Inclusive growth and climate change adaptation and mitigation in Australia and China: Removing barriers to solving wicked problems

Version 20

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Preface

This report aims to assist the Sino-Australian bilateral relationship adapt to meet China's new low carbon emissions policies and to facilitate a smoother transition to a low carbon future. Southwestern University of Finance and Economics (SWUFE), Chengdu, China and the University of Queensland, Brisbane, Australia held a workshop at SWUFE to develop a guide to China's low-carbon policies and their implications for the Sino-Australian energy trade and sectors. This report results from the workshop. Chapter 3 contains the guide to China's low emission policies and discusses market-based experiments within China's command-and-control electricity sector. Chapter 4 discusses Australia's poorly implemented neoliberal policies within its energy sector and provides an informative market-based case study for China on what to avoid. Chapter 2 discusses the implications of Australia and China's low emission policies. Chapter 5 discusses barriers to the transition to a low emissions economy.

Climate change is one of the world's major challenges. Others include increasing inequality and poor economic growth, creating a decline in inclusive growth. Declining inclusive growth and climate change are interrelated wicked problems. Their solution is technically and economically viable given appropriate investment but the absence of a price on carbon in Australia is a major obstacle to directing investment consistent with a low emissions future and government infrastructure investment calculations use a frozen high 'discount rate' when interest rates are at historical lows and underemployment rates are at historical highs.

Australia is transitioning from a mining to a more service orientated economy. However, Australia's uncoordinated growth and climate change policies are hindering inclusive growth and the transition to a lower emissions economy. Growth and climate change policies need bringing together to engender confidence and direct investment compatible with a low emissions future. Notably, Infrastructure Australia has gone some way to address this issue at the national level but the lack of transparency and independence in other jurisdictions and the frozen high 'discount rate' undermine Infrastructure Australia's effectiveness to address climate change and inclusive growth. Remarkably, the organisation Drawdown provides a ranking of the top 100 technologies that can reverse global warming and many can also promote inclusive growth.

Similarly, Australia's uncoordinated energy and climate change policy and poorly implemented neoliberal policies in the energy sector are undermining investment confidence and hindering both inclusive growth and the transition to a lower emissions economy. Energy and climate change policies need bringing together to restore investment confidence within the electricity sector. The Australian Energy Market Operator's Integrated Systems Plan has gone some way to address this problem but there is a requirement to write climate change objectives within the National Energy Objectives to integrate energy and climate policy to enhance coordination.

Poor policy coordination is also hindering solutions to a host of other interrelated wicked problems. These wicked problems include massive increases in retail electricity prices, private school fees and private health insurance, the inability to undertake major tax reform, such as introducing a tax on sugar or carbon or introduce road user charges to replace the declining revenue from fuel excise duty. There is ample and sound evidence-based

research to solve these wicked problems but there is an inability to enact policy in the interest of the electorate.
The key findings of this report are four common barriers to enacting policy to solve these wicked problems.

(1) Political donations present a conflict of interest.

(2) Adversarial politics and political wedging reduce the ability to address complex problems.

(3) There is an absence of academic economists informing the public debate to provide impartial advice.

(4) Unrealistic models of the economy and human behaviour are misinforming policy.

Chapter 5 discusses methods to address these barriers.

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Executive Summary

The report investigates barriers to inclusive growth and climate change adaptation and mitigation in Australia and China. Chapter 2 discusses inclusive growth and climate change adaptation and mitigation issues in Australia and related trade with China. The transition to a low carbon economy requires that the electricity sectors take the pivotal role within the economy. To that end, Chapters 3 and 4 discuss Australia and China's electricity sectors, respectively. Chapter 5 discusses four barriers to inclusive growth and climate change adaptation and mitigation.

Chapter 1: Introduction

- The biggest problems facing the world are climate change and declining inclusive growth. Both climate change and inclusive growth are interrelated wicked problems because the cost of climate change adaptation falls disproportionately on the poor, the cost of climate change mitigation falls disproportionality on the wealthy and well-directed climate change action could increase inclusive growth.
- China is the world's largest emitter of greenhouse gases and Australia is one of the world highest greenhouse emitter per capita. The electricity sectors in China and Australia are the largest emitting sectors within both countries. The electricity sector is best placed to transition the economy to zero net emissions and transitioning the Australia-China trade relationship is part of the solution to zero net emissions.
- Factors contributing to increases in inequality in Australia include the mining boom, property investment tax breaks and property market boom, privatisation and deregulation of the electricity sector and austerity measures. Reversing these trends requires an inclusive growth agenda that includes universal healthcare and education and removal of economic rents.

Chapter 2: Inclusive growth and climate change adaptation and mitigation

- The international decline in inclusive growth sees the benefits of economic growth going mainly to the top quintile, stagnate wages in the lower quintiles and a decline in the lower quintile's wages in some countries. Exacerbating inequality, climate change increases the risk of loss of assets that the top quintiles can easily insure against but the lower quintile is less able. As climate change increases, the risk of loss of assets and the cost of insuring against the risk also increases. The cost of climate change adaptation falls more heavily on the bottom quintile.
- Inclusive growth and climate change mitigation and adaptation are wicked problems to solve because there are numerous stakeholders with often-conflicting priorities. For instance, mitigation costs are directly born by a firm or country but the whole world benefits and powerful fossil fuel entities are able to fund lobbying and political donations against mitigation. Adaptation costs are born internationally and unevenly and those adapting have a little power domestically or even less internationally.
- The disproportionate growth of income going to the top quintile eventually undermines economic growth. Investment aimed at climate change adaptation and mitigations can provide for inclusive growth via energy efficiency and renewable energy both reducing the cost of living and creating jobs.
- The property market boom has exacerbated inequality with a growth in the number of renters unable to buy a property and landlords able to purchase more investment

properties using tax breaks. The tax breaks reduce revenue for government to provide services, further exacerbating inequality. Stakeholders benefiting from the property boom can use lobbying and political donations to perpetuate the property boom, further exacerbating inequality. This tax break fuelled building boom lead to an oversupply of apartments that represents unnecessary emissions exacerbating climate change.

- Australia's exposure to financial risk from fossil fuel asset ownership is extreme as the world transitions away from fossil fuels. There is a need to diversify exports and obtain as much revenue as possible from the fossil fuel within the remaining limited carbon budget available. There is a requirement to address tax dodging by fossil fuel companies to maximise the revenue from the remaining burnable fossil fuels. These extra government revenues will enable Australia to invest in the transition to zero net emission and simultaneously improve inclusive growth. However, the fossil fuel companies are in a powerful position to lobby and pay donations to reduce the royalties and taxes they pay to government.

Chapter 3: China's electricity sector and climate change mitigation policies

- Like Australia over the last 30 years, China's electricity sector has undergone major institutional and regulatory reform and their environmental and energy policies are separate. These policies need bringing together to smooth the transition to low emissions economies as both countries are experiencing problems coordinating the integration of renewable energy into their electricity sector.
- Unlike Australia, China uses 'The five year plan' (FYP) to coordinate changes within the economy where the Chinese Communist Party provides a broad description of a new direction. This description is interpreted in a cascade of layers of government and institutions to provide an increasing prescriptive interpretation. The FYPs have progressively more ambitious renewable energy targets and coal reduction targets.
- China's electricity sector uses a command-and-control approach with an egalitarian equal-dispatch method. This method has coal generators of differing efficiencies dispatching equally as a proportion of their capacity and coal generators filling the role of ramping up and down to match demand. This equal-dispatch results in relatively high emissions. Gas generators usually fill this ramping role in other countries. China has had experimental trials of market-based approaches. In comparison, Australia extensively introduced neoliberal policies to privatise and deregulate its electricity that uses an energy only market.
- Interestingly, Australia was the first country to abandon an emissions trading scheme (ETS) and China was the country to initiate the world's largest ETS. ETSs use a market-based approach to reduce emissions. In a contrary position, Australia has a market-based electricity sector but lacks a matching market-based emissions reduction scheme and China has a market-based emissions reduction scheme but lacks a matching market-based electricity sector. China's ETS could theoretically become much cheaper if matched with a market-based electricity scheme but in practice Australia's implementation of neoliberal policies saw Australian energy prices go from some of the cheapest in the OECD to the some of the most expensive. The poorly implemented neoliberal policies in Australia provide a useful case study for China of what pitfalls to avoid in any plans to implement a market-based approach to their electricity sector.

Chapter 4: Australia's electricity sector privatisation and mitigation policies

- Australia and China's electricity system have similarities in the physical geography they traverse. Both their land areas are extremely large and cover many climatic zones, which provides for opportunities and challenges. The opportunity is that Australia and China are among the top three countries for renewable energy resource as the large geographic terrain enables a more consistent flow of energy from the cheaper variable renewable energy to ensure more consistent and stable energy supply with lesser need for more expensive dispatchable energy. This situation will allow Australia and China to more cheaply transition from their heavy reliance on coal generation. However, the challenge is that the transmissions lines are incredibly long and go through some harsh terrains with increasing severe weather events from climate change, making transmissions more susceptible to failure.
- The electricity sector is pivotal in the transition to zero net emissions and promoting inclusive growth but Australia's poor implementation of neoliberal polices had exacerbated the growing inequity and undermined productivity. Privatisation and deregulation destroyed Australia's competitive advantage in energy. The poorly implemented neoliberal policies and lack of coordination between energy and climate polices is increasing the cost of transition to zero net emissions.
- The Australian Government commissioned the Australian Commerce and Consumer Commission (ACCC) to investigate the price rises in Australia's energy sector. The ACCC identified key failures of the neoliberal implementation that allows economic rents and the excessive transfer of wealth from electricity users to utility owners exacerbating inequality. There are misaligned incentives and inappropriate regulations in the network sector. There is the market power of three vertically integrated retail-generators whose synergies between retail and generation arms amplify market power. The half-hourly settlement period allows gaming of the market. Unpredictable outages in the ageing coal generators are causing price volatility that is profitable for existing generators. There is a requirement to move to a five-minute settlement period and extend the frequency control market to include shorter response times to moderate the price and electricity instability effect of these unpredictable outages.
- The privatisation and deregulation of the retail sector embodies "power of choice", which assumes the more choice available to customers then the greater likelihood that competition will align with the public good. However, the "power of choice" belies a faith in a theoretical economic model of human behaviour that is at odds with empirical findings. This presents an issue of using theory beyond its domain of applicability. Similar issues appear in Australia's private health insurance and private school systems that are undergoing considerable price rises and under investigations.

Chapter 5: Removing barriers to solving wicked problems

- Australia is failing meet its Paris commitment and inequality continues to increase. However, climate change and inclusive growth are only two of a host of outstanding wicked problems that Australia is having problems addressing. There exists extensive research on climate change and inequality with the technologies already available to for the transition to zero net emissions. Additionally, there exists

extensive research into the other wicked problems. The unique findings of this report are that there are four common themes to Australia's inability to address wicked problems. Removing these four barriers to solving wicked problems would ease the way to solve future wicked problems. The first two barriers are unique to Australia and the latter two more applicable to both Australia and China.

- Barrier 1: Political donations are a mechanism to allow powerful interests privileged access to politicians and decision-making process and to circumvent the public debate. The donation system is undermining the public's confidence in Australia's institution and politicians to act in the electorate's interests.
- Barrier 2: Adversarial politics and political wedging diminishes the ability to develop complex debate over the intricacies of solving wicked problems. This behaviour emerges from Australia's hybrid US Federal and UK Westminster system that is over a hundred years old and built for a slower less interconnect world when the didactic process was most probably more suited. Notably, the USA and Australia standout as countries regressing in climate change commitment. Additionally, Australia is following America's trend toward an increasingly inequitable and violent society. The use of a similar decision-making system in both countries helps explain the convergence in outcomes. It is time to perform an international comparative performance appraisal of Australia political system with a view to upgrading Australia's political system to best practice. The premise is that putting the same politicians in a different system would enhance the overall system's performance to solve wicked problems in the electorate's interest.
- Barrier 3: Disengagement of the academic economic profession from the public debate reduces impartial informed debate. In its stead, the debate is formed by powerful vested interests via their think tanks and consultant economist or guns for hirer. A similar trend is occurring in science and social sciences where there is an increasing requirement for industry-funded research. The "tobacco science" era provides a reminder of how unethical and misleading industry-funded research can become. Tobacco science led to unnecessary delays in implementing policies to reduce avoidable deaths.
- Barrier 4: Unrealistic models of the economy and human behaviour help inform the policy decision-making process. Any polices informed by such models are likely to be misguided. Australia's neoliberal policies implemented in the electricity and private health insurance sectors provide examples of using unrealistic models of the economy and human behaviour. Similarly, the failure to predict the global financial crisis provides an international example of the application of unrealistic models of the economy and human behaviour. Importantly, the property market boom in Australia and China requires the use of realistic models for each country to simulate policy options to select economically stable and equitable options.

Contents

Tables

Figures

Abbreviations

ABC	Australian Broadcasting Corporation
ABM	Agent-based Model
ABS	Australian Bureau of Statistics
ACC	Australia China Council
ACCC	Australian Commerce and Consumer Commission
ACT	Australian Capital Territory
AEA	American Economic Association
AEMC	Australian Electricity Market Commissions
AEMO	Australian Electricity Market Operator
AER	Australian Energy Regular
ATO	Australian Tax Office
BoE	Bank of England
BEPS	Base Erosion and Profit Shifting
CARC	Australian Senate Community Affairs Reference Committee
CCA	Australian Climate Change Authority
CCIEE	China Centre for International Economic Exchanges
CCP	Chinese Communist Party
CDM	Clean Development Mechanism
CEDA	Committee for Economic Development Australia
CIS	Centre for Independent Studies
CNY	Chinese Yuan
CORE	Curriculum in Open-access Resources in Economics
CPI	Consumer Price Index
CSIRO	Australian Commonwealth Scientific and Industrial Research Organisation
CWA	Climate Works Australia
CWF	Climate Works Foundation
DEE	Australian Department of Energy and Environment

DFAT	Australian Department of Foreign Affairs and Trade
DSGE	Dynamic Stochastic General Equilibrium
DSM	Demand Side Management
EABER	East Asian Bureau of Economic Research
EDR	Economic Demonstrated Resources
EEMG	Energy Economics and Management Group
ERF	Australian Emissions Reduction Fund
ESB	Australian Energy Security Board
ESPD	Chinese Energy Saving Power Dispatch
ETS	Emissions Trading Scheme
EV	Electric Vehicle
FDI	Foreign Direct Investment
FiT	Feed in Tariff
FS-UNEP	Frankfurt School-United Nations Environment Programme
FYP	Five-Year Plan
FYP13ED	13th Five-Year Plan for Energy Development
GCF	Global Financial Crisis
GDP	Gross Domestic Product
Gtce	Giga tonnes of coal equivalent
GW	Gigawatt
HDI	Human Development Index
HK	Hong Kong
ICE	Internal Combustion Engine
IEA	International Energy Agency
IMF	International Monetary Fund
ISP	Australian Integrated System Plan
JKM	Japan Korea Marker
kWh	Kilowatt-hour

LNG	Liquid Natural Gas
LRET	Australian Large Renewable Energy Target
LSS	Chinese Large Substitutes Small Policy
MEI	Melbourne Energy Institute
MEP	Chinese Ministry of Environmental Protection
MoST	Chinese Ministry of Science and Technology
MRC	Menzies Research Centre
MRRT	Mineral Resource Rent Tax
Mtce	Millions of tons of coal equivalent
NBP	National Balancing Point (UK)
NEA	Chinese National Energy Administration
NEG	Australian National Energy Guarantee
NEM	Australian National Electricity Market
NDRC	Chinese National Development and Reform Commission
NSP	Network Service Provider
NSW	New South Wales
NT	Northern Territory
NZ	New Zealand
TI	Transparency International
TWh	Tetra Watt hour
ODI	Overseas Direct Investment
OECD	Organisation for Economic Co-operation and Development
OPEC	Organisation of Petroleum Exporting Countries
OSH	Occupational Safety and Health
PPA	Power Purchase Agreement
PPP	Public Private Partnerships
PPRT	Petroleum Resource Rent Tax
PV	Photovoltaic

QLD	Queensland
RBA	Reserve Bank of Australia
REE	Rare Earth Elements
RMB	Renminbi
RPS	Renewable Portfolio Standards
RRT	Resource Rent Tax
SA	South Australia
SASAC	Chinese State Owned Assets Supervision and Administration Commission
SERC	Chinese State Electricity Regulatory Commission
SFC	Stock Flow Consistency
SME	Small and Medium Enterprises
SoE	School of Economic
SWUFE	Southwestern University of Finance and Economics
T&D	Transmissions and Distribution
TAFE	Technical and Further Education
TAI	the Australia Institute
TCI	the Climate Institute
ToS	Time of Supply
ToU	Time of Use
TIWB	Tax Inspectors without Borders
UK	The United Kingdom
UNDP	United Nations Development Programme
UQ	University of Queensland
USA	United States of America
VIC	Victoria
VRE	Variable Renewable Energy
WEA	World Economics Association
WEF	World Economic Forum

1 Introduction

Combating climate change and fostering inclusive economic growth are two of the most pressing priorities for policymakers in the 21st century. An inclusive growth agenda provides opportunities and distributes the benefits of economic growth equitably across society. Mitigating and adapting to climate change seeks to safeguard the very survival of the society in which economic activity unfolds. OECD (2017e) recommends bringing together the growth and climate agendas, calculating that integrating measures to tackle climate change into regular economic policy will have a positive impact on economic growth over the medium and long term, and claiming the transition to zero net carbon dioxide emissions can produce inclusive growth (OECD 2017a). This report investigates whether a transition from fossil fuels to renewable energy sources can promote inclusive growth in Australia. It highlights Australia's trading relationship with China, compares policy settings in the two countries, and recommends ways in which the twin objectives of inclusive growth and climate change agendas be brought together. We discuss making the transition from fossil fuels to renewable energy as a way to promote inclusive growth in Australia and make recommendations to remove barriers to the transition to zero net emissions and inclusive growth.

Australia's climate challenge involves both mitigation of the sources of climate change and adaptation to its unavoidable impacts. As Australia is one of the largest emitter of greenhouse gases per capita and one of the largest exporters of fossil fuels in the world, mitigating climate change entails a substantial reversal of existing trends and sources of economic value. Compounding this, adapting to climate change is a particularly acute challenge for Australia, which is already one of the hottest countries on earth.

China faces similar challenges of mitigation and adaptation, as the world's largest greenhouse gas emitter. However, China's energy transition also has a profound effect on Australia's climate challenge, as both Australia's major supplier of renewable energy technologies and the largest importer of Australia's non-renewable energy resources.

While climate change poses a monumental challenge for environmental sustainability, the way in which economic growth is generated and distributed poses risks to economic and social stability. To combat this, the OECD (2017b) proposes an 'inclusive growth' agenda, which includes such measures as affordable and universal education and healthcare, alongside the elimination of economic rents.1 The OECD suggests that the accumulation of economic rents, as manifested in highly polarised distributions of income and wealth, is partly responsible for the deceleration in productivity growth in most developing countries. For Australia, the OECD (2017d) links suggests that the mining boom of the early 2000s also contributed to the increasing concentration of income and wealth distributions. Reversing these trends is the key to pursuing an inclusive growth agenda, which both provides for sustainable economic growth and enables a swifter adaptation to climate change.

Both inclusive growth and climate change are wicked problems to solve for four reasons (1) incomplete or contradictory knowledge, (2) the number of people and opinions, (3) the large

1 The World Economic Forum (WEF 2017) provides a measure of inclusive growth called the Inclusive Development Index (IDI) that combines measures of growth, development, inclusion, intergenerational equity and sustainability, such as GDP per capita and the Gini coefficient.

economic burden and (4) the interconnected nature of these problems.[2] Crucially, vested interests whether they benefit from climate policies that favour fossil fuel technologies or from economic policies that increase the income and wealth of those at the top of these distributions, are a major but unavoidable obstacle in both addressing climate change and promoting inclusive growth. For instance, there is consensus among climate scientists that climate change is occurring and the main driver is anthropogenic but there still exist climate change deniers. Additionally, there are economists advocating government expenditure on infrastructure, education and health to promote inclusive growth using revenue from economic rents and eliminating base erosion and profit shifting. Others promote tax cuts and government austerity to promote economic growth, as part of trickledown theory description of the economy despite the evidence to contrary (Baker 2016; OECD 2013a; Ostry, Loungani & Fureceri 2016) .

The structure of the report follows. Chapter 2 discusses Sino-Australian trade and Australia's transition through the mining boom and the mechanisms that helped concentrate wealth in the two top quintiles during the mining boom, including the property market bubbles and tax avoidance within the fossil fuel industry, which impede inclusive growth and climate change adaptation and mitigation.

Chapters 3 and 4 focus on climate change mitigation in the Chinese and Australian electricity sectors, respectively. The electricity sector is pivotal in the transition to zero net emissions and as such needs to lead the economy in the transition for the following five reasons (TAI 2017b). (1) The fossil fuel electricity generators in both countries are responsible for the largest proportion of the countries emissions. (2) Fossil fuel generators within the electricity systems are amenable for replacement with renewable energy whereas technologies to displace emissions in other sectors such as iron and cement production are less advanced. (3) In both countries, the transport sector is also a major source of emissions where there is a convergence of the transport and electricity sectors as electric vehicles and trains become wider spread. (4) Electricity is a widely consumed commodity and the transition to a low emissions electricity system requires special consideration to promote inclusive growth. (5) The Australian 'energy only market' and Chinese command-and-control approach contrast but informatively the transition to renewable energy is proving difficult for both systems albeit for differing reasons.

Chapter 5 identifies four barriers to solving wicked problems and discusses options to remove these barriers. The role of improving government productivity (McKinsey 2017) provides part of the solution to these wicked problem. Government productivity' is important because governments can do 'more with less', but we also argue that governments need not be content with 'less' if governments crack down on Base Erosion and Profit Shifting, this means they can get 'more', amplifying any productivity gains in government.

Chapter 6 concludes the report and discusses policy recommendations.

2 https://www.wickedproblems.com/1_wicked_problems.php

2 Inclusive growth and climate change adaptation and mitigation

This chapter discusses the interrelationships between inclusive growth and climate change adaptation and mitigation to identity inadequate policies and inform policy recommendations.

It is important to make a clear distinction between climate change mitigation and climate change adaptation. Mitigation focuses on eliminating the cause of climate change. Adaptation focuses on making changes to ameliorate the effects of climate change. Early and rapid mitigation will reduce adaptation costs, as we will not need to adapt so much. Two examples crystallise the difference between adaption and mitigation. (1) Building higher wharfs to enable Australia to continue the export of coal in the facing of rising sea levels is an adaption to climate change that undermines mitigation efforts. (2) In contrast, relocating people from islands being overcome by the rising sea level is an adaptation but does little to mitigate climate change.

As it currently stands, mitigation is not in the interest of fossil fuel companies (and some shareholders, lobbyists, and employees), as the cost will be borne by them. Any country, company or individual contributing to mitigation is unable to capture the full benefit of their mitigation efforts, making mitigation an issue of international public good. Additionally, mitigation requires both improving energy efficiency and transitioning from fossil fuels to renewable energy[3]. The provision of renewable energy provides a public good in displacing emissions, which requires a strong public response and support. Mitigation presents a discord between the public good and mining vested interests. Hence there are vested-interests in preventing the transition including the fossil fuel shareholders, companies and employees facing wealth and income losses and politicians facing political donation losses (Evershed 2017; Hanrahan et al. 2017). Notable is the political instability and lack of direction over climate change policy (Turnbull 2009).

Some adaptation is inevitable, as we will be unable to limit global climate change satisfactorily. Adaptation costs fall on the entire population; the rich can more readily afford adaptation and the poor are less able to afford adaptation costs. Adaptation costs are borne disproportionately by the poor, in the absence of redistributive or progressive inclusive policy, but vested interests are content with status quo, and see climate change adaptation by the less financial able as 'someone else's problem'. Adaptation becomes an issue of wealth and income distribution which inclusive growth can address. We discuss methods to address the mitigation discord and promote inclusive growth.

Climate change adaption and mitigation is only one wicked problem faced by both Australian and China, others include the property market bubbles, population ageing and obesity epidemics. These problems impede inclusive growth and climate change adaptation and mitigation. A common theme to addressing these wicked problems is the public good versus vested interests that use political donations and lobbying to gain tax subsidies and tax breaks.

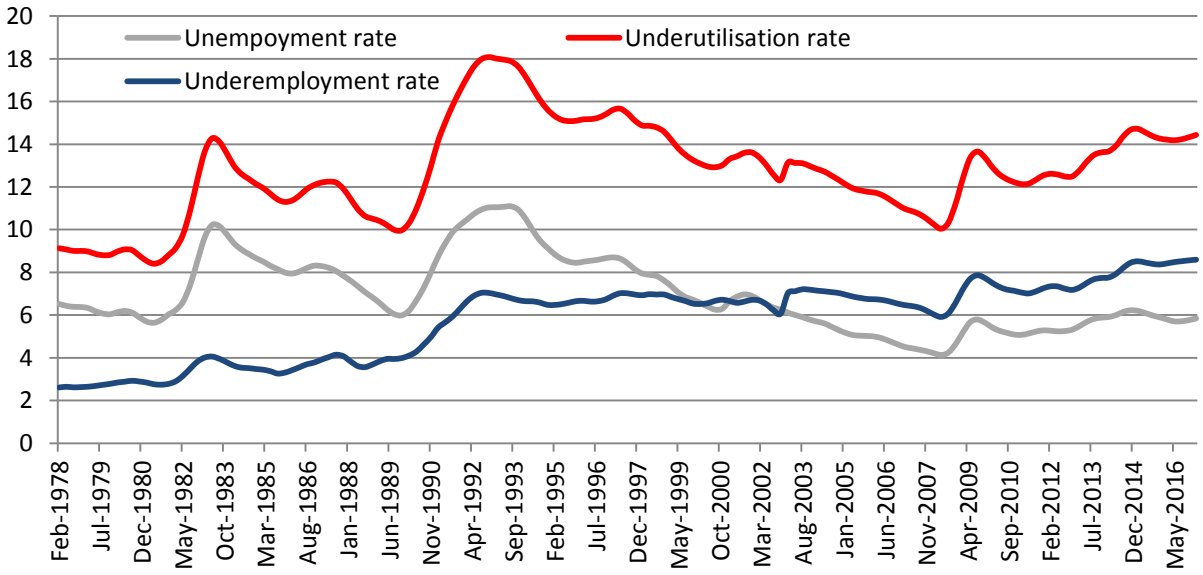
[3] The nuclear and clean coal options have proven financial unviable. The levelised costs of renewable energy are about the same as a new coal fire plant even without considering the cost of the carbon emissions (Finkel 2016). Concurring detail discussions of the unviability of nuclear include http://www.japantimes.co.jp/opinion/2017/02/04/commentary/world-commentary/dream-cheap-clean-nuclear-power/ and clean coal https://www.nytimes.com/2016/07/05/science/kemper-coal-mississippi.html

Australia benefited greatly from the commodity boom induced by China's industrialisation, but with the mining boom ending, we find the benefits mainly going to the top 40% of the population. Compounding this concentration in wealth problem are record-breaking and growing **under**employment, a housing bubble, underinvested in non-mining infrastructure, and declining economic growth and government revenues. Meanwhile total emissions continue to increase. (ABS 2017a; OECD 2017b; Smith, MH & Nwagbara 2017).

It is important to distinguish between **un**employment and **under**employment. Figure 1 shows the commonly advertised unemployment rate in light grey at a minimum of 4% just before the Global Financial Crisis (GFC) in 2008 and oscillating about 6% subsequently. Noting the ABS defines an employed person in a reference week as worked for one hour or more for pay, profit, commission or payment in kind or worked for one hour or more in a family business or on a farm. However, the unemployment rate used in isolation ignores the underemployment rate that is now at its highest since records began in 1978 and growing, shown in dark blue. Vandenbroek (2017) provides a guide to Australia's employment associated rates and the ABS defines them as follows.

- **Unemployment rate:** for any group, the number of unemployed persons expressed as a percentage of the labour force in the same group.
- **Underemployment rate:** the number of underemployed workers expressed as a percentage of the labour force
- **Underutilisation rate**: the sum of the number of persons unemployed and the number of persons in underemployment, expressed as a proportion of the labour force that is the sum of the unemployment and underemployment rates.

Figure 1: Moderate unemployment rate hiding growing underemployment and underutilisation



(Source: ABS 2017 6202.0 Labour Force, Australia - Table 23. Underutilised persons)

The structure of the chapter follows. Section 1 discusses declining demand for thermal coal and increasing demand for rare earth elements, disappointingly small fossil fuel royalties and the loss of a carbon price and resource rent tax. Section 2 discusses the decreasing full-time employment and exports from the Australian mining and manufacturing sectors and the increasing underemployment and exports from the service sectors. Notable is the growth in

Chinese tourists and students. Section 3 discusses potential economic instability contagion linkages between the Australian and Chinese property market bubbles and their role in hampering inclusive growth. Section 5 discusses areas for further research.

2.1 Australia's trade in fossil fuels and minerals with China

We discuss the importance of coal to Sino-Australian trade and the sensitivity of Australia's coal exports to any changes in Chinese policy or demand. The decreasing price for renewable energy generation is reducing the demand for Australian thermal coal exports. Foreign owned mining companies are using thin capitalisation and base erosion and profit shifting to avoid paying company and resource rent taxes. The demise of fossil fuels requires Australia to make plans to diversify its exports and maximise its revenue from resource rent taxes and royalties.

Table 1 compares the world coal energy flows with Australia and China in 2014. China consumed just over 51% of the world's production of coal with 18% of the world's population, making China the world's largest emissions country. In contrast, Australia consumed about 1% of the world's production of coal with 0.32% of the world's population, making it one the world highest emissions per capita countries. Furthermore, coal is a huge part of Australia export base; Australia exported 85% of coal produced and its coal exports comprised 28% of the world's exports. China imported about 8% of coal consumed and its imports comprised 18% of the world's imports, indicating China's reducing coal consumption by 1% would reduce world imports by 2.4%[4], assuming the 1% reduction came from imports only. This 2.4 multiplier indicates the sensitivity of world demand to changes in China's coal consumption. Determining sensitive multipliers for metallurgic and thermal coal would be informative.

Table 1: Comparing Chinese, Australian and world coal energy flows in 2014

Peta Joules	China	Australia	World
Produced	79,113	11,951	166,473
Imported	6,468		35,259
Exported		10,167	36,138
Consumed	85,581	1,784	

(IEA 2017).

Factors affecting coal consumption include (1) China's new pollution and climate change policies, (2) decreasing energy intensity due to Chinese coal fired power stations' higher energy efficiency and China transitioning from a manufacturing economy to a service economy and (3) decreasing economic activities induced by population ageing and deceleration in the historically high property asset prices or housing bubble. All these factors contribute to a large downside risk in demand for the export of Australian coal to China. Chapter 3 discusses factors affecting coal consumption in more detail.

Factors affecting coal consumption with China include both direct curtailment of coal generation and increasing investment in renewable energy. For instance, the China's National Energy Administration (NEA) has suspended plans to build 85 coal plants[5]. The National Development and Reform Commission (NDRC) of China issued a new policy document targeting a share of 20% of non-fossil fuels in total energy consumption by 2030

[4] The 2.4% is calculated from the figures within the paragraph 85,561 * 0.01 / 35,259 * 100

[5] http://news.bjx.com.cn/html/20170116/803648.shtml

and of more than 50% by 2050. The NDRC expects CO_2 emissions to peak by 2030 and aims to cap total energy demand at 6 Gt of coal equivalent (6 Gtce) by 2030, which would represent a 4.4 Gtce increase over the 2017 demand forecast (Enerdata 2017). China's National Energy Administration (NEA) recently announced investment of 2.5 trillion yuan (US$361 billion) into renewable energy by 2020[6]. This investment will accelerate the learning curve effect to reinforce the "more for less" and marks a significant shift from coal generation that will help drive the increasing penetration of renewable energy to address climate change and displace coal generation (FS-UNEP Collaborating Centre 2017).

Factors affecting coal consumption internationally include improving energy intensity also direct curtailment of coal generation and increasing investment in renewable energy. The Economist (2017) reports a consistent pattern across Asia of improved energy intensity, an increasing number of renewable energy installations, the decreasing capacity-utilisation of existing coal generators, the closure of old inefficient coal fired plant and the suspension or delay in building new coal plants. In 2016 new investments in renewable fell from the previous year but the overall installed capacity increased, reflecting the decline in price per unit of electricity generated. Similarly, the cost of battery storage is falling rapidly, enabling higher penetrations of variable renewable energy (VRE) (Pinho 2017a; Turner, de Pee & Murphy 2017). The renewable energy price declines provide developing countries the option of bypassing a system of centralised coal and gas generation with large transmission and distribution investments to go for a system of distributed renewable energy. In a similar way, the introduction of mobile phones enabled developing countries to bypass the expensive infrastructure required for landline telephones. The surge in the supply of cheap LNG from Australia and elsewhere is also competing with Australian coal exports. This situation provides diminishing alternative export markets for Australian thermal coal.

Limiting global warming to 2 degrees entails putting a limit on the amount of fossil fuels burnt or imposing a carbon 'budget' (TCI 2017). Meeting this budget will affect coal more strongly than oil or gas for the following reasons. (1) Coal contains less energy per tonne of carbon dioxide emitted than oil or gas. (2) Electricity from renewable energy has already reached parity with coal generators. (3) Electric vehicles (EVs) have yet to reach parity with internal combustion engine (ICE) vehicles to displace oil. (4) Renewable alternatives for aviation and maritime vehicles are even further away from displacing oil.

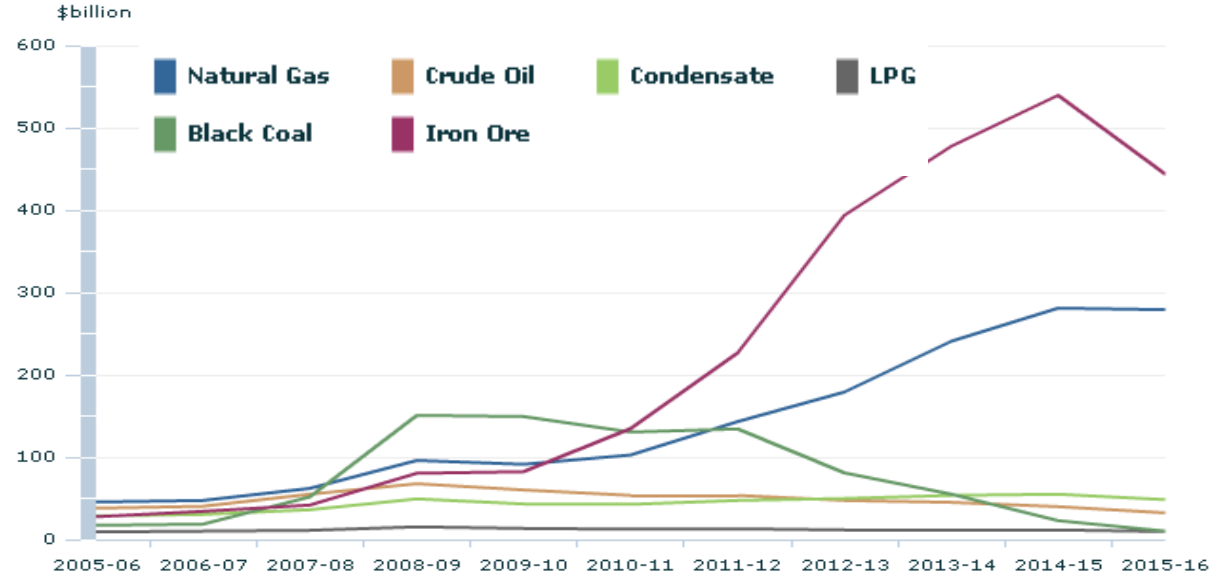
Helping meet this carbon budget UK and France have announced plans to eliminate the sale of petrol and diesel passenger vehicles by 2040 and China is working on a similar timetable to eliminate these vehicles.[7] The following quota system announced by the Chinese Government will help accelerate the price convergence of eVs with the ICE. The planned 2018 quota system for EVs in 2018 is for 8% of all new vehicles sales to be EVs (Clover & Ju 2017). Companies failing to meet the 8% quota are required to buy certificates from those companies that overshoot 8% target with the quota system expected to grow. This quota system will help accelerate EV price parity convergence with ICE vehicles, promote the deployment of eVs and reduce demand for oil. This quota system provides a way for the Australian Governments to promote eVs without the need for subsidies. Reducing oil imports for Australia has both energy security and economic advantages since Australia

[6] http://www.reuters.com/article/us-china-energy-renewables-idUSKBN14P06P
[7] http://www.independent.co.uk/news/world/asia/china-petrol-diesel-car-ban-gasoline-production-sales-electric-cabinet-official-state-media-a7938726.html

lacks oil-refining facilities; Australia exports its crude oil and is dependent on value-added imports. Chapter 4 discusses the requirement of a 5-minute settlement period to help coordinate energy storage, demand side management, electric vehicle recharging and VRE and promote inclusive growth (Parkinson 2017).

More than half the assets in the global coal industry are now held by companies that are either in bankruptcy proceedings or don't earn enough money to pay their interest bills, according to data compiled by Bloomberg (Fickling 2016). The bankruptcy of Peabody, the world's largest publicly traded coal mining company, early in 2016 indicates the financial fragility of coal assets. The Climate Institute (TCI 2017) discussed how different countries meeting their commitments to reduce emissions puts Australian coal assets at risk of becoming stranded. In agreement, the Australian Prudential Regulatory Authority (APRA 2017) identified the transition towards a zero net emissions economy as one form of climate-related financial risk. Figure 2 shows the value of Australia's Economic Demonstrated Resources (EDR)[8]. Consistent with world trend, there is the collapse of Australian black coal as an EDR.

Figure 2: Value of Selected Minerals and Energy Sources, Current prices, 2005-06 to 2015-16



(Source: ABS 2016a)

During the commodity boom, the Adani Group developed plans to open a new coalmine called Carmichael in the Galilee Basin in Queensland, which if completed, would be Australia's largest coalmine and one of the world's largest coalmines. Both Federal and Queensland Governments pledged financial support for the project, however, these plans ignore decreasing renewable energy prices, lower world coal prices, other countries meeting their emission reduction commitments and Australia's own emission reduction commitments. If completed, the output from the Carmichael coalmine would put downward pressure on international coal prices, which would reduce the asset value of Australia's existing coal mines and put them under further financial stress (Long 2017a). The refusal by Australia's

[8] EDR measures the physical extent of a given resource. EDR is a measure of the resources that are established, analytically demonstrated or assumed with reasonable certainty to be profitable for extraction or production under defined investment assumptions. Classifying a mineral resource as EDR reflects a high degree of certainty as to the size and quality of the resource and its economic viability.

four major banks to finance the proposed Carmichael coalmine confirms the high risk associated with coal assets. There is a major disconnection between the vested interests promoting the coalmine and the mitigation requirement to displace coal and the economic transformation occurring, as renewable energy becomes cheaper than coal.

Additionally, going ahead with the Carmichael mine bears parallels to the debacle occurring in the Australian gas industry induced by overinvestment (Verrender 2017a). Australians are paying more than the international price for gas to subsidise overinvestment in export infrastructure and the gas prices for industrial users has nearly tripled in 3 years. These inflated gas prices are inducing Australian electricity generator to bypass using gas as a transition fuel between coal and renewables because the inflated gas prices means that renewable energy and battery storage combinations become relatively more competitive than new gas generation (Vorrath 2017). This induced accelerated uptake of renewable energy puts further downward pressure on coal prices, which reduces the return on investment for all thermal coalmines in Australia.

