Saving Oil in a Hurry:
Oil Demand Restraint in Transport

Workshop on Managing Oil Demand in Transport

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Background

- Oil supply security a core mission
- Transport the biggest oil consuming sector
- IEA countries required to develop measures to conserve oil on very short notice
- In last 30 years many innovative transport policy experiments have occurred

Key issues

- How flexible is transport demand?
- Does this vary under emergency conditions?
- What variation might there be between IEA regions?
- Which policies are most effective and how cost effective they?
- What methods can IEA countries use to develop their own plans and policies?

Flexibility of transport demand (1)

- Demand for travel is relatively insensitive to many of the policies implemented
  - car trips and trip length continue to increase
  - most policies implemented have only minor impact
  - however, these are mainly focussed on providing increased choice rather than increasing restraints

Flexibility of transport demand (2)

- Recent experience suggests flexibility exists – when policies or conditions increase constraints
  - British fuel crisis in 2000
  - Congestion Charging in London
  - Road closures and suppression of demand

What happens under emergency conditions?

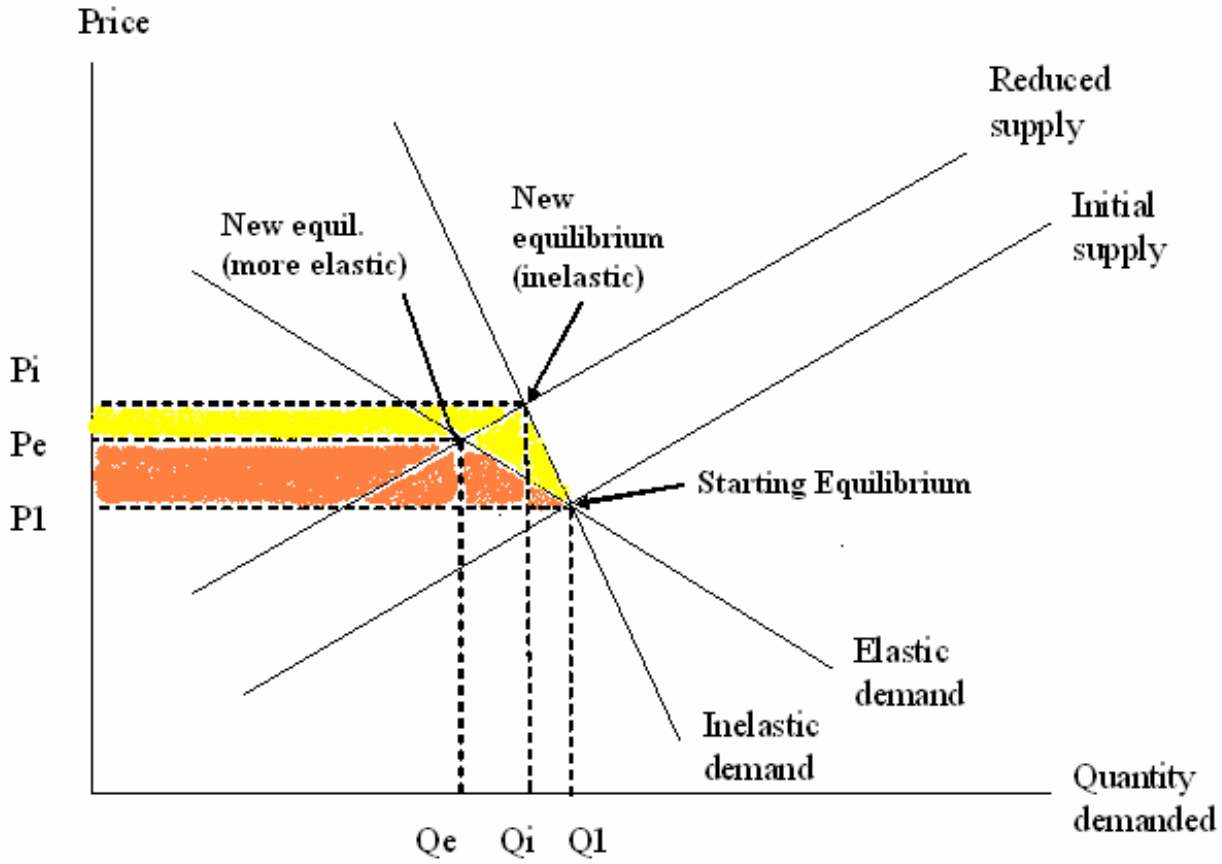
- One would expect increased flexibility
  - altruistic behaviour, actual shortages, price spikes
  - more restrictive policies may be more politically acceptable, especially if short-term
- Policy measures must be able to save oil quickly, on short notice
  - however, in some cases, significant pre-planning is necessary
  - up-front costs may be substantial for some measures

