



Paris 2050

Paris Climate Action Scenarios Workshop

Prepared by Vivid Economics

Objectives

Workshop

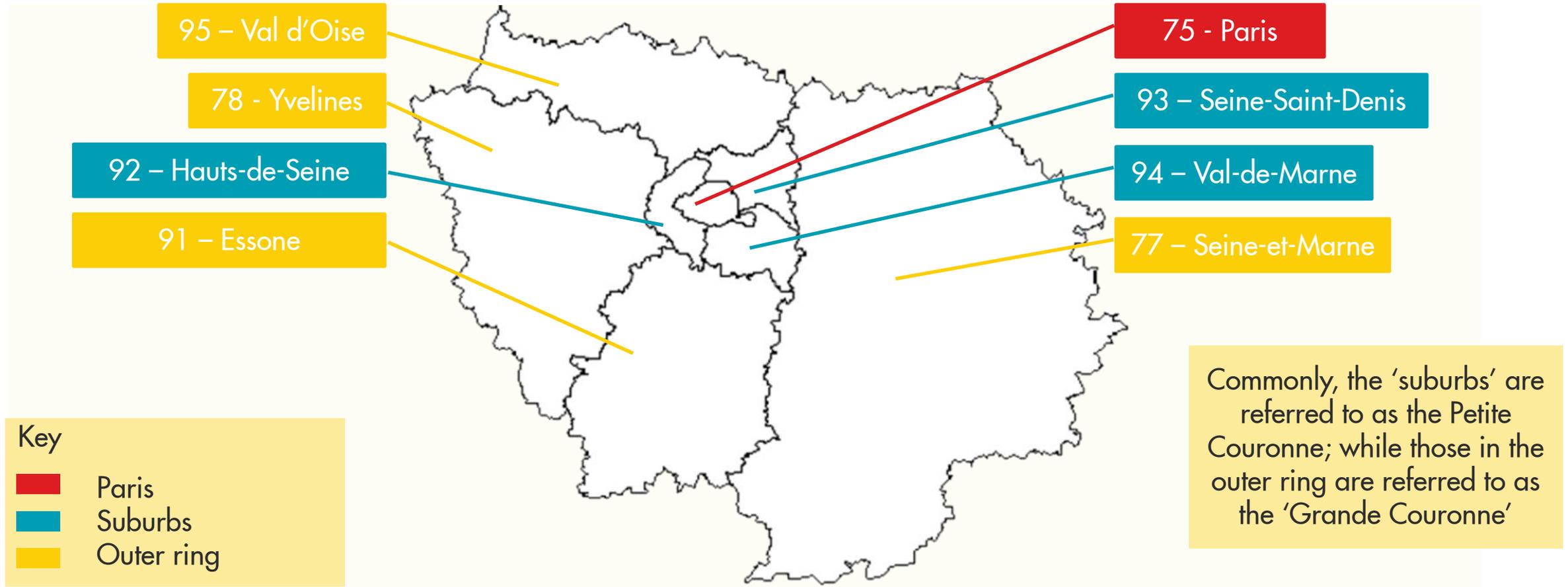
To develop a set of scenarios for Île-de-France in 2050, exploring critical drivers of change and how these may influence the goals to achieve the targets set out in the Climate Action Plan.

Session

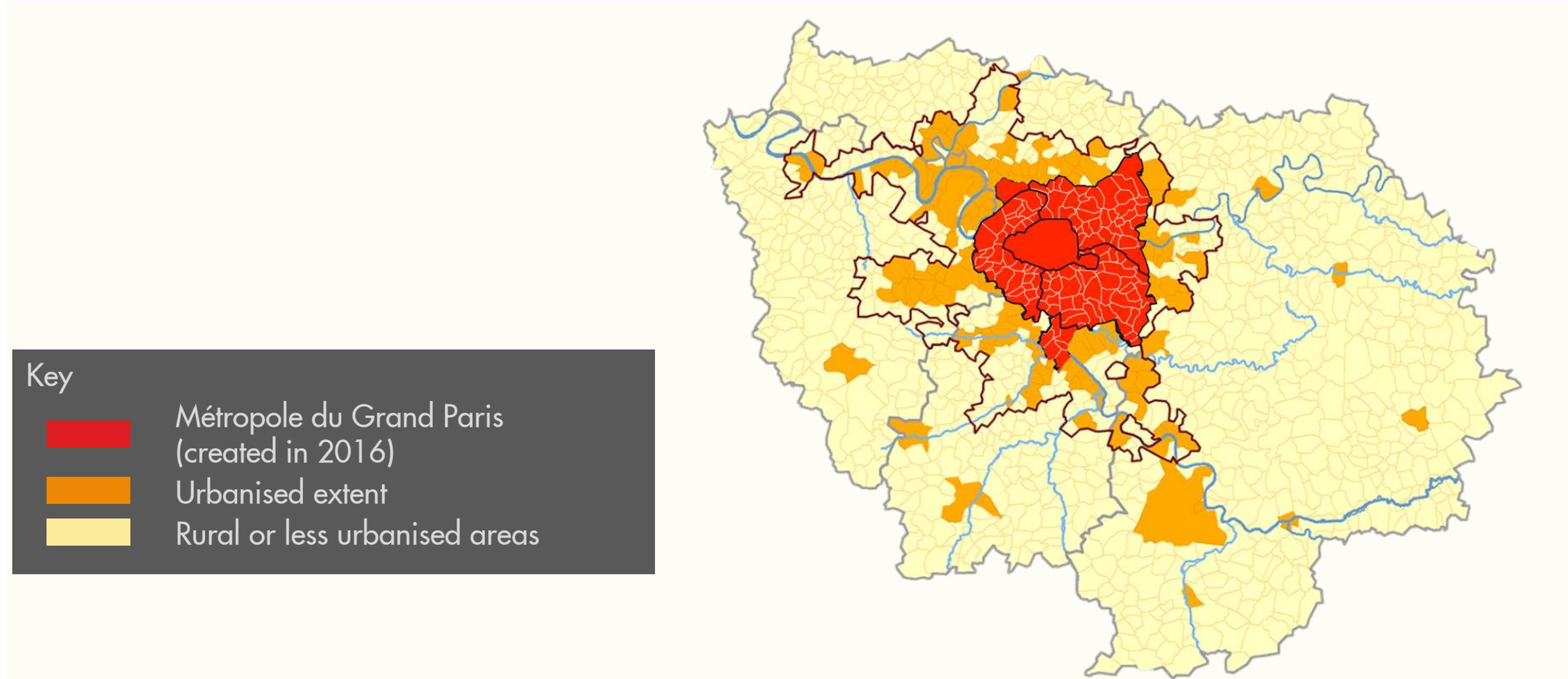
To understand:

- current social, economic and infrastructure conditions;
- the progress Paris has made over the last decade in dealing with the pressures of urbanisation;
- and the challenges it faces going ahead.

The Île de France region and its component departments



The new administrative echelon in the region reflects the reality of urbanization



Societal trends:

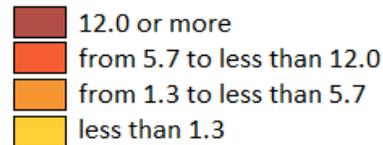
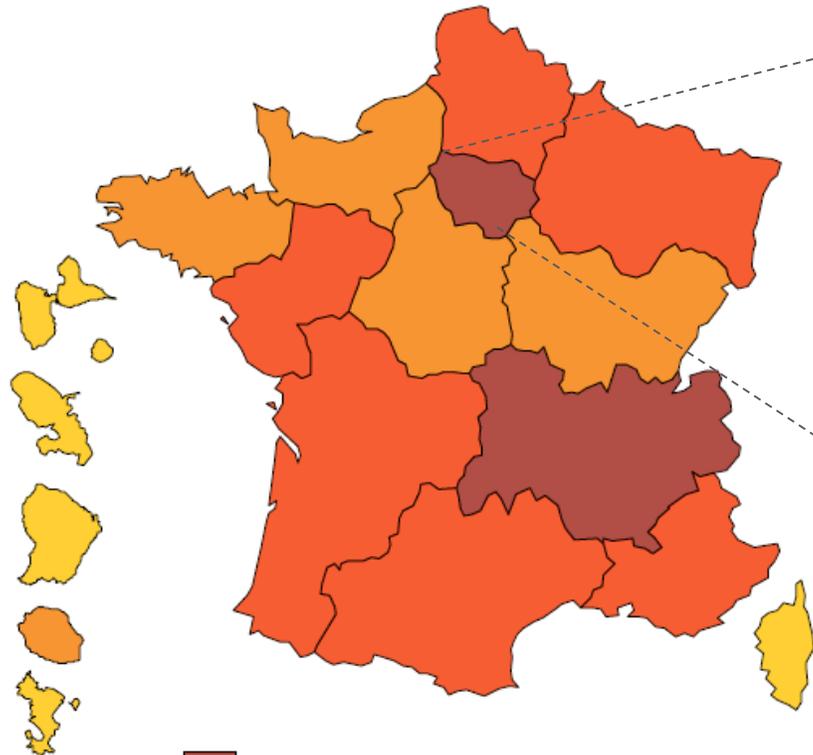


Demographics and labour market

2.1

Île-de-France is the most densely populated region in France, with the suburbs in line with major European cities

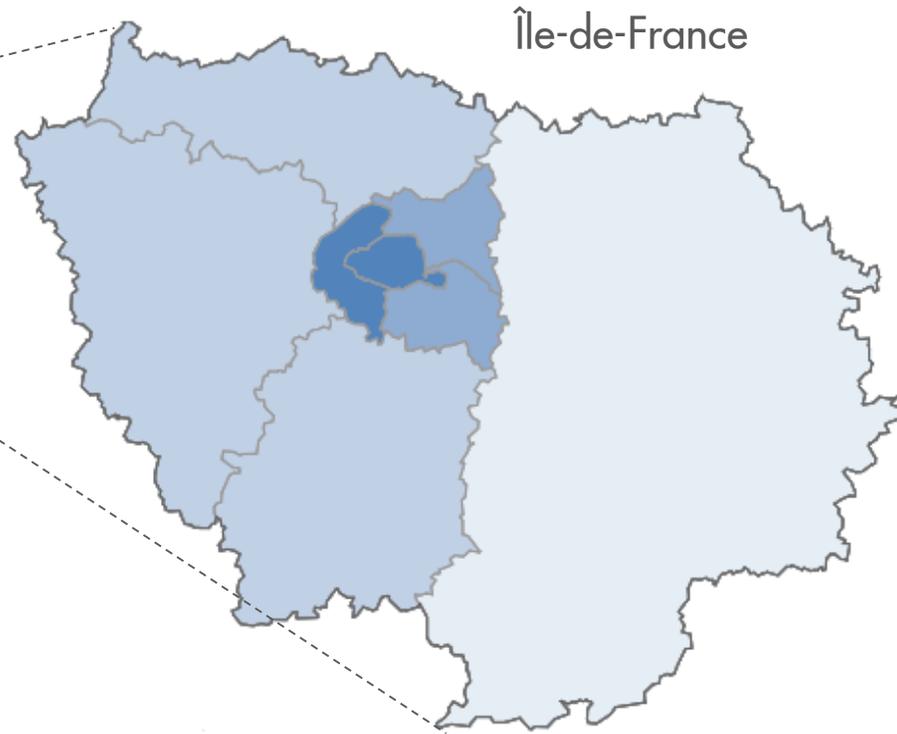
Share of the population of 2019 in France (in %)



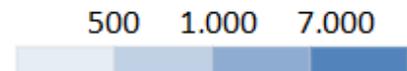
Source: INSEE (2016)

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Density of population (ppl per km², 2016)



Île-de-France



Population density in London varies between roughly 2,000 and 16,000 ppl per km² across boroughs

Department	Density (ppl per km ²)
Seine-et-Marne (77)	236
Yvelines (78)	627
Essonne (91)	713
Val-d'Oise (95)	981
Val-de-Marne (94)	5,624
Seine-Saint-Denis (93)	6,802
Hauts-de-Seine (92)	9,130
Paris (75)	20,781
Île-de-France	1,009
Inner London	11,352
Madrid	9,383
Berlin	5,615
Palermo	6,212

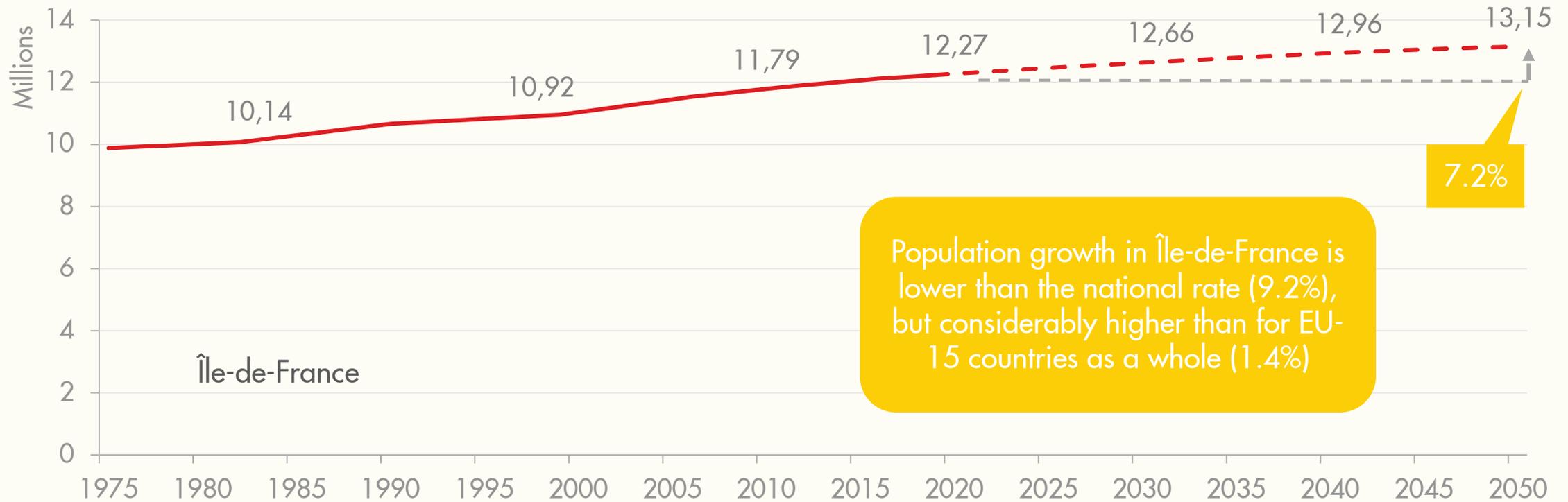
Source: INSEE and Mayor of London

September 2019

The regional population is expected to grow by 7.2% in the next 30 years, relative to just 1.4% across the EU-15



Though average annual growth is expected to fall from 0.49% (1990-2019) to 0.24% (2020-2050)



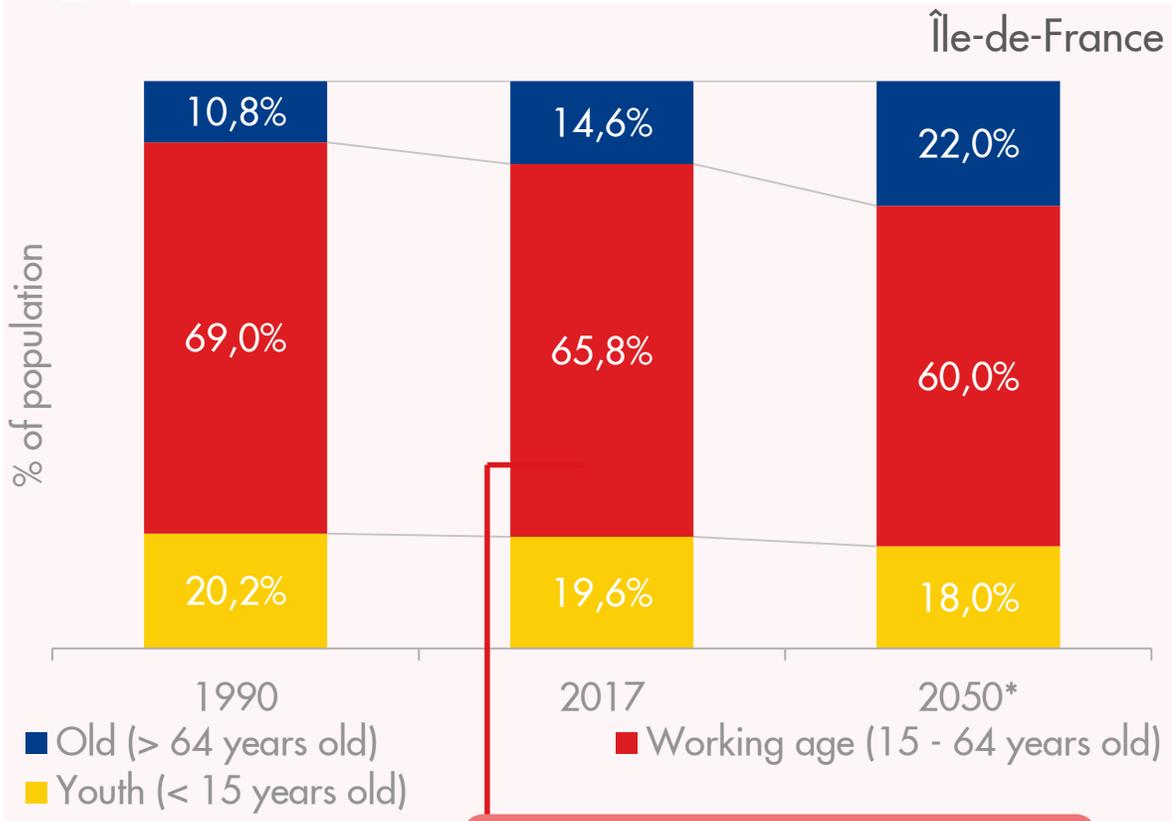
Population growth in Île-de-France is lower than the national rate (9.2%), but considerably higher than for EU-15 countries as a whole (1.4%)

Source: INSEE

Île-de-France's population is ageing, placing a greater burden on health and social services



The working age population share will fall from 66% to 60% by 2050



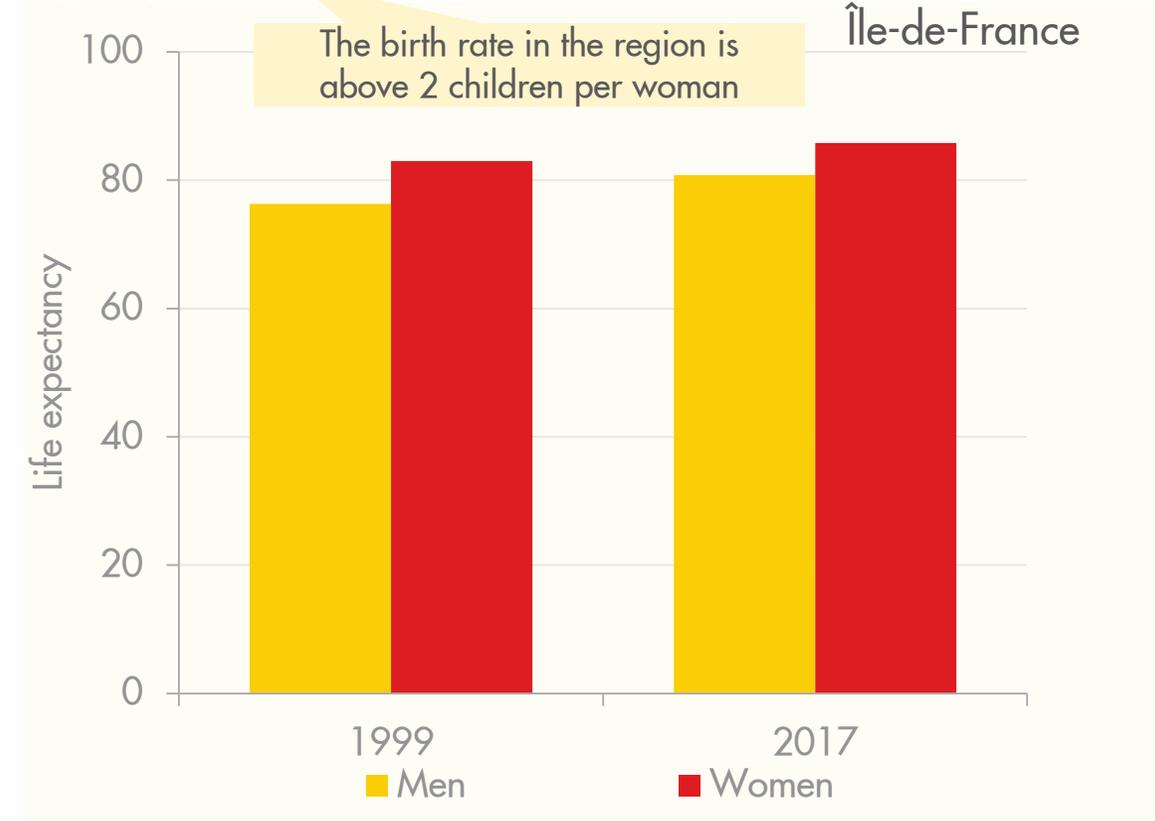
France (62%), London (66.3%), Madrid (67.3%), Berlin (66.5%)

