



Carbon Cost of Roads

Carbon Management at Transport Scotland

Presentation to Timber Transport Forum Conference
Henry Collin – Transport Scotland
11 March 2010

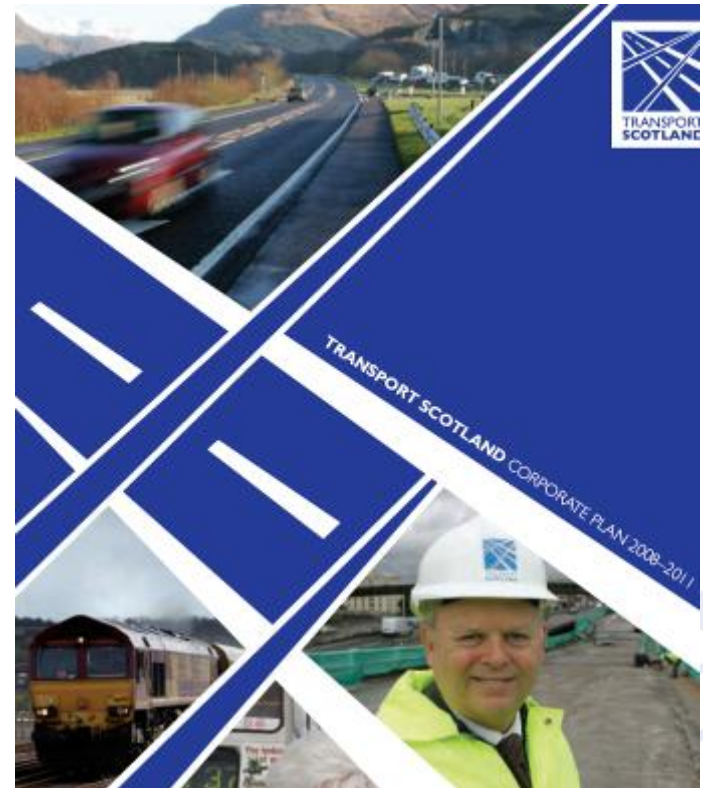
Contents

- Context
- Carbon Management System
- Early Results
- Timber Transport Implications

Transport Scotland's Key Priorities



- Improving journey times and connections
- Reducing emissions
- Improving quality, accessibility and affordability



Policy Context

Climate Change (Scotland) Act

- Headline Target: **80%** GHG reduction by 2050
- Interim Target: **42%** GHG reduction by 2020
- Power to require public bodies to report on carbon annually

Climate Change Delivery Plan (Scottish Government)

“The most accurate way of measuring Scotland's carbon footprint would be to look at the emissions associated with its consumption of goods and services.

While a consumption-based approach to measurement might be preferable, data are not yet sufficiently available or robust to use the consumption-based approach consistently”

EU Waste Framework Directive

- Headline Target: 70% non-hazardous construction & demolition waste recycled or reused by 2020

Climate Change (Scotland) Act 2009 (asp 12)



Climate Change (Scotland) Act 2009

2009 asp 12

CONTENTS

Section

PART 1

EMMISSIONS REDUCTION TARGETS

1 The 2050 target The 2050 target

2 The interim target The interim target

3 Annual targets Annual targets

4 Setting annual targets

5 Advice before setting annual targets

6 Modifying annual targets etc.

7 Advice before modifying annual targets etc.

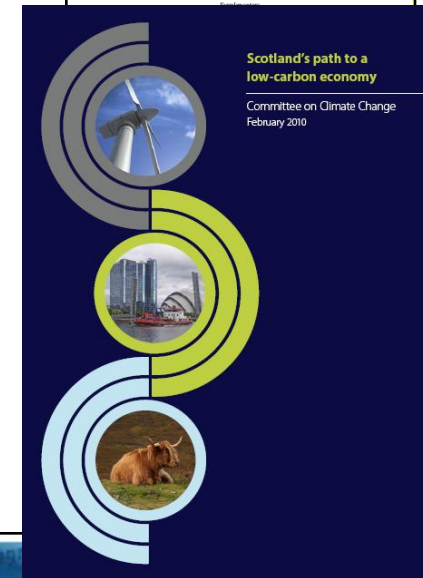
8 The domestic effort target The domestic effort target

