Intelligent Transport Systems for the mitigation of climate change induced impacts

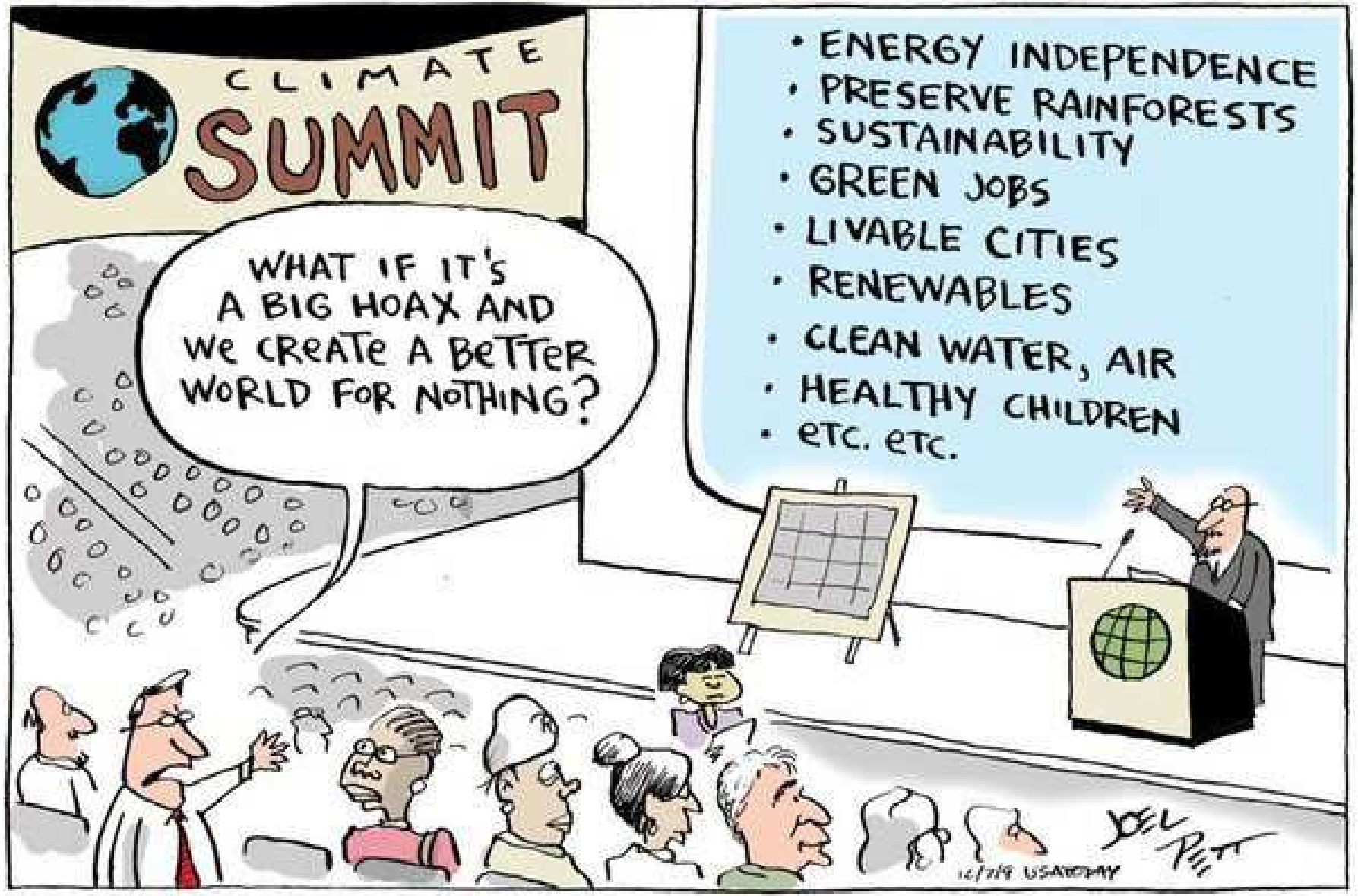
Transport and Climate Change:
European Researchers Act

Iraklis Stamos
Centre for Research and Technology Hellas
Hellenic Institute of Transport

Outline

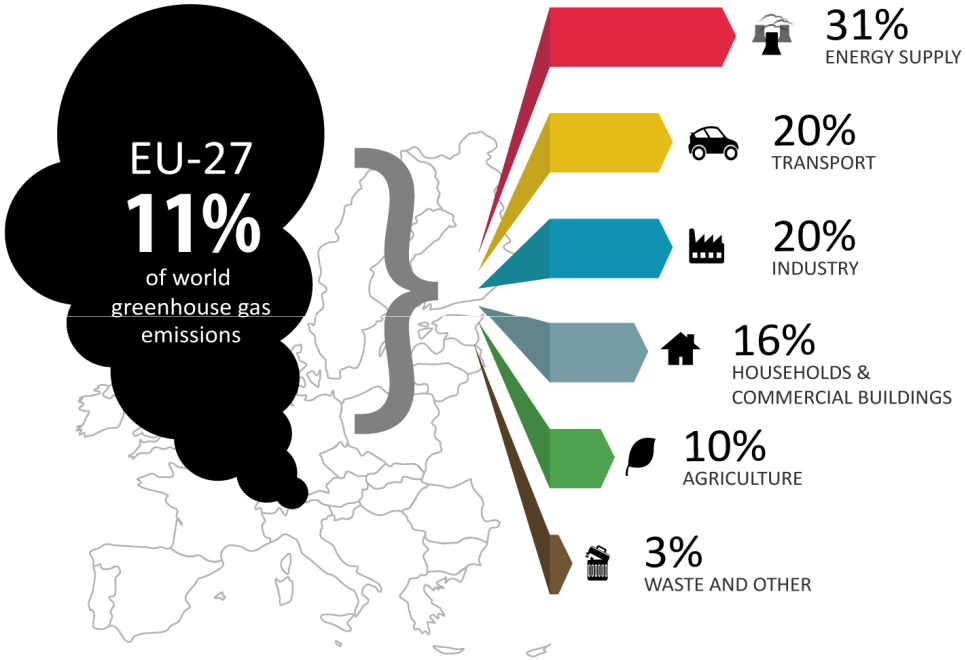
- Climate change
- The Transportation “Factor”
- Mitigation as a way to deal with CC
- Intelligent Transportation Systems
- Findings
- Conclusions

