Arthur D Little

Impact of material efficiency KPIs on urban mobility

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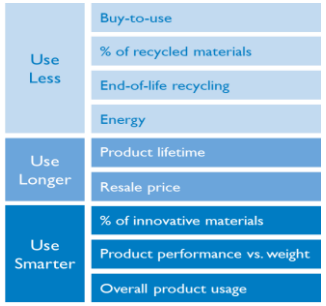
WORLD MATERIALS FORUM

Arthur D. Little has been framing material efficiency studies for WMF from 2016 to 2020

2016-17 — KPI definition

- Elaboration of the 9 KPIs



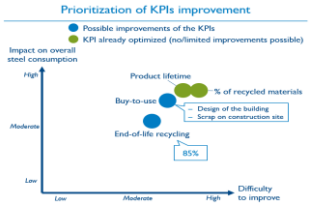
2017-18 — KPI measurement for companies

- KPIs dashboard to monitor a company:
  - KPI management
  - KPI measures

Booklet

2018-19 — KPI priorities by materials

- Global overview by materials
  - Deep dive on the steel industry
- Identification of the top priorities by materials



2019-21 — KPI enablers

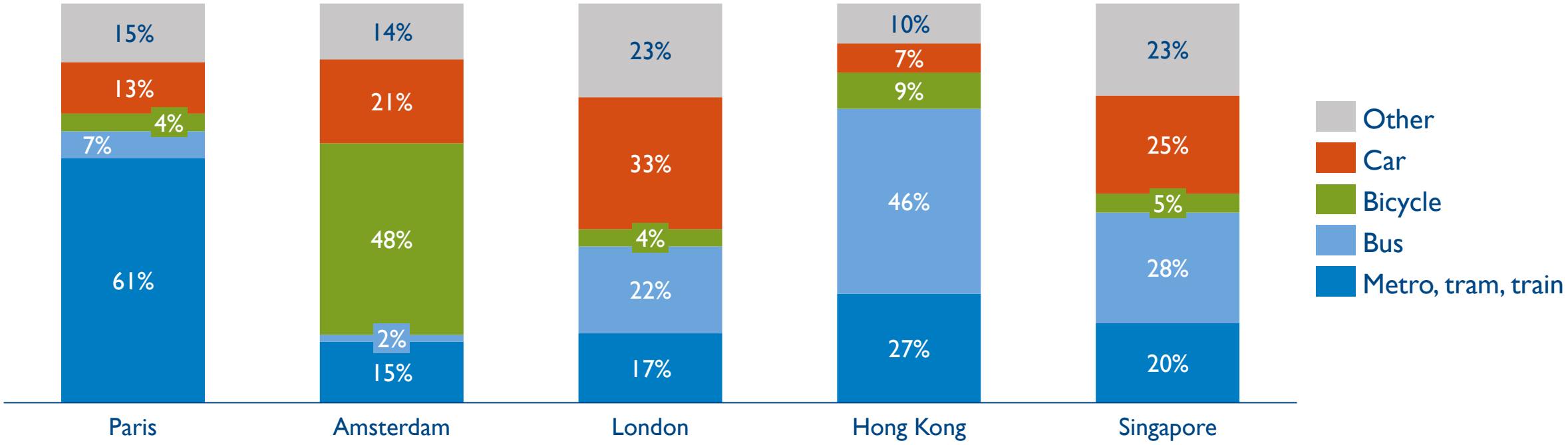
- Analysis of the enablers
  - P&L & internal pressure
  - Consumers
  - Finance
  - Regulation
- Evaluation of the impact of a better material efficiency management in Urban Mobility

Source: Arthur D. Little analysis

The selected cities have a very different modal mix, some with high volume public transports, others with bikes and cars

Traffic mix per city

In pax, sources may vary between 2014 and 2017, with hypothesis



Source: INSEE, TEMIS, NL Ministry of infrastructure, LTA Academy, Arthur D. Little

This study is focused on 4 KPIs that can be openly accessed

	KPIs	Description
Use Less	Buy-to-use	Material value in the product / material value used in production
	% of recycled materials	Weight of recycled / total weight of materials in new product
	End-of-life recycling	Weight of materials effectively recycled / total weight of materials
	Energy	Total energy consumption to produce the product
Use Longer	Product lifetime	Total lifetime of the product, from completion to waste
	Resale price	Resale price after Y years / initial price (Y is industry specific)
Use Smarter	% of innovative materials	Weight of new or innovative materials / total weight of materials
	Product performance vs. weight	Performance measurement of the product key functions vs. weight
	Overall product usage	% of the time the product is used relatively to its full capacity

