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The missing step

Does Australia need a national industrial policy?

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In 2014 Catherine Livingstone, President of the Business Council of Australia (BCA), suggested that in Australia "government, in collaboration with business, can provide for another decade of economic growth only by setting clear goals for different sectors based on a deep understanding of their competitive position. Government must design policy in a purposeful way so that as many sectors as possible can be as globally competitive as possible… Had government collaborated with the automotive manufacturing sector a decade ago, to facilitate the transition to a business model based on supplying niche products into global supply chains, we may now have a viable sector." And she concluded with the observation that "The latest unemployment figures speak for themselves."

Previously, the 2014 National Commission of Audit suggested that "Commonwealth funding of higher education promotes quality, equity of access and national consistency for higher education. This, in turn, contributes to a more skilled, flexible and productive workforce, with higher

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wages and lower unemployment resulting in higher tax revenues, reduced unemployment costs and improved international competitiveness".[2]

Apparently Australia has an excellent higher education system and our graduates are highly skilled and respected internationally. Why is it then that we shy away from developing a comprehensive and strategic industrial policy that will foster new industries creating the jobs for those highly qualified graduates?

Many governments around the world see strategic industrial development as one of their priorities for providing their citizens with a prosperous, safe and happy future. This is what they were elected for. They aim for high and stable workforce participation; and they try to avoid the so-called "brain-drain" whereby their country's sharpest minds move abroad, taking their ingenuity and skills with them to benefit another nation – not only is that highly skilled graduate taking their good ideas with them, but they may also be taking "embedded" Commonwealth investment with them.

Education is a continuum. It isn't finished after graduation from high school or university. A few will continue in academia – and face a ruthless selection process, which at the moment sees only 3% of graduates become tenured academics. The vast majority of graduates will take jobs outside a university environment. Internships, or "work integrated learning programs" as they are now called, provide a cost-effective and mutually-beneficial arrangement whereby future employers can seek out the best graduates for their industry and can ascertain their "fit" for the industry in question. These people are looking for challenging employment opportunities – or possibly even the right environment to start their own business – but whatever they choose they'll be putting their skills and knowledge to the benefit of the nation in the form of innovation and taxes.

The continuing debate in Australia is very much focussed on how best to fund and structure the education system for the Australian population, as well as for (fee paying) international students. But what comes after graduation?

Many students at research intensive universities have learned to work in areas in which the future is just about to begin. Most of them will not be challenged or satisfied by working in contexts from the past, and indeed for many computer science and engineering students the first year of their tertiary degree will be obsolete by the time they graduate.

Not surprisingly, closing the gap between producing highly educated graduates and fully exploiting their skills, ingenuity and dedication, relies on a mixture of strategic foresight, political commitment, funding, and a dollop of good luck. Inevitably, lessons from abroad are instructive, with the experience of Silicon-Valley leading the charge.

The genesis of Silicon Valley

Contrary to what contemporary politicians and public managers might have you believe, the development of Silicon Valley was not left to free market forces alone. The San Francisco Bay Area had long been a major site of United States Navy research and technology. In 1909, Charles Herrold started the first radio station in the USA in San Jose. The Federal Telegraph Corporation (FTC) in Palo Alto created the world's first global radio communication system, funded through a contract with the US Navy in 1912.

The National Advisory Committee for Aeronautics (NACA, forerunner of NASA) took over Moffett Field for aeronautics research in 1947. One of the companies at Moffett field that benefitted directly from the

[2] NCOA 2014: 7.13, *http://www.ncoa.gov.au/report/phase-one/part-b/7-13-higher-education-arrangements.html*

government-funded research and the subsequent government contracts was Lockheed.

After World War II, universities were experiencing enormous demand due to returning students. To address the financial demands of Stanford's growth requirements, and to provide local employment opportunities for graduating students, Frederick Terman proposed the leasing of Stanford's lands for use as an office park, named the Stanford Industrial Park (later Stanford Research Park). Leases were limited to high technology companies. Its first tenant was Varian Associates, founded by Stanford alumni in the 1930s to build military radar components.

