The 2014 John Freebairn Lecture in Public Policy:

Resolving Energy Policy Dilemmas in an Age of Carbon Constraints

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I am delighted to present this lecture in honour of John Freebairn. John has exemplified the best of the economics profession's contribution to Australian discussion of public policy for several decades. He has belonged to what I have called the independent centre of the Australian polity—seeking to analyse policy choice rigorously from the perspective of the public interest, representing no vested or partisan political interest.

At a time when the work of the economics profession is criticized by serious analysts of our society for being either irrelevant to the big policy choices or subservient to private interests in their contest with the public interest, John Freebairn's work demonstrates the continuing value of economic analysis. Without rigorous application of economic analysis to policy choice, policy-makers have no protection against the application of pressure from private vested interests. Populism annoys and purports to fight private vested interests, but without the guidance of rigorous economic analysis becomes their unwitting ally. Rigorous economic analysis—economic rationalism in the pejorative language of another era—is the indispensable shield of the public interest.

I commend John's work and ethic as an economist to younger members of the economics profession here this evening or subsequently reading the lecture.

Australia is a global superpower in energy supply in the early twenty first century. It is the world's largest exporter of coal and uranium and probably soon and for a while the largest exporter of natural gas. It is still for the time being the world's largest exporter of aluminium, the most energy-intensive product that is important in international trade.

Australia has the potential to be similarly or more important in global energy as the world moves through its transition to energy with low carbon emissions. At least amongst the world's developed countries, Australia has by far the greatest per capita potential for low-cost production of energy from most of the promising renewable sources: solar, wind, biomass, deep geothermal , wave and tidal. While endowed less richly than many countries with hydro-electric capacity, it has two developed sources that are large enough to assist substantially in the balancing of intermittent renewable generation, and potential for pumped hydro-electric storage capacity in those two systems and elsewhere. In the east Gippsland area of Victoria and adjacent Bass Strait, Australia has excellent proven geological structures for storage of carbon dioxide adjacent to immense low-cost fossil fuel resources: if capture and storage of carbon dioxide from fossil fuel combustion works commercially on a large scale anywhere, it will work in southeastern Victoria.

My lecture this evening examines the changing role of energy in the Australian economy. It analyses the implications for Australia of large changes in the global energy story that provide essential context for Australian developments. I then look at policy issues affecting the production and use of energy in Australia.

For many years, the fossil energy endowments have contributed to Australians' high standard of living as sources of relatively low cost electricity and heat for households, as coal and gas exports and as inputs into exports of processed metals.

The China resources boom of the early twenty first century contributed extraordinarily to growth in Australian public revenues, business investment, incomes and employment. It also interacted with policy innovations of the early twenty first century to turn Australia from a country with relatively low cost to one of relatively high cost energy for domestic users. A timing coincidence caused the beginnings of climate mitigation policies to be blamed for the energy price increases.

This evening I begin with discussion of recent and prospective developments in the global economy affecting supply, demand and price for various forms of energy. This sets the scene for discussion of Australia's transformation from low-cost to high-cost domestic energy. I then focus on Australia's place in the world's transition to a low carbon economy.

Global Energy Developments

Global energy markets have received four large shocks since the turn of the century. Not sudden shifts as in the two oil shocks of the 1970s, but longer-lasting change the effects of which accumulate to something that is larger on a durable basis. First, unexpected and unprecedentedly strong growth in demand for energy driven by strong and energy-intensive economic growth in China took markets by surprise and forced a big lift in oil, coal and gas prices. Second, high energy prices and concern for the environmental impacts of energy use led to higher energy efficiency and lower energy intensity of economic growth, most powerfully after 2008. Third, high energy prices and incentives to reduce greenhouse gas emissions in the developed countries led to sharply increased use of renewable energy, eventually leading to reduction in costs as the scale of deployment increased. Fourth, high energy prices drove deployment of unconventional gas technologies which increased supply from about 2008 and continues to do so.

In the late 1990s into the beginning of the new century, the standard forecasts anticipated that low global energy prices would remain for a long time. Prices rose steadily through the first few years of the new century as demand increased in China and a robust world economy, but expectations of low prices persisted and discouraged investment in new mining capacity. In early 2003, Rupert Murdoch, famously declared that the "greatest thing" to come out of the invasion of Iraq would be "cheap oil"—the return of oil prices to $20 per barrel.

It didn't turn out that way. The global economy expanded strongly, concentrated especially in Asian developing countries where it was exceptionally energy-intensive. China, with twice as many people as the old developed world, entered a decade of the fastest expansion in any economy ever. Global energy demand grew prodigiously. Global oil, coal and gas prices rose through to the Great Crash of 2008, with coal first of all.

Strong developed country growth and its contribution to energy demand ended with the Great Crash of 2008. Developing country growth in output rebounded strongly from 2009, but its relationship to energy use changed after a couple of years. After 2011, moderately slower growth in China and the developing world as a whole interacted with the early stages of the second, third and fourth of the early twenty first century energy shocks—the stronger focus on energy efficiency, the increased supply and lower cost of renewables, and the supply of unconventional gas. These developments all placed downward pressure on fossil fuel prices—disproportionately heavy on coal and light on gas as a result of the elevation of climate change and local environmental objectives. Meanwhile, mining companies' expectations on price had caught up with the market history but not with its future: massive investments in expanding coal supply were made just as the extraordinary growth in demand was drawing to an end.

China at first ran against the trend of increasing energy efficiency and declining energy intensity of economic activity. There was almost no reduction in energy intensity from 2001 to 2011 despite high global energy prices and increased integration of domestic into international energy markets. High investment shares of expenditure rose to the highest ever in any economy over a long period and contributed to high energy and metals intensity of economic growth. The fact that China's demand was especially focused on coal made the first decade of the twenty first century a time

when the world quickly ran out of time for taking action to reduce the chances of dangerous climate change

After China's massive Keynesian stimulus through state-related institutions from late 2008 had restored strong growth in the old style, China gradually moved towards a new model of economic growth that would reduce the investment and increase the consumption shares of expenditure, and reduce the intensity of energy use and carbon dioxide emissions in economic activity. We are still in the early stages of implementation of the new model. Investment shares of output have not yet fallen. Still, aggregate economic growth decelerated from an average of 10 percent per annum 2001-11 to 7-8 percent. By 2012, structural change and lower growth were substantially reducing the increase in Chinese and therefore global energy demand. Local environmental and global climate change concerns were a principal cause of a sharp decline in the coal share of energy and increase in renewable and nuclear energy. The huge upward pressure on global fossil fuel prices from Chinese economic growth ended in 2011 and will not return.

Coal prices relative to oil rose in response to massive increases in Chinese demand up to 2011, but fell behind after that. Oil prices have stayed high since 2011 as a result of resource constraints and limits to short-term substitution away from oil in energy use.

Figures 1, 2, 3, 4 and Table 1 tell the story of changing global energy demand and prices through the early twenty first century.

A Closer Look at Electricity Demand and Supply

After many decades when electricity demand grew inexorably except in recession, there was an absolute decline in electricity use in almost all developed countries through the recovery from the Great Crash of 2008.

The decline in intensity of electricity use in China came later, from 2012, but is turning out to be of major importance for global energy markets. From 2011 the Government began to enforce policies designed to reduce the energy intensity of growth by 16 percent over the five year plan period 2011-5.

China's focus on improved efficiency in energy use interacted with efforts to reduce the intensity of greenhouse gas emissions (by 17 percent over the same period) and to reduce carbon particulate emissions for health reasons.

