Michigan Energy Appraisal

Forecasting Overview

September 21, 2010

What is the MI Energy Appraisal?

- Short-term outlook (6 months - 1 year) semi-annual assessment of energy markets.
  - Electric
  - Natural Gas
  - Petroleum
  - Gasoline
  - Distillates
  - Household Heating Fuel Summary
  - “Special Section”

What is the MI Energy Appraisal?

- Recent historical MI energy consumption, supply, demand, and price analysis.
- Near term consumption and supplies are projected.
- Actual and expected prices are assessed as to their impacts on customer costs.
- Seasonal focus:
  - Fall Appraisal focuses on the winter heating season.
  - Spring Appraisal focuses on summer electric load and gasoline for the summer driving season.

Why is the Appraisal Conducted?

Provides a Situational Awareness

- Assists with identifying potential supply & demand problems.
  - Adequacy of supply, weakness in distribution system, energy price swings, etc.
- Gives an understanding of current and near term conditions impacting supply, demand, prices, and expected changes.
  - During recent fears of $5 gasoline, was able to provide a baseline of supply/demand data enabling the PSC to assure the Gov. there were not any supply problems and the fears were unfounded.

Comprehensive Assessment

- Conducted via statistical regression analysis.
- Comprised of 22 separate time series OLS & AR regression models.
- There are over 100 excel files that contain the raw data of the report.
- Database contains decades of data.
- Data gathered from (and compared across) a wide array of sources where available.

State, Regional, National, & Global

- Energy and fuels are heavily influenced by the global market.
- Scope varies by source
  - MI electric markets largely State and Regional.
  - Natural gas is much more integrated into a national market.
  - Petroleum products are affected by regional refining, and international market conditions & events.

Data Sources

- US Energy Information Administration
- Global Insight & Moody's
- MPSC
- NOAA, Natl. Weather Service Climate Prediction & Data Center
- US Department of Energy
- US Bureau of Labor Statistics
- US Bureau of Economic Analysis
- Michigan Dept. of Treasury
- American Automobile Association (AAA)
- Oil Price Information Service (OPIS)
- State Heating Oil & Propane Price (SHOPP) Survey

- We also utilize reputable media reports on energy and economics to get a better grasp of developing conditions for qualitative purposes.

Regressions! Electric

- Residential
  - Monthly Data beginning in 1990 from: NOAA, Global Insights, EIA
  - OLS Regression
  - Weather & number of households are primary determinants of residential demand for electricity.
- Residential demand per household
  - HDD deviations from normal
  - 1 month lag, HDD deviations from normal
  - CDD deviations from normal
  - 1 month lag, CDD deviations from normal
  - Winter trend
  - Summer trend
  - Monthly dummy variables
    - Output is then multiplied across total households in Michigan for total output in millions of kWh.
- Lags in HDD & CDD are included to account for difference in calendar and billing cycle months. Trend factors control for changes in intensity of electric usage.

Electric Regressions

- Commercial
  - Monthly Data beginning in 1993 from: NOAA, Global Insights, EIA
  - AR(1) Regression
  - Weather & commercial employment levels are primary determinants of commercial demand for electricity.
- Commercial Demand per Employee
  - Time trend
  - Quadratic time trend (time squared)
  - HDD deviations from normal
  - CDD deviations from normal
  - Monthly dummy variables
    - Output is then multiplied across the estimates for MI commercial employment over the forecast horizon.
- Lags of HDD/CDD were removed due to their low statistical significance. Quadratic time trend controls for changes across time eliminating spurious regression due to time correlations.

Commercial Employment

- Uses North American Industry Classification System (NAICS) categories 1-9.
  - Trade, transportation, & utilities
  - Information
  - Financial activities
  - Professional & business services
  - Education
  - Health services
  - Leisure & hospitality
  - Other services
  - Government
- Combined to form total MI commercial employment.

