ERCOT

Cost Comparison Study

Final Report

December 2004

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1. Overview

1.1 Introduction

The Electric Reliability Council of Texas, Inc. (ERCOT) is the organization that administers the state's power grid. ERCOT is one of ten regional reliability councils in North America and is one of the largest control areas in the United States. ERCOT serves approximately 85 percent of the state's electric load and 75 percent of the geographic land area in Texas.

Texas restructured its $20 billion electricity industry on January 1, 2002. Now, both individuals and corporations in most cities in Texas are now able to choose their power supplier. ERCOT oversees the transactions resulting from restructuring, while maintaining the overall reliability of the electric grid.

The primary regulatory authority for ERCOT is the Public Utility Commission of Texas. ERCOT's members include retail consumers, investor and municipally owned electric utilities, rural electric co-ops, river authorities, independent generators, power marketers, and retail electric providers.

1.2 Approach and Methodology

KEMA performed a Cost Comparison Study (Study) for ERCOT with the purpose of comparing the services provided by and the publically available costs of the existing North American Regional Transmission Organizations and Independent System Operators. For the purposes of the study both types of organizations will be referred to as ISO's.

The objectives of the Study are:

- Compile information regarding the costs and activities of ERCOT and other ISO organizations.
- Analyze the compiled information to compare and benchmark ERCOT and its significant costs.
- Prepare and provide ERCOT with a ISO Cost Comparison Study that documents:
    - What are ERCOT's costs
    - How ERCOT compares with the other ISO's
    - Factors that impact cost

KEMA used the following methodology to perform the study:

- Compile information regarding costs and activities
- Develop an estimated average among the ISO's examined based exclusively on publically available information
- Analyze compiled information considering:
    - Available quantitative cost data
    - Functional differences

  - ISO characteristics (i.e. geographic scope)
- Prepare findings and document observations
  - Identify common metrics to normalize results
  - Identify drivers that impact costs

This report is organized into the following major sections:

- Section 1 - ***Introduction*** - provides a description of the cost comparison study methodology and overall findings.

- Section 2 - ***ISO Cost Comparisons*** – identifies the key functional and scale differences for the ISO's and presents a qualitatively comparison of ERCOT with the other ISO's using the following major groupings:

  - Financial Data
  - Regional Market Attributes
  - Transmission Statistics
  - Operations Data

  The ISO data is from public sources, supplemented by additional information about ERCOT provided by ERCOT and KEMA's internal knowledge base. Please note that the 2004 budget data may not be reflective of the latest available versions for some of the ISO's public budgets. KEMA identified common metrics to help normalize results were possible since there is no uniform market design and there are differences among the ISO's structure, functionality, and footprint.

- Section 3 - ***Cost Drivers*** - will attempt to quantify the impacts of significant and relevant cost drivers for ERCOT. The following functional ERCOT groupings were used for the analysis:

  - Power System Operations
  - Market Operations
  - Market Settlements
  - Market Monitoring
  - Information Technology
  - Customer Services
  - Legal and Regulatory
  - Corporate and Executive
  - Capital Expenditures and Debt

  The ERCOT cost drivers were compared to an estimated average for the ISO's examined. KEMA calculated the estimated average by utilizing various sources of data including KEMA's internal knowledge base. Please note that for each functional grouping, since data was not available for all ISO's, the ISO average was calculated using public aggregate ISO budget data and estimated empirical values.

- Section 4 - ***Efficiency of Costs Dedicated to Reliability Measures*** - provides a focused review and comparison of ERCOT's operating costs related to their reliability functions. The basic premise for this comparison is to compare resources and operating costs related to each organization's reliability functions against a common set of reliability and power systems related measures.

- Section 5 - ***Summary*** - provides an overall summary on how ERCOT compares to the other ISO's and ERCOT's key cost drivers which either increase or decrease the costs.

1.3 Sources of Data

Sources of data were based on 2004 budgets, 2003 Actual, and the tariffs in effect as appropriate. The Study relied on ISO information from public sources, supplemented by additional ERCOT information provided by ERCOT and KEMA's internal knowledge base. The public sources of ISO information included FERC Form 1 reports, other regulatory filings, annual reports and information on websites. Please note that some of the statistical data and some of the budget data may not be reflective of the latest publically available versions for some of the ISO's. The focus should be on the order of magnitude and not on the exact value. For the purpose of the study KEMA has made the identity of the other ISO's anonymous using generic labels (i.e. ISO-A, ISO-B, etc.) and only identified ERCOT in the study.

KEMA utilized a methodology in deriving Benchmark values for the Study that was used for the comparisons in sections 3 and 4 of this report. This is a typical technique used in Benchmarking, where the Benchmark values are derived using a factor that provides correlation to the expected values. KEMA's base assumption is that there is an exact correlation between ERCOT's aggregate annual operating costs and associated detailed functional budgets to the other ISO aggregate annual operating costs and associated detailed functional budgets. This implies the other ISO's in this report have the same allocation at the various identified functional groupings for their detailed budgets, as ERCOT does for its budget. This assumption has not been verified by ERCOT or KEMA and may or may not be true for the other ISO's included in this report.

The reader should understand that there is no uniform system of accounts or account definitions common to the ISO's. Although FERC Form 1's and annual reports were used as a source of much of the data presented here, the Form 1's appear to have only limited applicability to ISO's. Further, in performing this work it is apparent that because there are no standard definitions, the same term can be used by the ISO with two or more meanings intended. Therefore the reader should take great care to draw inferences from the data. This Study also assumes the reader is knowledgeable about the North American electric power industry, including FERC's Order 2000 and the development of Regional Transmission Organizations and Independent System Operators.

1.4 Overall Findings

ERCOT's annual operating costs budgeted for 2004 are about $90M (not including capital expenditures and debt service) and are lower than the estimated average costs among the ISO's examined. ERCOT's costs are lower than estimated average in most categories with the exception of those that are impacted by ERCOT's unique roles as operator of retail markets and wholesale metering services – which are not performed by the other ISO's. When the different cost drivers are analyzed and the cost differences by budget category are identified, the only other categories where ERCOT's costs are higher than estimated average are those associated with market evolution where the ERCOT stakeholder market change process apparently drives somewhat higher costs.

ERCOT has average productivity and efficiency based on several reliability measures including, peak load, transmission miles, daily schedules, and network buses. ERCOT is less than average based on generators served. KEMA recognizes that there may be better productivity and efficiency metrics to measure and compare reliability but the lack of readily available data for the other ISO's impedes that exercise. In the future ERCOT might be more interested in measuring their efficiency in reliability functions with respect to planned vs. unplanned outages, frequency excursions beyond normal operating guidelines, number of reported disturbances to NERC and DOE per year, number of Emergency Electric Curtailment Plan (EECP) events per year, and others.

This report makes no attempt to value the costs or to identify areas where costs could be improved. It does, however, lead to a conclusion that overall and within each category ERCOT costs are lower than the estimated average, except where they can be attributed to ERCOT's role in retail market operations.

As explained in Section 1.3 above, the estimated average ISO cost for each function is derived exclusively from publically available information and assumes that the functional allocation factors for other ISOs are the same as the functional allocation factors for ERCOT.

The summary chart below shows ERCOT costs relative to the estimated average, in an overall sense.

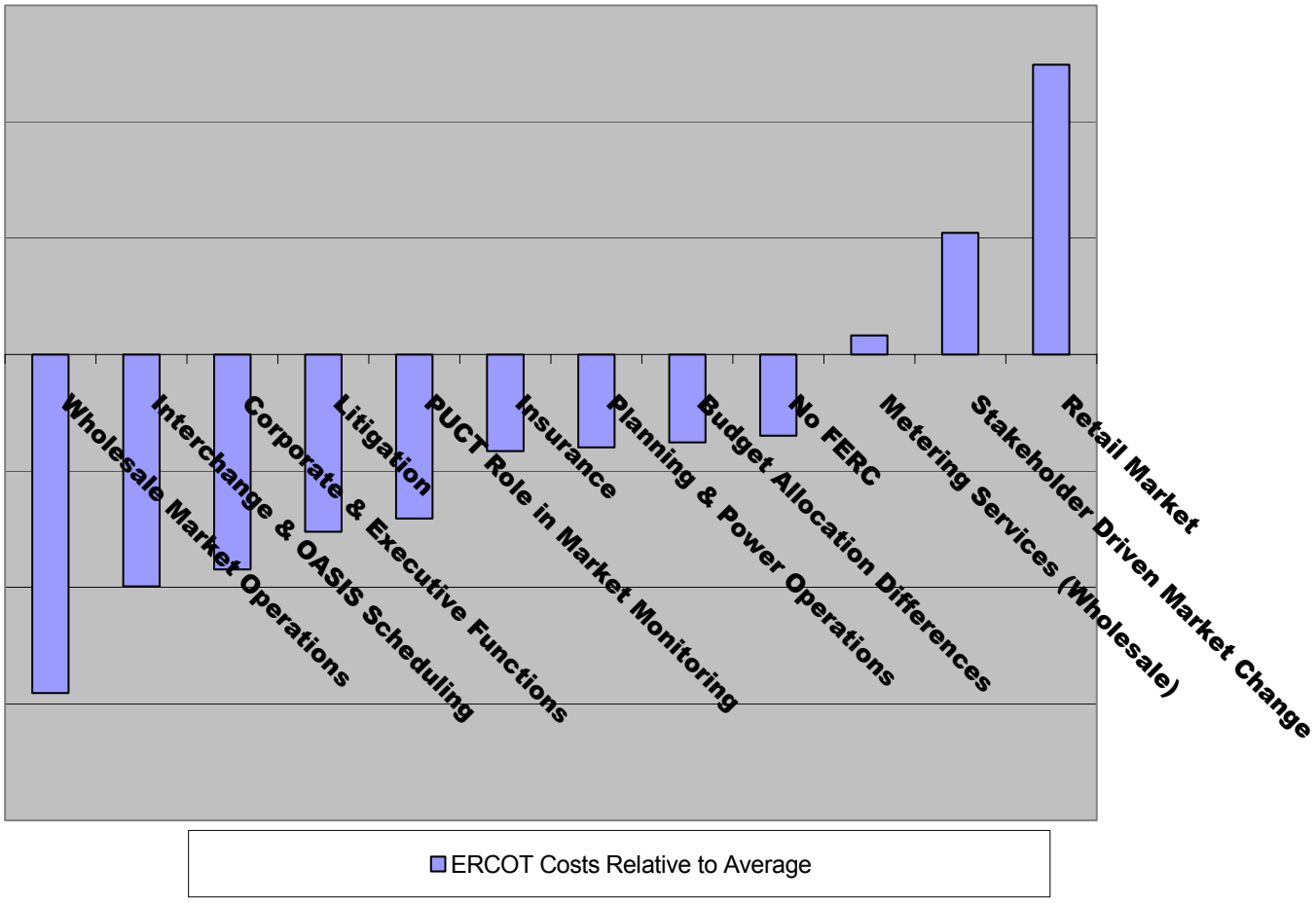


Chart 1 - ERCOT Cost Driver Impacts

The table below provides the supporting detail for the above chart.

Table 1 - ERCOT Cost Driver Details

General Cost Driver	Description	Relative to Average
Wholesale Market Operations	ERCOT does not operate a day-head energy markets, only residual day ahead ancillary services and real-time balancing energy markets. ERCOT also does not have to manage transmission reservations for energy or ancillary services transactions.	Lower
Interchange & OASIS Scheduling	ERCOT does not have the level of interchange and OASIS scheduling as other ISOs.	Lower
Corporate & Executive Functions	ERCOT's corporate and executive costs are the lowest among the ISOs due to lower staffing and labor costs.	Lower
Litigation	ERCOT does not need to deal with extensive litigation surrounding energy market issues.	Lower
PUCT Role in Market Monitoring	ERCOT is not responsible for market monitoring, though some related costs are allocated to other line items.	Lower
Insurance	ERCOT has much lower insurance costs than average.	Lower
Planning & Power Operations	ERCOT benefits from lower technical staff labor cost structures and from some efficiencies in operations; additionally ERCOT may not have the level of transmission outages / overloads that some of the ISOs have to manage.	Lower
Budget Allocation Differences	There are several cost differences that are due to different budget allocations.	Lower
No FERC	ERCOT does not need to report to FERC.	Lower
Metering Services (Wholesale)	ERCOT provides metering services unlike some other ISOs.	Higher
Stakeholder Driven Market Change	ERCOT governance and stakeholder process causes higher rates of incremental change or analysis of change at ERCOT than experienced by other ISOs.	Higher
Retail Market	ERCOT has retail market responsibilities unlike other ISOs.	Higher

2. ISO Cost Comparisons

This section identifies the key functional and scale differences for the ISO's and presents a qualitatively comparison of ERCOT with the other ISO's. The ISO data is from public sources, supplemented by additional ERCOT information provided by ERCOT and KEMA's internal knowledge base. Please note that some of the statistical data and some of the budget data may not be reflective of the latest publically available versions for some of the ISO's. The focus should be on the order of magnitude and not on the exact value. The comparative data for the other ISO's was sorted in ascending order and generically labeled for presentation purposes ("ISO-A", "ISO-B", "ISO-C", etc.) in each individual chart and table.

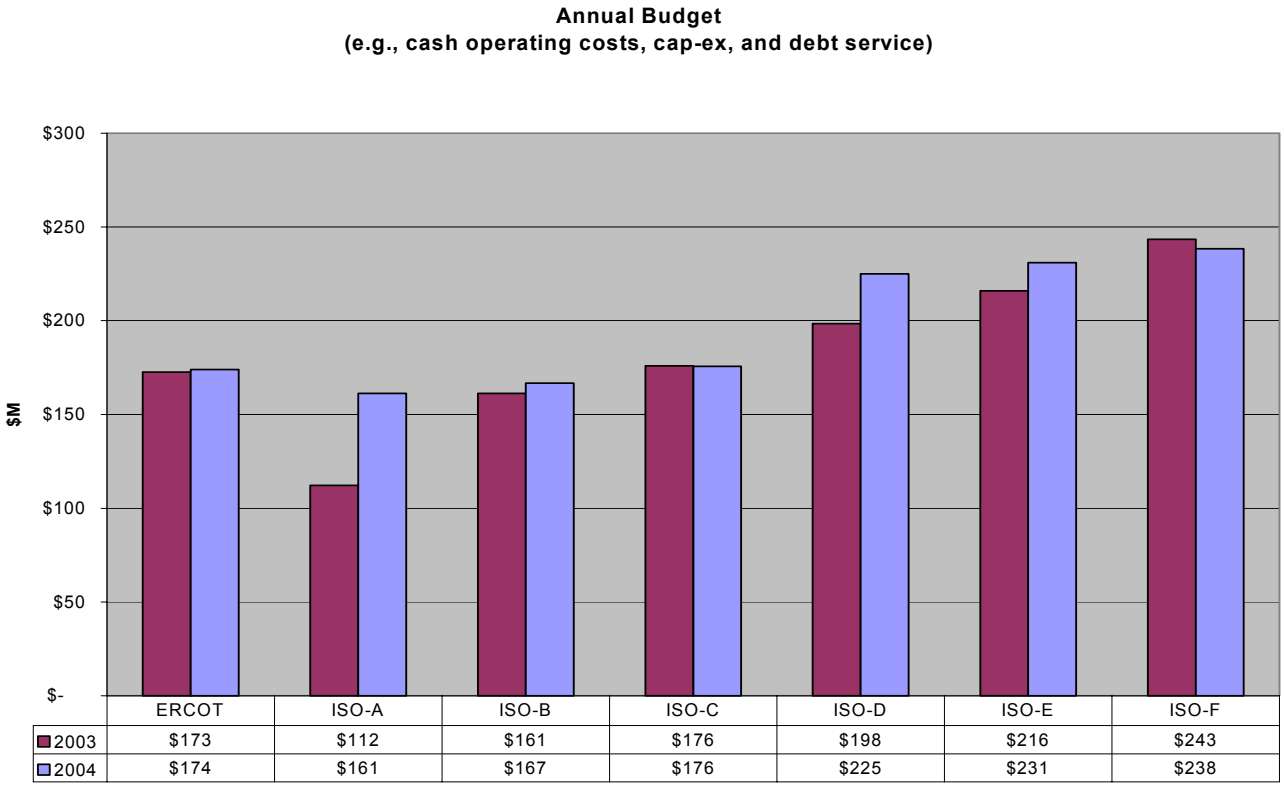
Please note, that the ISO order (from "ISO-A" to "ISO-F") in the statistical tables at the tops of many pages (such as page 16 "Peak Load") is not necessarily the same ISO order for the dollar or ratio data reflected in the associated chart at the bottom of the page. The statistics are sorted in ascending order from left to right. The dollar values or ratios are also sorted in ascending order from left to right. The ISO with the lowest peak load may not necessarily be the ISO with the lowest ratio of budget dollar to peak load and the charts reflect this.

