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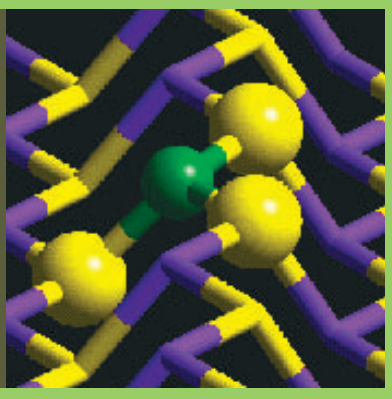


Economic benefits of the Australian Synchrotron

IMAGE: Sphalerite

Structure of copper-activated sphalerite during froth flotation, elucidated by synchrotron EXAFS.

Chapter 07

Economic benefits of the Australian Synchrotron

Wealth generation and growth in GDP is highly correlated with national R&D activity.

In Feldman and Florida's discussion of the convergence of technological infrastructure, innovation and economic benefit, they recall that "in his classic work on innovation and capitalism, Joseph Schumpeter (1954) argues powerfully that economic growth requires innovation"[1].

All major OECD countries have now invested or are investing in synchrotron facilities.

International Reviews

There have been many economic assessments of the benefits that flow to a community following the exploitation of a national synchrotron. Clearly there would not be as many synchrotron facilities in the world were this not the case[2]. Extracts from several international reviews are presented below.

The BESAC report (1997) (USA)

The BESAC report (1997)[3] evaluated the impact of the advent of synchrotron radiation on technology in the United States with a view to determining the appropriate level of funding support that the Department of Energy should give to the four DOE National facilities in the US. This review concluded that:

> *"Synchrotron radiation research has evolved from an esoteric endeavour practised by a small number of scientists primarily from the fields of solid state physics and surface science to a mainstream activity that provides essential information in the materials and chemical sciences, the life sciences, molecular environmental science, the geosciences, nascent technology and defence related research among many fields."*

Canadian Light Source proposal

The proposal prepared for the Canadian Government supporting the installation of the Canadian Light Source[4] concluded that:

> *"Countries are not building synchrotrons solely to support basic research, significant as that research has been and doubtless will be. They are building them because of the diversity, importance and potential of high-technology, industrial applications."*

Business Case for Diamond (UK)

The Business Case for the installation of Diamond in the United Kingdom[5] claimed that:

> *"[failure to install Diamond] would be an erosion of the UK's international presence in key areas of research, notably structural biology and materials research. This would lead to a significant loss of capability to carry out research in these and related areas and migration of funds and expertise to non-UK research institutions. This would have a severe negative impact on the UK's science base. There is also the risk that industrial users requiring synchrotron radiation, such as pharmaceutical companies, would relocate their activities overseas."*

National Synchrotron Light Source (USA)

Suffolk County in the USA, which had the National Synchrotron Light Source within its borders, evaluated the impact the NSLS had on the local economy[6]. Their assessment was that NSLS had contributed between $US1b and $US2b over the life of the project.

1 M.P. Feldman & R. Florida, 'The geographic sources of innovation: technological infrastructure and product innovation in the United States', Annals of the Association of American Geographers, 84(2) (1994) pp 210–229, citing J. Schumpeter, Capitalism, Socialism and Democracy, 1954, Harper & Row, New York.

2 List of world's synchrotron facilities at http://www.spring8.or.jp/ENGLISH/other_sr and at http://www-ssrl.slac.stanford_edu/SR_SOURCES.html

3 Report of the Basic Energy Sciences Advisory Committee (BESAC) on DOE Synchrotron Radiation Sources and Science, Washington, D.C., 1996.

4 Canadian Light Source, The Proposal for Construction of a National Synchrotron Light Source for Canada, Sept 1996 (SAL). Submission to Natural Sciences & Engineering Research Council (NSERC) of Canada.

5 P.R. Woodruffe, Business Case for the Diamond Synchrotron, Office at Science and Technology, Version 2.0 p 23

6 See OECD (1995) Megascience Policy Issues, The Megascience Forum, OECD, Paris.

Assessments of Potential Economic Benefits to Australia

There have been four assessments of the economic benefits that an Australian based synchrotron facility would contribute to the national economy.

