

Research and technological development in South Australia. Cooperation with Italy

South Australia is one of the six States and two Territories of the vast Australian continent, whose area of 7.7 million square kilometres is as wide area as Europe but with a population of about 22 million. In common thought, Australia is associated with nature, with the blue of the sea or immense deserts. But if you are visiting Australia for the first time it is clear that, apart from natural wonders, it is characterised by a young and vital energy.

South Australia is situated in the Southern part of Australia, with a Mediterranean climate and a population of about 1.7 million inhabitants, of which 1.1 million live in Adelaide, the capital of the state. Although the economy of South Australia is actively based on the traditionally key sectors of mining, automotive and agro-food, in the last decade the many efforts focused on boosting and improving excellence training, services, industry technology in the fields of defense and ICT, as well as renewable energy (Cleanthech). These strategic sectors are going to play a key role in the economic growth of South Australia in the coming years. Nowadays South Australia considers the development of knowledge, creativity and innovation as key elements of its future development. In the last years, the Government of South Australia, the universities and the research centres have been jointly engaged in increasing and improving the State research and development system. This has also encouraged the private sector to increasing its investments for the development of new technologies. This commitment demonstrates that the South Australia gives high priority to the enhancement and development of research and scientific innovation, which are considered crucial elements of sustainable development of the State.

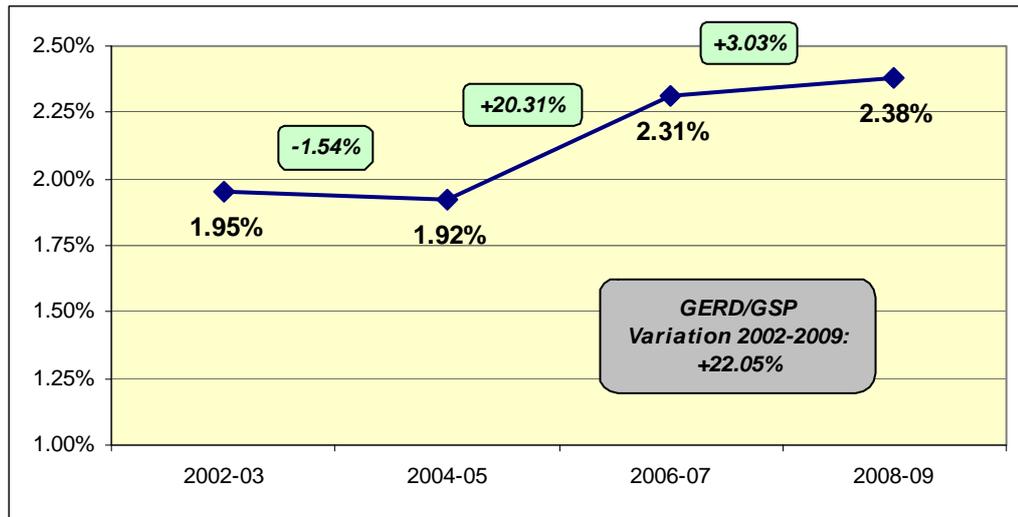
This article aims to analyze the system of research and technological development of South Australia highlighting the main economic resources for R&D and, through the number and quality of publications and patents, identifying the predominant research areas. In a scenario of active international cooperation, the analysis of areas of strengths and weaknesses of the South Australia R&D system could be a useful tool for the identification of excellent sectors and research centres.

Expenditure on Research and Technological Development Gross Expenditure on Research and Development (GERD) in South Australia increased by 67.1% between 2002-03 and 2008-09, rising from an annual expenditure amounted to 1.1 billion Australian dollars (€822 million) to 1.9 billion dollars (€1.4 billion).

