INFRASTRUCTURE VICTORIA

AUTOMATED AND ZERO EMISSIONS VEHICLES INFRASTRUCTURE ADVICE

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INFRASTRUCTURE VICTORIA

WHO WE ARE
AND WHAT WE DO

30-year infrastructure strategy

Research

Independent advice to government
(automated and zero emissions vehicles)

OUR VALUES

Independence Influence Partnership Openness Innovation People

INFRASTRUCTURE VICTORIA

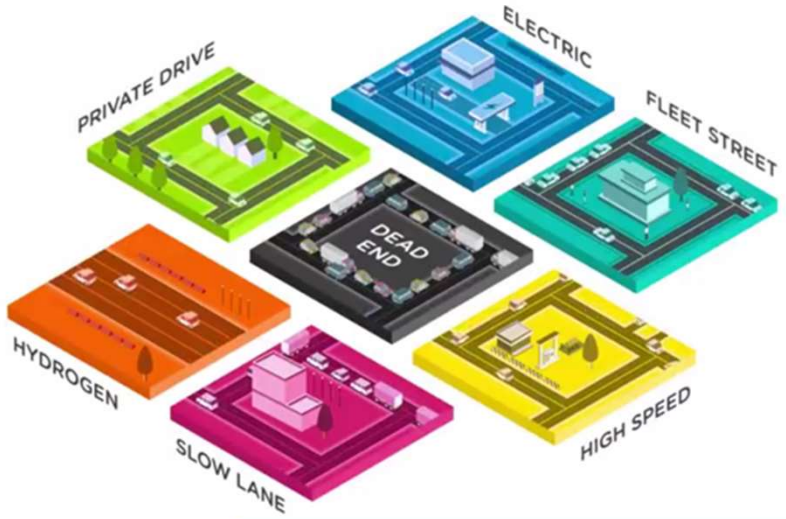
context of the study

The Government is seeking advice from IV on what infrastructure might be required:

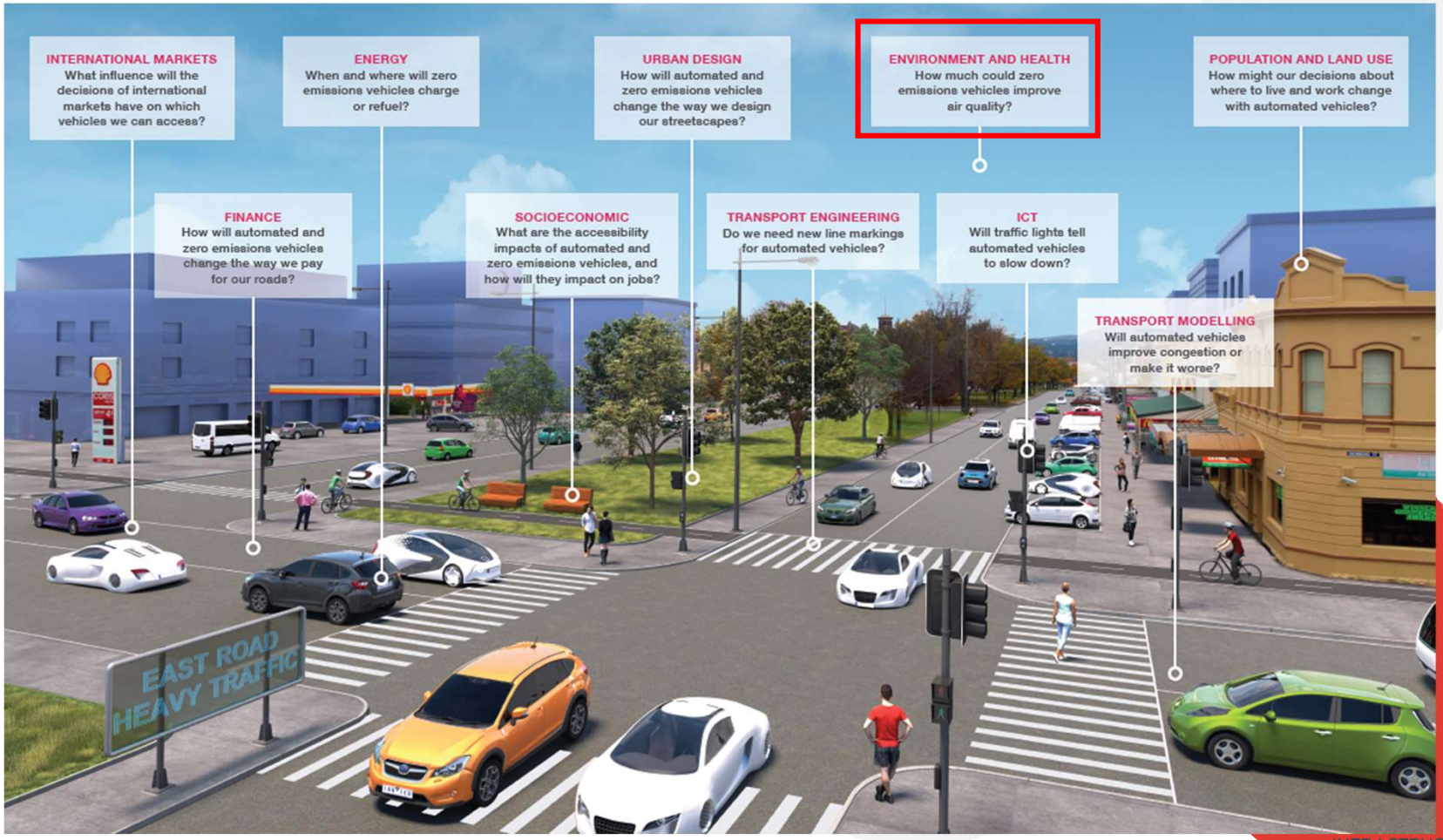
- to enable operation of highly automated vehicles (‘AVs’);
- in response to the ownership and market models that may emerge from the availability of highly automated vehicles; and
- for zero emission vehicles (‘ZEVs’) as a high proportion of the Victorian fleet.

