GDS Associates, Inc.

Engineers and Consultants

OCS Comments, PacifiCorp 2011 IRP
September 7, 2011
Attachment 1

ROCKY MOUNTAIN POWER
2011 INTEGRATED RESOURCE PLAN
Docket No. 11-2035-01

Evaluation of Long-Term Load Forecast

Report to Office of Consumer Service's Staff

August 30, 2011

GDS Associates, Inc.
1850 Parkway Place
Suite 800
Marietta, GA 30067
770.425.8100
www.gdsassociates.com

1. Executive Summary

This report presents a review of PacifiCorp's ("Company") 2011 Integrated Resource Plan ("IRP"), Docket No. 11-2035-01. The review has been conducted by GDS Associates, Inc. ("GDS") and focuses primarily on the Company's load forecast. GDS is a multi-service engineering and consulting firm headquartered in Marietta, GA.

In the 2008 IRP (Docket: 09-2035-01), GDS provided a similar review of the Company's load forecast and produced a summary report that was sponsored by the Office of Consumer Services ("OCS"). In the Utah Public Service Commission's ("PSC") Ruling and Order in that Docket, the PSC ordered the Company to consider all of GDS' recommendations and to comply with two of the recommendations. The PSC ordered PacifiCorp to begin producing a stand-alone load forecast report and to develop range forecasts that are to be used as part of the resource needs assessment. The Company has generally met those requirements in the 2011 IRP.

Since the Company did not make major changes to its forecasting processes or methodologies from the prior IRP, GDS focused on a handful of issues to review and comment on. Generally, GDS concludes that PacifiCorp continues to use forecasting methodologies that are standard in the industry. The key issues that GDS has investigated for this report are summarized in the list below.

- GDS reviewed the economic forecast obtained from IHS Global Insights. In particular, we focused on their projections of the next few years as the economy is expected to recover. As part of that review, we compared their forecasts to two other economic forecast vendors for the state of Utah (Woods & Poole Economics, Inc. and Moody's).
- As recommended in the 2008 IRP, GDS continues to maintain that an economic variable that includes commercial output would be preferable to using employment as a driver for commercial and industrial sales econometric models. There is a section of the report that focuses on this issue once again.
- In the 2011 load forecast, it became apparent that line losses for Utah and Oregon in particular are showing strong trends over the last seven years (Utah is trending down and Oregon is trending up). GDS summarizes these trends and feels that the Company should investigate the source(s) of such trends and revise their line loss projections as necessary.
- GDS performed a review of the new range forecasts prepared by the Company. The Company prepared high and low economic scenarios and a 1-in-10 year weather scenario. In general, GDS expected to see a greater range of uncertainty evident from these forecasts than has been produced by the Company.

The review of the major topics above led to GDS making six recommendations. Those recommendations are briefly summarized below.

1. PacifiCorp should obtain and examine economic forecasts from one or two vendors in addition to IHS Global Insights.
2. GDS continues to contend that use of a measure of commercial and industrial output (e.g., retail sales or gross regional product) would be a better theoretical driver in the commercial and industrial sales models.
3. We recommend that PacifiCorp initiate an investigation into line losses for Utah and Oregon, specifically, and for any other jurisdictions that exhibiting a strong trend over the last seven years and adjust their line loss projections accordingly.
4. GDS recommends the Company review economic range forecasts prepared by other utilities and produce ranges that have greater uncertainty built into them as the forecast horizon expands.
5. GDS recommends the Company move from a 1-in-10 year weather scenario to a 1-in-20 year weather scenario to produce an even more extreme weather case.

