Economic and Electricity Demand Analysis and

Comparison of the Council's 1995 Forecast to Current Data

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Introduction

Energy is a critical component of most human activity. It is an important ingredient in industrial production and provides essential services to support our standard of living. It should not be surprising therefore, that the levels of household and business activity in the regional economy are the dominant determinants of electricity demand both now and in the future. The objective of this analysis is to compare actual economic and demographic trends from 1991-2000 with the Council's forecast assumptions, and based on the results make a recommendation regarding changes to the energy demand forecast process for the upcoming fifth power plan.

The energy and economic forecasts were last updated in September of 1995, when the most recent actual data available was for 1993. The comparisons in this analysis highlight areas where economic activity has deviated from the assumptions, identify trends in key economic sectors and demographic measures, and examine the differences for implications for the electricity demand forecast. In addition to looking at the actual data from 1991-1999, the most recent individual short-term State economic forecast information is also compared to the Council's forecasts for years 2000-2003.

Electricity consumption occurs in three primary sectors. Electricity consumed in private homes is included in the residential sector. Electricity consumed in manufacturing business activities is included in the industrial sector. The commercial sector includes electricity consumed in non-manufacturing business activities and includes electricity consumed in office buildings, hospitals, retail stores, restaurants, warehouses etc... The price of electricity and the price of alternative energy forms, such as natural gas, are also important determinants of electricity demand and are key components of the Council's demand forecast. These factors will be evaluated in a future report.

Methods

Actual data on population, households, and twenty-four different employment sector combinations were collected from various sources for each of the 4 Northwest States and compared to the assumptions made in developing the Council's demand forecasts. The employment comparisons between actual and Council forecasts are based on three-State totals (Oregon, Washington & Idaho). Montana is excluded due to the lack of available data for the 16 western counties and their relatively small contribution to total employment numbers. Montana information is available and included for analysis of the population, and households, as well as electricity sales.

Given a 20-year time period and the recognized uncertainty in forecasting that far into the future, the Council forecasts were developed to bracket the highest and lowest plausible economic scenarios. This wide range of forecast scenarios supports a flexible strategy to make long-term decisions and investments in the Region. When compared with reliance on a single forecast, the broader range of scenarios provides information to help decision makers reduce the risk of either not having an adequate supply of electricity for the potential growth that could be experienced or of expensive investments in unnecessary resources if the potential growth does not materialize. Inside the highest and lowest scenarios is a more likely range

[1] With assistance from Terry Morlan, Manager, Economic Analysis, NPPC and Debbie Kitchin, Interworks, LLC

of outcomes that are considered about equally probable. These more likely outcomes are bounded by the medium-high and medium-low values that are displayed in the figures in this analysis.

Results

Demographics

Total population and total households in the region are broad indicators of the potential for overall economic growth and energy demand. Total population helps determine the available labor force and the total number of households in the region, which is the primary indicator of residential energy demand. As shown in Figure 1, census 2000 information indicates that the actual population is higher than the Council's medium forecast but it is still below the medium-high forecast level. Figure 2 shows that the 2000 population was under forecast by about 1.5 percent, or slightly over one year's worth of population growth. The Council's medium forecast of population is tracking very closely to the inter-census population estimates made by the US Census Bureau prior to 2000, although slightly under the census estimates. A significant adjustment in population estimates during a census year is not uncommon and inter-census data estimates will likely be revised to show a more consistent growth trend between census years 1990 and 2000. If this occurs, the Council's forecast for these inter-census years will be further under forecast, but are not likely to exceed the relatively small percentage error for year 2000.

Figure 1
Total Regional Population
1990-2000

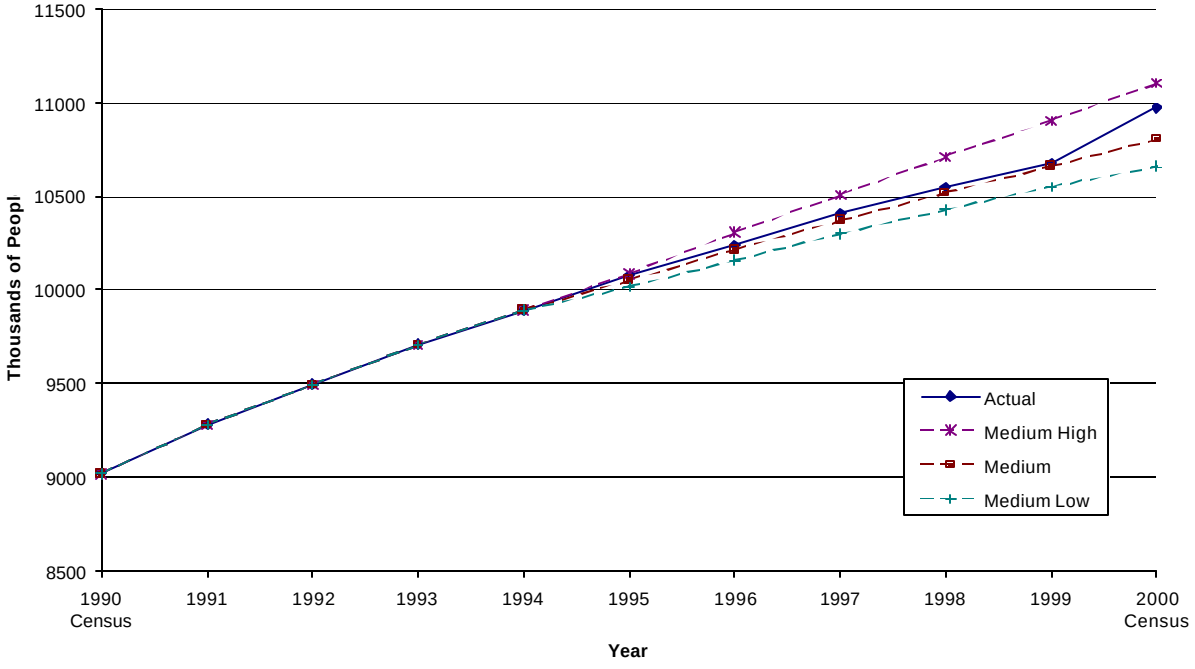
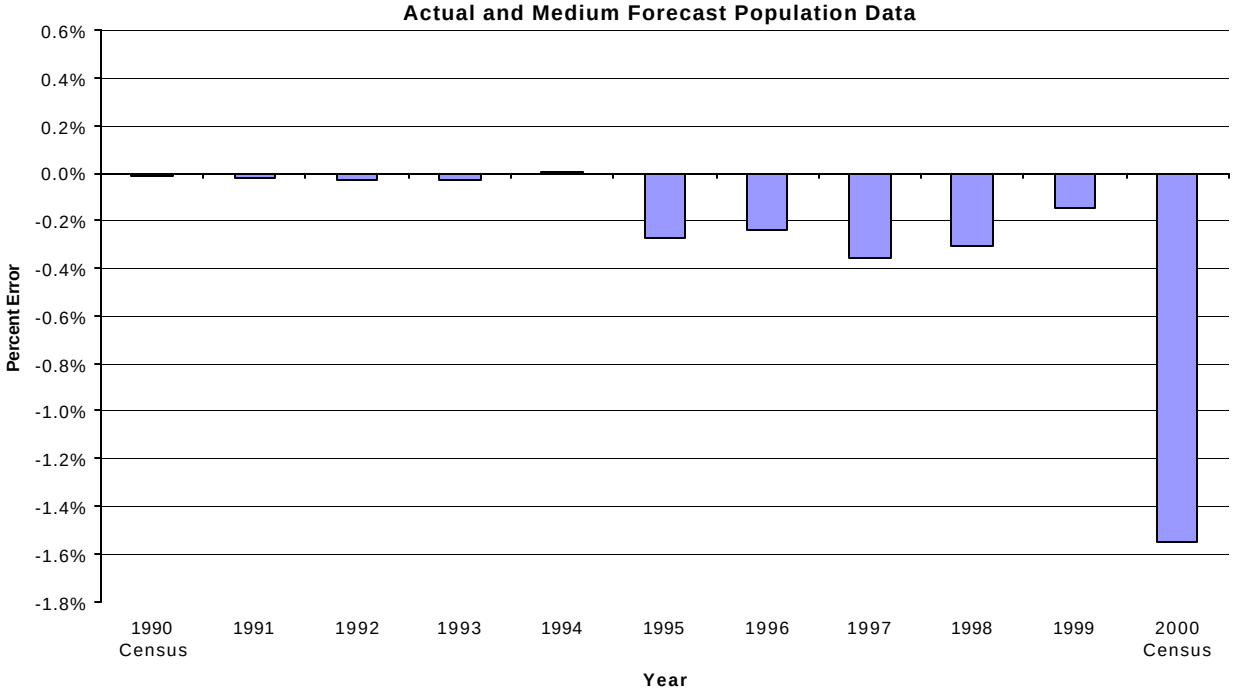
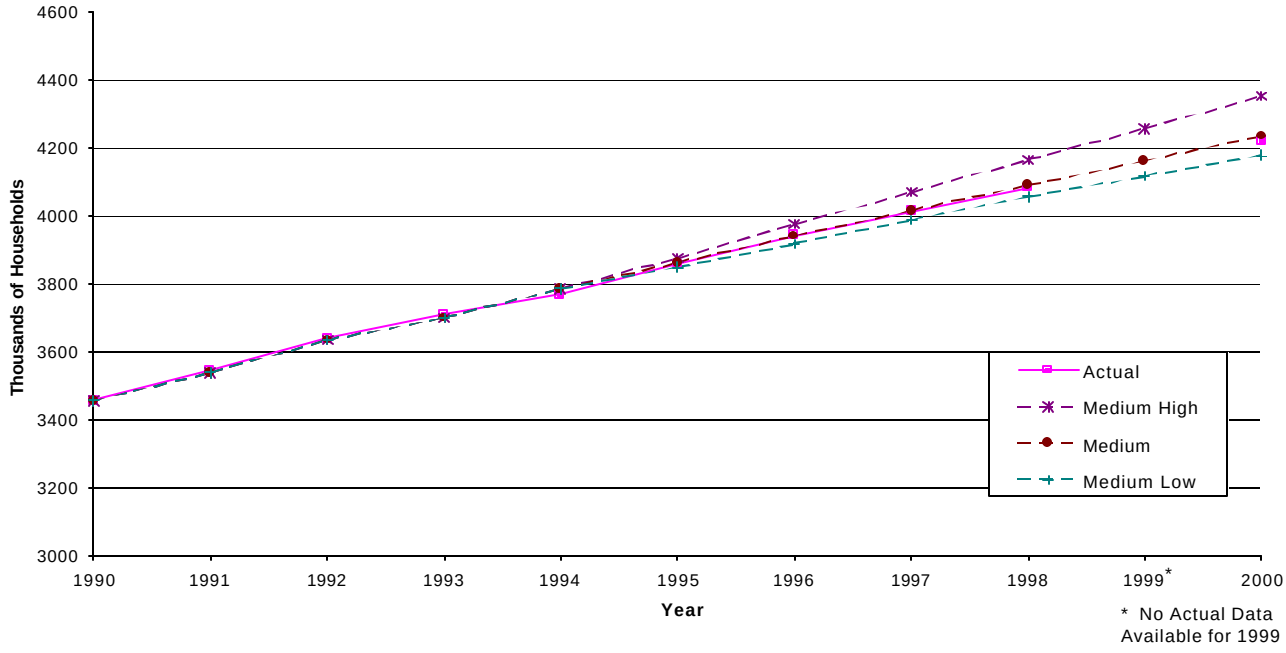


Figure 2
Percent Difference between
Actual and Medium Forecast Population Data



The Council's forecasts for households are also tracking very closely with the inter-census household estimates made by the US Census Bureau. This comparison is shown in Figure 3. Although the regional population estimate increased in census year 2000 data, it is interesting to note that total households do not show a comparable increase. At this broad scale, there appears to be no need to modify the Council's forecast assumptions for either population or households since both remain well within the bounds of the most likely forecast scenario.

Figure 3
Total Regional Households
1990-2000



Employment

Employment forecasts are a widely used measure of economic activity. Changes in employment are a key driver of energy needs. The Northwest, which along with the Nation has recently experienced the longest economic expansion in history, has experienced significant economic growth during the last decade. The Council forecasts 49 individual employment sectors and this information is used to help forecast electricity demands. Many industries are cyclical in nature and experience significant growth followed by equally significant declines. The Council's forecasts do not attempt to predict these short-term cycles but instead reflect probable long-term trends for the industry. While the Council's forecasts do not reflect short-term changes it is important to understand where we are in the business cycle in order to interpret the results of the comparison. Currently the US economy and the Northwest Economy are in the midst of a slowdown, and although it does not appear to be a recession, it is nonetheless very difficult to forecast for the short-term during times of transition. Recent events have added to the economic uncertainty.

Two major categories of business activity are typically distinguished in analyzing regional economic growth. Non-manufacturing businesses include activities such as services, construction, wholesale and retail trade, mining, agriculture and government. Non-manufacturing employment represents approximately 87 percent of total employment in the 3 State area. Electricity consumed in these activities is assigned to the commercial demand sector. Although a significant employer, electricity use by the non-manufacturing sector is estimated to represent only 38 percent of the electricity use by businesses. The second major category of business economic activity, manufacturing, is engaged in the transformation of substances or materials into new products. Manufacturing employment represents a significantly smaller proportion of total employment (about 13 percent), however, the sector's electricity use is significantly higher (about 62 percent). Electricity consumed in these activities is assigned to the industrial electricity demand sector. Differences from forecast values for employment in one sector can offset opposite differences in other sectors although there is not a direct relationship due to the differences in energy use.

