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Asphalt for Sustainable Pavements

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Emissions, Greenhouse, and Recycling

- Relevance to Australia
- Relevance to the road construction industry
- Emerging technologies
  - Warm mix asphalt (WMA)
  - Recycled asphalt pavements (RAP)
  - Perpetual pavements
  - Maintenance (Smoothness matters)
- Climate change adaption

Relevance of climate change and greenhouse to Australia

- What direct impact will reducing Australian greenhouse emissions have on climate change?

None

- Climate change and greenhouse gas are global issues.
- If Australia stopped producing all its greenhouse gas the impact on climate change would hardly be measureable.

Does this mean we should not bother to reduce greenhouse gas emissions?

No, Australia must continue to reduce emissions and the Australian asphalt industry is doing just that.

- As a major developed country we all have a responsibility to reduce global emissions. If we don't then how can we expect other countries to reduce their emissions.
- However, abatement must be done responsibly.

Embodied Energy

- Extraction of Crude
- Transport of Crude
- Oil refining
- Transport of Bitumen
- Asphalt Plant
- Transport of Asphalt

- Quarrying of rock
- Preparation of aggregate
- Transport of Aggregate

Similar lists can also be made for

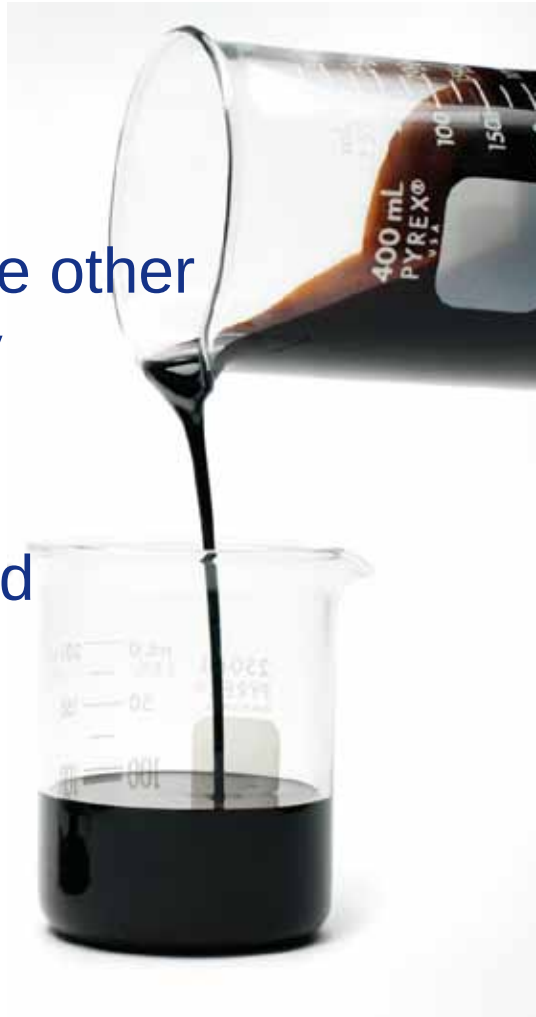
- Concrete
- Steel
- Sub base material

Embodied Energy

Importantly embodied energy does not include other potential energy such as the chemical energy in bitumen.

Bitumen is a hydrocarbon but is not consumed (combusted).

Bitumen remains100% recyclable.



Emissions from Road construction – Mickleham Rd

- 1,820* tonnes of greenhouse gas emissions
  - 75% embodied energy of materials
  - 22% on-site transport
  - 2% transport of material
  - 1% on-site electricity