I completed a paper just last month on recent and prospective developments in the Chinese energy sector to be published this year in the journal China and World Economy. Data presented in that paper describe a dramatic change in growth in energy demand and its composition after 2011. Growth in electricity demand fell to an average of 6.3 percent in the two years 2012 and 2013 after a decade of double digit growth. Expansion of coal use in electricity generation fell to an average of 3.25 percent per annum after a decade of double digit growth. The majority of the increase in generation came from hydro-electricity, wind, and nuclear. Solar increased by 270 percent per annum and became a significant element in energy supply for the first time.

The paper works through the implications of current Chinese energy and emissions policies to develop a perspective on developments between 2013 and 2020. The results indicate that almost the whole of the slower increase in electricity demand will be supplied from hydro-electric, wind, nuclear, solar, gas and biomass. The tonnage of coal used for electricity generation falls by an average of 0.7 percent per annum.

China's energy and climate change policy and planning agency, the National Development and Reform Commission, upgraded expectations on wind and solar power generation on 17 May, just two days ago. The 78 Gw of wind power installed at the end of 2013 is now expected almost to double in four years to 150 Gw by 2017. The 20 Gw of solar power installed by the end of 2013 is expected to increase by three and a half times to 70 Gw in 2017. The increase in Chinese wind power capacity over those four years will be approaching twice Australia's total power generation capacity of all kinds. The increase in China's solar power generation capacity will exceed by a wide margin Australia's total electricity generation capacity of all kinds.

The rapid increase in the role of new renewable sources of electricity began in the developed countries in response to policies to reduce greenhouse gas emissions. It moved to China and other developing countries as costs of renewables came down. The biggest quantitative change has been the increased supply of wind generation, with the solar contribution rising more rapidly from a low base. China was involved in the global shift to greater use of renewable energy at first as a source of capital goods for use in other countries—solar panels, wind turbines and hydro-electric generators. The increased scale of production of capital goods for wind and solar generation dramatically reduced their price—by about 80 percent between 2008 and 2014 for solar photovoltaic panels from China, which captured the major part of the rapidly growing global market. Cost reductions made renewable competitive with fossil energy in some circumstances and locations, especially where the decentralized nature of renewables production allowed investment in transmission and distribution to be reduced or avoided.

Measures to reduce carbon emissions also favoured investment in and generation of nuclear power. After more than two decades of stagnation in nuclear electricity output, major expansion programmes were developed and began to be implemented in China and India. There was some stirring of new investment in the developed countries. Increased scale of deployment in China lowered costs of manufacturing components for and installing nuclear plants, to the extent that in early 2011 the authorities anticipated that nuclear power costs would be competitive with coal in East China as early as 2016.

The Fukushima meltdown in March 2011 was a setback for expansion of nuclear power generation everywhere. The responses were strongest in two of the largest users of nuclear power: Japan and Germany. Before March 2011 in Japan, nuclear accounted for around 30 percent of electricity supply and official policy contemplated substantial increases in that ratio. All nuclear plants had ceased operations by May 2012. Since then, some plants have been reopened and there is discussion of using more of the old capacity. Comprehensive retreat from nuclear power has lasted longer in Germany, where 8.5GW of capacity was closed in 2011 and the remainder of the 22GW total remains slated for closure by 2020.

In other countries where nuclear power has been important, Fukushima led to review of policy and delays but not long-lasting retreat. China continued with new plants under construction, and made new projects subject to review. Review led to strengthening of safety requirements and to an all-clear for return to expansion. India's policy trajectory was broadly similar to China's.

Of long term importance, China and India are both engaged in large-scale state-supported research on thorium-based nuclear energy.

Once installed and connected to electricity grids, low-emissions generation capacity tends to be more fully utilized than fossil energy capacity, as it has much lower recurrent costs. There is, however, potential for waste of low-emissions electricity generating capacity through mismatch of timing of demand and supply—for example, when the wind is blowing strongly or the nuclear plant

pumping out a steady flow of power when demand is weak in the middle of the night. China is reducing wastage from mismatch in timing of low-emissions electricity supply with local demand through two responses: massive investment in technically highly efficient high voltage long-distance transmission lines; and the world's largest pumped hydro-electricity storage investment, with the installation of 30 Gw of capacity in the five year plan period 2011-5.

The reduction in costs of low-emissions energy resulting from greatly expanded manufacturing of capital goods in China has permanently changed the energy supply choices available to other developing countries. South Asian and African economic development is structurally different from China's and these regions are unlikely ever to experience the extreme energy intensity of Chinese economic growth in the first decade of the twenty first century. They are now likely to rely less heavily on centralised energy systems and fossil fuels than countries that went before them in modern economic growth.

The Unconventional Gas Revolution

The third major global energy shock came from the application of unconventional gas technologies after 2008. Technological change was driven by high fossil fuel prices. Production of gas from coal seams had its main early applications in eastern Australia, and from shale in the United States.

The new technologies are gradually being deployed in other countries, and will have a large impact where geological conditions are suitable for them.

Trade restriction in the United States has created a fragmented global market. Intercontinental transport of gas is expensive, especially if it involves sea voyages and therefore liquefaction (Figure 6). East Asian prices reflect prices in exporting countries including Australia, plus transport costs—Australian prices plus about $6 per British thermal unit—and are the highest in the world. Europe relies on a combination of gas from domestic reserves, by pipeline from the former Soviet Union and the Middle East, and liquefied natural gas from the Middle East and North Africa. It has occupied an intermediate price position, although it now faces uncertainty from disruption of supplies from the former Soviet Union. The United States once had relatively high prices, but the combination of increased domestic unconventional gas supplies and export restrictions has pushed prices to the lowest amongst developed countries. Eastern Australian prices, once the lowest in the developed world, are on a path soon to be the highest outside East Asia.

Increased priority for environmental objectives favours gas over coal. The relative ease with which production can be varied in gas-based generators also increases demand for gas for balancing natural variations in renewable energy output. But gas shares with all sources of electricity generation the effects of slowing electricity demand. And the new technologies are rapidly expanding gas supplies. For a while, the sum of these influences is likely to be towards lower global gas prices.

The large price differentials across regions are likely to diminish. Export restriction in the United States are being corroded by pressures from producer interests. Geo-political imperatives argue for some increase in exports to strategic partners in Europe and East Asia. Leakage through Canada and Mexico will indirectly increase US exports. Global gas price convergence will be assisted as well by the eventual redirection of exports from the former Soviet Union away from European towards East Asian markets. Convergence will eventually see downward movement of East Asian towards European and Australian towards United States prices. In the absence of new barriers to international trade, the end point should see similar prices in the export countries Australia and the

United States, with each lower than European and East Asian to an extent that reflects international transport costs. Figure 5 plots one of the possible convergence scenarios.

Abundant Cheap Energy to Abundant Expensive Energy in Australia

Australian domestic policy affects domestic energy prices in the context of the four big global shocks.

Energy costs everywhere have tradable and non-tradable components.

The tradable component of energy costs—the cost of energy raw materials—varies across countries with transport and transactions costs and restrictions on trade. Energy raw material prices are lower in countries with abundant domestic energy resources, which tend to be net exporters of energy. Prices in the exporting country are lower still if exports are restrained. The domestic cost advantage is higher in energy commodities in which international transport costs are low.

International transport costs per unit of energy are lowest for uranium, then in ascending order coal, gas, fossil fuels with low-cost carbon storage opportunities, and renewables. Under free trade, Australian domestic uranium costs are close to those in importers of uranium. Under free trade, the cost of power from renewables is much lower in Australia than in countries which are less well endowed with solar resources. Australia's advantages from low domestic energy costs from abundant energy resources—for example as a location for energy-intensive metals processing—will be greater in a world in which renewable energy plays a major role.

