KONRAD ADENAUER STIFTUNG

Regional Programme
Australia and the Pacific

PERISCOPE

Occasional Analysis Paper Series, Vol 1.

Challenges of Energy Security in Australia, Europe and the Asia-Pacific Region

January 2019

Impressum

Periscope:

'Periscope' is the occasional analytical paper series of the Konrad Adenauer Foundation's Regional Programme Australia and the Pacific. Just like the real-world sighting instrument, Periscope is meant to broaden our view – taking in perspectives from different angles. In this instance, it seeks to bring together perspectives from Germany, Europe and the Australia/Pacific region in order to augment our understanding of contemporary issues in the area of foreign and security policy as well as energy, economic and social policy matters.

Copyright:

Editors:

Dr Beatrice Gorawantschy, Simon Aleker

Publisher:

Konrad Adenauer Stiftung (Australia) Limited
Regional Programme Australia and the Pacific
11/3 Sydney Avenue
Barton, ACT 2600
Australia
Tel: +61 2 6154 9322
www.kas.de/australia

Disclaimer:

Design, Layout and Typeset:

Konrad Adenauer Stiftung (Australia) Limited e.V./Corporte Design
implemented by MBE Manuka.

Table of Contents

Foreword

Energy security in the modern world of digitalisation, industrialisation and globalisation is one of the most critical prerequisites for growing economies. Every modern economy is dependent on a reliable supply of energy in order to satisfy the high energy demands of emerging transportation, communication, security, and health industries. Thus, energy security plays a fundamental role in the wellbeing of the global population.

However, achieving energy security is accompanied by significant challenges, from rapid advancements in digitalisation to the impact of climate change and shifting conditions in the geopolitical environment. Furthermore, existing energy infrastructure in industrial countries, such as Germany and Australia will have to undergo a substantial and expensive transition towards non-fossil energy systems in order to realise the greenhouse gas reductions set out in The Paris Climate Agreement of 2015.

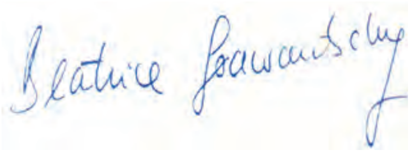
Climate change and energy supply security are of paramount concern for societies moving into the coming decades. In response, the Konrad-Adenauer-Stiftung (KAS) initiated the regional project 'Energy Security and Climate Change Asia-Pacific' in Hong Kong SAR in 2015, in order to foster networks and discussions on climate change mitigation and energy security in the region. In addition, in 2017 KAS established the Regional Programme Australia and the Pacific located in Canberra, to enhance collaboration between Australia and Germany in the fields of foreign and security policy, economic and social policy as well as energy policy.

In line with the Berlin-Canberra Declaration[1], the recommendations of the Australia-Germany Advisory Group (AGAG), and the Framework Agreement between the European Union and Australia, the KAS Canberra office launched its first Energy Security Policy Dialogue in 2018. This key event was organised in cooperation with the European Centre for Energy and Resource Security (EUCERS) at King's College London, and Climate-KIC Australia.

The inaugural Dialogue brought together leading international and regional experts from government, industry and academia, to exchange comparative and contemporary perspectives on the challenges for comprehensive energy security strategies. In particular, this new platform for energy policy debate provided the opportunity for those at the cutting edge of private and public interests to discuss the effect of energy and resource security on international relations and geopolitics in Australia, Europe and the Asia-Pacific region.

Reflecting on the thought-provoking discussions of the inaugural Energy Security Policy Dialogue, it is clear the debate will continue into 2019 and beyond. I hope that this paper will serve as a valuable contribution to highlight the manifold benefits that strategic dialogue between like-minded countries can offer – in particular in an area as important as the 21st century challenges in the energy sector.

Warm regards



Dr Beatrice Gorawantschy
Director Regional Programme
Australia and the Pacific

[1] A declaration of "Intent on a Strategic Partnership between Australia and Germany"

Executive Summary

Dr Peter Hefele

In recent years energy security has become a key component in national, regional, and global security strategies. Access to energy – and resources – is (again) seen as part of a 'great game', substantially shaping the tectonic power shifts between incumbent and rising powers. There is a global consensus that energy security nowadays comprises *three main dimensions: energy security, energy equity,* and *environmental sustainability.* These three goals constitute a 'trilemma' for policymakers, private actors, and business leaders, as complex economic and social factors, national resources, environmental concerns, and the behaviour of individuals are interwoven. All this creates a formidable challenge, which no country has so solved so far in a satisfactory manner, even if, i.e. the European Union or Germany have developed comprehensive policy frameworks to integrate these dimensions into a coherent setting.

Energy security can no longer be seen as a pure supply-side problem (as, i.e. in the oil crisis of the 1970s). Distribution and intelligent use of energy have shifted the focus towards a more sophisticated demand-side management. Furthermore, energy is increasingly seen as part of a broader understanding of resource security, acknowledging that they are inherently interconnected with issues like water or rare earth material and need to be dealt with using an overarching strategy. In addition, rapid and slow onset impacts of climate change – unstoppable by current mitigation efforts – are shifting the attention and resources of nations towards adaptation.

Climate change has massively increased the vulnerability of national/regional energy infrastructures, which is multiplied by the 'parallel revolutions' of *digitalisation, decentralisation* and *decarbonisation.* Information and Communication Technology (ICT) is changing the established energy sector and traditional energy business models by creating new consumption patterns, providers and platforms, also from outside the energy sector. Digitalisation opens new opportunities for innovation and energy efficiency but increases the leverage of cyberattacks on critical infrastructure.

The rapid deployment of renewable energies calls into questions the incumbent fossil-based power generation, as well as highly-centralised distribution networks. As an evermore rapid transformation towards a low-carbon economy is needed to mitigate climate change, decarbonisation leads to a dramatic revaluation of assets and investment strategies. Negative impacts on stable energy supply, energy justice, and social acceptance have to be carefully considered in order to ensure public support. On the other side, these transformations provide unique opportunities for innovation, new business models and value creation – provided that political and legal frameworks facilitate this transition and markets remain functioning.

There are *three major fields of future cooperation between Australia and Germany* in the areas of energy and climate change policy:

1. The 'great transformation' entails unequally distributed costs – socially as well as between regions, i.e. in lignite mining region. Active engagement by politics is needed in creating social support and in enhancing capacities to adopt and to adapt to structural economic changes. Germany has a long experience in de- and re-industrialisation processes and can provide valuable insights into how to manage these transitions.

2. Both nations are very much interested in a stable political and economic framework on regional as well as global levels – not least due to their massive dependence on well-functioning trade relations. As major middle powers and leaders in their respective regions, they have to actively contribute to regional integration, stability, and openness of markets. Energy and resource security play a crucial role in this respect.

3. Australia and Germany are home to a vast network of universities, research institutions, and think tanks in the field of energy and climate change. The challenges and complexity of the 'Energiewende' open a vast field of systematic exchange between both nations in basic research as well as in industrial application.

Introduction

Simon Aleker and Marian Schoen

In late 2016 Australia and Germany ratified the landmark Paris Agreement which came into force on the 4th November 2016. Complementary to the 2030 Agenda for Sustainable Development, with its 17 Sustainable Development Goals (SDG), the Paris Agreement under the UNFCC is a commitment of 184 countries to combat the threat of climate change and to reduce greenhouse-gas-emissions (GHG) as soon as possible. The Agreement's aim is to keep the global temperature rise this century below 2 degrees Celsius above pre-industrial levels, while pursuing efforts to further limit the temperature increase to a maximum of 1.5 degrees Celsius.

Key emitters of GHG are conventional energy sources like coal, oil and gas. Therefore a major and global energy transition from conventional to renewable or low GHG energy systems is required in order to achieve the goals of the Paris Agreement. As Australia and Germany are both industrialised countries which still rely heavily on conventional energy sources, energy transition poses a major challenge to the energy security of both countries.

Energy security in the 21st century is widely understood as a challenge to balance the trifecta of affordability, reliability and sustainability. The combination is more commonly referred to as the 'energy trilemma'; a seemingly impossible target of simultaneously achieving all three objectives. Nevertheless, with the expected future growth in energy demand, energy security will play a critical role in our environmental, social and economic development. The relevance of energy security will be a significant and determining factor of our wellbeing into the future, but there are several challenges to overcome in order to deliver the required energy security. Global trends and developments such as digitalisation, globalisation and climate change, as well as geopolitical challenges, have a severe impact on the way countries can think about, plan and provide energy security in the future. In most cases a sophisticated and profound energy transition is required.

In this context the energy policy challenge in coming decades will be to improve access to affordable and reliable energy, and strengthen energy efficiency and security, while creating opportunity at a time of rapid change and increasing uncertainty. The development of effective and sustainable energy policies must focus on the 'trilemma' of energy security, environmental compatibility and economic viability, to accelerate the actions and investments needed for a sustainable low carbon future.