Also please note that in charts reflecting data for both 2003 and 2004, the sorted order for 2003 is independent of the sorted order for 2004. For example, in the same chart, one ISO may be reflected as "ISO-A" based on 2003 information and the same ISO may be reflected as "ISO-F" based on 2004 information.

2.1 Financial Data

2.1.1 Annual Budget

The following is a comparison of ISO's 2003 and 2004 annual budget dollars. Annual budgets are based on estimated operating costs (excluding amortization and depreciation), capital expenditures, and debt service. ERCOT's 2004 annual budget of $174M is below the estimated average among the ISO's examined.

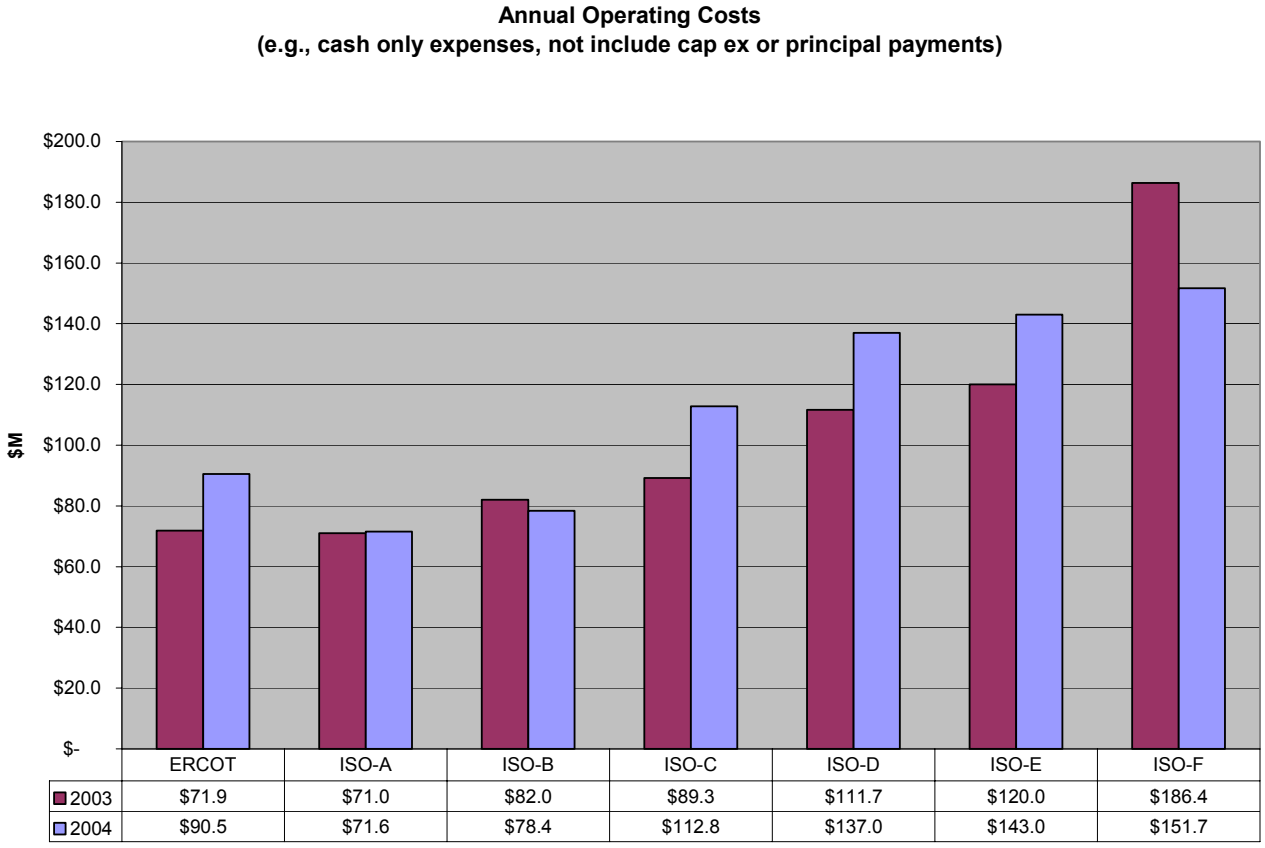


	ERCOT	ISO-A	ISO-B	ISO-C	ISO-D	ISO-E	ISO-F
2003	$173	$112	$161	$176	$198	$216	$243
2004	$174	$161	$167	$176	$225	$231	$238

Chart 2 - Annual Budgets

2.1.2 Annual Operating Costs

The following is a comparison of ISO's 2003 and 2004 annual operating costs (or annual budget net of capital expenditures and debt service). Operating costs include but are not limited to salaries. ERCOT's 2004 operating costs of about $90.5M and is below the estimated average among the ISO's examined.



	ERCOT	ISO-A	ISO-B	ISO-C	ISO-D	ISO-E	ISO-F
2003	$71.9	$71.0	$82.0	$89.3	$111.7	$120.0	$186.4
2004	$90.5	$71.6	$78.4	$112.8	$137.0	$143.0	$151.7

Chart 3 - Annual Operating Costs

2.1.3 Debt Service

The following is a comparison of ISO debt service as a percentage of the total annual budget. It compares ERCOT's 2003, projected 2004, and projected 2005 debt service percentage with 2003 data for the other ISO's.

In 2003, ERCOT's debt service as a percentage of annual costs was below the estimated average among the ISO's examined. As ERCOT increases its debt in 2004 ($23.5M Debt Service, $174M Annual Budget) and 2005 ($43M Debt Service, $256M Annual Budget) to fund capital expenditures associated with market improvements, ERCOT's debt serve as a percentage of budget will increase to be within average with the other ISO's.

Table 2 - Debt Service

Base Data	ERCOT	ISO-A	ISO-B	ISO-C	ISO-D	ISO-E	ISO-F
2003 Debt Service ($M)	$9.4	$15.7	$16.1	$24.2	$39.0	$44.1	$96.0

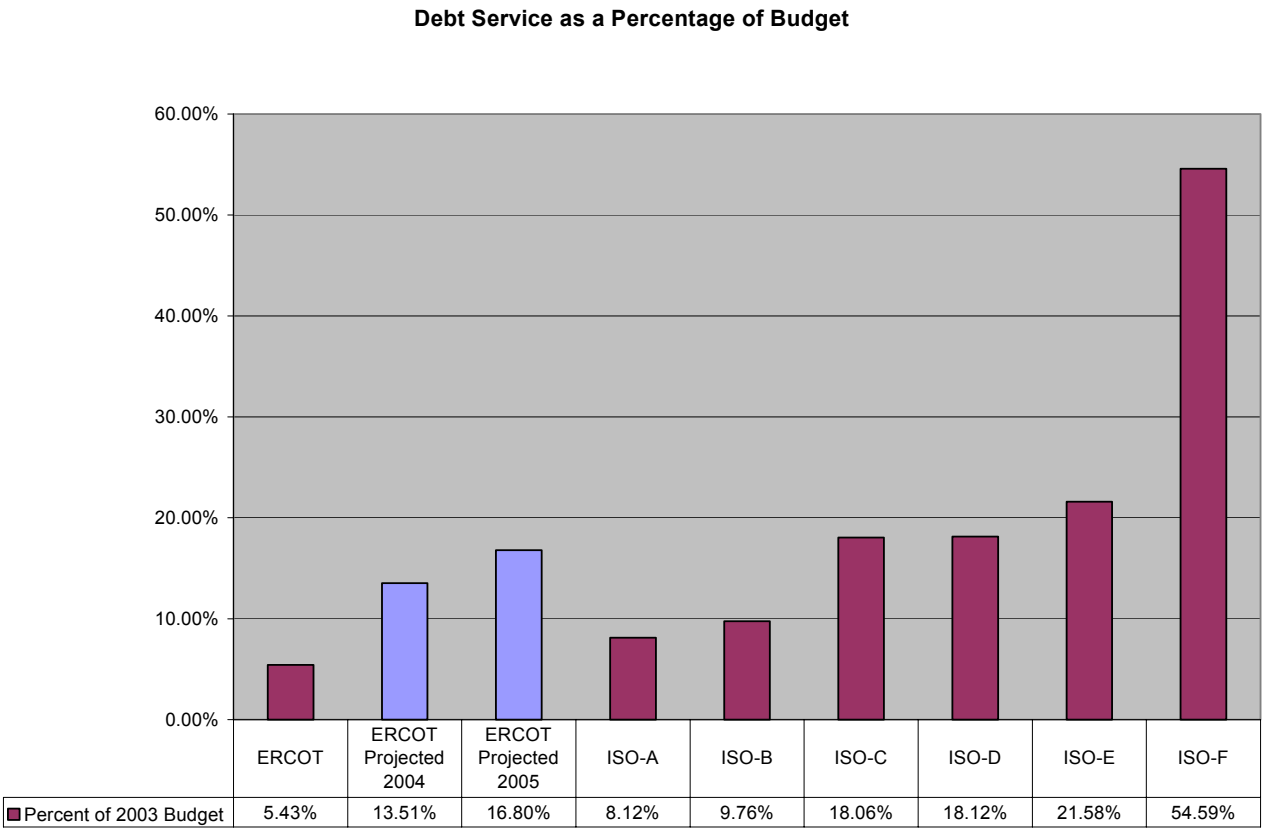


Chart 4 - Debt Service Ratio

2.1.4 Long-term Debt

The following is a comparison of ISO outstanding long-term debt for 2003. ERCOT's long-term debt obligation at the end of 2003 is above the estimated average among the ISO's examined. In general, ERCOT's debt is above average than established ISO's, but below average than newer ISO's.

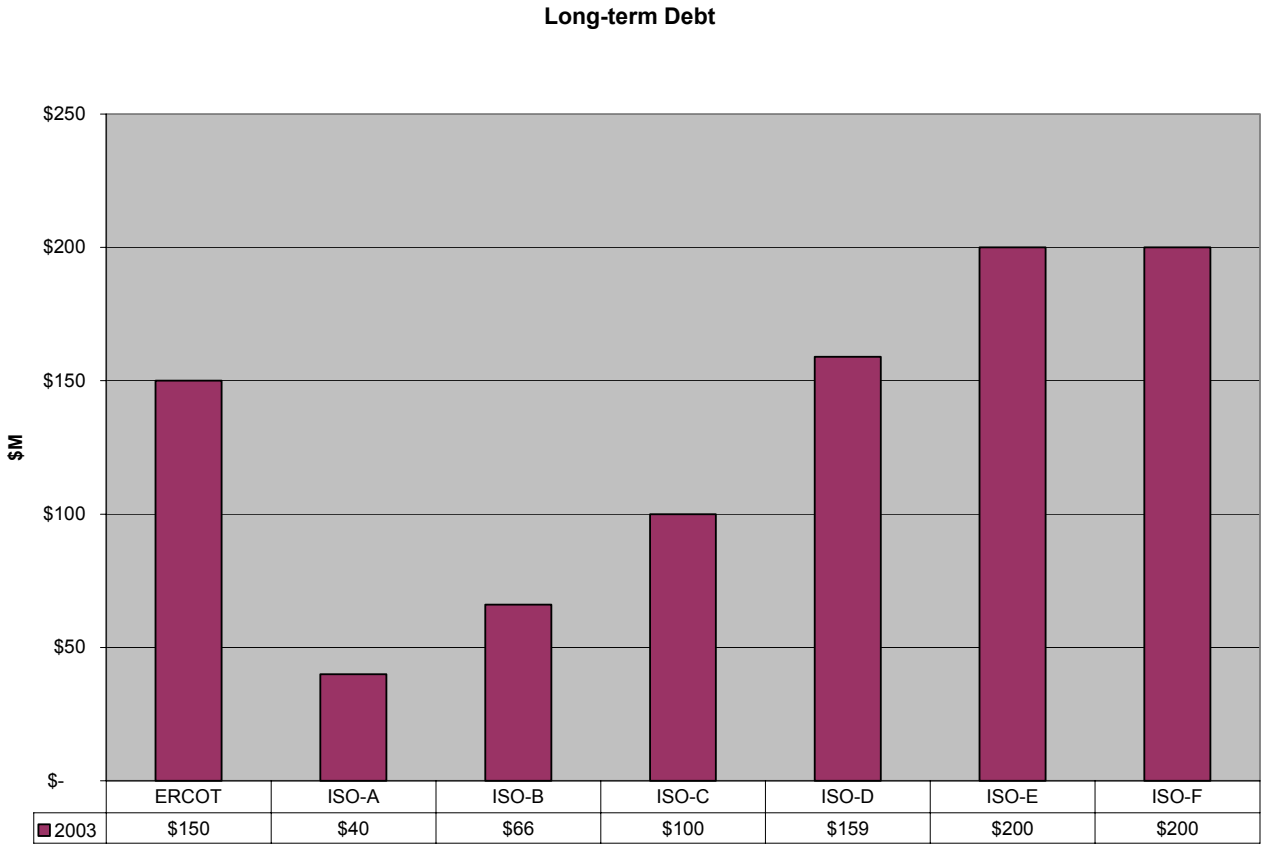


Chart 5 - Long-term Debt

2.1.5 Capital Expenditures

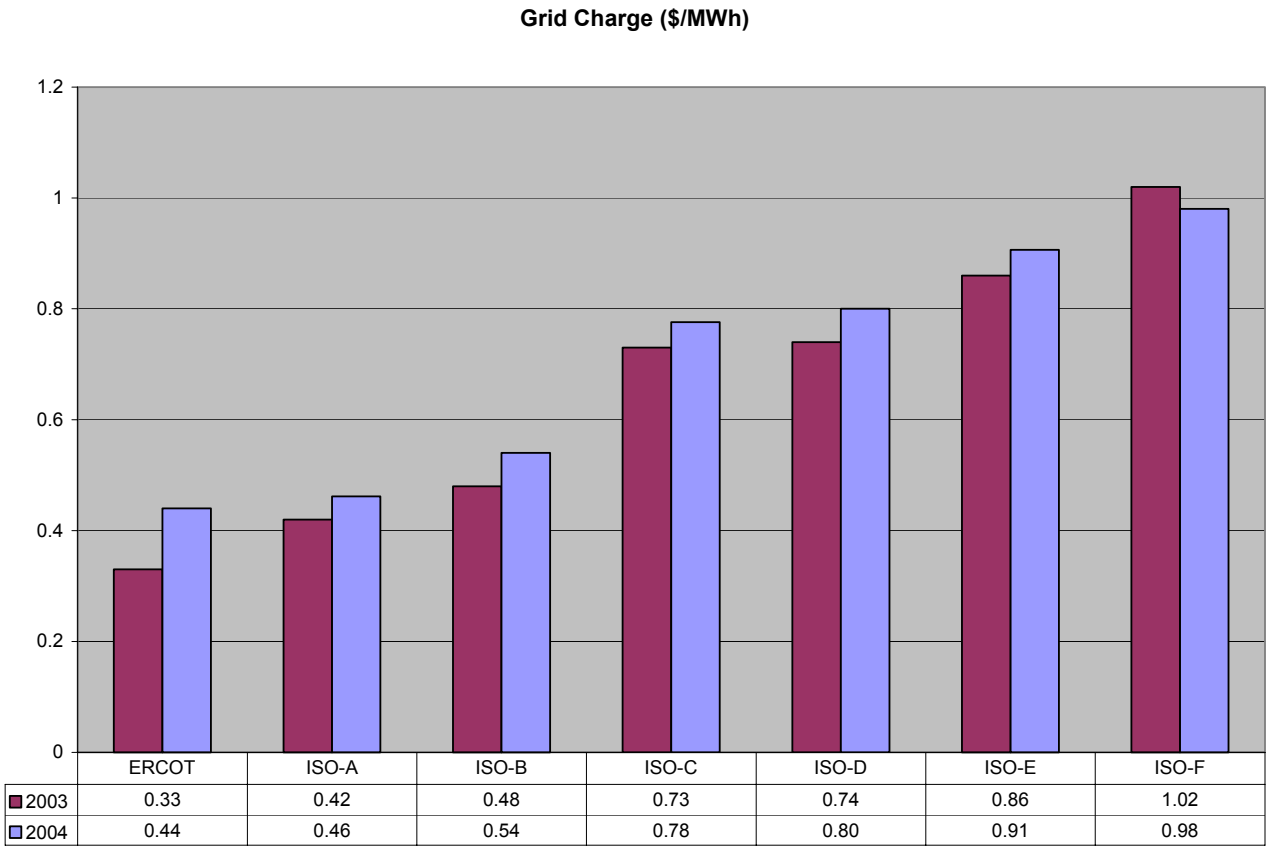
The following examines budgeted capital expenditures for ISO's in 2003 and 2004. ERCOT's costs are above the estimated average among the ISO's examined and is associated with ERCOT's stakeholder market change process, which drives higher costs and ERCOT's additional retail market responsibilities (please refer to section 3.9 for a detailed discussion).

