Commercial engagement of Solar ANU
ECI Open Day 2015

Matthew Stocks – December 2015
Dr Matthew Stocks

Who am I?

20 years experience in solar research and development with commercial focus

• Current
  – Fellow in Photovoltaics Group since 2013

• Training
  – PhD ANU Engineering 1994-1998
    • High efficiency silicon photovoltaics

• Commercialisation of ANU developed SLIVER technology
  – 1998-03 Research Fellow, ANU
  – 2003-09 Cell R&D Manager, Origin Energy, Adelaide
  – 2010-12 Chief Technologist, Transform Solar, USA
Solar at ANU

Major research and development activity at the ANU

• Two groups – Photovoltaics and Thermal

  – 1971: Kaneff & Carden establish solar research (solar thermal dishes and NH$_3$ thermochemistry)
  – 1991: Blakers joins ANU and establishes PV
Commercially focused Solar research

• Strong engagement with industry is key to our activities.

Why?
A renewable energy revolution

- 1.5 million solar households
- South Australia 40% (wind & PV)
- Tasmania ~100% (hydro & wind)
- ACT 2025: 100% (wind & PV)
- Renewable Electricity Target ➔ ~24%
- Off-river pumped hydro energy storage
- Land transport ➔ renewable electricity
- Gas is squeezed out by heat pumps
New generation capacity worldwide 2014

Silicon PV = 90% of worldwide solar
Global Photovoltaic Sales

15% per year growth rate in shipments

➔ 100% PV/wind by 2040
IEA World Energy Outlook projections: PV

IEA World Energy Outlook projections: wind

Important to have commercial focus

Key to relevance

• Renewables no longer cottage industry

Need scale to deliver impact
Research Directions

Critical mass is critical

• Highly overlapping
  – Avoid “orphan” areas
  – Encourages movement of staff between projects
  – Shared use of equipment

• Areas
  – Defect detection & quenching in silicon
  – High efficiency and tandem solar cells (particularly Si)
  – Quantum & nano photovoltaics (particularly for Si)
  – Hybrid PV-thermal concentrator systems (Si cells)
  – Solar air cooling (particularly for hybrid concentrator)
  – Dish concentrators & thermochemicals
Silicon PV remains dominant: >90%

Data: from 2000 to 2010: Navigant; from 2011: IHS (Mono-/Multi- proportion estimated). Graph: PSE AG 2014
Experimental research is resource intensive

- PV and Solar Thermal labs cost >$1.5M p.a. to operate
  - Tech staff, consumables, maintenance, etc.
- Core university funding for some academics
- Pure research sources (e.g. Australian Research Council) insufficient to fund labs and restricted to university funded academics
- Majority of our effort relies on commercially supported research
External funding key to scale of effort

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<th>Photovoltaics</th>
<th>Solar Thermal</th>
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<tbody>
<tr>
<td>Recurrent academics</td>
<td>5 (+ 2 ARC* fellowships)</td>
<td>2 (+ 1 ARC* fellowship)</td>
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<tr>
<td>Non-recurrent academics *</td>
<td>20</td>
<td>6</td>
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<tr>
<td>Technical staff *</td>
<td>16</td>
<td>5</td>
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<tr>
<td>PhD students</td>
<td>30</td>
<td>15</td>
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* Vast majority of research effort externally funded
Photovoltaics

• One of the two Australian based world leading PV research institutes

• Significant critical mass focused around silicon based single junction and tandem devices
  – Silicon based PV >90% market share

• Excellent research facilities enhanced with ASI foundation grant in 2010

• Group external grant income since 1991 (current dollars): ~$100M
Solar Thermal Group

• Australia’s leading academic research unit in Australia and one of the top units in the world in solar thermal and thermochemical technologies

• The group has substantially expanded its activities, size and funding base since 2013, and now has a strong multidisciplinary research programme

• Supported by a cutting-edge experimental infrastructure including the ANU Big Dish and the first-of-its-kind in the world and the first one in the southern hemisphere high-flux solar simulator.
Commercial partnerships

Diverse range of relationships

• PV Device manufacturers
  – TRINA, Transform Solar

• Module manufacture
  – Tindo, Endless Solar, Chromasun, Dow Corning, Defence, Tectonica

• Equipment manufacturers
  – Tempress, Centrotherm, Shamash Australia, Sierratherm, BT imaging, BraggOne

• System/Grid integration/Storage
  – Electranet, Tara Green, IT Power, Wizard Power, Vast, Sunrise CSP
ARENA – major funding partner

• Australian Renewable Energy Agency significant source of funding

• ARENA Objectives:
  – improve the competitiveness of renewable energy technologies
  – increase the supply of renewable energy in Australia.

• Projects focused on commercial outcomes with industry partner support and collaboration
SLIVER - successful industry partnership

• Novel PV cell design developed by ANU (2000)
  – Progressed to large scale manufacture in Idaho, US (2009)
    • Transform Solar – Origin/Micron Joint Venture
• $240 million dollar investment by Transform
  – ANU benefits
    • $18 million in R&D funding
    • >$11 million in royalties
High-temperature solar thermal energy storage via manganese-oxide based redox cycling

Proposed innovation

Organisation: The Australian National University
Host unit: Solar Thermal Group, RSE
Partners: University of Colorado Boulder, ETH Zurich, IT Power Pty Ltd

Approach

Start date: 1 November 2014
Funding: 1,193,533
Total project value: 3,068,471
“Blue sky” research and institutional collaboration still important

• Commercial research is only part of the picture
  – Next generation of technology often develops from fundamental developments not just commercial pull
  – Collaboration important for progressing technology
    • PV and Thermal groups have had collaborative projects with more than 25 domestic and international R&D institutions
  – Difficult for PhD students to be active in commercial projects
    • Training ground for next generation of researchers
    • Tension between need to publish and commercial confidentiality
Future for ANU Solar

• Continued focus on commercially relevant research
  – Research and development work across the solar energy spectrum from fundamental R&D through to end use and integration

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