… and along came the silicon transistor

In 1956, William Shockley founded Shockley Semiconductor Laboratory in the valley. Shockley believed that silicon was the better material for making transistors than germanium. Shockley intended to replace the current transistor with a new three-element design (today known as the Shockley diode), but the design was considerably more difficult to build than the "simple" transistor. In 1957, Shockley decided to end research on the silicon transistor. As a result of Shockley's abusive management style, eight engineers left the company to form Fairchild Semiconductor. Two of the original employees of Fairchild Semiconductor, Robert Noyce and Gordon Moore, would go on to found Intel.

… followed by the rise of software

Although semiconductors are still a major component of the area's economy, Silicon Valley has been most famous in recent years for innovations in software and Internet services, and has significantly influenced computer operating systems, software, and user interfaces.

Using money from NASA and the US Air Force, and while at Stanford Research Institute (now SRI International), Doug Engelbart invented the mouse and hypertext-based collaboration tools in the mid-1960s. When Engelbart's Augmentation Research Center declined in influence due to personal conflicts and the loss of government funding, Xerox hired some of Engelbart's best researchers. In turn, in the 1970s and 1980s, Xerox's Palo Alto Research Center (PARC) played a pivotal role in object-oriented programming, graphical user interfaces (GUIs), Ethernet, PostScript, and laser printers.

While Xerox marketed equipment using its technologies, for the most part its technologies flourished elsewhere. The diaspora of Xerox inventions led directly to 3Com and Adobe Systems, and indirectly to Cisco, Apple Computer, and Microsoft. Apple's Macintosh GUI was largely a result of Steve Jobs' visit to PARC and the subsequent hiring of key personnel. Cisco's impetus stemmed from the need to route a variety of protocols over Stanford's campus Ethernet.

… and investment, through venture capital firms

Since the early 1970s, there were many semiconductor companies in the area, computer firms using their devices, and programming and service companies serving both. Industrial space was plentiful and housing was still inexpensive. Growth was fuelled by the emergence of the venture capital industry and the availability of venture capital exploded after the successful US$1.3bn IPO of Apple Computer in December 1980. And the story continues.

… and a strong and supportive regulatory framework and legal expertise

The rise of Silicon Valley was also bolstered by the development of appropriate regulatory frameworks to support the rapid formation, funding, and expansion of high-tech companies, as well as the

development of a critical mass of litigators and judges experienced in resolving disputes between such firms. Since the early 1980s, many national (and later international) law firms opened offices in San Francisco and Palo Alto in order to provide Silicon Valley start-ups with legal services.

… and along came Apple

The iPad is an extraordinary invention from Apple and Steve Jobs, but as author Mariana Mazzucato has written, technologies like this "ride the wave" of past federal investments in research. The Association of American Universities (AAU) presents the dependency of commercial success on governmental funding on their website.[3]

The development of integrated circuits is a case in point. In the 1960's, the federal government was the only consumer of ICs, needing ever more sophisticated versions for missiles for the military and the space program. It was these federal contracts that made possible the development of the ICs that were ultimately used in the iPad.

The micro-hard disk is another example. In 2007, Albert Fert and Peter Grünberg were awarded the Nobel Prize for Physics for their work in developing giant magnetoresistance (GMR). The GMR is a quantum mechanical effect that has a main application in the magnetic field sensors used in hard disk drives. Dr. Grünberg's laboratory was affiliated with the Department of Energy's Argonne National Laboratory, and received vital support from the Department of Energy. Companies like IBM were able to use this new knowledge for applications in commercial products.

It is tempting to assume that all of this could "only happen in America", but the recent German example gives the lie to that.