	ERCOT	ISO-A	ISO-B	ISO-C	ISO-D	ISO-E	ISO-F
2003	$57	$15	$20	$23	$58	$59	$83
2004	$60	$18	$25	$32	$32	$43	$88

Chart 6 - Capital Expenditures

2.1.6 Grid Charge

The following represents the ratio of Revenue Requirement ($) per annual Volume (MWh). Each ISO defines their "Revenue Requirement" differently, and have different long term cost recovery mechanisms. Therefore, a comparison would not be practical but is presented for information purposes only.



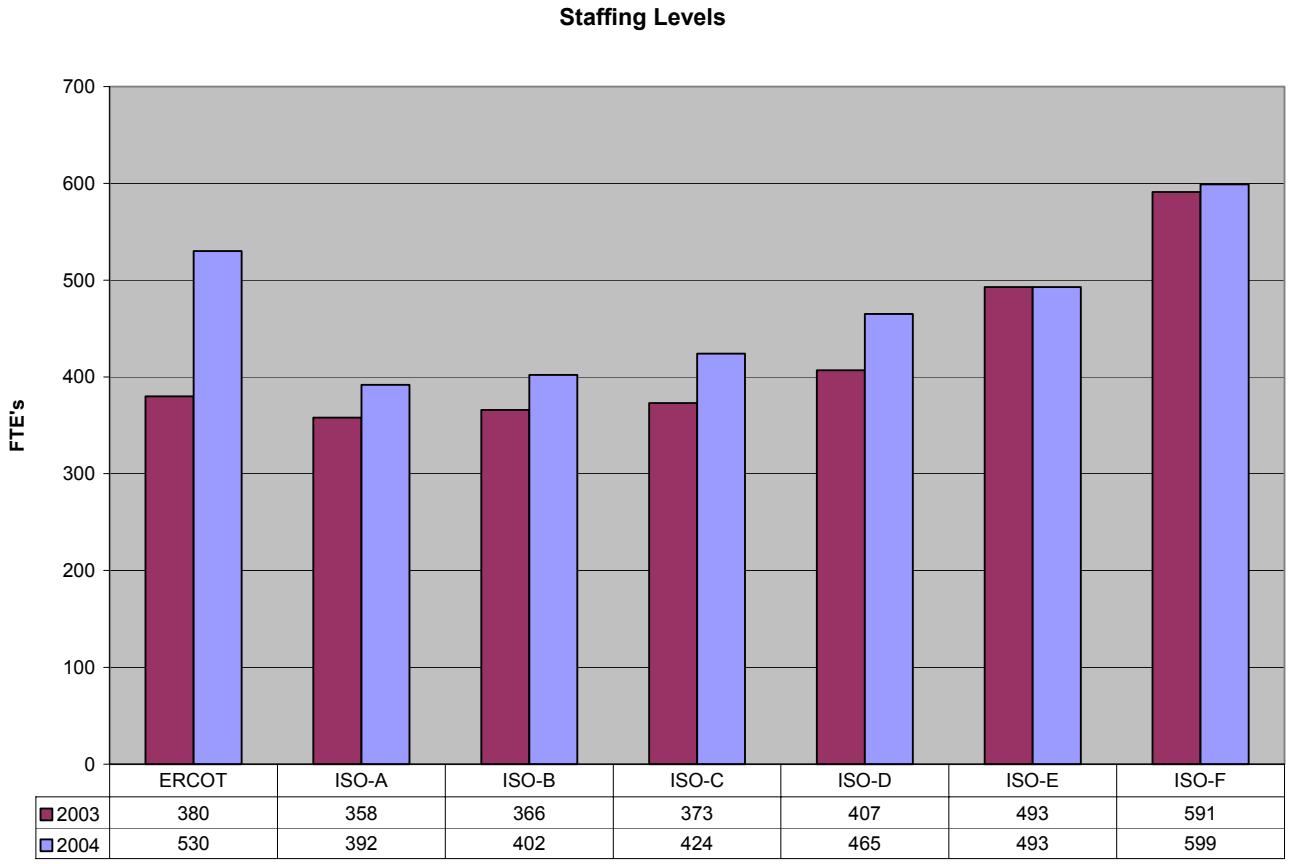
	ERCOT	ISO-A	ISO-B	ISO-C	ISO-D	ISO-E	ISO-F
2003	0.33	0.42	0.48	0.73	0.74	0.86	1.02
2004	0.44	0.46	0.54	0.78	0.80	0.91	0.98

Chart 7 - $/MWh Ratio

2.2 Regional Market Attributes

2.2.1 Staffing Levels

The following examines budgeted staffing levels for ISO's in 2003 and 2004. ERCOT is above the estimated average among the ISO's examined. Major differences that account for this includes the following: ERCOT has retail market obligations which other ISO's do not; this accounts for approximately 50 more ERCOT staff and ERCOT is itself responsible for generation metering functions that adds additional staff, which at other ISO's is performed by various other participants.

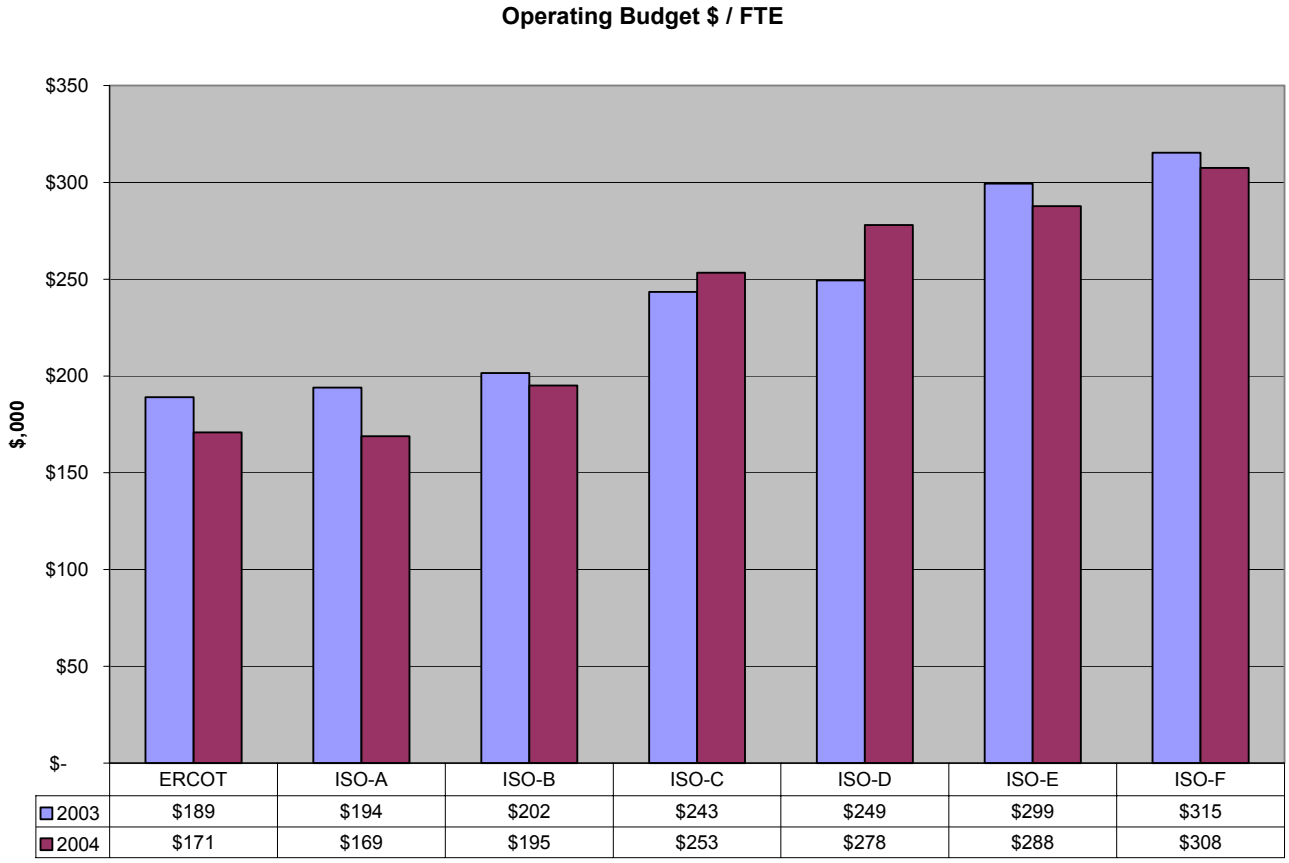


	ERCOT	ISO-A	ISO-B	ISO-C	ISO-D	ISO-E	ISO-F
2003	380	358	366	373	407	493	591
2004	530	392	402	424	465	493	599

Chart 8 - Staffing Levels

2.2.2 Operating Costs/ FTE

The following examines total operating costs (including salary and all other operating costs) spent per Full-Time Employee (FTE). In 2003, ERCOT was below average and in 2004 ERCOT will be below the estimated average among the ISO's examined.



	ERCOT	ISO-A	ISO-B	ISO-C	ISO-D	ISO-E	ISO-F
2003	$189	$194	$202	$243	$249	$299	$315
2004	$171	$169	$195	$253	$278	$288	$308

Chart 9 - Operating Costs/FTE Ratio

2.2.3 Cost of Living Index

The following compares the Cost of Living Index for the metropolitan areas for each ISO's corporate location. Consistent with the below average total operating cost per employee, the average Cost of Living Index for ERCOT is below the average among the ISO's examined.

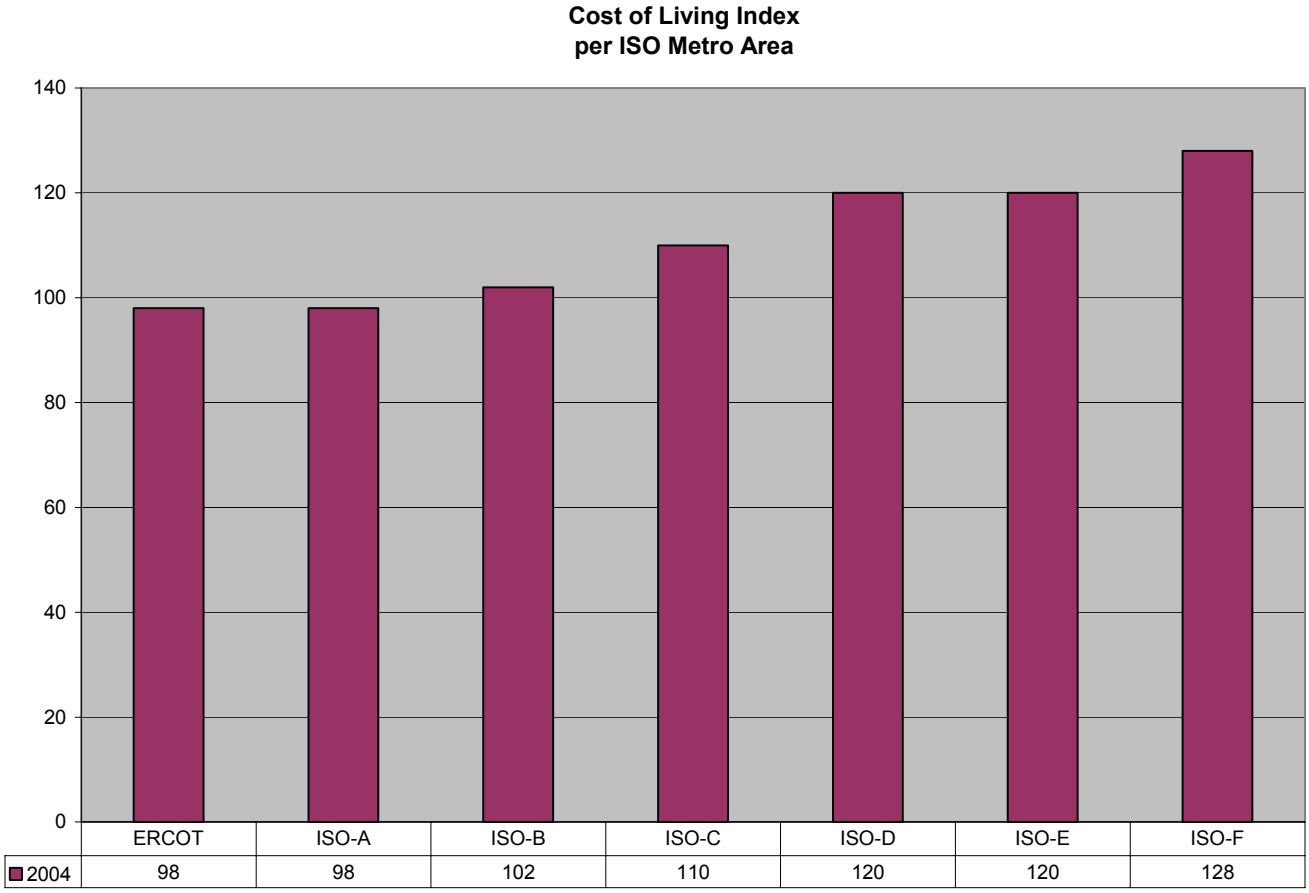


Chart 10 - Cost of Living Index

2.2.4 Budget$/ Population

The following represents the ratio of 2004 budget dollars to population served by each ISO. ERCOT's ratio of $9.7 per person served is below the estimated average among the ISO's examined.

Table 3 - Population

Base Data	ERCOT	ISO-A	ISO-B	ISO-C	ISO-D	ISO-E	ISO-F
Population (M)	18	12	13	18	25	30	30

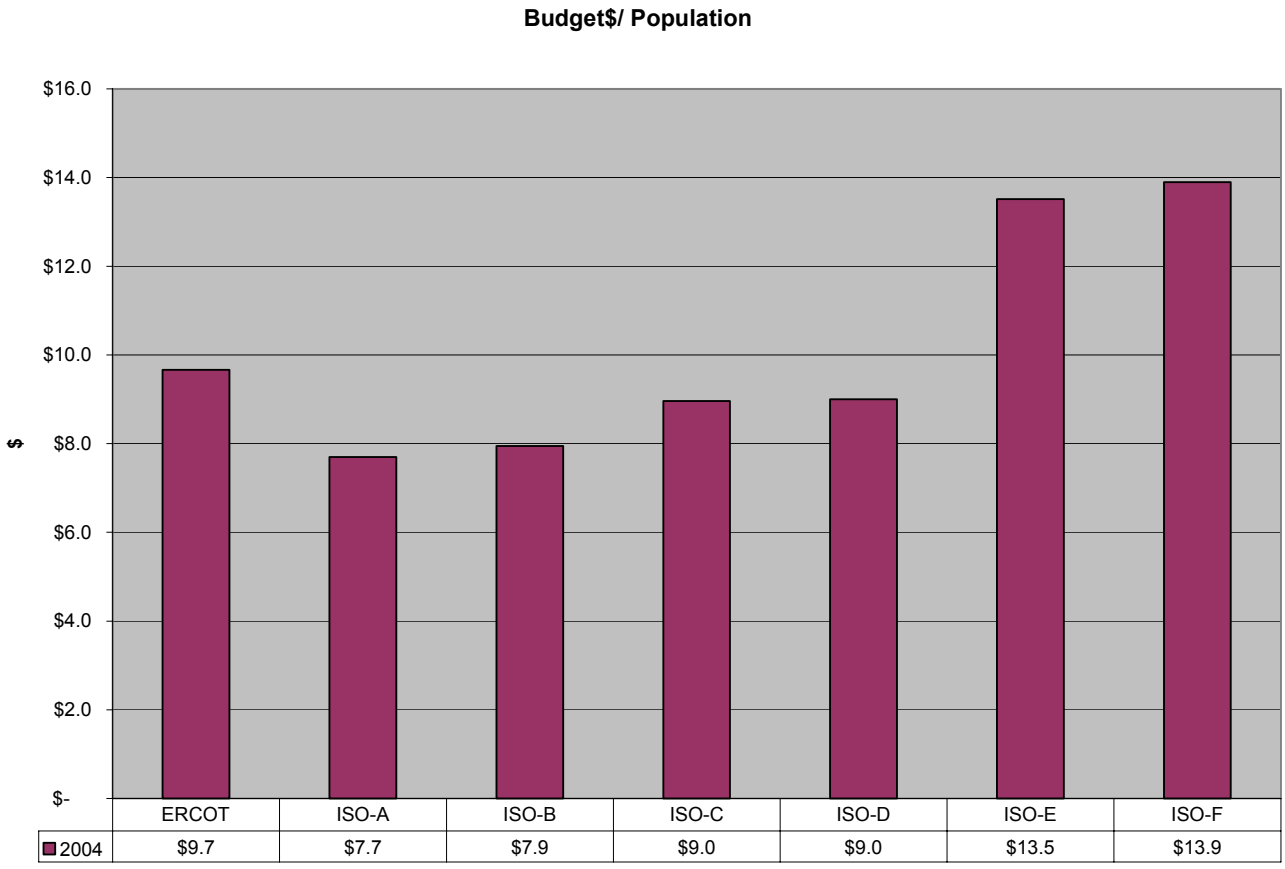


Chart 11 - Budget$/Population Ratio

2.2.5 Budget$/ Peak Load

The following represents the ratio of 2004 budget dollars to the peak load of each ISO. ERCOT's ratio of $2.9M per GW is below the estimated average among the ISO's examined.

