# METROPOLITAN COUNCIL'S FORECASTS METHODOLOGY

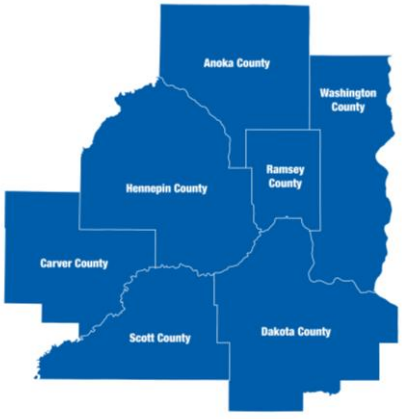
***2019 Update***


October 2019

# The Council's mission is to foster efficient and economic growth for a prosperous metropolitan region

## Metropolitan Council Members

| | | | |
|---|---|---|---|
| Nora Slawik | Chair | Raymond Zeran | District 9 |
| Judy Johnson | District 1 | Peter Lindstrom | District 10 |
| Reva Chamblis | District 2 | Susan Vento | District 11 |
| Christopher Ferguson | District 3 | Francisco J. Gonzalez | District 12 |
| Deb Barber | District 4 | Chai Lee | District 13 |
| Molly Cummings | District 5 | Kris Fredson | District 14 |
| Lynnea Atlas-Ingebretson | District 6 | Phillip Sterner | District 15 |
| Robert Lilligren | District 7 | Wendy Wulff | District 16 |
| Abdirahman Muse | District 8 | | |




The Metropolitan Council is the regional planning organization for the seven-county Twin Cities area. The Council operates the regional bus and rail system, collects and treats wastewater, coordinates regional water resources, plans and helps fund regional parks, and administers federal funds that provide housing opportunities for low- and moderate-income individuals and families. The 17-member Council board is appointed by and serves at the pleasure of the governor.

On request, this publication will be made available in alternative formats to people with disabilities. Call Metropolitan Council information at 651-602-1140 or TTY 651-291-0904.

# *Metropolitan Council's Forecasts Methodology*

The regional and local forecasts prepared by Metropolitan Council express future expectations based on an understanding of regional dynamics, and modeling of real estate market dynamics, land policies and plans. Consistent with *Minnesota Statutes* 473.146 and 473.859, the Council's forecasts provide a shared foundation for coordinated, comprehensive planning by the Council and local governments.

A regional forecast and local forecasts were included in the *Thrive MSP 2040* regional plan, adopted by Metropolitan Council on May 28, 2014.

These forecasts were subsequently updated and improved.

- Biennial updates to the regional model, in 2015, 2017, and 2019, included: updates of national population, economic and employment forecasts; updates of all time-series with observed data for recent years; and model vendor's programming improvements and recalibration.
- The 2015 update to local forecasts included: use of updated and more detailed planning data; use of more locally detailed land supply analysis; revision of land consumption rates; input of more detailed data on residential building costs and real estate prices (rents); updated transportation network definition and accessibility data.

## *Overview of forecasting program.*

Metropolitan Council's regional forecast considers the Twin Cities' situation within the larger, national economy: An analysis of regional economic competitiveness determines forecasted economic production and employment, which in turn prompt population growth through migration.

Subsequent to the *regional* forecast, *local* forecasts address the likely geographic pattern of future growth. Regional population, households and employment will locate in specific places. Metropolitan Council assumes that real estate and land market dynamics, interacting with activity patterns and future transportation accessibility, mainly determine outcomes. Land use policies and local plans also shape spatial distributions.

Considering the multi-scale aspects of future planning, Metropolitan Council employs multiple forecast modeling tools:

- A regional economic model for forecasting region-level economic activity and migration flows
- A land use model simulating and projecting real estate and land market dynamics, in order to locate future land use, households and employment to communities and zones
- A travel demand model for predicting modes, network paths and network conditions
- A hydrogeologic model for projecting water demands and water resource impacts.

This document addresses the first two models.