Source: OECD & INSEE
 * Projected

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This is mostly driven by increasing life expectancy

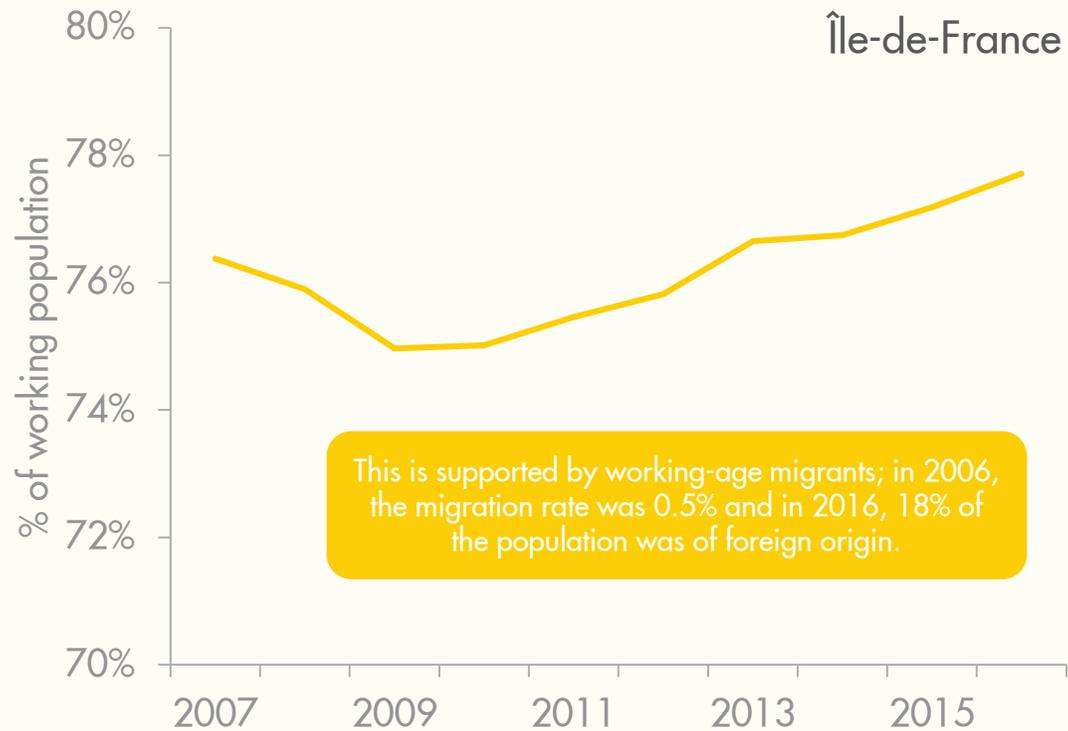


Source: INSEE

Though among the working age population, more people are economically active and employed



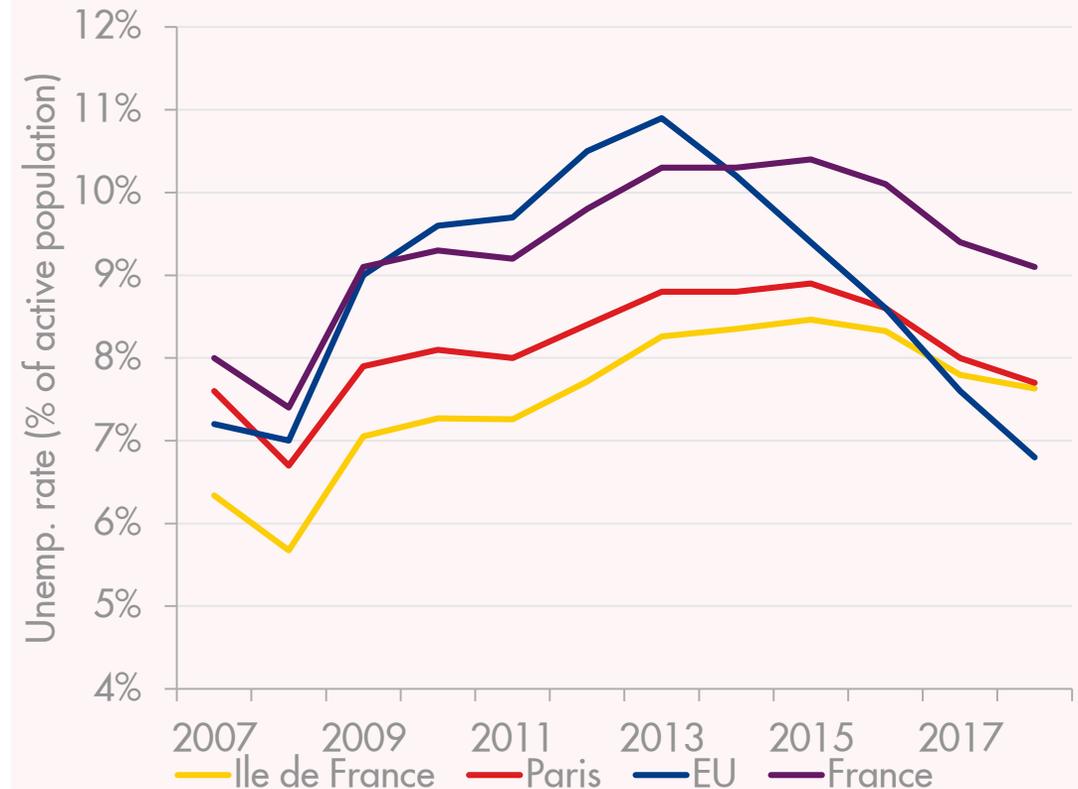
The labour force participation rate is on the rise



Source: INSEE



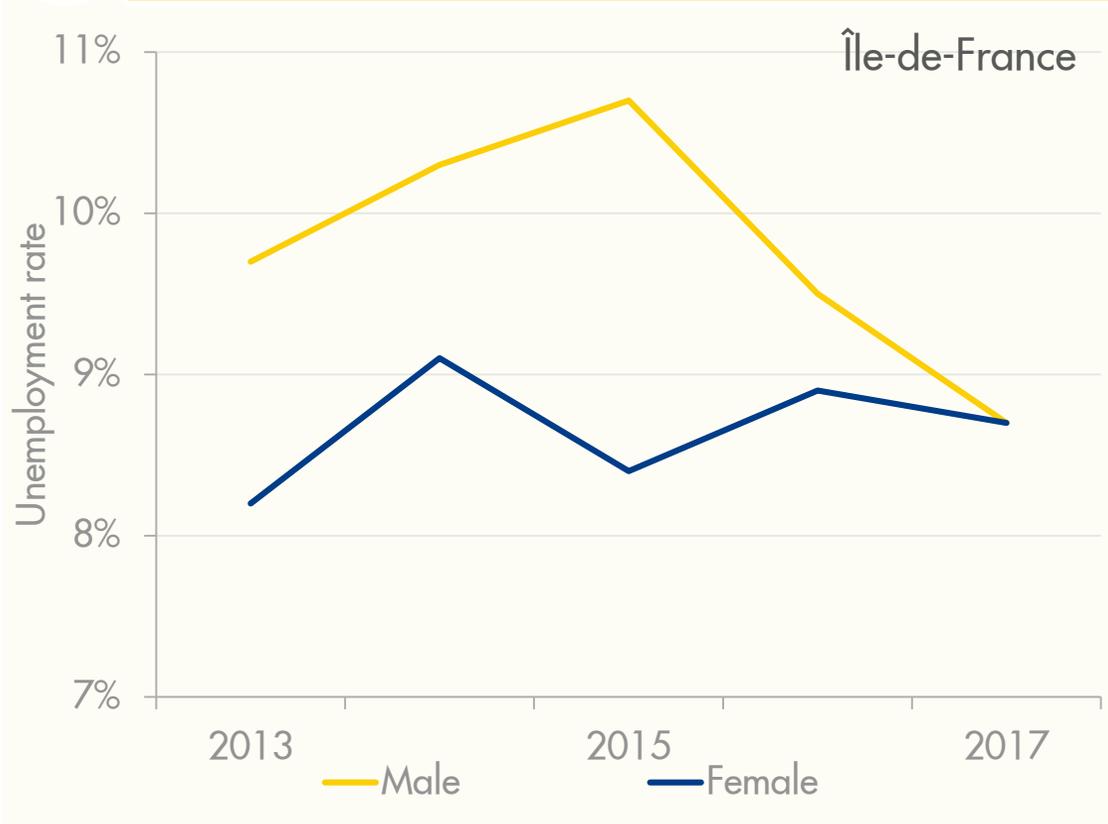
Unemployment continues to improve and remains below the national rate



Source: INSEE & Eurostat

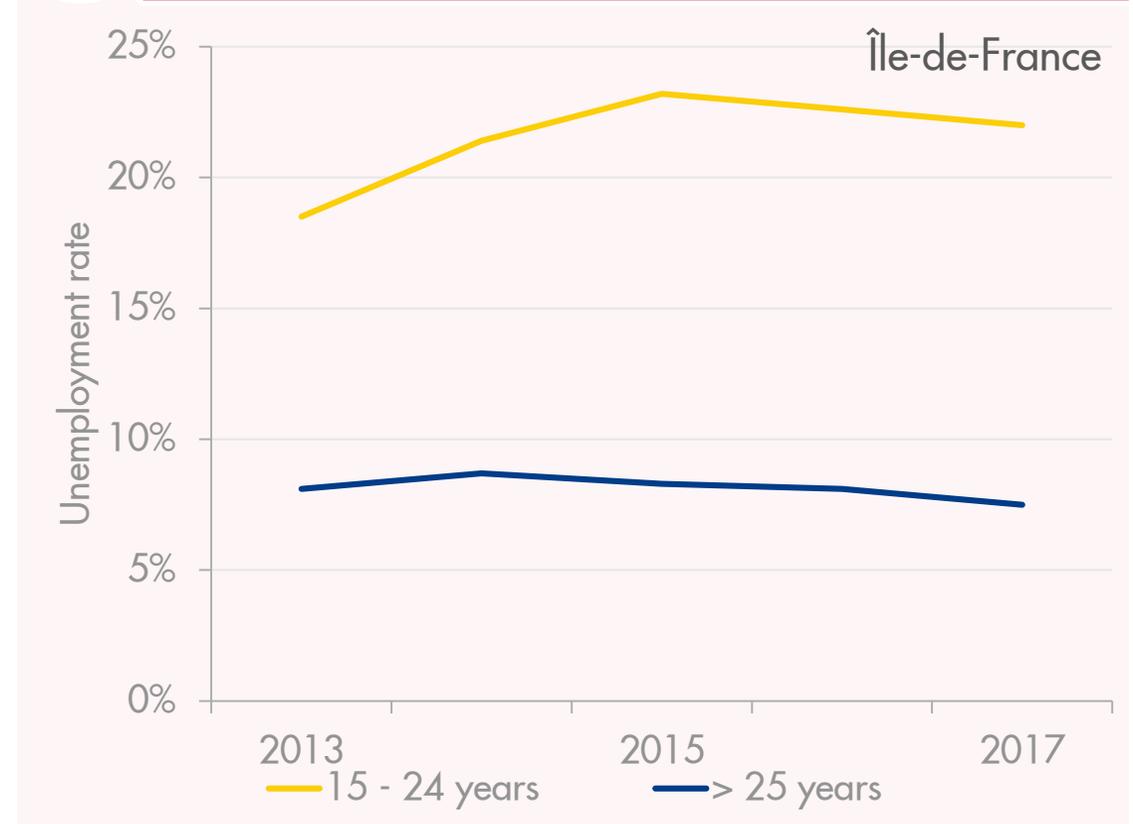
The gender employment gap has narrowed, but youth unemployment has become worse

 Unemployment rates have converged for both men and women around 8.5%



Source: INSEE

 Youth unemployment remains over double the regional average

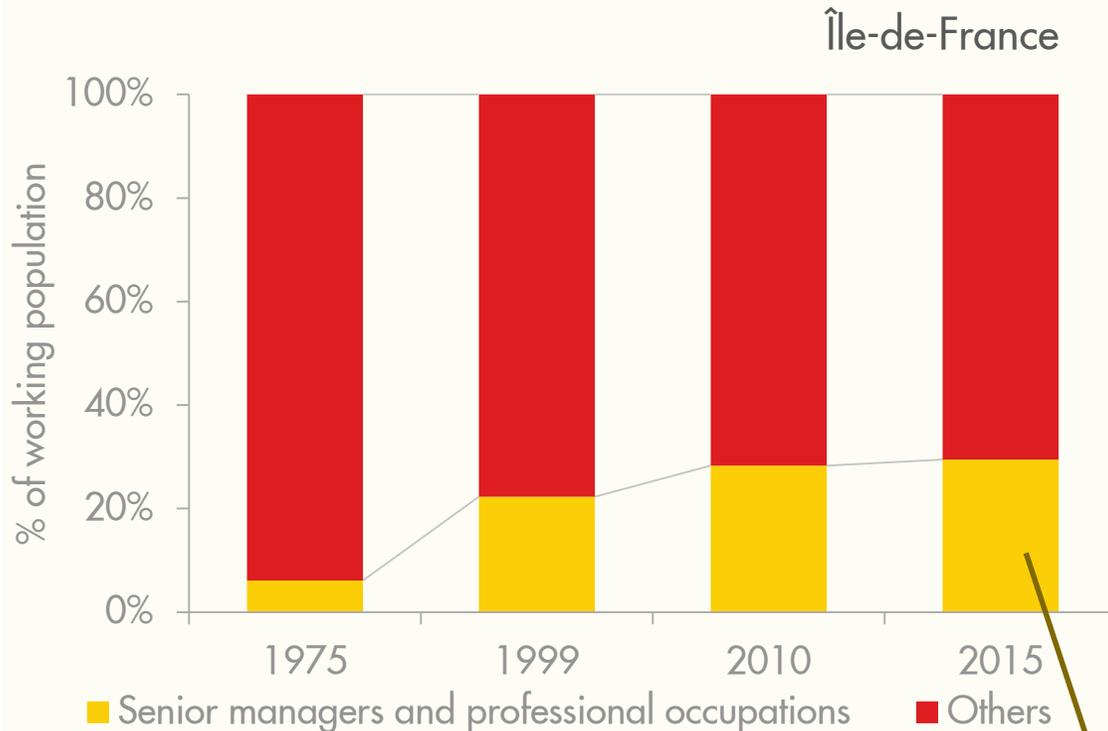


Source: INSEE

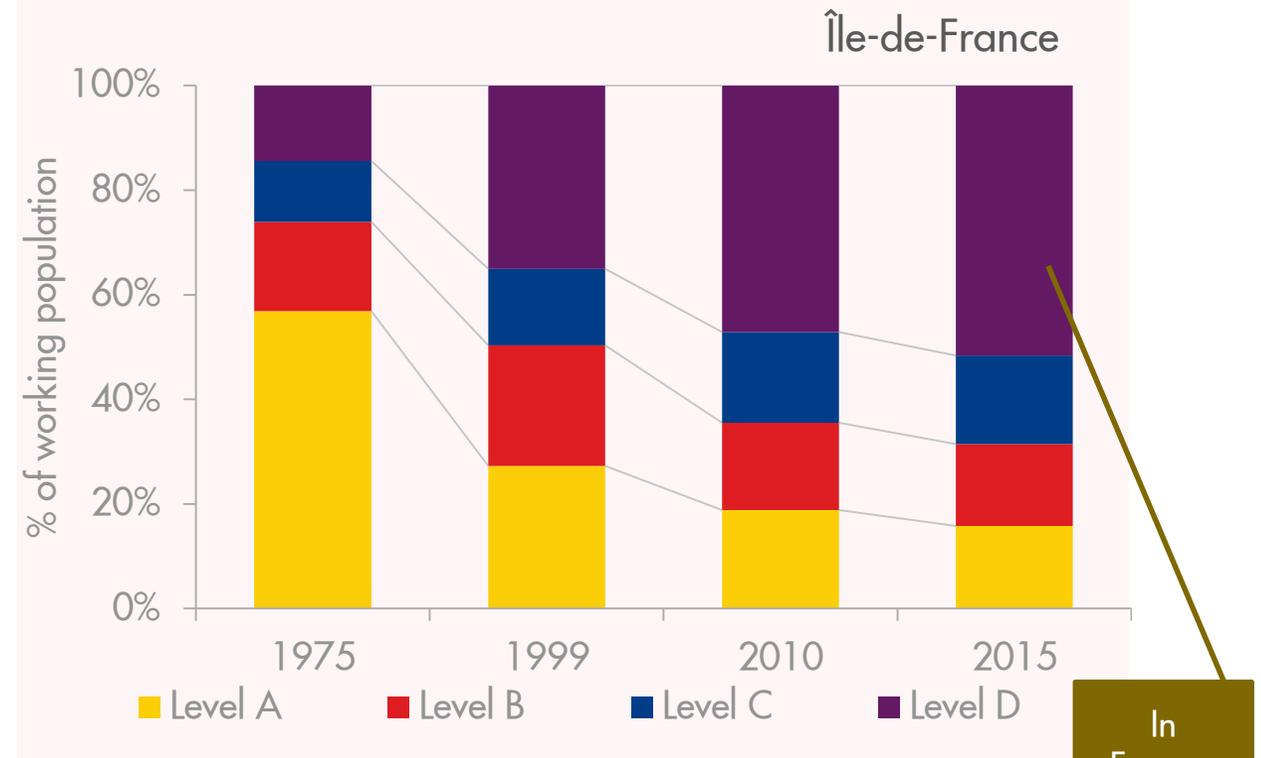
Île-de-France's workforce is also becoming better educated and shifting towards professional occupations



Nearly 30% of workers occupy senior management or professional positions



Around half the working population is university-educated



Note: Other occupations involve agriculture, artisans, traders, business leaders, employees, and ouvriers

Source: INSEE
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In France: 18%

Level A: Left school before 16 years old
Level B: Left school at 16 years old
Level C: Finish studies at 18 year old
Level D: Complete higher education

In France: 34%

Societal trends:



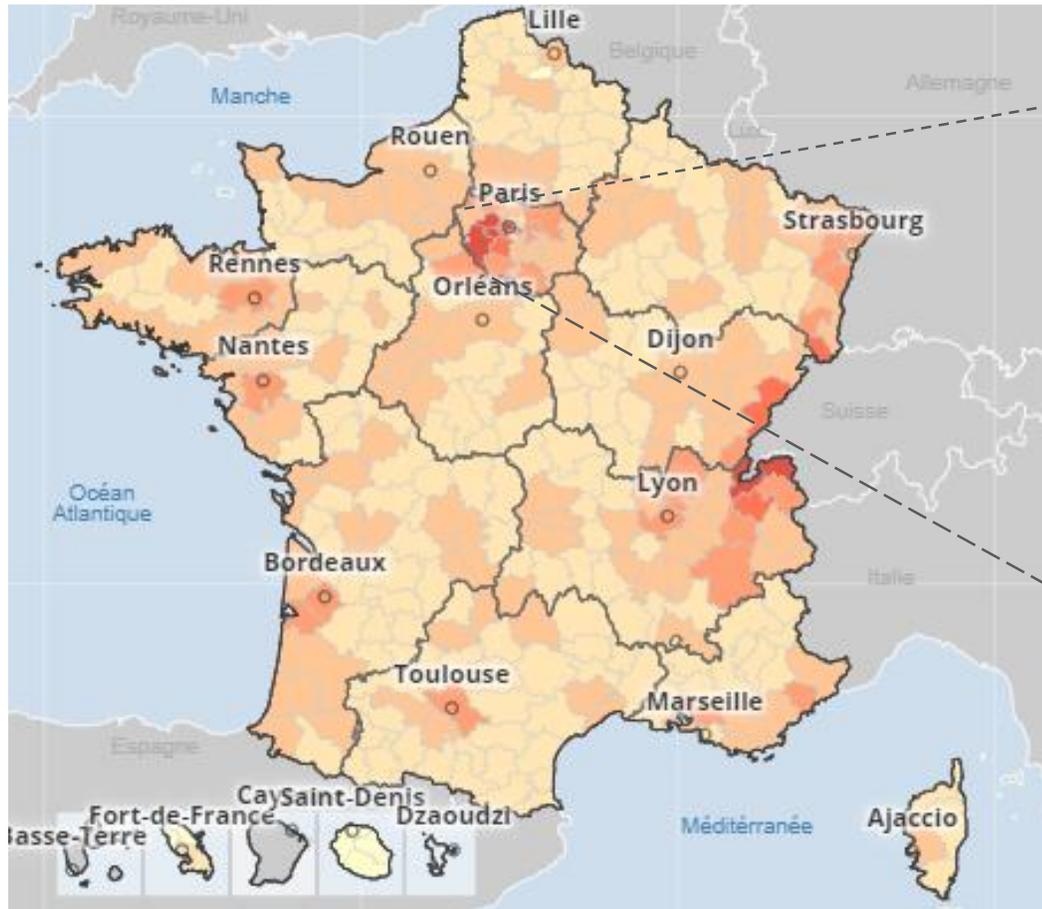
Income, inequality and affordability

2.2

Île-de-France is the richest region nationally

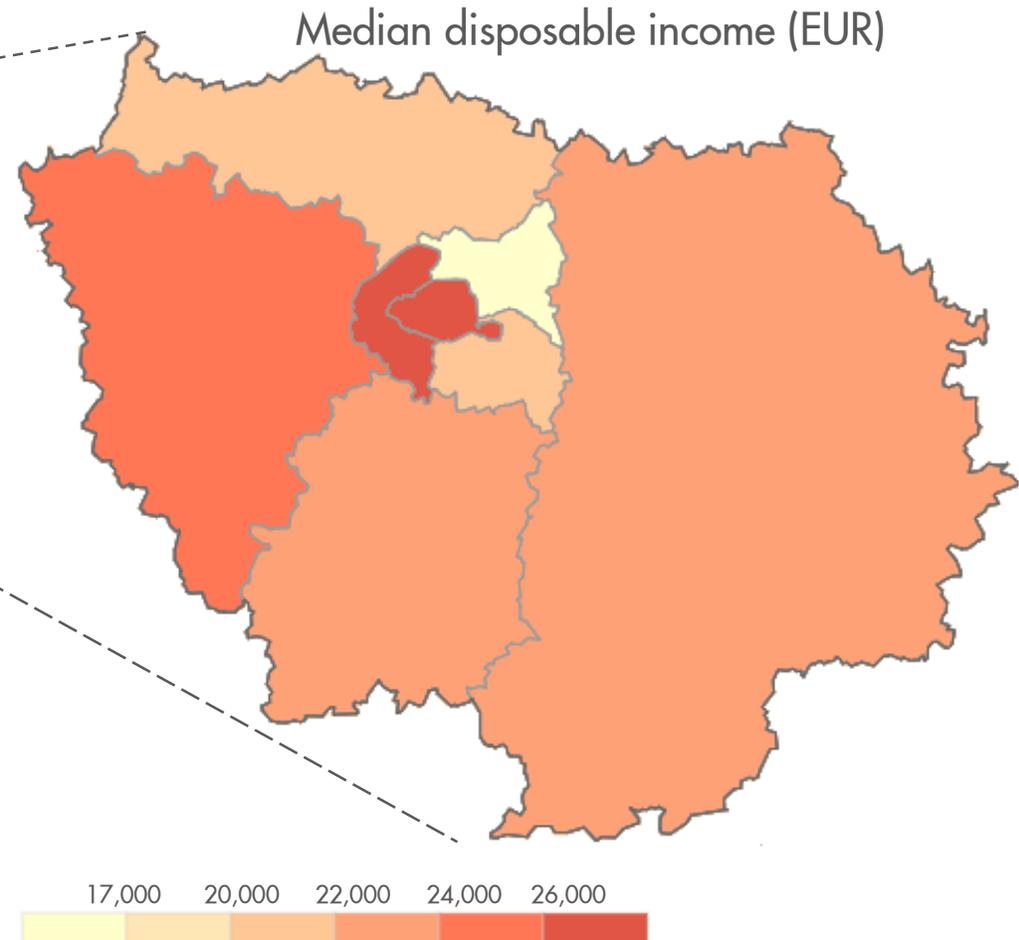


Median disposable income rarely falls below EUR 20,000 across the region, exceeding most of the country



Source: INSEE (2016)

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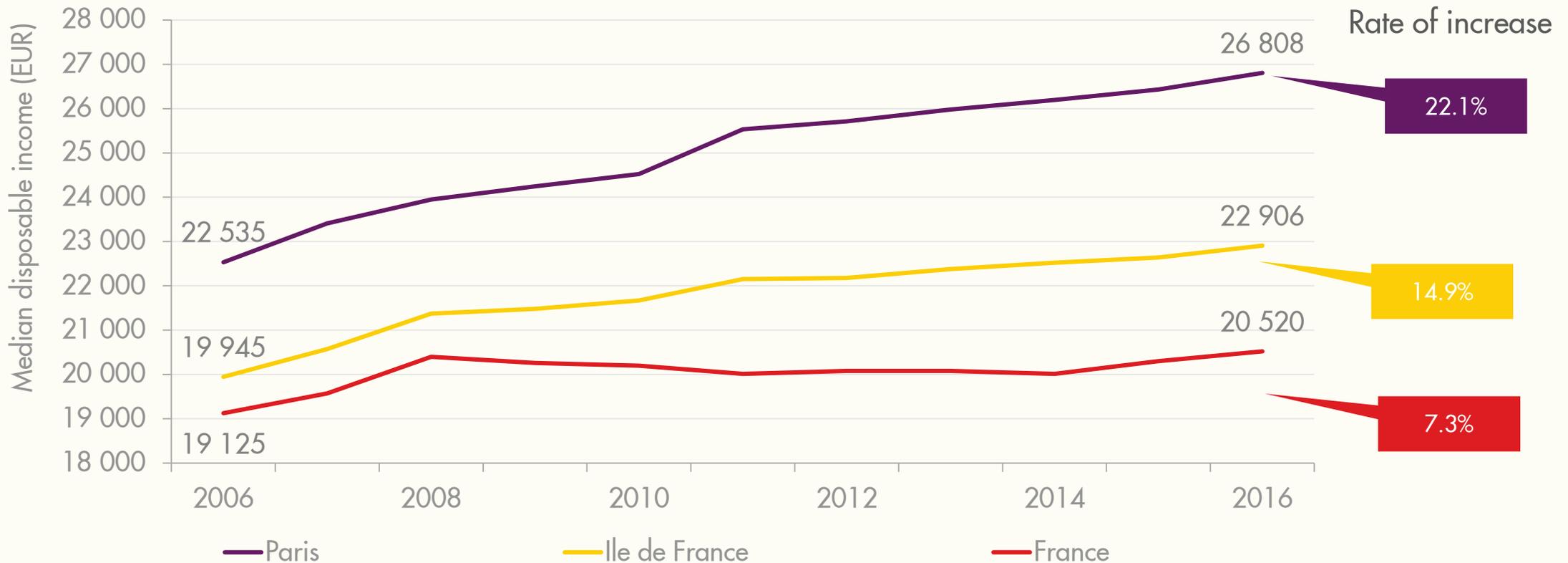


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Income growth outstrips the rest of France, and is highest in Paris



Income in Île-de-France and Paris is growing 2x and 3x the national rate



Source: INSEE

* Disposable income of households per number of consumption units. It includes working income, wealth income, transfers and social benefits, net of taxes.

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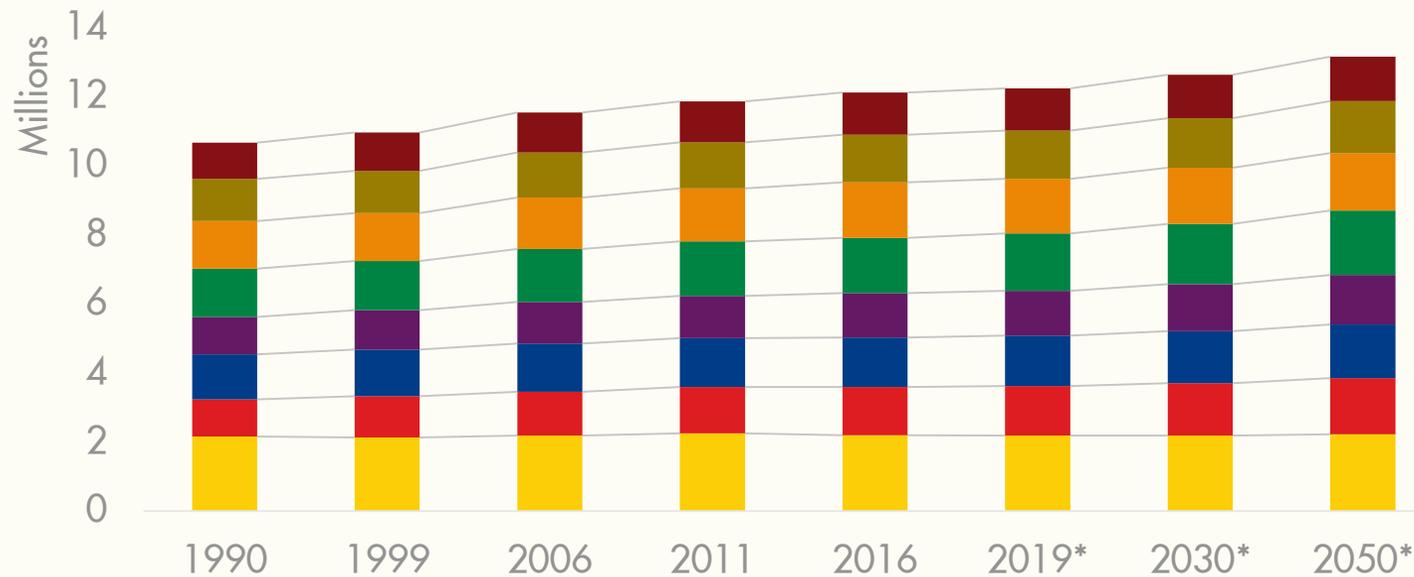
September 2019

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The suburbs and outer ring are driving regional population growth, while the population of Paris is stagnating



The annual growth rate has decreased from 5.5% (2006-2011) to 4.5% (2011-2019)



- The regional population share of Paris has fallen from 23% in 1990 to 18% in 2019 and is expected to fall to 17% by 2050
- Most of this is displaced by growth in the outer ring, increasing from 36% in 1990 to 44% in 2019 and 45% in 2050

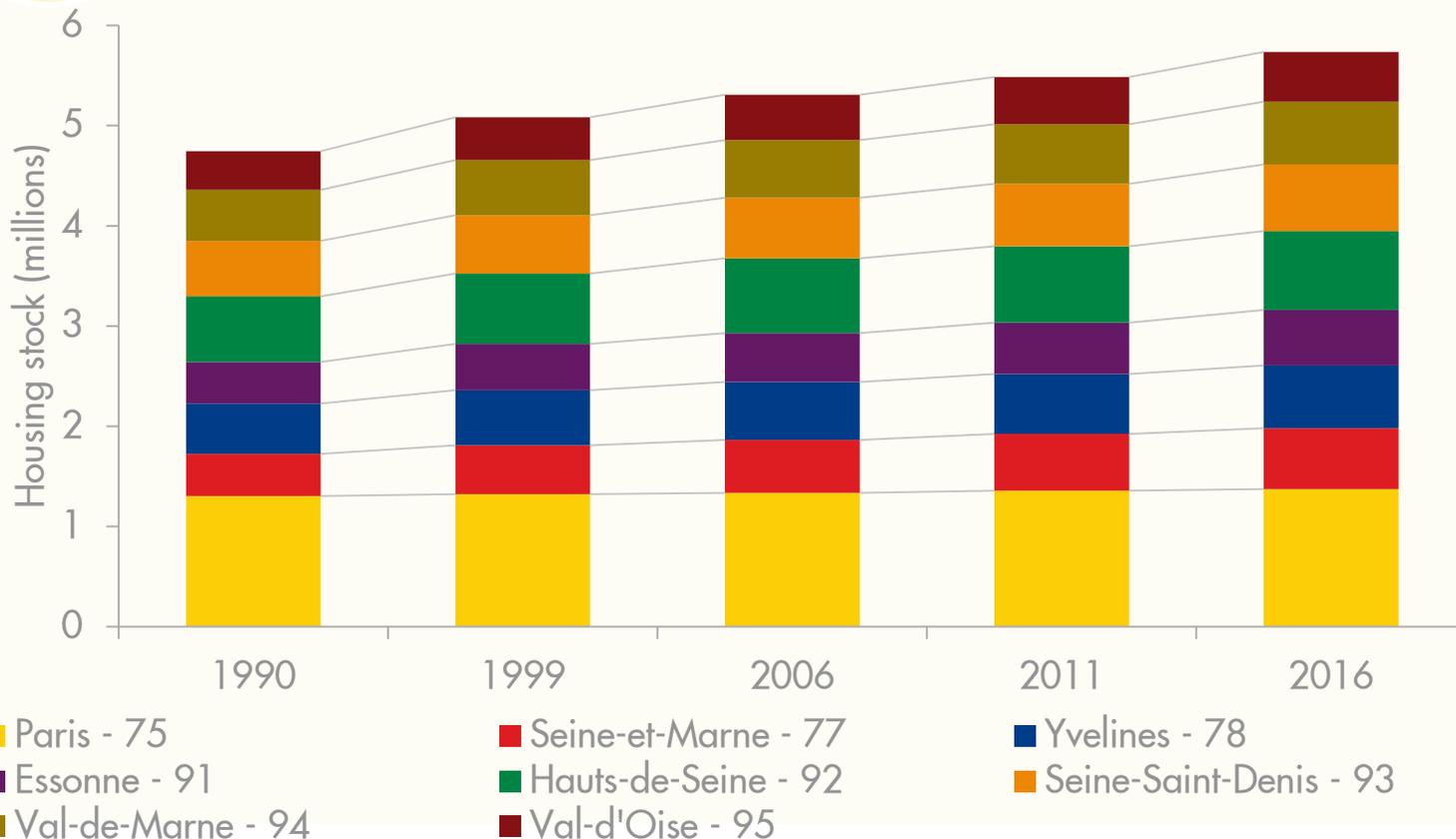
■ Paris - 75 ■ Seine-et-Marne - 77 ■ Yvelines - 78
■ Essonne - 91 ■ Hauts-de-Seine - 92 ■ Seine-Saint-Denis - 93
■ Val-de-Marne - 94 ■ Val-d'Oise - 95

Source: INSEE
Suburbs involve departments 92, 93 and 94

This mirrors growth in the housing stock, which has focused on the suburbs and especially the outer ring



Housing in the suburbs and outer ring has grown by over 900,000 units since 1990, compared to just 70,000 in Paris



The housing stock is keeping pace with population growth in the suburbs, and exceeding it in the outer ring. 70% of housing stock growth in the region is due to the private sector.

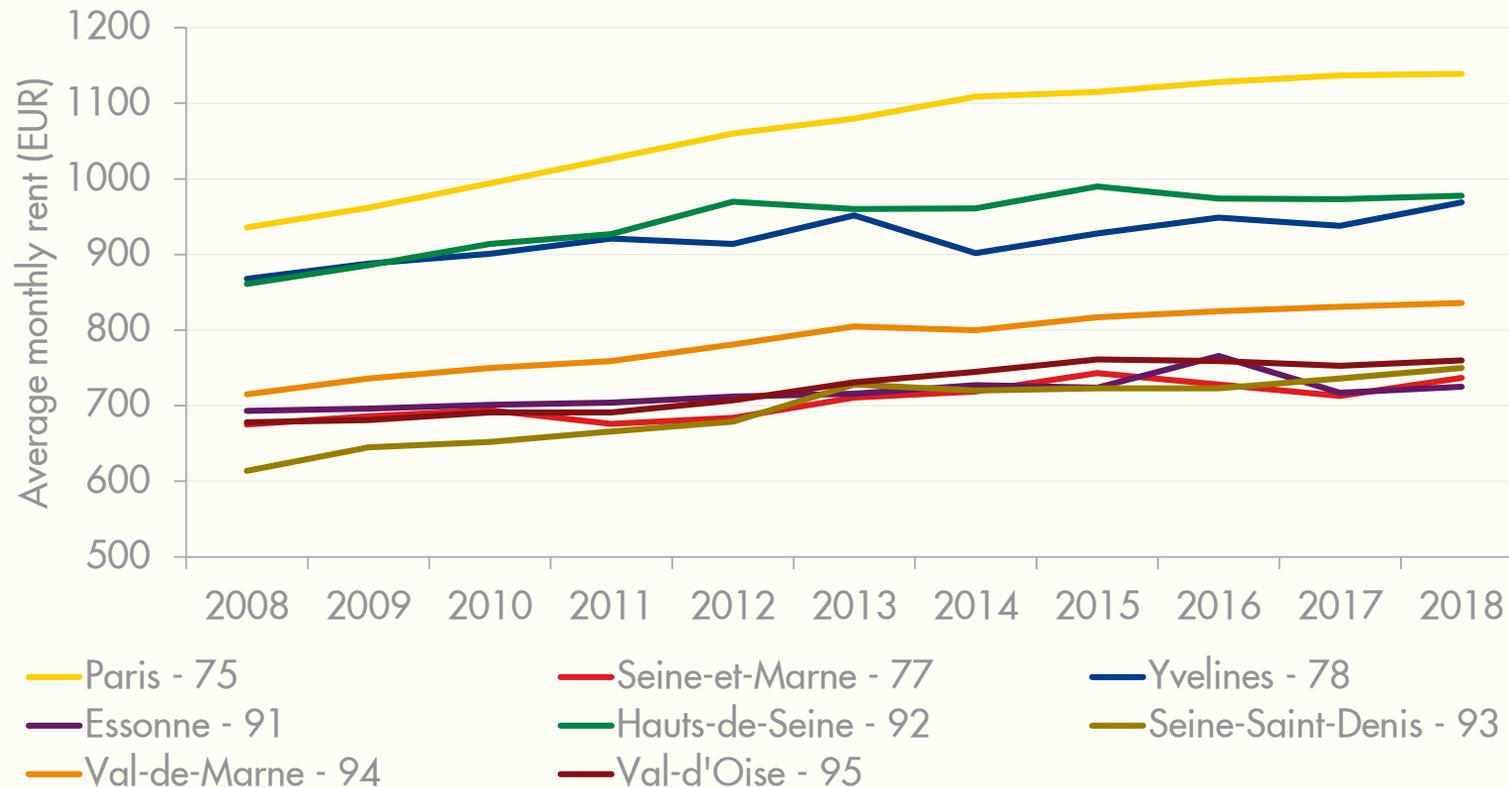
2006 - 2016 (%)	Population	Housing
Paris	0.4%	3.0%
Suburbs	6.0%	7.8%
Outer ring	6.3%	15.2%
Île-de-France	5.1%	8.0%

Source: OLAP, APUR

This is driving property prices up fastest in Paris, followed by the suburbs and then the outer ring



Paris' rental prices are more than 50% higher than in some regional departments



Department	Average monthly rent (€)	Average unitary rent (€/m ²)
Paris (75)	1139	22.9
Seine-et-Marne (77)	737	12.9
Yvelines (78)	969	15.5
Essonne (91)	725	12.7
Hauts-de-Seine (92)	978	18.6
Seine-Saint-Denis (93)	750	14.7
Val-de-Marne (94)	836	15.9
Val-d'Oise (95)	760	12.9
Île-de-France	935	17.4