Table 4 - Peak Load

Base Data	ERCOT	ISO-A	ISO-B	ISO-C	ISO-D	ISO-E	ISO-F
System Peak Load (GW)	60	25	25	31	46	64	111

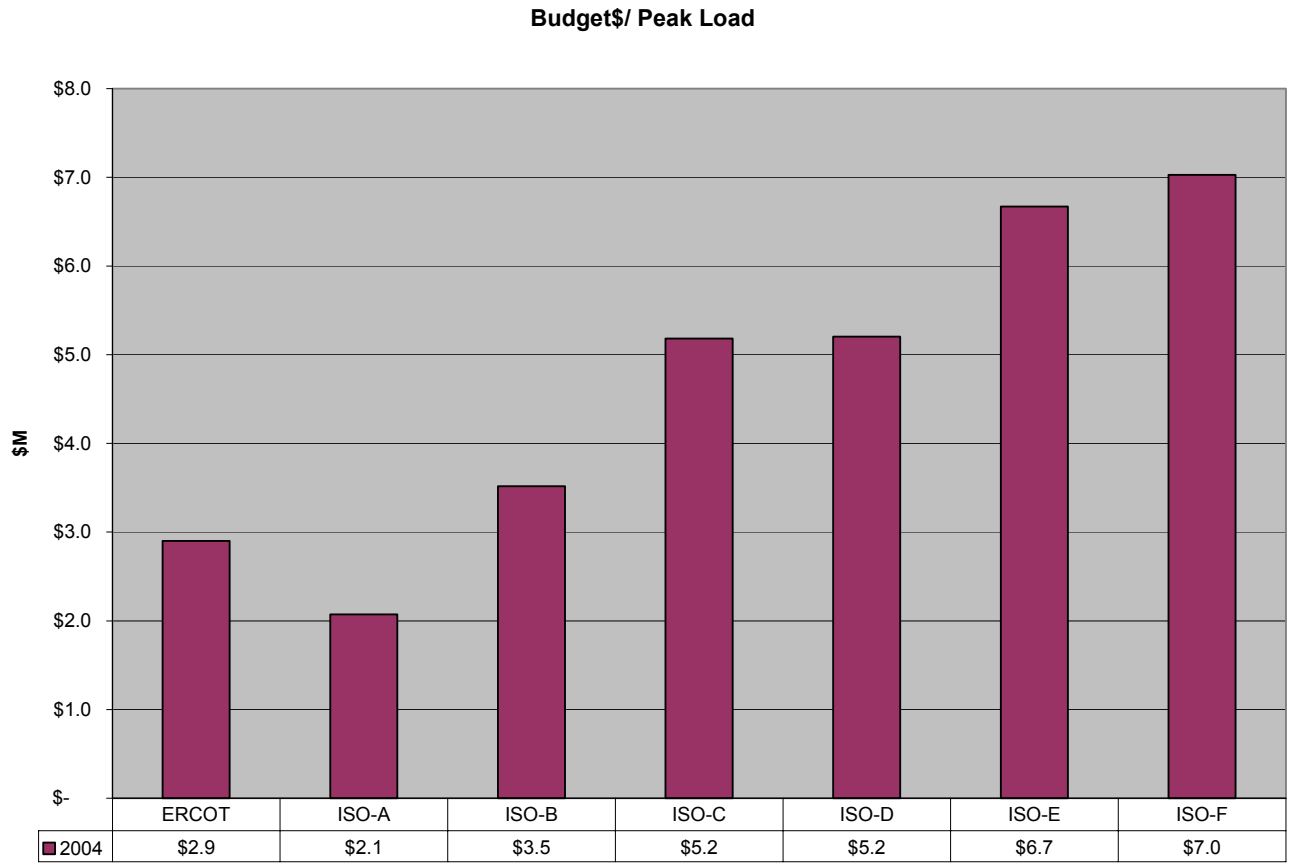


Chart 12 - Budget$/Peak Load Ratio

2.2.6 Budget$/ Installed Capacity

The following represents the ratio of 2004 budget dollars to the installed capacity of each ISO. ERCOT's ratio of $2.0M per GW is below the estimated average among the ISO's examined.

Table 5 - Installed Capacity

Base Data	ERCOT	ISO-A	ISO-B	ISO-C	ISO-D	ISO-E	ISO-F
System Installed Capacity (GW)	85	31	32	37	54	76	132

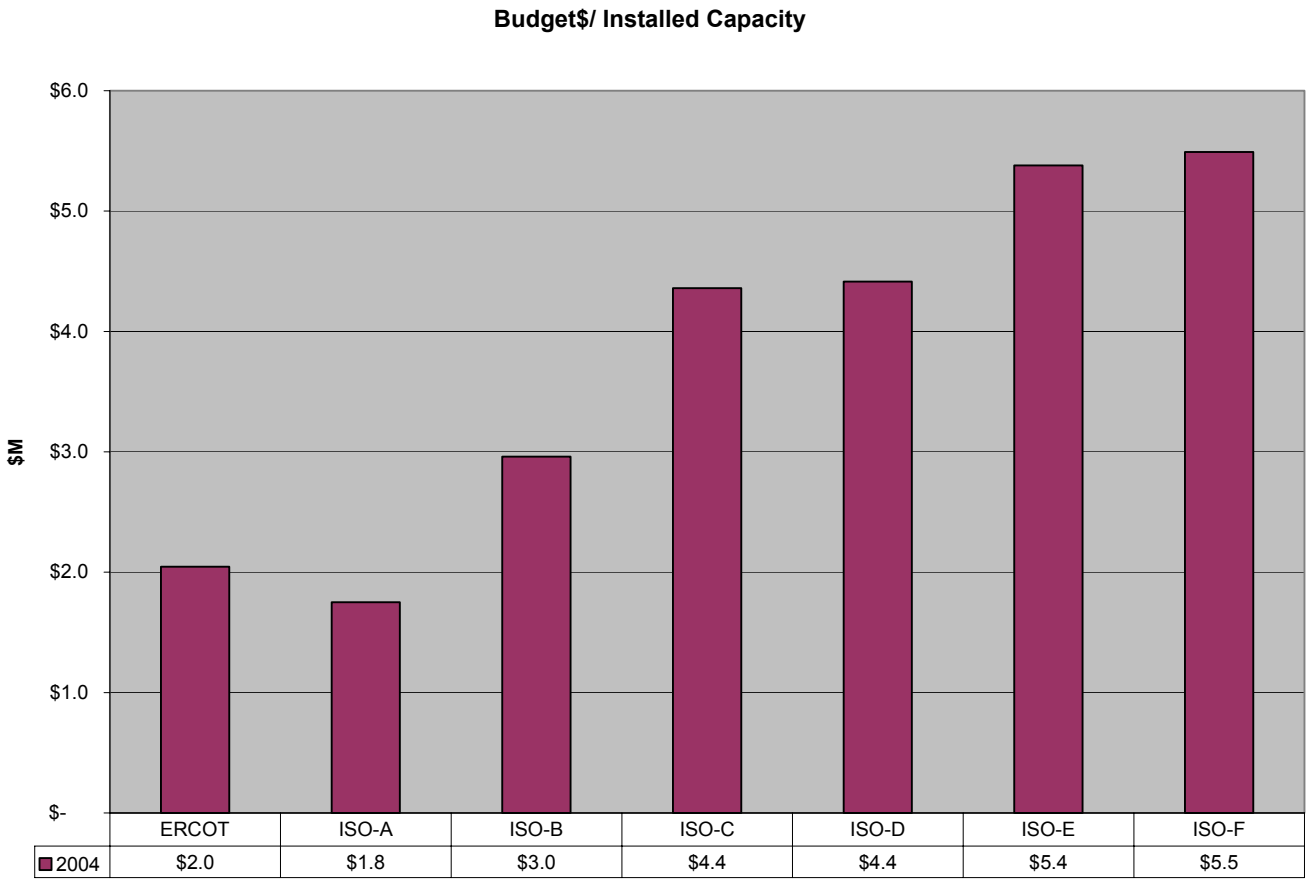


Chart 13 - Budget$/Installed Capacity Ratio

2.2.7 Budget$/ TWh

The following represents the ratio of 2004 budget dollars to the annual electricity use of each ISO. ERCOT's ratio of $589.8K per TWh (or $.58/MWh) is below the estimated average among the ISO's examined. Note that the budget dollars used in this analysis are different than the revenue requirements for each ISO used in the Grid Charge section 2.1.6.

Table 6 - TWh

Base Data	ERCOT	ISO-A	ISO-B	ISO-C	ISO-D	ISO-E	ISO-F
Annual Electricity Use (TWh)	295	120	153	159	232	315	348

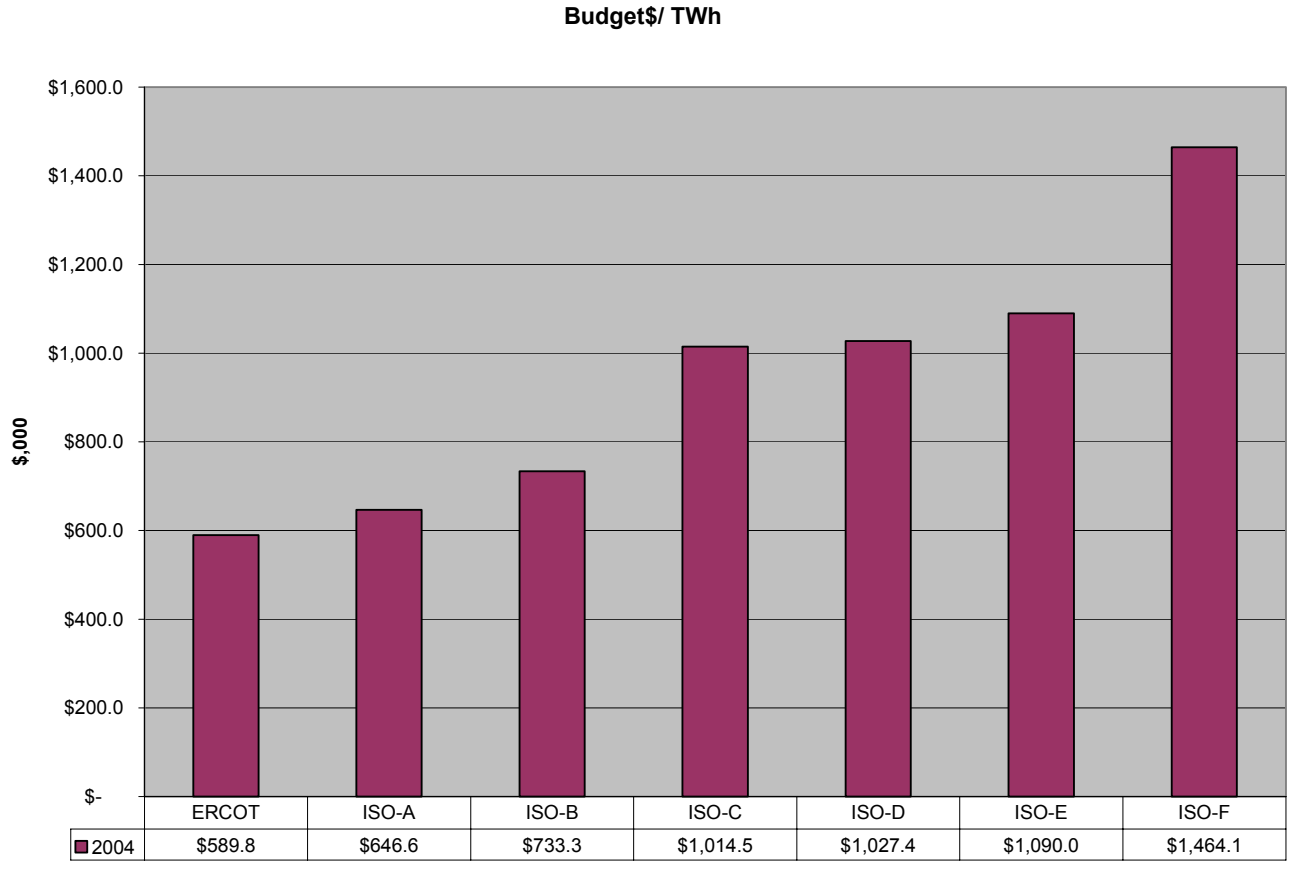


Chart 14 - Budget$/TWh Ratio

2.2.8 Budget$/ Generator

The following represents the ratio of 2004 budget dollars to generators located in each ISO. ERCOT's ratio of $290.0K per generator is below the estimated average among the ISO's examined.

Table 7 - Generators

Base Data	ERCOT	ISO-A	ISO-B	ISO-C	ISO-D	ISO-E	ISO-F
Generators	600	200	365	660	809	1131	1200

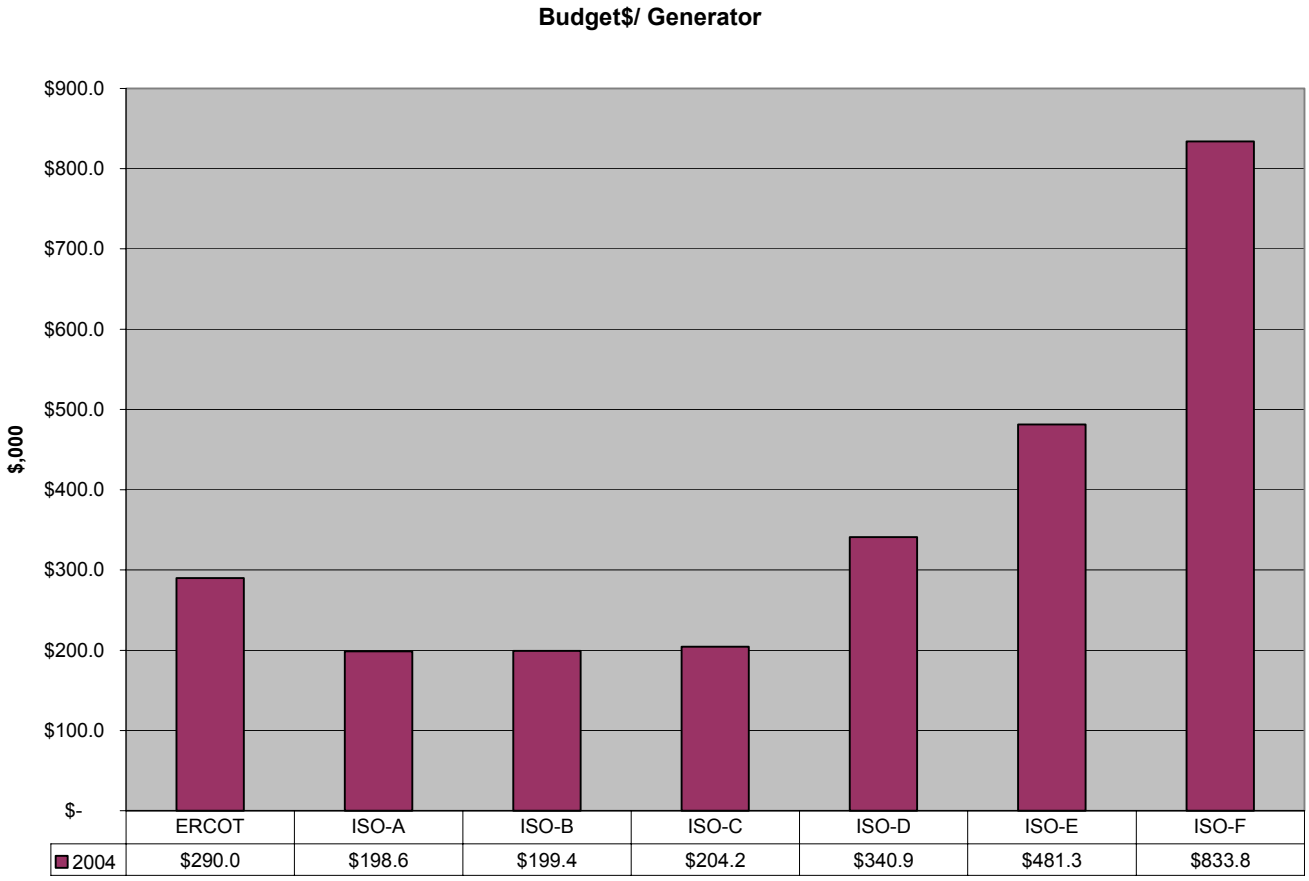


Chart 15 - Budget$/Generator Ratio

2.3 Transmission Statistics

2.3.1 Budget$/ Transmission Mile

The following represents the ratio of 2004 budget dollars to ISO transmission miles. The thousands of miles are the current high voltage transmission lines for the ISO. ERCOT's ratio of $4.6K budget dollars per transmission mile is below the estimated average among the ISO's examined.

