimizing vehicle travel demand — and along with that realize a full range of co-benefits, including considerable cost savings.

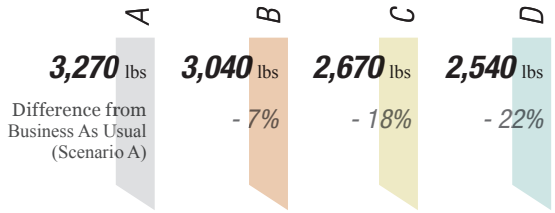
GHG emissions from passenger vehicles are determined by VMT (related to land use patterns), vehicle fuel economy, and the carbon intensity of automobile fuel. Assuming the same modest improvements in fuel emissions for all scenarios — a 10% reduction from baseline emissions[30] by 2050 — there would be substantial differences in CO_2e emissions (carbon dioxide equivalent, which includes the main forms of greenhouse gases). The land use-related variations in GHG are directly proportional to VMT and fuel use. By 2050, Scenario A (Business as Usual) would produce 1.65 million metric tons (MMT) of CO_2e annually. Scenario B (Forecast Future) would produce 7% less; Scenario C (Station Area Plans) would produce 18% less; and Scenario D (Corridor Focus) would produce 22% less.

Note that the transportation emissions reported here are limited to tailpipe (tank-to-wheel) emissions. A more complete picture of emissions would emerge in an analysis of full lifecycle (well-to-wheel) emissions, which take into account the emissions associated with generating fuel from various sources.

Annual Transportation GHG Emissions in 2050 (MMT CO_2e)



Annual Transportation GHG Emissions per Capita (lbs CO_2e)



Residential and Commercial Building Energy

With the most fossil fuel-dependent energy supply in the nation, conserving building energy use is a major goal for Hawaii. The Hawaii Clean Energy Initiative (HCEI) sets a statewide goal of achieving 70% clean energy by 2030, with 40% coming from renewable sources, and 30% from efficiency measures. The Honolulu TOD Study scenarios address the efficiency side of this goal, demonstrating the energy savings that can be realized through more compact development.

The scenarios vary in their building energy use profiles due to their different mixes of housing types. Scenarios that contain more Mixed-Use Walkable and Urban Infill development accommodate a higher proportion of growth in more energy-efficient housing types like apartments, attached single-family homes, and smaller single family homes, as well as more compact commercial building types. By contrast, a large proportion of Standard Suburban development leads to a higher proportion of larger single family homes, which are typically less energy-efficient.

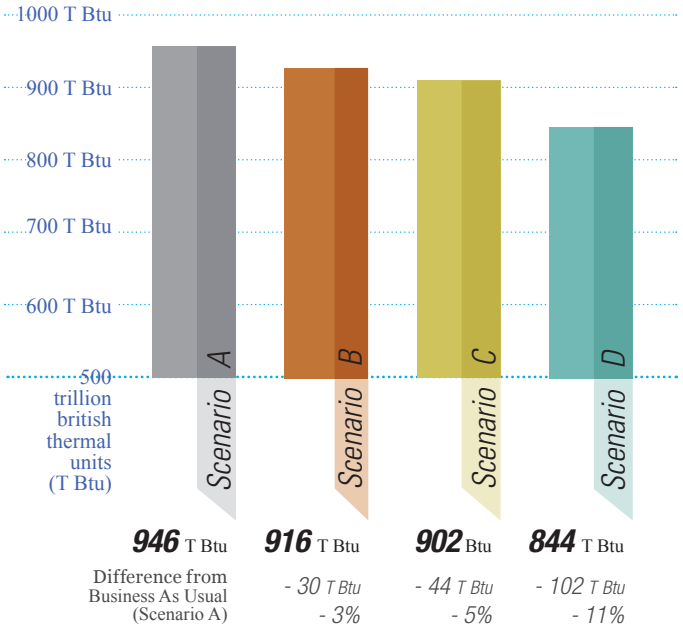
Energy Consumption, Cost, and Emissions

Variations in land use patterns lead to substantial differences in the amount of energy used. These differences will vary depending on policies regulating how efficient buildings become. Assuming the same efficiency standards for new buildings in all scenarios — an improvement to 30% below current baselines[31] by 2050 — there would be marked differences in energy use due to land use-related variations.

