

Apollo Bay's Roadmap to 100% Renewables



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Talking about energy

Some key terms

power

The ability to lift the weight

- Units of measurement: W, kW, MW
- Toaster=1kW, Hairdryer=2kW, Aircon=5kW

energy

Hold up the weight for a period of time

- Energy = Power * Time
- Unit of measurement: Wh, kWh, MWh
- Average Australian House= 20kWh per day



How much energy does Apollo Bay use?

According to recent Powercor data
Apollo Bay uses an estimated
20 GWh of energy per year



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Our current energy system

GENERATION



DISTRIBUTION



DEMAND



+ BACKUP



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The roadmap research scope

Small Scale

- Energy Efficiency
- Rooftop Solar

Large Scale

- Solar Farm
- Wind Farm

Managing Demand/Storage

- Community Battery
- Pumped Hydro
- Demand Management
- Microgrids



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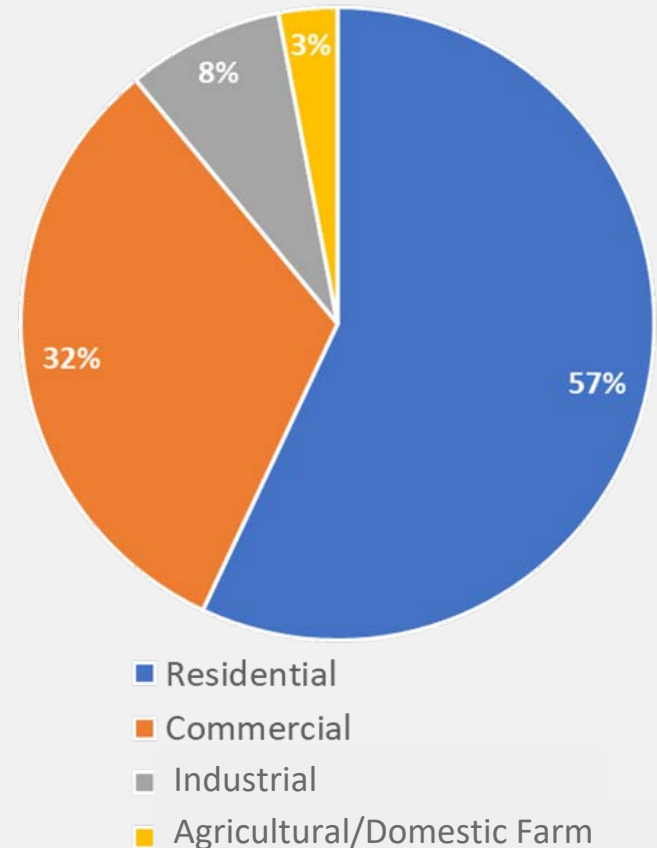
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Energy efficiency

- Most energy consumed by residential and commercial users
- Most residential energy used during winter
- Improve residential energy efficiency by upgrading space and water heating to heat pumps
- Conduct energy audits for residential/commercial properties
- Efficiency gains in winter better complement solar generation
- Funding from Sustainable Australian Fund available

Energy consumption could be reduced by up to 50%

Apollo Bay Region's Energy Consumption By Sector



Rooftop solar

- Facilitate the installation of rooftop solar
- Solar and/or battery bulk buy program to provide lower costs for customers is in progress
- Potential to generate around **40% (8GWh) of the community's current annual energy needs** from rooftop solar if all roofs are utilised (46,898m² or 7,328 kW)



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Rooftop solar

Advantages

- Quicker construction than large scale project
- Increased real estate value for the home/business property owner
- Lower electricity bills

Disadvantages

- Potential resistance from Powercor due to greater complexity for them in managing the current grid infrastructure
- Lack of equity and access as only home/business property owners can install – renters don't have much say
- Limited incentives for holiday home owners to install rooftop solar
- Energy only generated during the day



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Solar farm

- Build a community owned solar farm
- 11MW (30,000 panels requiring 11 ha) solar farm would make the Apollo Bay region 100% powered by renewable energy (including import/export)
- More regulatory requirements must be met for solar farms larger than 5MW
- Total completion time greater than 2 years

Community Solar Farm Projects

Location	Year	Size
Renmark, SA	2017	180 kW
Lismore, NSW	2018	200 kW
Mount Majura	2019	1 MW



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Solar farm

Advantages

- Flexibility on size and where it can be located
- Potential to co-operate with network distributor Powercor
- Possibility to provide 100% renewable energy for the community
- Potential to allow all members of the community to benefit, not just property owners
- Greater generation potential than rooftop solar due to more regular maintenance i.e. cleaning and monitoring

Disadvantages

- Requires large financial commitment from community or private investors
- Large land area required
- Energy only generated during the day



