PART II – Climate Change & Transport Sector

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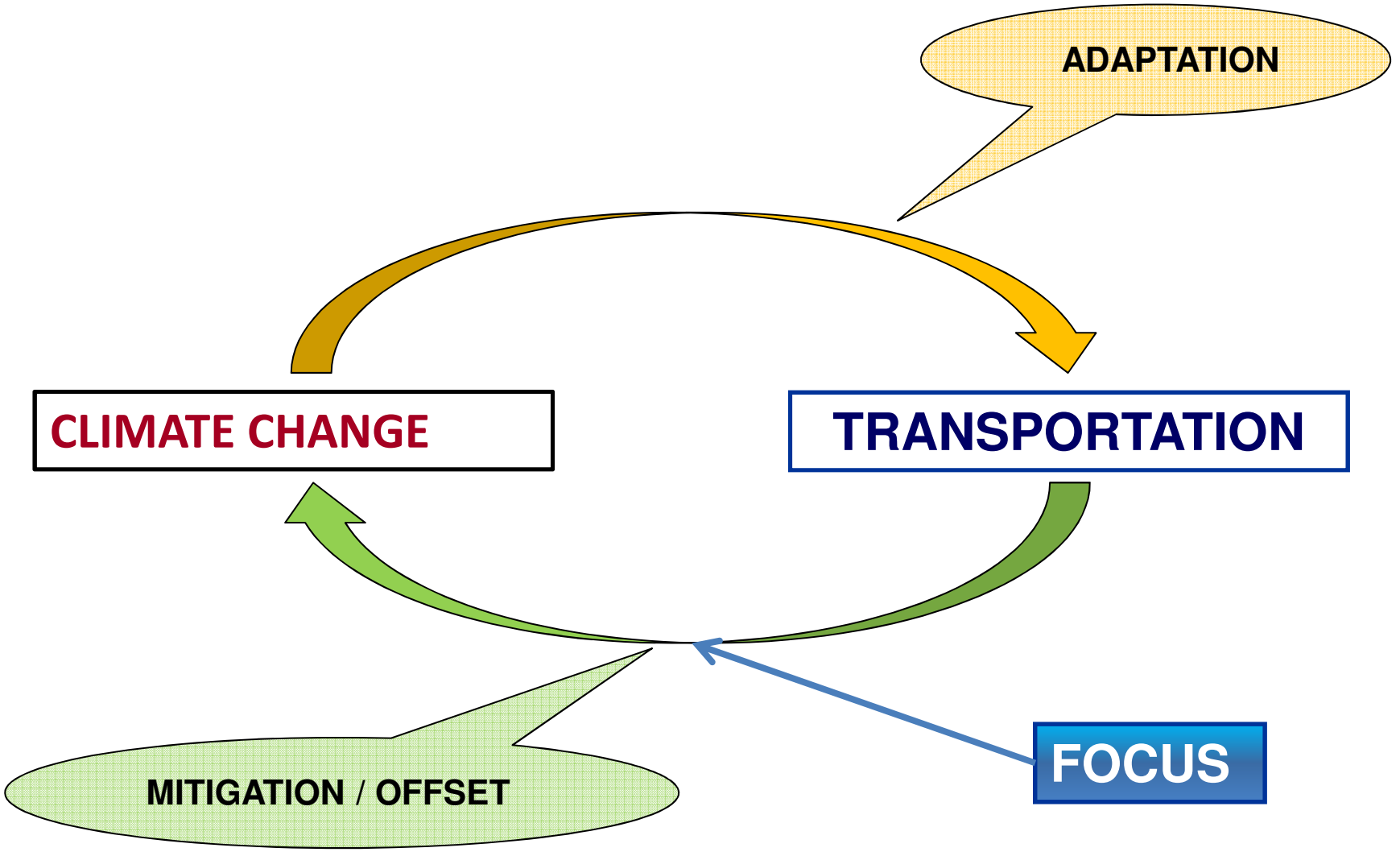
Reciprocity in climate change

