



Study on costs and benefits of the sustainable urban mobility transition - *Preliminary Simulation for Munich (DE)*

EIT Urban Mobility - Mobility for more liveable urban spaces

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Premise

The study has produced a quantified analysis of the costs and benefits of the transition to sustainable urban mobility in European cities by 2030 and 2050. The objective has been accomplished using a quantitative assessment tool (MOMOS¹) which allowed to simulate the impacts of different mobility transition scenarios.

MOMOS is a strategic and aggregated model, adaptable under several assumptions to different city circumstances in different European countries, and enabling for a rapid identification, development, screening, and assessment of different measures and policy scenarios and of their expected impacts. This tool does not intend to replace sophisticated transport models but allows for an evaluation of alternative solutions.

Within this study, the use of this tool and the simulation of the scenarios has allowed to fairly represent the entire EU27 context, while considering differences among cities in terms of size and geography, as well as per capita income, motorisation rates, fleet composition, energy prices, and value of travel time among other indicators. In fact, the tool has been applied to 12 “City Prototypes”. Each of them features a different combination of city dimension (Large, Medium, and Small) and geographic area (Northern, Central/Western, Southern, and Eastern Europe). 30 reference cities have been used to approximate relevant urban and transport variables (as input data) that define the prototypes at base year 2019.

Three transition scenarios have been considered: Scenario 1 “Promote and Regulate” which stimulates more sustainable travel behaviour through information, regulations, and promotions as well as the incentivization of innovative and shared mobility services; Scenario 2 “Plan and Build” which is centred on investments in technology and infrastructure and changes in the urban environment, with a focus on public transport²; Scenario 3 “Mixed” which is a mix between the two previous approaches: regulations and behavioural incentives as well as the provision of infrastructures and services.

¹ <http://www.trt.it/en/tools/momos/>

² Scenario 2's investments in public transport are focussed on metro/tram in Large cities, tram/buses in Medium cities, and buses in Small cities.

In this factsheet, the model has been preliminarily applied to a single city context to produce an initial estimation of the costs³ and benefits of the sustainable mobility transition scenarios in that urban context. Importantly, two clarifications are needed to explain these preliminary results.

The first one is related to the data input collection. In total, 43 inputs (see Table 1) have been used to feed the model and to represent the city's characteristics at base year by reproducing different circumstances, related to its socio-demographic aspects as well as mobility features (public transport infrastructure, innovative services, parking, traffic management solutions, etc.). Of all data collected, 20 inputs were publicly available through desk research (sources include, for example, reports of public transport operators, service provider websites, national statistics databases, previous sectorial studies, etc.) and 23 inputs have been estimated considering other similar contexts (e.g., a city with similar characteristics for which such data is available) or through the expertise and professional judgement of the author. Therefore, the production of a more realistic picture would only be possible through a tailored collaboration with local authorities and operators willing to share precise input data that could better describe the city's initial situation and parameters.

The second element concerns the implementation of policy measures and the construction of the three transition scenarios. In fact, most of the policies have been defined by taking into account the EIT Urban Mobility strategic objectives, as well as the targets of the Green Deal and of the EU Smart and Sustainable Mobility Strategy. However, each city also has its own vision and specific roadmap towards sustainable mobility transition (e.g., some policies could be preferred than others, local incentives might favour the development of infrastructure rather than the promotion of innovative services, etc.). Once again, a collaboration with local authorities would be necessary to tailor the city's transition simulation according to its own vision and path towards the future.

With these important considerations that need to be factored in, this factsheet presents a preliminary simulation for the city of **Munich (DE)** (*Large City Central/Western Europe*) and offers, through some Key indicators, an initial estimation of the cost and benefits of the city's transition to sustainable urban mobility by the years 2030 and 2050 for the assumed scenarios.

³ The three scenarios are simulated considering a penetration of innovative vehicle technologies inspired to the EU "Fit for 55" Strategy (as an example, it is assumed a share of about 85% of car electric vehicles in total European fleet by 2050). That said, the study considers only the costs affecting local authorities (administration, public transport operators, service providers) such as costs for the green fuel recharging urban infrastructure to support the evolution of vehicle technologies. Other relevant costs associated (government incentives, costs for the automotive sector, etc.) belonging to external entities are not considered within the study.

