2XEP: doubling energy productivity in Australia by 2030

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Abstract

The productivity of the Australian economy has been stagnant for much of the last two decades. The long-term negative impact of this on Australian competitiveness and living standards was masked by windfall gains from strong terms of trade resulting from rapidly escalating mining income, but this situation reversed as prices for key export commodities declined. To grow national income Australia must improve the productivity of labour, capital and other inputs (i.e. multi-factor productivity), and this is now a central concern of national and State governments. Australia spent about $A110 billion (B€77 at current exchange rate of €/$A0.7) on energy in 2011–12[1], which equates to about 7.5 % of Gross Domestic Product (GDP). This is a major and escalating cost to the economy. Boosting energy productivity is essential to improving the competitiveness of the Australian economy.

The Australian Alliance to Save Energy (A2SE) is educating business and government on the imperative for improving energy productivity, and has followed the lead of the US Alliance to Save Energy by proposing a target of doubling energy productivity (2xEP) of the Australian economy by 2030.

The focus on 'energy productivity' is a departure from the traditional energy efficiency approach. Energy productivity aims to measure the total value (or utility) gained from each physical unit of primary energy deployed or each dollar of delivered energy. This metric makes more sense both to business and to Australia's conservative government. 'Energy productivity' directly addresses the energy competitiveness issues faced by Australia particularly as a result of escalating energy prices, and captures the full value gained (multiple benefits) from improving the application of energy resources.

This paper reviews the justification for urgent action on energy productivity in Australia, discusses the concept of energy productivity including measurement methodology and proposed metrics, examines ways of improving energy productivity and the task of doubling energy productivity (2xEP) by 2030, and explains the approach of A2SE to build support for 2xEP.

Introduction

Since the 1960's Australia has built an energy intensive manufacturing sector on plentiful coal resources and low cost centralised coal-fired power generation. The legacy of long term access to low cost energy is relatively low energy productivity (except in some energy intensive internationally owned operations) and a low rate of improvement compared with other comparable economies. This structural weakness has been aggravated by the rapid escalation of energy prices in Australia (due to over-investment in electricity networks and domestic exposure to international LNG markets with the commencement of large scale export of gas from the east coast).

In September 2013, the Abbott-led Coalition gained power and rapidly dismantled most of the carbon mitigation policies of the previous government (including the carbon tax – our price on carbon pollution). The Coalition's alternative 'Direct Action' program, with its centrepiece 'Emission Reduction Fund' may not be sufficient in its current form to deliver Aus-

1. Australian Bureau of Statistics, 2013, 2014.

tralia's modest target of reducing greenhouse gas emissions in 2020 by 5 % from 2000 levels, particularly if the renewable energy target is reduced as the government proposes. Australia does not have a national energy efficiency improvement target or a coherent national energy efficiency program. (It is expected however that the Energy White Paper expected in March will call for the development of a national energy productivity plan).

A2SE recognised that improving the energy productivity of the Australian economy was probably the only method to reduce carbon emissions that would be accepted by all political parties – allowing for non-partisan and long term policy.. The Alliance to Save Energy in USA (represented on our Board) had successfully run a program to gain consensus from both sides of politics for setting a target for the USA of doubling energy productivity (2xEP) by 2030. We decided on a similar approach, and launched the A2SE Productivity Roadmap initiative, targeting a doubling of energy productivity (2xEP) in Australia by 2030. The 2xEP Roadmap project commenced in April 2014 with a workshop on Energy Productivity, where leaders from all sectors of the economy were invited to present on how they could achieve 2xEP in their sectors. We then developed a comprehensive framing paper which included the first steps to define economical pathways toward a significant and sustained change in energy productivity. [2] This paper is available on the A2SE web-site www.a2se.org.au.

We then undertook development of discussion papers for each of the major energy using sectors of the economy. These each look at the current status of energy productivity in the sector, the opportunities for improving energy productivity, whether it is feasible for the sector to achieve 2xEP by 2030, constraints to achieving the target and potential policies and actions that can be undertaken by the sector and by government to achieve the target. These papers are the basis for extensive stakeholder engagement to develop first cut 2xEP roadmaps for each sector.

