Whole-life Baseline Carbon Assessment of Residential Building Stock – A Victorian Case Study

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Responding to the climate emergency: metrics and tools for rational action

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On the Residential Building Sector

Characteristics

Larger share of energy & carbon footprint compared to non-residential
(Yu, et al., 2017; Li, et al., 2021)

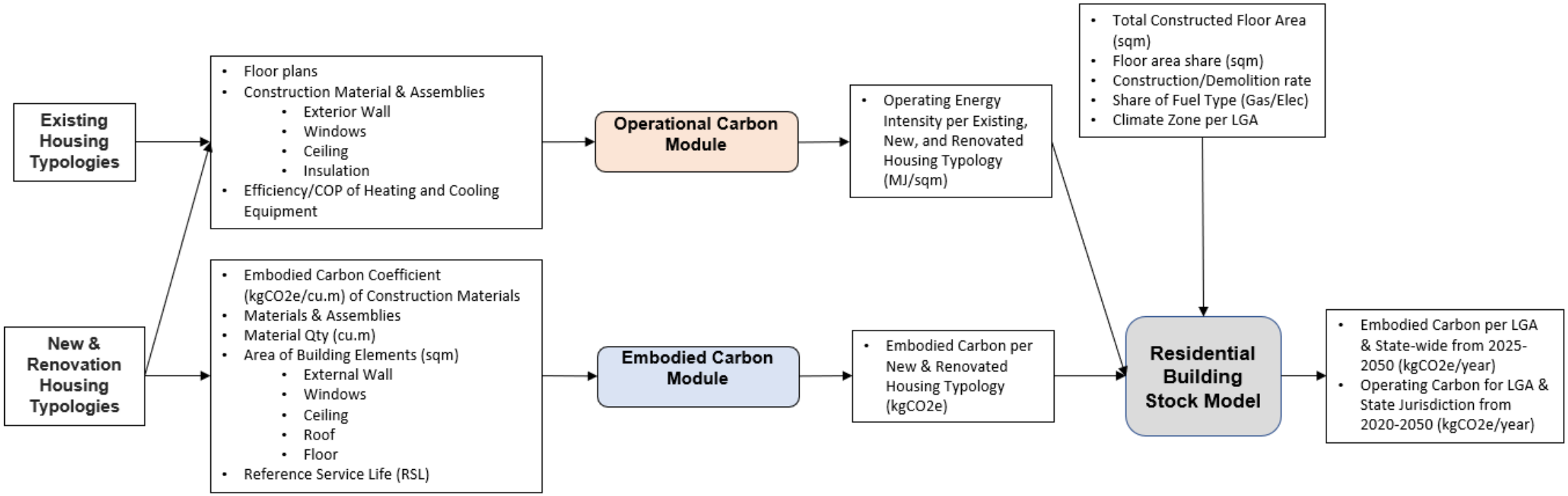
Decarbonisation policies mainly focus on reducing operational carbon emissions
(Frischknecht et al., 2019; Satola et al., 2021)