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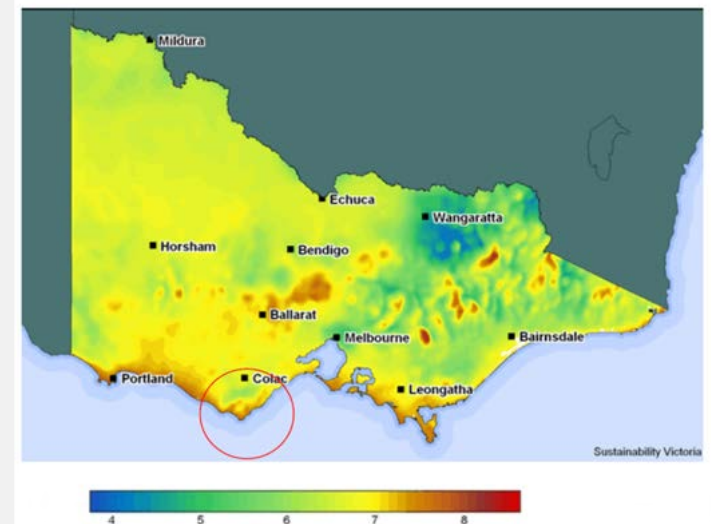
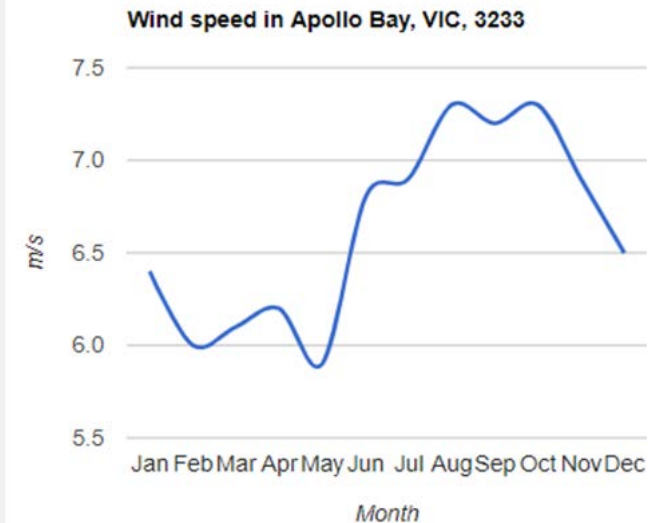
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Wind farm

- Average wind speed of 23.6 km/h
- Energy production: 7-8 MWh/day per MW
- Cost of Construction: \$1.5-2m per MW
- Energy cost: 5-6 c/kWh
- Construction time: 1-2 year for small projects

Wind Projects in Victoria

Project	Year	Power (MW)	Cost (\$M)
Ararat Wind Farm	2017	240	450
Bald Hills Wind Farm	2015	106	
Bulgana Green Power Hub	2018	194	350
Challicum Hills Wind Farm	2003	52	46
Codrington Wind Farm	2001	18	33
Kiata Wind Farm	2018	32	75
Murra Warra Wind Farm	2018	430	650
Portland Wind Farm	2010	195	330
Bulgana Green Power Hub	2018	194	350
Hepburne Wind Farm	2011	4.1	12.9



Wind speed in Victoria



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Wind farm

Advantages

- IEC wind Class II(medium)-III(low wind)
- Mature and trusted technology in the region
- Electricity production during night time
- Back up production in winter season
- Cheap source of electricity

Disadvantages

- High upfront capital cost
- Less flexibility in scale (smaller wind farms are less economically viable compared to solar farms)
- Land allocation
- Noise and Aesthetic impact

Community battery

- Mature and reliable technology
- Community batteries \$1.4-1.7m per MW
- Provides value to customers, network and grid
- Short construction time: ~1year



Community battery projects in Victoria

Project	Power (MW)	Energy (MWh)	Cost (\$M)
Ballarat Energy Storage System	30	30	43
Gannawarra Energy Storage System	25	50	41
Lake Bonney Wind Farm	25	52	38
Dalrymple ESCRI battery	30	8	30
Hornsedale Power Reserve	50	64	71



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Community battery

Advantages

- Lower cost compared to residential battery
- Potential for shared ownership (community and Powercor)
- Better maintenance, hence better efficiency and longer life
- Revenue generation by providing services to energy market and the network company (frequency, voltage, peak shaving,...)

