Transforming Greater Melbourne from a consumer to a producer by 2030

a new normal

"Nowadays we are in a time where the idea of poetry is again important, because all information is accessible at anytime, so information is no longer interesting. It is more about deciphering something. The door opener for allowing people to decipher something is beauty. It's not about direct communication, it's more about poetic communication, and poetry is always about encrypting and deciphering information."

Joachim Sauter, Professor for New Media Art and Design at the Universität der Künste in Berlin, Founder of ART+COM, Co-founder of Chaos Computer Club

This document was printed using vegetable based inks on ecoStar+ 100% Recycled Uncoated stock made with 100% recycled post-consumer waste.

We proudly acknowledge the people of the Kulin Nation as the owners of the lands on which A New Normal is based, and pay our respect to their Elders past, present and emerging.

We recognise the deep connection of First Peoples to Country and value their contribution to caring for, and managing the land, water, natural and built landscapes and their profound knowledge systems.

We commit to developing reciprocal relationships with our First peoples and as a cornerstone in defining A New Normal for our City.

We also extend our acknowledgement to all Aboriginal and Torres Strait Islander communities and their rich culture, and pays respect to their Elders past, present and emerging.

Strategy Acknowledgments

This strategy and implementation plan for the future of Greater Melbourne was prepared by...

finding infinity

In collaboration with...

CLARE COUSINS ARCHITECTS
DREAMER
Edition Office
FENDER KATSALIDIS
FIELDWORK
GRIMSHAW
Foolscape Studio
GREENAWAY ARCHITECTS
Ha°
Hassell
John Wardle Architects
KENNEDY NOLAN
NMBW
OPENWORK
WOWOWA
6°

Engineering peer review by...

MOTT MACDONALD
atelier ten

With support from...

Prof. Jens Bley, eCultureLab c/o CityScienceLab, HafenCity University, Hamburg, Germany

Thomas Supple, Cultural Curator

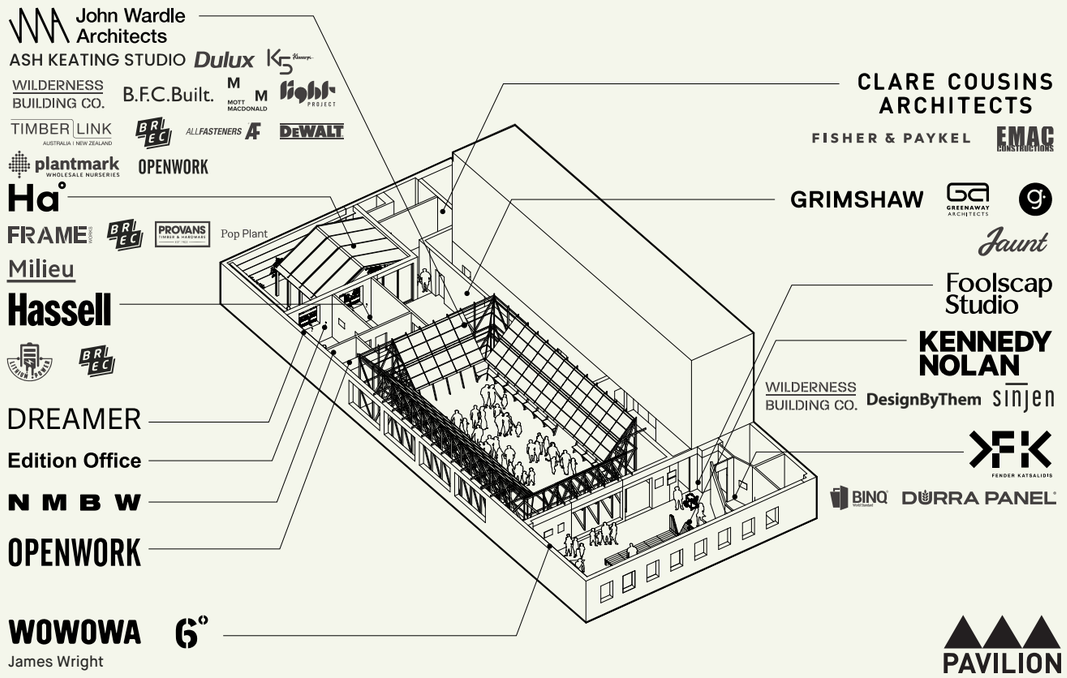
Revision 2 Issue - March 2021

Design Week Launch Acknowledgments

Proudly supported by...

CITY OF MELBOURNE
MELBOURNE DESIGN WEEK
GOLDEN AGE
Sustainability Victoria
VICTORIA State Government

Special thanks to...



Part of Melbourne Design Week 2021, an initiative of the Victorian Government in collaboration with the NGV.

With ongoing support from

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Foreword

Lord Mayor Sally Capp

No one could have imagined the devastating events that have unfolded around us in 2020. The intense summer bushfires that ravaged our countryside and choked our cities have brought a distressing reality to our climate emergency. Our recovery was barely underway when COVID-19 emerged, its rapid spread damaging communities and economies everywhere.

The environmental and economic challenges ahead are immense. We will overcome them together. From dislocation and disruption there comes the opportunity to re-evaluate the way we do things and reset our cities on a safer, more sustainable, more resilient path. As we rebuild, we will need courage and vision to stay the course.

Cities like Melbourne must play a leadership role in this “new normal”, working with our communities to demonstrate the social and economic advantages of new and better ways of thinking. We know Melbourne’s commitment to net zero emissions by 2040 will be more important than ever to many people in the wake of our horrendous bushfires; a transition to 100 per cent renewable energy for buildings and transport will play a major role in reaching that target. The creation of a circular economy is another necessity as we turn our minds to reducing or using waste more thoughtfully. Melbourne also plays an active part in an international community of cities dedicated to sharing ideas and acting together to adapt and respond.

This report, *A New Normal*, builds on case studies from cities around the world and proposes practical solutions to make better, healthier municipalities across Greater Melbourne while generating jobs and economic opportunities. The projects presented here have been carefully costed and developed with a focus on economic viability.

In addition, fifteen Melbourne architecture practices have collaborated to help visualise the findings by sharing their vision for transition and recovery. Their approach is to integrate the physical infrastructure that makes our city function with the cultural infrastructure that enables it to thrive.

Bringing together business, all levels of government and the people of Melbourne, the ideas presented in the New Normal will stir much–needed discussion and deserve serious consideration. In our recovery from the bushfires and COVID-19, we have an opportunity to re-imagine and transform our city with a vision for the long-term while solving our short term challenges.

Let’s build something to be proud of for generations to come.

Sally Capp

Lord Mayor of Melbourne

Executive Summary

<u>This proposal for Greater Melbourne has the potential to:</u>

- Provide economic recovery
- Secure our energy supply, water
- supply & movement network
- Create over 80,000 jobs
- Create a sustainable revenue in 7
- years
- Position Melbourne as a world leader in economic and environmental transition

The purpose of this document is to bring the private sector, the public sector and the people of Melbourne together in response to some startling shocks experienced in 2020 such as COVID-19 and recent bushfires plus the ongoing climate emergency. It proposes a vision of transformation for Melbourne to become a self-sufficient and more resilient city.

This report focuses on currently available and profitable technology, and as such can provide a rapid stimulus opportunity. We can transform Melbourne to operate on resources that will never run out - and profit from the transition.

According to the United Nations, global carbon emissions must halve by 2030. But national governments — including Australia's — are struggling to respond in time.

It is now becoming clear that the transition will not be led by nations. It will be led by cities.

Cities are where the majority of earth's population live. Cities are responsible for the majority of global carbon emissions. A city like Melbourne — already one of the wealthiest and most liveable in the world — is perfectly placed to lead the transition by transforming from a consumer to a producer by 2030.

Every year, Greater Melbourne currently burns enough coal to fill Melbourne's tallest building, the Eureka Tower, 100 times, enough oil to fill it 40 times, and enough natural gas to fill it 30 times. It produces enough waste to fill Eureka Tower 50 times a year, and consumes enough water to fill it 1000 times.

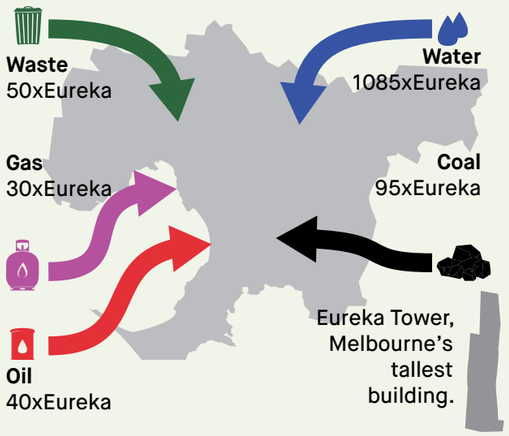


Figure 1: *Resources required to make the city work*

A New Normal details the opportunity and benefits associated with Melbourne making this transition happen by 2030. It identifies the 10 key initiatives that, if implemented, can transform Greater Melbourne into a self-sufficient city by 2030.

Let's not delude ourselves — these shifts are seismic. Fossil fuels and the internal combustion engine have underpinned the global economy for 200 years. So, how do we do it? We electrify transport and buildings. We drastically improve the efficiency of our buildings. We introduce energy storage and power our cities with renewable resources. We treat and reuse water, creating an endless supply. We use organic waste as a fuel for heat and power plants. We end the concept of landfill.

<u>10 Key Profitable Initiatives Required to Transform Melbourne By 2030:</u>

01 Electrify Transport

Phase out the internal combustion engine, transitioning to electric vehicles, while also discouraging vehicle ownership by improving public and human powered transport infrastructure

02 Energy Storage

Utilise the energy storage available in our electrified transport system in combination with thermal and hydro to create grid stability.

03 Electrify Architecture

Phase out natural gas, replacing gas heating and hot water with heat pumps, gas appliances with efficient electric equivalents

04 Efficient Architecture

Mandate the retrofit of all existing buildings with only profitable initiatives to reduce their energy & water consumption

05 Solar Architecture

Improve solar PV uptake within Greater Melbourne, installing solar PV on a minimum of 50% of all rooftops

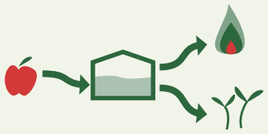
06 Solar & Wind Grid Scale

Transform the LaTrobe Valley into a renewable energy & agriculture region, ending coal fired generation

07 Water Unlimited

Treat and reuse sewer water within the city

08 Waste to Energy



Install anaerobic digesters throughout the city to convert organic waste into energy and fertiliser

09 End Landfill

Ban the sale of any product destined for landfill

10 New Architecture

Mandate net-positive energy, water-neutrality and zero-waste for all new buildings

Executive Summary

Importantly, the initiatives suggested for transforming Melbourne are all profitable — and have already been implemented in cities around the world. These initiatives use existing technology which is scalable, tested and ready to be implemented rapidly in Melbourne.

This opportunity could position Melbourne as a world leader on such an important transition.

The total required investment is estimated to be ~$100 billion. This is equivalent to ~20% of Melbourne's superannuation pool, or (per individual) the cost of private health insurance over 10 years. But with the opportunity to generate ~$14 billion annual income, the transformation can pay for itself in less than a decade. With a large increase in unemployment forecast due to COVID19, it is also important to recognise the employment opportunities this transition offers. Profitable technology providing a rapid stimulus opportunity.

It is estimated to generate over 80,000 annual jobs in construction and installation to 2030, as well as over 40,000 ongoing jobs in operations. This is an opportunity to stimulate the economy whilst creating lasting, meaningful change.

Implementing all of these initiatives requires a lot of change in a very short period of time, and humans don't instinctively like change. It is possible to make this change easier on the general public by connecting solutions with culture.

An implementation plan for rapid adoption of the solutions across Greater Melbourne has been developed. The approach is to integrate the physical infrastructure that makes our city work with the cultural infrastructure that enables it to thrive. It is designed to familiarise the public with the solutions, while providing our political leaders with much-needed public support helping to de-risk any uncertainty around the transformation.

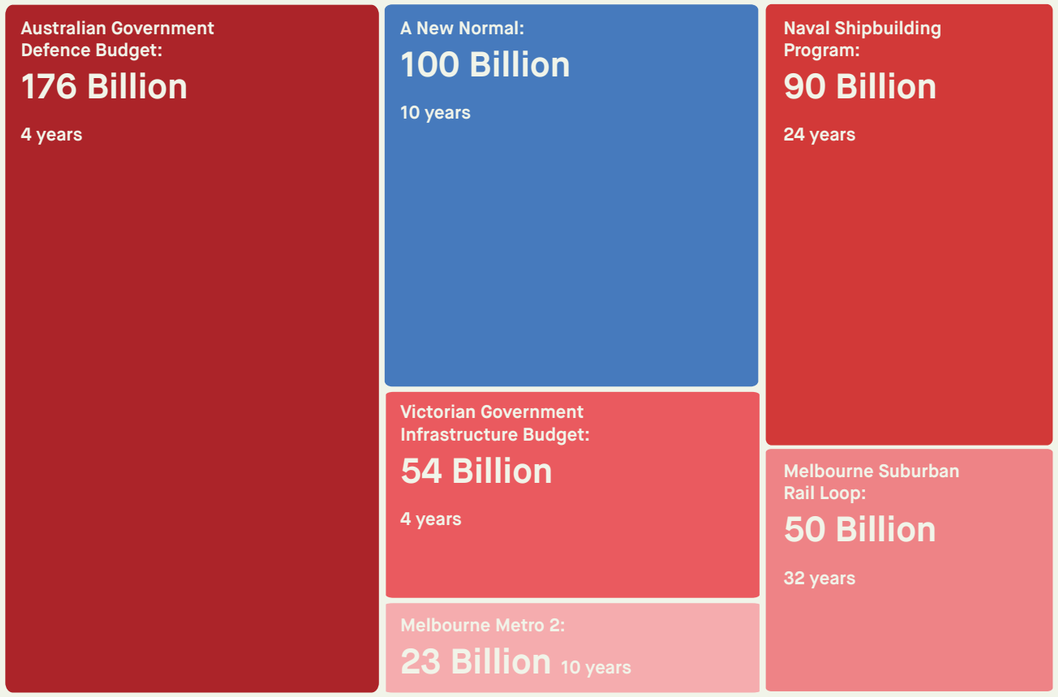
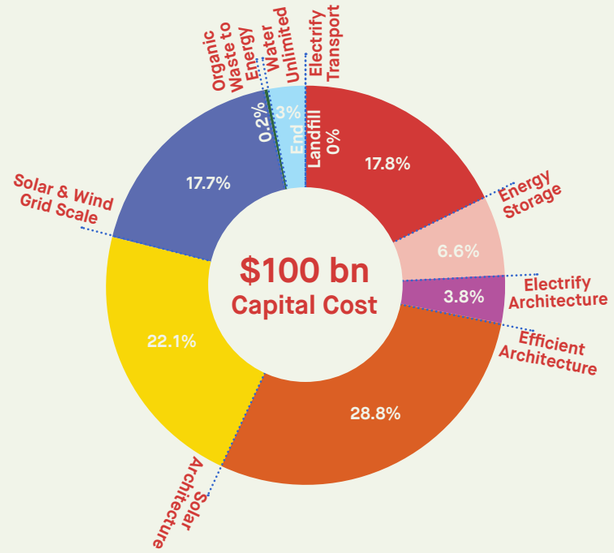
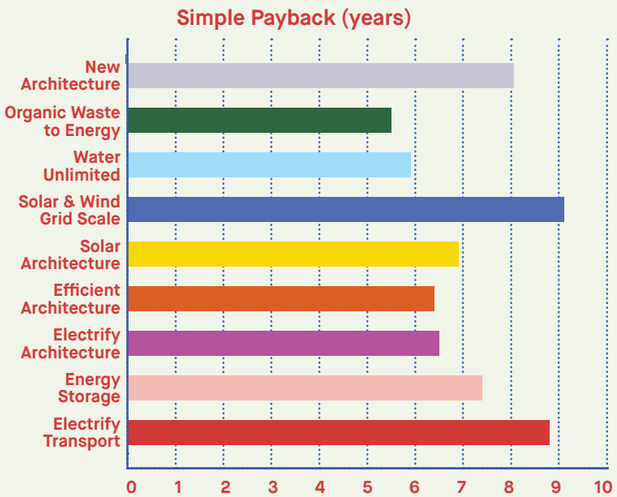
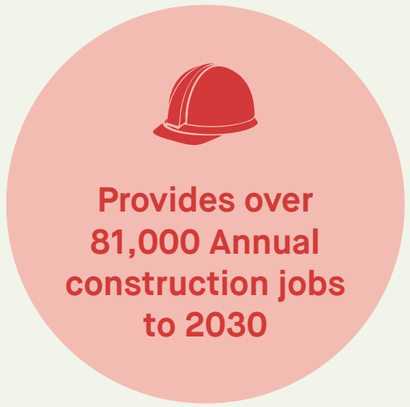
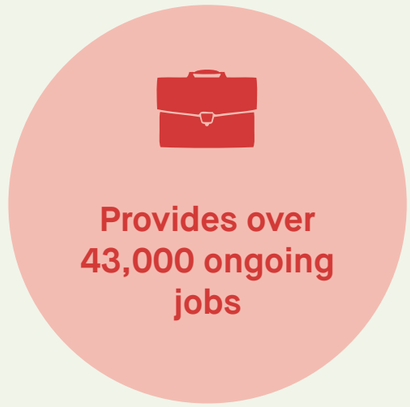


Figure 2: *Funding comparison*









Contents

Introduction

The approach in this document is to first examine Melbourne to understand and establish the baseline demands for the city. This allowed an understanding of the functionality of the city currently. Data was gathered on Melbourne's consumption of fossil fuels, water, and generation of waste.

The approach was not to propose new technology, but to de-risk the process by understanding where these initiatives have already been implemented in other cities. Case studies from around the world in cities were collated. The projects were broken down into ten initiatives, all of which have been implemented in a financially viable manner. Some environmental initiatives can be expensive and provide poor returns, however some are profitable. The question was asked: *if Melbourne implemented every single profitable initiative over the next decade, targeting the environmental and financial threshold, how far could we get?*

The investigation involved the capital cost, annual return, spatial requirements, construction jobs and ongoing jobs created throughout this process. It was found that the initiatives could be implemented across Greater Melbourne to transform the city from a consumer to a producer, while creating profits for investors and a much-needed boost in employment.

But given the urgency and enormity of the change required, how can these initiatives be implemented in time? This document proposes integrating the physical infrastructure that makes our cities work with the cultural infrastructure that enables them to thrive. From prototyping to piloting technologies linked with various cultural activities, the process helps to help warm the public up to the transformation and the introduction of new technology to Australia in general, while providing our political leaders with much-needed public support. All of this enables the private sector to implement, deliver and profit from these imperative initiatives.

The document focuses on Greater Melbourne, which comprises 31 different municipalities:

- City of Melbourne
- City of Port Phillip
- City of Stonnington
- City of Yarra
- City of Banyule
- City of Bayside
- City of Boroondara
- City of Brimbank
- City of Darebin
- City of Glen Eira
- City of Hobsons Bay
- City of Kingston
- City of Manningham
- City of Maribyrnong
- City of Monash
- City of Moonee Valley
- City of Moreland
- City of Whitehorse
- Shire of Cardinia
- City of Casey
- City of Frankston
- City of Greater Dandenong
- City of Hume
- City of Knox
- City of Maroondah
- City of Melton
- Shire of Mornington Peninsula
- Shire of Nillumbik
- City of Whittlesea
- City of Wyndham
- Shire of Yarra Ranges

Figure 3: *Greater Melbourne resource map*

Melbourne Currently

Melbourne is the 20th wealthiest and second most liveable[1] city globally. However, it sits just outside the top 1% in terms of emissions per capita[2].

Greater Melbourne covers around 10,000 square kilometres and consists of 31 municipalities, with a population of almost 5 million[3].

Standing at almost 300m, the Eureka Tower is Melbourne's tallest building.

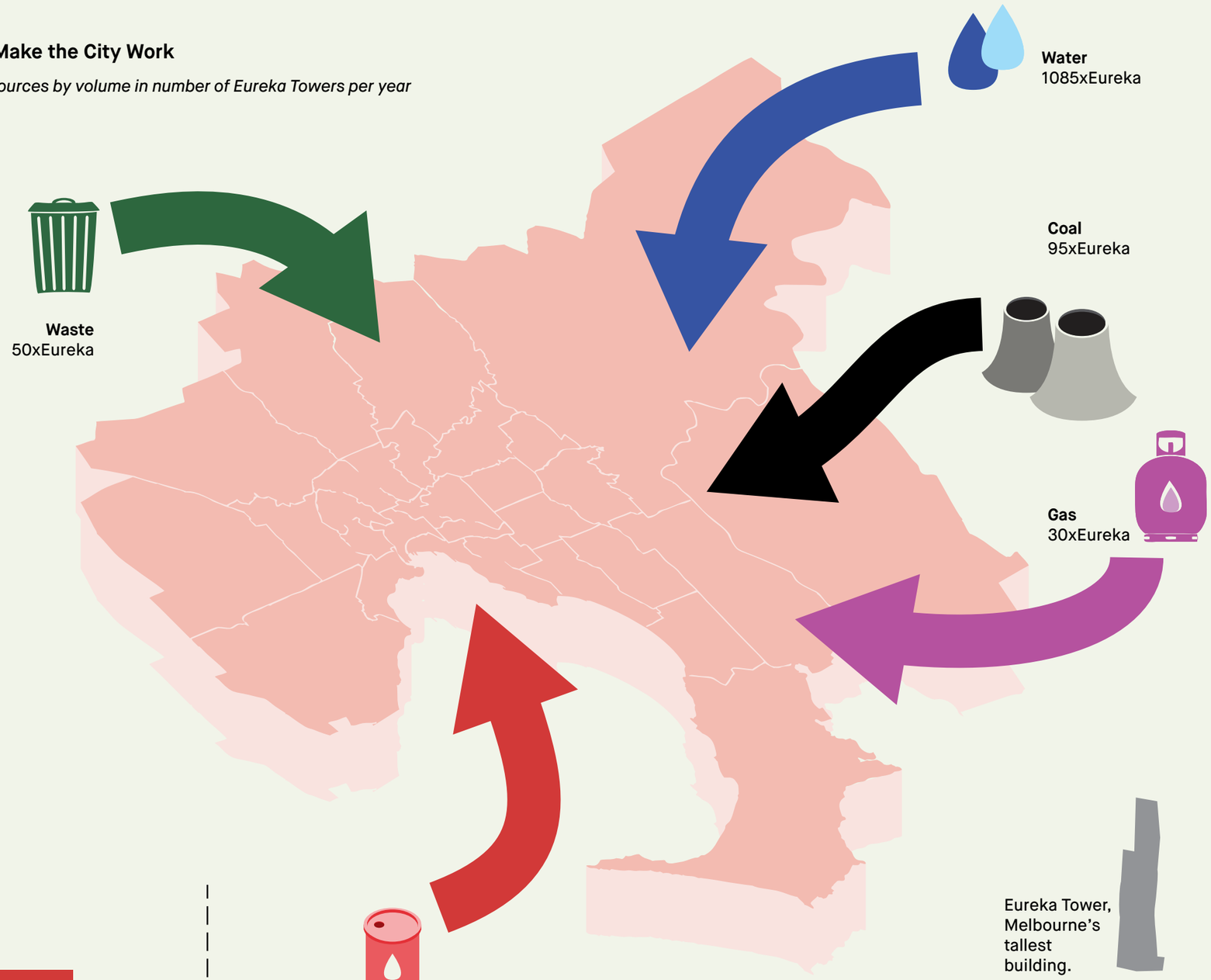
Energy
To power the city, Greater Melbourne burns enough brown coal to fill the Eureka Tower 100 times annually[4], enough oil to fill it 40 times and enough natural gas to fill it 30 times[4]. At current consumption rates, the finite resources that power our energy system will be exhausted globally in two lifetimes[5].

Water
Melbourne consumes enough water to fill Eureka tower 1,000 times annually. Greater Melbourne receives 10 times more water (as rainfall) than it consumes. And only 16% of the wastewater we treat is reused, with 84% being disposed of at sea. Melbourne is projected to run out of water as early as 2028[6]. Our backup plan — desalination — costs twice as much as recycling water and is highly energy intensive.[7]

Waste
Melbourne sends enough waste to landfill to fill the Eureka tower 50 times annually. 18% of this waste is organic matter[8], which is often wrapped in plastic bags, driven in carbon-emitting trucks and dumped in landfill to eventually digest creating methane — a greenhouse gas 28-36 times more damaging than carbon dioxide[9].