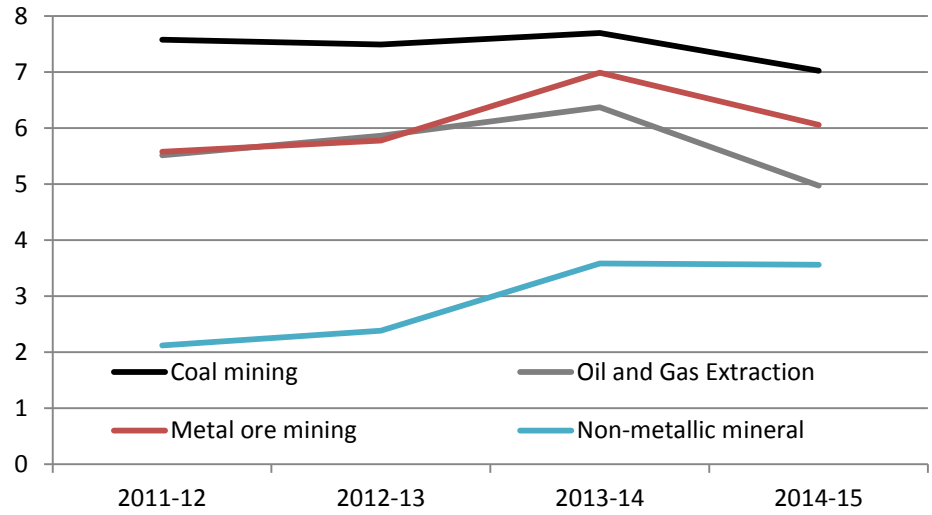
Lastly, Australia supporting coal exports for short-term gains is destroying Australia's largest and major tourism attraction, the Great Barrier Reef. Section 2.2 discusses the increasing and much larger importance of tourism, education or health in terms of employment and the much smaller and declining importance of mining as an employer in Australia. Given Australian employment is already adapting to the declining mining sector, the remaining question arises 'how important is the loss of government revenue from fossil fuel royalties and taxes?'

2.1.1 Government revenue from natural resource royalties and taxes

Figure 3 shows combined natural resource royalties and rent tax expenses for companies as a percentage of sales of goods. Note the ABS "Natural Resource Royalties" definition includes both resource rent taxes and royalties payments under mineral lease arrangements, payments under quarrying lease arrangements[9]. When considering revenue from rent taxes and royalties, one must consider government subsidies to the resource companies, including the reimbursement of excise duty on fuels and funding or subsidies for their other operational costs. ABS (2016b) provides incomplete data on these reimbursements, but the two years with complete data for the coal industry shows the reimbursements are about a quarter of the rent taxes and royalties paid.

[9] http://www.abs.gov.au/ausstats/abs@.nsf/Lookup/8415.0Glossary12011-12

Figure 3: Natural Resource Rent Taxes and Royalties as a percentage of sales of goods

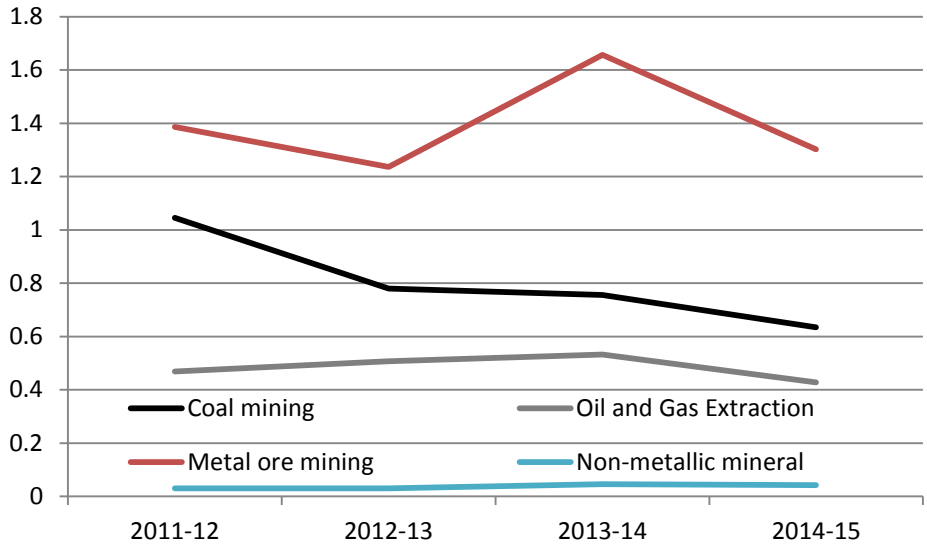


(Source: ABS 2016b)

Figure 4 shows the natural resource rent taxes and royalties as a percentage of total taxation revenue for all levels of government. As discussed, these percentages overestimate revenue as the mining sector receives large subsidies. The fossil fuel rent taxes and royalties decreased as a percentage of total taxation from about 1.4% to 1% between 2011-12 and 2014-15. For comparison in absolute terms, the fossil fuel rent taxes and royalties from oil and gas extraction and coal mining was $4.7b in 2014-15, which is less than the $5bin tax breaks given to housing investors, including negative gearing and capital gains tax concessions each year (ABS 2016b).[10] This indicates the government could easily accommodate the loss of fossil fuel rent taxes and royalties by withdrawing these tax breaks. Conversely, the fossil fuel rent taxes and royalties allowed the government to provide tax-breaks that mostly benefit the wealthy. The mining boom has passed and government revenue is declining, so the Turnbull Government is having problems sustaining these tax breaks and looking elsewhere to reduce government expenditure. This process forms a ratchet effect consisting of tax breaks in boom times and expenditure cuts in recessionary times to reduce the size of government (Denniss 2015). Section 2.3 discusses the role of these tax breaks in exacerbating the housing bubble, impeding inclusive growth and reinforcing the ratchet effect.

[10] http://www.abc.net.au/news/2016-04-25/research-calls-for-abolishing-income-tax-deduction/7356270

Figure 4: Natural Resource Rent Taxes and Royalties as a percentage of total taxation revenue all levels of government



(Source: ABS 2016b; ABS 2017c)

There is general concern that natural resource rent taxes and royalties paid by resource companies is inadequate compensation for the rights to sell Australia's resources (Garnaut 2013; Kraal 2017; McHugh 2017; Ong 2016; Verrender 2012). Comparing tax rates for petroleum companies in Australia and Norway is instructive, as Norway and Australia are comparable and unique in belonging to a small set of countries that are developed with relatively small populations and heavily dependent to fossil fuels exports. Both countries are fortunate to have the institution stability of developed countries to reduce the corruption found in less-developed countries with large fossil fuel deposits. Additionally, they are fortunate in having small populations to distribute intact revenues. Australia's Petroleum Resource Rent Tax (PRRT) of 40 percent and company tax rate of 30 percent produce a combined rate of 58 percent. Norway has a combined rate of 78 percent. Australia is in the fourth quintile of PRRT rates. This is incredible low by international standards. Even more so, when one considers Australia's physical and institution infrastructure and peaceful environment compared to other developing countries with fossil fuel resources.

So, the Turnbull Government commissioned the Australian Treasury (2017) to undertake a partial review on gas and oil resources. They found that a resource rent tax (RRT) is theoretically more efficient than using resource royalties, as RRT only applies when a company is making a profit, so will not deter companies from exploration or investing in new marginal projects. The downside is a delay in revenue for the government or in some cases, there is never any RRT revenue. In contrast, resource royalties, based on output quantity or value rather than profit, provide a much earlier and consistent source of revenue for governments but may deter companies from developing marginal resources.

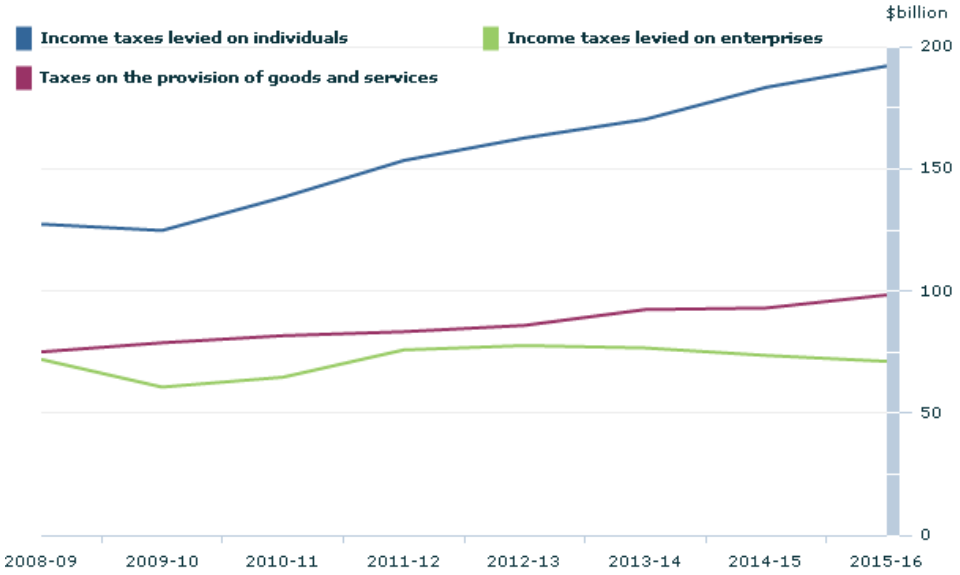
Submissions to the Australian Treasury (2017) PRRT Review included a number of arguments. (1) Royalties are better than RRT because they prevent the development of marginal resources, so avoid exhausting Australia's resources without revenue for the Australian public and prevent environmental damage with marginal economic benefit. (2) Supplementing royalties with RRT provides a better structure for revenue. Extending argument 2, RRT transfers the financial risk of exploration from the resource companies to

the Australian public. See McClure, Lanis and Govendir (2017b) for discussion of RRT and 'uplift rates'. (3) Australia's existing RRT rate is too low by international standards. Extending Argument 3, compared to most resource rich countries, both Australia and Norway are secure peaceful developed countries with highly educated work forces supported by strong health systems and developed transport infrastructure, and both exist in pirate free regions of the world. Resource companies are free riding without contributing to these infrastructures. Norway's RRT rate of 78 percent rate is more appropriate for Australia.

Furthermore, both RRT and company taxes are based on a company's taxable profits. Companies are becoming increasingly adept at minimising taxable income using base erosion and profit shifting, including debt loading and thin capitalisation (McClure, Lanis & Govendir 2017a, 2017b; OECD 2013a). These techniques are easier to arrange for international companies. RRT provides added incentive for resource companies to minimise taxable profits. The Australian Tax Office (ATO) reported that in 2014-15 almost 60% of large resource and energy companies paid no tax, in comparison 36% of all large companies paid no tax (Janda 2016; Liddy 2017). The ATO initiated law suits against ExxonMobil and Chevron for excessively using debt loading (McClure, Lanis & Govendir 2017b). The Federal Court upheld ATO's $300 million tax bill for Chevron, which sets a precedence for similar debt loading tax minimisation schemes (Long 2017b). The OECD (2013a) provides extensive policy recommendations to minimise base erosion and profit shifting (BEPS) that Australia could implement to strengthen the ability of the ATO to capture tax avoidance. McClure, Lanis and Govendir (2017b) compare the effectiveness of different international royalty and rent tax regimes in addressing debt loading, using the Australian ExxonMobil and Chevron tax avoidance as case studies. Their comparison provides guidance on developing a more robust tax regime. Relatedly, the United Nations have developed a specialised unit to help countries with resource companies avoiding taxes called 'Tax Inspectors without Borders' (TIWB).[11] TIWB provides an avenue for Australia to share intelligence on resource companies avoiding taxes and help the international community to strengthen co-operation on tax matters. One of the consequences of company tax avoidance is a larger share of the tax burden is falling onto individuals as income tax shown in Figure 5. This increasing burden has fallen mainly on the middle-income earners as the richer income-earning individuals can reduce their taxable income through housing investments, including negative gearing and capital gains tax concessions, and voluntary superannuation contributions. The extremely rich can further reduce taxes using BEPS. Consequently, the Australian tax system badly leaks at the top and needs repairing to 'reduce the burden' on individuals, and on those enterprises currently paying the statutory rate.

[11] Tax Inspectors Without Borders (TIWB) http://www.tiwb.org/

Figure 5: Commonwealth government tax revenue



(Source: ABS 2017c)

Political instability in resource rich countries is a well-established phenomenon (Garnaut 2013). There are at least three notable negative aspects to the rise of the resource sector as a political force during the commodity boom (1) the decline in the integrity of Australia's democracy, (2) reduced quality of public debate and undermining of scientific information and (3) the curtailment of the government's ability to tax the resource sector. Example 1, the resource sector funded a $22 million advertising campaign opposing the Mineral Resource Rent Tax (MRRT) plan by Labour Prime Minister Rudd. The mining donations provided the Coalition[12] with an advantage over Labor before the election (Davis 2011). The resource sector's advertising campaign helped install the Coalition Abbott/Turnbull Government that repealed both the price on carbon and MRRT (Garnaut 2013).

The resource sector's advertising campaign was quite a cost-effective way to avoid paying royalties and taxes but weakened Australia's ability to mitigate climate change, the credibility of the Government and its financial integrity. Consequently, the Coalition Government finds it difficult to balance its cash flow budget. Example 2, the parliamentary member for Pilbara, Brendon Grylls, proposed increasing royalties in iron ore when the WA mining lobby spent up to $5 million to depose him (Dempster 2017). Example 3, the resource sector's major sponsorship goes to Coalition through political donations (Evershed 2017; Hanrahan et al. 2017). Turnbull (2009) described the Coalition's climate change policy was to disguise a determination to do nothing. Given about four fifths of the mining companies are owned by foreigners investors or companies (RBA 2011), this makes the questionable practice of companies making political donations even more dubious, raising questions over whose interests the politicians are working. Example 4, think-tanks funded by vested-interest groups shape public opinions (Garnaut 2013), including the Institute of Public Affairs (IPA)

[12] The 'Coalition' refers to the Coalition of the Liberal and National Parties at the Federal level. Unfortunately, the word 'liberal' has a multitude of interpretations, making the title 'Liberal Party' ambiguous. See https://www.merriam-webster.com/words-at-play/liberal-meaning-origin-history. For reference, the Liberal Party's philosophy bears many similarities to the American Republican Party. The 'Nationals' traditionally represented the interests of farmers. See http://www.parliament.curriculum.edu.au/pol_parties.htm.

and the Centre for Independent Studies (CIS) funded by fossil fuel and tobacco companies. These organisations masquerade as advocates of the public good but cast doubt about climate change and argue for fossil fuel and tobacco's interests (Oreskes & Conway 2011). Like in Australia, Carreri and Dube (2017) found the pattern of the natural resources sector undermining democracy by distorting elections to support right-wing governments in Colombia.

In addition to government revenue from company and rent taxes and royalties, there was the employee income tax revenue from the mining sector during the mining boom but one has to compare this with the probable income tax generated without the mining boom. The boom induced a rise in the exchange rate which displaced employees from other export industries, particularly in manufacturing, and the higher exchange rate also restrained growth in education, tourism and agriculture (Gittins 2016; Grudnoff 2012). Noting, the education and tourism export industries are relatively labour-intensive compared to mining. Section 2.2 discusses the relative labour intensities in detail. Manufacturing is still recovering from the boom induced high exchange rate. As discussed, the housing investment income tax breaks to the wealthy would have not been possible without the surplus revenue from resources boom. In summary, the difference in total Australian income tax revenue with or without the resource boom may be slight but the boom-time tax breaks lead to the middle-income earners shouldering more of the tax burden, so reducing inclusive growth.

Furthermore, the quality of employment outcomes needs consideration. The boom induced overinvestment in gas export infrastructure, tripling the domestic price of gas with Australians paying more than international prices for gas. These gas prices are hampering manufacturing's recovery from the commodity boom. The boom induced underinvestment or crowded-out investment in transport infrastructure to relieve congestion in the cities to allow people to commute further distances to work and effectively improve the housing supply. Investment in transport infrastructure would improve the efficiency of Australia and provide for inclusive growth. There have been some public-private-partnerships (PPPs) in the provisions of toll roads and tunnels. However, the PPPs road and tunnel utilisation rates were consistently well below forecasts. This bias towards over forecasting enabled consultants and bankers to "upfront" fees before any revenue from the tolls on roads and tunnels that may well have failed the requirement for investment criteria if accurate forecast were provided.[13] This situation undermines inclusive growth, both exacerbating inequity and undermining Australia's productivity. Additionally, the situation highlights problems with government outsourcing decisions making to private companies to obtain some perceived arm's length 'transparency'. Problems include the misalignment between the public good and the objectives of consultants and bankers to maximise fees and a loss of capability within government to research and assess its own projects.

2.1.2 Maximising Australia's Government revenue from fossil fuels in the transition to zero net emissions and maintaining export diversification

Australia needs to put in place plans to maximise government revenue from its remaining fossil fuels assets in the transition to zero net emissions and provide a pathway to diversify employment away from fossil fuels to renewable energy or other industries. In the transition to zero net emissions, the risk of bankruptcies of fossil fuel companies will increase and given the large foreign ownership and use of thin capitalisation and BEPS, this will require

[13] http://epublications.bond.edu.au/cgi/viewcontent.cgi?article=1058&context=pib

careful consideration for creditor liabilities and mine rehabilitation costs. We consider the effects of the demise of the fossil fuel sector for Australia and Australian exports transitioning from being part of the climate change problem to climate change solution.

Fossil fuels consist more than 20% of Australia's goods and services exports, including coal 11.6%, natural gas 5.4% and crude petroleum 3.2%.[14] This is a significant part of Australian exports, and it is prudent putting in place pathways to diversify Australia's exports. Currently, the lower exchange rate is helping to expand tourism and education exports but China dominates the expansion in these existing industries, which ameliorates the ability of the tourism and education sectors to provide diversification to moderate export risk. Section 2.2 discusses the transition to tourism and education that contribute 5.2% and 4.4% of Australia's good and services exports. The Queensland State Government has already identified priority industries for development that can increase diversity of exports and import substitution, including advanced manufacturing, aerospace, biofuels, biomedical and life sciences, defence and mining equipment, technology and services.[15] Three specific recommends that aid Australia's transition to zero net emissions and fall within these priority areas include: (1) The transition from fossil fuels to renewable energy will require the increasing use of rare earth elements (REE) for the electronics in the renewable energy, smart grids and batteries to mitigate climate change. Australia has proven resources in REE.[16] Investing in REE exploration and extraction, rather than supporting the dying coal industry responsible for climate change, provides an opportunity for the mining industry to support the next economic transformation and mitigate climate change. However, Australia's skills and knowledge require developing in this area.[17] Research and development in the non-renewable natural resources sector include (2) improving iron ore refining without metallurgic coal and (3) reducing the heat and emission in the production of cement.

The Reserve Bank of Australia (RBA 2011) estimates slightly more than four fifths of coal and LNG companies are foreign owned. Foreign investment enabled Australia to develop the infrastructure to extract the fossil fuels quickly. However, foreign ownership subsidiaries operating in Australia are unable to access imputation tax credits, so motivated to engage in tax minimisation, including debt loading (McClure, Lanis & Govendir 2017b). This presents problems for creditors who bear the solvency risk, as there is less contributed capital from the owners to cover debts. The solvency risk also includes failure to pay employees and restore the environmental damage created by fossil fuel extraction. As discussed, debt loading presents a problem for Government Revenue through excessive interest deductions for tax purposes and reliance on RRT rather than royalties, which exacerbates this situation. Consequently, Australian Government Revenue from fossil fuels is a tiny part of total Government Revenue, as shown in Figure 4, and 60% of resource companies declare no taxable income (Janda 2016; Liddy 2017). Two other factors contribute to the poor revenue, (1) the depressed state of the fossil fuel industry and (2) the Government providing generous depreciation on assets and uplift rates to promote exploration and development.

The depressed state of the global prices for fossil fuels are unlikely to recover, making it imperative for the Australian Governments to extract as much wealth from the resources for

[14] http://dfat.gov.au/trade/resources/trade-at-a-glance/Pages/top-goods-services.aspx
[15] http://statedevelopment.qld.gov.au/industry-development/priority-industries.html
[16] http://www.australianminesatlas.gov.au/aimr/commodity/rare_earths.html
[17] http://www.abc.net.au/news/rural/rural-news/2015-09-22/rare-earth-miners-face-tough-market/6786970

Australians in the short term rather than provide royalty or tax holidays to fossil fuel companies. We have already discussed the drivers for the decline in coal prices. The decline in gas and oil prices is in large part due to two aspects (1) physically, the large reserves available in the USA from fracking for gas and shale oil and (2) legally, the USA lifting a ban on the export of crude oil in December 2015 and gas in 2016. On the oil supply side, OPEC traditionally used its cartel power to restrict supply to maintain high oil prices but the USA will supply the global market with shale oil once prices begin to rise. This shale oil reserve in effect has destroyed the market power of the OPEC cartel (Pinho 2017b). Oil is trading at free market prices. On the oil demand side, the introduction of electric vehicles will weaken demand for oil. The increasing demand from developing countries will offset this decline in demand from developed countries over the medium term. Initially, the international gas price linkage to oil prices caused the decline in international gas prices. Additionally, there has been a convergence in the four major global prices of gas, USA's Henry Hub, UK's National Balancing Point (NBP), Japan Korea Marker (JKM) and JCC/Brent oil index, toward the lowest priced Henry Hub in the USA (Wyeno & Chowdhury 2016). This increasing gas supply from fracking in USA is constraining gas prices. As the USA develops its export infrastructure, there will be three major suppliers shipping LNG to East Asia, including Qatar, Australia and USA (Salameh 2016). Joining the shipping supply, there is supply to East Asia via pipeline from surrounding countries. Existing pipelines include from Turkmenistan to Shanghai. Under construction pipelines, include one from Russia to Northeast China and Korea for completion 2019[18] and one from Myanmar to Yunnan, China's twin gas and crude oil pipelines.[19] There is a proposal to build another gas pipeline from Russia to North West China. Chapter 3 discusses China's plans to expand its gas generation fleet, which will increase demand for gas but the additional new large sources of gas supply coming online both by sea and overland will suppress any price increases.

Regarding the financial liability incurred by the mining sector for mining site rehabilitation, an early study estimates that 50,000 abandoned mines require rehabilitation in Australia.[20] A more recent estimation puts the number of abandoned mines at 60,000.[21] Poor data makes establishing the exact figures difficult but the rate of successfully rehabilitated mines in Australia is extremely low. During the mining boom, the focus was building mines, with less consideration or inadequate consideration paid to rehabilitation. As discussed, the coalmining companies holding these rehabilitation liabilities are financially fragile and the thin capitalisation leaves little capital for rehabilitation costs that are often underestimated (Campbell, R et al. 2017). This situation potentially leaves Australia to pay for the rehabilitation of the mines and in effect provide the mining industry with another subsidy. As the mining boom ends, the Australian Governments are assessing the adequacy of rehabilitation legislation and financial reserves held by mining companies for rehabilitation shown in the following list.

- Federal Senate inquiry into the rehabilitation of mining and resource projects due 23 August 2017.
- Victoria is reviewing its financial assurance policy for coalmines.

[18] http://www.chinadaily.com.cn/business/2017-03/16/content_28581640.htm
[19] https://www.ft.com/content/21d5f650-1e6a-11e7-a454-ab04428977f9
[20] https://theconversation.com/what-should-we-do-with-australias-50-000-abandoned-mines-18197
[21] http://www.abc.net.au/news/2017-02-15/australia-institute-report-raises-concerns-on-mine-rehab/8270558

- South Australia has an ongoing comprehensive review of mining laws that started in 2016.
- Queensland is reviewing its financial assurance mechanisms and related considerations of the rehabilitation framework (Queensland Government 2017).
- New South Wales is conducting as audit of the adequacy of mining rehabilitation security deposits.
- Northern Territory is developing mine closure guidelines.
- Western Australia is reviewing its Mining Rehabilitation Fund regulations.

Five recommendations to maximise Government Revenue from fossil fuels in the transition to zero net emissions include:

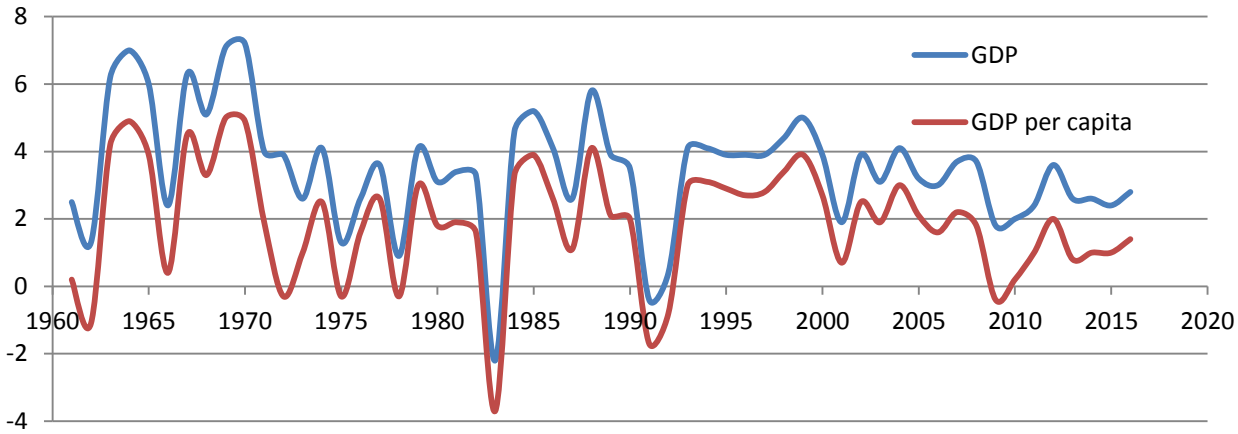
- examining other countries' legislation for best practice (McKinsey 2017),
- switching from RRT to a combined RRT and royalties like Norway's 78 percent RRT regime,
- reducing asset depreciation and 'uplift rates' to transfer the risk of investment from the Government to the fossil fuel companies,
- eliminating political donations from the mining sector and related entities, and
- banning advertising by the mining sector prior to and during any elections.

2.2 The employment market adjusting to the end of the commodity boom

We discuss the destructive effect of the commodity boom on fulltime employment in the manufacturing sector, the initially low and declining employment in the mining sector, the expanding employment in the service sector and the increase in the underemployment rate impeding inclusive growth.

Figure 6 shows Australia's world breaking record of non-recessionary growth or increase in GDP for 104 quarters, but this growth in part is due to population growth, including an increases in births over deaths and net immigration (Verrender 2017b). GDP per capita shows Australia in negative growth in 2009 and only a modest recovery since the Global Financial Crisis. The low and negative GDP per capita growth is partly the result of underemployment or reduced wage rates and inadequate infrastructure expenditure to match the increase in population (Productivity Commission 2016; Verrender 2017b). The increased construction employment induced during the investment phase of the commodity boom is over and the minimal employment sustained by the operations and maintenance phase of the boom has begun (EABER & CCIEE 2016).

Figure 6: Australian percentage change in GDP and GDP per capita (Chain volume measure) June figures

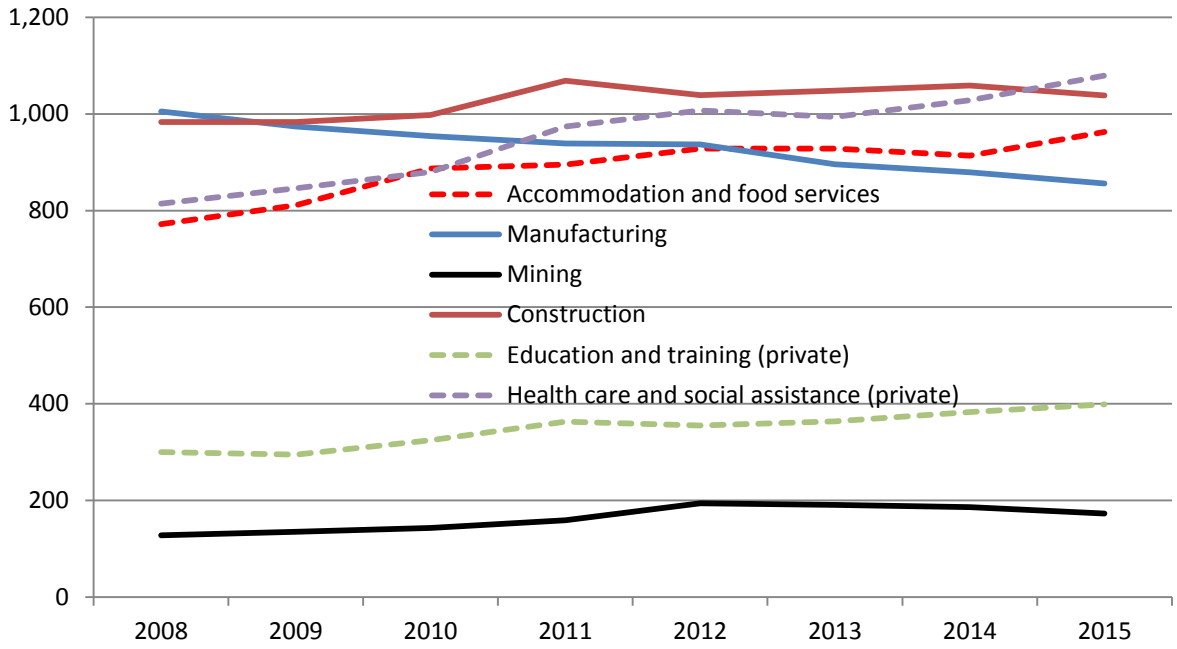


(Source: ABS 2016 5204.0 - Australian System of National Accounts, 2015-16)

Regarding the lack of capital investment, Coalition recently changed its interpretation of the budget deficit from "Underlying cash balances" to "Net operating balance" on the national accounts reflecting change from cash flow to accrual basis to interpret the deficit (Stiles 2017b). The "Underlying cash balances" approach equates to "austerity" measures that Ostry, Loungani and Fureceri (2016) found in an international comparative study to exacerbated inequality and hamper economic growth. The "deficit" redefinition allows investment in infrastructure without increasing the deficit and is consistent with long standing calls from the RBA and Labor for investment in infrastructure. The redefinition also brings Australia into line with New Zealand and Canada. However, Coalition's recent redefinition merely reverses an older decision made by the former Coalition Treasurer Costello who defined the deficit in terms of cash flow (Hutchens 2017). In addition to restricting government investments, Costello's cash flow definition or austerity measures put in place a process to shrink the size of the government, a ratchet effect of tax cuts in boom times and expenditure cuts during recessions (Denniss 2015). Section 2.3 discusses the tax cuts and infrastructure expenditure in more detail. These budget definitions and tax cuts are important if the government is to lead an inclusive growth strategy based the elimination of economic rents and investments to mitigate emission as suggested by the OECD (2017e).

Both the Australian and Chinese economies are transitioning from manufacturing to service focused (EABER & CCIEE 2016). Contrastingly, China had a rapid increase in the size of manufacturing sector during the boom, while the size of the Australian manufacturing sector continued its pre-boom decline. Figure 7 shows Australian employment by industry in thousands; manufacturing is steadily declining shown in blue; three service sectors shown in dashed lines are steadily increasing, mining shown in black is declining after peaking in the commodity boom; construction shown in brown is oscillating reflecting both the mining boom and housing bubble. Note Figure 7 shows the total mining employment of which coal mining comprises 23% and oil and gas extraction comprises between 9% and 12% from 2012 to 2015 (ABS 2016b). Importantly in the transition to zero net emissions, the employment in the fossil fuel component of mining comprises about one third of total mining employment.

Figure 7: Australian employment by industry in thousands of people as at the end of June each year



(Source: ABS 2016 Cat. No. 81550DO001_201415 Australian Industry, 2014-15, table 6)

The result of the mining boom for Australia was a reduction in full time jobs in the trade-exposed manufacturing sector and increase in part-time and casual job in the service sector or underemployment (EABER & CCIEE 2016; Gittins 2016). WEF (2017) ranked Australia's underemployment as 25th of 28 countries in its assessment of employment productivity. OECD (2017c) and WEF (2017) state that Australia's growing underemployment is one factor inhibiting inclusive growth and recommend training and education to address a skills mismatch

The tourism industry plays an important and growing role Australia's economy and to its communities but this role is at risk from assets compromised by climate change. Tourism employs 15 times more people than coal mining and can help transition Australia to a low carbon economy (Hughes et al. 2018). The rapid rise in tourism numbers, particularly from Mainland China proffers scope for further employment but the lack of trained people with the soft and hard skills necessary to fill these roles, the casual employment with low pay and perceived low status of jobs in the tourism industry are issues that require addressing (Chai et al. 2017). We discuss the transition dynamics in Australia and the potential role for the tourism industry in the transition to zero net emissions.

As the demand for Australia's commodities decreased, Australia's floating exchange rate depreciated, providing an automatic adjustment mechanism to encourage import substitution industries and alterative export industry such as the tourist and education industries. Figure 8 shows the relatively flat tourism number during the commodity boom while the Australian exchange rate was high and the dramatic increase in tourism number after the commodity boom. Gittins (2016) discusses the automatic processes in place enabling Australia's economy to adapt to declining coal demand from China and elsewhere. The Australian economy is already adjusting to the loss of coal exports and tourism provides more employment than mining per unit of GDP. The Great Barrier Reef is one of Australia's major

tourist attractions supporting the tourism industry. Australian Governments subsidising the dying coal industry to build further mines is subsidising the destruction of the Great Barrier Reef. The subsidies are impairing the development of a sustainable industry for an unsustainable industry. Section 2.1 discussed the Federal and Queensland Government financial support for the Carmichael coalmine.

Figure 8: Total monthly short-term visitor arrivals to Australia seasonally adjusted – ABS 3401.0

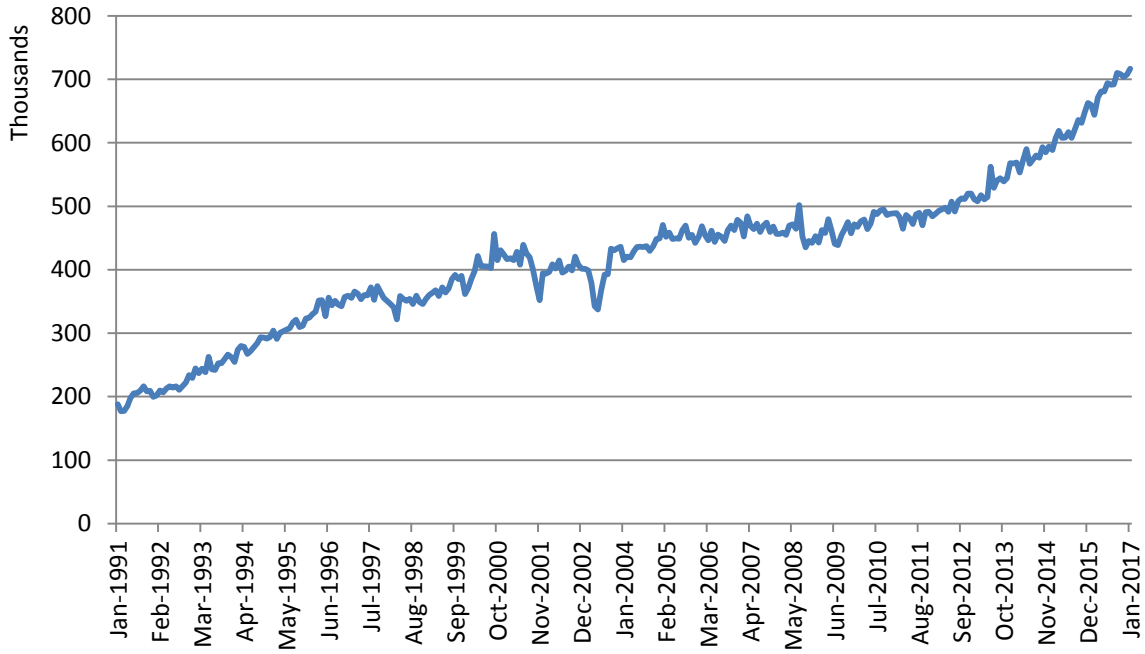
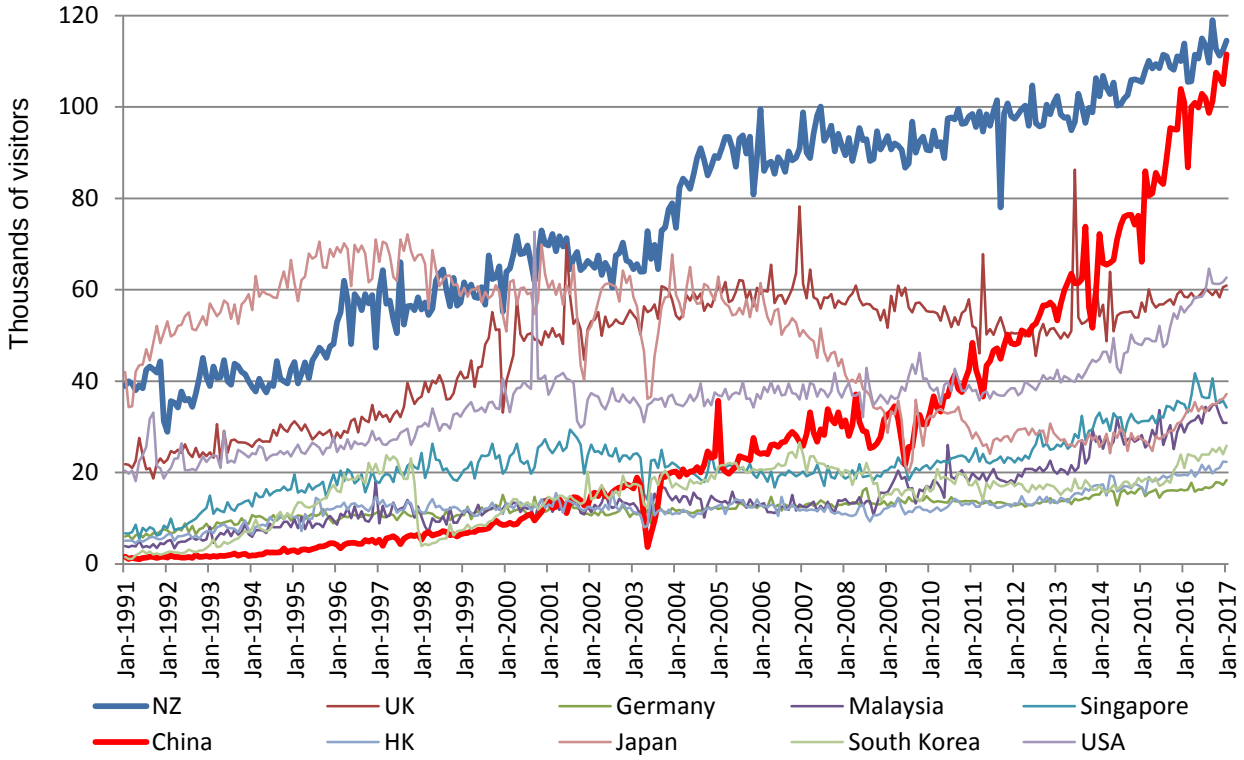


Figure 9 shows linear growth trend in the number of short-term visitors from NZ and an exponential growth trend in visitors from mainland China. The monthly number of Mainland Chinese visitors has most probably already surpassed those from NZ.

Figure 9: Monthly Australia short-term visitor arrivals seasonally adjusted – ABS 3401.0



As discussed, major issues facing the expansion of the tourism industry include the lack of trained people with the soft and hard skills, the casual employment with low pay and perceived low status (Chai et al. 2017).

Technical and further education (TAFE) tourism courses already exist to train people. Heavily subsidising the courses would help to encourage people into tourism but a review of the courses would be required to ensure they are meeting the soft and hard skills identified by Chai et al. (2017). Developing foreign language skills is a new requirement, as traditionally many visitors came from English speaking countries, such as, NZ, UK, HK, Singapore, Canada and the USA. Foreign language skills really take many years to develop, so a language component of a tourism course at TAFE would ideally be an extension of skill already built in high school.