Rationale for short-term restraint

- Most measures aim to allow a greater reaction by consumers to supply shortage or price spikes than would otherwise occur
- Increased responsiveness can save consumers money, reduce negative impacts, shorten duration of emergency
- Pricing measures not especially relevant, particularly if oil prices already high
  - however, governments should not reduce existing taxes as this could lead to increased demand

Effects of increasing elasticity of demand response during price spike

(loss in consumer surplus is orange area instead of yellow + orange…)



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Measures Considered

- Increases in public transport usage
- Carpooling
- Telecommuting / work schedule changes
- Driving bans / restrictions
- Speed limit reductions
- Information on tyre pressure effects

Methodology

- Relatively simple methods were developed
- Based on data from each country or region, where available
- review of how similar policies have affected behaviour
  - mode split, carpooling effectiveness, telecommuting potential, etc.
  - these are based on non-emergency conditions, so may be low estimates of effectiveness

Sample calculation: Telecommuting potential (1)

- Difficult to connect actual policy to outcome
  - promotion campaign, home computer subsidies, company commitment for emergency circumstances (or sign-up)
- Approach is to measure potential for telecommuting, based upon existing knowledge
  - not all jobs are ‘telecommutable’
  - telecommuting is a transient phenomenon

Sample calculation: Telecommuting potential (2)

- **Step 1:** Examine existing studies
  - US DOE (1994) estimates that information workers will be 61.1% of all workers by 2010
  - and potentially 44.9% will telecommute
  - but not all the time, and not forever, based on recent work of Mokhtarian
  - some evidence that non-work driving increases for those telecommuting

Sample calculation: Telecommuting potential (3)

- **Step 2:** Estimate potential ‘telecommutable’ jobs
  - examined US data on job categories and number of employees in each
  - led to estimate that 58% could telecommute
  - this detail was not available for other countries, but EU estimates of fraction of employment in service sector jobs was comparable

Sample calculation: Telecommuting potential (3)

- **Step 3:** Need data on
  - average commute length
  - private car trips
  - average car occupancy
  - total employment
  - fuel economy by country
  - current telecommute levels

	Japan/ RK	IEA Europe	US/ Canada	Australia/ NZ
Average commute length (km)	14	9	17	13
Percent private car trips	42%	49%	86%	79%
Total employed (millions)	85.0	133.0	144.6	8.4

Sample calculation: Telecommuting potential (4)

- **Step 4:** Calculate Maximum Telecommuting Fuel Savings (*MTFS*)
  - *TE = Total number employees who could feasibly start to telecommute*
  - *L = Average commute trip length (km)*
  - *C = Modal share of commute trips currently done by car (%)*
  - *R = Average car occupancy rate*
  - *F = Average fuel intensity of vehicle fleet (liters/100km)*

$$MTFS = \frac{TE \cdot L \cdot C \cdot F}{R \cdot 100}(litres)$$

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Telecommuting Fuel Savings Potential – Results (1)

- 6 potential scenarios:
  - telecommute everyday
    - 100%, 50% and 25% take-up among "telecommutable" job holders
  - telecommute twice a week
    - 100%, 50% and 25% take-up
  - all assume a 25% increase in non-work driving
- Other scenarios easy to calculate

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Telecommuting Fuel Savings Potential – Results (2)

Percent Total Fuel Saved	Japan/ RK	IEA Europe	US/ Can	Aus/ NZ	Total, IEA
Telecommute every day					
Maximum potential fuel savings (all regions), 100% take-up	5.8%	2.9%	8.5%	7.1%	6.4%
Low estimate, 25% up-take	1.5%	0.7%	2.1%	1.8%	1.6%
High estimate, 50% up-take	2.9%	1.4%	4.2%	3.6%	3.2%
Telecommute only 2 times/week					
Maximum potential fuel savings (all regions), 100% take-up	2.3%	1.2%	3.4%	2.9%	2.6%
Low estimate, 25% up-take	0.6%	0.3%	0.9%	0.7%	0.6%
High estimate, 50% up-take	1.2%	0.6%	1.7%	1.4%	1.3%