Input Data

Table 1: List of collected data inputs (either publicly available or estimated)

Group	Input data	Description	Available/Estimated
Urban Characteristics	Population	Population of the city	Publicly available
	Population Structure	Age distribution of the city population	Publicly available (at NUTS3 level)
	Population Growth	Expected trend of the population growth	Publicly available
	Population Distribution	Population distribution between city centre and outskirts	Estimated
	Urban Growth	Population shifts between city centre and outskirts	Estimated
	Average Income	Average income of the city population	Publicly available
	Economy	Economy city type, representing the relevance of industrial sector for the city in terms of employees working in manufacturing, construction and public utilities	Estimated
Urban Mobility Characteristics	Motorization Rate	Number of private cars per capita	Publicly available (at Country level)
	Motorization Rate Change	Annual growth of the motorization rate	Publicly available (at Country level)
	Modal Split	Modal split with respect to the urban area only (walk, bike, car, motorbike, bus, tram, metro)	Estimated
	Modal Split Change	Modal split trend over time in absence of policy activation	Estimated
	Congestion Level	Qualitative description of road congestion in the city (significant, only during rush hour, negligible)	Publicly available
	Incoming Trips	Share of incoming trips in the urban area, with respect to the total amount of trips within the area	Estimated
	Modal Split of the Incoming Trips	Modal Split of the incoming trips into the urban area (private car, bus, train)	Estimated
	Freight Vehicles Rate	Share of freight vehicles with respect to the total vehicles (freight and cars) travelling in the urban area	Estimated
	Freight Vehicles Rate Change	Annual change in the share of freight vehicles with respect to total vehicles travelling in the area	Estimated
Public Transport Characteristics	Ticket price	Ticket price for monthly passes and single tickets	Publicly available
	Cost	Implementation and management costs for public transport operators	Estimated
	Network	Length of the network	Publicly available
	Average Speed	Average speed of the vehicles	Estimated
	Transport Service	Annual vehicle-kilometre	Estimated

Group	Input data	Description	Available/Estimated
	Offer		
	Bus Vehicle Fleet	Composition of the fleet, with respect to the fuel type	Publicly available
Park & Ride	Parking Capacity	Number of parking lots	Estimated
	Network Extension	Length of the public transport routes connected with P&R park	Estimated
	Public Transport Frequency	Frequency of Park & Ride connection service	Estimated
	Tariff	Tariff for single use or subscription related to parking only (the cost of using PT not considered)	Estimated
Infrastructure and Traffic Management	Paid Parking	Number of paid parking lots in the urban area	Estimated
	Parking Price	Average hourly parking price	Publicly available
	Public Transport Reserved Lane	Length of the public transport reserved lanes	Estimated
	Bike Lane	Length of the bike lanes in the urban area	Publicly available
	Electric Charging Stations	Number of electric charging stations	Publicly available
	Hydrogen Charging Station	Number of hydrogen filling stations	Publicly available
Car Sharing	Subscribers	Number of subscribers	Estimated
	Type	Station Based or Free-Floating service	Publicly available
	Tariff	Fixed and hourly average tariff	Publicly available
	Vehicle Fleet	Number of car sharing vehicles	Publicly available
Bike Sharing	Vehicle Fleet	Number of bicycles of the bike Sharing service	Publicly available
	Electric Fleet	Share of electric bicycles in the fleet	Publicly available
	Tariff	Fixed and hourly average tariff	Publicly available
Vehicle Access Regulation	Limited Traffic Zone	Qualitative quantification of the share of urban area under Limited Traffic Zone	Estimated
	Pedestrian Areas	Qualitative quantification of the share of urban area with pedestrian areas	Estimated
Traffic Calming Measures	Traffic Calming Area	Share of the urban area under 30 km/h speed limit	Estimated
Road vehicle fleet composition	Vehicle fleet	Vehicle fleet composition by fuel type and emission standard (for conventional fuels) for private cars, car sharing cars, Light Duty Vehicles and Heavy Goods Vehicles. It is assumed that national data can be used as representative data for vehicle fleet composition also at urban level.	Estimated

Source: Own elaboration

Preliminary Simulation: MUNICH

EMISSIONS OF CO₂ (TANK-TO-WHEEL), CAR OWNERSHIP, FATALITIES

Emissions of CO₂ (Tank-to-wheel) [t CO₂ eq / capita per year]