Table 8 - Transmission Miles

Base Data	ERCOT	ISO-A	ISO-B	ISO-C	ISO-D	ISO-E	ISO-F
Transmission Miles (K)	38	8	18	18	21	26	55

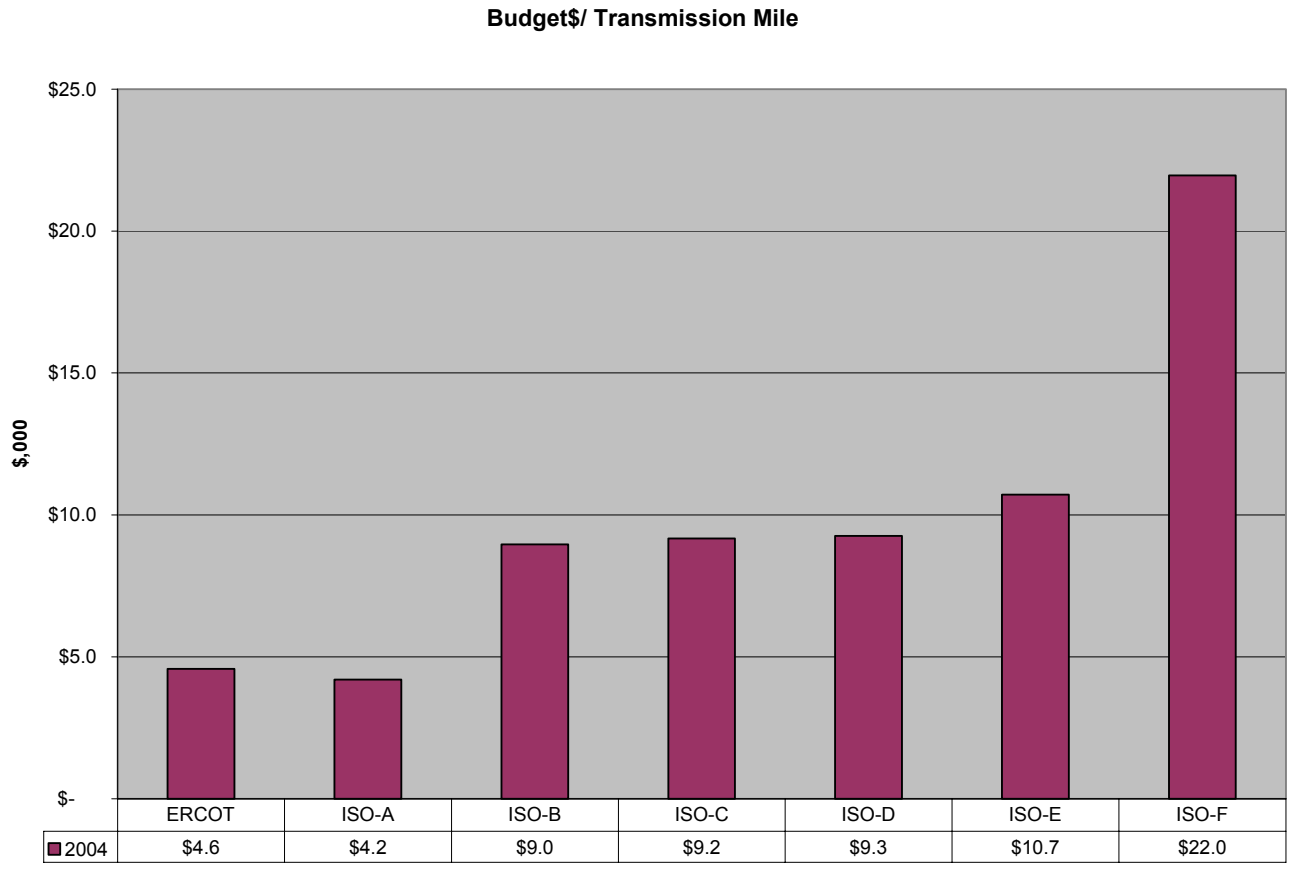


Chart 16 - Budget$/Transmission Mile Ratio

2.3.2 Budget$/ Network Node

The following represents the ratio of 2004 Budget dollars to ISO Network Nodes. The nodes are the number of buses utilized in the load flow program. ERCOT's ratio of $33.7K budget dollars per network node is below the estimated average among the ISO's examined.

Table 9 - Network Nodes

Base Data	ERCOT	ISO-A	ISO-B	ISO-C	ISO-D	ISO-E	ISO-F
Network Nodes	5,158	1100	1168	2200	3000	3000	3000

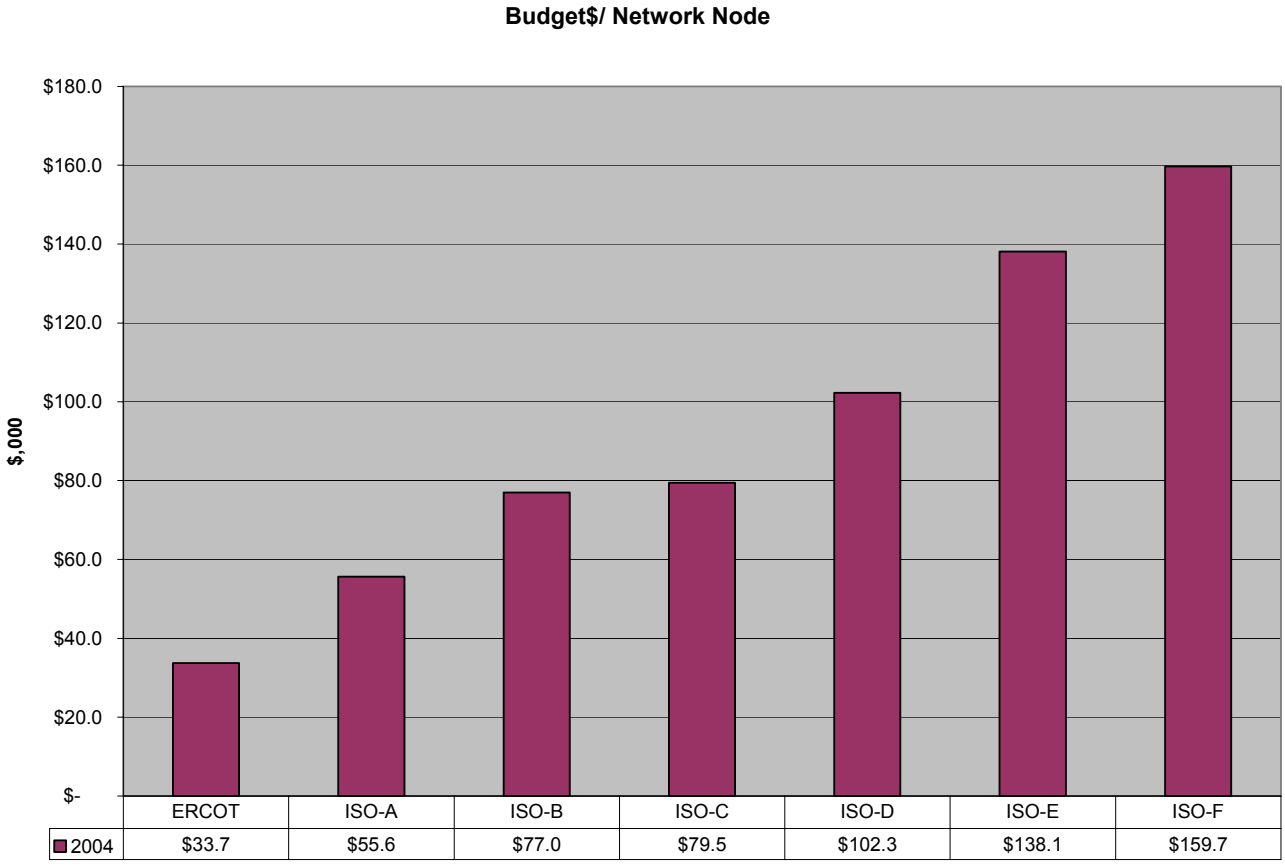


Chart 17 - Budget$/Network Node Ratio

2.4 Operations Data

2.4.1 Budget$/ Market Participant

The following represents the ratio of 2004 Budget dollars to ISO market participants. ERCOT's ratio of $690.4K budget dollars per market participant is below the estimated average among the ISO's examined.

Table 10 - Market Participants

Base Data	ERCOT	ISO-A	ISO-B	ISO-C	ISO-D	ISO-E	ISO-F
Market Participants	252	200	237	267	270	283	300

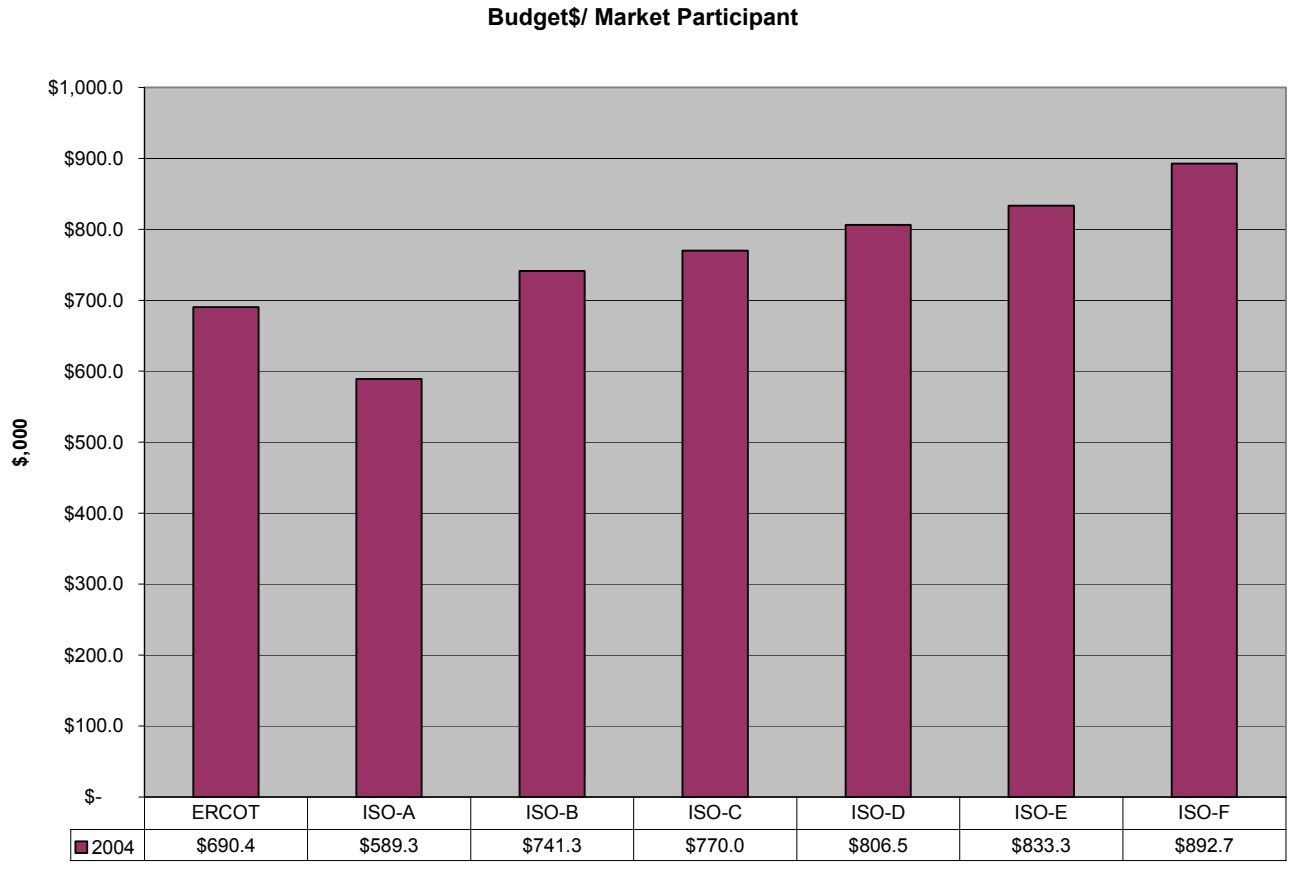


Chart 18 - Budget$/Market Participant Ratio

2.4.2 Budget$/ Settlement Line Item

The following represents the ratio of 2004 Budget dollars to ISO settlement line items. The settlement line items are the number of active charge types that are settled by the ISO. ERCOT's ratio of $2.5M budget dollars per settlement line item is within estimated average among the ISO's examined.

Table 11 - Settlement Line Items

Base Data	ERCOT	ISO-A	ISO-B	ISO-C	ISO-D	ISO-E	ISO-F
Settlement Charge Types	71	35	60	78	100	137	203

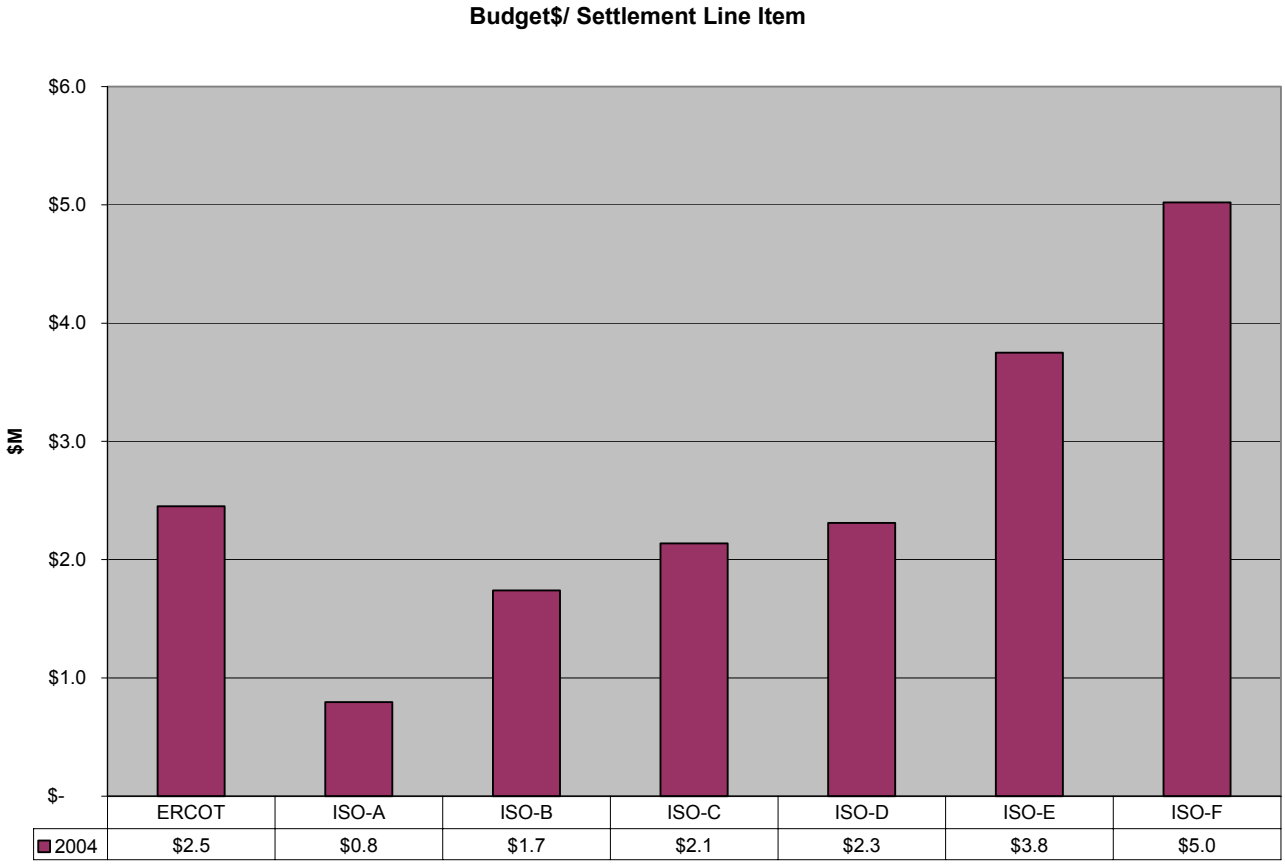


Chart 19 - Budget$/Settlement Line Item Ratio

2.4.3 Budget$/ Daily Schedule

The following represents the ratio of 2004 Budget dollars to ISO Daily Schedules. Daily schedules are the number of daily balanced schedules involving a specific transmission customer and specific injection and/or delivery points. ERCOT's ratio of $56.6K budget dollars per daily schedule is below the estimated average among the ISO's examined.