## *Methodology of REMI PI.*

Following a review of best practices in regional economic modeling, the Council selected REMI PI as the model best fitting the Council's understanding of regional growth. REMI PI utilizes computable general equilibrium techniques to project forward time-series of economic activity, as well as input-output matrices to represent inter-industry flows and impacts. Simulation and projection of economic activities (production, consumption, and trade) are central to the model. Macroeconomic functions

determine the balance of capital, and labor levels; and the model seeks equilibrium between industries' labor demand, wage levels, and labor supply.

Population changes are projected simultaneously using detailed cohort-component demographic techniques to project fertility and survival rates, and new economic geography techniques to project labor market results and migration. If industries' labor demand intensifies (or slackens), then labor supply adjusts up (or down) through migration. Thus, economic competitiveness and labor demand are the major determinants of migration in the REMI PI model.

A more detailed description can be found in the model documentation:

- Regional Economic Models Inc. (2019), *REMI PI+ Model Equations*, online at *www.remi.com*

Our Minnesota implementation of the model has two *home regions*: the Twin Cities 7-county metro is one; the rest of Minnesota is a second region; the rest of the nation and the world are additional linked economies.

The model delivered by Regional Economic Models Inc. assesses the Twin Cities metro having factor cost advantages, resource advantages, a high level of workforce productivity, and breadth of workforce supply. The model also finds under-performance in noneconomic attraction of population. In periods of economic expansion, the region has experienced, and may continue to experience, workforce supply shortages. These characteristics inform a forecast of slightly above-average growth in coming decades. REMI and Metropolitan Council forecast that the Twin Cities metro will account for 1.2 percent of national GDP in 2040.

### *Modifications to the as-delivered REMI PI model.*

In the implementation of REMI PI, the Council modifies some settings and data inputs to the "as delivered" model. First, the national forecast in the Council's model is controlled to match nation-level GDP and income projections from IHS Markit's 30-year Trend forecast; this is the same forecast used by the Minnesota State Economist as a baseline for long-term, national economic expectations. The Twin Cities metro region's growth is substantially tethered to national economic conditions. For more information, see:

- Minnesota Management & Budget (2019, and updated bi-annually), *Minnesota and U.S. Economic Outlook*, online at *http://mn.gov/mmb/forecast/forecast/*

Second, the Council updates regional time-series with observed actuals:

- Fertility rates schedules (fertility rates by race and by age of mother) are re-leveled so that the base year matches region-specific rates calculated from the most recent 5 years of births data tracked by Centers for Disease Control. In the Twin Cities metro, the 2012-16 total fertility rate for whites is 1.7 children per woman; the rate for blacks is 2.9; the rate for Latinos is 2.1; the rate for Asians is 1.8.
- The most recent two years of industry employment statistics are updated with data from Minnesota Department of Employment and Economic Development.

Model vendor-provided assumptions and time-series data are reviewed and modified as necessary. There are variables in the model that are recognized as difficult to project. Generally, the Council assumes a stable status quo or median values within the range of possibilities. Specifically:

- College-going population by race is projected to increase in tandem with growth in the resident population of 17-year-olds by race.
- The region's prison population is constrained to grow no more than 1 percent per year.

- The balance of long-distance commuters into the region and out of the region is adjusted for future years. This adjustment constrains long-distance commuting growth to the slow growth trend observed over the past decade.

A few model vendor-provided projections that have sometimes needed adjustment, but are not adjusted in the latest modeling, include the following:

- Tax rates for the Twin Cities and Minnesota are projected to remain level.
- Regional consumer prices relative to the national average are not adjusted in the latest modeling. In previous forecast updates, Metropolitan Council modified the REMI projection of Minnesota fuel prices to mitigate unexplained deviance from national average prices.
- Regional average housing prices relative to the national average is projected to remain in the 94 to 98 percent range throughout the forecast period. In previous forecast updates.

### *Regional households projection.*

To obtain household counts, the REMI PI population projection is parsed into households and household types using a schedule of age-specific head-of-household incidence rates. The base year schedule is obtained from analysis of Census Bureau's American Community Survey.

With the 2019 update, we are allowing rates to shift over time. This is necessary because of the significant shifts in actual households formation and actual behavior observed during the past decade.

