Economic, Social and Environmental Impacts of Changing Road Maintenance Spend: *Scotland Case Study*

PAVEMENT PRESERVATION & RECYCLING SUMMIT

PPRS PARIS 2015 FEBRUARY 22-25

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TRANSPORT SCOTLAND

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- Background: Scotland's Roads
- The context: National Roads Maintenance Review.
- Overview of framework and steps in research.
- Quantitative analysis – measuring and monetising impacts.
- Qualitative assessment - assessment of other impacts that cannot be or were not measured but may be of equal significance.
- Conclusions.

BACKGROUND

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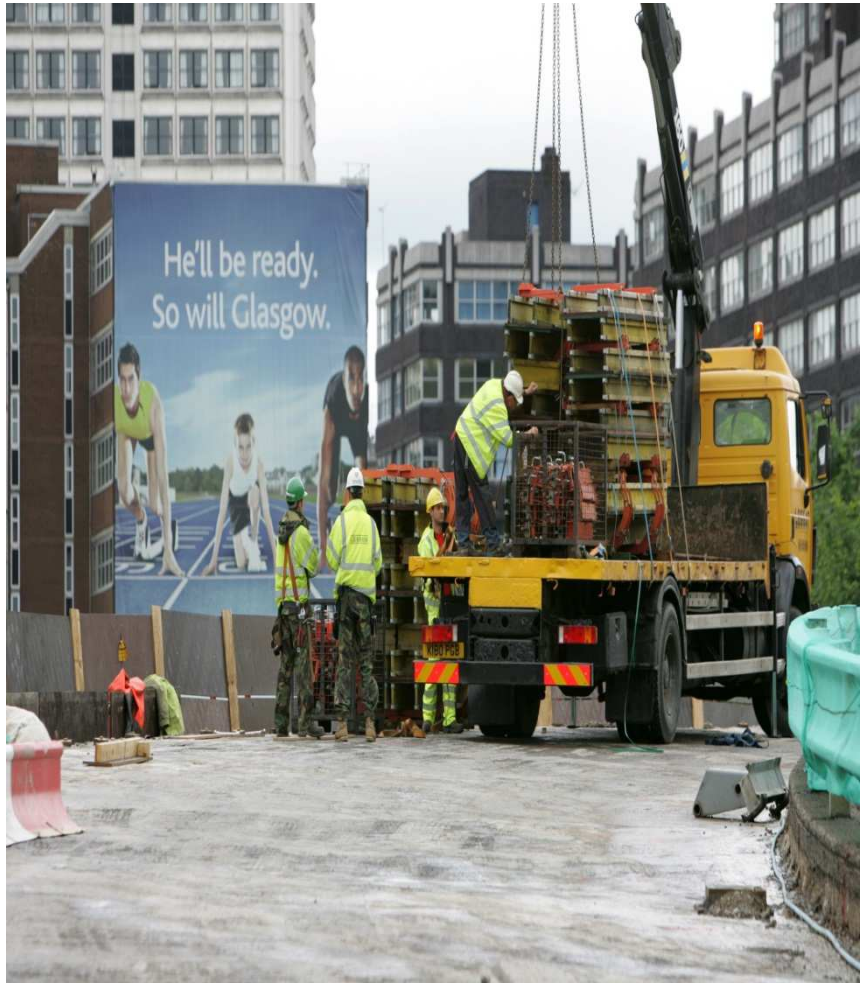
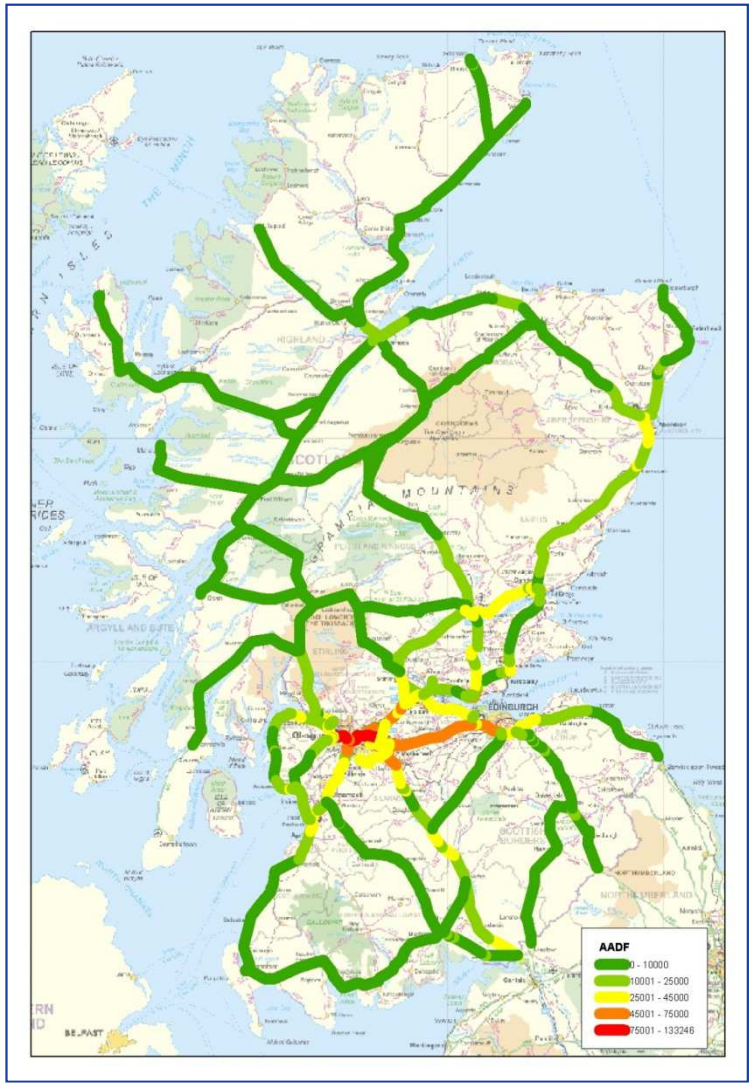
Scotland's Roads