Source: WMF & Arthur D. Little analysis

Each mode show a very different performance when evaluated with the selected material efficiency KPIs

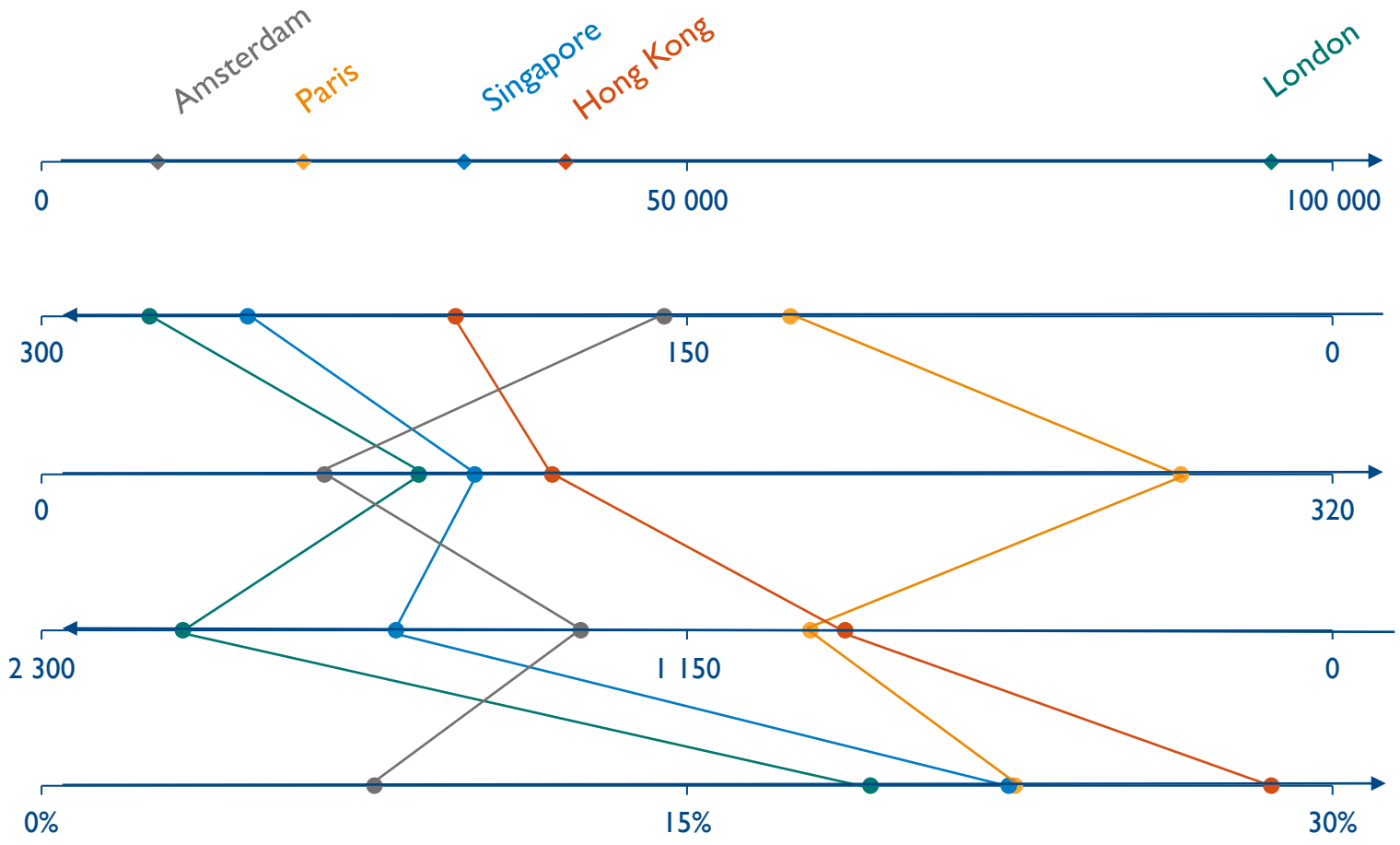
	Unit	Metro, tram	Bus	Bike	Car
Energy	kJ per pax.km	52	286	71	411
Product lifetime	mpax.km in lifetime	392,01	15,09	0,02	0,38
Product performance vs. weight	kg/mpax.km in lifetime	332	762	517	4 000
Overall product usage	% of time used vs. idle	30%	39%	2%	5%