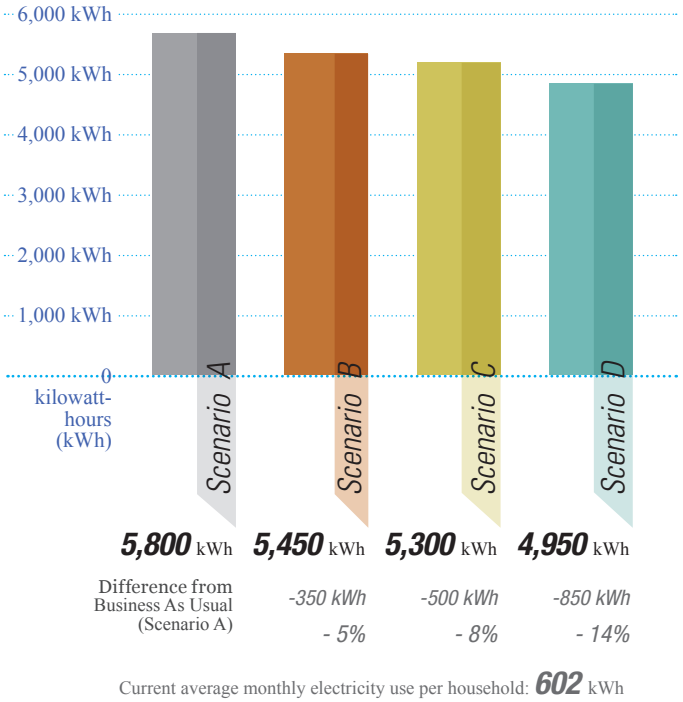
Cumulative energy use, including electricity and natural gas for all existing and new homes and commercial buildings to 2050, amounts to 946 trillion Btu in Scenario A. By comparison, Scenario B (Forecast Future) uses 3% less; Scenario C (Station Area Plans) uses 5% less, and Scenario D (Corridor Focus) uses 11% less. In 2050, the annual energy savings amount to as much as 1.4 trillion Btu in Scenario D — enough to power over 65,000 homes.

Looking at new residential growth alone, the differences between scenarios are magnified. Compared to Scenario A, the average new household in Scenario B uses 5% less electricity per year; Scenario C, 8% less; and Scenario D, 14% less. These savings equate to $220 per new household in Scenario B; $340 per household in Scenario C; and $590 per new household in Scenario D.

Cumulative Residential and Commercial Building Energy Use to 2050 (Btu)



Annual Residential Electricity Use per New Household in 2050 (kWh)



Current average monthly electricity use per household: **602** kWh

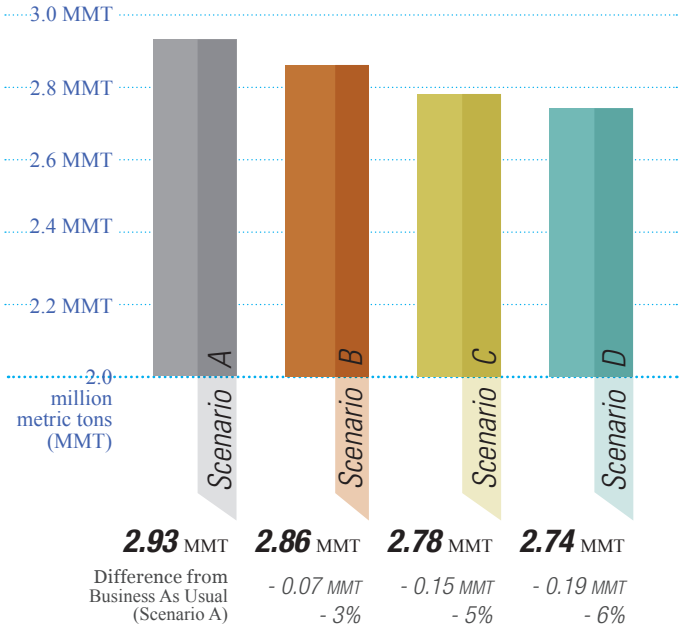
Energy Consumption, Cost, and Emissions (continued)

Over time, these household savings amount to a large sum: compared to the $46.5 billion total spent to 2050 in Scenario A, total residential energy costs (including existing and new growth households) in Scenario B would be $490 million less. In Scenario C, the costs would be $754 million less; in Scenario D, the costs would be $1.3 billion less. These estimates assume modest improvements in energy efficiency, applied to existing buildings as well as new growth.

The combined savings in residential and commercial energy are significant: compared to Scenario A, Scenario B uses 3% less energy per year; Scenario C uses 5% less; and Scenario D uses 6% less. The annual difference between Scenario A and Scenario D — about 1.3 trillion Btu — could power over 65,000 homes, or 15% of all households in 2050.

Conserving energy also reduces GHG emissions. The progressively more compact land uses of Scenarios B, C, and D would reduce emissions in proportion to energy use — 3%, 5%, and 6% each year, respectively, as compared to Scenario A. When combined with the effects of more stringent clean energy policies, which would reduce the amount of GHG emissions for every kilowatt-hour of electricity used, building energy emissions could be reduced even further.