The decarbonisation of energy systems is a challenge which is equally shared by Australia and Germany. Although both countries are major trading nations and like-minded international and regional players, their situation in terms of energy security is very different. Australia, for example, has an abundance of conventional energy resources and is therefore a major energy exporter. Germany, on the other hand, is a major conventional energy importer due to limited natural resources. The energy policy in both countries reflects the individual energy security situation they face. In Australia, the long term energy vision and policy preferences are set out in the Energy White Paper, released in 2015, and are framed around limiting government interventions in energy markets. Conversely, Germany's energy policy is framed around the 'Energiewende', aimed at guiding a profound energy transition towards a long-term and climate friendly energy system by 2050. This unprecedented transition to a more sustainable, secure and inclusive energy system that contributes to economic growth, societal wellbeing and sustainability, is being driven by forces inside and outside of the energy sector, such as new technological opportunities, policy shifts and changes in energy consumption.

Delegation of the Inaugural Energy Policy Dialogue, March 2018

As like-minded partners, Australia and Germany established the Australia-Germany Advisory Group (AGAG) in 2014 to develop a more substantial bilateral relationship. Among other topics, the AGAG made recommendations to strengthen the dialogue on energy, energy security, and climate change related matters. In light of this, the Australia-Germany Energy and Resources Working Group (ERWG) was established to foster and advance the energy transitions in both countries through the exchange of views, best practices and knowledge on the development of a sustainable energy system, with particular emphasis on energy efficiency and renewable energy. The potential for cooperation in global energy markets has also been a focus, given Germany's objective to diversify its energy supply and Australia's position as a major energy exporter.

Based on the positive momentum between Australia and Germany, the Regional Programme Australia and the Pacific of the Konrad-Adenauer-Stiftung, in cooperation with the European Centre for Energy and Resource Security (EUCERS) at King's College London, and Climate-KIC Australia, launched its first Energy Security Policy Dialogue in 2018.

With topics ranging from the geopolitics of energy security, the intersection of climate change with national security and regional stability, to energy efficiency and the digital transformation of energy systems and cybersecurity, this 1.5-track dialogue provided a platform to exchange views and discuss future avenues for collaboration between stakeholders leading the energy transition in their respective countries.

This paper summarises the key topics discussed at the first Energy Security Policy Dialogue and provides insights about the challenges Australia and Germany are facing in the field of energy security. It furthermore aims to highlight the positive effects a debate between like-minded partner-countries can offer. The challenges of energy security, particularly digitalisation, climate change and geopolitical aspects, will be summarised by Dr Graham Palmer. Dr Palmer also provides a discussion on the benefits energy efficiency initiatives in Australia and Germany can provide. A special contribution to this paper has been provided by Prof Dr Friedbert Pflüger, who discusses the aspects of sustainability and affordability of energy security in the EU. Dr Llewellyn Hughes presents an overview on the prospects of future cooperation in the energy nexus between Australia and Germany, with Dr Peter Hefele providing the executive summary for this paper.

As this analysis demonstrates, bilateral exchanges on best practices and technological and policy/regulatory solutions which promote open, transparent and competitive energy markets are ways to share experience and lessons learned to meet the strategic challenges of the energy transition. Australia's regional expertise and the opportunities for low carbon exports, and Germany's expertise in developing innovative technology solutions provide opportunities for collaboration and thought leadership.

Other initiatives such as the Australian-German Energy Transitions Hub, the establishment of a Climate Knowledge Innovation Community in Australia with links to EIT Climate KIC in Europe, and the support by the European Commission for an EU-Australian business network on sustainability and trade are further avenues for deepening engagement and cooperation on global energy issues.

Panel of keynote speakers at the Inaugural Energy Policy Conference with Prof Friedbert Pflüger, MP Carsten Müller, Dr Joachim Lang and Dr Kerry Schott AO

Climate Change and Energy Security

Dr Graham Palmer

The long-term effects of climate change are projected to be pervasive. Rising sea levels, storm inundation, the loss of low-lying critical infrastructure and arable land, will all contribute to global insecurity and increase the number of displaced people.

Some of the countries most vulnerable to extreme weather events are the developing countries in the Asia Pacific, especially Myanmar, Philippines, and Bangladesh. Geopolitical instability is exacerbated by growing populations, resource insecurity and natural and humanitarian disasters. Rising sea level is causing problems for megacities, such as Jakarta, and Pacific Islands.

Energy security lies at the intersection of climate change, national security, and global stability. The Paris Agreement established national emission targets. However, the challenge for governments and institutions is to develop coordinated strategies that can effectively address these complex challenges. Historically, national energy security was at the centre of national security considerations, most notably with respect to oil supply. However the challenges of climate change provide an opportunity to reset and rethink the traditional challenges. In particular, the emergence of low cost renewables and storage provide the opportunity to increase electrification of heating and transport. This opens the possibility to address climate and energy security as a part of a holistic policy framework.

Australia ratified the Paris Agreement in 2016, however there is debate as to whether Australia's current policies are sufficient to achieve its Paris target. The main policies include the Emissions Reduction Fund and the Safeguard Mechanism. Other policies include the National Energy Productivity Plan, Ozone and HFC measures, and Renewable Energy Target. The current public focus is on the National Energy Guarantee (NEG), which includes a low emissions obligation and a reliability obligation.

The highly contested and politicised Australian climate debate has made it difficult to establish effective climate policy. Perhaps the most durable policy has been the Renewable Energy Target (RET), which was implemented in 2001 and previously known as the Mandatory Renewable Energy Target (MRET). It has enjoyed broad public support and survived attempts to dilute the policy, and is the only enduring element of Australian climate policy. By itself, the RET is not the most efficient decarbonisation policy, but it has succeeded in driving investments in low-emission generation. The so-called 'energy trilemma' – reliability, affordability and decarbonised electricity supply – has tended to be seen as a suite of competing factors that must be traded off against each other. The NEG has been framed as a response to the 'trilemma'.

The Australian southern states have traditionally enjoyed low cost reticulated natural gas. The development of unconventional gas in Queensland has led to major export terminals and exposed the local market to world pricing. There has been discussion in Australia of the potential to largely dispense with natural gas for space heating, however the availability of locally sourced primary energy for heating and power hasn't incentivised an energy security shift away from gas.

As a major coal consumer and exporter, the future role of Australian coal remains contested. Carbon capture and sequestration (CCS) has remained a policy option since the late 1990s. Some international climate mitigation models, such as some of the integrated assessment models adopted as part of the IPCC scenario modelling process, show that CCS may be important for meeting climate targets.

There has been substantial public funding of CCS in Australia and CCS is considered to be a live policy option to meet climate targets. However, successful commercialisation is yet to be demonstrated at scale and there remains a significant public and private funding gap to establish whether CCS will be an important climate mitigation technology.

The idea of European Union integration was based, in part, on energy security challenges. Coal and nuclear power were originally tied to national sovereignty, but energy policy has evolved over the several years as the European electricity system has become integrated, and gas pipeline infrastructure has expanded. In contrast to the Australian 'energy trilemma', a lot of European research has shown that the trilemma can be thought of as a so-called 'energy trifecta'. In Germany, the three factors have been framed as different parts of an overall strategy, which are self-reinforcing rather than competing. In part, this is due to a near universal commitment to climate mitigation, and the European Union (EU) need to diversify energy resources.

Unlike Australia, which is a net-energy exporter, the EU is highly dependent on imported fuels. Although Russia has historically been a reliable supplier of natural gas, the reliance on Russian gas, and the transit of gas through Ukraine pipelines, has been viewed as a key vulnerability. The prevailing EU view is that there is a need to diversify gas supply and increase the number of LNG import terminals. Germany is also a natural gas transit country, with 45% of the piped gas transiting to other EU states. However, although the EU is dependent on imported oil and gas, it remains a major coal producer. In Germany, the prioritization of an exit from nuclear has had the unintended consequence of increasing reliance on coal. Over time, coal will be progressively substituted for renewables and gas. But energy transitions are also 'protracted affairs', and natural gas and LNG will have an important role in facilitating the transition to renewables.

While energy efficiency has been adopted in Australia as one part of a multi-faceted energy policy, in Germany, demand-side efficiency has had a central role. It has an equivalent status to supply-side energy strategies – a megajoule saved is one less megajoule that needs to be produced. Although the concept of 'energy efficiency first' emerged out of the Green Movement, it eventually came to be seen as a common sense approach that reconciled industry policy with environmental conservation.

The approach of Germany has been to make technological choices regarding energy supply, most notably choices around renewable energy, efficiency, and a decision to exit from nuclear power. There is an acknowledgment that policy needs to be ambitious to be effective.