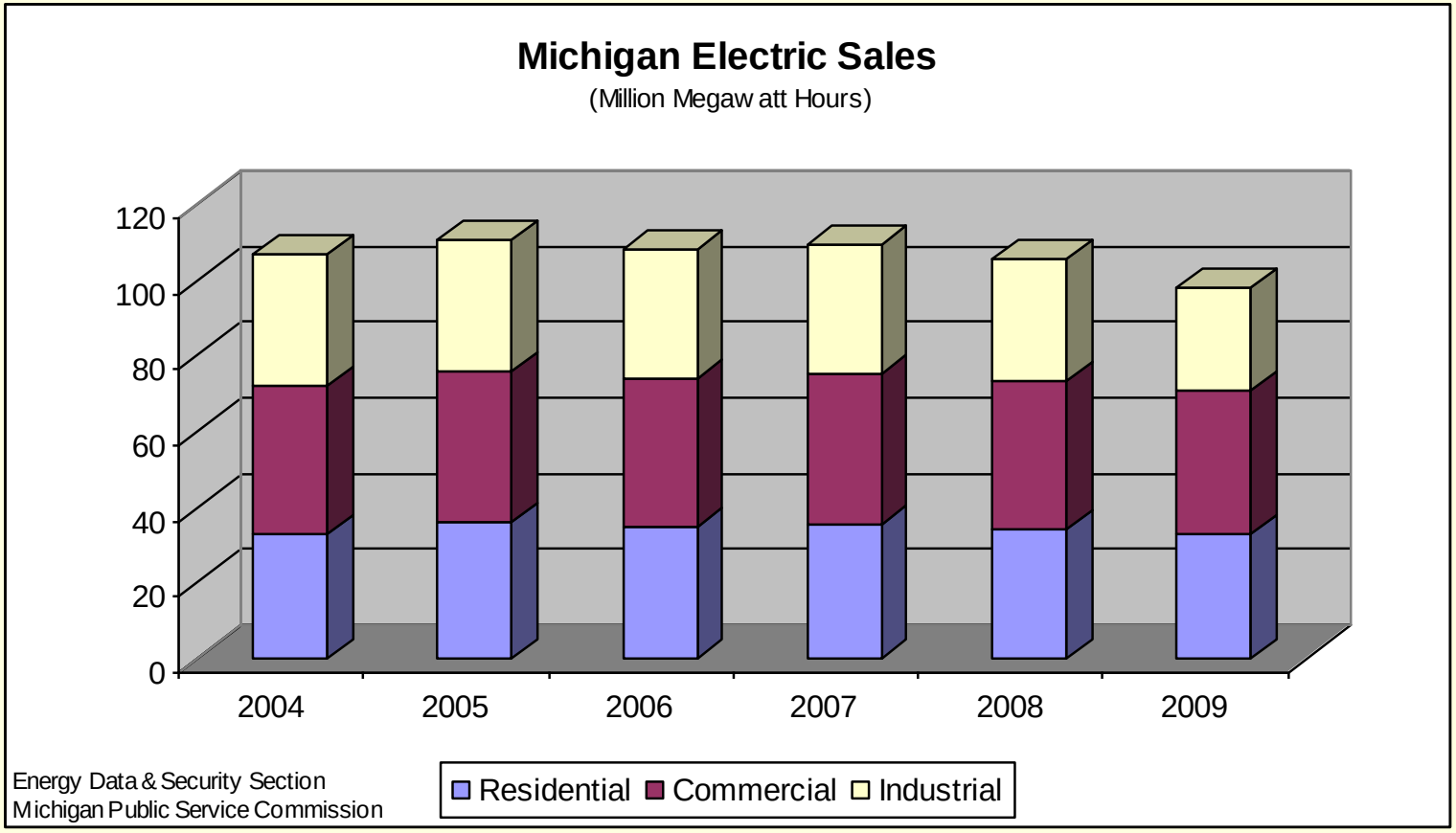
Electric Regressions

- Industrial
  - Monthly Data beginning in 1990 from: NOAA, Global Insights, EIA, BLS, BEA
  - AR(1) Regression
  - Economic activity is the primary determinant of industrial demand for electricity. Weather plays a small but notable role as well.
- Industrial Demand
  - CDD deviations
  - MI Industrial Production
  - Monthly dummies

- Secondary Industrial Regression - all of the above, plus:
  - US Durable Goods orders
  - MI Manufacturing Production
    - MI Auto Sector Breakout
  - Ratio of new orders to shipments
  - Lag variables for Durable goods orders
  - US GNP
  - Time Trend

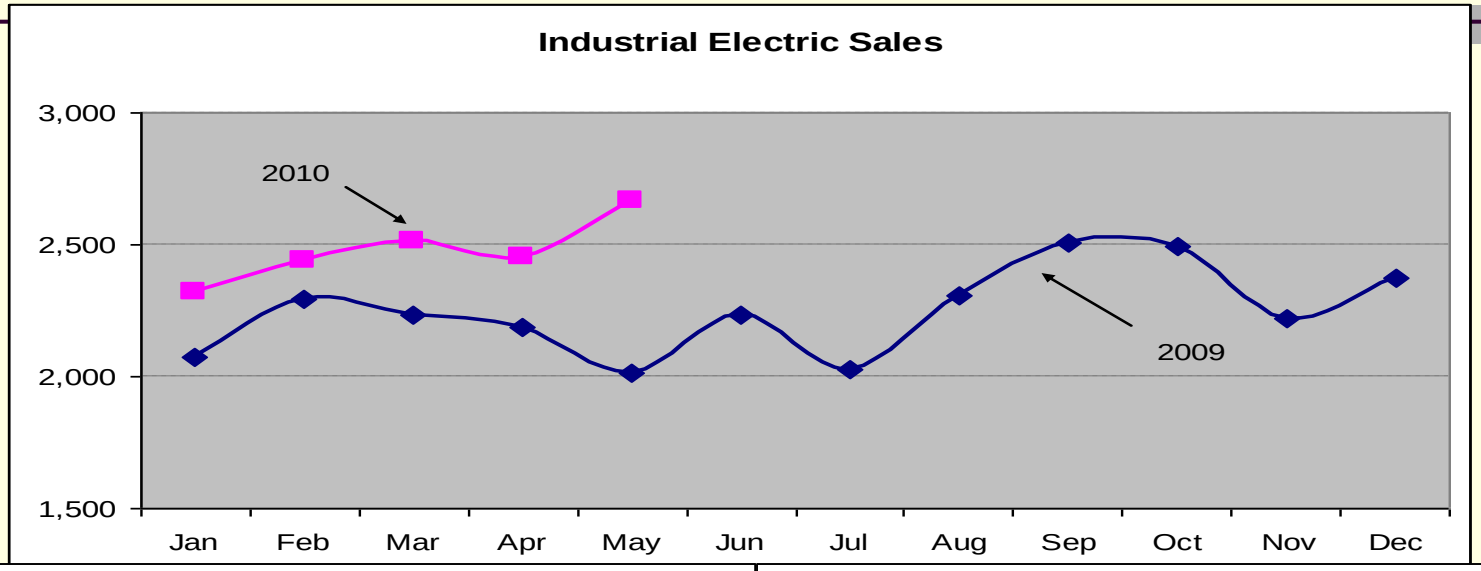
- HDD were not statistically significant. Secondary Industrial Regression newly developed to more accurately fit economic shift in industry.