Resources Required to Make the City Work

Figure 4: *Consumption of resources by volume in number of Eureka Towers per year*



Resource Depletion

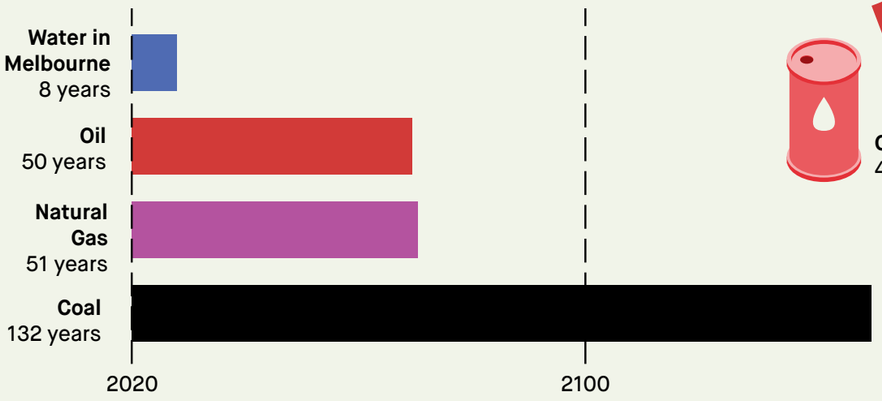


Figure 5: *Resource depletion*

Melbourne 2030

It is inevitable that our cities will become self-sufficient. But will the change come quickly enough?

In Melbourne, we have an opportunity to move ahead of the curve — and transform from a consumer to a producer by 2030. This could position Melbourne as a world leader on such an important transition, enabling us to export the knowledge and expertise in the future.

This means moving beyond:

- fossil fuels
- the internal combustion engine for transportation
- the disposal of treated wastewater
- single use plastics
- organic waste to landfill
- the sale of any consumer product destined for landfill

Let's not delude ourselves — these shifts are seismic. Every item on the list above is deeply entrenched in our current way of life. Fossil fuels and the internal combustion engine have underpinned the global economy for 200 years.

So, how do we do it?

We electrify transport and buildings. We drastically improve the efficiency of our buildings. We introduce energy storage and power our cities with renewable resources. We treat and reuse water, creating an endless supply. We use organic waste as a fuel for heat and power plants. We end the concept of landfill.

It is possible.

We can transform Melbourne to operate on resources that will never run out — and profit from the transition.

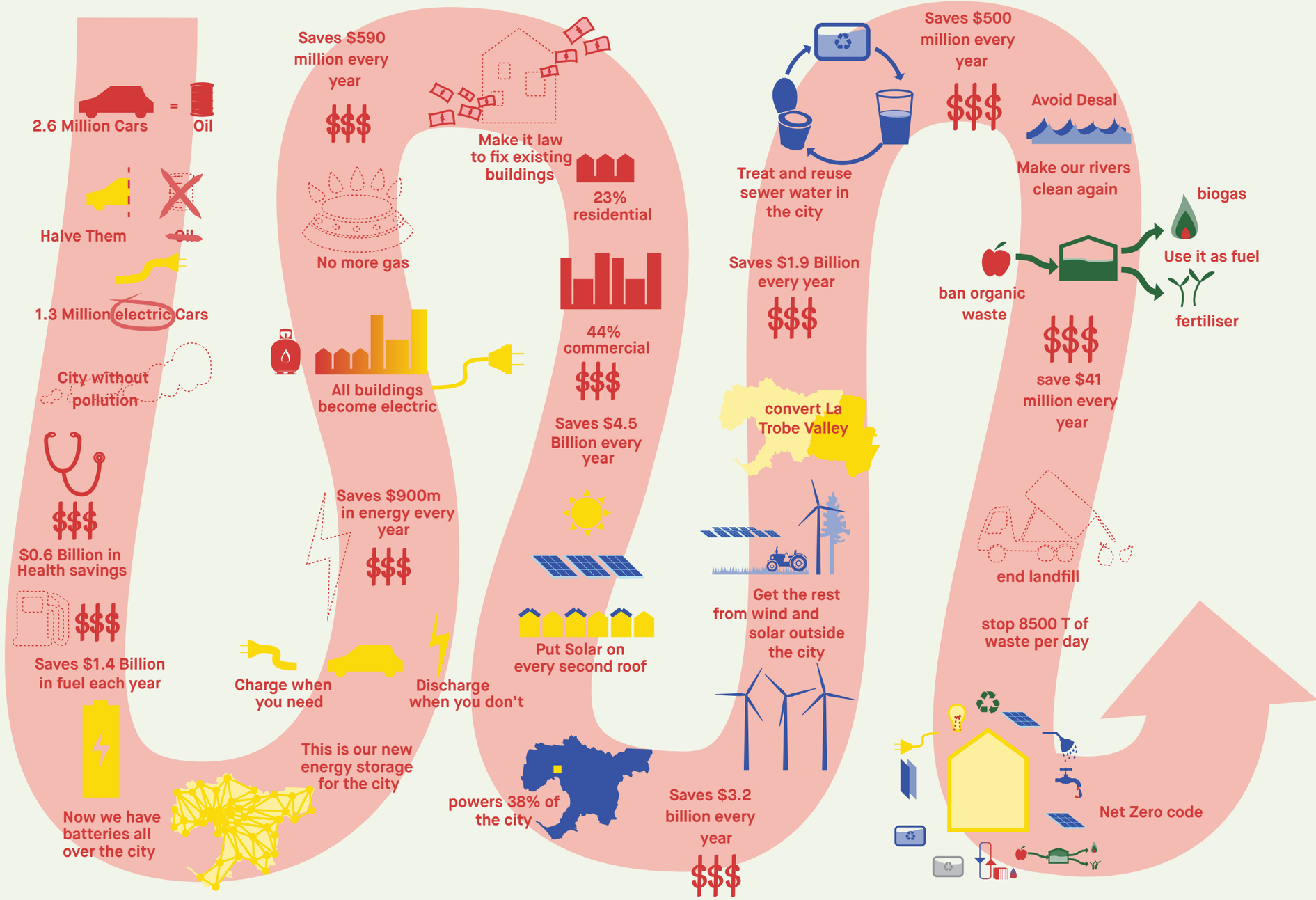


Figure 6: *How to transform Melbourne into a self-sufficient city by 2030.*

finding ínfinity

Melbourne 2030

Energy

This is how we will transform our energy system to be powered by resources that will never run out.

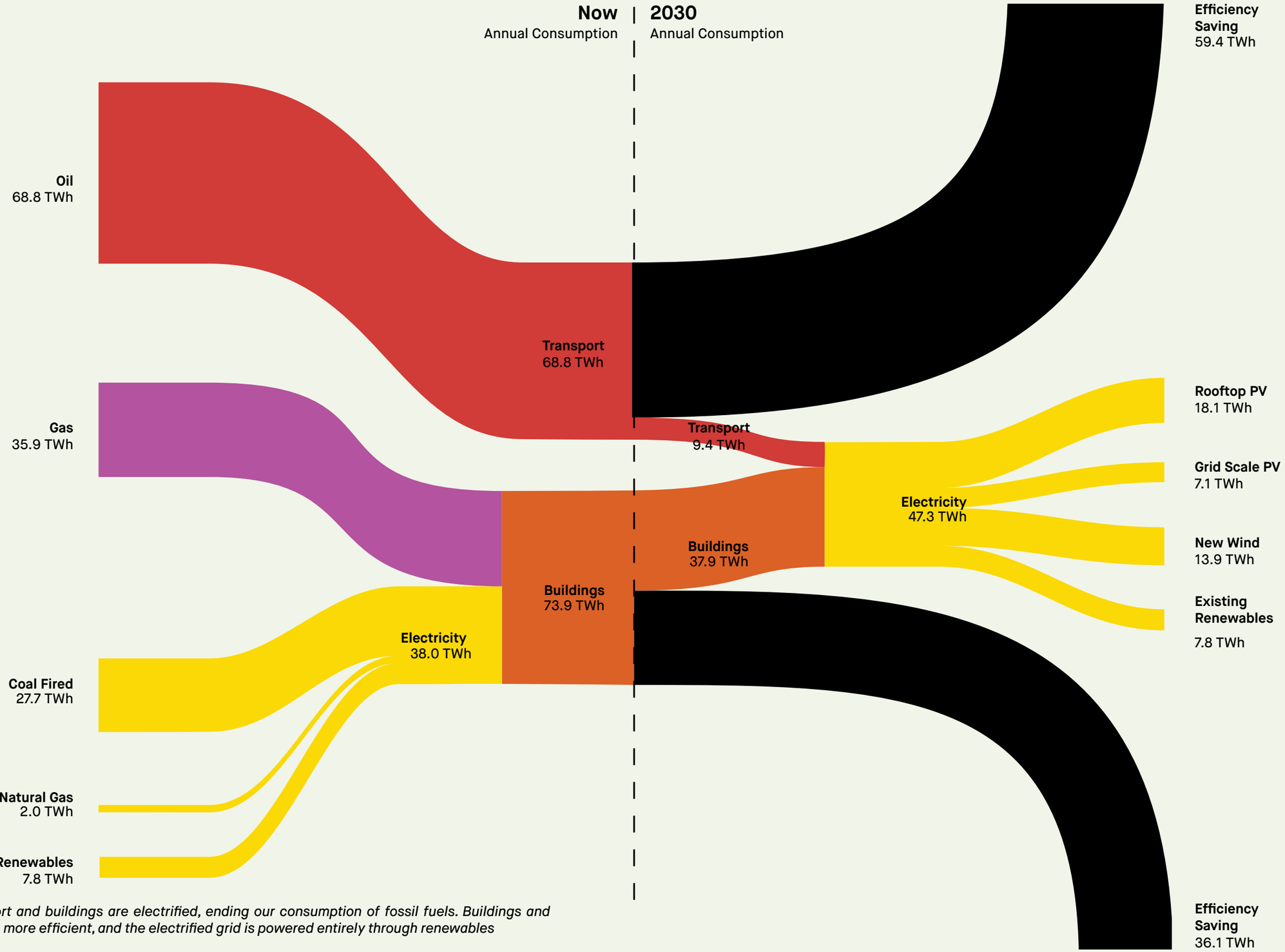


Figure 7: *Transport and buildings are electrified, ending our consumption of fossil fuels. Buildings and transport become more efficient, and the electrified grid is powered entirely through renewables*

finding ínfinity

Melbourne 2030

Water

This is how we will transform our water system to close the loop and provide an unlimited supply.

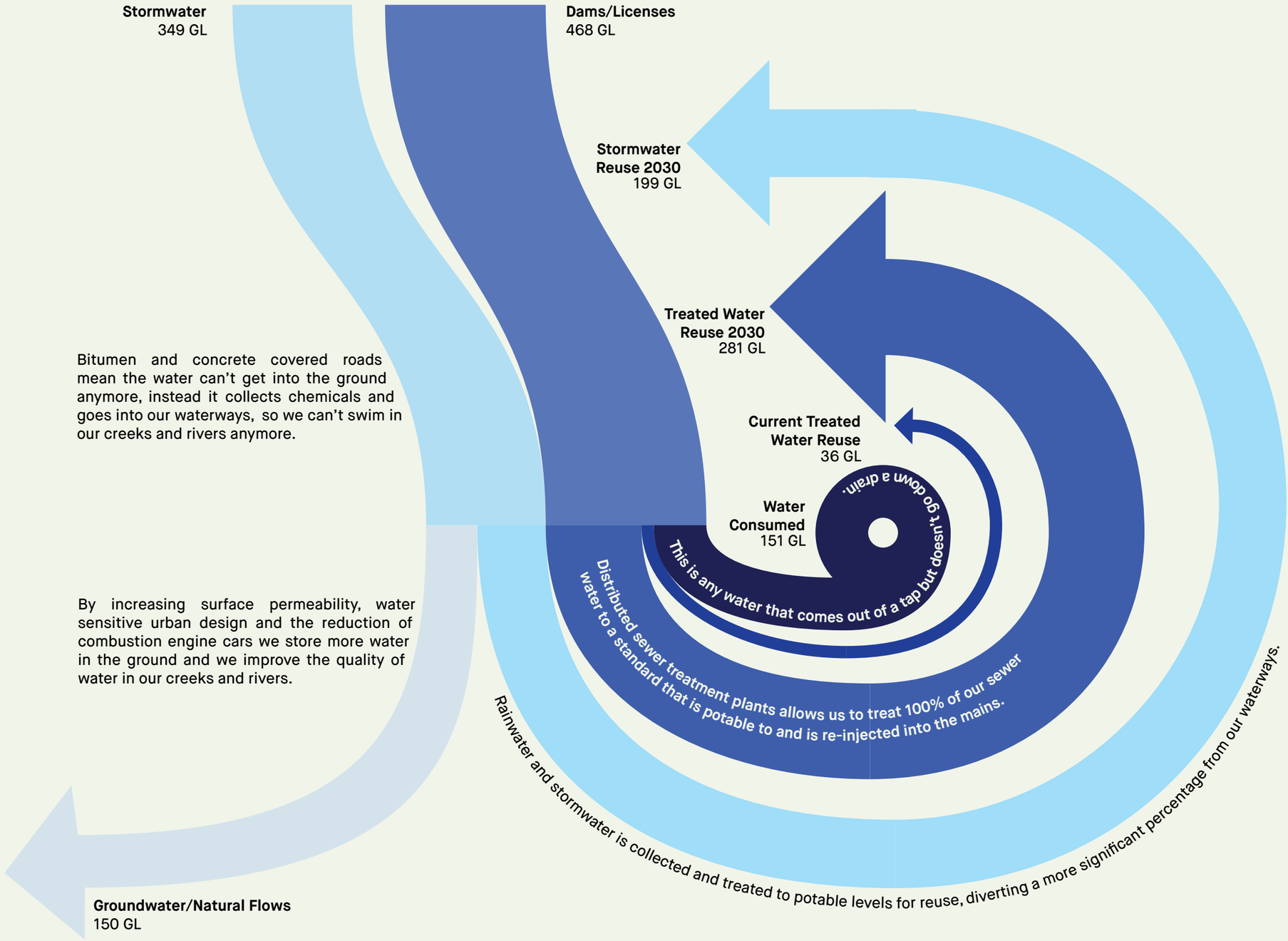


Figure 8: *We treat and reuse all of our sewer water and harvest stormwater for reuse to minimise or even eliminate water requirements from catchments outside of Greater Melbourne.*

Melbourne 2030

Waste

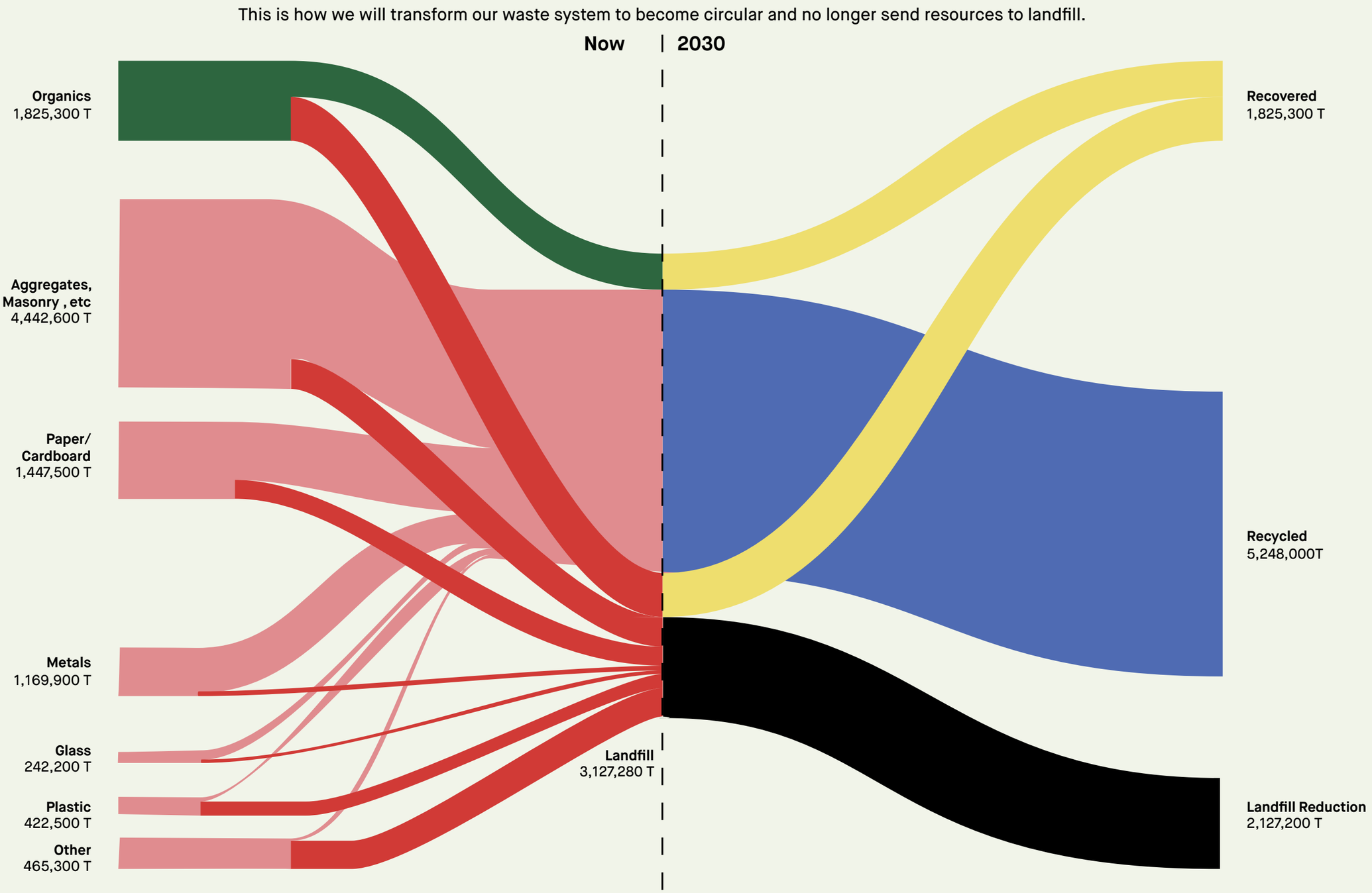
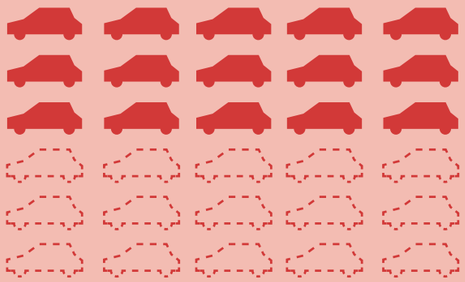


Figure 9: *Food waste is treated through anaerobic digestion, and all waste destined for landfill is avoided.*

01.

Electrify Transport

It's time to phase out the internal combustion engine.
The transport system will become entirely electric.



Halve the number of cars from 2.6 million to 1.3 million by 2030

Convert remaining 1.3 million cars to electric

Annual healthcare savings of at least $0.6bn/year. Annual fuel savings of $1.4bn/year

x 11,600

Annual construction jobs up to 2030

x 1,300

Number of jobs ongoing

Electrify Transport

The Challenge

Transport accounts for around 26% of Greater Melbourne's total emissions[10].

Even leaving aside the need to reduce carbon emissions, there are significant health concerns related to internal combustion engine transport. Air pollution from motor vehicles contributes significantly to health problems in cities. A British study found that these emissions cause 10,000 premature deaths annually in the UK — and increase healthcare costs by £6 billion[11]. It is estimated that tailpipe emissions caused ~385,000 premature deaths globally in 2015[12].

It is time to phase out the internal combustion engine entirely. In its place, we should:

- rapidly electrify the entire transport system;
- expand and encourage public transport;
- incentivise multi-modal and human-powered transport;
- incentivise carsharing over car ownership, with the aim of significantly reducing the number of cars within Melbourne;
- phase out the sale of cars with internal combustion engines;
- convert cars with combustion engines to electric.

Where Is This Currently Happening?

Mexico City

Mechanics in Mexico City are cost effectively converting internal combustion engine cars to electric.[13]

- City currently has over 5.5 million cars
- The air has double the level of particle pollutants considered safe by the WHO
- Electric vehicles are considered too expensive, so the mechanics decided to convert existing cars to ensure it is affordable
- The process costs around $6,000 USD per car

Paris

Paris recently ordered 800 electric buses in Europe's biggest electric bus purchase[14].

- The public transport operator aims to convert two thirds of its 4,700 buses to electric by 2025
- The remaining buses will run on biogas
- After 2025 any replacement buses purchased will be electric.

Germany

VW have launched electric conversion kits for classic VW Beetles in collaboration with firm eClassics in Germany[15].

- Conversion kit improves top speed and acceleration
- Converted car has range of around 200 km
- Fast charging points will allow 75% recharge within an hour
- Increases the weight of the car by around 500 kg
- Process removes the rear engine entirely creating additional storage space

Oslo

Oslo has effectively removed cars from the city centre[16].

Shenzhen

Shenzhen's public transport operator recently purchased 16,000 electric buses and 20,000 electric taxis, converting their entire network to electric while halving their fuel bills[17].

- removed 160,000 tonnes of annual emissions
- halved their fuel bills
- most of the buses charge for around 2 hours for a full day's service
- more than 20,000 taxis are now electric (over 99% of taxis in the city)
- following this more than 30 Chinese cities have plans to electrify 100% of public transport by 2020.

Amsterdam

Amsterdam is planning to ban the sale of cars with internal combustion engines by 2030, recently removed 10,000 car parks in the city, and offers cyclists tax incentives to commute via bicycle.

- Removed car parks and replaced them with bicycle lanes and gardens
- Banned driving on some streets
- Raised the price of congestion tolls

"We have to give the city back to the people, so children can play safely, so elderly people can have more benches to sit on" - Greens City Councillor Hanna Marcussen.

Shanghai

Every Ikea delivery in Shanghai is now made via electric vehicles[18].

- Worked with partners to transition the entire fleet in under a year
- In 2018 Ingka Group (Ikea's parent company) pledged to have 100% EV delivery by 2025
- Also pledged 100% EV delivery in 5 key cities by 2020 (New York, Los Angeles, Paris, Amsterdam and Shanghai)
- Also encouraging customers to use low emissions transport
- Now favouring smaller stores in urban cores over large stores on city fringes
- New Shanghai store will connect directly to city's metro
- Part of larger plan to reduce emissions of all of their products by 70% by 2030

Electrify Transport

A New Normal Solution

Enable existing mechanics or transform existing petrol stations to become workshops where internal combustion engine vehicles are converted to electric vehicles. As part of this, upskill mechanics to perform these conversions, stimulating the mechanical workforce. It is estimated that at high quantities, the cost is equivalent to $13,500 per car conversion[19].

Through the encouragement of more localised living and working habits, increased utilisation of public transport facilities, the global trend of increased uptake in car sharing, and human powered transport infrastructure, our suggested approach is to target halving the number of cars on the road – going from about 1 car per 1.8 people to 1 car per 3.7 people. For reference, Berlin has approximately 1 car per 3.1 people[20]. This will leave around 1.3 million cars to convert to electric.

Electric vehicles are significantly more efficient than combustion engine vehicles. Combustion engine converts around 12-30% of the energy in the fuel to power at the wheels, compared to electric vehicles convert around 77% of grid electricity to power[21].

500 mechanical workshops — each converting 5 cars per week — could complete the transition by 2030. This can be incentivised through government subsidies, which are justified through future healthcare savings. The benefit to consumers is an over 60% reduction in fuel costs.

In Melbourne, the trams and metro trains are already currently electric. Rural trains and buses are expected to be transforming anyway by 2030. Naturally commercial fleets can also fit into this scheme.

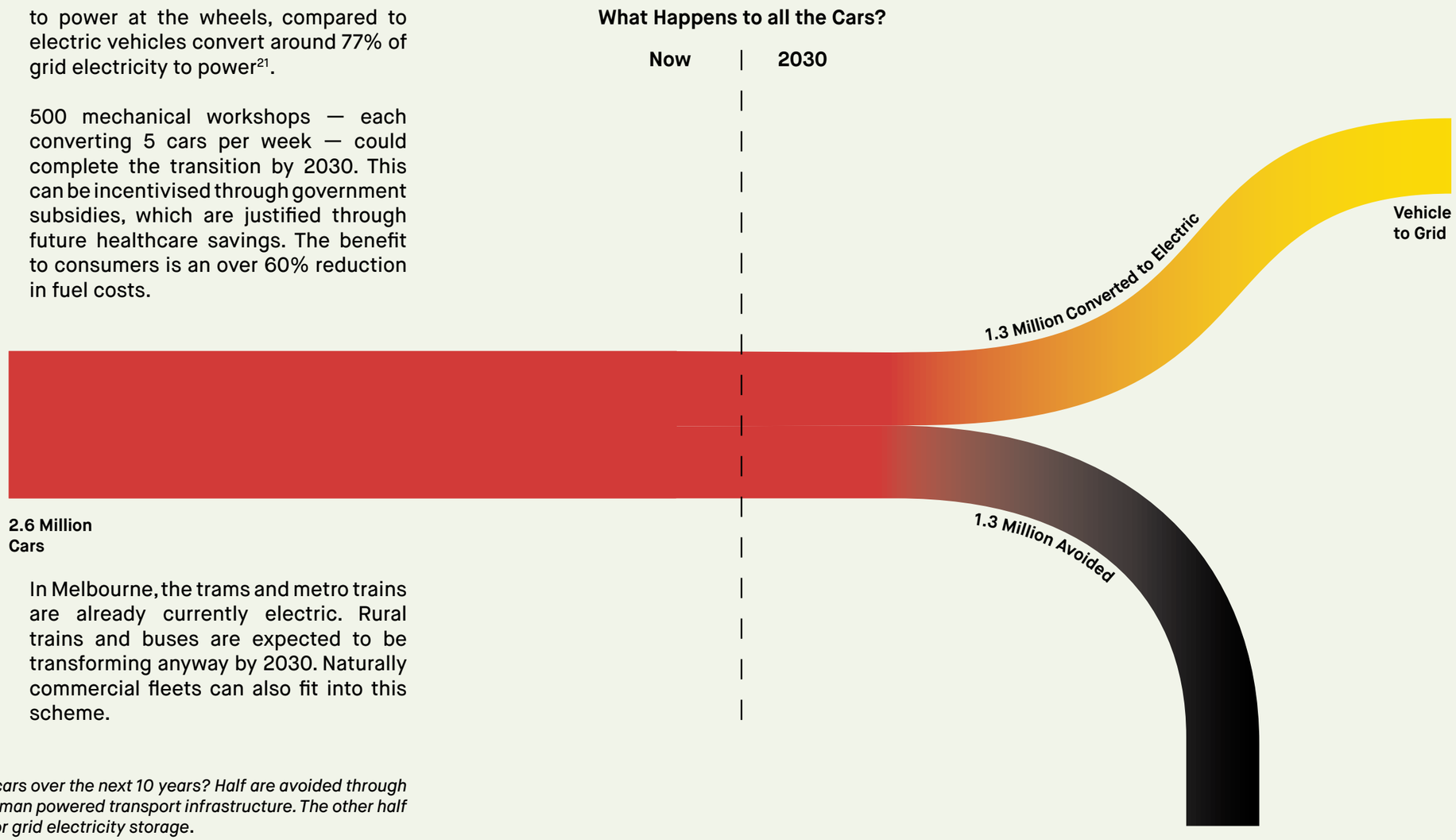


Figure 10: *What happens to Melbourne's 2.6 million cars over the next 10 years? Half are avoided through improvements to public transport, car sharing and human powered transport infrastructure. The other half are electrified, with their batteries then being used for grid electricity storage.*

What is the environmental impact?