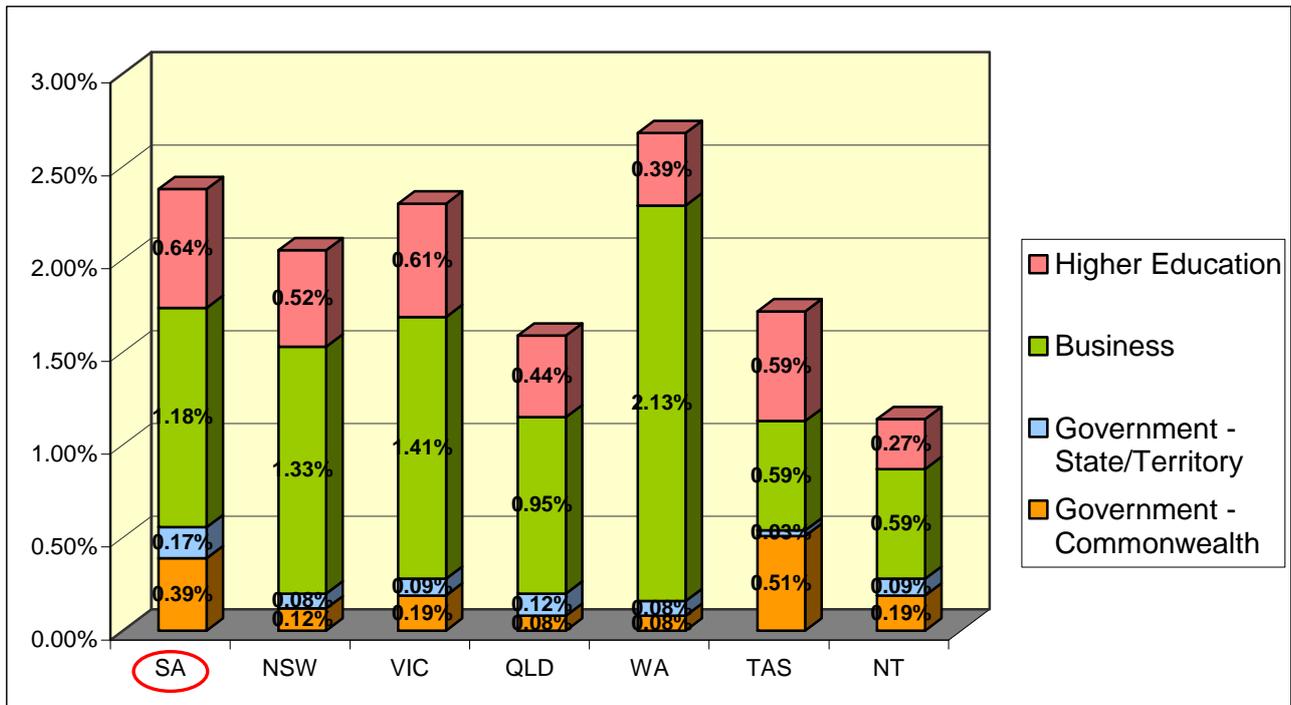
The ratio of GERD to Gross Domestic Product (GDP) is used as an indicator for the development of scientific and technological research in a Country. Between 2002-03 and 2008-09, the ratio of GERD / GDP of South Australia grew by 22.1%, from 1.95% in 2002-03 to 2.38% in 2008-09. This value was above the national average in Australia in 2008-09, which amounted to 2.21%, and was the third most highest value among all Australian States, higher than the ratio of New South Wales (Sydney) and Queensland (Brisbane). The South Australia expenditure on R&D, which amounted to 2.38% of Gross Domestic Product in 2008, is comparable to those of Countries that are recognised for their commitment to research and development of such as the United Kingdom (1.77%), Canada (1.84%), France (2.02%), Germany (2.64%) and the U.S. (2.77%).

The data shows that, among the Australian States, South Australia boosted the most outstanding contribution GERD / GSP from the public sector (State and National Government) and universities. In particular, in the last six years, the contribution to R&D by local universities increased by 42.22%, from 0.45% to 0.64% of GSP. These data demonstrate the strong commitment of the Government of South Australia and the local universities in supporting investment in knowledge, scientific research, and innovation.

South Australia ratio of GERD on GSP



Composition of GERD as percentage of GSP (2008-09)



In South Australia there are three local universities (the University of Adelaide, Flinders University, and the University of South Australia) and two foreign universities that decided to open a campus in Adelaide as a base for the South Pacific area (Carnegie Mellon University (USA) and the University College of London (UK)). In 2009 the enrolled university students were 78087, 23161 of which were foreigners. In fact, approximately 30% of the student population comes from abroad, mainly from China (26%), India (20%), ASEAN countries (13%), South Korea (6%) and Japan (2%). This presence is not only the second item of GSP in terms of economic wealth of the state, but allows South Australia to maintain a strategic bridge with the new ruling class of the fast growing Countries in the Asia-Pacific region educated in Adelaide. In addition, many of these students are actively involved in research and technology transfer. From 2005 to 2009 the increase of foreign researchers involved in research programs in South Australia was 25%. This figure is very important because it does not only make the system of training and research

in South Australia highly competitive, but it also contributes to building networks of international relations that help to generate new ideas, new projects and new professionalism.