Source: Shreya Dave MIT 2010, LTA Academy, INSEE, RATP, IDF Mobilités, press, Irisbus, Decathlon, Argus, Velib, Observatoire des Déplacements, Velib, Autolib

Legend: Highest performance ← → Lowest performance

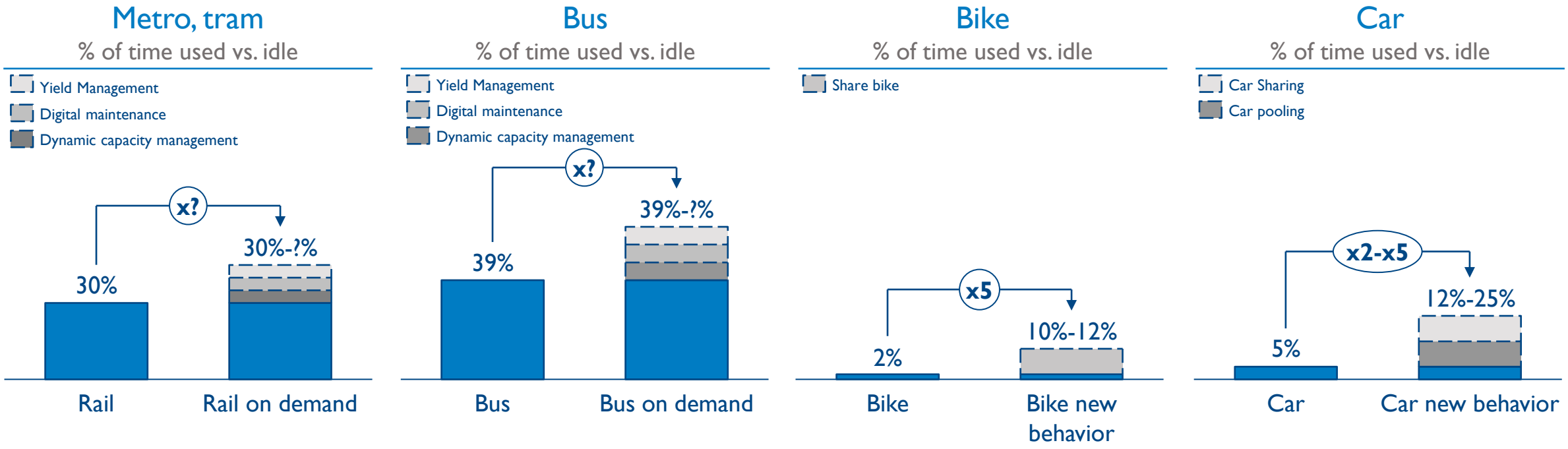
Transport mix is not a guarantee for performance efficiency : KPIs need to be followed

	Unit
Volume of transport	mpax.km
Energy	kJ per pax.km
Product lifetime	mpax.km in lifetime
Product performance vs. weight	Kg/mpax.km
Overall product usage	% of time used vs idle



Source: Shreya Dave MIT 2010, LTA Academy, INSEE, RATP, Irisbus, IDF Mobilités, press, Irisbus, Decathlon, Argus, Velib, Observatoire des Déplacements, Velib, Autolib, HK Statistics Section Transport Department, Singapore Land Transport Authority

Moreover, innovation could dramatically boost the usage of each mode and thus the material efficiency



Levers of innovation

- Digital maintenance
- Yields management
- Dynamic capacity management

- Behaviour change
- New business models
- Technological innovation

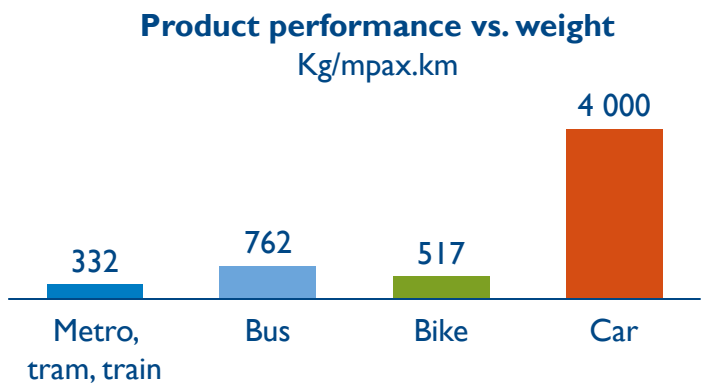
The magnitude will largely depends on the ability to deploy this new usages