scenarios

- **Electric avenue**, a world where all cars are electric
- **Private drive**, a world where your car drives you
- **Fleet street**, a world where no one owns their own car
- **Hydrogen highway**, a world where trucks lead a hydrogen revolution
- **Slow lane**, a world where human and machine meet on the road
- **High speed**, a world where driverless and electric cars arrive much sooner than we expect
- **Dead end**, a world where the hype never happened



evidence base



Evidence base

HIGHLIGHTS

> *Automated and zero emissions vehicles could be the biggest thing to happen to transport since the car itself.*

What 2046 could look like…

- 94% reduction in road deaths
- Road design similar to today
- Energy consumption could rise by 50%

environment and population health

Aurecon & ERM's brief was to assess the impacts of a zero emissions vehicle (ZEV) and autonomous vehicle (AV) fleet on:

- Population health (due to reduced exhaust emissions)
- Other health and non-health population impacts (noise, accidents, active transport, GHG emissions)
- Manufacturing impacts
- Disposal impacts

environment and population health

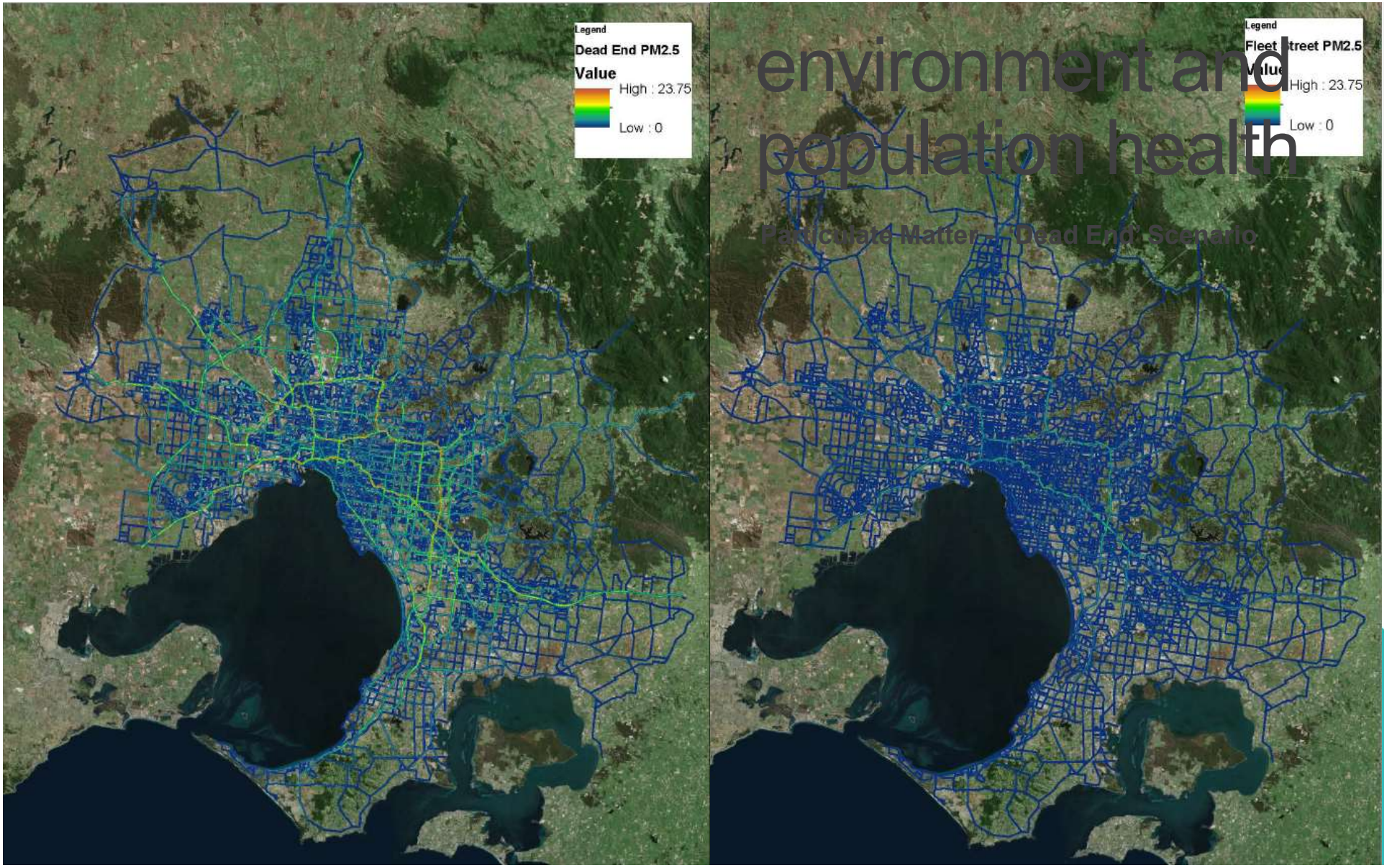
Key takeaways from this work:

- High uptake of ZEVs will substantially reduce emission of harmful pollutants, giving large health benefits
- “Given the magnitude of the health benefits and the significant opportunities and risks associated with a transformation to a ZEV / AV fleet, Aurecon and ERM recommend that the Victorian Government should consider the economic viability of policy measures to incentivise the uptake of ZEV and AV vehicles…”
- Thought should be given to where and how air quality standards will need to evolve to encourage uptake, but also adapt to the changing make-up of pollutants in the air shed going forward.

environment and population health

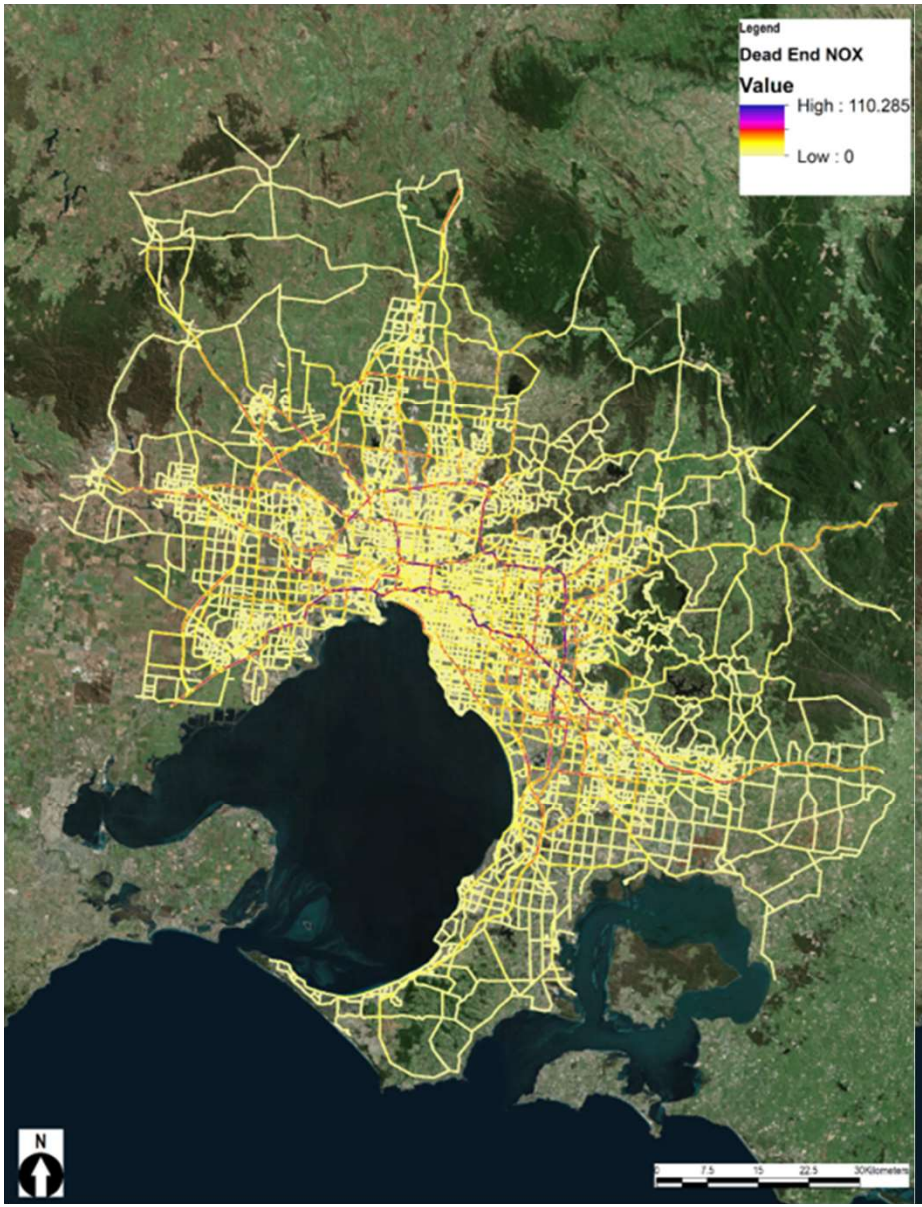
Important data points

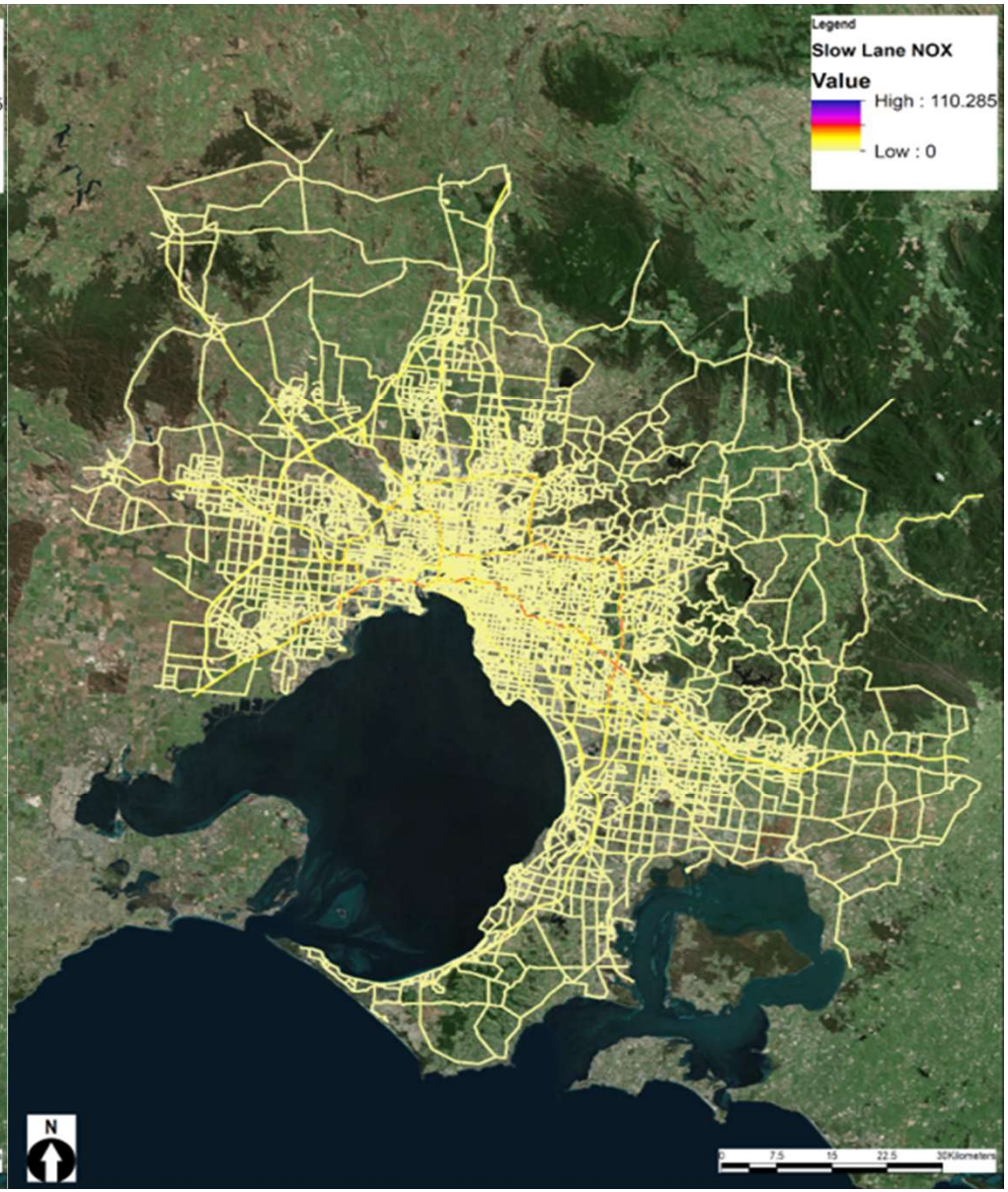
- ‘Dead End’ has a base of 5,425 DALYs. This can be improved on depending on scenario by close to 4,000 DALYs per annum
- 27,000,000 T of CO_2e can be avoided, ~25% Victorian GHG in 2015
- Slow lane scenario shows increase in PM2.5 emissions for: the Albert Park, Melbourne, Seabrook, South Melbourne, South Yarra – West, St. Kilda and St. Kilda East SA2 areas.
- In the Private drive empty running scenario there is an increase in PM2.5 emissions for: the Carlton, Fitzroy, Melbourne, South Yarra, St. Kilda and St. Kilda East SA2 areas.