Advertising could alter the perceived low status of tourism employment but the low pay and casual employment remain an issue. Factors that are or will amplify the negative aspect of low pay and causal employment include at least two factors. (1) The housing bubble is making it difficult for median income Australians to buy housing, as discussed in Section 2.3. (2) The push for privatising health, education and retirement income makes reliance on quality of publicly funded health, public schools and pensions uncertain. These aspects need considering by anybody entering the tourism profession. Alternatively, the governments could pursue inclusive growth policies that would allow people to enter lower paid occupations without becoming part of the working poor.

The Reserve Bank of Australia (RBA) could further aid the transition from coal to tourism and other industries by reducing interest rates. This would help increase company investment and employment generally and help depreciate the Australia dollar to further aid the tourism industry. However, the RBA is reluctant to reduce the interest rate further as it would

exacerbate the Australian housing bubble, blunting RBA's use of interest rates as a policy instrument to ameliorate the underemployment.

The casualization of employment or shift from fulltime to part-time employment, usually in the service sector, is hampering inclusive growth. The usual solution of training or education by the OECD (2017c) and WEF (2017) in isolation will be insufficient to address this issue.

2.3 Property market bubbles reducing inclusive growth

Commercial real estate became the largest target of Chinese Overseas Direct Investment (ODI) in Australia at 36% in 2016. Chinese Overseas Direct Investment in Australia or Foreign Direct Investment from China to Australia. Residential developments made up 51% of the commercial real estate ODI; other real estate ODI includes tourism and retail. NSW received 53% of Chinese ODI. The Chinese Government is increasingly concerned about excessive capital outflow and the lack of due diligence in purchases of foreign investments that are over leveraged (Ferguson et al. 2017). Both Australia and China are experiencing asset bubbles in their property markets. The following two mechanisms link the Chinese and Australian property market bubbles. (1) Chinese properties are built using Australian metallurgic and thermal coal and iron ore. (2) Chinese people who own real estate or mining investments in Australia and own real estate investments in China. These linkages have the potential for contagious market instability as both Chinese and Australian property markets are highly leveraged.

We could use the working definition of a bubble as prices above some agreed definition of a 'fundamental' value or the repayment obligations exceeding capacity to repay. A fundamental value perhaps based on the rental income exceeding the sum of the interest rate payments and deprecation. However, one factor of interest repayments is the market value of the property based on the market value of surrounding properties. This fundamental value becomes self-referential within the bubble. Regarding the other definition, the repayment obligation exceeding capacity to repay is contingent on capital gains. This definition only identifies a bubble when capital gains cease that is when buyers cease purchasing at ever-higher assets prices because they no longer expect capital gains to cover the costs of the asset purchase. This housing bubble definition bears many similarities to pyramid marketing where the pyramid collapses only when there lack new buyers. The first definition is self-referential and the second definition only identifies a bubble in hindsight. The Global Financial Crisis provides an example of the hindsight definition of a bubble that is the inadequacy and difficulty of government and financial agencies and the public in predicting or identifying a bubble during the bubble but consensus after the bubble. More usefully, Professor Steven Keen was the first to predict the Global Financial Crisis based on credit expansion via the financial sector.[22] Importantly, making the bubble difficult to identify, the credit expansion occurs in both the primary and secondary markets, consisting newly built and previously owned housing, respectively, but the national accounts only record newly built houses and are oblivious to a major source of inflation in the secondary market. We define a bubble as an unsustainable capital gains expectation fuelled credit expansion with special reference to the secondary market.

Tackling these asset bubbles is important for two reasons. (1) The asset bubble is creating landlord and tenant classes, preventing the less financially able from buying their own home.

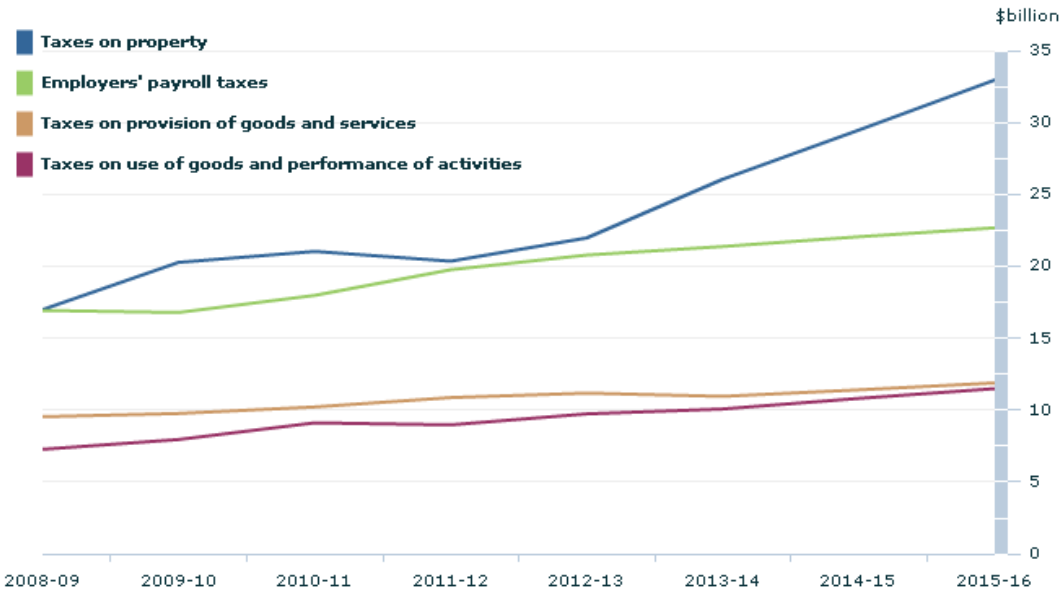
[22] https://rwer.wordpress.com/2010/05/13/keen-roubini-and-baker-win-revere-award-for-economics-2/

Both factors undermine inclusive growth and social stability. (2) Both the Japanese asset price bubble collapse and the more recent Global Financial Crisis provide examples of property market collapses that disproportionately affect the most financial vulnerable within prolonged recoveries.

In Australia, there are vested interests in perpetuating the housing bubble including:

- Property, Construction, Finance and Insurance industries
- 96% of politicians own property versus 50% of the general population
- 50% of politicians own investment properties versus 10% of the general population and the investment properties are predominately owned by members of the Coalition (McGhee 2017a)
- Political donations from the Property, Construction, Finance and Insurance industries to both Coalition and Labor but predominately Coalition (Evershed 2017; Hanrahan et al. 2017). The Coalition currently forms the government.
- Landlords with negative gearing and capital gains tax concessions, predominately with Coalition voter profiles
- State Governments receiving stamp duty as a percentage of each sale, see Figure 10. Taxes on property are becoming an increasing proportion of State revenue.

Figure 10: State Government Revenue – Comparing increasing taxes on property with other taxes



(Source ABS Cat. No. 5506.0 - Taxation Revenue, Australia, 2015-16)

There are at least six drivers perpetuating the housing bubble, including:

- Population increase due to more births than deaths and net immigration
- Trend toward more single people living alone and single parents
- Two tax breaks, negative gearing and capital gains tax concessions
- Increase in untenanted residences both for capital gains and as second residences
- Breakdown in government provision of affordable housing
- Irrational exuberance (Schiller 2000)

Regarding irrational exuberance and tax breaks, house prices have risen much more quickly than rental prices and the rate of addition of new housing stock is greater than population growth. If there really were a housing supply shortage, rents would also be skyrocketing, as they did in mining towns during the minerals boom. This indicates that the housing bubble is driven largely by capital gains speculation and irrational exuberance (ABS 2007; Holman 2017; Janda 2017a; Murphy 2017). While policies addressing supply side constraints are important over the long-term, the immediate and addressable issues are the policies driving the speculation. Two tax breaks, negative gearing and capital gains tax concessions, help explain both the unnecessary policy induced component of the property market bubble and the concentration of wealth in the richest two quintiles in Australia during the mining boom found by the OECD (2017b). Concurring, Australian Tax Office data shows that negatively gearing benefits the rich the most and the number of negatively geared properties owned per landlord has increased from 2013 to 2015, showing accelerating concentration of wealth (Burgess 2017; Jericho 2017a). The two tax breaks present a mechanism for wealthy Australians to concentrate wealth. The deregulation of the banking sector allows investors to access interest only loans to help them leverage their current property housing investments to buy more properties. The induced higher property prices, which benefit the investor class, have trapped an increasing proportion of Australians as tenants. Who will enter retirement as tenants and for those managing to buy a property, the higher property prices make it difficult to pay their mortgage and reduce their ability to save for retirement. The tax breaks make Australia's tax system extremely regressive and reduces government revenue. Both factors undermine inclusive growth. Key solutions to reducing the bubble pressure include removing the two tax breaks for landlords. These solutions are straightforward but the vested interests mentioned make implementation intractable. Nevertheless, the Australian Labor Party took these solutions to the 2016 federal elections.

Further reducing inclusive growth are political donations and corruption in the property market (Murray & Frijters 2016; Taylor, L 2016), compounding the situation are political donation laws that are easily circumvented (McGhee 2017b). Politicians are estimated to gift $11 billion a year to well-connected and lobbyist-hiring property developers (Murray 2017). This huge gift incentivises political donations and the gift destroys inclusive growth by concentrating wealth among property developers and depleting government revenue for infrastructure development to help productivity. Of course, the politicians required to eliminate the political donations would lose their political donations, presenting a problem of lock-in. Hence, there has been little progress in eliminating political donations. Eliminating political donations would improve both the perceived and real integrity of Australia's democracy to make decisions for the public good rather than for vested-interests (Lewis, C 2016). Additionally, adopting the ACT's method of land rezone can reduce the size of the gift where councils sell property development rights to property developers. Reducing the size of the gift reduces the incentive for property developers to engage in political donations, lobbying and corruption.

In addition to the elimination of political donations, ideally, those politicians owning investment properties would exercise fiduciary integrity over conflict of interest and excuse themselves from voting or drafting policy regarding investment properties (McGhee 2017a). Chapter 5 discusses political donations further.

Population increases from natural growth and immigration, currently about 1.5%[23], is a further driver for the housing bubble. Reducing immigration provides another policy lever to reduce the housing price bubble and increase inclusive growth within Australia but eliminating the tax breaks provides a primary policy to control the bubble and increase inclusive growth. If Australia is to benefit from immigration, Australia needs to provide adequate infrastructure including housing; otherwise, immigration serves only to depress wages and fuel the housing bubble to provide increasing capital gains and economic rents for those already owing investment properties (EABER & CCIEE 2016; Productivity Commission 2016; Verrender 2017b). The absorptive capacity of Australia at any time requires consideration to determine the optimum number of immigrants. As discussed in Section 2.2, Australia's world breaking record of non-recessionary growth for 104 quarters is due to immigration masking the recessions in GDP per capita. The recessions in GDP per capita indicate underemployment or reduced wage rates and poor infrastructure and immigration policy (Productivity Commission 2016; Verrender 2017b).

A more streamline way to determine the optimal number of immigrants requires development. The recent ad-hoc changes to replace the work Visa 457 with visas specifying stricter requirements for only highly skilled people unavailable in Australia would help relieve both underemployment and the housing bubble (Probyn 2017) but serves to distract attention away from the two tax breaks. The original intent of Visa 457 was to allow for temporary immigration of people with skills matching shortages in the Australia labour market but these temporary visas were often used as step towards permeant residency.[24] The passing of the mining boom requiring specialist workers, Australia's record underemployment and general decline in absorptive capacity justify suspending the 457 Visa. However, these changes are too late and driven by populist motives rather than a concern for sustainable growth, or a moderation in property prices. Developing some rules to determine the optimal number of immigrants each quarter based on economic conditions would remove the contentious nature of immigration and help the newly arrived immigrants find jobs and accommodation when each segment of the labour market is more absorptive. For instance, extending the RBA's remit to set quarterly immigration quotas would enable better management of economic growth and inflation in conjunction with the Department of Immigration and Border Protection. Prospective immigrants would require ranking to target specific labour shortages in occupations such as nursing and teaching and target occupations extracting economic rents such as medical specialist.

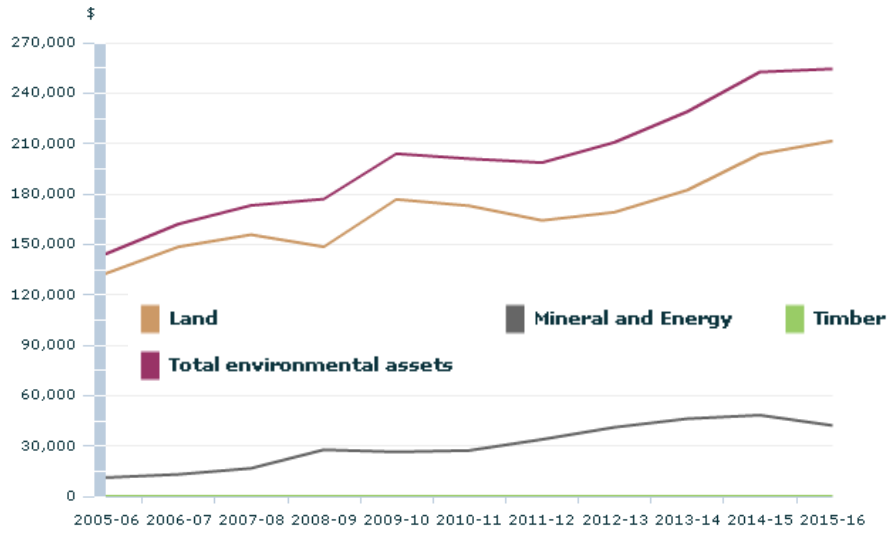
However, even with zero net immigration, there is still natural population growth of about 0.7% per annum driving property prices. Notably, Australia's major cities are the focus of the housing bubble and (Stiles 2017a). These cities also attract the largest number of immigrants and foreign investors. Relevantly, the annual increase in residential property prices to the December Quarter 2016 in Sydney and Melbourne are 10.3% and 10.8%, respectively.[25]

The following demand redistribution and supply constraints reduction methods could accommodate the increase of 1.5% increase in population growth include.

[23] http://www.abs.gov.au/ausstats/abs@.nsf/mf/3101.0
[24] https://www.theguardian.com/australia-news/2017/apr/18/australian-government-abolish-457-temporary-work-visa
[25] http://www.abs.gov.au/ausstats/abs@.nsf/mf/6416.0

- Encouraging higher density accommodation in the inner-city areas using a tax on land rents rather than stamp duties. A tax on land rents would make land expensive to own, encouraging people to sell land of low population density within densely populated areas (Bentley & D'Cruz 2016; Ingles 2016). Additionally, stamp duty is volatile and accounts for about one third of the State Governments revenue; a land tax would provide a steadier revenue stream. Importantly, the move to a tax on land rent would reduce the deposit gap for first home and improve liquidity in the property market as existing homeowners can more easily sell and buy houses without suffering a major capital loss from the stamp duty. The changes to higher density living would require appropriate changes to zoning and by-laws. Figure 11 compares Australia's land, timber mineral and energy assets per capital. In 2015-16, land accounted for 83% of the value of Australia's environmental assets, which would provide a substantial base for a tax. However, gaining support for a change to a land tax would be difficult in isolation and its acceptance would be more likely as part of a wider set of changes as promoted in the 2010 Henry Tax Review (Garnaut 2013; Ingles 2016). Chapter 5 discusses the requirement for a land tax as part of wider tax review.

Figure 11: Comparing Australia's land, timber, mineral and energy assets per capita



(Source: ABS 2016a)

- Improving transport infrastructure so people can live further from works, concurrent with the Grattan Institute favouring infrastructure expenditure (Galletta 2017).
- Relocating work to less densely populated areas, examples include Queensland Government headquartering their amalgamated distribution network company in Townsville and the Korean Government relocating departments to outside Seoul. The Federal Government is also advocating moving departments to rural locations (Vidot 2017). In South Korea, many Government workers maintain a residence in both Seoul and the vicinity of the newly located department. The Federal Department relocations could exacerbate the housing bubble in the short-term. In contrast, the Grattan Institute labelled the decentralisation push as inefficient and favoured spending more on infrastructure within the major cities to make the cities more liveable (Galletta 2017).

- Relocating military bases from cities to rural areas would allow the auctioning of land and military housing stock and promote rural economies (Holman 2017). This move would also allow for improvement of the city infrastructure. For example, Enoggera Barracks in Brisbane lies close to the central business district and two extremely congested commuter roads pass each side of the base between major residential areas and the central business district. A road through the base connecting the Northwest Brisbane suburbs to central Brisbane would reduce commuting time for all the residence living in Northwest. An analysis of all military bases for sale and relocation with the ability to improve city infrastructure and road structure requires implementing.

Some Australians perceive foreign investors as a major source of housing bubble pressure but newer legislation restricts foreign investors to buying new properties. This legislation ensures that foreign investment adds to the supply of housing stock. If Australia were to eliminate capital gains tax concessions and negative gearing, some of the speculative foreign investment for capital gains would evaporate. The Federal Government released plans in the 2017 budget to remove the capital gains tax concessions for foreign owners (Tan 2017) and limit the investment by foreign owners to 50% of new property developments. As foreign investment is limited to new development, these changes will reduce the supply of new properties (Tan 2017).

There is the issue of property buyers leaving properties untenanted, solely looking for capital gains. This would exacerbate the housing bubble by reducing effective supply. Unfortunately, there is a lack of statistics on untenanted dwellings and the issues of untenanted definition and misidentifying empty residences as untenanted dwellings when owners keep a second property for their own use. Again, if Australia were to eliminate capital gains tax concessions and negative gearing, some of the speculative investment for capital gains only would evaporate and property investors would more likely base their investment decisions on rental incomes. Additionally, if eliminating capital gains tax concessions and negative gearing were to fail to address the untenanted investment properties issue, introducing a surcharge or additional land tax for empty dwellings could help address this issue. This untenanted dwelling issue is a problem in other major cities around the world. We leave the investigation of solutions to the untenanted property problem for further research. The Federal Government released plans in the 2017 budget to introduce a vacancy tax of at least $5,000 for unoccupied dwellings but this is a token amount and unlikely to deter investors (Tan 2017).

The Australian Housing and Urban Research Institute (AHURI 2017) provides a number of recommendations to improve the efficiency of government in providing low cost housing. Removing the two tax breaks would both allow the housing market to function more efficiently to provide lower cost housing and provide revenue to support government funded low cost housing. The Centre for Independent Studies (CIS 2017), a think-tank funded by the tobacco and fossil fuel industries, argued for no increases in support for the financially vulnerable via public housing and for the private sector to take over public housing. However, this argument ignores the fact that the private sector is in a housing bubble and channelling more money into the bubble would further consolidate the dynamics of negative gearing and capital gains tax concessions to exacerbate the concentration of wealth previously discussed. Public housing addresses market failure. For instance, Anglicare in a major survey of rental

accommodation found only less than 2% were affordable for single households receiving government welfare and single people on a disability pension could afford only 0.87% of rental properties nationwide (Jericho 2017b).

In addition to the problems discussed, the bubble has other adverse effects on inclusive growth. (1) The bubble diverts investment away from other more productivity enhancing investments such as infrastructure and renewable energy. (2) The RBA is unable to lower interest rate to promote employment, as lower interest rates would further inflate the housing bubble. (3) The buying and selling of existing housing occurs outside the national accounts. Therefore, measures such as the consumer price index (CPI) fail to account for the increase in the cost of existing housings in the bubble. This masks the increasing financial burden of the bubble and intergenerational transfers caused by the housing bubble (Janda 2017b). The RBA assumes there is zero net expenditure by the household sector in these transactions, so the RBA ignores these transactions in CPI calculations. This assumption is also a major flaw in a major economic model used to model housing bubbles called Dynamic Stochastic General Equilibrium (DSGE) that left many economists blind to the possibility of a Global Financial Crisis. Chapter 5 discusses DSGE and a replacement model, Stock Flow Consistency/Agent-based Model (SFC/ABM) that incorporates the bubble inducing transactions outside the national accounts (Caiani et al. 2016).

2.4 Further research

The interrelatedness of inclusive growth and climate change adaptation and mitigation covers nearly every aspect of the economy and beyond the scope of this report, so we list the more important issues for further research.

- Population ageing slowing economic growth and increasing fiscal pressure
- Obesity epidemic reducing inclusive growth
- Privatising education reducing inclusive growth and undermining democracy
- Privatising health reducing inclusive growth
- Trade agreements, economic rent and base erosion and profit shifting
- Coalition's direct action reducing inclusive growth

2.5 Conclusion

The transition to a low emission economy affects every part of the economy and acts as a major stress test on both Government and private sector's decision-making to ensure investments are consistent with a low carbon future and avoid creating stranded assets. The increase in inequality, underemployment and mediocre economic growth per capita requires addressing within the transition to a low carbon future. That requires being together the climate change and inclusive growth agendas (OECD 2017d, 2017e).

The increase in service sector employment is overwhelming the decline in mining sector employment. The rapid rise in tourism numbers, particularly from China, represents further opportunity for Australia in this high employment sector. There exist similar opportunities and trends in the education of overseas students. However, Australia requires trained people and adequate infrastructure to make the most of these opportunities.

Within the mining sector, the decline in employment in fossil fuel extract will be sightly offset with employment in rare earth elements extraction. However, four larger issues than

employment arise with fossil fuels. (1) Australia's high exposure to fossil fuel assets and the financial risked associated with potential stranded assets. The G20 Task Force on Climate related Financial Disclosures [26, 27] is developing reporting standards for companies to disclose their climate change physical and transition risks, using scenario based analysis, to the market. Adopting these reporting standards would improve the ability to price the risk. Chapter 6 discusses pricing climate change risk further. (2) There is loss of revenue from royalties and resource rent taxes on fossil fuel extraction. Putting this in perspective, the tax breaks within the building sector, including negative gearing and capital gains tax concession, represent a similar loss of government revenue. Reversing these tax breaks would ameliorate the revenue loss from royalties and resource rent taxes on fossil fuel. (3) By international standards, Australia has performed poorly at deriving royalties and resource taxes from the sale of its fossil fuel deposits. The international carbon budget for burning fossil fuel is limited. This situation presents the requirement to extract as much rent from the sale of Australia's fossil fuels deposits within the given carbon budget and deferring investment in new fossil fuel extraction sites. (4) The loss of fuel excise duty requires replacing with road user charges to fund infrastructure investments and maintenance.

The lax taxing in the mining and building sector and the political donations from these sectors presents a conflict of interest in making decisions in the best interest of the electorate. The lax taxation also exacerbates inequality. Chapter 5 discusses political donations as a barrier to solving wicked problem.

The increase in inequality and poor economic growth found in Australia is an international phenomenon. The onset of increasing inequality coincided with the introduction of neoliberal policies. Ostry, Loungani and Fureceri (2016) members of the IMF staff found that neoliberal policies were oversold with some polices setting up adverse loops that prominently increased inequality and hampered economic growth. Ostry, Loungani and Fureceri (2016) called for a shift from faith in neoliberal policies to evidence-based policy development. Chapter 5 discusses the unrealistic models of the economy and human behaviour supporting the faith in the neoliberal policies. These models act to misinform policies and form another barrier to solving wicked problems. Chapter 4 focuses on the neoliberal policies in the Australian electricity market and electricity price rises that are exacerbating inequality and, in particular, the misguided model of human behaviour within the retail sector.

The failure to address inequality and climate change is two of a host of interrelated wicked problems that Australian adversarial politics and political wedging is ill equipped to address. This failure is most apparent in coordinating infrastructure expenditure with the requirement to factor in climate change risk and mitigation. Chapter 5 discusses adversarial politics and political wedging as one of the barriers to solving wicked problems.

The requirement for adequate infrastructure for the increases in overseas visitors becomes more presenting with Australia's population expected to rise rapidly. Chapter 5 and 6 discuss the requirement to bring together economic growth and climate policy together. This combining of policy is particularly important in infrastructure expenditure. To that end, Consult Australia (2018) recommends establishing an independent body to provide transparency to plan, assess, and prioritise infrastructure projects across **all** bodies in

[26] https://www.fsb-tcfd.org/
[27] https://theconversation.com/the-g20s-new-guidelines-will-help-investors-tackle-climate-change-80612

Australia. Acknowledging, Infrastructure Australia does provide independence but many legislatures lack independence, which in turn undermines the independence of Infrastructure Australia. Similarly, there is a requirement to bring together energy and climate change policies. To that end, the Integrated System Plan (AEMO 2017) also provides transparency and will help efficiently coordinate the separate state based renewable energy targets, transmissions requirements and the retirement of the coal generators across Australia's National Electricity Market. Chapter 4 and 6 discusses the requirement to integrate energy and climate policy. The independence and transparency is important to reduce corruption and pork barrelling.[28]

[28] http://www.smh.com.au/federal-politics/political-news/pork-barrelling-undermining-public-trust-says-former-turnbull-minister-darren-chester-20180119-h0lf4f.html

3 China's electricity sector and mitigation policies

3.1 Introduction

The coal generators in China's electricity sector contribute a major part of China's carbon emissions, placing pressure on emission mitigation efforts.[29] For instance, in 2013, China generated 78.2% of its electricity from coal. China's goals of emissions mitigation and sustainable development involved both energy efficiency improvements and the deployment of renewable energy in the electricity sector. To achieve these goals, China applied various measures, including legislation, pricing mechanism, financial incentives, emission trading schemes and demand side management.

There is a consensus that energy efficiency advancement and renewable energy deployment correlate strongly with effective policies and regulations and China faces many challenges in developing suitable policies and regulations (Jiang, Sun & Liu 2010; Li et al. 2011; Wang, Zhao & Chi 2014; Zhang, S & He 2013; Zhao et al. 2011). Five key challenges include (1) the dominance of coal as an energy source due to China's resource endowment, (2) a significant waste of renewable energy caused by the failure to connect to the electricity grids, (3) lack of innovation in regional policy, (4) incomplete financing system for renewable energy projects, and (5) inadequate investment in the technical research and development for renewable energy.

Institutional shortcomings have also received some attention.[30] Wang, Zhao and Chi (2014) discusses a lack of coordination and consistency in regulation and governance, and the enforcement of policies is incomplete as the regulatory system is weak. The dominance of state ownership is one constraint on the effectiveness of regulatory regimes via the conflict of interest between ownership and regulation. This situation calls for better separation of the regulatory and ownership entities. Privatisation is one possibility but noting privatisation in the electricity has had many problems in Australia. Chapter 4 discusses the problems occurring in Australia's privatised electricity sector.

Another missing element in the Chinese electricity system is a market mechanism to provide pricing for time of supply (ToS) and time of use (ToU) to reward generators for meeting peak demand periods and to induce customers to reduce their demand during peak demand periods, respectively. The ToU pricing contributes to demand side management (DSM). Although, China has conducted pilot schemes that use command-and-control approaches to imitate ToU pricing for DSM and ToS pricing for the dispatch of generators in a scheme called 'Energy Saving Power Dispatch' (ESPD). However, this lack of ToU and ToS price mutes the effectiveness of China's emissions trading scheme or price on carbon. In comparison, Australia lacks an emissions trading scheme or carbon price but has ToU pricing in some limited areas and ToS pricing only in the wholesale market.

The structure of Chapter 2 follows. Subsection 2 provides an overview of the Chinese electricity sector. Subsections 3 to 6 discuss China's energy efficiency and renewable

[29] For instance, according to National Bureau of Statistics of China, in 2012, coal combusted in the electricity generation accounted for over 50% of China's total coal supply. See http://data.stats.gov.cn/easyquery.htm?cn=C01.

[30] Through affecting information and transaction costs, institutions may facilitate or constrain reform performance and policy implementation (Erdogdu & Erkan 2013). In China, institutional environment is regarded as one of the crucial reasons for the incomplete implementation of policies (Taylor, RP et al. 2008).

energy incentives, including legislation, mandatory targets, pricing mechanism, financial incentives. Subsection 7 discusses three pilot schemes, including the energy saving power dispatch, demand side management and carbon emission trading. Subsection 8 summarises China's 2015 electricity reform and Subsection 9 concludes the chapter.

3.2 The Electricity Sector in China: An Overview

China's electricity sector has developed rapidly over the last two decades, surpassing the U.S. in electricity generation since 2011 to become the largest in the world. Total electricity generation in China reached 5245.1 Terawatt-hours (TWh) in 2013, an increase of over 100% from 2005 levels, and 1.3 times the amount generated by the U.S in the same year.[31] China's total installed capacity reached 1247.38 GW in 2013, an increase of 9.3% over the previous year, becoming the world largest.[32]

This section surveys China's electricity sector focusing on fuel mix, consumption, energy efficiency, industry structure and regulatory framework and institutions. A myriad of complex arrangements govern China's mammoth electricity sector. These arrangements often present different institutions and agents with conflicting incentives. Furthermore, these differing incentives and governance structures challenge the pursuit of environmental and energy efficiency objectives.

3.2.1 Installed Capacity and Generation: Fuel Mix

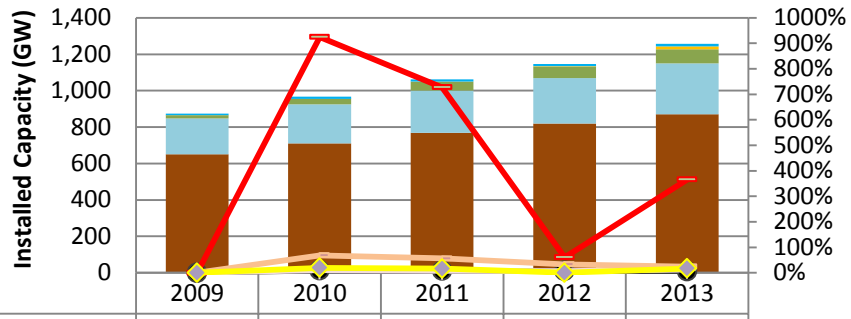
Both electricity generation and installed capacity in China are characterised by a high dependence on thermal energy, as demonstrated in Figure 12 and Figure 13. A notable feature of electricity sector is that coal's share in the generation mix is higher than its share in installed capacity. Two factors help explain this relative share: (1) solar PV and wind are never utilised at their installed capacity and (2) the generation order of dispatch as follows.

- Baseload served by nuclear, non-dispatchable hydro-generators, cogeneration plants and low marginal cost coal plants.
- Shoulder load served by flow constrained hydro-generators and intermediate cost coal plants.
- Peak load served by pumped-storage units, fully dispatchable hydro plants and the low marginal cost coal plants.[33]

China uses coal plants to ramp up and down to meet peak demand as well as for baseload. This peak load role for coal contrasts with most other countries that use coal for baseload and other resources to meet peak demand such as natural gas.[34]

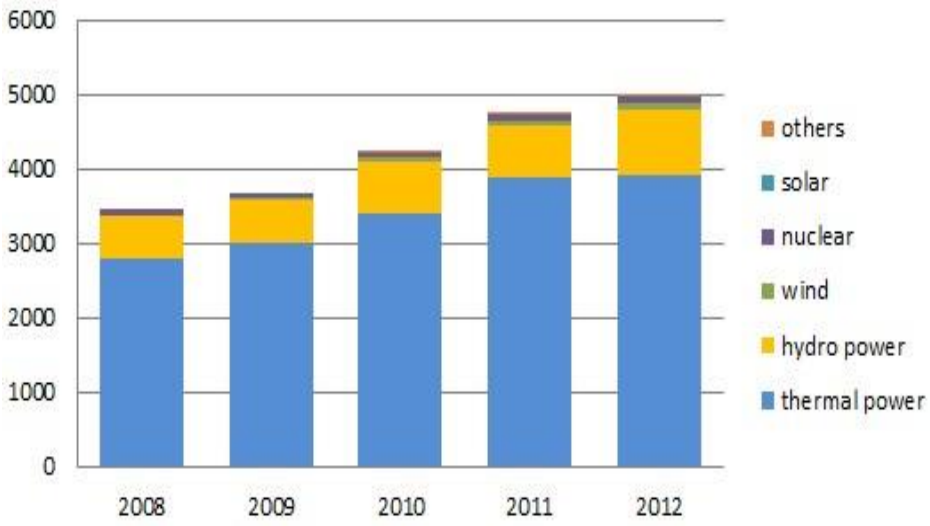
[31] US Energy Information Administration: http://www.eia.gov/
[32] Chinese National Energy Administration: http://www.nea.gov.cn/
[33] The main reason that natural gas is not used as a flexible resource is its relatively high price (Dong et al. 2012; Hu, J et al. 2013). The intermittency of wind power makes it unsuitable for meeting peak load demand. Nuclear power plants lack the flexibility to meet peak-demand, as they require operate at near full capacity to recoup their high capital cost and to operate safely. Coal plants operate in a peak-load role in response to command-and-control rather than price signals.
[34] The lack of sufficient of grid connection is main cause of renewable energy electricity spillage. China solves the renewable energy's intermittency and non-dispatchable problems by encouraging coal-fired plants into a fast ramping role to meet peak-load. Coal plants used for peak-load adjustment enjoy priority of utilisation,

Figure 12: Share of Installed Capacity (GW)



	2009	2010	2011	2012	2013
nuclear	9.08	10.82	12.57	12.57	14.66
solar	0.03	0.26	2.12	3.41	15.89
wind	17.60	29.58	46.23	61.42	76.52
hydro power	196.29	216.06	232.98	249.47	280.44
thermal power	651.08	709.67	768.34	819.68	870.09
increase rate of thermal		9.00%	8.27%	6.68%	6.15%
increase rate of hydro		10.07%	7.83%	7.08%	12.41%
increase rate of wind		68.05%	56.31%	32.86%	24.58%
increase rate of solar		924.81%	727.47%	60.88%	365.90%
increase rate of nuclear		19.23%	16.13%	0.00%	16.63%

Figure 13: Electricity Generation Mix (TWh)



This high dependence on coal for generation, and the associated consequences in terms of emissions, has led to the adoption of a new dispatch approach, the Energy Saving Power Dispatch (ESPD). Section 2.4 discusses ESPD in more detail. Notwithstanding efforts to reduce the coal share in electricity generation, China's electricity generated from coal in 2035 is projected to reach over 5500 TWh, which approximates the total coal generation in rest of the world in 2014.[35]

providing an incentive for coal plants into a fast ramping role. See http://news.bjx.com.cn/html/20160803/758172.shtml.

[35] See IEA (2013) and IEA (2016).

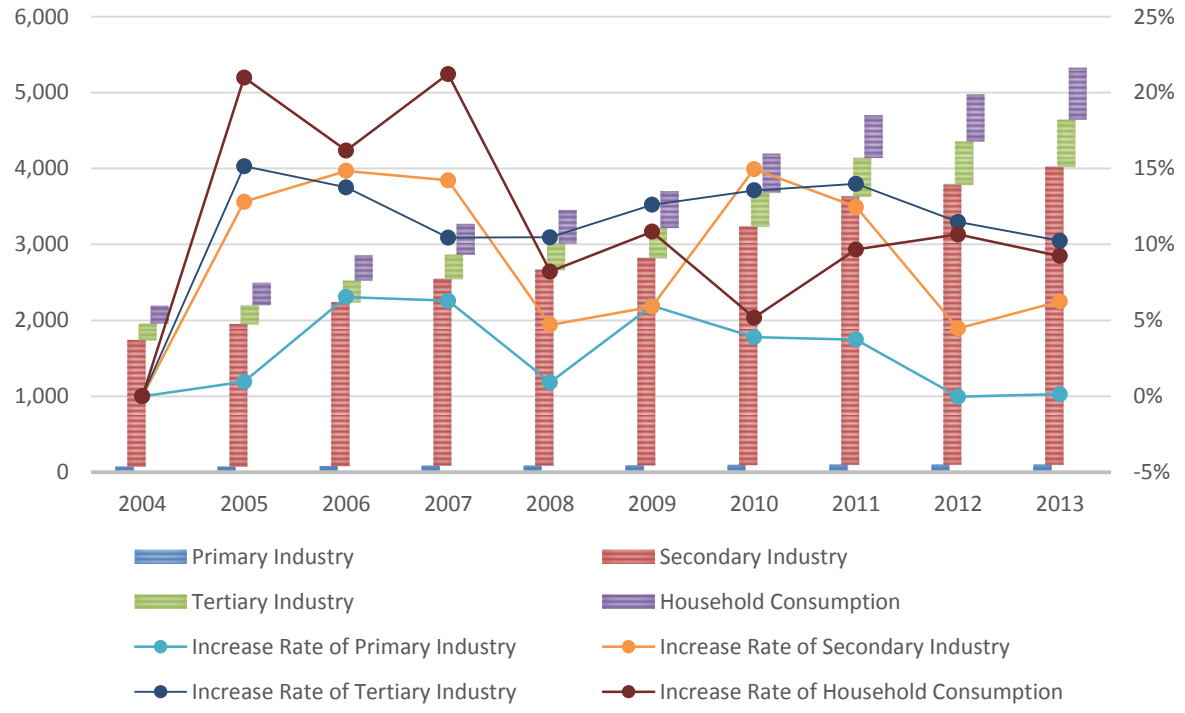
Despite a heavy dependence on coal, the share of renewable energy has expanded consistently over the last decade. As we can see from Figure 12, the rate of increase of all renewables exceeds that of thermal energy. Consequently, the share of coal in installed capacity has declined over the last few years as renewables displace coal. In a short period China has become the world's largest renewables electricity generator (Dent 2015). The Chinese Central Government's 12th Five-Year Plan (FYP), covering the period 2011-5, includes 2015 and 2020 targets for non-fossil generation's share of installed capacity at 33% and 36.3% and electricity generated at 24.1% and 26.9%[36] of total installed capacity targets of 1,437 GW and 1,885 GW, respectively. To achieve these targets, the Chinese Government has legislated pricing mechanisms and financial incentives including subsidies, preferential loans and taxes.

This high dependence on coal and the rapid increase in renewables have two important implications for energy policy in China. (1) The high dependence on coal implies that energy efficiency initiatives (EEI) may have a higher return than demand side management (DSM) as the former can reduce consumption throughout the whole day while the latter typically only reduce peak consumption. (2) The high rate of expansion of renewables has implications for distribution and transmission regulation and investment.

3.2.2 Consumption

Figure 14 provides an overview of electricity consumption in China by sector. Unsurprisingly, the secondary industry is the major consumer at more than 70% of total consumption. In contrast, despite decades of economic growth, residential electricity consumption remains around 10% of total consumption. In contrast, US residential electricity consumption accounted for around 35% of total consumption over the last decade.[37]

Figure 14: Electricity Consumption (TWh)



[36] Section 4 discusses mandated targets in more details.
[37] Calculations based on statistics from the OECD library.

The growth rate of electricity consumption in China averaged around 12% in the last decade, much higher than other countries (IEA 2014). However, as China's economic growth slows and the service sector expands faster than the manufacturing sector, we expect China's electricity consumption will follow similar trends found in other developed countries where the growth in electricity consumption will decelerate and services and residential users will account for a larger share of consumption. The increased adoption of electronic appliances, including air conditioners, washing machines and computers, would drive the increase growth in the services sectors and residential consumers demand for electricity. Accommodated by increasing income, their electricity consumption is expected to continue to grow over the coming decades.

The extent of the potential for growth in electricity consumption by households becomes obvious once we compare per capita consumption with other countries. Currently, China's per capita consumption of electricity falls between developed countries and other large developing countries such as India and Egypt in general. However, the residential electricity consumption per capita is lower than developing countries such as Brazil and Egypt (Hu, Z 2014), and the disparity with developed countries is even larger, around one-tenth of that in the U.S., one-sixth of that in Australia, one-fifth that of Japan and France, and one-third of that of Korea in 2012.[38] If the residential per capita consumption in China reaches that of Korea in 2012, this would add 1,103.95 TWh of demand to the system, necessitating an increase of over 10% in installed capacity.

Importantly, both residential and service sector consumers are likely to be more responsive to changes in electricity prices than manufacturers[39], implying electricity demand will become more amenable to both energy efficiency and DSM initiatives.

