

Urban planning policy must do more to integrate climate change adaptation and mitigation actions

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Highlights

- Evaluates urban planning policy documents across scales of government and sectors
- Limited inclusion of climate change in urban policy documents was found
- Limited integration of climate change mitigation and adaptation was evident
- Identifies opportunities for climate change action to be implemented in land use planning
- Framework developed can assist urban planners meet *Paris Agreement* targets

Abstract

Well-designed urban planning policy can mitigate greenhouse gas emissions and adapt to anticipated climate change impacts. However, there has been limited analysis of the extent to which urban planning policy documents addresses climate change adaptation and or mitigation. There is a need to rapidly reduce greenhouse gas emissions to limit warming to 1.5°C above pre-industrial levels by 2100, and to be well adapted to this change (in line with the *Paris Agreement*). Achieving this goal will assist in limiting damage and loss to humans and the natural environment. This paper presents a detailed qualitative and quantitative evaluation of urban planning documents (policy, regulation and law) in the state of Victoria, Australia, and the degree to which climate change mitigation and adaptation (with a focus on sea level rise) are addressed and integrated. Two scales of government (state and local) were analysed across three policy disciplines (urban planning, climate change and flood management). The evaluation framework contributes to the few tools for analysing legislation, regulation and strategic policies for climate change adequacy. The findings reveal limited climate change adaptation and mitigation actions in urban planning documents. Additionally, there is limited integration of adaptation and mitigation actions. Important opportunities for better alignment of policies across disciplines and government levels in line *Paris Agreement* goals are identified, to ensure implementation in decisions made about land use and development. The analysis finds that urban planning policy must do more to include and integrate climate change adaptation and mitigation actions.

Key words: climate change, adaptation, mitigation, integration, urban planning, sea level rise

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47

48 **Urban planning policy must do more to integrate climate change** 49 **adaptation and mitigation actions**

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51

52 **1 Climate change and the urban environment**

53 Cities are significant contributors to climate change. They are where the majority of humans now
54 reside and are a major source of greenhouse gas (GHG) emissions (UN-HABITAT 2011). Cities
55 are increasingly experiencing the impact of climate change through extreme weather events,
56 bushfires, flooding, storm surges and sea level rise (SLR) (IPCC 2014), which will increase as
57 climate change intensifies (IPCC 2018). These direct impacts will have secondary impacts on
58 cities, including: availability and reliability of urban water and food supplies, and area and
59 location of available habitable land. It is recognized internationally, that in order to avoid
60 catastrophic climate change impacts, there is a need to rapidly reduce GHG emissions, to limit
61 global warming to 1.5°C above pre-industrial levels by 2100. This is the goal of the *Paris*
62 *Agreement* (UN2015). Yet the United Nations Environment Program's (UNEP) annual
63 *Emissions Gap Report* indicates there is a significant gap between current global GHG
64 emissions, and the level of reduction needed over the next few decades in order to achieve the
65 *Paris Agreement* (UNEP 2019). It is also recognized that there is a need to adapt to the changes
66 that cannot be avoided (IPCC 2015; 2018).

67

68 While there have been numerous actions to address climate change in built environments, these
69 are largely focused on either adaptation or mitigation actions (Biesbroek et al. 2009; Reckien et
70 al. 2018). There has been limited action to integrate both adaptation and mitigation actions,
71 despite a recognized need to do so (IPCC 2015; 2018, Rosenzweig et al. 2018). Integration has
72 been advocated in the *Paris Agreement* and in the IPCC's fifth assessment report (Denton et al.
73 2014), and in other research contexts (Grafakos et al. 2018; Landauer et al. 2018). Integration of
74 adaptation and mitigation is important for avoiding the locking-in of counter-productive policy
75 and infrastructure, and for increasing the efficiency of resources (Grafakos et al. 2018; Landauer
76 et al. 2018). Despite this, there has been limited analysis of urban planning policies to establish
77 whether they are addressing adaptation, mitigation or their integration, and whether this is done
78 sufficiently. Policy integration has been defined by Howlett and colleagues (2017 p.70) as "the

79 smooth coexistence of the different elements of policy, including goals, policies and government
80 levels involved in policy mix design and creation, so that conflicts are minimised and, if
81 possible, synergies and complementarities are promoted.” This would apply to the integration of
82 adaptation and mitigation actions in policy.

83

84 Urban planning is a discipline which seeks to control the use and development of land for
85 managing the activities and spatial form of cities. Urban planning is touted as having a
86 significant influence on climate change actions (Carter et al. 2015; Rannow et al. 2010).
87 However at present, most cities are not addressing climate change to the extent needed to limit
88 climate change risk, and there is uncertainty about the achievements of climate change
89 adaptation plans (Seto et al. 2014). The potential for climate action at the city level is often
90 overlooked with a focus on national and supranational scales dominating (Ireland and Clausen
91 2019). Thus, despite the potential of urban planning to contribute to climate change mitigation
92 and adaptation (Bulkeley 2010; Shi et al. 2016; Solecki et al. 2018), there is a gap in our
93 understanding of how this is met by policy and legislation, and what best practice might look
94 like. While analysis of climate change policies has occurred (Guyadeen et al. 2019; Reckien et
95 al. 2018), there is limited published analysis of the coverage of climate change actions in urban
96 planning policy, including across scales of government and policy disciplines. The research
97 reported in this paper seeks to address this gap by:

- 98 1) Developing a set of criteria for evaluating urban planning policies’ coverage of: climate
99 change mitigation, adaptation, and their integration (in line with the *Paris Agreement*)
- 100 2) Applying these criteria to evaluate the coverage of climate change actions in the urban
101 planning policy context of the state of Victoria, Australia - across two scales of
102 government (local and state) and across three disciplines (urban planning, climate change
103 and flood management)

104

105 The following research questions are addressed:

- 106 1) Do the urban policy documents adequately address climate change mitigation in line with
107 limiting warming to 1.5°C above pre-industrial levels by 2100?
- 108 2) Do the urban policy documents address climate change adaptation?