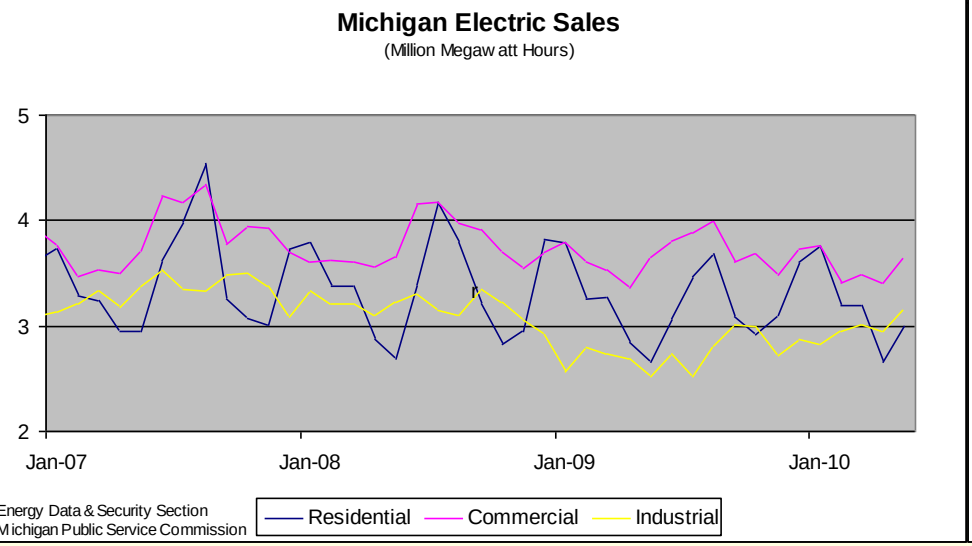
Electric Sales have Fallen

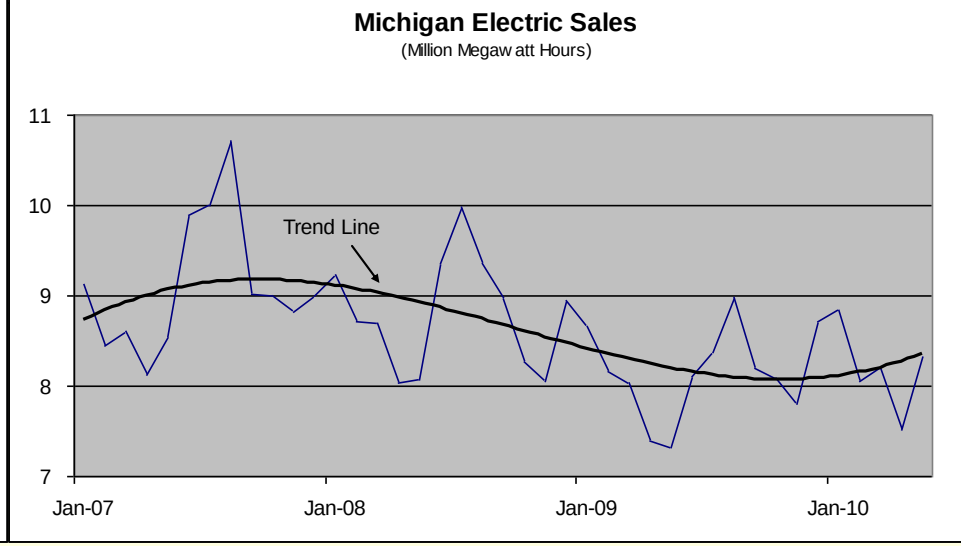


Michigan Electric Sales have fallen due to the recession's severe impact on Michigan automotive manufacturing and industrial customers.

Industrial Sales have led Resurgence in Electric Sales







Natural Gas

- Regression Overview
  - Monthly Data beginning in 1991 from: NOAA, Global Insights, EIA
  - AR(1) Regression
  - Primarily determined by weather and natural gas prices.
- Residential & Commercial – almost the same as electric. Only consider HDD and exclude CDD.
- Industrial adds price of natural gas for electric generators & an EIA data collection change dummy variable.
  - Prior to 2001 EIA lumped natural gas consumed by non-utility electric generators in with industrial demand. Post 2001, EIA separated the data.
- Electric Generation Natural Gas Demand
  - CDD deviation from normal
  - Price of natural gas for electric generators
  - Data collection change dummy
  - Monthly dummy variables
    - Electric demands for residential, commercial, and industry are also examined when reviewing the model.

Natural Gas Storage

- If levels are within the average normal range a simple 5 year average can be used to calculate average monthly changes in typical weather and adjusted to fit with the latest data available.
- If forecasts predict high or low storage, we assume (which is supported by data) that MI natural gas storage is highly correlated with the US storage due to limits in the available data.
- Natural Gas Storage in MI
  - Monthly Data beginning in 1991 from: NOAA, EIA
  - AR(1) Regression
- Working gas in underground storage in MI
  - US working gas in underground storage
  - Monthly dummy variables

MI Natural Gas Production

- Natural Gas Storage in MI
  - Not a regression. Calculated using other regression output and data.
  - Data from: Prior regressions, EIA, RED and Operations & Wholesale Markets Division.
- Net interstate deliveries of Natural Gas to MI