Twenty-four different sector or sector combinations were compared with the Council's forecasts. The majority of the sectors are very closely tracking the most likely forecast scenarios. This paper focuses on just those sectors with noteworthy differences. A complete display of all sector comparisons can be found in Appendix A.

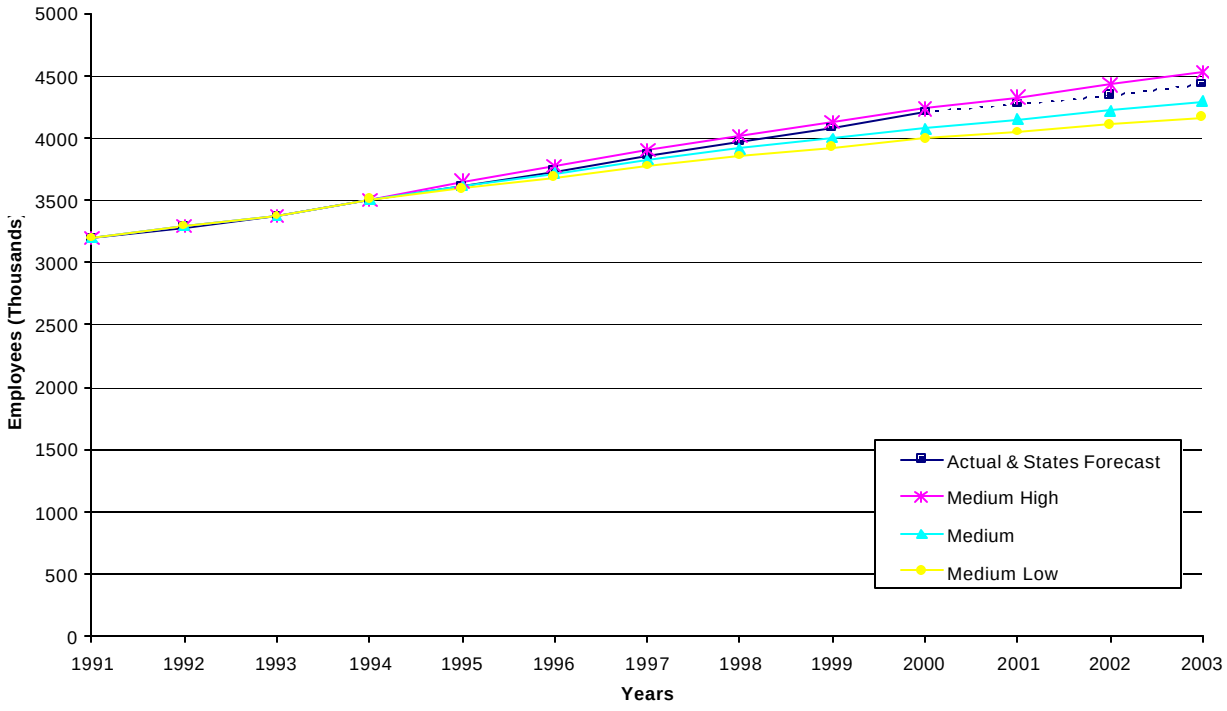
The data is discussed and displayed first for the total non-manufacturing sector, followed by individual discussions of non-manufacturing sectors with noteworthy deviations from the forecast values. Comparisons of total manufacturing industries follow, again with individual discussions of manufacturing sectors with noteworthy deviations from the forecast values. A description of each Sector or group that is taken directly from the Standard Industrial Classification Manual 1987 is provided in Italics at the beginning of each discussion. Actual data is displayed through 2000. Short-term forecast information from 3 States is plotted on the actual data line for 2001-2003 and is denoted as a dashed-line for this time period.

Non-Manufacturing Employment

The Council forecasts employment for 19 individual non-manufacturing sectors. These were summarized into 10 major sectors, which were evaluated for this analysis. Non-manufacturing activities account for the bulk of total employment. It includes sectors such as, services, trade, government, transportation, communications, finance, insurance, real estate, and energy sales and delivery. Economic activity in the non-manufacturing sectors tends to be less cyclical than manufacturing. In addition, electricity use is more uniformly related to employment. Most electricity consumption in the commercial sector occurs in buildings where the requirements per employee are relatively similar. Employees in different non-manufacturing sectors drive forecasts of electricity use in ten different building types, such as offices, schools, hospitals, groceries, and restaurants.

When aggregated these sectors consistently track between the Council's medium and medium-high forecast levels, although there is a trend towards the medium-high values. The States short-term forecasts continue to predict that these sectors will remain within the Council's most likely economic scenarios (see Figure 4).

Figure 4
Non Manufacturing Employment
(excluding agricultural employment)



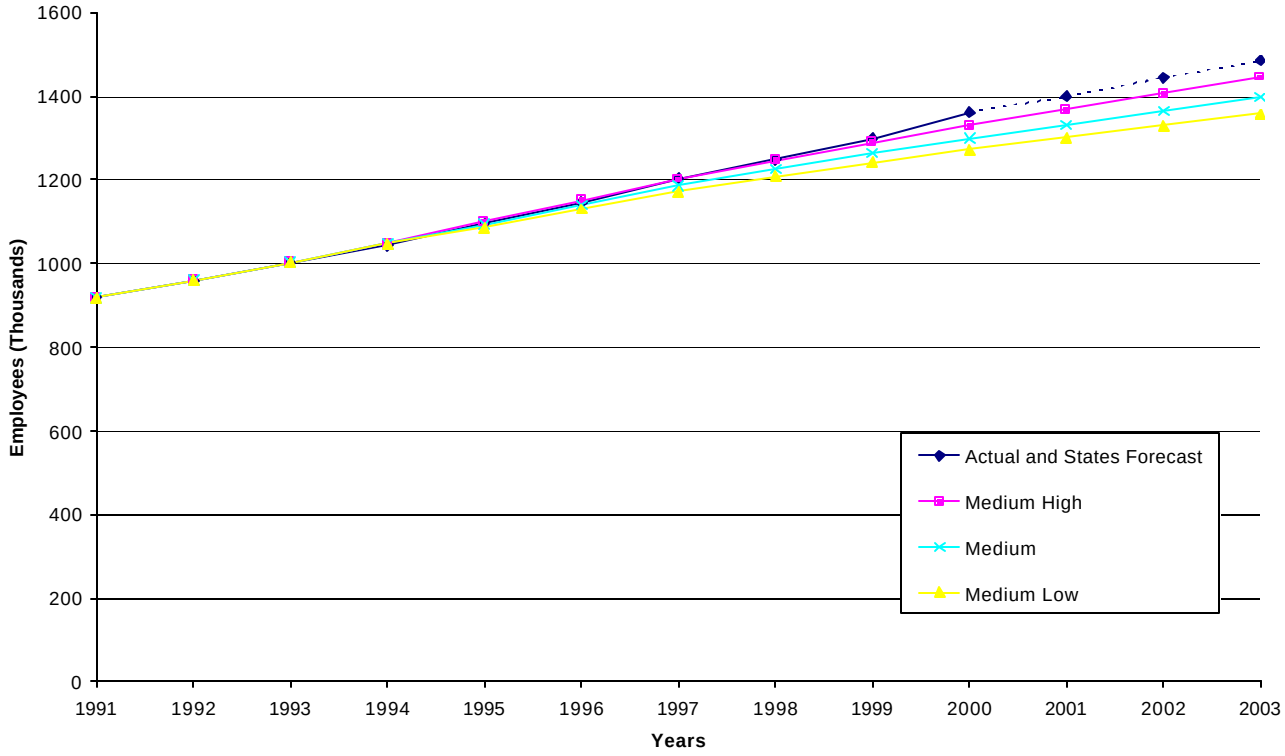
Several individual non-manufacturing sectors are showing noteworthy differences from the Council's most likely scenarios. These individual sectors are discussed in more detail below. Non-manufacturing sectors not specifically discussed are tracking with the Council's forecast values.

Noteworthy Variations in Forecasts for Non-Manufacturing Sectors

Services: *This division includes establishments primarily engaged in providing a wide variety of services for individuals, business and government establishments, and other organizations. Hotels and other lodging places; establishments providing personal business, repair, and amusement services; health, legal, engineering and other professional services; education institutions; membership organizations, and other miscellaneous services are included.*

This sector is noteworthy due to the high levels of employment experienced throughout the Region. The services sector has tracked very closely to the Council's medium-high forecast since 1996, and is projected by state forecasters to be above the medium-high forecast levels between 2000 and 2003 (see Figure 5). Although this sector has been tracking the medium-high scenario, it is important to remember that the probability of occurrence is considered roughly equal between the medium-high and medium-low values. In addition, the States' forecasts for continued increases in this sector may be optimistic given the current economic decline in the internet and computer services industries.

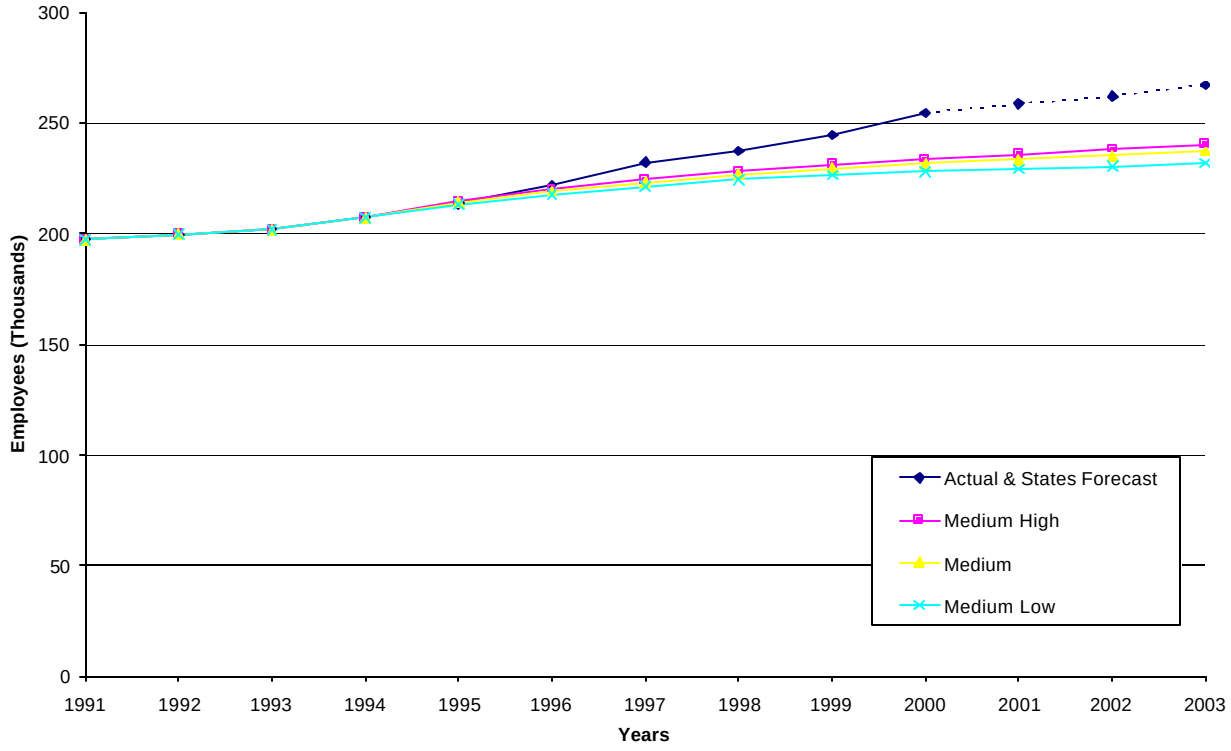
Figure 5
Services Employment



Transportation and Public Utilities: *This division includes establishments providing, to the general public or to other business enterprises, passenger and freight transportation, communications services, or electricity, gas, steam, water or sanitary services, and all establishments of the United States Postal Service*

The transportation and public utilities sector has experienced increased unpredicted growth between 1995 and 2000, with continued growth projected out to 2003 (see Figure 6). The sector is dominated by transportation employers (e.g., trucking, delivery etc.) that are not large users of electricity; but also includes wireless communications and internet service providers. The most significant growth was seen in Washington State with an increase of approximately 42,000 positions. If the trend continues as projected into 2003 the projected actual level will be 13 percent over the Council's medium forecast level.