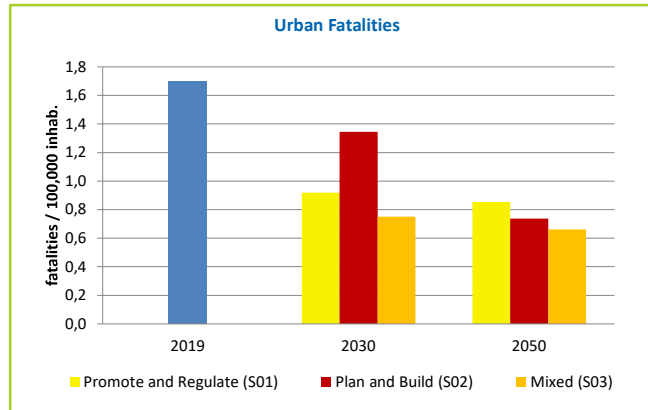
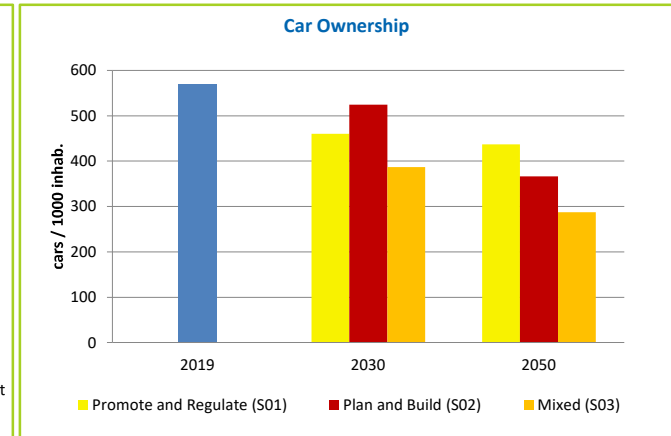
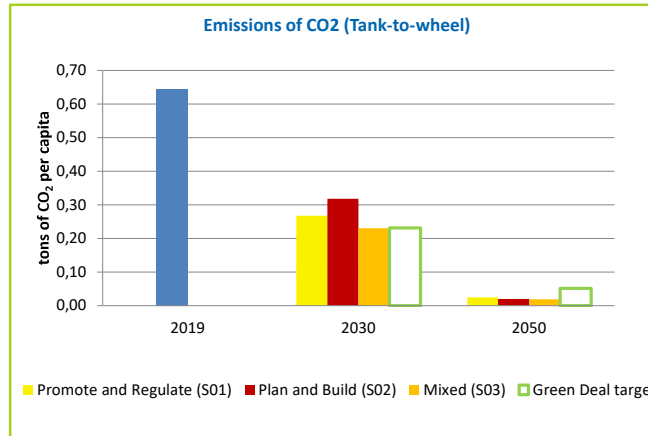
Scenario	2019	2030	2050
Promote and Regulate (S01)	0,643	0,267	0,025
Plan and Build (S02)	0,643	0,318	0,020
Mixed (S03)	0,643	0,230	0,019
Green Deal target		0,231	0,051

Car ownership level [cars / 1000 inhab.]

Scenario	2019	2030	2050
Promote and Regulate (S01)	569	460	437
Plan and Build (S02)	569	525	367
Mixed (S03)	569	387	288

Urban Fatalities [fatalities / 100,000 inhab.]

Scenario	2019	2030	2050
Promote and Regulate (S01)	1,699	0,919	0,854
Plan and Build (S02)	1,699	1,346	0,738
Mixed (S03)	1,699	0,751	0,661