Disadvantages

- Initial capital cost
- Complicated contract (Revenue and cost sharing)
- Short life time of batteries

Pumped hydro

- The closest suitable sites for pumped hydro are in Petticoat Creek area.
- Construction cost is \$1.5-1.9m per MW
- Construction time: 4-6 Years

Pumped hydro projects in Aus

Project	Power (MW)	Energy (MWh)	Cost (\$M)
Goat Hill	250	2000	410
Highbury	300	1350	400
Baroota	215	1570	406
Iron Duchess	90	390	170
Cultana	225	1755	477
Kidston	250	2000	330



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Pumped hydro

Advantages

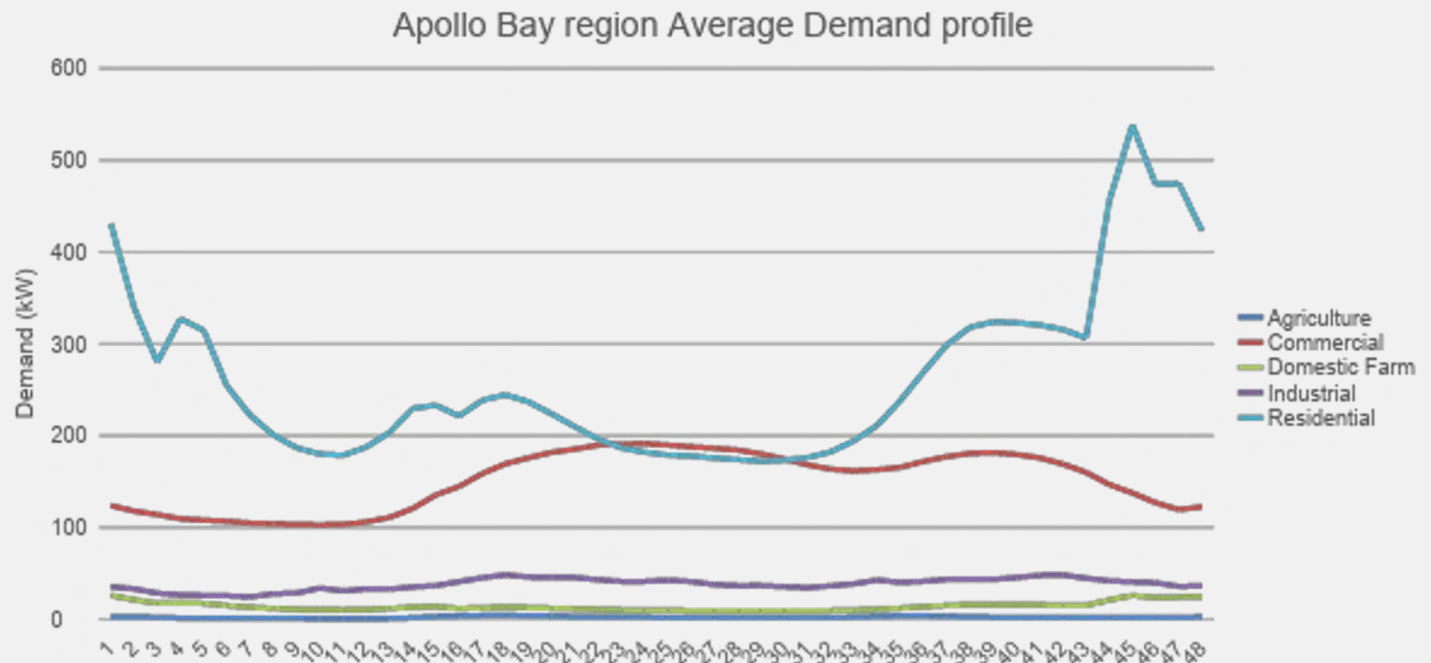
- Longer life time
- Mature technology
- Creating jobs locally
- Large energy capacity

Disadvantages

- Longer construction time
- Large area is needed
- Disturbance to wild life
- Sea water corrosion and sea life impact

Demand management

- Currently, large residential demand for power between 9pm to midnight
- Adjust when power is used to match renewable sources such as solar eg. encourage behaviour change to use during the day through cheap day time electricity rate



Micro grids

- Smart network that allows local sharing of local energy generation and storage
- Potential to operate independently from the main grid and avoid power outages
- Decreases reliance on the main grid
- Possibility of having a community energy retailer



Summary - Comparison

Category	Technology	Cost	Major Advantages	Major Disadvantages
Small Scale	Energy Efficiency	Low	Easy to implement	-
Small Scale	Rooftop Solar	Medium	Asset for owner	Only available for owners
Large Scale	Solar Farm	Medium	Flexible location	Only daytime generation
Large Scale	Wind Farm	Medium	Night time/winter generation	Location restrictions
Storage	Community Battery	High	Cheapest storage	Short life time
Storage	Pumped Hydro	Very High	Longer life time	Higher cost from corrosion

Lessons from the research

TARGET	FEATURE	ACTIONS
100%: 20 GWh	RENEWABLE APOLLO BAY	Build an unstoppable community movement
30 - 50% 6-10 GWh	EFFICIENCY	Education resources Explore funding support Enlist trusted commercial partners Enlist Council & Community partners
30% - 40% 6-8 GWh	ROOFTOP SOLAR	↑Community Solar Program ↑Commercial & industrial ↑Partner organisations
20 - 40% 4-8 GWh	SOLAR FARM/ WIND TURBINES	Funding for feasibility studies/ business case Explore potential development partnerships
Matching demand with supply	STORAGE/ MICROGRID	Pursue Funding