Scotland – Key Facts

- Devolved Administration
- Scottish National Party Government Since 2007
- Responsibilities include “Trunk” Road Network

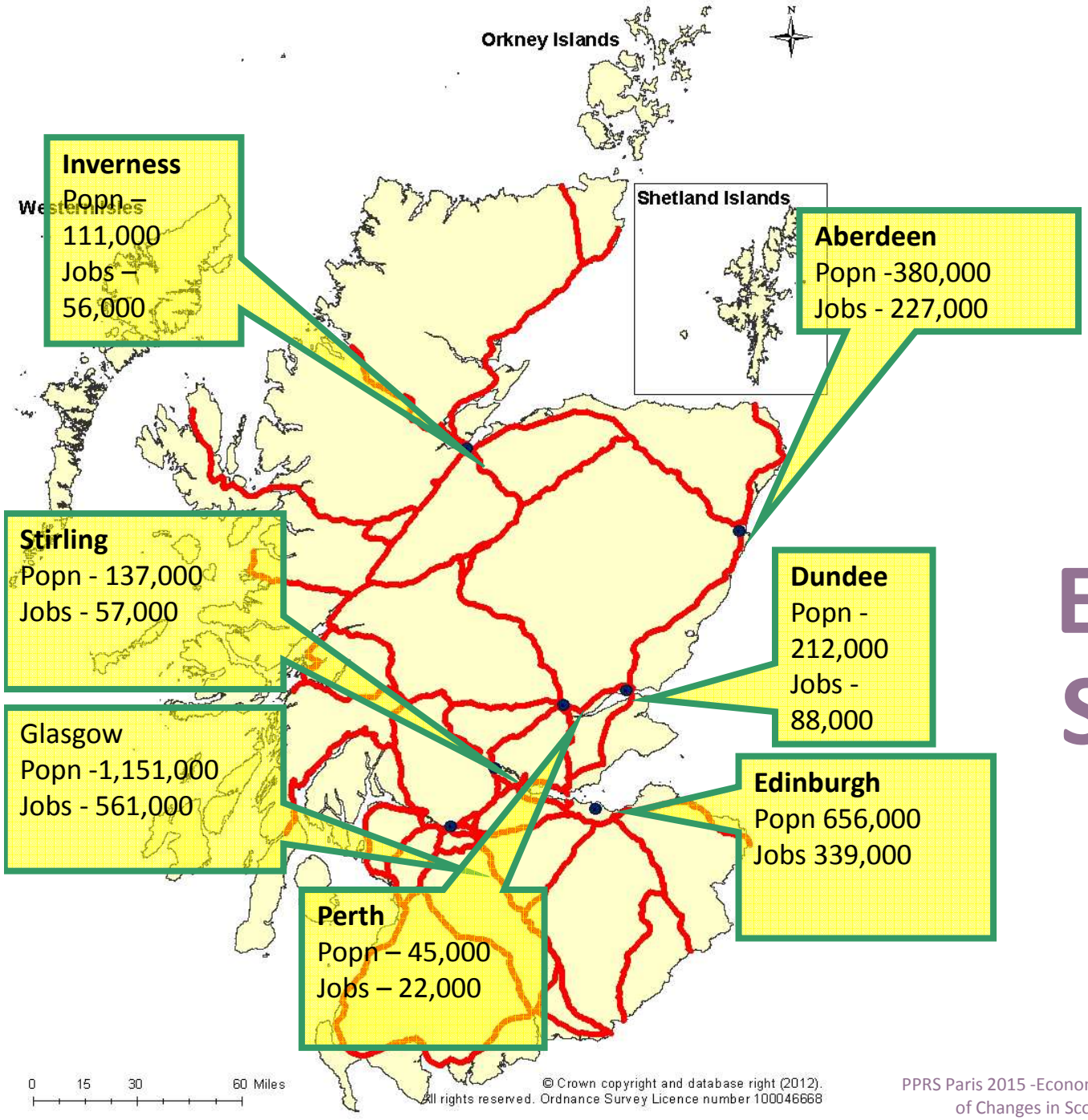




Trunk Road Network

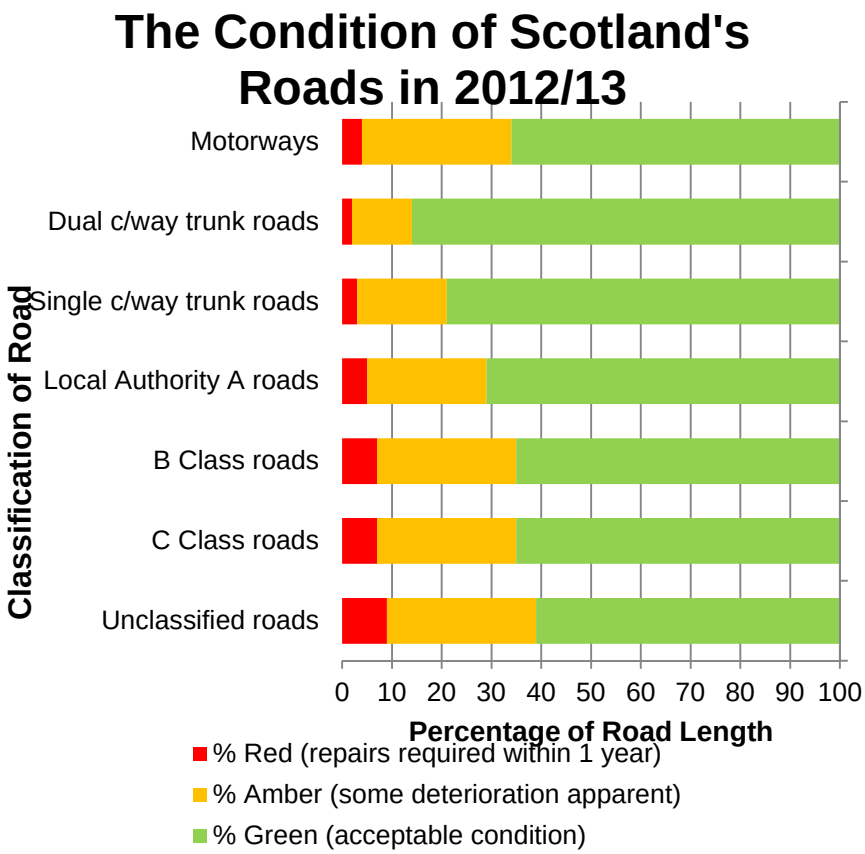
- **Population** 5,327,700
- **Area** 78,772 sq km
- **GVA** £117,116 million
- **Trunk Road** 3,405 km
- **6% of total Scottish road network**
- **39% of all traffic**
- **63% of all HGV traffic**
- **1,900 bridges**
- **4,100 other structures**
- **Valued at +£18bn**
- **Motorways** 596 km (17%)
- **A roads Dual** 518 km (15%)
- **A roads Single** 2315 km (65%)
- **Local Roads** 52,411 km
- **Freight lifted by road in 2010 - 132m tonnes**

