



THE UNIVERSITY OF
MELBOURNE

Energy

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Australian Research Council Centre of Excellence in



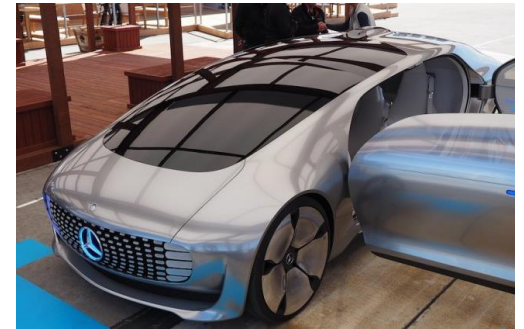
Generation



Storage



Consumption




Australian Research Council Centre of Excellence in

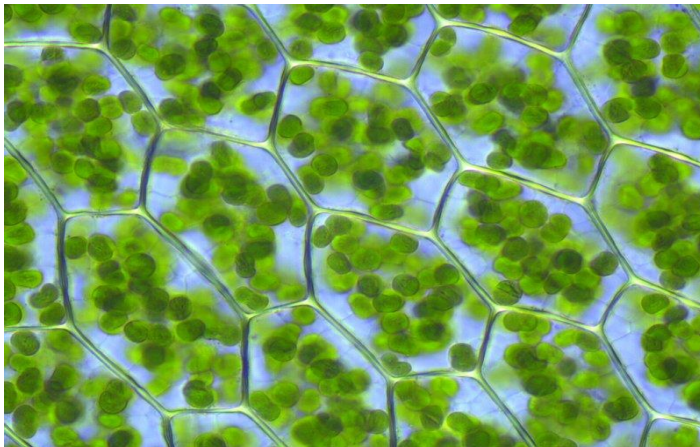


exciton science

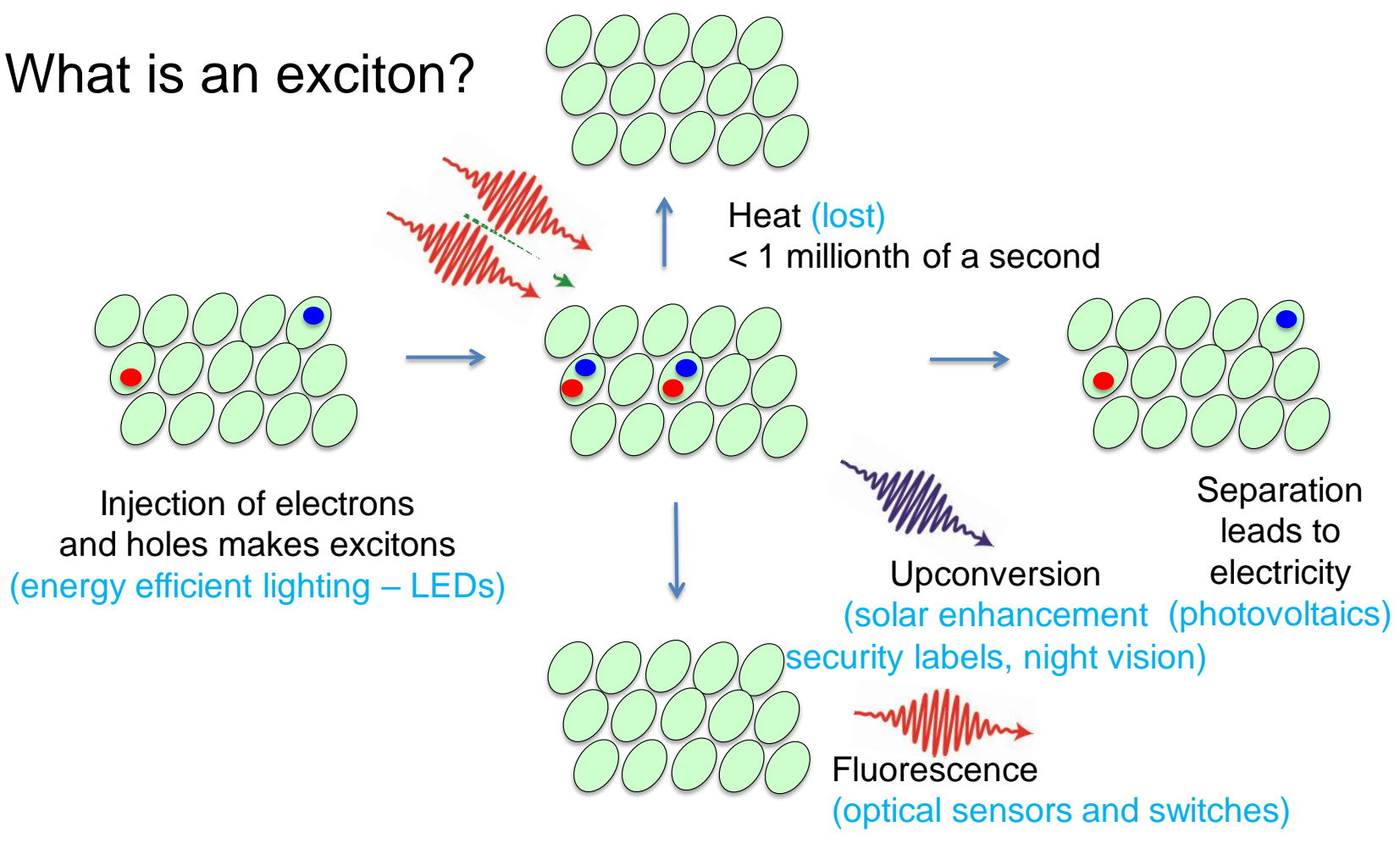
Next-Generation Light Harvesting Molecules for a Sustainable Energy Future