The German example

As a high wage / high value export country, Germany has developed a sophisticated intertwined set of policies to enhance the competitiveness of its industry through innovation, to keep unemployment figures low through a highly differentiated education system and financial incentives for priority industries. Take for instance the regenerative energy sector. Forty years ago Germany led nuclear power generation and the research that underpinned it. Chernobyl put an end to these ambitions. The transformation of Germany's energy supply system is a complex process that concerns society as a whole. The research community is expected to play a role as an important partner which can provide decisive answers to these complex issues. Therefore, German research in universities or research institutions like Max-Planck-Institutes is encouraged to produce world-leading fundamental research outputs. These drive research in areas like characteristics of advanced materials, chemical and physical analytics or system optimisation.

Following the political decision to retire all nuclear power stations in Germany in the aftermath of the Fukushima disaster in 2011, the government put into law the "Energiewende" (clean energy transition) to fundamentally change Germany's energy supply. As a consequence, the government established an "Energiewende Research Forum" to coordinate the process in all sectors.

The "Energiewende Research Forum" is set up as a platform for dialogue for everyone involved in the transformation of the national energy system. It will be able to assess the various options offered by science from different points of view and translate them into recommendations. It will provide an opportunity for high ranking representatives of the federal ministries, the Länder (states), the academies, the science organizations and universities to meet with

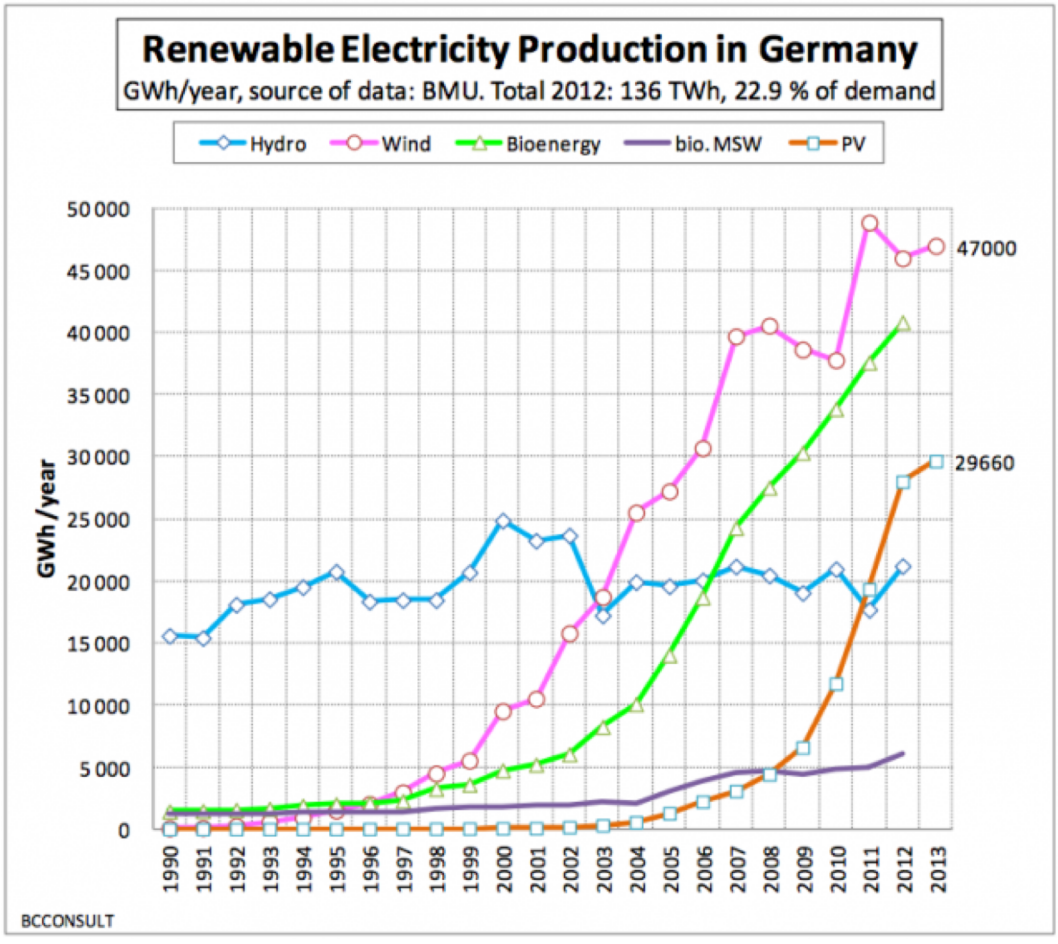
[3] *http://www.aau.edu/WorkArea/DownloadAsset.aspx?id=14900*