The non-tradable component of costs varies with the real exchange rate and the relative efficiency of Australian production in the energy sector. Relative efficiency is affected by the regulatory environment.

Tradable and non-tradable components of costs have both increased more rapidly in Australia than in the rest of the world since the turn of the century.

Relative costs of the tradable component have increased because export barriers have become less important in Australia and more important in some other countries, first of all the United States.

The deepening integration of Australian into international energy markets began in 1983 with the removal of the crude oil allocation system and the cancellation of the contract by contract approval for resource exports. Through the resources boom, some coal in New South Wales and Queensland which had been tied to domestic power generation was freed for export. Local coal users had to compete with exports and pay export parity prices at the same time as global coal prices were rising. Gas users are paying much higher prices as export capacity is established.

The increase in eastern Australian domestic gas prices with the development of an export industry will be larger than it would have been because the export capacity being installed on the Australian east coast exceeds current gas supply capacity. Competition amongst exporters will drive domestic prices up for as long as exporters' marginal costs are covered. Australian domestic prices may rise to well above export parity prices in the period ahead.

Do these outcomes argue for export restriction for coal or gas? The simple economics say that total economic value will be greater if markets sort out the allocation of resources between exports and domestic use. Private entities working through markets have made big mistakes in the Australian energy sector through the resources boom, but it is not clear that Governments would do better. The case for restriction of gas exports is possibly stronger because Australian users compete with

US producers who benefit from lower gas prices resulting from export restrictions. The case for export restriction is conceptually similar to the case for action against dumping. If the US export restriction is permanent, it is best for Australia to adjust to that reality. However, if the US export restriction is temporary, there may be a case for temporary countervailing action, to avoid the closure of capacity that will be competitive again without assistance when US export restrictions disappear. The problem with anti-dumping action, however, is that it is easily captured by producer interests and applied inappropriately.

The increase in the non-tradable component of energy costs arises from the large appreciation of the real exchange rate through the resources boom and a dramatic fall in the productivity of distribution in Australia mainly as a result of flaws in the regulatory arrangements. The Australian Bureau of Statistics estimates the average decline in total factor productivity in Australian utilities at 4.5 percent per annum between 2007-08 and 2011-12.

I have discussed the resources boom appreciation of the real exchange rate elsewhere and will not add to that here. Sooner or later, a substantial correction will come, which will reduce the excess of Australian over international energy costs.

A large part of the increased relative costs of energy in Australia derives from the regulatory reform that was completed in 2006. Here I focus on electricity although conceptually similar issues arise with gas.

The changes separated eastern Australian wholesale, transmission, distribution and retail markets. The reforms established a competitive wholesale market for power. The market has absorbed large increases in coal and gas prices from deeper integration into international markets and global developments, carbon pricing and unexpected declines in demand for power. The wholesale market is a success story, and should be left to continue as it is. There is now strong downward pressure on wholesale prices, as increased supply from renewables runs into declining demand. Established fossil fuel generators argue for government intervention to lift wholesale prices. The market is working well and should be left alone. If low prices lead to the withdrawal of one or more generators in the period ahead, the market is working as the market should. If they do not, as each supplier hopes that others will close first, the consumer will benefit from a longer period of low prices.

The transmission, distribution and retail functions are a different story. Transmission and distribution are natural monopolies. Price regulation in natural monopolies is inherently difficult. We have compounded the difficulty by seeking to regulate price principally by reference to rate of return. Averch and Johnson demonstrated in a famous article in the American Economic Review half a century ago that this is asking for trouble. It is never possible to set the rate of return exactly right. Set it too high, and there will be wasteful overinvestment. Set it too low, and underinvestment leads to risks of service failure. We have set the rate of return too high, and investment and therefore electricity prices have increased at rates beyond past Australian experience (Figures 6 and 7), and way beyond the twenty first century experience of other developed countries.

Reducing the regulated rate of return would immediately reduce the dominant “return on capital” component of network costs, and reduce incentives for wasteful investment in future. The Australian Energy Regulator has taken a first step in this direction. The inherent problem of rate of return regulation will remain, and there will still be a massive overhang of excessive investment.

The excess of past investment earns a return, and unnecessarily raises electricity prices. Higher prices reduce demand for all electricity, and makes self-provision of power through solar photovoltaics more attractive. Lower demand forces another increase in prices to secure the guaranteed rate of return for owners of the network, leading to a further reduction in demand and a further increase in prices (see Figure 8 for the decline in electricity demand in Australia that has accompanied higher prices).

Wood and Carter from the Grattan Institute have spoken of breaking this "death spiral" of the centralized electricity system by writing down the capital value of the network, leading to a once-for-all reduction in power prices to users. They leave for discussion the question of whether the cost of the write-downs should be carried by investors in the network, governments or users.

With solar photovoltaic costs continuing to fall and Australians like other consumers finding ways to use less electricity, demand for power from the centralized system is likely to continue to shrink.

The centralized system was once a major growth industry. It is time to think of it as an important but shrinking provider of services that are complementary to an expanding decentralized system. Getting this relationship right will maximize the likelihood of gradual restoration of Australia's position as an economy with low-cost energy, facilitate the transition towards expanded use of renewable energy, and preserve a larger and economically more valuable role for the centralized system.

We need to think about ownership and strategic leadership of the network in a different way.

The transmission system is simply and straightforwardly a natural monopoly. Strategic oversight should be provided by a planning agency, which considers alternative augmentations on the basis of assessments in the public interest. The planning agency would consider truncations of the integrated grid through sale to any interested parties if some parts of the grid do not generate benefits that warrant the spreading of costs amongst all users. Established private owners in South Australia and Victoria could retain their current roles, but extension of private ownership would allow for separation of management from ownership, with rights to ownership being sold by tender to parties seeking low-risk investment without necessarily having management responsibilities. Charges for use of transmission would be related mainly to access to capacity at specified times in the day and year, reflecting the relevant marginal cost of transmission.

Reform of the distribution function is more challenging, requiring larger changes to established arrangements. Here again it would be useful to separate management from ownership of the system. It is important that users be charged for capacity rather than volume of use and be able to buy and sell access to capacity in specified locations. New users would buy new capacity from others, or pay the marginal cost of capacity to service their requirements; this would bring to account the greater capital costs of energy infrastructure provision for greenfields expansion of cities compared with more dense settlement of established areas. There would be large advantages in facilitating the joint purchase of geographically contiguous distribution capacity by groups of users or by suppliers of energy services which enter contracts with groups of users. Trade in distribution capacity would introduce incentives to reduce peak power requirements by adjusting the timing of demand or sharing of capacity amongst users with different time profiles of use. It would facilitate greater use of storage at the place of use, for example by integrating the integration of energy requirements for households and electric cars.

There are currently large problems with the retail function. Costs have risen rapidly, mainly reflecting recovery of heavy expenditure on marketing. This is not a natural monopoly, but a few

suppliers who are also generators have built up large positions. This has constrained competitive access to the wholesale market. Facilitation of greater competition in retail services would encourage development of user services which focus on overall cost reduction, unaffected by retailers' interests in established generation capacity. Integration of distribution and retail functions would expand opportunities for cooperation between energy service suppliers and users to reduce electricity costs.

Charging for capacity would encourage an increasing proportion of users to leave the grid entirely—more as costs of storage fall. Established suppliers in the centralized system will need to meet this competitive challenge by minimising costs and increasing the advantages of using the grid as a complement to decentralized supply of power.