Regardless of policy, technological progress and the economics of energy are heading in the right direction. Few expected the magnitude of the cost declines of wind and solar. The German Feed-in Tariff (EEG) was largely responsible for the rapid price decline in photovoltaics, and the entire world now has access to low cost solar power.

In Germany, technology choices have been embedded in transition scenarios, and mapped onto transition pathways. These low-emission technologies will require new rules, especially for heat and power 'sector coupling'. Sector coupling will offer increased flexibility for integration of natural gas and power with heating and electrical loads. Heating loads are higher in Germany than Australia. Sector coupling also faces several technical and economic challenges, particularly in relation to high capital cost.

The benefit of adopting explicit transition pathways is that they permit industry and investors to confidently invest in research and technology deployment on the basis of predictable policy. Even though German climate targets are sometimes missed, there is nonetheless broad political and social agreement as to the goals of the 'Energiewende' (energy transition).

In contrast to the directed approach of Germany, the Australian approach has been to focus on the concept of 'technology neutrality', and the promotion of carbon pricing as a key tool in climate mitigation. Although rarely achieved in practice, the concept of policy efficiency is seen as important to achieving long-term goals at least cost. Keeping technological choices open, especially coal with carbon capture, is considered essential to maintaining policy efficiency. An approach of 'picking winners' is sometimes criticized for locking in sub-optimal future pathways.

In Germany, the challenges of intermittent renewable energy are framed as 'technological challenges', and the goal has been to increase renewables penetration. Australian community support for wind and solar, has been strong, but arguments persist over the most efficient policy instruments and energy security. Although the Australian Renewable Energy Target (RET), introduced in 2001, has been maintained and strengthened, support for renewables at a federal level has been more restrained, with an emphasis on establishing a resolution to renewables integration. Instead, there has been more support from the states.

Synthetic fuels, produced from renewable energy, are one of the long-term options for energy storage and transport. Synthetic fuels could take the form of compressed hydrogen, methane, or ammonia. Methane can be used for heating or power generation, and ammonia can be combusted directly or cracked back to hydrogen for use in fuel cells. Japan is currently pursuing hydrogen for demonstrating hydrogen technology at the 2020 Tokyo Olympic Games. Synfuels are not currently economic but may emerge in combination with curtailed renewable energy as renewable penetration increases. For example, during summer, surplus solar power could be diverted for synfuel production. In time, Australia's natural endowment of surplus wind and solar energy may facilitate the export of renewably produced hydrogen or other synfuels. Many firms have ongoing investments in synfuels, such as Siemens, BMW, Honda and Toyota. Steel-making is currently dependent on coal as a reducing agent, but could be supplanted by hydrogen in the future, alleviating one of the most intractable challenges of decarbonization. European nations have interconnected electricity and gas networks, permitting diversification

of national energy supplies, but electricity and pipeline infrastructure is far less advanced in Asia. Challenges include the high capital cost of synthetic fuel production, transport, storage, and use, and the relatively low round trip efficiency.

Many countries, especially those in Asia, face the twin challenges of reducing the carbon intensity of energy; and reducing the water intensity of energy. Both of the baseload low-emissions options – coal with carbon capture, and nuclear power – are water intensive. Other low emission options also require cooling water, especially geothermal and solar CSP. But wind requires no water and photovoltaics only require water to clean the panels. In water scarce regions, energy and water are intertwined. The energy-water nexus requires a multifaceted approach to sustainable development, of which climate change is but one part. At this stage, water is not embedded in the IPCC Conference of the Parties (COP) process.

The concept of 'resilience building' is one strategy that offers opportunities for nations and institutions to address these challenges. Resilience building requires coordination and engagement across all parts of governments, as well as industry, the community and other stakeholders.

National security, climate change, and global stability are interwoven issues that require an integrated response. The lessons of climate policy are that 'first best' policies may not be achievable. Nonetheless, building national consensus and driving overarching goals will support investor certainty. Policy support for sustainable energy technologies, energy diversification strategies and energy efficiency, can support multiple goals simultaneously, and enable national security and climate goals to head in the right direction.

References

IPCC, 2013: Summary for Policymakers. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. http://www.ipcc.ch/pdf/assessment-report/ar5/wg1/WG1AR5_SPM_FINAL.pdf

Digitalisation and Energy Security Strategies

Dr Graham Palmer

Energy systems are part of a nation's essential infrastructure. They are also undergoing a digital transformation and represent key vulnerability points for cyberattacks. The primary drivers of the transformation are the digitalisation of energy; the emergence of smaller, distributed and modularised generation; and the integration of energy systems into the internet.

The digitalisation of electricity has been enabled by the availability and dramatic cost reduction of power electronics over the past 15 years. Once embedded in electrical systems, power electronics permits the generation, control and monitoring of electricity at a highly granular level. Networking capability allows energy systems to be integrated into the internet. This has opened up possibilities for markets, business models, demand management, fault control, and system integration.

However, network capability is a two-edged sword. On the one hand, networking opens up opportunities for system integration in a way that was impossible twenty years ago. However, it also makes systems vulnerable to systemic faults and cyberattacks.

The European blackout of 2006 was a two hour blackout that affected 15 million customers across 12 nations. Millions of customers were cut-off, there were long delays in rail transport, subways had to be evacuated, and the cost to restaurants and bars in spoiled products and lost sales was estimated at USD139 million. The blackout began with a routine disconnection in northern Germany, but caused cascading trips throughout Europe, reaching to Portugal and Morocco in the south-west, and Greece and the Balkans in the south-east. One of the important benefits of interconnection is usually the increased reliability of supply; however the blackout also highlighted the risks when a systemic failure occurs. In the 2006 blackout, the source was a routine disconnection. However, a cyberattack that targets a point of vulnerability could potentially propagate outwards and affect an entire continent.

The digitalisation of industrial systems is captured within the expression Industry 4.0, a term which originated from a German government strategy to promote the computerization of manufacturing. It has come to refer to intelligent systems that incorporate constant learning and improvement, adaptability, resource efficiency, and smart integration of humans and technology. In the context of energy systems, it refers to the integration of distributed energy into electricity systems; the 'internet of things', including smart appliances; demand management; markets; system balancing of variable renewable energy; and energy storage management.

Energy is one element of critical infrastructure (CI), and together with telecommunications, underpins all CI. In the near future, many smart appliances, smart grids, and other networked enabled energy equipment will sit above the 5G network. Maintaining reliable telecommunications will be essential to obtain real-time feedback of energy systems. Of concern is that the energy sector has been identified as a key target for malicious cyberattacks.

In the past, dedicated SCADA (Supervisory control and data acquisition) communications systems used proprietary technologies and were physically isolated from the Internet. A shift towards fourth generation SCADA increases interoperability, but requires robust security. The risk of cyberattacks can be reduced, but will require the implementation of security measures, such as industrial firewall and VPN solutions.

The first reported attack of a SCADA system was the Stuxnet worm, which exploited Siemens PLC software to take control of an industrial control system. It was introduced into the host system by an infected USB drive and propagated via the host network. Stuxnet highlighted the risks of vulnerabilities in a highly connected world.

'Today, an individual equipped with just a laptop can bring about greater destruction than a conventional weapon.'

The Australian Protective Security Policy Framework (PSPF) provides policy and guidance for all types of security, including ICT. It is a mandatory requirement that government agencies adopt the PSPF. The overarching body for developing cybersecurity policy in Australia is the Australian Cyber Security Centre (ACSC). Cyber security has only been elevated as a key strategic priority in relation to energy infrastructure in the past three years. The Australian Energy Market Operator (AEMO) and the Energy Networks Australia have commissioned work to assess cyber security risks associated with electricity systems.

In Europe, responsibility for critical infrastructure and cyber security lies across several EU bodies and member states. The protection of critical infrastructure was first put on the EU agenda in 2004, and the European Commission adopted a green paper on the European Programme for Critical Infrastructure Protection (EPCIP), which sets the overall legislative framework. The 2013 EU Cyber security Strategy outlined overarching principles for cyber Security. Recent policies include the EU Cybersecurity Act and the introduction of an EU-wide certification scheme for ICT products and services. The Computer Emergency Response Team (CERT-EU) is a co-ordination body that responds to security incidents and cyberthreats.

In 2014, the Australian and German Governments formed an advisory group to broaden collaboration on digital transformation, STEM and ICT education, and progress development of global Industry 4.0 standards.

With the digital transformation of energy systems and changing energy mixes, business models will need to evolve, and regulatory strategies devised to reduce the vulnerability of energy systems to cyberattacks. Entire structures may need to be changed to cope with changes, but no-one has a suite of perfect solutions. There is a need to stay 'ahead of the curve', but the adoption of prospective solutions too rapidly carries the risk of choosing the wrong strategy. Maintaining co-operation, monitoring developments, and information sharing is key to a risk management approach. There is a need for an Australian-EU-Asia-Pacific dialogue to share information.