  Total demand for natural gas in MI

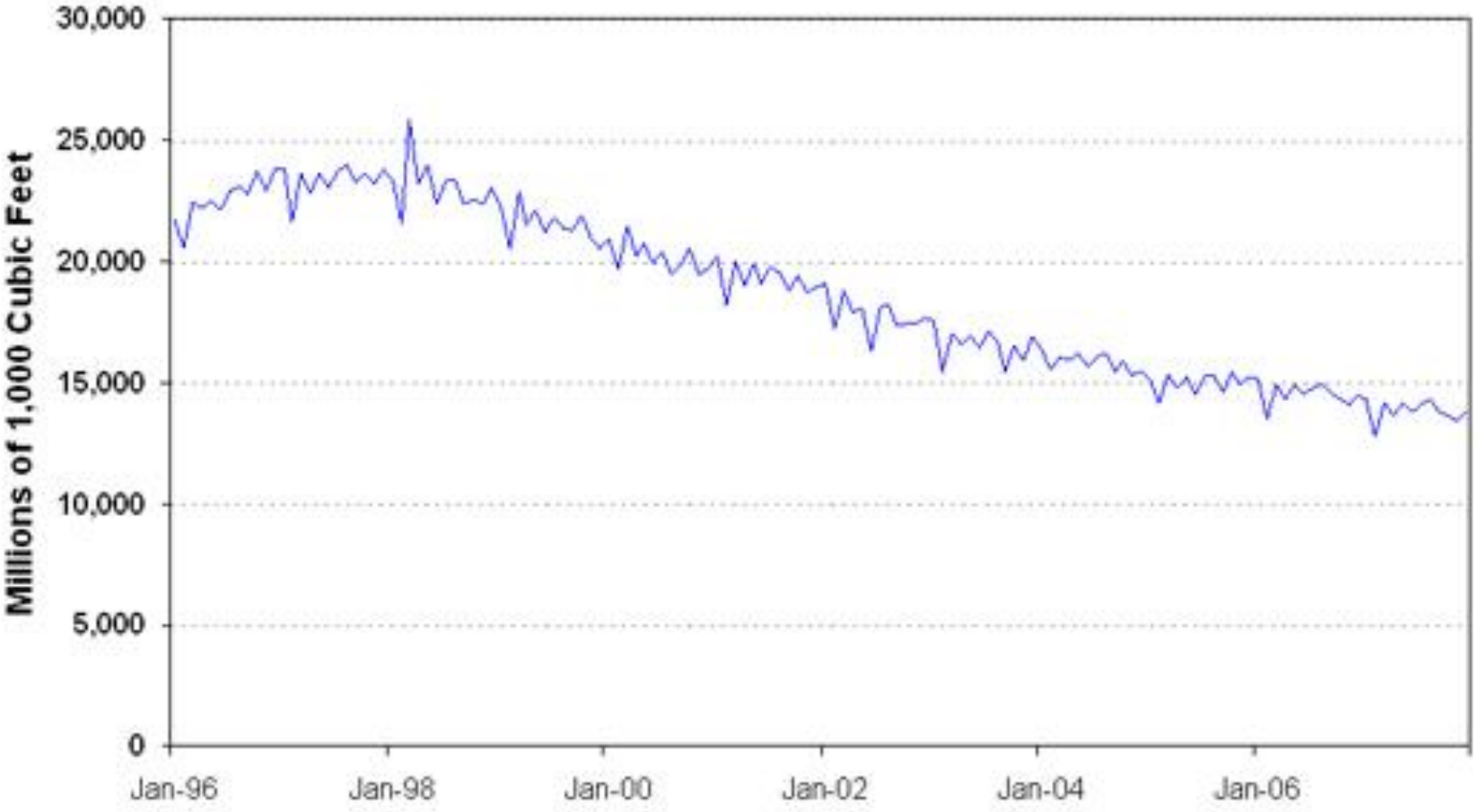
  - MI production

  + Change in storage

  = Total imports

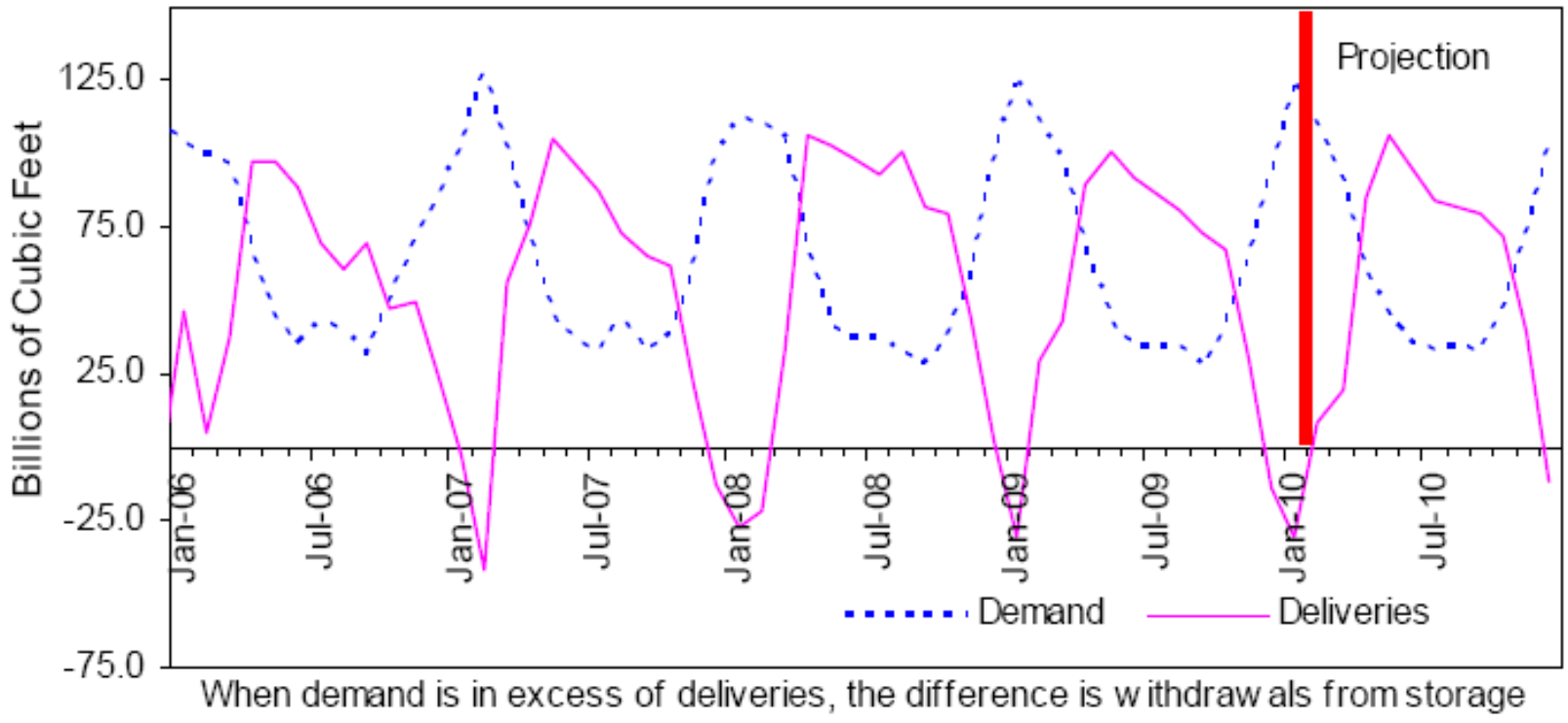
Michigan Natural Gas Production

January 1996 to December 2007



Source: Michigan Public Service Commission, Energy Appraisal

Michigan Natural Gas Supply & Demand



Petroleum

- MI Gasoline Sales
  Vehicle Miles Travelled
  - Monthly Data beginning in 1991 from: NOAA, Global Insights, EIA, AAA.
  - AR(1) Regression
  - Real disposable income and cost of gasoline are prime drivers.
- Vehicle Miles Travelled
  - Real disposable income in MI*time
  - 12 month distributed lag of US real gasoline prices degree 0
  - 12 month distributed lag of US real gasoline prices degree 1
  - 12 month distributed lag of US real gasoline prices degree 2
  - Monthly dummy variables

  lag of degree zero b0 = P(t) + P(t-1) + P(t-2) + P(t-3) + P(t-4) + P(t-5) + P(t-6) + P(t-7) + P(t-8) + P(t-9) + P(t-10) + P(t-11)

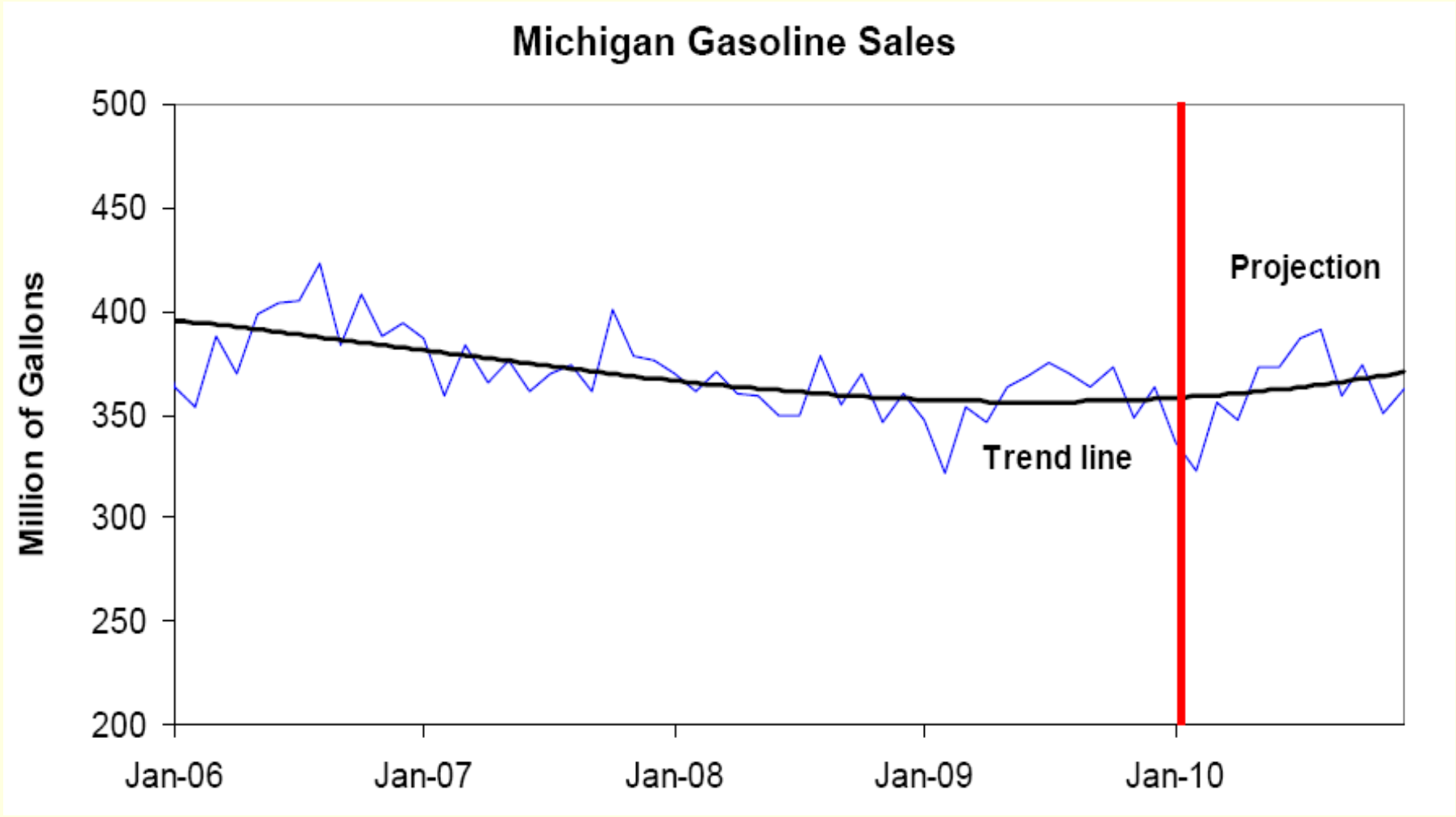
  b1 = P(t-1) + 2P(t-2) + 3P(t-3) + 4P(t-4) + 5P(t-5) + 6P(t-6) + 7P(t-7) + 8P(t-8) + 9P(t-9) + 10P(t-10) + 11P(t-11)

