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The energy–competitiveness relationship

Uncovering energy costs' impact on the competitiveness of Australia's industries.

Industrial energy costs in Australia

Measuring the response of:

- 1 Energy efficiency to energy price changes
- 2 Export competitiveness to energy intensity/cost changes

The switch to cleaner technologies and the impact of related government assistance



Background



Environmental considerations and rising energy costs have thrust energy use and energy efficiency to the fore



Energy costs have been rising in Australia, particularly for certain industries like Manufacturing



The extent to which energy costs impact on competitiveness is not well known in Australia

Energy prices

Higher energy prices in Australia have not been fully offset by reductions in energy intensity, resulting in rising energy costs over time



International competitiveness

Rising energy costs have a negative impact on the international competitiveness of energy intensive industries. Its significance, however, is generally overshadowed by other factors



Reduced emissions

Policy measures designed to encourage a switch to cleaner technologies have successfully reduced emissions



CleanTech

Government assistance (CleanTech) had wider impacts by also boosting business performance





Rising energy costs have the potential to affect both individual businesses (at the micro level) and broader economic activity and competitiveness (at the macro level). The impact will be greater for businesses that specialise in energy-intensive products or for businesses that are not as energy efficient as their competitors. While energy price rises may induce firms to become more energy efficient, the response is unlikely to fully offset the price rise — meaning energy costs rise when energy prices rise reducing competitiveness.

In Australia, industrial electricity prices have outpaced inflation between 2002–03 and 2013–14 by a factor of three.⁴⁴ In contrast to electricity, industrial natural gas prices have more closely tracked CPI over the same time period. But the recent opening-up of domestic natural gas to international markets is likely to bring increased volatility.

The impact of changing energy costs on industry competitiveness is not well known in Australia. This chapter investigates the energy efficiency response (as measured by energy intensity) of industries to energy price changes using Australian energy data. The chapter also explores how changes in energy intensity and energy costs affect the export competitiveness of industries. The relationship is explored fully by a research paper that is available from the Office of the Chief Economist (OCE) website.⁴⁵

Analysing energy costs is worthwhile for four reasons.

1. Energy costs as a proportion of total costs are prominent and rising for certain industries, such as Manufacturing and Transport, Postal & Warehousing. This can be observed for Australia and many other developed and developing countries throughout the world.
2. Energy policy is becoming more important. One of the key priorities of the *Energy White Paper* released in 2015 was keeping energy prices down while increasing energy productivity.⁴⁶ Similarly, the *National Energy Productivity Plan 2015–2030* (NEPP) outlines measures to improve Australia's energy productivity by 40 per cent by 2030.⁴⁷ Energy reform is also touted in the *Competition Policy Review*, including reference to deregulation of electricity and natural gas prices.⁴⁸ The *Industry and Innovation Competitiveness Agenda* highlights the need to improve regulation to provide competitive energy prices and greater choice for Australian households and businesses.⁴⁹
3. Energy sectors around the world are making the transition to low-carbon generation technologies to slow the effects of climate change. Within this trend, the overarching objectives of a competitive, reliable, affordable and secure energy system remain important.

As part of this transition, Australia has committed to reducing the impacts of climate change through the United Nations Conference of Parties (COP) 21 Paris Agreement.⁵⁰ Policy makers need to know how energy markets and related reforms will affect the economy as a result of this commitment.

4. Energy efficiency measures to reduce energy costs are growing in importance in most countries.

⁴⁴ Based on ABS custom data request

⁴⁵ Horne M and Reynolds C (2016) *Energy costs and export competitiveness: evidence from Australian industries*, Department of Industry, Innovation and Science, Research Paper (forthcoming)

⁴⁶ Department of Industry and Science (2015) *2015 Energy White Paper*, p. 2, report

⁴⁷ COAG Energy Council (2015) *National Energy Productivity Plan 2015–2030*, p. 4, report

⁴⁸ Harper et al. (2015) *The Australian Government Competition Policy Review*, p. 52

⁴⁹ Australian Government (2014) *Industry Innovation and Competitiveness Agenda*, Canberra, Box B3, pp. 41–42

⁵⁰ 2015 United Nations Climate Change Conference, held in Paris, France, from 30 November to 12 December

To determine the impact that energy costs have on competitiveness, analysis summarised in this chapter adopts the methodology of *Energy Efficiency and EU Industrial Competitiveness: Energy Costs and their Impact on Manufacturing Activity* by the Vienna Institute.⁵¹ In the report, the authors conduct a cross-country study of the Manufacturing industry to investigate whether:

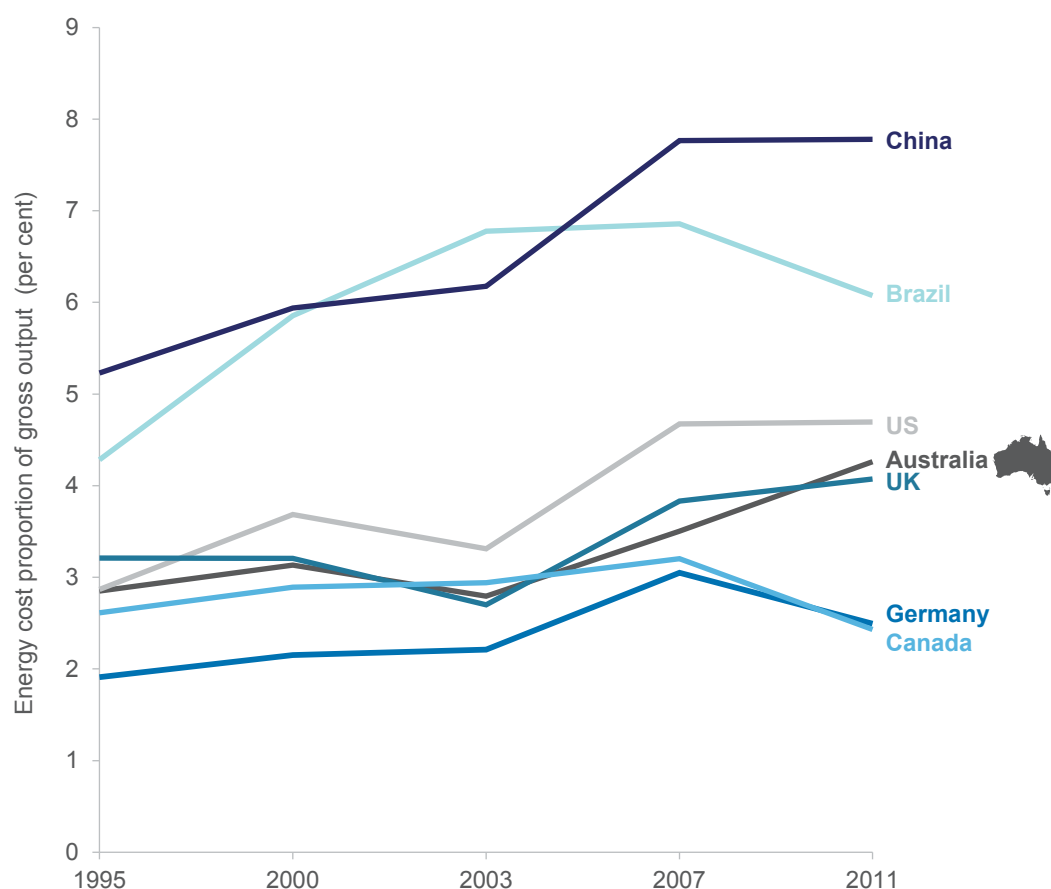
- energy price shocks drive energy efficiency improvements
- energy intensity or energy costs impact competitiveness, as measured by revealed comparative advantage (RCA).

Energy costs vary by country and by industry

Changes to energy costs relative to output have competitiveness implications. All else being equal, rising energy costs imply that a firm or industry is becoming less competitive compared to similar firms or industries.

From a whole-of-economy perspective, the magnitude of energy costs is influenced by the types of industries that make up the economy (Figure 4.1). Service-based economies such as Australia and the UK typically have lower proportional energy costs than more heavy-industry based economies such as China. In addition to the structural composition of an economy, the type of energy generation (the energy mix) impacts on energy cost levels as well.

Figure 4.1: Energy cost inputs to production as a percentage of gross output, Australia and selected countries, 1995 to 2011



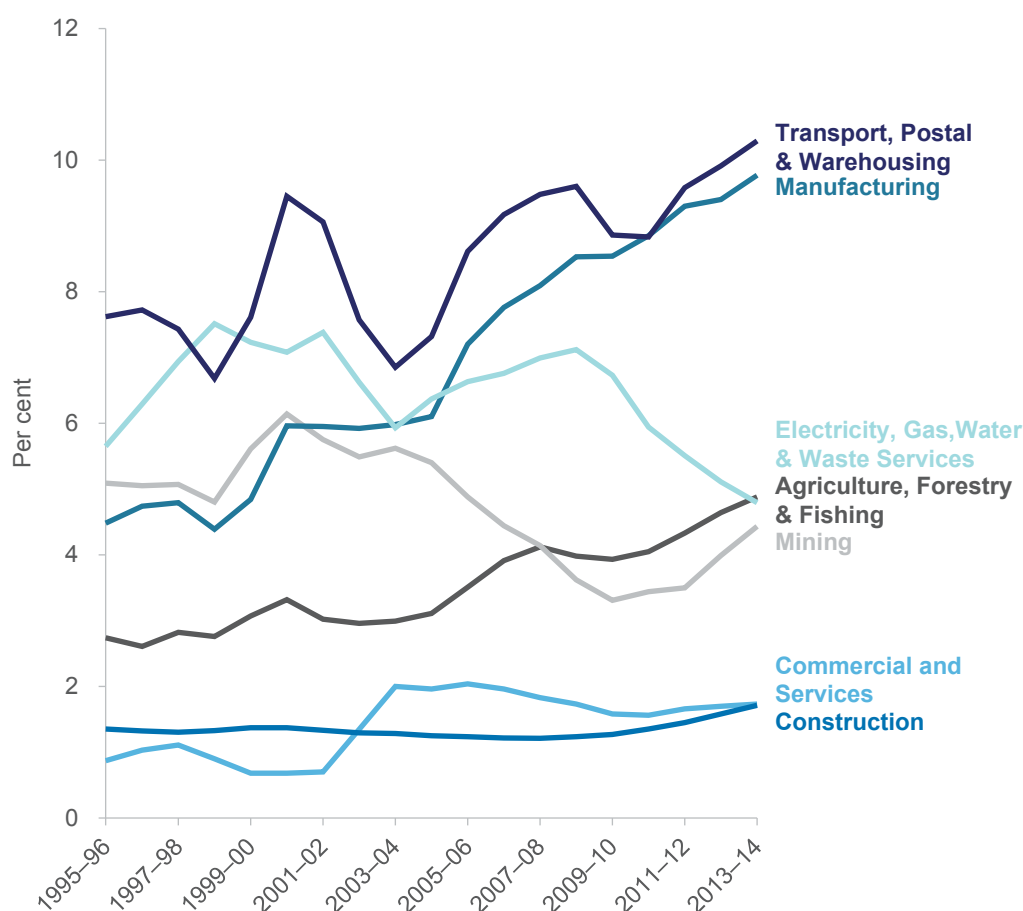
Source: World Input Output Database (WIOD)

⁵¹ Astrov V et al. (2015) *Energy Efficiency and EU Industrial Competitiveness: Energy Costs and their Impact on Manufacturing Activity*, The Vienna Institute for International Economic Studies, Research Report 405

This comparison of country energy costs is made possible by using the *World Input Output Database (WIOD)*.⁵² However, data is only available up to 2011. Since 2011 commodity prices have fallen, coinciding with (and being partly driven by) a large increase in the supply of energy, including the ‘shale gas boom’. These developments have led to a fall in overall energy costs for certain countries.

