Air pollution and Energy Efficiency co-benefits in the transport sector

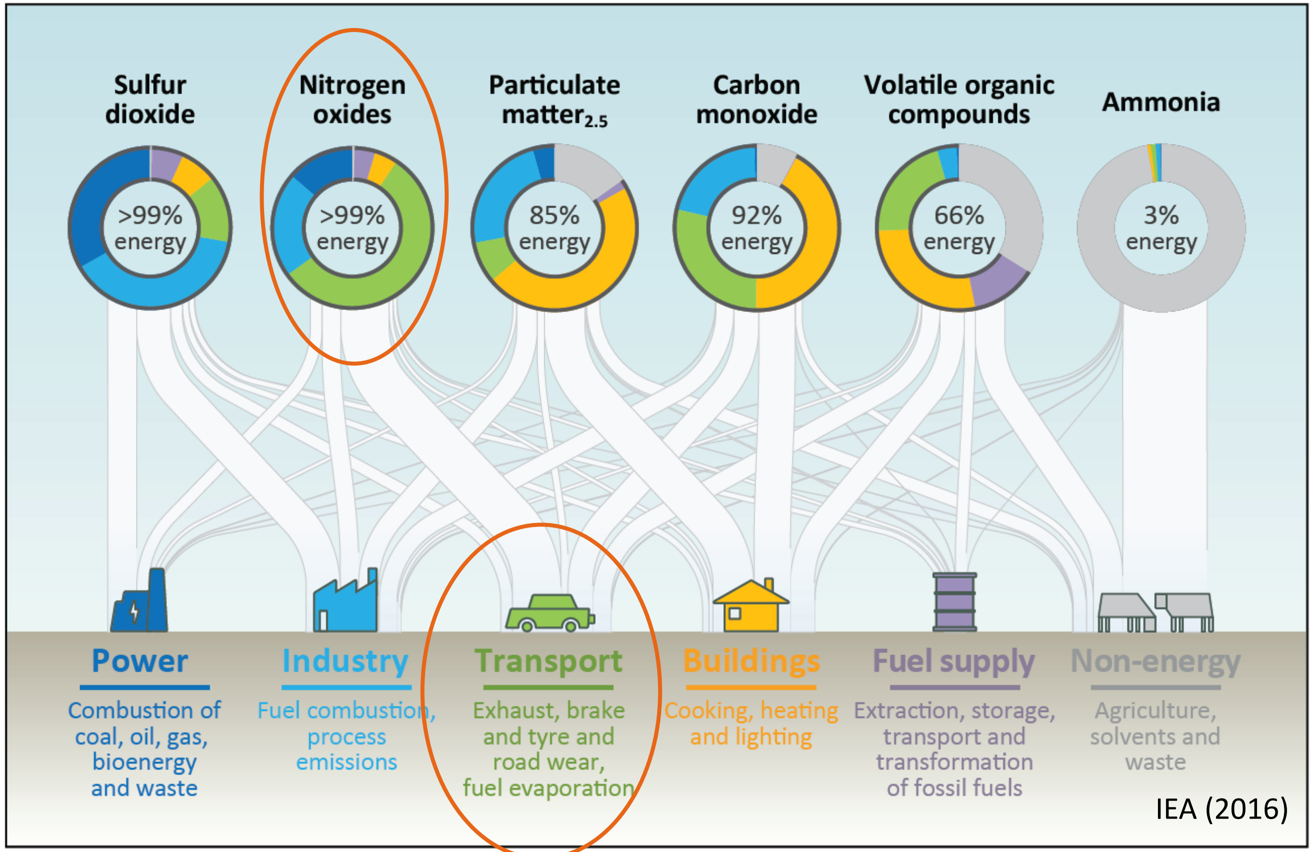
How to quantify the co-benefits?

