TRANSPORT HIERARCHY

Institution of MECHANICAL ENGINEERS

The UK's ambition to reduce CO_2, congestion and dependency on powered transport has not diminished. This policy statement takes a focused engineering look at the system design, addressing how we can change our approach to meet the demanding targets across our transport modes.

The Transport Hierarchy ('the Hierarchy') has been developed using robust engineering tools to allow the prioritisation of multiple measures to improve the complex system known as our transport network. This Hierarchy has shared similarities with the Waste Hierarchy (reduce, re-use, repair and recycle) and the Energy Hierarchy (reduce demand, use renewable sources, increase efficiency, use low-carbon technology, use conventional energy)[1].

The Hierarchy sets objectives that ensure resilience and adaptability in the energy requirements of our transport network, with a focus on delivering societal needs. It pulls together policy proposals that demonstrate a consensus for this type of approach. The combination of cross-modal consensus and sound engineering makes this a powerful tool to achieve the step change needed to deliver a sustainable transport network. The Institution believes that this Hierarchy should be used by all governmental departments and businesses when making decisions on their transport choices in terms of both use and planning activities.

The Institution makes the following recommendations:

That Government should:

1. Adopt and use the Hierarchy at all levels. Local authorities should use it for planning and local journeys. Departments (eg Health and Education) whose core activities are not transport, but generate demand for transport, should use it to evaluate the transport impacts of policy decisions.
2. Incentivise to reduce the use of fossil fuels.
3. Enable more journeys to be made without a car.
4. Demonstrate best practices in sustainable transport, eg reduce travel through use of IT, public transport, promoting car clubs and cycle hire.
5. Review policies that favour less-efficient modes, or penalise the efficient.

That business should:

Work to future-proof business models, products and services by:

1. Reducing travel impacts by encouraging flexible, home-working solutions.
2. Encouraging sustainable travel modes eg cycle commuting; public transport for business travel.
3. Encouraging lift sharing for commuter travel eg reduced car parking; organise car clubs for employees eg a cost-effective solution for businesses in place of private pool car fleets.
4. Review car use policies and rewards (companies give car allowances but do not always buy train tickets).

TRANSPORT HIERARCHY

COHERENCE, STRUCTURE AND RATIONALE

The Institution proposes a four-step system that can be utilised as a structure and rationale in our future transport system. The Hierarchy (**Figure 1**) can be used to achieve effective coherent planning and engineering of transport systems. It allows the prioritising of decisions using key issues, leading to economically, socially and environmentally sustainable solutions. The objective of the Hierarchy is to secure the most effective and sustainable solution in terms of outcomes achieved and resources required. The Hierarchy can be used to check and review the design and management of transport systems to deliver the continual-improvement element of the management cycle.

Priority 1: MINIMISE DEMAND: Enabling quality of life by reducing distances travelled.

Description
Demand for powered transport is generated by a need to access a product, service or activity, and the distance to it. Measures to reduce demand can increase freedom of choice about when, where, how and if to travel. The options chosen can result in a reduced demand for powered transport, by fewer or shorter journeys, or by increased walking and cycling.

Objectives
Maintain or improve quality of life and access to goods, services and activities, while reducing the need for powered travel. For personal transport, this is reducing 'passenger vehicle km travelled per year', while for freight it is reducing 'vehicle km travelled to deliver a product or service'. A key objective is to bring journey distances, whether to access goods, services or activities, below a threshold that allows more sustainable options.

Pitfall
There is the potential, through non-joined-up actions, of displacing one demand with another that incurs the same or worse net result.

Actions
Use spatial planning to design communities locally, decentralising services and localising manufacturing. Information and communications technologies (ICT) can provide solutions for delivering services, eg employment and retail, while reducing transport burdens[2].

Priority 2: ENABLE MODAL SHIFT: Enabling the use of more sustainable modes of transport.

Description
After minimising demand for powered transport, modal shift needs to be considered. This covers two types of measure: modal shift of whole journeys and inter-modality during journeys. Effective modal shift requires that overall transport demand is first reduced.

Objective
To make a greater proportion of journeys by more sustainable and preferably low-carbon modes.

Pitfall
Major modal shift to public transport could cause overcrowding by overloading our network's capacity.

Actions
Adopt measures that enable journeys to use sustainable modes and will increase freedom of choice, such as replacing short car journeys in favour of walking, cycling and public transport; replacing short-haul flying in favour of rail. Road is currently the UK's dominant method of transporting freight. Freight modal shift could move goods from road to rail and/or water. A switch to rail could give a reduction of 70% CO_2 emissions compared to the equivalent road journeys[3].