9 Progress towards targets Advice on progress

10 Greenhouse gases Greenhouse gases

11 The baseline Baseline

12 Baseline for additional greenhouse gases

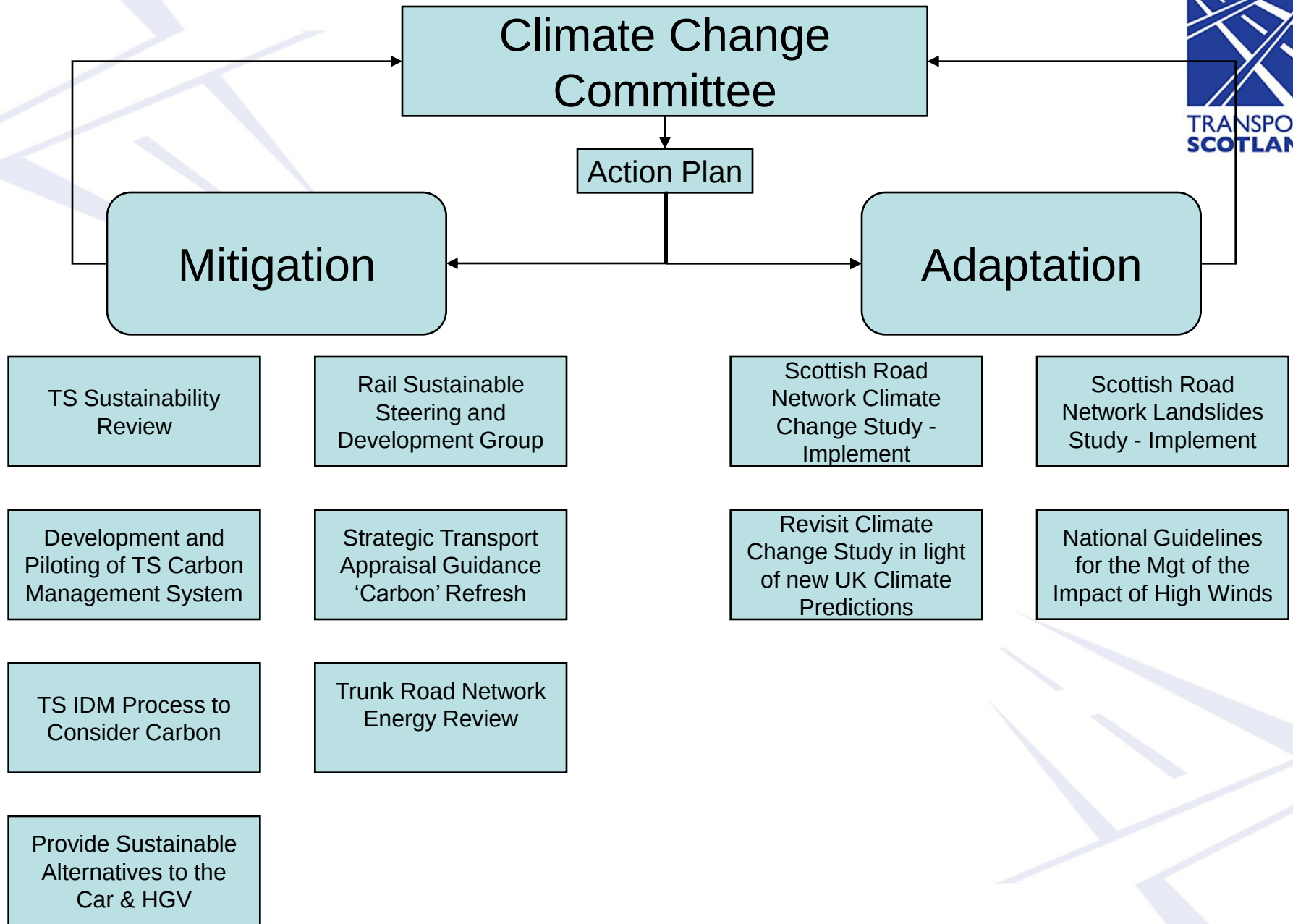


Climate Change Objectives

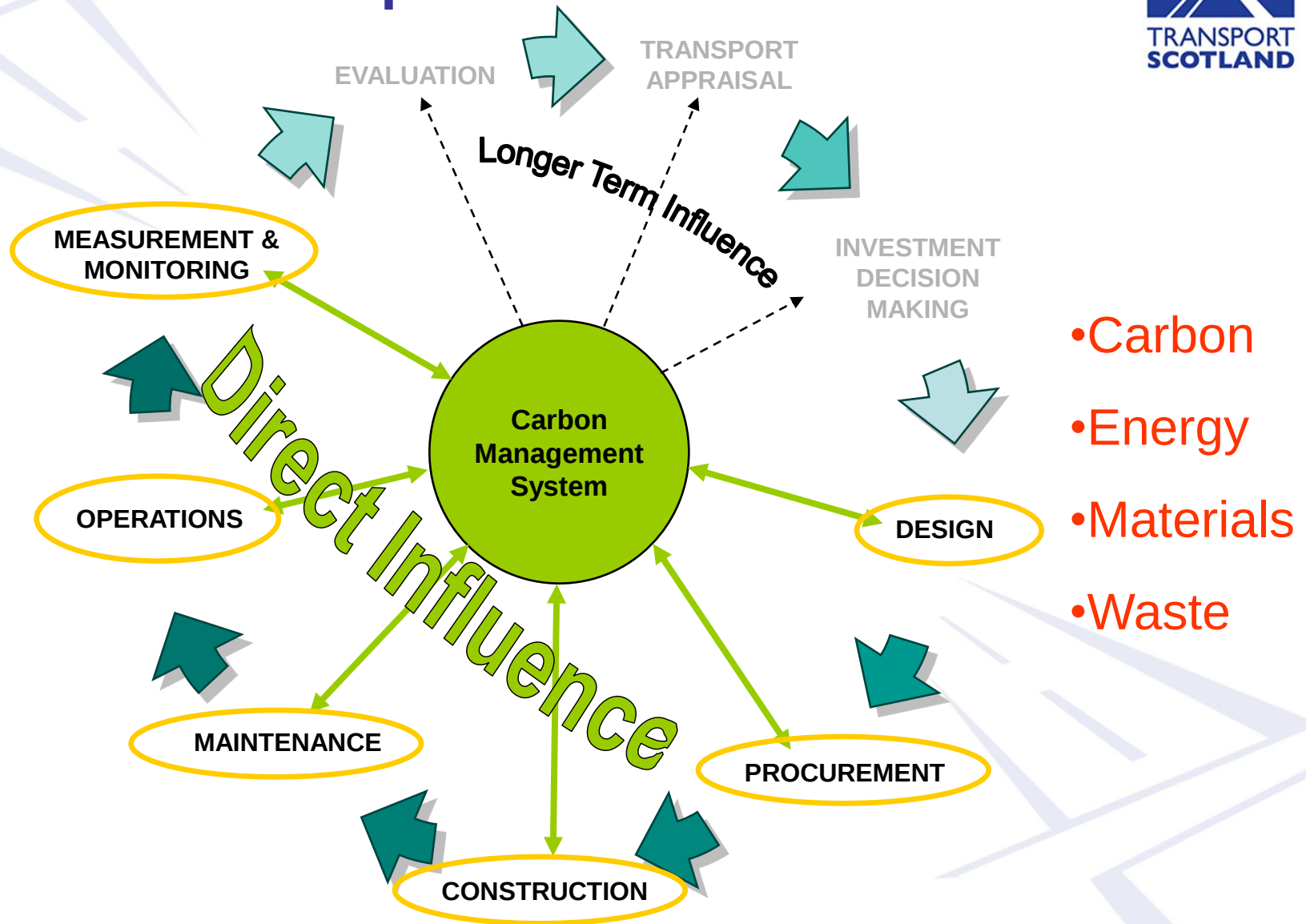
Vision: Transport Scotland will **lead** the way in reducing emissions and adapting to climate change.