Estimates for Australian industrial energy costs since 2011 are available from the ABS’ new experimental estimates of Capital, Labour, Energy, Materials and Services (KLEMS). For certain industries (such as those in Commercial & Services and Construction) energy costs as a proportion of total costs are small and relatively unchanged over time (see Figure 4.2). But energy costs for Manufacturing and Transport, Postal & Warehousing increased sharply to around 10 per cent in 2013–14.

Figure 4.2: Energy cost as a proportion of capital, labour, energy, materials and services (KLEMS) input costs, 1-digit industries, 1995–96 to 2013–14



Notes: The KLEMS estimates for industry energy inputs do not necessarily align with the industry energy inputs calculated in Table 3.1 in the previous chapter. KLEMS estimates classify electricity transmission, distribution, on-selling and electricity market operation; and gas supply as a service input rather than energy input.

Source: ABS cat. no. 5260.0 *Experimental Estimates of Industry Level KLEMS Multifactor Productivity, 2013–14*

The ABS KLEMS estimates define cost inputs using a more granular classification that cannot be achieved using publicly available ABS data, as used in Chapter 3. The main difference is that aspects of electricity transmission, distribution and on selling; and gas distribution are classified as services costs rather than energy costs. This means that the industry estimates of energy costs in Table 3.1 do not necessarily align with the estimates in Figure 4.2.

⁵² Timmer M et al. (2015) An Illustrated User Guide to the World Input-Output Database; the Case of Global Automotive Production, *Review of International Economics*, 23, pp. 575–605

Within these 1-digit industry groups, certain sub-industries have an even higher proportion of energy costs. For instance, electricity and natural gas inputs to Basic Non-Ferrous Metal Manufacturing were equal to 76 per cent of its Gross Value Added (GVA) in 2013–14.⁵³ Additional energy-intensive sub-industries are Pulp, Paper & Paperboard Manufacturing and Natural Rubber Product Manufacturing.

Despite these figures, aggregate energy costs as a proportion of gross output for the economy as a whole remain low. The *WIOD* shows that Australia's energy inputs have increased from three per cent of gross output in the mid-1990s to just above four per cent in 2011.⁵⁴ The KLEMS data tells a similar story.

What can levels of energy intensity tell us about energy efficiency?

The energy efficiency of firms and industries has improved markedly over time, both in Australia and throughout the world. Improvements in energy efficiency at the economy and industry levels are typically tracked by measures of energy intensity.

Analysis reported in this chapter defines energy intensity as energy product (total energy, electricity or natural gas) used per unit of real GVA. High levels of energy intensity are generally associated with low levels of energy efficiency and vice versa. The benefit of analysing energy intensity (rather than energy use or energy efficiency) is that output produced per unit of energy is easily comparable across countries or industries.

However, it does have one key limitation: it is not a direct measure of energy use or energy efficiency, and so improvements in energy intensity are not necessarily due to improvements in energy efficiency. It may be due to a changed structural composition of the economy (to less energy-intensive industries), or a changed level of real output.⁵⁵ This means care needs to be taken when interpreting changing energy intensity in the context of energy efficiency.

A focus on electricity and natural gas

When honing in on final (end-use) energy, electricity and natural gas are the two main energy sources in Australia (other than oil-derived fuels). In 2013–14, natural gas accounted for 21 per cent of net energy use by industry, while electricity accounted for 23 per cent.⁵⁶ In Manufacturing, these percentages increase to 40 per cent and 24 per cent respectively. This prominence, combined with data availability, mean electricity and natural gas are the basis of the energy-competitiveness investigation later in the chapter.

Energy prices

Price variables are incorporated to investigate whether industries adjust their energy intensity — and by extension, their energy efficiency — to energy price changes.

But sourcing energy price data at the industry level is challenging, partly due to the confidentiality of energy contracts between firms and energy providers. The Australian Energy Market Operator (AEMO) and International Energy Agency (IEA) provide aggregate indices, but these are less useful for studying effects at the industry level.

Another challenge is that firms often enter multi-year energy contracts, so they may be unaffected by short-term price fluctuations as represented by aggregate price indices.

Industry price data was sourced from the ABS (by special request) for the years 2002–03 to 2013–14. The annual data are nominal price indices for all 1-digit, and some 2-digit, ANZSIC industries.

⁵³ ABS cat. no. 5209.0.55.001 table 2, *Australian National Accounts: Input-Output Tables 2013–14*

⁵⁴ Timmer M et al. (2015) op. cit.