representatives of industry and societal groups. Georg Schütte, Deputy Minister of the Federal Ministry of Education and Research, chairs the Forum. It builds on the findings of the German Science Academies' analyses of the "Energy Systems of the Future" project and works with all the stakeholders to assess proposals, recommendations, scenarios and options for transforming the energy system that have been developed by research. The findings and proposals of this forum will be made available in the form of recommendations as contributions from the field of science to the respective decision-makers in industry, politics and civil society.

The Forum will also define areas of demand for further research and will encourage long-term research topics from the point of view of all stakeholders in industry and society. The wind energy industry is a useful example to illustrate the potential outcomes from the strategy.

The close cooperation between Germany's universities, research institutes (like Fraunhofer institutes) and the equipment manufacturers helps maintain an internationally unparalleled competitive edge. These partners work on optimizing existing technology and finding solutions for technical challenges. Industry and the respective research infrastructure such as the newly developed test stands for nacelles, rotor blades, supporting structures and foundations at universities and research institutes are just some examples of their various fields of activity.

All this explains why Germany's wind energy industry is one of the world's largest, and why it is at the forefront of technological development. Thanks to the innovative climate and the supply of excellent engineers supplied by the German universities, all of the major international turbine manufacturers are represented with production facilities in Germany. As well as these top-selling manufacturers, the



source: http://thinkprogress.org/climate/2014/05/13/3436923/germany-energy-records

supplier industry also makes a significant contribution to the wind market turnover. The political stability, long term political commitments and the excellent investment opportunities have led wind energy companies from around the world to base their operations in Germany.

In 2013/2014 the total Australian electricity consumption according to the data published by the Australian Energy Regulator was 145.8 TWh. This suggests that already today, Germany, despite the climatic condition in that part of the world, would be able to supply 93% of the total Australian electricity demand from renewable sources.

The German wind energy association has a forecast for global onshore and offshore wind power markets: "We expect the global market for wind turbines to pick up in 2014 to reach a record level of 45,000 megawatts … the German wind sector remains very well positioned vis-à-vis international competition. It will still be able to expand its leading position even if a growth corridor and mandatory direct marketing are introduced". And even the German Confederation of Trade Unions urges the government to keep up the high standards in investment security for enterprises to secure more highly qualified jobs in the sector. According to Siemens' CEO Peter Löscher, the company's "environmental solutions" portfolio, which is focused on renewables, is "already generating more than €27bn a year, 35 per cent of Siemens' total revenue, and the plan is to grow this to €40bn by 2015".

The example shows that a successful innovation policy should be based on

- long-term political considerations
- clear priorities and goals
- stable and long-term investment in education and research
- open public consultation processes
- a lot of coordination of all stakeholders, and
- financial security and a stable political environment for the companies and institutions that have invested in the enterprise.

What happens in Australia?

The company behind one of Australia's largest solar power plants is reported to have abandoned the project, in part due to uncertainty over the Renewable Energy Target (RET). The 100-megawatt Silex Mildura solar power station would have provided electricity to 40,000 homes, but after years of work the project has been shelved.[4] Many highly qualified jobs will go.