- **Mitigation:** We will consider the impact of all transport policies and projects in the context of the Government's Strategic Target of reducing emissions by 80% by 2050.
- **Adaptation:** We will introduce measures into the planning operation and maintenance for our trunk road and rail networks to ensure that our transport systems continue to adapt to climate change.





Scope of Review



Sustainability Review

- Review infrastructure project and network management processes
- Analyse key stages
- Approaches and practical tools
- Align with other TS and SG work
- Carbon management tool

Provides a framework for our responses to climate change mitigation

- Context
- Carbon Management System
- Early Results
- Timber Transport Implications

Framework for the Carbon Management System



**Step 1:
Identify Business Goals**

TS Corporate Plan & Climate Change Action Plan

**Step 2:
Set organisational boundaries**

Consider financial or contractual controls

**Step 3:
Set operational boundaries**

Trunk Road Network Maintenance & Operations,
Road & Rail Infrastructure Projects,
Corporate Activities, Staff Travel, ScotRail Franchise

**Step 4:
Identify GHG emission sources**

Map the Emission Scopes 1, 2, 3

**Step 5:
Select calculation approach**

Review other tools and guidance, develop
testing & beta versions of the CMS

**Step 6:
Collect data and choose emission factors**

Defra & University of Bath Inventory of Carbon Emissions

**Step 7:
Apply calculation approach**

Pilot the use of the CMS on Roads Schemes &
Collect operational data from supply chain

**Step 8:
Roll up to corporate level**

Link data feedback into the
CMS Annual Carbon Account

Transport Scotland Carbon Footprint



Core Footprint

1. TS Corporate, Buildings & Staff

- Buchanan House & Atlantic Quay services & supplies
- TS staff travel to work & staff travel for work

2. Network Systems

- Trunk road lighting and traffic management systems

5. ScotRail Operations

- Rail passenger services (energy)
- Depots and offices
- Station operations
- Corporate

3. Trunk Road Network Management & Maintenance

- Operating Company Routine & Cyclic Maintenance
- Patrols
- Traffic Scotland term contractors
- DBFOs

4. Transport Infrastructure Projects

- Trunk road projects
- Structural maintenance projects and minor schemes
- Rail projects



TRANSPORT SCOTLAND CARBON MANAGEMENT SYSTEM

Alpha v1.4

DEVELOPED BY

Halcrow



Annual Carbon Account Home

23 | March | 2009

Home

Emissions Summary

User Guide

Emission Factors

Links

Refit to screen



Transport Scotland Annual Carbon Account

TS Financial or Contractual Control

Annual Cyclic Footprint

TS Corporate

Trunk Road Network
Energy

ScotRail Operations

Trunk Road
Management &
Maintenance

Annual Project Footprint

Road Infrastructure
ProjectsRail Infrastructure
Projects

TS Policy Influence

Traffic From New
Road ProjectsRail Network
Management &
MaintenanceScotRail Leased
Rolling Stock

No Direct TS Influence

Trunk Road Traffic

Rail Freight Traffic

Cross Border Rail
Passenger Traffic

Select accounting year and click 'Start Annual Carbon Account'

Start Annual Carbon Account



News and Updates

22/01/2009 Alpha v1.4 release

Alpha version 1.4 released for testing with Transport Scotland.

Comments and feedback should be directed to:

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Louise.Hill@transportscotland.gsi.gov.uk

Overview

TRANSPORT
SCOTLAND



8 | September | 2009

Series 0700: Pavements

Enter the materials listed in the Bill of Quantities (design stage) or delivery notes (construction stage) in the table below using the drop down menus.

If an item is not available in the drop down menus please either:

- Choose the closest available match from the drop downs and clearly state this with assumptions in the user notes section; or
- List the item in the sundry items table at the bottom of the page.

