Australian Centre for Advanced Photovoltaics

Annual Conference
28-29 November 2013

"Recent developments in PV and ACAP’s role”

Martin Green, Director, ACAP
Annual capacity increase

EPVIA, IAEA, GWEA, Bloomberg
2013 Global Power & Utilities Survey

Figure 3: Percentage of respondents saying the following technology developments will have a high or very high impact on their market.

**Most impact**

- **60%** Energy efficiency measures
- **56%** The rapid fall in the price for solar modules
- **53%** The deployment of demand-side management technology
- **51%** Smart metering/grid deployment

**Least impact**

- **26%** Efficient electric heating – heat pumps etc
- **17%** Stationary electricity storage deployment
- **13%** Carbon capture and storage
- **11%** Offshore wind generation

Source: 13th PwC Annual Global Power & Utilities Survey
Power source for the future?

50.7 Terawatt
“Submerged” progress

- Nuclear
- Wind
- PV

Installed capacity, GW

- 25% World’s energy
- 1% World’s electricity

ACAP
AUSIAPV
German grid: this August
Manufacturing costs
Manufacturing costs
Manufacturing costs

- Manufacturing costs, US $/Watt
- ITRPV Roadmap
- Graph showing cost reduction from 2010 to 2020
- Key points: 11%, 13.3%
Manufacturing costs
Manufacturing costs
Genesis (November 2010)
Australia and the United States will embark on a joint solar power research program in a bid to drive down the cost of the technology. Prime Minister Julia Gillard and US Secretary of State Hillary Clinton made the announcement in Melbourne on Sunday, with the Australian government set to commit up to $50 million towards the program.
Outcome (December 2012)

The Minister for Resources and Energy, the Hon. Martin Ferguson AM MP, today announced a significant boost for solar research with more than $83 million for collaborative projects between Australian and United States researchers.

Two programs with real potential to deliver the next generation of solar technologies include the $33 million US-Australia Institute for Advanced Photovoltaics, led by the University of New South Wales, and the $35 million Australian Solar Thermal Research Initiative, led by CSIRO.
Organisation

Australia-US Institute for Advanced Photovoltaics

International Advisory Committee

Australian Centre for Advanced Photovoltaics

QESST

NREL | Georgia Tech | SNL | UCSB | LBNL | Stanford

Management Committee

National Steering Committee

PP2: Organic & Earth-Abundant Inorganic Thin Film Cells

UNSW | Melbourne | Monash | UQ | CSIRO

PP1: Silicon Cells

UNSW | ANU

PP3: Optics/Characterisation

UQ | UNSW | ANU

PP4: Manufacturing Issues

UNSW | CSIRO

PP5: Education, Training & Outreach

ACAP | AUSIAPV

UNSW | ANU | Melbourne | Monash | UQ | CSIRO
At a glance

GRANT RECIPIENT
University of NSW

AUSTRALIAN GOVERNMENT
FUNDING THROUGH ARENA
$33.1 million

TOTAL PROJECT VALUE
$68.5 million

What we're all about

The Australia-US Institute for Advanced Photovoltaics will develop the next generations of photovoltaic technology, providing a pipeline of opportunities for performance increase and cost reduction.

This international research collaboration will provide a pathway for highly visible, structured photovoltaic research collaboration between Australian and American researchers, research institutes and agencies, with significant joint programs based on the clear synergies between participating bodies.

It is planned that the Institute will significantly accelerate photovoltaic development beyond that achievable by Australia or US individually, leveraging past and current funding, by combining the Australian Centre for Advanced Photovoltaics (ACAP) with the recently announced NSF/DOE Energy Research Center for Quantum Energy and Sustainable Technologies (QEST), based at Arizona State University, the National Renewable Energy Laboratory, Sandia National Laboratories, Lawrence Berkeley National Laboratories, Stanford University, Georgia Institute of Technology and University of California – Santa Barbara.

Partners

"The Institute's long-term research will provide a pipeline to 'over the horizon' photovoltaic technology, as well as the training of the next generation of photovoltaic research scientists and engineers by exposure to world-class facilities across Australia and the US; establishing Australia as the photovoltaic research and educational hub of the Asia-Pacific region."

Professor Martin Green
Project Director

http://www.ausiapv.net.au
ACAP Program

Our Research

**PP1 Silicon Cells**
PP1 will focus on three main areas: cells made from solar grade silicon, rear contact cells and silicon-based tandem cells, both monolithic and mechanically stacked.

**PP2 Organic and Earth-Abundant Inorganic Thin-Film Cells**
This PP focusses on "earth abundant" thin-film materials, including Si and CzTS, as well as organic cells (OPV), organic/inorganic hybrid cells, and third generation approaches.

**PP3 Optics and Characterisation**
We aim at experimental demonstration that theoretical conversion limits could be extended by use of structures that have a high local density of optical states, with particular emphasis on thin film inorganic solar cells.

**PP4 Manufacturing Issues**
This PP aims at delivery of a substantiated methodology for assessing manufacturing costs of the different technologies under investigation by the Centre.

