ENERGY COSTS IN THE WA MINERALS INDUSTRY

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DISCUSSION PAPER 99.24

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1. Introduction

As a result of deregulation of the WA electricity and gas markets in the mid-1990s and the associated enhanced competition in energy supply, energy costs have fallen. For example, gas prices in the Pilbara region have fallen by half over the course of the 1990s. There is still considerable scope for further reductions in energy costs in WA. Institutional reform involving the breakup of existing monopoly providers of coal, gas and electricity and more competition could see gas and electricity prices fall further, by the order of 25 percent. Some indication of the scope for further falls in electricity prices is given by Figure 1 which shows that WA prices are the highest in Australia.

![Figure 1: Comparison of Electricity Tariffs by State](image)


In order to analyse the effects of lower energy prices on the resources sector and on the broader WA economy, the ERC has been carrying out a project “Energy Costs and Mineral Production in WA”, sponsored by Australian Research Council. An important element of this project is information regarding the structure of energy
costs for WA industries. Due to the importance of mining and mineral processing in
WA, the energy data are required for this industry in particular.

2. Can Official Sources Provide the Data?

To obtain information on energy costs, the following organisations have been
either contacted or their publications and web sites have been examined:

- WA Office of Energy
- WA Department of Minerals and Energy
- WA Department of Resources Development
- Australian Bureau of Agricultural and Resource Economics (ABARE)
- Australian Bureau of Statistics (ABS)

The first 3 are WA government departments mainly engaged in setting rules and
taking various regulative responsibilities. Data on energy prices are confidential and
not available (for example, the WA Office of Energy will not reveal information on
energy prices). Therefore, it is impossible for them to provide detailed cost data.

ABARE (1999) does provide data on energy consumption and production by
state, as well as by the nation, from 1973/74. But the data are in physical units/energy
equivalents only. As energy prices are not readily available, the physical
measurement makes it difficult to convert the data into value terms. Therefore
ABARE’s energy data are not well-suited for the current study. The ABS publish
Energy Accounts for Australia (Catalogue No. 4604.0). This publication provides
accounts, at the national level, showing energy resources, production, conversion and
consumption, as well as residuals discharged into the natural environment at the
national level. The major energy forms shown in the accounts are petroleum, coal,
electricity, uranium, biomass (wood and bagasse), and other renewable resources such
as wind and solar energy. Two major limitations of this publication make it
unsuitable for the current study. One is that the statistics are in physical
measurements, a limitation similar to that of ABARE’s energy data. Another
limitation is that the end use of energy by sector is too aggregated as the sectors are
Agriculture, Mining, Iron and steel, Chemical, Other industry, Construction, Road

2
transport, Rail transport, Air transport, Water transport, Commercial, Residential and Others. As most of the mineral-processing industries are combined with other industries, this source is not well-suited for WA.

The Manufacturing Section of the ABS runs a Manufacturing Collection every year. The main purpose of the collection is to provide data to the Input-Output Section in Canberra. Based on their surveys, the ABS provided unpublished data relating to metal product manufacturing for the year 1994/95. The energy inputs covered by the data are electricity, gas for fuel, petroleum fuel products, coal for fuel and other fuels. For Australia, New South Wales, Victoria and Queensland, data for industry groups (3 digit ANZSIC) are available; while for South Australia, Western Australia and Tasmania, only data for industry subdivision (2 digit ANZSIC) are available. Similar data for mining industries are not available. Table 1 presents a comparison of the energy costs in the metal product manufacturing industry by state. Panel A of the table expresses total energy as a percentage of value added by manufacturing industry. Panels B and C contain the within-energy cost shares, which express expenditure on each type of energy as a percentage of all total energy costs. Figure 2 gives a plot of these shares. Two prominent features emerge from this figure:

- In these industries, the energy cost share is highest in WA, reflecting a combination of high physical intensity and high prices.

- In terms of the specific form of energy consumed in WA, 86 percent is accounted for by Coal, oil and gas, again the highest in Australia.