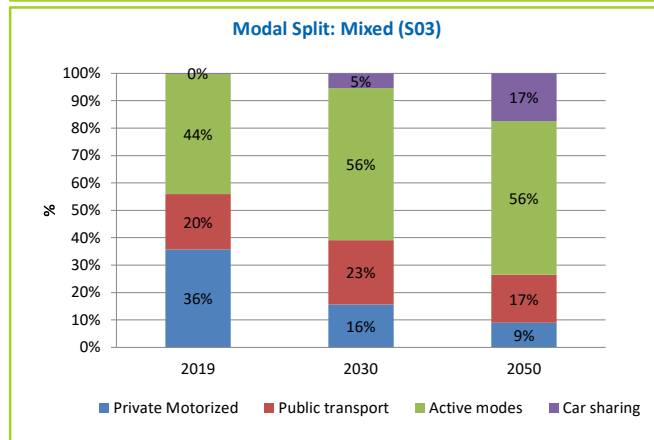
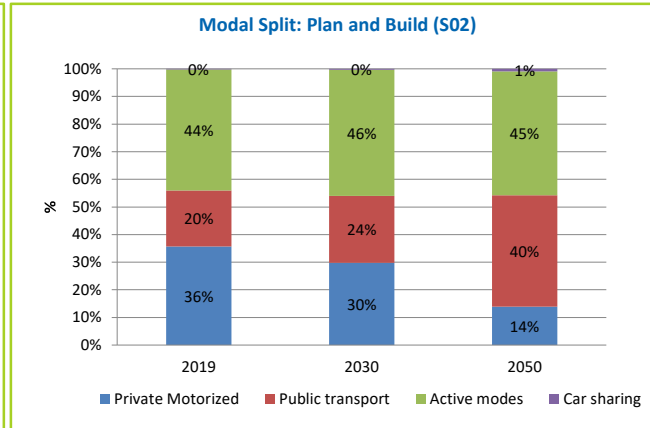
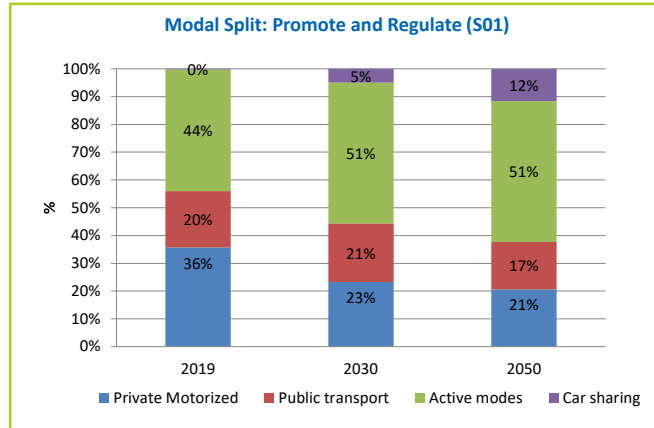
KEY INDICATORS

Preliminary Simulation: MUNICH

MODAL SPLIT

Aggregate mode split [%]

Scenario	Mode	2019	2030	2050
Promote and Regulate (S01)	Private Motorized	36%	23%	21%
Promote and Regulate (S01)	Public transport	20%	21%	17%
Promote and Regulate (S01)	Active modes	44%	51%	51%
Promote and Regulate (S01)	Car sharing	0%	5%	12%
Plan and Build (S02)	Private Motorized	36%	30%	14%
Plan and Build (S02)	Public transport	20%	24%	40%
Plan and Build (S02)	Active modes	44%	46%	45%
Plan and Build (S02)	Car sharing	0%	0%	1%
Mixed (S03)	Private Motorized	36%	16%	9%
Mixed (S03)	Public transport	20%	23%	17%
Mixed (S03)	Active modes	44%	56%	56%
Mixed (S03)	Car sharing	0%	5%	17%



KEY INDICATORS

Preliminary Simulation: MUNICH

ECONOMIC OUTPUTS (discounted, cumulated from 2019)*

City total revenues [mio euro]

Scenario	2019	2030	2050
Promote and Regulate (S01)	0	713	3.103
Plan and Build (S02)	0	302	2.443
Mixed (S03)	0	994	4.162

City total costs [mio euro]