Annual Residential and Commercial Building Energy GHG Emissions in 2050 (MMT CO_2e)



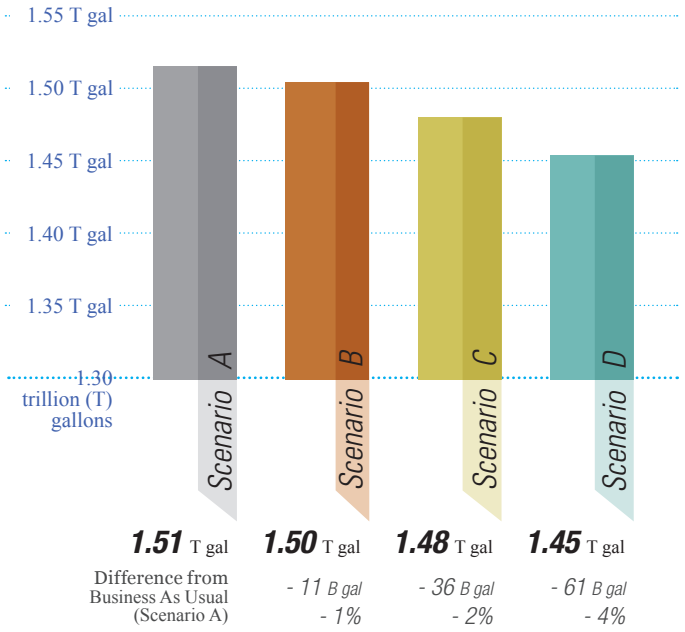
Residential Water Use

Variations in land use patterns and their related building profiles also lead to substantial differences in residential water use and cost. Residential water use is a function of both indoor and outdoor water needs, with outdoor use (landscape irrigation) accounting for the majority of the difference among housing types. Because homes with larger yards require more water for landscape irrigation, lot size is generally correlated with a household's overall water consumption. Thus, scenarios with a greater proportion of the Standard Suburban Land Development Category, which includes some larger-lot single-family homes, require more water than scenarios with a greater proportion of Mixed-Use Walkable or Urban Infill development, which include more attached and multifamily homes.

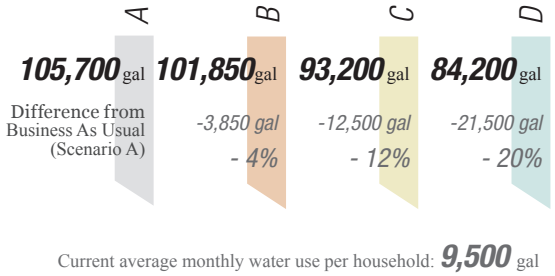
Water use will vary based on efficiency and conservation policies, which will be increasingly important as population grows relative to Oahu's limited water supply. Assuming the same modest improvements for all scenarios — an improvement to 30% below current baselines[32] by 2050 — we can see the potential savings attributable to land use patterns alone.

Compared to Scenario A, which uses 1.51 trillion gallons of water per year to 2050, Scenario B (Forecast Future) uses 11 billion gallons, or 1%, less; Scenario C (Station Area Plans) uses 36 billion gallons, or 2%, less; and Scenario D (Corridor Focus) uses 62 billion gallons, or 4%, less. The average new home using 3,850 fewer gallons per year in Scenario B; 12,500 fewer gallons in Scenario C; and 21,500 fewer gallons in Scenario D. Annually, the water savings are substantial: in 2050, Scenario A uses 39.8 billion gallons, while Scenario D uses 2.4 billion gallons less — enough to supply over 26,000 homes for a year.

Cumulative Residential Water Use to 2050



Annual Residential Water Use per New Household in 2050



Current average monthly water use per household: **9,500** gal

Greenhouse Gas Emissions Summary

Combined transportation and building sector impacts provide the most complete picture of the greenhouse gas emissions and fiscal implications of the futures presented by the Honolulu TOD Study scenarios. Passenger vehicle transportation, along with residential and commercial building energy use, currently account for over half of total carbon emissions on Oahu. Land use and transportation planning on Oahu, in conjunction with statewide policies in regulating energy emissions and efficiency, will be crucial to meeting the state's goals for GHG reductions, as well as its fiscal health.