109 3) Are actions to achieve climate change mitigation and adaptation integrated: with each
110 other; across levels of government; and across policy disciplines?

111
112 The results of this research will be important for informing the future revision and development
113 of urban policy to address climate change. This is particularly important given the reported
114 barriers urban planners face when addressing climate change, including uncertainty and volatility
115 in climate change adaptation policy frameworks (McClure and Baker 2018).

116

117 **2 Urban Planning and climate change action**

118 **2.1 Urban Planning**

119 Urban planning seeks to manage the use and development of land in a way that considers,
120 confronts and resolves the conflicts between demand for growth, social equity and the
121 environment (Campbell 1996). There are numerous tools available to urban planners to articulate
122 and affect the desired outcomes for cities, and these can be expressed at multiple scales. As noted
123 by Hopkins, “a plan identifies a decision that should be made in light of other concurrent or
124 future decisions” (Hopkins 2001 p.5), and can be articulated in many ways, including vision,
125 agenda, design, strategy, and policy (Hopkins 2001 p.36). Plans are usually undertaken in
126 complex contexts, can involve private and or public actors, and can vary in scale. Plans provide
127 information to decision makers and are largely non-binding, compared to other tools available to
128 planners including regulation and legislation (Hopkins 2001).

129

130 The control exercised by plans has been discussed by Booth (1996) as falling into two categories,
131 discretionary and regulatory. Discretionary planning systems are flexible, and lack certainty in
132 decision making, and can be political in nature (Booth 1996 p.5-6). In contrast, regulatory
133 systems emphasise administrative decision making, and rely on a complete statement of rights
134 and permissions in advance – prior to decision making (Booth 1996). Discretionary systems are
135 useful for the flexibility and therefore creativity that they encourage (Healey et al. 1988). In
136 contrast, partly because environmental limits are ‘non-negotiable’, regulation has been posited as
137 critical in advancing environmentally sustainable initiatives (Williams and Dair 2007) including
138 climate change mitigation and adaptation initiatives (Hurlimann et al. 2018). It is recognized that
139 urban planning can have a critical role in facilitating climate change mitigation and adaptation

140 (Seto et al. 2014; Ürge-Vorsatz et al. 2018). Evidence indicates that planning can drive
141 adaptation (Hurlimann et al. 2014; Tribbia and Moser 2008; Wilson 2006), including to sea level
142 rise in existing urban settlements. A key approach has been ‘retreat, accommodate or protect’
143 (IPCC Coastal Zone Management Subgroup 1991).

144

145 However, it must be acknowledged that past and current urban planning activities have resulted
146 in climate change impacts and path dependency (Matthews et al. 2015). Thus, significant
147 changes to the status quo of urban planning activities are required in many locations across the
148 world to achieve the goal of limiting warming to 1.5°C but also to avoid the risk and harm
149 attributable to even this amount of warming (Solecki et al. 2018).

150

151 A key challenge for urban planning is the scale of urbanization currently occurring and
152 anticipated to occur in the future (UN 2018). Status quo urbanization will contribute to increased
153 GHG emissions from both the process of development and the continued use of new urban areas.
154 Research has shown a direct relationship between urbanization and carbon dioxide emissions
155 (Wang et al. 2018). The rapid increase in urbanization will require significant investment in
156 infrastructure, which itself is a key driver of GHG emissions (Seto et al. 2014). Within urban
157 form, there is a strong relationship between the need for transportation and GHG emissions (Bart
158 2010; Hou et al. 2018). Higher residential density, with higher employment densities,
159 improvements to public transport provision, and mixed land use, can all facilitate a reduction in
160 GHG emissions (Seto et al. 2014; Wang et al. 2018). Some of the major urban planning
161 mechanisms which can influence the mitigation of GHG emissions are discussed by Seto et al.
162 (2014), and can be found in Table 1. Planners must also be mindful of the potential for synergies
163 and conflict between these goals (Caparros-Midwood et al. 2019). Weller (2008) also stresses
164 that new-urbanist-style developments that implement these on-site mechanisms do not cancel out
165 their benefits with larger total ecological-footprint. An additional challenge is implementing
166 change in existing built form (Hurlimann and March 2012).

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173 **Table 1: Urban planning mechanisms to mitigate climate change***

<p><i>State and Metropolitan level</i></p> <ul style="list-style-type: none"> - Development restrictions to contain urban growth (e.g. zoning; permit restrictions) - Urban growth boundary - Affordable housing mandates (to reduce the spatial disjoint between home and work) - Mixed use zoning to support self-contained communities - Zoning to prevent sprawl and direct growth to desired areas <p><i>Local level</i></p> <ul style="list-style-type: none"> - Transfer of development rights to support transit-oriented corridors - Mixed use zoning to encourage urban regeneration and infill - Zoning overlays and form-based codes to achieve desired outcomes such as new urbanism - Design codes and flexible parking to achieve transit-oriented development and other design-based climate change actions (e.g. local composting facilities) - Mixed-use zoning to support eco-communities - Code revisions/design guidelines to achieve pedestrian zones - Code revisions/design guidelines to achieve car-free districts and/or traffic calming

174 *Source of content: Seto et al. (2014 p.959)

175

176

177 **2.2 Urban planning policy for climate change action**

178 There has been limited but increasing research to appraise urban planning policies' responses to
 179 climate change. Research has been applied to fields aligned with urban planning such as water
 180 supply and coastal management (Ekstrom et al. 2017). Additionally, policy interaction dynamics
 181 have been addressed in multiple contexts including Europe (Russel et al. 2018), Indonesia (Di
 182 Gregorio et al. 2017) and Australia (Baker et al. 2012). Likewise, Heikkinen et al. (2018)
 183 analysed twelve cities' adaptation and mitigation strategies for their overall approach to urban
 184 development. They found that most cities propose status quo actions. Few actions integrating
 185 adaptation and mitigation were proposed.