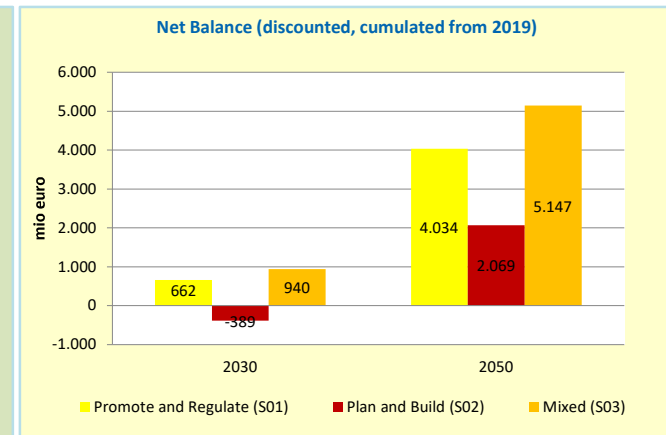
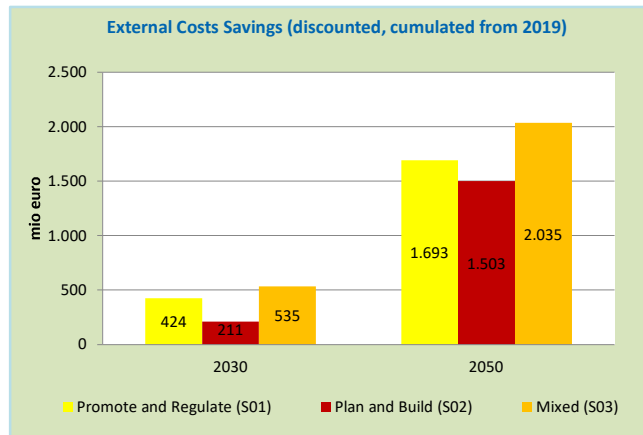
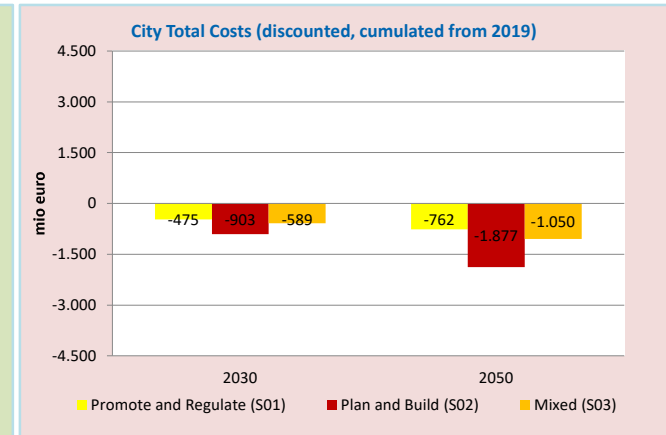
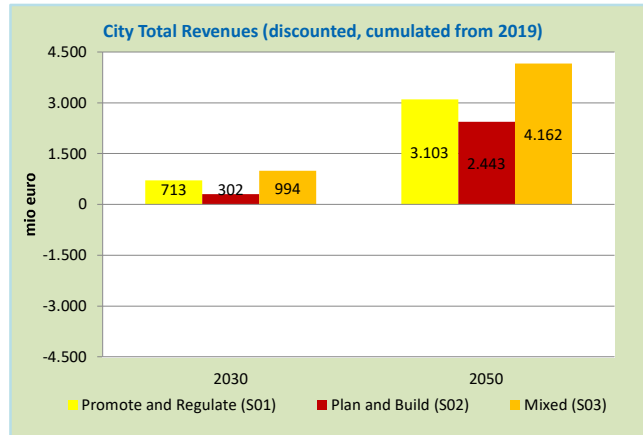
Scenario	2019	2030	2050
Promote and Regulate (S01)	0	475	762
Plan and Build (S02)	0	903	1.877
Mixed (S03)	0	589	1.050

External costs savings [mio euro]

Scenario	2019	2030	2050
Promote and Regulate (S01)	0	424	1.693
Plan and Build (S02)	0	211	1.503
Mixed (S03)	0	535	2.035

Net balance [mio euro]

Scenario	2019	2030	2050
Promote and Regulate (S01)	0	662	4.034
Plan and Build (S02)	0	-389	2.069
Mixed (S03)	0	940	5.147



* Costs and Revenues are the incremental ones associated with the implemented policies and with respect to the BAU (in which no policy measures are activated)

KEY INDICATORS

Preliminary Simulation: MUNICH

ECONOMIC OUTPUTS PER CAPITA (discounted, cumulated from 2019)*

City total revenues [euro / capita]

Scenario	2019	2030	2050
Promote and Regulate (S01)	0	457	1.989
Plan and Build (S02)	0	194	1.566
Mixed (S03)	0	637	2.668

City total costs [euro / capita]