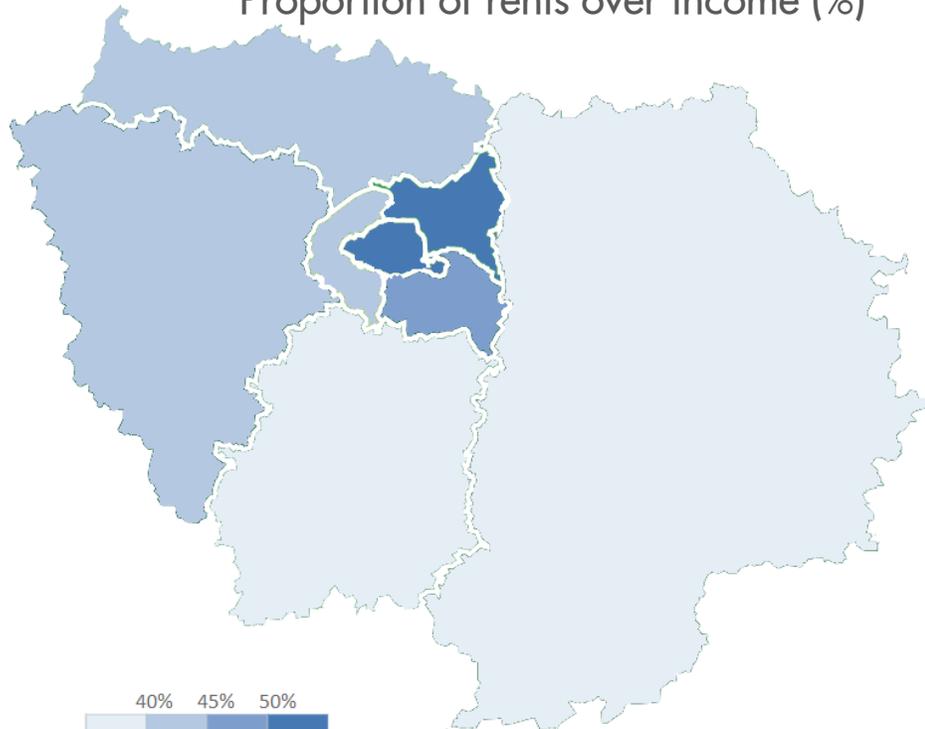
Source: OLAP

When considering income, house price affordability is a clear issue for households in Paris and the suburbs



These departments spend a considerably higher proportion of their disposable income on property than in other departments in the region

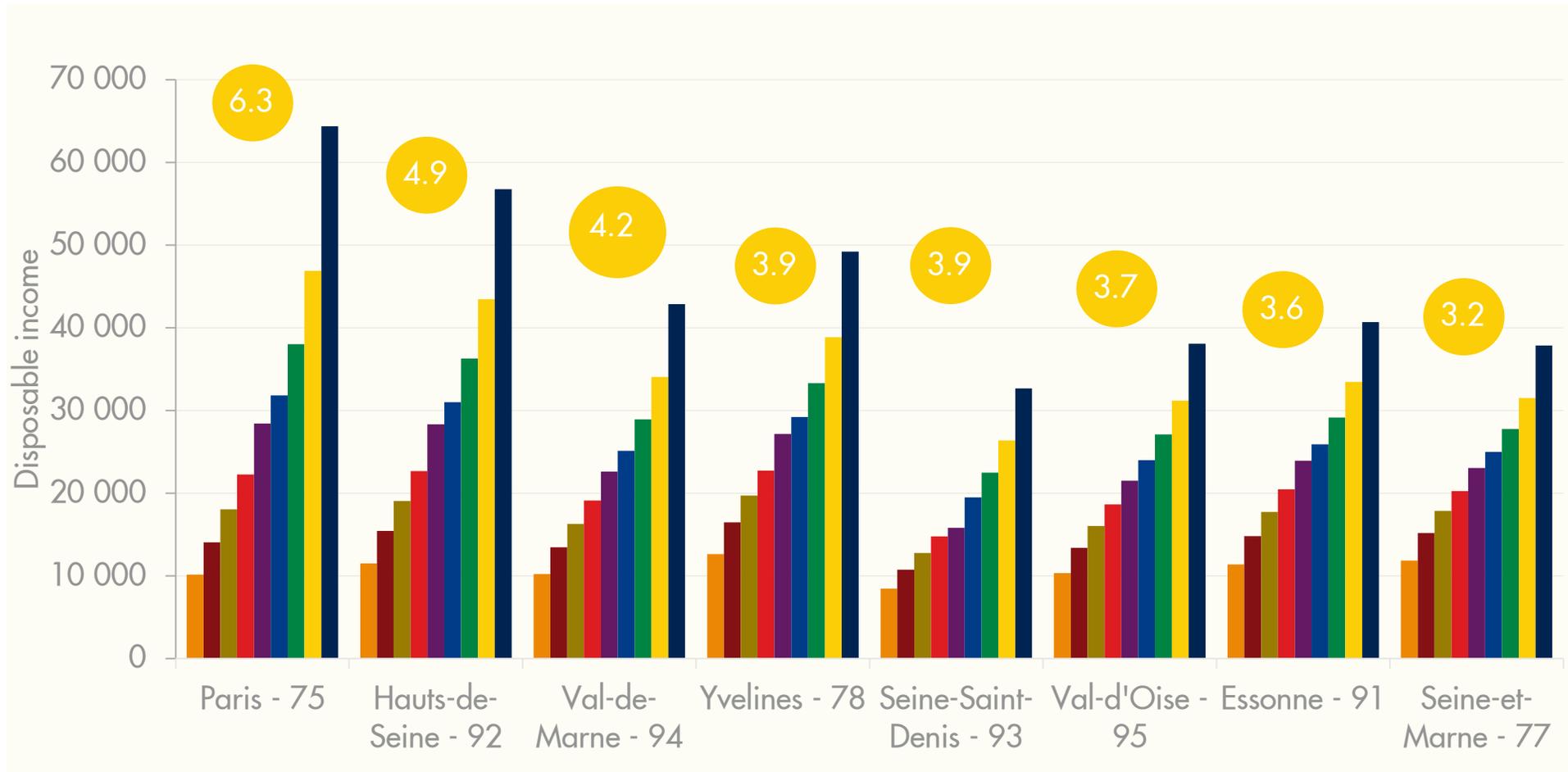
Proportion of rents over income (%)



Department	Average monthly rent (€)	Rent / income*	Average unitary rent (€/m ²)
Paris (75)	1139	50.5%	22.9
Seine-et-Marne (77)	737	38.7%	12.9
Yvelines (78)	969	44.1%	15.5
Essonne (91)	725	39.7%	12.7
Hauts-de-Seine (92)	978	44.0%	18.6
Seine-Saint-Denis (93)	750	51.0%	14.7
Val-de-Marne (94)	836	45.1%	15.9
Val-d'Oise (95)	760	42.8%	12.9
Île-de-France	935		17.4

*Rents as a proportion of income used annual disposable income

This strongly correlates with income inequality *within* each department



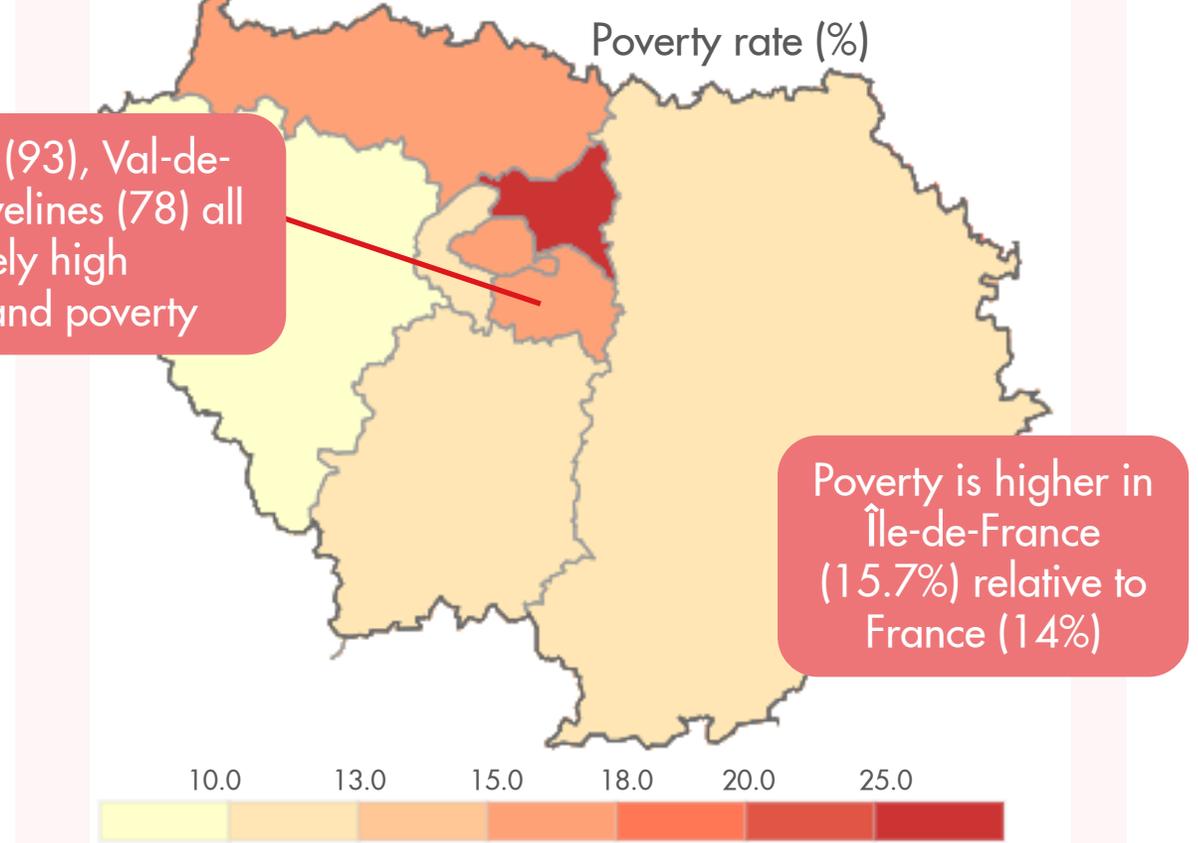
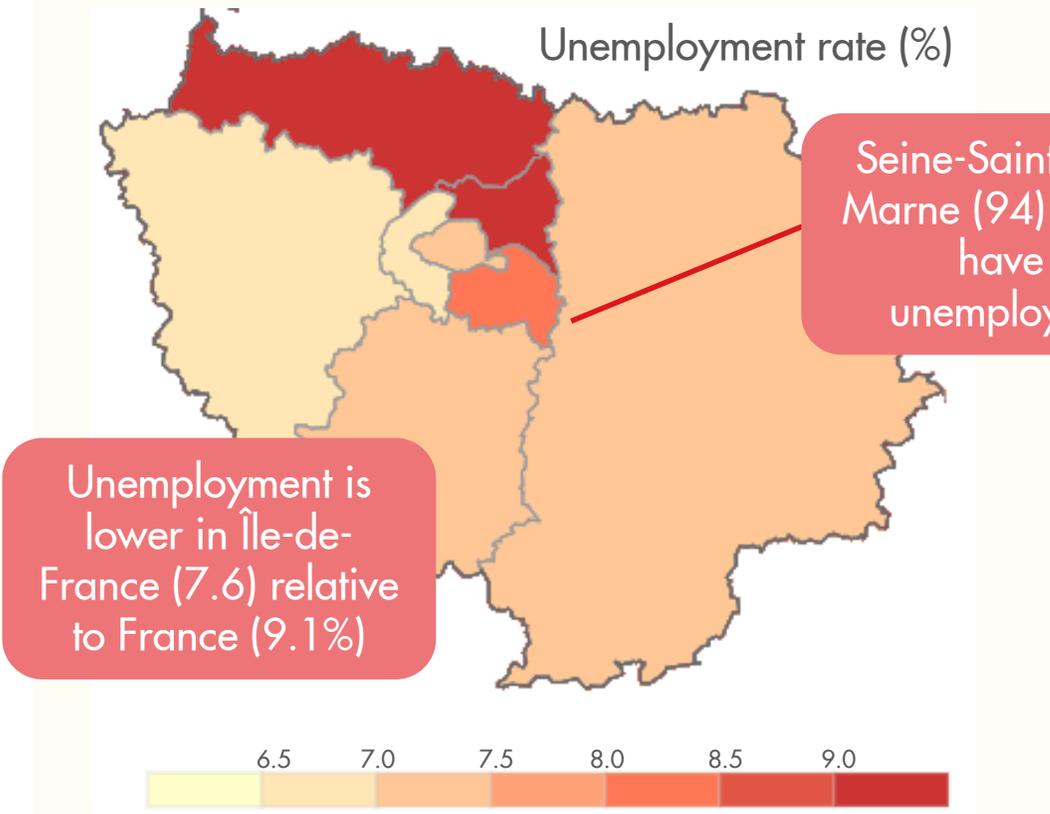
The income interdecil 9th/1st of Paris (6.3) is between 1.5 to 2 times the ratio for the other departments

*Interdecil 9D/1D is calculates the ratio between the income of the 9th and 1st decil

Some of the most unequal departments also suffer from high unemployment and poverty

 Unemployment in the north of the region is higher

 Departments in the center, North and East are hit the hardest by poverty



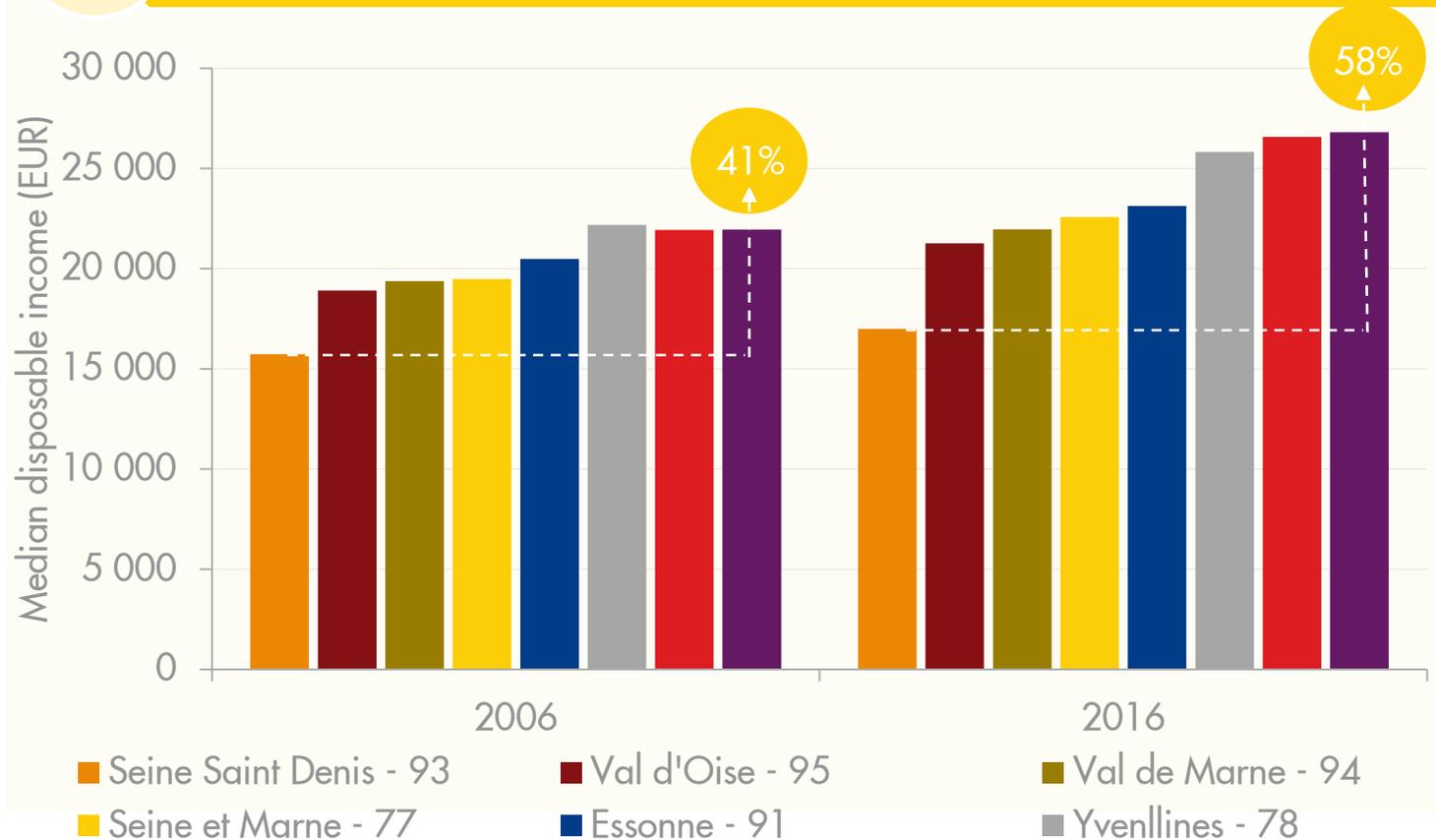
Source: INSEE (2018)

Source: INSEE (2016)

Income inequality *across* departments is also widening over time



Median income in Paris (75) is now 58% higher than in Seine-Saint-Denis (93)



Median disposable income across departments have diverged in the last 10 years.

The Gini coefficient is higher in Île-de-France (34.5) than in France (29.3) and the EU (30.8)

Compared to France and the wider EU, electricity bills do not seem to be a major household cost



Households in Île-de-France spend roughly 17% of their income on energy bills, relative to 22% nationally and 23% across the EU as a whole

	Île-de-France	France	EU
Electricity participation on households energy consumption (%)	33.5	32.1	24.1
Electricity consumption per capita (MWh)	1.92	2.15	1.57
Average electricity price (TTC, euro/MWh)	171.5	171.5	199.6
Estimated monthly energy expenditure (EUR)	328.9	369.2	314.0
Estimated energy expenditure of households as a proportion of income (%)	17.2	21.6	22.8

Electricity prices are low in France, relative to the EU.

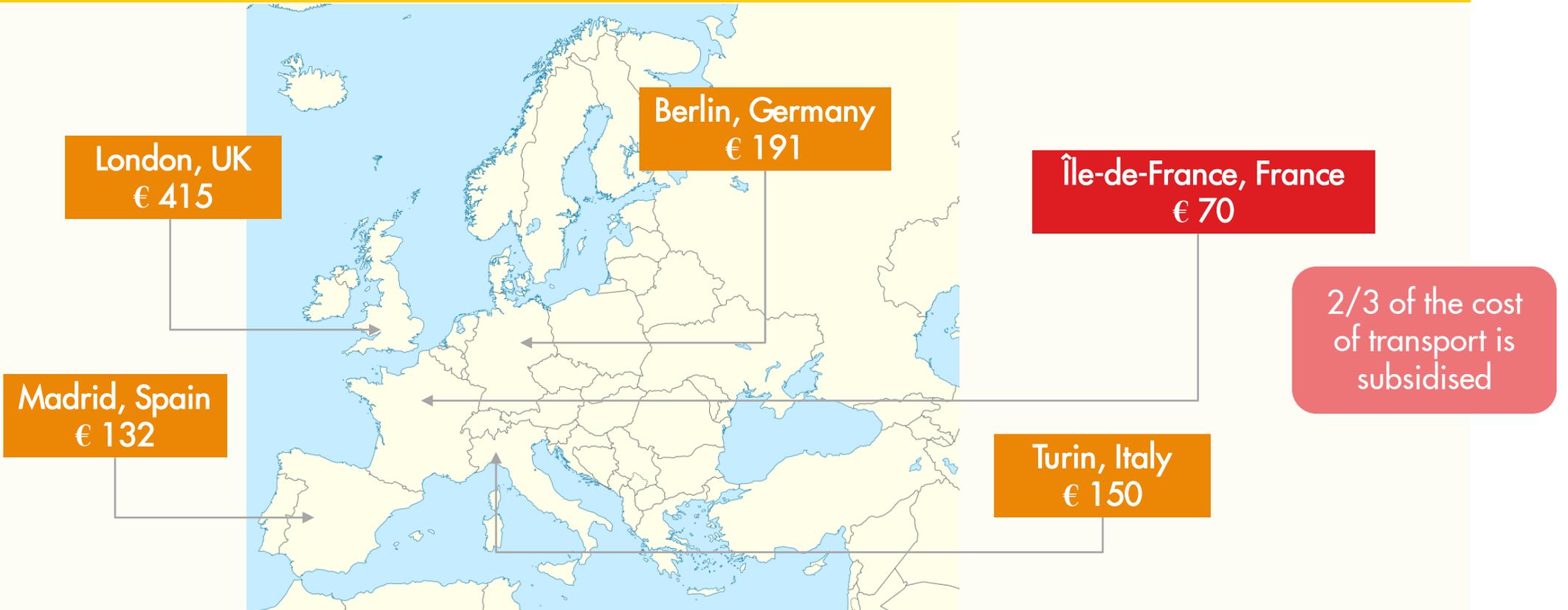
Consumption per capita is lower in Île-de-France than France overall due to: (i) the higher density of urban development and (ii) the prominence of gas central heating.