Climate Change



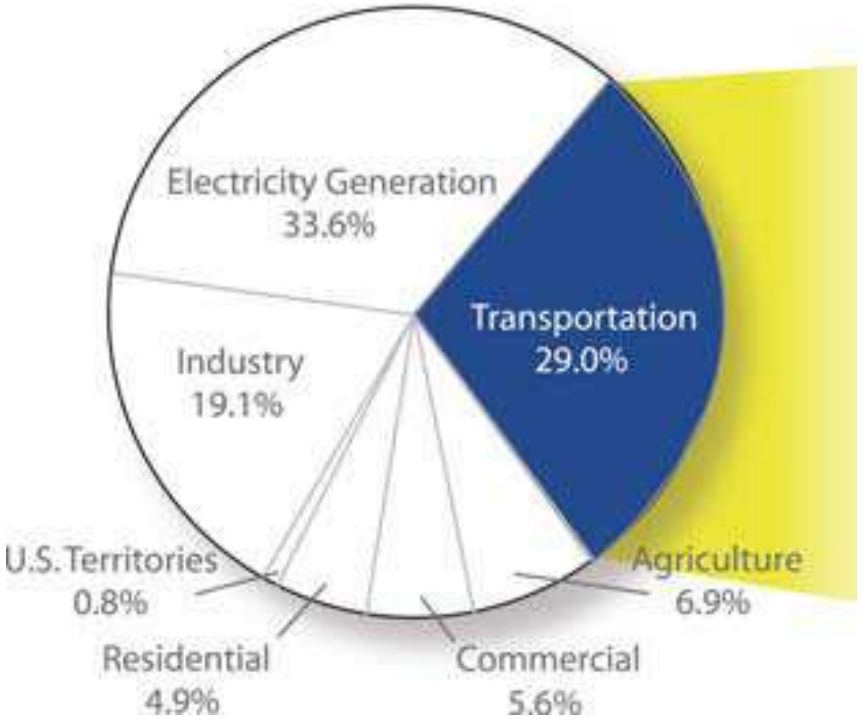
The Transportation Factor

CO2 transport emissions, EU, 2011



Transport: 20%

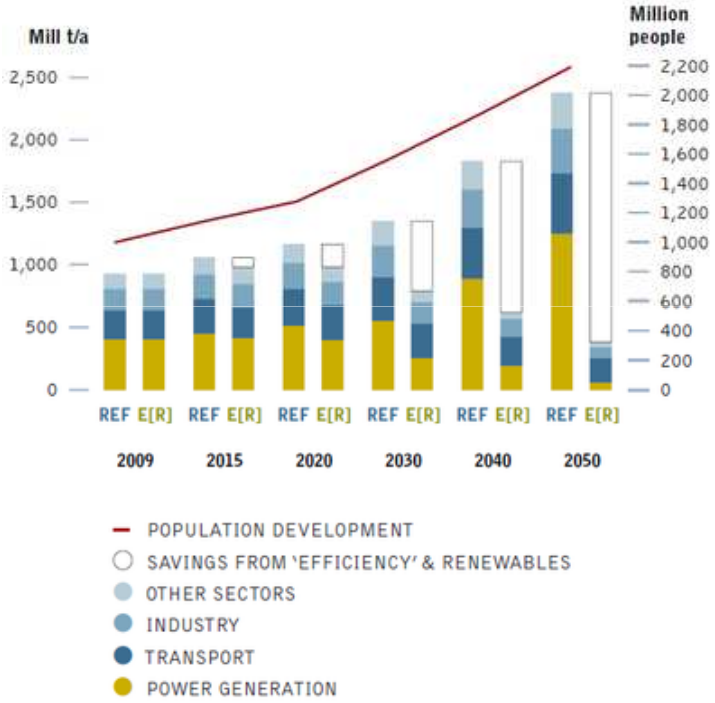
CO2 transport emissions, USA, 2013



Transport: 29%

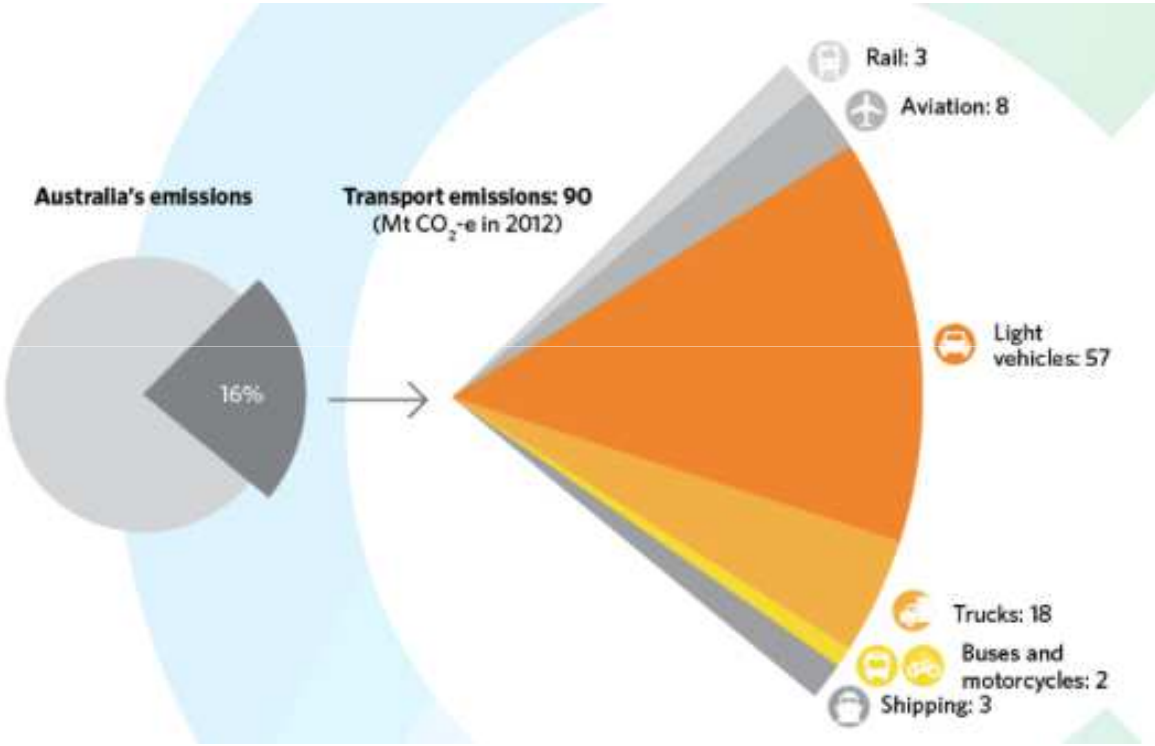
A worldwide phenomenon

CO2 transport emissions, AFR, 2010

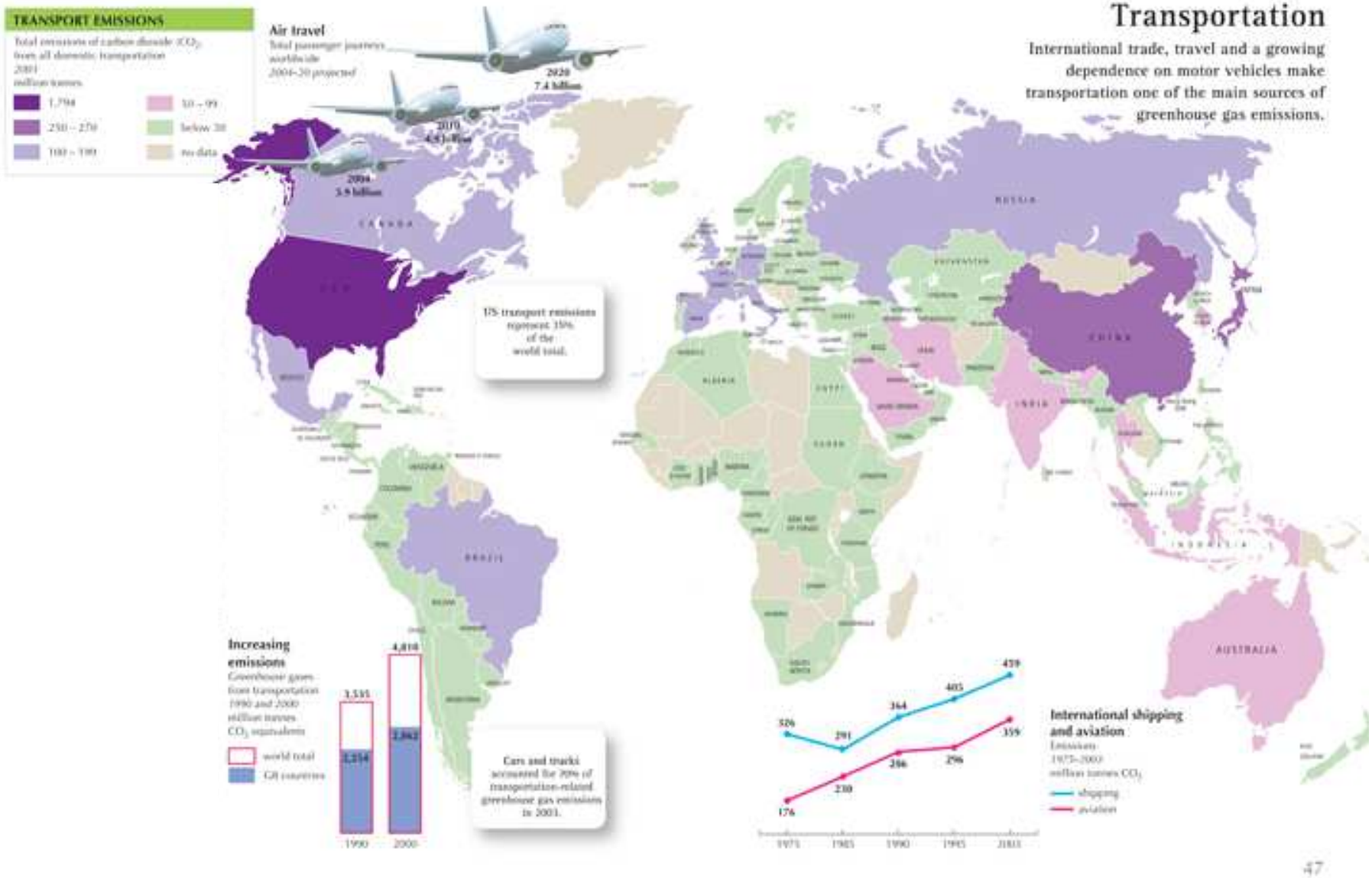


Transport: 22%

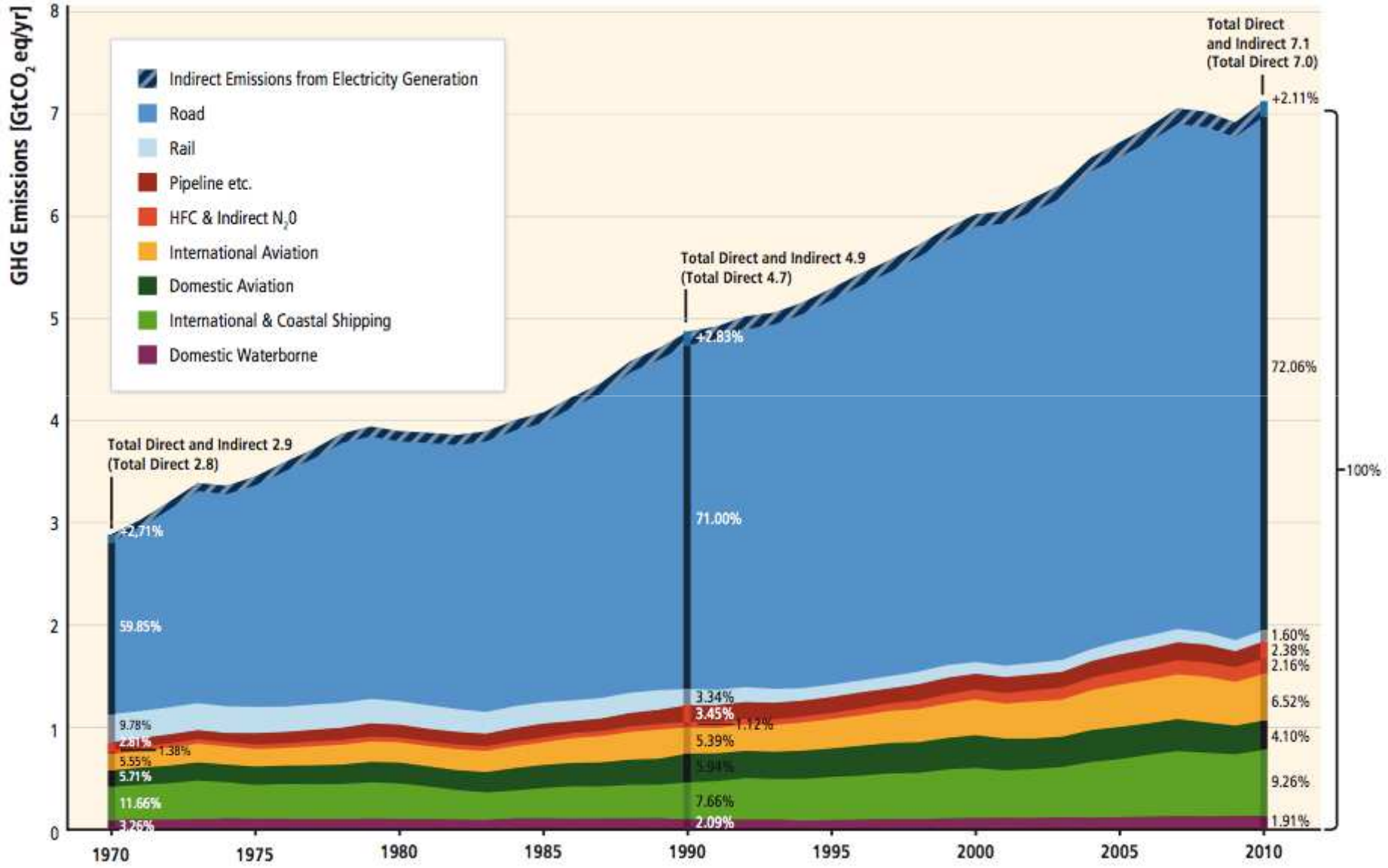
CO2 transport emissions, AUS, 2014



Transport: 16%


Transportation
International trade, travel and a growing dependence on motor vehicles make transportation one of the main sources of greenhouse gas emissions.
TRANSPORT EMISSIONS
Air travel
2020
7.4 billion
2010
2006
5.9 billion
US transport emissions represent 35% of the world total.
Increasing emissions
3,535
4,810