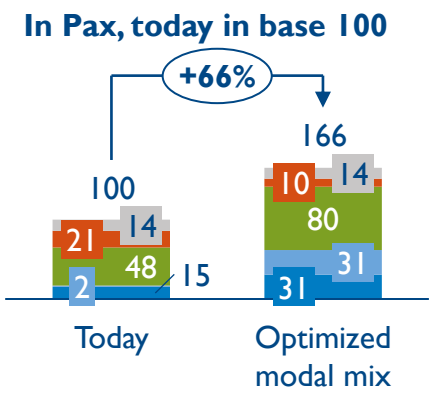
Source: Arthur D. Little, Velib, Autolib, Observatoire des Déplacements

Tremendous evolution could be implemented by using material efficiency KPIs

Optimize modal mix

Example of Amsterdam

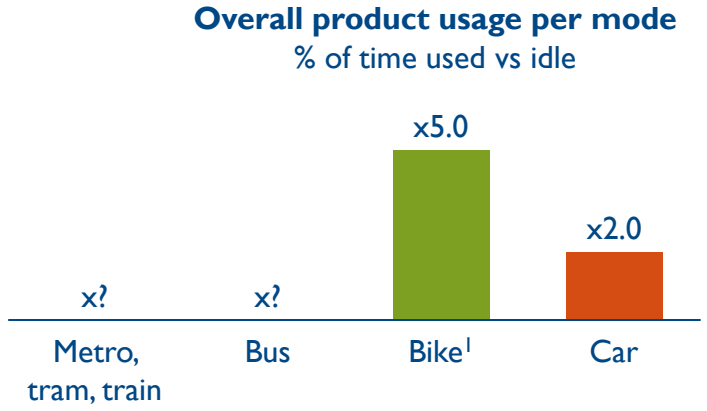


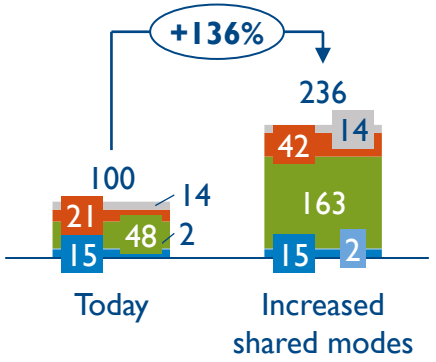


- By optimizing modal mix (lowering car utilization by 50%), Amsterdam could increase its transport capacity by **66%** with the same materials efficiency Product performance KPIs

Increase shared modes

Example of Paris





- By adopting new habits of shared modes, Paris could increase its transport capacity by **136%** with the same materials consumption

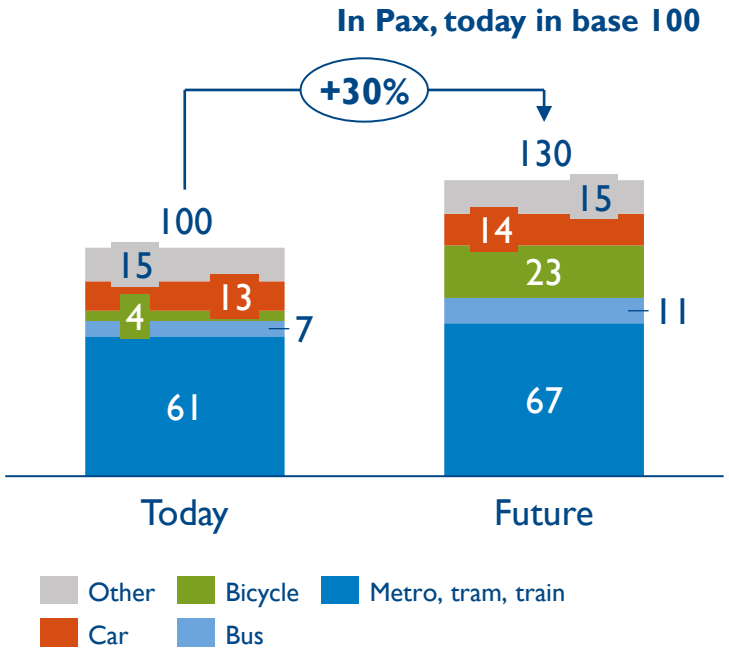
Source: Arthur D. Little
Note: 1) Taking into account that 40% of the bike fleet is already shared