Trunk Road Network & Key Sectors of the Economy



Growing the Economy - Scotland's Cities

Road Challenges



Keeping Scotland on the Move

- Maintaining;
- Optimising;
- Improving

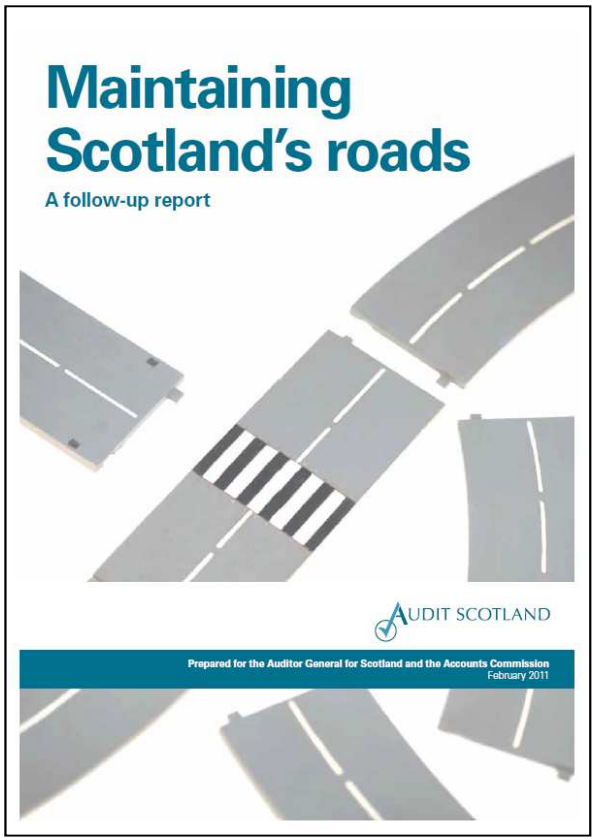
- £214.2m 2014/15

THE CONTEXT | 2

National Roads Maintenance Review

Introduction

- 2011 Government National Road Maintenance review following Audit Scotland report
- How is the road network in Scotland managed and maintained?
- A workstream to look at: Wider Economic Issues, Costs and Benefits



Terms of Reference

›Estimate the economic and social impacts of reductions in trunk and local road maintenance expenditure over a ten and twenty year time period.