The need for large-scale reform argues for caution in privatization of network assets that remain in state ownership. Uncertainty about pricing reform would reduce the sale price for assets. Commitment to retain established pricing systems so as to reduce uncertainty and increase sales prices would block efficiency-raising reform. New privatisation of networks should await fundamental reform of network pricing systems.

On the other hand, the competitive wholesale power market provides favourable economic conditions for the sale of generation assets. Sale of generation assets should be structured to expand competition wherever it is possible to do so, for example by defining sites for pumped hydro storage in the Snowy Mountains and Tasmanian hydro-electric systems and selling them separately.

It will be hard to avoid further increases in Australian energy prices in the period immediately ahead. This will be most pronounced in gas, where domestic prices will rise sharply whatever happens to carbon pricing, on the way to and for a while beyond export parity pricing. The electricity story will be more complex. Established policy would see some reduction of wholesale prices, possibly exceeding any upward pressure from increased prices for renewable energy certificates required for compliance with the Renewable Energy Target. The downward adjustments in regulated rates of return would in itself reduce network costs, but this will be outweighed in the immediate future by momentum for expanded network investment and the requirement under the current regulatory approach to raise prices to offset the effects on revenue of reduced demand. Reform as suggested in this note would see gradual downward adjustment in network costs in future.

While the short term prospect is for higher prices, there are longer term prospects for restoring Australia's old position as a country with relatively low energy costs. Expansion of domestic gas supply will bring prices back to export parity. Export parity prices themselves will fall with increased sales into East Asia from the United States and the former Soviet Union. Reform of network regulation and ownership has to run the gauntlet of opposition from established suppliers, but has the potential gradually to remove the huge excess burden imposed by regulatory distortions since 2006. Regulatory reform to allow the centralized system to complement decentralized self-generation of power will lower overall power costs to users and minimize the amount of redundant capacity in the centralized networks. The eventual reversal of much of the real exchange rate appreciation of the resources boom will see a substantial fall in Australian relative to other countries' energy costs.

Established energy producers have argued for removal of incentives for reducing greenhouse gas emissions as a means of reducing energy costs. The data do not provide support the claim that interventions to reduce emissions have increased costs to users more in Australia than in other

countries, and the cost of meeting carbon pricing obligations under established law is due to fall with the linkage to the European Trading System in 2015. If we were to exchange doing next to nothing for doing about the same or less than most others, there would be some temporary advantage over other countries, but that would be small compared with the large deterioration in Australia's relative cost position over the past decade.

Early movement to a world in which low-emissions energy plays a large role in all countries would facilitate the re-emergence of relatively low energy costs in Australia. The superior renewable energy resources of Australia would allow low cost production, and their increased use would be more completely reflected in low domestic prices than are Australia's superior resources of internationally tradable fossil energy. Efficient integration of decentralized provision of power with the established network would also facilitate the re-emergence of relatively low energy costs in Australia, allowing users to introduce proportions of low-cost decentralized power into their private energy mix.

Reconciling Environmental, Commercial and Economic Objectives

Resources development has negative environmental alongside positive commercial effects. Good economic analysis assigns values to environmental damage and takes them fully into account in assessing the value of a project.

It is common for business interests and people with concern for environmental values to take absolute positions for and against certain kinds of developments and technologies. The resulting head butting has no knock-out winners, and ends up unnecessarily damaging environmental, business and economic value.

Sound institutional and policy arrangements can provide certainty about the evaluative criteria that are to be applied in approvals processes, reduce the supply price of investment and greatly improve the trade-off between environmental and commercial values, and so generate a maximum of economic value. Sound arrangements are built on shared understanding of the external environmental effects that is based on objective scientific assessments. These understandings can provide the foundations for rules of general application.

It has become difficult to place scientific assessments at the centre of policy in Australia in recent times. Big business has never been so directly influential with Government and senses that it might be a winner which takes all on environmental matters. The difficulty is compounded by an extraordinary fact, that the four business leaders who have been given the most senior external advisory roles to the current Commonwealth Government share a strong view that the science is wrong on the most important of the environmental issues under current discussion: climate change. We can expect trench warfare over development projects, delays, increases in the supply price of investment and damage to all relevant interests until this phase of Australian management of the interface between the environment and the resource sector is brought to an end.

Conflict between business interests in the energy sector and environmental values is now intense in relation to climate change, the application of unconventional gas production technologies, wind power, geo-sequestration of carbon wastes and local environmental damage from coal production and export.

Tonight I will talk mainly about climate change and the transition to the low-carbon economy, but similar issues arise in other areas of conflict between environmental and business values.

Objective reading of the science leaves no reasonable doubt that the release of greenhouse gases into the atmosphere imposes costs on humanity. Legitimate differences in views about the relative value of the welfare of current and future generations, about the inherent value of patterns of human life and settlement that would be disrupted by unmitigated or weakly mitigated climate change and about the likely rate of reduction of costs of low emissions technologies lead to different assessments of the cost of carbon. The rigorously calculated assessments range from a low around $US10 per tonne of carbon dioxide equivalent and rising over time more rapidly than the general price level, to well over $US40 per tonne and rising over time. The world's most elaborate official calculation of the cost of carbon for policy purposes, through a United States Inter-Agency Committee led by the Department of Energy, suggested about $US30. No legitimate assessment based on the science says that the external cost of carbon emissions is near zero.

This century so far has seen the beginning of global action to reduce the prospective impact of human-induced climate change. Policy everywhere has contributed much to the second and third shocks: the reductions in energy use per unit of economic activity and expansion of low-emissions energy supply. The relationship between economic activity and carbon emissions is changing. Not fast enough to avoid substantial costs from human-induced climate change. Not fast enough now to be confident that we will stay within the international community's agreed guiderail, to hold temperature increase to 2 degrees Celsius. But enough to show that the 2 degrees is not out of the question, and could be achieved at modest cost. Virtually all developed countries, including Australia, are now experiencing large reductions in energy intensity of economic output and absolute reductions in carbon emissions. For some of them, including Australia and the United States, this represents a radical change in trajectory.

The move in Australia to repeal the carbon laws enacted in 2011, and replace them with an ineffective Emissions Reduction Fund does not make sense to anyone who understands the implications of modern science on climate change.

Here I will briefly sketch two futures: one in which the Senate rejects repeal or amendment of all of the carbon laws; and one in which the Senate supports the government's repeal and likely amendment proposals.

Until recently, the Australian Renewable Energy Agency (ARENA) was not on the repeal list. ARENA is the successor of agencies that have been active in supporting innovation in low-emissions energy for over a decade. The Coalition made commitments during the 2013 election campaign that ARENA would continue under a Coalition Government. ARENA was one of many agencies for which abolition was recommended by the Commission of Audit, on the grounds that their work was unnecessary. The abolition was announced in the Budget Papers.

There is nothing new about Government breaches of election promises. During the election campaign, the Coalition committed itself to honour Australia's pledge to the United Nations to reduce emissions not by 5 percent from 2000 levels by 2020, but by 5, 15 or 25 percent depending on what other countries were doing. We have heard nothing about the 15 or 25 since the election. The surprise is not the breach of a commitment, but that ARENA had never been discussed as possibly being slated for abolition.

Repeal and its rejection are still both future possibilities. Repeal of the established laws on the Climate Change Authority, carbon pricing, the Clean Energy Finance Corporation and the Australian Renewable Energy Agency and amendment of the Renewable Energy Target require majority support in the Senate as well as the House of Representatives. None of the repeal bills will receive the support of the Senate before the end of June. When the Senators elected in 2013 take their

places in July, if proposals are opposed by the Labor Party and the Greens, the passage of repeal legislation requires support from 6 of the 8 other non-Coalition Senators. That support may be likely, but cannot be taken for granted.

