



**XXIV<sup>th</sup> World  
Road Congress  
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## Road system energy – a review of alternatives

**Lisa Rossiter**  
*On behalf of TC A.1*

- New Zealand Transport Agency
- [lisa.rossiter@nzta.govt.nz](mailto:lisa.rossiter@nzta.govt.nz)



**NZ TRANSPORT AGENCY**  
WAKA KOTAHI

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### ALTERNATIVE SOLUTIONS FOR FOSSIL FUELS FOR THE ROAD SYSTEM

Key aim:

- to identify and analyse techniques and technologies that reduce energy usage (or produce energy) in the context of operating a highway system and its associated infrastructure.



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### How can highway infrastructure and roads help?

- Highways and their infrastructure are large assets that
  - provide opportunities to generate energy in their own right; and
  - provide opportunities to help reduce their own energy consumption.



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### Why use these opportunities?

- Climate change and finite fossil fuels are driving us to consider alternative ways to generate energy
- Demand for energy is increasing – with decentralised energy playing a greater role than ever before
- Security of energy supply a significant concern
- Save expenditure or earn income

=> All part of carbon management strategies



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### What has been considered?

- *Reduction of energy* used by highway infrastructure
- *Generation of energy* within the bounds of highway infrastructure



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### What has not been considered?

- Policy factors or considerations
- Vehicles on the highways
- Products not yet in the commercial market were not reviewed



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### **Technologies that *generate* energy:**

- Pavements that collect thermal energy
- Photovoltaic panels
- Wind microgeneration
- Hydro microgeneration
- Fuel cells/generation

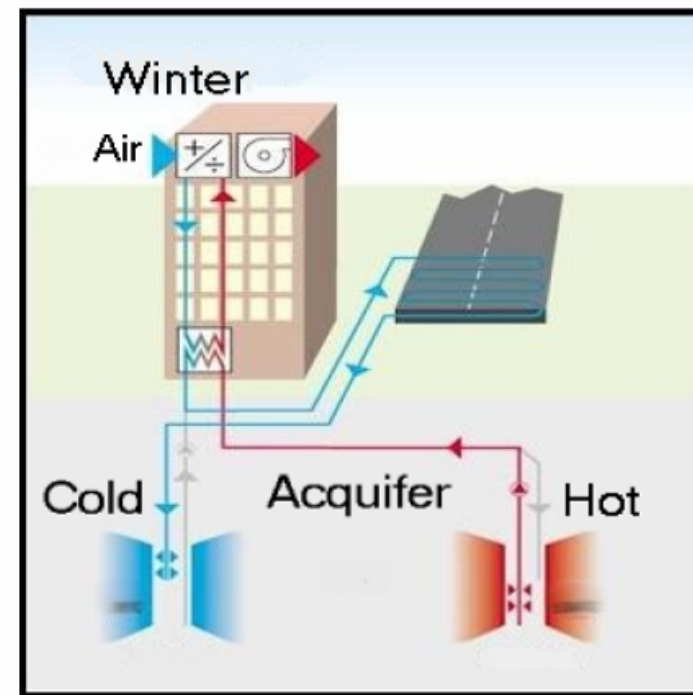
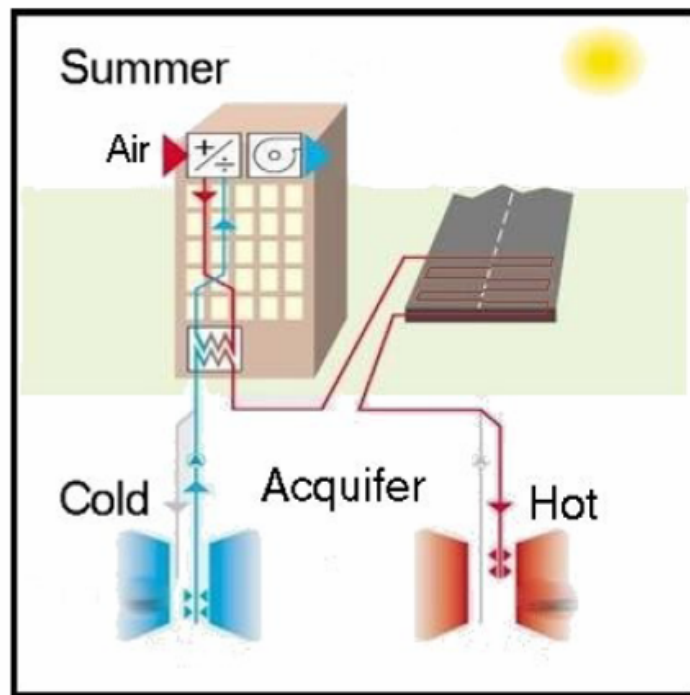
### **Technologies that *reduce* energy use:**