Discussion papers are complete for the manufacturing, mining and agriculture sectors (and will be available from our website). Papers are in preparation for the built environment (commercial and residential) and for the passenger transport sector. We are raising funds at present to develop a freight transport sector paper and are also in discussions about an infrastructure paper (focused on the water industry). We have put the energy supply sector on hold until we have completed roadmaps for the key end use sectors, because there are other projects addressing this sector.

WHY ENERGY PRODUCTIVITY?

Energy conservation, efficiency, intensity and productivity are frequently used interchangeably, but there are important differences. Energy conservation is about reducing energy use, and does not explicitly consider the value delivered by energy services foregone. Thermodynamic energy efficiency is measured at the device level, such as a refrigerator, air-conditioner or lamp. Consequently energy efficiency in the operational context is generally associated with using less energy to provide the same service. Even though organisations such as the International Energy Agency (IEA) have recently attempted to extend the definition of energy efficiency to include the concept of producing more services for the same energy inputs, the association prevails. [3, 4, 5]

Energy intensity is commonly used these days as an aggregate energy efficiency indicator, even though it is an imperfect aggregate indicator for the concept of energy efficiency defined above.[6] In Australia energy intensity is now measured by government agencies as ***final*** energy demand per unit of economic value added. In the past this term has generally been used at industry level to refer to energy use/unit output, and the meaning of energy intensive industry was industry with high GJ/tonne.

By using concepts of economic output, 'energy productivity' aims to capture the total economic benefit to society or total value created (typically through increased Gross Domestic Product), which captures the 'other dividends' of investing in improved energy efficiency as presented by the IEA in their report 'Capturing the multiple benefits of energy efficiency'. This may include benefits such as improved health[7], which flows through in economic benefits such as reduced absenteeism. Consequently, energy productivity, i.e. the measure of the economic value created per unit of energy consumed (or energy dollar spend), as illustrated in Figure 1 below, is influenced by changes in the economic structure, business cycles[8] (e.g. exchange rates, energy market functioning and government policy settings.

Since the competitiveness of a society is heavily influenced by its productivity[9] the use of 'energy productivity' presents the opportunity to explore the full range of strategies to influence this broad measure as discussed later. Furthermore, the language of energy productivity has a distinct advantage since governments and business people are not generally compelled by energy performance metrics. However, they do understand the language of value creation and productivity improvement. By using the 'energy productivity' metric, energy can be more readily understood to be part of the national economic agenda, as well as the shareholder value creation agenda of individual firms.

HOW IS ENERGY PRODUCTIVITY MEASURED?

The traditional use of energy efficiency as the main energy performance metric had the benefit of simplicity, measuring physical energy performance per unit of output or compared to a theoretical benchmark such as best available technology standards. Energy productivity is a more complex concept, influenced by the diverse range of factors ranging from exchange rates to energy market regulation, product market structure and dynamics, and changes in the structure of the economy as

2. Stadler, A., Jutsen, J. Pears, A. & Smith M (2014), 2xEP: Australia's Energy Productivity Opportunity, Draft Version 1.2 Sydney: Australian Alliance to Save Energy.

3. Lawrence Berkley National Laboratory (2015).

4. Ang, B. W. (2006).

5. International Energy Agency (2014).

6. Samuelson, R. D. (2014).

7. E.g. for homes – insulation and efficient heating/cooling or mining – control of ventilation systems.

8. Down turns can result in underutilisation of capacity without a corresponding drop in energy demand in magnitude and time frame, whilst commodity boom periods could pending monetary policy setting result in significant change in the exchange rate.