Feature	Material	Depth (mm)	Quantity (see unit)	Unit	Recycled Content (source)	Recycled Content (%)	Density (t/m³)	Tonnes	Emission factor (tCO₂/t)	Emission (tCO₂)
Sub-base	Type 1		132	m³	Secondary	50%	2.55	336.6	0.005	0.8
Base Course	Rolled Asphalt	100	12,340	m²	Secondary	25%	2.31	2,844.6	0.045	96.0
Binder Course	Rolled Asphalt	60	15,305	m²	Secondary	25%	2.31	2,116.9	0.045	71.4
Surface Course	Stone Mastic Asphalt (SMA)	40	14,853	m²			2.31	1,369.6	0.045	61.6
Base Course	Rolled Asphalt	130	1,320	m²			2.31	395.6	0.045	17.8
Binder Course	Rolled Asphalt	40	660	m²			2.31	60.9	0.045	2.7
Surface Course	Stone Mastic Asphalt (SMA)	40	495	m²			2.31	45.6	0.045	2.1
Regulating Course	Rolled Asphalt		200	t			2.31	200.0	0.045	9.0
Regulating Course	Macadam		50	t			2.31	50.0	0.045	2.3
TOTAL:										263.8
Emissions saved due to re-use of materials:										0.0
Emissions saved due to recycled materials:										56.7

CMS Projects Tool: Emissions Summary



Road Infrastructure Projects Tool

14 | September | 2009

Project Emissions Summary				Method of Measurement						Emission Factors						User Guide						Links	
SHW Series:	100	200	300	400	500	600	700	1100	1200	1300	1400	1500	1600	1700	1800	2000	2300	2400					Innovations

Project Emissions Summary

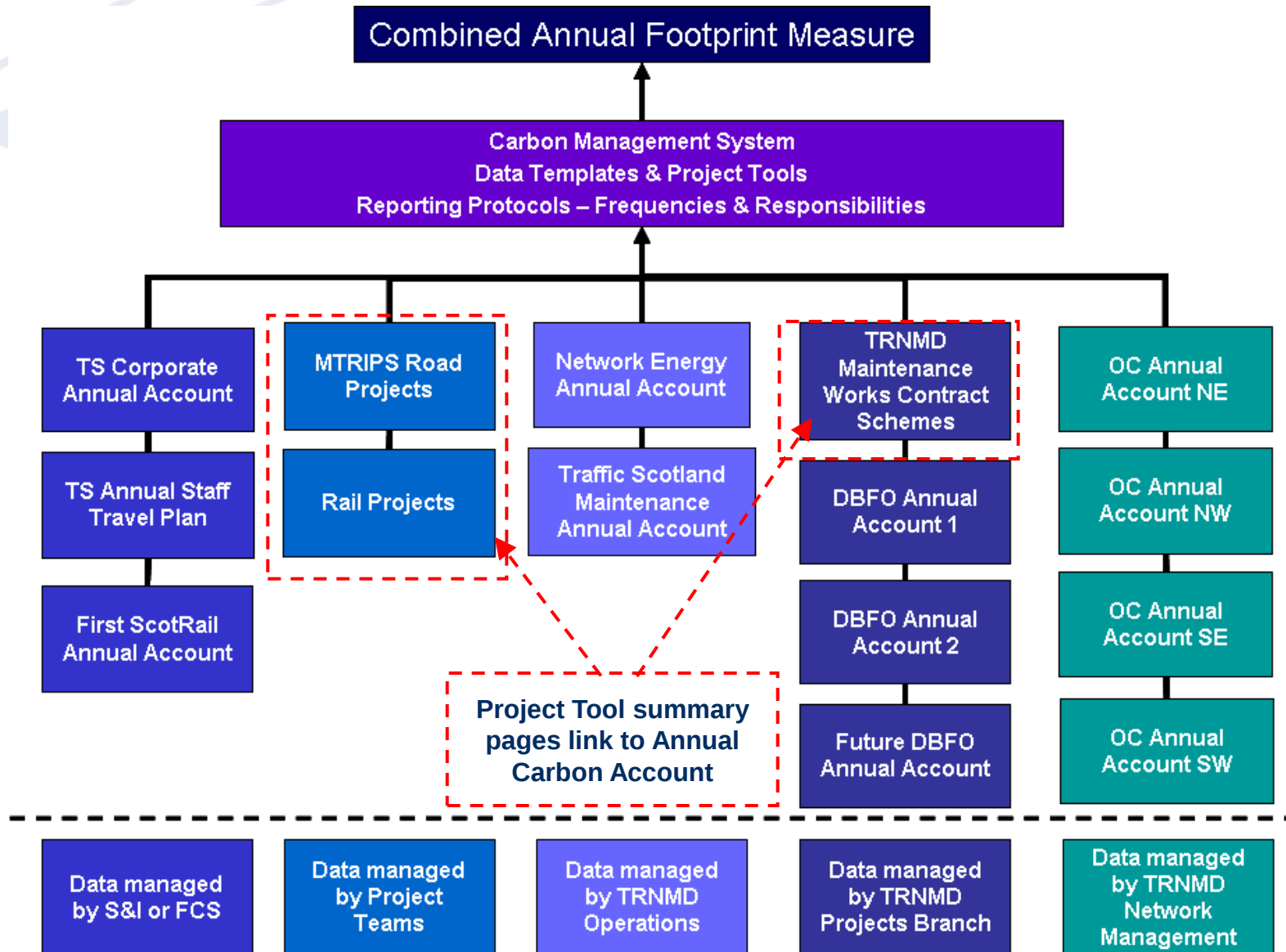
Series	Emission Sources			Savings			Total Emissions (tCO ₂)	
	Materials	Plant	Transport	Reused Materials	Recycled Materials	New Materials	Project Emissions	
Series 0100: Preliminaries							0.0	0.0%
Series 0200: Site Clearance	0.0	0.0	0.0				0.0	0.0%
Series 0300: Fencing	0.4	0.0	0.0				0.4	0.1%
Series 0400: Road Restraint System	13.8	0.0	0.0				13.8	3.7%
Series 0500: Drainage and Service Ducts	0.0	0.0	0.0				0.0	0.0%
Series 0600: Earthworks	61.1	0.0	0.0				61.1	16.5%
Series 0700: Road Pavements	221.1	0.7	24.7				246.4	66.3%
Series 1100: Kerbs, Footways and Paved Areas	26.8	0.0	0.0				26.8	7.2%
Series 1200: Traffic Signs and Road Markings	22.8	0.0	0.0				22.8	6.1%
Series 1300: Lighting Columns and Masts	0.0	0.0	0.0				0.0	0.0%
Series 1400: Electrical Work for Lighting and Signs	0.0	0.0	0.0				0.0	0.0%
Series 1500: Motorway Communications							0.0	0.0%
Series 1600: Piling and Embedded Retaining Walls							0.0	0.0%
Series 1700: Structural Concrete	0.0	0.0	0.0				0.0	0.0%
Series 1800: Structural Steelwork	0.0	0.0	0.0				0.0	0.0%
Series 2000: Waterproofing for Concrete Structures	0.0	0.0	0.0				0.0	0.0%
Series 2300: Bridge Expansion Joints and Sealing of Gaps	0.0	0.0	0.0				0.0	0.0%
Series 2400: Brickwork, Blockwork and Stonework	0.0	0.0	0.0				0.0	0.0%
Totals	346.0	0.7	24.7	0.0	0.0	0.0	371.4	
Percentage	93.2%	0.2%	6.7%	0.0%	0.0%	0.0%		