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- ACEx is an ARC Centre of Excellence (2017-2022).
 - Our programs cover
 - New Approaches to Solar Energy Conversion
 - Basic Research into Light-Matter Interactions
 - Energy Efficient Devices, Sensors and other optical applications of new materials.
 - Key Partners are: CSIRO, DSTG, RBA.
 - 15 CIs, 30 Postdocs, 75 PhD students, 20 MSc/hons.
 - Links to Berkeley, Munich, Cambridge, MIT, Wuhan.



What is an exciton?

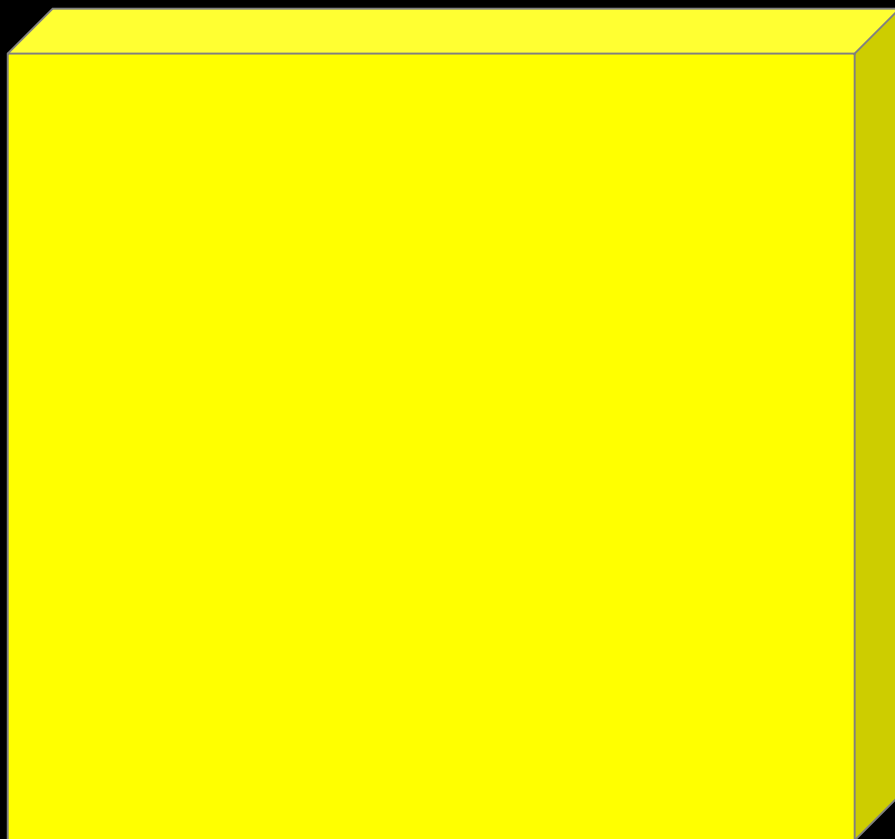




The Sun – Our Ultimate Energy Source



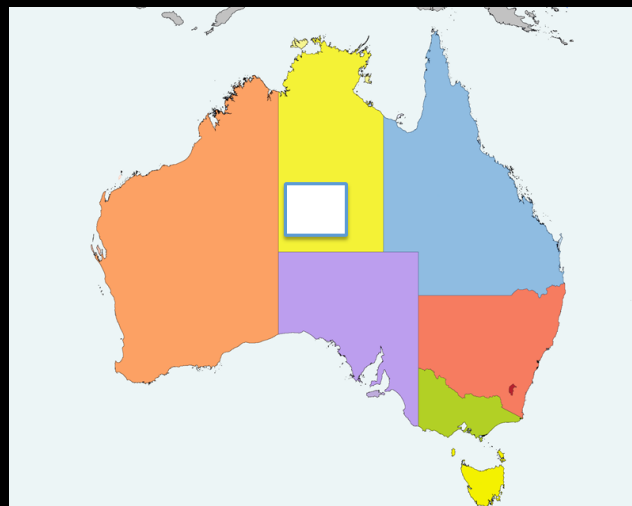
Sunlight Incidence (120,000 TW)