- Reflective signage materials
- LED lighting



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## Pavements & Thermal Collection





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### **Pavements & Thermal Collection**

#### *Benefits*

- Supplements and supports winter maintenance
- Can provide heating and cooling to nearby properties and other facilities

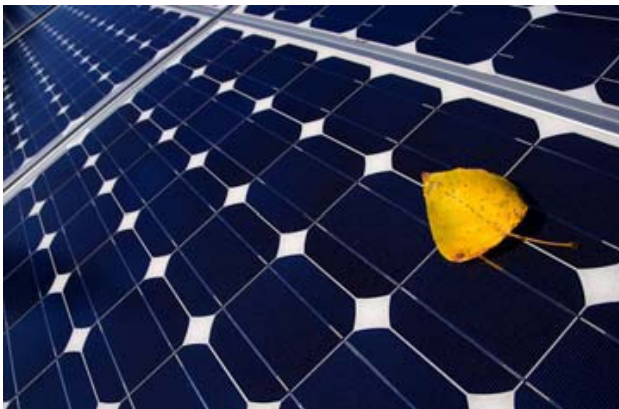
#### *Barriers*

- Best for new build – requires significant road rebuilding to introduce to existing networks
- Requires retro fitting buildings with new equipment
- Long term maintenance considerations



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## Photovoltaics



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### Photovoltaics

#### *Benefits*

- Low ongoing operating costs once established
- Ideal for locations where no grid connection
- When connected to the grid - can be used to reduce overall peak demand
- Efficiencies are increasing

#### *Barriers*

- High initial capital cost
- Sensitive to latitude (day time / night time)
- Conversion from DC to AC leads to conversion losses



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## Wind Microgeneration



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### Wind Microgeneration

#### *Benefits*

- Easy installation
- Can be retrofitted & can be portable
- Low relative capital cost
- Can feed excess energy back to the grid
- Can operate by the movement of vehicles

#### *Barriers*

- Wind and location
- Amenity factors – e.g. noise and visual intrusion
- Efficiency





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### Hydro Microgeneration

#### *Benefits*

- Efficient – low flows can still generate power
- Reliability - simple technology
- Low impact on environment once in place

#### *Barriers*

- Site – optimal sites hard to find
- Output – limited by locational factors
- Seasonality



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### Fuel Cells

- Approach is to use land associated with highways to generate fuel for vehicles or other equipment
- Uses a combination of techniques
- Decentralised generation of fuels (e.g. Hydrogen)
- Implemented along A22 highway in Italy



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### Fuel Cells

#### *Benefits*

- Efficient use of land
- Low impact on environment once in place

#### *Barriers*

- Site – optimal sites hard to find
- Output – limited by locational factors





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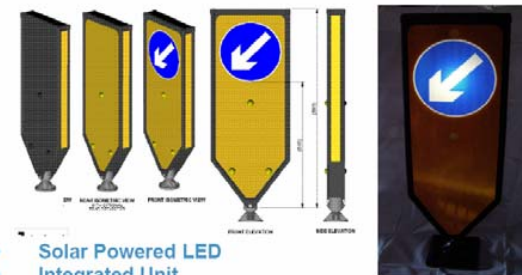
## Reflective Signage

### *Benefits*

- Enhanced reflectivity – allowing reduced lighting
- Longevity
- Improved safety

### *Barriers*

- Higher initial capital cost
- Reduced lighting benefits often not realised due to other requirements



- Solar Powered LED
- Integrated Unit
- Passive Safe, complies to BS EN 12767
- Uses latest retro-reflective DG<sup>3</sup> material from 3M™



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## LED Lighting Solutions

### *Benefits*

- Precise lighting footprint
- Reduction in 'sky glow'
- Reduced energy and maintenance requirements
- Quality of light

### *Barriers*

- Initial capital cost



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## Cape Town, South Africa



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### Conclusions

- Technologies exist now to enable highways to create energy and/or reduce energy consumption
- Opportunities to incorporate these technologies are greatest at initial planning stages
- These technologies have been implemented slowly in many countries because of fiscal and institutional barriers to implementation
- Technologies will become more viable (economically) as they become more established
- All new highways in the future should incorporate these technologies