~26% reduction in emissions (assuming electricity used is renewable – see initiatives five & six), however this results in a 10-35% increase in electricity consumption.

How much space will it take?

Savings in car parking space outweigh the space taken up by conversion stations. There are 217,000 car parks in the City of Melbourne alone, meaning if we halve the number of people who drive to work, we free up around 109,000 parks.

How much will it cost?

The cost of converting 1.3 million cars has been estimated to be $17.8 bn. This will be through a combination of government subsidies and individual investment.

What is the return on investment?

Healthcare savings have been estimated to be $0.6-2.6 bn/year and fuel saving $1.4 bn/year, meaning the conversions pay for themselves in under 9 years.

capital cost:	annual savings:	payback period:
$17.8 billion	**$2 billion**	**9 years**

construction jobs/year to 2030:	ongoing jobs:
11,600	**1,300**

Employment was estimated based on 40 hours per conversion, plus jobs in battery manufacturing and maintenance based on a study by Lappeenranta University of Technology[22].

Electrify Transport

Car Conversions:
Grimshaw x Greenshoot x Greenaway Architects

The electrified vehicle ‘pit stop’ aims to connect people to the process of electrifying existing cars through the ‘new normal’ service station car conversion experience - cars are converted and charged, and their spare parts repurposed and recycled, whilst powered by solar.

People reconnect to their own health and wellbeing at the same time by the installation of feedback loop ‘Mobile GP’ installed into their vehicles.

Due to the conversion of existing cars, the facility enables current technology vehicles to remain relevant in a future age of automotive technology. DIY is supported by a RACV helpdesk, and creates an opportunity for the next generations of mechanics to upskill.

The process is about empowering personal choice to convert their vehicles whilst encouraging citizens to reconnect with health and wellbeing. The service station represents in real time - choice, social interaction through DIY, convenience - which slowly adapts the cities transport networks into living arteries for our cities which are healthier places to be, and that allow natural systems and habitats to regenerate.

GRIMSHAW

www.grimshaw.global

www.greenshootconsulting.com

www.greenawayarchitects.com.au

Electrify Transport

Upgrading the Train:
Foolscap

Work; Eat; Sleep; Relax; Repeat!

By 2030, we need to provide a legitimate, electric alternative to air travel. As a way of encouraging consumers to use the train more, to demonstrate to our political leaders that Australian's enjoy and want a better train system that is fast and electric, we start by improving the experience on our existing trains. The trains between Melbourne, Sydney & Adelaide become the most desirable path between cities because the experience is tailored to the next generation.

Not fast, not slow, our proposal is a celebration of medium-paced travel, which repurposes existing rail infrastructure to connect Australia's largest urban centres: Melbourne, Sydney and Adelaide. Through great design, we can create demand for trains, improve efficiency—and have fun doing it.

Currently, the XPT trains are the only long-distance public transport option for travelling between Melbourne and Sydney. These trains are up to 37 years old and run on diesel-powered engines. They're old, tired, and far from an inspiring way to travel.

This proposition, which could be kickstarted immediately, would see old carriages stripped down to their shell, before being repurposed as mobile F+B destinations. The opportunities are endless: we've included a café, restaurant, bar, lounge, co-working facilities and sleeper cars to celebrate the rich hospitality culture of our cities. The result: a reimagining of the past, to create future-forward travel experiences in convivial, relaxed style.

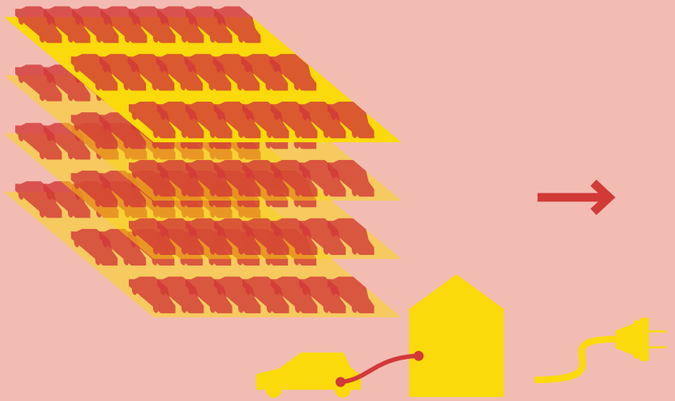
Foolscap
Studio

www.foolscapstudio.com.au

02.

Energy Storage

As the grid transitions to 100% renewable energy, storage will be necessary to ensure that power can be accessed where and when it is required.



Multi-storey car parks and houses

Become batteries for the city

Creating a distributed storage network 300x the size of the world's current largest battery

x 500

Annual construction jobs up to 2030

Energy Storage

The Challenge

As our transport system becomes increasingly electrified, the opportunity becomes more and more prevalent to synergise our transportation systems with our energy storage systems.

The most common fear about the transition to renewable energy concerns the volatility of wind and solar generation. Despite the understandable fears, a combination of existing renewable energy and storage technologies is adequate to power Australia — even during peak periods like winter evenings after overcast days — without any requirement for "baseload" generation[23].

A vast amount of energy storage will be built into the electrified transportation system through vehicle batteries, limiting the requirement for additional energy storage. Vehicle to grid charging and discharging is becoming increasingly prevalent across the world and this enables our mobile energy storage in our transportation system to act as energy storage for our stationary energy system.

Additionally, energy will be stored in the form of hot and chilled water and this storage capacity can be used in combination with existing and planned grid-scale pumped hydro energy storage in the Snowy Mountains & Tasmania.

Where Is This Currently Happening?

California

A study by the Lawrence Berkeley National Laboratory in California shows that using batteries of the 1.5 million electric vehicles mandated by 2025 in California as grid energy storage could eliminate the need to build stationary grid storage altogether[24].

The study found that:

- implementing vehicle to grid charging has the potential capacity of $12.8 to $15.4 billion in stationary storage
- implementing single direction controlled charging of electric vehicles, which is already possible with most electric vehicles and has little cost impact over uncontrolled charging, could save $1.45-1.75 billion.

Germany & UK

Nissan have been running trials using its Leaf model as home battery storage throughout the world.

- Nissan Leaf trials in Germany have seen the car used as grid storage, earning €20 per week[25]
- Trials in the UK with Ovo found that allowing the energy supplier control of vehicle to grid charging will more than cover the annual cost of charging the vehicle[26]
- Ovo automatically trades electricity from the battery, refuelling during off peak periods and selling to the grid at peak times for around 4x the price
- Across the year, the amount earned from allowing the grid to use the battery for storage outweighs the cost of charging, meaning zero-cost fuel

Energy Storage

A New Normal Solution

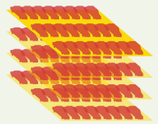
Convert all parking spaces to allow vehicles to both charge and discharge using vehicle to grid (V2G) technology — making V2G chargers standard throughout Melbourne.

V2G chargers to be available soon in Australia are estimated to retail at around $10,000. It is estimated with bulk purchasing V2G chargers will cost around $5,000 per unit including installation.

This solution creates a distributed storage network across the entire city. It can be incentivised through government subsidies, justified through the reduction in the requirement for grid stability upgrades and stationary grid storage infrastructure.

Widespread implementation of V2G would allow the 1.3 million electric cars to be used as grid storage — creating an additional 40 GWh of storage capacity. This is 300 times larger than the world's largest battery (currently in in South Australia). It would be enough to store as much electricity as Melbourne consumes in 9 hours on average. Buses, logistics fleets and other vehicles will provide additional stability and storage beyond the 1.3 million cars.

1 car = 30 kWh storage



1.3 million cars = 40 GWh storage

Snowy Hydro 2.0 = 350 GWh storage

"Tesla big battery" in SA = 0.13 GWh

Distributed Energy Storage

Figure 11: *Distributed storage network across Greater Melbourne, created by vehicle to grid technology.*

What is the environmental impact?

It would reduce the amount of additional energy storage required for the grid to transform to 100% renewable energy, and reduce new infrastructure requirements.

How much space will it take?

1.3 million car parks converted to use V2G technology.

How much will it cost?

The cost of installing these V2G chargers has been estimated to be $6.6 billion – not accounting for anticipated savings in upgrading grid stabilisation infrastructure and other grid scale stationary storage.

What is the return on investment?

This would return about $830-950 million annually to consumers from the use of car batteries for grid storage, paying for itself in 7-8 years.

capital cost:	annual savings:	payback period:
$6.6 billion	**$0.83 billion**	**8 years**

construction jobs/year to 2030:
500

Battery income is estimated based on the UK trials mentioned on the previous page, where customers were estimated to generate £350-400 annually through allowing their car battery to be used[27].
Employment in installation of V2G charging stations is estimated based on 8 hours installation time per charger.

Energy Storage

Multi-level car park battery bank: Hassell

In this project we take an existing multilevel car park in Little Collins Street and alter its purpose. The car park becomes a home for electric cars and their batteries are linked together to store and discharge the energy for the city.

Application of this Vehicle to Grid (V2G) technology in Melbourne is important. As a way of accelerating the uptake of this technology the approach is to create a connection with the people of Melbourne through a multipurpose use of existing carparks. The dual uses being both technology & culture.

When the city's workers disperse home, the car park is emptied. Performers and the people of Melbourne are invited into this void. The battery powered cars and bikes of the audience then focus their energy on powering the performance. The car park is activated; the surrounding area is transformed. The building connects the cities people, and is enlivened by it.

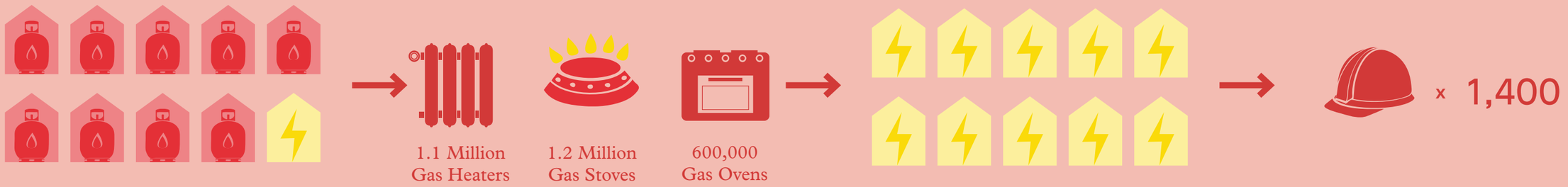
Hassell

www.hassellstudio.com

03.

Electrify Architecture

It's time to turn off the gas tap to the city —
and transform all existing buildings to become 100% electric.



90% of Melbourne homes have a gas connection

Replace gas hot water and heating with heat pumps, and gas cooking equipment with electrical equivalents

100% of homes are run on electricity

Annual construction jobs up to 2030

Electrify Architecture

The Challenge

The grid can never fully decarbonise without removing natural gas.

Even ignoring carbon emissions, there are serious concerns around both health* and future supply — The Australian Energy Market Operator (AEMO) have predicted an annual shortfall of gas production in Victoria by 2022, and intermittently on peak demand days by winter 2021[28].

The New England Journal of Medicine noted “gas is associated with health and environmental hazards and reduced social welfare at every stage of its life cycle”[29].

New buildings must be constructed without gas connections; existing buildings will require retrofitting to function without gas. Currently over 90% of Melbourne households have a mains gas connection, with over 65% with gas heating, hot water and cooking.

In households, gas heaters and hot water units can be replaced with heat pumps, which run on electricity — and can generate three to five times more heat with the same amount of energy input. Gas stoves can be replaced with efficient induction units, gas ovens by electrical ovens.

In industry, electrification is not only viable, but can give manufacturing industries a competitive advantage through the availability of abundant and affordable clean energy[30].

Where Is This Currently Happening?

California

Berkely, California recently became the first city in the US to ban natural gas connections to new multi-family construction beginning 2020[31].

“There’s been a lingering perception that burning gas was cleaner than electricity, which might have been true 20 years ago when electricity came from burning coal,” said Pierre Delforge, a senior scientist with the Natural Resources Defense Council . “We need to think about what the grid will look like in 10 or 20 years, not what it looked like yesterday.”

Menlo Park

Menlo Park will mandate all electric buildings by January 1, 2020[32].

- New commercial, office and industrial buildings must rely only on electricity
- Includes all electric cooking in restaurants
- New homes may have natural gas stoves, but must be wired to enable electric stoves in the future
- During council discussions, of the 10 public opinions voiced only 1 requested less restrictive rules, while the other 9 suggested the council should go further
- California Codes and Standards program estimates eliminating gas infrastructure from family homes can save ~$6,000 in construction costs, as well as ongoing connection costs

Amsterdam

Amsterdam plans to phase out natural gas entirely by 2050[33].

- Currently natural gas heats around 90% of homes and businesses in Amsterdam
- Various methods are planned for the transition including heat pumps and district heating
- Various grants and financing opportunities are offered by the City to encourage people to go gas-free

Electrify Architecture

A New Normal Solution

Ban gas connections to new buildings and installation of new gas appliances — and phase out gas connections to existing buildings by 2030.

All gas heaters and hot water units should be replaced with heat pumps at the end of their working lives. All other gas appliances can be replaced with efficient electrical equivalents when heating and hot water systems are replaced — allowing gas connections to be removed entirely. Finance can be provided for replacing appliances with repayments through savings in energy bills.

It has been estimated that the cost and return of converting all households to 100% electric at the end of the working lives of their heating and hot water systems.

Non-residential costs and returns have not been considered in this section. These costs are considered in the Efficient Architecture section. The graph to the right does, however, account for their increase in grid electricity consumption.

Stove and oven replacement costs were estimated at $700 and $300 respectively. Hot water units are to be replaced at end of life, with heat pumps costing around $2,700 more per residence than gas boilers. Gas heaters are to be replaced at end of life, with electrical equivalents costing around the same amount as new gas units. These costs are estimated overall to include installation when performed at scale.

1.4 million residences with grid connections will each save around $280 in gas connection fees, as well as around $140 due to the increased efficiency of electrical equipment.

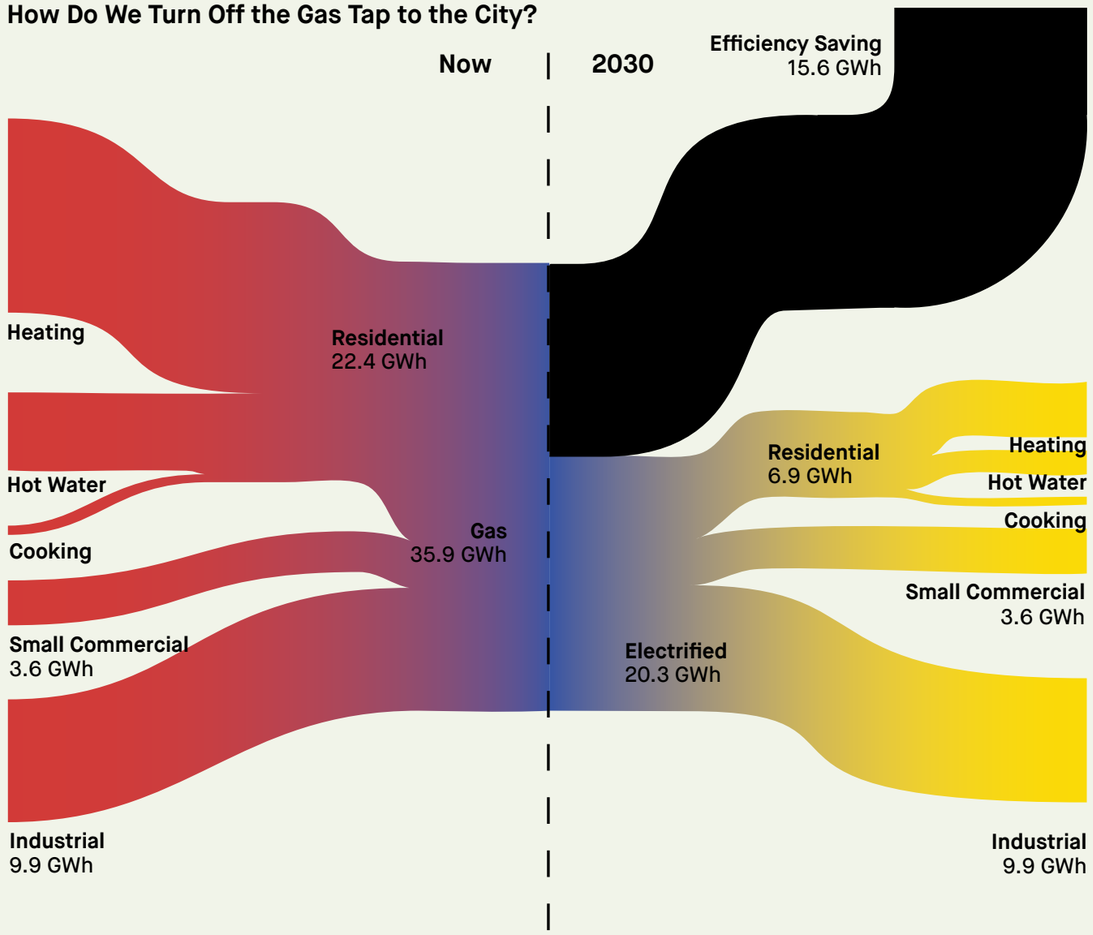


Figure 12: *Converting gas consumption to electrical equivalents. Large savings are possible in heating and hot water due to the efficiency of electrical heat pumps when compared to gas.*

What is the environmental impact?

It would reduce gas consumption by around 129 PJ, but could increase electrical consumption by around 40%. Overall, with renewable electricity, emissions would be reduced by 6.6 million tonnes of CO_2.

How much space will it take?

In some buildings this may require additional space, as heat pumps & hot water storage can take up around five times the space of gas hot water. The spatial requirements for single dwelling homes are not dissimilar to gas.

How much will it cost?

The cost of replacing every residence's gas appliances with electrical units has been estimated to be $3.8 billion.

What is the return on investment?

Through savings in gas connection fees as well as improved efficiency of electrical appliances, it has been estimated that this will save residents around $585 million annually, paying itself off in around 6.5 years.

capital cost:	annual savings:	payback period:
$3.8 billion	**$0.59 billion**	**6.5 years**

construction jobs/year to 2030:
1,400

Jobs in this section were estimated as part of energy efficiency retrofit jobs based on Beyond Zero Emissions' Energy Efficient Buildings Plan[34].

Electrify Architecture

Southbank Apartments Car Park:
Clare Cousins Architects

Through the decommissioning of carbon intensive gas infrastructure and its replacement with a spatially efficient electric alternative, an opportunity for broad scale community development arises...

In an effort to help re-pedestrianise Southbank's problematic commercial zone, City of Melbourne have recently banned exposed podium car parking; opting for a slightly more activated veneer of apartments. If coupled with New Normal initiatives, the momentum toward a pro-pedestrian and genuinely engaged Southbank can be taken to a fully realised and activated outcome. With minimal demolition and by utilising a building podium's existing structure, this proposal seeks to capitalise on the reclaimed space of an electrified building stock.

These reclaimed spaces are programmed with the much needed community facilities that are painfully absent from the Southbank fabric. Once a car-park, now a basketball court, a co-working space, a ground floor market all provide the civic amenity from which a community can grow.

CLARE COUSINS ARCHITECTS

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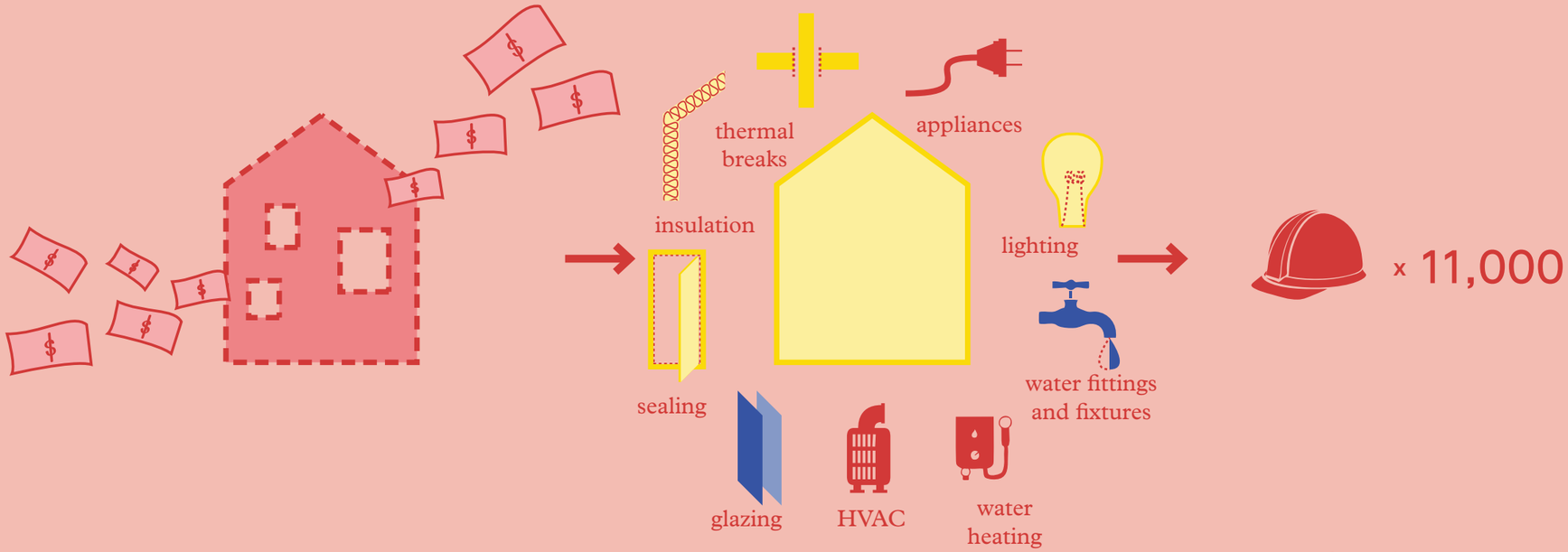
04.

Efficient Architecture

No more cost-effective way to make major cuts in energy use and greenhouse gas emissions exists than retrofitting buildings. It's time to make it mandatory.



Efficient Architecture

The Challenge

Existing buildings present a much larger problem — and a larger opportunity — than new buildings.

Existing building stock around the globe is typically inefficient. And nearly two thirds of the building area that exists today will still be in use in 2050[35] — we only add 1% of new housing stock per year.

Reducing energy consumption through retrofitting buildings is a significant and cost-effective opportunity.

In their Energy Efficient Buildings Plan, Beyond Zero Emissions (BZE) estimate that energy efficiency could result in a reduction of 53% in residential energy consumption (23% when not including the savings from electrification discussed previously) and 44% in non-residential consumption[36].

Where Is This Currently Happening?

Los Angeles

Los Angeles recently announced their "Green New Deal"[37]

- requires all current building stock to be retrofit to net positive by 2050
- targets reductions in building energy use per m2 for all building types of 22% by 2025, 34% by 2035 and 44% by 2050

California

The Rocky Mountain Institute, US Department of Energy (DOE) and the California Energy Commission (CEC) will retrofit 46,000 m² of multifamily low-income buildings to become zero emissions as pilot projects[38].

- This is happening through US$7.7 million from the DOE and CEC
- Low income families are estimated to spend up to 20% of income on energy (compared to US average of 4%)
- The retrofits will be via prefabricated systems, intended to be cost effective and scalable throughout the country

New York City

New York City's recently passed "Green New Deal" bill includes[39]:

- by 2030, mandatory energy efficiency retrofits of all properties over ~2,300 m2 floor area to reduce emissions by 40%
- by 2050, existing buildings will be required to be retrofit to slash emissions by 80%
- this is estimated to create 3.600 construction jobs and 4,400 maintenance and operations jobs.