Gap

Need to incorporate embodied carbon for (whole-life) GHG emissions reduction

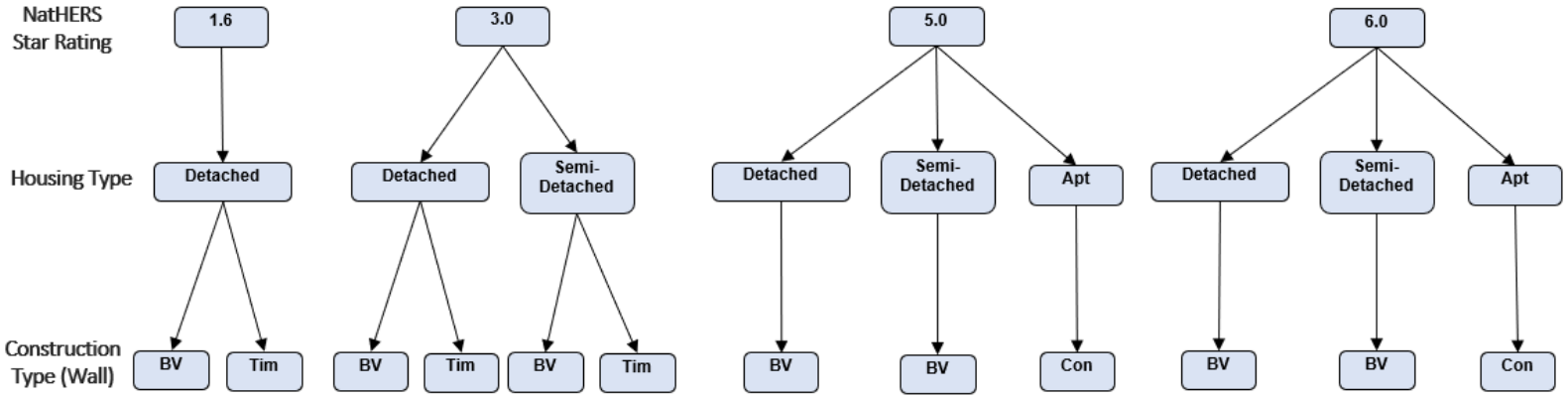
Develop a **typology-based life-cycle carbon calculation and assessment framework** for the residential building stock up to a state-level jurisdiction;