186

187 In British Columbia, Baynham and Stevens (2014) conducted a content analysis of 39 official
 188 community plans to evaluate their mitigation and adaptation content. They found that 25 of the
 189 plans explicitly addressed climate change, however there was large variation in the plans and
 190 their quality. Additionally, they found that the plans included mitigation far more
 191 comprehensively than adaptation. In India, Kumar and Geneletti (2015) found that the majority
 192 of the sample of spatial plans had limited actions to address climate change; and did not integrate
 193 climate change issues into spatial policy processes effectively. Hamin (2011) examined seven
 194 municipal climate change plans to evaluate their adaptation and mitigation actions, finding a
 195 need for explicit consideration of how adaptation policies may impact mitigation. This is in
 196 contrast to Hamin and Gurrans' (2009) work comparing land use plans and policies addressing

197 climate change in the USA and Australia. They found that half of the actions identified created
198 conflicts in achieving adaptation and mitigation goals. While the research reviewed here has
199 been beneficial to inform planning for climate change actions, it has been limited to a small
200 number of specific analyses and contexts. There is a gap in the work; that which looks across a
201 range or planning policy types in the one jurisdiction, including across scales of government and
202 disciplines. The research in this paper seeks to address this gap.

203

204 **3 Research Method**

205

206 ***3.1 Background information on the case study – Victoria, Australia***

207 Australia has a federal system of government, where power is shared by a federal government
208 and six states. There are an additional eight territories that can be self-governed or administered
209 federally. The state of Victoria is located in the south-east corner of the Australia's main island.
210 It makes up just 3% of the country's total land area (Geoscience Australia 2020), yet is home to
211 26% of the country's population (ABS 2019a). The majority of the state's 6.5 million residents
212 live in the greater metropolitan area of Melbourne which is the state's capital, and home to more
213 than 4.9 million people (ABS 2019b). The state is divided into 79 local government areas, 31 of
214 which are in the greater metropolitan area of Melbourne. The south east area of Australia is
215 facing significant climate change impacts now and into the future. Since 1910, temperature has
216 increased by over one degree, extreme hot weather events have increased in frequency, along
217 with extreme fire weather frequency and duration. Sea levels have also risen, giving rise to
218 increased risks of inundation, and rainfall has declined in the April – October period (BoM and
219 CSIRO 2018).

220

221 ***3.2 Policy context for land use management in Victoria***

222 The *Planning and Environment Act 1987* (hereafter the *P&EAct*) is the key piece of legislation
223 providing the framework for Victoria's planning system. Objectives for the use and development
224 of land are articulated through planning schemes for each of the 79 local governments (Eccles
225 and Bryant 2011), with the Department of Environment Land Water and Planning (DELWP) the
226 key department involved in planning, climate change and flooding. *The P&EAct* formulates the
227 content of these schemes, the process of amendments, and administration of the schemes. The

228 *Victorian Planning Provisions* (VPPs) constitute subordinate legislation under the Act. They are
229 a comprehensive set of planning provisions including zones and overlays for the whole of
230 Victoria, a state-wide reference, used as required to construct planning schemes. *Local Planning*
231 *Policy Frameworks* (LPPFs) set out the purpose of each council's planning scheme, and the
232 vision and strategic direction for the municipality. The City of Melbourne's (CoM) LPPF
233 appears as clauses (cl) 20-22 of its planning scheme. Legislation and policy outside the *P&E Act*
234 also has an effect on use and development of land (Eccles and Bryant 2011). *Plan Melbourne* is
235 the current strategic planning document for the greater Melbourne area, and is accompanied by
236 the *Implementation Actions for Plan Melbourne*.

237

238 Planning for climate change mitigation and adaptation in Victoria is influenced by many levels
239 and fields of government policy. The *Climate Change Act 2017* (hereafter the *CCAct*) is the key
240 piece of legislation for climate action in the state. The *CCAct* and *Victoria's Climate Change*
241 *Framework (CCF)*, are key documents outlining the state's response to climate change.

242 *Victoria's Climate Change Adaptation Plan 2017-2020* 'lays out a blueprint for action that will
243 help Victoria meet the challenges and act on the opportunities of climate change.'

244

245 In terms of policy relevant to SLR, the *Victorian Coastal Strategy 2014* (VCS) was developed to
246 create and implement a vision and framework for planning and managing the state's coast. It is a
247 periodic update of previous coastal strategies. There is a myriad of water related policies and
248 guidance documents relevant to flooding and SLR. The CoM's *Water Sensitive Urban Design*
249 *(WSUD) Guidelines* provide information on applying WSUD principles to urban developments
250 and water projects. Melbourne Water's *Planning for Sea-level Rise* focuses on strategic
251 adaptation across the greater Melbourne area. The State Government's *Guidelines for*
252 *Development in Flood Affected Areas* (hereafter *Flood Guidelines*) aims to 'provide a clear,
253 consistent and transparent process for managing land use and development in flood affected
254 areas in Victoria' (p. 5).

255

256 The documents analysed for this research can be found in Table 2, grouped by discipline and
257 scale of government. While there are many policies outside those listed in Table 2 that will
258 influence the adaptation to and mitigation of climate change in Melbourne, Victoria, those

259 analysed are the key policies and legislation applicable to the research questions posed. Analysis
 260 of further policies may be warranted in future. The policy and legislation documents considered
 261 in the analysis were strategic (e.g. strategies), regulatory (e.g. planning schemes and documents
 262 to guide decision making), and statutory (e.g. Acts of Parliament).