2,354
2,962
1990
2000
Cars and trucks accounted for 70% of transportation-related greenhouse gas emissions in 2003.
International shipping and aviation
526
291
364
405
459
176
230
286
296
359
1975
1985
1990
1995
2003
shipping
aviation
AUSTRALIA
47

CO2 by transport mode



How to address CC

- Governments
- Policy stakeholders
- Academia
- Research
- Business
- NGOs

How to address CC

Mitigation: Policies and strategies that reduce GHG emissions and/or enhance Greenhouse Gas absorption and storage – GHG "sinks" (IPCC, 2007)

Adaptation: Initiatives and measures to reduce the vulnerability of natural and human systems against actual or expected climate change effects (IPCC, 2007)

Confronting Climate Change: *Avoiding the unmanagable (mitigation) and managing the unavoidable (adaptation)* (UN report, 2007)

Mitigation

Mitigation is very important as:

- it reduces the level of adaptation required in the future
- "buys time" for societies to implement adaptation strategies and avoid costly impacts

Due to this relationship, mitigation is referred to as the "**number one preparedness strategy**" (CIG, 2007)

Mitigation vs. Adaptation

While **Mitigation** and Adaptation strategies are complementary, mitigation is not sufficient alone →

- **Impacts of today are result of past GHG emissions**
- **Current reduction efforts are neither sufficient nor occurring fast enough to avoid future impacts**

Similarly, adaptation is not sufficient alone →

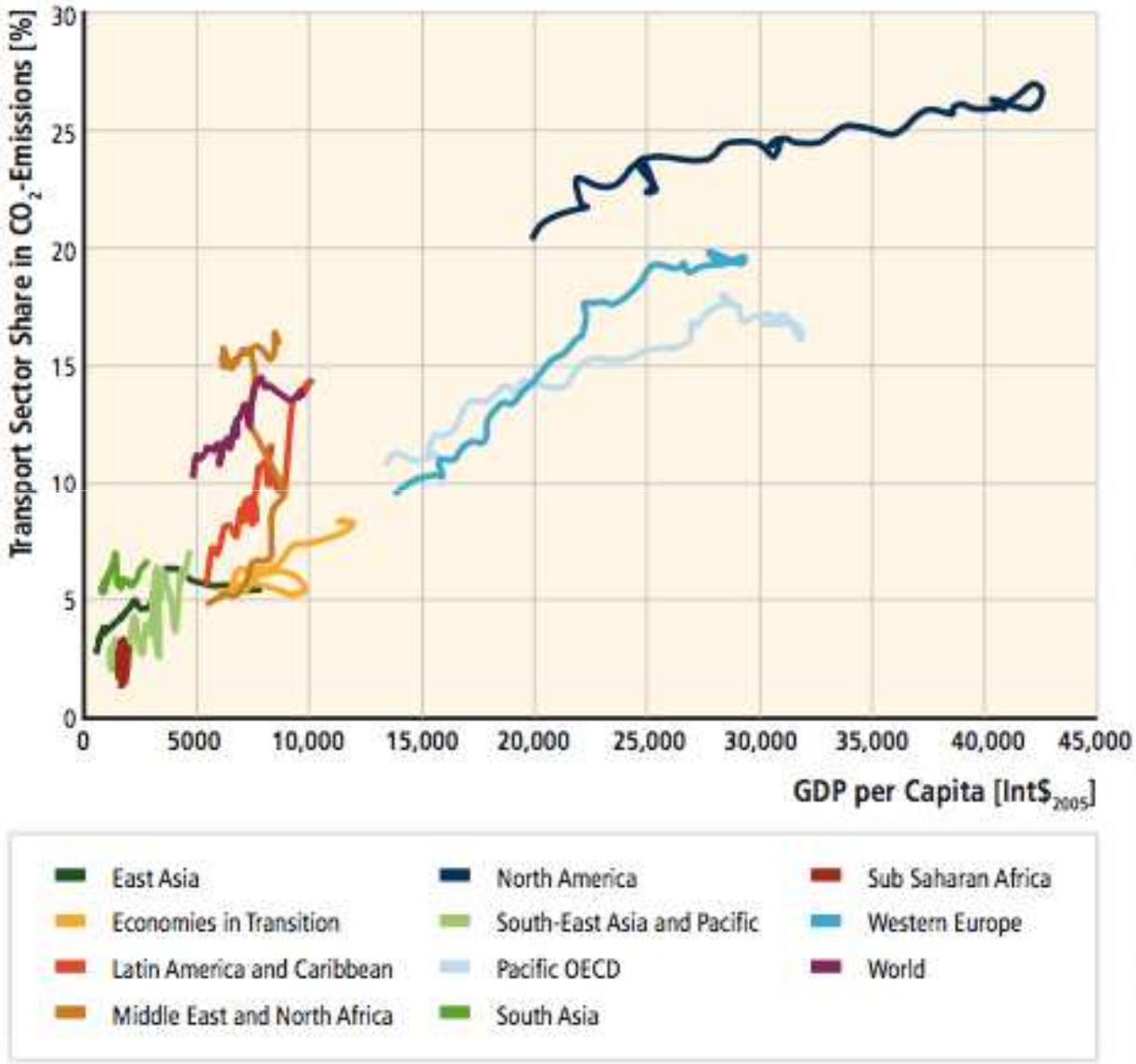
- In the absence of mitigation efforts, the extent of adaptation would be broadened and become more costly

