insight 2050

Scenario Results Report

DRAFT *Revised November 3, 2014*

morpc
Mid-Ohio Regional Planning Commission

COLUMBUS 2020

ULI Urban Land Institute Columbus

CALTHORPE ASSOCIATES
URBAN DESIGNERS, PLANNERS, ARCHITECTS

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Introduction

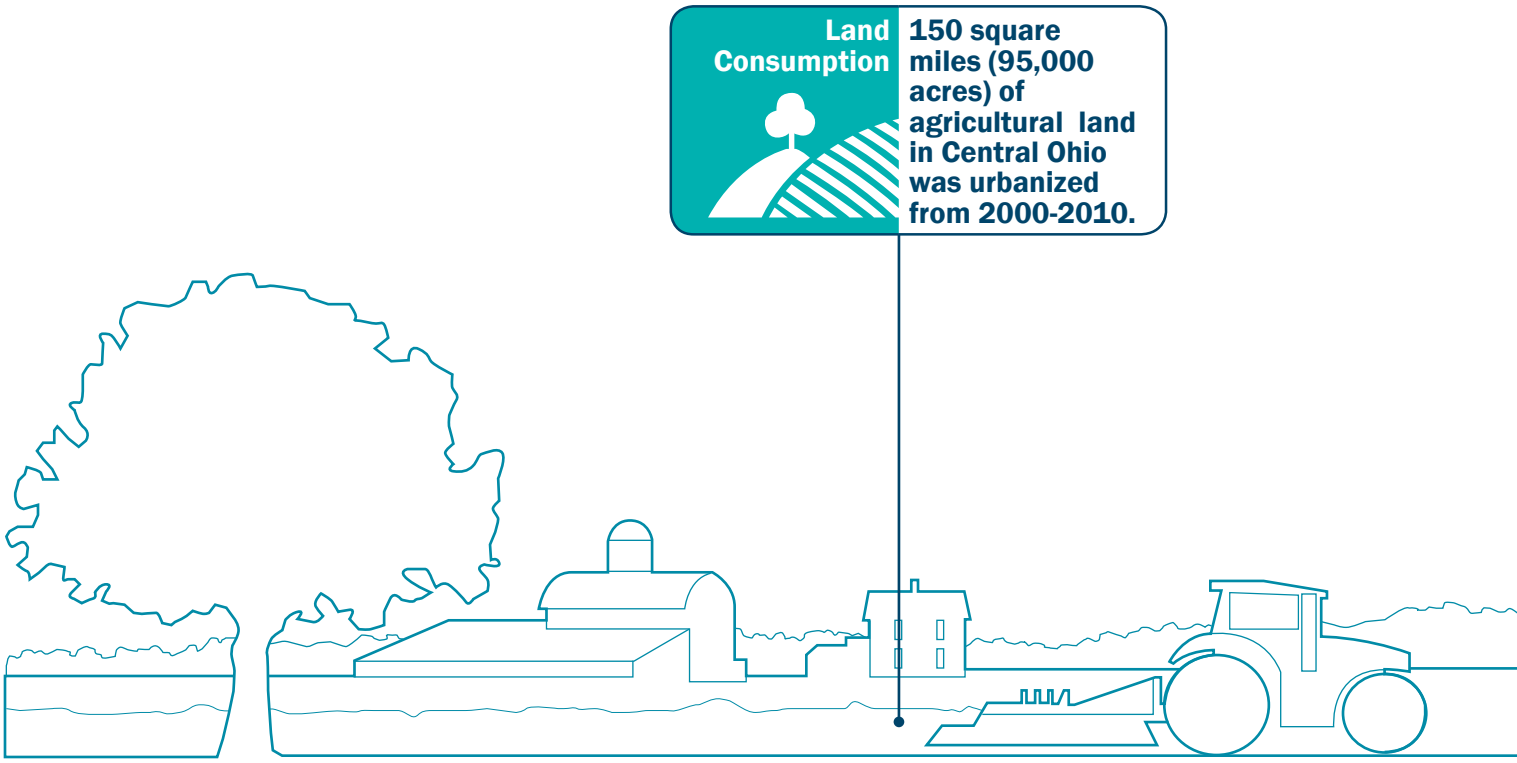
insight2050 is an effort to prepare Central Ohio for future growth. With the region slated to grow by more than 500,000 people and an additional 300,000 jobs by 2050, insight2050 is designed to provide local and regional policy makers, business leaders, developers, and public stakeholders with a clear and objective understanding of the impacts of varying growth and public investment decisions. insight2050 is not about producing a regional plan or regulating how land use decisions are made by the more than 200 jurisdictions that make up the Central Ohio region. Rather, it strives to arm decision makers and stakeholders with solid and defensible information about the fiscal, mobility, environmental, and public health impacts of development and investment choices.

The analysis behind this first phase of insight2050 relies on the RapidFire modeling platform developed by project consultants Calthorpe Associates. This model facilitates the creation of regional land use scenarios and allows for the modeling of a complete range of metrics, including land consumption, infrastructure costs, air pollution, household expenses for transportation and utilities, and public health and safety costs. While land use patterns reflect many separate local decision making processes, the objective scenarios and metrics generated by the RapidFire model provide critical insights to public and private decision makers about the impacts of key policies, while also supporting conversations about the region's future competitiveness, sustainability, and quality of life. The scenarios are intended to illustrate the impacts of varying future growth patterns, and are not meant to serve as a prescriptive vision or plan for the region.

This report describes the range of scenarios developed for the Central Ohio region, the process to build them and customize the RapidFire model for use in Central Ohio, and the analysis of the scenarios for a complete range of fiscal, transportation, environmental, public health, and other metrics.

insight2050 Steering Committee and Consulting Team

insight2050 is a collaboration among the Mid-Ohio Regional Planning Commission (MORPC), Columbus 2020, and the Urban Land Institute (ULI) Columbus. This phase of the process has been guided by a Steering Committee made up of over 30 volunteers from the public and private sectors. Most major cities and counties are represented, as are key academic, non-profit, and community stakeholders from



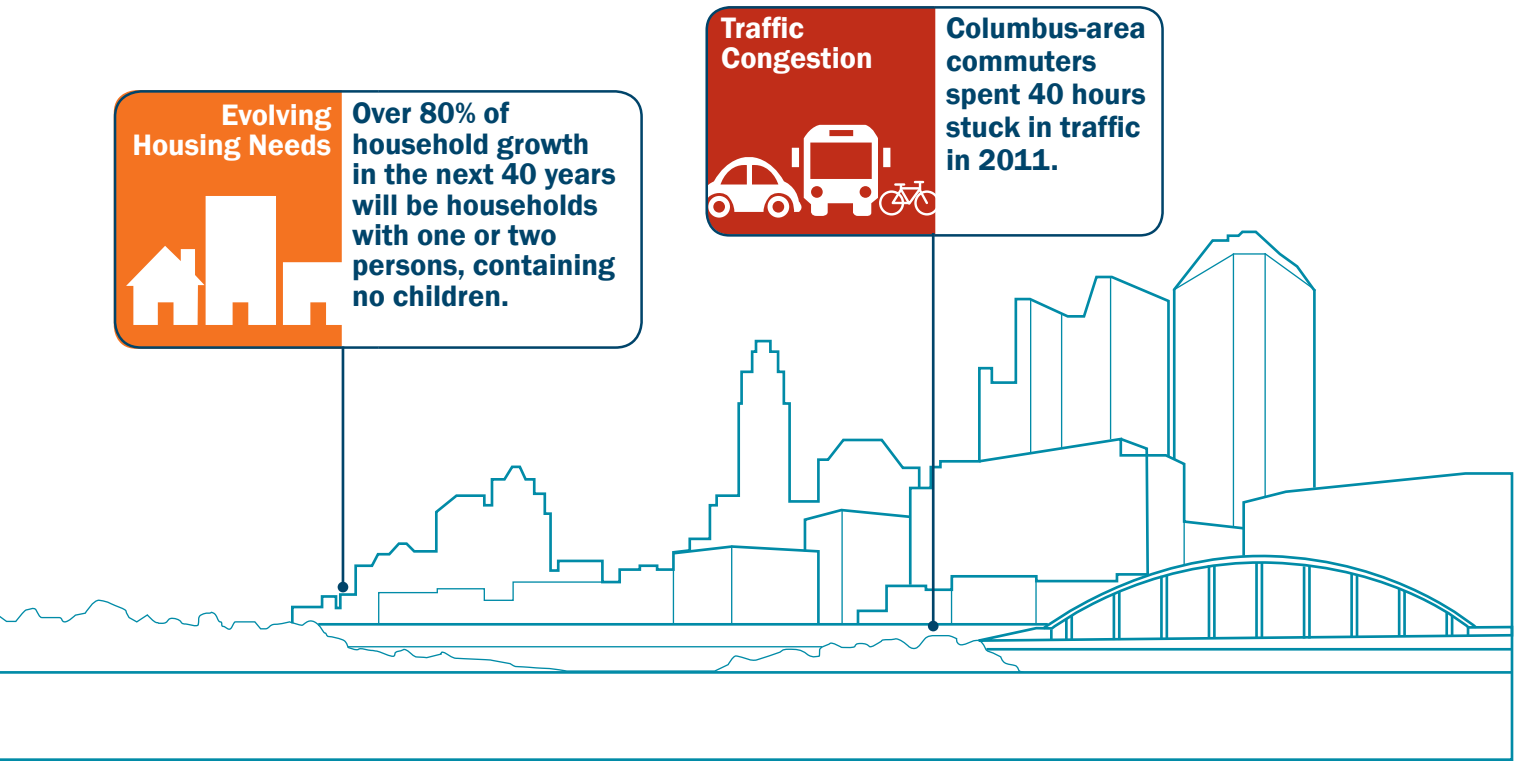
across the 7-county insight2050 study area (Delaware, Fairfield, Franklin, Licking, Madison, Pickaway, and Union counties). The Steering Committee has been critical in providing input on scenarios, modeling assumptions, and project communication. There is also a project Executive Committee made up of representatives from MORPC, Columbus 2020, the City of Columbus, the Central Ohio Transit Authority (COTA), and ULI Columbus; see Appendix D for a complete list of Steering Committee and Executive Committee members.

The insight2050 consulting team has been led by Calthorpe Associates, one of the nation's most experienced planning firms. Calthorpe Associates' work has focused on the customization and deployment of the RapidFire model for Central Ohio, and the evaluation and presentation of the impacts of future growth and development decisions. The customization of fiscal impacts assumptions was performed by market analysis experts Strategic Economics.

Scenario Planning for Central Ohio

Like other metropolitan regions across the US, Central Ohio is looking towards a future population that is significantly different than the population that drove its growth over the past decades. As a nation and a region, we are seeing an increasing proportion of aging baby boomers and young adults. Indeed, these age cohorts are slated to represent nearly 80% of the growth in Central Ohio over the next two to three decades. This changing population is expressing a demand for a broader range of housing types – more small-lot single family homes, more townhomes, and more multifamily apartments and condos – in more complete, walkable communities. In many ways, insight2050 scenarios are aimed at thinking ahead to how Central Ohio will meet these needs while keeping an eye on fiscal and environmental sustainability, the cost of living, and quality of life associated with development decisions.

The insight2050 scenarios described in this report range from a depiction of 'Past Trends' to more 'Focused Growth' and 'Maximum Infill' options. Again, the scenarios do not prescribe any specific solution, but rather lay out different ways the region can grow and accommodate projected growth. More and better information brings more people and more interests to the table, helps people understand the impacts of their choices, and leads to more sustainable decisions.



Scenario Drivers

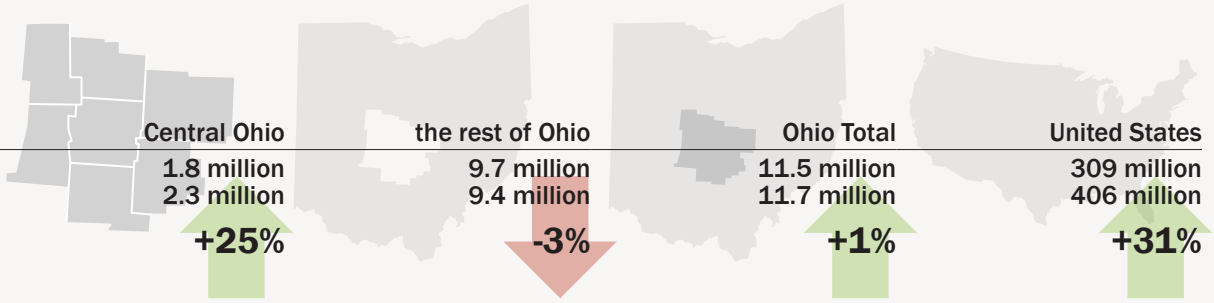
The insight2050 scenarios address important questions about Central Ohio's future growth, and the specific role that demographic changes and housing demand will play over the coming decades.

Growth

How much will Central Ohio grow between now and 2050?

Each of the insight2050 scenarios accommodates the same number of people, homes, and jobs. insight2050 uses regional projections from MORPC for population and employment through 2050, based on official projections from the state. According to these projections, the 7-county region will grow by about 500,000 people and 300,000 jobs between 2010 and 2050; about 300,000 new housing units will be needed to accommodate population growth. This rate of growth is roughly on pace with national growth rates, and far exceeds that of other cities in Ohio.

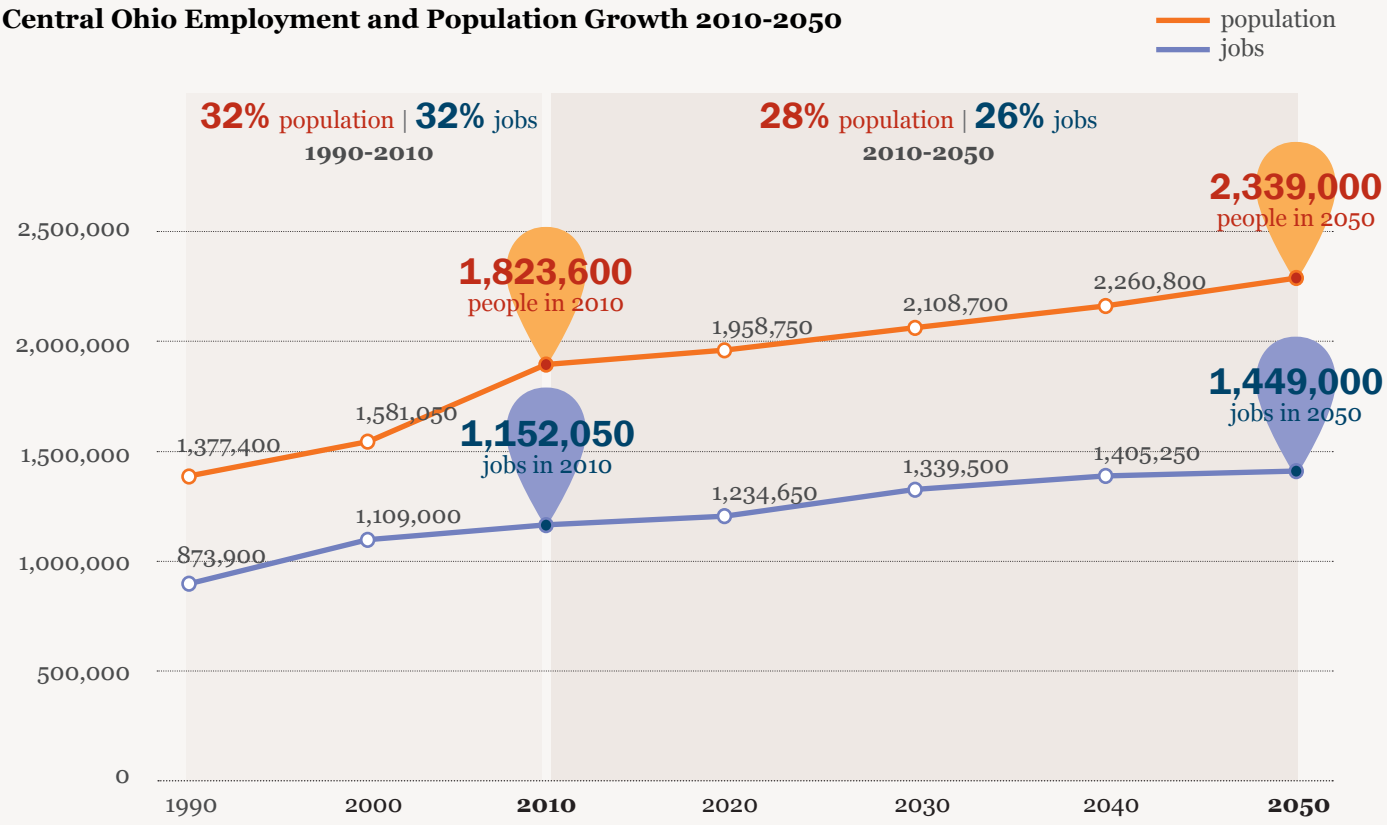
Population Growth by Regions 2010-2040



	Central Ohio	the rest of Ohio	Ohio Total	United States
2010	1.8 million	9.7 million	11.5 million	309 million
2040	2.3 million	9.4 million	11.7 million	406 million
Percent Change	+25%	-3%	+1%	+31%

Source: US Census Bureau, American Community Survey 2012

Central Ohio Employment and Population Growth 2010-2050



Source: US Census Bureau, American Community Survey 2012

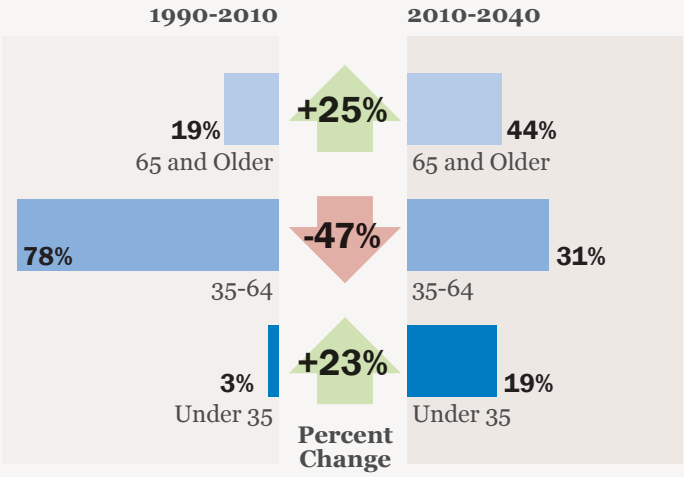
The Changing Profile of Central Ohio's Growth

Who is Central Ohio now and who will it be in the future?

The past 40 years have seen Central Ohio communities grow by more than 675,000 people, enough to fill Ohio Stadium more than six times. More than 400,000 housing units were constructed and more than 625,000 jobs were added by our region's employers. While Columbus and other historic downtowns have remained vital, growth over the past decades has been characterized, for the most part, by single family residential growth outside the outerbelt, and new suburban employment concentrations. Most growth was designed around automobile access and investments in a robust highway and roadway network. This form of growth accelerated as the Baby Boomers entered their peak wage-earning and family-raising years. Local plans and policies, and regional infrastructure investments, pivoted towards supporting this generation's demand for larger-lot single family homes and suburban lifestyles. With some ebbs and flows, the region has been fairly prosperous through the past 30 to 40 years.

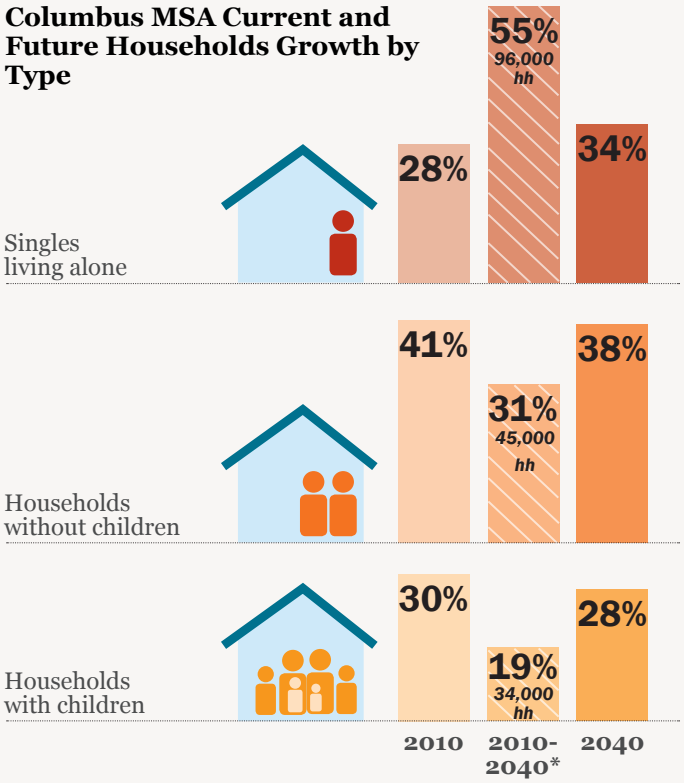
Over the next 40 years, Central Ohio, like most other regions and states across the United States, will be experiencing dramatic changes related to demographics and the shifting preferences of existing and future residents and workers. Nearly 80% of the growth in the last two decades (1990 to 2010) was among 35 to 64 year olds. Over the next decades, this same group will account for only 31% of growth. Aging baby boomers will make up nearly 45% of growth and those under 35 will account for more than 25%. Households with children will account for less than 20% of growth over the next decades, and the region will be more diverse; racial and ethnic minorities are expected to account for a majority of the region's growth by 2050. These significant shifts have implications for the kinds of homes and communities needed and preferred by existing and future residents of Central Ohio.

Columbus MSA Current and Future Population Growth by Age Group



Source: Arthur C. Nelson, COLUMBUS, OHIO Metropolitan Area trends, Preferences, and opportunities: 2010 to 2030 and to 2040 (NRDC)

Columbus MSA Current and Future Households Growth by Type



*Refers to households added from 2010-2040, excluding households that existed prior to 2010.

Source: US Census Bureau, American Community Survey 2012

Scenario Drivers

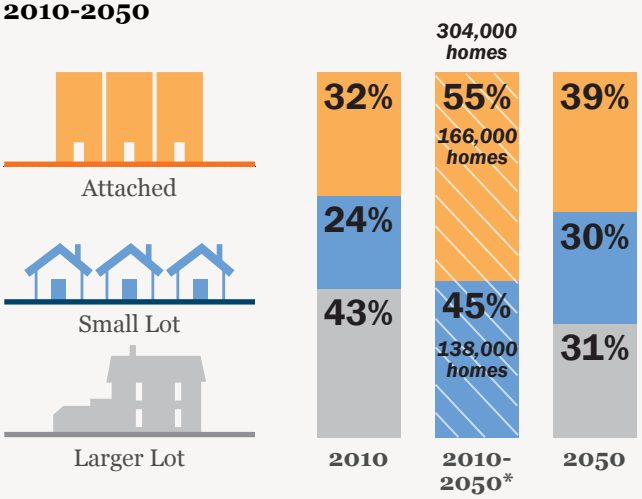
Evolving Housing Needs

What kinds of communities and housing do residents need now & into the future?