Security relies, in part, on trusted brands and relationships. But there are issues around supply chains, and second and third tier suppliers. Major brands usually have a global presence. For example, Siemens has a large presence in China and conducts research and development globally. From a security perspective, it is difficult to create a sharp demarcation between allies and potential adversaries.

The asymmetric and pervasive nature of cyber threats means that traditional distinctions can become blurred. These include the distinction between: physical and cybersecurity threats; official and non-official threats; national and international; traditional and non-traditional; defensive and offensive cyberattacks.

The role of microgrids as a distributed energy source demonstrates a dual role in building resilience. On the one hand, distributed energy can potentially provide ongoing power during system outages, and it can be easier to isolate specific parts of the system in the event of cyberattacks. But the integration of microgrids into a networked system introduces systematic and cyber vulnerabilities. The 2006 European blackout is an example of the benefit-vulnerability trade-off. Addressing these technical challenges will require coherent regulatory frameworks that systematically address specific and general vulnerabilities.

One of the emerging technologies in peer-to-peer energy trading and distributed energy is distributed ledgers and blockchain. To date, the financial sector has progressed the furthest with blockchain. Blockchain is one example of cryptographic security, providing data integrity, authentication, and non–repudiation. Although there is significant interest in blockchain applications for energy, there are few practical implementations to date. Blockchain-enabled solutions may eventually support cyber security by providing a security layer, and there are many examples of startup ventures. At this early stage, blockchain should not be assumed to be a silver bullet, but the application of cryptography to energy markets holds promise for enhancing the security of energy systems.

A weakness of the current international framework is that there are no adequate international standards in cybersecurity. A recent German pact noted that international standards 'need to be more than an airbag or seat belt solution' – in other words, the solutions need to be embedded within the product or process rather than layered on top of existing products.

There is a need to accede to a 'higher level', reflecting a need to produce an overarching top-down framework that can be applied across multiple technology implementations. The exponential increase in internet of things (IoT) connected devices means that there is a need to embrace the internet of things.

Energy systems have already embraced several elements of Industry 4.0. Furthermore, there is an inexorable shift away from centralised and 'lumpy' generation assets towards modular and decentralised assets. However, electricity systems are yet to fully embed the physical architecture of microgrids and distributed generation, and the market and control architecture of peer-to-peer trading and blockchain-enabled solutions. These technologies offer the prospect of capturing the security benefits of distributed architectures while reducing the risks of cyberattacks.

References

Australian Signals Directorate, 2016, Australian Government Information Security Manual Principles, http://www.dpmc.gov.au/guidelines/index.cfm

Australian Department of Foreign Affairs and Trade, 2015, Collaboration, Innovation & Opportunity - Report of the Australia-Germany Advisory Group, https://dfat.gov.au/about-us/publications/international-relations/Documents/australia-germany-advisory-group.pdf

Australian Department of Resources Energy and Tourism, 2011, National Energy Security Assessment 2011, https://www.energy.gov.au/sites/g/files/net3411/f/national-energy-security assessment-2011_0.pdf

Bruch M, Münch V, Aichinger M, Kuhn M, Weymann M, Schmid G, 2011, Power Blackout Risks Risk Management Options Emerging Risk Initiative-Position Paper, CRO Forum, http://fpn.advisen.com/articles/article140935191888258975.html

Healey D, Meckler S, Antia U, Cottle E, 2016, Cyber Security Strategy for the Energy Sector, http://www.europarl.europa.eu/RegData/etudes/STUD/2016/587333/IPOL_STU(2016)587333_EN.pdf

Geopolitics and Energy Security

Dr Graham Palmer

Globally, energy demand is projected to grow by 30% by 2035. Much of the growth is being driven by the burgeoning Asian middle class. Total energy demand in Asia is projected to increase around 70% to 330 exajoules per annum by around 2035, while liquefied natural gas (LNG) demand is projected to double to 20 exajoules per annum (BP 2017). Asia currently has the highest share of coal consumption, comprising around 50% of primary energy demand. Of the fossil fuels, coal has lowest resource security risk and cost, but fails climate goals

The projected growth of Asian economic, cultural and political power is encapsulated in the concept of the 'Asian Century'. China's economic rise is being accompanied by a challenge to the geopolitical status-quo. But many Asian nations are highly dependent on imported fuels. Japan depends on imports for around 90% of its primary energy needs, and South Korea depends on 80%. The reliance on imported fuels increases vulnerability to supply shocks, which could be driven by geopolitical disputes, natural disasters, or economic shocks.

Around 61% of global petroleum production is moved by shipping, and nearly one-third currently transits the Strait of Malacca, the second-largest oil transit chokepoint in the world, after the Strait of Hormuz. The South China Sea is a significant transit route for both crude oil entering refineries in China, Japan and South Korea, and refined products being shipped eastwards and southwards. The Strait of Malacca is also an important transit route for LNG from the Persian Gulf and Africa. The largest importers of LNG in Asia are Japan and South Korea, and increasingly, China.

As a major exporter of metallurgical and thermal coal, and LNG, Australia is self-sufficient in stationary energy. However, in relation to coal, there is the risk of stranded resources and energy assets, as carbon risk is built into investment decisions by financial institutions and investment funds.

Membership of the International Energy Agency (IEA) requires oil importing countries hold a strategic oil reserve. Australia almost achieved oil self-sufficiency in the 1990s, but the trend dramatically reversed around 2000. The gap between production and consumption has been steadily widening – Australia is now 38% self-sufficient in petroleum. Australia's petroleum reserves are limited to commercial fuel held in supply chains. The vulnerability of liquid fuels has not been fully grasped in Australia and has tended to be framed within a narrow economics framework. The additional cost of oil or petroleum holdings, and maintaining refining capacity, has been considered too high. Furthermore, the Australian petroleum industry has not advocated for increased government oversight of the petroleum industry. In the 2015 Energy White Paper, the Australian Government was sanguine about Australia's liquid fuel security, arguing that supply is not vulnerable to external supply shocks due to the depth, liquidity and diversity of international crude and fuel markets.

As a resource-rich country, Australia has not traditionally emphasized the role of energy efficiency in economic production and consumer end-use. Since Australians have been accustomed to low electricity and gas prices, there has been less incentive to invest in energy efficiency. Higher efficiency would have mitigated the impact of the significant rises in the cost of electricity and natural gas in recent years.

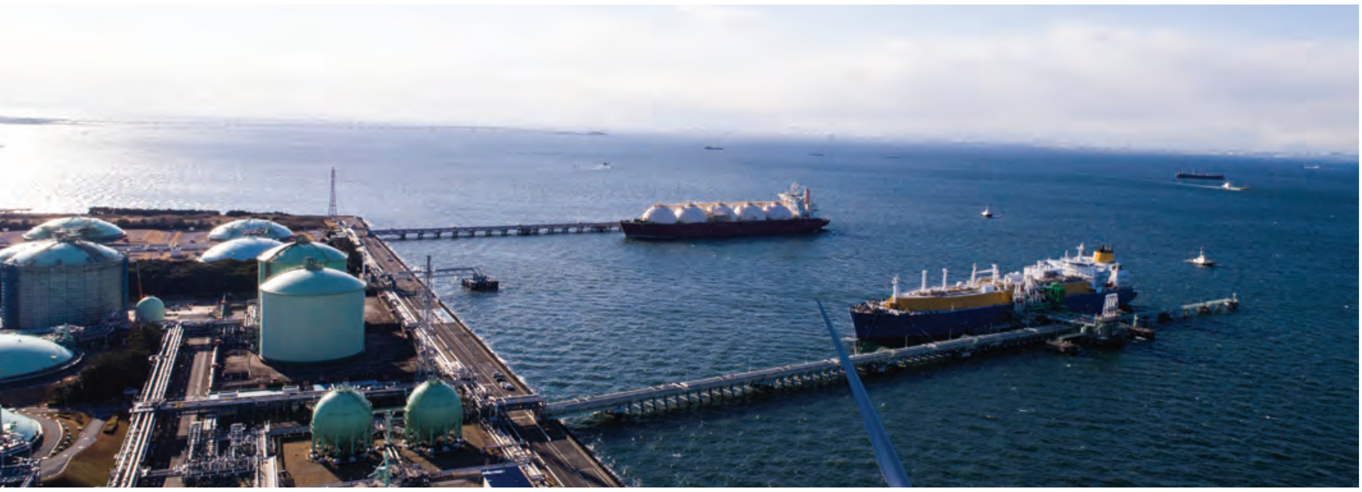
The responses to energy security concerns are multi-faceted. These include diversification of energy sources and suppliers; improving the functioning of markets; rethinking production and transport infrastructure; improving the energy efficiency of production; implementing risk management systems; and intelligent demand side management.