3.2.3 Energy Efficiency and Demand Side Management Initiatives

Conventionally, energy efficiency is defined as the physical service provided per unit of energy. More broadly, energy efficiency usually refers to *'using less energy to provide the same service'*.[40] Thus, the measurement of energy efficiency varies with the context.

In the context of white goods and electronic goods, for example, when comparing appliances that provide the same service, the most energy efficient is the one that uses least energy. In the context of power plants, energy efficiency is commonly measured by heat rate: the amount of energy used by an electrical generator or power plant to generate one kilowatt-hour (kWh) of electricity. In transmission and distribution (T&D) of electricity, energy efficiency is measured by line loss: the disparity between the amount of electricity generated by power plants and the amount that is available for final consumption.

[38] This comparison is based on the data from OECD, World Bank and China Bureau of Statistics, with residential electricity consumption of OECD countries from http://stats.oecd.org/BrandedView.aspx?oecd_bv_id=elect-data-en&doi=data-00462-en, and the data of population from http://data.worldbank.org/indicator/SP.POP.TOTL.

[39] For instance, based on the computable general equilibrium model, (He et al. 2011) calculates the price elasticity of residential electricity consumers in China as -0.3, contrasted with that of industry and commerce which is around -0.018. According to (Shi, Zheng & Song 2012), high income group of residents in China are more price elastic than the low income group, while rural families respond more sensitively to electricity prices than urban families.

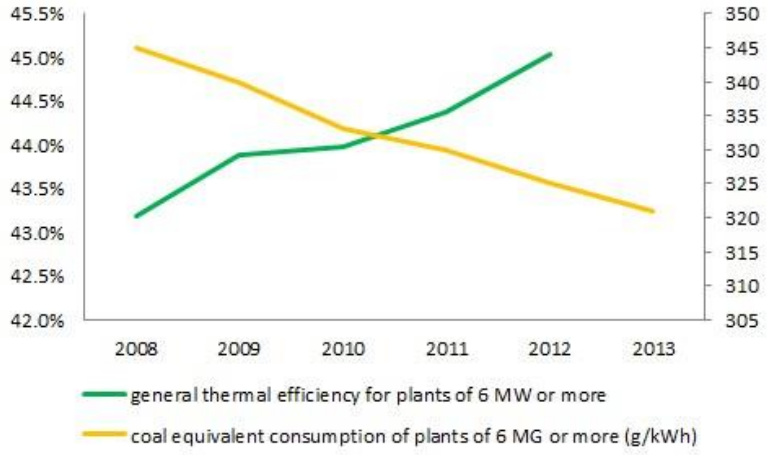
[40] See http://eetd.lbl.gov/ee/ee-1.html.

Chinese policy makers see improvements in energy efficiency as a key component of meeting the increase in demand for electricity in a more sustainable way.[41] There are a number of energy efficiency programs using different approaches.

From the consumer's side, there is a pilot DSM program in five major Chinese cities (Beijing, Suzhou, Tangshan, Foshan and Shanghai). Section 7 describes the program in detail. Two grid companies, State Grid Corporation and Southern Power Grid, implemented the DSM achieving electricity savings of 16.2 TWh and forestalling 3,440 MW of new capacity in 2013. All 30 provinces, autonomous regions and municipal cities covered by the two grid companies met their annual DSM targets in 2013.[42] During the 12th FYP period, the potential of accumulated savings could amount to 6.334 TWh of generation, forestalling capacity by 18,356 MW (Zeng et al. 2013).

In the electricity generation sector, as depicted in Figure 15, the general thermal efficiency of plants over six MW in China has improved consistently since 2008. Energy efficiency exceeded 45% for the first time in 2014, with 28% of coal-fired power in 2014 applying supercritical and ultra-supercritical technology that use pulverised coal combustion systems to operate at higher temperatures and pressures to achieve higher efficiencies than conventional units.[43] China's coal-fired power plants are currently more efficient on average than the U.S. coal plants.[44]

Figure 15: Energy Efficiency of Electricity Generation



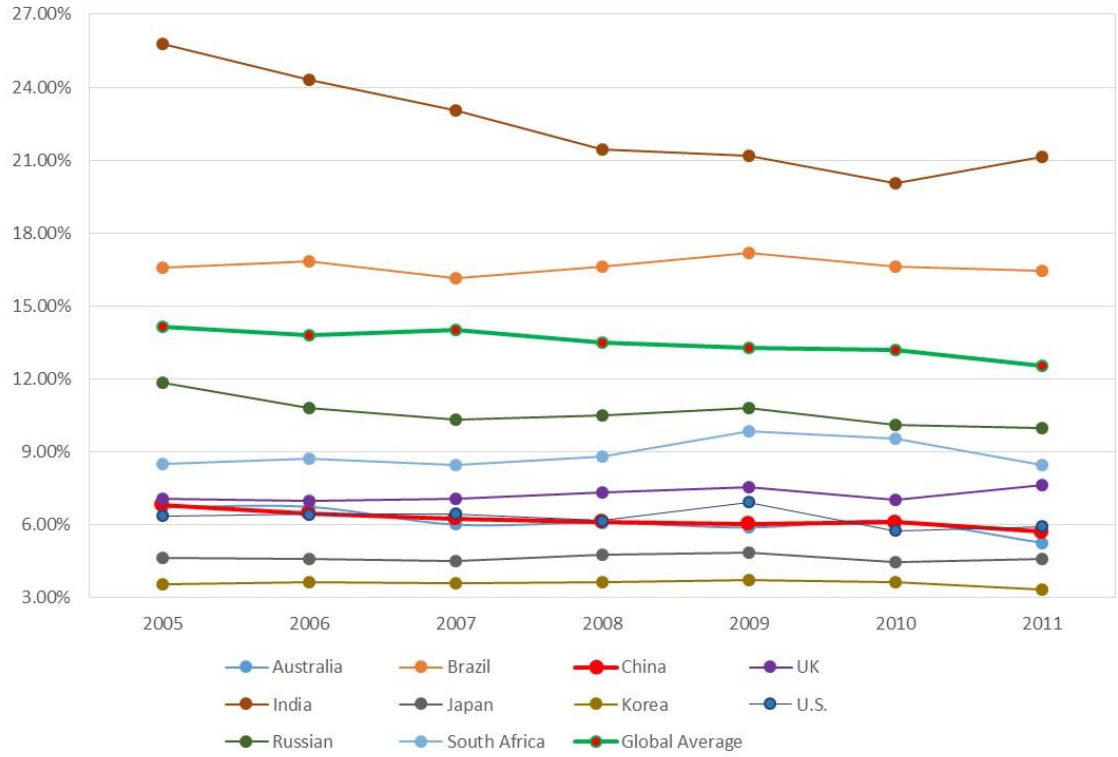
A combination of different policies and programs achieved this improvement in power plant energy efficiency, including the 'Large Substitutes Small' (LSS) program that aims to replace small and inefficient power plants with large and efficient generators.[45] LSS became part of

[41] See http://www.gov.cn/zhengce/.
[42] See National Development and Reform Commission (NDRC) at http://www.sdpc.gov.cn/fzgggz/jjyx/dzxqcgl/201407/t20140731_620758.html.
[43] See China Electricity Council at http://www.cec.org.cn/.
[44] See http://theenergycollective.com/michael-davidson/251931/transforming-china-s-grid-will-coal-remainking-china-s-energy-mix.
[45] Small and inefficient generation units include those below 50 MW, those below 100 MW, which have been operating for over 20 years, those below 200 MW, which have been at the end of their design life, and those that fail to meet environmental standards, laws and regulations. See http://www.gov.cn/zwgk/200701/26/content_509911.htm.

the energy conservation and emission reduction project in 2007, which reinforced LSS.[46] The estimated total capacity of small thermal power generating units decommissioned from 2005 to 2014 exceeded 95 GW.[47] However, the LSS program will have achieved its maximum impact as it becomes increasingly difficult to find small, inefficient plants to substitute.

Finally, China actively pursued energy efficiency in transmission and distribution, achieving similar levels as other geographically dispersed developed countries such as Australia and the U.S. See Figure 16. Additionally, China lacks non-technical losses that result from as power theft found in other geographically dispersed developing countries such as India and Brazil (IEA 2014).

Figure 16: Rate of Line Losses



(Data source: World Bank) We calculated the global average based on the data from 165 countries.

A combination of policies could reduce network losses, including active maintenance, efficient transformers, high voltage lines, smart grids and distributed generation.[48] It is worth pointing out that each per cent point reduction in network losses amount to a gain of 54.64 TWh, which is nearly equivalent to the amount of national consumption in some OECD countries such as Greece, Switzerland and Portugal.[49]

[46] This program was launched in 1990s; however, due to the electricity shortage and the resulted necessity to encourage investment in generation, it had never received adequate attention before 2007.
[47] See China Electricity Council at http://www.cec.org.cn/yaowenkuaidi/2015-03-10/134972.html.
[48] The smart grid is an electrical grid that uses intelligent technologies to integrate information about behaviours of power generators, consumers and agents to improve economic efficiency and reliability of electricity production and distribution. Smart grids help integrate distributed generation that generates electricity closer to the point of consumption than central generator.
[49] See IEA (2014).

3.2.4 Structure of the Electricity Sector

A single monopoly vertically integrated utility operated by the central government dominated the Chinese electricity sector before 2002.[50] Subsequently, the central government dismantled the monopoly into 11 independent state-owned companies that include five generation-companies, known as the 'Big Five', two regional grid companies and four auxiliary service companies.[51] The auxiliary service companies are responsible for the design, construction and maintenance of the electricity system.

Figure 17 shows China's largest grid companies the State Grid Corporation of China and Southern Power Grid that manage the transmission grids in 26 provinces, five provinces respectively.[52] These two grid companies control more than 90% of national transmission capacity (IEA 2006). Geng, Yang and Janus (2009) discuss the problems of these state-owned enterprises, including low operating efficiency and industrial productivity, which are commonplace in the electricity sector.

Figure 17: Geographic Distribution of Electricity Grid Companies

In the generation sector, generators sell electricity to grid companies rather than to end users, at prices administratively predetermined under wholesale contracts. Since 2004, the contracted wholesale prices are set in reference to a benchmark price based on the cost of an efficient coal unit operating at full capacity for about 5000 hours per year (Hu, J et al. 2013). Section 5 discusses how the wholesale price varies according to types of power plants.

[50] The Ministry of Power Industry was responsible for the operation of the monopoly vertically integrated sector until 1997 when responsibility was transferred to the State Power Corporation until the monopoly was dismantled in 2002.

[51] The 'Big Five' refers to Huaneng Group, Datang Group, Huadian Corporation, Guodian Corparation, and Power Investment Corporation. The two grid companies are the State Grid Corporation of China and China Southern Power Grid. The four auxiliary service companies include China Power Engineering Consulting Group, China Hydropower Engineering Consulting Group, China Water Resources and Hydropower Construction Group, and China Gezhouba Group.

[52] Totally, there are six multi-provincial regional grids across China as presented in Figure 17. Five of them (i.e., Northeast, North China, Northwest, Central China and East China) are operated by the State Grid Corporation of China and one is owned by the Southern Power Grid. In addition, there are two provincial networks in Inner Mongolia and Tibet owned by local governments, not being part of any regional company. The western part of the grid in Inner Mongolia is managed by an independent company.

In 2003, the Chinese government introduced a trial of partially competitive wholesale market in some eastern and southern provinces, allowing generation prices to be determined through a competitive bidding process.[53] These trials finished in 2006 without further trials.[54] Subsequently, the 2015 electricity reform reintroduced competitive bidding to set wholesale prices but bidding rule details still require defining.

Grid companies in China control both transmission and distribution. Provincial/municipal grid companies operate the transmission and distribution within the boundary of each province. The 2015 electricity reform excluded separation of transmission and distribution despite discussion of separation leading up to the reform. The two regional grid companies control the development and operation of regional grids and regional electricity markets, as well as regional electricity dispatch. The State Grid Corporation of China is responsible for the interconnection and trading between regional grids, including the China Southern Power Grid.

T&D prices are determined by the residual between generation prices paid to plants and retail prices charged to end users by the grid companies. Importantly, T&D prices are not based on T&D costs.

However, Shenzhen and Western Inner Mongolia were chosen to be part of a trial, from 2015, on setting T&D prices independently using a cost-plus-return basis.[55] For example, in the case of Shenzhen, the first special economic zone in China, both total revenue of the grid company and electricity T&D prices are regulated through a revenue cap. In essence, total revenue, consisting of a fixed return on capital and taxes to decouple the grid company's revenue from sales volume. T&D unit prices to customers are calculated as the quotient of total revenue divided by total T&D volume.

Under the current system, grid companies sell electricity directly to final consumers. The 'National Development and Reform Commission' (NDRC) provides guidelines on retail prices but local governments ultimately determine prices, so prices vary by provinces. Section 5 provides more details on retail prices. Since 2015, private firms have been able to buy electricity from generators and sell electricity to final consumers. Moreover, a market is being established where large buyers will be able to buy directly from generators or traders.[56]

The grid companies function as the system operators to determine the dispatch of electricity according to wholesale contracts and dispatch protocols.[57] The grid companies and generators sign annual contracts allocating the number of operation hours to generators. A dispatch protocol complements the contract stipulating dispatch timing, taking into account

[53] A maximum of 10 to 20 per cent of the electricity generated by participating power plants could be transacted through the market.
[54] The need for electricity generation to support the rapid economic growth in the last decade has likely influenced the decision to retain a centralised approach to price making. Such approach could ensure that investment was undertaken in a timely manner rather than subject to the vagaries of market forces.
[55] Following Shenzhen and Western Inner Mongolia, four other provinces/autonomous regions (i.e., Anhui, Hubei, Ningxia and Yunnan) have also undertaken pilot programs entailing the separation of T&D prices.
[56] See, more details, Document No. 9 issued by the State Council in March 2015 at http://www.escn.com.cn/news/show-225985.html.
[57] See the details of the Interim Measures for Promoting the Transparency, Fairness and Justness of Electricity Dispatch at http://www.sgcc.com.cn/fgbz/dlfg/37302.shtml.

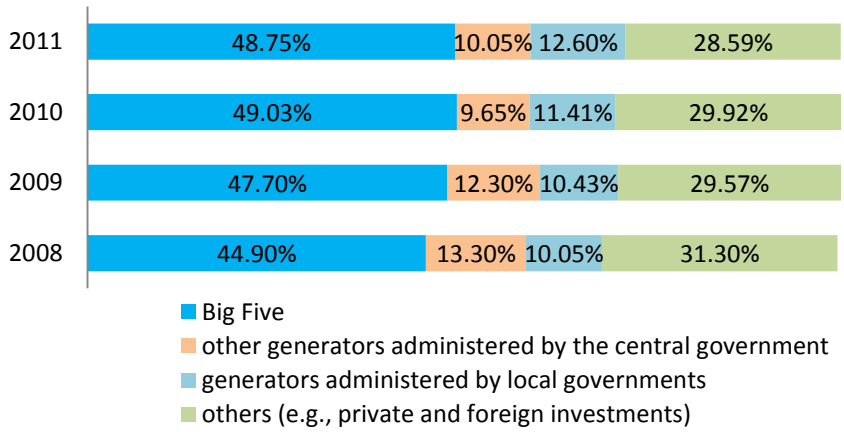
the demand and supply of electricity, the availability of generators and other conditions at the time of dispatch.[58]

Electricity dispatch in China follows an 'equal-share-dispatch' convention that allocates equal operating hours to each contracted generator. However, this convention proves contrary to emissions reductions as high emission intensive generators operate for as many hours as the low emission intensive generators (Teng, Wang & Zhiqiang 2014). The convention also induces inefficient generation investment by encouraging overbuilding (Kahrl et al. 2011).

As discussed in Section 2.1, the system operator trailed ESPD in an attempt to prioritise energy efficiency and emissions reduction. ESPD ranks generators in terms of energy efficiency and emission rates to determine order of dispatch,[59] dispatching the higher efficiency and less pollution generators until they are operating at full capacity before dispatching the next generator in the rank. This dispatch approach facilitates the full use of renewable energy and more efficient thermal generators. However, there lacks progress toward a nationwide ESPD implementation since its five-province trial in 2007. ESPD depends heavily on administrative orders and documents, which could partially explain the slow progress.

Another feature of China's electricity sector is the dominance of state-owned enterprises. As we can see from Figure 18, the 'Big Five' companies controlled by central government own about half of the nation's installed capacity. Other generators administered by the central government and large generators administered by local governments control around 20% of the total capacity.

Figure 18: Ratio of Installed Capacity by ownership



(Data source: the Annual Report of Electricity Supervision published by the State Electricity Regulatory Commission (SERC) from 2009 to 2012)

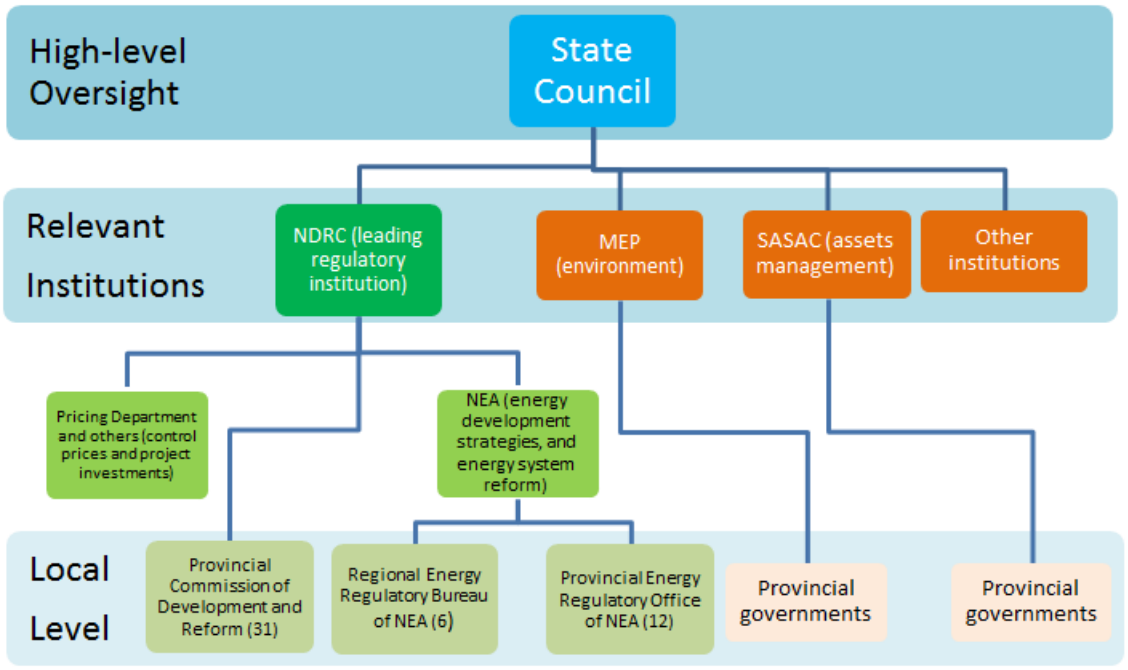
[58] See a sample dispatch protocol at http://www.mianfeiwendang.com/doc/4ed2a10a4a0c6efc6195cdc6/5.

[59] There are seven classes of generation (1) single-sourced generators using renewable energy such as wind, solar, tidal and hydropower, (2) Flexible units fired by renewable energy like hydro-power, biomass and geothermal power and solid waste fired generators meeting environmental protection requirements, (3) nuclear power plants, (4) coal-fired cogeneration units running in terms of 'electricity upon heat' and units with comprehensive use of resources including residual heat, residual gas, residual pressure, coal gangue, coal bed/coal mine methane, (5) natural gas and coal gasification based generation units, (6) other coal-fired generators, including cogeneration units without heat load and (7) oil and oil products-fired generation.

3.2.5 Regulatory Framework and Institutions

China has an extensive regulatory framework for the governance of the electricity sector, shown in Figure 19. Regulatory institutions exist in both the central and local governments. At the central government level, the key institutions include the State Council, the NDRC, and the National Energy Administration (NEA), Ministry of Environmental Protection (MEP) and the State Owned Assets Supervision and Administration Commission (SASAC).

Figure 19: Regulatory Institutions of the Electricity Sector



The State Council is China's top administrative authority for the economy and assigns responsibilities and tasks to central and provincial regulatory authorities. The State Council has the ultimate control over the decision making of development and operation of the electricity sector but remains uninvolved in directly regulating the electricity sector.

The NDRC, a macroeconomic management agency to formulate policies for social and economic development and reform, is the leading regulatory institution to control prices and investments in the electricity sector. This institution reviews the costs of electricity corporations and controls prices through its Pricing Department. It also possesses the deterministic rights on the construction of large generation plants. In contrast, NDRC's provincial-level counterpart, the Development and Reform Commission, undertakes the construction of small plants.[60]

The NEA department under the jurisdiction of the NDRC is responsible for developing and implementing energy strategies, plans and policies, advising on energy system reform and regulating the sector. The NEA was established 2008 and restructured in 2013 to incorporate the functions of the State Electricity Regulatory Commission (SERC), including

[60] In recent years, more authorising rights of plants construction are granted to provincial Development and Reform Commission.

designing and supervising generation markets and implementing reforms in the electricity sector.[61]

The MEP issues environmental policies and conducts environmental implementation and supervision. With respect to the electricity sector, the MEP assesses the environmental impacts of project construction and pollution from electricity production.

The SASAC is a special commission, directly under the State Council, which oversees all public enterprises and is responsible for the maintenance and valuation of national assets. SASAC maintains microscopic supervision of state-owned electricity corporations, including the ability approve or refuse mergers and acquisitions within the electricity sector.

These institutions regulate the entire electricity supply process, including setting electricity prices, dispatching existing generation and deciding on whether to invest in new generation.

Institutions can affect information and transaction costs related to reform design and implementation. Institutions may reduce information and transaction costs or increase them to become a constraint on reform performance (Erdogdu & Erkan 2013). In China, many policy initiatives to increase energy efficiency investments and integration of renewable energy generated electricity fail to meet expectation in implementation. Taylor, RP et al. (2008) consider the institutional environmental a key reason for this failure.

One prominent problem China's electricity sector confronts is the competing interests between institutions at the same level and between central and local government levels. For instance, in most provinces, the state owns the large power plants while provincial level companies own the small and medium plants. The imposition of a carbon price gave an advantage to larger plants that can generation more efficiency. These larger plant gained additional operating hours at the expense of smaller plants. This generation shift from small and medium plants to large units induces a revenue shift from provincial companies to state-owned companies. Due to the disparity between the goals of central government and local governments, the implementation of these policies is not socially maximising. Section 2.7.1 discusses the allocation of hours.

3.3 Legislation Related to the Electricity Sector

This section discusses how four major electricity sector legislations relate to electricity pricing, the dispatch principle, economic incentives and regulatory measures. The four legislations are (1) the Electricity Law, (2) the Energy Conservation Law, (3) the Law on the Prevention and Control of Atmospheric Pollution, and (4) the Renewable Energy Law.

3.3.1 Electricity Law

The milestone legislation in China's electricity sector, the Electricity Law, enacted in 1996, predates other major institutional reform within the electricity sector.

Electricity pricing includes key Articles 35, 36, 37 and 41.

[61] SERC, the independent electricity regulator, lead electricity sector reforms, including breaking-up monopolies and promoting market competition and supervising policy implementation. SERC was established in 2003 and dissolved in 2013.

- Article 35: ‘The rates of electricity – including the rates charged to the generating companies for incorporation into the power network, the rates of mutual supply between different power networks and the sales rates of electricity supplied to consumers – shall be based on a centralized policy, fixed in accordance with a unified principle and administered at different levels.’
- Article 36: ‘Establishment of electricity rates shall be based on the principles of reasonable compensation of cost and reasonable determination of profits, legal incorporation of taxes, fairly shared burdens and promotion of electric power construction.’
- Article 37: ‘A principle of equal rates for equal quality of electricity supplied by the same power network shall be applied with regard to incorporation into a power network’.
- Article 41: ‘China uses two systems for fixing electricity rates according to consumer type and time of use. A common rate applies to the same consumer type using same level of voltage on the same power network.’
- The State Council specifies formulates measures for the application of Article 41. The State Council also determines consumer type classifications and time of use periods.

Dispatch principle includes key Articles 21 and 22.

- Article 21: ‘Centralized dispatching and level-by-level administration shall be exercised in the operation of power networks. No units or individuals may illegally intervene in the dispatching of power networks.’
- Article 22: ‘Requests by power-generating enterprises in the status of qualified independent legal persons to incorporate the power they generate into a network shall be accepted by the enterprise that operates the network’

These articles promote the grid connection of electricity generation and emphasize renewable energy. However, the regulatory framework is ambiguous about implementation, causing delays in connection.

Since the enactment over two decades ago, the Electricity Law has undergone little amendment despite significant economic and technological change in the sector. The Electricity Law’s failure to accommodate or reflect significant changes has impeded adoption and promote of renewable energy, distributed generation and smart grids in particular. There is a requirement for amendments to the Electricity Law to (1) establish independent electricity trade centres at different levels and (2) introduce competition into the retail sector by splitting the existing monopoly retailer. However, among the many barriers impeding amendment two key examples include vested interests and multiple changes in the entities managing the Electricity Law over a short time.

Vested interests include those of grid companies, some electricity generation companies, particular those with thermal power plants, and those of the government institutions that regulate the sector.

Four entities have managed the Electricity Law (1) the Electricity Ministry before the electricity reform in 2002, (2) the National Electricity Corporation (NEC) after the electricity

reform in 2002, (3) SERC established in 2003 replaced the NEC during a revision of the Electricity Law and (4) the National Energy Bureau in 2013 replaced the dismantled SERC.[62]

3.3.2 Energy Conservation Law

The Energy Conservation Law enacted 1997 promotes energy conservation in the whole of society, enhancing energy utilisation efficiency, protecting and improving environment, and promoting comprehensive, coordinated and sustainable economic and social development.

The 2007 amendment incorporates more industries within the spectrum of energy conservation and strengthens administrative enforcement. The amendment requires the major energy consumers to cut energy consumption, including construction projects, transport sector and government institutions and industries such as electricity, iron and steel, non-ferrous metals, building materials, oil processing, chemical and coal.

The 2007 amendment also clarifies work allocated to different government departments. Article 11 states "The State Council and the local people's governments at and above the county level shall strengthen their leadership in energy conservation work in disposition, coordination, supervision, inspection and promotion of the energy conservation work". Articles 13 and 14 stipulate that the respective administrative departments under the State Council shall set down national standards and industrial standards for energy conservation, and encourage provincial and lower levels government to set stricter standards.[63]

The Energy Conservation Law also specifies energy conservation incentives and penalties. For instance, Article 59 encourages and supports the development of solar power, wind power, methane from biomass and other renewable energy in rural areas and the development of small-scale hydropower generation. Articles 60 to 65 stipulate incentives including financial subsidies, tax, government procurement, preferential loans and retail price. Article 66 specifies support for DSM, energy management contracts and voluntary energy conservation agreements through taxes deduction and pricing. Furthermore, the article encourages adopting rates for peak load, seasonal and interruptible load to encourage consumers to adjust their use in a rational manner. Article 66 also supports differential rates to eliminate, restrict, permit or encourage the enterprises of major energy-consuming industries. Section 3.7.2 also discusses Article 66.

Regarding the dispatch of electricity, Article 32 states that grid companies are required to arrange grid connection for electricity generated by heat, cogeneration units and units using waste heat and pressure. This article also requires grid companies to connect electricity generated by other units that comprehensively utilise resources. Article 78 stipulates that if a grid enterprise fails to comply, the electricity regulatory authority shall order it to compensate any financial losses incurred by the electricity generating companies.

The July 2016 amendment further facilitates energy conservation. Amended Article 15: *"Fixed asset investment projects should be systematically evaluated and reviewed in terms of energy conservation. Projects must meet compulsory energy conservation standards before construction starts and projects failing to meet conservation standards are prohibited from operating. With respect to the government projects inconsistent with compulsory energy*

[62] See http://www.sinoergy.com/bianji1/10186/.
[63] More details in English about the 2007 version of this law could be found at http://www.lawinfochina.com/display.aspx?lib=law&id=6467#menu1.

conservation standard, the competent examination and approval department shall not approve or verify the construction thereof". All fixed assets projects are required to meet compulsory energy conservation standards. However, only government projects need to go through the examination and approval procedure by related authority. In contrast, non-government projects are excluded. This is one of the improvements made by the latest amendment.

3.3.3 Law on the Prevention and Control of Atmospheric Pollution

China enacted the Law on the Prevention and Control of Atmospheric Pollution in 1988 and revised the law in 1995, 2000, and 2015. The 2015 revision entered into force January 2016. The law aims to prevent and control atmospheric pollution, protect and improve the environment and the ecological environment, safeguard human health, and promote the sustainable development of the economy and society. The 2015 revision comprises a number of improvements, including the following three key examples.

1. It strengthens local governments' responsibility to improve the quality of the atmospheric environment 30 of the law's 129 articles are about the legislative responsibility. Article 3 states that the local government shall be responsible for the quality of the atmospheric environment in the area. The Ministry of Environmental Protection shall carry out the assessment on the performance of the provincial government. If the city government fails to meet the requirements, the higher-level environmental protection department shall carry out talks and regional restrictions on the subordinate government leaders who fail to complete the task.
2. According to the actual situation of China's economic and social development, this law sets quality standards for products containing volatile organic compounds (such as coal, stone tar, biomass fuel, paint and other products), fireworks, fumes and filtration. This emphasizes the importance of preventing and controlling the source of pollution.
3. The financial penalties have been increased to deter polluting firms. A firm can be fined 100,000 to 1,000,000 RMB under the following three conditions: (1) emitting pollutants to the air without permission, (2) exceeding pollution ceilings, and (3) polluting illegally by shirking the surveillance. The fines in the current version of the law are much higher than the fines in previous version of the law that were between 10,000 and 100,000 RMB. The fines in the previous versions were insufficient to incentivise firms to install anti-pollution equipment.

Other amendments include (1) promoting regional cooperation to prevent and control atmospheric pollution, (2) mandating a China wide total emission targets rather than limited control areas for acid rain and sulphur dioxide , (3) mandating targets for specific firms and (4) establishing platforms for data sharing and cooperation to promote efficient research on how to deal with smog.

3.3.4 Renewable Energy Law

The Renewable Energy Law aims to promote the exploitation of renewable energy[64], increase energy supply, improve the energy structure, ensure energy safety, protect the environment, and attain the sustainable development of the economy and society (Article 1). First formulated in 2005 and amended in 2009, the law establishes four key mechanisms to develop renewable energy, including (1) setting national renewable energy targets, (2) obliging connection and purchase of electricity generated from renewables, (3) building a national feed-in tariff system, and (4) arranging cost-sharing and fund allocation.

The Renewable Energy Law employs a top-down approach for energy planning and mandating targets where the central government designs a national plan for the development and utilization of renewable energy resources and according to this national plan, the provincial governments design plans for their respective regions (Article 8). The provincial governments file their renewable energy development plans with the central government before implementation to enhance the central government's supervision over provincial renewable energy planning (Schuman & Lin 2012).

This law guarantees the connection of all electricity generated from renewable energy to the grids. According to Article 14, power grid companies are required to sign a grid-connection agreement with companies owning renewable energy generators provided the enterprise has legally obtained an administrative license or has submitted construction record for the project. Power grid companies are also required to purchase all the power generated by the grid-connected renewable energy within their power grid region, and provide grid-connection services for renewable energy. The 2009 amendments stress that grid companies should purchase all of the renewable power generated within their jurisdictions up to the amount of renewable energy set by regulatory authorities as proportion of total power. For the full implementation of these provisions, the renewable power must meet grid connection technical standards and renewable power generators have a responsibility to cooperate with grid companies to ensure grid security. Simultaneously, grid companies should implement measures to strengthen grid construction, to develop a smart grid and energy storage, and so on.

Articles 19 and 13 provide pricing information. The State Council's price administration department determines the electricity price for renewable energy generation considering the type of renewable energy and geographic regional conditions. The electricity connected to grids should be beneficial to the promotion of exploitation of renewable energy and economically reasonable. Moreover, timely readjustment should be made along with the development of technology for exploitation of renewable energy. Article 19 stipulates that the price for grid-connected power should be publicly available and if biding used to determine the price of grid-connected power generated by renewable energy power projects, the winning bid determines the price. However, the final price should not exceed the price level of grid-connected power of similar renewable energy generation projects. Article 13 paragraph 3 stipulates that the price of grid-connected power generated by renewable energy power projects decided by invited bid as follows. Where more than one person applies for the construction of the same project for grid-connected power generation with

[64] For instance, if a technological innovation reduces the generation cost of electricity from renewable energy, the related electricity price should be reduced accordingly.

renewable energy, requiring administrative license, the licensee shall be determined by invited bid.

On expense sharing, Article 20 states that expenses incurred by the power grids from purchasing renewable energy generated power could be passed onto consumers in some sharing method. The prerequisite is that the purchased power generated from renewables should accord with the provisions of Article 19 that is the State Council's price administration department shall formulate the specific cost sharing method. According to Article 21, other reasonable expenses related to power from renewable energy such as transmission costs can be recovered via increasing the retail price. Article 22 stipulates how to set retail prices for the renewable power generated by the independent power systems that are the power systems isolated from the nation's main power system. Their retail prices depend on the type of renewable energy and their geographic location. If cost exceeds revenue from selling power, the grid company can pass the excess onto consumers using the sharing method stipulated in Article 20.

Articles 24 to 26 detail economic incentives and regulatory measures using a special renewable energy development in five key areas:

1. promoting scientific and technological research in formulating standards and demonstrating engineering for the exploitation of renewable energy
2. promoting projects for the use of renewable energy in people's daily lives in rural and pastoral areas
3. promoting the construction of independent systems of power generated with renewable energy in outlying areas and on islands
4. surveying and assessing renewable energy resources, and constructing of relevant information systems, and
5. promotion of localized production of equipment for exploitation of renewable energy.

Preferential loans with financial interest subsidy and preferential taxation may be offered to projects for exploitation of renewable energy that are listed in the national development guidance catalogue of the renewable energy industry and meet the requirements for granting loans (Article 25 and 26).

Article 29 stipulates penalties for noncompliant grid companies if a power grid enterprise fails to purchase all power from a renewable energy generator and has caused economic losses to the owner of the generator, the power grid enterprise is required to compensate the generator owner. The power regulatory institution shall order the grid enterprise to rectify within a fixed period. If grid enterprise remains noncompliant, its maximum penalty is the amount of the economic losses suffered by the enterprise of power generated with renewable energy.

The Renewable Energy Law stipulates that the grid companies must purchase all the electricity generated from renewable energy but lacks details on implementation.[65] Given the higher on-grid tariff as well as the extra expenses for physical connection and the

[65] For instance, neither an explicit specification on the procedure of grid connection nor a clear stipulation on the compensation of the curtailment losses for renewable energy operators is provided (Hong et al. 2013).

variability, grid companies have little motivation to accommodate the electricity generated from renewable energy – particularly that generated from wind and solar.[66]

The legislation provides principles and some frameworks for the development of the electricity sector but lacks explicit targets and details. The renewable energy development plans and regulatory documents supplement the Renewable Energy Law and include mandatory targets set by governing institutions. However, these supplementary documents lack legal enforceability. The next section discusses the mandatory target.

3.4 Mandatory Targets

China issued a list of mandatory targets to develop clean energy and renewable energy, reduce the proportion of fossil fuel, facilitate energy supply capacity, control the aggregate amount of energy consumption, and improve energy efficiency. We discuss these targets in the following subsections (1) renewable portfolio, (2) energy insensitivity and total energy use, (3) technology standards and (4) mandated target measurement.

3.4.1 Renewable Portfolio

The FYPs mainly determine renewable portfolio capacity targets. In addition to the General Economic and Social Development FYP released by the Communist Party of China (CPC) through the plenary sessions of the Central Committee and national congresses, there are FYPs created by local governments and by associations for the development of a specific sector. Hence, there are many FYPs related to the electricity sector. We discuss two such plans.

China Electricity Council comprises of electricity sector organisations, enterprises and institutions and makes the FYP for the sector.[67] However, in 2016 the NDRC and the State Council released the 13th FYP (2015-2020) (FYP13) for electricity.[68] Table 2 shows the FYP13 planned increase in electricity and cumulative capacity discrepancies between Energy Development (FYP13-ED) and State Council's Energy Development Strategy Action Plan (EDSAP).

[66] When a large amount of variable renewable electricity is connected to the grid, the stability of power system is put into risks and additional measures should be taken. Measures can help to improve the grid friendliness of renewables include better technical standards and more accurate forecast for electricity generated from renewables (Kat 2011).
[67] Note the NDRC did not replace the CEC.
[68] See http://energy.people.com.cn/n1/2016/1107/c71661-28841645.html.

Table 2: FYP for increasing electricity capacity and cumulative capacity discrepancies among Electricity, ED and EDSAP FYPs (GW)

	FYP13-Electricity			FYP13-ED	EDSAP
	Initially (2015)	incremental	Accumulated (2020)	Accumulated (2020)	Accumulated (2020)
Wind	131	79	210	210	200
solar	42	69	110	110	100
Hydro-power	320	40	340	340	350
Nuclear-power	27	30	58	58	58
Natural gas	66	50	110		
Biomass	13	2	15		
Coal	900	200*	1,100		
Other fossil fuel	27	30*	37*		
Total installed capacity	1,530	500	2,000		
Share of non-fossil fuel	35%		39%		

(Source: NEA 2016 cited in Chinapower[69]) *Estimates based on NEA (2016). Note the FYP13-Electrcity accumulated target in 2020 is not the sum of the initial endowment in 2015 and the planned incremental target in all cases. This provides scope for adjustments in case something unexpected may happen. The incremental column also incorporates the planned decommissioning of plant.

Over the five years, the planned increase for installed capacity of electricity generators is 500 GW and non-fossil fuel powered plants is 770 GW. FYP13 pays considerable attention to natural gas generation and proposes an increase in installed capacity of gas by 50 GW; the proposal would grow the total gas installed capacity to 110 GW or 5% of all install capacity. FYP13 also preferentially promotes hydropower and strives to raise safely the proportion of nuclear power in the electricity generation mix. The proposed increases in installed capacity of hydropower and nuclear power will be 40 GW and 30 GW, respectively. FYP13 particularly promotes distributed generation and proposes to increase wind and solar power by 79 GW and 69 GW respectively. In contract, FYP13 proposes to reduce the share of coal-fuelled plants by 20 GW. Meanwhile, coal-powered plants' role will increasingly assist in meeting peak-load and managing volatility from increasing penetration of solar and wind power.

FYP13 for Energy Development (FYP13ED) details the energy structure of installed capacity and electricity generation in 2020 at 39% and 31% for non-fossil-fuel powered plants, respectively. In contrast, the State Council's Energy Development Strategy Action Plan (2014-2020) published November 2014 expects installed capacity by 2020 are 350 GW, 58 GW, 200 GW and 100 GW for hydro-powered, nuclear-powered, wind-powered and solar-powered plants, respectively.

The FYP have become more consistent that is the inconsistencies between FYP12ED and EDSAP12 and between FYP13ED and EDSAP13 have narrowed, as shown in the Table 2. The NEA, a department of the NDRC, now makes both FYP13-Electricity and FYP13-ED with reference to the targets set by EDSAP. This contrasted with the past when different plans were made by different authority without reference to the State Council.

3.4.2 Energy Intensity and Total Energy Use

FYP13 for Energy Development (FYP13ED) also sets mandatory targets for energy intensity and total energy. FYP13ED mandates three 2020 targets, being maximums for (1) coal

[69] http://www.chinapower.com.cn/

equivalent consumption of thermal power plants of 310g/kWh, (2) rate of line loss in the electrical networks of 6.5% and (3) aggregate primary energy consumption of 4 billion tons of the standard coal equivalent with whole electricity consumption between 6.8 and 7.2 trillion kWh. The Energy Development Strategy Action Plan (2014-2020) caps annual primary energy consumption at 4.8 billion tons of the standard coal equivalent by 2020. This means that the annual increase rate of primary energy use in China must be no more than 3.5 percent by 2020. The plans aim to hold annual coal consumption below 4.2 billion tons until 2020.[70] The central government allocates targets to provincial governments and target achievement provides performance evaluation crucial to the promotion of local officials.