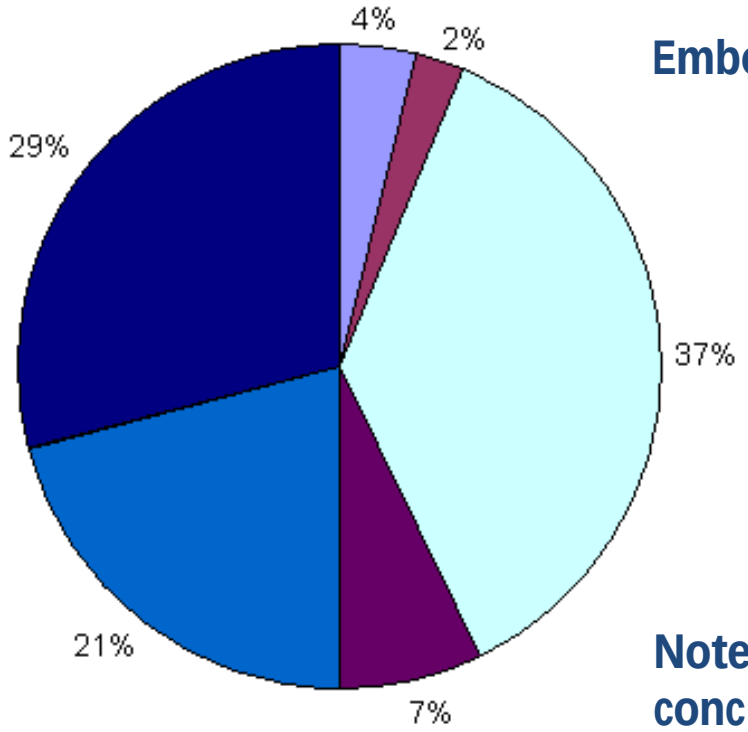
- = 760 tonnes CO_2-e / km
- = 190 tonnes CO_2-e / lane km

* Excluding 'uncertainty factor'

- **NOTE: Greenhouse gas associate with site clearance not included.**

Source VicRoads

Carbon Footprint Results – Mickleham Rd



Embodied Energy of Materials

- Steel Reinforcement
- Other Steel (including gantries, road barriers, wire rope, steel poles)
- Concrete
- Hot Mix Asphalt
- Aggregate/Base
- Cement Treated Crushed Rock

Note: The road surface is hot mix asphalt. Steel, concrete materials are ancillary materials (gutters, reinforcing, steel poles etc)

Source: VicRoads Greenhouse Gas Emission Framework 2008

Reducing Greenhouse Emissions

To reduce greenhouse emissions we must address

- Embodied energy of materials,
- Energy used on site to construct the pavement

In some cases land clearance is also a significant source of greenhouse emissions.

One option is Warm Mix Asphalt.

Warm Mix Asphalt

Asphalt is a very low greenhouse material, particularly when compared to concrete (due to the very high level of embodied energy arising from the production of cement.)

One technology to even further lower emissions is warm mix asphalt.

- Asphalt is usually laid at temperatures around 160^{o} C.
- Warm Mix can be laid at temperatures around 110^{o} C. A significant saving in energy and greenhouse emissions.

Warm Mix Asphalt

WMA can achieve a significant reduction in energy use and greenhouse emissions, typically a 20% reduction in energy and emissions at asphalt plants.

It also is safer to handle and produces less fuming.

Two types of process may be used

- Additive based systems,
- Alternative manufacturing techniques (eg foam).

Warm Mix Asphalt

- Reduced energy consumption as improved coating of materials allows for lower temperatures to be used.
- Lower fuel consumption.
- Lower temperature compared to HMA resulting in more comfortable and safer workplaces.
- Improved productivity as deep / thick asphalt works can be opened to traffic more quickly reducing the length of time a road is closed for repair.
- Improved productivity through an extended paving season and longer haul distances as WMA is easier to compact at lower temperatures.

AAPA/Austroads Warm Mix Validation Project

Most Australian State Road Authorities are supportive.

As a result AAPA and Austroads have worked together to validate the hypothesis that warm mix and hot mix will give similar quality outcomes.