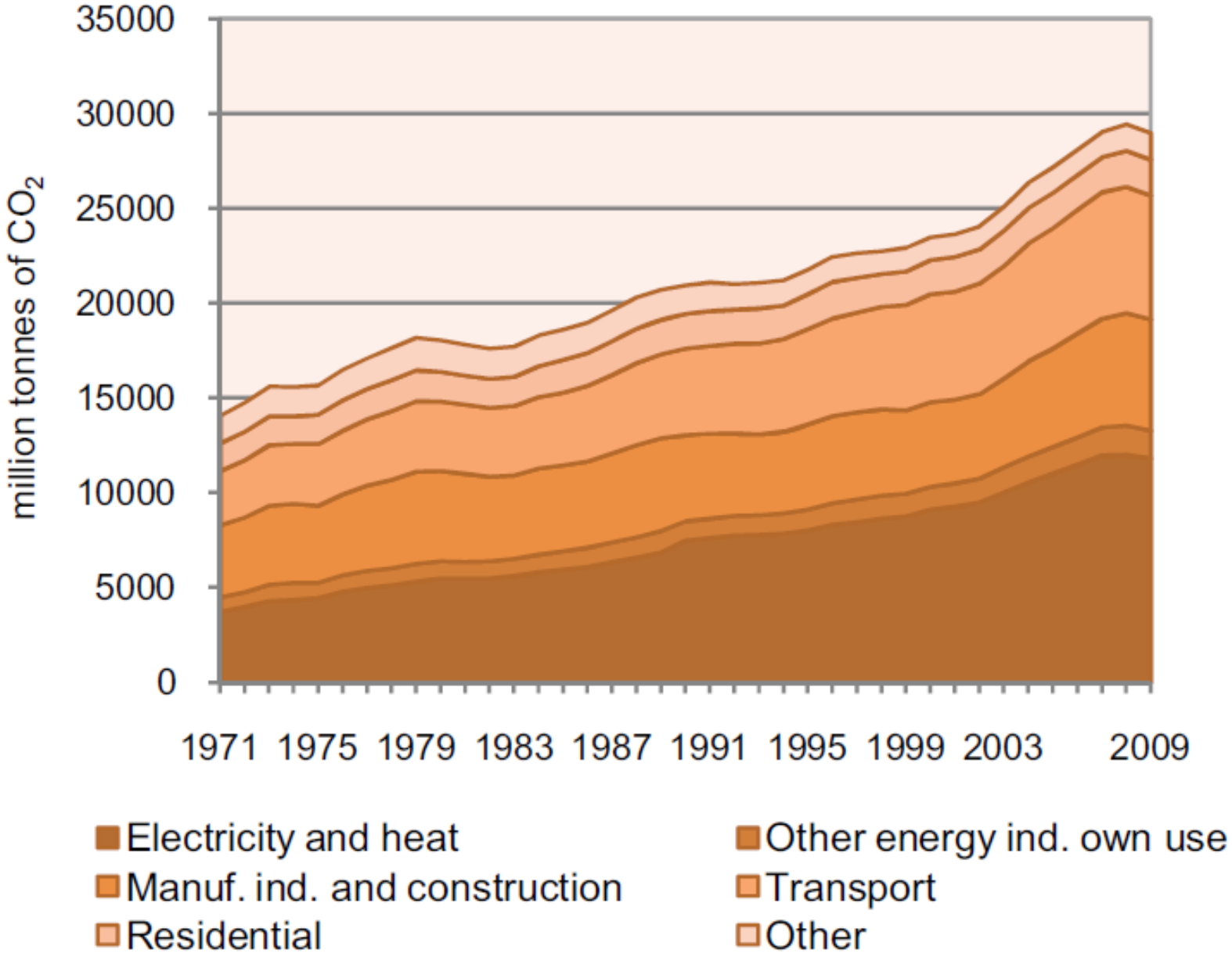


Outline

1. Emissions – Global Context
2. Emissions – Local Context
3. Mitigation Approaches

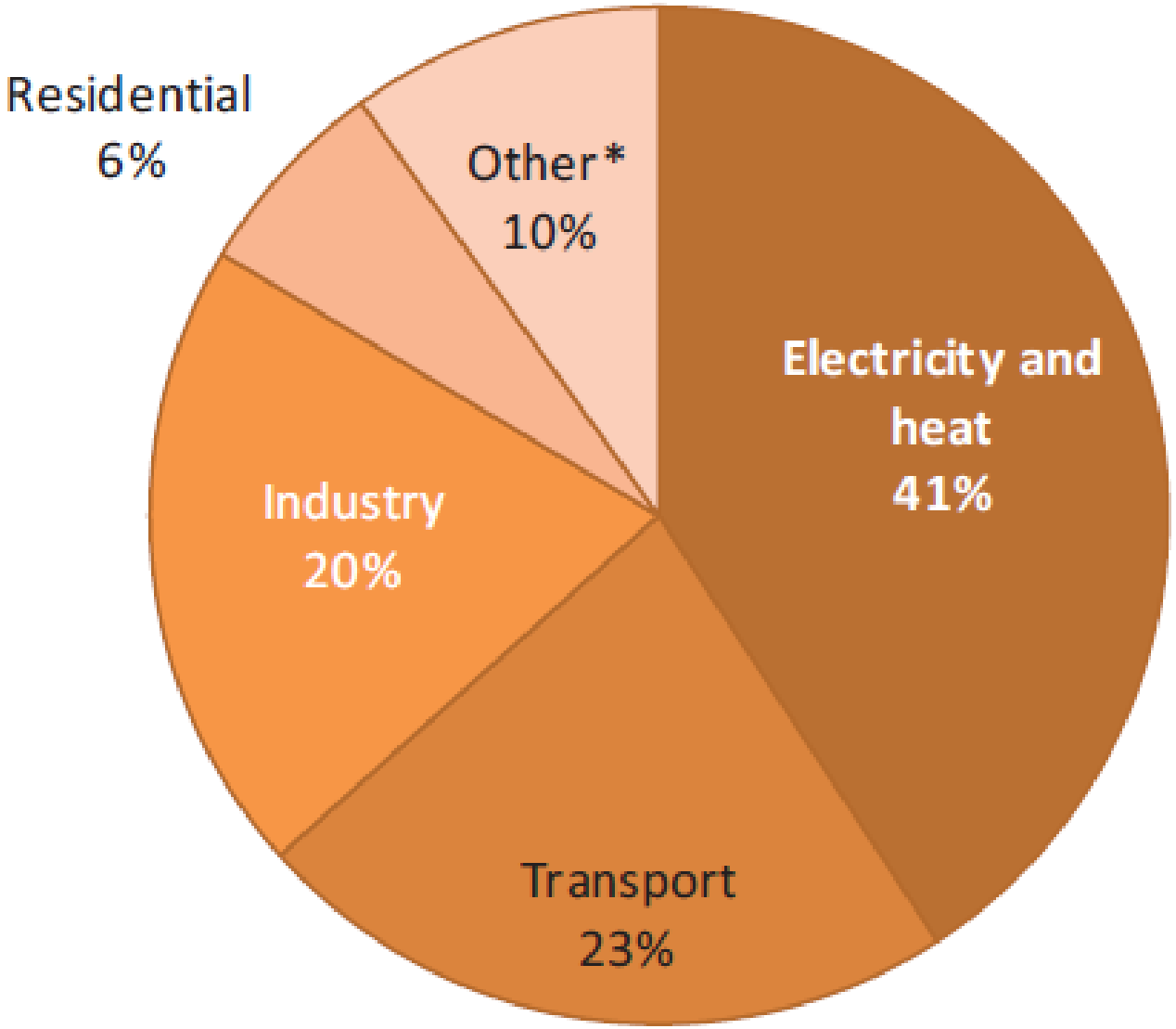
Global Context

Trends in world CO2 emissions



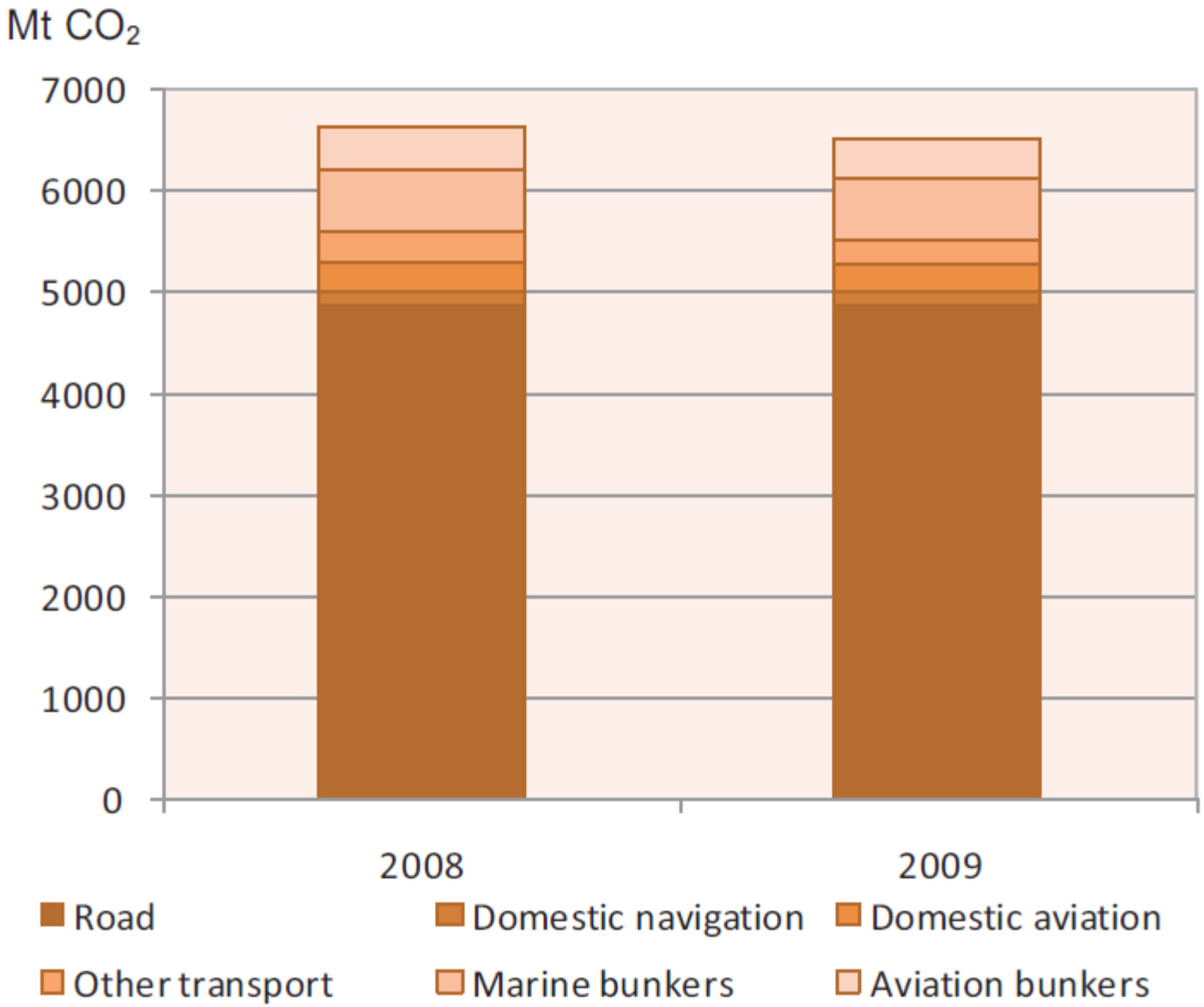
CO2 emissions from fuel combustion – highlights, IEA 2011

