Exploratory study to quantify costs of climate adaptation investments in Greater Melbourne

24 June 2021

Building a better working world

Disclaimer

Ernst & Young ("Consultant") was engaged on the instructions of The Eastern Alliance for Greenhouse Action ("Client") to explore and quantify the costs of climate adaptation ("Project"), in accordance with the consulting services agreement dated 28/10/2020 ("the Engagement Agreement").

The results of the Consultant's work, including the assumptions and qualifications made in preparing the report, are set out in the Consultant's report dated 21/05/2021 ("Report"). You should read the Report in its entirety including the disclaimers and attachments. A reference to the Report includes any part of the Report. No further work has been undertaken by the Consultant since the date of the Report to update it.

Unless otherwise agreed in writing with the Consultant and notwithstanding that the recipient may be a member company or association of the Client, the recipient's access to the Report is made only on the following basis and in either accessing the Report or obtaining a copy of the Report the recipient agrees to the following terms.

1. Subject to the provisions of this notice, the Report has been prepared for the Client and may not be disclosed to any other party or used by any other party or relied upon by any other party without the prior written consent of the Consultant.

2. The Consultant disclaims all liability in relation to any other party who seeks to rely upon the Report or any of its contents.

3. The Consultant has acted in accordance with the instructions of the Client in conducting its work and preparing the Report, and, in doing so, has prepared the Report for the benefit of the Client, and has considered only the interests of the Client. The Consultant has not been engaged to act, and has not acted, as advisor to any other party. Accordingly, the Consultant makes no representations as to the appropriateness, accuracy or completeness of the Report for any other party's purposes.

4. No reliance may be placed upon the Report or any of its contents by any recipient of the Report for any purpose and any party receiving a copy of the Report must make and rely on their own enquiries in relation to the issues to which the Report relates, the contents of the Report and all matters arising from or relating to or in any way connected with the Report or its contents.

5. The Report is confidential and must be maintained in the strictest confidence and must not be disclosed to any party for any purpose without the prior written consent of the Consultant.

6. No duty of care is owed by the Consultant to any recipient of the Report in respect of any use that the recipient may make of the Report.

7. The Consultant disclaims all liability, and takes no responsibility, for any document issued by any other party in connection with the Project.

8. No claim or demand or any actions or proceedings may be brought against the Consultant arising from or connected with the contents of the Report or the provision of the Report to any recipient. The Consultant will be released and forever discharged from any such claims, demands, actions or proceedings.

9. To the fullest extent permitted by law, the recipient of the Report shall be liable for all claims, demands, actions, proceedings, costs, expenses, loss, damage and liability made against or brought against or incurred by the Consultant arising from or connected with the Report, the contents of the Report or the provision of the Report to the recipient.

10. In the event that a recipient wishes to rely upon the Report that party must inform the Consultant and, if the Consultant so agrees, sign and return to the Consultant a standard form of the Consultant's reliance letter. A copy of the reliance letter can be obtained from the Consultant. The recipient's reliance upon the Report will be governed by the terms of that reliance letter.

Table of contents

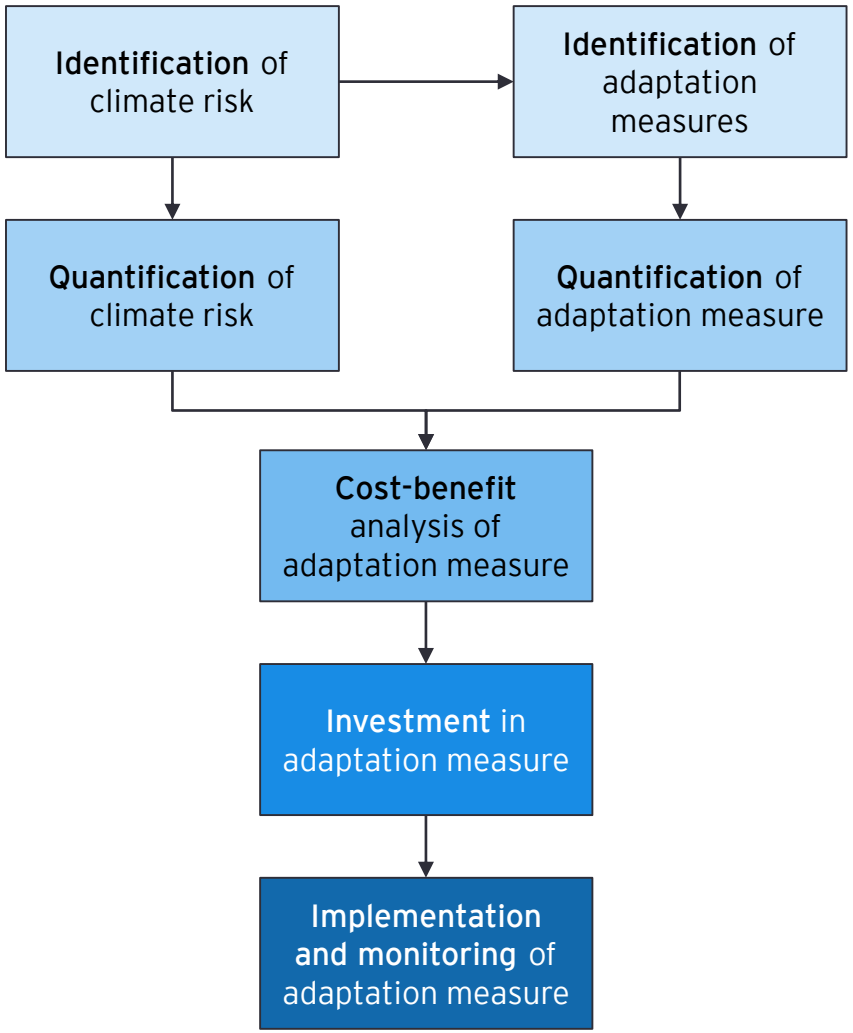
Acknowledgement

Melbourne's Climate Journey is a community led project supporting Greater Melbourne communities to adapt to a changing climate, supported by the Department of Environment, Land, Water and Planning (DELWP) and funded through the *Supporting Our Regions to Adapt* program.

1 Introduction

Project drivers

- Investment in adaptation is necessary to preserve our quality of life and to continue our societal and economic growth.
- Determining the level of adaptation investment required is complex and requires access to a significant evidence base.
- Multiple steps are required to develop this evidence base, including identification of [1]:
  - Climate impacts;
  - Benefits of adaptation; and
  - The counterfactual (i.e. the impact of failing to adapt to the climate risk).



