



Australian Centre for Advanced Photovoltaics

Renate Egan

Professor
Executive Director





**Engineering Faculty
School of Photovoltaics and
Renewable Energy Engineering
Australian Centre for
Advanced Photovoltaics**

**Founded 2012
by Professor Martin Green**

**Hosted by School of Photovoltaics
and Renewable Energy Engineering
Faculty of Engineering, UNSW**

**ACAP receives funding by the Australian
Renewable Energy Agency (ARENA).**



A National Partnership

ACAP is a national research initiative that

- **Creates a National Network** across 6 research institutes
- **Maintains a critical mass**, having significant local and global impact
- Provides **long-term certainty needed for research**
- **Seeds new innovations** and **connects research to industry**
- **Builds capacity** through graduate study and postdoctoral fellows
 - Close to 50 fellowships and 100 graduate students annually
- Leverages world class **Research Infrastructure**
 - ARENA's 19 MAUD investment in R&D infrastructure
- Supports other programs of work, some funded by ARENA

Establishes a spring-board for innovation

Early-stage research relies on government funding to manage technology and commercial risk



ARENA



MONASH
University



THE UNIVERSITY OF
MELBOURNE



THE UNIVERSITY OF
QUEENSLAND
AUSTRALIA



THE UNIVERSITY OF
SYDNEY

Australian Centre for Advanced Photovoltaics



Renate Egan
Executive Director



Renate Egan
UNSW NODE Leader



Udo Bach
Monash NODE Leader



Jacek Jasieniak
Monash NODE Leader



Anita Ho-Ballie
USyd NODE Leader



Paul Burn
UQ NODE Leader



Paul Shaw
UQ NODE Leader



Richard Corkish
Chief Operating Officer



Anthony Chesman
CSIRO Manufacturing
NODE Leader



Greg Wilson
CSIRO Energy Node
Leader



David Jones
UMelb NODE Leader



Daniel MacDonald
ANU NODE Leader

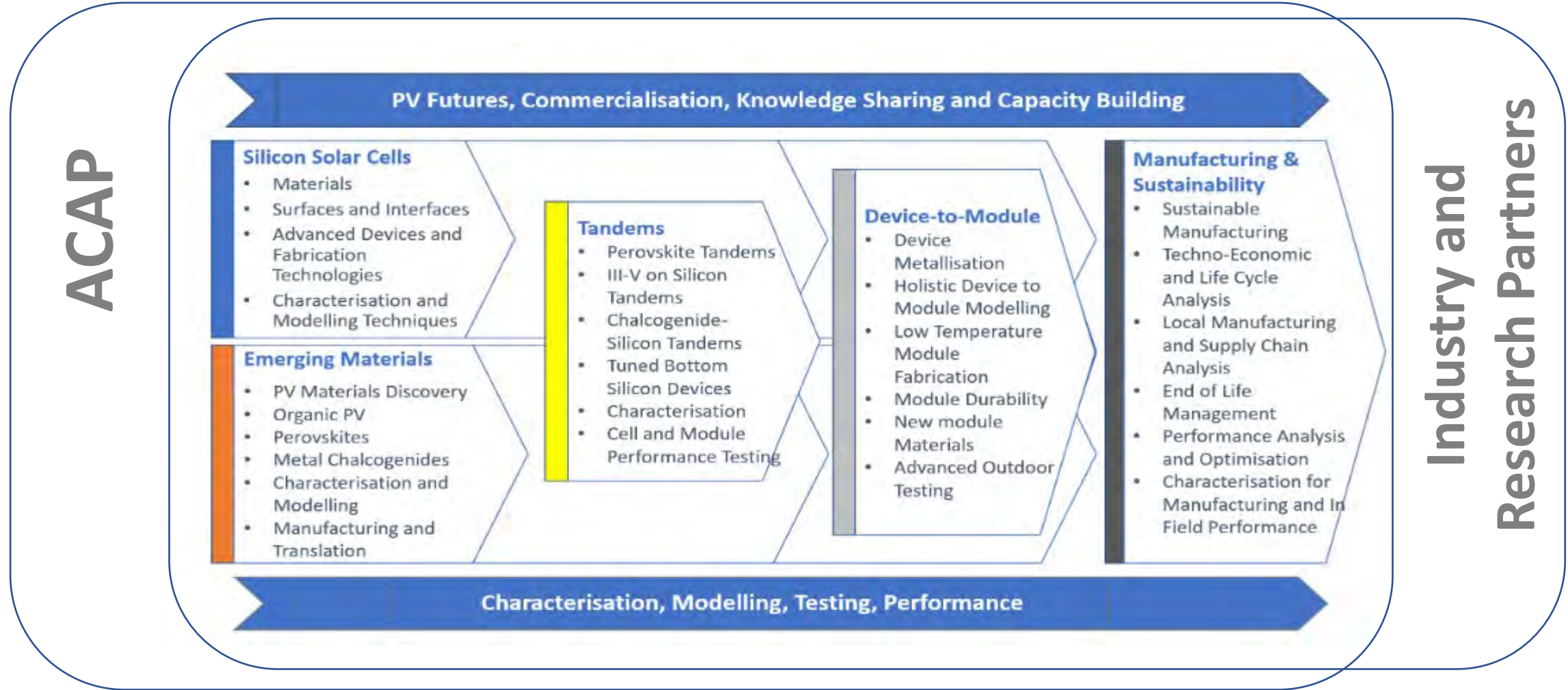


Andrew Blakers
Technical Advisory Committee
Member



Martin Green
Technical Advisory Committee
Member

Research Program Targets Global Impact



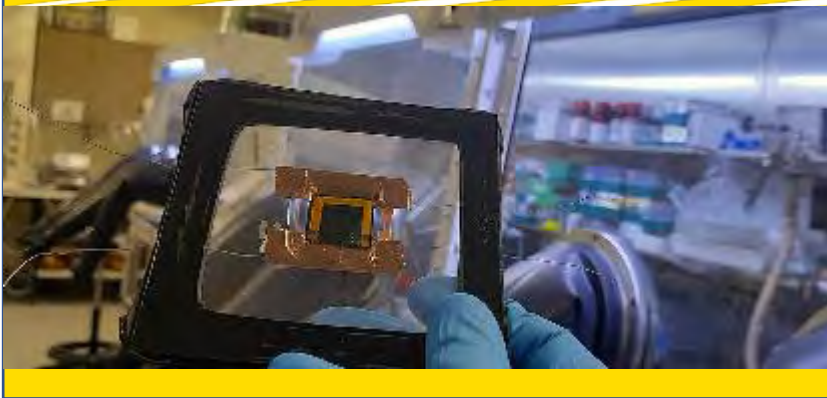
ACAP2 Research Activities

- Collaborative Research to 2030

Tandem Solar Cells