3.4.3 Technology Standards

The National Energy Bureau develops FYPs for technology standard targets, including (1) National Energy Technology, which specifies the targets for technology development in the electricity sector, (2) the Development of Wind Power, (3) for the Development of Solar Power, (4) the Medium and Long Term Plan for the Development of Nuclear Power and so on.[71] These technology standards place requirements or restrictions on the construction or operation of generation technologies. An example is the Large Substitutes Small policy, which requires the decommissioning of small, inefficient thermal power plants to allow the construction of larger, more economically efficient and less emission-intensive plants.[72] Under this policy, there are plans to close more plants in the 100 and 200 MW range between the years 2011 and 2020 (Productivity Commission, 2011).

3.4.4 Review of Mandated Target

The mandated targets sent a clear signal promoting renewable energy to electricity generators, grid companies and governments at different levels. However, there exist implementation lags between policy formulation mandating the targets and construction of generators (Schuman & Lin 2012).

Wang, Zhao and Chi (2014) examined the effectiveness of mandated target measures during FYP11 from the perspective of local governments' responses to the obliged objectives set by the central government. They find that the central government's credible commitment drove the initially disparate attitudes of provinces to a converged result. However, the outcome is significantly constrained by the initial energy intensity of each province. Thus, a more appropriate task division would make the mandated targets a more effective. To limit local governments' strategic responses to the timeframe of the FYP obligatory targets, the local situation including local officials' office tenure, usually three to five years, requires consideration. A more flexible way to assess the successful implementation of the policy implementation is required, for instance, by placing more emphasis on the quality and effort of policy implementation. For instance, local officials focus on the economic performance in the year their position expires and there is insufficient incentive for them to optimise their performance during their tenure or to be concern about

[70] In 2013, 3.6 billion tons was burned. This means that, in order to achieve this goal, China can increase its annual coal use by only around 17% from the 2013 level before 2020.

[71] The collection of the 12th Five-Year Plans for development of the electricity sector is available at http://www.ce.cn/cysc/ny/gdxw/201302/06/t20130206_21334762.shtml

[72] The policy focused on closing small plants (below 50 MW capacity), larger older plants (less than 100 MW and in operation for over 20 years), and plants of less than 200 MW that have reached the end of their design life.

the economic and environmental status after they leave. Local officials usually work in the same position for less than 8 years, 6 years for lower level official, comprising two contracts of about 3 or 4 years duration.

Through a stylised investment model, Alzate and Garcia (2012) conclude that a renewable portfolio standard (RPS) cannot induce socially optimal investment in renewable capacity because RPS promotes investment in renewable energy technology but underinvestment in the conventional technology.[73]

The planning and regulatory documents set mandatory targets, but leave the details of implementation. Thus, to put the targets into practice, incentive-based instruments such as pricing mechanism and financial incentives are widely applied in China. We discuss pricing mechanism to facilitate the development of energy efficiency and renewable energy in China in the next section.

3.5 Pricing Mechanism

China implemented substantial reforms addressing electricity-pricing issues over the past three decades, resulting in a complex pricing system. At the early stage of reform, a key means to attract investment into electricity generation was an on-grid tariff that is the price paid to the generator by the network operator. This price helped to develop a market mechanism and to create competition in the generation sector.

In 2004, China introduced user type retail pricing to reduce energy intensity. These user types included residential, light industry, heavy industry, commercial and agricultural and based on their voltage requirements. Section 2.5.3 discusses retail prices in more detail. In 2007, the policy in China for on-grid tariff aims to phase out aged and small-sized coal-fired electricity generation plants by lowering their on-grid tariffs. In recent years, the rising concern about environmental protection and the promotion of clean energy utilisation prompted progressive development of renewable electricity generation on-grid tariffs.

In the current system, governments at various levels strictly regulate electricity prices, including generation prices (or on-grid tariffs), transmission and distribution (T&D) prices and retail prices.

3.5.1 Generation Prices

In most cases, the NDRC fixes wholesale contract prices for electricity sold by generators to grid entities. These fixed wholesale contract prices differ for each generation type. The exception was in 2003 when the Chinese government introduced a trial of partially competitive wholesale market in some eastern and southern provinces, allowing generation prices to be determined through a competitive bidding process. The participating power plants could transact a maximum of 10 to 20 per cent their electricity through the market. However, there has been no further competitive bidding since the trials terminated in 2006.

[73] Constrained by the RPS, an investor has to develop a site that is not profitable in the socially optimal situation. To compensate the losses resulted from the investment in renewable energy, the investor has to obtain more profits from conventional capacity. To serve this goal, the investor can only set spot prices higher than the level under socially optimal capacity configuration – which induces a lower capacity margin (i.e., the level by which available electricity generation capacity exceeds the maximum expected level of demand) in the conventional technology.

3.5.1.1 Thermal-power Plants

For the generation prices of electricity generated by thermal-power plants, the NDRC employs benchmark prices based on estimates of generation costs and recommendations from local pricing bureaus. Due to the different proximity to coal mines, generation prices for thermal-power plants differ between regions and provinces. In general, east China has the highest prices, followed by south China, north China and middle China, with northwest China as the lowest.

Within a province, generation prices for thermal-fired electricity vary by technology types. For instance, coal-fired plants with the same desulphurisation enjoy the same price but differ from the price for other technologies such as hydropower.

NDRC considers the changes in coal prices when determining prices for coal-fired electricity. Coal dominates the thermal-power plants due to the coal-intensive feature of China's resources. Contrastingly, the price of coal fluctuates having been liberalised whereas there are fixed wholesale prices for electricity still being regulated. Therefore, a conflict between the liberalised coal price and the regulated electricity price arises. To solve this problem, in 2004 the central government approved a price link between coal and electricity generated by coal-fired plants. According to this policy, the generation prices as well as retail prices of electricity will increase if the average price of coal increases by five percent or more in the previous a six-month period. However, NDRC only allowed a couple of co-movements over the whole of the past decade.

3.5.1.2 Hydro-power Plants

Prices for electricity from hydrogenation are not set in the method of benchmark. Instead, the price is set subject to costs and differs from project to project. Factors influencing prices include the hydrological and geological condition of plants, water adjustment capabilities of reservoirs, and specific requirements for possible resettlement during construction. The prices of large hydrogenation plants are approved by the NDRC and those of the smaller plants determined by provincial governments.

Overall, the price of electricity from hydrogenation plants is much lower than that generated from other energy. Compared to the price of electricity generated from coal, wind and nuclear, and hydropower are lower by 30%, 60% and 44% respectively.[74] Although it has been suggested for a while that electricity connected to the same grid should enjoy the same tariff. Furthermore, the generation price of hydropower generated electricity remains very stable, partly because that coal price fluctuations do not influence hydropower much.

3.5.1.3 Other Renewable Energy Plants

China implemented a feed-in tariff (FiT) for electricity generated from renewable energy such as wind, solar and biomass. The benchmark price for electricity from coal-generation plant provides the basis for the FiT, which differs across different techno-economic performances of renewable energy technologies, geographic locations, and availability of renewable energy resources. The FiT aims to reduce the risks of renewable electricity investment and to make it more competitive.

[74] http://www.360doc.com/content/11/0129/19/37133_89810727.shtml

There are four fixed benchmark price regions for wind power generated electricity based on wind intensity regions, ranking in order from highest to lowest wind intensity:

1. 0.51 RMB/kWh region includes northwest Inner Mongolia and northwest Xinjiang
2. 0.54 RMB/kWh region includes east Inner Mongolia, north Hebei and west Gansu
3. 0.58 RMB/kWh region including southern Xinjiang, southern Gansu, Ningxia and parts of Jilin and Heilongjiang
4. 0.61 RMB/kWh region including regions not listed elsewhere

There are three regionally based FiT for solar generated electricity: 0.9, 0.95 and 1 RMB/kwh. Distributed solar generation has further subsidy of 0.42 RMB/kwh.

The FiT for electricity generated from biomass plants is the 2005 benchmark price of desulfurized coal-fired plants in each region plus a subsidy of 0.25 RMB/kwh.

The current FIT scheme fails to consider the vast variety of renewable source across different regions, as the richness of resources differs greatly in various areas (Zhang, S & He 2013).

3.5.1.4 Nuclear-power plants

The generation prices for nuclear-power plants built after mid-2013 are based on a national-wide benchmark, which is set at 0.43 RMB/kwh. This contrasts with the previous method with which the price of nuclear-power generated electricity is set subject to the costs of individual plants similar to electricity from hydrogenation plant discussed above.

3.5.2 Transmission and Distribution Prices

For a few decades, China used alternatives to basing its T&D prices on costs-of-service. T&D prices are the residual between generation prices paid to generators and retail prices charged to end users by the grid companies. Following the latest reforms launched in March 2015, China has run trials in several places to set T&D prices based on cost-of-service, with Shenzhen as the leading city.

3.5.3 Retail Prices

China regulates its retail electricity prices and calculates them using a cost-plus principle that is quite similar to a cost-of-service regime (Teng, Wang & Zhiqiang 2014). Retail electricity prices comprise on-grid tariff (65-70%), variable taxes and surcharges (10-15%) and T&D charges (Edwards 2012; Teng, Wang & Zhiqiang 2014). Surcharge examples at the national level include (1) Three Gorges Dam construction, (2) relocation subsidies for peoples displaced by the Dam project, (3) rural power grid maintenance, (4) urban public utility services and (5) for renewable energy project subsidies. The NDRC determines retail prices for three types (1) residential, (2) agricultural and industrial and (3) commercial or other. These prices also consider voltage requirements 110V or 240V. In general, residential and agricultural prices are lower than the average price.

To alleviate the pressure for installed capacity by phasing out inefficient companies, in 2004 a differentiated electricity price scheme was implemented for six energy-intensive industries, including aluminium, ferroalloy, calcium carbide, caustic soda, cement, and steel. Companies based on their energy intensity within these industries were categorised as (1) encourage, (2) permit, (3) restrict, or (4) eliminate. The electricity prices for category (1) and

(2) companies were the normal electricity price for industry in their areas and category (3) and (4) companies were the normal electricity price for industry in their areas plus a surcharge. The 2006 revision of the pricing scheme included the phosphorus and zinc smelting industries. The 2007 revision of the pricing scheme allowed local governments to receive the surcharge revenue to encourage provincial authorities to apply the scheme.

Excepting the differentiated pricing scheme for the eight industries discussed, retail prices for the three categories of consumer are uniform within each province. In 2013, progressive electricity tariffs were introduced to residential consumers to encourage energy saving and to protect those with lower income. With the progressive tariff if total electricity consumption exceeds a consumption threshold, a higher fixed tariff is charged. The threshold varies between provinces. Only the residential consumers are subject to the progressive tariff other consumer receive a flat tariff.

In price setting, the NDRC takes existing prices as the starting point rather than reviewing the costs in detail. This mechanism of setting retail electricity prices contributes to keep prices relatively low and stable, which is favourable for economic development and social stability but lacks transparency and poorly reflects costs, particularly environmental costs. However, the March 2015 reform improves price transparency and reflects costs by allowing large end users to transact directly with generators and generators, distributors and grid companies to sell electricity.

As discussed in previous sections, the cost of generating electricity from renewable energy is higher and the on-grid tariffs paid by grid companies reflect this. All electricity users pay for the higher price of renewable energy in the form of surcharges that the grid companies incorporated into the retail prices. However, the grid companies lack reimbursement for the costs of building transmission lines and providing connections for renewable energy producers that are often remote and wide spread. Moreover, the line loss for long-distance transmission is high. Thus, the grid companies have disincentive to integrate electricity generated from renewable energy. The aim of China's electricity reform in 2002 was to allow cost reflective electricity prices but renewable energy grid connection and transmission costs remained an issue. In response, reform in early 2015 intensifies the objective to introduce market mechanisms into the electricity sector.

3.6 Financial Incentives

We discuss other financial measures beside pricing mechanisms to incentivise energy efficiency and renewable energy investments including (1) capital subsidies, (2) preferential loans and tax incentives and (3) other support programs.

3.6.1 Capital Subsidies

Capital subsidies are direct financial transfers from governments to households or firms investing in low-emissions electricity generation such as solar PV cells or wind turbines. A key example allocated through annual national fiscal budget is the Renewable Energy Development Fund that supports research and development of renewable energy technologies, facilitate information dissemination, survey and investigate renewable energy resources and potentials, and support the development of renewable electricity projects particularly those in rural and remote areas.

3.6.2 Preferential Loans and Tax Incentives

Preferential loans reduce the cost of borrowing to invest in low-emissions generation technologies. Direct tax incentives provide tax credits for investment in renewable generation, or for the production of renewable electricity. In China, tax incentives come from both central and local governments, and can be technology specific (Campbell, RJ 2014). The national scheme offers a reduced valued-added tax rate for electricity generated from renewable energy, including wind, small hydroelectricity and biomass. According to 'The Implementing Regulations for Enterprise Income Tax Law' promulgated in January 2008, companies engaging in projects development related to renewable energy and energy conservation technologies received a tax concession consisting of a three-year exemption plus three years of taxation at 50% of the full tax rate.

3.6.3 Support Programs

3.6.3.1 Top-1000 Energy-Consuming Enterprise Program

The Top-1000 Energy-Consuming Enterprise Program (Top-1000 Program) is a national program launched in 2006, which aims to promote energy efficiency by setting energy-saving targets for the largest and least efficient energy consuming companies. This program covers approximately 1,000 companies that consume about one-third of the country's energy use in 2004. This project covers electricity generation companies, which comprise one of the major energy-consuming industries.

In the 11th FYP period, the target of this program was to realise a saving of 100 million tons of coal equivalent (Mtce). This program allocates targets to included companies and each province and requires them to report their energy consumption quarterly to the National Bureau of Statistics. The NDRC reported a saving of over 150 Mtce surpassing the 11th FYP objective.[75] Price et al. (2010) estimate the Top-1000 Program contributed 10% to 25% of the savings supporting China's efforts to meet a 20% reduction in energy use per unit of GDP by 2010.

The 12th FYP period Top-1000 Program target was set at 250 Mtce due to its success during the 11th FYP period. This makes the Top-1000 Program the world's largest energy saving campaign, representing a contribution of approximately 38% to China's energy saving goal. [76] Effectively implement such a large initiative requires the development of supplementary measures, including effective monitoring guidelines, a systematic means for gathering and disseminating energy-efficiency information such as guidebooks, database, software tools, and industry- or technology-specific energy efficiency reports to the participating companies, and so on (Price et al. 2011).

3.6.3.2 Funding Programs Promoting Research and Technologies

China offers a series of centrally managed programmes to fund science and technology research. There are three major research programmes supporting the technology development of energy efficiency and renewable energy (1) the National Basic Research Programme (Program973), (2) the National High-Tech Research and Development Programme (Program 863), and (3) the National Key Technologies R&D Program.

[75] http://politics.people.com.cn/GB/1027/14140058.html
[76] http://www.efchina.org/Case-Study-en/case-2014112606-en

Program 973 initiated in 1997 to achieve technological and strategic edge in various fundamental and basic research includes energy as a major field. Program topics closely related to the electricity sector include energy management and operational control of smart grid, power machinery's efficient and clean thermal power conversion, pollutant formation and control of ultrafine particles formed during combustion of fossil fuels. The State Programs of Science and Technology Development Annual Report states funding for the energy field in 2011 at CNY409.5 million that is 9.1% of the total fund of CNY4.5 billion. The finding was increase by CNY189.67 million in 2012.

Program 863 established March 1986 was to stimulate the development of advanced technologies in a wide range of fields to strengthen China's independent innovation capacity in the high-tech fields. Program 863 supports advanced energy technologies such as magnetic hydrodynamic generation and advanced nuclear reactors. The Chinese Ministry of Science and Technology (MoST) Annual Report states total funding in 2011 at CNY10.64 billion with 18.4% allocated to energy research. In 2012, the total fund increased to CNY10.96 billion with 8.2% allocated to energy research.

The National Key Technology R&D Program, initiated in 1982, is the first national program to address major science and technology issues. In contrast to Program 863, this key technology program focuses on industrial needs and innovation related to environmental pollution control and supports energy efficient. The total fund of this program was approximately CNY14.34 billion and CNY16.72 billion in 2011 and 2012 and the topics related to energy, resources and environment received 18.4% (i.e., 3.2% for energy, 6.6% for resources, and 8.6% for environment) and 14.1% (i.e., 3.7% for energy, 4.3% for resources, and 6.1% for environment), respectively.

Another program focusing on Chinese small and medium enterprises (SME) in the field of energy conservation and emission reduction is the EU-China SME Energy Conservation and Emission Reduction Research Collaboration Fund, which supports collaboration with EU enterprises and research institutes to carry out joint research, technology transfer, re-innovation and commercialisation of research results.[77]

3.6.4 Review of Financial incentives

Renewable energy subsidies contribute to increasing the share of renewables in energy consumption, improving energy efficiency, and addressing the remoteness of renewable energy generation from demand (Ouyang & Lin 2014). However, to alleviate energy poverty and to facilitate economic growth, the Chinese Government provides substantial subsidy and low interest loan to fossil fuels, which offsets the effect of China's efforts to promote energy efficiency and renewable energy (Ouyang & Lin 2014; Reddy 2013). Using the price-gap approach to estimate energy subsidies Lin and Jiang (2011) find China's energy subsidy amounted to CNY 356.73 billion in 2007, equivalent to 1.43% of GDP. This approach quantifies the gap or subsidy as the difference between world energy prices and domestic end-user prices.

Regarding the implementation of subsidies to renewable energy, payment delays by grid companies to renewable generators is common. This strains the cash flow of generators and

[77] http://www.access4.eu/China/274.php

increases the risk and the overall cost of a project. According to NEA, the amount of delayed subsidy payments due to renewable generators by 2014 has reached over CNY 14 billion.[78]

China's research fund management and allocation features four key problems. (1) Fragmented research fund management caused by many government departments, at both central and local levels, managing research-funding applications, leading to severe overlapping and inefficient use of fund. (2) The funding is not assigned to the competitive applicants. (3) Research applications consume half of researchers' time. (4) Rent seeking as well as fund abuse is common. In early 2015, MoST announced two key research funding reforms eliminating Programs 973 and 863 by 2017 and establishing an independent institute to manage research funding.

3.7 Pilot Incentive Measures

3.7.1 The Energy Saving Power Dispatch (ESPD)

Long-term contracts signed between generators and grid companies dominate electricity dispatch in China where the grid companies are obliged to allocate roughly equal operating hours to each contracted generator. This 'equal-share-dispatch' mode rewards and allows inefficient plants to operate as much as the efficient ones, contrary to sound economic principles (Teng, Wang & Zhiqiang 2014).

The NDRC, SERC and MEP jointly introduced Energy Saving Power Dispatch (ESPD) in 2007 as an alternative and more efficiency dispatch method to equal-share-dispatch. ESPD divides generators into seven classes based on their carbon intensity.

1. Inflexible dispatch renewable energy generators including wind, solar, tidal and hydro-power
2. Flexible dispatch renewable energy generators including hydro-power, biomass and geothermal power and solid waste fired generators meeting environmental protection requirements
3. Nuclear power plants
4. Coal-fired cogeneration units running in terms of 'electricity upon heat' and units with comprehensive use of resources including residual heat, residual gas, residual pressure, coal gangue, coal bed/coal mine methane
5. Natural gas and coal gasification based generation units
6. Other coal-fired generators, including cogeneration units without heat load
7. Oil and oil product fired generation.

The ESPD applies to all the generators connected to the grid, except the generation units contracted in international agreement. ESPD ranks the units according to their energy efficiency within the seven classes and if units have the same energy efficiency, pollution emissions level determines the ranking. The order of dispatched is rank order from one to seven.

Determining the power dispatching order in terms of efficiency and pollutant emission indices of generating units, the ESPD facilitated the full use of high efficiency units and renewable energy source. Nevertheless, the ESPD is essentially a centralized dispatch mechanism and

[78] http://finance.sina.com.cn/chanjing/cyxw/20150410/041321923676.shtml

lacking a market mechanism (Ciwei et al. 2010; Yen-Chiang & Nannan 2010). Any national ESPD rollout stalled following the 2007 five province trial.

The ESPD has many merits over equal-share-dispatch but does present the problem where coal generators take on a fast-ramping role that is both environmentally and efficiently suboptimal; coal generators running at a constant output operate both more efficiently and with fewer emissions per unit output. A market dispatch approach with carbon pricing would minimise such suboptimal use of coal generation. All generators would submit their marginal cost to supply electricity in five minutes intervals and the bids ranked with the cheaper bids accepted until supply met the demand. The marginal cost of the generator in last bid where supply met demand would determine the price for electricity trade during those five-minutes. Under such a system, the faster ramping capable dispatchable hydroelectricity would take on the fast ramping role to take advantage of the higher prices obtained during peak demand leaving the more efficient and less emissions intensive coal plants to run even more efficiently at full capacity at a lower price. This system would displace the less efficient and more emissions intensive coal plant. Additionally, the time dependent pricing signal incorporating a sufficient carbon pricing would encourage more investment in the flexible dispatchable renewable energy and energy storage and renewable energy generally and discourage investment in coal generation. Note coal generates would generally submit two bids to supply electricity (1) a lower bid for supplying electricity up to their minimum operating level and (2) a higher bid for electricity supplied between their minimum operating level and maximum capacity.

3.7.2 Demand Side Management

By increasing the flexibility of electricity consumption, demand side management (DSM) provides a cost-effective method both for energy saving and accommodating renewable energy generated electricity.

The main measure for DSM in each pilot city is peak load management. To capture the peak-shifting potential, the following methods are employed: widening the price between peak and off-peak loads; setting interruptible load protocols with customers; implementing special policies for energy-storing equipment; and so on (Hu, Z, Moskovitz & Zhao 2005; Zeng et al. 2013). However, it is not easy for China to move from pilots to national wide DSM (Yu 2012). Two key factors limit the application of DSM in China. (1) The setting of electricity prices do not reflect actual cost that is no real market prices or real time pricing exist (Kat 2011). Hence, there is little space for price signals to motivate demand changes. For instance, lacking real-time pricing, the Jiangsu Province DSM pilot used two or three pricing periods to match the daily peak and off-peak load cycle. This coarse approximation to real time pricing reduces the effectiveness of DSM. (2) There is also a lack of a long-term, stable and sufficient funding (Yu 2010). (3) The relative size of residential electricity demand in China is less than 20%. This compares with over 30% in the US. Therefore, using DSM on such a small portion of the demand reduces the effectiveness of DSM. Chinese industrial electricity demand lacks the strong daily or seasonal cycles apparent in residential demand.

Despite the limitations DSM, the margin for energy efficiency improvement by technical innovation is large (Yu 2010).

3.7.3 Carbon Emission Trade

The emission-trading scheme is an instrument, which internalises the environmental externalities of carbon emissions through a market mechanism. Under this scheme, companies are assigned an emission quota and will profit from selling excess permits to other firms if their carbon emission is lower than the quota. China's pilot carbon emission trading system was initiated in 2008. An expanded pilot scheme included Beijing, Tianjin, Shanghai, Chongqing, Guangzhou, Shenzhen and Hubei, covering 2000 businesses in energy-intensive industries. In 2014, about 15.68 million tonnes of carbon dioxide equivalent were traded under these schemes, with a value of CNY570 million.[79] The planned start date for the national emission-trading scheme is 2017. Relevant work has already started in several provinces, including Jiangxi.

The electricity sector is China's largest emitter of greenhouse gases and plays a crucial role both directly and indirectly in pricing carbon, so covered by the compulsory carbon-trading scheme. The carbon trading scheme or 'cap and trade' has two major components (1) determining the total allowable amount of carbon to be emitted known as the 'cap' and (2) and creating tradeable certificates for the right to emit carbon dioxide to the total allowable amount. Government gives or requires emitters to buy certificates for their current emissions. Emitters who reduce their emissions can sell their spare certificates. This provides a profit motive for emitters who can reduce their emissions for less than the value of the certificate. Theoretically, the mechanism provides the least cost method to reduce emissions. The price of carbon passes through to the end consumer with the more carbon intensive goods becoming relatively more expense. This induces the consumer to use less carbon intensive goods or swap to cheaper less carbon intensive alternative. Over time, the government can reduce the size of the cap or total emissions, which will raise the value of the certificates and make it more profitable for companies to reduce emissions.

However, the highly regulated wholesale and retail electricity prices and the equal-share-dispatching policy in China's electricity sector mutes the intended effect of an emission trading scheme on prices (Teng, Wang & Zhiqiang 2014). This in turn limits the impact of emission trading system on the development of energy efficiency and renewable energy in the electricity sector.

For example, one of the three main mechanisms for carbon emission trading is the Clean Development Mechanism (CDM) that is defined in Kyoto Protocol to assist developing countries to achieve the sustainable development through technologies provided by developed countries aiming to reduce emissions. Schroeder (2009) and Lewis, JI (2010) investigate CDM's role in promoting China's renewable energy. They find CDM has provided useful subsidy for renewable energy projects in China but CDM cannot be consider to be the main driver of renewable energy deployment, as the total amount of emission reduction achieved through the CDM is just about three percent in China, which is a small share of total annual greenhouse gas emissions.

3.8 Reform in 2015

The growth in the Chinese economy and electricity demand are slowing and the installed capacity and supply of electricity exceeds demand. This situation offers time and space for

[79] http://finance.chinanews.com/cj/2015/02-17/7072348.shtml

China to undertake new electricity sector reforms. Inefficiency in the grid monopoly is a major source for criticism. The State Council electricity reform in 2015 aimed to introduce competition into the wholesale and retail electricity sectors, key examples include (1) bidding for the connection of electricity generation to the electrical grids, (2) private investors will be allowed to access electricity retail, and (3) an electricity trade centre established for the large-users.[80]

The State Council discussed the separation of transmission and distribution but the State Grid Corporation continues to maintain its monopoly over both transmission and distribution. Additionally, the newly established dispatch centre lacks independence and central planning continues to control electricity dispatch. There lacks consensus on whether government driven industrial policies can promote the development of certain industries and which policies are the most effective in the energy transformation. Finally, whether consumers will benefit from retail price competition is questionable, as retail competition does not seem to deliver lower electricity prices to retail customers across the board or over time (Su 2015).

3.9 Conclusion

China's transition from a centrally planned economy to a more market based economy is occurring during a period of increasing global inequality and the requirement to address climate change. Both inequality and climate change issues are relevant to the energy sector. Additionally, the transition to what form of market-based economy China wishes to become is also relevant to the electricity sector. There are an array of choices forming a continuum from a mixed economy like Norway or Denmark with higher human development indices and social cohesion but lower GDP per capita to a more market orientated economy like the USA with a lower human development index and social cohesion but higher GDP per capita.

China has successfully introduced the world's largest emission trading scheme to ready China's adaptation to climate change but as discussed the centrally planned electricity pricing mutes the transformative effect of a carbon price on people's decision making. However, both the Energy Saving Power Dispatch (ESPD) and Jiangsu Province DSM pilots provide examples of central planned schemes that mimic a market price signal. While both schemes have flaws, they do provide the opportunity to transition China to more market orientated schemes and develop some of the technology required for a market base approach, such as metering for time of use and time of supply.

Countries around the world are grappling with the issues of higher penetrations of renewable energy. While high penetrations of renewable generation are technically feasible, they difficult to realise because market design presents a barrier to cost-effective integration of variable power generation (Riesz, Gilmore & Magnus 2013). The requirement for institutional structure and regulations that promote allocative efficiency is particularly pertinent to the complex electricity sector, which is essential to the national economy and living standards of people. The balance between market mechanism and government intervention deserves a careful consideration in developing a mixed economy. For instance, there is a strong positive correlation between the promulgation of relevant policies and the increasing rate of projects promoting energy efficiency and renewable energy (Zhao et al. 2011).

[80] Document No. 9 issued by the State Council in March 2015

Five major challenges facing the Chinese electricity sector include (1) failure to connect renewable energy to the electricity grids causing a significant spillage, (2) incomplete financing systems for renewable energy projects, (3) inadequate investment in the technical research and development for renewable energy, and lack of (4) policy coordination and consistency and (5) the government's capacity in policy implementation.

Pricing mechanisms require rationalisation and development (Jiang, Sun & Liu 2010; Zhang, H, Pu & Zhang 2013). Expanded financing channels are preferable to support the investment in renewable energy projects and to facilitate renewable energy related technology innovation (Liu et al. 2014). Policy coordination and implementation processes also require more attention as they have become obvious barriers to efficient regulation of the electricity sector.

Xu (2010) identifies a lack of government capacity in policymaking and implementation in many areas such as energy and environment sector. Notably, in the last 17 years the Chinese electricity sector underwent four major institutional restructures but retains the central planning mechanism. While countries around the world are grappling with the integration of higher penetrations of renewable energy into their electricity grids by improving existing market design, China has developed an emissions trading scheme but still lacks any other market mechanisms to help coordinate the integration.

4 Australia's electricity sector: oversold and poorly implemented neoliberal policies and uncoordinated climate and energy policies

China's new low-carbon policies will have a profound effect on Sino-Australian relations. The overall effect of these policies and China's transition to a more services based economy on Australian economy and the interrelationship between climate change adaptation and mitigation and inclusive growth were discussed in Chapter 2. In contrast, this chapter discusses barriers to transitioning to a low carbon future with inclusive growth in the Australian energy sector and in particular the electricity sector. We also contrast Australia and China's electricity systems transition to a low carbon future.

China and Australia rank among the top three countries in the world for solar and wind resources (Drew 2016). The land areas of mainland China and Australia are comparable at 9.6 and 7.7 million square kilometres. The Australia's National Electricity Market (NEM) stretches 5,000 km from far north Queensland to Tasmania involving a remarkable geographical (AEMO 2016). In comparison, a straight-line journey between Chengdu-Ulaanbaatar-Pyongyang-Busan-Fukuoka-Osaka is 5,000 km. Importantly, Georgilakis (2008) finds that increasing geographic spread increases the predictability, reduces variability and minimises near-zero or peak output events of variable renewable energy such as solar and wind (Bell et al. 2015). The abundant solar and wind resources and geographic spread presents China and Australia's electricity systems with similar renewable energy integration challenges and advantages. Additionally, both China and Australia's electricity systems heavy reliance on coal generation presents a similar challenge to transitioning a low carbon future.

China's electricity sector is experimenting with moving away from its command-and-control approach towards using a market based approach and some privatisation, as discussed in Chapter 3. Teng, Jotzo and Wang (2017) calculates that if China's electricity sector adopted a market-based approach, it would half the price of China's Emissions Trading Scheme. These savings provides a motivation for China's electricity sector to adopt a more market-based approach. Informatively, Australia adopted neoliberal policies in the 1980s, which lead to adopting a market-based approach within its energy sector, including deregulation and privatisation. Noting, this deregulation and privatisation is partially incomplete in some states.

However, prior to deregulation and privatisation, Australia had some of the cheapest domestic energy prices in the world but afterwards Australia's domestic energy prices rose rapidly and Australia had a gas supply crisis (CWA 2017). Consequently, the Australian Competition and Consumer Commission (ACCC 2017) is conducting a major investigation of the NEM. An OECD international comparison of retail electricity prices saw Australia's domestic electricity price ranking move from fourth to tenth cheapest between 2004 and 2016 (ACCC 2017). The OECD calculations most probable underestimates the price increase because the OECD uses the average of lowest tariff advertised by each retailer in each jurisdiction weighted by the number of customers. In a more realistic appraisal, Carbon Energy Markets find retail prices in the states of South Australia, Victoria, Queensland and NSW are among the six most expensive countries in the OECD (ACCC 2017). These price rises saw Australia's economy lose cheap domestic energy as a competitive advantage and prompted a major political debate.

Implementing the neoliberal policies in the energy sector also contributed to increased inequality with Australia's income Gini index increasing from 0.302 to 0.323 between 1994-95 and 2016-17 and wealth Gini index increasing from 0.573 to 0.605 between 2013-14 and 2016-17 (ABS 2017d). Australia's implementation of neoliberal policies in the energy sector has reduced inclusive growth (MRC 2017).

China will have the world's largest Emissions Trading Scheme (ETS) once implemented. In contrast, Australia became the first country in the world to dismantle an ETS despite the success of the scheme in mitigating emissions and providing least costs abatement. Prior to implementation, financially vulnerable individuals were overcompensated via tax breaks and increases in transfer payments for any pass-through of a carbons price to retail prices. Australia has lacked a credible and coherent national climate policy since the Abbott Coalition Government dismantled the ETS in 2014 (Butler 2017; Turnbull 2009). The Australian Department of Energy and Environment (DEE 2017) published emissions projections showing Australia will clearly fail to meet its Paris commitment and emissions targets. The projections forecast Australia's 2020 and 2030 emissions at 551 and 570 Mt CO_2-e, which are respectively 5% and 29-33% above the 2020 and 2030 targets.

The Australian Climate Change Authority and Australian Electricity Market Commissions (CCA & AEMC 2017) recommend bringing together energy and climate change agendas and observe the lack of cohesion between energy and emissions policy places considerable pressure on the Australian National Electricity Market's (NEM) ability to supply secure and low cost electricity for Australian businesses and consumers. Heeding these calls, the Turnbull Coalition Government commissioned Australia's Chief Scientist Finkel to review and make recommendations on integrating climate and energy policies. However, the Finkel Review (Finkel et al. 2017) reframed the emissions debate from an economy-wide issue under the ETS to an electricity sector only issue. Turnbull rejected the Finkel Review's recommendation for a Clean Energy Target to mitigate emissions and instead outlined a National Energy Guarantee (NEG) policy without crucial details. Australia still lacks a creditable national policy to mitigate emissions to reach the 2020 and 2030 targets.

In addition to bringing together energy and emissions policies, the OECD (2017e) recommends bringing together the growth and climate agendas, calculating that integrating measures to tackle climate change into regular economic policy will have a positive impact on economic growth over the medium and long term, claiming the transition to zero emissions can produce inclusive growth (OECD 2017a), as discussed in Chapter 1.

This chapter has two subsections. Subsection 1 evaluates Australia's implementation of neoliberal policies to electricity sector and reviews the success and failures. In this evaluation, we consider the pre-existing faults in the NEM before investigating the modification required for the transition to a low carbon future in Subsection 2. Subsection 2 discusses integrating the climate change policy with energy policy to improve inclusive growth (OECD 2017a) and the pivotal role of the electricity sector in the transition to a low emission economic (TAI 2017b).

4.1 Poor implementation and overselling of neoliberal policies

We discuss the aims of the neoliberal policy and provide a description of the NEM.

Neoliberal Policies

Quinn (2008) finds countries with high levels of public ownership have high levels of corruption. This situation favours privatisation. However, there are countries with moderate levels of public ownership and public provision of service that have higher levels of HDI than those with extreme levels of privatisation and public service provisions through the private sector (UNDP 2016). We contend that these two factors indication some optimal level of privatisation and private provision of public services between two extremes but tending to favour privatisation and private provision of public services. This observation is consistent with Ostry, Loungani and Fureceri (2016) who conclude that neoliberalism has been oversold and there is a requirement for an evidence-based approach to decision making rather than faith. We review the success of the neoliberal polices implemented in the Australian electricity sector to inform any potential privatisation in Chinese electricity sector and to assess the institutional readiness of Australia's electricity system for climate change (Foster et al. 2013).

Ostry, Loungani and Fureceri (2016) define neoliberalism's two main planks.

1. *Smaller role for the state through privatization and limits on the ability of governments to run fiscal deficits and accumulate debt'*
2. *Increased competition through deregulation and the opening up of domestic markets, including financial markets, to foreign competition*

We specifically discuss privatisation and competition in relation to the electricity sector and the observation by Ostry, Loungani and Fureceri (2016) that FDI associated with knowledge transfer increases inclusive growth. Goodman and Loveman (1991) state that *the pros and cons of privatization can be measured against the standards of good management—regardless of ownership* and make three conclusions.

> *1. Neither public nor private managers will always act in the best interests of their shareholders. Privatization will be effective only if private managers have incentives to act in the public interest, which includes, but is not limited to, efficiency.*
>
> *2. Profits and the public interest overlap best when the privatized service or asset is in a competitive market. It takes competition from other companies to discipline managerial behaviour.*
>
> *3. When these conditions are not met, continued governmental involvement will likely be necessary. The simple transfer of ownership from public to private hands will not necessarily reduce the cost or enhance the quality of services.*

Stone (2017) finds both neither public nor private provision inherently efficient or inefficient and he stresses that three efficiencies technical, allocative and dynamic be evaluated over the short and long term in any decisions to privatise or outsource government services.

The National Electricity Market (NEM)

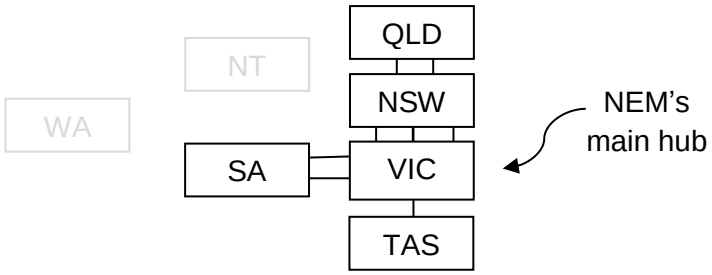
The NEM has five major institutions:

- The Council of Australian Government (CoAG) Energy Council provides broad policy direction for rule setting within the NEM.

- The Australian Energy Market Commissions (AEMC) oversees the development of new rules.
- The Australian Energy Regular (AER) oversees the enforcement of the rules.
- The Australian Energy Market Operator (AEMO), the independent systems operator, oversees the day-to-day running of the NEM.
- Energy Security Board – established on the recommend of Finkel Review to coordinate the other institution and ensure long-term energy security.

Figure 20 shows the topology of the five states comprising the Australian National Electricity Market (NEM): Queensland (QLD), New South Wales (NSW), South Australia (SA), Tasmania (TAS) and Victoria (VIC). The Australian Capital Territory (ACT) is located within NSW. The number of lines between each state represents the number of interstate transmission lines or interconnectors. Both the Northern Territory (NT) and Western Australia (WA) have their own independent electricity markets and networks unconnected to the NEM and both are relatively small compared to the NEM.

Figure 20: Topology of the states and interconnectors comprising the National Electricity Market



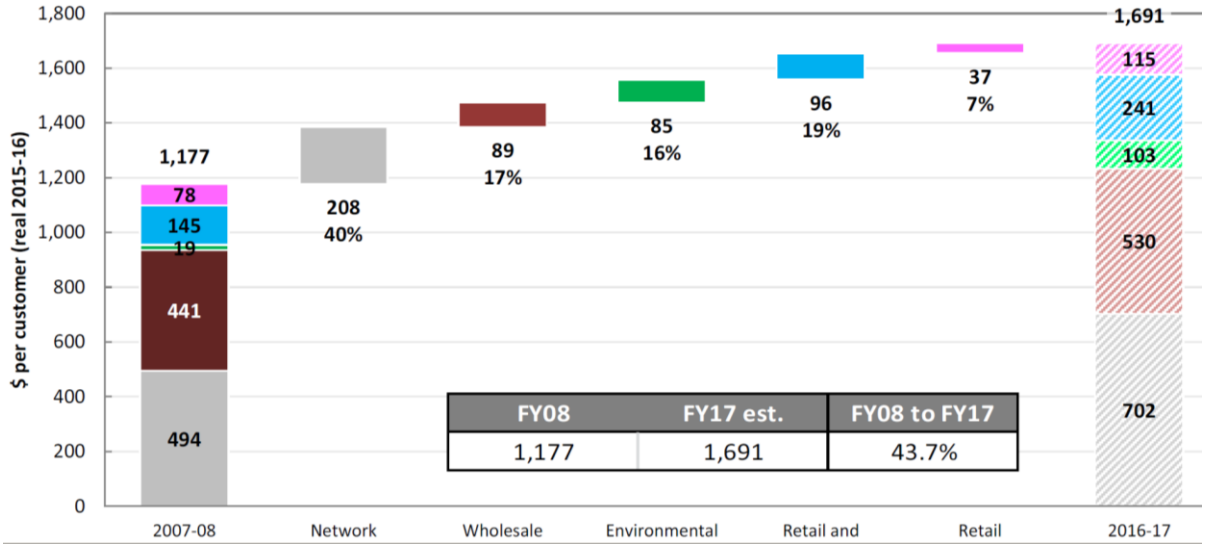
Implementing neoliberal policies required the separation of Australia's vertically integrated State electricity monopolies into four parts retail, transmission, distribution and generation (Newbery 2018). Intending, competition within the deregulated and privatised retail and generation sectors would promote innovation and efficiency to reduce prices and regulation of the privatised natural monopolies in the distribution and transmission sectors would act similarly. This plan fits with Goodman and Loveman (1991).