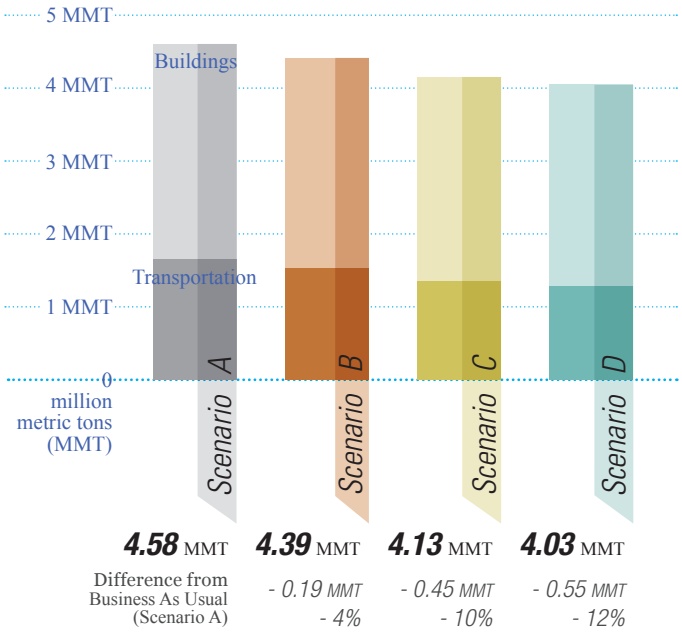
Greenhouse Gas Emissions from Transportation and Buildings

Total GHG emissions — including those from passenger vehicles, and emissions associated with residential and commercial building energy consumption — vary across the scenarios due to their differences in land use patterns. In 2050, Scenario A (Business as Usual), with the highest proportion of growth occurring as Standard Suburban development, would produce 4.6 million metric tons (MMT) of annual GHG emissions from buildings and transportation, the highest among the scenarios. Emissions decrease as land use patterns become more compact: in comparison to Scenario A, Scenario B (Forecast Future) results in 4% lower emissions; Scenario C (Station Area Plans) results in 10% lower emissions, and Scenario D (Corridor Focus) results in 12% lower emissions.

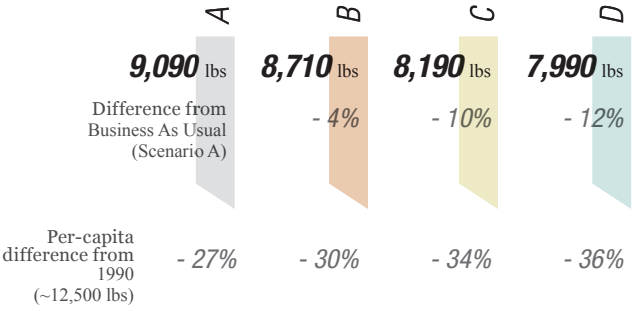
To put these figures into context, Hawaii's Act 234, passed in 2007, mandates a statewide reduction to 1990 levels of greenhouse gas emissions by 2020. California's Assembly Bill 32, the legislation upon which Act 234 was modeled, envisions an 80% reduction from 1990 levels by 2050. Oahu's 1990 emissions from building energy and passenger vehicle transportation can be estimated to be about 4.6 MMT; an 80% reduction target would fall below 1 MMT.

The results of the Honolulu TOD Study scenarios make it clear that decisions made about where and how to grow will play a fundamental role in meeting goals for reduced GHG emissions. It is only through a combination of smart land use and transportation planning with progressive "green" building- and auto-related energy policies that statewide targets for ongoing progress can be achieved.

Annual Transportation and Building Energy GHG Emissions, 2050 (MMT CO_2e)



Annual Transportation and Building GHG Emissions per Capita (lbs CO_2e)