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Table 2: The documents analysed relevant to climate change and sea level in Melbourne Australia

	Local - City of Melbourne (CoM)	State and Regional
General Climate Change		<ul style="list-style-type: none"> - <i>Climate Change Act 2017</i> - Victoria's Climate Change Adaptation Plan 2017-2020 (DELWP 2016a) - Victoria's Climate Change Framework (DELWP 2016b)
Urban Planning	<i>Victorian Planning Provisions – Local Planning Policy Section (DELWP 2019b)</i>	<ul style="list-style-type: none"> - <i>The Planning and Environment Act 1987</i> (including Amendments as of August 2018) - <i>Victorian Planning Provisions – State Planning Policy Section (DELWP 2019c)</i> - <i>Plan Melbourne</i> (DELWP 2017b) - <i>Plan Melbourne Implementation Plan</i> (DELWP 2017a)
Flood management including pluvial and SLR	<i>CoM WSUD Guidelines (CoM undated)</i>	<ul style="list-style-type: none"> - <i>Victorian Coastal Strategy</i> (Victorian Coastal Council 2014) - <i>Planning for Sea Level Rise Guideline – Port Phillip and Westernport Region 2017</i> (Melbourne Water 2017) - <i>WSUD Guidelines for South Eastern Councils</i> (Melbourne Water 2013) - <i>Guidelines for Development in Flood Affected Areas</i> (DELWP 2019a)

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 268

3.3 Development of the evaluative criteria

269 The analysis of policy documents can provide information to decision makers to inform their
 270 approach to a policy problem (Althaus et al. 2018; Sanderson 2002). However, common
 271 procedures for the evaluation of plan quality are lacking (Stevens et al. 2014). This research
 272 combined both qualitative and quantitative evaluation. A descriptive evaluation of the
 273 documents' content was undertaken, in order to consider how the documents function in relation
 274 to their appropriateness (Althaus et al. 2018) to address climate change. This is a normative
 275 approach to policy evaluation, which has been undertaken in other contexts (Le Gouais and
 276 Wach 2013; Miller et al. 2014). Following the method of Stevens et al (2014): a written protocol
 277 of items to measure, in line with the research aim, was developed to assess both adaptation
 278 (focusing on SLR), and mitigation in the policy documents (Table 3). The evaluative criteria, and
 279 their scales of measurement are presented in Table 3.

280

281 A scale to measure each item was developed, informed by a range of scales previously used in
 282 plan analysis (Baker et al. 2012; Stevens and Senbel 2017). In addition to the scoring, notes were
 283 made to justify the coding decisions made, to inform the integrated consideration of the results.
 284 The analysis of one document was undertaken by two researchers first, and discussed in detail, to
 285 ensure consistency of the results. Regular team meetings were held to discuss the analysis. All
 286 authors contributed to analysis of the documents, with one author conducting the majority of the
 287 evaluations.

288
 289

Table 3: Document Evaluation Matrix

Evaluation Criteria	Scale
Mitigation	
M1 Does the document address climate change mitigation?	0 = No, 1 = Yes, implicit, 2 = Yes, Explicit
M2 Is a mitigation aim specified (e.g. specific level of warming limit, goals for GHG emission reductions?) If yes, what level?	0 = Status quo, 1 = some level of emissions reduction, but inadequate to achieve Paris Agreement, 2 = Paris Agreement target or greater
State and Metropolitan level (developed from Seto et.al. 2014 p.959) M3 Development restrictions M4 Urban growth boundaries (UGB) M5 Affordable housing mandates M6 Mixed use zoning (MUZ) to support self-contained communities M7 Zoning to prevent sprawl and direct growth to desired areas	0 = No, 1 = Yes, implicit, 2 = Yes, Explicit, 3 = Implicit and stated in another way
Local Level M8 Transfer of development rights to support transit-oriented (TO) corridors M9 MUZ to encourage urban regeneration and infill M10 Zoning overlays and form-based codes to achieve desired outcomes such as new urbanism M11 Design codes and flexible parking to achieve TOD M12 MUZ to support eco-communities M13 Code revisions/ design guidelines for pedestrian zones M14 Code revisions/ design guidelines to achieve car-free districts and/or traffic calming	
Adaptation	
A1 Does the document address climate change adaptation? A2 Is SLR mentioned?	0=No, 1=Yes, implicit, 2= Yes, Explicit
A3 What level of SLR risk is planned for, and across what time frame?	0=No level or timeframe specified; 1=level specified is less than 0.8m, or not by 2100, 2= 0.8m by 2100, 3=>0.8m and timeframes 2100 or earlier
A3 Does the approach to SLR consider retreat? A4 Does the approach to SLR consider accommodate? A5 Does the approach to SLR consider protect?	0=No, 1=Yes, implicit, 2= Yes, Explicit
Integration	
I1 Is the integration of adaptation and mitigation acknowledged?	0=No, 1=Yes implicit, 2= Yes Explicit

290

291

292 **4 Results and Discussion**

293

294 **4.1 Climate change mitigation**

295 The results of the policy evaluation can be found in Table 4. Looking at mitigation across policy

296 documents analysed (Table 4), seven of the twelve policy documents explicitly mention

297 mitigation. Of these, five documents specify targets in line with the Paris Agreement. Mitigation

298 is not addressed in the *P&EAct*, *Planning for Sea Level Rise* and *Flood Guidelines*. Regarding

299 the specific mitigation actions (criteria M3-M14), three are not addressed at all.