3. The ERC Survey of Energy Costs

Since the ABS energy data for WA are available only for metal product manufacturing at the industry subdivision level (2 digit ANZSIC) and there are no data available for the mining industry at all, the information available is far from complete. Detailed information on energy costs for the mining industry as a whole and for sub-industry groups of both mining and mineral-processing industries remains
**TABLE 1**

ENERGY USAGE IN METAL PRODUCT MANUFACTURING INDUSTRY, 1994-95

(Percent)

<table>
<thead>
<tr>
<th>Using industry (1)</th>
<th>NSW (2)</th>
<th>VIC (3)</th>
<th>QLD (4)</th>
<th>SA (5)</th>
<th>WA (6)</th>
<th>TAS (7)</th>
<th>AUS (8)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Total energy (Percent of value added by manufacturing industry)</td>
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<td></td>
<td></td>
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<td></td>
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<tr>
<td>Basic metal products</td>
<td>2.4</td>
<td>.4</td>
<td>5.0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3.0</td>
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<tr>
<td>Fabricated metal products</td>
<td>.3</td>
<td>.3</td>
<td>.2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>.2</td>
</tr>
<tr>
<td>Total metal product manufacturing</td>
<td>2.6</td>
<td>1.6</td>
<td>5.2</td>
<td>1.9</td>
<td>8.6</td>
<td>6.5</td>
<td>3.3</td>
</tr>
<tr>
<td>B. Coal, oil and gas (Percent of total energy costs)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basic metal products</td>
<td>28.1</td>
<td>35.9</td>
<td>57.3</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>46.6</td>
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<tr>
<td>Fabricated metal products</td>
<td>32.1</td>
<td>27.9</td>
<td>34.6</td>
<td>-</td>
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<td>32.5</td>
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<tr>
<td>Total metal product manufacturing</td>
<td>28.5</td>
<td>22.1</td>
<td>56.3</td>
<td>56.6</td>
<td>86.4</td>
<td>14.0</td>
<td>45.5</td>
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<tr>
<td>C. Electricity (Percent of total energy costs)</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basic metal products</td>
<td>71.9</td>
<td>64.1</td>
<td>42.7</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>53.4</td>
</tr>
<tr>
<td>Fabricated metal products</td>
<td>67.9</td>
<td>72.1</td>
<td>65.4</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>67.5</td>
</tr>
<tr>
<td>Total metal product manufacturing</td>
<td>71.5</td>
<td>77.9</td>
<td>43.7</td>
<td>43.4</td>
<td>13.6</td>
<td>86.0</td>
<td>54.5</td>
</tr>
</tbody>
</table>

Sources:
1. Energy cost figures are from ABS unpublished data.
2. Data on value added by Manufacturing are from Australian Bureau of Statistics (1997).
FIGURE 2

COMPARISON OF ENERGY COSTS IN METAL PRODUCT MANUFACTURING INDUSTRY, 1994-95

A. All energy

B. Electricity

C. Coal, oil and gas
unknown. To overcome this problem, the ERC, with the help of the Chamber of Minerals and Energy of WA, conducted a survey of WA mining companies. The survey collected data on sales revenue, the size of workforce, the proportion of products exported, and the forms and value of energy consumed. In subsequent sections, we present an overview of the survey results. Due to the confidentiality of the individual returns, the responses are set out in summary form.

The survey was distributed to 46 minerals companies who are Production Members of the Chamber. As 21 companies responded to the survey, the response rate was about 46 percent. Table 2 classifies the respondents' activity into three categories -- mining, mineral processing, and both mining and mineral processing. Most of these companies (12 out of 21) are gold producers, and the rest are engaged in the production of iron ore, alumina, nickel, coal, zirconia, heavy mineral sands, and other minerals.

TABLE 2

THE BUSINESS OF THE RESPONDENTS

<table>
<thead>
<tr>
<th>Industry category</th>
<th>Number of respondent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mining</td>
<td>9</td>
</tr>
<tr>
<td>Mineral processing</td>
<td>4</td>
</tr>
<tr>
<td>Both mining and mineral processing</td>
<td>8</td>
</tr>
<tr>
<td>Total</td>
<td>21</td>
</tr>
</tbody>
</table>

1 The classification is based on the definitions given in the 1993 edition of the Australian and New Zealand Standard Industrial Classification (ANZSIC) (1292.0). According to ANZSIC, mining broadly relates to the extraction of minerals occurring naturally as solids such as coal and ores; liquids such as crude petroleum; or gases such as natural gas. It also includes a variety of services to mining and mineral exploration. Mineral processing broadly relates to the physical or chemical transformation of minerals into mineral materials or components into new products. It includes (i) petroleum, coal, and associated product manufacturing; (ii) non-metallic mineral product manufacturing; and (iii) metal product manufacturing.
4. **Company Size**

Sales revenue of the companies ranges from around $20 million p.a to $1.5 billion, with an average of $275 million; see Figure 3. Figure 4 presents the frequency distribution of sales and, as can be seen, most companies are in the category of less than $50 million.