Residential Building Stock Model

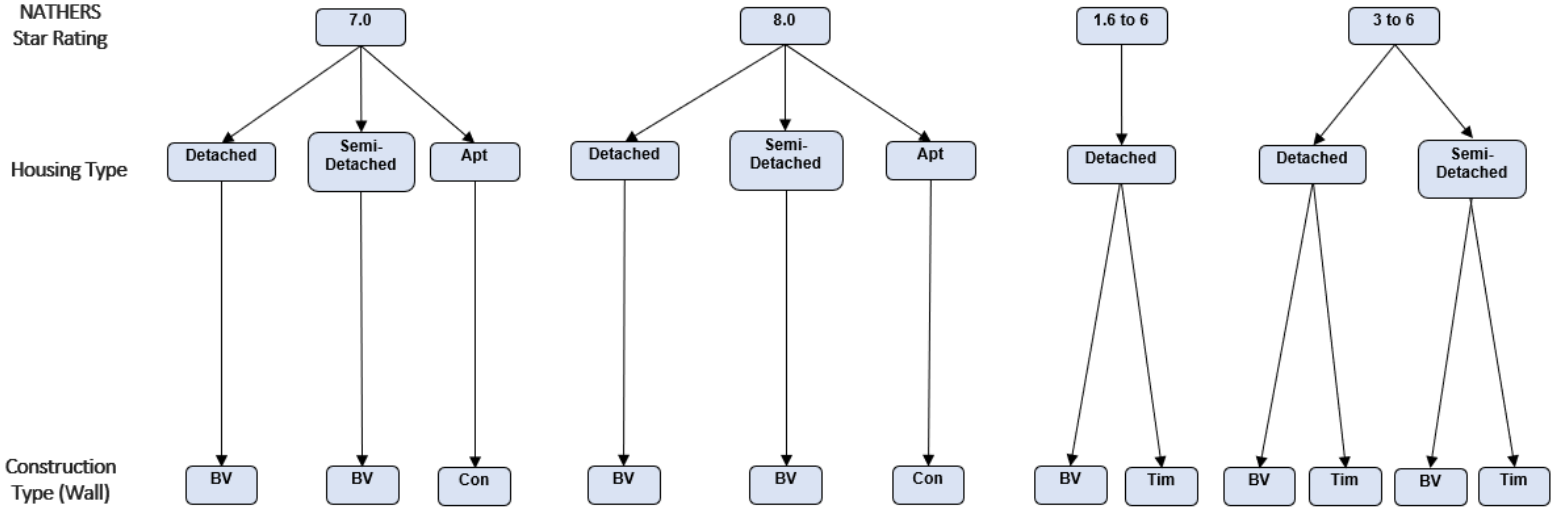


Housing Typologies

Existing Housing



New & Renovation Housing

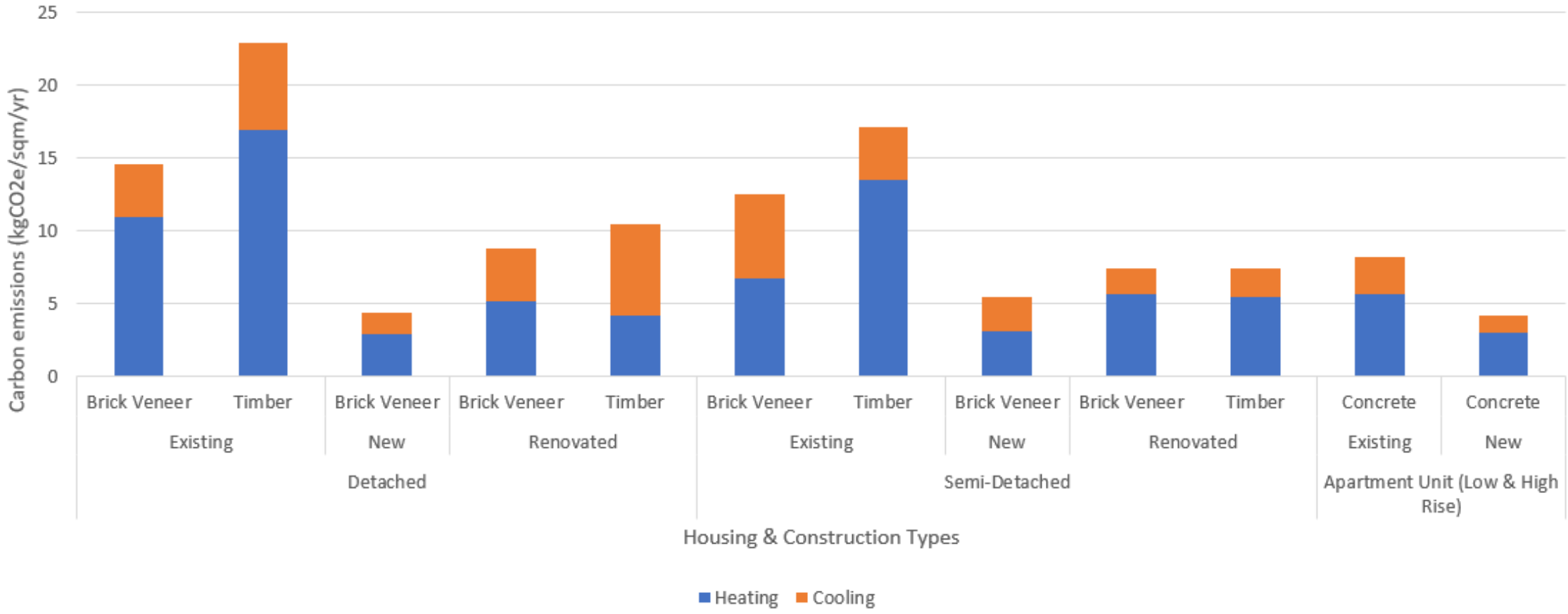


*BV – Brick Veneer
Tim – Timber
Con – Concrete

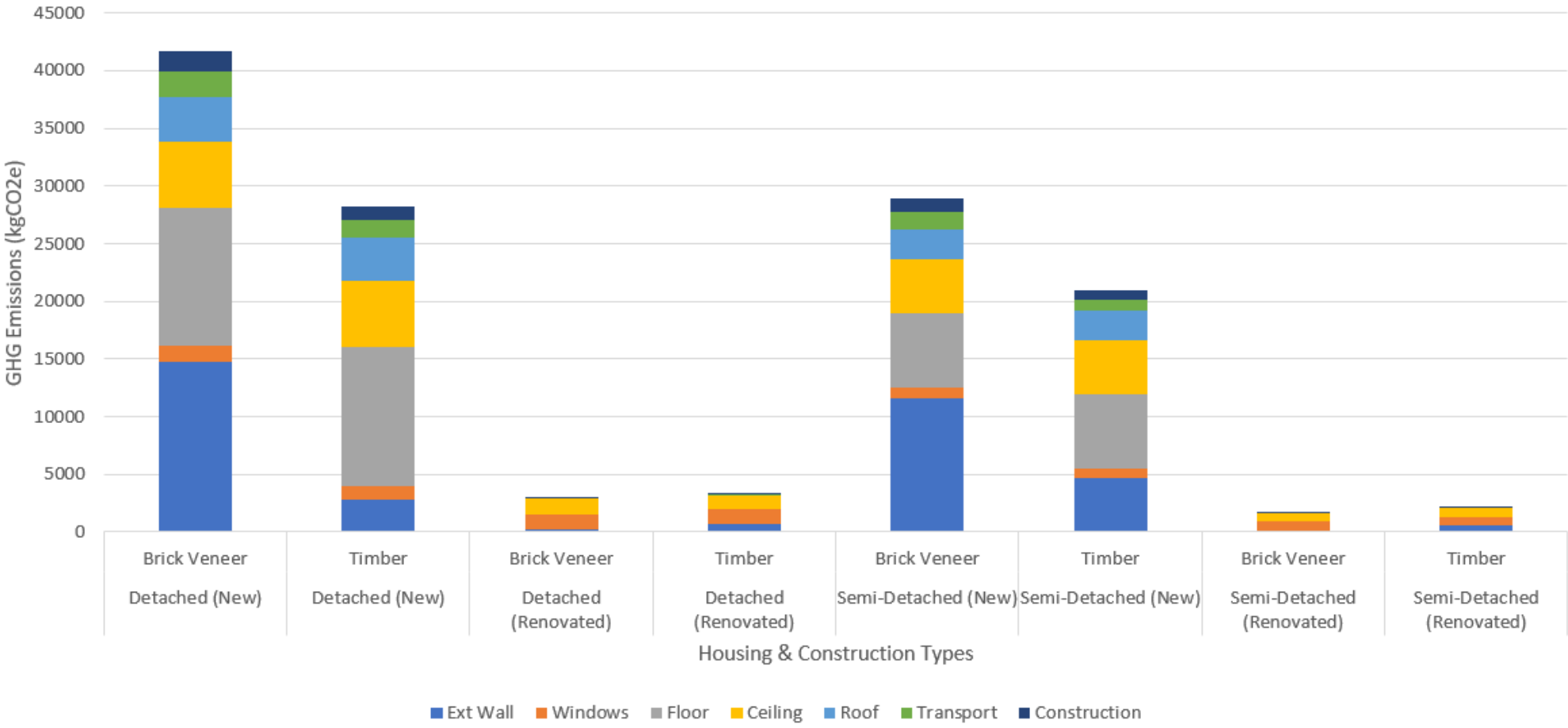
Housing Typologies - Renovation

Housing & Construction Types	Construction Year	Renovation Changes
Detached (Brick Veneer)	Pre-1991	Insulation (Ceiling): R3.0 Insulation (Wall): R3.0 Windows: Clear Double Glazed
Detached (Timber)	Pre-1991	Insulation (Ceiling): R3.0 Insulation (Wall): R2.0 Windows: Clear Double Glazed
Detached (Brick Veneer)	1992-2006	Insulation (Ceiling): R2.0 Insulation (Wall): R0.14 Windows: Clear Double Glazed
Detached (Timber)	1992-2006	Insulation (Ceiling): R4.0 Insulation (Wall): R3.0 Windows: Clear Double Glazed
Semi-Detached (Brick Veneer)	1992-2006	Insulation (Ceiling): R1.5 Insulation (Wall): R1.0 Windows: Clear Double Glazed
Semi-Detached (Timber)	1992-2006	Insulation (Ceiling): R1.5 Insulation (Wall): R1.5 Windows: Clear Double Glazed