Netherlands & Europe

Zero energy housing retrofits that began in the Netherlands but have now been happening around Europe and inspiring similar solutions in New York and California. Retrofits are performed at no upfront cost to the residents[40].

- Over 5,000 homes have been retrofit
- Objective is that residents have the same monthly expenses after the retrofit, with the savings in energy costs covering the financing of retrofits
- Comes with 30-year performance warranty on indoor climate and energy performance
- Beginning with the social housing sector, but aims to scale internationally to any existing residential buildings

Efficient Architecture

A New Normal Solution

Mandate the retrofit of all existing buildings using only cost-effective initiatives.

This will not only reduce the environmental impact of buildings, but also save owners and occupants money, and make buildings healthier and more resilient. An extremely important and influential component of upgrading a building is upgrading the air quality of the building. Through systems like heat recovery, air-tightness and increased fresh air rates, energy efficient buildings are also significantly healthier buildings. The improvement of the quality of air in buildings would provide noticeable benefits on topics such as air contamination related to bushfires and airborne viruses.

Governments and banks could assist in financing upgrades, allowing these to occur at no up-front cost to residents, tenants and building owners — but instead be paid off through savings in future energy bills.

Existing buildings need to be professionally reviewed, with all cost-effective initiatives identified being implemented on a case by case basis.

Initiatives might include:

- improving building fabric
  - building sealing
  - glazing
  - insulation
  - thermal breaks
- upgrading inefficient water heating and HVAC equipment
- heat recovery ventilation
- upgrading inefficient appliances and electronics
- replacing inefficient lighting with LEDs
- upgrading water fixtures and fittings.

Savings estimates are based on the BZE Energy Efficient Buildings Plan[41], scaled by population to reflect Melbourne. Jobs, costs, efficiency improvements and savings for residential building electrification are not included in this section as they have already been considered in the previous section, however non-residential electrification is included.

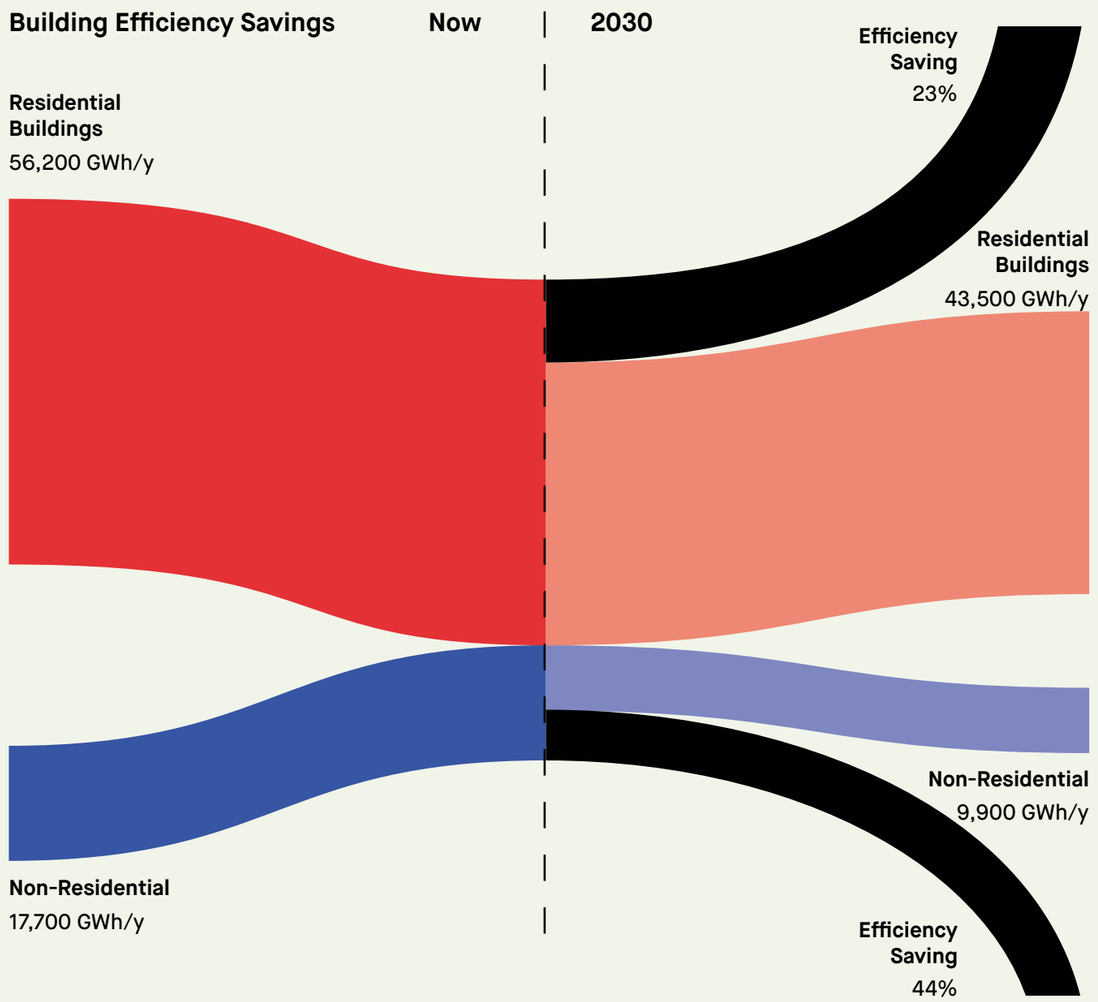


Figure 13: *Efficiency savings created by mandatory retrofits in residential and non-residential buildings*

What is the environmental impact?

Translating Australia wide figures from Beyond Zero Emissions (BZE) to Melbourne, we have estimated a 28% reduction in energy consumption.

How much space will it take?

Spatial requirements are generally minimal. Some increases in wall thickness may be required to accommodate additional insulation.

How much will it cost?

Based on BZE figures for Australia, we estimate the capital cost for Greater Melbourne at $28.7 bn.

What is the return on investment?

This is estimated to save around $4.5 billion annually, resulting in a simple payback of around 6.4 years.

capital cost:
$28.7 billion

annual savings:
$4.5 billion

payback period:
6.4 years

construction jobs/year to 2030:
11,000

Efficient Architecture

Retrofitting Existing Buildings: Fender Katsalidis

Our cities are home to solid, functional, beautiful structures from all ages of history. How can they be part of a future in which buildings touch the earth more lightly, and deliver more for people whilst consuming less?

What better way than to wrap them up in a quilt of insulation?

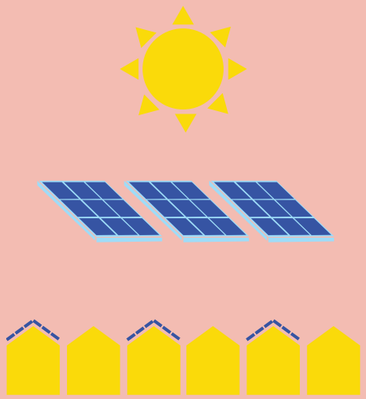
Fabric first upgrades drastically reduce the energy footprint of existing buildings. We propose full Passive House retrofits, which replace inefficient glazing, seal gaps and add appropriate insulation to protect the indoor environments from external extremes. We propose building resilience into our cities without having to start from scratch. We have all the knowledge and technology to do this right now.

This is win-win: improve comfort; improve health; slash emissions. We can – and should – normalise a culture of valuing our existing structures for what they are, and unearthing their hidden potential to be part of our thriving, low impact future.

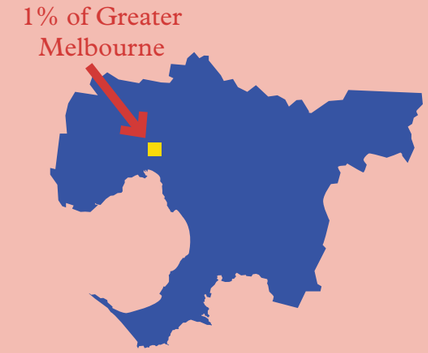
05.

Solar Architecture

Solar power on every second rooftop in Melbourne.



If we install solar power on every second rooftop



Less than 1% of the area of Greater Melbourne is required to produce enough energy to power 38% of Melbourne

x 42,500

Annual construction jobs up to 2030

x 5,900

Number of jobs ongoing

Solar Architecture

The Challenge

Yes, buildings must become efficient and electric. But they also need to power themselves.

Solar architecture is crucial to Melbourne becoming an energy producer. Currently only one hundredth of solar PV potential within the Melbourne CBD has been realised[42]. There is a lack of awareness, a lack of capital — and there are technical considerations like rooftop plant space.

Maximising solar generation within the city reduces the need for new grid scale infrastructure. It also allows both physical and financial decentralisation of our energy infrastructure, resulting in greater energy security and better returns for consumers.

We need to expand take-up of PV in Melbourne significantly, aiming to cover every roof and unshaded façade that is financially viable and technically feasible. Modelling from the University of New South Wales (UNSW), Australian Photovoltaic Institute (APVI) and the Institute of Sustainable Futures (ISF) suggests that Greater Melbourne could generate 95% of its current electricity consumption through rooftop solar PV within its boundaries[43].

Where Is This Currently Happening?

Honolulu

Honolulu has the most PV installed per capita of US cities[44].

- As of 2017 almost 20% of single family houses and townhouses have solar PV (~50,000 dwellings total)
- Since 2017 permits for PV have continued to be issued at record rates

Los Angeles

Los Angeles now has the most installed PV total of any city in the US[45].

- LA also plans to expand Feed-in-Tariff programs, create standard plans for carport solar, require all newly built parking structures to have solar, keep waiting time for residential PV interconnection to under 2 weeks
- The Green Dot Amino Leadership charter school in LA has a 650 panel solar facade that supplies 75% of its energy needs

Melbourne

Kinley is a 3,000 dwelling residential development by Intrapac Property on the eastern fringe of Melbourne[46].

- All homes must install a solar PV system
- Enforced through design and planning controls
- Balancing demand using Internet of Things (IOT) technology to create load sinks (e.g. hot water systems and air-conditioning that run when there is excess solar power)
- Solar PV is available to residents at no upfront cost via signing up with a low cost energy provider for a certain period of time, paying off the panels through their energy bills

Adelaide

32% of residences in Adelaide now have solar PV systems installed[47].

- total capacity is more than 800MW
- most of these systems have been installed in the last 10 years
- during peak solar generation times, PV has generated more than 40% of South Australia's energy needs
- rooftop PV has often contributed more than one third of the state's power for brief periods in recent years.

Solar Architecture

A New Normal Solution

Improve solar PV uptake within Greater Melbourne, installing solar PV on a minimum of 50% of all rooftops.

This may include raising PV over rooftop plant space or habitable spaces where necessary. Façade PV should be investigated where suitable. This can be incentivised through government subsidies. Maximising rooftop PV area should be made mandatory for new buildings.

A total of around 2.5% of Greater Melbourne's total area would be required to power the entire city with solar energy.

If we covered every potential rooftop in Greater Melbourne with solar PV we could generate enough to meet around 76% of demand after electrification. If we covered just half of rooftops, we could generate enough to meet 38% of demand.

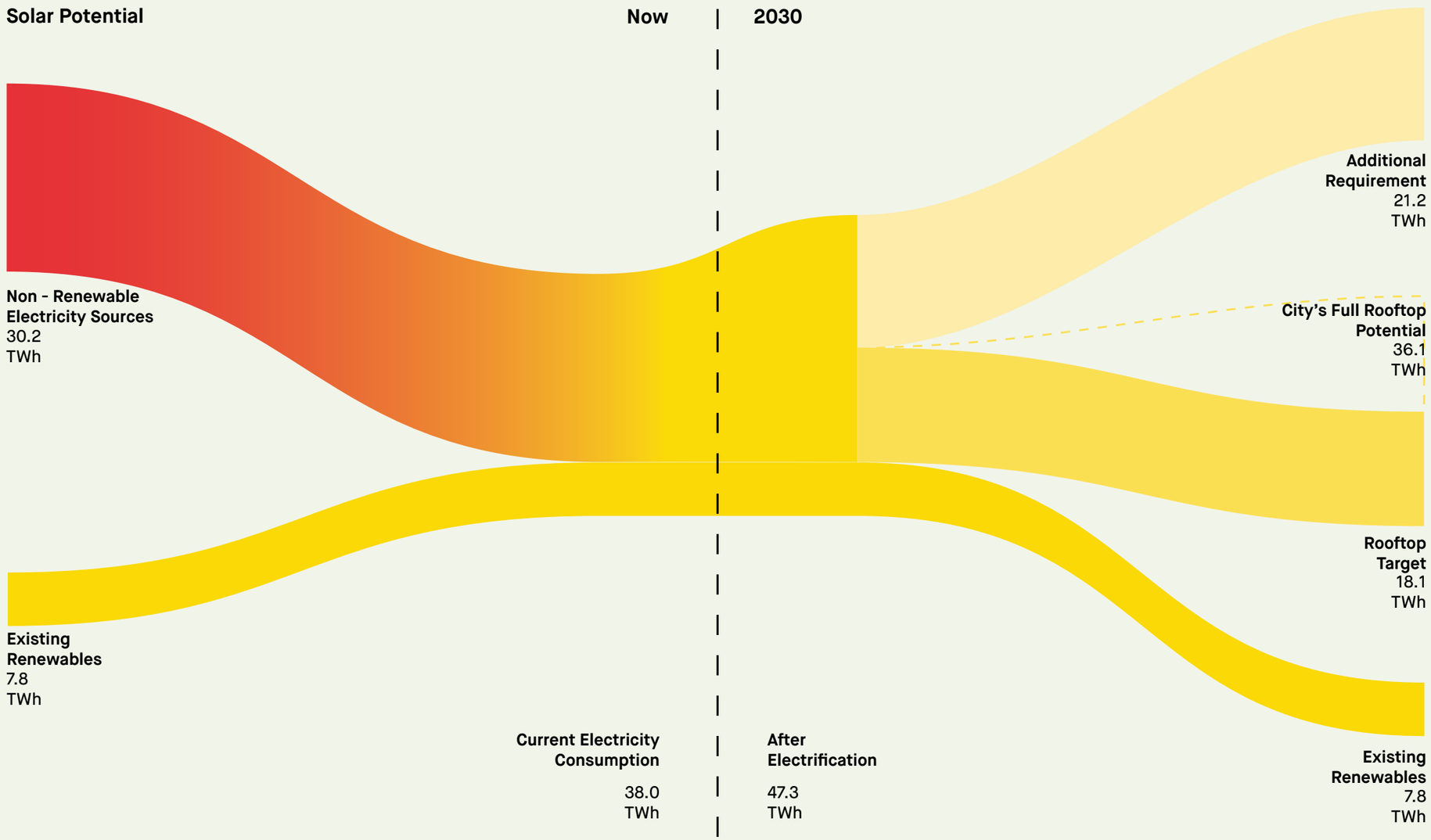


Figure 14: *The impact of increasing solar PV uptake in Greater Melbourne.*

What is the environmental impact?

Meet 38% of the fully electrified city's demands within Greater Melbourne.

How much space will it take?

Around 80 km² of roof space, which is around half of the total suitable roof space available.

How much will it cost?

The cost of this solar PV has been estimated to be $22 billion.

What is the return on investment?

If half of the electricity is used on site, it has been estimated that these solar installations would save their owners around $3.2 billion annually, paying themselves off in around 7 years.

capital cost:	annual savings:	payback period:
$22 billion	**$3.2 billion**	**7 years**

construction jobs/year to 2030:	ongoing jobs:
42,500	**5,900**

Potential employment in construction and installation to 2030, as well as ongoing employment is based on a study by The Australia Institute[48].

Solar Architecture

Melbourne's Rooftops:
John Wardle Architects

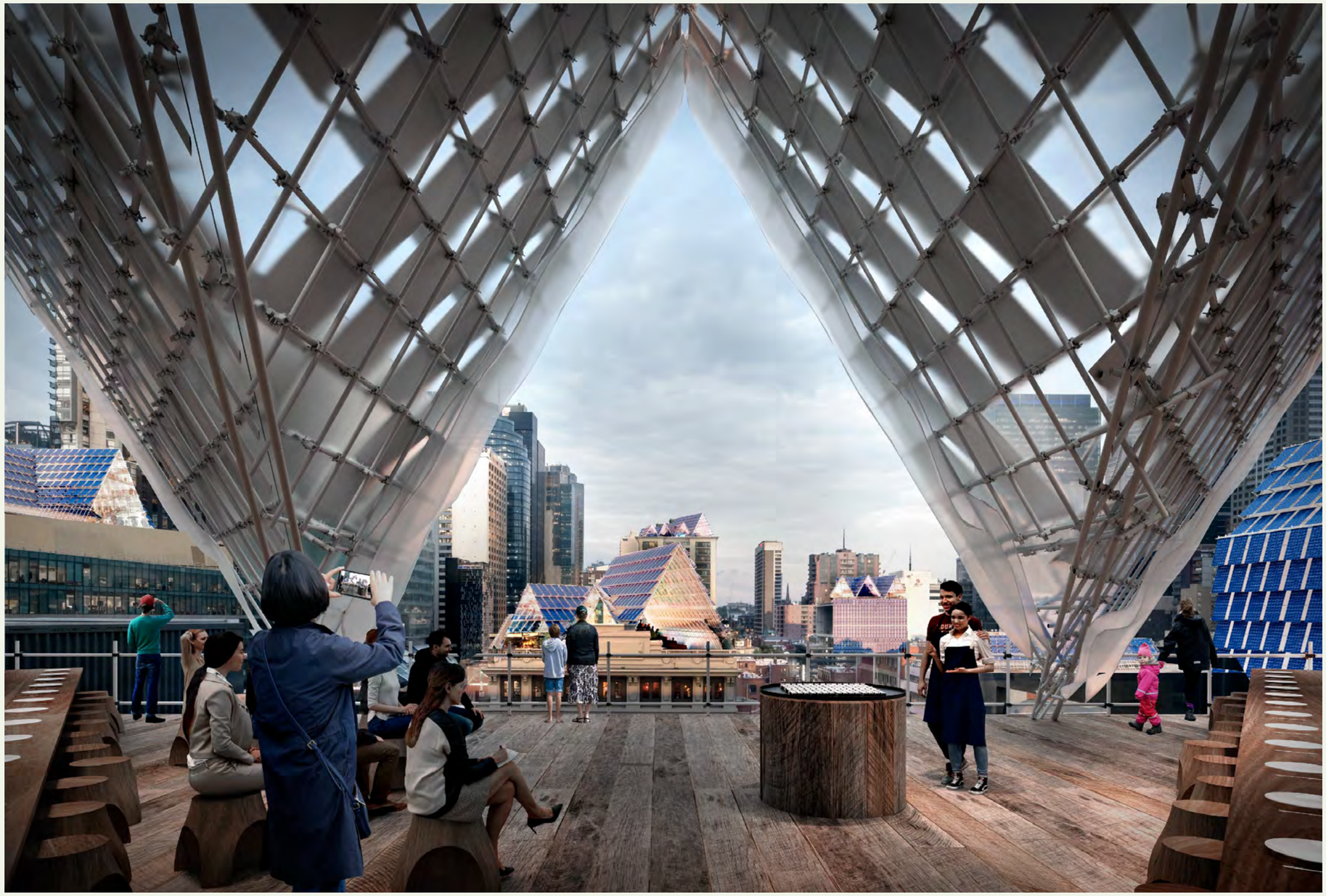
In Melbourne, there is a culture of converting unused rooftops to thriving venues. The vertical laneway of Curtin House famously culminates in a rooftop cinema. In other places, restaurants and bars pop up to occupy the city's fifth elevation.

With this in mind, a new solar architecture takes the form of a rooftop module that is made of simple components assembled into a tent-like form. It is both the infrastructure to carry photovoltaics and a new place for Melbournians to experience. These habitable solar arrays recognise an existing pattern of use. There is a layer added to the city - of bars, cafes, clubs, dining and performance – that builds upon what is already here. The new spaces prompt ideas for other uses too - learning spaces, co-working offices, artist studios, gardens and galleries.

These activities are wrapped in photovoltaics that generate all the electricity they need and more, contributing back to the grid. The roofs that enclose them are steeply pitched to maximise the catchment area and to capture the sun. There is a rawness to the supporting structure, with the appearance of temporary scaffolding and the photovoltaic panels are simply bolted together. The open-ended interior space frames views and feels protected, warm and inviting.

The tent forms are infinitely flexible to suit different rooftop conditions and uses. In plan they can be arranged in a circle, as a starfish, in X and Y-shapes, as a larger field and, of course, in a single line. The modules also support climbing vines and plants to frame garden pockets.

Melbourne's rooftop culture is amplified, expanded and electrified.

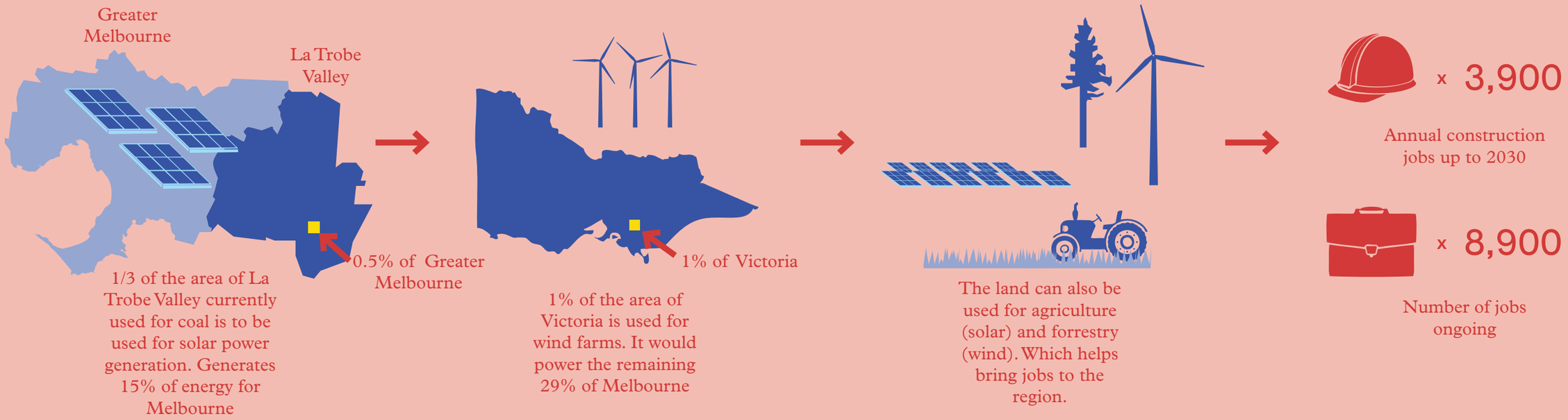


www.johnwardlearchitects.com

06.

Solar & Wind Grid Scale

After coal, Victoria's La Trobe Valley can prosper—
by becoming Australia's new renewable energy hub.



Solar & Wind Grid Scale

The Challenge

In 2020, our energy system runs almost entirely on fossil fuels. These are finite, and emit carbon dioxide — and other particles with environmental and health impacts. The economic cost of air pollution is projected to rise to 1% of global GDP by 2060[49]. Air pollution lowers life expectancy by 1.8 years globally[50] and is killing more people than smoking[51].

The International Monetary Fund estimates fossil fuel subsidies in Australia at around $29 billion annually[52] — of which around $6 billion can be attributed to Melbourne. This means that we are subsidising fossil fuels with 150% of the cost of what would be required to power the entire city with wind and solar over the next 10 years.

While technically possible, it is unlikely that all of Melbourne's electricity will be supplied from within the city. It is expected that we will need to import some energy from surrounding areas. As of mid 2019, Victoria has around 6,100 MW of installed renewable capacity, which generated around 10,000 GWh in the 2018-19 financial year [53].

We need to supply Melbourne with clean, affordable, renewable energy, through solar PV and wind. As this transition will end the coal industry in Victoria, the LaTrobe Valley's immediate future lies in the transformation from coal region to a renewable energy hub in conjunction with agriculture and forestry. It could become the Australian centre of renewable energy innovation, connected to universities, manufacturing, agriculture and the food industry. This expertise can then be exported around Australia and the world.

Where Is This Currently Happening?

Germany

Germany will decommission all of its 84 coal fired power plants within the next 19 years[54].

- Currently 35% of energy is from coal
- 12.6GW of coal power capacity will be decommissioned by 2022, and another 25.6 GW by 2030
- Support package of €40 billion over 20 years will help affected areas transition away from coal-based economies
- If conditions allow, the final decommissioning dates may be brought forward by 3 years to 2035

Copenhagen

Copenhagen intends to be entirely carbon neutral by 2025[55].

- The city's energy utility, HOFOR, has invested billions of euros to build 360 wind turbines by 2025
- It will replace its coal fired power plants with biomass plants burning sustainably sourced wood pellets
- At the same time, an average couple living in a flat is estimated to save €537 each year on energy bills
- The public investment of around €360 million to reach the carbon neutral target is expected to attract almost €40 billion in private green investment

Britain

Britain recently went a week without burning coal for the first time since the industrial revolution[56].