High disposable income also means lower energy bills are an even lower share of income.

Similarly, public transport in Île-de-France is among the most affordable in Western European metropolitan areas



Price of a monthly travel pass in the metropolitan area is among the cheapest in Europe



Source: Île-de-France mobilités
Travel pass covers all public transport modes of each metropolitan area
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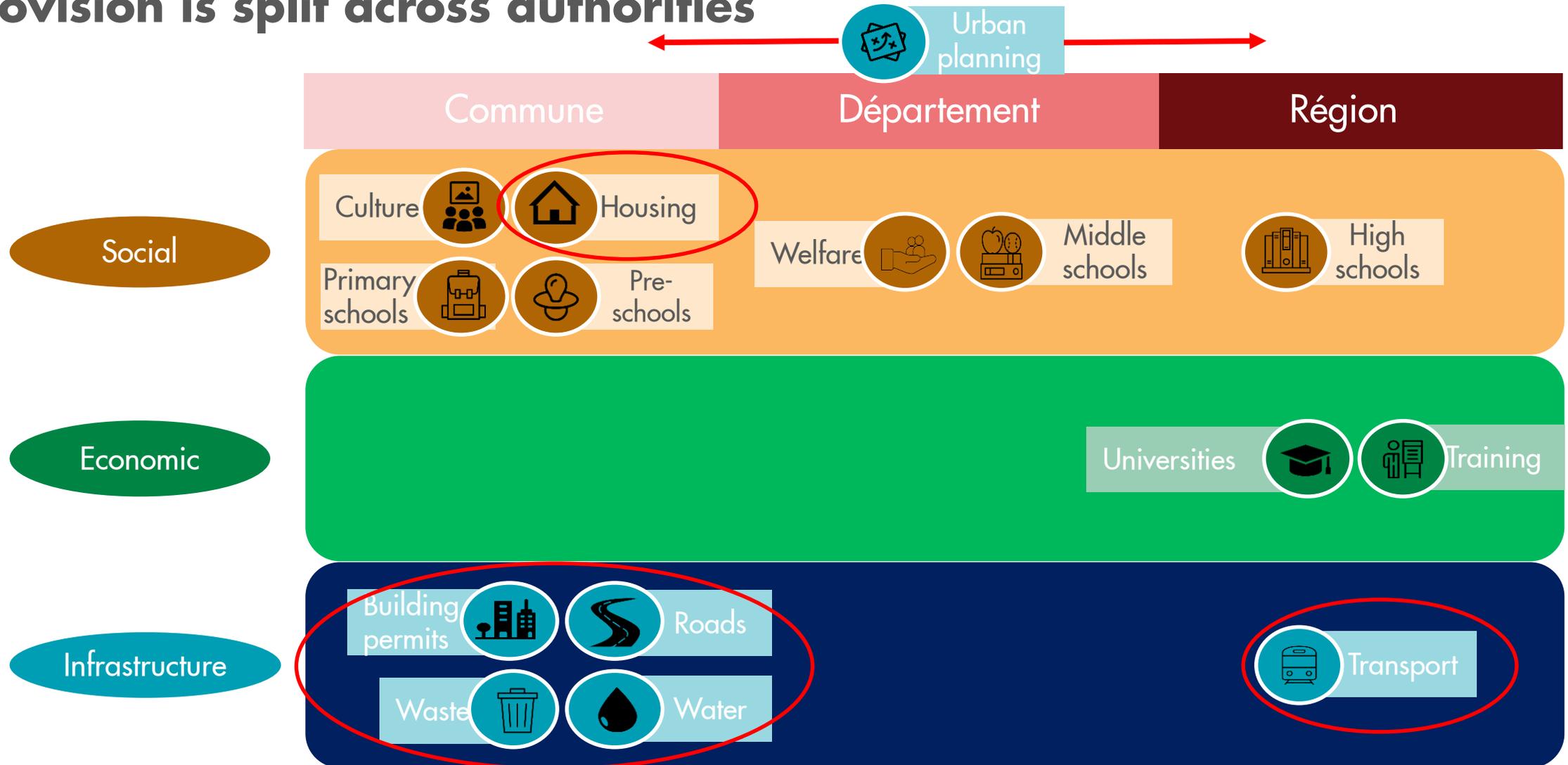
Societal trends:



Governance structure

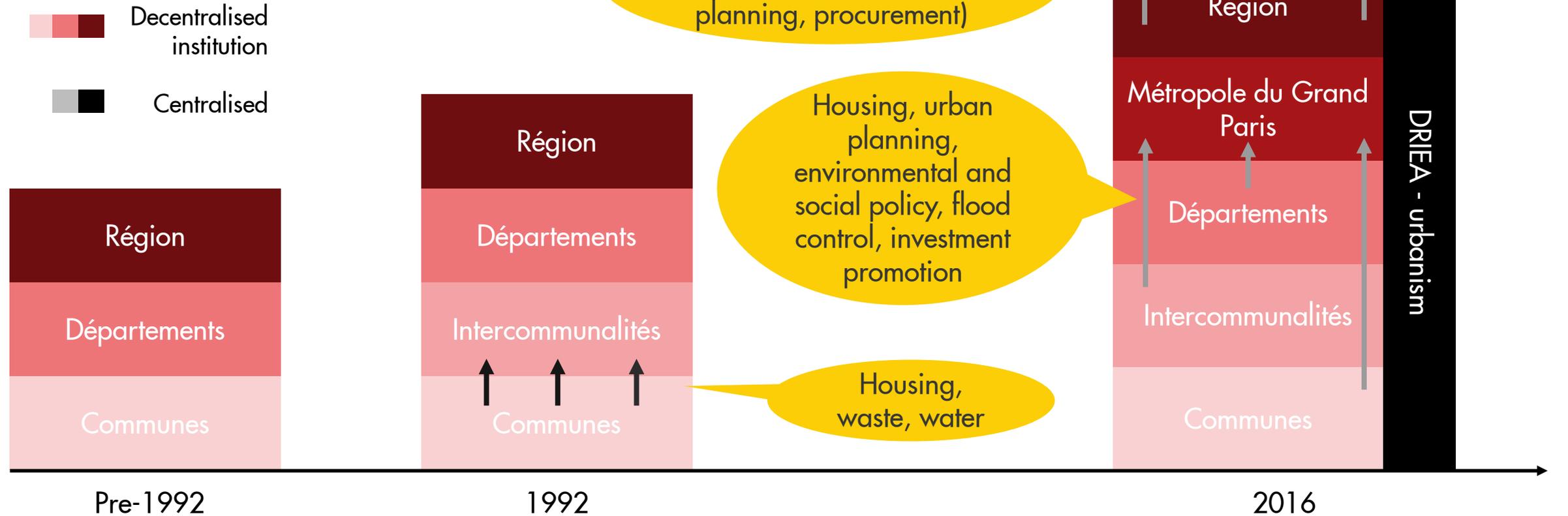
2.3

Responsibility for the various elements of urban planning and service provision is split across authorities



Though several cross-authority coordination mechanisms exist and are well-suited to lead urban planning efforts

Responsibilities devolved



Economic trends:



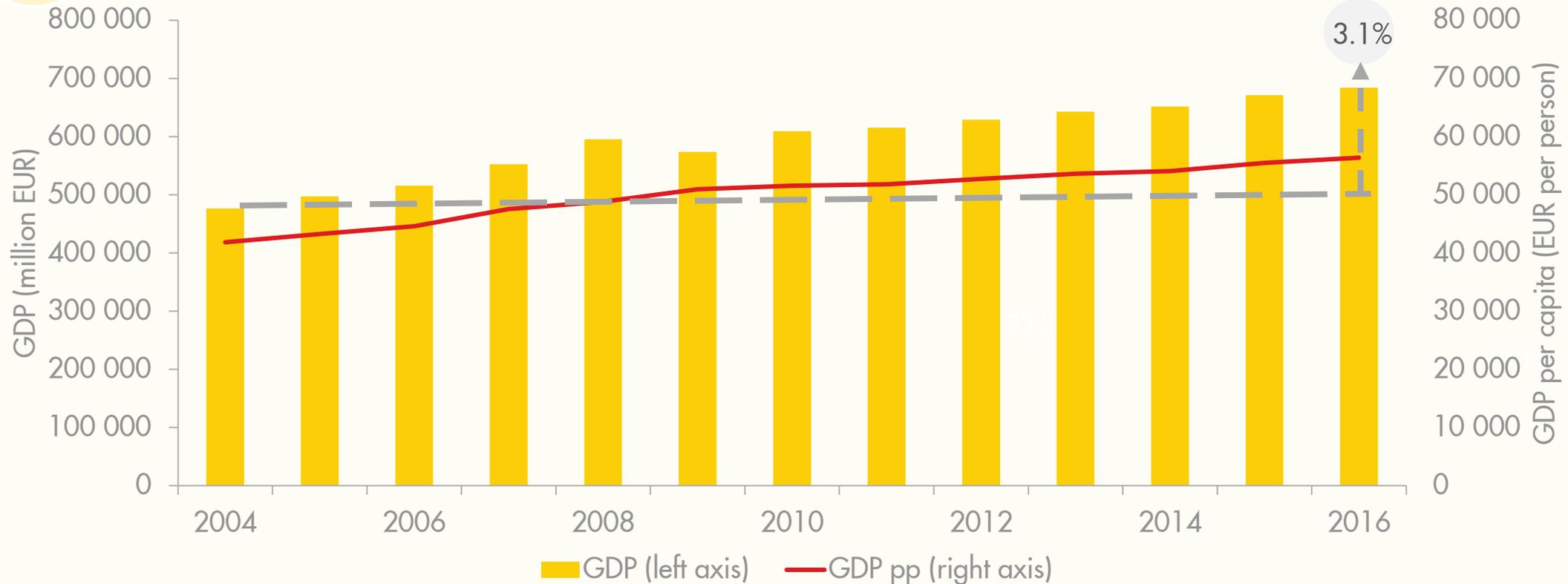
GVA, sector drivers and intensity

3

Île-de-France has experienced steady GDP growth, averaging 3% over the last 10 years



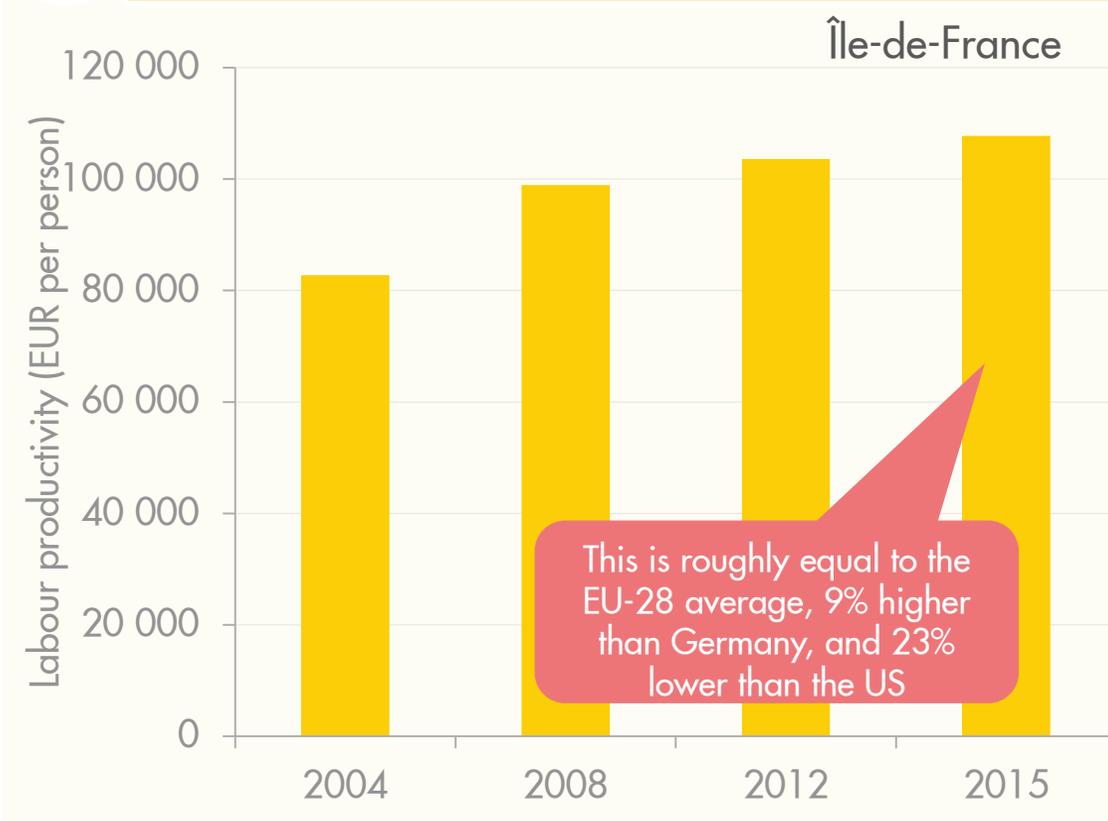
GDP has for years grown in excess of the national growth rate (2.3%)



Source: INSEE and OECD

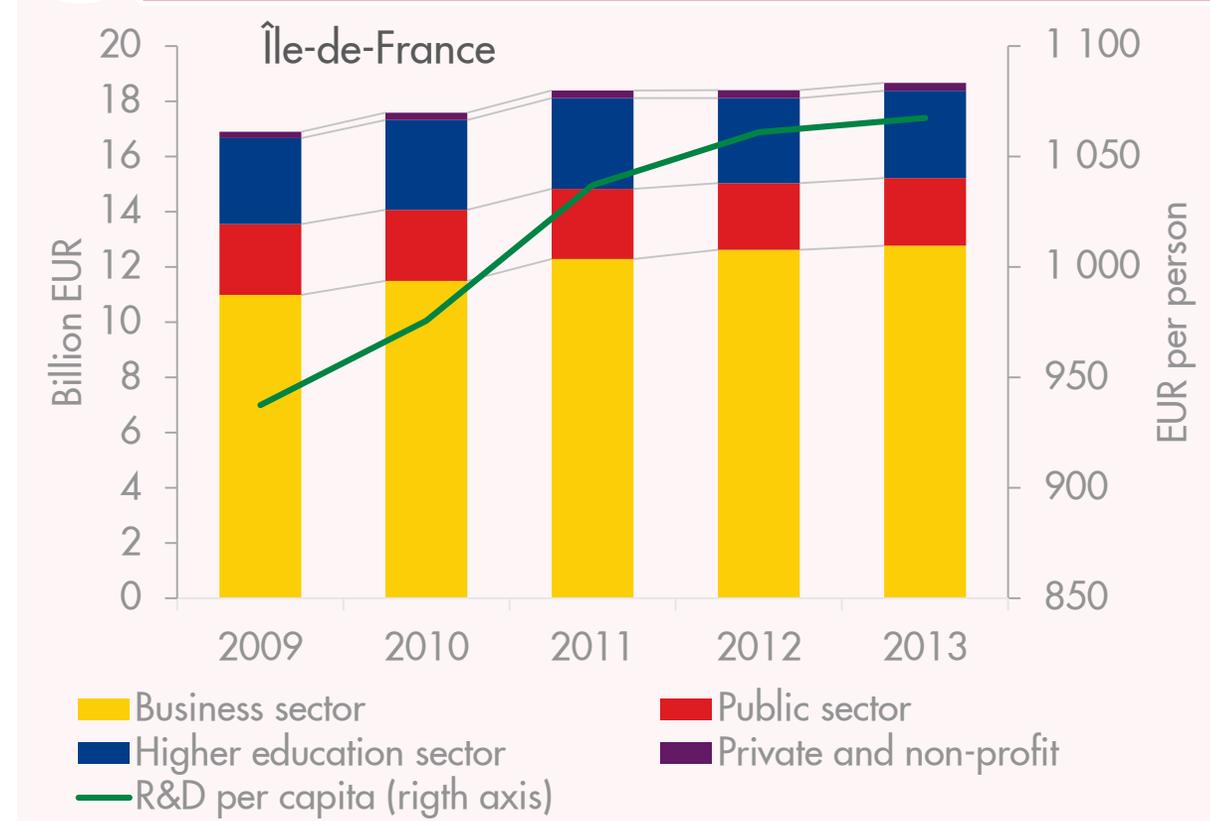
This has been supported by consistent gains in labour productivity and among the highest R&D spending in the EU

 **Labour productivity (GVA per employee) has increased by over 25% in 10 years**



Source: INSEE

 **R&D expenditure per capita in Île-de-France is well above London (EUR 529) and Madrid (EUR 452)**

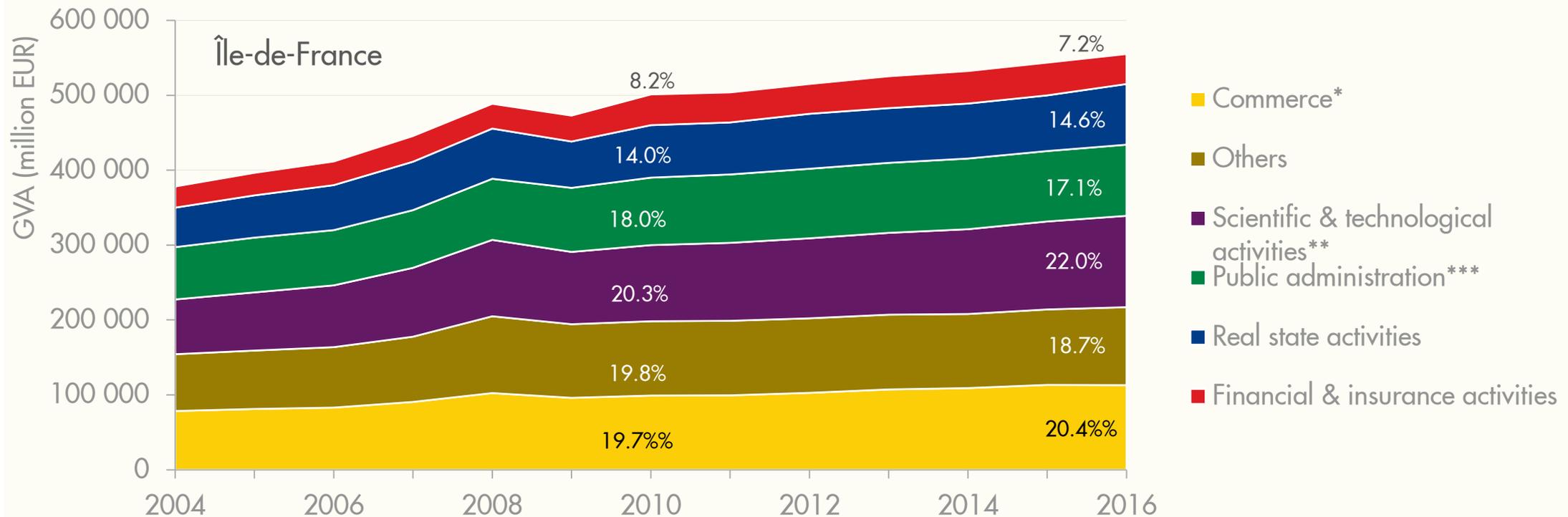


Source: OECD

Commerce, science and public administration are the largest sectors, with the highest growth in science and technology



These three sectors account for roughly 60% of GVA in Île-de-France



Source: INSEE

* Wholesale and retail trade, transport, accommodation and catering

** Professional, scientific, technological activities, administrative and support service activities

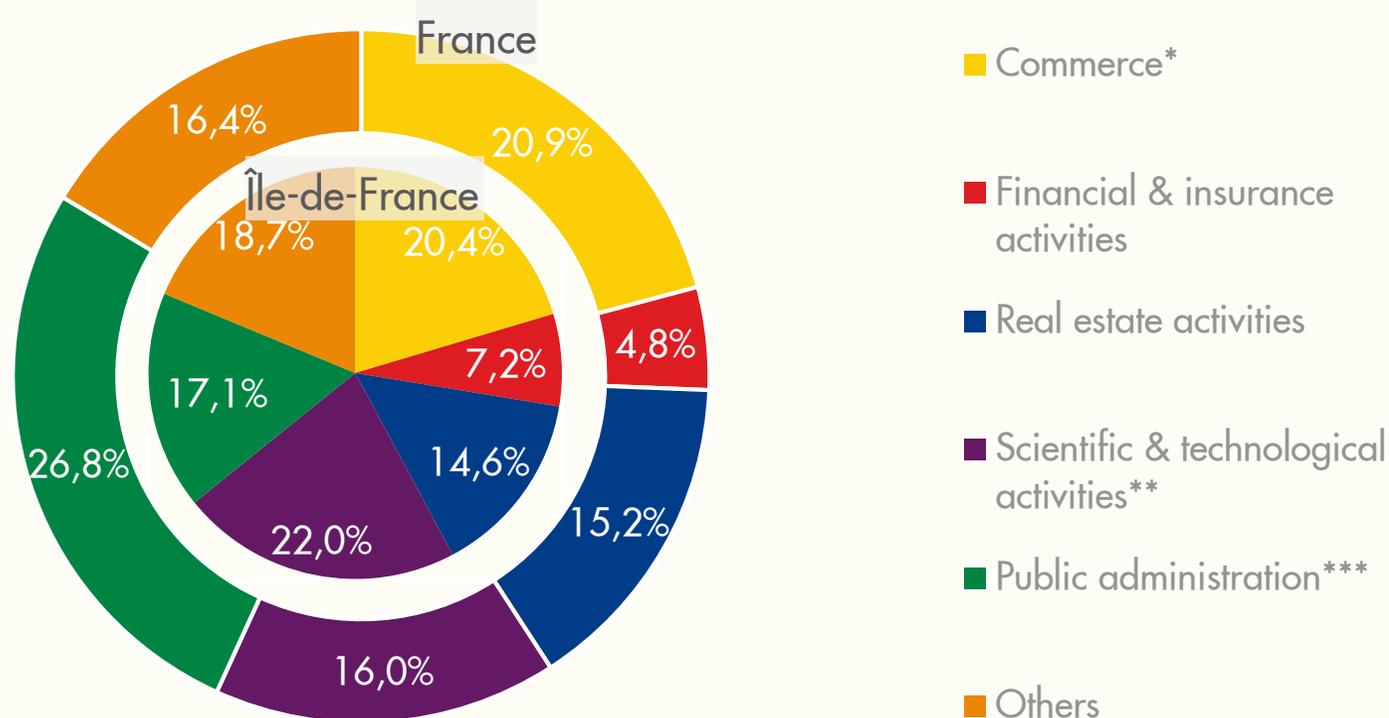
*** Public administration, education and health

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Relative to France, there is more science, technology and finance activity in Île-de-France at the expense of public administration



Science and technology illustrates 22% of Île-de-France's GVA but 16% of France's GVA.