Figure 6
Transportation & Public Utilities Employment

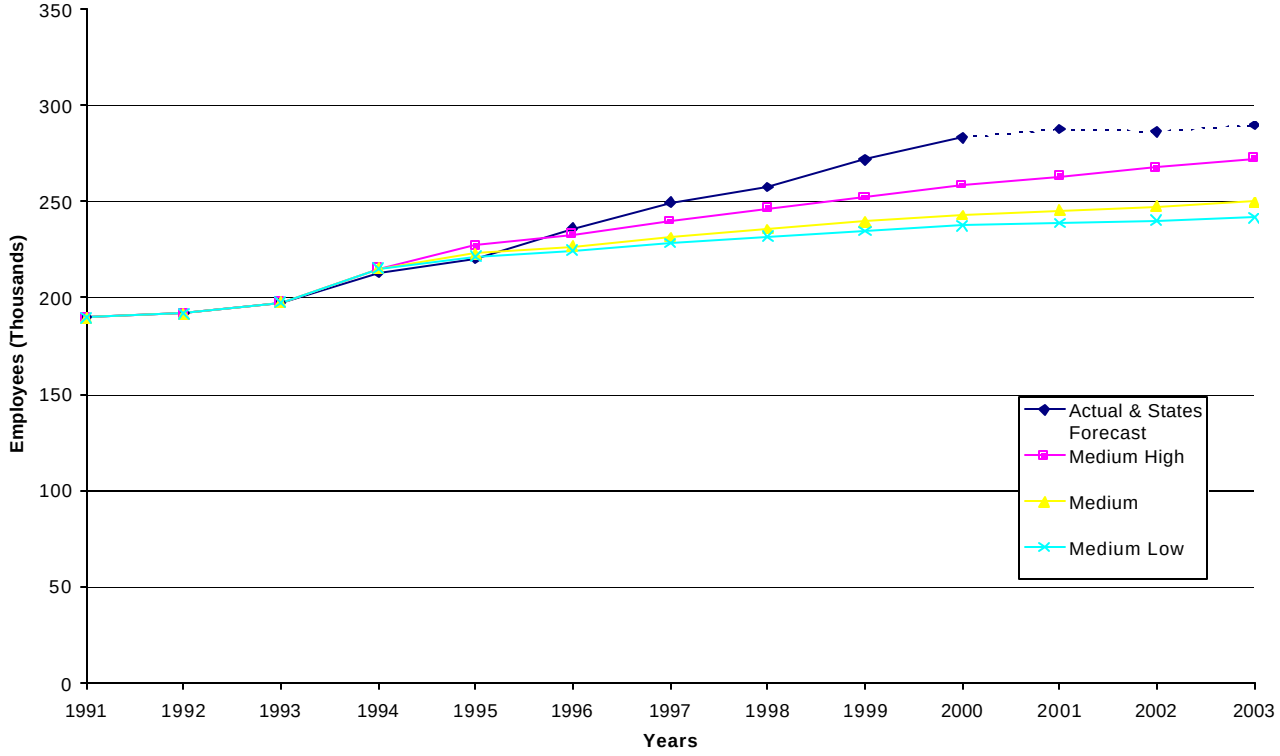


Construction: *This division includes establishments primarily engaged in construction. The term construction includes new work, additions, alterations, reconstruction, installations and repairs.*

Construction employment does not directly affect the energy demand forecasts but information is included on it because the actual values consistently lie outside the Council's medium-high through medium-low forecasts.

The construction sector has seen continued and unpredicted growth between 1996 and 2000, likely related to the period of unprecedented economic growth that both the Nation and the Region have experienced. According to the States short-term forecasts the growth is expected to continue through 2003 (see Figure 7). The largest increases are attributable to Washington State with a projected increase of approximately 49,000 employees. Oregon follows closely with a projected increase of approximately 38,000 employees.

Figure 7
Construction Employment



Manufacturing Employment

Economic activity in the manufacturing sector is the primary determinant of energy use in the industrial sector. While employment is a general indicator of that economic activity it is not used directly to drive the industrial sector forecasts. Energy use is more directly related to industrial production, which also depends on assumptions about productivity growth in the manufacturing sectors. Productivity assumptions have not been evaluated in this review. Nevertheless, employment trends are a good indicator of the general assumptions that support the industrial demand forecasts.

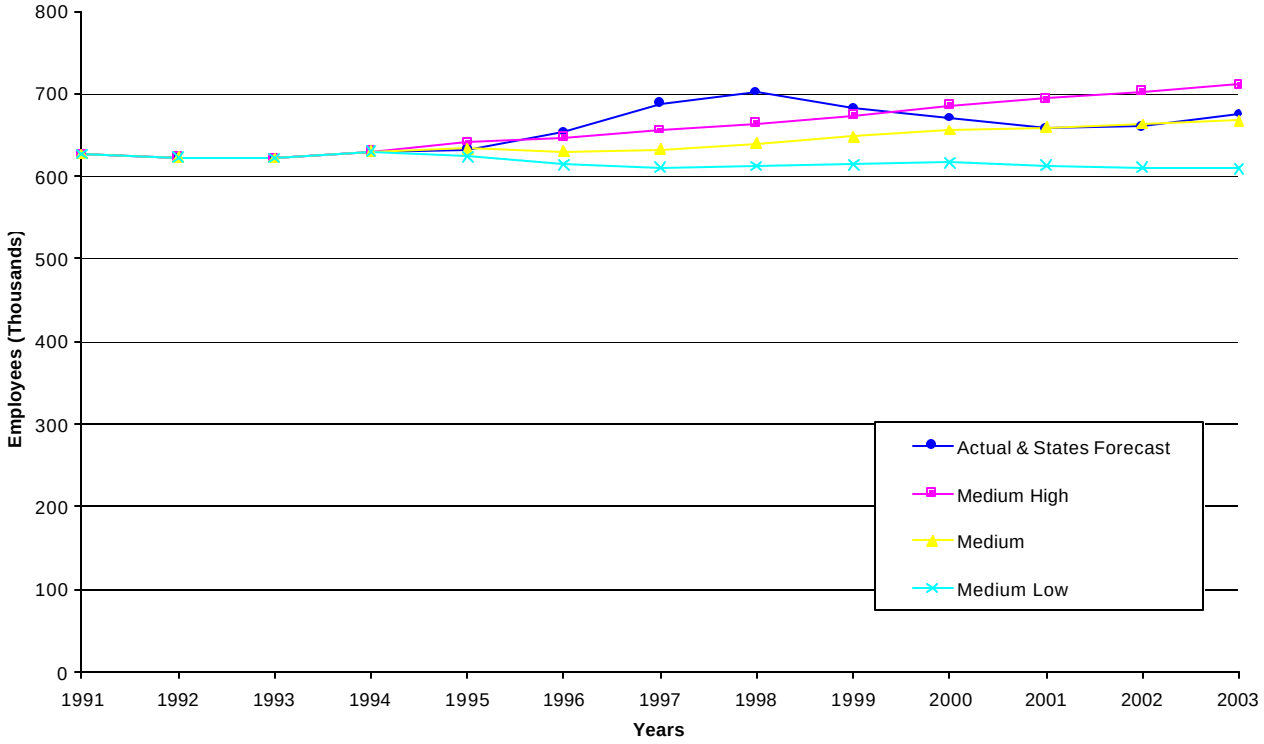
The manufacturing employment forecasts include 29 different manufacturing industry sectors. Each sector uses electricity in different ways to produce its products. As a result, the relationship between the economic activity forecast and the electricity demand vary dramatically among the different manufacturing sectors. In fact, 5 of the 29 manufacturing sectors account for about 85 percent of total industrial electricity consumption. Those same five sectors account for only a third of manufacturing employment. The five major industrial consumers of electricity are primary metals (dominated by aluminum in this region), paper, chemicals, lumber and wood products, and food processing. The largest consumer of electricity is primary metals, which is dominated by aluminum plants. Aluminum demand for electricity is not modeled using economic assumption, but rather is determined by direct assumption.

In addition to being highly individualistic, manufacturing sector economic activity, and therefore electricity use, tends to be more cyclical than other sectors. This is evident in the actual data on manufacturing employment, but is not reflected in the forecasts of employment because the forecasts focus on long-term trends and do not attempt to address business cycles. The presence of business cycles makes it more difficult to assess the forecast trends for manufacturing and the industrial sector based on a relatively short historical period.

For this analysis we reviewed 14 sector or sector aggregates that represented 23 of the 29 manufacturing sectors. The sectors that were not evaluated, when combined represent less than 10 percent of the manufacturing employment and individually represent no more than 3 percent of the total manufacturing employment. Several sectors that were evaluated are showing noteworthy differences from the Council's most likely scenarios. These individual sectors are discussed in more detail below. Manufacturing sectors not specifically discussed are tracking with the Council's forecast values or represent an insignificant proportion of the demand forecast.

Total manufacturing employment is tracking closely to the Council's medium forecast with a significant exception from 1996-2000 related to a cyclical increase in transportation equipment employment in Washington (primarily Boeing), and an increase in electronics employment in Oregon during the same time period (see Figure 8). The States short-term forecasts indicate a continued trend that tracks with the Council's medium forecast.

Figure 8
Manufacturing Employment

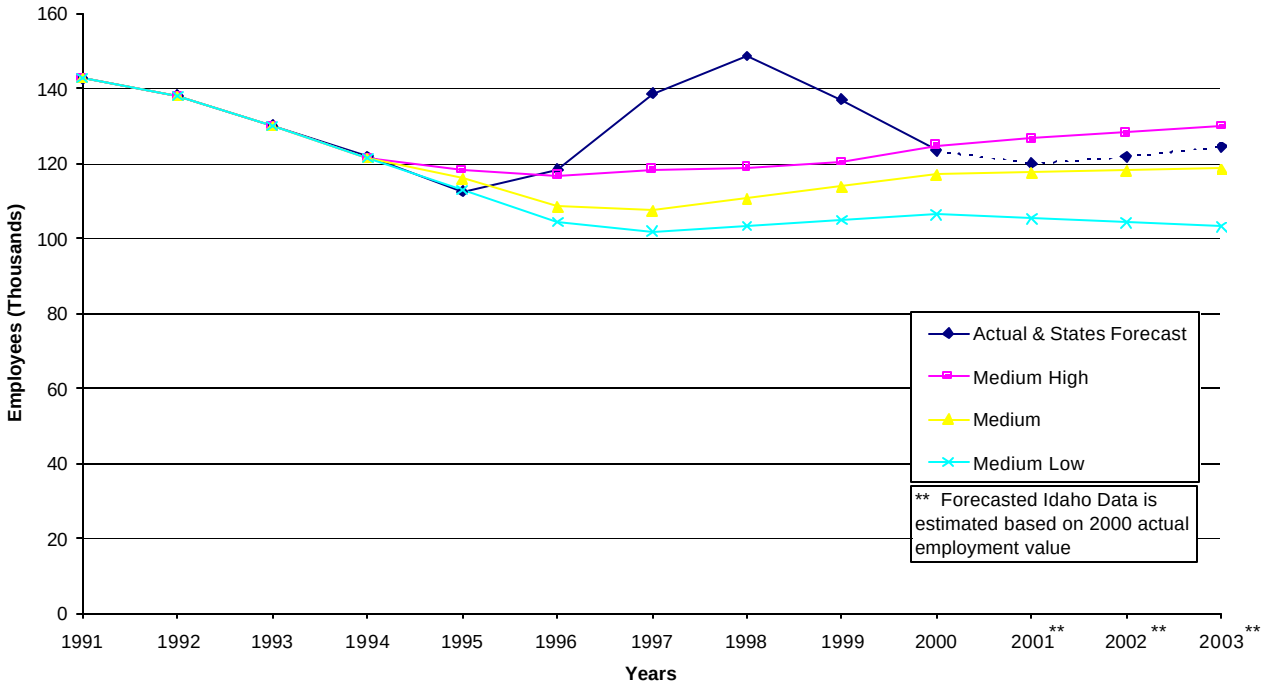


Noteworthy Variations in Forecasts for Manufacturing Sectors

Transportation Equipment: *This major group includes establishments engaged in manufacturing equipment for transportation of passengers and cargo by land, air, and water. Important products produced by establishments in this group include motor vehicles, aircraft, guided missiles and space vehicles, ships, boats, railroad equipment and miscellaneous transportation equipment such as motorcycles, bicycles, and snowmobiles.*

Transportation equipment manufacturing employment is typically cyclical in nature and difficult to track on a short-term basis. This sector experienced a significant cyclical growth and then decline, during the 1996-2000 period. This cycle is reflected in a significant increase in employment in Washington (primarily Boeing) which experienced an increase of 33,000 jobs between 1995 and 1998, and then a corresponding decrease of 28,000 jobs between 1998 and 2000 (see Figure 9). Short-term forecasts by the states indicate that the Council's medium forecast may be slightly low (about 5 percent), for this sector, however, due to the cyclical nature of this sector a change is not warranted.