AAPA and Austroads developed a warm mix validation test protocol and commenced a two year validation test program

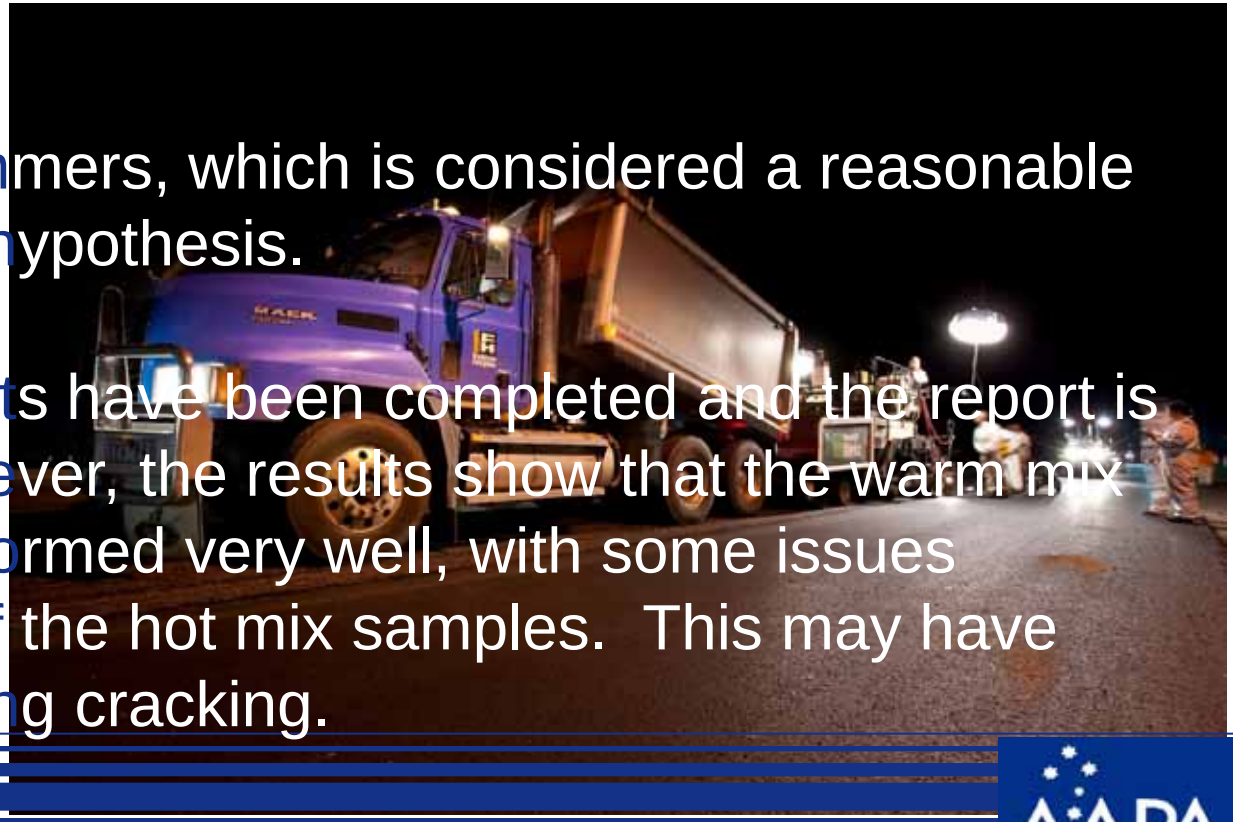
- Coordinated through the joint AAPA /Austroads Asphalt Research Reference Group (ARRG) and through a working group jointly chaired by AAPA and ARRB.

AAPA/Austroads Warm Mix Validation Project

Site evaluations and testing is being undertaken at 6 monthly intervals.

This will include 2 summers, which is considered a reasonable period to validate the hypothesis.

The first 6 monthly tests have been completed and the report is being prepared. However, the results show that the warm mix and hot mix have performed very well, with some issues associated with one of the hot mix samples. This may have been due to pre-existing cracking.



Recycling

Recycling has benefits for all of the community and industry.

Recycling reduces the demand on raw materials and waste disposal sites.

Particularly relevant to road construction where valuable materials such as bitumen and aggregate can be recycled again and again. Also other waste products may be able to be used such as used glass.

Recycled Asphalt Pavement - Roads are Linear Quarries

Over time pavements do wear out – or more likely, the top wearing course wears.

This wearing course can be quickly milled and a new course applied.

The milled material is not waste material but is still bitumen and aggregate and can be reused in pavements as reclaimed asphalt pavement (RAP).