Figure 1: The Transport Hierarchy

MORE SUSTAINABLE

Priority 1	Minimise demand	Manage the reasons why transport is needed and the context in which transport demand is derived, to deliver the same access to services and activities with less powered/motorised transport.
Priority 2	Enable modal shift	Enable the choice of transport modes with the lowest environmental impacts, and enable easier changes between modes.
Priority 3	Optimise system efficiency	Increase all efficiency measures of transport modes and their use, particularly in terms of gCO_2/km for passengers and gCO_2/tkm for freight.
Priority 4	Increase capacity	After optimisation of the first three steps, any capacity increases that are required should be prioritised to the most efficient and sustainable modes.

LESS SUSTAINABLE

Priority 3: OPTIMISE SYSTEM EFFICIENCY: Getting better outputs from given inputs, including indicators such as kWh/pkm or gCO_2/km for passengers, and kWh/tkm or gCO_2/tkm for freight.

Description
The next step, after minimising demand and encouraging modal shift, is to increase transport efficiency by getting better outputs from given inputs. There are many measures of system efficiency that are appropriate in different circumstances. System efficiency and sustainability can be optimised by vehicle load factors, economic efficiency, land-use, societal and environmental efficiency; this links to the Energy Hierarchy and consideration of fuels and energy sources for lowest environmental impacts.

Objective
Use existing infrastructure and vehicles as efficiently as possible, extracting the maximum benefit for the minimum environmental/social/economic cost.

Pitfall
The rebound effect – obtaining improved efficiency (eg less fuel use in cars, therefore lower cost per journey) without reducing need for powered transport can lead to increased travel and energy use.

Actions
Prioritise behavioural changes, enabling transport to be used more efficiently. Information on carbon intensity of choices, including car sharing/higher load factors on public transport/freight, eco-driving techniques, integration and modernisation of infrastructure. Mass reduction and sensible power-weight ratios can increase efficiency in terms of kWh/pkm and kWh/tkm. Low CO_2 fuels can increase efficiency in terms of gCO_2/km and gCO_2/tkm.

Priority 4: INCREASE CAPACITY for powered transport.

Description
This should be considered only once the first three steps have been fully explored. Capacity increase should be prioritised to the most efficient and sustainable modes.

Objective
Assessment against the Hierarchy will help those involved in activities that might create demand for transport (eg retail operators, schools and manufacturers) to identify ways to deliver services using less transport or alternative efficient modes.

Pitfalls
Not having an integrated approach to planning multimodal infrastructure may result in money being invested which increases the use of powered transport. Increasing capacity is likely to lead to increased transport demand by 'inducing' new journeys.

Actions
Prioritising demand reduction, modal shift and greater efficiency, the Hierarchy enables a more-accurate assessment of the need for increased capacity.

HOW SHOULD STAKEHOLDERS USE THE HIERARCHY?

Government

Government departments have an opportunity to use planning strategies to promote an integrated transport network[2]. Rail operator licences could be an example where 'inter-modality' might be included. Their licence could prioritise the role of rail stations as 'transport hubs'. These hubs would require integration with bus and cycle routes, cycle hire facilities, provision of car club vehicles, electric vehicle facilities and ease of pedestrian access. The Institution recommends that the UK Government adopts this Hierarchy as a key tool for all future transport planning, policies and industry strategies.

UK business and manufacturing

Businesses have an opportunity through new development and operation of products and services for different transport modes aligned to decarbonisation. This could encourage reshoring of goods manufactured outside the UK with long supply chains or energy-intensive transport (air, marine or road freight).

Reducing demand for business journeys offers operational benefits, including remote working (eg teleconferencing), reducing costs and travel time. Investing in technology to reduce transport demand, eg access to broadband, can make the UK a more-attractive place for inward investment.

Transport providers

Opportunities exist for the range of manufacturers and providers.

1. Bicycle industry: Encouraging the use of bicycles could lead to an additional £3 billion for the UK economy, as this becomes a strong growth area and reduces our dependency and cost of importing oil.
2. Railways and train operators: Electrification of railways requires design, manufacture and operation of new electric trains using low-cost overhead line systems. Increased use of railways for freight has engineering challenges but provides business opportunities. Modal shift will see increases in traffic on freight and passenger networks, so there must be smart ticketing to provide inter-modality between journeys, as well as passenger information, bikes available at stations, security for customers and good car parks.