Recent studies by the National Association of Realtors (NAR), Urban Land Institute, and other organizations across the country are pointing towards increasing preferences for walkable, complete communities where daily needs are within close proximity to homes and jobs. NAR's 2013 Community Preference Survey points out that "Americans prefer walkable, mixed-use neighborhoods and shorter commutes." More than 60 percent of respondents "favor a neighborhood with a mix of houses and stores and other businesses that are easy to walk to, rather than neighborhoods that require more driving between home, work and recreation."

These trends and changing preferences raise important questions about the vitality and competitiveness of our region and communities over the coming decades. What types of places will attract the skilled labor forces our businesses require? Are today's land use plans and development regulations aligned with the goal of attracting residents and businesses, helping communities to remain competitive and improve their tax bases? Are private developers able to respond to these emerging market trends? A recent study of regional housing demand commissioned by the Urban Land Institute provides a look at the housing demand profile of our changing population. It lays out a shrinking demand for larger-lot single family homes (those on lots greater than 7,200 square feet), and an increasing demand for well-located smaller-lot detached homes, attached/townhome products, and multifamily housing. With more than 330,000 larger-lot homes on the ground now, demand is for an additional 140,000 smaller-lot detached single family homes, and 166,000 attached units. Through 2050, this represents a broader choice in housing products, with just over 60% of homes on single family detached lots in 2050 (compared to 67% in 2010) and just under 40% in townhomes and multifamily products. The insight2050 scenarios are designed in part to test the impacts of meeting this projected demand, compared to maintaining a trend-based housing profile, or building out the housing profile of the local jurisdictions' current plans and policies.

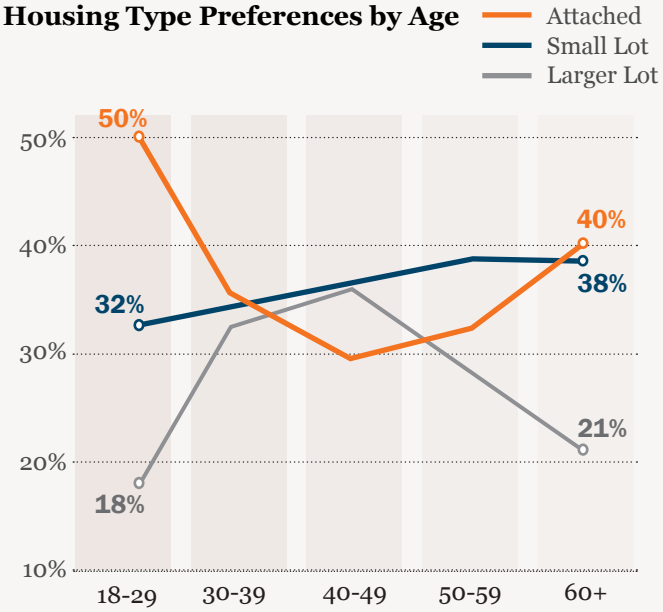
Columbus MSA Housing Needs by Home Type 2010-2050



*Refers to households added from 2010-2050, excluding households that existed prior to 2010.

Source: Arthur C. Nelson, COLUMBUS, OHIO Metropolitan Area trends, Preferences, and opportunities: 2010 to 2030 and to 2040 (NRDC)

Housing Type Preferences by Age



Source: National Association of Realtors (2011)

Local Examples

The City of Newark is preparing for shifting demands and demographics by working to attract millennials to the community. To that end the City is working to make its downtown Courthouse Square a destination by incorporating pedestrian-friendly street designs and necessities within walking distance to mixed-use developments.

The City of Columbus is planning for shifting demographics and demand by accommodating a range of development options in its downtown and urban neighborhoods. A market study for the City's East Franklinton Plan forecasts a potential 2,000-plus market rate housing units; 50,000 square feet of retail; and 100,000 square feet of office, incubator and arts space over the next 10 years. Meanwhile in West Franklinton the City is focusing on stabilizing housing, attracting retail and creating jobs.

Mixed-use projects like The Lane in Upper Arlington, The Heights in Worthington and Bridge Park as a part of the Bridge Street District in Dublin (shown at right) are responding to shifting demographics leading to greater market demand for walkable neighborhoods with access to offices, retail and restaurants.

Building Scenarios

The insight2050 scenarios depict the growth choices facing Central Ohio by combining different land patterns with variations in housing type mix, concentrations of development, and the proportion of growth accommodated either on previously undeveloped land, or through infill and redevelopment on already urbanized "refill" land. They also vary in the proportion of growth accommodated in incorporated or unincorporated areas of the 7-county region.

Using the RapidFire model, land use scenarios are defined by the proportion of growth allocated to Urban, Compact, and Standard 'place types'. The place types represent distinct forms of land use, each of which is associated with a unique set of assumptions describing housing type mix, travel behavior, land consumption, infrastructure costs, and other key factors. The place types are based upon and calibrated to development in the Central Ohio region. The model varies the amount of each place type in four insight2050 growth scenarios:

- Past Trends – extends past development trends (from 1990) forward to 2050
- Planned Future – reflects and extends local plans with moderate infill/redevelopment
- Focused Growth – informed by housing demand forecasts, with significant infill/redevelopment
- Maximum Infill – informed by housing demand forecasts, with maximum infill/redevelopment in existing corridors and city centers

Because the scenarios accommodate new growth with different proportions of the three place types, the scenarios vary in performance in terms of transportation, local government finances, environmental sustainability, and public health. The scenarios illustrate the differing impacts of varying future growth patterns, and are not meant to serve as a prescriptive vision or plan for the region. They do not allocate growth to specific locations, but rather to growth patterns in generalized location types (i.e. infill vs. greenfield locations).

The RapidFire Model

The insight2050 scenarios were produced using the RapidFire scenario modeling tool developed by the planning and design firm Calthorpe Associates. The model is a spreadsheet-based tool used to evaluate scenarios at the national, state, regional, 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 varying land use patterns across a range of critical metrics.

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 land use, energy, water, transport, and infrastructure investment policies. The model produces results for a range of metrics, including:

- Land consumption
- Travel behavior and vehicle miles traveled (VMT)
- Air pollution and public health impacts
- Fuel use and cost
- Building energy and water use, and cost
- Local fiscal impacts, including capital infrastructure costs, operations and maintenance costs, and local revenues
- Greenhouse Gas (CO_2e) emissions from cars and buildings

The RapidFire model underwent significant customization to prepare it for Central Ohio scenario development and analysis. This included refinement of fiscal impacts assumptions to reflect the unique cost, tax, and revenue structures of Ohio; additional sensitivity to rural housing and development types; and calibration of all analytical models to reflect Ohio land patterns and development intensities and policy assumptions.

A detailed description of the RapidFire model can be found in the RapidFire Technical Summary, available at www.calthorpe.com/scenario_modeling_tools.

Place Types

Building Place Types

The place types used to build the insight2050 scenarios are based on the characteristics of development in communities across Central Ohio. These Urban, Compact, and Standard place types represent the range of development patterns found in the region, from the most intense and mixed parts of Downtown Columbus, to compact walkable neighborhoods and towns such as Granville and Grandview Heights to standard suburban areas that are common across the 7-county region. Each of the three place types vary in their development intensity, mix of uses, and walkability. Higher levels of each of these characteristics are generally associated with lower automobile use, as well as lower household transportation costs and energy and water bills. The maps below illustrate how these factors come together to impact automobile use in typical Central Ohio communities.

Walkability

Intersections per square mile

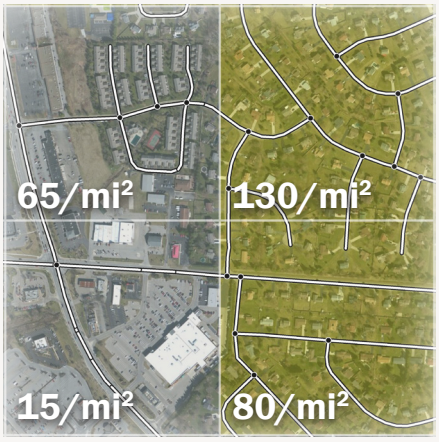
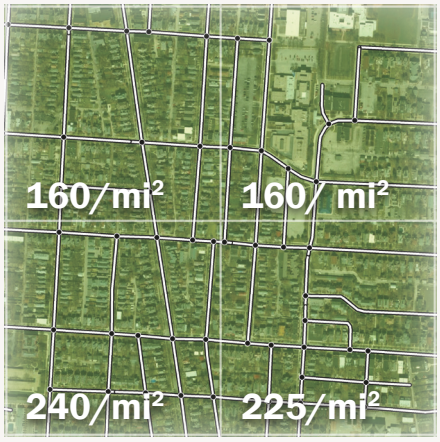
- under 80
- 80 - 150
- over 150

Activity Density

Households and jobs per acre

- under 0.5 (not shown)
- 0.5 - 6.0
- over 6.0

Household Driving (VMT)

	Standard *(Pickerington, Fairfield County)*	**Compact** *(Victorian Village)*
Walkability		
Activity Density		
Household Driving (VMT)	**19,000 miles / year**	**10,200 miles / year**

How Place Types Change

This photo montage illustrates how a typical 'Standard' development environment can transition to a more 'Compact' place over time.

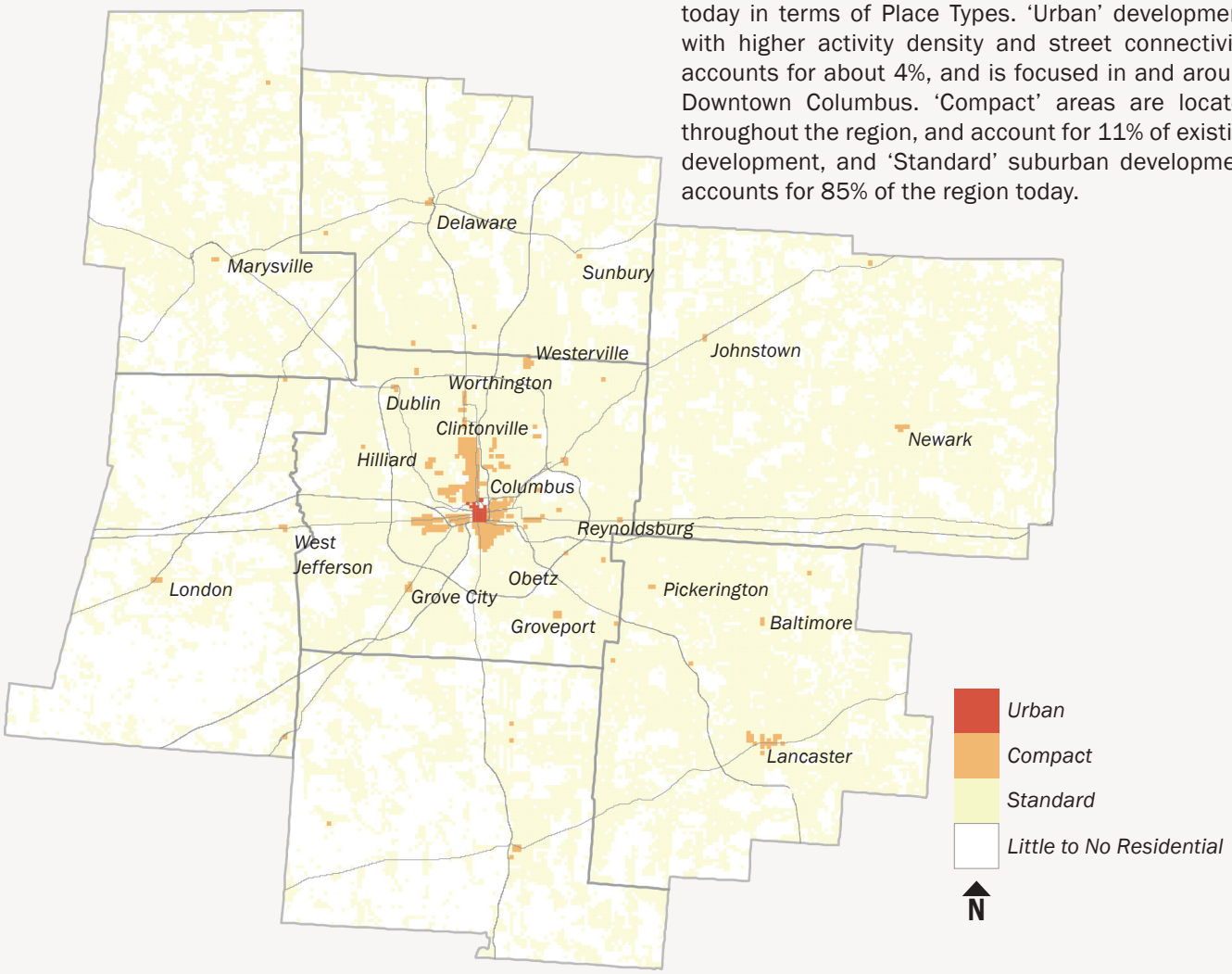
This intersection is typical of many 'Standard' suburban corridors in Central Ohio and the US. There are many opportunities for moderate intensification and improvements to the streetscape.

Sidewalk, crosswalk, landscaping, and other public improvements can set the stage for new residential and commercial development on the corridor.

Moderate scale commercial and residential development can bring vitality and activity to the corridor and place more people and jobs within easy walk, bike, transit, and drive access.

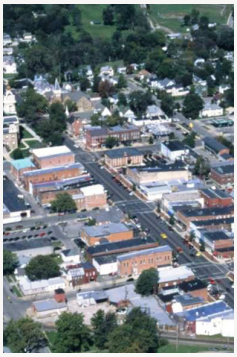
Place Types in Central Ohio Today

This map illustrates how Central Ohio can be described today in terms of Place Types. 'Urban' development, with higher activity density and street connectivity, accounts for about 4%, and is focused in and around Downtown Columbus. 'Compact' areas are located throughout the region, and account for 11% of existing development, and 'Standard' suburban development accounts for 85% of the region today.



Urban

Compact



Standard

Place Types Summary

Urban

Land Use Characteristics

Virtually all new Urban growth would be considered infill or redevelopment, and much of it would occur in the existing urban core in and around Downtown Columbus. The majority of housing in Urban areas is multifamily and attached single family (townhome), with some smaller-lot single family homes.

Transportation Infrastructure

Supported by higher 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.

Development Mix and Intensity

Housing Mix

Transportation Options

Typical miles driven per household

less than 10,000 per year

Compact

Land Use Characteristics

Less intense than Urban, but yet highly walkable with a rich mix of retail, commercial, residential, and civic uses. There are numerous examples of Compact communities in Central Ohio, from places like Clintonville and Grandview Heights that originally grew around street car lines in the 1920s and 30s, to smaller towns like London, Plain City, Johnstown, or Sunbury. New Compact growth can occur in already urbanized areas, on the urban edge, or in larger-scale redevelopment projects. The Compact place type contains a diverse mix of housing, from multifamily and attached single family (townhome) to small- and medium-lot single family homes

Transportation Infrastructure

Well served by regional and local transit service, but may not benefit from as much service as Urban growth. 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.

Development Mix and Intensity

Housing Mix

Transportation Options

Typical miles driven per household

10,000-15,000 per year

Standard

Land Use Characteristics

Represents the majority of suburban auto-oriented development that has occurred in Central Ohio over the past decades. Densities tend to be lower than those of Compact areas, with uses that are generally not highly mixed or organized to facilitate walking, biking, or transit service. The Standard place type can contain a wide variety of housing types, though medium and larger-lot single family homes comprise the majority of this development form.

Transportation Infrastructure

Not typically well served by regional transit service. Local street networks are not as well connected as those in Compact and Urban place types. There are fewer destinations available via walk or bicycle; most trips are made via automobile.

Development Mix and Intensity

Housing Mix

Transportation Options

Typical miles driven per household

above 15,000 per year

Urban Examples

Gay & 4th - Columbus

25 S. High - Columbus

Compact Examples

Granville

Circleville

Hilliard

Standard Examples

Amberleigh Subdivision, Dublin

Grove City (Pinnacle)

Morse Road, Columbus

insight2050 Scenarios Overview

Each of the insight2050 scenarios represents a different way of accommodating projected housing and job growth in Central Ohio to the year 2050. Each includes the same total number of people, homes, and jobs, but varies in where and how they are located across the region. 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 Central Ohio's current and future residents.

scenarioA
Past Trends

This scenario extends the land use and transportation investment decisions of the past decades forward to 2050. A majority of growth is accommodated on previously undeveloped land, with most growth (85%) tending towards suburban and rural, auto-oriented development. New development is composed primarily of larger-lot single family homes and suburban office parks and commercial centers.

scenarioB
Planned Future

The housing and job distribution of this scenario reflects the direction of local plans and policies from the cities and townships across the Central Ohio region. There is more Compact growth than in the Past Trends scenario, and more smaller-lot single family and attached homes, though the majority of growth is still auto-oriented and tends to be located at the periphery of cities and towns. About half of new growth is accommodated as infill or redevelopment; the rest occurs on previously undeveloped land.

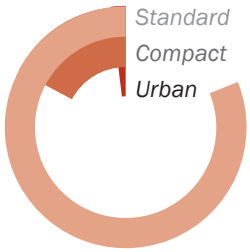
scenarioC
Focused Growth

This scenario seeks to accommodate more growth in infill and redevelopment locations in and around existing cities and towns. Land patterns and housing mix are informed by housing demand forecasts, with significantly more smaller-lot single family, attached single family, and multifamily homes than the Planned Future or Past Trends scenarios. A large majority (84%) of growth takes the form of Compact development in walkable, moderate intensity mixed-use areas. There is also significant Urban development (10% of new growth) in Downtown Columbus. There is very little Standard growth or new larger-lot single family housing development in this scenario, as the majority of demand for this product is met through the existing supply.

scenarioD
Maximum Infill

This scenario strives to maximize growth accommodated through infill on previously developed lands and within existing urban areas. The Urban place type assumes nearly 30% of growth in existing city centers and commercial corridors where significant redevelopment opportunities exist. An additional 70% takes the form of moderate intensity and walkable Compact development. Like the Focused Future scenario, the residential mix is informed by housing demand forecasts, with significantly higher proportions of multifamily, attached single family/townhomes, and smaller-lot single family homes. There is very little new larger-lot single family housing development in this scenario, as the majority of demand for this product is met through the existing supply.

Place Type Proportions	Infill / Redeveloped Land vs. Undeveloped Land	Housing Unit Mix



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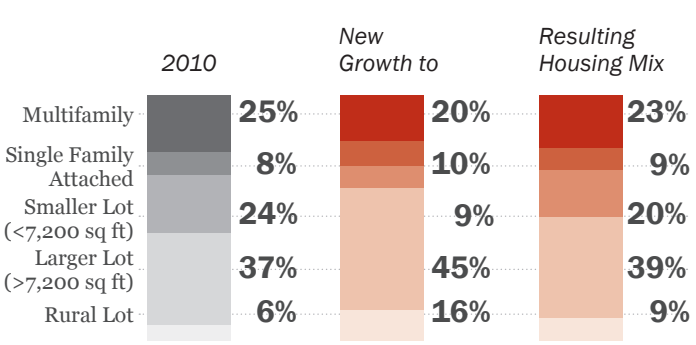

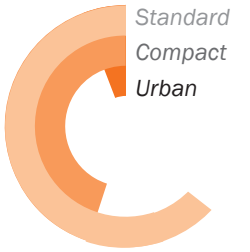

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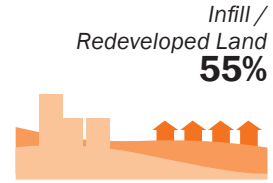

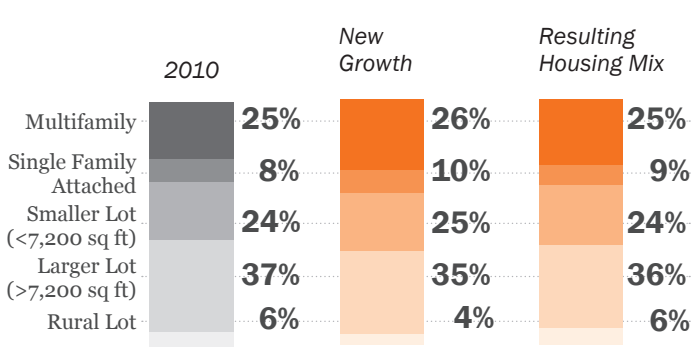

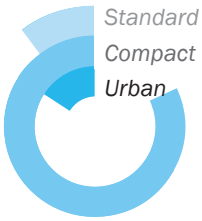

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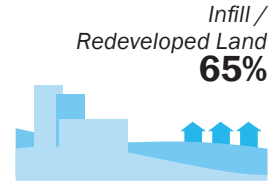

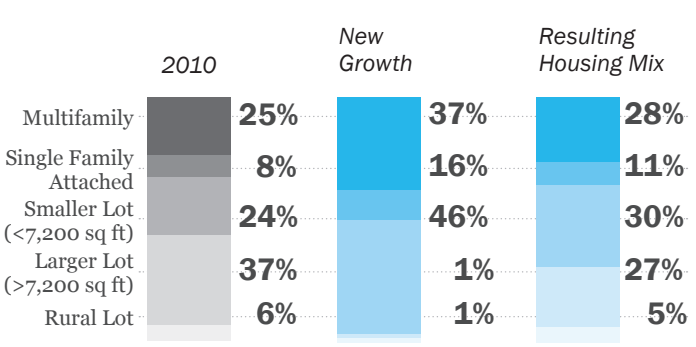

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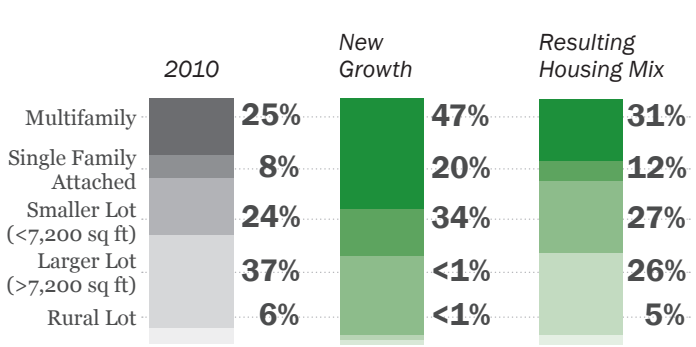


insight2050 Scenario Metrics Summary

The comparative scenario metrics summarized here are described in more detail in the following sections. For clarity, values are rounded. All costs are expressed in 2014 dollars.