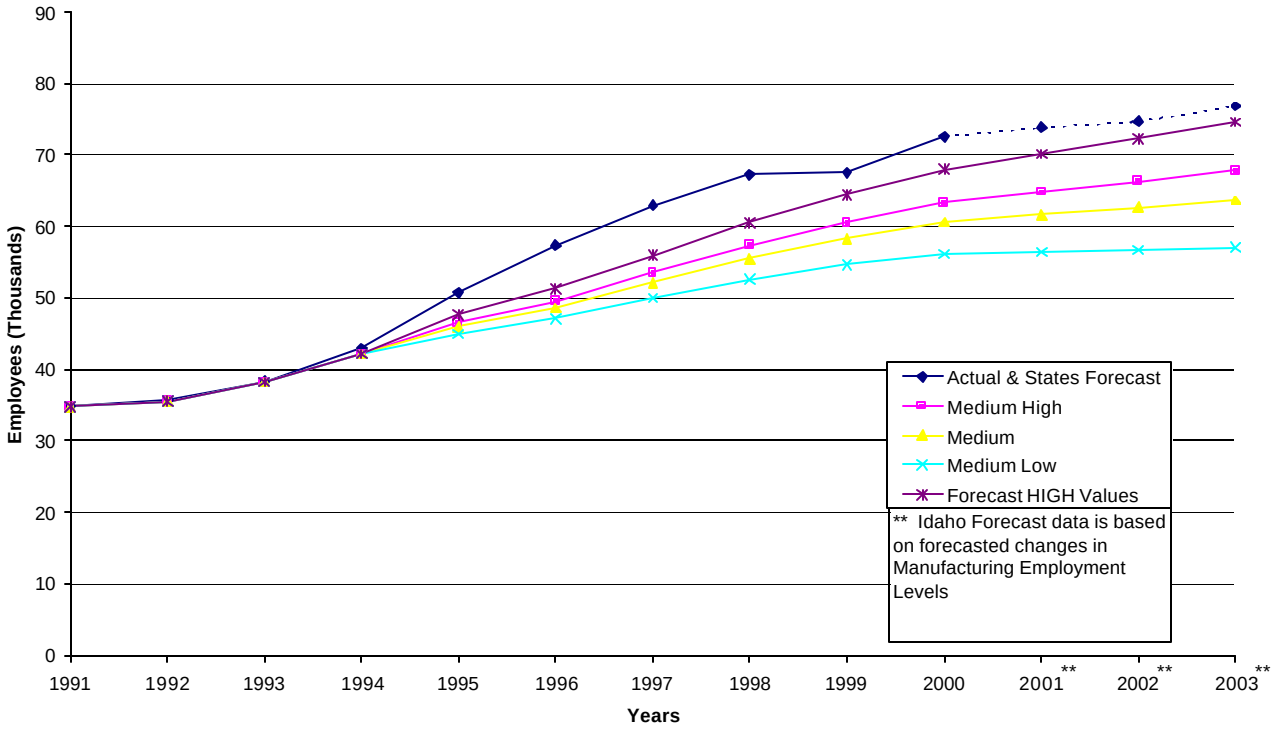
Figure 9
Transportation Equipment Employment



Electronic and Other Electronic Equipment: *This group includes establishments engaged in manufacturing machinery, apparatus, and supplies for the generation, storage, transmission, transformation, and utilization of electrical energy. Included are the manufacturing of electricity distribution equipment; electrical apparatus; household appliances; electrical lighting and wiring equipment; radio and television receiving equipment communications equipment, electronic components and accessories, and other electrical equipment and supplies.*

The electronic and other electronic equipment sector experienced significant unpredicted growth between 1994 and 2000 (see Figure 10). The majority of this growth is due to increases in employment in Oregon in the high technology manufacturing industry. This growth level exceeds the Council's unlikely high forecast level, and if it continues as projected by the States short-term forecasts will be 21 percent over the medium forecast level in 2000. This sector when combined with transportation equipment accounts for all of the increase in growth at the aggregate level of manufacturing employment between 1994 and 1997. Without the offsetting declines seen in other industries (e.g., Paper & Allied products) a change to the Council's forecast for the industrial energy demand could be warranted.

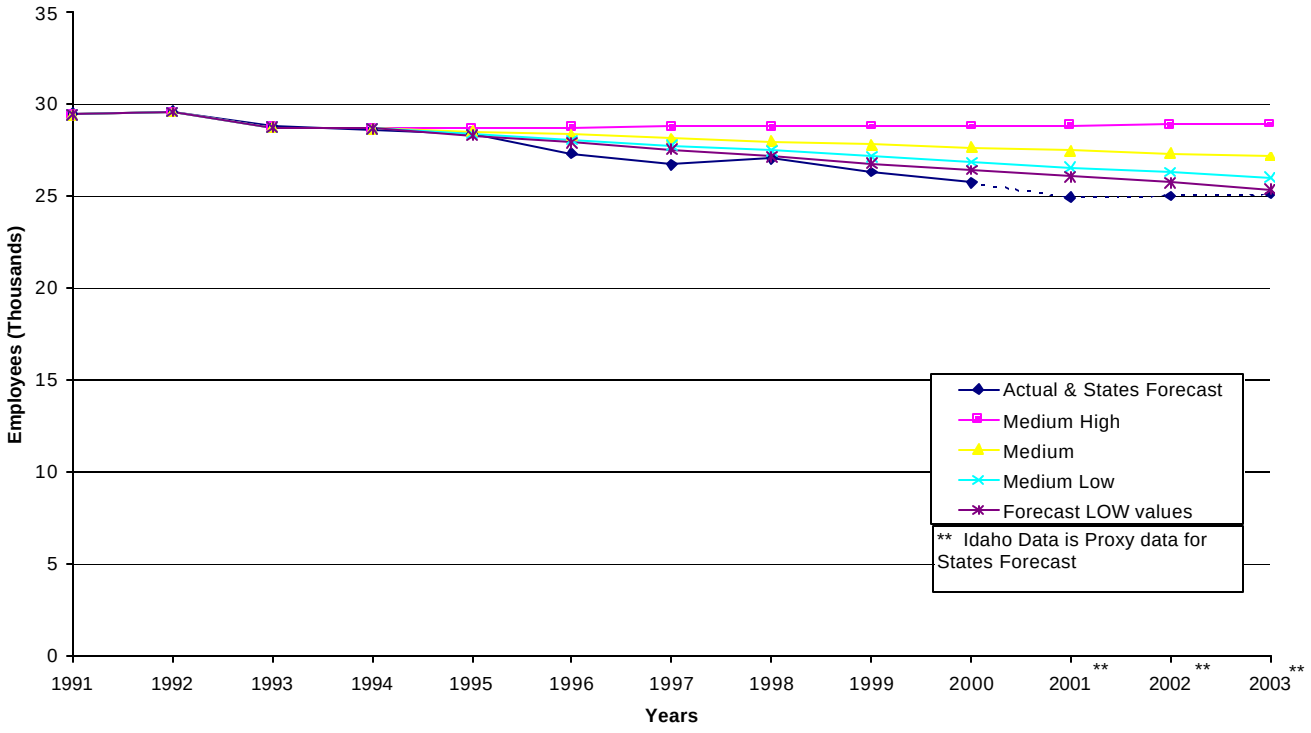
Figure 10
Electronic & Other Electric Equipment
Employment



Paper and Allied Products: *This group includes establishments primarily engaged in the manufacture of pulps from wood and other cellulose fibers, and from rags; the manufacture of paper and paperboard; and the manufacture of paper and paperboard into converted products, such as paper coated off the paper machine, paper bags, paper boxes, and envelopes. Also included are establishments primarily engaged in manufacturing bags of plastic film and sheet.*

Paper and allied products' manufacturing has seen a steady decline from 1991-2000 and is projected to continue to decline slightly between 2000-2003. Although this sector was forecast to decline the actual rate of decline exceeds the Council's unlikely low forecast scenario (see Figure 11). A total decrease of approximately 4400 jobs between 1991 and 2000 represents a 15 percent decrease sector-wide, and an 8 percent difference from the medium forecast levels for 2003. This sector utilizes a large amount of energy resources for manufacturing and processing its products. In 1989 the sector was projected to represent 20 percent of the electricity consumed by industry as a whole in the region (1991 Power Plan). This reduction of energy demand within the region without offsetting increases seen in other sectors (e.g., Electronic & Other Electronic Equipment) could require adjustments to the electricity demand forecast.

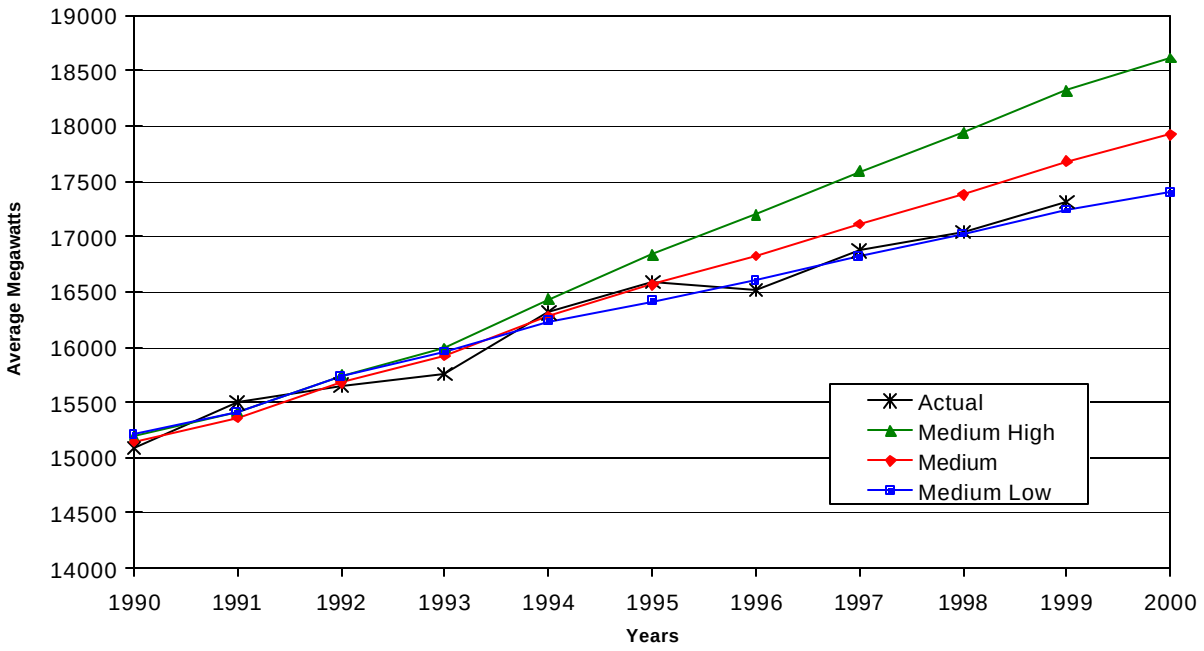
Figure 11
Paper & Allied Products
Employment



Energy Demand/Load Implications

There is no actual data on electricity consumption in individual non-manufacturing or manufacturing sectors. Therefore we cannot directly check what the effect of specific errors in the economic assumptions might be on the accuracy of that sector's demand forecast. What we can do is check whether the aggregate demand forecasts and forecasts of the residential, commercial, and industrial sectors are in error. For the total demand comparison, the loads of the aluminum and other industries served directly by Bonneville (DSI) are removed. The DSI component is not affected by economic assumptions. The actual total Non-DSI sales of electricity are slightly under the medium forecast level. The over-forecast averages 1.3 percent from 1997-1999 (see Figure 12). These small errors appear to be related partly to errors in the industrial forecast.

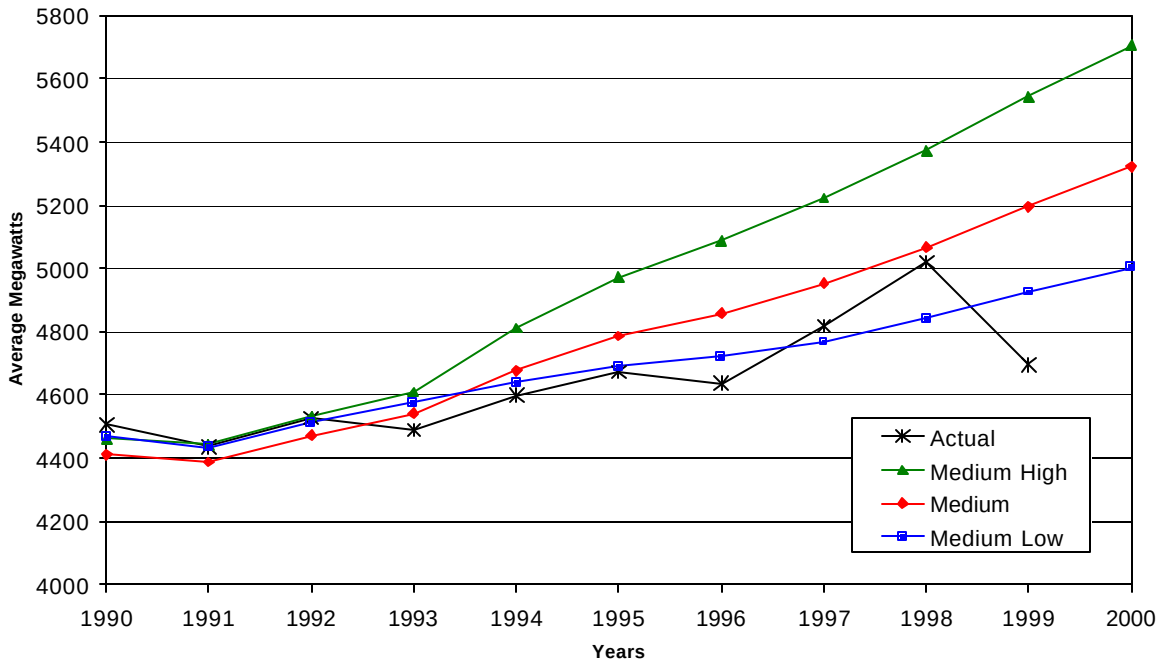
Figure 12
Total Non-DSI Sales Versus Forecasts



Between 1994 and 1999 (the last year of actual sales data available), the Council's medium forecasts of non-DSI industrial demand averaged 3.9 percent over actual levels (see Figure 13)[2]. The industrial sector of electricity demand is dominated by relatively few industries and their forecasts are not directly related to employment, but are driven by the production levels of each of those specific industries. Determining the relationship between the actual employment figures and electricity use is therefore difficult. The paper and allied products industry which is a significant share of the industrial energy demand did experience unexpected declines in employment which may partially explain the over-forecast of sales in this sector (see Figure 11).

[2] The average error of the non-DSI industrial forecast and therefore the total non-DSI forecast may be overstated by an error in the actual 1999 sales data used. Correcting this by using an alternate source to estimate actual industrial sales results in an average industrial error of only 2.6 percent for 1994-1999.

Figure 13
Non DSI Industrial Sales Versus Forecasts



Commercial sector electricity demand is tracking within 1 percent of the Council's medium forecast values. This result is apparently due to offsetting errors in the relationship of employment to energy use in these sectors, since given the recent period of economic growth and the under-forecast of non-manufacturing employment, we would have expected the Council's forecast to be lower than the actual demand. The residential sector of electricity demand is tracking very closely to the Council's medium forecast values. This result was expected since the total households' forecast, are directly tracking the medium forecast values.