World CO2 emissions by sector, 2009



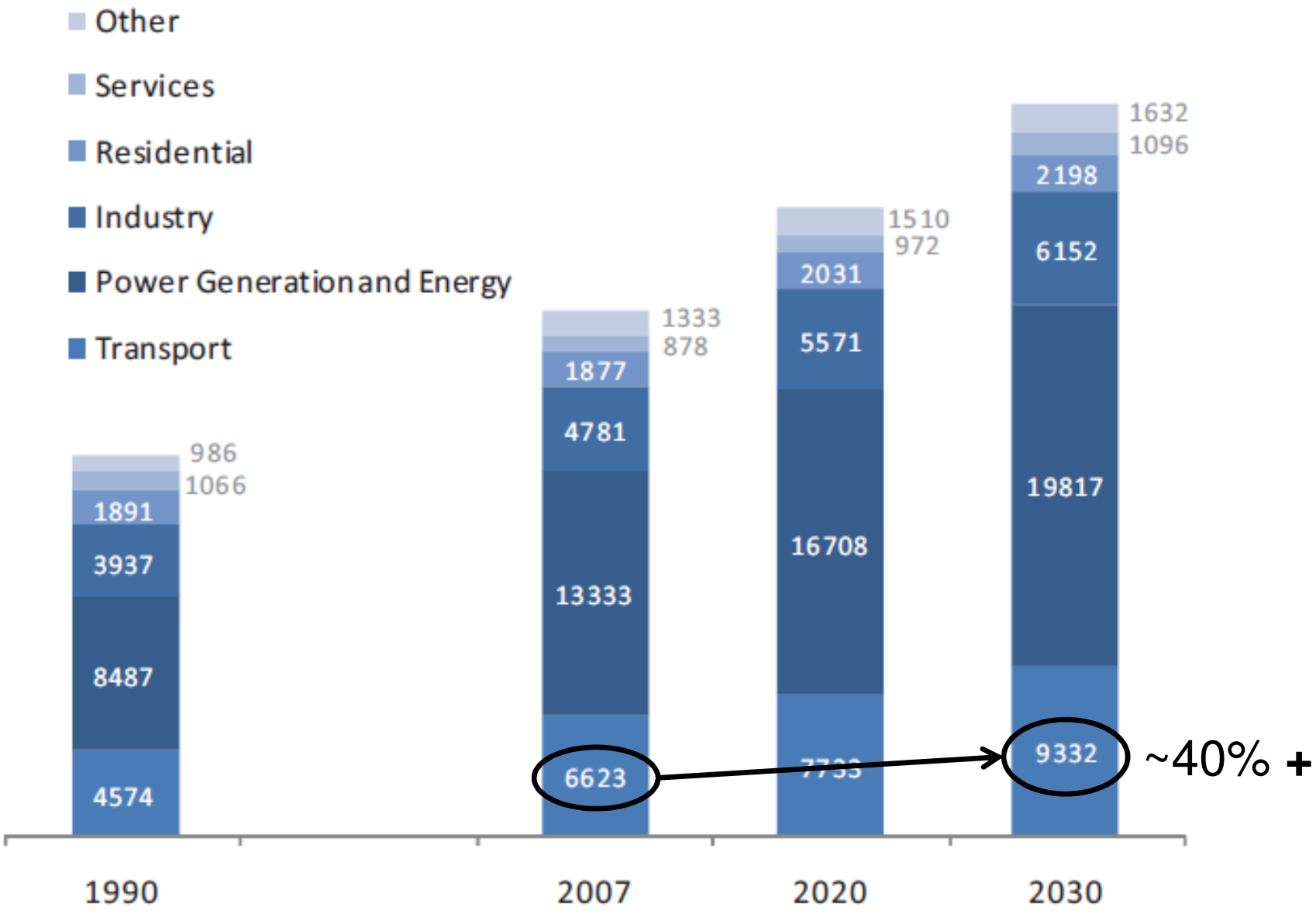
CO2 emissions from fuel combustion – highlights, IEA 2011

Breakdown in CO2 emissions, 2008/9



CO2 emissions from fuel combustion – highlights, IEA 2011

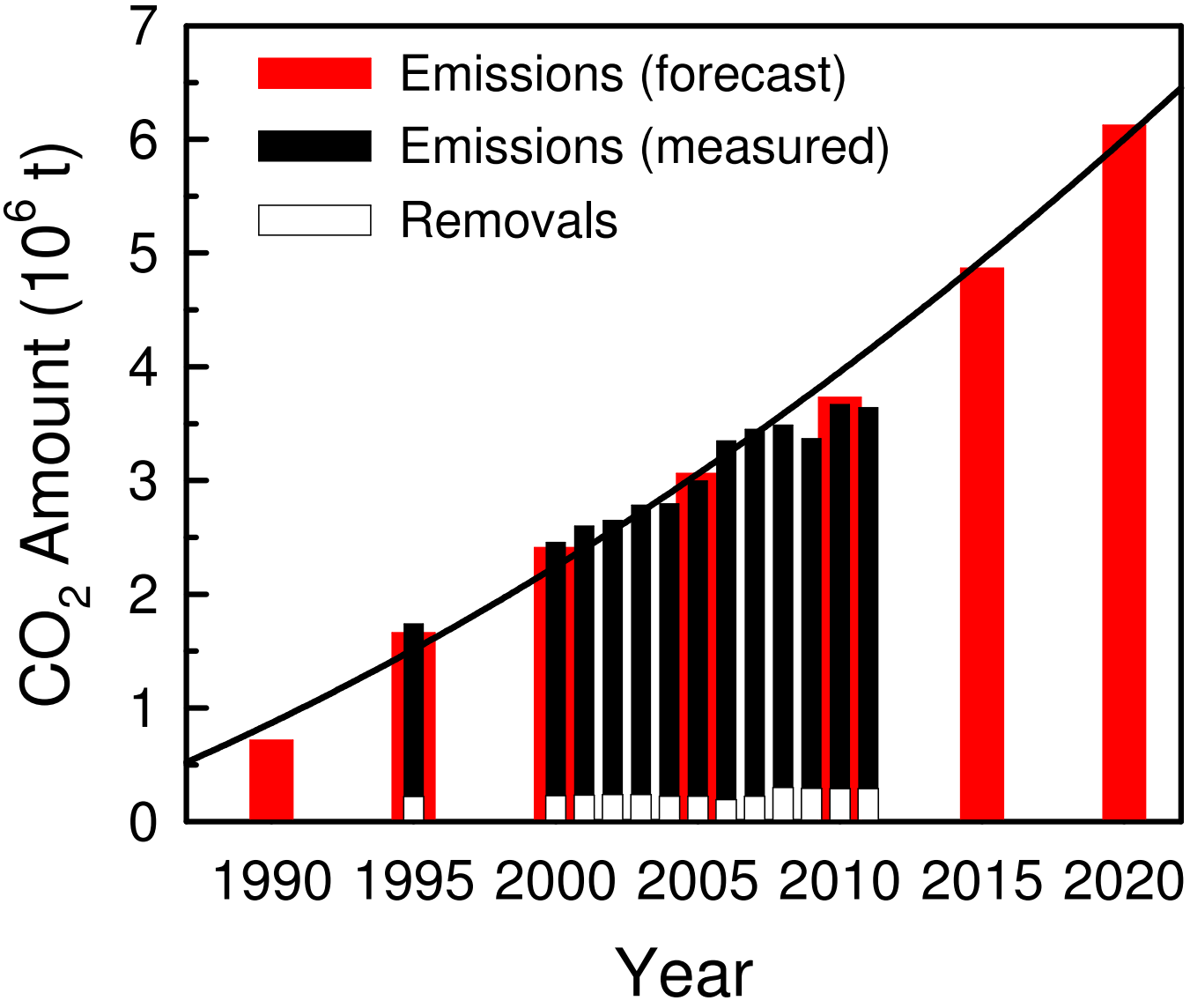
Projected world CO2 emission trends (Mt)