These universities are flanked by major research centres that operate internationally and contribute to an active and historical vocation of pure research, applied research and development of new technologies. In this respect it is to be mentioned that five Nobel Prize winners were trained in Adelaide: Sir. William Henry Bragg - Physics - 1915, Professor William Lawrence Bragg - Physics - 1915, Sir. Howard Walter Florey - Physiology / Medicine - 1945, Dr. J. M. Coetzee - Literature - 2003, Prof. J. Robin Warren - Physiology / Medicine - 2005.

Concerning the analysis of the publications and patents generated in the period 2005-2009 by the three South Australia universities and the National Research Centres operating in South Australia, the key data are summarised below. For a more deep and detailed evaluation of the data, refer to the report “*Potentialities for Collaboration: An Overview of the Research & Development system in South Australia*” written by students of the Bocconi University, Milan (Dr. Sara Benetti) and the University of Trento (Dr. Silvia Decarli) and coordinated by Adj.Prof. Nicola Sasanelli, Special Envoy of the Government of South Australia for research and technology transfer to Europe. This analysis showed that the State research excellences are mainly in the following four areas: health science, agro-food, engineering, and science.

Number of Publications, Citations and Average Number of Citations in South Australia 2005-09

University/Research centre	Number of Publication	Number of citations	Average number Citation for publication
University of Adelaide	4,256	24,186	5.68
Flinders University	1,369	7,393	5.40
University of South Australia	1,313	4,111	3.13
CSIRO	738	6,467	8.76
SARDI	562	2,647	4.71
DSTO	154	296	1.92
CRC	18	65	3.61
Total	8410	45165	5.4

Source: Scopus Database

University of Adelaide (4256 publications in total) – The most productive units in terms of publication are:

School of Paediatrician & Reproductive Health (149 publications (Pub.), 1558 total number of citations (cit) 10:46 and the average number Citation for publication (Aver)
 School of Molecular & Biomedical Science (535 (Pub.), 5524 (cit) and 10:33 (to Aver);
 School of Earth and Environmental Sciences (948 (Pub.), 6764 (cit), and 7.14 (Aver);
 School of Chemistry and Physics (363 (Pub.), 2404 (cit), and 6.62 (have), and
 School of Agriculture, Food and Wine (364 publications, 2149 (cit), and 5.90 (Aver).

Flinders University (1369 publications in total) – The most productive units in terms of publication are:

School of Psychology (257 (Pub.), 2104 (cit), and 8.19 (Aver);
 School of Medicine (301 (Pub.) 2226 (cit) and 7:40 (Aver), and
 School of Biological Sciences (398 (Pub.), 2297 (cit), and 5.77 (Aver).

University of South Australia (1313 publications in total) – The most productive units in terms of publication are:

School of Health Sciences (350 (Pub.), 1981 (cit), and 5.66 (Aver),
 School of Pharmacy and Medical Science (350 (Pub.), 1411 (cited), and 5.64 (Aver), and
 School of Electrical and Information Engineering (197 (Pub.), 226 (cited), and 1.15 (Aver)

Regarding the patent registered by South Australia's University and research centers at the European Patent Office EPO, United States Patent Office USPTO and Australian Patent Office APO, the following table shows the main figures.

Number of patent registered in South Australia 2005-09

University/Research center	Num. of Patent
CSIRO	822
University of Adelaide	126
University of South Australia	79
CRC	19
Flinders University	13
DSTO	1
SARDI	-
Totale	1060

In Particular:

University of Adelaide –

School of Agriculture, Food and Wine - 26 patents,
 Paediatrician & Reproductive Health School of -10 patents, and
 School of Chemistry and Physics - 8 patents.

Flinders University-

School of Medicine - 6 patents.

University of South Australia –

School of Electrical and Information Engineering - 38 patents;
 School of Advanced Manufacturing and Mechanical Engineering - 15 patents.