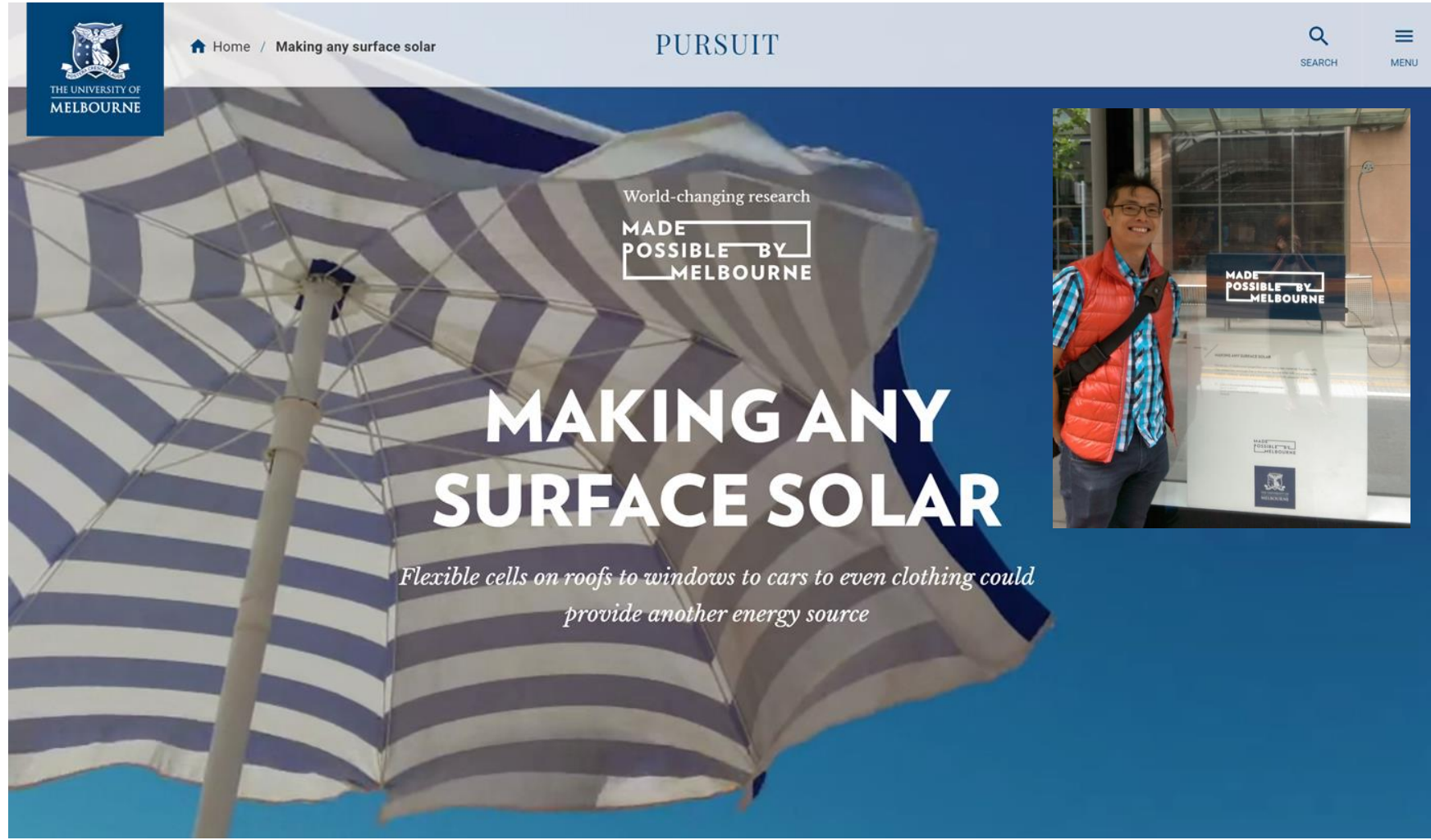



Energy Demand
(16 TW)



Current PV Installations
(~0.4 TW)





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PURSUIT

SEARCH MENU

World-changing research
MADE POSSIBLE BY MELBOURNE

MAKING ANY SURFACE SOLAR

Flexible cells on roofs to windows to cars to even clothing could provide another energy source



<https://pursuit.unimelb.edu.au/madepossible/10/>




With appropriate levels of device stability and efficiency, printed solar cells can significantly assist in meeting energy demand because of the **speed** as well as **low-cost** (both monetary and energy) of their production and installation.

- Base load power – pumped hydro
- Local storage – batteries
- Mobile storage – supercapacitors
- Solar fuel – artificial leaf



Australian battery technology
Zcell flow battery is an alternative to lithium ion batteries.


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- 5% of the world's electricity is spent keeping the internet going.
 - 5% of the world's energy is spent on ship freight.
 - 5% of the world's energy is spent making ammonia for fertiliser. This fertiliser is essential for production of about 40% of the world's food.
 - Per kilometre it is now cheaper in terms of energy to go by plane than by car. An A380 uses < 3.3L/100km per passenger in flight.
 - It costs more energy to ship carrots to Melbourne from regional NSW than the energy contained in the carrot.

Note: That only 30-40% of the energy we use is in the form of electricity, the rest is chemical fuels (diesel, oil, gas or coal driven machines and engines.)

- **Combustion**
 - Candle (0.04%)
 - Gas lamp (0.3%)
- **Incandescent**
 - Tungsten (2.6%)
 - Halogen (5.1%)
- **Fluorescent** (15%)
- **LED** (>20%)

% of energy consumed emitted as visible light in brackets.