Mitigation

"Without aggressive and sustained mitigation policies being implemented, t**ransport emissions could increase at a faster rate than emissions from the other energy end-use sectors** by 2050"

- Intergovernmental Panel on Climate Change (IPCC), 2014

Mitigation



Reducing global transport(GHG) emissions will be challenging since **the continuing growth in passenger and freight activity could outweigh all mitigation measures** unless transport emissions can be strongly decoupled from GDP growth

(UN, 2010)

How challenging is mitigation?

Mitigation options

UN Framework Convention on Climate Change, 2014

Agreement to reduce CO2 transport emissions by a **minimum of 50% at the latest by 2050**, mainly through:

1. Innovative vehicle technologies (advanced engine management systems and efficient vehicle powertrains)

2. Use of sustainable biofuel (1st gen: vegetable oil, biodiesel – 2nd gen: biofuel from biomass – 3rd gen: biodegradable fuels from algae)

3. **An improved transport infrastructure together with Intelligent Transport Systems (ITS)**

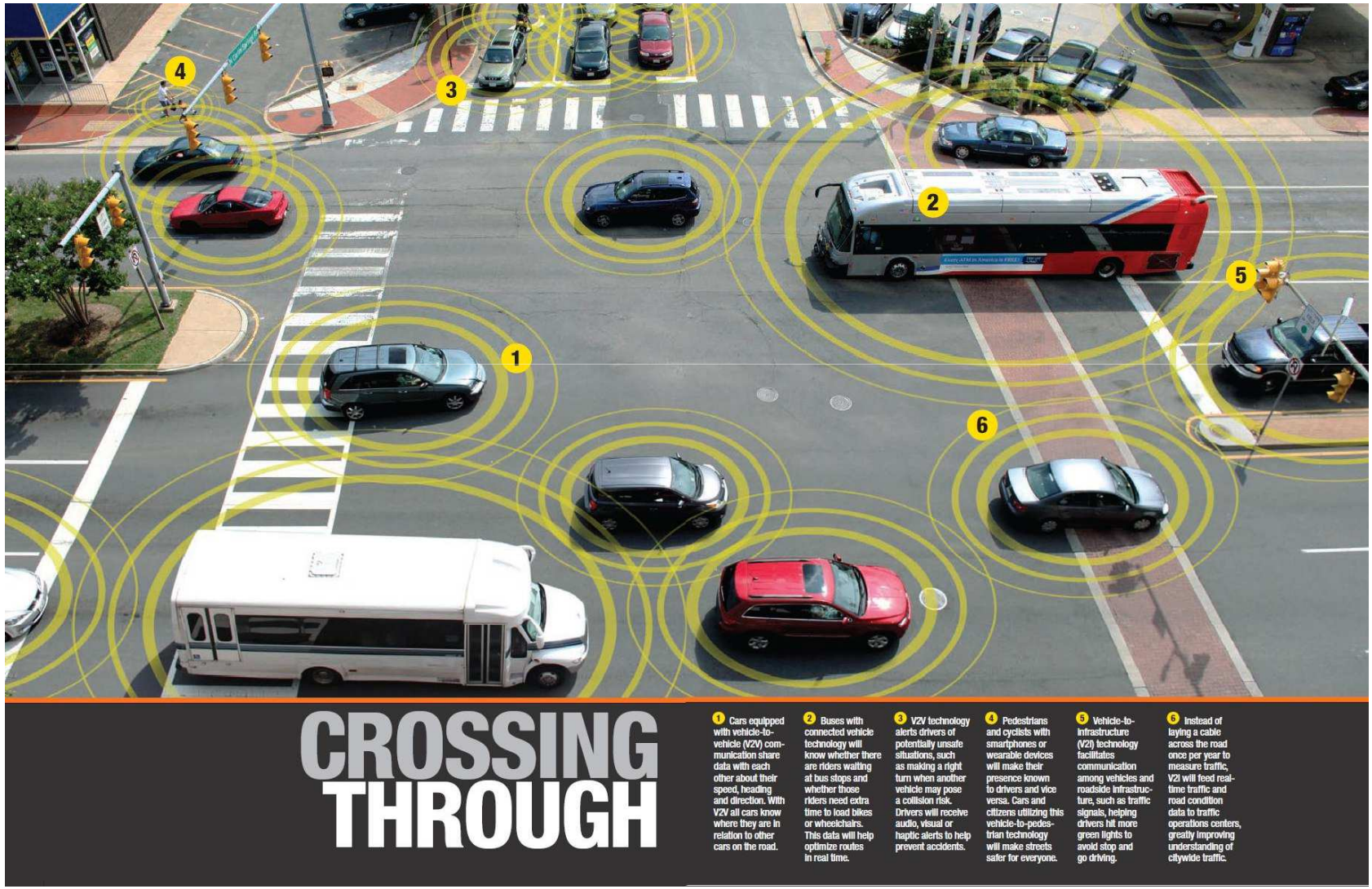
4. Travelers information (e.g. campaigns for use of public transport and modal transport)

5. Legal instruments (e.g. tax incentives for low carbon products and processes, taxation of CO2 intensive products and processes)

Intelligent Transportation Systems

“ITS" is used to define the use of Information and Communication Technologies (or ICT) in the field of transport, to create real time flow of information and data in order to enable more “intelligent” use of infrastructures and vehicles and to enhance the management of traffic and mobility.”

