

APPENDIX D: Development of 2022 MTP Demographic Forecasts



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DEVELOPMENT OF 2022 DEMOGRAPHIC FORECASTS

The production of the 1999-2025 demographic forecast for the H-GAC region involved three primary steps: the generation of regional control totals for population and employment, the allocation of population to the RAZ level, and the allocation of employment to the RAZ level. Summary technical documentation for each of these steps follow.

D.1. Generating Regional Control Totals

The REMI econometric model was used to generate regional population and employment control totals for the 1999-2025 demographic forecast of the Houston-Galveston-Brazoria Consolidated Metropolitan Statistical Area (CMSA). The REMI model constructs regional and national economic forecasting models which reveal the economic and demographic impact that public policy initiatives or external events may have on a local economy. Due to time and budget constraints, only national crude oil price influence and local transportation funding alternatives were examined.

Instead of predicting a single scenario, six scenarios are selected and a range of population and employment were explored. The highest level of population and employment occurs when both national crude oil price rise and MTP is funded under the aggressive scenario. The lowest level of population and employment is recorded when national crude oil price fall combined with MTP's conservative scenario. Among the two extreme scenarios, four other scenarios show mid situations. We incorporate REMI's residual growth rate for 49 sectors and adjust aggregate economic migrants to further specify our regional economy. The six scenarios are listed below:

1. Baseline MTP under national crude price rise;
2. Aggressive MTP under national crude price rise;
3. Conservative MTP under national crude price rise;
4. Baseline MTP under national crude price drop;
5. Aggressive MTP under national crude price drop;
6. Conservative MTP under national crude price drop.

Assumptions Concerning the Effect of National Crude Oil Price Influenceⁱ

If the crude oil price increases by 25% from 1998 price (\$12.09 nominal dollars per barrel for imported crude oil), the average price of gasoline oil and fuel oil in the U.S. market will increase by 13% of 1998's priceⁱⁱ. Since US consumption of gasoline oil and fuel oil holds 2.6% of total U.S. consumption for the year 1998, consumer expenditure price index (all personal consumption expenditures) will increase by 0.34% from 1998's price due to the increment in crude oil prices.

If the crude oil price drops by 25% from 1998's imported crude oil price, the average price of gasoline oil and fuel oil is predicted to drop by 13% in 1999. As a result, consumer price index drops by 0.34% from 2.6% of 1998's total consumption.

Production of U.S. crude oil is assumed to increase by 25% from 1998's output starting from 1999. Since 1% increment in crude oil price corresponds to 1% rise in U.S. crude oil production, a 25% increase in crude oil leads to a 25% rise in U.S. crude oil production. Similarly, U.S. crude oil production cuts by 25% from its current production if the crude oil price expunges by 25% from market price.

At the regional level, oil and gas mining production is assumed to fluctuate with the U.S. national transformation. Productions as well as exports in oil and gas related chemicals, petrochemicals, machinery are assumed to be affected the same degree as the rest of regions in the United States.

Regional Effects Under the Metropolitan Transportation Plan

Six transportation investment scenarios are specified for the period from 2000 to 2025. The baseline scenario has \$75 million invested annually in addition to historical average investment in transportation. The aggressive scenario describes when additional \$202 million per year is invested in transportation maintenance and capital expansion. The conservative scenario shows what if there is a shortage of \$75 million each year in transportation investment. The historical average investment in transportation maintenance and capital expansion is \$1.775 billion per year from 1990 to 1995. Production cost saving is the sum of truck and car operation cost saving and delivery time saving due to the new road expansion. The factor in production cost savings is \$2.2 dollar (in 1998 U.S. dollars) for each dollar invested in new road expansion. The production cost saving is weighted by the number of employees for 49 private sectors in Houston-Galveston-Brazoria CMSA. A factor of \$0.13 (in 1998 U.S. dollars) is used to calculate consumer travel time saving resulted from the construction of new roads

Regional Economy and Demography at the Year 2025

By the year 2025, total population would reach 6,564,020 persons under the most aggressive scenario. Among them, the white accounts for 76.4%, Black for 15.8%, and others for 7.8%. The annual population growth rate from 1999 to 2025 is between 1.2% and 1.5% for the two extreme scenarios. Total employment hits 3,651,448 persons at the year 2025. Amongst the available jobs, 88% of the total jobs are private non-farm jobs, 11.8% of the total are government jobs, and 0.2% of the total jobs are farm jobs. The annual employment growth rate for the forecast period is 1.2% for the highest possible growth scenario. The real relative wage rateⁱⁱⁱ increases by 0.011 percentage point from 1999 to 2025. The real relative employment opportunity^{iv} is going up by 0.013 percentage point. Therefore, our regional economy is creating more high paying jobs and employment opportunities compared to that the rest of regions in the United States.

D.2. Allocation of Regional Employment

The following provides a brief summary of the employment allocation. Two major factors determined the control total share of employment allocated to a particular RAZ

- RAZ level growth rates based on 1990-1999 historical employment databases, and
- historical land use conversion rates constrained by the availability of vacant and re-useable land.