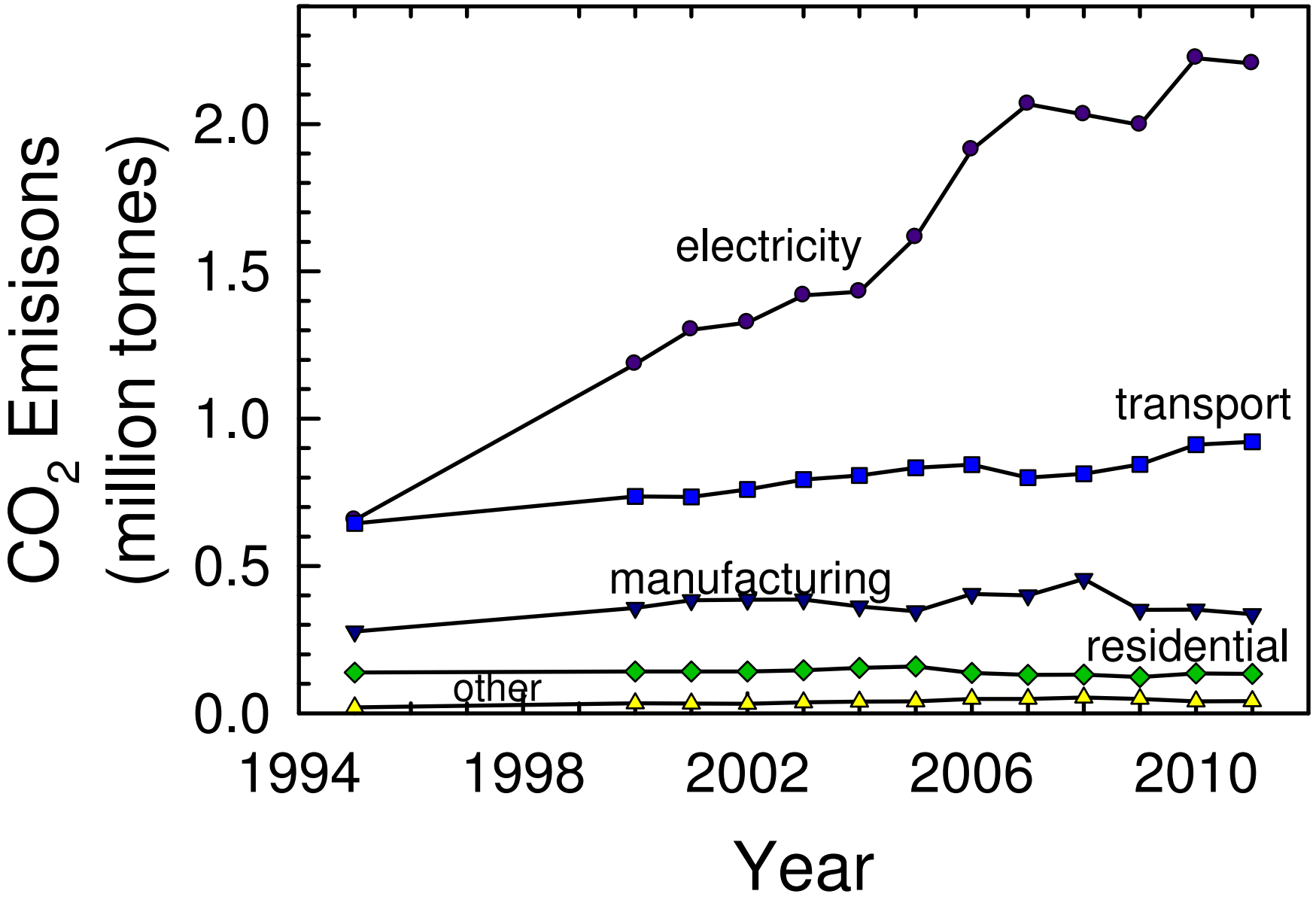
Reducing Transport GHG Emissions, Trends and Data, OECD 2010