Source: OECD

* Wholesale and retail trade, transport, accommodation and catering

**Professional, scientific, technological activities, administrative and support service activities

***Public administration, education and health

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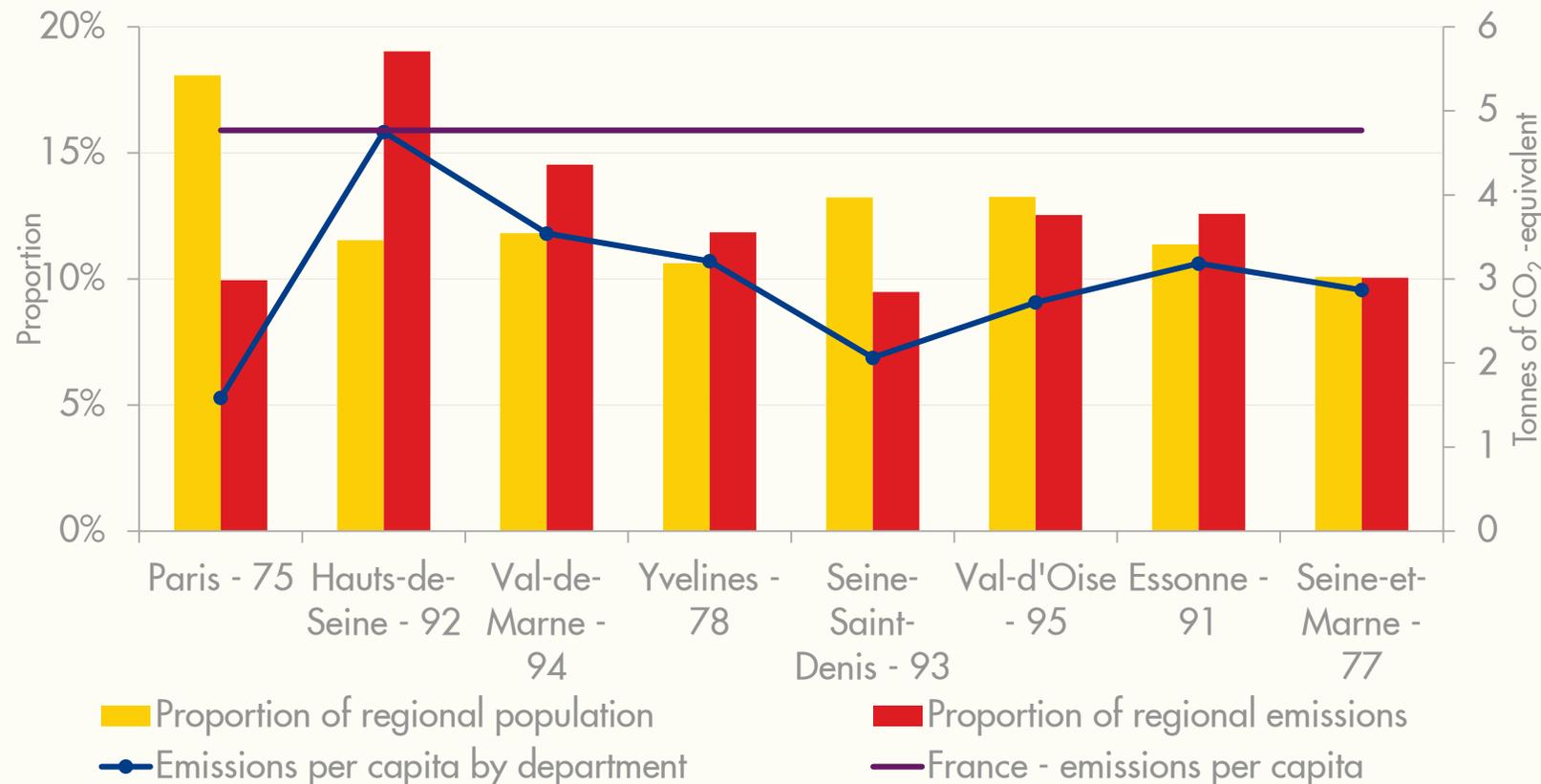
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The need for road transport drives emission intensity per capita, with Paris performing the best



Departments in the outer ring are more intensive due to increased road traffic



At 1.5 tCO₂, Paris has the lowest emission per capita across all departments

The suburbs are also relatively low between 2 and 3 tCO₂ per capita

All departments are below the French average of 4.8 tCO₂ per capita, except for Hauts-de-Seine

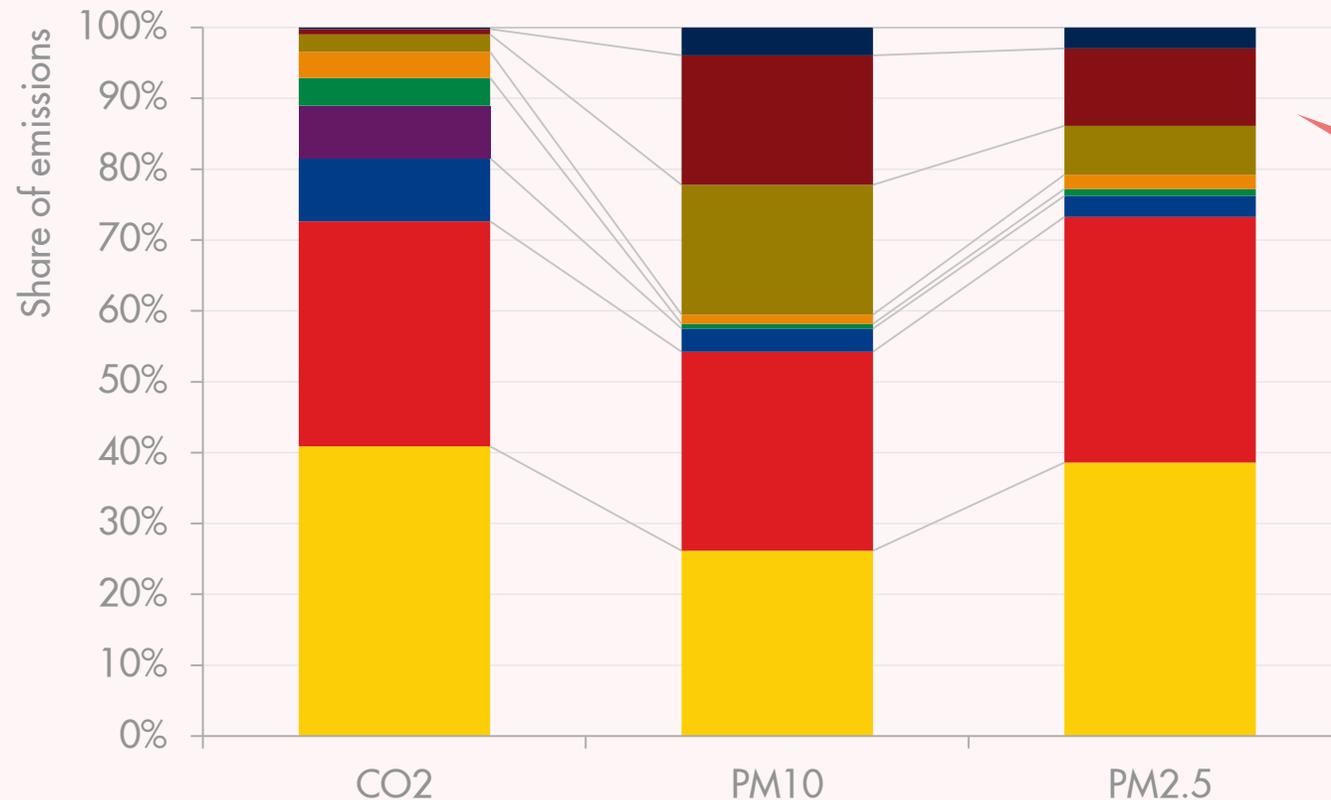
Source: Airparif

Road transport and buildings are the largest polluters by a significant margin



Together, road transport and buildings account for over 70% of CO₂ and 50% of PM10

- Île-de-France
- Rail and river traffic
 - Construction
 - Agriculture
 - Airports
 - Waste
 - Energy
 - Manufacturing
 - Road traffic
 - Buildings

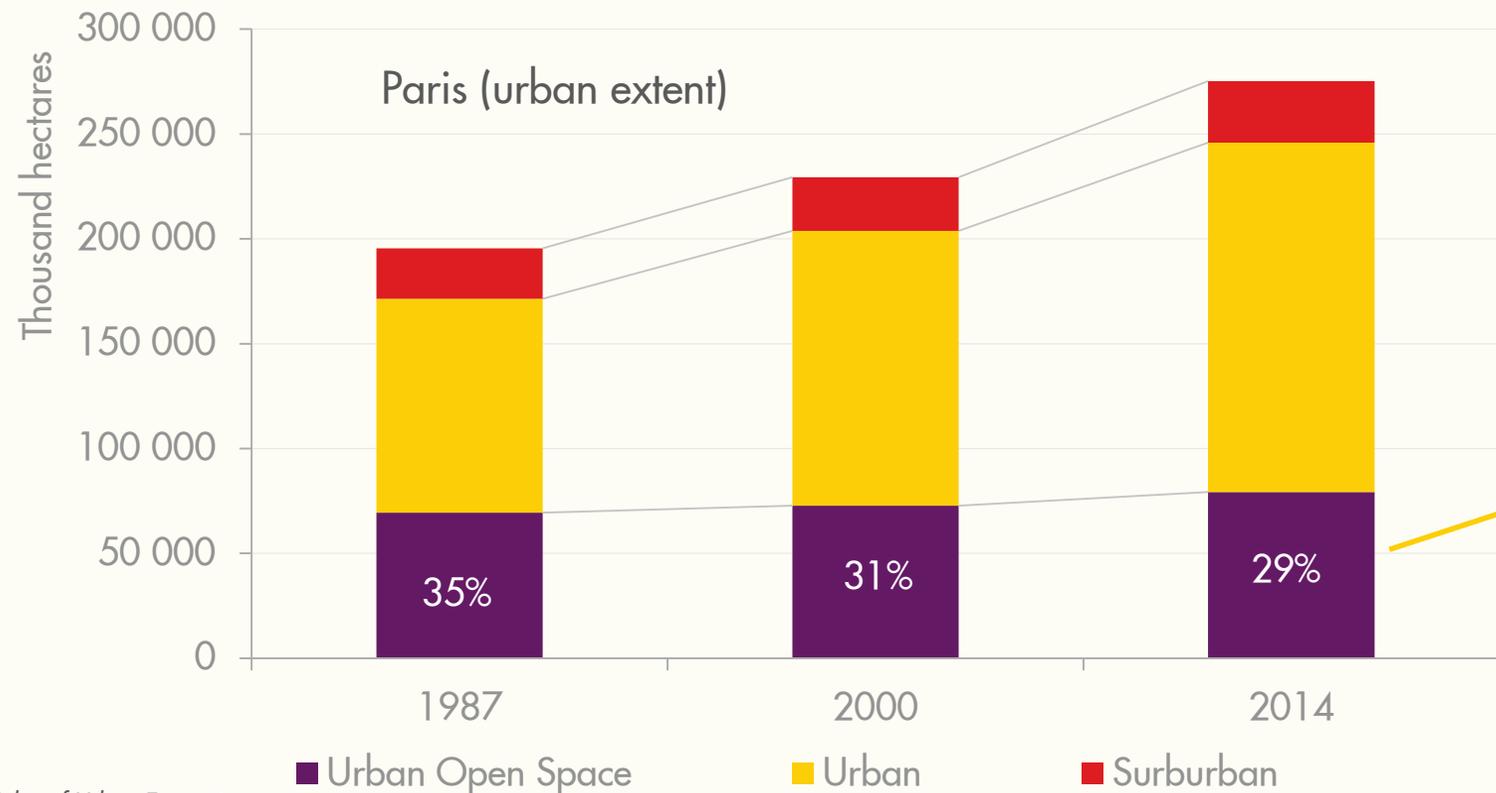


Agriculture and construction are also significant emitters of particulate matter

As the city boundary grows, urban open space is becoming rarer



Since 1987, the share of open space across the wider city's 'urban extent' has fallen from 35% to 29%



European comparators:
Berlin: 37%
London: 29%
New York City: 21%

Source: Global Atlas of Urban Expansion

Technical and infrastructure trends:



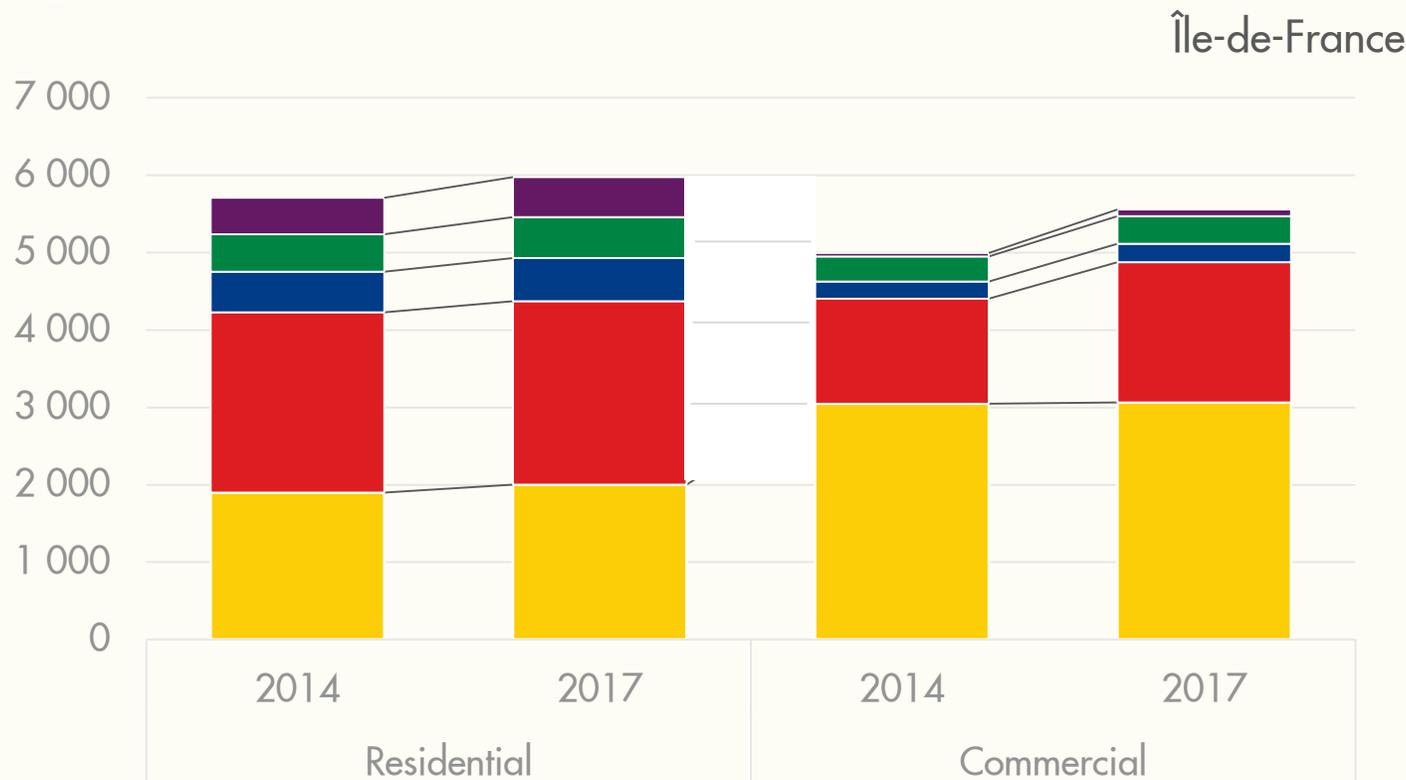
Buildings, energy, transport and waste

4.1

Buildings in Île-de-France rely relatively more on electricity than the EU average



While commercial buildings in Île-de-France rely heavily on electricity, residential buildings split consumption between electricity and natural gas



Residential sector 2017 (%)	Île-de-France	France	EU
Electricity	33.5	32.1	24.1
Natural gas	39.6	33.5	36.0
Petroleum products	9.3	10.8	32.1
Wood	8.7	19.6	
Central heating	8.9	3.9	7.8
Electricity consumption per capita (MWh p.a.)	1.92	2.15	1.57

Current emissions from Île-de-France buildings: 41% of the total. Decarbonisation is difficult due to the generalised use of gas-powered central heating.