Table 12 - Daily Schedules

Base Data	ERCOT	ISO-A	ISO-B	ISO-C	ISO-D	ISO-E	ISO-F
Daily Schedules	3,072	240	288	540	800	850	1400

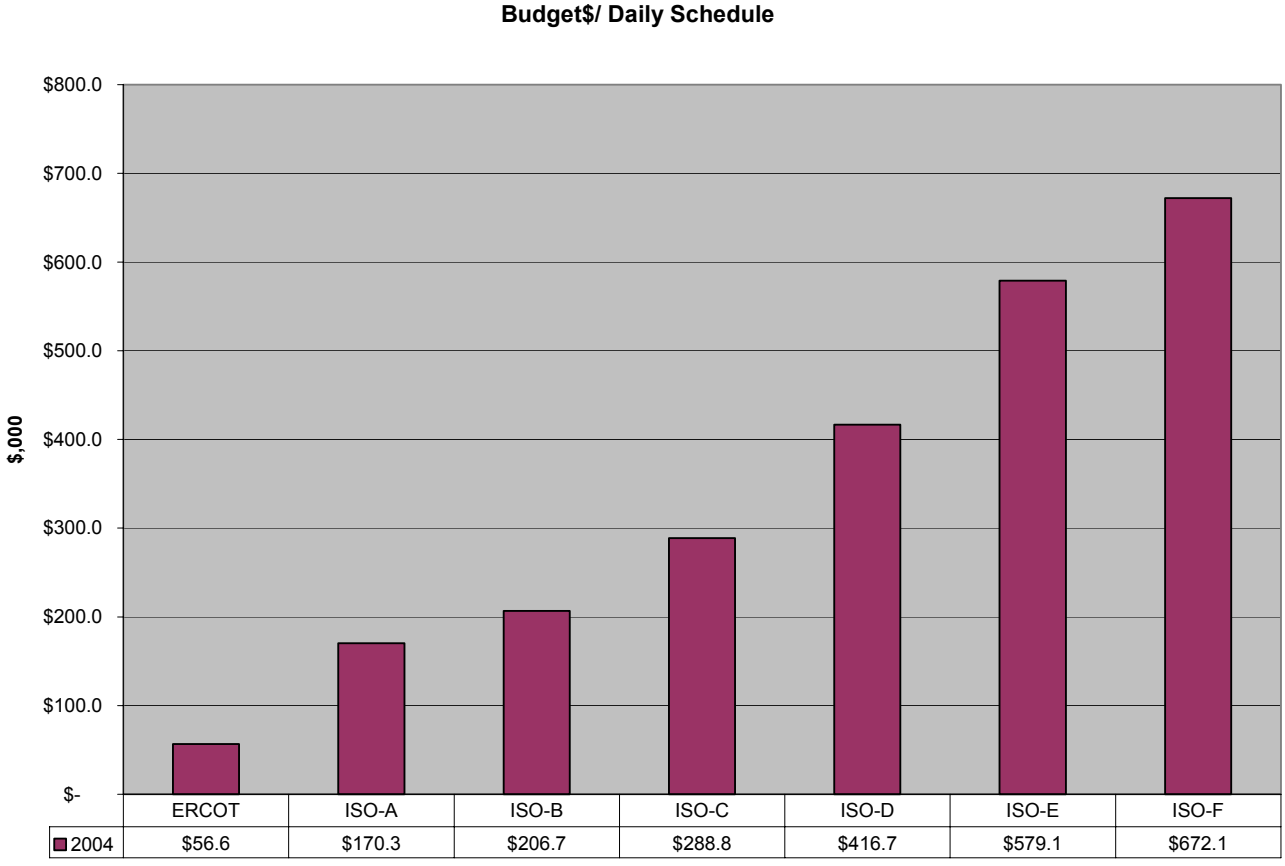


Chart 20 - Budget$/Daily Schedule Ratio

2.5 Miscellaneous Data

The following table compares various miscellaneous data among the ISO's examined.

Table 13 - Miscellaneous Comparative Data

	ERCOT	ISO-A	ISO-B	ISO-C	ISO-D	ISO-E	ISO-F
General							
Nodal / Zonal	Zonal	Zonal	Nodal	Zonal	Nodal	Zonal	Nodal
FERC Jurisdiction	No	Yes	Yes	No	Yes	Yes	Yes
Governing Bodies	1	2	2	2	17	2	8
Number of States/Provinces Served	1	1	6	1	16	1	6
Population Served (millions)	18	30	13	12	30	18	25
Presence of Pre-ISO pool	No	No	Yes	Yes	No	Yes	Yes
Functions							
Tariff Admin & Design	PUCT Tariff Only	X	X	X	X	X	X
Congestion Management	X	X	X	X	X	X	X
Parallel Path Flow	X	X	X	X	X	X	X
Ancillary Services	X	X	X	X	X	X	X
OASIS	[Note 2]	X	X		X	X	X
Market Monitoring	[Note 1]	X	X	X	X	X	X
Transmission Planning							
Planning	X	X	X	X	X	X	X
Expansion Studies	X	X	X	X	X		X
Interregional Coordination	X	X	X	X	X	X	X
Markets							
Day Ahead Energy Market			X		X	X	X
Same-day Energy Market	15 min	10 min	Hourly	5 min	5 min	Hourly	Hourly
Ancillary Services	Market Based & Cost Based	Market Based & RMR Cost Based	Market Based	Market Based	Cost Based	Market Based	Market & Cost Based
Transmission	Cost Based	Market Based		Market Based			Market Based
Retail Functions							
Retail Load Profiling	X						
Retail Registration& Switching Clearinghouse	X						
Retail Meter Data Aggregation	X						
Renewable Energy Accounting	X						

NOTES
1. FERC requires RTOs to perform this function. The PUCT performs this function in ERCOT.
2. ERCOT does not operate an OASIS node but manages energy transactions within the ERCOT Interconnected Region.

3. Cost Drivers

This section will attempt to quantify the impacts of significant and relevant cost drivers for ERCOT. KEMA utilized a methodology in deriving Benchmark values for the comparisons in this section. KEMA's base assumption is that there is an exact correlation between ERCOT's aggregate annual operating costs and associated detailed functional budgets to the other ISO aggregate annual operating costs and associated detailed functional budgets. This implies the other ISO's in this report have the same allocation at the various identified functional groupings for their detailed budgets, as ERCOT does for its budget. This assumption has not been verified by ERCOT or KEMA and may or may not be true for the other ISO's included in this report.

The following functional ERCOT groupings were used for the analysis:

- Power System Operations
- Market Operations
- Market Settlements
- Market Monitoring
- Information Technology
- Customer Services
- Legal and Regulatory
- Corporate and Executive
- Capital Expenditures and Debt

3.1 Power System Operations

ERCOT's 2004 budget of $16M is somewhat below the estimated average cost attributed to ISO's for system operations. In part this is because some ISO's have higher costs associated with interchange scheduling, OASIS, and dealing with multiple control areas. Allowing for these outliers, ERCOT operations costs associated with control room operations and system planning would be slightly less than the estimated average, which is probably also a result of lower local labor costs. No data is available referencing operator workload with regard to switching, overloads, plant failures, etc to use in producing a more refined comment.

Table 14 - Power System Operations Functions

Power System Operations	Cost Drivers
The following major functions are included: System Planning Transmission/Grid Planning and Studies Connection Assessments System Operations Pre-Scheduling and Support Outage Coordination Operations Scheduling Interchange Scheduling Real Time Scheduling OASIS Support Engineering and Maintenance Loads and Resources Operations Engineering Transmission Maintenance System Coordination Regional Coordination Reliability Coordination NERC Compliance Operations Support Operations Training / Analysis Reliability Compliance Engineering and Technical Support Network Modeling Documentation and Market manuals Security and Operating policies and procedures	Number of generators Type of generators (mix) Peak load / net energy Number of connections to neighboring control areas Number of interconnections to neighboring control areas Number of daily interchange schedules or NERC Tags Number of circuit ends Switching of circuits Size of transmission system – voltage system Number of transmission constraints – points of daily congestion Number of shifts in the control room / operators per shift / supervisors per shift Extent of back up control center (e.g. # of staff) Number of control centers Day ahead vs. other Retail (ERCOT) Oversight of transmission maintenance Who determines when outage can occur Training support (simulator, time/staffing provided for training)

3.2 Market Operations

ERCOT 2004 budget for market operations costs are higher that the other ISO's at $12M and 100 headcount. However, $4M and 50 headcount of that are associated with retail operations, which do not exist at other ISO's. Within market operations, ERCOT has lower operating costs than the average for ISO's that operate markets, which is explained by the fact that ERCOT does not operate a day-head energy market today, only residual day ahead ancillary services and real-time balancing energy markets. ERCOT also does not have to manage transmission reservations for energy or ancillary services transactions and therefore is not subject to NERC Transaction Load Curtailments (TLR) or IDC issues. Most of the other ISO's operate day ahead SMD style markets and one ISO operates a unique structure of day and hour ahead ancillary and energy markets.

ERCOT has relatively high market evolution/development costs, which is explained by ongoing stakeholder pressures for changes to the current market. Secondary factors include the lack of an FTR/TCC (congestion rights) market administered by ERCOT, which adds costs to operations and settlements. All of the ISO's operate highly automated market operations, which reduce the overall impact of complexity.

Table 15 - Market Operations Functions

Market Operations	Cost Drivers
The following major functions are included: Wholesale Markets Administration/Operations Day Ahead Energy and Ancillary Services Hour Ahead Energy and Ancillary Services Real Time Energy Daily and Monthly Capacity Daily, Monthly and Annual Financial Transmission Rights (FTR) Auctions Regulation Spinning Reserve Wholesale Market Evolution / Development Market Participant Registration / Qualification Tariff/Protocol Evolution / Development Market Participant Training Market Analysis and Reporting Publishing all Market Data on OASIS Market Power Mitigation Maintaining the Transmission Network Model Performing Load Forecasting functions Testing of New Market Rules Retail Market Support Centralized Retail Customer Registration Customer Switching Administration Load Profiling Services	Types of markets operated Number and type of markets supported The maturity of the market Retail Market Functions

3.3 Market Settlements

ERCOT's identified settlement costs are higher that the average for the ISO's, and is mainly attributed to load profiling and metering functions. ERCOT load profiling is associated with operating retail markets. The load profiling is budgeted at $1.8M out of $4M overall. Without the load profiling functions, ERCOT's settlements budget of $2.2M would be lower than the other ISO's. ERCOT's costs for meter acquisition and aggregation are higher than the other ISO's. ISO's that do not perform metering functions do not have the associated metering costs. The number of meter locations drives metering costs and ERCOT costs are in line with the relative scale and footprint. ERCOT settlement and billing costs are lower because ERCOT does not operate multiple markets or have as many charge types as the other ISO's.

Table 16 - Market Settlements Functions

Market Settlements	Cost Drivers
The following major functions are included: Wholesale Revenue Metering Metering Standards Generation Metering Installation Review and Inspection Data Acquisition System Operation Analysis of Meter Data (VEE) Application of Losses and Data Aggregation Unaccounted For Energy (UFE) Determination and Allocation Provision of Meter Data to Settlement Systems Metering Dispute Research. Load Profiling Development and Maintenance of Load Profiles Load Research Profiling Methodology Profiling System Operations Profiling Dispute Research. Settlement & Billing Daily Settlement Statement Review Market Reports Settlement System Operations and Related Manual Calculations (i.e. RMR Settlement) Final Settlements Statements Invoice Preparation, Validation, Transmittal, and Confirmation Settlement Dispute Research Automated Compliance Programs and Settlement Adjustments Meter Data Quality Analysis	Metering aspect of settlements Reading meters, auditing meters, and meter values (validation, estimation, editing). Degree of automation Desired accuracy of settlement statements Number of market participants Number of market instruments/charge types Number of data points (billing determinants) Time resolution of meters Volume of notices of disagreements Quality of meter installations Closing period / settlement cycle

3.4 Market Monitoring

ERCOT has no identified costs for market monitoring because this is performed by the PUCT. However, ERCOT has identified that it funds $0.5M of PUCT consulting resources plus there are other resources applied distributed throughout the organization.

Table 17 - Market Monitoring Functions

Market Monitoring	Cost Drivers
The following major functions are included: Market Analysis and Surveillance Review and Monitor the Efficiency/Effectiveness of the Market Report on Market Performance Investigate Violations and/or Anomalies Develops Sanctions and/or Proposed Market Design Changes Conducts Studies Responds to Information Requests Market Mitigation and Compliance Enforcement of Tariff/Protocol Provisions Automated Market Mitigation Programs and Adjustments Operational Investigations Monitoring Conformance to Contracts Monitoring Inappropriate Outcomes of the Market Rules Providing Input to the Development of the Associated Market Rules	The role and authority of ISO/RTO in monitoring/compliance/sanctions The approach to market compliance Maturity of markets The breadth of entities requiring regular reporting Number of participants External oversight Real-time mitigation

3.5 Information Technology

ERCOT's IT costs are lower than the estimated average of the ISO's at about $30M. Major factors accounting for differences include the use of contractors vs. full time staff, the lease vs. own decision, the cost of telecommunications and the amount of infrastructure to be supported which is related to market complexity and to a lesser extent, scale. ERCOT has lower costs due to a less complex market structures contrasted against the higher cost of the infrastructure required to support the retail activities. To some extent, IT costs also are driven by headcount (PCs, networks, and support) and ERCOT is a "median" data point in this regard.

Table 18 - Information Technology Functions

Information Technology	Cost Drivers
The following major functions are included: Application Software Development and Support Control Systems Market & Scheduling Systems Centralized Retail Customer Registration Systems Data Acquisition (Metering) System Profiling Systems Settlements System Corporate Systems (HR, Finance, Payroll, etc.) Enterprise Systems (Web sites, Change Management System, etc.) Analytical & Reporting Systems (Data Warehouse, etc.) Infrastructure Operations and Support Cyber security Operations Field Support for Metering Data Network Operations and Support Voice Communications Support Hardware Operations and Support Fully Operational Backup Control Center Systems Engineering End User Support (Desktop and Help Desk) IT Planning Strategic Planning Architecture Standards Technology Assessment Asset & Contract Management Change Management & IT Financial Planning	Lease vs. buy Age of assets – asset lifecycle – cycle for replacement Architecture Standards Number of PCs Number of servers Number of applications Maturity of markets / # of markets Number of connected entities (members, generators) In-house vs. contracted vendor services

3.6 Customer Services

ERCOT's budgeted costs for customer services, not including retail services, are generally below the ISO's estimated average. However, ISO's with recent or ongoing major market changes tend to have higher customer support services around liaison, studies, and meetings. The ERCOT stakeholder process apparently drives somewhat higher costs than estimated average in the Committee Liaison Administration budget area. ISO's with mature market structures and stable bases of market participants have lower costs, as there are fewer new things to discuss and fewer problems to resolve. Note, however, that ERCOT's lower costs for customer services on the wholesale side are to some extent counterbalanced by higher reported costs for market operations; we suspect that some costs of evaluating potential changes and performing analyses of change impacts are actually covered in market operations where others report them in customer services.

ERCOT customer services costs for retail are identified at $1M out of $3.5M which would seem to be low compared to the share of market operations allocated to retail; we believe that a similar argument as above applies.

Table 19 - Customer Services Functions

Customer Services	Cost Drivers
The following major functions are included: Wholesale Client Services Market Participant Lifecycle Management Customer Help Center Participant Security Certificates Administration Customer or Account Management Client-facing Process Management Market Communications Market Rule Exemptions Dispute Resolution and Research Committee Liaison Committees, Subcommittees and Working Groups Administration Providing Meeting Facilities, Associated Technology Infrastructure, and Catering Retail Client Services (similar to Wholesale Client Services functions) Technical Support Coordinating Large Stakeholder Initiatives Market Participant Surveys Benchmarking Efforts Market Training Develop and Deliver Training Coordinate Communication/Implementation/Training relating to Market Rule Changes	The nature of services provided The method of service provision – centralized versus decentralized The number of participants or customers The volume of stakeholder forums

3.7 Legal and Regulatory

ERCOT has lower costs that the other ISO's budgeted for legal and regulatory affairs. There are two primary drivers for this. One, ERCOT does not have to go through the tedious FERC tariff filing process that other ISO's do. Second, ERCOT is also not part of extensive litigation surrounding energy market manipulation issues. The typical ISO has to provide regulatory support to at least one state body and to FERC. Some have multiple state bodies to deal with. ERCOT only has the Texas PUC to support for regulatory affairs and does not have to file FERC tariffs.