ANU-led team reaches 30% solar cell efficiency target

Reliable, reproducible, cost effective



Manufacturing and Deployment at Scale

Performance,
Sustainability,
Sovereign Capability
Skills



End of Life and Recycling

Technologies, Logistics and
Planning for End of Life
Management



Emerging Technologies



- Seeded under ACAP

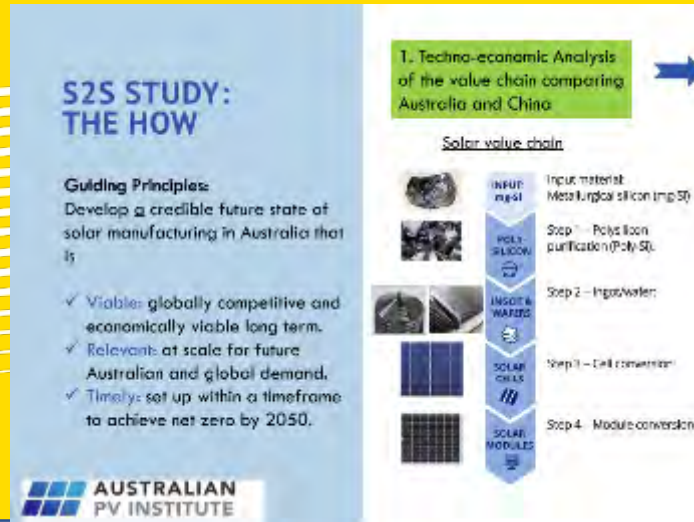
Adamantine Research

Competitively funded in ARENA Solar PV R&D round
Now with commercial pathways, industry partnerships
Recognised nationally with Prime Ministers Prize for Science



Manufacturing Costing

ACAP PhD students, ACAP Fellow developed models and capability, now used in National Feasibility Study: Silicon to Solar Supply Chain Opportunity Assessment



AI for Accelerated Development

Selected for WildFutures initiative – funded by Blackbird



GreenDynamic

Business Plan

Next Generation AI Boosted Solution for Renewable Energy Development

Postdoctoral Fellows

- Pablo Dias (UNSW)
- Now founder with Solar Cycle Ltd



- Navid Haghdadi (UNSW),
- now at Ausgrid



- Jessica Jiang (UNSW)
- Developing strong industry partnerships.
- Leading RJ TRAC Project



- Rhett Evans (UNSW)
- now at 5B



- James Bullock (UoM)
- Leading Silicon program at UoM



- Bin Lu (ANU)
- Eureka Prize Winner

- Jae Sun Yun (UNSW)
- Now at Univ Surrey



- Kean Chern Fong (ANU)
- Silicon program co-lead PP1



- Daniel Chen (UNSW)
- now at SunDrive



- Nathan Chang (UNSW) – Program Lead PP5



- Anastasia Soeriyadi (UNSW)
- Now at Oxford

Commercial Outcomes



- Supported by ACAP

SunDrive Pty Ltd

...creating unique solutions to reduce the cost of high-efficiency solar cells, whilst enhancing their performance and sustainability with abundant materials...producing some of the most efficient solar cells ever made
Vincent Allen, technology concept started with PhD research at UNSW



Solar Cycle Ltd

Making solar even more sustainable by building a circular economy

Pablo Dias (ACAP Fellow)

IP patented at UNSW

Raised \$30M to Scale Advanced Recycling for the **Solar** Industry



Lab360 Solar Pty Ltd

Lab 360 develops commercial daytime photoluminescence systems and services.