- electrical grid operator says this will be "the new normal" and says this will mean lower electricity prices
- in 2013 coal powered a third of the country's grid
- the government has pledged to phase out coal completely by 2025

South Australia

By 2025, South Australia is expected to be producing more renewable energy on an annual basis than it consumes[57].

- The state will generate 73% of its electricity through renewables by 2021, 100% by 2025
- The grid will remain connected to the rest of the country, exporting excess and importing when needed
- This has led to SA having the cheapest wholesale power in the country for the first time in recent months[58]

finding ínfinity

Solar & Wind Grid Scale

A New Normal Solution

Announce a ban on coal fired generation by 2030 and incentivise investment in grid scale renewables in the LaTrobe Valley — while investing in reskilling the labour force in the region.

Currently over 150 km2 of the LaTrobe Valley is occupied by coal generation. Covering only a third of this area with around 5.1 GW of PV — combined with existing renewables and rooftop PV in Melbourne — would generate enough energy to power well over half the city. The remaining electricity would come from new wind energy projects throughout the region.

Through this it is estimated that around 3,900 renewable energy construction and installation jobs would be created annually to 2030, and around 1,100 ongoing jobs in maintenance and operations[59].

Solar generation can be combined with agriculture, while wind generation can be combined with forestry to replace cattle grazing, for efficient land use. This is estimated to add around net 7,800 ongoing jobs in forestry and vegetable growing[60].

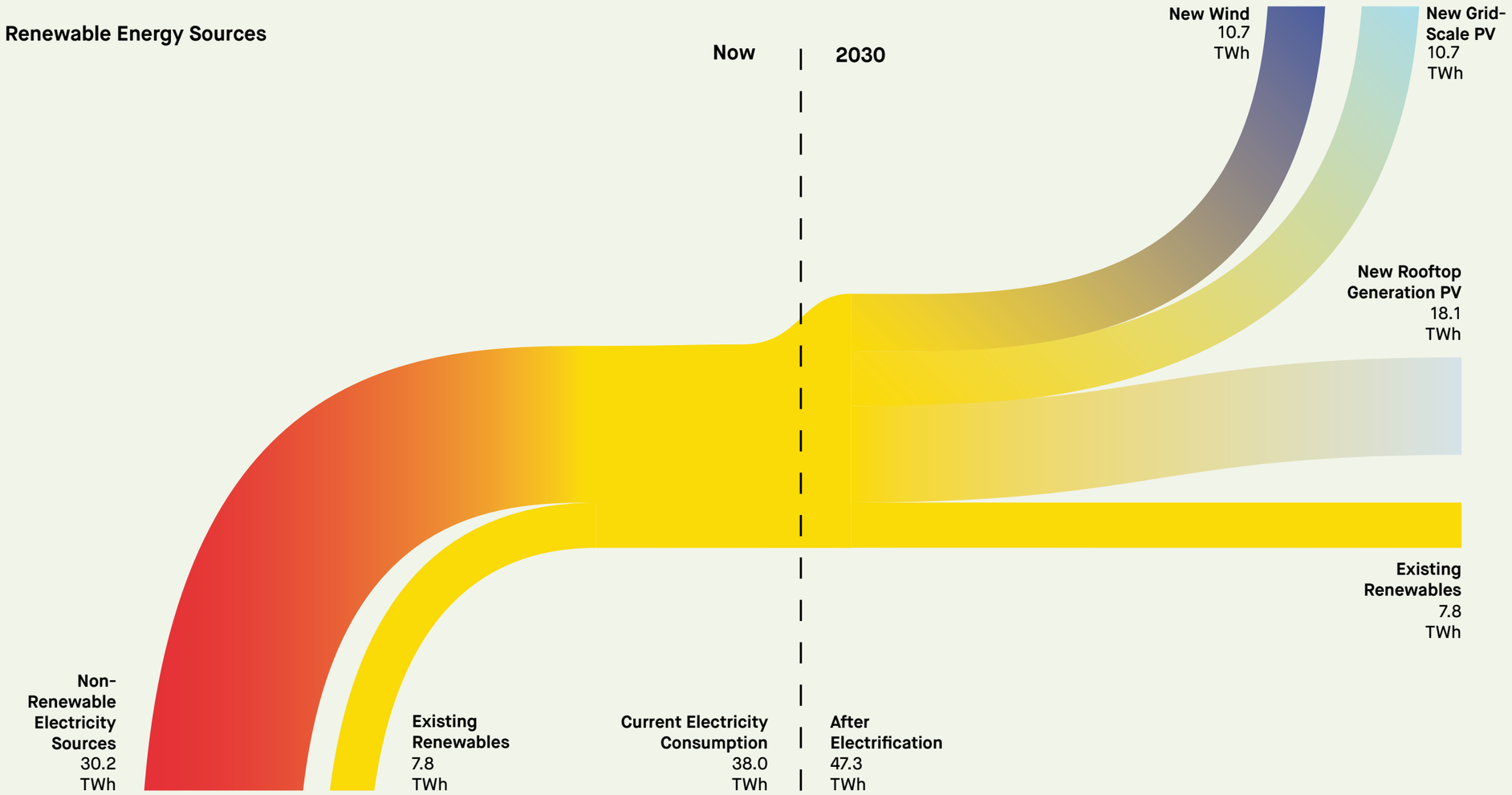


Figure 15: *Demonstrating the increase in electricity consumption in 2030 as the grid is electrified, and where renewable energy comes from in this scenario.*

What is the environmental impact?

The region will provide 45% of Melbourne's annual consumption (29% wind, 15% solar), and allow the end of brown coal generation.

How much space will it take?

Around 50 km^2 of solar PV, taking up one third of the space of existing coal generation, and 1,500 km^2 of wind[61].

capital cost:	annual savings:	payback period:
$17.6 billion	**$1.9 billion**	**9 years**

How much will it cost?

The cost of grid scale PV has been estimated to be $9.4 billion and wind energy $8.2 billion[62].

What is the return on investment?

Based on average wholesale electricity prices, the expected income has been estimated to be $1.9 billion annually, resulting in a payback of 9 years[63].

construction jobs/year to 2030:	ongoing jobs:
3,900	**8,900**

finding ínfinity

Solar & Wind Grid Scale

Welcome to the Valley of the Sun: Ha

A Latrobe Valley where solar agriculture underpins a 21st century economy — and one that provides 50% of Greater Melbourne's power.

What is solar agriculture? It's simple — the mixed use of agricultural land for both food production and energy production (through solar farms). It's not theoretical. It's tried and tested. And it delivers.

For the Valley it offers jobs and a safer, cleaner environment — while maintaining the region's proud identity as an energy producer.

For the City of Melbourne it is not just a clean energy supply, but a vast new food bowl to feed our growing metropolis.

But how do we make sure we bring the local community — and Melburnians — along for the ride?

By quite literally giving them a taste of solar agriculture in the Latrobe Valley.

What you're looking at is a prefabricated and repeatable greenhouse structure and restaurant. People visit, walk the property — and enjoy a day featuring food grown right there on the property. In a building powered by the solar they see all around them.

It's an immersive, delicious, experience of our energy future.

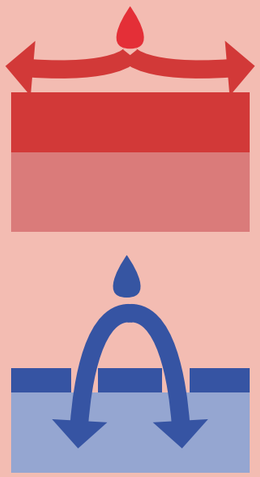
Ha°

www.h-a.com.au

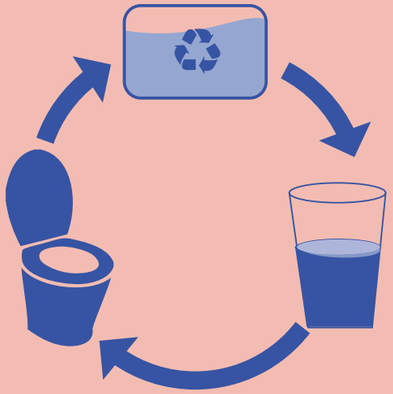
07.

Water Unlimited

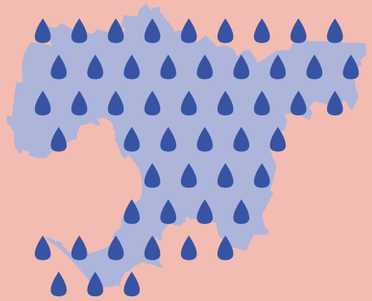
With its water supply forecast to run out as early as 2028, Melbourne must start treating and reusing water.



Increase the permeabilitiy of our suburban streets



Treat and reuse sewer water within our city



Decentralised water treatment plants distributed throughout the city

x 1,000

Annual construction jobs up to 2030

Water Unlimited

The Challenge

By 2030, almost half the world's population will be living in "high water stress" — with water becoming increasingly scarce[64].

We live in the driest continent on the planet, with rapid population growth and dwindling rainfall. Melbourne's water supply is predicted to run out as early as 2028[65].

The current contingency plan for Melbourne is a desalination plant, which produces clean water at roughly twice the cost of treated wastewater.

Desalination is twice as expensive to build and twice as expensive to operate in comparison to wastewater treatment. The desalinisation plant in Melbourne is sized to cover roughly 150GL/year (only 34% of current consumption). This plant is currently costing the state $649 million every year and not currently producing water.[66]

Currently Melbourne's water is supplied through catchments near the city. Sewer water is pumped out of the city to two major treatment plants — and still 84% of treated waste water is disposed of at sea[67].

Furthermore, the rainwater that falls on paved areas within the city collects pollution — mostly from cars — and enters the stormwater system untreated, damaging our waterways and port.

Where Is This Currently Happening?

London

70% of London's water is supplied by reservoirs filled by the River Thames[68].

- London has a similar annual rainfall to Melbourne
- Classified as "seriously water stressed" by the Environment Agency
- Thames water is said to have been through 5-7 people before reaching London
- London also has an artificially recharged aquifer, which is topped up with treated water when rainfall is plentiful and used as back-up during droughts

Israel

87% of Israel's wastewater is recycled[69].

- Majority of recycled water is used for irrigation
- Around 50% is treated using an advanced process which allows it to be reused for any crops, rather than limited types of irrigation
- Accounts for almost a third of all agricultural water use in Israel, or 20% of the country's total consumption

Perth

Perth refills its drinking water aquifer with treated waste water[70].

- Water is stored and naturally filtered until it is needed
- Greatly improves water security as it does not rely on rainfall
- The groundwater replenishment scheme currently supplies 2% of Perth's water
- Plans are underway to upgrade the capacity of the scheme after successful trial periods
- A 2012 survey showed that 79% of residents supported the water recycling scheme

Singapore

NEWater is the brand name given to reclaimed water treated and used for drinking in Singapore[71].

- Currently makes up 40% of the drinking water supply
- Expected to rise to 55% by 2060
- Studies by an international group of experts in engineering, biomedical sciences and water technology found that the quality was well within the WHO and USEPA requirements for drinking water
- Launched in 2003, and has since gone through twice yearly independent audits by international expert panels to ensure high quality and safety.

Water Unlimited

A New Normal Solution

Ban the disposal of treated water. Treat and reuse water within the city, creating a water source that will never run out.

Greater Melbourne's sewer water should be treated to drinking water standard via a combination of membrane bioreactor (MBR), Hydroxon & reverse osmosis (RO) water treatment plants. These treatment plants can be decentralised and distributed throughout the city, then the water produced fed back into the grid.

At current consumption rates, around 960 ML/day of water will need to be treated[72]. This could be achieved via decentralised treatment plants distributed across the city. These plants could be funded publicly to avoid additional spending on desalination, through public-private partnerships, or through community ownership. While there are many combinations that could work including centralised or semi-centralised treatment, decentralised treatment plants are recommended throughout the city in order to minimise pumping energy requirements and encourage decentralised ownership.

With the removal of fossil fuel transport, pollution of stormwater runoff will be decreased, however the city should still minimise runoff through favouring permeable surfaces, creating raingardens and wetlands and other water sensitive urban design techniques. This will help to improve water quality in our waterways and port, and replenish groundwater. Collection, treatment and use of rainwater should also be encouraged in all buildings in Melbourne.

It is estimated that around 1,000 full time jobs will be created on average through to 2030 in the construction of these plants, based on construction of the Woodman Point treatment plant expansion in Western Australia[73].

A Water Source That Will Never Run Out

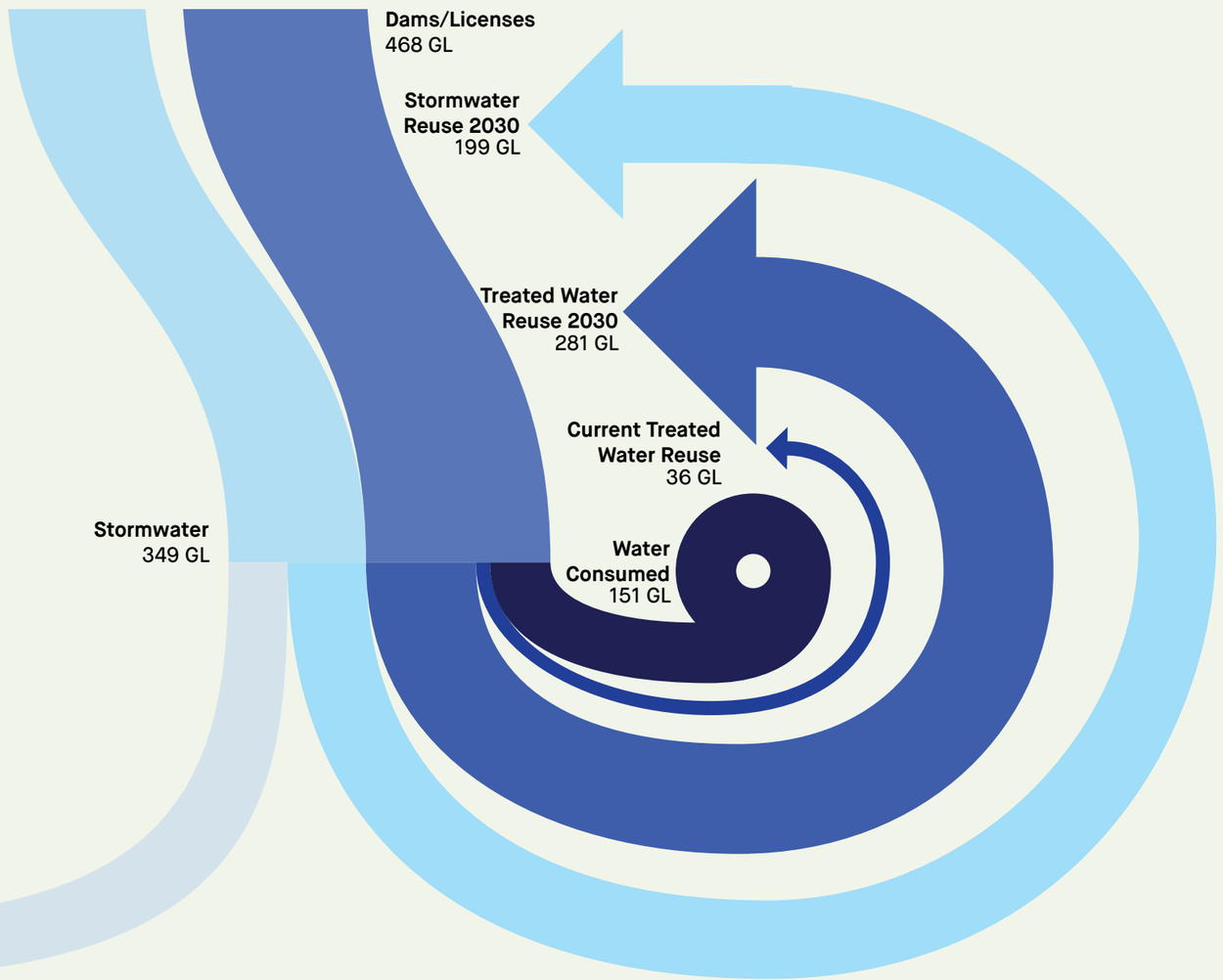


Figure 16: *We treat and reuse all of our sewer water and harvest stormwater for reuse to minimise or even eliminate water requirements from catchments outside of Greater Melbourne.*

What is the environmental impact?

The city becomes water neutral, with a water supply that is unlimited.

How much space will it take?

Around 960 treatment plants, each treating 1 ML/day, taking up about 550 m2 each without storage (or equivalent to 40 car parking spaces), distributed across the city.

How much will it cost?

Around $3 billion in equipment costs – less than the cost of Victoria's $3.5 billion desalination plant[74], while capable of supplying more than twice the amount of water.

What is the return on investment?

Based on the current cost to water retailers on the supply and sewerage networks, these treatment plants could generate around $500 million annually, paying for themselves in around 6 years[75].

capital cost: **$3 billion**

annual savings: **$0.5 billion**

payback period: **6 years**

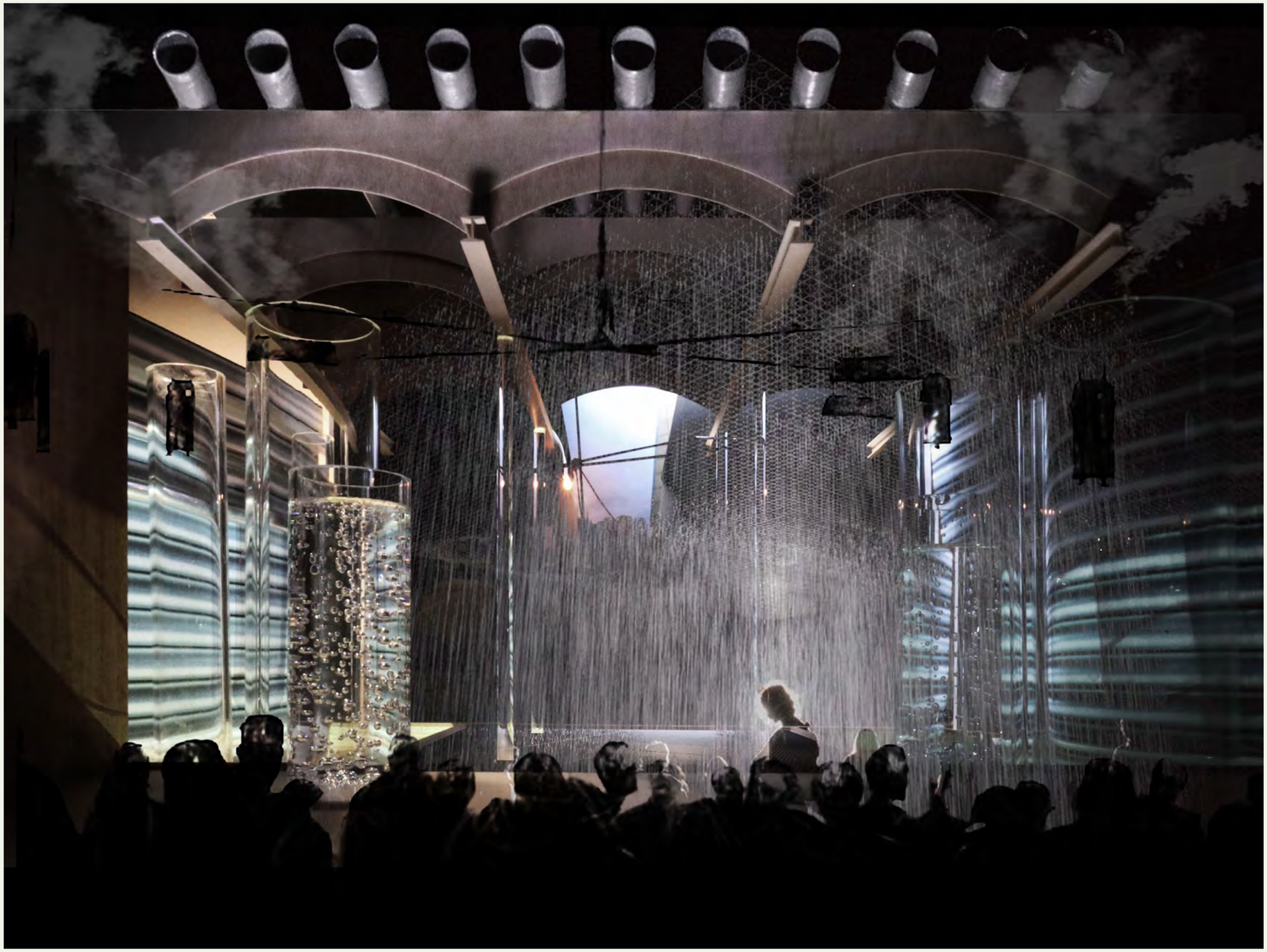
construction jobs/year to 2030: **1,000**

Water Unlimited

MCG:
Openwork

It is a challenge in any location to encourage the general public to embrace treated water in their daily lives. Knowing this, it is important to prepare the public and normalise the treatment of wastewater to a drinkable standard in Melbourne due to the logic and financial viability in comparison to the much higher cost desalination process. The outcome will leave future generations with a more cost effective, more secure and high quality water supply. To achieve this we must engage the people of Melbourne with treated water in new ways. This is another example of connecting technology with culture. And in Melbourne what better location to do that than the iconic MCG.

An early adopter of Water Unlimited, The Water Tank Club (or the MCC – Melbourne Cistern Club) has been established as a pilot project under the bleachers at the MCG. Untreated water from the roof and plaza of the precinct is filtered through a series of pipes and tanks that form the walls of the void space under the concrete seating bleachers of the G. Clean, treated water is stored in tanks that are lit from beneath and used for drinking, swimming and misting - making the air wet and a dripping ceiling – a moist cathedral to celebrate performance, left over space and hydraulic engineering. In a spatial version of 'beer-goggles' punters see each other across the room, their normal faces made wonderful and warped through the lens of the clean water tanks. Night's end is signalled by sun rise, reflected into the space from the Collins Place Towers.



Water Unlimited

Middle Ring:
NMBW

This is a typical suburban cul-de-sac – that has changed its local transport system.

The property owners negotiated to close their no-through road to everyday traffic and install a shared carport at the entrance of the street – a max. 200m from the other-end of the street. This simple act – and small personal behavioural change – frees up enormous real estate for other uses – real estate that can be put-to-use for cultural and environmental production.

Energy, waste and water can be re-negotiated at street scale. Reduced traffic allows for more permeable road and driveway surfacing rather than concrete and asphalt – dramatically reducing the burden on the stormwater system – and allowing local water retention. Verges re-wilded with native species further treat the water for re-use.

The things we normally do in garages, including workshops, storage, gardening equipment, water storage and rubbish collection are all able to be re-thought collectively. Without the fixed dimensions of the car and its turning circles being the key determining factor in the spatial layout – buildings can be more flexible to respond to our human and environmental needs. More density with better design can be incorporated much more easily if parking is separated from dwellings. Homes suited for an aging population and people with mobility needs can be accommodated with drop-off zones and small electric transfer vehicles.

Water Unlimited

Middle Ring:
NMBW

Deep root zones for large canopy trees can replace car parks – helping to reduce the heat island affect – also filtering privacy between dwellings, allowing comfortable medium density development. Reduced traffic also makes for a safer street, encouraging people to increase use of the space between buildings – further facilitating neighbourly interaction.

In this location in particular, of West Footscray, there is a train station within 300m of the end of the street. There is ample parking around the station, which can act as a hub for last-mile shared transport. There are mixed use commercial, cultural and industrial buildings that can co-exist with residential uses for a productive live-work environment for all ages.

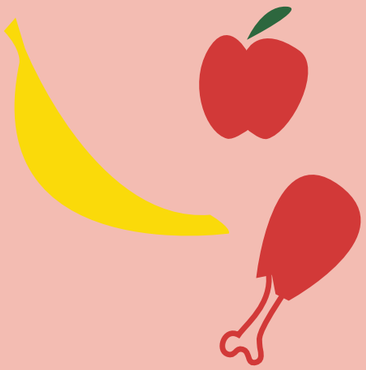
To get started this prototype could be thought of as a timed trial. The street could be closed to cars for one weekend, and a range of trial programs put in place. Removable prototypes of zero-carbon, low energy, lightweight alternative live-work typologies could be built in frontyards, nature strips and in redundant street reserves for people to visit and imagine.

This could be timed to occur simultaneously in multiple middle-suburban locations. It has already been done at a much larger scale in Swanston Street, which was famously covered in rolled turf along its entire entire length in 1985 – enabling people to envisage what the space could be used for without cars.

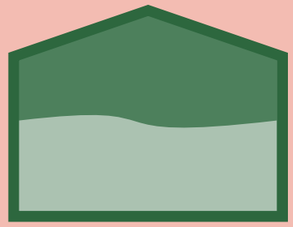
08.

Organic Waste to Energy

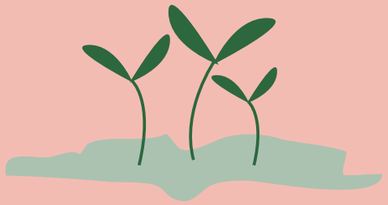
Our organic waste has significant value.
It can be profitably converted into energy and fertiliser.