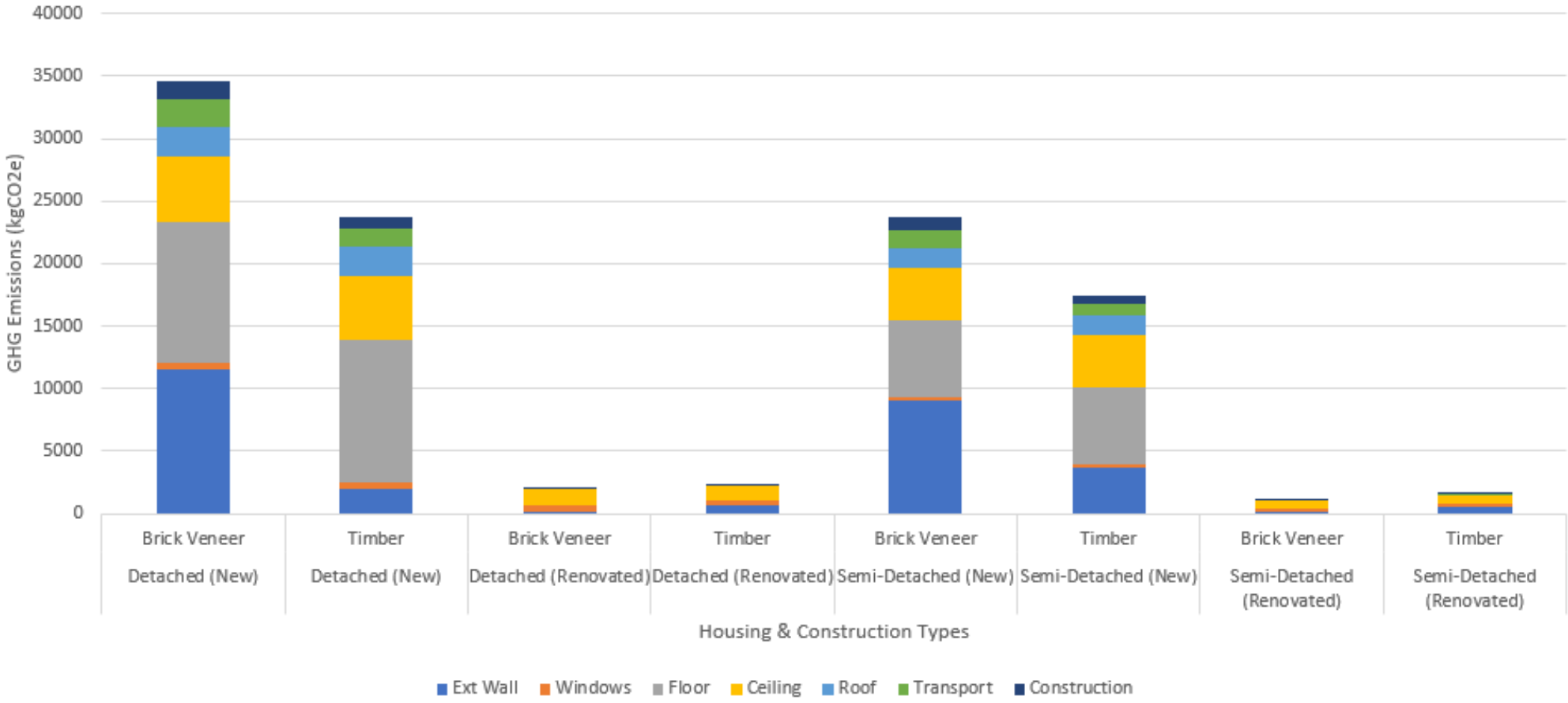
Operational Carbon – By Housing Typology
Melbourne LGA (Climate Zone 6)