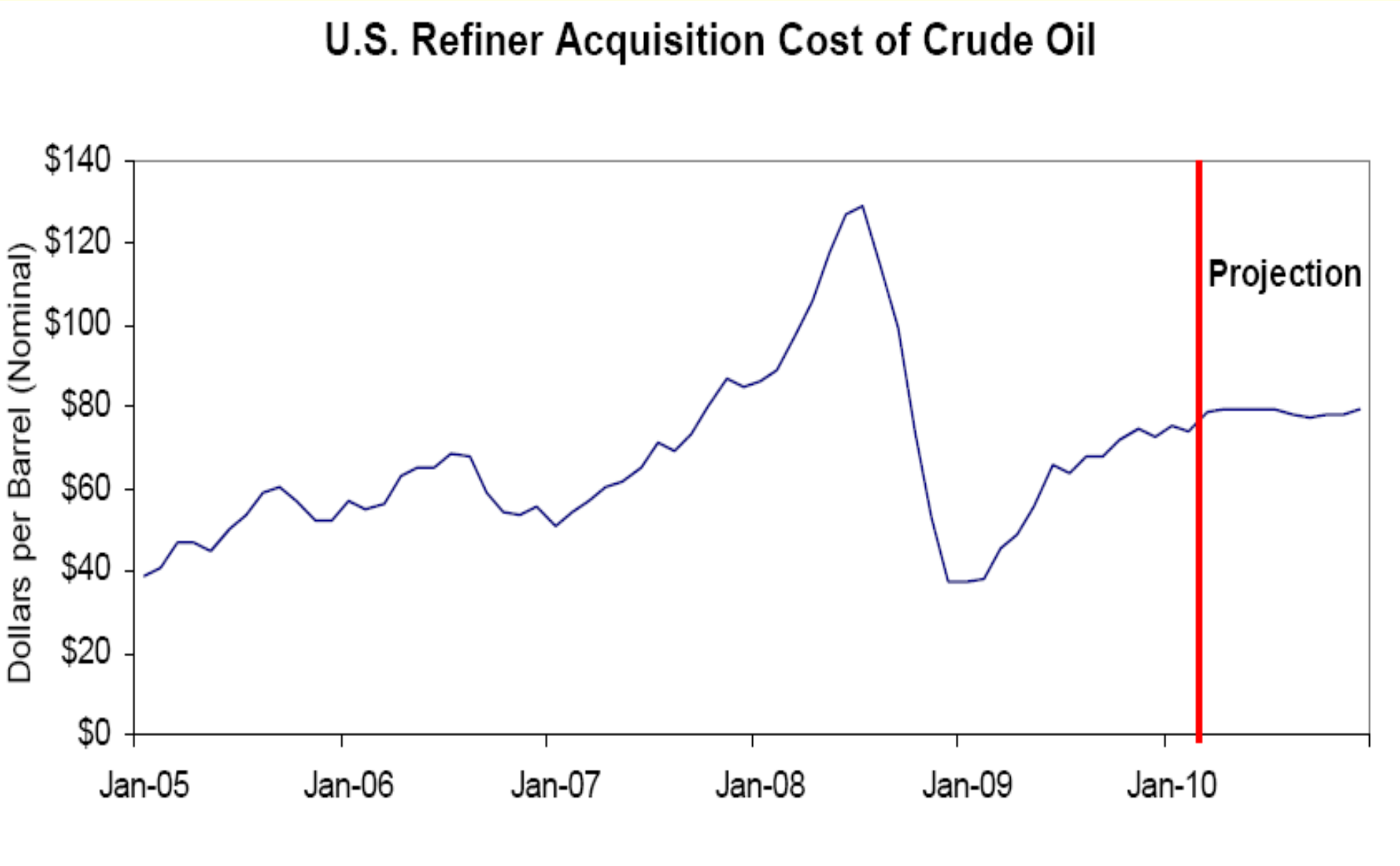
  b2 = P(t-1) + 4P(t-2) + 9P(t-3) + 16P(t-4) + 25P(t-5) + 36P(t-6) + 49P(t-7) + 64P(t-8) + 81P(t-9) + 100P(t-10) + 121P(t-11)

- Lagged variables are used to capture the fact that gasoline prices over the last year impact driving habits with more recent prices having a larger impact than each month prior.

Petroleum Continued

- Gasoline
  - Monthly Data beginning in 1991 from: NOAA, Global Insights, EIA, AAA.
  - OLS Regression
  - Real disposable income and cost of gasoline are prime drivers.
- Total Gasoline Sales in MI
  - Vehicle miles travelled (from prior regression)
  - US real gasoline prices
  - Dummy variable for RFG implementation in 1995
  - Monthly dummy variables
- MI disposable income is calculated in the miles travelled section and, as a result, not included again.