3. Bus and taxi companies: An emphasis on inter-modality will increase the use of mass transportation systems and smart ticketing.
4. Car manufacturers:
   - Fleet replacement: Reducing demand for transport could result in lower volume sales; to achieve targets, current fossil-fuelled fleets need replacing. This could represent a significant repurchasing opportunity with a possible reduction in the size of fleet caused by reduced demand. There is a consequential pitfall that the cost of new cars could rise if there is a reduction in the numbers produced by volume manufacturers
   - New business models: There is an opportunity to adapt to potentially lower sales volumes by taking advantage of new customer approaches to travel, eg the future might see mobility being purchased when needed rather than the vehicle itself.
   - Engineering challenges: Vehicle efficiency improvements eg intensive use by multiple users in car clubs, instead of current model where vehicles are typically used for about one hour a day.
   - Re-use and recycling: Increasing emphasis placed on the need to re-use and recycle vehicle components (and systems).
5. Aviation: With the need to switch away from fossil fuels to meet carbon reduction targets, aviation will need to adopt biofuels or synthetic fuels.
6. Maritime: As with aviation, alternative fuels need to be selected. In addition there is a real potential for increasing shipping using inshore and inland waterways, as well as coastal and short sea shipping for freight.

Infrastructure providers

Opportunities exist for upgrading, replacing and renewing infrastructures:

1. Building ‘transport hubs’ around rail stations gives opportunities for public transport interchanges to become quicker and more convenient for travellers, along with introducing smart ticketing.
2. The Government’s commitment to long-term infrastructure projects creates and supports employment, manufacturing and maintenance business opportunities.
3. Greening electricity provides engineering challenges, as does creating localised generation and delivery of electricity.
4. Reducing the carbon footprint of airports and journeys made to access them will continue. Airport operational efficiencies, eg taxiing and holding patterns for aircraft, continue to be improved. Better links are needed to fast, efficient, high-quality public transport systems.
5. If inshore, coastal and short sea shipping increases, new and improved facilities will be needed. There will be a need for an effective, low-cost interchange with rail and international shipping, improving the provision and capacity of ports with electrified rail links to inland distribution centres.
6. Considerable investment is being put into providing an electric vehicle recharging infrastructure.

Transport users and communities

By making choices in accordance with the Hierarchy, opportunities will develop to reduce the impacts of transport in terms of air quality, noise and social impacts of busy roads. Communities will have quieter roads, safer play areas, pedestrian streets, and opportunities to access services, goods, employment and leisure nearer to home, with reduced journey times. Cost savings through adopting this approach will lead to improvements in public transport and cycling facilities, giving lower cost options.

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GOVERNMENT DEPARTMENTS HAVE AN OPPORTUNITY TO USE PLANNING STRATEGIES TO PROMOTE AN INTEGRATED TRANSPORT NETWORK.

CONCLUSIONS

The Hierarchy can lead to policy decisions being joined up, future-proofed, and long term can ensure a future sustainable transport system.

Using this Hierarchy as a guide:

- Businesses involved as transport providers and users can future-proof their business models, products and services.
- Government and local authorities can formulate future-proof policies and strategies.
- Communities can benefit by having manufacturing jobs, services and activities accessible closer to home, impacting air quality, congestion and noise associated with excessive transport.

REFERENCES

1 Energy Policy Statement 09/03 – The Energy Hierarchy; Institution of Mechanical Engineers

2 Sustainable Development Commission: Smarter Moves: How Information Communications Technology can promote Sustainable Mobility, January 2010

3 Freight on Rail, http://www.freightonrail.org.uk/FactsFigures.htm accessed 29 January 2013

BIBLIOGRAPHY

Croner's Environment Magazine, Creating a hierarchy for transport, D Kenning, Autumn 2012

Quantifying transport resilience: Active Mode Accessibility, S Rendall, S Page et al, March 2011

Reducing emissions for transport, B Robinson, 2012

A Paradigm Shift Towards Sustainable Low-Carbon Transport: Financing the Vision ASAP, K Sakamoto, H Dalkmann & D Palmer, August 2010

Sustainable Development Commission: Fairness in a Car Dependent Society report (D. Kay et al) February 2011 (Chapter 5 – A Sustainable Approach to Transport & Appendix 2 – Hierarchies in sustainability and transport)

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