Source: SDES

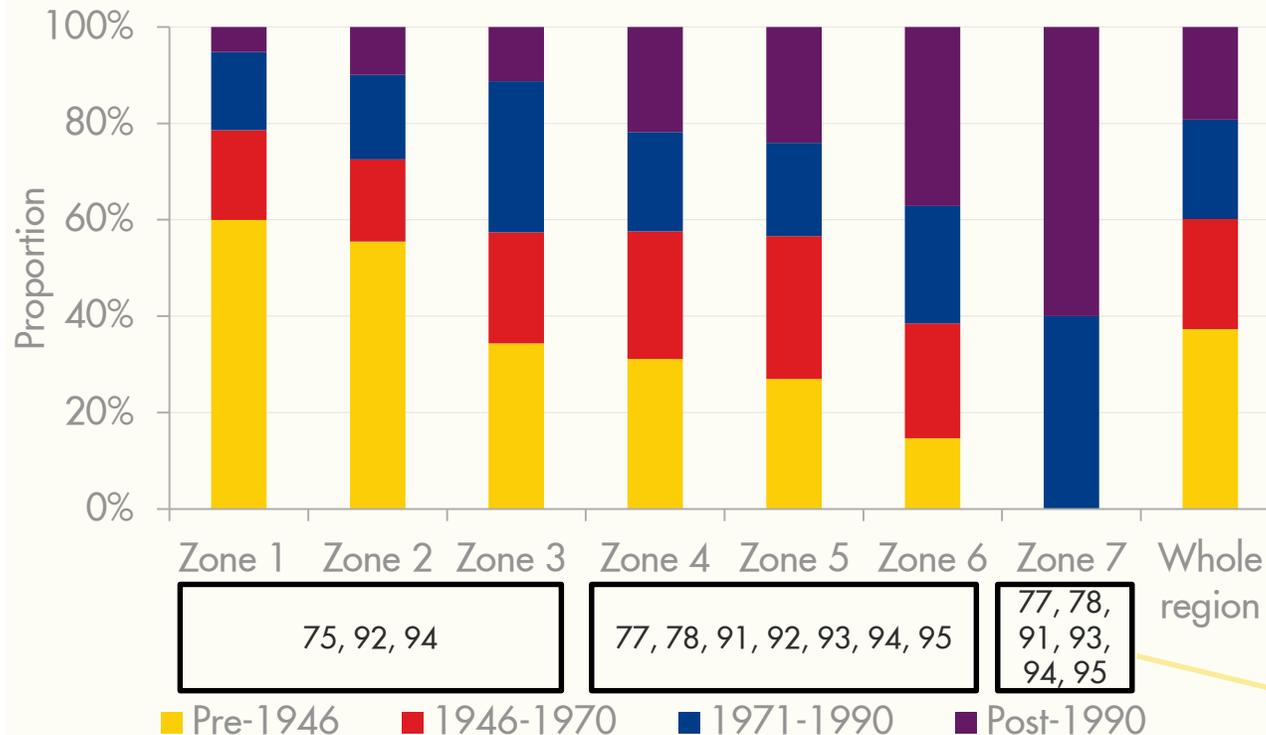
■ Electricity ■ Natural gas ■ Petroleum products ■ Central heating ■ Wood

Source: SDES and Eurostat
* Reported as others

Paris and the suburbs have an old building stock, though new regulations aim to improve efficiency



The proportion of old buildings is large throughout the region, and largest among the highest-rent zones



- In 2017, only 25% of all building renovations led to a change in its energy efficiency class
- Since January 2019, new buildings must consume less than 50kWh/m²/year
- Financial incentives are in place to encourage effective retrofits

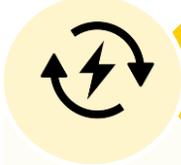


Climate Action Plan
1 million buildings thermally renovated by 2050

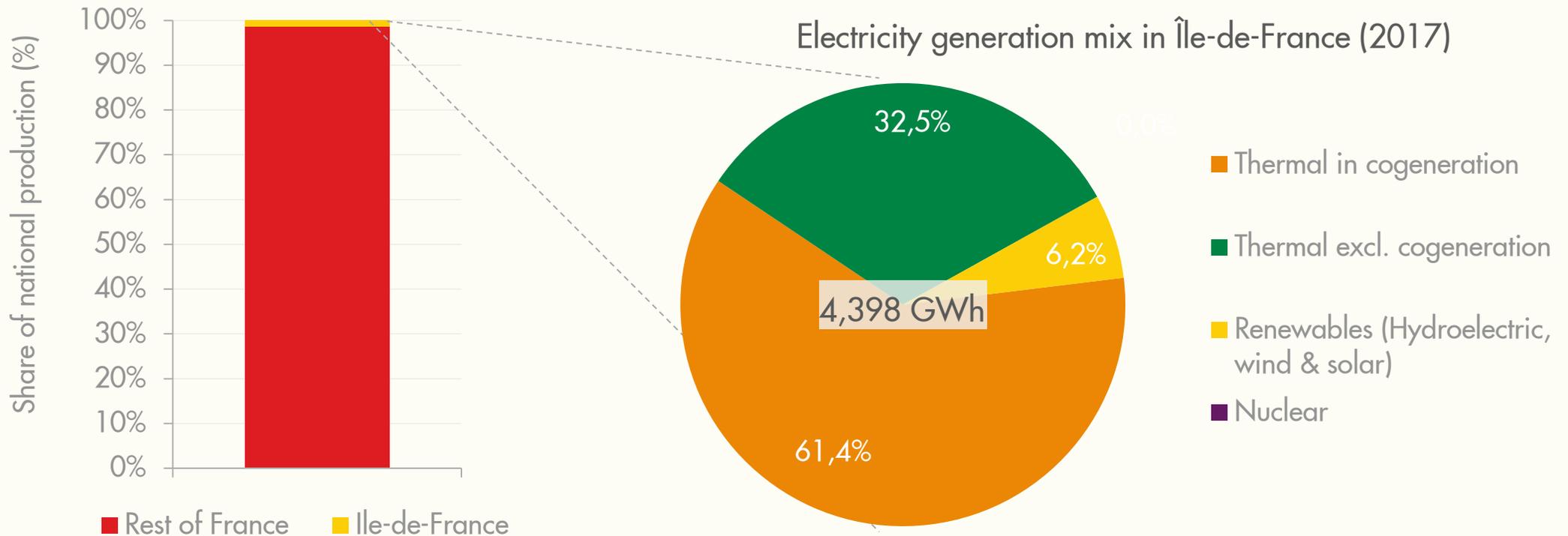
Zones are defined as groups of communes with similar private sector rent levels. The departments to which communes in each zone belong is indicated here.

Source: OLAP (2018), ADEME (2017)

Despite accounting for 20% of national population, Île-de-France generates just 1.4% of national electricity



Île-de-France imports 90% of the electricity it consumes

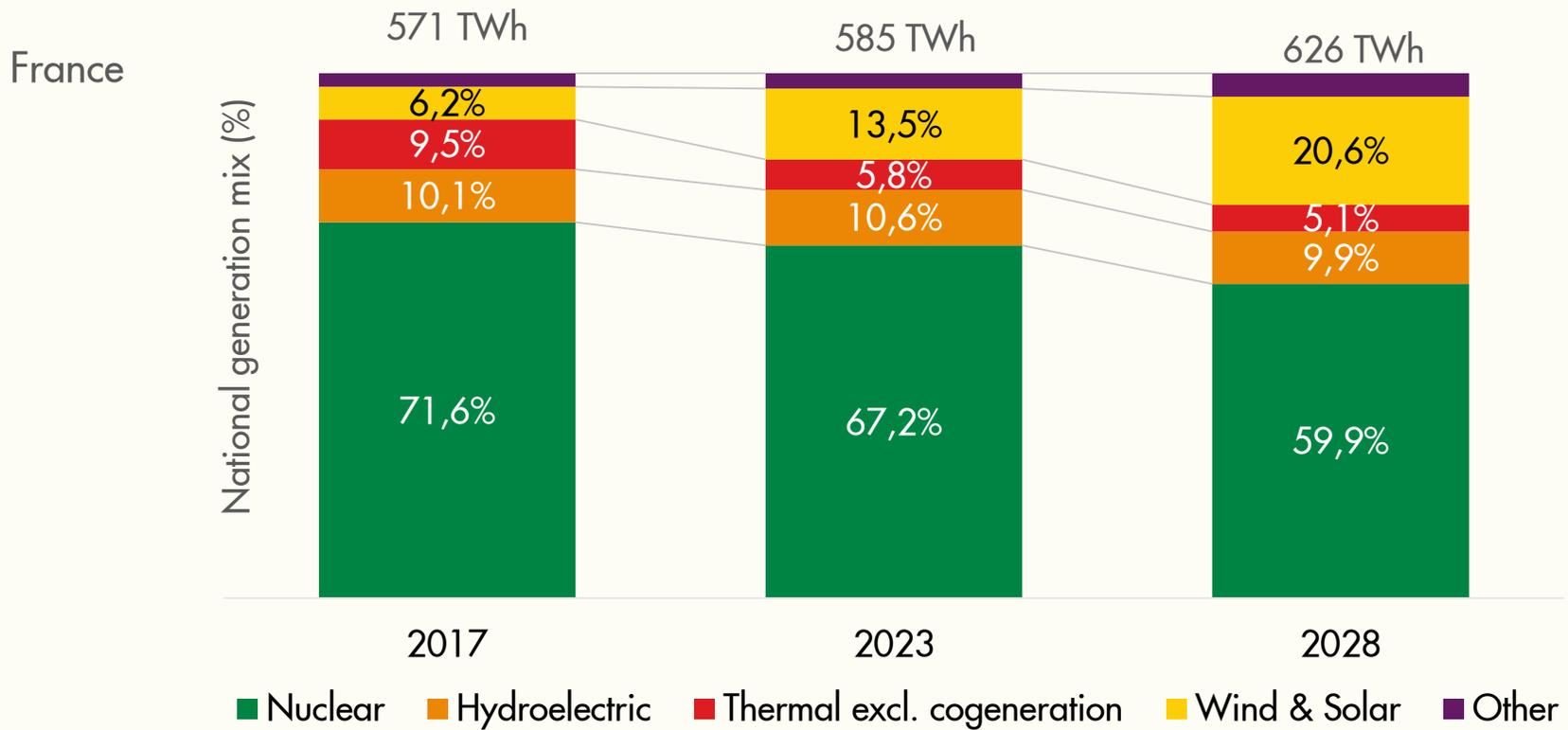


Source: SDES

The national generation mix is expected to shift to renewables in the future



By 2028, wind and solar will account for three times the current share of national generation



Source: SDES and PPE

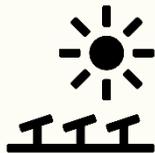
As does Paris, with a target of 100% of energy supply from renewable sources, and 20% of this generated locally



This will be met through a combination of solar, geothermal and biogas/fuel



Solar PV uptake of 20% roof space by 2050



New 5-10,000 m² solar plant by 2020



Additional 330 GWh geothermal per year



Convert gas/oil plants to biogas/fuel by 2030



RE supply reaches 10% of consumption by 2020 and 20% by 2030

- More analysis is required to accurately quantify economically feasible potential for rooftop solar PV
- The Energy Master Plan (heating, cooling, gas and electricity) will assess the need for grid and network improvements

Source: Paris Climate Action Plan (2018)

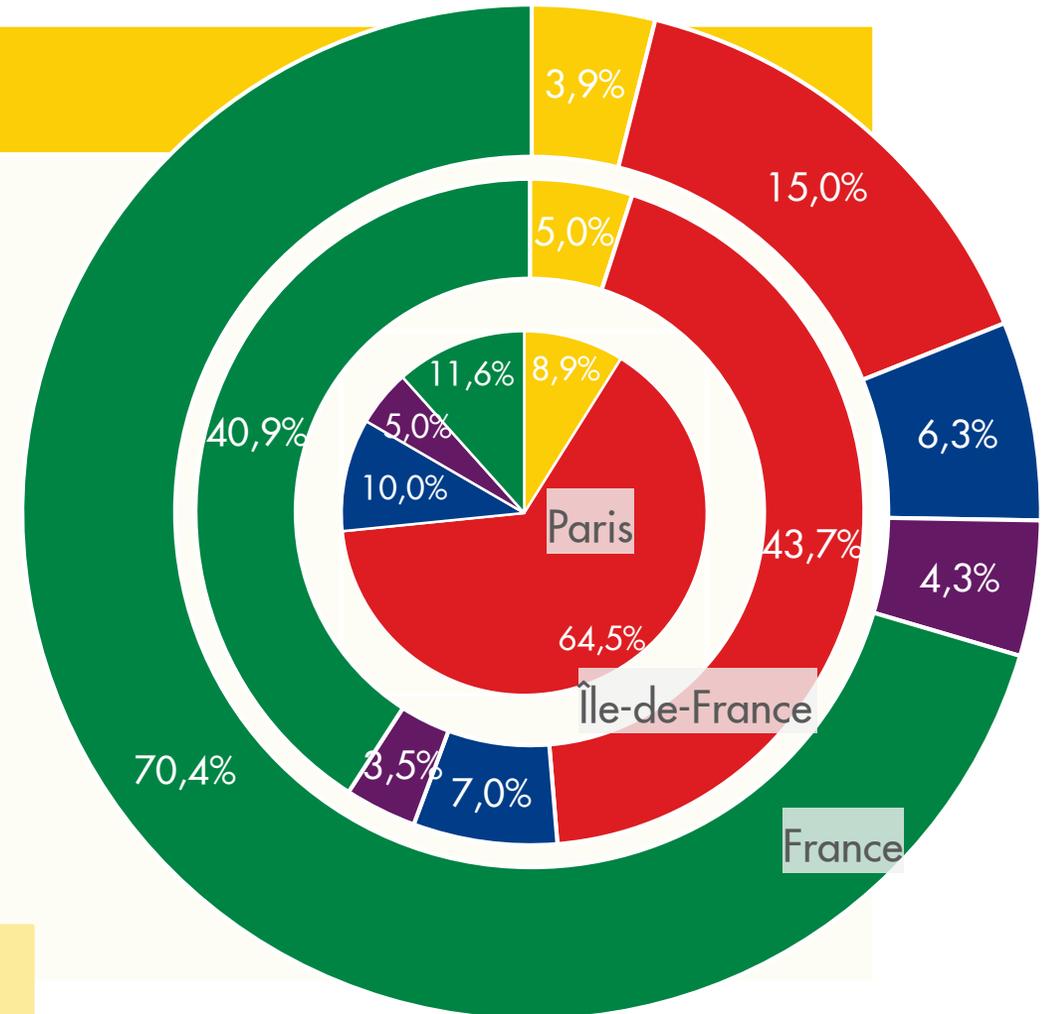
While transport in Paris is relatively low-carbon, Île de France is lagging behind



Public transport accounts for 65% of transport in Paris but just 44% of transport in Île-de-France

Mode of transport used to work (2016, %)	Paris	Île-de-France	France
Motorcycles	8.9	5.0	3.9
Public transport	64.5	43.7	15.0
Walking	10.0	7.0	6.3
No transport	5.0	3.5	4.3
Car, truck and vans	11.6	40.9	70.4

- Two wheels
- Public transport
- Walking
- No transportation
- Car, truck or van



Source: INSEE

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A key question is whether this difference is driven by commuting needs or other journey types?

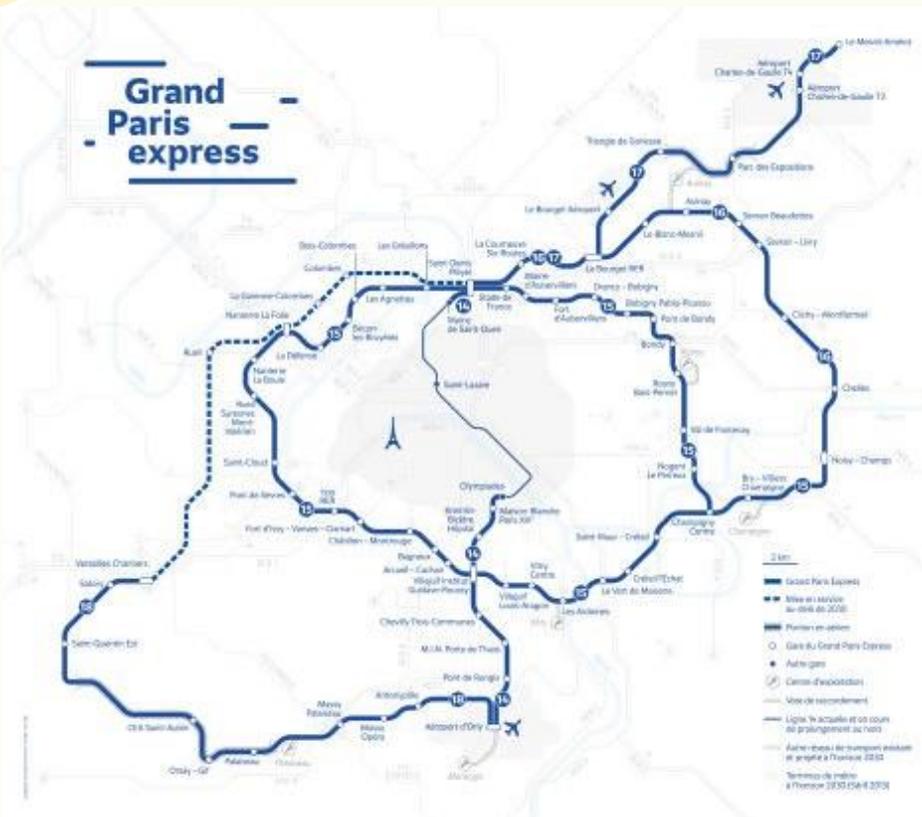
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If driven by commuting, the Grand Paris Express metro may accelerate a shift towards public transport



The network aims to improve mobility, shorten commuting times and reduce the environmental impacts of commuters



Objectives of the new metro network

- Facilitate bypassing Paris when going from one suburb to another
- Join the capital to its outskirts (all departments in the Île-de-France will benefit from new connections)
- Connect the main Parisian airports to the city, its suburbs and each other

Sources: Société du Grand Paris

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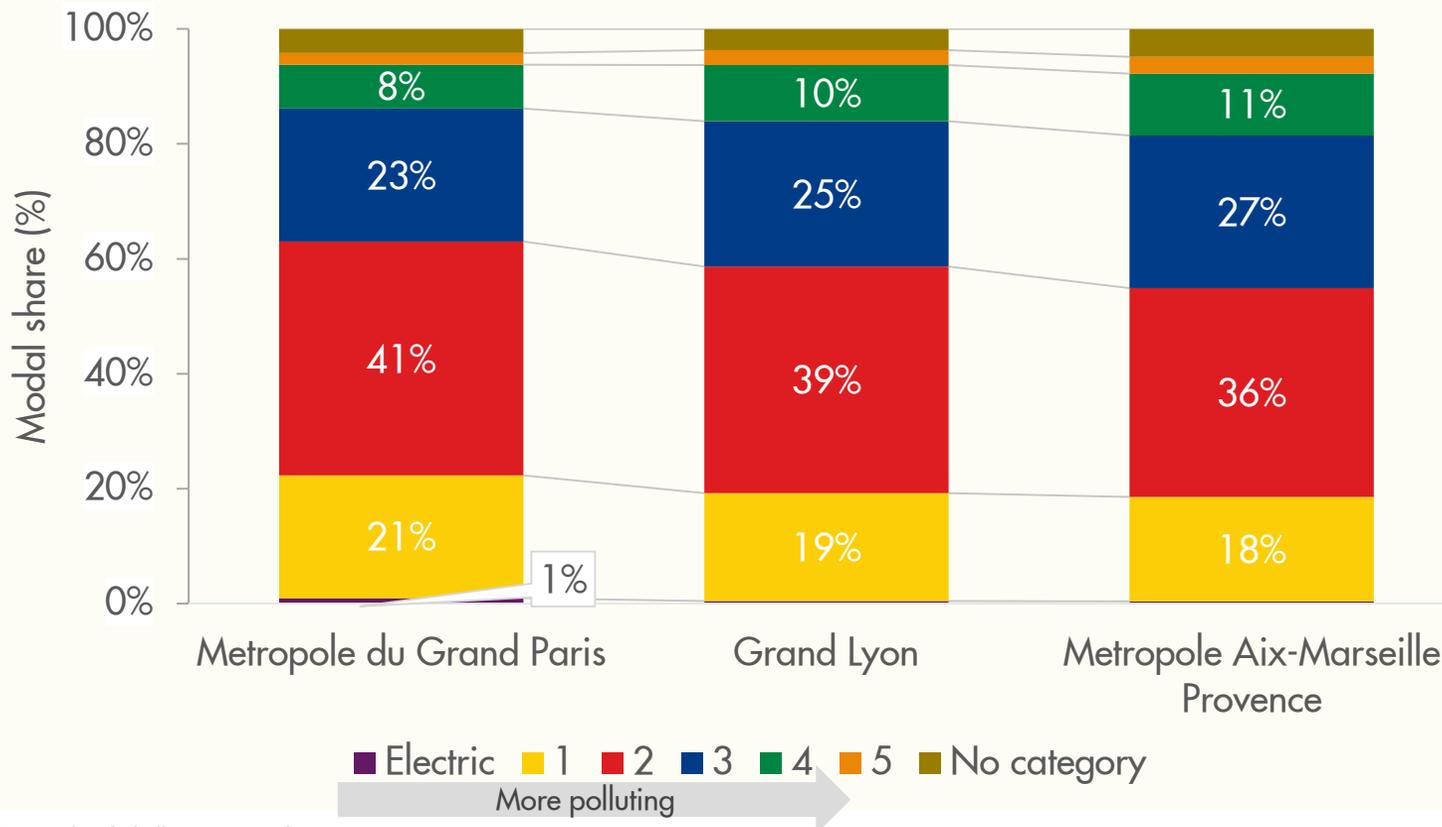
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If driven by other journey types, Île-de-France may need to modernise its vehicle fleet



The vehicle fleet in the Paris metropole is cleaner than other French metropolitan areas, but has considerable potential to decarbonize



Congestion will become an increasing issue as the population rises and will amplify emissions from an inefficiency vehicle fleet

Access to French low emission zones (LEZ):

- Level 5 vehicles cannot enter;
- Levels 3 and 4 cannot enter during episodes of high pollution;
- Levels 4 and below will be progressively phased out



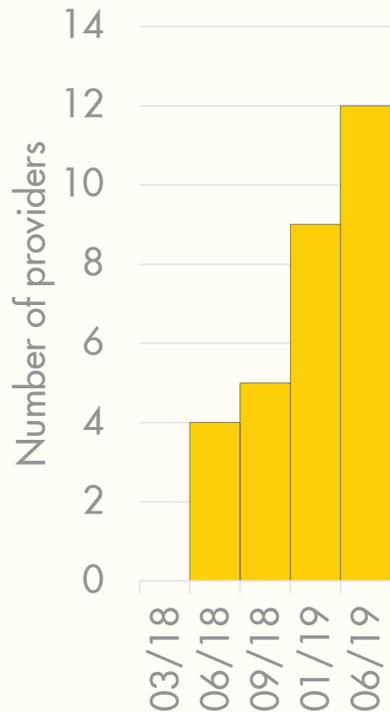
Climate Action Plan:

- Zero-diesel target by 2024
- Zero-petrol target by 2030
- Extension of the LEZ to the whole Métropole

Within Paris, disruptive technologies such as free-floating scooters are emerging, though their long-term impacts are unclear



Rapid growth in popularity though still relatively nascent technology and low modal share



An alternative to other 'soft' modes of transportation...