Telecommuting Fuel Savings Potential – Results (3)

- Consensus estimate (based on previous results):
  - assumes employers are supportive of telecommuting and have provided resources to employees

	Japan / RK	IEA Europe	US / Can	Aus / NZ	Total
Thousand barrels saved per day	88	102	523	21	734
% transport fuel saved	4.2%	1.8%	4.4%	4.0%	3.7%
% total fuel saved	2.3%	1.2%	3.4%	2.9%	2.6%

Sample calculation: Driving ban (1)

- Driving bans will normally allow drivers to only use their car on certain days of the week (e.g. based on licence plate numbers)
- Has been used in Mexico City and Athens for air pollution reduction
  - evasive behaviour has undermined effectiveness as a long-term policy
- Very effective during short-term use during Paris pollution crisis in 1997
  - one day reduction of about 30%
  - evasive behaviour more difficult, altruistic effect, other modes available

Sample calculation: Driving ban (1)

- **Step 1:** Examine existing studies
  - other than studies showing the failure of the Mexico City policy, there was little information
  - web information showed that short-term policy was effective in Paris
  - driving bans were under active consideration during the 1970's crisis
  - DIW study in 1996 did not consider behavioural effects

Sample calculation: Driving ban (2)

- **Step 2**: Consider behavioural mechanisms
  - As household car ownership increases, ability to evade ban increases
    - Probability of car availability can be expressed as $P=B^n$
      - *B=percent vehicles available on a given day*
      - *n=number of vehicles owned in a given household*
    - Availability of other modal choices makes policy more feasible
  - Assumptions:
    - all trips previously taken are made if vehicle allowed on that day
    - no increase in driving from giving rides to those without car
    - further adjustment assumes all work VKT still occurs (i.e., some people are driven by others to work, more circuitous routing occurs, etc.)
    - Overall, off-sets represent some increase in driving when it is allowed

Sample calculation: Driving ban (3)

- **Step 3**: Data on car ownership distribution
  - not readily available, so needed to make assumptions for most regions based on limited data

	City of San Francisco (1990)	Bay Area excluding City of San Francisco (1990)	without zero-vehicle house-holds	UK data (2001)	without zero-vehicle house-holds
Zero vehicle	30.7%	7.4%		27.0%	
One vehicle	41.6%	32.5%	34.5%	44.0%	60.3%
Two vehicle	21.1%	3.9%	41.4%	23.0%	31.5%
Three-Plus vehicles	6.6%	22.6%	24.1%	6.0%	8.2%

Sample calculation: Driving ban (4)

- **Step 4**: Calculate off-sets to maximum VKT reduction
  - Estimate of VKT reduction and off-sets with odd/even ban (billion VKT and percentages)

	Japan/RK	IEA Europe	US/ Canada	Aus/NZ
50% VKT reduction applied to all VKT	1.5	4.2	6.6	0.3
Adjust for HH vehicle ownership	1.1	3.3	4.0	0.2
Assume all commute VKT still made	0.7	2.7	2.1	0.2
Off-set to maximum savings	21.9%	21.9%	38.8%	21.9%
Off-set with all commute VKT still made	49.5%	34.2%	68.1%	48.6%

Odd/even driving ban - Results

Percent total fuel saved	Japan/ RK	IEA Europe	US/ Can	Aus /NZ	Total
50% VKT reduction applied to all VKT	27.2%	31.0%	37.2%	34.3%	33.9%
adjust for HH vehicle ownership	21.2%	24.2%	22.8%	26.8%	23.1%
assume all commute VKT still made	13.7%	22.4%	9.5%	14.7%	14.2%

Estimated fuel savings of policy measures

- Estimates contain many assumptions and caveats on actual reductions
  - However, good confidence of the order of magnitude of various policy measures
    - **VERY LARGE**: more than one million barrels/day
    - **LARGE**: more than 500 thousand barrels/day
    - **MODERATE**: more than 100 thousand barrels/day
    - **SMALL**: less than 100 thousand barrels/day