Greater Melbourne sends 1,500T of food waste to landfill every day



This waste is to be redirected to anaerobic digestors which are distributed across the city. Each receiving 10T of food waste per day



Transforms organic matter into energy through biogas. Creates fertiliser to be reused

x 140

Annual construction jobs up to 2030

x 270

Number of jobs ongoing

Organic Waste to Energy

The Challenge

We've been hiding from food waste for decades.

We put it in a plastic bag and pay someone to remove it. In landfill, food waste rots — releasing methane, a greenhouse gas 28-36 times more potent than carbon dioxide[76].

We estimate Melbourne sends around 1,500 tonnes of food waste to landfill per day[77].

Anaerobic digesters are essentially large mechanical stomachs – bacteria converts organic matter into methane, which is captured and combusted to create electricity and heat, as well as organic liquid fertiliser.

Where Is This Currently Happening?

Florida

Disney World in Orlando, Florida installed a large anaerobic digester to manage all food waste from the theme park[78].

- Food waste is mixed with biosolids from the sewage treatment system
- Treats 120,000 tonnes/year
- Gas generated powers a 5.4 MW combined heat and power plant which gives of heat and electricity for the park
- Cost US$30 million to build
- For scale around 5 of these would consume all of Melbourne's food waste.

Copenhagen

With Copenhagen's target of carbon neutrality by 2025, the gas grid must become fully decarbonised[79].

- New biogas upgrading facility means 44% of the city's grid gas supply is now biogas as of June 2019
- Aiming for 60% biogas in the grid by 2020
- Anticipating 100% before 2025, ahead of schedule

India

Around 80 million Indian homes, with 400 million people are still without electricity. As a result of this, over 4 million homemade family scale digesters have been created throughout the country[80].

- Mostly consuming animal manure
- Provide families with gas for cooking and electricity
- This was helped in part by a program in the 1970s called the National Biogas and Manure Management Program

finding ínfinity

Organic Waste to Energy

A New Normal Solution

Ban the disposal of organic waste to landfill — and build anaerobic digesters throughout the city to convert food waste into electricity, heat and organic fertiliser.

Around 150 anaerobic digesters, each processing 10 tonnes of food waste per day, would process all of Melbourne's food waste — and supply around 400 GWh of energy (enough to power around 84,000 homes[81]) and 136,000 tonnes of organic fertiliser per year in the process. The non-food portion of the city's organic waste, mainly garden waste, can still be composted.

The digesters could be co-located with water treatment plants, with energy from the digesters used to power the water treatment.

An additional benefit is to return nutrients lost in food waste to the soil, via the organic fertiliser created.

The installation of these digesters is estimated, based on a European study, to provide around 140 full time jobs to 2030, and 270 ongoing jobs[82].

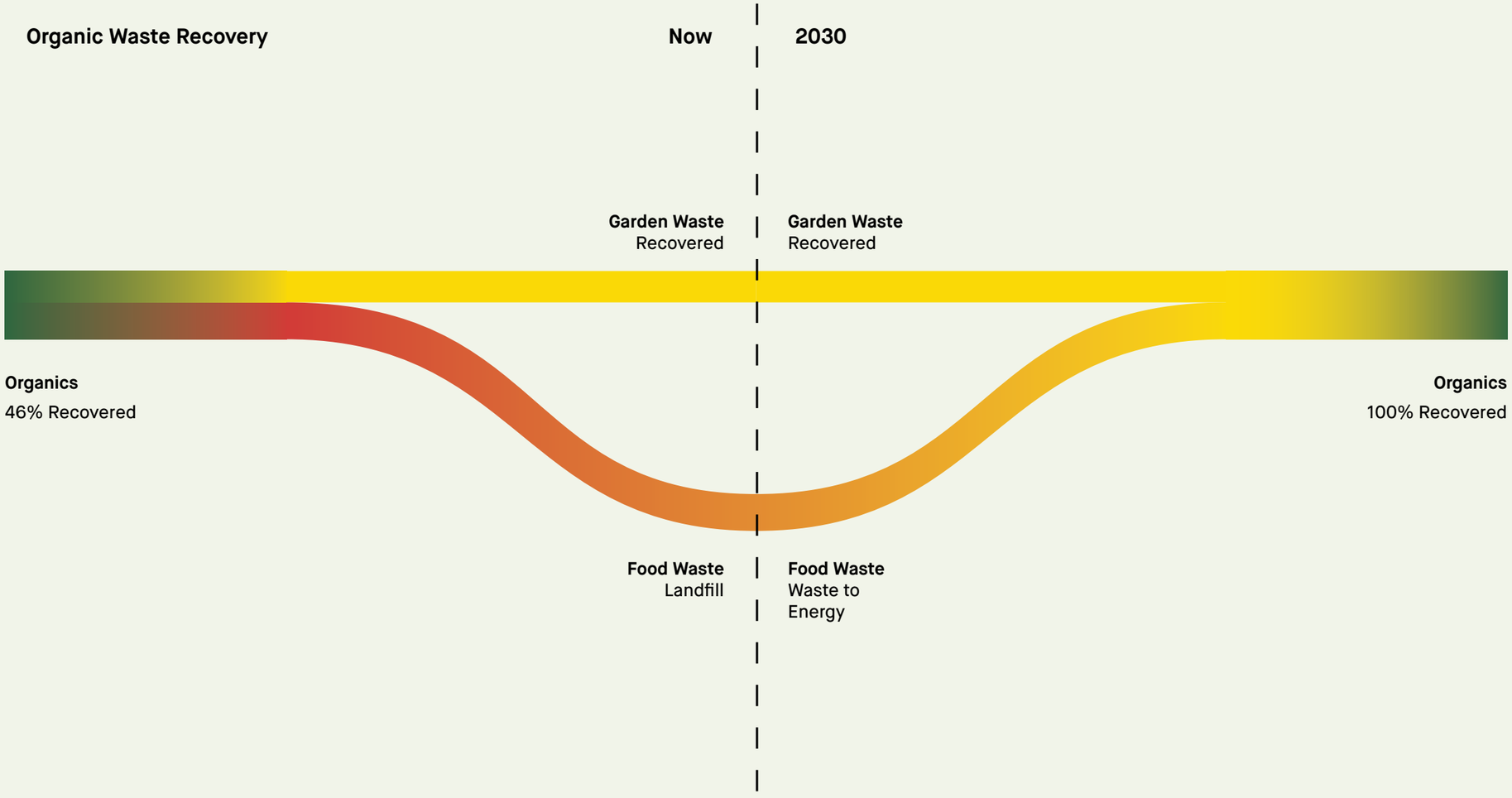


Figure 17: *Anaerobic digesters transform Melbourne's organic waste into energy.*

What is the environmental impact?

100% reduction in organic waste to landfill, and enough energy to power 84,000 homes or around 1% of the city's current electricity consumption, while also providing organic fertiliser to improve soil health.

How much space will it take?

Around 150 digesters, each taking up about 220 m2 – around 15 car parking spaces for each digestor.

How much will it cost?

The total cost of the digestors are estimated to cost around $220 million.

What is the return on investment?

The digestors would generate net income of around $35 million annually, paying for themselves in just over 6 years.

capital cost:	annual savings:	payback period:
$0.22 billion	**$0.04 billion**	**6 years**

construction jobs/year to 2030:	ongoing jobs:
140	**270**

Organic Waste to Energy

Swimming Pools Across Melbourne:
WOWOWA

As a case study, Fitzroy swimming pool would be the first of 150 anaerobic digestors to be rolled out across Melbourne to deal with the city's expanding food waste problem.

This tower combines two unlikely companions, waste and recreation. Collecting 10 tonnes of food waste a day from the surrounding food and beverage businesses; the tower converts this waste into biogas, used to heat the swimming pool's sauna, spa and indoor pool. Housed within the tower are two large tanks, stacked to minimise its footprint, while also celebrating this new industrial form on the suburban streetscape.

The tower also produces a nutrient-rich fertiliser to feed an expanding landscape of plants growing in and around the pool and in the adjacent park. Nearby residents are encouraged to drop off their food waste before heading inside to jump into the pool or sauna.

WOWOWA

www.wowowa.com.au

Organic Waste to Energy

Queen Victoria Market:
6 Degrees

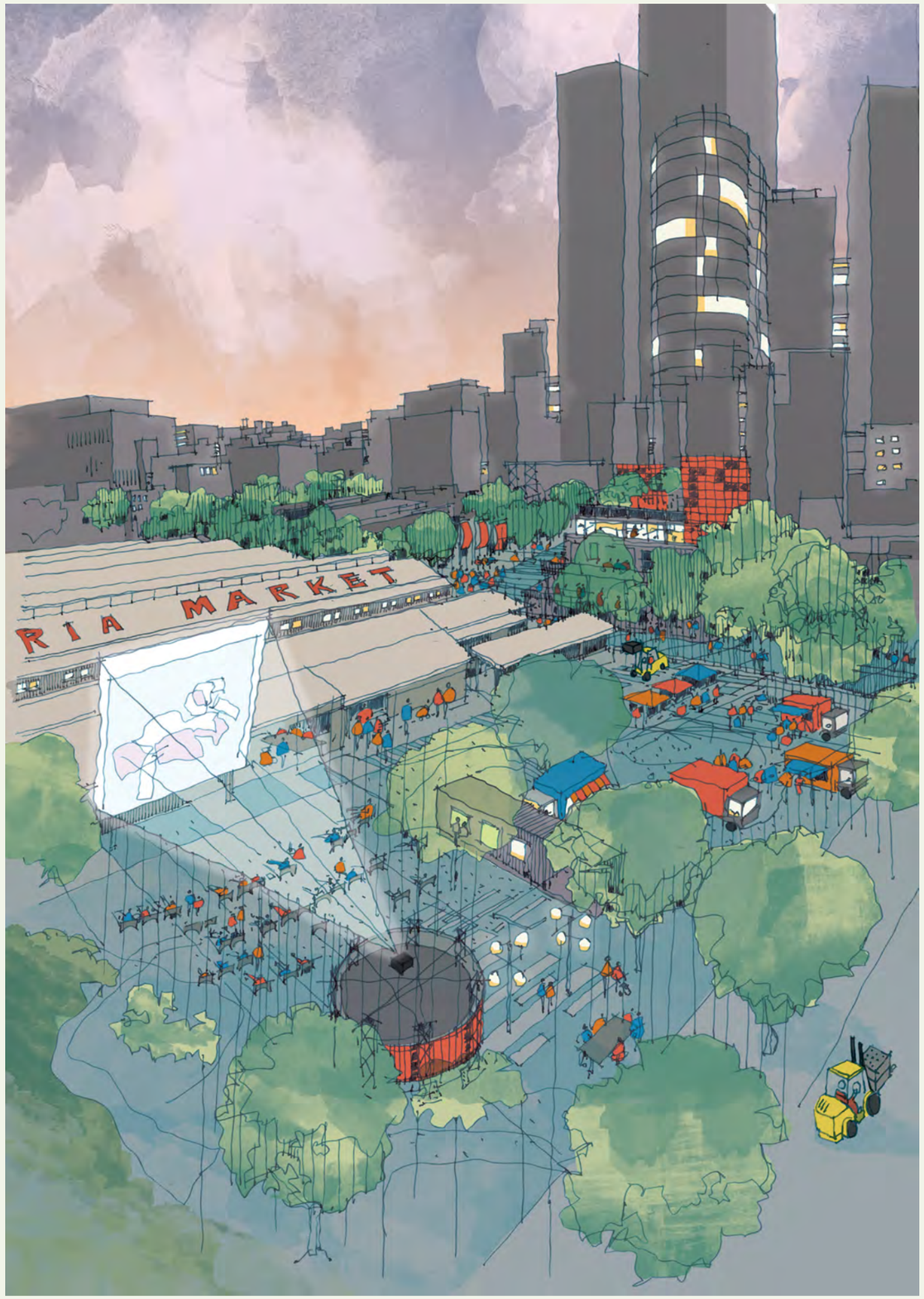
Queen Victoria Market is one of the Melbourne's most loved precincts. Opened in 1878 it has provided a continuous destination for generations of Melbournians and visitors for over 140 years.

The market sheds and halls have changed and developed over the decades and the market is currently undergoing a further series of redevelopments to underground the cars and reclaim the existing asphalt carpark as public space and parkland.

As a product of selling fresh fruit, vegetables, meat and fish, the market produces hundreds of tons of organic waste every month.

This proposal looks to take the significant organic waste generated at Victoria Markets and turn it into energy, for use by both the market stall holders and visitors to the precinct. Gas is generated through the use of an anaerobic digester. The methane produced will provide energy, through a gas engine, to power a moonlight cinema for Melbourne City Council's proposed new park atop the existing market carpark. The methane will also be used by the market's fleet of forklifts and piped through the market to provide gas for the food outlets. Food trucks can jack in to service points adjacent to the digester to service the moonlight cinema or other market events, and Public BBQ's will be provided in the park for general use.

Food waste and surplus vegetables, usually destined for landfill, will instead be transparently utilised to help power a treasured Melbourne precinct, while the bi-product, a nutrient rich fertiliser, will be offered to market shoppers to take home to their gardens and used on nearby city parks.



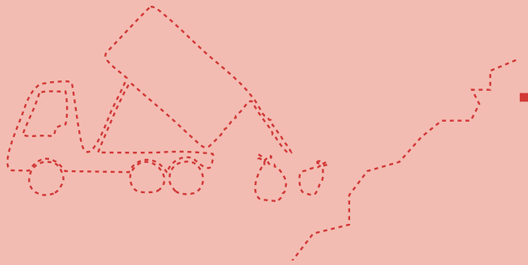
sixdegrees

www.sixdegrees.com.au

09.

End Landfill

It's time to end the concept of landfill — by banning the sale of any product destined for the landfill.



We need to end the sale of any product that is destined for landfill

This requires communication and awareness for consumers, the private sector and the government

Linked with this we require facilities to repair, reuse and repurpose our existing materials and products

x 18,100

Number of jobs ongoing

End Landfill

The Challenge

Cities import products made from raw materials, use them — and dispose of them in landfill. Melbourne sends around 8,500 tonnes of waste to landfill every day[83], enough to fill the Eureka Tower 50 times annually.

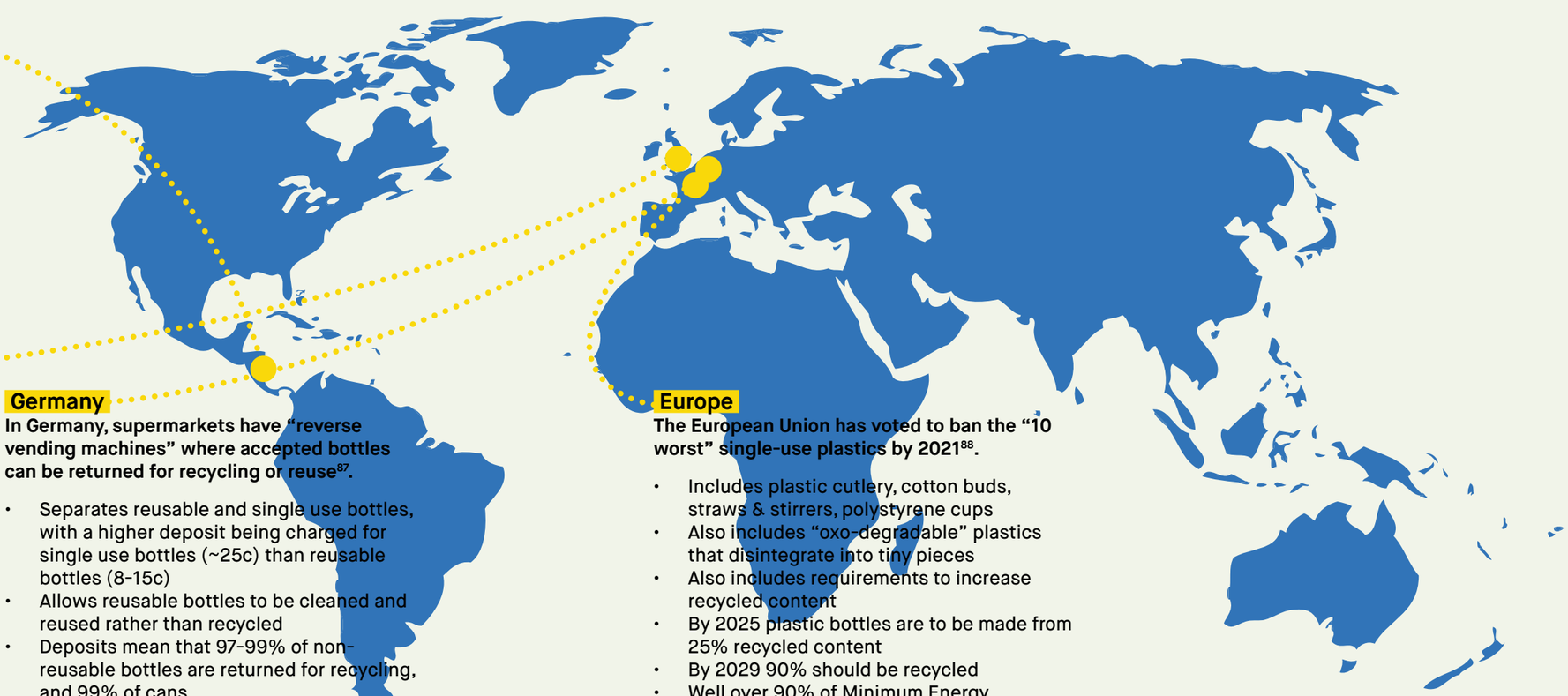
Some cities are investing in waste to energy plants - combusting plastics and other non-organic, non-recyclable waste. Unfortunately, this is not a viable long-term solution: it promotes linear consumption of finite resources rather than a circular approach, and creates unnecessary emissions.

Instead, we need to end the sale and consumption of non-organic, non-recyclable products. Additionally, we need to move away from products where recycling is "cascading" – i.e. the materials lose value each time they go through the recycling process. Many plastics are only recyclable in a cascading manner.

According to the Ellen Macarthur Foundation, the cost of externalities from the production of plastic packaging is greater than the entire profit pool of the plastic packaging industry[84].

Even when including the profit to their producers, the negative impacts of the plastic packaging industry mean that it creates a net economic loss for the world – the public losses outweigh the private profits.

Where Is This Currently Happening?



Costa Rica

In June 2017, Costa Rica announced plans to completely eliminate single-use plastics by 2021[85].

- Costa Rica will be the first country in the world to do so
- The strategy relies on an online platform where businesses and citizens can track progress of what is being implemented and register their own products or materials
- Government estimates 30% increase in business activity related to renewable materials

London

Traditional milk deliveries in glass bottles are regaining popularity in London[86].

- Empty bottles are collected as new bottles are delivered
- Bottles are cleaned and reused rather than recycled
- Delivery companies reporting up to 95% of new customers are requesting reusable glass bottles

Germany

In Germany, supermarkets have "reverse vending machines" where accepted bottles can be returned for recycling or reuse[87].

- Separates reusable and single use bottles, with a higher deposit being charged for single use bottles (~25c) than reusable bottles (8-15c)
- Allows reusable bottles to be cleaned and reused rather than recycled
- Deposits mean that 97-99% of non-reusable bottles are returned for recycling, and 99% of cans
- New law means that companies must specify on bottles whether they are to be recycled or reused

Europe

The European Union has voted to ban the "10 worst" single-use plastics by 2021[88].

- Includes plastic cutlery, cotton buds, straws & stirrers, polystyrene cups
- Also includes "oxo-degradable" plastics that disintegrate into tiny pieces
- Also includes requirements to increase recycled content
- By 2025 plastic bottles are to be made from 25% recycled content
- By 2029 90% should be recycled
- Well over 90% of Minimum Energy Performance Standard (MEPs) voted in favour of the ban

finding ínfinity

End Landfill

A New Normal Solution

Ban the sale of any products unavoidably destined for landfill. Encourage reuse over recycling.

Some of the products & practices must be eradicated by 2030 include:

- Single use plastics
- Non-reusable construction products
- Mixed, non-recyclable packaging
- Disposal of glass rather than recycling
- Disposal of paper and cardboard

Regulation banning the use of any material that is not organic or 100% recyclable are required across all industries. Key areas include retail and consumer products, construction, agriculture, manufacturing, and logistics. Unavoidable waste from life-saving sectors, such as cutting edge medicine, will need investment in research into viable alternatives.

Adoption of a circular economy is estimated to add $1.65 billion annually to global GDP[89]. This is estimated to create around 18,100 ongoing jobs[90].

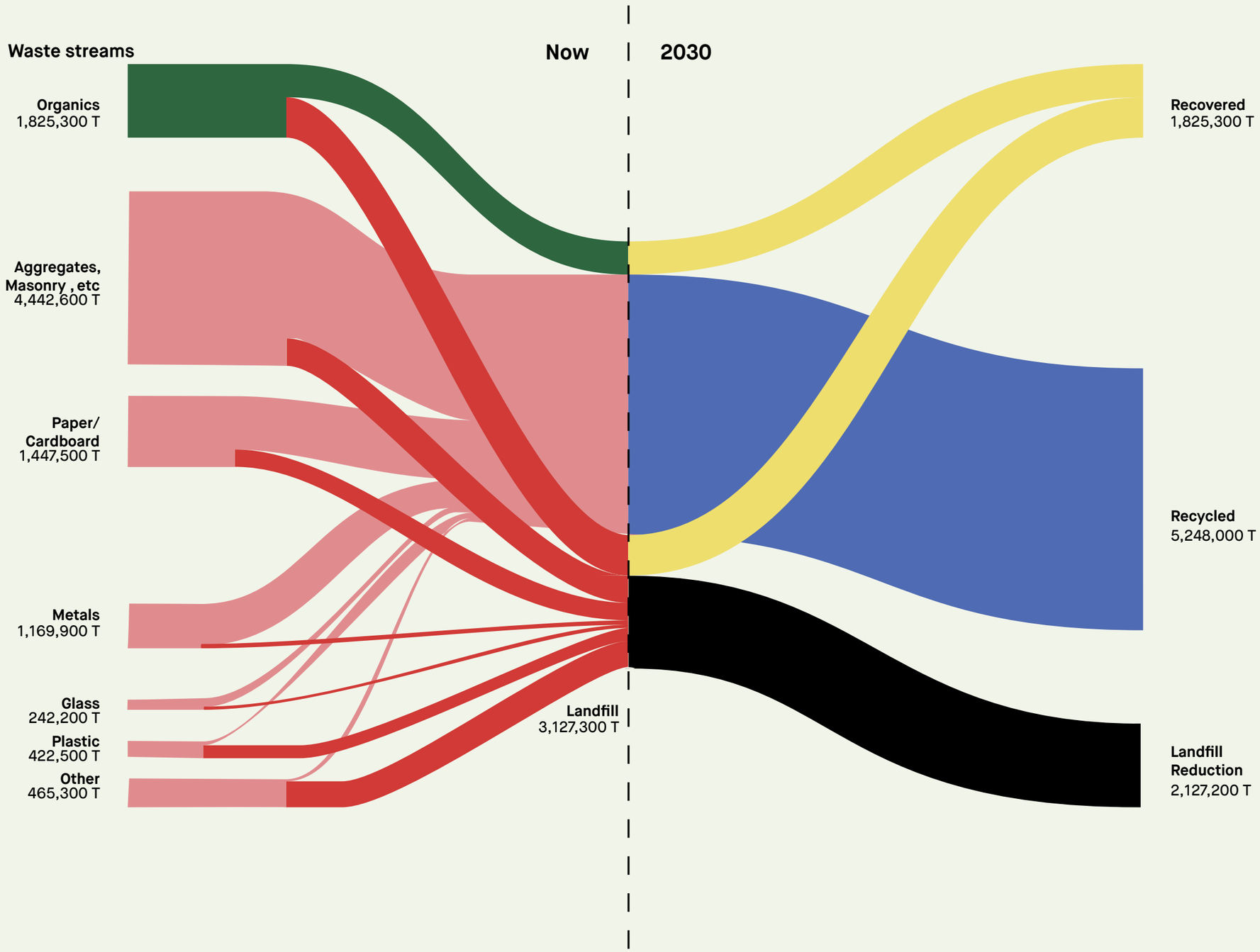


Figure 18: *Food waste is treated through anaerobic digestion, and all waste destined for landfill is avoided.*

What is the environmental impact?
100% reduction in waste to landfill, or 8,500 tonnes per day avoided.

ongoing jobs:
18,100

End Landfill

Replace Me:
Dreamer

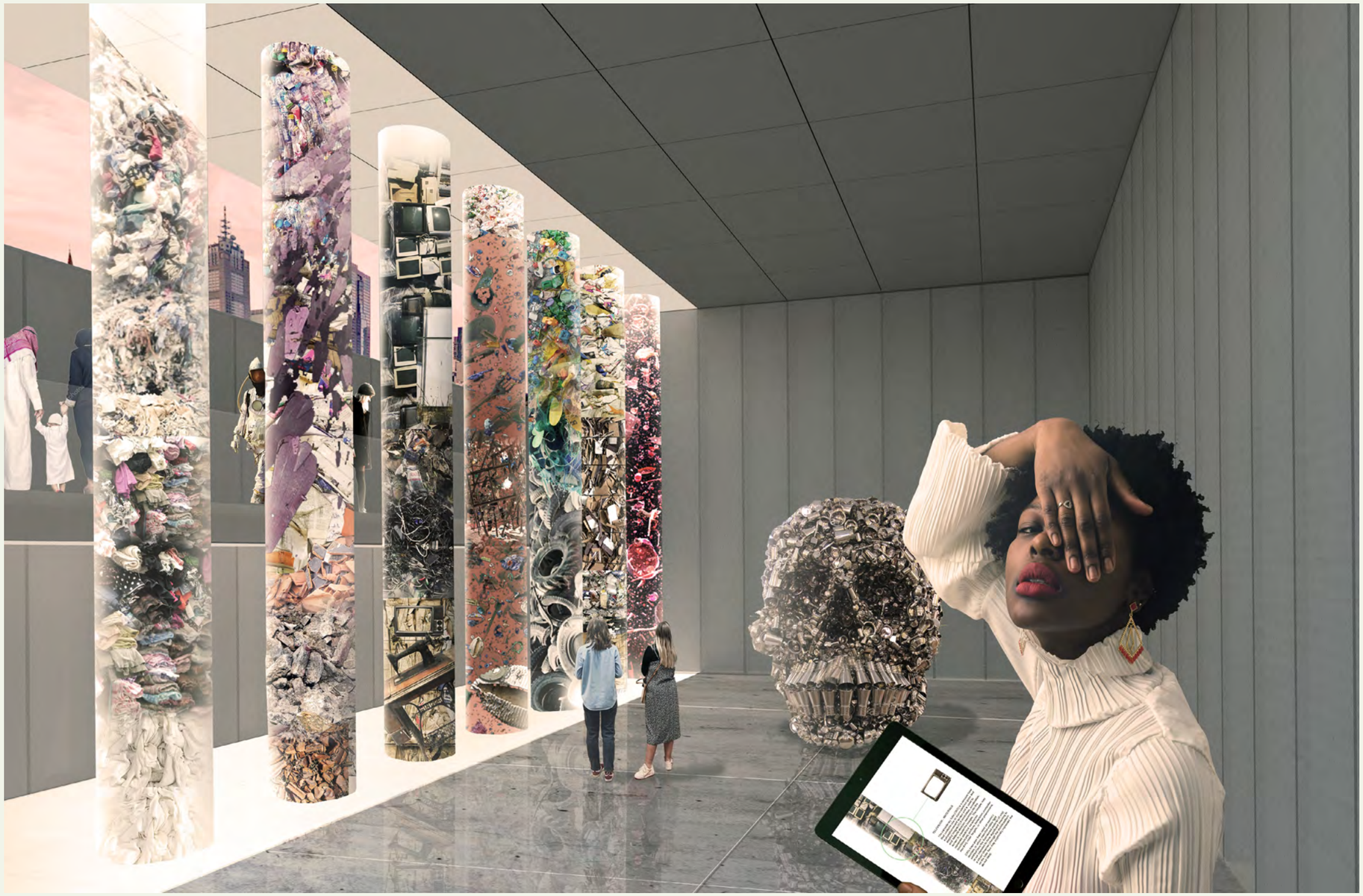
We need to end the sale of any product that is destined for landfill. A physical space is required for communication, awareness and education for consumers to make better choices. The popularity of such a space will send a message of support to political leaders to introduce much needed regulation. But let's not preach to the converted here, it's an important message for all of Melbourne. This creates an opportunity once again to connect technology or solutions with culture by connecting waste with art.