The size of the workforce varies substantially across companies. The smallest hires less than 50 people, while the largest employs about 5,500. The average employment is about 850. See Figures 5 and 6. Figures 7 and 8 present information on sales per worker. For all companies except two, sales per worker fall in the range of $.2 - $.5 million; the modal range is $.3 - $.4 million. We investigate the relationship between the size of workforce and sales by regressing the former on the latter. This yields:

\[
\text{Workforce} = 41.69 + 3.15 \times \text{Sales} \\
(166.2) \quad (.35)
\]

\[R^2 = .82,\]

where standard errors are given in parenthesis. As the constant term is not significant, suppressing it gives the following result:

\[
\text{Workforce} = 3.20 \times \text{Sales} \\
(.28)
\]

This indicates that when sales rise by $1 million, employment increases by three and a bit jobs. Figure 9 presents the corresponding scatter plot.

5. **Energy Costs**

Total energy cost p.a. of the 21 companies is $673 million. The annual energy costs of the sample companies range from around $2 million to $300 million, with an average of about $30 million. See Figures 10 and 11. Energy costs are less than $5 million in 8 companies, between $5 - $10 million in 5 companies, between $10-$50 million in another 5 companies and more than $50 million for 3 large users. Figure
FIGURE 3

SALES

Note: Due to confidentiality, sales for one company are not available.

FIGURE 4

FREQUENCY DISTRIBUTION OF SALES
FIGURE 5

WORKFORCE

Workforce (Jobs)

<table>
<thead>
<tr>
<th>Company</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
<th>16</th>
<th>17</th>
<th>18</th>
<th>19</th>
<th>20</th>
<th>21</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>7</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
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<td>1</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

FIGURE 6

FREQUENCY DISTRIBUTION OF WORKFORCE

Frequency

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>
FIGURE 7

SALES PER WORKER

Sales per worker
($m)

1 2 3 4 5 6 7 8 9
10 11
12 13 14 15 16 17 18 19
20
Company

Mean

FIGURE 8

FREQUENCY DISTRIBUTION OF SALES PER WORKER

Frequency

< .2 .21 - .3 .31 - .4 .41 - .5 .51 - .6 .61 - .7 .71 - .8
Sales per worker ($m)
FIGURE 9

THE RELATIONSHIP BETWEEN WORKFORCE AND SALES

Workforce (Jobs)

Sales ($m)

\[ \text{Workforce} = 3.20 \times \text{Sales} \]

\[ R^2 = 0.82 \]

FIGURE 10

TOTAL ENERGY COSTS

Energy costs ($m)

Company
12 presents the ratio of the energy costs to sales. These ratios vary from about 1 percent to 22 percent, with an average of 9 percent. The frequency distribution of the cost shares is given in Figure 13 from which it can be noted that most companies' energy ratios fall in the range of 5 – 10 percent. The second most prominent range is 10 – 15 percent.

The following are the empirical relationships between energy costs and (i) sales and (ii) workforce:

(i) \[ \text{Energy costs} = -13.785 + 0.171 \text{ Sales} \]
\[ R^2 = 0.90 \]
\[ (6.467) \ (0.014) \]

(ii) \[ \text{Energy costs} = -6.087 + 0.043 \text{ Workforce} \]
\[ R^2 = 0.70 \]
\[ (10.999) \ (0.007) \]

Equation (i) indicates that when sales increase by $1 million, energy costs rise by about $.2 million. According to equation (ii), an additional job causes energy costs to increase by about $.04 million. Figures 14 and 15 give the plots corresponding to equations (i) and (ii).
FIGURE 12