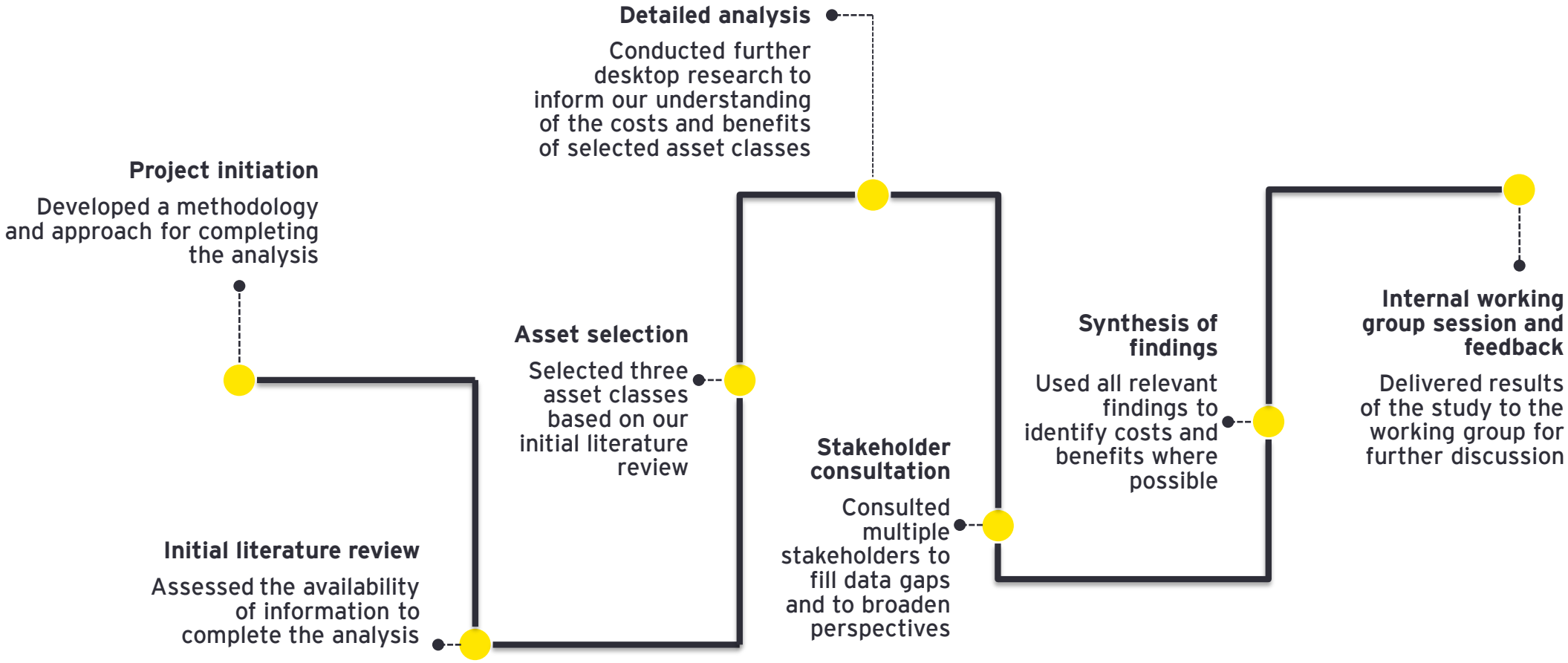
[1] Note: All values given in 2020 dollars unless otherwise stated.

Report scope and objectives

- The scope of this work covered the Greater Melbourne region and considered a range of climate hazards (e.g. flooding and heatwaves) and asset classes (e.g. buildings and electricity networks).
- The objectives were to:

Report methodology

- Report content was prepared in the following stages:



Initial literature review

Findings from initial literature review

- In the initial literature review, a high-level analysis of the availability and quality of information relating to seven asset classes was conducted:

	Assessment metrics			
Asset class	Climate impacts	Cost of climate impacts	Adaptation measures	Cost of adaptation measures
Energy	H	M	H	M
Building	H	M	H	M
Green infrastructure	H	M	H	M
Road	M	M	L	L
Rail	H	M	M	M
Shipping and ports	H	M	M	L
Water	H	M	H	M

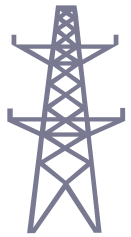
H — Available information can be used to conclude on the assessment metric in the Greater Melbourne region

M — Additional assumptions required to supplement available information to conclude on the assessment metric in the Greater Melbourne region

L — Further work required to develop data to conclude on the assessment metric in the Greater Melbourne region

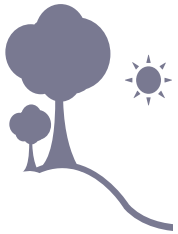
Selection and scoping of asset classes for detailed analysis

- Based on the findings from the initial literature review, and in consultation with the Regional Adaptation Strategy Stakeholder Committee, the scope of the study was narrowed to the asset classes with highest quality data and information:



Electricity sector

Electricity transmission and distribution infrastructure servicing the Greater Melbourne region