- In 2010, the overall average household size in the Twin Cities region was 2.50.
- Because of the overall aging of the population, and declining birth rates, we expected to see more empty-nest and small households going forward. If age-specific household incidence rates had remained constant and unchanged during 2010-2018, average household size would have declined to 2.46. This is not what happened.
- Instead, households composition patterns did change. During 2010-2018, we have observed a "doubling up" phenomenon, with more households including extended family members and unrelated persons (roommates, etc.), and slowing household formation rates, with delays in the age at which adult children leave their parents' households. The average household size did not decline to 2.46, but instead has leveled off at 2.51. This can be thought of as 1 in every 20 households having an extra household member. It can also be thought of as a 2% reduction in overall housing consumption – the region's population occupying 24,000 fewer housing units in 2018 than was previously forecasted at the time of the *Thrive 2040* regional plan.

We cannot be certain whether this is a continuing trend, or a temporary shift in behavior, where household incidence rates would eventually bounce back. We have made a "middle-of-the road" assumption – an assumption that the changes in household formation and housing consumption are tapering, and that age-specific household incidence rates will stabilize after 2020.

This assumption results in overall average household sizes that are 0.05 to 0.06 points higher than previous forecasts throughout the 2018-2040 period.

### *Methodology of Cube Land.*

The forecast model described above provides details on future demographics and industry composition at a macro-level, without local geographic detail. Additional modeling, at a local scale, is necessary to project the geographic distribution of households and industries' employment over time.

In 2009, Council staff prepared an internal needs assessment and a state-of-the-practice review of land use models. Council staff recommended adoption of a market simulation model capable of producing

zonal assignment of households, population and employment, as well as accounting future land use. In 2010, the Council licensed and implemented Citilabs Cube Land as a platform for local real estate and land market modeling and scenarios analysis. Cube Land was chosen in part for its potential to integrate with the Council's travel demand model, allowing land use patterns and transportation network conditions to iteratively adjust over time.

The logic of Cube Land is the market sorting and equilibration of real estate demand and supply, and the addition of new supply, assuming best-use and value-maximizing decisions of developers, site selectors, and households. Cube Land assumes that developers will build in places where households or firms find value, where that value exceeds costs of construction and land, and where policies and land capacity allow for development. Cube Land includes three submodels:

- The *demand submodel* simulates an auction in which different market segments are willing to pay differential amounts for combinations of real estate and place characteristics.
- The *rent submodel* uses estimated bids, along with other local characteristics, to estimate rents for different real estate types at specific locations.
- The *supply submodel* projects forward real estate development by comparing rents with supply costs, and locating new development based on estimated profits (rent minus supply costs) and land supply availability.

In summary, households and worksites choose real estate in specific locations to maximize value. Developers respond by supplying real estate responsive to the demand.

The demand model mathematically represents the location choices of different household market segments and industry sectors using variables – and parameters for variables – identified and estimated through discrete choice analysis of existing behavior (known through survey data). Variables include neighborhood characteristics and accessibility to destinations. These quantified preferences allow the model to estimate probabilities of all potential real estate choices for each defined household type and worksite type. The location options correspond to the Transportation Analysis Zone (TAZ) system used in the Council's four-step travel demand model.

Many of the factors that matter to site selectors and households can change over time: Summarized land use and remaining available land supply, industry mix, and socioeconomic mix of zones are projected and updated within the model. Accessibility measures are projected and updated through iterative looping with a linked four-step travel demand model .

Concurrently, the rent model calculates and updates rents within the model. If real estate and land in a certain location are highly desirable to one or more market segments, rents can change, altering estimated distributions (or probabilities) of household and worksite location choices, and prompting substitutions. Ultimately, the model seeks an equilibrium solution where all forecasted future households and employment are sorted into locations, proportionate to updated choice probabilities.