Table 4: Results of the quantitative policy evaluation*

	Mitigation														Adaptation						Int [#]
	Address mitigation?	Mitigation aim specified?	Development restrictions	UGB	Affordable housing	MUZ – self contained communities	Zoning to prevent sprawl	Transfer of development rights / support TOD	MUZ for regeneration / infill	Zoning/overlays/codes for e.g. new urbanism	Design codes/ flexible parking for TOD	MUZ for eco communities	Code / design guidelines for pedestrian zones	Code / design guidelines for car free / calm traffic	Addresses adaptation?	Addresses SLR?	What SLR and timeframe	Does it consider retreat	Does it consider accommodate?	Does it consider protect?	Address integration of adaptation and mitigation
Plan / Criteria	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	M13	M14	A1	A2	A3	A4	A5	A6	I1
Planning																					
State: Planning and Environment Act (L)	0	0	1	2	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
State: Plan Melbourne (S)	1	2	3	2	3	3	3	3	1	3	3	3	1	1	2	1	1	1	0	1	1
State: Plan Melbourne Implementation (S)	2	2	0	0	0	2	1	0	2	1	0	2	0	2	1	1	0	1	1	1	0
State: Victorian Planning Provisions (VPPs) (R)	2	0	1	2	0	2	1	2	1	2	0	1	3	1	1	1	3	1	2	0	0
Local: LPPF City of Melbourne (R)	1	1	0	0	0	0	0	2	1	1	0	3	1	3	1	1	3	0	1	1	0
Climate Change																					
State: Climate Change Framework (CCF) (S)	2	2	1	0	0	0	0	0	0	0	0	0	0	2	2	1	1	0	0	0	1
State: Climate Change Adaptation Plan (S)	2	2	0	0	0	0	0	0	0	0	0	0	0	2	2	2	0	1	0	1	1
State: Climate Change Act 2017 (L)	2	2	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
SLR and flood management																					
State: Coastal Strategy (VCS) (S)	2	0	0	2	0	0	2	0	0	0	0	0	2	1	2	1	3	1	0	1	0
Regional: Planning for SLR (S)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	2	1	2	2	0
Local: WSUD Guidelines (R)	2	1	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0
State: Guidelines for Development in Flood Affected Areas (R)	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	2	1	1	2	1	0

† Refers to *integration* of mitigation and adaptation

* Refer to Table 3 for the document evaluation matrix values and scoring system;

** The values of 2 are highlighted here as they represent when the variable listed is explicitly addressed in the document;

** S=strategy; L=legislation; R= regulation

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305 Mitigation was explicitly addressed in all three of the climate change documents (M1). These documents
306 specified a GHG mitigation target in line with the *Paris Agreement* (M2). In terms of climate change
307 mitigation actions, for *Victoria's CCF* most of the focus is on non-land use and non-transport emission
308 reductions. The 2050 target will be achieved primary through transformation of the stationary and transport
309 energy systems, including electrification, moving to renewable generation, and increases in building
310 efficiency. In the *CCAct*, focus is given to land use rights for forestry and carbon management for
311 sequestration. It sets the requirement to develop Emission Reduction Targets every five years to ensure the
312 long-term target of net zero for 2050 is met.

313

314 All but one of the planning documents acknowledged the need to mitigate climate change (M1) - the
315 *P&EAct*. There are clauses in the Act that give preference to development in established areas via
316 mechanisms such as an urban growth boundary (thus potentially having a climate change benefit), but
317 provide no rationale. Although the operation of the Planning Scheme is legislated by this Act, details of how
318 planning could or should be used to encourage outcomes are absent. In terms of the planning documents,
319 only *Plan Melbourne* and its *Implementation Actions* place mitigation actions in line with the *Paris*
320 *Agreement* (M2). *Plan Melbourne Implementation Actions*, and the VPPs are where the greatest number of
321 mitigative actions were outlined. *Plan Melbourne's* 2050 zero net emissions target is enacted through a range
322 of stated outcomes such as increased energy efficiency of buildings, and actions intended to facilitate the
323 uptake of renewable and low-emission energy technologies. Other outcomes that have potential to reduce
324 emissions (despite being framed for their liveability rather than climate benefits), include focussing future
325 development in existing areas, in grey fields and in key growth corridors including through the use of an
326 urban growth boundary, the creation of 20-minute neighbourhoods accessible by non-motorised modes of
327 transport and the creation of walkable communities including using transit-oriented development.

328

329 Much of the VPPs' potential for mitigating climate change occurs through reduced transport emissions as a
330 result of broader urban design goals. The VPPs explicitly support an urban growth boundary, increased
331 density, development in existing urban areas and the provision of affordable housing (without any specific
332 targets). Urban consolidation and reduced 'environmental impacts' through the efficient provision of utilities
333 (water, energy and transport) are the reasons given. Although such outcomes have a climate benefit, they are
334 not explicitly worded as such in the VPPs. A tool for achieving the desired outcomes is the Mixed Use Zone;
335 however, it is only one of several zones and principles available to municipalities, and few of its climate-
336 related strengths are carried across to other zones. In addition, clarity around what Mixed Use zones should
337 include in terms of covering all three aspects of live/work/visit (Dovey and Pafka 2017) to ensure functional
338 mix for reduced travel is lacking. The VPPs contain some design codes, for example stipulating the

339 minimum number of parking spaces required in applications, mainly for access and to alleviate on-street
340 parking issues. These may be reduced via permit application, and the Parking Overlay allows for the
341 submission of applications with reduced parking if other requirements are met. Despite this, the VPPs appear
342 to endorse a generally car-centric approach to land-use planning. The VPPs also acknowledge that land use
343 needs to ‘protect greenhouse sinks,’ ‘facilitate industry initiatives to reduce GHG emissions’, ‘support
344 transition to a low-carbon economy’, amongst other aims. These are very high-level strategies within the
345 VPPs, and not necessarily accompanied by implementation tools and triggers.