Local Context

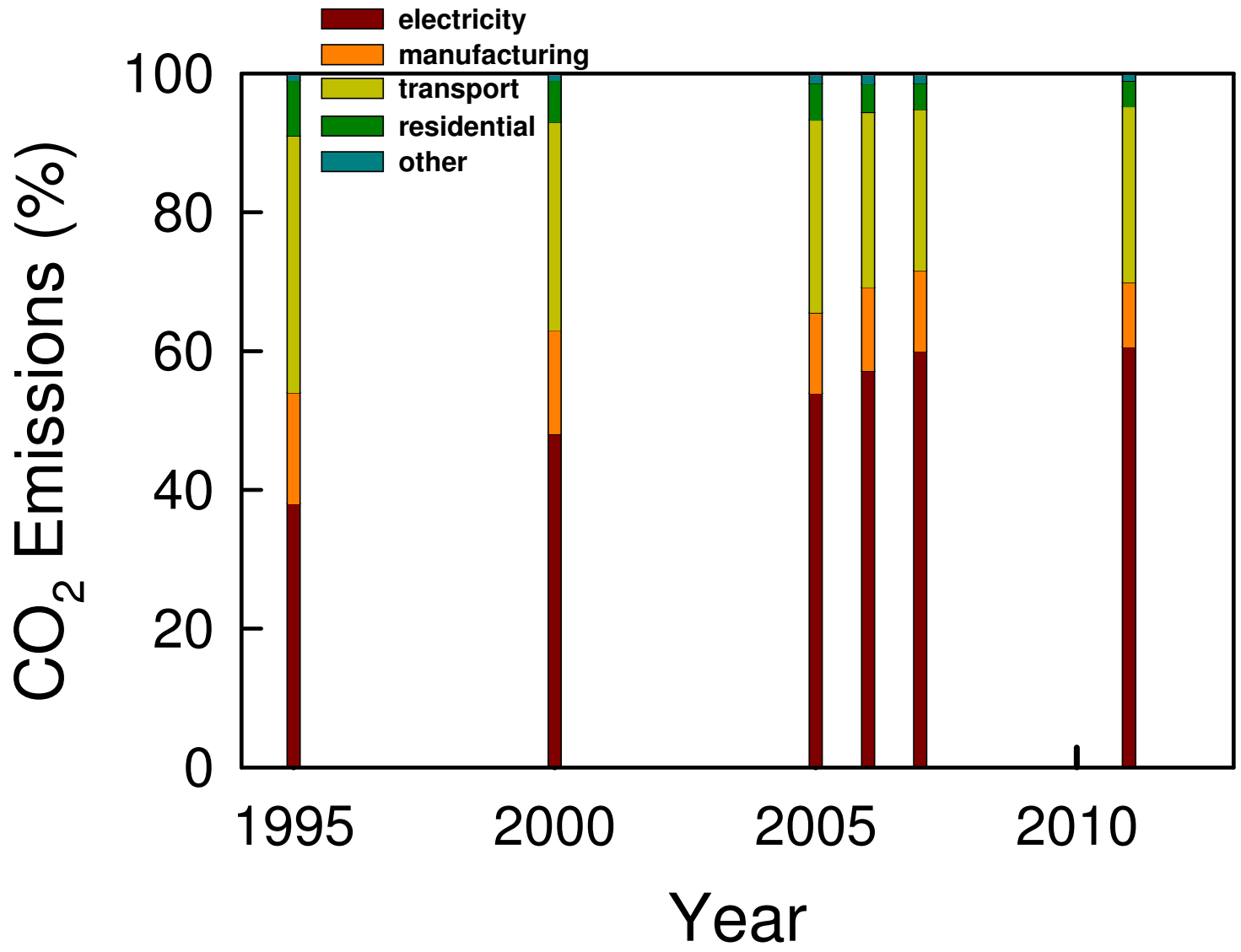
Projected CO2 emissions, Mauritius



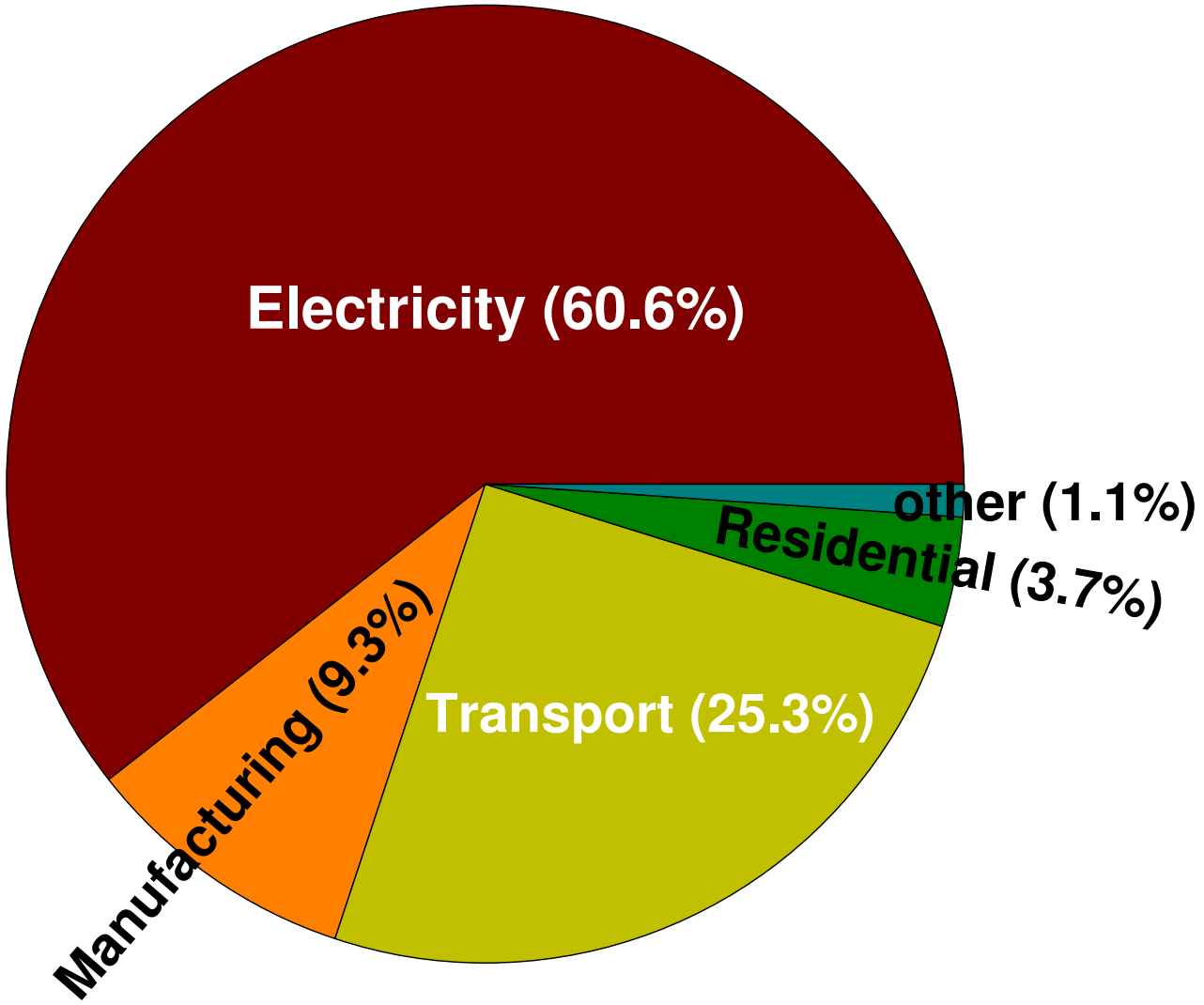
Trends in CO2 emissions, Mauritius



Relative sectoral CO2 emissions, Mauritius

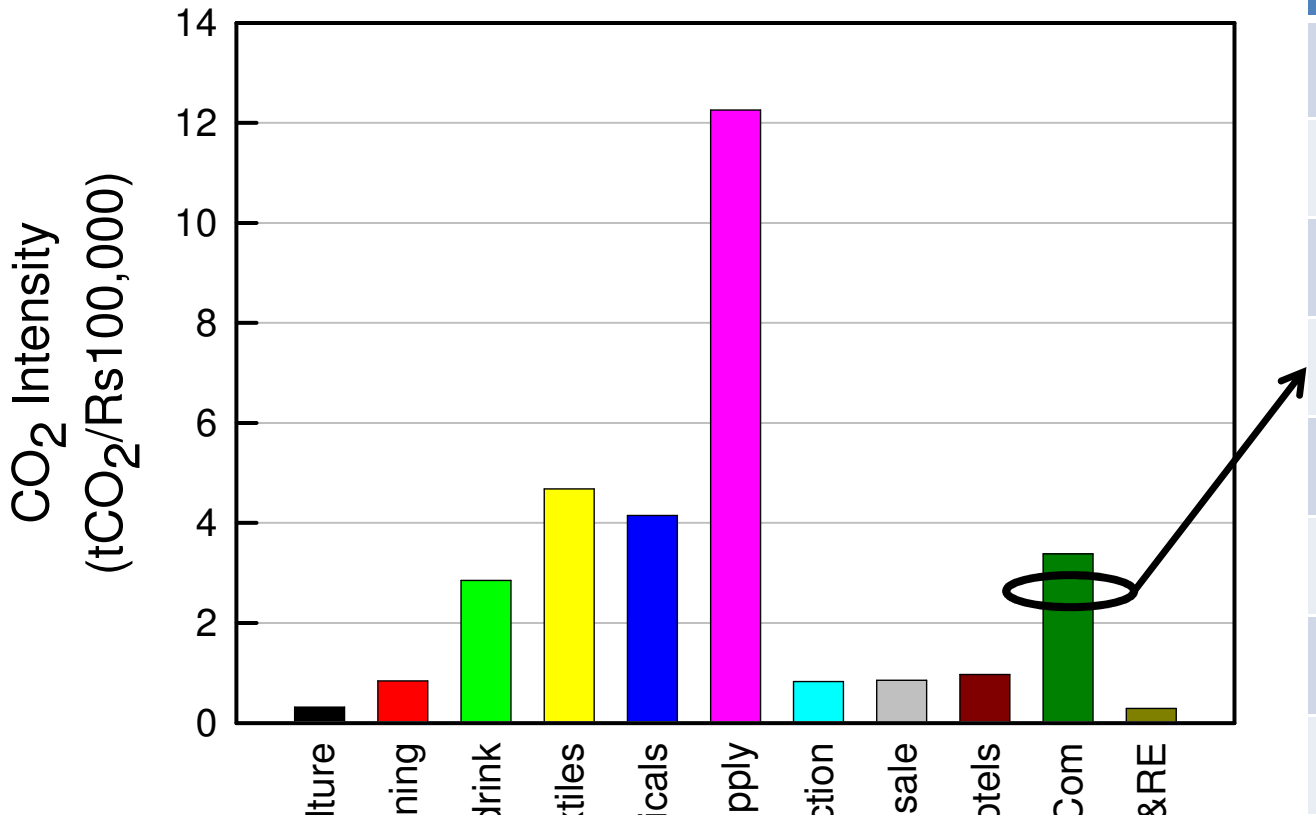


Sectoral CO2 emissions: Mauritius, 2011



Environment Statistics, CSO - 2011

Sectoral CO2 intensities, Mauritius



Year	tCO2/Rs100,000
2002	4.54
2003	4.70
2004	4.71
2005	4.54
2006	4.52
2007	4.09
2008	3.82
2009	3.38

Mitigation Approaches

(maritime transport and aviation)

Maritime Transport & Aviation

Trans-boundary characteristics:

- 'discussions and negotiations on emission reductions from international bunkering are tackled at the international level by the International Maritime Organization (IMO) and the International Civil Aviation Organization (ICAO)'
- IMO & ICAO – 50% emission reductions below 2005 levels by 2050

Maritime Transport

- ~90% of international trade done via shipping
- Already a highly carbon-efficient mode of transport

Mode of freight transportation	gCO2/tonne/km
Air plane (air cargo), average Cargo B747	500 g
Modern lorry or truck	60 to 150 g
Modern train	30 to 100 g
Modern ship (sea freight)	10 to 40 g
Airship (Zeppelin, Cargolifter) as planned	55 g

IMO