IP patented at UNSW

Competitively funded in ARENA Commercialisation Round
Now in commercialisation



World Class Infrastructure

- \$28 million dollar investment in solar research futures

Monash: Combinatorial Sputtering

- to accelerate discovery of new materials, with in-situ measurements of thickness and optical constants
- strengthen ACAP's leadership in materials discovery for solar cells



UNSW: solar cell analysis

- advanced solar cell measurement system that offers a wide range of capabilities in one convenient package
- upgrade for 210 mm solar cells



ANU: Photo-Emission Spectroscopy

- measure a wide range of properties for single junction and tandem solar cells of all materials classes, under vacuum or ambient pressure, from room temperature to 500°C, with automated spatial mapping

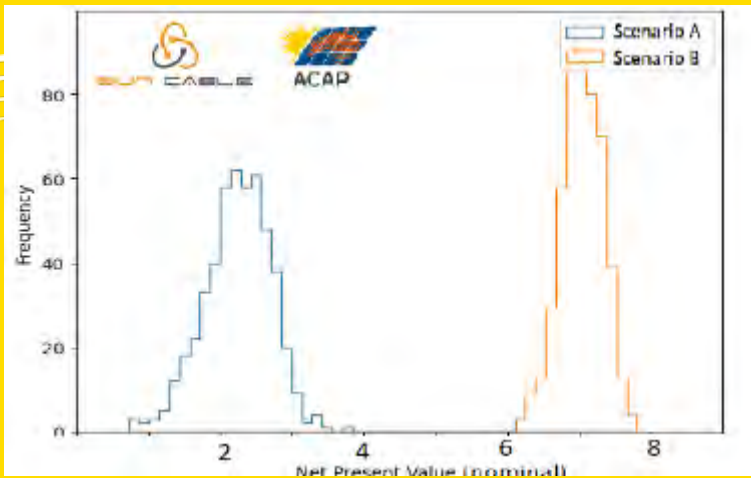


New Australian Partnerships

- ACAP Research Project Collaborations

Sun Cable Pty Ltd

To develop a model based on UNSW PP4, Techno-economic analysis to deliver independent modelling of different technology options.



SunDrive Pty Ltd

To develop new module fabrication methods for bifacial copper-plated silicon heterojunction (SHJ) cells, targeting efficiencies in excess of 23% by October 2022.



5B Pty Ltd

Study stress and load dynamics of modules in prefabricated arrays during build, transport, deployment and operation.



New International Partnerships

- ACAP Consortium and Global Partner Projects

ACAP Industry Consortium



Korea

- SKKU- Sungkyunkwan University
- KRICT - Korea Research Institute of Chemical Technology
- KENTECH-Korea Inst of Energy Tech
- Korea University
- Chungnam National University
- Kyung Hee University
- Gyeongsang National University
- Ajou University
- UNIST-Ulsan Nat Inst Science & Tech

Inviting New Partners

ACAP Consortium discussions open with Gold and Silver Gold Consortium Partners





The Australian Centre for Advance Photovoltaics (ACAP) receives funding from the Australian Renewable Energy Agency (ARENA)



Solar PV is disruptive and we're just getting started

*New industry opportunities will come from delivering
ultra-low cost solar (ULCS)*

Enabling a low cost of energy.

Targeting USD15/MWhr

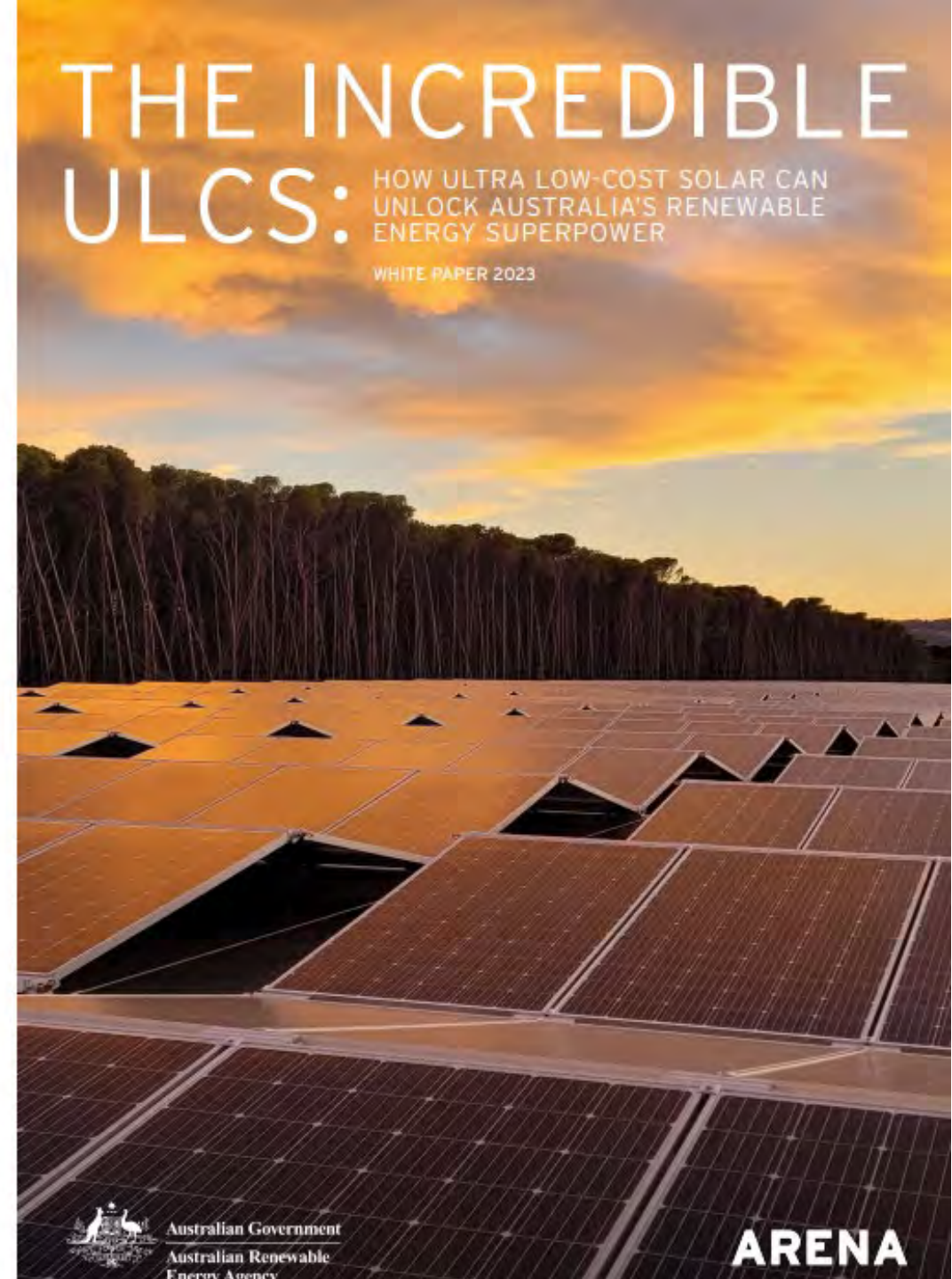
Challenge targets include;