346

347 Climate change is an underlying theme in the CoM’s LPPF, and many clauses within it include wording that
348 calls for a response. Mitigation targets include: 'Residents reduce their GHG emissions by 35 percent per
349 capita by 2020 (from 2006 levels)', and 'Workers reduce their GHG emissions by 59 per cent per capita by
350 2020 (from 2006 levels)'. Actions to achieve these include improved building design and the use of
351 ‘alternative energy generated on-site’. Implicit responses include the approach to increase mixed-use and
352 density thus generally encouraging efficiencies, particularly for transport. There are many clauses that
353 support higher density and mixed use development adjacent to public transport (i.e. TOD). Infill for urban
354 consolidation is not explicit, as the LPPF mostly uses ‘infill’ to describe redevelopment that is sympathetic to
355 existing *low*-density neighbourhoods. Mixed use developments are generally supported, with their implied
356 benefit being the opportunities for increased energy, water, material and transport efficiency. The CoM’s
357 *WSUD Guidelines* is predominantly focused on providing advice on implementation of WSUD and so
358 acknowledges that the majority of the work to achieve emissions reduction falls under the *Zero Net*
359 *Emissions Roadmap*. Nevertheless, some sections discuss the potential climate impacts of WSUD treatments
360 and highlight the need to achieve, where possible, *climate neutrality*. Additionally, the *Flood Guidelines*
361 implies that emissions should be reduced but no obligation is placed on users of this plan.

362

363 **4.2 Climate change adaptation**

364 Looking at the quantification of adaptation across the policy documents shows that it was addressed in seven
365 of the twelve documents. SLR and specific levels are mentioned in the VPPs, LPPF and *Planning for Sea*
366 *Level Rise* documents only. The *CCAct* covers adaptation in its guiding principles for risk management, and
367 its policy objectives, including ‘to build the resilience of the State's infrastructure, built environment and
368 communities through effective adaptation and disaster preparedness action’. It sets the requirements and
369 guidelines for developing Adaptation Action Plans every five years with a system-based planning approach
370 to adaptation, covering key systems of built environment, education and training, health and human services,
371 natural environment, primary production, transport; and the water cycle.

372

373 The *CCF* covers adaptation in terms of sectors (which will each have a specific adaptation plan developed).
374 The climate change phenomena to which the framework responds include water insecurity, extreme weather,
375 SLR, vector borne disease, damaged infrastructure, altered plant growth patterns, flooding, reduced snow and
376 wildfire. *Victoria's Climate Change Adaptation Plan* approaches adaptation in two ways; in terms of sectoral
377 resilience (e.g. 'health and human services', 'agricultural industries', 'water security' and 'the built
378 environment'), and issues ('heat', 'wildfire', 'drought', 'high tide and storm surge', 'acidic oceans', 'average
379 temperature increase' and 'SLR'). Regarding SLR, no modelled level is cited – one of the actions of the plan
380 itself is to establish benchmarks. The future need to 'build away from the coast to reduce risk of storm surge'
381 is implied. Accommodate appears to be considered as an option but is never explicitly stated. While the word
382 'protect' is often used, it is used in an ill-defined manner, rather than to distinguish actions from
383 'accommodate' and 'retreat'.

384

385 In terms of the planning documents, climate change adaptation was not addressed in the *P&E Act* and was
386 only explicitly addressed in *Plan Melbourne*. The adaptation issues mentioned in *Plan Melbourne* include
387 increased evaporation, reduced rainfall, heat-island effect and extreme heat, reductions in rainfall, flood /
388 inundation, bushfire, increased demand for essential services, rising food prices, food insecurity, damage to
389 infrastructure, stormwater quality, dust storms and reduced air quality. Sea level rise is described alongside
390 wildfire as a 'natural hazard,' with a projected sea-level increase of 20cm by 2040 mentioned once.

391

392 The VPPs acknowledge that land uses, and particularly applications for changes to land-use, need to respond
393 to each of SLR, bush fire and the urban heat island effect. In regard to SLR, cl 13.01-2S states that SLR of
394 not less than 0.8 metres by 2100 and an increase of 0.2 metres over current 1 in 100-year flood levels by
395 2040 should be planned for. Additionally, the combined effects of tides, storm surges, coastal processes and
396 local conditions should be planned for. 'Retreat' of existing settlements is not mentioned, but new growth is
397 to be directed away from 'identified coastal hazard areas' (cl 13.01-1S) and to low risk locations.
398 'Accommodate' is mentioned in the same clause: 'Develop adaptation response strategies for existing
399 settlements in risk areas to accommodate change over time'. Arguably, 'protect' is an allowable response by
400 the same clause which states, 'Ensure planning controls allow for risk mitigation or risk adaptation strategies
401 to be implemented'. Notably, as with the Act, 'mitigation' is used with regard to climate change risks (e.g.
402 'flood mitigation'), not climate change itself.

403

404 The Melbourne LPPF cites energy security and SLR as the main issues to which the municipality needs to
405 adapt, with more extreme flooding, intense storms and heatwaves mentioned. An approach to sea-level rise

406 adaptation actions is mentioned only for the Fisherman’s Bend Renewal Area which is in close proximity to
407 the coast and Yarra River:

408 Ensure the individual and combined impacts of SLR and flooding from storm events is
409 appropriately managed through a combination of precinct wide and property specific physical
410 and management measures (CoM LPPF cl 21.12-3).

411 This appears at odds with the advice from the *Flood Guidelines* (discussed below).

412

413 The LPPF is considered subordinate to the VPPs so the modelled sea-level rise of ‘not less than 0.8 metres
414 by 2100 and an increase of 0.2 metres over current 1 in 100-year flood levels by 2040’ is the level to which
415 the Municipality should respond. There is an implication that *accommodate* and *protect* are preferred
416 responses, e.g. via the statement ‘there is a need to consider design elements for flood-prone areas’, ‘creating
417 resilience against the impacts of SLR and flooding from storm events without compromising the urban form
418 at the ground level’ and ‘Design elements and materials should be resilient including water proof doors and
419 windows and elevated power outlets’. This appears at odds with the VPP, and may be due to the fact that
420 there is no overlay to trigger identification of coastal hazard area / future SLR for the CoM, in most local
421 government areas in the state (Hurlimann et al. 2014).