Among the National Research Centres that operate in South Australia, the **Commonwealth Scientific and Industrial Research Organisation (CSIRO)** stands out and in particular the following institutes:

CSIRO Land and Water,
 CSIRO Plant Industry,
 CSIRO Ecosystem Sciences,
 CSIRO Mathematics, Informatics and Statistics, CSIRO Process Science and Engineering, and
 CSIRO Education.

In the period 2005-2009, the CSIRO recorded 738 (Pub.), 6467 (cit), 8.76 (Aver) and 822 patent registrations. However, it must be taken into account that the CSIRO is a national centre and therefore the number of publications and patents cited above is a national value. Besides the CSIRO, the following institutions are based in South Australia:

South Australia Research and Development Institute (SARDI) with 562 (Pub.), 2647 (cit), and 4.71 (Aver);

Cooperative Research Centres (CRCs) operating in South Australia with 18 (Pub.), 65 (Cit.), and 3.61 (Aver) and with 19 patents, and

Defence Science and Technology Organisation (DSTO) with 154 (Pub.), 296 (cit), and 1.92 (Aver).

According to this figure, the research and development system of South Australia is very active and its main local actors (State Governments, universities, research centres and private companies) are strongly committed to make the State more and more competitive in this field. The increasing South Australian investments in R&D are the consequence of a well defined strategy followed in the last decade, that includes the policy of attracting talents and investments in R&D. Thanks to this, nowadays South Australia

can boast an active role in the international arena through alliances and agreements in the research and innovation fields.

South Australia and Australia in general have a strategic geographical position that allows to take full advantage of the extraordinary economic development of the Asia-Pacific Countries (ASEAN and Oceania, China, Japan, South Korea and India). This region, with a total GDP of 15,000 billion dollars and a population of about 3.3 billion, is now the most important geopolitical area of the world in terms of economic and social development, as well as a breeding ground of new ideas and extraordinary opportunities. In this area, GDP per capita is equal to \$4,750. If this value is compared to the US and European ones (\$46,000 and \$32,500 respectively) and a sustainable world economy is assumed, it follows that in the coming years this geopolitical area is going to become extremely important for the development of the entire planet. It is a growing popular opinion that the Pacific Ocean will be the "sea of the future", like the Mediterranean and the Atlantic were in the past: the cradle of the third millennium new economic, cultural, scientific and technological knowledge.

Australia, and in particular South Australia, are characterised by a European culture built on the basis of a secular migration, a strong focus on excellence training activities and an active research and technological development, which can play a strategic role for Europe.

The European partners who want to start cooperation activities with South Australia can rely on a stable economic system that has been maintaining the highest AAA rating for many years, an efficient system of public and private institutions, high-level universities and world-class research centres. Thanks to the cooperation with South Australia, entrepreneurs, academics and researchers of the "old" Europe can play an active role throughout the Asia-Pacific area now considered of great interest.

In this context, in these last years, the Government of South Australia, bolstered by a large presence of Australians with Italian and European origins fully integrated into the political, social and economic state, has embarked on a cooperation activity with some Italian Regions. In particular, the cooperation developed in the fields of scientific research and technology transfer, where the exchange of international experiences are a real added value. This strategy fits perfectly into regional strategic plans that allow to promote each other's stakeholders (universities, research centres, high-tech company, etc..) permitting a direct sharing of mutual priority areas. The Government of South Australia signed five Memoranda of Understanding with the Governments of the Italian Regions, three of which (with Puglia, Basilicata and the Province of Trento) and already started and present encouraging results.

With the **Region Apulia**, in 2008 it was signed an agreement which draws the two Governments mutually supportive cooperation in the fields of training and research excellence in science and technology for a total of 1.5 million through a three-year program.

During the first year of cover the following research projects were funded:

- 1- Improved Wastewater Reclamation-CNR-IRSA (Bari) and University of Adelaide;
- 2- Strategies to Reduce Biogenic Amines in Fermented Beverages-Univ. Foggia and Australian Wine Research Institute;
- 3- Integrated Aquaculture, University of Lecce and Salento SARDI;4- Stress Responses in Durum Wheat-CNR - ISPA (Bari) and University of Adelaide;
- 5- FUTRO: Future Urban Transportation-CNR - ISSIA (Bari), Politecnico di Bari and University of South Australia;
- 6- Metal immobilisation During the wastewater treatment process - University of Bari Department of Science and vegetable production Maswon Institute University of South Australia;
- 7- Development of New Microsatellite Markers for Genetic Map of Saturation in the Olive-University of Foggia Dep. of Agri-Environmental Sciences, Chemistry and Plant Defence and School of Agriculture University of Adelaide;