The reason given is the Government's review of the RET allegedly aims at the complete removal of the target. The RET presently mandates that 20 per cent of all electricity would come from renewable sources by 2020. That figure was set at 41,000 gigawatt hours based on earlier power consumption figures, but it is currently being reviewed.

"There's a number of factors, including low wholesale electricity prices and the uncertainty surrounding the Renewable Energy Target. They're the two main factors," said Michael Goldsworthy, the CEO of Silex Systems. He says the RET had offered an attractive price for renewable energy, but this advantage had been eroded due to uncertainty over the future of the policy. "There's not as much pressure on the market to have renewable energy in their portfolio now simply because the RET is at least going to be wound back and possibly abolished," he added.

A report released on 18 August 2014 by several environmental groups[5] shows that, if the RET is wound back from its current target or cut altogether, extra profits worth $9 billion would go directly to power companies that burn coal and $2 billion to

[4] http://www.abc.net.au/news/2014-08-18/silex-shelves-major-solar-power-station-on-ret-uncertainty/5679086

[5] http://www.climateinstitute.org.au/verve/_resources/Jacobs_ImpactsChangingRETonElectricityMarketParticipants_FINAL_140814.pdf

those companies that burn gas. “That’s because renewables, once they’re constructed, they’re ... essentially free to operate; the fuel that they use – sun or wind – is free compared to the fossil fuel generators which have to pay for coal and gas,” explained Dugald Murray, the chief economist with the Australian Conservation Foundation. “That’s what we’ve really highlighted in the report today – that if you do wind back renewable energy investment, consumers don’t benefit, the country doesn’t benefit,” added Mr Jackson.

Would a long term perspective and integrating policies benefit Australia?

Based on the absence of any national debate on the issue, it seems it is difficult in Australia to come to a general understanding about how our society should look in 20 or 30 years from now. Apparently, it is also difficult to pick future winners in industry, let alone to provide those industries with the necessary financial and political support that would see them sustained long enough for them to gain their own momentum. As a middle power with little more than 24 million people, Australia will have to make choices and identify priorities to pursue. These strategic priorities need to be broad enough to not strangle emerging ideas, and the Chief Scientist’s five high level Strategic Priorities for research in Australia are a good start.

But as we’ve seen, there is no “quick fix”. “Success” relies on a long-term mutually-reinforcing relationship between fundamental research and strategic programmes to help technology companies through the “valley of death”. The Australian Government invests in the higher education and research sector – but since the second step is missing, the consequence is that other nations benefit mostly from the inventions made in Australia. With the manufacturing sector increasingly on its knees in Australia, we need to address this deficit now. The BCA calls for the government to “design policy in a purposeful way so that as many sectors as possible can be as globally competitive as possible.”

Ironically, the discussion on the federal budget has seen the whole country focused on the financial deficit and the “need” for cuts in services, research, education, health and aged care. One critical point seems to have been overlooked in this equation: Australia’s future demands strong and reliable incentives by the government to be set now for those sectors that have the most potential to sustain a competitive position in the global economy.

Unless strategic priorities are set, and support provided, Australia will fail to generate the wealth and prosperity that we have come to enjoy and expect. A coherent, integrated and resourced policy framework for education, research and industry should aim at implementing the National Innovation and Science Agenda (NISA).

Dr Martin Grabert has thirty years’ experience in the Australian, European and German research and higher education communities. Having moved to Australia in 2010, he was the Director for International & Business Relations at the Group of Eight Ltd. In that capacity he supported Australia’s eight research-intensive universities in developing their global relationships, and he works closely with government departments and learned academies on international education and research policies. Martin is CEO of Montroix Pty Ltd, a company offering services to governments and the research sector.

Previously, being Brussels based he had responsibilities as Director for two significant European research enterprises – one German (KoWi), the other inter-governmental (COST) – spanning all research fields with global reach, engaging mostly with universities, research institutes and politics. He holds a PhD in aeronautical engineering.