The steps process used in allocating employment follows:

- Employment and population control totals were obtained from an econometric model of the regional economy. Even though the most aggressive modeling scenario, the control totals obtained under this scenario were on par with those of other government agencies.
- Using 1999 regional employment databases, employment was grouped into six categories, (office, retail, industrial, medical, education, and Government) and aggregated to the RAZ level. Then, 1990 and 1999 regional employment databases were used to estimate RAZ level growth rates. Growth rates were restricted to values between 0 and 10%.
- These growth rates were applied to each RAZ to project growth for a target year.
- Land use conversion rates were calculated based on historical land use and employment data. Conversion rates were calculated for three different zones: areas within 610 loop, areas outside of the 610 loop, and for the CBD like activity centers (CBD, Greenway Plaza, Galleria Area)
- Growth constraints were applied based on the availability of vacant and re-useable land.
- Given land-use constrained growth for a target year, the regional share of controlled employment was calculated for each RAZ.

Allocation of Regional Population

Regional households and population were allocated to the RAZ level under the assumption that RAZ level population and household growth would follow may be fitted to a logistic curve. Logistic growth rates were used in all areas, except for the in the CBD. Data on land use patterns were used to constrain growth. That is, if there was not enough land available for the addition of the new households, then the number of households was held constant through the rest of the forecasted period. The residential density used to determine the amount of land needed for each new

household was based on the residential densities in 1990. The base landuse data used to control residential growth was from 1990. In some cases, additional land use data to collect additional information which would provide some insight to areas where the use of land may have changed significantly since 1990.

In the CBD, an exponential growth rate was applied and households were allowed to grow beyond the amount of available land. These assumptions were made because of current gentrification occurring in the CBD and surrounding areas.

The calculated growth rates were used to “grow” households each year through 2025 for each of the RAZs. These predicted numbers were then scaled to the REMI regional forecast.

The household population and total population was determined using previously predicted average household sizes and population in group quarters by RAZ. The household population was determined by multiplying the number of households by average household size. The total population was determined by adding predicted group quarters population to the household population.

The previous forecast allocation activities included an analysis of historical patterns in average household size and group quarters population. Change in patterns of average household size were predicted using these historical data and current literature and family living patterns. Specifically, the previous forecast noted that trends in the HGAC region were similar to national and state trends. It was noted that household formation was “occurring at a faster rate than the population growth (3.5 percent for the U.S. and 2.6 percent for the state), because of the decrease in average household size. Overall, the assumptions were for decreasing sizes in the average households.

Group quarters population include, but are not limited to, those persons residing in prisons, institutions, and college dormitories. Growth or decline in group quarters population was predicted using historical data and information that was current at the time of the previous forecast which described planned projects for group quarters.

Notes for Population Allocation:

The logistic growth curve was determined for each of the RAZs using the following steps:

1. To calculate the interim year 1991 through 1994, use interpolation based on 90-95 growth rates from 1990 to 1995 Population and Household Estimates.

2. To calculate the 1995 to 2000 interim years, recent growth rates are used to "grow" the 1995 estimates to 2000^a using the following conditional statements

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IF z > y AND z > x AND z > w AND z > v AND z > u
  THEN new2000 = ((z + 1)5)*1995
ELSE IF y > x AND y > w AND y > v AND y > u
  THEN new2000 = ((y + 1)5)*1995
ELSE IF x > w AND x > v AND x > u
  THEN new2000 = ((x + 1)5)*1995
ELSE IF w > v AND w > u
  THEN new2000 = ((w + 1)5)*1995
ELSE IF v > u
  THEN new2000 = ((v + 1)5)*1995
ELSE new2000 = ((u + 1)5)*1995

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where:

1995 = 1995 estimate
 new2000 = new CRUDE estimate for 2000
 u = new 90 to 20 CAGR (from results of METHOD I)
 v = old 90 to 20 CAGR
 w = CAGR between 1990 and 1995 estimates
 x = CAGR between 1995 and 1997 housing unit counts provided by TxDOT
 y = CAGR between utility connections counted in 1997 and new hookups in 1999 provided by HL&P
 z = CAGR 1991 and 1998 "Real Estate study data"

^a the TxDOT data represents the 2-year period of growth between 1995 and 1997 and the HL&P data represents the 2-year period of growth between 1997 and 1999 however both of the rates of growth are used in the above calculations based on the following assumption: the growth rates found between 1995 and 1997 in the TxDOT data are assumed to continue through the year 2000

ⁱ Energy related data is from Energy Information Administration: <http://www.eia.doe.gov>

ⁱⁱ The percent change is based on annual historical average rate for all grades of gasoline oil and fuel oil in the U.S. market.

ⁱⁱⁱ The real relative wage rate (relative to the US); a determinant of economic migrants; takes into account average wage by industry and cost of living in region (including taxes and housing prices).

^{iv} The residence adjusted employment divided by the labor force relative to the US; a measure of the probability of being employed; a determinant of economic migrants.