- 30% of users would have used public transport if the scooter was unavailable
- 44% would have walked
- 9% would have cycled

... or a complement...

- 23% of trips are done in combination with another mode of transport

...with an estimated modal share of about 0.8%...

- relative to cycling's 3 – 5%

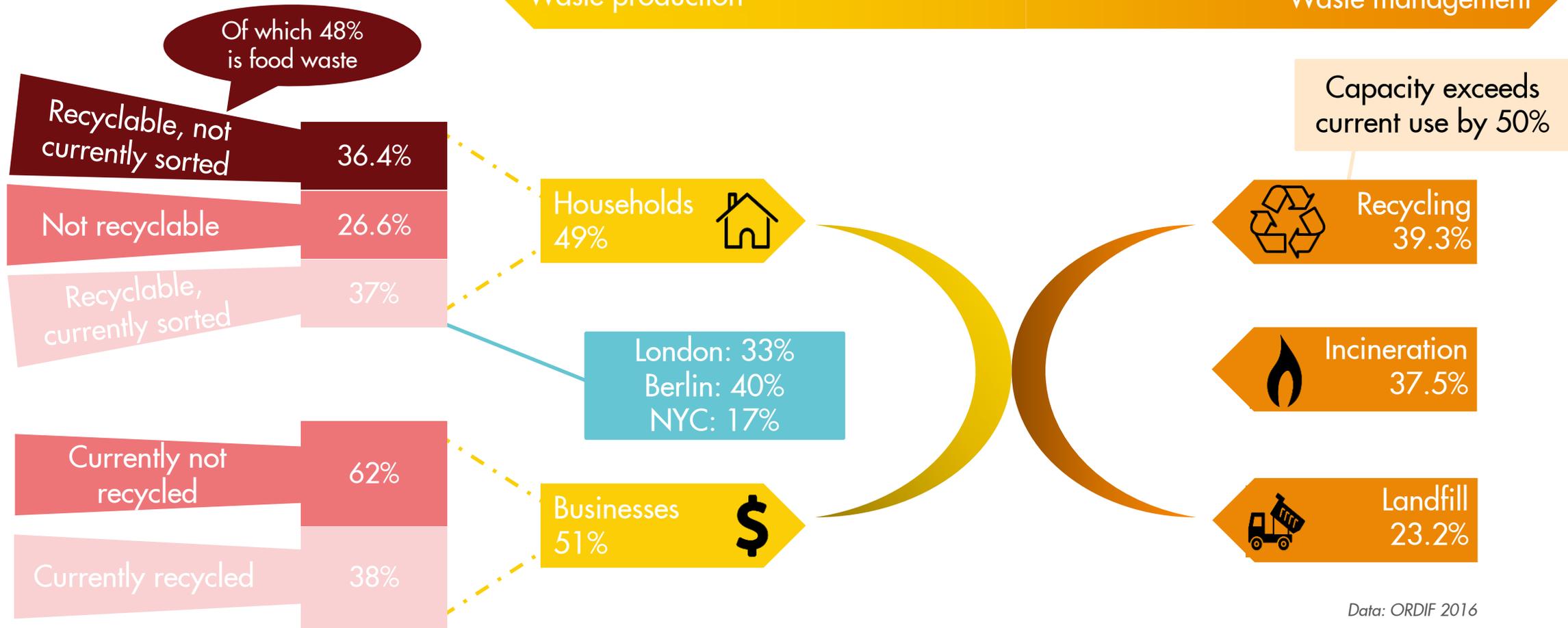
...and 55% of trips lasting under 15 minutes.

- showcasing a focus on Paris and its nearby banlieues

Source: 6t Bureau de Recherche, 'Usages et usagers de la trottinette électrique en free-floating en France'

With improved household separation, Île-de-France could double the amount of waste it recycles

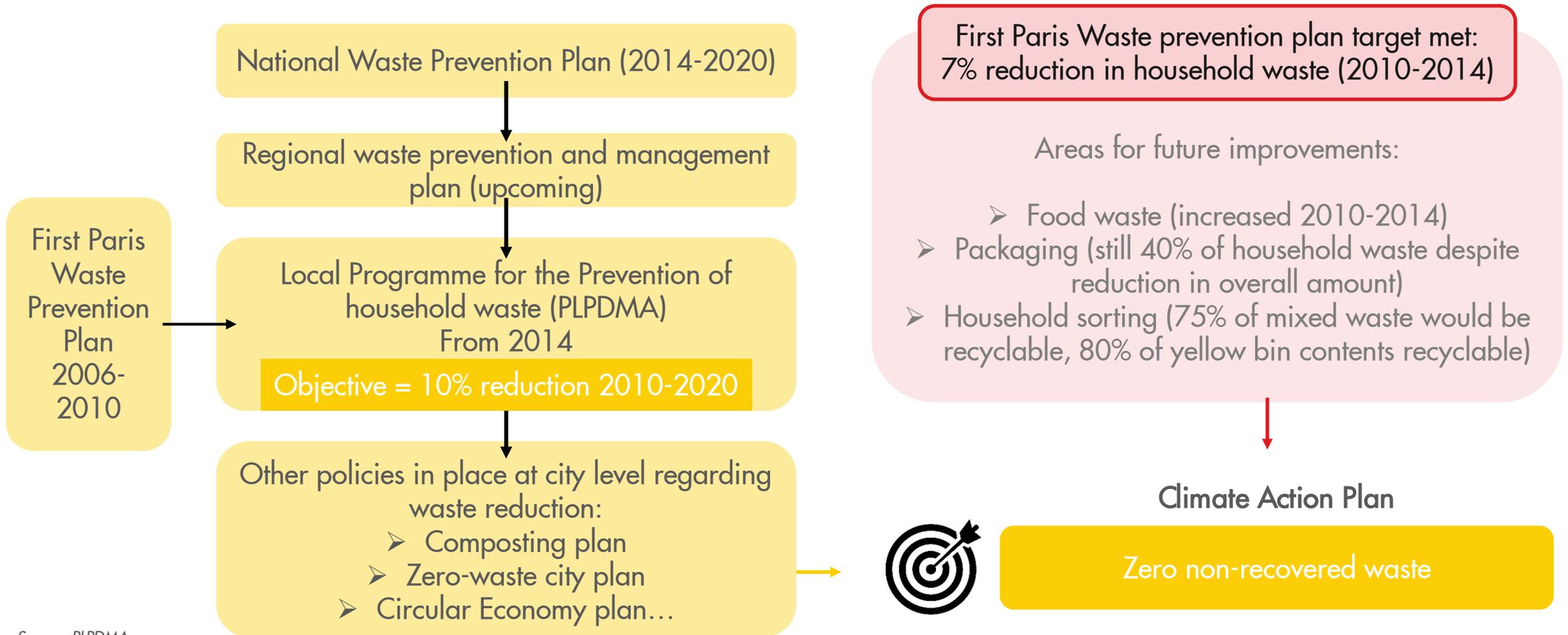
Île-de-France



Data: ORDIF 2016

September 2019

Paris and Île-de-France have several strategies to reach 'zero non-recovered waste' and support a circular economy



Source: PLPDMA

Technical and infrastructure trends:



Disaster risk management

4.2

Paris faces prominent risks from heatwaves, flooding and slow onset air pollution



Heatwaves have a deadly potential, particularly in Paris

The three warmest years in the history of Paris have been recorded since 2000

A crucial governance issue for the whole country...

- Around 15,000 deaths have been attributed to the 2003 heatwave

... which particularly concerns the Parisian urban area

- Temperatures in Paris are on average 2.5°C higher than in surrounding rural areas
- This difference reached 8°C during the 2003 heatwave

Source: Météo France



Flood risk has been underestimated in the Île-de-France region

60% of the Seine river flood zones are developed, 107,700 homes are located in the 100-year flood zone

The 2016 flood cost approximately 1.4 billion EUR



Air pollution remains a pressing issue

10,200 preventable deaths per year are attributable to air pollution exposure
70% of Parisians are exposed to poor air quality



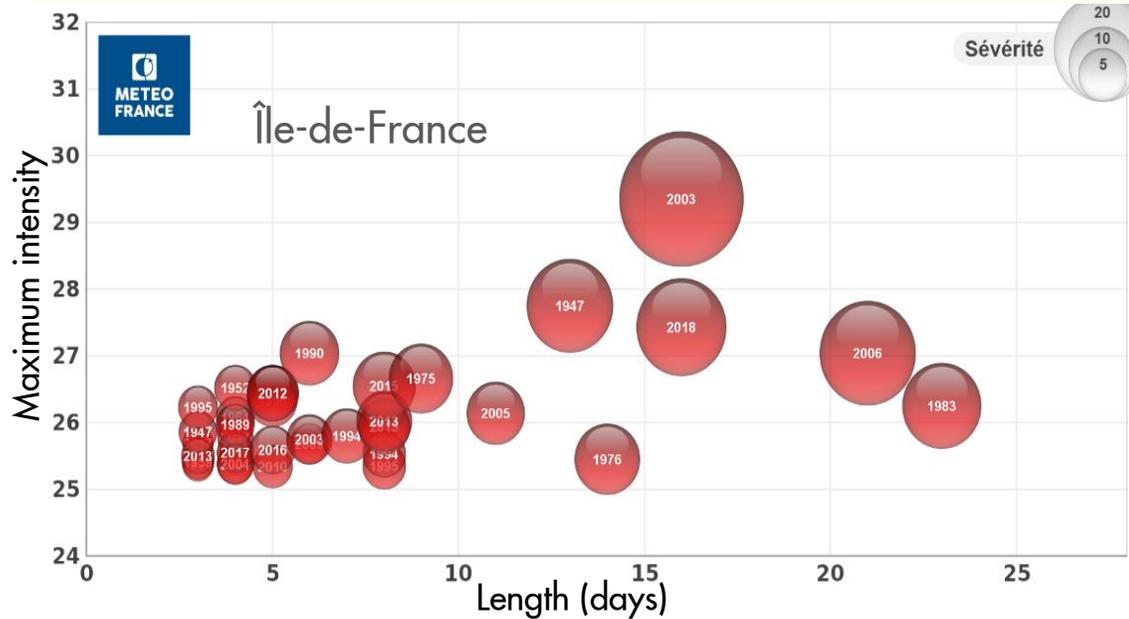
Climate Action Plan:
Exceed European regulations on pollutant concentrations by 2030

Source: 100 Resilient Cities Paris report

Heatwaves will become more frequent and more severe



Historical patterns show extreme events reaching higher temperatures and lasting longer



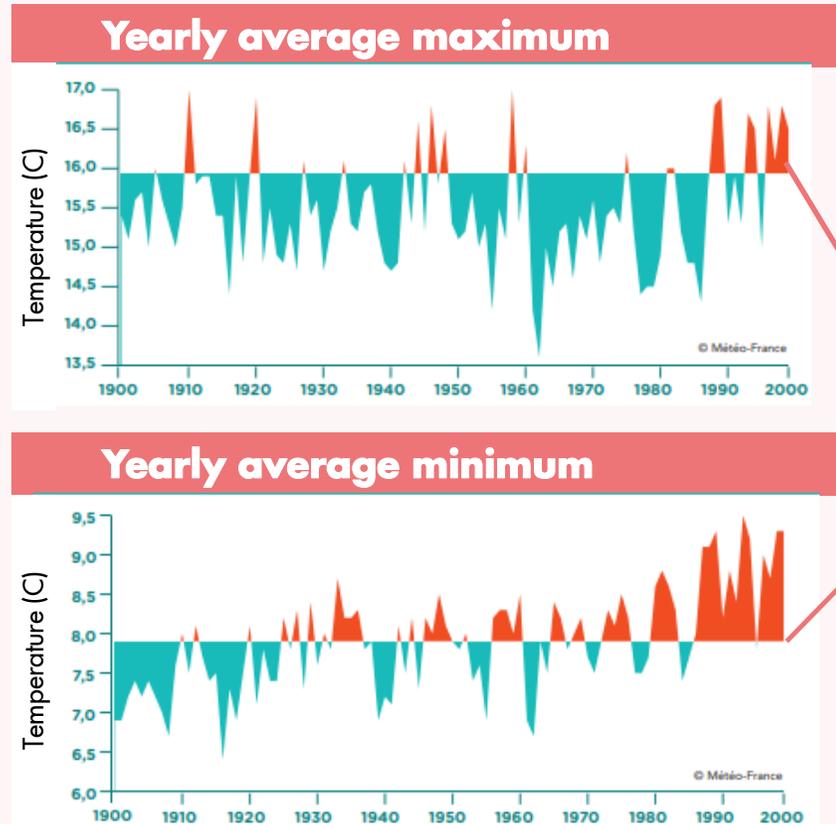
Severity: linked to the number of days above a high seasonal average temperature and the extent of the difference

Source: Météo France

Copyright of Shell International



While average temperatures throughout the year are showing an upward trend



Source: Météo France, Agence Parisienne du Climat

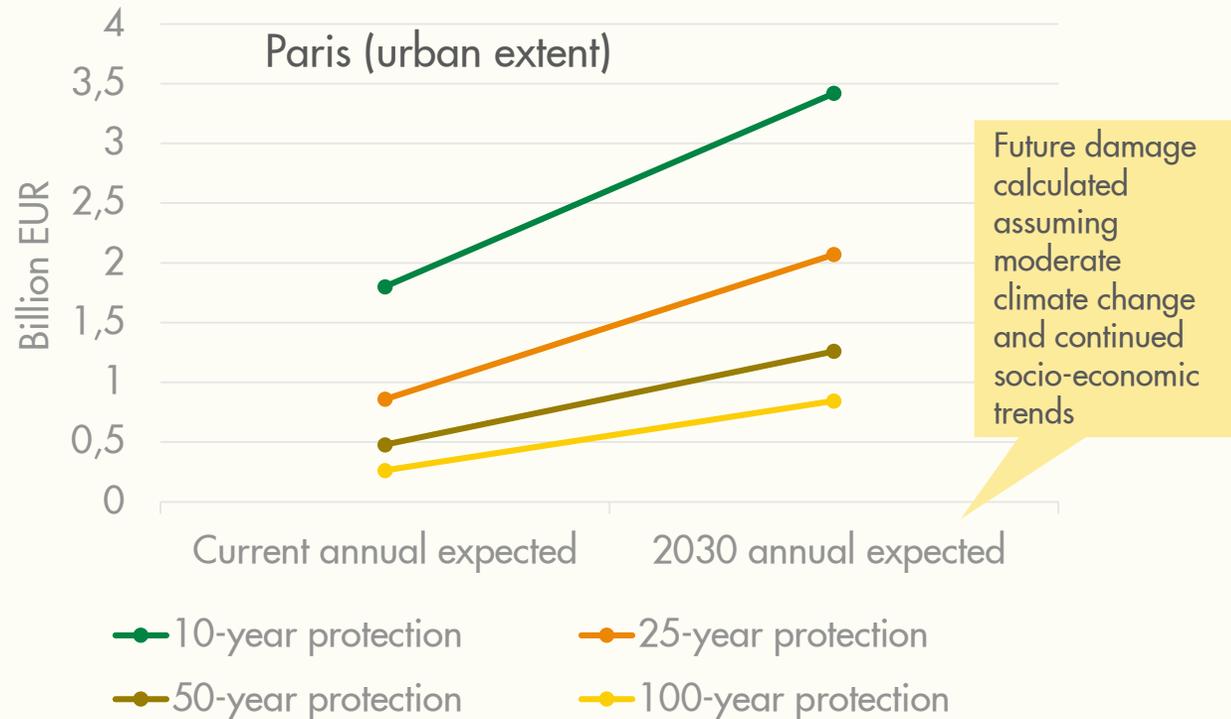
September 2019

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The payback for flood protection will rise in the future as climate change worsens



1-in-100 year protection levels reduce expected annual damage in 2030 by roughly 300% relative to 1-in-10 year protection



OECD recommendations to improve flood management, following the 2016 Seine flood

Risk governance

- Coordination between authorities
- Long-term vision
- Precise objectives, well-allocated responsibilities
- Connection with other public policies

Resilience

- Improve risk awareness
- Improve local resilience
- Harmonise the responsibility for flood protection
- Strengthen resilience of network operators

Financing prevention

- Establish a clear financial strategy for flood prevention
- Engage all the beneficiaries of preventive measures

Source: Aqueduct Global Flood Analyzer

Source: OECD, 'Preventing the flooding of the Seine in the Paris-Île-de-France region'

Île-de-France is actively tackling flood and heatwave risk



The Paris heatwave plan aims to limit the impact of heatwaves on the most vulnerable

Targeting vulnerable populations:

- Isolated elderly people are checked upon regularly
- Information on good practices in hospitals and schools
- Cooling equipment (fans...) provided in schools
- Water bottles and information provided to the homeless

Cooling islands throughout the city:

- Extended opening hours for parks and swimming pools
- List of publicly accessible air-conditioned rooms
- Additional water fountains installed
- Cooling fountains installed



Climate Action Plan:

- Transform school yards into cooling areas available to all outside school times
- Create new water basins and swimming venues accessible to all



Flood protection measures have been updated since the 2016 flood

- Centralisation of the flood protection measures within a Strategic Committee

Governance identified as a crucial flood management issue for the region by the OECD

- Consideration given to drought risk in elaborating flood management strategies

A 30% decrease in the flow of the Seine and its affluents is expected by 2080 (100 RC)

- Sequana risk management exercises for first responders, administrative authorities and network providers



Climate Action Plan: run risk management simulations every two years

Remaining areas of concern: sustainability of funding sources and resilience of network providers.

Summary of key headlines

5

Summary: societal trends



- Île-de-France faces increasing demographic pressure with high population growth and an ageing population
- Housing growth is focussed on the suburbs and especially the outer ring
- This is driving property prices up fastest in Paris, followed by the suburbs and the outer ring
- Departments with the highest inequality, tend to also suffer from the biggest housing affordability issues, unemployment and poverty
- Spatial inequality is driven by house prices, rather than energy or transport
- Existing cross-authority coordination mechanisms are well-suited to lead urban planning efforts

Summary: economic trends



- The regional economy consistently outperforms France, driven by science, technology and innovation
- Demand for road traffic drives emission intensity; Paris and the suburbs have fewer emissions per person
- Road transport and buildings are the largest polluters of CO₂ and particulate matter by a significant margin
- As the city grows over time, less importance is being given to urban open space

Summary: infrastructure trends



- Buildings are emission intensive because the stock in Paris and its suburbs is old and inefficient, though new standards should gradually improve this
- Outer ring emissions suffer from a heavy dependence on inefficient road transport
- If driven by commuting, the Grand Paris Express should help reduce this. If driven by other journey types, decarbonisation will depend on the vehicle fleet
- Waste reform is needed in the first mile (household separation), where there is significant potential to increase recycling
- The expected damage from heatwaves and floods will continue to rise; strategic early-stage investments will help mitigate this