- ***New materials and tandem solar cell development***
- ***Lowering barriers & reducing cost of deployment at scale***
- ***Demand creation and management to match generation***



Australian Government
Australian Renewable
Energy Agency

ARENA



THE INCREDIBLE ULCS:

HOW ULTRA LOW-COST SOLAR CAN
UNLOCK AUSTRALIA'S RENEWABLE
ENERGY SUPERPOWER

WHITE PAPER 2023



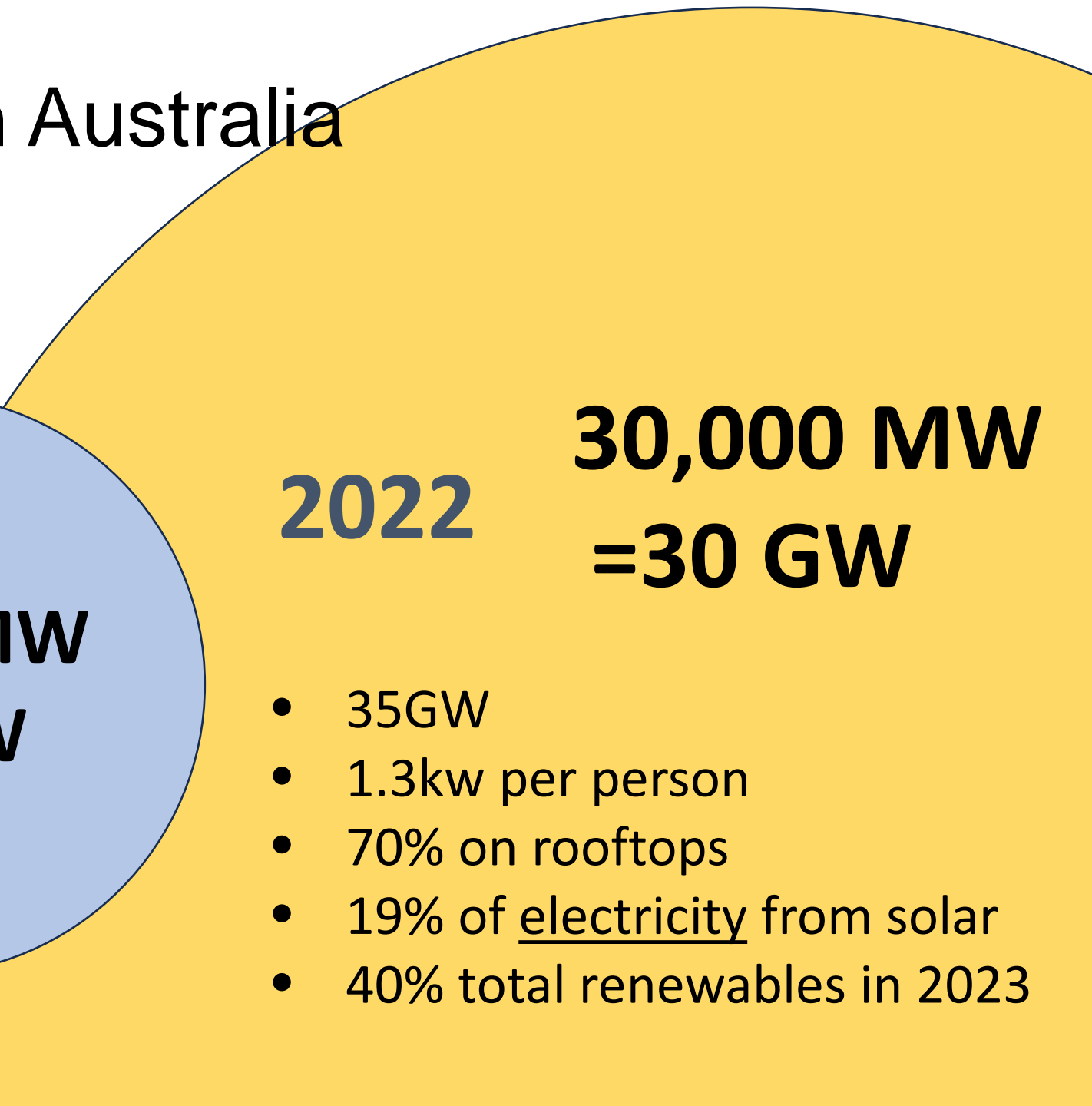
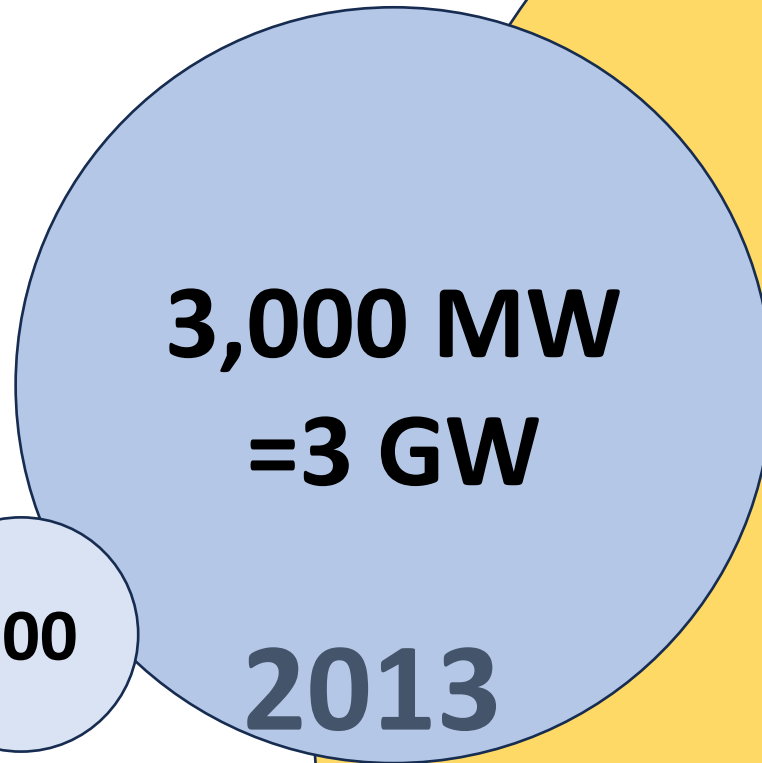
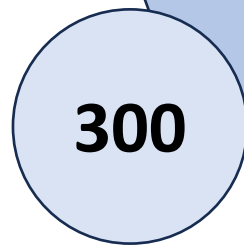
Australian Government
Australian Renewable
Energy Agency