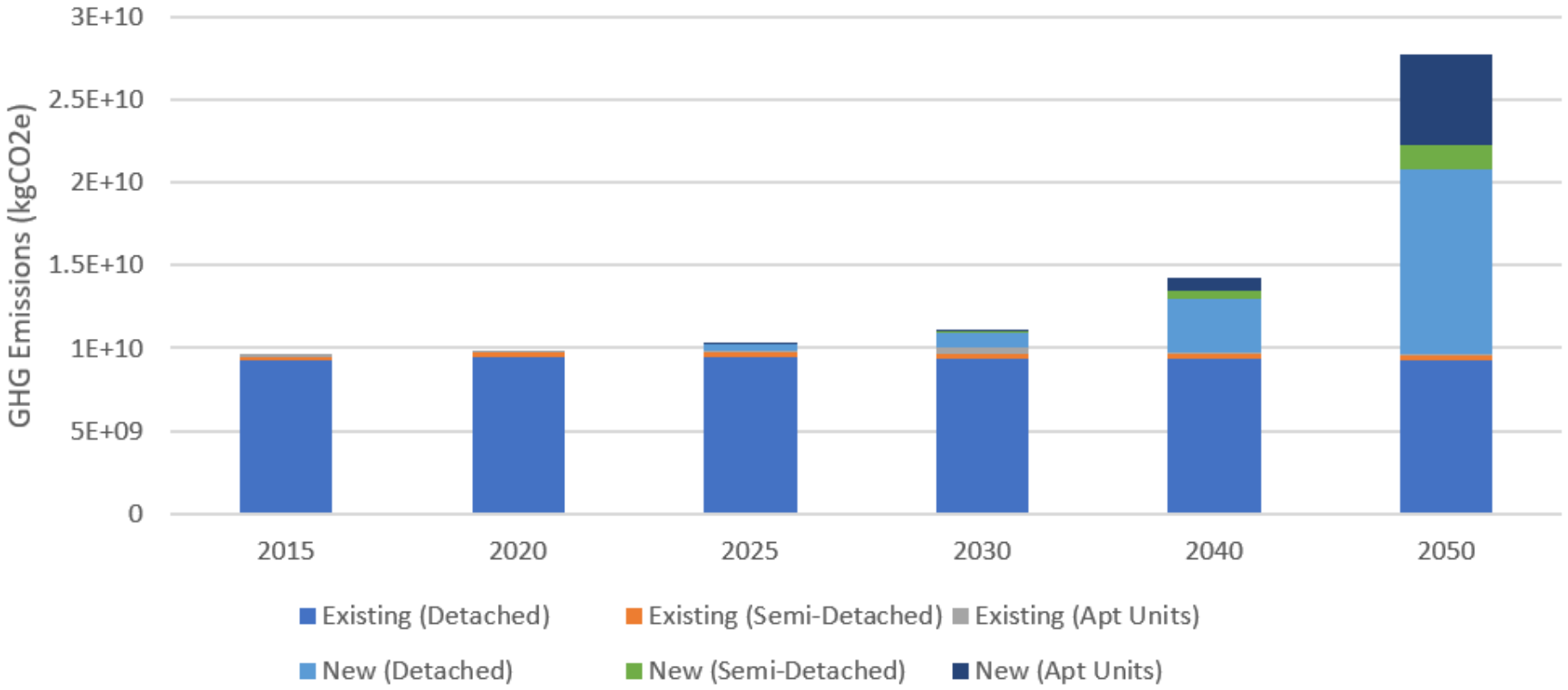
Embodied Carbon – By Housing Typology (EPiC – Hybrid Based LCA)



