

Hanna -Submission to **Electric Vehicles** Senate Select Committee 2018 July

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RE: The use and manufacture of electric vehicles in Australia

To the Senate Standing Committees on Environment and Communications

Thank you for the opportunity to provide a submission to the “The use and manufacture of electric vehicles in Australia” Inquiry.

I note the Terms of Reference for this review. This submission provides comment on TOR:

- f. health benefits.
 - a. potential economic, environmental and social benefits of widespread electric vehicle uptake in Australia
 - c. measures to support the acceleration of electric vehicle uptake

Motivation to make this submission is provided by my grave concerns informed via professional expertise in the current and future, direct and indirect health harm arising from the combustion of fossil fuels for transport in Australia. I forward this as a personal submission as I have not had time to seek authorisation from my organisations.

I present the case that sufficient benefit exists for widespread uptake of electric vehicles in Australia on the grounds of human health - by dramatically reducing respiratory and cardiac disease and associated costs via lost productivity, and additional health budget demands.

I further argue that sufficient grounds exist for this transition, based on averted greenhouse gas emissions, which reduce current and future health burden, health budget demands, plus aversion of increasingly frequent disasters.

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About the Author:

Dr Elizabeth (Liz) Hanna. After a professional career spanning 16 years in Intensive Care, I transitioned to Senior Health Administration, and the tertiary sector, health workforce training, public health (and an MPH), and a PhD in environmental health. My PhD examined exposures from multiple angles. Starting with physiological endpoints arising from hazardous exposures, personal understanding of risk and willingness to adopt self-protective behaviours, I then examined health sector expertise and capacity to provide informed advice and to diagnose and manage exposure related disorders, as well as surveillance and health intelligence available to governments upon which to understand prevalence, trends and to ultimately build sound policy. My research completed with a comparison of Australia's entire chemical risk pathway to international best practice.

I therefore have a deep knowledge of human physiology, which is relevant to the health threats of climate change, plus a deep understanding of public health, and how climate impacts upon the population, the vulnerable groups, and the relationship between policy levers, and health and social outcomes. This is capped by a grounding in climate science, and expertise in climate change and human health, adaptation and mitigation strategies. Thus, my expertise in complex exposure risk pathways now also includes how climate change mitigation becomes a health determinant.

Of specific relevance to this Inquiry, is my understanding of the physiological harm resulting from individual and population levels of exposures to traffic exhaust fumes and to climate extremes.

I was recently appointed Chair of the Environmental Health working Group for the World Federation of Public Health Associations. My professional background includes several terms on the enHealth Council (Australia's peak advisory body to AHMAC¹ on Environmental Health, on the Board and Convening the Environmental Health Group of the Public Health Association of Australia (for which I received the President's Award in 2017). For the past 15 years, I have focused entirely on human health research and policy development of Climate Change Adaptation (CCA), climate health risks, risk awareness and behavioural protective responses. I have also led Climate Change Vulnerability Assessments for the Pacific Island States and the State of Victoria, and for the past two decades, lectured climate change impacts on human health and supervised PhD candidates examining CCA in many parts of the world. I am the Key Contact for Climate Change for the *Australian College of Nurses*, and immediate Past President of the *Climate and Health Alliance*. Currently I am an Honorary Senior Fellow at the *Climate Change Institute* at the *Australian National University*, and for the years of its operation, I convened Australia's *National Climate Change Adaptation Network for Human Health* at ANU, as a hub of the National Climate Change Adaptation Research Facility (NCCARF).

¹ Australia's Health Ministers Advisory Council

Vehicle emissions are bad for human health.

Fossil fuelled transport releases exhaust gas fumes that are a toxic compound to human health. Various gases contribute significantly to the outdoor air pollution in urban areas. These include, among others, Hydrocarbons (HC), Nitrogen oxides (NO_x), Carbon monoxide (CO), Sulphur dioxide (SO₂), and particulate matter [referred to by their size in microns – the smaller PM_{2.5} is among the most harmful vehicle pollutants as it can penetrate deeper into the lungs causing irritation and sensitivity.

We also know there is a *dose response relationship*, meaning the higher the dose (exposure level), the more severe the health outcomes. Air pollution causes a variety of respiratory and allergic disease associations, and proximity to roadways and industrial sites are associated with higher rates of asthma and allergies (1).