⁵⁵ Stanwix G et al. (2015) *End-use energy intensity in Australia*, Department of Industry and Science, Research Report, Canberra, June, p. 1

⁵⁶ ABS cat. no. 4604.0 *Energy Account Australia, 2013–14*

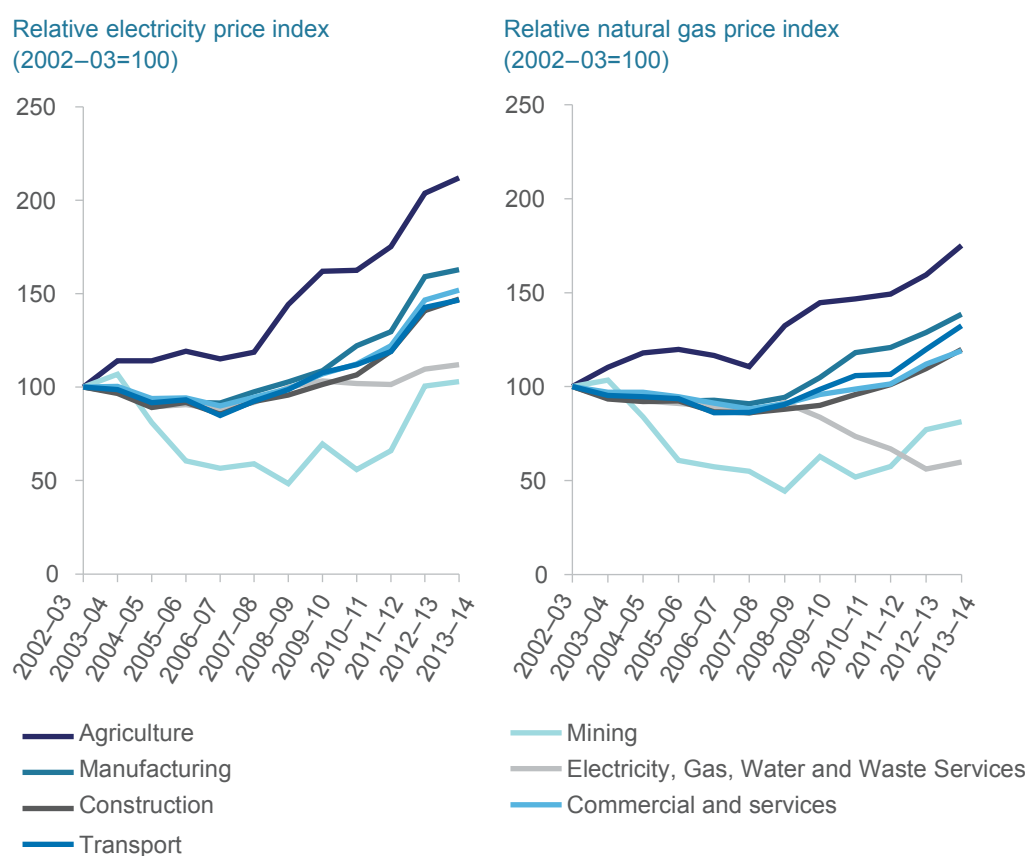
An initial investigation shows that electricity and natural gas prices have consistently increased over the past decade for all industries. The one exception is the nominal gas price for the Electricity, Gas, Water & Waste Services industry, which has remained broadly constant.

Before analysing the extent to which energy prices affect energy efficiency, prices need to be transformed to better reflect the cost relative to output (consistent with the Vienna Institute paper methodology). This is because it is the proportional cost share that is the greater consideration for business.

To account for this, the nominal price indices are divided by industry output price deflators to determine the relative energy price. This better reflects how much of an energy price increase (or decrease) is being absorbed by the industry in the form of an increased (or decreased) cost relative to output.

For most industries, the price of electricity and natural gas relative to the price of industry output has increased substantially over the five most recent years of data — in some cases, by more than 50 per cent. The relative price increase for Agriculture has been particularly large, with the relative electricity price more than doubling over the entire eleven year period. But this is mainly due to weak growth in output prices rather than Agriculture being subject to higher nominal price growth than other industries. A notable exception to all other industries is the Mining industry (see Figure 4.3), where the persistent initial decline meant energy costs were decreasing in prominence, despite a steady increase in the underlying nominal price index. Much of the relative decrease was due to the large increase in the value of output for the Mining industry as part of the resources boom.⁵⁷ But in the past five years this trend has reversed, with relative energy prices rising.

Figure 4.3: Relative electricity and natural gas price indices for 1-digit industries, 2002–03 to 2013–14



Source: ABS special request; Department of Industry, Innovation and Science calculations

⁵⁷ Downes P et al. (2014) *The Effect of the Mining Boom on the Australian Economy*, Research Discussion Paper 2014–08, Reserve Bank of Australia, August 2014

The trends for both price indices are similar, although the magnitude of change has been greater for electricity than for natural gas. A notable exception is the recent decline in the relative natural gas price for Electricity, Gas, Water & Waste Services. This corresponds with an unchanging underlying gas price index for this industry and rising output growth.

The three components discussed — energy costs, energy intensity (proxy for energy efficiency) and energy prices — will provide insight into the relationship energy has with competitiveness.

Do Australian industries improve their energy efficiency in the face of rising energy prices?

Results from Horne and Reynolds (2016) show that Australian industries respond to energy price rises by becoming more energy efficient (i.e. they reduce their energy intensity).⁵⁸ While the response differs in magnitude (depending on industry and energy type), it is consistently much smaller than the actual price rise in the short term, which means that energy costs rise when energy prices rise.

This is an intuitive result, particularly for the short term. It is difficult for firms to immediately improve their energy efficiency or switch to alternative, cheaper sources of energy in response to price shocks.

Energy efficiency responses are expected to be larger over the long term and for energy intensive-industries. However, this could not be fully tested due to data limitations. For 1-digit industries, the effect was smaller than estimated for the EU by the Vienna Institute. This is partly due to the inclusion of industries with proportionally low energy costs such as Commercial & Services (Figure 4.2).