Land Consumption

Includes all previously undeveloped land that is urbanized from 2010-2050.

Local Fiscal Impacts

Capital and ongoing operations and maintenance (O&M) costs for new local roads, sewer, water, waste-water infrastructure, and select services (2010-2050).

Transportation

Miles driven in passenger vehicles in Central Ohio in 2050.

scenarioA Past Trends

This scenario extends the land use and transportation investment decisions of the past decades forward to 2050.

495 square miles

O&M 11.0 | Capital 3.32

$14.3 billion

$408 Million
Average Annual Costs Capital + O&M 2010-2050

15.9 billion miles

8,450 *miles / year (per new resident, 2050)*

scenarioB Planned Future

The housing and job distribution of this scenario reflects the direction of local plans and policies from the cities and townships across the Central Ohio region.

270 square miles

10.3 | 3.5

$13.8 billion

$393 Million
Average Annual Costs Capital + O&M 2010-2050

15.3 billion miles

7,450 *miles / year (per new resident, 2050)*

scenarioC Focused Growth

This scenario seeks to accommodate more growth in infill and redevelopment locations in and around existing cities and towns.

45 square miles

9.1 | 2.4

$11.4 billion

$329 Million
Average Annual Costs Capital + O&M 2010-2050

12.0 billion miles

4,450 *miles / year (per new resident, 2050)*

scenarioD Maximum Infill

This scenario strives to maximize growth accommodated through infill on previously developed lands and within existing urban areas.

15 square miles

9.1 | 2.2

$11.2 billion

$328 Million
Average Annual Costs Capital + O&M 2010-2050

11.1 billion miles

3,850 *miles / year (per new resident, 2050)*

Public Health Costs

Annual costs due to health incidences related to auto emissions, including hospitalization, premature mortality, and lost work days, in 2050.

Scenario A used as baseline for comparison

-$41
Million

-$246
Million

-$315
Million

Building Energy Use

Cumulative energy (electricity and gas) consumed by new and existing residential and commercial buildings from 2010-2050.

4.27
quadrillion Btu
(British thermal units)
$78.2 B
Cumulative Costs 2010-2050

4.23
quadrillion Btu
$77.5 Billion
Cumulative Costs 2010-2050

4.15
quadrillion Btu
$76.0 Billion
Cumulative Costs 2010-2050

4.12
quadrillion Btu
$75.5 Billion
Cumulative Costs 2010-2050

Building Water Use

Cumulative water used to serve and maintain new and existing homes from 2010 - 2050.

3.19
trillion gallons

3.12
trillion gallons

3.03
trillion gallons

3.01
trillion gallons

Greenhouse Gas Emissions

Annual CO2e emissions from passenger vehicles, and residential and commercial buildings, in 2050.

Buildings *Transport*

29.1 | 6.7

35.8
MMT / year
(Million Metric Tons)

28.8 | 6.5

35.2
MMT / year

28.2 | 5.0

33.3
MMT / year

28.0 | 4.7

32.7
MMT / year

Household Costs

Annual automobile transportation (fuel, insurance, maintenance) and home energy and water costs, 2050

$13,100
per new household

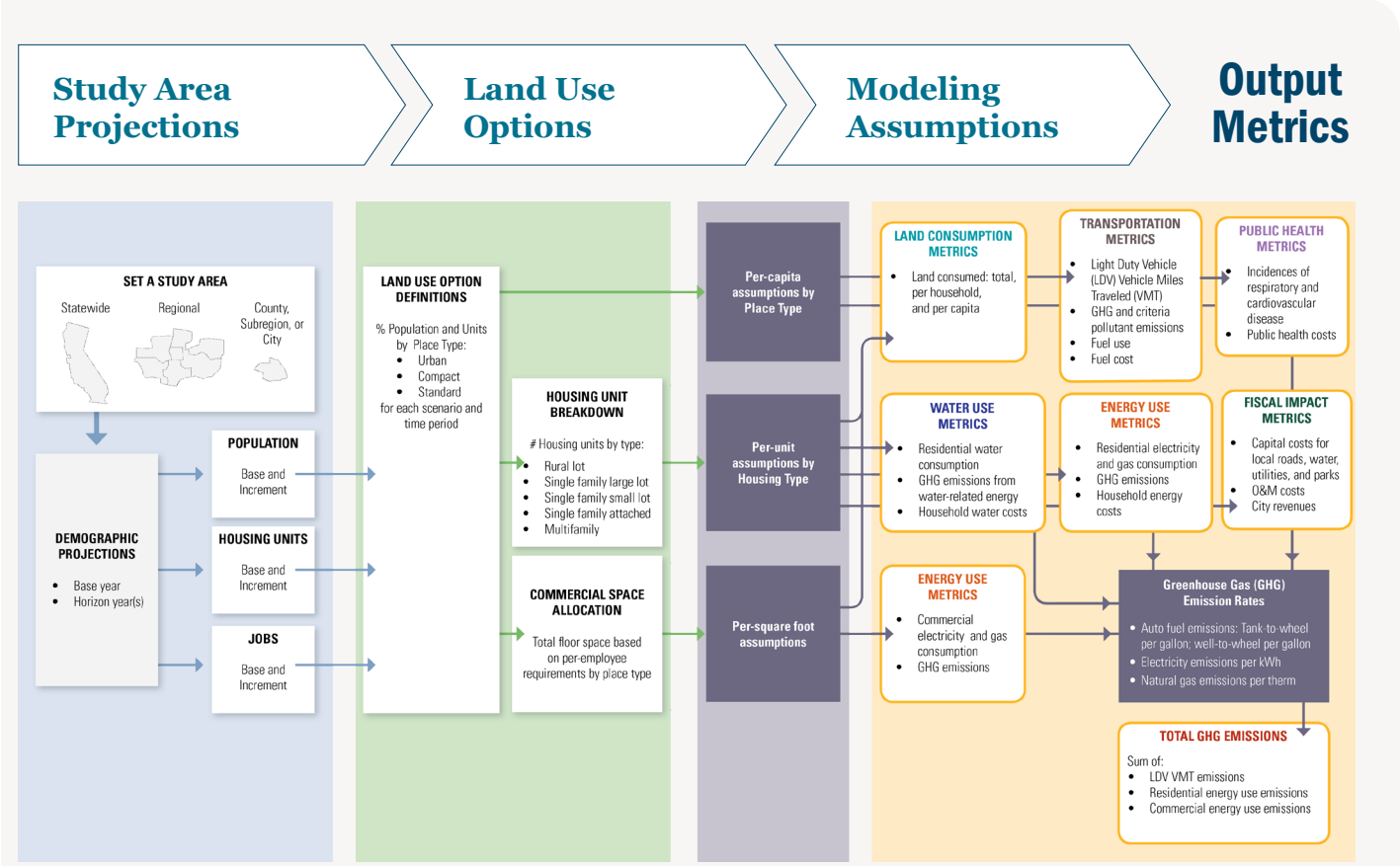
$11,600
per new household

$7,700
per new household

$6,800
per new household

Scenario Metrics

This section explores the impacts of the insight2050 scenarios. It describes the analysis of the scenarios for the complete range of fiscal, environmental, transportation, and other RapidFire output metrics. The RapidFire model underwent significant calibration and customization to prepare it for scenario development and analysis in Central Ohio. The customized model was used to develop and model the full range of metrics for the four insight2050 scenarios described in this report. Region-wide results are presented here; the 7-county region includes Delaware, Fairfield, Franklin, Licking, Madison, Pickaway, and Union counties. Input assumptions for the model and 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.



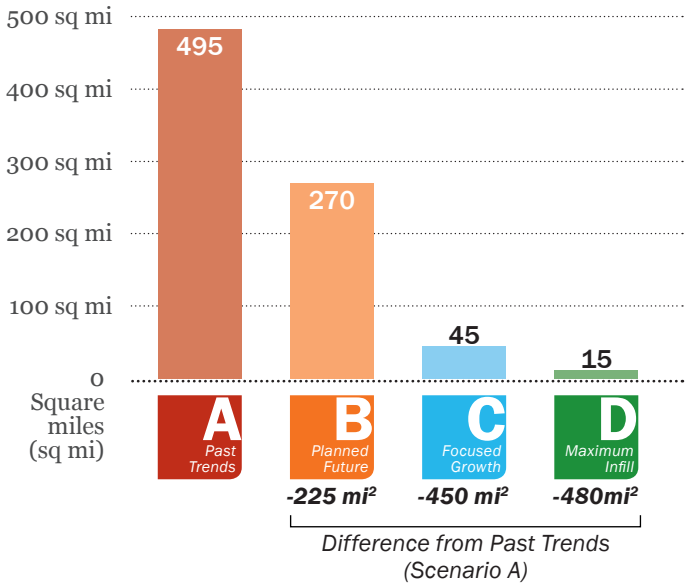
The methodology for calculating scenario metrics is outlined in the RapidFire Technical Summary, available at www.calthorpe.com/scenario_modeling_tools.

Land Consumption

The amount of land needed to accommodate new population growth varies widely among the scenarios. New land consumption includes all land that will be newly urbanized, including residential and employment areas, roadways, open space, agricultural, and public lands. Scenarios that accommodate new growth with greater shares of Urban and Compact development- which include more infill, redevelopment, and focused use of previously undeveloped land - consume less land overall. By contrast, scenarios that place a greater share of new growth in the Standard development pattern consume more land.

The Past Trends scenario, which sees significant additional Standard growth at the outer edges of the region consumes about 500 square miles of previously undeveloped land, or 225 miles more than the Focused Growth scenario (the equivalent land area of the City of Columbus today) The Planned Future scenario consumes 270 square miles; Focused Growth consumes 45 square miles; and Maximum Infill consumes 15 square miles. There were approximately 1,000 square miles of urbanized or developed land in the region as of 2010.

Cumulative New Land Consumption to 2050



Fiscal Impacts

Fiscal Impacts

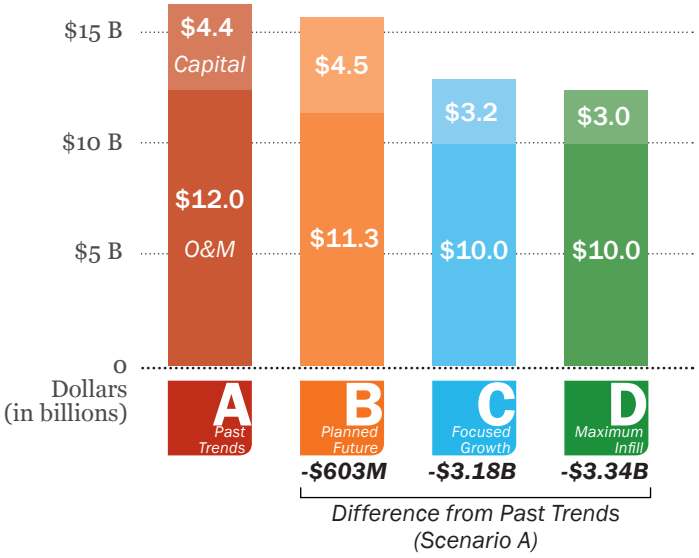
The insight2050 fiscal impact analysis is a regional study designed to provide an understanding of the 'order of magnitude' variations in scenarios as they relate to local government revenues and costs associated with **new** development; the analysis does not include all categories of costs or revenues. The analysis focuses primarily on impacts to the general funds of local jurisdictions (cities and townships), but does include certain county-level costs and revenues in order to provide an equivalent set of service categories for comparison purposes. Therefore, the analysis does include sheriff costs related to townships, but does not consider road maintenance costs for cities or counties because those services are typically provided outside of the general fund. Similarly, the analysis does not include impacts to school districts or other special districts that are funded separately. The fiscal analysis is focused on the costs and revenues associated with new (not existing) residential and commercial development.

Infrastructure and Operations & Maintenance Costs

Increased land consumption can lead to higher costs for local infrastructure and community services, as growth on previously undeveloped land often requires significant capital investments to extend or build new local roads and water and sewer systems, and to provide new public safety services. Growth focused in existing urban areas can take advantage of existing infrastructure and capitalize on the efficiencies of providing service to higher concentrations of jobs and housing. Moreover, accommodating growth within focused urban areas can help to ensure that future infrastructure investments generate a high return on investment.

The cost difference between new compact and more dispersed development can also vary significantly when public sector operations and maintenance (O&M) costs are taken into account. O&M costs include the ongoing expenditures required to operate and maintain the infrastructure serving new residential and commercial growth, as well as the costs to provide other services included in a typical local government (city, village, or township) operating budget.

Cumulative Local Capital Infrastructure Costs and Operations and Maintenance (O&M) Expenditures (2014 dollars)



Average Annual Local Capital Infrastructure & O&M Costs

A	B	C	D
$408M	$393M	$329M	$328M
Difference from Past Trends (Scenario A)	-$15M	-$79M	-$83M

The insight2050 scenarios are compared for their regional impacts on local government O&M costs, including:

- General Government: including administrative and legislative functions
- Fire: including all fire services in incorporated and unincorporated areas
- Community Services: including community and recreation services
- Engineering and Public Works: including only general fund public works functions

Fiscal Impacts

- Police and Sheriff: including police and sheriff patrol services in incorporated and unincorporated areas

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 can cost more to provide when development is more dispersed.

Focusing new growth in and around existing urban areas can reduce costs significantly, as demonstrated by reviewing the capital infrastructure and ongoing O&M costs for each of the insight2050 scenarios. As compared to the Past Trends scenario, following the development pattern of the Planned Future scenario would save $605 million to 2050. The Compact Future scenario saves $3.2 billion, which is a 19% savings compared to Past Trends, and an average annual savings of $79 million. The Maximum Infill scenario saves a total of $3.3 billion compared to Past Trends. The fiscal analysis of the RapidFire scenario model focuses on local and subregional costs borne by cities, townships, and counties for new developments only. It does not include the cost of new regional roadway and transit infrastructure that might be part of the facilities that support a scenario growth pattern.

Note that the cost variations across scenarios do not always vary directly with the proportion of dispersed or Standard development in a scenario. For example, the Planned Future scenario, which is more compact than Past Trends, sees a slight increase in costs for capital infrastructure compared to Past Trends due to the higher proportion of rural and unincorporated residential development in the Past Trends scenario;This is because development in rural areas is served by septic systems and thus does not incur the higher cost of sewer infrastructure (the cost of installing and maintaining private septic systems falls to individuals, and its costs are not included in the scenarios). For more detail on the cost assumptions, refer to the “Fiscal Impacts Methodology and Results Report” in the appendix.

Revenues

The insight2050 scenarios are compared for their regional impacts on tax revenue, including:

- Annual income tax and property tax (apportioned to general fund and public safety uses) revenue associated in the model with new commercial development. Commercial development includes all non-residential development.
- Annual property tax revenue apportioned to general fund and public safety uses for new residential development. (Additional property tax revenue levies for schools, libraries, and other services were not included in these scenarios.)
- Annual county sales tax revenue generated from households in new residential development.

Calculating Commercial Income Tax, Property Tax, and Sales Tax Revenue

Income tax is typically the most significant revenue source for cities in Ohio. Since the bulk of income tax is generated in a worker’s city of employment, income tax revenue was associated with growth in commercial and other non-residential space for modeling purposes. Income tax revenues received by worker home locations and income tax generated by business profits were also modeled in order to account for their regional distribution in the different scenarios.

Property tax comprises a relatively small share of city revenues, but is the primary source of funding for townships. The portion of property taxes dedicated to city and township general funds and public safety costs were calculated for the scenarios. General fund and public safety revenue streams were calculated because cities typically fund public safety services out of their general funds, whereas townships must levy additional property taxes to fund public safety services. Annual county sales tax revenue, which funds general county services, most notably public safety, is also included in the scenarios revenue comparison. Note that school districts are funded by separate property tax levies and were not included in these scenarios. For more detail on the revenue assumptions, refer to the “Fiscal Impacts Methodology and Results Report” in the appendix.

Fiscal Impacts

Scenarios Revenue from New Commercial and Residential Development

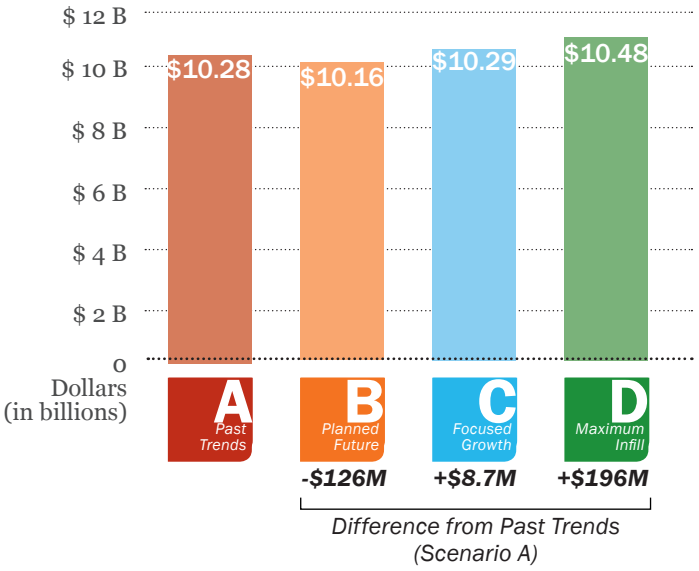
As the majority of income tax is generated in an Ohio worker's city of employment, higher income tax revenue is seen in scenarios with the highest proportions of commercial development in higher value urban locations, followed by compact locations; these places also levy relatively high average income tax rates. Thus the Compact Future and Maximum Infill scenarios see higher commercial tax revenue than the Past Trends and Planned Future scenarios. Focused Growth sees an additional $533 million in revenues through 2050 compared to Past Trends, while Maximum Infill sees a nearly $700 million increase.

Property tax revenue from residential development in Ohio does not favor compact development as strongly as does income tax revenue. In the case of city, township, and county property tax and sales tax revenue related to new residential development, the Compact Future and Maximum Infill scenarios result in tax revenue of $525 million and $500 million less, respectively, than the additional revenue generated in the Past Trends scenario. This is in large part due to the higher proportion of large, higher-value single-family residential development in the Past Trends scenario, and the Past Trends scenario's inclusion of more homes in unincorporated areas with higher property tax rates.

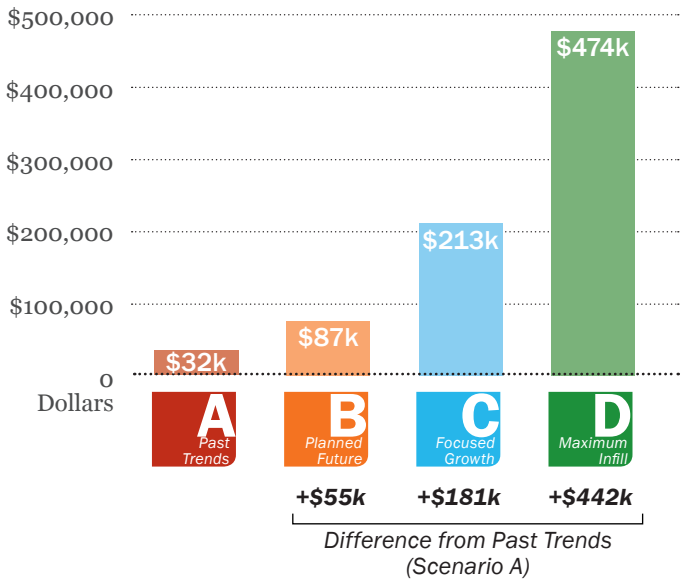
Overall, despite their lower residential revenues, the Compact Future and Maximum Infill scenarios enjoy moderately higher overall revenues when one combines the commercial and residential categories. To 2050, the Maximum Infill scenario sees nearly $200 million more in total revenue, or about $5 million per year. Tax revenue on a per-acre basis illustrates more variation across the insight2050 scenarios. Per-acre residential and commercial revenues add up to $32,000 in Past Trends and $87,000 in the Planned Future scenario. The more compact Focused Growth and Maximum infill scenarios have per acre revenues of $213,000, and $474,000 respectively.

Overall, the insight2050 scenarios illustrate the fiscal efficiency of more compact land patterns in the costs to supply and operate and maintain local infrastructure and community services. While not as significant as the cost advantages, there are also revenue advantages to the more compact scenarios, particularly from a commercial tax revenue perspective and when viewed on a per-acre basis.

Cumulative Residential and Commercial Tax Revenues to 2050 (2014 dollars)



Cumulative Residential and Commercial Tax Revenues per Acre to 2050(2014 dollars)



Transportation

Transportation system impacts – including vehicle miles traveled (VMT), fuel use and cost of driving, 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. (Refer to the appendix for specific policy-based assumptions about auto fuel economy and technology, and fuel composition and cost.)

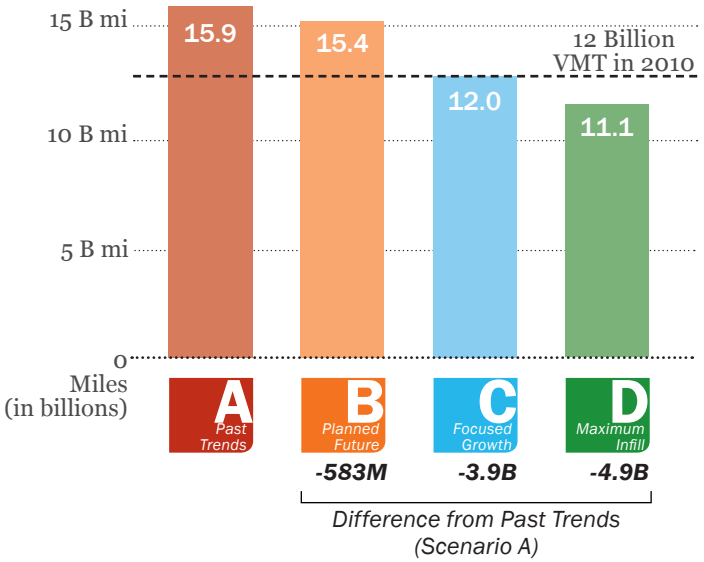
Vehicle Miles Traveled (VMT)

VMT is calculated by applying assumptions about the distances people drive each year to projected population growth. These assumptions, which differ by place type, are calibrated to per-capita driving rates and modeling data from the Central Ohio region. This data, as well as national data sets, illustrate that per-capita VMT of both new and existing population vary based on the form of new growth[1]. For example, when a majority of new growth occurs as Compact or Urban 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 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 Compact and Urban place type development would see increased transit, bicycle, pedestrian, streetscape, and livability investments. Conversely, scenarios dominated by Standard development would see larger budget outlays to highway and road expansion and maintenance.