ARENA

Total Installed Solar in Australia

3 MW in 1992
30 MW in 2000
300 MW in 2009

1992 2000 **2009**

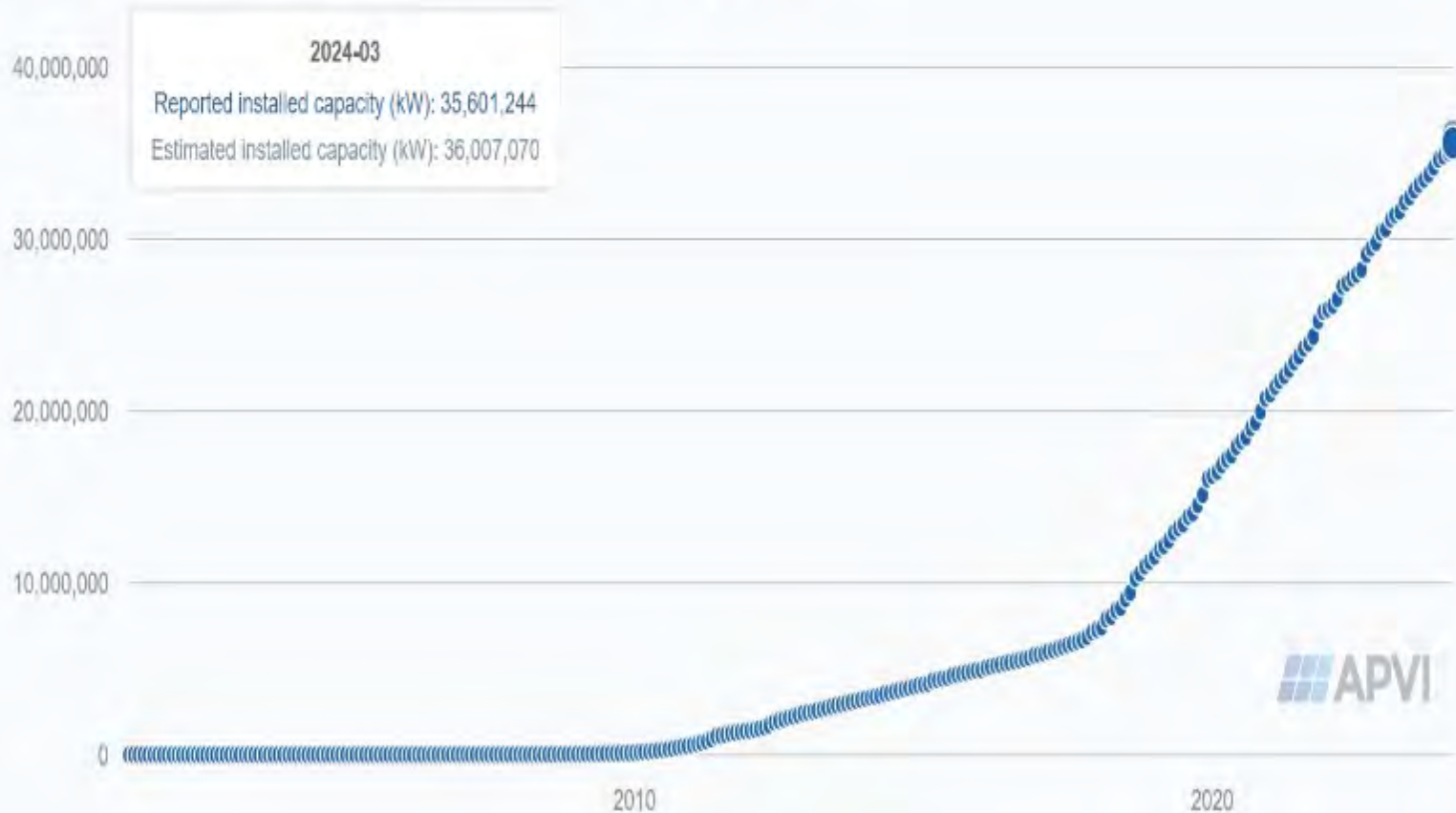


- 35GW
- 1.3kw per person
- 70% on rooftops
- 19% of electricity from solar
- 40% total renewables in 2023