OVERVIEW OF THE FRAMEWORK AND STEPS IN RESEARCH

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How did we go about this?

- Uses Scottish Transport Appraisal Guidance
  - Environment
  - Safety
  - Economy
  - Integration
  - Accessibility and Social Inclusion
- Quantitative and Qualitative assessments
- Undertaken by TRL consultants

QUANTITATIVE ANALYSIS: Measuring and monetising impacts

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How did we go about quantifying this (half the story)?

Steps

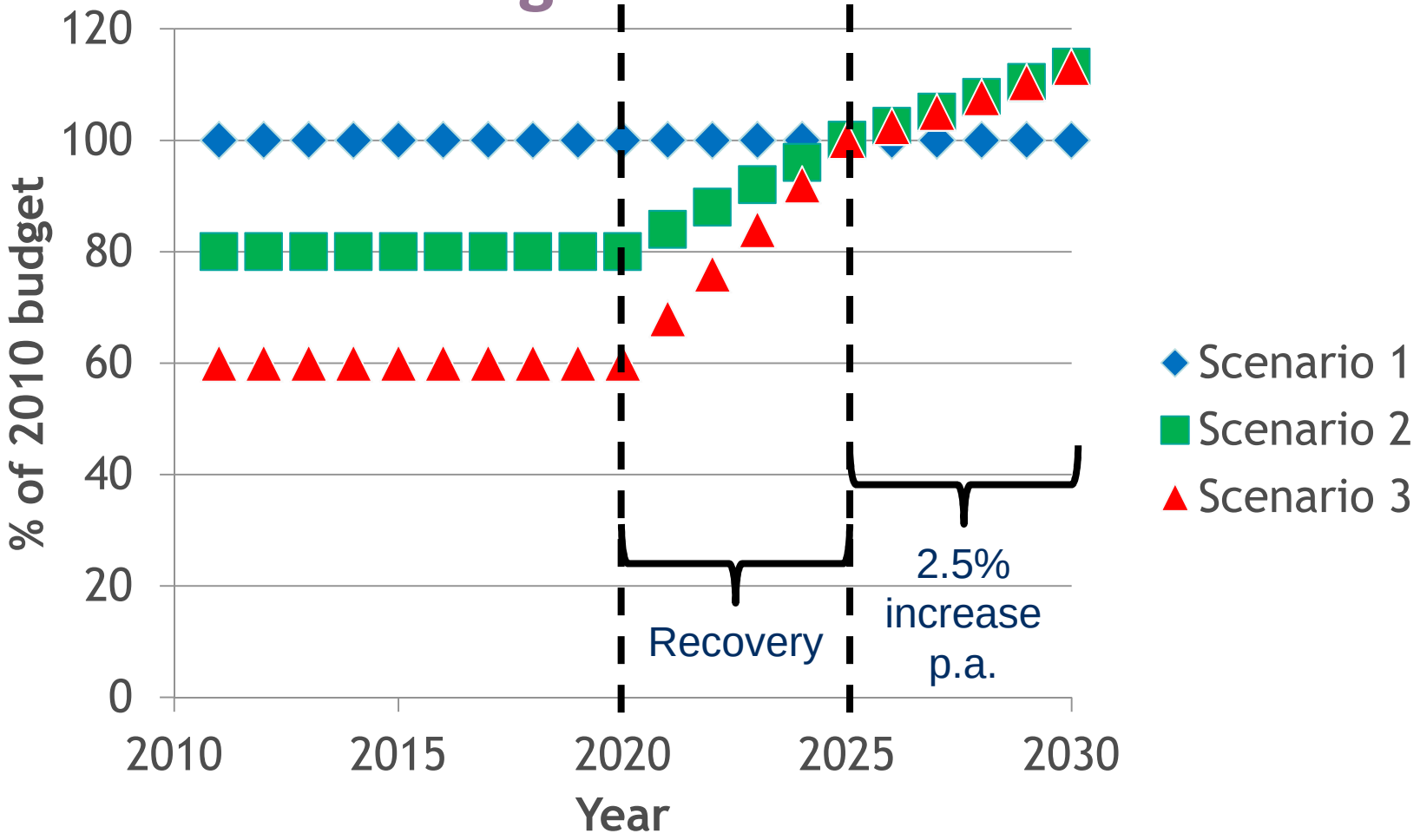
Subjective allocation of spending reduction → **Model impact on condition** → **Translate conditions into impacts** → **Quantify impacts over time**