Urban forests

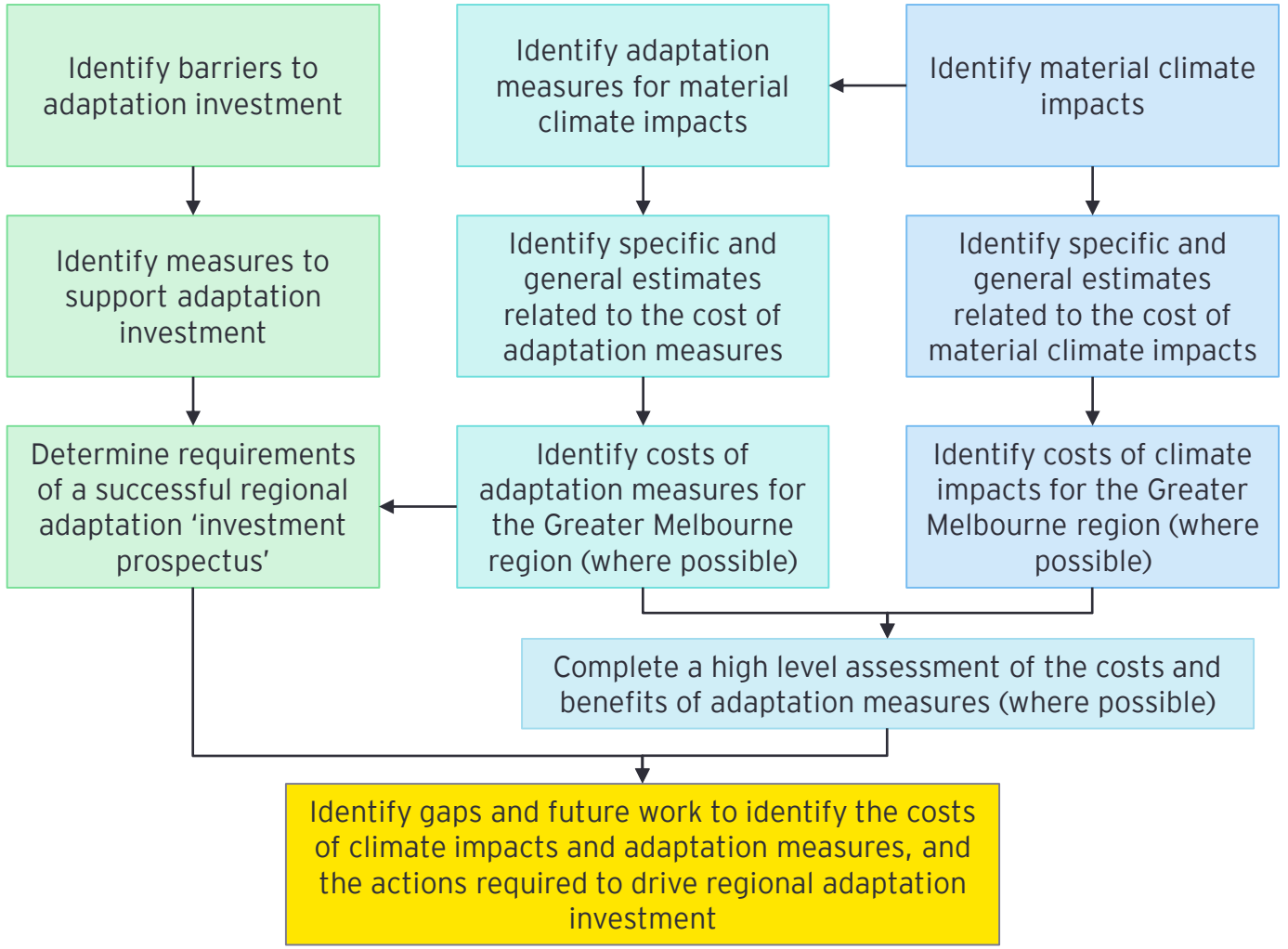
Trees, vegetation and ecosystem components (e.g. soil and water) located in or near urban environments within the Greater Melbourne region

Building sector

Privately and publicly owned residential, commercial and industrial buildings within the Greater Melbourne Region

Detailed analysis methodology

- The work was intended to identify the costs and benefits where possible, and to identify gaps where further work needs to be done or additional data was required.
- The detailed analysis methodology and workflow was developed to achieve this.



3 Adaptation investment

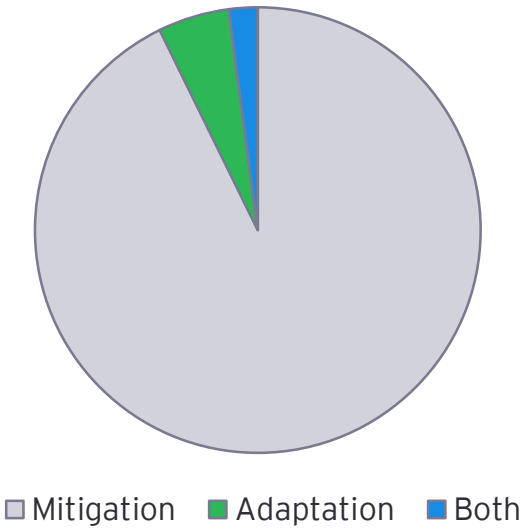
Barriers to adaptation investment

- US$40b of global climate finance in 2017-2018 was directed toward adaptation projects – four to ten times less than the estimated adaptation costs by 2030.[1]
- A number of barriers to adaptation investment currently exist which drive this adaptation investment gap:

Barriers to adaptation investment

- Limited availability of information of climate change/adaptation
- Adaptation investments can fall outside of the scope of private investors
- Regulatory landscape does not support adaptation investment
- Adaptation projects do not fit traditional cost-benefit models
- Disconnect between investor in adaptation investment and beneficiary
- Adaptation requires long-term planning consideration

2017-2018 Global Climate Finance Flows (US$b)[1]



[1]Daniel Puig et al., *The Adaptation Finance Gap Report*. United Nations Environment Programme, 2016. https://unepdtu.org/publications/the-adaptation-finance-gap-report/.

Supporting adaptation investment

- Due to these significant gaps, there is an increasing focus on the work needed to support adaptation investment:

Climate-KIC Australia[1]	UN Development Programme[2]	Investor Group on Climate Change[3]	Stakeholder consultations
Bring public and private stakeholders together	Implement stakeholder capacity building	Blend mitigation and adaptation to increase returns	Consider through lens of risk management, not cost benefit
Adopt systematic adaptation approach (e.g. at regional level)	Assess climate risks and identify adaptation measures	Develop models to accurately assess adaptation outcomes	Utilise blended public and private ownership models
Incorporate systemic approach into regular financial practices	Develop an adaptation project pipeline	Increase collaboration to drive funding and implementation	Ensure company directors are aware of climate risk responsibilities

[1]Genevieve Mortimer et al., *Adaptation Finance: Emerging approaches to solve the climate adaptation finance gap*. Climate-KIC Australia, 2020. https://climate-kic.org.au/wp-content/uploads/2020/11/Adaptation-Finance_300ppi.pdf.