The neoliberal polices progressed at differing rates in each state, as each state is an independent jurisdiction. In the late 1990's, Victoria became the first state to implement a competitive wholesale electricity market modelled on the UK's energy system. In 1998, the NEM formed allowing the interconnection of states and the trading of electricity in the wholesale electricity market.

As discussed, the electricity retail price rises are under investigation by the Australian Competition and Consumer Commission (ACCC 2017). One measure of the effectiveness of the neoliberal policies in each sector is the contribution of each sector to price increases in domestic electricity prices. Figure 21, the estimated increase in average residential bill per customer from 2007-08 to 2016-17, shows that the bill increased by 43.7% and the contributions to the increase are network 40%, retail 26%, wholesale 17% and environmental or green charges 16%. This bill increase of 43.7% between 2007 and 2017 provides an annual compound rate of 8% per cent more than twice the growth in wages (3.1 per cent) and inflation (2.4 per cent). In contrast, there was a 63.4 per cent increase in

c/kWh between 2007-08 and 2016-17. The increased bill and c/kWh rates differ because retail customers reduced electricity demand between 2007-08 and 2016-17.

Figure 21: Estimated increase in average residential bill per customer from 2007-08 to 2016-17, NEM mainland, - real value in 2015-16 dollars, excluding GST



(Source: ACCC 2017, fig. 2.5)

We discuss five major issues that require addressing in the NEM. (1) There is a lack of competition in both the generation and retail sectors exacerbated by three large vertically integrated retail-generators. (2) The half-hourly settlement period allows gaming of the wholesale spot market. (3) Unpredictable outages in the ageing coal generators and the requirement to extend the frequency control market to include shorter response times. (4) There is ineffectual competition in the retail sector – lots of customer churn but little innovations and the three lager retail-generators remain dominate. (5) There is a misalignment of the incentives in the network sector with the public good and missing economies of scale.

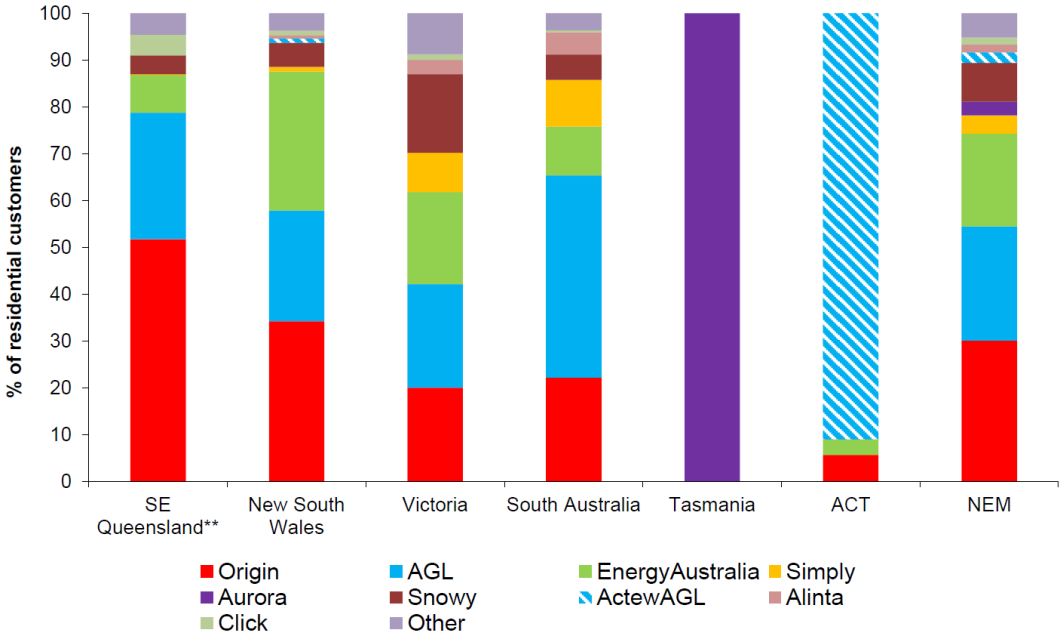
4.1.1 Market power and the vertically integrated retail-generators

As Goodman and Loveman (1991) discussed, the alignment of profits and the public good requires competition but the NEM has three vertically integrated retail-generators AGL, EnergyAustralia and Origin Energy that dominate both the retail and generation sectors in VIC, NSW and SA, see Figure 22, Figure 24 and Figure 23. These three retail-generators dominate QLD's retail sector but other companies dominate in QLD's generator sector. Importantly, capacity constraints on the interconnector between the states provide for separate market prices for each state, which amplifies the ability to exercise market power within each state (Bell et al. 2017).

Two factors further amplify the market power of the retail-generators. (1) The usual requirement to make financial 'hedge' contracts to manage the risk of future wholesale prices of electricity between retailers and generators is internally managed within a retail-generator company. This internal hedging reduces cost and risk to retail-generators, which provides a competitive advantage to the retail-generator and presents a barrier to new entrance to the industry. The internal hedging also reduces the number of potential hedging contracts for the retail only or generation only companies, which also provides a competitive

advantage to the retail-generator and presents a barrier to new entrance to the industry. (2) Companies seeking finance to build new generators require power purchase agreements (PPA) from retailers. The retail-generators can purchase their own PPA. This internal PPA transaction reduces the number of potential retailers to purchase PPA, which presents a further barrier to entry for new generation companies. However, there is a recent trend to bypass retailers and negotiate PPAs directly with customer (ACCC 2017).

Figure 22: Retail Electricity Market Share (residential customers), March 2017

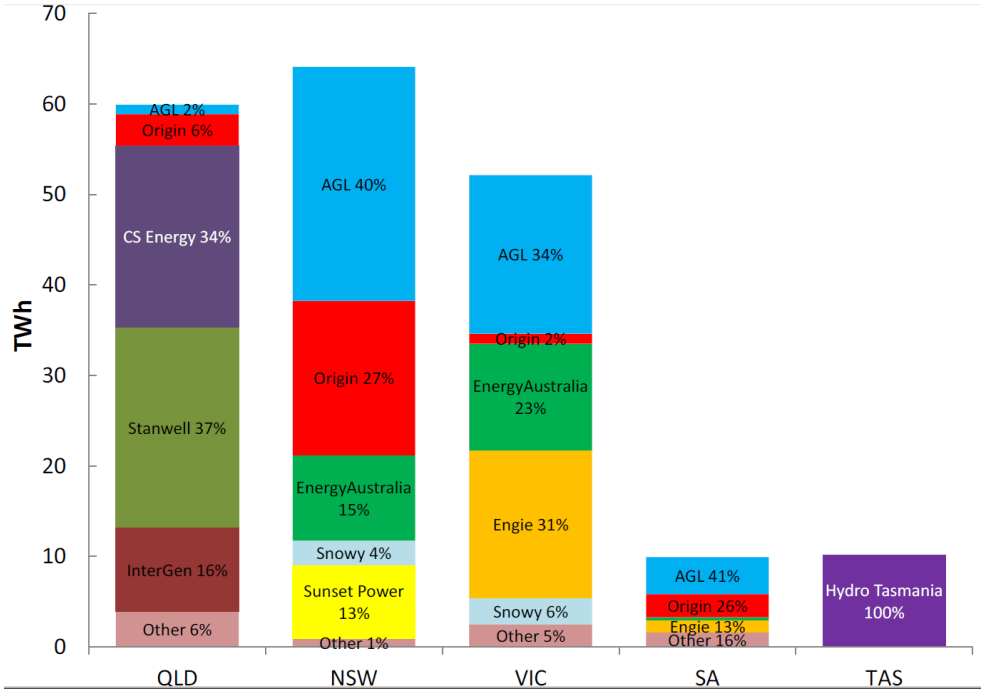


(Source: ACCC 2017, fig. 3.9)

Figure 23: Market share by generation capacity

(Source: ACCC 2017, fig. 3.2)

Figure 24: Market share by generation dispatch, 2016-17



(Source: ACCC 2017, fig. 3.3)

Splitting the retail-generating companies into separate retail and generating companies with the requirement that all hedge contracts go via the Australian stock exchange would help improve competition and make it easier for new retail only and generation only companies to enter the NEM. Similarly, building a high capacity transmission backbone through the states in the NEM would also promote competition between the generators to reduce wholesale market prices (Bell et al. 2017).

Notably, reducing market power within the NEM by splitting the retail-generators and improving transmissions would also help reduce the cost of integrating renewable energy into the NEM. Three key reasons include. (1) PPAs would be easier to obtain for new renewable generation installations. (2) The high capacity transmission backbone through the NEM would also allow for the integration of higher penetrations of variable renewable energy (Bell et al. 2017). (3) Currently, the retailer-generators can profitably circumvent their Large Renewable Energy Target obligations of the retail side of the business. Providing motivation to circumvent their obligations, the retail-generators are the largest owners of coal generators and introducing further renewable energy into the NEM reduces the profitability of the coal generators. Additionally, the retail-generators can extract extra profits from the NEM for their coal generators using strategic bidding to increase wholesale spot prices detailed in Section 4.1.2. The increased profits for generators covers any penalties the retail side of the business pays for failing to meet its LRET obligations. The wholesale spot price increases are passed onto the retail customers. In effect, the retail customers are paying for the penalties imposed on the retail-generators for failing to meet their LRET obligations.

However, the absence of market power alone is insufficient for competition to align with the public good. We discuss the unique features of the household retail sector in section 4.1.4.

Furthermore, the “to big to fail” issue arises whenever a retailer or generator become a significant portion of the market. This issue becomes even more problematic for retail-generators affecting both markets. A potential source of financial stress is the rapid decline in renewable energy prices, which reduces the asset value of the fossil fuel generators. The three retail-generators own the largest portion of NEM’s fossil fuel generation making them potentially susceptible to financial stress. Therefore, sufficient financial provision for the closure and clean-up costs of the fossil fuel generation should be transferred into the newly formed generation company if a retail-generator is split.

Similarly, foreign ownership of crucial energy infrastructure, such as the electricity system, presents an economy wide risk as many of these energy companies are exposed to a decline in fossil fuel asset values.

4.1.2 The half-hourly settlement period allowing gaming of the market

Exacerbating the market power within the generation sector is the way that the NEM calculates the half-hourly settlement price paid to each generator. The settlement price is the weighted average of six 5-minute periods dispatch prices determined by last generator’s dispatch bid to meet electricity demand. Under the current rules, any generator can rebid a 5-minute interval at a higher price prior to dispatch without providing enough time for competing peaking gas generators to ramp up to meet higher price interval. This strategic bidding or “market gaming” provides above normal profits for the fossil generators (ACCC 2017).

The gaming allows a transfer of wealth from the electricity consumers to the shareholders and management of the retail-generators to reduce inclusive growth. The gaming is legal and the retail-generators are only acting in the best interest of their shareholders albeit damaging to other businesses and exacerbating inequality.

The AER took proceeding against the generation company Stanwell for strategic bidding in February 2008 when spot prices reached $9,000 per MWh but the Federal Court dismissed the AER’s case in August 2011. Following this dismissal, AEMC replaced the rule “bids are made in good faith” with a rule specifically prohibiting strategic bidding (ACCC 2017) commencing 1 July 2016.

However, this rule change prohibiting strategic bidding did not deter the strategic bidding in SA in July 2016. The Melbourne Energy Institute (MEI 2016) found evidence of strategic bidding in South Australia when wholesale electricity prices reached record levels in July 2016 shown in Table 3.

Table 3: Number of high price settlement period in each of the four mainland NEM regions for the financial years FY10 through FY16, and July 2016

	>$300 events				>$1000 events			
	NSW	QLD	SA	VIC	NSW	QLD	SA	VIC
2010	120	48	88	47	69	42	73	39
2011	39	37	23	13	31	22	16	10
2012	1	22	12	0	1	5	11	0
2013	2	168	89	30	0	47	71	18
2014	7	59	74	26	4	43	33	13
2015	1	106	49	1	1	90	37	0
2016	10	88	185	16	6	64	48	8
July 2016	4	0	236	8	0	0	53	0
Total	184	528	756	141	112	313	342	88

(Source: MEI 2016)

Contributing to the situation are four factors. (1) Market power exercised by the generation companies in SA discussed in the above section. (2) The increase in gas prices related to the LNG exports and SA being heavily reliant on gas generation. (3) The disorderly sequence if station withdraws and mothballing and interconnector upgrades. (4) SA having the highest penetration of wind generation in any liberalised energy-only markets.[81]

The increase in domestic gas prices induced by LNG exports is a consequence of reliance on neoliberal polices rather than planning an energy strategy. The AEMO has predicted a major gas shortage in 2018 and there is discussion of market intervention to restrict exports if the energy companies fail to reserve more gas for domestic use.[82] Chapter 2 discussed the lack of planning in the gas sector.

The Finkel Review recommended that three years notice of generation closure be given to allow construction of new generation. The Federal Government accepted this recommendation.

The AEMC is changing the settlement period from 30-minutes to 5-minutes commencing 1 July 2021.[83] This change will reduce the ability of the generators to engage in strategic bidding.

Both the three-year advance notice of closure and the 5-minute settlement period remedy existing faults in the NEM. Moreover, both changes help reduce the cost and improve the stability of the NEM in the transition to zero emissions. The 5-minute settlement is fundamental to integrating variable renewable energy and storage to rewards dispatchable renewable energy and storage for matching the supply of variable renewable energy with electricity demand. The three-year advance notice of closure would provide time to replace the retiring coal generation stations with pump-hydro storage or equivalent storage.[84] The only misgiving is that the change to a 5-minute period will take over three years allowing the generators to continue gaming the market and acting as a barrier to the integration of renewable energy. The delay will cost the public more and exacerbate emissions.

[81] http://reneweconomy.com.au/sa-power-prices-inflated-generators-gaming-market-says-report-87163/
[82] http://www.abc.net.au/news/2017-09-25/gas-shortfall-could-be-worse-than-expected-accc-aemo-report-says/8984306
[83] http://www.aemc.gov.au/Rule-Changes/Five-Minute-Settlement
[84] http://www.abc.net.au/news/2017-06-16/pumped-hydro-sites-identified-in-sa/8623758

4.1.3 Frequency control and unpredictable outages in the ageing coal generators

In addition to the incident of generators gaming of the market in July 2016 discussed above, South Australia had a blackout that covered the entire state in September 2016. [85] Consequently, the South Australia Government entered into a contract with Tesla to build the world's largest lithium battery at a South Australian windfarm called the Hornsdale Power Reserve (HPR) to provide price and system stability. [86] HPR also provides Frequency Control Ancillary Services (FCAS) with response times as fast 200 milliseconds. However, the AEMO offers payment for FCAS in three response times 5 minute, 60 second and 6 seconds. Tesla claims that '30 to 40%' of its fast response service is unpaid as HPR responds too quickly to register for the fastest rate of 6 seconds.[87]

Traditionally, the coal and gas generators provided FCAS but The Australia Institute (TAI 2017a) finds the age of these generators is increasing their susceptibility to severe weather and making them more prone to unpredictable failure. Exacerbating this susceptibility is the increase in intensity and number of severe weather events. Additionally, as the penetration of renewable energy increases, there will be fewer coal and gas generators to provide FCAS, making the NEM even more susceptible to their failure.

The Finkel Review recommended changing rules to better incentivise distributed energy resources in providing FCAS and voltage control. The Federal Government has accepted the recommendation and the AEMO is currently reviewing the FCAS market with a view to introduce shorter response times, which would smooth the transition to zero emissions.[88]

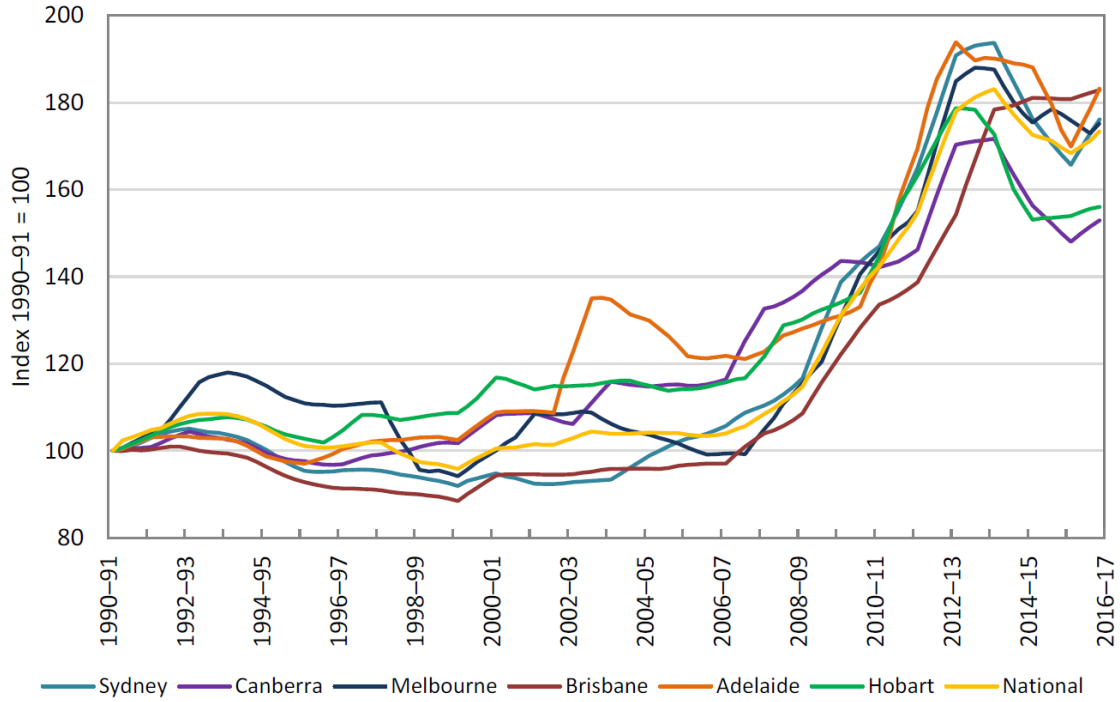
4.1.4 The retail sector

The ACCC (2017) provides an extensive review of the retail sector. (1) The evidence shows that privatisation and deregulation has been a costly failure for customers in the NEM but profitable for companies operating in the NEM. (2) The retailers cite customer churn as an indication of competition. However, customer churn is a misguided indication of competition aligning with the public good as it only adds to the cost of the service with little evidence of innovation and the three large retail-generators have maintained their dominance in the sector. (3) Retail domestic customers are largely disengaged from selecting from the multiple offers made by the retails, which allow retailers maintain higher profits. (4) The retail tariffs largely fail to reflect the underlying drivers for investment in generation and network infrastructure, so fail to provide a price signal to promote behavioural change in customers to reduce these drivers for further investments. The wholesale spot price is a driver for generation investment. Peak demand is a driver for network investment. Section 4.1.5 discusses network investment further.

Figure 25 shows the increase in retail electicity index adjusted for inflation. Electricity prices rise were far in excess of wage growth and price rises in other sectors of the economics. Between 2007 and 2017, electrcity compound annual growth rate was 8 per cent. In comeparison wage and consumer price index were 3.1 and 2.4 per cent repectively.

[85] http://www.abc.net.au/news/2017-03-28/wind-farm-settings-to-blame-for-sa-blackout-aemo-says/8389920
[86] http://www.abc.net.au/news/2017-11-23/worlds-most-powerful-lithium-ion-battery-finished-in-sa/918386887 https://www.businessinsider.com.au/it-looks-like-teslas-batteries-work-too-fast-for-south-australia-to-calculate-what-theyre-worth-2018-3
[88] https://www.aemo.com.au/Media-Centre/AEMO-Hornsdale-report

Figure 25: Retail electricity price index (inflation adjusted) Australian capital cities



(Source: ACCC 2017, fig. 1.2)

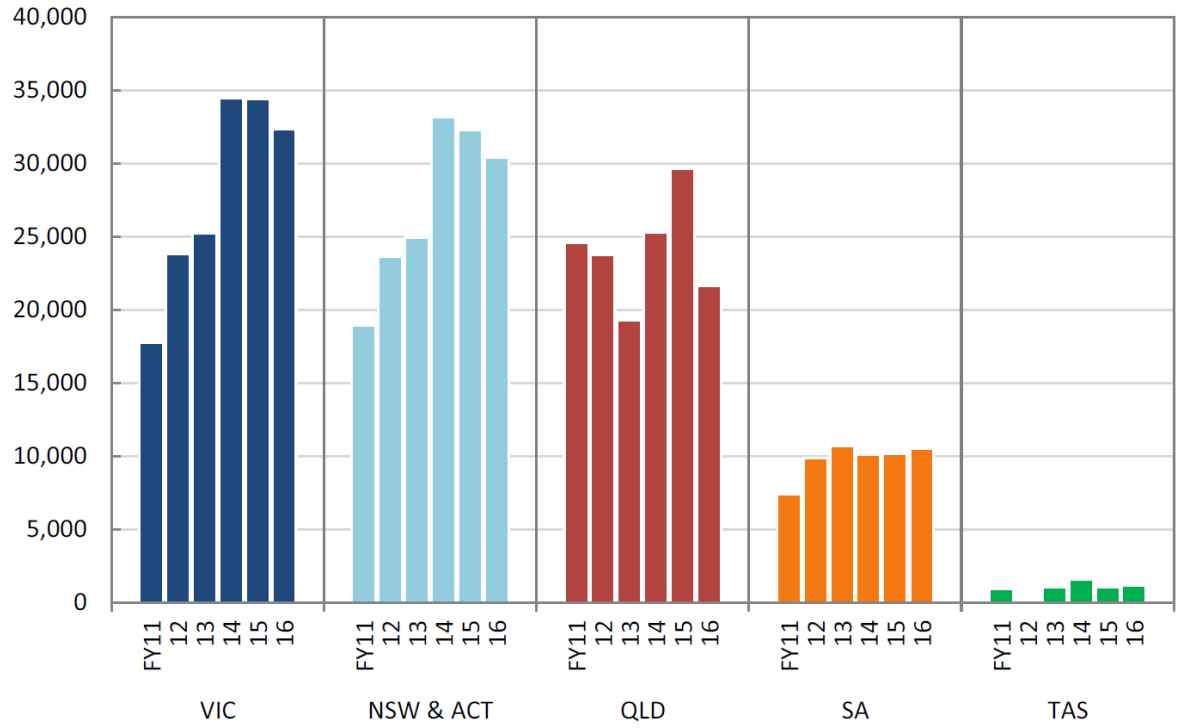
Figure 26 shows the progressive deregulation process by state with Victoria leading the way to full deregulation retail prices and Tasmania lagging all other states. However, Victoria has highest retail costs. Compounding the failure of privatisation and deregulation in Victoria is the fact that Victoria has the highest population density making network operation relatively cheaper per person. The lowest retail prices are in regulated Tasmania.

Figure 26: Full retail contestability and prices regulation by state

(Source: ACCC 2017, fig. 3.8)

Figure 27 shows the number of residential disconnections by NEM region from 2010 to 2016. Notable Victora proportionaltly had the largest increase in disconnections. NSW had a significant increases in disconnection in 2014 when the retail sector was deregulated. The shape of disconnection profile for VIC and NSW follows the shape of the electrcity retail price index for Melbourne and Sydney in Figure 25. The shape rise in disconnections show that privatisation and deregulation has been particularly harsh for the most financial vulnerable.

Figure 27: Residential disconnections by NEM region (2010-2016)



(Source: ACCC 2017, fig. 4.2)

As part of the neoliberal policies being implemented in Australia, the AEMC's introduced the "Power of choice"[89] that '*provides more opportunities for consumers to make informed choices about the way they use electricity based on the benefits that end use services provide. Ultimately, consumers will be in the best position to decide what works for them.'* There was an expectation that retail domestic customers would engage with the multiple choices on offer in a privatised and deregulated market and so align competition with the public good. However, any engagement was slight. What went wrong with the AEMC's "Power of Choice"?

The "Power of choice" assumes the mainstream neoclassical economics' view of humans as utility maximising agents that has been shown to be at odds with psychology for over 40 years. Bounded rationality presents a more realistic version of human psychology that is people have limited time and computational ability and use heuristics or short cuts in making decisions. Chapter 5 discusses and compares neoclassical economics' view of humans as utility maximising agents with psychology and behavioural economics' view of humans as bounded rationally. We discuss the "Power of choice" and contrast its neoclassical economics' view of human behaviour against the more realistic bounded rationality.

There are over 1,600 offers available to small customers in the NEM and retailers present offers in ways that makes them difficult to compare (ACCC 2017). However, people can usually only hold seven options in working memory at one time. A solution to a limited working memory is websites that compare offers but the (ACCC 2017) found the comparison sites misleading the public, which served to undermine faith in the comparison sites. Additionally, the (ACCC 2017) has found misleading and deceptive adverting among the

[89] http://www.aemc.gov.au/Major-Pages/Power-of-choice

retailers, including the big three retail-generators, and subcontractors. The courts prosecuted these retailers, including the big three, and a comparison website company for misleading and deceptive adverting. A government comparison website was developed but this also drew little interest from retail customers.

Furthermore, one needs to consider that the privatisation and deregulation of the electricity sector was part of the neoliberal policies implemented throughout the Australian economy, including privatising health insurance, schools, superannuation and telecommunications. There are far more choices to make across a range of sectors. Notably, both private schools and health insurance are undergoing major price increases similar to electricity retail prices. Privatisation and competition working in the public good to hold down prices has also failed in these sectors. The privatisation of health, education and retail electricity has served to concentrate wealth and perpetuate inequality.

While the price increases in the electricity retail sector are under investigation by the ACCC (2017), the price increases in the private health insurance sector are under investigation by the Australian Senate Community Affairs Reference Committee (CARC 2017). The Australian Government subsidises private health insurance. There are approximately 46,500 private health insurance products. This presents amazing choice. However, private health insurance is similar to the electricity sector with its deceptive advertising and complex to understand and difficult to compare policies. Two factors further exacerbating decision-making difficulty in the medical insurance sector. (1) Medical goods and services are more complex and diverse than electricity, making the comparison of policies even more difficult for the public. (2) The 46,500 health insurance products compared to the 1,600 offers in the retail electricity would make decision making in health insurance relatively more difficult. In addition to policy price increases, there has been an increase in "junk" policies, out-of-pocket expenses and exclusions. Chapter 5 discusses the poor cost effectiveness and outcomes of the US health system that Australia is imitating with its privatisation of health insurance.

The Australian education has undergone privatisation to provide people with more "Power of choice". The privatised schools are subsidised by the Government. However, the cost of education has doubled since 1988 and Australian student performance in national and internal assessments has decline in real and relative terms.[90] The Federal Government commissioned Gonski to lead a major review of Australian education. Australia is imitating the US with its mediocre, unequal and expensive education system.[91] As well as being expensive and leading to overall mediocre results, a privatised education system institutionalises intergenerational poverty and privilege.[92] The privatisation and diverting government funds from public to private schools is undermining inclusive growth. Tax breaks for school donations exacerbate the situation.

Privatisation and competition works well in many areas of the economy but in the retail electricity, health insurance and education sectors the neoliberal policies are failing. Chapter 5 discusses the limited domain of applicability of neoclassical economics and its relationship to neoliberal policies.

[90] https://docs.education.gov.au/system/files/doc/other/tors.pdf
[91] https://www.theatlantic.com/education/archive/2013/12/american-schools-vs-the-world-expensive-unequal-bad-at-math/281983/
[92] http://www.abc.net.au/news/2018-02-07/school-catchments-best-public-schools-best-private/9381942

4.1.5 Networks: misaligned incentives and inappropriate regulations

The ACCC (2017) discussed how network costs are the largest part of the retail bill and contributed to the largest increase in costs from 2007 to 2016 see Figure 21. The transmissions distribution networks are natural monopolies, so privatisation without the prospect of competition requires ongoing regulation. Goodman and Loveman (1991) state the simple transfer of ownership from public to private hands will not necessarily reduce the cost or enhance the quality of services. Neither public nor private managers will always act in the best interests of their shareholders and managers require incentives to act in the public interest, which includes, but is not limited to, efficiency.

We consider three aspects. (1) Why did the regulation of network fail to prevent massive cost increases? (2) What are the right incentives for managers of a network? (3) What options are there to reduce the ongoing financial burden of overbuilding in networks?

There are at least five reasons for the massive cost increase of networks. (1) The NEM provides network companies with a guaranteed return on their assets. This guaranteed return incentivises them to build more network infrastructure and provided little incentive to become efficient or use methods to defer investment in infrastructure such as demand side management, virtual generators or energy storage. The ACCC (2017) notes a deterioration in network efficiency. (2) The 2006 National Electricity Rules were prescriptive allowing the network companies to justify the building of new infrastructure and disempowered the Australian Energy Regular (AER) to limit network building. (3) Furthermore, the AEMO was constantly over forecasting demand for electricity, which justified the network companies to build more infrastructures. This over forecasting exacerbated the overbuilding of network infrastructure. The underutilised network and decreasing electricity demand lead to an increase in cost per unit of electricity consumed. (4) Limited merit reviews provided the networks companies with the ability to contest any decisions made by the AER.[93] There was great incentive for the network companies to contest any decision. The tribunal overseeing the contested decisions quite often found in favour of the network companies to build more infrastructure. (5) The uptake of air conditioning drove peak demand that required the building of further capacity in the network. This extra building also exacerbated inequality because more affluent household installed the largest air conditioners and the cost of the additional network is shared among all consumers.

There are at least four ways to reduce further cost increases or network overbuilding. (1) The peak demand drives the requirement to build more network infrastructure. Using a cost reflective tariff would provide a price signal for customer to modify their behaviour to avoid using electricity during these peaks. As discussed above, cost reflective tariff in conjunction with solar PV and energy storage provide customers with considerable flexibility to manage their demand to defer investment in new network and generation infrastructures. However, this would require a rollout of smart meters and there has been a limited rollout other than in Victoria. (2) Additionally, the cost reflective tariffs are currently opt-in, which require changing to opt-out. (3) There is a requirement to align the remuneration for networks more closely with demand side objectives rather than purely a guaranteed return on asset. (4) Remove the Limited Merit Reviews, which the Australian Government is implementing. (5)

[93] https://www.aer.gov.au/system/files/AER%20State%20of%20the%20energy%20market%202017%20-%20A4.pdf

Include the ability for networks to control air conditioners remotely to reduce their power during periods of peak demand.

Customers are bearing the cost of the network overbuilding for the life the asset. This situation has reduced inclusive growth both reducing productivity and increasing inequity. There are at least two ways to reduce the cost burden of the overbuilt network on customers. (1) Stakeholder have asked for the value of the networks to be written down (Finkel et al. 2017). This could be readily justified for any network build because of network owners using a Limited Merit Review to overrule an AER decision. The write down would certainly improve inclusive growth. (2) Amalgamating and nationalising the networks to gain economies of scale. The NEM covers seven jurisdictions and contains 25 network service providers (NSP) (AER 2016). These multiple jurisdictions and NSPs serve only 19 million residents (AEMO 2016) and presents a costly duplication of overheads and regulatory burden. Foster et al. (2013) and Quiggin, J (2017) have discussed the advantages of renationalising the grid. These include

- providing the cheapest finance rate for the network from the Federal Government,
- reducing coordination costs between networks,
- reducing expenditure on administration, sales, marketing and managers to hire more technicians and engineers to ensure the physical security of supply,
- replacing the guaranteed return on asset remuneration with demand side management incentive payments,
- enabling whole NEM grid planning within one entity, which becomes more pressing with the introduction of more distributed variable renewable energy,
- providing spread of risk, a single company owning the NEM's network has a an incredible geographic spread, and
- reducing the financial risk from private and foreign ownership of one of Australia's major strategic assets.

4.2 Integrating the climate change and energy policies to improve inclusive growth

The previous section discussed numerous faults in the implementation of the neoliberal policies in the NEM that if remedied would reduce costs for customers and improve the stability of the NEM. These remedies would also allow a much less costly transition to zero net emissions and cheaper source of electricity. However, the overbuilding of networks will be an ongoing expense unless the asset value of the network is written-down or the network nationalised.

There is agreement between the AEMC, ACCC and Gatton Institute that environment cost add about 7% to the retail bill. This is the smallest component of the retail bill. There is consensus among scientists on the requirement to address climate change. There are three factors making the electricity sector pivotal in the whole of economy transition to zero net emissions. (1) The electricity sector in China and Australia contributes the largest share of emissions in each country. (2) There is a requirement for the electricity sector to lead the other sectors to reduce emission intensity to allow electrification of other sectors of the economy (TAI 2017b). (3) It is relatively cheaper and easier for the electricity sector to transition to zero net emissions because the technology already exists and is rapidly becoming cheaper. However, there is generally agreement that uncertainty about climate

change policy in the electricity sector has contributed to increase the cost of electricity because of the reluctance to make generation investment (ACCC 2017; Finkel et al. 2017). Butler (2017) provides a history of the climate policy changes causing this environment of uncertainty. We discuss (1) the equity effects of environmental costs directly added retail bill, (2) the dynamic efficiency of the subsidising the transition to zero net emissions, (3) the allocative efficiency of the NEM to facilitate the transition to zero net emissions and (4) the integration of climate policy into the national electricity rule.

The addition of environment cost to the retail bill has equity implications because the cost disproportionality falls on lower income households since higher income households can afford solar PV and solar water heating (Bell & Foster 2017). The previous section discussed how Australia's neoliberal policies implemented within the electricity sector have failed to constrain electricity prices increases with associated increases in disconnections being the most obvious indicators of induced financial stress for lower income households. The environmental costs are small but add stress to already financially stressed households, so require attention. The government directly funding renewable energy would remove this inequality provided the tax system is progressive and there is exists sufficient revenue to fund the renewable energy. However, Australia's tax has become exceptional porous at the top end with tax breaks for the wealthy. Exacerbating the tax breaks is the international tax dodging using tax havens indicated by the Panama and Paradise papers. There is also pressure for an international race to the bottom on company tax rates. Chapter 5 discusses these tax issues and relations to political donations and corruption.

The green costs reflect investment in renewable energy. This investment is having a major dynamic efficient effect creating a rapid decrease in renewable energy generator prices. Newbery (2018) provides a proof of the dynamics efficiency overwhelming the green cost of the investment in renewable energy. Reality supports Newbery's proof in Germany building wind generator without subsidy. The investment in renewable to induce dynamic efficiency has worked as intended.

Additionally, renewable energy's nearly zero marginal cost of producing energy is having a major allocative efficiency effect to reduce wholesale spot prices (Bell wind). However, the previous section discussed five reasons why the full effect of renewable energy fails to flow through to retail prices. (1) There is concentration of market-power by the three retail-generators. (2) The "Power of choice" has proven largely ineffectual in the retail market. (3) The generators game the market to inflate the wholesale spot prices. (4) The short notice of closure of old fossil fuel generators provides insufficient time to build new generation. (5) The unpredictable failures of the ageing and increasing unreliable fossil fuel generators exacerbated by increasing severe weather events causing higher wholesale spot prices. TAI (2017a) distinguishes between the predictable variation of renewable energy and unpredictable failures of fossil fuel generations. The previous section also discussed solutions to these market failures.

However, the issue of the nearly zero margin cost of variable renewable energy causing the wholesale price to decrease requires consideration since the generators would be unable to recuperate the investment costs of new generation. This situation makes investment decisions in new generation particularly sensitive to policy supporting renewable energy. The NEM has an energy only market and there is discussion of introducing capacity markets to supplement energy only markets (Newbery 2018). However, the energy only market is

having the desired effect of fossil fuel generators exiting the market and a capacity market would cost consumers more and prolong the fossil fuel generators, paying more to produce more emissions. Alternatively, the accelerated introduction of the 5-minurte rule would help facilitate the introduction of dispatchable renewable energy generation and these dispatchable renewable energy sources would provide the higher market bids to maintain a wholesale market price were generator would find sufficient return on investment. Section 5 discusses the uncertainty surrounding climate change policy and its relationship to political donations and the fossil fuel industry manipulating the public debate and undermining Australia's democracy.

Three years after dismantling Australia's function economy wide Emission Trading Scheme (ETS) in 2014, the Coalition Government outlines a replacement called the National Energy Guarantee (NEG).[94] In the interim emissions have grown. Notably the NEG only applies to the electricity sector, so fails to take advantage of a whole of economics response to mitigate emissions at least cost abatement via an ETS. Additionally, the NEG unlike an ETS fails to provide a tool to control an economy wide carbon budget. These two factors make the NEG second best to an ETS. Exacerbating second best policy status of the NEG's is the Coalition's use of the NEG to provide a sectorial equal share of emissions abatement. As discussed, there is a requirement for the electricity sector to lead the rest of the economy in the transition zero net emission and the technology already exist for the electricity sector to make the transition. The NEG comprises a reliability guarantee and an emissions guarantee.

- An **emissions guarantee** will be set to contribute to Australia's international commitments. The level of the guarantee will be determined by the Commonwealth and enforced by the AER.
- A **reliability guarantee** will be set to deliver the right level of dispatchable energy—from ready-to-use sources such as coal, gas, pumped hydro and batteries—needed in each state. It will be set by the AEMC and AEMO.

The emission guarantee set by the federal government will perpetuate investment uncertainty because this setting could change each election or whenever a party changes the Prime Minster. Additionally, the Federal Government setting the emission guarantee and the AEMO and AEMC setting the reliability guarantee perpetuates the lack of coordination between climate and energy policy in the NEM that has exacerbate price increases.

Climate change mitigation and energy polices need integrating to enable a smooth, reliable and low cost transition to zero net emissions. To that end, writing Australia's commitments to address climate change into the National Electricity Rules would provide more investment certainty and align energy policy with climate policy as recommended by the OECD.

The NEG looks like a well-designed political wedge rather than a serious attempt to mitigate emissions or merely second-rate policy. Chapter 5 discusses political wedges undermining the credibility of Australian democracy and its politicians and Australia's ability to solve wicked problems.

[94] https://www.energy.gov.au/government-priorities/better-energy-future-australia

4.3 Conclusion

The Australian energy sector provides an excellent case study of how not to implement neoliberal and climate change mitigation policies. The fact that Australia went from one of the cheapest places in the OECD for domestic energy to one of the more expensive raises the questions about both the efficacy of neoliberal policies and the decisions making capability of Australia's Parliamentary system to solve wicked problems. Similarly, the disarray in the health insurance and education sectors both requiring major investigations raises the questions about both the efficacy of neoliberal policies and the decisions making capability of Australia's Parliamentary system. Section 5 discusses these issues.

As discussed, Teng, Jotzo and Wang (2017) calculates that if China's electricity sector adopted a market-based approach, it would half the price of China's ETS. However, as the NEM shows there is a large gap between the theoretical predictions of neoclassical economics and market-based approaches implementation in the real world. Mainstream or neoclassical economic theory provides at best an approximation to limited domains within an economy. Outside these limited domains, mainstream economics hinders thinking and misguides policy development. Section 5 discusses neoclassical economics supporting the neoliberal polices and their limited domain of applicability and why alternative schools of economic thought are absent from policy development.