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: The Past Trends scenario, which accommodates 87% of growth in auto-oriented Standard development, produces an average annual VMT of 8,470 per new person per year by 2050. This is 4,000 miles more than the Focused Growth scenario (4,450 miles per capita), and 4,600 more than Maximum Infill (3,850 miles per capita). These figures can be compared to the 2010 region-wide average of about 6,600 miles per person.

Annual Vehicle Miles Traveled (VMT) in 2050



Annual VMT Per Person in 2050

	A	B	C	D
	6,820	6,570	5,130	4,740
Difference from Past Trends (Scenario A)		-250	-1690	-2080

In total, residents of Central Ohio traveled about 12 billion miles per year in their automobiles in 2010. In the Past Trends scenario, this rises to an annual VMT of 15.9 billion miles in 2050; for Planned Future, the total is 15.4 billion. VMT is held at about its 2010 level in the Focused Growth scenario, at 12.0 billion (4 billion miles per year less than Past Trends). Maximum Infill results in an annual total of 11.1 billion miles, nearly 5 billion less than Past Trends. The difference between Past Trends and Focused Growth is equivalent to taking nearly 400,000 cars off Central Ohio's roads each year - the same number of cars on the road every day in Central Ohio during the peak hour of the morning commute.

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

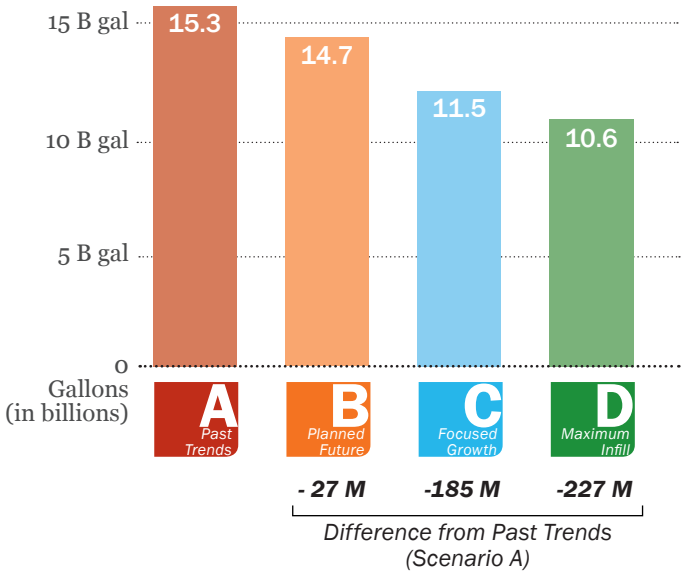
Transportation

Automobile Fuel Use and Cost of Driving

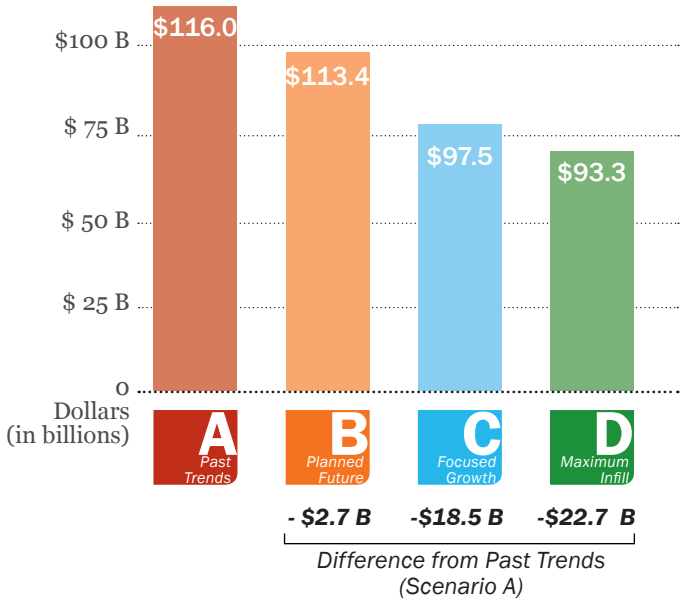
Variations in passenger VMT lead to substantial differences in the amount of gas (or equivalent) used. These differences will vary depending on how efficient cars become. Assuming the same vehicle fuel economy for all scenarios, there would be substantial differences in fuel use due to land use-related VMT variations. By 2050, Past Trends would require 740 million gallons of fuel annually. Planned Future would require 27 million gallons less, Focused Growth would require 185 million gallons less, and Maximum Infill would require 227 million gallons less than the Past Trends scenario.

Reduced VMT and fuel use leads to lower costs for all households. When compared to Past Trends, Planned Future saves the average Central Ohio household $470 per year in driving costs in 2050 (including auto ownership, maintenance, and other driving-related costs); Focused Growth saves $3,200; and Maximum Infill saves $3,900 per year – significant savings that could be applied to housing and other essentials. For the entire region, the driving-related savings total $18.5 billion through 2050 in Focused Growth, and almost $23 billion in the Maximum Infill scenario.

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



Cumulative Fuel Costs to 2050 (2014 dollars)



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

	A	B	C	D
	740 M	717 M	560 M	518 M
Difference from Past Trends (Scenario A)		-23 M	-180 M	-222 M

*Annual Driving Costs per New Household in 2050 (2014 dollars)**

	A	B	C	D
	$10.3 k	$9.0 k	$5.4 k	$4.7 k
Difference from Past Trends (Scenario A)		-$1,300	-$4,900	-$5,600

**includes fuel, insurance, and maintenance associated with auto ownership*

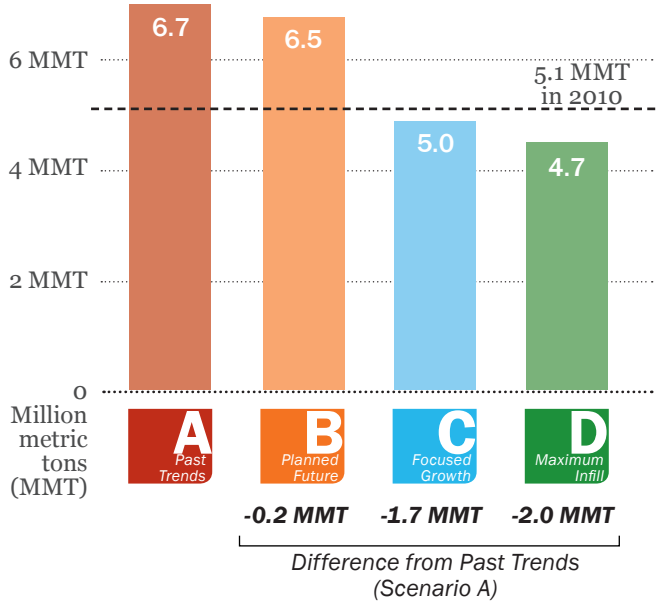
Transportation

Greenhouse Gas (GHG) Emissions from Passenger Vehicles

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 rate of fuel emissions for all scenarios, there would be substantial differences in CO2e 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, Past Trends would produce 6.7 million metric tons (MMT) of CO2e annually. Planned Future would produce 4% less; Focused Growth would produce 25% less, the equivalent of about 600,000 cars worth of emissions annually; and Maximum Infill would produce 30% less, the equivalent annual GHG emissions of about 730,000 passenger cars. When combined with the effects of more stringent vehicle and fuels policies, which would reduce the amount of fuel used and GHG emissions for every mile traveled, automobile-related emissions could be reduced even further.

Note that the transportation GHG emissions reported here are limited to tailpipe (tank-to-wheel) emissions. A more complete picture of emissions emerges in an analysis of full lifecycle (well-to-wheel) emissions, which take into account the emissions associated with generating fuel from various sources. The RapidFire model estimates both fuel combustion and full fuel lifecycle emissions.

Annual Transportation GHG Emissions in 2050(MMT CO2e)



Annual Transportation GHG Emissions per Capita (lbs CO2e)

	A	B	C	D
	6,350	6,100	4,750	4,400
Difference from Past Trends (Scenario A)		-250	-1,600	-1,950

Public Health

Air Pollutant Emissions from Passenger Vehicles

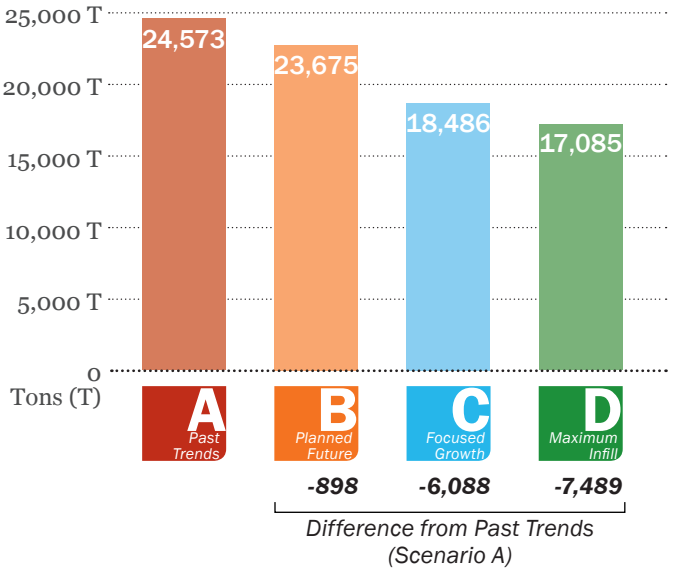
Differences in VMT lead to different levels of air pollutants (including nitrogen oxides, volatile organic compounds, and particulate matter) among the insight2050 scenarios. With higher VMT, the Past Trends scenario sees 2050 passenger-vehicle pollutant emissions that are 4% higher than emissions in Planned Future, 25% higher than Focused Growth, and 30% higher than Maximum Infill. These results translate to significant public health impacts, as described in the following sections.

Health Incidences and Costs

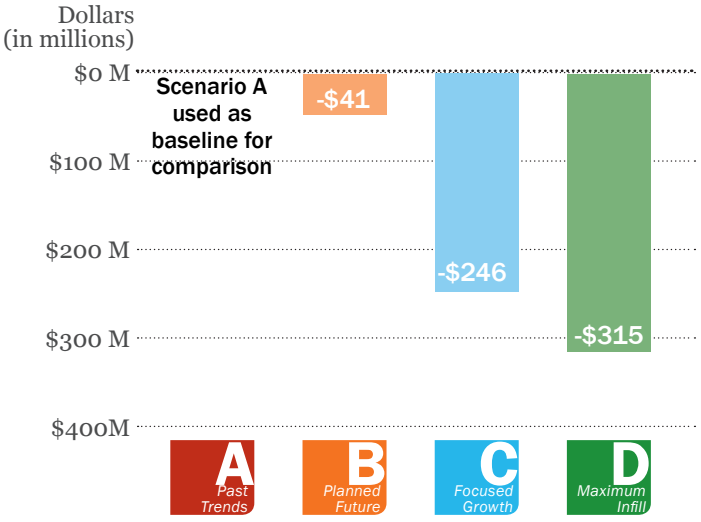
Auto-related air pollution results in a spectrum of health incidences, including cases of chronic bronchitis; acute myocardial infarction; respiratory and cardiovascular hospitalizations; respiratory-related ER visits; acute bronchitis; work loss days; premature mortality; asthma exacerbation; and acute, lower, and upper respiratory symptoms. Health incidences and their related costs are reduced along with miles driven and consequential reduction in passenger vehicle emissions. Using research-based rates and valuations , the RapidFire model estimates savings (rather than absolute totals) in health incidences and costs to 2050[1].

Relative to the Past Trends scenario, all scenarios show significant reductions in health incidences and costs. In 2050, Planned Future results in a $41 million annual savings to treat respiratory health incidences related to passenger vehicle pollution. In Focused Growth, the savings rise to nearly $250 million per year, and go up to $315 million per year in the Maximum Infill scenario.

Annual Automobile Pollutant Emissions in 2050



Annual Health Costs in 2050



1 The public health incidence and cost assumptions were initially developed by TIAX, LLC for the American Lung Association. Assumptions are based on national data from the EPA, Office of Air Quality Planning & Standards, Air Benefit and Cost Group (August 2010). While valuations (costs) were extrapolated for 2035, they are applied to 2050 pollutant emissions as an approximate estimate of costs in that year.

Residential and Commercial Building Energy

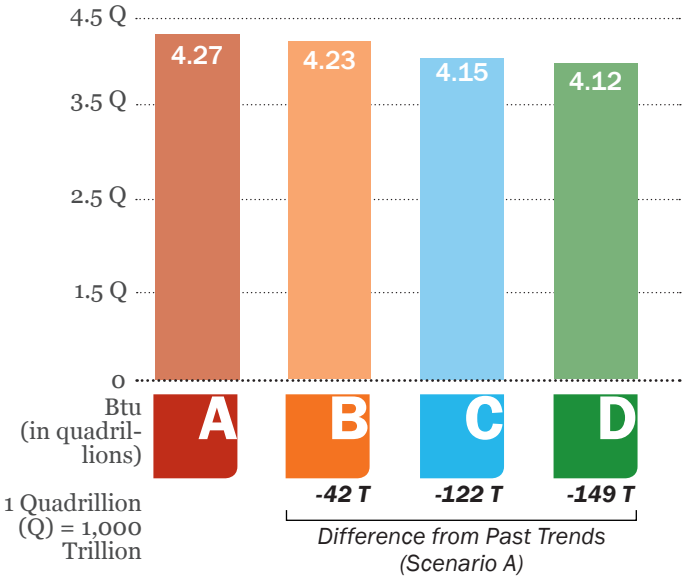
The insight2050 scenarios vary in their building energy use profiles due to their different mixes of housing types and commercial building types. Scenarios that contain more Compact and Urban development accommodate a higher proportion of growth in more energy-efficient building types such as apartments, attached single-family homes, and smaller single family homes, as well as more compact commercial building types. By contrast, a large proportion of Standard place type development leads to a higher proportion of larger single family homes, which are typically less energy-efficient.

Energy Consumption, Cost, and Emissions

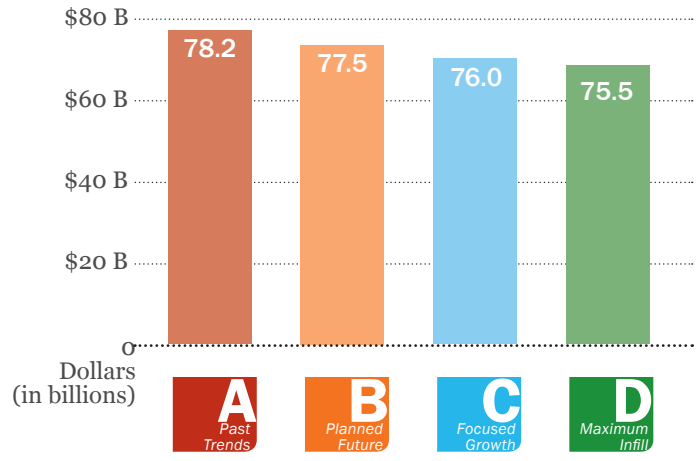
Variations in land use patterns lead to substantial differences in the amount of energy used. These differences depend in part on policies regulating how efficient buildings become. Assuming the same efficiency standards for all scenarios, there would be marked differences in energy use due to land use-related and building program variations.

The combined energy and cost savings in residential and commercial energy through 2050 are significant: compared to Past Trends, Focused Growth saves enough energy to power more than 25,000 homes for a year. With the Maximum Infill scenario, that savings rises to the equivalent of 32,000 homes. Energy costs for households and businesses add up as well: to 2050, total residential and commercial energy costs (including existing and new growth) in Planned Future would be $800 million less than Past Trends. In Focused Growth, the costs would be $2.3 billion less; in the Maximum Infill scenario, the costs would be $2.8 billion less.

Cumulative Residential and Commercial Building Energy Use to 2050 (British Thermal Units, Btu)



Cumulative Residential & Commercial Energy Costs to 2050 (2014 dollars)



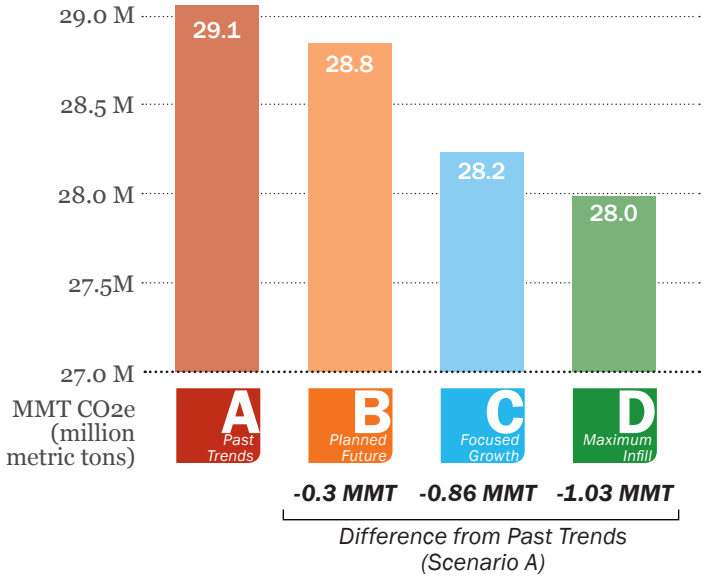
Annual Residential & Commercial Energy Costs in 2050 (2014 dollars)

A	B	C	D
$3.82 B	$3.78 B	$3.70 B	$3.68 B
Difference from Past Trends (Scenario A)	-$38.8 M	-$112 M	-$134 M

Residential and Commercial Building Energy

Conserving energy also reduces greenhouse gas (GHG) emissions. More compact land uses reduce building emissions in proportion to energy use – 1%, 3%, and 4% each year, for the Planned Future, Focused Growth, and Maximum Infill scenarios respectively, as compared to Past Trends. The annual reduction in the Focused Growth scenario equals the equivalent of the yearly emissions of over 200,000 cars on Central Ohio roads. 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 CO2e)



12 Billion VMT in 2010

Comparing Energy Sources

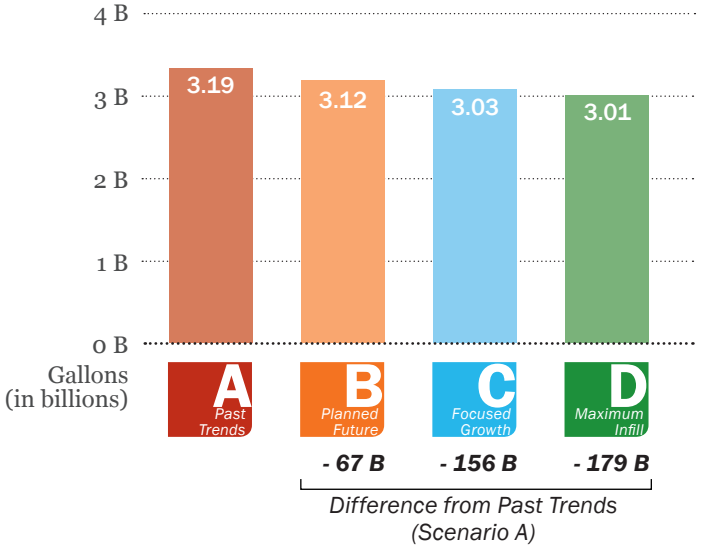
The insight2050 scenarios tally greenhouse gas (GHG) emissions from passenger vehicle transportation as well as residential and commercial buildings. These two sectors generally combine for 35-50% of total GHG emissions in a metropolitan area. In Central Ohio, where the electricity mix includes a relatively high proportion (~70%) of coal, building electricity use takes on a much higher proportion of overall emissions, at nearly 50% of the total. The insight2050 scenarios illustrate the role that land use pattern differences can play in reducing building and transportation energy use and related GHG emissions. Additional policies to reduce the carbon intensity of the power generation portfolio (i.e. more renewable or lower-carbon electricity generation, cleaner power plant technology) can also play a role in reducing emissions.

Residential Water Use

Variations in land use patterns and their related building profiles 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 place type, which includes more larger-lot single-family homes, require more water than scenarios with a greater proportion of Compact or Urban development, which include more attached and multifamily homes, and smaller-lot single-family homes.

Assuming the same modest improvements for all scenarios, there are the potential savings attributable to land use patterns and building program alone. Compared to Past Trends, which uses 91 billion gallons of water per year in 2050, Planned Future uses 88 billion gallons, or 3%, less; Focused Growth uses 84 billion gallons, or 8%, less; and Maximum Infill uses 83 billion gallons, or 9%, less. Cumulatively, the water savings are substantial: by 2050, Focused Growth uses 156 billion gallons less water – enough to supply over 46,000 homes for a year; that difference rises to 53,000 homes in the Maximum Infill scenario. When combined with the effects of more stringent building and landscape policies, which would reduce the amount of indoor and outdoor water used, water use could be reduced even further.

Cumulative Residential Water Use to 2050 (gallons)



Annual Residential Water Use per Household in 2050 (gallons)

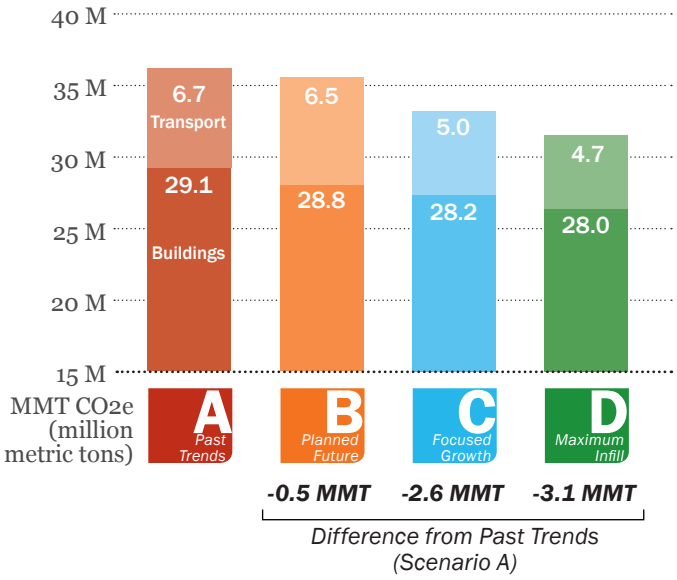
	A	B	C	D
	84,100	81,150	77,700	76,750
Difference from Past Trends (Scenario A)		-2,950	-6,400	-7,350

Greenhouse Gas Emissions Summary

Combined transportation and building sector impacts provide the most complete picture of the greenhouse gas emissions of the varying futures presented by the insight2050 scenarios. Passenger vehicle transportation, along with residential and commercial building energy use, currently account for over half of total carbon emissions in Central Ohio. Land use and transportation planning in the region, in conjunction with state and federal policies in regulating energy emissions and efficiency, will play a role in reducing greenhouse gas (GHG) emissions.