RAP is able to be recycled into new pavements and not into a lower value product.

Recycled Asphalt Pavement - Roads are Linear Quarries

RAP is used extensively in the US, Europe and is gaining momentum in Australia.

The US manufactures approximately 600 million tons of asphalt each year. Approximately 100 million tons of asphalt is also reclaimed each year. Of this approximately 95% is reused in new pavements.

Most Australian States now allow a proportion of RAP.

The Warm Mix validation project include RAP mixtures as a means of further demonstrating the effectiveness of RAP.

RAP reduces waste, cost, greenhouse emissions and the need for land fill sites.

Perpetual Pavements

Pavement life is critical to both whole of life cost and sustainability.

A pavement that needs frequent maintenance or replacement wastes material and energy. It also causes disruption to traffic

A pavement that may last a long time but then needs total rehabilitation or replacement is also not cost effective or sustainable.

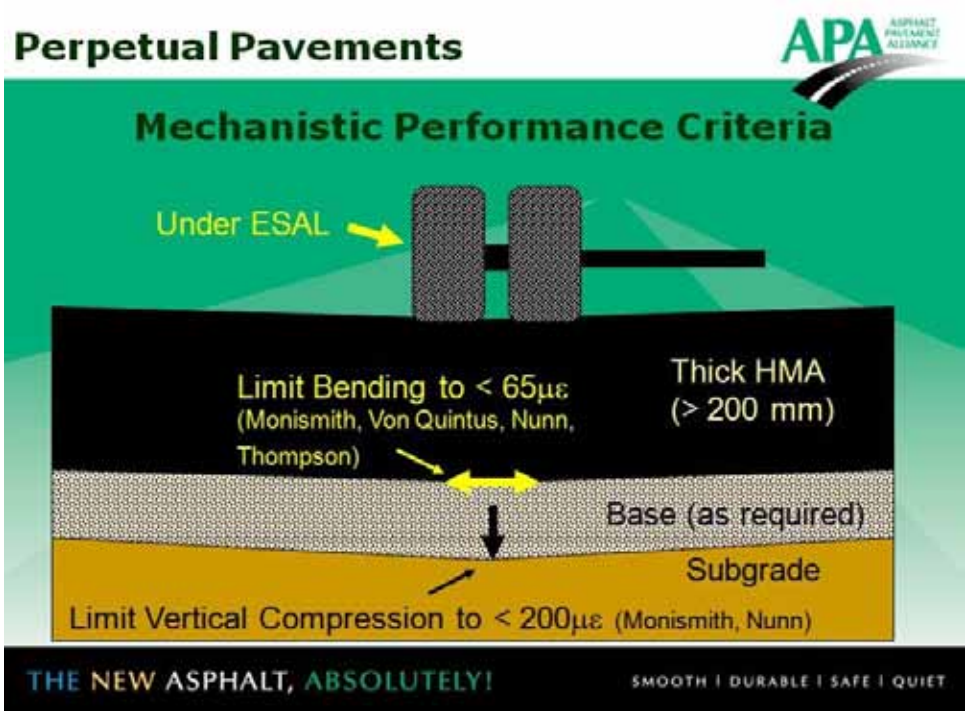
An ideal pavement is one that can be placed once and then last for many, many years with minimal maintenance.

Perpetual Pavements

Perpetual pavements is a term used in Europe and the US to describe a pavement that is designed according to mechanistic performance criteria or the fatigue endurance limit.

The fatigue endurance limit is the limit past which the base of the pavement could fail. If this limit is not exceeded then the pavement will last in perpetuity.

Maintenance of the pavement is then achieved by occasionally milling and replacing the wearing course at infrequent intervals.



Perpetual Pavements

The fatigue endurance limit (perpetual pavements) approach to pavement design is the most effective means of designing pavements.

It achieves an appropriate design and design thickness that is both:

- not to thin as this would lead to premature failure,
- not too thick as this wastes both money and resources.

AAPA is undertaking a major project to evaluate overseas data to Australia and to work with Austroads (and ARRB) to amend the Austroads Guidelines to support this design approach.