9. Schwab, K., Sala-i-Martin, X., & World Economic Forum. (2014).

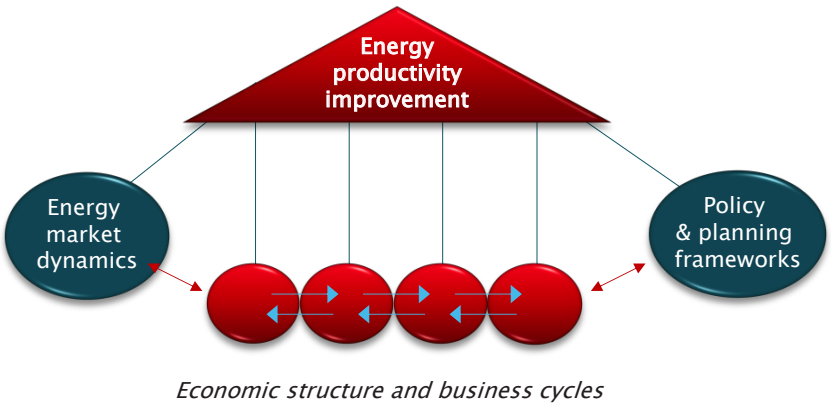

Figure 1. Drivers and market context impacting energy productivity outcomes.

discussed (illustrated in Figure 1). This presents a number of challenges to policy makers and industry alike:

- Firstly, structural changes in the economy and underlying changes in the way energy is used are typically gradual[10], whereas exchange rates and commodity prices fluctuate over much shorter timeframes. In a commodity driven, open economy, the impact of these short term changes can result in a volatile measure. An absolute year-on-year target is therefore not a practical option for policy makers, or corporates.
- Secondly, the aggregate classic energy productivity (EP) indicators and variations do not reveal the drivers behind the observed trends in energy productivity. EP captures such a broad range of factors that the impact of government policies or company strategies may get lost in the 'noise' of counteracting influences, unless the factors targeted for 'improvement' can be isolated.
- Thirdly, differences in economic structures and stage of economic development complicate international comparisons of energy productivity. A broad brush global ranking, although of some value, is less meaningful than benchmarking against competitor nations in global markets and the improvement trend.

A2SE's evolving measurement approach proposes to addresses these challenges. It will:

- Setting a long term improvement target that will bring Australia's improvement in energy productivity performance (i.e. change in real GDP per unit of primary energy) in line with the improvement targets set by key Group of 20 (G20) economies.[11]
- Measure progress towards targets using a three (or five) year moving average to reduce the impact of irregular patters (e.g. extreme weather conditions) and changes in business cycles. This will smooth out the trend, as illustrated in Figure 2 with reference to Australian data, and more closely reflect the real underlying changes in energy use, which is typically more gradual.
- Establish a measurement framework that is sufficiently flexibility to accommodate the diversity of influences across economic sectors, as well as the needs of users ranging from national and state governments, to industry associations and individual firms.
- Utilise decomposition analysis (IDA, also referred to as factorisation) as an analytical tool to decompose productivity measures to a number of pre-defined factors of interest[12] targeted by policy makers or corporate strategists.[13] The proposed approach is not dissimilar to that adopted by the Australian Bureau of Resource and Energy Economics (BREE), which utilises the Log Mean Divisia Index (LMDI) energy accounting framework to separate the effect of structural changes and increased economic activity from the underlying change in the efficiency with which energy is used in the economy as illustrated in Figure 3.[14]

The framework for energy productivity is proposed to use three levels of measurement, namely:

- The primary metric used at national level is $-real GDP per physical unit of energy deployed (typically primary energy). At sector level sales and service income is used as the numerator.
- The secondary metric is proposed to track energy cost as a key dimension of competitiveness. Energy price competitiveness can be measured as $-nominal GDP or Value Added per dollar $-energy consumed. At sector level, sales and service income can be used as the numerator.
- The introduction of a tertiary measurement level consisting of composite energy productivity indices, which allows for a level of flexibility at sector and even site level (i.e. does not prescribe measures at micro level). Since indices are in-

10. Enerdata. (2010).

11. Note, this refers to trend, rather than absolute energy productivity target . Absolute benchmarks are however appropriate at industry level, considering domestic and global competitors in key markets measured as Sales & Service Income per unit of energy (primary at sector level and final at individual firm level).

12. E.g. energy efficiency or structural shifts, such as reduced passenger miles in a specific mode of transport, such as cars, that could reduce overall energy use.