Conclusions

The Region as a whole has experienced a period of strong growth in both population and employment during the last decade. Some sectors increased (e.g., electronics & electrical components, services) and some sectors declining (e.g., paper and allied products).

The non-manufacturing sector, which employs the highest number of employees, is closely tracking the Councils medium-high forecast scenario. Manufacturing industries, which consume a significant amount of energy in the Region, saw a cyclical period of growth and decline and are projected to continue to track very closely to the Council's medium forecast scenario into 2003. With a very few exceptions the Council's economic forecasts for demographics and employment are adequately predicting the actual values that the Region is experiencing. Under-forecast errors in individual sectors appear to be offset by over-forecast errors in other sectors with an overall balancing effect occurring at the aggregate levels of manufacturing and non-manufacturing.

Given the significant and unprecedented period of economic growth the Region has experienced it would follow that we would also see electricity sales that exceed the forecast values. The electricity sales data however, indicate that the actual sales are also reasonably tracking with the Council's medium forecasts.

The electricity sales are likely tracking the medium forecast values because of the particular industries that experienced the most growth are not large consumers of energy. Several industries where energy consumption is high actually experienced significant declines in employment. It appears therefore, that the offsetting forecast errors from the economic analysis also produced offsetting errors in the energy demand forecast.

Based on this analysis it is my recommendation that the economic forecast assumptions are reasonably accurate and useable for the long-term outlook in the fifth power plan. No changes to the non-DSI electricity demand forecasts are indicated by this assessment of the underlying economic assumptions. Actual fuel prices will also affect the energy demand forecasts, that analysis is currently underway and when complete may or may not provide information that would dictate an adjustment in the demand forecast. In the short-term actual data could continue to be monitored for key industries (e.g., electronic and other electronic equipment) and if trends do not appear to be off-set in other industries short-term adjustments could be implemented.

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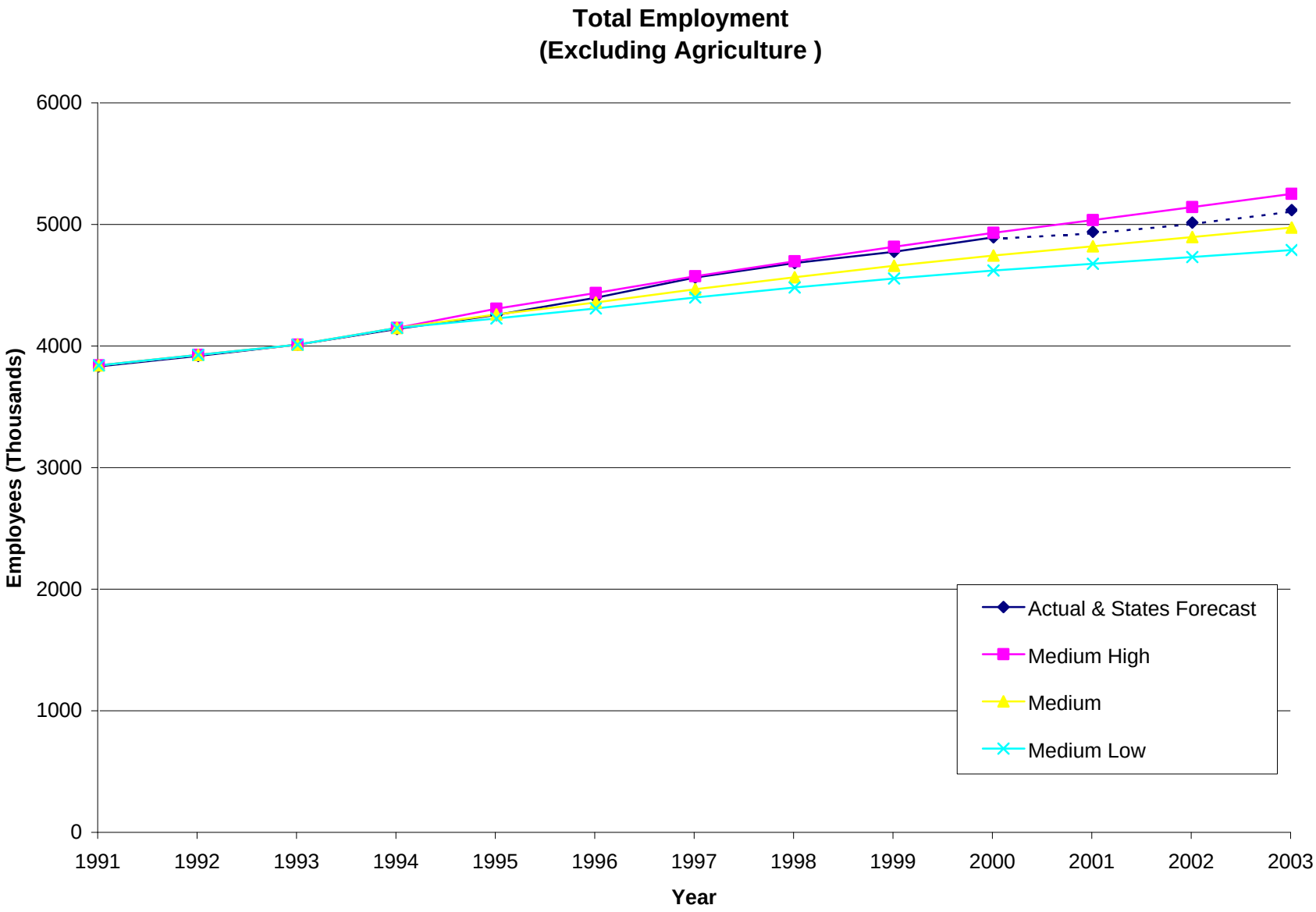
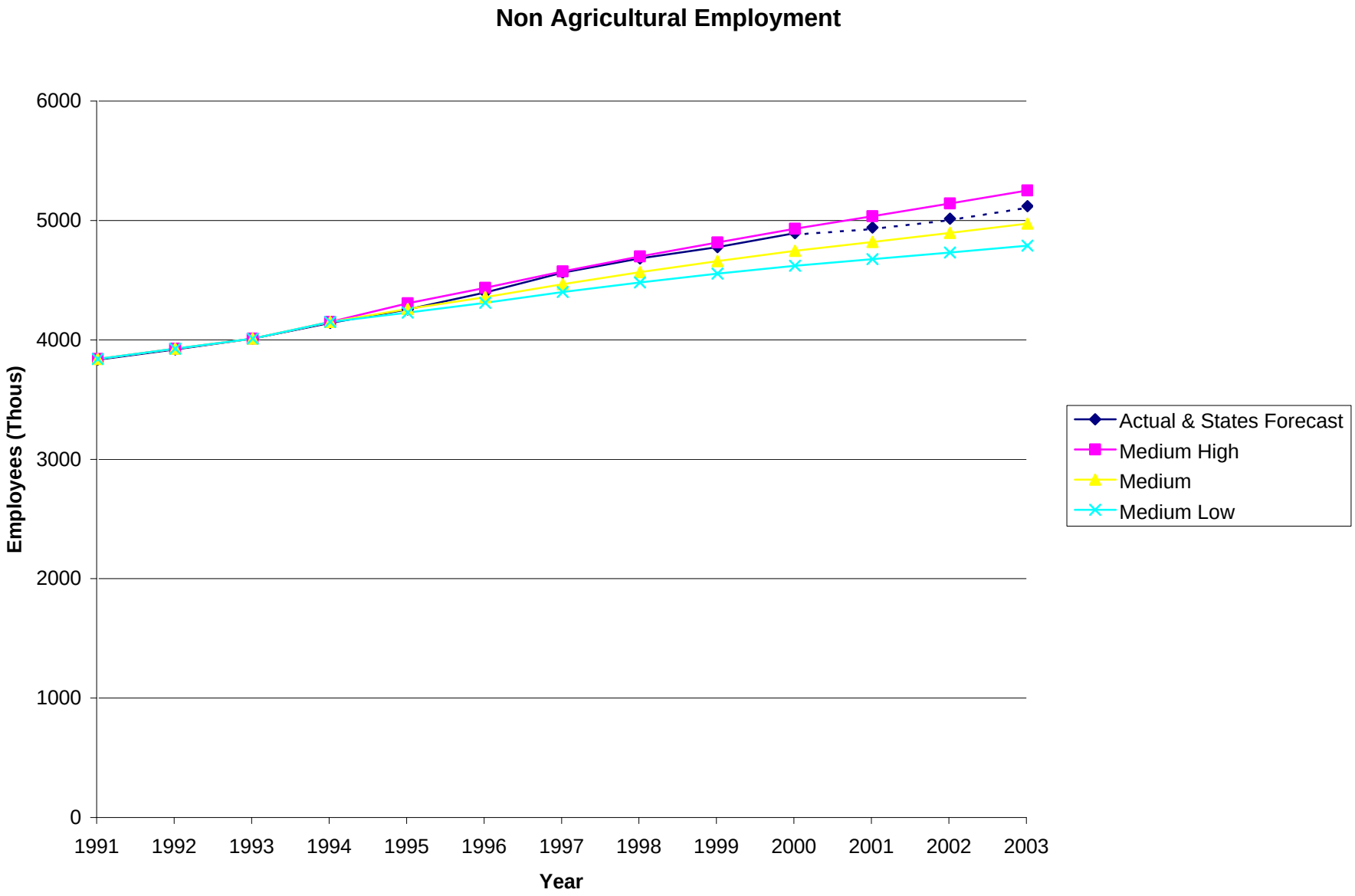
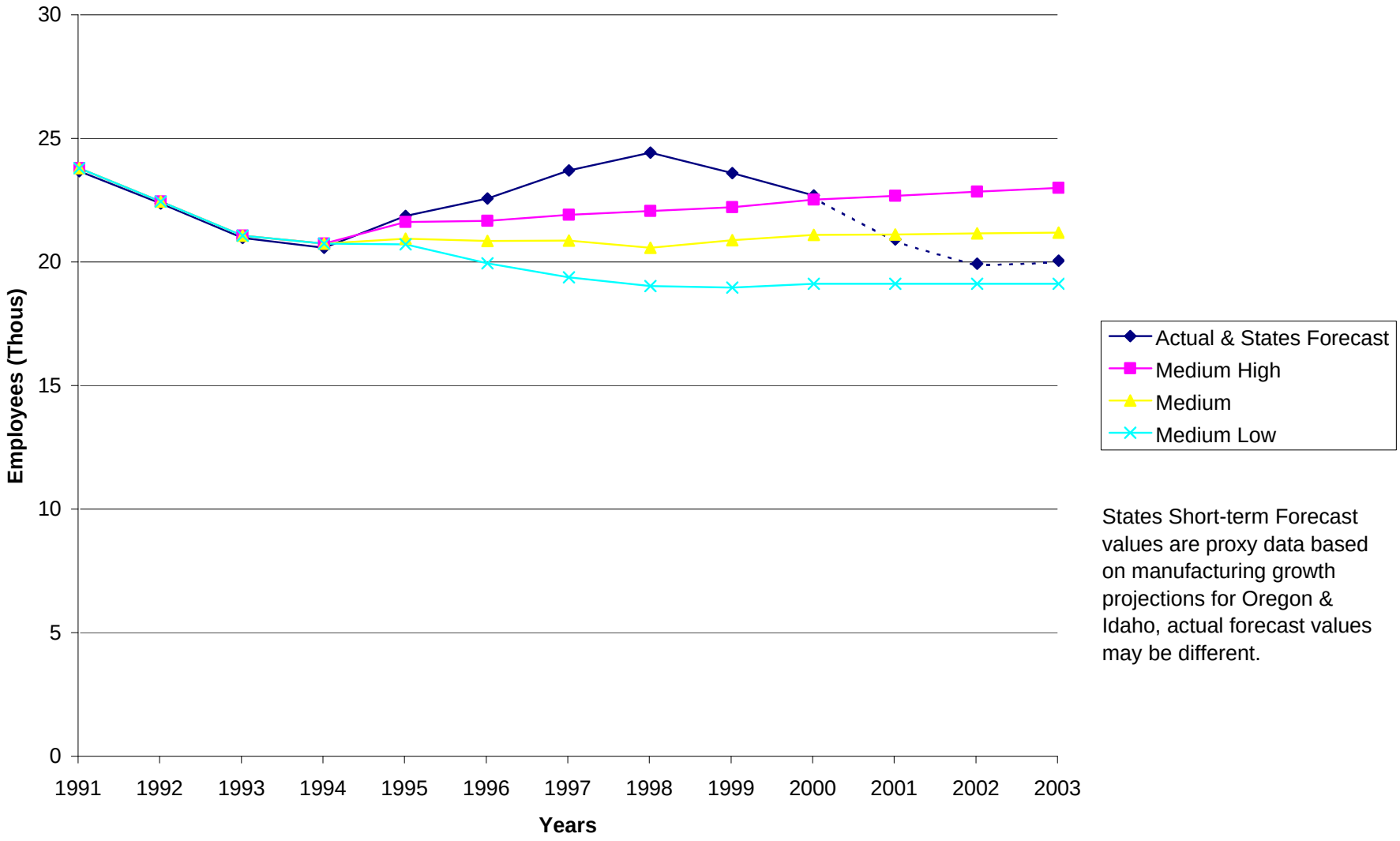
Appendix A

Demographic and Employment Sector Comparisons Evaluated for Review of the Council's Economic Assumptions