Long-term exposure to ambient (outdoor) air pollution is associated with respiratory diseases, including sensitivities and allergenicity, cardiovascular diseases (heart attacks and angina), cerebrovascular disease (strokes) and cognitive impairment. Exposure to elevated levels of PM_{2.5} is associated with smaller total cerebral brain volume, a marker of age-associated brain atrophy, and with higher odds of brain infarcts. We now know that air pollution is associated with insidious effects on structural brain aging even in dementia-and stroke-free persons (2).

The World Health Organisation (WHO) reports that over 4.2 million deaths a year are linked to exposure to outdoor air pollution, and children are particularly susceptible. The WHO 2018 Fact Sheet on Air Pollution finds 9 out of 10 people worldwide breathe polluted air, almost all urban residents on the planet. Air pollution causes 24% of all stroke deaths (1.4 million deaths annually), 25% of global heart disease deaths (2.4 million deaths), and 43% of all lung disease and lung cancer deaths (1.8 million deaths every year (3).

Countries with the strongest emission standards have the lowest health burden. Australia has had road vehicle emission standards in place for new vehicles since the early 1970s and these have been progressively tightened over the past 40 years. However, Australia still lags behind the USA and Europe, notably in Sulphur standards (4). Australia has an opportunity to reduce greenhouse gas emissions and lower fuel bills for Australian motorists by making light vehicles more efficient (5). Strengthening light vehicle emissions standards is an excellent way to achieve this (5), as is the promotion of electric vehicles.

Governments can reduce deaths and disease by regulating to ensure clean air. I am not aware of recent studies that have quantified the full cost savings of reduced health care costs, or personal costs due loss of productivity arising from exposure specifically to transport component of Australia's air pollution. A 2015 study conducted by the Climate and Health Alliance identified that the health care costs for Hunter Valley residents

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(Singleton and Muswellbrook), due their proximity to coal fired power stations amounted to \$65 million per year, purely from exposure to fine particles (PM2.5) (6).

Arguments put forward to resist measures that protect the environment often cite costs, as a barrier. However, these proponents rarely include full accounting in their cost estimates. Savings from the health sector usually outweigh initial costs, and personal loss of income due to ill health is never factored in to such arguments. National GDPs benefit from a healthy population. And with respect to lower emission cars, the added cost to the purchase of a new car of an estimated \$1500 would be offset several times by fuel savings of about \$8500 over the life of the vehicle, leaving motorists financially ahead.

Electric cars do not emit the toxic mix of chemicals, so they offer even greater health benefits than vehicles with tight emissions standards. It logically follows that the health savings would be considerable, although I do not have the exact figures.

Burden of Diseases in Australia from Coronary Heart Disease, Stroke and Respiratory disease.

Data for this section derives from Australia's Health 2018, a publication of the AIHW (7)

- In 2016, *Coronary Heart Disease* (CHD) was the leading single cause of death in Australia, accounting for 19,100 deaths as the underlying cause of death. This represents 12% of all deaths.
- In 2015–16, there were 157,000 hospitalisations where CHD was the principal diagnosis (1.5% of all hospitalisations). Most were emergency admissions.
- In 2015–16, the age-standardised rate of hospitalisations declined to 569 hospitalisations per 100,000 population.
- Of all CHD hospitalisations, 45% had a coronary angiography (a diagnostic procedure) and 24% underwent revascularisation (surgical procedures to restore blood supply to the heart).
- In 2011, CHD accounted for 7.7% of the total burden of disease in Australia, 12% of the overall fatal burden of disease, and 3.2% of the non-fatal burden.
- The burden was more than twice as high in males than females and increased rapidly from age 45 onwards—to 17% among people aged 85 and over

Stroke occurs when a blood vessel supplying blood to the brain either suddenly becomes blocked (known as an ischaemic stroke) or ruptures and begins to bleed (known as a haemorrhagic stroke). Either may result in part of the brain dying, leading to sudden impairment that can affect a number of functions. Stroke often causes paralysis of parts of the body normally controlled by the area of the brain affected by the stroke, or speech problems and other symptoms, such as difficulties with swallowing, vision and thinking.

- Strokes are highly debilitating, and costly in terms of massive reduction in quality of life, capacity to work, limiting the capacity of the carer to work, and entails long

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periods of hospitalisation and rehabilitation, in addition to long term care and support.