2. Review of GDS Recommendations in 2008 IRP

The last IRP filed by the Company was in UT Docket No. 09-2035-01, and is called the "2008 IRP". GDS conducted a review of the Company's load forecasting procedures, methodologies, and results in the 2008 IRP. The GDS report was sponsored by the OCS. The Utah PSC, on page 39 of its Report & Order to Docket No. 09-2035-01 (dated April 1, 2010), made the following directions and recommendations regarding GDS' report:

> We recognize the GDS report was not available for consideration in the formation of the 2008 IRP and therefore direct the Company and interested parties to examine and consider all of the suggestions contained in the report. At a minimum, the Company is directed to provide a range of load forecasts that comport with industry standards as recommended by GDS. Further, as recommended by GDS, we direct the Company to provide the Commission with a comprehensive stand-alone load forecast report when the forecast is updated. The GDS suggestions could reduce last minute revisions due to load forecast changes and thereby assist in the timely completion of future IRPS.

Given the directive of the PSC, this section will briefly review the recommendations made by GDS in the 2008 IRP and provide a synopsis of the Company's response to those recommendations.

2.1 Develop Range Forecasts

GDS Recommendation

PacifiCorp should produce a more robust set of range or scenario forecasts for use in the IRP and other planning and budgetary functions. At a minimum, optimistic and pessimistic economic scenarios and extreme and mild weather scenarios should be prepared and presented as part of the load forecast. These ranges should be modeled using regression and/or Monte Carlo simulation techniques. Furthermore, these scenarios should be considered as part of the IRP process.

Status in 2011 IRP

Page 13, of Appendix A, of the 2011 IRP introduces the range forecasts that have been developed by the Company in response to the PSC order in 09-2035-01. The forecasts were used during the System Optimizer stage of portfolio analysis, as described in Chapter 8 of the 2011 IRP report. This was one of the minimum requirements as directed by the PSC.

2.2 Economic Variables in Commercial Models

GDS Recommendation

PacifiCorp should consider changing the economic driver variables in the commercial and industrial energy sales models. Currently, they use number of employees to drive electricity consumption for both classifications. GDS would suggest use of a theoretically better indicator of electricity consumption such as industrial output (gross state product).

Status in 2011 IRP

The Company continues to use employment as economic drivers for commercial and industrial sales models. However, this was a recommendation the PSC did not specifically direct PacifiCorp to adopt.

2.3 Stand Alone Load Forecast Report

GDS Recommendation

The Company should prepare a comprehensive stand-alone Load Forecast report every time the forecast is updated. The report should include at a minimum historical and projected power requirements[1], a discussion of methodologies employed and steps completed to generate the load forecast, presentation of range or scenario forecasts, and a description and display of all key inputs and assumptions.

Status in 2011 IRP

A Load Forecast Report is included in the 2011 IRP as Appendix A.

2.4 Hourly Forecasting Methodology

GDS Recommendation

With regard to the hourly forecast methodology, GDS recommends PacifiCorp consider several technical points. These recommendations are detailed in Appendix A of this report and summarized below.

a. *Investigate deviation from heating and cooling degree days instead of diversity factor in selecting an assignment weather year.*

b. *Use a weighted average instead of simple average absolute deviation statistic as the selection criteria for an assignment weather year.*

c. *Investigate use of a calibration methodology that does not put as much of the adjustment into the lowest loads of the year but rather spreads the adjustment more evenly to intermediate and base loads. If the current methodology is kept, be mindful of producing unreasonably high or low minimum loads that may skew power supply resource planning.*

Status in 2011 IRP

The company continues to employ the same methodology as in the 2008 IRP. However, this was a recommendation the PSC did not specifically direct PacifiCorp to adopt.

[1] In the context of this report, power requirements are defined as historical and projected number of customers, energy sales, and peak demand, by jurisdiction and customer classification.

3. Issues in 2011 IRP

This section of the report presents several issues that GDS investigated in its further review of the Company's load forecasting procedures and methodologies. In general, the Company has not changed forecasting methodologies from the 2008 IRP, so GDS' review focused less on methodology this time and more on specific issues that may impact planning. A more detailed review of the range forecasts was conducted, however, since they were added to the load forecasting process in the 2011 IRP. As concluded in GDS' 2008 IRP review, PacifiCorp generally uses methods and procedures that meet or exceed industry standards.