Boomerang Proposal

The Boomerang Proposal Part IV (1999)[7], the original proposal for an Australian synchrotron, included an analysis of economic benefit by considering scenarios in the areas of:

- biotechnology and, in particular, structure-based drug design
- micromachining – nanostructured products
- environmental management
- scientific instrumentation
- diagnostic medical services
- mineral and oil assays
- high technology materials.

The new procedure of structure-based drug design where new drugs are developed through an analysis of target structures rather than through extensive trial and error clearly depends on knowing the structure of the target molecule, and it is apparent that this is dependent on synchrotron access. To access the economic consequences involves a number of assumptions not the least of which is the level of funding support – investment that will be available in Australia to take the intellectual property (IP) generated in a synchrotron study all the way to a marketable product. The maximum conceivable revenue can be assessed.
The Boomerang Proposal suggested:

"The installation of Boomerang would provide the opportunity for Australia to compete on a level playing field as a pharmaceutical supplier in the 21st century. It could be expected that products based on the generation of IP by Australian researchers at Boomerang could generate annual revenue of as much as $2b."

Of course as stated previously, to capture the full benefit of the IP would require major investment in development and drug trials.

With respect to micromachining, the assessment predicted possible revenue of $60–120m per annum.

Centre for Strategic Economic Studies

The Centre for Strategic Economic Studies (CSES) also carried out an evaluation in 1999 of the impact of a national synchrotron light source on the Australian economy[8]. They also used a scenario-based analysis but were able to introduce the data into a well respected economic model. Their summary analysis of the impact of the facility concluded:

"The establishment of a national synchrotron light source facility in Australia will provide a key link in emerging product and process developments that will be critical to the very industries that are now at the core of the local economy and those industries likely to form the engine for growth in the 21st century."

Other more specific conclusions were:

"Input-Output analysis of the direct, indirect and induced effects of the synchrotron reveals that it will generate a total of $687 million in additional output and $367 million additional value added, create a total of 441 additional jobs and generate tax revenue of almost $83 million over the 25 year life of the project."

"Those industries that are direct and potential users of synchrotron light-based research in Australia currently account for 2.7 million jobs or 32% of total employment: more than $187b or 28% of total industry gross product; more than $61b or fully 78% of our industry attributable merchandise exports and more than $3b or 77% of industry attributable R&D expenditure."

"A possible pharmaceutical industry development scenario could see the introduction of an Australian synchrotron facility contribute towards $1.3b per annum in additional industry revenue by 2010 and 3,200 additional jobs."

"If each extraction, processing and remediation benefited from synchrotron-based research as much as assays analysis, then up to $1b of mining production over the next 20 years would be directly attributable to synchrotron research."

"A possible induced investment scenario could see cluster development involving additional investments of $170m per annum by 2010, rising to $355m per annum by 2020; creating 850 new jobs by 2010 rising to 2,000 new jobs by 2020; and a potential $1.8b per annum in additional exports by 2010 rising to $4b per annum by 2020."

The delay in installing the facility relative to the assumptions in the CSES report means, of course, that these analyses are all delayed by three years.

Centre for International Economics

A separate report from the Centre for International Economics focussed more on the user demand and did not adopt any scenario analyses[9]. Some comments from this report are listed below:

"Royalties from a single successful drug delivery have been demonstrated to vastly exceed the threshold benefits (i.e. the total cost over the life of the facility) required for the synchrotron investment."

7 J.W. Boldeman, prepared for the Australian Synchrotron Research Program, 1999.

8 Report for the Victorian Government by The Centre for Strategic Economic Studies, Victoria University (Melbourne), 1999.

9 Centre for International Economics (CIE). The Net Benefits of a National Synchrotron Investment. Report prepared for The Steering Committee for the Australian Synchrotron Research Program, 20 October 1999, CIE, Canberra and Sydney, 1999.

"Synchrotron applications in microtechnology are likely to be at the very top end of the value adding spectrum."

"In the important mining and minerals sector, even very small unit cost savings that might be derived through synchrotron applications will translate into large dollar boosts to sectoral output value."