environment and population health

Particulate Matter - Dead End Scenario


Legend
Dead End NOX
Value
High : 110.285
Low : 0
N
0 7.5 15 22.5 30Kilometers

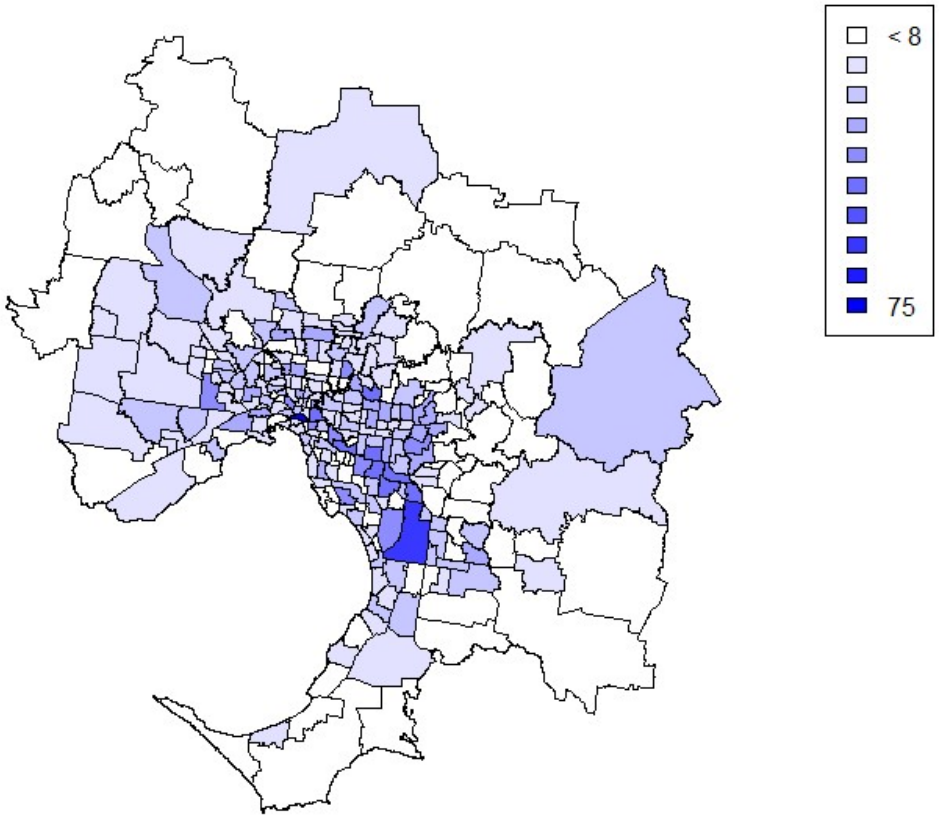

Legend
Slow Lane NOX
Value
High : 110.285
Low : 0
N
0 7.5 15 22.5 30Kilometers

population exposure – overall findings

- 100% reduction in combustion emissions (NOX, CO, hydrocarbons etc.) for Electric avenue, hydrogen highway, private drive & private drive empty running.
- PM2.5 reduced by 40 – 48% in most scenarios due to changes in fleet size and weight of EVs.
- Overall reduction for Private drive empty running scenario is only 36% as this scenario includes higher vehicle numbers compared to the dead end scenario.