The average energy intensity response for 2-digit Manufacturing industries is larger. But again, it is still not large enough to prevent energy costs rising as energy prices rise in the short term. These findings are in line with expectations and consistent with other research.⁵⁹ Testing the response for energy intensive Manufacturing sub-industries over the long term will likely find larger responses.

Identifying the relationship between relative energy prices and energy intensity relies on controlling for other factors. Without doing so, the magnitude of relationships is typically inaccurate due to 'unobserved' influence. For this study, capital intensity (capital per employee) is included because capital-intensive industries are more likely to be energy-intensive. A linear time trend, output gap and carbon tax and GFC dummy variables are also included. Full details are available in the technical paper.⁶⁰

The industries in the 1-digit analysis are Mining; Manufacturing; Electricity, Gas, Water & Waste Services; Construction; Transport; and Commercial & Services.

Below is a summary of the 1-digit industry energy intensity response to price change, followed by the same analysis for 2-digit Manufacturing.

Results for the 1-digit industry aggregation

Multiple models were tested using relative electricity and/or relative natural gas prices to explain changes in the different energy intensities — electricity intensity, natural gas intensity and energy intensity.

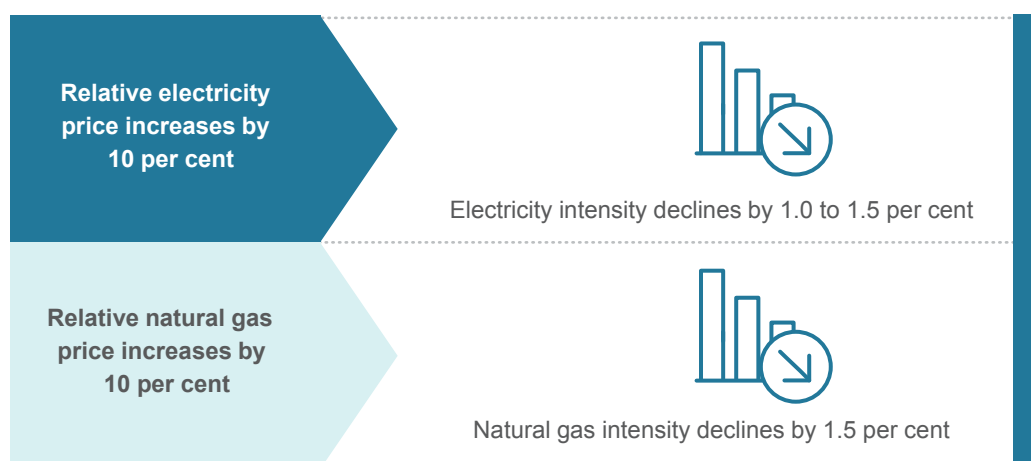
The most meaningful relationships involved electricity intensity and natural gas intensity rather than the broader energy intensity. For electricity, a 10 per cent increase in the relative price of electricity leads to a reduction in electricity intensity of roughly 1.0 to 1.5 per cent (Figure 4.4), depending on model specification.

⁵⁸ Horne and Reynolds (2016) op. cit.

⁵⁹ Astrov V et al. (2015) Op Cit and Horvath A (2014) The effect of energy prices on competitiveness of energy-intensive industries in the EU (Chapter 9), *International Entrepreneurship and Corporate Growth in Visegrad Countries*, Miskolc: University of Miskolc, pp. 129–146

⁶⁰ Horne and Reynolds (2016) op. cit.

Figure 4.4: Short-run electricity intensity and natural gas intensity response to relative energy price changes, 1-digit industry analysis



Source: Department of Industry, Innovation and Science calculations

A similar negative relationship exists between relative natural gas prices and natural gas intensities. A 10 per cent increase in the relative price of natural gas leads to a reduction in natural gas intensity of roughly 1.5 per cent.

However, control variables lacked explanatory power for natural gas models, meaning the results are not as robust as those uncovered for electricity. Still, the results are partly substantiated by a recent cross-country study that finds a high price responsiveness for natural gas demand, albeit in the long run.⁶¹

Results using 2-digit Manufacturing aggregation

Following the 1-digit analysis, analysis turns to four Manufacturing sub-industry groups. The groups were:

- food, beverages and textiles
- wood, paper and printing
- petroleum and chemical products
- metal and other manufacturing.

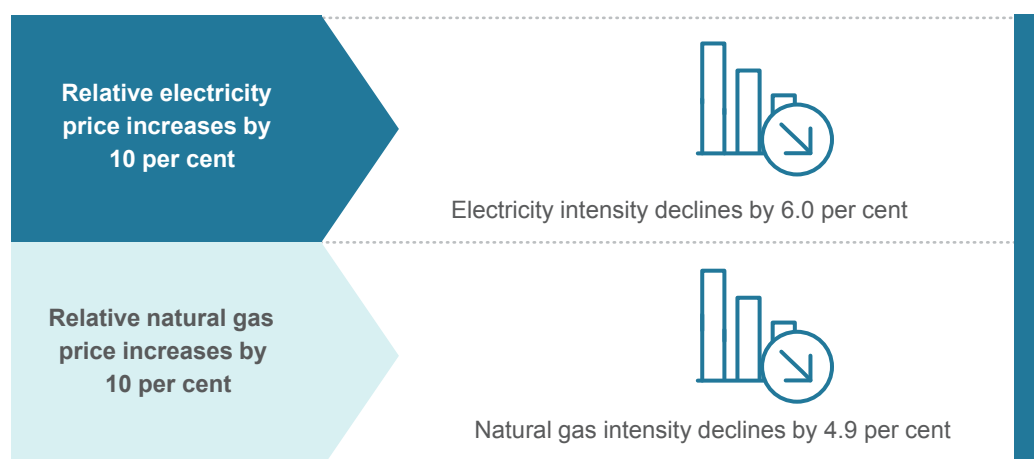
This allows for a refined focus on some of the most energy-intensive industries, where energy price rises are much more likely to drive improvements in energy efficiency/intensity.