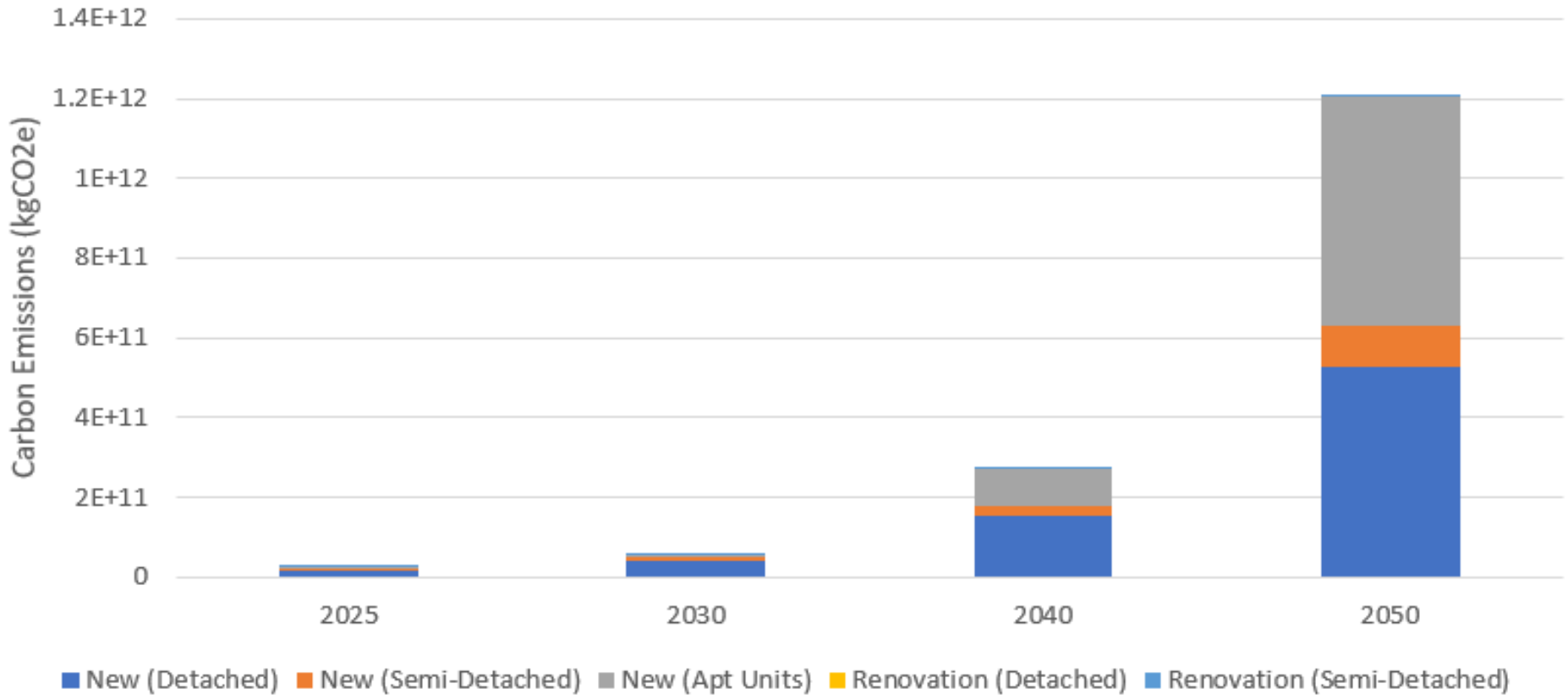
Embodied Carbon – By Housing Typology (Process-Based LCA)