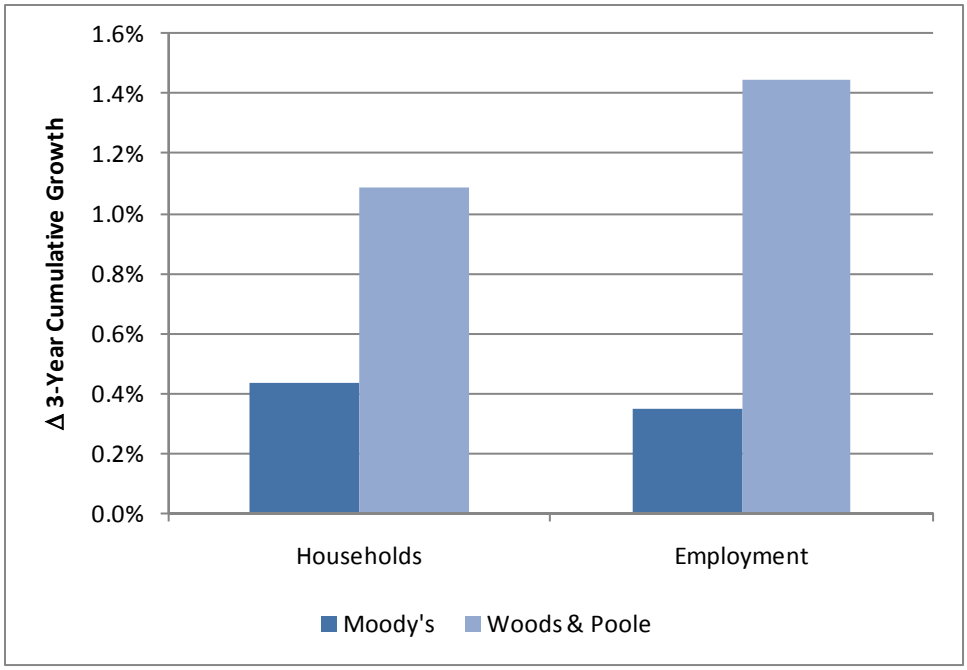
3.1 Economic Projections

PacifiCorp obtains historical and projected economic data from IHS Global Insights. The economic data used in the current forecast was released in June 2010. The economic projections reflect expectations that the economic recovery will happen in 2011 and 2012.[2]

The rebound in employment in 2011 and 2012 has a significant effect on the load forecast for the commercial and industrial sectors. GDS obtained economic projections for the state of Utah from two other economic forecast providers: Woods & Poole Economics, Inc. and Moody's Analytics. At least in this instance, IHS Global Insights tends to be the most optimistic in terms of sustained growth through 2012. Figure 3.1 shows the extent to which Global Insight's three-year cumulative growth rate is higher than the other two economic forecast providers for the state of Utah.

[2] Although the Utah economy did contract during the national recession, it did outperform most of the states in the union. As a result, the load forecast for Utah remained more optimistic than forecasts for other states.

Figure 3.1 –Extent to Which Global Insights Utah Cumulative Economic Forecasts (2009-2012) Exceed Other Economic Forecast Providers



The Woods & Poole forecast is copyrighted 2010 and is therefore of a vintage comparable to PacifiCorp's economic forecast. The Moody's forecast, however, was purchased in April 2011, and Moody's tends to update their forecasts as often as monthly. Therefore, the Moody's projections are likely to take into consideration more recent economic factors.

Given the high level of uncertainty associated with economic projections to begin with, GDS would recommend PacifiCorp begin using two or three different providers of economic projections as part of their load forecasting process. A first step in the forecast would be to compare the forecasts and make a rational selection for one of the projections or use a projection that is a blend of the several sources. Given the nature of compounding of economic data, small differences in growth rates can have an impact on the long-term load forecast. Moody's and Woods & Poole, used in the comparisons above, are both nationally known economic forecasters. Other possible sources for forecasts include local universities, state governments, or local economists.