The neoliberal policies implemented in the electricity sector have exacerbated inequality and reduced productive. The poor implementation of neoliberal policies requires remedying to enable a lower cost transition to zero net emissions.

Additionally, the conflict of interest in taking political donations from the fossil fuel sector and the failure to develop coherent and credible policy to meet Australia's commitments to climate change mitigation requires consideration. Section 5 discusses political donations and the conflict of interest in addressing inequality and climate change mitigation.

5 Removing barriers to solving wicked problems

Two of the biggest issues facing Australia and the world today are climate change and decreasing inclusive growth. The latest data shows that Australia is failing to meet its Paris commitments for climate-change mitigation and to address the decline in inclusive growth. The section discusses the issue of why the Australian political system is unable to solve these wicked problems and other interrelated wicked problems, including reforms in taxation and political donations. Acknowledging, Australia's adversarial political system is functioning reasonably well in solving less challenging problems.

The Australian Department of Energy and Environment (DEE 2017) published emissions projections showing Australia will clearly fail to meet its Paris commitment emissions targets by 5% and 29-33% above the target for 2020 and 2030. The projections forecast Australia's emissions at 551 and 570 Mt CO_2-e, respectively. The report also announced the Coalition's plans to roll over the emission reduction fund (ERF) and loosen the safeguards mechanism that sets emissions baselines or limits for big polluters. The ERF uses general tax revenue to pay for emissions reduction and loosening safe guards allows the polluters to increase pollution without paying for their pollution. The government is subsidizing an increase in pollution from general tax revenue. These actions are likely to increase inequality, as the government will have less general tax revenue left to fund education, health and other services. Additionally, the ERF is a less efficient and more expensive command-and-control approach than the polluter-pays market-based carbon price approach. Using an ERF without support from a carbon price to meet Australia's emissions targets may well be financially unfeasible but prove favorable to the sectors making political donations to the Coalition. These actions are consistent with the Coalition's track record for opposing, delaying or minimizing action on climate change mitigation and advantageous to its political donors (Butler 2017; Turnbull 2009).

The Australian Bureau of Statistics (ABS 2017d) announced that inequality has remained stable since 2013-14. This respite is welcome news as Australia's income Gini index increased from 0.302 to 0.323 since 1994-5 peaking at 0.336 and the wealth Gini index increased from 0.573 to 0.605. However, Sheil and Stilwell (2017) discuss how the ABS requires to update their Gini index calculation method to international best practice adopted by the OECD, as the ABS current calculation will underestimate inequality. Sheil and Stilwell (2017) claim the stability of ABS's Gini appears anomalous, given the large increase in the value of houses in Australian cities during recent years and the fact that few among the poorest 40 per cent own one. Most of the wealth the ABS apportions to the bottom of the distribution comprises non-income earning items such as cars, furniture and clothing.

Additionally, ABS (2017d) shows the largest increase in household expenditure was in housing and accommodation. These factors are consistent with the increase in the number renters and concentration of wealth with property owners discussed in Chapter 2. Tax reform, abolishing negative gearing and capital gains concessions, is part of the solution to addressing increasing inequality. However, the Coalition has resisted making any such tax reforms. The current situation benefits the Coalition's political donors. Importantly, a major reasons for concern over increases in inequality is the association with increases in violence, as the ABS (2017b) shows the Australian adult prisoner numbers continue to rise with the national imprisonment rate, the number of prisoner per capita, increasing by 4% from 2106 to 2017. Most of the increase related to violence and drug related offences.

Australia adopted neoliberal policies in the 1980s. However, the neoliberal policies have had mixed results lifting millions out of poverty in some developing countries and incidences of successful privatisations but there has been a prominent increase in inequality that has stifled economic growth (Ostry, Loungani & Fureceri 2016). Neoliberalism has also challenged national sovereignty and labour and environmental protection by placing companies in a position to move operations to countries with the lowest environment and labour protection (IMF 2000). The deregulation of cross boarder financial markets challenges national sovereignty over the ability to tax the companies, as discussed in Chapter 5. Again, this calls for tax reform that may be unbeneficial to many of those making political donations.

The four wicked problems climate change adaption and mitigation, inclusive growth, tax reform and political donations are strongly interrelated. Additionally, domestic surveys show that both the level of confidence and trust in Australia's political system has fallen significantly. Factors cited include a lack of integrity and clear guiding values on the part of elected representatives and disaffection with the adversarial nature of parliaments (Essential Research 2017; Productivity Commission 2017a).

This section discusses four barriers to solving the wicked problems (1) political donations, (2) adversarial political system including political wedging, (3) the absence of academic economists informing the public debate and (4) the lack of real world applicability of academic economics highlighted by its failure to predict the global financial crisis. Noting, all four barriers hinder Australia's ability to develop and implement policies to solve complex problem, so eliminating these barriers would place Australian in a better position to address the four wicked problems discussed and others such as population ageing.

5.1 Political donations hampering Australia's ability to promote inclusive growth and address climate change

Lewis, C (2016) provides a comprehensive discuss of the tension between the ideals of a democracy and ability of the rich being able to usurp power by using donations to gain direct access to politician to influence decision making. Hamilton (2018) provides a more recent discussion focused on foreign political donations in Australia. Leading the country in addressing the corrupting influence of political donations, the Victorian Labor Government has proposed a ban on foreign donations with a two-year imprisonment term for violations and proposed other laws tightening domestic political donation. The Victorian Green Party has criticised the proposals as insufficient and containing potential loopholes for politicians to exploit (Willingham 2017). However, these proposals only apply to the state of Victoria and the focus of this report is the corrupting influence of political donations at the federal level of government. Following recommendations from the Australia Security Intelligence Organisation and popular calls within Australia, the Joint Standing Committee on Electoral Matters recommended that the Federal government ban any foreign citizens and entities from making political donations. If implemented, this ban would only bring Australian law closer to foreign political donations laws in other countries. Still outstanding, the Federal Government has yet to address the lax domestic political donation laws.

As Chapter 2 discussed, the Coalition is the major recipient of political donations from the mining industry and industries benefiting from perpetuating the housing construction boom. Despite a consensus of economists not on the payroll of business benefiting from the housing bubble, the Coalition has failed to heed their calls to eliminate or modify capital

gains concessions and negative gearing both taxes breaks work against inclusive growth. Consistent with the Coalition's corporate donations, sixty five percent of Australian voters surveyed believe Liberal, the largest party within the Coalition, is too close to the big corporate and financial interests and sixty six percent believe liberal is out of touch with ordinary people (Essential Research 2017). In contrast, forty-two percent of those surveyed believe Labor is too close to big business and fifty-eight percent believe Labor looks after the interests of working people. These results are consistent with Labor's donations from the corporate sector being smaller than Liberal's. However, given Labor's founding principle is social progress for working people, these survey results showing a considerable shift toward corporate interests. Acknowledging, Labor requires the corporate donations to match the Coalition's donations to fund advertising and think tanks used to form public opinion. This interrelated dynamic of Labor's increasing corporate donations and shift in focus from Labor's historical foundations on social progress to meeting the interests of the corporate sector is undermining Labor's unique perspective in problem solving and a loss of diversity within Australia's political landscape.

As discussed in Chapter 2, despite a consensus about anthropogenic induced climate change amongst climate scientists not on the payroll of mining or fossil fuel companies, the Coalition has eliminated the standard policy tools to effect least cost climate change mitigation, namely a carbon price (Productivity Commission 2017a). The Coalition has also failed to extend the renewable energy target that would enable the electricity sector to take its pivotal role in leading the economic transition to zero net emission by 2050. Acknowledging, the Coalition did implement several climate change mitigation policies after abolishing a price on carbon, but these policies have been described as inadequate and window-dressing (Turnbull 2009). However, the Coalition's mitigation policies could serve as a useful adjunct to a carbon price and renewable energy target(s). Noting the Coalition's mitigation policies involve paying businesses from the general tax revenue, which is regressive and counter to inclusive economic growth. Finally, consistent with donations form the mining sector, the Coalition still favours the building of more coal fire power stations, arguing that newer coal power stations have lower emissions intensities, approximately 80% of older stations. However, this small reduction in intensity is well short of the required zero net emissions and the generation companies are unwilling to build any more coal fired power stations. This unwillingness is consistent with the UK's announcement of the closure of all power stations by 2025 (Cockburn 2017).

In additional to political donation to directly influence political decisions, the corporate sector already has considerable power through media ownership and advertising to indirectly influence political decisions by confusing and shaping public opinion. For instance, spreading misinformation among the public that their lacks consensus among climate scientist over climate changes and its anthropogenic causes. There is also corporate funding of university research that is oblique to climate change mitigation that acts to drown mitigation research in a sea of irrelevant information (Oreskes & Conway 2011).

Replacing political donation with taxpayer funded political active can be argued from a purely financial perspective without ethical arguments by comparing political donations revenue from vested interested versus the loss of tax and royalty revenue from political decisions made in favour of the vested interest. Relevant to addressing both mitigation and equitable growth are loss of government revenue from the carbon price, Mineral Resource Rent Tax, capital gain tax concessions and negative gearing versus the revenue from political

donations from the mining industry and finance a construction industries. If the political donation revenue is less than the loss of government revenue, taxpayer funded political activity would be more profitable for the Government. The Productivity Commission (2017a) is well positioned to analyse the efficacy of government with political activities funded by the taxpayer in the public interest versus political donations from vested interests.

Additionally, the Australia Institute (TAI 2017c) has already formed a National Integrity Committee of corruption fighters and retired judges that have launched a blue print of best practice for an anticorruption watchdog. Furthermore, Transparency International (TI 2017) has already analysed corruption in the mining countries, including Australia, and have developed a raft of policy recommendations to minimise the corruption.

5.2 Adversarial politics' inability to solve wicked problems

The four interrelated wicked problems have stretched the limits of the problem solving ability of Australia's century old adversarial political system (Popper 1999). However, despite Australia's limited ability to solve wicked problems, Australia's natural resources enable Australia to feature in the top 10 countries for HDI (UNDP 2016).

The adversarial politics between Australia's two main federal parties, the Coalition and Labor, has failed to solve the two wicked problems facing Australia namely, inclusive growth and climate change mitigation. Relatedly, the Productivity Commission (2017a) recommends urgent action to fix Australia's energy markets, urging the Australian governments to cooperate to reform the national electricity market and specifically stop the piecemeal and stop-start approach to emissions reduction and adopt a single effective price on carbon. The latest climate change related political wedge is the Nation Energy Guarantee, discussed in Chapter 4. Additionally, the Productivity Commission (2017a) discusses the inclusive growth related unresolved wicked problem that is Australia's national tax system, regarded as one of the most complex in the world, is costing the community more and raising relatively less. Similarly, the discussion within Houses of Parliament on political donations reform has been ongoing since 2007 when a core commitment of the Rudd Government was political donation reform but there has been effectively no progress at the federal level other than the proposal to ban foreign political donation.

One key feature of adversarial politics that prevents solutions to wicked problems is political wedging where politicians take a position on an issue that drives a wedge between the different wings of the other party (Gittins 2017). Consistent with the effectiveness of wedging are the following electoral survey results being 68 and 51 percent believe the Liberal and Labor parties are divided (Essential Research 2017). In addition to the destructive effects of wedging on Australia's productivity, other adverse effects are undermining confidence in politicians and democracy generally. These adverse effects include such perceptions that Liberal and Labor will promise to do anything to win votes 67 and 69 percent, are trustworthy 34 and 32 percent, clear about what they stand for 40 and 45 percent and out of touch with ordinary people 66 and 52 percent.

There solutions to the wedging problem found in Australia's adversarial binary system include to simplify the system that is using a single party system and to increase complexity that is proportional representation. Using a single party system would solve the wedging problem but create a severe form of groupthink and every single party systems country underperforms Australia with its adversarial system in terms of corruption and HDI.

Alternatively use proportional representation to increase the complexity of political wedging. Noting, some countries with proportional representation outperform Australia in terms of HDI and corruption. The complexity of proportional representation systems can make wedging difficult to implement and multiple perspectives engenders a more consolatory approach to favour solution to wicked problems.

Lastly, the world has undergone tremendous change since foundation of the Commonwealth of Australia Commonwealth over a century ago. The adversarial system adopted from Britain and the Federal Systems form the US were thought best practice at the time. The wicked problems facing Australia today are less suited to the adversarial approach. There is a requirement to consider best practice electoral systems to improve the Australia's problem solving efficiency (Popper 1999).

The Productivity Commission (2017a) is well positioned to perform a comparative analysis of the efficacy of electoral and federal systems, having partially completed the analysis. Any constitutional change to enhance the ability of Australia's political system to solve wicked problems could consider the performance of political systems of other countries in solving wicked problems ranked by their HDI adjusted for their natural resource endowments. For instance, given New Zealand's comparatively low endowment of natural resource, it has a relatively high HDI and low corruption compared with Australia. In addition, any changes require restoring Australian's confidence in their political system, including putting in place measures to ensure the integrity of the elected official.

5.3 Disengagement of the academic profession from the public debate

There has been a gradual reduction the number of academic economists in the public debate to lift the quality of the debate and provide impartial advice (Garnaut 2013). There are at least three reinforcing factors contributing to this disengagement, the academic publication requirements, the higher kudos given to theoretical economics over applied economics or economic policy and the decline in the number of Australians teaching in Universities.

University economic school's performance is judge by the number research papers published in highly ranked journals. The teaching performance is a lesser consideration. Therefore, the school hirers staff who publish in the highly ranked journals. These journals are predominantly theoretical international/American journals within two subfields of economics. None of the Australian economic journals ranks highly. It is easy to see how the situation is self-reinforcing to both disengage academics from the Australian public debate and eliminate Australian graduates from the academic staff to replace them with US graduates. A further interesting result is Australian University teaching staffs becoming increasingly culturally diverse but increasingly and invisibly more academically similar, which presents a form of cultural façadism. A consequence of a more academically similar staff is a reduction width of economics taught undermining Australia ability to solve wicked problems. This issue is discussed in the next section.

The decline of academic economists from the public debate has left a void that is filled by consultants, think tanks, newspapers and government bodies. Consultants can frame their research and results to suit the expectation of the client, creating a 'guns for hirer' culture (Denniss 2012; Gittins 2012). The news media's reporting of climate change is divided on one side the 'The Australian' represents the pro-coal and anti-renewable energy agenda and

ABC represent a scientific basis to their research and reporting of climate change. However, the Coalition lead government has cut their funding for both ABC and CSIRO. As discussed, there are coal and tobacco fund think tanks sponsoring research that floods the public space with extremely framed research. Counter balancing coal/tobacco sponsored think tanks are 'The Australian Institute' sponsored by individuals.

Australia's Chief Scientist is endeavouring to encourage public engagement of academics by measuring the impact factor of their research on Australian society.[95],[96] However, the existing journal publication ranking system and academic staff's interest in international journal publications presents a large inertia to Chief Scientist's endeavours within economics schools particularly. Linking academics' promotion and pay increases to publishing in Australian journals could help overcome the inertia and simultaneously improve the quality of the Australian journals and interest in the public debate.

The Chief Scientist is also endeavouring to encourage academic collaboration with industry to improve productivity. This collaboration proves successful in overseas countries, such as Germany and Sweden. To that end, the Australian Centre for Research Collaboration Program was developed specifically to foster collaboration between universities and industry. However, Germany and Sweden contain a larger number of head offices whereas Australia has many branch offices that lack the depth or interest to support research collaboration to the same extent.

5.4 Economic and political ideas hampering Australia's ability to promote inclusive growth and address climate change

> *"…the ideas of economists and political philosophers, both when they are right and when they are wrong, are more powerful than is commonly understood… the power of vested interests is vastly exaggerated compared to the gradual encroachment of an idea."*
>
> (Keynes 1936)

Economic thought develops as a succession of economic and political philosophies being unable to solve or contributing to a major crisis with another economic and political philosophy emerging to address and solve the crisis. For instance, the Great Depression saw the displacement of classical economics with Keynesianism. The great stagflation saw neoliberalism replace Keynesianism. The Global Financial Crisis (GFC) saw the failure of neoliberalism and the economic theories underpinning neoliberalism. Theories underpinning neoliberalism both helped ferment the GFC and were unable to predict the crisis or at best distractions from studying the real economy. (Bell 2009, sec. 3.1; CEDA 2017; Dow et al. 2009; Ostry, Loungani & Fureceri 2016).

Ostry, Loungani and Fureceri (2016), staff at the IMF, define neoliberalism's two main planks. *'The first is increased competition—achieved through deregulation and the opening up of domestic markets, including financial markets, to foreign competition. The second is a smaller role for the state, achieved through privatization and limits on the ability of governments to run fiscal deficits and accumulate debt.'* Ostry, Loungani and Fureceri (2016)

[95] http://www.arc.gov.au/research-impact-principles-and-framework#impact
[96] https://www.atse.org.au/atse/content/publications/reports/industry-innovation/research-engagement-for-australia.aspx

claims the positives of freer trade are a reduction in global poverty and transfer of technology and knowledge associated with foreign direct investment. Additionally, there are instances of privatised state-owned enterprises delivering efficient provision of services. Ostry, Loungani and Fureceri (2016) analyse two specific policies of the agenda (1) removing restrictions on the movement of capital across borders and (2) reducing fiscal deficits and debt levels or fiscal austerity. Ostry, Loungani and Fureceri (2016) make three conclusions about these particular policies rather than the whole agenda. (1) It was difficult to determine any positive effect on economic growth when looking at a broad range of countries but (2) the cost in terms of inequity is prominent and (3) the increase in inequality has hurt the level and sustainability of growth. Removing restrictions on the movement of capital across borders was associated with exacerbating the size and frequency of boom-bust cycles. The boom-bust cycles provide a mechanism to increase inequality.

Section 1 relates the economic theories supporting neoliberalism and their role in the global financial crisis, decreasing inclusive growth and exacerbating emissions. Theories supporting neoliberalism include game theory and neo-classical economics and its general equilibrium models, including computable general equilibrium (CGE), General Trade Analysis Project (GTAP) and dynamic stochastic general equilibrium (DSGE). These general equilibrium models were introduced in Chapter 2.

Section 2 also discusses factors hampering the transition of the academic economics profession from teaching economic theory supporting neoliberalism to developing theory more suited to promoting inclusive growth and potential pathways to developing newer theories of economics that are more coherent with the requirements of evidence based policy and inclusive growth (Bell 2009; CEDA 2017; Dow et al. 2009).

5.4.1 Neoliberalism oversold and its supporting economic theories flawed

Arnsperger and Varoufakis (2006) and Farmer and Geanakoplos (2008, p. 5) discuss the hard-core assumptions within neoclassical and equilibrium economics shown in Table 4. Arnsperger and Varoufakis (2006) note that other assumptions such as agents with complete knowledge are usually attributed to the neoclassical framework. This assumption of rational expectation or unbounded rationality in neoclassical economics provides for individuals with complete knowledge and unlimited computing power, but Farmer and Geanakoplos (2008, p. 12) state that some neoclassical theory relaxes the rational expectation assumption by introducing some form of bounded rationality (Simon 1972). There are two points to note about neoclassical economics relaxing rational expectation assumptions; the incremental move toward more realistic assumptions and the fact that the framework is blurring at the edges that makes it difficult to create a sharp definition. However, the main general equilibrium models used in policy development, including CGE, GTAP and DSGE, use rational expectations assumptions. Rational expectations assume that people behave in a way to maximise their utility or profits but have unbounded computational ability and time to make these calculations. This contrasts with bounded rationality (Simon 1972). Thaler and Mullainathan (2008) provide an extensive contrast between bounded rationally and rational expectations.

Additionally, rational expectations assumptions are pervasive within undergraduate economics courses to provide the foundation for learning the general equilibrium models in more advanced courses. The undergraduates are usually unaware of this longer-term goal

and cease studying economics before learning about the flaws in these models but do leave with a clear idea of how to apply "economics" to policy problems unaware that they are applying neoclassic economics (Dow et al. 2009; Mitra-Kahn 2008). Game theory is the other major theory that supports neoliberalism and forms part of the undergraduate curriculum. Game theory makes unrealistic rationality assumptions, consequently has come under increasing criticisms (Kay 2005; Lucas, McCubbins & Turner 2015; Rubinstein 2012). These criticisms include game theory's unrealistic narrow view of the economy and diverting attention and funds away from alternative approaches to study the economy that could have been more valuable.

Table 4: Neoclassical Assumptions

	Arnsperger and Varoufakis (2006)	Farmer and Geanakoplos (2008, p. 5)
1	Methodological instrumentalism	Agent optimisation of utility
2	Methodological individualism	Perfect competition (price taking)
3	Methodological equilibration	Market clearing
4		Rational expectations (unbounded rationality)

We discuss neoclassical economics hard-core assumptions.

Instrumentalism

The philosophy underlying neoclassical economics is instrumentalism; *'a system of pragmatic philosophy that considers idea to be instruments that should guide our actions and their value is measured by their success'*.[97] Friedman (1953, p. 15), a major proponent of instrumentalism, states *'..., the relevant question to ask about the "assumptions" of a theory is not whether they are descriptively "realistic", for they never are, but whether they are sufficiently good approximations for the purpose in hand. And this question can be answered only by seeing whether the theory works, which means whether it yields sufficiently accurate predictions.'* The inability to predict the global financial crisis indicates the assumptions in neoclassical economics are insufficiently realistic. Later in this section, we discuss flaws in instrumentalism and Bell (2009, sec. 5.3) provides a more extensive discussion.

1. Methodological instrumentalism

Methodological instrumentalism explains all behaviour as a desire to maximise preference-satisfaction. There is no room for philosophical question as to whether a person will act in such a way. Traditionally in neoclassical economics, preference-satisfaction is constant and determined exogenously (outside the model). Behavioural economics provides substantial experimental evidences against the utility maximising model of an individual. Point 4 on rational expectations (unbounded rationality) briefly discusses the evidence and Bell (2009, secs. 2.1.2-4 & 2.1.8) provides a more extensive discussion.

In contrast, preferences in neoclassical economics depend on utility maximising, preferences in 'complexity economics' depend on behavioural rules and the structure

[97] https://www.vocabulary.com/dictionary/instrumentalism

and history of interaction between agents in the model. The UK Treasury current uses such a model for forecasting, which Section 5.4.2.2 discusses.

2. Methodological individualism

Arnsperger and Varoufakis (2006) note that methodological individualism has two forms (1) explanation in terms of individuals alone or (2) explanation in terms of individuals plus relations between individuals. We use the first form to describe neoclassical methodological individualism, so that explanations for socio-economic processes are to be found by studying individuals interacting via a price signal only, where the individuals retain independent and constant preferences. This approach serves to isolate the individual from other non-price interactions and any influence that structure may have on interactions and on individuals and vice versa. This approach does allow modelling a complicated system with a simple system and consequently reduced computational requirements. However, the cost to neoclassical economics for using such oversimplification is its failure to link microeconomic to macroeconomic. This phenomenon is known as the 'micro-foundation problem' (Bell 2009, sec. 2.1.4).

In comparison, complexity economics studies the relationships among structure, interactions and individuals to explain macro socio-economic processes as an emergent process. The wetness property of water provides an example of emergence as the interaction of water molecules via Van der Waals forces; water molecules as individuals lack a wetness property. The Bank of England model (Baptista et al. 2016; Haldane & Turrell 2017) discussed in section 5.4.2.2 uses emergence (Bell 2009, secs. 2.1.4 & 2.2.1) (Sections 2.1.4 and 2.2.1) via financial transactions between individuals and firms with differing behavioural rules to link the micro and macro level. This approach solves the micro-foundation problem found in neoclassical economics.

3. Methodological equilibration

Methodological equilibration is the imposition of equilibrium or market stability. Once the neoclassical agent's utility function and constraints are postulated, to develop predictions at the macro level the aggregate behaviour of the individuals has to be sufficiently regular. Arnsperger and Varoufakis (2006) reduce the equilibration process to three steps:

1. Discover an equilibrium
2. Assume that agents or their behaviour will find themselves at equilibrium
3. Demonstrate that any small perturbations are incapable of dislodging self-interested behaviour from the discovered equilibrium.

This simple approach provides for elegant analytical mathematical solutions to predict economic variables, albeit inaccurately, for example missing the GFC. Relatedly, the neoclassical micro-foundations project failed to find a price vector for a unique equilibrium. Importantly, multiple equilibrium indicate that markets are prone to sudden large changes, such as the GFC, with intervening periods of milder volatility (Bell 2009, sec. 2.1.4; Mitra-Kahn 2008). Neoclassical economists' solution to the lack of unique equilibria is just to assume one exists. Neoclassical economists ignore the micro-foundation problem. Events, such as the GFC, are considered 'Black Swan' event and

unpredictable within the neoclassical. However, at least six economists outside the neoclassical school did predict the GFC (CPA Australia 2001).

In contrast, the imposition of equilibration within 'complexity economics' is unnecessary, which provides a more realistic model of the economy and treats the economy as an evolutionary system without the requirement for a unique equilibria or equilibrium. The economy being an evolutionary system has been known since the late 19th century (Veblen 1898) when neoclassical economics' analytical mathematical approach could be justified due to their insufficient computing power to model the economy as an evolutionary system. However, relaxing the equilibrium assumption creates modelling calibration and predictions issues for complex systems and evolutionary models (Bell 2009, sec. 2.2.3). The Bank of England (Baptista et al. 2016; Haldane & Turrell 2017) model overcame the calibration issue by combing a complex systems and evolutionary modelling technique called Agent-Based Modelling (ABM) with a quadruple-entry bookkeeping method using the system of national account called Stock Flow Consistent (SFC) models.

4. Rational Expectations (unbounded rationality)

Simon (1984, p. 36) considers the rational expectation or unbounded rationality assumption a fundamental part of neoclassical economics, which is also implicit in the neoliberalism's justification for competition achieved through privatisation and deregulation. The unbounded rationality assumption is that consumers make optimal decisions over what to buy from many options across all goods and services available to find an optimal bag or goods and services. This unlimited ability to optimize or unbounded rationality assumption exists in game theory and the general equilibrium models. Importantly, the results of these models help justify the neoliberal agenda. The literature generally refers to unbounded rationality as rational expectations. van der Sar (2004, p. 432) notes that for nearly half a century rational choice theories have been tested against individual behaviour but repeatedly the underlying assumptions and predictive value appear descriptively false. Rational expectations assume that people behave in a way to maximise their utility or profits but Thaler and Mullainathan (2008) state that these maximisers in the neoclassical framework ignore virtually all the findings of cognitive and social psychologists. Bell (2009, sec. 2.1.2.1) discusses the inconsistencies between neoclassical economics' behavioural assumptions and the findings of cognitive and social psychologists in more detail.

All modelling involves simplifying assumptions but the assumptions in neoclassical economics have major problems that go well beyond the normal simplification. Salzano and Colander (2007, p. X) comment, *'The problem with [neoclassical] economics is twofold[:] the first is the simplicity of the model assumptions do not allow the complexity of the common sense interactions that one would expect; the second is the failure of the models to fit the data in an acceptable way.'* Similarly, Blaug (1992) observes, *'The history of general equilibrium theory from Walras to Arrow–Debreu has been a journey down a blind alley ... because the most rigorous solution to the existence problem by Arrow and Debreu turns general equilibrium into a mathematical puzzle applied to a virtual economy that can be imagined but could not possibly exist, while the extremely relevant 'stability problem' has never been solved either rigorously or sloppily.'* Section 5.4.2.2 discusses the Bank of

England model (Baptista et al. 2016; Haldane & Turrell 2017) and other advances in economics that can address these issues.

Important to understanding the failure of neoclassical economics and instrumentalism is the distinction between mathematics and science. Therefore, we explain the distinction between a mathematical and a scientific approach to economics and between neoliberal and evidence-based policy by the example of the simple mathematical rule that the three internal angles of a triangle add to 180 degrees (Zaman 2016). The 180-degree rule holds true for a small sheet of paper on a flat surface. However, if the triangle is enlarged and with careful measurement, one finds the 180-degree rule no longer holds because the earth's surface is curved. The 180-deree rule is mathematics and the careful observation and measurement is scientific that falsifies the original rule. Ideally, the scientific observation is incorporated by expanding the original rule to apply over a wider domain that is developing spherical geometry and the realisation that earth is not flat is an important discovery.

Alternatively, we can reject the observation and protect the internal logical consistency of the rule by assuming the earth is flat or accept the observation and limit the domain of applicability to a small sheet of paper. Importantly, the set of mathematical economic tools, including game theory and neoclassical economics general equilibrium models that support the neoliberal policies display similarity to the latter flat earth or limited domain case. Finally, neoclassical economics and game theory are branches of mathematics and like all mathematics are tautologically true as the conclusions are contained within the premises or assumptions. Therefore, the garbage in-garbage out rule still applies despite logically consistent mathematical proofs. If the behavioural assumptions are insufficiently realistic, any conclusions may or may not be applicable in the real world, so could well misinform policy development.

Notably, these general equilibrium models strongly support the neoliberal agenda for financial deregulation and the deregulation of capital flows between countries. Notwithstanding the strong theoretical support, the IMF has shifted from the neoliberal view that any financial intervention was counterproductive to a more nuanced view that longer term foreign direct investment can beneficially support knowledge transfer whereas short-term capital flows serve to increase the risk of greater volatility and crisis (Ostry, Loungani & Fureceri 2016). This IMF evidence based policy is consistent with the multiple equilibrium observation.

In summary, the failure of the neoliberal economic theories to incorporate observation such as bounded rationality, multiple equilibria and role of money in credit expansion show that neoliberal economics has failed to advance as a science and devoid of foundation. These neoliberal economic theories are only a set of mathematical rules applicable at best to a small domain within the economy. We discuss the partial success of neoliberalism before discussing reasons for the slow speed at which the economics profession is transitioning from neoliberal economics supporting neoliberalism to newer more realistic models and theories supporting evidence based policy.

Despite neoliberal economics lacking any scientific foundation, there have been some successes in neoliberal policies. This occasional or partial success of neoliberalism does require explanation and reconciling with scientific approaches to economics and evidence based policy. For instance, Ostry, Loungani and Fureceri (2016) claim that there are

instances internationally of state enterprise privatisations that have been successful in improving services without specific examples or description for whom the privatisation has been successful. The fact that neoliberal economic theory only applies to a small domain within an economy helps reconcile this partial success, but being a small domain theory also limits its usefulness, so these neoliberal theories require augmenting. Specifically, the neoliberal economic models focus on the theoretical efficiency of market economies to allocate goods and services, so of little use in comparing the actual efficiency of private and public ownership and service provision (Stone 2017).

Favouring privatisation, Quinn (2008) discusses the high level of corruption and bureaucratic inefficiency in countries with high levels of state ownership. This privatisation effect on reducing corruption would favour the neoliberal agenda in countries with high levels of state ownership, such as, the ex-communist countries who are managing the transition with varying degrees of success. However, the applicability of the neoliberal prescription for further privatisation becomes less clear for a group of 10 countries, including Australia, that have higher HDI and state ownership and provision of services and lower corruption than the USA (UNDP 2016). Transparency International provides a corruption perception index.[98] This situation implies an optimal level of state ownership and service provision above that in the USA where transparency of government plays more important role in increasing HDI than further privatisation. Therefore, we consider two aspects transparency and privatisation.

Regarding transparency, the Australian National Electricity Market Integrated System Plan (AEMO 2017) provides a good example of transparent government and the plan brings together the energy and climate change agendas. Similarly, Infrastructure Australia brings together the climate and growth agendas within good governance, including transparency and independence, but many legislatures lack independence, which in turn undermines the effectiveness of Infrastructure Australia's independence and transparency. To rectify this situation, Consult Australia (2018) recommends establishing an independent body to plan, assess, and prioritise infrastructure projects across **all** legislatures. This independent body could bring together the inclusive growth and climate agendas in a consistent way to ensure a lower cost and smoother transition to a low emissions economy. Importantly, in addition to reducing corruption, transparency of government provides a mechanism to adopt best practice. This adoption of best practice in government plays a counterpart to competition in the private sector (McKinsey 2017).

Regarding privatization, we consider the issue of when further privatisation becomes counterproductive and augment neoliberal economics with bounded rationality (Simon 1972) to help identify counterproductive privatisations.

In a more pragmatic business school perspective on privatisation, Goodman and Loveman (1991) state that *the pros and cons of privatization can be measured against the standards of good management—regardless of ownership* and make three conclusions.

[98] https://www.transparency.org/news/feature/corruption_perceptions_index_2016

1. Neither public nor private managers will always act in the best interests of their shareholders. Privatization will be effective only if private managers have incentives to act in the public interest, which includes, but is not limited to, efficiency.[99]

2. Profits and the public interest overlap best when the privatized service or asset is in a competitive market. It takes competition from other companies to discipline managerial behaviour.

3. When these conditions are not met, continued governmental involvement will likely be necessary. The simple transfer of ownership from public to private hands will not necessarily reduce the cost or enhance the quality of services.

We also contend in addition to a competitive market stipulated in Goodman and Loveman (1991) that bounded rationality requires consideration in any planned privatisation. For instance, in medical service privatisation, the individual has the choice of numerous insurance policies from different insurance companies, so meeting the privatisation requirement for competition. However, these numerous insurance policies are complex, opaque and forever changing and contain a list of medical treatments that takes trainee doctors seven years to understand. This situation requires considering bounded rationality where the inability to make optimal insurance selections reduces the effectiveness of competition to hold down prices. Consistent with this bounded rational analysis, the US's privatised health system is the most expensive in the world and consistently underperforms countries with publically owned medical systems in many dimension, including efficiency (BBC 2010; TCF 2010). Similarly, Australia's foray into the privatisation of medical insurance has led to price escalation and inefficiency, both factors undermining inclusive growth. Additionally, Stone (2017) discusses the efficiencies from the economies of scale in Medicare. Chapter 4 discussed the privatisation of Australia's energy sector failing to meet the conditions in Goodman and Loveman (1991) and bound rationality problems in the retail sector where prices went from some the cheapest in the world to the most expensive.

We have discussed situations where privatisation, part of the neoliberal agenda, undermines inclusive growth. We now consider four mechanisms through which free trade and deregulation, another part of the neoliberal agenda, undermine inclusive growth and climate change mitigation. This situation highlights requirement for new international institutions and agreements.

First, free trade exacerbates emissions as companies manufacturing in countries with stricter emissions and pollution controls either move their manufacturing operations to countries with weaker emissions and pollution controls or lose sales to the companies operating in countries with weaker controls. Countries operating stricter emissions and pollution controls are subsidising companies operating under weaker controls. In addition, the employees at companies operating in countries with weak controls are also subsidising the companies via diminished health. Climate Works Foundation (CWF 2017) discusses how the Europe Union (EU) is on goal to reduce emissions by 20% in 2020 but if the emissions of imported goods are factored, the EU emissions have actually increased 11%. Australia is in a similar situation of importing more emissions intensive goods rather manufacturing goods. This

[99] Similarly, Stone (2017) finds both neither public nor private provision inherently efficient or inefficient and he stresses that three efficiencies technical, allocative and dynamic be evaluated over the short and long term in any decisions to privatise or outsource.

situation highlights a major loophole in the accounting for emissions and pollution, requiring modification of international carbon accounting. These pollution subsidies to countries with weak pollution controls provides justification for countries operating stricter controls to impose carbon tariffs on imports from countries with weaker emissions and pollution controls; otherwise, companies will continue to engage in a global race-to-the bottom on pollution, emissions and employee health.

Second, extending the period of time a patent is applicable as part of a "free" trade agreement provides a monopoly to the patent holder who can extract above normal profits. This situation prevents competition so reduces the public good of the trade agreement (Goodman & Loveman 1991). This term "free" becomes a misnomer a better terminology would be "monopoly" trade agreement. For instance, extending pharmaceutical patent periods works to impoverish a country's health system that could otherwise buy much cheaper generic versions, as was the case in the Australia-US free trade deal undermining Australia's Pharmaceutical Benefit Scheme.[100] Patents can also function as a tax minimisation device by holding patents in companies registered in tax havens.

Third, we discuss how the combination of free trade and unregulated international capital flows undermines inclusive growth. The comparative advantage argument acknowledges that there are winners and losers from free trade but claims that there is an overall increase in wealth from the specialization within each country (Ricardo 1817). However, there are counter arguments to comparative advantage being wealth creating. For instance, there is the abandonment of existing factories and equipment as each country specialises to engage in comparative advantage, which leads to the destruction of capital (Keen 2011).

Nevertheless, let us assume that comparative advantage does lead to a net increase in wealth. Ideally, the government in each country would use some of the extra wealth generated from comparative advantage to help those adversely affected by free trade to relocate and retrain for other employment and to invest in R&D to improve productivity. However, the increase in free trade and unregulated capital flows creates an environment where tax dodging becomes easier, as discussed in Chapter 2. The Panama and Paradise papers confirm wide spread tax dodging (ICIJ 2017). Tax dodging allows entities to concentrate wealth and leaves governments less financially able to help those adversely affected by free trade and investment in R&D.[101]

For instance, Case and Deaton (2017) identified a sharp increase in "deaths of despair" among those most adversely affected by free trade in the US, namely those white non-Hispanic Americans without a college education. Members of this group previously filled many of the high-paying manufacturing positions. The US health system of employers paying for health insurance exacerbates the situation. Notably, Australia saw an increase in "deaths of despair" from 2000 to 2015 but the undifferentiated statistics hide which group is most affect. Unlike the US health insurance system, Australia's universal health insurance, Medicare, would help moderate any "deaths of despair" effects of free trade. The lack of assistance for people unemployed because of a free trade deal, tax dodging and capital destruction all reduce inclusive growth. There lacks a global tax account regulator and anti-tax dodging agreements to ensure all companies are paying their fair share of taxes in the

[100] https://theconversation.com/how-the-us-trade-deal-undermined-australias-pbs-32573
[101] http://www.abc.net.au/news/2017-11-07/paradise-papers-why-tax-avoidance-matters/9123850

countries they operate. There are indications that a global tax institution and framework is starting to develop albeit slowly.[102]

Fourth, there are calls to reduce company tax rates, arguing that there is a requirement to compete in free trade with countries with lower tax rates. As discussed in Chapter 2, this argument is flawed, because many companies are already pay zero company tax and few companies pay the full company tax rate. Additionally, Australian taxpayers receive full imputation credits on company dividends hence only pay their individual marginal tax rate on dividends.

Assuming fiscal responsibility that is a lower tax rates equates to a cut in government services. This would entail the private sector taking over the role of the government service. The provision of services via the private sector may well be less efficient than through the public sector (Stone 2017), for example health insurance and energy sector. Additionally, Australia is at a level of HDI where any cuts in government service would likely reduce the HDI to that of the USA or even lower. Acknowledging, the whole the Australian tax system does require restructuring, including company taxes. Unfortunately, Australia's adversarial politics are unable solve wicked problems, such as major tax reform, as discussed in Section 5.2. However, simply cutting taxes and government services will only reduce inclusive growth, as Ostry, Loungani and Fureceri (2016) found in countries exercising such austerity measures.

Ostry, Loungani and Fureceri (2016) concludes the neoliberal agenda has been oversold. This conclusion raises questions about the roles of countries and companies within the globalisation process beyond the neoliberal agenda. Profit maximisation behaviour of companies features highly in both the neoliberal agenda and the economics underpinning the agenda. This raises two issues (1) aligning profit maximisation with the public good and (2) the existence of a company beyond a purely profit maximising agent.

Goodman and Loveman (1991) note the profit motive of a firm best aligns with the public good in restricted set of circumstances. However, this profit motive alignment with the public good within a global setting becomes even more restrictive when one considers concentration of wealth, employee health, pollution and emissions. Rectifying these market failures within the neoliberal agenda would require international agreements and accounting for tax dodging and embodied emissions and pollution in traded service and goods to prevent a race-to-the-bottom on taxation, emissions and pollution.