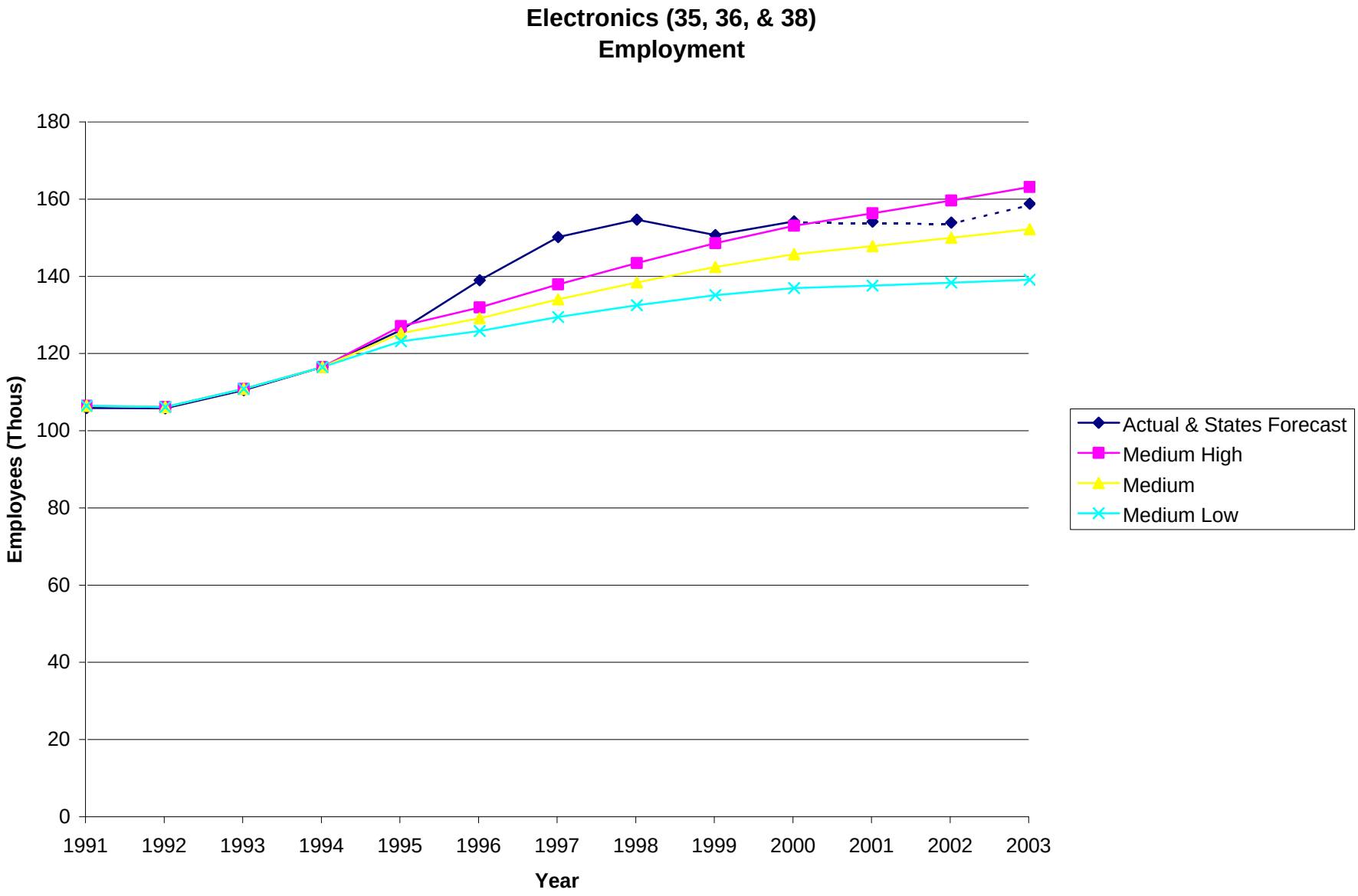

Total Employment
(Excluding Agriculture)
Employees (Thousands)
6000
5000
4000
3000
2000
1000
0
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Year
Actual & States Forecast
Medium High
Medium
Medium Low

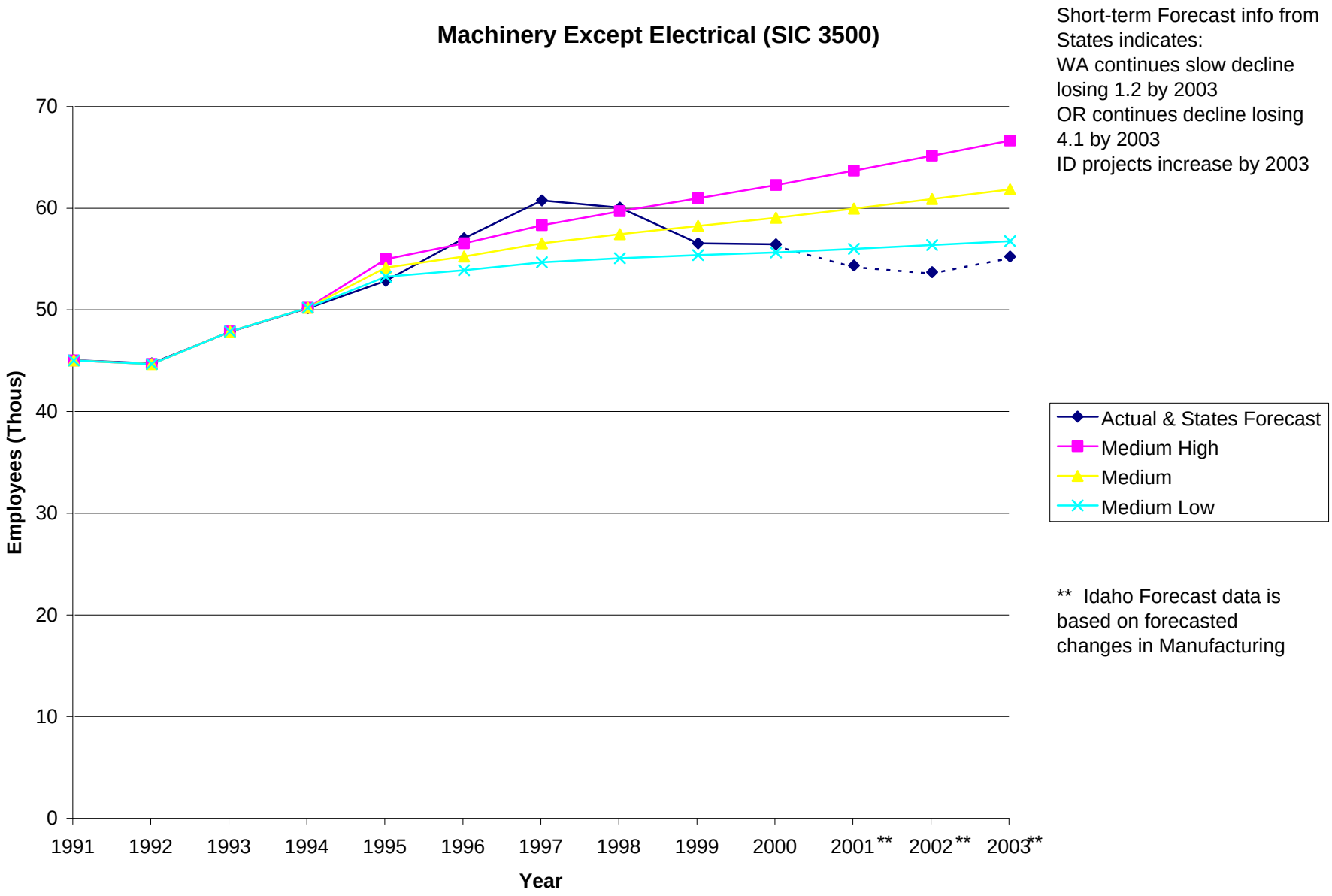

Non Agricultural Employment
Employees (Thous)
6000
5000
4000
3000
2000
1000
0
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Year
Actual & States Forecast
Medium High
Medium
Medium Low

Primary Metals (including Aluminum)



States Short-term Forecast values are proxy data based on manufacturing growth projections for Oregon & Idaho, actual forecast values may be different.

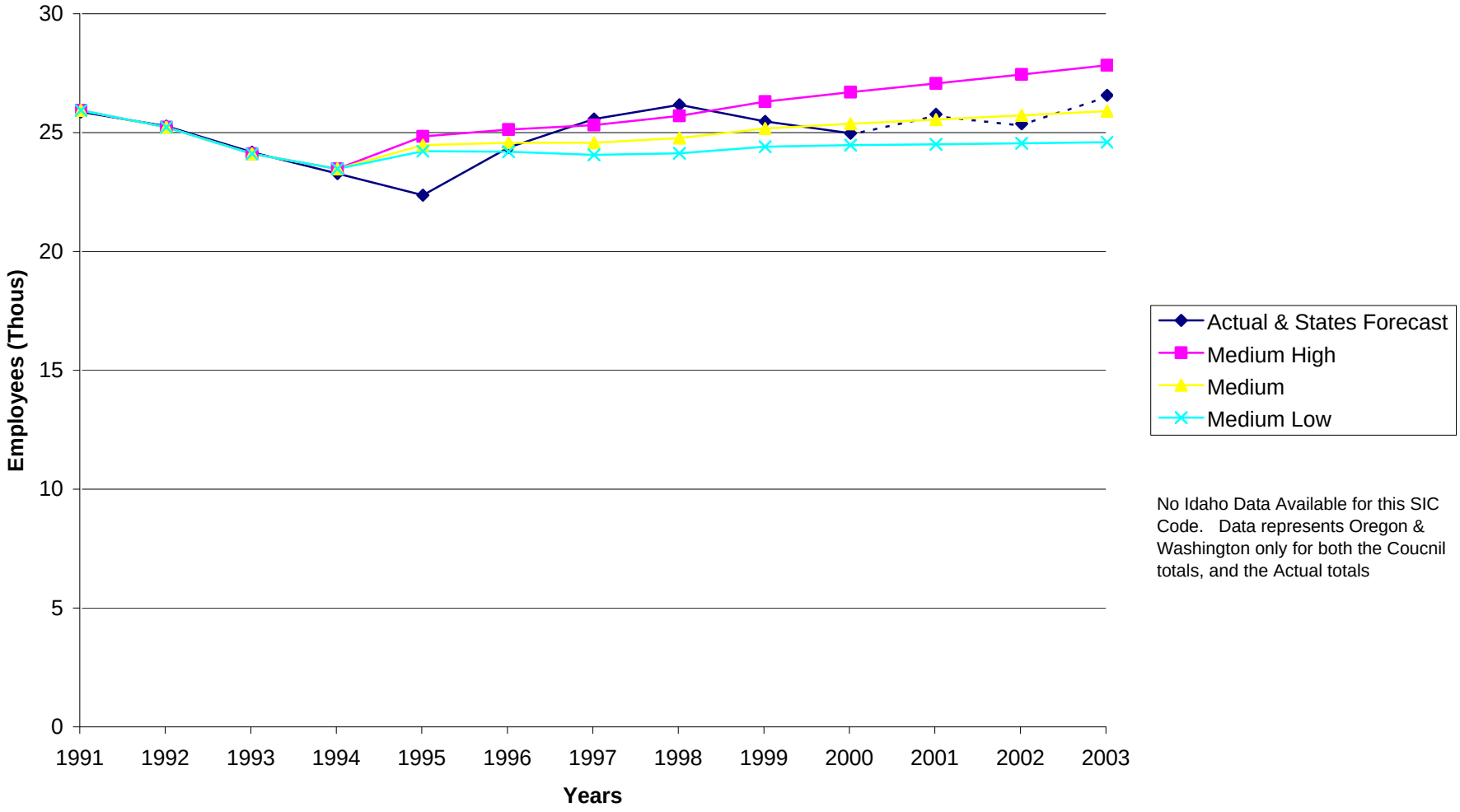

Electronics (35, 36, & 38)
Employment
Employees (Thous)
180
160
140
120
100
80
60
40
20
0
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Year
Actual & States Forecast
Medium High
Medium
Medium Low