3.2 Employment as Variable in C/I Sales Models

This issue was discussed by GDS in its 2008 IRP review report. Currently, the Company uses non-manufacturing employment as the economic driver for commercial usage and manufacturing employment as the economic driver for industrial sales.[3]

[3] For the industrial class, only a portion of the sales are modeled using econometric techniques. The remaining loads are projected on an individual customer basis using expertise and input from Customer and Community Managers ("CCM"). The discussion in section 3.2 of this report refers only to the econometric models.

GDS still contends that a non-employment economic driver for modeling commercial and industrial sales is more philosophically fitting than using employment. Small and large manufacturing companies can increase output using electric machinery, computers, and robots without increasing employment (in fact, maybe even decreasing its labor force in the process). Data warehouses and the increase in computing power and storage needs lead to increased commercial electricity consumption. During the economic recovery, it is highly likely that many businesses will increase output prior to hiring new employees. Some portion of this increased output will be the result of use of electricity. Therefore, the current models would not pick up this recovery quite as quickly if this "jobless recovery" occurs. As an example, the Energy Information Administration's Annual Energy Outlook 2010 expects an increase in output per employee, or labor productivity: "To achieve the reference case's long-run 2.4 percent economic growth, there is an anticipated steady growth in labor productivity. The improvement in labor productivity reflects the positive effects of a growing capital stock as well as technological change over time".[4] Because the Company's models are used to project average use per consumer, GDS recommends using a variable that is also on a "per unit" basis. We recommend the Company try to use retail sales per employee or total income per employee for the commercial sector and gross regional product per employee for the industrial sector.

It is not expected that the long-term load forecast would be impacted significantly by this change. The short-term load forecast, however, could change somewhat given the concept of employment lagging recovery in commercial activity in the next couple of years as the national economy attempts to recover.

3.3 Line Losses

In its review of the 2008 IRP, GDS supported the use of a 5-year moving average methodology for projected line losses. At the time, there was less evidence of a trend in line losses in Utah and Oregon, the two jurisdictions that drive consumption for PacifiCorp. With extra history now available, it is apparent that Utah line losses are currently trending down and Oregon line losses are currently trending up (see figures 3.3 and 3.4). Specifically, GDS stated "[a five-year average] is sound in the absence of any specific knowledge of operational system changes that might impact losses". We should have further clarified that this is the case if the historical series is stable and does not exhibit a trend, but rather exhibits year-to-year variations that cannot be explained. In a case where a trend exists, the forecaster should investigate the trend and try to identify source(s) for the trend to determine if the trend is likely to continue for any time during the forecast horizon. For example, it could be the high growth in Utah's industrial sector, which tends to have losses lower than system averages, might be causing a declining loss factor. If industrial sales are expected to grow at high rates, then, it would make more sense to trend losses down further instead of using a five-year moving average.

[4] *Assumptions to the Annual Energy Outlook 2010*. U.S. Energy Information Administration. Report #: DOE/EIA-0554(2010). Released April 9, 2010.