Senate consideration of the repeal bills is now bound to be caught up in disputation over the Budget. On a quick count, the tax increases and expenditure reductions that do not seem to have the support of either the Greens or Labor and which therefore are at the mercy of the new Senate have a total value of $12-18 billion over the 4 years of the forward estimates. Retention of carbon pricing and rejection of the Government's Emissions Reduction Fund would reduce the budget deficit by $6-7 billion in 2014-5, and a total of $6-12 billion in the following three years depending on the European Emissions Trading System's carbon price. By coincidence, retention of carbon pricing would more or less precisely fill the gap from Senate rejection of some Budget measures. To put it another way, Australia can stay within the boundaries of fiscal responsibility over the next four years as defined by the Government in this year's Budget by retaining carbon pricing rather than the array of changes that are at risk in the Senate.

Which set of measures would be better in their effects on the economy, income distribution and Australia's contribution to the global effort to reduce the costs of climate change?

There is not much between them on effects on the economy. Emissions-intensive and trade-exposed activities are protected against adverse effects of carbon pricing on competitiveness. There is little to separate the two approaches to meeting fiscal objectives—although retention of the carbon laws would protect the budget against future demands related to climate change mitigation.

Low and middle income households generally have been thoroughly compensated for carbon pricing by the raising of the tax free threshold and social security adjustments. The Government proposes to retain the compensation in the absence of the carbon pricing that initially paid for it. The lift in the tax free threshold and the adjustments to social security are a benefit to low income households, which the Government proposes to pay for by the budget measures under threat in the Senate, which are disproportionately costly for low income households.

There are big differences in climate change outcomes between repeal and its rejection, which would eventually have commercial and economic consequences.

Under status quo policies, the Climate Change Authority would continue its careful work on appropriate Australian emissions reduction targets in the light of what other countries are doing. The Authority would have the chance further to explain how it formed its judgment, that 19 percent by 2020 was appropriate for Australia. It would develop detailed proposals and good reasons for them on emissions reduction targets for 2030 and 2050, which would assist the Australian Government to play a constructive part in the effort of the United Nations Framework Convention on Climate Change to secure a strong agreement at its Paris meeting in 2015. The Government and the Parliament need not accept the recommendations, but would benefit from having been presented with carefully researched advice and, if it chose to depart from recommendations, having to be clear on why it wished to do so.

The Renewable Energy Target would continue to force rapid expansion of electricity generation from large-scale renewable energy projects. Demand for electricity from the centralized power systems may continue its recent gradual decline, as energy efficiency and decentralized provision of solar electricity continue to rise. The difficulty and costs of meeting the targets will have been increased by recent policy uncertainty, but early confirmation that there would be no amendment

of the 41 Twh target for 2020 would allow the goal to be met. Grants for innovation in new technologies from the Australian Renewable Energy Agency would reduce the cost of meeting the target by accelerating the introduction of new low emissions technologies into Australia—where the activities of pioneering firms have large spillover benefits for others.

The combination of increasing renewable power supply and declining wholesale demand would continue to put downward pressure on wholesale power prices. Sooner or later there would be withdrawal of established coal and gas generation capacity. Emissions from electricity generation in December 2013, after 18 months with the full Clean Energy Future package, the second year of operation of the full Clean Energy Future package, were over 9 percent below the last quarter before the package. Emissions from electricity would continue on their new downward path. Pending large-scale withdrawal of capacity, the presence of the Renewable Energy Target may even reduce power costs to users, with lower wholesale prices covering the costs of renewable energy certificates.

While European carbon prices remain relatively low, the additional presence of carbon pricing after 2015 initially has only a small effect on electricity, favouring gas over coal and lower-emissions black coal over higher-emissions brown coal. If and when carbon prices within the joint European-Australian emissions trading system rise in response to stronger global action, these effects become more important. At some point, carbon pricing takes over from the renewable energy target in driving emissions reduction in the electricity sector. Unlike the Renewable Energy Target, carbon pricing favours even-handedly all low emissions power generation, including nuclear, gas and fossil fuel generation with carbon capture and storage.

Carbon pricing initially has its main effect outside the electricity sector. Carbon liability even at a low rate reminds investors throughout the economy of carbon risks, and encourages investors in new plants to choose low-emissions technologies where these are available at moderate excess cost. This is likely to be especially important for investors in coal and gas liquefaction projects, where fugitive emissions are large and can sometimes be reduced substantially at relatively low cost.

A Carbon Farming Initiative is embedded in established laws and policies: landowners can obtain credits for certified reductions in emissions in farm and related processing activities and for sequestering carbon permanently in forests, woodlands, pastures and soils. Where the sequestration meets international rules, credits can be sold to liable entities, which can then use them in acquitting liabilities.

Within established institutions and laws, Australia is likely to strengthen its emissions reduction targets in line with international action, to meet its targets and do its fair share in an increasing global effort at relatively low cost.

What can we expect if the carbon laws are repealed and, in the case of the Renewable Energy Target amended to reduce its ambition?

First, we can expect less effort to match the increasing ambition of the rest of the world. This makes a good outcome in the Paris meeting less likely. We can't be sure about the effect of one country's free riding on others—just as we cannot be sure that the outcome of World War I would have been different if we had declined to send troops to Gallipoli or the Western Front. Making a full contribution to the global effort on climate change is difficult in every country. We can be sure that a no-show by Australia, or a weak show, would make it harder for others to do as much as

they might otherwise do. Besides, Australians expect their country to do its fair share in an international effort in which we have an interest in success.

Second, we can expect reversal of the recent tendency for total greenhouse gases in Australia to fall and emissions from the electricity sector to fall rapidly. The Minister for the Environment takes comfort in the downward revision of expectations of future emissions to 2020 in recent forecasts by Government agencies. Those downward revisions reflect the effects of current policies, and in any case point to a large effort to achieve an absolute reduction in emissions. While there will be some forward momentum from established policies, this cannot be expected to last for long. The Minister and the Prime Minister take comfort from large opportunities for carbon sequestration on farms, and have cited my own work as authority for their confidence. Incentives for genuine carbon sequestration in the land—emissions that meet agreed international criteria--will be greatly reduced by the removal of opportunities for sale of credits to entities with carbon pricing liabilities. The proposed Emissions Reduction Fund will influence emissions in the small minority of firms, accounting for a tiny minority of emissions, which win contracts under the Emissions Reduction Fund. The absence of carbon constraints on all other economic entities in the country is much more important.

There is no reason to expect that there would be any reduction at all on 2000 emissions under the alternative policies, let alone reduction by 5, 15 or 25 percent.

Failure to match the efforts of other countries or to meet even weak targets will have negative consequences in international relations. We will be working strongly against one of if not the foremost of the international diplomatic objectives of the President and Secretary for State of the United States of America.

At home, the Government asserts that it will achieve substantial emissions reductions under the alternative policies. Many Australians have taken the Prime Minister and Minister for Environments at their words. It will not be long before their words are tested by unfolding reality, and fail.

The Government will then come under pressure to show that it is returning emissions to a downward path. Opposition parties will propose measures, perhaps with more populist appeal and greater business and economic cost than the Clean Energy Future. It would be surprising and against the usual pattern of Australian politics and policy in the twenty first century if the Government—this Government or a successor—does not respond with arbitrary and costly interventions in particular industries and processes.