1. Technical & Operational reduction measures
    + Energy Efficient Design Index, EEDI (new ships)
    + Ship Energy Efficiency Management Plan, SEEMP (all ships) – operational efficiency expected to deliver 20% emission reductions
2. Market-Based Mechanisms
    + carbon levy
    + emissions trading

Sustainable Shipping Initiative

Vision 2040

- A vision for a sustainable shipping industry in 2040
- Members include the largest shipping companies/stakeholders in the world

http://www.forumforthefuture.org/project/sustainable-shipping-initiative/more/ssi-vision-2040

ICAO strategy

- ICAO Programme of Action on International Aviation and Climate Change - States and relevant organizations will work through ICAO to achieve a global annual average fuel efficiency improvement of 2 per cent over the medium term until 2020 and an aspirational global fuel efficiency improvement rate of 2 per cent per annum in the long term from 2021 to 2050, calculated on the basis of volume of fuel used per revenue tonne kilometre performed (http://www.icao.int/environmental-protection/Pages/programme-of-action.aspx)

- States have to submit Action Plan for emission reductions

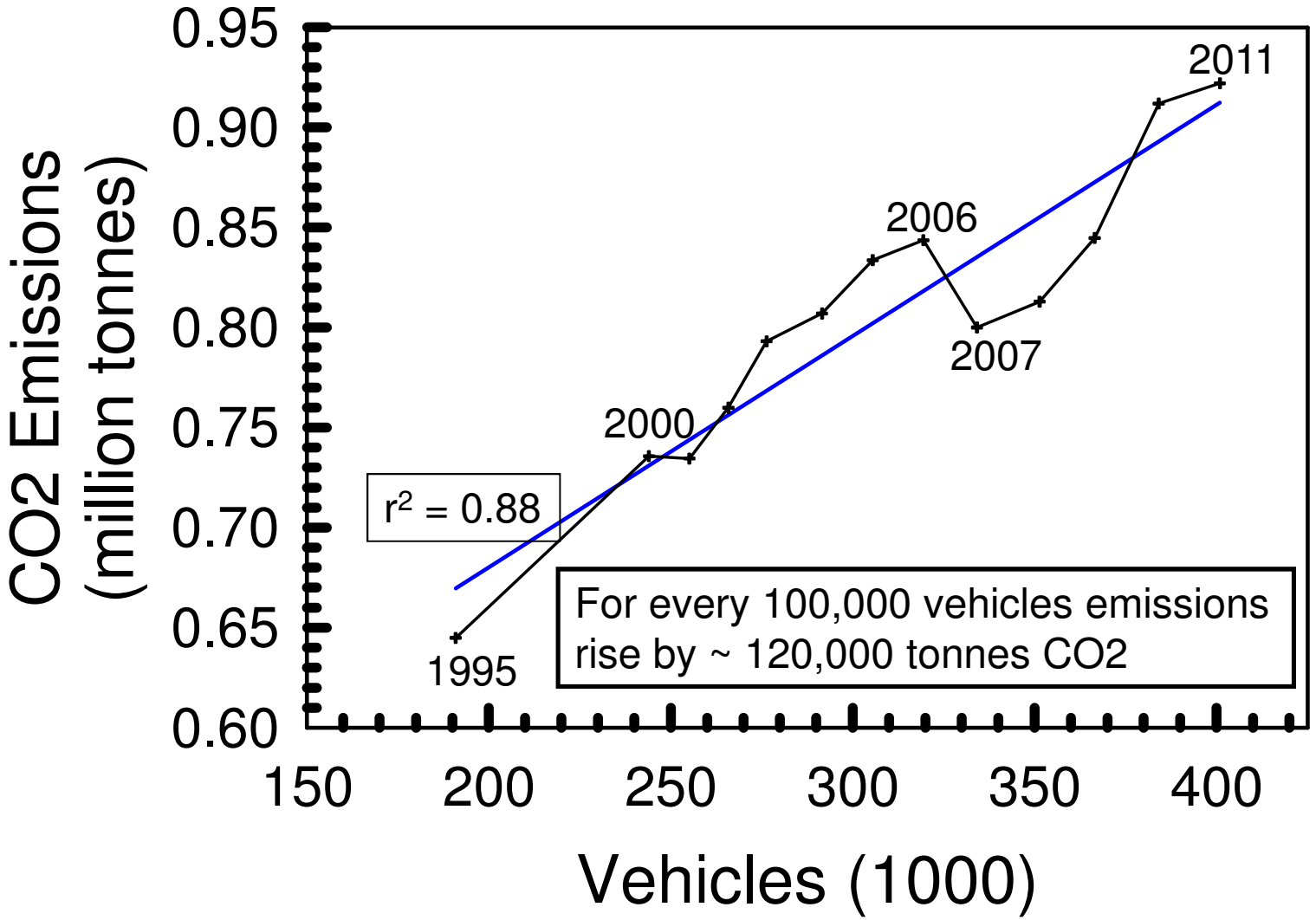
- ICAO emissions calculator: http://www2.icao.int/en/carbonoffset/Pages/default.aspx.