Figure 3.2 – Historical Utah Line Losses

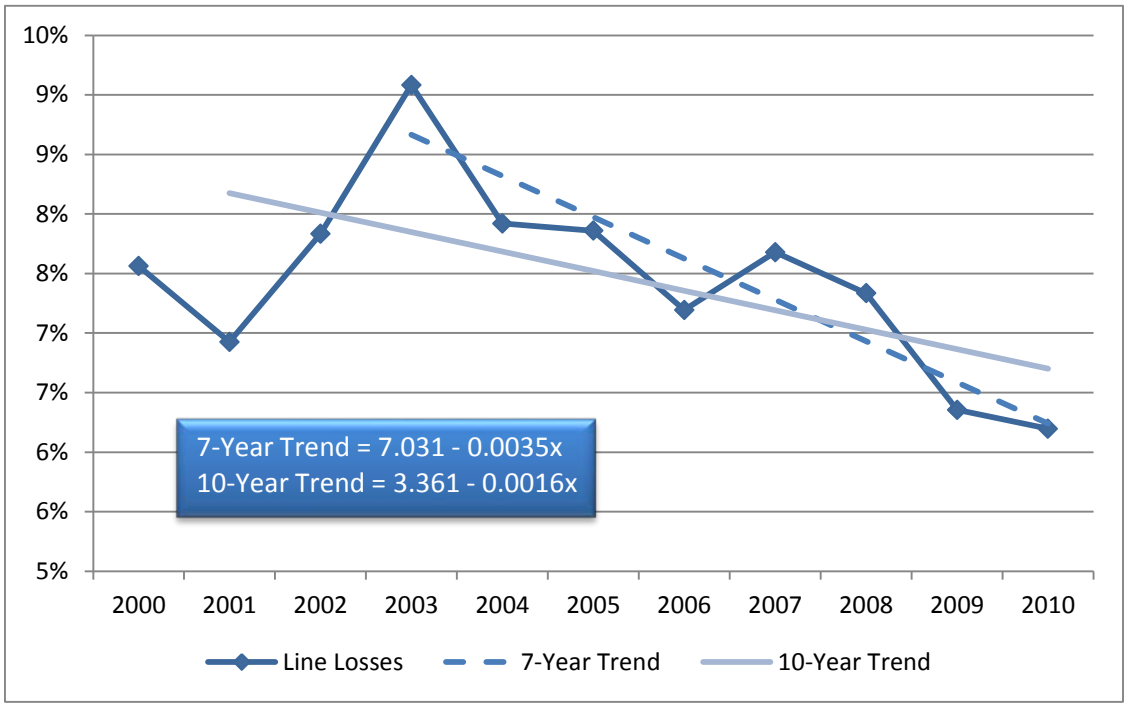
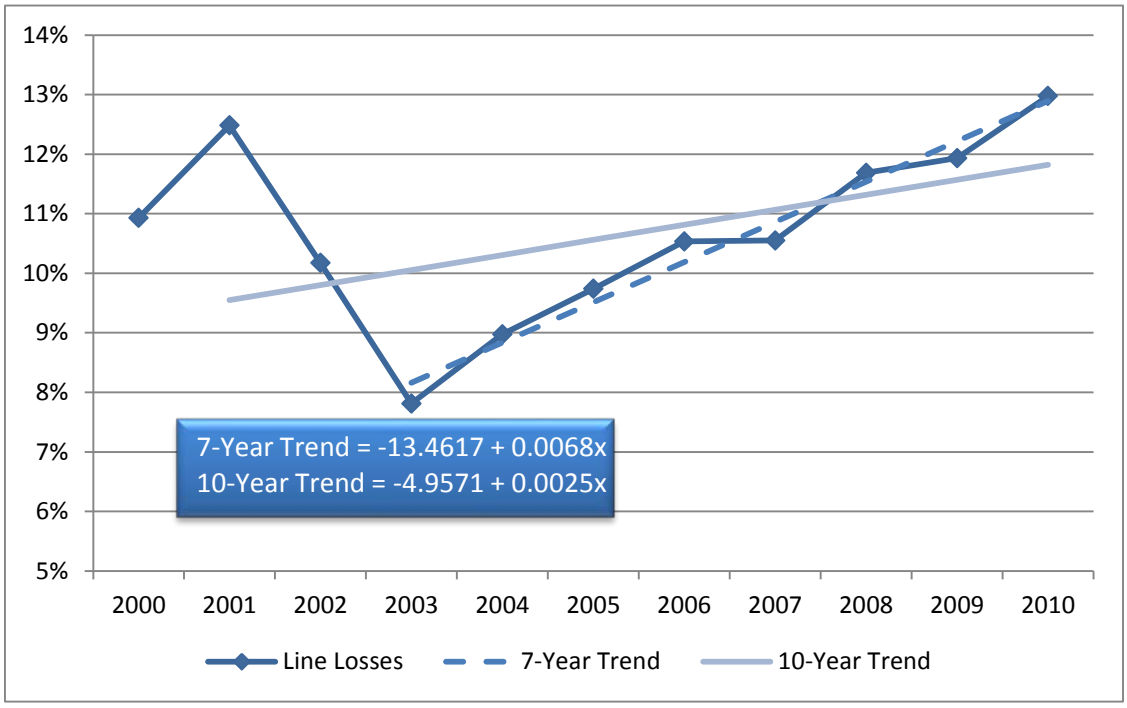