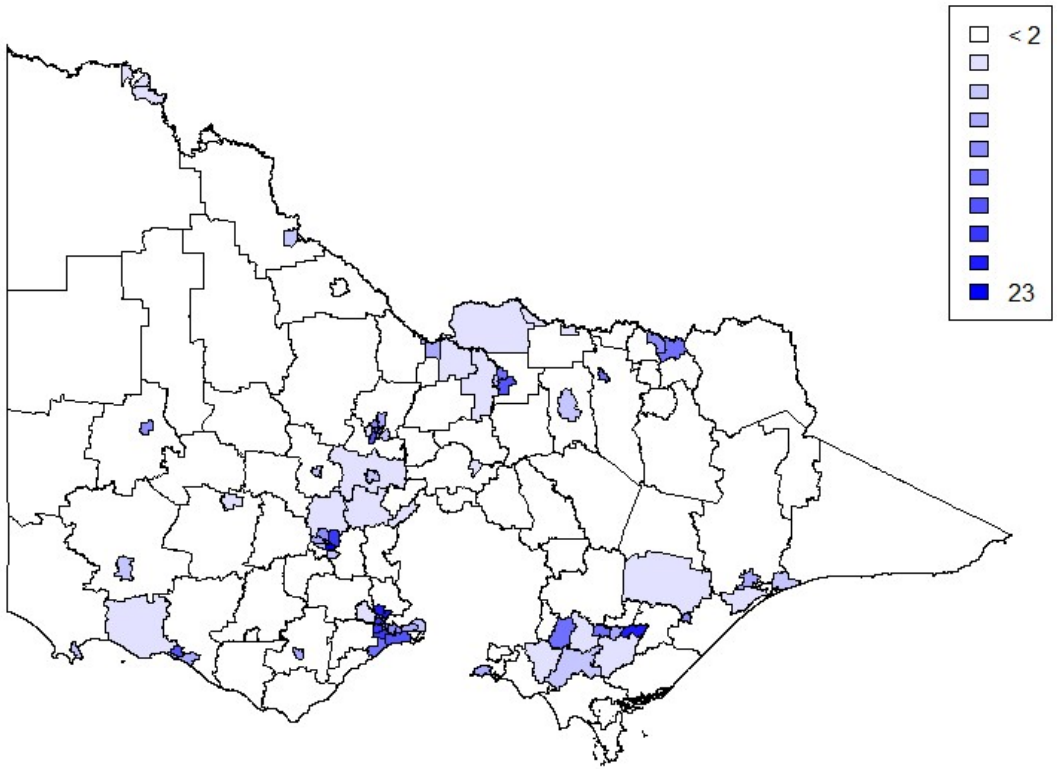
environment and population health

Estimated avoided DALYs Melbourne Fleet Street



environment and population health

Estimated avoided DALYs Victoria Fleet Street

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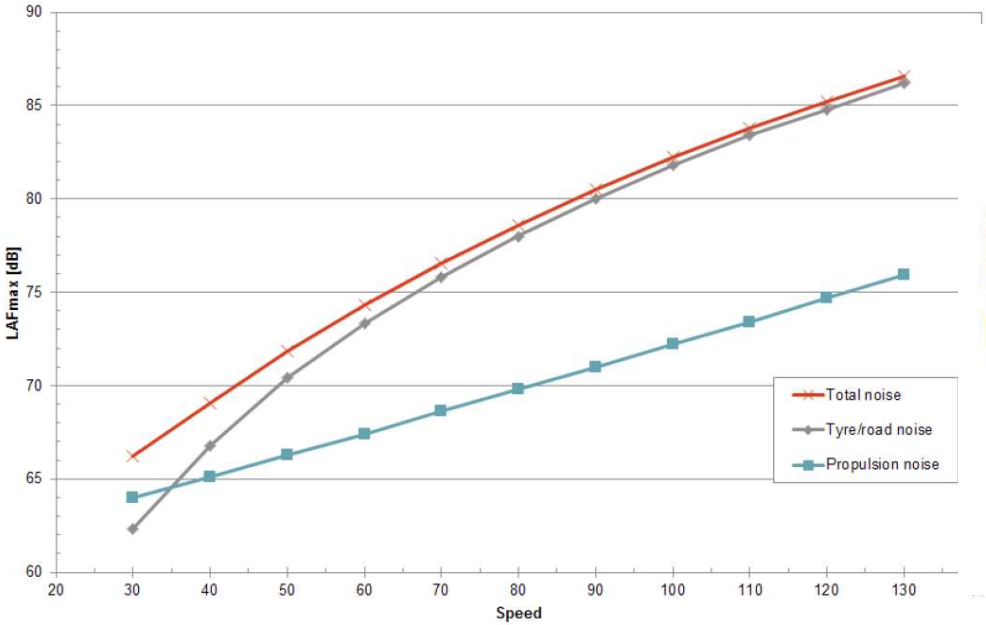
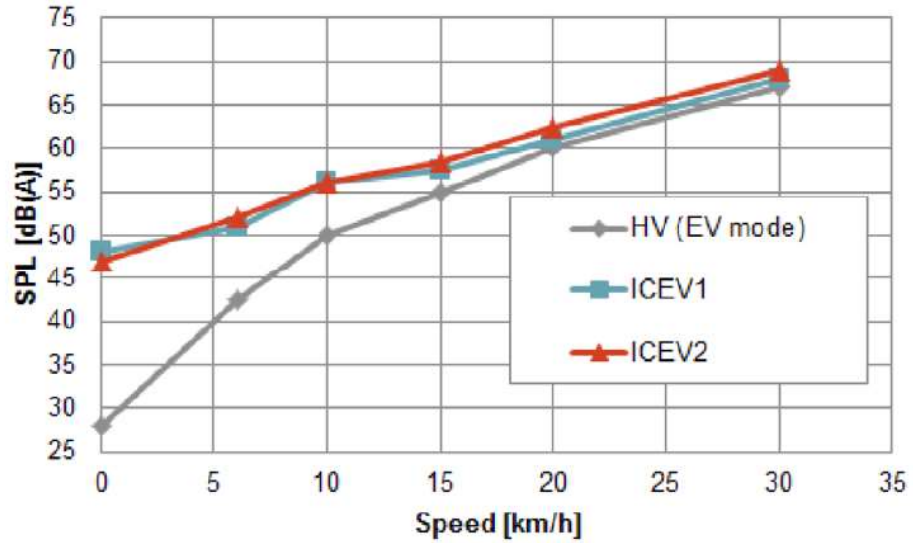
environment and population health