Overview

- Air pollution and the transport sector
- How to quantify Air pollution and Energy Efficiency (EE)
- Policy types
- Research gaps on Air pollution and EE co-benefits quantification
- Trade-offs and consequences of policies/measures
- Recommendations

Air pollution and the transport sector

- Major contributor to air pollution, especially in densely populated areas
- NOx the biggest concern, with WHO limits exceeding for more than 90% of urban population
- 3 million premature deaths because of bad outdoor air quality



Quantifying Air pollution and EE in transport

- Derived from ASIF methodolgy

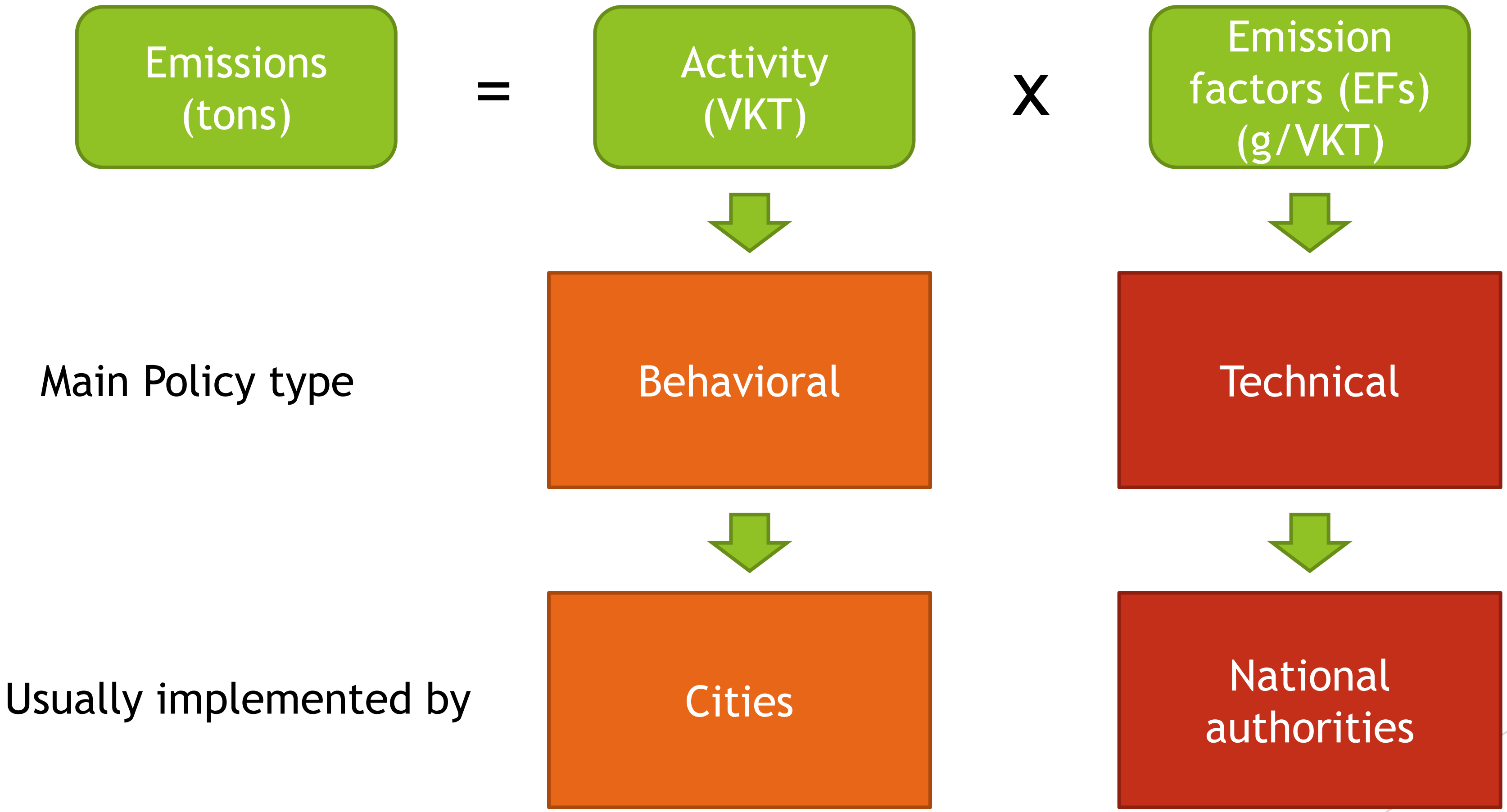
Emissions (tons) = Activity (VKT) x Emission factors (EFs) (g/VKT)

- Activity from different sources
  - Influenced by many parameters
  - Accuracy is challenging

Vehicle Approach	User Approach	Infrastructure Approach
Vehicle stock	Trip number by mode	Traffic counts (by vehicle type)
x	x	x
Annual average mileage	Average trip distance	Infrastructure link length
	/	
	Load factor	
=	=	=
VKT	VKT	VKT

- Emission factors easier to measure
  - Laboratory or on-road measurements technologies complimentary and robust

What type of policies implemented by who?