Figure 3.3 – Historical Oregon Line Losses

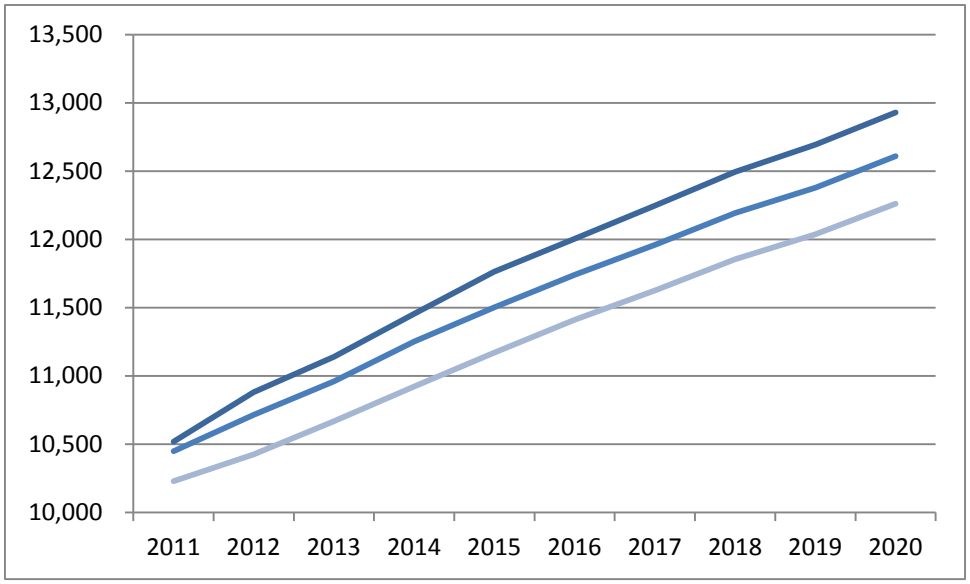


A moving average is useful because it helps smooth year-to-year variations in the historical data that are unexplainable. The longer the historical period used in the average, the less any one year has an impact on the forecast. However, a longer-period moving average is also less responsive to changes in underlying trends. GDS recommends that, given that there are currently trends in line losses for the two largest jurisdictions, PacifiCorp should investigate the causes for these trends and take them into account in projecting line losses. A sophisticated line loss forecast might use a trend or a shorter moving average in the short-term and then blend into a longer-term average for the longer forecast horizon.

3.4 Range Forecasts

In the 2011 IRP, PacifiCorp produced a series of range forecasts in compliance with the Utah PSC's directive in 09-2035-01. The company produced high and low economic forecasts for energy and demand and an extreme weather peak demand forecast. Also as directed, the Company used the high and low cases in its portfolio planning, as described in Chapter 8 (Cases 25-27 represent range forecast scenarios in the System Optimizer analyses).