Estimated fuel savings of policy measures: **VERY LARGE savings**

Carpooling: large programme to designate emergency carpool lanes along all motorways, designate park-and-ride lots, inform public and match riders
Driving ban: odd/even licence plate scheme. Provide police enforcement, appropriate information and signage
Speed limits: reduce highway speed limits to 90km/hr. Provide police enforcement or speed cameras, appropriate information and signage

Estimated fuel savings of policy measures: **LARGE savings**

Transit: free public transit (set fares to zero)
Telecommuting: large programme, including active participation of businesses, public information on benefits of telecommuting, minor investments in needed infrastructure to facilitate
Compressed work week: programme with employer participation and public information campaign
Driving ban: 1 in 10 days based on licence plate, with police enforcement and signage

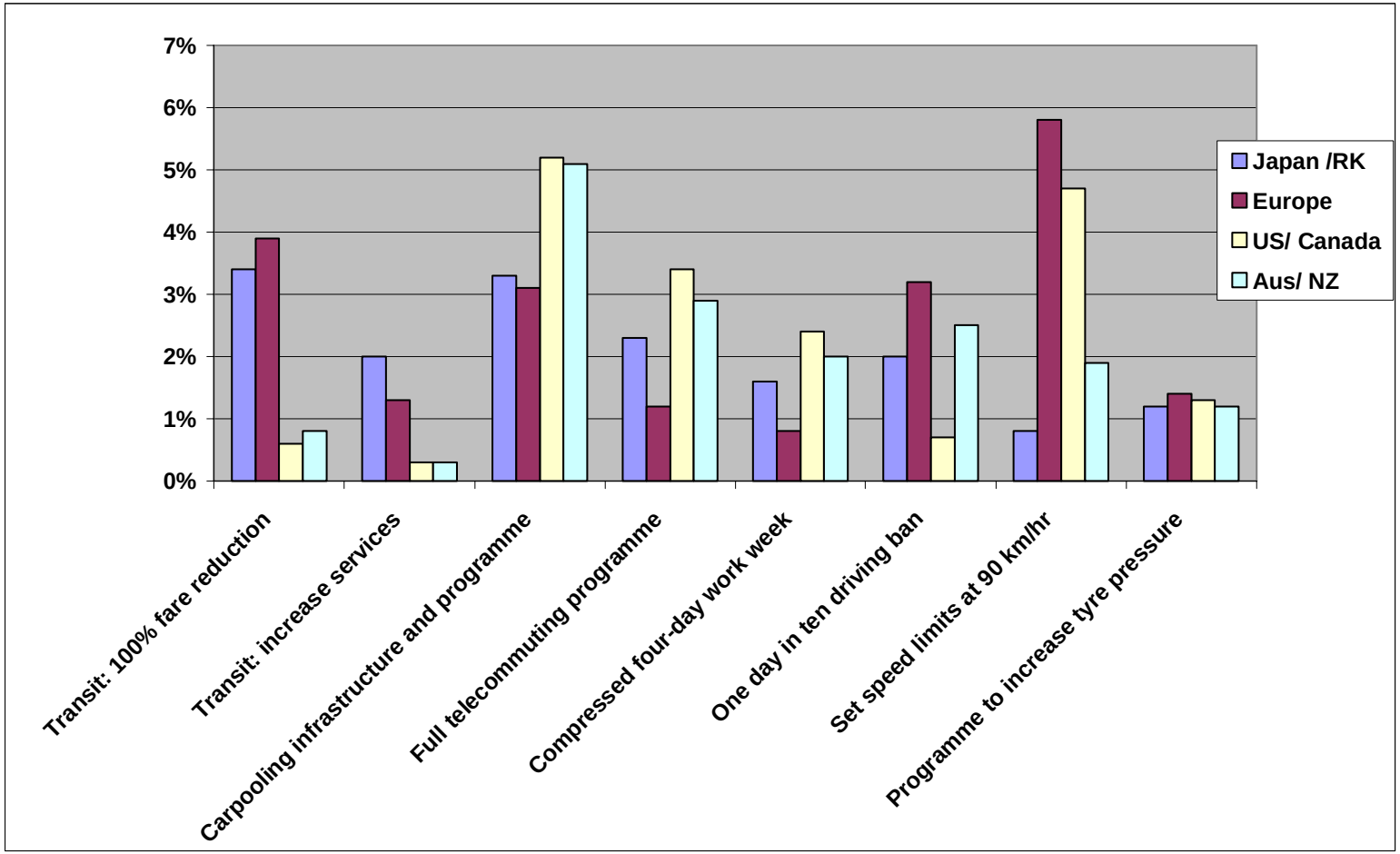
Estimated fuel savings of policy measures: **MODERATE savings**