Total Installed Capacity 35.6 GW (March 24)

a total of over 3.69 million PV installations

Australian PV installations since April 2001: total capacity (kW)



Australia #1 in PV per capita at end 2022

End 2023 we have 34.2 GW or 1.3kW per person

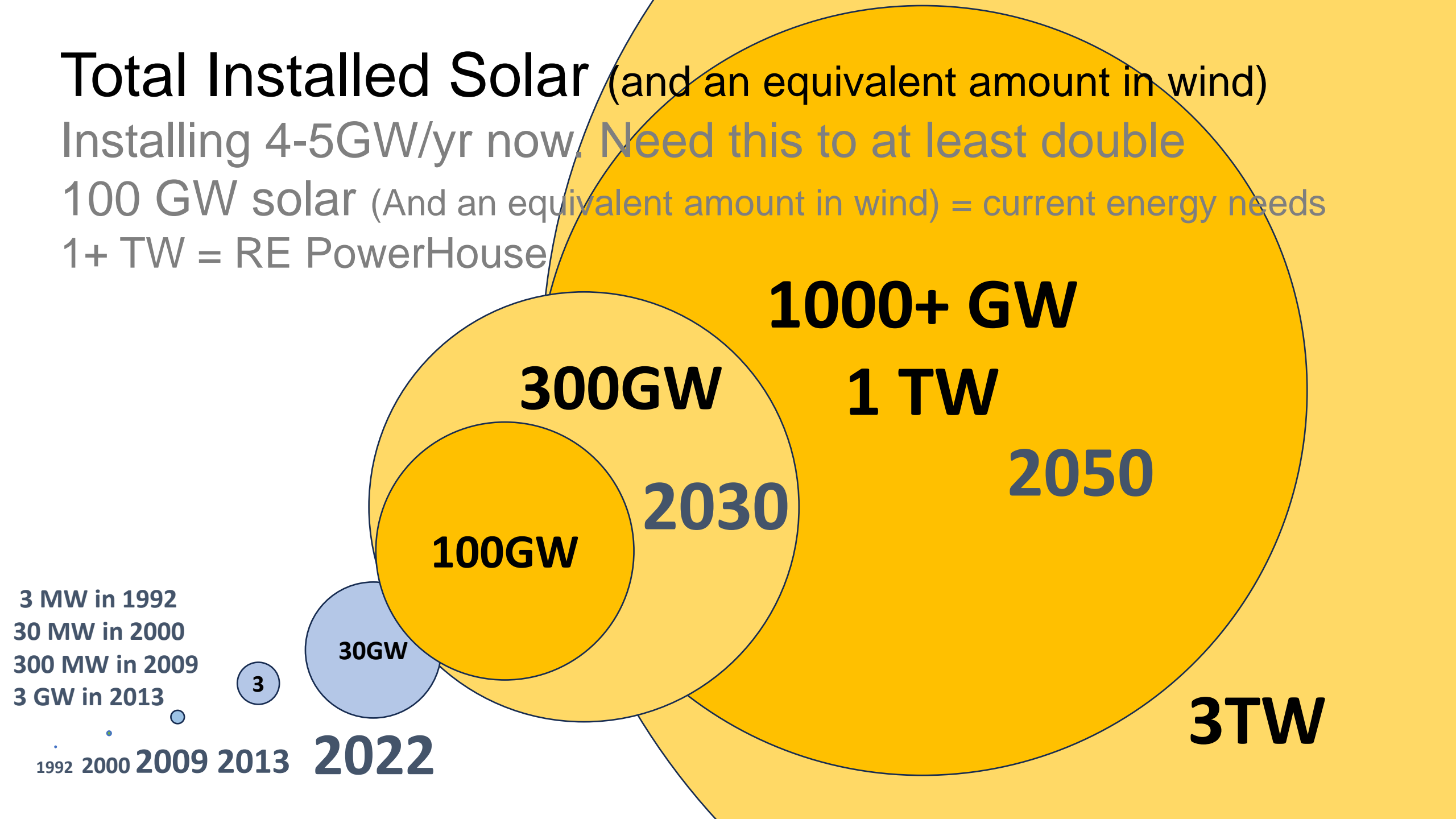
And has been in the top ten for total installed capacity for over twenty years.