422

423 Melbourne Water’s (2017) *Planning for Sea-level Rise* focuses on strategic adaptation to a single climate
424 change phenomenon, and in doing so consigns the task of mitigation to other documents. The extent of SLR
425 to which the document responds is that which is detailed in superordinate legislation and policies, i.e. ‘not
426 less than 0.8 metres by 2100’. The document also calls for ‘the combined effects of tides, storm surges,
427 coastal processes and local conditions such as topography and geology’ to be considered ‘when assessing
428 risks and coastal impacts associated with climate change’ (p.6). Recommendations such as ‘apply a long-
429 term planning approach’ seem to suggest that *retreat* is an optional method of adapting to SLR. Although the
430 term *accommodate* is not used, it is explicitly endorsed in the instructions on elevating 'freeboard' (the
431 difference between the floor level of a building and the 1% AEP flood level (p.17)). In contrast, *protect* is
432 explicitly *not* recommended except in some circumstances, e.g. when underground car parks are below the
433 modelled flood level they ‘may be protected with levees’ (p. 19).

434 In the VCS, climate change is mentioned several times, with the Strategy’s main purpose appearing to be
435 protection of the existing character of townships and landscapes in the context of a dynamic coast. In terms
436 of mitigation, there is explicit but brief mention of the potential of coastal environments to host wind and
437 wave energy generation industries (p.77-78). Town boundaries feature heavily, yet apart from isolated
438 mentions of their benefits for enabling active and sustainable transport, the main purpose of boundaries

439 appears to be to preserve character. The mechanism by which town boundaries would be maintained is the
 440 VPP and local planning schemes, thus placing actual decision-making regarding this aspect of the strategy
 441 with local government. SLR of not less than 0.2m by 2040 and 0.8m by 2100 is defined, consistent with
 442 legislation and other policies. *Retreat* is considered an opportunistic intervention for human uses where
 443 coastal location is ‘not necessary and (there is) no provision of support to coastal activity’. In contrast
 444 *accommodate* is neither mentioned nor implied, and nor is *protect*, apart from occasions where it is explicitly
 445 *not* recommended because it prevents coastal vegetation communities from retreating. *Protect* is also used in
 446 the context of protecting habitat and marine ecosystems for their significant value as ‘blue carbon’ sinks (p.
 447 33), thus implicitly considering protection of coastal ecosystems as a mitigation strategy, although there no
 448 land use planning or design guidelines are provided.

449 In the *WSUD Guidelines*, WSUD is recognised throughout the document as an important approach for
 450 responding to the impacts of climate change. The phenomena to which the plan responds are ‘peak flows’,
 451 ‘flooding’, ‘the heat island effect’ and ‘changing natural flow regimes’ all of which are attributable to climate
 452 change, but not always explicitly in the Guidelines. The *Flood Guidelines* acknowledge Victoria’s ‘climate
 453 variability’ and ‘change’, with the approaches therein mindful of the impacts on coastal, riverine and inland
 454 flooding. No extent of SLR is explicitly articulated, referring the reader to the *VCS 2014* for benchmarks.
 455 The *Flood Guidelines* consider, but largely dismiss *retreat* as unworkable: ‘once communities are
 456 established, it is difficult for them to retreat because of a flood threat’. Avoiding placing urban areas in risky
 457 areas in the first place is recommended: ‘if urban growth is planned, consider the most suitable location, ...
 458 informed by flood studies and coastal hazard assessments’ (p.12), and, ‘avoid intensifying the impacts of
 459 flooding through inappropriately located uses and developments.’ (p.19). The *Flood Guidelines* contain
 460 extensive information on how *accommodate* might be used to adapt to floods attributable to climate change,
 461 with most of this taking the form of guidance on urban planning, subdivisions and building design to
 462 accommodate a ‘1% annual exceedance probability flood level’ (a large flood having a 1% chance of
 463 occurring in any given year). Like *retreat*, *protect* is considered and largely discarded as unreliable, for
 464 example, ‘Permanent or temporary flood walls, flood barriers, levees or other flood protection structures are
 465 sometimes proposed for new development. ... They are not fail-safe and should only be considered for
 466 protecting existing development. They should not be used to justify new buildings or roads in unsafe
 467 locations or to offset floor level requirements for new buildings.’

468 469 **4.3 Integration of climate change mitigation and adaptation**

470 None of the documents analysed explicitly integrated adaptation and mitigation actions (see Table 4). The
 471 *Climate Change Adaptation Plan* does imply integration on a few occasions, namely when adaptive

472 outcomes are noted to produce a co-benefit for mitigation: for example, increased energy efficiency is seen
 473 as an opportunity to both reduce GHGs and enable security of supply (p.49). Similarly, the *CCF* integrates
 474 adaptation with mitigation, but the word ‘integration’ is not used. It seeks to push the Victorian energy and
 475 other systems into a new and fundamentally different stable state via both mitigation and adaptation in the
 476 one framework. This is exemplified by statements like, ‘reducing emissions and building resilience’ (p.40),
 477 ‘while reducing emissions will go some way to combatting climate change, we need to plan for the already
 478 unavoidable impacts of climate change’ (p.1) and by, ‘accelerating the transition to a net zero emissions and
 479 climate-resilient Victoria’ (p.5). Despite the commendable potential of the Framework to meaningfully
 480 integrate mitigation and adaptation, the power and potential that the concept of *integration* could have
 481 brought to the Plan is not fully realised. Furthermore success remains uncertain given Victoria’s track record
 482 on sustained policy implementation (Buxton et al. 2011), and possible inconsistencies with other strategic
 483 plans.