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, Past Trends, with the highest proportion of growth occurring as Standard suburban development, would produce about 36 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 Past Trends, Planned Future results in 2% lower annual emissions; Focused Growth results in 7% lower emissions, and Maximum Infill results in 9% lower emissions. For Focused Growth, the reduction is equal to the annual GHG emissions of 600,000 cars on Central Ohio roads; for Maximum Infill the reduction is the equivalent of the yearly emissions from 730,000 cars.

Annual Transportation and Building Energy GHG Emissions in 2050 (MMT CO2e)



Annual Transportation and Building Energy GHG Emissions per Capita (lbs CO2e)

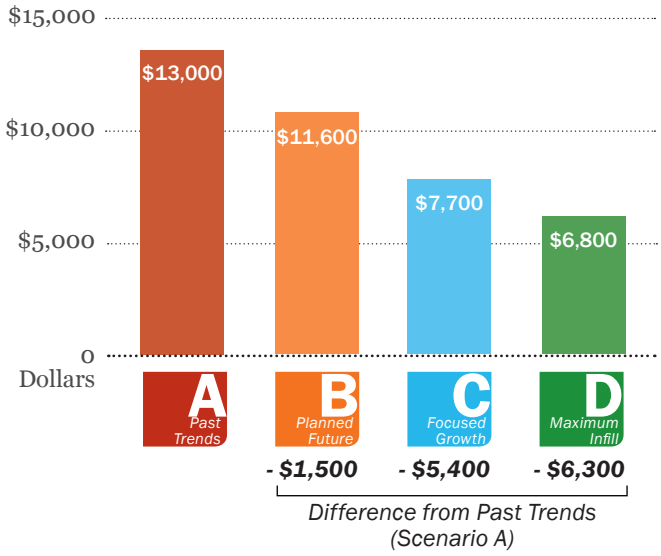
	A	B	C	D
	33,700	33,200	31,350	30,850
Difference from Past Trends (Scenario A)		-500	-2350	-2850

Household Costs Summary

The total cost burden for the insight2050 scenarios varies along with their land patterns and resource consumption. Infrastructure costs to serve new development and its associated travel demand, as well as household transportation, energy, and water costs, are higher in scenarios with greater land consumption, higher VMT, and building programs that rely more on larger-lot single family construction.

Breaking costs down to the household level exposes the impact of land use and policy choices on Central Ohio households: by 2050, the Past Trends scenario would cost the average new household about $13,000 in expenditures associated with driving and residential energy and water use per year. By comparison, Planned Future would cost about $1,500 less; Focused Growth would cost about $5,400 less; and the Maximum Infill scenario would cost nearly $6,300 less per year. 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. Collectively to 2050, household spending amounts to $94 billion in the Past Trends scenario. By comparison, Planned Future would cost $10.5 billion less; Focused Growth would cost $39 billion less; and Maximum Infill would cost $46 billion less.

Annual Household Costs per New Household in 2050 (2014 dollars)



Appendix A: RapidFire Inputs and Outputs Catalog

RapidFire Model Output Metrics and Input Assumptions

Summary of Output Metrics

Land Consumption

- *Land Consumed (square miles)*

Fiscal Impacts

- *Capital Costs for local infrastructure to serve new development ($)*
- *Operations and Maintenance Costs to provide ongoing services for new development ($)*
- *Revenues associated with new residential and commercial development ($)*

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 ($)*
- *Building Water Use, Cost, and Emissions*
- *Water Consumed (AF)*
- *Water Cost ($)*

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

- *Place type proportions for each scenario and time period*
- *Housing unit composition for each place type*

Fiscal Impacts

- *Per-unit capital cost assumptions to provide local roads, sewer, and water facilities for new development, by building type and place type*
- *Per-unit operations and maintenance cost assumptions to provide ongoing services to new development, by building type and place type*

Land Consumption

- *Percent greenfield vs. infill/greyfield/brownfield growth for each place type and scenario*
- *Residential and employment densities by building type, place type, and scenario*

Summary of Input Assumptions [continued]

Vehicle Miles Traveled (VMT)

- *Baseline Per Capita Light Duty Vehicle (LDV) VMT*
- *VMT adjustment factors by place type 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, combustion (tank-to-wheel) for total fleet, internal combustion engine vehicles alone*, and alternative/electric vehicles alone**
- *Baseline fuel emissions, full lifecycle (well-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*
- *New efficiency factor for new units of the growth increment*
- *Upgrade efficiency factor for base/existing housing stock*
- *Baseline residential electricity and natural gas prices*
- *Residential electricity and natural gas prices 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 place type*
- *Baseline average annual energy use per square foot for base/existing commercial space*
- *Annual baseline energy use for new commercial space*
- *New efficiency factor for new floorspace of the growth increment*
- *Upgrade efficiency factor for base/existing commercial space*
- *Baseline commercial electricity and natural gas prices*
- *Commercial electricity and natural gas prices 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 baseline)*
- *Upgrade efficiency factor for base/existing housing stock*
- *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)**

** RapidFire input or output not applied or analyzed as part of this process.*

Appendix B: Central Ohio RapidFire Technical Assumptions

Transportation	
Fuel economy	*On-road passenger vehicle average: 20.7 mpg estimated based on MORPC regional vehicle mix and EIA average performance for light-duty vehicles (short/long wheelbase, including cars and light trucks) for 2012.*
Fuel price	*$5 per gallon (2014 dollars)*
Auto operating cost	*$0.63 per mile (2014 dollars), including ownership and maintenance. AAA Your Driving Costs 2013 data, including depreciation, insurance, finance charges, maintenance, and tires.*
Transportation fuel emissions	*19.9 lbs carbon dioxide equivalent (CO_2e) per gallon, statewide average*
Buildings	
Baseline energy use of buildings	*Energy Information Administration (EIA) Residential Energy Consumption Survey 2009 average annual energy use per housing unit by type for East North Central Region.* • *Rural lot single family: 11,980 kWh; 970 therms* • *Larger lot single family: 11,980 kWh; 970 therms* • *Smaller lot single family: 11,980 kWh; 970 therms* • *Townhome: 8,035 kWh; 750 therms* • *Multifamily: 6,550 kWh; 650 therms.* *Commercial energy use: baseline averages by sector estimated based on EIA Commercial Buildings Energy Consumption Survey data, 2003 (published 2006) and job sector/floorspace distribution among categories.* • *Retail: 21.9 kWh/sf; 0.86 therms* • *Office: 18.2 kWh/sf; 0.43 therms* • *Warehouse: 10.9 kWh/sf; 0.30 therms* • *Civic/Institutional: 20.3 kWh/sf; 0.68 therms*
Electricity price	*$0.12 per kWh, EIA state average.*
Natural gas price	*$0.85 per therm, EIA state average.*
Baseline residential water use	*Annual baseline estimate from Ohio EPA Water + Wastewater survey: 0.26 AF. Use for new units estimated on per-capita indoor estimates and estimated outdoor irrigation needs.* • *Rural lot single family: 0.32 AF* • *Larger lot single family: 0.27 AF* • *Smaller lot single family: 0.19 AF* • *Townhome: 0.18 AF* • *Multifamily: 0.15 AF*
Water price	*$2,960 per AF. From Ohio EPA Water + Wastewater cost survey. Regional composite rates cover drinker water and wastewater.*
Energy Emissions	
Electricity emissions	*Average rate for carbon dioxide equivalent (CO_2e) from EIA 2012 Summary Statistics for Ohio: 2.09 lbs/kWh.*
Natural gas emissions	*Static rate based on carbon content: 11.7 lbs/therm.*

Appendix C: insight2050 Committees

Steering Committee

Mark Barbash	Finance Fund
Trudy Bartley	PACT Neighborhood
Chris Bauserman	Delaware County Engineer's Office
Marilyn Brown	Franklin County Commissioner
Shawna Davis	Ohio Health
Tom Goodney	Educational Service Center of Central Ohio
Bill Greenlee	ROI Realty
Bill Habig	Raccoon Valley Partners, LLC
Tracy Hatmaker	Prairie Township
Charles Hillman	Columbus Metropolitan Housing Authority
Jim Hilz	Building Industry Association of Central Ohio
Doug Kridler	Columbus Foundation
Mitch Lynd	Lynd Fruit Farms
Glenn Marzluf	Del-Co Water Company, Inc.
Holly Mattei	Fairfield County Regional Planning Commission
Linda Mauger	OSU, Office of Geriatrics and Gerontology
Keith Myers	OSU, Office of Administration & Planning
Mike Pannell	Franklin County Emergency Management and Homeland Security
Torrance Richardson	Columbus Regional Airport Authority
Jim Schimmer	Franklin County Economic Development
Ike Stage	City of Grove City
Laura Swanson	Columbus Appartment Association
Krystina Schaefer	Public Utilities Commission of Ohio
Guy Worley	Columbus Downtown Development Corporation
Jerry Newton	Licking County Planning Commission
Nathan Wymer	Nationwide Insurance
David Efland	City of Delaware

Executive Committee

Terry Foegler	City of Dublin
Kenny McDonald	Columbus 2020
William Murdock	Mid-Ohio Regional Planning Commission
Vince Papsidero	City of Columbus
Eric Phillips	Union County-Marysville, Economic Development Partnership
Yaromir Steiner, Chair	Steiner + Associates
Curtis Stitt	Central Ohio Transit Authority

Appendix D: Central Ohio RapidFire Fiscal Assumptions Development and Methodology

Central Ohio RapidFire Fiscal Assumptions Development and Methodology

October 30, 2014

prepared for:
Mid-Ohio Regional Planning Commission
Calthorpe Associates

Introduction

The insight2050 project is an effort to prepare Central Ohio for future growth by providing objective metrics that help inform local decision making. The analysis behind the project relies on the "RapidFire" model, developed by consulting-team lead Calthorpe Associates. The RapidFire model measures the impacts of varying land use scenarios on criteria such as land consumption, energy and water use, and greenhouse gas emissions. The insight2050 scenarios also include analysis of specific impacts associated with different future development conditions. Strategic Economics was retained as part of the insight2050 consulting team to develop Central Ohio-specific assumptions to calculate the fiscal impact of the insght2050 scenarios. This report summarizes the methodology and results of the fiscal assumptions development. The report is organized into three main sections and an appendix: Summary of Findings; Key Assumptions and Methodology; Full Results; and Appendix: List of Interviews.

About Fiscal Impact Analysis

Fiscal impact analysis typically measures future revenues and costs to local government as a result of new growth and development. As with all fiscal impact analyses, the assumptions drive the results. Strategic Economics created the assumptions described in this report based on available data; input from Mid-Ohio Regional Planning Commission staff; interviews with planning and finance staff from cities, counties, and townships; state publications; real estate market factors; and appropriate industry standards. However, the analysis is not intended to be predictive of actual outcomes of new development projects, nor to compare total costs to total revenues, as in a fiscal impact analysis based on a specific development project. Rather, this fiscal impact analysis tool is best suited to provide an understanding of the "order of magnitude" revenues and costs of various development scenarios for comparison on a region-wide basis.

This fiscal impact analysis primarily examined impacts to the general fund of local jurisdictions (cities and townships). Therefore, the analysis does not consider impacts to the school districts or other special districts that are funded separately.

In order to measure the fiscal impacts of various land development patterns, Strategic Economics measured the local government costs and revenues incurred from each individual household, resident, worker, or thousand square feet of space which could be integrated with the RapidFire model. This methodology allows the comparison of different development patterns rather than specific development projects.

The analysis is in part derived from the most recent budgets and Comprehensive Annual Financial Reports (CAFRs) of representative Mid-Ohio cities, townships, and counties for fiscal year (FY) 2012-13, and all outputs are reported in 2014 dollars.

Ohio Context

Ohio has a unique local government fiscal structure, which required Strategic Economics to calibrate the fiscal impact engine of the RapidFire model in several ways. First of all, in Ohio, the types of costs and revenues incurred from new growth are different for incorporated places (cities and villages) and unincorporated places (townships outside of cities). For example, incorporated cities and villages receive most of their local revenues from income tax, while unincorporated townships rely primarily on property tax. Strategic Economics therefore developed different methodologies for calculating the revenues for each type of jurisdiction, and created a new approach to calculating income tax revenues across the different scenarios.

Secondly, unincorporated townships and incorporated cities typically provide different levels of services and the mix of services provided may differ as well; this is especially true for rural townships

which generally provide a much lower level of infrastructure and municipal services. For example, most, if not all, townships provide fire protection services, but few provide police services, which is a service category that is typically provided by cities. In order to be able to adequately compare the fiscal impact of the growth scenarios, Strategic Economics assumed that new development in unincorporated townships would receive a mix of services roughly comparable to what is offered in cities through a city's general fund. Budget data from townships and cities was carefully categorized and certain county-level costs (and revenues) were included in order to ensure that the key categories were accounted for across the region and to provide an equivalent set of service categories for comparison purposes. Therefore, the analysis does include sheriff costs related to townships and county sales tax revenues, but does not consider road maintenance costs for cities or counties, or the revenues that often pay for them (gas tax and license fees), because those costs and revenues are typically handled outside of the general fund and because it was not possible to accurately measure townships' share of county costs.

A review of county budget information found that counties maintain roads and bridges in township areas, but that they also maintain certain roads, and more commonly bridges, within cities. Based on the budget information available it was not possible to determine what portion of county expenditures were used for roads/bridges in townships versus cities. Although it is likely that a larger proportion is spent on township roads it would be inaccurate to attribute all of those costs to townships. Many county roads, even if located within townships, also act as regional roads, and some portion of the trips are pass-through, so the costs associated with those trips should not be attributed to townships. For these reasons road maintenance was excluded for both cities and townships. As discussed in the previous section since this is a regional study designed to provide an understanding of the "order of magnitude" revenues and costs of the development scenarios for comparison, it does not include all categories of costs (or revenues), but it is important that the set of costs included for townships match those included for cities in order to allow comparison of development scenarios.

The specific methodologies to calculate the revenue and cost impacts are explained in more detail in the Key Assumptions and Methodology section.

Local Costs and Revenues

The analysis considered the following categories of costs and revenues to local governments (cities and townships): **infrastructure costs** of new facilities to accommodate new development; **operations and maintenance (O&M) costs** for maintaining facilities and provision of municipal services; and **revenues,** including property taxes, income taxes, and sales taxes.

Each of these cost and revenue categories is described in more detail below.

Infrastructure Costs

Infrastructure costs, or the capital costs of building public infrastructure and facilities to serve new development, are one-time costs. The infrastructure costs considered in this analysis include the following major categories:

- Roads: the costs of new local roads required to serve development (excluding state highways and non-local roadways);
- Sewer: the costs of wastewater treatment facilities required to serve development; and
- Water: the costs of water facilities required to serve development.

While the above categories of infrastructure exclude other types of facilities and improvements (police stations, fire stations, community centers, etc.), they encompass the infrastructure costs

associated with new development. Some cities may charge development impact fees for other categories of infrastructure, including general government, police, fire, and parks. Those categories are not charged consistently and typically make up a smaller portion of infrastructure costs associated with new development, and were therefore excluded from this analysis.

Operations and Maintenance Costs

The operations and maintenance costs (O&M costs) represent the cost of providing ongoing services to new development. Strategic Economics calculated O&M costs on a per capita basis based on the general fund expenditures of the representative cities included in the analysis, and/or applicable public safety expenditures of representative townships and counties. O&M costs are broken out into the following major categories:

- General Government: including administrative and legislative functions;
- Fire: including all fire protection services in incorporated and unincorporated areas;
- Community Services: including community, health, and recreation services;
- Engineering and Public Works: including only general fund public works functions; and
- Police and Sheriff: including police and sheriff services in incorporated and unincorporated areas.

Services provided outside of the general fund were excluded, with the exception of applicable public safety expenditures. Similarly, debt service costs were excluded from the analysis.

Revenues

Revenues are calculated on a per-square-foot and per household basis based on statewide averages for some revenue factors and on property value calculations. The methodology for deriving revenue estimates is described in further detail in the Key Assumptions and Methodology section of this report.

Place Types

The RapidFire model allocates growth under different scenarios based on categories of place types that represent certain land use mixes and intensities. Strategic Economics identified sets of cities and townships to represent the Standard, Compact, and Urban place types of the RapidFire model's framework. Further information on the place types and a list of "exemplar" cities used in the analysis are included in the Key Assumptions and Methodology section.

The place types as defined by the RapidFire model and in the fiscal analysis are as follows:

- **Standard** is the least intense place type and is represented by suburban and stand-alone cities that have lower densities and fewer nonresidential uses. For the purposes of conducting the analysis in the Mid-Ohio region, the Standard place type was split into Standard-Incorporated (cities) and Standard-Unincorporated (townships).
- **Compact** is less intense than Urban, but is a walkable development pattern with a mix of single-family small-lot, single-family attached/townhome and multi-family units in addition to a mix of nonresidential uses.
- **Urban** is the most intense of the place types, with a greater share of multifamily and townhouse development, as well as higher density commercial uses.

Summary of Findings

This section summarizes the findings of the fiscal analysis for insight2050. The results are presented for major sources of revenue and major categories of infrastructure and operations and maintenance costs.

Revenue

This section summarizes the revenue results of the fiscal analysis, including:

- Annual income tax and property tax (apportioned to general fund and public safety uses) revenue per thousand square feet of new commercial development.
- Annual property tax revenue apportioned to general fund and public safety uses, per new housing unit.
- Annual county sales tax revenue per housing unit.

The results are broken out for each commercial property type, residential unit type, and place type. This section describes results only; the detailed calculation methodology is described in the Key Assumptions and Methodology section of this report.

Commercial Income Tax and Property Tax Revenue

Income tax is typically the most significant revenue source for cities in Ohio. Since the bulk of income tax is generated in a worker's city of employment, Strategic Economics associated income tax revenue with growth in commercial space. Adjustments were also incorporated to account for worker residence locations and the portion of revenues generated by business profits.

Property tax comprises a relatively small share of city revenues, but is the primary source of funding for townships. Strategic Economics calculated the portion of property taxes dedicated to city and township general funds and public safety costs. General fund and public safety revenue streams were calculated because cities typically fund public safety services out of their general funds, whereas townships must levy additional property taxes to fund public safety services.

Strategic Economics calculated income tax and property tax revenue associated with office, retail, industrial, warehouse, civic/institutional, and "other" commercial land uses for each place type. The analysis includes general fund and public safety services revenues only. The results are presented in **Figures 1-6**. As shown in the figures, there is no income tax revenue from commercial development in unincorporated areas since townships do not levy income tax. On the other hand, unincorporated areas receive relatively high property tax revenues due to the high property tax rates in townships compared to cities. The summary of the findings for each commercial land use is as follows:

- Office development in higher density place types (Urban and Compact) generates higher total income tax and property tax revenues than in lower density place types (Standard-Incorporated and Standard-Unincorporated), as shown in Figure 1. This result is primarily due to higher worker densities, higher property values, and higher property tax rates in exemplar cities representing Urban and Compact place types.

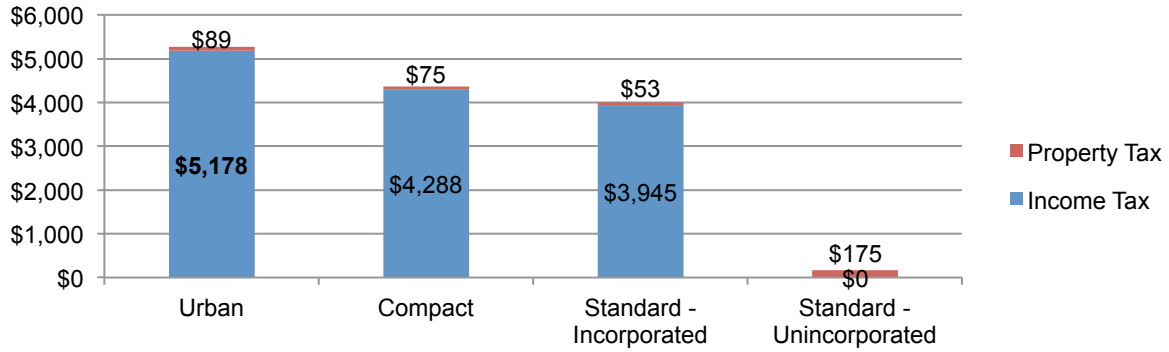
- Retail development generates higher income tax revenues in place types with higher development intensities, as shown in Figure 2. However, retail property tax revenues do not follow the same pattern, largely because retail development in Standard places often commands higher rents and assessed property values than in other locations.

- Industrial and Warehouse developments generate the most overall revenues in the Urban place type, followed by the Standard-Incorporated place type (Figure 3 and Figure 4). The income tax revenues are higher in Standard-Incorporated locations than in Compact cities because of the higher average weighted income tax rates in those places.

- Civic/Institutional income tax revenues are also positively correlated with higher-density place types (Figure 5). As with the office land use, this result is due to higher employee densities in the Urban and Compact place types. Strategic Economics conservatively assumed that these uses do not generate property tax since users of this space are primarily government and non-profit organizations exempt from property tax.

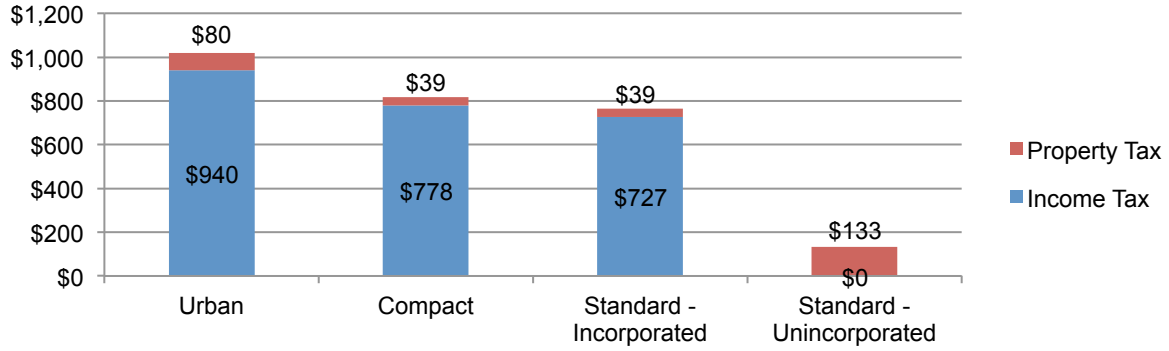
- "Other" commercial land uses not included in the above categories generate slightly higher income tax and property tax revenues in Standard-Incorporated place types compared to Compact place types (Figure 6). This relationship is driven by higher income tax rates and higher assessed property values in Standard-Incorporated cities.