It's 2030 and Melbourne is a trash free city. Welcome to Replace Me, a retrospective art gallery making the invisible visible and celebrating the beauty and value of the discarded.

The gallery's permanent collection will comprise a series of "cores" – tubes of solid landfill waste drilled and extracted from extinct landfill sites across Melbourne. Like layers of ice drilled in Antarctica they depict our changing relationship to waste over time. Once drilled, local and international Artists work with the cores - curating, cleaning, assembling and constructing, creating contemporary works of art.

Visitors would use an augmented reality app as they explore, being guided to discover hidden bottles from the 19th century, durable 1950s appliances, and select moments in the masses of recent fashion, electronic and plastic waste.

Replace Me unpacks the material and cultural value of our discarded items. It serves as a signpost pointing to the moment we were empowered as a community to take a different direction.



DREAMER

www.dreamerlab.com.au

End Landfill

The Cathedral of Circularity:
Edition Office

The Circular Economy. A social enterprise that teaches repair and reuse. The facility repairs and sells refurbished products, and hosts workshops where individuals can come along and learn how to repair their own things. This allows people to rethink how they use and dispose of resources. At the same time, workshops with businesses and manufacturers are hosted encouraging the transition into circular products in all industries.

We all know that person who has a natural ability to fix things, to take the seemingly useless and transform it into a re-vamped, well oiled thing of beauty. Or maybe they just help you fix your bike chain. Regardless, this is their church. A Cathedral of repair, where tech and machinery of all types are archived, pulled apart, sorted for parts. Where people can bring anything from a toaster to a state of the art road bike for repairs. Inside, alongside the archive of parts, is a community tool library.

The building, acknowledging its use, re-purposes the existing structure and superimposes a new mass timber structural system, which itself can be unbolted and the materials easily repurposed for future alternate use.

Edition Office

www.edition-office.com

10.

New Architecture

We can now construct profitable buildings with no negative environmental impact. It must become the industry standard.

Net Positive Energy - Produces more renewable energy than it consumes annually

Net Positive Water - Produces more water than it consumes annually

Zero Waste Operations- Produces no waste to landfill through the life of the building

Zero Impact Construction - Construct new buildings without emitting carbon or sending waste to landfill.

x 8700

Annual construction jobs up to 2030

x 8700

Number of jobs ongoing

New Architecture

The Challenge

The previous nine initiatives will transform Melbourne as it currently is. This final initiative will ensure all new building stock does not require additional resources into the future.

As a minimum, new buildings should have no negative environmental impact on the city. Where possible they should be utilised to collect and redistribute resources. New buildings should be constructed with the lowest possible embodied carbon impact of materials — and designed to give back energy and water, and treat their own waste.

The Building Code of Australia and local council standards need updating to mandate net-zero energy, minimise embodied carbon, water-neutrality and zero-waste for all construction projects.

Net-Positive buildings typically cost <10% more than buildings targeting minimum council compliance — but the difference pays for itself in under 10 years.

The initiatives required are often more profitable than investing in Australian shares, which have an average annual return of 9.5% over the past 30 years[91], and can often be more profitable than the projects themselves.

Where Is This Currently Happening?

California

All residential construction from 2020 in California is to be "Zero Net Energy" (ZNE), and all commercial construction from 2030[92].

- A ZNE building is defined as "An energy-efficient building where, on a source energy basis, the actual annual consumed energy is less than or equal to the on-site renewable generated energy"

Vancouver

Similarly, Vancouver have implemented a Zero Emissions Building Plan with a step down approach to all new buildings becoming net zero by 2030[93].

The plan focusses on:

- building envelopes and passive design
- active efficiency
- renewable generation
- Introduced in 2016.

Toronto

Toronto have implemented a Zero Emissions Buildings Framework with a step down approach to all new buildings becoming net zero by 2030[94].

- The program has targets for reductions by 2022, 2026 and 2030, with the code getting more stringent by each date
- Higher performing buildings are rewarded for targeting zero emissions earlier through a tier system

New Architecture

A New Normal Solution

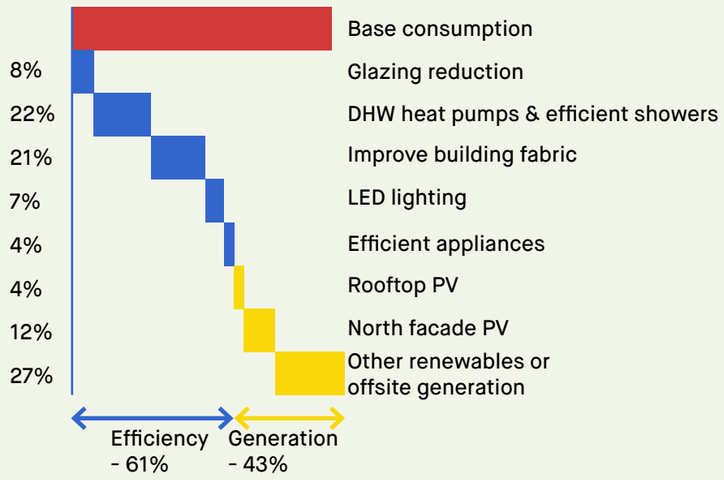
Mandate net-positive buildings as the construction industry standard.

Building codes need to be adapted to dictate that any new construction must be triple net-zero: must create more energy than it consumes, treat and export more water than it consumes and create no waste. This needs to happen at both building code and council planning control levels.

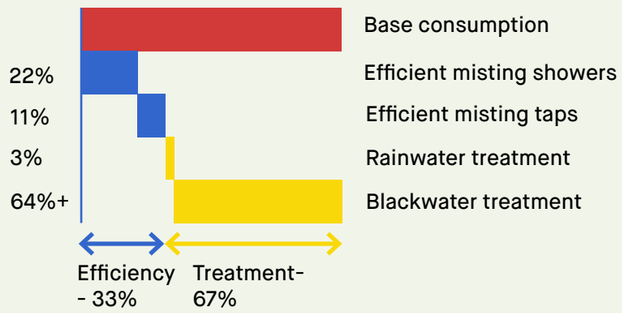
In the meantime, architects and engineers can accelerate this by pushing the limits on every project, seeking the environmental and financial threshold, helping to demonstrate that this form of construction is "normal" educating consumers and developers and encouraging regulation.

Based on a conservative estimate of 5% increase to costs of new construction, a triple net-zero building code is estimated to provide around 8,700 jobs annually, both to 2030 and beyond[95].

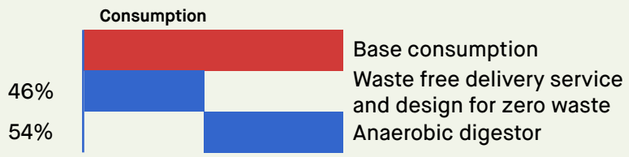
Net Positive Energy



Net Positive Water



Zero Waste



Net Zero Code

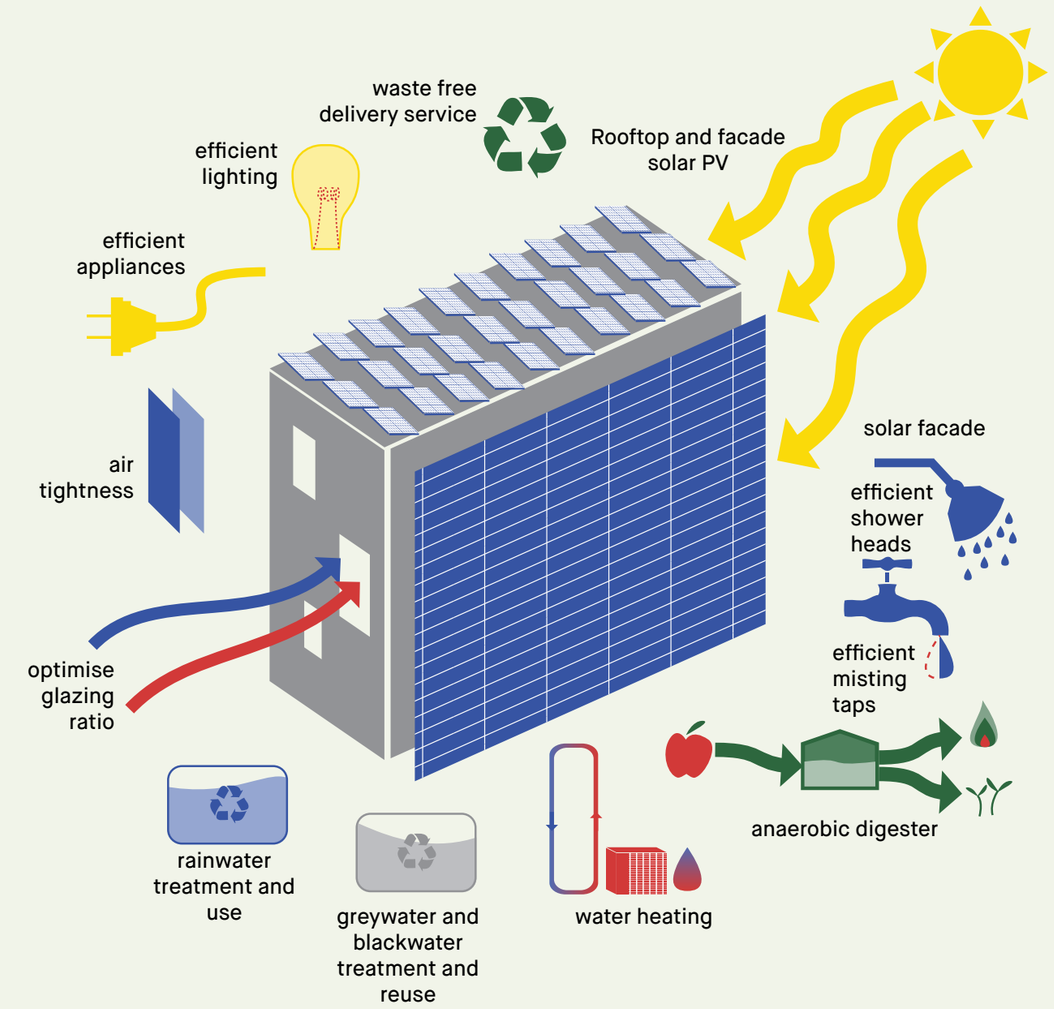


Figure 19: *New architecture must create more energy than it consumes, treat and export more water than it consumes and create no waste.*

What is the environmental impact?

New buildings produce no net increase to overall consumption, meaning population growth is accommodated without increasing the city's consumption.

How much space will it take?

New construction may require larger plant rooms to accommodate heat pumps, water treatment and organic waste to energy, as well as allowances for thicker walls.

How much will it cost?

Self-sufficient buildings typically cost under 10% more than equivalent buildings meeting current minimum compliance.

What is the return on investment?

The initiatives required for buildings to be self-sufficient typically pay themselves off within 10 years. These initiatives can often be externally financed.

construction jobs/year to 2030:
8,700

ongoing jobs:
8,700

New Architecture

An apartment building at Docklands:
Kennedy Nolan

Melbourne is a Design City and now we can use design to solve our most pressing issues. Best of all, we don't need to invent the solutions – we just need to deploy them!

We know how to take buildings off grid and have a net positive effect on our city - we only need to look to the past. On site infrastructure is efficient and operationally cost-effective - its how we did it in the past.

Solar panels as cladding operate buildings on the power of the sun. Placement of the panels give shadow, texture and depth like verandas.

Visible infrastructure animates space in much the same way as distillery equipment, exciting in scale and materiality, the forms and shapes are intriguing and dramatic and real.

Cross laminated timber construction is relatively new, but timber feels so familiar to us. This eternally renewable resource is well suited to cellular construction and so enjoyable to be near.

Less glass, more wall, articulation, texture – people want these in buildings –glazed sheaths have alienated us and are a thing of the past.

KENNEDY
NOLAN

www.kennedynolan.com.au

New Architecture

Carbon neutral construction:
Fieldwork

We have all the tried, tested and proven technologies today, to build the office building of the future.

That is a carbon neutral building in construction and operation.

The first step towards achieving this is by building with Mass timber. Products such as Cross Laminated Timber and Glulam - which are already being manufactured in in Australia - are a more sustainable alternative to concrete and steel, due to their renewability, reduced carbon impacts, and carbon sequestration. Combined with a highly efficient envelope, reduced glazing and solar shading the buildings embodied and operational energy can be reduced drastically.

The second step relates to renewables energy supply. Photovoltaics are a technology that Australians are well acquainted with. The office building of the future maximises all opportunity to integrate PV in to facade and rooftop, to power the building from the sun.

Further to the building, is the construction site itself that can reduce its environmental impact and carbon footprint. In various countries worldwide, technology has been developed to power machinery and equipment off the grid - moving away from diesel, to electric. This, along with timber prefabrication and its reduction in waste, will lead to a quieter, healthier and quicker construction site.

Finally, to spread awareness and secure the legacy of a more sustainable building practice, TAFE students and tradespersons as the practitioners to the future will be engaged and educated - through on-site education and involvement.

FIELDWORK

www.fieldworkprojects.com.au

Funding the Transition

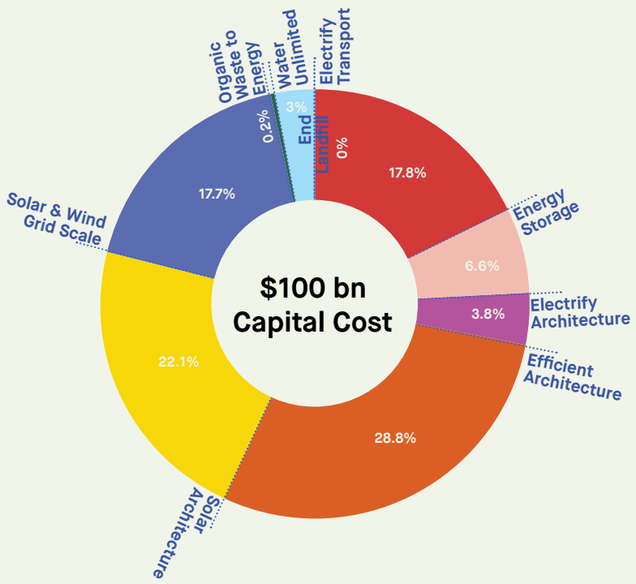
It has been estimated that the 10 initiatives will require around $100 billion in investment. But this is not simply a cost, the investment will pay for itself within 10 years, and continue to be profitable in the long term.

To put this in perspective, this is equivalent to:

- roughly 20% of Melbourne's superannuation pool[96] with an estimated return on investment significantly greater than that of average superannuation funds[97]
- per person it is similar to the cost of private health insurance or car insurance over 10 years, but as an investment, not as a cost

In total, we need to invest an average of $10 billion annually over the next 10 years. To compare to other significant investments:

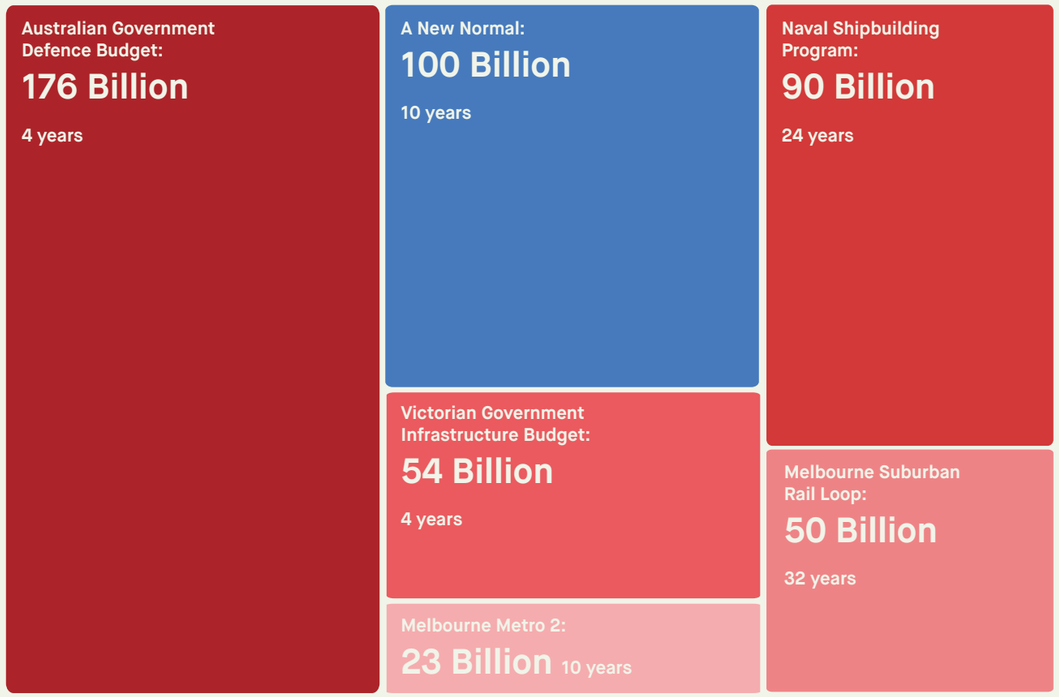
- Naval Shipbuilding Program: $90 billion investment over 24 years with no economic return
- Australian Federal Government Defense Budget: $176 billion to or an average of $44 billion annually over 4 years until 2022, with no economic return
- Melbourne Suburban Rail Loop: $50 billion over 32 years with 20,000 total jobs forecast during construction
- Melbourne Metro Tunnel: $23 billion over 10 years
- Victorian Government average annual infrastructure budget over the next 4 years: $23 billion



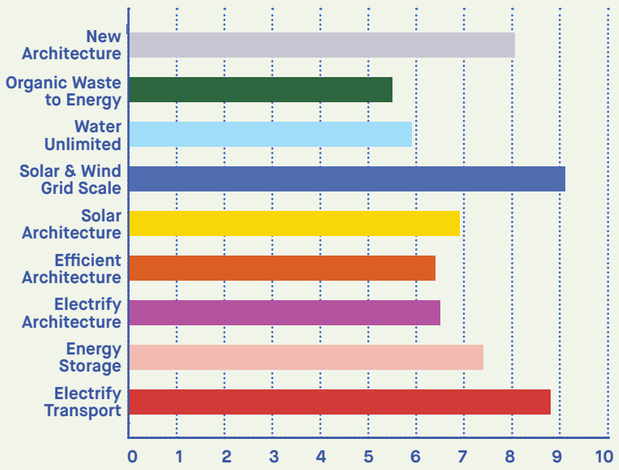
Summary

	Capital cost ($b)	Annual income ($b)	Simple payback (years)	Construction jobs/ year to 2030	Ongoing jobs
Electrify transport	17.7	2.0	8.8	11,600	1,300
Energy storage	6.6	0.9	7.4	500	
Electrify architecture	3.8	0.6	6.5	1,400	
Efficient architecture	28.7	4.5	6.4	11,000	
Solar architecture	22.0	3.2	6.9	42,500	5,900
Solar & wind grid scale	17.6	1.9	9.1	3,900	8,900
Water unlimited	3.0	0.5	5.9	1,000	
Organic waste to energy	0.2	0.04	5.4	140	270
End landfill	N/A	N/A	N/A		18,100
New architecture	N/A	N/A	N/A	8,700	8,700
Total	99.6	13.7	7.3	81,000	43,000

Comparison



Simple Payback (years)