- In 2015, an estimated 394,000 (1.7% of all) Australians had suffered a stroke at some time in their lives, and 40% were living with ongoing disability.
- In 2015, there were around 36,700 stroke events—around 100 every day, this gives an age-standardised rate of 130 per 100,000 of population
- Stroke accounted for 3.0% of the total burden of disease in Australia
- In 2016, there were 8,200 stroke related deaths, accounting for 5.2% of all deaths
- The decline in stroke deaths has slowed among younger age groups
- In 2015–16, there were 37,300 acute care hospitalisations for a principal diagnosis of stroke = 134 per 100,000 population.
- Hospitalisation rates were 1.4 times higher among males than females
- The average length of stay for stroke patients in acute hospital care was 8 days in 2015–16.
- Stroke patients in rehabilitation care had an average length of stay of 26 days.

Chronic respiratory conditions affect the airways, including the lungs, as well as passages that transfer air from the mouth and nose into the lungs. These conditions are characterised by symptoms such as wheezing, shortness of breath, chest tightness and cough. Conditions include asthma, chronic obstructive pulmonary disease (COPD)—which covers emphysema and chronic bronchitis—allergic rhinitis ('hay fever') and other conditions such as chronic sinusitis, bronchiectasis, and pulmonary fibrosis and others.

Risk factors associated with chronic respiratory conditions can be behavioural (smoking), environmental or genetic. Involuntary exposure to air pollutants occurs when breathing outdoor air polluted by traffic in urban environments.

- Chronic respiratory conditions affect almost one-third (31% or 7 million) Australians.
- The 2 most common respiratory conditions are hay fever (4.5 million = 19% of the population) and asthma (2.5 million =11%).
- Hay fever is most common in the middle years of life, whereas asthma is most prevalent in young people (between 15 and 59 years)
- COPD affects 460,400 Australians aged 45 and over (5.1%), 7.5% for people aged under 40, down to 30% for people aged 75 and over
- 31% of persons with COPD have never smoked cigarettes
- Chronic respiratory diseases contributed 8.3% of the total burden of disease and injury in Australia:
- COPD contributed the highest percentage of total burden of all respiratory conditions (43%), followed by asthma (29%) and upper respiratory conditions (including hay fever 20%).
- COPD was the fifth leading underlying cause of death in Australia in 2016, with 7,212 deaths (4.6% of all deaths);
- The age-standardised death rate for COPD has increased to 70 deaths per 100,000 population,
- The age-standardised death rates for asthma increased to 1.6 deaths per 100,000 in 2016
- In 2016, there were 455 deaths due to asthma and 381 deaths due to bronchiectasis.

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- Most of the 9 deaths and several thousand hospitalised during the Victorian 2016 Thunderstorm Asthma outbreak occurred among people **who were not aware** their lungs had sensitized to airborne triggers, and were not taking asthma medications.

Ill-health is costly

Australia's urban air pollution derives primarily from vehicular and industrial emissions. As heavy industry declines, the proportional contribution from vehicles elevates. The current attributable fraction of disease burden due to exposure to vehicle fumes in Australia is not known, beyond knowing that vehicular emissions are a major contributor (up to 70%) to Australia's air pollution. Diesel and heavy vehicles are the worst offenders, however, due the preponderance of car dependency in Australian cities, the number of passenger vehicles on Australian roads is large.

In 2008-09, hospital admissions in Australia for cardiovascular disease costs on average \$9,982 for every man and \$8,634 for every woman admitted. Out-of-hospital medical expenses, at (\$1,497 million), accounted for a further 20% of total CVD health-care expenditure, and prescription pharmaceuticals account for nearly one-quarter of total health-care expenditure for CVD (\$1,648 million) (8). Ten years on, today's costs to the health budget will be much higher.

Costs to the individual are not included in these figures. Costs include out-of-pocket expenses, as well as lost income for themselves and family members. Societal costs include lost productivity for the term of illness and often, diminished capacity thereafter. Death is also costly to the family and carries opportunity costs. The associated grief and mental strain add significant additional financial loss, plus general decay in wellbeing and happiness as well as the loss of the contributions to the family, community and society provided by the individual, such as partnering and parenting, mentoring, goodwill and support.