Dashboards based on material efficiency KPIs could help local organizations to increase mobility without increasing material usage

Mobility increase

Pax, today 100 base

Example of Paris



KPIs evaluation

Material efficiency KPIs dashboard

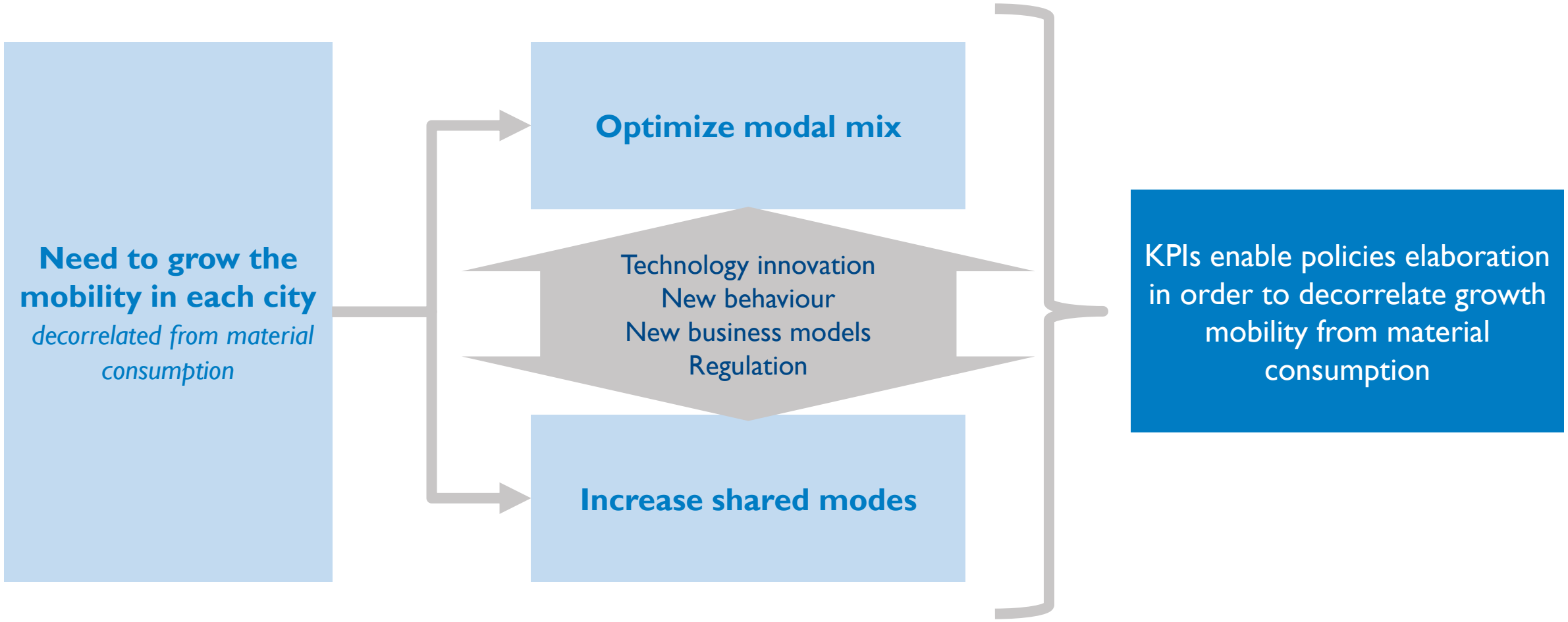
	Metro, tram	Bus	Bike	Car	Total[1]
Energy *kJ per pax.km*	32 / 35	19 / 32	3 / 16	53 / 25	107 / 107
Product lifetime *Mpax.lm in lifetime*	240 / 263	1 / 2	0 / 0	0 / 0	241 / 264
Product performance vs. weight *Kg/mpax.km*	203 / 222	52 / 84	23 / 119	516 / 240	794 / 665
Overall product usage *% of time used vs idle*	16% / 17%	3% / 4%	0% / 0%	1% / 0%	19% / 22%

Pushing Share bike Pushing Share cars

Illustration of a urban policy that implements a 30% mobility increase, while increasing material efficiency performance

Source: Arthur D. Little
Note: 1) adding always 15% of Others

Growth in urban mobility and material consumptions can be decorrelated and KPIs could support this objective



Source: Arthur D. Little

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