13. Ang, B. W. (2004).

14. Che, N., & Pham, P. (2012).

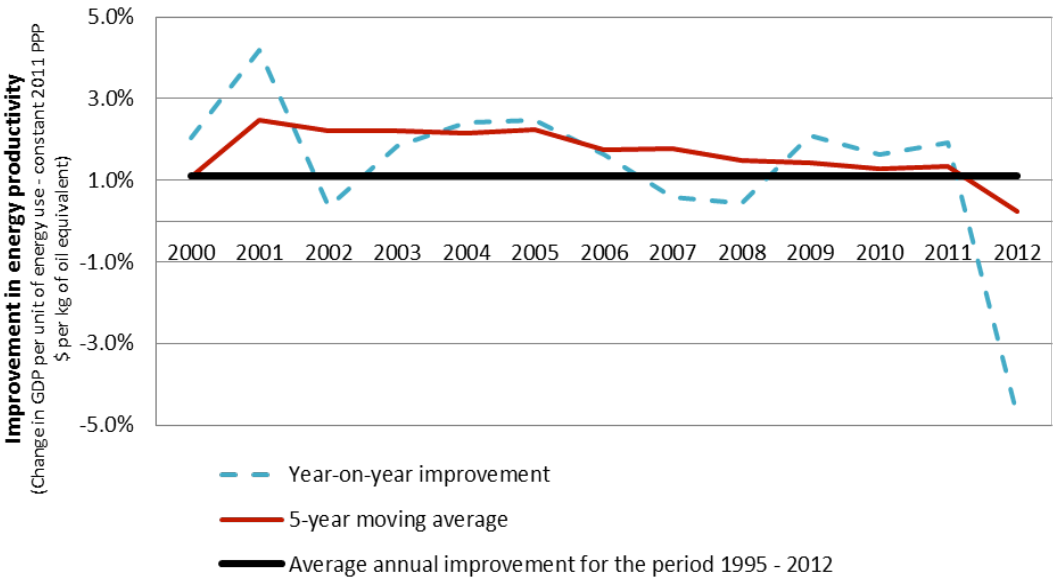

Figure 2. Trend in Australian energy productivity improvement on a constant PPP basis.

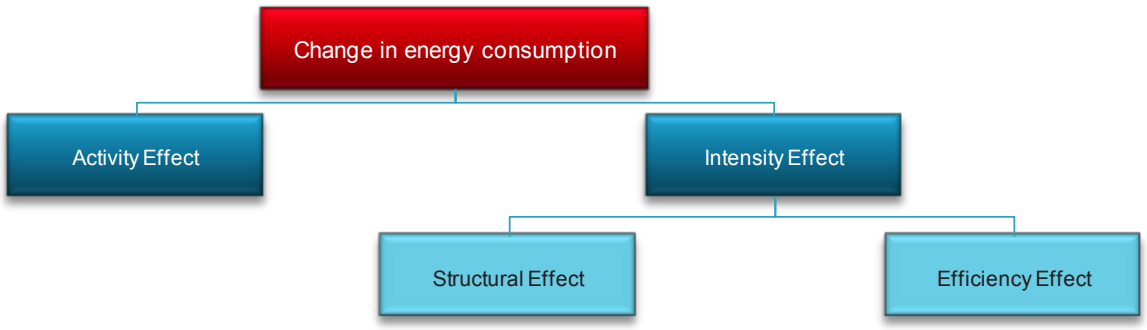

Figure 3. Decomposition of change in energy consumption.

sensitive to unit of measurement, it will enable individual firms and industry associations supporting the energy productivity agenda to select measures that a most appropriate to their economic activity and energy productivity strategy. However, at a macro level aggregation of a diverse range of measures in a weighted composite energy productivity index will support comparisons in improvement trends across sectors and subsectors irrespective of the measures used. In the same way, similar weighted composite energy productivity indices can be developed to measure the impact of a specific program.

It is recognised that not all 'qualitative improvement' in economic output will translate into improved GDP over the measurement timeframes (e.g. reduced air pollution or emissions). Consequently, a set of shadow measures have also been proposed that allows for example for the impact of renewables to be reflected in the primary measure (i.e. adjustments made to primary energy use) and the secondary measure (i.e. energy price competitiveness) to take account of externalities (e.g. add shadow carbon price to the cost of energy).