Failure in meeting modest expectations of Australian emissions reductions is likely to encourage various community groups to act directly against particular carbon-intensive activities. This has been the tendency in the United States, where community pressure closed the possibility of new coal power generation several years before it was excluded by Federal regulation. Such action will have some effect in reducing emissions, but is divisive, arbitrary, costly, and divisive.

On climate change as on other environmental impacts of resource development, the alternative to disorder and arbitrary outcomes is acceptance of honest science as the starting point for policy development, and from that point, building support in the centre of the polity for development that takes full account of external costs. On climate change policy, this is most likely to be achieved with broadly based carbon pricing. Australia now has the laws and institutions and administrative systems that can do the job effectively and at low cost. Better to keep the laws and gradually to make them more effective.

Australians Doing Well Through the Global Energy Transition

The early twenty first century resources boom, deepening integration of Australian into global energy markets in response to new export opportunities created by the boom and mistakes in regulation of newly corporatized and privatized utilities changed Australia from a country with relatively low to relatively high domestic energy prices. What had been an advantage for economic growth for the time became a disadvantage. The shift coincided with but was not caused by the introduction of carbon pricing. Current uncertainty about policies intermediating between resource developments and environmental impacts has further increased the cost of energy.

The rest of the world is moving awkwardly towards much less carbon-intensive economic activity just as Australia is talking about moving the other way. This has the potential to generate tensions between Australia and important international partners and also to separate us from new opportunities in a low carbon world. Australia has potential for relative energy cost advantages in a low carbon world beyond those in the fossil energy world that has started its retreat into history.

To be a country of low energy costs in a low carbon world requires changes of several kinds. It requires the crystallization of the real exchange rate depreciation that has lifted Australian relative costs far above those elsewhere. It requires fundamental reform of the institutional arrangements for transmission and distribution of electricity.

Australia needs to restore broadly supported arrangements for reconciling business, economic and environmental objectives. Reconciliation requires honest science in a central place in official policy.

The reality that others are moving to reduce the energy intensity of economic activity and the emissions intensity of energy use has large implications for Australia, even if we try to ignore them. The actions of others have changed radically the demand for coal, and left many billions of dollars of investment in coal mining without any prospect of shareholders receiving even the cost of their capital The actions of others have brought down the costs of renewable energy to the extent that the economic foundations of the old centralized power systems have been shaken and cracked.

Australia has immense advantages as a producer of energy. We now must use these advantages in the low carbon world to which the rest of the world has been travelling gradually and along which it will continue to travel slowly or fast. This is the world for which Australians must construct energy policy for the future.

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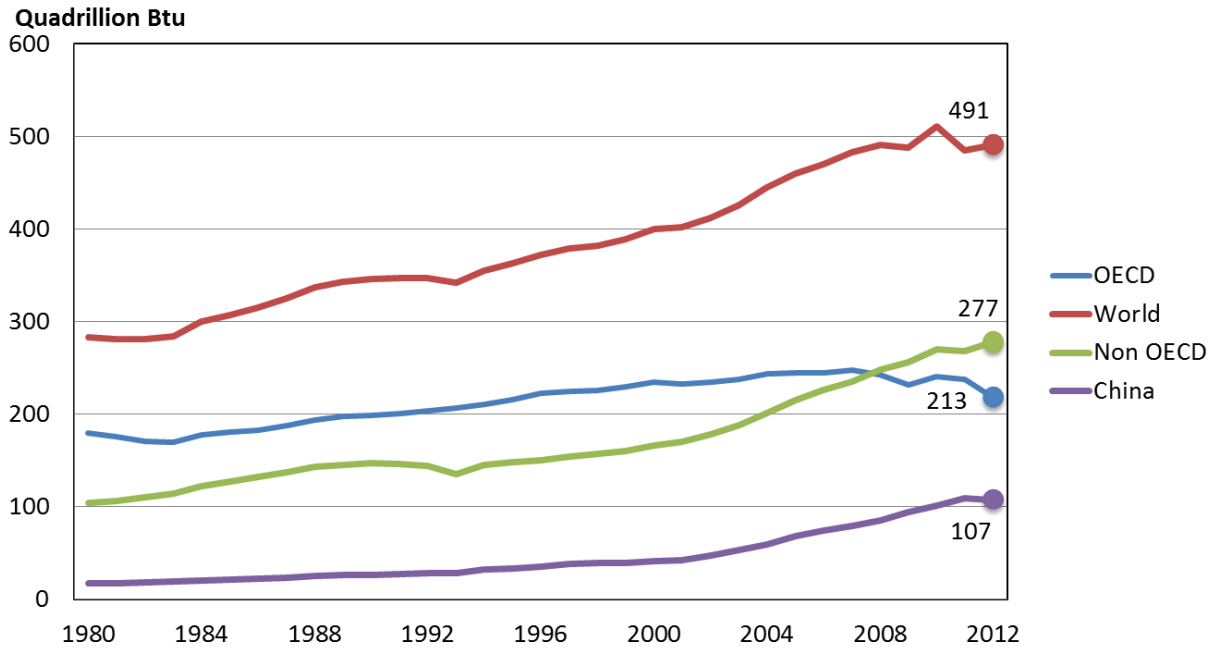
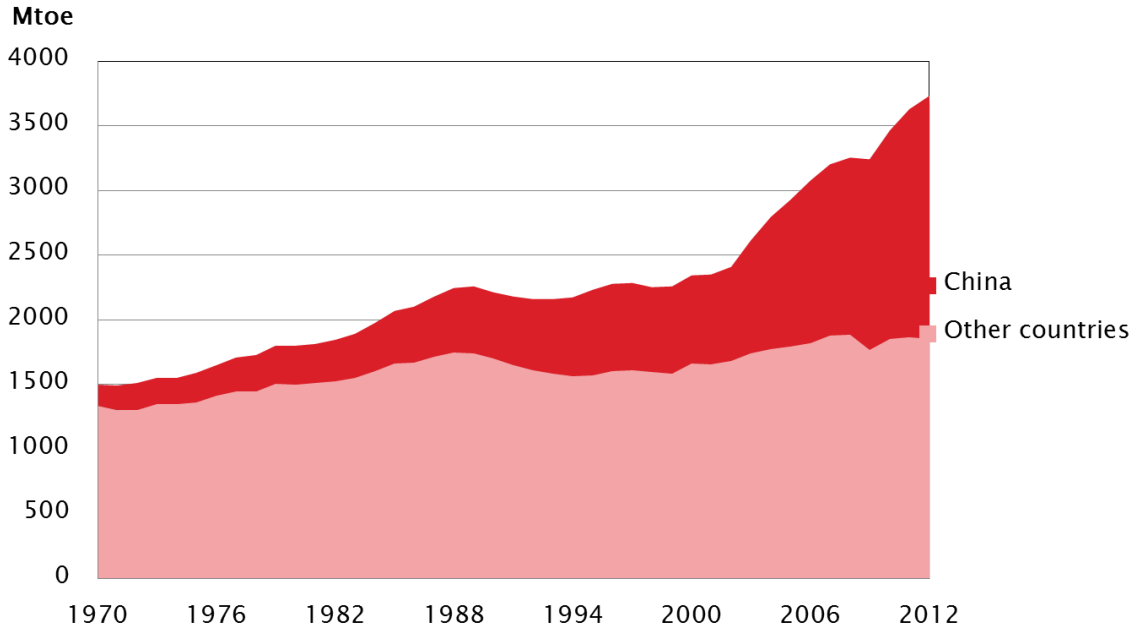
Figure 1. Primary Energy Demand