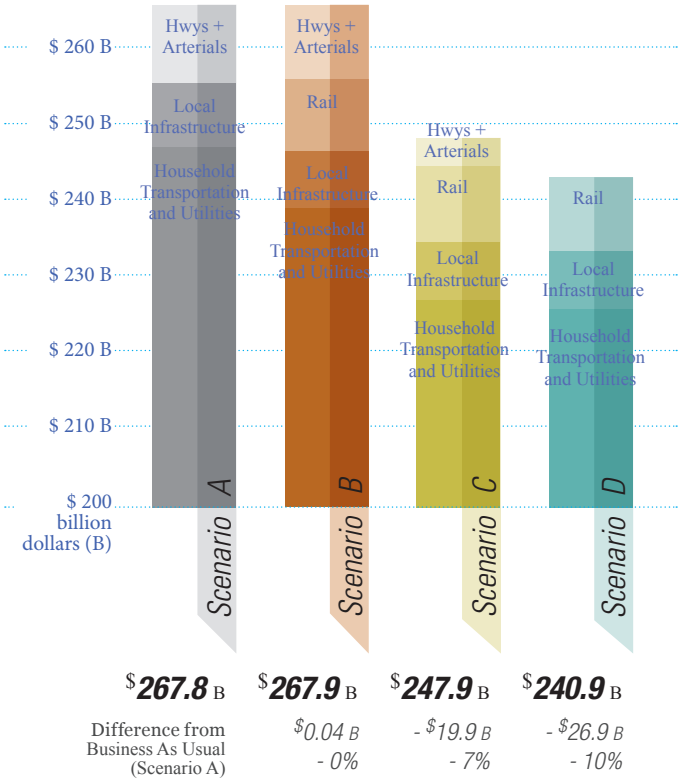
Cost Summary

The public and private costs associated with each of the Honolulu TOD Study scenarios are a product of their resource consumption, land pattern, and transit focus. A combined look at household costs for transportation and utilities, and the costs to build and maintain local and regional infrastructure illustrate that the corridor-focused scenarios show significant total savings even when the costs of the proposed rail transit system are included.[33] Cumulative savings total nearly $27 billion when comparing Scenario D to Scenario A, and significant savings of $20 billion are also realized in Scenario C.

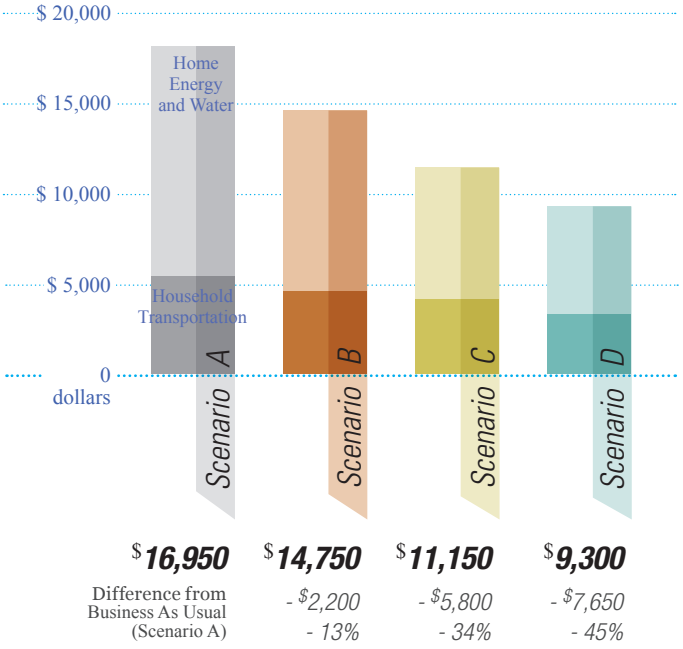
Looking at just household cost burdens for transportation and utilities (energy and water use) exposes the impact of land use and policy choices on Honolulu households' direct costs: in 2050, Scenario A (Business as Usual) would cost the average household $17,350 in expenditures associated with driving and residential energy and water use. By comparison, Scenario B (Forecast Future) would cost $950 less; Scenario C (Station Area Plans) would cost $2,450 less; and Scenario D (Corridor Focus) would cost $3,000 less.

Per new household, the differences are even greater: by 2050, Scenario A (Business as Usual) would cost the average new household $16,950 in expenditures associated with driving and residential energy and water use. Scenario B would cost $2,200 less; Scenario C would cost $5,800 less; and Scenario D would cost $7,650 less. Over time, the differences in annual expenditures would amount to a significant sum for each household — money that could instead be applied to a home mortgage or other living expenses, which would be spent in the local economy. Collectively to 2050, household spending amounts to $249 billion in Scenario A. Scenario B saves more than $8 billion; Scenario C saves $22 billion; and Scenario D saves $25 billion.

Cumulative (2010 to 2050) Expenditures for Regional and Local Infrastructure and Services + Household Transportation and Utilities (2011 dollars) to 2050 (2011 dollars)



Annual Household Costs per New Household in 2050 (2011 dollars)



Endnotes

1. Developed area includes low-, medium-, and high-intensity developed lands and developed open space as classified by the Coastal Change Analysis Program (C-CAP) 1992, 2001, and 2005 Hawaii Land Cover datasets. NOAA Coastal Services Center, 2009.

2. Inrix National Travel Scorecard, 2012. Accessed at www.scorecard.inrix.com, May 2012.

3. U.S. Census Bureau, American Community Survey, 5-Year Estimates, 2010.

4. Helber Hastert & Fee, Planners. *Honolulu General Plan Update Affordable Housing Trend Report*, 2010

5. U.S. Energy Information Administration, *Average Retail Price of Electricity to Ultimate Customers by Sector*, 2010.

6. U.S. Energy Information Administration, *Hawaii State Energy Profile*, 2009.

7. U.S. Environmental Protection Agency, Emissions and Generation Resource Integrated Database (eGRID2012) year 2009 data, 2012.