Rationale for doubling Australia's energy productivity

Australia's energy productivity, measured as GDP per unit of energy input, is 14 % lower than the average of the G20 economies in US$ purchasing power parity terms[15] (see Figure 4[16]). Not only are the USA and Europe already adding more economic value per unit of energy, they have set aggressive improvement targets (European Union targets a 20 % decrease in energy intensity compared to 1990 levels by 2020 and more than 27 % by 2030, whilst the USA has adopted a target to double energy productivity by 2030 compared to 2005 levels) and, as a result, are accelerating away from Australia. Making this more problematic is the fact that, at the same time as Australian energy prices have been rapidly increasing in the last 5 years, energy prices in Europe and the USA have been largely static or

15. World Bank, n.d.
16. Stadler, A., et al (2014).

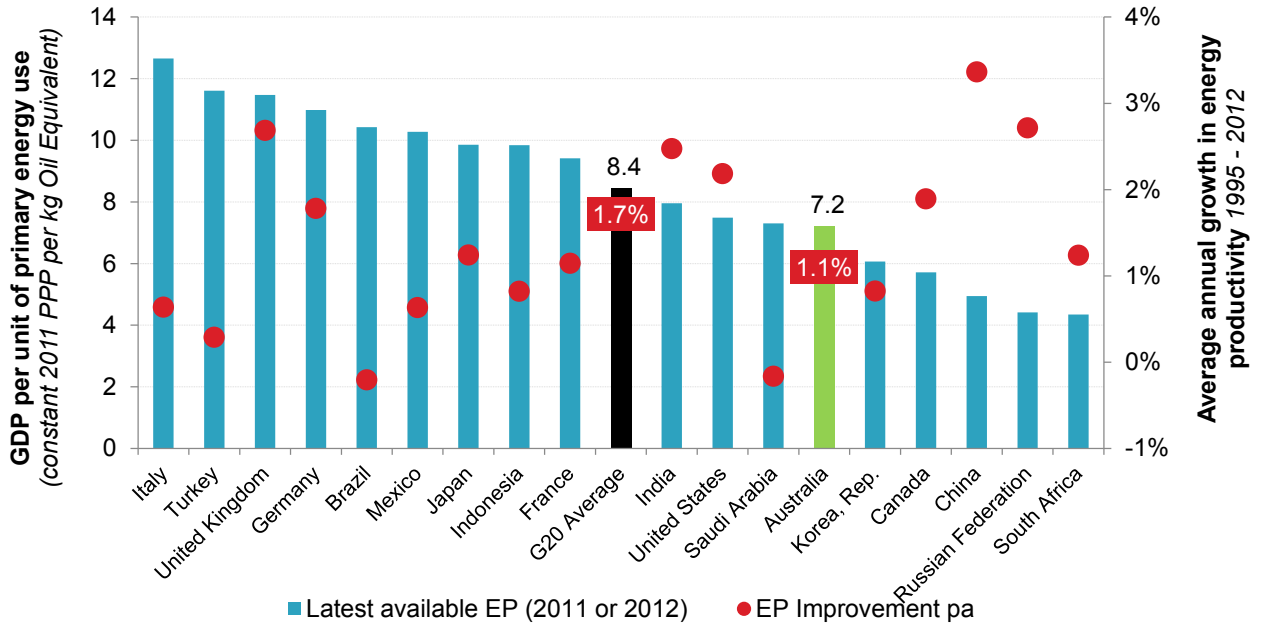

Figure 4. Australia's energy performance rank low relative to G20 peers and is improving at a much slower rate.

declining in real terms.[17] In comparison, Australia has achieved a meagre energy productivity improvement of 1.1 % per annum over the period 1995–2012.