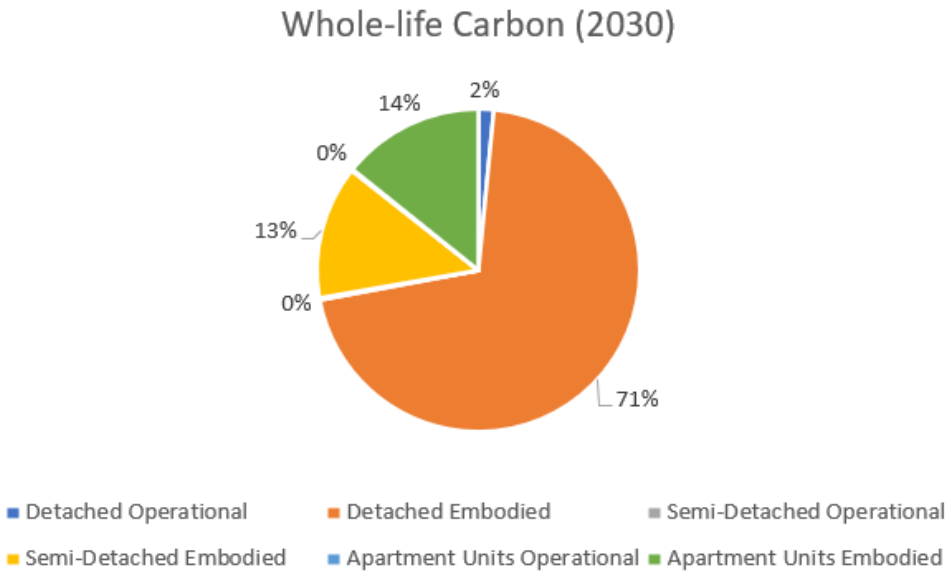
Operational Carbon – Residential Building Stock to 2050

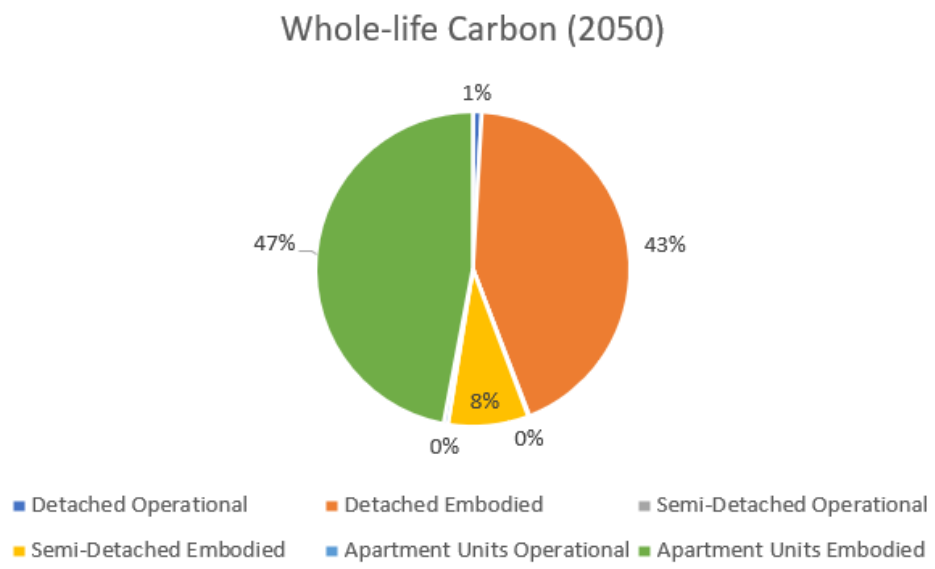


Embodied Carbon – Residential Building Stock to 2050



Whole-life Carbon – Residential Building Stock to 2050





Conclusions & Recommendations

- Heating contributed the most in operational carbon
- Brick veneer external walls and concrete floor slabs contributed the most in embodied carbon
- Existing detached housing comprised most of the operational carbon, though high construction rates set for most LGAs > more whole-life carbon emissions from new housing
- Embodied carbon would have higher contribution to whole-life carbon emissions given set construction rates
- Renovation as a key strategy in residential sector decarbonization
- Include embodied carbon in decarbonization policies
- Investigate various scenarios (e.g. renewables integration, carbon targets)
- Integrating the influence of household decisions in residential building stock emissions

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