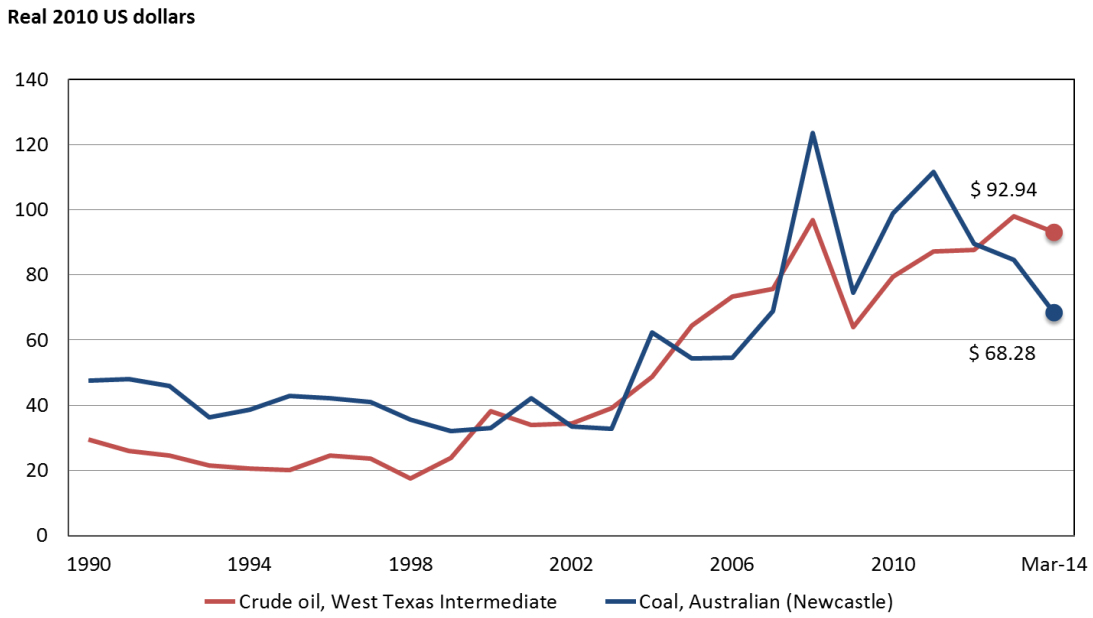
Source: BP Statistical Review of World Energy 2013, International Energy Agency

Figure 2. Coal consumption of China compared to other countries



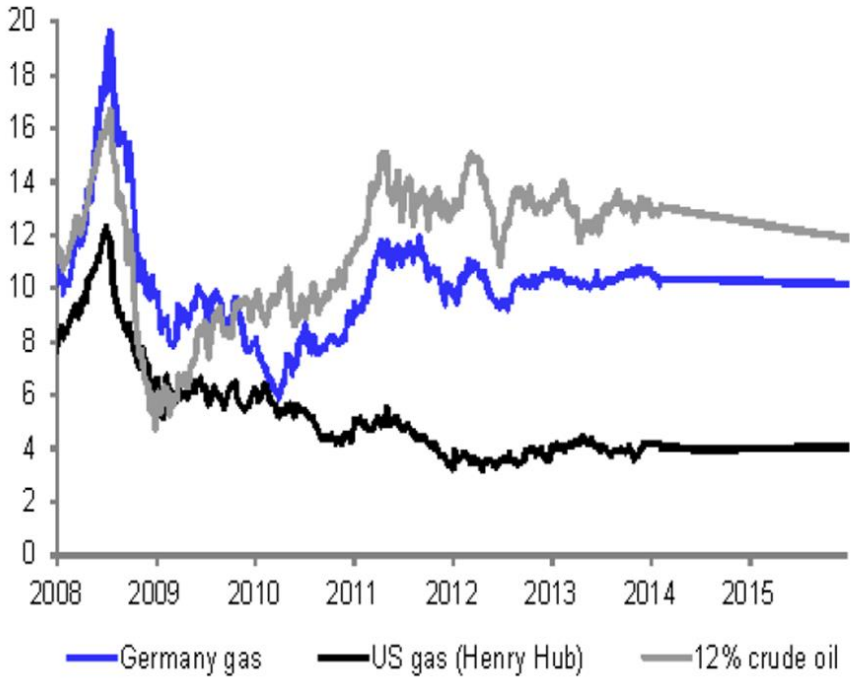
Source: BP Statistical Review of World Energy

Figure 3. Crude oil and coal annual prices



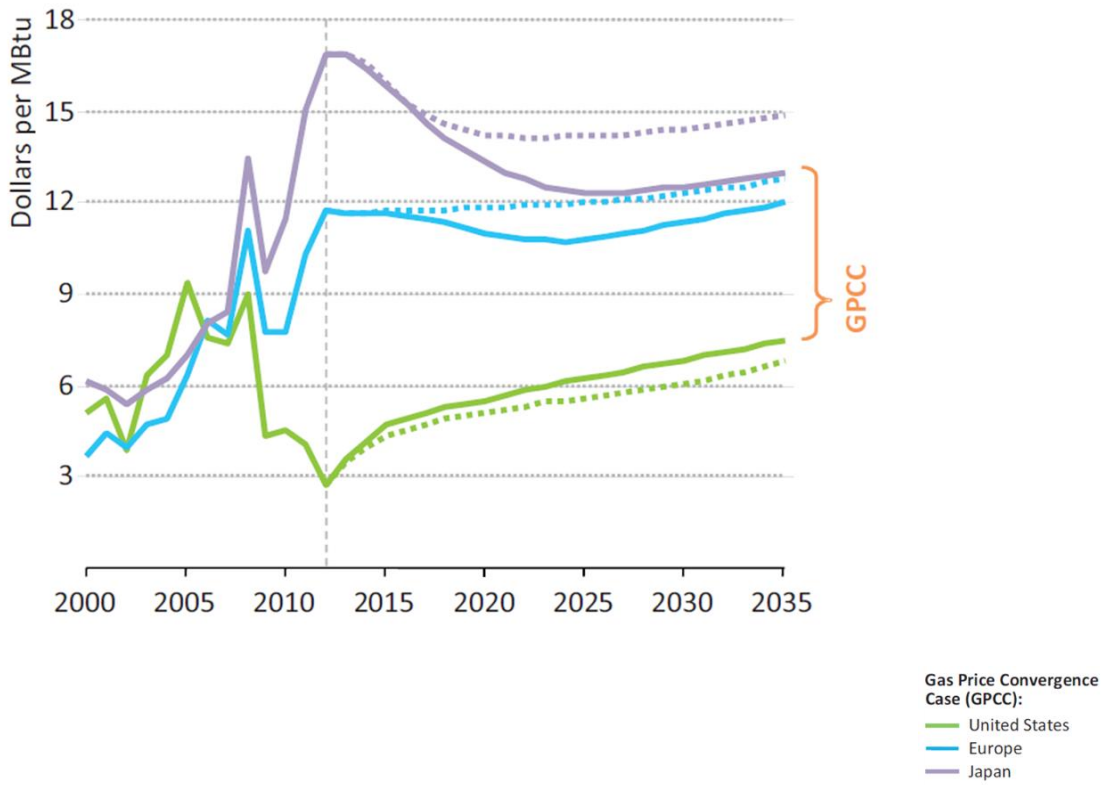
Source: International Energy Agency

Figure 4. German hub, German oil-linked, and US Henry Hub gas prices, 2008-14 (€/mmbtu)*