RATIO OF ENERGY COSTS TO SALES

FIGURE 13

FREQUENCY DISTRIBUTION OF RATIO OF ENERGY COSTS TO SALES
Though the intercept in equation (i) is significant, the intercepts in both equations have the wrong signs. This seems to be caused by a few extremely large observations indicated by large triangles in Figures 14 and 15. An analysis shows that those large observations have very large residuals. The effect of including these outliers is to make the regression lines steeper and the intercepts negative, as shown in the figures. To eliminate the influence of these outliers, equations (i) and (ii) are reestimated with those observations omitted. The new estimates are as follows:

\[ (i') \quad \text{Energy costs} = 0.366 + 0.070 \text{ Sales} \quad R^2 = 0.50, \]  
\[ (3.817) \quad (0.017) \]

\[ (ii') \quad \text{Energy costs} = 1.191 + 0.017 \text{ Workforce} \quad R^2 = 0.56. \]  
\[ (2.141) \quad (0.004) \]
Equation (i') suggests that a $1-million rise in sales leads to an increase in energy costs by about $.1 m. Equation (ii') indicates that a new job entails energy costs rising by about $.02 m. Both intercepts are now positive, but they are not significantly different from zero. Figures 16 and 17 give the plots with the outlying observations excluded.

6. **Types of Energy**

The survey also contains information on various forms of energy consumed -- gas, electricity, coal, diesel and other. Figure 18 shows the costs by energy form, averaged over companies. The averages range from around $.2 million for other to $16 million for gas. Figure 19 gives the share of the total energy costs accounted for by each form. As can be seen, about half of energy costs are accounted for by gas
consumption. Electricity accounts for the second largest share (28 percent), followed by diesel (20 percent). The three types of energy account for about 97 percent of total energy costs.

7. Energy Suppliers

From where do the companies source their energy? Table 3 presents the information on energy suppliers. Columns 2 and 3 show the number of users each supplier serves. As can be seen, Kleenheat is the main supplier in the gas market; Western Power dominates the electricity supply; and BP and Shell share the diesel market. But the number of users does not give a complete picture of each supplier's economic importance. Column 4 presents each supplier's share in the total dollar
value of the sales for each energy type. As can be seen, though Kleenheat serves half of the gas users, it only accounts for .2 percent of total gas costs. While North West Shelf Gas supplies only two users, it accounts for about 77 percent of total gas costs. Similarly, TransAlta Energy has only one customer, but it accounts for about 46 percent of total electricity costs, which is almost the same as that of Western Power who serves 12 customers. Column 5 of the table and Figure 20 shows the shares of total energy usage accounted for by different suppliers. It can be seen that North West Shelf Gas is the largest energy supplier for minerals companies. Other prominent suppliers include BP, Western Power and TransAlta Energy.
FIGURE 18

AVERAGE ENERGY COSTS BY ENERGY FORM

FIGURE 19

SHARES OF ENERGY COSTS BY ENERGY FORM
## TABLE 3

### SUPPLIERS OF ENERGY

<table>
<thead>
<tr>
<th>Energy supplier</th>
<th>Users</th>
<th>Supplier's share</th>
<th>Percent of grand total costs by type</th>
<th>Percent of energy costs by type</th>
<th>Percent of total users</th>
<th>Percent of energy costs by type</th>
<th>Percent of total users</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
<td>(6)</td>
<td>(7)</td>
</tr>
<tr>
<td>Gas</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>East Spar Joint Venture</td>
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<td>7.3</td>
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<td>3.0</td>
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<td>20.0</td>
<td>100.0</td>
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<tr>
<td>Coal</td>
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<tr>
<td>Griffin</td>
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<td>2.5</td>
<td>100.0</td>
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</tr>
<tr>
<td>Other</td>
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<td>Tosco Refining</td>
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<td>94.8</td>
<td>.7</td>
<td>25.0</td>
<td>94.8</td>
<td>.7</td>
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<tr>
<td>Other</td>
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<td>5.2</td>
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<td>.0</td>
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<tr>
<td>Total</td>
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<td>100.0</td>
<td>.7</td>
<td>100.0</td>
<td>.7</td>
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<td>Grand total</td>
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</tr>
</tbody>
</table>
8. **Energy Prices**

Table 4 presents prices for electricity, gas and diesel. As can be seen, prices vary substantially across users. The average price is $0.09 per KWhr for electricity, $4.05 per GJ for gas and $0.20 per litre for diesel. Due to the extremely limited number of users, prices for coal and other forms of energy are not given here.
TABLE 4