Table 20 - Legal and Regulatory Functions

Legal and Regulatory	Cost Drivers
The following major functions are included: Legal Services Commercial Contracts Litigation Market Credit Labor Relations Records Management Regulatory and Government Affairs Regulatory Support (FERC, State/Province) Preparation of Pleadings Tariff Filings and Amendments Rate cases Other Regulatory Filings	Regulatory filings and reporting requirements with FERC State/province regulatory filings and reporting requirements Litigation Human resources representation/labor issues Settlements disputes Third-party subpoenas/information requests Investigations

3.8 Corporate and Executive

ERCOT's corporate and executive costs overall are lower than the estimated average of the other ISO's. Some of the key cost drivers include insurance (ERCOT has lower than estimated average costs), finance (ERCOT has higher than estimated average costs, which can be attributed to the added costs of supporting credit management, AR and AP, for the retail markets), and facilities (ERCOT has higher than estimated average costs, which may be reflected by higher aggregate costs due to older facilities, security, maintenance, local area network charges, utilities, and property taxes). ERCOT project management costs are lower than estimated average. In part this is because some of the other ISO's have major new market projects underway, but there is also a possibility that some of the costs reported in this category are classified in market operations at ERCOT.

Table 21 - Corporate and Executive Functions

Corporate and Executive	Cost Drivers
The following major functions are included: Finance Corporate Accounting and Reporting Treasury, including Market Cash Management Market Credit Management Procurement External Audits (e.g. SAS70) Internal Audit Chief Executive Officer Compensation and Travel Chief of Staff and Administrative Support Human Resources Staff Recruitment and Hiring Labor Relations Benefits Administration General Management Training, Ethics Affirmation Process Payroll Facilities Facilities planning Buildings and Grounds Maintenance Property Leases / Utilities / Taxes Security Other (e.g. networks, phones, supplies) Project Management Development, Maintenance and Support of Project Management Methodologies Project Reporting and Aggregation Corporate Communications Board/Governance/Corporate Strategy Insurance	Cost drivers are associated with the level of services and staffing required supporting the identified functions.

3.9 Capital Expenditures and Debt

Debt service is a function of the amount of historical capital expenditure required for start up and ongoing capital expenditures, as well as the nature of the financing of those investments.

Here it is important to note that some ISO's had pre-existing infrastructure from pool operations that could have allowed for a lower cost basis for capitalization as an ISO. In general this places downward pressure on their debt obligations. ERCOT did not have this advantage.

ERCOT did not exist as a pre-ISO pool (it did exist as a reliability coordinator). This had an impact on ERCOT start up costs that translates into ongoing debt service costs. It also implies that ERCOT did not have long established metering systems in place; it is typical that the newer ISO's have higher operating costs associated with less robust metering structures and the attendant settlements problems as compared with some ISO's that had the benefit of years of experience processing metering data. In addition, ERCOT's unique retail responsibilities and ongoing stakeholder driven market development activities pressure ERCOT's capital expenditures and operating costs.

- **Capital Expenditures.** Capital budget line items and budgets over time are very much a factor of where the different ISO's are in terms of implementing major new market systems and the development timeframe for each project. Some ISO's do not have comparable single large projects underway; while others are nearing completion of major project to re-do the market and operations systems. These ISO's may have less capital expenditures budgeted for 2004. In contrast, ISO's that are in the midst of launching a new market and greater capital expenditures budgeted for 2004. Based on the 2004 budget data, ERCOT's capital budget seem higher than the average of the ISO's examined. This may be reflective by the volume of ongoing market improvements that is a stakeholder driven process and the retail market responsibilities.

- **Debt Service.** ISO debt service obligations vary based on a number of factors, including but not limited to capital investment required to start-up and development of an ISO, debt structures, functional scope and responsibilities of each ISO over time, and market needs. ISO's that were started from existing power pools, are more mature, and have lower capital expenditure requirements looking forward. They also tend to have lower debt obligations, while ISO's that required significant start-up costs or are undergoing significant market changes have higher debt obligations. When all these factors are considered, based on 2003 and 2004 data, ERCOT has long-term debt and debt service obligations in line with ISO's that are still aggressively developing their markets.

4. Efficiency of Costs Dedicated to Reliability Measures

4.1 Definition

KEMA performed a focused review and comparison of ERCOT's operating costs related to their reliability functions. The basic premise for this comparison is to compare resources and operating costs related to each organization's reliability functions against a common set of reliability and power systems related measures.

KEMA used a benchmarking exercise developed by the Transmission System Operators (TSO) organization, which is an international body composed of transmission operators, ISO's and RTOs. The TSO has done extensive work in the benchmarking area and published a paper [1]on the topic. These TSO benchmarks were developed to measure three basic performance quantities; efficiency, productivity and effectivity.

1. Efficiency is defined and calculated as:

   Efficiency [E] = Output [O] / Total Costs [TC]

2. Productivity is defined and calculated as:

   Productivity [P] = Output [O] / Resources [R]

3. Effectivity is defined and calculated as:

   Effectivity [Ef] = Resources [R] / Total Costs [TC]

Efficiency can also be defined as a measure of productivity times the effectivity and plotted on a two-axis chart as shown later in this section.

Output [O] is defined as some of the same reliability related attributes described in Regional Market Attributes section 2.2 and Transmission Statistics section 2.3 of this report. KEMA selected the following attributes to measure and compare reliability metrics: peak load served, transmission miles operated, number of daily schedules processed, number of load flow model busses analyzed, and number of generators dispatched. KEMA recognizes that there may be better "outputs" to measure and compare reliability metrics but the lack of readily available data for the other ISO's impedes that exercise. In the future ERCOT might be more interested in measuring their efficiency in reliability functions with respect to planned vs. unplanned outages, frequency excursions beyond normal operating guidelines, number of reported disturbances to NERC and DOE per year, number of Emergency Electric Curtailment Plan

[1] International Benchmarking of Transmission System Operators – An effort to monitor and improve performance -, Albert DiCaprio, Jens Büchner, Jan van Putten, Jaime Sanchiz Garrote, Chris Stewart

(EECP) events per year, and others. Please also note that these efficiency benchmarks can also be applied to other operating areas and their respective missions, goals, and outputs.

The Total Costs [TC] used was estimated by identifying costs dedicated to the reliability functions of the ISO. These functions are defined under Power Systems Operations section 3.1 of this report. The costs attributed to these functions were adjusted to remove administrative overhead and non-reliability functions like administration of tariffs and contracts, which some ISO's perform under this classification.

The Resources [R] used are estimates of headcounts (FTEs) dedicated to perform the power systems operations related to the outputs and total costs defined above.

Each of the charts shown in the next sections can be interpreted as follows:

- The horizontal x-axis represents the calculated degree of ***productivity*** given by the number of resources (FTEs) used per output (Reliability Related Attribute). The lower the number of FTEs used to serve load for example, the more productive is the organization.

- The vertical y-axis represents the calculated ***effectivity*** in performing the reliability function given by the cost spent per resource. The lower the cost per FTE, the more effectively is the use of those dollars to perform the reliability functions. Since all the charts use the same coefficient for effectivity, the vertical axis results are the same for every chart. It is worth noting that ERCOT has the lowest calculated cost/FTE within the Power System Operations functional grouping.

- The size of the "bubble" assigned to each organization represents the calculated level of ***efficiency*** for the particular output measured. The larger the bubble, the more efficient is the organization in producing the particular output. The ERCOT results are shown in a red and shadowed bubble (labeled ERCOT) in all charts for easier identification.

4.2 Sample Metrics

KEMA utilized a methodology in deriving Benchmark values for the comparisons in this section. KEMA's base assumption is that there is an exact correlation between ERCOT's aggregate annual operating costs and associated detailed functional budgets to the other ISO aggregate annual operating costs and associated detailed functional budgets. This implies the other ISO's in this report have the same allocation at the various identified functional groupings for their detailed budgets, as ERCOT does for its budget. This assumption has not been verified by ERCOT or KEMA and may or may not be true for the other ISO's included in this report.

4.2.1 Efficiency for Peak Load Served

In this measure, ERCOT resulted with the third best productivity ratio and the best efficiency measured. When compared to the computed median and estimated averages for all the samples, ERCOT has a combination of a higher peak load, close to estimated average number of FTEs and lower operating costs.

The following chart represents the efficiency measure for peak load served by ERCOT compared to the ISO's examined.

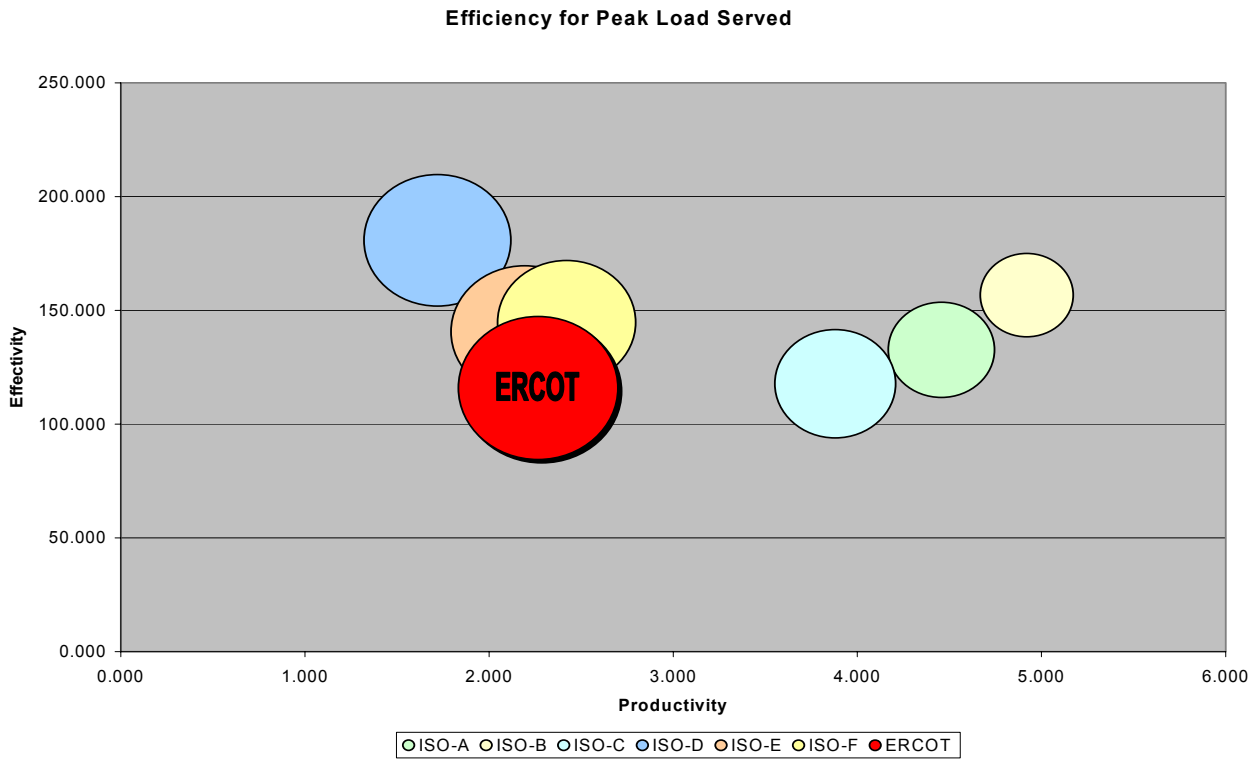


Chart 21 - Efficiency for Peak Load Served

4.2.2 Efficiency for Transmission Miles Served

In this measure, ERCOT resulted with the second best productivity ratio and the best efficiency measured. When compared to the computed median and estimated averages for all the samples, ERCOT has a combination of a higher number of transmission miles served, close to estimated average number of FTEs and lower operating costs.

The following chart represents the efficiency measure for transmission miles served by ERCOT compared to the ISO's examined.

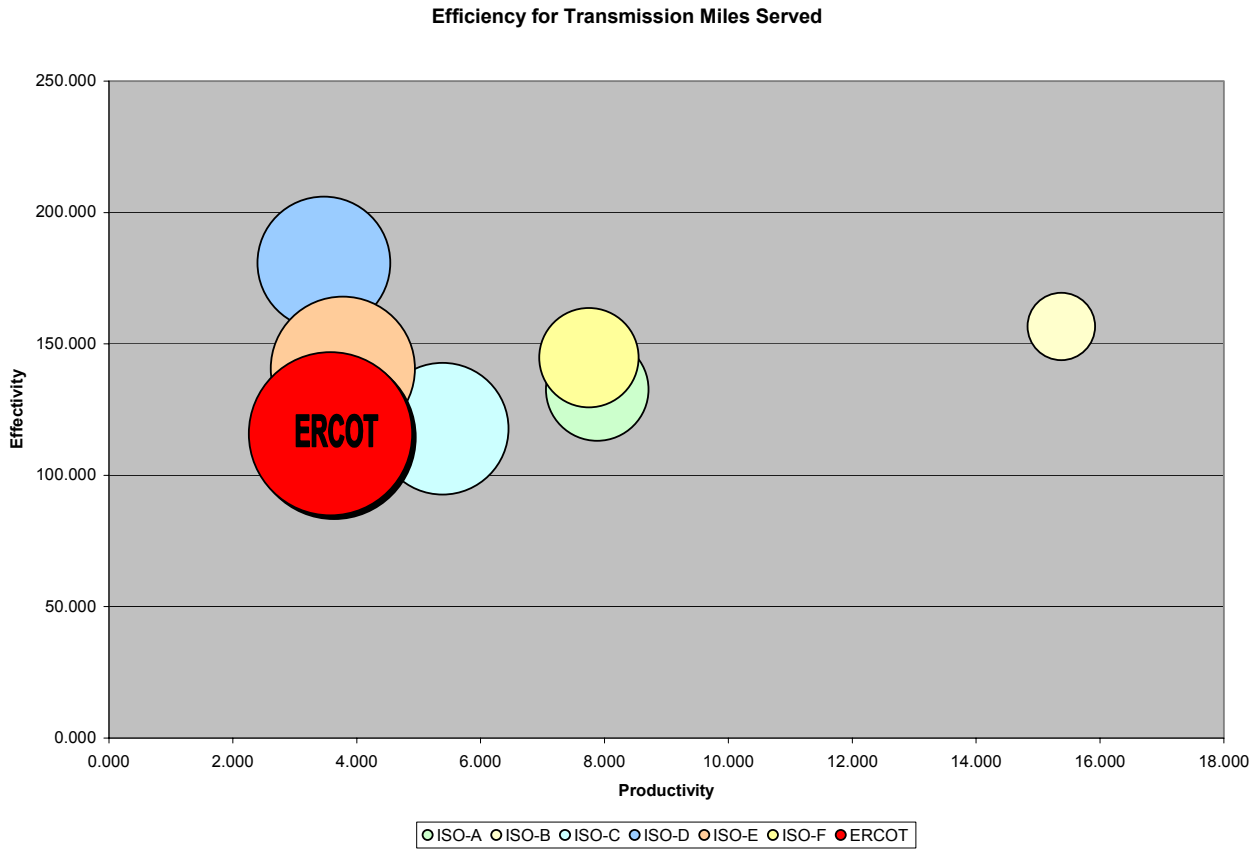


Chart 22 - Efficiency for Transmission Miles Served

4.2.3 Efficiency for Daily Schedules Processed

In this measure, ERCOT resulted with the best productivity ratio and the best efficiency measured. When compared to the computed median and estimated averages for all the samples, ERCOT has a combination of the highest number of daily schedules processed, close to estimated average number of FTEs and lower operating costs.

The following chart represents the efficiency measure for daily schedules processed by ERCOT compared to the ISO's examined.