Aviation – generic measures

- **Energy efficiency**: reducing CO2/passenger km by a combination of efficient engines, lightweight aircraft (dreamliner), increasing number of passengers per flight (A380), using turbo propellers on short-hauls; taxying using electric engine on nosewheel's axle ….
- **Operational**: Optimisation of airline timetables, route networks and flight frequencies to increase load factors (minimise the number of empty seats flown), together with the optimisation of airspace;
- **Alternative fuels**: biofuels (sustainability of first generation fuels?)
- **Market based mechanisms**: carbon levy; emissions trading;
- **Reducing demand**: government interventions (fares); cancelling frequent flyer programmes; (http://en.wikipedia.org/wiki/Environmental_impact_of_aviation)

Mitigation Approaches
(road transport)

Road Transport (Mauritius)



Energy efficiency by mode
(averaged over 84 global cities)

Mode	Energy Efficiency (MJ per pass.km)
Car	2.45
Bus	1.05
Metro	0.46
Suburban Rail	0.61
Light Rail	0.56
Tram	0.52

Technologies for CC Mitigation – Transport Sector, 2011 (http://tech-action.org)

1. Reducing overall travel

- by encouraging and enabling people to use mass transit and to walk and cycle
- by having denser communities, so that people are closer together
- by having more mixed land use, so that people's trip destinations – shops, schools, workplaces and friends' houses, for example – are also closer together
- by having greater community self-reliance, so that people can meet more of their needs and pursue more of their interests within their own communities
- Encourage use of ICT

2. Increasing use of low-carbon modes

a) The Walkable Locality
b) Supporting Cycling
c) Mass Transit
d) Influencing Travel Choices

Walking & Cycling

- the provision of walkways / bike paths that enable people to walk / cycle from one point to another as directly as possible
- town planning measures to maximize the proportion of journeys that are walkable / can be biked
- the integration of walkway /bike path networks with mass transit routes and services
- control of motorized traffic and non-transport land uses, and separation of walkways / bike paths from motorized traffic, to ensure that pedestrian travel / biking is safe and pleasant
- make bikes more affordable
- the enactment and enforcement of laws and regulations to support these measures

Mass transit

- Average travel speed must be higher than private modes of transport (one determinant of modal shift)
- Transit-oriented development - town planning measures that foster higher density residential complexes and a mix of other land uses like schools, shops, workplaces, health facilities, as well as good walking and bike paths, limited parking,
- Increasing the status and attractiveness of mass transit (e.g. good bus connectivity, climate control, comfortable, decreased number of road accidents, a cheap mode of travel etc …)

Influencing travel choices

- information provision, especially about the routes, timetables and costs of mass transit services, and about cycling routes
- behaviour change programs, which employ a range of methods to encourage and assist people to use more sustainable low carbon transport
- **integrated ticketing** for different modes of mass transit, which make multi-modal travel easier

3. Making current modes low carbon

a) Private Vehicle Demand Management
b) Improving Private Vehicle Operating Standards
c) Traffic Management
d) Electric Vehicles
e) Vehicle and Fuel Technologies

Private vehicle demand management

- **parking policy** – restricted parking and high price
- **price incentives and disincentives** – tollways, vehicle registration charges (Singapore – 150% of car price), congestion taxes, fuel taxes
- **restricting areas** within which private vehicles can travel (e.g. car-free city centres – Curitiba)
- **street design and traffic calming measures** (e.g. 'road diet' in Toronto)
- **car-pooling** – several persons sharing a ride (coupled with incentives)
- **car-sharing schemes** - cooperatives of car ownership

Private vehicle operating standards

- **standards for vehicle fuel economy** – applied to new vehicles; beware of 'rebound effect' – standards make driving cheaper and people tend to drive longer distances and take more trips!
- **vehicle inspections** – especially when there are emission charges
- **taxation and pricing measures for vehicle performance** – fuel taxes, emissions-related road taxes
- **inclusion of emissions standards in warranties**
- **getting older vehicles off the roads** - legislation
- **standards for fuel quality** – cleaner burning fuels
- **driver or owner education**

Traffic management

- **Designing transport network** – to adjust driving conditions so as to enable vehicles to operate in the least emissions-intensive manner possible
    e.g. increasing average speeds to an optimal level (60 – 90 km/hr)
    e.g. "smoothing flow" – reducing need to accelerate/decelerate

'can have the effect of increasing the attractiveness of private transport – rebound effect'

- **Mechanisms to avoid 'rebound effect'** - emissions charges or fuel levies; reduced parking;
- **the allocation of road lanes and space to favour more efficient modes**

Electric vehicles

- **Only when charged from renewable sources**

Modèle	Assomptions	Facteur d'émission	Emission / km
Nissan Leaf	160 km – 24kWh	0.990484 kgCO2/kWh	~148 gCO2/km
Nissan March	100 km – 5.5 L	2.2104 kgCO2/L(fuel)	~122 gCO2/km

Emissions match when Nissan March would use 6.7 L for 100 km

BARRIERS

- Availability of recharging infrastructure
- Cost of vehicles (especially batteries)