Quantifying the true health, happiness and economic burden *attributable* to the disease states known to be directly linked to exposure to air pollution from traffic sources is complex. A comprehensive, but dated, study published in 2005, based on 2001 data, estimated the direct economic health costs to range between \$1.6 billion and \$3.6 billion per year – using the value of a human life at \$1.3 million, and for one year of disability life cost at \$55,000 (9). A follow up analysis modelled morbidity and mortality from exposure to air pollution in Australia using 2008 data identified that air pollution causes 520 deaths in Sydney every year. The report noted that significant health savings can be achieved by removing the industrial and vehicular pollution from our major cities (10). This report provides a good summary of air toxics and the then Australian guidelines.

The Department of Prime Minister and Cabinet estimated in 2014 the statistical value of an Australian life to be \$4.2m or \$182 000 a year in 2014 dollars (11). Notably, this figure excludes social benefits of a human life. Applying this figure, updated to 2018 cost

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structures to the total numbers of Australia admissions, out of hospital medical and pharmaceutical expenses, other health and welfare support costs, with the added figures for lost income, wellbeing and societal costs elevates this figure into the stratosphere.

It is cheaper to avoid illness, for the family, and for the nation.

The global climate is changing - Warming:

The laws of science exist regardless of humans. As our scientific knowledge expands, we gain a deeper understanding of the laws of nature, but we do not design them. The relationship between atmospheric greenhouse gas (GHG) concentrations and global temperatures fall under the laws of nature. The part played by humanity has merely been increasing the concentration of GHGs by post industrialisation burning of fossil fuels, as a relatively cheap energy source. Science tells us that practice is warming the planet.

We did not factor in the full costs of our fossil fuel dependence. Many wanted “indisputable proof” of the science that a) the relationship exists (yet some steadfastly refuse to accept the science), and b) the effect is here and now.

Global meteorological records provide rigorous, immutable evidence that warming is well underway. The world recently witnessed an unprecedented run of three consecutive world record breaking hot years (2014-2016), to 1°C above pre industrial levels (12). Last year 2017, came in third, and was the world’s hottest year without an El Niño present in the tropical Pacific Ocean (13).

Overall, the global annual temperature has increased at an average rate of 0.07°C per decade since 1880, which has more than doubled since 1970 to an average warming of 0.17°C per decade. All 17 years of the 21st century rank among the eighteen warmest on record (1998 is currently the eighth warmest). The six warmest years have all occurred since 2010 (14).

As Australia’s population projections occurred sooner than anticipated, future warming has also been brought forward, such that projected date of crossing the 1.5°C warming threshold has now been brought forward to 2026 (15). This rate of warming is unsafe for humans and human society.

Health and societal impacts of fossil fuelled global warming

At this relatively small amount of warming of 1°C, the impacts upon human societies are increasingly evident. Australia has lurched from the Millennium Drought, through to devastating floods, and is back in a severe protracted drought again. International news

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broadcasts report fires, floods, droughts, storms and sea level rise on a seemingly continual basis. As I write this (17-7-2018), heat extremes plague Europe, heatwaves and early fires affect the USA, Japan is recuperating from the worst floods in history, a town in Greenland had to evacuate as a giant floating ice shelf parked on its beach and its disintegration is sending damaging tsunamic-like waves, and the list continues.

All these result in human suffering and ill health. Events have amplified since the IPCC 2012 SPREX report (16, 17). Embedded further warming arising from the inertia in the climate systems means we must expect continued exacerbation of these devastating impacts arising from disturbance of climate system. These will be more frequent and more intense, as the relationship is not linear. Our intergenerational legacy is at stake.

Australia's climate can be described as: *Hot and getting hotter*. Heat exposure is Australia's greatest climate health threat, which also precipitates fires, and damages agricultural systems, crops, stock, wildlife and ecosystems. The rapidity of CO₂ emissions, and global warming is unprecedented in human history and will require significant adaptive changes to infrastructure, such as urban and housing design, and heat tolerance of bitumen and rail tracks (so they do not warp on hot days), and indeed all human systems.

Extreme heat is the leading cause of weather related deaths across the world (18). Humans evolved in a cooler climate, and despite having a highly effective thermoregulatory system which maintains a stable core temperature of about 37°C, we have an upper limit to our tolerance to exposure to extreme heat, and importantly, to have the capacity to exercise, function or work for any extended periods (19). Australians are already dying in the increasingly hot summers, and increased fire regimes (20).