›Scenario 1: ›Maintain 2010/11 spending

›Scenario 2: ›20% reduction over 10 years, return to base level over next 5, real terms annual increase of 2.5% over following 5.

›Scenario 3: ›40% reduction over 10 years, return to base level over next 5, real terms annual increase of 2.5% over following 5.

Budget Scenarios



Model Assumptions

- Scaling of Results for Local Roads
- Allocation of Budget to Activities
- Even distribution of travel
- Standard and Consistent Unit Rates
- No unplanned maintenance

Allocating reductions across budget lines: trunk roads

Activity	Activity spend as percentage of current budgeted activity spend	
	Scenario 2 (Overall 20% cut)	Scenario 3 (Overall 40% cut)
Inventory, inspection, testing, routine and cyclic activity	87	72
Miscellaneous	88	71
Structural maintenance – pavements (carriageways)	56	24
Structural maintenance – structures	96	86
Minor improvements	93	75
Total overall budget (%)	**80**	**60**

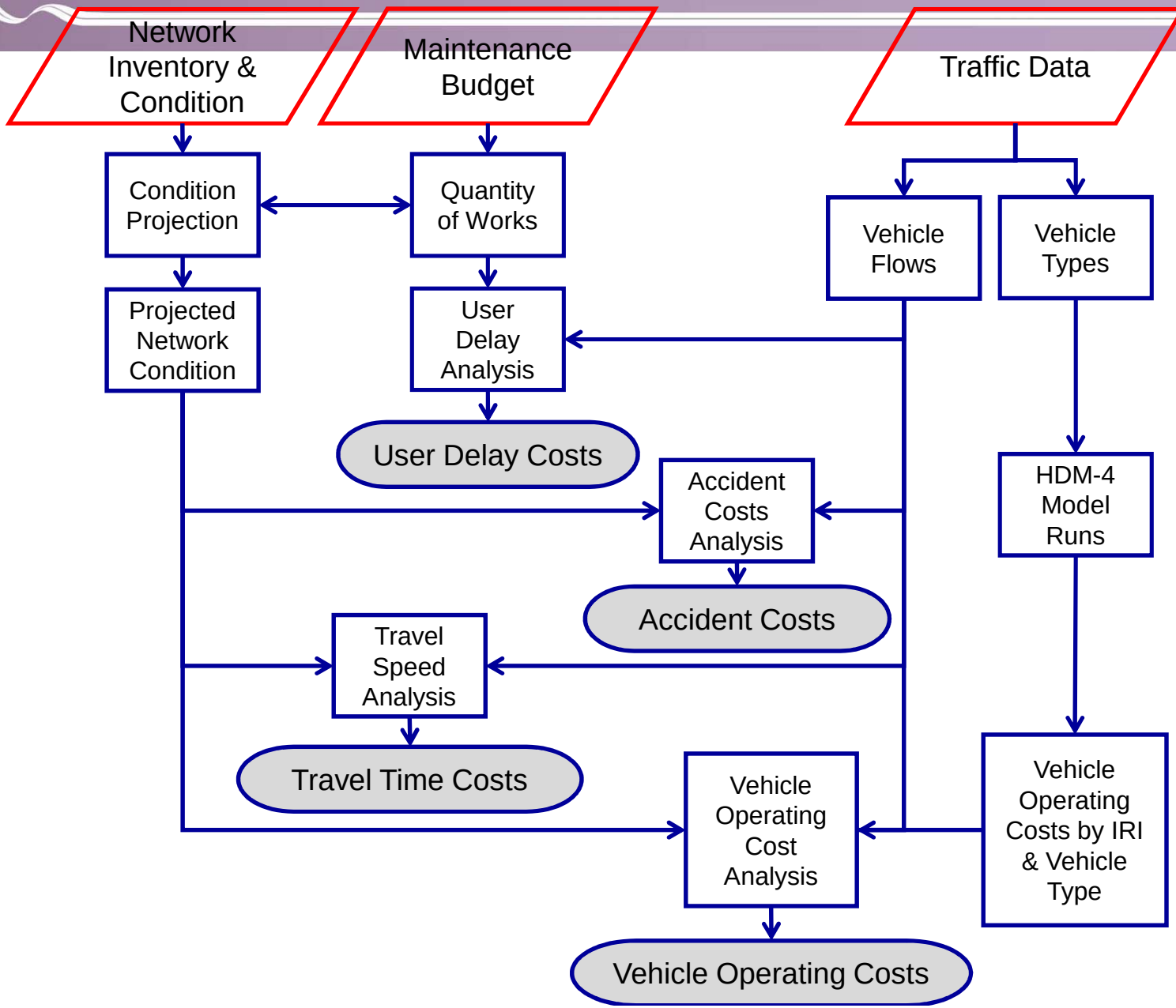
Modelling the impact on condition

(Analyses undertaken by WDM Ltd)

- Trunk roads:
  - Road Condition Indicator (RCI) to Residual Life conversion
  - Treatment interventions are based on RCI
  - Distribution of treatment remains constant for future years
- Local roads:
  - SCANNER data (RCI used for condition)
  - Spending Review budgets
  - Condition reports
- Valuation of network for trunk roads
- Calculation of depreciation for local roads