The Asia Pacific region recently overtook Europe and Eurasia as the largest producing region of renewable power. China is now the largest producer of renewable energy, with 150 GW of wind power and 120 GW of solar photovoltaics. Growth of these technologies is currently exponential, with a global doubling time of installed capacity of around 3 years. An expansion of renewable energy is a strategy with resource security and climate mitigation co-benefits. The main security risk is the intermittency of wind and solar. Strategies to reduce risk include energy market design that sufficiently incentivises dispatchable supply and storage while supporting growth of renewable capacity.

Through the 1970s and 80s, Japan adopted nuclear, in part, as a hedge against oil supply constraints. An operating nuclear reactor will typically contain a year's worth of supply in the reactor core, contributing to medium term energy security. In Japan, an expansion was planned to facilitate energy security and emission abatement strategies, but the 2011 Fukushima accident forced a significant revision of the role of nuclear. Furthermore, many other countries also reviewed their nuclear planning, most notably Germany. China's strategy of expanding a suite of power sources includes an expansion of nuclear, and will be the world's largest producer of nuclear power – by 2030, nuclear capacity is planned to be 120 to 150 GW.

In the longer term, a shift towards alternative fuels and electric will reduce petroleum vulnerability. These include synthetic fuels produced from renewable or nuclear power, biofuels, or liquification from fossil fuels. Aviation and shipping are likely to remain dependent on petroleum-based fuels for the foreseeable future. Liquid fuels permit high energy density storage and transportation, but other storage choices potentially enable alternative means of storing and transporting energy. For example, the German gas network typically holds the equivalent of several weeks natural gas consumption, and renewably sourced methane, via the methanation process, could be used to support renewables and buffer intermittency.

Most IEA oil importing countries hold a strategic oil reserve. For example, Germany holds substantial petroleum reserves in caverns in the north of Germany. But there also needs to be flexibility in addressing the challenge of oil security, and increasing fuel holdings is only one strategy. Other options include: maintaining or expanding local refining capacity; broadening



supply chains; arranging stock cover through leasing agreements, referred to as 'tickets'; and entering into oil-sharing agreements – for example, Germany has oil stockholding share agreements with Belgium, France, Italy and Netherlands.

The global natural gas market is liquid and there is currently surplus gas available. Strategies for improving natural gas resilience include diversifying supply, expanding pipeline infrastructure, and building LNG import terminals. By 2021, Australia is expected to be the largest LNG exporter. But despite a surplus of natural gas, the opening of export terminals has exposed the local market to the international market and there is now a challenge of bringing affordable gas to the domestic market.

A response to maritime vulnerabilities includes the construction of pipeline infrastructure. For example, the Myanmar-China oil and natural gas pipeline project stretches from Myanmar's ports in the Bay of Bengal to the Yunnan province of China. The oil portion of the pipeline was completed in August 2014, and it is now operational at full capacity.

In addition to energy security, the challenge of mineral ore production is part of the broader challenge of energy security. One class of ores, classified as the rare earths, has attracted attention because of the concentration of rare earth mining in China. Although China currently produces 90% of the global supply of rare earths, there are several international sources that could be developed given a higher commodity price. Nonetheless, alternative sources would require investment and time to develop. Many energy supply and use technologies, including renewable energy systems, rely on rare earths.

The mineral ore challenge highlights the co-dependence between mineral ores, rare earths, machinery, and suppliers. For example, although China is the world's major producer of rare earths, it requires imported machinery and components to extract and process the materials, reflecting the interconnectedness of global supply chains. Furthermore, co-dependence includes economic aspects. For example, the EU is dependent on Russian gas, but Russia is equally dependent on EU gas revenues.

At a global level, population growth, growing energy demand, and growing resource competition increase geopolitical risks and energy security vulnerabilities. Of the three main fossil fuels, only natural gas has projected significant growth.

Coal consumption has traditionally been geographically close, or within the country of origin. Imported coal is considered to have low supply risk. Both Australia and Germany possess substantial coal resources and have historically embedded coal as an integral part of the energy resource base. Although the future role of coal in Australian remains active in public policy debate, Australia is yet to adopt explicit goals for reduced consumption and export. On the other hand, Germany has a stated policy of coal reduction, including the recent 'Commission on Growth, Structural Change and Employment', which will propose a plan for a coal phase-out.

Internationally traded LNG is expanding, with the US and Australia leading the expansion. Oil remains the most geopolitically vulnerable energy resource, and liquid fuels for transport have been the most difficult to substitute.

There are several strategies that reduce the geopolitical risks of energy supply. In most nations, there is a slow but steady long-run trend towards increased electrification of total energy demand. The multiple methods of generating electricity increase the potential for diversity of energy supply, with countries able to adopt the technologies most suited to meeting national energy goals. A shift towards electrified transport, including rail and electric cars, will reduce liquid fuel reliance. In the longer term, hydrogen- or ammonia-based transport fuels, produced from multiple supply pathways, could substantially supplant petroleum-based fuels. From a fuel substitution perspective, heavy transport, shipping, and air travel are considered the most challenging.

Another strategy is the adoption of strong national energy efficiency policies. These provide two geopolitical benefits. Firstly, they reduce the energy intensity of national economies, enabling higher economic output for a given energy supply. Secondly, they improve the feasibility of higher cost energy supply options that meet other national goals, especially those that are lower emissions and less reliant on imported fuels. Germany is an exemplar of this approach.

Upscaling of local renewable energy reduces demand for conventional fuels, both locally produced and imported. On the other hand, intermittency presents a form of short-term resource security risk, increasing the need for electricity interconnection and gas fired generation for capacity firming. Technology diversity and geographic dispersion of variable renewables are two strategies to improve short-term security of supply. Energy storage, such as pumped hydro, provide additional smoothing of variable supply.

References

BP, 2017, BP Energy Outlook – 2017, https://www.bp.com/en/global/corporate/energy-economics/energy-outlook.html

BMU, 2018, Commission on Growth, Structural Change and Employment takes up work, https://www.bmu.de/en/report/7918/

Discussion: Energy Efficiency Initiatives

Dr Graham Palmer

Discussions of energy security usually focus on energy supply. But the provision of energy services comprises both supply and demand factors. The metric that provides an international comparative measure is the energy intensity of economic activity.

At a national level, energy intensity is the ratio of energy consumption to economic output. Taking energy consumption in tonnes-oil-equivalent and GDP as purchasing power parity (PPP), in 2015, Australia and Germany's energy intensity was 0.12 and 0.09 respectively, with an OECD and World average of 0.11 and 0.13 respectively (IEA 2017). Hence Australia uses comparatively more energy per unit of economic output, and Germany less, than OECD nations.

Energy efficiency is one, but not the only factor, that defines energy demand. Changes in energy demand are often decomposed to three factors:

- The growth effect, which relates to the growth of primary drivers, such as economic activity or wealth; population; or other direct factors such as tonne-kilometres shifted by freight.
- The structure effect, which relates to changes in the underlying structure of energy consuming activities. Examples include changes in the share of industry sub-sectors, such as a shift from manufacturing to service sectors; a change in ownership rates of appliances; and a shift in the share of modes of transport, such as from private vehicles to urban transit.
- The efficiency effect, which is a measure of the energy consumption per unit of activity. For transport, one measure is the diesel use per tonne-kilometre of freight; for heating or cooling, it is the energy use per square metre of housing area.

Most commonly, energy efficiency refers specifically to the last factor. However, these factors can interact in different, and sometimes unintended ways. For example, the rebound effect refers to the increasing use of an efficient product or service because an efficient product is cheaper to use than a less efficient one. One of the common examples is building heating – heaters will tend to be operated for longer and at a higher temperature when the heating system is efficient, because it is cheaper to run. On the other hand, rising fuel prices incentivise reduced heater use, or energy conservation.

Energy efficiency is often promoted as a 'win-win' policy because it addresses multiple policy objectives, including a positive economic cost-benefit. Furthermore, with respect to greenhouse emissions, energy policy measures may drive actions that exhibit a negative cost-of-abatement – the action saves both money, and reduces emissions. An example of such an action is building insulation, which typically delivers fuel savings greater than installation costs when it is installed at the time of construction.

However, despite the widespread availability and popularity of energy efficiency, there are many reasons that the full benefits may be unrealised.

Insufficient access to capital, budget constraints, or a lack of awareness of efficiency options, are prime examples. Furthermore, there are many other reasons that optimal efficiency outcomes may not be achieved.