The climate of northern Australia is already a difficult environment for human activity, where the **average daily maximum temperatures** range between 33°C and 39°C (21), tending to be higher inland and lower towards the northern and eastern coasts and on the Great Dividing Range. It is not uncommon for daily temperatures at individual inland locations to exceed 40°C on a regular basis during these months (21). Much of rural Australia experiences extreme heat through summer, such as 54 consecutive days over 35°C in Moree in the summer of 2017, and Canberra experiencing 18 days over 35°C, a figure that was not projected to become customary until 2090 (22). Canberra also had 3 days over 40°C, which is double the projection for 2090 under the mid-range climate scenario of RCP 4.5 (23).

Protecting human health, and societal functioning during the increasingly hot days, and extended heat waves will present a major challenge that Australia must confront. Some places on the planet are becoming uninhabitable and many global megacities will present intolerable heat stress risks (24), and drive out-migration. The uninhabitable regions of Australia will also expand. The withdrawal of people from their home regions will be a

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painful and stressful process, as will retreat from low lying coastal regions. The human toll, and economic costs of these far outweigh the inconvenience of shifting to renewables. Left unchecked, climate change will unleash these scenarios on today's children. Hence the urgency of rapid decarbonisation cannot be overstressed.

Australia's social fabric and economic basis is also highly vulnerable to climate change. Water security is precarious in many places, and another major drought is gripping the country as Agricultural productivity and livelihoods are stretched to breaking point. As climate change progressively unfolds, the list of industries at risk of significant upheaval or even collapse will expand. Many will be predictable, such as agriculture and tourism. The death of the Great Barrier Reef will risk 69,000 tourism jobs and communities along the Queensland coast, and loss of the \$7 billion industry would wreak havoc to the Queensland economy (25). Failure to mitigate and adapt will inevitably lead to system disruption, widespread grief and loss, across personal, financial, ecological and infrastructure domains.

Prevention is the best budgetary expenditure possible. Returns from public health / prevention investments range from 3:1 to more than 70:1. It makes good economic sense to invest in health protection, and brilliant economic sense to protect health from global warming and climate change, and prevent further climate upheaval by rapidly transitioning to a low carbon economy. Transportation is necessary, which makes (post production) carbon free electric vehicles a critical component in that transition.

The Paris Agreement & Australia's commitment

On 10 November 2016, Australia ratified the Paris Agreement and the Doha Amendment to the Kyoto Protocol, reinforcing our commitment to action on climate change by pledging to reduce carbon emissions by 26 - 28 % below 2005 levels by 2030.

The United Nations argue that the world is not yet on pathways consistent with the stated temperature goals of limiting global temperature rise to "well below 2 degrees Celsius" and endeavouring to keep average temperature rise below a more ambitious 1.5 degree limit. (26). UNEP warns Paris pledges, including Australia's commitment, fall well short, and unless greater ambition is shown, will fail the target, as existing pledges made in Paris in 2015 will push the world to temperature rise of 2.9 to 3.4°C this century (27).

All countries, must urgently commit to greater emissions cuts than their existing pledges. Three clear reasons exist as to why Australia should increase its efforts. We are:

- one of the highest emitting countries per capita,
- and one of the wealthiest,
- and one of the most vulnerable due our pre-existing extreme climate.

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Not only is Australia is morally obliged to embark on a high emission reduction pathway, it is in our self-interest to do so.

However, Australia's greenhouse gas emissions increased for the third consecutive year in 2016-17. The 0.7 per cent rise last financial year, comes after a 0.8 per cent increase during the 2015/16 financial year. Emissions rose 1.5 percent throughout 2017.

The Department of the Environment and Energy's latest figures report that transport emissions accounted for 17.7% of Australia's total net emissions (excluding LULUCF), which represents an increase of 1.3% over the previous year (2015 – 2016) (28). Light vehicles make up 10% of Australia's emissions.

Electrifying the transport fleet provides a relatively simple means to significantly cut emissions, without interrupting lifestyles. Note, this assumes that the electricity fuelling the vehicles is not sourced from fossil fuels. For example, electric cars running on Melbourne's electricity sourced from Hazelwood coal fired power station, were not a particularly clean form a transport.

Decisions made NOW, climate policies designed NOW, are critical to redirect the trajectory, away from its current path of further warming. The more ambitious our early mitigation, the easier and cheaper the available and feasible transformation options, and less need for Australia to rely on socially and scientifically contested negative emissions technologies and high-cost emission reduction options in the future (26).