Figure 1: Annual General Fund and Public Safety Income and Property Tax Revenue per 1,000 Square Feet of Office Space, by Place Type



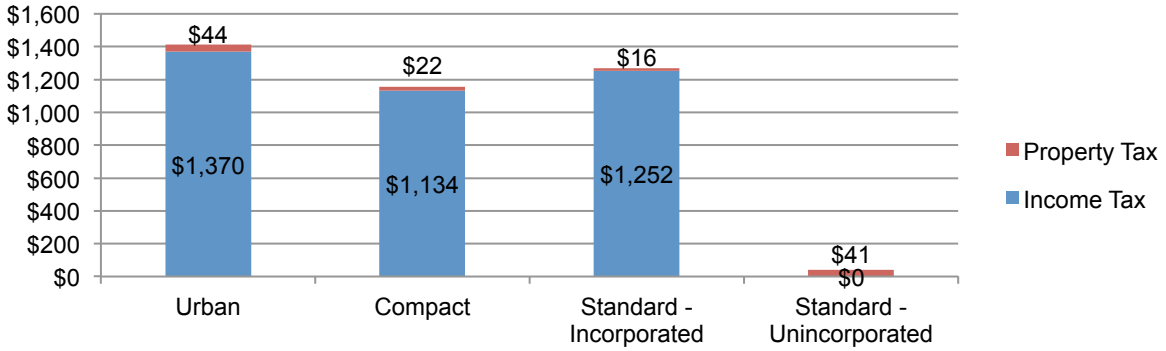
Source: Strategic Economics, 2014.

Figure 2: Annual General Fund and Public Safety Income and Property Tax Revenue per 1,000 Square Feet of Retail Space, by Place Type



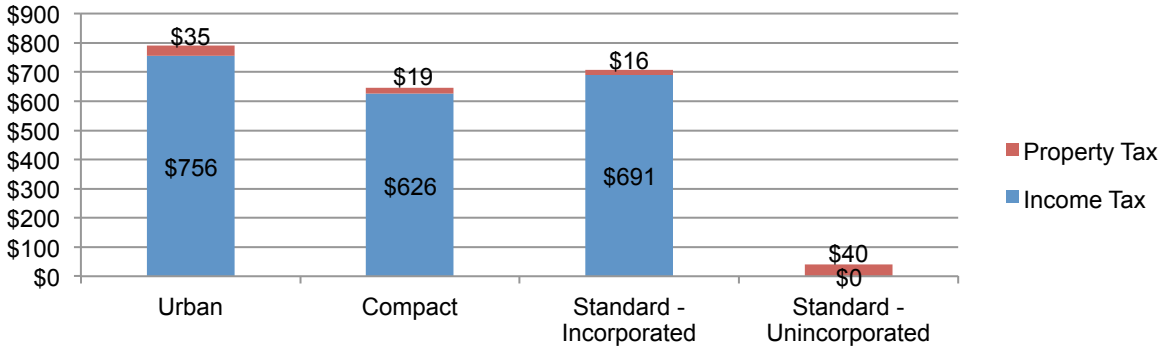
Source: Strategic Economics, 2014.

Figure 3: Annual General Fund and Public Safety Income and Property Tax Revenue per 1,000 Square Feet of Industrial Space, by Place Type



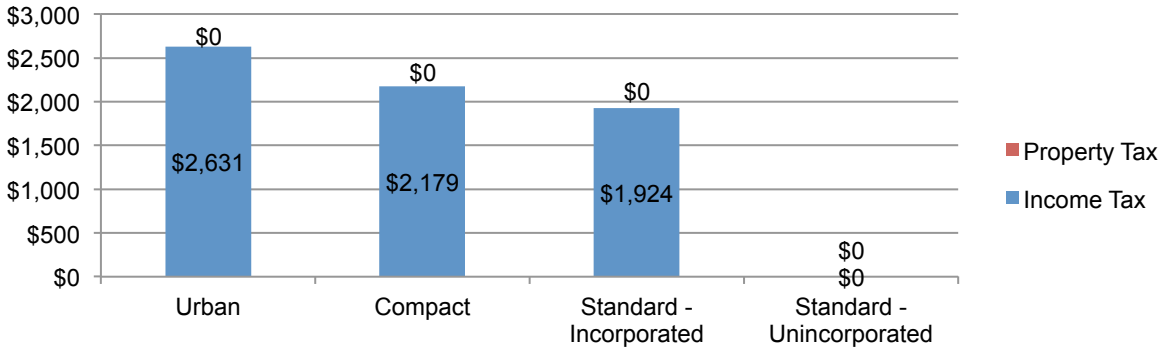
Source: Strategic Economics, 2014.

Figure 4: Annual General Fund and Public Safety Income and Property Tax Revenue per 1,000 Square Feet of Warehouse Space, by Place Type



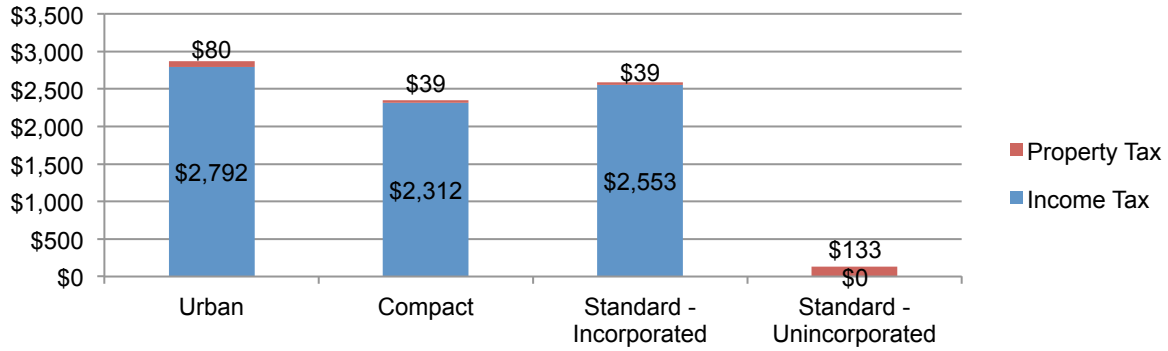
Source: Strategic Economics, 2014.

Figure 5: Annual General Fund and Public Safety Income and Property Tax Revenue per 1,000 Square Feet of Civic/Institutional Space, by Place Type



Source: Strategic Economics, 2014.

Figure 6: Annual General Fund and Public Safety Income and Property Tax Revenue per 1,000 Square Feet of Other Space, by Place Type



Source: Strategic Economics, 2014.

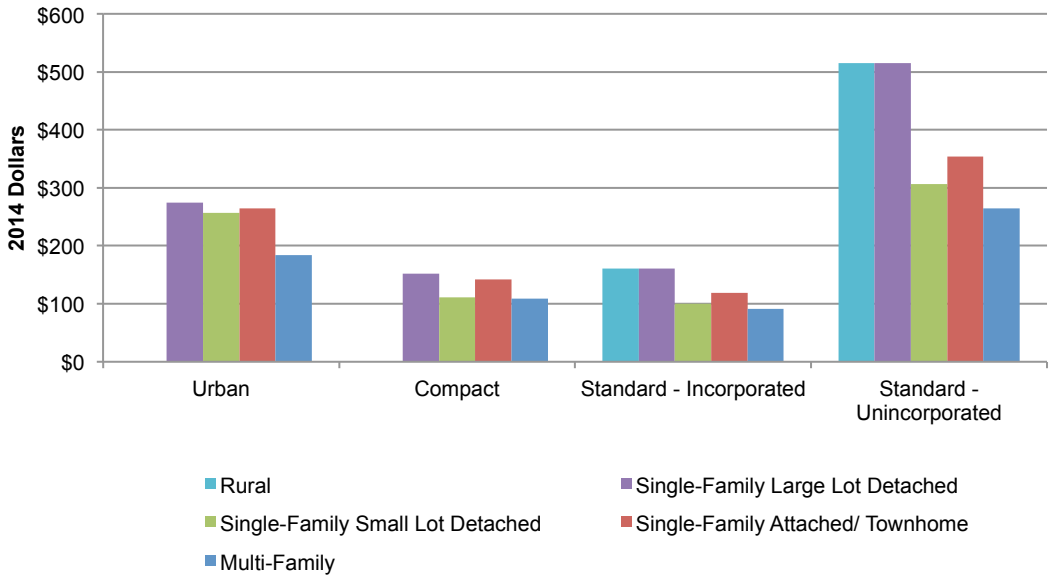
Residential Property Tax Revenue

Strategic Economics calculated property tax revenues generated by residential uses. As with commercial property tax calculations, Strategic Economics calculated the portion of property taxes dedicated to city and township general funds and public safety costs. These revenues were calculated on a per-household basis.

The results are shown in Figure 7 below. As shown, housing units in unincorporated areas generate significantly more property tax revenue compared to incorporated areas. The higher revenue generation is the result of higher property tax rates and higher assessed values per housing unit (due mostly to larger unit sizes) in these locations.

Although property tax revenues are generally lower on a per-unit basis for attached units (multi-family, attached, and small-lot single-family) than for detached units, the total revenues on a per acre basis are likely to be higher for attached housing types.

*Figure 7: Annual General Fund and Public Safety Property Tax Revenues per Housing Unit, by Building Type and Place Type**



*The RapidFire model does not include Rural housing types in the Urban and Compact place types.
Source: Strategic Economics, 2014.

Sales Tax Revenue

Strategic Economics calculated annual county sales tax revenue of $535 per housing unit for every place type. Sales tax revenues fund general county services. The uniform calculation of retail revenues by place type is based on the assumption that average retail spending by households may vary by income, but does not vary significantly by location.

Costs

This section summarizes the costs results of the fiscal analysis, including infrastructure costs, or the capital costs of building public infrastructure and facilities to serve new development, and operations and maintenance costs, or the costs of providing ongoing services to new development. Strategic Economics estimated infrastructure costs, which are one-time costs, based on connection fees assessed in various cities and national information on infrastructure costs that has been adjusted for the Ohio context. As described earlier, the operations and maintenance (O&M) costs are estimated as per capita, per worker, or per household figures based on the general fund expenditures of the representative cities, townships, and counties included in the analysis.

For each category of costs the results are broken out for each commercial property type, residential unit type, and place type. This section provides a summary of the results of the analysis; the detailed calculation methodology and the full results are provided in the Assumptions and Methodology section of this report.

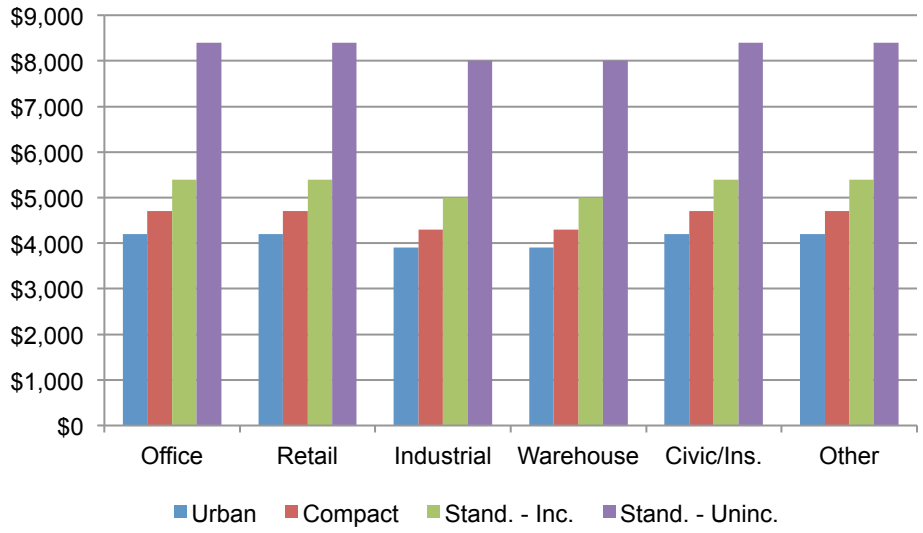
Infrastructure Costs

As described earlier, Strategic Economics calculated infrastructure costs for the following major categories:

- Roads: the costs of new local roads required to serve development (excluding state highways and non-local roadways);
- Sewer: the costs of wastewater facilities required to serve development; and
- Water: the costs of water infrastructure required to serve development.

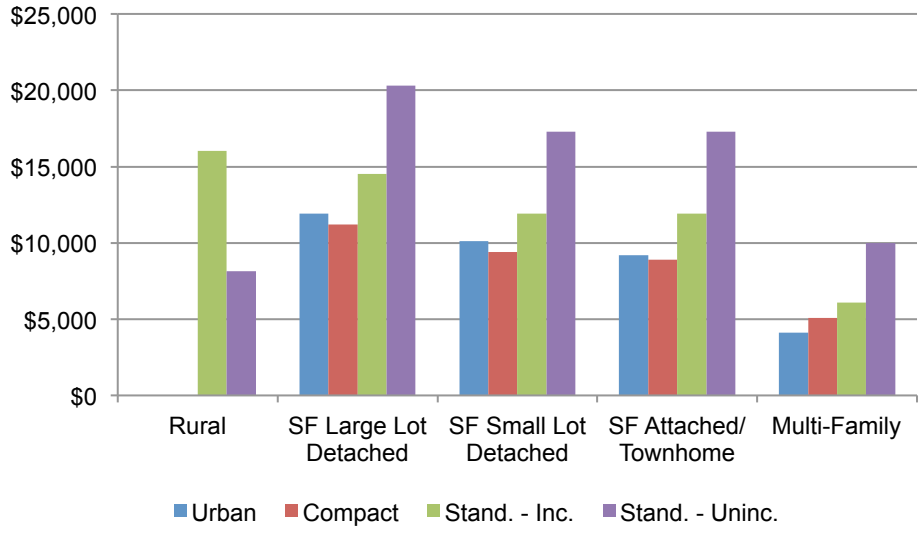
As shown in Figure 8 and Figure 9, Strategic Economics calculated that infrastructure costs are generally higher in unincorporated places, which is largely due to the higher costs associated with providing sewer and water infrastructure to those areas. The exception is for the rural housing type, where unincorporated places were assumed to have septic systems and well water, and therefore not incur sewer and water infrastructure costs (Figure 9). (The model does not include the rural housing type in the Urban and Compact place types.)

Figure 8: Infrastructure Costs per 1,000 Square Feet of Commercial Space, by Use and Place Type



Source: Strategic Economics, 2014.

Figure 9: Infrastructure Costs per Housing Unit, by Unit Type and Place Type



Source: Strategic Economics, 2014.

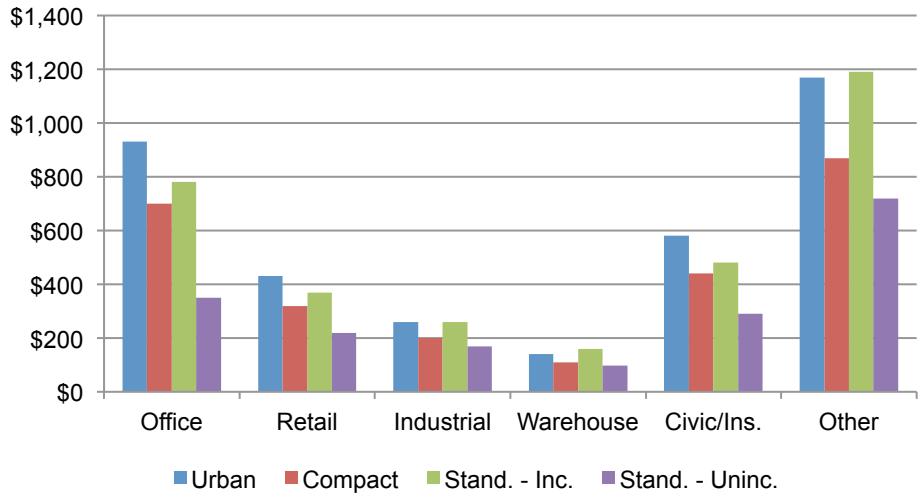
Operations and Maintenance (O&M) Costs

As described earlier, Strategic Economics calculated the local government O&M costs for the following major categories:

- General Government: including administrative and legislative functions;
- Fire: including all fire services in incorporated and unincorporated areas;
- Community Services: including community, health, and recreation services;
- Engineering and Public Works: including only general fund public works functions; and
- Police and Sheriff: including police and sheriff services in incorporated and unincorporated areas.

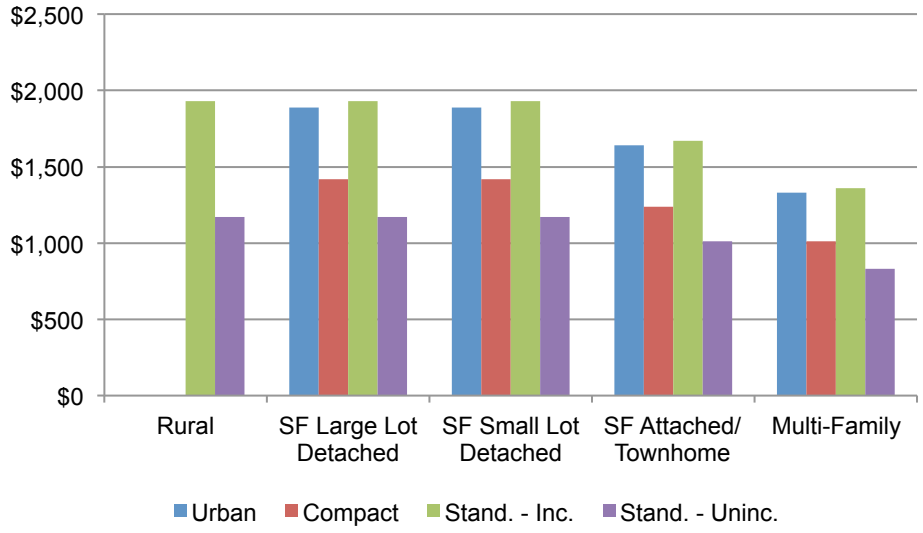
As shown in Figure 10 and Figure 11, Strategic Economics calculated that O&M costs are generally higher in Urban and Standard-Incorporated places and that O&M costs are lowest in unincorporated places. The differences in O&M costs are partly driven by differing levels of service. Incorporated cities often provide a greater level of service than unincorporated places (e.g., providing police services, or a wider array of community programs). In order to provide a comparison for public safety costs, the analysis includes the costs for providing municipal police services for incorporated cities and the costs for providing county-provided sheriff services to unincorporated places. Sheriff costs that are provided on a countywide basis, such as jail costs, were excluded from the analysis.

Figure 10: O&M Costs per 1,000 Square Feet of Commercial Space, by Use and Place Type



Source: Strategic Economics, 2014.

Figure 11: O&M Costs per Housing Unit, by Building Type and Place Type



Source: Strategic Economics, 2014.

Key Assumptions and Methodology

Base Assumptions

As with all fiscal impact analyses, the assumptions drive the results. Strategic Economics created its assumptions based on available data, including population and housing characteristics, municipal revenue and cost factors, real estate market indicators, and commonly applied fiscal impact analysis standards. The analysis uses current averages for costs and revenues to calculate results.

Demographic and Household Characteristics

Strategic Economics used U.S. Census 2008-2012 American Community Survey Estimates for household counts and the renter/owner tenure split in the seven-county Mid-Ohio region.

Figure 12: Households and Tenure

	Seven County Region
Number of Households	697,565
Renter Households	37%
Owner Households	63%

Source: U.S. Census American Community Survey 2008-2012 Estimates.

Strategic Economics used U.S. Census 2008-2012 American Community Survey Public Use Microdata Sample (PUMS) Estimates for persons per household by housing type for the State of Ohio. (PUMS data was not available at the city or county level.)

Figure 13: Persons per Household by Housing Unit Type

Housing Unit Type	Average Household Size
Single Family Attached	2.11
Single Family Detached	2.45
Multi-Family	1.72

Source: U.S. Census American Community Survey PUMS 2008-2012 Estimates.

Place Type Exemplars

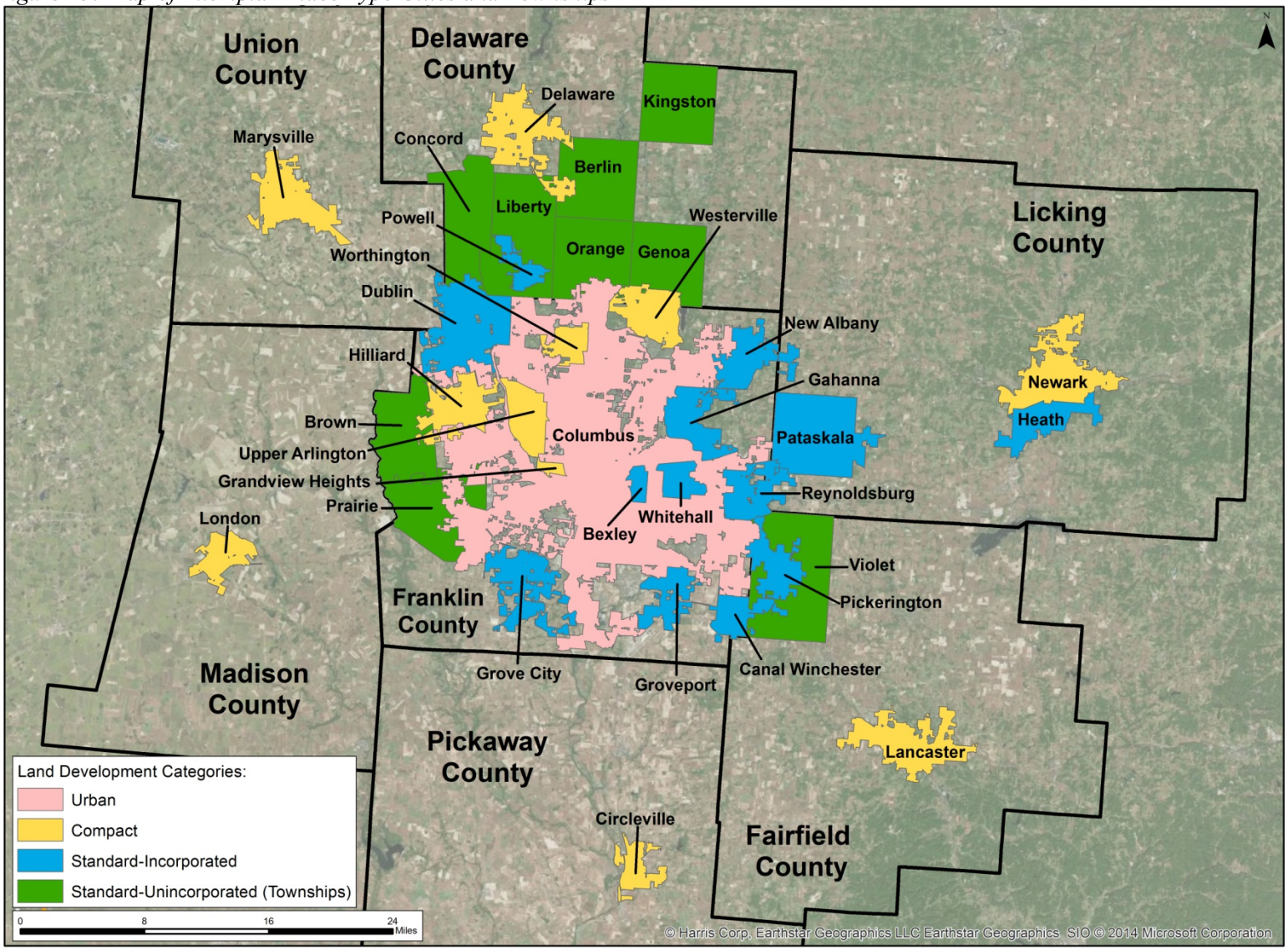
Based on input from Calthorpe Associates, Strategic Economics developed a list of cities and townships to represent the four place types used in the RapidFire model. These "exemplar" cities were selected primarily based on vehicle miles traveled (VMT), intersection density, land use density, and mix of uses. The exemplars were used throughout the fiscal model to calculate existing conditions by place type, though some data was limited for specific exemplar cities. Urban and compact place types are relatively rare in the Columbus region, so the most similar corollary cities were used to represent those categories. The place type assignments are shown in the table below and in the map on the following page.