Table Key:

Greater than 10% of overall footprint

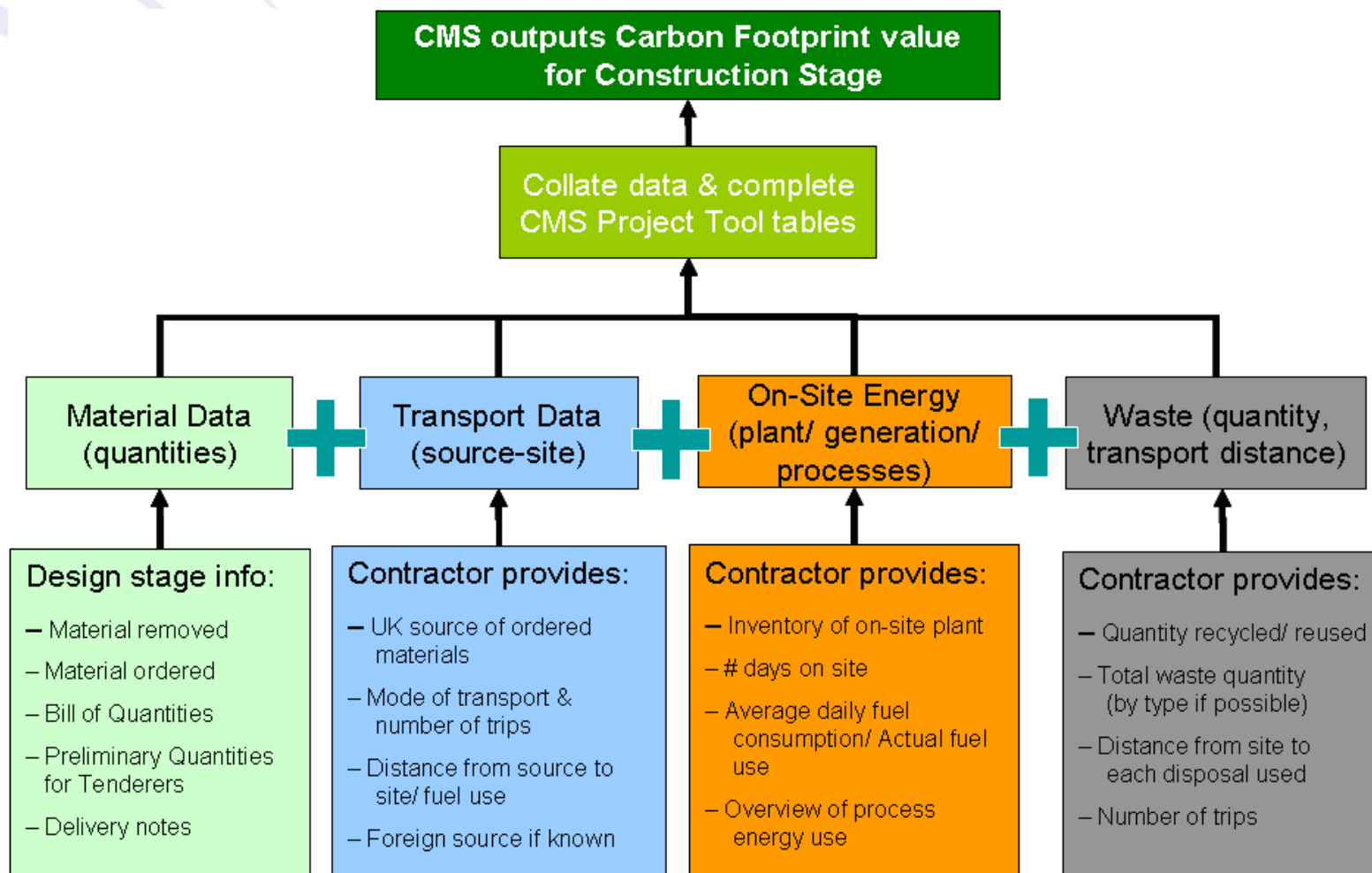
Greater than 25% of overall footprint

CMS Annual Account Overview



- Context
- Carbon Management System
- **Early Results**
- Timber Transport Implications