Measures to support the uptake of electric vehicles

Public health is well experienced in social engineering, ie facilitating behaviour change, as demonstrated by long history involved in shifting community acceptance away from smoking and shifts in dietary behaviours.

Fundamental to success is the need for a multi-pronged approach. This involves:

- 1) Understanding the array of underlying human behaviours surrounding the issue, such whether decisions are based on attitudes & believe systems, economic arguments, peer acceptance, ease of transition, location or situation specific barriers
- 2) Addressing ALL these facets - amplifying enablers, and reducing the barriers
- 3) Supporting the early adopters - the "masses" eventually follow
 - a. Avoid situations where the shift proves to be a disaster
- 4) Building positive benefits – and facilitating public awareness of these

Importantly, the decision must be **an easy one** to make and then sustain. There are various models applied to behaviour change based on human psychology. Each share the salient features of the process a person uses to change their habits and behaviours, and then integrate changes into their lives.

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Behaviour change follows a suite of steps or progressive stages:

- Pre-contemplative/unaware
 - Not ready, not yet convinced
- Contemplative
 - Starting to think about it, know there is a problem
- Preparing
 - Level of belief has risen. Determination, investigation of options and making plans emerges,
- Action/trying
 - Embarking on the change – not yet at the point of reaping the benefits
- Maintaining
 - Now settled & convinced, mindset has flipped into endorsing new behaviour.
 - Yet can still relapse if overwhelmed by difficulty
- Termination/advocacy/transcendence
 - Depending upon experience & levels peer/societal reinforcement, either discontinues, or remains committed.

Success or failure involves many external influences which act as enablers, facilitators, and barriers.

A new vehicle is a very large investment, and thus, not one that is taken regularly.

Considerable investment involved therefore drives a significant contemplative phase and “homework” as to assessing the relative merits and disadvantages from an acutely personal perspective. This is the “will it work for me” consideration. As such, the decision is more important and protracted than most other purchases / decisions.

Electric car disincentives must be removed

- Cost
 - Purchase: Electric cars are much cheaper in Europe where the uptake is far greater than here.
 - Running costs: promoting the cost savings of using a cheaper fuel source
- Ability to recharge – en route, and at home & at popular destinations
 - Inconvenience – or fears of inconvenience must be allayed
- Attitude of the benefit.
 - Early adopters are already on board – if they can afford it
 - “Wanna be’s” are still contemplating – replacing a car unnecessarily (prior to the end of its use-by date) is not necessarily a major environmental benefit
 - Social marketing can shift attitudes from the contemplative towards action-orientated intentions.
 - Shift public perception to one of accepting moral responsibility – actively and overtly being seen as “doing my part” – as was the common mindset during both past world wars.
 - Promote public perception that community sectors will be advantaged by supporting the shift, ie making shopping attractive if charging stations are available. Encourage competition.

Potential strategies to assist the shift

Generate trust. It is imperative to run a clear and consistent strategy, that is not reversed, or later proves to be a “poor decision” by those adopting the strategy.

- Convert all government fleets to electric
- Facilitate the already existing pro-electric car advocates to get their message across
 - Eg taxis are already on board
- Remove tariffs – taxes, cost restrictions to reduce initial purchase price
- Promote / legislate that all new apartments & all shopping centres & parking venues include recharging stations
- Gradually extend this to cover existing areas
- Consider incentives – such as exists in international markets, in reduced running expenses, eg registration
- Consider support for locally made electric cars and scooters... local manufacturer??
- Actively support transition to electric buses
- Ensure electricity sources are from clean renewables and not coal fuelled
- Investigate (and adopt) range of financial incentives for users and suppliers

Concluding remarks

The need for Australia to accelerate its emission reduction targets is unequivocal. The immediate health savings alone from reducing vehicular emissions provides sufficient reason to actively encourage Australia to transition to electric cars. Climate change provides another powerful health and budgetary incentive.

If there WERE no other energy options, making the pro-electric vehicle arguments would be more difficult. But alternatives are plentiful, and Australia is blessed with plentiful supply, and fledgling industries eager to embrace. Australian households have also demonstrated enthusiasm to also embrace low carbon lifestyles – ***When they can***. Facilitating the shift to electric vehicles eases the decision, and helps Australia meet its Paris obligations

Full accounting is required for energy policies, with all costs, and all benefits encapsulated, with sound estimations of forward costing, and costing to other sectors, such as health and social costs. Too often, through failure to have a “health in all policies approach” policy decisions leave health costs to the individual, and to the society through health bills, health budgets and loss of citizen capacity, productivity and societal engagement.