8. See, for example, Nelson, Arthur C., *The New California Dream: How Demographic and Economic Trends May Shape the Housing Market*, Urban Land Institute, December 2011. Also, Center for Transit-Oriented Development, *Hidden in Plain Sight: Capturing the Demand for Housing Near Transit*, 2004.

9. U.S. Census Bureau, Decennial Census of Population and Housing. 2000, 2010.

10. U.S. Census Bureau, American Community Survey 5-year Estimates, 2010.

11. This study does not suggest that no new larger-lot homes will be built to 2050, but rather that the aggregate number of larger-lot homes will not change.

12. For station area plans from the City and County of Honolulu, see honoluludpp.org/planning/TOD/TOD.pdf

13. See, for example, Cervero, Robert et. al, *TRCP Report 102: Transit-Oriented Development in the United States: Experiences, Challenges, and Prospects*, Transportation Research Board, 2004.

14. Parcels with floor-area ratios ranging from below 0.25 to 0.5 and improvements-to-land ratios ranging from below 0.15 to 0.5 were considered to have redevelopment potential.

15. Average VMT per household on Oahu is approximately 14,500 per year. Center for Neighborhood Technology, H+T® Affordability Index, 2010.

16. Ibid.

17. Ibid.

18. Oahu residential energy comes primarily from electricity.

19. Kilowatt-hour per new household figures include residential electricity use only; natural gas use, while minimal, is included in total energy use (expressed in British thermal units, or Btu). Usage estimates for all scenarios reflect a policy-based assumption of 30% less energy use by 2050.

20. Developed area includes low-, medium-, and high-intensity developed lands and developed open space as classified by the Coastal Change Analysis Program (C-CAP) 2005 Hawaii Land Cover dataset. NOAA Coastal Services Center, 2009.

21. Operations and maintenance costs include community services, customer services, design and construction, emergency management, emergency services, environmental services, facility maintenance, fire, police, and transportation services.

22. See, for example, Center for Transit Oriented Development, *Capturing the Value of Transit*, Federal Transit Administration, 2008.

23. For a description of the RapidFire VMT modeling methodology, refer to the RapidFire Technical Summary, available at www.calthorpe.com/scenario_modeling_tools.

24. U.S. Energy Information Administration, *Annual Energy Outlook 2012 Early Release*, 2012.

25. City and County of Honolulu Department of Transportation Services, *Honolulu High-Capacity Transit Corridor Project Alternatives Analysis Report*, 2006.

26. Roadway cost estimates assume a mix of different types of roadway construction, including high-cost and lower-cost projects. High-cost construction, priced at $155.8 billion per lane-mile (2011 dollars) based on the elevated facility analyzed as part of the Honolulu High-Capacity Transit Corridor Project "Managed Lane" alternative, is assumed for the first 55 lane-miles of additional highway capacity needed. Lower-cost construction, priced at $17.2 million per lane-mile (2011 dollars), is assumed for the remaining highway lane-miles needed (from Federal Highway Administration (FHWA), Highway Economic Requirements System inputs, 2008). The average cost of adding arterial lane-miles is assumed to be $5 million, based on FHWA data.

27. Total VMT in Scenario D is 4.8 billion miles, compared to approximately 4.6 billion miles in 2010.

28. Roadway maintenance costs are applied to new freeway lane-miles, assuming an average cost of $183,000 per lane-mile every 10 years.

29. Estimate based on further analysis applied to GHG inventory by sector. University of Hawaii Economic Research Organization (UHERO), *Hawaii Greenhouse Gas Emissions Profile, 1990 and 2005*, 2009.

30. 21.6 lbs CO_2e per gallon, based on a 10% emissions reduction from a baseline of 24 lbs CO_2e per gallon.

31. Refer to the Appendix for specific baseline energy use assumptions.

32. Refer to the Appendix for description of baseline water use assumptions.

33. Rail costs in this analysis include the capital costs for the minimum operating segment included in the 2009 Federal EIS ($4.49 billion in 2011 dollars), as well as the cost estimates for the Kapolei, Waikiki, and University of Hawaii extensions included in the Oahu Metropolitan Planning Organization Oahu Regional Transportation Plan 2035 ($3.04 Billion in 2011 dollars). Operations and maintenance costs are based on estimates in the EIS documents, and total $2.42 billion from 2021-2050. Cumulative rail capital and operations costs total to $9.95 billion with the extensions included.