484

485 The urban planning policies that were analysed did not explicitly integrate climate change mitigation and
 486 adaptation. For *Plan Melbourne*, the need for both mitigation and adaptation is identified as ‘one of the key
 487 issues shaping the plan’. Yet the Plan states that ‘adapting to changing climate is about taking deliberate
 488 steps to manage and mitigate ... potential impacts’, thus using the term ‘mitigate’ to mean something other
 489 than reducing emissions. This also follows through to *Plan Melbourne Implementation* where, ‘mitigation’ is
 490 only used in the phrase ‘risk-mitigation’, with adaptation to climate change phenomena seen as the principle
 491 way in which risks to property and lives can be minimised. Despite the ambition of *Plan Melbourne*, the
 492 overall focus of the Plan is for growth and development which seems at odds with the imperative for the
 493 scale and nature of the energy descent that is likely to be necessary. For the flood management documents,
 494 there is acknowledgment that WSUDs should be *climate sensitive* or *climate neutral*, thus implying a level of
 495 integration.

496

497 **4.4 Addressing climate change across scales of government and disciplines**

498 When considering the consistency of addressing climate change across scales of government of
 499 implementation it appears that the State *CCAct* facilitated the integration of its mitigation aims across policy
 500 scales into other climate change specific documents. However, this did not consistently integrate into other
 501 policy disciplines (urban planning and flood management). The absence of any mention of climate change in
 502 the *P&EAct* increases the likelihood that, as a whole, future land-use planning in Victoria will not make a
 503 contribution to transformative change to meet climate change mitigation and adaptation targets, and that it
 504 will exacerbate the problem. The VPPs cover diverse issues, e.g. housing, infrastructure, roads and native
 505 vegetation. They are generally outcome-based and provide benefit by bestowing broad discretionary power

506 upon local government. This has the potential for provisions developed in good faith to benefit human
507 wellbeing in the short term, to also have negative impacts on longer term wellbeing, e.g. by failing to protect
508 the climate. SLR translates across scales of government (state to local), but does not effectively integrate into
509 urban planning tools and regulations, which is problematic (Hurlimann et al. 2014). Overall, there are some
510 inconsistencies across scales of government and disciplines with regards to climate change adaptation and
511 mitigation goals, which should be addressed.

512

513 **5 Conclusions**

514 This analysis has provided important insights into planning for climate change in the state of Victoria,
515 Australia, and the extent to which the need to mitigate GHG emissions and adapt to climate changes is
516 addressed. The findings add to the limited research focused on policy to address climate change, by looking
517 across scales of government (local and state) and disciplines (urban planning; climate change and flood
518 management). Overall, the analysis found that the state of Victoria has articulated strong goals for climate
519 change mitigation through its *CCAct*, and supportive strategic climate change documents that align with the
520 *Paris Agreement* target to limit warming to 1.5°C from preindustrial levels by 2100. The focus of these
521 documents is strongly on the potential for emissions reduction through the electricity sector, with limited
522 consideration of the range of land use planning and policy mechanisms or design guidelines that could assist
523 in emissions reduction and adaptation activities. This indicates that there are important gaps which if not
524 addressed may fail to see the documents' goals come to fruition.

525

526 When assessing the land use planning documents for the state it was found that not all acknowledged the
527 need to mitigate GHG emissions, let alone in line with the *Paris Agreement*. While some land use planning
528 mechanisms to mitigate climate change were activated, many were not, indicating the potential for greater
529 initiatives in this regard. Those mechanisms, when activated, were often done so under the premise of
530 liveability rather than explicitly to address climate change, and specific goals were not articulated.
531 Additionally, it was found that there were occasions when 'mitigation' was used with reference to climate
532 change phenomena / risk (which is in fact adaptation), rather than as a way to describe a reduction of GHG
533 emissions. This conflicts with the typical use of 'mitigation' and could have important implications for the
534 clear articulation of policy to address climate change. Confusion with the use of climate change terminology
535 has been identified as a barrier to addressing climate change action in the Australian construction industry
536 (Hurlimann et al. 2018), and appears to extend beyond that discipline and into policy documents. Thus
537 overall, there are important gaps in land use planning documents with regards to actions to clearly articulate
538 the state's climate change goals, and implement a range of land use mechanisms to achieve this.

539

540 Analysis of the SLR and flood management documents revealed they did not address climate change
 541 mitigation actions in any significant way. It was found that there were important adaptation strategies
 542 addressed in these (e.g. to avoid developing in low-lying areas that would be subject to future SLR), but that
 543 these were not reinforced in the urban planning documents analysed. Thus, developments are being approved
 544 and facilitated in low-lying areas of the capital city. Hence, there are important ways in which the policies
 545 across disciplines are not aligned. Improved alignment of decisions would help ensure appropriate land use
 546 and investment in light of future climate change impacts. The biggest gap observed was the lack of
 547 translation of climate change goals into land use policy, regulation or legislation. This should be addressed
 548 as a priority. The integration of climate change adaptation and mitigation was poor. Apart from some implicit
 549 mentions across some documents, there was limited explicit integration, with most focussing on either
 550 mitigation or adaptation but not both.

551
 552 Overall, the research has indicated important opportunities for policies, across disciplines and government
 553 levels in the state of Victoria Australia, to be better aligned and integrated to achieve climate change goals,
 554 and to ensure these are implemented in decisions made about land use and development. The research
 555 indicates important ways in which legislation, regulation and strategic policy in Victoria could be analysed to
 556 address climate change more holistically. The proposed framework has potential for an extended scope with
 557 a wider range of mitigation and adaptation actions, including codes and design guidelines for low carbon
 558 development, or zoning for green and blue carbon storage. In addition, it can be adapted for use in other
 559 contexts, internationally. Further research into other case studies, and into actual decisions made including
 560 comparative analysis of different contexts, would provide further insight into this important area of research
 561 to address climate change in line with global goals. The framework developed in this research could be used
 562 as a starting point for the analysis.

563

564

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