All government policies, and especially those so intricately entwined in crafting our collective future, MUST prioritise the goal of national and human wellbeing.

References:

1. Schultz AA, Schauer JJ, Malecki KM. Allergic disease associations with regional and localized estimates of air pollution. *Environmental research*. 2017; 155: 77-85.
2. Wilker EH, Martinez-Ramirez S, Kloog I, Schwartz J, Mostofsky E, Koutrakis P, et al. Fine Particulate Matter, Residential Proximity to Major Roads, and Markers of Small Vessel Disease in a Memory Study Population. *Journal of Alzheimer's disease : JAD*. 2016; 53 (4): 1315-23.
3. WHO (World Health Organization). Air Pollution Fact Sheet. Geneva: WHO; 2018 Updated May 2. Available from: <http://www.who.int/airpollution/en/>. [cited 3rd June 2018].
4. Miller JD, Façanha C. The State Of Clean Transport Policy.A 2014 Synthesis Of Vehicle And Fuel Policy Developments Washington DC,,: International Council on Clean Transportation; 2014.p. 73. Available from: https://www.theicct.org/sites/default/files/publications/ICCT_StateOfCleanTransportPolicy_2014.pdf. [cited 16th July 2018].
5. Climate Change Authority. Light vehicle emissions standards for Australia. Canberra; 2018 June. Available from: <http://www.climatechangeauthority.gov.au/reviews/light-vehicle-emissions-standards-australia>. [cited 16th July 2018].
6. Armstrong F. Coal and health in the Hunter: Lessons from one valley for the world. Melbourne: Climate and Health Alliance (CAHA); 2015 February.p. pp68. Available from: http://caha.org.au/wp-content/uploads/2010/01/Climate-and-Health-Alliance_Report_Layout_PRINTv2.pdf. [cited 12th February 2015].
7. AIHW. Australia's Health 2018. Cat. no: AUS 221. Canberra: Australian Institute of Health and Welfare; 2018 20th June.p. 570. Available from: <https://www.aihw.gov.au/getmedia/7c42913d-295f-4bc9-9c24-4e44eff4a04a/aihw-aus-221.pdf.aspx?inline=true>. [cited 16th July 2018].
8. AIHW. Health-care expenditure on cardiovascular diseases 2008–09 Cat. no. CVD 65. Canberra: Australian Institute of Health and Welfare; 20174.p. 63. Available from: <https://www.aihw.gov.au/getmedia/5dc2bc3b-1d93-4cb2-a74b-d61867ad7ae2/16689.pdf.aspx?inline=true>. [cited 9th July 2018].
9. Bureau of Transport and Regional Economics. Health Impacts Of Transport Emissions In Australia: Economic Costs. Working Paper 63. Canberra: Commonwealth of Australia 2005.p. 169. Available from: https://bitre.gov.au/publications/2005/files/wp_063.pdf. [cited 17th July 2018].
10. Morgan G, Broome R, Jalaludin B. Summary for Policy Makers of the Health Risk Assessment on Air Pollution in Australia. Prepared for: National Environment Protection Council. Sydney: Commonwealth of Australia 2013 November.p. 37. Available from: <https://www.environment.gov.au/system/files/pages/dfe7ed5d-1eaf-4ff2-bfe7-dbb7ebaf21a9/files/summary-policy-makers-hra-air-pollution-australia.pdf>. [cited 17th July 2018].
11. Department of Prime Minister and Cabinet. Value of statistical life. Best Practice Regulation Guidance Note. Canberra: Australian Government; 2014.p. 3. Available from: https://www.pmc.gov.au/sites/default/files/publications/Value_of_Statistical_Life_guidance_note.pdf. [cited 9th July 2018].
12. WMO. WMO Statement on the Status of the Global Climate in 2016. Report WMO-No. 1189. Geneva: World Meteorological Organization; 2017.p. 28. Available from: http://library.wmo.int/opac/doc_num.php?explnum_id=3414. [cited 12th April 2017].
13. NOAA National Centers for Environmental Information. State of the Climate: Global Climate Report for Annual 2017,. 2018 January 2018. Available from: <https://www.ncdc.noaa.gov/sotc/global/201713>. [cited 27th January2018].
14. NOAA NCEI. State of the Climate: Global Analysis for Annual 2016. National Oceanic and Atmospheric Administration - National Center for Environmental Information;