ENERGY PRICES

<table>
<thead>
<tr>
<th>Energy</th>
<th>Price</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
</tr>
<tr>
<td>Electricity ($/KWhr)</td>
<td>.07</td>
</tr>
<tr>
<td>Gas ($/GJ)</td>
<td>1.90</td>
</tr>
<tr>
<td>Diesel ($/Litre)</td>
<td>.22</td>
</tr>
</tbody>
</table>
ATTACHMENT

ENERGY COST SURVEY
ENERGY COST SURVEY

ALL RESPONSES WILL BE TREATED AS STRICTLY CONFIDENTIAL

If you have any query in completing this form, please contact

Dr Ye Qiang
Economic Research Centre
The University of Western Australia
Telephone: 9380 3638
Facsimile: 9380 1073
Email: yqiang@ecel.uwa.edu.au

Person we should contact if any queries arise regarding your responses

<table>
<thead>
<tr>
<th>Name</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Telephone Number</td>
<td></td>
</tr>
<tr>
<td>Facsimile Number</td>
<td></td>
</tr>
<tr>
<td>Email Address</td>
<td></td>
</tr>
</tbody>
</table>

PLEASE RETURN THIS BY JUNE 11, 1999
1. Please read the following text box

Mining broadly relates to the extraction of minerals occurring naturally as solids such as coal and ores; liquids such as crude petroleum; or gases such as natural gas. It also includes a variety of services to mining and mineral exploration.

Mineral processing broadly relates to the physical or chemical transformation of minerals into mineral materials or components into new products. It includes (i) petroleum, coal, and associated product manufacturing; (ii) non-metallic mineral product manufacturing; and (iii) metal product manufacturing.

-- The 1993 edition of the Australian and New Zealand Standard Industrial Classification (ANZSIC) (1292.0)

What is the major activity of your company? Please indicate by ticking the appropriate box.

- **Mining**
  - [ ]

- **Mineral processing**
  - [ ]

- **Other (Please state)**
  - [ ]

2. What major product(s) does your company produce? Please tick the appropriate box(es).

- **Petroleum**
  - [ ]

- **Iron ore**
  - [ ]

- **Gold**
  - [ ]

- **Alumina**
  - [ ]

- **Nickel**
  - [ ]

- **Heavy mineral sands (ilmenite, rutile, leucoxene, zircon)**
  - [ ]

- **Diamonds**
  - [ ]
Base metals (Copper, Lead and Zinc)
Manganese
Salt
Coal
Tantalite, Tin, Spodumene
Other (Please state)_________________________________________

3. What was the approximate sales revenue of your company in the last year?

$________ million

4. What proportion of your sales represent exports? Please tick the appropriate box.

Less than 5 percent
5 - 10 percent
11 - 20 percent
21 - 30 percent
31 - 40 percent
41 - 50 percent
51 - 60 percent
61 - 70 percent
71 - 80 percent
Over 80 percent
5. What is the current total workforce of your company? Please tick the appropriate box. (If you have hired contractors, please provide an estimate.)

- Less than 50 people
- 51 - 100 people
- 101 - 200 people
- 201 - 300 people
- 301 - 400 people
- 401 - 500 people
- 501 - 600 people
- 601 - 800 people
- 801 - 1,000 people
- 1,001 - 1,500 people
- 1,501 - 2,000 people
- 2,001 - 3,000 people
- Over 3,000 people

6. What was the approximate cost of your energy purchases (including energy used up in producing energy) in the last year? Please give the cost in the appropriate box(es). (If you have hired contractors, please provide an estimate.)

- Electricity $ 
- Gas $ 
- Coal $ 
- Diesel $ 
- Other forms of energy $
7. Who are your major energy suppliers? Please provide supplier names.

Electricity
Gas
Coal
Diesel
Other forms of energy

8. What are the approximate average prices that you pay for energy? Please indicate prices of the relevant forms of energy.

Electricity $________ per ________
Gas $________ per ________
Coal $________ per ________
Diesel $________ per ________
Other forms of energy $________ per ________

Thank you for completing this form

Please post it by June 11 1999 to:

Dr Ye Qiang
Economic Research Centre
The University of Western Australia
Nedlands, WA 6907
Fax: (08) 9380 1073

If you would like a copy of a paper describing the results of this survey, please give your name and address and we will send it to you:

Name __________________________________________
Address ________________________________________
_______________________________________________
_______________________________________________
REFERENCES