Transit: 50% reduction in current public transit fares
Transit: increase weekend and off-peak transit service and increase peak service frequency by 10%
Carpooling: small programme to inform public, match riders
Tyre pressure: large public information programme

Estimated fuel savings of policy measures: **SMALL savings**

Bus priority: convert all existing carpool and bus lanes to 24-hour bus priority usage and convert some other lanes to bus-only lanes

Percent reduction in total fuel use by IEA region, selected measures



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Cost Effectiveness Calculations

- Main Assumptions:
  - Costs are those borne by governments (i.e., transfer payments not excluded)
  - Includes cost of planning and investment to be prepared for emergency
  - Includes costs undertaken during emergency
  - Most important caveat: consumer indirect costs (time, safety) not included – and these can be very large!
    - Consumer mobility benefits may be large if measure provides alternative travel or non-travel options
  - Emergency situation assumed to last 90 days
  - No linkage between amount of outreach and consumer response

Cost effectiveness - Results

- Categorised as follows:
  - **VERY INEXPENSIVE**: less than $1 per barrel saved
  - **INEXPENSIVE**: less than $10 per barrel saved
  - **MODERATE**: less than $50 per barrel saved
  - **EXPENSIVE**: more than $100 per barrel saved
- Effectiveness shown as: Very Large, Large, Moderate, Small
  - note: no measures were between $50-$100 per barrel saved

VERY INEXPENSIVE measures

	Other Potential Impacts
Carpooling: large programme to designate emergency carpool lanes along all motorways, designate park-and-ride lots, inform public and match riders	
Driving ban: odd/even licence plate scheme. Provide police enforcement, appropriate information and signage	Possibly high societal costs from restricted travel
Telecommuting: large programme, including active participation of businesses, public information on benefits of telecommuting, minor investments in needed infrastructure to facilitate	
Compressed work week: programme with employer participation and public information campaign	
Tyre pressure: large public information programme	Likely safety benefits
Carpooling: small programme to inform public, match riders	

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INEXPENSIVE measures

	Other Potential Impacts
Speed limits: reduce highway speed limits to 90km/hr. Provide police enforcement or speed cameras, appropriate information and signage	Safety benefits but time costs
Driving ban: 1 in 10 days based on licence plate, with police enforcement and signage	Possibly high societal costs from restricted travel

MODERATE COST measures

Bus priority: convert all existing carpool and bus lanes to 24-hour bus priority usage and convert other lanes to bus-only lanes

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EXPENSIVE measures

Telecommuting: Large programme with purchase of computers for 50% of participants
Transit: free public transit (set fares to zero); 50% fare reduction similar cost
Transit: increase weekend and off-peak transit service and increase peak service frequency by 10%

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Conclusions

- *Those policies that restrict driving are most effective*
  - driving ban, mandatory carpooling, speed limit reduction are all cost effective
  - more restrictive policies are politically unpopular
  - may be “expensive” in terms of reduced mobility
- Voluntary carpooling also effective and cost effective, but not when expensive infrastructure needed
- Telecommuting and compressed work weeks could be effective and cost effective, if businesses are supportive
- Transit options are generally expensive with small to moderate savings
  - would need long-term pre-planning to significantly increase transit service (which may provide other benefits)

Other Conclusions / Next Steps

- Analysis has been reasonably thorough, but…
  - Behavioural reactions very difficult to estimate; many simplifying assumptions have been made
  - Some costs very difficult to measure (e.g. time, safety)
  - Effect of varying outreach costs should be considered, but no evidence available
  - Synergistic effects not considered!
- Countries should expand on this analysis in their own context
- More empirical evidence would be helpful! When disruptions do occur, countries should carefully monitor the success of their actions – *need to be ready to measure and analyze effects*