The notion of 'split incentives' is the case in which the energy efficiency investor does not obtain the full benefit of the investment. One example is the landlord-tenant relationship – an efficiency investment by the landlord accrues to the tenant, unless the landlord can recoup some of the investment through higher rental. Conversely, the tenant may be unwilling to make the efficiency investment themselves because they may move out before realising the benefits.

Appliance, building or equipment purchasers often have imperfect information, or do not have ready access to sufficient information. This can sometimes lead to the so-called 'bounded rationality' problem, which is the idea that agents make choices that are 'satisficing' rather than optimising. It is based on the principal, that in everyday life, people make decisions that are 'good enough' rather than optimal.

Given that consumers and businesses frequently make choices that are sub-optimal from an efficiency perspective, policy makers can constrain the available options by adopting regulations or market-based instruments. Policies can be directed at maximising the public good characteristics of energy efficiency. For example, one of the earliest successful initiatives was the Japanese Top-Runner program, which set a minimum efficiency requirement for each appliance class. The minimum was set according to the weighted average value for all products in that product category, thereby truncating the worst performers and gradually lifting the weighted average. The adoption of national standards enabled economies of scale that would have been difficult in the absence of the policy.

Energy efficiency measures may be targeted towards a product or process within an industry or sub-sector. Other policies may have a broader scope, with an overarching national performance target. Policies may be funded within a defined budgetary period, comprise special purpose funding, or have ongoing funding. As part of the ordinary political cycle, policies are regularly reprioritised, wound up, or superseded.

Australia

Since 1992, Australia has adopted 55 national energy efficiency policies and measures, many of which were limited in scope, wound up, or superseded. In addition, there are also many state-based policies. The longest running national program is the Equipment Energy Efficiency Program (E3), which covers a range of residential appliances, commercial equipment, and lighting. It incorporates the Minimum Energy Performance Standards (MEPS), High Efficiency Performance Standards (HEPS) and Greenhouse and Minimum Standards (GEMS) legislation.

The most recent and significant policy is the National Energy Productivity Plan (NEPP). The Australian Government set a target to improve energy productivity by 40 per cent by 2030. The COAG Energy Council signed a new NEPP in 2015, which covers all energy use and incorporates energy market reforms and energy efficiency measures in buildings, equipment and vehicles.

In relation to buildings, the three main policies include: the Commercial Building Disclosure Program; 6 Star NatHERS Rating for Buildings, which is part of the National Construction Code; and NABERS (the National Australian Built Environment Rating System). Vehicles are covered by the fuel consumption labelling standard (ADR81/02) and fuel consumption label.

The Australian Energy Efficiency Council (EEC) is Australia's peak body for energy efficiency, and publisher of the Australian Energy Efficiency Policy Handbook. The EEC identified a suite of actions that require high-level support, and which would improve productivity and global competitiveness. These include supporting strategies that recalibrate investment between supply-side and demand-side strategies; strengthening standards for appliances, buildings and vehicles; and encouraging a globally competitive energy efficiency industry.

As a resource-rich country, with population centres in temperate regions, Australian Federal governments have not historically placed a high priority on energy efficiency policies.

Furthermore, as a pioneer society since European settlement, development and resource extraction has often been given a stronger role than preservation. Supply-side strategies have been prioritised over demand-side strategies.

Many state-based policies have been adopted, however appliance and equipment standards can only be practically implemented as national polices. Nonetheless, some state-based schemes, such as the Victorian Energy Efficiency Target (VEET) scheme, which commenced in 2009, have been effective and cost-effective.

European Union (EU)

The primary EU energy efficiency directive is Energy Efficiency Directive 2012/27/EU (EED), which was approved and entered into force in 2012. It establishes a common framework of measures to ensure the EU 2020 Energy Strategy of a 20% improvement in energy efficiency.

Germany

Since 1990, Germany has adopted 150 national energy efficiency policies and measures, with 103 still in force. EU countries must draw up National Energy Efficiency Action Plans (NEEAPs) every three years. These must include estimates of energy consumption, planned energy efficiency measures, and the expected national improvements. The National Action Plan on Energy Efficiency (NAPE) is Germany's response to the EU directive, and is part of a broader response to climate and energy policy. It represents one of the two pillars of the 'Energiewende', along with the deployment of renewable energy. NAPE comprises three elements:

- Improving energy efficiency in buildings.
- Establishing energy efficiency as an investment and business model.
- Encouraging individual responsibility for energy efficiency.

As a major manufactured goods exporter and leading producer of high value goods, Germany has legislated policies that align with the 'Energiewende', and that support Germany industry. Three important examples include -

- *Richtlinie für die Förderung von energieeffizienten und klimaschonenden Produktionsprozessen* (Guideline for the promotion of energy-efficient and climate-friendly production processes)
- *Richtlinie für die Förderung von Energiemanagementsystemen* (Guideline for the promotion of energy management systems).
- KfW Special Fund for Energy Efficiency in SMEs

In contrast to Australia, Germany has long been a net energy importer. Furthermore, Germany has a long tradition of embracing the values of nature protection and preservation, and embedding these into cultural norms and legislation. Energy efficiency and productivity has a central role in Germany, reflected in the idea that 'a megajoule saved is a megajoule that does not need to be supplied.'

References

EUR-Lex, 2010, Energy 2020 A strategy for competitive, sustainable and secure energy, https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1409650806265&uri=CELEX:52010DC0639

IEA, 2017, Key world energy statistics, https://www.iea.org/publications/freepublications/publication/KeyWorld2017.pdf

IEA, 2018, Energy Efficiency: Policies and Measures Databases – Australia, https://www.iea.org/policiesandmeasures/energyefficiency/?country=Australia

IEA, 2018, Energy Efficiency: Policies and Measures Databases – Germany, https://www.iea.org/policiesandmeasures/energyefficiency/?country=Germany

EU-Energy: Supply Security done – but what about sustainability and affordability?

Prof Dr Friedbert Pflüger

Generally speaking, it is safe to say that following the Russian-Ukrainian gas crisis of 2009, energy supply security – one pillar of the energy security 'trilemma', with the other two being affordability and sustainability – was pretty much on top of the EU's energy agenda. This is because the grade of vulnerability to external shocks in the EU at that time was significantly higher than it is today – and it was definitely felt in more than a dozen European countries that were cut-off from Russian gas supplies. People froze to death, lights on the facades of buildings were turned off, heating on public transport was cut, and gas-powered vehicles ground to a halt. This was largely due to the fact that, at that time, the EU had entire regions that were isolated from the rest of the European energy market (energy islands) and most pipelines lacked reverse flow capabilities, thus hindering countries that did have gas from delivering their supplies to those in need. Even in the rare instances where some countries did have the means to deliver gas to areas where it was badly needed, contractual stipulations prevented them from doing so due to so-called destination clauses.

After being caught unawares, the EU took a number of measures to boost energy supply security. On the broader policy level, the EU launched the Energy Union framework strategy and passed the Third Energy Package. Both of these measures aimed to facilitate the free flow of energy across national borders in the EU, the development of new technologies, new energy efficiency measures and the expansion of energy infrastructure.

So, where does Europe stand today? On the renewables front, the EU's share of renewables in energy production has increased by 65 percent from 19 percent in 2009 to about 31 percent in 2017. It is also saving more energy. EU primary energy consumption actually peaked in 2006 and has decreased by 10 percent in 2016. Nevertheless, the EU has committed itself to limit its primary energy consumption to no more than 1 483 metric tons of oil equivalent by 2020 (Mtoe). Today, it still stands at 1,543 Mtoe, which means that more needs to be done. Particularly the heating sector, which tends to frequently be overlooked, has a lot of untapped energy saving potential. In Germany, for instance, family-owned enterprises – so-called 'Hidden Champions' – are developing innovative technological solutions like hybrid appliances, for instance, which integrate two independent heat generators into one unit: a gas or oil-condensing boiler combined with an electrical heat pump. This energy mix combines 'renewable' with 'highly efficient', thus giving the consumer the option to utilize the most cost-effective and energy-efficient operating method. What is remarkable here is that this is taking place in the private sector, demonstrating that subsidies are not always necessary to drive climate-friendly solutions forward. Sometimes, just the right regulatory framework suffices as an incentive.

As far as energy supply security is concerned, the EU has improved its situation considerably. Remarkable advancements have been made in expanding the bloc's grid connectivity and gas interconnectors. Already, interconnectors between Poland, Hungary, Slovakia and Ukraine have raised their capacity from about 1 bcm/y at the beginning of 2013 to nearly 22 bcm/y by the end of 2015. Additional plans are already underway to further boost that by another 6 bcm. As a result, Gazprom has been forced to lower its gas prices for Ukraine. However, it is a general rule that sufficient gas supplies have to be available to be fed into the infrastructure before it is built. Thus, any new gas supplies will actually help drive the expansion of energy infrastructure/interconnectors in Europe forward.