34. U.S. Energy Information Administration, *Annual Energy Outlook 2012 Early Release*, 2012.

Appendix: Model Assumptions

	Base Year	2050
TRANSPORTATION		
Fuel economy	Passenger vehicle average: 20.7 mpg (est. per 2007 and projected 2035 mpg change from OMPO RTP). Represents on-road cars, trucks, SUVs, vans.	37 mpg, per EIA Reference Case fleet mix scenario.[34]
Fuel price	$4.13 Hawaii state average motor gasoline price, extrapolated from 2008.	$15.00 per gallon.
Auto operating cost	$0.26 per mile, including ownership and maintenance.	$0.45 per mile, based on Edmunds.com *True Cost of Ownership* data for Hawaii.
Roadway costs	Costs estimated for additional lane-miles only.	$139.6 billion per lane-mile for high-cost freeway projects; $15.4 million per lane-mile for lower-cost freeway projects; $5 million per lane-mile for arterials. Freeway maintenance: $18,300 per lane-mile, per year.
Transportation fuel emissions	24 lbs carbon dioxide equivalent (CO_2e) per gallon, derived from ORTP 2007 total fuel consumed and tons CO_2e.	21.6 lbs CO_2e per gallon, based on a modest assumption of 10% emissions reduction from baseline by 2050.
BUILDINGS		
Energy use of new buildings	HECO 2010 average electricity use per housing unit by type (single family 729 kWh/month avg; multifamily 426 kWh/month avg). Gas use (though minimal) differentiation by type is assumed based on EIA RECS data. • Larger-lot single family: 9,800 kWh/year; 17 thm/year • Smaller-lot single family: 7,250 kWh/year; 13 thm/year • Townhome: 7,000 kWh/year; 11 thm/year • Multifamily: 5,112 kWh/year; 9 thm/year Commercial energy use: 22.6 kWh/sq ft/year, based on EIA CBECS data, 2006.	30% below baselines, reflecting modest efficiency improvements.
Energy use of existing buildings	HECO 2010 average electricity use per household: 7,224 kWh. Average natural gas use per household: 11 therms, estimated based on total residential consumption and number of households, 2008. (Minimal natural gas market penetration/use rates for the residential sector are assumed into the future.) Commercial energy use: 22.6 kWh/sq ft/year, based on EIA CBECS data, 2006.	0.5% less energy used per year, reflecting modest improvements for building retrofits.
Electricity price	$0.35 per kWh state average (residential).	$0.69 state average, twice the baseline price.
Natural gas price	$4.19 per therm state average.	$9.33 per therm state average, reflecting a trend-based 2% annual increase in price.
Water use of new residential buildings	Estimated use per housing unit, by type, by subregion. Indoor use based on average per-capita rates; outdoor use based on lot size and evapotranspiration (water use) zone.	30% reduction below base year rates, reflecting modest efficiency and conservation policies.
Water use of existing residential buildings	313 gallons per household/day Oahu average (0.35 acre-feet per year), estimated from total water use and households served. Includes indoor and outdoor water use.	0.5% less water used per year, reflecting modest improvements for building retrofits. (This translates to a 50% reduction by 2050.)
Water price	$3.68 per 1,000 gallons ($1,200 per acre-foot) Oahu average.	$5.58 per 1,000 gallons ($1,819 per acre-foot), representing a 1.1% annual increase in price.
ENERGY EMISSIONS		
Electricity emissions	1.75 lbs CO2e/kWh state average.	1.05 lbs/kWh state average, based on a 40% reduction in emissions from the increase of renewable energy sources in state portfolio (HCEI goal is 40% renewables by 2030).
Natural gas emissions	11.7 lbs/therm average.	11.7 lbs/therm average (no change, since emissions are constant).

Background

RapidFire Model Output Metrics and Input Assumptions

Summary of Output Metrics

Land Consumption

- Land Consumed (square miles)

Fiscal Impacts

- Capital Costs for Roads and Wet and Dry Utility Provision ($)
- Operations and Maintenance Costs ($)

Transportation System Impacts and Emissions

- Vehicle Miles Traveled (VMT) (miles)
- Fuel Consumed (gal)
- Fuel Cost ($)
- Transportation Electricity Consumed (kWh)
- Transportation Electricity Cost ($)
- Transportation Electricity CO_2e Emissions (MMT)
- ICE Fuel Combustion CO_2e Emissions (MMT)
- ICE Full Fuel Lifecycle CO_2e Emissions (MMT)
- Criteria Pollutant Emissions (tons)

Public Health Impacts Related to Transportation Emissions*

- Respiratory and Cardiovascular Health Incidences (#)
- Health Costs associated with Health Incidences ($)

Building Energy, Cost, and Emissions

- Residential Energy Consumed (Btu)
- Commercial Energy Consumed (Btu)
- Total Energy Consumed (Btu)
- Residential Building CO_2e Emissions (MMT)
- Commercial Building CO_2e Emissions (MMT)
- Residential Energy Cost ($)
- Building Water Use, Cost, and Emissions
- Water Consumed (AF)
- Water Cost ($)
- Water-Related Electricity Use (GWh)
- Water-Related Electricity CO_2e Emissions (MMT)