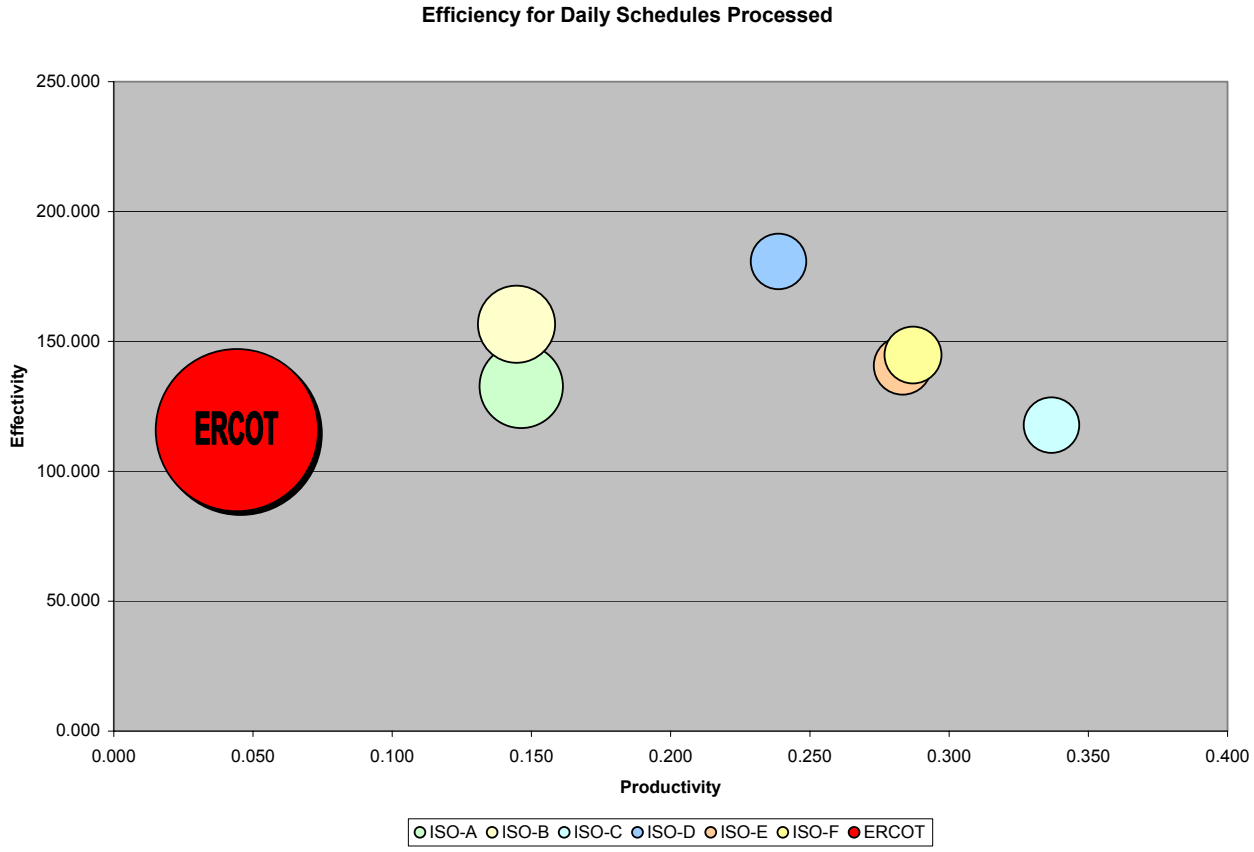


Chart 23 - Efficiency for Daily Schedules Processed

4.2.4 Efficiency for Network Busses Modeled

In this measure, ERCOT resulted with the best productivity ratio and the best efficiency measured. When compared to the computed median and estimated averages for all the samples, ERCOT has a combination of the highest number of busses modeled, close to estimated average number of FTEs and lower operating costs.

The following chart represents the efficiency measure for network model busses modeled in their load flows by ERCOT compared to the ISO's examined.

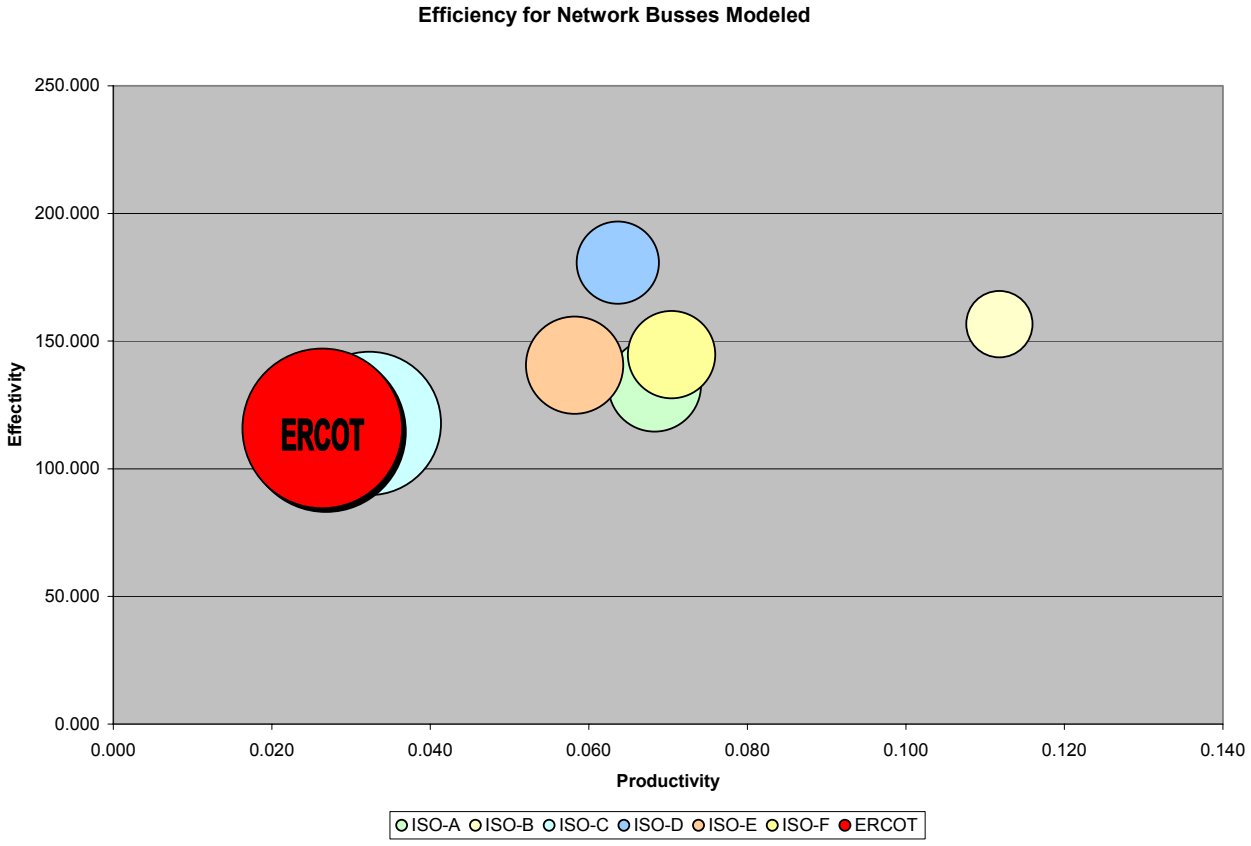


Chart 24 - Efficiency for Network Busses Modeled

4.2.5 Efficiency for Generators Served

In this measure, ERCOT resulted with the fourth best productivity ratio and the third best efficiency measured. When compared to the computed median and estimated averages for all the samples, ERCOT has a combination of a lower number of generators, close to estimated average number of FTEs and lower operating costs

The following chart represents the efficiency measure for generators served by ERCOT compared to the ISO's examined.

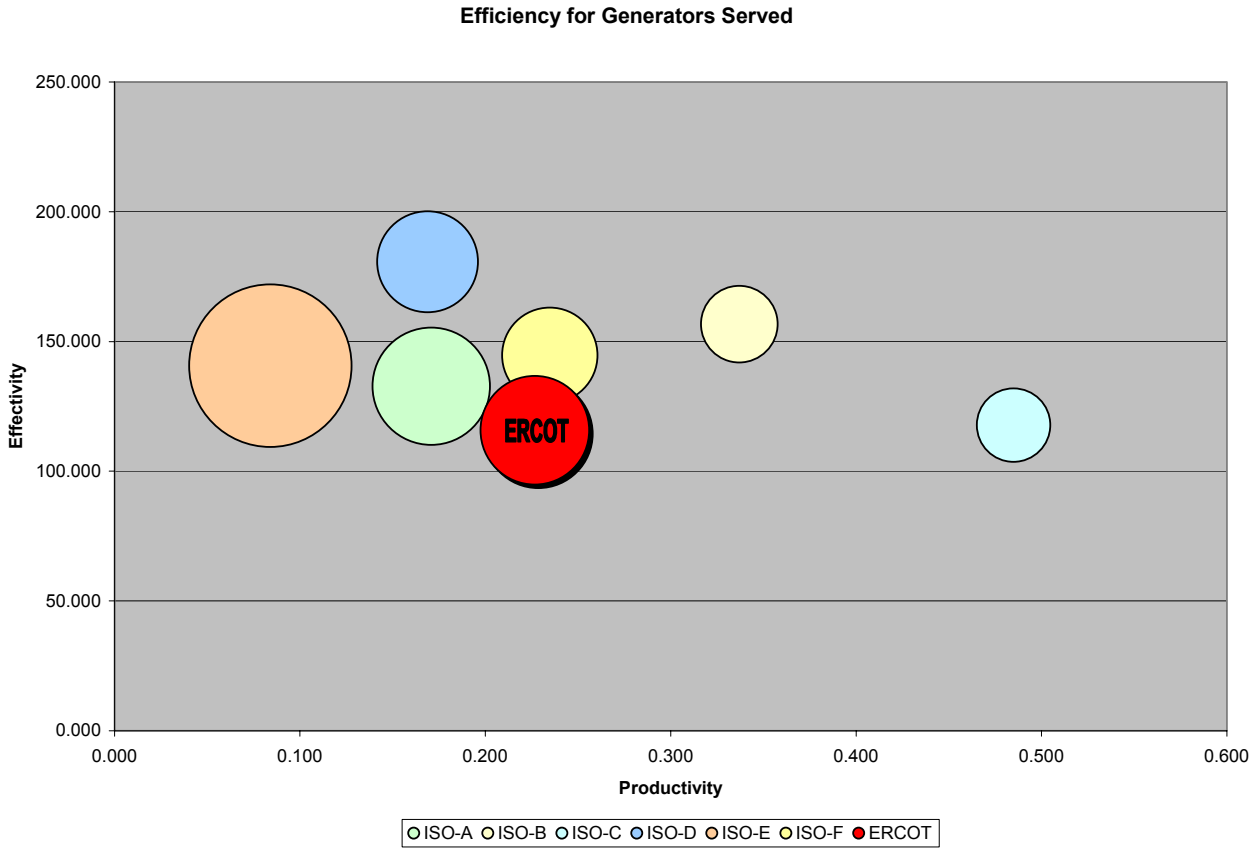


Chart 25 - Efficiency for Generators Served

5. Summary

ERCOT's annual operating costs budgeted for 2004 are about $90M (not including capital expenditures and debt service) and are lower than the estimated average costs among the ISO's examined. In each case the differences between ERCOT costs and the estimated average costs have been attributed to one or more of the cost drivers identified in Cost Drivers section 3 of this report. Differences in market model / ISO responsibilities and functionality are the dominant drivers causing cost differences. The scale or "footprint" of ERCOT operations is not a significant cost driver with the exception of transaction volumes handled. This is because (a) ERCOT's scale in terms of MW, network size, geography is not radically different from the other ISO's and (b) since most business functions are automated the ISO operations tend to scale well. ERCOT's transaction volumes are greater that the estimated average due to the retail markets, which is part of the costs associated with and attributed to retail operations.

It is possible that there are differences in control room and planning costs attributable to different operating conditions – meaning frequency of outages, overloads, plant failures, and the like; and to differences in the rates of new construction in the territory where ERCOT may have higher construction of new generation and transmission facilities than the other ISO's. However, comparative data pertaining to these items was not available and the control room and planning costs are not so different as to make exploring this line of reasoning critical to the report.

The only area where ERCOT's costs are higher than the estimated average and where the difference cannot be attributed to major functionality differences (retail, metering) is ERCOT's costs associated with market evolution and development, and associated stakeholder liaison. We believe that some of the costs embedded in market evolution at ERCOT are identified in other areas by other ISO's which may partially explain relative differences, and that additionally the ERCOT governance and stakeholder process may cause higher rates of incremental change or analysis of market changes at ERCOT than experienced by other ISO's. Also, those ISO's with stable SMD based market structures will have less ongoing change analysis to deal with.

ERCOT has average productivity and efficiency based on several reliability measures including, peak load, transmission miles, daily schedules, and network buses. ERCOT is less than average based on generators served. KEMA recognizes that there may be better productivity and efficiency metrics to measure and compare reliability but the lack of readily available data for the other ISO's impedes that exercise. In the future ERCOT might be more interested in measuring their efficiency in reliability functions with respect to planned vs. unplanned outages, frequency excursions beyond normal operating guidelines, number of reported disturbances to NERC and DOE per year, number of Emergency Electric Curtailment Plan (EECP) events per year, and others.

The following table provides an overall summary of the findings. Please note that KEMA utilized a methodology to derive the Benchmark for the comparison of the various identified functional ERCOT groupings. KEMA's base assumption is that there is an exact correlation between ERCOT's aggregate annual operating costs and associated detailed functional budgets to the other ISO aggregate annual operating costs and associated detailed functional budgets. This implies the other ISO's in this report have the same allocation at the various identified functional groupings for their detailed budgets, as ERCOT does for its budget. This assumption has not been verified by ERCOT or KEMA and may or may not be true for the other ISO's included in this report.

Table 22 - Overall Summary of Findings

Operating Function	ERCOT Budget ($M)	ERCOT Relative to Average	Key Cost Driver	Cost Impact
Power System Operations and Trans Planning				
Control Room	$ 5.32	Lower	ERCOT benefits from some efficiencies in operations and may not have the level of transmission outages / overloads that some of the ISOs have to manage. Also, labor costs are lower.	Decrease
Transmission Planning	$ 2.97	Lower	ERCOT does not have to deal with multiple control areas.	Decrease
Other	$ 7.46	Lower	ERCOT does not do wholesale Interchange / OASIS scheduling to the same degree as the other ISOs.	Decrease
Market Operations & Development				
Market Operations	$ 2.15	Lower	ERCOT market operations are less complex than others, primarily due to no DA energy market and no transmission reservation requirements.	Decrease
Market Evolution & Development	$ 6.11	Higher	Stakeholder driven change initiatives drive increased costs. Some of the other ISOs have mature SMD markets and have lower ongoing evolution costs as a result.	Increase
Centralized Retail Registration	$ 4.08	Higher	ERCOT is unique in operating retail markets and this is a major cost that other ISOs do not have.	Increase
Settlements				
Settlements	$ 1.31	Lower	Transaction volume is lower due to the market structure.	Decrease
Metering	$ 1.03	Higher	ERCOT provides metering services which not all ISOs do; some have little or no costs as participants perform this function.	Increase
Other	$ 1.80	Higher	ERCOT uniquely performs load profiling as part of its retail market operations.	Increase
Market Monitoring				
	$ -	Lower	Other ISOs perform market monitoring. The PUCT performs the bulk of this activity in Texas, although ERCOT has some costs embedded in market operations and IT that support the PUCT market monitoring.	Decrease
Information Technology				
	$ 32.37	Lower	ERCOT costs are slightly lower due to a less complex market structure, lower local labor costs, and the historic costs of IT acquisitions that drive maintenance contracts.	Decrease
Customer Services				
Client Services	$ 1.75	Lower	May be attributed to lower labor costs.	Decrease
Committee Liaison Administration	$ 0.86	Higher	ERCOT currently has a more active stakeholder process than many ISOs for market planning, design and changes compared to relative market maturity of other ISOs.	Increase
Retail Client Support	$ 0.96	Higher	Supporting retail markets is a cost unique to ERCOT.	Increase
Technical Support	$ -	Lower	Some of the ISOs identify this separately, it is embedded in ERCOT market operations and stakeholder process which explains some of the higher costs in those areas.	Decrease
Market Training	$ -	Lower	Some of the ISOs identify this separately, it is embedded in ERCOT market operations and stakeholder process which explains some of the higher costs in those areas.	Decrease
Legal & Regulatory				
Legal Services	$ 2.69	Lower	ERCOT does not have the ongoing litigation of some of the ISOs that drive the costs up.	Decrease
Regulatory and Government Affairs	$ 0.36	Lower	ERCOT does not have to support the FERC filings and tariff activities that burden the other ISOs.	Decrease
Corporate & Executive				
Finance	$ 4.46	Higher	ERCOT has higher finance department costs due to the burden of credit management in the retail operations.	Increase
Internal Audit	$ 0.21	Lower	May be attributed to lower labor costs.	Decrease
Executive Office	$ 0.69	Lower	Some of the other ISOs have corporate strategic planning officers in these costs.	Decrease
Human Resources	$ 0.71	Lower	May be attributed to lower labor costs.	Decrease
Facilities	$ 5.97	Higher	ERCOT has slightly higher costs, than the other ISOs – this may be reflected by slightly higher aggregate cost due to multiple facilities, security, maintenance, local area network charges, utilities, and property taxes required to support projects.	Increase
Project Management	$ 0.63	Lower	ERCOT does not have major ongoing market redesign projects underway. ERCOT categorizes some of these costs under market operations which partially explains why that category is higher than average.	Decrease
Corporate Communications	$ 0.47	Higher	Other ISOs may embed this in client services, or other categories. All have activities in this area.	Increase
Board and Governance	$ 0.31	Lower	ERCOT identifies some of these costs under customer service.	Decrease
Strategy and Development	$ -	Lower	ERCOT identifies these costs under market operations.	Decrease
Insurance	$ 1.75	Lower	Better contracts and/or local rate benefits.	Decrease