Strategies to improve energy productivity

Improvement in energy productivity can be achieved by either increasing the value of economic output in quantitative or qualitative[18] terms using the same or less energy, or by reducing the demand for energy required to produce the same economic output. Strategies that can be used to increase energy productivity can be grouped under four broad strategic areas as illustrated in Figure 5, namely:

- Traditional energy management, which includes energy efficiency improvement and demand management,
- System optimisation, both at facility level and across industry value chains, with an energy focus. This includes strategies such as capacity utilisation of manufacturing plants and energy networks, as well as the integrated transport centric urban infrastructure design.
- Transformation of business models use by industry sectors. While energy is seldom the driver behind industry transformation, increased consideration of the energy implications of new ways of designing, developing and delivering services and products could have significant business and societal benefits.
- Value creation or preservation, including a focus on increased throughput, value add and/or improving the quality of outputs which could in some instances also reduce downstream energy consumption, waste or emissions (e.g. improving the quality of ore shipped to smelters can reduce downstream energy consumption associated with removing impurities during smelting by up to 10 times, with obvious implications for air pollution[19], or a switch to more greatly transformed products with greater value and lower energy intensity.

These strategic areas are not mutually exclusive. Multiple strategies can be pursued on a complementary basis. Whilst industry could drive improvements in many of the areas without government intervention, policy support targeting priority barriers to could accelerate required changes.

What is required for Australia to double its energy productivity?

A2SE is working with business, government and research partners to develop a 2xEP Roadmap – a credible plan to substantially improve Australia's energy productivity. Initially, A2SE proposes a target of doubling our energy productivity by 2030.[20] This has the benefit of being a stretch target that appears challenging (but probably within reach), as well as aligning with the existing USA improvement target adopted by the Obama administration in 2014. The feasibility of achieving this target will be tested at a sectoral and aggregate level as roadmap development continues.

17. Alliance to Save Energy, 2013b; European Commission, 2014.

18. Quality can manifest in increased economic value due in the short term due to the perceived value attached by consumers (e.g. organic food). However, this also includes longer term societal impacts such as reduced air pollution or emissions which may not manifest in the short term in reduced cost to the economy or increased economic output.

19. Pease, J. (2014, September).

20. Base year set for illustrative purposes as 2010, but still to be agreed in consultation with stakeholders.

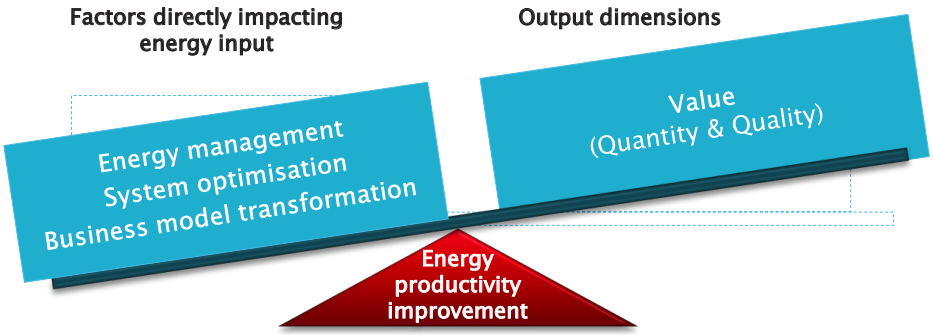

Figure 5. Energy productivity strategies target a reduction in inputs and/or increase in the value of outputs.

Our preliminary high-level estimate of the magnitude of the change required for doubling energy productivity implies a 3.5 % per annum improvement in energy productivity (i.e. 2010 to 2030).[21] This measure translates to an increase from $219 real GDP (2010$) per unit of energy input (primary energy measured in GJ) in 2010 to $438 in 2030. Based on our preliminary assessment using a decomposition analysis approach similar to that illustrated in Figure 3, about 60 % of the improvement is expected to be driven by current projections of the economic *output growth and structural changes* in the sectoral composition of the Australian economy.

The remaining 40 % (or 1.4 % per annum) of the improvement will be required from enhancements in the *productive use of energy*[22] in the economy. This is more than three times the annual improvement in the efficiency effect at the current aggregate rate of 0.4 % over the last 8 year period ending June 2013.[23] However, this is not dissimilar from the average annual energy efficiency improvement by Australia's industrial sector recorded between 2008 and 2010[24], albeit that this period was characterised by major government energy-efficiency programs targeting improvements in energy performance in industry, including the Energy Efficiency Opportunity program (EEO) and the Clean Technology Investment Program (CTIP), which were dismantled by the incoming Liberal government in late 2013.