Total Greenhouse Gas (GHG) Emissions

- Total CO_2e Emissions (Transportation & Buildings, MMT)

Building Program

- Housing type mix

Summary of Input Assumptions

Demographics

- Baseline population and population growth
- Baseline households and household growth
- Baseline housing units and housing unit growth
- Baseline non-farm jobs and job growth

Scenarios

- Land Development Category (LDC) proportions for each scenario and time period
- Housing unit composition for each LDC

Fiscal Impacts

- Per-unit capital cost assumptions for roads and wet and dry utility provision by building type and Land Development Category (LDC)
- Per-unit operations and maintenance cost assumptions for roads, utilities, and public services by building type and LDC

Land Consumption

- Percent greenfield vs. infill/greyfield/brownfield growth for each land development category, scenario, and time period
- Acres per capita required for greenfield development in each land development category, scenario, and time period

* Denotes an optional input which was not applied in calculating the output metrics presented in this report.

Summary of Input Assumptions [continued]

Vehicle Miles Traveled (VMT)

- Baseline Per Capita Light Duty Vehicle (LDV) VMT
- VMT adjustment factors by LDC and scenario for growth increment population
- VMT escalation and deceleration rates for the baseline environment population
- Elasticity of VMT with respect to driving costs per mile*

Vehicle Fuel Economy and Cost

- Baseline fuel economy for total fleet, internal combustion engine vehicles alone*, and alternative/electric vehicles alone*
- Fuel economy in horizon years for total fleet, internal combustion engine vehicles alone*, and alternative/electric vehicles alone*
- Elasticity of fuel economy with respect to fuel cost*

Transportation Emissions

- Baseline fuel emissions, full lifecycle (well-to-wheel) for total fleet, internal combustion engine vehicles alone*, and alternative/electric vehicles alone*
- Baseline fuel emissions, combustion (tank-to-wheel) for total fleet, internal combustion engine vehicles alone*, and alternative/electric vehicles alone*
- Percent gasoline vs. diesel in liquid fuel mix
- Composition of gasoline and diesel fuel mix
- Criteria pollutant emissions per mile traveled

Public Health Impacts Related to Transportation Emissions*

- Health incidences per ton of pollutant
- Health costs per ton of pollutant

Building Energy Emissions

- Electricity generation emissions (lbs/kWh)
- Natural gas combustion emissions (lbs/therm)
- Electricity generation emissions in horizon years (lbs/kWh)
- Natural gas combustion emissions in horizon years (lbs/therm)

Residential Building Energy Use & Price

- Baseline average annual energy use per unit for base/existing population
- Annual energy use by building type
- Housing unit replacement rate for base/existing housing stock
- Upgrade efficiency reduction factor 'A' for base/existing housing stock
- New efficiency reduction factor 'B' for replacement units of base/existing housing stock
- Upgrade efficiency reduction factor 'C' for replacement units of base/existing housing stock
- New efficiency factor 'D' for new units of the growth increment
- Upgrade efficiency factor 'E' for new units of the growth increment
- Baseline residential electricity price
- Baseline residential gas price
- Residential electricity price in horizon years
- Residential gas price in horizon years

Commercial Building Energy Use & Price

- Non-farm job proportion by floorspace-type category
- Floorspace per employee by category for each LDC
- Commercial space replacement rate for base/existing housing stock
- Baseline average annual energy use per square foot for base/existing commercial space
- Annual baseline energy use for new commercial space
- Replacement rate for base/existing commercial space
- Upgrade efficiency reduction factor for base/existing commercial space
- New efficiency reduction factor for replacement commercial space
- Upgrade efficiency reduction factor for replacement commercial space
- New efficiency factor for new floorspace of the growth increment
- Upgrade efficiency factor for new floorspace of the growth increment
- Baseline commercial electricity price
- Baseline commercial gas price
- Commercial electricity and gas price in horizon years

Residential Building Water Use

- Baseline per capita indoor water demand by building type
- Baseline per-unit outdoor water demand by building type
- New residential water efficiency (% reduction from 2005)
- Baseline water price ($/acre foot)
- Water price in horizon years ($/acre foot)

Residential Water-Related Energy Use and Emissions

- Average water energy proxy (electricity required per million gallons water used)

Credits

Consulting Team:

Lead:
Calthorpe Associates

Market Analysis and Implementation:
Strategic Economics

Local Planning and Development Expertise:
Bowers + Kubota

Acknowledgements:

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The Pacific Resource PARTNERSHIP

CALTHORPE ASSOCIATES
URBAN DESIGNERS. PLANNERS. ARCHITECTS