One of the first aspects that stands out from the analysis is that relative prices have a statistically significant impact on overall energy intensity. This is in contrast to the 1-digit analysis where electricity intensity and natural gas intensity models returned significant results (there were no statistically significant results for overall energy intensity).

The impact of relative natural gas and relative electricity prices on energy intensity were much larger than for the 1-digit analysis. For a 10 per cent increase in the relative price of electricity or natural gas, energy intensity declines by between 4.9 and 6.0 per cent (Figure 4.5). This is a very large short-term effect, but is in line with expectations that energy prices matter more for energy-intensive industries.

⁶¹ Burke P and Yang H (2016) The price and income elasticities of natural gas demand: International evidence, *Energy Economics* 59, pp. 466–474

Figure 4.5: Short-run energy intensity response to relative energy price changes, 2-digit Manufacturing analysis



Source: Department of Industry, Innovation and Science calculations

But these results are not particularly robust. The sample size is small, and the inclusion of control variables used in the 1-digit analysis did not have any explanatory power in multiple alternative specifications for these 2-digit Manufacturing groups. This means the model constructed is likely to be inadequate. The results remain preliminary until they can be substantiated by data that allows for a more thorough investigation.

The relationship between energy prices and energy intensities is in line with expectations, and consistent with other research.⁶² While the extent that price drives energy efficiency/intensity is small in the short term, the magnitude is expected to be larger once industries have had more time to effectively switch energy sources or alter their energy-use behaviour.

Energy efficiency has the potential to enhance the cost competitiveness for a variety of industries — particularly energy-intensive sectors such as Manufacturing.

The Clean Technology Investment Programme aimed to help Manufacturing businesses invest in energy-efficient equipment, technologies, processes and products. The following feature article investigates what impact the programme had on the participating firms' emissions and growth performance.

⁶² Astrov V et al. (2015) op. cit.



Feature article: Measuring the impact of the Clean Technology Investment Programme

Sasan Bakhtiari — Senior Economist, DIIS

In 2011, the Australian Government introduced a Clean Energy Future Plan: the Clean Energy Act (2011).⁶³ One element of the plan was a Clean Technology Investment Fund (CleanTech). It was aimed, in part, to help Manufacturing facilities make a smoother transition to newer and cleaner technologies and equipment.

The CleanTech programme ran from the beginning of 2012–13 to the end of 2013–14, and offered grants of up to half the proposed clean technology project cost. Manufacturing facilities were the main target of the programme. (Note: A facility is a plant or establishment that may or may not be tied to a larger parent firm that controls multiple facilities.)

A two-part study investigated:

- whether the CleanTech programme helped Manufacturing facilities to improve their energy and emissions efficiencies
- whether there was any broader impact from the CleanTech programme through instigating dynamism and growth among firms that received those grants.⁶⁴

In these studies, comparisons are based on a multitude of performance indicators at the firm and facility level. The two main sources of information are The National Greenhouse and Energy Reporting Scheme (NGERS)⁶⁵ and the Business Longitudinal Analysis Data Environment (BLADE).⁶⁶

The Department of Industry, Innovation and Science keeps an administrative record of all facilities and projects that received CleanTech grants to monitor their progress. This list is used to identify those firms and facilities in each database that received assistance via CleanTech. In total, 547 projects received CleanTech grants, most of which concluded by 2014.

⁶³ See Act C2011A00131 on <http://www.comlaw.gov.au>

⁶⁴ Bakhtiari S (2016) Clean Technology, Regulation and Government Intervention: The Australian Experience, Department of Industry, Innovation, and Science (forthcoming) and Bakhtiari S (2016) Business Dynamics of a Clean Energy Policy, Department of Industry, Innovation, and Science (forthcoming)

⁶⁵ This reporting scheme was introduced in 2008 as part of Australia's international obligations. The database is available from the Clean Energy Regulator by authorisation (see <http://www.cleanenergyregulator.gov.au>). The database reports energy consumption and emissions for each facility.

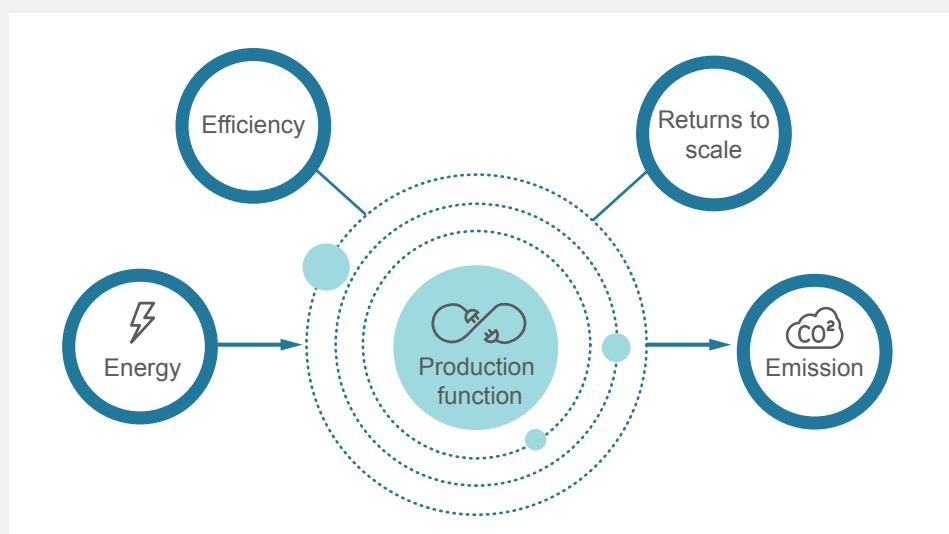
⁶⁶ The BLADE is a statistical asset that integrates financial and business characteristics data for over 2 million actively trading businesses in Australia from 2001–02 to 2013–14. Firm-level data from other sources (subject to the approval of the Australian Bureau of Statistics (ABS)) can be linked to the BLADE by using the Australian Business Numbers (ABNs) of firms.