Noise levels of EVs vs. ICEVs



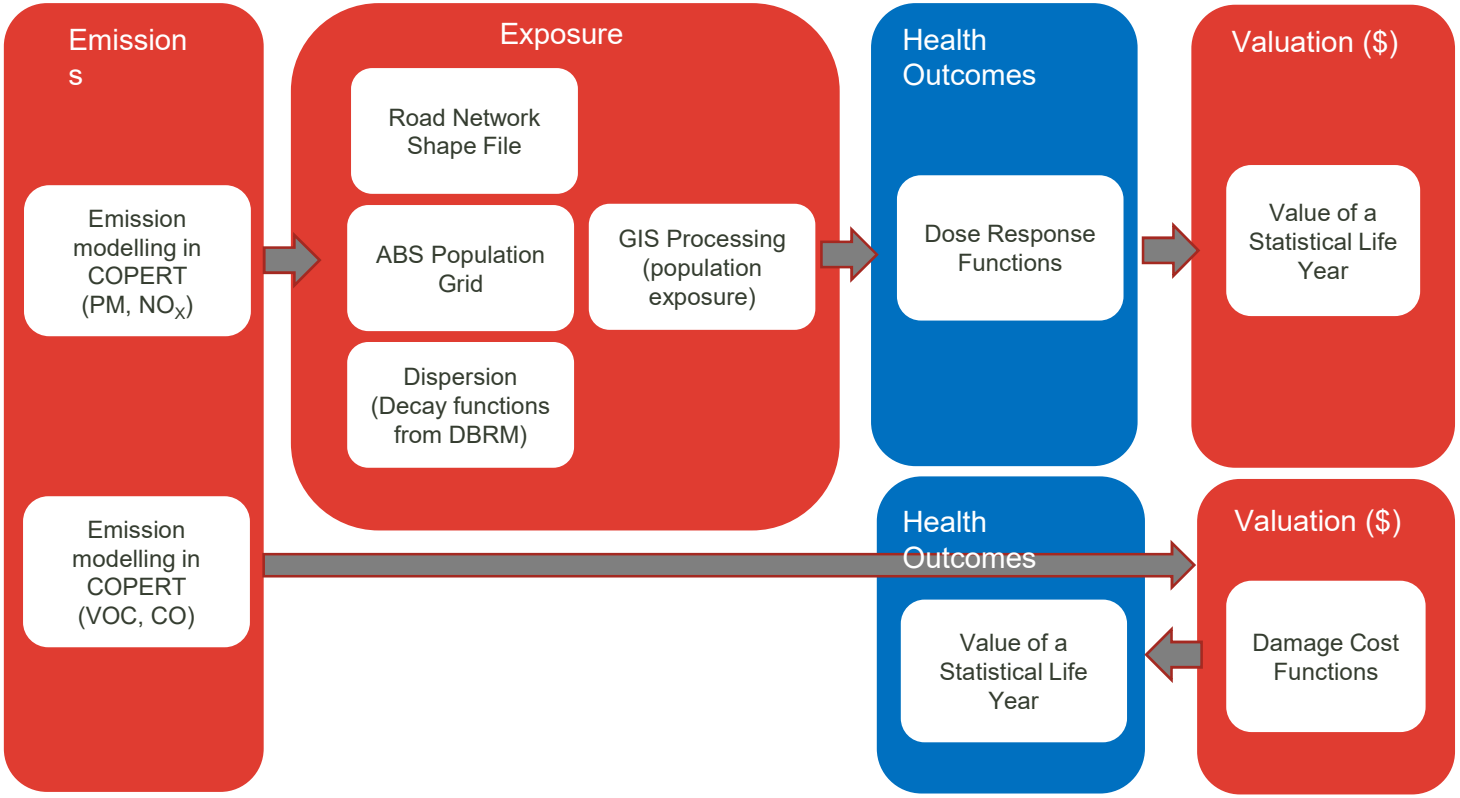


Population Health Impacts

	Electric avenue (2046)	High speed (2031)	Fleet street (2046)	Hydrogen highway (2046)	Slow lane (2046)	Private drive (2046)	Dead end (2046)
Total DALYs							
Regional	57	46	56	57	122	53	214
Metro	1 731	1 297	1 583	1 933	3 906	2 119	5 196
Remote	5	4	5	5	10	4	14
TOTAL (DALYs)	1 793	1 347	1 644	1 995	4 037	2 175	5 425
Total Change from Dead end scenario (DALYs Avoided)							
Regional	158	130	158	157	93	162	
Metro	3 464	2 961	3 613	3 263	1 290	3 077	
Remote	10	8	10	10	4	10	
TOTAL (DALYs)	3 632	3 099	3 781	3 430	1 388	3 250	
TOTAL ($m)	706	603	735	667	270	632	