Measures to boost reverse flow capability have also been undertaken. Under the EU's Gas Security Regulation, reverse flows have become mandatory, thus ensuring that in times of need, EU Member States can readily deliver energy supplies in both directions, wherever it is needed most. Much has also been done to boost gas storage capacity. Indeed, from the world's top ten gas storage countries, half today are from the EU. Moreover, from 2017 to 2023, over 30 gas storage sites are either planned or under construction. So, it is evident that progress is continuing here as well.

In addition, LNG import capacity has improved considerably. The EU now has 30 LNG import terminals with plenty of capacity to easily absorb additional shipments, be they from the US, Australia, Malaysia, Qatar, perhaps from the Eastern Mediterranean in the future, or elsewhere.

Moreover, on the legal/contractual front, the EU has banned destination clauses, which was a key hindrance to market flexibility during the gas crisis over a decade ago. This means that wherever natural gas comes from, once it is in the EU, companies can resell it to consumers in other regions, thus making where the gas actually was sourced virtually irrelevant.

Finally, several new gas options are on the horizon, including LNG from across the globe, piped gas from Azerbaijan (which is set to be delivered through the Trans Adriatic Pipeline (TAP) via the Southern Corridor), as well as gas from Iraqi-Kurdistan and Iran over the medium to long-term.

Considerable improvements have boosted the EU's supply security situation to a point where it can safely be said that it is not a top priority any longer. Not many could have foreseen how successful EU policy would be just a few years ago when it came to tackling the supply security issue. Indeed, it has come a long way. But now, it is Europe's other two pillars of the energy security trilemma, namely sustainability and affordability, that are starting to wobble.

The low price in the Emissions Trading Scheme (ETS) has not had the intended effect of incentivizing the substitution of coal power plants with more climate-friendly gas power plants. Coal use in Germany, for instance, has actually increased and the country had a number of ultra-efficient gas-fired power plants shut down because they became economically untenable. Ironically, it was Germany that undertook the most ambitious and costly measures to tackle climate change. Yet, after the 'Energiewende' was announced in 2011, Germany has only had one year where it has reduced its carbon emissions. They have increased in all other years since. As a result, the EU's largest economy will not be able to meet its 2020 climate targets.

Here, the UK's Dash for Gas in the 1990s and the US shale revolution provide valuable CO2 reduction lessons for Europe, namely that immediate CO2 reduction seems to be achieved more effectively when one picks the "low hanging fruit" first. In other words, given the urgency of climate change, the EU should perhaps first focus on weeding out the most carbon-intensive fuels like coal and oil first and substituting them with natural gas, be it in the power or transport sectors.

While the primary focus now seems to lie on strengthening the sustainability pillar in the wake of the Paris Agreement, it would be a mistake to discount the increasing challenge of higher energy prices and its impact on affordability and competitiveness. Three current trends signal the likelihood of higher rather than lower prices over the medium term.

Firstly, there is a decline in indigenous gas production. The EU's gas import gap is projected to widen due to a decline in domestic gas production, which has already decreased by 25 percent from 346 billion cubic meters (bcm) in 2004 to 259 bcm in 2015. This trend is expected to continue, particularly in light of the Groningen

gas field – Europe's largest – facing a complete shutdown by 2030. Less supply and projected higher demand usually equates to higher prices.

Secondly, generous subsidies for renewable energy have not only borne fruit, but also imposed costs. EU countries like Denmark, Germany, Italy and Ireland have some of the highest household electricity prices in the world, not least due to the heavy subsidization of renewables. In 2016, some 330,000 households in Germany had their electricity cut-off because they could not afford to pay their bills. Another 6,6 million received notices due to late payments. High electricity prices are reducing the disposable incomes of consumers while also threatening the global competitiveness of European companies. The looming specter of energy poverty should not be ignored.

Thirdly, the EU is currently risking over-politicizing its energy sector, which can limit market competitiveness and undermine the rule of law. The bloc should not be following in President Trump's footsteps by reneging on agreements or contradicting its own laws. However, it is doing exactly that. Case in point is the Nord Stream 2 pipeline, which the EU Commission is attempting to hinder under a legal pretext despite the pipeline having a full business case and complying with all Third Energy Package regulations. Looking inward and implementing protectionist policies is not the solution and never has been.

Ultimately, it is clear that through effective policies, the EU has successfully tackled the supply security challenge. Now, it must also tackle the dual challenges of sustainability and affordability.

Prospects for Future Cooperation

Assoc Prof Dr Llewelyn Hughes

Australia and Germany are engaged in the common challenge of decarbonising their energy systems. Both countries are signatories to the Paris Agreement. By 2030 Australia is committed to reducing emissions to 26-28 per cent on 2005 levels, while Germany is committed to reducing emissions by 55 percent below 1990 emissions.

While progress is being made, Australia and Germany continue to face enormous difficulties in decarbonising. The biggest problem is time. Fossil fuels are embedded in energy systems, and energy infrastructure is often durable and capital intensive. The distributional effects of replacing energy systems also make decarbonisation prone to political conflict, which slows the speed of the energy transition. And consumers expect secure energy supplies – whether in the form of reliable electricity or reasonably priced transport fuels – which requires careful planning by governments and industry.

Challenges and Complementarities

Distance suggests Australia and Germany share little beyond this shared long-term commitment to decarbonisation and the policy challenges it creates. Yet such an assessment is wrong, for at least three reasons.

First, the two countries share a **common set of challenges.** Both Australia and Germany are grappling with how to ensure the reliability of electricity systems under high penetration of renewable energy drawn from technologies such as solar photovoltaics and wind turbines. Electricity systems – once overwhelmingly centrally managed – are also increasingly drawing on distributed and intermittent sources of power. And both countries also face the challenge of managing the transition to new forms of economic activity in regions that have historically centred on the mining of, or production of energy from, coal and other fossil fuels.

In addition, governments in Australia and Germany face a complex political environment in which national and regional governments both have important roles to play. The existence of this common agenda provides an opportunity for policymakers, and businesses, in each country to learn from one another in order to better prepare for and implement deep decarbonisation strategies.

Second, Australia and Germany enjoy **important complementarities** in designing and implementing decarbonisation strategies. Germany is an acknowledged lead market in many of the technologies – and policies – that define the clean energy transition. Aside from its attractiveness as a market, Australia also sits within the Asia-Pacific region, which is at the centre of the challenge to decarbonise energy systems globally. There is tremendous expertise in the Australian government, industry, and research communities, about the economic and political changes that are occurring across the region. Australia and Germany thus have the potential to join technology leadership with knowledge and ease of access to define and promote new markets for low carbon solutions to the Asia-Pacific region.

Third, innovation and manufacturing in **renewable energy industries are increasingly globalised.** Rather than considering energy transitions as domestic policy issues, cross border trade, investment, and innovation, in low-carbon technologies and products can and should be at the centre of analyses of the low carbon transition.

Emerging Initiatives

Governments and businesses in Germany and Australia thus have much to give, and to learn, from one another in pushing forward with the decarbonisation project. Important efforts are already underway that are designed to take advantage of these complementarities between Australia and Germany.

The **Australian-German Energy Transition Hub** illustrates the kind of opportunities that exist. The Hub is a new initiative supported by Australia's Department of Foreign Affairs and Trade, and Germany's Research and Education Ministry BMBF, with important contributions made by the University of Melbourne and Australian National University – as the lead universities on the Australian side of the partnership. The Hub brings together more than 70 researchers across research institutions in Australia and Germany, including the Potsdam Institute of Climate Impact Research, the Mercator Research Institute on Global Commons and Climate Change, the University of Münster, and DW Berlin on the German side.

The work of the Hub illustrates the opportunities that exist for policy learning and industry collaboration. Hub partners in Germany are working with their Australian counterparts to incorporate Australia into the REMIND integrated assessment model, which enables scenario analyses of global energy and climate assessments. Importantly for business, it can be used to assess energy transition risks, which has emerged as an important issue due to initiatives such as the Task Force of Climate-Related Financial Disclosures (TFCD).

The Hub is also examining the joint challenges Australia and Germany face as the role of coal in power generation falls in response to rapidly falling system prices for renewable energy. This work engages questions of how to manage system reliability in electricity systems with high penetration of intermittent renewable electricity sources, including the use of demand response as a way of managing energy security risks within the electricity sector. The Hub is also examining how to manage the social implications of energy transitions in communities for which coal has played an important economic role – challenges that Australia and Germany share in common.