Piloting CMS



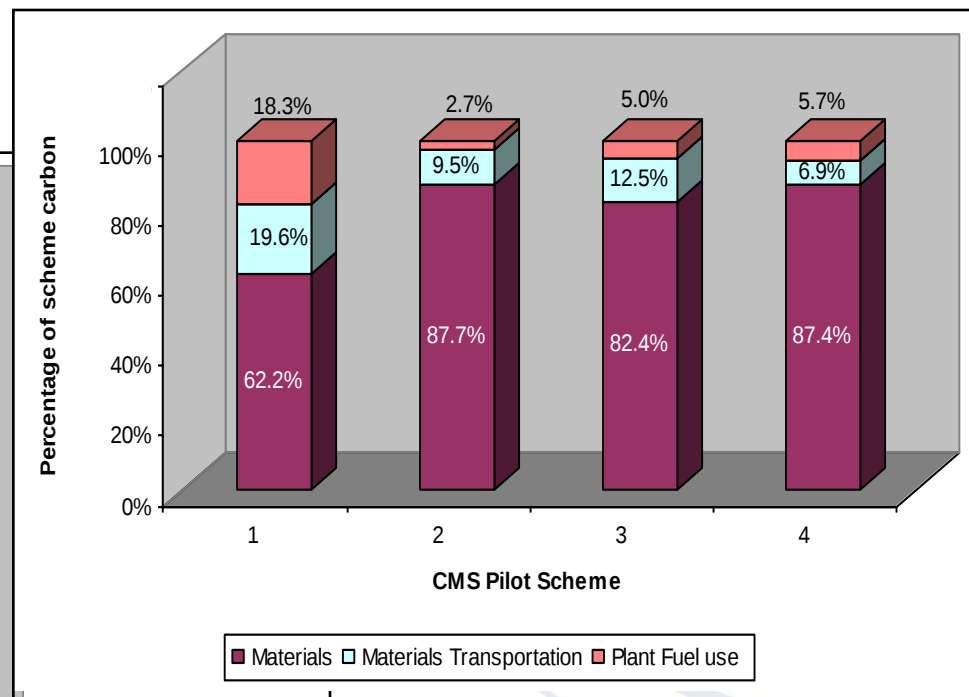
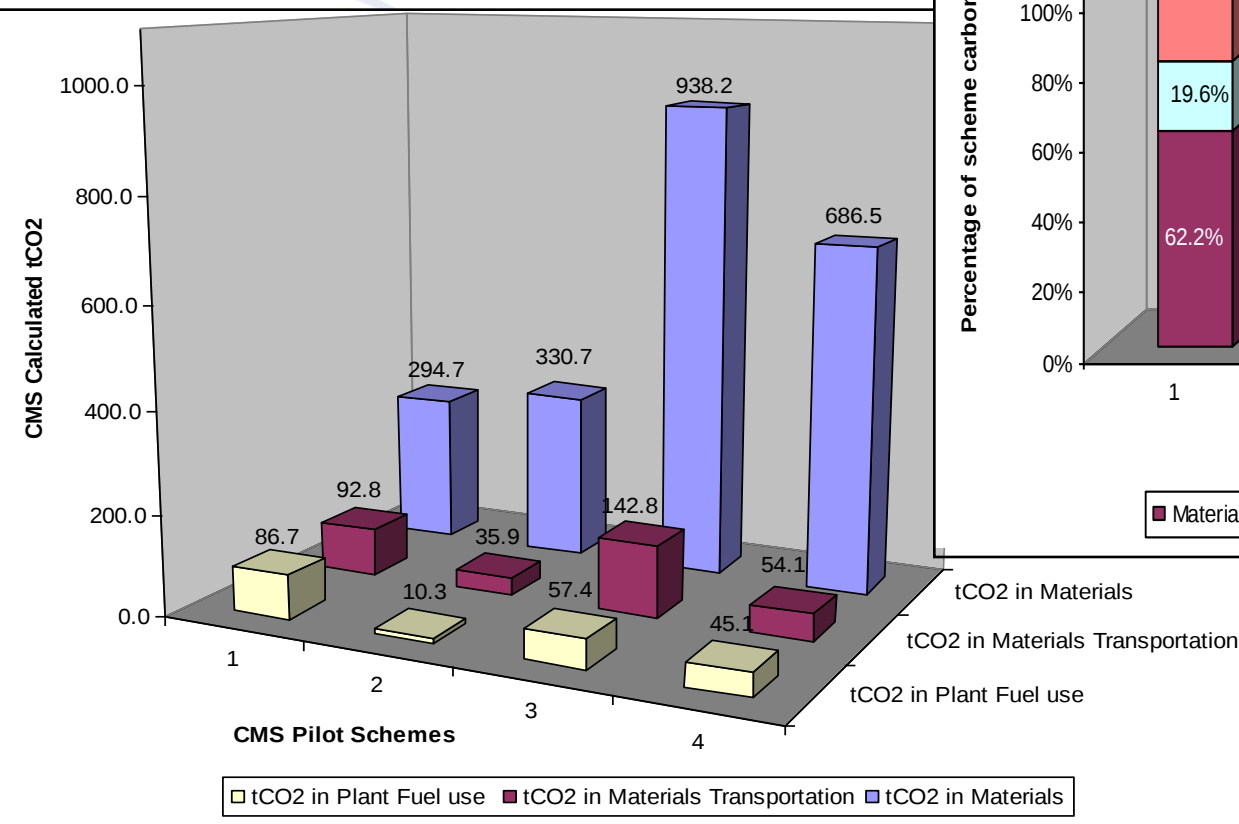
Piloting CMS