ITS all about connection



ITS Goals

- **Reduced Congestion**
- **Reduced Environmental Impact**
- **Improved Energy Efficiency**
- Improved Safety
- Increased and Higher Quality Mobility
- Improved Economic Productivity

ITS: How they do it

Arterial Management

Freeway Management

Transit Management

Incident management

Collision Avoidance Systems

Traveler information

Roadway Operation and Maintenance

Information Management

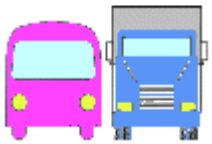
Road Weather Management

Crash Prevention and Safety

Inter-Modal Freight

Emergency management

Electronic payment and pricing



Commercial Vehicle operation

Driver Assistance Systems

ITS contributing to CC mitigation

Arterial Management

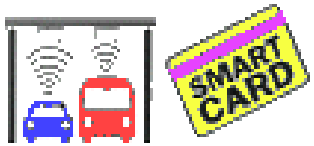
Freeway Management

Transit Management

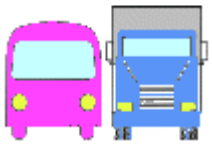
Traveler information

Information Management

Inter-Modal Freight



Electronic payment and pricing



Commercial Vehicle operation

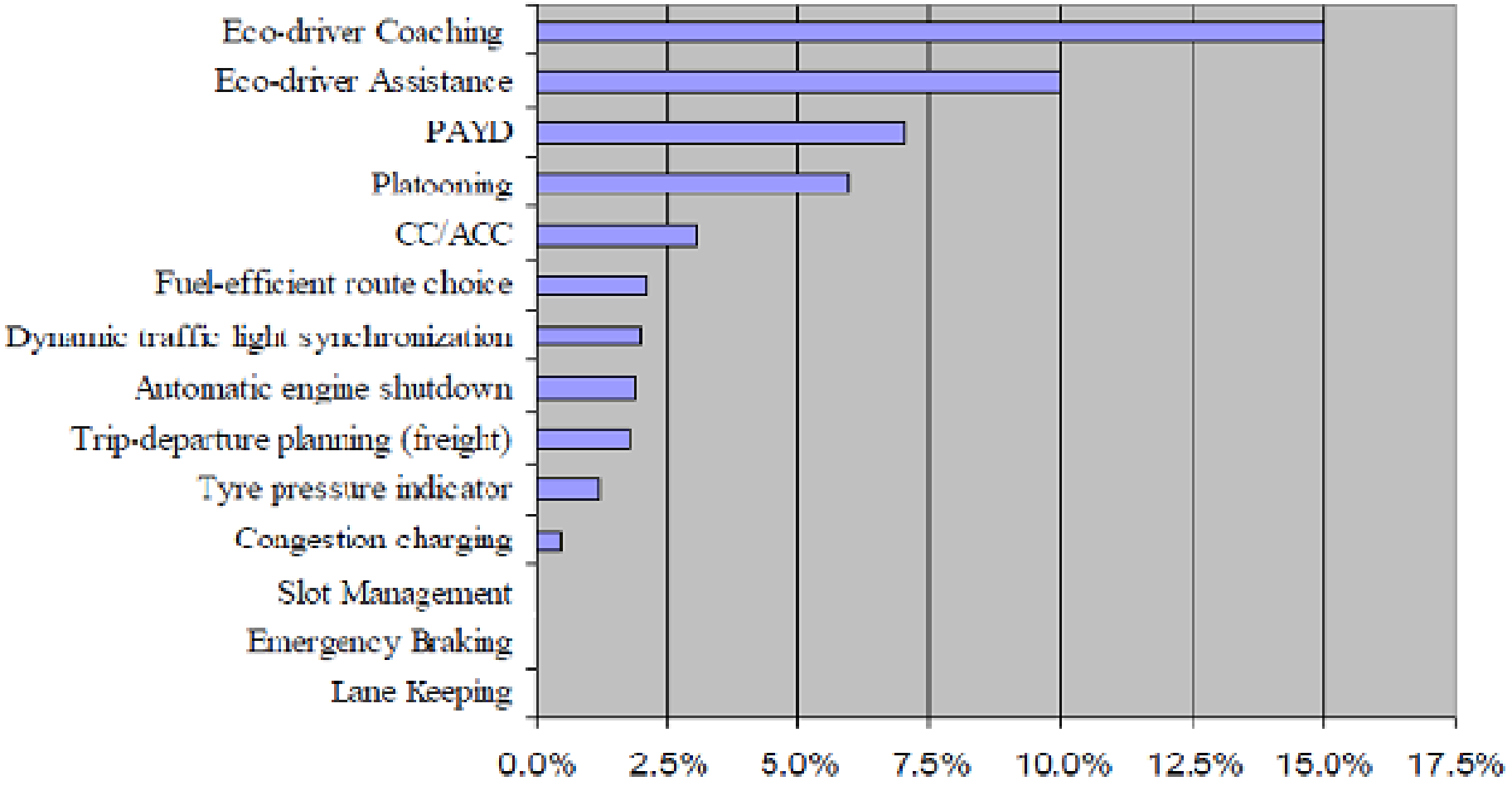
Driver Assistance Systems

In detail:

- Transport demand / Mode choice
  - (multi-modal) travel information, journey planning
  - car-sharing, ride-sharing
  - road charging, integrated ticketing
  - access management
  - logistics, fleet management (avoidance of empty runs, increase load factors)
- Efficiency of traffic
  - traffic management
  - travel information, navigation
  - public transport priority
- Driver behaviour
  - eco-driving support, navigation

