

# METROPOLITAN COUNCIL'S FORECASTS METHODOLOGY



March 2015

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

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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.

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## Forecasts Methodology

Long-range forecasts at Metropolitan Council are updated at least once per decade. Population, households and employment levels are projected with a 30-year time horizon. The regional and local forecasts express future expectations based on an understanding of regional dynamics, and modeling of real estate and land market dynamics, land policies and planning. 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 development guide, adopted by Metropolitan Council on May 28, 2014. These forecasts were subsequently updated and improved in early 2015:

The update to the regional model includes: 1) update of the national economic and employment forecast prepared by Global Insight, 2) updates of all time-series with the most recent year of historical data, and 3) model vendor's programming improvements and recalibration.

The update and improvements to local forecasts include: 1) input of updated and more detailed planning data; input of more locally detailed and conservative land supply analysis, 2) revision of land consumption rates, 3) input of more detailed data on residential building costs and real estate prices (rents), and 4) updated transportation network definition and accessibility data.

A draft set of forecasts was published on April 8, 2015. A public comment period will start on April 8, 2015 through May 11, 2015. The Council proposes to adopt new forecasts in June or July 2015, and approve forecasts for use in Council system plans.

### *Project overview*

Metropolitan Council's regional forecast considers the Twin Cities' situation within the larger, national economy: The region's business conditions and competitive advantages determine regional economic and employment levels, 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 site in specific places. We assume that real estate and land market dynamics interacting with future transportation accessibility, primarily determine outcomes, shaped by regional land use policies and local plans.

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

- A regional economic model for forecasting region-level economic activity and migration flows in response to economic opportunity.
- 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.

## REMI PI methodology

In 2011, following a review of best practices in regional economic modeling, the Council selected REMI PI (Regional Economic Models Inc.) as the model best fitting the Council's understanding of regional growth. REMI PI is a structural macroeconomic simulation model.<sup>1</sup> It makes use of computable general equilibrium techniques for simultaneous solution of macroeconomic accounts, as well as input-output matrices to represent inter-industry flows and impacts. Also, the model employs new economic geography techniques to represent trade, migration flows, and other aggregated interactions among regions.

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, births, aging and survival rates, and new economic geography techniques to project labor market results and migration. If industries' labor demand intensifies (or slackens), 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.

Our Minnesota implementation of the model has two *home regions*: the 7-county Twin Cities region is one and the remaining 80 counties of Minnesota are a second region. The rest of the U.S. and the world are additional linked economies. The model delivered by Regional Economic Models Inc. assesses the Twin Cities region having factor cost advantages, resource advantages and breadth of workforce supply. The model also assesses a historic trend of under-performance in noneconomic, amenity-driven 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. Metropolitan Council forecasts that the Twin Cities region will account for 1.40% of national GDP in 2020 and 1.44% in 2040.

### How we customized the REMI PI model

In the implementation of REMI PI, Council staff modified 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 projections and industry employment projections drawn from Global Insight'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 national forecast is significant in that the Twin Cities region and Minnesota are part of nation, and the region's economic growth is tethered to national economic conditions.<sup>2</sup>

Second, Council staff updated regional time-series tables with known numbers and facts on the ground:

- 2013-2014 regional population by race and age are updated with estimates by U.S. Census Bureau; and

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<sup>1</sup> A more detailed description of Regional Economic Models Inc. (2014) and REMI PI+ Model Equations is available at [www.remi.com/download/documentation/pi+/pi+\\_version\\_1.6/PI+\\_v1.6\\_Model\\_Equations.pdf](http://www.remi.com/download/documentation/pi+/pi+_version_1.6/PI+_v1.6_Model_Equations.pdf)

<sup>2</sup> For more information see Minnesota and U.S. Economic Outlook available at <http://mn.gov/mmb/forecast/forecast/>

- 2013-2014 regional industry employment statistics are updated with data from Minnesota Department of Employment and Economic Development.

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

- REMI's fertility-rate schedules (fertility rates by race and by age of mother) are replaced with region-specific constants determined from Census American Community Survey data. In the Twin Cities region, the total fertility rate for whites is 1.65 children per woman; the rate for blacks is 2.97; the rate for Latinos is 2.50; the rate for Asians and other race groups is 2.58.
- College-going population by race is projected to increase in tandem with growth in the resident population of 17-year-olds by race.
- REMI's personal income components are adjusted to approximate the State Economist's 5-year projections of state payrolls totals and other personal income components.

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

- Property tax rates and other tax rates for the Twin Cities region are projected to remain level after 2013. In previous forecast updates, we reflected rising property tax rates during the 2010–2012 time period.
- Regional consumer prices relative to the national average are not adjusted in the latest modeling. In previous forecast updates, we 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 93% to 96% range throughout the forecast period. In previous forecast updates, we made adjustments to mitigate unexplained drops in the relative housing price.

The forecast models described above provide details on future demographics and industry composition at a macro-level, without geographic detail. To obtain household counts, the REMI PI population projection is parsed into household types using age-specific household formation rates obtained from analysis of American Community Survey data published by the U.S. Census Bureau.

Additional modeling at a local scale is necessary to project the geographic distribution of households and industries' employment over time.

### *Cube Land methodology*

In 2009, Council staff conducted an internal needs assessment and a state-of-the-practice review of land use models. We recommended adoption of a market simulation model capable of producing zonal projections of households, population and employment, as well as accounting for 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 site selectors, developers 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 sub-models:

- The **demand sub-model** simulates an auction in which different market segments are willing to pay differential amounts for combinations of real estate and place characteristics.
- The **rent sub-model** uses estimated bids, along with other local characteristics, to estimate rents for different real estate types at specific locations.
- The **supply sub-model** 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, so as to maximize value. Developers respond by supplying real estate responsive to this demand.

The demand model mathematically represents the preference structures 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 post-2000 Transportation Analysis Zones (TAZs) used in the Council's travel demand model.

Many of the variables that determine the choice probabilities 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 travel demand model.

Concurrently, the rent model uses estimated bids—as well as other zonal characteristics—to calculate and update 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 choice substitution. 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 sub-model projects the addition of new housing and employment-bearing 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 lower development costs and/or higher rents for valued location characteristics.

### **Data used in our Cube Land modeling**

The Twin Cities implementation of Cube Land segments worksites and employment into 8 industry sectors. These groups have varying preferences and use varying amounts of 5 types of employment-bearing real estate. Households are segmented by socioeconomic characteristics into 5 major household types (and additional subtypes), which then select housing from 8 housing product types. This segmentation enables moderate 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. The variables identified as most significant, and included in the Council's modeling, are compiled for 1,201 Transportation Analysis Zones. These zonal characteristics also inform the calibration of the model to year 2010 conditions. 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, we 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 is richly informed about base-year conditions and the envelope of future possibilities.

### *Forecast maintenance and updates*

We receive annual updates of the REMI PI software and time-series data inputs. The model received in August 2014 includes time-series data for years 1990-2012, as well as national demographic adjustments to reflect U.S. Census Bureau's immigration assumptions from December 2012.<sup>3</sup>

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<sup>3</sup> For more information see U.S. Census Bureau (2015), *National Population Projections*, available at [www.census.gov/population/projections/data/national/](http://www.census.gov/population/projections/data/national/)



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