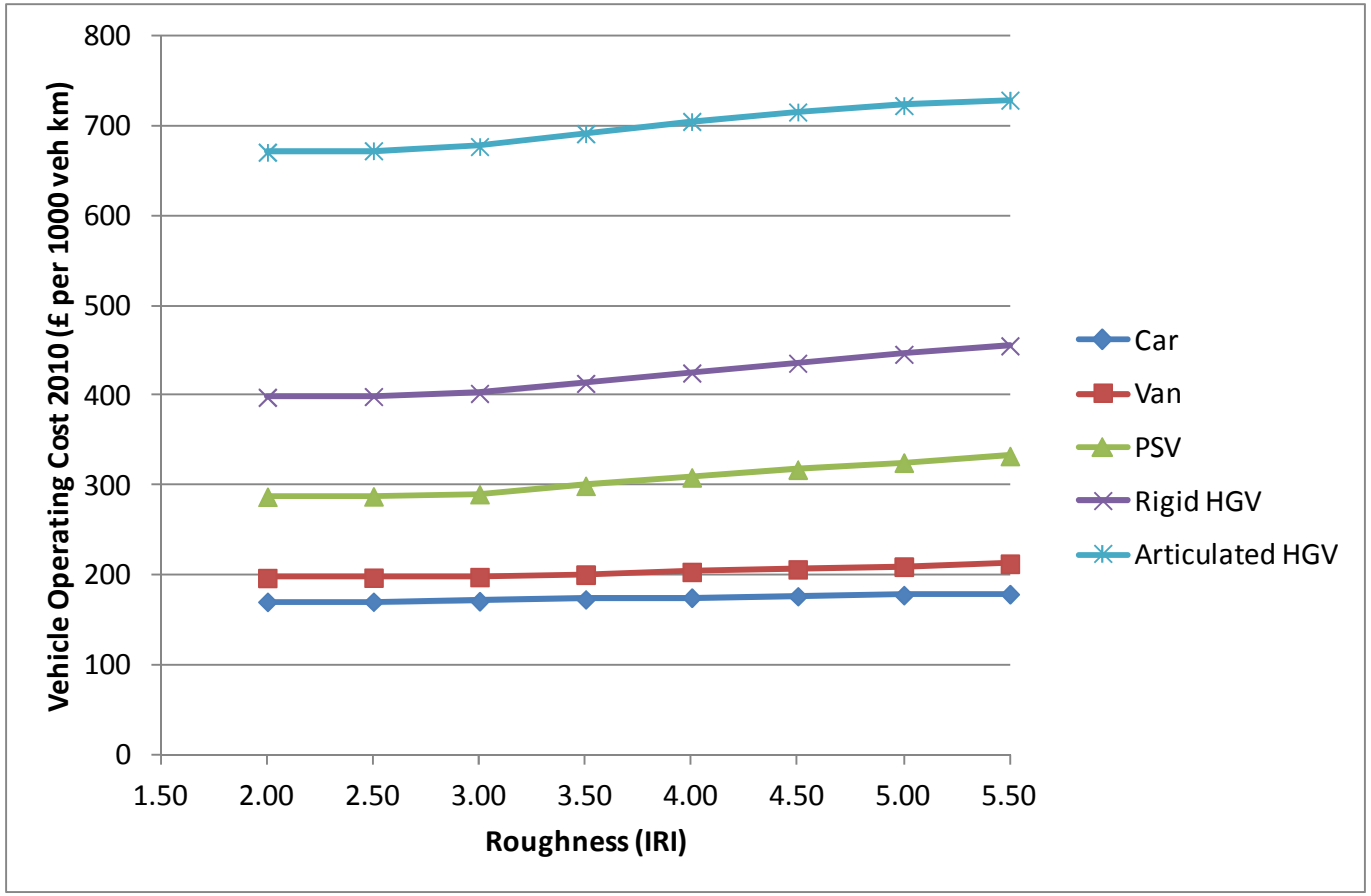
Translating these into impacts

1	Change in vehicle operating costs due to surface condition
2	Change in travel time costs due to surface condition
3	Change in accident costs due to surface condition
4	Change in delay costs at roadworks
5	Change in accident costs due to reduced lighting
6	Change in the carbon emissions, local air quality and noise
7	Change in the (road) asset value (not part of NPV)


Network Inventory & Condition
Maintenance Budget
Traffic Data
Condition Projection
Quantity of Works
Vehicle Flows
Vehicle Types
Projected Network Condition
User Delay Analysis
User Delay Costs
Accident Costs Analysis
HDM-4 Model Runs
Accident Costs
Travel Speed Analysis
Travel Time Costs
Vehicle Operating Cost Analysis
Vehicle Operating Costs by IRI & Vehicle Type
Vehicle Operating Costs

Vehicle Operating Costs

- If road conditions deteriorate, there is an increased cost of vehicle operation
  - more fuel
  - more frequent repairs)



Travel Time Costs

- Worsening in road conditions
- Slowing of vehicle speeds
- Increase in the journey time.

User Delay Costs

- Fewer planned disruptions (due to less maintenance work being carried out) result in reduced delays at roadworks and a decrease in journey time costs.
- Unplanned maintenance NOT modelled
- Delay costs at roadworks were modelled using the Department for Transport QUADRO (Queues and Delays at Roadworks) delay cost model (Department for Transport, 2006).

Accident Costs

- Increased risk of accidents due to lower skid resistance.
- Street lighting is reduced may increase traffic accidents.

Carbon Costs

› Carbon Dioxide Emissions were Calculated based on the aggregation of:

- Embodied CO_2 related to the materials used in the maintenance works carried out on the network
- CO_2 emissions from vehicles delayed through roadwork sites.
- CO_2 emissions due to changes in vehicle fuel consumption as a result of changes in pavement roughness.

› CO_2 monetised using the central non-traded price of carbon as provided in STAG.