70% of this is rooftop solar.
Nearly 40% of free-standing homes are powered by solar

Nearly 20% of electricity comes from solar and a similar amount from wind and water for a total 40% renewables on the National Electricity Market

Total Installed Solar (and an equivalent amount in wind)

Installing 4-5GW/yr now. Need this to at least double
100 GW solar (And an equivalent amount in wind) = current energy needs
1+ TW = RE PowerHouse



1000+ GW

1 TW

2050

300GW

2030

100GW

30GW

3

3TW

2022

2013

2009

2000

1992

3 MW in 1992

30 MW in 2000

300 MW in 2009

3 GW in 2013



300 GW!

**Where are we going to put all this solar?
Do we have space for the energy transition?**

[https://apvi.org.au/wp-content/uploads/2019/06/isf-rooftop-solar-potential-report-final .pdf](https://apvi.org.au/wp-content/uploads/2019/06/isf-rooftop-solar-potential-report-final.pdf)



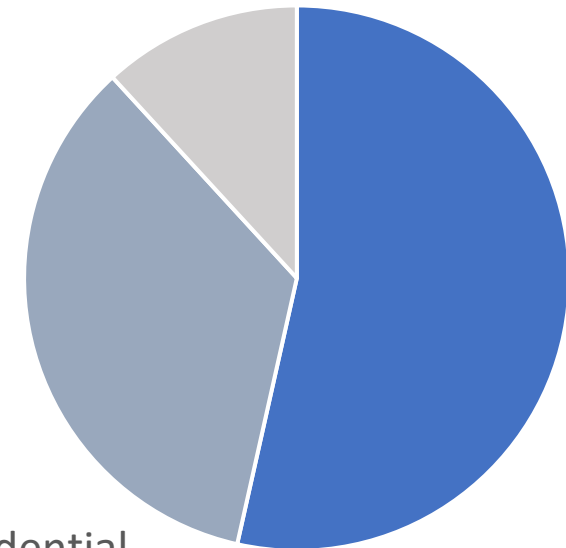
HOW MUCH ROOFTOP SOLAR CAN BE INSTALLED IN AUSTRALIA?

PREPARED FOR:

Clean Energy Finance Corporation and Property Council of Australia



190 GW Rooftop Potential



- residential
- C&I
- other



300 GW!

**Where are we going to
put all this solar?
Do we have space for
the energy transition?**

Image Credit: Gavin Mooney, Kaluza

ISP Step Change scenario:
- 61 GW Wind
- 55 GW Solar
= 1040 km² (0.014%)

Renewable superpower
- 300 GW Wind
- 270 GW Solar
= 5200 km² (0.068%)



3 TW!

How much will that cost?

**And do we have to
import everything?**



3 TW!

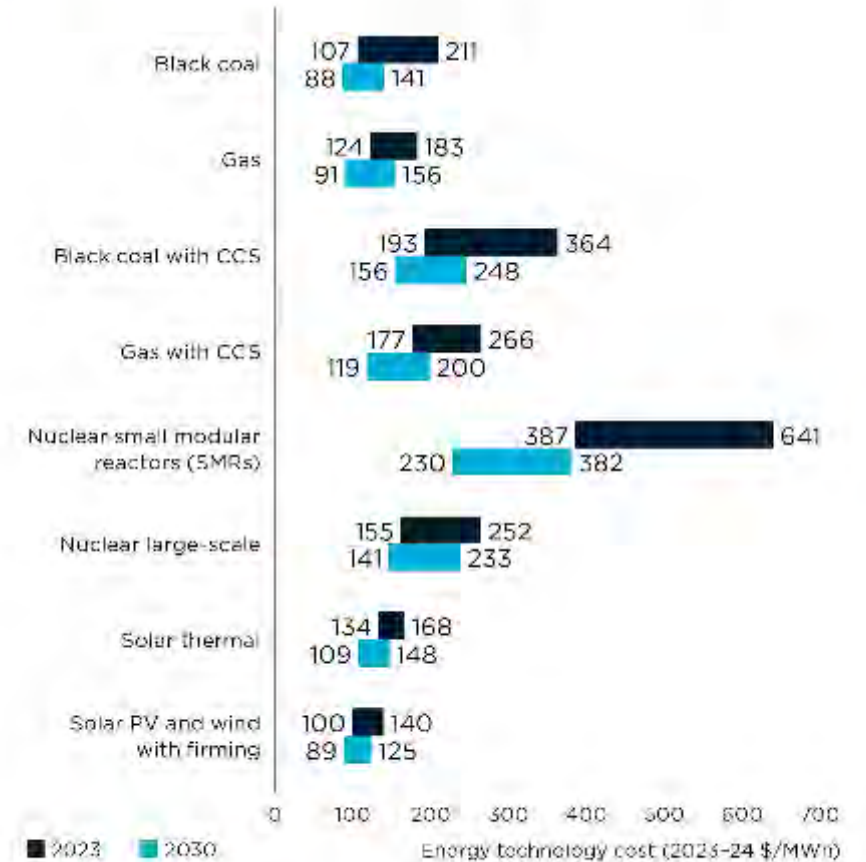
How much will that cost?

And do we have to import everything?

<https://www.csiro.au/en/research/technology-space/energy/GenCost/FAQ-GenCost>

Levelised cost of electricity (LCOE)

Solar PV and wind with firming have the lowest cost range of any new-build technology, both now and in 2030.





Silicon to Solar

Foundations for Solar PV
Manufacturing in Australia



**AUSTRALIAN
PV INSTITUTE**



ACAP



Australian Government
Australian Renewable
Energy Agency

ARENA

Developing a solar PV manufacturing roadmap for Australia





Opens
August

Solar Sunshot

On 28 March 2024, the Australian Government announced up to \$1 billion funding for the Solar Sunshot program, to build Australia's solar photovoltaic (PV) manufacturing capabilities.





Solar ScaleUp Challenge

Powered by **ARENA**

What submissions are we looking for?