- ***Slow lane:*** *Lowest avoided DALYs (1,388)*
- ***Fleet Street:*** *Highest avoided DALYs (3,781)*
- *Benefits concentrated in the metro region*

Population Health Impacts Methodology (Aurecon / ERM)



A question for policymakers

Given the substantial population health benefits associated with the uptake of ZEVs and AVs

- Are policy settings (tax, infrastructure investment, industry development) appropriate to encourage the optimal level and timing of ZEV and AV uptake?
- Are there changes to policy settings / new policy measures that could:
  - Address barriers to uptake?
  - Incentivise uptake?
  - Provide a net benefit to society?

Appendix 1 - ERM Population Exposure Process Summary (1)

- AZEVIA Dashboard
- Metropolitan Melbourne Link Statistics
- Tailpipe Emissions - COPERT Australia
- Non-Tailpipe Emissions – Published Paper
- 2046 Network shape file
- SA2 Boundary areas from Australian Bureau of Statistics
- Victorian Population on 1 km^2 basis
- UK DMRB – decay curve

- Assumption that for dead end and slow lane that combustion engines were the best of current engine technology
- Used COPERT + Non-tailpipe emissions to generate factor for various road speeds and fleet mix equivalent to a road type
- Multiply emission factor by actual number of vehicles on each link within the AZEVIA Dashboard

Appendix 1 - ERM Population Exposure Process Summary (2)

- For NO2 and PM10
- Buffers created in GIS around each road link at varying distances
- Point data created for each buffer
- Decay curve from UK DMRB used along with emission rate for each road link to define concentration at each point around the road link
- Inverse distance weight method used to interpolate and summed

Appendix 1 - ERM Population Exposure Process Summary (3)

- For all species except NO2 and PM10
- Total emissions for each road link applied to an SA2 area and summed
- Each scenario taken away from the dead end scenario to determine emission reductions

- Fishnet of 1km size used to overlay Victorian Population data
- Spatial join used to get average raster value per 1 km2 to derive population exposure

Table 4-1 – Dead end and Slow lane scenario emissions for Melbourne by SA2 group (kg / year)

	CO	VOCs	PM_{10}	SO_2	Benzene	Toluene	Ethylbenzene	Xylenes	$PM_{2.5}$	NOx
Dead End										
Metro	42,249,316	8,076,247	4,511,411	325,441	323,666	621,724	107,533	482,048	2,419,953	11,402,495
Regional	2,193,447	522,793	257,162	16,820	14,761	28,162	4,868	23,943	137,014	780,038
Remote	4,965,928	917,493	508,212	38,023	37,895	72,852	12,602	55,734	272,753	1,249,624
Dead End Total	**49,408,691**	**9,516,533**	**5,276,784**	**380,284**	**376,322**	**722,737**	**125,003**	**561,724**	**2,829,720**	**13,432,156**
Slow Lane										
Metro	20,449,367	3,953,641	3,727,068	188,270	60,305	110,875	19,281	113,172	1,979,043	8,001,779
Regional	1,244,376	310,865	219,132	10,420	3,115	5,617	974	7,187	116,154	591,324
Remote	2,376,777	437,473	416,484	21,142	8,044	14,965	2,600	14,063	220,572	839,352
Slow Lane Total	**24,070,520**	**4,701,979**	**4,362,684**	**219,832**	**71,464**	**131,457**	**22,855**	**134,422**	**2,315,769**	**9,432,455**

Table 4-2 – $PM_{2.5}$ emissions by scenario (kg / year)

	Dead end	Electric Avenue	Fleet Street	High Speed[1]	Hydrogen Highway	Private Drive	Slow lane
Metro	2,419,953	1,366,486	1,260,279	n/a	1,440,412	1,473,552	1,979,043
Regional	137,014	78,404	76,889	n/a	75,759	76,424	116,154
Remote	272,753	152,752	143,099	n/a	159,925	161,369	220,572
Total	**2,829,720**	**1,597,642**	**1,480,268**	**n/a**	**1,676,096**	**1,711,344**	**2,315,769**

Note[1]: No transport modelling and therefore emission modelling was undertaken for this scenario. The health impacts of the High speed scenario have been estimated by scaling the Fleet Street scenario results.

Table 4-3 – NOx emissions by scenario (kg / year)

	Dead end	Slow lane
Metro	11,402,495	8,001,779
Regional	780,038	591,324
Remote	1,249,624	839,352
Total	**13,432,156**	**9,432,455**