- To assess integration of the tool into TS procedures
- To test the user-friendliness of the tool
- To assess data issues
- To engage with the supply chain in using the tool before embedding into forthcoming contracts
- To assess the resource and procedural implications of full CMS rollout
- To provide initial estimates of carbon footprints for certain project stages and types
- To provide clear management information on implications of CMS deployment from 2010-11

Early Pilot Results

Works Contract Scheme	Materials		Materials Transportation		Plant Fuel use		Total Calculated tCO2	Potential savings through recycled content in Pavement materials	
	tCO2	%	tCO2	%	tCO2	%		tCO2	%
(1) 1.25 km Motorway Inlay Works	294.7	62.2%	92.8	19.6%	86.7	18.3%	474.2	92.2	19.4%
(2) 0.7 km Urban A-Road Resurfacing Works	330.7	87.7%	35.9	9.5%	10.3	2.7%	376.9	54.2	14.4%
(3) 1.6 km Motorway Reconstruction and Inlay Works	938.2	82.4%	142.8	12.5%	57.4	5.0%	1138.3	213.7	18.8%
(4) 2.9 km Motorway Inlay & Partial Reconstruction Works	686.5	87.4%	54.1	6.9%	45.1	5.7%	785.7	215.9	27.5%

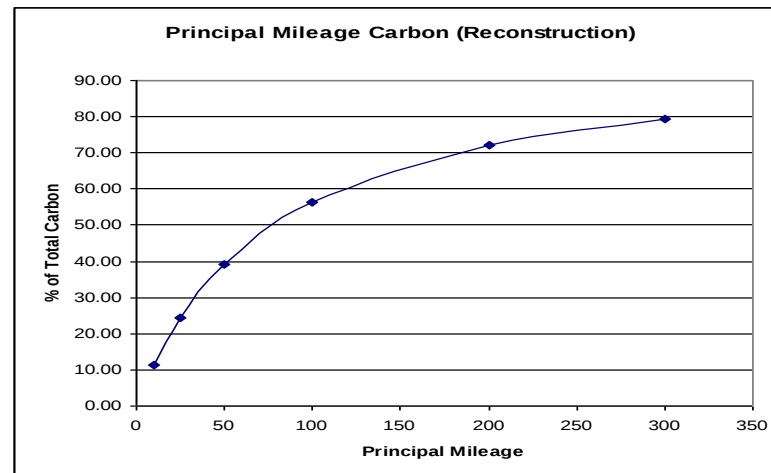
Early Pilot Results



Transport Influence



Treatment Option		Assumed distance to site (miles)					
		10	25	50	100	200	300
		Embodied Carbon					
1	Full reconstruction 500m length, 2 lanes (7.3m) 200mm sub-base, 250mm base layer, 50mm binder layer, 45mm surfacing	Total tonnage of materials (t)	4764.3	4764.3	4764.3	4764.3	4764.3
		Materials (tCO ₂)	140	140	140	140	140
		Transport (tCO ₂)	18	45	90	181	542
		Total (tCO ₂)	158	185	230	321	682
		Transport as %age of total	11.39	24.32	39.13	56.39	79.47
2	Drainage scheme - filter drain replacement 250m length, 300mm internal diameter Filled with virgin aggregates	Total tonnage of materials (t)	466.3	466.3	466.3	466.3	466.3
		Materials (tCO ₂)	10	10	10	10	10
		Transport (tCO ₂)	1.8	4.4	8.9	17.7	53.1
		Total (tCO ₂)	11.8	14.4	18.9	27.7	63.1
		Transport as %age of total	15.25	30.56	47.09	63.90	84.15
3	Re-Surfacing 500m length, 2 lanes (7.3m) 45mm planing & resurface	Total tonnage of materials (t)	757.2	757.2	757.2	757.2	757.2
		Materials (tCO ₂)	17	17	17	17	17
		Transport (tCO ₂)	2.9	7.2	14.4	28.7	86.2
		Total (tCO ₂)	19.9	24.2	31.4	45.7	103.2
		Transport as %age of total	14.57	29.75	45.86	62.80	83.53



Sustainable Maintenance

A9 Carrbridge WS2+1 Crack and Seat

- reusing in situ materials to minimise resource consumption, waste disposal and emissions
- Carbon savings via reduced waste and transport
- 20% less carbon in process compared with full depth reconstruction



Full depth reconstruction/DBM50	1312 tCO ₂
Crack & Seat with DBM50	1143 tCO ₂
Crack & Seat with EME2	1045 tCO ₂