Figure 14: Place Type Exemplar Cities and Townships

Urban	Compact	Standard - Incorporated	Standard - Unincorporated
Columbus	Circleville	Bexley	Berlin (Delaware County)
	Delaware	Canal Winchester	Brown (Franklin County)
	Grandview Heights	Dublin	Concord (Delaware County)
	Hilliard	Gahanna	Genoa (Delaware County)
	Lancaster	Grove City	Kingston (Delaware County)
	London	Groveport	Liberty (Delaware County)
	Marysville	Heath	Orange (Delaware County)
	Newark	New Albany	Prairie (Franklin County)
	Upper Arlington	Pataskala	Violet (Fairfield County)
	Westerville	Pickerington	
	Worthington	Powell	
		Reynoldsburg	
		Whitehall	

Source: Calthorpe Associates, 2014; Strategic Economics, 2014.

Figure 15: Map of Exemplar Place Type Cities and Townships



Sources: MORPC, 2014; US Census TIGER Line Data, 2013; Strategic Economics, 2014.

Housing Unit Types
As required by the RapidFire model, Strategic Economics calculated the fiscal impacts of four housing types:

- Single-family small lot detached homes ("SF Small Lot Detached")
- Single-family large lot detached homes ("SF Large Lot Detached")
- Single-family attached/townhomes ("SF Attached / Townhome")
- Multi-family housing units ("Multi-Family")

For purposes of calculating the impacts of new housing units, Strategic Economics assumed that only multi-family housing units will be constructed as both rental and ownership properties.

Average Housing Unit Size and Lot Density
Calthorpe Associates provided housing unit sizes and densities for each housing unit type, by place type, as shown below.

Figure 16: Average Unit Size (Square Feet), by Housing Unit Type and Place Type

	Urban	Compact	Standard - Incorporated	Standard - Unincorporated
Rural	n/a	n/a	2,450	2,600
Single-Family Large Lot Detached	2,300	2,300	2,450	2,300
Single-Family Small Lot Detached	1,550	1,550	1,650	1,750
Single-Family Attached/ Townhome	1,650	1,650	1,650	1,700
Multi-Family	1,200	1,350	1,350	1,350

Source: Calthorpe Associates, 2014; Strategic Economics, 2014.

Commercial Land Uses
Strategic Economics calculated the fiscal impacts of six commercial land use types:

- Office
- Retail
- Industrial
- Warehouse
- Civic/Institutional
- Other

Industry Sector Land Use Groupings
Strategic Economics assigned industry sectors to primary land use categories. These groupings were used to weight a variety of factors in the commercial income tax analysis.

Figure 17: Industry Sector Groupings by Commercial Land Use

Land Use	Industry
Office	Information
Office	Finance and Insurance
Office	Real Estate and Rental and Leasing
Office	Professional, Scientific, and Technical Services
Office	Management of Companies and Enterprises
Office	Admin. and Support and Waste Mgmt. and Remediation Svc.
Retail	Retail Trade
Retail	Accommodation and Food Services
Retail	Other Services
Industrial	Utilities
Industrial	Construction
Industrial	Manufacturing
Warehouse	Wholesale Trade
Warehouse	Transportation and Warehousing
Civic/Institutional	State and Local Government
Civic/Institutional	Educational Services
Civic/Institutional	Health Care and Social Assistance
Other	Agriculture, Forestry, Fishing, and Hunting
Other	Mining
Other	Arts, Entertainment, and Recreation

Source: Strategic Economics, 2014.

Commercial Land Use Employee Density

Strategic Economics used employee density assumptions expressed as square feet per employee by commercial land use and place type. The density estimates were roughly based on Arthur Nelson's "Columbus, Ohio: Metropolitan Area Trends, Preferences, and Opportunities" (which were in turn estimated based on the U.S. Energy Information Administration's "Commercial Buildings Energy Consumption Survey" of 2006) and further adjusted based on input from Calthorpe Associates.

Figure 18: Square Feet per Employee, by Commercial Land Use and Place Type

Land Use	Urban	Compact	Standard - Incorporated	Standard - Unincorporated
Office	250	250	300	400
Retail	550	550	650	650
Industrial	900	900	900	900
Warehouse	1,550	1,550	1,550	1,550
Civic/Institutional	400	400	500	500
Other	200	200	200	200

Source: Arthur Nelson, 2014; U.S. EIA, 2006; Calthorpe Associates, 2014; Strategic Economics, 2014.

Property Valuation

The following assumptions were used to calculate the capitalized values of commercial properties. Rental, vacancy, and capitalization rate data were primarily collected from CoStar market data for the first quarter of 2014. Data were adjusted based on additional information from sources including CB Richard Ellis (2014 Market Outlook and market reports for the first quarter of 2014) and Colliers

International (Columbus Research Knowledge Report for the first quarter of 2014). Lease rates for the Urban place type were based on the Downtown or Central Columbus market areas, and lease rates for Compact and Standard-Incorporated values were based on varying subareas of the central Columbus region. Values for Standard-Unincorporated place types were based on values in outlying counties. Operating expenses ratios were based on Strategic Economics' past experience conducting financial analyses and informed by the Institute of Real Estate Managements' 2012 "The Sample: Trends in Office Building Operations" report.

Figure 19: Capitalized Value Assumptions by Commercial Land Use and Place Type

		Urban				
	Units	**Office**	**Retail**	**Industrial**	**Warehouse**	**Other**
Monthly Rent	Per Leasable SF	$1.43	$1.26	$0.49	$0.40	$1.26
Building Efficiency	% Leasable	85%	85%	95%	95%	85%
Vacancy	Percent	5.0%	5.0%	5.0%	5.0%	5.0%
Operating Expenses	Percent	30.0%	30.0%	25.0%	25.0%	30.0%
Capitalization Rate	Percent	9.40%	9.30%	8.00%	8.00%	9.30%

		Compact				
	Units	**Office**	**Retail**	**Industrial**	**Warehouse**	**Other**
Monthly Rent	Per Leasable SF	$1.60	$0.79	$0.30	$0.27	$0.79
Building Efficiency	% Leasable	85%	85%	100%	100%	85%
Vacancy	Percent	9.0%	7.0%	7.0%	6.8%	7.0%
Operating Expenses	Percent	30.0%	30.0%	25.0%	25.0%	30.0%
Capitalization Rate	Percent	9.40%	9.30%	8.00%	8.00%	9.30%

		Standard - Incorporated				
	Units	**Office**	**Retail**	**Industrial**	**Warehouse**	**Other**
Monthly Rent	Per Leasable SF	$1.32	$0.93	$0.26	$0.26	$0.93
Building Efficiency	% Leasable	85%	85%	100%	100%	85%
Vacancy	Percent	9.0%	7.0%	7.0%	6.8%	7.0%
Operating Expenses	Percent	30.0%	30.0%	25.0%	25.0%	30.0%
Capitalization Rate	Percent	9.40%	9.30%	8.00%	8.00%	9.30%

		Standard - Unincorporated				
	Units	**Office**	**Retail**	**Industrial**	**Warehouse**	**Other**
Monthly Rent	Per Leasable SF	$1.53	$1.12	$0.23	$0.23	$1.12
Building Efficiency	% Leasable	85%	85%	100%	100%	85%
Vacancy	Percent	9.0%	7.0%	7.0%	6.8%	7.0%
Operating Expenses	Percent	30.0%	30.0%	25.0%	25.0%	30.0%
Capitalization Rate	Percent	9.40%	9.30%	8.00%	8.00%	9.30%

Source: CoStar, 2014; CB Richard Ellis, 2014; Colliers International, 2014; IREM, 2012; Strategic Economics, 2014.

The following assumptions were used to calculate the capitalized value of residential rental properties. Weighted average rents were calculated based on CoStar data for apartments brought to market in 2009 or later. Rents were weighted based on the distribution of units among exemplar cities within each place type. Rents for the Urban place type were based on newer apartments in Downtown

Columbus only. Capitalization rates were based primarily on the CB Richard Ellis report "Columbus Market Outlook 2014."

Figure 20: Capitalized Value Assumptions for New Apartment Units

	Units	Urban	Compact	Standard - Incorporated	Standard - Unincorporated
Monthly Rent	Per Leasable SF	$1.59	$1.04	$1.01	$1.01
Building Efficiency	% Leasable	80%	80%	80%	80%
Vacancy	Percent	5.0%	5.0%	5.0%	5.0%
Operating Expenses	Percent	25.0%	25.0%	25.0%	25.0%
Capitalization Rate	Percent	6.75%	6.75%	6.75%	6.75%

Source: CoStar, 2014; CB Richard Ellis, 2014; Strategic Economics, 2014.

Revenue Assumptions and Methodology

This section describes the assumptions and methodology used to calculate the income tax, property tax, and sales tax revenues.

Income Tax Revenue

Strategic Economics used the following steps to calculate general fund income tax revenues per thousand square feet of commercial space:

1. **Based on industry employment and wage data, a weighted average wage was calculated for each commercial land use.** This weighted average wage by land use was required in order to provide a base of revenue from which employee withholding income tax would be estimated. Strategic Economics calculated the weighted average wage for each land use by dividing total aggregate wages for each land use's industries by total employment within each land use. The employment and wage data again came from the 2012 QCEW.

Figure 21: Weighted Average Wages by Land Use, Mid-Ohio Region

Land Use	Weighted Average Annual Wage per Worker
Office	$60,434
Retail	$24,127
Industrial	$57,555
Warehouse	$54,686
Civic/Institutional	$49,122
Other	$26,072

Source: U.S. BLS QCEW, 2012; Strategic Economics, 2014.

2. **Wages per thousand square feet of commercial land uses were calculated for each place type.** In order to provide income tax revenue per thousand square feet of commercial land uses, Strategic Economics needed to estimate total wages per thousand square feet of space. For each commercial land use, Strategic Economics calculated workers per thousand square feet of building area based on square feet per employee assumptions (described in the Base Assumptions section). Strategic Economics then multiplied each average wage by the number of workers per thousand square feet, by land use and place type.

3. **Weighted average general fund income tax rates were calculated for each place type.** Strategic Economics calculates an income tax rate for each place type in order to calculate

income tax revenue by place type. Strategic Economics gathered all income tax rates for the place type exemplar cities. As necessary, the rates were reduced for cities in which budget research showed a portion of the income tax revenue is allocated to non-general fund uses (for example, only 75 percent of Columbus and Dublin income tax are apportioned to those cities' general funds). A weighted average rate by place type was then calculated based on each exemplar city's share of its respective place type's total employment. Employment data came from the U.S. Census Longitudinal Employer-Household Dynamics (LEHD) dataset for 2011 and income tax rates from the Ohio Department of Taxation.

Figure 22: Weighted Average General Fund Income Tax Rate by Place Type

Place Type	Weighted Average General Fund Rate
Urban	1.875%
Compact	1.437%
Standard - Incorporated	1.680%

Source: Ohio Department of Taxation, 2014; U.S. Census LEHD, 2011; city budgets; Strategic Economics, 2014.

4. **Employee withholding income tax revenue by place of work was calculated for each commercial land use and place type, per thousand square feet of space.** Strategic Economics multiplied the average income tax rates (calculated in step 4) by the wage per thousand square feet of commercial space (by land use and place type) that was calculated in step 3. This provided employee withholding income tax revenue per thousand square feet of commercial space, by land use type and place type. This represents the wage-based income tax revenue collected by the city in which a given employee works.

Figure 23: Employee Withholding Portion of General Fund Income Tax Revenue per Thousand Square Feet of Commercial Space, by Land Use and Place Type

Land Use	Urban	Compact	Standard - Incorporated	Standard - Unincorporated
Office	$4,533	$3,474	$3,384	$0
Retail	$823	$630	$624	$0
Industrial	$1,199	$919	$1,074	$0
Warehouse	$662	$507	$593	$0
Civic/Institutional	$2,303	$1,765	$1,650	$0
Other	$2,444	$1,873	$2,190	$0

Source: Strategic Economics, 2014.

5. **Applicable general fund income tax rates for worker places of residence were calculated based on commute patterns.** Strategic Economics examined worker commute patterns in order to adjust general fund income tax rates for calculating individual filing receipts paid to worker places of residence. Strategic Economics used 2011 LEHD worker commute data for the analysis. Home location data was gathered for the top ten employment cities in the Mid-Ohio region. The top employment cities were then grouped into place types, and the home locations of workers in those cities were aggregated (including workers that live and work in the same place). This produced each home city's percentage of total workers that commute to the employment cities in a given place type. These percentages were used as weighting factors in calculating weighted average income tax rates, credits, and credit limits for the home cities feeding a given place type's employment cities.

Figure 24: Weighted Average Income Tax Rates, Credits, and Credit Limits for Place of Residence of Workers

	Urban	Compact	Standard - Incorporated
Rate	2.34%	2.10%	2.25%
Credit	98.49%	74.33%	95.56%
Credit Limit	2.32%	1.67%	2.19%

Source: LEHD, 2014; Ohio Department of Taxation, 2014; Strategic Economics, 2014.

6. **Additional general fund income tax individual filing receipts for worker places of residence were calculated for commercial land uses and place types.** Since Columbus is overwhelmingly the largest employment location in the Mid-Ohio region, Strategic Economics applied the Columbus income tax rate as the standard assumed rate for workers' places of employment. The weighted average credit limit for home cities (by place type) was subtracted from this rate to arrive at the income tax rate for payments owed to worker home cities. The rate was appropriately reduced to account for the portion of income tax apportioned to the general fund. Strategic Economics then assumed that 25 percent of workers live and work in different cities and calculated general fund individual withholding income tax receipts by land use and place type, per thousand square feet of commercial space.

Figure 25: Individual Filing Portion of General Fund Income Tax Revenue per Thousand Square Feet of Commercial Space, by Land Use and Place Type

Land Use	Urban	Compact	Standard - Incorporated	Standard - Unincorporated
Office	$81	$382	$140	$0
Retail	$15	$69	$26	$0
Industrial	$22	$101	$44	$0
Warehouse	$12	$56	$24	$0
Civic/Institutional	$41	$194	$68	$0
Other	$44	$206	$90	$0

Source: Strategic Economics, 2014.

7. **Additional income tax levied on business profits was calculated for commercial land uses and place types, based on percentage factor of income tax revenues.** Business profit taxes comprise the third and final component of income tax receipts. Strategic Economics applied an additional percent factor to employee withholding revenue to account for the revenue driven by business profits. Based on budget data and other city documents, Strategic Economics gathered the net profits share of withholding income tax receipts for six of the top ten employment cities in the Mid-Ohio region. This factor was then multiplied by previously calculated employee withholding income tax to arrive at business profit income tax revenue for each commercial land use and place type.

Figure 26: Business Profit Portion of General Fund Income Tax Revenue per Thousand Square Feet of Commercial Space, by Land Use and Place Type

Land Use	Urban	Compact	Standard - Incorporated	Standard - Unincorporated
Office	$564	$432	$421	$0
Retail	$102	$78	$78	$0
Industrial	$149	$114	$134	$0
Warehouse	$82	$63	$74	$0
Civic/Institutional	$287	$220	$205	$0
Other	$304	$233	$273	$0

Source: City budgets; Strategic Economics, 2014.

8. **Total general fund income tax revenue per thousand square feet was calculated for each commercial land use and place type.** Strategic Economics summed the three calculated sources of general fund income tax revenue to arrive at total general fund income tax revenue per thousand square feet of commercial space, by land use and place type.

Figure 27: Total Annual General Fund Income Tax Revenue per Thousand Square Feet of Commercial Space, by Land Use and Place Type

Land Use	Urban	Compact	Standard - Incorporated	Standard - Unincorporated
Office	$5,178	$4,288	$3,945	$0
Retail	$940	$778	$727	$0
Industrial	$1,370	$1,134	$1,252	$0
Warehouse	$756	$626	$691	$0
Civic/Institutional	$2,631	$2,179	$1,924	$0
Other	$2,792	$2,312	$2,553	$0

Source: Strategic Economics, 2014.

Commercial Property Tax Revenue

Strategic Economics calculated general fund and public safety property tax revenues per thousand square feet of commercial space via the following steps:

1. **The capitalized value per square foot of commercial and industrial space was calculated for each commercial land use and place type.** Based on the capitalized value assumptions in the Base Assumptions section of this report, Strategic Economics calculated the capitalized value per square foot of the commercial land uses.

Figure 28: Capitalized Value per Square Foot of Commercial Land Uses, by Place Type

	Value per Square Foot					
Place Type	Office	Retail	Industrial	Warehouse	Civic/ Institutional	Other
Urban	$101	$89	$49	$40	n/a	$89
Compact	$106	$55	$31	$27	n/a	$55
Standard - Incorporated	$87	$64	$26	$26	n/a	$64
Standard - Unincorporated	$101	$77	$24	$23	n/a	$77

Source: Strategic Economics, 2014.

2. **Average general fund and public safety property tax rates were calculated by place type.** General fund and public safety property tax apportionment rates were gathered from the Ohio Department of Taxation 2013 Property Tax Rate Abstract for each place type exemplar city. These rates were averaged for each place type, producing general fund and public safety property tax rates for commercial properties.

Figure 29: Average General Fund and Public Safety Commercial Property Tax Rate by Place Type

Place Type	Rate
Urban	2.5%
Compact	2.0%
Standard - Incorporated	1.7%
Standard - Unincorporated	4.9%

Source: Ohio Department of Taxation, 2014; Strategic Economics, 2014.

3. **Annual general fund and public safety commercial property tax revenue were calculated per thousand square feet of space, by commercial land use and place type.** Strategic Economics multiplied the capitalized value of commercial land uses (by place type) per thousand square feet by the standard 35 percent assessment rate and the effective general fund and public safety property tax rate. This output the annual general fund and public safety property tax revenue per thousand square feet of commercial space, by land use and place type.

Figure 30: Annual General Fund and Public Safety Commercial Property Tax Revenue per Thousand Square Feet, by Land Use and Place Type

Place Type	Office	Retail	Industrial	Warehouse	Civic/ Institutional	Other
Urban	$89	$80	$44	$35	$0	$80
Compact	$75	$39	$22	$19	$0	$39
Standard - Incorporated	$53	$39	$16	$16	$0	$39
Standard - Unincorporated	$175	$133	$41	$40	$0	$133

Source: Strategic Economics, 2014.

Residential Property Tax Revenue

Strategic Economics calculated general fund and public safety property tax revenues per housing unit via the following steps:

1. **Average value per *ownership* housing unit was calculated for each unit type and place type.** Strategic Economics purchased a data report from DataQuick showing median sales values per square foot of residential properties constructed and sold after 2010. The data was broken out for Mid-Ohio cities and included attached residential units, small-lot detached single-family units (less than 7,200 square foot lot), and large-lot single-family units (greater than 7,200 square foot lot). Strategic Economics grouped the cities by their place type exemplar categories, and the median sales per square foot rates were averaged for each unit type by place type. These sales per square foot rates were then multiplied by the average square feet per unit type and place type.

Figure 31: Average Value per New Ownership Housing Unit, by Unit Type and Place Type

Place Type	Rural	SF Large Lot Detached	SF Small Lot Detached	SF Attached/ Townhome	Multi-Family
Urban	n/a	$308,200	$288,300	$297,825	$216,600
Compact	n/a	$216,191	$156,792	$200,697	$164,206
Standard - Incorporated	$266,839	$266,839	$165,198	$196,051	$160,405
Standard - Unincorporated	$294,067	$294,067	$175,210	$201,992	$160,405

Source: DataQuick, 2011-2014; Strategic Economics, 2014.

2. **Capitalized average values per *rental* multi-family housing units were calculated by place type.** Strategic Economics collected average rental rates per square foot of apartment buildings opened in 2009 or later, in Mid-Ohio cities, from CoStar. The cities were sorted by their exemplar place types, and a weighted average effective rental rate was calculated for each place type. Capitalized values per square foot by place type were calculated using the assumptions described in the Base Assumptions section of this report. These values were then multiplied by the multi-family unit size assumptions described in the Base Assumptions section of this report.

Figure 32: Average Value per New Multi-Family Rental Unit

Place Type	Value per Unit
Urban	$189,952
Compact	$139,299
Standard - Incorporated	$135,604
Standard - Unincorporated	$135,604

Source: Strategic Economics, 2014.

3. **Average values of multi-family housing units were calculated by place type.** Strategic Economics used U.S. Census data to examine the owner/renter tenure split in the Mid-Ohio region, as shown in the Base Assumptions. This tenure split was used to weight rental and owner property values for each place type and unit type to arrive at a weighted total value per multi-family housing unit.

4. **Average general fund and public safety property tax rates were calculated by place type.** General fund and public safety property tax apportionment rates were gathered from the Ohio Department of Taxation 2013 Property Tax Rate Abstract for each place type exemplar city. These rates were averaged for each place type, producing general fund and public safety property tax rates for residential properties (the rates were nearly identical to the commercial rates).