Michigan Gasoline Sales
Million of Gallons
500
450
400
350
300
250
200
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Projection
Trend line


U.S. Refiner Acquisition Cost of Crude Oil
Dollars per Barrel (Nominal)
$140
$120
$100
$80
$60
$40
$20
$0
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Projection

Regional Petroleum

- Regional Gasoline sales – the same as MI but calculated by computing EN Central (Illinois, Indiana, Michigan, Ohio, and Wisconsin) data.
  - Data must be turned from quarterly data into monthly data and is done assuming a smooth transition between quarters.
  - Regressions are run month by month to generate Auto regression data to populate the following month over the forecast period.

Regional Gasoline Production

- Regional Production
  - Monthly Data beginning in 1990 from: NOAA, Global Insights, prior regressions, EIA, BLS, BEA
  - AR(1) Regression
  - Refinery inputs of gasoline blendstock, regions share of US refining, the real ratio of US wholesale gasoline to wholesale distillate prices, and stocks.
- Regional Gasoline Production
  - US refinery inputs of gasoline blendstock
  - Real ratio of US wholesale gasoline prices to US wholesale distillate prices
  - 1 month lag of ratio of US gasoline stocks to distillate stocks.
  - Dummy variables for months when production was disrupted (May & June 1998, July & August 2001)
  - Monthly dummies
- Similar for Distillate fuels

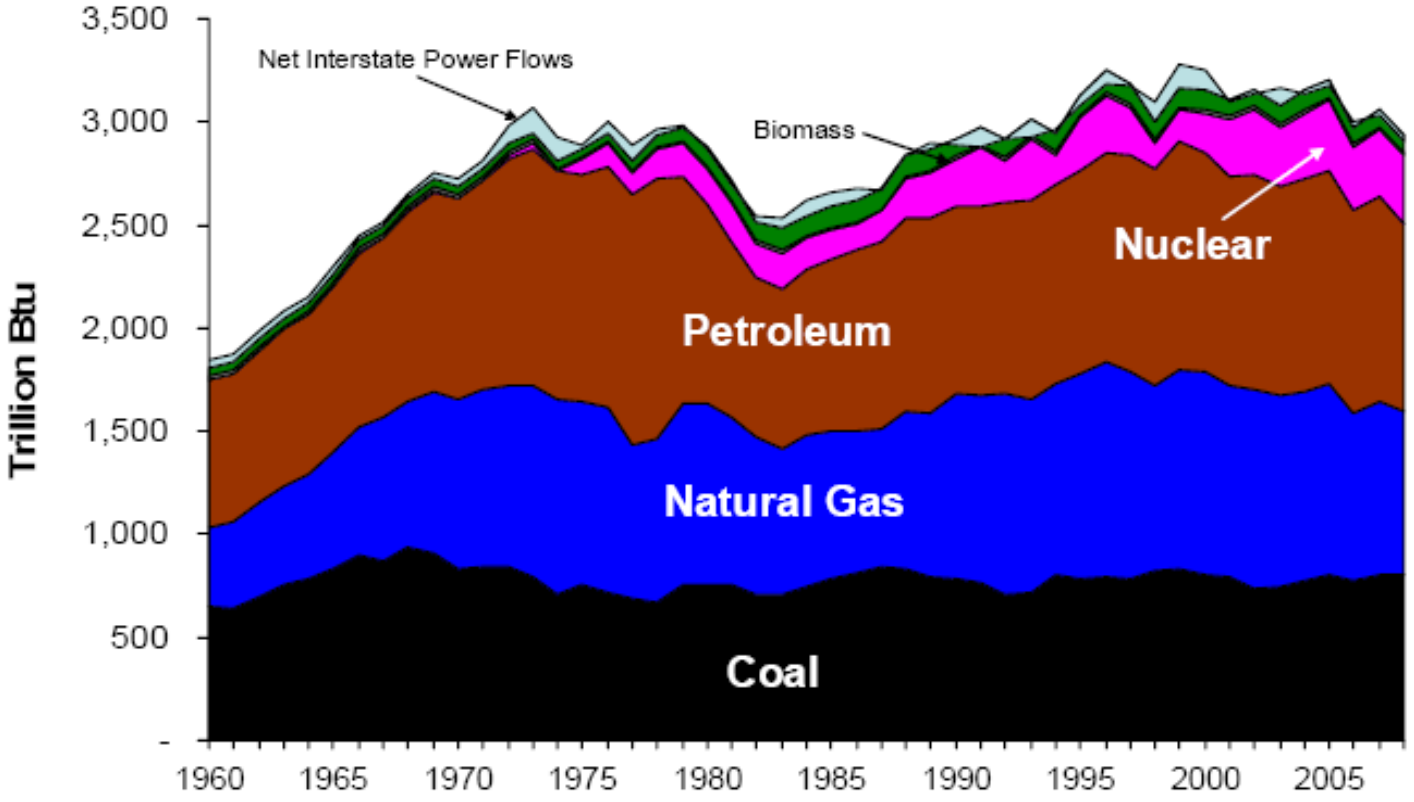
Variables Included

- Natural Gas Production
- Real disposable personal income
- Regional & MI GSP
- MI Industrial production index
- Durable Goods orders
- Manufacturing Production (Auto breakout)
- Ratio of orders to shipments
- US GNP
- MI Employment (by sector)
- HDD & CDD
- HDD & CDD Deviations from normal
- Seasonal & Time trends
- Fuel transitions and stoppages
- Prices
- Storage inventories
- Total vehicle miles travelled
- US average Vehicle MPG
- Gasoline and Distillate Stocks
- Gasoline & distillate prices
- Ratios of gasoline and Distillate stocks and prices
- Producer Price Index
- Consumer Price Index
- Refinery inputs of crude oil
- Refinery inputs of gasoline blendstock
- Regional refining capacity as a % of US capacity
- Real producer price of diesel
- MI refinery production
- Regional demand
- Total vehicle miles travelled
- Real highway cost per mile
- 1-11 Month lag variables
- Polynomial Distributed Lags
- Number of households
- And more…