On clean technology

The CleanTech programme was designed to accelerate emissions reductions and encourage adoption of newer and cleaner technologies and equipment. The main point of interest in this analysis is whether reductions in Manufacturing emissions are directly associated with shifts in technology rather than changes in the scale of business activity.

The analysis adopts a production function approach, where facilities consume energy (input) and produce emissions (output) as shown in Figure 4.6. Using this approach, it is possible to isolate and study the amount of change in facilities' emissions that is due to a change in technology between two time periods, holding energy consumption fixed.

Figure 4.6: A production function presentation of emissions technology



Source: Department of Industry, Innovation and Science

This analysis method is applied to the change that took place from 2010–11 to 2013–14. This period captures changes in firm behaviour that have likely occurred since November 2011, when the Clean Energy Act (2011) passed legislation but was not actually in force. It also captures changes for the period when the scheme was in force — from July 2012 to July 2014.

Overall, there has been a 9.7 per cent reduction in Manufacturing emissions directly associated with the technological shift, rather than a change in energy consumption.

Facilities receiving the CleanTech grants achieved some extra emissions reduction on top of the general trend, but in different ways. Small and very large facilities (in terms of energy consumption) seem to have invested more heavily in clean technology and realised larger-than-average emission reductions. A significant proportion of mid-size facilities with CleanTech grants achieved emission reductions by reducing energy consumption.

On growth and job creation

The availability of CleanTech grants to eligible firms and their facilities was meant to create a smoother path to switching technologies with minimal operational interruption. To test this, the BLADE can be used to identify operational characteristics of CleanTech and non-participating firms. (Note: This part of the analysis was carried out at the firm level rather than the facility level.)

Carefully comparing the CleanTech firms with a comparison group (through a matching process explained in the box below) shows that the CleanTech programme helped firms not only to maintain their operation levels, but also to expand faster. Both employment and turnover among these firms grew about 25 per cent faster than similar firms without CleanTech grants. Exports grew about 50 per cent faster, but only for those CleanTech firms already exporting. Moreover, the results show that CleanTech firms are more likely to create full-time jobs compared to the firms in the comparison group. As expected, some increase in capital expenditure is also detected.

A difference-in-differences approach

Evaluating whether receiving CleanTech grant(s) by a firm has any impact on the performance indicator X means ideally considering

$$\Delta = X \text{ of a firm with CleanTech} - X \text{ of the same firm without CleanTech}$$

and averaging the difference over all firms for statistical purposes.

However, it is impossible to observe a firm in both states simultaneously.

The next best alternative is to construct a set of counterfactuals that closely mimic the CleanTech firms. In this study, the counterfactuals rely on a matching process where each CleanTech firm is matched to its three nearest neighbours. The nearness of a neighbour is determined based on similarity in employment size, prior growth in employment, exports and foreign ownership status, and the industry group of the firm.

For X , I used the next period growth in employment, turnover, exports, and capital expenditure. The average treatment effect (Δ) shows the impact of CleanTech on the growth rate.

Repeating the same exercise within sub-groups of firms with certain characteristics sheds additional light on the areas of CleanTech that have been the most effective. The most interesting finding is that the CleanTech programme has been most effective among firms that experienced job losses before the programme. With the help of CleanTech, these firms started creating jobs and seeing their turnover increase.

While there is no evidence that CleanTech helped firms start exporting, exporting firms with CleanTech grants also saw their export values increase faster than similar firms. Finally, most of the positive impacts of the CleanTech programme seem to be concentrated among medium-sized and large firms.

Summary

A micro-econometric analysis of the Manufacturing sector allows to decouple the technology-related effect of the CleanTech programme on firms and their facilities from size and other effects. The findings point out that:

1. Overall, there has been a general shift towards the adoption of cleaner technologies.
2. Small and large facilities had extra reductions in emissions by investing more heavily in clean technologies.
3. Mid-size CleanTech facilities achieved extra emissions reduction by investing in reducing energy consumption, particularly through electricity efficiency.
4. The CleanTech programme had a wider impact by helping contracting businesses turn around and start creating jobs and increasing turnover. It also helped exporting businesses increase the value of their exports. Overall, the CleanTech programme seems to have boosted business activity in the Manufacturing sector.