Figure 33: Average General Fund and Public Safety Residential Property Tax Rate by Place Type

Place Type	Rate
Urban	2.5%
Compact	2.0%
Standard - Incorporated	1.7%
Standard - Unincorporated	5.0%

Source: Ohio Department of Taxation, 2014; Strategic Economics, 2014.

5. **Residential general fund and public safety property tax revenues were calculated.** Strategic Economics multiplied the housing unit values (by housing unit type and place type) by the standard 35 percent assessment rate and the effective general fund and public safety property tax rate. This produced annual general fund and public safety property tax revenue per residential unit, by unit type and place type. These amounts do not reflect the ten percent "non-business credit" (formerly the "10% rollback") or the "owner occupancy credit" (formerly the "2 ½% rollback") applied to some residential property taxes. While those credits reduce the amount paid by property owners, the state reimburses the lost revenues back to cities and townships (minus a nominal administrative fee). As of 2013, these credits no longer apply to new levies.

Figure 34: Annual General Fund and Public Safety Residential Property Tax Revenue per Unit Type and Place Type

Place Type	Rural	SF Large Lot Detached	SF Small Lot Detached	SF Attached/ Townhome	Multi-Family (Rental and Owner)
Urban	n/a	$274	$256	$265	$184
Compact	n/a	$152	$111	$142	$109
Standard - Incorporated	$161	$161	$100	$118	$91
Standard - Unincorporated	$515	$515	$307	$354	$265

Source: Strategic Economics, 2014.

Sales Tax Revenue

Strategic Economics calculated sales tax revenue per housing unit via the following steps:

1. **Gathered and updated sales tax revenue.** Strategic Economics gathered each county's 2013 sales tax revenue. In order to account for Franklin County's increased rate between 2013 and 2014, Strategic Economics converted sales tax revenue to taxable sales and applied the new rate.

2. **Total sales tax revenue per housing unit was calculated.** Strategic Economics calculated taxable sales per household by dividing total seven-county taxable sales by the number of households in the seven-county region, resulting in annual total sales tax revenue of $535.19 per future household. This amount was applied as the sales tax revenue per future housing unit.

Cost Assumptions and Methodology

This section describes the assumptions and methodology used to calculate the infrastructure and O&M costs.

Infrastructure Costs

Strategic Economics calculated infrastructure costs for the following major categories:

- Roads, or the costs of new roads required to serve development;
- Sewer, or the costs of wastewater facilities required to serve development; and
- Water, or the costs of water infrastructure required to serve development.

Strategic Economics calculated costs for sewer and water infrastructure using the following steps:

1. **Gathered connection fee data.** Strategic Economics gathered data on sewer and water connection fees for exemplar cities and townships. Very few cities have impact fees in place in Ohio, so impact fee data was not used for any of the infrastructure categories.
2. **Sewer and water infrastructure costs per housing unit and per 1,000 square feet of commercial space were calculated.** Strategic Economics used the connection fees as a proxy for sewer and water infrastructure costs. Per housing unit and per 1,000 square feet of commercial space amounts were calculated for all cities and townships for which data was available. The resulting amounts were averaged by place type. The average for each place type was applied as the sewer and water infrastructure cost per housing unit and per 1,000 square feet of commercial space.

Strategic Economics calculated costs for roads using the following steps:

1. **Gathered data on road costs.** Strategic Economics gathered data on road costs. Local data on road costs by mile and type was not available, so national costs by road type and location type were used. The road costs by road type were applied to the place types used in the analysis. Costs shown in Figure 35 were used in the analysis.

Figure 35: Road Costs Per Mile by Place Type

Road Type	Cost Per Mile
2-Lane Undivided Road – Standard Place Type	$2 million
2-Lane Undivided Road – Compact Place Type	$2 million
2-Lane Undivided Road – Urban Place Type	$4 million

Source: American Road & Transportation Builders Association, 2014.

2. **Gathered data on road miles by unit type and place type.** Strategic Economics used examples from other regions for road miles by unit type and place type (Nashville, TN and San Mateo/Santa Clara counties, CA). Local data on road miles was not available.
3. **Road costs per housing unit and per 1,000 square feet of commercial space were calculated.** Strategic Economics used road costs by mile and place type, and data on road miles by unit type and place type to calculate road costs on a per housing unit and per 1,000 square feet of commercial space basis.

Operations and Maintenance Costs

Strategic Economics calculated O&M costs using the following steps:

1. **Gathered budget data for exemplar cities and townships.** O&M costs are based on actual general fund expenditures for the exemplar cities and townships shown in Figure 14 above.

Strategic Economics gathered budget data for all of the exemplar cities and townships except Berlin and Concord townships. In most cases budget documents were used, but in some cases Comprehensive Annual Financial Reports (CAFRs) were used. Budget data for counties was also collected.

2. **Categorized O&M costs by city and township.** Strategic Economics used the city and township budget information to compile general fund costs for the following major service areas:

   - Community Service
   - Engineering and Public Works
   - General Government
   - Fire
   - Police/Sheriff

   In order to provide a comparison for public safety costs, the analysis includes the costs for providing municipal police services for incorporated cities and the costs for providing county-provided sheriff services to unincorporated places. Sheriff costs that are provided on a countywide basis, such as jail costs, were excluded from the analysis.

3. **Calculated service base.** The service base is the population served by a city or township. To calculate O&M costs on a per capita basis, the existing service base – or "daytime population" of residents and workers – was established by applying a "Service Population Factor." The residential service population was assumed to have a 1.0 factor, while the employment service population was assumed to have a 0.3 factor. Each worker is counted as producing 0.30 of the impacts of a resident for analytical purposes, since workers spend approximately a third of the time of a resident in the city, and are assumed to require fewer services in general (fire, police, etc.).

4. **Calculated O&M costs on a per capita basis, per household, and per 1,000 square feet of commercial space.** Strategic Economics divided general fund costs for each city and township by the service base for that city or township to calculate a per capita O&M cost. Those per capita costs were then averaged by place type to obtain the per capita cost assumptions for the fiscal model. Figure 36 and Figure 37 show the per capita and per worker costs for O&M by major service category and place type. Strategic Economics applied the average household sizes by housing unit type and employee density assumptions shown in Figure 16 and Figure 18 to calculate, per average costs per household and per 1,000 square feet of commercial space.

Figure 36: Per Capita Operations and Maintenance Costs, by Cost Category and Place Type

Cost Category	Urban	Compact	Standard - Incorporated	Standard - Unincorporated
General Government	$128	$169	$217	$61
Fire	$232	$140	$134	$243
Police/Sheriff	$297	$156	$213	$137
Community Service	$51	$61	$81	$17
Engineering and Public Works	$66	$57	$145	$17
Total	$774	$583	$790	$476

Source: Strategic Economics, 2014.

Figure 37: Per Worker Operations and Maintenance Costs, by Cost Category and Place Type

Cost Category	Urban	Compact	Standard - Incorporated	Standard - Unincorporated
General Government	$38	$51	$65	$18
Fire	$70	$42	$40	$73
Police/Sheriff	$89	$47	$64	$41
Community Service	$15	$18	$24	$5
Engineering and Public Works	$20	$17	$43	$5
Total	$232	$175	$237	$143

Source: Strategic Economics, 2014.

Full Results

This section provides the full results of the fiscal analysis for insight2050. The results are provided by land use and place type for all studied categories of revenues and costs.

Revenue

Revenues Associated with Commercial Space

Figures 39 through 41 show annual general fund revenues for commercial space, by land use and place type.

Figure 38: Annual General Fund Income Tax Revenue per Thousand Square Feet of Commercial Space, by Land Use and Place Type*

Land Use	Urban	Compact	Standard - Incorporated	Standard - Unincorporated
Office	$5,178	$4,288	$3,945	$0
Retail	$940	$778	$727	$0
Industrial	$1,370	$1,134	$1,252	$0
Warehouse	$756	$626	$691	$0
Civic/Institutional	$2,631	$2,179	$1,924	$0
Other	$2,792	$2,312	$2,553	$0

*Includes withholdings (place of work), individual filings (place of residence), and business profit income taxes.
Source: Strategic Economics, 2014.

Figure 39: Annual General Fund and Public Safety Commercial Property Tax Revenue per Thousand Square Feet, by Land Use and Place Type

Land Use	Urban	Compact	Standard - Incorporated	Standard - Unincorporated
Office	$89	$75	$53	$175
Retail	$80	$39	$39	$133
Industrial	$44	$22	$16	$41
Warehouse	$35	$19	$16	$40
Civic/Institutional	$0	$0	$0	$0
Other	$80	$39	$39	$133

Source: Strategic Economics, 2014.

Figure 40: Total Combined Annual General Fund and Public Safety Commercial Income & Property Tax Revenues per Thousand Square Feet, by Land Use and Place Type

Land Use	Urban	Compact	Standard - Incorporated	Standard - Unincorporated
Office	$5,267	$4,363	$3,997	$175
Retail	$1,019	$817	$766	$133
Industrial	$1,413	$1,156	$1,268	$41
Warehouse	$791	$645	$707	$40
Civic/Institutional	$2,631	$2,179	$1,924	$0
Other	$2,872	$2,351	$2,592	$133

Source: Strategic Economics, 2014.

Revenues Associated with Housing Units

Figures 42 and 43 show annual general fund revenues per housing unit, by land use and place type.

Figure 41: Annual General Fund and Public Safety Residential Property Tax Revenues per Unit Type and Place Type

	Urban	Compact	Standard - Incorporated	Standard - Unincorporated
Rural	n/a	n/a	$161	$515
SF Large Lot Detached	$274	$152	$161	$515
SF Small Lot Detached	$256	$111	$100	$307
SF Attached/ Townhome	$265	$142	$118	$354
Multi-Family	$184	$109	$91	$265

Source: Strategic Economics, 2014.

Figure 42: Annual County Sales Tax Revenue per Housing Unit

	Urban	Compact	Standard - Incorporated	Standard - Unincorporated
All Housing Types	$535	$535	$535	$535

Source: Strategic Economics, 2014.

Costs

Infrastructure Costs Associated with Commercial Space

Figures 44 through 49 show infrastructure costs for each type of commercial land use studied by infrastructure category and place type.

Figure 43: Office Infrastructure Costs per 1,000 Square Feet, by Cost Category and Place Type

Infrastructure Type	Urban	Compact	Standard - Incorporated	Standard - Unincorporated
Roads	$2,100	$2,400	$2,800	$2,800
Sewer	$1,400	$1,200	$1,200	$3,300
Water	$700	$1,100	$1,400	$2,300
Total	$4,200	$4,700	$5,400	$8,400

Source: Strategic Economics, 2014.

Figure 44: Retail Infrastructure Costs per 1,000 Square Feet, by Cost Category and Place Type

Infrastructure Type	Urban	Compact	Standard - Incorporated	Standard - Unincorporated
Roads	$2,100	$2,400	$2,800	$2,800
Sewer	$1,400	$1,200	$1,200	$3,300
Water	$700	$1,100	$1,400	$2,300
Total	$4,200	$4,700	$5,400	$8,400

Source: Strategic Economics, 2014.

Figure 45: Industrial Infrastructure Costs per 1,000 Square Feet, by Cost Category and Place Type

Infrastructure Type	Urban	Compact	Standard - Incorporated	Standard - Unincorporated
Roads	$1,800	$2,000	$2,400	$2,400
Sewer	$1,400	$1,200	$1,200	$3,300
Water	$700	$1,100	$1,400	$2,300
Total	$3,900	$4,300	$5,000	$8,000

Source: Strategic Economics, 2014.

Figure 46: Warehouse Infrastructure Costs per 1,000 Square Feet, by Cost Category and Place Type

Infrastructure Type	Urban	Compact	Standard - Incorporated	Standard - Unincorporated
Roads	$1,800	$2,000	$2,400	$2,400
Sewer	$1,400	$1,200	$1,200	$3,300
Water	$700	$1,100	$1,400	$2,300
Total	$3,900	$4,300	$5,000	$8,000

Source: Strategic Economics, 2014.

Figure 47: Civic/Institutional Infrastructure Costs per 1,000 Square Feet, by Cost Category and Place Type

Infrastructure Type	Urban	Compact	Standard - Incorporated	Standard - Unincorporated
Roads	$2,100	$2,400	$2,800	$2,800
Sewer	$1,400	$1,200	$1,200	$3,300
Water	$700	$1,100	$1,400	$2,300
Total	$4,200	$4,700	$5,400	$8,400

Source: Strategic Economics, 2014.

Figure 48: Other Infrastructure Costs per 1,000 Square Feet, by Cost Category and Place Type

Infrastructure Type	Urban	Compact	Standard - Incorporated	Standard - Unincorporated
Roads	$2,100	$2,400	$2,800	$2,800
Sewer	$1,400	$1,200	$1,200	$3,300
Water	$700	$1,100	$1,400	$2,300
Total	$4,200	$4,700	$5,400	$8,400

Source: Strategic Economics, 2014.

Infrastructure Costs Associated with Housing Units

Figures 50 through 54 show infrastructure costs for each housing unit type studied by infrastructure category and place type.

Figure 49: Rural Lot Per Household Infrastructure Costs, by Cost Category and Place Type

Cost Category	Urban	Compact	Standard - Incorporated	Standard - Unincorporated
Roads	n/a	n/a	$7,625	$8,125
Sewer	n/a	n/a	$4,900	$0
Water	n/a	n/a	$3,500	$0
Total	n/a	n/a	$16,025	$8,125

Source: Strategic Economics, 2014.

Figure 50: Single Family Large-Lot Per Household Infrastructure Costs, by Cost Category and Place Type

Infrastructure Type	Urban	Compact	Standard - Incorporated	Standard - Unincorporated
Roads	$5,300	$5,300	$6,100	$6,500
Sewer	$3,100	$3,100	$4,900	$7,300
Water	$3,500	$2,800	$3,500	$6,500
Total	$11,900	$11,200	$14,500	$20,300

Source: Strategic Economics, 2014.

Figure 51: Single Family Small-Lot Per Household Infrastructure Costs, by Cost Category and Place Type

Infrastructure Type	Urban	Compact	Standard - Incorporated	Standard - Unincorporated
Roads	$3,500	$3,500	$3,500	$3,500
Sewer	$3,100	$3,100	$4,900	$7,300
Water	$3,500	$2,800	$3,500	$6,500
Total	$10,100	$9,400	$11,900	$17,300

Source: Strategic Economics, 2014.

Figure 52: Single Family Attached / Townhome Per Household Infrastructure Costs, by Cost Category and Place Type

Infrastructure Type	Urban	Compact	Standard - Incorporated	Standard - Unincorporated
Roads	$2,600	$3,000	$3,500	$3,500
Sewer	$3,100	$3,100	$4,900	$7,300
Water	$3,500	$2,800	$3,500	$6,500
Total	$9,200	$8,900	$11,900	$17,300

Source: Strategic Economics, 2014.

Figure 53: Multi-Family Per Household Infrastructure Costs, by Cost Category and Place Type

Infrastructure Type	Urban	Compact	Standard - Incorporated	Standard - Unincorporated
Roads	$1,500	$2,200	$2,900	$2,900
Sewer	$1,700	$1,500	$1,500	$4,200
Water	$900	$1,400	$1,700	$2,900
Total	$4,100	$5,100	$6,100	$10,000

Source: Strategic Economics, 2014.

Operations and Maintenance Costs Associated with Commercial Space

Figures 55 through 60 show operations and maintenance costs for each type of commercial land use studied by cost category and place type.

Figure 54: Annual Office Operations and Maintenance Costs per 1,000 Square Feet, by Cost Category and Place Type

Cost Category	Urban	Compact	Standard - Incorporated	Standard - Unincorporated
General Government	$150	$200	$220	$50
Fire	$280	$170	$130	$180
Police/Sheriff	$360	$190	$210	$100
Community Service	$60	$70	$80	$10
Engineering and Public Works	$80	$70	$140	$10
Total	$930	$700	$780	$350

Source: Strategic Economics, 2014.

Figure 55: Annual Retail Operations and Maintenance Costs per 1,000 Square Feet, by Cost Category and Place Type

Cost Category	Urban	Compact	Standard - Incorporated	Standard - Unincorporated
General Government	$70	$90	$100	$30
Fire	$130	$80	$60	$110
Police/Sheriff	$160	$90	$100	$60
Community Service	$30	$30	$40	$10
Engineering and Public Works	$40	$30	$70	$10
Total	$430	$320	$370	$220

Source: Strategic Economics, 2014.

Figure 56: Annual Industrial Operations and Maintenance Costs per 1,000 Square Feet, by Cost Category and Place Type

Cost Category	Urban	Compact	Standard - Incorporated	Standard - Unincorporated
General Government	$40	$60	$70	$20
Fire	$80	$50	$40	$80
Police/Sheriff	$100	$50	$70	$50
Community Service	$20	$20	$30	$10
Engineering and Public Works	$20	$20	$50	$10
Total	$260	$200	$260	$170

Source: Strategic Economics, 2014.

Figure 57: Annual Warehouse Operations and Maintenance Costs per 1,000 Square Feet, by Cost Category and Place Type

Cost Category	Urban	Compact	Standard - Incorporated	Standard - Unincorporated
General Government	$20	$30	$40	$10
Fire	$40	$30	$30	$50
Police/Sheriff	$60	$30	$40	$30
Community Service	$10	$10	$20	$3
Engineering and Public Works	$10	$10	$30	$3
Total	$140	$110	$160	$97

Source: Strategic Economics, 2014.

Figure 58: Annual Civic/Institutional Operations and Maintenance Costs per 1,000 Square Feet, by Cost Category and Place Type

Cost Category	Urban	Compact	Standard - Incorporated	Standard - Unincorporated
General Government	$100	$130	$130	$40
Fire	$170	$100	$80	$150
Police/Sheriff	$220	$120	$130	$80
Community Service	$40	$50	$50	$10
Engineering and Public Works	$50	$40	$90	$10
Total	$580	$440	$480	$290

Source: Strategic Economics, 2014.

Figure 59: Annual Other Operations and Maintenance Costs per 1,000 Square Feet, by Cost Category and Place Type

Cost Category	Urban	Compact	Standard - Incorporated	Standard - Unincorporated
General Government	$190	$250	$330	$90
Fire	$350	$210	$200	$360
Police/Sheriff	$450	$230	$320	$210
Community Service	$80	$90	$120	$30
Engineering and Public Works	$100	$90	$220	$30
Total	$1,170	$870	$1,190	$720

Source: Strategic Economics, 2014.

Operations and Maintenance Costs Associated with Housing Units

Figures 61 through 65 show operations and maintenance costs for each housing unit type studied by cost category and place type.

Figure 60: Annual Rural Lot Per Household Operations and Maintenance Costs, by Cost Category and Place Type

Cost Category	Urban	Compact	Standard - Incorporated	Standard - Unincorporated
General Government	n/a	n/a	$530	$150
Fire	n/a	n/a	$330	$600
Police/Sheriff	n/a	n/a	$520	$340
Community Service	n/a	n/a	$200	$40
Engineering and Public Works	n/a	n/a	$350	$40
Total	n/a	n/a	$1,930	$1,170

Source: Strategic Economics, 2014.

Figure 61: Annual Single Family Large-Lot Per Household Operations and Maintenance Costs, by Cost Category and Place Type

Cost Category	Urban	Compact	Standard - Incorporated	Standard - Unincorporated
General Government	$310	$410	$530	$150
Fire	$570	$340	$330	$600
Police/Sheriff	$730	$380	$520	$340
Community Service	$120	$150	$200	$40
Engineering and Public Works	$160	$140	$350	$40
Total	$1,890	$1,420	$1,930	$1,170

Source: Strategic Economics, 2014.

Figure 62: Annual Single Family Small-Lot Per Household Operations and Maintenance Costs, by Cost Category and Place Type

Cost Category	Urban	Compact	Standard - Incorporated	Standard - Unincorporated
General Government	$310	$410	$530	$150
Fire	$570	$340	$330	$600
Police/Sheriff	$730	$380	$520	$340
Community Service	$120	$150	$200	$40
Engineering and Public Works	$160	$140	$350	$40
Total	$1,890	$1,420	$1,930	$1,170

Source: Strategic Economics, 2014.

Figure 63: Annual Single Family Attached / Townhome Per Household Operations and Maintenance Costs, by Cost Category and Place Type

Cost Category	Urban	Compact	Standard - Incorporated	Standard - Unincorporated
General Government	$270	$360	$460	$130
Fire	$490	$300	$280	$510
Police/Sheriff	$630	$330	$450	$290
Community Service	$110	$130	$170	$40
Engineering and Public Works	$140	$120	$310	$40
Total	$1,640	$1,240	$1,670	$1,010

Source: Strategic Economics, 2014.

Figure 64: Annual Multi-Family Per Household Operations and Maintenance Costs, by Cost Category and Place Type

Cost Category	Urban	Compact	Standard - Incorporated	Standard - Unincorporated
General Government	$220	$290	$370	$110
Fire	$400	$240	$230	$420
Police/Sheriff	$510	$270	$370	$240
Community Service	$90	$110	$140	$30
Engineering and Public Works	$110	$100	$250	$30
Total	$1,330	$1,010	$1,360	$830

Source: Strategic Economics, 2014.

Appendix: List of Interviews

Strategic Economics attended (by phone) two insight2050 Executive Committee meetings and three insight2050 Steering Committee meetings, where members provided information and feedback for the analysis. In addition to those meetings, Strategic Economics conducted interviews with the following city, township, county, and regional government staff members:

Adam Robins, Deputy Director of Finance and Management, City of Columbus

Alan Moran, Bridge and Pavement Program Manager, City of Columbus

Andy Taylor, Principal Planner, Mid-Ohio Regional Planning Commission

Angel Mumma, Director of Finance / Deputy City Manager, City of Dublin

Ann Aubry, Deputy Director of Public Utilities, City of Columbus

Chris Bauserman, County Engineer, Delaware County

Dave Anderson, Township Administrator, Liberty Township

Jason Sanson, Private Development Section Manager, City of Columbus

Jennifer Gallagher, Deputy Director of Public Service, City of Columbus

Kevin Wheeler, Assistant Planning Administrator, City of Columbus

Marsha Grigsby, City Manager, City of Dublin

Paul Rakosky, Director of Finance and Management, City of Columbus

Robert Newman, Capital and Debt Coordinator, Finance and Management, City of Columbus

Seiji Kille, Fiscal Services Director, Delaware County

Terry Foegler, Director of Strategic Initiatives/Special Projects, City of Dublin

Tim Hansley, County Administrator, Delaware County