Australia is an ideal test-bed for better understanding the technical, economic, and policy aspects of low-carbon export opportunities. Australian governments at the federal and state levels are beginning to explore, for example, the opportunities for exporting hydrogen to the Asia-Pacific region. The Hub is leading a stakeholder engagement process in the Pilbara Kimberly region, including with a focus on industrial processes and export opportunities. It is also playing an important role in using Australian research's recognised expertise in the Asia Pacific region to identify and explain energy market dynamics in South East Asia and elsewhere.

One of the most existing opportunities that exist between the two countries lies in the promotion of innovation in low carbon technologies. German companies are a noted leader in design and manufacturing across a range of technologies, and Australia has a real opportunity to learn from the German experience. An interesting transplant from the European experience is the emergence of the Climate-KIC initiative in Australia. **Climate-KIC** is designed to promote the low carbon energy transition through building entrepreneurial networks between the private, public, and academic sectors.

Prospects for Future Cooperation

The initiatives described above are small, but are scalable. They also show that pushing forward with the low carbon transition can engage government at the federal and regional levels, incumbent and newly emerging businesses, and research communities. The development of networks through 'Track Two' initiatives can also provide a real source of resilience in the face of the inevitable challenges that emerge from the distributional implications of reorganising energy systems. Crucial to further developing the prospects for future cooperation lies now in deepening engagement across the initiatives described above – and others – while broadening the engagement of Australian and German governments, businesses, and civil society.

Authors

Simon Aleker

Simon Aleker is the Programme Manager for Energy and Climate Policy/Development Policy at the KAS Regional Programme Australia and the Pacific. He graduated in Geography from the University of Tübingen. After his research on economic and regional development in the state of Saarland he joined the National Research Institute of Papua New Guinea as an Adviser of the National Land Development Program. Before joining the Konrad Adenauer Stiftung Simon was engaged as Consultant and Research Associate at the National Research Institute of Papua New Guinea and is the author or co-author of several PNG related publications in the field of urban planning and urban development.

Dr Beatrice Gorawantschy

Dr Beatrice Gorawantschy holds a PhD in political science from the Saar University, Germany. She has been with the Konrad-Adenauer Foundation since 1992. After being posted to Ankara, Turkey (1993/94), she served as resident representative of KAS Manila, Philippines from 1995-1998 and thereafter as desk officer for South Asia, Southeast Asia, Turkey and Iran at KAS Headquarters in Germany from 1998-2002. From 2002-2005, she served as resident representative of the KAS Office in Bangkok, Thailand. This was followed by a four-year term as director of the Paris office where she was responsible for France, Italy, the Vatican and Spain. From 2009-2012 she was resident representative of KAS' India office.

From 2012 - 2015, she was Director of the Team Asia and the Pacific at Headquarters in Berlin, and from 2015-2017 she headed the Regional Programme Political Dialogue Asia and the Pacific based in Singapore. In March 2017 the new Regional Programme Australia and the Pacific, based in Canberra, was established under her directorship.

Dr Peter Hefele

Dr Peter Hefele finished his PhD Studies in Economics and Economic History in 1997 at the Catholic Uni-versity Eichstätt-Ingolstadt (Germany). He worked as an economic researcher at the Institute for Economy and Society/Bonn and joint Konrad-Adenauer-Stiftung in 2003 as Head of the Department of Economic Education. In 2006 he became Head of Division China, South East Asia, India/Team Asia and the Pacific at Konrad-Adenauer-Stiftung in Berlin (Germany).

From December 2010 to February 2015, he worked as Director of the China Office of Konrad-Adenauer-Stiftung in Shanghai. Since March 2015 he is Director of the Regional Project 'Energy Security and Climate Change' (RECAP), based in Hong Kong SAR/PR China.

His main fields of expertise are economic policy, transformational economy, international development cooperation and energy/climate policy. He is also an expert on political, economic and social developments in Asia and China.

Assoc Prof Dr Llewelyn Hughes

Dr Llewelyn Hughes is Associate Professor at the Crawford School of Public Policy at the Australian National University (ANU), where he sits on the Energy Change Institute's Executive Committee. He has authored numerous papers on energy-policy related issues, and is the author of Globalizing Oil: Firms and Oil Market Governance in France, Japan, and the United States, published by Cambridge University Press. Llewelyn is also Research Director at GR Japan, a government and public affairs consultancy based in Tokyo, where his advice helps companies in the solar photovoltaic, wind, and energy efficiency sectors navigate regulatory affairs in the Japanese market. He received a PhD from the Massachusetts Institute of Technology (MIT), and holds a Masters degree from the Graduate School of Law and Politics at the University of Tokyo. Llewelyn is trained as a simultaneous and consecutive interpreter in the Japanese language, and is a citizen of Australia, New Zealand and Great Britain.

Prof Dr Friedbert Pflüger

Professor Dr Friedbert Pflüger is Director of the European Centre of Energy and Resource Security (EUCERS) at the Department of War Studies, King's College London. He has previously served as a press secretary to former German President Richard von Weizsäcker. Member of the German Bundestag from 1990-2006, Chairman of the Bundestag Committee on the Affairs of the European Union (1998-2004) and Deputy Minister of Defence in the first Merkel Government (2005/06). Since September 2009 he is Professor for International Relations at the Department of War Studies, King's College London. He is also non-resident senior fellow at the Atlantic Council's Energy and Environment Program. Friedbert Pflüger has his own consultancy in Berlin/Erbil and is Senior Advisor for Roland Berger Strategy Consultants. He publishes frequently on current issues in energy and resource security.

Dr Graham Palmer

Dr Graham Palmer is a consultant and researcher, with an industry background as an engineer and researcher in manufacturing, HVAC and electronics. He has published in the area of biophysical economics, renewable energy, life-cycle analysis, and energy-economic modelling. Graham obtained his PhD in the energy-return-on-investment (EROI) of electricity supply. His current research interests include the future roles of hydrogen and emerging energy storage systems.

Marian Schoen

Marian Schoen is Regional Director for Victoria/Tasmania, and National Director, Partnerships for Climate KIC Australia. Previously she was Executive Director of the European Union Centre on Shared Complex Challenges at the University of Melbourne, an EU public diplomacy initiative to foster dialogue and collaboration between EU-AUS researchers, policymakers and practitioners on shared challenges of climate and energy, regional governance and innovation and entrepreneurship.

Her career in higher education spans roles in Europe and Australia as Deputy Director, LH Martin Institute for Tertiary Education Leadership and Management; General Manager, Melbourne School of Engineering; Executive Director, Melbourne Law School and Director of the Australia Centre Europe established by the Australian Group of Eight Universities in Berlin to develop European research and education partnerships and collaborations.

She has extensive experience in constitutional review and public administration, and formerly held positions as Director, Corporate Services and Public Affairs, National Native Title Tribunal; Executive Director of the Constitutional Centenary Foundation; Secretary to the Advisory Committee on Executive Government to the Constitutional Commission and Principal Legal Counsel to the Ombudsman Commission of Papua New Guinea.

Inaugural Energy Policy Dialogue

'Global Energy Security and Climate Change in Australia, Europe and the Asia-Pacific Region.'

Brisbane, Sydney, Canberra and Melbourne, 24-29 March 2018

The Konrad-Adenauer-Stiftung Energy Policy Delegation (from left): Professor Friedbert Pflüger, Dr Joachim Lang, Dr Peter Hefele, MP Carsten Müller, Dr Beatrice Gorawantschy, Christoph von Speßhardt, Dr Peter Röttgen, Dr Frank Umbach, Simon Aleker (missing in this picture is Carola Logan)

Introduction of speakers at the Inaugural Energy Policy Conference by Prof Dr Friedbert Pflüger, Director, EUCER

Keynote speech by Dr Joachim Lang, Director General of BDI at the Inaugural Energy Policy Conference

Keynote speech by Carsten Müller, Member of the German Federal Parliament at the Inaugural Energy Policy Conference

Panel of the Inaugural Energy Policy Conference with Patrick Suckling, Ambassador for Environment at DFAT, MP Carsten Müller, Member of the German Federal Parliament and Caroline Lambert, Climate and Environment Counsellor of the EU

Panel of the Inaugural Energy Policy Conference with Dr Paul Burke, Kane Thornton, Dr Peter Röttgen, Dr Paul Barnes and Colonel Ian Cumming

Third panel of the Inaugural Energy Policy Conference with Dr Frank Umbach, Prof Dr Friedbert Pflüger Jeff Connolly and Fergus Hanson

Notes

KONRAD
ADENAUER
STIFTUNG

Contact

Konrad Adenauer Stiftung (Australia) Limited
Regional Programme Australia and the Pacific
11/3 Sydney Avenue
Barton, ACT 2600
Australia
Tel: +61 2 6154 9322

Follow us:
www.kas.de/australia
www.facebook.com/KAS.canberra
www.linkedin.com/company/konradadenauerstiftungaustralia