Examples of Air pollution policies and EE co-benefits

Air pollution policies family	Policy type	Description	Policy example	Target	Air pollution benefits	EE benefits
Behavioral (the people)	car-free days	No cars allowed for one day in a large area	Paris sans voiture	cities, once a year / every sundays	Low	Low
	low emission zones	only certain type of vehicles allowed, based on emission limits	Berlin, Germany	all the time or during traffic/emission peaks	Medium	Low
	car use restriction	some cars not allowed, based on registration number	Hoy no circula, Mexico	All cars	Low	Low
Technical (the vehicles)	Emission standards	impose emission limit at the tailpipe, in mg/km	Euro norms	All new cars	High	Low / Negative
	Periodic technical inspection	Frequent tests of all vehicles on the road	Turkey	High emitters with defective emission control	Medium	Low
	Vehicle Retrofit	Install cleaner fuel system such as LPG, CNG	CNG light and heavy duty in Argentina	All used vehicles	Medium	Low / Negative
Systemic (the infrastructure)	Congestion charging	reduce the number of vehicles in an area to improve traffic flow	London	city centers	Medium	Low
	Traffic calming (speed limits)	reducing speed limits to improve traffic flow	Brussels	city centers	Medium	Low
	car-free zones	only non-motorized modes allowed all year long	Ghent	city centers	High	Medium

Emission reduction policies

Region	Emission standards						Fuel sulfur standards	
	Light-duty vehicles			Heavy-duty vehicles				
	Global vehicle sales in 2014 (%)	Passenger-kms activity (%)	National standard	Global vehicle sales in 2014 (%)	Tonne-kms activity (%)	National standard	Diesel ppm (year)	Gasoline ppm (year)
United States	19.0%	15.9%	Tier 3 (2017)	11.8%	10.9%	US 2010	10 (2017)	10 (2017)
Canada	2.4%	1.5%	Tier 3 (2017)	1.5%	1.2%	Phase 2	15	10 (2017)
European Union	21.0%	14.7%	Euro 6	9.4%	9.3%	Euro VI	10	10
Japan	7.1%	2.8%	PNLTES	2.9%	1.4%	PNLT	10	10
Korea	1.8%	1.4%	CARB NMOG / Euro 6 (diesel)	1.5%	1.0%	Euro VI	10	10
Australia	1.4%	1.0%	Euro 6 (2018)	0.5%	0.5%	Euro V	10	50
Turkey	1.2%	1.4%	Euro 5	1.5%	1.8%	Euro VI	10	10
China	23.9%	15.2%	China 5 (2018)	48.5%	19.8%	China IV (2014), China V (diesel, 2017)	10 (2017)	10 (2017)
Russia	3.4%	3.6%	Euro 5	1.9%	1.7%	Euro V	10	10
Brazil	5.5%	4.1%	L-6	2.8%	6.4%	P-7	50	500
Argentina	0.8%	0.8%	Euro 5	0.3%	0.9%	Euro V (2018)	150	10
India	8.8%	4.3%	Bharat IV (2017)	3.9%	11.4%	Bharat IV (2017)	50 (2017)	50 (2017)
Mexico	2.0%	2.7%	Between Euro 3-4	0.9%	2.9%	Euro IV	500	80
Indonesia	1.4%	1.0%	Euro 2	2.5%	1.5%	Euro II	500	3 500
South Africa	0.8%	1.7%	Euro 2	0.6%	1.0%	Euro II	500	500
Saudi Arabia	0.7%	1.0%	Euro 2	0.5%	5.3%	Euro II	10	N/A