Potential CO2 reduction

CO2 transport emissions, EU 27, 2014



Potential CO2 reduction

CO2 transport emissions, Japan, 2007

System implemented	CO_2 reduction	
(1) Advanced navigation system (2) Dynamic Route Guidance System	(1) Preventing wandering or misdirected traffic (2) Dispersing traffic demand	214 276
(3) Dynamic Parking Lot Guidance System		8
(4) Advanced Traffic Management System		329
(5) ACCS (Adaptive Cruise Control System)		89
(6) ETC (Electronic Toll Collection)		19
(7) Advanced Logistics System		522
Total		1457

in thousand tons per year

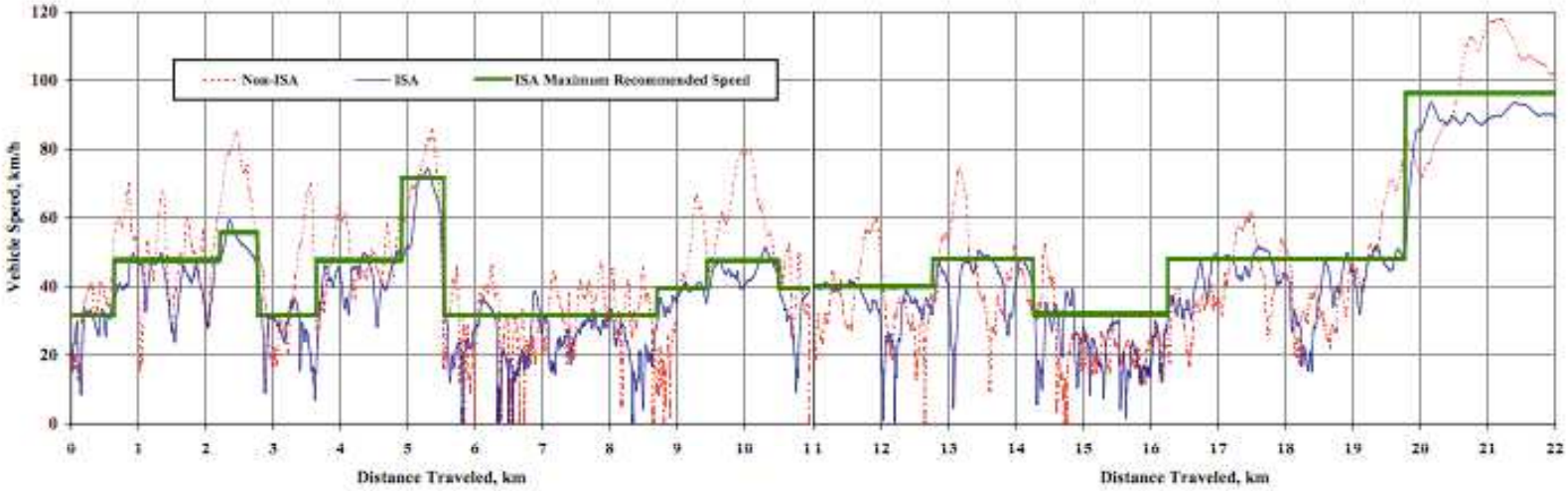
Potential environmental benefit

ITS environmental contribution, USA, 2010

Description	Benefit-Cost Ratio or Other Metric	Safety Benefit	Mobility Benefit
Coordinates traffic signals to reduce congestion, improve traffic flow	17:1 to 62:1	High	High
Adjusts the length of traffic signal phases based on real time information about traffic	Improves travel time 6 to 11 percent	Medium	High
Uses traffic signals at on-ramps to control the rate of vehicles entering the freeway	15:1	Low	High
Provides real time, traffic-related information to drivers	3 percent decrease in crashes	Low	High
Monitors availability of spaces and disseminates information to drivers; reduces traffic congestion associated with looking for spaces	5 percent to 9 percent reduction in travel time.	Medium	Medium
HOV facilities manage traffic volume by restricting some lanes to transit vehicles, vanpools and carpools. HOT facilities use electronic toll systems to charge single occupancy vehicles for use of an HOV lane.	23 percent would play $2 to save 10 minutes; 59 percent would pay $2 to save 20 minutes.	Medium	High
Uses technology to detect and share information about hazardous road conditions.	2:1 to 10:1	High	High
Uses technology such as open road tolling to process toll transactions at full highway speeds.	2:1 to 3:1 Reduced crash rates up to 49 percent and increased speed up to 57 percent.	Medium (High for open road tolling)	High

Dynamic eco-driving field exp.

Emissions reduction, USA, 2008



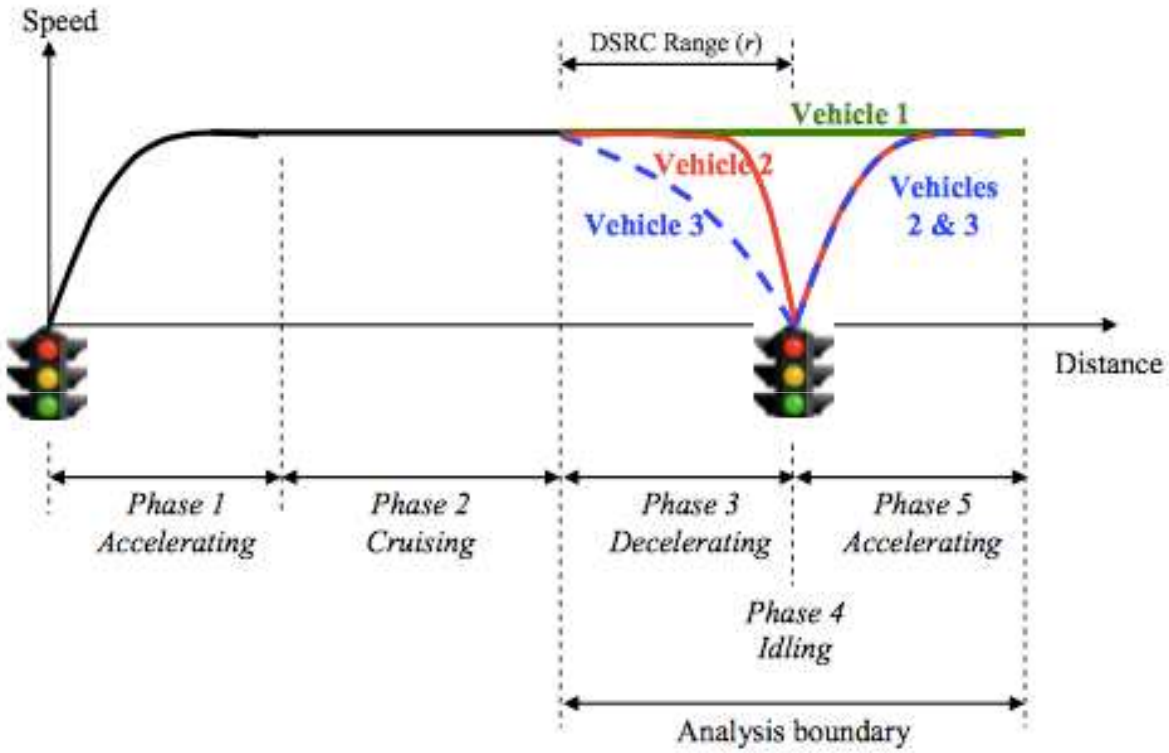
Energy/Emissions	Non-ISA	ISA	Difference
CO2 (g)	5439	4781	-12%
CO (g)	97.01	50.47	-48%
HC (g)	3.20	1.90	-41%
NOx (g)	6.28	3.97	-37%
Fuel (g)	1766	1534	-13%