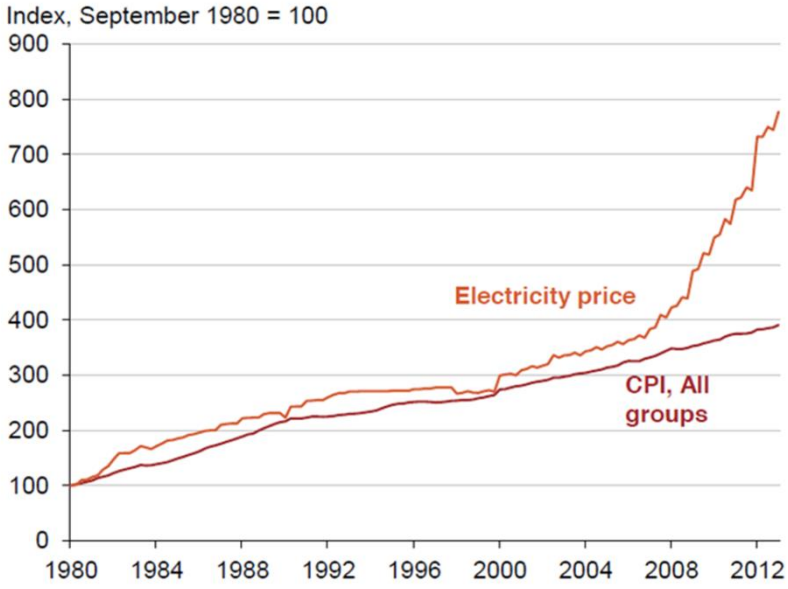
*Prices shown are historic until year-end 2013, thereafter forward curves. From Mark C. Lewis, 2014, *Europe's Electric Shock: Lessons for Australia*, report prepared for Energy Supply Association of Australia drawing from Deutche Bank Global Energy Research.

Figure 5. Regional gas prices in the Gas Price Convergence Case



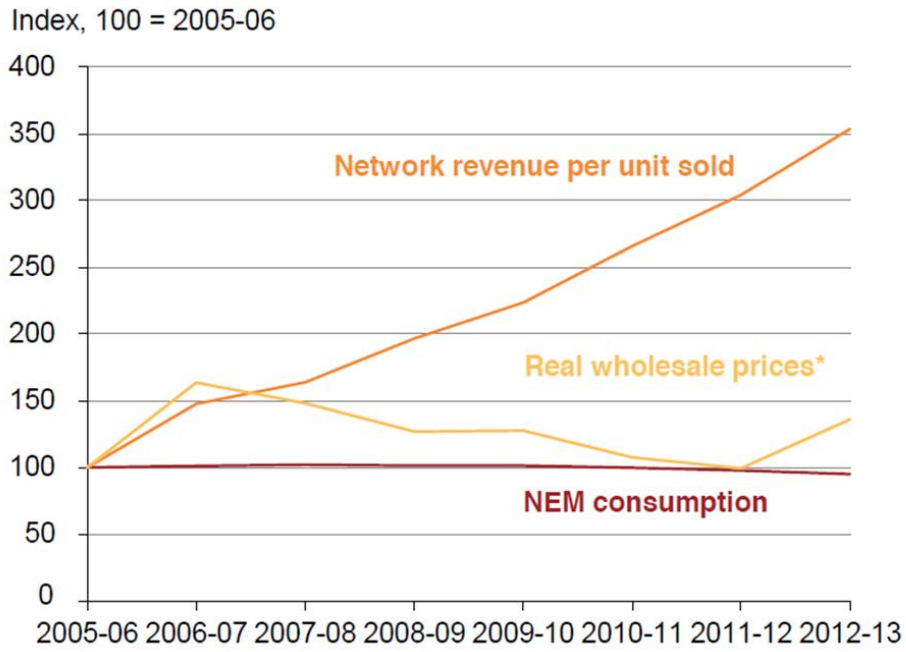
From: International Energy Agency, 2013, *World Energy Outlook 2013*, OECD/IEA.

Figure 6. Spot the Carbon Price: Electricity Price and CPI



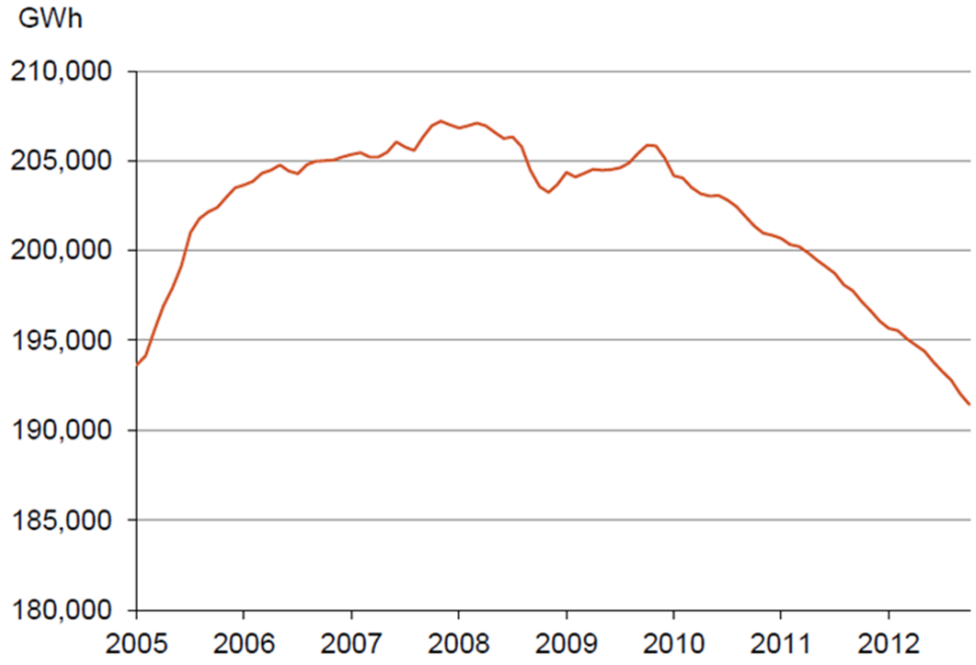
From Wood, T., Carter, L., and Harrison, C., 2013, *Shock to the system: dealing with falling electricity demand*, Grattan Institute.

Figure 7. Electricity Consumption and Unit Costs of Network and Wholesale Power



From Wood, T., Carter, L., and Harrison, C., 2013, *Shock to the system: dealing with falling electricity demand*, Grattan Institute.

Figure 8. Eastern Australian Electricity Demand 2005-13*



*12 month rolling average.

From Wood, T., Carter, L., and Harrison, C., 2013, *Shock to the system: dealing with falling electricity demand*, Grattan Institute.

Table 1. Renewable-electricity production by source in Germany (GWh)

Renewable–electricity production by source in Germany (GWh)						
	2007	2009	2012 estimate*	2012 actual	2013 estimate*	2013 actual**
Hydro	21,169	19,147	18,000	21,200	19,000	20,800
Onshore Wind	39,713	38,542	51,152	45,325	54,064	46,200
Offshore Wind	0	38	1,903	675	3,250	1,000
Biomass	24,191	30,441	36,710	40,850	38,562	45,320
Solar PV	3,075	6,578	17,397	28,000	20,293	29,700
Geothermal	0	19	97	25	164	40
Total	88,238	94,765	125,259	136,075	135,333	143,060

*The 2012 and 2013 estimate numbers represent the German Government's estimate in 2010 of the indicative trajectory for Germany achieving its 2020 target for renewable energy under the legally binding EU-wide targets signed up to by all Member States under the Renewable-Energy Directive; **preliminary estimates. From Mark C. Lewis, 2014, *Europe's Electric Shock: Lessons for Australia*, report prepared for Energy Supply Association of Australia drawing from Deutche Bank Global Energy Research.