Total Energy Use in Michigan

1960-2008*

Includes the primary energy used to generate electricity

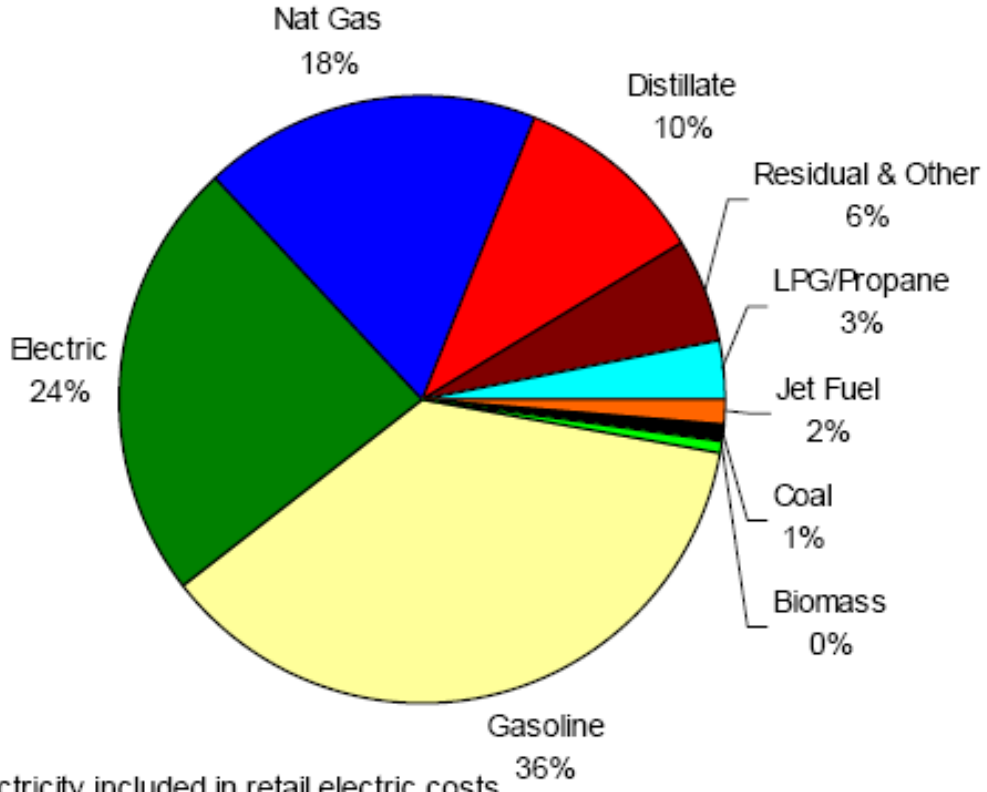


*Latest data available

Source: State Energy Data Report, Energy Information Administration,
Graph prepared by: Energy Data and Security, Michigan Public Service Commission

Michigan Spent an Estimated $40 Billion on Energy in 2008

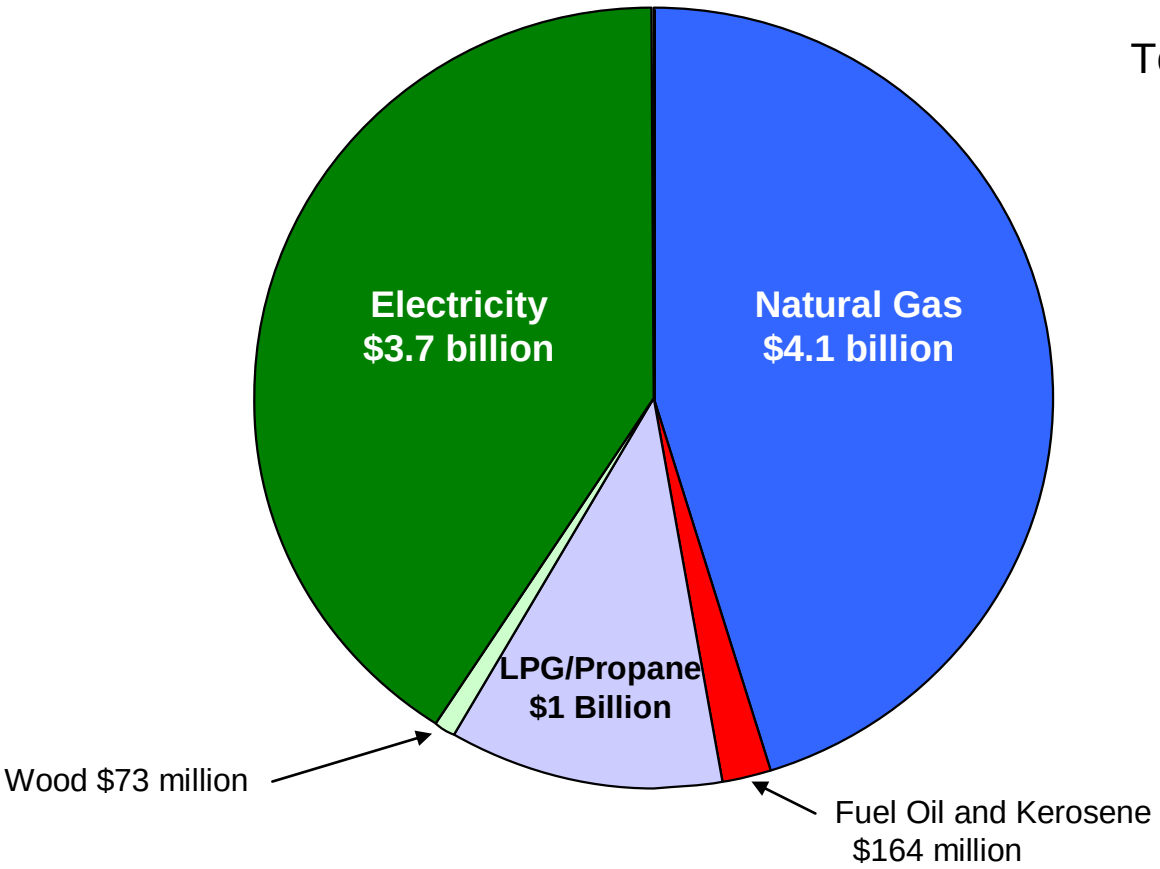
Preliminary Data, Nominal 2008 Dollars



Cost of fuels used to generate electricity included in retail electric costs.
Source: State Energy Expenditures Report Energy Information Administration
Graph prepared by: Energy Data and Security, Michigan Public Service Commission