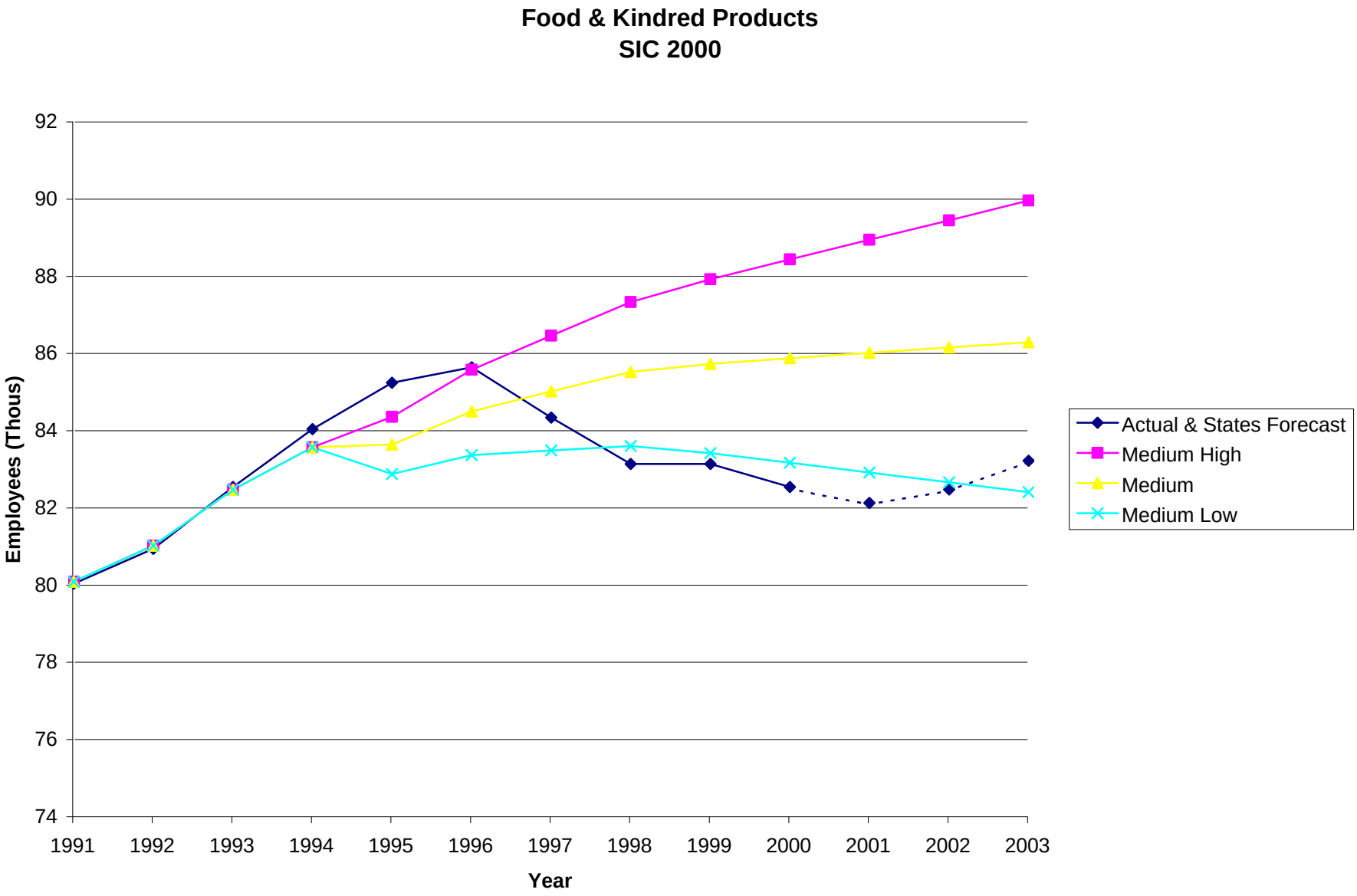
Short-term Forecast info from States indicates:
WA continues slow decline losing 1.2 by 2003
OR continues decline losing 4.1 by 2003
ID projects increase by 2003

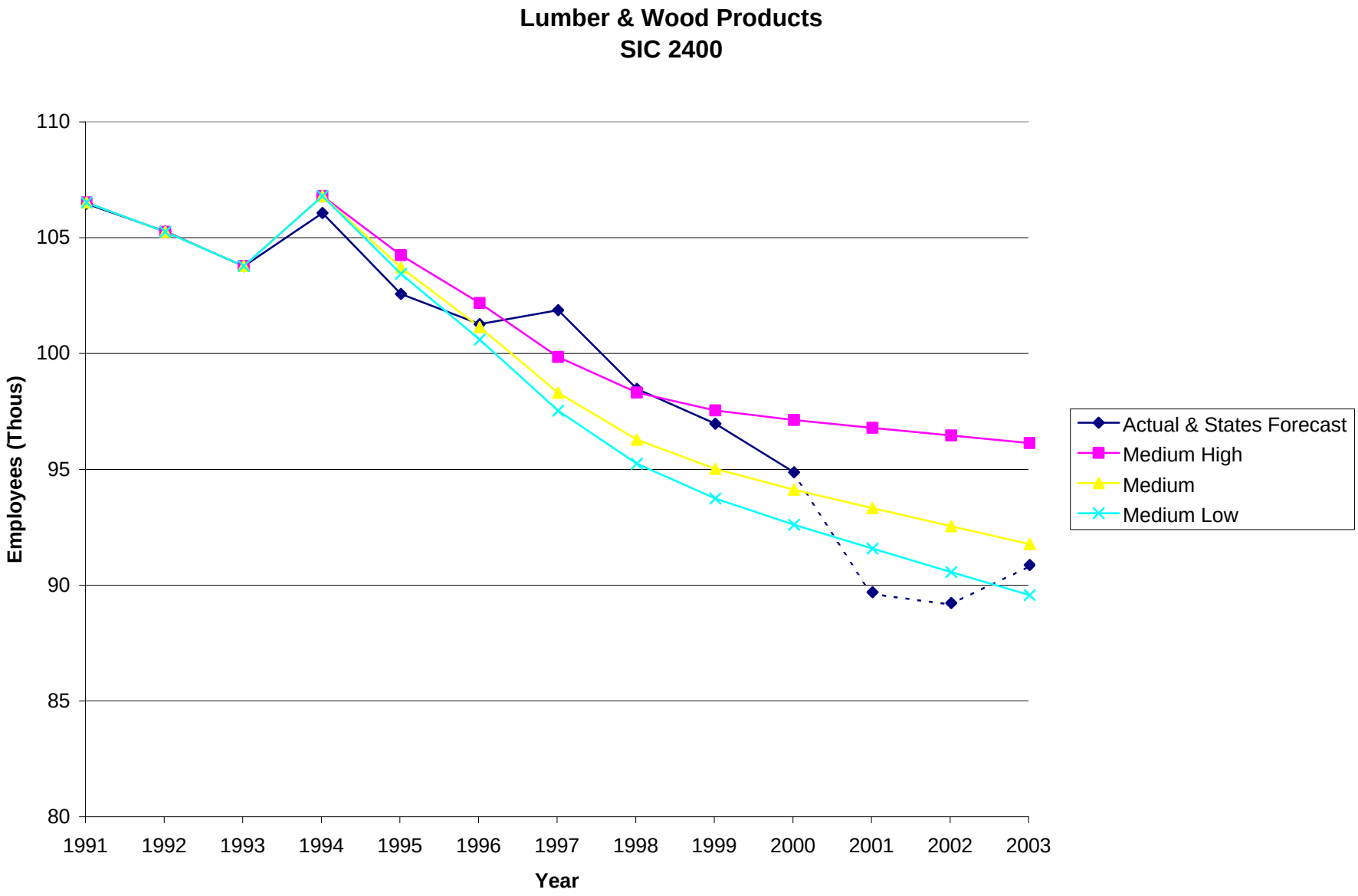
** Idaho Forecast data is based on forecasted changes in Manufacturing

Instruments & Related Products
SIC 3800
Washington & Oregon

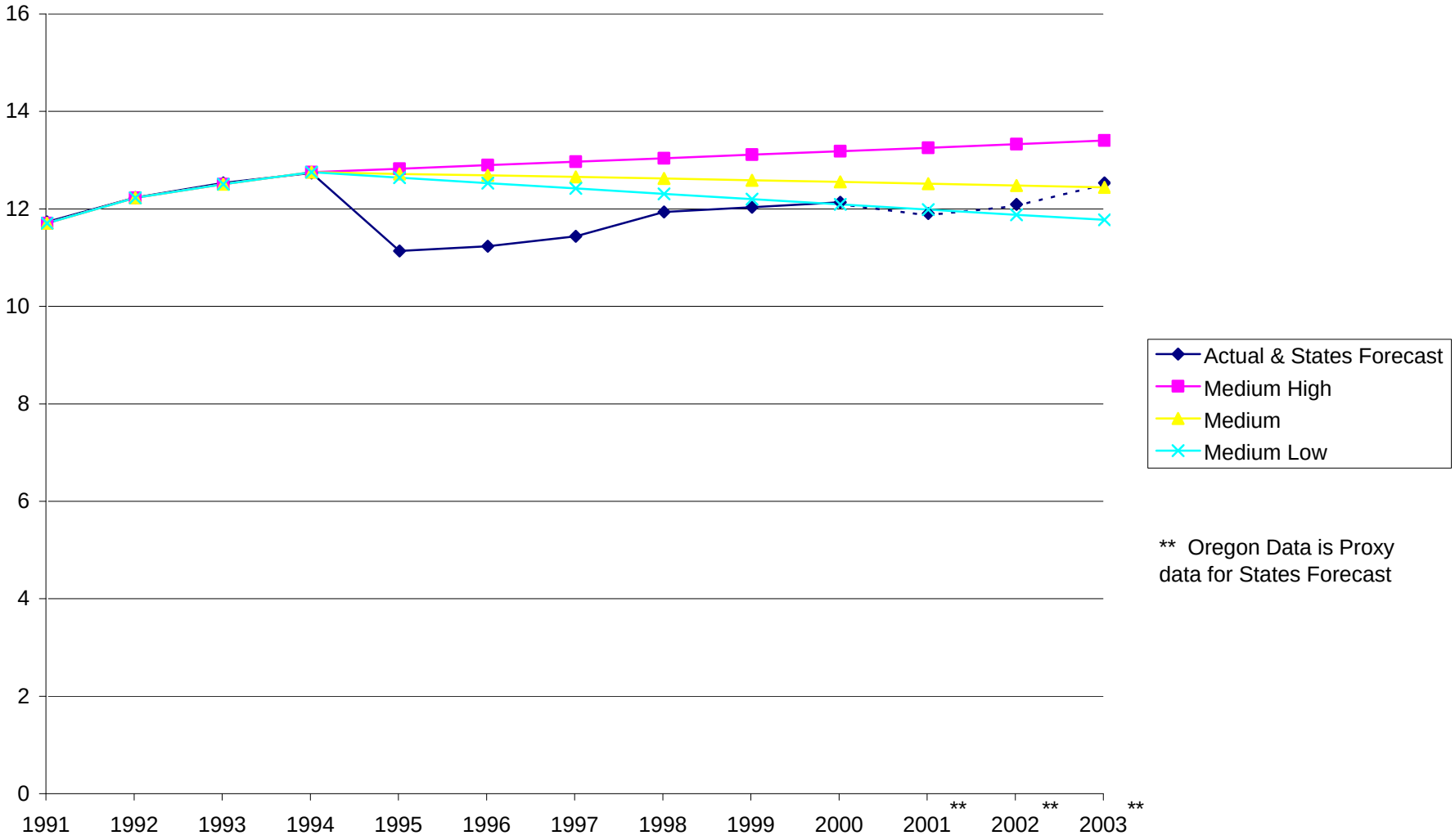


No Idaho Data Available for this SIC Code. Data represents Oregon & Washington only for both the Coucnil totals, and the Actual totals

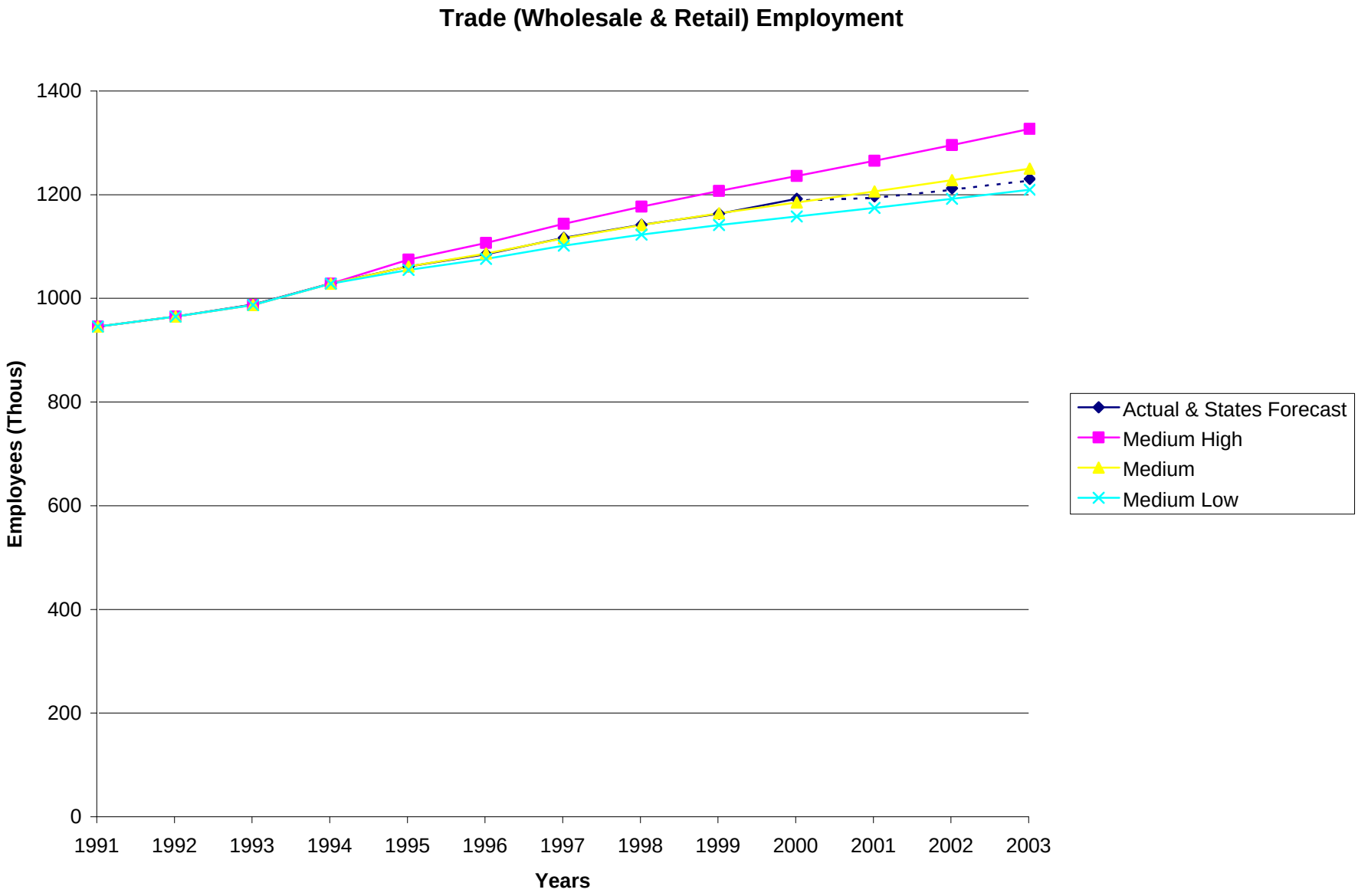

Food & Kindred Products
SIC 2000
Employees (Thous)
92
90
88
86
84
82
80
78
76
74
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Year
Actual & States Forecast
Medium High
Medium
Medium Low