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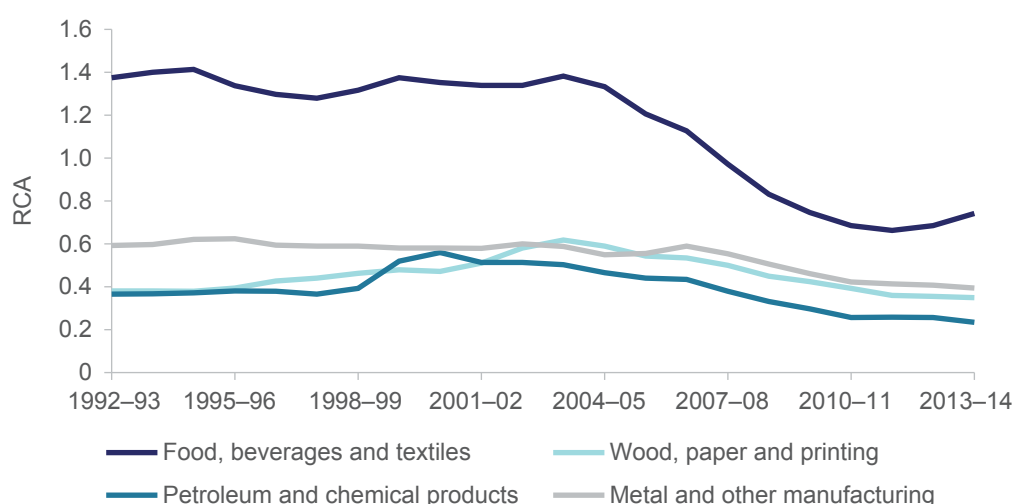
Do energy costs have an impact on Australia's industrial competitiveness?

The results of the analysis underlying this chapter show that increases in energy intensity (and associated increases in energy costs) have a negative but small impact on the competitiveness of Australia's Manufacturing industries, as measured by RCA and accounting for other factors.⁶⁷ However, no relationship is found when the analysis is extended to less energy-intensive industries.

RCA is an applied use of comparative advantage theory. It compares export volumes for industries or products/services of a domestic economy to the share of the same industries or products/services in world trade. Values greater than one imply a comparative advantage.⁶⁸

To illustrate, all four Manufacturing groups analysed earlier had values of less than one in 2013–14 (Figure 4.7), with a general decline across all groups for the time period of data available. This implies that these Australian industry groups are uncompetitive relative to the rest of the world.

Figure 4.7: RCA for 2-digit Manufacturing groups, 1992–93 to 2013–14



Source: Department of Industry, Innovation and Science calculations

The relationship between RCA and energy intensity, or RCA and energy costs is the principle focus to investigate the energy-competitiveness relationship. Labour productivity is also included in the analysis as a control variable given its established link with competitiveness.⁶⁹ Likewise, capital intensity and wages and salaries are incorporated, as per the Vienna Institute paper.

Multiple specifications also include the price of industrial energy for Australia relative to industrial energy prices for OECD countries. A higher ratio implies that Australia has higher energy costs and *vice versa*.

⁶⁷ Horne and Reynolds (2016) op. cit.

⁶⁸ Department of Industry (2014) *Australian Innovation System Report 2014*, Canberra, Box 3.1 p. 83

⁶⁹ See for example Auzina-Emsina A (2014) *Labour productivity, economic growth and global competitiveness in post-crisis period*, 19th International Scientific Conference; Economics and Management 2014, ICEM 2014, 23–25 April 2014, Riga, Latvia

Results

The main finding for the 1-digit analysis is that there is no identifiable relationship. This may be due to data limitations or an inadequate model specification. For instance, RCA data is not readily available for service-based industries — 1-digit industries are restricted to Agriculture, Mining and Manufacturing because they are the only industries with reliable export data.

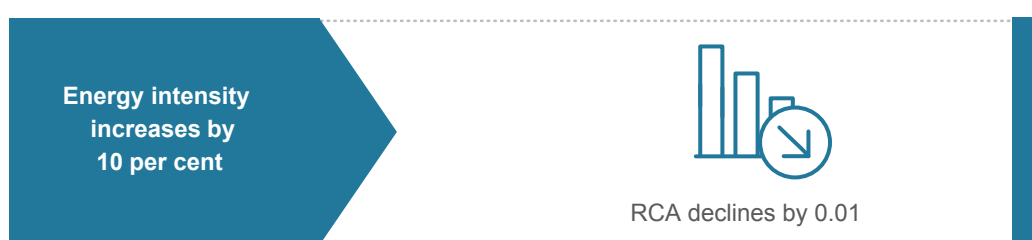
While a relationship might exist for a broader spectrum of industries, RCA cannot test this. However, including lower energy cost industries (as per Figure 4.2) may mean that the influence of energy costs on export performance is even less relevant.

To determine whether a relationship exists within higher energy-intensive industries, the analysis was extended to the same Manufacturing sub-industries investigated earlier:

- food, beverages and textiles
- wood, paper and printing
- petroleum and chemical products
- metal and other manufacturing.

An effect was uncovered using a growth (or first-difference) model.⁷⁰ The finding was that a 10 per cent increase in energy intensity (and implied increase in energy cost) leads to an average reduction in RCA of 0.01 (Figure 4.8) across the four 2-digit Manufacturing groups. While this effect size appears small, in the context of RCA values less than one (Figure 4.7), it is larger than it first appears.

Figure 4.8: Energy intensity and industrial competitiveness as measured by RCA, 2-digit Manufacturing



Source: Department of Industry, Innovation and Science calculations

For control variables, the relative price of energy in Australia compared to other OECD countries proved to have high explanatory power, with an effect size similar to changes in energy intensity. That is, a 10 per cent decrease in the relative price of energy in Australia led to an increase in RCA of about 0.01. Labour productivity tended to have a positive influence on RCA, while capital intensity had a negative influence on RCA.

The available Australian data show that rising energy costs do have a detrimental but small impact on the competitiveness of Australian Manufacturing industries after controlling for other factors. But there is no discernible effect for less energy-intensive sectors. Testing these results definitively will require longer time period data sets covering a wider range of industries (particularly energy-intensive industries) that are currently unavailable.

⁷⁰ This is an econometric specification whereby changes in growth rates are used to test a relationship.