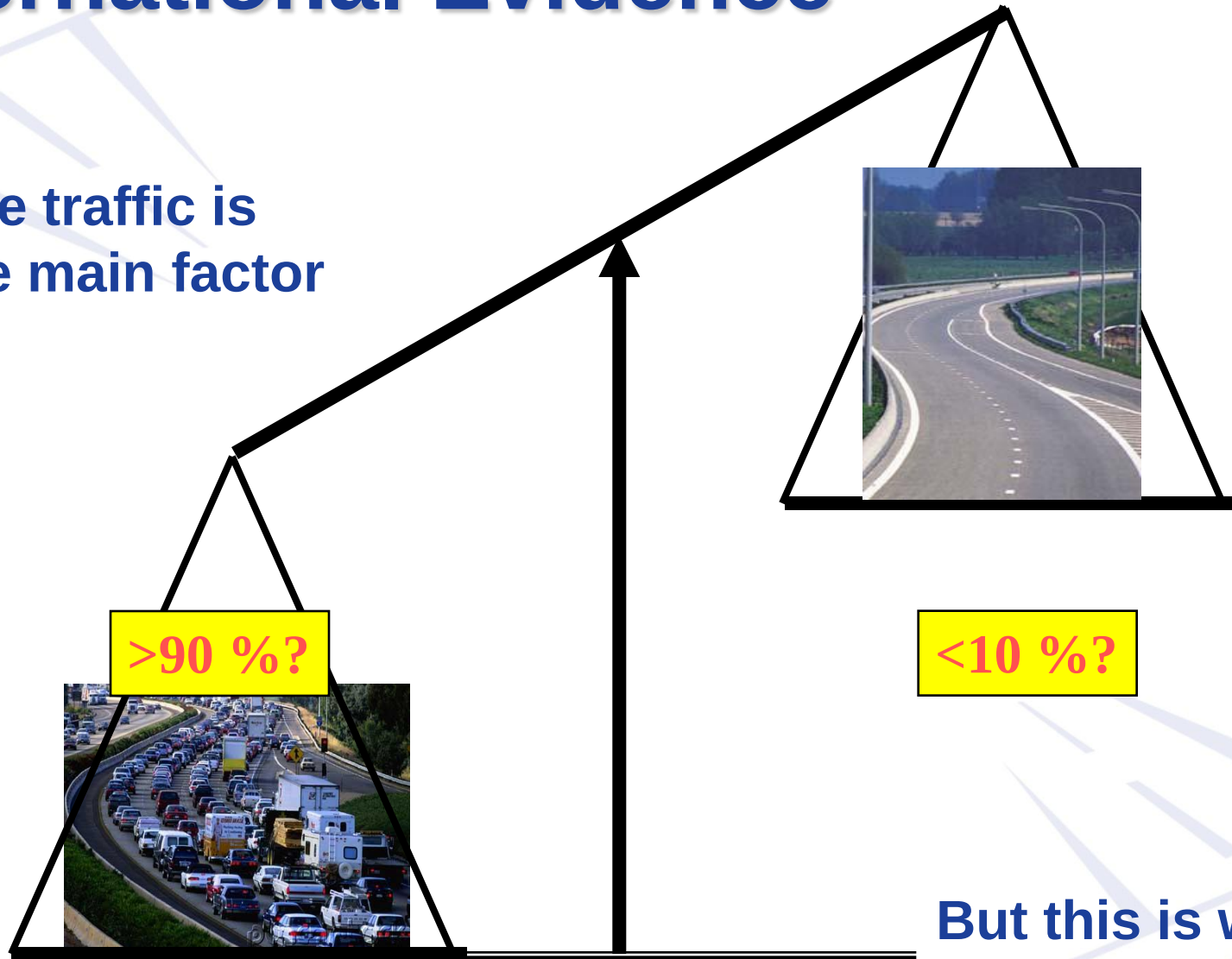
Emerging Findings

- Carbon embodied in materials is principal contribution to pilot scheme footprints
- Pilot schemes (pavement maintenance) range from 400 to 1200 tCO₂
- Major schemes will be at least an order of magnitude greater (structures)
- Recycling contributions significant
- Transport distance is a key influence

- Context
- Carbon Management System
- Early Results
- **Timber Transport Implications**

International Evidence

The traffic is
the main factor



But this is what
we can influence

Road Life Cycle Footprint



Appraisal with Whole Life Carbon

Carbon Data Reporting, Analysis & Feedback

Design

Carbon estimates
at Outline,
Specimen &
Detailed Design
Stages

Construction

Materials,
Energy,
Transportation
and Plant Fuel
Consumption

Maintenance

Structural
Maintenance
Materials,
Plant &
Transport
Fuel

Works
Contracts
(x4 Areas)

Operational
Utilities,
Materials &
Fuel
Consumption

4x Operating
Companies
2x DBFO

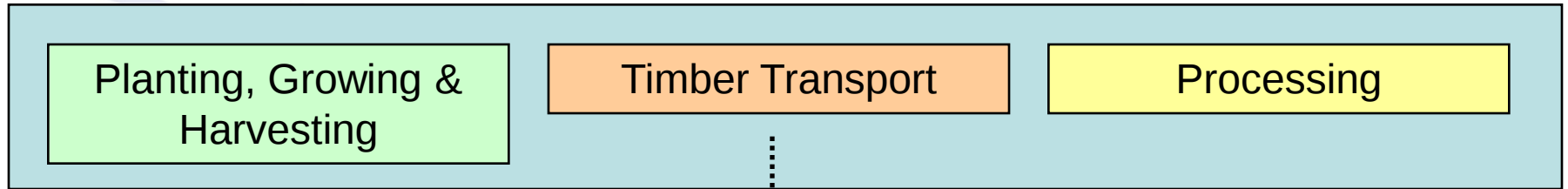
Operations

Network Energy Use

Traffic Scotland
Equipment
Maintenance

Carbon Management System

Timber Life Cycle Footprint



Two key areas:

- Size of footprint associated with road maintenance (and operation eg lighting)
- Emissions from timber HGV transport operations along the road

Carbon Factors

- Maintenance footprint influenced by
 - Type/size of road pavement
 - Type of maintenance (overlay, reconstruction etc)
 - Frequency of maintenance
- CMS can estimate these with basic inputs
 - Material type & quantity
 - Transport distance of materials/waste
 - Plant/fuel used on site
- Transport footprint influenced by
 - HGV type/efficiency/fuel
 - HGV movements per annum



A black and white photograph of a winding road through a forested landscape. The road curves from the foreground towards the right and then back towards the left. The road is flanked by dense evergreen forests on both sides. In the distance, rolling hills or mountains are visible under a pale sky. The text "Thank You Questions" is overlaid in a large, orange, sans-serif font in the center of the image.

Thank You
Questions

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