Figure 3.4 – Economic Range Demand Forecasts



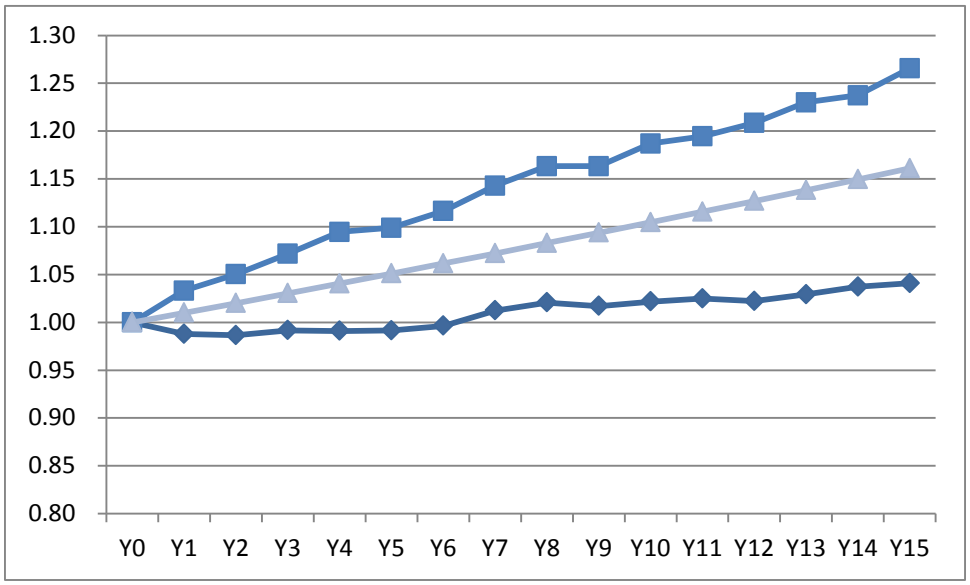
GDS wants to acknowledge the Company's efforts to incorporate these range forecasts into its planning and forecasting process. However, the range between the high and low forecasts, especially 20 years out, is lower than GDS would expect. Economic variables compound over time and therefore forecast errors will tend to compound over time. As a result, it is understandable that the forecaster would be less certain about a projection twenty years out than a projection two years out. Therefore, GDS would expect to see high and low economic scenarios that demonstrate increasing uncertainty over time. As shown in the table below, the percent difference between the base case and the scenario cases tend to remain constant over time.

Table 3.1 – Summary of Economic Range Demand Forecasts

Year	Base Case	High Case	% From Base	Low Case	% From Base
2011	10,449	10,519	0.7%	10,229	-2.1%
2012	10,716	10,881	1.5%	10,426	-2.7%
2013	10,960	11,140	1.6%	10,667	-2.7%
2014	11,253	11,455	1.8%	10,922	-2.9%
2015	11,501	11,763	2.3%	11,172	-2.9%
2016	11,741	12,003	2.2%	11,410	-2.8%
2017	11,960	12,247	2.4%	11,626	-2.8%
2018	12,195	12,494	2.5%	11,856	-2.8%
2019	12,378	12,692	2.5%	12,036	-2.8%
2020	12,608	12,929	2.5%	12,260	-2.8%

To demonstrate the compounding effect, GDS conducted a simple simulation. We began with a series that grows at 1.0% per year for 15 years. We then ran 100 simulation runs in which we allowed the growth rate from year-to-year to vary randomly by ±2.5%. We then used the 5th and 95th percentile cases in each year to examine the range of possible outcomes. The result is a range of -5.7% to 4.6% five years out, -7.5% to 7.5% ten years out, and -10.3% to 9.0% twenty years out. The base, 5th and 95th percentiles from the simple simulation are shown graphically below.