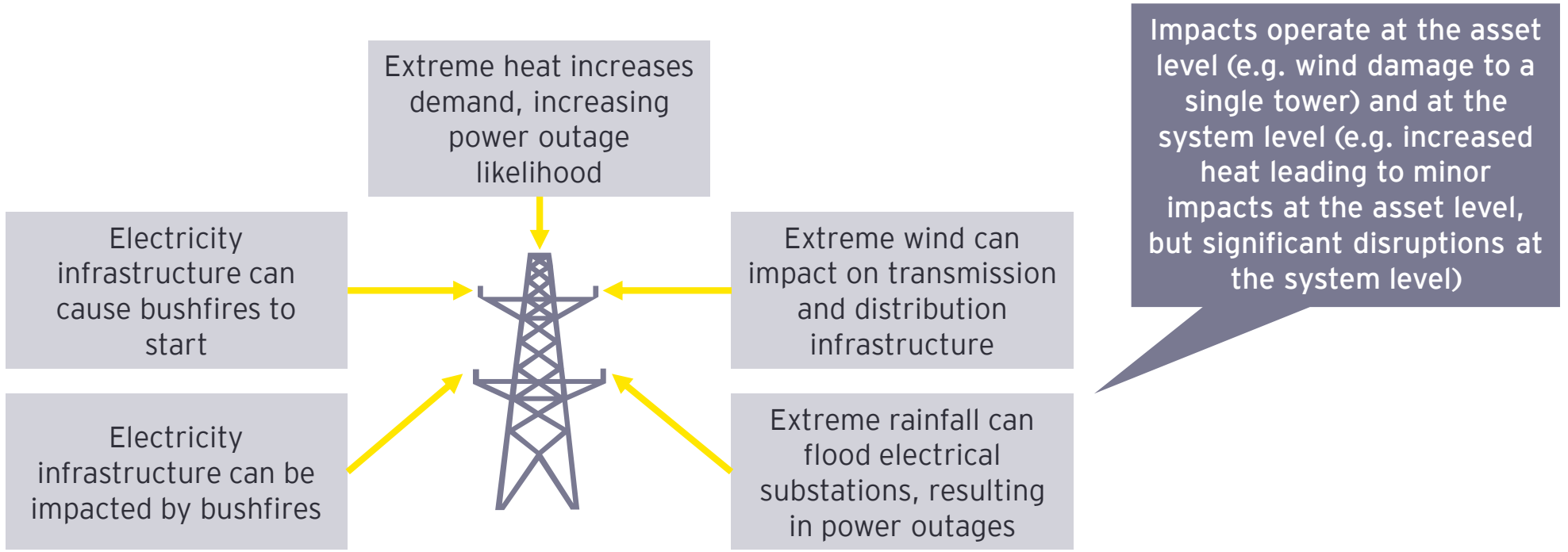
[2]"Engaging the Private Sector," United Nations Environment Programme, 2018, https://www.adaptation-undp.org/privatesector/.

[3]Zsuzsa Banhalmi-Zakar and David Rissik, *From Risk to Return: Investing in Climate Change Adaptation*. Investor Group on Climate Change, 2020. https://igcc.org.au/wp-content/uploads/2020/06/Adaptation_FINAL.pdf.

4 Electricity sector

Electricity sector – climate impacts

- The two most significant climate-related impacts for electricity transmission and distribution infrastructure servicing the Greater Melbourne region are related to bushfires and extreme weather events.
- The cost of damage to this infrastructure is ultimately borne by the consumer, in addition to other impacts (e.g. increased mortality, impacts to the economy).



Electricity sector – cost of climate impacts

- To estimate the costs of climate impacts, the results of a US study have been leveraged which estimated a 25% annual expenditure increase under the worst climate scenario by 2090.[1]
- In Victoria, this would equate to an increase in annual transmission and distribution costs by 2090 of $2 billion.

$7b

in annual transmission and distribution costs in Victoria by 2090 without climate change[2]

Impact of climate change

$9b

in annual transmission and distribution costs in Victoria by 2090 under RCP8.5

[1]Charles Fant et al., "Climate change impacts and costs to U.S. electricity transmission and distribution infrastructure," *Energy* 195 (2020): https://doi.org/10.1016/j.energy.2020.116899.

[2]Based on current Australian Energy Regulator transmission and distribution determinations in Victoria, and assumed growth in capital and operating expenditure over time.

Electricity sector – cost of climate adaptation

- The US study estimated a 50% reduction in costs under a 'Proactive' adaptation strategy:
  - Increasing transformer capacity
  - Reinforcing wood poles with steel or concrete
  - Upgrading powerline capacity
  - Building protective sea walls
  - Ongoing vegetation management supported by advances in outage prediction[1]
- In Victoria, this would equate to savings of $1 billion annually by 2090 compared to a scenario with no adaptation.

$9b

in annual transmission and distribution costs in Victoria by 2090 under RCP8.5

$8b

in annual transmission and distribution costs in Victoria by 2090 under RCP8.5

[1]Charles Fant et al., "Climate change impacts and costs to U.S. electricity transmission and distribution infrastructure," *Energy* 195 (2020): https://doi.org/10.1016/j.energy.2020.116899.