- 8- Business Model and Product-Market Strategy in Biotechnology Dep. Economics of Science. Math. and Statistics University of Foggia and Entrepreneurship, Commercialisation and Innovation Centre, University of Adelaide;
- 9- Sustainable Energy Consumption-Dep. Economics of Science. Math. and Statistics University of Foggia and Entrepreneurship, Commercialisation and Innovation Centre, University of Adelaide.
- 10- Immersion Program for Teachers of Italian - Adelaide and Flinders University 2009-University 'del Salento
- 11- Immersion Program for Teachers of Italian - Adelaide and Flinders University 2010-University 'del Salento.

Moreover, Masters Courses in South Australian universities were funded to the following three Puglia students

- 1-Brunetti Gianluca from Bari Uni to Uni. of SA (Master of Water Resource Management) 2009-2010;
- 2-Ivan Malatesta from Uni. Bari to Uni. of Adelaide (Master of Project Management) 2009;
- 3-Nicole Mosca from ISSIA CNR Bari to Uni. of SA (Master of Engineering, Transport Systems Engineering) 2009-2010;

During 2009-2010, the following Puglia researchers visited research centers in South Australia in the occasion of joint projects for periods ranging from several months to a year:

- 1-Ing. Gianluigi De Ruvo of CNR ISSIA at the University 'of South Australia (Robotics);
- 2-Dr. Joseph Laera IRSA CNR at the University of Adelaide (Water Sciences Group);
- 3-Ing. Tommaso Palmisano at the Polytechnic of Bari University of Adelaide (Physics / Photonics Group);
- 4-Dr. Luigi Petrone, University 'at Mawson Institute of Bari, University of South Australia.
- 5-Dr. Capolecchia Damiano, University 'at Mawson Institute of Bari, University of South Australia.

In addition, during the Fiera del Levante in 2009, the following two technical-scientific conferences were held at the University of Bari,:

1. New Materials for Medicine (Chaired by Prof. Riccardo D'Agostino University of Bari and Professor Rob Short University of South Australia)
2. Water and Renewable (Chaired by Dr. Antonio Lopez IRSA-CNR and Prof. Jin Bo Adelaide University)

The conference illustrated the potential activities for bilateral cooperation, joint research opportunities, and marketing of the results in two specific areas of biomedical engineering and management and water conservation. many professors and researchers from South Australia participated to these events.

During the Fiera del Levante 2010, a conference was held in Bari: "Brilliant Blend Forum on the topic of research, migration and tourism".

The two regional governments are ready to start the second year of cooperation and in light of the results of the first year, there is a great interest by the two scientific communities. In particular, there is an interest in the fields of biomedicine and nanotechnology applied to biosensors, water management, the sensors optoelectronics, photonics, and agro-food.

With the **Basilicata Region**, an agreement was signed in 2009, through which the two Governments mutually agreed to finance joint pilot projects. In 2010 a project in the field of environmental protection "land care" was co-financed, titled KOALA– Uni of Adelaide/Uni of Basilicata- MADES For the second year there is interest in a second project entitled Socio Ecological Aspects Environmental Protection, which will involve further research.

In 2010 an agreement was signed with the **Autonomous Province of Trento**, through which the two Governments mutually agreed to finance joint pilot projects. In 2011 the first project was co-funded in the field of Tracking the metabolome of wine grapes into wine-Australian Wine Research Institute / Edmund Mach Foundation, Trento. There is a great interest in two other joint pilot projects:

1. Nanophotonic-University of Trento (Nanoscience Laboratory) and Adelaide Uni (Institute for Photonics & Advance Sensing);
2. The environmental remediation project-University of Trento and University of South Australia (Centre for Environmental Risk Assessment and Remediation)

Share experiences, knowledge, information, training programs and workshops, which are more and more expensive and require more and more specialised staff represent an absolute must in an increasingly globalized context. South Australia is based on the development of knowledge, creativity and innovation as key elements for its future and international cooperation is considered a strategic choice, related to inter-regional partnerships that allow to share specific initiatives considered as priority by both partners.

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