Figure 3.5 – Simulation Results of Compounding of Uncertainty



GDS has also collected a reference of several other utilities with publically available IRP's that have range forecasts (GDS did not prepare these forecasts). These references are provided to demonstrate the type of economic ranges that GDS would expect to see from PacifiCorp. [5]

References to Range Forecasts Prepared by Other Utilities (web links were active as of August 23, 2011)

- Arizona Public Service Company
  - Resource Plan Report, January 29, 2009, page 158
  - http://www.aps.com/_files/various/ResourceAlt/APS_2009_Resource_Plan_Report_sFINAL_012909.pdf
- Avista
  - 2009 Integrated Resource Plan, page 2-15
  - http://www.utc.wa.gov/
  - Docket No: UE-081613
- Cheyenne Light, Fuel & Power and Black Hills Power
  - 2007 Integrated Resource Plan, pages 13 and 15
  - http://puc.sd.gov/commission/dockets/electric/2009/el09-018/tietjen2.pdf
- Delmarva Power & Light Company
  - 2010 Integrated Resource Plan, Appendix 3
  - http://depsc.delaware.gov/dpl2010irp.shtml
- Entergy New Orleans, Inc.
  - 2009 Integrated Resource Plan, page 3
  - http://www.entergy-neworleans.com/content/irp/ENO_IRP_100106.pdf
- Idaho Power Company
  - 2011 Integrated Resource Plan, Appendix A, pages 14-15
  - http://www.puc.idaho.gov/internet/cases/elec/IPC/IPCE1111/20110630APPENDIX%20A.PDF
- Kaua'i Island Utility Cooperative
  - 2008 Integrated Resource Plan, Appendix B
  - http://www.kiuc.coop/
- Montana-Dakota Utilities Company
  - 2011 Integrate Resource Plan, pages 10-13
  - http://psc.mt.gov/Docs/ElectronicDocuments/pdfFiles/N2011-8-70_IN_20110815_IRP1.pdf

[5] GDS does not attest to the validity of the methodologies used to create any of the referenced scenario forecasts. Rather, they are provided as an example of the increasing nature of uncertainty as the forecast progresses.

GDS would also expect to see higher uncertainty for extreme weather conditions. The 1-in-10 scenario produces a high forecast that is approximately 3.5% higher than the base case in 2020. It is not uncommon to see weather impacts that are as high as 12-15%. That, of course, depends on system characteristics such as appliance stock and customer make-up of the system (proportion of loads that are weather sensitive). GDS would recommend generating a 1-in-20 year extreme weather case in order to better understand truly extreme weather events.

4. Recommendations

Generally, the Company uses forecasting methodologies that meet or exceed industry standards and has produced a load forecast for the 2011 IRP that is reasonable. However, based upon the review in Section 3 above, GDS makes several recommendations for future IRP development.

1. PacifiCorp should obtain and examine economic forecasts from one or two vendors in addition to IHS Global Insights. Multiple economic forecasts will help the Company recognize if a particular economic projection is too optimistic or pessimistic relative to its peers and should help provide a consensus forecast.
2. As recommended in the 2008 IRP, GDS continues to contend that use of a measure of commercial and industrial output (e.g., retail sales or gross regional product) would be a better theoretical driver in the commercial and industrial sales models. Even if these variables have slightly worse model fit than using employment, they should still have acceptable statistical fit. If not, then continued use of employment would be appropriate.
3. We recommend that PacifiCorp initiate an investigation into line losses for Utah and Oregon, specifically, and for any other jurisdictions that exhibit a strong trend over the last seven years. The Company should try to identify the cause of the trends and develop line loss projections based on that knowledge. The projections may include trends or shorter moving-averages in the short term.
4. GDS recommends the Company review economic range forecasts prepared by other utilities and produce ranges that have greater uncertainty built into them as the forecast horizon expands. Such a range would demonstrate the Company's increasing uncertainty about load into the future, which will be a more useful tool in analyzing and stress-testing potential portfolios in the System Optimizer and PaR modeling.
5. GDS recommends the Company move from a 1-in-10 year weather scenario to a 1-in-20 year weather scenario to produce an even more extreme weather case. As with producing a wider margin of uncertainty in the economic ranges, this will be a useful projection for portfolio analysis. Given that the forecast is a 20-year outlook, it makes sense to test a 1-in-20 year weather event.