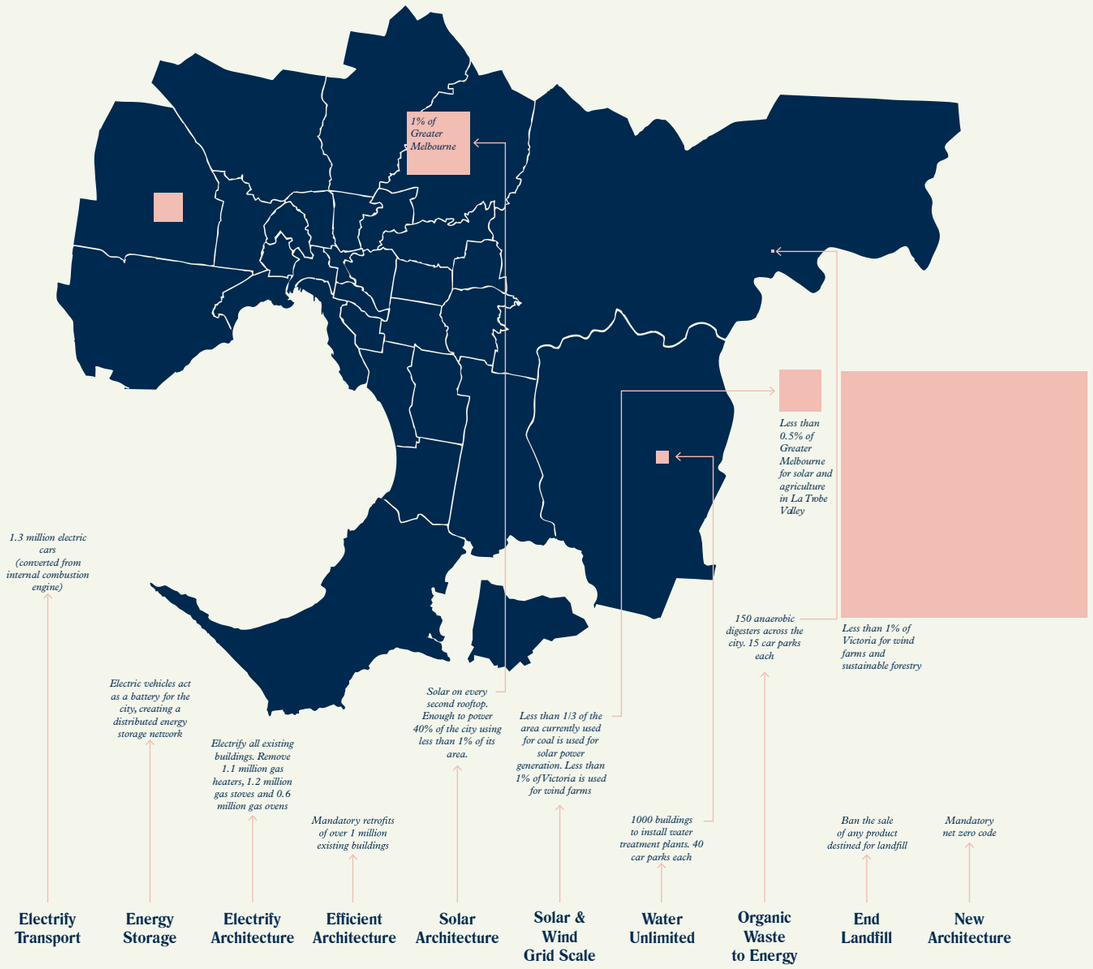


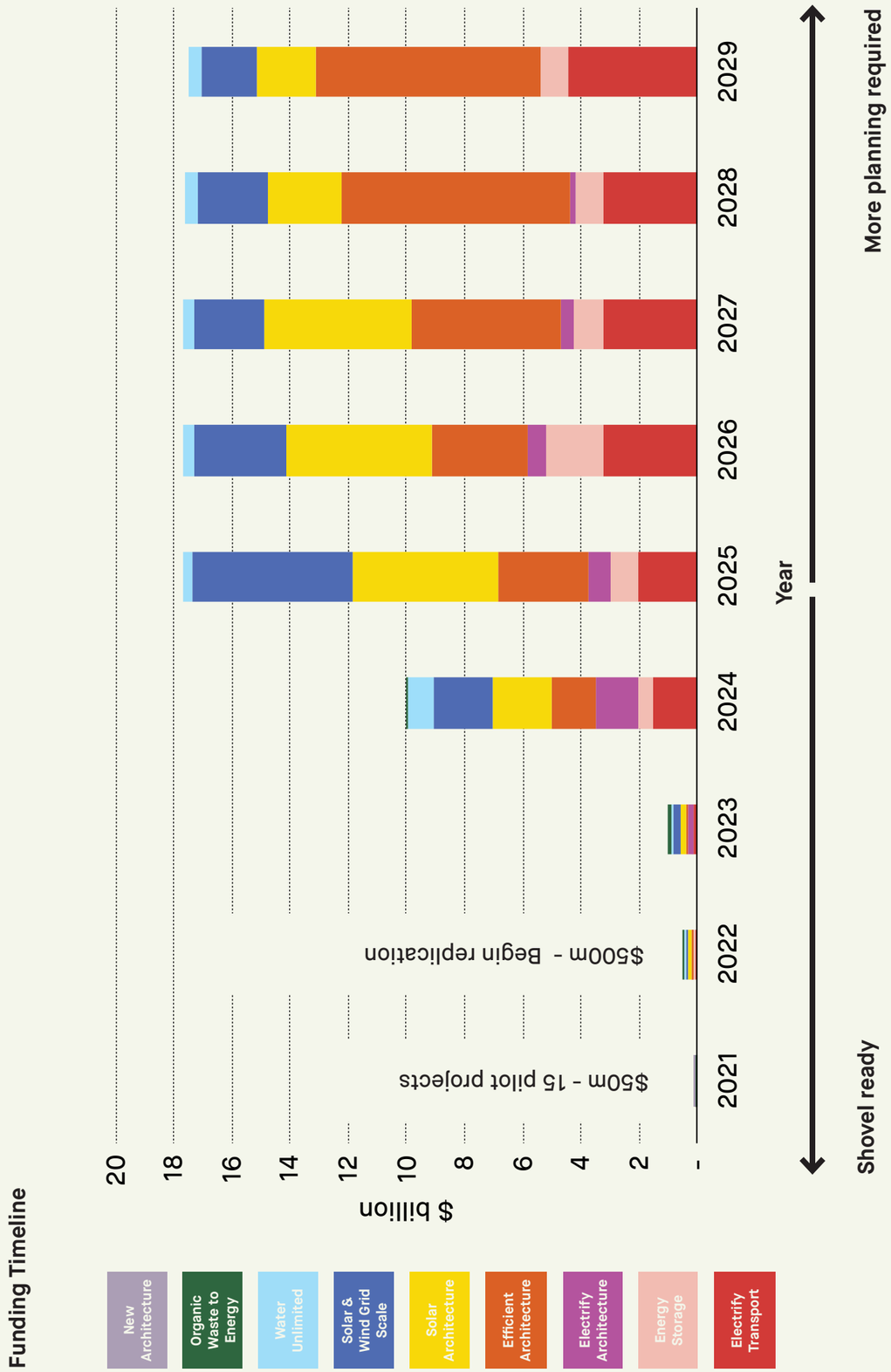
finding ínfinity

Funding the Transition

The proposed initiatives range from being shovel ready (ready to be implemented immediately) to requiring more planning and design. The funding timeline outlined has taken this into account, focusing short term investment on the initiatives that are shovel ready, and longer term investments on those that require more time to implement.

Spatial Requirements





Funding the Transition

Who will invest in the transition?

State Government can drive this transition through subsidies and initiating public private partnerships (PPPs).

Potential roles of the public sector, private sector and individuals in funding this transition for Greater Melbourne are shown in the table.

The most likely outcome is that the private sector will drive this transition both in scale of investment & in profits while providing the people of Melbourne with secure jobs.

In Copenhagen, private green investment initiatives in areas such as public transport, renewable energy, retrofitting buildings and electric vehicles to the value of €40 billion was unlocked with a Public Investment of €360 million, which equates to less than 1% of the overall cost of the transition[98].

Funding Roles

	Public Sector	Private Sector	Individuals
Electrify transport	Subsidise conversions & re-skilling of mechanics, justified through health savings	Convert workshops, train mechanics, based on profit from conversions	Pay subsidised cost for car conversions based on fuel savings
Energy storage	Mandate charging points for new development, subsidise existing car parks, justify through savings in grid scale stationary storage	Invest in charging infrastructure for large car parks	Invest in charging infrastructure for homes
Electrify architecture	Mandate no gas connection by 2030	Invest in commercial / multi residential retrofits, finance residential electrical equipment	Invest in household electrical equipment, justified through savings in gas & gas connection fees
Efficient architecture	Mandate retrofits	Invest in commercial retrofits, finance residential retrofits	Invest in residential retrofits, financed through private sector, justified through savings in bills
Solar architecture	Mandate maximum solar for new development, subsidise solar for existing buildings	Invest in commercial / industrial rooftop solar, finance residential rooftop solar	Invest in subsidised residential rooftop solar, financed through private sector, justified through savings in bills
Solar & wind grid scale	Drive investment through public private partnerships, mandate the phasing out of coal, invest in re-skilling coal labour force	Invest in solar agriculture and wind forestry	Switch to 100% renewable energy retailers, potential for individual investment
Water unlimited	Initiate investment through public private partnerships	Invest in water treatment and reuse	Demonstrate support for recycled water system, potential for individual investment
Organic waste to energy	Initiate investment through public private partnerships	Invest in organic waste to energy treatment plants	Separate & contribute organic waste, potential for individual investment
End landfill	Mandate avoidance of products destined for landfill	Invest in improving supply chains and recycling infrastructure	Embrace new alternative systems and products
New architecture	Mandate triple net-zero development	Invest in / finance triple net-zero development	Invest in triple net-zero property (personal and through REITs)

Jobs

Investing in the transition over the next 10 years will provide an enormous amount of stimulus to employment, which will be integral in the economic wellbeing of Melbourne as the city recovers from COVID-19 while also contending with the ongoing climate crisis. It is estimated to provide an average of 81,000 jobs in construction & installation annually until 2030. After this has completed it will result in an estimated 43,000 ongoing jobs.

01 Electrify Transport

× 11,600 × 1,300

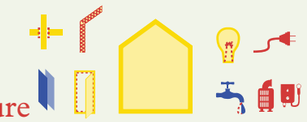
02 Energy Storage

× 500

03 Electrify Architecture

× 1,400

04 Efficient Architecture



× 11,000

05 Solar Architecture

× 42,500 × 5,900

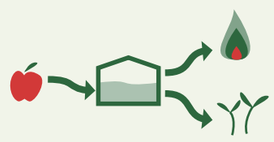
06 Solar & Wind Grid Scale

× 3,900 × 8,900

07 Water Unlimited

× 1,000

08 Waste to Energy



× 140 × 270

09 End Landfill

× 18,100

10 New Architecture

× 8,700 × 8,700

Provides over 81,000 Annual construction jobs to 2030

Provides over 43,000 ongoing jobs

Getting Started

Targeting sustainable job creation in industry post COVID-19, while addressing the existential threat of climate change and attempting to create a sense of optimism for economic recovery, A New Normal has identified an opportunity to get started rapidly.

To create as many jobs as possible, each initiative was compared and prioritised into three tiers based on the following criteria:

- Construction jobs
- Ongoing jobs
- Technology maturity and readiness for rapid roll out
- Profitability

Tier 1 initiatives were classed as those that had the strongest performance in all four areas, these are as follows:

- Solar Architecture
- Electrify Transport
- Organic Waste to Energy
- Solar Agriculture
- Wind Forestry

Using only Tier 1 initiatives, four potential "Year 1" scenarios to kick start the process were analysed further in terms of their potential benefits.

The scenarios investigated are as follows:

- Option 1 - $100 million
- Option 2 - $500 million
- Option 3 - $1 billion
- Option 4 - $10 billion

The objective is utilise the minimum government spend possible in order to kick start or boost a number of industries with long term potential in terms of profit and jobs.

"A New Normal" could be positioned as a Public Private Partnership utilising the stimulus funds to help initiate the PPP.

Tier 1 Initiatives:

- **Solar architecture:** begin installing solar PV systems on rooftops. It is the strongest jobs performer, & most shovel ready.
- **Electrify transport:** build an initial car conversion facility for training purposes and begin funding the conversion of vehicles to electric.
- **Organic waste to energy:** build an initial pilot anaerobic digester consuming all food waste from a single municipality, then rolling out anaerobic digesters to all municipalities in Greater Melbourne
- **Solar agriculture:** directly fund a solar PV and agriculture project in the LaTrobe Valley, potentially at a defunct coal facility such as Hazelwood.
- **Wind forestry:** fund the purchase and conversion of under utilised land for wind energy and forestry combined.

Tier 2 Initiatives:

- **New architecture:** bridge financing net-positive developments.
- **Efficient architecture:** funding or financing retrofits of existing buildings for energy and water efficiency.
- **Electrify architecture:** residential electrification scheme, heat pumps rolled out for space heating and water heating, and electric appliances for cooking.
- **Water unlimited:** work with Melbourne Water to identify optimal locations and options for integration of water treatment plants into the water system within the city
- **Energy storage:** invest in Virtual Power Plant style systems to control vehicle owners' batteries, while creating an incentive program for existing EV owners to install vehicle to grid chargers.

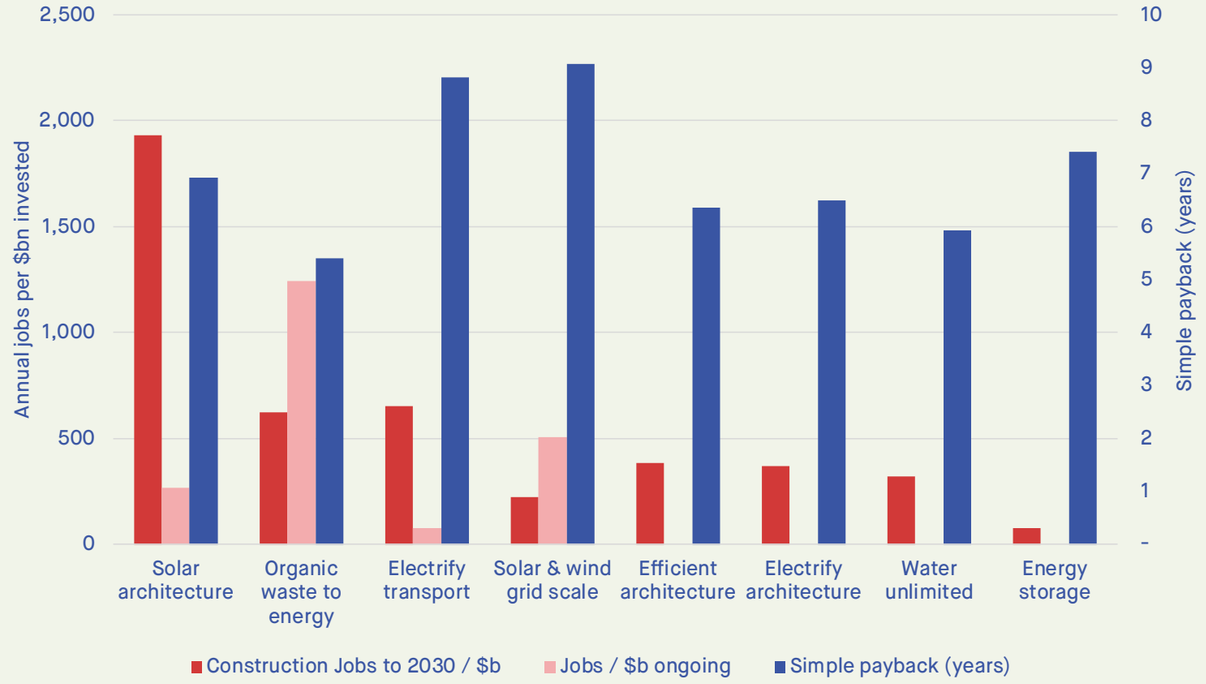


Figure 20: *the order of priority for each initiative in relation to job creation. Construction jobs are annual to 2030 assuming the investment is consistent over the ten years.*

	Initiatives prioritised by job creation	Total cost ($bn)	Payback (years)	Construction job years / $b investment	Ongoing jobs / $b investment
Tier 1	Solar Architecture	22.0	6.9	19,333	267
	Electrify Transport (car conversions)	17.7	8.8	6,541	74
	Organic Waste to Energy	0.2	5.4	6,207	1,241
	Solar Agriculture	9.4	14.2	3,311	212
	Wind Forestry	8.2	6.4	1,242	733
Tier 2	New Architecture - operations	-	-	6,662	666
	Efficient Architecture	28.7	6.4	3,820	-
	Electrify Architecture	3.8	6.5	3,695	-
	Water Unlimited	3.0	5.9	3,223	-
	Energy Storage	6.6	7.4	769	-
Tier 3	Middle Ring	N/A	N/A	N/A	N/A
	End Landfill	N/A	N/A	N/A	N/A
	Electrify Transport (electric train)	N/A	N/A	N/A	N/A
	New Architecture - construction	N/A	N/A	N/A	N/A

Getting Started

Using only tier 1 initiatives, four alternative stimulus / investment scenarios were analysed and the results are demonstrated below.

$100 million
Construction job years: 1,000
Ongoing jobs: 40
Waste avoided: 17.5 kt
Carbon avoided: 97.3 kt
Payback: 8.1 years

$500 million
Construction job years: 4,960
Ongoing jobs: 300
Waste avoided: 312 kt
Carbon avoided: 615 kt
Payback: 7.4 years

$1 billion
Construction job years: 9,300
Ongoing jobs: 540
Waste avoided: 550 kt
Carbon avoided: 1,105 kt
Payback: 7.5 years

$10 billion
Construction job years: 96,100
Ongoing jobs: 4,000
Waste avoided: 550 kt
Carbon avoided: 10,050 kt
Payback: 7.8 years

Initiative	CAPEX ($m)	% of total spend	Construction job years	Ongoing jobs	Result
Option 1	100	0.1%	1,000	40	
Solar Architecture	40	0.18%	770	11	Roll out solar to 0.09% of Melbourne's roof tops
Electrify Transport	15	0.08%	100	1	Build initial facility & pay for conversion of ~1,000 cars
Organic Waste to Energy	7	3%	40	9	Roll out the first of 31 municipality scale digesters
Solar Agriculture*	15	0.16%	50	3	8MW of PV & begin agriculture, 0.16 km2 area
Wind Forestry*	23	0.26%	30	17	Build 4 x 3MW wind turbines, begin forestry planting, 36 km2 area
Option 2	500	0.5%	4,960	300	
Solar Architecture	175	0.80%	3,400	47	Roll out solar to 0.4% of Melbourne's roof tops
Electrify Transport	75	0.42%	500	6	Build initial facility & pay for conversion of ~5,400 cars
Organic Waste to Energy	125	57%	780	155	Roll out 18 (of 31) municipality scale digesters
Solar Agriculture*	50	0.53%	170	11	27MW of PV & begin agriculture, 0.53 km2 area
Wind Forestry*	75	0.91%	140	84	Build 13 x 3MW wind turbines, begin forestry planting, 117 km2 area
Option 3	1,000	1%	9,300	540	
Solar Architecture	330	1.5%	6,400	88	Roll out solar to 0.75% of Melbourne's roof tops
Electrify Transport	150	0.85%	1000	11	Build initial facility & pay for conversion of ~11,000 cars
Organic Waste to Energy	220	100%	1,400	270	Roll out all 31 municipality scale digesters
Solar Agriculture*	100	1.1%	330	21	54MW of PV a& begin agriculture, 1.06 km2 area
Wind Forestry*	200	2.4%	250	150	Build 35 x 3MW wind turbines, begin forestry planting, 315 km2 area
Option 4	10,000	10%	96,100	4,000	
Solar Architecture	4,000	18%	77,000	1,070	Roll out solar to 9% of Melbourne's roof tops
Electrify Transport	1,500	8.5%	10,000	110	Build initial facility & pay for conversion of ~111,000 cars
Organic Waste to Energy	220	100%	1,400	270	Roll out all 31 municipality scale digesters
Solar Agriculture*	1,100	12%	3,600	230	600MW of PV & begin agriculture, 11.8 km2 area
Wind Forestry*	3,180	39%	3,900	2,330	Build 560 x 3MW wind turbines, begin forestry planting, 5,040 km2 area

*CAPEX estimates only include wind & solar PV, no CAPEX estimated for forestry and agriculture

Public Engagement

This is a lot to change, in a relatively short period of time. Rapid change on this scale has happened many times before but humans instinctively don't like change all that much. History has proved that change can benefit us, even if we are reluctant towards it.

So how can we accelerate this transition?

Technology & Culture

We make this change easy on ourselves by connecting each of these solutions with cultural activities. We give the technology that makes our cities work a feeling. Rather than hiding it away, we allow people to be emotionally connected to our infrastructure.

A New Normal

A New Normal is a 5-step process designed to familiarise the public with the transformation while informing politicians with public support and enabling businesses to provide the solutions.

1. Workshop it;
2. Communicate it;
3. Prototype it;
4. Build it; and
5. Replicate it.

Workshop

It kicks off with a workshop in the most influential cultural institution in the city - the National Gallery of Victoria. The workshop will occur in 2020.

Influential minds across a wide range of industries will come together to redesign the infrastructure of the city in one day. It's a thought-provoking workshop that shows a number of already existing solutions from around the globe, and asks the question: *why not implement them all here?*

Communications

The results of the workshop will form the basis for a virtual reality & augmented reality tour of Melbourne.

Instead of being forced to tell our politicians what we don't want through protest, this creates an opportunity to work together with our politicians and technology to create engaging cultural activities showing what we do want, through virtual prototypes.

Each combination of technology and culture selected by the people will form a virtual prototype. We will collect data from this immersive VR & AR process and provide it to our political leaders to give the public a voice. Successful concepts that are well received by the public will move through to the prototyping phas.e

Prototypes

As public support for the virtual prototypes gains momentum, we move beyond virtual reality and build 10 small scale physical prototypes across the city. We measure attendance and sentiment to determine the success of each proto-test.

The prototypes enable us all to touch and feel them, discuss them, engage with them, interact with them, and provide our feedback. These examples are aimed at matching essential technology for the future of our cities with cultural activities. These prototypes are only temporary to engage with people and test the cultural connections. Once again, we collect data from that process and provide it to our political leaders to give the public a voice. Examples of potential prototypes can be seen in Appendix B.

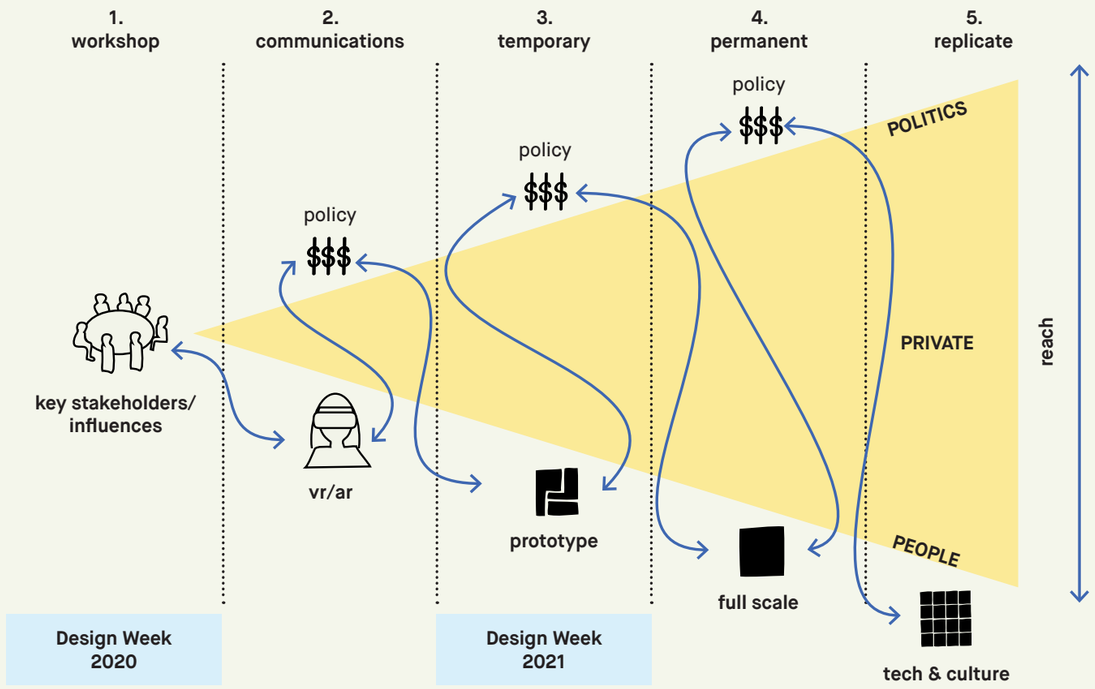
Full Scale

If the prototypes are successful we build them at full scale. 10 full scale permanent projects will be built in this phase across the city. These will be economically feasible, and sustain their own operations.

With the vast reduction of cars in the streets, there is an incredible opportunity to use this space for public infrastructure, and the public engagement process integrated into the prototyping phase enables funds to be locally sourced – empowering the people to own their own infrastructure.

Replication

The process of prototyping and building full scale versions of each initiative throughout the city will allow us to identify and overcome all the barriers for their wider implementation. The full-scale models will also act as financial and technical case studies proving the feasibility and helping to secure investment. Once we have built a full-scale version of each, we simply replicate them throughout the city until self-sufficiency is achieved.



Conclusion

The question was asked: if Melbourne implemented every single profitable initiative over the next decade, targeting the environmental and financial threshold, how far could we get?

The answer; we can transform Melbourne to operate on resources that will never run out — and profit from the transition. It is possible.

By 2030 Melbourne can be an electrical city powered entirely by renewables. The LaTrobe Valley can become a renewable energy and agriculture hub. Our air will be cleaner, resulting in improvements in public health and quality of rainwater collected from rooftops. Our buildings will be more comfortable, and healthier, with better indoor environmental quality. Our water system can be an endless loop, with natural flows being returned to groundwater and waterways, which are no longer polluted by stormwater runoff from roads trafficked by fossil fuel burning cars. Our organic waste can give us energy which can be used to treat water and export to the electrical grid, as well as heat public demands such as pools. Additionally, our organic waste can also provide fertiliser to be used to grow food within the city and to stimulate agriculture and soil rehabilitation in the LaTrobe Valley. Our city can avoid sending any waste to landfill, instead benefiting from the reuse and recycling of materials in a circular manner.

Greater Melbourne will be more resilient to resource depletion, changing rainfall patterns due to climate change and more extreme temperatures.

But this utopian scenario also has economic benefits – it will be earning $14 billion annually compared to a business as usual scenario and providing much needed jobs – 81,000 during construction and 43,000 in ongoing operations – as Melbourne recovers from the impacts of COVID-19. Melbourne is uniquely placed to lead this transition, and become an example for other cities in the world to follow. It can then export its knowledge and experience to the rest of the world as other cities transition. Experts from around the world will visit Melbourne to learn about the process, and other cities will invite experts from Melbourne to visit and help implement the solutions there. Universities can participate and apply their expertise, positioning themselves as world leaders attracting a wider range of students from around the world.

This future will benefit us all. Let's get started. Not tomorrow. Today.

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It’s not over, this is just the beginning.

This document is not intended to be final. We have compiled the best argument we could for this transition. But this document will be and must be challenged. By technical experts. By financial experts. By political experts. By legal experts. By cultural experts. But most importantly, it can never be perfect without the feedback of the people of Melbourne. We would like as much feedback as possible to be able to improve the approach moving forwards and to be able to demonstrate to State Government the public response. Positive or negative, we would like to receive your feedback. But please do try to be constructive. We’re all in this together. Let us know your thoughts.

www.normalise.it

Contact us -
hello@findinginfinity.com