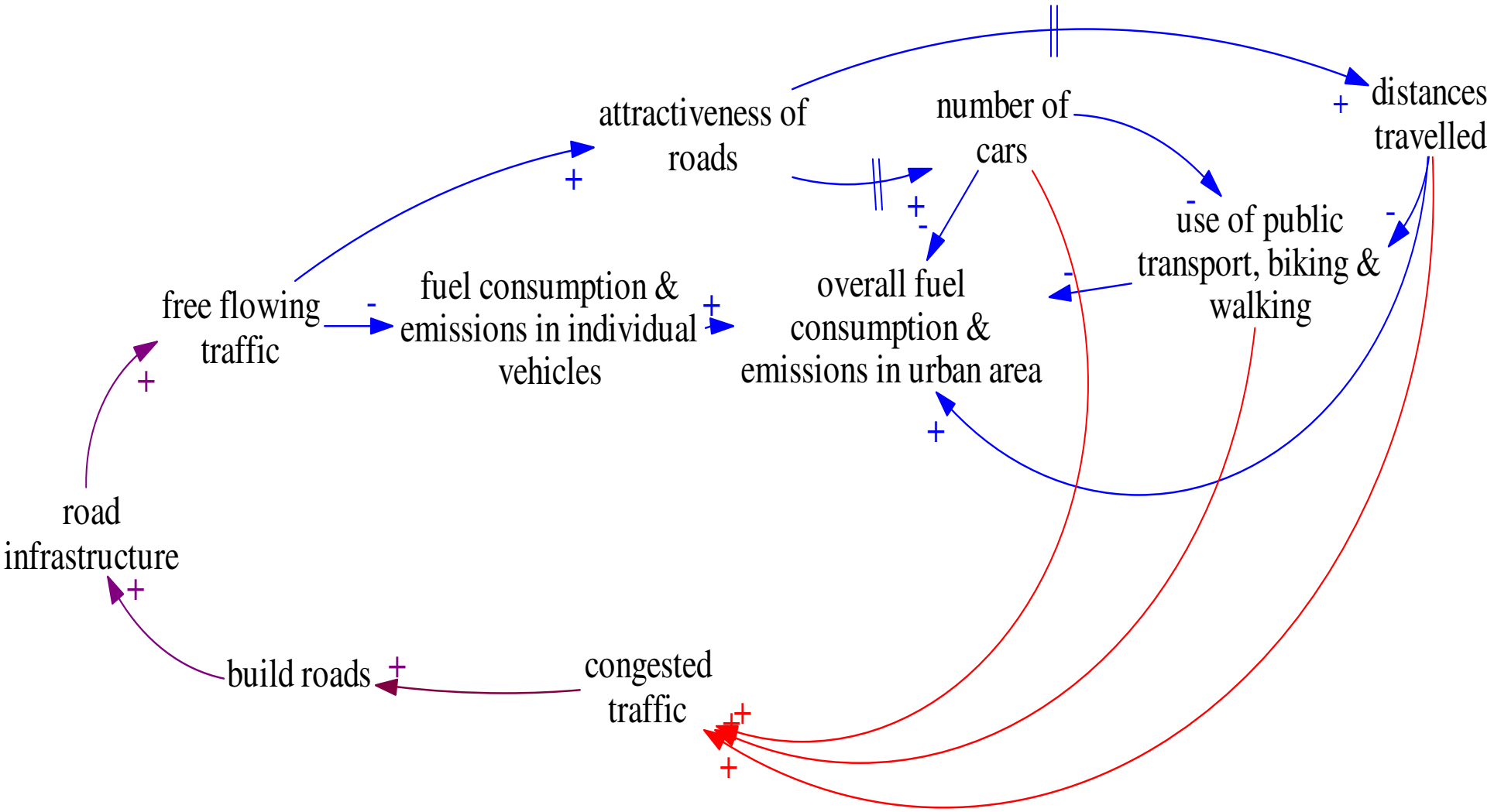
Vehicle and fuel technologies

- **Drive train technologies**

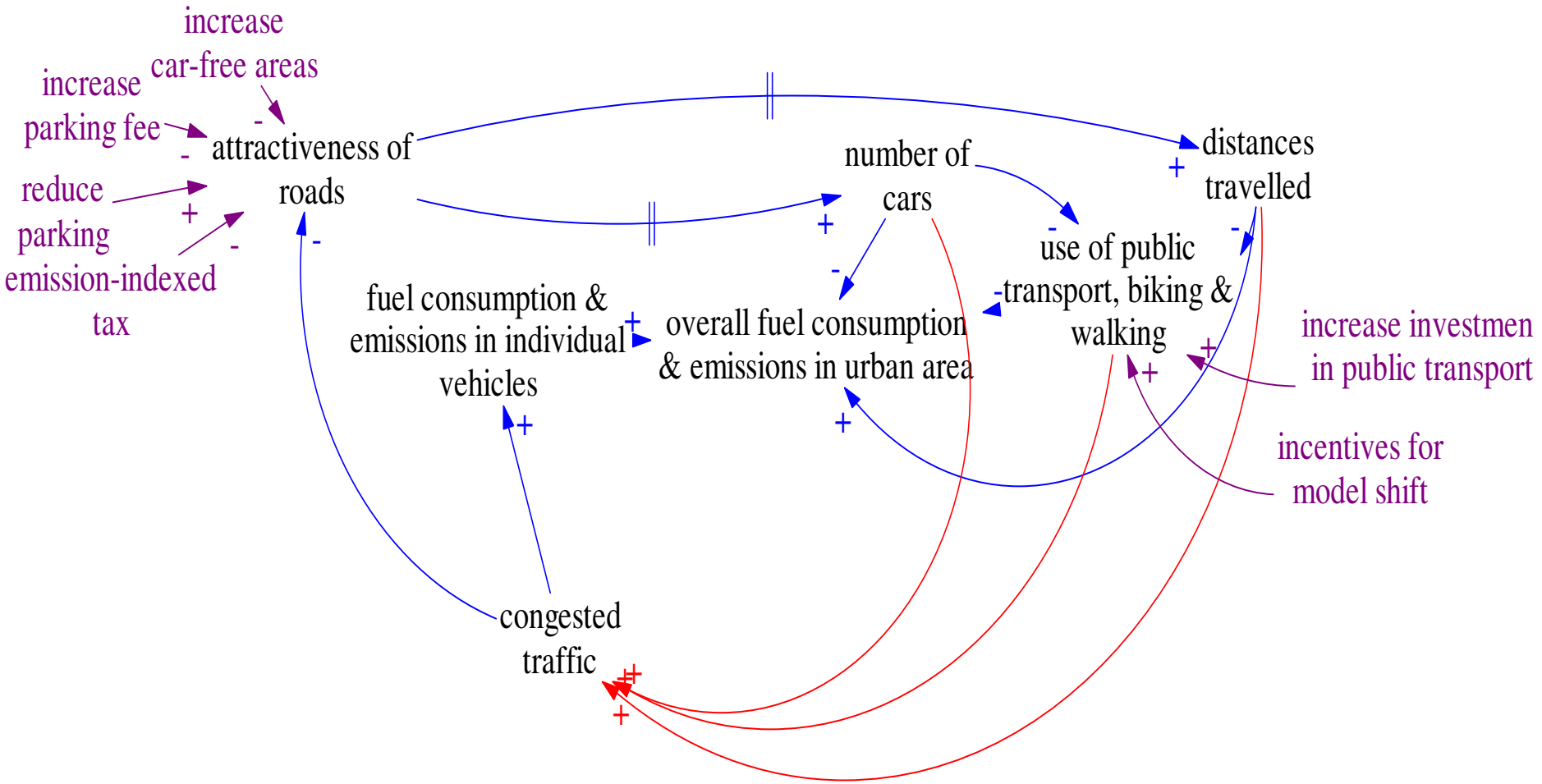
Technology	Mechanical efficient (%)
Spark-ignited ICE	15-20% (best ~32%)
Compression ignition ICE	22-28% (best ~43%)
Micro turbines (similar to combined cycle GT)	**26%**
Fuel cells	**36%**
Electric drives	**Up to 85%**
Catenary electric motors	**Renewable power source**
hybridisation	**ICE operates at max .effi.**

- **Low-carbon fuels** – biodiesel, ethanol, renewable electricity, LPG, (NG?)

Congestion – build roads!!!



Congestion – *make it worse* …..



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Thank You

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