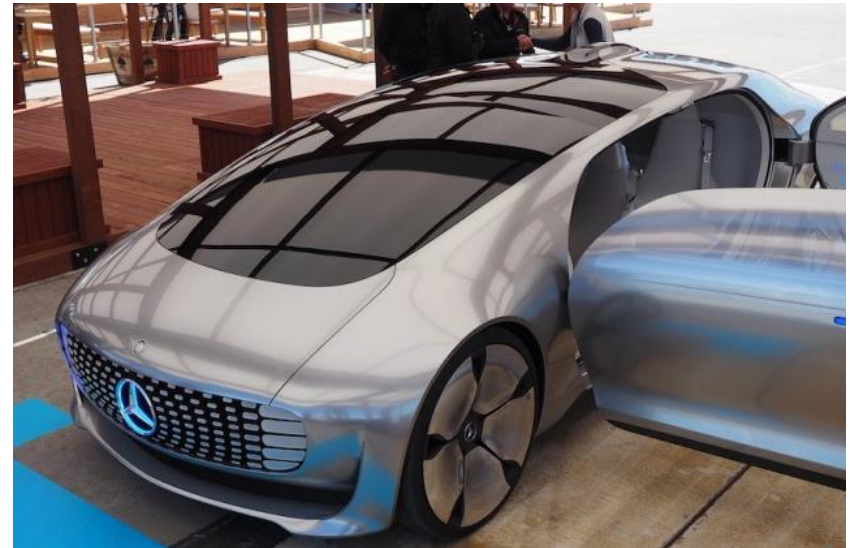
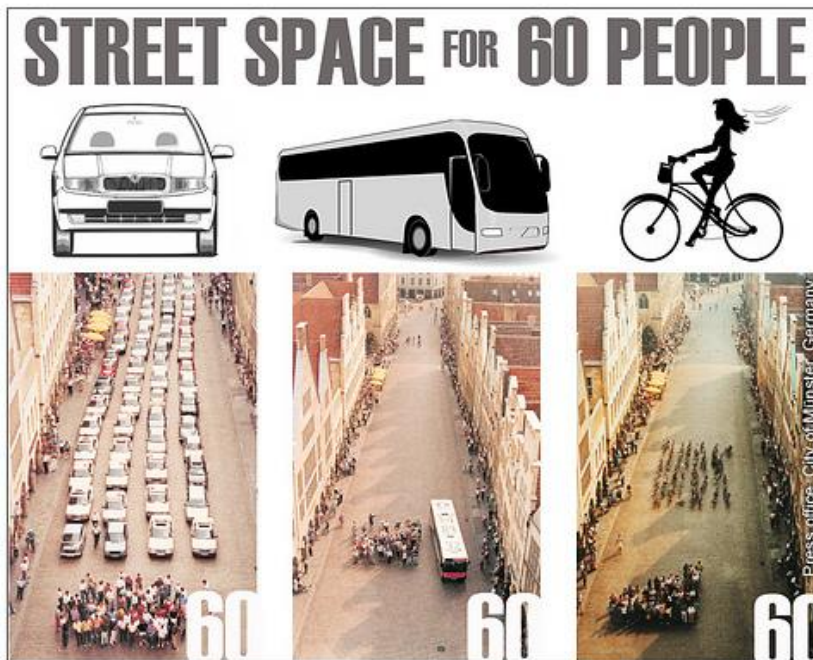


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- Near-infrared (NIR) light 800-1500 nm contains almost half the solar spectrum.
 - Current solar cells can convert 400-1000 nm into electricity.
 - The NIR is considered a nuisance, it ends up as heat, which in turn needs energy to remove (air conditioners, fans etc.)

NIR could be managed by:

- Perfect **NIR reflectors** – keep heat out or in. E-Glass is expensive – a cheap, transparent NIR reflector will change our buildings and cities forever.
- Efficient **thermoelectric** materials and devices.
- **Up converters** – 50% UC would change the energy landscape.

- How fast is your car?
- Electric cars, driverless cars and car sharing





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ARENA



Questions?