Residential Energy Expenditure in Michigan

Millions of Nominal Dollars in calendar year 2008*

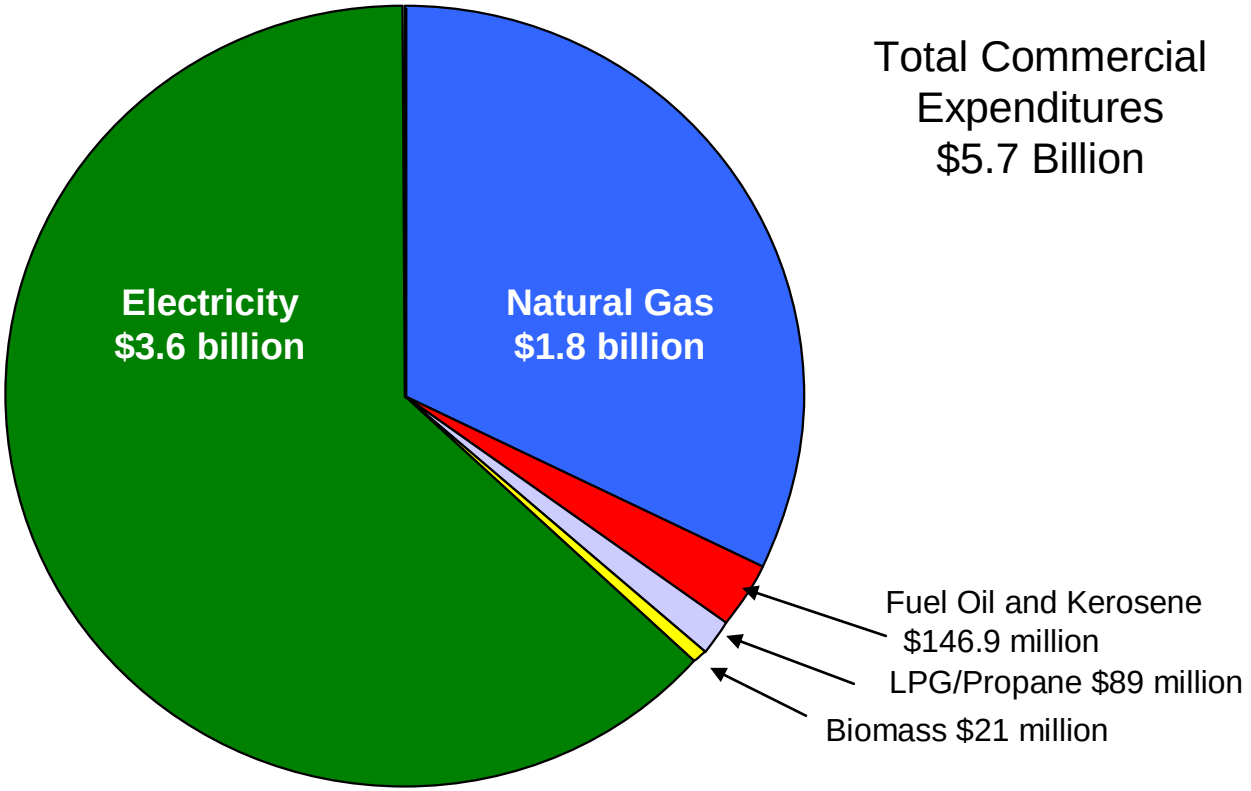


Total Residential Expenditures
$9 Billion

* Latest data available
Source: State Energy Expenditures Report, Energy Information Administration
Graph prepared by: Energy Data and Security, Michigan Public Service Commission

Commercial Energy Expenditure in Michigan

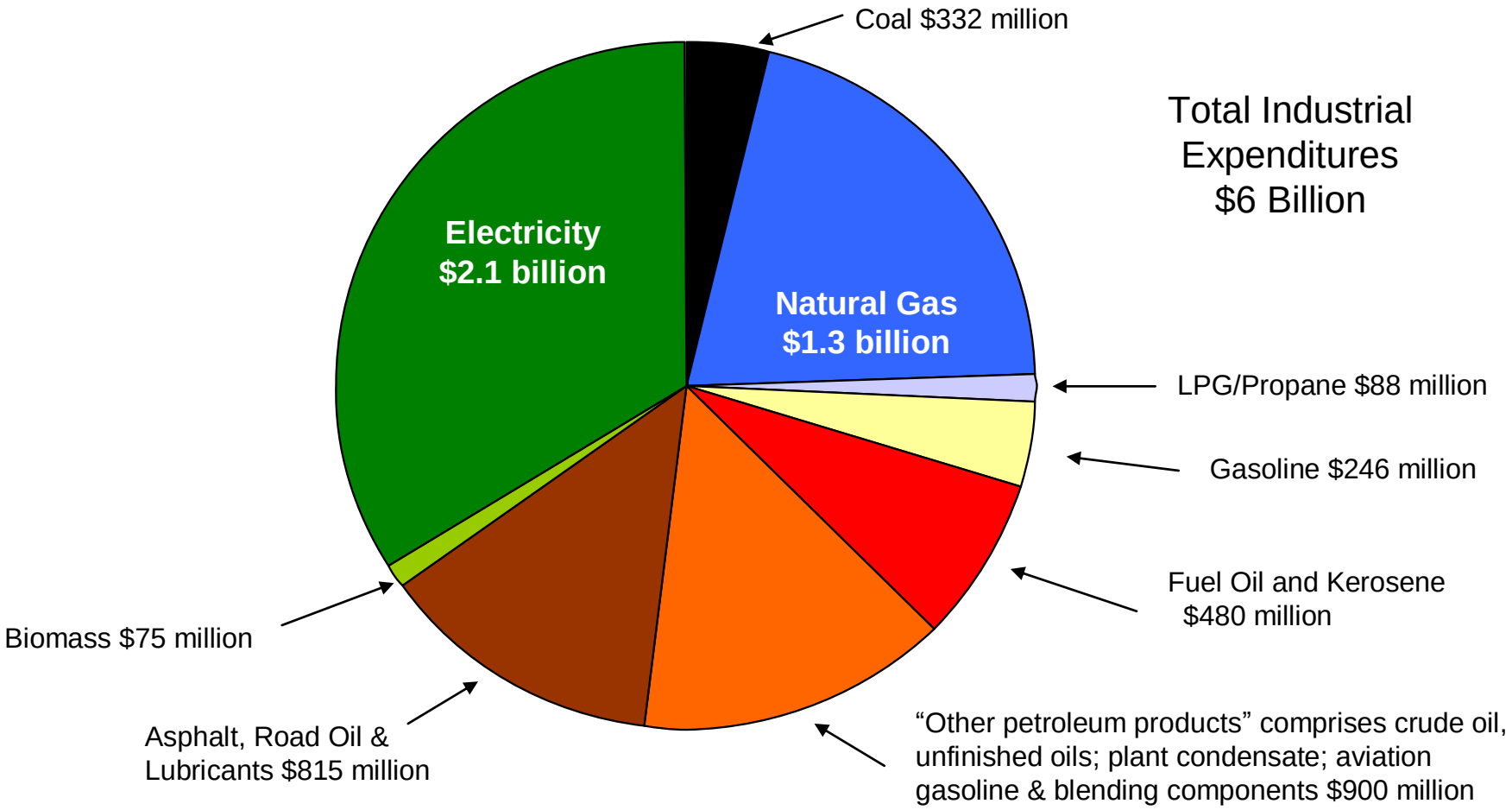
Millions of Nominal Dollars in calendar year 2008*



* Latest data available
Source: State Energy Expenditures Report, Energy Information Administration
Graph prepared by: Energy Data and Security, Michigan Public Service Commission

Industrial Energy Expenditure in Michigan

Millions of Nominal Dollars in calendar year 2008*



* Latest data available

Source: State Energy Expenditures Report, Energy Information Administration

Graph prepared by: Energy Data and Security, Michigan Public Service Commission

Questions?

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Michigan Energy Appraisal
http://www.dleg.state.mi.us/mpsc/reports/energy/