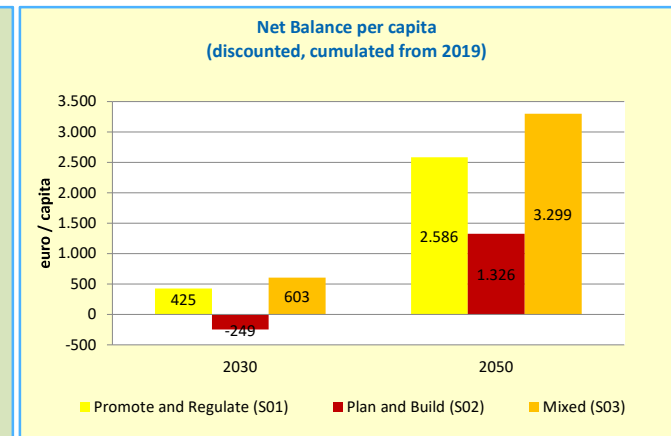
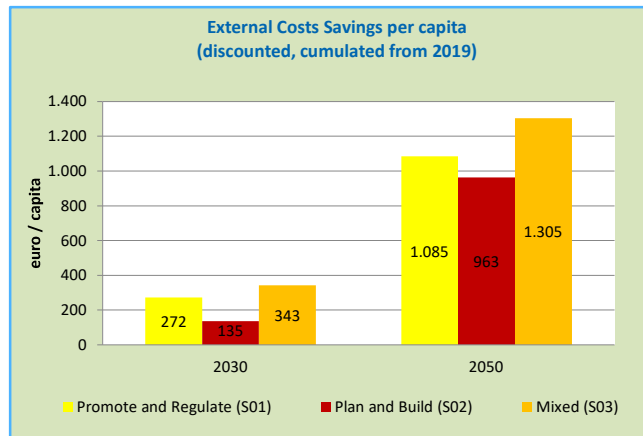
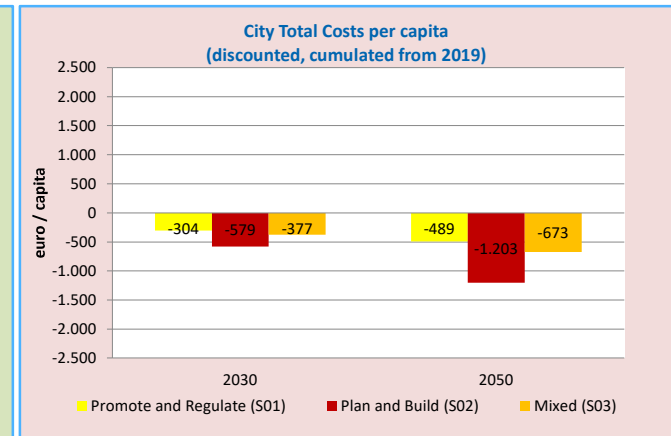
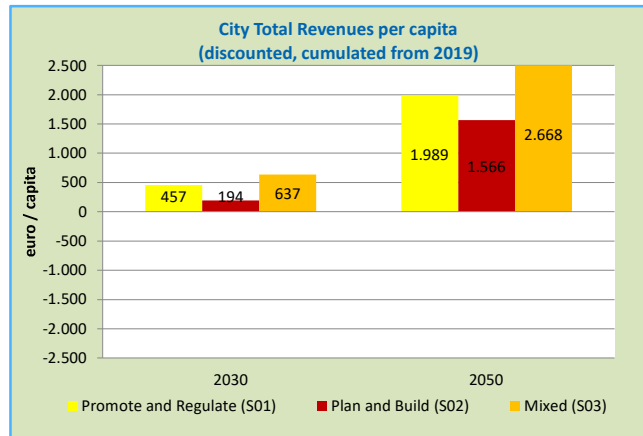
Scenario	2019	2030	2050
Promote and Regulate (S01)	0	304	489
Plan and Build (S02)	0	579	1.203
Mixed (S03)	0	377	673

External costs savings [euro / capita]

Scenario	2019	2030	2050
Promote and Regulate (S01)	0	272	1.085
Plan and Build (S02)	0	135	963
Mixed (S03)	0	343	1.305

Net balance [euro / capita]

Scenario	2019	2030	2050
Promote and Regulate (S01)	0	425	2.586
Plan and Build (S02)	0	-249	1.326
Mixed (S03)	0	603	3.299



* Costs and Revenues are the incremental ones associated with the implemented policies and with respect to the BAU (in which no policy measures are activated)

KEY INDICATORS