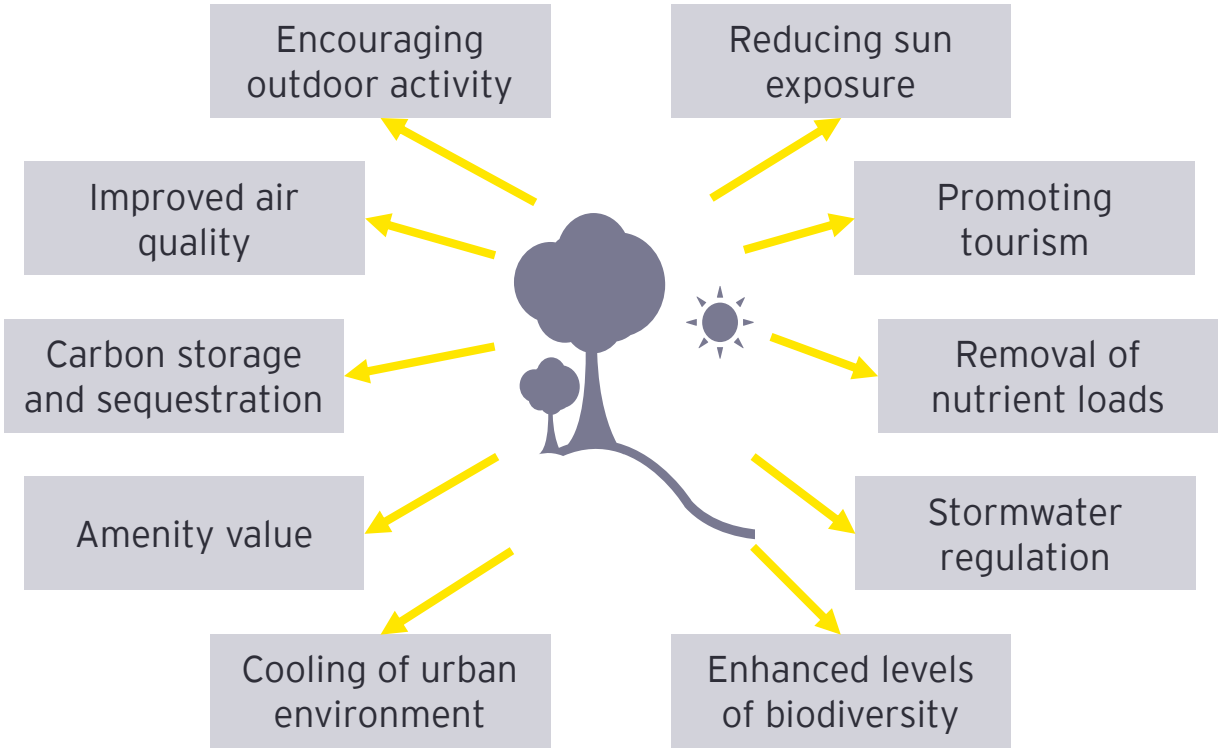
Electricity sector – overall findings

- There is a solid understanding of potential climate impacts to the transmission and distribution network, however quantification of these impacts at a local level is still limited.
- A failure to adequately adapt this infrastructure presents a serious risk.
- Additional work is required to:
  - Develop the data and modelling needed to quantify the climate impacts to the transmission and distribution infrastructure servicing Greater Melbourne;
  - Assess the cost and benefits of relevant adaptation measures; and
  - Identify a system-wide implementation approach.

5 Urban forest

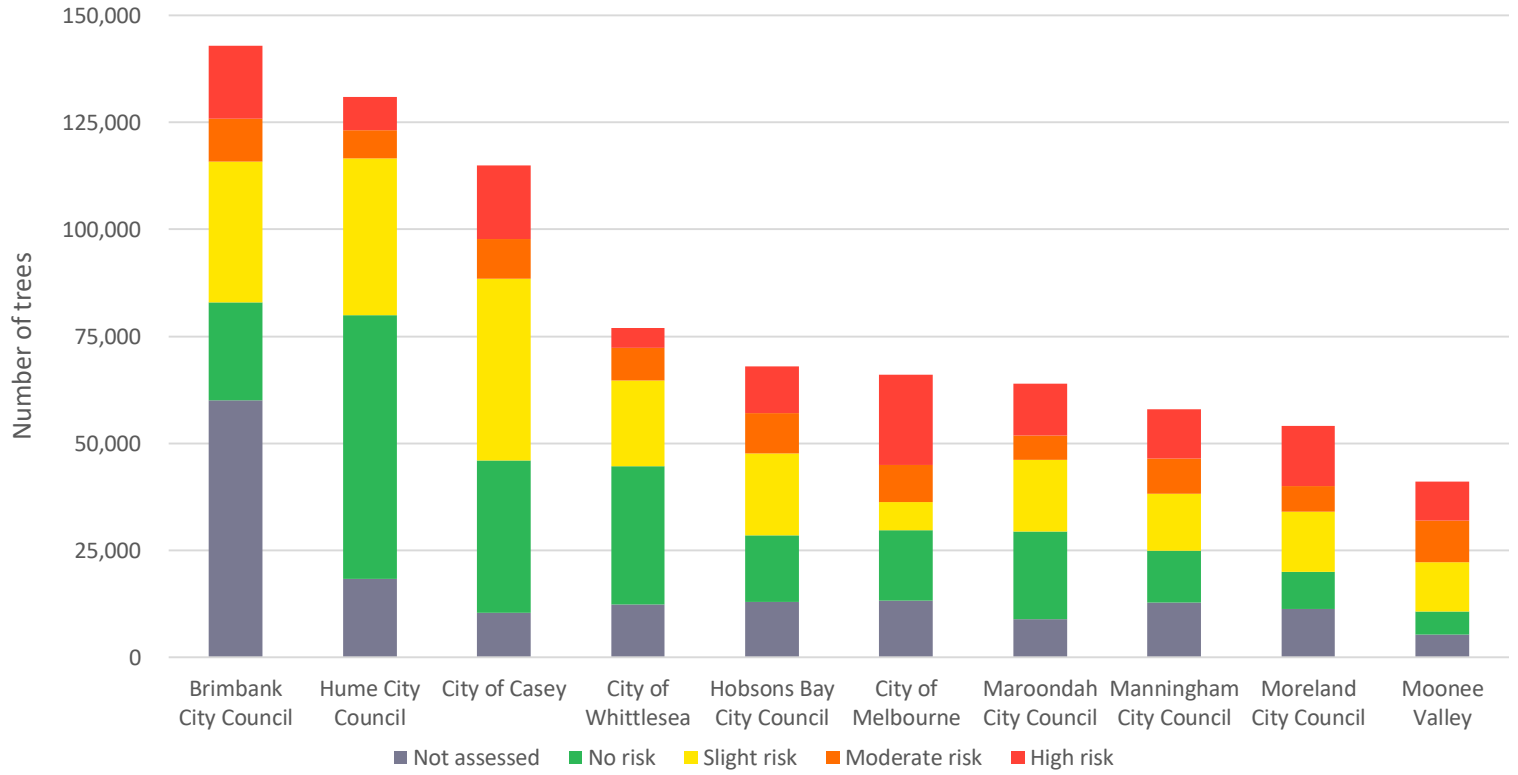
Urban forest – climate impacts

- To understand the potential effects of climate change on the urban forest, the benefits that this asset provides must be understood:



Urban forest – climate impacts

- The National Environmental Science Programme assessed the risks from increasing temperatures to Australia's urban forest from climate change in the business as usual emissions scenario (IPCC RCP8.5) by 2070:



[1]Dave Kendal et al., *Risks to Australia's urban forest from climate change and urban heat*. Clean Air and Urban Landscapes Hub, 2017. https://nespurban.edu.au/wp-content/uploads/2018/11/CAULRR07_RisksAustralianUrbanForest_Oct2017.pdf.

Urban forest – cost of climate impacts

- A benefit value of approximately $30 per tree annually has been estimated for the following services based on the City of Melbourne's Urban Forest Strategy:[1]
  - Removal of air pollution
  - Storage of carbon
  - Sequestration of carbon
  - Reduction in energy costs
  - Avoided carbon emissions through reduced energy use

$23m

in annual benefits delivered by council-managed trees in Greater Melbourne without climate change

Impact of climate change on benefits

$20m

in annual benefits delivered by council-managed trees in Greater Melbourne by 2070 due to loss of trees under RCP8.5

[1]City of Melbourne, *Urban Forest Strategy: Making a Great City Greener 2012–2032*. 2012. https://www.melbourne.vic.gov.au/SiteCollectionDocuments/urban-forest-strategy.pdf.