PricewaterhouseCoopers Feasibility Study

The National Synchrotron Steering Group established by the Federal Government as a consequence of the submission of the Boomerang Proposal commissioned PricewaterhouseCoopers to conduct a feasibility study and strategic business plan for a national synchrotron facility[10]. Their evaluation of the potential economic benefits arising from the establishment of the facility include:

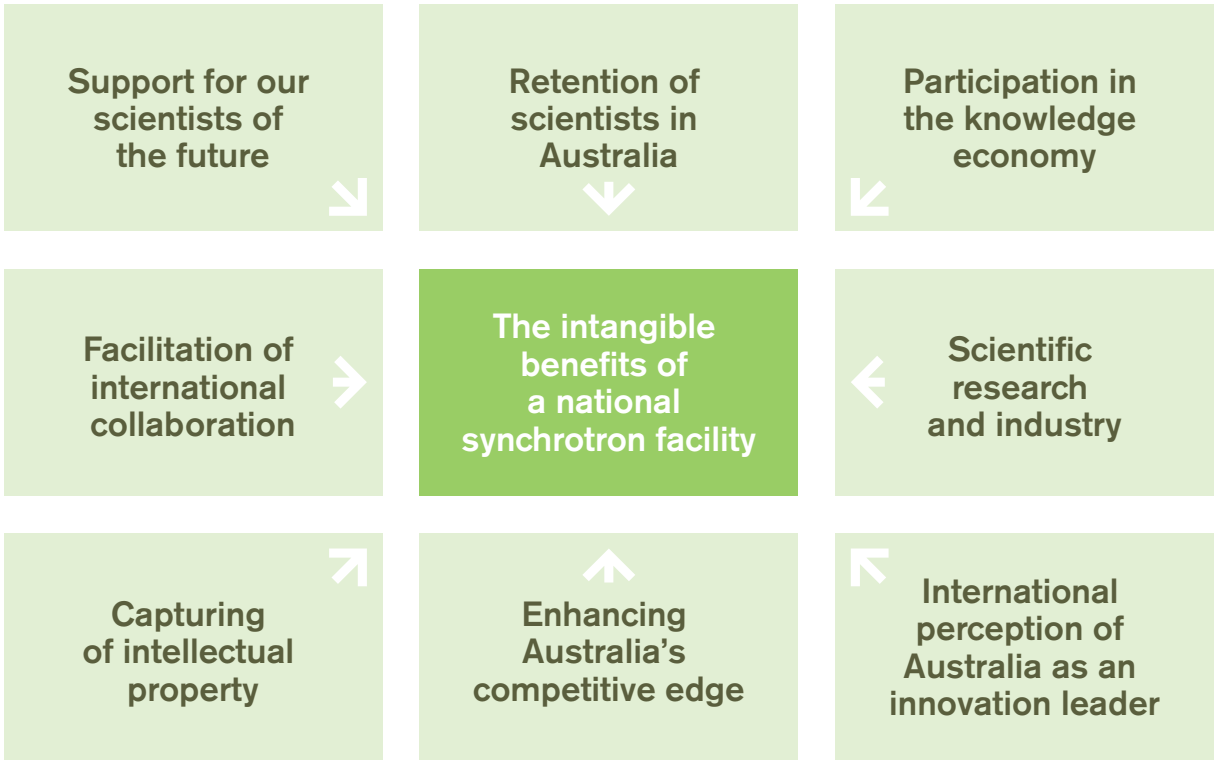
"Net national benefits – the core quantitative contribution of this investment cost to the Australian economy is the improvement in productivity that research can create. It is known that the synchrotron will be relevant to key sectors of the Australian economy such as biotechnology and mining. From foreign experience, synchrotron technology plays a critical role in R&D in some of these sectors. As a result, quantitative estimates can be provided to show how reasonable the expectations of a net national benefit might be.

- *The synchrotron need only contribute to output improvements of 0.03% for the mining, chemical and agricultural sectors to recoup its costs.*
- *Indicative scenario modelling using the MONASH model showed improvements in GDP of $640m per year after ten years when minor productivity improvements were applied to just a few key parts of the mining, chemicals and agricultural sectors of the economy. The improvement is permanent as it places the economy on a higher investment and growth path overall.*

Such an improvement would normally be associated with a corresponding boost in tax receipts to the Commonwealth and State Governments of up to $450m per annum."

Why do we need a Synchrotron?

The intangible economic benefits



10 PricewaterhouseCoopers, Feasibility Study and Strategic Business Plan for a National Synchrotron Facility. Report prepared for the National Synchrotron Steering Group, October 2000.