Previous studies[25] of the potential for energy savings for the period ending 2020 have predominantly focused on energy efficiency opportunities (i.e. one of the four strategic areas illustrated in Figure 5). These studies identified an economic potential of about 47 % (or 537 PJ) of the required 1,147 PJ final energy-demand reduction required to reach the 2xEP goal of $438/GJ by 2030. This would leave a shortfall of 790 PJ of energy savings. Targeting a reduction in inputs through energy efficiency will therefore not be sufficient. Consideration also needs to be given to the other three strategic areas referred to in Figure 5 to close this gap.

Meeting this challenge necessitates a long-term perspective stretching to 2030 and beyond, and incorporating all the other energy productivity strategies, including system optimisation and transformation of the business models used by industry and government.

Potential Benefits from 2xEP

The benefits of improved energy productivity will be confirmed as the Roadmap project continues, including through a more in-depth empirical review of economic productivity in Australia and by commissioning economic modelling specifically for this initiative. However, based on recent studies that have drawn a link between the more efficient use of energy and economic growth,[26] doubling energy productivity would deliver a 2.8 % increase in GDP by 2030, equivalent to a gain of $59.5 bn GDP ($2010) in that year, assuming all else being constant. This is a significant contribution to GDP, given that the G20 economies will aim to lift their collective GDP from all economic activity by more than 2 % above the trajectory implied by current policies over the coming five years[27].

In addition, as established by the American Alliance Commission on National Energy Efficiency Policy, a doubling of energy productivity also has the benefit of cost effectively reducing greenhouse gas emissions by 33 % by 2030, compared to 2005 levels[28]. The impact of an Australian energy-productivity strategy on the country's emissions profile will be assessed in detail as part of future iterations of the analysis. However, A2SE's preliminary modelling suggests that doubling energy productivity by 2030 equates to an approximately 25 % reduction in Australia's forecast 2030 emissions[29]. The preliminary modelling is based the 2030 aggregate emissions intensity projected and assumed a 74:26 split in projected energy savings between stationary and transport fuels. This split assumes that passenger vehicles standards will be increased.

21. Based on Bureau of Resources and Energy Economics (BREE) forecast for 2030 and modelled improvement in economic output flowing from annual improvement in energy efficiency.

22. The efficiency effect, excluding structural effects and growth in activity levels as illustrated in the decomposition framework presented in Figure 3.

23. In modelling the impact of doubling energy productivity, the A2SE 2XEP Project utilised energy consumption and demand forecast data produced by BREE, and economic data and projections produced by the Australian Treasury and Australian Bureau of Statistics.

24. ClimateWorks. (2013b).

25. ClimateWorks. (2013a; 2014); Department of Industry. (2014); Pitt & Sherry. (2013).

26. Empirical link of 10% improvement in energy:1% gain in GDP/capita was established (Vivid Economics, 2013).

27. G20, 2014.

28. Alliance to Save Energy, 2013b.

29. Department of the Environment, 2013.

Conclusion

A2SE is engaged in a highly challenging undertaking of attempting to gain consensus by business in all major energy using sectors to setting and delivering major improvements in energy productivity in the next 15 years, and to then gain support for this proposed target and programs from all major political parties at State and national levels.

In the last 12 months, 'energy productivity' has rapidly gained support as the best approach to address energy use to drive improved energy performance in the Australia economy, and is bringing energy management into core government policy priorities. We are gaining momentum rapidly because this approach makes better sense to business people and policy makers and provides targets which align with human desires to keep improving rather than the concept of conserving or implied 'doing without'.

We are gaining confidence that in 2015 we can achieve our objective of gaining general business and government support for 2xEP.

The next stage in our process is to conduct comprehensive engagement of key stakeholders in each sector to gain feedback on the sector plans and convert them into agreed sector Roadmaps with agreed energy productivity target and specific plans to deliver them. These sector stakeholders, together with roadmap 'patrons', will join A2SE in approaching governments to seek support for the Roadmaps. We will then prepare a consolidated national roadmap and engage on a communications program aimed at gaining strong business and political consensus for the plan by the end of this year.

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