Urban forest – cost of adaptation measures

- Resilient Melbourne proposed targets to increase tree canopy cover from between 4% and 25% to between 20% and 30% by 2050.[1] It was estimated to cost $750 million in purchasing, installation and maintenance over 30 years for these targets to be achieved.[2]
- Based on this level of investment and the modelled tree loss due to climate change, the investment required to preserve the existing urban forest has been estimated at approximately $90 million over 30 years.

$90m

total investment in purchasing, installation and maintenance to maintain benefits delivered by council-managed trees in Greater Melbourne by 2070 under RCP8.5

[1]The Nature Conservancy and Resilient Melbourne, *Living Melbourne: Our Metropolitan Urban Forest*. 2019. https://resilientmelbourne.com.au/wp-content/uploads/2019/05/LivingMelbourne_Strategy_online.pdf.

[2]Marsden Jacob, *Living Melbourne: our metropolitan urban forest - Funding options*. 2019.

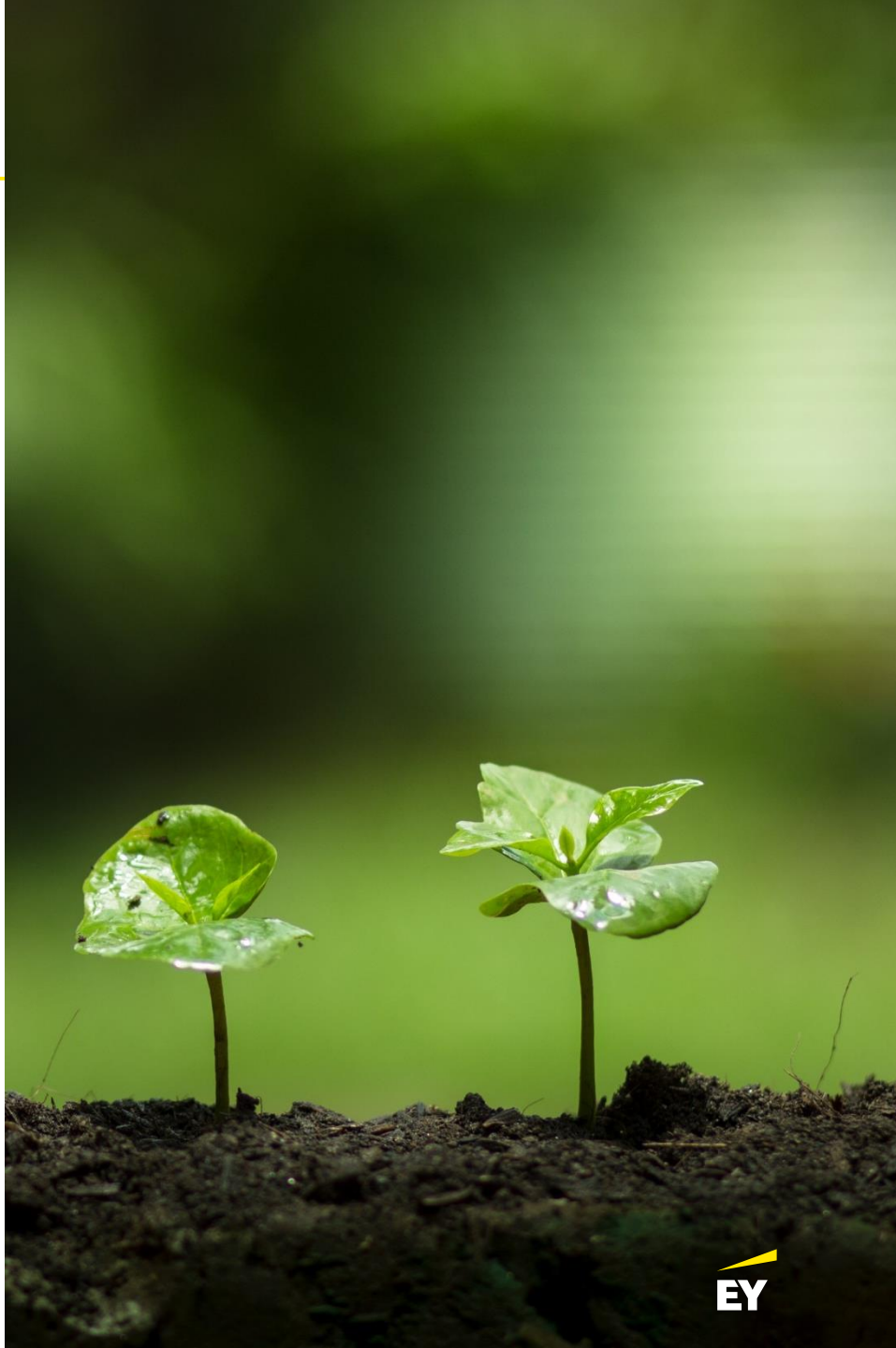
Urban forest – ongoing work

- Developing a better understanding of the range of economic benefits of Melbourne's urban forest will allow for more accurate estimations of climate impacts, which can then guide adaptation investment decisions.
- DELWP is developing an Urban Environmental-Economic Account for Melbourne which will allow for an accurate and wholistic valuation of the benefits delivered by the urban forest in Melbourne.
- As an example of how this may be used to inform policy changes, DELWP estimated the value of the additional cooling effect from enhanced Melbourne green infrastructure in 2051 based on amendments to Victorian planning policy of between $0.5 and 1.1 billion per year (excluding the impact of climate change). This considered:
  - Avoided productivity losses ($360m to $845m annually)
  - Avoided mortality costs ($170m to $240m annually)
  - Avoided ambulance costs and emergency department presentations ($1m to $1.5m annually)[1]

[1]The State of Victoria Department of Environment, Land, Water & Planning, *Urban Environmental-Economic Account for Melbourne: Scoping report*. 2021.

Urban forest – overall findings

- The impact of climate change on the urban forest is well-known, but the level of adaptation investment required is less clear.
- The impacts of climate change on the urban forest will have significant and wide-ranging impacts for communities and across sectors.
- Additional work is required to develop a more detailed understanding of the impact of climate change on the range of benefits delivered, and thus the level of adaptation required.
- DELWP's work to develop an Urban Environmental-Economic Account for Melbourne will be an important step to understanding the benefits of urban forest and informing future work.