We're seeking solutions that can reduce cost and unlock scaleup opportunities:

1. **Reduce 'balance of plant' and installation cost and timelines**, such as innovative solar farm design, or the use of technologies such as robotics, automation, advanced analytics and artificial intelligence.
2. **Reduce operations and maintenance costs**, such as the use of robotics for cleaning and vegetation management, or intelligent fault detection.
3. **Reduce the levelised cost of energy (LCOE)** in other ways such as extending asset lifetimes, boosting efficiency in the field, reducing degradation rates and reducing failure rates.
4. **Enable scale and further cost reduction** through other contributions such as providing available land for solar projects, potential offtake agreements for cheap electricity, or access to testing facilities for new solar technologies.

Submissions may be for standalone late-stage prototypes, pilots or demonstrations, or be part of a real-world, large-scale project. While the primary focus is on technology solutions, we're open to hearing about other solutions – such as commercial innovations – that can help achieve these objectives.

Closes
August
16

More > Energy & Climate > Sustainability

How solar beat every forecast to win the renewables race

Solar power is on track to generate more electricity than all the world's nuclear power plants in 2026, its gas-fired power plants in 2030 and its coal-fired ones in 2032.

The Economist

Jul 3, 2024 - 5.00min

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Over 2023, the world's solar parks, their panels currently covering less than 10,000 square kilometres, produced about 1,600 terawatt-hours of energy. Bloomberg

The Economist

Headline

Special Double Issue

Climate & Energy

The Energy Transition

Investment

DAWN OF THE SOLAR AGE

A SPECIAL DOUBLE



“THE SUN HAS WON”

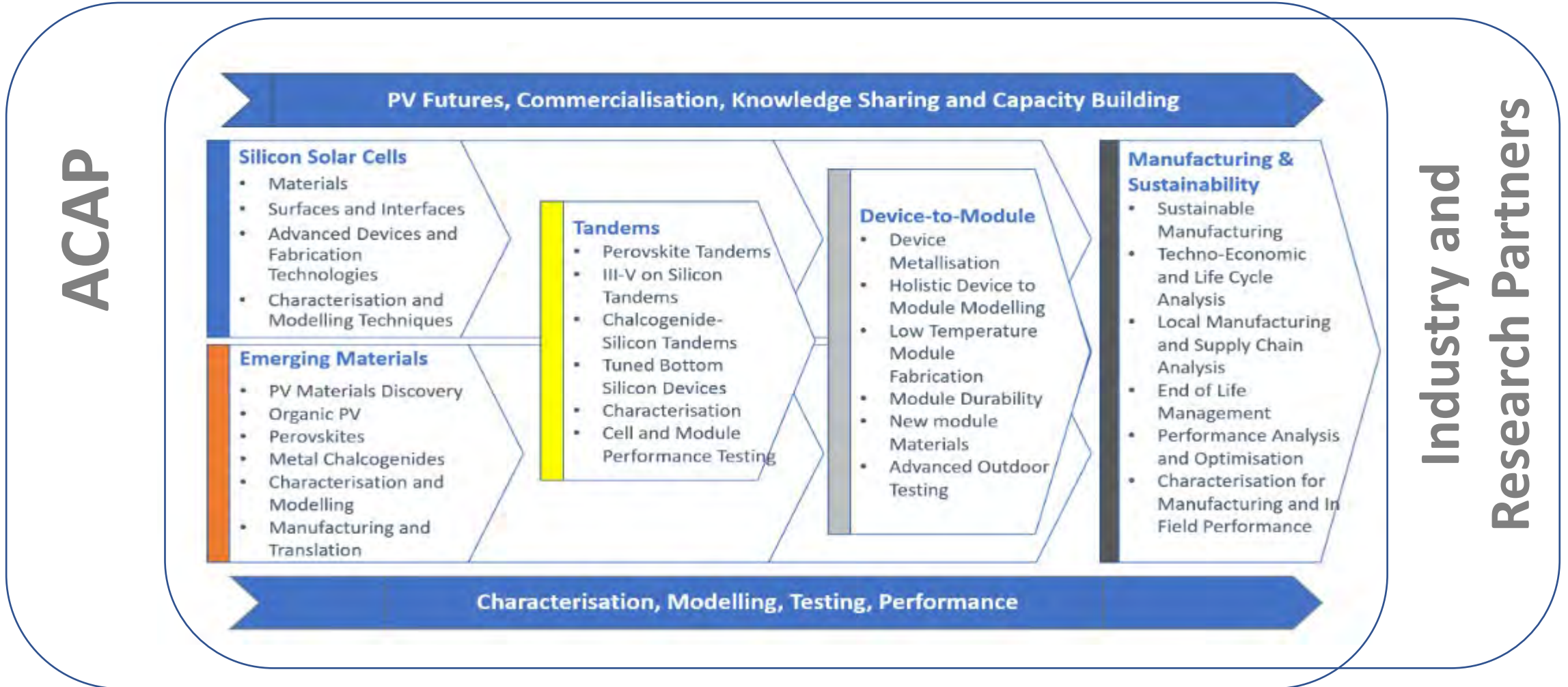
The Economist. June 2024

Success! What does this mean for research?

- Silicon Solar Cells – toward 30%
 - All back contact silicon
 - Bifaciality
 - Efficiency enhancement
- Efficiencies beyond 30%
 - New materials
 - Tandems, multijunction technologies
- Sustainability at TW Scale
- Quality, Lifetime
- Field performance and Reliability
- Deployment – driving down the cost 30c/W installed (halving current cost)
- Recycling and End of Life
- Integration
 - grid, batteries, demand management, demand generation
 - green hydrogen, green minerals processing, carbon capture



A Research Program Targeting Global Impact



New International Partnerships

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ACAP Industry Consortium



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Thank You