- 2017 January 18th. Available from: <http://www.ncdc.noaa.gov/sotc/global/201613>. [cited 19th January, 2017].
15. Henley BJ, King AD. Trajectories toward the 1.5°C Paris target: Modulation by the Interdecadal Pacific Oscillation. *Geophysical Research Letters*. 2017; 44 (9): 4256–62
 16. IPCC. Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change [Field, C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley (eds.)]. Cambridge, UK and New York, NY, USA. 582 pp.: Cambridge University Press; 2012.p. 582 pp. Available from: http://www.ipcc-wg2.gov/SREX/images/uploads/SREX-All_FINAL.pdf. [cited 7th March 2012].
 17. Birkmann J, Welle T. Assessing the risk of loss and damage: exposure, vulnerability and risk to climate-related hazards for different country classifications. *Int J Global Warming*. 2015; 8 (2): 191-212.
 18. Oleson KW, Monaghan A, Wilhelmi O, Barlage M, Brunzell N, Feddema J, et al. Interactions between urbanization, heat stress, and climate change. *Climatic Change*. 2013; 129 (3): 525-41.
 19. Hanna EG, Tait PW. Limitations to thermoregulation and acclimatisation challenges human adaptation to global warming. *Int J Environ Res Public Health* 2015; 12 (7): 8034-74.
 20. Hughes L, Hanna L, Fenwick J. The silent killer: Climate change and the health impacts of extreme heat. Sydney: Climate Council of Australia Ltd 2016. Available from: <http://www.climatecouncil.org.au/uploads/b6cd8665c633434e8d02910eee3ca87c.pdf>. [cited 2nd July 2016].
 21. Davis C, Hanna EG. Temperature and rainfall trends in Northern Australia 1911-2013: implications for human activity and regional development. *Climate Research*. 2016; 71 (1): 1-16.
 22. BOM. Exceptional heat in southeast Australia in early 2017. Special Climate Statement 61. Melbourne: Australian Government Bureau of Meteorology 2017 February 22- Updated 11 April.p. 40. Available from: <http://www.bom.gov.au/climate/current/statements/scs61.pdf>. [cited 23rd February 2017].
 23. CSIRO and BOM. Climate Change in Australia: Projections for Australia's NRM Regions. Technical Report. Canberra: CSIRO and Bureau of Meteorology, Australia; 2015 January p. 222. Available from: <http://www.climatechangeinaustralia.gov.au/en/publications-library/technical-report/>. [cited 27th January 2015].
 24. Matthews TKR, Wilby RL, Murphy C. Communicating the deadly consequences of global warming for human heat stress. *Proceedings of the National Academy of Sciences*. 2017; 114 (15): 3861-6.
 25. Hughes L, Steffen W, Alexander D, Rice M. Climate Change: A Deadly Threat To Coral Reefs. Climate Council of Australia Ltd. ; 2017 April.p. 36. Available from: <http://www.climatecouncil.org.au/uploads/6d266714311144e304bcb23bde8446f9.pdf>. [cited 21st April 2017].
 26. UNEP. The Emissions Gap Report 2016. A UNEP Synthesis Report. Nairobi: United Nations Environment Programme (UNEP); 2016 November.p. 86. Available from: http://wedocs.unep.org/bitstream/handle/20.500.11822/10016/emission_gap_report_2016.pdf?sequence=1&isAllowed=y. [cited 4th April 2017].
 27. 3rd November, UNEP. World must urgently up action to cut a further 25% from predicted 2030 emissions, says UN Environment report. Media Release. Nairobi: United Nations Environment Programme (UNEP); 2016.
 28. Australian Government Department of the Environment and Energy. National Inventory Report 2016 Volume 1. The Australian Government Submission to the United Nations Framework Convention on Climate Change. Australian National Greenhouse Accounts. Canberra: Commonwealth of Australia; 2018 April.p. 382. Available from: <http://www.environment.gov.au/system/files/resources/02bcfbfd1-38b2-4e7c-88bd-b2b7624051da/files/national-inventory-report-2016-volume-1.pdf>. [cited 16th July 2018].