Building sector

Building sector – cost of impacts due to inundation

- A national assessment of the risks of climate change to Australia's coastal zone was completed in 2009 for residential buildings, and in 2011 for commercial and industrial buildings:

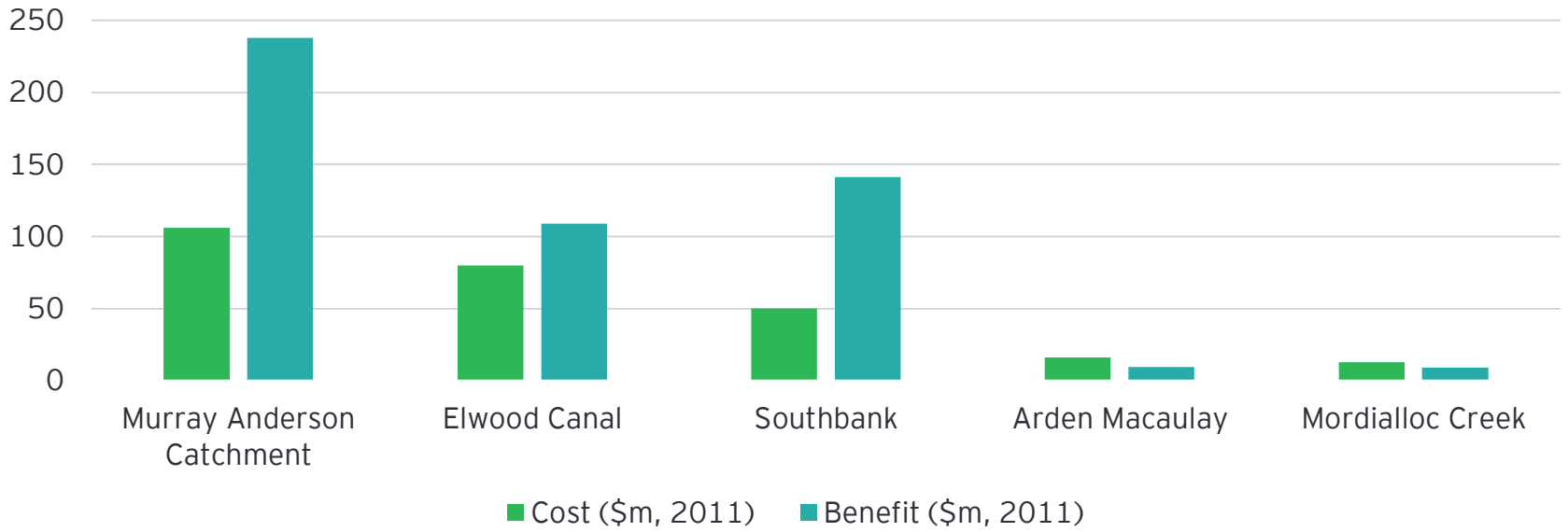
Residential buildings	Commercial buildings	Industrial buildings
$6.5 – 10.3b	$8 – 12b	$0.5 – 0.8b
in replacement value of 27,600 to 44,600 residential buildings at risk from inundation in Victoria ($, 2009)[1]	in replacement value of 1,500 and 2,000 commercial buildings at risk from inundation in Victoria ($, 2009)[1]	in replacement value of 600 and 1,000 industrial buildings at risk from inundation in Victoria ($, 2011)[2]

[1]Australian Government Department of Climate Change, *Climate Change Risks to Australia's Coast: A First Pass National Assessment*. 2009. https://www.environment.gov.au/system/files/resources/fa553e97-2ead-47bb-ac80-c12adffea944/files/cc-risks-full-report.pdf.

[2]Australian Government Department of Climate Change and Energy Efficiency, *Climate Change Risks to Coastal Buildings and Infrastructure: A Supplement to the First Pass National Assessment*. 2011. https://www.environment.gov.au/system/files/resources/0f56e5e6-e25e-4183-bbef-ca61e56777ef/files/risks-coastal-buildings.pdf.

Building sector – cost of adaptation to inundation risk

- A high-level estimate in the 2009 inundation analysis suggested that it would cost up to $5 billion to construct dykes or sea walls in low-lying areas of Port Phillip Bay, and an additional $5 billion to build flood gates on the river systems feeding into the bay ($, 2009).[1]
- A cost-benefit analysis of small-scale adaptation measures in the Port Phillip Bay was conducted in 2012:[2]



[1]Australian Government Department of Climate Change, *Climate Change Risks to Australia's Coast: A First Pass National Assessment*. 2009. https://www.environment.gov.au/system/files/resources/fa553e97-2ead-47bb-ac80-c12adffea944/files/cc-risks-full-report.pdf.

[2]"Case Studies", Association of Bayside Municipalities, 2012, https://www.abm.org.au/wp-content/adaptationproject/case.html.

Building sector – cost of impacts due to increased temperatures

- A 2009 CSIRO assessment identified a 111% increase in cooling energy demand for five star energy-rated houses in Melbourne by 2050 under the most extreme A1F1 scenario (below). The impacts on commercial and industrial buildings were not assessed.[1]
- A 2012 study also estimated that the total economic cost to the community in the City of Melbourne due to hot weather was $1.8 billion due to impacts on health, transport and energy ($300m of which was due to the urban heat island effect).[2]

$0.6b

in annual cooling energy costs for houses in Melbourne without climate change

$1.3b

in annual cooling energy costs for houses in Melbourne by 2050 under the A1F1 scenario

[1]Xiaoming Wang, Dong Chen and Zhengen Ren, "Assessment of climate change impact on residential building heating and cooling energy requirement in Australia," *Building and Environment* 45, no. 7 (July 2010): 1663-1682, https://doi.org/10.1016/j.buildenv.2010.01.022.

[2]AECOM Australia, *Economic Assessment of the Urban Heat Island Effect*. City of Melbourne, 2012. https://www.melbourne.vic.gov.au/sitecollectiondocuments/eco-assessment-of-urban-heat-island-effect.pdf.

Building sector – cost of adaptation to risk of increased temperatures

- ASBEC estimated that a 10% reduction in average household energy consumption could be achieved through the implementation of HVAC upgrades: gap sealing, weather stripping, insulation, replacement of air conditions and space heaters and improved maintenance.[1]
- This analysis did not consider the impact of climate change directly.