A major focus of neoliberal economics is the profit maximisation of firms to such an extent that it underemphasises other reasons for the existence of a company. Obviously, companies are required to make a profit to survive. Similarly, people are required to breathe to live. Both are truisms but ignore the wider issues of existence. Beinhocker (2006) discusses neoclassical economics' focus on the action of firms maximising profits to moving the economy toward allocative efficiency toward a general equilibrium and considers this misses the more important wealth generating effect of innovation or dynamic efficiency of a firm. This shift would redefine economics away from 'allocation of scarce resources' toward 'creating wealth through innovation'. Beinhocker (2006) illustrates the limitation of neoclassical economics' focus on allocative efficiency with an example from a preindustrial

[102] http://www.oecd.org/tax/transparency/

country. The number of oxen and ploughs can be distributed in an allocatively efficient way to maximise food production but any large jump in food production takes innovations such tractors. Notably, neoclassical economic modelling considers any innovation external to the model, a residual, and lumps together innovation and modelling errors (Solow 1956). Innovation is a distinctly non-equilibrium process and neoclassical economics is particularly ill equipped to usefully model innovation.

Additionally, Stone (2017) finds neither public nor private provision inherently efficient or inefficient but stresses that three efficiencies technical, allocative and dynamic be evaluated over the short- and long-term in any decisions. For instance, Korea initially followed an anti-neoliberal agenda by protecting its manufacturing sector from overseas' competition and maintaining a high degree of financial regulation. This anti-neoliberal policy denied Korea international allocative efficiency in the short-term but now Korea has some of the world's largest and dynamically efficient companies, notably, Samsung Electronics and Hyundai Heavy Industry shipbuilding and electric and hydrogen vehicles. In another example, the European Union's support of the Airbus sacrificed short-term allocative efficiency for long-term dynamic efficiencies. In contrast, many of the countries forced into accepting the neoliberal agenda as a condition of loans from the World Bank performed less well.

We have shown the economic theories supporting the neoliberal agenda are seriously flawed and at best only applicable to a small domain within the economy under certain conditions. Musgrave (1981) notes that Friedman and neoclassical economics fail to acknowledge or clearly specify the domain of their assumptions and when the model is operating outside the domain of the assumptions, so the modelling results may well be misleading or simply incorrect. The gap between the real economy and the domain assumptions of neoclassical economics makes it inappropriate for policy development unless used with great caution (Bell 2009, sec. 5.3.2; Keen 2001; Quiggin 2010; WEA 2017). Colander (2000, p. 3) equates neoclassical economics *'to the celestial mechanics of a non-existent universe'* for using theory outside its domain assumptions. There is considerable evidence that following the neoliberal agenda and using the supporting economics theories have undermined inclusive growth and served to shift manufacturing from countries with strict pollution and emissions controls to countries with lax controls. Policy makers, and institutions such as the IMF that advise them, must be guided not by faith, but evidence of what has worked (Ostry, Loungani & Fureceri 2016).

5.4.2 Transitioning from faith based to evidence based economics

A major flaw in equilibrium economics has been known since 1972-4 when the Sonnenschein–Mantel–Debreu theorem showed there lacks a unique equilibrium, proving neoclassical economics is theoretically unsound (Mitra-Kahn 2008). There have been numerous verified accounts of how the unbounded rationality assumptions within game theory, neoclassical economics and general equilibrium theory are at odds with phycology (Kahneman & Tversky 1979; Simon 1972, 1979; Smith, VL 1991; Thaler & Mullainathan 2008; Tversky & Kahneman 1974; van der Sar 2004). Finally, the inability to predict the global finical crisis, the biggest economic event this century, questions the value of neoclassical economics in informing policy decisions.

Economics consists of a number of schools of thought but the teaching in universities fails to reflect this diversity of thought (Dow et al. 2009; Krueger 1991). The predominant

neoclassical/game theory school of thought are taught with its equilibrium approach and unbounded rational. The lack of diversity of thought taught reduces the questioning of the basic premises of neoclassical economics and game theory. Importantly, university economics courses provide decision-making tools for tomorrow's decisions makers within business and government. The near all disappearance of courses in the "history of economics" or "comparative systems" from the curriculum of economic schools exacerbates the narrow worldview. There has been a tendency to replace diversity of thought with mathematics supporting the neoclassical and game theoretic approaches.

This situation leaves most economics graduates with a limited set of tools to solve problems and a lack of awareness of other economic schools of thought that both offer alternative tools and perspectives. In addition, the situation stultifies the ability for economics to progress beyond the neoliberal toolset (Dow et al. 2009; Kay 2005; Krueger 1991).

Subsection 1 discusses why the mainstream economics failed to transition from its equilibrium and unbounded rational based assumptions with poor predictive performance to a more realistic and evidence based foundation. Section 2 discusses developments beyond mainstream neoclassical economics and game theory.

5.4.2.1 Factors preventing the transition to evidence based economics

The factors preventing the transition to evidence based economics include:

(1) the usual general causes of inertia within an academic profession,
(2) self-selection process of focusing on theoretical mathematical rigor within neoclassical economics and game theory, ignoring empirical irregularities making them imperious to change and eliminating courses not perceive as possessing mathematical rigor,
(3) Nobel prizes in economics rewarding and reinforcing the focus on mathematical economic theory,
(4) Large organisations, such as the World Bank and IMF, continue to use neoclassical economics. This usage supports the global neoliberal agenda.
(5) Neoclassical economics helps justify concentrates of wealth as the "natural" outcome of the economy as people are paid what they are worth. Therefore, popular with the wealthy that can more readily fund think tanks and make political donations to perpetuate neoclassical economics and neoliberalism. Supporting this view, neoclassical economics has a "natural" rate of unemployment, so justifying poverty as "natural". An alternative simpler explanation is that policy decisions, corruption, inheritances and network effects largely determine concentrations of wealth. Acknowledging, there are true innovators who gain incredible wealth but these people are an incredibly small percentage of the population.
(6) Methodological individualism in neoclassical economics fits well with people holding political beliefs containing extreme versions of individualisms. Importantly, climate change mitigation requires collective action as well as individual action. This collective action does not fit well with many people holding such extreme versions of individualism. A notable exception is the ex UK Prime Minister Margaret Thatcher who held extreme individualism beliefs but supported climate change action. However, Thatcher completed a Chemistry Bachelor of Science degree, which could account for understanding and accepting and the science behind climate change.

There are the usual reasons for general inertia to change within any academic field. In that, every professional academic has devoted considerable time to developing a career. This inertia comes from the sunk costs in the form of time invested in courses developed, publications in relevant journals and textbooks written. Noting, academia necessitates a certain degree of inertia to avoid faddism, which does warrant slower progress. Consistent with slower progress, Max Planks observed *"science progresses one funeral at a time"* or more fully, *"A new scientific truth does not triumph by convincing its opponents and making them see the light, but rather because its opponents eventually die, and a new generation grows up that is familiar with it".* However, as discussed, the Sonnenschein–Mantel–Debreu theorem showed a critical flaw in general equilibrium economics in 1972-4 (Mitra-Kahn 2008). Over forty years later, these general equilibrium models are still taught in universities to inform policy decisions and trade agreements. The inertia within the economics profession requires more explanation than the retirement of academics.

Comparing two papers on the state of economics education in 1991 and 2009, Krueger (1991) and Dow et al. (2009) respectively, highlights the progressive narrowing of academic economics towards theoretical mathematical rigor at the expense of empirical relevance and eliminating courses without theoretical mathematical rigor. Krueger (1991) is a study published by a commission initiated by the American Association of Economics focusing on *"the extent to which graduate education in economics may have become too removed from real economic problems."* The commissioners reported, *"that it underemphasise the 'linkages' between tools, both theory and econometrics, and 'real world problems' that is the weakness of graduate education in economics," and that both students and faculty sensed "the absence of facts, institutional information, data, real-world issues, applications, and policy problems."* Concluding, *"The commission's fear is that graduate programs may be turning out a generation with too many idiot savants skilled in technique but innocent of real economic issues."*

Dow et al. (2009) found nineteen years later that little has been achieved to address the issues raised in the American Association of Economics report (Krueger 1991) and the production of idiots savant's helped set the stage for the global financial crisis. Perversely, the retirement of academic economists, has seen a decrease in the diversity of schools of thought taught. The retiring non-mainstream economists are replaced with neoclassical economist and games theorist who either disregard the nonmainstream course or keep the course title and replace the content with neoclassical economics and game theory. For the academic economics profession, Max Planks' observation would be '*science regresses one funeral at a time'*.

Reinforcing the regression is the 'Nobel Prize' in economics that provides the ultimate recognition for work in economics. The prize bestows the work of the Laurette with extreme credibility for referencing in other academic work. Understandably, the prize provides a strong direction for the development of economics curriculum, as people want to study or research in the Laurette field. The international university ranking systems that factor the number of Laurates associated with the university reinforces the importance of the prize. Universities use their ranking in student marketing to increases profits and to obtain research funding that helps maintain international ranking. There is a clear motive to emulate or clone the wining universities.

Reinforcing the above effects is the Nobel Prize legacy. Syll (2016) cites Offer and Söderberg (2016) out of the 76 economics laureates awarded 28 (37%) have been affiliated to The University of Chicago. Of all laureates, 80% have been from the US (by birth or by naturalisation). Only 7% of the laureates have come from outside North America or Western Europe and only one woman ever received the prize. The University of Chicago is the clear winner by Nobel Prize count for Economics. This university is also the epicentre of neoclassical economics. Offer and Söderberg (2016) finds that 'the ascendancy of market liberalism with Reagan (US President 1981-89) and Thatcher (UK Prime Minister 1975-90) coincides with the creation and establishment of the prize in 1969. Especially, during the long chair of Assar Lindbeck (1980-94), when the newly established economics prize derived credibility from the original Nobel prizes, which helped market neoliberalism to the world. Although, not all economists who received the prize are proponents of neoliberalism, it is still an undeniable fact that neoliberal and conservative leaning male economists are highly over-represented among the laureates. Their often ideologically biased doctrines have largely motivated the neoliberal economic policies for more than forty years.'

Perversely, the legacy of the Nobel Prize is perpetuating economic theories long since falsified; Quiggin (2010) discusses some of these theories in his book titled 'Zombie Economics: How Dead Ideas Still Walk among Us'. Importantly, the frequency of Nobel Prizes awarded outside neoclassical economics and game theory has increased in recent years.

5.4.2.2 Developments in evidence based economics

The previous section discussed factors locking the academic profession into neoclassical economics and game theory, which helped support he neoliberal agenda. We discuss alternatives schools of thought to the current mainstream to develop a more evidence-based approach to economics. There lacks a clear alternative and gaining consensus between the numerous schools of economic thought is unlikely. Therefore, putting in place a process to encourage dialogue is preferable to selecting an alternative to the current mainstream for the following reasons.

Recognising, each school of thought, including the mainstream, represents an alternative theoretical framework or belief system. The scientific approach of measurement and observation and falsification to select among the belief systems could be used. However, the same set of observations may support more than one belief systems, which presents the issue that each of the frameworks may capture a part of the economies' underlying structure. This situation presents the possibility of a synthesis, requiring dialogue.

Equally, if the same set of observations or measurements can falsify a belief system, the measurements maybe rejected as spurious or inconsequential to the hard-core of a belief system but the observations may falsify a minor hypothesis within the theoretical framework. These minor hypotheses provide a protective-belt for the hard-core beliefs (Lakatos 1976). This situation is known as the under determination of scientific theory[103]. Popper (1972a, 1972b, 1972c) considers theoretical frameworks or belief systems adept at avoiding falsification as unscientific. The schools of economic thought resemble religions with each school having strong followings, containing at least some useful insights and major disagreements.

[103] https://plato.stanford.edu/entries/scientific-underdetermination/

The solution to resolve this situation between the school of thought bears similarities to Locke's (1689) proposal for religious tolerance, as the solution to the fear of an invasion by Catholicism in 17th century England might provoke religious persecution. He argued that tolerance was the only sensible solution. Importantly, this tolerance provided a peace, which was one factor enabling England to lead the world in the Industrial Revolution. Similarly, there is a requirement for toleration between the alternative schools of thought, including mainstream economics, to promote an evolution of economics.

We discuss three developments spurred by the global financial crisis, which embody Locke's (1689) call for tolerance and a scientific approach to provide economics' with a more empirical evidenced–based foundation and the potential for synthesis (1) the Curriculum in Open-access Resources in Economics, (2) World Economics Association and (3) the Bank of England's macroeconomic modelling.

The Curriculum in Open-access Resources in Economics (CORE 2016) project, launched in October 2013, developed a new approach to economics teaching for undergraduates.[104] The CORE (2016) project developed by a consortium of universities addresses many of the issues raised by Krueger (1991) and Dow et al. (2009). The curriculum contains elements from many schools of thought, views theories within their historical context and tests the usefulness of the theory against current world problems such as climate change and inequality. The CORE (2016) project provides an empirical evidence–based foundation and potential for synthesis. The course text is free.

The World Economics Association (WEA 2017) launched in 2011 promotes a pluralistic approach to economics to foster dialogue between the various schools of thought. WEA's key principles include worldwide membership and governance, and inclusiveness towards the variety of theoretical perspectives and applications of economics. WEA welcomes, as members, non-economists interested in economics and its relationship with their own field of interest. WEA is registered under UK law as a non-profit community interest company. There is a voluntary membership fee. The WEA provides free access to its peer reviewed journals.

The Bank of England (BoE) (Haldane & Turrell 2017) discusses how *'Macroeconomic modelling has been under intense scrutiny since the Great Financial Crisis, when serious shortcomings were exposed in the methodology used to understand the economy as a whole. Criticism of the assumptions employed in the dominant models, particularly that economic agents are homogeneous and optimising and that the economy is equilibrating. BoE seeks to explore an interdisciplinary approach to macroeconomic modelling, with techniques drawn from other (natural and social) sciences. Specifically, it discusses agent-based modelling, which is used across a wide range of disciplines, as an example of such a technique. Agent-based models are complementary to existing approaches and are suited to answering macroeconomic questions where complexity, heterogeneity, networks, and heuristics play an important role.'*

BoE (Baptista et al. 2016) used an agent-based model of the UK housing market to study the impact of policies on key housing market indicators. This approach enabled the BoE to 'tackle the heterogeneity (differences in stakeholders) in this market by modelling the

[104] https://www.ineteconomics.org/education/curricula-modules/core-project

individual behaviour and interactions of first-time buyers, home owners, buy-to-let investors, and renters from the bottom up, and observe the resulting aggregate dynamics in the property and credit markets. The agent-based model was calibrated using a large selection of micro-data, mostly from household surveys and housing market data sources. BoE performed a series of comparative statics exercises to investigate the impact of the size of the rental/buy-to-let sector and different types of buy-to-let investors on housing booms and busts. The results suggest that an increase in the size of the buy-to-let sector may amplify house price cycles and increase house price volatility. Furthermore, in order to illustrate the effects of policies on several housing market indicators, the BoE implement a loan-to-income portfolio limit. The BoE find that this policy attenuates the house price cycle.'

Australia and China could adapt the BoE model to model the Australian and Chinese housing market bubbles with the aim to test stabilisation policies and policies to address inequality. The BoE model combines two major modelling traditions Agent-based Modelling (ABM) and Stock Flow Consistency (SFC). The ABM/SFC model overcomes many of the problems inherent in neoclassical economics' DSGE model; these include.

- The ABM allows a more realistic non-linear evolutionary modelling of the economy. This allows sectors of the economy to be in disequilibrium for instance labour market disequilibrium that is unemployment. In contrast, DSGE is a series of equilibrium snapshots overtime. The equilibrium assumption requires all sectors of the economics are in equilibrium. This assumption requires labour market equilibrium that is either people are employed or on vacation. Involuntary unemployment does not exist. Following this DSGE logic through, the "Great Depression" was many people simultaneously taking extremely long vacations more of a "Great Vacation" than a "Great Depression".
- ABM allows heterogeneous agent to model effects on small groups within the economy. In contrast, DSGE lacks the resolution. ABM and SFC seamlessly link the macro and micro component of the economy; the macroeconomic emerges from the microeconomic. For instance, business cycles emerge from the transactions between agents. In contrast, DSGE just imposes equilibrium, as discussed the neoclassical models lack micro-foundations. The SFC model links the system of national accounts with quadruple accounting system to ensure consistent modelling of credit expansion. In contrast, DSGE treats money as a bartered asset without the ability to model any credit expansion. The inability to model credit helped blind neoclassical economists to the GFC. The BoE's ABM/SFC model overcomes this credit blindness. The BoE's ABM/SFC model provides an opportunity for both Australia and China to better understand and manage their housing bubbles and the role of credit in the formation of the bubble.

6 Conclusion

This report has studied the pivotal role of the Australian and Chinese electricity sectors in climate change adaptation and mitigation and maintaining inclusive growth in the transition to low carbon economies. There has been a rapid development and decrease in the costs of renewable energy, and associated technologies, which make the transition to zero net emission in the electricity sector both technically and economically feasible. These developments will allow the electricity system to fulfil its pivotal role in transitioning the economy to zero net emissions (TAI 2017b). Showing commitment and technical feasibility, twenty countries in the Powering Past Coal Alliance announced the elimination of coal by 2030.[105] The alliance has grown to 50 nations, states and businesses as at January 2014.[106] Similar international commitments to phasing out internal combustion engine vehicles are also appearing, notably in China, France, Norway, UK, and California.

However, the Australian Department of Energy and Environment (DEE 2017) published emissions projections showing Australia will clearly fail to meet its Paris commitment published emissions projections showing Australia will clearly fail to meet its Paris commitment emissions targets by 5% and 29-33% above the target for 2020 and 2030. The projections forecast Australia's emissions at 551 and 570 Mt CO_2-e, respectively. If embodied emissions from imported goods were considered, Australia would be faring much worse (CWF 2017).

The Australian Bureau of Statistics (ABS 2017d) announced that inequality has remained stable since 2013-14. This respite is welcome news as Australia's income Gini index increased from 0.302 to 0.323 since 1994-5 peaking at 0.336 and the wealth Gini index increased from 0.573 to 0.605. However, Sheil and Stilwell (2017) discuss how the ABS requires to update their Gini index calculation method to international best practice adopted by the OECD, as the ABS current calculation will underestimate inequality. Sheil and Stilwell (2017) claim the stability of ABS's Gini appears anomalous, given the large increase in the value of houses in Australian cities during recent years and the fact that few among the poorest 40 per cent own one. Most of the wealth the ABS apportions to the bottom of the distribution comprises non-income earning items such as cars, furniture and clothing. Notably, Ostry, Loungani and Fureceri (2016) and OECD (2017c) found increasing inequality a prominent feature of the neoliberal policies that permeated the world since the 1980s.

Australia is failing to meet its Paris agreement and to address increasing inequality. We discuss the reports key findings.

6.1 Australia's poorly implemented electricity sector liberalisation confounding its pivotal role in the transition

Contributing to Australia's decline in inclusive growth was the poorly implemented neoliberal polices in the electricity and energy sector, which saw Australian energy prices move from some of the cheapest in the OECD to the most expensive and Australia lose its competitive advantage in energy. Consequently, the Australian Competition and Consumer Commission (ACCC 2017) was directed to conduct an inquiry into the price rises. The interim report

[105] http://www.abc.net.au/news/2017-11-17/20-countries-have-signed-up-to-phase-out-coal-power-by-2030/9161056

[106] https://greennews.ie/ireland-fails-take-offer-join-powering-past-coal-alliance/

discusses two major causes, being the overbuilding of network infrastructure and market power exercised by three retail-generators. The overbuilding of infrastructure reduces productivity and presents an ongoing transfer of wealth from electricity users to network owners, increasing inequality. The dominance of the retail and generator sectors by three large retail-generators has allowed significant market power to shift wealth from electricity users to the owners of the retail-generators. The electricity sector provides an example of neoliberal policies being oversold (Ostry, Loungani & Fureceri 2016) and their supporting neoclassical economics used beyond the domain of its assumptions. Section 4.1 discusses these issues in more detail.

As discussed in Chapter 3, China is experimenting with market-based approaches in its electricity sector. Teng, Jotzo and Wang (2017) calculate that a market-based approach could half the cost of the China's new Emissions Trading Scheme. The ACCC inquiry into Australia's market-based implementation confirms that adopting a market-based approach presents considerable risk to energy prices and inequality. The inquiry will provide useful insight for China on what to avoid in its market-based implementation. Notably, two major classifications of policy failure include the failure to implement market reforms in accordance with the underlying economic theory and implementing reforms in accordance with the theory but the theory departs from reality, as discussed in Chapter 4.

Exacerbating both stability and price problems caused by the poorly implemented neoliberal polices in Australia are the Coalition's uncoordinated climate change and energy policies. To address this lack of leadership, the Australian Energy Market Operators (AEMO 2017) initiated an 'Integrated Systems Plan' consultation to coordinate the transition to zero net emissions in the electricity system. The options outlined in the consultation plan would go a long way to smooth the integration of renewable energy but ideally, the National Energy Objectives needs rewriting to include climate change mitigation and adaption objectives.[107] Noting, the collaborative Integrated Systems Plan is a move toward transparent central planning and so acknowledges limitations to the market-based approach to co-ordinate the development of the gas and electricity systems. Additionally, the political donations from the mining industry provide a conflict of interest in implementing mitigation policies.

6.2 Australia's Parliament's record of failing to solve wicked problems

The neoliberal failures in the energy sector and the failure to address climate change mitigation at the Federal level are not isolated occurrences of the failure to address wicked problems adequately. Australia has a growing list of unaddressed or unresolved wicked problems including.[108]

- Obesity
- Indigenous disadvantage
- Land degradation
- Population ageing
- Evidence versus opinion: The attack on science
- Increasingly complex tax system that has become increasingly porous at the top but driving less income – little of the Henry Tax Review was implements

[107] http://www.aemc.gov.au/Energy-Rules/National-electricity-rules
[108] https://theconversation.com/a-challenged-democracy-wicked-problems-and-political-failures-39040

- The negative gearing and capital gains concessions for properties
- The private education and health insurance discussed in Section 4.1.4
- Tax havens and tax dodging
- Increasing prison population and violent crime usually associated with increases in inequality

Solving these problems requires collaboration and complex evaluations, which are unsuited to adversarial politics.[109] For instance, the 'Integrated Systems Plan' (AEMO 2017) is seeking collaboration to solve the wicked problem of coherently integrating climate and energy policy but is occurring outside the political domain that has made tangled progress over 5 years.

6.3 Forming common objectives to simplify wicked problems

Solving the wicked problems requires interconnect thinking to ensure that any solutions add to the country's long-term objectives to benefit the electorate. Notably, political donations are likely to undermine any consensus over long-term objectives. We consider three objectives and confounding political donations.

Garnaut (2008) envisioned breaking the link between GDP and carbon emissions in his foundational document to shape Australia's future. This vision provides a shape to the economy other than a pure focus on GDP. Donations from the mining sector have made this objective difficult to reach.

Denniss (2017) seeks to break the link between GDP and accelerating waste to shape a circular economy rather than have a waste driven GDP. Importantly, from 1997 to 2012 the population rose by 22 per cent and gross value added increased 64 per cent but waste increased 145 per cent (ABS 2013). Addressing this waste problem would require considerable behavioural change and at odds with taking donations from the fashion industry or makers of disposable items.

The human development index (HDI) comprises three major components (1) long and heathy life, (2) knowledge and (3) a decent standard of living. HDI provides an objective more conducive to inclusive growth over the long-term (OECD 2017c). Donations from the farming sector would make raising the HDI and life expectancy by reducing obesity via a sugar tax difficult.

The decision to take no action over Australia's existing policies and political donations is likely to increase inequality and continue Australia's increase in violent crime (ABS 2017b). This trend would take Australia closer to the social environment prevalent in the USA and reduce Australia's HDI to that of the USA. Removing political donations will make it easier to solve wicked problems.

6.4 Removing four barriers to solving wicked problems

Australia and China face many of the same wicked problems but each country has its own unique political system. Chapter 5 found four major barriers to solve wicked problems in Australia. The first two barriers are unique to Australia but the latter two barriers are applicable to Australia and China. The first two barriers diminish and corrupt parliament's

[109] http://www.apsc.gov.au/publications-and-media/archive/publications-archive/tackling-wicked-problems

information processing ability, being (1) political wedging & adversarial politics and (2) political donations. The second two barriers relate to the quality of the information parliament uses whether directly or indirectly via public opinion, including (3) mainstream economics' unrealistic models of the economy and human behaviour and (4) the absence of academic economists informing the public debate, with industry and political funded think tanks filling the void.

6.4.1 Political wedging and adversarial politics

On federation, Australia based its political system on the UK Westminster and the US federal systems that were two of the best performing democracies at the time. The adversarial system performed well solving problems using the didactic approach. However, Australia's list of unresolved wicked problems is increasing and the adversarial approach is proving unsuitable. These unresolved wicked problems include climate change, declining inclusive growth, increasingly complex tax system that drives less income and has become increasingly porous at the top and political donations and corruption concerning the construction and mining sectors.[110] The inability to solve these problems has diminished the electorates' confidence in Australian adversarial systems and its politicians. Specifically, political wedging has become a major barrier to addressing these wicked problems and undermining the electorate's confidence. The House of Representatives' electoral voting system supporting the adversarial or binary politics perpetuates either Labor or the Coalition in Government and effectively locks out the minor parties in the House of Representatives, a house unrepresentative of the electorate. The adversarial or binary politics operating in the unrepresentative House of Representatives both makes political wedging easier and reduces the diversity of thought and collaboration required to solve wicked problems.

Notably, Australia and the USA are exceptional among OECD countries as regressing in the pursuit of climate change mitigation. Additionally, there are a number of countries outperforming the UK and USA in terms of HDI (UNDP 2016), a commonality of these higher performing countries is proportional representation. Australia has an unusually large natural resource endowment for the size of its population, which inflates its HDI. It is time to review these country's political systems with a view to updating Australia's political system to enhance its problem solving ability. The electoral cycle and the regular political wedging within the houses of parliament would make any long-term constitutional reform planning unlikely to succeed (Garnaut 2013). Outsourcing to the private sectors presents a conflict of interest and any political reform would necessarily be a transparent long process involving consultation with the electorate. To initiate the process, the Productive Commission, building on existing work, would be in a position to provide an independent international comparative performance appraisal of Australia's political system for public discussion. As discussed, indicators of success could include HDI, climate change mitigation and circular economy. Importantly, these indicators focus on the shape of GDP rather than only size (Denniss 2017).

[110] https://www.theguardian.com/australia-news/2018/jan/05/coalition-leans-on-promised-income-tax-cuts-after-standard-of-living-slump; https://www.theguardian.com/australia-news/2017/dec/07/australian-tax-office-says-36-of-big-firms-and-multinationals-paid-no-tax;

6.4.2 Political donations

Political donations are both one of the outstanding wicked problems and a major barrier to solving the other wicked problems. Relatedly, both Labour and Liberal Parties are drifting away from their original roots of representing unionised employees and the middleclass, respectively, and towards representing the interests of the national and international corporate sectors. The distinctions between the parties diminish as both parties take donations from the same corporate sectors and in some cases from the same sponsors. This convergence represents a loss of diversity in the political landscape for the electorate and loss of integrity. The dissatisfaction with the two big parties has seen an historical fall in the big party vote and an increase in the size of the smaller parties.[111] Additionally, the competition for political donations between Labor and the Coalition helps explain the inability and reluctance to make substantial political donations and tax reform.[112]

Notwithstanding the recent Coalition proposal to ban foreign donations presents another political wedge. The Coalition has reframed the original intent to ban foreign donations to politicians to include a ban on donations to charity registered advocacy groups that encourage electoral participation in the political process to promote a health democracy. This reframing diminishes support for individual democratic involvement but leaves in place major donations from the corporate sector to influence government. This foreign donations political wedge maintains the Coalition's political donators and undermines the minor parties. As discussed in Chapter 5, the "Joint Standing Committee on Electoral Matters" has taken 10 years over political donation reform without success. The time has come for independent advice on political donations. There is a conflict of interest to outsourcing such work to the private sector. To initiate the public discussion process with an options document, the Productivity Commission could make an international comparison of political donation systems against two performance indicators HDI and climate change mitigation. Beside the ethical concerns of political donations, any costs in taxpayer funded political activity options need comparing against the loss of government revenue from the various tax breaks given to political donators, including capital gain tax concessions, negative gearing, abolition of the carbon price, Mineral Resource Tax, Petroleum and superannuation tax breaks for the wealthy.

6.4.3 Absence of academic economists informing the public debate

Confounding solutions to wicked problems is the withdrawal of academic economists from the public debate to provide an independent expert voice. In their place are politically funded think tanks and consultant economists or guns for hire[113] where there is a tendency to frame any research results in a way favourable to their sponsor. The tobacco industry provides an example of how askew industry funded research can become. The tobacco industry's research legacy is the pejorative term "tobacco science". More rec

[111] http://insidestory.org.au/the-upside-of-the-falling-big-party-vote/

[112] https://www.theguardian.com/australia-news/2017/dec/11/greens-single-out-13-companies-that-paid-no-tax-yet-donated-to-major-parties

[113] https://www.theguardian.com/commentisfree/2011/sep/12/thinktanks-crushing-democracy-pr-agenices; https://www.theguardian.com/environment/2013/feb/14/funding-climate-change-denial-thinktanks-network

ently, the sugar industry is behaving similarly to prevent a sugar tax.[114]

One of the major causes of the withdrawal of academic economists from the public debate is replacing the academic staff with American PhD graduates based on their publications in international journals and with the requirement for them to publish in international journals. One solution would be to make it a condition of employment to publish in Australian journals on Australian policy issues. Section 5.3 discusses other causes and solutions in more detail.

[114] http://www.abc.net.au/news/2018-01-24/sugar-tax-and-the-power-of-big-business/9353626

6.4.4 Unrealistic models of the economy and human behaviour

The importance of economics theory in misguiding policy development is significant. The failure to predict the global financial crisis (GFC) is the most prominent indicator of the failure of mainstream economics to produce a realistic model of the economy. However, less visible is the formal training economist goes through that inculcates the same general equilibrium theory misinforming the prediction of the GFC. Notably, the same neoclassical theory underlies most of the modelling to justify free trade agreements. A major flaw in neoclassical economics has been known since 1972-4 when the Sonnenschein–Mantel–Debreu theorem showed there lacks a unique equilibrium, proving neoclassical economics' general equilibrium approach is theoretically unsound (Mitra-Kahn 2008).

Remarkably, the GFC has not lead to a major re-evaluation of mainstream economics. Post GFC, Dow et al. (2009) discuss the progressive narrowing of academic economics towards theoretical mathematical rigor at the expense of empirical relevance and eliminating courses without theoretical mathematical rigor. Eighteen years earlier, the same faults were found by the American Economic Association's review of university education Krueger (1991).

Importantly, the mainstream or neoclassical economics supports the neoliberal policies introduced into Australia in 1980s. However, Ostry, Loungani and Fureceri (2016), staff at the IMF, find that neoliberalism has been oversold after analysing two specific neoliberal policies (1) removing restrictions on the movement of capital across borders and (2) reducing fiscal deficits and debt levels or fiscal austerity.

- Removing restrictions on the movement of capital across borders was associated with exacerbating the size and frequency of boom-bust cycles. The boom-bust cycles provide a mechanism to increase inequality.
- For austerity, it was difficult to determine any positive effect on economic growth when looking at a broad range of countries but the cost in terms of inequity is prominent and the increase in inequality has hurt the level and sustainability of growth.

Section 5.4 discusses these issues further, the use of mainstream economics theory outside its domain of applicability, and the lock-in of neoclassical economics within the academic economics profession.

Constructively, there are three significant developments outside mainstream economics spurred by the GFC, which could help Australia and China in developing more realistic economics models by taking a more pluralistic approach to economics.

- The World Economics Association (WEA 2017) promotes a pluralistic and international approach to economics, which complements the older American Economic Association that promotes neoclassical economics with a strong North American influence.
- The Curriculum in Open-access Resources in Economics (CORE 2016) project, launched in October 2013, developed a new approach to economics teaching for undergraduates. [115] The CORE (2016) project developed by a consortium of

[115] https://www.ineteconomics.org/education/curricula-modules/core-project

universities addresses many of the issues raised by Krueger (1991) and Dow et al. (2009).

- As an alternative to neoclassical general equilibrium models, Australia and China could adapt the Bank of England (Baptista et al. 2016) model to model the Australian and Chinese housing market bubbles with the aim to test stabilisation policies and policies to address inequality. The Bank of England model combines two major modelling traditions Agent-based Modelling (ABM) and Stock Flow Consistency (SFC). The ABM/SFC model overcomes many of the problems inherent in neoclassical economics' general equilibrium models.

Section 5.4 discusses the above three post GFC developments in more detail.

6.5 Long term plan to restore confidence in Australia's democracy

Crucially, these four barriers to solving wicked problems are interrelated and solving them would require farsighted leadership and putting aside the immediate short-term interests of the party for the long-term health of Australia's democracy. Meanwhile, Australia's adversarial political norm of serial political wedging in conjunction with domestic and foreign corporate political denotations continues to diminish Australia's ability to solve problems in the interest of the electorate and undermines the electorate's confidence in Australia's political institutions and politicians.

Removing the four barriers to improve Australia's ability to solve wicked problems are long-term but any inaction over climate change mitigation and the inclusive growth exacerbates both chronic problems where early action would make lighter work. The next Federal election could see a change in party leading the government. The Coalition has underperformed in addressing both climate change mitigation and inclusive growth issues. In contrast, Labor's suite of policy options looks more promising to address both issues.

Regardless of the next federal election outcome to address climate change mitigation and inclusive growth, it should not detract from completing a comprehensive upgrade of Australia's underperforming US Federal-UK Westminster Houses of Parliament hybrid and unique political donations system. The four barriers to solve wicked problems require long-term solutions and Australia will undoubtable face other wicked problems in the near future. Two emerging wicked problems are the obesity epidemic and the inability to apply a sugar tax and the decline in revenue from fuel excise to fund transport infrastructure and inability to implement road user charges.

6.6 Bring together the climate change mitigation and inclusive growth agendas

In addition to bringing together energy and emissions policies, the OECD (2017e) recommends bringing together the growth and climate agendas, calculating that integrating measures to tackle climate change into regular economic policy will have a positive impact on economic growth over the medium and long term, claiming the transition to zero emissions can produce inclusive growth (OECD 2017a), as discussed in Chapter 1.

Bring together of the climate change inclusive growth agendas provides for a building boom in energy efficiency and renewable energy to take up the slack after the decline the housings and mining booms. Fortuitously, historically low interest rates will make funding the

transition much easier. However, the Grattan Institute discussed the requirement to reflect these historical low interest rates in 'discount rate' calculations for infrastructure investment.[116] The Integrated System Plan (AEMO 2017) will help efficiently coordinate the separate state based renewable energy targets and the retirement of the coal generators. Writing the emissions targets into the National Energy Objectives to provide investment confidence would enable a cheaper transition.

However, beyond the Integrated Systems Plan for the electricity system, Australia lacks an integrated long-term response to climate adaptation and mitigation for other major infrastructures. This situation is particularly concerning with Australia's rapid population growth being amongst the fastest in the developed world. Compounding the rapid population growth, developing a fully integrated system of infrastructure is extremely challenging with Australia's multiple layers of government and private sector ownership of infrastructure. To overcome these challenge and deliver interconnected, integrated, and sustainable infrastructure strategy incorporating climate change, Consult Australia (2018) recommends establishing an independent body to plan, assess, and prioritise infrastructure projects. Acknowledging, Infrastructure Australia does provide independence but many legislatures lack independence, which in turn undermines the effectiveness Infrastructure Australia's independence to prioritise projects. Importantly, independence with transparency can help reduce corruption and facilitate the adoption of best practice (McKinsey 2017).

Ostry, Loungani and Fureceri (2016) found one successful neoliberal policy for increasing economic growth was foreign direct investment (FDI) if associated with knowledge transfer but found the removal of restrictions on the movement of capita across countries' borders exacerbated inequality. Fortunately, the Chinese Government imposed restrictions on Chinese entities making FDI into unstable assets. These restrictions will help switch Chinese investment from the Australian housing market where there is little knowledge transfer to the renewable energy sector where there is considerable more knowledge transfer. The switch should be beneficial to both countries helping stabilise Australia's housing market and support Australia's transition to zero net emission while providing Chinese investors with a more secure income stream.

For employment, Chapter 2 found the importance of the decline in the mining sector overstated and the size of the service sector increasing to generate new employment along with a historically high underemployment rate, indicating a 'gig' economy. The Productivity Commission (2017b) found Australia's regional economy transitioning the end of the resources investment boom as expected without requiring any exceptional actions. Three notable aspects to the transition are the requirement to develop the renewable energy zones, the increase in tourism and the natural resource requirements specific to renewable energy and storage. Developing renewable energy zones would bear similarities to the mining boom with a high employment construction phase and low employment operations phase. The increase in tourism signifies Australia's switch to a more service intensive economy.

For governments, the transition to zero net emissions will include further losses of royalties from the extraction of fossil fuel and the fuel excise duties. As discussed, major tax reform is one of Australia's unaddressed wicked problems and the loss of royalties and fuel excise duty intensifies the urgency for tax reform. Relatedly, the OECD (2013b) discusses the lack

[116] http://apo.org.au/node/134201

of consistency between environmental damage and tax on the different forms of fossil fuels. The reintroduction of a carbon price on all fossil fuels could address this inconsistency but would need considering concurrently with the abolition of fuel excise duty and introduction of road user charges. Noting, an ETS provides a carbon budgeting mechanism but lacks the guaranteed revenue from a carbon tax. These tax issues require considering within any tax reform but as discussed, Australia's current political system has proven unable to address major tax reform.

For businesses, climate change presents a financial risk both adapting to the physical risks of climate change and transitioning to zero net emissions. The G20 Task Force on Climate related Financial Disclosures [117,118] is developing reporting standards for companies to disclose their climate change physical and transition risks, using scenario based analysis, to the market. This will provide a better assessment of asset values and likely motivate continual improvements in adaptation and mitigation. This development of financial disclosure bears similarities to the major cultural change in the development of workplace Occupational Safety Health (OSH) that requires continual improvement in employee health and safety practices. Initially, some businesses were reluctant about introducing OSH practices but OSH has been accepted and created a cultural change for the better.

For health, eliminating the burning of fossil fuels presents major health benefits and freeing up resources for other activities. The transition will bring about a redistribution of income and wealth and environmental improvements to reshape countries, which the fossil fuel companies are resisting. Similarly, there are benefits to health, freeing up resources for other activities for smokers that stop smoking (Denniss 2017), which the tobacco industry continues to resists to maintain its income and wealth. The tobacco industry misleading the public over the cancer causing effects of tobacco bears similarities to the fossil fuel companies misleading the public over the adverse effects of burning fossil fuels on climate.[119] The class action against the tobacco industry called Tobacco Master Settlement Agreement totalled $206 billion. San Francisco is to sue oil companies over misleading the public and expects the settlement figure with the oil companies to be in the billions of dollars.[120] Australian entities holding the fossil fuel companies accountable for misleading the public provides an additional avenue to fund Australia's climate change adaptation and mitigation.

Lastly, the organisation Drawdown[121] made a comprehensive evaluation of solutions to reverse global warming using technologies that are already viable to calculate each solutions cumulative impact on reducing carbon to the year 2050 and their costs and net benefits or savings. These solutions have intrinsic value regardless of their climate value. Drawdown lists the top 100 solutions within a global context but these solutions require considering with a local context and enabling policy support, in particular a carbon price to coordinate the transition. Drawdown's "no regret" solutions bring together inclusive growth and climate change adaptation and mitigation.

[117] https://www.fsb-tcfd.org/
[118] https://theconversation.com/the-g20s-new-guidelines-will-help-investors-tackle-climate-change-80612
[119] http://www.ciel.org/news/smoke-and-fumes-2/
[120] http://www.independent.co.uk/environment/san-francisco-big-oil-lawsuit-climate-changes-fossil-fuels-knew-decades-tobacco-california-city-a7958871.html
[121] http://www.drawdown.org/

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