**PP5 Education, Training and Outreach**
PP5 involves education, training and outreach, including researcher exchanges.

See projects ➔

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http://www.acap.net.au
### ACAP Program

#### Our Research

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http://www.acap.net.au
**ACAP Program**

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[UNSW Australia] [CSIRO] [ACAP] [AUSIAPV]
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## Milestones

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<tr>
<th>Milestone</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
<th>Year 5</th>
<th>Year 6</th>
<th>Year 7</th>
<th>Year 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>PP1 Solar Silicon Rear Contact Tandem Cost Target</td>
<td>16% 18% 18%</td>
<td>17% 19% 20%</td>
<td>18% 20% 22% 15c/kWh*</td>
<td>19% 21% 24% 13c/kWh*</td>
<td>20% 22% 26% 11c/kWh*</td>
<td>21% 23% 28% 10c/kWh*</td>
<td>22% 24% 30% 8c/kWh*</td>
<td>23% 25% 32% 6c/kWh*</td>
</tr>
<tr>
<td>PP2 Cell (&gt;1cm²) Cost Target</td>
<td>- -</td>
<td>- -</td>
<td>8% 15c/kWh*</td>
<td>10% 13c/kWh*</td>
<td>11.5% 11c/kWh*</td>
<td>13% 10c/kWh*</td>
<td>14% 8c/kWh*</td>
<td>15% 6c/kWh*</td>
</tr>
<tr>
<td>PP3 Path Enhanced Cost Target</td>
<td>x2</td>
<td>x4</td>
<td>x8 15c/kWh*</td>
<td>x16 13c/kWh*</td>
<td>x20 11c/kWh*</td>
<td>x25 10c/kWh*</td>
<td>x35 8c/kWh*</td>
<td>x50 6c/kWh*</td>
</tr>
<tr>
<td>PP4 Evaluations ** Cost Target</td>
<td>- -</td>
<td>- -</td>
<td>2 15c/kWh*</td>
<td>6 13c/kWh*</td>
<td>10 11c/kWh*</td>
<td>15 10c/kWh*</td>
<td>20 8c/kWh*</td>
<td>25 6c/kWh*</td>
</tr>
</tbody>
</table>

### PP1-4 Publications
- Joint** Total** Citations** Keynote/Plenary** Patents** Industry Support
  - 3 8 25 15 35 50
  - 3 8 20 20 50
  - 2 4 6 8
  - 1 4 4
  - 2 3

### PP5 Training
- Honours** Masters** PhD** Postdoctoral** Researcher Exchanges**
  - 4 10 3 60 20 75 3 12 30 90 3 35 20 7 12 3 14 20 20 18 8 80
  - 4 7 3 7 12 7 90 20 35 105 25 10 18

### PP5 Outreach
- Major Events** Public Lectures** Magazine / News** Policy Support**
  - 4 3 4 2 14 12 15 6 20 12 22 8 26 25 30 11 32 28 38 14
  - 3 9 3 4 12 15 8 20 18 22 20 28 25

* In at least one strand.
** Cumulative numbers
Review

(a) The Grantee will provide to the Institute a written submission for consideration by the Review Panel by no later than 30 September 2015 or other date as notified by the Institute in writing.

(b) The Grantee’s submission should, in relation to Program, detail:

(c) Grantee’s progress against Milestones & any other relevant objectives;

(i) quality & impact of research results to date, including research undertaken by Collaborating Organisations;

(ii) future research & other work planned by the Grantee as part of the Program, including future research & work to be undertaken by Collaborating Organisations;

(iii) interaction & collaboration with Collaborating Organisations;

(iv) interaction & collaboration with industry in Australia & overseas;

(v) information on knowledge sharing activities, including in accordance with communication activities (item 5; Schedule 3), dissemination of public research (item 6; Schedule 3), and knowledge sharing & dissemination by Collaborating Organisations;

(vi) information on governance & management of Program by Grantee;

(vii) risks to Program that have emerged & how they have been or are being managed;

(viii) future risks to Program & how these will be managed by Grantee & Collaborating Organisations;

(ix) a financial statement for Program, including how Contributions have been expended to date & details of cash and in-kind Other Contributions that have been provided & extent to which they have been expended or allocated;

(xi) any other information reasonably requested by the Institute, including information relevant to assessment of performance of Grantee & Collaborating Organisation in conducting Program or relevant to assessment of value of future work to be undertaken as part of Program.
Program

10:15-10:30  ARENA Keynote
10:30-11:00  COFFEE

11:00-12:30  LECTURES (NODE DIRECTORS)

<table>
<thead>
<tr>
<th>Time</th>
<th>Speaker</th>
</tr>
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<tbody>
<tr>
<td>11:00-11:15</td>
<td>Director ANU node</td>
</tr>
<tr>
<td>11:15-11:30</td>
<td>Director UQ node</td>
</tr>
<tr>
<td>11:30-11:45</td>
<td>Director CSIRO node</td>
</tr>
<tr>
<td>11:45-12:00</td>
<td>Director Melbourne U node</td>
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<tr>
<td>12:00-12:15</td>
<td>Director Monash node</td>
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<tr>
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<td>Director UNSW node</td>
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12:30-13:30  LUNCH – own arrangements

12:30-15:00  MANAGEMENT COMMITTEE MEETING with lunch
             Room G22, Tyree Energy Technologies building

13:30-14:30  TETB Tour

14:30-16:30  POSTERS SESSION (lower ground lobby, TETB)

14:30-15:00  COFFEE (in poster area)

16:50-18:30  RECEPTION for participants
Thank you!