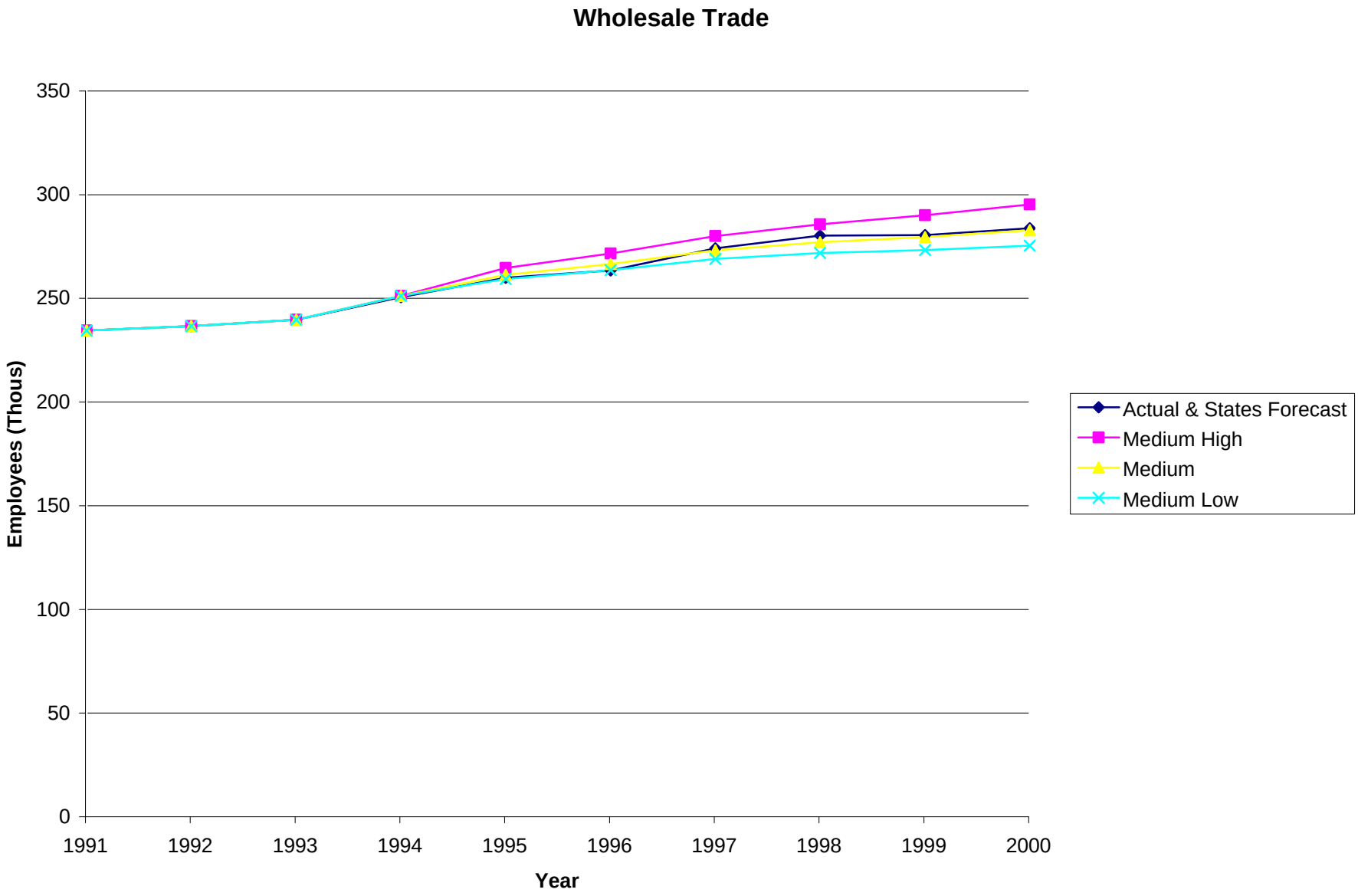

Lumber & Wood Products
SIC 2400
Employees (Thous)
110
105
100
95
90
85
80
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Year
Actual & States Forecast
Medium High
Medium
Medium Low

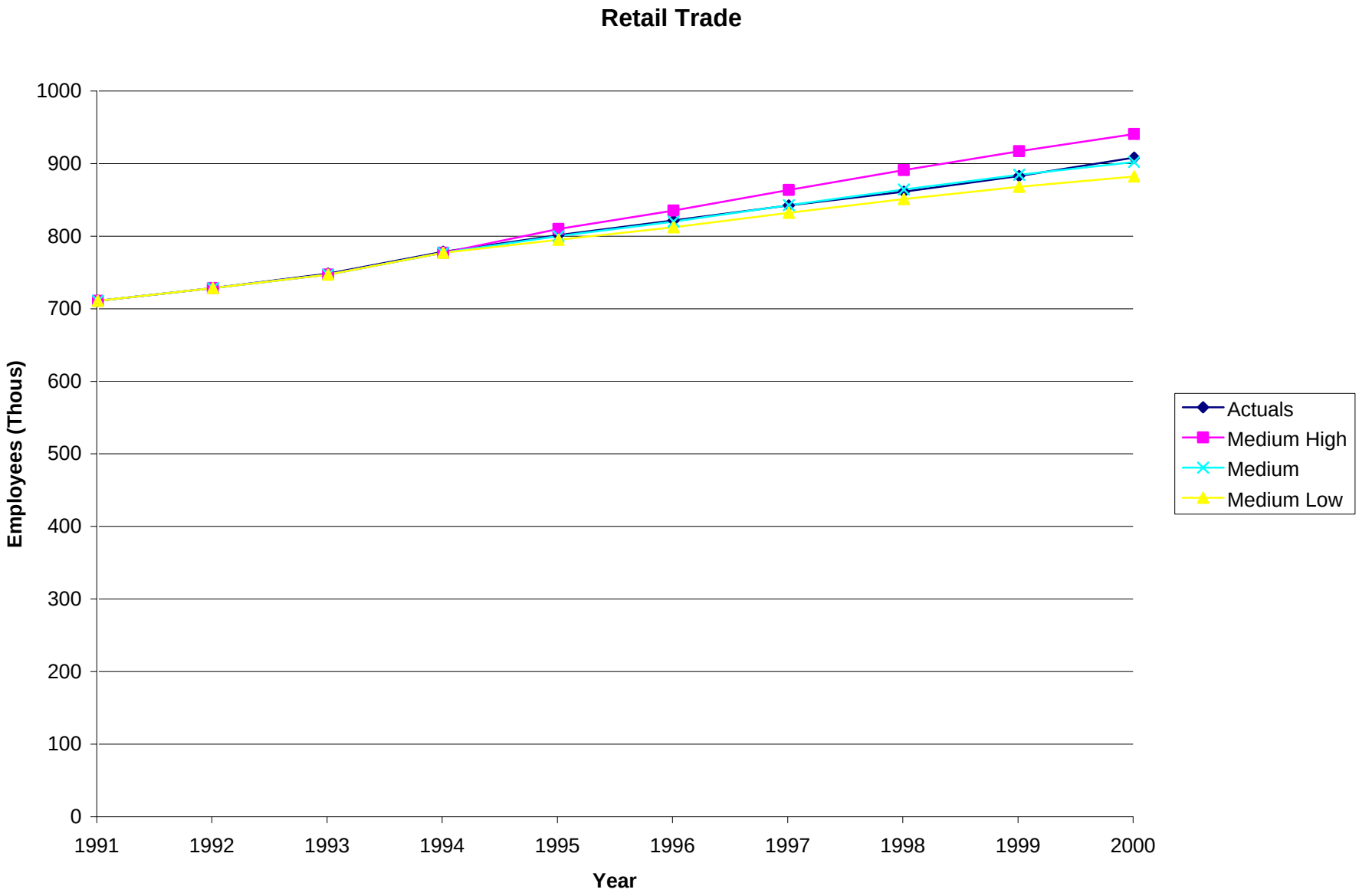
Chemicals & Allied Products
SIC 2800



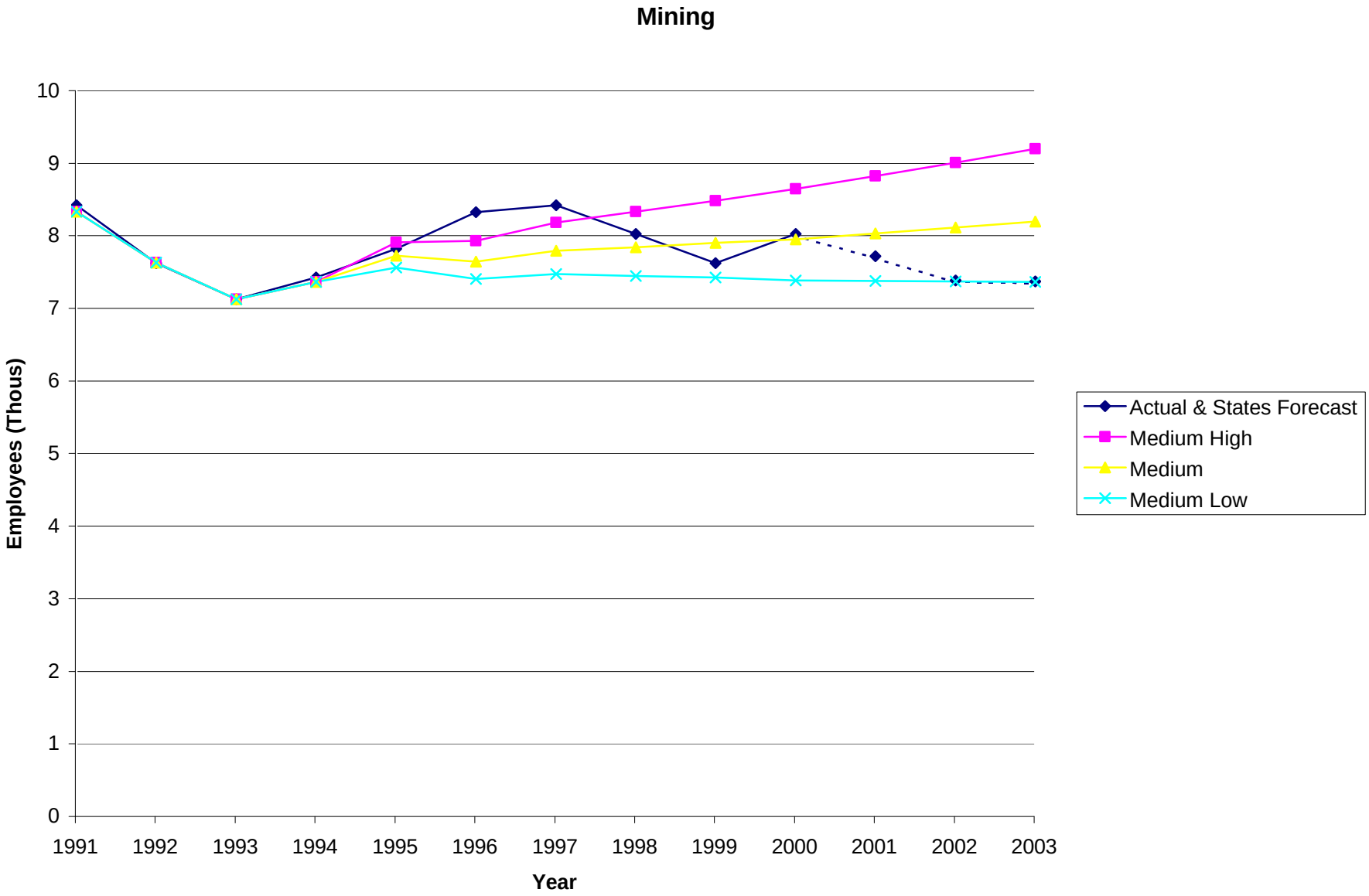
** Oregon Data is Proxy data for States Forecast


Trade (Wholesale & Retail) Employment
Employees (Thous)
1400
1200
1000
800
600
400
200
0
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Years
Actual & States Forecast
Medium High
Medium
Medium Low


Wholesale Trade
350
300
250
200
150
100
50
0
Employees (Thous)
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
Year
Actual & States Forecast
Medium High
Medium
Medium Low


Retail Trade
Employees (Thous)
1000
900
800
700
600
500
400
300
200
100
0
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
Year
Actuals
Medium High
Medium
Medium Low


Finance Insurance & Real Estate (FIRE)
Employees (Thous)
350
300
250
200
150
100
50
0
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Year
Actual & States Forecast
Medium High
Medium
Medium Low


Mining
Employees (Thous)
10
9
8
7
6
5
4
3
2
1
0
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Year
Actual & States Forecast
Medium High
Medium
Medium Low