The discussion above concerns different market sectors valuing locations, and sorting themselves to accomplish best-value results. Importantly, Cube Land allows supply response to growing and changing market demand. To accommodate growth in households and employment – which has been forecasted using the region-level forecast models – the Cube Land supply submodel projects the addition of new housing and built space. In the Twin Cities implementation of Cube Land, the major determinants of such development are land supply and estimated rents for each zonal location. As rents are dynamically estimated within the model, the geographic distribution of new development is likewise dynamic – with new growth precipitated by the demand for valued location characteristics.

### *Data and Variables Used in the Council's Cube Land Modeling*

The Twin Cities implementation of Cube Land segments worksites and employment into industry sectors; these groups have varying preferences for 5 types of employment-bearing real estate. Households are segmented by socioeconomic characteristics into major household types (and additional subtypes), which then select housing from 8 housing product types. This segmentation enables representation of how real estate and location preferences vary among different household and industry types.

The Cube Land system allows flexibility in defining the set of variables that comprise preferences and valuations of real estate. In the 2014 model runs that informed local forecast allocations, variables were assembled for local zones (Transportation Analysis Zones). Zonal characteristics include:

- Real Estate Characteristics:
  - Start-year land use mix and undeveloped land supply
  - Existing housing stock and employment-bearing built space
  - Average land consumption per real estate unit
  - Average building costs and land values
  - Average real estate prices (rents)

- Surrounding Land Uses:
  - Proximity to lakes and rivers
  - Zonal demographics
  - Zonal employment
  - Housing density

- Regional Systems and Services:
  - Proximity to parks
  - Wastewater service availability
  - High frequency bus stops and LRT stations

- Transportation Accessibility, obtained through interaction with the Council's travel demand model:
  - Number of jobs within 20-minute travel time (by automobile and by transit)
  - Number of households within 20-minute travel time (by automobile and by transit)

The Cube Land model also uses local planned land use and regional policies when forecasting future real estate and land supply, including:

- Planned land use acreage (from analysis of local comprehensive plans)
- Allowable real estate types
- Existing housing densities
- Maximum housing capacities and densities (from local comprehensive plans)

Several of the dataset inputs listed above were revised and improved in 2015. Most notably, Council staff calculated maximum housing capacities using more locally detailed data and a conservative assumption that housing growth will be restricted to sites that are currently undeveloped or under-utilized (under-built) relative to local land prices. In summary, the Cube Land model was richly informed about base year conditions and the envelope of future possibilities.

### *Model maintenance and forecast updates.*

Metropolitan Council receives annual updates of the REMI PI software and time-series data inputs. The model received in July 2019 includes time-series data for years 2001-2017, as well as national

demographic adjustments to reflect US Census Bureau's demographic and immigration assumptions from 2017-18.

For more information on national projections, see:

- US Census Bureau (2017-18), *National Population Projections Datasets*, online at *www.census.gov/data/datasets/2017/demo/popproj/2017-popproj.html*

A regional forecast and local forecasts were included in the *Thrive MSP 2040* regional plan, adopted by Metropolitan Council on May 28, 2014.

These forecasts were subsequently updated and improved.

- Biennial updates to the regional model, in 2015, 2017, and 2019, included: updates of national population, economic and employment forecasts; updates of all time-series with observed data for recent years; and model vendor's programming improvements and recalibration.
- The 2015 update to local forecasts included: use of updated and more detailed planning data; use of more locally detailed land supply analysis; revision of land consumption rates; input of more detailed data on residential building costs and real estate prices (rents); updated transportation network definition and accessibility data.

The Council adopted an updated set of local forecasts on July 8, 2015, and approved these for use in Council system plans. For this work, geographic representation of regional system plans and policies was limited: definition of the Metropolitan Urban Services Area (wastewater treatment service area); the 2040 regional transportation network, incorporating the planned, long-term program of transitways and highway improvements to 2040; and planned land use from local prepared by communities during 2005-2014. The planned land use data may not yet include land that will be added to the urbanizing land supply and guided for development during 2031-40.


390 Robert Street North
Saint Paul, MN 55101-1805

651.602.1000
TTY 651.291.0904
public.info@metc.state.mn.us
metrocouncil.org

Follow us on:
twitter.com/metcouncilnews
facebook.com/MetropolitanCouncil
youtube.com/MetropolitanCouncil