Plant emissions

A common image the community appears to have is that bitumen and asphalt facilities are dirty and smelly.

These old facilities have long since ceased to exist and modern bitumen and asphalt plants form part of many modern communities.

Two examples of modern facilities

New Boral Asphalt Plant Ballarat Vic

BP Storage Facility Pinkenba Qld

Smoothness Matters

Road maintenance is an important safety and economic issue. A well maintained road is a safe road. Also a well maintained road will make the transport of goods and materials quicker and cheaper.

Well maintained roads also reduce environmental impacts. This comes from reduced fuel consumption due to less congestion during road repairs and less need to undertake major repairs.

Rough roads also increases fuel consumption. The US Federal Highway Administration found that a slightly smoother pavement could reduce fuel consumption of heavy vehicles by 4.5% Smoother roads across the US could likely save at least 4 percent of the fuel consumed, that is a reduction of about 7 billion gallons

Climate Change Adaption

Climate change is occurring

This is more reason to ensure that our roads are designed to last, in all weather conditions.

A well designed asphalt perpetual pavement will provide an indefinite life with minimum maintenance.

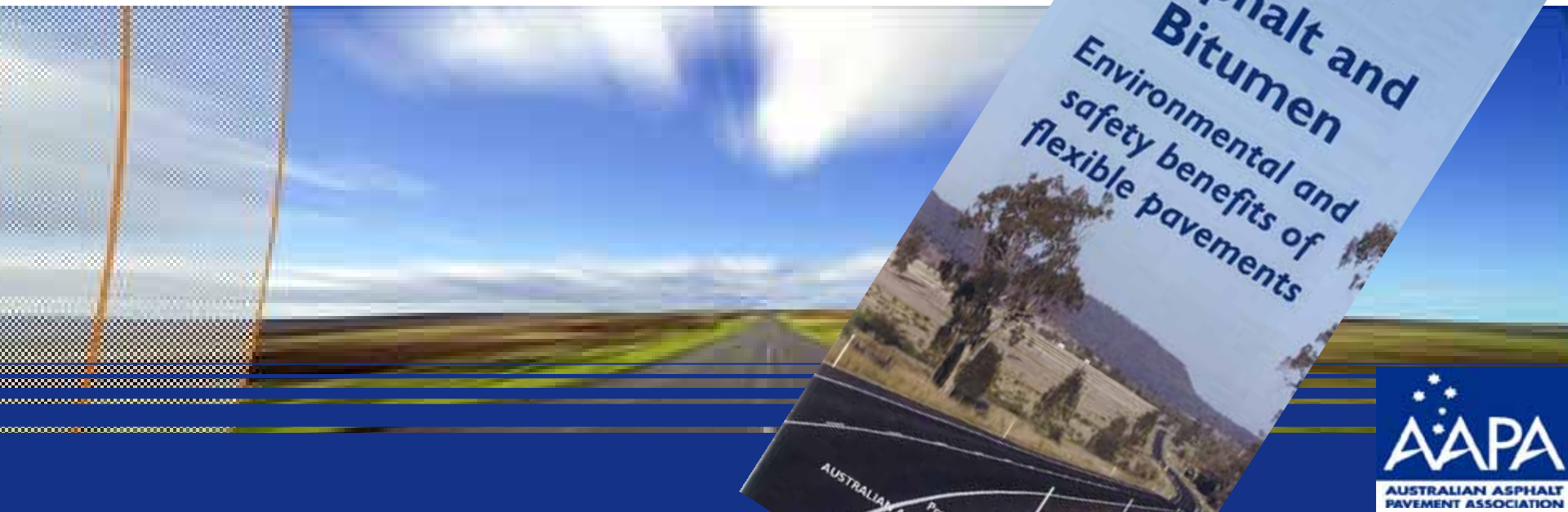
Conclusion

Asphalt is a low greenhouse, sustainable road surface.

New developments are showing that emissions and waste can be even further reduced

Asphalt perpetual pavements will last indefinitely with minimal maintenance.

ASPHALT
100% RECYCLABLE



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