Standards: *Stricter than Euro 6/VI* | *EURO 6/VI Equivalent* | *EURO 5/V Equivalent* | *EURO 4/IV Equivalent* | *EURO 3/III Equivalent* | *EURO 2/II Equivalent*

IEA (2016)

Examples of EE policies and air pollution co-benefits

EE policies familiy	Policy type	Description	Policy example	Target	EE benefits	Air pollution benefits
Avoid (system efficiency)	Combined land use	Mix activities (residential, commercial, industrial) in a limited area to reduce trip distances	Rurh Valley, Germany	metropolitan areas	High	High
	Transit Oriented Development	Urban/housing expansion concentrated around exisitng/furure public transport routes	Portland, Oregon, US	metropolitan areas	High	High
Shift (trip efficiency)	Dedicated public transport lane / BRT	Provide more space for public transport, to ensure reliable trip times	Bogota, Columbia Curitiba, Brazil	metropolitan areas	Medium	Medium
	Freight road charging	Distanced-based road freight transport charges to encourage shift to rail/inland navigation	Germany	Freight	HIgh	Low / Negative
Improve (vehicle efficiency)	Fuel economy standard	Average fuel economy of new vehicles mandatad by law, by car manufacturer	US CAFE Standard	New road vehicles	High	Low
	Technology mandates	Requiring a minimum share of certain vehicle technologies (eg electric cars) in the new registrations	China ZEV Mandate	New road vehicles	Medium	Medium
Cross cutting	Fuel/road pricing	Increase trip cost by increasing energy / distance prices to encourage more efficient mobility	Turkey high fuel prices	All vehicles	High	Medium
	Pay as you drive (PAYD) car insurance	Distance-based car insurance	Many private insurance providers	All cars	Medium	Low

Research Gaps

- VKT evaluation of behavioral policies often lack evidence
  - Role of modelling essential for both ex-ante and ex-post policy assessment
  - Monitoring data key to assumption validation and credibility of the analysis
  - Traffic models (“Infrastructure approach” to get VKT) better for local policy and for transport demand projections
  - “Vehicle approach” more convenient for national scale policies

- EFs more and more robust from different measurement types
  - Laboratory and on-road measurement complimentary
  - EFs database readily available in emission inventory software such as COPERT, HBEFA or MOVES, with a detailed specification of the vehicle fleet
    - Improving vehicle sampling would deliver more robust EFs

Trade-offs between air pollution and EE in the transport sector (1)

- Induced demand and traffic evaporation
  - Role of modelling essential for both ex-ante and ex-post policy assessment
- The role of regulation
  - Shift from trucks to (diesel) trains or inland navigation good for EE, bad for air pollution, with higher emission limits for diesel trains and barges
- Technology trade-offs a cost issue
  - Technologies available to improve both EE and Air pollution at the vehicle level
  - Cost minimization strategy driving the trade-offs between Air pollution and EE
    - Economic tools to break this trend?

Trade-offs between air pollution and EE in the transport sector (2)

- Electric transport reduce or delocalize air pollution ?
  - Power to propel electric mobility is produced from primary energy sources
  - Power plants usually placed far away from densely populated areas
  - Pollutant emissions from power plant regulated in many regions, esp. in OECD countries, with decreasing unitary emission reduction targets
  - Growing share of renewable electricity reduces pollutant emissions during the lifetime of the vehicle, with no need for retrofits
  - Many transport operators using electricity (mainly rail operators) buying green certificates that also guarantees pollutant-free power supply

Recommendation – Focus on VKT evaluation

- Use big data to know traffic activity and derive policy impacts
  - Limited progress in traffic management assessment in the last 20 years
  - More consistent and harmonized traffic model developments
  - Use "big data" traffic activity data sources (e.g. Google Traffic, Waze Uber Movement)
  - Link traffic data with local policy agenda
  - Link ex-post evaluation and ex-ante policy impact assessment during tendering processes

- Start working on global traffic emission model
  - Using big data as baseline and approach for projections
  - Check validity of GDP as main demand driver
  - Collaboration between traffic engineers and transport emission experts

Questions?

IEA (2016)

York press (2016)