Quantitative analysis – results

Cumulative discounted costs (£m 2002 Prices)	Trunk Roads			Local Roads			All Roads	
	Scenario 1 (Base Case)	Scenario 2	Scenario 3	Scenario 1 (Base Case)	Scenario 2	Scenario 3	Scenario 2	Scenario 3
Financial Costs to Government								
Maintenance works	2,152	-266	-568	5,677	-688	-1,459	-954	**-2,027**
Impacts on Society								
Vehicle operating costs	73,223	+376	+625	274,246	+1,485	+2,966	+1,861	**+3,591**
Travel time (surface condition related)	362	+57	+94	1,572	+77	+158	+134	**+252**
Accidents (skid related)	345	0	+21	N/A	N/A	N/A	0	**+21**
Delays (through roadworks)	119	-25	-38	1,480	-354	-712	-379	**-750**
Lighting (accidents)	128	+1	+2	2,155	+18	+37	+19	**+39**
CO_2 Emissions	5,765	-36	-58	14,971	-14	-16	-50	**-74**
Overall impact on society	79,942	373	646	294,424	1,212	2,433	1,585	**3,079**
Economic analysis								
Works costs reduction	Base Case	266	568	Base Case	688	1,459	954	**2,027**
Increase in user costs	Base Case	373	647	Base Case	1,212	2,433	1,585	**3,080**
Net Present Value	Base Case	-107	-79	Base Case	-524	-974	-631	**-1,053**

Sensitivity Analysis

› Shortening the analysis to 10 years to remove the effect of increases in maintenance budgets in the later years

› Higher than predicted inflationary rises in road maintenance costs. In recent years these have been up to 8% per annum

› Removing traffic growth and projected increases in fuel costs from the analysis

Sensitivity analysis

Sensitivity tests	Trunk roads		Local roads	
	Scenario 2 (20% cut)	Scenario 3 (40% cut)	Scenario 2 (20% cut)	Scenario 3 (40% cut)
Base analysis (20 years, standard growth and indexing assumptions)	**-107**	**-79**	**-524**	**-974**
Reduced (10 year) time period analysis	112	263	-	-
Higher inflation rates on works costs	-62	44	-	-
Vehicle operating costs: No traffic growth or fuel price increases	307	983	332	743
Scaling up methodology for local road sample to network effects	-	-	-447	-806

QUALITATIVE ASSESSMENT

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Assessment of other impacts that cannot be or were not measured but may be of equal significance

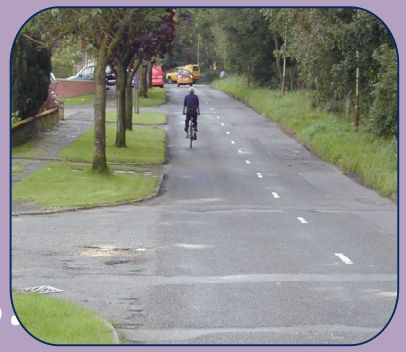
Second half of the story –assessment of impacts that have not been quantified

- Biggest surprise. These impacts arguably as significant as the quantified impacts.
- Some impossible or hard to quantify, some out of scope of the analysis.
- Literature review:
  - 132 documents reviewed
  - 65 relevant
- Workshop featuring guest expert presenters
- "Based on the literature review, the user group most affected by a reduction in road maintenance would be pedestrians. Pedestrians would be affected in every aspect including noise and vibration, global air quality, visual amenity, cultural and landscape, physical fitness, accidents, security, and community accessibility."

CONCLUSIONS

- Savings on road maintenance spend would be significantly outweighed by wider additional costs.

- A £1 reduction in road maintenance results in a £1.50 cost to the wider Scottish economy and society



- Qualitative findings further reinforce this.

CONCLUSIONS

- Impact is greater for local roads
- Most significant quantified impact - increase in vehicle operating costs
- Public dissatisfaction with road conditions is likely to increase – not reflected in the quantitative analysis
- Investing in the maintenance of this significant capital asset delivers economic and social benefits to Scotland

CONCLUSIONS

“Every £1 spent on road maintenance in Scotland provides a benefit of £1.50 to the Scottish economy.

“I therefore confirm today I will invest an additional £10 million in trunk road maintenance in 2013-14.”

John Swinney
Finance Minister

Budget Bill 2013-14 Stage 3
Scottish Parliament
February 6, 2013

Links

Summary report:

› http://www.transportscotland.gov.uk/consultations/j235740-00.htm

Impacts on trunk roads:

› http://www.transportscotland.gov.uk/consultations/j235739-00.htm

Impacts on local roads and review of evidence:

http://www.transportscotland.gov.uk/consultations/j235737-00.htm

National Roads Maintenance Review (Scotland) website

› http://www.transportscotland.gov.uk/road/maintenance/national-roads-maintenance-review