$170m

total investment to reduce average household energy consumption in Greater Melbourne by 10%

$55m

savings in annual cooling energy costs for houses in Melbourne

[1]ClimateWorks Australia, *Low Carbon, High Performance: Modelling Assumptions*. Australian Sustainable Built Environment Council, 2016. https://www.asbec.asn.au/wordpress//wp-content/uploads/2016/05/160509-ClimateWorks-Low-Carbon-High-Performance-Modelling-Assumptions.pdf.

Building sector – overall findings

- The literature indicate an emphasis on mitigation in the building sector, with less focus on adaptation specifically.
- A failure to address climate impacts may have wide-ranging and significant impacts on the building sector, from increased costs of maintenance, to higher insurance premiums to abandonment of property.
- Additional work is required to understand the cost of climate impacts in the building sector, the cost and benefits of adaptation measures to increase resilience to these impacts, and the appropriate level of investment to achieve the desired resilience outcomes.

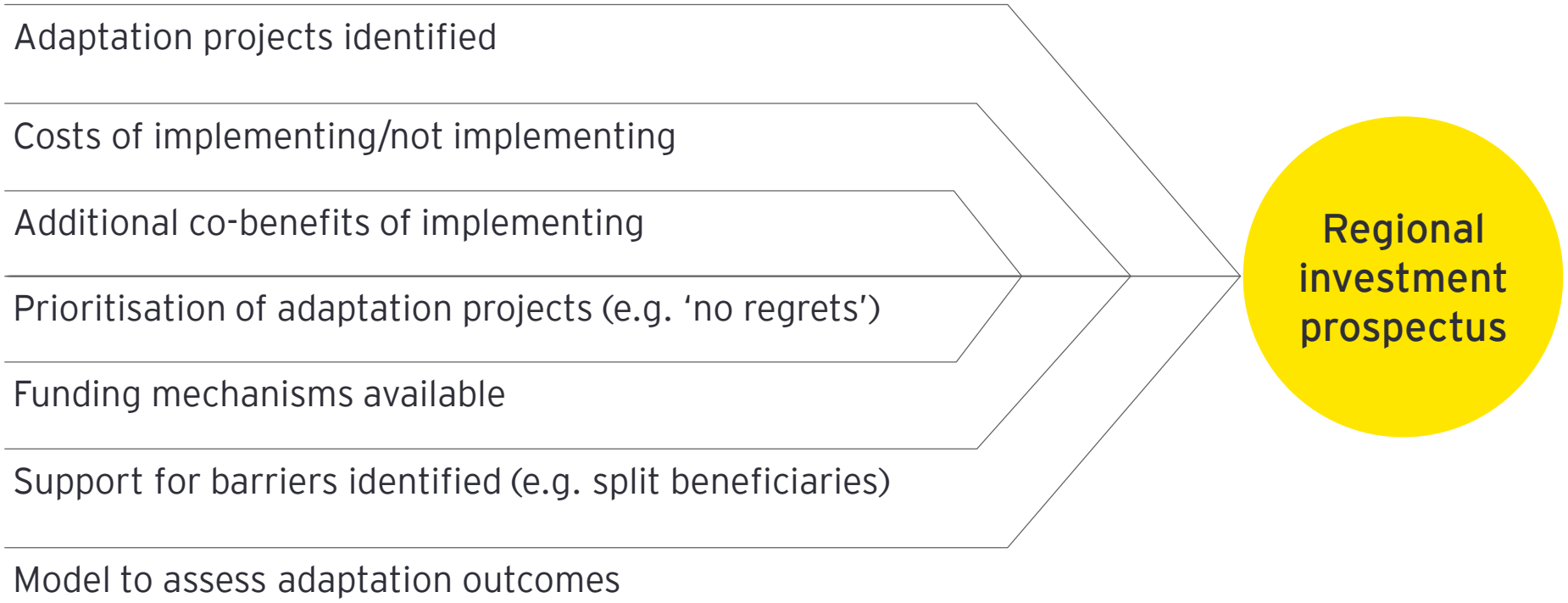
7 Recommendations

Findings and recommendations

Area	Finding	Recommendation
General	Public information is not sufficient to allow for a reliable estimate of the cost of climate impacts or the level of adaptation investment required for the Greater Melbourne region.	Complete further analysis to develop detailed and accurate estimates of the cost of climate impacts, and the cost and benefits of potential adaptation measures.
Electricity sector	The need for further adaptation is understood, however modelling, planning and regulatory barriers prevent sufficient investment.	Support an increased focus by regulators, market operators and network owners on an approach to assessing and delivering adaptation investment.
Urban forest	Previous analysis has made it difficult to holistically and accurately understand the cost and benefits of investment in Greater Melbourne's urban forest.	Use DELWP's ongoing development of an Urban Environmental-Economic Account for Melbourne provides an opportunity to quantify the benefits of Melbourne's urban forest and assess adaptation measures accordingly.
Building sector	Focus has been on mitigation of emissions rather than adaptation to climate impacts.	Complete additional work to understand the level and types of adaptation investment required for the range of climate impacts to the building sector.
Adaptation investment	The barriers to adaptation have resulted in a significant investment-deficit at global and regional levels.	Work to address the significant barriers in place to adaptation investment at a regional level (e.g. lack of information, counterfactual) and then develop a regional investment prospectus to support.

Developing a ‘regional investment prospectus’

- The development of a regional ‘investment prospectus’ can act as an important tool to support private investment in adaptation measures in the Greater Melbourne region. In addition, ‘bundling’ individual projects at the regional level can make adaptation more conducive to government support.



Acknowledgement

Melbourne's Climate Journey is a community led project supporting Greater Melbourne communities to adapt to a changing climate, supported by the Department of Environment, Land, Water and Planning (DELWP) and funded through the *Supporting Our Regions to Adapt* program.

EY | Building a better working world

EY exists to build a better working world, helping to create long-term value for clients, people and society and build trust in the capital markets.

Enabled by data and technology, diverse EY teams in over 150 countries provide trust through assurance and help clients grow, transform and operate.

Working across assurance, consulting, law, strategy, tax and transactions, EY teams ask better questions to find new answers for the complex issues facing our world today.

Our report may be relied upon by Eastern Alliance for Greenhouse Action for the purpose of quantifying costs of climate adaptation investments in Greater Melbourne only pursuant to the terms of our engagement letter dated 20 October 2020. We disclaim all responsibility to any other party for any loss or liability that the other party may suffer or incur arising from or relating to or in any way connected with the contents of our report, the provision of our report to the other party or the reliance upon our report by the other party.

ey.com