in: Barth & Boriboonsomsin (2008) “Energy and Emissions Impacts of a Freeway-Based Dynamic Eco- Driving System”, *Transportation Research Part D: Environment*, Elsevier Press

Intersection Optimization

Emissions reduction, USA, 2009

Signal timing synchronization can help reduce intersection-influenced fuel consumption by 14% for cars and 12% for trucks



in: M. Li et al., "Traffic Energy and Emission Reductions at Signalized Intersections: A Study of the Benefits of Advanced Driver Information", *International Journal on ITS*, January, 2009.

Parking guidance

Aalborg, DEN, 2005

- Funded under EU THERMIE program
- 9 car parks, 3000 parking spaces, 39 VMS signs
- Real time information on car park occupancy and guidance to car parks
- Saves approx. 7500 hrs/yr
- **1.5% reduction in emissions and energy consumption**

Access Control

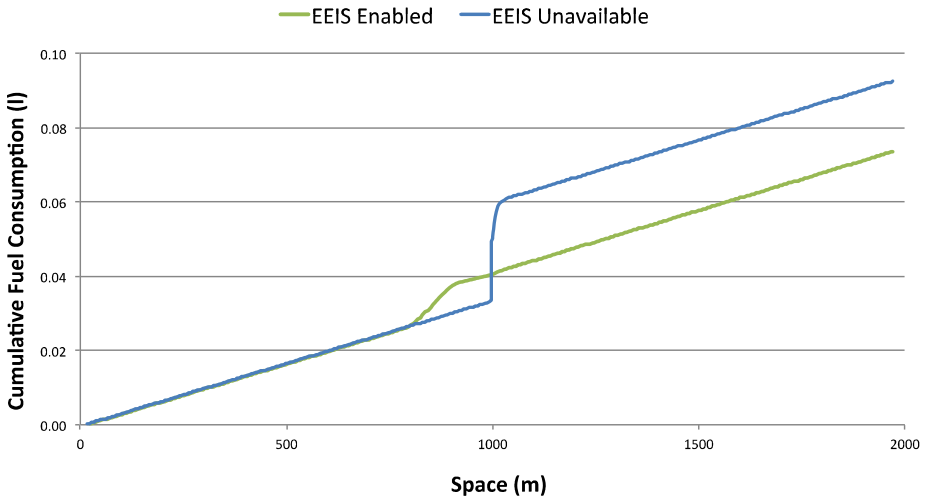
Rome, ITA, 2002

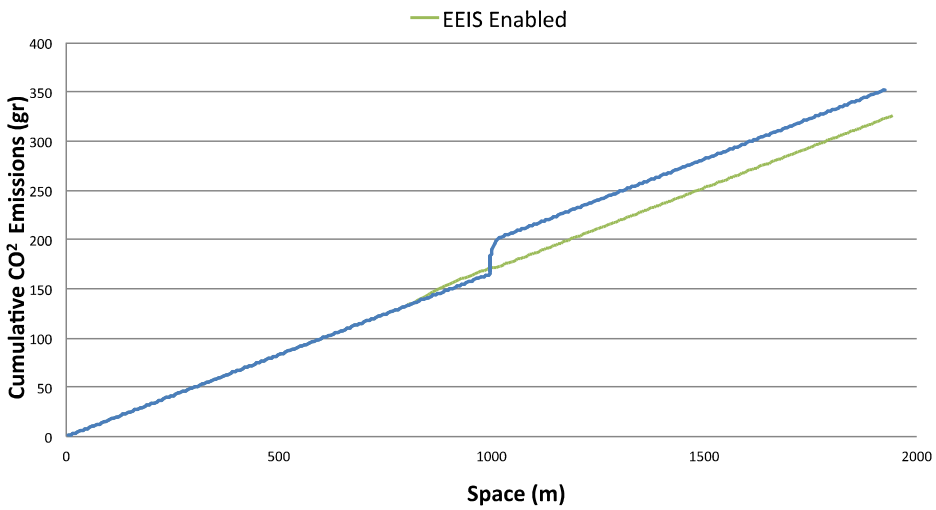
- Central Rome, M-F day times and Saturday afternoons
- 23 entry points, €2 charge for those without permit
- Technology based on TELEPASS:
  - TV Camera and infra-red Illuminators
  - Microwave Transponder
  - In-vehicle Unit with Smart Card (free pass or stored value)
- 10-15% reduction in traffic depending on time of day, 6% increase in PT use
- **approx. 4.5% emissions reduction per year**

Speed advice

Thessaloniki, GRE, 2015

- Funded under the COMPASS4D program
- Energy Efficient Intersection Service
- Speed advice to 250 taxis for adoption of optimal speed profile





- **approx. 3% emissions reduction per year**

Conclusions

- CO2 emissions from the transportation sector are projected to rise
  - ongoing reliance on fossil fuels
  - increases in vehicle miles travelled
  - growth in the “developing” world
- A range of mitigation strategies is needed to address their reduction
- ITS comprise key tools for improved road traffic and travel, able to significantly reduce CO2 emissions

Conclusions

- Need to standardize the evaluation of ITS contribution to CO2 reduction
  - modelling and/or experimental conditions
  - ITS penetration rate
- Compliance with the EU ITS directive 2010/40/EC
  - deployment framework for ITS in EU

La Fin - Merci!

Iraklis Stamos

Research Associate

Centre for Research and Technology Hellas

Hellenic Institute of Transport

emai: stamos@certh.gr

tel: +30 2310498268